FANUC ROBODRILL α-D14M*i*A5
FANUC ROBODRILL α-D14L*i*A5
FANUC ROBODRILL α-D14S*i*A5
FANUC ROBODRILL α-D21M*i*A5
FANUC ROBODRILL α-D21L*i*A5
FANUC ROBODRILL α-D21S*i*A5

(Control Unit: FANUC Series 31*i*-B5)

OPERATOR'S MANUAL

⚠ WARNING

To use the products explained herein safely, read carefully and understand completely all the descriptions about safety at the beginning of this manual and those about the functions you are going to use. Failing to follow any safety precaution or any direction described herein may lead to death or injury. Always keep this manual near your product, so you can reference it whenever necessary.

B-85314EN/01

⚠ WARNING

Before starting to install, operate, or maintain the product, carefully read and understand the "SAFETY PRECAUTIONS." Failing to follow any of these safety precautions and other cautions stated herein may lead to death or injury.

The model covered by this manual, and its abbreviation is:

Product Name	Abbreviation
FANUC ROBODRILL α-D14M*i*A5, α-D14(L,S)*i*A5 FANUC ROBODRILL α-D21M*i*A5, α-D21(L,S)*i*A5 Controller: A04B-0102- B201, B301, B302 FANUC Series 31*i*-B5 Mechanical Unit: A04B-0099-B101, B103, B111, B113, A04B-0102-B101, B102, B103, B104, B105, B106, B111, B112, B113, B114, B115, B116	α-D14M*i*A5, α-D14(L,S)*i*A5 α-D21M*i*A5, α-D21(L,S)*i*A5

To help prevent accidents that may occur due to incorrect handling, this operator's manual indicates cautions with marks. The meaning of each mark is explained below. Before starting to read the text of the cautions, be sure to understand the meaning of the corresponding marks.

⚠ **DANGER:**	Indicates that incorrect handling will invite an imminent danger of death or serious injury.
⚠ **WARNING:**	Indicates that incorrect handling may lead to death or serious injury.
⚠ **CAUTION:**	Indicates that incorrect handling may lead to light or moderate injury.
CAUTION:	Indicates that incorrect handling may lead to damage not only to the product of interest but also to other properties.
ATTENTION:	Describes precautions for protecting the product of interest from damage.
SUPPLEMENT:	Describes information for effective and efficient use of the product of interest.

- No part of this manual may be reproduced in any form.
- All specifications and designs are subject to change without notice.

The products in this manual are controlled based on Japan's "Foreign Exchange and Foreign Trade Law". The export of α-D14M*i*A5/D14L*i*A5/D14S*i*A5, α-D21M*i*A5 /D21L*i*A5/D21S*i*A5 from Japan is subject to an export license by the government of Japan. Other models in this manual may also be subject to export controls. Further, re-export to another country may be subject to the license of the government of the country from where the product is re-exported. Furthermore, the product may also be controlled by re-export regulations of the United States government. Should you wish to export or re-export these products, please contact FANUC for advice.

In this manual, we have tried to describe as many matters as possible.
However, we cannot describe all the matters which must not be done or which cannot be done, because there are so many possibilities. Therefore, matters which are not especially described as possible in this manual should be regarded as "impossible." If you wonder whether a specific matter is possible, ask FANUC.

The original language of this manual is English. The other language manuals are a translation from the English one.

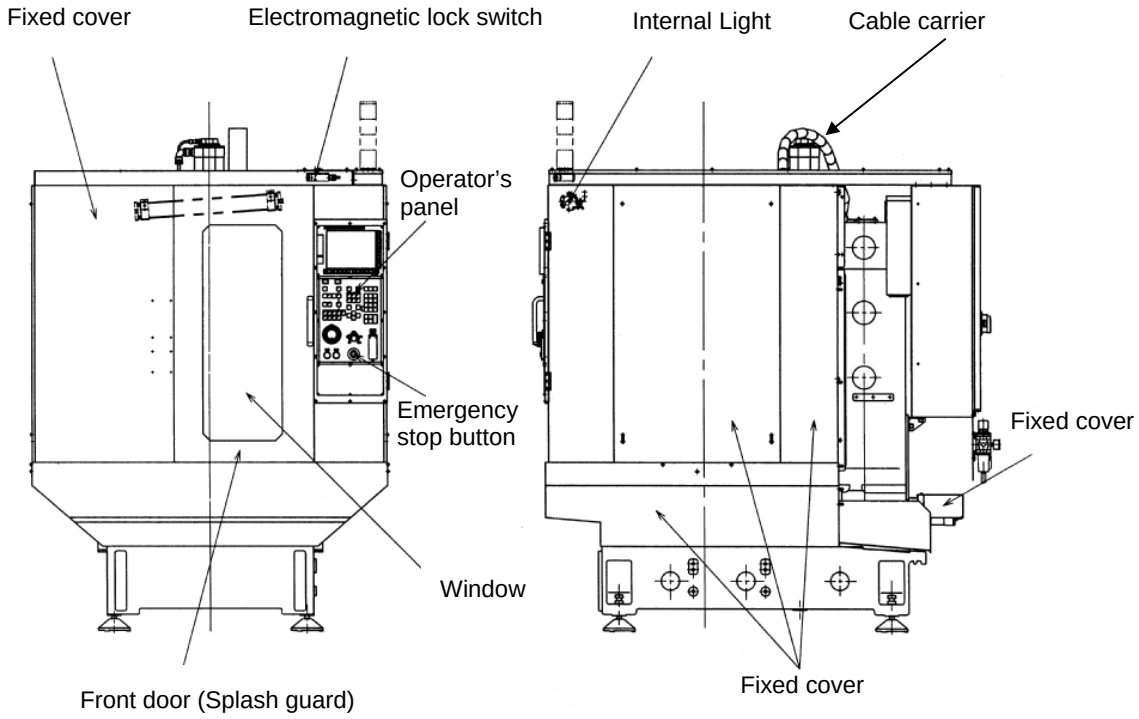
SAFETY PRECAUTIONS

Before starting to use the machine, be sure to read this section about safety precautions and the descriptions about the functions you are going to use carefully to understand them fully. Otherwise, an accident may occur. Use the machine only after you understand them fully.

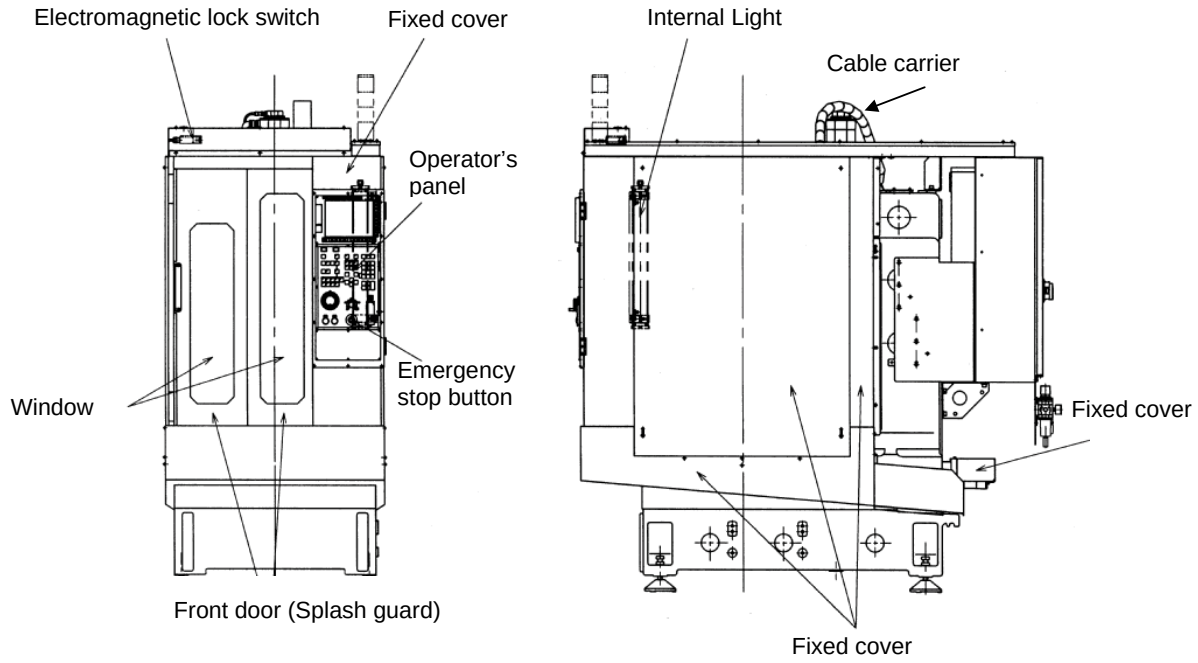
When using the machine, follow all national and local regulations applicable to safety, health, and environmental hygiene.

1 SAFETY FUNCTIONS OF THE MACHINE

The ROBODRILL α-D*i*A5 adopts a door interlock system that stops the machine when the door is open. This is to protect the operator from dangerous situations. The door interlock system consists of an electromagnetic lock switch, control circuit, and software.
A light that lights the machining area can be installed inside the splash guard. The following provides an outline of the machine and the safety equipment.



α-D14/21M/L*i*A5



α-D14/21S*i*A5

(1) Electromagnetic lock switch
The electromagnetic lock switch is located in the upper section on the front door. Opening the front door causes the spindle, X-, Y-, and Z-axes to stop operating. Once they have stopped, the electromagnetic lock switch releases the door lock, making it possible to open the front door.

(2) Mode select lock function
The machines designed for use in Europe or China have a software-controlled mode select lock function.

(3) Fixed cover
A fixed cover is located around each movable part of the machine.

(4) Emergency stop button
The emergency stop button is located in the lowest section on the operator's panel. Refer to Section 3, "EMERGENCY STOP," in Part III, "ROUTINE OPERATIONS," for details.
Pressing the emergency stop button is the first thing you should do once a failure occurs. Make it possible to press the emergency stop button whenever necessary. Neither hang anything on the button nor cover it with anything.

2 CAUTIONS

Before starting to install, operate, or maintain the machine, read the safety precautions herein carefully. Failing to follow any of these descriptions about the safety precautions and other cautions stated herein may lead to death or injury.

⚠ DANGER

You could get caught in the machine, possibly leading to injury. Do not put your body, hand, or foot closer to any movable parts.

1 When running the machine with the front door kept open, be careful to prevent any portion of your body from touching its movable parts, such as the table. Otherwise, you may get caught, possibly leading to injury.
2 Do not put your whole body into the machine. If you do so, it is difficult for others to notice that you are working on the machine. Therefore, they may fail to recognize you working inside the machine and may start the machine.
3 Do not adjust the coolant nozzle during operation. Doing so may cause injury.
4 The operator is not allowed to open the front door even if the power is off. Opening the front door disables safety devices, possibly leading to injury.
5 If you are an operator and need to open the front door, ask a maintenance engineer. Opening the front door with no sufficient knowledge may lead to injury because of an unexpected behavior of the machine.
6 Before opening the front door, make sure that the Z-axis (spindle head) will not move down. In rare cases, the Z-axis brake gets out of order, thus letting the Z-axis move down. Even after you have opened the front door, be careful that the Z-axis may move down. If you have to work underneath the Z-axis, pop it up by inserting a wood between it and the table beforehand, so it is prevented from moving down in case the brake should get out of order.
7 Pay attention not to get your head or hand caught in the automatic door (optional). If the machine has the optional automatic door mechanism, the front door can be automatically opened and closed in step with programs. Be careful not to be caught in the door during work.
8 When removing the Z-axis motor, be careful not let the Z-axis (spindle head) move down. Because the Z-axis brake is in the motor, removing the motor allows the Z-axis to go down, causing a risk that you may be caught, hence injury. When removing the motor, fix the table and Z-axis with packing materials.
9 Do not perform automatic operation with the coupling bolts for the Z-axis loose. Otherwise, the ball screw may break, which may cause the spindle head to go down in the worst case.

⚠ DANGER

You could get caught in rotating portions, possibly leading to injury. Do not put your body, hand, or foot closer to any rotating portions.

1 When the power is on, do not use a cross-slot screwdriver to open the front door. Doing so enables you to enter the machine area even when the tool is rotating, possibly leading to injury. When the power is on, use the front door open/close button to open or close the front door.
2 One or two servo motors can be controlled as the fourth and/or fifth axes (additional axes). The additional axis must be installed on the table. Otherwise, it is impossible for the fixed cover or front door to protect the operator from the motion of the additional axis, possibly leading to injury.
3 To avoid accidents, such as engulfment, always wear safe clothing as stated below when working.
   - Wear a cap. Tuck any long hair into the cap as it can be caught in the machine or hinder vision.
   - Wear safety shoes.
   - Wear protective glasses.
   - Button up the sleeves of outer clothes.
   - Do not wear necklaces, bracelets, or the like.
   - Do not wear scarves, mufflers, or the like.
4 Before opening the front door with the power switched off, make sure that the spindle is not rotating. When the spindle is rotating, switching off the power prevents the spindle from stopping in a controlled manner, thus letting the spindle keep rotating under its own inertia; chips may fly out or you may touch the rotating spindle, hence injury.

⚠ DANGER

An explosion or fire could occur. Watch for explosions and fires when machining a workpiece made of a combustible metal.

1 When machining a combustible metal, use an appropriate coolant for machining combustible metals.
If fire breaks out during machining of a combustible metal, in particular, using a water-soluble coolant, the water reacts with the combustible metal, possibly leading to explosive combustion due to hydrogen gas or vapor explosion.
2 Do not machine any combustible metal such as magnesium with a machine equipped with an automatic fire extinguisher for general fires. If the automatic fire extinguisher operates, the agent in the extinguisher reacts with the combustible metal, possibly leading to explosive combustion due to hydrogen gas or vapor explosion.
3 Use a ROBODRILL equipped with an automatic fire extinguisher to machine only the fire extinguishable materials with the extinguisher. If the ROBODRILL is used to machine other materials, the extinguisher cannot be expected to extinguish fire, possibly leading to fire or explosion due to chemical reactions. The fire extinguishable materials of each type of automatic fire extinguisher are listed below.
[Materials available with an automatic fire extinguisher for general fires]
- Resins • Formed plastics • Wood • Fibers
- Water-soluble coolants • Water-insoluble combustible liquids (hazardous materials almost insoluble in water such as kerosene, class 3 petroleum (with an inflammation point of 70°C to 200°C), class 4 petroleum (with an inflammation point of 200°C to 250°C), fire-resistant coolants (with an inflammation point of 250°C or higher), machine oils, and lubricants)

[Materials available with an automatic fire extinguisher for combustible metal fires]
- Hazardous substances belonging to the second category (flammable solids) and third category (spontaneously flammable substances and substances which emit flammable gases when contacting with water) in the hazardous substance categories of the Fire Defense Law (For all combustible metals including magnesium, aluminum, and titanium, use an automatic fire extinguisher for combustible metal fires.)
- Combustible metals (such as magnesium)
- Resins • Formed plastics • Wood • Fibers
- Water-soluble coolants • Water-insoluble combustible liquids (hazardous materials almost insoluble in water such as kerosene, class 3 petroleum (with an inflammation point of 70°C to 200°C), class 4 petroleum (with an inflammation point of 200°C to 250°C), fire-resistant coolants (with an inflammation point of 250°C or higher), machine oils, and lubricants)
- Water-soluble combustible liquids (such as alcohol)

4 When using a mist collector or dust chamber together with a machine tool that machines combustible metals, the mist collector or dust chamber must be specific to combustible metals. Otherwise, a fire or explosion may occur within the mist collector or dust chamber.

⚠ DANGER

An explosion or fire could occur. Watch for explosions and fires when machining a workpiece made of a combustible metal.

5 Do not use any ROBODRILL equipped with an automatic fire extinguisher if the fire-extinguishing agent container is in rust, has flaw or is damaged, or the container cap is loose. The fire extinguisher may burst.
6 Do not install any automatic fire extinguisher at any location subject to high temperatures and high humidity.
7 On automatic fire extinguishers, do not use any fire-extinguishing agent containers that were produced five or more years ago. Do not improperly discard or leave any fire-extinguishing agent containers or pressurized containers unattained. It is likely that they may burst.
8 When the ROBODRILL is used to machine carbon- or graphite-made workpieces, it is likely that, if fine carbon or graphite powder resulting from machining gets dry, it may lead to dust explosion or rapid combustion. Be very careful when processing or handling such powder.
9 Use specified batteries and replace them in the correct way. If a battery is installed in a wrong way, it can explode, causing you to get injured.
10 After operation of the automatic fire-extinguisher for combustible metal fires, leave the machine untouched without removing an ejected fire-extinguishing agent until chips and the machine have completely cooled down. Hot burned chips may reignite on exposure to air. Remove the burned chips and fire-extinguishing agent once they have completely cooled down (you do not feel heat when you hold your hands over the accumulated fire-extinguishing agent).

⚠ WARNING

Chips, coolant, and broken tools may fly out. Be careful not to get hit by any flying objects on your body or eyes.

1 Before starting to switch on the air blower with the front door kept open, wear protective glasses. Otherwise, chips may get into your eyes, possibly leading to loss of vision.
2 If the polycarbonate of the front or side window is damaged, immediately replace the polycarbonate or door. When a lattice type window is installed, if the ABS sheet, which protects the polycarbonate, is damaged, immediately replace the door. Otherwise, objects flying from the inside of the machine can crash through the window, possibly leading to injury.
3 A high-speed spindle mounted on the ROBODRILL must meet the following requirements. Otherwise, safety devices, such as the interlock, may fail to operate, possibly leading to injury.
   - Register the number of the tool to be mounted in the parameter and confirm that the parameter setting matches the place in which the high-speed spindle holder is mounted. If the parameter setting differs from the place, safety measures during operation or work by the ROBODRILL become insufficient and injury may occur.
   - To operate the machine with the front door (safety door) of the ROBODRILL left open, make sure that the high-speed spindle motor does not rotate. If the front door is opened with the high-speed spindle motor rotating, injury may occur. Be sure to use the high-speed spindle control amplifier from NAKANISHI Inc. (for the FANUC ROBODRILL). Otherwise, safety is not ensured.
   - Prepare a circuit that shuts down the power between the motor and control unit when the door of the machine is opened.
   - Use a high–speed spindle having a speed detector.
4 The operator is not allowed to remove any fixed cover. Some portions inside the fixed covers are rotating or moving at high speed. Removing any fixed cover has the following risks.
   - You may touch portions rotating or moving at high speed.
   - A broken tool or workpiece chips may fly out.
   - Chips may fly out.
   - Coolant may splatter from the machine.
   - Noise may leak out.
5 Before switching on the power and operating the machine during or after maintenance work, make sure that no tool or the like is left in the machine. Otherwise, when the machine runs, any tool or the like may get caught in it or it may strike the tool or the like toward people around the machine.

⚠ WARNING

Chips, coolant, and broken tools may fly out. Be careful not to get hit by any flying objects on your body or eyes.

6 When replacing the filter regulator and oil filter mantle (element)
   a) Before starting auto drain maintenance, turn off the main circuit breaker. Otherwise, you may get injured due to an unpredictable motion.
   b) Before removing the bowl, stop compressed air supply to remove any residual pressure and make sure that there is no pressure inside the bowl. If there remains compressed air, the bowl can be blown, resulting in human injury or death.
   c) Do not remove the bowl guard.
   If the bowl is destructed, broken pieces can scatter, resulting in human injury or death.

⚠ WARNING

There is a risk of an electrical shock. Do not touch any portion through which current flows or splash liquid onto that portion.

1 When installing the machine, keep the main circuit breaker (outside the control unit cabinet) in its off position.
2 When making electrical adjustments with a cover removed, use a tool with a sufficient electrical protection (for example, a screwdriver made of plastic). Otherwise, there may occur an electrical shock.
3 If a power or connection cable gets damaged, immediately stop using the machine. Otherwise, an electrical shock or fire may occur. Do not start using the machine until a maintenance engineer replaces the damaged cable.
4 Do not switch on the power for the machine with any cable detached. Otherwise, an electrical shock may occur.
5 Before opening the control unit cabinet door, for example, to replace fuses or batteries, be sure to switch off the power with the main circuit breaker. Otherwise, there may occur an electrical shock.
6 Before connecting the power cable, turn off the switchboard breaker. Otherwise, an electric shock may result.
7 Keep in mind that setting the control unit cabinet door circuit breaker to its off position does not remove the power from its primary side. Also keep in mind that, even if the circuit breaker is in its off position, there is a risk of an electrical shock on any component connected to the primary side of the circuit breaker, including the following:
   - External power transformer connected to the primary side of the circuit breaker
   - Nonstandard peripheral equipment connected to the primary side of the circuit breaker
   - Automatic fire extinguisher connected to the primary side of the circuit breaker
8 There may remain a voltage on some portions in the control unit cabinet even after the main circuit breaker is set to its off position, possibly leading to an electrical shock. Do not touch any portion in the control unit cabinet unless you have sufficient knowledge about electricity.
   There may remain a voltage also on each motor and their power lines. Before starting maintenance work on these parts, wait for at least 20 minutes after the power has been shut off.
9 Do not touch the inside of the control unit cabinet with a wet hand. Otherwise, there may occur an electrical shock.
10 Do not splash liquid to the operator's panel or control unit cabinet. Otherwise, there may occur an electrical shock.
11 Avoid using any coolant or lubricant (such as grease or oil) that can unmake polycarbonate, nitrile rubber (NBR), hydrogenerated nitrile rubber (HNBR), fluorocarbon rubber, nylon, and acrylate resin、ABS resins. Dilution water rich with residual chlorine can unmake these substances. As the machine uses these substances as sealant, the machine may get less sealed, possibly leading to an electrical shock because of fault current or to a burn because of lack of grease resulting from a spill.

⚠ WARNING

There is a risk of an electrical shock. Do not touch any portion through which current flows or splash liquid onto that portion.

12 The operator is not allowed to open the control unit cabinet door. Some portions in the cabinet have high voltage, having a risk of an electrical shock. If the operator has to switch on the power, use the main circuit breaker (outside the control unit cabinet) or the power switch (on the operator's panel).
13 Before removing the cover of the automatic fire-extinguisher control box, be sure to turn off the circuit breaker of the automatic fire-extinguisher. Removing the cover with the power to the automatic fire-extinguisher kept on may lead to a shock hazard. Keep in mind that turning off the circuit breaker of the ROBODRILL does not remove the power from the automatic fire-extinguisher.
14 Do not touch the controller terminals inside the automatic fire extinguisher panel. It is likely that the fire extinguisher power may be on even if the ROBODRILL circuit breaker is in its off position. Before touching the controller terminals, make sure that the fire extinguisher power is off. Otherwise, there is a risk of an electrical shock.
15 When replacing maintenance parts (except the battery for the separate absolute pulse coder explained in 2.6.1.1 in Part V), be sure to keep the control unit cabinet door circuit breaker set to its off position. Otherwise, there may occur damage to the maintenance parts or an electrical shock.
16 Provide a sufficient space around the cable carrier. If a sufficient space is not allowed between the cable carrier and the ceiling, walls, beams, or other installations (for example, a non-FANUC material prepared by the customer, such as a ceiling cover) of a building in which the machine is installed, a broken cable in the cable carrier has a higher risk of a fire or electrical shock.
17 When assembling the Z-axis motor to the machine, keep the power for the machine main body switched off. Otherwise, injury or an electrical shock may occur unexpectedly.
18 After maintenance work, make sure that all components, including screws, that were removed for maintenance purposes are back in place. Otherwise, safety devices may fail to function or injury may occur because of a malfunction or an electric shock.
19 The person in charge of routine maintenance and preventive maintenance shall not be engaged in replacement of the CNC memory backup battery or fluorescent lamps within the machine. Only the maintenance engineer is allowed to replace such electrical components. Work by any person with no sufficient knowledge may disable safety devices from working, possibly resulting in an unexpected behavior of the machine that may cause injury or an electric shock.
20 When replacing the fluorescent lamp, turn off the main circuit breaker. Otherwise, you can get electrically.

⚠ WARNING

Other danger

1 Do not get close to the machine if you are using a pace maker. Otherwise, the pace maker may be adversely affected.
2 Do not touch the following portions of the machine during operation and for a while after operation because they may be very hot. There may be a risk of burn injury. Use a protector, such as heat-resistant gloves, if you cannot avoid touching them.
   - X-, Y-, Z-, and additional axis servo motors
   - Spindle motor
   - Coolant motor
3 Do not touch the following portions of the machine when the power is on and for a while after the power is switched off because they may be very hot. There may be a risk of burn injury. Use a protector, such as heat-resistant gloves, if you cannot avoid touching them.
   - Power line
   - Heat generating/releasing portions (such as transformers and heat sink fins) in the control unit cabinet.
4 Coolants and lubricants (such as grease and oil) are harmful. Take the following precautions. For additional precautions and measures to be taken if they have gotten to human bodies or been inhaled, follow the instructions stated on the package of the products or those from the respective manufacturers, such as MSDS.
   - Do not breathe vapor or mist of any of these substances.
   - Do not expose the skin (especially, cuts) directly to any of these substances more than necessary.
   - Wear protective glasses to keep the eyes from these substances.
   - Do not drink any of these substances.
5 Do not use any rotten coolant or lubricant (such as grease or oil) as it is quite harmful. As for how you can tell that a coolant or lubricant is rotten, contact its manufacturer. Save or dispose of it according to the instructions from the manufacturer.
6 Do not detach the coolant hose during operation. The toxic coolant may spout out and splash onto humans. Before detaching the coolant hose, switch off the power and make sure that the pump is at rest.
7 To use the built-in Ethernet function for the first time, set up an IP address and other data carefully and perform communication test sufficiently after consulting with your network administrator. Be very careful because specifying the IP address and other data incorrectly can cause an adverse effect, such as a communication failure, to the entire network and can also cause other machines to malfunction.
8 Before starting to use the machine, be sure to perform grounding to prevent radio disturbance and electrical leakage. For grounding conditions, see Chapter 1, "INSTALLATION REQUIREMENTS".

⚠ WARNING

Other danger

9 Do not change any parameter unless you have sufficient knowledge. Changing a parameter may disable the interlock, leading to a higher risk of injury. After changing any parameter, make sure that the interlock works.

10 To lift the machine, use a crane and rope or cable with a load capacity of not less than the mass of the ROBODRILL main body of interest. Listed below are the mass of the main body of each ROBODRILL model. The mass in parentheses contains all options. Enclosed between each pair of parentheses is the total mass including all options.

- α-D14/21M*i*A5 2000kg (2300kg)
- α-D14/21L*i*A5 2100kg (2400kg)
- α-D14/21S*i*A5 1950kg (2200kg)

When lifting the machine, make sure that it stays in balance.

11 Do not use any coolant with a low inflammation point (such as class 2 petroleum, with an inflammation point of below 70°C). Otherwise, a fire may occur. Class 3 petroleum (with an inflammation point of 70°C to 200°C), class 4 petroleum (with an inflammation point of 200°C to 250°C), and burn-resistant coolants (with an inflammation point of 250°C or higher) can also catch fire. When using these liquids, exercise care on the way and method of using them, for example, by suppressing generation of oily smoke.

12 Do not get anything burnable or flammable (such as thinner, gasoline, paper, wood chip, cloth, fiber, or spray) close to the machine (including the power and connection cables) or leave it near the machine. Otherwise, heat or sparks generated in cutting may let it catch fire.

13 During machining using a coolant, be careful to supply a sufficient amount of coolant properly. If a coolant is not supplied normally, sparks, frictional heat, and others may be generated depending on the cutting condition, possibly letting cut scraps of a combustible workpiece or the coolant catch fire. Clean the cut scrap receiver and filter in the coolant tank so that a sufficient amount of coolant is supplied properly and the filter is not clogged. If the amount of the coolant in the coolant tank is insufficient, replenish the coolant in the tank immediately. Periodically check that the coolant pump runs normally.

14 Always maintain a sufficient amount of coolant for machining. If there is no sufficient coolant, a resultant temperature rise may cause a fire or damage to the tool and workpiece.

15 When using a mist collector or dust chamber together with the ROBODRILL with an automatic fire extinguisher, be sure to attach a fire prevention dumper to the duct section. Otherwise, fire spark may be inhaled, causing fire spread during occurrence of a fire.

16 Watch for fires when handling flammable workpieces.

17 Watch for fires when using a water-insoluble coolant.

18 Use the machine with appropriate tools and under appropriate cutting conditions. Cutting under an unreasonable cutting condition or with a worn tool may lead to fire because of heat generated in cutting. It can also break the tool and cause sparks, which may let cut scraps and the water-insoluble coolant catch fire. Use appropriate tools and appropriate cutting conditions while referencing materials supplied by tool manufacturers.

⚠ WARNING

Other danger

19 If a tool breaks, stop cutting immediately. Otherwise, any tool chip left in the workpiece may grind against the rest of the tool on the Z-axis (spindle head), causing sparks, which may let cut scraps and the water-insoluble coolant catch fire.
20 Do not use the machine under any cutting condition that may cause sparks. Otherwise, a fire may break out. Previously check the program and settings sufficiently, and make sure that the tool will not be overloaded or interfere with jigs.
21 Sweep away chips. A pileup of chips in the machine can increase a risk of a fire. Periodically do the sweeping to avoid a pileup of chips.
22 Keep mist of oil or dust from stirring up around the machine. Otherwise, sparks may let it catch fire.
23 When machining a combustible workpiece or using a water-insoluble coolant, always monitor the machine status. The automatic fire extinguisher is designed for temporary use for the initial stage of fire. Always monitor the machine status so that an appropriate action can be taken immediately in case fire should break out.
24 Machining a combustible metal without using any coolant may generate sparks, frictional heat, and others depending on the cutting condition or due to a worn tool, having a high risk of letting cut scraps catch fire.
25 Rig a fire extinguisher near the machine in case of fires. It is also recommended to equip the machine with an automatic fire extinguisher.
26 Periodically clean the piping and wiring (sensors and nozzle in particular) in the automatic fire extinguisher. In particular, chips and coolant adhered to the sensors and nozzle can prevent detection of a fire and emission of fire-extinguishing agent.
27 We recommend you to install a ceiling cover. In case fire should break out, the ceiling cover may be able to prevent or retard the spread of fire to the building, to let the fire die down because of a reduction in the amount of oxygen within the splash guard, and to enhance the effect of the automatic fire extinguisher.
28 Perform inspections and maintenance periodically. Be sure to perform the inspection items described in Part V, "MAINTENANCE" herein. Otherwise, any defect in the machine may lead to death, injury, or damage to the machine.
29 When exchanging maintenance parts, follow the applicable descriptions herein. Using noncompliant parts or the wrong replacement method may cause a defect in the machine, possibly leading to injury.
30 Before removing a cover for maintenance purposes, be sure to set the control unit cabinet door circuit breaker for the machine to its off position.
31 Before installation or maintenance of each option, turn off the circuit breaker of the controller cabinet door and the circuit breaker of each option.
32 When turning on the power with the cover removed for maintenance, check that there is no other person near the machine.
33 Before starting maintenance work, post a notice near the control unit cabinet door circuit breaker to indicate that no one except the maintenance personnel of interest is allowed to switch on the power.

⚠ WARNING

Other danger

34 When working in a high place, use a ladder and secure a footing to reduce a risk of a fall. Do not climb the machine or any other thing (such as a chair or desk) that is not intended for use as a step ladder. Otherwise, you may get out of balance, possibly leading to an accident.
35 Before inspecting the X/Y/Z-axis telescopic covers, be sure to turn off the power. Otherwise, an unexpected motion may cause injury.
36 When transporting or lifting the machine, keep it in the transportation status shown above. Otherwise, the machine may fall down, possibly leading to injury.
37 Before starting to install the coolant unit, make sure that the circuit breaker in the ROBODRILL control unit cabinet is in its OFF position to shut off power for safety purposes. In addition, stop supplying air to the machine.
38 Read "SAFETY PRECAUTIONS FOR INSTALLATION" carefully and follow the steps stated in it. Failing to follow them may lead to injury or death
39 Before starting to mount the tool length switch, make sue that the main circuit breaker (outside the control unit cabinet) is in its OFF position for safety purposes. In addition, stop supplying air to the machine.
40 Clean cut scraps from the splash guard to prevent large amounts of cut scraps from being accumulated. If fire occurs when large amounts of cut scraps are accumulated, it may become impossible to distinguish the fire completely with the automatic fire-extinguisher.
41 After operation of the automatic fire-extinguisher, leave the machine untouched without removing an ejected fire-extinguishing agent until chips and the machine have completely cooled down. You may get burned if you touch hot burned chips. Remove the burned chips and fire-extinguishing agent once they have completely cooled down (you do not feel heat when you hold your hands over the fire-extinguishing agent).

⚠ WARNING

Other danger

42 When doing cleanup work after operation of the automatic fire-extinguisher, be sure to wear protectors such as protective gloves, goggles, and a mask. Otherwise, during the cleanup work after fire extinction, there is a risk for you to be burned if you carelessly touch hot chips or parts, and there is also a risk for you to be injured if you get a fire-extinguishing agent or chips into your eyes or mouth.

[First-aid actions against fire-extinguishing agent]

Take the actions listed below, immediately contact a doctor, and follow the doctor's directions.

When fire-extinguishing agent was inhaled

- Lie quietly in fresh air.
- Wash the nasal cavity in lukewarm water and gargle the throat.

When fire-extinguishing agent stays on the skin

- Wash away the stain in water or soap-and-water solution.

When fire-extinguishing agent got in the eye

- If the eye contacted any fire-extinguishing agent, wash it down in a large quantity of water and submit to medical treatment.

When fire-extinguishing agent was swallowed down

- If the victim is conscious, have his or her mouth rinsed out in water.
- Burp up and submit to medical treatment quickly.

Protecting personnel providing first aid

- The deliverer shall wear appropriate protective equipment so that he or she will not touch fire-extinguishing agent.

＊ For explanations about how to handle other types of fire-extinguishing agent, refer to the "Material Safety Data Sheet" attached to the automatic fire-extinguisher in use.

43 Before performing work at closing time, be sure to turn off the power. Otherwise, the operator may get injured by an unexpected operation.

44 When greasing, turn off the power. Otherwise, you may get injured due to an unpredictable machine motion.

45 Before setting any setting terminal on the HDI I/F unit for the high-speed skip function, wait for several minutes after turning off the power to the machine. Otherwise, there is a risk of an electrical shock or burn injury.

⚠ CAUTION

1 If a coolant or lubricant (such as grease or oil) gets to you hand, wipe it off immediately. Otherwise, it makes the hand very slippery, making it difficult to handle workpieces or to operate the equipment; it is likely that injury or damage to the workpieces may result.
2 The table can hold up to 300 kg (for the α-D14S*i*A5 and α-D21S*i*A5, 200 kg), including jigs and workpieces. Be careful not to exceed this maximum loading weight. If it is exceeded, the table may get damaged, possibly leading to injury and damage to the workpiece and jig.
3 Be careful when handling workpieces, no matter whether they are yet to be machined or have already been machined, because they have sharp edges and burrs. Otherwise, you may get injured. Wear a protector such as gloves.
4 When using or exchanging tools, be careful not to get injured with their sharp edge. When handling tools, wear a protector such as gloves.
5 When handling chips, be careful not to get injured. Wear a protector such as gloves.
6 When disposing of tools, follow all regulations applicable to handling of dangerous articles. Unconsidered disposal may lead to injury to others if they touch the wastes.
7 If you want to use an unrecommended coolant or lubricant (such as grease or oil), check the instructions from its manufacturer, and use it by exercising care sufficiently on its use conditions and method according to the instructions. Otherwise, unrecommended coolants and lubricants can adversely affect human bodies, the machine, and environment. Some coolant or lubricant types and some of their combinations lead to poor lubrication or sludge development on the LM guide or ball screw, causing possible endurance degradation. Before starting to use a coolant, check it carefully with its manufacturer.
8 If a coolant or lubricant (such as grease or oil) has spilt out to the floor, wipe it off immediately. Otherwise, the floor becomes very slippery, possibly leading to overturn and injury.
9 Periodically clean the machine so that chips will not block the coolant outlet or chip tray. Coolant leakage can make the floor slippery, possibly leading to overturn and injury.
10 As for storage of coolants and lubricants (such as grease and oil), follow the instructions from their manufacturers. When disposing of them, follow all regulations applicable to industrial wastes.
11 Use a crane to mount or dismount an object that apparently weighs 20 kg or heavier, that cannot be borne with your hands, or that you feel heavy when you try to lift it. Lifting heavy stuff may impose a burden on your back or let it fall from your hands, possibly leading to injury.
12 Sufficiently illuminate the shop floor where the machine is installed so that you can see the machine and parts clearly. Working in a dark place can invite an incorrect operation, possibly leading to an accident. The shop floor must be illuminated with at least 300 lx. An optional internal light is available.
13 Do not work in an unnatural posture, reaching out to mount or dismount workpieces on the table when it is far away from you. Doing so may impose a burden on your back or let workpieces fall, possibly leading to injury unexpectedly. When working with workpieces on the table, bring the table sufficiently toward you beforehand.

⚠ CAUTION

14 Pressing the emergency stop button is the first thing you should do once a failure occurs. Make it possible to press the emergency stop button whenever necessary. Neither hang anything on the button nor cover it with anything.

15 Before releasing the emergency stop button, remove the cause of the abnormality. Otherwise, a dangerous condition may recur, possibly leading to injury.

16 Connect any related external equipment to the emergency stop function securely. If an accident occurs, a poor connection may disable the emergency stop device from operating normally, possibly leading to injury or damage to tools.

17 Do not handle the operator's panel or display unit with gloved fingers. Doing so may let you press the wrong key or more than one key at a time, possibly leading to the malfunction of the machine, injury, or damage to workpieces or even the machine.

18 Install the machine on a flat, sufficiently strong floor. Otherwise, the machine may jolt during operation, possibly leading to injury. The floor on which the machine is installed must satisfy all of the following conditions:

- The floor must have a load resistance of 3 tf/m^2 (29.4 kN/m^2) or more.
- The floor is completely flat, with no protuberance or hollow.
- The floor must not deteriorate with age and in regular use.

  For the recommended floor conditions, see Chapter 1, "INSTALLATION REQUIREMENTS".

19 Connect piping securely to prevent a coolant from leaking from it. If a coolant leaks, the floor becomes slippery, thereby causing injury due to falling down.

20 When a machine cleaning coolant unit is used, if the shower gun is pointed towards the outside of the splash guard, spilled coolant makes the floor slippery, which can cause dangerous falls.

21 The life of a fluorescent lamp is about 6,000 hours. The life depends on the ambient environment. When the fluorescent lamp is burned out or begins blinking, replace it immediately. If you work under dim lighting, you may get injured inadvertently.

22 When replacing the fluorescent lamp, be careful not to cut yourself with any metal sheet in the inside light unit.

23 If operating the automatic door with the cover removed for inevitable inspection reasons, be careful not to jam your fingers in the door.

24 When you operate the robot using the CNC of the ROBODRILL with the robot interface (option), you cannot perform an operation that requires a high response because of the characteristic of control. So, be very careful when operating the robot.

CAUTION

1 Before starting work, securely attach the workpiece to the jig. Also keep the jig stationary on the table. If you fail to fix the workpiece securely, it may come off the jig and fly out during work, possibly leading to damage to itself and the machine.
2 Before starting work, make sure that the tool is securely attached to the tooling. Otherwise, the tool may come off, possibly leading to damage to the workpiece and machine.
3 Before starting work, make sure that the tool is not worn out or broken. Otherwise, chips of the tool may fly out, possibly leading to damage to the machine.
4 Before starting work, make sure that the tooling is securely attached to the turret grip as directed (see Section 6, "MOUNTING TOOLS," in Part III). Otherwise, the tooling may come off and fly out, possibly damaging the workpiece and machine.
5 The weight of a tool to be mounted on the turret is 2 kg or less and the total weight of 14/21 tools is 15 kg/23 kg or less. To mount a tool with a weight of 2 kg or more (up to 3 kg), set the tool weight to 3 kg (see Section I-5, "TOOLS"). The factory-adjusted tool weight is 3 kg for safety. If the setting is inappropriate, the tool may be removed, damaging the workpiece or machine.
6 Before starting automatic operation, make sure that:
- The jig is securely fixed on the table.
- The workpiece is securely attached to the jig. In particular, if the jig is of an air cylinder type, the specified air pressure is supplied.

If machining is performed without fixing the workpiece and jig securely, they may come off and fly out, possibly damaging the workpiece and machine.

ATTENTION

1 When using a ceiling cover as a full cover for the entire machine, be sure to use a mist collector. Otherwise, mist of coolant can fill the inside of the machine, possibly making the machine get out of order. In addition, hot air from the spindle motor can also fill the inside of the machine, possibly making the machine get out of order.
2 Make sure that proper greasing and oiling are applied to the ball screws and LM guides along each axis. Otherwise, there may occur damage to a ball screw or LM guide.
The central lubricating device hose between the table and saddle is a consumable item. If the hose is damaged, replace it immediately.
3 After making sure that the lock is completely released, open the front door. An attempt to open the door when the lock is not released makes an excessive impact on the electromagnetic lock switch, possibly leading to damage to it.
4 When opening or closing the front door, do so slowly (at or below 300mm/sec). Opening or closing it rapidly may damage the machine.
5 If a cushion rubber on the front door is damaged or missing, replace it with, or install, a new one promptly. Using the machine with the cushion rubber damaged or missing may damage the machine.
6 When installing a jig on the table, make sure that the load is applied uniformly over the table surface. Nonuniform load on the table may lead to damage to a ball screw or LM guide. It may also affect the precision.
7 Be careful not to generate rust in the machine. Rust may be generated on a part on which painting is not applied such as the table surface or telescopic cover depending on the environment. Rust generated in the machine may interfere with the movement of a movable part, resulting in damage to the machine. For dry cutting, in particular, periodically apply a rust inhibitor so as not to generate rust.
8 Using the machine to grind workpieces or to cut ceramic-, carbon-, or graphite-made workpieces may result in sealing materials being adversely affected by fine polishing or cutting powder, possibly damaging the spindle, ball screw, LM guide, or other parts earlier than their service life. If you want to use it for such purposes after understanding these cautions, please contract for fare-paying periodic maintenance.
9 Manage the coolant according to the directions from its manufacturer properly as for its pH, the way its undiluted solution is mixed with dilution water, the salinity concentration of the dilution water, and the frequency at which the coolant is replaced. Otherwise, the machine may get rust or corroded, leading to trouble on the machine.
10 Even when using a recommended coolant or lubricant (such as grease or oil), observe the instructions from its manufacturer. It may adversely affect the machine parts and painting depending on the way it is used.

ATTENTION

11 Do not use any type of coolant listed below since it can adversely affect the machine, possibly causing damage to the machine:
- Coolant containing sulfur with a high degree of activity: Some coolants may contain sulfur with a very high degree of activity. If this type of coolant enters the inside of the machine, it can corrode copper, silver, and other metals, possibly causing damage to parts.
- Highly-penetrative synthetic coolant: Some coolants containing polyalkylene glycol have a high permeability and may cause insulation degradation, poor lubrication, or a component failure when entering the inside of the machine.
- High-alkali, water-soluble coolant: Some coolants to which alkanolamines and other agents are added to increase the pH value may be strongly alkaline, which have a pH of 10 or more even with the working solution. This type of coolant can cause damage to resin and other materials if adhered to them for a long time.
- Coolant containing chlorine: Some coolants containing chlorine (for example, chloride components, such as chlorinated paraffin) affect materials such as resin and rubber badly, leading to possible defective parts.

12 Sweep off chips from the inside of the machine diligently. Check the inside of each axis cover and casting for any chips semiannually. If chips are found inside any axis cover or casting, remove them. Even when using a recommended coolant or lubricant (such as grease or oil), observe the instructions from its manufacturer. It may adversely affect the machine parts and painting depending on the way it is used.

13 To prevent coolant and other liquids, and chips from entering the inside of the control unit, be sure to close and lock the control unit cabinet door. For the same purpose, be sure to close the covers of the operator’s panel and cable duct and tighten the cover mounting screws securely. Keep the operator’s panel and cable duct cover from any cutting fluid splash.

SUPPLEMENT

When installing the machine, provide a service access clearance. See the floor plan shown in Section 3.1, "INSTALLING LEVELING BOLTS AND BLOCKS," in Section 3, "INSTALLATION," in Part II, "INSTALLATION;" for explanations about the service access clearance.

The following lubricants are recommended:

Brand	Manufacturer	Component to be lubricated	Timing of application
ALVANIA GREASE S1	SHOWA SHELL SEKIYU K. K.	GUIDE RAIL TURRET GEAR CAM FOLLOWER SPINDLE NOSE GEAR	At the time of maintenance
ALVANIA GREASE S2			
MULTEMP LRL3	KYODO YUSHI	BALL SCREW (X, Y, Z)	
MOLY HD GREASE NO.2	SUMICO	SPINDLE TOOL CLAMP SPRINGS	When exchanging Tool clamp springs
MOLYSPEED GREASE NO. 1	SUMICO	TURRET MECHANISM INSIDE	When overhauling Turret mechanism
ANTIRUST P- 2800	JX Nippon Oil & Energy Corporation	GUIDE RAIL (X, Y, Z) TAPERED PORTION OF THE SPINDLE TABLE SURFACE	At the time of packing, transportation, and storage.
ANTIRUST P- 3600			
Mobil Vactra Oil No.2(SLC)	Mobil Oil corp.	GUIDE RAIL (X, Y, Z) BALL SCREW (X, Y, Z)	Replenish when the leavings in the pump becomes scarce.
UNIWAY EV68	JX Nippon Oil & Energy Corporation		
Shell Tonna S3M 68	SHOWA SHELL SEKIYU K.K.		
FANUC specification: A90L-0001-0534#LHL3007 (LUBE specification:LHL300-7, volume 700cm^3=700 ml)	LUBE	GUIDE RAIL (X, Y, Z) BALL SCREW (X, Y, Z)	When the grease level low alarm is issued for the greasing unit
FANUC specification: A90L-0001-0534#LHL3004S (LUBE specification: LHL300-4S, volume 400cm^3=400ml)			

The following coolants are recommended:

Property	Manufacturer	Product name
Soluble	Yushiro Chemical Industry	Yushiroken FGE350
	Castrol	Alusol B
	JX Nippon Oil & Energy Corporation	Unisoluble EM-B
	Blaser Swisslube Japan	Blasocut 2000 CF

* Yushiro Chemical Industry Yushiroken FGE350 falls under the control of the Pollutant Release and Transfer Register (PRTR) law.
FGE350PR, which does not fall under the control of this law, is recommended for use in Japan.

3 WARNING LABELS

Warning labels are posted to indicate the items to which attention must be paid during daily work.
The machine bears warning labels at the locations stated below. See the subsequent pages for details of each warning label.
Keep all warning labels visible and readable. Do not stain, scratch, or remove warning labels.
If any warning label is missing or illegible, contact a FANUC service representative or a dealer nearby.

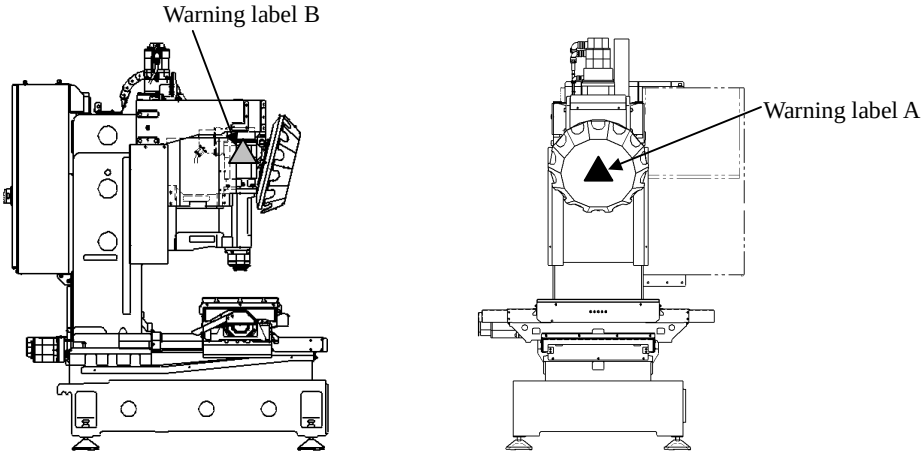


Fig. 2.3.1 Warning label location inside the machine

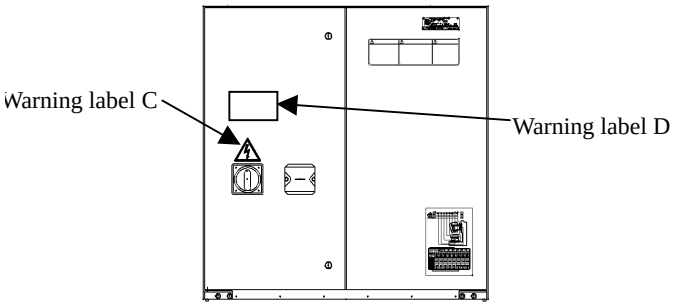


Fig. 2.3.2 Warning label location on the control unit cabinet (behind the machine)

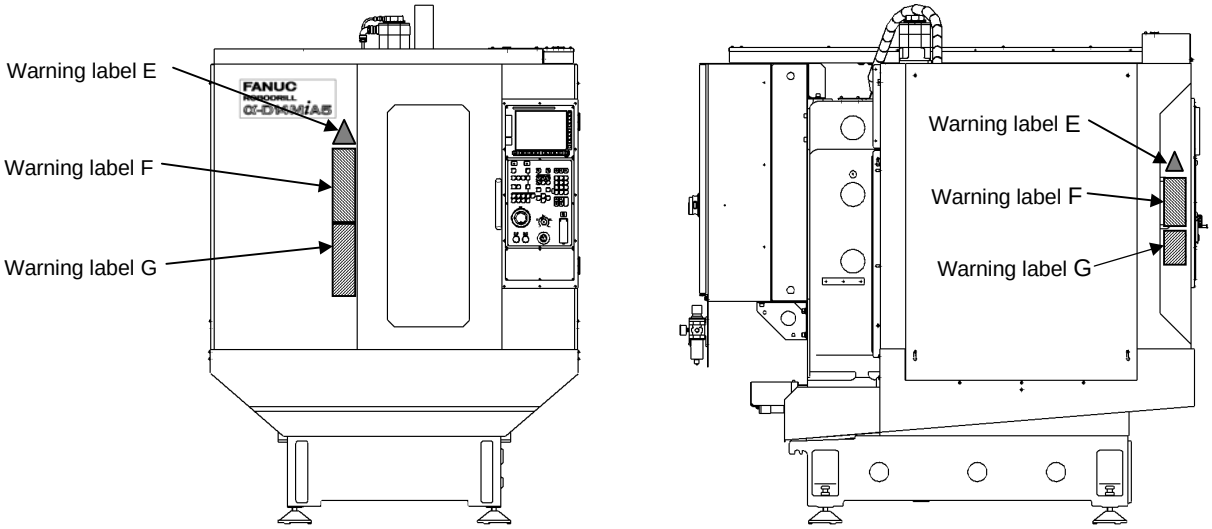
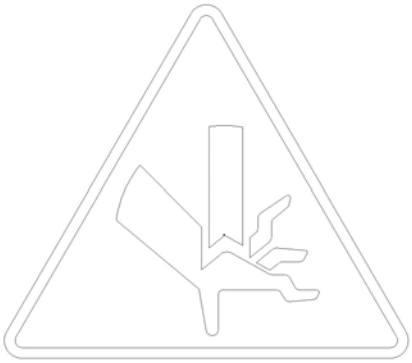


Fig. 2.3.3 Warning label locations on the front surface of the machine
Left: α-D14/21M/L*i*A5 (front view) Right: α-D14/21S*i*A5 (side view)



Warning label A

[Location] This warning label is posted on the turret cover.

A rotating turret or falling Z-axis may cause injury.

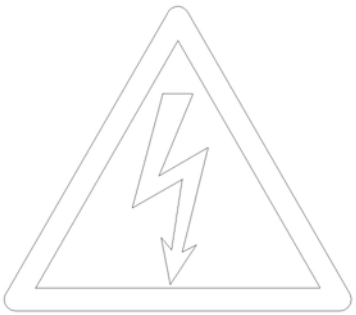
1. Pay attention to the tool that is rotating or going down.
2. To work with workpieces on the table, bring the table sufficiently toward you beforehand.
3. When exchanging workpieces, do not get close to the turret.

Warning label B

[Location] This warning label is posted on side of a spindle motor and servo motors.

There may be a risk of burn injury.

Use a protector, such as heat-resistant gloves, if you cannot avoid touching them.



Warning label C

[Location] This warning label is posted on the control unit cabinet door or other sections of the machine.

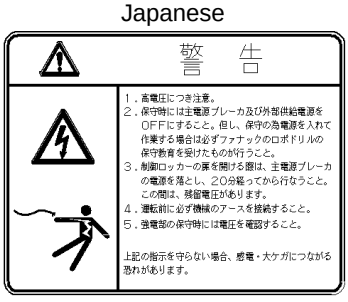
There are electrical shock hazards that may cause death or serous injury.

1. Pay attention to high voltage.
2. Do not use the machine unless you have sufficient knowledge.

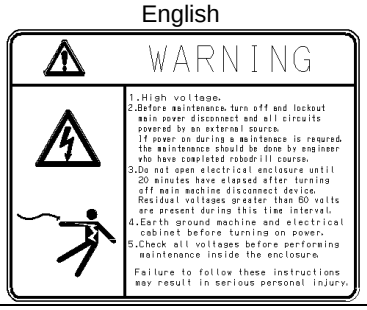
Warning label D

［Location］This warning label is on the door of the controller cabinet.

Japanese



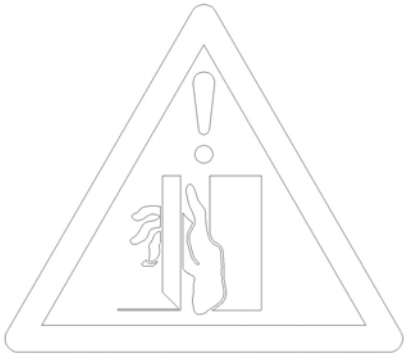
English



Chinese

1. High voltage
2. Before maintenance, turn off the main power and shut off all external power sources.
   Only the engineer who completed ROBODRILL course can maintain during power on.
3. Before opening control cabinet, turn off the main breaker and wait 20 minutes.
   Residual voltages greater than 60 volts is remaining in this period.
4. Before turning on the power, be sure to connect the earth of the machine.
5. Before maintenance of high voltage area, be sure to check remaining voltage.

If these safety instructions are not followed, serious injury might be caused.



Warning label E * Only for machines with an automatic door (optional)

[Location] This warning label is posted on the front surface of the machine.

The automatic door may behave unexpectedly, causing a risk that your arm or body may get caught.

Be careful to avoid getting caught in the automatic door.

Warning label F * Only for machines designed for general use (not for those designed for use in Europe or China)

[Location] This warning label is posted on the front surface of the machine.

Note: The values stated on each warning label vary depending on the specification of the machine.

Warning in Japanese

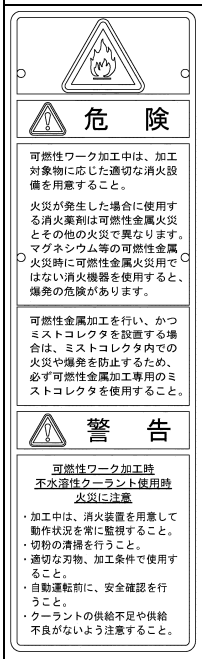
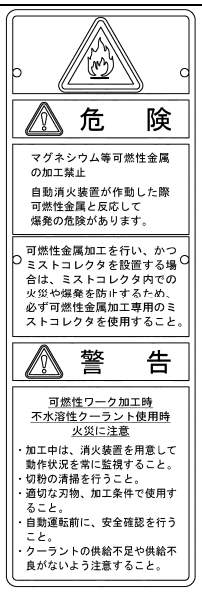
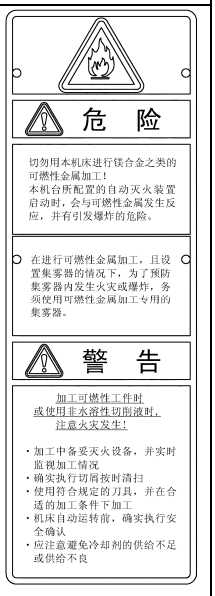
Warning in English

Warning in Chinese

1. Read the operator's manual and understand the descriptions in it before starting to install, operate, and maintain the machine.
2. You could get caught in the machine, possibly leading to injury. Do not put your body, hand, or foot closer to any movable parts.
3. You could get caught in rotating portions, possibly leading to injury. Do not put your body, hand, or foot closer to any rotating portions.
4. An explosion or fire could occur. Watch for explosions and fires when machining a workpiece made of a combustible metal.
5. Chips, coolant, and broken tools may fly out. Be careful not to get hit by any flying objects on your body or eyes.
6. There is a risk of an electrical shock. Do not touch any portion through which current flows or splash liquid onto that portion.
7. Other danger is described in the operator's manual. Refer to the manual.

Warning label G

[Location] This warning label is posted on the front surface of the machine.

Machine with an automatic fire extinguisher for combustible metal (optional) or no automatic fire extinguisher			Machine with an automatic fire extinguisher for general fires (option)		
Warning in Japanese	Warning in English	Warning in China	Warning in Japanese	Warning in English	Warning in China
					

When handling flammable workpieces, keep a fire extinguisher appropriate for materials to be machined available. Failing to follow this may lead to death or serious injury.
The use especially of a fire extinguisher which cannot extinguish combustible metal fires to extinguish a fire caused by a combustible metal such as magnesium may cause an explosion hazard.

When handling flammable workpieces or using a water-insoluble coolant, observe the following precautions so as to avoid a risk of a fire:

1. Use approximate tools and cutting conditions.
2. Ensure safety by making sure that the tool is not subjected to strong force or does not interfere with jigs.
3 Sweep off chips periodically. Remove all chips after work.
4 Keep a fire extinguisher available during work. Always watch the status of the machine operation.
5 Be careful to supply a sufficient amount of the coolant stably.

PREFACE

1 INTENDED USE OF THE PRODUCT

The FANUC ROBODRILL α-D*i*A5 series is a machine tool that operates under control of a CNC (computer numerical control unit). It can be used for drilling, tapping, light milling, milling, and boring. It should not be used for any other purposes.

2 DEFINITION OF USERS

2.1 Operator

In this document, the term operator refers to a person who operates a machine. The operator must read this manual to understand the contents of the manual. If the operator uses the machine without understanding the contents of the manual, the operator or people around the operator may be in serious danger.
The operator can perform whatever is described in Section 1, "DAILY MAINTENANCE," in Part V.
The operator is not allowed to carry out any maintenance that involves:

(1) Any work that becomes possible only after a cover whose removal requires a tool (fixed cover) is removed.
(2) Installing the machine or moving it from one place to another
(3) Repairing the machine
(4) Anything described in Section 2, "PERIODICAL MAINTENANCE," in Part V, "MAINTENANCE."

2.2 Person in charge of routine maintenance and preventive maintenance

This person should have completed an advanced course at the FANUC ROBODRILL School or have the equivalent knowledge and should also be qualified by the company or organization to which that person belongs.

The person in charge of routine maintenance and preventive maintenance is allowed to carry out:

(1) Work that can be done only after a cover whose removal requires use of a tool (fixed cover) is removed
(2) Work other than described in 2.6.1(1), 2.6.1.2, or 2.6.3 in Section 2, "PERIODICAL MAINTENANCE," in Part V.

The person in charge of routine maintenance and preventive maintenance must read this operator's manual and understand the information herein. If he or she operates the machine without understanding any description, it is likely that serious danger may arise to him or her and those around him or her.

The person in charge of routine maintenance and preventive maintenance is not allowed to carry out any maintenance work that involves:

(1) Installing the machine or moving it from one place to another
(2) Repairing the machine
(3) Work described in 2.6.1(1), 2.6.1.2, or 2.6.3 in Section 2, "PERIODICAL MAINTENANCE," in Part V.

The person in charge of routine maintenance and preventive maintenance must observe the cautions described below:

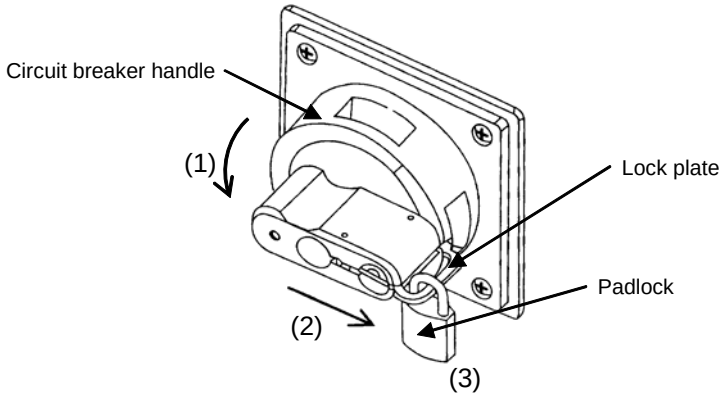
Cautions that Person in charge of routine maintenance and preventive maintenance must observe during maintenance

⚠ WARNING

1 Before removing a cover for maintenance purposes, be sure to set the control unit cabinet door circuit breaker for the machine to its off position. Otherwise, an unexpected behavior of the machine may lead to injury or an electric shock.
2 Before switching on the power with a cover removed for maintenance purposes, make sure that no one is beside the machine. Otherwise, an unexpected behavior of the machine may lead to injury or an electric shock.
3 Before starting maintenance work, post a notice near the control unit cabinet door circuit breaker to indicate that no one except the worker of interest is allowed to switch on the power.
4 Before switching on the power and operating the machine during or after maintenance work, make sure that no tool or the like is left in the machine. Otherwise, when the machine runs, it may strike the tool or the like toward people around the machine.
5 When making electrical adjustments with a cover removed, use a tool with a sufficient electrical protection (for example, a screwdriver made of plastic). Otherwise, there is a risk of an electrical shock.
6 After maintenance work, make sure that all components, including screws, that were removed for maintenance purposes are back in place. Otherwise, safety devices may fail to function, or injury may occur, because of a malfunction or electric shock.
7 When replacing maintenance parts (except the battery for the separate absolute pulse coder explained in 2.6.1.1 of Part V), be sure to keep the control unit cabinet door circuit breaker set to its off position. Otherwise, there may occur damage to the maintenance parts or an electrical shock.
8 The person in charge of routine maintenance and preventive maintenance shall not be engaged in replacement of the CNC memory backup battery or fluorescent lamps within the machine. Only the maintenance engineer is allowed to replace such electrical components. Work by any person with no sufficient knowledge may disable safety devices from working, resulting in an unexpected behavior of the machine that may cause injury or an electric shock.
9 To prevent coolant and other liquids, and chips from entering the inside of the control unit, after maintenance work, be sure to close and lock the control unit cabinet door. For the same purpose, be sure to close the covers of the operator's panel and cable duct and tighten the cover mounting screws securely.

The main circuit breaker installed in the controller rack of the ROBODRILL can be locked to OFF. To do this, perform the following steps:

(1) Turn off the main circuit breaker when the door of the control unit cabinet is closed.
(2) Pull out the lock plate, and lock a padlock.
Use a padlock with a diameter of 4.0 to 8.0 mm.



While the main circuit breaker is locked to OFF, the power to the machine cannot be turned on. Furthermore, the door of the controller rack cannot be opened.

2.3 Maintenance engineer

This person should have sufficient mechanical or electrical knowledge to be capable of maintenance and have also completed a maintenance course at the FANUC FA School or FANUC Robomachine School. Alternatively, the person should have the equivalent knowledge and should also be qualified by the company or organization to which that person belongs. Maintenance engineer are allowed to be engaged in:

(1) Installing the machine and moving it from one place to another
(2) Replacing the machine
(3) Work described in 2.6.1(1), 2.6.1.2, and 2.6.3 of Section 2, "PERIODICAL MAINTENANCE," in Part V

The maintenance engineer must read this operator's manual and understand the information herein. If he or she operates the machine without understanding any description herein, it is likely that serious danger may arise to him or her and those around him or her.
Be sure to observe the "Cautions that Person in charge of routine maintenance and preventive maintenance must observe during maintenance" stated above. Experienced maintenance engineers in particular shall take sufficient care because they may get involved in accidents that can occur because of inattention or wontedness.

3 ORGANIZATION OF THIS MANUAL

The model covered by this manual, and its abbreviation is:

Product Name	Abbreviation
FANUC ROBODRILL α-D14M*i*A5, α-D14L*i*A5, α-D14S*i*A5 FANUC ROBODRILL α-D21M*i*A5, α-D21L*i*A5, α-D21S*i*A5 Controller: A04B-0102-B201、B301、B302 FANUC Series 31*i*-B5 Mechanical Unit: A04B-0099-B101, B103, B111, B113, A04B-0102-B101, B102, B103, B104, B105, B106, B111, B112, B113, B114, B115, B116	α-D14M*i*A5, α-D14L*i*A5, α-D14S*i*A5 α-D21M*i*A5, α-D21L*i*A5, α-D21S*i*A5

The following manuals are related to this machine:

(1) FANUC ROBODRILL α-D14*i*A5/D21*i*A5 OPERATOR'S MANUAL (B–85314EN): This manual. Describes how to operate and maintain this machine.
(2) FANUC Series 31*i*–MODEL B OPERATOR'S MANUAL (B–64484EN): Describes how to operate numerical control (NC) units and how to prepare programs.
(3) FANUC ROBODRILL α-D14*i*A5/D21*i*A5 MAINTENANCE MANUAL (B–85315EN): Describes alarms, troubleshooting, and replacement of parts.
(4) FANUC Series 31*i*–MODEL B MAINTENANCE MANUAL (B–64485EN): Describes troubleshooting and adjustment of NC units.

Before using this machine, be sure to read the necessary part of manual (1).
For daily handling or for reference, use manuals (1) and (2).
Use manuals (3) and (4) for troubleshooting, replacement of parts, and adjustment of the machine.
The NC used for this machine is an exclusive controller used for this series. For the basic specification and the optional specification to which the NC is applicable, see the principal specification listed in APPENDIX in this manual and refer to the copy of the order specification. **The description of manuals (1) and (3) has priority over that of manuals (2) and (4). When there are differences between the description of the manuals, the description in manuals (1) and (3) applies.**

This manual has the following contents:

SAFETY PRECAUTIONS:	Explains safety precautions, cautions, and warning labels of the machine.
I OUTLINE :	Description of what can be done with this machine. The names of the parts and the description of the equipment and devices used with this machine are given.
II INSTALLATION:	Instructions for initially installing or moving this machine are given.
III ROUTINE OPERATIONS:	The flow of operation for machining is described.
IV DETAILED OPERATIONS:	Each of the machining operations that can be done with this machine is described in detail.
V MAINTENANCE:	Routine inspection to be done daily before starting machining, periodic inspection, and replacement of the expendable parts are described.
APPENDIX:	The principal specification, various figures and tables, and other useful information are compiled.

Before starting to use the machine, be sure to read "SAFETY PRECAUTIONS" herein.
Before using this machine for the first time, read Parts I and III. If the machine has not been installed yet, read Part II. Also, before operating the machine, be sure to read Part V. Prepare a schedule for inspection and maintenance.
Individual operation on this machine is described in Part IV. For NC operation, however, refer to manual (2) above.

In this manual, the keys appearing on the operator's panel are indicated as shown below. (For details of each key, see Chapter 3 in Part I.)

- Soft keys displayed on the bottom of the screen: Enclosed in [ ] (Example) [PARAMETER], [ALARM]
- Keys on the operator's panel (function keys, edit keys, and so forth): Enclosed in < >
  (Example) <CANCEL>, <INPUT>

4 CONTACT

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I. OUTLINE

1 OUTLINE

The α-D*i*A5 series is a machine tool capable of performing efficient light milling, milling, and boring in addition to drilling and rigid tapping.

1.1 FEATURES

(1) Linear machining and arc machining
High precision linear and arc light milling and milling at various angles can be done. Drilling and tapping can also be done.

(2) High speed turret
The turret permits short–cut random selection to enable high–speed tool changes. It is not necessary to consider tool interference because the spindle goes down independently.

(3) Rigid tapping
For rigid tapping in which the spindle and the Z axis are synchronously fed, a tap with a floating mechanism is not required.
This enables precision tapping in a short time.

(4) Abundant NC functions
A variety of NC functions supporting various types of machining ranging from parts machining such as drilling and tapping to milling and model machining are provided.

(5) Absolute–position detecting system
The absolute–position detecting system is one of the standard features. Return to the reference position is not required after switching the power on (annual battery replacement is necessary).

(6) Highly reliable
The problems that conventionally occurred with pneumatic or hydraulic technology have been solved using electronic technology.
As a result, reliability has been sufficiently enhanced and easy maintenance is assured.

(7) Optimum spindle speed selection
The spindle speed of the spindle motor can be changed over a wide range: 100 min^{-1} to 10,000 min^{-1} (240 min^{-1} to 24,000 min^{-1} as option). The spindle speed is programmable at every 1 min^{-1} and therefore the optimum spindle speed can be set.

(8) High performance AC servo motor
As the servo motors for the X–axis, Y–axis, and Z–axis, AC servo motors are used. Therefore, no maintenance including brush replacement is required.
The rapid traverse rate along each axis is 54 m/min (X–axis, Y–axis, Z–axis), so that waste time can be minimized when cutting is not performed.

(9) Quick operation function
A quick operation function beyond the operability of the conventional CNC machine tools is provided as standard. This function enables the operator to operate the machine as desired with the graphical screen and guidance.

(10) Safety functions
The safety-related functions of a machine that supports the CE mark/Chinese safety standard comply with Safety Category 3 and Performance Level d, according to the IEuropean Safety Standard.
This machine was manufactured in accordance with Appendix 1 of the 2006/42/EC Machine Directive.
Declaration of CE mark conformity is attached on Section K, "DECLARATION OF CONFORMITY" in APPENDIX.

1.2 USE OF THE MACHINE

The FANUC ROBODRILL α-D*i*A5 series is a machine tool that performs cutting (drilling, tapping, light milling, milling, and boring) under control of a CNC (computerized numerical controller).
Do not use this series for any purpose other than stated above.
The cutting power of the ROBODRILL varies with the workpiece type, cutter, coolant, and other factors. For details, refer to the applicable cutter or coolant operator's manuals.

The following table lists examples of machining for the 10,000 min^{-1} spindle specification.

Workpiece	S45C	FC200	ADC12
Drilling Tool diameter (mm) × feedrate (mm/rev)	ϕ 30 x 0.10	ϕ 30 x 0.25	ϕ 32 x 0.35
Tapping Tapping screw designation × pitch (mm)	M20 x 2.5	M27 x 3.0	M30 x 3.5

These values depend on the types and rigidity of tooling, cutters, jigs, and workpieces, the property and supply state of coolant, and so forth.

The following table lists the specifications of the machines.

[α-D14*i*A5 series]

Item		Specification		
		α-D14S*i*A5	**α-D14M*i*A5**	**α-D14L*i*A5**
Travel distance	X-axis travel (Longitudinal movement of table)	300mm	500mm	700mm
	Y-axis travel (Cross movement of saddle)	300+100mm	400mm	
	Z-axis travel (Vertical movement of spindle head)	330mm		
	Distance from table surface to spindle gage plane	150 to 480mm (When no high column is specified)		
	Distance from front of column to spindle center line	380mm		
Table	Size of work area on table (X-axis × Y-axis)	630mm×330mm	650mm×400mm	850mm×410mm
	Capacity of workpiece mass	200kg (uniform load)	300kg (uniform load)	300kg (uniform load)
	Working surface configuration	3T-slots, size 14mm pitch 125mm		
Spindle	Speed range	100 to 10,000min^{-1}		
	Spindle gage (Call number)	7/24 taper No.30 (with air blow)		
Feedrate	Rapid traverse rate	54000mm/min (X,Y,Z)		
	Feedrate	1 to 30,000mm/min		
Turret	Tool change system	Turret type		
	Shape of tool shank	MAS BT30		
	Shape of pull stud	MAS P30T-1(45°)		
	Tool storage capacity	14 tools		
	Maximum tool diameter	Distance from taper gauge/maximum diameter 0 to 28mm/50mm 34 to 120mm/80mm 120 to 250mm/40mm (80 mm when the tool mass is set to 3 kg)		
	Maximum tool length	200mm	250mm[*2]	
	Method of tool selection	Random shortest path		
	Maximum tool mass	Maximum 2kg/tool (total mass：15kg)	or	Maximum 3kg/tool (total mass：22kg)
	Tool changing time (Cut To Cut)	Approx. 1.4 s.	or	Approx. 1.9 s
Motors	Spindle motor	FANUC AC SPINDLE MOTOR 11.0kW (1 min rating) / 3.7kW (continuous rating)		
	Feed axis motor	FANUC AC SERVO MOTOR MODEL αiS8/4000 X, Y, Z: αiS8/4000 (2.0kW)		
Power source	Power supply	200 to 220 V a.c.+10 to -15% 3-phase, 50/60Hz±1Hz 10kVA		
	Compressed air supply	0.35 to 0.55MPa (gage pressure) (0.5MPa is recommended) 0.15m^3/min (150L/min) (at atmospheric pressure) Solid material 5 μm or less (nominal) Moisture Dew point under atmospheric pressure –17°C or below Oil content concentration on the primary side 1 mg/m^3 or below		
Machine size	Machine height	2236±10mm (When no high column is specified)		
	Floor space	995mm×2210mm	1565mm×2040mm	2115mm×2040mm
	Mass of machine	Approx. 1,950kg	Approx. 2,000kg	Approx. 2,100kg

Item		Specification		
		α-D14S*i*A5	**α-D14M*i*A5**	**α-D14L*i*A5**
Accuracy *1	Bidirectional accuracy of positioning of an axis (ISO230-2:1997,2006)	0.006mm		
	Bidirectional repeatability of positioning of an axis (ISO230-2:1997,2006)	＜0.004mm		

*1 Positioning accuracy is the adjusted and measured value in compliance with applicable standard at FANUC's factory. Depending on an influence of JIG and workpiece mass on table, the use conditions and installation environment, there may be a case where the accuracy shown in this catalog can not be achieved.

*2 Changed by specifications.

[[α-D21*i*A5 series]

Item		Specification		
		α-D21S*i*A5	**α-D21M*i*A5**	**α-D21L*i*A5**
Travel distance	X-axis travel (Longitudinal movement of table)	300mm	500mm	700mm
	Y-axis travel (Cross movement of saddle)	300+100mm	400mm	
	Z-axis travel (Vertical movement of spindle head)	330mm		
	Distance from table surface to spindle gage plane	150 to 480mm (When no high column is specified)		
	Distance from front of column to spindle center line	380mm		
Table	Size of work area on table (X-axis × Y-axis)	630mm×330mm	650mm×400mm	850mm×410mm
	Capacity of workpiece mass	200kg (uniform load)	300kg (uniform load)	300kg (uniform load)
	Working surface configuration	3T-slots, size 14mm pitch 125mm		
Spindle	Speed range	100 to 10,000min^{-1}		
	Spindle gage (Call number)	7/24 taper No.30 (with air blow)		
Feedrate	Rapid traverse rate	54000mm/min (X,Y,Z)		
	Feedrate	1 to 30,000mm/min		
Turret	Tool change system	Turret type		
	Shape of tool shank	MAS BT30		
	Shape of pull stud	MAS P30T-1(45°)		
	Tool storage capacity	21 tools		
	Maximum tool diameter	Distance from taper gauge/maximum diameter 0 to 28mm/50mm 34 to 120mm/80mm 120 to 250mm/40mm (80 mm when the tool mass is set to 3 kg)		
	Maximum tool length	190mm*2	250mm*2	
	Method of tool selection	Random shortest path		
	Maximum tool mass	Maximum 2kg/tool (total mass：23kg)	or	Maximum 3kg/tool (total mass：33kg)
	Tool changing time (Cut To Cut)	Approx. 1.7 s	or	Approx. 1.9 s
Motors	Spindle motor	FANUC AC SPINDLE MOTOR 11.0kW (1 min rating) / 3.7kW (continuous rating)		
	Feed axis motor	FANUC AC SERVO MOTOR MODEL α*i*S8/4000 X, Y, Z: α*i*S8/4000 (2.0kW)		
Power source	Power supply	200 to 220 V a.c. +10 to -15% 3-phase, 50/60Hz±1Hz 10kVA		
	Compressed air supply	0.35 to 0.55MPa (gage pressure) (0.5MPa is recommended) 0.15m^3/min (150L/min) (at atmospheric pressure) Solid material 5 μm or less (nominal) Moisture Dew point under atmospheric pressure –17°C or below Oil content concentration on the primary side 1 mg/m^3 or below		
Machine size	Machine height	2236±10mm (When no high column is specified)		
	Floor space	995mm×2210mm	1565mm×2040mm	2115mm×2040mm
	Mass of machine	Approx. 1,950kg	Approx. 2,000kg	Approx. 2,100kg

Item		Specification		
		α-D21S*i*A5	α-D21M*i*A5	α-D21L*i*A5
Accuracy *1	Bidirectional accuracy of positioning of an axis (ISO230-2:1997,2006)	0.006mm		
	Bidirectional repeatability of positioning of an axis (ISO230-2:1997,2006)	＜0.004mm		

Environmental conditions

Ambient temperature

Operating: 0°C to 45°C (5°C to 45°C when the automatic greasing unit (option) is mounted)

Storage or transportation: 20°C to 60°C

Temperature drift

0.3°C/min or lower

Humidity

Usual: 75% or lower (relative humidity)

Short-period: 95% or lower

Vibration

2 m/s^2 (0.2 G) or lower

Floor

Load resistance: 3 tf/m^2 (29.4 kN/m^2) or more

To maintain stable machining accuracy and fully realize machining performance, the following conditions are recommended:

Load resistance: 5 tf/m^2 (49.0 kN/m^2) or more

Compressive strength: 367 kgf/cm^2 (36 N/mm^2) or more

Atmosphere

No corrosive gas

No flammable gas

Neither cut scraps nor coolant shall be splashed directly on the CNC LCD or operator's panel.

*If the LCD or operator’s panel is severely soiled, gently wipe it with a soft cloth moistened with a small amount of mild solution of neutral detergent to remove oil and other foreign matters attached to the surface.

Grounding

Class C grounding (with a grounding resistance of 10 Ω or less) defined in the electric facility standards is required.

Ground the machine separately from other machines (one-point grounding).

Pneumatic source

Pressure 0.35 to 0.55 MPa (0.5 MPa is recommended)

Flow rate 0.15 m^3/min (150 L/min) (flow rate under atmospheric pressure)

Solid (nominal value) 5μm or lower

Moisture Dew point under atmospheric pressure –17°C or below

Primary side oil content 1mg/m^3 or lower

1.3 SOUND PRESSURE LEVEL

The equivalent continuous A–weighted average sound level measured on the shop floor where the machine is installed is 70 dB or lower.
The following table lists the measurement conditions.

Measurement condition

Item	Condition
Program	O400
Tool	See the table below.
Workpiece material	S45C (150(l) x95(w) x30(d)mm)
Cutting depth	1mm
Coolant	See the table below.
Cycle time	57s
Measurement time	57s

Tool list

Item	Manufacturer	Model
Tool	SANDVIK	RA265.2-80 (with six teeth)
Tip	SANDVIK	SM30
Coolant	Castrol	Alusol B

- Program used
  O400
  G91G28Z0;
  G00G40G49G80G90;
  G54G28X0Y0Z0;
  M06T01;
  M03S800;
  G00X0Y0;
  G00G90G43Z1.H01;
  M08;
  G01G90Z-1.F600;
  X250.;
  Y-40.;
  X0;
  M05;
  G91M09;
  G28Z0G49;
  M02;

2 PART NAMES

2.1 MACHINE

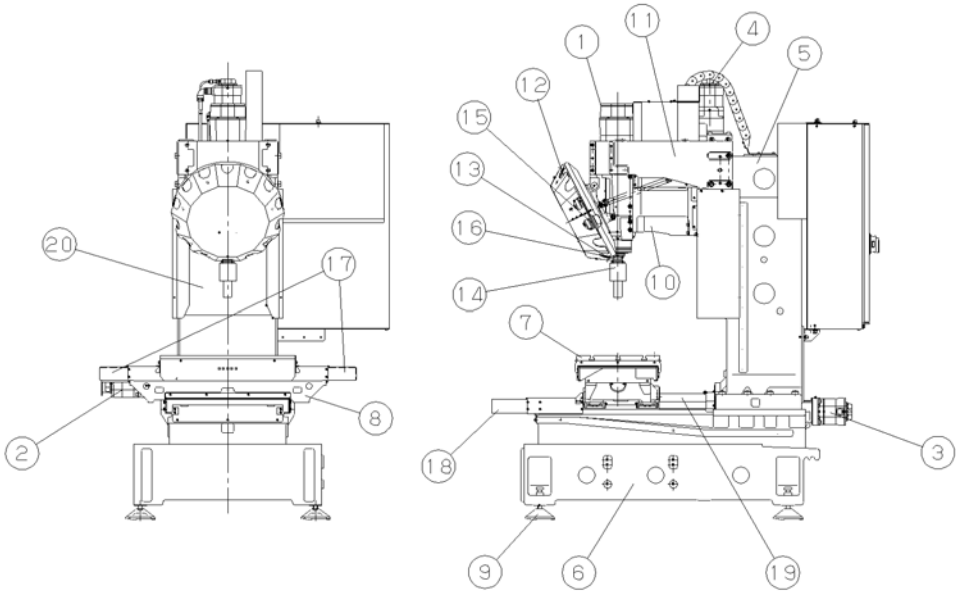


Fig. 2.1 (a) Inner view of Machine

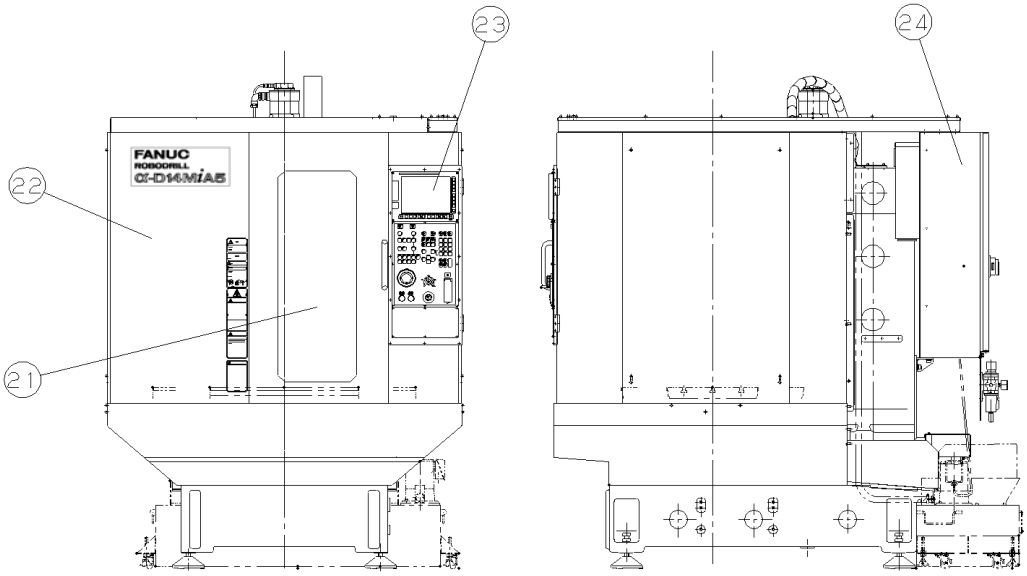


Fig.2.1 (b) Outer view of Machine

(1)Spindle motor
(2) X axis servo motor (Serial pulse coder)
(3) Y axis servo motor (Serial pulse coder)
(4) Z axis servo motor (Serial pulse coder)
(5) Column
(6) Bed
(7) Table
(8) Saddle
(9) Leveling block

(10) Spindle head
(11) Turret support
(12) Turret
(13) Grip
(14) Tooling
(15) Turret gear
(16) Spindle (MS) gear
(17) X axis telescopic cover
(18) Y axis telescopic cover (front side)
(19) Y axis slide cover
(20) Z axis take–up cover
(21) Front door (window: polycarbonate [PC])
(22) Splash guard
(23) Controller operator's panel
(24) Controller rack

2.2 CONTROLLER RACK

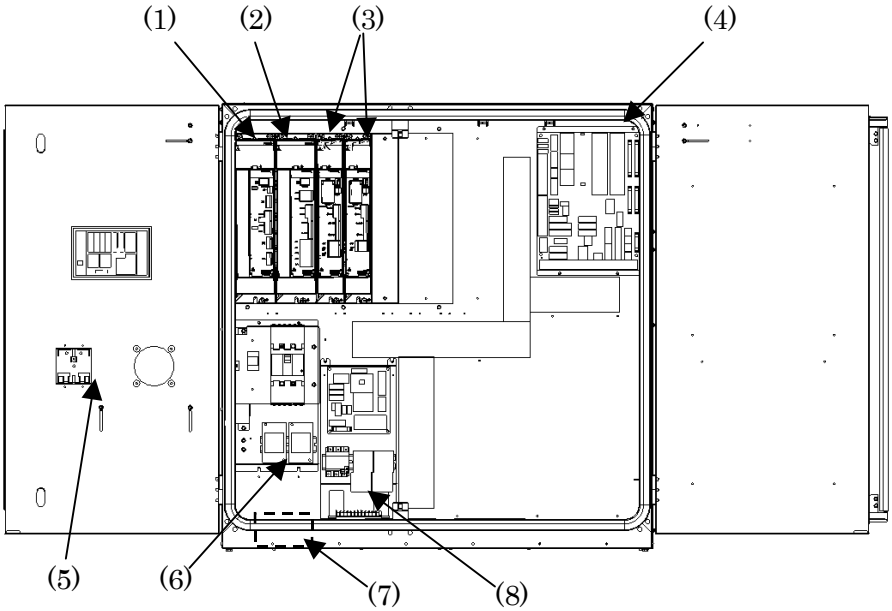


Fig.2.2 Inside of Controller rack

(1) Power supply
(2) Spindle amplifier
(3) Servo amplifier
(4) Wiring PCB unit
(5) Absolute pulse coder backup battery
(6) Breaker unit
(7) Noise filter (machines for Europe and China only)
(8) Power panel unit

2.3 VIEW AND COMPONENTS OF THE OPERATOR'S PANEL

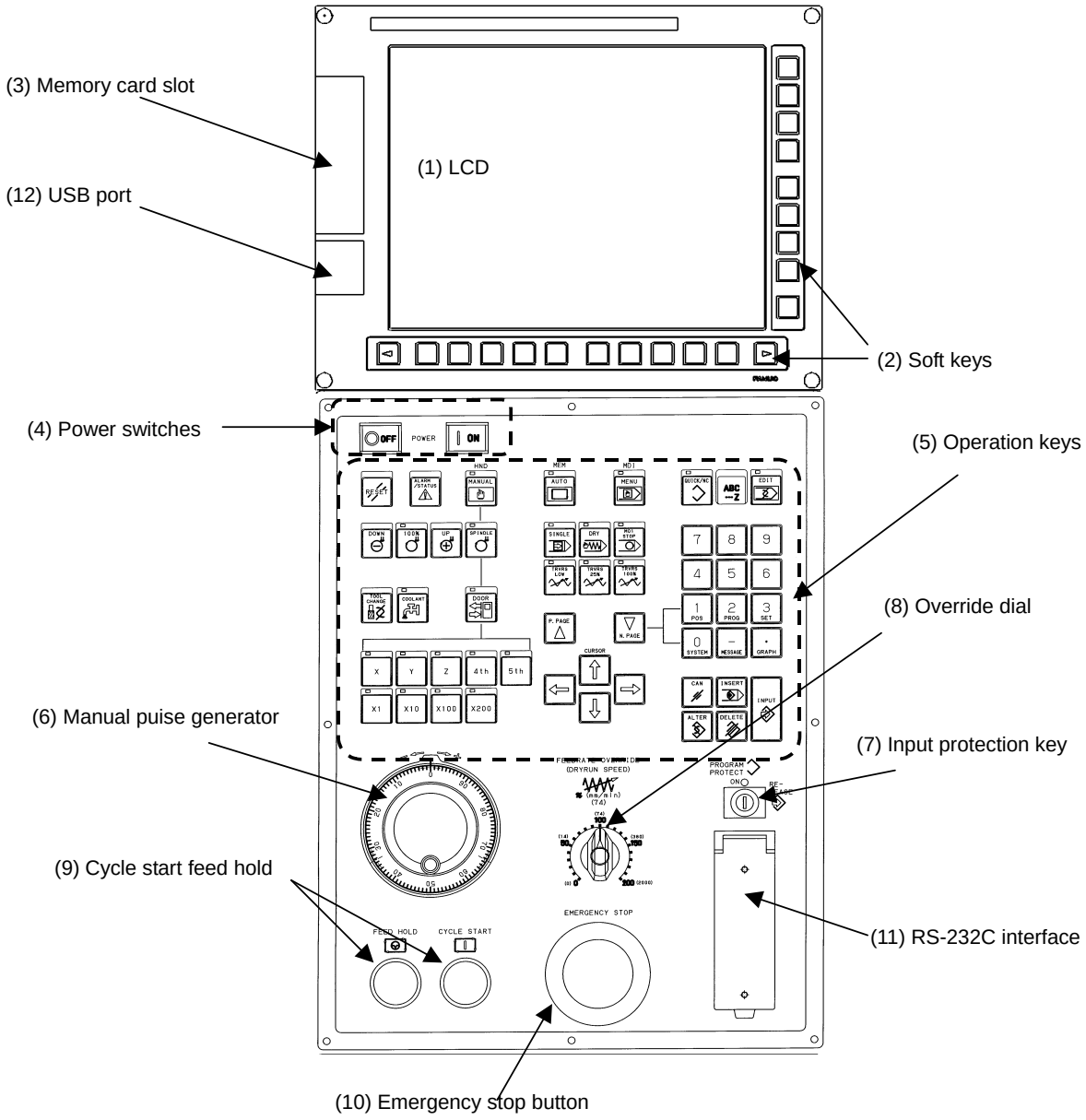


Fig.2.3 Inside of view and components of the operator's panel

3 OPERATOR'S PANEL

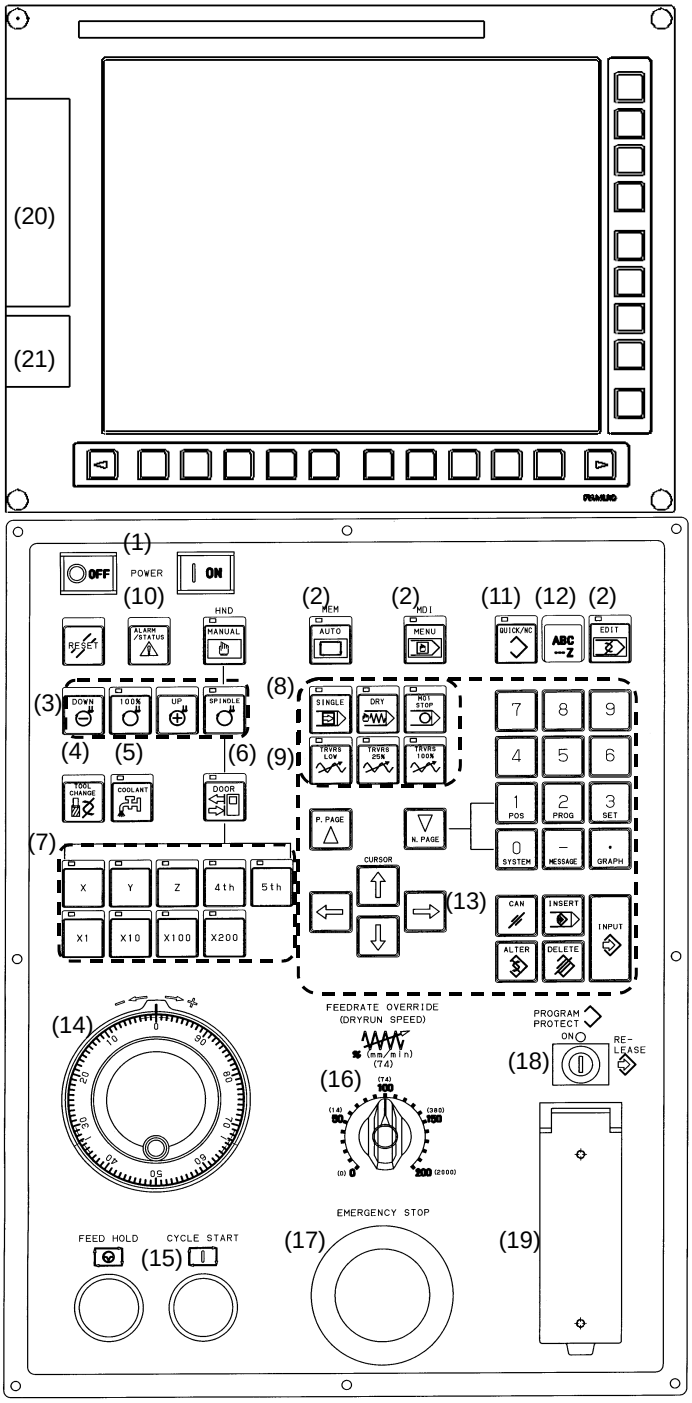


Fig.3 (a) Standard type operator's panel

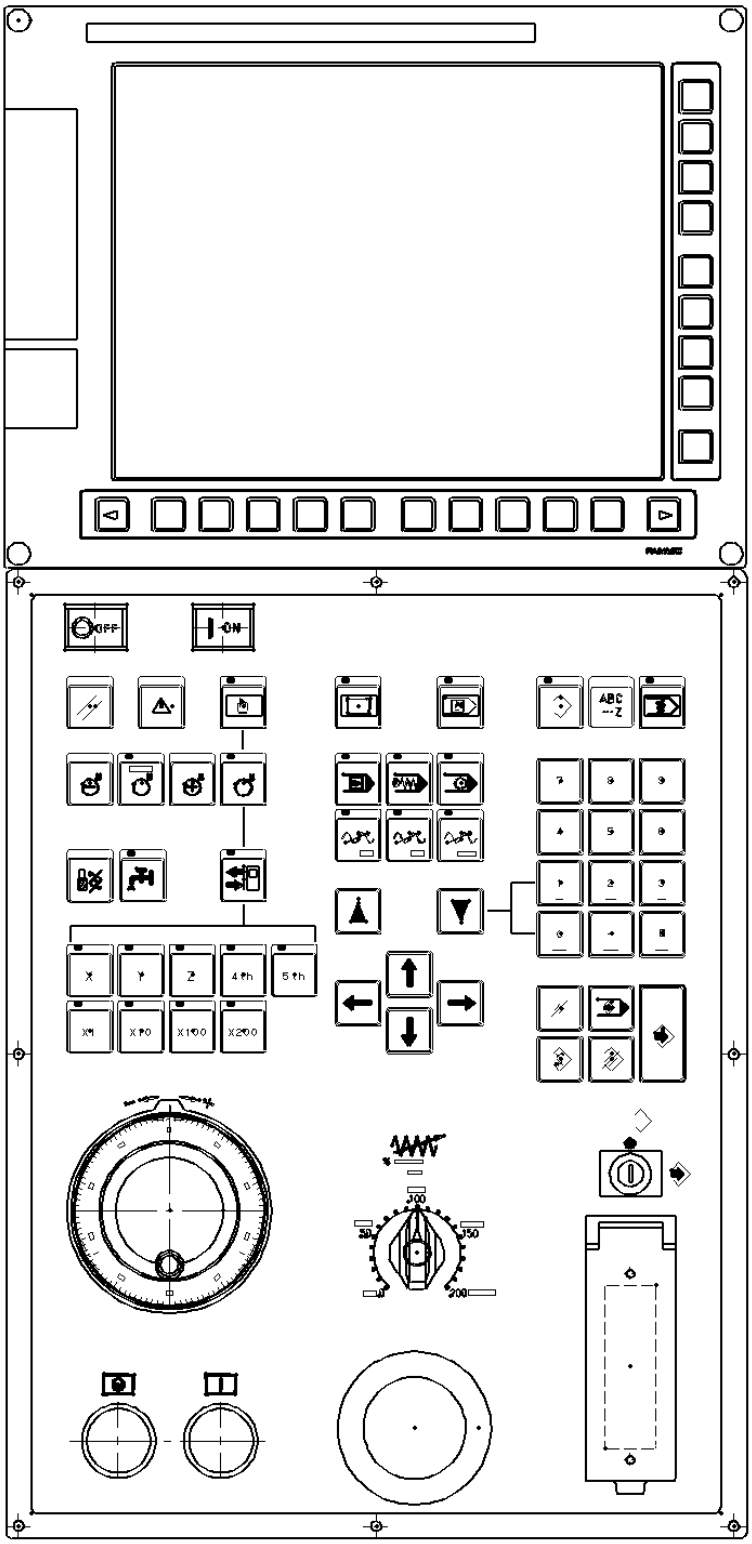


Fig.3 (b) Standard type operator's panel (for use in Europe)

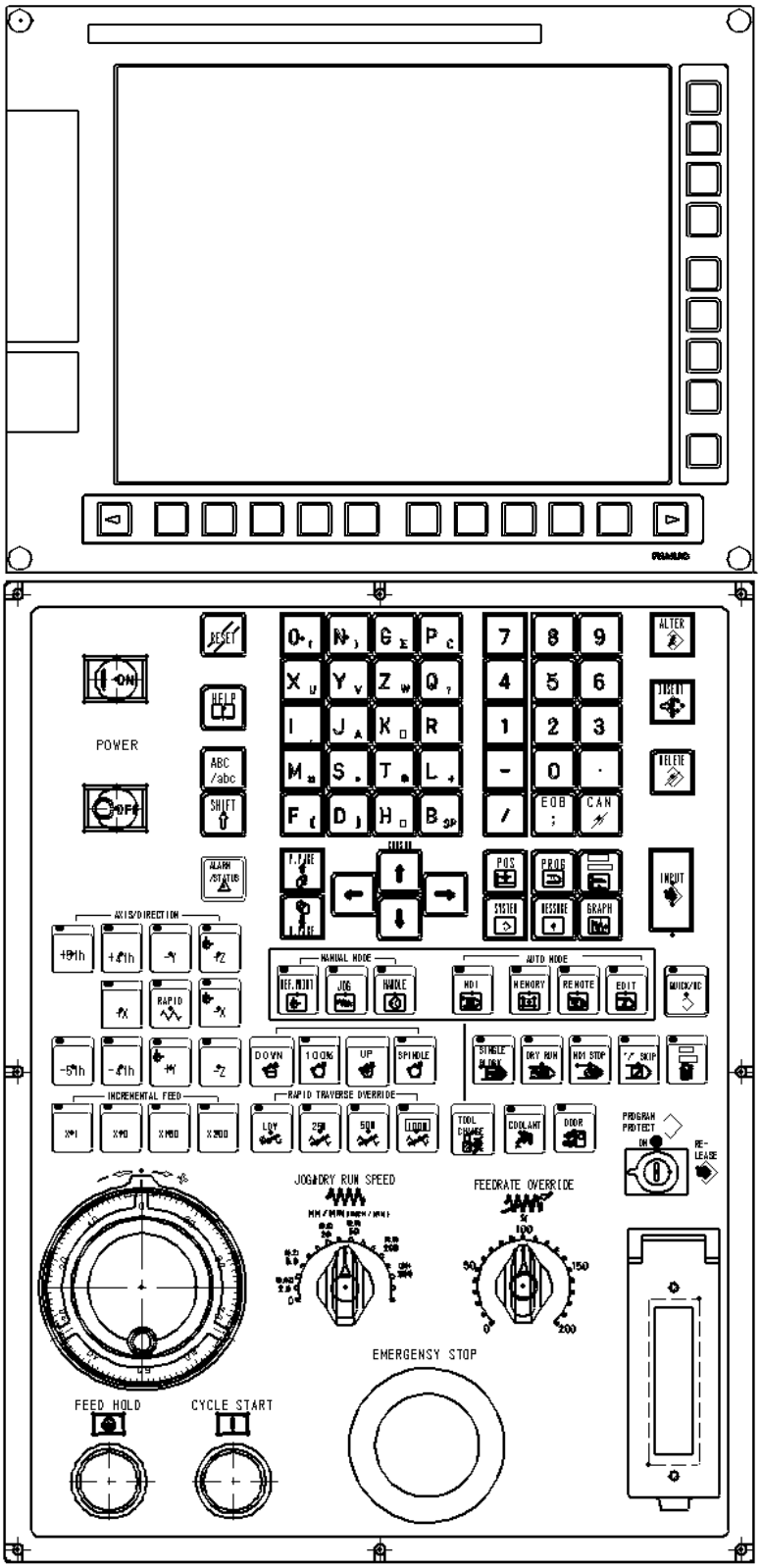


Fig.3 (c) Full keyboard type operator's panel

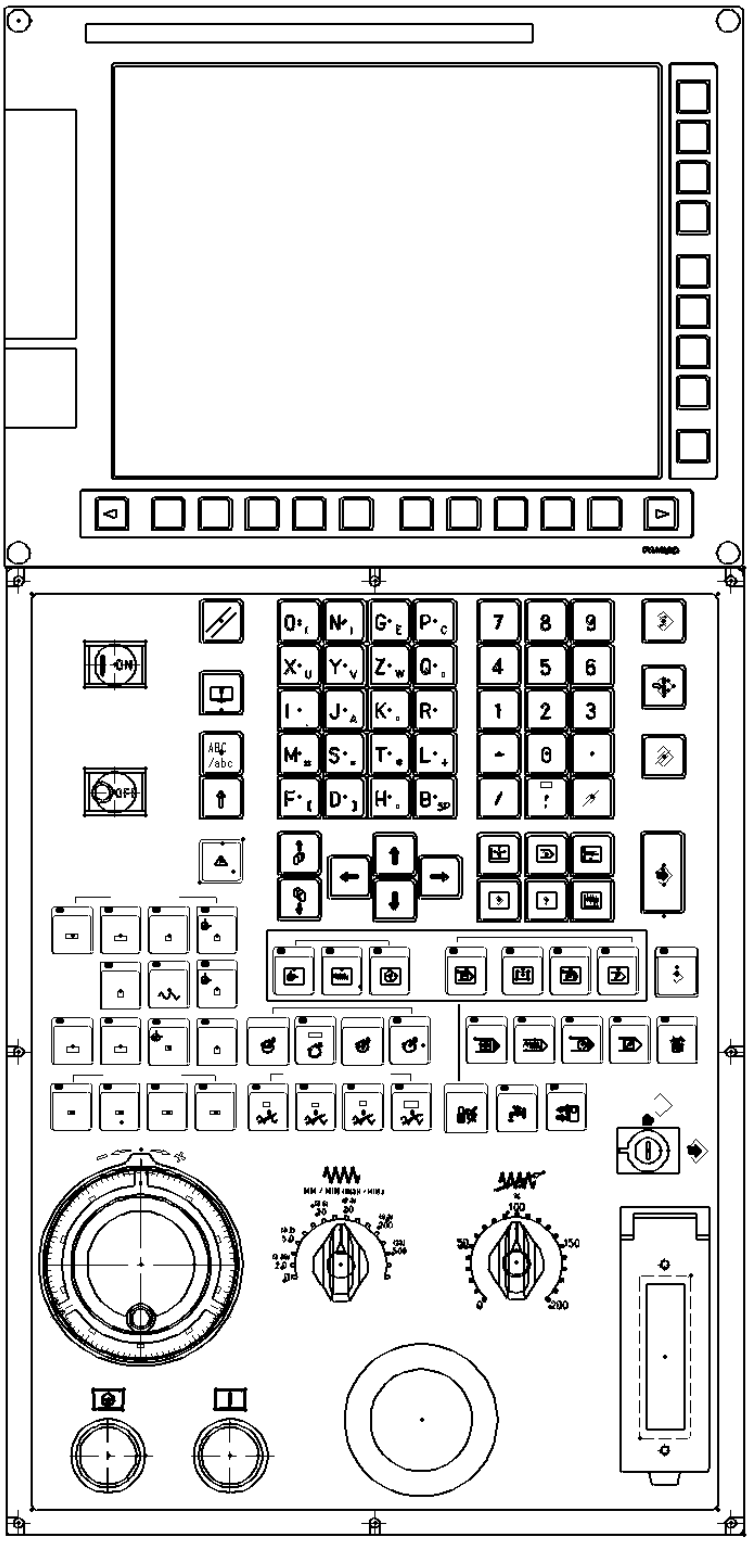


Fig.3 (d) Full keyboard type operator's panel (for use in Europe)

No.	Name	Function
(1)	Power ON/OFF buttons	These switches turn the control power on and off. (When an alarm is issued, you cannot sometimes turn off the power.)
(2)	Operation mode selection keys	[MANUAL (HANDLE) key] Selects the mode that allows the manual pulse generator to be used to cause movement along each axis. [AUTO (MEMORY) key] Selects automatic operation (memory) mode. With the standard operator's panel, this key is also used to select remote operation mode. [MENU (MDI) key] Selects MDI operation mode. When this key is pressed while QUICK screen is being displayed, MENU OPERATION screen appears. [EDIT key] Selects program editing (EDIT) mode. [(REF.POINT) key] (provided for the full keyboard type only) Selects reference position return mode. [(JOG) key] (provided for the full keyboard type only) Selects jog mode. [(REMOTE) key] (provided for the full keyboard type only) Selects remote operation mode.
(3)	Spindle operation key Spindle speed override keys	[Spindle operation key] Turns and stops the spindle. [Spindle speed override keys] These keys change the spindle speed specified with the S function by 30 to 200%. Decrease: The spindle speed is decreased. 100%: The spindle speed specified with the S function is restored. Increase: The spindle speed is increased. (When the front door lock is released, the spindle override is invalid.)
(4)	Tool change key	When this key is pressed when the LED of the MENU (MDI) key is on, a tool change to the adjacent tool on the right on the turret takes place.
(5)	Coolant key	Turns coolant or cuttings air blow on and off.
(6)	DOOR key	Releases the lock of the front door. After the lock is released, you can open the door.
(7)	Axis selection keys Handle magnification selection keys	[Axis selection keys] In manual mode (reference position return, jog, or handle mode), these keys are used to select the target axis for movement and the movement direction. In reference position return and jog modes → Movement is made only when the key is being pressed. In handle mode → A target axis for movement is selected. [Handle magnification selection keys] In handle mode, these keys are used to select the amount of travel per handle feed unit.
(8)	Operation selection keys	[SINGLE BLOCK key] Selects the function of executing one block in automatic operation then stopping automatic operation. [DRY RUN key] Selects the function that sets the rapid traverse rate and cutting feedrate to the jog feed rate in automatic operation, ignoring the programmed F feedrate. [M01 STOP key] Selects the function that stops operation after executing a block containing M01 in a program. ["/" SKIP key] (provided for the full keyboard type only) Selects the function that suppresses the execution of blocks containing "/" in a program. [AUTO P.OFF key] (provided for the full keyboard type only) Selects the function that turns off the power automatically when a program terminates or when an alarm is issued.

No.	Name	Function
(9)	Rapid traverse override keys	These keys are used to select the rapid traverse rate. (The 50% key is provided only for the full keyboard type.)
(10)	Alarm/status key	Displays information about alarms, operator messages, diagnosis, and so forth in a window.
(11)	QUICK/NC key	Switches the LCD display between QUICK screen and CNC screen.
(12)	Alphabet keys (ABC···Z)	Turns on and off the alphabetical character input function using soft keys. When this key is set to ON, alphabetical characters are indicated in soft keys to allow you to enter alphabetical characters. (For the standard type operator's panel only)
(13)	MDI keys	[Page keys] Used to change pages and screens. [Cursor keys] Used to move the cursor. [Numeric keypad] Used to enter numeric values. [Alphabet keys] (provided for the full keyboard type only) Used to enter alphabetical characters. [Reset key] Used to, for example, release an alarm. [Input key] Used to enter data. [Cancel key] Cancels characters or numbers being entered. [Alter key] Replaces the portion indicated by the cursor with a new command during program editing on CNC screen. [Insert key] Inserts a new command after the command indicated by the cursor during program editing on CNC screen. [Delete key] Deletes the command indicated by the cursor during program editing on CNC screen. [Help key] (provided for the full keyboard type only) Used to display the help screen of CNC screen. (You cannot use this key when QUICK screen is being displayed.) [Shift key] (provided for the full keyboard type only) Used to enter a character indicated in the lower right part of each address and numeric key. [Screen change keys] (provided for the full keyboard type only) Used to switch between screens within QUICK screen. <POS> Changes the screen display to a position indication screen. ABS, REL, ALL, MONITOR, etc. <PROG> Changes the screen display to a program indication screen. PROG, [MDI], FROPY, etc. <OFFSET/SETTING> Changes the screen display to an offset indication or setting screen. OFFSET, SETING, WORK, etc. <SYSTEM> Changes the screen display to a parameter or diagnosis screen. PARAMETER, STATUS, [PMC], etc. <MESSAGE> Changes the screen display to an alarm or operator message screen. Alarm, Diagnose, History, etc. <GRAPHIC> Changes the screen display to a graphics display.

No.	Name	Function
(14)	Manual pulse generator	Used to operate each axis (X, Y, Z, 4, 5) of the machine manually (in handle mode).
(15)	Cycle start/ Feed hold buttons	Automatic operation starts when you press the start button. During operation, the start button is turned on When you press the stop button, the machine is placed in temporary halt state (feed hold state). In this state, the temporary stop button is turned on.
(16)	Override dials	[Feedrate override dial] The feedrate specified with the F function for an axis is changed by 0 to 200%. For the standard type operator's panel, the feedrate in dry run operation can also be changed with this dial. [Jog override dial] (provided for the full keyboard type only) The feedrate in jog mode and dry run operation is changed.
(17)	Emergency stop button	Used to stop machine movement in a moment in case of emergency.
(18)	Program protect key switch	When this switch is set to ON, editing and input of programs and data are disabled.
(19)	RS-232-C interface	Used to connect an external I/O device such as the Handy File.
(20)	Memory card slot	Accepts an ATA card or other memory card or a compact flash card (with the adapter).
(21)	USB port	Accepts a USB stick memory.

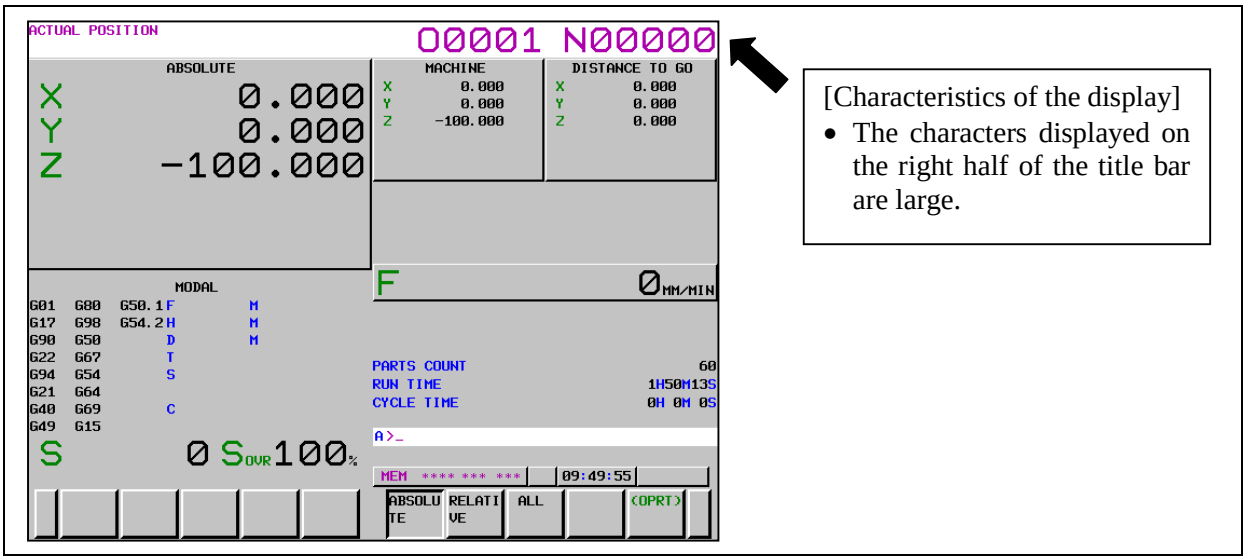
4 BASIC OPERATIONS

4.1 SCREEN SWITCHING

The screens for the ROBODRILL are grouped into the following two types.

[CNC screen]

This is a typical FANUC Series 31*i*–B5 screen.

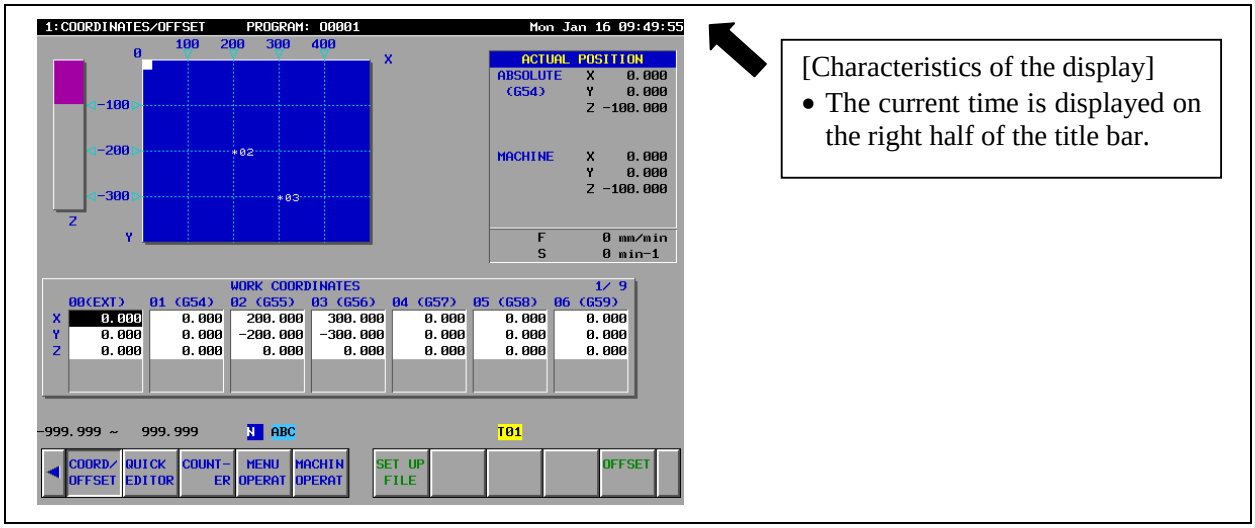


[Characteristics of the display]
- The characters displayed on the right half of the title bar are large.

Fig.4.1 (a) CNC screen

[QUICK screen]

This is specially developed for the ROBODRILL.



[Characteristics of the display]
- The current time is displayed on the right half of the title bar.

Fig.4.1 (b) QUICK screen

4.1.1 Switching between the QUICK Screen and CNC Screen

The QUICK screen and CNC screen are alternately displayed each time the QUICK/NC key is pressed.

4.1.2 CNC Screen Switching

The CNC screen is classified as one of the following:

<POS>:	Displays the current position.
<PROG>:	Enables you to edit and view programs.
<OFFSET/SETTING>:	Enables you to specify offset and workpiece coordinate data.
<SYSTEM>:	Enables you to set parameters.
<MESSAGE>:	Displays alarms and operator messages.
<GRAPHIC>:	Manual Guide i

These screen groups can be selected as stated below:

(Operator's panel of standard type)
To select one of the following screen groups, press the numeral key labeled the corresponding screen group name, and then press a page key.

(POS group)

(PROG group)

(OFFSET/SETTING group)

(SYSTEM group)

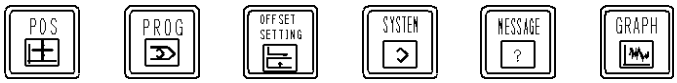
(MESSAGE group)

(GRAPHIC group)

+ **or**

→ Switched to the respective screen group

(Operator's panel with a full keyboard)
Press one of the following keys.



4.2 ENTERING ALPHABETIC CHARACTERS

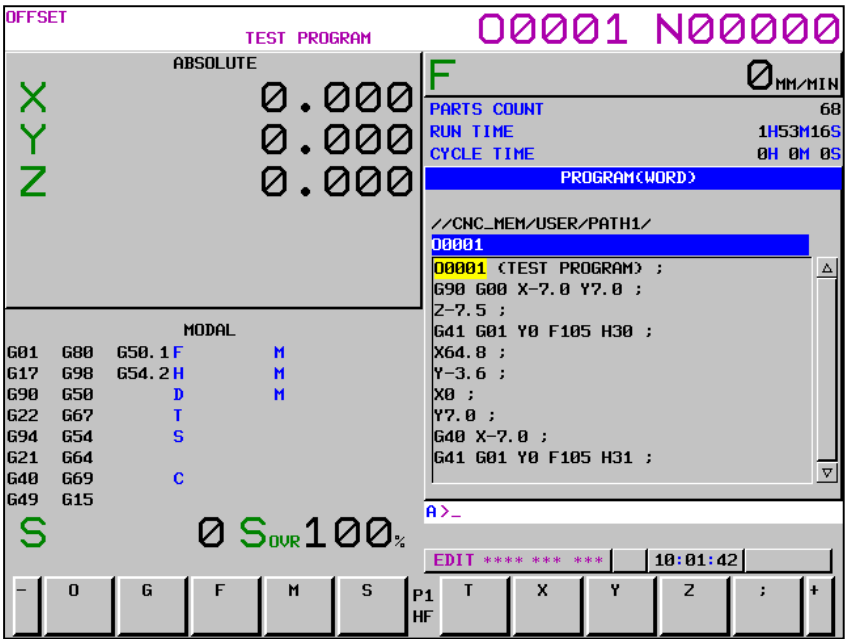
4.2.1 On the Standard Type Operator's Panel

On the standard type operator's panel, soft keys are used to enter alphabetic characters.

Press the ABC ··· Z key on the operator's panel.

Soft keys labeled alphabetic characters appear, enabling alphabetic characters to be entered.

Pressing the ABC ··· Z key again cancels the alphabetic character entry mode.

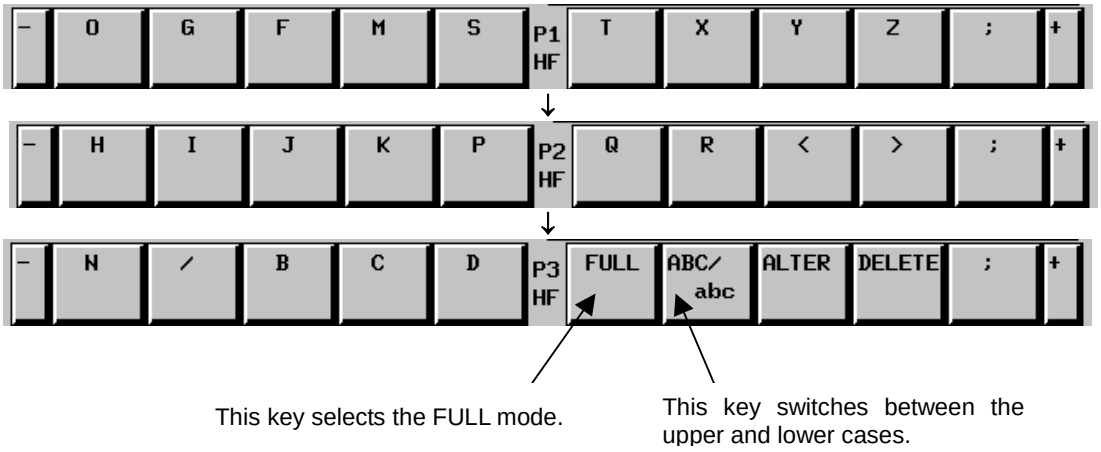


SUPPLEMENT

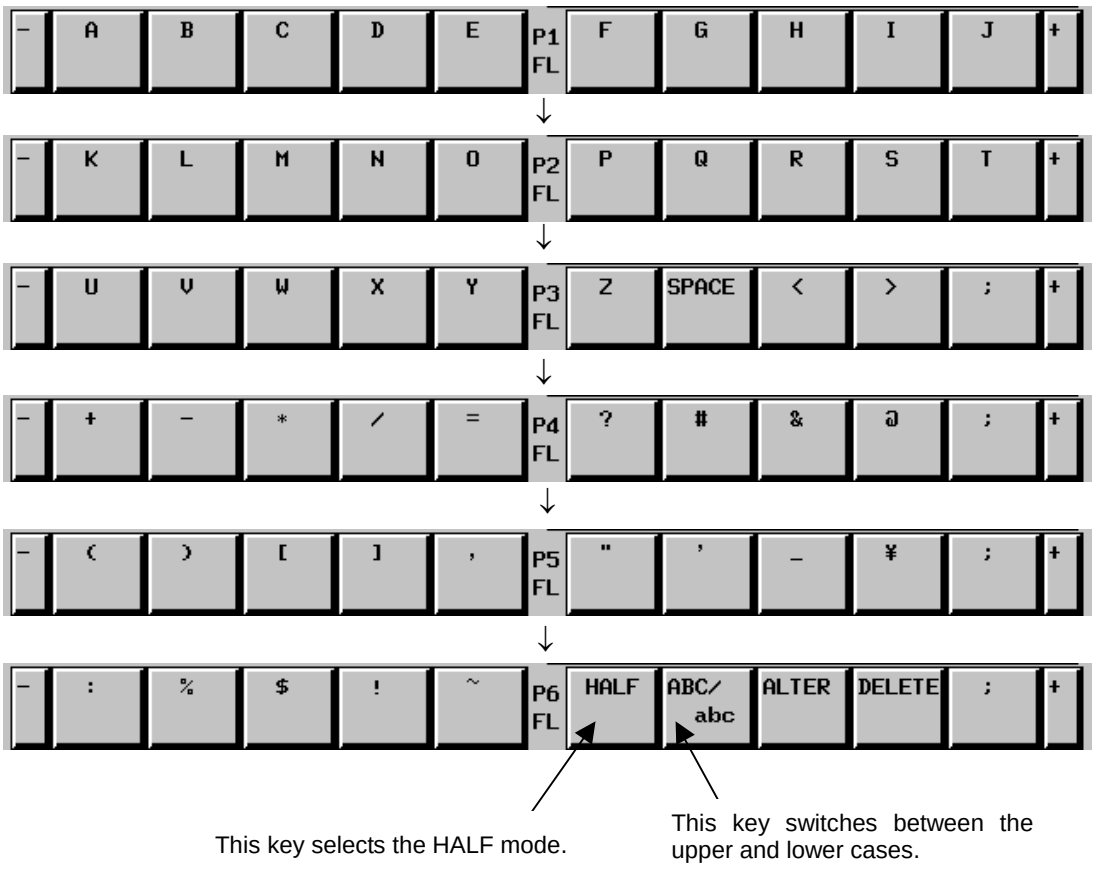
On the QUICK screen, alphabetic character entry is available only to the functions that require entering alphabetic characters.

4.2.1.1 Arrangement of the letter keys

The letter keys are arranged in either the HALF pattern for program entry or the FULL pattern for comment entry.
HALF pattern arrangement (switched using a soft key at either end).



FULL pattern arrangement (switched using a soft key at either end).



4.2.2 On the Full-Keyboard Type Operator's Panel

On the full-keyboard type operator's panel, use alphabet keys on the operator's panel.
To enter a symbol such as "<" or ">" the keyboard on the operator's panel does not have, follow the steps below.

[On the QUICK or MANUAL GUIDE *i* screen]

(1) Press

to select the lowercase mode.

(2) Press

.

(3) Press

or

.

With the above operation, the symbol "<" or ">" is entered.

[On the NC screen]

(1) Display the PROGRAM or program directory screen and press soft key [(OPRT)].
(2) Press the rightmost soft key several times to display soft key [INPUT].
(3) Press [INPUT]. Symbols including "<" and ">" are displayed on soft keys.
(4) Press soft key "<" or ">".

With the above operation, the symbol "<" or ">" is entered.

5 TOOLS

The standard tools of the former Japan Machine Tool Builder's Association (MAS403–1982 BT30 P30T–1) can be used. When you purchase tools, confirm the shape and dimensions by referring to the figure of the taper shank (MAS403–1982 BT30) and the pull stud (MAS403–1982 P30T–1) of the Japan Machine Tool Builder's Association standard shown below.

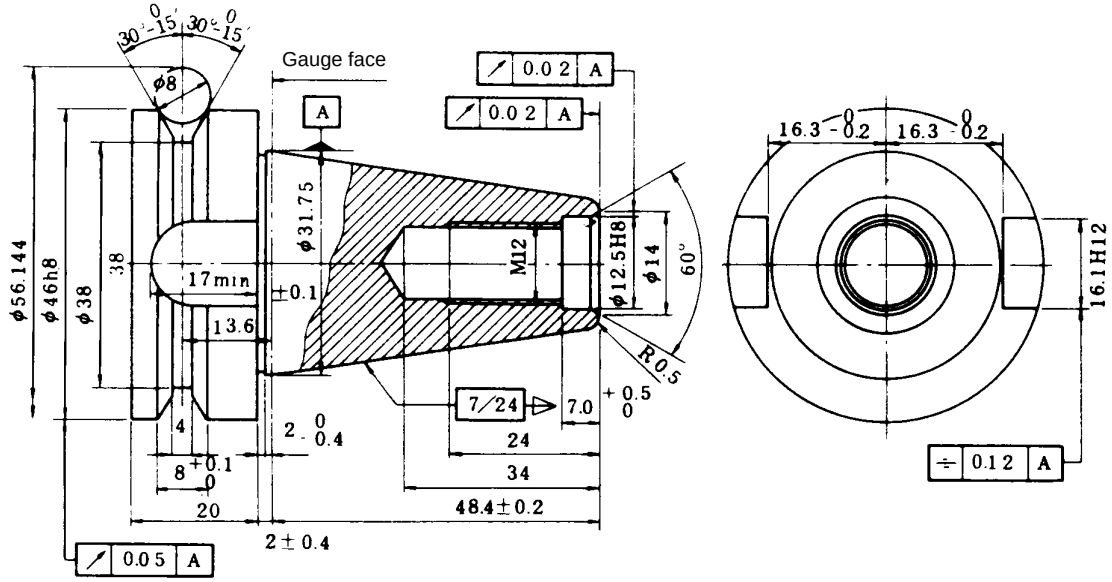


Fig.5 (a) Taper Shank

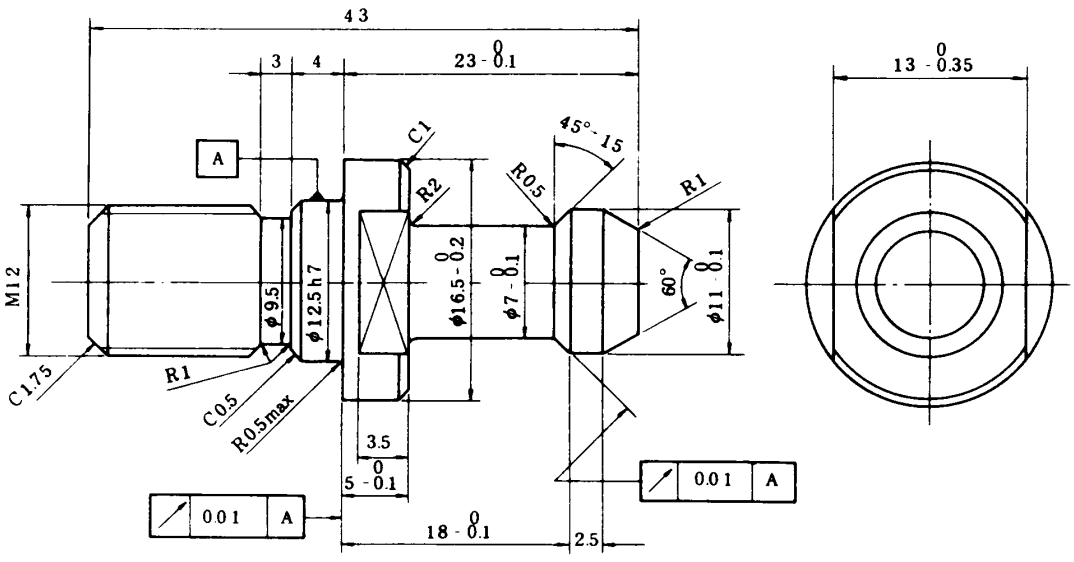
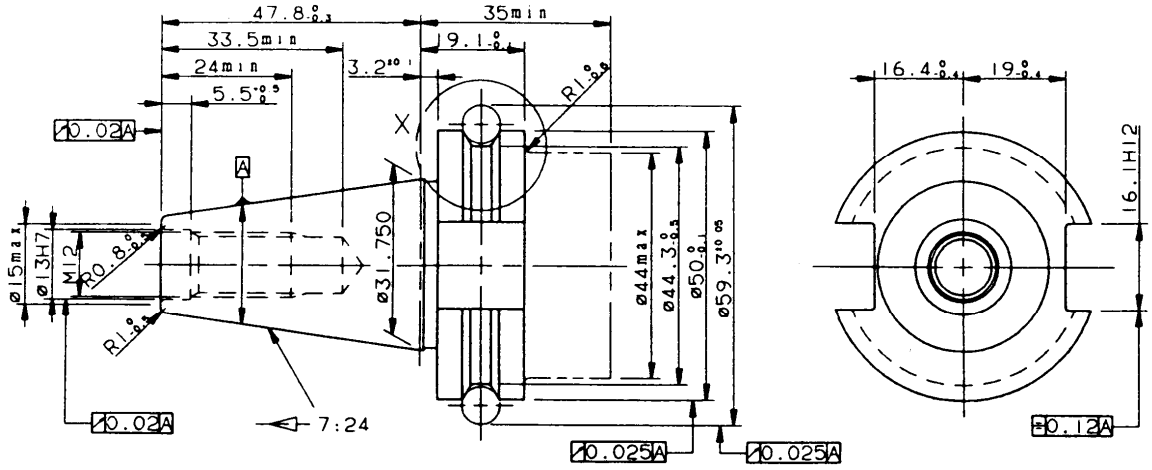


Fig.5 (b) Pull Stud

The shapes and the dimensions of the taper shank (DIN 69871–A30) and the pull stud (A290–6056–X801) of the German industrial standard are shown in the figures below.



Details of the X portion

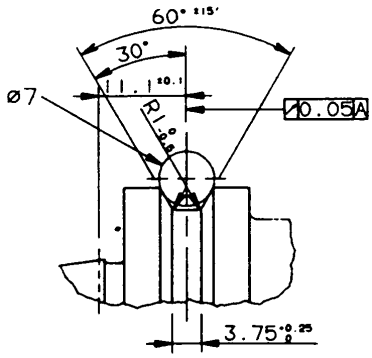


Fig.5 (c) Taper Shank

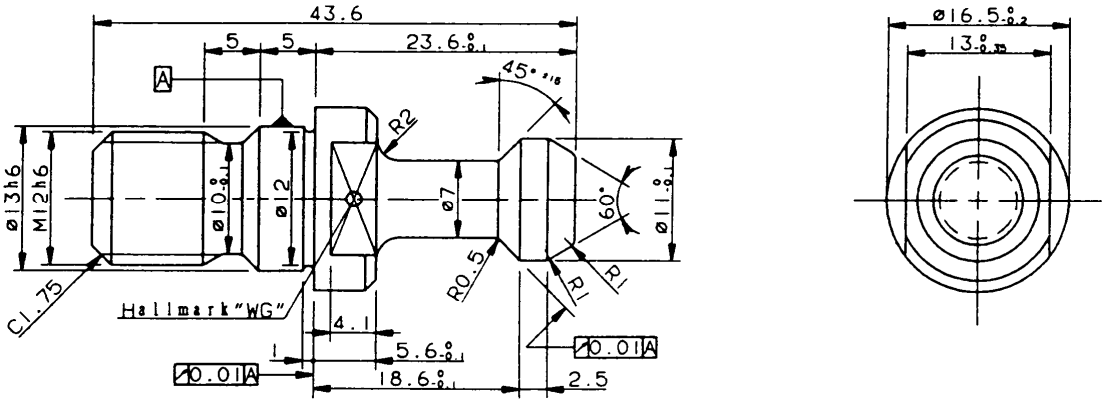


Fig.5 (d) Pull Stud

Center–through specification

The shape and dimensions of pull studs that comply with the center–through specification are shown below.

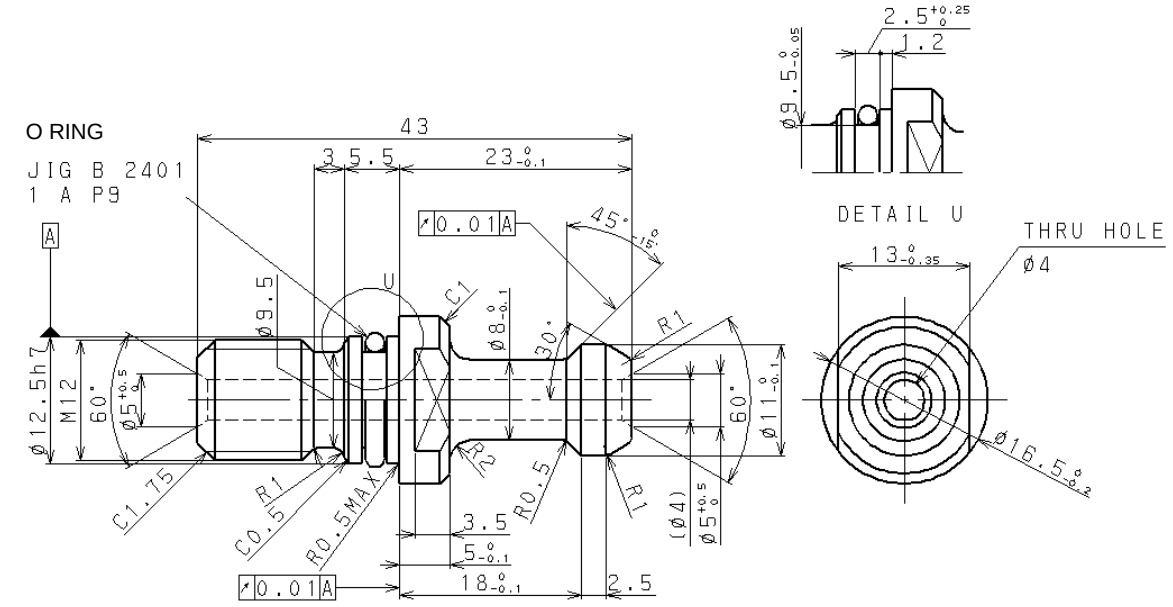


Fig.5 (e) Pull Stud (MAS and BIG PLUS)

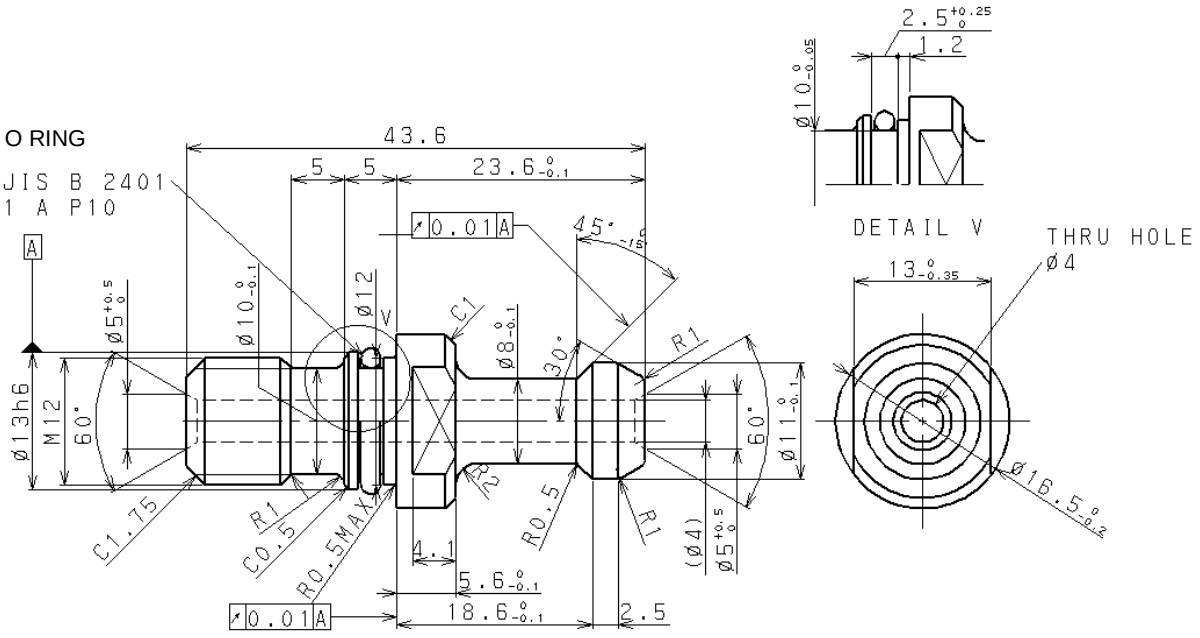


Fig.5 (f) Pull Stud (DIN)

Double–plane bound center through spindle (BIG PLUS) specification

The figure and dimensions of a taper shank based on the double–plane bound center through spindle (BIG PLUS) specification are shown below.

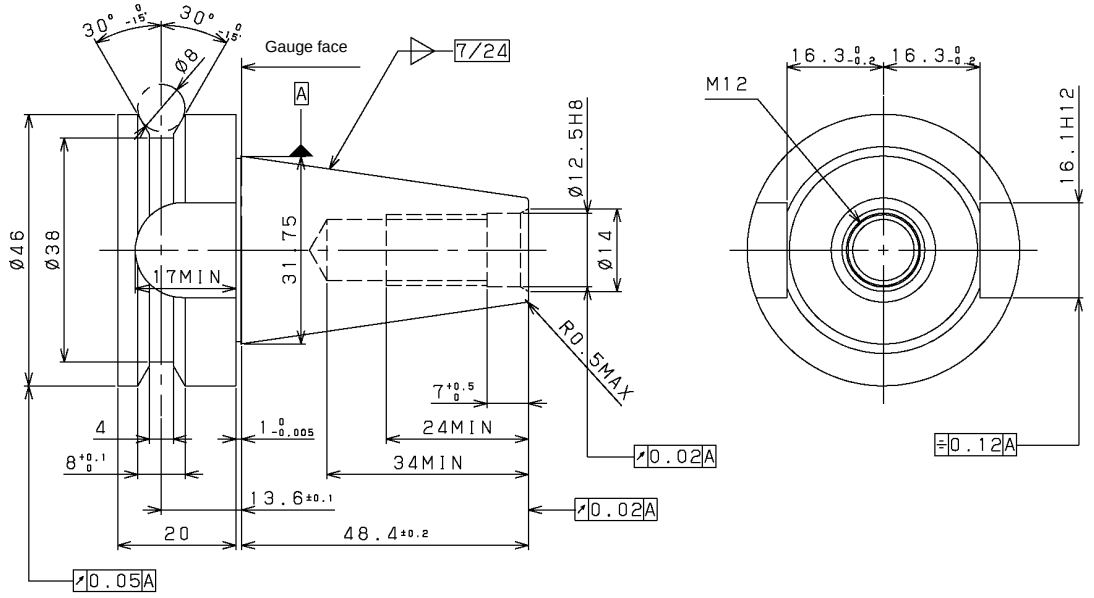


Fig.5 (g) Taper Shank (BIG PLUS)

Double–plane bound center through spindle (NC5) specification

The figures and dimensions of a taper shank and pull stud based on the double–plane bound center through spindle (NC5) specification are shown below.

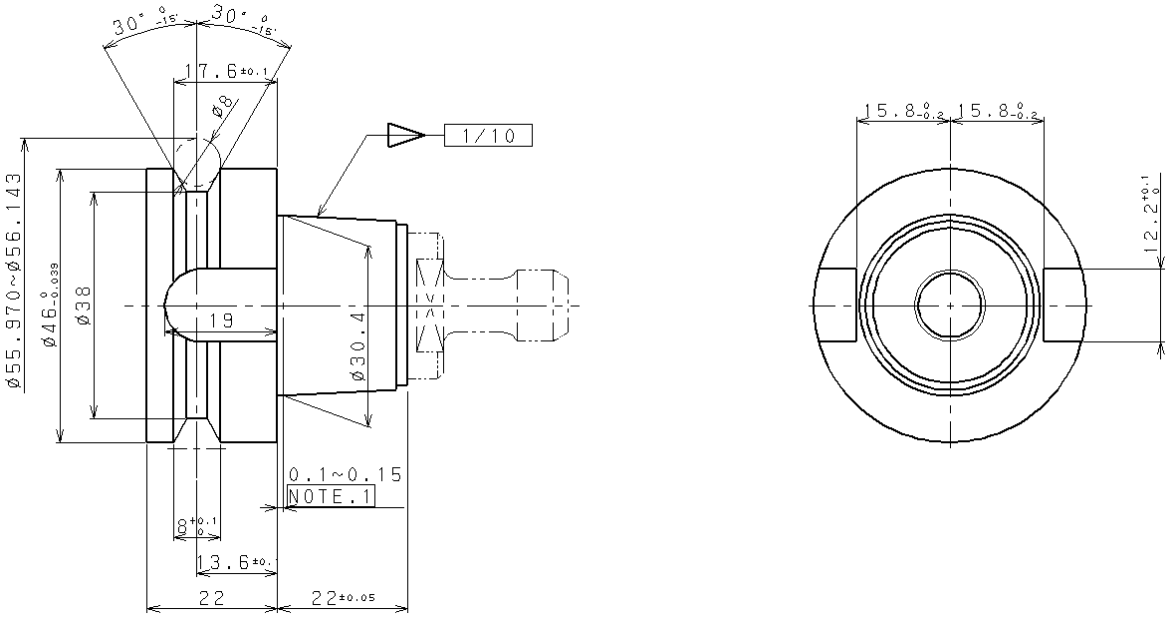


Fig.5 (h) Taper Shank (NC5)

SUPPLEMENT

The distance (0.1 to 0.15) between the ϕ 30.4 reference diameter and ϕ 46 end face is an adjustment value dedicated to the ROBODRILL.

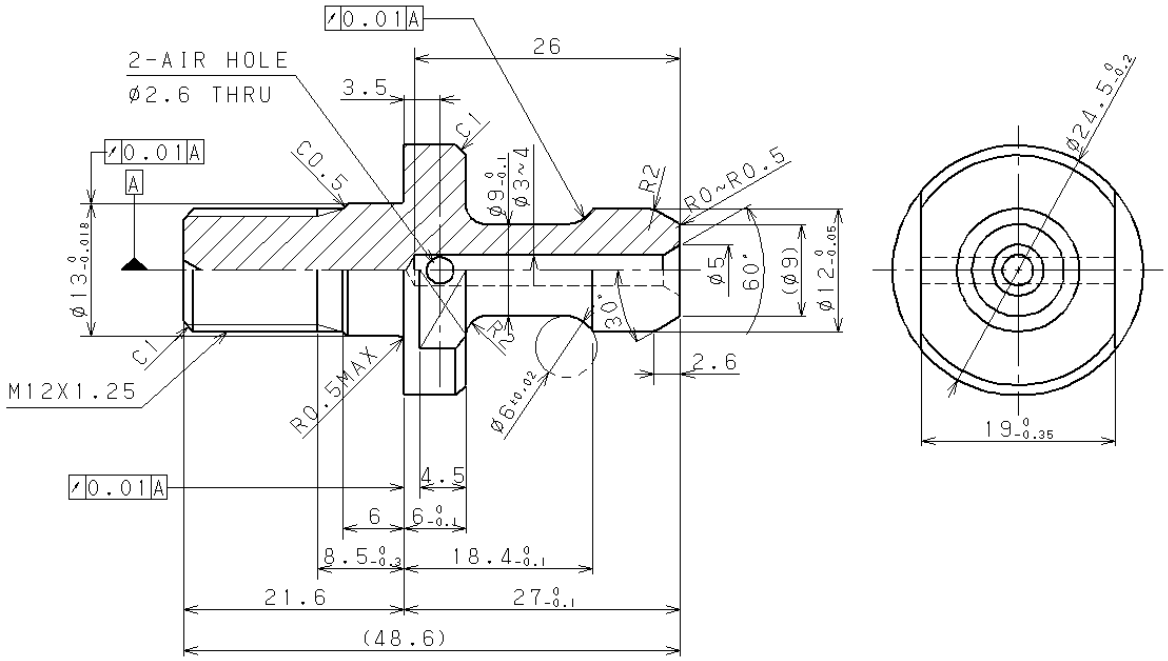


Fig.5 (i) Pull Stud (without NC5 and center through)

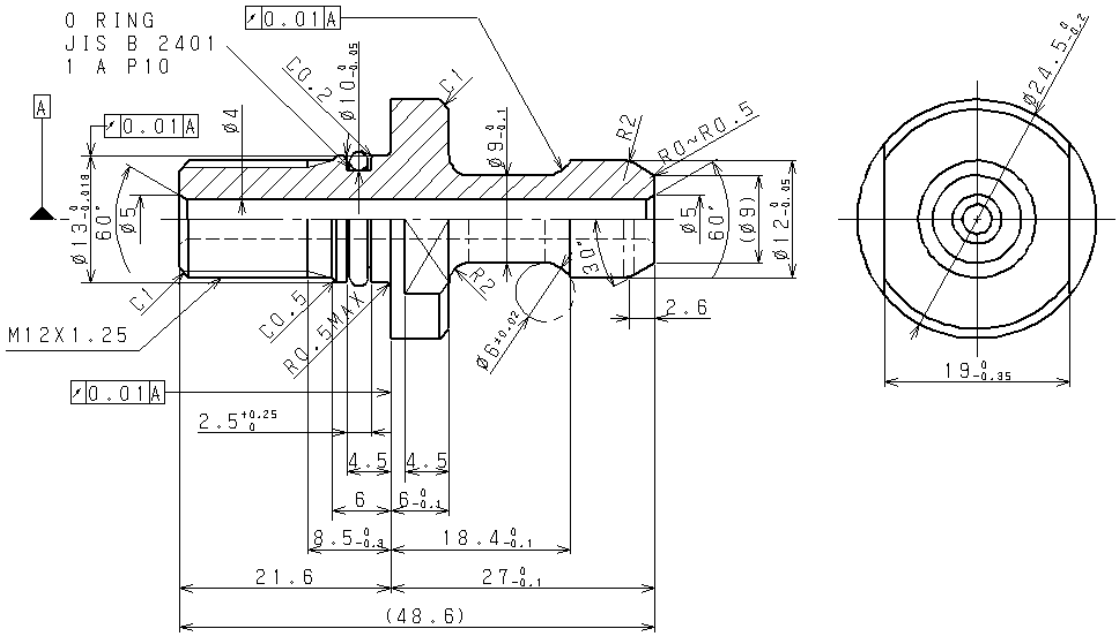


Fig.5 (j) Pull Stud (with NC5 and center through)

In the α-D*i*A5 series, the maximum tool diameter, length, and weight are limited as listed below. Before operating the machine, check the dimensions and weight of the tool.

(1) Maximum tool diameter

Length (mm) from the taper gauge surface	Maximum diameter (mm)
28 or less	Dia.50
From 28 (exclusive) to 120 (inclusive)	Dia.80
From 120 (exclusive) to 250 (inclusive)	Dia.40

(2) Maximum tool length

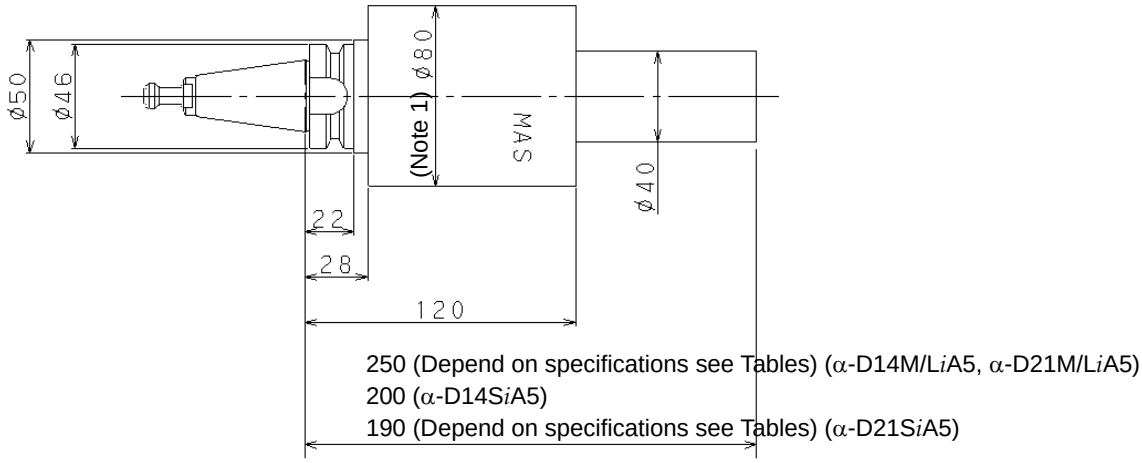
Model	Specification	Maximum tool length
α-D14M/L*i*A5	SPG with one door	250mm
	SPG with two doors	240mm
α-D14S*i*A5	SPG with two doors	200mm

Model	Specification	Maximum tool length
α-D21M/L*i*A5	SPG with one door	250mm
	SPG with two doors	215mm
α-D21S*i*A5	HIGH COLUMN 0, 100mm	190mm
	HIGH COLUMN 200mm	90mm

(3) Maximum tool mass

α-D14M/L/S*i*A5: 2 kg (total mass of 15 kg)/3 kg (total mass of 22 kg)
α-D21M/L/S*i*A5: 2 kg (total mass of 23 kg)/3 kg (total mass of 33 kg)

Before starting to use a tool that weighs 2 kg or heavier (up to 3 kg), set up the machine for a tool mass of 3 kg. (It is factory-set to 3 kg for safety purposes.)



Note 1) This value is ϕ100 for the high torque spindle specification.

Fig.5 (k) Tool Limits

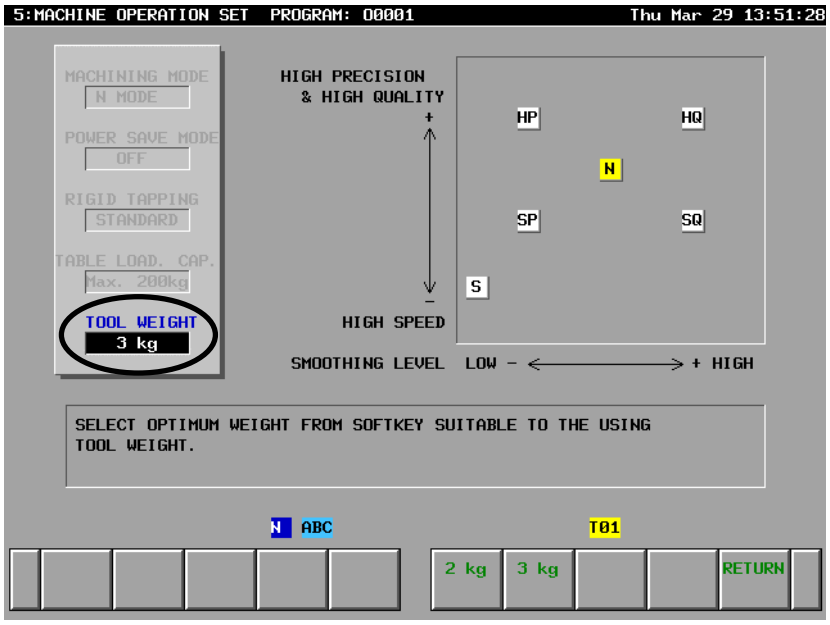
Be very careful not to use tools that do not satisfy the dimensional restrictions above. Otherwise, the troubles listed below can occur.

(1) A tool longer than the maximum tool length can interfere with the front door when the turret turns.
(2) When the maximum tool diameter is exceeded:
* Rigid tapping may not be able to be performed normally.
* It is likely that interference may occur between the tool and jigs or the like placed around the spindle.

(3) When the maximum tool mass is exceeded:
* Automatic tool exchange may fail.
* If an excessively heavy tool is used, the temperature of the spindle bearing rises abnormally, reducing the life of the spindle bearing.

SUPPLEMENT

The tool mass can be set on the "5: MACHINE OPERATION SET" QUICK screen. For details, see Subsection 1.3.4, "MACHINE OPERATION SET Screen", in Chapter 1, "QUICK SCREEN", in Part IV.



6 JIGS

⚠ WARNING

A maximum load of 300 kg (α-D14S*i*A5, α-D21S*i*A5: 200 kg maximum), including jigs and workpieces, can be put on the table. Avoid putting more on the table than the maximum load. Exceeding the maximum load capacity is so dangerous that the table, workpieces, and jigs may get broken, possibly causing injury to the operator.

CAUTION

When installing a jig on the table, make sure that the load is applied uniformly over the table surface. Nonuniform load on the table may lead to damage to a ball screw or LM guide. It may also affect the precision.

Three T–shaped grooves with the nominal size of 14 mm are provided at intervals of 125 mm on the top surface of the table. (See Appendix A, "DIMENSIONS OF THE MACHINE".)

7 COOLANT

⚠ DANGER

When machining a combustible metal, use an appropriate coolant for machining combustible metals.
If fire breaks out during machining of a combustible metal, in particular, using a water-soluble coolant, the water reacts with the combustible metal, possibly leading to explosive combustion due to hydrogen gas or vapor explosion.

⚠ WARNING

1 Do not use any coolant with a low inflammation point (such as class 2 petroleum, with an inflammation point of below 70°C). Otherwise, a fire may occur. Class 3 petroleum (with an inflammation point of 70°C to 200°C), class 4 petroleum (with an inflammation point of 200°C to 250°C), and burn-resistant coolants (with an inflammation point of 250°C or higher) can also catch fire. When using these liquids, exercise care on the way and method of using them, for example, by suppressing generation of oily smoke.
2 During machining using a coolant, be careful to supply a sufficient amount of coolant properly. If a coolant is not supplied normally, sparks, frictional heat, and others may be generated depending on the cutting condition, possibly letting cut scraps of a combustible workpiece or the coolant catch fire. Clean the cut scrap receiver and filter in the coolant tank so that a sufficient amount of coolant is supplied properly and the filter is not clogged. If the amount of the coolant in the coolant tank is insufficient, replenish the coolant in the tank immediately. Periodically check that the coolant pump runs normally.
3 Do not use any rotten coolant or lubricant (such as grease or oil) as it is quite harmful. As for how you can tell that a coolant or lubricant is rotten, contact its manufacturer. Save or dispose of it according to the instructions from the manufacturer.
4 Avoid using any coolant or lubricant (such as grease or oil) that can unmake polycarbonate, nitrile rubber (NBR), hydrogenerated nitrile rubber (HNBR), fluorocarbon rubber, nylon, and acrylate resin, ABS resins. Dilution water rich with residual chlorine can unmake these substances. As the machine uses these substances as sealant, the machine may get less sealed, possibly leading to an electrical shock because of fault current or to a burn because of lack of grease resulting from a spill.

ATTENTION

1 Do not use any type of coolant listed below since it can adversely affect the machine, possibly causing damage to the machine:
   - Coolant containing sulfur with a high degree of activity: Some coolants may contain sulfur with a very high degree of activity. If this type of coolant enters the inside of the machine, it can corrode copper, silver, and other metals, possibly causing damage to parts.
   - Highly-penetrative synthetic coolant: Some coolants made using polyalkylene glycol and other oils may be highly penetrative, which can penetrate the inside of the machine, possibly causing low insulating resistance and damage to parts.
   - High-alkali, water-soluble coolant: Some coolants to which alkanolamines and other agents are added to increase the pH value may be strongly alkaline, which have a pH of 10 or more even with the working solution. This type of coolant can cause damage to resin and other materials if adhered to them for a long time.
   - Coolant containing chlorine: Some coolants containing chlorine (for example, chloride components, such as chlorinated paraffin) affect materials such as resin and rubber badly, leading to possible defective parts.

2 Frequently skim (remove) oil floating on the coolant in the coolant tank off to maintain the status in which no oil is floating. Decreasing the amount of oil in the coolant can decrease the amount of sludge generated.

3 Always keep the coolant fresh. New coolant can emulsify oil in sludge again with its surfactant property, which has a cleaning effect on sludge attached on the surface of the machine.

The capacity of the coolant tank of the ROBODRILL α-D*i*A5 series is approximately $0.1m^3$(100L) or $0.2m^3$ (200L). (The capacity of the coolant tank of the ROBODRILL α-D14/21S*i*A5 is approximately $0.14m^3$ (140L) only.) When water-soluble coolant is thinned with water, take every precaution so water does not drop on the machine or the NC unit.

FANUC recommends the following coolants (cutting fluids).

Property	Manufacturer	Product name
Soluble	Yushiro Chemical Industry	Yushiroken FGE350 *
	Castrol	Alusol B
	JX Nippon Oil&Energy Corporation	Unisoluble EM-B
	Blaser Swisslube Japan	Blasocut 2000 CF

* Yushiro Chemical Industry Yushiroken FGE350 falls under the control of the Pollutant Release and Transfer Register (PRTR) law.
FGE350PR, which does not fall under the control of this law, is recommended for use in Japan.

See Item d), "COOLANTS AND LUBRICANTS," in Item 2 in "SAFETY PRECAUTIONS;" Section 8, "COOLANT SUPPLY," in Part III; and Subsection 1.1.2, "Replenishing the Tank with Coolant," in Part V for explanations about coolants.

II. INSTALLATION

SAFETY PRECAUTIONS FOR INSTALLATION

⚠ WARNING
Read "SAFETY PRECAUTIONS FOR INSTALLATION" carefully and follow the steps stated in it. Failing to follow them may lead to injury or death.

The machine shall be moved or installed by the maintenance engineer.

Moving or installing the ROBODRILL requires understanding it in details.
No person other than the maintenance personnel of the ROBODRILL shall move or install it.
The term "maintenance personnel" refers to those people who have working knowledge about machinery and electricity for maintenance and have finished the maintenance course of the FA school or ROBOMACHINE school or who have equivalent knowledge and have been certified by the company they work for.
Fork lift or crane operators in charge of moving the ROBODRILL shall have the relevant license.

⚠ WARNING
1 When removing the Z-axis motor, be careful not let the Z-axis (spindle head) move down. Because the Z-axis brake is in the motor, removing the motor allows the Z-axis to move down, causing a risk that you may be caught, hence injury. When removing the motor, fix the table and Z-axis with the packing materials.
2 To lift the machine, use a crane and rope or cable with a load capacity of not less than the mass of the ROBODRILL main body of interest. Listed below are the mass of the main body of each ROBODRILL model. The mass in parentheses contains all options. Enclosed between each pair of parentheses is the total mass including all options.
α-D14/21M*i*A5: 2000 kg (2300kg)
α-D14/21L*i*A5: 2100 kg (2400kg)
α-D14/21S*i*A5: 1950 kg (2200kg)
When lifting the machine, make sure that it stays in balance.
3 Before starting to use the machine, be sure to perform grounding to prevent radio disturbance and electrical leakage. For grounding conditions, see Chapter 1, "INSTALLATION REQUIREMENTS".

⚠ CAUTION
1 Install the machine on a flat, sufficiently strong floor. Otherwise, the machine may jolt during operation, possibly leading to injury. The floor on which the machine is installed must satisfy the following conditions:
- The floor must have a load resistance of 3 tf/m^2 (29.4 kN/m^2) or more.
- The floor is completely flat, with no protuberance or hollow.
- The floor must not deteriorate with age and in regular use.

For the recommended floor conditions, see Chapter 1, "INSTALLATION REQUIREMENTS".
2 Sufficiently illuminate the shop floor where the machine is installed so that you can see the machine and parts clearly. Working in a dark place can invite an incorrect operation, possibly leading to an accident. The shop floor must be illuminated with at least 300 lx. An optional internal light is available.

ATTENTION

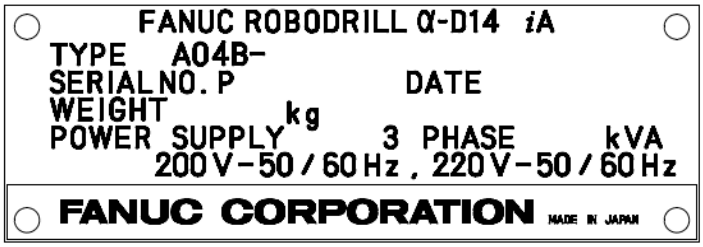
1 Pay attention to how the machine is transported and packed.
- Fix the Z-axis (spindle head) and table with packing materials.
- Apply a rust inhibitor to the specified portions of the machine. (See 2.1.)
- Fix the turret mechanism with nylon ties.

2 Allow a service access clearance (see the floor plan shown in Section 3.1, "INSTALLING LEVELING BOLTS AND BLOCKS," in Section 3, "INSTALLATION," in Part II, "INSTALLATION") in an area where the machine is installed.

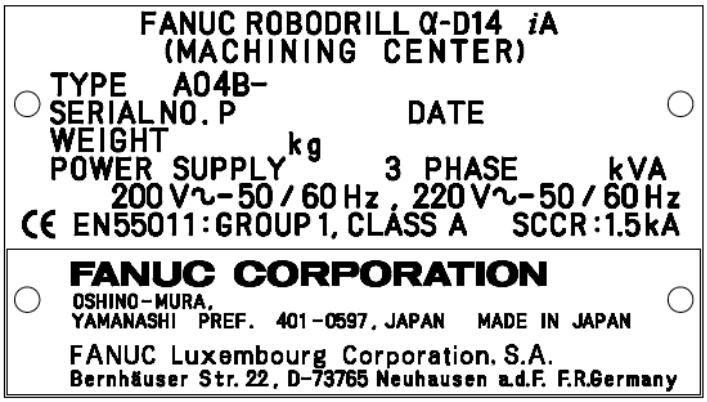
1 INSTALLATION REQUIREMENTS

ATTENTION
The installation site for the machine main body must satisfy the installation requirements stated below. Otherwise, the product main body may get out of order.

Power supply voltage, frequency (Hz), and power capacity (kVA) Check the following nameplate on the upper side of the NC rack:
If the value of the power supply voltage indicated on "POWER SUPPLY □ V" in the nameplate is in the range of +10% to –15%, the power supply voltage is valid. (220V is valid for only 60Hz) (3 PHASE = three phases) If this range is exceeded, install an appropriate transformer.
As for machines designed for use in Europe or China, supply power to them through an adequate transformer complying with the IEC standards.
If the frequency is 50 ± 1 or 60 ±1 Hz, it is valid.
* Be sure to perform grounding to prevent radio disturbance and electrical leakage. Class C grounding (with a grounding resistance of 10 Ω or less) defined in the electric facility standards is required. Ground the machine separately from other machines (one-point grounding).
For the circuit breaker of the facility, use a circuit breaker whose rated current is at least
"50 × (number of ROBODRILLs connected to the secondary side of the circuit breaker)" [A].
Use a power cable whose rated current is at least the rated current of the circuit breaker of the facility between the circuit breaker of the facility and each ROBODRILL. (For details of power cabling, see Subsection 3.4.2.1, "Power cable connection", in Subsection 3.4.2, "Connection and Phase Matching", in Section 3.4, "CONNECTING THE POWER SUPPLY", in Chapter 3, "INSTALLATION", described later.)



JAPAN and export standard



European specification

(1) Ambient temperature
In operation: 0 °C to 45 °C (5°C to 45°C when the automatic greasing unit (option) is mounted)
In storage or transportation: –20 °C to 60 °C

(2) Temperature change
Within 0.3 °C/min.

(3) Humidity
Normal: 75% or less (relative humidity)
Temporary: 95% or less

(4) Vibration
2 m/s^2 (0.2 G) or lower

(5) Floor
Load resistance: 3 tf/m^2 (29.4 kN/m^2) or more
To maintain stable machining accuracy and fully realize machining performance, the following conditions are recommended:
Load resistance: 5 tf/m^2 (49.0 kN/m^2) or more
Compressive strength: 367 kgf/cm^2 (36 N/mm^2) or more

(6) Atmosphere
No corrosive gas
No flammable gas
Neither cut scraps nor coolant shall be splashed directly on the CNC LCD or operator's panel.
* If the LCD or operator's panel is severely soiled, gently wipe it with a soft cloth moistened with a small amount of mild solution of neutral detergent to remove oil and other foreign matters attached to the surface.
Then, thoroughly wipe off neutral detergent with a soft cloth moistened with water and wrung tightly and dry the surface well with a soft, dry cloth.

(7) Grounding
Class C grounding (with a grounding resistance of 10 Ω or less) defined in the electric facility standards is required.
Ground the machine separately from other machines (one-point grounding).

(8) Compressed air supply
Service pressure: 0.35 to 0.55 MPa (0.5 MPa is recommended.)
Flow rate: 0.15 m^3/min (150L/min) (flow rate under atmospheric pressure)
Solid material: 5 μm or less (nominal)
Moisture: Dew point under atmospheric pressure –17°C or below
Oil content concentration on the primary side: 1 mg/m^3 or below

2 TRANSPORTATION PROCEDURE

2.1 PREPARATION BEFORE TRANSPORTATION

Prepare for transporting the machine according to the following steps:

(1) Remove the Y–axis telescopic cover (at the front).
(2) Remove the coolant nozzle base at the bottom of the spindle head.
(3) Move the table to the position indicated by the machine coordinates
X= 250(D14/21M*i*A5)/350(D14/21L*i*A5)/150(D14/21S*i*A5),
Y= -350(D14/21M/L*i*A5)/ -277(D14/21S*i*A5).
(4) Firmly secure the packing plate using the M12 tapped hole on the top rear of the table. Be careful not to damage the top of the table.

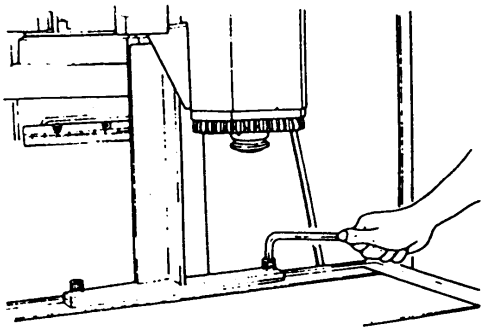


Fig.2.1 (a) Securing the Packing Plate (at the Table)

(5) Slowly lower the spindle head to the position where Z= -282. Be careful not to hit the spindle head against the packing plate.
(6) Check whether the position of the hole on the packing plate is aligned with that of the tapped hole for installing the coolant nozzle base at the bottom of the spindle head. If not, move the table slightly to make the adjustment.
(7) After the hole position is aligned correctly, lower the spindle head until it touches the packing plate.
(8) Turn off the power.
(9) Fix the spindle head to the packing plate with an M12×30 bolt, spring washer, and plain washer.

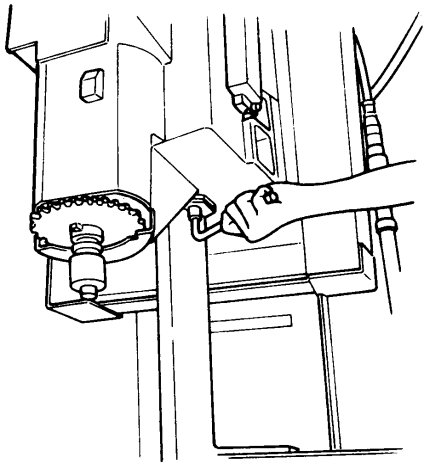


Fig.2.1 (b) Securing the Packing Plate (at Spindle Head)

(10) Secure the turret with the nylon band or equivalent.

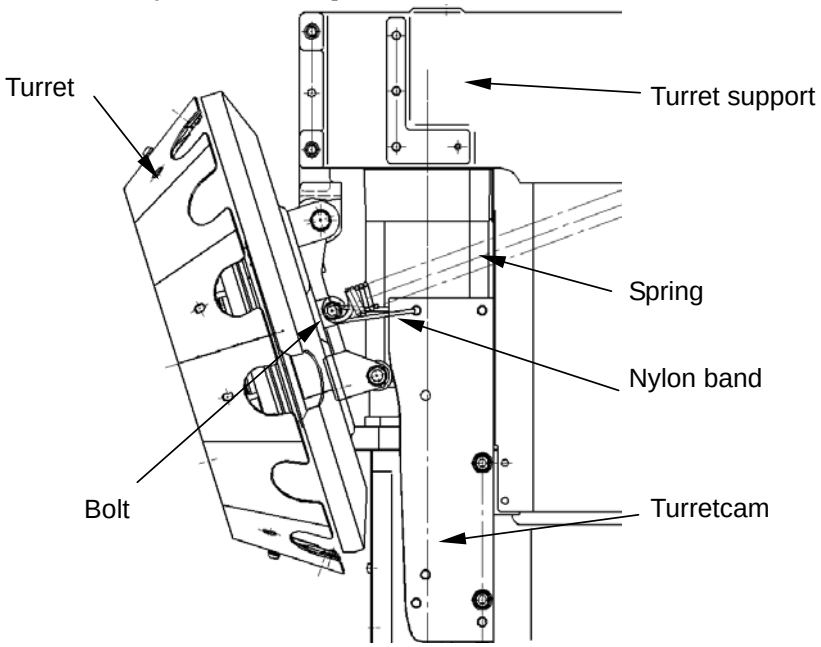


Fig.2.1 (c) Securing the Turret

(11) Install three M30 eyebolts in the upper front of the bed and on top of the column.
These eyebolts must comply with JIS B 1168 or have a working load of 14.7 kN or more.

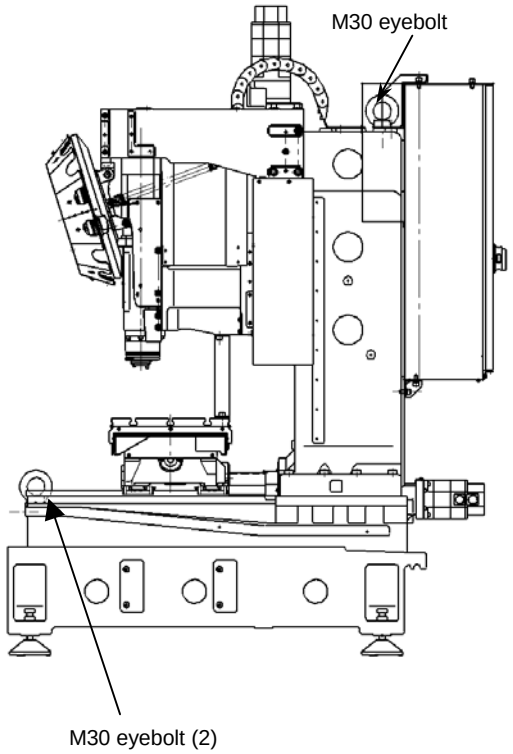


Fig.2.1 (d) Transportation status

> ⚠ **WARNING**
> When transporting or lifting the machine, keep it in the transportation status shown above. Otherwise, the machine may fall down, possibly leading to injury.

(12) Apply corrosion-preventive grease to the following parts:
  (a) X-, Y-, and Z-axis rolling guide sections (LM guide) and ball screw
  (b) Internal face of the spindle taper part
  (c) Upper face of the table
  (d) Turret rear side and spindle nose gears
  (e) X/Y-axis telescopic covers
  (f) Machined surfaces of castings and untreated metal-sheet parts

2.2 TRANSPORTATION

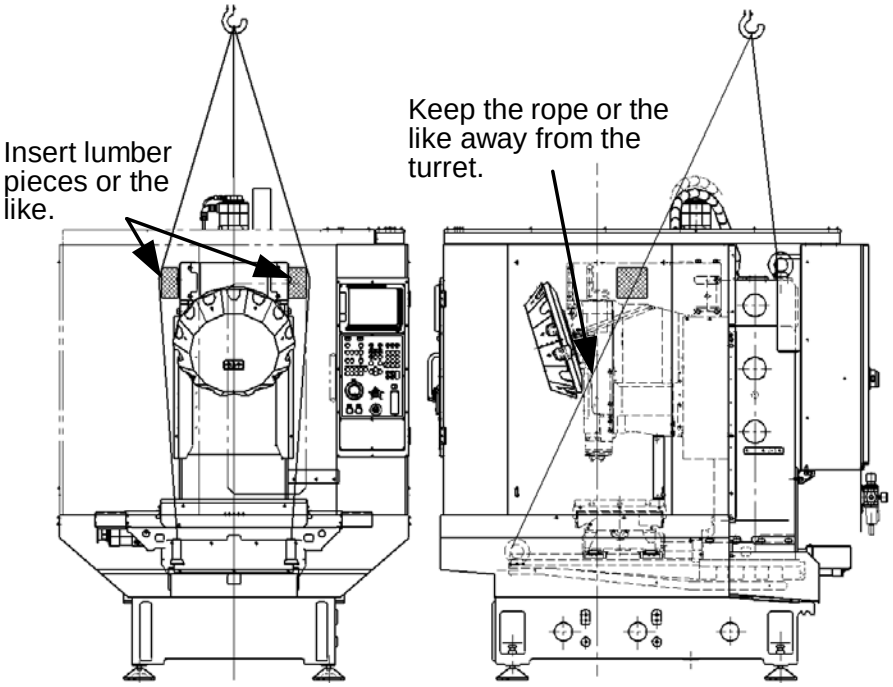


Fig.2.2 Lift the machine

Three eyebolts and a rope or cable are used to lift the machine.

> ⚠ **WARNING**
> To lift the machine, use a crane and rope or cable with a load capacity of not less than the mass of the ROBODRILL main body of interest. Listed below are the mass of the main body of each ROBODRILL model. The mass in parentheses contains all options. Enclosed between each pair of parentheses is the total mass including all options.
> α-D14/21M*i*A5: 2000 kg (2300kg)
> α-D14/21L*i*A5: 2100 kg (2400kg)
> α-D14/21S*i*A5: 1950 kg (2200kg)
> When lifting the machine, make sure that it stays in balance.

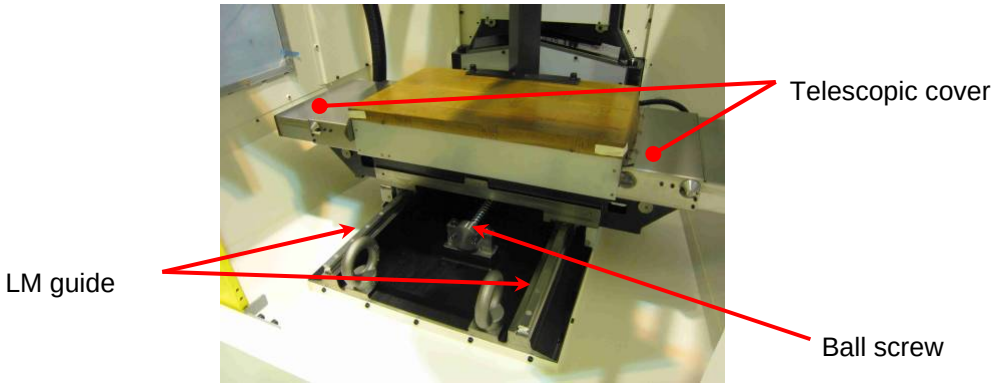
ATTENTION

- Be very careful not to impact the machine when lifting it; move it up slowly.
- If the rope or cable can directly touch the machine, insert cloth or wood between the rope or cable and the machine to prevent the machine from being damaged. Insert lumber pieces or the like into the places shown in Fig. 2.2 to keep the rope or the like away from the turret. Otherwise, the cover may be deformed.

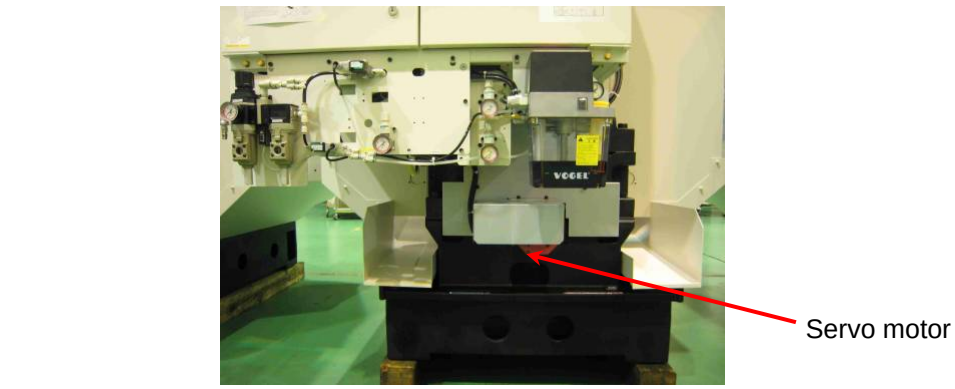
Notes on transportation and installation

When transporting and installing the ROBODRILL, note the following:

During transportation, the Y-axis telescopic cover is removed to lift the machine. So, precision components (such as the LM guide and ball screws) are exposed. Furthermore, a servo motor is mounted on the rear of the machine. Special care should be taken not to apply impact to these precision components. Impact on these precision components can damage the components or degrade machine accuracy.
In addition, do not step onto the X-axis telescopic cover. Otherwise, the cover can be deformed or damaged.



Machine inside



Machine rear side

3 INSTALLATION

3.1 INSTALLING LEVELING BOLTS AND BLOCKS

Position the attached leveling blocks under the four leveling bolts and slowly put the machine on the blocks. Set the nuts over the casting (bed).

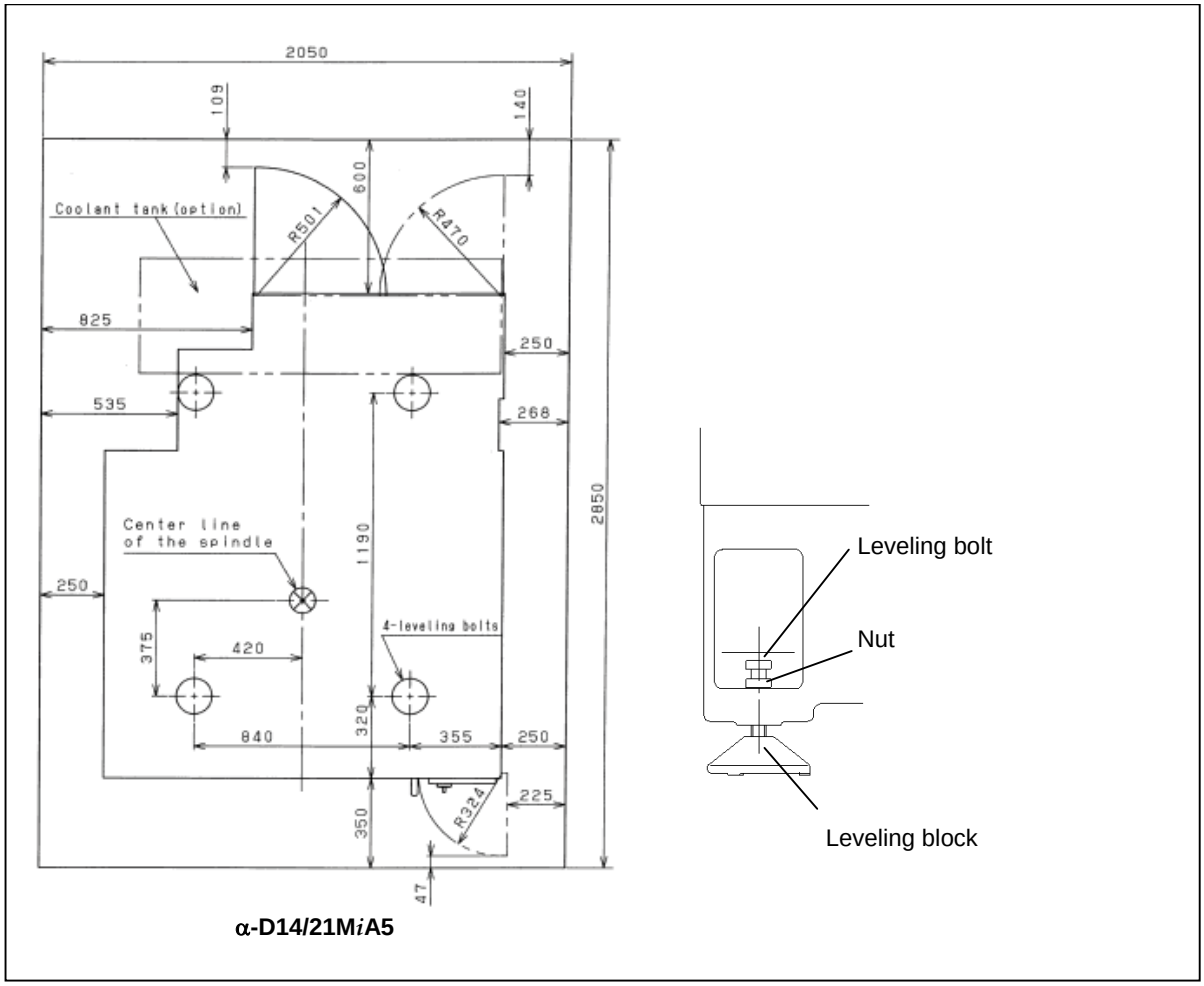


Fig.3.1(a) Mount the YC stand with the shown surface (surface with white resin) facing forward. (1/2)

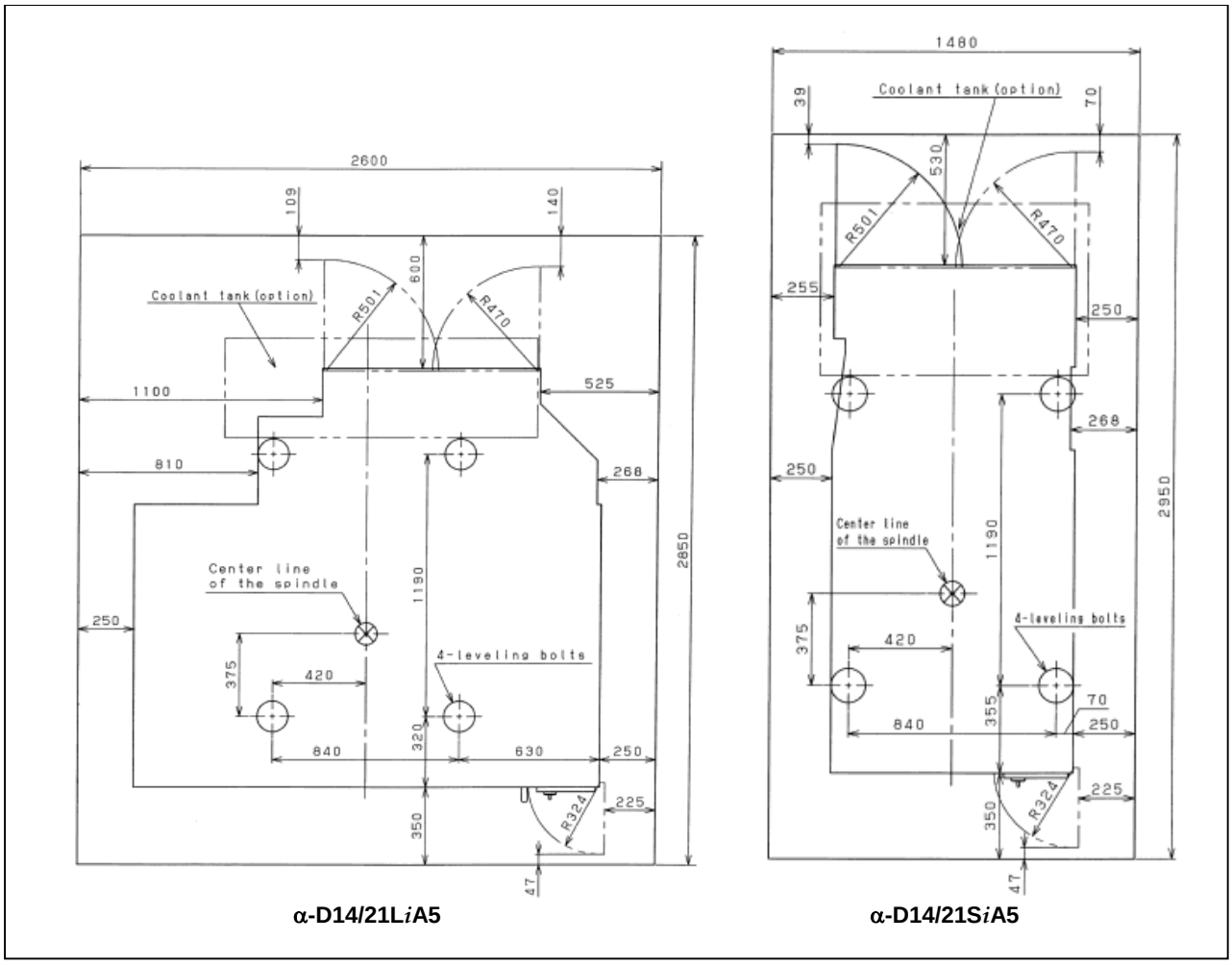
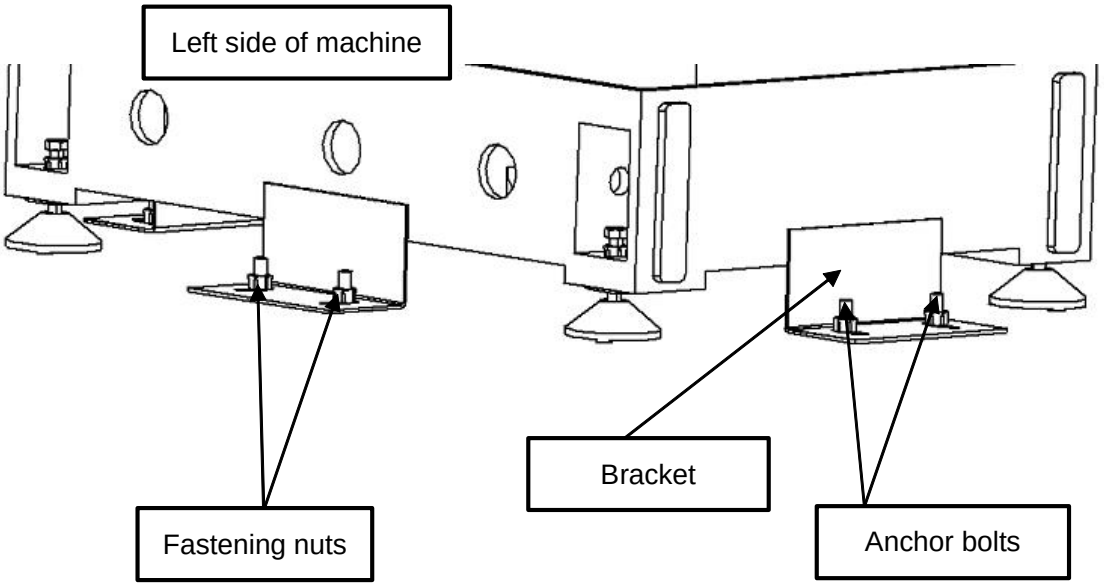


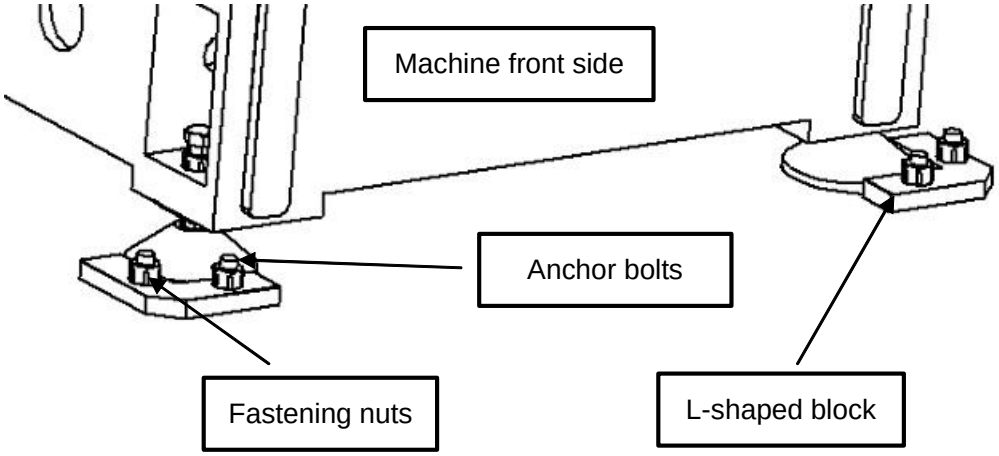
Fig.3.1(b) Mount the YC stand with the shown surface (surface with white resin) facing forward.(2/2)

Depending on the surface condition and inclination of the floor, the friction between the floor and the leveling blocks can become decrease, allowing the machine to slightly move with long-term use. Therefore, when the machine is to be used for a long period of time without changing the installation place, it is recommended that the machine be fastened to the floor as shown in Fig. 3.1(c) and (d).



Fastened in 4 places (front, rear, right, and left)

Fig. 3.1 (c) Example of fastening with anchor bolts and angles (1/2)



Fastened in 4 places (front, rear, right, and left)

Fig. 3.1 (d) Example of fastening with anchor bolts and L-shaped blocks (2/2)

3.2 REMOVING THE EYEBOLTS FOR LIFTING THE MACHINE

Remove the two M30 eyebolts on the top front of the bed.

3.3 REMOVING THE PACKING PLATE

Untie the nylon band that secures the turret.
Remove the packing plate according to the following steps:

(1) Remove the bolts fixing the packing plate on the top of the table and at the bottom of the spindle head.
(2) After turning on the power, slowly raise the spindle head and remove the packing plate. (See II–3.4 for connecting the power supply.)

3.4 CONNECTING THE POWER SUPPLY

3.4.1 Installing a Noise Filter

The ROBODRILL designed for use in Europe complies with the Machine, EMC, and Low-Voltage Directives. The ROBODRILL designed for use in China complies with the Compulsory National Standards of China (GB15760-2004). The ROBODRILL control unit cabinet designed for use in Europe or China contains a noise filter so that it can comply with the EMC Directives (2004/108/EC). The noise filter decreases noise emitted from the ROBODRILL to the outside through the power cable.
There is a switch on the top of the noise filter as shown below:

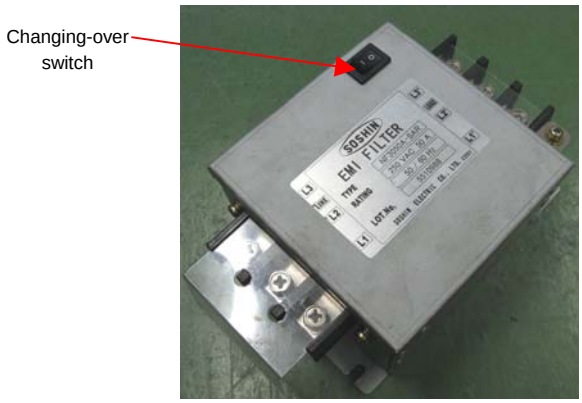


Fig. 3.4.1 Photo of the noise filter

When this switch is set to ON (|), the noise elimination efficiency in the frequency band 150 kHz to 30 MHz, defined by the above standards, is improved.
If any line of the 200Va.c., three-phase power supply lines in the factory is grounded, there is a difference in potential between the power supply phase and ground, allowing leakage current to flow from the power supply phase to ground.
Consequently, if a ground-fault circuit interrupter is used as the circuit breaker of the facility from which power is supplied to the ROBODRILL, the ground-fault circuit interrupter may operate.

The main circuit breaker on the ROBODRILL designed for use in Europe or China is of an automatic type. Therefore, leakage current does not cause the main circuit breaker to trip.

CAUTION
In a factory in which the machine is set, when one phase line of the power supply is grounded, set this switch to OFF (○) when using the machine. Even when this switch is set to ON (|), no electrical shock can occur if the machine is grounded properly.

3.4.2 Connection and Phase Matching

3.4.2.1 Power cable connection

> ⚠ **WARNING**
> Before connecting the power cable, turn off the switchboard breaker.
> Otherwise, an electric shock may result.

Connect the power cable to the main breaker [QF1] in the controller cabinet.
See Figs. 3.4.2.1 (a) and (b).

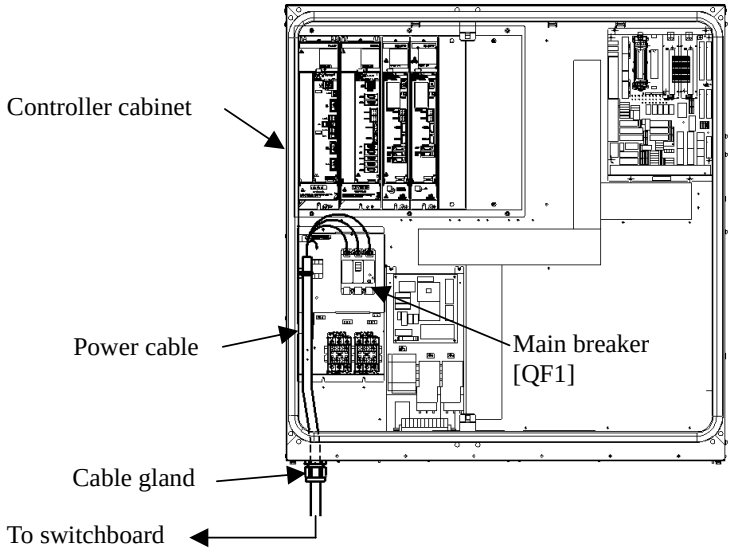


Fig. 3.4.2.1 (a) Connection of the power cable in the controller cabinet

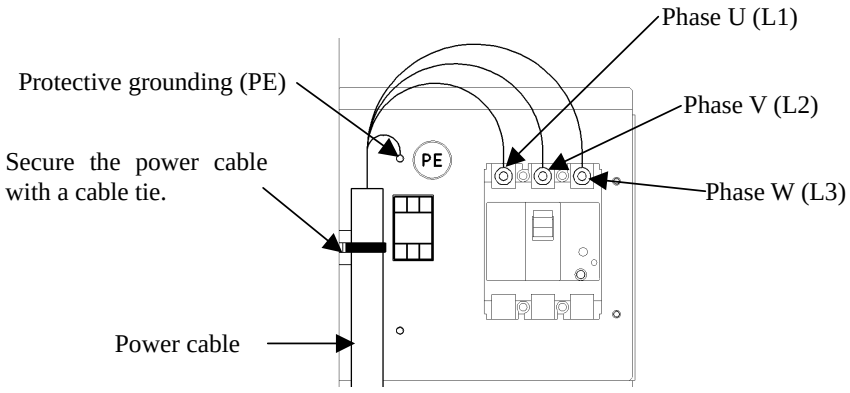


Fig. 3.4.2.1 (b) Enlarged view of the section around the main breaker

Then, connect the power cable to the power terminal on the switchboard. For the power specifications of the switchboard, see Section 1.2, “USE OF THE MACHINE,” in Part I, “OUTLINE,” and Chapter 1, “INSTALLATION REQUIREMENTS,” in Part II, “INSTALLATION,” (this part).
When the customer prepares a power cable, note the following:

(1) Use an appropriate cable that conforms to IEC standards and satisfies the following specifications:

Rated voltage	500 V or more
Rated temperature	80℃ or more
Conductor cross-sectional area	10 mm^2 (AWG8) or more
Crimp terminal on the ROBODRILL main circuit breaker side (including a ground wire)	M5 flat, ring crimp terminal (maximum width: 15.0 mm) Note: For the three power lines, insulate the crimp section of the terminal using heat-shrinkable tube.
Insulator color	Black (U, V, and W lines) Yellow/green spiral (ground wire)

(2) Inside the controller cabinet, there is a hole with a diameter of 38 mm on a left part of the bottom of the cabinet so that the power cable can be routed via this hole. When installing the cable, attach a cable grand (cord grip) suitable for the outer diameter of the cable and hole diameter on the bottom of the cabinet to prevent coolant and chips from entering the inside of the cabinet.

(3) When a machine is to be exported to EU countries and China, attach a ferrite core to the cable to meet the requirements of the EMC Directive. Fig. 3.4.2.1 (c) shows how the ferrite core is attached.

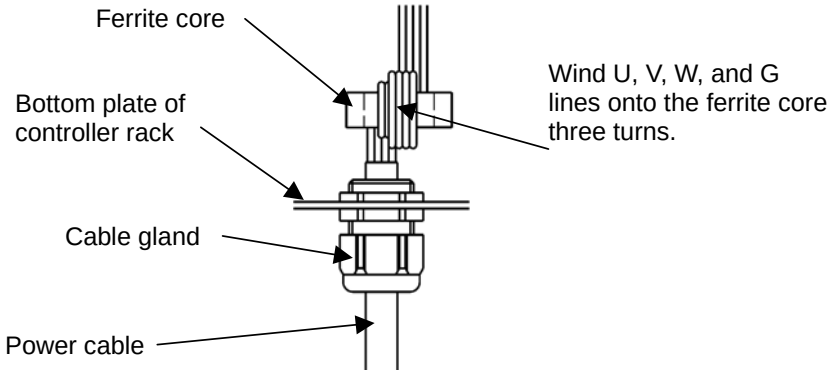


Fig. 3.4.2.1 (c) Attaching a ferrite core

* FANUC ordering information of the ferrite core: A99L-0137-0001#T36

3.4.2.2 Phase Matching

Connect an input terminal block phase rotation meter as shown in Fig. 3.4.2.2, and connect the power supply so that the phase rotation meter disk rotates clockwise.

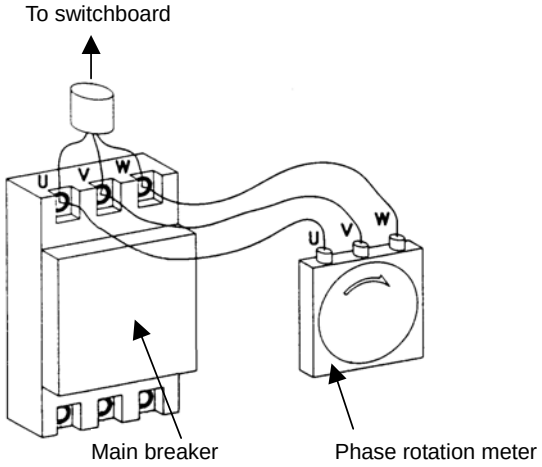


Fig.3.4.2.2 Connecting of Phase Rotation Meter

3.4.2.3 Other cables connection

Following items should be refered when connecting other cables for custom PMC or others.

1. There are two openings for cable (cable openings) on the bottom of the controller cabinet. When cabling, use these openings. Use of the front opening of the controller cabinet, or addition of cabling hole to the controller cabinet should not permitted.

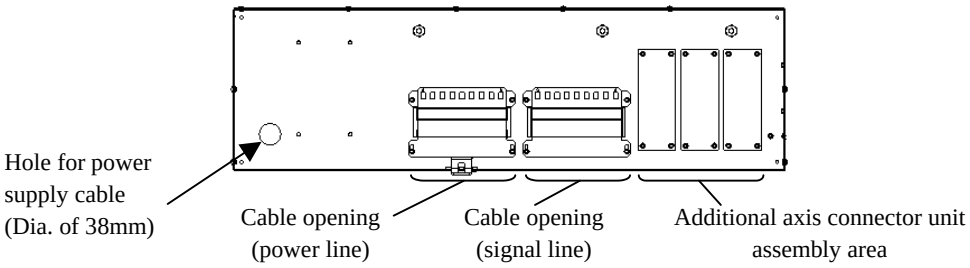


Fig.3.4.2.3 (a) Bottom of the controller cabinet

2. As shown on Fig.3.4.2.3 (a), cable openings are divided ; one is for power line and another is for signal line. Divide the power line cables and the signal line cables, respectively.
3. 200Va.c. and 24Vd.c. power supply can be used, on the terminal block shown in table 3.4.2.3. Total current shouled be limited not to exceed the Max. current. Solderless terminals should be assembled to the end of each cable.

Table 3.4.2.3 Terminal block for power supply output

Power supply	Terminal block	Max. current	Note
AC200V	Main brealer (QF1) terminal block on load side	10A	・Terminal size : M5 (width : Max. 15.0mm) ・When the tool taper cleaning option is installed, this area cannot be used.
	Power panel unit : XT5 (U21, V21, W21, earth)	5A	・Terminal size : M3.5 (width : Max. 6.6mm) ・Center thorough coolant option also use this area.
DC24V	Wiring PCB : XT1 (+24E, 0V)	1A	・Terminal size : M3.5 (width : Max. 6.8mm)

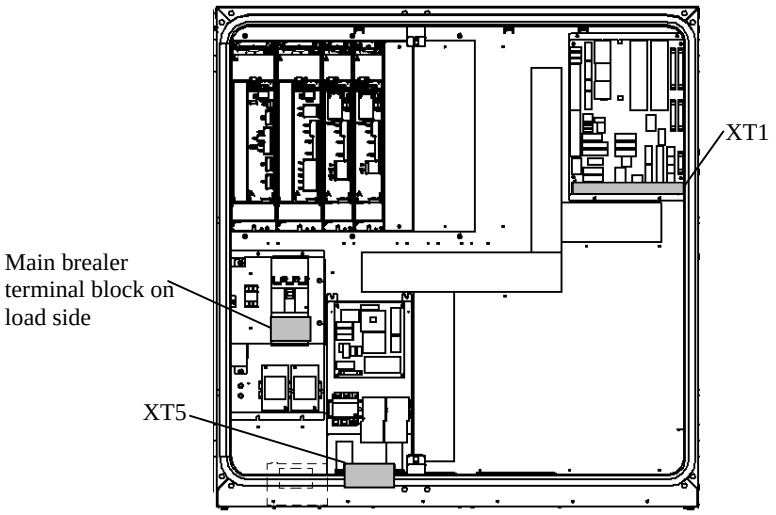


Fig. 3.4.2.3 (b) Terminal block location in controller cabinet

4. Maximum number of the cable connected to the one termininal should be 2. 3 or more cables should not be connected to one terminal.
5. Use the cable with correct conductor size and insulator thickness suitable for each purpose. Material of cable insulator should durable enough for coolant and the surroundings condition.

3.4.3 Fuses

Open the control unit cabinet door and you will see fuses at the locations shown below. Confirm these fuses are not blown out.

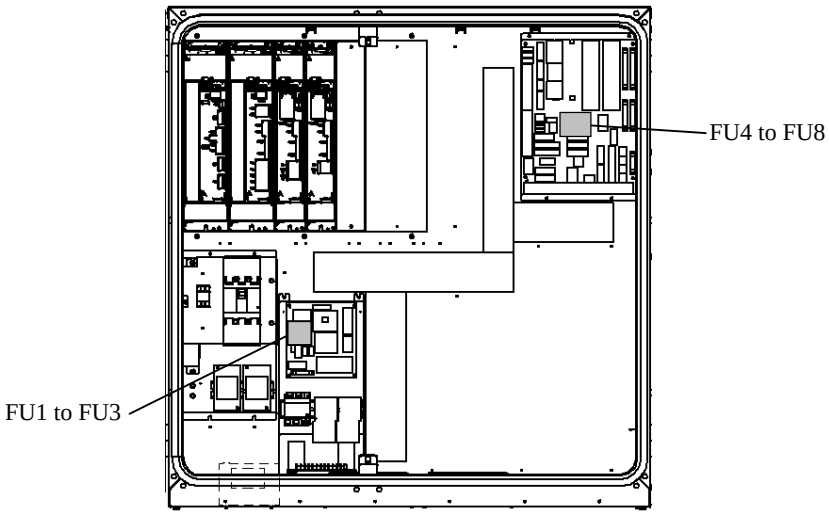


Fig. 3.4.3 (a) Fuse locations inside the control unit cabinet

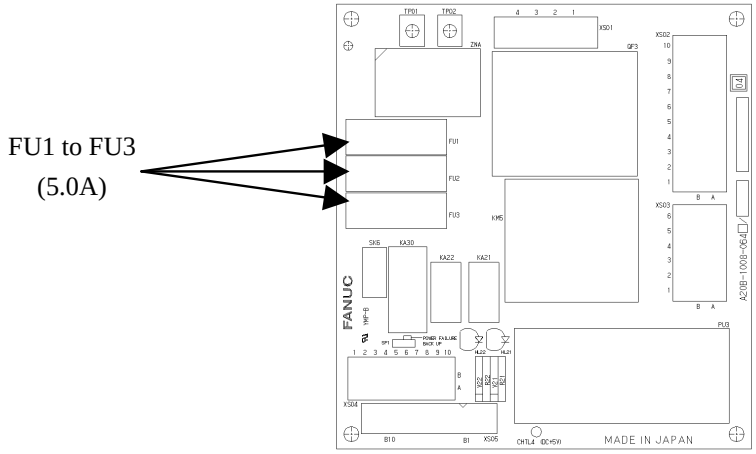


Fig. 3.4.3 (b) Detailed illustration of locations of fuses FU1 to FU3 (power panel PCB)

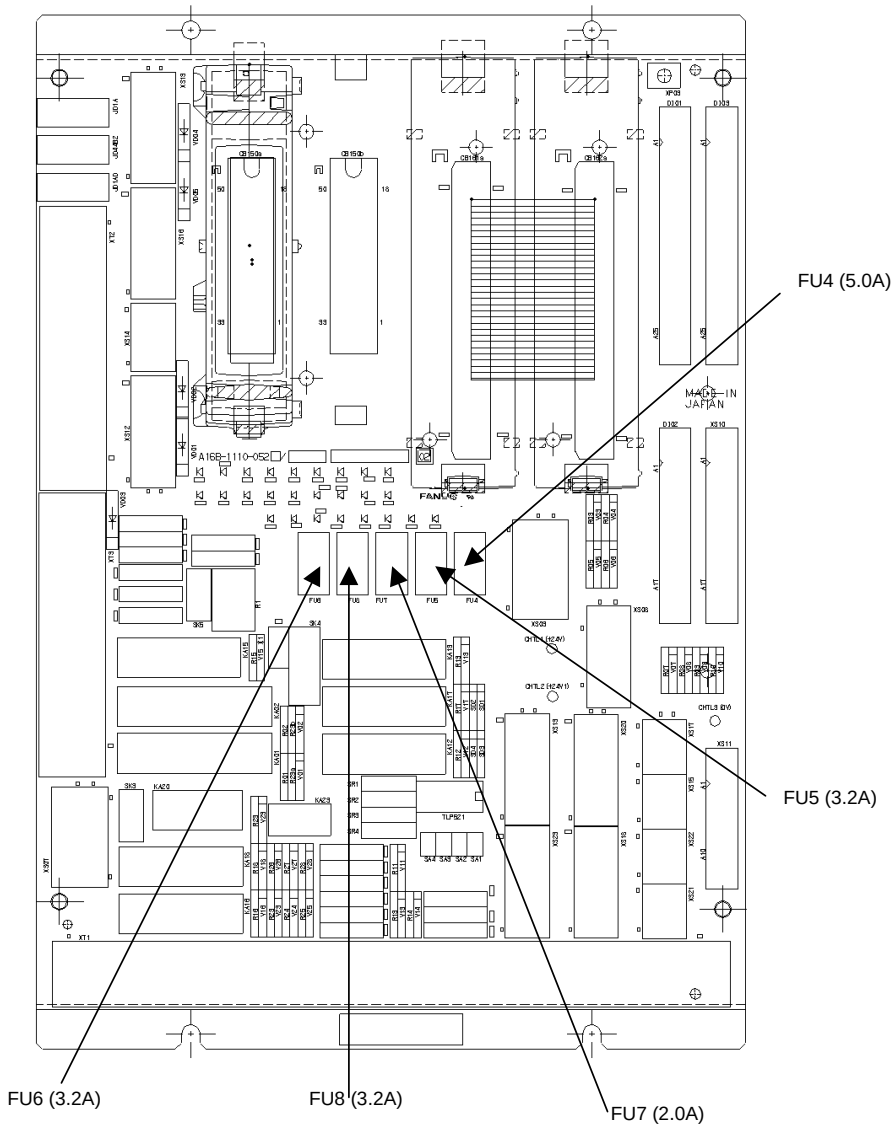


Fig. 3.4.3 (c) Detailed illustration of locations of fuses FU4 to FU8 (wiring PCB)

Fuses are also mounted on the rear side of the operator's panel and of the CNC unit. Also confirm these fuses are not blown out.

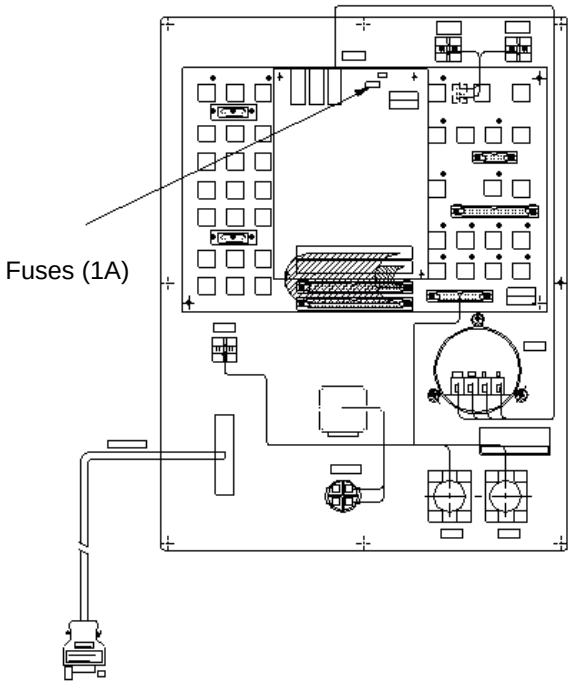


Fig. 3.4.3 (d) Fuses on the operator's panel I/O board (on the rear side of the operator's panel unit)

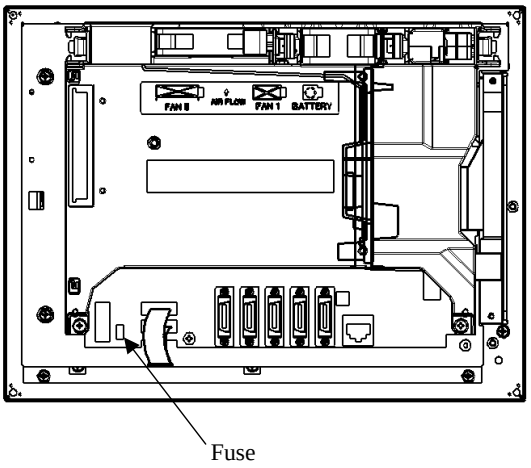


Fig. 3.4.3 (e) Fuse on the rear side of the CNC unit

3.4.4 Setting of Input Power Supply

Check the following items for each input power supply.

Current values of the thermal relays

	Contactor	Setting (Refer to the SUPPLEMENT)
Coolant	KM3	1.5 A (*1)
Flood coolant	KM4	2.2 A (*2)
Coolant for cleaning the tapered part (optional)	QF4	5.0 A (*3)

SUPPLEMENT
*1 Adjust the setting between 1.4 A and 2.0 A.
*2 Adjust the setting between 1.7 A and 2.5 A.
*3 Adjust the setting between 4.0 A and 6.3 A.

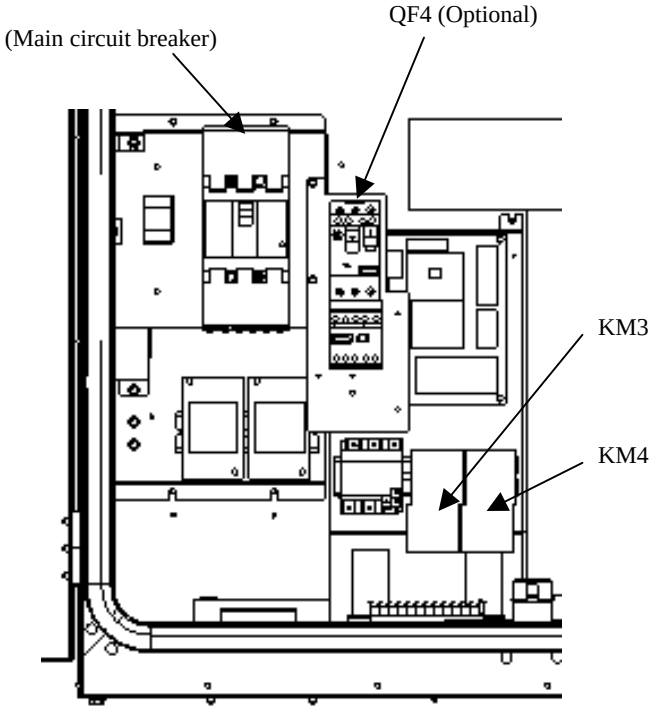


Fig. 3.4.4 KM3, KM4, and QF4 locations (lower left section inside the control cabinet)

3.5 CONNECTING THE COMPRESSED AIR SUPPLY

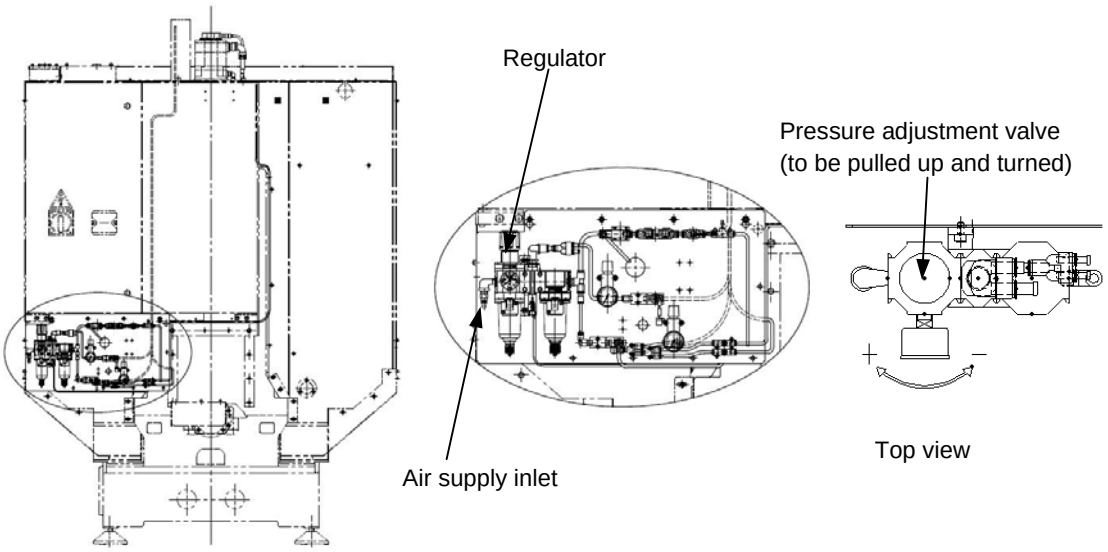
In the α-D*i*A5 series, compressed air is used for spindle air blow and opening and closing the automatic door.
Connect a dry-air tube meeting the following requirements to the filter regulator IN coupler (Nitto Kohki Co., Ltd. 20PM) in the lower section of the control unit cabinet.

Compressed-air source:
0.35 to 0.55 MPa (gauge pressure) (0.5 MPa is recommended.)
0.15 m^3/min (For opening and closing an automatic door, +0.02 m^3/min is added.)
Solid material: 5 μm or less (nominal)
Moisture: Dew point under atmospheric pressure –17°C or below
Oil content concentration on the primary side: 1 mg/m^3 or below

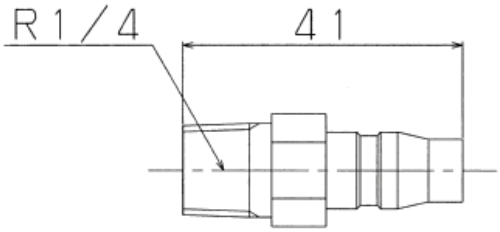
Basically, adjust the setting pressure of the primary filter/regulator to 0.5 MPa.

When a pressure different from this pressure value must be set, it must be set within the range from 0.35 to 0.55 MPa. (The setting pressure for operating the pressure switch is 0.1 MPa.) When the setting pressure is lower than 0.5 MPa, the opening and closing speed of the side automatic door may lower.

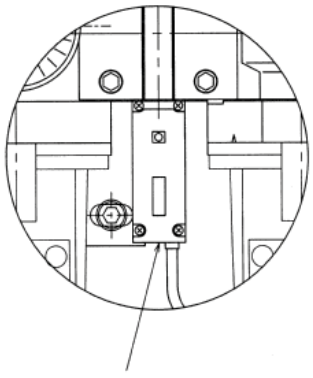
Generally dry air needs to be input. If the input air contains a small amount of moisture, connect a drain tube to the filter regulator and mist separator to drain water to a proper place.



(Joint on IN side)



(Enlarged view of the pressure switch)



Setting pressure: 0.1 MPa

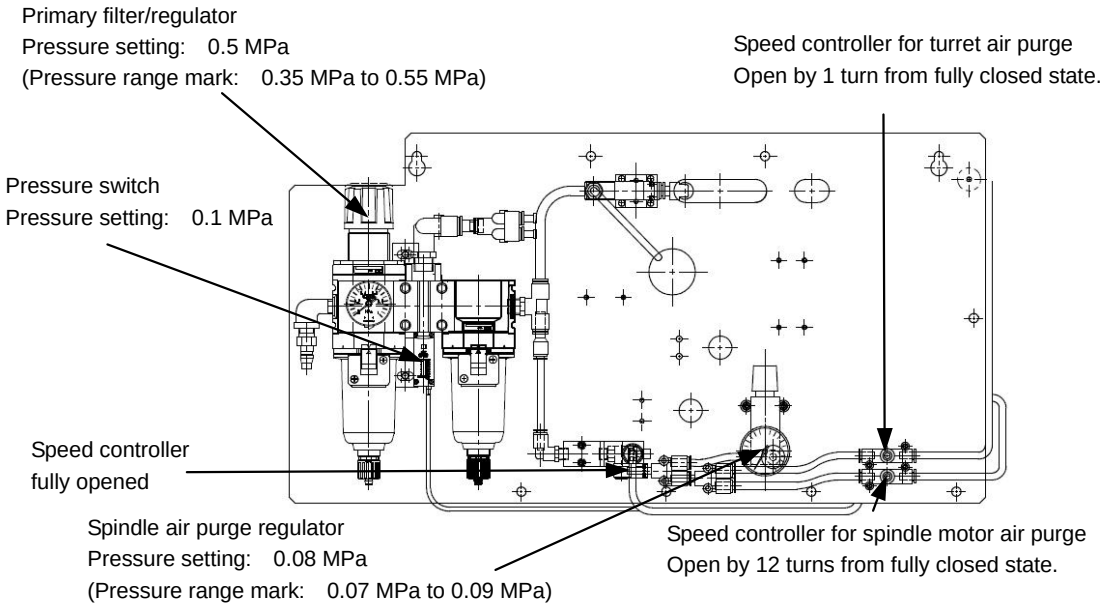


Fig. 3.5 (a) For standard specification

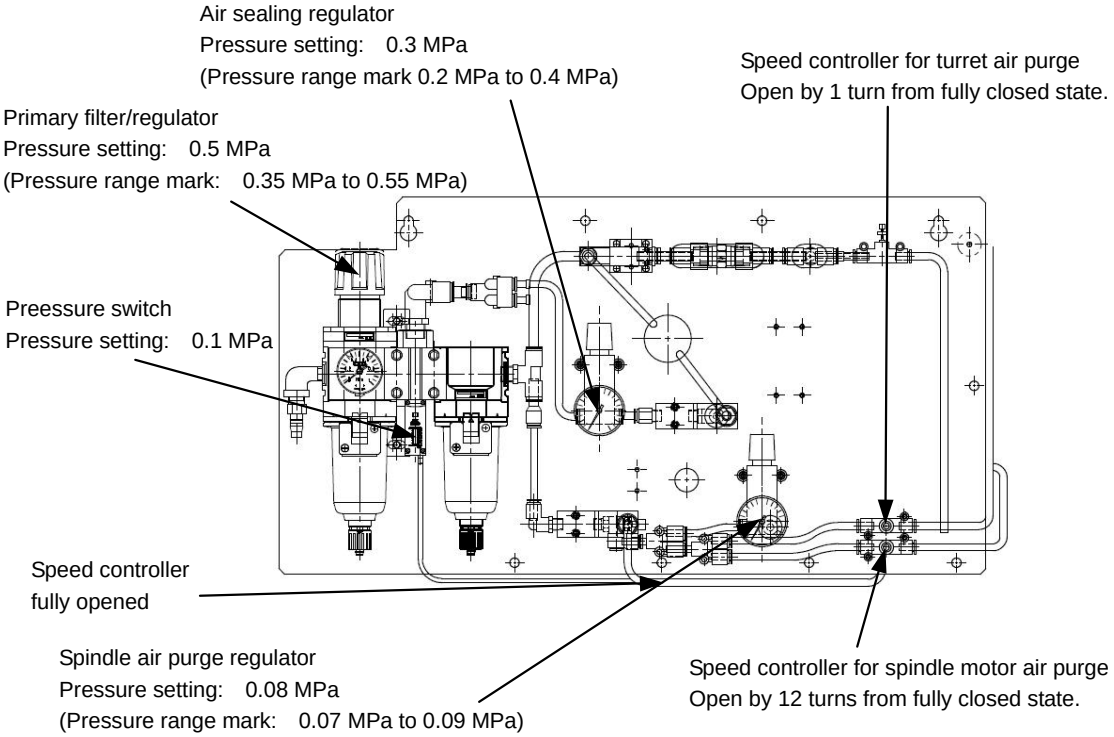


Fig. 3.5 (b) For center-through specification

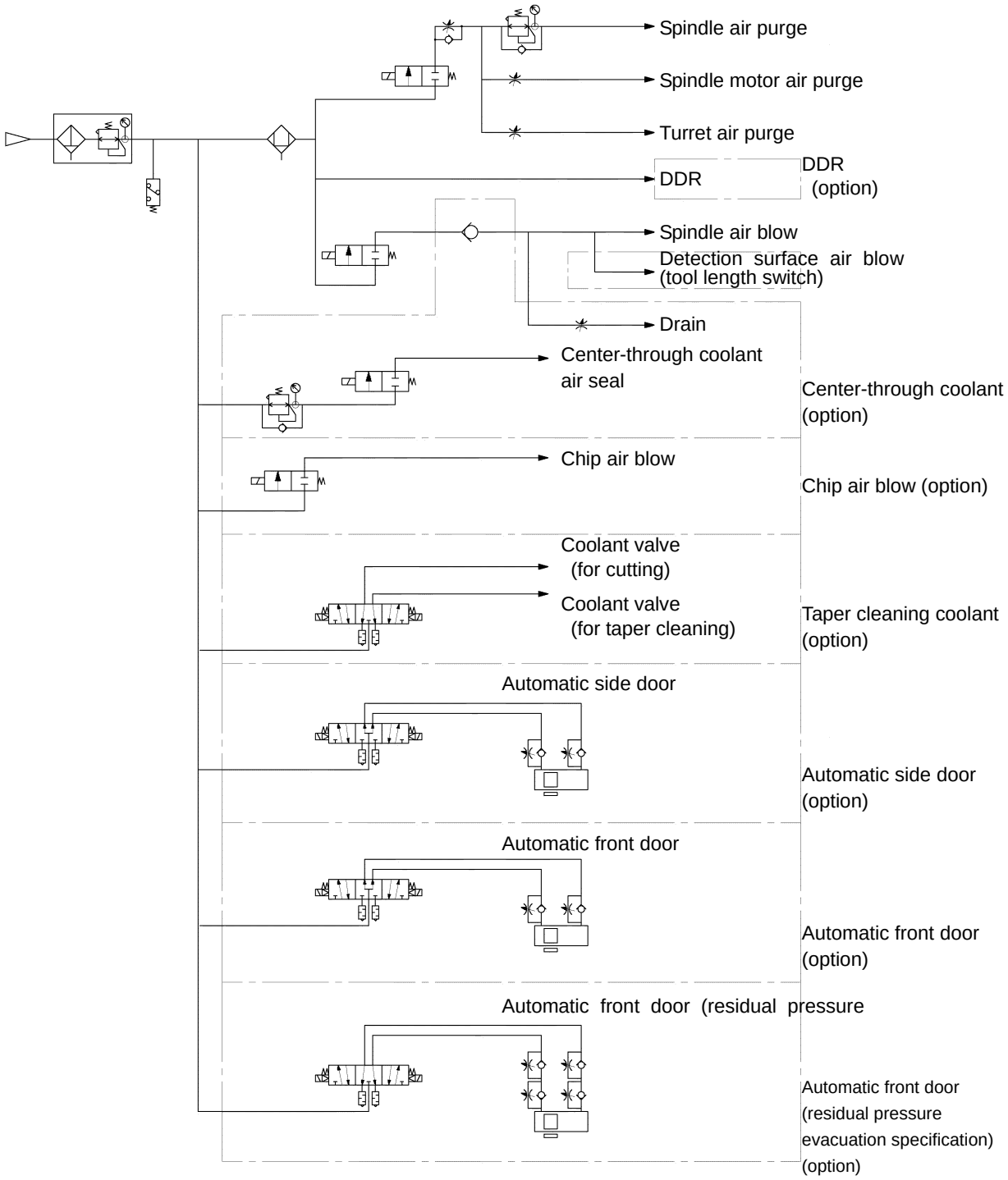


Fig. 3.5 (c) Air circuit diagram

3.6 REMOVING CORROSION-PREVENTIVE GREASE

ATTENTION

Be careful not to generate rust in the machine. Rust may be generated on a part on which painting is not applied such as the table surface or telescopic cover depending on the environment. Rust generated in the machine may interfere with the movement of a movable part, resulting in damage to the machine. For dry cutting, in particular, periodically apply a rust inhibitor so as not to generate rust.

The following parts are coated with corrosion-preventive grease for preventing them from being corroded during transportation. Remove the corrosion-preventive grease from these parts.

(1) X-, Y-, and Z-axis rolling guide sections (LM guide) and ball screw
(2) Internal face of spindle taper part
(3) Upper face of table
(4) Turret rear side and spindle nose gears
(5) X-/Y-axis telescopic cover
(6) Others, including machined surfaces of castings and untreated metal-sheet parts

CAUTION

After removing the corrosion-preventive grease, apply lubricating grease. (See Subsection 2.1.1 in Part V.)

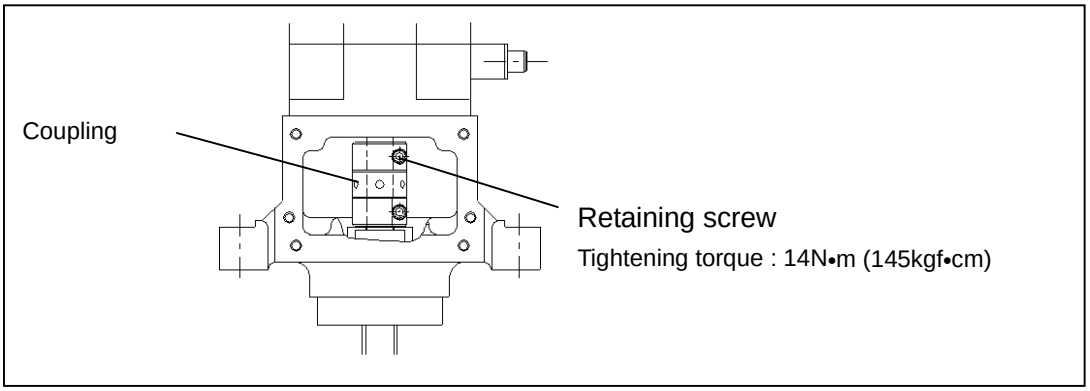
3.7 MOUNTING A Z-AXIS MOTOR AT MACHINE INSTALLATION

The α-D*i*A5 series may be shipped with its Z-axis motor dismounted. In this case, the Z-axis motor must be mounted so that the factory-set machine zero point is reestablished correctly when the machine is installed. To achieve this, follow the procedure below.

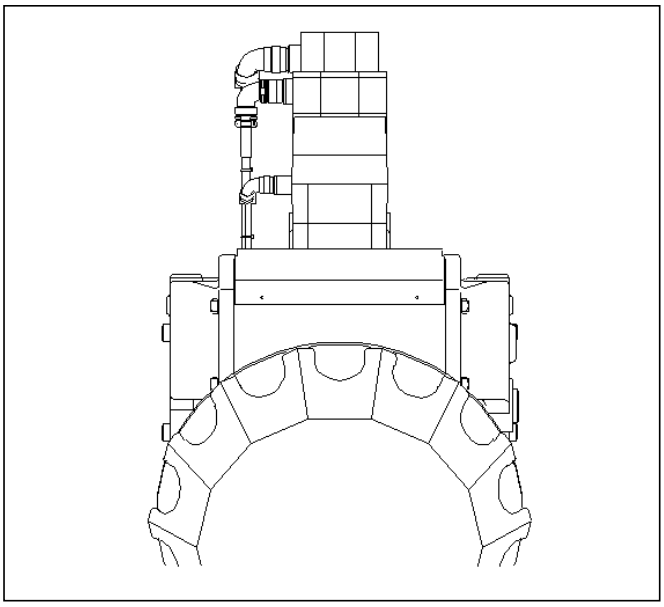
(1) Turn off the power to the machine, or check that the power to the machine is already off.

> ⚠ **WARNING**
> Before mounting the Z-axis motor, turn off the power of the machine main body. Otherwise, an unexpected injury or electric shock may result.

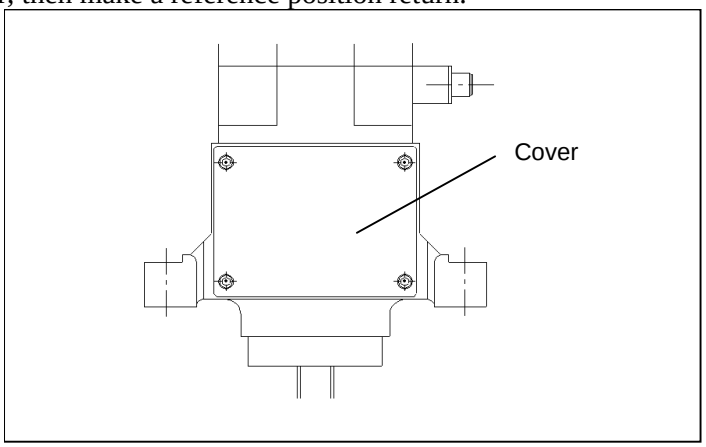
(2) Remove the cover from the Z–axis housing. (These items are packaged separately when shipped.)
(3) Wipe off any rust inhibitor grease from the coupling.
(4) After making sure that the motor shaft is provided with a key, place the servo motor on the housing with the motor shaft key aligned to the key groove of the coupling.



(5) As shown below, after making sure that the motor connector is on the left–hand side of the machine as viewed from the front of the machine, tighten the motor mounting bolts. If the motor and housing mounting bolt holes are not in line, align them by rotating the motor manually with a relatively strong force.



(6) Tighten the retaining screws of the coupling to a specified torque (14 N•m (145 kgf•cm)). If the screws are in such a phase that a torque wrench cannot be used for tightening, secure the screws using a tool such as an L-shaped wrench.
(7) After fastening the coupling, loosen the four motor mounting bolts, then tighten the bolts again so that they each come at the center of the mounting hole.
(8) Connect the three Z-axis motor cables.
(9) When the retaining screws were not able to be tightened with a torque wrench in (6), turn on power, make phase adjustment, then tighten the screws to the specified torque (14 N•m (145 kgf•cm)).
(10) Mount the Z-axis housing cover, then tighten the screws.
(11) Turn on the power, then make a reference position return.



⚠ DANGER
Do not perform automatic operation with the coupling bolts loose. Otherwise, the ball screw may break, which may cause the spindle head to go down in the worst case.

SUPPLEMENT
The motor grid position used as the reference for the zero point varies from one servo motor to another. If a servo motor is mounted in other than its original machine, the machine zero point will shift, causing abnormal machine operation. To avoid this, motors must be mounted only on the machine with which they are supplied.
After motor installation, an alarm is issued to request origin return when the power is turned on. For an explanation of how to perform origin return, see Section V3.

3.8 LEVEL ADJUSTING

ATTENTION
1 If the machine is not leveled, the machine accuracy may not be guaranteed.
2 Check the level of the machine periodically. If the machine may not be leveled due to an earthquake or another factor, be sure to check the level.

After removing the devices for transportation, level the machine tool.

(1) Turn on the power and move the table to the middle of X and Y-axis stroke.
(2) After loosening fixing nuts, adjust the leveling bolts to a suitable length.
(3) As shown below, place a 150-mm level of accuracy class JIS 1 on the table and adjust the four leveling bolts alternately until a level of 0.005 mm/m or below can be attained at or around the middle of the X- and Y-axis strokes.
Finally, secure the leveling bolts with the fixing nuts.
(4) Make sure that a level of 0.04 mm/m or below has been attained at both the plus- and minus-side stroke ends of the Y-axis.

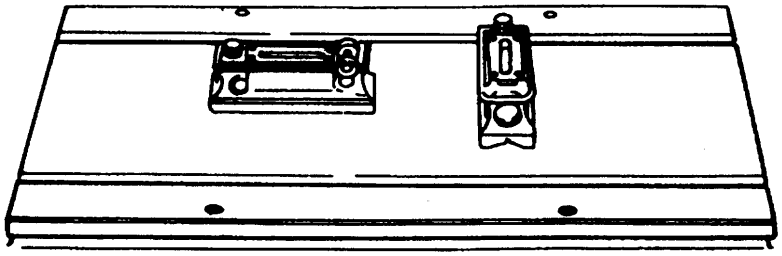


Fig.3.8 Leveling

3.9 MOUNTIONG TOOLS

CAUTION
The weight of a tool to be mounted on the turret is 2 kg or less and the total weight of 14/21 tools is 15 kg/23 kg or less. To mount a tool with a weight of 2 kg or more (up to 3 kg), set the tool weight to 3 kg (see Section I-5, "TOOLS"). The factory-adjusted tool weight is 3 kg for safety. If the setting is inappropriate, the tool may be removed, damaging the workpiece or machine.

(1) Attach one arbor to the grip through the notch of the cover at the right rear of the turret.

(2) Press the

key on the MDI operator's panel.

(3) Press the

key, which is one of the rapid traverse selection buttons on the machine operator's panel.

(4) Press the

key on the machine operator's panel. Change cutting tools once under no–load running.
Then, check whether tools were changed smoothly. If not, prepare to press the <EMERGENCY STOP> key immediately.

(5) Attach one arbor to the grip through the notch.

(6) Press the

key.

Check whether the arbor and the spindle head are firmly clamped together.

CAUTION
Make sure that the tool is securely mounted on the turret grip according to the instructions (provided in Section III-6, "MOUNTING TOOLS"). If the tool is not securely mounted, it may be removed, damaging the workpiece or machine.

If tools can be changed smoothly, any of the rapid traverse selection buttons may be pressed on the machine operator's panel.

(7) After repeating the same procedure, check whether fourteen and twenty one arbors are gripped in the turret.

(8) Turn off the power.

ATTENTION
1 Since the turret is precisely adjusted, be careful not to grab the turret carelessly or not to apply load to the turret.
Very unevenly distributed weight of tools on the turret may cause a problem such as the unevenly worn decelerator in the turret in the long run.
2 For this reason, regardless of whether the weight setting is 2 kg or 3 kg, for both the 14- and 21-tool specifications, evenly mount the tools so that the difference between the right and left sides in tool weight is 6 kg or less when the turret is divided into two sections at the center.

3.10 INSTALLING THE COOLANT UNIT

After installing the machine, install the coolant unit (and flood–coolant unit) according to the following steps. For details of each option, read the descriptions of the coolant and center-through coolant in Part IV, “Detailed Operations.”

(1) Install the coolant tank at the back of the machine, or under the NC rack. The coolant tank must, however, be installed so that the pump is positioned at the right of the machine, when viewing the machine from the front.
(2) Install the nozzle at the bottom of the spindle head.
(3) Connect the pump to the nozzle, and the pump to the pipe of the flood–coolant unit.

> ⚠ **CAUTION**
> Connect piping securely to prevent a coolant from leaking from it. If a coolant leaks, the floor becomes slippery, thereby causing injury due to falling down.

(4) Connect the controller rack to the pump terminal with the coolant cable.

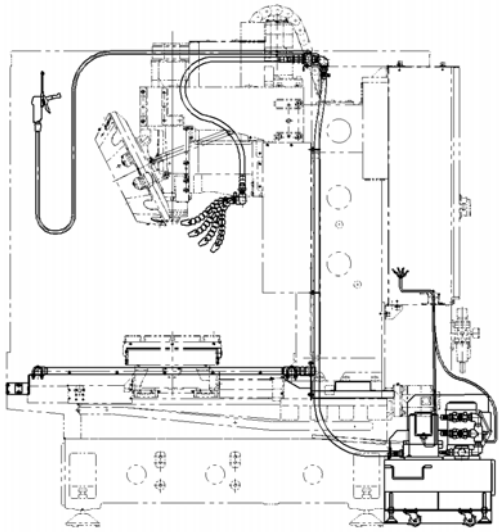
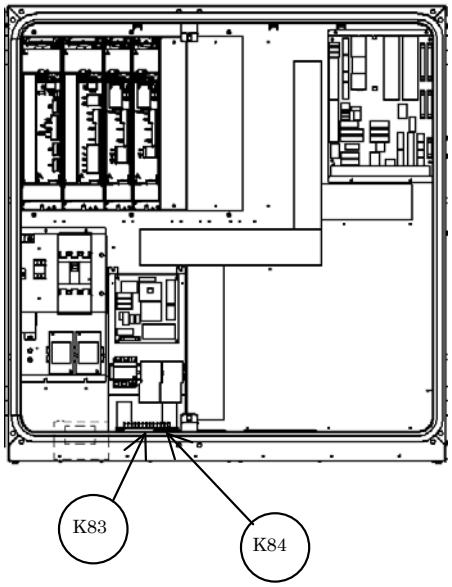
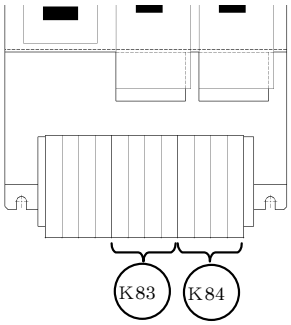


Fig.3.10 (a)





K83…coolant
(CLU, CLV, CLW, G)

K84…Flood coolant
(FCLU, FCLV, FCLW, G)

Fig.3.10 (b)

(5) Press the coolant button. Check that the pump rotates in the direction shown by the arrow when viewing the pump from the window on the top of the pump. Then stop the rotation of the pump.

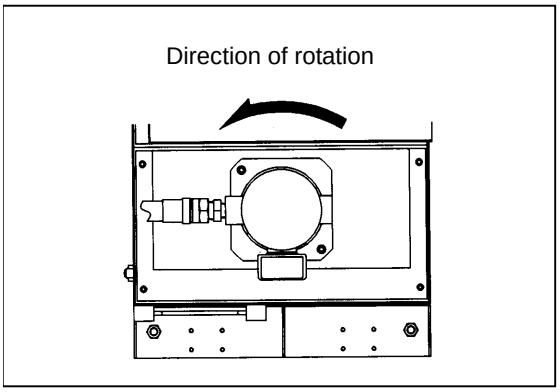


Fig.3.10 (c)

(6) Supply the coolant to the coolant tank.

3.11 Y-AXIS TELESCOPIC COVER (Y-COVER F)

(1) Mount the YC stand with the shown surface (surface with white resin) facing forward.
(2) Lay the YF cover over the YC stand by rotating the cover horizontally.
(3) Mount the YF cover on the saddle. At this time, temporarily tighten the flange securing bolt.
(4) Move the telescopic cover along the Y-axis toward you until it stops. Push in the free cover as far as possible, so that the telescopic cover does not push the YC stand vertically. Then, tighten the flange securing bolts.

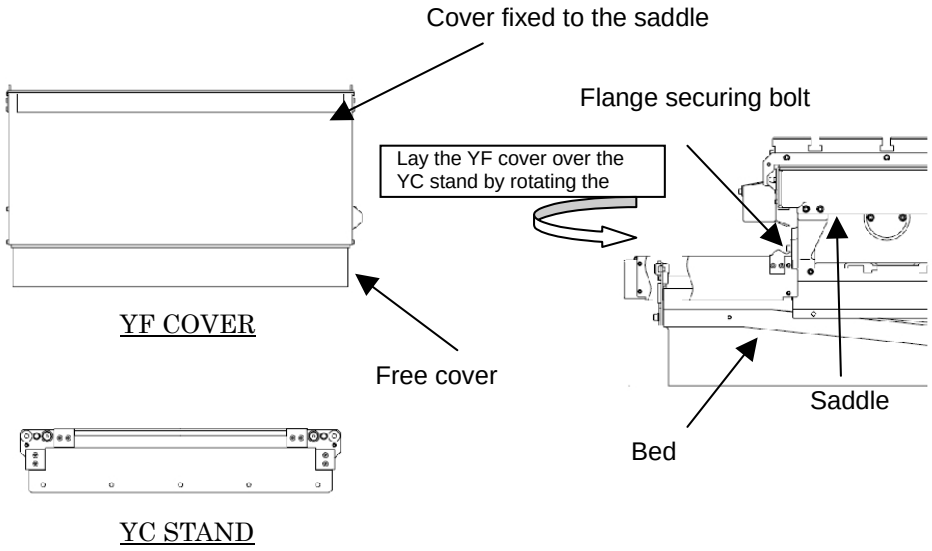


Fig.3.11

ATTENTION

If the Y-axis is moved in situations where no coolant is present such as during machine installation or dray machining, sounds may be generated because the bottom of YF COVER and the white resin portion of the YC stand rub each other (grabbing itself is normal). In this case, remove YF COVER and apply a lubricant such as grease to the back of the cover.

4 PACKING

When the machine is moved, transported, or lifted, the machine must be packed to prevent the machine from being impacted.

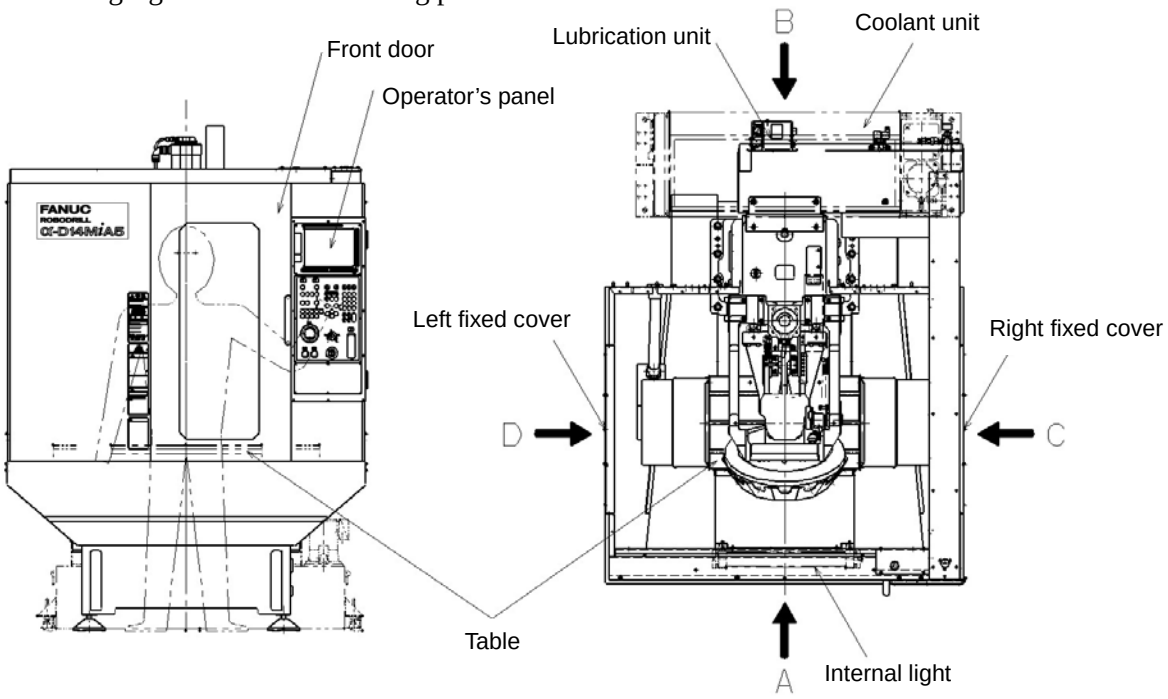
Pack the machine according to the following steps:

(1) Sufficiently clean the top of the table and the inside of the splash guard so that cuttings or other foreign matter do not remain in the machine.
(2) Remove the tools from the turret.
(3) See II–2.1 when packing the machine.

III. ROUTINE OPERATIONS

1 OPERATING POSITIONS

The following figure shows the working places for the α-D14/21*i*A5 series.



The following table lists the operating positions and working places.

No.	Operation	Operating position	Working place	Viewed from
1	Workpiece change and jig setting	Machine front section	Operator's panel and table top	A
2	Program editing and data input/output	Machine front section	Operator's panel	A
3	Power on/off	Machine front/rear section	Operator's panel and controller cabinet rear section	A, B
4	Tool change	Machine front section	Turret	A
5	Chip cleaning	Machine front/rear section	Inside the splash guard and coolant unit	A, B
6	Coolant replenishment	Machine rear section	Coolant unit	B
7	Fuse replacement	Machine rear section	Inside the controller cabinet	B
8	Air pressure supplying and shutting off	Machine rear section	Air unit	B
9	Greasing	Machine front section/both sides	Inside the splash guard	A, C, D
10	Lubricant replenishment for the lubrication unit	Machine rear section	Lubrication unit	B
11	Fluorescent lamp replacement	Machine front section	Intra-machine lamp	A
12	Spindle motor cleaning	Machine front section	Spindle motor	A

Before greasing, turn off the power, and remove the fixed side covers and the protective cover.
Do not perform operation at a location other than the operation locations described on the previous page. Working in the following places, for example, is likely to be hazardous because of a bad working condition or unstable footing.

- Inside the machine
- On top of the controller cabinet
- On top of the column
- On top of the splash guard
- On top of the turret support

2 SWITCHING POWER ON AND OFF

2.1 SWITCHING POWER ON

(1) Turn the breaker handle on the controller cabinet until it clicks in the ON position. (Check that the door of the controller cabinet is closed. If it is open, close it before turning the breaker handle to the ON position.)

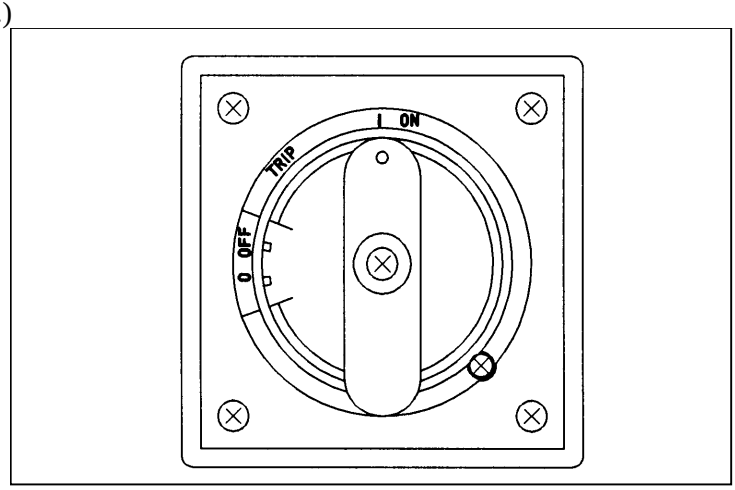


Fig.2.1 Breaker handle on controller cabinet (ON position)

(2) Turn the power on by pressing the POWER | ON button on the operator's panel.

(3) Approximately 1 minute after switching the power on, the CNC or QUICK screen appears on the LCD and the machine is ready for operation. (The screen to be displayed can be selected by setting "INITIAL SCREEN(POWER ON)" in the screen displayed by selecting "QUICK SCREEN" - "5: MAINTENANCE/SETTING" - "FUNCTION SELECTION".)

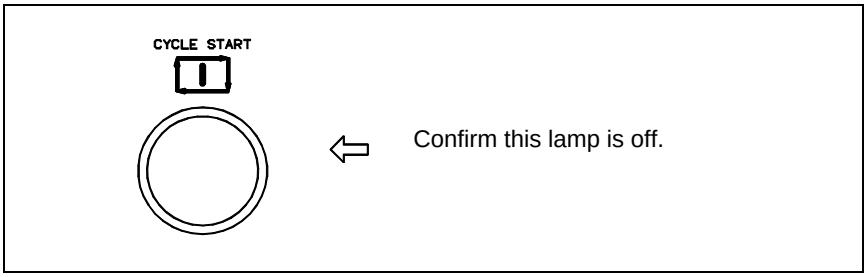
(4) Confirm that the fan motor for ventilation of the control unit rack running.

ATTENTION

When the power is switched on, do not simultaneously press any button (on the MDI panel or the machine operator's panel) other than the POWER | ON button.

2.2 SWITCHING POWER OFF

(1) Confirm that the lamp of the <CYCLE START> button lamp on the operator's panel is off.



(2) Confirm that no movable parts of the machine are moving.
(3) If any input/output device is connected, turn it off.
(4) Press the OFF POWER button.
(5) Turn the breaker handle on the door of the controller cabinet to the OFF position.

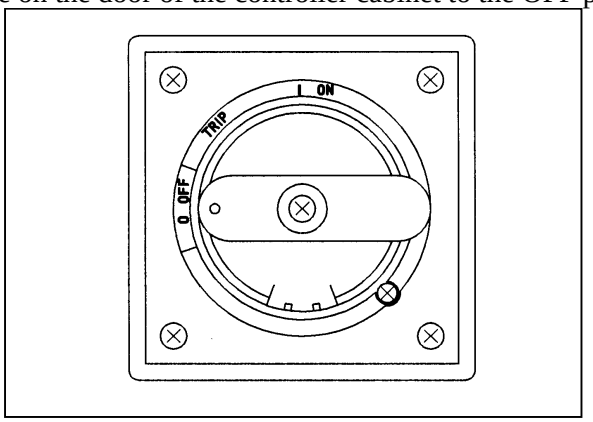


Fig.2.2 Breaker handle (OFF position)

⚠ WARNING

Keep in mind that setting the breaker handle to its off position does not remove the power from its primary side. Also keep in mind that, even if the breaker handle is in its off position, there is a risk of an electrical shock on any component connected to the primary side of the breaker, including the following:

1 External power transformer connected to the primary side of the main breaker
2 Nonstandard peripheral equipment connected to the primary side of the main breaker

ATTENTION

When the power is switched on, do not simultaneously press any button (on the MDI panel or the machine operator's panel) other than the POWER I ON button.

SUPPLEMENT

1 The controller cabinet door opens when the breaker handle is fully turned to its off position unless it is locked. Normally, the door should be locked.
2 An automatic power disconnect function is available. It switches the power off automatically at the end of a program (M30). (See Section 16, "AUTOMATIC POWER SUPPLY SHUT-OFF," in Part IV.)

3 EMERGENCY STOP

⚠ WARNING

1 Pressing the <EMERGENCY STOP> button is the first thing you should do once a failure occurs. Make it possible to press the <EMERGENCY STOP> button whenever necessary. Neither hang anything on the button nor cover it with anything.

2 Before releasing the <EMERGENCY STOP> button, remove the cause of the abnormality. Otherwise, a dangerous condition may recur, possibly leading to injury.

This button is used to instantly stop the movement of the machine at the time of an emergency.
If the machine shows unexpected operation, all operation of the machine can be stopped by pressing the <>EMERGENCY STOP> button.

When the <EMERGENCY STOP> button is pressed, the following events occur:

(1) All moving axes stop immediately.
(2) The rotating spindle stops immediately.
(3) Coolant stops its operation. And all the automatic operation nor manual operation become unoperable state.
(4) The control unit is reset and the machine alarm status is assumed.
(5) The Z axis slightly descends.

If the <EMERGENCY STOP> button is pressed while tool change is in progress, the following takes place depending on the status of operation:

(1) If the spindle orientation is in progress, the spindle stops immediately.
(2) If the Z axis is ascending, the Z axis stops moving immediately and the spindle is freed from the controlled status.
(3) If the turret is rotating, it stops quickly.
(4) If the Z axis is descending, the Z axis stops moving immediately and the spindle is freed from the controlled status.
(See Section V-4" for recovering the machine after pressing the <EMERGENCY STOP> button during the tool change job.)

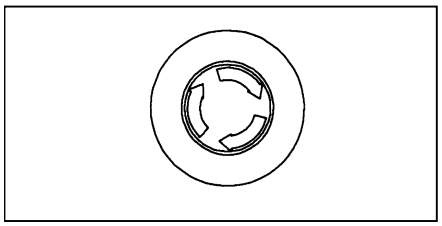


Fig.3 EMERGENCY STOP Button

The <EMERGENCY STOP> button is locked when it is pressed. It is unlocked when it is turned clockwise.

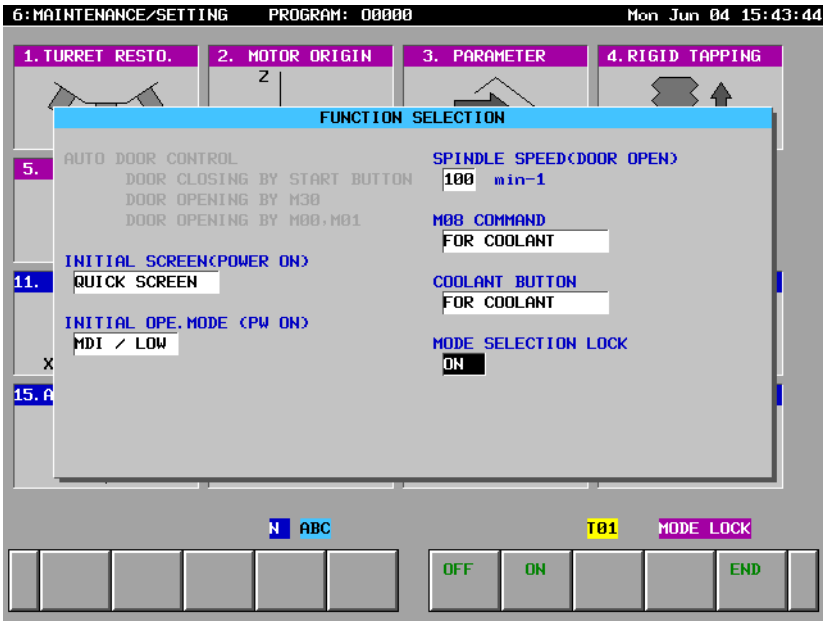
SUPPLEMENT

The emergency stop causes electric current to the motors to be cut off.

4 MODE SELECTION (machines for Europe and China only)

4.1 OVERVIEW

Do not switch the operation modes.
Make a setting by selecting the quick screen, “6:MAINTENANCE/SETTING” screen, and “FUNCTION SELECTION” in this order.



MODE SELECTION LOCK
ON
: The operation modes cannot be changed

MODE SELECTION LOCK
OFF
: The operation modes can be changed.

Set this item to "ON" when the operation modes need not be changed, for example, after the start of mass manufacturing.

4.2 LIMITATIONS PUT IN EFFECT WHEN MODE SWITCHING IS INHIBITED (QUICK SCREEN)

The following functions of the QUICK SCREEN cannot be used when operation mode switching is inhibited.
If an attempt is made to use any of these functions, the message "A CHANGE OF MODE IS PROHIBITED" appears.
Before trying to use the functions, set MODE SELECTION LOCK to "OFF."

(a) Menu operation
(b) Quick editor
(c) Set–up file calling
(d) Turret restoration and return to motor origin

4.3 ENABLING MODE SWITCHING

Changing the MODE SELECTION LOCK setting from "ON" to "OFF" requires entering a password.
Clicking the "OFF" soft key displays the following window. Enter the password you set up before and press the <INPUT> key on the operator's panel.

When you enter the correct password, the MODE SELECTION LOCK setting becomes "OFF" .

SUPPLEMENT
The password has been factory–set to "771".

4.4 CHANGING THE PASSWORD

The following procedure can be used to change the password for MODE SELECTION LOCK.

(1) Place the cursor on MODE SELECTION LOCK .
(2) Enter the current password, and press the <INPUT> key on the operator's panel. The following window appears.

(3) Enter a new password, and press the <INPUT> key on the operator's

Now the new password is valid.

5 OPENING/CLOSING THE FRONT DOOR

⚠ DANGER

1 Before opening the front door, make sure that the Z-axis (spindle head) will not move down. In rare cases, the Z-axis brake gets out of order, thus letting the Z-axis move down. Even after you have opened the front door, be careful that the Z-axis may move down. If you have to work underneath the Z-axis, pop it up by inserting a wood between it and the table beforehand, so the Z-axis is prevented from moving down in case the brake should get out of order.
2 Before opening the front door with the power switched off, make sure that the spindle is not rotating. When the spindle is rotating, switching off the power prevents the spindle from stopping in a controlled manner, thus letting the spindle keep rotating under its own inertia; chips may fly out or you may touch the rotating spindle, hence injury.

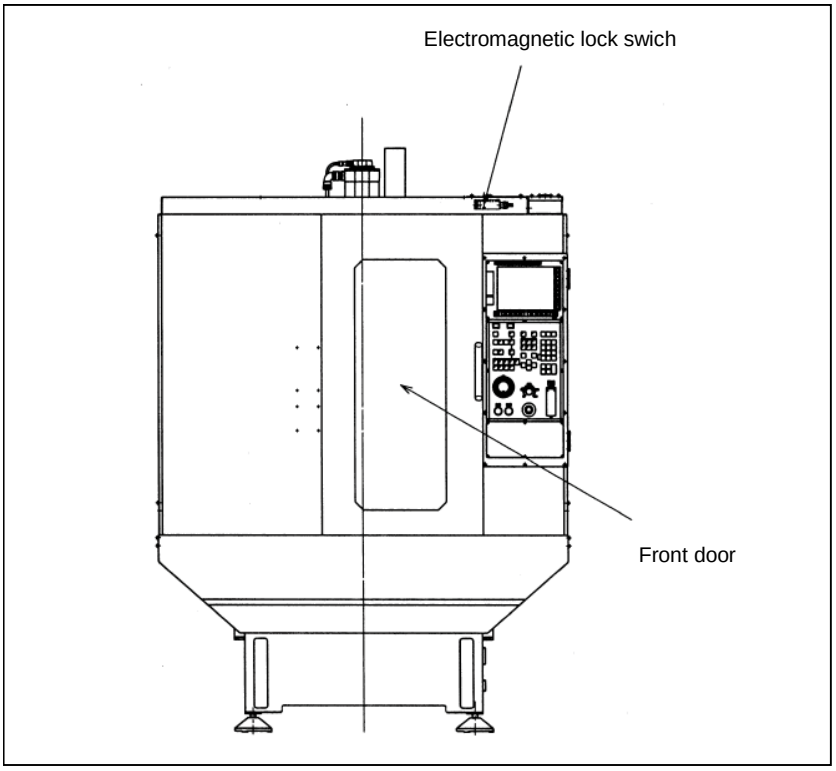
⚠ WARNING

If the polycarbonate used in the window of the front door is broken, replace the polycarbonate or the door as soon as possible. If the ABS sheet protecting the polycarbonate used in a grid-type window is broken, replace the door as soon as possible. It is likely that objects flying away from the inside of the machine may smash through the window, leading to injury.

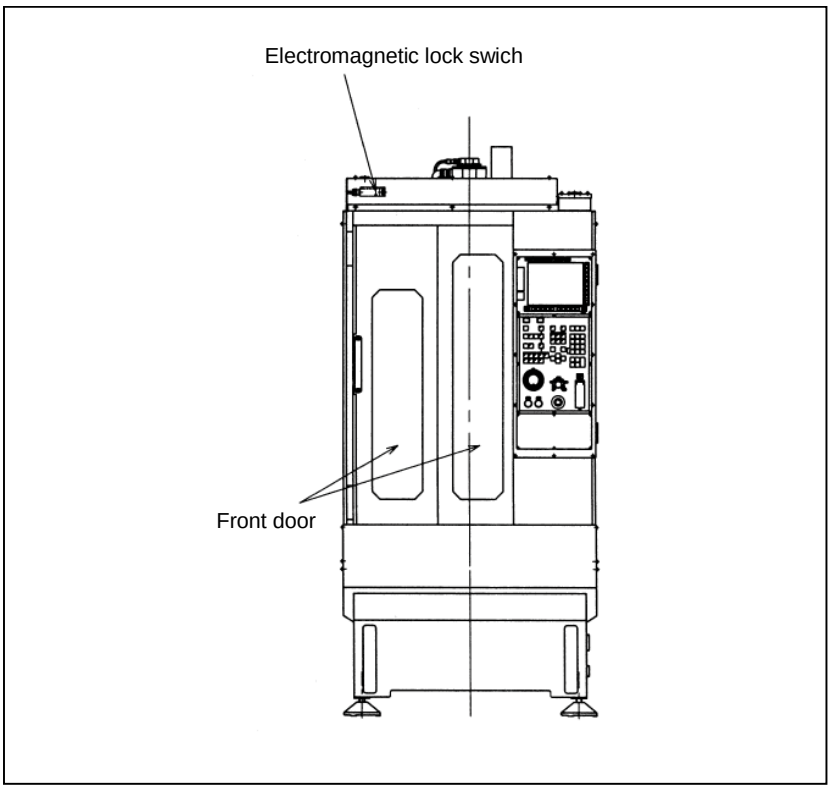
ATTENTION

1 After making sure that the lock is completely released, open the front door. An attempt to open the door when the lock is not released makes an excessive impact on the electromagnetic lock switch, possibly leading to damage to it.
2 Open and close the front door slowly (300 mm/s or less). Opening or closing the front door violently may damage the machine.
3 If the rubber cushion of the front door is damaged or comes off, immediately replace it with a new one. Using the front door with the rubber cushion left damaged or removed, the machine may be damaged.
4 If the machine is used in such a hard condition as that in which a large amount of chips are blown over the machine due to milling and other machining, chips accumulated on the door rail may prevent the door from being opened and closed normally. Periodically clean the door rail.

The α-D14/21*i*A5 series monitors the state of the splash–guard front door (safety door), using a controller.
To assure safe use of the machine, there are restrictions on the operation of the machine with the safety door open. During machine operation, unlocking the safety door (pressing the <DOOR> key on the operator's panel) suspends the operation. This function is known as a splash–guard door interlock function.



α-D14/21M/L*i*A5



α-D14/21S*i*A5

5.1 LOCKING THE SAFETY DOOR

ATTENTION
After making sure that the lock is completely released, open the front door.
An attempt to open the door when the lock is not released makes an excessive impact on the electromagnetic lock switch, possibly leading to damage to it.

The safety door is equipped with a lock mechanism, which usually prevents the door from opening. Performing either of the following steps unlocks the door, allowing you to open it.

- Press the <DOOR> key.
- Issue M02 or M30 (if PMC parameter K12#6 = 1).
- Press the emergency stop button (if PMC parameter K26#7 = 0).
- Press the power off switch (When an automatic fire-extinguisher is provided, and PMC parameter K26#7 = 0, the door is unlocked only for approximately 2 seconds.).

When the safety door is unlocked, the <DOOR> key LED on the operator's panel lights.

Performing the following steps locks the safety door.
When the safety door is open:

- Close the safety door.

When the safety door is closed (but not locked):

- Press the <DOOR> key on the operator's panel.
- Turn the power OFF.

When the safety door is locked, the <DOOR> key LED on the operator's panel goes off.
(If the safety door is released immediately before it is completely closed, the operator message "2004 DOOR IS UNLOCKED FORCIBLY" is displayed. This message, however, does not indicate a failure.)

In the following cases, the safety door cannot be unlocked.

- Within about 45 seconds after the power is turned on.
- When the spindle or an axis is moving.
- When an alarm occurs for the spindle or an axis, and safety cannot be confirmed.

5.2 RESTRICTIONS ON THE OPERATION OF THE MACHINE WITH THE SAFETY DOOR OPEN

The following restrictions are placed on the operation of the machine with the safety door open.

(1) Automatic operation is impossible.
(2) MDI operation is impossible.
(3) No coolant can be supplied. However, an air blow is output even when the safety door is open.
(4) Tool exchange is impossible.
(5) There are speed limits to manual operation. Only the following operations are possible.
   - Spindle rotation of 100 min^{-1} or less (Machines for Europe and China are excluded.)
   - Manual X-, Y-, and Z-axis movement of 1.9 m/min or less
   - Manual additional axis movement of 600 degrees/min or less
   - Manual handle feed
(6) During manual operation with the safety door open:
   - If the mode is switched, the spindle and each axis stop.
   - When the safety door is closed, the spindle and each axis stop.

5.3 IF THE SAFETY DOOR IS UNLOCKED DURING OPERATION

When the safety door is locked (closed), unlocking it (pressing the <DOOR> button on the operator's panel) stops the machine in the sequence stated below.

(1) The spindle and axes are decelerated to a stop by effecting feed hold.
If a tool is being changed, the machine is stopped after the tool has been changed.
The coolant and air blow operations stop.
(2) If rigid tapping is being performed, after the drill bit reaches the hole bottom or R point, the spindle and axes are decelerated to a stop.
The rigid mode is retained.
(3) If dwelling is being performed, the dwelling is brought to a pause.
(4) If spindle orientation is being performed, the machine is stopped after the orientation is finished.

To resume automatic operation, follow the steps below.

(1) Close the safety door without doing anything else (Closing the door locks it automatically).
If the door is closed but not locked, press the DOOR button on the operator's panel.
(2) If the spindle was rotating when the safety door was opened, press the spindle rotation button during the manual mode to cause the spindle to start rotating (If the spindle is not started to rotate, operator message No. 2009 will be displayed when the start button is pressed, in which case it is impossible to resume automatic operation).
(3) If coolant and air blow output operations are performed, press the <COOLANT> button then perform another coolant output operation (If the <COOLANT> button is not pressed, automatic operation is resumed with no coolant supplied when the start button is pressed).
(4) Select the operation mode, and press the <CYCLE START> button.

5.4 OPENING AND CLOSING THE DOOR WHEN THE POWER IS OFF

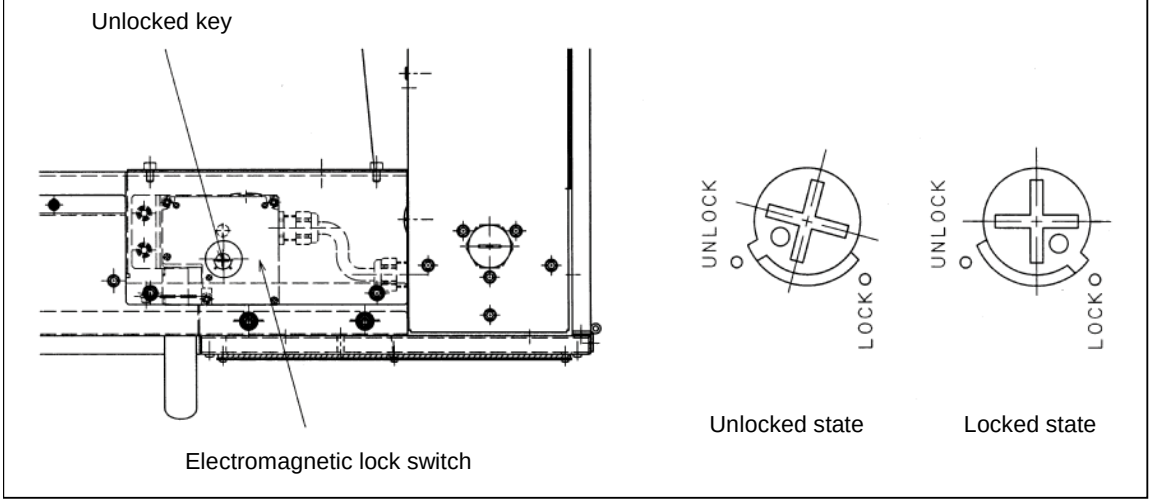
⚠ DANGER

1 The operator is not allowed to open the front door even when the power is off. Opening the front door disables safety devices, possibly leading to injury.
2 If you are an operator and need to open the front door, ask a maintenance engineer. Opening the front door with no sufficient knowledge may lead to injury because of an unexpected behavior of the machine.

ATTENTION

After making sure that the lock is completely released, open the front door. An attempt to open the door when the lock is not released makes an excessive impact on the electromagnetic lock switch, possibly leading to damage to it.

To open the door when the power is off, the maintenance personnel must use a Phillips screwdriver.



Unlocked state Locked state

Electromagnetic lock switch

⚠ DANGER

When the power is on, do not use a cross-slot screwdriver to open the front door. Doing so enables you to enter the machining area even when the tool is rotating, possibly leading to injury. When the power is on, use the front door open/close button to open or close the front door.
When an axis is moving or the spindle is rotating, forcibly releasing the electromagnetic lock switch takes the machine to an emergency stop.

5.5 SWITCHING OF SAFETY DOOR LOCK CONTROL

A machine operation related to the locking/unlocking of the safety door can be selected.
If the machine is equipped with the optional automatic door, all the following parameters except K11#2 are invalid for it (their settings are assumed to be 0).

(1) Safety door control when machining ends
Whether to unlock the safety door when machining ends can be selected.

Number	#7	#6	#5	#4	#3	#2	#1	#0
K11	0							

K11#7 0(*): When M00/M01 is specified, the safety door is not unlocked.
1: When M00/M01 is specified, the safety door is unlocked.

Number	#7	#6	#5	#4	#3	#2	#1	#0
K12		1						

K12#6 0: When M02/M30 is specified, the safety door is not unlocked.
1(*): When M02/M30 is specified, the safety door is unlocked.

SUPPLEMENT
The settings marked with * are factory settings.

(2) Safety door control in single–block operation
Whether to unlock the safety door automatically when operation stops in the single–block operation mode can be selected.

Number	#7	#6	#5	#4	#3	#2	#1	#0
K11							0	

K11#1 0(*): The safety door is not unlocked when operation stops in the single-block operation mode.
1: The safety door is unlocked when operation stops in the single-block operation mode.

Number		Initial value
T82	Wait time from the stop of operation in the single-block operation mode until the safety door is unlocked (msec)	2000

SUPPLEMENT
The settings marked with * are factory settings.

(3) General safety door control

Number	#7	#6	#5	#4	#3	#2	#1	#0
K12	0							

K12#6

0(*):
- The safety door is not unlocked when the power is turned on.
- The safety door is locked when the safety door is closed.
- The safety door is not locked when automatic operation/MDI operation is started.
- The safety door is not unlocked after a tool change is made using the tool change button on the operator's panel.

1:
- The door is unlocked when the power is turned on.
- The door is not locked even when the safety door is closed.
- The safety door is locked when automatic operation/MDI operation is started.
- The safety door is unlocked after a tool change is made using the tool change button on the operator's panel.

Number	#7	#6	#5	#4	#3	#2	#1	#0
K11						0		

K11#2

0(*): The door open/close key on the operator's panel can be used regardless of the operation mode.

1: The door open/close key on the operator's panel can be used only in the manual mode.

SUPPLEMENT

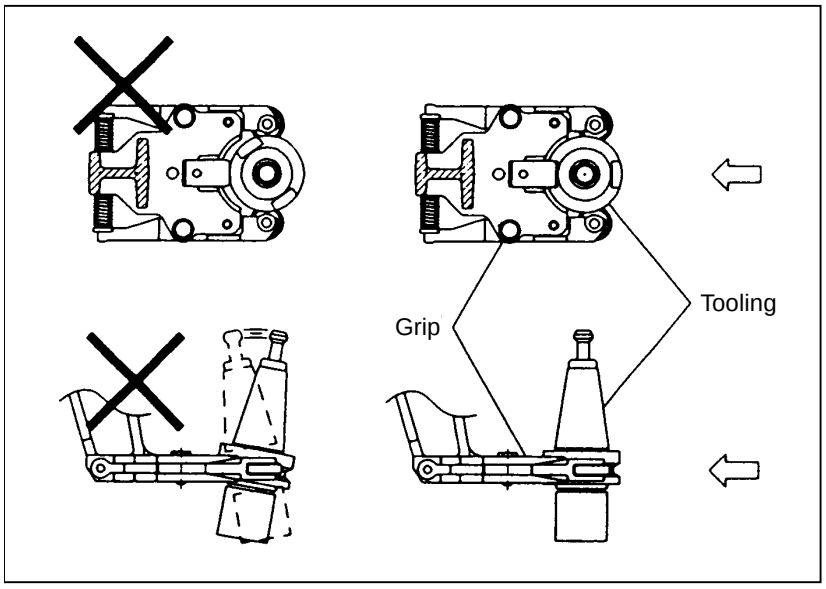
The settings marked with * are factory settings.

6 MOUNTING TOOLS

CAUTION
1 Make sure that the tool is securely attached to the tooling. Otherwise, the tool may come off, possibly leading to damage to the workpiece and machine.
2 Make sure that the tool is not worn out or broken. Otherwise, chips of the tool may fly out, possibly leading to damage to the machine.
3 Attach the tooling to the turret grip securely as directed in this chapter. Otherwise, the tooling will come off and fly out, possibly damaging the workpiece and machine.

The used tools must not exceed the maximum tool diameter, the maximum tool length, or the maximum tool weight. For details of the tools that may be used and for the installation of tools, see Section I-5, "TOOLS".

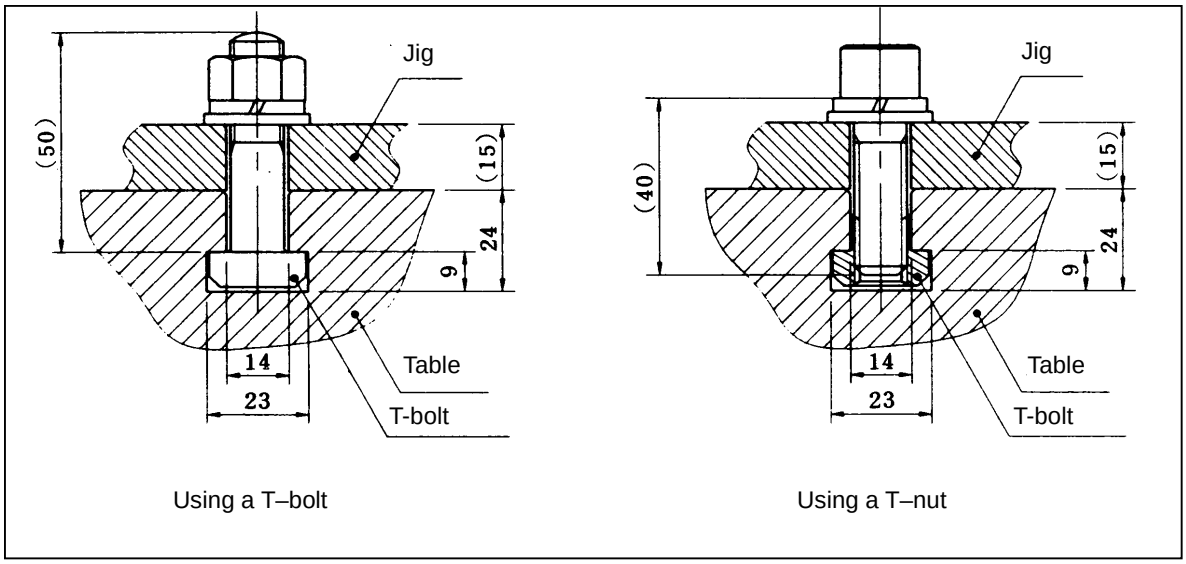
Install each tool by pushing it into the respective grip until it stops.



After mounting the tools, check whether they are firmly installed.
Install the tools so that they are well–distributed over the turret, and so that there is no gross imbalance of weight.

7 MOUNTING JIGS AND WORKPIECES

To fix the jigs on the table, the T–bolt having the nominal diameter of 14 mm (as specified in JIS B 1166) or the T–nut having the nominal diameter of 14 mm (as specified in JIS B 1167) can be used.



⚠ CAUTION

A maximum load of 300 kg (α-D14S*i*A5, α-D21S*i*A5: 200 kg maximum), including jigs and workpieces, can be put on the table. Avoid putting more on the table than the maximum load. If it is exceeded, the table may get damaged, possibly leading to injury and damage to the workpiece and jig.

CAUTION

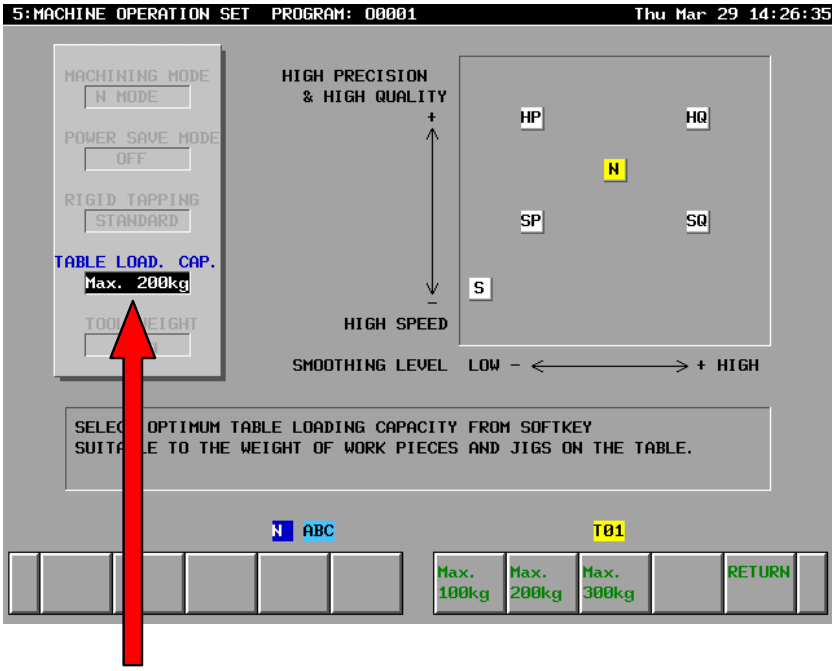
Before starting automatic operation, make sure that:

- The jig is securely fixed on the table.
- The workpiece is securely attached to the jig. In particular, if the jig is of an air cylinder type, the specified air pressure is supplied.

If machining is performed without fixing the workpiece and jig securely, they may come off and fly out, possibly damaging the workpiece and machine.

SUPPLEMENT

When the load to be placed on the table weighs 100 kg or more, change the setting of "Permissible mass of workpiece" to "Max. 200kg" or "Max. 300kg" on the QUICK screen. If operation is continued with "Max. 100kg", a servo alarm may be generated.



Set table load

8 COOLANT SUPPLY

⚠ WARNING

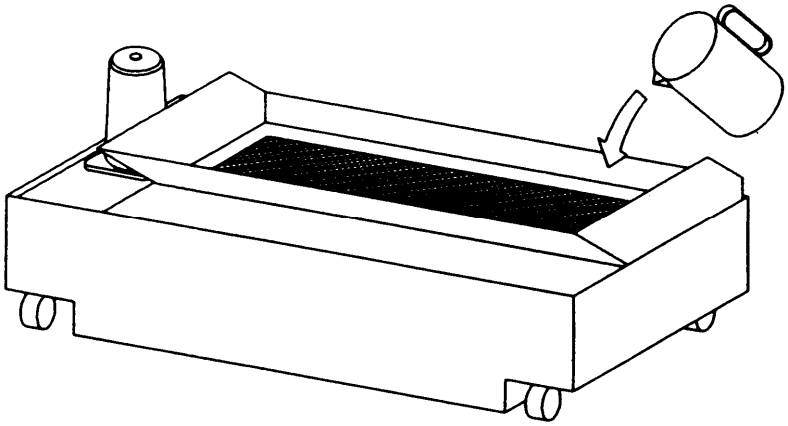
1 Do not use any coolant with a low inflammation point (such as class 2 petroleum, with an inflammation point of below 70°C). Otherwise, a fire may occur. Class 3 petroleum (with an inflammation point of 70°C to 200°C), class 4 petroleum (with an inflammation point of 200°C to 250°C), and burn-resistant coolants (with an inflammation point of 250°C or higher) can also catch fire. When using these liquids, exercise care on the way and method of using them, for example, by suppressing generation of oily smoke.
2 Do not use any rotten coolant or lubricant (such as grease or oil) as it is quite harmful. Save or dispose of it according to the instructions from their manufacturers.
3 Avoid using any coolant or lubricant (such as grease or oil) that can unmake polycarbonate, nitrile rubber (NBR), hydrogenerated nitrile rubber (HNBR), fluorocarbon rubber, nylon, and acrylate resin, ABS resins. Dilution water rich with residual chlorine can unmake these substances. As the machine uses these substances as sealant, it may get less sealed, possibly leading to an electrical shock because of fault current or to a burn because of lack of grease resulting from a spill.

ATTENTION

1 Manage the coolant according to the directions from its manufacturer properly as for its pH, the way its undiluted solution is mixed with dilution water, the salinity concentration of the dilution water, and the frequency at which the coolant is replaced. Otherwise, the machine may get rust or corroded, leading to trouble on the machine.
2 Do not use any type of coolant listed below since it can adversely affect the machine, possibly causing damage to the machine:
   - Coolant containing sulfur with a high degree of activity: Some coolants may contain sulfur with a very high degree of activity. If this type of coolant enters the inside of the machine, it can corrode copper, silver, and other metals, possibly causing damage to parts.
   - Highly-penetrative synthetic coolant: Some coolants containing polyalkylene glycol have a high permeability and may cause insulation degradation, poor lubrication, or a component failure when entering the inside of the machine.
   - High-alkali, water-soluble coolant: Some coolants to which alkanolamines and other agents are added to increase the pH value may be strongly alkaline, which have a pH of 10 or more even with the working solution. This type of coolant can cause damage to resin and other materials if adhered to them for a long time.
   - Coolant containing chlorine: Some coolants containing chlorine (for example, chloride components, such as chlorinated paraffin) affect materials such as resin and rubber badly, leading to possible defective parts.

Check if there is a sufficient amount of coolant.
If the coolant is insufficient, supply coolant. When supplying coolant, follow the procedure shown in the figure below.

⚠ WARNING
Always maintain a sufficient amount of coolant for machining. If there is no sufficient coolant, a resultant temperature rise may cause a fire or damage to the tool and workpiece.



When water soluble coolant is to be used, prepare it by diluting the stock solution with water in a container and stir the mixture well, before pouring it into the coolant tank.

ATTENTION
1 Frequently skim (remove) oil floating on the coolant in the coolant tank off to maintain the status in which no oil is floating. Decreasing the amount of oil in the coolant can decrease the amount of sludge generated.
2 Always keep the coolant fresh. New coolant can emulsify oil in sludge again with its surfactant property, which has a cleaning effect on sludge attached on the surface of the machine.

See Item d), "COOLANTS AND LUBRICANTS," in Item 2 in "SAFETY PRECAUTIONS;" Section 7, "COOLANT," in Part I; and Subsection 1.1.2, "Replenishing the Tank with Coolant," in Part V for explanations about coolants.

ATTENTION
Do not spill water within the splash guard. Water can cause corrosion.

9 PREPARING PROGRAMS [CNC OPERATION]

Call the program according to the following procedure.
The following three methods can be used to call the program.

Press

to select [CNC operation].

1 Press the mode selection key

to put the machine in the operation mode (MEM).

2 Select the program screen.

On the standard operator's panel, press

and

in the stated sequence.

On the full keyboard-type operator's panel, press

.

(Method 1)

3-1 On the program screen or program check screen, enter the program name and press [PROGRM SEARCH].

Example)

To call O0010, press "O", "1", and "0" in the stated sequence, and the press the soft key [PROGRM SEARCH].
Program O0010 will be called.

SUPPLEMENT

If O0010 is not found, the message "SPECIFIED PROGRAM NOT FOUND " appears. Press the <CANCEL> or <RESET> key and enter the program number again.

(Method 2)

3-2 On the program screen or program check screen, press the soft key [PROGRM SEARCH].
Next, press the soft key [PREV PROGRM] or [NEXT PROGRM].
Pressing [PREV PROGRM] causes a backward search through the folder. Pressing [NEXT PROGRM] causes a forward search.

(Method 3)

3-3 On the program creation screen, select the program to be called, using the cursor keys.
Next, press the soft keys [OPERATION(OPRT)] and [MAIN PROGRM].

This is the end of preparation for automatic operation.

10 TRIAL RUN

ATTENTION

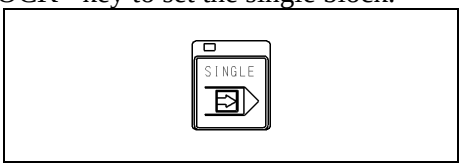
When making a trial run, exercise extreme care to avoid a collision (interference) between the workpiece, jig, or the like and the tool or spindle, by using the functions described below to keep a sufficiently low speed. A collision (interference) may cause damage to the machine.

The functions below can be used for a trial run.

(1) SINGLE BLOCK

Single block is the function that executes one block of the program each time the <CYCLE START> button is pressed.

Turn on the <SINGLE BLOCK> key to set the single block.



One block of the program is executed and the machine tool stops.

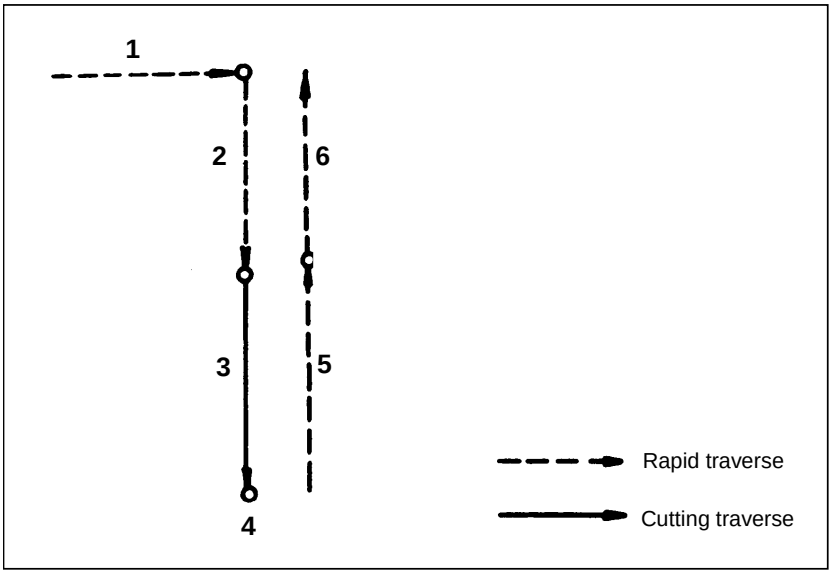
When the <CYCLE START> button is pressed, the next block is executed and the machine tool stops.

To release the single block mode press the <SINGLE BLOCK> key again.

SUPPLEMENT

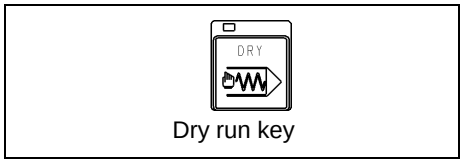
1 For G28 and G29, after the single block is executed, the machine tool stops even during machining.

2 The single block stop point in a canned cycle is any of the end point 1, 2, or 6 in the figure shown below.



(2) DRY RUN

When dry run is effected, the F–function specified in the program is ignored and the feedrate is set to the maximum jog feedrate at rapid traverse or cutting feed command.
Use the dry run key to turn the dry run function on or off.



Dry run key

SUPPLEMENT

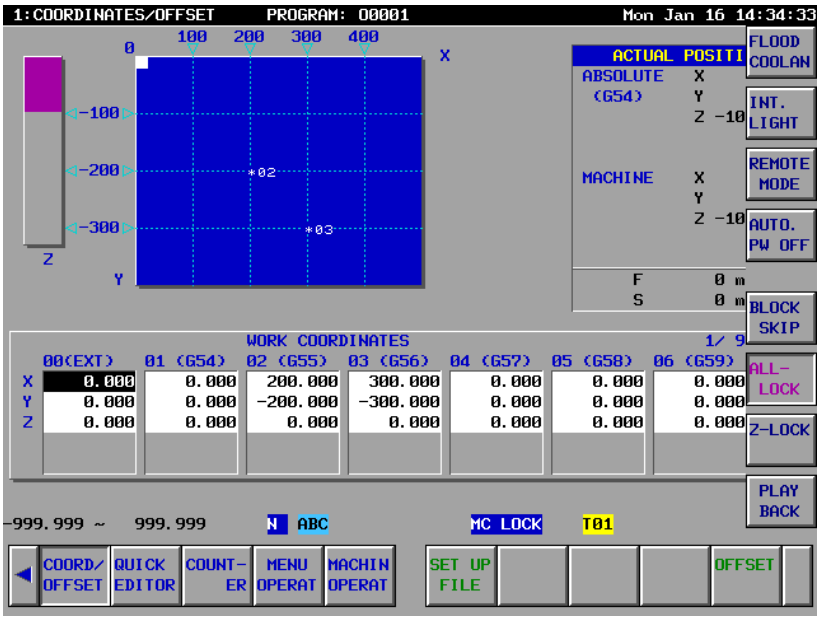
1 During tool exchange operation, the dry run function cannot be turned on/off.
2 The rapid traverse rate can be held as it is by resetting NC parameter No.1401#6 (RDR) = 0.

(3) MACHINE LOCK

By making the machine lock on, the machine tool can be displayed as if it were moving although it is not. The display changes momentarily at the specified speed. This operation support function is used for program check.
To switch the machine lock on or off, use the corresponding soft key arranged in a column on the quick screen.

SUPPLEMENT

1 Even if the G27 or G28 command is executed, the reference position LED (HOME) does not light because the machine tool does not move to the reference position.
2 All M and S functions except M06 (tool change command) are executed.
3 After executing a machine lock operation, be sure to turn the power off then back on.



(4) Z AXIS LOCK

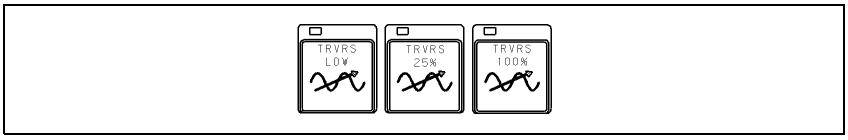
When the Z AXIS LOCK is on, only the Z axis enters the machine lock status. This Z axis lock is useful in checking the program contents by drawing the axis movement with a ball–point pen.

To switch the Z axis lock on or off, use the corresponding soft key arranged in a column on the quick screen.

SUPPLEMENT

1 Even when the G27 or G28 command is executed, the reference position lamp does not light because the machine tool does not move to the reference position.
2 The M–function and the S–functions are executed. (Only the tool change command, M06, is not executed.)
3 After executing a Z axis lock operation, be sure to turn the power off then back on.

(5) RAPID TRAVERSE RATE OVERRIDE



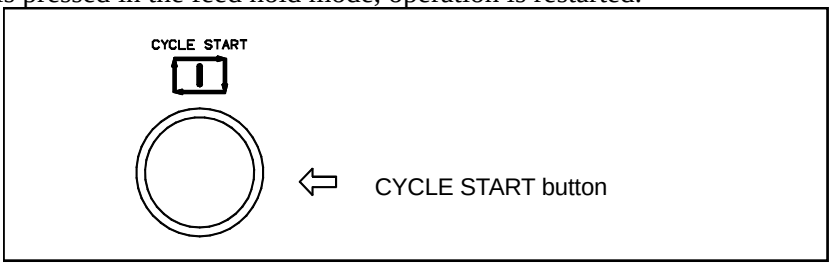
An override of 100%, 25%, or LOW can be applied. If an override of 25% is applied when the rapid traverse rate is 54 m/min, the rapid traverse rate becomes about 13 m/min. When an override of LOW is applied, the fixed rapid traverse rate 400 mm/min is used. A rapid traverse command for applying this override is as follows:

<a> Rapid traverse by G00
<b> Rapid traverse during a canned cycle
<c> Rapid traverse at G27, G28, or G29
<d> Manual rapid traverse
<e> Rapid traverse for manual return to the reference position
<f> Rapid traverse in tool change sequence

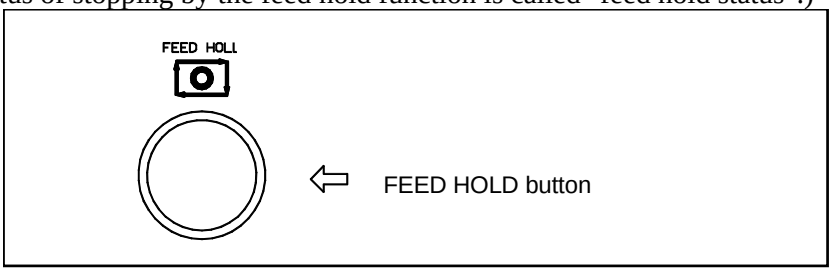
The following operations are related to the trial run: (For details of each operation, see Section III–3, "EMERGENCY STOP" and Section IV–5.4, "Settings and Operations of Automatic Running.")

(i) CYCLE START

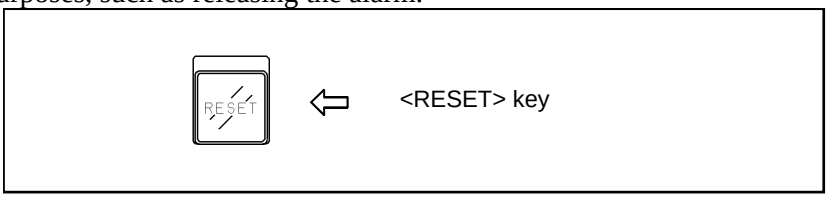
Operation is started by pressing the <CYCLE START> button. When the <CYCLE START> button is pressed in the feed hold mode, operation is restarted.



(ii) FEED HOLD
When the <FEED HOLD> button is pressed, traverse of the axes stops during traverse. For restart, press the <CYCLE START> button.
The status of stopping by the feed hold function is called "feed hold status".)



(iii) RESET
Automatic running is suspended by pressing the <RESET> key. The <RESET> key is used for other purposes, such as releasing the alarm.

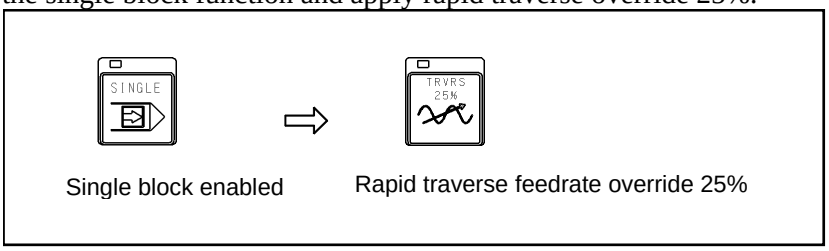


Trial run is performed using the functions described above.

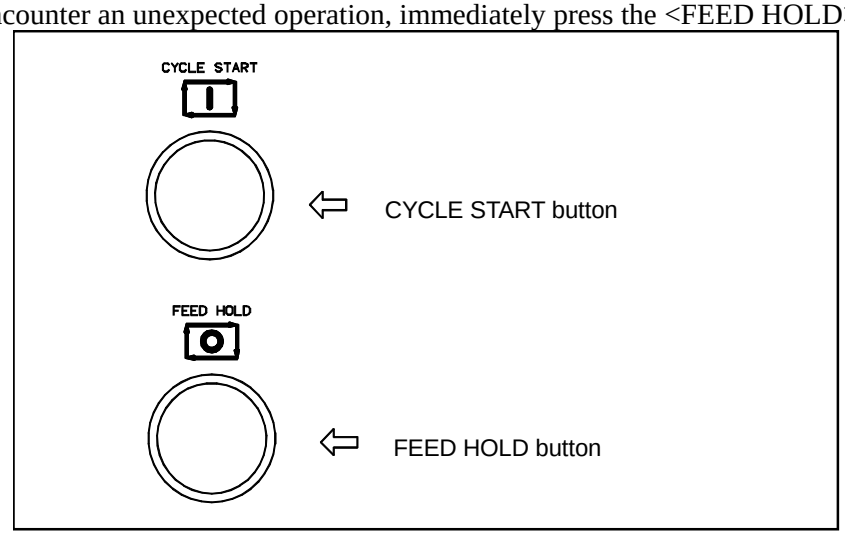
Generally, the dry run function need not be used when a proven machining program is used. Dry run is useful for checking that the F values in the program are appropriate or for conducting a trial run to check the operation of a program that is used for the first time.
The following is the description of an example of a normal trial run:

(1) Show the program screen in the AUTO mode, and call the program to be used.
See Section 9, "PREPARING PROGRAMS [CNC OPERATION]," in Part III.

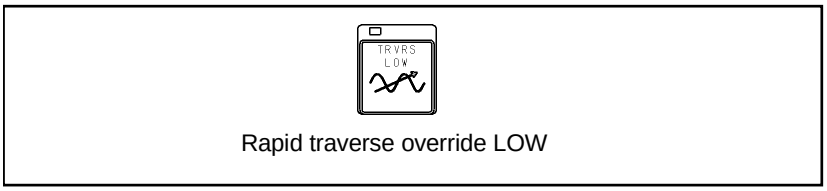
(2) Enable the single block function and apply rapid traverse override 25%.



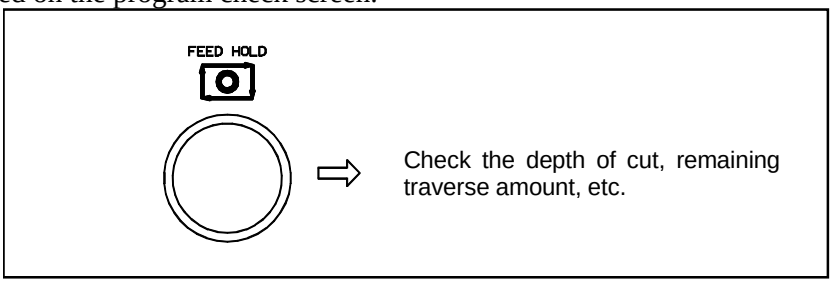
(3) Press the <CYCLE START> button as necessary, and check each operation of the program. (If you encounter an unexpected operation, immediately press the <FEED HOLD> button.)



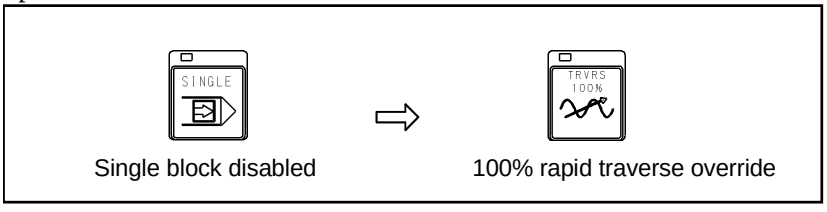
(4) At a position where the workpiece and the tool are close to each other, set the rapid traverse override to LOW.



(5) Stop operation by pressing the <FEED HOLD> button just before the workpiece and the tool contact each other. Check the depth of the cut, the workpiece coordinate system, the cutter compensation in the program, and the remaining traverse amount of the current block that is displayed on the program check screen.



(6) Confirm that the machining status is not abnormal in the machining block.
(7) When a series of machining checks have been finished and the program has been executed, the trial run ends.
(8) Disable the single block function, apply the 100% rapid traverse feedrate override, and perform regular operation.



ATTENTION

If a small reciprocating motion is continued, the bearing runs out of lubricant, possibly reducing its life.
When specifying such an operation, it is necessary to move the axis over a certain distance periodically.

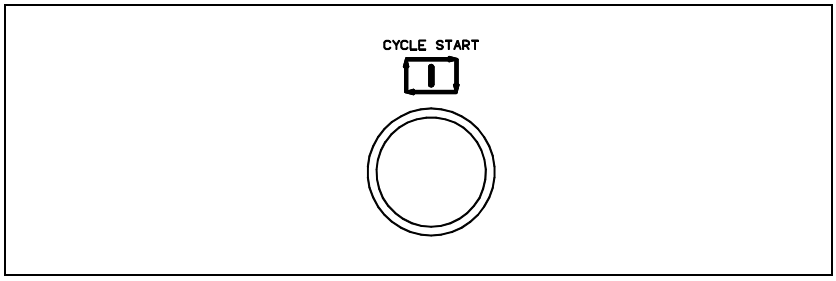
11 AUTOMATIC RUNNING [CNC OPERATION]

Machine operation that follows the program is called automatic running.
The starting, stopping, and restarting procedure of automatic running is described in this section. (For details of each operation, see Section IV-5, "AUTOMATIC RUNNING.")

11.1 STARTING AUTOMATIC RUNNING

(1) Show the program screen in the memory mode and call the program to be used.
See Section 9, "PREPARING PROGRAMS [CNC OPERATION]," in Part III.

(2) Press the <CYCLE START> button.

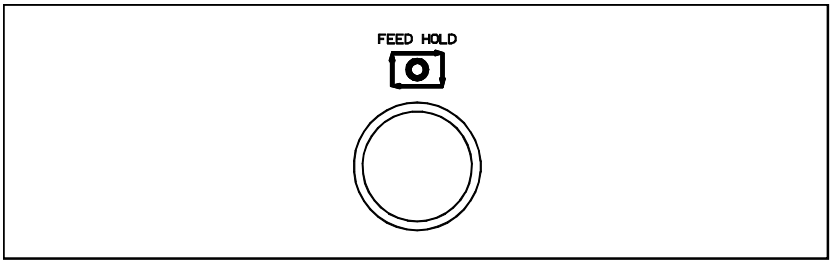


When the <CYCLE START> button is pressed, automatic running starts, and the <CYCLE START> lamp lights.

11.2 STOPPING AUTOMATIC RUNNING

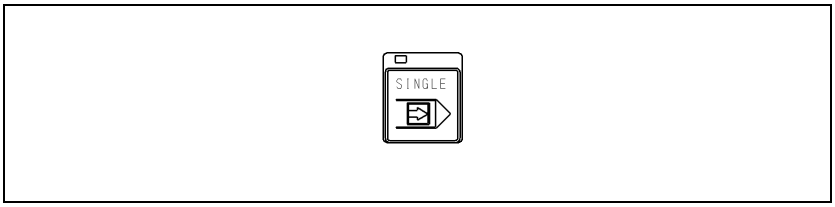
The feed hold function or the single block function stops automatic running.

(1) Stop by feed hold function



When the <FEED HOLD> button is pressed, automatic running stops, and the <FEED HOLD> lamp lights.
At the same time, the <CYCLE START> lamp goes off.

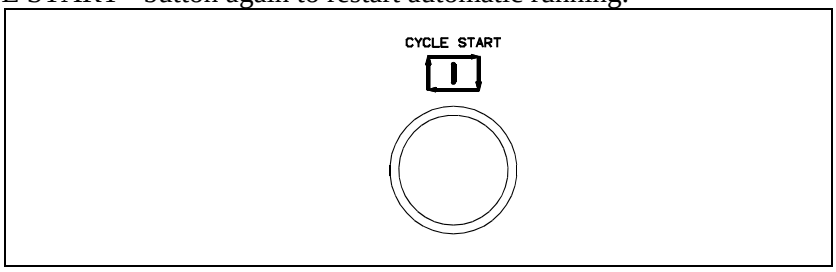
(2) Stop by single block function



When the single block function is enabled, the machine stops after executing one block of the program. When the <CYCLE START> button is pressed again, the machine stops after executing another block.

11.3 RESTARTING AUTOMATIC RUNNING

Press the <CYCLE START> button again to restart automatic running.

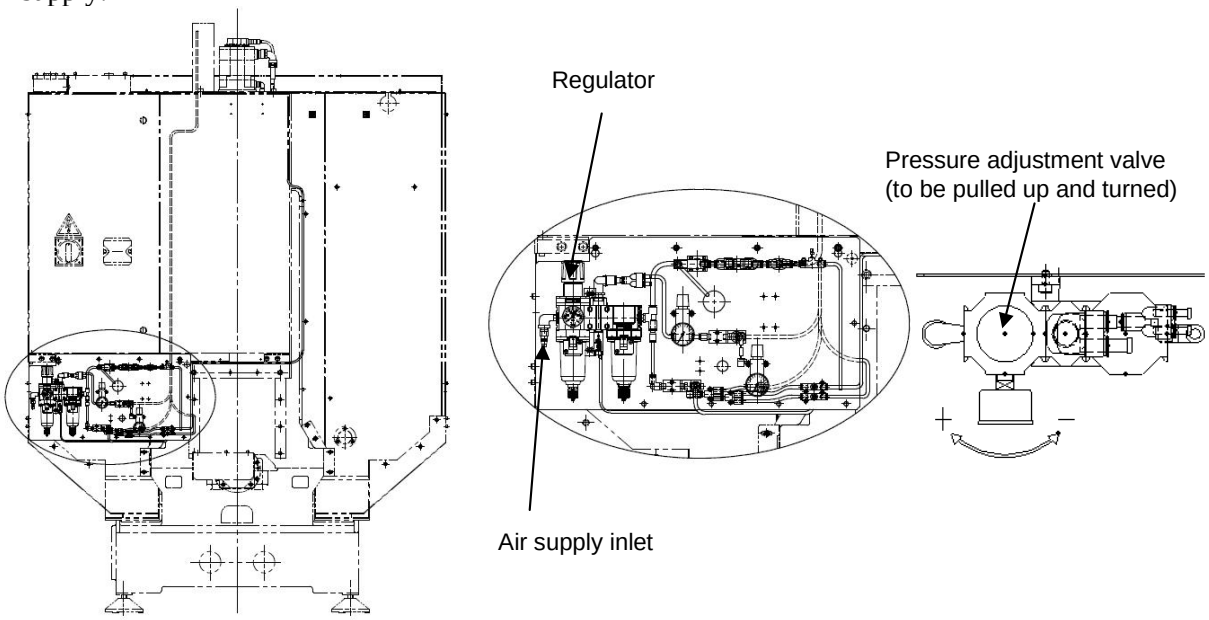


When the <CYCLE START> button is pressed, the automatic running restarts, and the <CYCLE START> lamp lights. At the same time, the <FEED HOLD> lamp goes off.

12 POWER SHUTOFF METHODS

12.1 AIR SUPPLY SHUTOFF METHOD

Removing the hose from the supply inlet or closing the regulator pressure adjustment valve shuts off the air supply.

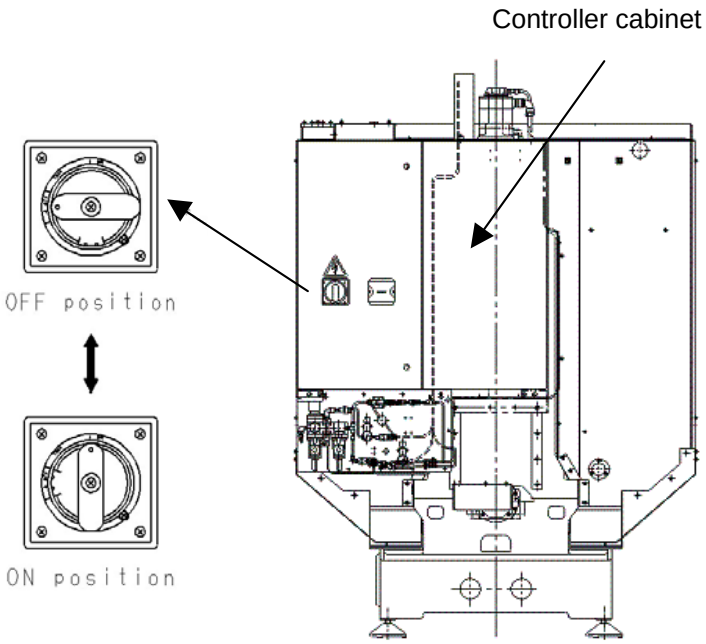


Compressed air is used for spindle taper air blow and other purposes.
The residual pressure can be released by closing the regulator pressure adjustment valve.

12.2 ELECTRIC POWER SUPPLY SHUTOFF METHOD

Setting the breaker handle on the rear of the machine shuts off all electric power supplies on the secondary side of the main breaker.

> ⚠ **WARNING**
> Keep in mind that setting the breaker handle to its off position does not remove the power from its primary side. Also keep in mind that, even if the breaker handle is in its off position, there is a risk of an electrical shock on any component connected to the primary side of the main breaker, including the following:
> 1 External power transformer connected to the primary side of the main breaker
> 2 Nonstandard peripheral equipment connected to the primary side of the main breaker



IV. DETAILED OPERATIONS

1 QUICK SCREEN

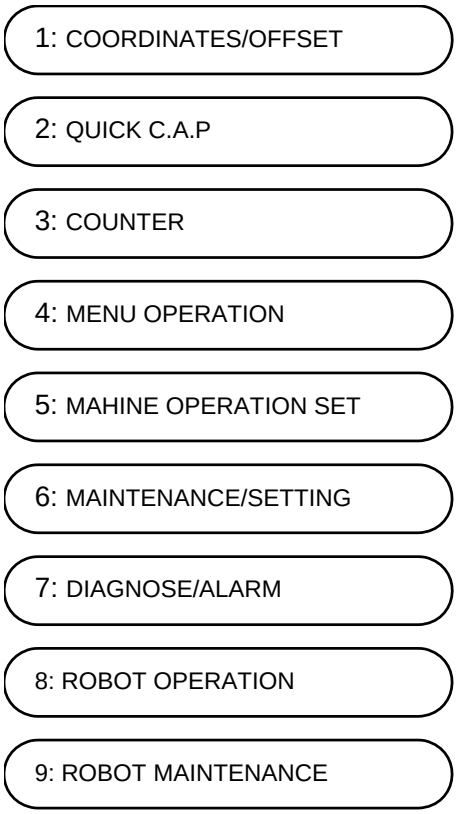
1.1 OVERVIEW

"QUICK SCREEN" is the exclusive screen to ROBODRILL. By using QUICK SCREEN, it is possible to operate the machine and to create a machining program even if an operator is not used to CNC operation. And an operator who is used to CNC operation well, too, can perform various operations by using QUICK SCREEN easily.

1.2 CONSTITUTION OF QUICK SCREEN

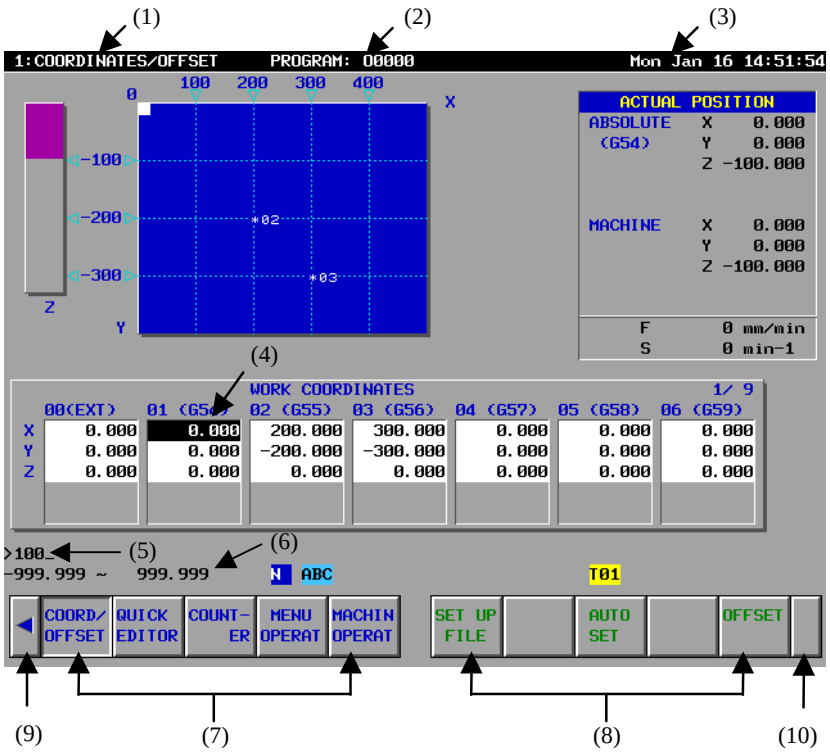
1.2.1 Overview

QUICK SCREEN is constituted as follows.



SUPPLEMENT
1 A detailed explanation is provided in manual of Appendix IV.11. QUICK EDTOR.
2 The ROBOT OPERATION and ROBOT MAINTENANCE screens are displayed only when required robot interface options are used

1.2.2 Descriptions of Screen Displays



(1) Screen name
The number and name of the currently selected QUICK SCREEN are displayed.

(2) Selected program number
The number of the currently selected program is displayed.

(3) Current time
The current date and time are displayed.

(4) Cursor
The selected entry item is indicated. The cursor is moved using the cursor keys on the operator's panel.

(5) Display of an entered value or operation guidance message
The data entered from the operator's panel is displayed.
If an entered value or selected soft key is invalid, a guidance message is displayed.

(6) Display of maximum and minimum values
A range of values that can be entered to an item where the cursor is set is indicated.

(7) Screen switching soft keys
These soft keys are used to select a QUICK SCREEN.

(8) Function selection soft keys
These soft keys are used to select a function on an individual screen.

(9) Screen name display switching soft key
This soft key is used to switch the displays on the screen switching soft keys (7).

(10) Function selection switching soft key
This soft key is used to switch functions displayed on the function selection soft keys (8). It is used if a screen has many functions. (This soft key is usable when it has a triangle mark.)

1.2.3 Screen Switching Methods

The following three methods can be used for QUICK SCREEN switching:

- Soft keys
- Screen number and PAGE key
- <MENU> (<MDI>) key

1.2.3.1 Soft key-triggered screen switching

The left–side six soft keys are used for screen switching.
The screen to be displayed can be selected, using the screen switching soft keys.
Pressing the leftmost soft key (having a triangle mark) switches the screen names displayed on the screen switching soft keys.

1.2.3.2 Screen number and PAGE key-triggered screen switching

Numeral and page (previous or next page) keys are used for screen switching.

[Example Switching to the 6:MAINTENANCE/SETTING Screen]

Because the MAINTENANCE SETTING Screen is numbered 6, press the <6> and <PAGE△> or <PAGE▽> keys in the stated sequence.

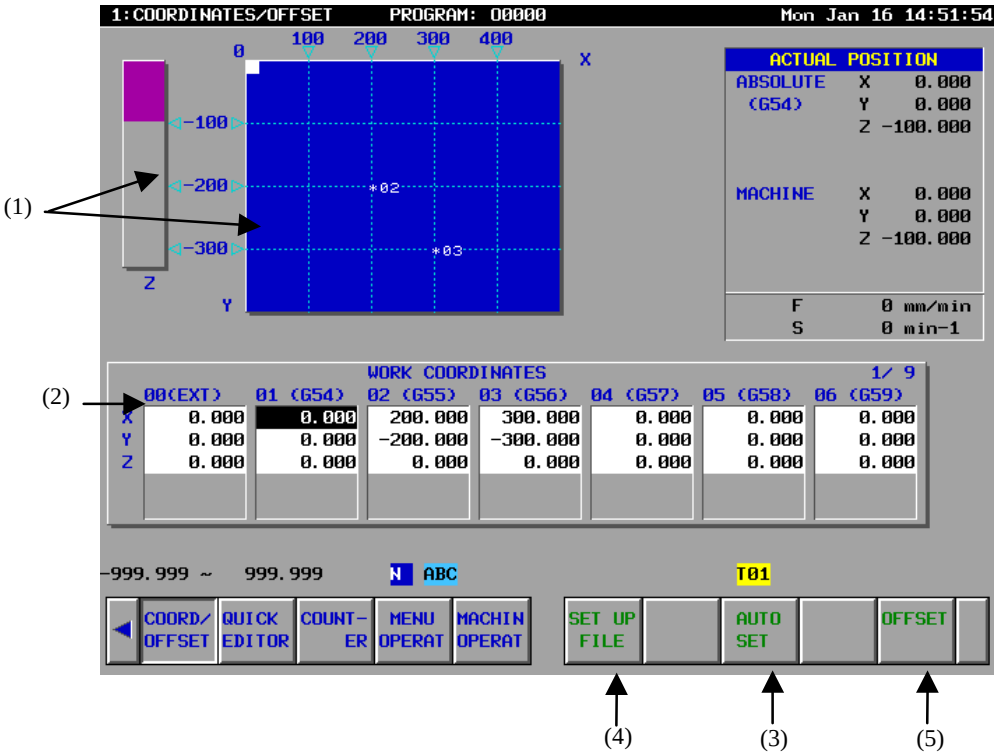
1.2.3.3 MENU OPERATION key-triggered screen switching

In addition to the methods described above, a special key can be used to display the MENU OPERATION SCREEN; no other screens can be displayed using a special key.
When a QUICK SCREEN is displayed, pressing the <MENU> (<MDI>) key on the operator's panel displays the MENU OPERATION SCREEN.

1.3 EXPLANATION OF EACH SCREEN

1.3.1 Coordinate/Tool Compensation

This screen enables you to set up a workpiece coordinate system, a tool compensation amount, table payload, and a machining mode. It can also be used to save and restore the data you set up.



(1) GRAPHICAL DISPLAY

The present position of tool and the origin of workpiece coordinate system are displayed graphically.

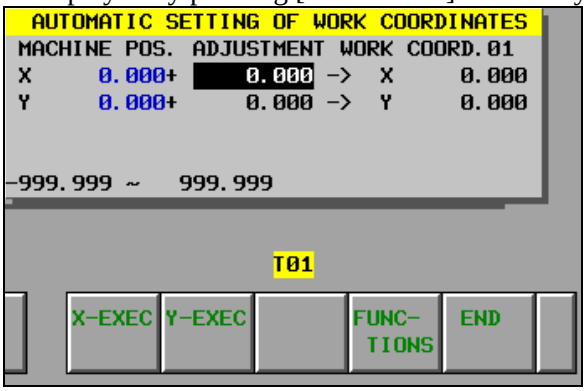
(2) WORK COORDINATE SYSEM

Input the workpiece coordinate system number.

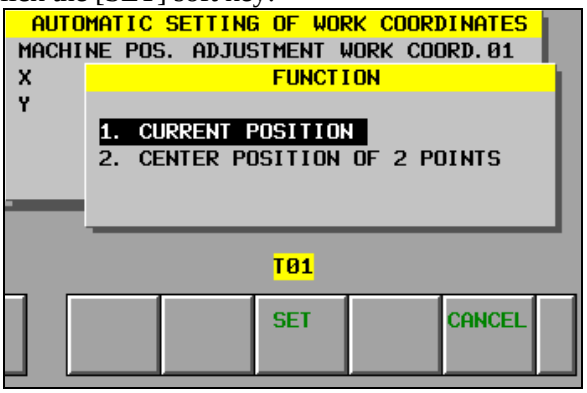
(3) AUTOMATIC SETTING

The current machine coordinates or the center position between two points can be set as the origin of the workpiece coordinate system.

The following window is displayed by pressing [AUTO SET] of soft key.

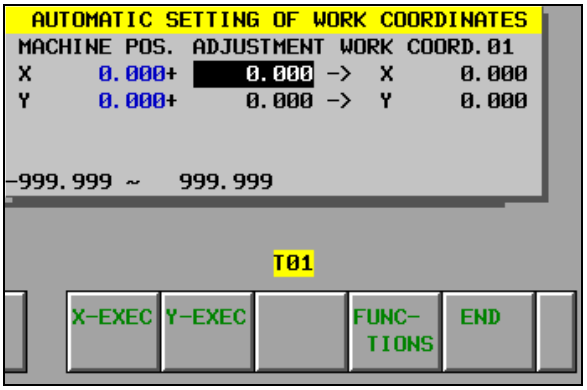


Clicking the [FUNCTIONS] soft key displays the window shown below. To select a method for setting up a workpiece coordinate system, select the method by using the cursor keys on the operator's panel, then click the [SET] soft key.



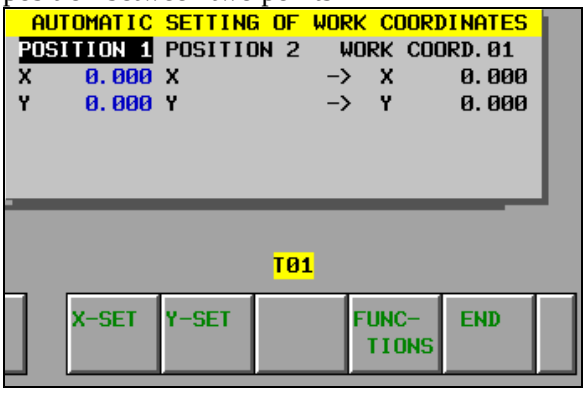
The following explains how to set up a workpiece coordinate system by using each method.

(a) Setting the current machine coordinates



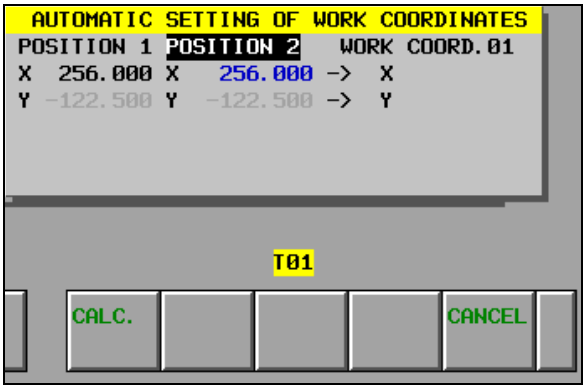
When "1. CURRENT POSITION" is selected, the above window is displayed, allowing the current machine coordinates to be set as the origin of the workpiece coordinate system. It is also possible to set the origin by adding an adjustment value to each machine coordinate value. Clicking the [X-EXEC] or [Y-EXEC] soft key automatically sets up, as the workpiece coordinate system origin, the sum of the current machine coordinate value and the adjustment value for each axis.

(b) Setting the center position between two points

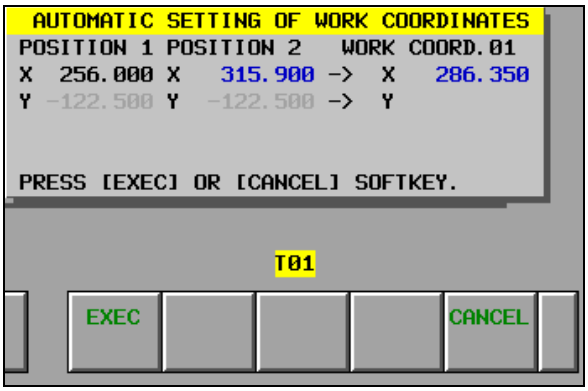


When "2. CENTER POSITION OF 2 POINTS" is selected, the above window is displayed, allowing the center position between specified two points to be calculated and set as the origin of the workpiece coordinate system.

When setting the center position between two points as the workpiece coordinate system origin, make settings for one axis at a time. Move the table to the first point, click the [X-SET] or [Y-SET] soft key, and set POSITION 1.



When the above window is displayed, move the table to the second point, and click the [CALC.] soft key. POSITION 2 is then set, and the center position between the two points is calculated at the same time.



When the above window is displayed, click the [EXEC] soft key. The calculated center position between the two points is set as the origin of the workpiece coordinate system.
Then, the screen display returns to the first screen. When setting the second axis, perform the similar operations.
Clicking the [CANCEL] soft key returns you to the previous step.

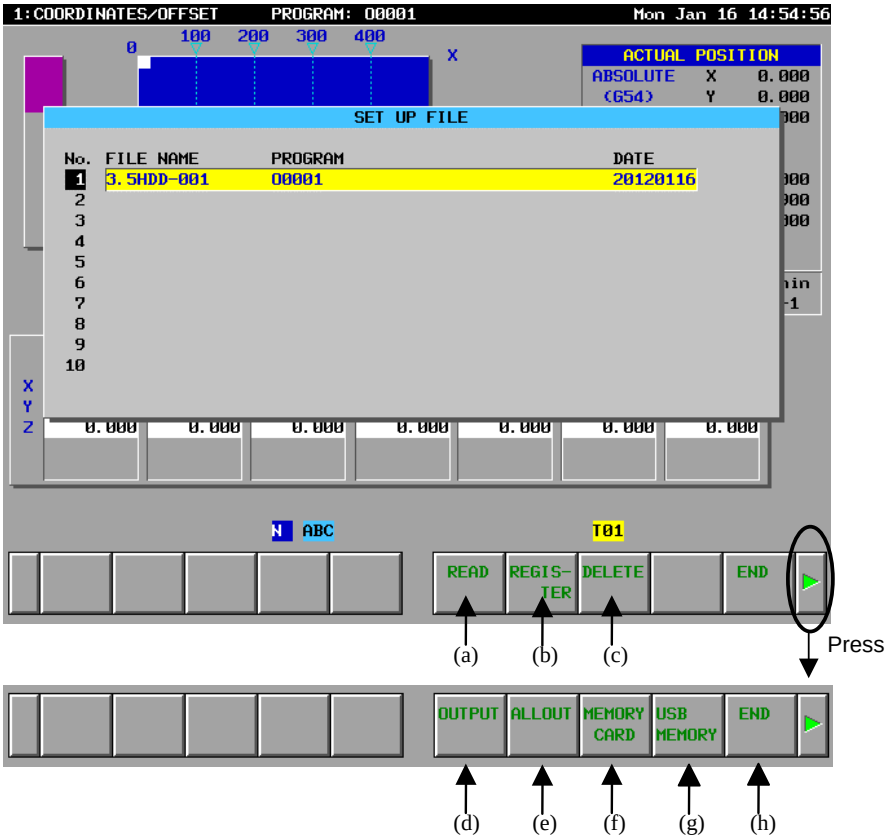
SUPPLEMENT

To add the Z-axis to AUTOMATIC SETTING OF WORK COORDINATES, set the following parameter:
PMC parameter keep relay K00#2 = 1

(4) SETUP FILE

This screen enables you to save and restore all setup data (such as workpiece coordinate system, tool compensation amount, and tool life management data) and machining programs at a time, thus curtailing the required setup time.

Clicking the SET UP FILE soft key displays a list of setup files in a window as shown below. The cursor can be used to select one of 10 setup files. The selected file can be called, registered, and deleted.



(a) READ

The selected setup file is read from storage memory and used for automatic setting of the setup data. If the setup file contains a program, it is possible to select whether to save the program to the CNC memory.

A program is called if it is included in the file list. This is, however, impossible if the program is not in memory.

(b) REGISTER

Clicking the [REGISTER] soft key displays the window and soft keys that can be used for registration.

Enter the target file name and program number, and the date, then click the [EXEC] soft key.

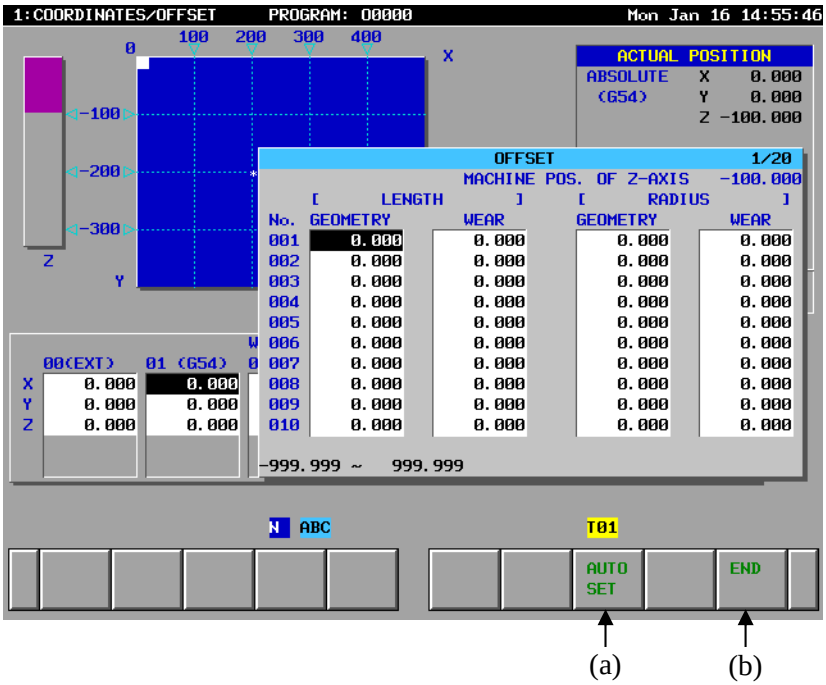
The following data can be saved.

- Workpiece coordinate system and workpiece coordinate system offset
- Tool offset value
- Table payload
- AI tool monitor setting
- Tool life management setting
- Counter screen function (ON/OFF), name, and M code
- PALLET SETTING screen machining program number (option)
- Machining programs (whether to register them can be selected, and the maximum registerable size is 50 Kbytes.)
- Settings of the spindle speed restriction function (enabling/disabling the function, restriction value, restriction function)

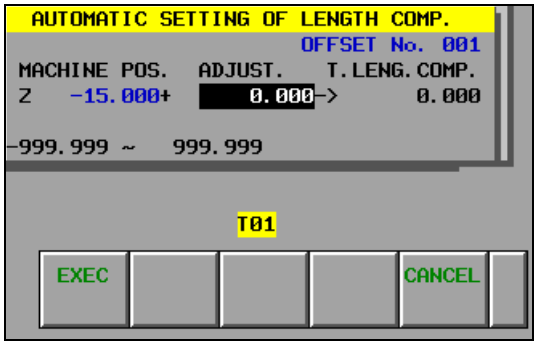
(c) DELETE
The SET UP FILE data registered in a memory can be deleted.
(d) OUTPUT
The selected setup files are output to the memory card or the USB memory.
(e) ALL OUTPUT
All setup files are output to the memory card or the USB memory.
(f) MEMORY CARD
(g) USB MEMORY
Setup files are input from the memory card or the USB memory.
(h) END
Setup file read and register operations are terminated.

(5) OFFSET

Pressing the soft key [OFFSET] displays the window that can be used for tool offset value setting as shown below. Place the cursor on the desired number, using the cursor and page keys, and enter a tool offset value.



(a) AUTO SET
This soft key is displayed only when the cursor is placed on [LENGTH] - "GEOMETRY". The current Z-axis machine coordinates can be used as a tool offset value.

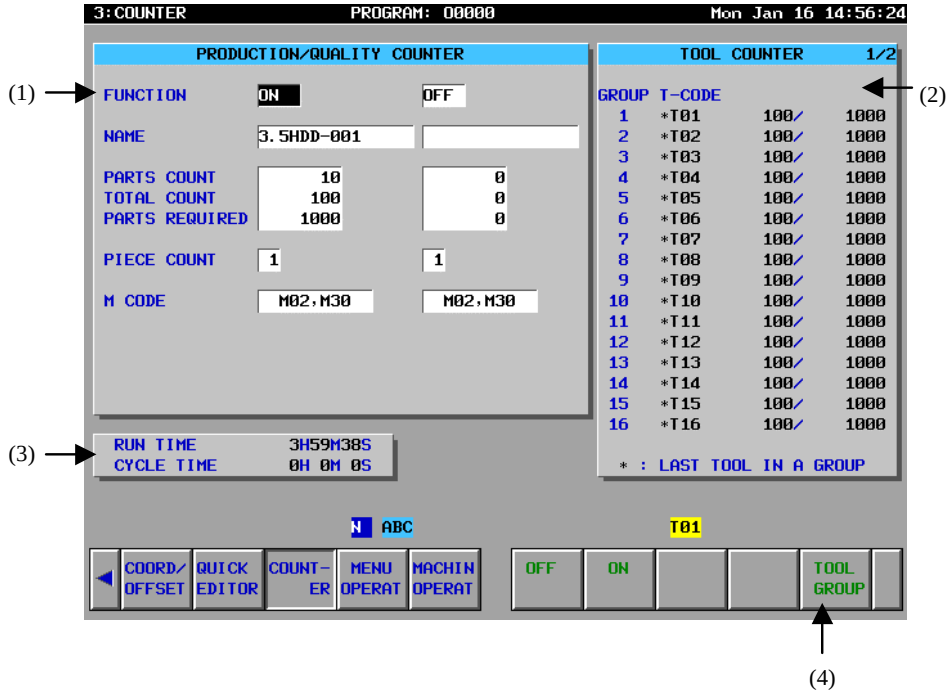


Enter an adjustment value and press the [EXEC] soft key. The current Z-axis machine coordinates are set in [LENGTH] - "GEOMETRY" for the selected offset number.

(b) END
Tool offset value setting is terminated.

1.3.2 Counter

On this screen, it is possible to set up the count function for the quantity of products. The screen displays the current use status and operating time for all tool groups.



(1) PRODUTION / COUNTER

Two PARTS COUNT are available on this screen.

FUNCTION:

Select "ON" if the corresponding counter is to be used. If not, select "OFF."

NAME:

Any name consisting of numbers, letters, and symbols can be specified.

On the standard type operator's panel, press the ABC …Z key to enter letters and symbols.

PARTS COUNT and TOTAL COUNT:

Respectively display the production count and the total production count. Also a number can be entered to these items.

PARTS REQUIRED:

Used to specify a scheduled production count.

A status indicator lamp can be turned on when the scheduled production count is reached. Also the operator message "2015 PRODUCTION IS COMPLETED." appears.

PIECE COUNT:

Used to specify a number of machined parts per cycle (count scaling factor). A number specified as “PIECE COUNT” is used as an increment to the production count and the total production count.

M CODE:

Used to select, from soft keys, an M code for counting the quantity of products. Specifying the selected M code increments the product count and total product count. The two counters each have dedicated up-count M codes, M91 and M92.

(2) TOOL COUNTER

This counter displays the tool number (T code) of a tool in use, the number of times (cycle quantity) that the tool was used, the time (duration) during which the tool was used, its life in a list form for each of all tool groups. If the tool of interest is the last one in a tool group, the tool number is prefixed with "*".

The operator can learn of the use condition of all tool groups in one glance.

To specify a tool group, press the soft key [TOOL GROUP].

(3) RUNNING TIME

RUN TIME: Displays the cumulative running time counted during automatic operation (excluding stop and pause).

CYCLE TIME: Displays the running time counted during one cycle of automatic operation (excluding stop and pause).

It is automatically preset with "0" at the cycle-start from reset as well as by switching off the power.

(4) TOOL GROUP

This soft key can be used to specify a tool group.

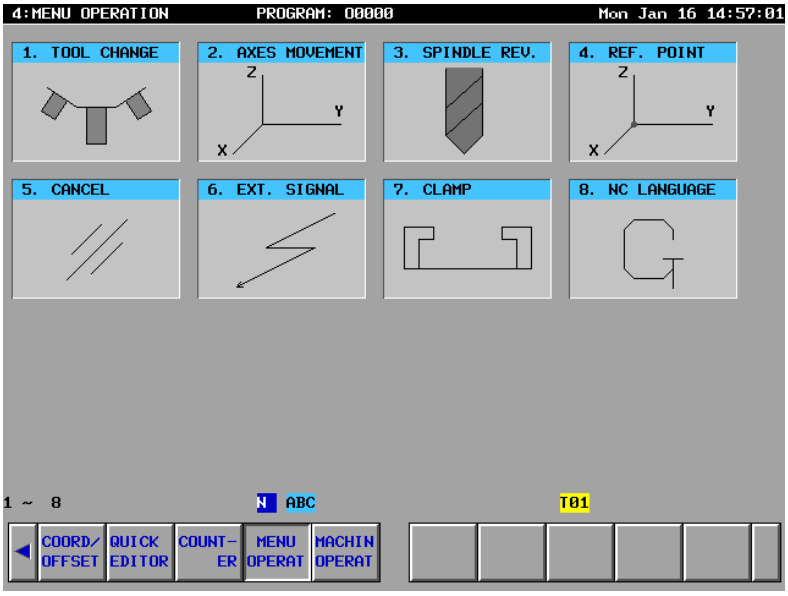
See Section 12, "TOOL LIFE MANAGMENT," in Part IV.

1.3.3 Menu Operation

This screen is used to perform one block running by conversational operations. (Correspondence to MDI running on CNC SCREEN.)

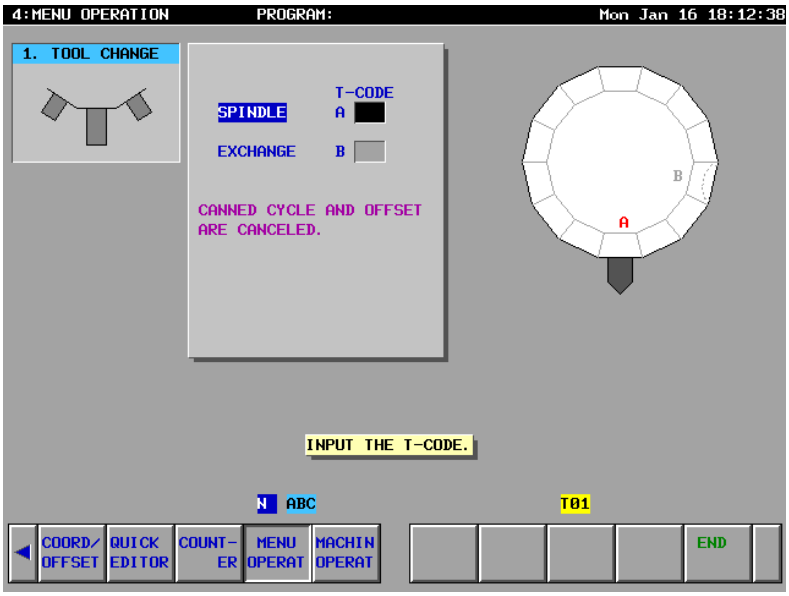
It is possible to run the machine tool by inputting data in accordance with instructions easily even if an operator is not used to CNC operation.

To perform a particular operation, enter the corresponding number 1 to 8.



(1) TOOL CHANGE

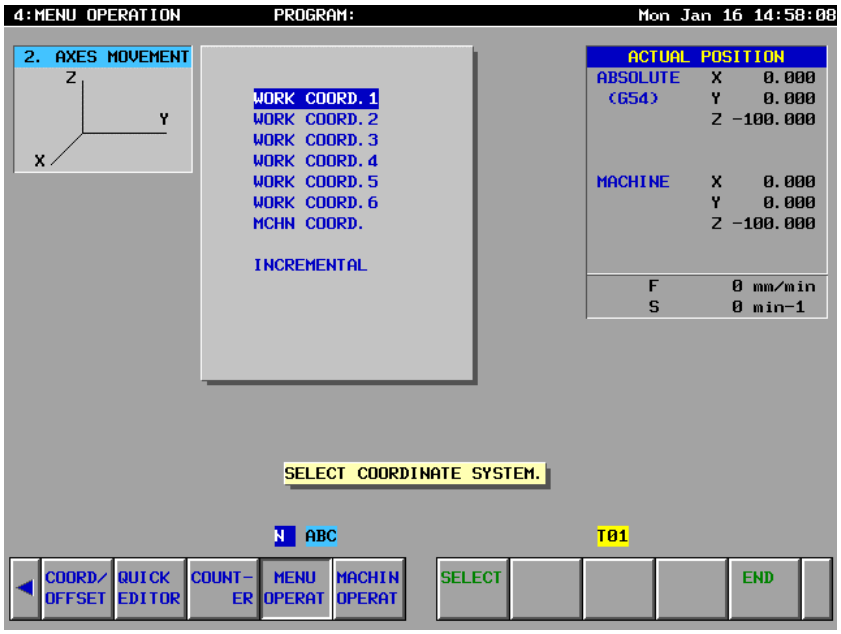
This function is used to change a tool for another by conversational operations. It is also possible to move a selected tool to the tool change position (a notched part on the turret cover).
When the MENU OPERATION screen is displayed, pressing <1>, then <INPUT> displays the following screen:



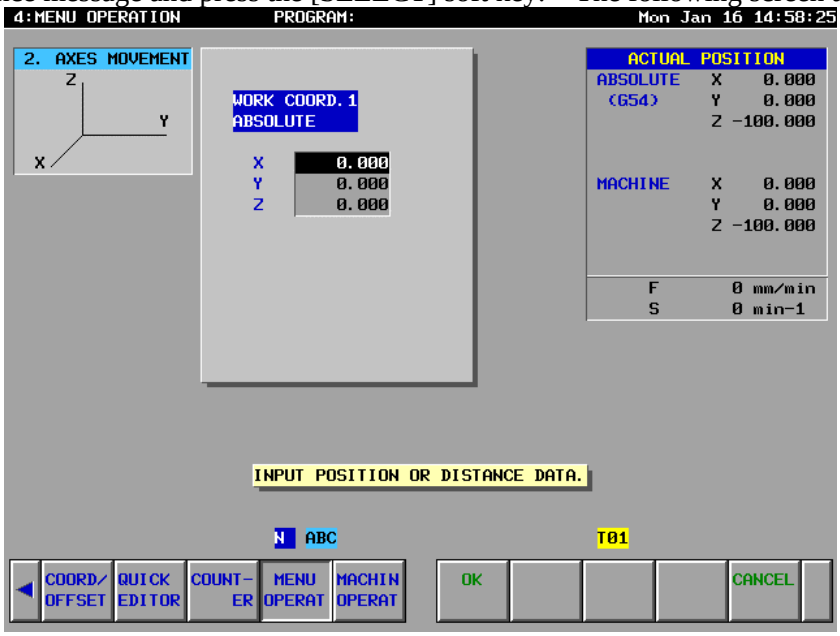
After the above screen is displayed, select a position (SPINDLE or EXCHANGE) to which the tool is moved, by using the cursor keys on the operator's panel. Then, enter data according to the guidance messages displayed on the screen, and press the <CYCLE START> button. The turret then turns, and the selected tool moves to the specified position.

(2) AXES MOVEMNT

This function is intended to move the tool along axes to an arbitrary position in the specified coordinate system easily, using menus.
When the MENU OPERATION screen is displayed, pressing <2>, then <INPUT> displays the following screen:



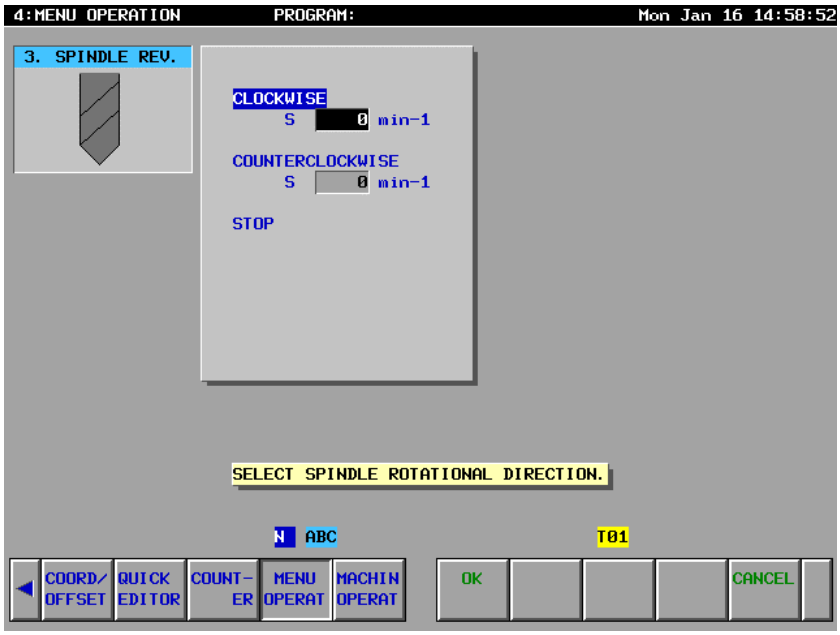
Select a coordinate system and absolute/incremental mode for moving the tool along axes according to the guidance message and press the [SELECT] soft key. The following screen appears:



Enter the coordinates of the end point (when the absolute command is used) or travel distance (when the incremental command is used) according to the guidance message. Press the <CYCLE START> button. The tool moves to the position at the specified coordinates.

(3) SPINDLE REVOLUTIONS

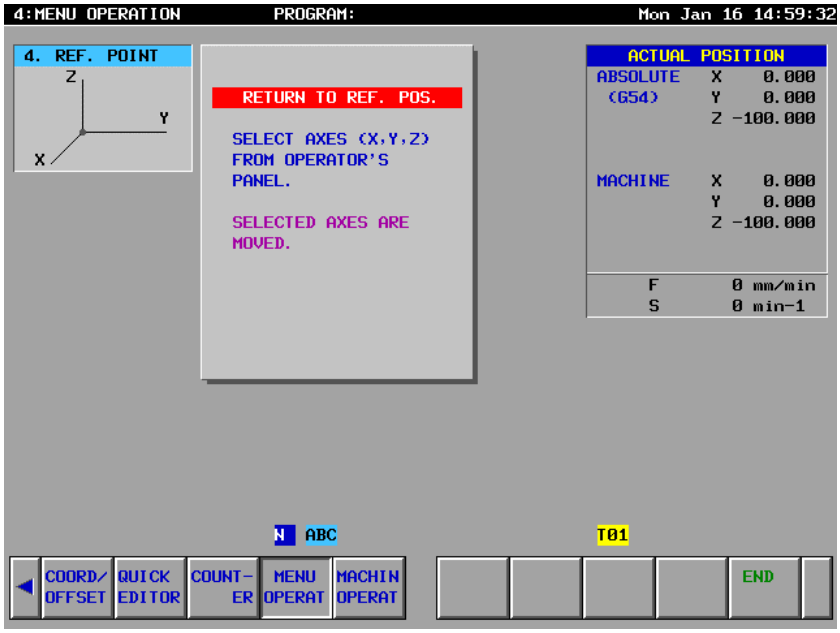
This function is intended to rotate and stop the spindle easily, using menus.
When the MENU OPERATION screen is displayed, pressing <3>, then <INPUT> displays the following screen:



Select a direction of rotation or stop and enter a speed according to the guidance message. Press the <CYCLE START> button. The specified operation is performed.

(4) RESTORATION TO THE REFERENCE POINT

This function is intended to make a reference position return for a specified axis easily, using menus. When the MENU OPERATION screen is displayed, pressing <4>, then <INPUT> displays the following screen:



A reference position return for the specified axis is completed when you operate according to guidance messages displayed on the screen.

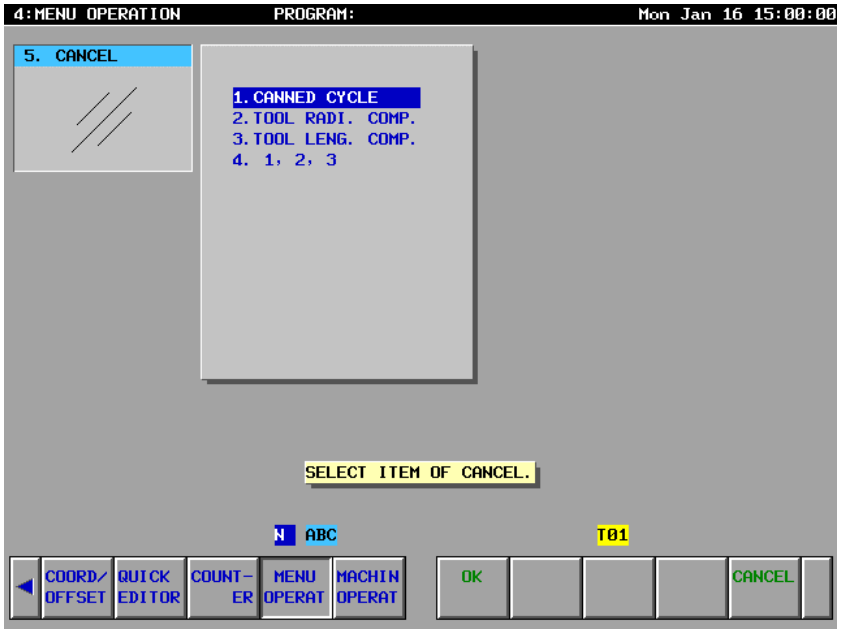
SUPPLEMENT

With a full keyboard type operator's panel, a reference position return cannot be made on the MENU OPERATION screen.
Use the <REF.POINT> key on the operator's panel.

(5) CANCEL

This function is intended to cancel a canned cycle, cutter compensation, and tool length compensation easily, using menus.

When the MENU OPERATION screen is displayed, pressing <5>, then <INPUT> displays the following screen:

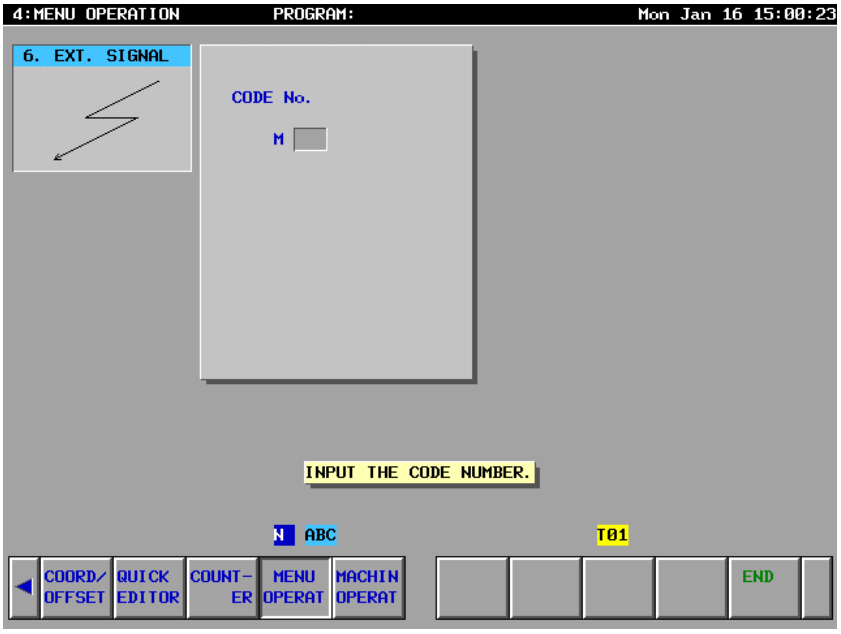


A specified item is canceled when you select the item according to guidance messages displayed on the screen and press the <CYCLE START> button.

(6) EXTERNAL SIGNAL

This function is intended to output M codes easily, using menus.

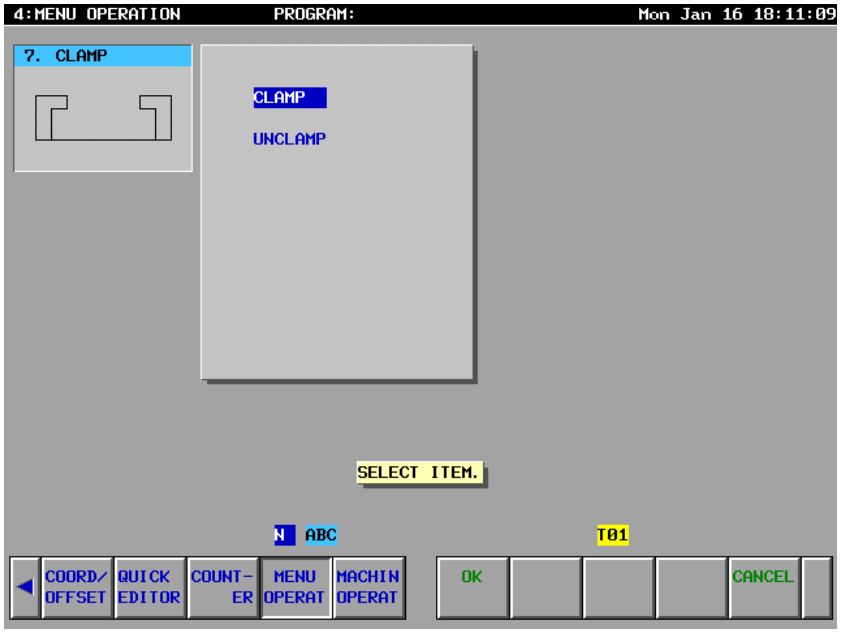
When the MENU OPERATION screen is displayed, pressing <6>, then <INPUT> displays the following screen:



Enter a code number according to the guidance message and press the <CYCLE START> button. The specified signal is output.

(7) CLAMP

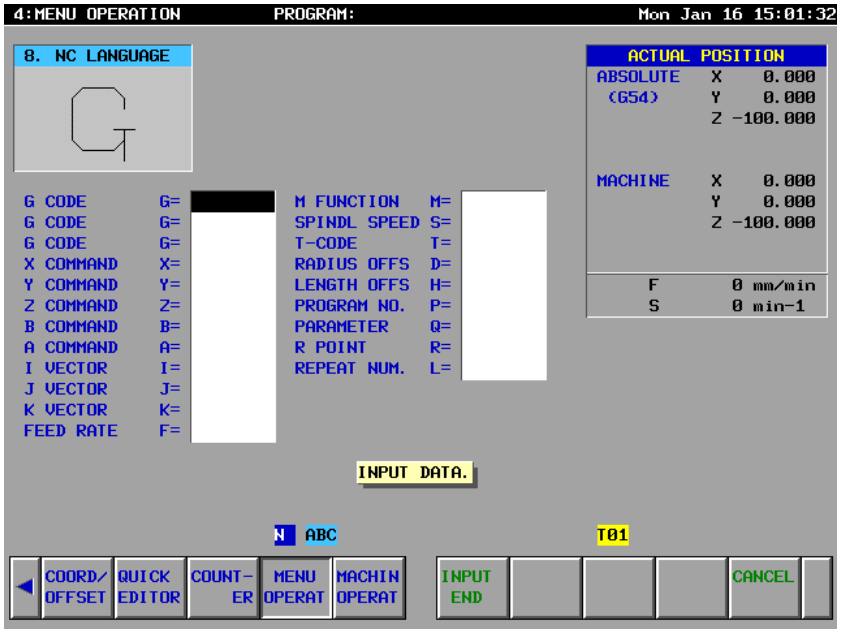
This function is intended to clamp and unclamp additional axes easily, using menus.
When the MENU OPERATION screen is displayed, pressing <7>, then <INPUT> displays the following screen:



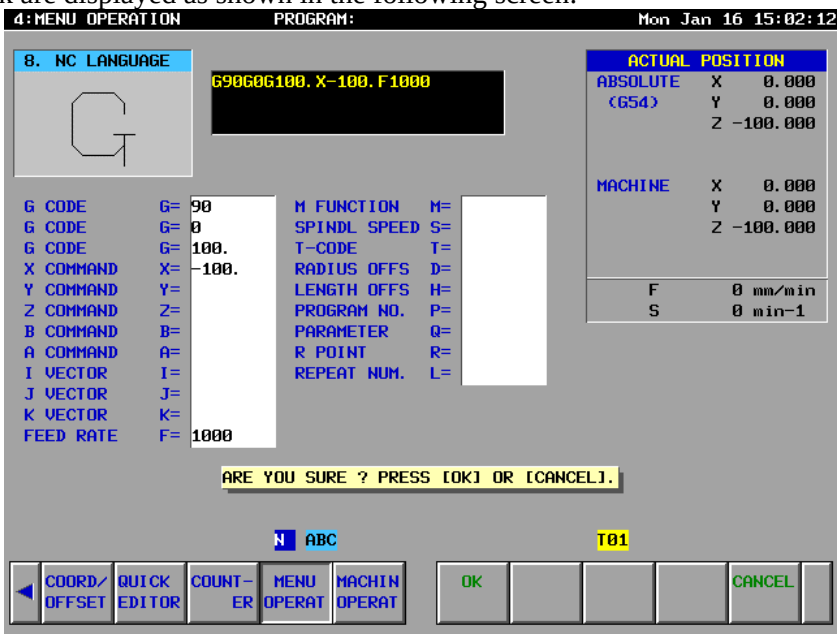
A specified operation is performed when you select the corresponding item according to guidance messages displayed on the screen and press the <CYCLE START> button.

(8) NC LANGUAGE

This function is intended to execute NC language commands for one block easily, using menus.
When the MENU OPERATION screen is displayed, pressing <8>, then <INPUT> displays the following screen:



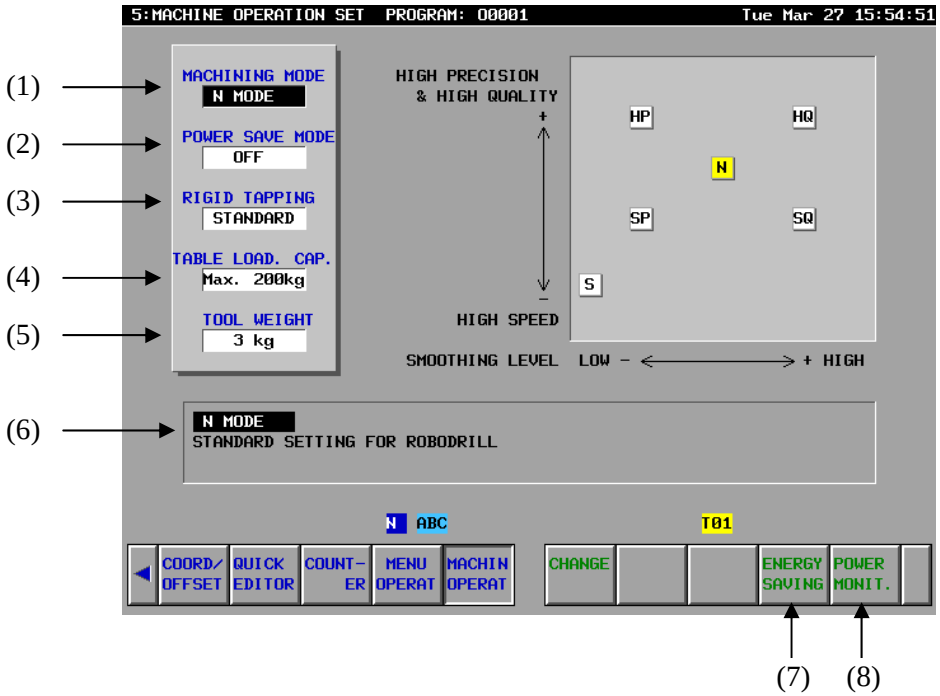
Enter a numeric value for each desired item and press the [INPUT END] soft key. The commands for one block are displayed as shown in the following screen:



Press the <CYCLE START> button. The specified operation is executed.

1.3.4 MACHINE OPERATION SET Screen

This screen enables you to make settings related to machine operation including a machining mode and acceleration in rigid tapping.
Pressing the [CHANGE] soft key displays the soft keys corresponding to the item at the cursor, which enables you to change the setting.
From this screen, you can also move to the ENERGY SAVING SETTING or POWER CONSUMPTION screen.



(1) MACHINING MODE
The selected machining mode is displayed. Pressing the [CHANGE] soft key opens a window, which enables you to select a mode suitable for machining. For details, see Chapter 36, "MACHINING MODE SETTING FUNCTION", in Part IV.

(2) POWER SAVE MODE
Whether to enable (ON) or disable (OFF) the power saving mode can be selected.
For details of the power saving mode, see Chapter 40, "POWER SAVING MODE", in Part IV.

(3) RIGID TAPPING
[HIGH SPEED], [STANDARD], or [LOW HEAT] can be selected as the setting of rigid tapping operation.

- [HIGH SPEED]
  As compared with [STANDARD], the spindle acceleration is increased to speed up rigid tapping operation.
  The heat output of the spindle motor is also increased, however.
- [LOW HEAT]
  As compared with [STANDARD], the spindle acceleration is decreased to slow rigid tapping operation.
  For this reason, the heat output of the spindle motor can be suppressed to some extent.

(4) TABLE LOAD. CAP.

[Max. 100kg], [Max. 200kg], or [Max. 300kg] can be selected according to the load on the table (workpiece, jigs, and others).

- Max. 100kg: When the total load (such as a workpiece and jigs) on the table is not heavier than 100 kg
- Max. 200kg: When the total load on the table is not heavier than 200 kg
- Max. 300kg: When the total load on the table is not heavier than 300 kg

SUPPLEMENT

For the α-D14/21S*i*A5, these soft keys are [Max. 100kg], [Max. 150kg], and [Max. 200kg], respectively.

(5) TOOL WEIGHT

[3 kg] or [2 kg] can be selected according to the weight of the tool used.

- 3 kg: When a tool weighing 2 kg or more is used
- 2 kg: When a tool weighing less than 2 kg is used

(6) Guidance message

The description of the setting item at the cursor is displayed.

(7) [ENERGY SAVING] key

The ENERGY SAVING SETTING screen is displayed. For details, see Chapter 39, "ENERGY SAVING SETTING SCREEN", in Part IV.

(8) [POWER MONIT.] key

The POWER CONSUMPTION screen is displayed. For details, see Chapter 38, "ELECTRIC POWER CONSUMPTION MONITOR", in Part IV.

The settings of "MACHINING MODE", "POWER SAVE MODE", and "RIGID TAPPING" can be changed by specifying M31 in the MEM or MDI mode.

<Format>

M31 L_ P_ R_ ;

L_: Machining mode to be set

- L1 : HP mode (setting to enable machining that is precise and faithful to program commands)
- L2 : HQ mode (setting to put emphasis on surface smoothness)
- L3 : N mode (standard setting for the ROBODRILL)
- L4 : SP mode (intermediate mode between HP and S)
- L5 : SQ mode (intermediate mode between HQ and S)
- L6 : S mode (setting to shorten the cycle time most)
- L7 : L7 mode (user-specific machining mode 1)
- L8 : L8 mode (user-specific machining mode 2)
- L9 : L9 mode (user-specific machining mode 3)

(For details of each mode, see Chapter 36, "MACHINING MODE SETTING FUNCTION", in Part IV.)

P_ : Power saving mode ON/OFF

- P0 : Standard mode
- P1 : Power saving mode

(For details of the power saving mode, see Chapter 40, "POWER SAVING MODE", in Part IV.)

R_ : Rigid tapping operation setting

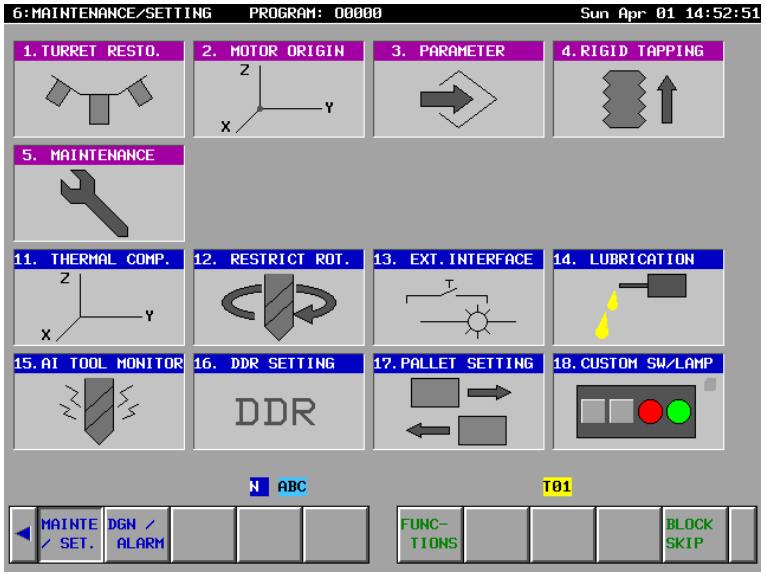
- R1.: Low heat output (slow operation)
- R2.: Standard (standard operation)
- R3.: High speed (high-speed operation)

SUPPLEMENT

- Be sure to specify “M31 ** ;” in a block that does not contain any other command.
- Be sure to specify “M31” at the beginning of a block.
- If a command such as ”L_ M31 ;” is executed, alarm PS0127, "DUPLICATE NC, MACRO STATEMENT." is issued.
- Be sure to specify “M31 ** ;” in a state where a canned cycle is cancelled. If "M31 ** ;" is specified in the canned cycle mode, alarm MC3130, "DURING CANNED CYCLE" is issued.
- Specify R_ with a period (.) such as "R1." or "R2.".
- If any of the L7 to L9 modes is disabled when specified, alarm MC3130, "DATA ERROR L" is issued.
- If a value beyond the setting range is specified, alarm MC3130, "DATA ERROR *" is issued. (*: L, P, or R)
- Once set, the machining mode is not cleared even after the end of the program.
- All arguments do not have to be specified. For example, commands "M31 L2 ;" and "M31 P1 R2 ;" are available.

1.3.5 Maintenance/Setting

Various types of maintenance and setting can be performed.
To perform each function, enter the corresponding number.



(1) TURRET RESTO.

Turret restoration is performed to restore the turret to the normal position when the machine is stopped during replacement of the tool due to an alarm, power-off, or other reasons.
For details, see Chapter 4, "AUTOMATIC TURRET RESTORATION" in Part V.

(2) MOTOR ORIGIN

During motor replacement, detaching the pulse coder cable causes the control unit to lose the machine zero point and an alarm to be issued to make a request for a return to the reference position. In this case, it is necessary to perform motor origin restoration.
For details, see Chapter 3, "SERVO MOTOR ORIGIN RESTORATION " in Part V.

(3) PARAMETER

This function can be used if all parameters were lost for some reason or are to be returned to the factory-made settings. It also enables the current settings of the parameters to be checked with the factory-made settings.
For details, see Chapter 5, "PARAMETER RESET, CHECK, AND REGISTRATION FUNCTIONS" in Part V.

(4) RIGID TAPPING

This function can be used to pull out a tapping tool that has dug into a workpiece and stayed in it.
For details, see Chapter 6, "RIGID TAPPING RETURN FUNCTION" in Part V.

(5) MAINTENANCE

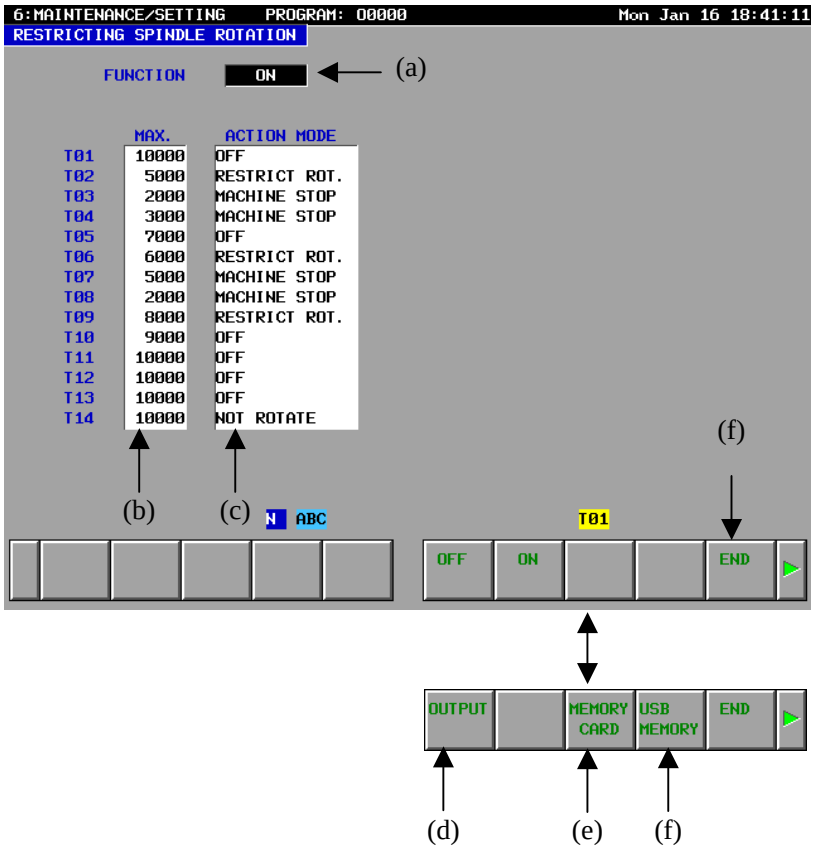
The time of maintenance can be reported through an alarm or operator message for the periodic maintenance items such as greasing. For the items, the progress from the previous maintenance can be checked and the notification method can be set.
For details, see Chapter 35, "PERIODICAL MAINTENANCE SCREEN" in Part IV.

(6) THERMAL COMP.

This function estimates a thermal displacement caused along X-, Y-, and Z-axes by machine motion and correct it with using no sensor.
For details, see Chapter 15, "AI THERMAL DISPLACEMENT COMPENSATION FUNCTION" in Part IV.

(7) RESTRICT ROT.

If the spindle is rotated at high speed due to a programming error or the like, a machining failure may occur or the tool may be removed from the spindle when using a large-diameter tool that is not appropriate for high velocity revolution. For the touch prove, the spindle is prohibited from being rotated. This function prevents the spindle from rotating at a speed above the limitation value by setting the limitation value and a limitation function for the spindle speed of each tool.



(a) Spindle speed restriction function on/off

Specifies whether the spindle speed restriction function is enabled or disabled with the [ON] or [OFF] soft key.

When [OFF] is selected, the settings of the spindle speed restriction function are disabled.

(b) MAX.

Sets the maximum allowable velocity for each tool number. It is possible to set the velocity between 100 and 10000 for the standard spindle, high torque spindle and high acceleration spindle or the speed between 240 and 24000 for the high-speed spindle.

(c) ACTION MODE

Sets, for each tool number, what tool control is performed when the spindle speed exceeds the limitation value. Select one of the following soft keys that appear when the cursor is moved to the ACTION MODE field.

OFF: The spindle speed is not restricted for the tool number.

RESTRICT: When the spindle speed exceeds the limitation value, the spindle speed is reduced to the limitation value and the machining is continued. At the same time, operator message "2029 REACH THE LIMIT SPINDLE SPEED" appears.

MCHN STOP: When the spindle speed exceeds the limitation value, alarm "EX1072 OVER THE MAXIMUM SPINDLE SPEED" is issued and the machine is stopped. However, the spindle continues to rotate at a velocity specified by the limitation value without stopping.

NOT ROTATE: The spindle is prohibited to rotate for the tool number. When the spindle is specified to rotate, the spindle does not rotate, alarm "EX1053 SPINDLE ROTATION IS PROHIBITED" is issued, and the machine is stopped. Tool exchange and spindle orientation can be specified.

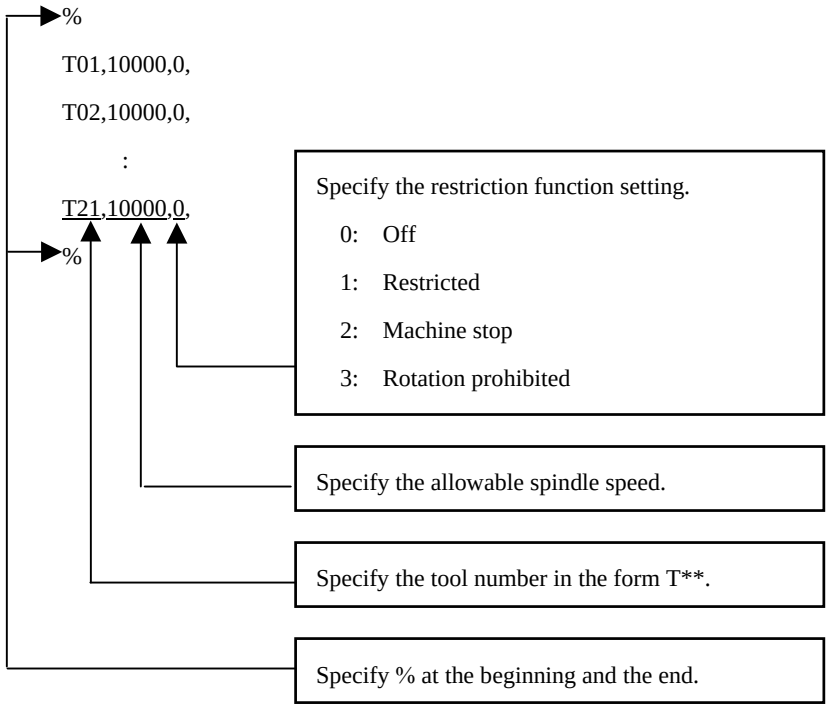
CAUTION

1 If the spindle speed exceeds the limitation value when [RESTRICT] is selected, the spindle speed is reduced to the limitation value, but the cutting speed is not changed. Note that the cutting conditions are changed.
2 If the spindle speed exceeds the limitation value during a rigid tapping cycle, an alarm is issued and the machine is stopped even when the restriction function is set to [RESTRICT].
3 When the spindle speed is increased by the rigid tapping extraction override function, the [RESTRICT] and [MCHN STOP] settings are disabled even if the set limitation value is exceeded. Create the program and set the parameters so that the limitation value is not exceeded.

(d) OUTPUT

The settings of the spindle speed restriction function are output to a memory card or USB memory. Press the soft key [OUTPUT], enter a file name in the file name input window that appears, and press the soft key [EXEC]. A file name of up to eight characters and an extension of up to three characters can be set. To cancel data output, press the soft key [CANCEL].

The settings of the spindle speed restriction function are output to a each device in the text format. The format is described below.



(e) MEMORY CARD

(f) USB MEMORY

The settings of the spindle speed restriction function can be read from the memory card or USB memory. Press the soft key [MEMORY CARD] or [USB MEMORY] to display the files in the memory card in the list window, select the file from which the settings are read, and press the soft key [INPUT]. Then, press the soft key [EXEC] to read the selected file and the settings are changed. To cancel read operation, press the soft key [CANCEL].

The files must have the format indicated in "(d) OUTPUT".

SUPPLEMENT

A file used to read settings does not have to include the settings of all tool numbers. For example, when settings are read with a file including the following description, the allowable spindle speed can be set to 5000 rpm and the restriction function can be set to [MCHN STOP] only for the setting of tool number T8.

```
%
T08,5000,2,
%
```

CAUTION
When data is input or output, the setting of enabling or disabling the spindle speed restriction function is neither saved nor restored. Be sure to check whether the function is enabled or disabled on the QUICK screen.

(g) END
Setting of the spindle speed restriction function is completed and the MAINTENANCE/ SETTING screen is displayed.

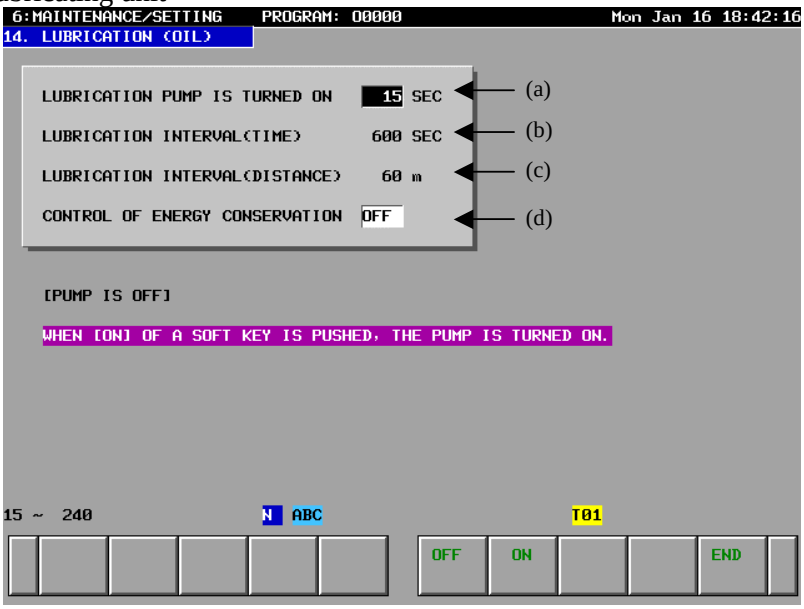
(8) EXT. INTERFACE

This function can be used to select and set up the signals to be used on terminal boards on the ROBODRILL.
For details, see Chapter 14, "EXTERNAL INTRFACE FUNCTION" in Part IV.

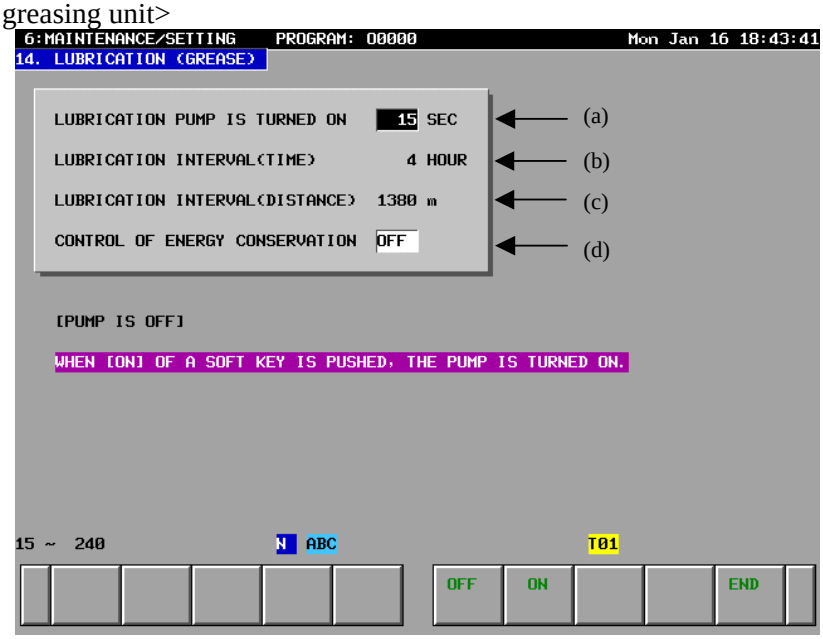
(9) LUBRICATION (Option)

This function can be used to make and check settings related to the operation of an optional automatic lubricating unit and an optional automatic greasing unit.

<Automatic lubricating unit>



<Automatic greasing unit>



(a) LUBRICATION PUMP IS TURNED ON
Pressing the soft key [ON] drives the pump for a specified duration. The pump discharges oil only once no matter how long it is driven. The duration is 15 seconds by default. It can range from 15 to 240 seconds.

(b) LUBRICATION INTERVAL (TIME)
This item indicates the time from when the pump stops until it is driven next.
The default time is 600 seconds for the automatic lubricating unit or four hours for the automatic greasing unit.

(c) LUBRICATION INTERVAL (DISTANCE)
This item indicates the distance of movement made from when the pump stops until it is driven next.
The default distance is 60 m for the automatic lubricating unit or 1380 m for the automatic greasing unit.

(d) CONTROL OF ENERGY CONSERVATION
Selecting "ON" prevents the pump from being driven after the interval indicated in (b) has elapsed as long as the axes are at rest. When a movement along an axis is made after the interval indicated in (b), the pump is driven and discharges oil.
OFF is assumed by default.

(10) AI TOOL MONITOR (option)

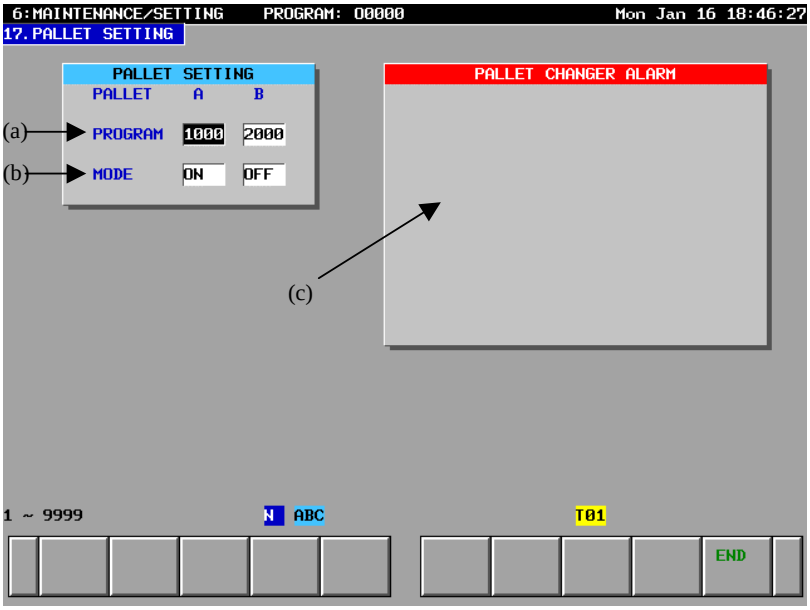
This function can be used to set data related to the AI tool monitor function.
For details, see Chapter 13, “AI TOOL MONITOR”, in Part IV.

(11) DDR SETTING (option)

The rotation part weight can be set and the pole position can be detected for DDR. For details, see Chapter 33, "DDR (OPTION)" in Part IV.

(12) PALLET SETTING (option)

If a machining program number is set up for each of workpieces mounted on the two pallets (A and B) in advance, the machining programs can be automatically called and executed.



(a) Program number setting

A machining program number can be specified for each of pallets A and B.

The program numbers specified here are assigned to the following macro variables.

#998: Machining program number for pallet A

#999: Machining program number for pallet B

In addition, the machining program number for a pallet currently on the table is set to #990.

SUPPLEMENT

- Do not use the macro variables (#990, #998, and #999) mentioned above for any other purposes.
- The machining programs mentioned above must be in a subprogram form.

(b) Selecting the workpiece No. search function

Whether to use the workpiece No. search function can be specified for each of pallets A and B.

ON: The workpiece No. search function is used.
To put it another way, after pallet change, the machining program number set up in (a) above is assigned to #990, and the program #990 is called for machining.

OFF: The workpiece No. search function is not used.
After pallet change, 9023 is assigned to #990, and O9023 is called for execution.
O9023 is, however, a program that is previously registered but performs no operation.
Do not use O9023 in machining program registration because its contents have already been determined.

Given below is a main program example.

```
O0001;
M65;          ←  M code for exchanging pallets
M98 P#990;    ←  Calls a machining program (subprogram) corresponding to the pallet.
M01;          ←  Stops program execution when the <M01 STOP> button on the operator's panel is set to ON.
M99 ;         ←  Passes control back to the beginning of the program.
```

SUPPLEMENT

To call a program in the data server or memory card and use it, change the M code for calling a subprogram above from M98 to M198.

(c) Pallet changer alarm detail displays

Details of alarms related to the pallet changer are displayed on the screen.

[Alarm types]

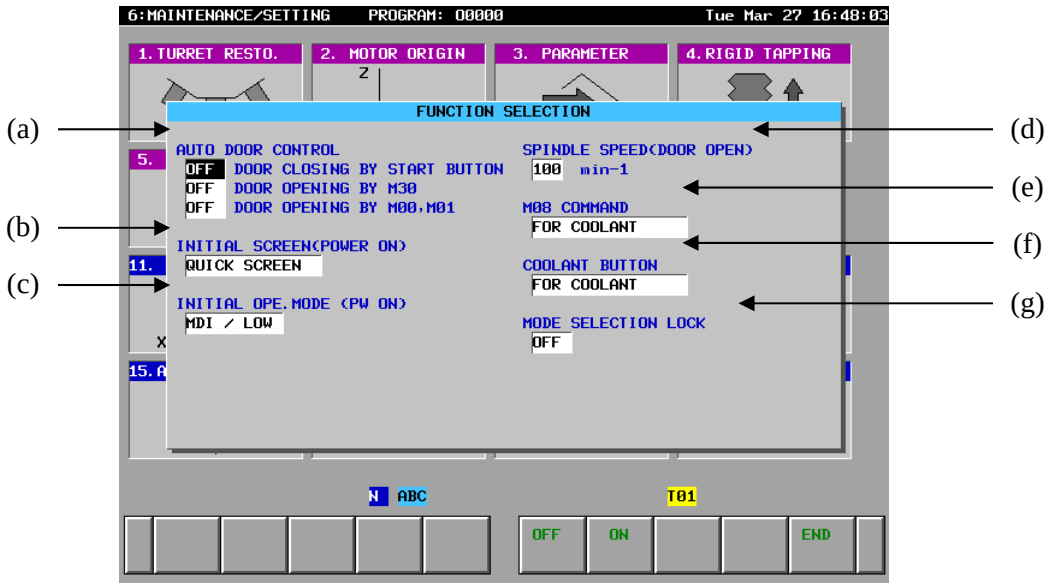
Safety door	Pallet unclamp
Pallet-in-place detected	Hydraulic unit
Pallet transportation	Relay (SR5) abnormal
Whether there is a pallet	Relay (SR6 or SR7) abnormal
Pallet A unlock	Relay (SR8) abnormal
Pallet B unlock	Relay (SR9) abnormal
Automatic door	

(13) CUSTOM SW/LAMP

This function creates switches and lamps in a QUICK screen to check the status of jigs and external devices and operate them. For details, see Chapter 42, "CUSTOM OPERATOR'S PANEL FUNCTION", in Part IV.

(14) FUNCTION SELECTION

Pressing the soft key [FUNCTION SELECTION] displays the following window.



(a) **AUTO DOOR CONTROL (option)**

This item is used to set up each function related to automatic door control. Selecting ON puts the following functions to work.

- DOOR CLOSING BY START BUTTON:
  Closes the door automatically at cycle-start and starts operation.
- DOOR OPENING BY M30:
  Opens the automatic door when M30 is issued.
- DOOR OPENING BY M00, M01:
  Opens the automatic door when M00 or M01 is issued.

(b) **INITIAL SCREEN (POWER ON)**

This item is used to select the screen displayed when the power is switched on.

(c) **INITIAL OPE. MODE (POWER ON)**

This item is used to specify the machine status to be selected when the power is switched on.

- MDI/LOW: In the MDI mode, the rapid traverse rate is set to LOW.
- AUTO/ 100%: In the MEM mode, the rapid traverse rate is set to 100%.

(d) **SPINDLE SPEED (DOOR OPEN)**

This item is used to specify an upper limit to the spindle speed when the door is open.

(e) **M08 COMMAND**

This item is used to specify whether M08 is to be used for coolant control or for air blow control.

(f) **COOLANT BUTTON**

This item is used to specify whether the <COOLANT> button on the operator's panel is used for coolant control or for air blow control.

(g) **MODE SELECTION LOCK (only for CE mark specification)**

ON: Operation mode switching is disabled.
OFF:Operation mode switching is enabled.

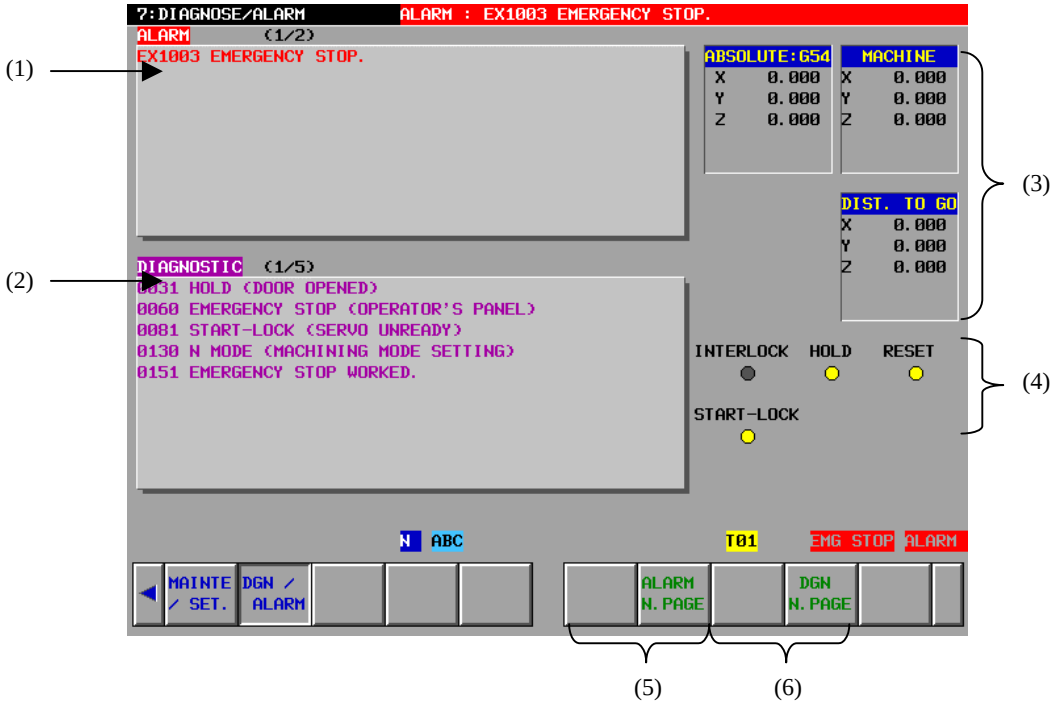
(15) BLOCK SKIP

Pressing the soft key [BLOCK SKIP] displays the OPTIONAL BLOCK SKIP window. This window allows you to specify whether to execute each of the blocks containing “/1” to “/9” in the program.

For details, see Subsection 5.4.7, “Optional Block Skip,” in Chapter 5, “AUTOMATIC RUNNING,” in Part IV.

1.3.6 Diagnose/Alarm

On this screen, it is possible to find the causes of troubles in the machine.



(1) Alarm

(2) Diagnosis

Alarms and diagnosis information (including operator messages) are displayed in the corresponding areas. See Appendix E and F for details.

(3) Coordinate value displays

These areas display workpiece coordinates, machine coordinates, and the distance yet to go.

(4) Diagnosis monitor

Small circles are used to indicate the operation status of the machine. When a circle is yellow, the machine is in the status described above the circle.

The causes for each machine operation status are detailed in (1).

- INTERLOCK: The axes are inhibited from moving.
- HOLD: Program execution is at rest.
- RESET: The machine is reset.
- START-LOCK: Programmed operation is inhibited from starting.

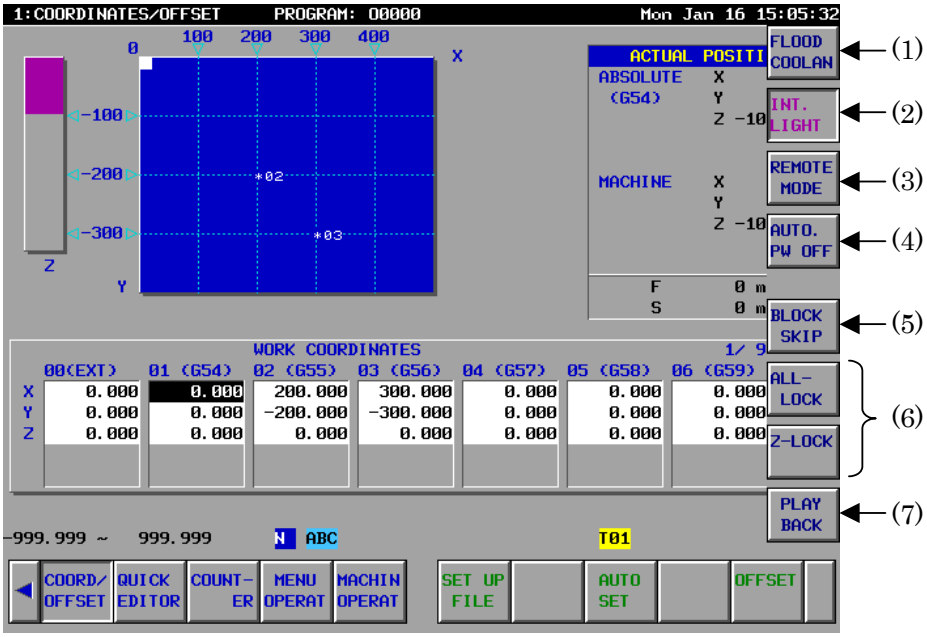
(5) Soft key [ALARM P.PAGE] and [ALARM N.PAGE]

(6) Soft key [DGN P.PAGE] and [DGN N.PAGE]

A soft key is used to switch between the alarm and diagnosis information display pages.

1.3.7 Soft Keys Arranged in a Column

The soft keys arranged in a column can be used to make various settings.



(1) FLOOD COOLAN (See SUPPLEMENT 1.)

ON: Coolant is supplied.
OFF: No coolant is supplied.

(2) INT. LIGHT (See SUPPLEMENT 1.)

ON: The intra-machine lamp is turned on.
OFF: The intra-machine lamp is turned off.

(3) REMOTE MODE (See SUPPLEMENT 2.)

ON: The machine runs as directed by programs in external memory.
OFF: The machine runs as directed by programs in the CNC memory.

(4) AUTO. PW OFF (See SUPPLEMENT 2.)

ON: The CNC power is switched off about 5 seconds after M30 is issued.
OFF: No automatic power-off takes place.

(5) BLOCK SKIP (See SUPPLEMENT 2 and 3.)

ON: Commands in program blocks containing "/1"("/") are skipped.
OFF: Commands in program blocks containing "/1"("/") are not skipped.

(6) MACHINE LOCK

OFF: The machine runs as directed by programs (normal operation).
ALL-LOCK: Programs are executed without running the machine. This machine lock mode is used to check programs.
Coordinate values displayed on the screen are updated according to move commands. In addition, the M and S functions are executed.
Z-LOCK: Programs are executed by keeping only the Z-axis at rest. This machine lock mode is used to check programs.

(7) PLAY BACK

ON: Programs can be created by registering machine positions obtained from manual operations as programmed positions into memory.
OFF: This function is unusable.

SUPPLEMENT

1 On a machine on which the machining cleaning coolant (option) is not installed, the [FLOOD COOLAN] vertical soft key is not displayed. On a machine on which the internal light (option) is not installed, the [INT. LIGHT] vertical soft key is not displayed.
2 On a full keyboard type operator's panel, [REMOTE MODE], [AUTO.PW OFF] and [BLOCK SKIP] keys are not displayed. Use the corresponding buttons on the operator’s panel.
3 As the [BLOCK SKIP] vertical soft key, only “/1”(“/”)can be set by pressing. Execute the setting “/2” to “/9” using “Maintenance/Setting” screen (For detail, refer to the section 5.4.7 “Optional Block Skip” of “IV 5 AUTOMATIC RUNNING”).

2 CREATING A PROGRAM

This chapter explains how to create and edit a program to be used in the automatic operation mode of the ROBODRILL and how to input a program from and output it to an external input/output device.
You can create a program using the "PROGRAM" NC screen or QUICK EDITOR QUICK screen.

SUPPLEMENT
Only basic operations are explained for QUICK EDITOR in this chapter. For details, see Chapter 11, "QUICK EDITOR", in Part IV.

2.1 Creating a Program

2.1.1 NC Screen

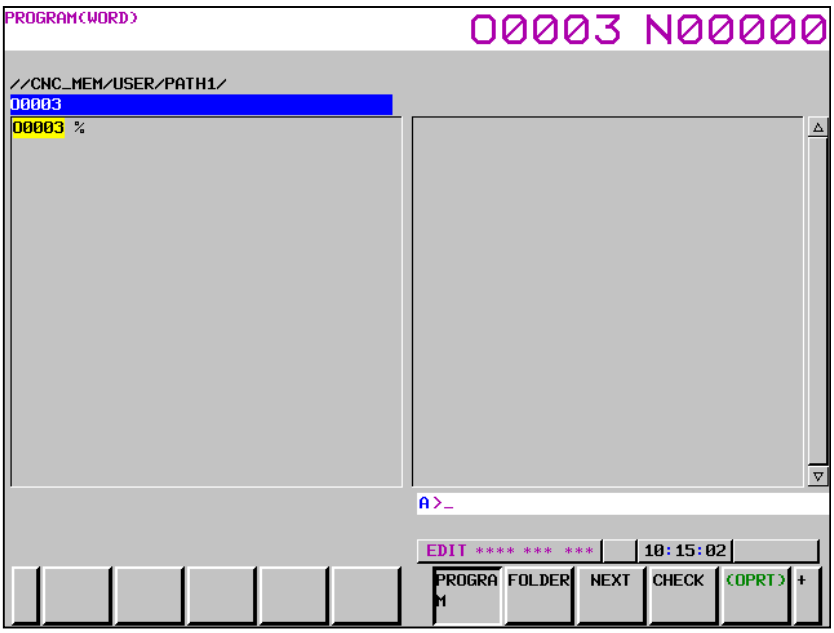
(1) Put the system in the EDIT mode.
(2) Turn off the protect key.
(3) Press the [PROG] function key or the [2 PROG] + [▽ N. PAGE] keys to display the “PROGRAM” screen.

<Method 1>

(4) If the "PROGRAM" screen is not displayed, press the [PROGRAM] soft key.
(5) Enter the number (<O> ****) of a new program to be created from the operator's panel and press the <INPUT> key on the panel.

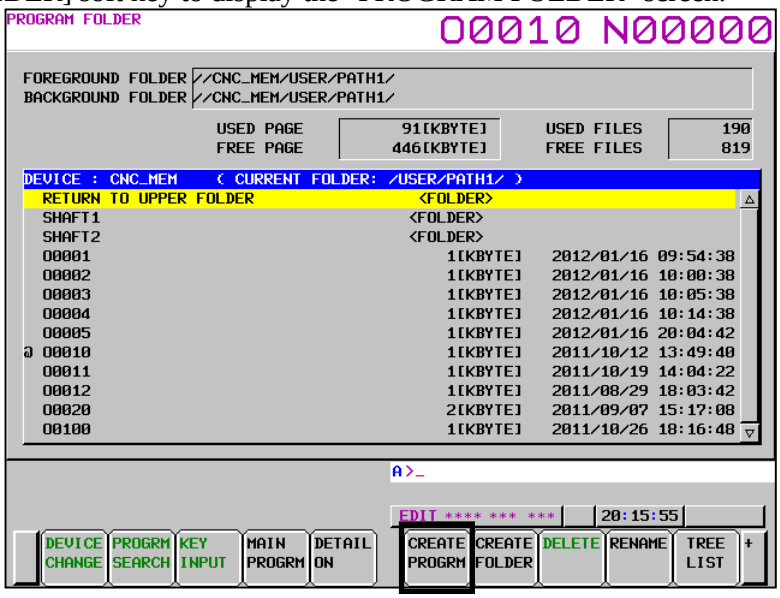
(Example) To create program "O0003"

On the operator's panel, enter [0 ,] → [3], then press <INPUT>.



<Method 2>

(4) Press the [FOLDER] soft key to display the "PROGRAM FOLDER" screen.



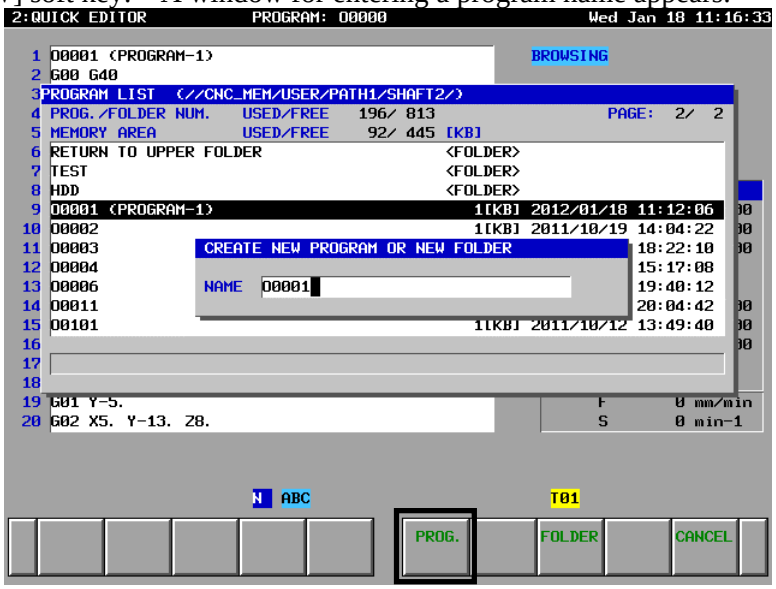
(5) Enter the number or name of a program to be created from the operator's panel and press the [CREATE PROGRM] soft key. The program is created and added to the list.

SUPPLEMENT

With <method 2>, the created program is not set to the main program. To edit the program, see Section 2.2, "Selecting a Program", and set it to the main program.

2.1.2 QUICK Screen

(1) Press the [QUICK EDITOR] soft key to display "2: QUICK EDITOR".
(2) Press the [LIST] soft key to display PROGRAM LIST.
(3) Press the [NEW] soft key. A window for entering a program name appears.



(4) Enter the name of a new program to be created and press the [PROG.] soft key. The created program is added to PROGRAM LIST.

2.2 Selecting a Program

Select a program to be edited from the CNC memory.

2.2.1 NC Screen

(1) Put the system in the EDIT mode.

(2) Press the PROG function key or the 2 PROG + N. PAGE keys to display the “PROGRAM” screen.

<Method 1>

(3) Press the [(OPRT)] soft key, then the [PROGRM SEARCH] soft key.

(4) Press the [NEXT PROGRM] or [PREV PROGRM] soft key. Pressing [NEXT PROGRM] selects the next program and pressing [PREV PROGRM] selects the previous program in sequence.

<Method 2>

(3) Enter the number of a program to be selected from the operator's panel and press ⇩ or the [PROGRM SEARCH] soft key. The program having the entered number is selected.

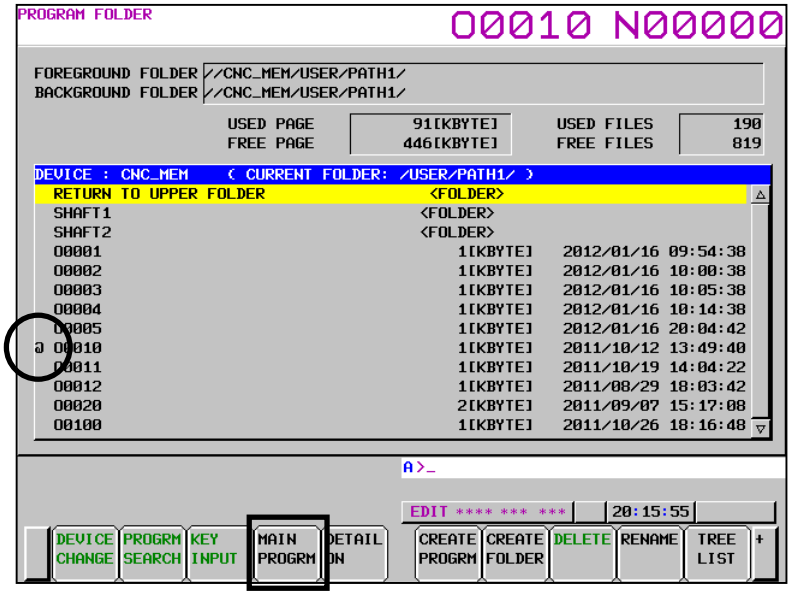
SUPPLEMENT

If the called program is missing, the message "SPECIFIED PROGRAM NOT FOUND" appears. The message disappears when the <RESET> key is pressed or any other operation is performed

<Method 3>

(3) Press the [FOLDER] soft key to display the "PROGRAM FOLDER" screen.

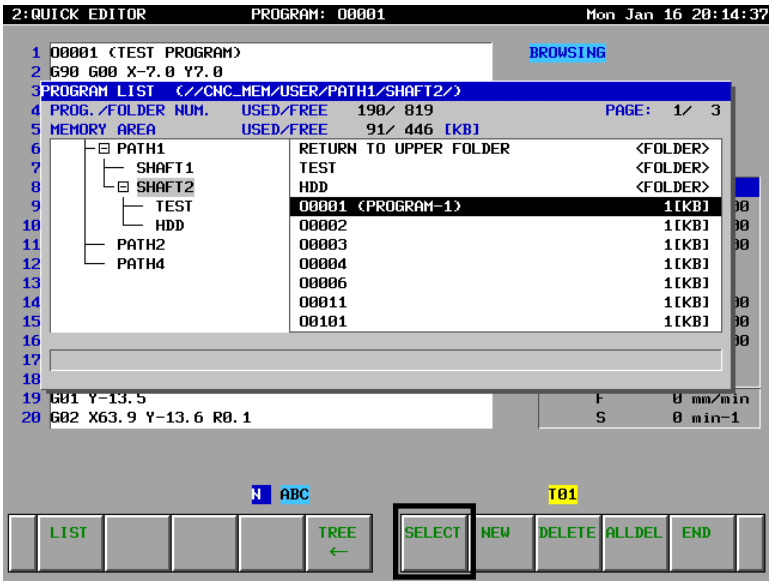
(4) Use the cursor keys on the operator's panel to position the cursor on a program to be selected and press the [MAIN PROGRAM] soft key. The symbol "@" is displayed to the left of the selected program name.



(5) Display the "PROGRAM" screen. The selected program is displayed.

2.2.2 QUICK Screen

(1) Press the [QUICK EDITOR] soft key to display "2: QUICK EDITOR".
(2) Press the [LIST] soft key to display PROGRAM LIST.
(3) Use the cursor keys on the operator's panel to position the cursor on a program to be selected and press the [SELECT] soft key.
(When a folder tree is displayed, press the [LIST→] soft key to change the window and select a program.)



(4) The selected program appears on the screen.

SUPPLEMENT

When a program to be edited is selected on the QUICK screen, it is not set to the main program. To perform automatic operation, set the program to the main program on the NC screen.

2.3 Modifying a Program

2.3.1 NC Screen

(1) Put the system in the EDIT mode.

(2) Press the PROG function key or the 2 PROG + N. PAGE keys to display the “PROGRAM” screen.

<Altering a word>

(1) Position the cursor on a word to be altered.

(2) Enter a new word and press ALTER on the operator's panel. The word at the cursor is altered.

(Example) To change the spindle speed from "S1000" to "S800"

```
O1000 ;
G92 X0 Y0 Z50.0 ;
M03 S1000 ;
%
```

↓

Enter S → 8 → 0 SYSTEM → 0 SYSTEM → ALTER.

↓

```
O1000 ;
G92 X0 Y0 Z50.0 ;
M03 S800 ;
%
```

<Inserting a word>

(1) Position the cursor on the word to the left of the position in which to insert a word.

(2) Enter a word to be inserted and press INSERT on the operator's panel. The word is inserted following the word at the cursor.

(Example) To insert "M08" following "Z50.0"

```
O1000 ;
G92 X0 Y0 Z50.0 ;
%
```

↓

Enter M → 0 SYSTEM → 8 → INSERT.

↓

```
O1000 ;
G92 X0 Y0 Z50.0 M08 ;
%
```

<Deleting a word>

(1) Position the cursor on a word to be deleted.

(2) Press on the operator's panel.

(Example) To delete “M08”

```
O1000 ;
G92 X0 Y0 Z50.0 M08 ;
%
```

↓

Press .

↓

```
O1000 ;
G92 X0 Y0 Z50.0 ;
%
```

SUPPLEMENT

The cursor can be moved by one of the following three methods:

(1) By the cursor keys

Press the cursor keys on the operator's panel to move the cursor.

(2) By searching for an address

Example) To move the cursor to the next S address

(2-1) Enter address from the operator's panel or using the alphabet character soft key and press the or cursor key.

(2-2) Pressing causes the cursor to move down from the current cursor position to the next S word. Pressing causes the cursor to move up from the current cursor position to the next S word.

(3) By specifying a word

Example) To move the cursor to word “S800”

(3-1) Enter "S800" from the operator's panel and press the or cursor key.

(3-2) Pressing causes the cursor to move down from the current cursor position to the next "S800". Pressing causes the cursor to move up from the current cursor position to the next "S800".

2.3.2 QUICK Screen

Selecting a program using QUICK EDITOR and pressing the [EDIT] soft key allows you to modify the program.

<Inserting a word>

(1) Move the cursor to the position in which to insert a word.

(2) Confirm that the mode is set to "<INS>". If the mode is set to "[OVER]", press

on the operator's panel to change the mode.

(3) You can insert characters directly into the program using keys on the operator's panel or alphabet character soft keys.

<Altering a word>

(1) Position the cursor on a word to be altered.

(2) Confirm that the mode is set to "[OVER]". If the mode is set to "<INS>", press

on the operator's panel to change the mode.

(3) You can overwrite the program with characters entered using keys on the operator's panel or alphabet character soft keys.

SUPPLEMENT

When a G or M code (address "G" or "M" and a 2-digit number following it) is entered, a window appears, which allows you to enter words following the G or M code at a time (simple input of words). For details, see Chapter 11, "QUICK EDITOR", in Part IV.

<Deleting a word>

(1) Position the cursor on a word to be deleted.

(2) Press

or

on the operator's panel. Pressing

deletes the character to the left of the cursor. Pressing

deletes the character at the cursor.

SUPPLEMENT

The cursor can be moved by one of the following methods:

(1) By the cursor keys
Press the cursor keys on the operator's panel to move the cursor.

(2) By the cursor jump function
Pressing the [CURSOR JUMP] soft key can move the cursor to the specified position. For details, see Chapter 11, "QUICK EDITOR", in Part IV.

(3) By searching for a character string
Pressing the [SEARCH] soft key can search for a character string. For details, see Chapter 11, "QUICK EDITOR", in Part IV.

SUPPLEMENT

QUICK EDITOR has other functions useful for editing a program. For details, see Chapter 11, "QUICK EDITOR", in Part IV.

2.4 Deleting a Program

2.4.1 NC Screen

(1) Select the EDIT mode.

(2) Press the PROG function key or 2 PROG + ▽ N. PAGE to display the “PROGRAM” screen.

<Method 1>

(3) Enter the number of a program to be deleted from the operator's panel and press DELETE.

(Example) To delete program "O1000", enter

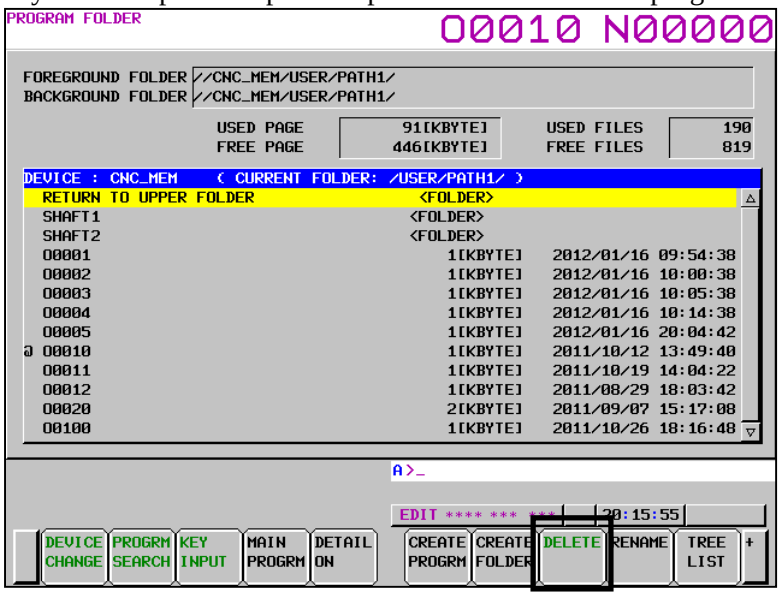
O → 1 POS → 0 SYSTEM → 0 SYSTEM → 0 SYSTEM and press DELETE.

(4) The message "DELETE PROGRAM?" appears. To delete the program, press the [EXEC] soft key. To cancel the deletion, press the [CAN] soft key.

<Method 2>

(3) Press the [FOLDER] soft key to display the PROGRAM FOLDER screen.

(4) Use the cursor keys on the operator's panel to position the cursor on a program to be deleted.

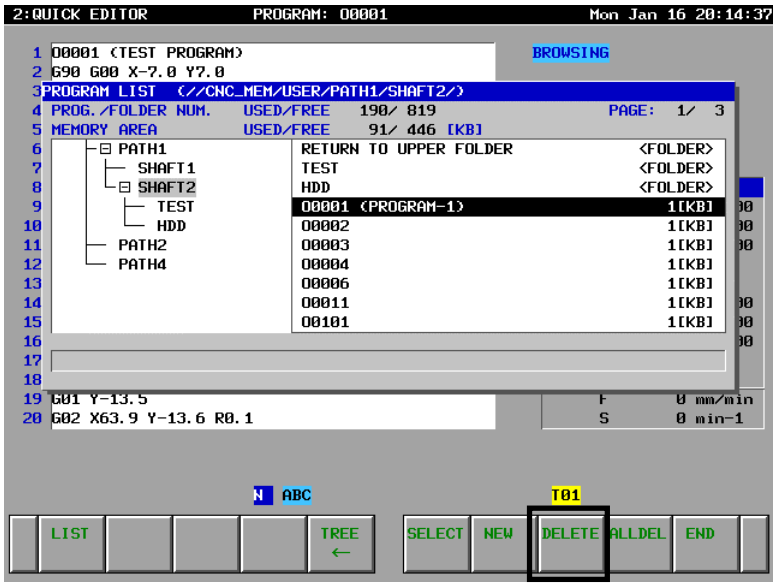


(5) Press the [(OPRT)] soft key, then the [DELETE] soft key.

(6) The message "DELETE PROGRAM?" appears. To delete the program, press the [EXEC] soft key. To cancel the deletion, press the [CAN] soft key.

2.4.2 QUICK Screen

(1) Press the [QUICK EDITOR] soft key to display "2: QUICK EDITOR".
(2) Press the [LIST] soft key to display PROGRAM LIST.
(3) Use the cursor keys on the operator's panel to position the cursor on a program to be selected and press the [SELECT] soft key.
(When a folder tree is displayed, press the [LIST→] soft key to change the window and select a program.)



(4) Press the [EXEC.] soft key. The selected program is deleted.

SUPPLEMENT
Pressing the [ALLDEL] soft key can delete all programs in the folder.

2.5 Inputting and Outputting a Program

A program can be input from and output to an external input/output device.

2.5.1 NC Screen

2.5.1.1 Setting an external input/output device

External input/output devices include a memory card and USB memory inserted into slots on the left side of the LCD, personal computer connected using the embedded Ethernet, and data server.
An external input/output device set for NC parameter No. 0020 is selected (see the table below).

NC parameter No. 0020 settings and corresponding input/output devices

Setting	External input/output device
0,1	RS-232-C interface
4	Memory card interface
5	Data server interface
9	Embedded Ethernet interface
17	USB memory interface

2.5.1.2 Program Input

Input a program from an external input/output device to the CNC memory.

Procedure

(1) Place the input/output device in the read enable state.
(2) Press the

function key to display the "PROGRAM" screen or "PROGRAM FOLDER" screen.
(3) Press the

key on the operator's panel to put the system in the edit mode or in the emergency stop state.
(4) Press the [(OPRT)] soft key.
(5) Press the [F INPUT] soft key (if [F INPUT] is not displayed, press the forward menu key ▷ to change displayed soft keys).
(6) To specify the name of a file to be input, enter the file name from the keyboard and press [F SET] soft key. To specify the name of a program to be input, enter the program name from the keyboard and press the [P SET] soft key.
If the name of a file to be input is omitted, default file name "ALL-PROG.TXT" is used.
For operation performed when [F SET] and [P SET] are omitted, see the table below.

〔F SET〕	〔P SET〕	Input file name	Input program	Input program name
–	–	ALL-PROG.TXT	All programs in ALL-PROG.TXT	Saved file name
–	O	ALL-PROG.TXT	First program in ALL-PROG.TXT	Program name set using [P SET]
O	–	File name set using [F SET]	All programs in the file specified using [F SET]	Saved file name
O	O	File name set using [F SET]	First program in the file specified using [F SET]	Program name set using [P SET]

O: When specified
–: When omitted

(7) Press the [EXEC] soft key.
"INPUT" blinks at the lower right of the screen and the program is input. When the input is finished, "INPUT" goes off.
To cancel the input, press the [CAN] soft key.

The read program is registered to the currently selected foreground folder.

2.5.1.3 Program Output

Output a program registered to the CNC memory to an external input/output device.

Procedure

(1) Place the input/output device in the output enable state.
(2) Press the

function key to display the "PROGRAM" screen or "PROGRAM FOLDER" screen.
(3) Press the

key on the operator's panel to put the system in the edit mode or in the emergency stop state.
(4) Press the [(OPRT)] soft key.
(5) Press the [F OUTPUT] soft key (if [F OUTPUT] is not displayed, press the forward menu key to change displayed soft keys).
(6) Enter the number of a program to be output from the keyboard and press the [P SET] soft key. To specify an output file name, enter the file name from the keyboard and press the [F SET] soft key.
If the name of a file or program to be output is omitted, all programs in the foreground folder are output to "ALL-PROG.TXT".
For operation performed when [F SET] and [P SET] are omitted, see the table below.

〔F SET〕	〔P SET〕	Output file name	Output program
–	– or O-9999	ALL-PROG.TXT	All programs in the foreground folder that are displayed in PROGRAM LIST
–	O	File name set using [P SET]	Program in the NC memory that is set using [P SET]
O	– or O-9999	File name set using [F SET]	All programs in the foreground folder that are displayed in PROGRAM LIST
O	O	File name set using [F SET]	Program in the NC memory that is set using [P SET]

O: When specified
–: When omitted

(7) Press the [EXEC] soft key.
"OUTPUT" blinks at the lower right of the screen and the program is output. When the output is finished, "OUTPUT" goes off.
To cancel the output, press the [CAN] soft key.

2.5.2 QUICK Screen

SUPPLEMENT

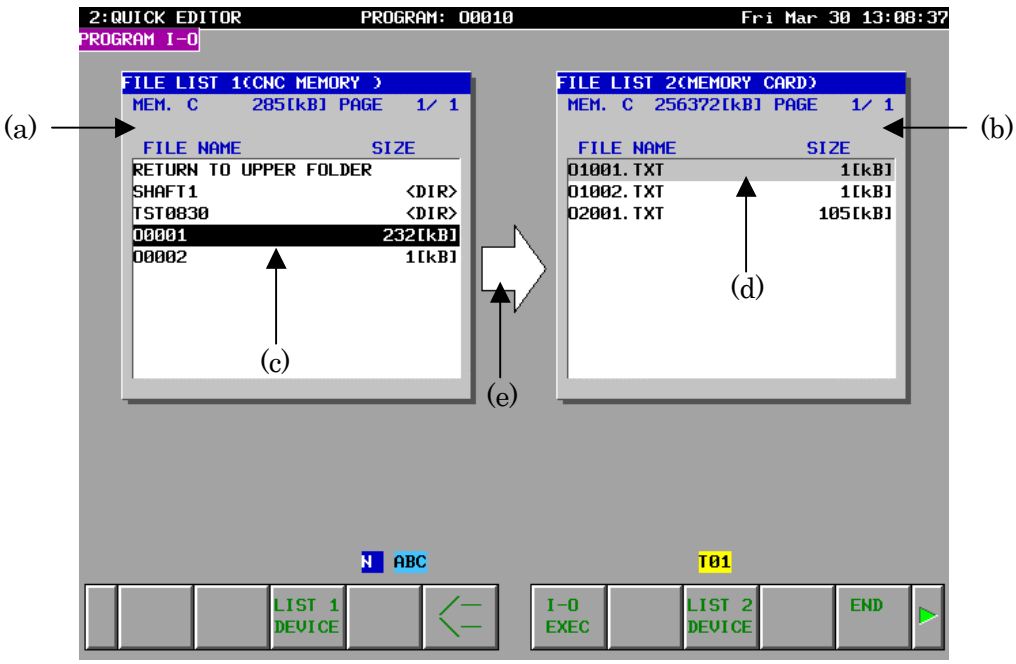
- Using the QUICK screen, a program can be input from or output to a memory card or USB memory.
- To input or output a program using the QUICK screen, NC parameter No. 0020 does not have to be set.

2.5.2.1 PROGRAM I-O screen

Between an external input/output device (memory card or USB memory) and program memory or data server in the CNC, programs and folders can be input and output easily.

Displaying the PROGRAM I-O screen

(1) Press the [QUICK EDITOR] soft key to display "2: QUICK EDITOR".
(2) Press the [PROG. I-O] soft key to display the PROGRAM I-O screen.



(a), (b) Information (remaining capacity and file list) related to the selected device is displayed.
Press the [LIST1 DEVICE] and [LIST2 DEVICE] soft keys to change the devices.
(The selected device is displayed in parentheses in each window title.)

(c), (d) Cursor.
The cursor is displayed in black in the active window or in gray in the inactive window.

(e) The file selected by the cursor is copied in the direction indicated by this arrow.
To change the direction of the arrow, press the [←] soft key.

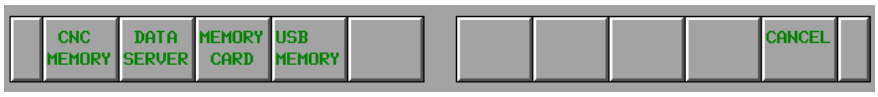
Operation method

(1) Use <↑> and <↓> to select a file or folder and use <←> and <→> to change the active window. To move to a file in a folder, position the cursor on a desired folder and press the <INPUT> key.

(2) The arrow displayed at the center of the screen indicates the direction in which to output a program. The direction of the arrow can be changed by pressing the [←] or [→] soft key.

(3) To change the device displayed in FILE LIST 1, press the [LIST1 DEVICE] soft key. To change the device displayed in FILE LIST 2, press the [LIST2 DEVICE] soft key. The following soft keys are displayed. Select a target device for inputting or outputting a program by pressing the corresponding soft key.

[LIST1 DEVICE]



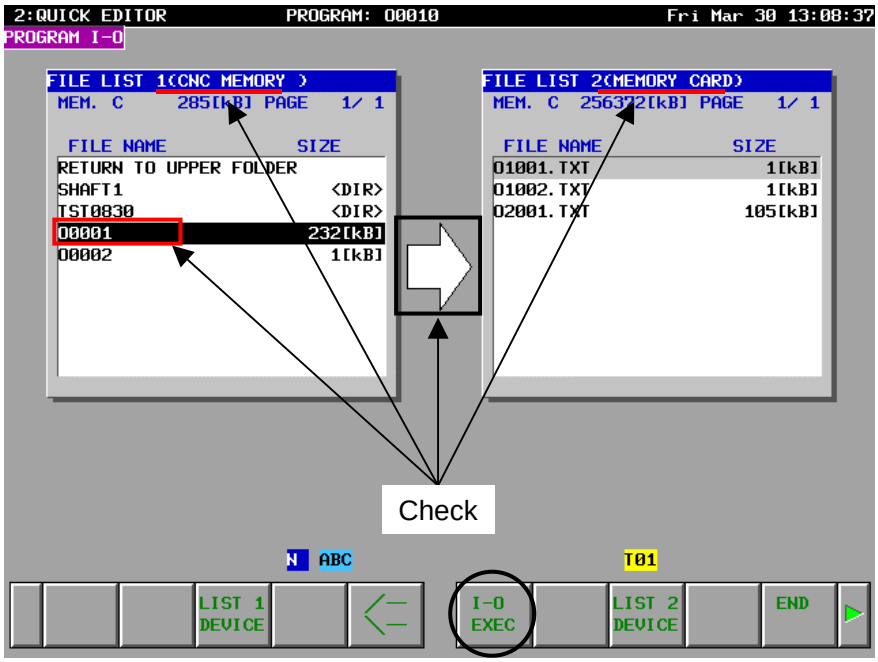
[LIST2 DEVICE]

Inputting and outputting a program

(1) First, select a file to be output. In the file list at the source of the arrow, position the cursor on a file or folder to be output.

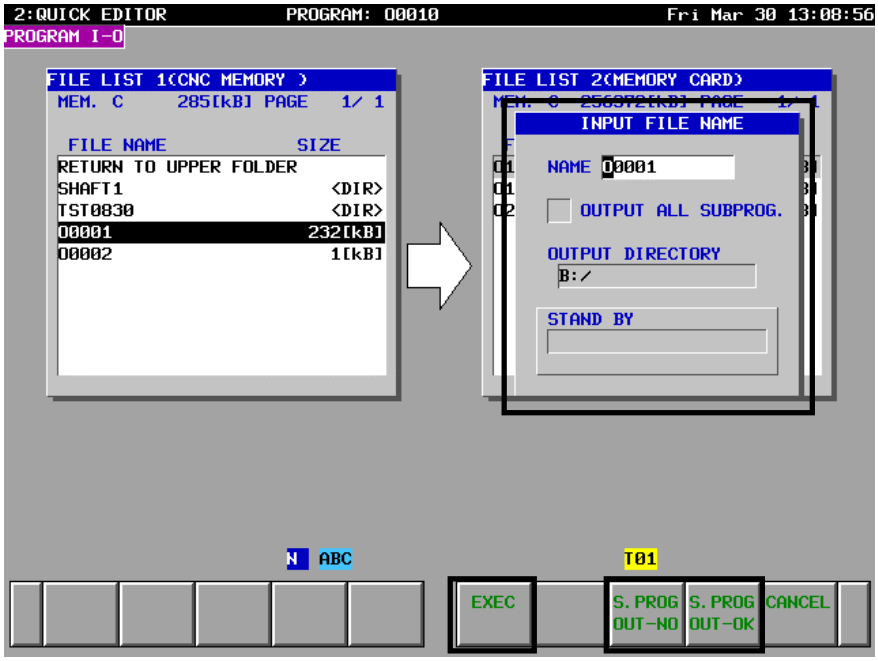
(2) Then, select a folder to which to output the file or folder. Operate the file list at the destination of the arrow and move the folder to which to output the file or folder.

(3) For example, to output program "O0001" in the CNC memory to the root folder in the memory card, set items as shown in the figure below.



(4) Select a correct file to be output and a correct folder to which to output the file, then press the [I-O EXEC] soft key.
The "INPUT FILE NAME" window appears. Enter an output file name and press the [EXEC] soft key. The selected file or folder moves to the output destination device.

(5) When a program is output from the CNC memory or data server to an external input/output device, the subprograms called from the selected program can be output at a time. To output these subprograms, press the [S.PROG OUT-NO] soft key and check "OUTPUT ALL SUBPROG." To uncheck the item, press the [S.PROG OUT-OK] soft key.



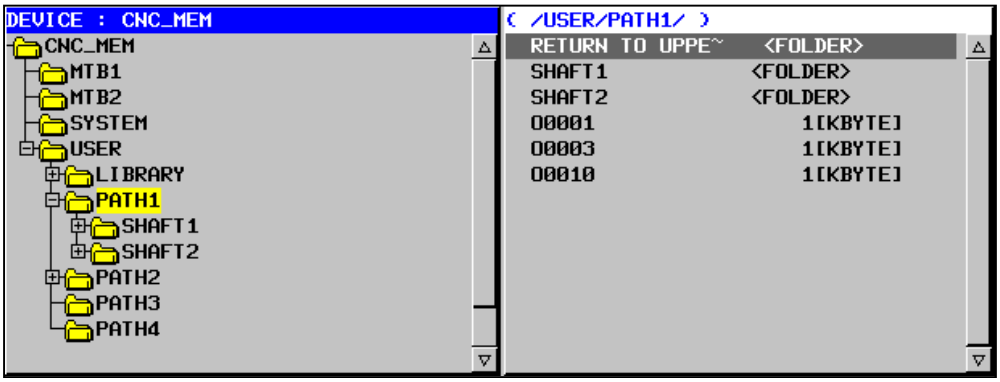
2.6 Folder Tree Display

In the PROGRAM LIST screen, a folder tree can be displayed. The folder tree can be used to make the program management in folder units easier.

2.6.1 NC Screen

2.6.1.1 Procedure for displaying a folder tree

(1) Press PROG on the operator's panel or press 2 PROG, then ▽ N. PAGE on the operator's panel to display the "PROGRAM" screen.
(2) Press the [FOLDER] soft key to display "PROGRAM LIST".
(3) Press the [(OPRT)] soft key, then the [TREE LIST] soft key.



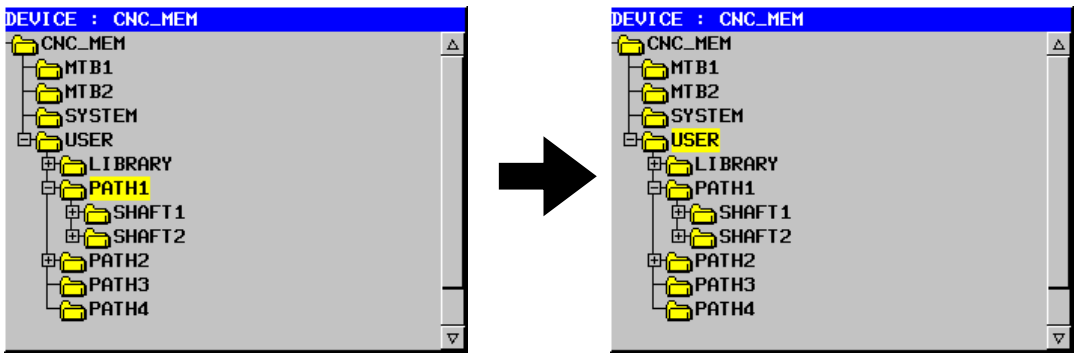
SUPPLEMENT
To cancel tree display, press the [LIST] soft key.

2.6.1.2 Changing the displayed folder

The displayed folder can be changed by using the cursor keys on the operator's panel.

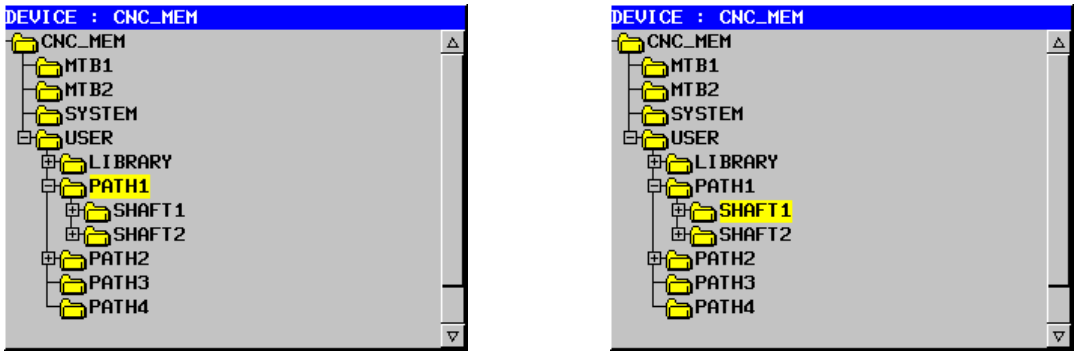
Selecting the upper-level folder

Press the ⇦ cursor key to display the upper-level folder.



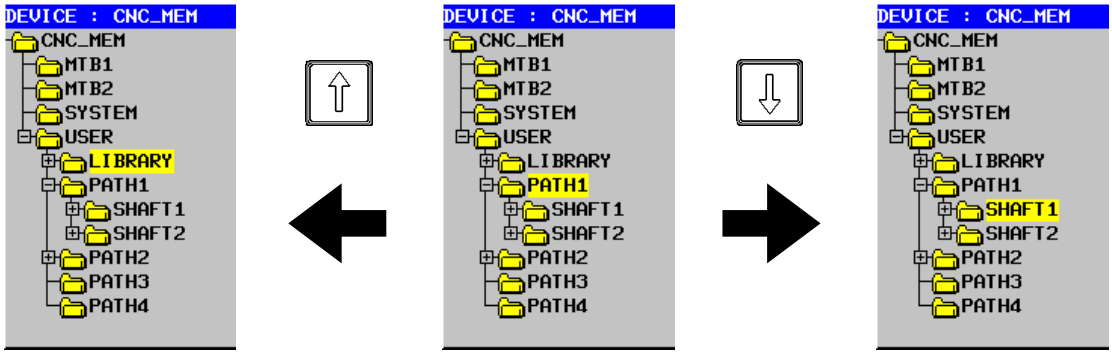
Selecting the lower-level folder

Press the [⇨] cursor key to display the lower-level folder.



Selecting an adjacent folder

Press the [⇧] or [⇩] cursor key to display an adjacent folder.



2.6.1.3 Program list operation

It is possible to switch between folder tree operation and program list operation.
By switching to program list operation, when a folder tree is displayed, program operation such as creation and deletion can be performed in the same way as on the ordinary list screen.

(1) Display a folder tree.
(2) Press the [SHIFT ⇧] key, then the [⇨] cursor key to switch to program list operation.
(3) Press the [SHIFT ⇧] key, then the [⇦] cursor key to return to folder tree operation.

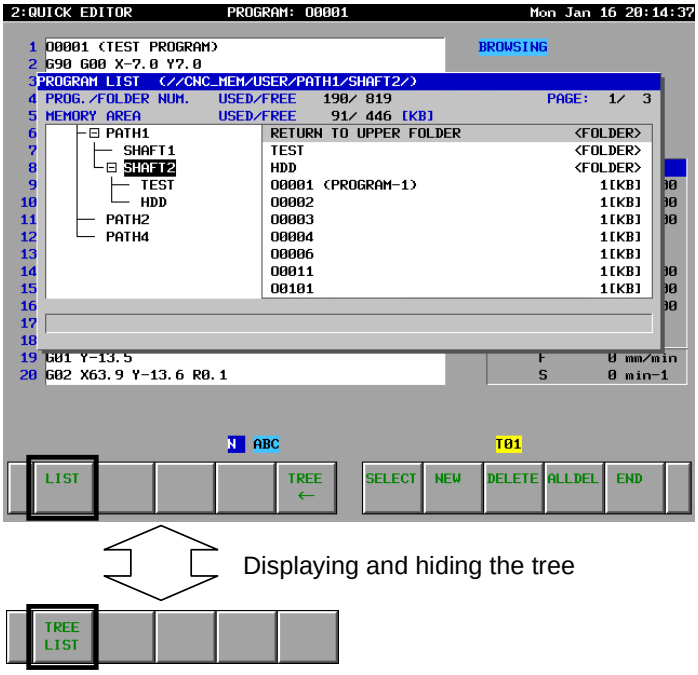
CAUTION
This operation cannot be performed with the standard operator's panel.

2.6.2 QUICK Screen

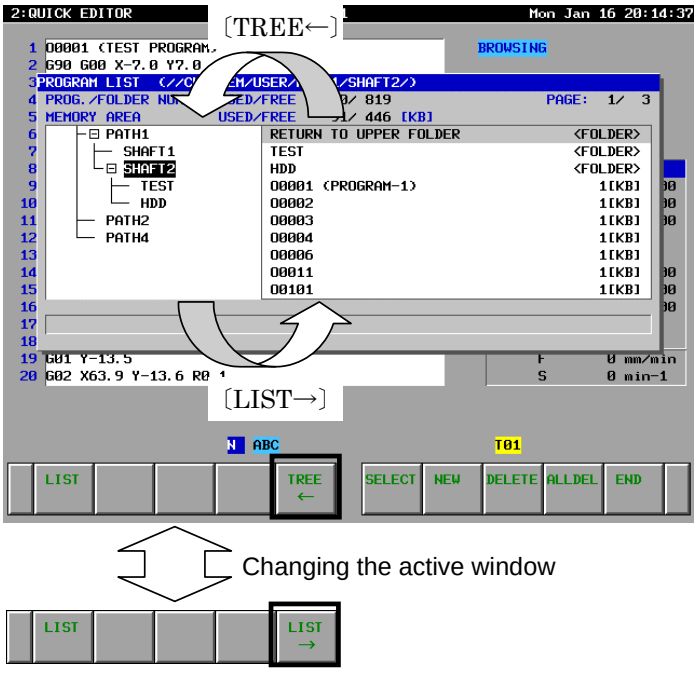
2.6.2.1 Procedure for displaying a folder tree

(1) Press the [QUICK EDITOR] soft key to display "2: QUICK EDITOR", then press the [LIST] soft key to display PROGRAM LIST.

(2) Press the [TREE LIST] soft key to display a folder tree. To close the folder tree display, press the [LIST] soft key.



(3) When a tree is displayed, press the [LIST→] or [TREE←] soft key to change the active window.



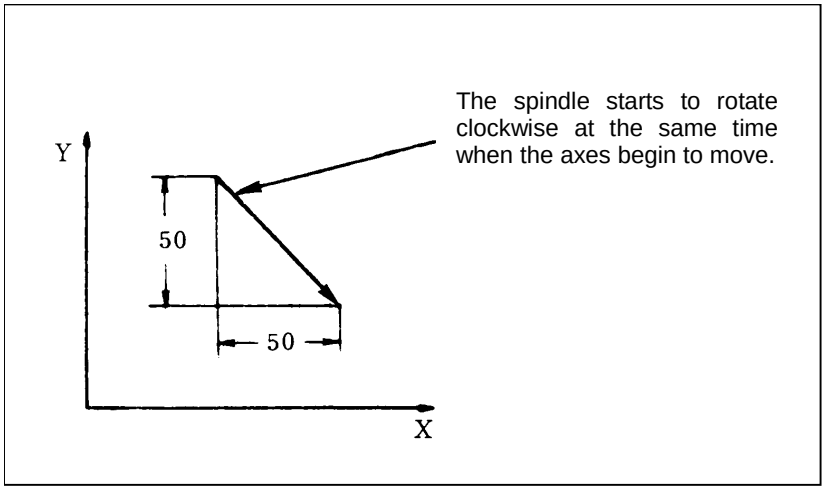
(4) Other operation methods are the same as on the NC screen.

2.7 PROGRAMMING

2.7.1 General

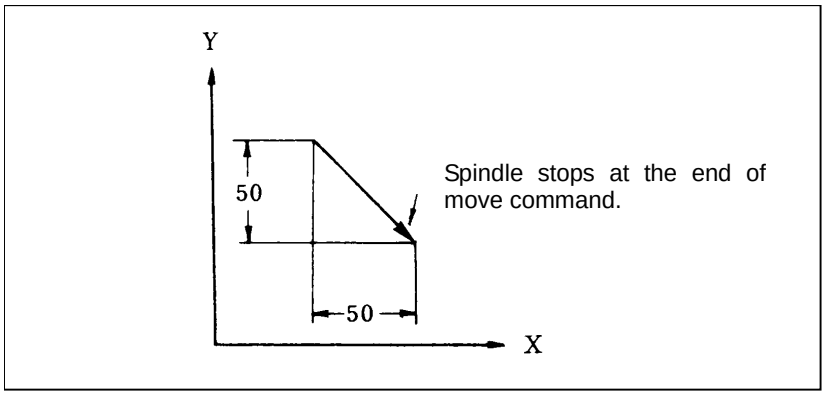
S codes are used for spindle speed control, M codes are used for ON/OFF of the various functions of the machine tool. When move command and an S or M code are commanded in the same block, the S or M function is executed simultaneously with the move command except some M codes.

(Example 1) N1 G01 X50.0 Y-50.0 M03;
(Spindle rotation clockwise)



Only commands M00, M01, M02, M05, M09 and M30 start to be executed when the move command is finished.

(Example 2) N10 G01 X50.0 Y-50.0 M05; (Spindle stop)



2.7.2 Spindle Speed Function (S Function)

The spindle speed is directly controlled by address S and a following 2- to 4-digit number.
(Example) S150……150 min^{-1}
S4000……4,000 min^{-1}

SUPPLEMENT
Spindle speed can be specified ranging from 100 min^{-1} to 10,000 min^{-1} (10,000min^{-1}spindle: Standard spindle, High torque spindle, High acceleration spindle), 240 to 24,000min^{-1} (24,000min^{-1} spindle: High speed spindle) in increments of 1 min^{-1}.

2.7.3 Miscellaneous Function (M Function)

Up to three M codes can be specified at the same time. An M code not marked with * in the table below must be specified as the first M code.

M code	Name	Meaning	Sequence
M00	Program stop	The machine stops after M00.	D
M01	Optional stop	The machine stops after M01.	D
M02	End of program	The machine finishes the program.	D
M03	Spindle CW	The spindle starts to rotate clockwise.	I
M04	Spindle CCW	The spindle starts to rotate counterclockwise.	I
M05	Spindle STOP	The spindle will stop.	D
M06	Tool change	A tool changed will be done.	I
*M07	Air blow ON	The air for chip will blow. (NOTE 1)	I
*M08	Coolant ON	The coolant oil will blow. (NOTE 1)	I
*M09	Coolant OFF	The coolant oil will stop.	D
*M10	Clamp	When clamp/unclamp signal is used by means of additional axis specifications, the 4-axis is clamped.	
*M11	Unclamp	When clamp/unclamp signal is used by means of additional axis specifications, the 4-axis is clamped.	
M12	M code that suppresses buffering	In this block, advanced preview processing is disabled. Use this M code if you want to execute a macro statement at the end of the execution of the immediately preceding block for a custom macro. (NOTE 2)	I
M13	High speed spindle clockwise rotation	The motor in the high-speed spindle holder rotates clockwise.	I
M14	High speed spindle counterclockwise rotation	The motor in the high-speed spindle holder rotates counterclockwise.	I
M15	High speed spindle stop	The motor in the high-speed spindle holder stops rotating.	D
M16	High speed DDR positioning at tool change	The DDR is positioned at a high speed at tool change (option).	I
M17	Touch probe power ON	The touch probe power is switched on (option).	I
M18	Touch probe power OFF	The touch probe power is switched off (option).	I
M19	Spindle orientation	The spindle is positioned to a specific point.	I
M20	Center-through coolant pump OFF	Stops the center-through coolant pump. (Option)	I
M21	Center-through coolant pump ON	Starts the center-through coolant pump. (Option)	I
M22	Center-through coolant ON	Supplies coolant from the tool tip. (Option)	I
M23	Air purge ON	Outputs air from the tool tip. (Option)	I

M code	Name	Meaning	Sequence
M24	Center-through coolant/air purge OFF	Stops center-through coolant/air purge. (Option)	D
M25	Turret indexing	The full-automatic turret recovery function is used to perform turret indexing (option).	I
M26	Spindle taper cleaning function enable	A cleaning function for the spindle taper that may have been smeared with coolant is enabled (option).	D
M27	Spindle taper cleaning function disable	A cleaning function for the spindle taper that may have been smeared with coolant is disabled (option).	D
M28	Small hope peck drilling cycle ON	Turns small-diameter, deep hole drilling cycle mode ON. (Option)	I
M29	Rigid mode	Tapping cycle is rigid mode	I
M30	End of program	The machine finishes the program.	D
M31	Setting of the machining mode and power saving mode	See Subsections 36.3, “Setting the Machining Mode Using a Program Command”, and 40.2.2, “Setting the Power Saving Mode Using a Program Command,” in Part IV.	I
*M32	Peck cycle	Triggers AI function no–load detection.	I
*M33	Peck cycle	Judges on AI function no–load detection.	I
*M34	Peck cycle	Ends AI function no–load detection.	I
M35	(Reservation)		
M36	(Reservation)		
M37	(Reservation)		
M38	Start of touch probe abnormality detection	Starts detecting touch probe abnormality.	I
M39	End of touch probe abnormality detection	Ends detecting touch probe abnormality.	I
*M40	AI function disable	Disables the AI function.	I
*M41	AI function enable	Enables the AI function.	I
M42	-	Used by the machine a menu.	I
*M43	M code for alarm determination	Checks the current tool life and automatic lubrication status and outputs an alarm.	I
M44	Programmed data rewrite	Sets the data of AI tool monitor.	I
M45	-	Used by macroprogram 09029.	I
M46	-	Used by macroprogram 09029.	I
M47	Setting of the rapid traverse override	Sets and changes the rapid traverse rate in the program.	I
*M50 (NOTE2)	Air blow ON	The air for chip will blow.	I
*M52	Safety gate closing	The safety gate (side door) is closed. (Robot system)	I
*M53	Safety gate opening	The safety gate (side door) is opened. (Robot system)	I
M54	(Reservation)		
M57	(Reservation)		
M58	(Reservation)		
M59	(Reservation)		
*M60 to M65	Automatic door opening/closing and output signal ON until answer comes	In the case of splashguard B with automatic door opening/closing specifications, the door opens/closes automatically.	I
*M66	High speed spindle holder detection ON	The high-speed spindle holder detection mode is turned on.	I
*M67	High speed spindle holder detection OFF	The high-speed spindle holder detection mode is turned off.	I
*M68	The 5-axis clamp	When clamp/unclamp signal is used by means of additional axis specifications, the 5-axis is clamped.	

M code	Name	Meaning	Sequence
*M69	The 5-axis unclamp	When clamp/unclamp signal is used by means of additional axis specifications, the 5-axis is unclamped.	
*M70	4th-axis clamp check (dedicated to DDR)	Checks whether the 4th axis (DDR) is clamped normally.	
*M71	The 4-axis clamp	When clamp/unclamp signal is used by means of additional axis specifications, the 4-axis is clamped.	
*M72	The 4-axis unclamp	When clamp/unclamp signal is used by means of additional axis specifications, the 4-axis is unclamped.	
*M73	X-axis mirror image ON	X-axis turns the mirror image function ON.	I
*M74	Y-axis mirror image ON	Y-axis turns the mirror image function ON.	I
M75	Learning control for parts cutting B ON/OFF	See Chapter 43, "LEARNING CONTROL FOR PARTS CUTTING B", in Part IV.	I
*M76	The 4-axis mirror image ON	The 4-axis turns the mirror image function ON.	I
*M77	Mirror image OFF	Mirror image is OFF	I
*M78	High speed spindle connection	The high-speed spindle is connected.	I
*M79	High speed spindle disconnection	The high-speed spindle is disconnected.	I
M80 to M89	For external interface	See IV-14.4.1 (5), "M code output function".	I
M90	(Reservation)		
*M91	Product control counter 1	Counts the amount of products for counter 1.	I
*M92	Product control counter 2	Counts the amount of products for counter 2.	I
M93	(Reservation)		
M94	(Reservation)		
M95	(Reservation)		
M96	Interruption type custom macro ON	Enables the custom macro interrupt function.	I
M97	Interruption type custom macro OFF	Disables the custom macro interrupt function.	I
M98	Calling of subprogram		I
M99	End of subprogram		I
M100 to M129	For external interface	See IV-14.4.1 (5), "M code output function".	I
*M130	Flood coolant ON	Causes the machine cleaning coolant to come out.	I
*M131	Flood coolant OFF	Stops the machine cleaning coolant.	I
M132	Tool registration (tool runout detection function)	Registers tool data.	I
M133	Runout measurement (tool runout detection function)	Measures tool runout.	I
*M170	5th-axis clamp check (dedicated to DDR)	Checks to see if the fifth axis (DDR) is normally clamped.	
*M171	The 5-axis clamp (dedicated to DDR)	Clamps the fifth axis (DDR).	
*M172	The 5-axis unclamp (dedicated to DDR)	Unclamps the fifth axis (DDR).	
M198	Subprogram call from external memory		I

SUPPLEMENT

"I" and "D" in the column "Sequence" means as follows:

I: This function will be active as soon as the block is read.

D: This function will be active after all commands in the block have been executed.

CAUTION
1 When the center through coolant specification is applied, M07 and M08 must be specified as the first M code.
2 With the ROBODRILL of this series, AI contour control is enabled by default at the start of automatic operation (NC parameter No. 1604#0 = 1). Accordingly, program advanced preview processing is performed automatically. When you do not want to perform advanced preview processing for, for example, custom macro conditional expressions, add a block specifying M12.

(1) M00: Program stop
Automatic operation is stopped after a block containing M00 is executed. Even when the program is stopped, all modal information remains unchanged as in single block operation. The automatic operation can be restarted by pushing the <CYCLE START> button.
In the status light (option) specifications, a yellow display lamp illuminates.

(2) M01: Optional stop
Similar to the M00, automatic operation is stopped after a block which contains M01 is executed. This code is effective only when the optional stop switch is ON on the operator's panel. In the status light (option) specifications, a yellow display lamp illuminates.

(3) M02, M30: End of program
(a) Indicates the end of the main program. Used when the program is loaded in memory from tape.
(b) Ends automatic operation and resets.
(c) For memory operation, passes program control to the beginning of the program.
(d) In the status light (option) specifications, the yellow display lamp blinks.
(e) M30 puts the automatic power turn-off function into effect, provided that the function is enabled.

(4) M29: Rigid mode
When M29 Sxxxx is commanded previous to tapping/reverse tapping cycle command, the machine becomes rigid mode. Refer to IV-2.2.6.

(5) M32 to M34, M40 to M46: AI tool monitor
These M functions are related to the AI tool monitor. For details, see descriptions about the AI tool monitor.

(6) M47: Setting of the rapid traverse override
By specifying M47 C**; (C = 0 to 100), the rapid traverse rate can be set and changed in the program.
By specifying M47 C0; M02/M30, the specification can be canceled. The specification is also canceled by inputting the reset signal by pressing the reset button on the operator’s panel. The value specified in the M47 command corresponds to the override value specified when 100% is selected with the rapid traverse override key on the operator’s panel. (When 50% is selected with the rapid traverse override key on the operator’s panel and M47 C50; is specified, an override of 25% is applied.)
(This function is enabled when bit 7 of K32 is set to 1.)

(7) M60 to M65: Automatic opening and closing of the door
This function is provided for the splash guard with an automatic door. With this function, the door can be opened while a program is being executed to access the inside of the machine. After the access is completed, the door can be closed automatically by applying an external signal to the machine. After the door is closed, program execution resumes.
This function is useful when a robot or pallet changer is used.

(8) M98: Calling of subprogram
This code is used to enter a subprogram. Refer to "Execution of subprogram" in the Operator's Manual of NC for details.

(9) M99: End of subprogram
This code shows the end of a subprogram. Executing M99 takes the control back to the main program. Refer to "Preparation of Subprograms" in the Operator's Manual of NC for details.

SUPPLEMENT

- If there is a block following M00, M01, M02 or M30, it is not read into the buffer.
- M codes M00 to M199 are reserved for use for the ROBODRILL.
- To use the external M code BCD output function, use M codes M200 or higher.

2.7.4 Tool Function (T Function)

Specify a tool position by using a 2-digit or 3-digit number after T.

M06T□□ (□□ : Tool number) or
M06T□□□ (□□□ : Tool group number)

A tool thus specified can be randomly specified via the shortest path. When using the tool life management function, specify a tool group number in the T code. In addition to the T function, the following incremental command can be specified:

M06Pn (n : the nth from present tool position with CW)

SUPPLEMENT

- When T is not specified in a command such as M06, the current tool is changed to the tool with the adjacent tool number on the right.
- When a tool number other than 01, 02, ..., 14(*) is specified, alarm 251 (an ATC error) is issued.
- If a value other than 1, 2, ..., 14(*) is specified in n after P, the remainder obtained by dividing the value by 14(*) is assumed. For example, when 58 is specified in n, n is assumed to be 2.
- Executing a tool change command in the canned cycle, tool length compensation, or cutter compensation mode results in the alarm PS347 (tool change was specified in the mode where it should not) being raised. Before issuing a tool change command, be sure to exit the canned cycle, tool length compensation, or cutter compensation mode.
  (G49 and G80 can be issued in the same block as for M06.)
- When Tool change sequence is being executed, Z axis must not be moved by manual operation after stopping the Tool change sequence by single block or pressing the <FEED HOLD> button.
- When the tool change (M06) command is specified, coolant stops. Therefore, specify the command to turn on the coolant (M08) in the next block as necessary (When the PMC parameter K00#7 is set to 0).

* For the α-D21*i*A5 series, up to 21.

CAUTION

Do not specify S together with M06 in the same block.

2.7.5 Spindle Orientation Function (M19 Function)

(1) M19 ;
The spindle stops at the position of angle specified in parameter (Note) by means of this command.

SUPPLEMENT
At this time of the shipment the spindle stop position is adjusted so that the spindle key is parallel with the Y-axis direction

(2) M19 S_ ;
↑
└— Angle specification (0° to 359°)
This command enable the angle (0° to 359°) to be specified.

SUPPLEMENT
- This command is effective until a spindle rotation command (M03, M04), spindle stop command (M05), or a command specifying a miscellaneous function for terminating the program (such as M00 and M01) is executed. (The reset key stops spindle excitation but does not cancel a command.) When a tool change is specified during this command, alarm 252 (an ATC spindle alarm) is issued. When a spindle index function command is executed during rigid tapping, alarm EX1007 (M19 not permitted during tapping) is issued.
- Do not execute this command during canned cycle. In fine boring (G76) and back boring (G87), the spindle index is automatically performed and the table shifts. Table shift direction is set in parameter No. 5101.

2.7.6 Rigid Tapping Cycle (Function M29)

(1) General

Tapping cycle (G84) and reverse tapping cycle (G74) are effective in both of rigid mode and conventional mode. These modes are switched by M code. Rigid tapping is performed by simultaneously feeding the spindle and the Z axis without the floating tapper, therefore, effective for high-speed and high-accuracy tapping.

(2) Command format

G□□ X_ Y_ Z_ R_ P_ Q_ F_ K_ ;

- K_ : Repeat number
- F_ : Cutting feedrate
- Q_ : Depth of cut in the peck tapping cycle
- P_ : Dwell time at the bottom of tapping and R-point return
- R_ : Position command at R-point
- Z_ : Position command at the bottom of tapping
- X_ Y_ : Position command of tapping
- G74 : Reverse tapping cycle
- G84 : Tapping cycle

SUPPLEMENT
- The machining start point in a peck tapping cycle and clearance d in a high-speed peck tapping cycle are specified in CNC parameter No. 5213.
- A peck tapping cycle is validated by the Q command. When Q0 is specified, no peck tapping cycle is executed.

(3) Rigid mode

To specify the rigid mode, M29Sxxxx; is commanded previous to tapping/reverse tapping cycle command. The spindle is stopped, and tapping/reverse tapping cycle is the following command becomes rigid mode.

```
      …
      …
M29Sxxxx ;
G□□  X___ Y___ Z___ R___ P___ Q___ F___ K___ ;
X___ Y___ ;
X___ Y___ ;
      …
      …
G80 ;
      …
      …
F ___ Sxxxx;   Lead of thread
```

Rigid mode

Sxxxx should be less than 6000 (6000 min^{-1}) (Standard spindle, High torque spindle) [or 8000 (8000 min^{-1}) (High acceleration spindle, High speed spindle)]. When a value greater than this value is specified, PS alarm No. 0200 is issued in the G__ block.
F __ should be less than 30000 (30 m/min). If a value more than 30000 is commanded, the feed rate does not exceed 30000 (30 m/min).
It is impossible to input Sxxxx again before inputting G□□ , after having input Sxxxx once. Do not specify M29 during the canned cycle in the conventional mode. In any case, a PS alarm (No. 0203) occurs.
When the rigid tapping cycle ends, the spindle stops, that is, S0 is specified.
After specifying G code (G80, other canned cycle G code, or G code in group 01), rigid mode will change to former mode.

SUPPLEMENT
- G□□ indicates the reverse tapping cycle (G74) and tapping cycle (G84).
- Be sure to input Sxxxx in the M29 block. Even when the canned cycle cancel (G80) is entered without executing the tapping cycles (G74, G84) after the rigid mode is selected by M29Sxxxx;, the rigid mode is not released.
- Specify M29Sxxxx independently without fail.
- Do not issue M03, M04, or M05 in the block that follows directly any block containing G80 (canned cycle cancel).
- Don't specify M03, M04 and M05 in the block between M29Sxxxx and G80.

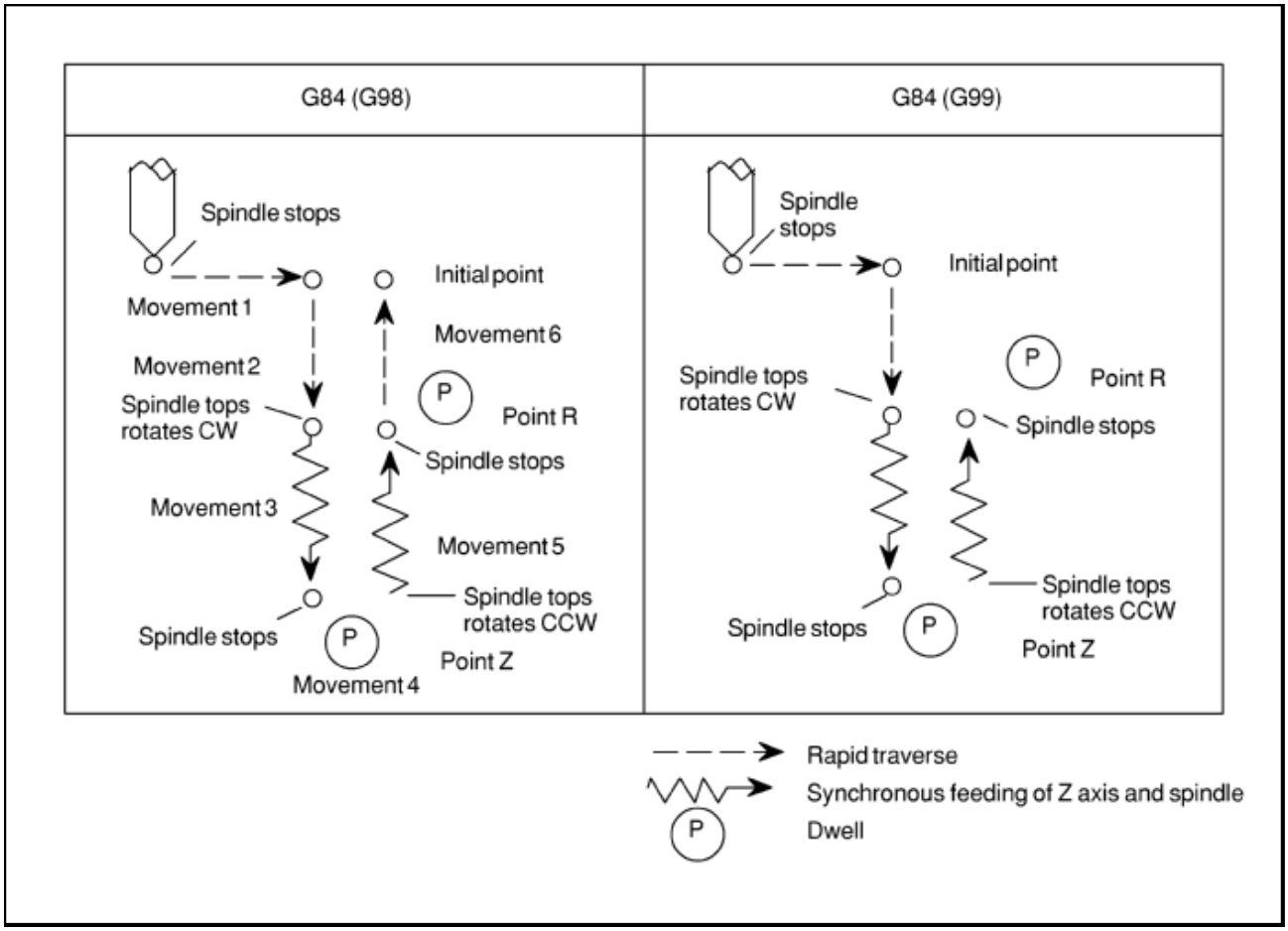
(4) Conventional mode (floating tap)

Command method in conventional mode remains. Refer to the NC's OPERATOR'S MANUAL for details.

```
…
…
M03 (or M04) Sxxxx ;
G□□ X___ Y___ Z___ R___ P___ Q___ F___ K___ ;
X___ Y___ ;
X___ Y___ ;
…
…
G80 ;
```

(5) G84 (Tapping cycle)

Command method in conventional mode remains.
G84 in rigid mode is shown below.

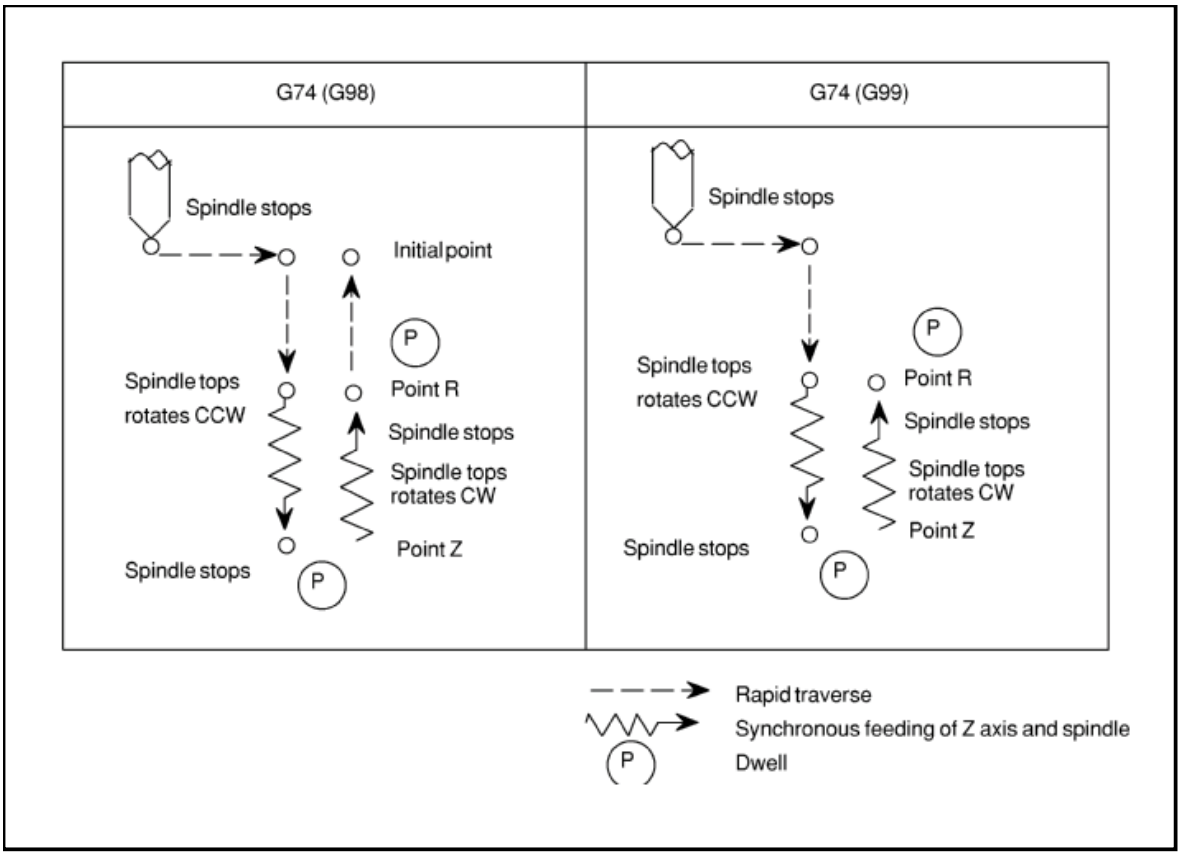


SUPPLEMENT

- Feedrate override during synchronously feeding Z axis and spindle is assumed 100%. Override of spindle is also assumed 100%.
- Single block
  When executing tapping cycle in single block, the machine dwells or stops at terminate points of movement 1, 2 and 6.
- Feed hold
  When specifying feed hold while movement 3 through 5, FEED HOLD lamp will be lit immediately, but the machine will not stop immediately and stops after movement 6 will finish. When specifying feed hold while movement 6 is executed, the machine will stop immediately.

(6) G74 (Reverse tapping cycle)

Command method in conventional mode remains.
G74 in rigid mode is shown below.



Notes and other instructions are the same as those described in (5), "G84 (Tapping cycle)", above, except for the difference between reverse tapping and tapping.

2.7.7 Rigid Tapping Extraction Override Function

2.7.7.1 Outline

In rigid tapping, an extraction operation can be overridden to reduce processing time.
Either of the following values can be enabled as an extraction override at the time of extraction: Fixed override value set in the parameter or override value specified in a program.

2.7.7.2 Parameter specification

Set NC parameter No. 5200#4 = 1 and specify the override value in parameter No. 5211.
An override value of 0% to 200% can be set in units of 1%. By setting NC parameter No. 5201#3 = 1, an override value of 0% to 2000% can be set in units of 10%.

2.7.7.3 Programmed command

By setting NC parameter No. 5200#4 = 1 and NC parameter No. 5201#4 = 1, the spindle speed used at the time of extraction operation (called the return spindle speed hereinafter) can be specified in a program.
To specify an extraction override in a program, use address J, and specify a return spindle speed as part of hole machining data in a G84 block.
To make this function available, set NC parameter No. 5201#4 (OV3) = 1 and NC parameter No. 5200#4 (DOV) = 1.
At address J, specify a return spindle speed. Then the following calculation is made to convert the specified speed to an override value and override the extraction operation:

$$\frac{\text{Return spindle speed (value specified at address J)}}{\text{Spindle speed (value specified at address S)}} \times 100 = \text{Extraction override value}$$

Therefore, the spindle speed at the time of extraction may not sometimes match the speed specified at address J.
If the extraction override is not within the range from 100% to 200% (from 100% to 2000% when NC parameter No. 5202#6 is set to 1) as a result of the conversion by the above calculation, the extraction override is assumed to be 100% (the return spindle speed is ignored).

Example:

To perform an extraction twice faster than the tapping operation, specify the following :

```
.
M29 S1000;
G84 Z-100.F1000 J2000;
.
.
```

Since address J specifies a return spindle speed, do not specify a decimal point and minus sign. Note that if a value with a decimal point is specified, the specified value is converted considering the least input increment. (For example, when J1. is specified in metric input, the value specified at J is assumed to be 1000.) If a minus sign is used, an invalid extraction override value is obtained, so the return spindle speed is ignored (the extraction override is set to 100%).

2.7.7.4 Parameters

	#7	#6	#5	#4	#3	#2	#1	#0
5200				DOV				

#4 DOV In rigid tapping, override at the time of the extraction operation is:
0 : Disabled.
1 : Enabled.

	#7	#6	#5	#4	#3	#2	#1	#0
5201				OV3	OVU			

#3 OVU The increment system of the parameter for rigid tapping extraction override (parameter No. 5211) is:
0 : 1%.
1 : 10%.

#4 OV3 Override applied to the extraction operation by specifying a spindle speed for the extraction in the program is:
0 : Disabled.
1 : Enabled.

	#7	#6	#5	#4	#3	#2	#1	#0
5202		OVE						

#6 OVE The range of an extraction override specified in a program for rigid tapping (address J) is:
0 : 100% to 200%
1 : 100% to 2000%

NOTE
After setting this parameter, switch off the power.

5211	Override value at rigid tapping extraction

[Data type] Byte
[Unit of data] 1% or 10%
[Valid data range] 0 to 200
This parameter sets the override value at the time of the extraction operation in rigid tapping.
(Set an override value for a rigid tapping return in parameter No. 5381.)
If it is 0, no override is applied.

5381	Rigid tapping return override value

[Data type] Word
[Unit of data] %
[Valid data range] 0 to 200
This parameter sets an override value for a rigid tapping return. If it is 0, no override is applied.

2.7.7.5 Notes

- The rigid tapping extraction override function is valid when NC parameter No. 5200#4 is set to 1.
- Note that the increment system of the extraction override value (parameter No. 5211) changes depending on the setting of NC parameter No. 5201#3.
- Programmed extraction override is valid when NC parameter No. 5200#4 and of NC parameter No. 5201#4 are both set to 1.
  When NC parameter No. 5200#4 is set to 0, extraction override is disabled.
  When NC parameter No. 5200#4 is set to 1 and NC parameter No. 5201#4 is set to 0, parameter-set extraction override is enabled.
- To enable an extraction override of up to 2000% (20 times) to be set in the parameter, set NC parameter No. 5201#3 to 1.
- To enable an extraction override of up to 2000% (20 times) to be set in a program, set NC parameter No. 5202#6 to 1.
- If the extraction override value specified in a program is not within the range from 100% to 200% or from 100% to 2000%, the extraction override is assumed to be 100%.
- At address J at which a return spindle speed is specified, do not use a decimal point and minus sign.
- By using the following equation, calculate the maximum allowable extraction override value, and be careful not to apply an override exceeding the calculated maximum value, so that the spindle speed resulting from the application of the extraction override does not exceed the maximum spindle speed (set in parameter No. 5241, 5242, 5243, and 5244):

$$\frac{\text{Maximum spindle speed (parameter-set value)}}{\text{Spindle speed (specified at address S)}} \times 100 = \text{Maximum extraction override value}$$

A match with the maximum spindle speed (parameter-set value) does not sometimes occur depending on the extraction override value.

- A command at address J in a G84 block is valid only when rigid tapping is performed.
- When address J specifying the return spindle speed is specified in the tapping canned cycle mode, the specified return spindle speed is kept valid until the canned cycle mode is canceled unless a new return spindle speed is specified.

SUPPLEMENT

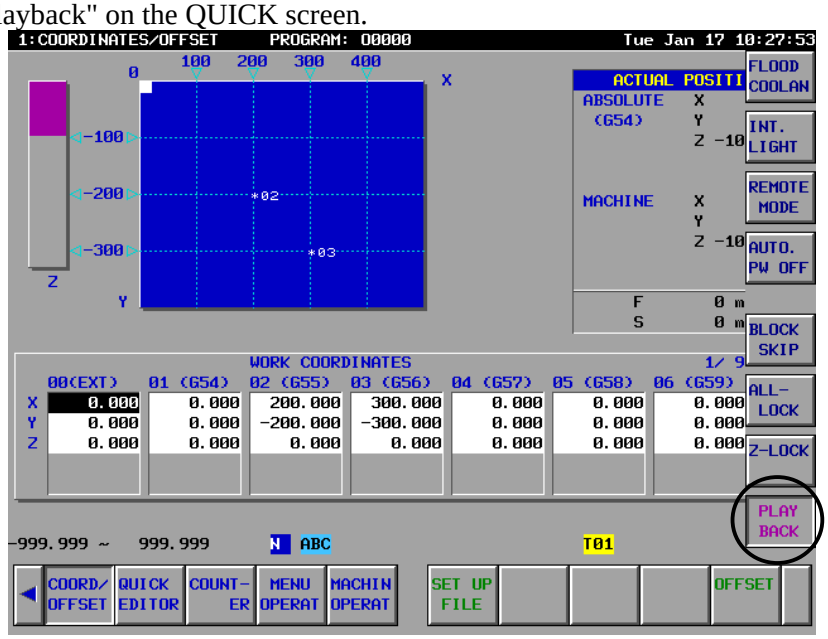
A greater override may result in lack of precision.
Set an override while checking the precision.

2.8 PLAYBACK

The machine position obtained by the manual operation is inserted in a program and a program can be created. In other words, after the tool is moved by the manual operation (jog or handle feed), the tool can be moved by the same distance in the automatic operation (playback).
Words other than X, Y, Z (B, C, D, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, EOB) can be registered in the memory by exactly the same operation as EDIT mode.

The machine position is inserted by the following procedure.

(1) "Enable" "Playback" on the QUICK screen.



(2) In the handle (<THND>) mode or jog (<TJOG>) mode, move the machine to the required position.

(3) Press the PROG function key or 2 PROG + N. PAGE.

(4) Move the cursor to the location where the machine position is to be inserted.

(5) Enter the address X [X] .

(6) Push the INSERT key, then the machine position along the X axis is stored in the memory.

If the current machine position is X10.521 Y30.270 Z-15.0, for example, X10521 is stored in memory as X-axis coordinate value, by pushing the INSERT key.

Content stored in the program = X10521

Push [Y], INSERT , [Z] and INSERT keys, then the machine position along the Y and Z axis is stored in the memory respectively.

SUPPLEMENT

- After entering the address X, Y or Z, enter numerical values and push

key then the values entered in the machine position are added and registered. This is used to correct the machine position through key entry.
- The coordinate value registered in this way is an absolute coordinate.
- Enter G90 (Absolute command) at the head of a program.
- Insert in the same way as edit operation for program commands other than machine position.
- Insert an EOB ([;] ,

), and one block registration completes.

3 DISPLAYING AND CHANGING PARAMETERS

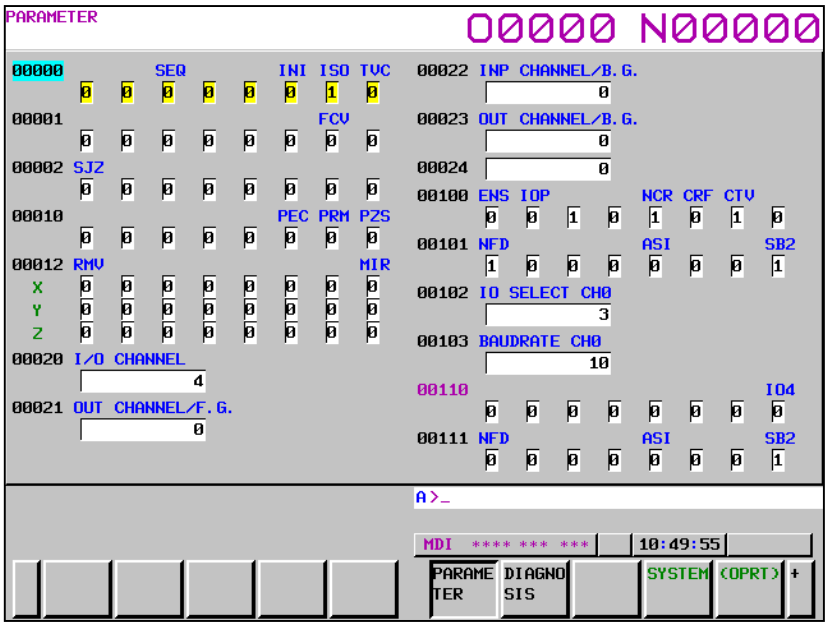
3.1 DISPLAYING PARAMETERS

SUPPLEMENT
Modes need not be changed when parameters are only monitored. Modes can be monitored even automatic operation.

3.1.1 NC Parameter

Follow the procedure below to display parameters.

(1) After pressing the SYSTEM function key or 0 SYSTEM and N. PAGE, pressing the chapter selection soft key [PARAM] selects the parameter screen.



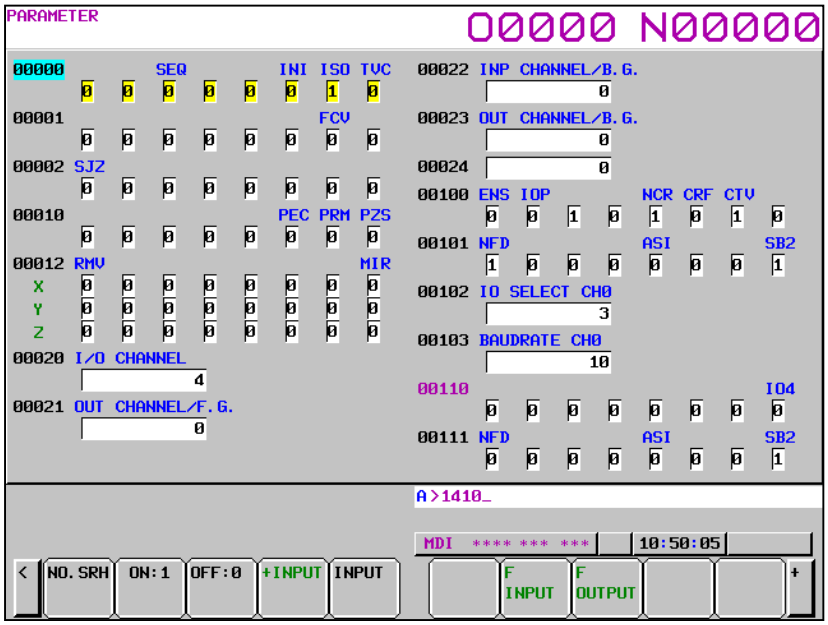
(2) The parameter screen consists of multiple pages. Use step (a) or (b) to display the page that contains the parameter you want to display.

(a) Use the page select key P. PAGE, N. PAGE or the cursor move keys ↑ ↓ → → to display the desired page.

(b) Enter the data number of the parameter you want to display from the keyboard, then press the [NO.SRH] soft key. The parameter page containing the specified data number appears with the cursor positioned at the data number (The data is indicated with the yellow cursor).

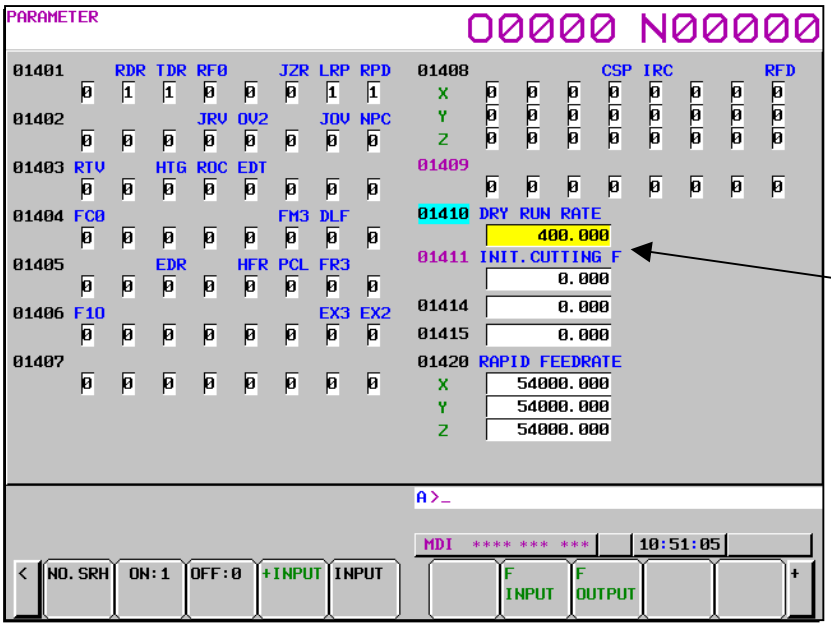
SUPPLEMENT

If key entry is started with the section select soft keys displayed, they are replaced automatically by operation select soft keys including [NO.SRH]. Pressing the [(OPRT)] soft key can also cause the operation select keys to be displayed.



← Data entered from the keyboard

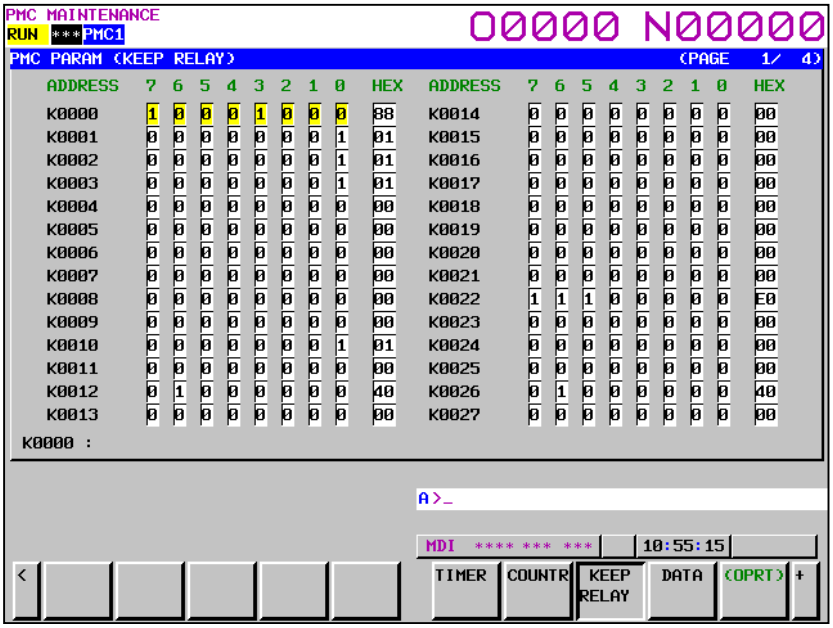
← Soft key display (section select)



Cursor display

3.1.2 PMC Parameter

(1) After pressing the SYSTEM function key or 0 SYSTEM and N. PAGE, pressing the chapter selection soft key [PMC MAINTE] selects the PMC maintenance screen.
(2) Pressing the soft key [KEEP RELAY] displays the "PMC PARAM (KEEP RELAY)" screen.



The parameter screen consists of multiple pages. Use step (a) or (b) to display the page that contains the parameter you want to display.

(a) Use the page switch keys or the cursor move keys to display the necessary page.
(b) Enter the data number for the parameter you want to display from the keypad, then press the soft key [INSPECT]. The page containing the specified data number appears with the cursor positioned at the data number (The data is indicated with the yellow cursor).

3.2 CHANGING PARAMETERS

> ⚠ **WARNING**
> Do not change any parameter unless you have sufficient knowledge. Changing a parameter may disable the interlock, leading to a higher risk of injury. After changing any parameter, make sure that the interlock works.

> **SUPPLEMENT**
> Parameters can be changed only in the MDI mode, where the machine is at rest or in the emergency stop state.

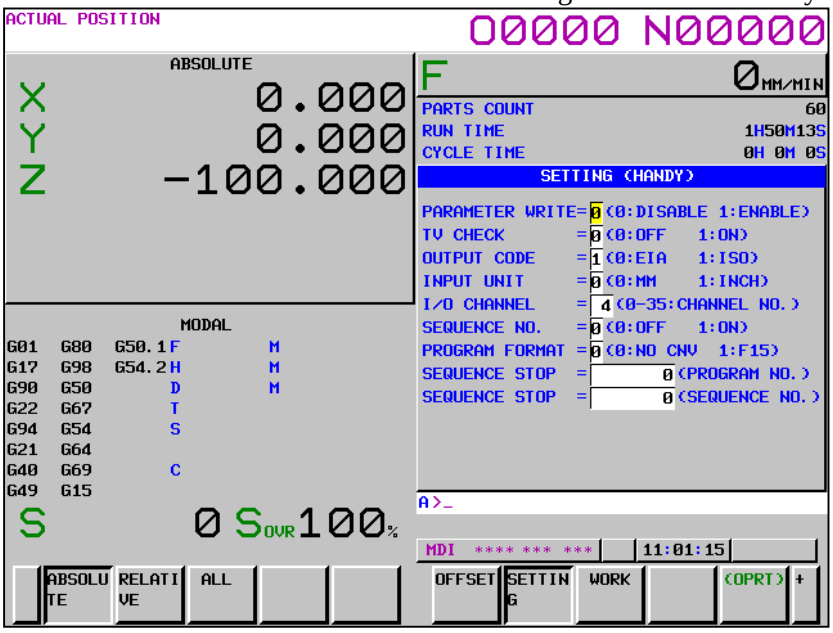
Some parameter settings can be used to change the behavior of the machine. After changing parameters, the machine may not operate or something very dangerous may occur depending on the situation. Therefore, parameters are usually not changeable (i.e., write-protected). Setting "PARAMETER WRITE" in the SETTING window to "1" can cancel write protection.
Before re-setting a parameter, be sure to check the number for the parameter and the new setting.

Following is the procedure for changing NC parameters.

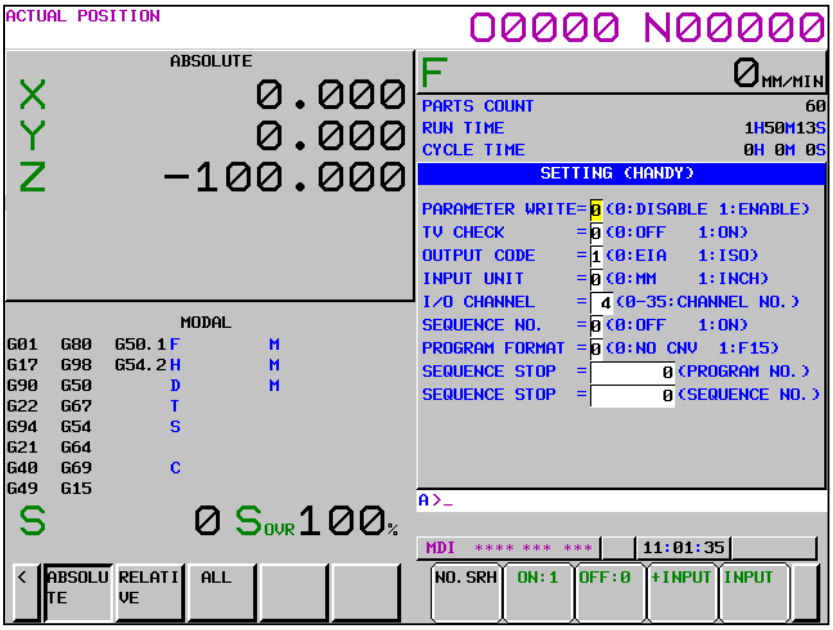
(1) Enter the MDI mode, or bring the machine to an emergency stop.
(2) Enable parameter writing.
(2)-1 The first page of the setting screen appears.

After pressing [3 SET] and [▽ N. PAGE] in the stated sequence, click the chapter selection soft key [SETTING].

(2)-2 Position the cursor on "PARAMETER WRITE" using the cursor move keys.



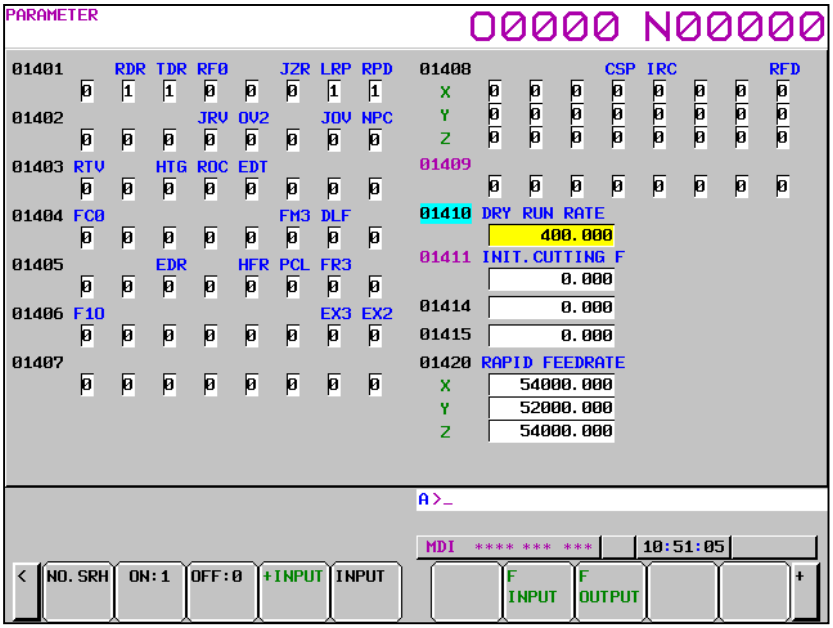
(2)-3 Press the [(OPRT)] soft key to display operation select soft keys.



(2)-4 To set "PARAMETER WRITE=" to 1, press the [ON:1] soft key, or alternatively enter 1 and press the [INPUT] soft key. From now on, the parameters can be set. At the same time, an alarm condition (P/S 100 PARAMETER WRITE ENABLE) occurs in the NC.

(3) After pressing the SYSTEM or SYSTEM function key, press N. PAGE and then the chapter selection soft key [PARAM].
(4) Display the page containing the parameter you want to set and position the cursor on the parameter.
(5) Enter data you want to set and press the [INPUT] soft key (or the <INPUT> key on the operator's panel). The parameter indicated by the cursor is set to the entered data.

Example: 400 [INPUT]



Data can be entered continuously for parameters, starting at the selected parameter, by separating each data item with a semicolon (;).

Example:

Entering 10;20;30;40 and pressing the [INPUT] key assigns values 10, 20, 30, and 40 to parameters in order starting at the parameter indicated by the cursor.

(6) Repeat steps (4) and (5) as required.
(7) If parameter setting is complete, set "PARAMETER WRITE=" to 0 on the setting screen to disable further parameter setting.
(8) Reset the NC to release the alarm condition (P/S 100).
If an alarm condition (000 PLEASE TURN OFF POWER) occurs in the NC, turn it off before continuing operation.

The program protection key can be used to enable or disable parameter entry.
Set NC parameter of No. 3299#0 (PKY) = 1.
If the program protection key is set to "ON": Parameters cannot be changed.
If the program protection key is set to "RELEASE": Parameters can be changed.
If this function is used, it is impossible to enable "PARAMETER WRITE" on the "SETTING".

3.3 CHANGING OFFSET DATA

For example, let's set the compensation amount with compensation No. 001.
Suppose that the setting is -100.0.

Press the

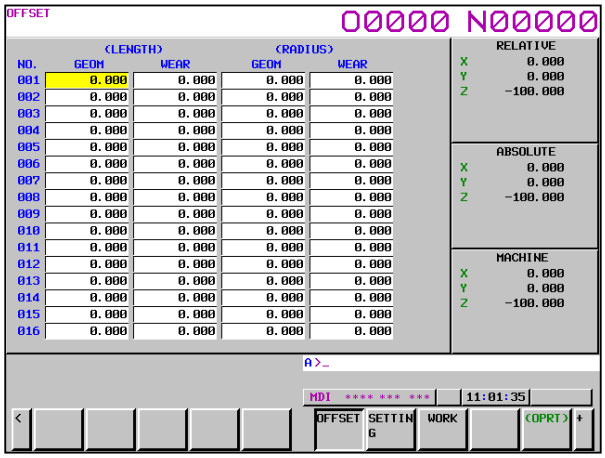
function key or

+

.

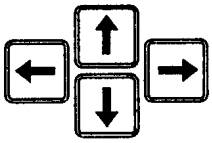
↓

Soft key [OFFSET]



OFFSET screen appears

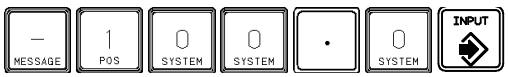
↓



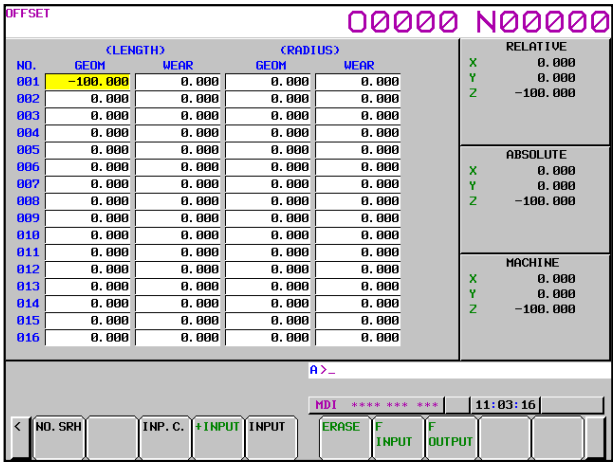
Move the cursor to the target number for setting. Here, place the cursor at 001.

↓

Enter the following values:



↓



3.4 CHANGING WORKPIECE COORDINATE SYSTEM DATA

For example, let's set an offset value of the workpiece reference position in the G54 system.

Press the

function key or

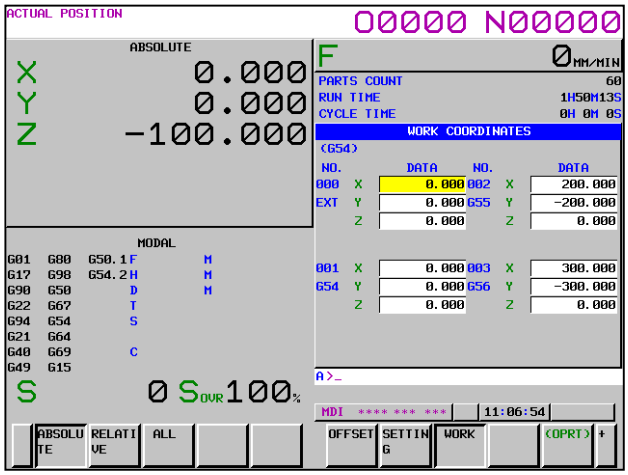
+

.

↓

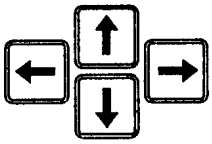
Soft key [WORK]

↓



The WORK OFFSET (workpiece offset) screen is displayed.

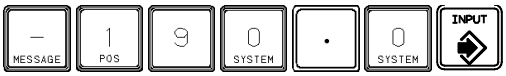
↓



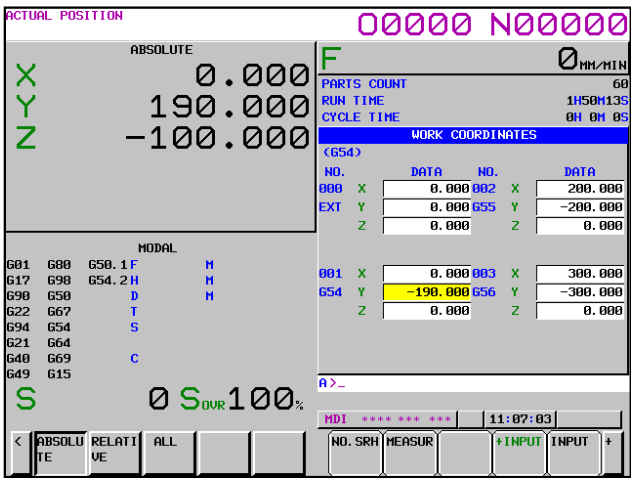
In this example, move the cursor to Y in No. 1 (offset value of the workpiece reference position in the G54 system).

↓

Enter the following values:



↓



3.5 CUSTOM MACRO VARIABLES

3.5.1 Custom Macro Variables

This section explains how to display and set common variables on the screen. For details on programs that use custom macro variables and system variables, refer to "Custom macro" in the CNC User's Manual (B-64484EN).

3.5.2 Setting and Displaying Common Variables

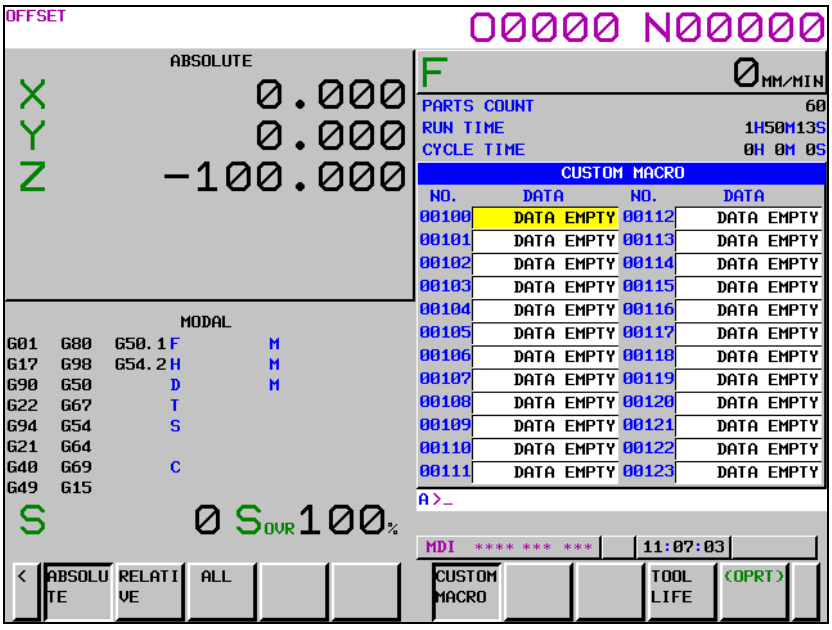
(1) After pressing the

function key or

+

,

(2) Press the soft key [MACRO] to select the macro variable screen.



(3) Enter variable number, then press the [NO. SRH] .

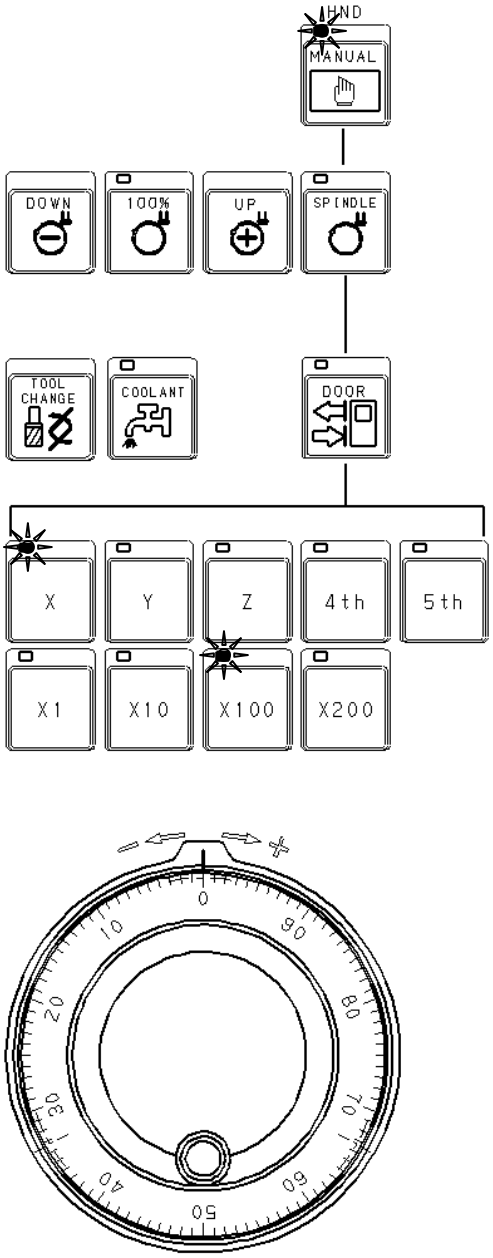
(4) Enter a value to be set from the operator's panel and press the <INPUT> key on the operator's panel or the soft key [INPUT]. The numeric value is set for the item at the cursor.

SUPPLEMENT

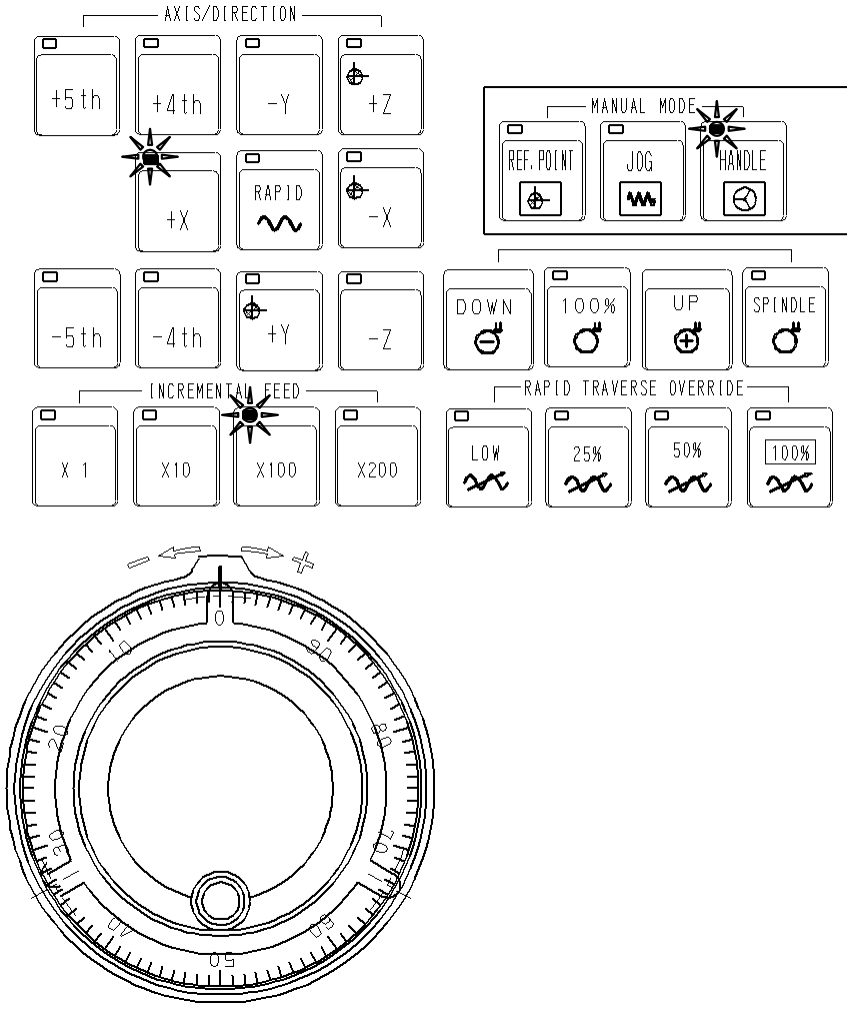
- Before setting a variable, set the program protection key to "RELEASE".
- To set “DATA EMPTY”, just press the soft key [INPUT] without entering a value.

4 MANUAL RUNNING [CNC OPERATION]

To operate the ROBODRILL manually, first select the manual operation mode key on the operator's panel, then the appropriate function keys (such as spindle, automatic door, and axis movement).



Standard type operator's panel



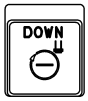
Full keyboard type operator's panel

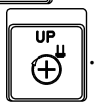
4.1 MANUAL OPERATION OF THE SPINDLE

Set the S command with MDI. A combination of

and

rotates the spindle.

The spindle speed can be adjusted using 

and 

.

4.2 AUTOMATIC DOOR

The door is automatically opened or closed by

.

4.3 AXIS MOVEMENT

(1) First select the manual operation mode using

.

(2) Select the target axis using

.

(3) Select the feedrate using

.

(4) Rotate the handle to drive the tool along the axis.

Feedrate selection	Metric	Inches
×200	0.2 mm	0.02 inch
×100	0.1 mm	0.01 inch
×10	0.01 mm	0.001 inch
×1	0.001 mm	0.0001 inch

5 AUTOMATIC RUNNING [CNC OPERATION]

Automatic running means to run the machine tool according to a program.

5.1 MDI RUNNING

A program of one block can be entered to run the machine in the MDI mode.

SUPPLEMENT
A program for MDI running can be edited irrespective of the program protect key status.

5.1.1 Preparations for MDI Running

(1) Press the

key on the operator's panel to set the MDI mode.

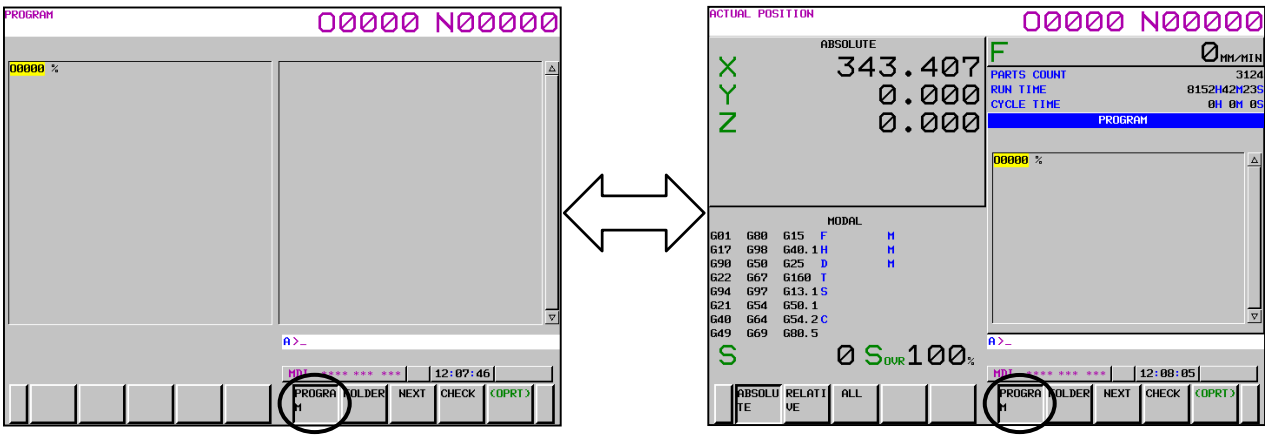
(2) Press the

function key or

, then

on the operator's panel to display the "PROGRAM" screen.

SUPPLEMENT
Pressing the [PROGRAM] key can switch the size of the program editing screen between "full screen" and "non-maximized size."



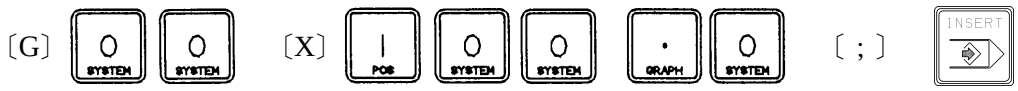
5.1.2 Examples of MDI Running

(Examples 1) To move the axis

G00X100.0

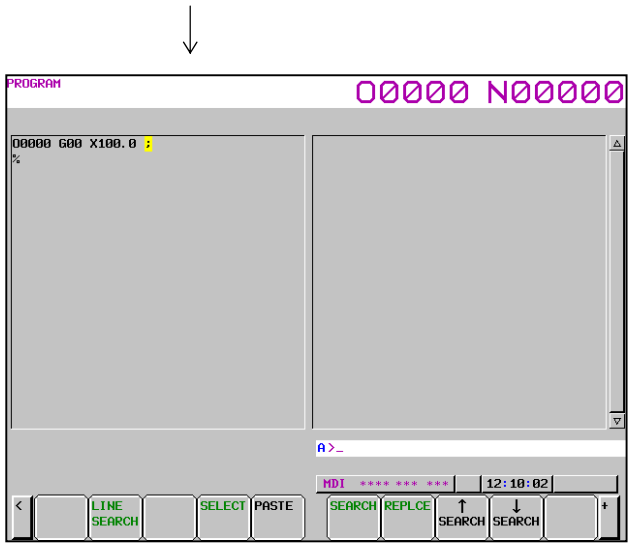
Enter data for each address. For the first key input, address data switches to "address". For the second and subsequent key inputs, address data switches to "numeric".

Press the following keys on the operator's panel:

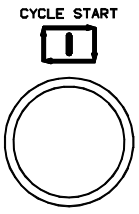


SUPPLEMENT

On the standard type operator's panel, letters are entered using soft keys. See Section I-4.2.



Press the <CYCLE START> button.



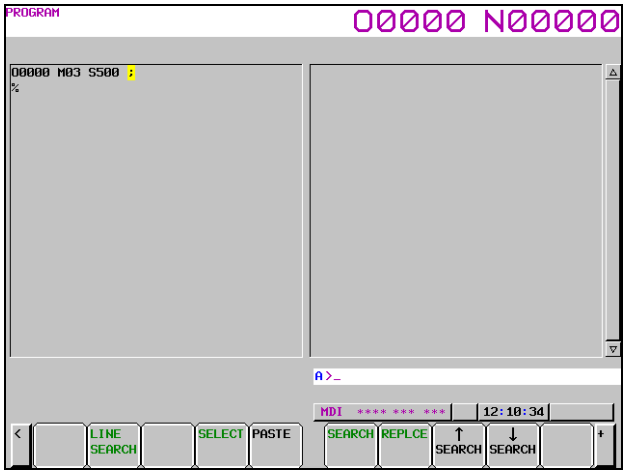
(Examples 2) To turn the spindle

M03S500

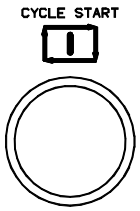
Press the following keys on the operator's panel:

〔M〕 0 3 〔S〕 5 0 0 〔 ; 〕 INSERT

SUPPLEMENT
On the standard type operator's panel, letters are entered using soft keys.
See Section I-4.2.



Press the <CYCLE START> button.



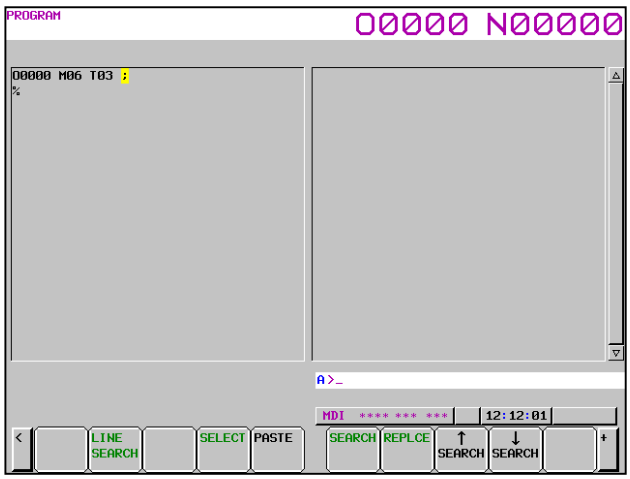
(Examples 3) To replace the tool

M06T03

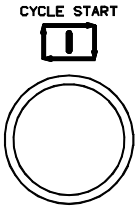
Press the following keys on the operator's panel:

SUPPLEMENT

On the standard type operator's panel, letters are entered using soft keys. See Section I-4.2.



Press the <CYCLE START> button.



5.2 MEMORY RUNNING (MEM)

Memory running means to run the machine tool according to a program stored in CNC memory.

5.2.1 Preparing Programs

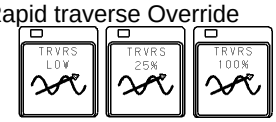
See Chapter 9, "PREPARING PROGRAMS [CNC OPERATION]", in Part III or Section 2.2, "Selecting a Program", in Chapter 2, "CREATING A PROGRAM", in Part IV and set a program to be used for memory running to the main program.

5.2.2 Machining program check

CAUTION
As for these operation support functions, be sure to read Section 10, "TRIAL RUN," in Part III to assure safe operation.

Whether the part program coded by the programmer is correct must be checked.
Whether jig settings and offset are correct must also be checked.

This machine tool provides various operation support functions that can perform these checks efficiently and safely. An example of effectively checking the machining program is given here. These support functions are validated for the command to be executed immediately after each function button is turned on and for the subsequent commands.

Machine lock	(1) When the machine lock is on, each axis of the machine tool does not move. (2) This button is used to check whether the M/S function and command formats, such as G code and axis address are correct. (3) The machine lock can be turned on and off, using soft keys arranged in a column on the quick screen.
Z axis lock	(1) This key is used to check the relative movement of the spindle and table with the Z axis movement fixed. (2) The machine lock can be turned on and off, using soft keys arranged in a column on the quick screen.
Single block key	(1) Stops the machine each time one block of a program is executed. The operator can check a program by executing it on a block-by-block basis and pressing the cycle start button.
Dry run	(1) When dry run is on, the F function (that is, feedrate) specified by the program is ignored and the machine tool is set to the jog feed speed. (2) Before pressing this key, check that no mechanical interference occurs during running.
Rapid traverse Override 	(1) The feedrate specified by the move command for the machine tool can be reduced according to the percentage which corresponds to a key by pressing one of the rapid traverse override keys: TRVRS LOW, TRVRS 25%, TRVRS 100%

SUPPLEMENT
Even if the machine lock or the Z axis lock is on, the spindle turns and coolant ON/OFF is executed. The tool change command is not executed.

CAUTION

Be sure to keep the following functions turned off for actual machining. Otherwise, the tool, tooling, and workpiece may be damaged.

- Machine lock
  (If a program containing axis movement commands was suspended with the machine lock kept on, be sure to switch the power off and on again.)
- Z-axis lock button
  (If a program containing axis movement commands was suspended with the Z-axis lock kept on, be sure to switch the power off and on again.)
- Dry run
  (If actual machining is started with the dry run function turned on, the feedrate will become improper, leading to danger.)

With the ROBODRILL of this series, AI contour control is enabled by default at the start of automatic operation (NC parameter No. 1604#0 = 1). Accordingly, advanced preview processing is automatically performed for the program. If you do not want to perform advanced preview processing for, for example, custom macro conditional expressions, add a block specifying M12 (stop of advanced preview processing).

5.2.3 Starting memory running

(1) Press the

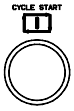
mode selection key.

(2) Confirm that a program to be used for operation is selected.
Press the

function key or

, then

on the operator's panel to display the "PROGRAM" screen.
Confirm that the program to be used for operation is displayed.

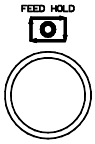
(3) When the <CYCLE START> button 

is pressed, memory running starts and the corresponding lamp lights.

SUPPLEMENT

The <CYCLE START> button is ignored in the following cases:
(1) When the <FEED HOLD> button is being pressed
(2) When the <EMERGENCY STOP> button is being pressed
(3) When the <RESET> key is being pressed
(4) When the mode is invalid
(5) When a sequence number is being searched
(6) When an alarm is on
(7) When automatic running is in progress
(8) When the NC is not ready
(9) When the external workpiece number search signal and the external program number search signal are on

5.2.4 Stopping memory running

(1) Press the <FEED HOLD> button 

.

When the <FEED HOLD> button is pressed, the FEED HOLD LED lights and the CYCLE START LED go off.

<1> When the axis is moving, the feed stops after deceleration.
<2> When it is being executed, the dwell is halted.
<3> Automatic running stops after M □□ and S □□ operations are executed.
(i) When the SPINDLE STOP button is pressed, all operations stop.
(ii) When an M00 code is entered, the block that includes the M00 code is executed, then the operation automatically stops.
(iii) When an M01 code is entered with the <M01 STOP> button on, the operation automatically stops and the FEED HOLD LED lights.

5.3 REMOTE OPERATION

A file (program) registered on a memory card or floppy-format external input/output device (FANUC Handy File, FANUC PROGRAM FILE Mate, or FANUC FLOPPY CASSETTE) can be freely selected and executed.

- A directory of NC program files registered on a memory card or floppy cassette can be displayed. (File directory display)
- An NC program file on a memory card or floppy cassette can be selected to start DNC operation. (DNC operation)

CAUTION
Any program in the USB memory cannot be used for DNC operation.

5.3.1 File Directory Display

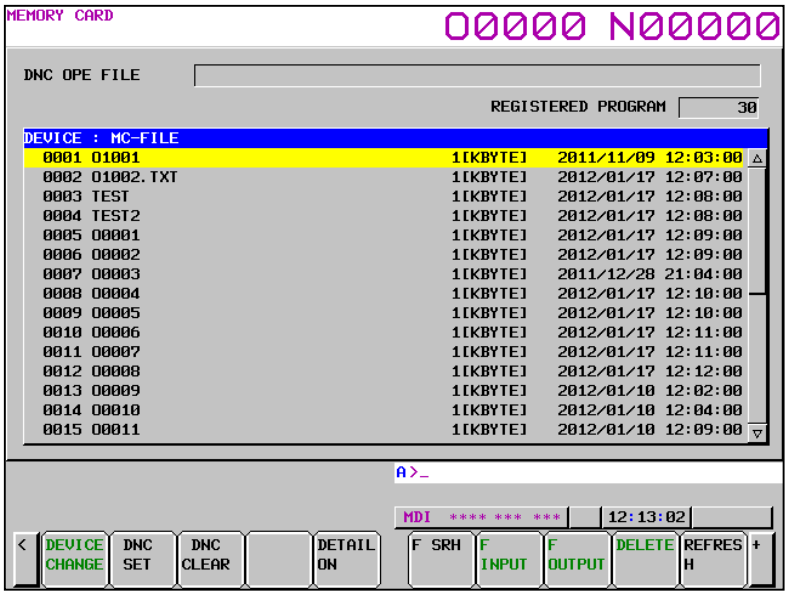
A directory of files (programs) registered on a memory card or floppy-format external input/output device can be displayed.
When using a memory card, set NC parameter No. 0020 = 4. When using a floppy-format input/output device, set NC parameter No. 0020 = 0.

(1) Press the

function key or

, then

on the operator's panel to display the "PROGRAM" screen.
(2) Press the [FOLDER] soft key to display "PROGRAM FOLDER".
(3) Press the [(OPRT)], [DEVICE CHANGE], [MEMORY CARD] (or [Floppy]), and [REFRESH] soft keys to display the directory of the memory card (or floppy cassette).



SUPPLEMENT

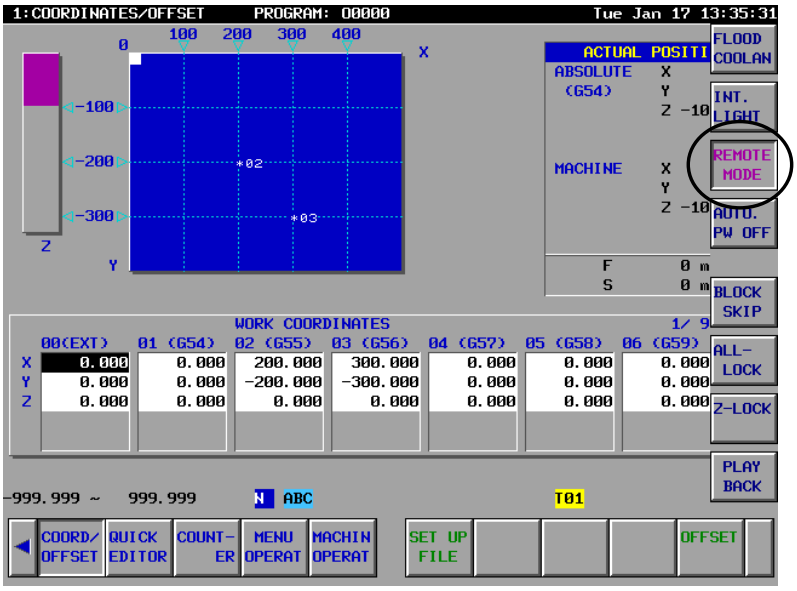
Directory display is disabled during DNC operation.

5.3.2 DNC Operation

(1) Set the operation mode to the remote mode (RMT).
When using an operator's panel of standard type:

Set [REMOTE MODE] to ON with the vertical soft key on the quick screen then select

on the operator's panel.

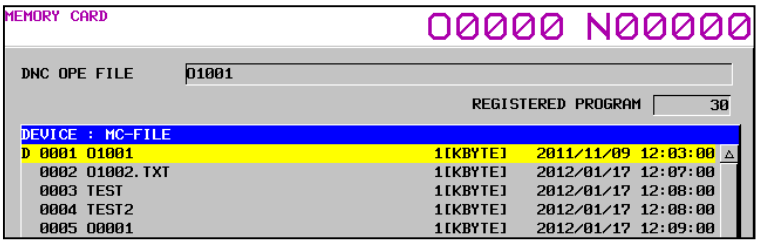


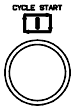
When using an operator's panel of full keyboard type:

Select

on the operator's panel.

(2) On the directory display screen of the memory card (or floppy-format external input/output device), move the cursor to a file subject to DNC operation then press [DNC SET]. This operation selects a file subject to DNC operation and displays the mark "D".



(3) Press the start button 

. The selected file is executed.

(4) To cancel the setting of a file subject to DNC operation, press [DNC CLEAR] in step (2) above. This operation cancels the setting of a file subject to DNC operation and erases the mark "D".

SUPPLEMENT
During execution of DNC operation, DNC cancellation operation is disabled.

5.3.3 Parameters

No.	#7	#6	#5	#4	#3	#2	#1	#0
0138	MNC							

[Input type] Parameter input
[Data type] Bit

#7 MNC From the memory card, external subprogram call and DNC operation are:
0: Not performed.
1: Performed.

5.3.4 Restrictions

(1) Selectable files
Only files registered in the same directory can be selected as DNC setting data or schedule setting data. Files belonging to different directories may not be selected.

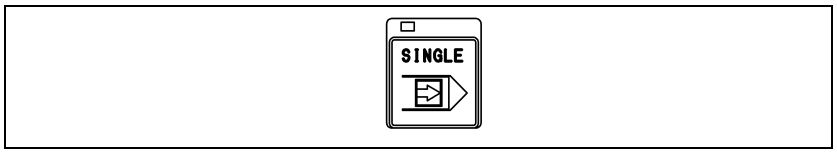
(2) Floppy disk directory display during file execution
During DNC operation, the floppy cassette directory cannot be displayed.

5.4 SETTINGS AND OPERATIONS OF AUTOMATIC RUNNING

5.4.1 Single Block (SINGL BLOCK)

Single block is the function that executes one block of the program each time the <CYCLE START> button is pressed.

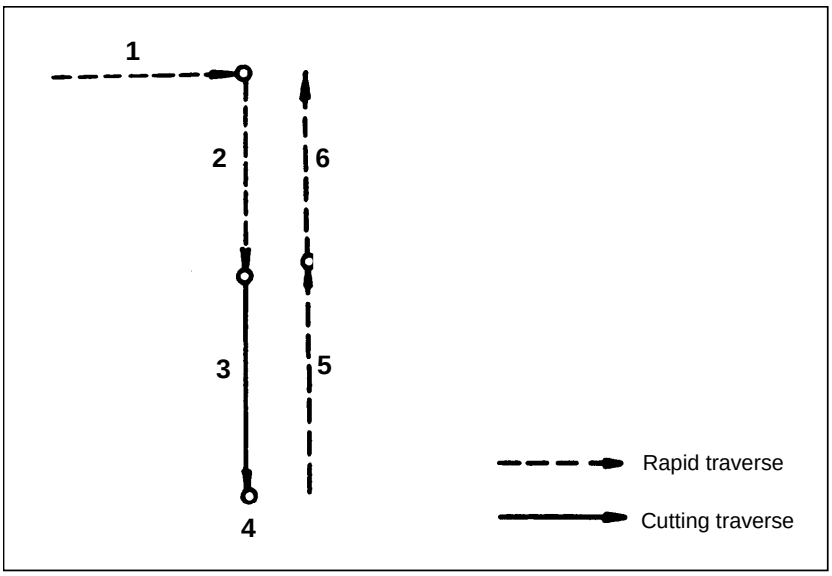
(1) Turn on the SINGLE key to set the single block.



One block of the program is executed and the machine tool stops.
When the <CYCLE START> button is pressed, the next block is executed and the machine tool stops.
To release the single block mode press the <SINGLE> key again.

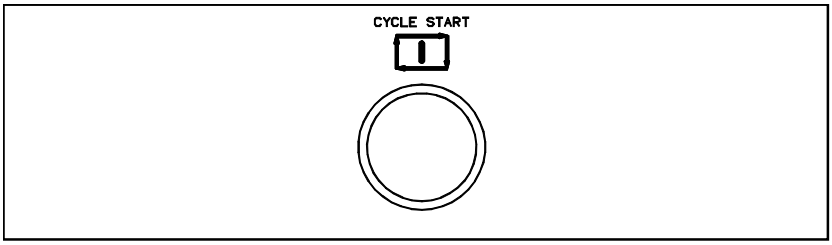
SUPPLEMENT

- For G28 and G29, after the single block is executed, the machine tool stops even during machining.
- The single block stop point in a canned cycle is any of the end point 1, 2, or 6 in the figure shown below. (See the figure shown below.)



5.4.2 Restarting Automatic Running after Feed Hold or Stop

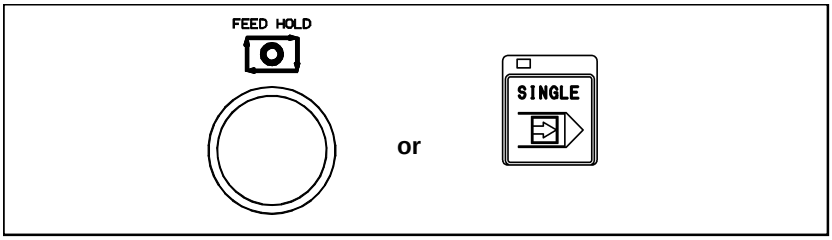
(1) Return to the mode at feed hold by pressing the relevant mode selection key.
(2) Press the <CYCLE START> button.



The FEED HOLD lamp goes off when it is lit.

5.4.3 Manual Running Execution During Automatic Running

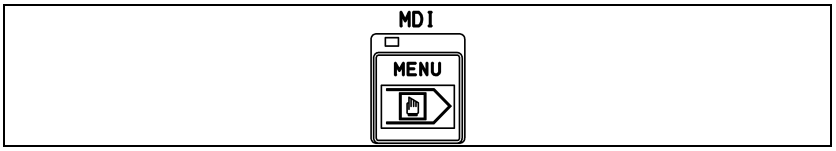
(1) Press the <FEED HOLD> button or the <SINGLE> button during automatic running to stop or halt the machine tool.



(2) Look at the position indicator and record the coordinates of the stop position.
(3) Execute manual running (see 4. in IV).
(4) Return the axis to the recorded coordinates (start point of manual running) while looking at the position indicator.
(5) To restart automatic running, switch the mode to the original mode.
(6) Press the <CYCLE START> button.

5.4.4 MDI Command Execution During Automatic Running

(1) Turn on the <SINGLE> key. The machine tool stops after one block of the program has been executed.
(2) Set the MDI mode.

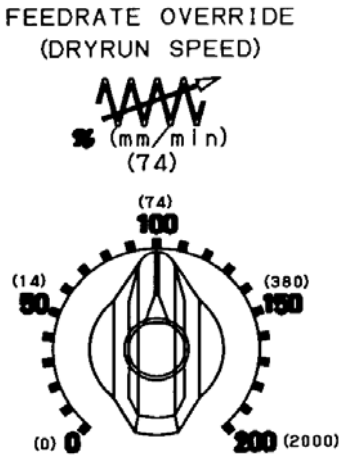


(3) Operate the MDI (see Section 5.1 in IV).
(4) To restart automatic running, press the MEM mode selection button and then the <CYCLE START> button.

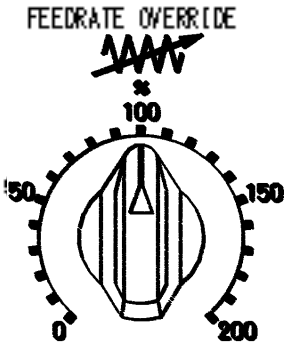
SUPPLEMENT
- Old modal data remains. If new modal data is needed, it must be registered. (Example: G code, travel during a canned cycle)
- The modal data specified from the MDI after MDI operation affects the subsequent automatic running.
- The MDI cannot be used to specify cutter compensation.
- The MDI command cannot be executed when automatic running is being stopped by the feed hold.

5.4.5 Feedrate Override Dial (FEEDRATE OVERRIDE)

This dial allows you to override the cutting feedrate between 0% and 200% in 10% units.



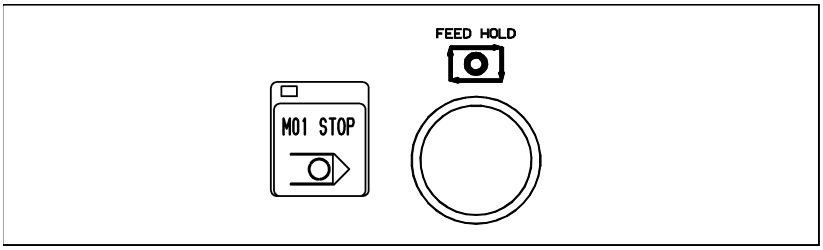
Standard type operator's panel



Full keyboard type operator's panel

5.4.6 M01 Stop (OPT STOP)

When the block that includes M01 is encountered, the instruction of that block is executed. After the block has been executed, the axes and spindle stop, and the coolant power supply is turned off, and the FEED HOLD LED lights.
To validate M01, the <M01 STOP> key must be on.
To restart the operation, press the <CYCLE START> button.



SUPPLEMENT
"M00" is available as a similar command.
When M00 is executed, the FEED HOLD LED lights (optional stop status) regardless of whether the <M01 STOP> key is on or off.

5.4.7 Optional Block Skip

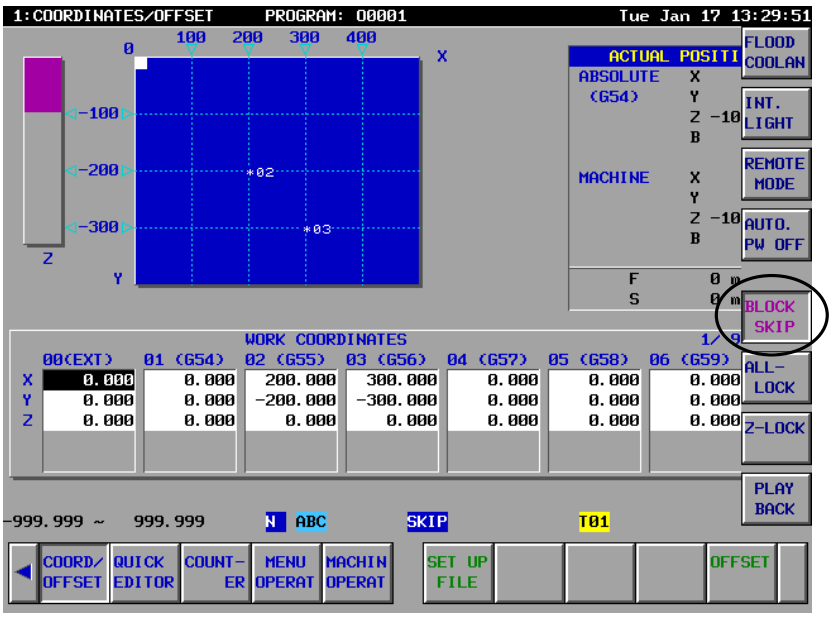
This function is intended to skip program blocks that contain “/1” to “/9".
You can specify multiple optional block skip commands in one block. In this case, when the setting corresponding to one of the specified commands is set to on, that block is skipped.

SUPPLEMENT

- For “/1”, “1” can be omitted. When multiple optional block skip commands are specified in one block, however, “1” cannot be omitted.
- “/1” to “/9” must be specified at the beginning of the block to be skipped. If the block to be skipped does not begin with “/1” to “/9”, the section between "/" and a block immediately before EOB is skipped.

There are the following two methods for setting optional block skip:

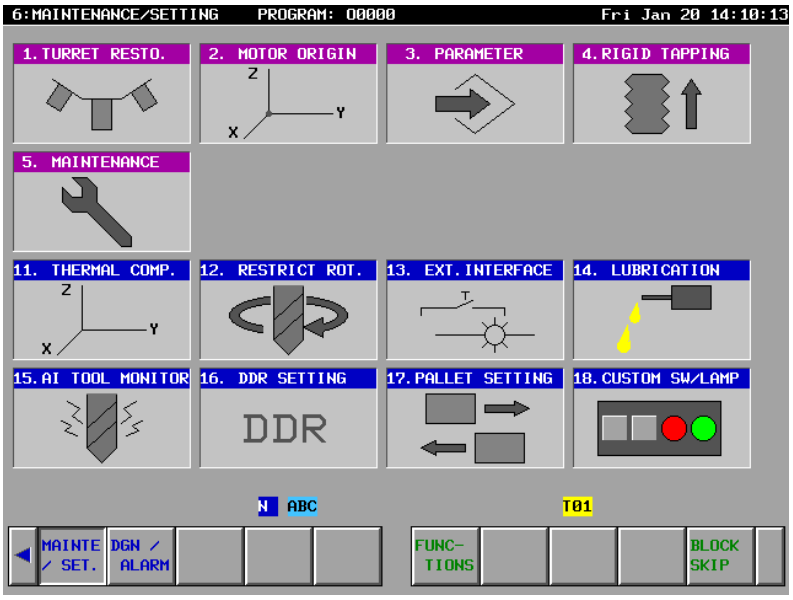
(1) Using the relevant vertical soft key (only for “/1” (“/”))
Use the [BLOCK SKIP] vertical soft key on the QUICK screen to specify whether to skip blocks in a program. When the soft key is set to on, the block contains “/1” (“/”) in the program is skipped.



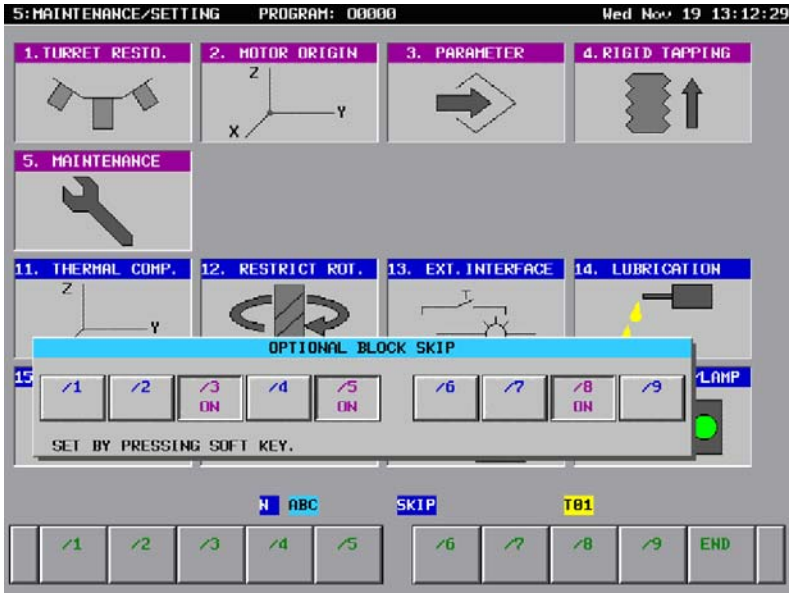
SUPPLEMENT

On a full keyboard type operator’s panel, the [BLOCK SKIP] vertical soft key is not displayed. To specify whether to skip blocks containing “/1”, use the [“/” SKIP] key on the operator’s panel.

(2) Using the OPTIONAL BLOCK SKIP window
Display the “6: MAINTENANCE/SETTING” screen from the QUICK screen.



Pressing the [BLOCK SKIP] soft key on this screen displays the following window:



Pressing the [/1] to [/9] soft key can specify whether to skip blocks containing “/1” to “/9”. When some of these soft keys are set to on, the blocks containing the relevant optional block skip commands are skipped (with the setting in the above screen, blocks containing “/3”, “/5”, and “/8” are skipped).

SUPPLEMENT

- The [/1] soft key has the same function as the [BLOCK SKIP] vertical soft key. Specifying whether to skip blocks containing “/1” can be set by pressing either key.
- On a full keyborad type operator’s panel, the [/1] soft key is not displayed. To specify whether to skip blocks containing "/1", use the [“/” SKIP] key on the operator’s panel.

CAUTION
The change to the optional block skip setting that is made during programmed operation is not effective for blocks for which advanced preview processing has already been performed.

5.4.8 Rapid Traverse Rate Override

The rapid traverse rate override can be set to 100%, 25%, or LOW. If an override of 25% is applied when the rapid traverse rate is 54 m/min, the rapid traverse rate becomes about 13 m/min. When the rapid traverse override is set to LOW, the rapid traverse rate is 400 mm/minute. This override is applicable to the following rapid traverses:

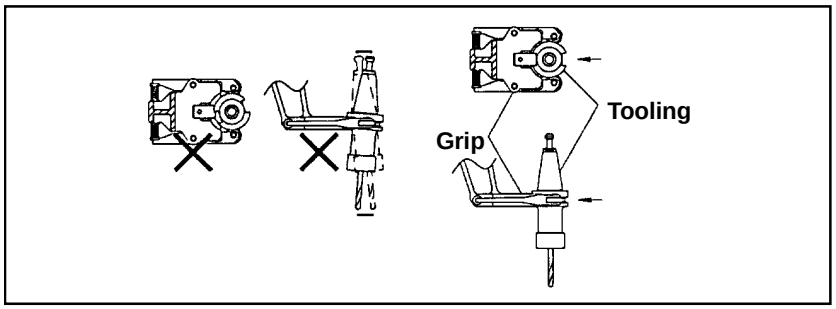
(1) Rapid traverse by G00
(2) Rapid traverse during a canned cycle
(3) Rapid traverse at G27, G28, or G29
(4) Manual rapid traverse
(5) Rapid traverse for manual return to the reference position
(6) Rapid traverse in tool change sequence

SUPPLEMENT
When the rapid traverse override is specified with the M47 command, the green LED at the upper left corner of the button blinks.
When the LED blinks, the selected rapid traverse rate $\times$ M47 C**, (example: 100% $\times$ 50% = 50%) is applied.

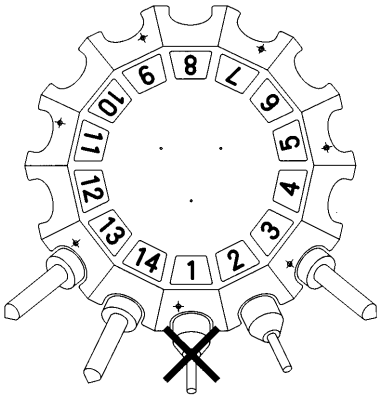
6 TOOL CHANGE

6.1 TOOL CHANGE PRECAUTIONS

(1) Never try to install the tool directly on the spindle since it is dangerous. Be sure to install it on the tool cartridge.
(2) Never try to use tool arbors other than those specified. (See Item I.5, "TOOLS" for the tool arbors that can be used.)
(3) When installing the tool to the tool cartridge, be sure to insert it in all the way to the end until the grip key is fully engaged in the keyway of the tool. Upon completion of the tool installation, confirm that the tool has been firmly secured without any play.



(4) Never try to install the tool on the tool cartridge which is located below the spindle.)



(5) If the single block is ON, making tool change causes the Z-axis to stop at the reference position (Z = 0). Pressing the <TOOL CHANGE> button again or the <CYCLE START> button starts tool change.
(6) When the operation is stopped by pressing the <FEED HOLD> button, never try to move the Z-axis in the manual running mode. The unit will lose track of the coordinate and failure will occur.

6.2 COMMANDS WITH M CODES

When specifying the tool change using the program or MDI, the following command needs to be given using the M06 code:

Following T, specify the tool to be indexed with a 2- or 3-digit number.
M06 T□□ (□□ : Tool No.) or M06 T□□□ (□□□ : Tool group number)

With this command, the tool having the specified number is selected in the shorter path.

In addition to the above, the following command may be used:

M06 Pn (n : The n-th tool from the current tool in the clockwise direction)
The tool cartridge always rotates clockwise.

NOTE

1 PS alarm (ATC alarm) is displayed when a tool number other than 01 to 14(*) are specified.
2 When a tool number other than 1 to 14(*) are specified for the "n" following P, the number minus multiple of 14(*) will be effective. For example, "n" will be 2 when n = 58 is specified.
3 Alarm 252 (ATC alarm) will be displayed when the tool change command is executed during the cutter compensation, tool length compensation, or canned cycle. To execute the tool change command, be sure to cancel the cutter compensation, tool length compensation, or canned cycle. (Commands G49 and G80 may be specified within the block for M06.)
4 When X and Y axes movement and a tool change are commanded within the same block
(Example) G00 X500.0 M06 T02
In this case, the tool change operation is executed first.
Then, at the same time the Z axis moves to the top, the turret begins to rotate, and the X (Y) axis begins to move.
If the X (Y) axis is still moving even after the turret rotation is completed, the tool change operation is temporarily interrupted until the movement of the X (Y) axis is completed.
Upon completion of the X (Y) axis movement, the tool change operation resumes.
5 If a specified tool has the same tool number as the currently selected tool, spindle orientation and return to the Z-axis reference position are performed, but tool change is not.
6 Do not specify S together with M06 in the same block.

* For the α-D21*i*A5 series, up to 21.

6.3 <TOOL CHANGE> KEY

A tool change can be executed by pressing the tool change button in the MDI mode.
When <TOOL CHANGE> key is pressed, the tool cartridge rotates clockwise to select the tool next to the current one.

6.4 MEASURES WHEN AN ERROR OCCURS DURING TOOL CHANGE

The ROBODRILL series has a function for checking whether an arbor is mounted on the spindle.
This function is designed to stop the machine for safety in an emergency situation, for example, when the pull stud of the arbor is broken during machining.
If the reset button is pressed while the tools are being changed, tool change stops, and an alarm is issued.
The following table lists how to recover from an incorrect tool change operation.

Description		Action
An incorrect tool number was specified.		Correct the program.
The tool was changed with the tool of an unspecified tool number.		Perform automatic recovery.
The operator stopped the machine while the tool was being changed.	When the machine was stopped with the EMERGENCY STOP button or <RESET> key.	Perform automatic recovery.
	When the machine was stopped with the STOP button.	Restart the machine.

The ROBODRILL is provided with an automatic tool change recovery program (described later) so a tool change alarm can be released easily. Most tool change alarms can be released using this program.
For detailed information, see Section V-4.

7 SPINDLE-SPEED FUNCTIONS

7.1 ROTATION OF THE SPINDLE

The rotating direction of the spindle is defined when viewing the tip of the spindle from the spindle motor side.
Spindle rotation key is lit depending on the direction of the spindle rotation.
The spindle speed can be specified for each rotation using the address S and a number from two to four (five) digits. The unit of the number is min^{-1}.
Rotation of the spindle can be controlled by either of the following two methods:

SUPPLEMENT
- Specify a spindle speed that does not exceed the maximum allowable rotation speed defined for each tooling by the respective tooling manufacturer.

7.1.1 Method Using the M Code

In the AUTO or MDI mode, the spindle rotation can be controlled by the following M codes:

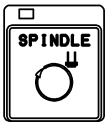
M03: Rotates the spindle clockwise.
M04: Rotates the spindle counterclockwise.
M05: Stops the spindle motion after completing all the commands within a given block.

Examples

M03 S1500: Rotates the spindle clockwise at the speed of 1,500 min^{-1}.
S4000: Sets the spindle speed to 4,000 min^{-1}.
M04: Rotates the spindle counterclockwise.
M05: Stops the spindle.

7.1.2 Method Using the Spindle Key (Manual) on the Operator's Panel

(1) Specify the spindle speed in the MDI mode.
(Example) S1000
(2) Select one of the MANUAL modes.
(3) When the spindle operation key is pressed, the LED goes on, and the spindle rotates. (The spindle rotates in the same direction as the direction in which the spindle rotated previously. When the spindle rotates for the first time after power-on, it rotates clockwise.)
(4) When the spindle operation key is pressed again, the LED goes off, and spindle rotation stops.



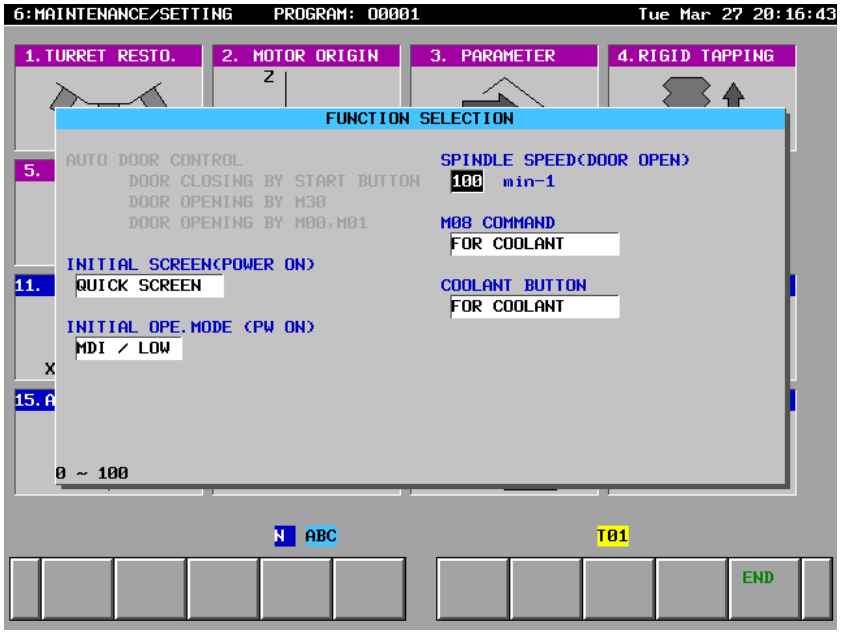
SUPPLEMENT

- The spindle rotation can be stopped in any mode.
  Pressing this button during automatic operation stops the machine by effecting feed hold.
- The lamp blinks during the rigid tapping mode.
- If a spindle speed is not specified, pressing the key cannot cause the spindle to rotate. (When the safety door is closed)

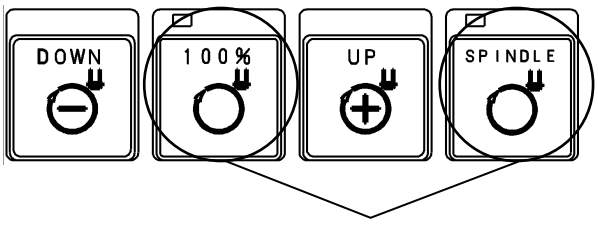
7.1.3 Spindle Rotation When the Safety Door is Open

Even if the safety door is open, pressing the SPINDLE key causes the spindle to rotate under the following conditions.

- The spindle rotates at a specified constant speed (with S commands ignored). A speed can be set using "FUNCTION SELECTION" on the "6: MAINTENANCE/SETTING" screen displayed from the quick screen.
- Spindle overriding is ignored.



Machines for Europe and China:
The spindle rotates only when the <SPINDLE> and <100%> keys are pressed simultaneously.



The two keys are pressed simultaneously.

7.1.4 Spindle Overheat Detection

(1) Overview

Keeping the spindle rotate at high speed for a prolonged time leads to heat generation in the spindle bearing.

If heat conducted from the spindle motor is added to the heat generated in the spindle bearing, the spindle bearing may get damaged because of the heat even before the spindle motor overheats.

The spindle overheat detection function protects the spindle by limiting the spindle rotation speed if the spindle motor gets too hot.

(2) Specifications

The spindle overheat detection function monitors the temperature of the spindle motor and the rotation speed of the spindle. If the two monitored values exceed the settings listed in Table 1 below for a certain period of time, an alarm (EX1074) is raised to decelerate each axis to a halt.

(3) Action

If the spindle overheat function worked, review the use conditions of the machine so that the temperature, rotation speed, and time limits will not be exceeded.

Also check if the cooling fan for the spindle motor is running normally, because it is likely that the cooling ability of the cooling fan may have decreased. When you confirmed that the cooling fan was normally running, clean the cooling paths of the cooling fan and spindle motor, and the side fan (provided if the machine meets the High acceleration spindle or High speed spindle) for the spindle motor if they are dusty.

See Section 2.4, "MAINTENANCE OF AC SPINDLE MOTOR," in Part V, "MAINTENANCE," for explanations about how to clean.

Table 1: Related parameters

Address	Standard setting	Description	Unit
K26#6	1	Function ON/OFF 0: Function disabled 1: Function enabled	-
D142	100	Temperature limit value	°C
D144	10,000min^{-1} specification: 8500 (Standard spindle, High torque spindle, High acceleration spindle) 24,000min^{-1} specification: 19500 (High speed spindle)	Speed limit values	min^{-1}
D146	30000	Timer	ms

7.1.5 Notes on the Spindle

7.1.5.1 Life of the spindle

⚠ CAUTION

The calculated life of the spindle is about 10,000 hours under normal use conditions for both the 10,000 min^{-1} and 24,000 min^{-1} spindle specifications when continuously rotated at the maximum speed.

However, the actual life depends on the use status including the cutting load and transmission of heat generated in cutting. The spindle may be damaged for a relatively short time depending on the use condition of the machine.

The warranty period of the spindle is limited to the warranty period of the machine.

7.1.5.2 Mist collector and Dust collector

⚠ CAUTION

Be sure to use a mist collector or dust collector for each ROBODRILL with a ceiling cover. Also be sure to operate the mist collector or dust collector while the ROBODRILL is running.

Using a ROBODRILL with a ceiling cover degrades the internal environment of the ROBODRILL. If neither mist collector nor dust collector is installed, the degradation of the ROBODRILL internal environment may cause any of the following problems in a relatively short period:

1: Temperature rise in the ROBODRILL
   A temperature rise in a ROBODRILL is likely to cause an overheat alarm. It may also shorten the grease life of the spindle and motor bearings, which may cause a problem in a relatively short period.
2: Filling of the mist of a coolant (when used)
   If the mist of a coolant fills the inside of the ROBODRILL, the coolant is likely to enter the ROBODRILL mechanical unit and spindle motor.
   The cable covering and plastic parts also become susceptible to the coolant. Consequently, a problem may arise with the ROBODRILL mechanical unit, spindle motor, cable covering, or plastic parts in a relatively short period.
3: Filling of chips (for dry cutting)
   If chips fill the inside of the ROBODRILL, they are likely to enter the ROBODRILL mechanical unit and spindle motor.
   Consequently, a problem may arise with the ROBODRILL mechanical unit or spindle motor in a relatively short period.
   To prevent dust explosion, be sure to use an explosion-proof dust collector.

The capacity of a mist collector or dust collector required per ROBODRILL is listed below.

Be sure to install a mist collector or dust collector for each ROBODRILL. Do not bifurcate piping using a large mist collector. If a large mist collector is used and piping is bifurcated, the required capacity may not be assured in some bifurcated piping due to pipe resistance.

Be sure to periodically inspect and maintain the mist collector or dust collector you use as specified by the manufacturer. In particular, be sure to periodically maintain the filter to keep the capacity.

	Ceiling basic cover	Ceiling full cover
Standard spindle, High torque spindle, High acceleration spindle	7 m^3/min or more	7 m^3/min or more
High speed spindle	7 m^3/min or more	13 m^3/min or more

⚠ CAUTION

When a mist collector is used, the use of a ROBODRILL genuine ceiling cover is recommended.
When you prepare a ceiling cover individually, install the duct of the mist collector in a similar place as on a ROBODRILL genuine ceiling cover. The mist inside the machine is led toward the duct of the mist collector. Be careful not to place the spindle or spindle motor on the flow path.
The section above the column on the rear of the machine and the section above the spindle motor on the ceiling side of the machine, in particular, are inappropriate for a place where the duct of the mist collector is installed. If the duct of the mist collector is installed in these sections, much mist may adhere to the spindle, spindle motor, and cooling fan, which affects reliability. When the mist collector is stopped, concentrated coolant may drop from the duct, which may damage the spindle, spindle motor, or cooling fan at an early stage.

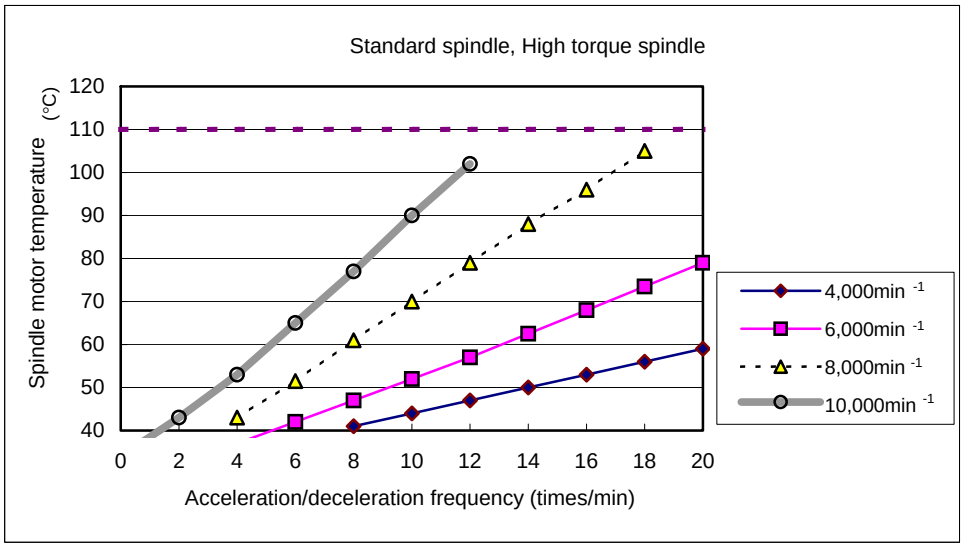
7.1.5.3 Acceleration/deceleration frequencies of the spindle

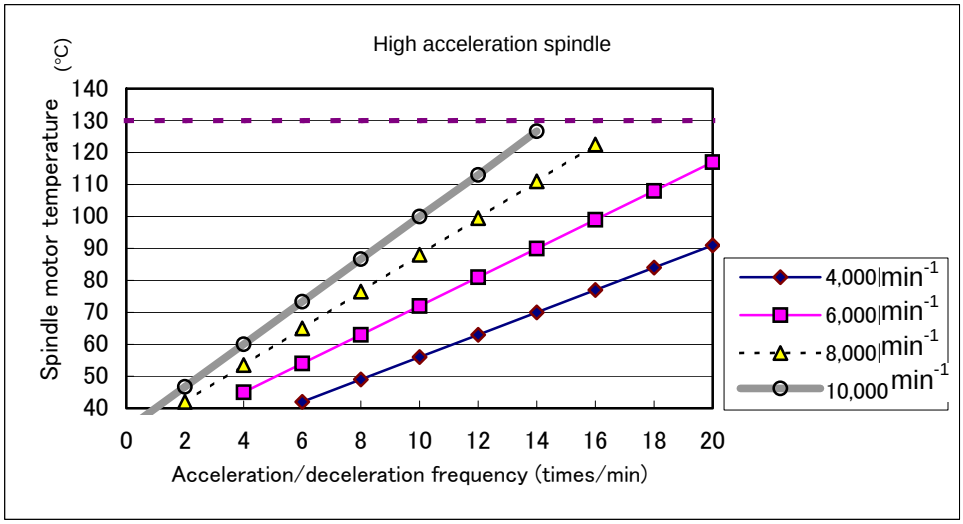
(1) If the spindle motor frequently repeats acceleration and deceleration, its temperature can increase rapidly even when its cutting load is low. The following lists the maximum acceleration/ deceleration frequencies at which the spindle can run continuously without causing the spindle motor to overheat:

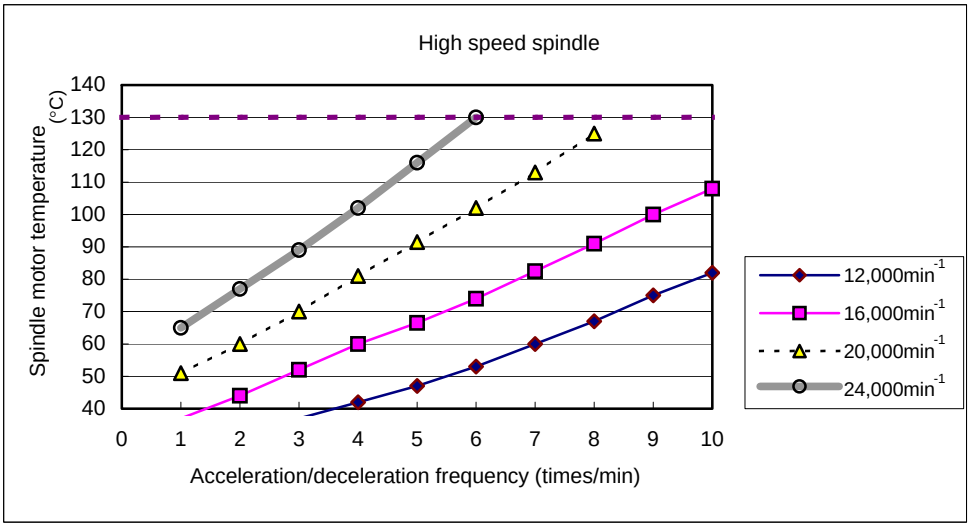
- Continuous rigid tapping only
  Standard spindle, High torque spindle : 20 holes/min
  High acceleration spindle : 13 holes/min
  High speed spindle : 24 holes/min
- Continuous acceleration/deceleration (between 0 min^{-1} and maximum rotation speed) only
  Standard spindle, High torque spindle : 12 times/min
  High acceleration spindle : 13 times/min
  High speed spindle : 5 times/min

The above acceleration/deceleration frequencies apply to operation at a room temperature of 25°C when [STANDARD] is selected for RIGID TAPPING or when parts machining repetition control B is not used. If the ambient temperature of the machine is higher, the machine may overheat even below the acceleration/deceleration frequencies above.
The setting of RIGID TAPPING can be changed on the “5: MACHINE OPERATION SET” screen. If the machine overheats during rigid tapping, changing the setting of RIGID TAPPING to [LOW HEAT] can slow rigid tapping operation to suppress the temperature rise of the spindle motor to some extent.

(2) The following graphs show the relationship between the acceleration/deceleration frequency for each specified speed and spindle motor temperature.

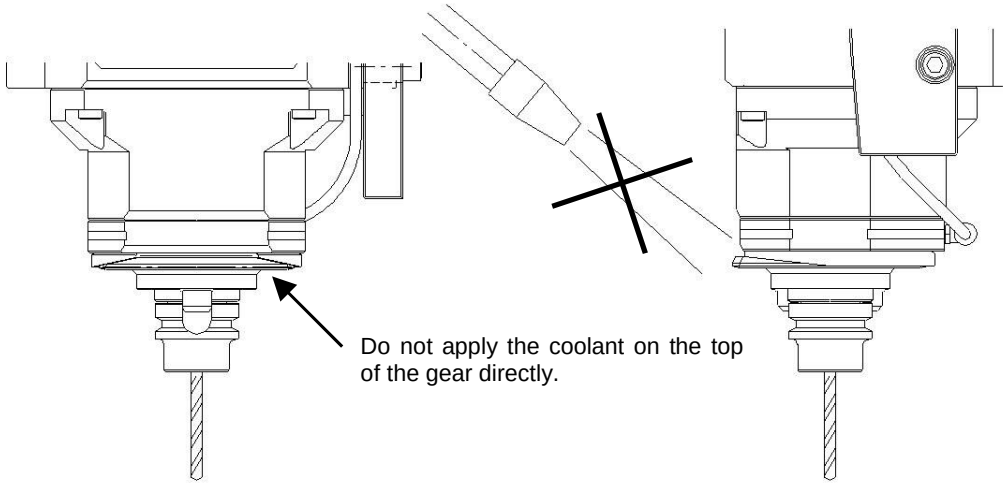






7.1.5.4 How to apply the coolant

> ⚠ **CAUTION**
> The ROBODRILL has an air purge function to protect the spindle from the coolant, dust, and other foreign matters. This function may be unable to prevent the coolant from entering the inside of the spindle depending on the position of the coolant nozzle and force of the flowing coolant.
> As shown in the figure below, avoid directly applying the coolant on the top of the spindle gear from the front of the spindle.
> Carefully apply the coolant not only with the coolant nozzle of a ROBODRILL genuine option, but also with any coolant nozzle for cleaning jigs added by users.



7.1.5.5 Unusual sound

Sounds coming from the spindle of the ROBODRILL are broadly divided into the following two types.

(1) Sound generated by a retainer (intermittent rustle sound)
This unusual sound is generated intermittently at relatively low speed. It is likely to be generated when the machine is stopped for an extended period of time or after the machine is transported.
Such sound may be generated at a normal spindle in greater or lesser degrees and does not affect the life or machining accuracy of a bearing.
The sound may be eliminated by carrying out a spindle run-in as described in Section 1.2.4 in Part V, "MAINTENANCE."

(2) Scale sound (continuous unusual buzz sound)
The scale of this continuous unusual sound changes in proportion to the speed of the spindle. The sound is generated when there is damage on a ball of a bearing or an inner or outer ring orbital plane. When the orbital plane of a bearing sustains a dent or other damage due to a collision, remarkable scale sound is generated.
Although the extent of the damage of the bearing is concerned, because grease in a bearing degrades early, the spindle may be damaged relatively in a short time.
The replacement of the spindle needs to be considered.

7.1.5.6 Spindle run-out

The spindle run-out of the ROBODRILL may be increased by the following causes:

(1) Collision
When a collision occurs, external force that is then applied to the spindle mainly in the diameter direction can deform the tapered part of the spindle or bend the spindle shaft.
The spindle run-out tends to worsen suddenly by a collision. In addition, when the shaft is rotated, scale sound may be generated as described in Subsection 7.1.5.5.

(2) Foreign matter such as chips or metallic soap adhered to the tapered part of the spindle
If chips are caught in the tapered part of the spindle, the spindle run-out increases temporarily.
If metallic soap (solid material of calcium and magnesium) is adhered to the tapered part of the spindle, the spindle run-out tends to increase gradually as the degree of the adhesion develops.

SUPPLEMENT

- Periodically measuring the spindle run-out by using a test bar is effective in understanding the spindle status.
- Increase in spindle run-out can be suppressed by cleaning the inside of the tapered part of the spindle. When cleaning the tapered part of the spindle, exercise special care not to damage the tapered part of the spindle.
- Use of RO water (water clarified by a reverse osmosis membrane) or hardness adjustment agent (sequestering agent) supplied by coolant manufacturers is effective in suppressing the deposition of metallic soap.

7.1.5.7 Tool coming off from the spindle

Excessive drawing force applied to the tool can cause the tool to come off from the spindle. Check whether the machining conditions are appropriate for the tool.

⚠ CAUTION

When a reamer with a reverse helical flute is extracted from a reamed hole at a higher speed than the speed (lead × rotation speed), chips can be caught in the relief of the reamer edge, allowing the tool to come off from the spindle.
Generally, a reamer with a reverse helical flute cannot be extracted at rapid traverse rate. Specify a cutting feed for the tool extraction operation to suppress the extraction speed.

7.1.5.8 Clamping force of the draw bar unit

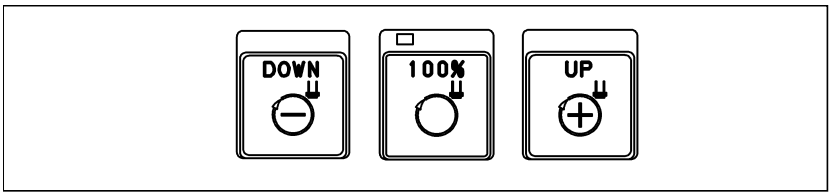
The draw bar unit, which grips a tool, is sealed with an O-ring to protect the internal mechanism from foreign matter such as coolant and sludge. The O-ring, however, is a consumable part. Depending on the use conditions (brand and management condition of the coolant used, frequency of tool replacement, center-through coolant supply pressure, machining conditions, vibration and impact during machining, etc.), the clamping force may decrease in a relatively short period, which affects machining.
If an excessive impact is applied due to an inappropriate machining condition or collision with the spindle and the tool comes off from the spindle, the coil spring of the draw bar unit may get broken. This status may decrease the clamping force in a relatively short period, which affects machining.
The warranty period of the draw bar unit is limited to the warranty period of the machine.

SUPPLEMENT

To prevent a machining problem due to the decreased clamping force, periodically measure the clamping force and perform periodical maintenance according to the change in clamping force.
For the measurement of the clamping force and the replacement of the draw bar unit, contact a FANUC service representative.

7.2 SPINDLE OVERRIDE

The spindle speed may be overridden in all the running modes.
Pressing the SPINDLE OVERRIDE < DOWN > or < UP > key can specify an override speed from 30% to 200% in 10% units to control the spindle speed. When <100% >key is pressed, the spindle speed becomes that of S command.



(Examples) With 80% override at S3000
3,000× 80/100 = 2,400
The spindle speed is 2,400 min^{-1}.

When the overridden spindle speed exceeds the spindle's maximum speed, the spindle rotates at its maximum speed.

(Examples) When an override of 120% is set at S9000 with a maximum spindle speed of 10,000 min^{-1}, the spindle speed is 10,000 min^{-1} rather than 9,000×120/100 = 10,800 min^{-1}.
(In case of standard specification.)

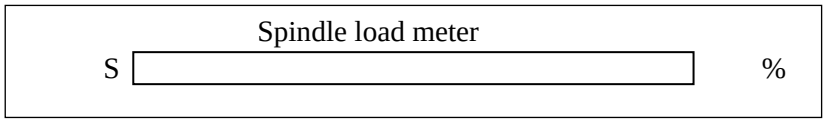
SUPPLEMENT

The override setting for the spindle is not valid in the tapping cycle (G74 and G84).

7.3 SPINDLE LOAD METER

The spindle load meter is displayed on the operating monitor screen. Select this screen according to the following procedure.

(1) Press the function key or the + keys to display the current position display screen.
(2) Press the rightmost soft key to change the soft key page.
(3) Press soft key [MONITOR].



With a 24,000 min^{-1} standard or high torque spindle, or 10,000 min^{-1} high acceleration spindle of the α-D14/21*i*A5 series, the spindle load meter indicates a 100% value when the power generated on the spindle matches the continuous rating. With a 10,000 min^{-1} standard or high torque spindle, the value indicated by the load meter for the power generated on the spindle varies depending on the spindle speed.

The following table lists rough estimates of load meter readings.

Standard spindle	Speed (min^{-1})	1500 or less	2000	3000	6000	8000	10000
	Continuous rating (%)	71	71	100	138	169	131
High torque spindle	Continuous rating (%)	60	61	102	156	193	149
High acceleration spindle	Speed (min^{-1})	100 to 10000					
	Continuous rating (%)	100					
High speed spindle	Speed (min^{-1})	240 to 24000					
	Continuous rating (%)	100					

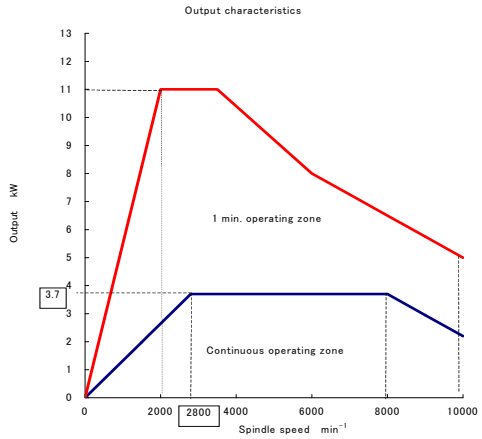
7.4 SPINDLE ORIENTATION (M19)

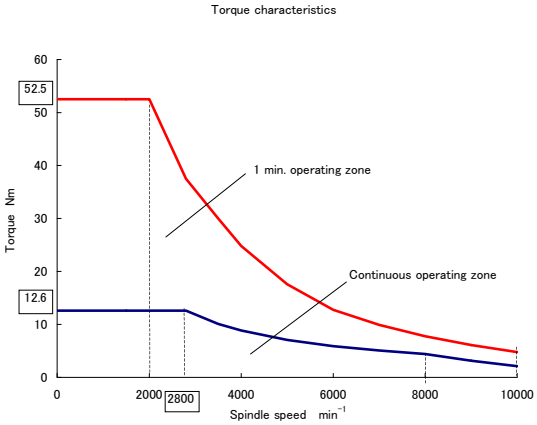
Spindle orientation is a function for stopping the spindle at a position specified with a parameter. This is done using the M19 command.
The machine is factory-set so that the spindle stops with the spindle key in parallel to the Y-axis. Do not change this angle (Changing this angle disables automatic tool change recovery operation).

SUPPLEMENT

- This command remains effective until the spindle rotation command (M03 or M04), spindle stop command (M05), or program end auxiliary function (M00 or M01) is issued.
- Issuing this command during rigid tapping generates an alarm (EX 1007). (M19 cannot be specified during tapping)
- Do not issue this command during a canned cycle. Fine boring (G76) and back boring (G87) cause automatic spindle orientation.

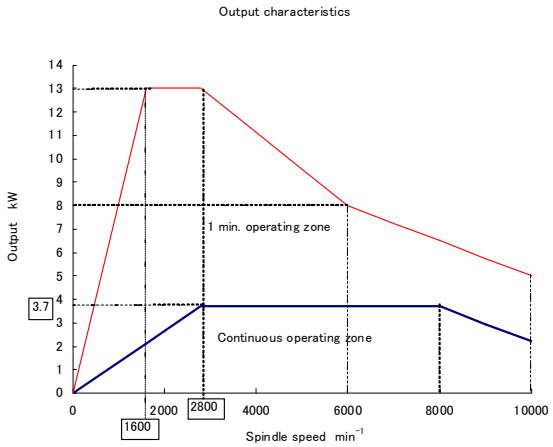
7.5 SPINDLE MOTOR CHARACTERISTIC

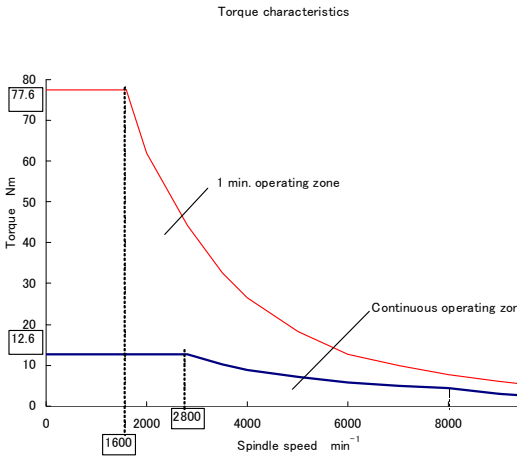




NOTE
1 The graphs shown above are obtained when the efficiency is 1.
2 Spindle motor specification: A06B-1404-B904#F302, A06B-1474-B128#F321
3 Spindle amplifier model: αiSP 11

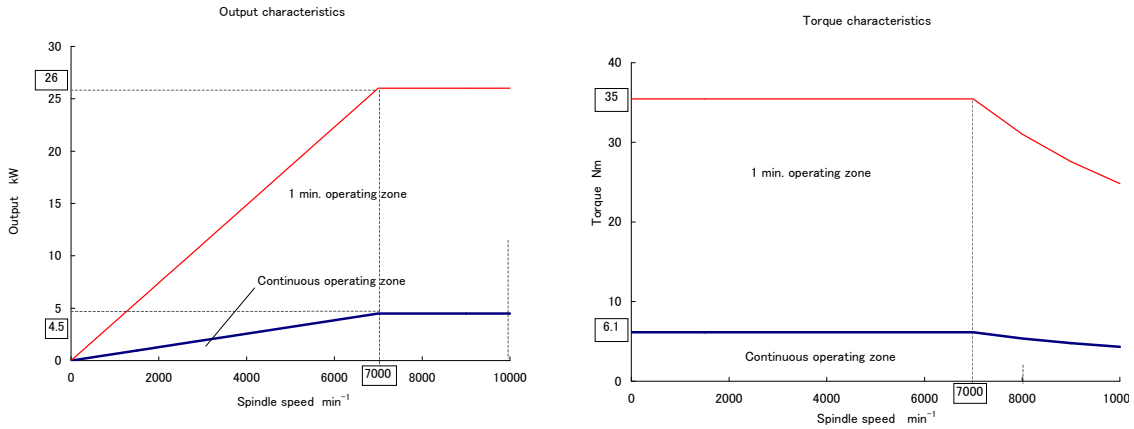
Standard spindle





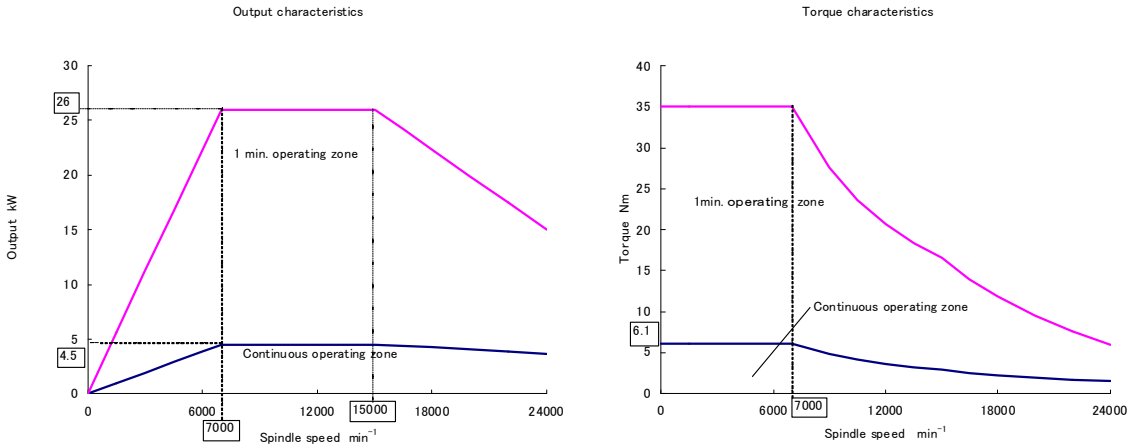
NOTE
1 The graphs shown above are obtained when the efficiency is 1.
2 Spindle motor specification: A06B-1404-B904#FE02, A06B-1474-B128#F521
3 Spindle amplifier model: αiSP 15

High torque spindle



NOTE
1 The graphs shown above are obtained when the efficiency is 1.
2 Spindle motor specification: A06B-1421-B900#F321, A06B-1461-B900#F321
3 Spindle amplifier model: αiSP 26

High acceleration spindle



NOTE
1 The graphs shown above are obtained when the efficiency is 1.
2 Spindle motor specification: A06B-1420-B900#F621, A06B-1460-B900#F521
3 Spindle amplifier model: αiSP 30

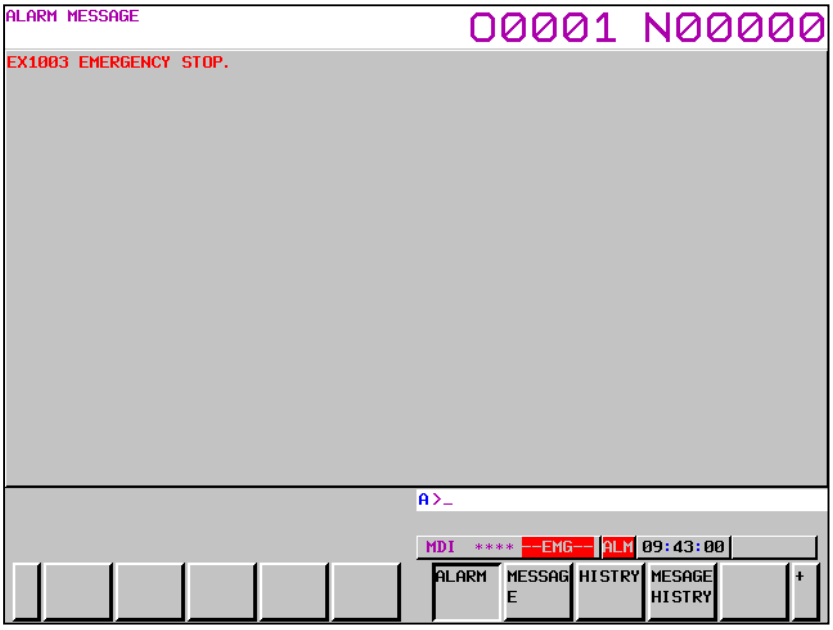
High speed spindle

8 DISPLAYING ALARM, OPERATOR, AND DIAGNOSTIC MESSAGES

8.1 CNC SCREEN

8.1.1 Alarm Message

If an alarm occurs, “ALARM MESSAGE” screen is automatically displayed (When CNC parameter No. 3111#7 = 0 is set).



[Displaying the alarm message screen]

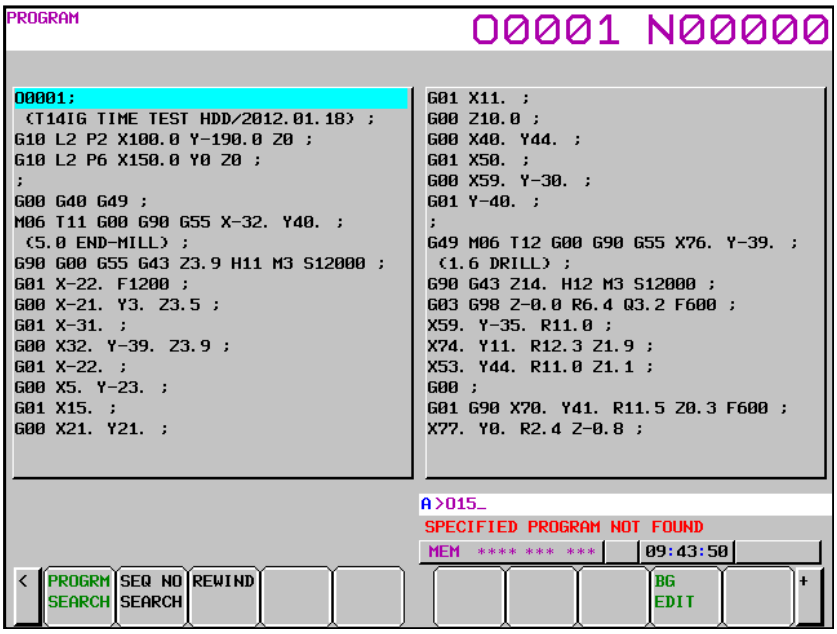
(1) On the standard operator's panel, press the

key, then the

key. On the full keyboard operator's panel, press the

key.

(2) Press the soft key [ALARM].

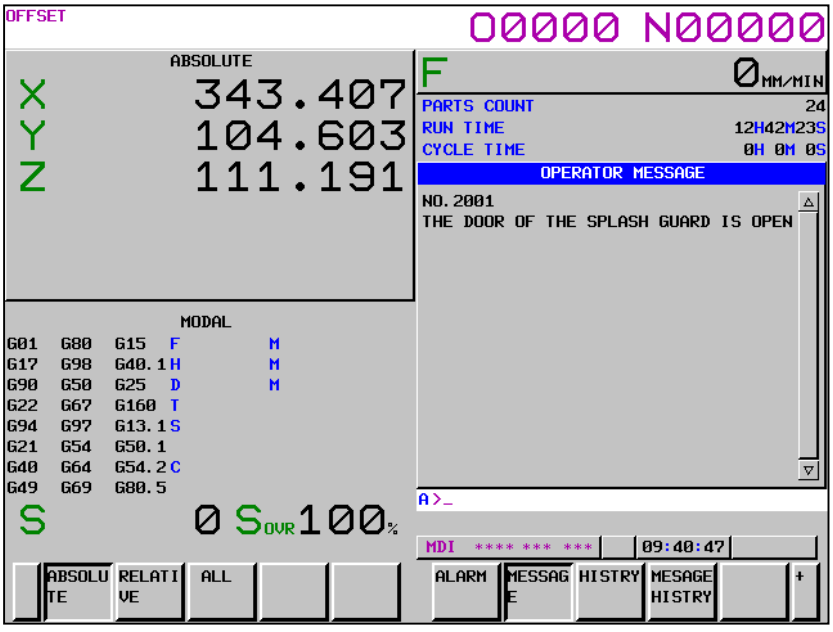


SUPPLEMENT

- If an alarm occurs during edit operation using background editing, the alarm is displayed on PROGRAM without screen switching.
- While you are using background editing, do not press the <RESET> key. Otherwise, automatic machine operation would stop.
- To release an alarm which occurs during background editing, press any key.

8.1.2 Operator Message

When an operator message is issued, “OPERATOR MESSAGE” screen is automatically displayed (When CNC parameter No. 3111#7 = 0 is set).



[Displaying the Operator message screen]

(1) On the standard operator's panel, press the

key, then the

key. On the full keyboard operator's panel, press the

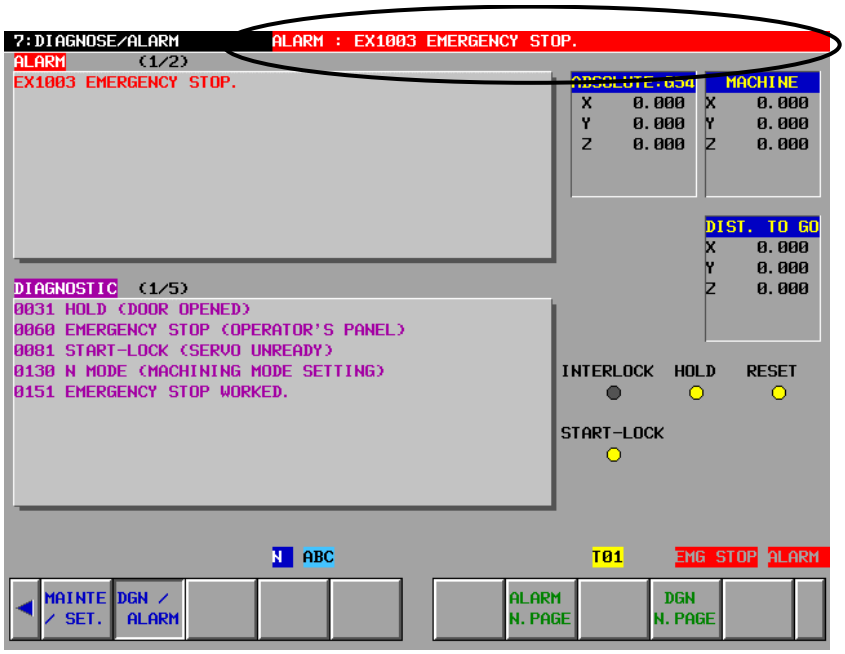
key.

(2) Press the soft key [MESSAGE].

8.2 QUICK SCREEN

8.2.1 Common to Screens

When an alarm or operator message is issued, it is displayed at the top of the screen (When CNC parameter No. 3111#7 = 0 is set).
One message is displayed at a time.
An alarm message is displayed in red and an operator message is displayed in magenta.



8.2.2 Diagnose/Alarm Screen

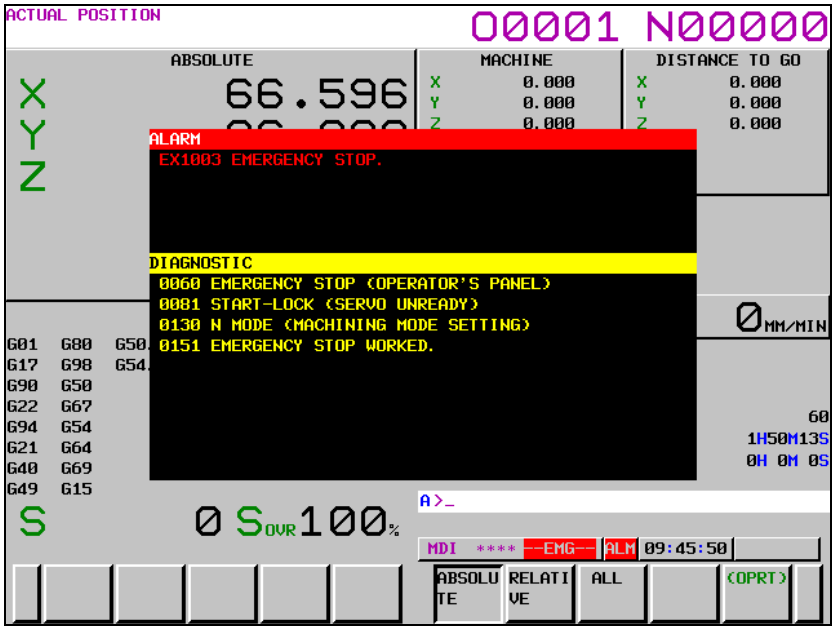
On “6:DIAGNOSE/ALARM”, you can check the displayed alarm, operator, and diagnostic messages. (See the figure above.)
“ALARM” window displays all alarms being displayed.
(The [ALARM P.PAGE] and [ALARM N.PAGE] soft keys can be used.)
“DIAGNOSTIC” window displays all operator and diagnostic messages being displayed.
(The [DGN P.PAGE] and [DGN N.PAGE] soft keys can be used.)

Diagnostic messages are numbered 0 to 999. Operator messages are numbered starting with 2000.

8.3 COMMON TO CNC SCREEN AND QUICK SCREEN

Pressing the

key on the operator's panel displays message window in the center of the screen.



Pressing the

key again closes message window.

SUPPLEMENT

- For details of each message, see the alarm list and operator and diagnostic message list in the corresponding Appendix herein.
- No message detail is displayed on the MANUAL GUIDE *i* screen.

9 RELEASING OVERTRAVEL

The term overtravel refers to a fact that the tool goes beyond a range specified for each axis. If an overtravel occurs, an alarm is generated. To reset the overtravel, it is necessary to return the tool to within a specified range.

Overtravel

An alarm from OT0500 to OT0507 is displayed on the screen.

Examples

" OT0500 (X) + OVERTRAVEL (SOFT 1) "

How to release

An overtravel is released according to the following procedure.

(1) Put the machine in the manual operation mode.
(2) The axes on which an overtravel occurred are displayed on the screen.
Select one using the axis selection key.
(3) Rotate the manual pulse generator in the direction opposite to the direction indicated on the screen to place the tool within a range of stroke.
(4) Pressing the <RESET> key clears the alarm indication and reset the alarm.

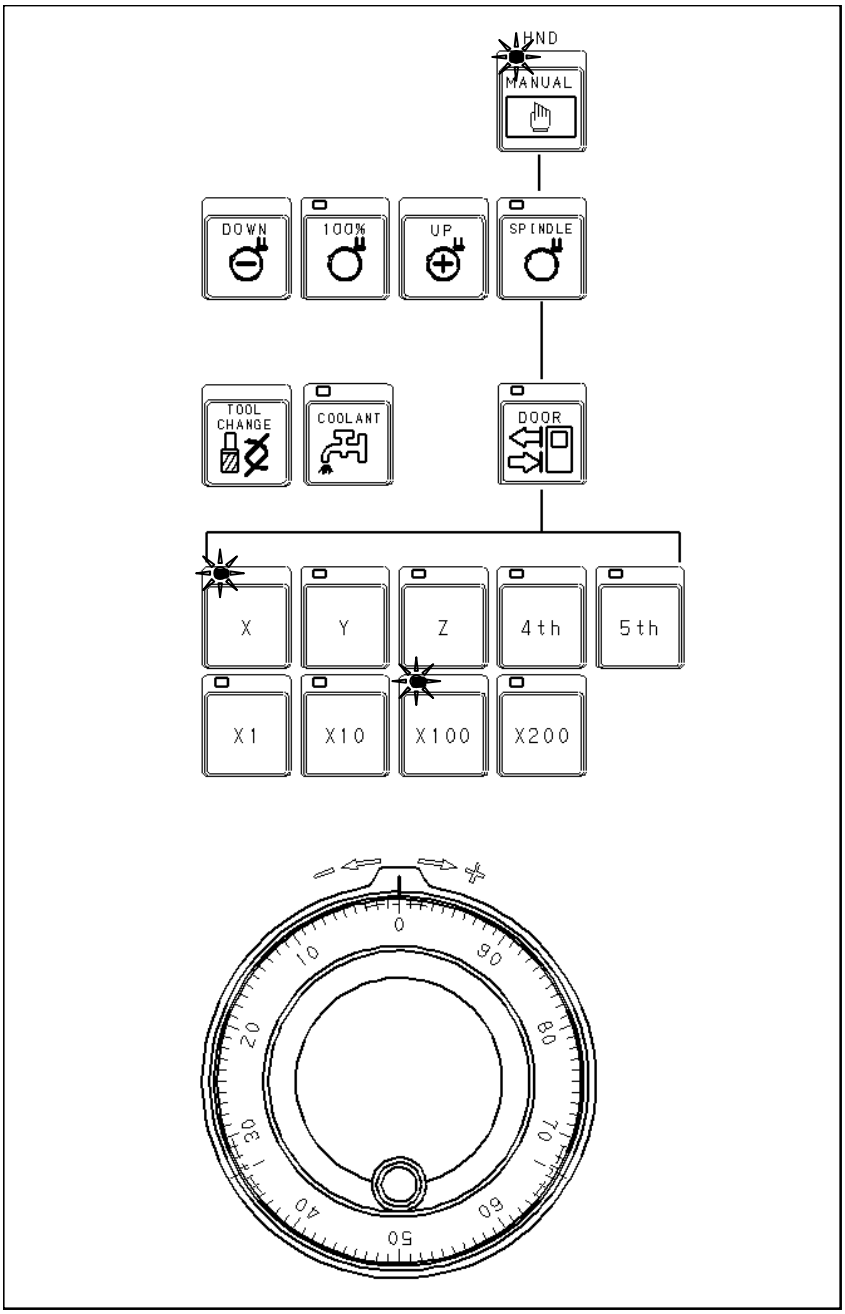


Fig. 9(a) Basic-keyboard type operator's panel

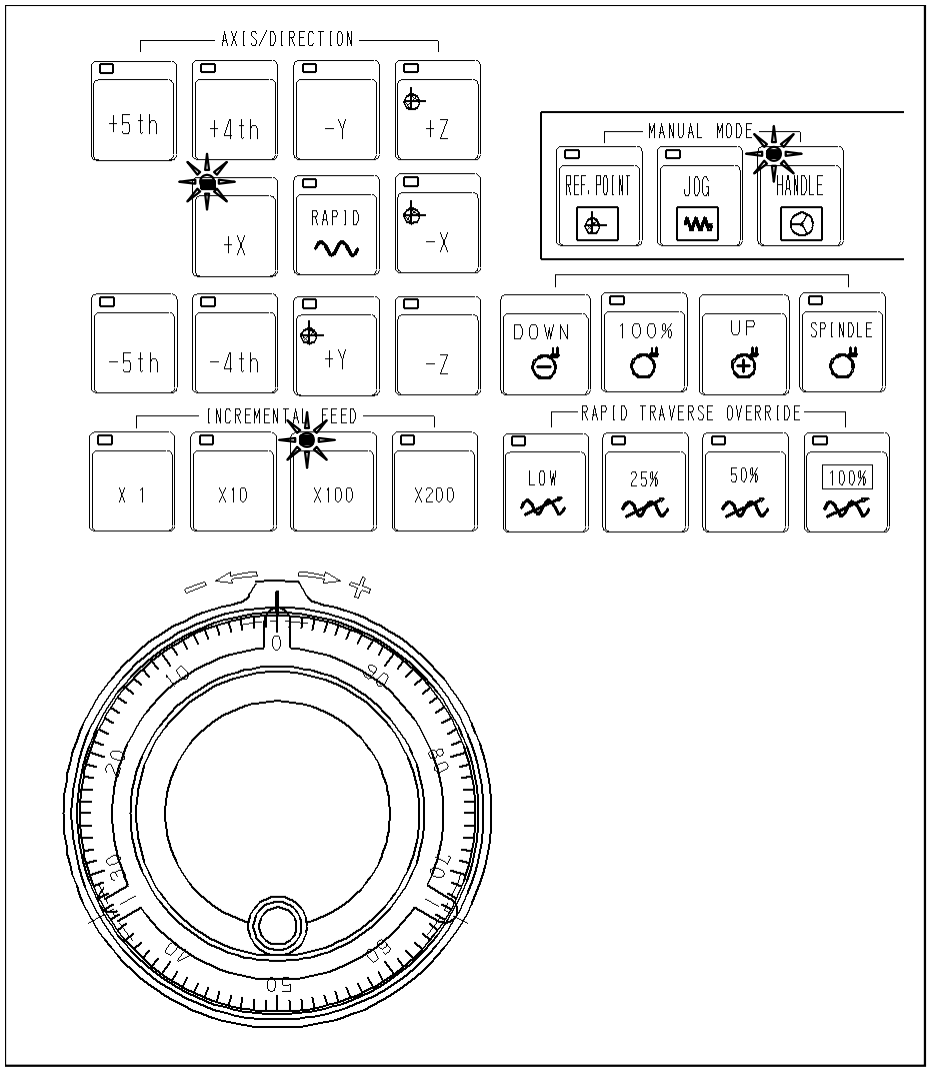


Fig. 9(b) Full-keyboard type operator's panel

10 RELEASING THE TOOL TRAPPING STATE

If the cutter bites into the workpiece and the machine stops, follow the procedure below to release the state.

(1) Press Reset key

on the operator's panel to release the alarm.

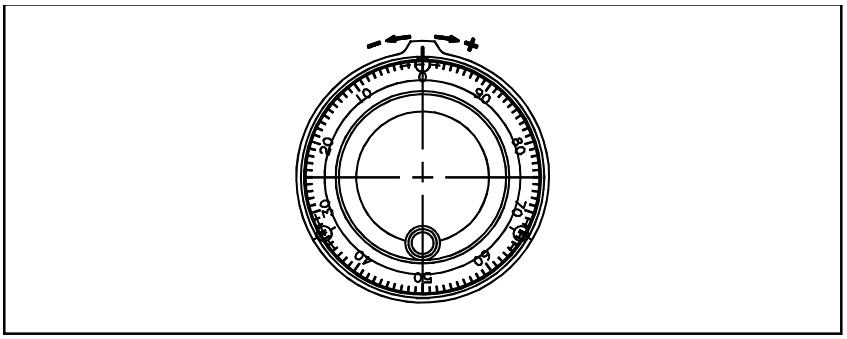
(2) Press Manual operation mode key

.

(3) Press Z axis key

.

(4) Turn the manual pulse generator clockwise (in the positive direction) and pull out the cutter from the workpiece.



SUPPLEMENT

- When a T-slot cutter is trapped, it cannot be pulled out upward. Remove the cutter from the arm bar.
- When a tap is trapped, the rigid tapping return function is available.
  See Subsection IV.6

11 QUICK EDITOR

11.1 OVERVIEW

QUICK EDITOR is a full–screen editor which is the exclusive one to ROBODRILL and provides various functions to edit a CNC program on the QUICK SCREEN.

11.2 FEATURES AND NOTES OF QUICK EDITOR

11.2.1 Features of QUICK EDITOR

(1) QUICK EDITOR provides an editing area of 9999 lines. Each line can consist of up to 46 characters.
(2) Each editing operation can be performed at an arbitrary position in the editing area by using page key, cursor key, or cursor jump function (see Subsection 11.5.6).
(3) It is unnecessary to enter EOB (end of block).
QUICK EDITOR interprets one line in the editing area as one block in principle, and add EOB to each line when a program is registered in the CNC.
But some lines in the editing area can be treated as one block by using continuous line function (see Subsection 11.5.10).
(4) It is possible to edit the machining program in the operation.
Consequently the machining program can be modified while the machining processes are checked. But the program is not applied immediately because the program cannot be registered in the CNC in the operation (see Subsection 11.5.4).
(5) G and M codes can be specified very easily.
Consequently the number of use of alphabet is reduced and the fact that no address key exists on the operator's panel does not cause inconvenience. Furthermore addresses which follow G or M code are displayed automatically. This is very useful to a CNC programmer.

11.2.2 Notes

- The program with lines more than 9999 cannot be edited (created).
- During background editing, a program cannot be edited, cannot be registered, and cannot be deleted by QUICK EDITOR.
- If the alphabet keyboard type operator's panel is provided, some functions cannot be used.
- Before registering or deleting the program currently being executed, note the contents of the notes appended to each description. Similarly, before performing other operations, note the contents of the relevant notes.

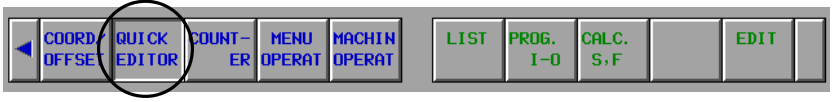
11.3 QUICK EDITOR SCREEN

This chapter describes how to display the QUICK EDITOR screen and how to select each editing function.

11.3.1 Procedure for Displaying QUICK EDITOR Screen

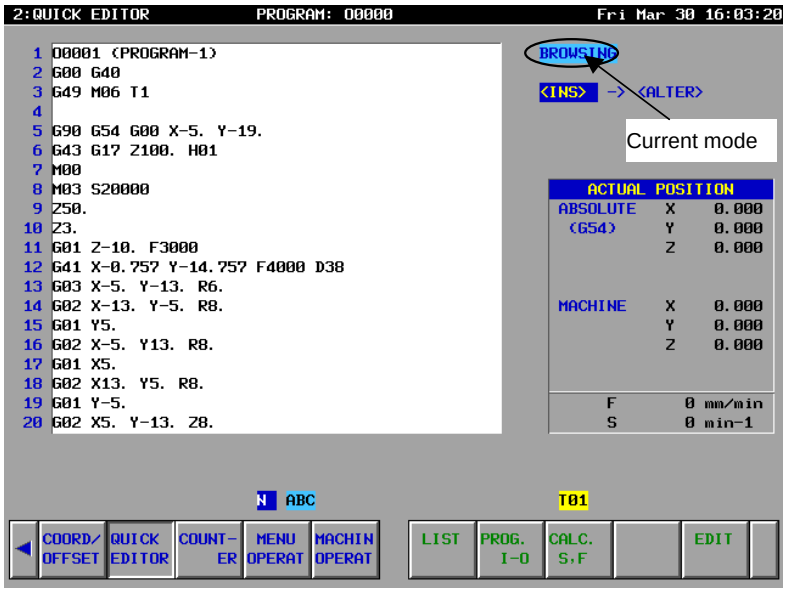
QUICK EDITOR screen is in the QUICK SCREEN (screen number: 2).Procedures for displaying QUICK EDITOR screen are as follows.

(1) The way by using soft–keys
Press the soft–key [QUICK EDITOR] for screen change.



(2) The way by inputting screen number and page key
Press <2>, and <PAGE> key on the operator's panel because QUICK EDITOR screen number is "2".

QUICK EDITOR screen (next page) is displayed by the above way (1) or (2).



SUPPLEMENT

The last program will be read and displayed on the editing area automatically after QUICK EDITOR screen is selected.
However, if QUICK EDITOR screen is displayed for the first time after power on, the program whose number is selected in the CNC screen is displayed.

11.3.2 Browse Mode and Edit Mode

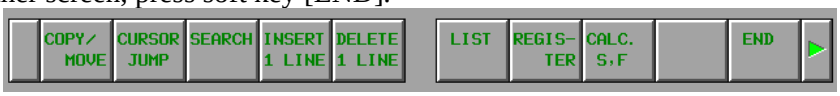
For “QUICK EDITOR”, there are two modes: Browse mode and Edit mode.

(1) Browse mode
An existing program can be referenced or deleted. Moreover, a new program can be created, and a program can be input to and output from the memory card. No program can be edited.
(2) Edit mode
You can create a new program and edit a program using various edit functions described later.

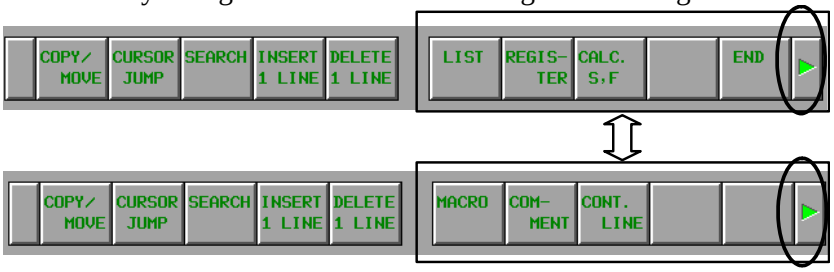
Immediately after the quick editor screen is selected, the “BROWSING” mode is set. In this state, a program can be referenced, but no program can be edited.
Pressing soft key [EDIT] displays the cursor and puts the screen in the “EDITING” mode. You can create and edit a program.
The current mode is displayed at the upper right of the edit area.

11.3.3 Selecting an Edit Function

Pressing soft key [EDIT] on QUICK screen shown on the previous page changes the displayed soft keys as shown below. You can create and edit a program. (Edit mode)
In this mode, the screen cannot be changed because the left–side soft keys are also assigned edit functions. To switch to another screen, press soft key [END].



Pressing the rightmost soft key changes the edit functions assigned to the right–side soft keys as follows:



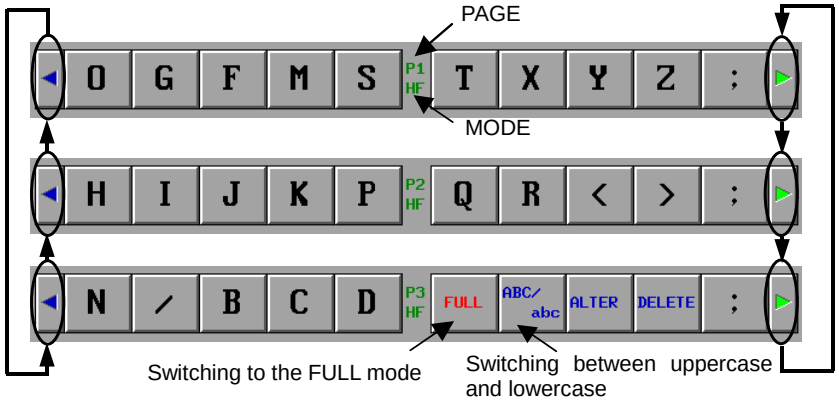
For details of each edit function, see Section 11.5, "EDITING FUNCTION OF QUICK EDITOR".

11.4 INPUT FUNCTION OF QUICK EDITOR

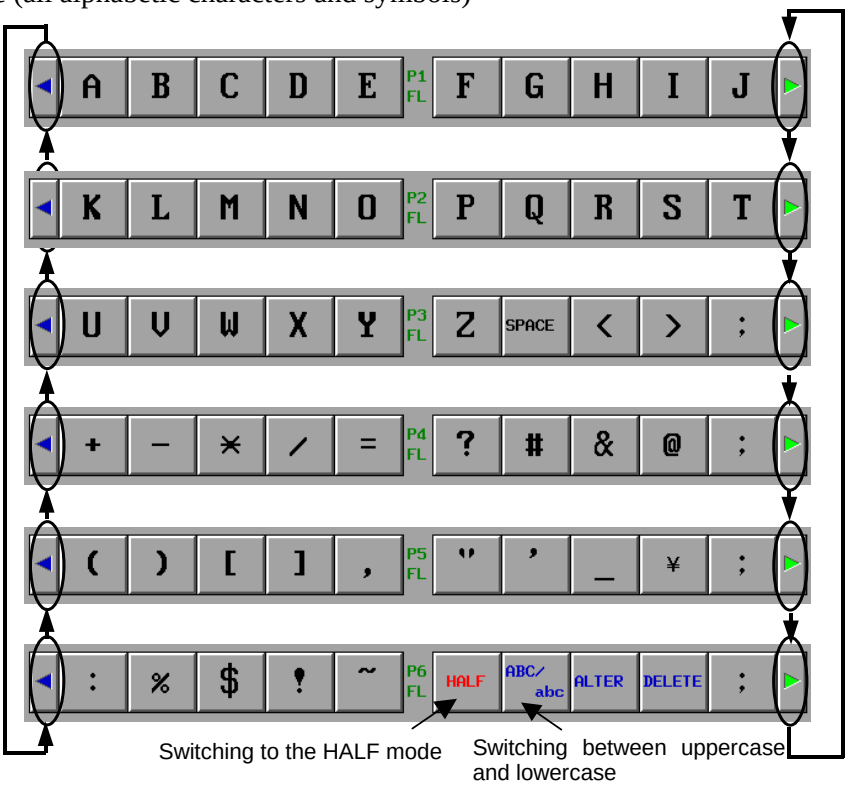
11.4.1 Entering Alphabetic Characters and Symbols

Pressing the ABC …Z key on the operator's panel displays alphabetic characters and symbols in the soft key area. You can press a desired soft key to enter the corresponding character or symbol.
For entering alphabetic characters and symbols, there are two modes:
HALF mode and FULL mode.

(1) HALF mode (frequently used alphabetic characters and symbols)



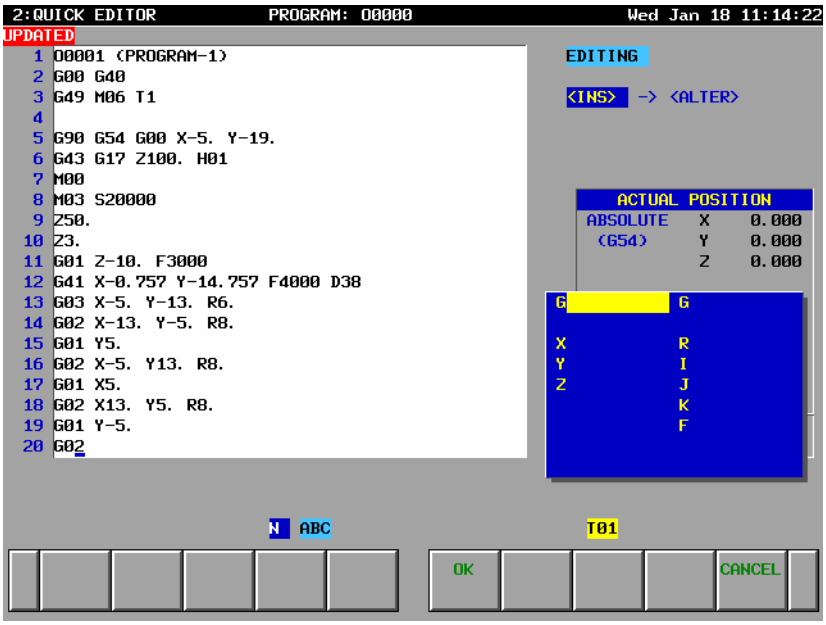
(2) FULL mode (all alphabetic characters and symbols)



Pressing the ABC …Z key again displays the names of edit functions in the soft key area.

SUPPLEMENT
An operator's panel having a full keyboard does not have this function.

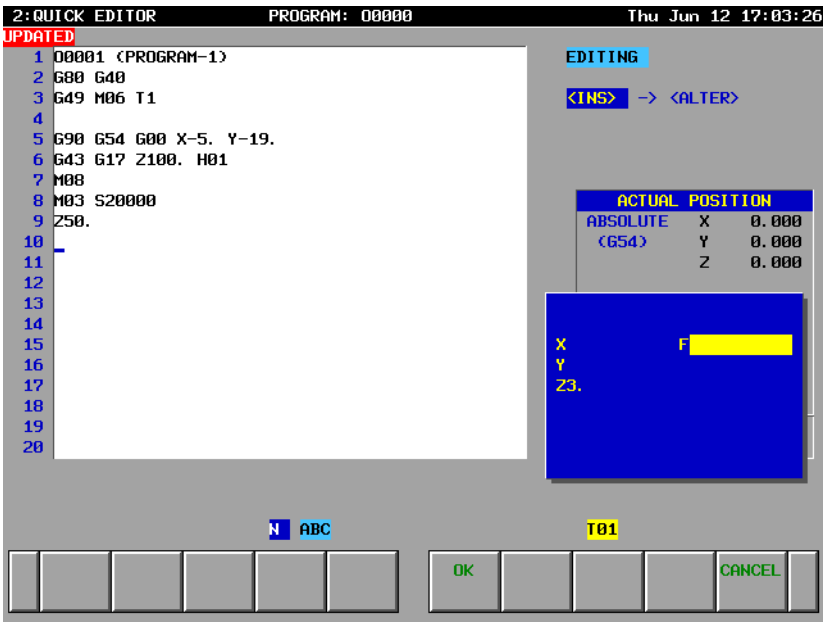
11.4.2 Simple Input of G and M Codes



(1) Then a G or M code (addresses G or M and a 2-digit number following it) is entered, addresses (such as X_ and Y_) that can follow the G code or the M code are displayed in the window as shown above. Enter numbers as required. In the window for entering G codes, they can be entered in a batch, because address G is also displayed.
(2) Pressing the soft key [OK] or the <INSERT> key on the operator's panel causes only the words specified in the window to be inserted into or written over the editing area.
(3) Pressing the soft key [CANCEL] causes the window to be closed with nothing entered. This is equivalent to pressing the [CANCEL], [OK], or <INSERT> key without entering a number into the window.
(4) Any number entered into the window can be canceled by placing the cursor on the number and then pressing only the <INPUT> key.

SUPPLEMENT
The G code and the M code must be specified with 2 digits long.

11.4.3 Simple Input of Words by Input Key



Pressing the <INPUT> key on the operators panel displays, in the window, those addresses (such as X, Y, Z, and F) which are most likely to be used independently in a block.
In the same manner as described in Subsection 11.4.2, words can be entered into the editing area without using letter keys.

See Subsection 11.4.2 for explanations about how the [OK], [CANCEL], and <INSERT> keys work.
This is a handy way to specify repetitive use of a canned cycle.

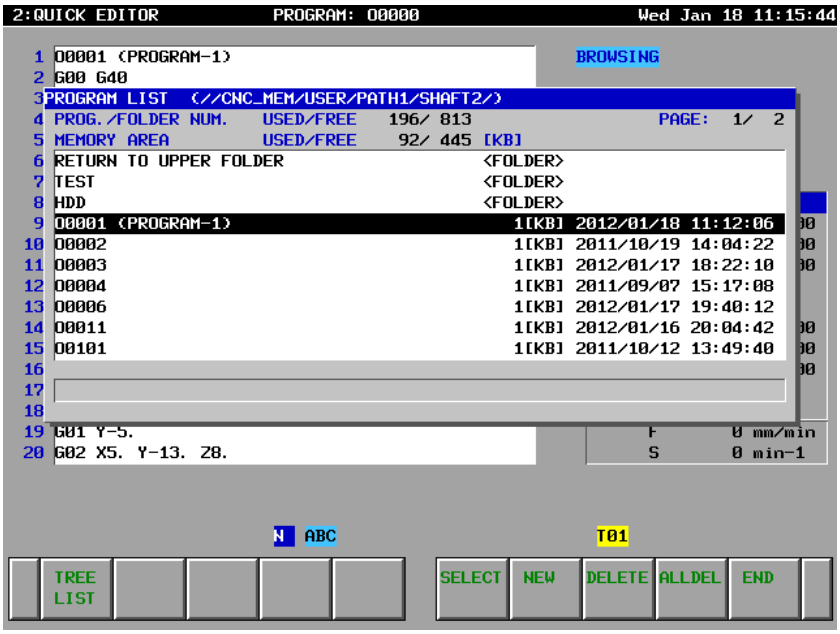
11.4.4 Other Operations

(1) To enter a space, use the [INSERT] key on the operator's panel.
(2) To delete the character to the left of the cursor, use the [CANCEL] key.
(3) To delete the character at the cursor, use the [DELETE] key.

11.5 EDITING FUNCTION OF QUICK EDITOR

11.5.1 Selecting the Program

Pressing the soft key [LIST] displays a list of programs shown below.



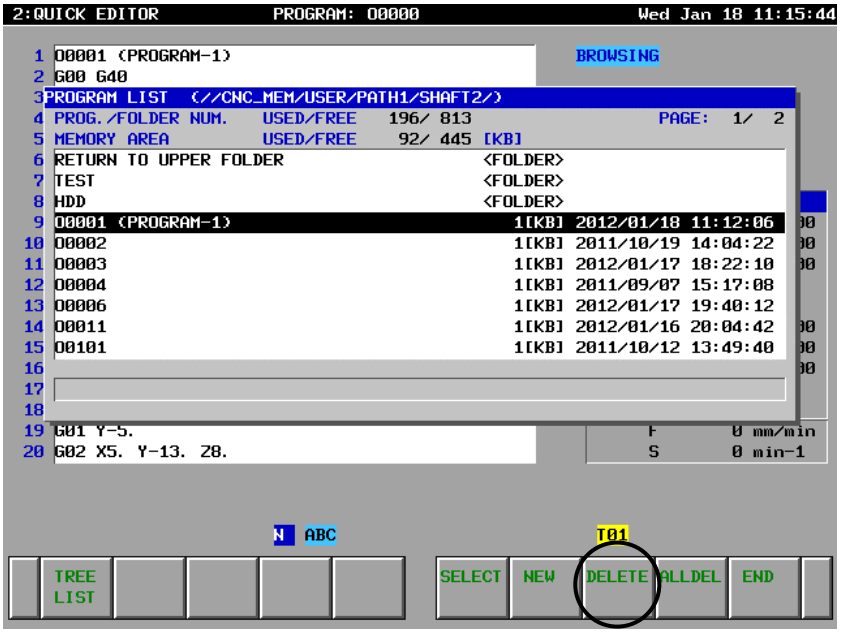
After placing the cursor on a program in the list, pressing the soft key [SELECT] can select it for reference and editing.
Selecting a program this way closes the program creation window and displays the selected program on the screen.
Pressing the soft key [TREE LIST] displays folders in a tree. Tree display can be used to make management in folder units easier.

SUPPLEMENT

- In the edit mode, it is impossible to select any protected program.
- It is impossible to select any program consisting of more than 9999 lines.

11.5.2 Deleting the Program

(1) Pressing the soft key [LIST] displays a list of programs shown below.



(2) After placing the cursor on a program in the list to select it, pressing the soft keys [DELETE] and [EXEC] deletes it.

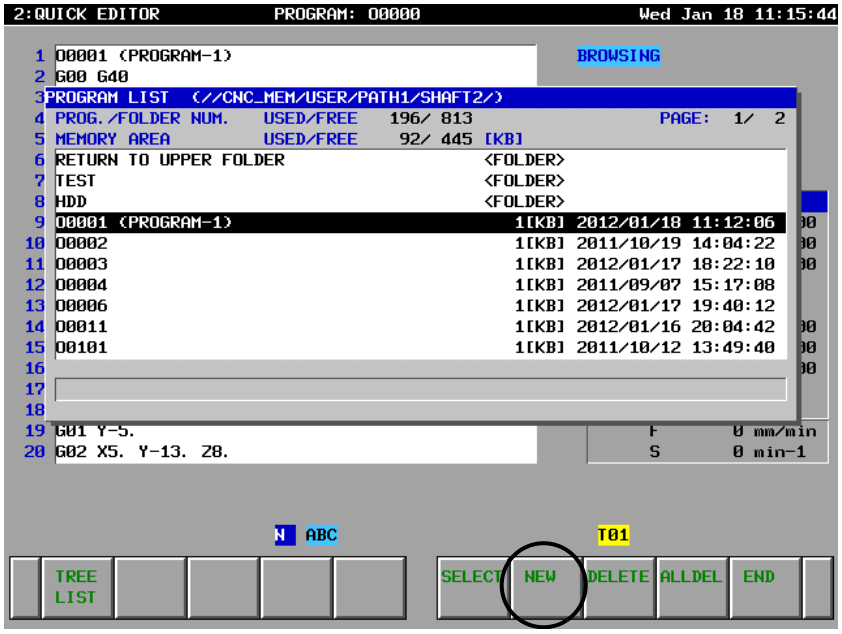
(3) In addition, pressing soft keys [ALLDEL] and [EXEC] deletes all unprotected programs from the folders displayed in the program list.

SUPPLEMENT

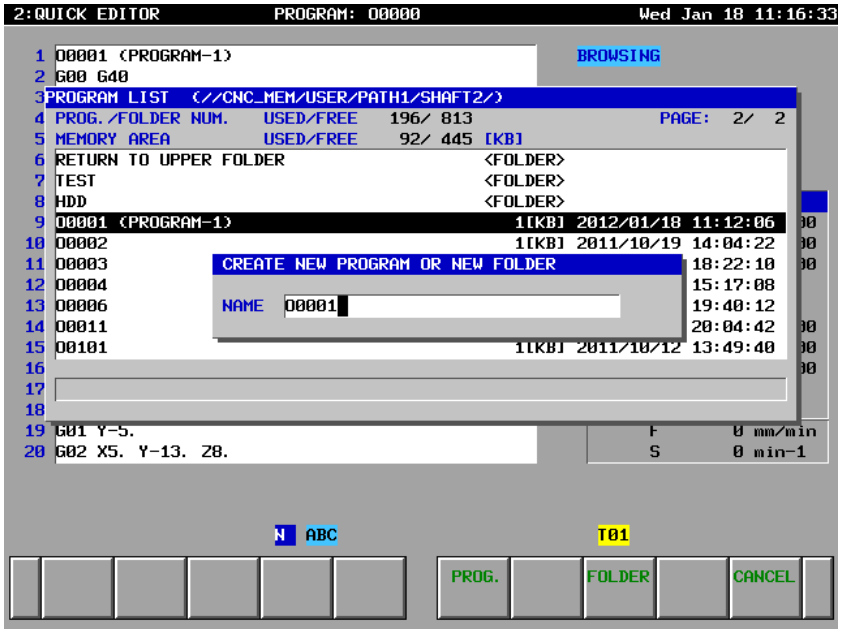
- It is impossible to delete any program when it is being executed to run the machine.
- It is impossible to delete a main program if its subprogram is running.
- It is possible to delete a subprogram that may be called by a main program even when another subprogram called by the same main program is running. However, an alarm message (PS0310: FILE NOT FOUND) is issued unless any deleted subprogram is registered again before it is called.
- It is impossible to delete any protected program.

11.5.3 Creating Programs

Pressing the soft key [LIST] displays a list of programs shown below.



To create a program, press the soft key [NEW].



Enter the name of a program to be created here. Pressing the soft key [PROG.] closes the program name entry window and adds the new program to the program list. To edit the program, press the soft key [SELECT].

SUPPLEMENT

Each program name can contain up to 32 characters including alphanumeric characters and the symbols "+", "-", "_", and ".".

11.5.4 Registering the Program

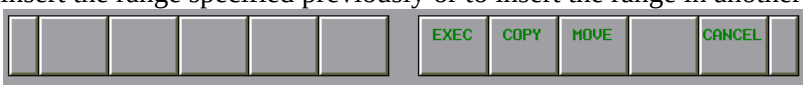
In the edit mode, a program being edited can be registered by pressing the [REGISTER] soft key then the [EXEC] soft key.

SUPPLEMENT

- When the machine is in the operation, the executing program cannot be registered until the operation is finished.
  However, it is possible to edit it.
- After the executing program is edited, if screen change or program selection is performed, a message which asks whether to register the program is displayed. (See section 11. 5. 14.)
  As described in Note 1, however, [YES] cannot be selected.
  If [NO] is selected, the change will not be reflected in the program. In this case, screen change or program selection can be executed by the following procedure.
  (1) Change the program number into an unregistered number, and register it.
  (2) Perform screen change or program selection.
  (3) After the operation is finished, return the program number (1) to the former one, and register it.
  (4) The program registered in step (1) is no longer required (because it was reregistered in step (3)). Delete it.
- It is possible to edit and register a subprogram that may be called by a main program even when another subprogram called by the same main program is running. Note, however, that an alarm message (PS0310: FILE NOT FOUND) is issued if the subprogram is called when it is being registered.
- If an inappropriate format for the CNC exists in a program, the registration might end in failure. In this case, register the program again after modification on the inappropriate format.
- If the power is switched off without registering an edited program, any modification to the program becomes null.

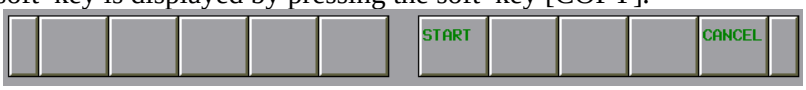
11.5.5 Copy and Move (by Line)

The above soft–key is displayed by pressing the soft–key [COPY/MOVE].
However, [EXEC] is not displayed when this function is selected for the first time after displaying QUICK EDITOR screen.
[EXEC] is used to insert the range specified previously or to insert the range in another program.



Procedure for copying

(1) The following soft–key is displayed by pressing the soft–key [COPY].



(2) Move the cursor to the start of the range to be copied and press the soft–key [START]. Then the following soft–key is displayed.

(3) Specify the range to be copied by moving the cursor. Then the range is displayed reversely. The range is specified by pressing the soft–key [END] and then the display is returned to a normal one.

(4) Executing

(a) Copying the specified range in the same program
Move the cursor to the line at which the range is to be inserted and press the soft–key [EXEC] .
If you want to copy the same range successively, press [COPY/MOVE] and [EXEC] .

(b) Copying the specified range in another program
Press the soft–key [CANCEL] first. (The specified range is not lost by pressing [CANCEL].)
Press the soft–key [LIST] and select a program in which the range is to be inserted.
After the program is displayed, move the cursor to the line at which the range is to be inserted and press the soft–key [COPY/MOVE] and [EXEC].

Procedure for moving

Moving is the same as copying, except that the specified range is deleted.

SUPPLEMENT

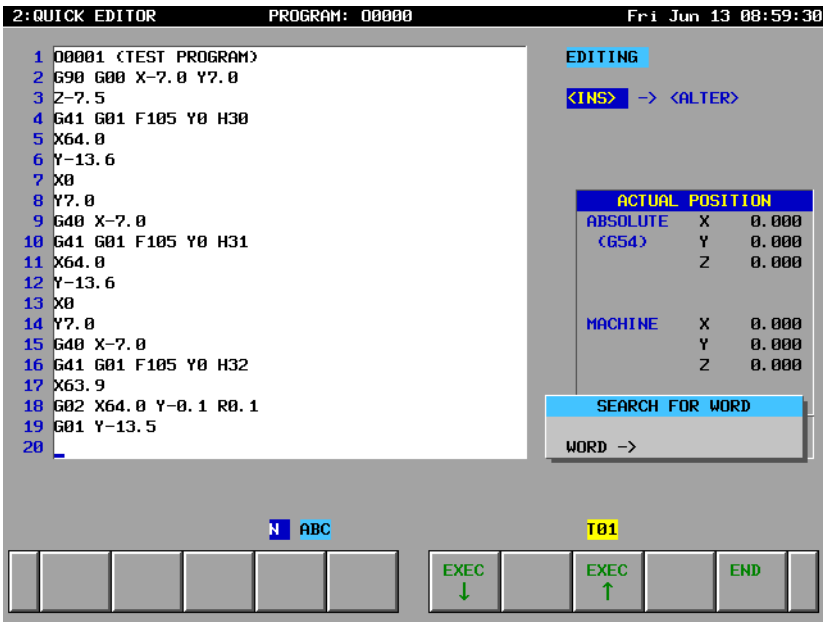
- If the program will exceed 9999 lines by copying, copying cannot be executed.
- The range to be copied or moved cannot be specified by the character.
- The range to be copied or moved can be specified up to 100 lines.

11.5.6 Cursor Jump

The above window and soft–key are displayed by pressing the soft–key [CURSOR JUMP] . Select from the soft–key.

[TOP] ..... The cursor is moved to the top, that is, line 1 of the program.
[GO TO LINE]..... When the line number of the destination of jump is entered according to the message, the cursor is positioned to the specified line.
[BOTTOM]..... The cursor is moved to the bottom of the program.

11.5.7 Search for the Specified Word



The above window is displayed by pressing the soft–key [SEARCH].
The [EXEC ↓] soft key is used to perform downward search, and the [EXEC ↑] soft key is used to perform upward search.
Upon entering a word for which a search is to be made, it is displayed in reverse video at the bottom of the window. Press the [EXEC ↓] or [EXEC ↑] soft key after entering the word. The window is closed and the cursor is positioned to the point at which the specified word was first found.

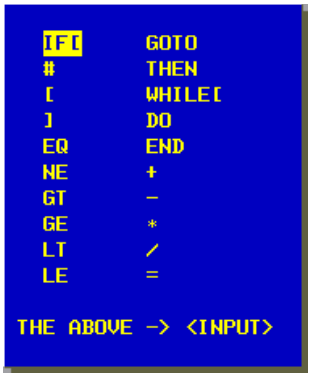
If the specified word is not found, the message "THE WORD IS NOT FOUND." is displayed.
That word for which a search was made most recently remains stored in the system. Therefore, to subsequently search for the same word again, it is only necessary to press [SEARCH] then [EXEC↓]→[EXEC ↑]. The word itself does not have to be entered again.

Pressing [SEARCH] causes the word for which a search was last made, if any, to appear at the bottom of the window.

SUPPLEMENT
The word to be searched for can be specified up to 10 letters.

11.5.8 Entering a Macro Statement

You can simply enter words frequently used for creating custom macros.
Pressing soft key [MACRO] displays the following window:

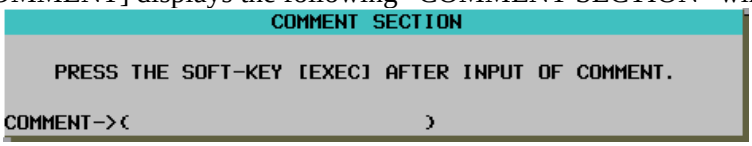


To input a character displayed in the window in the edit area, move the cursor to the character to be input and press <INPUT> key.

SUPPLEMENT
When the window is displayed, the cursor in the window is moved. Before using this function, move the cursor to the position in which a character is to be input.

11.5.9 Entering a Comment

Pressing soft key [COMMENT] displays the following “COMMENT SECTION” window:

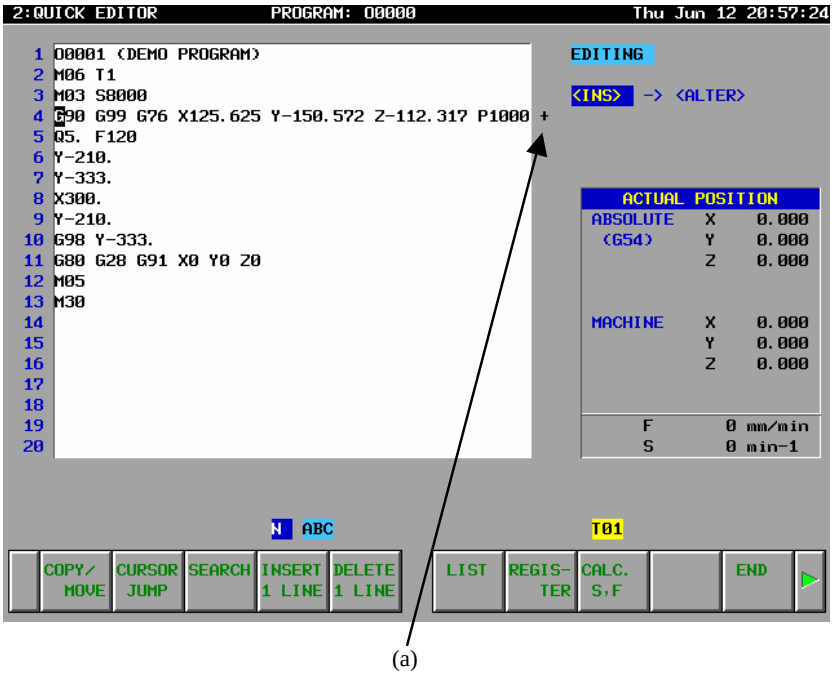


When you enter a character string, it is temporarily displayed at the bottom of the window. After entry, press soft key [EXEC]. The window is closed and the input comment enclosed by parentheses is inserted or overwritten in the cursor position.

SUPPLEMENT
A comment input using this function cannot extend over multiple lines.
You can check the positions of the parentheses at the bottom of the window to see the allowable length for inputting a comment in the current position.

11.5.10 Setting and Cancel of Continuous Line

With QUICK EDITOR, end of block (EOB) is not used. QUICK EDITOR interprets one line in the editing area as one block in principle, and automatically adds EOB to each line when a program is registered in the CNC.
To input a long block which cannot be displayed in one line in the editing area, this function can be used to treat multiple lines in the editing area as one block.



Move the cursor to the desired line and press the soft–key [CONT. LINE].
Then the mark of "+" is displayed at the right side of the line. (See the above (a).)
Mark “+” means that a line which has the mark is followed by the next line. And those lines are treated as one block. In the above example, lines 4 and 5 are treated as one block.
If you want to cancel this function, move the cursor to the desired line and press the soft–key [CONT.LINE] again. Then the mark of "+" disappears and the treatment as one block is canceled.

SUPPLEMENT
This function cannot be used at the bottom of the editing area.

11.5.11 Inserting a Line

A line is inserted by pressing the soft–key [INSERT 1 LINE] and then the cursor is moved to the head of the line.

SUPPLEMENT
If the bottom line (line 9999) of the editing area is not empty, this function cannot be executed.

11.5.12 Deleting a Line

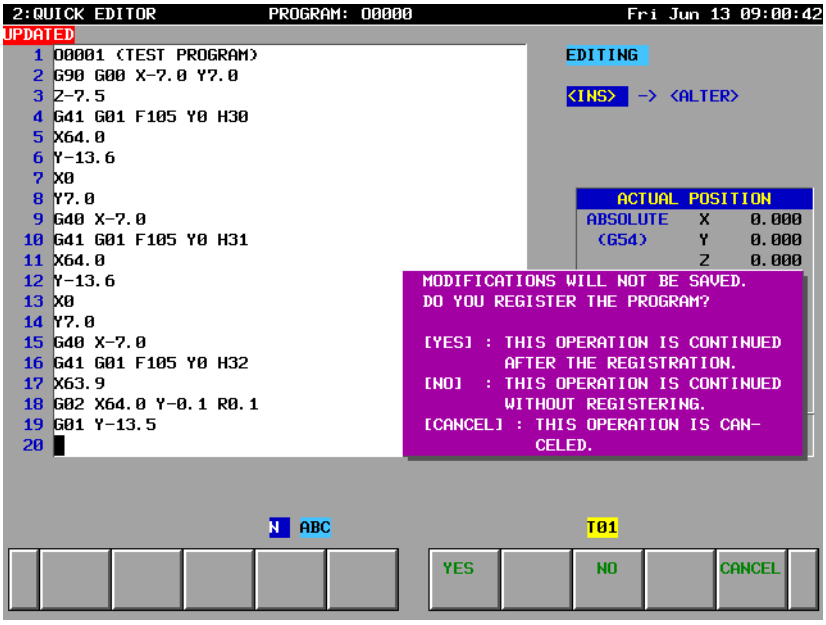
The current line is deleted by pressing the soft–key [DELETE 1 LINE].

11.5.13 Setting of Inserting or Overwriting Mode

Pressing the <ALTER> key on the operator's panel switches back and forth between the insert mode and write–over mode.
The currently selected mode is displayed at the upper right of the edit area.

11.5.14 Screen Change and Program Selection after Editing

After a program is edited (that is, it is changed), if an attempt is made to change the screen (to another QUICK screen or CNC screen) or display the program list without registering the program, the following message appears. Select a desired soft key according to the instructions in the message.
After a read program is changed, "UPDATED" is displayed at the upper left of the screen.



[YES] ..... Screen change or program selection is performed after the current program is registered.
[NO] ..... Screen change or program selection is performed without registering the current program.
[CANCEL] ..... Screen change or program selection is not performed.

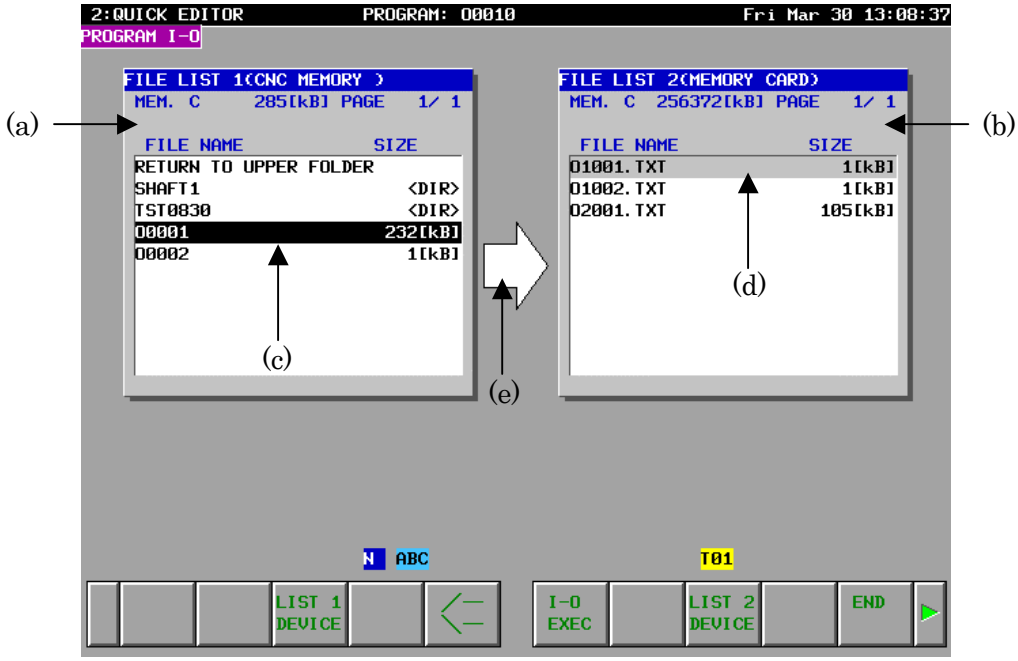
11.6 PROGRAM INPUT/OUTPUT

Between an external input/output device (memory card or USB memory) and program memory or data server in the CNC, programs and folders can be input and output easily.

11.6.1 PROGRAM I-O Screen

Displaying the PROGRAM I-O screen

(1) Press the [QUICK EDITOR] soft key to display "2: QUICK EDITOR".
(2) Press the [PROG. I-O] soft key to display the PROGRAM I-O screen.



(a), (b): Information (remaining capacity and file list) related to the selected device is displayed. Press the [LIST1 DEVICE] and [LIST2 DEVICE] soft keys to change the devices. (The selected device is displayed in parentheses in each window title.)
(c), (d): Cursor.
The cursor is displayed in black in the active window or in gray in the inactive window.
(e): The file selected by the cursor is copied in the direction indicated by this arrow.
To change the direction of the arrow, press the [←] soft key.

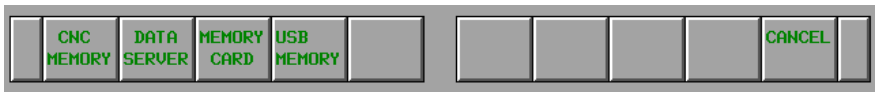
Operation method

(1) Use <↑> and <↓> to select a file or folder and use <←> and <→> to change the active window. To move to a file in a folder, position the cursor on a desired folder and press the <INPUT> key.

(2) The arrow displayed at the center of the screen indicates the direction in which to output a program. The direction of the arrow can be changed by pressing the [←] or [→] soft key.

(3) To change the device displayed in FILE LIST 1, press the [LIST1 DEVICE] soft key. To change the device displayed in FILE LIST 2, press the [LIST2 DEVICE] soft key. The following soft keys are displayed. Select a target device for inputting or outputting a program by pressing the corresponding soft key.

[LIST1 DEVICE]



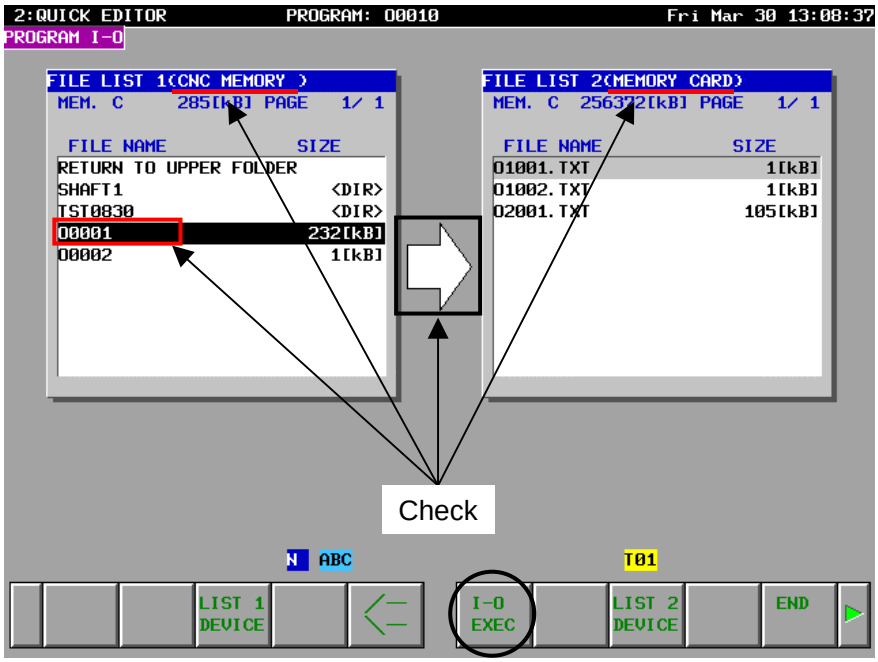
[LIST2 DEVICE]

Inputting and outputting a program

(1) First, select a file to be output. In the file list at the source of the arrow, position the cursor on a file or folder to be output.

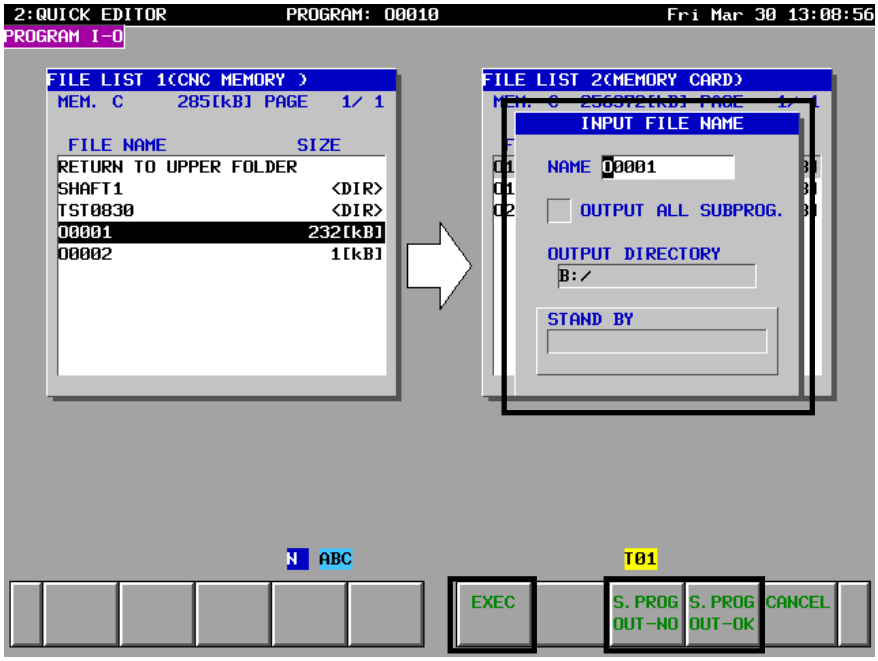
(2) Then, select a folder to which to output the file or folder. Operate the file list at the destination of the arrow and move the folder to which to output the file or folder.

(3) For example, to output program "O0001" in the CNC memory to the root folder in the memory card, set items as shown in the figure below.



(4) Select a correct file to be output and a correct folder to which to output the file, then press [I-O EXEC] soft key.
The "INPUT FILE NAME" window appears. Enter an output file name and press the [EXEC] soft key. The selected file or folder moves to the output destination device.

(5) When a program is output from the CNC memory or data server to an external input/output device, the subprograms called from the selected program can be output at a time. To output these subprograms, press the [S.PROG OUT-OK] soft key and check "OUTPUT ALL SUBPROG.". To uncheck the item, press the [S.PROG OUT-NO] soft key.

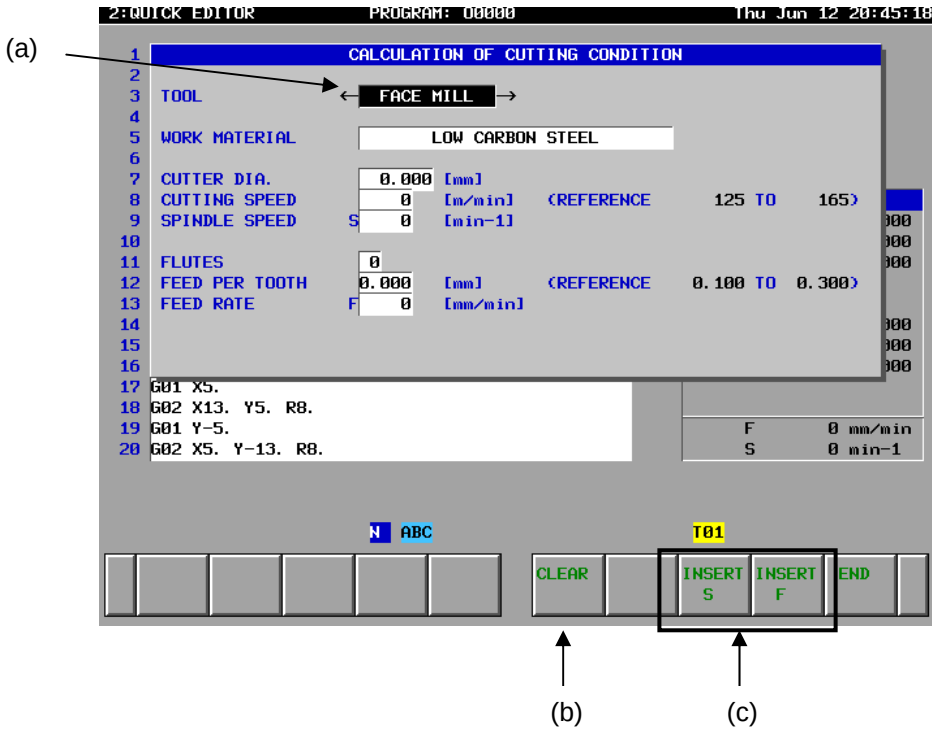


11.7 CUTTING CONDITION CALCULATION FUNCTION

By entering tool information (the tool diameter and the number of flutes), cutting feedrate, and other information, spindle speed S and feedrate F, which are required for a machining program, can be obtained easily. Furthermore, the obtained spindle speed S and feedrate F can be inserted to the machining program.

11.7.1 Screen Explanation (Common to Each Tool)

Pressing the soft key [CALC. S,F] displays the following window:



(a) TOOL
Using the right and left cursor keys (<→> and <←>), select the type of the tool to be used from the four types: the face mill, end mill, drill, and tap.
The items used for calculation vary depending on the selected tool.

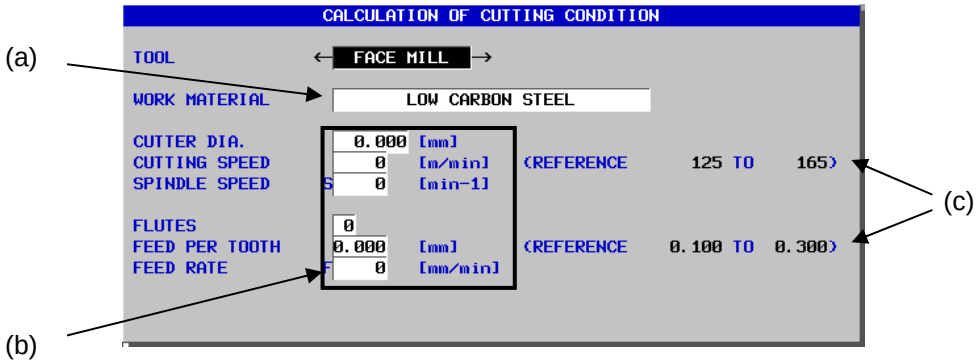
(b) [CLEAR] key
Entered values and calculated results are cleared.

(c) [INSERT S] and [INSERT F] keys
The [INSERT S] and [INSERT F] keys insert the calculated spindle speed S and feedrate F as an S code and an F code to a machining program, respectively.
These soft keys are displayed only when the QUICK EDITOR is in the Edit mode.

11.7.2 Calculating Cutting Conditions (When Face Mill or End Mill is Selected)

11.7.2.1 Screen explanation

When the face mill or end mill is selected in TOOL, the following window is displayed:



(a) WORK MATERIAL
With the right and left cursor keys (<→>, <←>), select the material of the workpiece to be machined from the following nine types: "LOW CARBON STEEL", "MEDIUM CARBON STEEL", "HIGH CARBON STEEL", "LOW ALLOY STEEL", "HIGH ALLOY STEEL", "STAINLESS STEEL", "GRAY CAST IRON", "DUCTILE STEEL", and "ALUMINUM ALLOY".

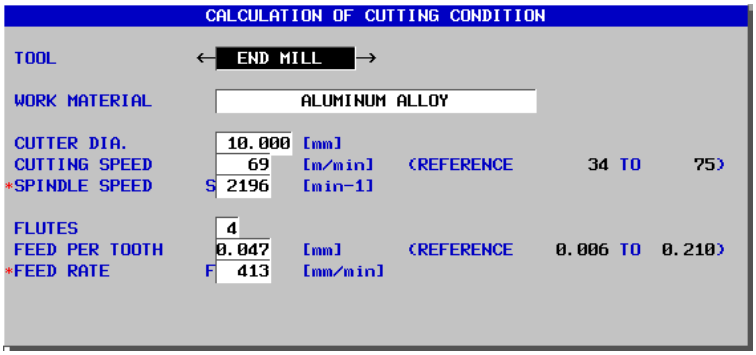
(b) Input of numeric values and display of calculation results
Enter values used for calculation. The results of automatic calculation from the entered values are displayed (the calculation results are marked with an asterisk (*) to the left of their item names).
When the face mill or end mill is selected, the six items including "CUTTER DIA.", "CUTTING SPEED", "SPINDLE SPEED S", "FLUTES", "FEED PER TOOTH", and "FEED RATE F" are displayed.

(c) REFERENCE
According to the work material selected in (a), the ranges of generally used cutting speeds and feeds per tooth are displayed.

11.7.2.2 Calculation procedure

The following explains the procedure for automatically calculating spindle speed S and feedrate F:

(1) Enter the diameter of the tool used in "CUTTER DIA.".
(2) Enter a value in "CUTTING SPEED". Consult the reference as necessary.
Then, the calculation result is indicated in "SPINDLE SPEED S" (marked with an asterisk (*) to the left of the item name).
(3) In "FLUTES", enter the number of the flutes of the tool used.
(4) Enter a value in "FEED PER TOOTH". Consult the reference as necessary.
Then, the calculation result is indicated in "FEED RATE F" (marked with an asterisk (*) to the left of the item name).



(5) Pressing the soft keys [INSERT S] and [INSERT F] inserts the calculation results to the machining program (in the above calculation example, S2196 and F413 are inserted).

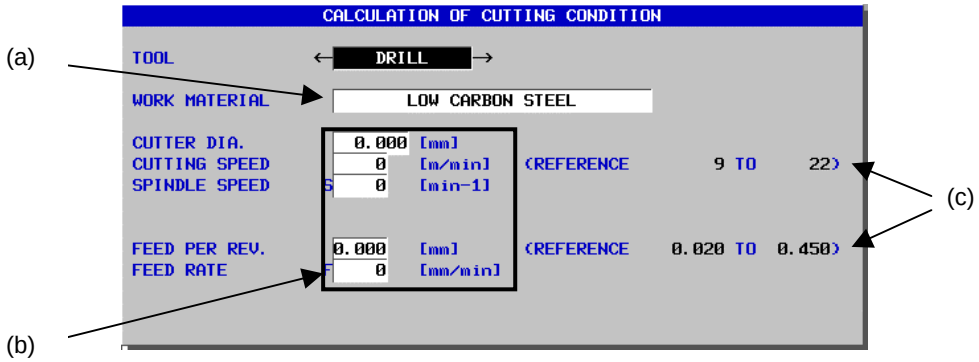
SUPPLEMENT

- [INSERT S] and [INSERT F] can be used only when the QUICK EDITOR is in the edit mode.
- It is impossible to enter a value in the automatically calculated items (the items marked with "*"). Pressing the soft key [CLEAR] erases all data, allowing you to enter values.
- In addition to SPINDLE SPEED S and FEED RATE F, other items can be calculated automatically. For example, when the cutter diameter and spindle speed S are entered, the cutting speed is calculated.

11.7.3 Calculating Cutting Conditions (When Drill is Selected)

11.7.3.1 Screen explanation

When the drill is selected in TOOL, the following window is displayed:



(a) WORK MATERIAL
With the right and left cursor keys (<→> and <←>), select the material of the workpiece to be machined from the following nine types: "LOW CARBON STEEL", "MEDIUM CARBON STEEL", "HIGH CARBON STEEL", "LOW ALLOY STEEL", "HIGH ALLOY STEEL", "STAINLESS STEEL", "GRAY CAST IRON", "DUCTILE STEEL", and "ALUMINUM ALLOY".

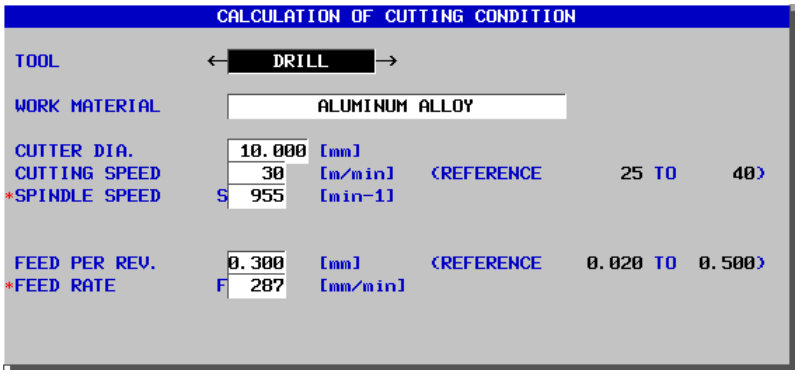
(b) Input of numeric values and display of calculation results
Enter values used for calculation. The results of automatic calculation from the entered values are displayed (the calculation results are marked with an asterisk (*) to the left of their item names).
When the drill is selected, the five items including "CUTTER DIA.", "CUTTING SPEED", "SPINDLE SPEED S", "FEED PER REV.", and "FEED RATE F" are displayed.

(c) REFERENCE
According to the work material selected in (a), the ranges of generally used cutting speeds and feeds per revolution are displayed.

11.7.3.2 Calculation procedure

The following explains the procedure for automatically calculating spindle speed S and feedrate F:

(1) Enter the diameter of the drill used in "CUTTER DIA.".
(2) Enter a value in "CUTTING SPEED". Consult the reference as necessary.
Then, the calculation result is indicated in "SPINDLE SPEED S" (marked with an asterisk (*) to the left of the item name).
(3) In "FEED PER REV.", enter a value. Consult the reference as necessary.
Then, the calculation result is indicated in "FEED RATE F" (marked with an asterisk (*) to the left of the item name).



(4) Pressing the soft keys [INSERT S] and [INSERT F] inserts the calculation results to the machining program (in the above calculation example, S955 and F287 are inserted).

SUPPLEMENT

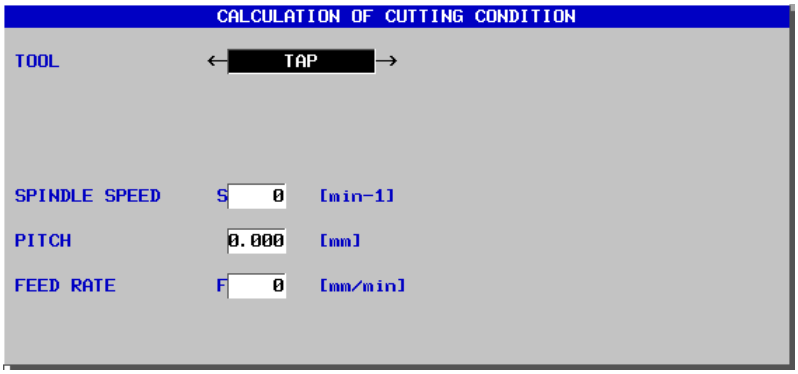
- [INSERT S] and [INSERT F] can be used only when the QUICK EDITOR is in the Edit mode.
- It is impossible to enter a value in the automatically calculated items (the items marked with "*"). Pressing the soft key [CLEAR] erases all data, allowing you to enter values.
- In addition to SPINDLE SPEED S and FEED RATE F, other items can be calculated automatically. For example, when the cutter diameter and spindle speed S are entered, the cutting speed is calculated.

11.7.4 Calculating Cutting Conditions (When Tap is Selected)

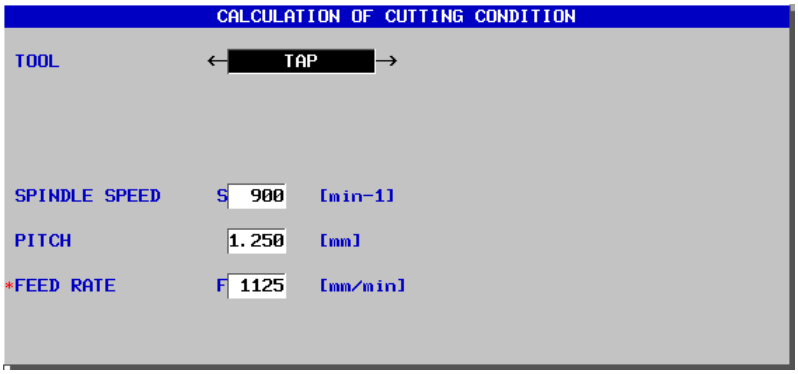
When the tap is selected in TOOL, the items to be displayed vary depending on the input unit (inch/metric).

11.7.4.1 Screen explanation and calculation procedure (metric)

For the metric input, the following window is displayed:



When two of the three items are entered, the remaining item is calculated automatically (the automatically calculated item is marked with an asterisk (*) to the left of the item name).



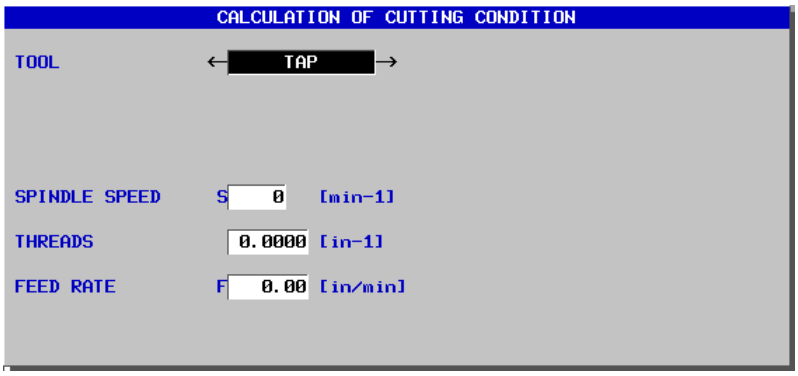
Pressing the soft keys [INSERT S] and [INSERT F] inserts SPINDLE SPEED S and FEED RATE F to the machining program (in the above example, S900 and F1125 are inserted).

SUPPLEMENT

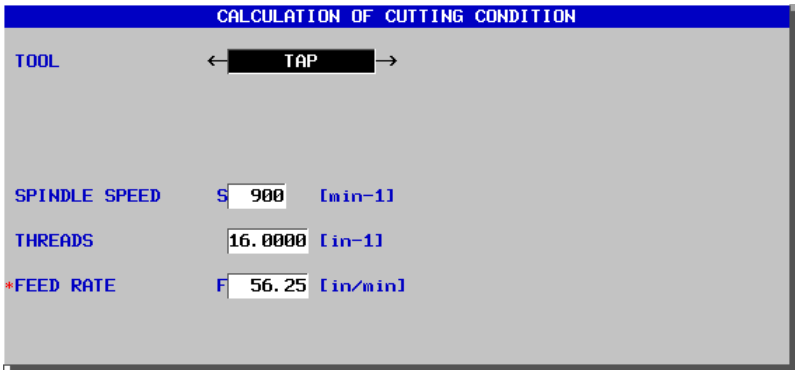
- [INSERT S] and [INSERT F] can be used only when the QUICK EDITOR is in the edit mode.
- It is impossible to enter a value in the automatically calculated item (the item marked with "*"). Pressing the soft key [CLEAR] erases all data, allowing you to enter values.

11.7.4.2 Screen explanation and calculation procedure (inch)

For the inch input, the following window is displayed:



When two of the three items are entered, the remaining item is calculated automatically (the automatically calculated item is marked with an asterisk (*) to the left of the item name).



Pressing the soft keys [INSERT S] and [INSERT F] inserts SPINDLE SPEED S and FEED RATE F to the machining program (in the above example, S900 and F56.25 are inserted).

SUPPLEMENT

- [INSERT S] and [INSERT F] can be used only when the QUICK EDITOR is in the edit mode.
- It is impossible to enter a value in the automatically calculated item (the item marked with "*"). Pressing the soft key [CLEAR] erases all data, allowing you to enter values.

12 TOOL LIFE MANAGEMENT

12.1 OVERVIEW

Tools are classified into some groups. The life (by cycle quantity or duration) of tools is specified for each tool group. Each time a tool in a group is used, its life is counted. When the tool life expires, the next tool in the group is automatically selected for use. This way, it is possible to continue machining while managing the tool life. The data used for tool life management includes a tool group number, tool life value, remaining life setting (expiration advance notice), tool number, and tool offset value specification code. This data is registered in the CNC.

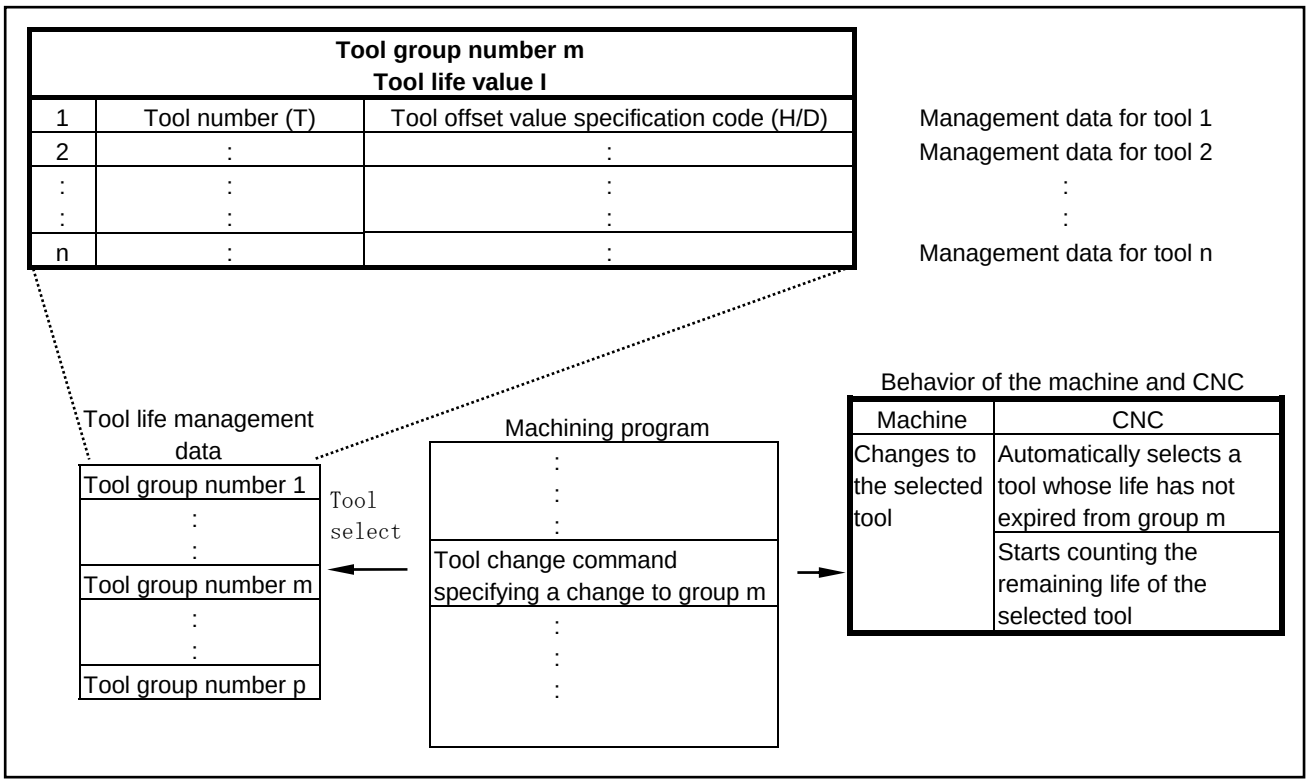


Fig.12.1 (a) Selecting tools with the machining program

12.1.1 Tool Life Management Data

The tool life management data consists of a tool group number, tool number, tool offset value specification code, tool life value, and remaining life setting.

<Explanation>

- Tool group number

Parameters GS1 (No. 6800#0) and GS2 (No. 6800#1) can be used to select a pair of the number of tool groups that can be registered and the maximum number of tools that can belong to each group.
The pairs indicated with (*1) and (*2) are factory-set, respectively, to the α-D14*i*A5 and α-D21*i*A5 series.

Table12.1.1 (a) Maximum number of groups that can be registered and maximum number of tools that can be registered

GS2 (No. 6800#1)	GS1 (No. 6800#0)	Number of groups	Number of tools	
0	0	8	32	
0	1	16	16	(*1)
1	0	32	8	(*2)
1	1	64	4	

SUPPLEMENT
Once you have re-set parameter GS1 (NC parameter No. 6800#0) or GS2 (NC parameter No. 6800#1), register the tool life management data again, using G10L3 (involving data deletion for all groups). Otherwise, no new pair is selected.

- Tool number

Tool numbers are specified, using the T code.

- Tool offset value specification code

There are two types of tool offset value specification codes; one is the H code (for tool length compensation), and the other is the D code (for cutter compensation).

SUPPLEMENT
It is possible to omit registration of a tool offset value specification code if it is not used.

- Tool life value

The tool life value can be registered either as duration or cycle quantity. Its maximum value is: 100000 minutes (60000 minutes as counted at an interval of 0.1 seconds) or 99999999 cycles.

- Remaining life setting

The remaining life setting (until a new tool is selected) can be specified between 1 to 100000 minutes (60000 minutes as counted at an interval of 0.1 seconds) or up to 99999999 cycles.

12.1.2 Registering, Changing, or Deleting Tool Life Management Data

Programs can be used to register tool life management data in the CNC, to change, and to delete it.

<Explanation>

A different program format applies to each of the following four types:

- Tool life management data registration with all groups deleted

Programmed tool management data is registered after all registered tool life management data has been deleted.

- Changing tool life management data

It is possible to set tool life management data in a group that has no registered tool life management data and to change any registered tool life management data.

- Deleting tool life management data

It is possible to delete tool life management data.

- Specifying a tool life count type

It is possible to specify a count type (duration or cycle quantity) for each tool group.

<Format>

Tool life management data registration with all groups deleted

Format	Description
G10L3; P-L-; T-H-D-; T-H-D-; · P-L-; T-H-D-; T-H-D-; · G11; M02(M30);	G10L3: Registers tool life management data after deleting data from all groups. P-: Group number L-: Tool life value T-: Tool number H-: Tool offset value specification code (H code) D-: Tool offset value specification code (D code) G11: End of registration

Changing tool life management data

Format	Description
G10L3P1; P-L-; T-H-D-; T-H-D-; · P-L-; T-H-D-; T-H-D-; · G11; M02(M30);	G10L3P1: Starts changing data in a group P-: Group number L-: Tool life value T-: Tool number H-: Tool offset value specification code (H code) D-: Tool offset value specification code (D code) G11: End of registration

Deleting tool life management data

Format	Description
G10L3P2; P-; P-; P-; P-; . G11; M02(M30);	G10L3P2: Starts deleting data in a group P-: Group number G11: End of registration

Specifying a tool life count type for a tool life group

Format	Description
G10L3 (or G10L3P1); P-L-Q-; T-H-D-; T-H-D-; . G11; M02(M30);	Q: Life count type (1: Cycle quantity. 2: Duration.)

SUPPLEMENT

If no Q command is specified, a life count type is specified according to the setting of parameter LTM (No. 6800#2).

Remaining life setting

Format	Description
G10L3; (or G10L3P1); P-L-R-; T-H-D-; T-H-D-; . G11; M02(M30);	R-: Remaining life setting (until a new tool is selected)

SUPPLEMENT

1 If no remaining life setting (R) is specified or a specified remaining life setting is 0, it is registered as 0. In this case, the expiration advance notice function is invalid.
2 No value greater than the life value (L) can be specified as remaining life setting (R). An attempt to specify such a value results in an alarm (PS0431) being issued.
3 The remaining life setting (R) cannot contain a decimal point or sign.
4 The measurement unit for the remaining life setting (R) is the same as specified in parameter FGL (No. 6805#1) for selecting a measurement unit for tool life values.

Tool life value

Table.12.1.2 (a) Life count type and maximum life value

Life count type	Maximum life value
Cycle quantity	99999999 cycles
Duration	100000 minutes
	60000 minutes (SUPPLEMENT)

Table.12.1.2 (b) Life value measurement unit and L command maximum value (when duration is specified)

FGL (No.6805#1)	Measurement unit for the life value	L command maximum value	Example
0	1-minute units	100000	L100:
		60000 (SUPPLEMENT)	Life value is 100 minutes.
1	0.1-second units	60000000	L1000:
		36000000(SUPPLEMENT)	Life value is 100 seconds.

SUPPLEMENT
If the specified life count interval is 0.1 seconds (parameter FCO (No. 6805#0) = 1), a duration of up to 60000 minutes can be specified.

12.1.3 Tool Life Management Commands in Machining Programs

<Explanation>

- Commands

Commands for tool life management are described below.

M06 T* ;**

*** represents the sum of a desired tool group number and 100.

Example: To specify tool group number 1, issue "M06T101;".

This command selects a command whose life has not expired from a specified group, ends life management for the previous tool, and starts life counting for the newly selected tool.

SUPPLEMENT
1 M06 is treated as an M code with no buffering.
2 When issuing more than one M code in the same block, specify M06 as the first M code.

H99 ;

This is the H code registered in the tool life management data for a tool currently in use. It enables tool length compensation. Parameter No. 13265 can also be used to enable compensation with non-99 H codes.

H00 ;

This H code cancels tool length compensation.

D99 ;

This is the D code registered in the tool life management data for a tool currently in use. It enables cutter compensation. Parameter No. 13266 can also be used to enable compensation with non-99 D codes.

D00 ;

This D code cancels cutter compensation.

SUPPLEMENT

H99/D99 cannot precede the M06 command. Issuing a code other than H99/D99 or a code other than the H/D code specified in parameter No. 13265/13266 after M06 prevents the H or D code for tool life management data from being selected.

Program examples

M06 T101;	Selects a tool whose life has not expired from tool group 1 (assuming tool number 10 is selected).
:	
:	Counts the tool life for tool group 1 (counting the tool life of tool number 10).
:	
:	
M06 T102;	Selects a tool whose life has not expired from tool group 2 (assuming tool number 12 is selected).
:	
:	Counts the tool life of the tools in tool group 2 (counting the tool life of tool number 12).
:	
G43 H99 ;	Uses the tool length compensation for the tool selected from tool group number 2.
:	
:	
G41 D99 ;	Uses the cutter compensation for the tool selected from tool group number 2.
:	
:	
D00 ;	Cancels the cutter compensation.
:	
:	
H00 ;	Cancels the tool length compensation.
:	
:	
M06 T103 ;	Selects a tool whose life has not expired from tool group 3.
:	Counts the tool life of the tools in tool group 3.
:	

12.1.4 Selecting Tool Life Count Types and Tools

Table.12.1.4 Tool life management count types and intervals

Tool life count type	Cycle quantity	Duration
Life count interval	The counter is incremented by 1 only for a tool used with a single program. However, the tool life count restart M code (M43) can be used for re-counting.	Parameter FCO (No. 6805#0) 0: 1-second interval 1: 0.1-second interval

<Explanation>

- Specifying a cycle quantity

Executing the tool life management command (M06T***) selects a tool whose life has not expired from a specified tool group and increments the life counter for the selected tool by 1. Only the first tool group number command and tool change command that are issued after the control unit has started an automatic operation from a reset state can perform the operation stated above provided that no tool life count restart M code is issued.

SUPPLEMENT

No cycle quantity is incremented or no new tool is selected no matter how many times a single program specifies the same tool group number.

- Specifying a duration

Executing the tool life management command (M06T***) selects a tool whose life has not expired from a specified tool group and starts life management for the selected tool. As for the time during which the tool is used in the cutting mode, tool life management (count) is carried out at intervals of 1 or 0.1 seconds. This life count interval is specified using parameter FCO (No. 6805#0). The time needed for a single block stop, feed hold, rapid traverse, dwell, machine lock, and interlock is counted.

SUPPLEMENT

The alarm message "EX1011 ALL TOOL IN SAME GROUP ARE USED" appears when M02 or M30 is issued or the tool life count restart M code(M43) is issued after the life of the last tool in the group has expired.

12.1.5 Tool Life Count Restart M Code (M43)

<Explanation>

If the specified life count type is cycle quantity, an alarm (EX1011) is issued if the tool life of even one group turns out to have expired when the tool life count restart M code (M43) is issued.
Once M43 has issued, the tool management command (M06T***) selects a tool whose life has not expired from a specified tool group and increments the tool life counter by 1. This way, a tool life management command can count the tool life unless it is the first one issued after the CNC has started automatic operation from a reset state.

Example: Program not using the tool life count restart M code (assuming the specified life count type is cycle quantity)

```
M06 T101 ;   Changes to a tool whose life has not expired in tool group 1 (incrementing the
             tool life counter for tool group 1 by 1).
  :
  :
M06 T102 ;   Changes to a tool whose life has not expired in tool group 2 (incrementing the
             tool life counter for tool group 2 by 1).
  :
  :
M06 T101 ;   Changes to the previously selected tool in tool group 1 (without incrementing
             the tool life counter for tool group 1).
  :
  :
```

Example: Program using the tool life count restart M code (assuming the specified life count type is cycle quantity)

```
M06 T101 ;   Changes to a tool whose life has not expired in tool group 1 (incrementing the
             tool life counter for tool group 1 by 1).
  :
  :
M06 T102 ;   Changes to a tool whose life has not expired in tool group 2 (incrementing the
             tool life counter for tool group 2 by 1).
  :
  :
M43 ;        Restarts tool life counting.
M06 T101 ;   Changes to a tool whose life has not expired in tool group 1 (incrementing the
             tool life counter for tool group 1 by 1).
  :
  :
```

SUPPLEMENT

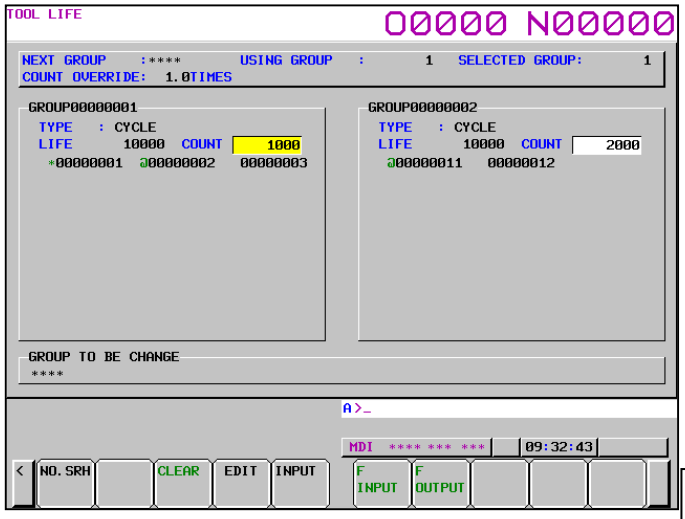
1 The tool life count restart M code is treated as an M code with no buffering.
2 An alarm (EX1011) is issued if the tool life of even one group turns out to have expired when the tool life count restart M code is issued.

12.2 DISPLAYING AND SPECIFYING TOOL LIFE MANAGEMENT DATA

Tool life management data can be displayed, so the operator can take hold of its current status. The operator can also edit the displayed tool life management data.
The following two screens are available:

- TOOL LIFE list screen
- TOOL LIFE group editing screen

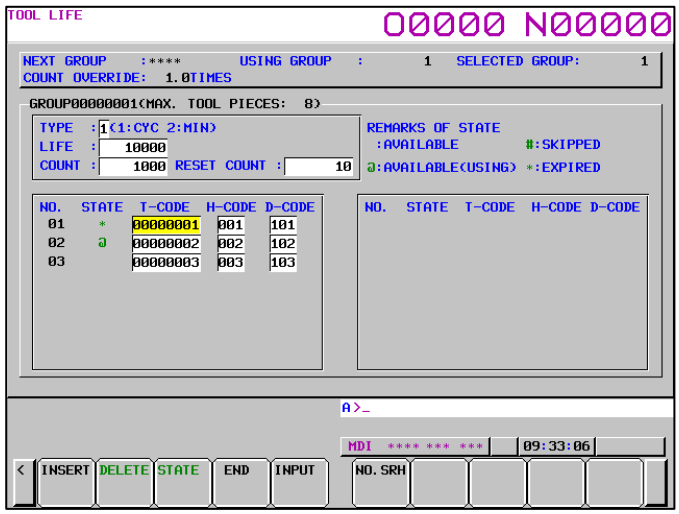
Overview



List screen

[EDIT]

[END]



Group editing screen

TOOL LIFE list screen
Displayed items:

- USING GROUP and SELECTED GROUP
- Group number
  Count type
  Life and Life counter
  Tool life state
  T-code
  Group to be change

Functions:
Searching for groups
Clearing execution data
Setting up the life counter

When the list screen is displayed, pressing the soft key [EDIT] displays the group editing screen. When the group editing screen is displayed, pressing the soft key [END] displays the list screen.

TOOL LIFE group editing screen
Displayed items:

- USING GROUP and SELECTED GROUP
- Group number and Tool pieces
- Count type
- Life and Life counter, and reset count
- Tool life state
- T-code, H-code, and D-code

Functions:

- Specifying tool data
- Deleting groups
- Setting up the tool status
- Deleting tools
- Searching for groups
- Specifying a life counter type, life value, life counter, and remaining life setting

12.2.1 Tool Life Management (List Screen)

This screen can be used to learn of the life management status of all tools in a group and those tools whose life has expired. It is also possible to set up the tool life counter and clear execution data.

12.2.1.1 Displaying the list screen

Follow the step below to display the list screen.

(1) Display the 「3:COUNTER」 quick screen and press the soft key [TOOL GROUP].

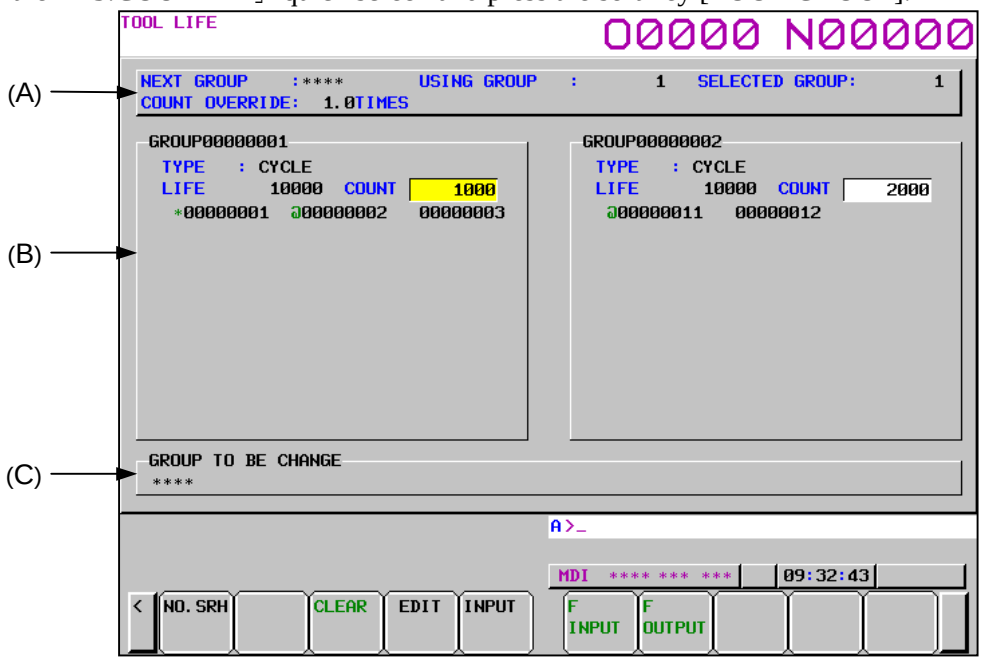


Fig.12.2 (a) Displaying the TOOL LIFE list screen

- Contents of (A)

This area displays tool group numbers. If there is no corresponding tool group, ****, instead of a tool group number, is displayed.

NEXT GROUP: Not used with the ROBODRILL.
USING GROUP: Tool group number being currently subjected to life counting.
SELECTED GROUP: Tool group number being currently or most recently subjected to life counting .
COUNT OVERRIDE: Not used with the ROBODRILL.

- Contents of (B)

This area displays specified tool life values, current tool life counter readings, and registered tool numbers (in sequence in which they are used). If the specified life count type is duration, the measurement unit used in displaying and setting life values and tool life counter values is as listed below (according to the setting of parameter FCO (No. 6805#0)).

Parameter FCO (No.6805#0)	0	1
Measurement unit used in displaying and setting life values and tool life counter values	1-minute units	0.1-minute units

The following table summarizes the meaning of each symbol that precedes tool numbers.

Symbol	Tool status
No symbol	Unused
@	In use (the tool life has not expired)
#	Skip (the AI tool monitor function has detected that a warning level was exceeded, or a skip was specified.)
*	The tool life has expired.

SUPPLEMENT

1 The tool life counter contains a count value for a tool indicated with the symbol "@".
2 If parameter EMD (No. 6801#3) = 0, the symbol "@" remains displayed for a tool whose life has expired until the next tool is selected.
3 If parameter EMD (No. 6801#3) = 1, what is displayed varies depending on which life count type is in use, as described below.
- If the specified life count type is duration, the symbol "*" (the tool life has expired) substitutes the symbol "@" when the tool life expires.
- If the specified life count type is cycle quantity, the symbol "*" (the tool life has expired) does not substitute the symbol "@" even when the tool life value becomes equal to the tool life counter value, because the counter is incremented by one at the end (such as M02 or M30) of the program. The symbol "*" appears only when the life of the tool is counted after the CNC has been reset.

- Contents of (C)

This area displays tool group numbers in which the life of all tools has expired.
If the area becomes full before all the tool group numbers are displayed, ">>" is displayed at the end of the area.
If there is no tool group in which the tool life has expired, **** is displayed.

12.2.1.2 Specifying data on the list screen

The ROBODRILL is factory-set in such a way that tool life management data can be specified even during automatic operation. However, resetting parameter TCI (No. 6804#1) to 0 disables tool life management data from being specified during automatic operation.

SUPPLEMENT

As for setting up tool groups in use:
(1) Only the tool life counter can be re-set during automatic operation (when OP signal = "1" and parameter TCI (No. 6804#1) = 1).
(2) If the CNC has been reset (OP signal = "0" and RST signal = "0"), the following editing operation stops life management because it cannot be continued:
- Clearing execution data

- Setting up the tool life counter

The tool life counter can be set with a value, using the following steps.
(1) Place the cursor on the tool life counter for a tool group to be set up.
(2) Enter a value.
(3) Press the soft key [INPUT] or the INPUT key on the operator's panel.

- Clearing execution data

All the execution data used so far for the tool group indicated with the cursor can be cleared, using the following steps. To be specific, the status of all tools in the tool group becomes "unused" and the tool life counter is reset to 0.

(1) Place the cursor on the tool group whose execution data is to be cleared.
(2) Press the soft key [DELETE].
(3) Press the soft key [EXEC].

SUPPLEMENT

Setting parameter GRS (No. 6800#4) = 1 can clear the execution data for all registered tool groups.

- Selecting a tool group

A tool group can be selected as follows:

Method 1

(1) Enter a tool group number.
(2) Press the soft key [NO. SRH].

Method 2

(1) Press the page key

or

to display the desired group.

(2) Press the cursor key or to move the cursor to a group at either the left or right.

- Switching to the group editing screen

The TOOL LIFE group editing screen can be selected, using the following steps.

(1) Place the cursor on the tool group to be edited.
(2) Press the soft key [EDIT].

12.2.2 TOOL LIFE Group Editing Screen

The group editing screen can be used to edit tool life management data (such as tool life value, tool life counter, and tool data) for a tool group.

12.2.2.1 Displaying the group editing screen

Follow the steps below to display the group editing screen.

(1) On the list screen, place the cursor on a tool group to be edited.
(2) Press the soft key [OPERATION].
(3) Press the soft key [EDIT].

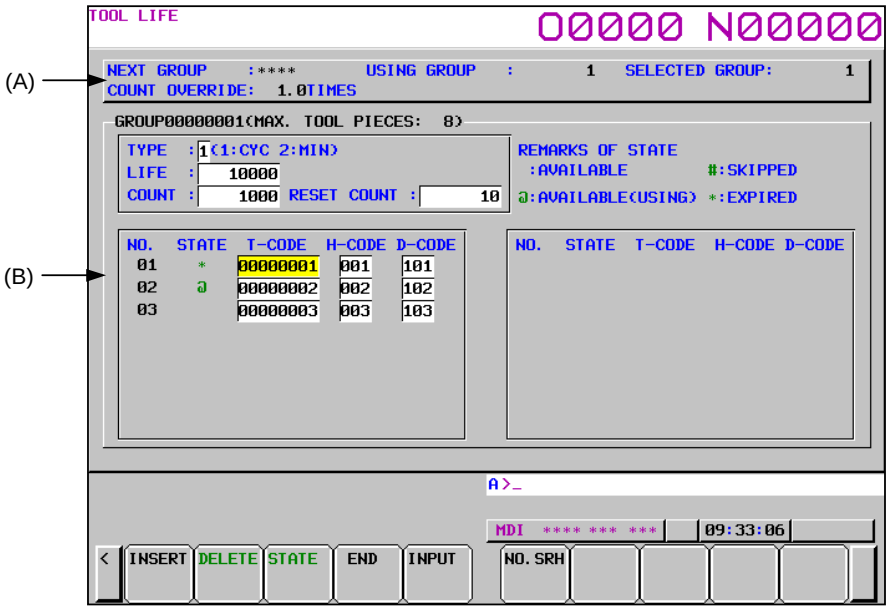


Fig.12.2.2.1 Displaying the TOOL LIFE group editing screen

SUPPLEMENT

If no tool has been registered in a tool group, no value is displayed for TYPE, LIFE, COUNT, or RESET COUNT.

- Contents of (A)

In the same manner as for the list screen, this area displays a tool group number. If there is no corresponding tool group, ****, instead of a tool group number, is displayed.

NEXT GROUP: Not used with the ROBODRILL.
USING GROUP: Tool group number being currently subjected to life counting.
SELECTED GROUP: Tool group number being currently or most recently subjected to life counting.
COUNT OVERRIDE: Not used with the ROBODRILL.

- Contents of (B)

The details of the tool life management data related to a selected tool group are displayed as shown below.

TYPE:

1	The specified life count type is cycle quantity.
2	The specified life count type is duration.

LIFE: Tool life value
COUNT: Tool life counter
RESET COUNT: Tool life available until a new tool is selected

STATE:

Tool number	Tool status
No symbol	Unused
@	In use (the tool life has not expired)
#	Skip (the AI tool monitor function has detected that a warning level was exceeded, or a skip was specified.)
*	The tool life has expired.

T code: Tool number
H code: Tool length compensation specification code
D code: Cutter compensation specification code

SUPPLEMENT

1 The tool life counter contains a count value for a tool indicated with the symbol "@".
2 If parameter EMD (No. 6801#3) = 0, the symbol "@" remains displayed for a tool whose life has expired until the next tool is selected.
3 If parameter EMD (No. 6801#3) = 1, what is displayed varies depending on which life count type is in use, as described below.
   - If the specified life count type is duration, the symbol "*" (the tool life has expired) substitutes the symbol "@" when the tool life expires.
   - If the specified life count type is cycle quantity, the symbol "*" (the tool life has expired) does not substitute the symbol "@" even when the tool life value becomes equal to the tool life counter value, because the counter is incremented by one at the end (such as M02 or M30) of the program. The symbol "*" appears only when the life of the tool is counted after the CNC has been reset.

12.2.2.2 Specifying data on the group editing screen

The ROBODRILL is factory-set in such a way that tool life management data can be specified even during automatic operation. However, resetting parameter TCI (No. 6804#1) = 0 disables tool life management data from being specified during automatic operation.

The group editing screen has the editing items listed below.

Editable items	Mode
Specifying the life count type, tool life value, tool life counter, remaining life value, and tool data (T code, H code, and D code)	All modes
Adding tool numbers (T code)	MDI
Deleting all tool group data at a time	MDI
Deleting tool data (status, T code, H code, and D code)	MDI
Specifying to skip tools	MDI
Specifying to clear tools (life recovery)	MDI

If no tool group has been registered, it is impossible to specify a life count type, tool life value, tool life counter, and remaining tool life setting. First add a tool number (T code).

SUPPLEMENT

As for editing tool groups in use:

1 Only the tool life counter can be re-set during automatic operation (when OP signal = "1" and parameter TCI (No. 6804#1) = 1).
2 If the CNC has been reset (OP signal = "0" and RST signal = "0"), the following editing operation stops life management because it cannot be continued:
- Adding tool numbers (T code)
- Deleting all tool group data at a time
- Deleting tool data (status, T code, H code, and D code)

- Specifying the life count type, tool life value, tool life counter, remaining life value, and tool data

To specify the life count type, tool life value, tool life counter, remaining life value, or tool data:

(1) Place the cursor on the item you want to specify.
(2) Enter a value.
(3) Press the soft key [INPUT] or the <INPUT> key on the operator's panel.

SUPPLEMENT

1 Changing the tool life value or tool life counter of tools does not affect the status of the tools.
2 Changing the life count type resets the related tool life value and tool life counter to 0.

- Adding tool numbers

To add a tool number to a tool group, follow the steps below:

(1) Select the MDI mode.
(2) Place the cursor on the tool data (either T code, H code, or D code) for a tool number 1 less than the tool number to be added.
(3) Enter the tool number to be added.
(4) Press the soft key [INSERT].

- Deleting all tool group data at a time

To delete all tool group data at a time:

(1) Select the MDI mode.
(2) Select a tool group to be deleted.
(3) Press the soft key [DELETE].
(4) Press the soft key [GROUP].
(5) Press the soft key [EXEC].

- Deleting tool data

To delete tool data from a tool group:

(1) Select the MDI mode.
(2) Place the cursor on the tool data (either T code, H code, or D code) for a tool to be deleted.
(3) Press the soft key [DELETE].
(4) Press the soft key [<CURSOR>].

SUPPLEMENT

1 Deleting all tools from a tool group is equivalent to deleting the tool group.
2 Deleting a tool indicated with the symbol "@" (tool in use) moves the symbol to a tool whose life has expired and which is numbered 1 less than the deleted tool number or to a skipped tool.

- Specifying to skip tools

To place tool data in a skipped status:

(1) Select the MDI mode.
(2) Place the cursor on the tool data (either T code, H code, or D code) for a tool to be deleted.
(3) Press the soft key [STATE].
(4) Press the soft key [SKIP].

- Specifying to clear tools (life recovery)

To place tool data in a cleared status:

(1) Select the MDI mode.
(2) Place the cursor on the tool data (either T code, H code, or D code) for a tool to be cleared.
(3) Press the soft key [STATE].
(4) Press the soft key [CLEAR].

- Selecting tool groups

To select a tool group:

Method 1

(1) Enter a tool group number.
(2) Press the soft key [NO. SRH].

Method 2

(1) Display a tool group to be selected, using the

or

page switch key.

- Switching to the list screen

To return to the TOOL LIFE list screen:

(1) Press the soft key [END].

12.3 PARAMETERS

	#7	#6	#5	#4	#3	#2	#1	#0
6800				GRS		LTM	GS2	GS1

[Input classification] Parameter input
[Data type] Bit

 # 0 GS1

 # 1 GS2 These parameters (GS1 and GS2) can be used to select a pair of the number of tool groups that can be registered and the number of tools in each group.

GS2	GS1	Number of groups	Number of tools
0	0	8	32
0	1	16	16
1	0	32	8
1	1	64	4

SUPPLEMENT
Once you have re-set these parameters, set up tool data again, using G10L3; (registration with tool data for all groups deleted).

 # 2 LTM This parameter can select a tool life count type as follows:
0: Cycle quantity
1: Duration

SUPPLEMENT
Once you have re-set this parameter, set up tool data again, using G10L3; (registration with tool data for all groups deleted).

 # 4 GRS This parameter can specify what data to clear when the tool change reset signal (TLRST) is input, as follows:
0: If the tool life of a tool group specified using the tool group number select signal has expired, the execution data of the tool group is cleared.
1: The execution data of all registered tool groups is cleared.

If the parameter is 1, clearing execution data on the TOOL LIFE list screen amounts to clearing the execution data for all registered tool groups.

	#7	#6	#5	#4	#3	#2	#1	#0
6801					EMD			

[Input classification] Parameter input
[Data type] Bit

 # 3 EMD This parameter specifies when the tool life management function is to display the symbol "*" to indicate the life of a tool has expired, as follows:
0: When the next tool is put in use.
1: When the tool life of the tool of interest expires.

SUPPLEMENT

- If this parameter is 0, the symbol "@" remains displayed for a tool whose life has expired until the next tool whose life has not expired is put in use.
- If the parameter is 1, what is displayed varies depending on which life count type is in use, as described below. If the specified life count type is duration, the symbol "*" (the tool life has expired) substitutes the symbol "@" when the tool life expires. If the specified life count type is cycle quantity, the symbol "*" (the tool life has expired) does not substitute the symbol "@" even when the tool life value becomes equal to the tool life counter value, because the counter is incremented by one at the end (such as M02 or M30) of the program. The symbol "*" appears only when the tool is put in use by the tool group command (T code) or the tool change command (M06) issued after the CNC has been reset.

	#7	#6	#5	#4	#3	#2	#1	#0
6804							TCI	

[Input classification] Parameter input
[Data type] Bit

 # 1 TCI This parameter specifies whether to enable or disable tool life data editing during automatic operation (the OP signal is "1"), as follows:
0: Disable
1: Enable

SUPPLEMENT

If the parameter is 1, tool life data can be edited even during automatic operation (the OP signal is "1"). However, if the group subjected to editing is one in use or the next group to use, only the life counter can be preset. It is impossible to change other data.

	#7	#6	#5	#4	#3	#2	#1	#0
6805		TRU					FGL	FCO

[Input classification] Parameter input
[Data type] Bit

 # 0 FCO This parameter specifies a life count interval if the specified life count type is duration, as follows:
0: 1-second interval
1: 0.1-second interval

As the result of setting by the parameter, the measurement unit for displaying and setting the tool life value and tool life counter on the TOOL LIFE screen is set up as follows:

Parameter FCO	0	1
Measurement unit for displaying and setting the tool life value and tool life counter	1-minute unit	0.1-minute unit

SUPPLEMENT

Once you have re-set this parameter, set up tool data again, using G10L3; (registration with tool data for all groups deleted).

 # 1 FGL This parameter specifies a measurement unit used in life data registration triggered by G10 if the specified life count type is duration, as follows:
0: 1-minute unit
1: 0.1-minute unit

 # 6 TRU This parameter specifies whether to count a cutting time below 1 second if the specified life count type is duration and if the specified life count interval is 1 second (parameter FCO (NC parameter No. 6805#0) = 0), as follows:
0: A cutting time below 1 second is discarded; it is not counted.
1: A cutting time below 1 second is counted by rounding it up to the nearest 1-second digit.

SUPPLEMENT
If the specified life count interval is 0.1 second (parameter FCO (No. 6805#0) = 1), a cutting time below 0.1 seconds is always counted by rounding it up to the nearest 0.1-second digit.

13265	H code for enabling tool length compensation in tool life management

[Input classification] Parameter input
[Data type] Doubleword
[Data range] 0 to 9999
Usually, issuing H99 enables tool length compensation according to an H code for a tool currently in use. Specifying any H code other than H99 in the parameter can give it the same function as H99. If the parameter is 0, H99 is assumed. The data that can be specified ranges from 0 to 9999.

13266	D code for enabling cutter compensation in tool life management

[Input classification] Parameter input
[Data type] Doubleword
[Data range] 0 to 9999
Usually in tool life management, issuing D99 enables cutter compensation according to a D code for a tool currently in use. Specifying any D code other than D99 in the parameter can give it the same function as D99. If the parameter is 0, D99 is assumed.

12.4 ALARMS AND MESSAGES

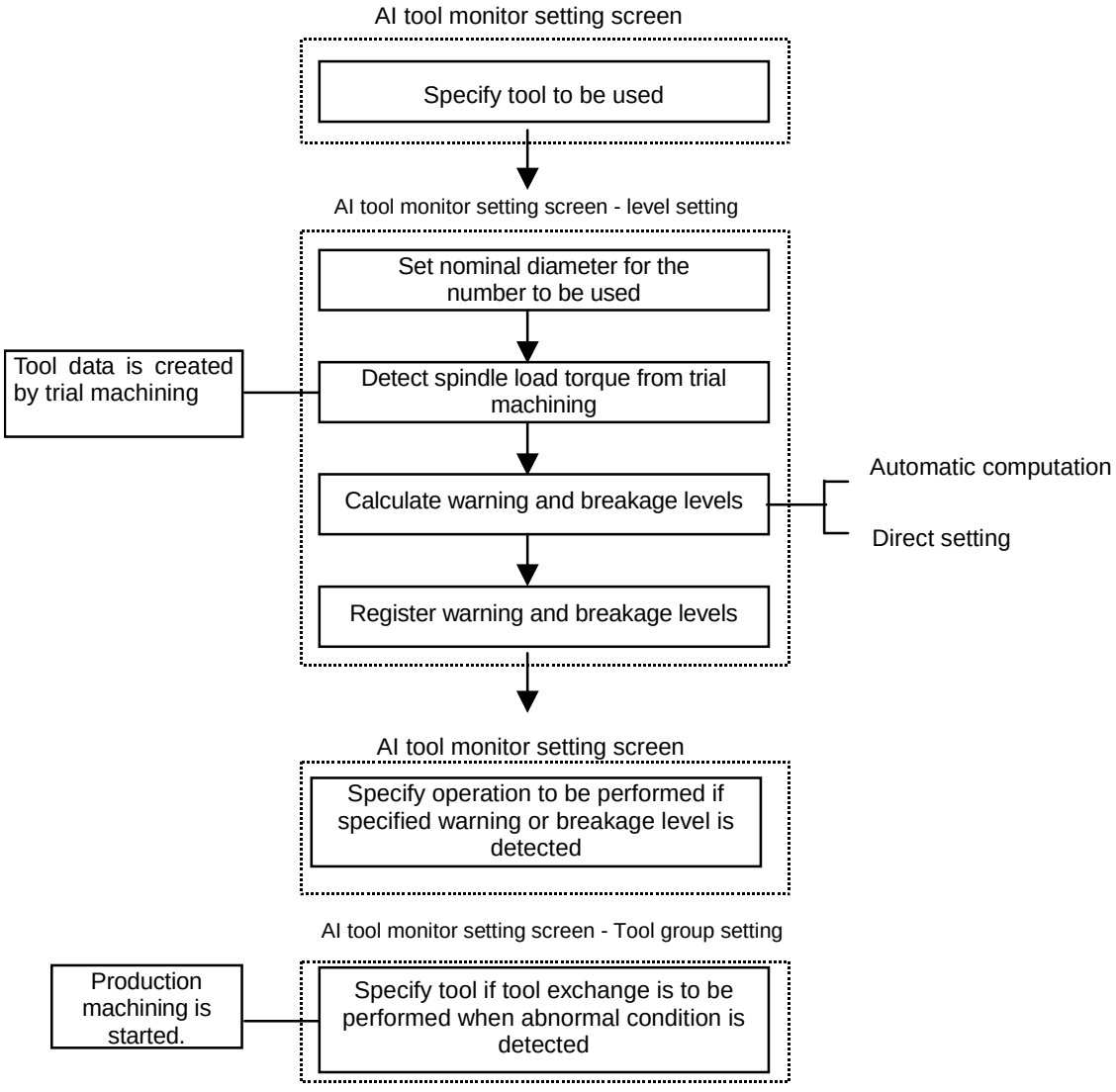
Number	Message	Description
PS0149	FORMAT ERROR IN G10L3	In tool life management data registration (G10L3 to G11), an address other than Q1, Q2, P1, or P2, or an unusable address was specified.
PS0150	ILLEGAL LIFE GROUP NUMBER	An attempt was made to specify a tool group number greater than the maximum allowable value. A tool group number (P specified after G10L3;) or a tool group number specified in a tool life management T code command in a machining program was greater than the maximum allowable value.
PS0151	GROUP NOT FOUND AT LIFE DATA	A tool group specified in a machining program has not been specified in tool life management data.
PS0152	OVER MAXIMUM TOOL NUMBER	An attempt was made to register more tools in a tool group than the maximum number of tools that can be registered.
PS0153	T-CODE NOT FOUND	In tool life data registration, no T code was registered in a block where one should be.
PS0154	NOT USING TOOL IN LIFE GROUP	H99 or D99 was specified when no tool management data number was assigned to a spindle position. Collect the program.
PS0155	ILLEGAL T-CODE COMMAND	A T code in the same machining program block as for M06 does not correspond to the tool group currently in use. Correct the program.
PS0156	P/L COMMAND NOT FOUND	No P or L command was specified at the beginning of a program for specifying a tool group. Correct the program.
PS0157	TOO MANY TOOL GROUPS	An attempt was made to specify a value greater than the maximum allowable value as a tool group number. A tool group number (P specified after G10L3;) or a tool group number specified in a tool life management T code command in a machining program was greater than the maximum allowable value.
PS0158	TOOL LIFE VALUE OUT OF RANGE	An attempt was made to specify too great a value as tool life. Correct the setting.
PS0159	ILLEGAL TOOL LIFE DATA	Tool life management data was collapsed for some reason. Register the tool group and the tool data for the tool group again, using G10L3; or an MDI input.
PS0430	TOOL LIFE PAIRS ZERO	The tool life management pair quantity parameter (No. 6813) was 0. Set the parameter with 64.
PS0431	ILLEGAL T/R DATA OF TOOL LIFE	The remaining life setting (R) is invalid.
IO1104	OVER MAXIMUM TOOL LIFE PAIRS	An attempt was made to exceed the maximum number of tool life management pairs allowable in the system.
EX1011	ALL TOOL IN SAME GROUP ARE USED.	The tool life of all tools registered in a group expired. Clear tool information on the TOOL LIFE screen.

13 AI TOOL MONITOR (OPTION)

13.1 OVERVIEW

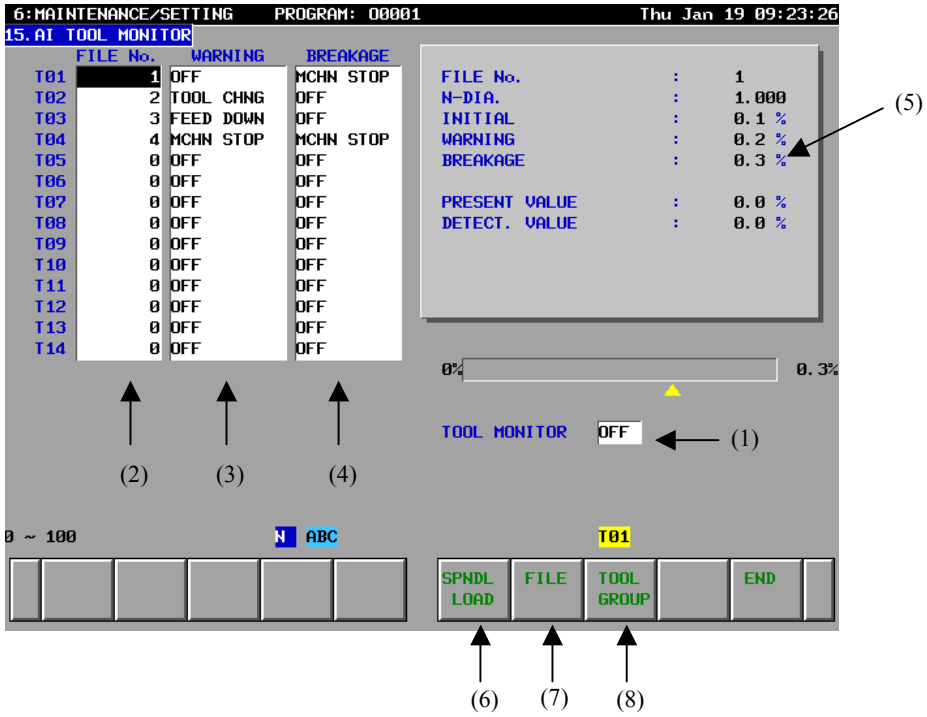
The AI TOOL MONITOR function monitors the load on a spindle during hole machining, issues alarms on any abnormal drilling load, and detects breakage. If an alarm condition is detected, the AI TOOL MONITOR function decelerates the tool, enables tool exchange, and stops the machine. If breakage is detected, it stops the machine.

The AI TOOL MONITOR function is enabled when the following conditions are satisfied.
(1) The spindle is rotating.
(2) The Z–axis is lowering.
(3) Tapping has not been specified.
(4) The current mode is cutting feed mode.
The execution flow of the AI TOOL MONITOR is shown below:



13.2 AI TOOL MONITOR SETTING SCREEN

Before the AI tool monitor function can be used, some data items must be set. To set these data items, use "15: AI TOOL MONITOR" of "6: MAINTENANCE/SETTING", which is a QUICK Screen.



(1) AI TOOL MONITOR

Specify whether to use the AI tool monitor function.

OFF: The AI tool monitor function is disabled.

ON: The AI tool monitor function is enabled

(2) FILE No. SETTING

Set a spindle load level file number for each tool.

Pressing the FILE key causes a file number to be displayed on the screen.

(3) OPERATION WHEN WARNING LOAD IS REACHED

Select the machine operation to be performed when spindle load ≥ warning–level load.

OFF: Machining is continued as is.

FEED DOWN: Tool movement is decelerated to reduce the load on the tool. Machining is continued.

TOOL CHNG: Machining is continued; when the next tool change command is specified, the tool is changed to a reserved tool registered in the same group.

DOWN+CHNG: Tool movement is decelerated; when the next tool change command is specified, the tool is changed to a reserved tool registered in the same group.

MCHN STOP: Machining is stopped, and the tool is moved along the Z–axis to the machine zero point. Moreover, spindle rotation and coolant output are stopped, and an alarm is displayed.

(4) OPERATION WHEN BREAKAGE LOAD IS REACHED (AI tool monitor function)

Select a machine operation to be performed when spindle load ≥ breakage–level load.

OFF: Machining is continued as is.

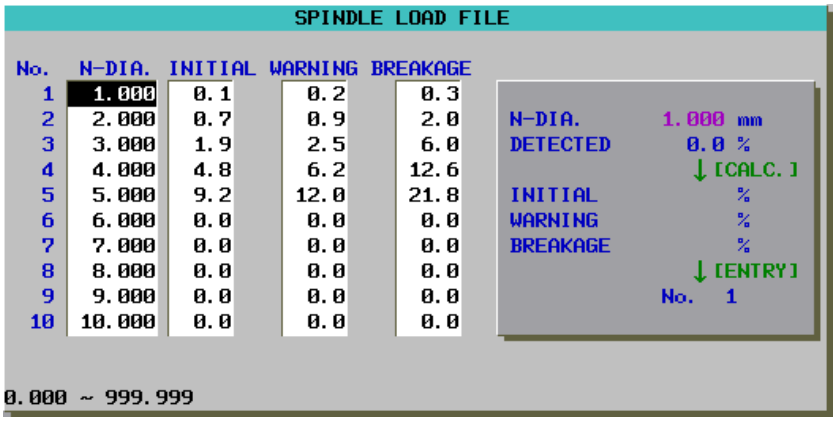
MCHN STOP: Machining is stopped, and the tool is moved along the Z–axis to the machine zero point. Moreover, spindle rotation and coolant output are stopped, and an alarm is displayed.

(5) MONITOR DISPLAY OR DIRECTORY DISPLAY OF SPINDLE LOAD LEVEL FILES

Displays monitor information such as load information related to the currently used tool and tool group information or directory of spindle load level files.

(6) REFERENCE LOAD CALCULATION AND REGISTRATION INTO FILE

When the [SPNDL LOAD] soft key is pressed, the following windows are displayed:



Use the page and cursor keys to move the cursor to an item for the target file number and press soft key [CALC.]. The warning level and damage level are calculated using the detected value and nominal diameter set for the file number. To set the calculated values in the file, press soft key [ENTRY].

You can also directly enter a value for the item at the cursor.

(7) REFERENCE LOAD CALCULATION AND REGISTRATION INTO FILE

Switching between the directory display of spindle load level files or monitor information display

This soft key switches the display in the right–hand part of the screen ((5)) between the directory display of spindle load level files or monitor information. When monitor information is displayed, pressing soft key [FILE] switches the display to the directory of spindle load level files. When the directory of spindle load level files is displayed, pressing soft key [MONITOR] switches the display to monitor information.

When monitor information is displayed, pressing the page key changes the displayed tool group. When the directory of spindle load level files is displayed, pressing the page key changes the displayed file numbers.

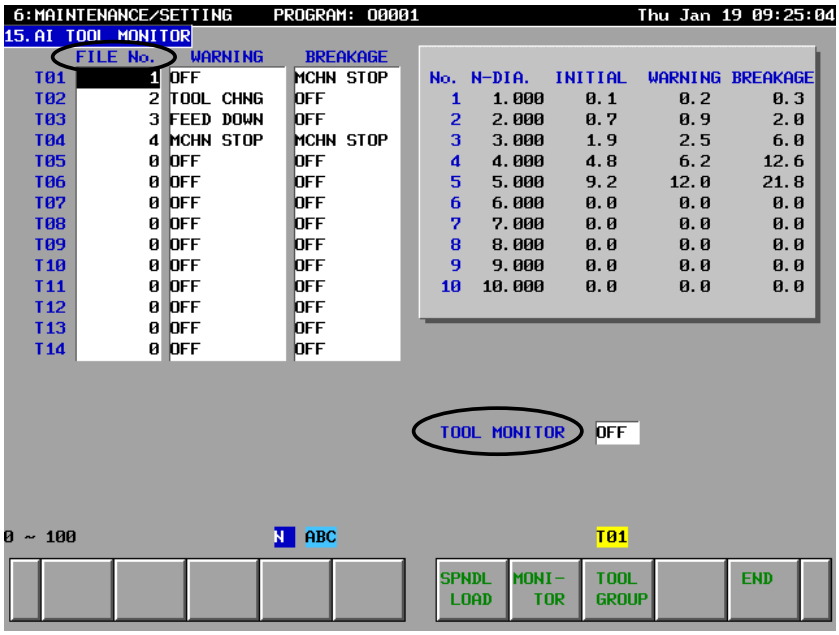
(8) TOOL GROUP SRTTING

A tool group is set.

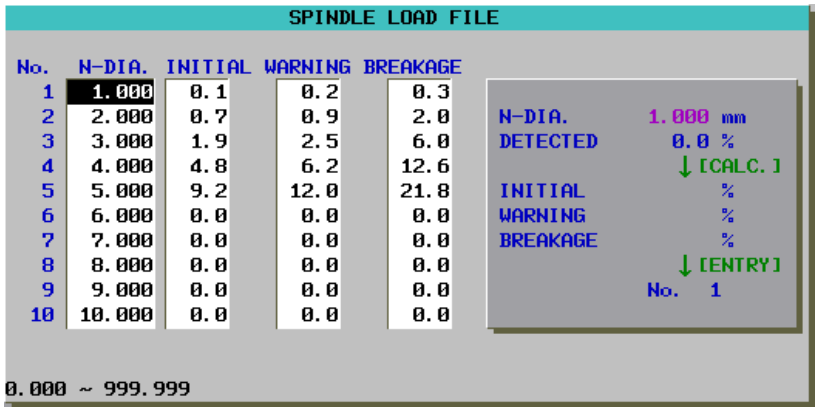
For details, see Chapter 12, "TOOL LIFE MANAGEMENT FUNCTION" in Part IV.

13.3 SETTING DATA

(1) Mount a tool to be used on the cartridge.
(2) Display the AI tool monitor setting screen, and assign the file number of a spindle load level file to each tool to be used. At this point, [TOOL MONITOR] should be “OFF”.



(3) Press soft key [SPNDL LOAD]. [SPINDLE LOAD FILE] appears.



(4) Set a tool nominal diameter for each file number set in step (2).
(5) Perform test cutting according to the actual cutting conditions and check the load put by test cutting.
For the detected spindle load value (%), the maximum torque (%) during test cutting is displayed at termination of hole machining.
This detected value is used as the basic value for automatically calculating the warning level and damage level (When the program performs continuous machining, perform single operation).
(6) Calculate the warning level and damage level.
Use the page and cursor keys to position the cursor on the file number set for the tool with which test cutting was performed, and press soft key [CALC.]. In the right–hand part of the window, the automatically calculated warning level value and damage level value are displayed.

SUPPLEMENT
Pressing [CALC.] without positioning the cursor on the file number used for test cutting does not calculate correct data.

(7) Register the warning level and damage level.
Press soft key [ENTRY]. The automatically calculated values are registered.
You can also change the setting for the item at the cursor manually.
(8) After setting data for all file numbers to be used, press soft key [END].
[SPINDLE LOAD FILE] is closed.
(9) For each tool to be used, set operation to be performed when the warning load is detected and that to be performed when the damage load is detected.
Move the cursor to [WARNING] and [BREAKAGE], and select operations by using soft keys.

Operation to be performed when the warning load is detected.

OFF: Continues machining even when the warning level is exceeded.

FEED DOWN: Reduces the federate to decrease the load on the tool and continues machining when the warning level is reached. (Reduces the federate to up to 60%.)

TOOL CHNG: Continues machining when the warning level is reached, and replaces the tool with the next one registered to the same group when the next tool change command is issued.

DOWN_CHANGE: Reduces the federate when the warning level is reached, and replaces the tool with the next one registered to the same group when the next tool change command is issued.

MCHN STOP: Stops feeding the tool along the Z–axis when the warning level is detected. The Z–axis automatically returns to the reference position.
After automatic return, performs spindle or coolant unit stop processing and displays an alarm.
Operation is performed for machine stop as follows:
(a) Damage to a tool is detected.
(b) Feeding the tool along the axis stops.
(c) The Z–axis automatically returns to the reference position (25% of rapid traverse override)
(d) The spindle or coolant unit stops.
(e) An alarm is displayed.

The following message is displayed during reference position return of the Z–axis:
"2013 EXECUTING TOOL ESCAPE"
The following alarm is displayed when damage to a used tool is detected:
"1010 TOOL BREAKAGE WAS DETECTED"

Operation to be performed when the damage load is detected.

OFF: Continues machining even when the damage level is exceeded.

MCHN STOP: Stops feeding the tool along the Z-axis when the damage level is detected. The tool automatically returns to the reference position along the Z-axis.
After automatic return, performs spindle or coolant unit stop processing and displays an alarm. Operation to be performed for machine stop is the same as for the warning load.

(10) Enable the AI tool monitor function (set it to ON).
On [TOOL FILE] Screen, move the cursor to [TOOL MONITOR] and select [ON] by pressing the corresponding soft key.

13.4 TOOL GROUP CREATION AND AUTOMATIC TOOL EXCHANGE

If the spindle load reaches the warning level, a used tool can be replaced with a spare one when the next tool change command is issued. To replace the tool, a tool group must be set.

13.4.1 Setting a Tool Group

When soft key [TOOL GROUP] is pressed on the AI tool monitor setting screen, the tool life management screen appears.
See Chapter 12, "TOOL LIFE MANAGEMENT FUNCTION" in Part IV, and set a tool group.

SUPPLEMENT

- When the tool use count or time exceeds the life value, the tool is replaced with another tool even when the spindle load does not exceed the warning level. When only the AI tool monitor function is to be used to change tools, set a sufficiently large value as the life value.
- Tool life management can be done by tool use count and time and tools can be changed without using the AI tool monitor function. In such a case, set a correct tool life value.

13.4.2 Program Creation

To use a tool group, change the T–code and H–code values as described below.

(1) Specify the T-code using a 3-digit number (T□□□) corresponding to the tool group.
Example)
M06 T101
T101 ← Tool group 1
T102 ← Tool group 2
T103 ← Tool group 3
.
.

(2) Specify the H–code using the H99 command.
When H99 is specified, compensation is performed using the H code specified when the tool group is set, at tool replacement.
Example)
M06 T101

Tool life management screen T101: Group 1 Specify group 1 as follows: T1 ⇒ T2 ⇒ T3 (H62) (H63) (H64)

G43 Z30. H99

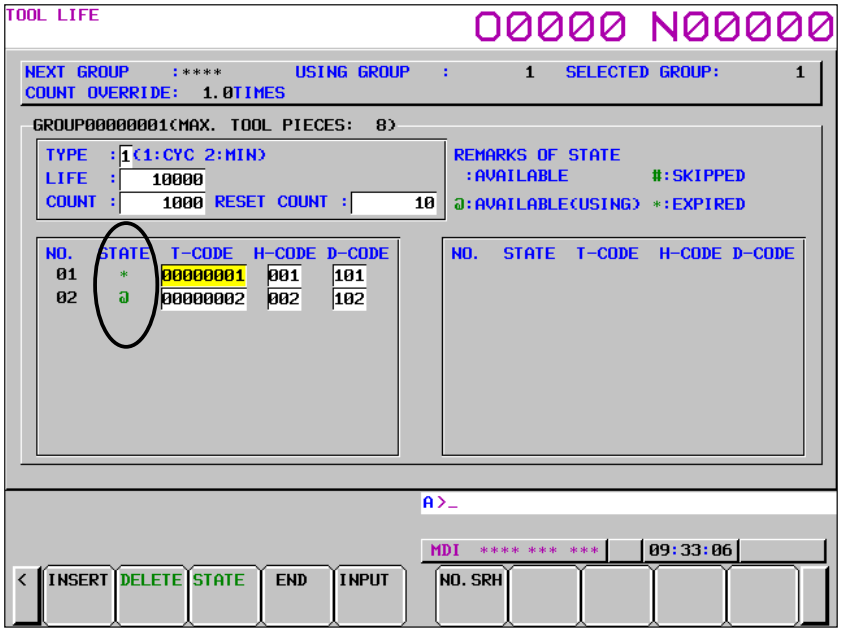
The following compensation values are used: H62 when T1 is used H63 when T2 is used H64 when T3 is used

13.4.3 Registering a Tool Length Compensation Value

Set a compensation value for each specified tool length compensation code.

13.5 CONFIRMING THE CURRENT STATUS AND CLEARING

(1) Confirming the current status
Display “TOOL LIFE” screen.



In "STATE" on “TOOL LIFE” screen, the following symbols are displayed according to the usage of the tools:

ə : Tool being used in a group
#: Tool of which life count (or time) has been reached
*: Tool for which the AI tool monitor function detected a spindle load exceeding the warning level.

(2) Examples of displayed alarms
An alarm is displayed in the following conditions:

(a) When a tool breakage is detected
When [MCHN STOP] is set as the operation to be performed when a breakage load is detected, the machine stops at that point, and the following alarm is displayed:
"EX1010 TOOL BREAKAGE WAS DETECTED."

(b) When all tools in a group were used up
When the warning level is exceeded for the last tool in a tool group, the alarm shown below is displayed at the end of program execution if [TOOL CHNG] or [DOWN+CHNG] is set as the operation to be performed when a warning load is detected.
When the breakage level is exceeded for the last tool, the following alarm is displayed immediately if [MCHN STOP] is set as the operation to be performed when a breakage load is detected:
"EX1011 ALL TOOLS IN SAME GROUP ARE USED."

SUPPLEMENT
Set TOOL CHNG or DOWN+CHNG for the last tool in a group. Otherwise, the above alarm is not displayed.

(c) If the breakage of the last tool is detected, the above two alarms are displayed at the same time if [MCHN STOP] is set as the operation to be performed when a breakage load is detected.

SUPPLEMENT

If M99 is specified at the end of a program, or if a large program is executed Because M99 is not regarded as the last command of the program, no alarm message will be displayed.
Specify M43 at any location separately from any other command.
M43 is a tool use status read command. It can read the tool status and display alarm messages.

(3) Clearing
When the warning or breakage level is exceeded for all tools in a tool group, or when the life count or time for each of the tools is reached, the tools must be replaced with new ones, and tool life management must be performed from the beginning. In this case, clear tool information.
For details, see Chapter 12, "TOOL LIFE MANAGEMENT FUNCTION" in Part IV.

13.6 SUPPLEMENT TO PROGRAM COMMANDS

(1) Using program commands to specify whether to enable or disable the AI tool monitor function
M40: Disables AI TOOL MONITOR.
M41: Enables AI TOOL MONITOR.

```
O1200 ;
G40G49G80G59 ;
G91G28Z0. ;
G28X0Y0 ;
M06T101 ;
G90G43G00Z30. H99 ;                    } AI TOOL MONITOR is enabled.
X40.Y20. ;
M08 . ;
M03S600. ;
G81Z-20. F150K0 ;
M40 ;                                  ← M40 (Disable AI TOOL MONITOR)
X80. ;      AI TOOL MONITOR is disabled
X85. ;
M41 ;                                  ← M41 (Enable AI TOOL MONITOR)
X90. ;
X100. ;
80M09 ;
G91G28Z0M05 ;                          } AI TOOL MONITOR is enabled.
G28X0Y0 ;
G49M30 ;
```

When M40 (disable AI TOOL MONITOR) is executed, the AI TOOL MONITOR function is disabled and remains so until M41 (enable AI TOOL MONITOR) is executed. In this case, "TOOLMN STP" is displayed in the lower section of the QUICK screen. If the setting for operations to be performed on warning and breakage levels has not been specified on the TOOL LIFE screen, these operations will not be per formed even after M41 is specified. If the setting for operations to be performed on warning or breakage level is turned off in M41 (enable AI TOOL MONITOR), "TOOLMN STP" will not be displayed.

SUPPLEMENT
This function can be used when [TOOL MONITOR] is set to ON on the AI tool monitor setting screen. If [TOOL MONITOR] is OFF, the AI tool monitor function does not operate even when M41 is specified.

(2) Peck cycle

M- CODE	Function
M32	Starts to detect a no–load condition for the AI function.
M33	Judges on a no–load condition for the AI function.
M34	Checks whether a no–load error has occurred. Disables the no–load detection function for a peck cycle. (Enables the standard no–load detection function.)

The term peck cycle refers to a peck drilling cycle directed by G73 or G83.
In this peck drilling cycle, a workpiece may not be machined in the first machining cycle depending on the position of the R point. To overcome this problem, the commands listed above are provided so as to perform control different from a G81 or G82 canned cycle.

When using these M commands :

M32 ;;
G83 X Y ——— ;
M33 ;
X Y ;
M33
X Y ;
M33
G98 X Y (Last hole position)
M34 ;

Specify the program as listed above, so that it starts with M32, M33 is issued before the position of the hole, and M34 is issued at the end of the peck cycle.

(3) Using a program command to set AI tool monitor data
You can use a program command to set the spindle load level file number, operation to be performed when the warning load is detected, and that to be performed when the damage load is detected, for each tool number.

For a tool number (T): :

- File number
  (U) ⇒ 1 to 100
- Operation to be performed when the warning load is detected
  (V) ⇒ 0:Disabled
  1:Deceleration
  2:Tool change
  3:Deceleration + tool change
  4:Machine stop
- Operation to be performed when the damage level is detected
  (W) ⇒ 0:Disabled
  1:Machine stop

Command format

M44 T U□□ V○ WΔ ;

Tool numbers where data is to be updated:
1 to 14 (1 to 21 for the α-D21*i*A5 series), 99 (Specifying 99 causes rewriting for the currently used tool.)

M-code for specifying to update data.

To update data in a program, it is necessary to execute O9029, using a custom macro function. For this reason, program number O9029 cannot be used for another purpose.

SUPPLEMENT
If data updating in a program is specified incorrectly, an alarm will be issued.

(Example) M44 T98 U41.5 V1 W2 ;
(1) (2) (3)

(1) T98 is out of a valid range.
(2) A decimal point cannot be used.
(3) W2 is out of a valid range.

If any of the above errors occurs, the message "1013 AI TOOL MONITOR DATA ERROR" will be displayed.
Specifying 0 for the file number (U) disables the AI tool monitor function for the tool. When specifying 0 for the file number, specify 0 or set OFF for the operation to be performed when a warning load is detected (V) and for the operation to be performed when a breakage load is detected (W).
Otherwise, an alarm will be issued.

The NC unit does not recognize a T–code (current tool number) immediately after the power is switched on. To have the T–code recognized, exchange a tool. Once a tool is exchanged, the current tool number is recognized. If this operation is not performed, the NC unit becomes inoperable when T99 is issued for updating data in a program, and an alarm will be issued.

13.7 ALARM MESSAGES DISPLAYED BY THE AI TOOL MONITOR FUNCTION

(1) Alarms

Number	Message	Description	Response
EX1010	TOOL BREAKAGE WAS DETECTED.	The tool in current use reached a breakage level.	Reset the system, then exchange the broken tool.
EX1011	ALL TOOL IN SAME GROUP ARE USED.	All tools in a specified tool group reached a warning or breakage level.	Reset the system, then check the tool, or exchange the tool and clear data about use status.
EX1013	AI TOOL MONITOR DATA ERROR.	Abnormal data related to the AI function – Program format error – Data out of tolerance	Reset the system, then check the specified command, and exchange the tool if T99 has been specified.

(2) Messages

Number	Message	Description
2013	EXECUTING TOOL ESCAPE.	A breakage level was detected and the machine stopped feeding. The machine is returning to the Z–axis reference position.

13.8 SIGNAL OUTPUT

When a warning or breakage level is detected, a signal can be output to an external device.
For setting and connection of signal output, see 14 external interface function.

14 EXTERNAL INTERFACE FUNCTION

14.1 OVERVIEW

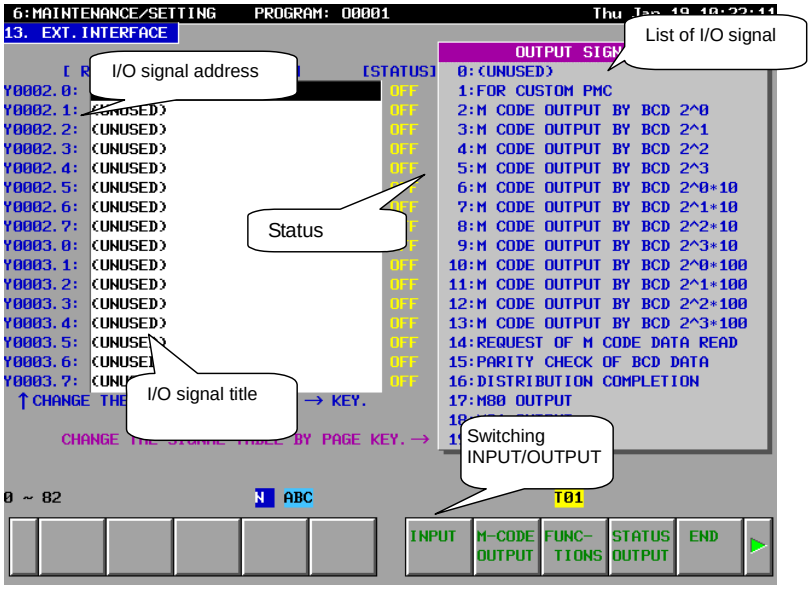
The ROBODRILL is supplied with an external interface (16 output and 16 input signals (*)) as standard. You can change the nature of each input/output signal without restrictions to suit your machine.

Standard specifications		User's requirements
OUTPUT 1: M80 OUTPUT OUTPUT 2: M81 OUTPUT OUTPUT 3: M82 OUTPUT • • • INPUT 1: WORK NO. SEARCH 1 INPUT 2: WORK NO. SEARCH 2 INPUT 3: WORK NO. SEARCH 3 • •	→ Can be customized as desired	OUTPUT 1: M CODE BCD OUTPUT 1 OUTPUT 2: M CODE BCD OUTPUT 2 OUTPUT 3: M CODE BCD OUTPUT 3 • • • INPUT 1: PROGRAM NO. SEARCH 1 INPUT 2: PROGRAM NO. SEARCH 2 INPUT 3: PROGRAM NO. SEARCH 3 • •

SUPPLEMENT
It can be increased max. input 48 points and max. output 32 points as optional.

14.2 SETTING INPUT/OUTPUT SIGNALS AND FUNCTIONS

The input/output signals and functions are set in "13: EXT. INTERFACE" in the "6: MAINTENANCE/ SETTING" QUICK screen.



14.2.1 Setting the Input/Output Signals

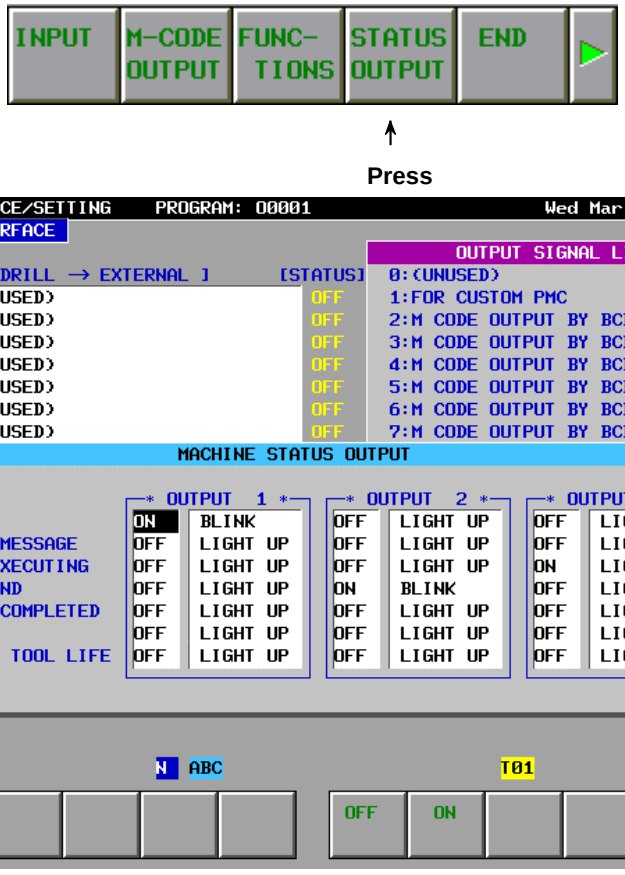
(1) Press the [INPUT] or [OUTPUT] soft key to select whether to set an input or output signal.
(2) Position the cursor on a desired address and enter a number displayed in SIGNAL LIST from the operator's panel (signals displayed in SIGNAL LIST can be changed by using the page keys).

To set "2:M CODE OUTPUT BY BCD 2^0" at output address "Y0002.0", for example, press the [OUTPUT] soft key and display output signal addresses, then position the cursor on Y0002.0 and press <2>, then <INPUT> on the operator's panel.

14.2.2 Setting Functions

(a) Setting machine status output

(1) Setting machine status output
Press the [STAT. OUTPUT] soft key. The following window appears.



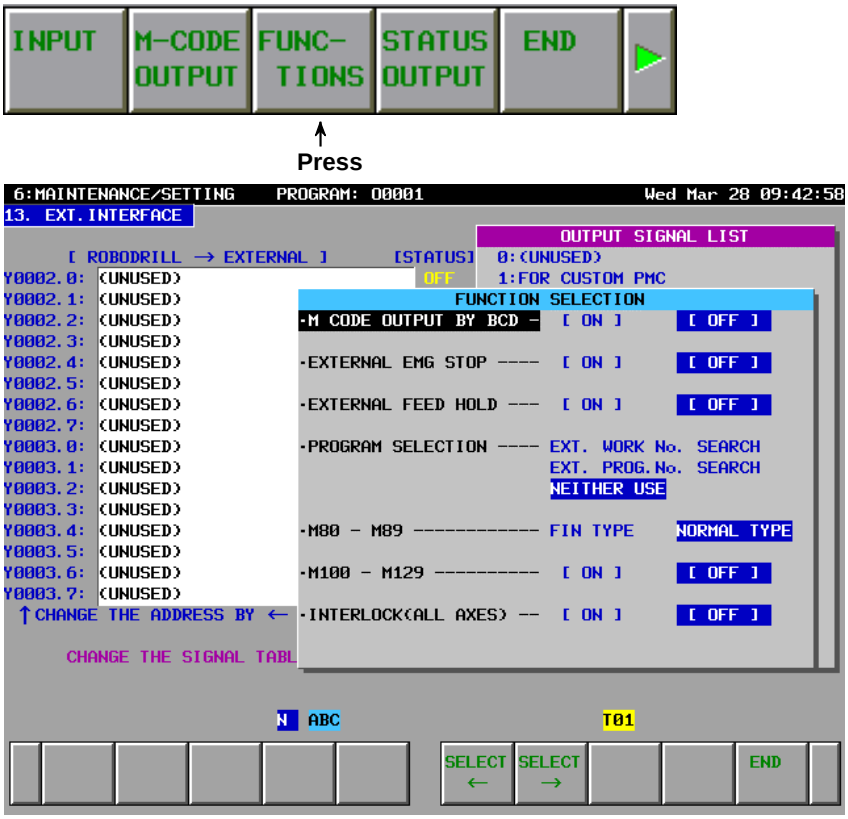
(2) Position the cursor on the menu item corresponding to an output to be set, and select whether to output the item by pressing the [ON] or [OFF] soft key and the output type by pressing the [LIGHT UP] or [BLINK] soft key.
(3) After setting the item, press the [END] soft key to close the window.

SUPPLEMENT

When multiple menu items (ALARM and OPERATOR MESSAGE, for example) for the same output (OUTPUT 1, for example) are set to "ON", the output types of the menu items may be different (LIGHT UP for one and BLINK for the other, for example). In this case, when the conditions of the menu items for which "ON" is set are satisfied simultaneously (for example when an alarm and operator message are issued), the output types of the menu items become LIGHT UP.

(b) Setting other functions

(1) Press the [FUNCTIONS] soft key. The following window appears.



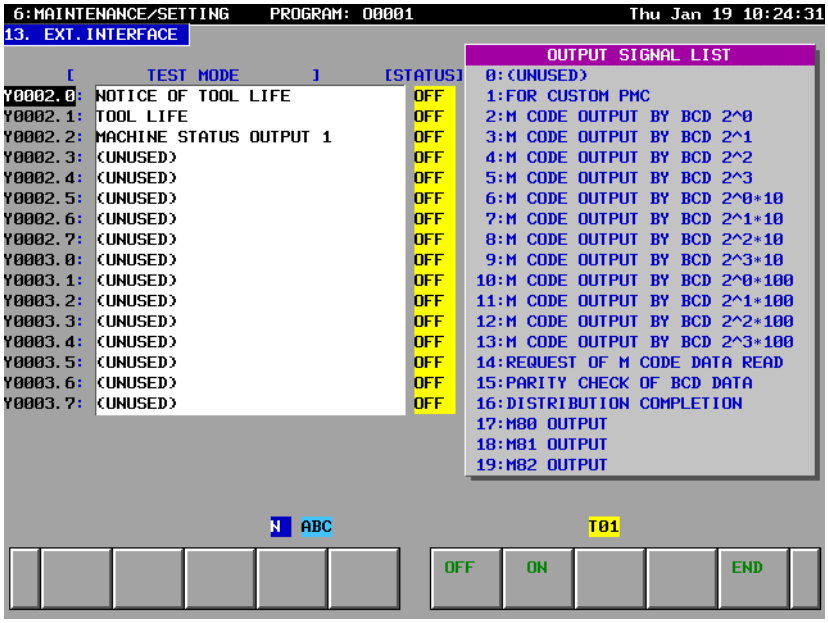
(2) Position the cursor to the item corresponding to the desired function, then press the [SELECT←] or [SELECT→] soft key.

(3) After setting the function, press the [END] soft key.

14.3 OUTPUT SIGNAL CHECK FUNCTION

This function can turn a signal on or off independently of the output signal setting. Use this function to check output signal wiring, for example.

(1) Press the rightmost soft key [>] to display the following soft keys, and then press a soft key [TEST].



(2) Position the cursor to the address of the output to be checked, then press the [ON] or [OFF] soft key.
(3) After checking the output, press the [END] soft key.

SUPPLEMENT

- When TEST mode terminates, the ON or OFF status set with this function is automatically cancelled.
- When testing an output signal for which “1: FOR CUSTOM PMC” is set, disable the custom PMC function (by setting PMC keep relay K15#7 = 0).

14.4 INPUT/OUTPUT SIGNALS

The following input/output signals are supported.

(1) Output signals (ROBODRILL → External equipment)

No.	Signal name	Function
0	(UNUSED)	Does not output any signal.
1	FOR CUSTOM PMC	Output signal reserved for custom PMC.
2	M CODE OUTPUT BY BCD 2^0	See (4) in "Detailed description of input/output signals."
3	M CODE OUTPUT BY BCD 2^1	See (4) in "Detailed description of input/output signals."
4	M CODE OUTPUT BY BCD 2^2	See (4) in "Detailed description of input/output signals."
5	M CODE OUTPUT BY BCD 2^3	See (4) in "Detailed description of input/output signals."
6	M CODE OUTPUT BY BCD 2^0*10	See (4) in "Detailed description of input/output signals."
7	M CODE OUTPUT BY BCD 2^1*10	See (4) in "Detailed description of input/output signals."
8	M CODE OUTPUT BY BCD 2^2*10	See (4) in "Detailed description of input/output signals."
9	M CODE OUTPUT BY BCD 2^3*10	See (4) in "Detailed description of input/output signals."
10	M CODE OUTPUT BY BCD 2^0*100	See (4) in "Detailed description of input/output signals."
11	M CODE OUTPUT BY BCD 2^1*100	See (4) in "Detailed description of input/output signals."
12	M CODE OUTPUT BY BCD 2^2*100	See (4) in "Detailed description of input/output signals."
13	M CODE OUTPUT BY BCD 2^3*100	See (4) in "Detailed description of input/output signals."
14	REQUEST OF M CODE DATA READ	See (4) in "Detailed description of input/output signals."
15	PARITY CHECK OF BCD DATA	See (4) in "Detailed description of input/output signals."
16	DISTRIBUTION COMPLETION	See (4) in "Detailed description of input/output signals."
17	M80 OUTPUT	See (5) in "Detailed description of input/output signals."
18	M81 OUTPUT	See (5) in "Detailed description of input/output signals."
19	M82 OUTPUT	See (5) in "Detailed description of input/output signals."
20	M83 OUTPUT	See (5) in "Detailed description of input/output signals."
21	M84 OUTPUT	See (5) in "Detailed description of input/output signals."
22	M85 OUTPUT	See (5) in "Detailed description of input/output signals."
23	M86 OUTPUT	See (5) in "Detailed description of input/output signals."
24	M87 OUTPUT	See (5) in "Detailed description of input/output signals."
25	M88 OUTPUT	See (5) in "Detailed description of input/output signals."
26	M89 OUTPUT	See (5) in "Detailed description of input/output signals."
27	IN THE AUTO MODE	Outputs the operation mode status of the ROBODRILL. (*1)
28	CYCLE START (IN PROGRESS)	Remains on during programmed operation.
29	FEED HOLD	Remains on in the feed hold state.
30	EMERGENCY STOP	Remains off in the emergency stop state.
31	RESET	Remains on in the reset state.
32	MACHINE STATUS OUTPUT 1	See (6) in "Detailed description of input/output signals."
33	MACHINE STATUS OUTPUT 2	See (6) in "Detailed description of input/output signals."
34	MACHINE STATUS OUTPUT 3	See (6) in "Detailed description of input/output signals."
35	SPINDLE IS AT HOLD	Remains on in the spindle stop state.
36	AUTOMATIC DOOR CLOSE STATE	Goes on when the automatic door close limit is reached.
37	AUTOMATIC DOOR OPEN STATE	Goes on when the automatic door open limit is reached.
38	SPLASH GUARD DOOR CLOSE	Goes on when the splash guard door is closed.
39	PRODUCTION COMPLETED	Goes on when machining has been completed.
40	SEARCH END OF THE PROGRAM No.	See (3) in "Detailed description of input/output signals."
41		
42	WARNING LEVEL DETECTION	Goes on when the spindle load exceeds the warning level. (*2)
43	BREAKAGE LEVEL DETECTION	Goes on when the spindle load exceeds the breakage level. (*2)
44	DOOR OPEN (M60)	See (1) in "Detailed description of input/output signals."
45	DOOR OPEN (M61)	See (1) in "Detailed description of input/output signals."
46	DOOR OPEN (M62)	See (1) in "Detailed description of input/output signals."
47	DOOR OPEN (M63)	See (1) in "Detailed description of input/output signals."

No.	Signal name	Function
48	DOOR OPEN (M64)	See (1) in "Detailed description of input/output signals."
49	DOOR OPEN (M65)	See (1) in "Detailed description of input/output signals."
50	BATTERY ALARM	Goes on when the battery voltage drops to a preset level.
51	TOOL LIFE	Goes on once all of the tools in the tool group have reached the end of their service life.
52	M100 OUTPUT	See (5) in "Detailed description of input/output signals."
53	M101 OUTPUT	See (5) in "Detailed description of input/output signals."
54	M102 OUTPUT	See (5) in "Detailed description of input/output signals."
55	M103 OUTPUT	See (5) in "Detailed description of input/output signals."
56	M104 OUTPUT	See (5) in "Detailed description of input/output signals."
57	M105 OUTPUT	See (5) in "Detailed description of input/output signals."
58	M106 OUTPUT	See (5) in "Detailed description of input/output signals."
59	M107 OUTPUT	See (5) in "Detailed description of input/output signals."
60	M108 OUTPUT	See (5) in "Detailed description of input/output signals."
61	M109 OUTPUT	See (5) in "Detailed description of input/output signals."
62	M120 OUTPUT	See (5) in "Detailed description of input/output signals."
63	M121 OUTPUT	See (5) in "Detailed description of input/output signals."
64	M122 OUTPUT	See (5) in "Detailed description of input/output signals."
65	M123 OUTPUT	See (5) in "Detailed description of input/output signals."
66	M124 OUTPUT	See (5) in "Detailed description of input/output signals."
67	M125 OUTPUT	See (5) in "Detailed description of input/output signals."
68	M126 OUTPUT	See (5) in "Detailed description of input/output signals."
69	M127 OUTPUT	See (5) in "Detailed description of input/output signals."
70	M128 OUTPUT	See (5) in "Detailed description of input/output signals."
71	M129 OUTPUT	See (5) in "Detailed description of input/output signals."
72	1st. REF. POINT (X-AXIS)	Goes on upon the completion of reference position return.
73	1st. REF. POINT (Y-AXIS)	Goes on upon the completion of reference position return.
74	1st. REF. POINT (Z-AXIS)	Goes on upon the completion of reference position return.
75	1st. REF. POINT (4TH-AXIS)	Goes on upon the completion of reference position return.
76	1st. REF. POINT (5TH-AXIS)	Goes on upon the completion of reference position return.
77	MANUAL MODE	Goes on when manual mode is selected.
78	POSITION SWITCH	See (10) in "Detailed description of input/output signals."
79	NOTICE OF TOOL LIFE	Is set to ON when the number of times that the last tool in the tool group will be able to be used in the future is not greater than the tool life limit to trigger an expiration advance notice.
80	ALARM OUTPUT 2	See (9) in "Detailed description of input/output signals."
81		
82	PROBE ON/OFF	See the item describing the touch probe control function.

(2) Input signals (External equipment → ROBODRILL)

No.	Signal name	Function
0	(UNUSED)	Ignores the signal input.
1	FOR CUSTOM PMC	Input signal reserved for custom PMC.
2	PROGRAM NUMBER SEARCH 2^0	See (3) in "Detailed description of input/output signals."
3	PROGRAM NUMBER SEARCH 2^1	See (3) in "Detailed description of input/output signals."
4	PROGRAM NUMBER SEARCH 2^2	See (3) in "Detailed description of input/output signals."
5	PROGRAM NUMBER SEARCH 2^3	See (3) in "Detailed description of input/output signals."
6	PROGRAM NUMBER SEARCH 2^0*10	See (3) in "Detailed description of input/output signals."
7	PROGRAM NUMBER SEARCH 2^1*10	See (3) in "Detailed description of input/output signals."
8	PROGRAM NUMBER SEARCH 2^2*10	See (3) in "Detailed description of input/output signals."
9	PROGRAM NUMBER SEARCH 2^3*10	See (3) in "Detailed description of input/output signals."
10	PROGRAM NUMBER SEARCH 2^0*100	See (3) in "Detailed description of input/output signals."
11	PROGRAM NUMBER SEARCH 2^1*100	See (3) in "Detailed description of input/output signals."

No.	Signal name	Function
12	PROGRAM NUMBER SEARCH 2^2*100	See (3) in "Detailed description of input/output signals."
13	PROGRAM NUMBER SEARCH 2^3*100	See (3) in "Detailed description of input/output signals."
14	PROGRAM NUMBER SEARCH 2^0*1000	See (3) in "Detailed description of input/output signals."
15	PROGRAM NUMBER SEARCH 2^1*1000	See (3) in "Detailed description of input/output signals."
16	PROGRAM NUMBER SEARCH 2^2*1000	See (3) in "Detailed description of input/output signals."
17	PROGRAM NUMBER SEARCH 2^3*1000	See (3) in "Detailed description of input/output signals."
18	REQUEST OF PROG. No. DATA READ	See (3) in "Detailed description of input/output signals."
19	WORK NUMBER SEARCH 2^0	See (2) in "Detailed description of input/output signals."
20	WORK NUMBER SEARCH 2^1	See (2) in "Detailed description of input/output signals."
21	WORK NUMBER SEARCH 2^2	See (2) in "Detailed description of input/output signals."
22	WORK NUMBER SEARCH 2^3	See (2) in "Detailed description of input/output signals."
23	EXTERNAL START	See (3) in "Detailed description of input/output signals."
24	EXTERNAL HOLD	When turned off, stops the programmed operation. (*3)
25	EXTERNAL RESET	When turned on, resets the CNC.
26	EXTERNAL EMERGENCY STOP	When turned OFF, places the machine in the emergency stop state. (*4)
27	COMPLETION (FIN)	See (4) in "Detailed description of input/output signals."
28	RESET AND REWIND	When turned on, resets the CNC and calls the beginning of a program.
29	EXTERNAL DOOR OPEN CONTROL	When turned on, opens the automatic door. (*5)
30	EXTERNAL DOOR CLOSE CONTROL	When turned on, closes the automatic door. (*5)
31	DNC OPERATION	When turned on, places the machine in DNC operation mode.
32	REQUEST OF DOOR CLOSE	See (1) in "Detailed description of input/output signals."
33	SINGLE BLOCK ON	When turned on, places the machine in single block operation mode. (*6)
34	DRY RUN ON	When turned on, places the machine in dry run operation mode. (*7)
35	M100 FIN	See (5) in "Detailed description of input/output signals."
36	M101 FIN	See (5) in "Detailed description of input/output signals."
37	M102 FIN	See (5) in "Detailed description of input/output signals."
38	M103 FIN	See (5) in "Detailed description of input/output signals."
39	M104 FIN	See (5) in "Detailed description of input/output signals."
40	M105 FIN	See (5) in "Detailed description of input/output signals."
41	M106 FIN	See (5) in "Detailed description of input/output signals."
42	M107 FIN	See (5) in "Detailed description of input/output signals."
43	M108 FIN	See (5) in "Detailed description of input/output signals."
44	M109 FIN	See (5) in "Detailed description of input/output signals."
45	TOOL BREAKAGE	The signal being on indicates that the tool is damaged.
46	SKIP	See (7) in "Detailed description of input/output signals."
47	INTERRUPT-TYPE CUSTOM MACRO	Another program is called while the current program is being executed. (*9)
48	AUTO. MEASUREMENT OF TOOL LENG.	See (8) in "Detailed description of input/output signals."(*9)
49	INTERLOCK (ALL AXES)	See (7) in "Detailed description of input/output signals."(*8)
50	SKIP 2	See (7) in "Detailed description of input/output signals."(*9)
51	SKIP 3	See (7) in "Detailed description of input/output signals."
52	SKIP 4	See (7) in "Detailed description of input/output signals."
53	SKIP 5	See (7) in "Detailed description of input/output signals."
54	SKIP 6	See (7) in "Detailed description of input/output signals."
55	SKIP 7	See (7) in "Detailed description of input/output signals."

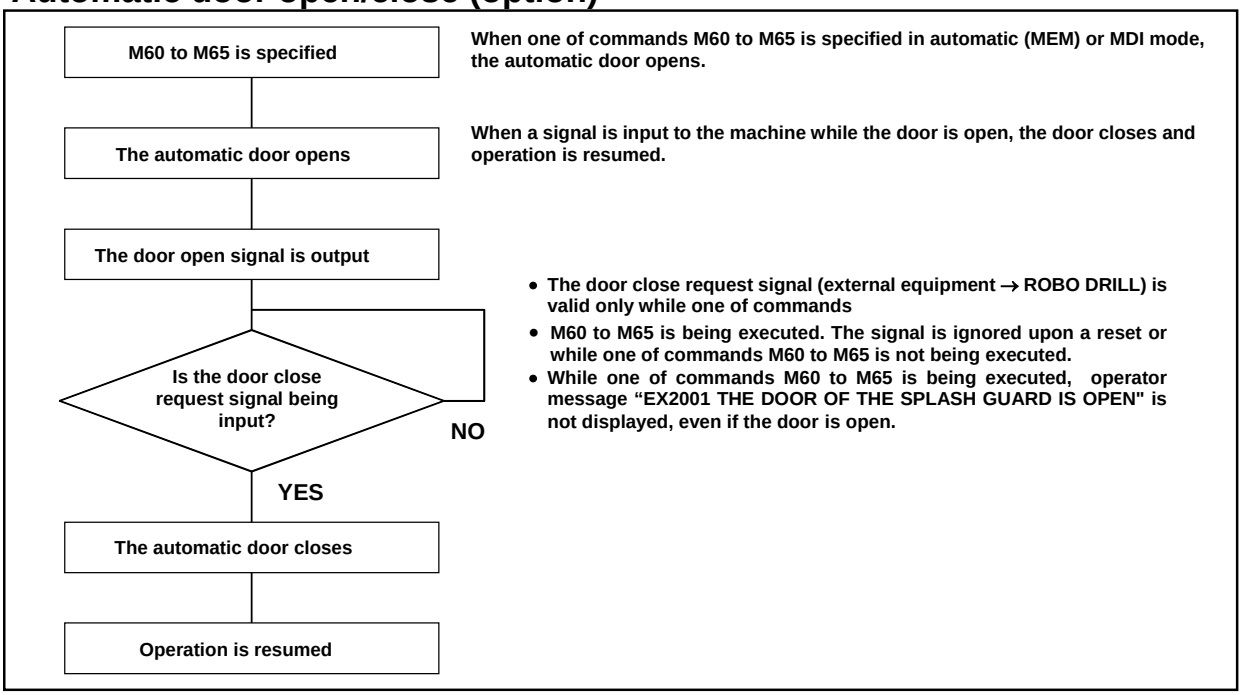
No.	Signal name	Function
56	SKIP 8	See (7) in "Detailed description of input/output signals."
57	ALARM OUTPUT 2 RELEASE	See (9) in "Detailed description of input/output signals."
58	PROBE STATUS	See the item describing the touch probe control function.
59	PROBE BATTERY LOW	See the item describing the touch probe control function.
60	PROBE ERROR	See the item describing the touch probe control function.
61	4th-AXIS OVERHEAT (DD MOTOR)	When set to OFF, an overheat alarm is output (DD motor).
62	5th-AXIS OVERHEAT (DD MOTOR)	When set to OFF, an overheat alarm is output (DD motor).

SUPPLEMENT

*1 The output status can be selected by setting keep relay K06#7.
*2 The output status can be selected by setting keep relay K08#6.
*3 Set [ON] in the EXTERNAL FEED HOLD field of the FUNCTION SELECTION window.
*4 Set [ON] in the EXTERNAL EMG STOP field of the FUNCTION SELECTION window.
*5 The signal reception mode can be selected by setting keep relay K07#1.
*6 Set keep relay K08#3 = 1.
*7 Set keep relay K08#4 = 1.
*8 At "FUNCTION SELECTION," set "INTERLOCK (ALL AXES)" to "ON."
*9 Option

14.4.1 Detailed Description of Input/Output Signals

(1) Automatic door open/close (option)



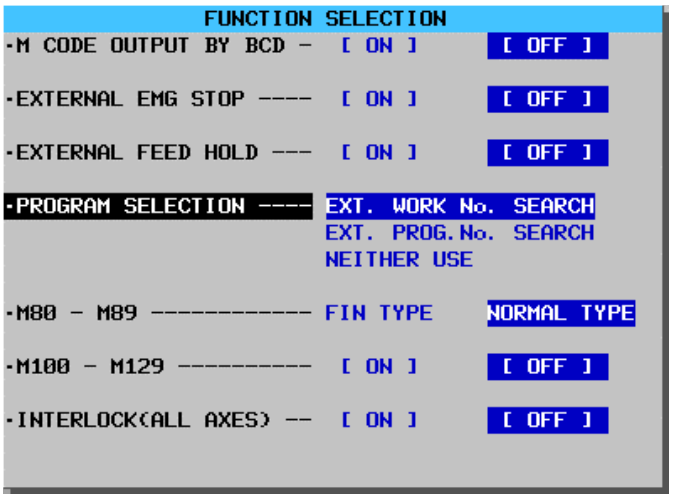
(2) External work number search function

Some machining programs can be stored in program memory. A required program can thus be called by using the rotary switch or similar.

After selecting the number of the program, press the <CYCLE START> button. The specified program is selected, and automatic operation starts.

Program numbers O0001 to O0015 can be selected.

When using the external work number search function, set EXT. WORK No. SEARCH for "PROGRAM SELECTION".



[Relationship between signal statuses and selected program numbers]

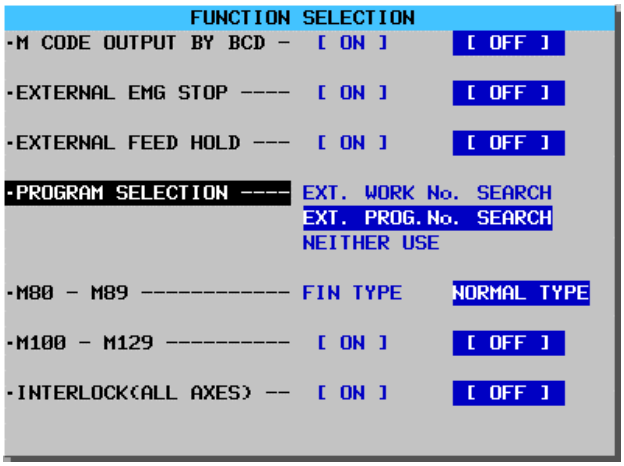
Work No. search 2^3	Work No. search 2^2	Work No. search 2^1	Work No. search 2^0	Selected program number
0	0	0	0	Not selected
0	0	0	1	O0001
0	0	1	0	O0002
0	0	1	1	O0003
0	1	0	0	O0004
0	1	0	1	O0005
0	1	1	0	O0006
0	1	1	1	O0007
1	0	0	0	O0008
1	0	0	1	O0009
1	0	1	0	O0010
1	0	1	1	O0011
1	1	0	0	O0012
1	1	0	1	O0013
1	1	1	0	O0014
1	1	1	1	O0015

SUPPLEMENT

- This function can be used only in automatic operation (MEM) mode, not during MDI operation.
- The program number must be selected from O0001 to O0015.
- Not all program numbers need be used to store programs in memory.
- If the program corresponding to a specified number is not found in memory, an alarm is output at activation. (Alarm message "PS0078 PROGRAM NUMBER IS NOT FOUND")
- No program is selected if the function is started in the automatic operation stop state (single block stop, for example) or automatic operation halt state (feed hold stop). The currently selected program is resumed from the current stop point.
- When resuming the execution of a part-completed program, search for a sequence number in automatic operation (MEM) mode, then restart the program. A program number is not selected, but execution of the currently selected program is resumed from the point at which execution was stopped.
- When the function is started with all signals open, no program number is selected, but the currently selected program is executed.
  To enable automatic operation of a program other than O0001 to O0015, follow the steps shown below:
  - Search for a program number (on the screen).
  - Set all signals for program selection switches to OPEN.
  - Press the operation start button.
- This function cannot be used simultaneously with the external program number search function.

(3) External program number search function

When a sequencer or other external equipment issues a program number to the ROBODRILL, this function retrieves the corresponding program from the memory of the ROBODRILL control unit.
Program numbers O0001 to O9999 can be selected. Specify a desired program with a four-digit binary-coded decimal (BCD) number.
To use the external program number search function, set EXT.PRPG.No.SEARCH for "PRPGRAM SELECTION".



(a) Interface

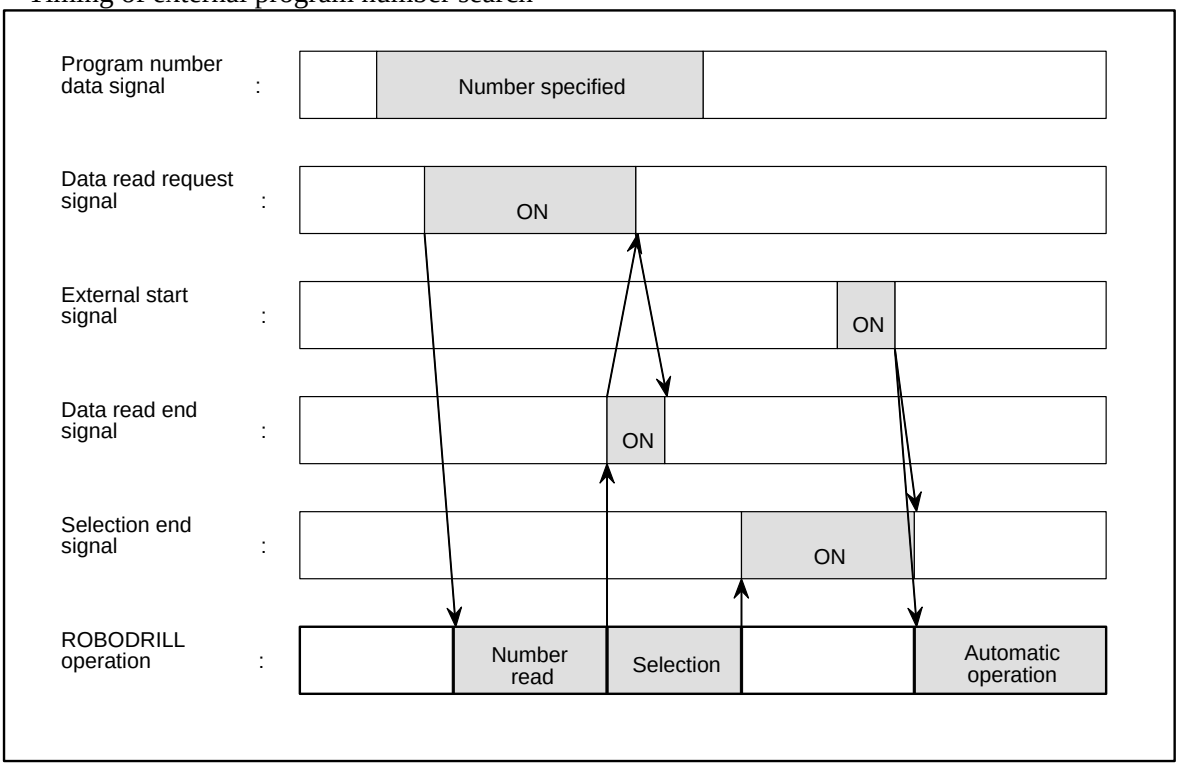
(External equipment → ROBODRILL)

Signal name	Function
Program number search 2^0 | Program number search 2^3*1000	Specify a program with a binary–coded decimal (BCD) number. Wiring is not required for a bit that is always set to 0. Omit wiring according to the program numbers to be used.
Program number read request	When the signal is input, the ROBODRILL reads the data corresponding to the program number specified by the program number data signal.
External start	When a signal is input after a program number has been selected (while the ROBODRILL is sending the selection end signal), automatic operation starts. Enter a pulse signal of 200 ms or longer. (Automatic operation starts at the falling edge of the pulse signal.)

(ROBODRILL → External equipment)

Signal name	Function
Program number selection end	Indicates that a program number has been selected and that automatic operation can be started. This signal is output after output of the data read end signal ends. After this signal is output, turn the data read request signal off. This signal goes off at the following timings: - When operation is activated - Upon a reset - When a new program number is selected

(b) Timing of external program number search

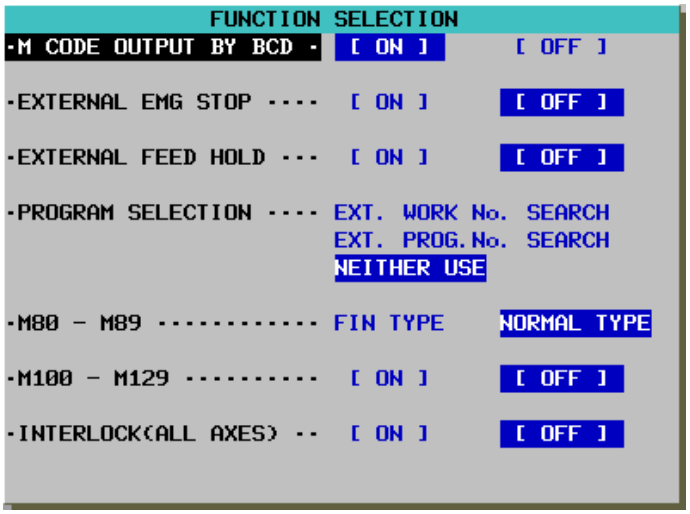


SUPPLEMENT

- This function cannot be used simultaneously with the external work number search function.
- No program is selected when the function is started in automatic operation stop state (single block stop, for example) or automatic operation halt state (feed hold stop).
  The currently selected program is started from the point at which execution stopped.
- When the program corresponding to the specified number cannot be found in memory, an alarm is output at activation. (Alarm message " PS0078 SEQUENCE NUMBER NOT FOUND")
- When program number 0 is specified, no program numbers are selected. The currently selected program is executed.
- Programs O8000 to O8999 can be protected by setting an NC parameter No. 3202#0(NE8).
  Programs O9000 to O9999 are protected beforehand according to the setting of a NC parameter No. 3202#4(NE9).

(4) External M code BCD output function

This function outputs a specified M code number to a sequencer or other external equipment.
When the external equipment operates according to the specified M code, it is interlocked with the ROBODRILL.
The M code number is output as a three-digit binary-coded decimal (BCD) number.
To use the external M code BCD output function, set NEITHER USE for "M CODE OUTPUT BY BCD".



(a) Interface

(ROBODRILL → External equipment)

Signal name	Function
M code BCD output 2^0 | M code BCD output 2^3*100	A specified M code is output as a binary–coded decimal (BCD) number. Not all data need be read. Omit wiring according to the M codes to be used.
M code data read request	Indicates that the M code number data signal is being output. Read the M code number while the signal is being output.
Distribution end	Indicates that an auxiliary function (M, S, or T code) is specified and that axial movement has been completed. (Usually, this feature is not used.)
BCD data parity check	Outputs the results of a parity check.

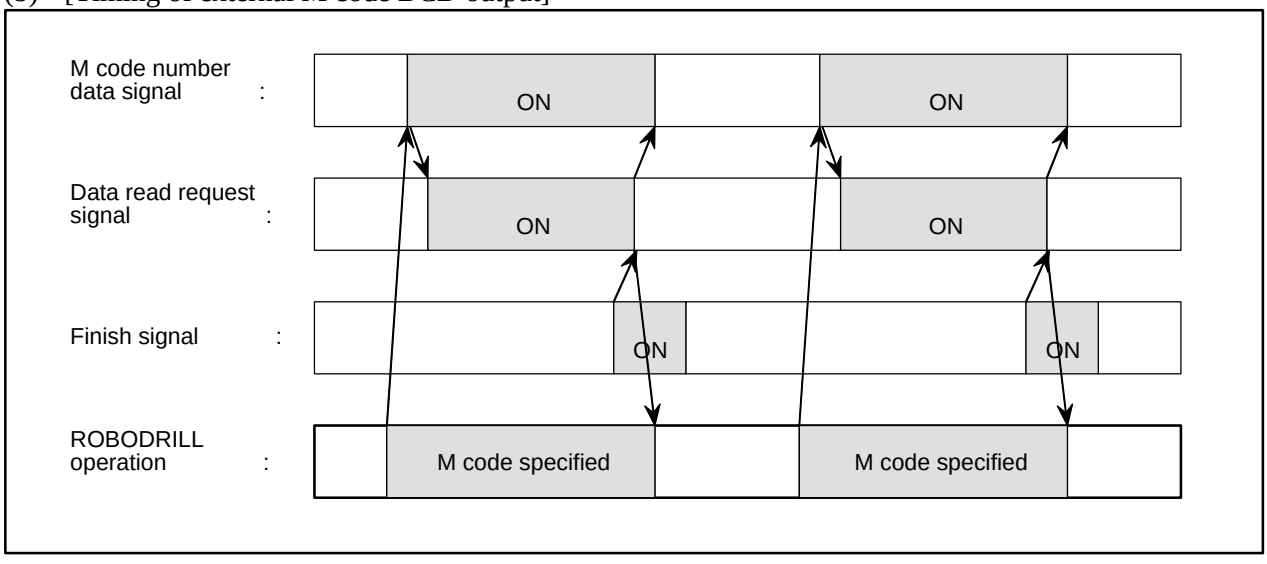
Parity check	Check signal	Parity of specified M code	
		K04#5=0	K04#5=1
Even parity check (K01#1=0)	0	Odd	Even
	1	Even	Odd
Odd parity check (K01#1=1)	0	Even	Odd
	1	Odd	Even

(PMC parameter)
K01#1: Switching between even parity check and odd parity check
K04#5: Switching the output status of the results of parity check

(External equipment → ROBODRILL)

Signal name	Function
Finish (FIN)	The signal is input once operation of the external equipment ends. When the signal is input, the ROBODRILL terminates M code output and proceeds to the next block of the program.

(b) [Timing of external M code BCD output]



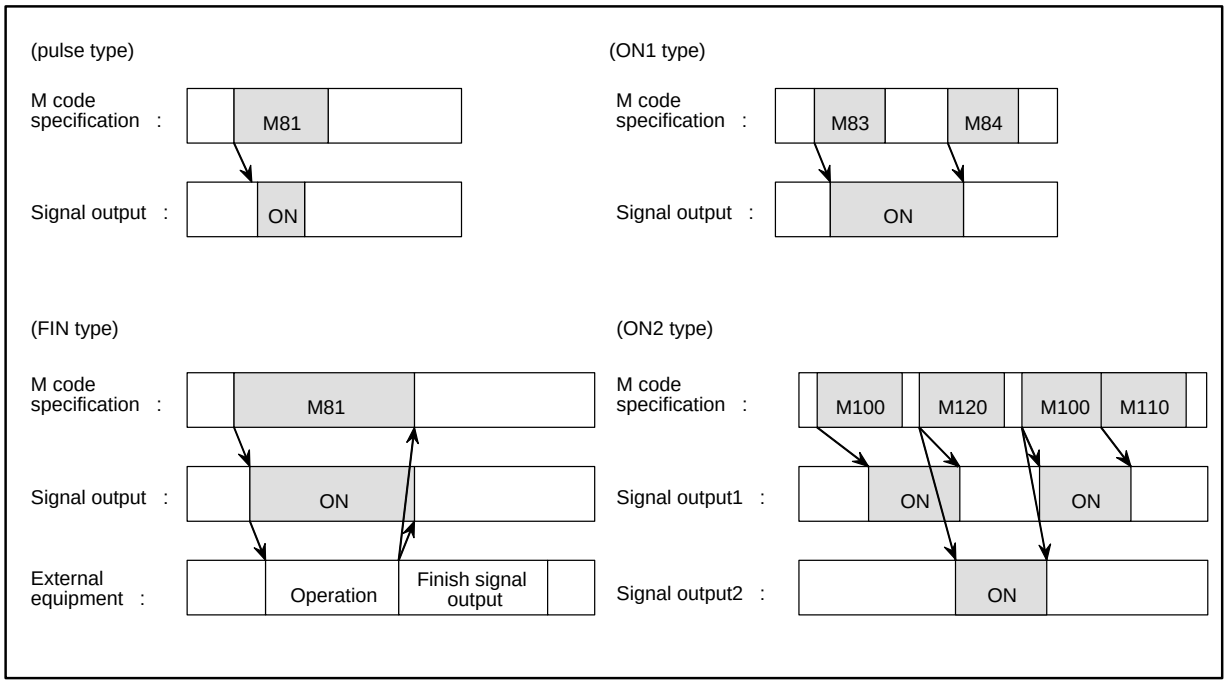
SUPPLEMENT

- This function cannot be used simultaneously with the M code output function.
- Use M codes M200 or higher. (M codes M00 to M199 are reserved for the ROBODRILL; They cannot be used for any other purposes.)
- Specify this function with the first M code if two or more M codes are to be specified.

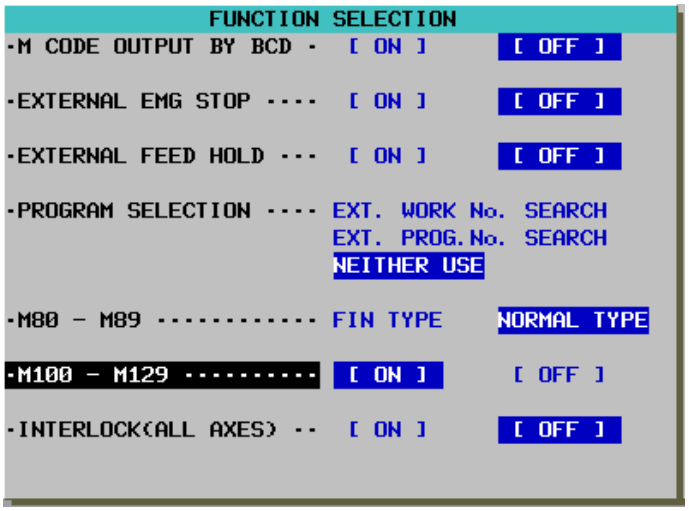
(5) M code output function (M80 to M89, M100 to M129)

This function outputs a signal corresponding to a specified M code.

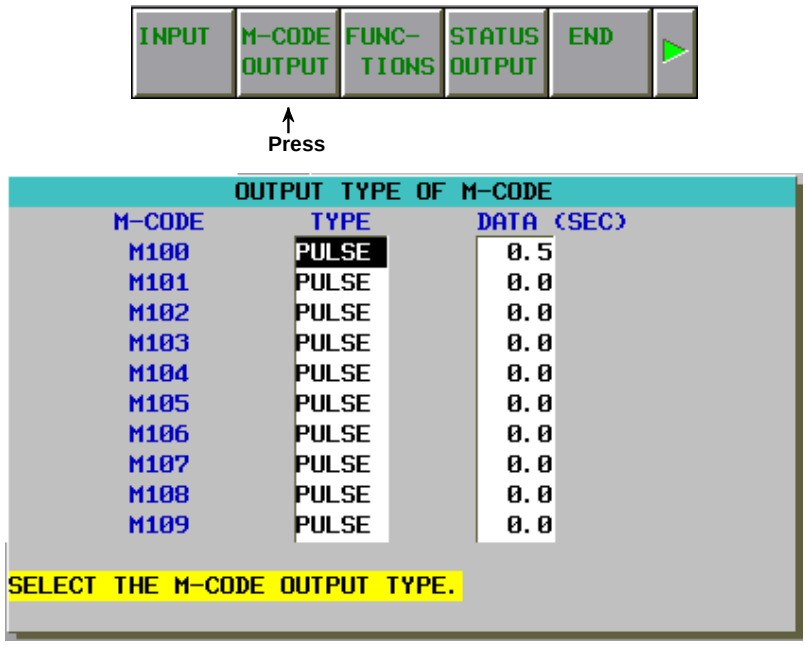
M code	Signal name	Output type	Function
M81 M82	M81 OUTPUT M82 OUTPUT	Instantaneous	Outputs a pulse signal of 100 ms duration.
M83 M84	M83 OUTPUT	ON1	Turns an output signal on (M83). Turns an output signal off (M84).
M80 M85 M86 M87 M88 M89	M80 OUTPUT M85 OUTPUT M86 OUTPUT M87 OUTPUT M88 OUTPUT M89 OUTPUT	FIN	Turned on at the beginning of the specification of an M code. Turned off when the finish signal is input from the external equipment.
M100 M101 M102 M103 M104 M105 M106 M107 M108 M109	M100 OUTPUT M101 OUTPUT M102 OUTPUT M103 OUTPUT M104 OUTPUT M105 OUTPUT M106 OUTPUT M107 OUTPUT M108 OUTPUT M109 OUTPUT	Selectable	Selects an output type from pulse, FIN, ON1, and ON2. Pulse: Used only by M10□ FIN: Used only by M10□. Individual M codes have a corresponding FIN signal. ON/OFF1: Used in combination with M11□ ON/OFF2: Used in combination with M11□ and M12X. □ : 0 to 9
M110 M111 M112 M113 M114 M115 M116 M117 M118 M119		ON1	Turns off the M10□ and M12□ output. This is used when ON1 or ON2 is selected as the output type of M100 to M109. Each M code is used in combination with an M code having the same least significant digit. (Example: M100 ←→ M110) □ : 0 to 9
M120 M121 M122 M123 M124 M125 M126 M127 M128 M129	M120 OUTPUT M121 OUTPUT M122 OUTPUT M123 OUTPUT M124 OUTPUT M125 OUTPUT M126 OUTPUT M127 OUTPUT M128 OUTPUT M129 OUTPUT	ON2	Turns off the M10□ output and, at the same time, turns on the M12□ output. This is used when ON2 is selected as the output type of M100 to M109. Each M code is used in combination with an M code having the same least significant digit. (Example: M100 ←→ M120) □ : 0 to 9



When an M code of pulse ON1 or ON2 type is specified, the ROBODRILL automatically proceeds to the next program block after the signal has been output (or stopped).
When an M code of FIN type is specified, the ROBODRILL waits until a finish signal is input from the external equipment. After this signal is input, the ROBODRILL proceeds to the next program block.
To use the function to output M100 to M129, set [M100 - M129] to [ON].

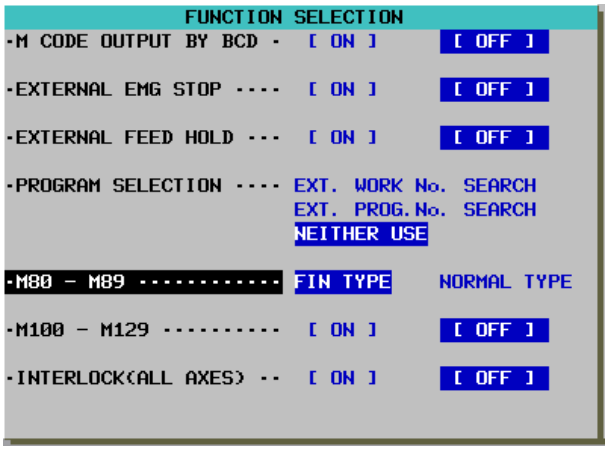


To set the output type of M100 to M109, use "M code output type. Press soft key [M-CODE OUTPUT].



	Item	Contents
1	TYPE	A desired M code output type is selected by pressing the corresponding soft key.
2	DATA	This is used when PULSE or FIN is selected as the M code output type. PULSE type: The ON duration of the pulse signal is set. FIN type: The duration for waiting for the FIN signal is set. If the completion signal is not input within the specified period, feed hold occurs and operator message EX2003 TIME OUT (M100 - M109) appears.

All of M80 to M89 can be changed to FIN type. To do this, set M80-M89 to FIN TYPE.
After FIN TYPE is set, M84 output can be used.



(6) Machine status output function

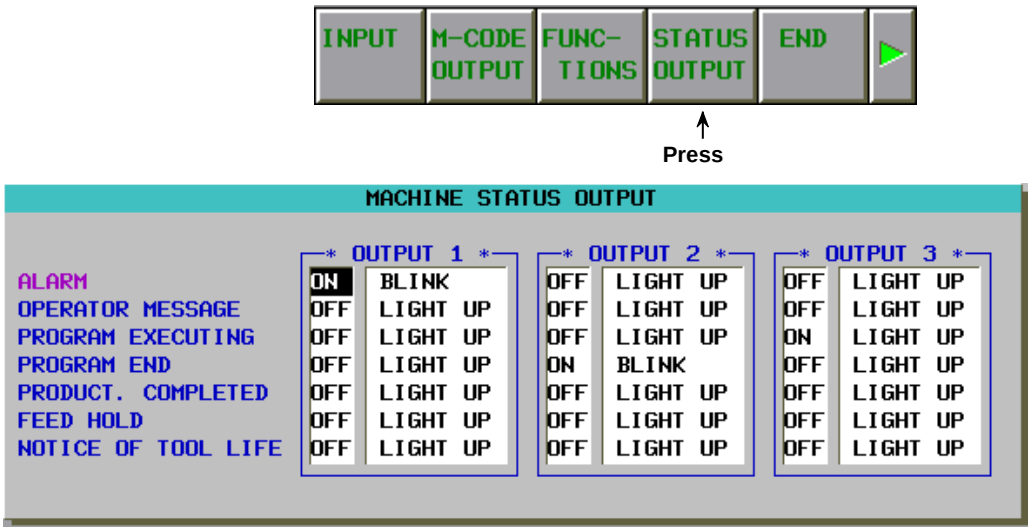
This function outputs machine status signals.

These settings are indicated by the blink and illumination of the machine signal lamps(optional) and output 1 corresponds to the red lamp, output 2 to the yellow lamp, and output 3 to the blue lamp. (When using CE, these are the yellow lamp, blue lamp, and green lamp, respectively.)

In addition, signals are also output to a relay contact of terminal blocks XT3-9 to XT3-14. When blink is specified, the contact output terminals are opened and closed repeatedly. When illumination is specified, the contact output terminals are closed.

Set the machine state in which this signal is output in the MACHINE STATUS OUTPUT, as described below.

Press the soft key [STATUS OUTPUT].



ALARM: A signal is output if a CNC alarm occurs.

When the optional signal lamp(see Chapter 21, "SIGNAL LAMP (OPTION)", in Part IV, "DETAILED OPERATIONS") are to be used, do not change this setting.

OPERATOR MESSAGE: A signal is output while an operator message is displayed.

PROGRAM EXECUTING: A signal is output during programmed operation.

PROGRAM END: A signal is output upon the completion of programmed operation (execution of M00, M01, M02, or M30).

PRODUCT. COMPLETED: A signal is output upon the completion of production (QUICK screen - production management function).

FEED HOLD: A signal is output while the FEED HOLD button's indicator on the operator's panel is lit.

NOTICE OF TOOL LIFE: A signal is output when the number of times that the last tool in the tool group will be able to be used in the future is not greater than the tool life limit to trigger an expiration advance notice.

OUTPUT 1 to OUTPUT 3: Select the state where the lamps are illuminated and the output type (LIGHT UP/BLINK).

Example 1: To blink OUTPUT 1 (red lamp) when an alarm occurs

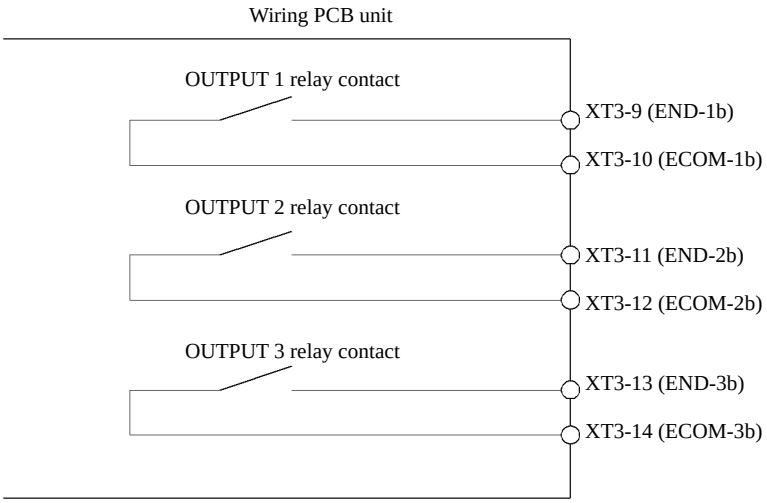
→
- Set OUTPUT 1 to ON and BLINK.
- Set OUTPUT 2 and OUTPUT 3 to OFF.
  (LIGHT UP/BLINK does not need to be set.)

Example 2: To blink OUTPUT 2 (yellow lamp) and illuminate OUTPUT 3 when a program ends

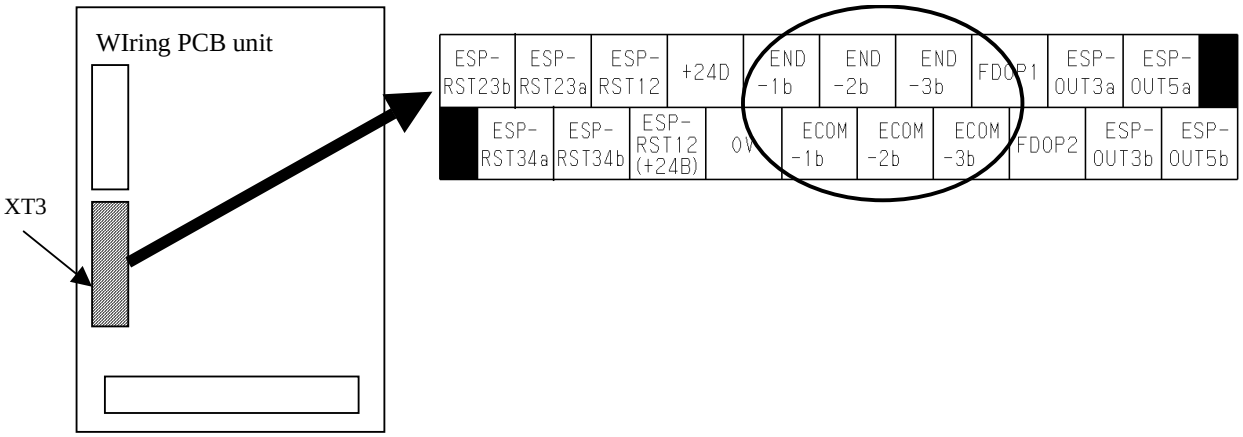
→
- Set OUTPUT 1 to OFF.
  (LIGHT UP/BLINK does not need to be set.)
- Set OUTPUT 2 to ON and BLINK.
- Set OUTPUT 3 to ON and LIGHT UP.

When multiple menu items are selected for the same output, in which the output types of the menu items are different (e.g., LIGHT UP for one, BLINK for the other), if the conditions of the menu items simultaneously selected are satisfied, the output types of the menu items become LIGHT UP. For example, when OUTPUT 1 is set to BLINK during occurrence of an alarm and LIGHT UP during occurrence of notice of tool life, if both an alarm and notice of tool life occur, OUTPUT 1 lights.

Supplement (a) Relay contact output terminal circuit diagram



Supplement (b) Position of terminal block XT3 and relay contact output terminals on the wiring PCB unit



OUTPUT 1: XT3-9 (END-1b), 10 (ECOM-1b)
OUTPUT 2: XT3-11 (END-2b), 12 (ECOM-2b)
OUTPUT 3: XT3-13 (END-3b), 14 (ECOM-3b)
* +DC24V: XT3-7 (+24D)
* 0V : XT3-8

XT3 is an M3.5 screw terminal block. A current of up to 1 A (including startup current) for 24 VDC or 200 VAC can flow between the corresponding terminals. However, the voltage used for OUTPUT 1 to OUTPUT 3 must be the same. For example, when 24 VDC is used for OUTPUT 1, only 24 VDC can be used for OUTPUT 2 and OUTPUT 3 and 200 VAC cannot be used.

(7) Skip function (option)

When a signal is input from the external equipment while a G31 move command is being executed, this function instigates the following operation:

- The current coordinates at the time of signal input are stored into the CNC.
- The current block is terminated and execution of the next block is started.

This function is used for the following:

(a) Grinding and other machining for which the end point is not programmed, instead being given by a signal
When the tool is moved in the G31 mode, the block being executed is terminated with setting the position at which the external signal is input as the machining end point.

(b) The dimensions of the workpiece are calculated by a custom macro instruction, based on the stored coordinates.
Workpiece dimension calculation: Movement is made in G31 mode to determine the shape and dimensions of a workpiece or other object.
The coordinates are calculated and stored in the CNC according to the signal received from a sensor.

For details, refer to the "CNC Operator's Manual."

SUPPLEMENT

- A block in G31 mode is unconditionally changed to G01 mode.
  The feedrate specified with an F code is selected.
- When using this function for measurement, program a constant feedrate.
  If the feedrate is allowed to vary, the measurement error will increase.
  Provided the feedrate is constant, the measurement error can be calculated as follows:

$$\mathrm{ERRmax} = \mathrm{Fm} \times \frac{1}{60} \times \frac{4}{1000}$$

  ERRmax: Maximum measurement error (mm or inch)
  Fm: Feedrate (mm/min or inch/min)
- The amount of overrun after a skip signal is input is calculated as follows:

$$\mathrm{Qmax} = \mathrm{Fm} \times \frac{1}{60} \times \left(\frac{20 + Tc + Ts}{1000}\right)$$

  Qmax: Overrun (mm or inch)
  Fm: Feedrate (mm/min or inch/min)
  Tc: Cutting time constant (msec)
  Ts: Servo time constant (usually 33 msec)
- The skip signal must have a width of at least 10 msec.

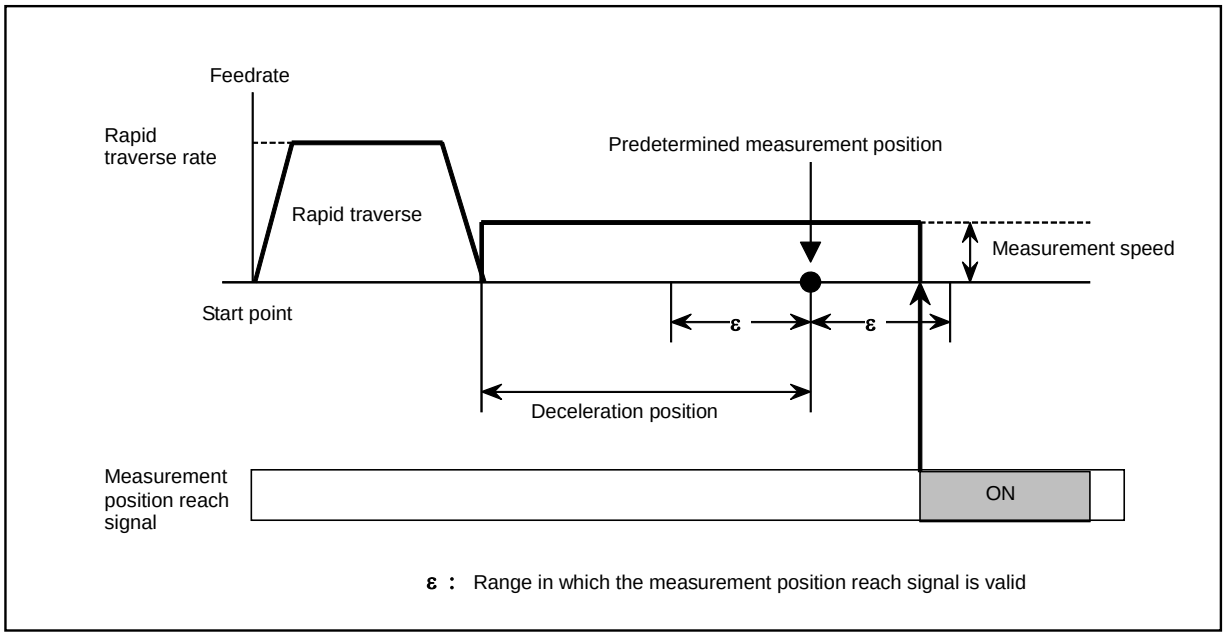
"SKIP"	(46)	→	X0004.7
"SKIP2"	(50)	→	X0004.2
"SKIP3"	(51)	→	X0004.3
"SKIP4"	(52)	→	X0004.4
"SKIP5"	(53)	→	X0004.5
"SKIP6"	(54)	→	X0004.6
"SKIP7"	(55)	→	X0004.0
"SKIP8"	(56)	→	X0004.1

Set each item as above.

(8) Automatic tool length measurement function (option)

When G37 is specified, the tool moves to a predetermined measurement position.
If a signal (measurement position reach signal) is input from external equipment while the tool is moving to the measurement position, the tool stops immediately.
This function adds the difference between the stop position and the predetermined measurement position to the current tool length compensation.

For details, refer to the "CNC Operator's Manual."



[Parameter settings]
Set the following parameters:

NC parameters
No. 6241: Measurement speed
No. 6251: Deceleration position
No. 6254: Range in which the measurement position reach signal is valid

SUPPLEMENT
When the skip signal at address X0004.7 is already used, set automatic tool length measurement (48) at address X0004.2.

(9) Alarm output 2

This signal is mainly used for controlling the buzzer when an alarm occurs.

- Turned on when an alarm occurs.
- Turned off when the alarm is released.
- Turned off when the alarm output 2 release signal (57) is input.
- Turned off when the specified time (PMC parameter T06) has elapsed.
  (When PMC parameter K06#2 is set to 1)

(10) Position switches

This signal is turned on when five position switches are on.
PMC parameter keep relay K02#5

K02#5 = 0: Uses position switches 1, 2, 3, 4, and 5.
K02#5 = 1: Uses position switches 1, 2, 3, 4, and 7.

The data (axis, maximum value, and minimum value) of the position switches is to be set using NC parameters.

NC parameter
No.6910 to: Axis setting (X=1, Y=2, Z=3 …)
No.6930 to: Maximum value
No.6950 to: Minimum value

14.5 EXTERNAL INTERFACE CONNECTION

Connection diagram of 50-pin terminal block (XT1) on wiring PCB
(Terminal size: M3.5, maximum terminal width: 6.8 mm)

Name	Address	Signal	Destination
UDI01	X 4.0	User DI01	XTC1-01
UDI02	X 4.1	User DI02	XTC1-02
UDI03	X 4.2	User DI03	XTC1-05
UDI04	X 4.3	User DI04	XTC1-06
UDI05	X 4.4	User DI05	XTC1-07
UDI06	X 4.5	User DI06	XTC1-08
UDI07	X 4.6	User DI07	XTC1-11
UDI08	X 4.7	User DI08	XTC1-12
UDI09	X 5.0	User DI09	XTC1-13
UDI10	X 5.1	User DI10	XTC1-14
UDI11	X 5.2	User DI11	XTC1-17
UDI12	X 5.3	User DI12	XTC1-18
UDI13	X 5.4	User DI13	XTC1-19
UDI14	X 5.5	User DI14	XTC1-20
UDI15	X 5.6	User DI15	XTC1-23
UDI16	X 5.7	User DI16	XTC1-24
UDO01	Y 2.0	User DO01	XTC1-25
UDO02	Y 2.1	User DO02	XTC1-26
UDO03	Y 2.2	User DO03	XTC1-29
UDO04	Y 2.3	User DO04	XTC1-30
UDO05	Y 2.4	User DO05	XTC1-31
UDO06	Y 2.5	User DO06	XTC1-32
UDO07	Y 2.6	User DO07	XTC1-35
UDO08	Y 2.7	User DO08	XTC1-36
UDO09	Y 3.0	User DO09	XTC1-37
UDO10	Y 3.1	User DO10	XTC1-38
UDO11	Y 3.2	User DO11	XTC1-41
UDO12	Y 3.3	User DO12	XTC1-42
UDO13	Y 3.4	User DO13	XTC1-43
UDO14	Y 3.5	User DO14	XTC1-44
UDO15	Y 3.6	User DO15	XTC1-47
UDO16	Y 3.7	User DO16	XTC1-48

01	X 4.0	02	X 4.1
03	+24E	04	+24E
05	X 4.2	06	X 4.3
07	X 4.4	08	X 4.5
09	+24E	10	+24E
11	X 4.6	12	X 4.7
13	X 5.0	14	X 5.1
15	+24E	16	+24E
17	X 5.2	18	X 5.3
19	X 5.4	20	X 5.5
21	+24E	22	+24E
23	X 5.6	24	X 5.7
25	Y 2.0	26	Y 2.1
27	0V	28	0V
29	Y 2.2	30	Y 2.3
31	Y 2.4	32	Y 2.5
33	0V	34	0V
35	Y 2.6	36	Y 2.7
37	Y 3.0	38	Y 3.1
39	0V	40	0V
41	Y 3.2	42	Y 3.3
43	Y 3.4	44	Y 3.5
45	0V	46	0V
47	Y 3.6	48	Y 3.7
49	0V	50	+24E

Connection diagram from DI01 on wiring PCB to 50-pin terminal block (XTC1)
(Terminal size: M3.5, maximum terminal width: 6.8 mm)

Name	Address	Signal	Destination
UDI17	X 0.0	User DI17	XTC1-01
UDI18	X 0.1	User DI18	XTC1-02
UDI19	X 0.2	User DI19	XTC1-05
UDI20	X 0.3	User DI20	XTC1-06
UDI21	X 0.4	User DI21	XTC1-07
UDI22	X 0.5	User DI22	XTC1-08
UDI23	X 0.6	User DI23	XTC1-11
UDI24	X 0.7	User DI24	XTC1-12
UDI25	X 1.0	User DI25	XTC1-13
UDI26	X 1.1	User DI26	XTC1-14
UDI27	X 1.2	User DI27	XTC1-17
UDI28	X 1.3	User DI28	XTC1-18
UDI29	X 1.4	User DI29	XTC1-19
UDI30	X 1.5	User DI30	XTC1-20
UDI31	X 1.6	User DI31	XTC1-23
UDI32	X 1.7	User DI32	XTC1-24
UDO17	Y 0.0	User DO17	XTC1-25
UDO18	Y 0.1	User DO18	XTC1-26
UDO19	Y 0.2	User DO19	XTC1-29
UDO20	Y 0.3	User DO20	XTC1-30
UDO21	Y 0.4	User DO21	XTC1-31
UDO22	Y 0.5	User DO22	XTC1-32
UDO23	Y 0.6	User DO23	XTC1-35
UDO24	Y 0.7	User DO24	XTC1-36
UDO25	Y 1.0	User DO25	XTC1-37
UDO26	Y 1.1	User DO26	XTC1-38
UDO27	Y 1.2	User DO27	XTC1-41
UDO28	Y 1.3	User DO28	XTC1-42
UDO29	Y 1.4	User DO29	XTC1-43
UDO30	Y 1.5	User DO30	XTC1-44
UDO31	Y 1.6	User DO31	XTC1-47
UDO32	Y 1.7	User DO32	XTC1-48

01	X 0.0	02	X 0.1
03	+24E	04	+24E
05	X 0.2	06	X 0.3
07	X 0.4	08	X 0.5
09	+24E	10	+24E
11	X 0.6	12	X 0.7
13	X 1.0	14	X 1.1
15	+24E	16	+24E
17	X 1.2	18	X 1.3
19	X 1.4	20	X 1.5
21	+24E	22	+24E
23	X 1.6	24	X 1.7
25	Y 0.0	26	Y 0.1
27	0V	28	0V
29	Y 0.2	30	Y 0.3
31	Y 0.4	32	Y 0.5
33	0V	34	0V
35	Y 0.6	36	Y 0.7
37	Y 1.0	38	Y 1.1
39	0V	40	0V
41	Y 1.2	42	Y 1.3
43	Y 1.4	44	Y 1.5
45	0V	46	0V
47	Y 1.6	48	Y 1.7
49	0V	50	+24E

Connection diagram from DI02 on wiring PCB to 34-pin terminal block (XTC2)
(Terminal size: M3.5, maximum terminal width: 6.8 mm)

Name	Address	Signal	Destination
UDI33	X 2.0	User DI33	XTC2-01
UDI34	X 2.1	User DI34	XTC2-02
UDI35	X 2.2	User DI35	XTC2-05
UDI36	X 2.3	User DI36	XTC2-06
UDI37	X 2.4	User DI37	XTC2-07
UDI38	X 2.5	User DI38	XTC2-08
UDI39	X 2.6	User DI39	XTC2-11
UDI40	X 2.7	User DI40	XTC2-12
UDI41	X 3.0	User DI41	XTC2-13
UDI42	X 3.1	User DI42	XTC2-14
UDI43	X 3.2	User DI43	XTC2-17
UDI44	X 3.3	User DI44	XTC2-18
UDI45	X 3.4	User DI45	XTC2-19
UDI46	X 3.5	User DI46	XTC2-20
UDI47	X 3.6	User DI47	XTC2-23
UDI48	X 3.7	User DI48	XTC2-24

01	X 2.0	02	X 2.1
03	+24E	04	+24E
05	X 2.2	06	X 2.3
07	X 2.4	08	X 2.5
09	+24E	10	+24E
11	X 2.6	12	X 2.7
13	X3.0	14	X 3.1
15	+24E	16	+24E
17	X 3.2	18	X 3.3
19	X 3.4	20	X 3.5
21	+24E	22	+24E
23	X 3.6	24	X 3.7
25	+24E	26	+24E
27	+24E	28	+24E
29	+24E	30	0V
31	0V	32	0V
33	0V	34	0V

ATTENTION

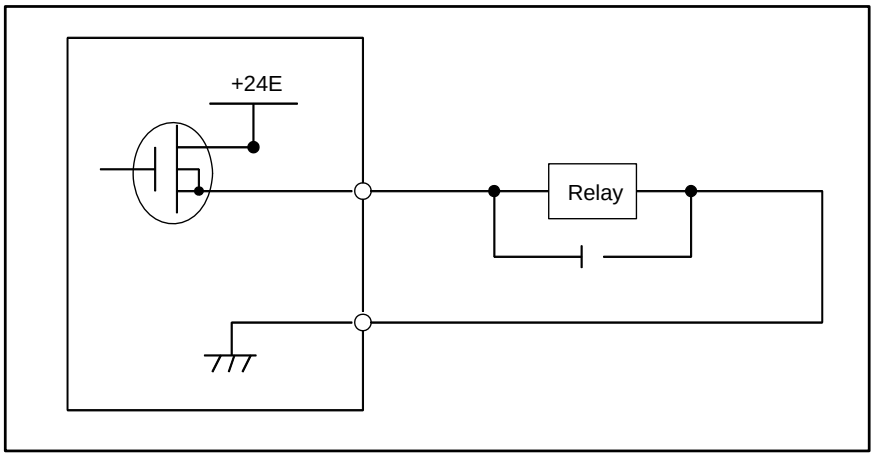
[Output signals]

Output signals are used for driving relays and light-emitting diodes for indicators. A transistor is used as the driver.

(a) Output signal standard [0 V common] current flow type Output signal specifications:

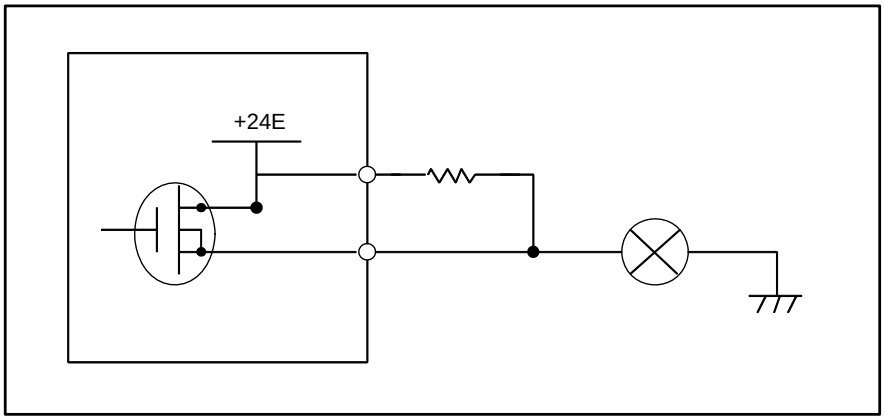
Maximum output current:	200 mA (including instantaneous values)
Maximum voltage:	24 V +20%
Saturation voltage:	1.0 V (Max.)
Leakage current:	100 μA (Max.)

(b) Output circuit



(c) When connecting an inductive load such as a relay, always insert a spark killer. Insert the spark killer near the load as much as possible (within 20 cm). When connecting a capacitive load, always insert a resistor for limiting the current in series so that the load can be used within the rated current and voltage including instantaneous cases.

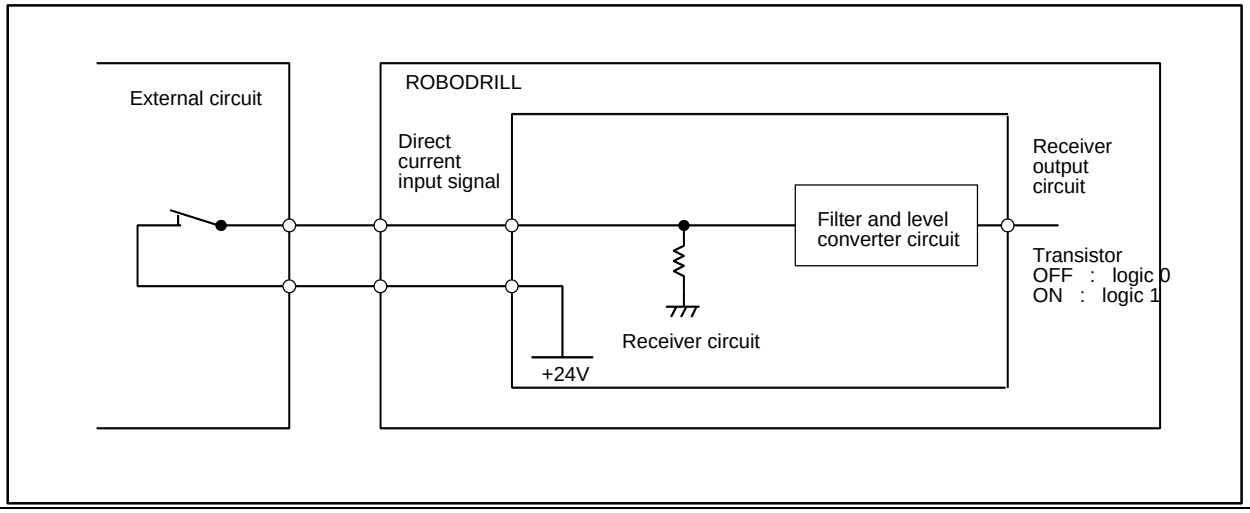
(d) When a lamp is lit directly by the transistor output, a surge current may flow, resulting in damage to the transistor. For this reason, insert a protection circuit so that the transistor can be used within the rated current and voltage including instantaneous cases.



[Input signals]

(a) Each contact must satisfy the following conditions:
Contact capacity:
30 VDC, 16 mA or more
Leakage current between contacts when opened:
1 mA or less (Voltage: 26.4 V)
Voltage drop between contacts when closed:
2 V or less (Current: 8.5 mA)
(Including cable voltage drop)

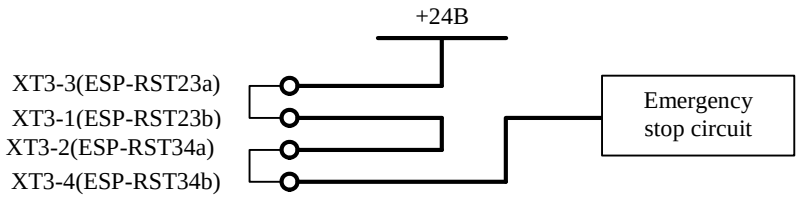
(b) The following shows the receiver circuit:



14.6 EMERGENCY STOP

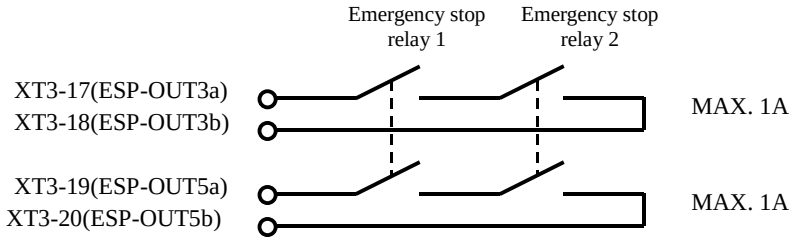
> ⚠ **WARNING**
> Be sure to connect the emergency stop function of external equipment to the system. If an accident should occur, poor connection can prevent the emergency stop device from functioning, which can result in injury or can cause damage to tools.

(1) Terminals for connecting the external emergency stop signal



When inputting the emergency stop signal of external equipment to the machine, remove the jumper connecting XT3-1 and XT3-3 or the jumper connecting XT3-2 and XT3-4.

(2) Contact which outputs the emergency stop state of the machine



The emergency stop state of the machine can be acquired from XT3-17 and XT3-18, and XT3-19 and XT3-20.
When the machine is in the emergency stop state or powered off, the connection between terminals XT3-17 and XT3-18 and the connection between terminals XT3-19 and XT3-20 are interrupted.

14.7 EXTERNAL POWER SUPPLY

The +24E terminal on the external interface terminal block (XT1) can be used for external power supply of 24Vd.c. (Maximum 1A).
If 24Vd.c. is not output, check fuse 6 (FU6) (3.2 A).

14.8 RELAY MODULE

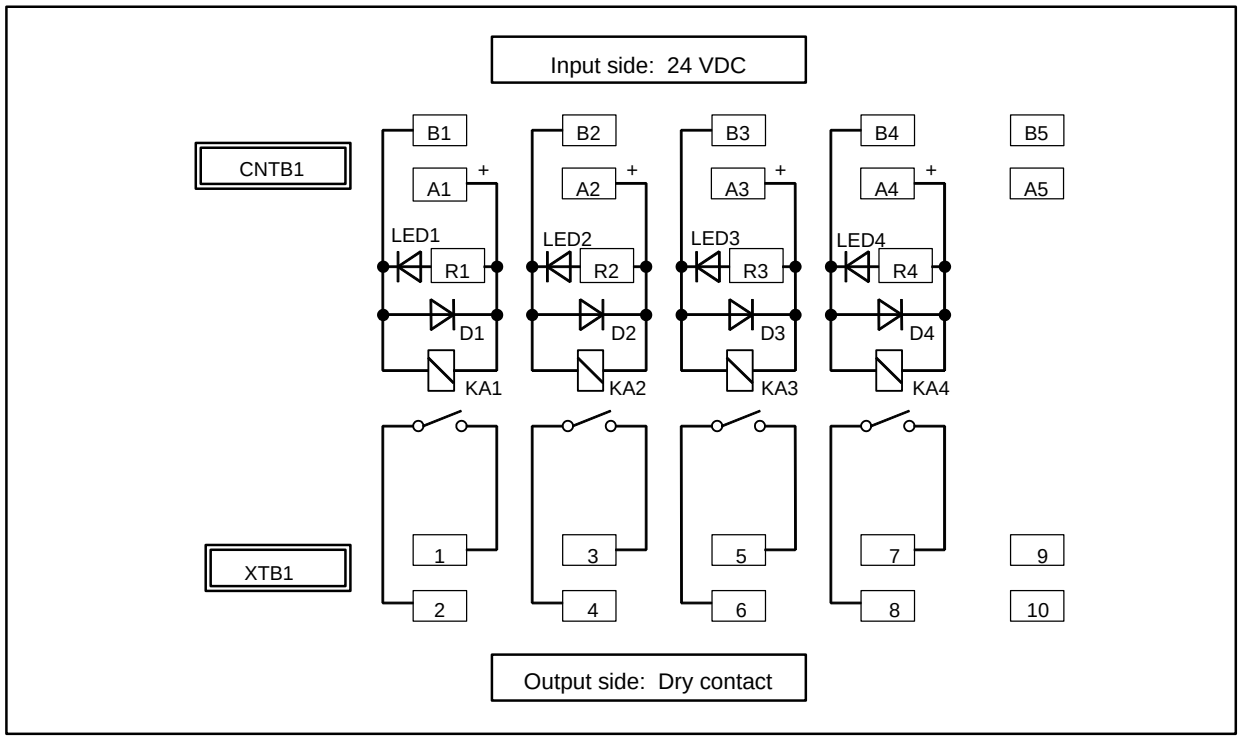
14.8.1 Overview

The relay module outputs four independent relay contact signals (dry contacts) for an input signal (24 VDC). As a type of contact, a choice between contact a and contact b can be made.

14.8.2 Connection

14.8.2.1 Internal connection diagram

- With a coil surge absorption diode
- With an operation indication LED



14.8.2.2 Pin allocation

Input side
CNTB1
HIROSE: HIF3CD-10PA-2.54DSA

	A	B
01	TH01	0V
02	TH02	0V
03	TH03	0V
04	TH04	0V
05		

Output side
XTB1
YOSHIDA: PS7-10A (M3 screw)

		1	TH01A
2	TH01B	3	TH02A
4	TH02B	5	TH03A
6	TH03B	7	TH04A
8	TH04B	9	
10			

14.8.3 Specifications

14.8.3.1 Ordering information

	Name	Specification	Contact configuration
(1)	Relay module	A20B-1007-0720	4a
(2)	Relay module	A20B-1007-0722	4b

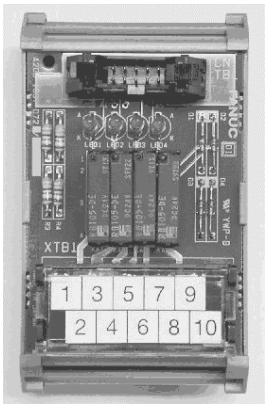
SUPPLEMENT
Do not use different voltages for the relay contacts on one module.
(1) and (2) differ in the internal relay specification.

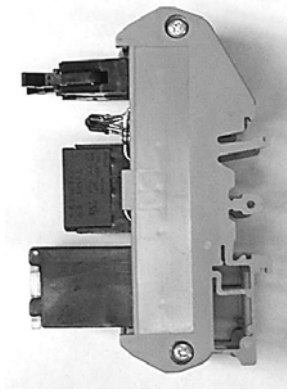
14.8.3.2 Rating

Per relay

	Item	Rating	Remarks
Contact	Rated conducting current	5 A	
	Maximum switching capacity	AC250V 5A 30VDC 5A	a contact
		AC250V 1A 30VDC 1A	b contact
	Minimum applicable load	0.1VDC 0.1mA	
Coil	Rated voltage	24VDC	
	Operating voltage	70% or less of the rated voltage	
	Return voltage	5% or more of the rated voltage	
	Power consumption	200mW	a contact
		360mW	b contact
Terminal block	Screw size	M3	
	Applicable wire	1.25mm^2	
	Tightening torque	0.5 to 0.75N·m	

14.8.3.3 Outside dimensions





90mm

53mm

62mm

Mounting method
Mounting using a DIN35 rail

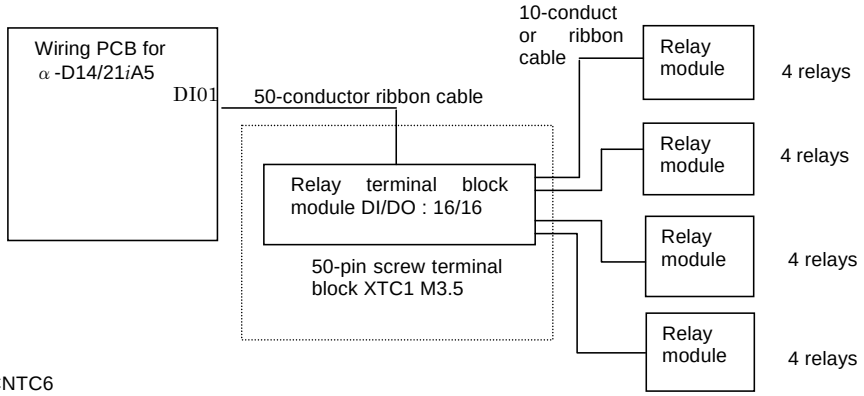
14.9 USER TERMINAL BLOCK MODULE

14.9.1 Overview

The user terminal block module is designed to expand 16 input signals and 16 output signals on the terminal block. Four points are made available so that a three-wire proximity switch of NPN type can be handled. In addition, the user terminal block module can be easily connected to a relay module by using a 10-conductor ribbon cable. The user terminal block module can be expanded for connection with up to four relay modules.

14.9.2 Connection

Block diagram



CNTC6
[AMP 316517-5]

	A	B
01	X 0.0	+24E.
02		0V
03	X 0.1	+24E
04		0V
05	X 0.2	+24E
06		0V
07	X 0.3	+24E
08		0V
09		
10		

CNTC1
[HIROSE3CB-50PA]

	A	B
01	X 0.0	X 0.1
02	+24E	+24E
03	X 0.2	X 0.3
04	X 0.4	X 0.5
05	+24E	+24E
06	X 0.6	X 0.7
07	X 1.0	X 1.1
08	+24E	+24E
09	X 1.2	X 1.3
10	X 1.4	X 1.5
11	+24E	+24E
12	X 1.6	X 1.7
13	Y 0.0	Y 0.1
14	0V	0V
15	Y 0.2	Y 0.3
16	Y 0.4	Y 0.5
17	0V	0V
18	Y 0.6	Y 0.7
19	Y 1.0	Y 1.1
20	0V	0V
21	Y 1.2	Y 1.3
22	Y 1.4	Y 1.5
23	0V	0V
24	Y 1.6	Y 1.7
25	0V	+24E

CNTC2
[HIROSE HIF3CD-10PA]

	A	B
01	Y 0.0	0V
02	Y 0.1	0V
03	Y 0.2	0V
04	Y 0.3	0V
05		

CNTC3
[HIROSE HIF3CD-10PA]

	A	B
01	Y 0.4	0V
02	Y 0.5	0V
03	Y 0.6	0V
04	Y 0.7	0V
05		

CNTC4
[HIROSE HIF3CD-10PA]

	A	B
01	Y 1.0	0V
02	Y 1.1	0V
03	Y 1.2	0V
04	Y 1.3	0V
05		

CNTC5
[HIROSE HIF3CD-10PA]

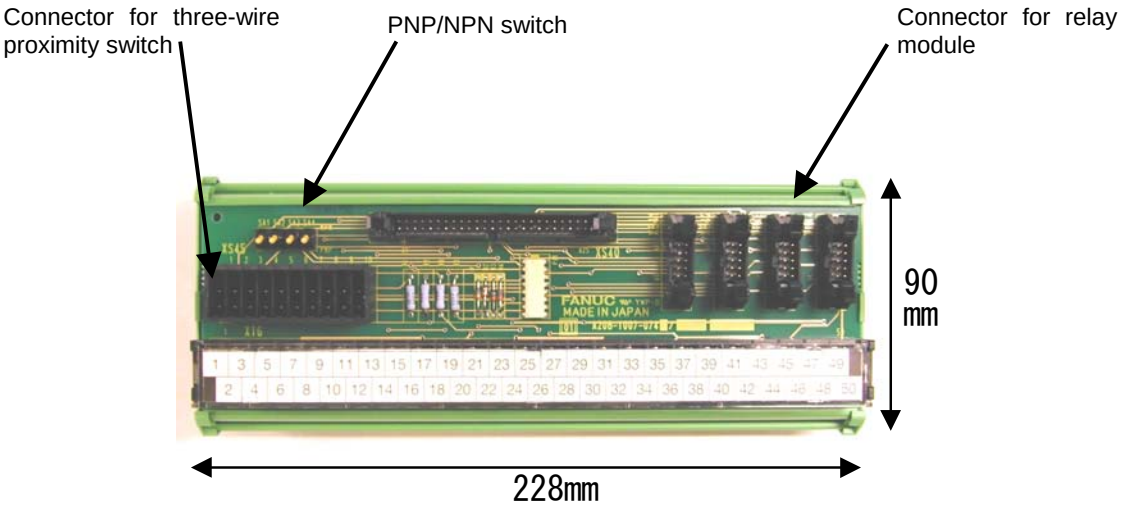
	A	B
01	Y 1.4	0V
02	Y 1.5	0V
03	Y 1.6	0V
04	Y 1.7	0V
05		

14.9.3 Specifications

14.9.3.1 Ordering information

	Name	Specification	Contact configuration
(1)	User terminal block module	A20B-1007-0740	

14.9.3.2 Outside dimensions



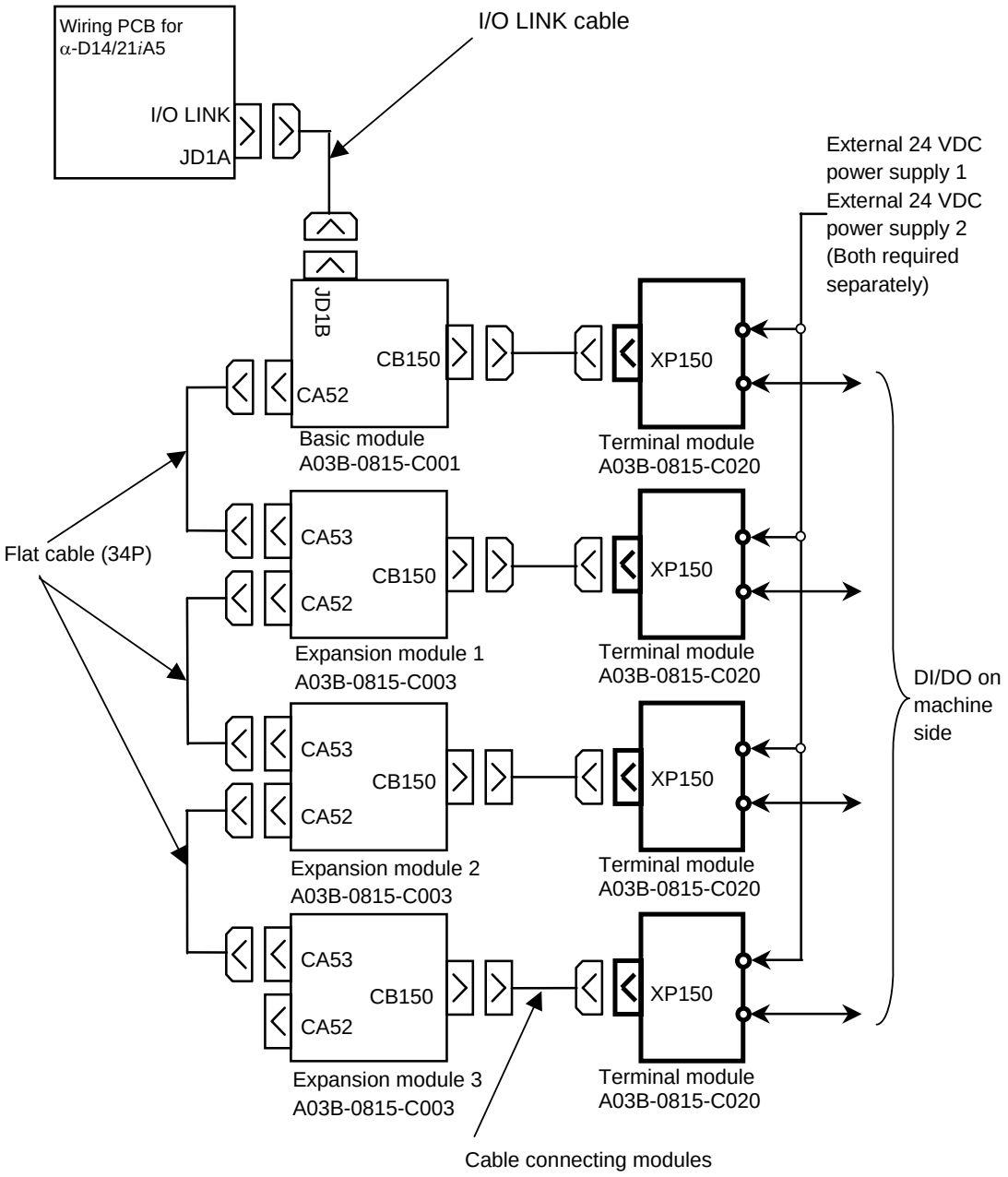
Mounting method
Mounting using a DIN35 rail

14.10 TERMINAL MODULE A

14.10.1 Overview

Terminal module A, connected via a connector panel I/O module and a cable, allows input/output signals (24 DI signals and 16 DO signals) of the machine to be relayed through a terminal block.
Signals can be expanded to up to 96 DI signals and 64 DO signals.

14.10.2 Connection



When the signals of the basic module [A03B-0815-C001] are assigned to the terminal module

XP150 (HIROSE HIF3CB-50PA-2.54DSA)

A1	+24V2	B1	Y229.0
A2	+24V2	B2	Y228.0
A3	0V	B3	0V
A4	Y229.1	B4	Y229.2
A5	Y228.1	B5	Y228.2
A6	0V	B6	0V
A7	Y229.3	B7	Y229.4
A8	Y228.3	B8	Y228.4
A9	0V	B9	DICOM0
A10	Y229.5	B10	Y229.6
A11	Y228.5	B11	Y228.6
A12	X229.0	B12	X229.1
A13	Y229.7	B13	X230.0
A14	Y228.7	B14	X228.0
A15	X229.2	B15	X229.3
A16	X230.1	B16	X230.2
A17	X228.1	B17	X228.2
A18	X229.4	B18	X229.5
A19	X230.3	B19	X230.4
A20	X228.3	B20	X228.4
A21	X229.6	B21	X229.7
A22	X230.5	B22	X230.6
A23	X228.5	B23	X228.6
A24	X230.7	B24	+24V1
A25	X228.7	B25	+24V1

Address
Input signals: 24 signals X228.0 to X230.7
Output signals: 16 signals Y228.0 to Y229.7

XT150A (YOSHIDA PX7-32A)

1	0V	17	+24V2
2	DICOM	18	DICOM
3	X228.2	19	X228.0
4	X228.3	20	X228.1
5	DICOM	21	DICOM
6	X228.6	22	X228.4
7	X228.7	23	X228.5
8	+24V2	24	+24V2
9	X229.2	25	X229.0
10	X229.3	26	X229.1
11	+24V2	27	+24V2
12	X229.6	28	X229.4
13	X229.7	29	X229.5
14	+24V2	30	+24V2
15	X230.2	31	X230.0
16	X230.3	32	X230.1

XT150B (YOSHIDA PX7-32A)

1	+24V2	17	+24V2
2	X230.6	18	X230.4
3	X230.7	19	X230.5
4	0V	20	0V
5	Y228.2	21	Y228.0
6	Y228.3	22	Y228.1
7	0V	23	0V
8	Y228.6	24	Y228.4
9	Y228.7	25	Y228.5
10	0V	26	0V
11	Y229.2	27	Y229.0
12	Y229.3	28	Y229.1
13	0V	29	0V
14	Y229.6	30	Y229.4
15	Y229.7	31	Y229.5
16	0V	32	+24V1

When the signals of the Expansion module 1 [A03B-0815-C003] are assigned to the terminal module

XP150 (HIROSE HIF3CB-50PA-2.54DSA)

A1	+24V2	B1	Y231.0
A2	+24V2	B2	Y230.0
A3	0V	B3	0V
A4	Y231.1	B4	Y231.2
A5	Y230.1	B5	Y230.2
A6	0V	B6	0V
A7	Y231.3	B7	Y231.4
A8	Y230.3	B8	Y230.4
A9	0V	B9	DICOM0
A10	Y231.5	B10	Y231.6
A11	Y230.5	B11	Y230.6
A12	X232.0	B12	X232.1
A13	Y231.7	B13	X233.0
A14	Y230.7	B14	X231.0
A15	X232.2	B15	X232.3
A16	X233.1	B16	X233.2
A17	X231.1	B17	X231.2
A18	X232.4	B18	X232.5
A19	X233.3	B19	X233.4
A20	X231.3	B20	X231.4
A21	X232.6	B21	X232.7
A22	X233.5	B22	X233.6
A23	X231.5	B23	X231.6
A24	X233.7	B24	+24V1
A25	X231.7	B25	+24V1

Address
Input signals: 24 signals X231.0 to X233.7
Output signals: 16 signals Y230.0 to Y231.7

XT150A (YOSHIDA PX7-32A

1	0V	17	+24V2
2	DICOM	18	DICOM
3	X231.2	19	X231.0
4	X231.3	20	X231.1
5	DICOM	21	DICOM
6	X231.6	22	X231.4
7	X231.7	23	X231.5
8	+24V2	24	+24V2
9	X232.2	25	X232.0
10	X232.3	26	X232.1
11	+24V2	27	+24V2
12	X232.6	28	X232.4
13	X232.7	29	X232.5
14	+24V2	30	+24V2
15	X233.2	31	X233.0
16	X233.3	32	X233.1

XT150B (YOSHIDA PX7-32A)

1	+24V2	17	+24V2
2	X233.6	18	X233.4
3	X233.7	19	X233.5
4	0V	20	0V
5	Y230.2	21	Y230.0
6	Y230.3	22	Y230.1
7	0V	23	0V
8	Y230.6	24	Y230.4
9	Y230.7	25	Y230.5
10	0V	26	0V
11	Y231.2	27	Y231.0
12	Y231.3	28	Y231.1
13	0V	29	0V
14	Y231.6	30	Y231.4
15	Y231.7	31	Y231.5
16	0V	32	+24V1

When the signals of the Expansion module 2 [A03B-0815-C003] are assigned to the terminal module

XP150 (HIROSE HIF3CB-50PA-2.54DSA)

A1	+24V2	B1	Y233.0
A2	+24V2	B2	Y232.0
A3	0V	B3	0V
A4	Y233.1	B4	Y233.2
A5	Y232.1	B5	Y232.2
A6	0V	B6	0V
A7	Y233.3	B7	Y233.4
A8	Y232.3	B8	Y232.4
A9	0V	B9	DICOM0
A10	Y233.5	B10	Y233.6
A11	Y232.5	B11	Y232.6
A12	X235.0	B12	X235.1
A13	Y233.7	B13	X236.0
A14	Y232.7	B14	X234.0
A15	X234.2	B15	X235.3
A16	X236.1	B16	X236.2
A17	X234.1	B17	X234.2
A18	X235.4	B18	X235.5
A19	X236.3	B19	X236.4
A20	X234.3	B20	X234.4
A21	X235.6	B21	X235.7
A22	X236.5	B22	X236.6
A23	X234.5	B23	X234.6
A24	X236.7	B24	+24V1
A25	X234.7	B25	+24V1

Address
Input signals: 24 signals X234.0 to X236.7
Output signals: 16 signals Y232.0 to Y233.7

XT150A (YOSHIDA PX7-32A)

1	0V	17	+24V2
2	DICOM	18	DICOM
3	X234.2	19	X234.0
4	X234.3	20	X234.1
5	DICOM	21	DICOM
6	X234.6	22	X234.4
7	X234.7	23	X234.5
8	+24V2	24	+24V2
9	X235.2	25	X235.0
10	X235.3	26	X235.1
11	+24V2	27	+24V2
12	X235.6	28	X235.4
13	X235.7	29	X235.5
14	+24V2	30	+24V2
15	X236.2	31	X236.0
16	X236.3	32	X236.1

XT150B (YOSHIDA PX7-32A)

1	+24V2	17	+24V2
2	X236.6	18	X236.4
3	X236.7	19	X236.5
4	0V	20	0V
5	Y232.2	21	Y232.0
6	Y232.3	22	Y232.1
7	0V	23	0V
8	Y232.6	24	Y232.4
9	Y232.7	25	Y232.5
10	0V	26	0V
11	Y233.2	27	Y233.0
12	Y233.3	28	Y233.1
13	0V	29	0V
14	Y233.6	30	Y233.4
15	Y233.7	31	Y233.5
16	0V	32	+24V1

When the signals of the Expansion module 3 [A03B-0815-C003] are assigned to the terminal module

XP150 (HIROSE HIF3CB-50PA-2.54DSA)

A1	+24V2	B1	Y235.0
A2	+24V2	B2	Y234.0
A3	0V	B3	0V
A4	Y235.1	B4	Y235.2
A5	Y234.1	B5	Y234.2
A6	0V	B6	0V
A7	Y235.3	B7	Y235.4
A8	Y234.3	B8	Y234.4
A9	0V	B9	DICOM0
A10	Y235.5	B10	Y235.6
A11	Y234.5	B11	Y234.6
A12	X238.0	B12	X238.1
A13	Y235.7	B13	X239.0
A14	Y234.7	B14	X237.0
A15	X238.2	B15	X238.3
A16	X239.1	B16	X239.2
A17	X237.1	B17	X237.2
A18	X238.4	B18	X238.5
A19	X239.3	B19	X239.4
A20	X237.3	B20	X237.4
A21	X238.6	B21	X238.7
A22	X239.5	B22	X239.6
A23	X237.5	B23	X237.6
A24	X239.7	B24	+24V1
A25	X237.7	B25	+24V1

Address
Input signals: 24 signals X237.0 to X239.7
Output signals: 16 signals Y234.0 to Y235.7

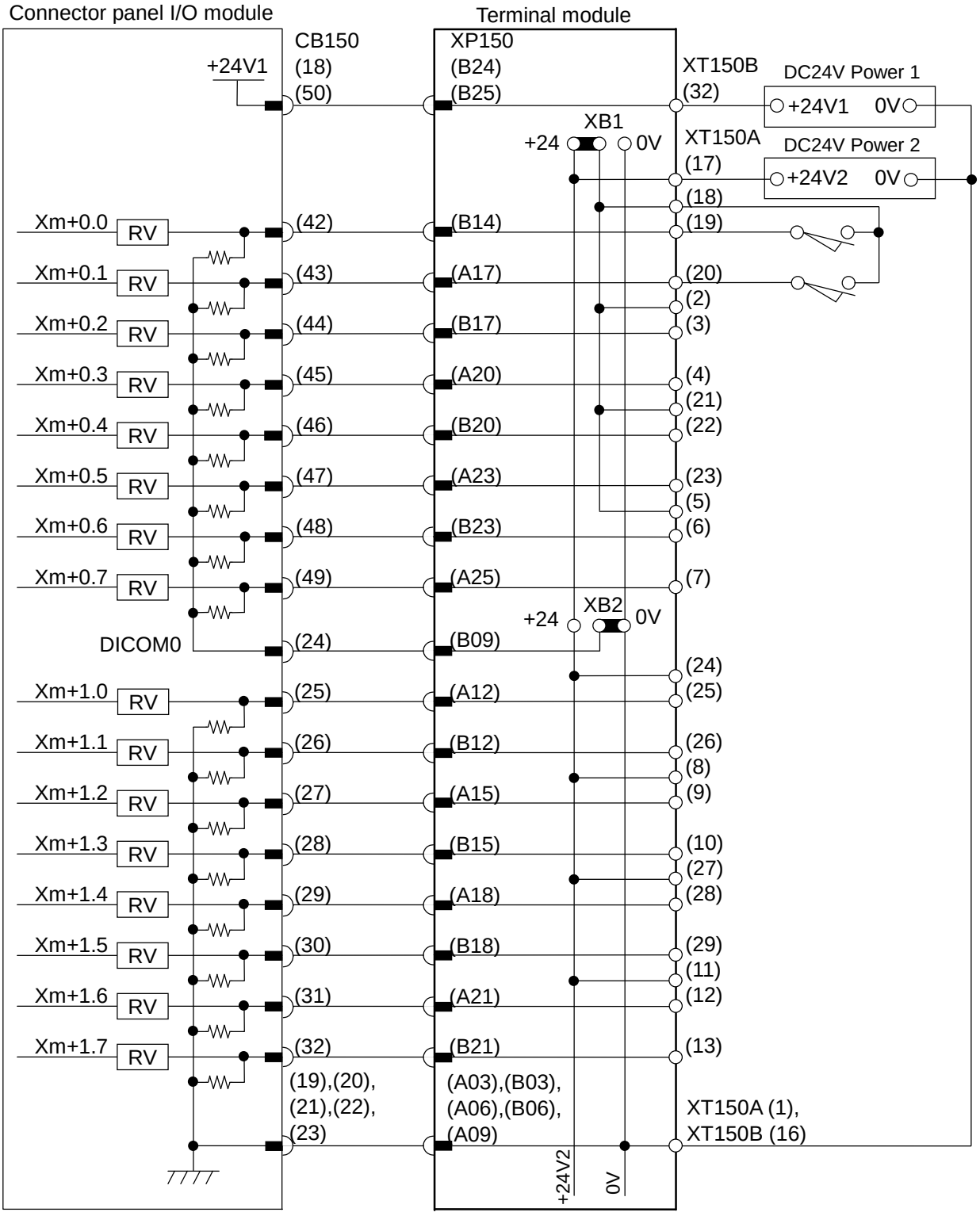
XT150A (YOSHIDA PX7-32A)

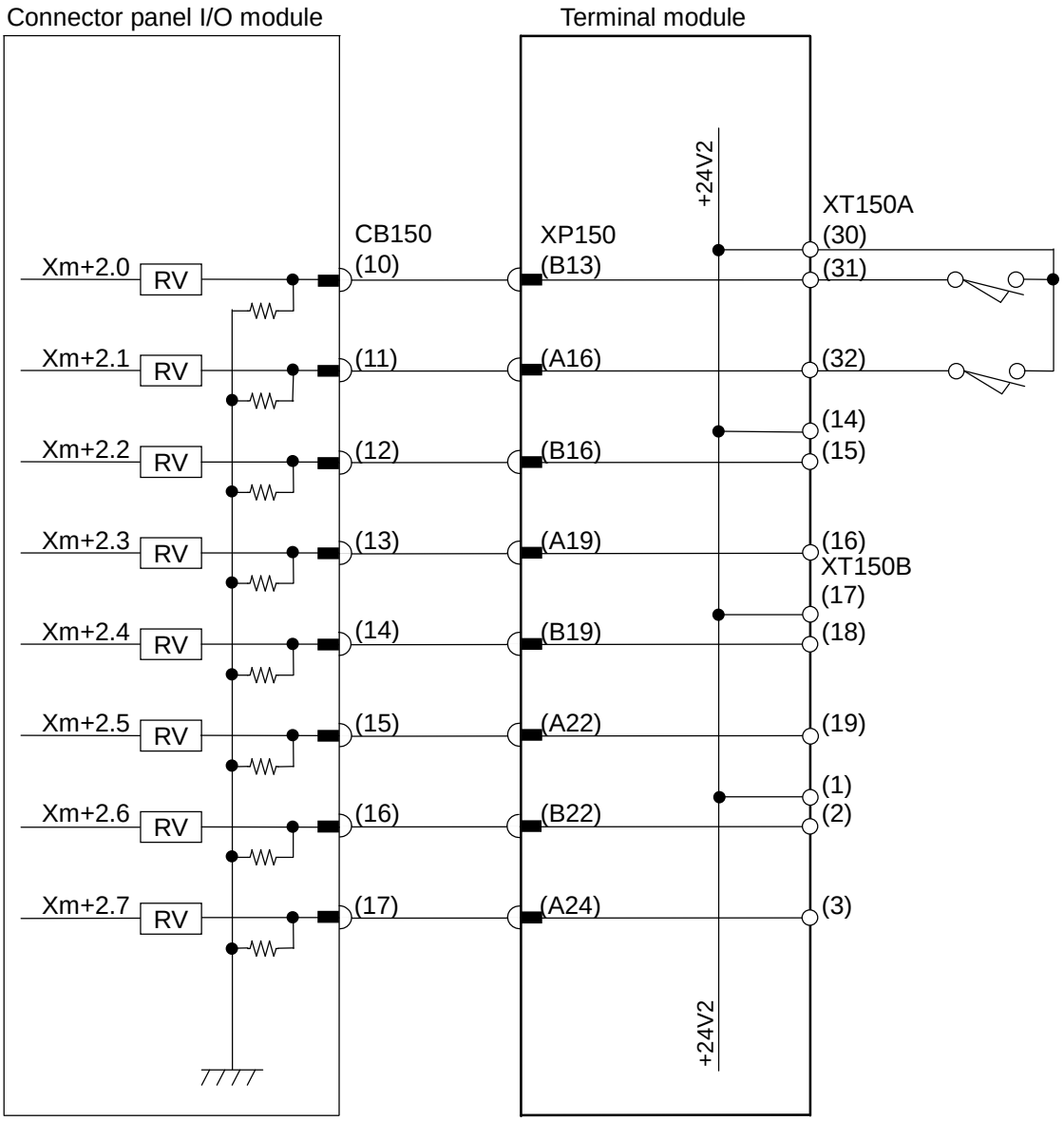
1	0V	17	+24V2
2	DICOM	18	DICOM
3	X237.2	19	X237.0
4	X237.3	20	X237.1
5	DICOM	21	DICOM
6	X237.6	22	X237.4
7	X237.7	23	X237.5
8	+24V2	24	+24V2
9	X238.2	25	X238.0
10	X238.3	26	X238.1
11	+24V2	27	+24V2
12	X238.6	28	X238.4
13	X238.7	29	X238.5
14	+24V2	30	+24V2
15	X239.2	31	X239.0
16	X239.3	32	X239.1

XT150B (YOSHIDA PX7-32A)

1	+24V2	17	+24V2
2	X239.6	18	X239.4
3	X239.7	19	X239.5
4	0V	20	0V
5	Y234.2	21	Y234.0
6	Y234.3	22	Y234.1
7	0V	23	0V
8	Y234.6	24	Y234.4
9	Y234.7	25	Y234.5
10	0V	26	0V
11	Y235.2	27	Y235.0
12	Y235.3	28	Y235.1
13	0V	29	0V
14	Y235.6	30	Y235.4
15	Y235.7	31	Y235.5
16	0V	32	+24V1

< Input signal (DI) circuit diagram >





Basic module: Xm = 228
Expansion module 1: Xm = 231
Expansion module 2: Xm = 234
Expansion module 3: Xm = 237

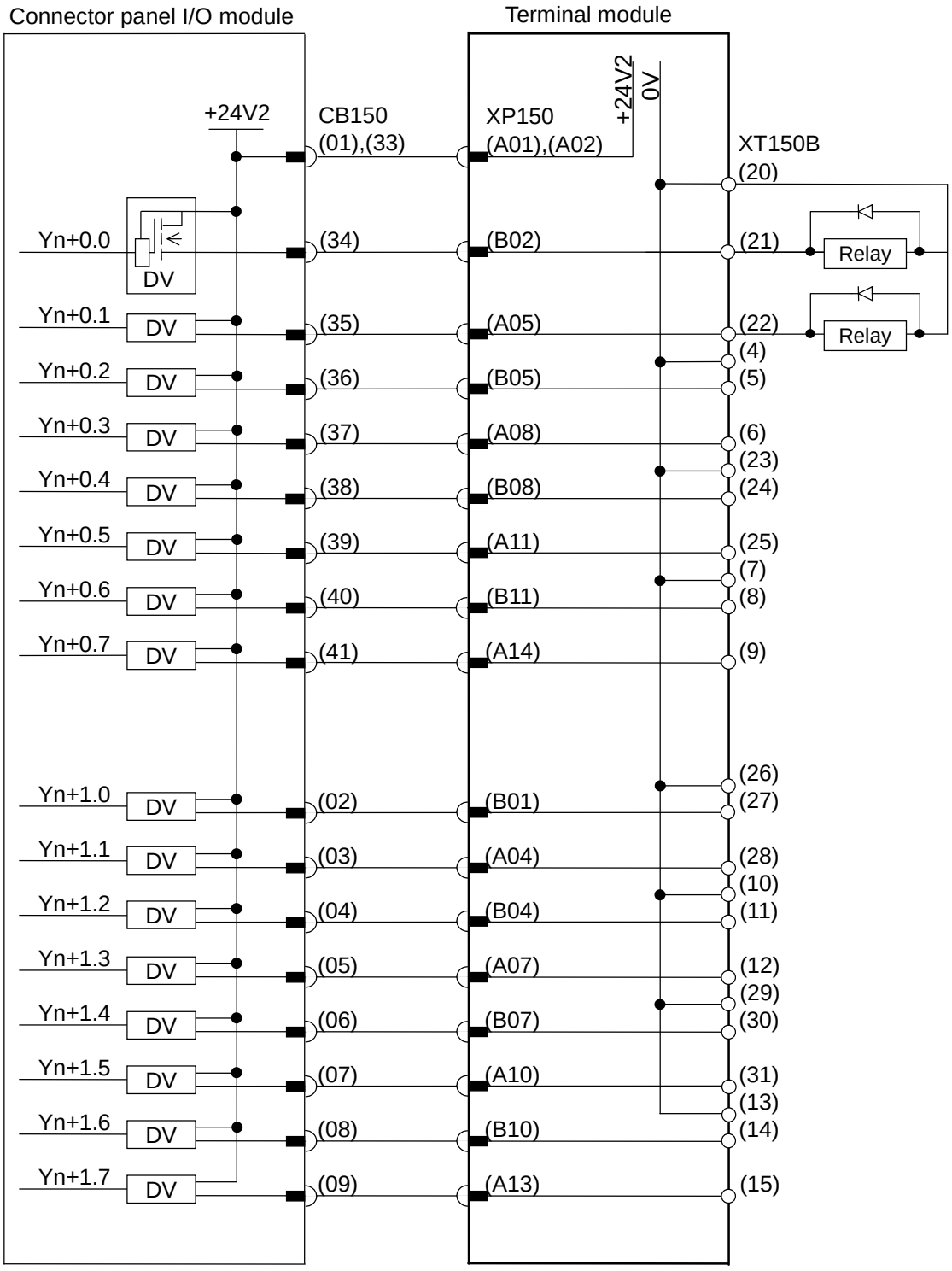
NOTE

Xm+0.1 to Xm+0.7 are DI pins that allow common signal selection. Specifically, when setting terminal XB1 is set to 0 V and setting terminal XB2 is set to +24 V, and DICOM0 is connected to +24, DI signals with logic inverted can be input. In this case, if a cable ground-fault accident occurs, a state equivalent to the DI signal ON state is observed. From the point of view of safety, setting terminal XB1 should be set to +24 and XB2 be set to 0 V, where possible, so that 0 V is applied to DICOM0.

The setting terminals are factory-set as follows:

Setting terminal XB1: +24
Setting terminal XB2: 0V

< Output signal (DO) circuit diagram >



Basic module: Yn = 228
Expansion module 1: Yn = 230
Expansion module 2: Yn = 232
Expansion module 3: Yn = 234

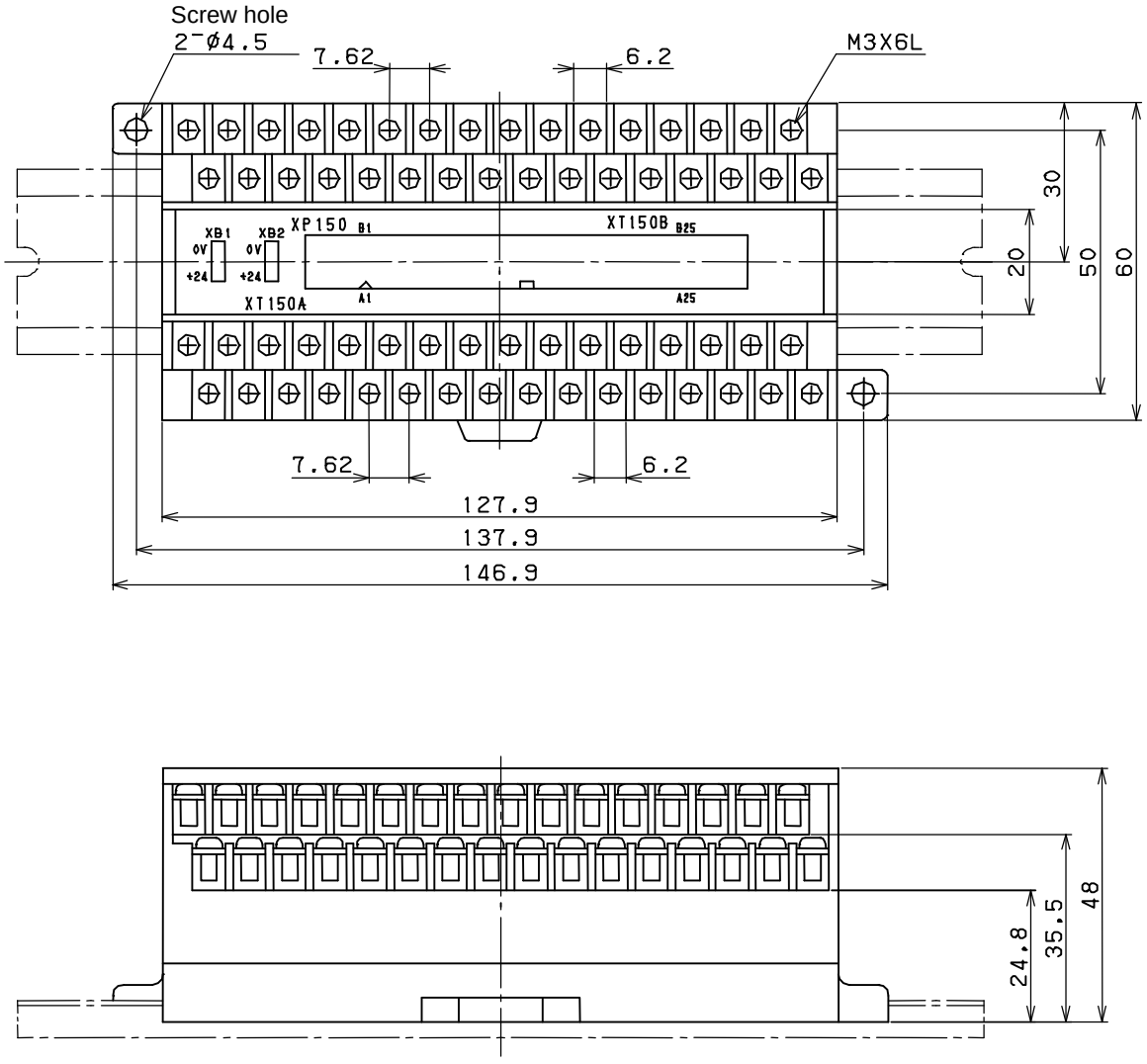
14.10.3 Specifications

14.10.3.1 Ordering information

	Name	Specification	Remarks
(1)	Terminal module A	A03B-0815-C020	

14.10.3.2 Outside dimensions

The terminal module can be mounted by using screws or mounted on a DIN rail.



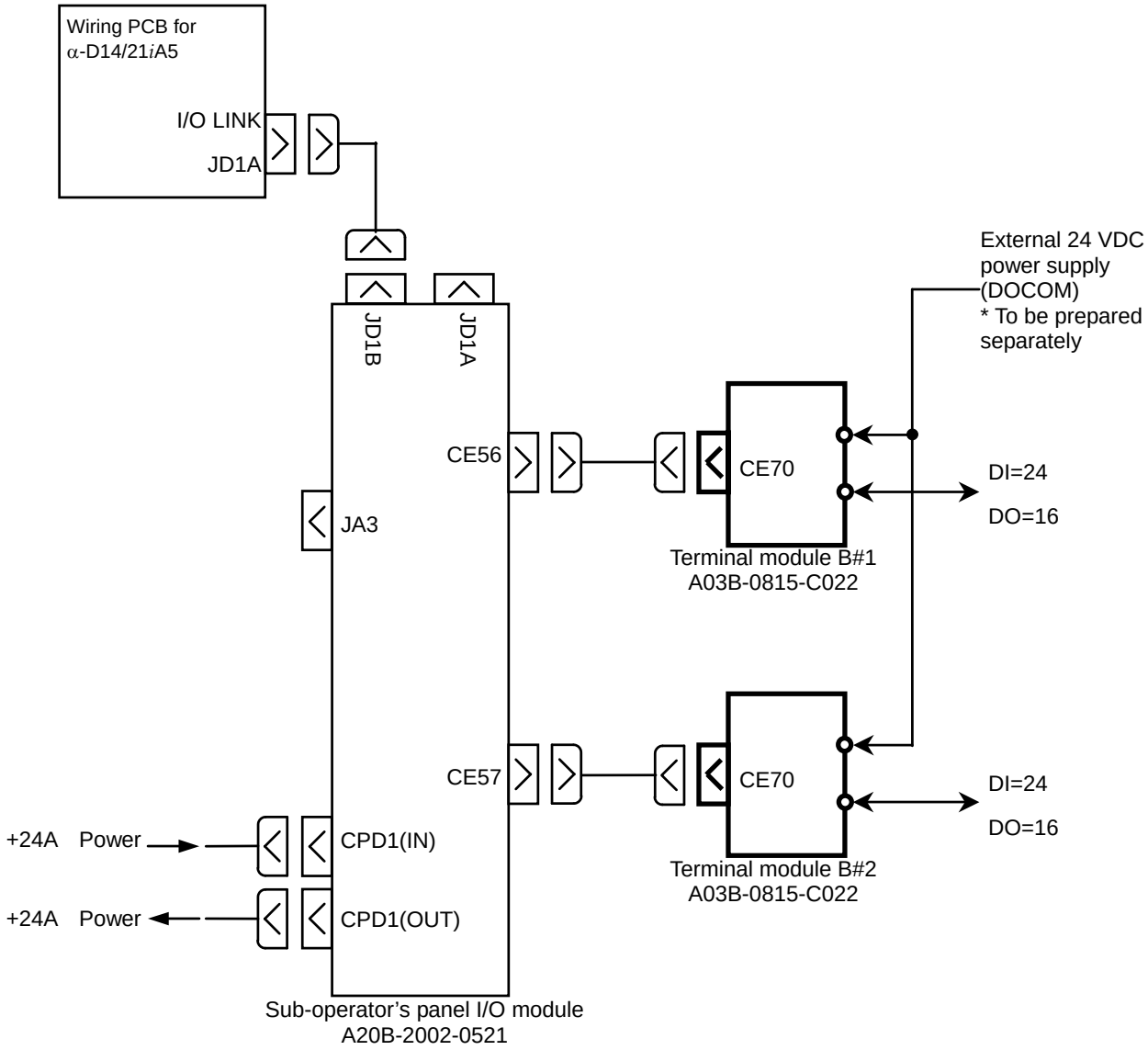
(Unit: mm)

14.11 TERMINAL MODULE B

14.11.1 Overview

The terminal module B, connected via an operator's panel I/O module and a cable, allows input/output signals (24 DI signals and 16 DO signals) of the machine to be relayed through a terminal block.
Signals can be expanded to up to 48 DI signals and 32 DO signals.

14.11.2 Connection



* Connect the 24 VDC external power supply to #1 or #2. It need not be connected to both #1 and #2.

Pin layout in terminal module B#1 [CE56 to CE70 connection]

CE70 (HIROSE HIF3CB-50PA-2.54DSA)

A1	0V	B1	+24A
A2	X240.0	B2	X240.1
A3	X240.2	B3	X240.3
A4	X240.4	B4	X240.5
A5	X240.6	B5	X240.7
A6	X241.0	B6	X241.1
A7	X241.2	B7	X241.3
A8	X241.4	B8	X241.5
A9	X241.6	B9	X241.7
A10	X242.0	B10	X242.1
A11	X242.2	B11	X242.3
A12	X242.4	B12	X242.5
A13	X242.6	B13	X242.7
A14	DICOM0	B14	
A15		B15	
A16	Y240.0	B16	Y240.1
A17	Y240.2	B17	Y240.3
A18	Y240.4	B18	Y240.5
A19	Y240.6	B19	Y240.7
A20	Y241.0	B20	Y241.1
A21	Y241.2	B21	Y241.3
A22	Y241.4	B22	Y241.5
A23	Y241.6	B23	Y241.7
A24	DOCOM	B24	DOCOM
A25	DOCOM	B25	DOCOM

XT70A (YOSHIDA PX7-32A)

1	0V	17	0V
2	DICOM	18	DICOM
3	X240.2	19	X240.0
4	X240.3	20	X240.1
5	DICOM	21	DICOM
6	X240.6	22	X240.4
7	X240.7	23	X240.5
8	+24A	24	+24A
9	X241.2	25	X241.0
10	X241.3	26	X241.1
11	+24A	27	+24A
12	X241.6	28	X241.4
13	X241.7	29	X241.5
14	+24A	30	+24A
15	X242.2	31	X242.0
16	X242.3	32	X242.1

XT70B (YOSHIDA PX7-32A)

1	+24A	17	+24A
2	X242.6	18	X242.4
3	X242.7	19	X242.5
4	0V	20	0V
5	Y240.2	21	Y240.0
6	Y240.3	22	Y240.1
7	0V	23	0V
8	Y240.6	24	Y240.4
9	Y240.7	25	Y240.5
10	0V	26	0V
11	Y241.2	27	Y241.0
12	Y241.3	28	Y241.1
13	0V	29	0V
14	Y241.6	30	Y241.4
15	Y241.7	31	Y241.5
16	0V	32	DOCOM

Pin layout in terminal module B#2 [CE57 to CE70 connection]

CE70 (HIROSE HIF3CB-50PA-2.54DSA)

A1	0V	B1	+24A
A2	X243.0	B2	X243.1
A3	X243.2	B3	X243.3
A4	X243.4	B4	X243.5
A5	X243.6	B5	X243.7
A6	X244.0	B6	X244.1
A7	X244.2	B7	X244.3
A8	X244.4	B8	X244.5
A9	X244.6	B9	X244.7
A10	X245.0	B10	X245.1
A11	X245.2	B11	X245.3
A12	X245.4	B12	X245.5
A13	X245.6	B13	X245.7
A14		B14	DICOM5
A15		B15	
A16	Y242.0	B16	Y242.1
A17	Y242.2	B17	Y242.3
A18	Y242.4	B18	Y242.5
A19	Y242.6	B19	Y242.7
A20	Y243.0	B20	Y243.1
A21	Y243.2	B21	Y243.3
A22	Y243.4	B22	Y243.5
A23	Y243.6	B23	Y243.7
A24	DOCOM	B24	DOCOM
A25	DOCOM	B25	DOCOM

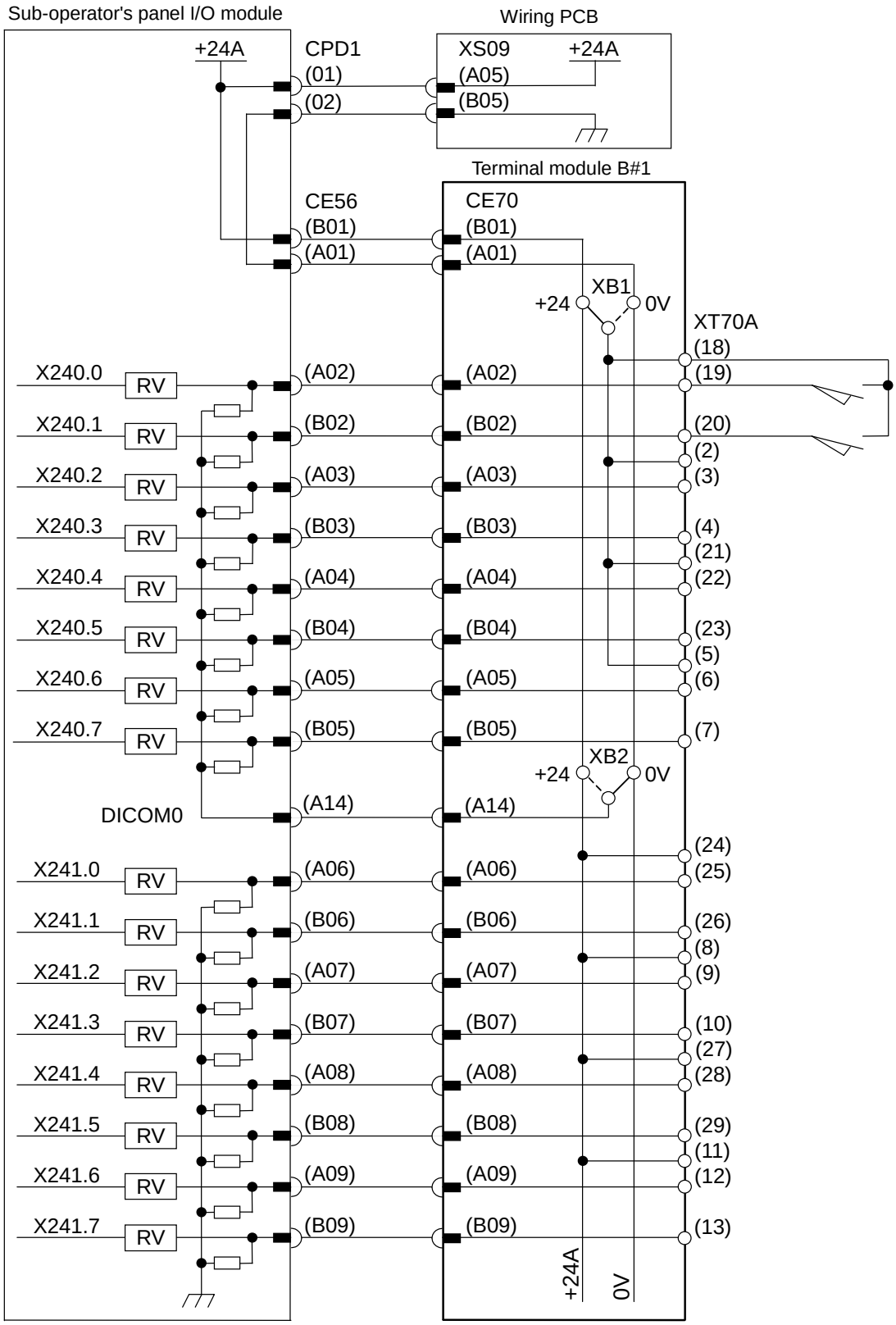
XT70A (YOSHIDA PX7-32A)

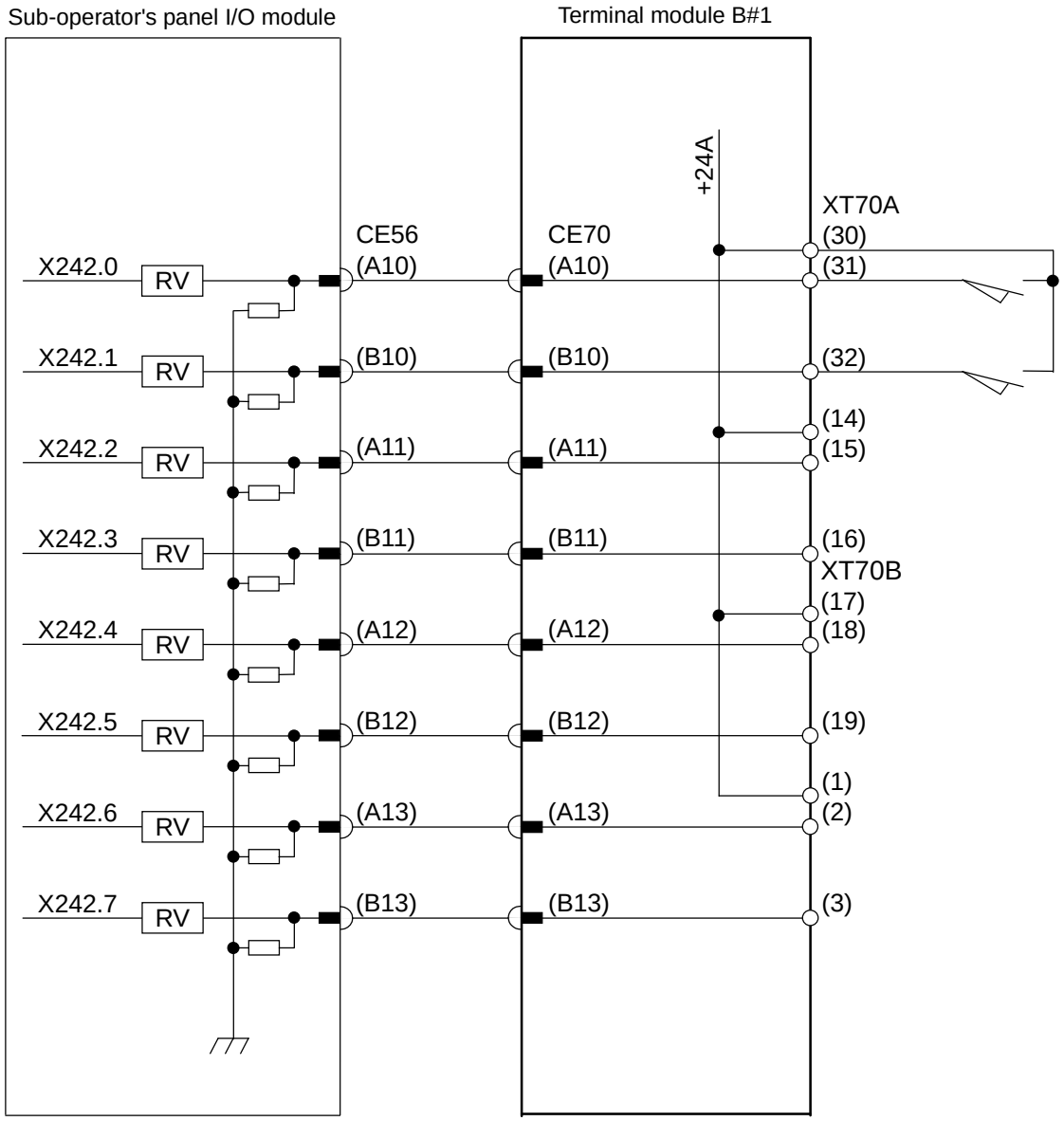
1	0V	17	0V
2	DICOM	18	DICOM
3	X243.2	19	X243.0
4	X243.3	20	X243.1
5	DICOM	21	DICOM
6	X243.6	22	X243.4
7	X243.7	23	X243.5
8	+24A	24	+24A
9	X244.2	25	X244.0
10	X244.3	26	X244.1
11	+24A	27	+24A
12	X244.6	28	X244.4
13	X244.7	29	X244.5
14	+24A	30	+24A
15	X245.2	31	X245.0
16	X245.3	32	X245.1

XT70B (YOSHIDA PX7-32A)

1	+24A	17	+24A
2	X245.6	18	X245.4
3	X245.7	19	X245.5
4	0V	20	0V
5	Y242.2	21	Y242.0
6	Y242.3	22	Y242.1
7	0V	23	0V
8	Y242.6	24	Y242.4
9	Y242.7	25	Y242.5
10	0V	26	0V
11	Y243.2	27	Y243.0
12	Y243.3	28	Y243.1
13	0V	29	0V
14	Y243.6	30	Y243.4
15	Y243.7	31	Y243.5
16	0V	32	DOCOM

<Input signal (DI) circuit diagram> [CE56 to CE70 connection]

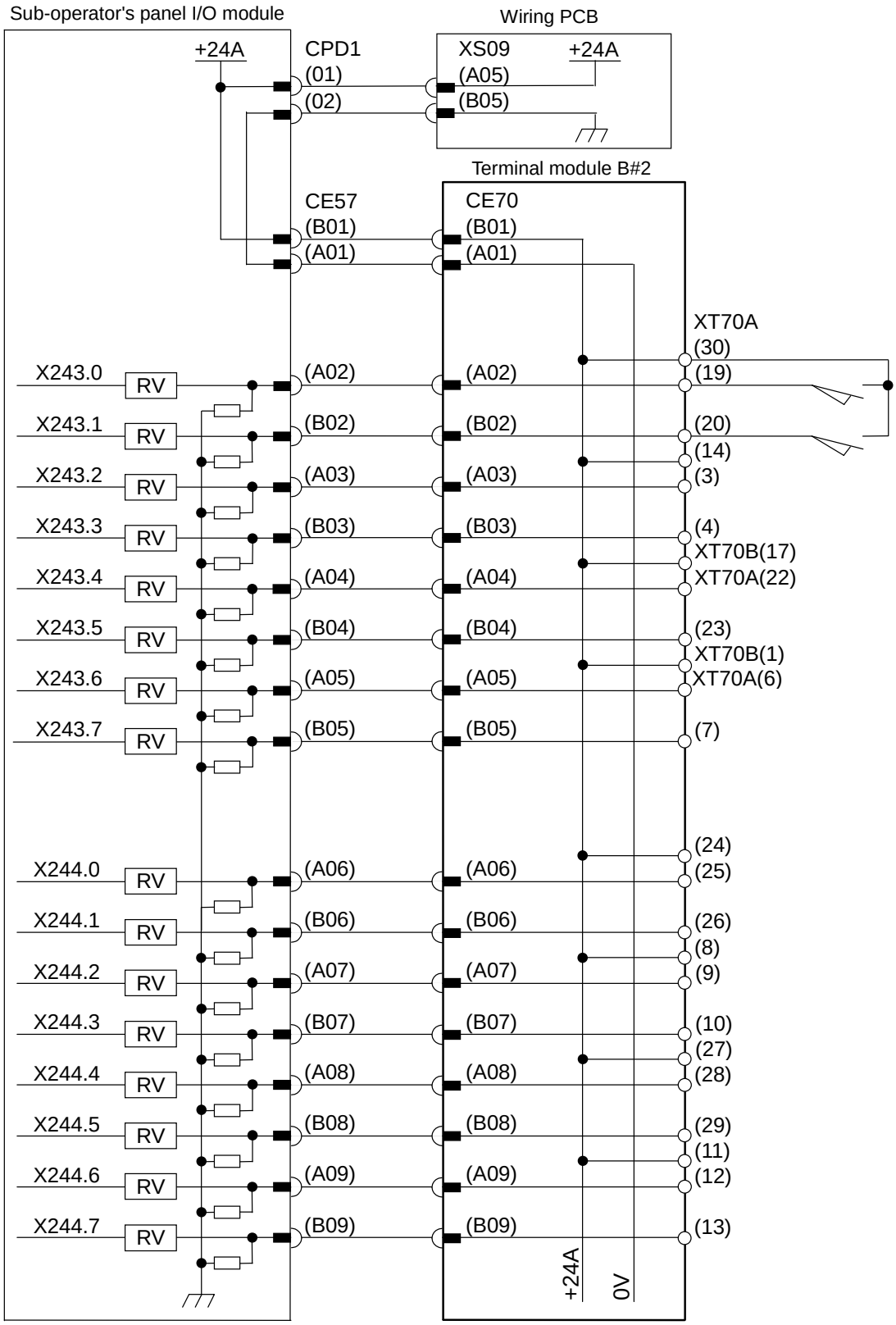


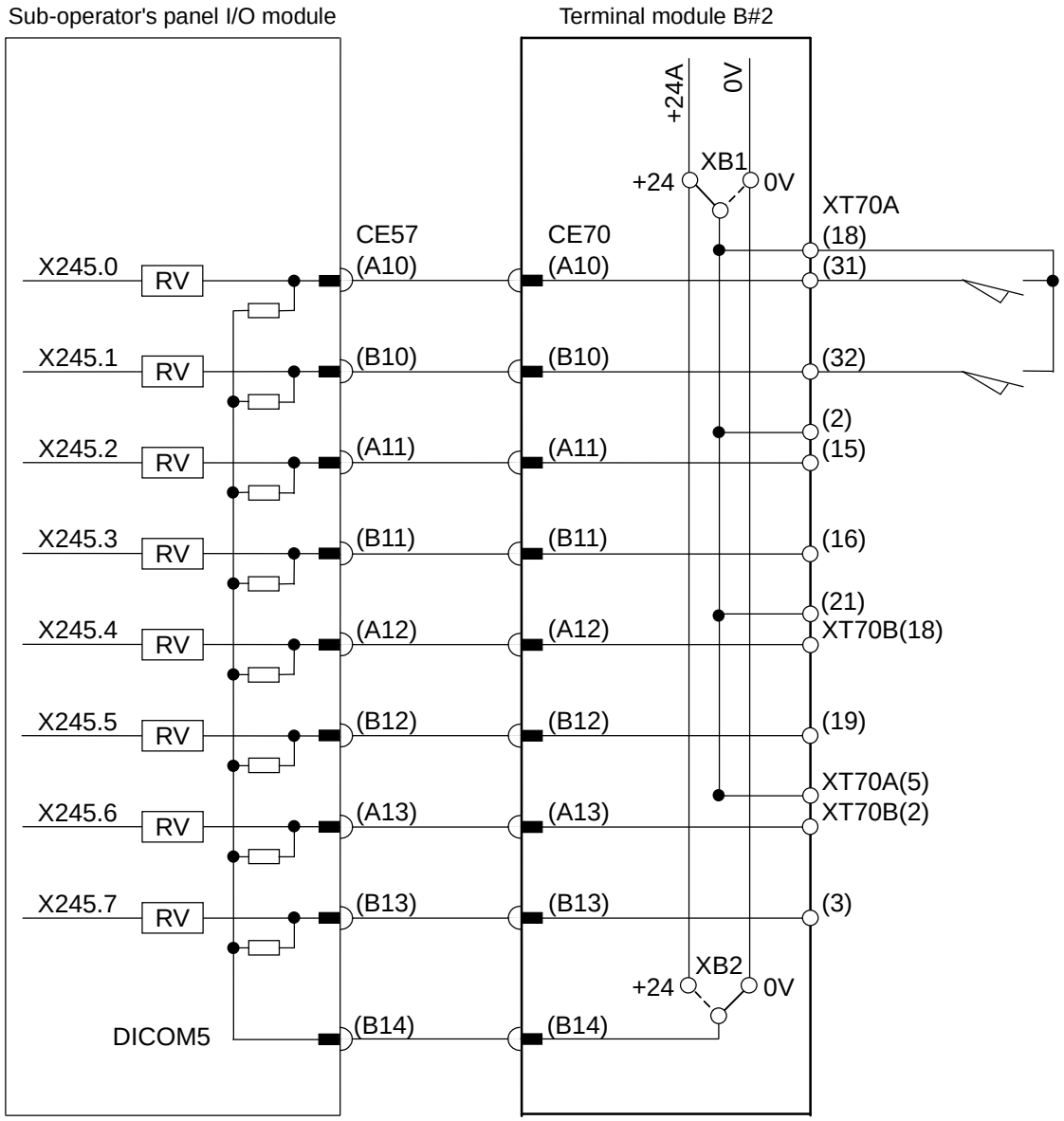


NOTE

X240#0 to X240#7 are DI pins that allows common signal selection. Specifically, when setting terminal XB1 is set to 0 V and setting terminal XB2 is set to +24, and DICOM is connected to +24 V, DI signals with logic inverted can be input. In this case, if a cable ground-fault accident occurs, a state equivalent to the DI signal ON state is observed. From the point of view of safety, setting terminal XB1 should be set to +24 and XB2 be set to 0 V, where possible, so that 0 V is applied to DICOM.

<Input signal (DI) circuit diagram> [CE57 to CE70 connection]



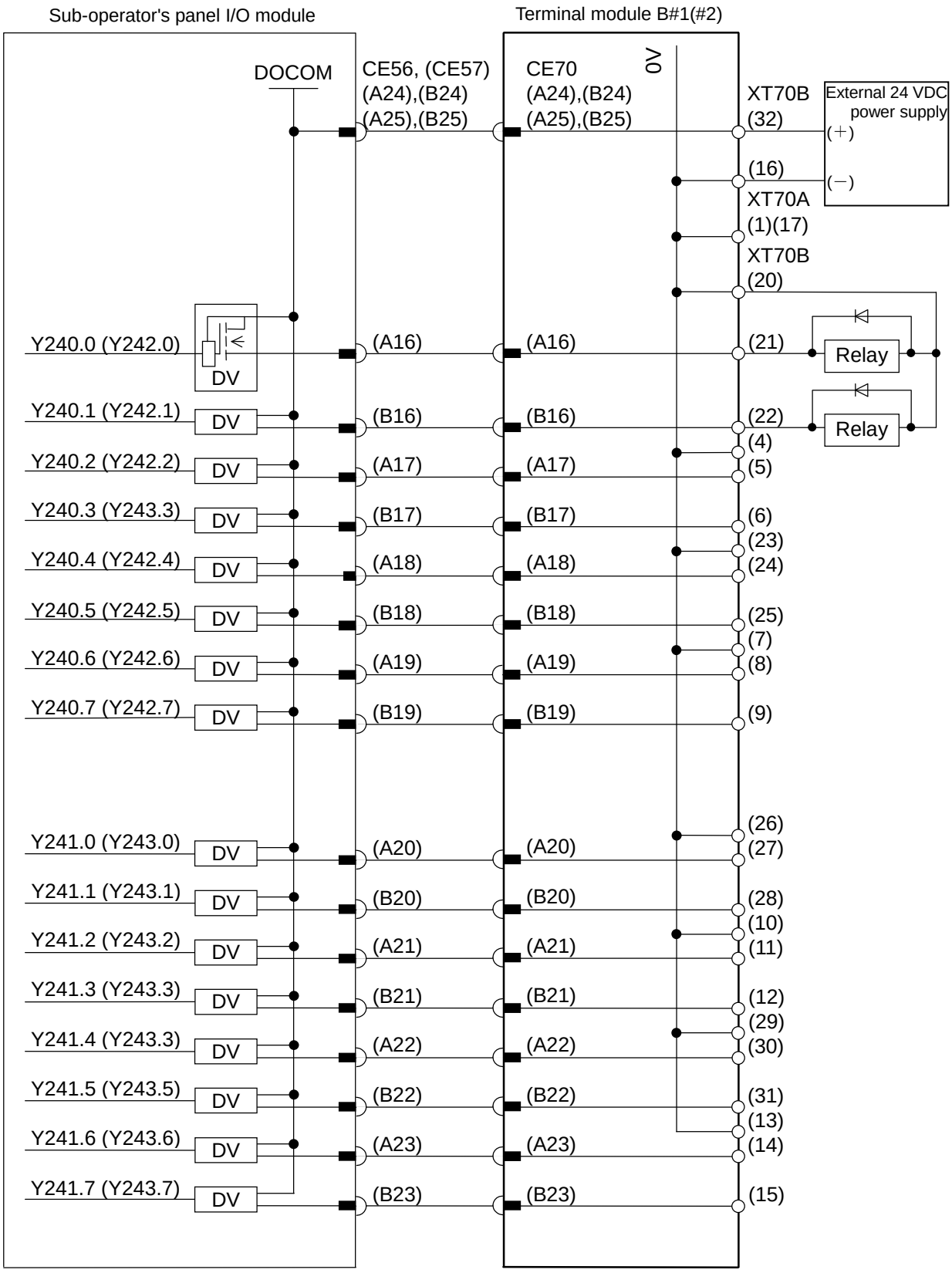


NOTE

X245#0 to X245#7 are DI pins that allows common signal selection. Specifically, when setting terminal XB1 is set to 0 V and setting terminal XB2 is set to +24, and DICOM is connected to +24 V, DI signals with logic inverted can be input. In this case, if a cable ground-fault accident occurs, a state equivalent to the DI signal ON state is observed. From the point of view of safety, setting terminal XB1 should be set to +24 and XB2 be set to 0 V, where possible, so that 0 V is applied to DICOM.

<Output signal (DO) circuit diagram>

#2 address enclosed in ()



* Connect the 24 VDC external power supply to #1 or #2. It need not be connected to both #1 and #2.

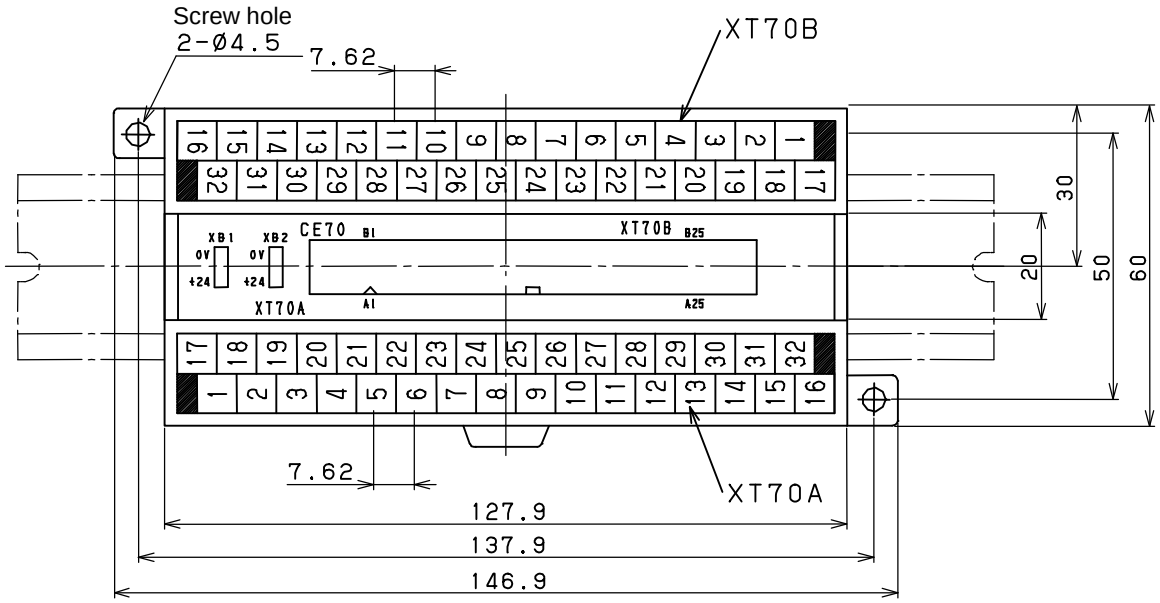
14.11.3 Specifications

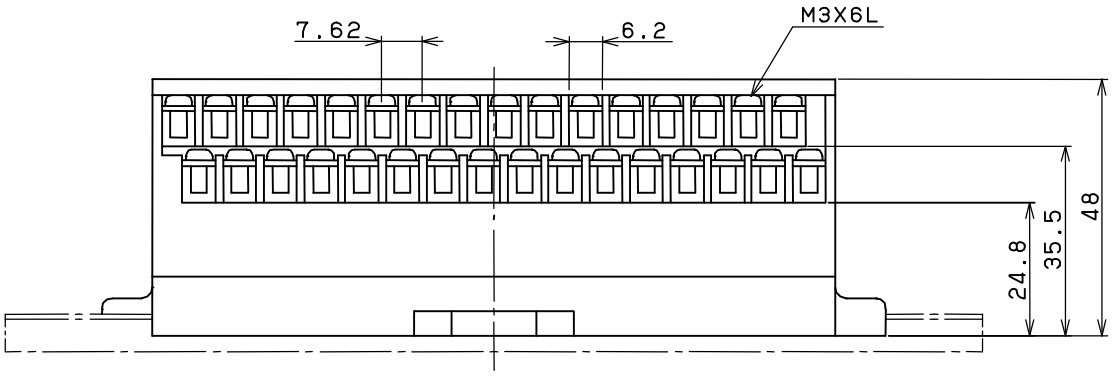
14.11.3.1 Ordering information

	Name	Specification	Remarks
(1)	Terminal module B	A03B-0815-C022	

14.11.3.2 Outside dimensions

The terminal module B can be mounted by using screws or mounted on a DIN rail.





(Unit: mm)

15 AI THERMAL DISPLACEMENT COMPENSATION FUNCTION

15.1 OVERVIEW

The AI thermal displacement compensation function estimates the amounts of thermal displacements in the X-, Y-, and Z-axis directions that are generated by the motion of the machine and compensates the displacements without using sensors.
Generally, after the machine starts motion, the X-, Y-, and Z-axes are extending along these axes and they become stable after two or three hours. Conventionally, for machining requiring a high precision, dry running is performed before start of machining to cancel the extension and machining is started when the axes become stable. With this function, machining can be started without dry run.

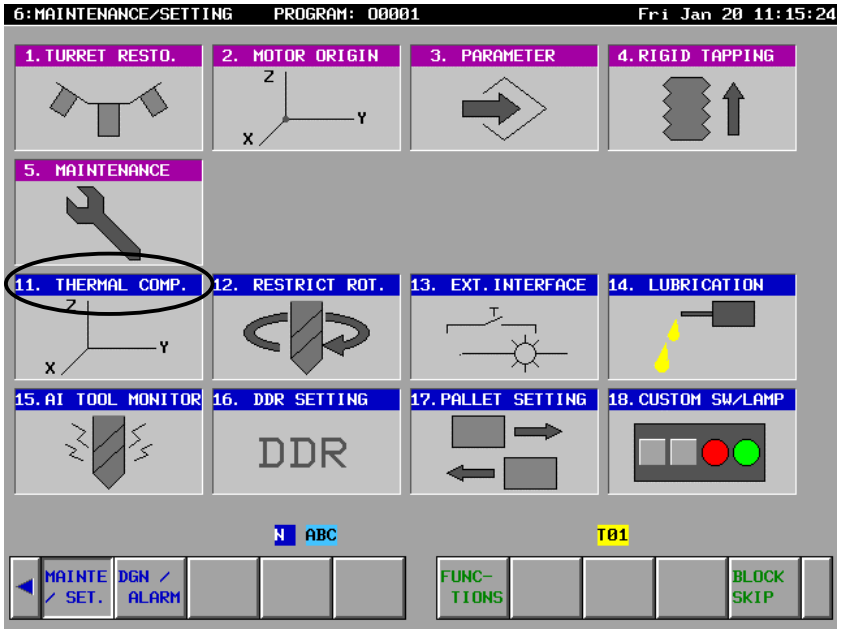
SUPPLEMENT

- Displacement may not be able to be precisely compensated depending on the use conditions and environment.
- When thermal displacement is small, do not use this function; use of this function may make the axis state more unstable.
- This function cannot compensate any displacement that is not generated by the motion of the machine, such as the displacement due to a worn tool.
- The items displayed on the screen and functions may differ depending on the software edition.

Using this function does not require any special settings; simply enable (turn ON) the function on the operation screen.
A function for adjusting the effect of compensation is also provided.

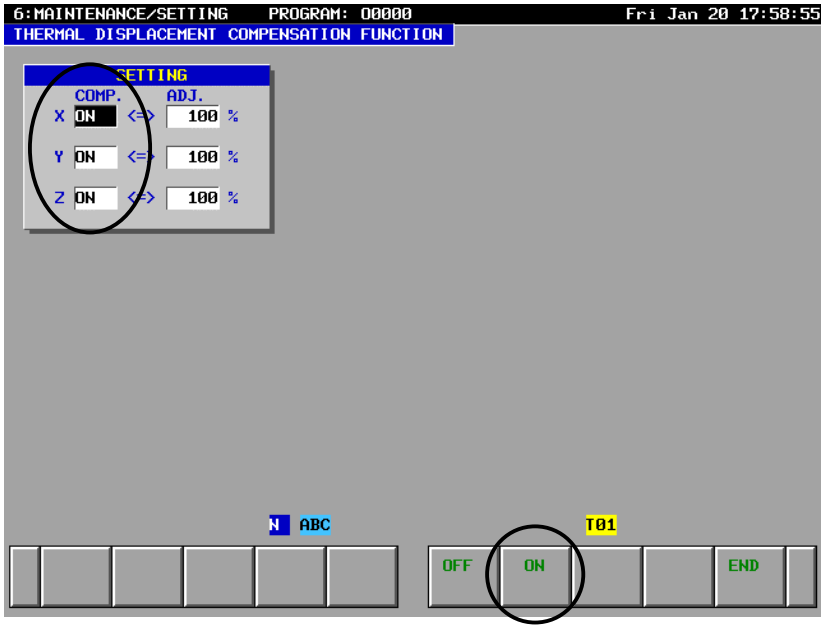
15.2 Compensation Method

(1) Display QUICK screen "6: MAINTENANCE/SETTING".



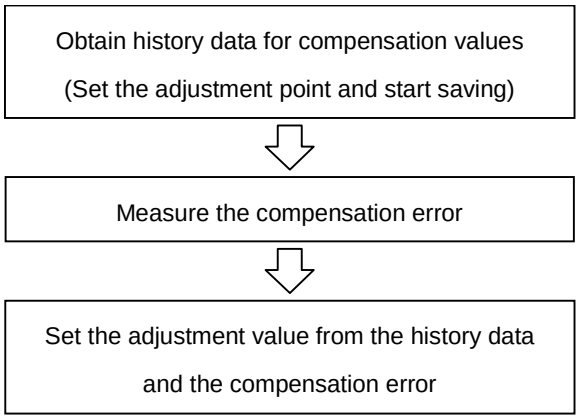
(2) Key in <1>,<1> and <INPUT> to display the "11. THERMAL COMP." screen.

(3) For each axis, specify whether to enable or disable the thermal displacement compensation function. Position the cursor to the "COMP." field for the desired axis in the "SETTING" window, and press the soft key [ON]. This causes the thermal displacement compensation function to be enabled for the axis set to ON.



15.3 Adjustment

This function estimates the amounts of thermal displacements based on the operating state of the machine, using the software, without using sensors, and performs compensation.
If the compensation value (the amount of a thermal displacement estimated with the software) differs from the amount of an actual thermal displacement, the compensation value can be adjusted to reduce the difference (compensation error). The adjustment value is set in accordance with history data for compensation values obtained when machining was actually performed and the compensation error.
A simple diagram of the adjustment flow is shown below.

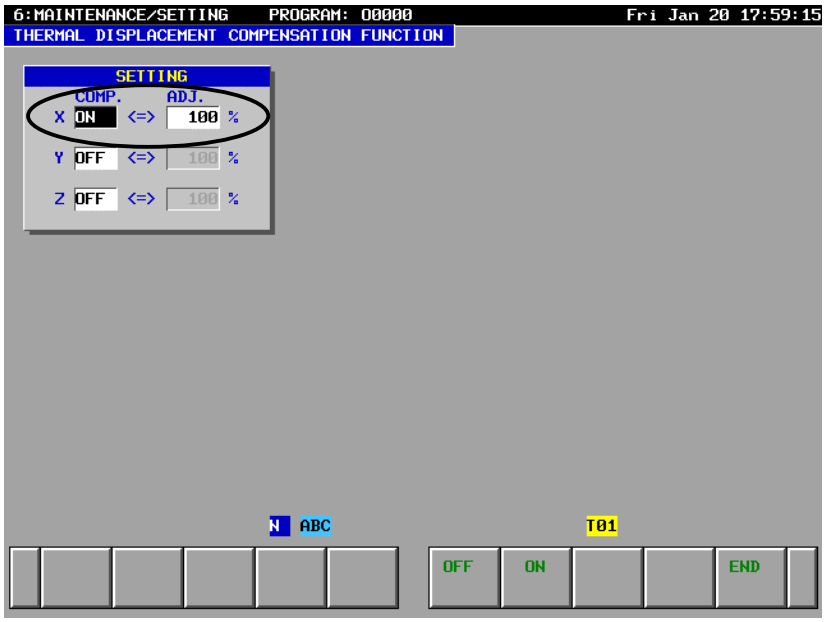


For each model, the following initial values are set for the adjustment value and the adjustment point (point at which a history of compensation values is to be saved).

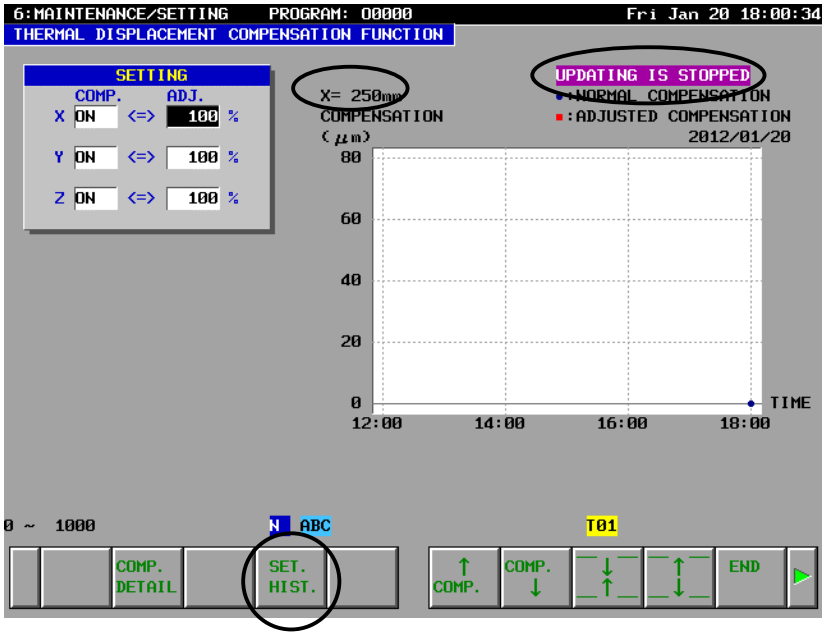
Model	Adjustment value (%) (same for X, Y, and Z)	Adjustment point (X, Y, Z) (mm)
α-D14/21S*i*A5	100	(150, -150, -250)
α-D14/21M*i*A5	100	(250, -200, -250)
α-D14/21L*i*A5	100	(350, -200, -250)

15.3.1 Setting the adjustment point

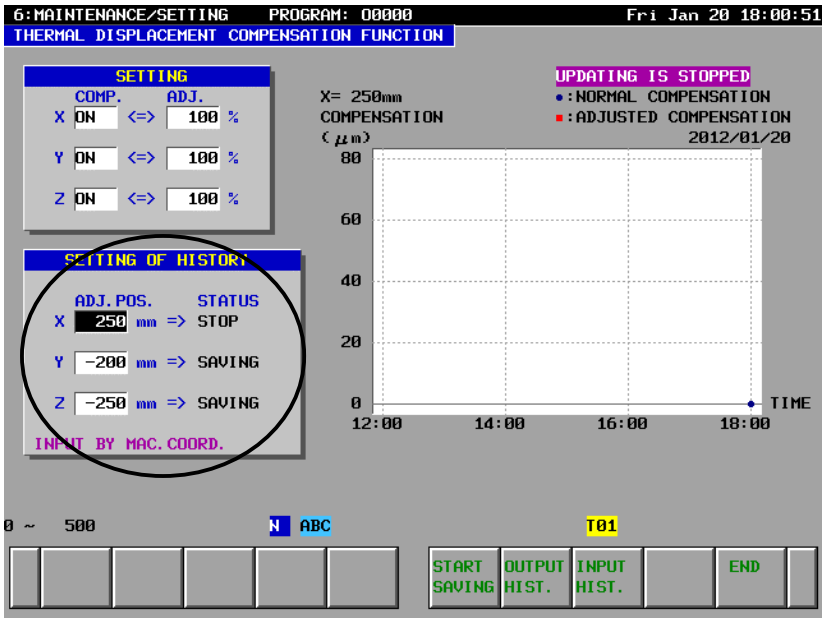
(1) Set the position (adjustment point) at which a history of compensation values is to be saved. Set the "COMP." field for the desired axis in the "SETTING" window to ON, and the "ADJ." field for that axis will change from gray to white, enabling the cursor to move to this field.



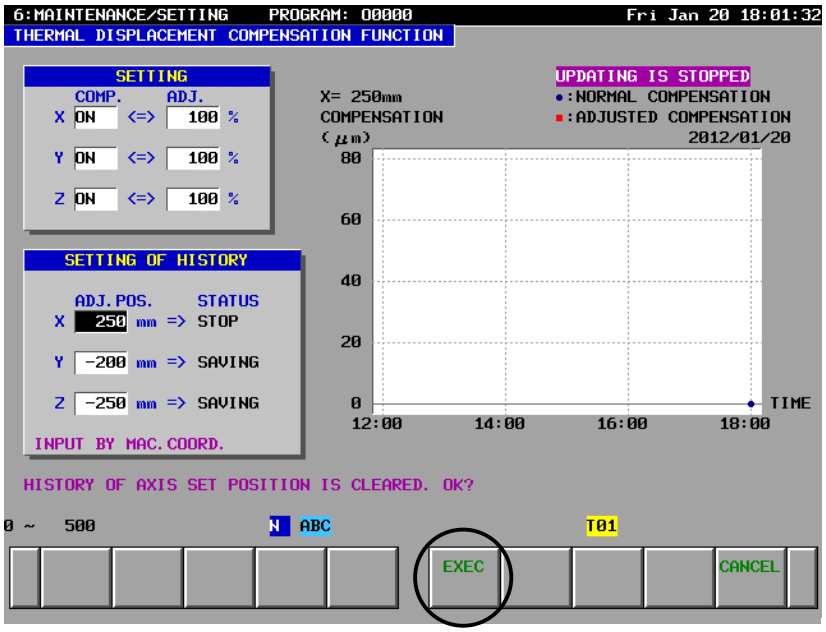
(2) Move the cursor to that "ADJ." field in the "SETTING" window, and a graph such as the one below appears on the screen. Above the upper left corner of the graph are displayed the currently selected axis and the coordinate of the adjustment point, and above the upper right corner is displayed the state of the currently displayed history data.



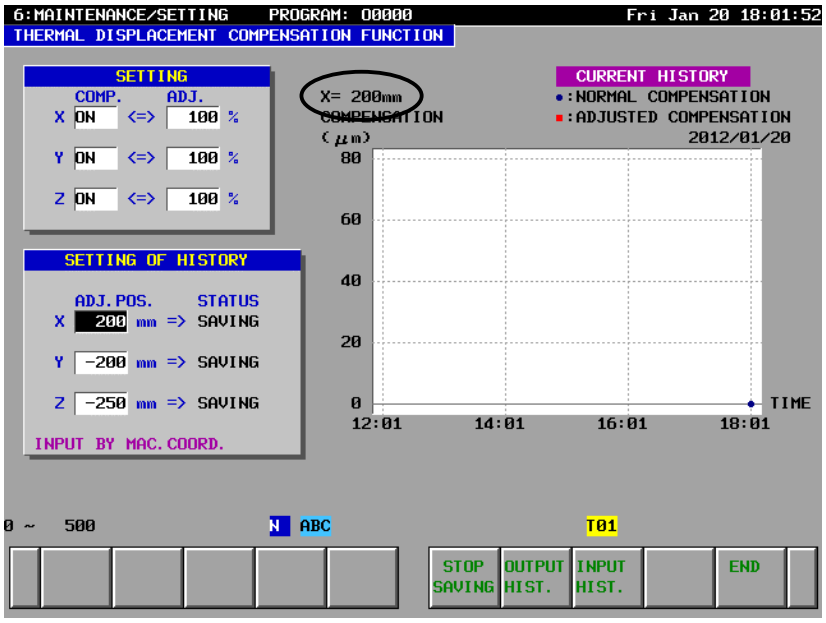
(3) Press the soft key [SET. HIST.], and the "SETTING OF HISTORY" window will appear.



(4) Move the cursor to the field for the axis for which the adjustment point is to be changed, and enter the machine coordinate of the position to be set as the adjustment point. Check the message that appears, and if it is OK, press the soft key [EXEC] or the <INPUT> key on the operator's panel. The adjustment point will be changed, and the existing history data for that axis will be erased.



(5) After the setting, check that the coordinate of the adjustment point displayed above the upper left corner of the graph has been changed to the new value.

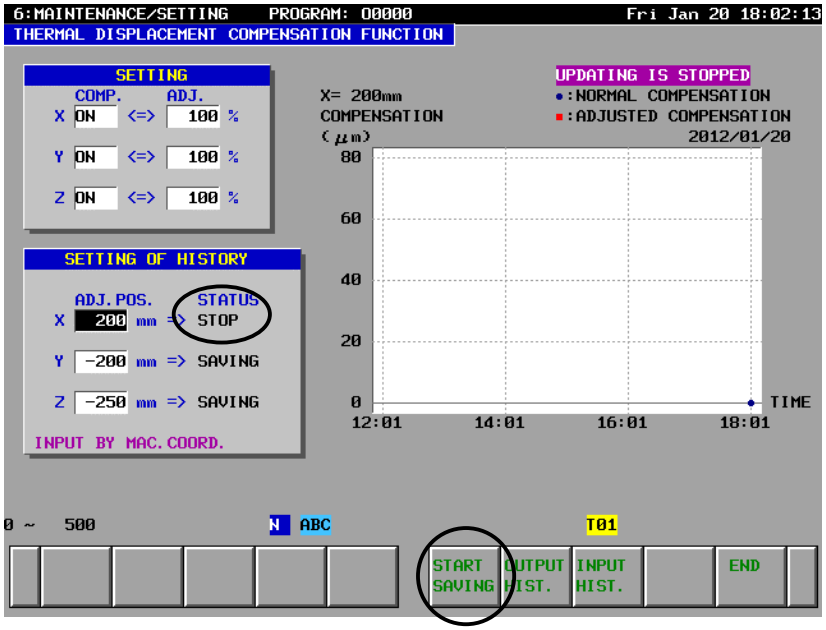


SUPPLEMENT

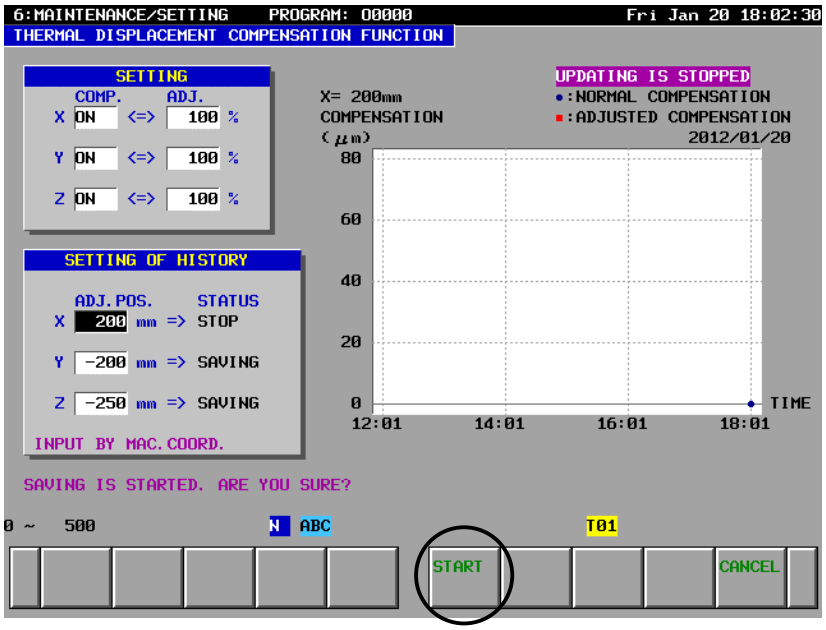
- History data is used as the basis for adjustment. For each model, initial values are set for the adjustment point as described earlier. If required, change the position to a position where precision is required or a position where the workpiece dimensions after machining can be measured.

15.3.2 Starting the saving of history data for compensation values

(1) If "STOP" is displayed in the "STATUS" field for an axis in the "SETTING OF HISTORY" window, no history data will be saved for that axis. Position the cursor on the field for that axis in the "SETTING OF HISTORY" window, and press the soft key [START SAVING].



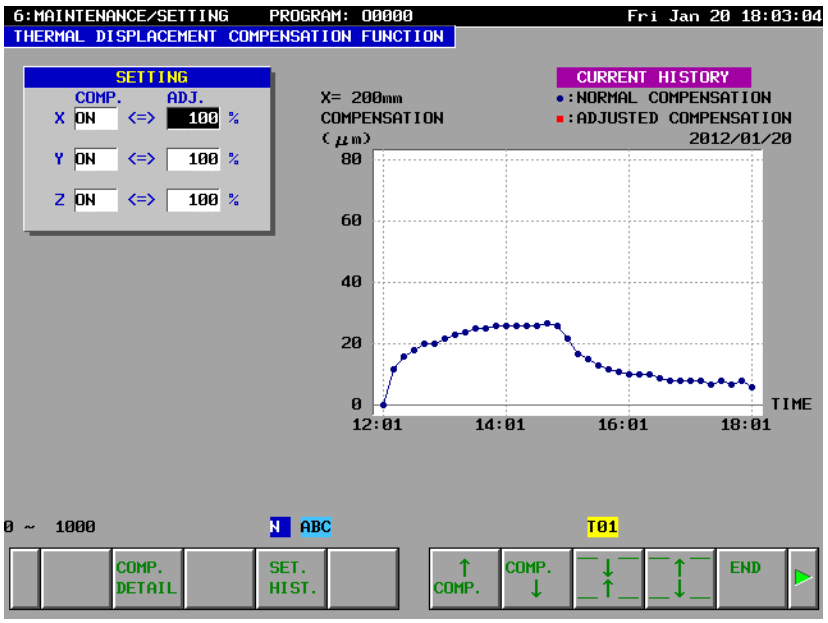
(2) Check the message that appears, and if it is OK, press the soft key [START]. "SAVING" will be displayed in the STATUS field for the selected axis, and the updating of history will be started. After the setting, press the soft key [END] to close the "SETTING OF HISTORY" window.



SUPPLEMENT

- If the adjustment point is changed while the saving of history is stopped, the saving of history will be automatically started.

(3) After the completion of the above settings, actually perform machining after checking that the adjustment value is at 100%. History data for compensation values at the adjustment point that has been set will be saved after every ten minutes, for 24 hours, and will be displayed on the graph.



SUPPLEMENT

- History data is constantly updated regardless of whether the power is ON or OFF. If necessary, stop the saving as described later in "Stopping the saving of history data" and output history data to a memory card as described in "Outputting history data to a memory card".
- If the history data memory is full, history data will be deleted starting with the oldest data to keep saving the latest 24-hour history data.

15.3.3 Setting the adjustment value

Based on history data for compensation values obtained as described in the previous subsection, set the adjustment value in the "ADJ." field for the desired axis in the "SETTING" window.

(1) Measure the workpiece dimensions corresponding to the position specified as the adjustment point, make a note of the compensation error (shift amount of machining when the machining was performed with the thermal displacement compensation function being enabled) and the time at which machining was performed at the adjustment point. Also, by referring to the table below, judge the effect of compensation (insufficient compensation (the compensation value being less than the amount of an actual thermal displacement) or excessive compensation (the compensation value being greater than the amount of an actual thermal displacement)).

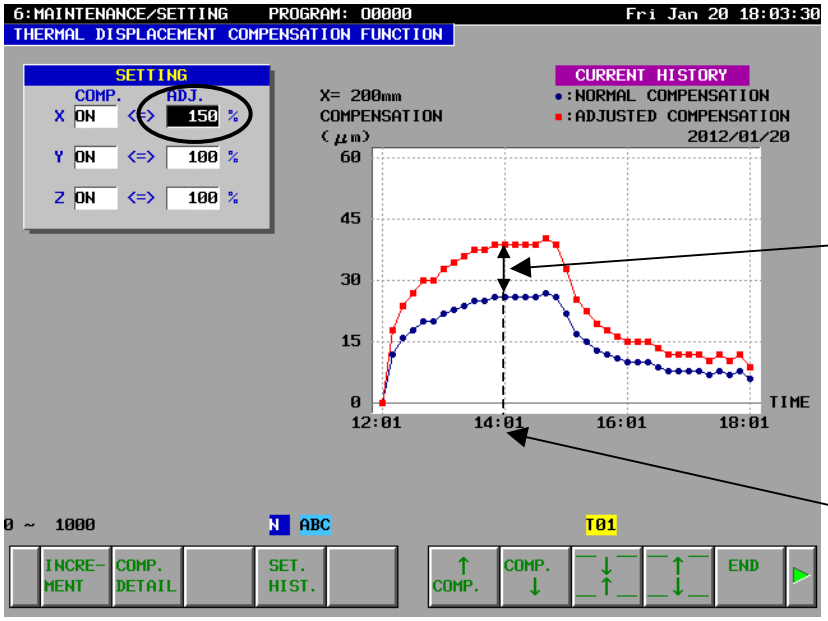
	If machining shifts in the negative (-) direction in relation to the coordinate system	**If machining shifts in the positive (+) direction in relation to the coordinate system coordinate system**
X-axis	Insufficient compensation	Excessive compensation
Y-axis (if the compensation value at the time machining was performed at the adjustment point is positive (+))	Excessive compensation	Insufficient compensation
Y-axis (if the compensation value at the time machining was performed at the adjustment point is negative (-))	Insufficient compensation	Excessive compensation
Z-axis	Insufficient compensation	Excessive compensation

(2) Move the cursor to the "ADJ." field for the axis for which an adjustment is to be made, and enter the adjustment value, and the compensation value will decrease or increase in accordance with the entered value. (If a value greater than 100% is entered, the compensation value will increase, and if a value less than 100% is entered, the compensation value will decrease.) If, at this time, history data has been obtained, the post-adjustment compensation value will be estimated and displayed in red on the graph.

(3) Focusing on the time at which machining was performed at the adjustment point, set the adjustment value so that the increment in adjustment-time compensation value (difference between the normal compensation value (compensation value when the adjustment value is at 100%) and the post-adjustment compensation value) is about the same as the compensation error. For insufficient compensation (the compensation value being less than the amount of an actual thermal displacement), set a large adjustment value, and for excessive compensation (the compensation value being greater than the amount of an actual thermal displacement), set a small adjustment value. (See the table below.)

	For insufficient compensation	For excessive compensation
Adjustment value	Set a value greater than 100%.	Set a value less than 100%.

The following shows an example in which the compensation value is 25 μm and the compensation error is 12 μm.



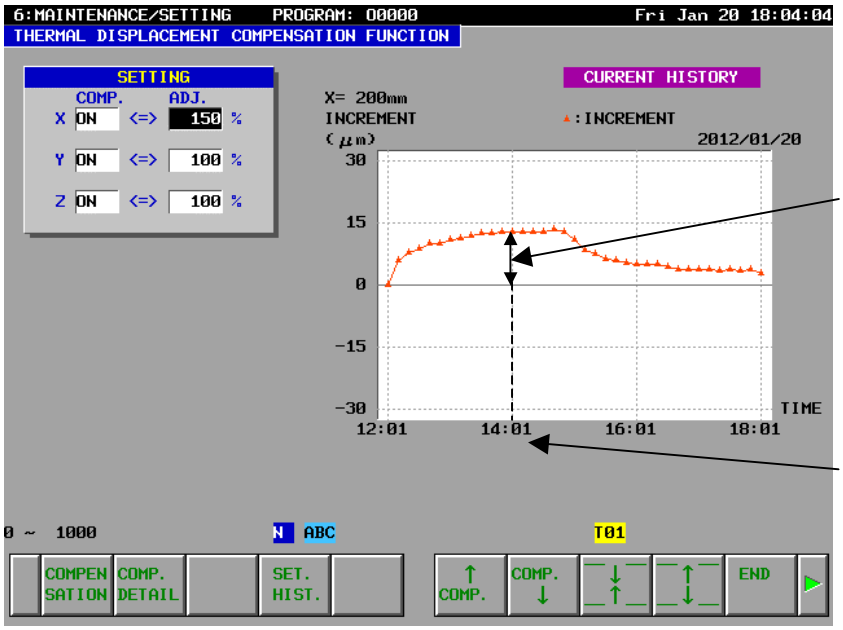
Set the adjustment value so that the increment is about the same as the measured compensation error (12 μm).

Time at which machining was performed at the adjustment point

SUPPLEMENT

- As history data for compensation values (displayed blue on the graph), the normal compensation value (compensation value at the time the adjustment value is at 100%) is always saved regardless of the setting of the adjustment value.

(4) It may be difficult to read off the increment in adjustment-time compensation value, as in the case in which the compensation error is smaller than the compensation value. In such a case, press the soft key [INCRE-MENT] (displayed when a value other than 100% is set as the adjustment value). Instead of "NORMAL COMPENSATION" and "ADJUSTED COMPENSATION", "INCREMENT" (difference between the normal compensation value (compensation value when the adjustment value is at 100%) and the post-adjustment compensation value) is displayed on the graph. Focusing on the time at which machining was performed at the adjustment point, set the adjustment value so that the adjustment-time increment is about the same as the compensation error.
To return to the original graph display, press the soft key [COMPENSATION].



Set the adjustment value so that the increment is about the same as the measured compensation error (12 μm).

Time at which machining was performed at the adjustment point

(5) By performing machining in the state in which the adjustment value has been set as described above, it is possible to perform more accurate thermal displacement compensation.

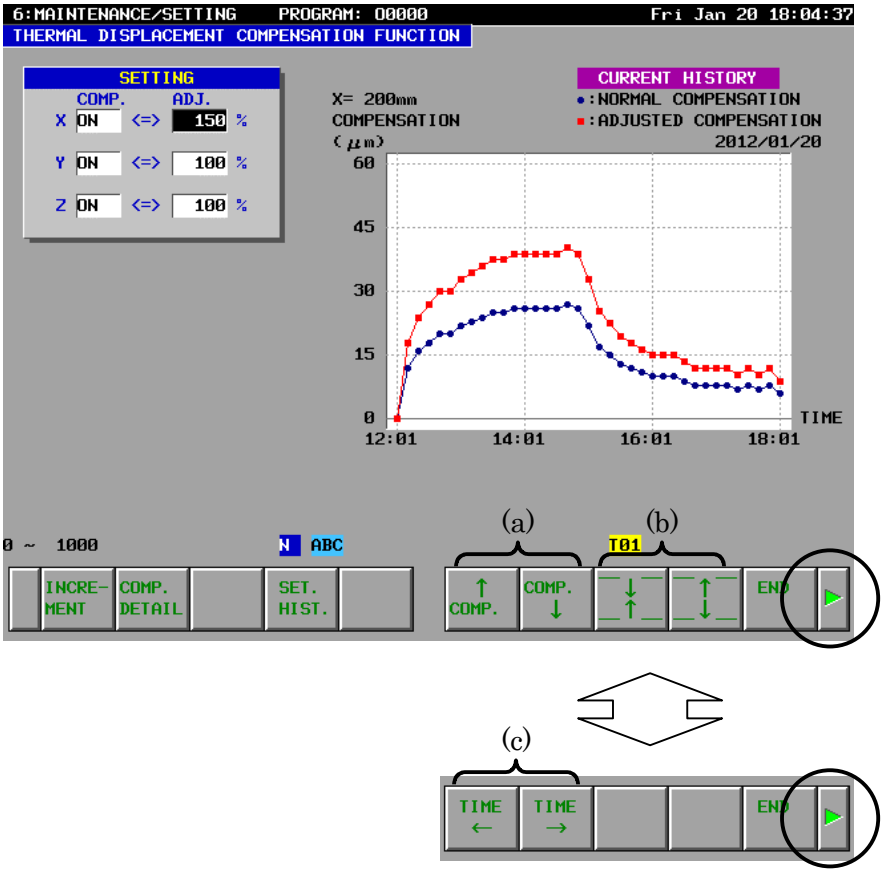
SUPPLEMENT

- Only one adjustment point can be specified for each axis.
- After an adjustment, the compensation error may increase at other than the specified position.

15.4 Changing the Graph Display

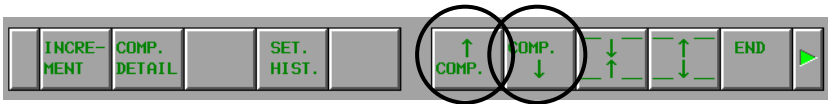
Using the operations described below, it is possible to scroll on the graph (along the vertical and horizontal axes) and to change the scale of the compensation value (vertical axis). It is also possible to display the compensation value at any one time.

(1) Move the cursor to the "ADJ." field for the desired axis, press the rightmost soft key, and the functions of the soft keys on the right half of the screen will change.

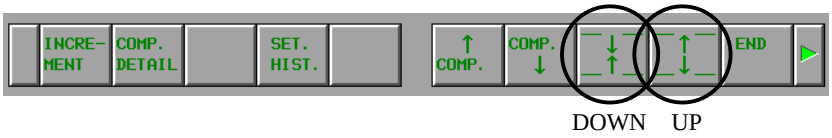


(a) Scroll along the compensation value (vertical axis) ([↑ COMP.] and [COMP. ↓]).
(b) Change the scale of the compensation value (vertical axis) ([DOWN] and [UP]).
(c) Scroll along the time (horizontal axis) ([TIME←] and [TIME→]).

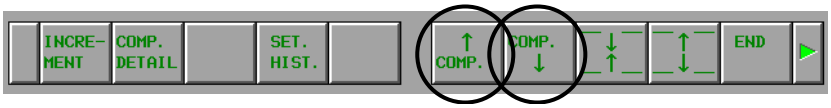
(2) Press the soft keys [↑ COMP.] and [COMP. ↓] to scroll up and down the axis of the compensation value.



Press the soft keys [DOWN] and [UP] to change the scale of the compensation value.

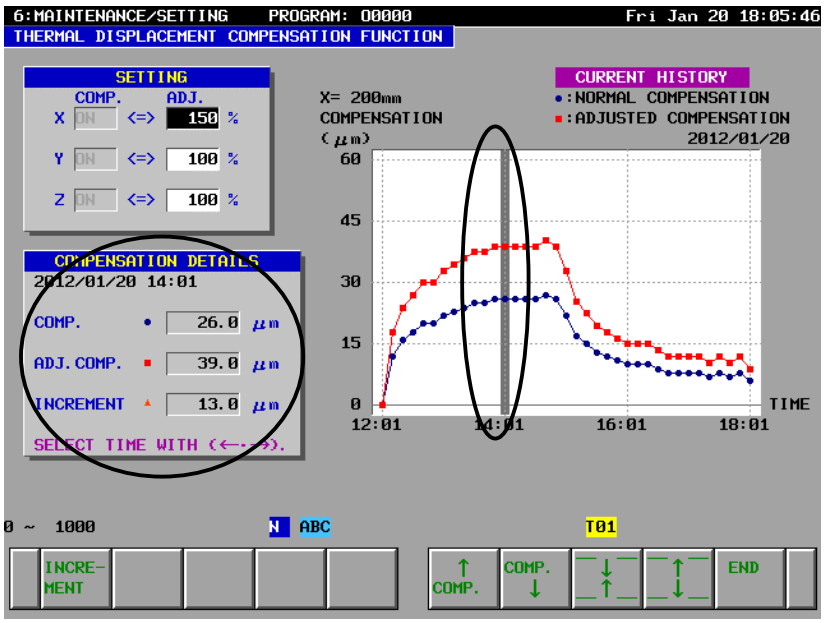


Press the soft keys [TIME←] and [TIME→] to scroll along the time axis.



(2) To display the compensation value, press the soft key [COMP. DETAIL].

The "COMPENSATION DETAILS" window is displayed, and a gray cursor appears on the graph. The "COMPENSATION DETAILS" window shows the "selected time", "compensation value (normal compensation value)" (COMP.), "estimated compensation value (post-adjustment estimated compensation value)" (ADJ. COMP.), and "increment (adjustment-time increment)" (INCREMENT).



Press the cursor keys <←> and <→> to move the cursor to the desired time. Press the cursor keys < ↑ > and < ↓ > to change the axis on which to display the details of the compensation value.

SUPPLEMENT

- Even while the "COMPENSATION DETAILS" window is displayed, the adjustment value can be set.

15.5 History Data Management

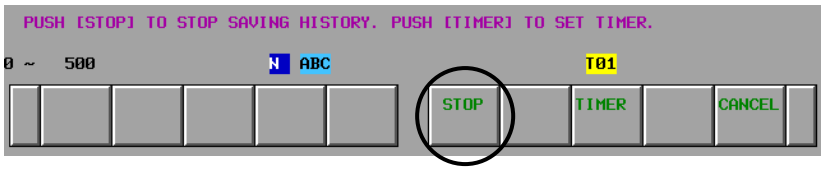
History data for compensation values is constantly updated regardless of whether the power is ON or OFF. If necessary, stop the saving as described later in "Stopping the saving of history data" and output history data to a memory card as described in "Outputting history data to a memory card".

15.5.1 Stopping the saving of history data

It is possible to stop the saving of history data and retain the history data at the time it is stopped. It is also possible to set the time to automatically stop the saving of history data.

(1) Press the soft key [SET. HIST.] to display the "SETTING OF HISTORY" window.

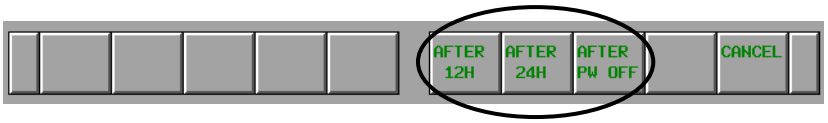
(2) Position the cursor to the field for the axis for which the saving is to be stopped, press the soft key [STOP SAVING], and the screen below will appear. To stop the saving of history data at this time, press the soft key [STOP]. "STOP" will be displayed in the "STATUS" field for that axis in the "SETTING OF HISTORY" window, and history data will be no longer updated.



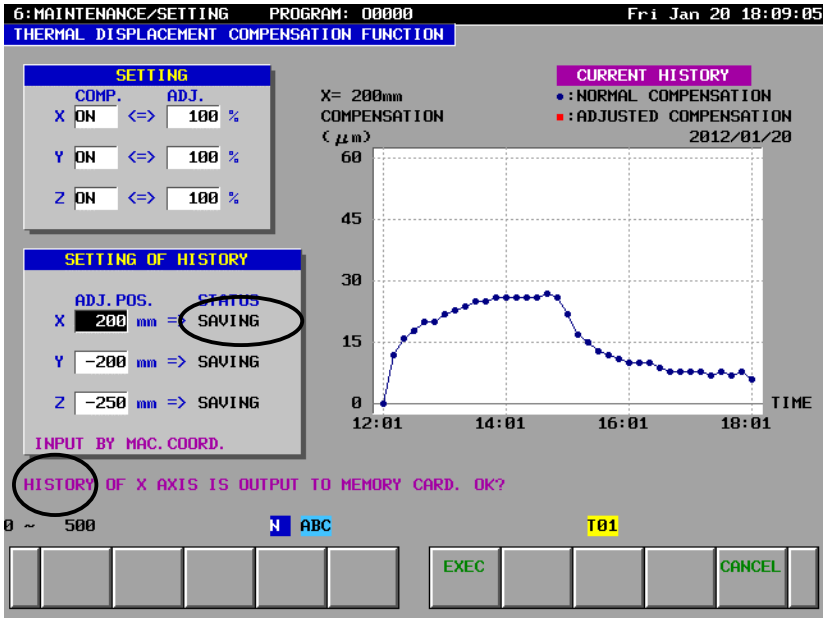
SUPPLEMENT

- Even while the saving of history data is stopped, the adjustment value can be set in the same way as that when it is saved.

(3) To set the timer, press the soft key [TIMER]. The soft keys below will appear. Press either the soft key [AFTER xxH] (where xx is the number of hours after which the saving is to be stopped) or [AFTER PW OFF] (stoppage of the saving when the power is turned OFF). The timer will be set, and after the specified hours have passed or when the power is turned off, the saving of history data will be stopped.



For the axis for which the timer has been set, "SAVING(*)" will appear in the "STATUS" field for that axis in the "SETTING OF HISTORY" window. Position the cursor on the field for that axis to display the number of hours after which the saving of history data will be stopped below the "SETTING OF HISTORY" window.

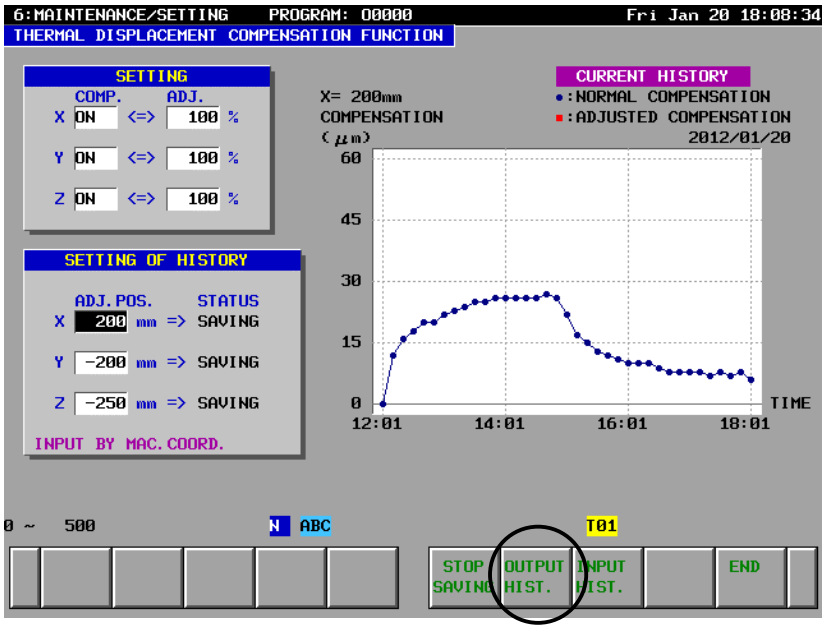


(4) To cancel the timer or set it again, position the cursor on the field for the axis for which the timer has been set, press the soft key [STOP SAVING], and press the soft key [TIMER]. Press the soft key [TIMER CANCEL] to cancel the timer. Press the soft key [AFTER xxH] or [AFTER PW OFF] to set the timer again.

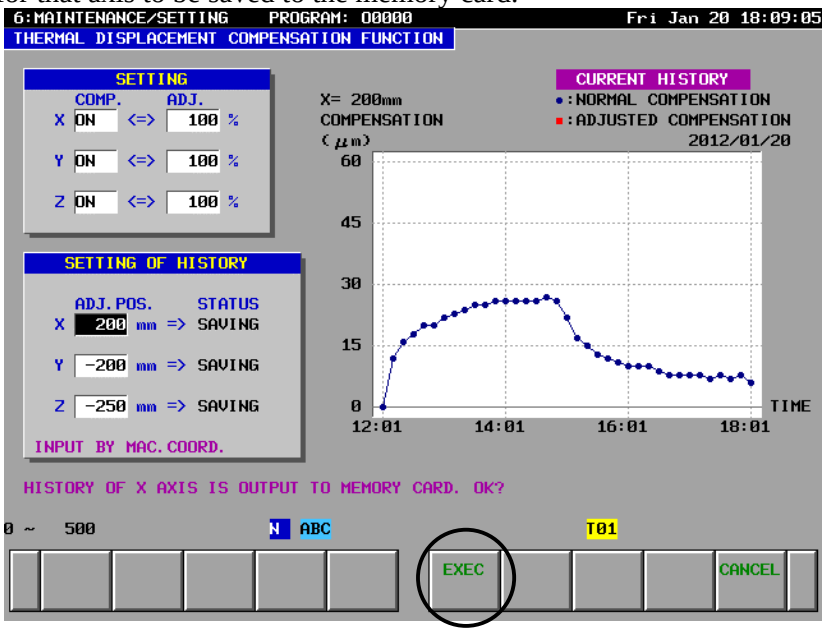
15.5.2 Outputting history data to a memory card

The latest history data for each axis can be saved to a memory card.

(1) First, insert a memory card into the memory card slot on the left side of the screen, and then press the soft key [SET. HIST.] to display the "SETTING OF HISTORY" window.
(2) Move the cursor to the field for the axis for which history data is to be output to the memory card, and press the soft key [OUTPUT HIST.].



(3) Check the message that appears, and if it is OK, press the soft key [EXEC]. This will cause the history data for that axis to be saved to the memory card.



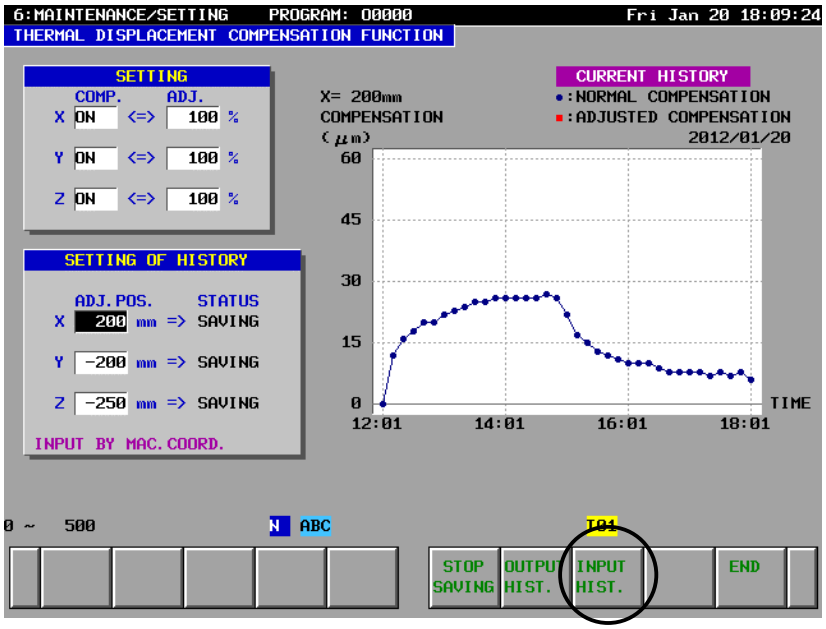
SUPPLEMENT

- The file name of the history data output to a memory card is as follows:
  X-axis: GRPDT_X.CSV
  Y-axis: GRPDT_Y.CSV
  Z-axis: GRPDT_Z.CSV
- If a file with the same file name exists on the memory card, the file will be overwritten with the new history data.

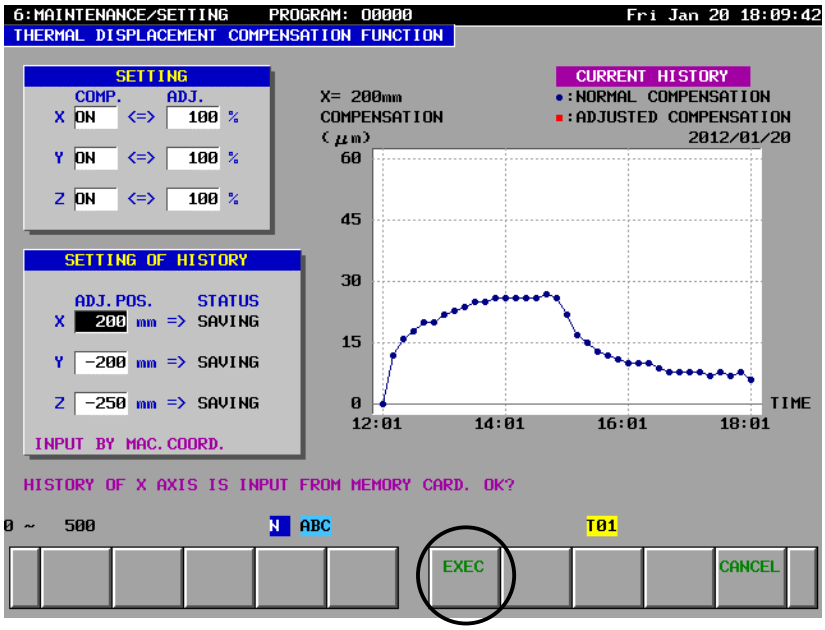
15.5.3 Inputting history data from a memory card

It is possible to load the history data saved to a memory card (past history data) to make adjustments.

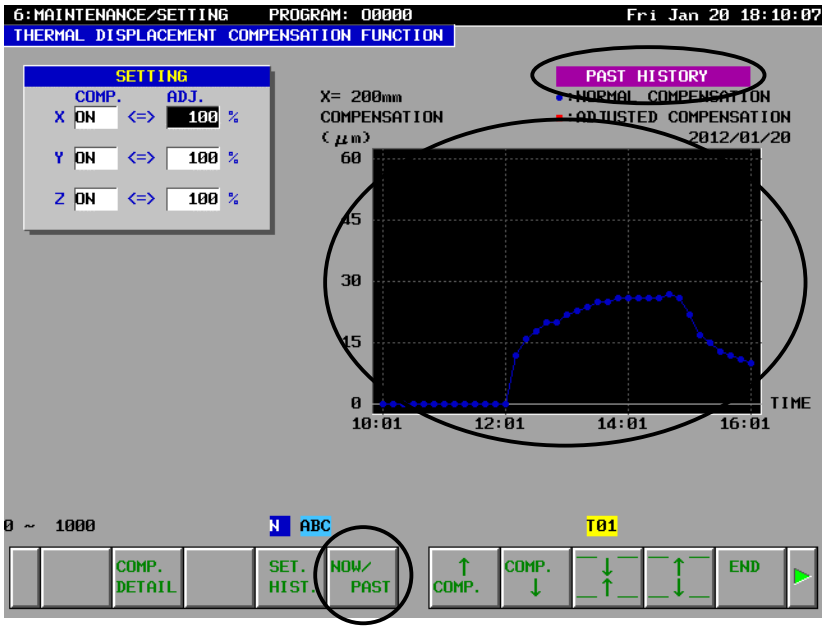
(1) First, insert a memory card to which history data has been saved into the memory card slot on the left side of the screen, and then press the soft key [SET. HIST.] to display the "SETTING OF HISTORY" window.
(2) Move the cursor to the axis for which history data is to be input, and press the soft key [INPUT HIST.].



(3) Check the message that appears, and if it is OK, press the soft key [EXEC]. History data for the specified axis will be loaded from the memory card. Press the soft key [END] to close the "SETTING OF HISTORY" window.



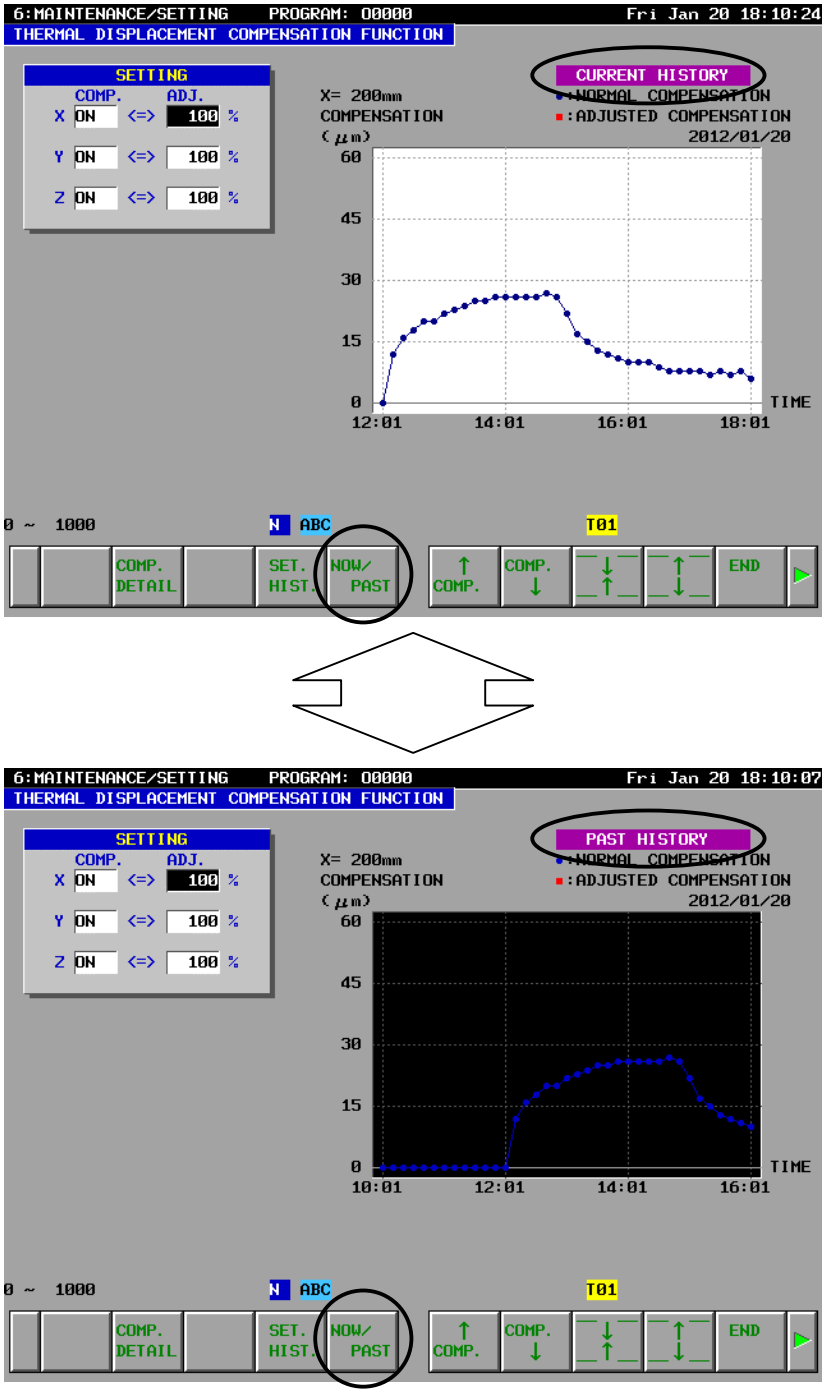
(4) The history data that has been loaded from the memory card (past history data) is displayed on the screen. When past history data is displayed on the graph, "PAST HISTORY" appears above the upper right corner of the graph, and the color of the background of the graph changes from white to black. When the cursor is positioned to the field for the axis for which the past history data has been loaded, the soft key [NOW/PAST] will be added.



SUPPLEMENT

- While the "SETTING OF HISTORY" window appears, the latest history data is always displayed even if past history data is loaded from a memory card.

(5) To switch from the past history data to the latest history data, press the soft key [NOW/PAST]. "CURRENT HISTORY" will appear above the upper right corner of the graph and the latest history data will be displayed on the graph. Each time the soft key [NOW/PAST] is pressed, "PAST HISTORY" and "CURRENT HISTORY" are displayed alternately.



SUPPLEMENT

- History data input from a memory card (past history data) will be erased when the power is turned OFF.
- If the file name of the history data output to a memory card or the history data itself is edited, the history data can no longer be input.

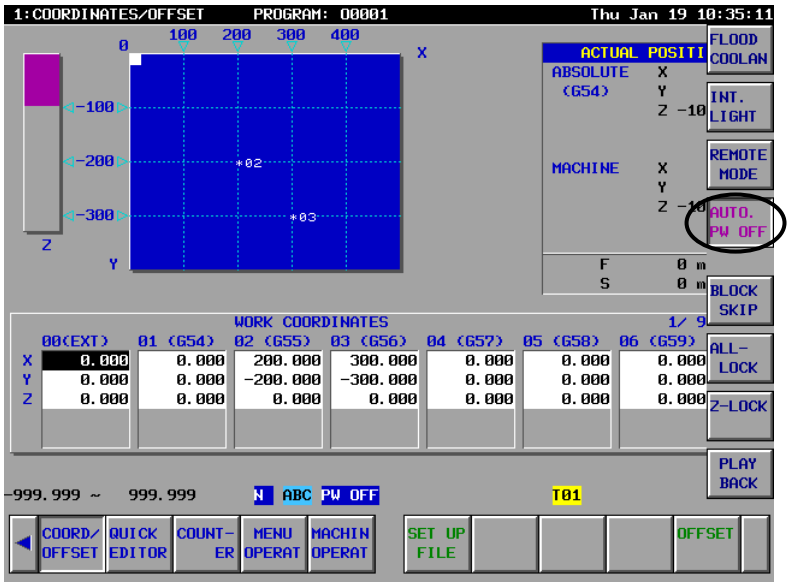
16 AUTOMATIC POWER SUPPLY SHUT-OFF

This function automatically shuts off the power supply to the unit upon termination of a given program.

16.1 USE

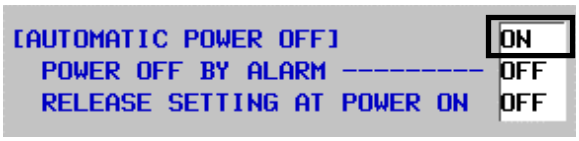
(1) Set "AUTO. PW OFF" to on.

(a) For the standard type of operator's panel: Set "AUTO. PW OFF" on the vertical soft key of the QUICK Screen to on.



(b) For the full keyboard type of operator's panel: Set "AUTO. P OFF" on the operator's panel to on (to turn on the lamp at the upper left of the button).

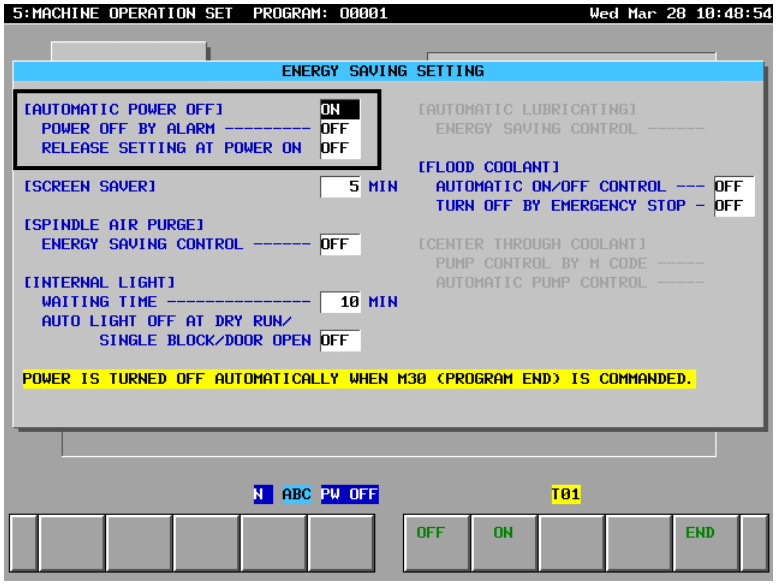
(c) Step common to the standard type and the full keyboard type of operator's panel
On the ENERGY SAVING SETTING screen, position the cursor to the field to the right of "[AUTOMATIC POWER OFF]", and set it to ON, using the soft key. (For details of the ENERGY SAVING SETTING screen, see Section IV 39, "ENERGY SAVING SETTING SCREEN".)



(2) When M30 (end of program) is issued, the power is turned off after about 5 seconds.

16.2 SETTING THE CONDITIONS FOR THE AUTOMATIC POWER SUPPLY SHUT-OFF FUNCTION

Conditions for automatic power supply shut-off can be set with the ENERGY SAVING SETTING screen (for details, see Section IV 39, "ENERGY SAVING SETTING SCREEN").



POWER OFF BY ALARM: Selects whether to activate (ON) or not (OFF) the automatic power supply shut-off function in the event of an alarm.

RELEASE SETTING AT POWER ON: Selects whether to release (ON) or not (OFF) the automatic power shut-off setting when the power is turned on.

SUPPLEMENT

- With M02 (end of program), the automatic power supply shut-off function is not effective.
- When the automatic circuit breaker function (option) or the automatic fire-extinguisher (option) is provided, the circuit breaker of the control unit trips. Before turning on the power again, turn off the circuit breaker then back on.
- For about 70 seconds after the power is turned on, the automatic power supply shut-off function is not effective.
- If, in custom PMC, the automatic power supply shut-off disable signal (SO20_4:R1370.4) is turned ON, the automatic power supply shut-off function is not effective even if the setting of the function is ON. (For the standard type of operator's panel, the "PW OFF" display at the bottom of the screen disappears. For the full keyboard type of operator's panel, the lamp of the "AUTO POWER OFF" button goes out.)

17 COOLANT (OPTION)

For safety precautions, see d), "COOLANTS AND LUBRICANTS", in 2 in "SAFETY PRECAUTIONS".
For installing the coolant unit, see Section 3.10, "INSTALLING THE COOLANT UNIT", in Part II.

⚠ WARNING

1 Do not use coolants with a low flash point (lower than 70°C, such as class 2 petroleum). Use of such coolants can cause fire. Even when class 3 petroleum (with a flash point of 70°C to 200°C), class 4 petroleum (with a flash point of 200°C to 250°C), and non-flammable coolants (with a flash point of 250°C or higher) are used, they can catch fire. So, pay sufficient attention to the use conditions and the way of using coolants; for example, suppress generation of oil smoke.
2 Do not use rotten coolants and lubricants (grease and oil). They become very harmful when they get rotten. For the state of a coolant or lubricant considered to be rotten, contact the supplier. Store or dispose of rotten coolant or lubricant according to the instructions from the supplier.
3 Avoid using such coolants and lubricants (grease and oil) that may change the properties of polycarbonate, nitrile rubber (NBR), hydrogenated nitrile rubber (HNBR), fluororubber, nylon, acrylics, and ABS resins. The properties of these materials can also be changed when diluent water contains a large amount of residual chlorine. Because this machine uses these materials as sealing materials, use of such a coolant, lubricant, or diluent water can degrade the sealing effect. Degraded sealing can cause electric leakage, resulting in an electric shock. Degraded sealing can also cause grease to leak and be burnt in.

⚠ CAUTION

Securely connect the piping not to allow coolant to leak. When coolant leaks, the floor becomes slippery, which can cause dangerous falls.

SUPPLEMENT

Do not use the following coolants because they may greatly affect the machine, possibly causing defects to occur:

- Coolant containing highly active sulfur: There are coolants that contain very highly active sulfur. If such a coolant enters inside the machine, it may corrode copper, silver, and other metals, possibly causing parts failure.
- Highly osmotic, synthetic-type coolant: Some coolants that use polyalkylene glycol and other substances are very highly osmotic. Such a coolant may enter inside the machine, possibly causing insulation degradation and part failure.
- Highly alkaline, water-soluble coolant: Some coolants whose high pH value is increased by the use of alkanolamine or other substance are highly alkaline, with pH values of 10 or greater when diluted at their standard dilution ratios. Such a coolant may cause chemical change to resin and other materials, possibly degrading them, if it adheres to them for a long period of time.
- Coolant containing chlorine: Some coolants containing chlorine (for example, chloride components, such as chlorinated paraffin) affect materials such as resin and rubber badly, leading to possible defective parts.

The ROBODRILL has an optional coolant unit. The coolant unit supplies coolant to the machining surface. There are two coolant types, a machine cleaning coolant and a coolant with a taper cleaning function. The capacity of the tank on the D14/21M/L*i*A5 is about $0.1m^3$(100L) or $0.2m^3$(200 L). The capacity of the tank on the D14/21S*i*A5 is about $0.14m^3$(140L). As for the center-through coolant, see the center-through coolant chapter.

17.1 COOLANT UNIT (OPTION)

17.1.1 Overview

The coolant unit is a device for supplying coolant to a surface while it is being machined. The coolant comes out from the nozzle at the bottom of the spindle head.

17.1.2 Installation

17.1.2.1 Operating cautions

> ⚠ **WARNING**
> Before starting to install the coolant unit, make sure that the circuit breaker in the ROBODRILL control unit cabinet is in its OFF position to shut off power for safety purposes.

17.1.2.2 Hose installation

(1) Insert the external coolant hose into the mating joint and fasten it with hose ties.
(2) Connect the internal coolant hose to the coupler in the upper section behind the splash guard and to the coupler on the nozzle.

Notes)

- The recommended tightening torque for the screw fastening the internal coolant hose to the coupler is 59 N·m.
- Do not use sealing tape on the screws.
- When fastening the coolant hose, be careful not to cause it to twist. The hose should not lean or bend to the right or left as viewed from the machine front surface.
- Keep the hose from touching the turret support.

* Check the condition of the coolant hose periodically. If you found it to have become soft or bent abnormally, correct its mounting condition or replace it as required.

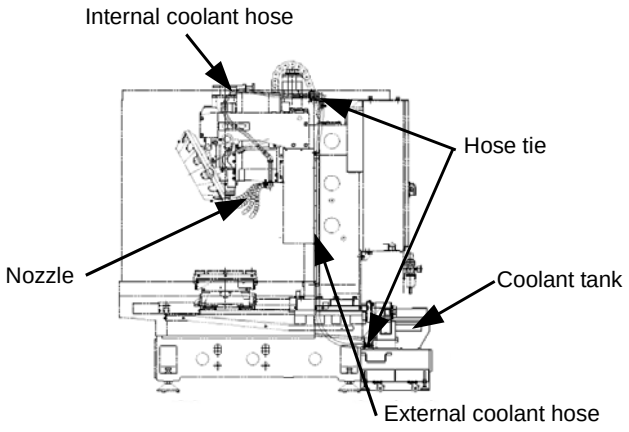


Fig. 17.1.2.2(a) Coolant hose installation

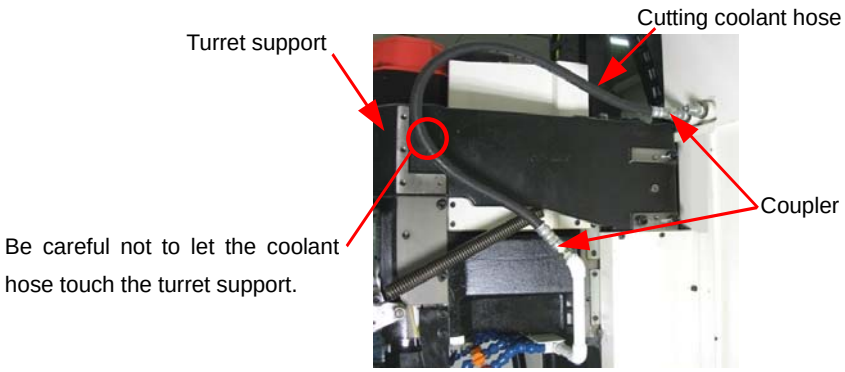


Fig. 17.1.2.2(b) Internal coolant hose installation

17.1.2.3 Cabling

Connect the cables to the coolant pump and the terminal block:XT5 in the controller cabinet.

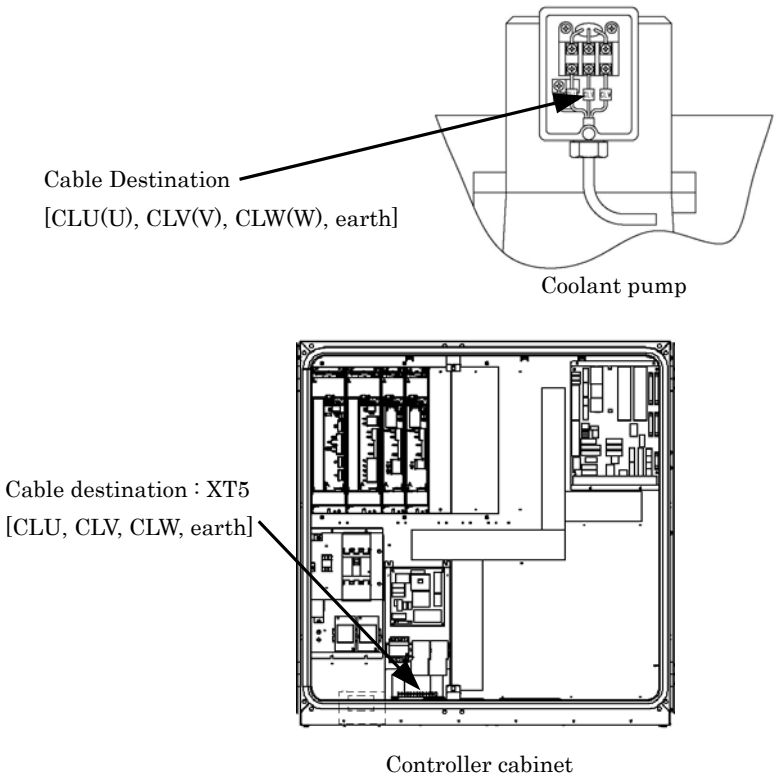


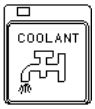
Fig. 17.1.2.3 Coolant pump cable connections

17.1.2.4 Operation

To supply coolant to the machining surface, follow the procedure described below.

(1) Confirm that the reservoir is filled with coolant. If not, replenish the reservoir with coolant.
(2) Open the valve on the nozzle.
(3) Press the <COOLANT> key to rotate the pump. This causes coolant to come out of the nozzle tip. (The pump can be stopped by pressing the button again.)

When the coolant unit is operating



When the coolant unit is at a halt

(4) Adjust the nozzle position so that coolant is poured on the correct position. Do not place the nozzle too close to the tool since it may cause interference between the nozzle and the turret during a tool change.

> ⚠ **DANGER**
> Never try to adjust the nozzle while the machine is running. Otherwise, dangerous situations are produced, which can lead to injury.

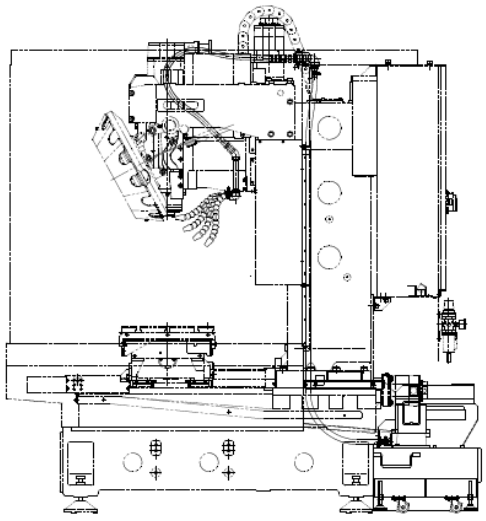


Fig.17.1.2.4 (a) Nozzle

The coolant unit can be turned on (supplying coolant) and off (stop supplying coolant) automatically using the M code command or manually using the coolant button mentioned in step (3) above. To turn on and off the coolant unit automatically, execute M08 (ON) or M09 (OFF) in either the AUTO (MEM) or MENU (MDI) mode.

> **ATTENTION**
> Never try to operate the pump for a prolonged period of time when the coolant reservoir is empty. (Be sure to fill the reservoir with coolant before operating the pump by following step (1) above.) Never try to operate the pump with the valve closed. Failure to observe either one of these practices may result in pump failure.

SUPPLEMENT

- The coolant unit will be turned on or off during automatic running in the M code as follows.
  M08: The coolant unit is immediately turned on when the block is read.
  M09: The coolant unit is turned off after the block has been executed.
- The coolant unit is turned off during the tool change. Turn the coolant unit on using the coolant key or the M08 code as required. (PMC Parameter K00#7=0)
- Fig. 17.1 (b) shows the rotating direction of the pump.

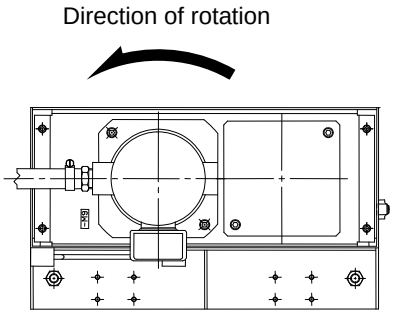
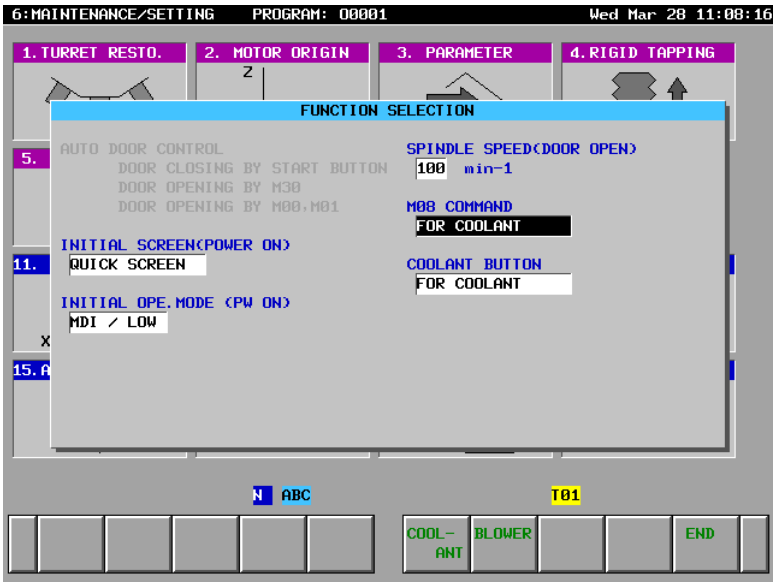


Fig.17.1.2.4 (b) Pump

SUPPLEMENT

To use the <COOLANT> key on the operator's panel and M08 command for controlling the coolant unit, select [FUNCTIONS] on “6: MAINTENANCE / SETTING” Screen of QUICK Screen and set "FOR COOLANT" for M08 COMMAND” and “COOLANT BUTTON”.



17.2 MACHINE CLEANING COOLANT CONTROL (OPTIONAL)

17.2.1 Overview

This coolant unit is intended to wash chip deposits and other extraneous substances out from the inside of the machine.
The ROBODRILL uses a 400-W motor for machine cleaning coolant.
The control unit is rated up to 200 V, 2.6 A.
When using non-FANUC coolant, adjust the thermal setting of the control MCC according to the rating of the coolant motor.

17.2.2 Installation

17.2.2.1 Operating cautions

> ⚠ **WARNING**
> Before starting to install the coolant unit, make sure that the circuit breaker in the ROBODRILL control unit cabinet is in its OFF position to shut off power for safety purposes.

17.2.2.2 Hose installation

(1) Install the internal pipe.
(2) Insert the external coolant hose into the mating joint and fasten it with hose ties.
(3) Install the shower gun hose inside the machine.
(4) Insert the shower gun hose into the mating joint and fasten it with hose ties.

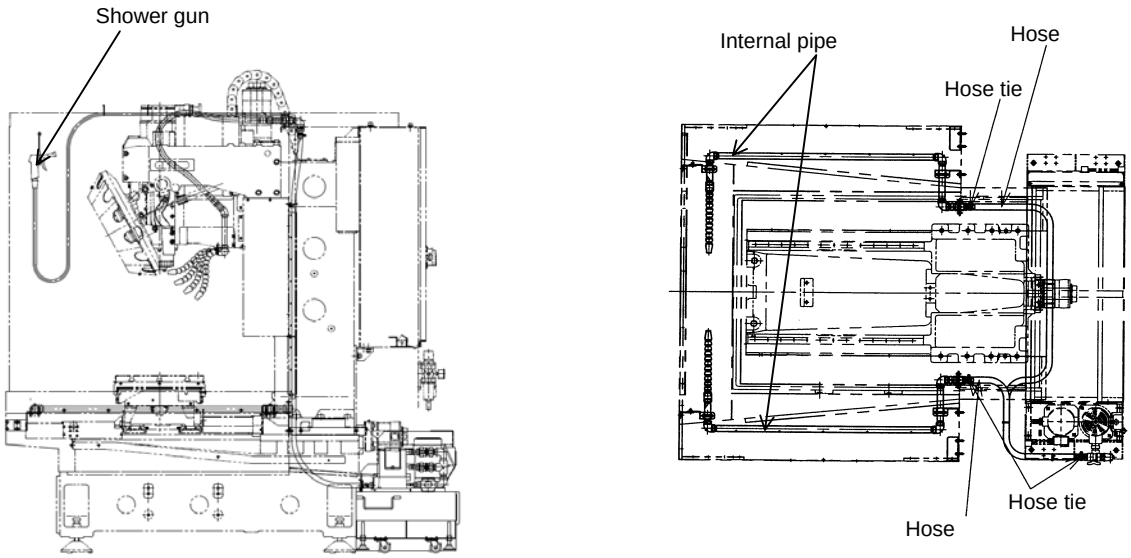


Fig. 17.2.2.2 Flood coolant piping

17.2.2.3 Cabling

Connect the cables to the coolant pump and the terminal block:XT5 in the controller cabinet.

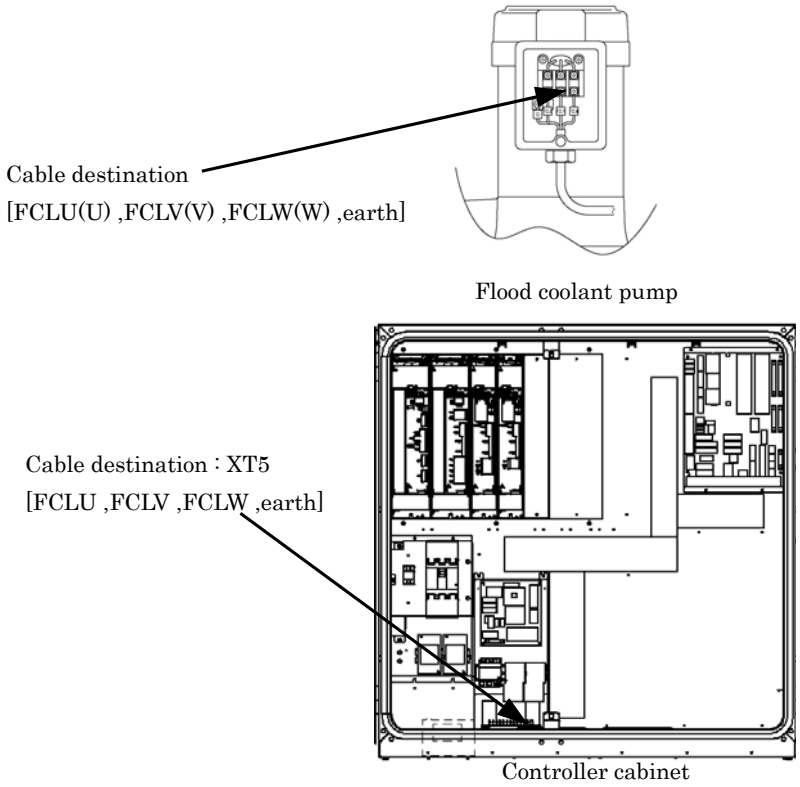
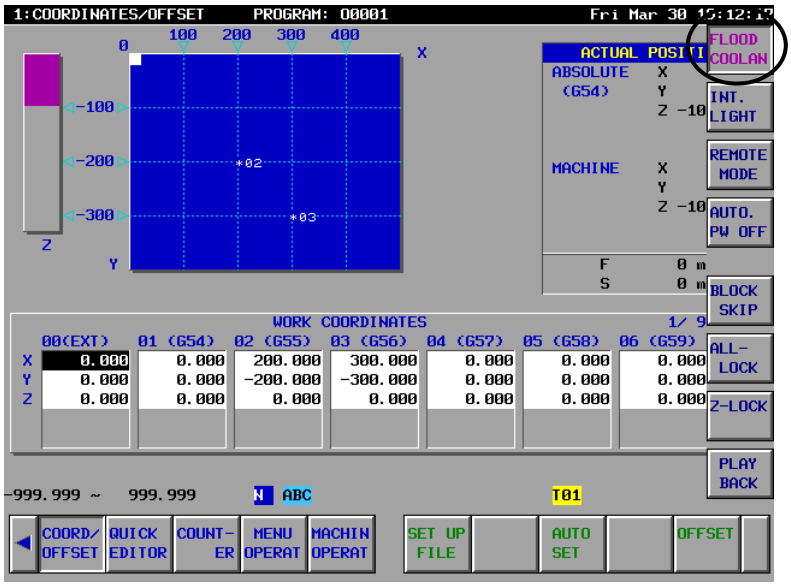


Fig. 17.2.2.3 Coolant pump cable connections

17.2.2.4 Operation

To use the machine cleaning coolant, select the quick screen, and press the [FLOOD COOLAN] vertical soft key to ON.



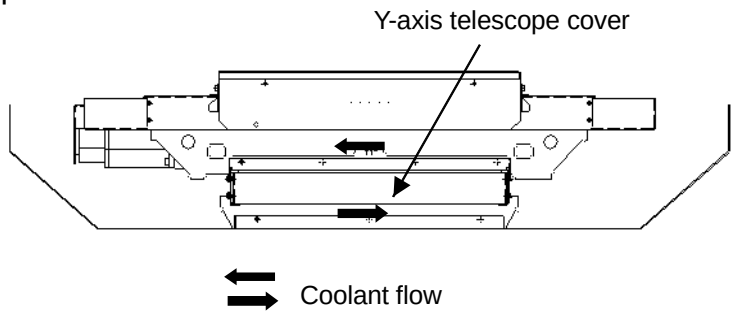
The following program instructions can be used to control the machine cleaning coolant.

M130 ; : Machine cleaning coolant ON
M131 ; : Machine cleaning coolant OFF

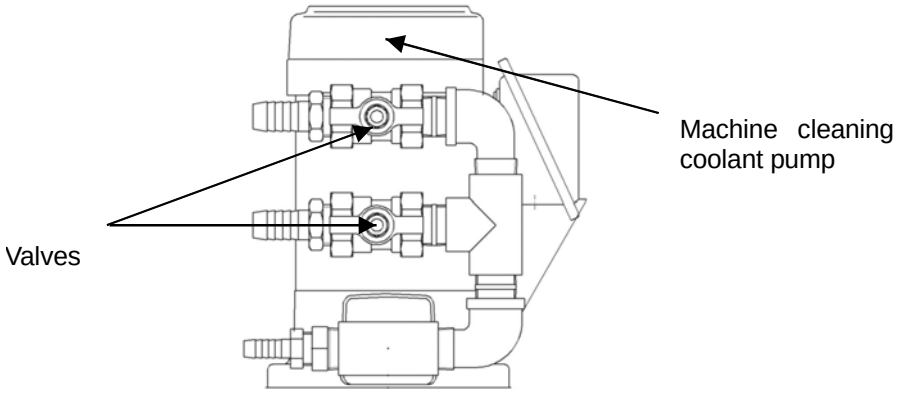
> ⚠ **CAUTION**
> When a machine cleaning coolant unit is used, if the shower gun is pointed towards the outside of the splash guard, spilled coolant makes the floor slippery, which can cause dangerous falls.

SUPPLEMENT

- Adjust two cabin-cleaning nozzles so that one nozzle produces a coolant flow above the Y-axis telescope cover and the other produces another coolant flow below the Y-axis telescope cover, to prevent chips from accumulating below the Y-axis telescope cover.



- If the machine cleaning coolant is output too strongly, adjust the output amount by using the valves at the pump outlets.



17.2.3 Settings Relating to the Machine Cleaning Coolant

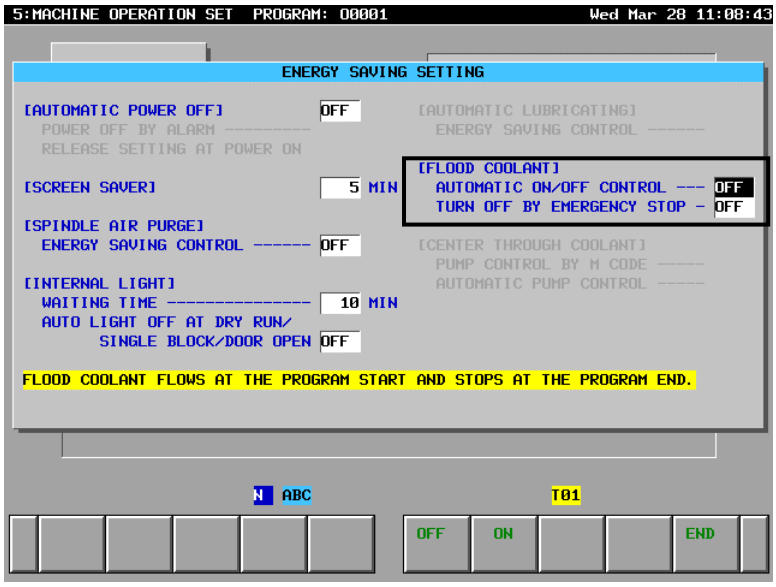
To use the machine cleaning coolant, set the following parameter:

PMC parameter keep relay

	#7	#6	#5	#4	#3	#2	#1	#0
K54								

#2 The machine cleaning coolant (option) is:
0: Disabled.
1: Enabled.

On the ENERGY SAVING SETTING screen of the electronic power consumption monitor, the following items relating to the machine cleaning coolant can be set. (For details of the ENERGY SAVING SETTING screen, see Section IV 39, "ENERGY SAVING SETTING SCREEN".)



- AUTOMATIC ON/OFF CONTROL
  Automatically stops the machine cleaning coolant when machining is not performed.
  The machine cleaning coolant will stop when a fixed period of time (standard value: 1 minute, which can be changed with bit PMC parameter T02) elapses after the program operation (including MDI operation) is elapsed. When program operation starts, the machine cleaning coolant will start again.
  Also, pressing the start button on the operator's panel causes the machine cleaning coolant to start.
- TURN OFF BY EMERGENCY STOP
  Stops the machine cleaning coolant when the machine enters the emergency stop state.

17.3 COOLANT WITH A FUNCTION FOR CLEANING CHIPS FROM TAPERED PORTIONS (OPTIONAL)

17.3.1 Overview

When a tool is indexed and mounted during tool change operation, the taper shank of the tooling and the inside of the taper of the spindle shaft are cleaned by coolant to remove adhered chips.

17.3.2 Installation

17.3.2.1 Operating cautions

> ⚠ **WARNING**
> Before starting to install the coolant unit, make sure that the circuit breaker in the ROBODRILL control unit cabinet is in its OFF position to shut off power for safety purposes. In addition, stop supplying air to the machine.

17.3.2.2 Hose installation

(1) Attach the air tube to the filter unit coolant valve and air panel.
(2) Attach the external coolant hose to the coolant unit and the coupler in the upper section behind the splash guard of the machine.
(3) Install the machine coolant hose for cutting (see Section 17.1).
(4) Connect the taper cleaning coolant hose to the coupler in the upper section behind the splash guard.
(5) Fasten the taper cleaning coolant hose to the cutting coolant hose, using nylon ties and metal rings (4 places), with the taper cleaning coolant hose kept in parallel to the cutting coolant hose and with the fastening positions equally spaced from one another.
(6) Fasten the taper cleaning coolant hose to the vertical portions of the cutting nozzle steel pipe and coupler, using nylon ties.
(7) Connect the coolant hose to the taper cleaning nozzle coupler.
(8) Fasten the hose to the horizontal portion of the cutting nozzle steel pipe, using a nylon tie.
(9) Make sure that the coolant hose does not touch the turret support while moving the Z-axis.

> **CAUTION**
> - The recommended tightening torque for the coupler screw for the external coolant hose is 118 N·m.
> - The recommended tightening torque for the coupler screw for the internal coolant hose is 59 N·m.
> - Do not use sealing tape on the screws.
> - When fastening the hoses with nylon ties, make the nylon ties slightly dig into the hoses.
>
> * Check the conditions of the coolant hoses periodically. If you found any hose to have become soft or bent abnormally or any nylon tie to be loose or displaced, correct its mounting condition or replace them as required.

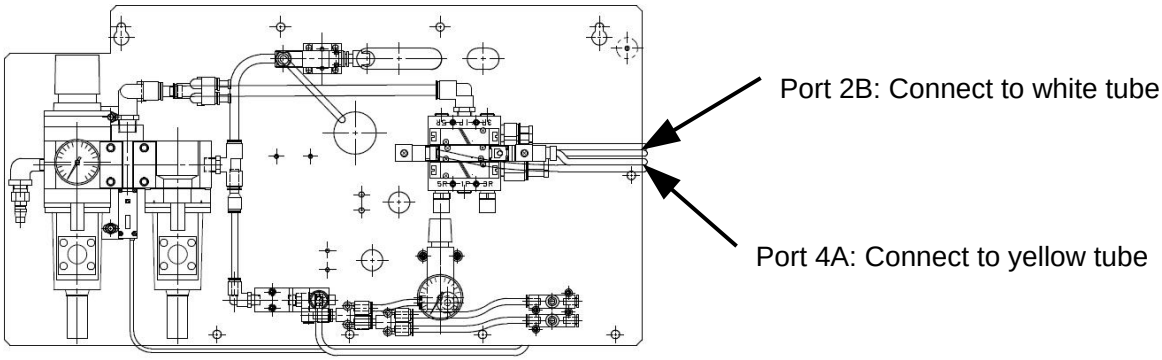


Fig. 17.3.2.2(a) Air tube installation

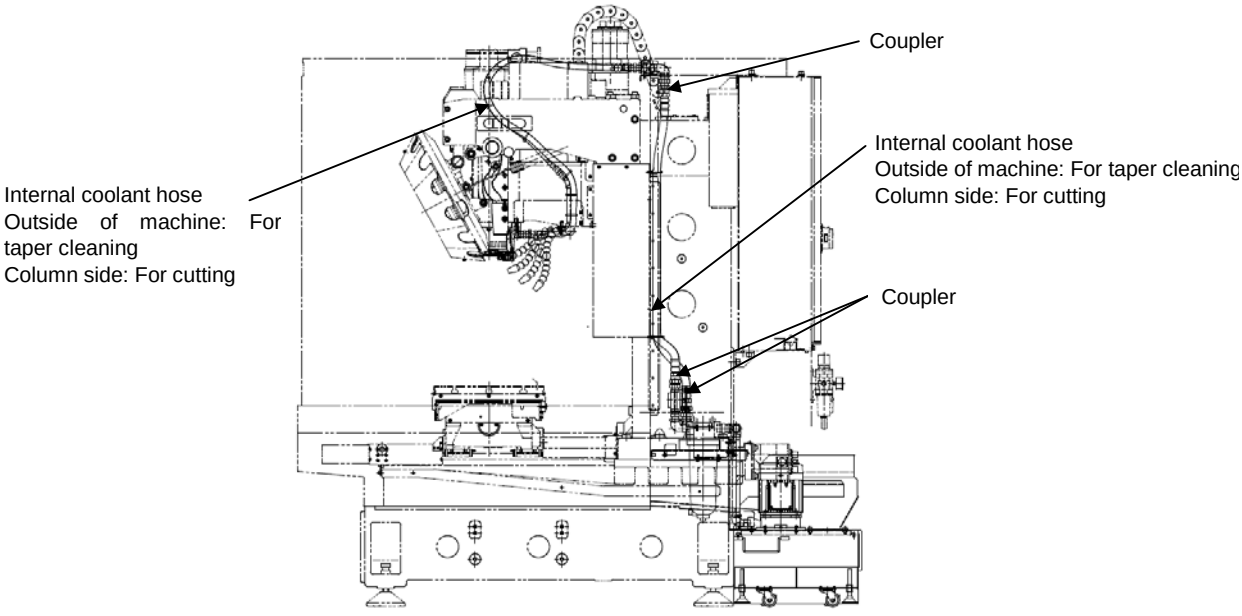
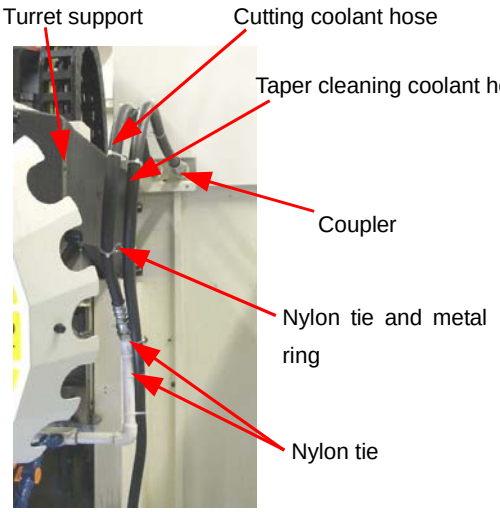
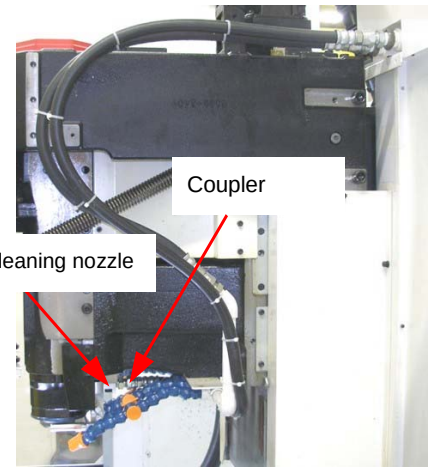


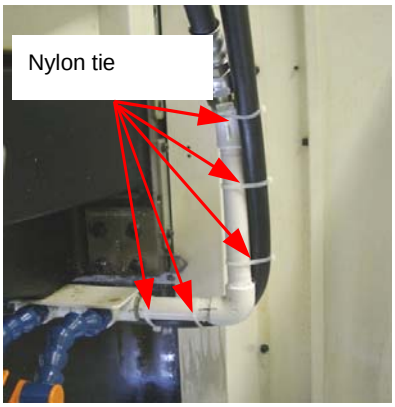
Fig. 17.3.2.2(b) Coolant hose installation



Coolant hose fastening



Connection to nozzle



Coolant hose fastening (nozzle section)

Fig. 17.3.2.2(c) Internal coolant hose installation

17.3.2.3 Cabling

Connect the cables to the coolant pump terminal board and the connector:TP01 in the controller cabinet.

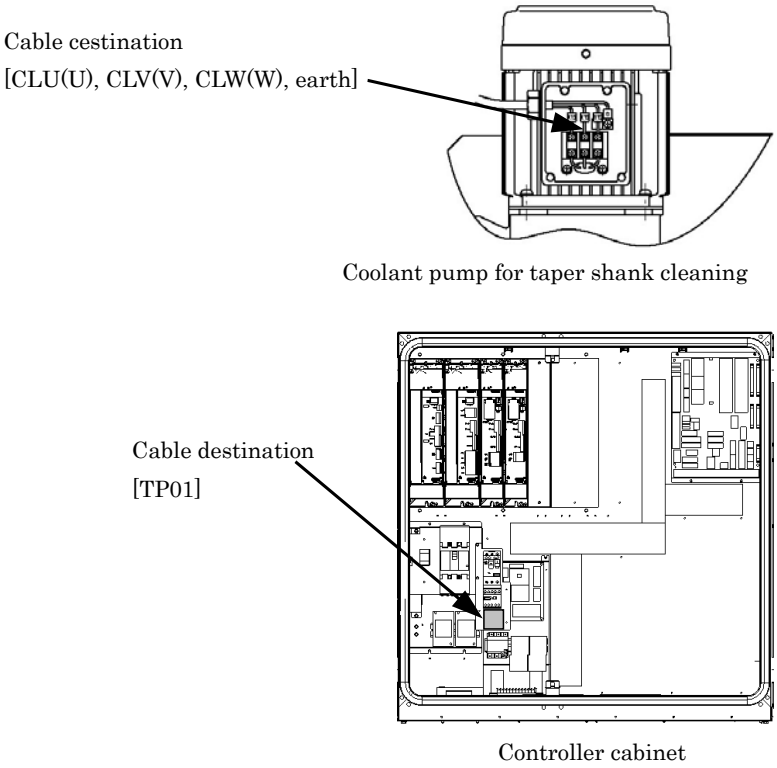


Fig. 17.3.2.3 Coolant pump cable connections

17.3.3 Control

1. Operation

One of the following two operation sequences takes place according to the parameter setting:

(1) Pattern 1 (cleaning only when a tool is mounted)
- (a) When a tool change is specified, machining coolant is stopped.
- (b) An upward movement is made along the Z-axis to detach the tool from the spindle, then the turret turns at the top on the Z-axis.
- (c) A specified tool is indexed, then output of taper cleaning coolant starts.
- (d) Z-axis movement stops for a set period of time, and the tapers of the tool and spindle are cleaned.
- (e) A downward movement along the Z-axis is made to mount the tool.
- (f) When the tool change is completed, the cleaning coolant is stopped.
- (g) Machining is restarted.

(2) Pattern 2 (cleaning when a tool is indexed and when a tool is mounted)
- (a) When a tool change is specified, machining coolant is stopped.
- (b) An upward movement is made along the Z-axis to detach the tool from the spindle, then when an area around the +98-mm point on the Z-axis in the machine coordinate system is reached, output of cleaning coolant starts.
- (c) The turret turns, and a specified tool is indexed.
- (d) Z-axis movement stops for a set period of time, and the tapers of the tool and spindle are cleaned.
- (e) A downward movement along the Z-axis is made to mount the tool.

(f) When the tool change is completed, the cleaning coolant is stopped.
(g) Machining is restarted.

2. Program

To clean the taper of the spindle, use special codes.
Before issuing a tool change command for the tool to be cleaned, specify the following:

M26 Cxxx;: Stop movement for a specified time and perform cleaning. (1000 equals 1 second.)
($0 \leq C \leq 32000$, up to 32 seconds)
M26 C0;: Perform cleaning, but make downward movement along the Z-axis at normal speed without stopping the movement.
M27;: Do not perform cleaning. (Required for modal processing)

A specified code can be processed as a one-shot code or a modal code, which can be selected by parameter setting.

3. Parameters [PMC parameters]

No.	#7	#6	#5	#4	#3	#2	#1	#0
K26								

#0 0: Disables the spindle taper cleaning function.
1: Enables the spindle taper cleaning function.

#1 0: Processes the M26 C_ command as a one-shot command.
1: Processes the M26 C_ command as a modal command.

#2 0: Does not output cleaning coolant during tool indexing.
1: Outputs cleaning coolant during tool indexing.

#4 0: Stops machining coolant during tool change.
1: Outputs machining coolant even during tool change
(Valid when K26#0=0 and K00#7=1).

#5 0: When one coolant pump is used for machining and taper cleaning
1: When a separate coolant pump is provided for taper cleaning as well as a coolant pump for machining

SUPPLEMENT
K26#4 and K26#5 can be set to perform cleaning with the machining coolant without using the taper cleaning function.

No.	#7	#6	#5	#4	#3	#2	#1	#0
D512								

#3 0: Does not output cleaning coolant according to the on/off state of machining coolant.
1: Outputs cleaning coolant only when machining coolant is on.

4. Supplement

(1) When the coolant button on the operator's panel is pressed during taper cleaning, coolant is turned on or off according to the operation. (If D512#3=1 is set, and machining coolant is off, the on/off operation is disabled.)

(2) If coolant control is performed when taper cleaning by the blower is enabled, coolant control takes priority, and the blower operation when a tool is mounted, stop at a specified position, and movement at a low speed are not controlled (No air is output).
(3) If K26#2=1 is set, and operation pattern 2 is selected, M26 and M27 are always processed as modal codes (Once M26 is specified, coolant is always output at the time of turret indexing until M27 is specified).
(4) After tool change, restart of machining coolant depends on the setting of K00#7.
(K00#7=1: Restarts machining coolant after tool change)
(5) During tool change, the reset key stops both taper cleaning coolant and machining coolant regardless of the settings of K01#7 (specifying whether to stop the spindle and coolant by the reset key) and K00#7.

5. Interface

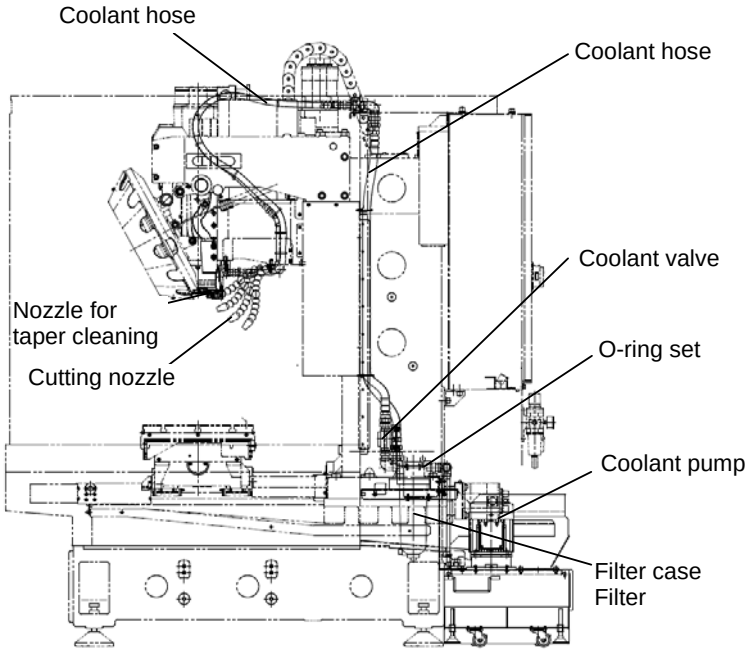
(1) Output signals
Taper cleaning coolant valve control: Y4.4
Connected to: XS18-A5, B5 (0 V)
Machining coolant valve control: Y4.5
Connected to: XS18-A6, B6 (0 V)
Coolant pump control: Y4.6
Connected to: XS18-A7, B7 (0 V)

Basic operation: When both the taper cleaning and machining coolant valves are off, the pump is turned off. If any one of the valves is on, the pump is operated.

(2) SI (system → custom PMC) signals when a custom PMC is used
Taper cleaning coolant valve control: SI79.1 (R1429.1)
Machining coolant valve control: SI79.2 (R1429.2)

17.3.4 Mechanical Unit

1. Names of components



17.4 INSPECTION AND CONSUMABLE REPLACEMENT

Refer to the applicable maintenance manual for replacement procedures.

(1) Coolant hoses
The coolant hoses can break after prolonged use or because of degradation due to the effect of coolant. They are consumables. Check them periodically to see if they are abnormally soft or hard or have flaw and if they are properly mounted. If any abnormal condition is found, replace them.

(2) Filter (taper cleaning option)
When the filter in the filter case installed in the coolant reservoir is clogged, the amount of coolant output from the nozzle becomes insufficient, and so an adequate cleaning effect cannot be obtained. Since the filter is a consumable, replace it periodically or when the output amount decreases.
The standard filter has a grade of 150 μm. The customer, however, can select a desired grade. Note that as a finer filter grade is used, the filter life becomes shorter.

Filter ordering information

Grade	Ordering information
150μm (standard)	A97L-0203-0282#G78X7-1N
125μm	A97L-0203-0282#G78W8-1N
100μm	A97L-0203-0282#G78V8-1N
75μm	A97L-0203-0282#G78Q8-1N
50μm	A97L-0203-0282#G78L8-1N
25μm	A97L-0203-0282#G78F8-1N
10μm	A97L-0203-0282#G78C8-1N
5μm	A97L-0203-0282#G78B3-1N
3μm	A97L-0203-0282#G78A3-1N
1μm	A97L-0203-0282#G78Y7-1N

(3) O-rings (taper cleaning option)
An O-ring is used as a packing for leakage protection in the lid of the filter case, drain plug, and air plug. An O-ring degraded for prolonged use or by the influence of coolant can allow coolant to leak.
Since the O-rings are consumables, replace them periodically or when a leakage occurs.

O-ring set (one large O-ring and four small O-ring, material: Baiton)
Ordering information A97L-0203-0282#001

18 BLOWER CONTROL FUNCTION (OPTION)

⚠ WARNING
Before starting to switch on the air blower with the front door kept open, wear protective glasses. Otherwise, chips may get into your eyes, possibly leading to loss of vision.

(1) Turning the blower on or off by specifying an M code

M50/M07 : Blower turned on	M09 : Blower turned off

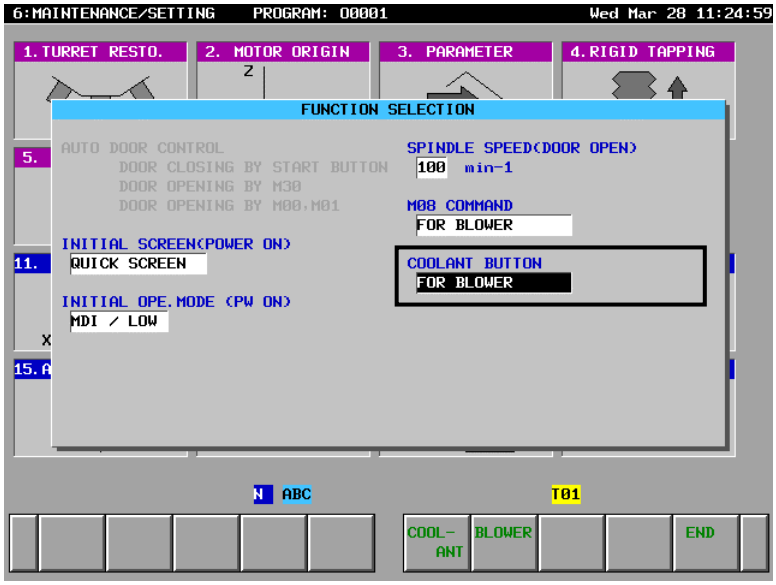
You can also use M08 for turning air blow on.
Select [FUNCTIONS] on “6: MAINTENANCE/SETTING” of QUICK screen and set "FOR BLOWER" for “M08 COMMAND”. (Normally, "FOR COOLANT" is selected.)

(2) Turning the blower on or off from the machine operator's panel.

Press → Blower is turned on.

Press → Blower is turned off.

Select [FUNCTIONS] on “6: MAINTENANCE/SETTING” of QUICK screen and set "FOR BLOWER" for “COOLANT BUTTON”. (Normally, "FOR COOLANT" is selected.)



Basic control is the same as for the coolant unit.
Even when the safety door is open, air blow operation can be turned on.

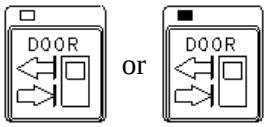
19 OPENING AND CLOSING THE AUTOMATIC DOOR (OPTION)

When the front door has the automatic door open/close function, the door can be opened and closed automatically by button operations.

<MANUAL mode>

(1) Before opening or closing the door, confirm the absence of any foreign material at the door slides.
(2) The door can be automatically opened or closed by pressing the <DOOR OPEN/CLOSE> key.

(3) When the door has been properly opened or closed, the <DOOR OPEN/CLOSE> key lamp lights to indicate that the motion has been completed.

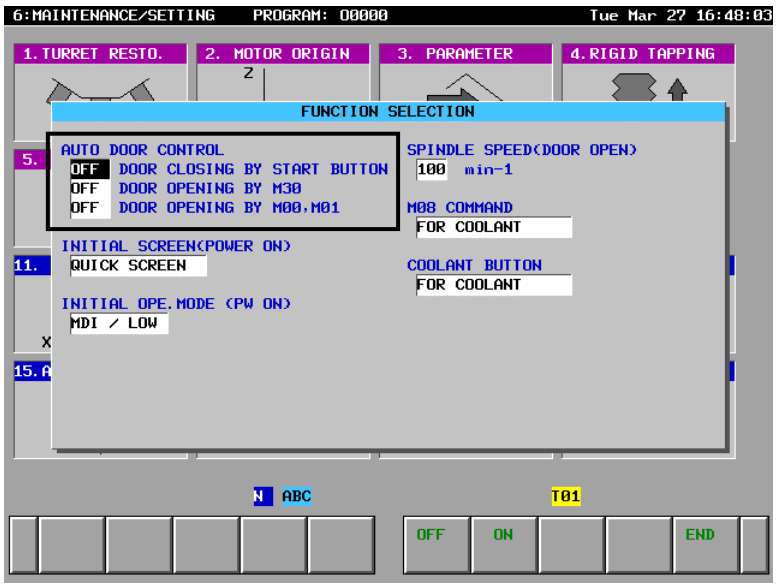


The <DOOR OPEN/CLOSE> key is enabled, regardless of the operation mode. This means that when the <DOOR OPEN/CLOSE> key is pressed during automatic operation, a gradual stop occurs along each axis, and the automatic door opens.

SUPPLEMENT
To enable the <DOOR OPEN/CLOSE> key in the manual mode, set the following parameter:
PMC parameter keep relay K11#2 = 1

<AUTO and MENU modes>

To set conditions for opening and closing the door in the automatic (MEM) mode and menu operation (MDI) mode, select [FUNCTIONS] on “6: MAINTENANCE / SETTING” of QUICK Screen.



DOOR CLOSING BY START BUTTON:

Automatically closes the door at the cycle start and starts programmed operation.

DOOR OPENING BY M30:

Opens the automatic door when M30 is issued. (M02 is ignored.)

DOOR OPENING BY M00, M01:

Opens the automatic door when M00 or M01 is issued. (M01: only when the switch on the operator's panel is ON)

> ⚠ **DANGER**
> Be careful not to get your head or hand caught in the automatic door during work. If the head or hand becomes caught in the door, head or hand injury can be caused.

> **SUPPLEMENT**
> - If it takes more than six seconds to open (or close) the door because of foreign matter, alarm 1008 "AUTO DOOR TOTAL TIME OVER." is issued. Remove the foreign matter, and press the <RESET> key to release the alarm, then press the DOOR key to complete the door open or close operation.
> - The automatic door does not operate in the emergency stop state. (The electromagnetic lock is released.)
> - It takes 2 seconds or more (not longer than 3 seconds) to open or close the door [3 seconds or more (not longer than 4 seconds) for the L type]. If the time required for the door open/close operation is not within this range, adjust the open/close time with the speed control adjustment screws mounted on the air cylinder.

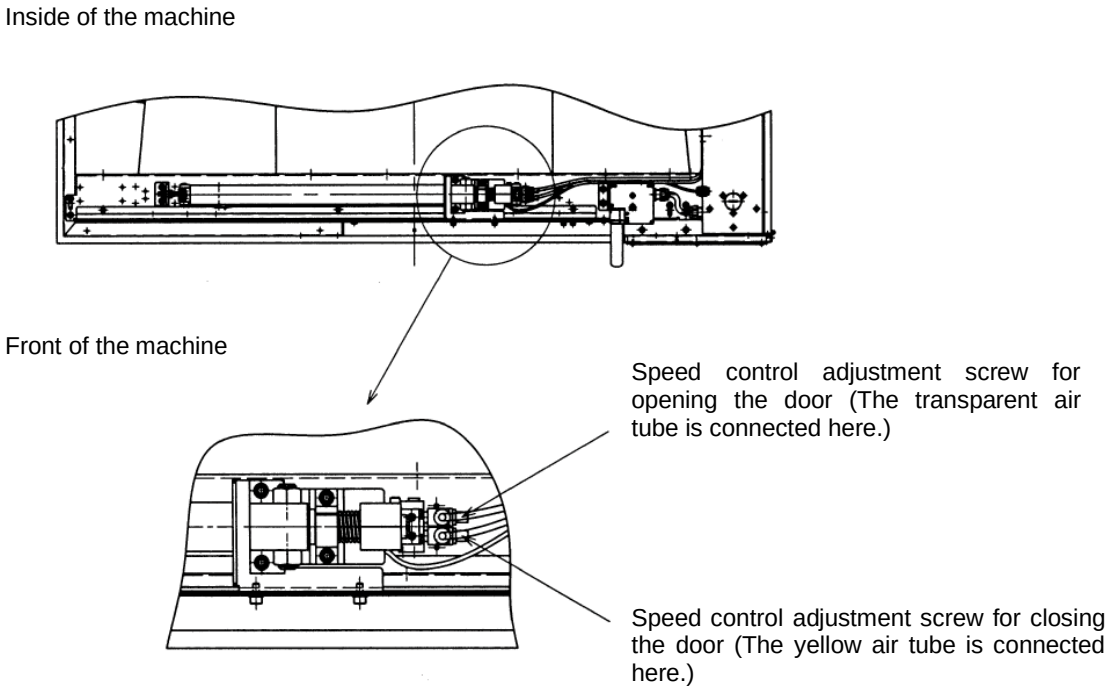


Fig. 19 (a) α-D14M/L*i*A5, α-D21M/L*i*A5

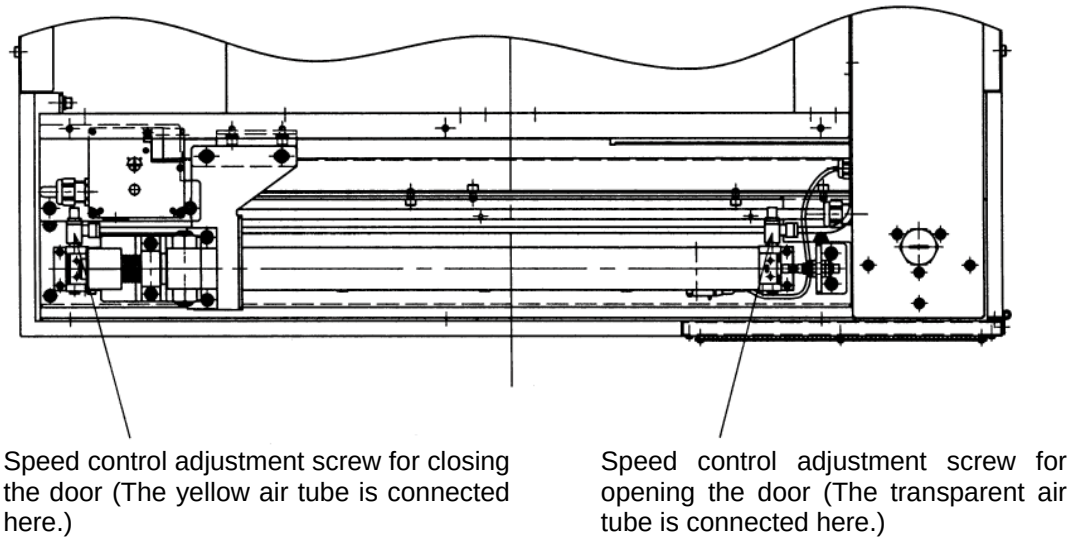


Fig. 19 (b) α-D14S*i*A5, α-D21S*i*A5

- Tightening the adjustment screw by one rotation slows the door open/close speed by approximately 0.1 to 0.2 second.
- Do not set the opening/closing time to two seconds or shorter (for the α-D14(21)M/S*i*A5). If the time is set to two seconds or shorter (three seconds or shorter for the α-D14(21)L*i*A5), defects may occur.

Related parameters

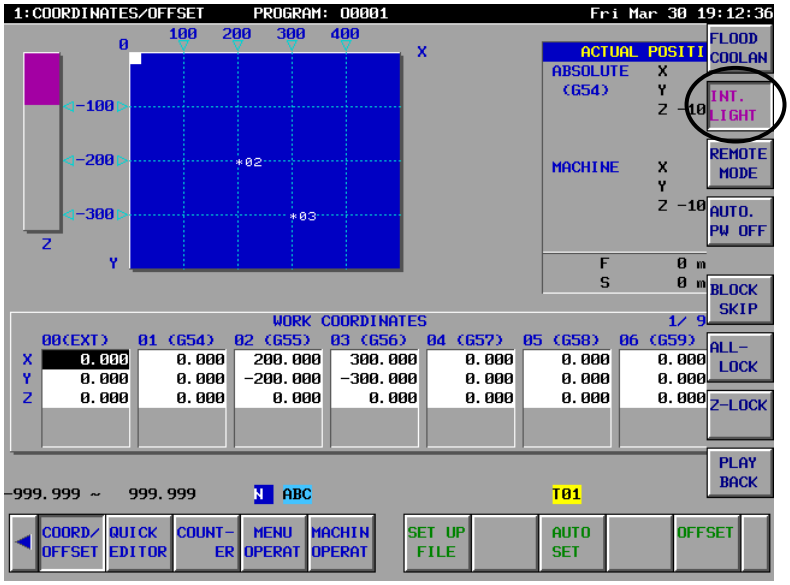
[PMC PARAMETER (TIMER)]

Address	Default	Function
T20	6000	Total time for door open and close operations [ms]

20 INTERNAL LIGHT (OPTION)

20.1 TURNING THE INTERNAL LIGHT ON/OFF

If the internal light option is enabled, [INT. LIGHT] appears as a vertical soft key on the QUICK screen. By pressing this key, the internal light can be turned ON/OFF.



To use the internal light, the following parameters must be set. If either parameter is not set, [INT. LIGHT] does not appear as a vertical soft key.

PMC parameter keep relay

	#7	#6	#5	#4	#3	#2	#1	#0
K54								

#0 The internal light (option) is:
0: Disabled.
1: Enabled.

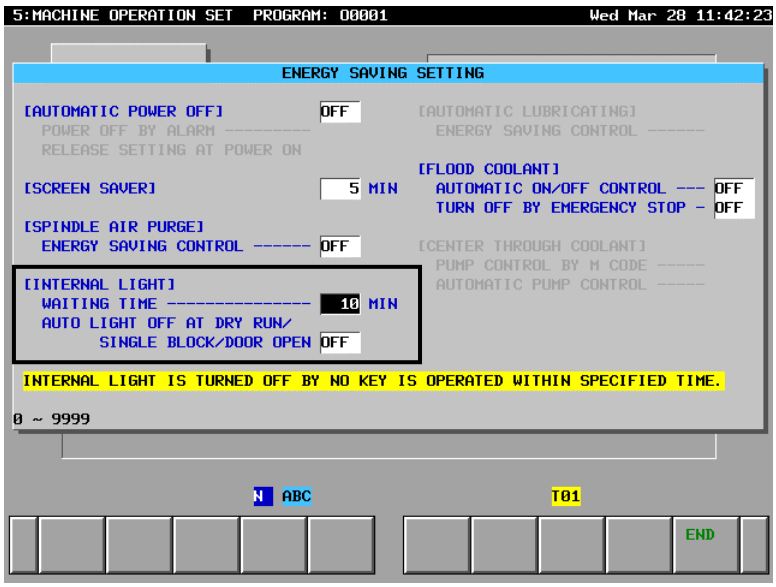
#1 The type of the internal light is:
0: fluorescent.
1: LED.

20.2 AUTOMATICALLY TURNING OFF THE INTERNAL LIGHT

The internal light is automatically turned off if no key on the operator's panel (NOTE1) is pressed within the specified period (standard setting: 10 minutes). Subsequently, pressing any key on the operator's panel turns on the internal light automatically.
In the following cases, however, the internal light is not automatically turned off even if no key on the operator's panel is pressed within the specified period:

- The door is open.
- Dry run mode is selected.
- Single block mode is selected.

Settings for these functions can be changed on the ENERGY SAVING SETTING screen. (For details of the ENERGY SAVING SETTING screen, see Section IV 39, "ENERGY SAVING SETTING SCREEN".)



- WAITING TIME
  Changes the waiting time after which the internal light is to be automatically turned off. (up to 9999 minutes, in 1-minute units).
  If not using automatic turn off, set "0" in this field.
- AUTO LIGHT OFF AT DRY RUN/SINGLE BLOCK/DOOR OPEN
  If set to ON, the internal light will also be automatically turned off if the dry run mode and the single operation mode are ON or the door is open.

SUPPLEMENT

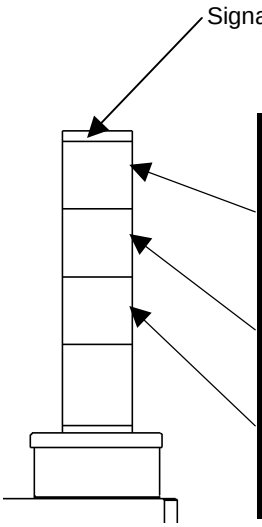
In this section, the keys refer to the Sheet keys other than the digits, Change, Insert, Delete, Cancel, Input, Edit, Cursor, Page, Reset, QUICK/NC, the Alphabet (ABC…Z), and Alarm/status.

ATTENTION

If a fluorescent tube is used for the internal light, turning the light ON/OFF frequently will shorten the life of the fluorescent tube. If the intended use requires that the fluorescent tube be turned ON/OFF frequently, it is recommended to keep it ON continuously. The life of a fluorescent tube is shortened by about one hour each time is turned ON/OFF. The life of a fluorescent tube is about 6000 hours if it is lit continuously.

21 SIGNAL LAMP (OPTION)

The stopped state of the machine is indicated with the red (yellow), yellow (blue), and green lamps. The lamps are arranged in the order shown in the figure below. Do not change this order.



	Standard specification	CE mark specification
Output 1 lamp	Red	Yellow
Output 2 lamp	Yellow	Blue
Output 3 lamp	Green	Green

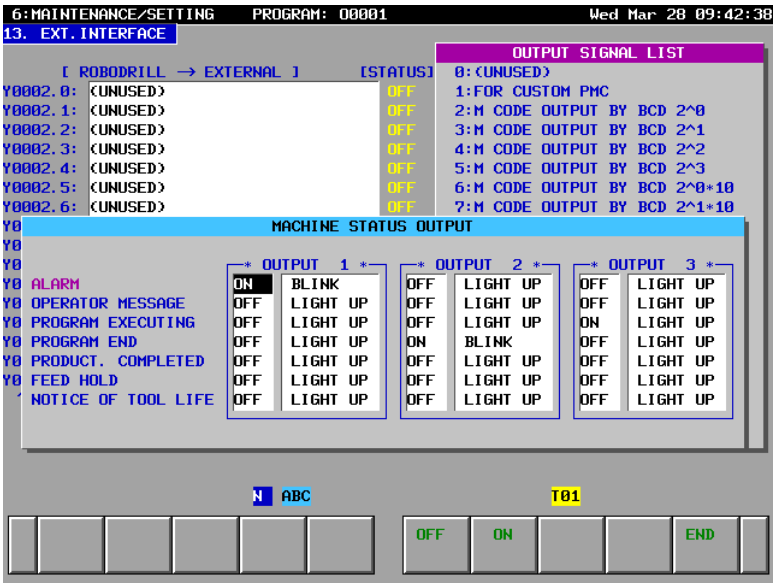
Initially, the lamps are set as follows:

Initial setting of each lamp

Status	Lamp operation
The machine is stopped by an alarm.	Output 1 lamp blinking
In a program, the machine is stopped by: • Program stop (M00) • Optional stop (M01) • Program end (M02 or M30)	Output 2 lamp blinking
A program is being executed.	Output 3 lamp ON

SUPPLEMENT

The setting of the status indicator can be changed using “MACHINE STATUS OUTPUT” displayed by selecting QUICK screen – “6: MAINTENANCE/ SETTING” – “13. EXT. INTERFACE”.



Position the cursor to the output menu to be set, then press the [ON] or [OFF] soft key. Select an output type (LIGHT UP/BLINK). After making the desired changes, press the [END] soft key.

SUPPLEMENT

Do not change the settings for the occurrence of alarms.

22 ADDITIONAL AXIS CONTROL (OPTION)

⚠ DANGER
One or two servo motors can be controlled for the fourth axis and fifth axis (additional axes). When installing an additional axis, be sure to install it on the table. If it is installed in any other place, the fixed cover or front door cannot be used to protect the operator from the operation of the additional axis, which can lead to injury.

Like the X-, Y-, and Z-axes, the additional axis can be driven only by manual operation when the front door is open. It can be fed by the manual handle or at a feedrate of 600 degrees/min or less.

The following tables list combinations of a motor and amplifier that can be controlled.

One additional axis specification

Motor		Amplifier	
Model name *1	Model number *2	Model name *1	Model number
β0.5/3000	A06B-0113-Bxxx	α*i* SV 20	A06B-6240-H103
α1/3000	A06B-0371-Bxxx		
α2/2000	A06B-0372-Bxxx		
α2/3000	A06B-0373-Bxxx		
α*i*F1/5000 (α1/5000*i*)	A06B-0202-Bxxx		
α*i*F2/5000 (α2/5000*i*)	A06B-0205-Bxxx		
α*i*S2/5000 (α2/5000*i*s)	A06B-0212-Bxxx		
α*i*S4/5000 (α4/5000*i*s)	A06B-0215-Bxxx		
α3/3000	A06B-0123-Bxxx	α*i* SV 40	A06B-6240-H104
α6/2000	A06B-0127-Bxxx		
α*i*F4/4000 (α4/4000*i*)	A06B-0223-Bxxx		
α*i*F8/3000 (α8/3000*i*)	A06B-0227-Bxxx		
D*i*S 85/400	A06B-0483-B20x		
D*i*S 60/400	A06B-0493-B20x		
D*i*S 110/300	A06B-0484-B10x	α*i* SV 80	A06B-6240-H105
D*i*S 260/300	A06B-0483-B30x		
D*i*S 150/300	A06B-0494-B30x		

*1 Old model names are indicated in parentheses.
*2 xxx and x are replaced by numbers according to the specification and shape of the motor.

Two additional axis specification

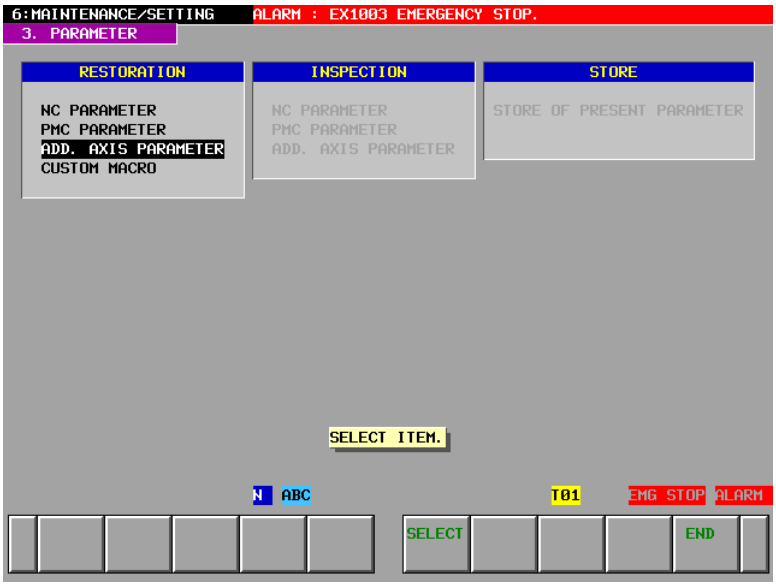
Motor *3 *4		Amplifier	
Fourth axis	Fifth axis	Model name *3	Model number *4
β0.5/3000	β0.5/3000	α*i* SV 20/20	A06B-6240-H205
α1/3000	α1/3000		
α2/2000	α2/2000		
α2/3000	α2/3000		
α*i*F1/5000 (α1/5000*i*)	α*i*F1/5000 (α1/5000*i*)		
α*i*F2/5000 (α2/5000*i*)	α*i*F2/5000 (α2/5000*i*)		
α*i*S2/5000 (α2/5000*i*s)	α*i*S2/5000 (α2/5000*i*s)		
α*i*S4/5000 (α4/5000*i*s)	α*i*S4/5000 (α4/5000*i*s)		
β0.5/3000	α3/3000	α*i* SV 20/40	A06B-6240-H206
α1/3000			
α2/2000	α6/2000		
α2/3000			
α*i*F1/5000 (α1/5000*i*)	α*i*F4/4000 (α4/4000*i*)		
α*i*F2/5000 (α2/5000*i*)	α*i*F8/3000 (α8/3000*i*)		
α*i*S2/5000 (α2/5000*i*s)	D*i*S 85/400		
α*i*F4/5000 (α4/5000*i*s)	D*i*S 60/400		
α3/3000	α3/3000	α*i* SV 40/40	A06B-6240-H207
α6/2000	α6/2000		
α*i*F4/4000 (α4/4000*i*)	α*i*F4/4000 (α4/4000*i*)		
α*i*F8/3000 (α8/3000*i*)	α*i*F8/3000 (α8/3000*i*)		
D*i*S 85/400	D*i*S 85/400		
D*i*S 60/400	D*i*S 60/400		
α3/3000	D*i*S 110/300	α*i* SV 40/80	A06B-6240-H208
α6/2000			
α*i*F 4/4000 (α4/4000*i*)			
α*i*F 8/3000 (α8/3000*i*)	D*i*S 260/300		
D*i*S 85/400			
D*i*S 60/400	D*i*S 150/300		

*3 Old model name are indicated in parentheses.

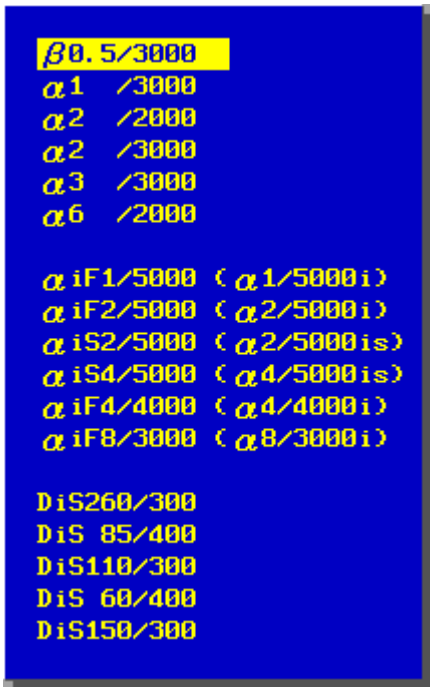
*4 For the specification of each motor, see the table of the one additional axis specification.

22.1 SETTING SERVO PARAMETERS

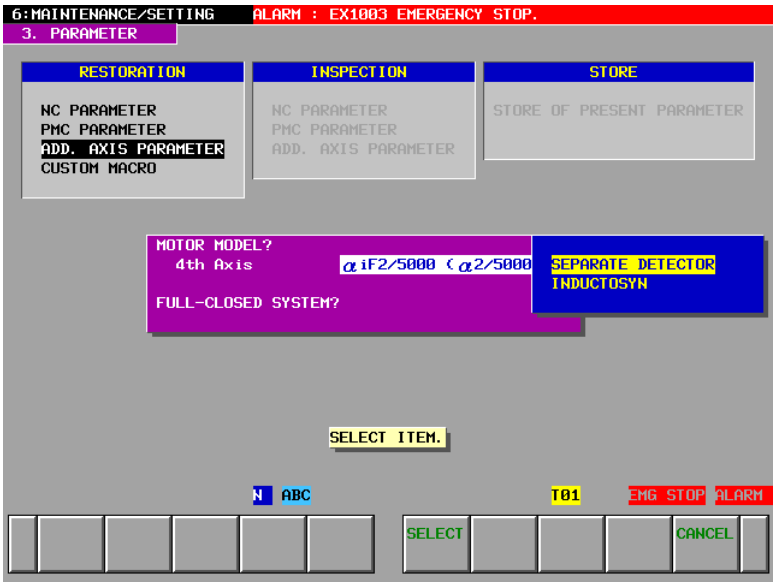
(1) Display QUICK Screen, “6:MAINTENANCE/ SETTING”, then “3:PARAMETER”.
(2) Press soft key [RESTOR]. The cursor is displayed in the “RESTORATION” menu.
Move the cursor to "ADD.AXIS PARAMETER" and press soft key [SELECT].



(3) Select the motor model.

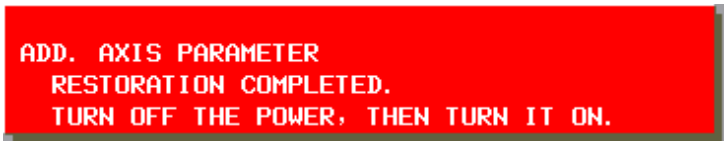


(4) For a closed loop system, the window shown below appears. Select the type of the closed loop system (separate detector, inductosyn).



(5) The following window appears. Press soft key [EXEC].

(6) After termination of parameter setting, the following window appears.
Turn the power off, then on again, and change and set parameters as required.



22.2 OTHER RELATED PARAMETERS (STANDARD SETTING)

B : 4th axis A : 5th axis

Number	Description
1006B(A)	#0; 0: Linear axis, 1: Rotation axis #5; Reference position return direction (0: +, 1: -)
1020B(A)	Axis name (66: B, 65: A)
1820B(A)	Command multiply (CMR)
1821B(A)	Reference counter capacity
1850B(A)	Grid shift (When making a shift of 1^{o}, set 10,000.)
2021B(A)	Load inertia ratio
2022B(A)	Direction of motor rotation (111: Clockwise, -111: Counterclockwise)
2084B(A)	Numerator of the flexible feed gear ratio (N)
2085B(A)	Denominator of the flexible feed gear ratio (M)

ATTENTION

When you change the value of parameter No. 2084, set the same value for parameter No. 2078.
When you change the value of parameter No. 2085, set the same value for parameter No. 2079.
For closed loop systems, however, the settings in parameters No. 2084 and No. 2078 are not the same, and the settings in parameter No. 2085 and No. 2079 are not the same.

No. 2078 : Dual position feedback conversion coefficient (numerator)
No. 2079 : Dual position feedback conversion coefficient (denominator)

22.3 CALCULATING THE FLEXIBLE FEED GEAR (DETECTION MULTIPLY DMR)

Example: Gear reduction ratio of the index table… 1 : 90
Servo motor used…α3 (with a serial pulse coder, 1,000,000 P/rev)
Detection unit…….0.0001°

(Calculation)
Target number of pulses issued per table rotation $\frac{360}{0.0001}$ = 600000 P

Number of pulses of the pulse coder per table rotation 1000000×90=90,000,000 P
Therefore, flexible feed gear N/M is calculated as follows:

$\frac{N}{M} = \frac{3600000}{90,000,000} = \frac{4}{100}$ ….. (No. 2084B (A))
….. (No. 2085B (A))

SUPPLEMENT

When changing the above standard setting of the flexible feed gear ratio (N/M) to a nonstandard setting, also change the reference counter capacity (parameter No. 1821B (A)).

Reference counter capacity (No.1821B(A)) = $\frac{N(\text{No.2084B(A)})}{M(\text{No.2085B(A)})} \times 1000000$

Example: Assuming N/M = 6/100

Reference counter capacity = $\frac{6}{100} \times 1000000 = 60000$ ….. (No.1821B(A))

22.4 GRID SHIFT

Setting a grid shift amount in No. 1850B (A) can shift the reference position (zero point).

SUPPLEMENT

- Once the parameter is re–set, it is necessary to switch off the power.
- The parameter can be set with a value from 0 to 99999999 in the least input increment units.
- To shift the table zero point by 1°, set the parameter to "10000."

22.5 REMOVING AUXILIARY AXES

To use the system when a servo amplifier for an additional axis is mounted but its additional axis motor and cable are removed, perform the following steps:

(1) Check and change the NC parameters listed below for the additional axis for which motor and cable are removed. (If the settings of these parameters are not changed, a servo alarm is issued, and the system cannot be used.)
If PMC parameter keep relay K12#3 is set to 0, when the power is turned on again after the motor and cable for the additional axis are removed, the settings of these parameters are changed automatically. When the parameters are to be entered from the screen, set K12#3 to 1.

NC parameter	Factory-set	Removing auxiliary axis
No.0012#7	0	1
No.1005#7	1	1
No.1815#5	1	0

22.6 SERVO PARAMETERS

There are numbers of servo parameters for each motor model. As for detail of these parameters, please refer the latest motor parameter manual (B-65270EN).

22.7 INDEX TABLE FUNCTION (OPTION)

(1) Specifying a command

(a) With the clamp/unclamp command
(Clamp or unclamp command for the fourth axis)

```
M72 : (Unclamp)
BΔΔ : (Index)    Note) When using the fourth axis as the B-axis
M71 : (Clamp)
```

or

```
M11 : (Unclamp)
BΔΔ : (Index)    Note) When using the fourth axis as the B-axis
M10 : (Clamp)
```

(Clamp or unclamp command for the fifth axis)

```
M69 : (Unclamp)
AΔΔ : (Index)    Note) When using the fifth axis as the A-axis
M68 : (Clamp)
```

(When making a reference position return, specify the unclamp command before movement along the additional axis starts.)

(b) Without the clamp/unclamp command

```
BΔΔ : (Index)    Note) When using the fourth axis as the B-axis
```

```
AΔΔ : (Index)    Note) When using the fifth axis as the A-axis
```

(c) Entering a value for the move command for the additional axis

Without a decimal point	B1 (or A1) →0.001°
With a decimal point	B1 (or A1) → 1°

(d) Absolute/incremental command
The absolute or incremental command can be specified with G90 or G91.

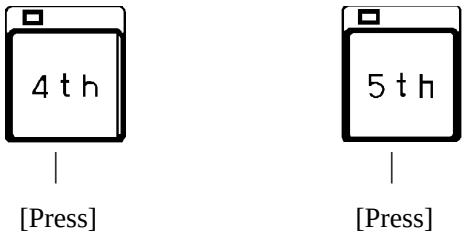
(e) Number of axes to be subject to simultaneous control
Among all axes, including the fourth and fifth axes, up to three axes can be controlled simultaneously. In MANUAL mode, however, only one axis can be controlled at a time.

(f) Feedrate
G00/G01 can be applied in the same way as for the X-, Y-, and Z-axes.

(2) Manual operation

Handle–mode operation can be executed in the same way as for the X-, Y-, and Z-axes.

(Selecting the fourth axis) (Selecting the fifth axis)

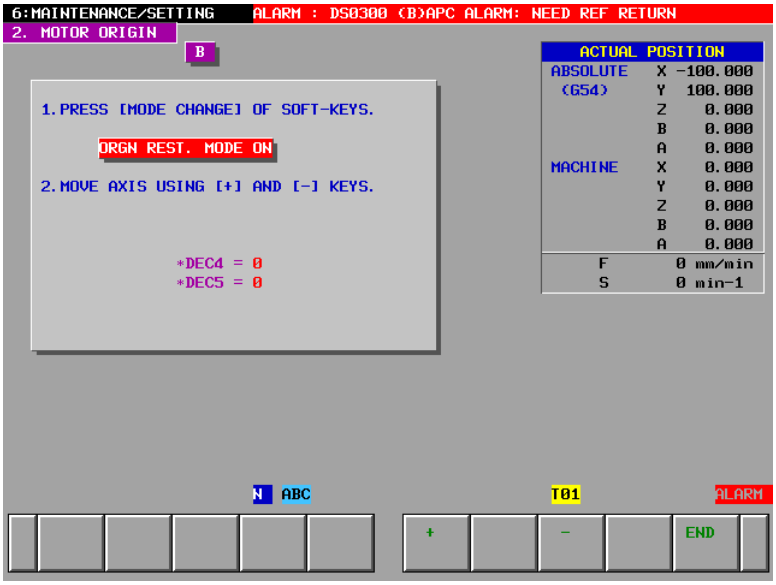


[Press] [Press]

(3) Return to the zero point (establishing the motor zero point)

Return to the zero point (establishing the motor zero point) Display QUICK Screen, “6: MAINTENANCE/SETTING”, then “2:MOTOR ORIGIN”.

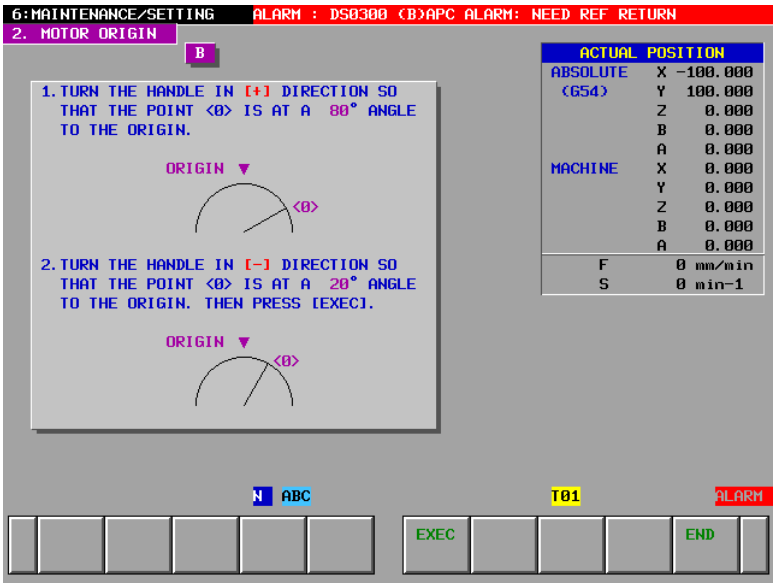
[For return to the motor origin with a dog]



Pressing the [+] or [-] soft key causes a return to the motor zero point on the fourth (or fifth) axis. (Pressing the [+] key instigates movements in the positive direction, while pressing the [-] key instigates movement in the negative direction.)

Keep the soft key held down until the completion of return to the zero point (establishing the motor zero point).

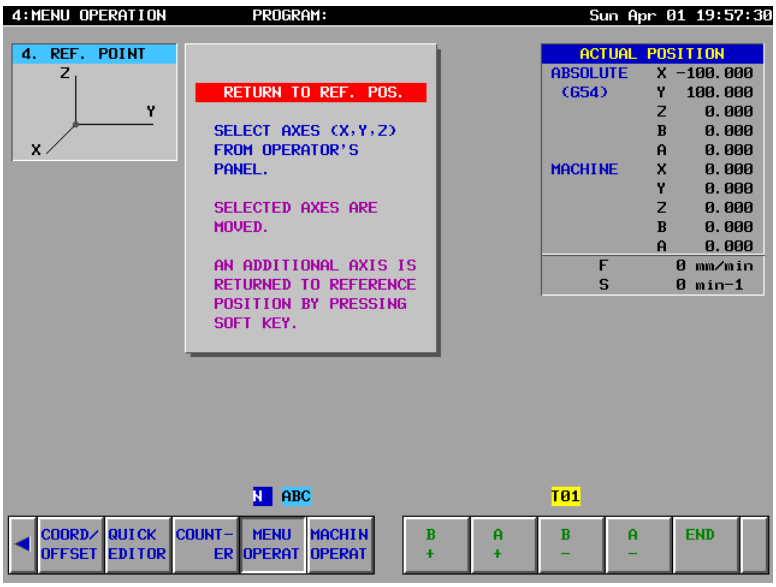
[For return to the motor origin without a dog]



Perform motor origin return operation according to the guidance.

(4) Reference position return (moving to the machine zero point)

To specify this operation, select the Quick screen, 4: MENU OPERATION, then 4. REF. POINT screen.



Pressing the soft key [B+] or [B–] instigates reference position return (movement to the machine zero point) on the fourth axis. Pressing the soft key [A+] or [A–] instigates reference position return on the fifth axis (Pressing the [+] key instigates movement in the positive direction. Pressing the [–] instigates movement in the negative direction).
Keep the soft key held down until the completion of reference position return.

SUPPLEMENT

When motor reference position return is performed with the safety door open, alarm 90 REFERENCE RETURN INCOMPLETE may be issued. In this case, close the safety door, then perform motor reference position return.
(When the safety door is open, the move speed about the additional axis is limited to 600 deg/min.)

(5) Turning the servo motor off

If the clamp or unclamp command is used for the fourth or fifth axis, the servo off function can be used to prevent the servo motor from being overloaded by the use of the fourth or fifth axis. (K02#1, K02#2)
When the servo off function is used, the servo motor is activated or deactivated according to the status of the clamp/unclamp check switch. (K03#2, K12#1)

SUPPLEMENT

If executing the servo off function immediately after the clamp check signal turns ON causes a position shift on the additional axis,
the position shift can be prevented by setting an appropriate value in timer T136 (T142) to delay the timing of the servo off function.

(6) Disabling movement along axes (interlock)

If the clamp/unclamp command is used for the fourth or fifth axis, operation is restricted as described below: (K03#2, K02#1)

In the clamp state :

X–, Y–, and Z–axes	→	Movement along the axes is not disabled.
Fourth and fifth axes	→	Movement along the axes is disabled.

In the unclamp state :

X–, Y–, and Z–axes	→	Movement along the axes can be enabled and disabled as necessary. (K03#3, K02#2)
Fourth and fifth axes	→	Movement along the axes is not disabled.

(7) Clamp/unclamp command

(Fourth axis)

Clamp command : M71 (or M10)	Unclamp command : M72 (or M11)

(Fifth axis)

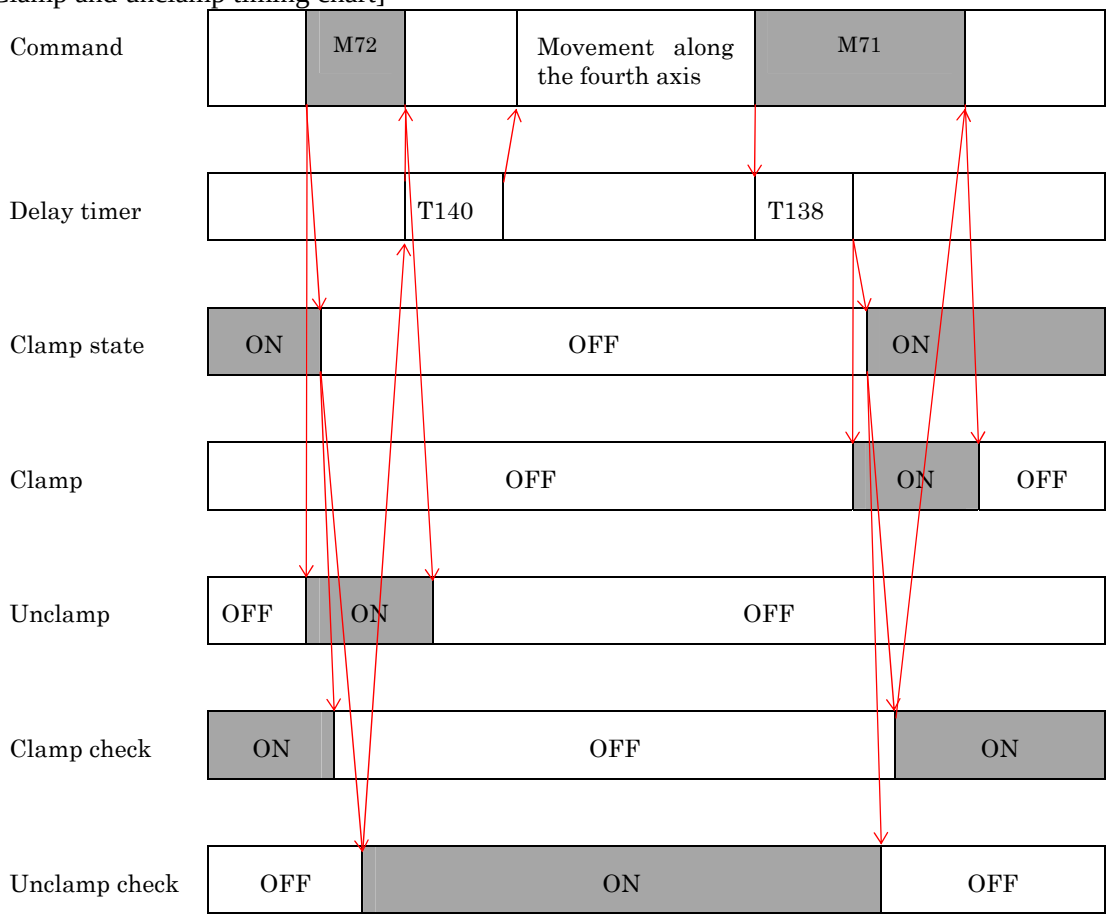
Clamp command : M68	Unclamp command : M69)

When using the clamp/unclamp command for the fourth axis, specify M72 or M11 (unclamp command) before movement along the axis starts, and M71 or M10 (clamp command) after completion of the movement. When using the clamp/unclamp command for the fifth axis, specify M69 before movement along the axis starts, and M68 after completion of the movement.

SUPPLEMENT

When the additional axis is clamped (with the M10, M68, or M71 command), an alarm may be issued due to a position shift or an excessive error. This is because the clamp signal is input during the in-position check. If this occurs, the alarm can be prevented from being issued by setting an appropriate value in timer T138 (T144) or by adding a dwell before the M10, M68, or M71 command to delay the clamp.
If it is necessary to delay the start of axis movement after the unclamp check signal is turned ON to protect the brake mechanism of the index table when the additional axis is unclamped, set an appropriate value in timer T140 (T146).
The settings of T138 and T140 (T144 and T146) are also effective to DDR. For details, see Chapter 33, "DDR" in Part IV.

[Clamp and unclamp timing chart]



(8) Detach function

When the power line, signal line, or similar, for the fourth or fifth axis is disconnected, the function automatically sets a detach (axis isolation) parameter so that an axis alarm will not be displayed. When the power line, signal line, or similar is subsequently reconnected, the detach (axis isolation) parameter is automatically reset so that the axis can be used.

After a power line, signal line, or similar has been connected or disconnected, turn the power on. After a QUICK screen or NC screen is displayed, turn the power off then on again.

(9) Overtravel function

The range of motion along the fourth or fifth axis can be restricted by using a proximity switch. When the switch is tripped, the following alarms can be output:

506 OVERTRAVEL: +* (* corresponds to a displayed axis name.)
507 OVERTRAVEL: –*

(10) Setting parameters

PMC parameter keep relay

	#7	#6	#5	#4	#3	#2	#1	#0
K02								

#1 0: In the fourth-axis clamp state, the servo motor is not deactivated.
1: In the fourth-axis clamp state, the servo motor is not deactivated.

#2 0: In the fifth-axis clamp state, the servo motor is not deactivated.
1: In the fifth-axis clamp state, the servo motor is deactivated.

	#7	#6	#5	#4	#3	#2	#1	#0
K03								

#2 0: The clamp/unclamp command is not used for the fourth axis.
1: The clamp/unclamp command is used for the fourth axis.

#3 0: In the fourth-axis unclamp state, the X-, Y-, and Z-axes are not interlocked.
1: In the fourth-axis unclamp state, the X-, Y-, and Z-axes are interlocked.

	#7	#6	#5	#4	#3	#2	#1	#0
K12								

#1 0: The clamp/unclamp command is not used for the fifth axis.
1: The clamp/unclamp command is used for the fifth axis.

#2 0: In the fifth-axis unclamp state, the X-, Y-, and Z-axes are not interlocked.
1: In the fifth-axis unclamp state, the X-, Y-, and Z-axes are interlocked.

#3 0: The detach function and hardware over travel function are used for the fourth and fifth axes.
1: The detach function and hardware over travel function are not used for the fourth and fifth axes.

	#7	#6	#5	#4	#3	#2	#1	#0
K27								

#2 0: The FIN output when the fourth axis is clamped waits for the servo off function.
1: The FIN output when the fourth axis is clamped does not wait for the servo off function (when PMC parameter K02#1 = 1).

#3 0: The FIN output when the fifth axis is clamped waits for the servo off function.
1: The FIN output when the fifth axis is clamped does not wait for the servo off function (when PMC parameter K02#2 = 1).

PMC parameter timers

Number	Standard value	Description
T136	**	Time from the time the clamp of the fourth axis is checked until the servo off function is executed In msec
T138	**	Delay time of the start of the clamp immediately after movement along the fourth axis In msec
T140	**	Interlock time after the fourth axis is unclamped In msec
T142	**	Time from the time the clamp of the fifth axis is checked until the servo off function is executed In msec
T144	**	Delay time of the start of the clamp immediately after movement along the fifth axis In msec
T146	**	Interlock time after the fifth axis is unclamped In msec

(**: Adjustment value from the index table manufacturer)

CNC parameters

	#7	#6	#5	#4	#3	#2	#1	#0
3004			OTH					

#5 0: The hardware overtravel function is not used for the fourth and fifth axes.
1: The hardware overtravel function is used for the fourth and fifth axes.

22.8 ADDITIONAL AXIS CABLE FOR THE INDEX TABLE

There are two methods of connection between the controller cabinet and the index table;

- Connection with additional axis connector unit
- Connection without additional axis connector unit

Each connection block diagrams are shown on Fig. 4.22.8 (a) to (d)
(JF1, JF2, CZ2, CZ2L, CZ2M, XS21, XS22, and XS40 to XS43 mean connectors on each unit.
a to n mean connectors on each cable. Please refer to table 4.22.8.1 (a).)

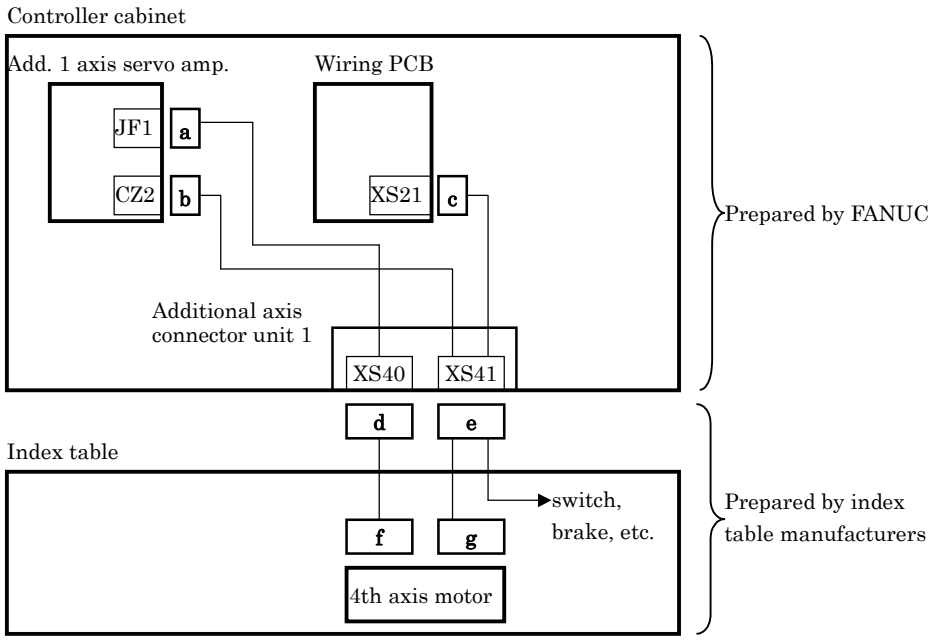


Fig. 22.8 (a) Connection block diagram between the controller cabinet and the index table (Additional 1 axis with additional axis connector unit)

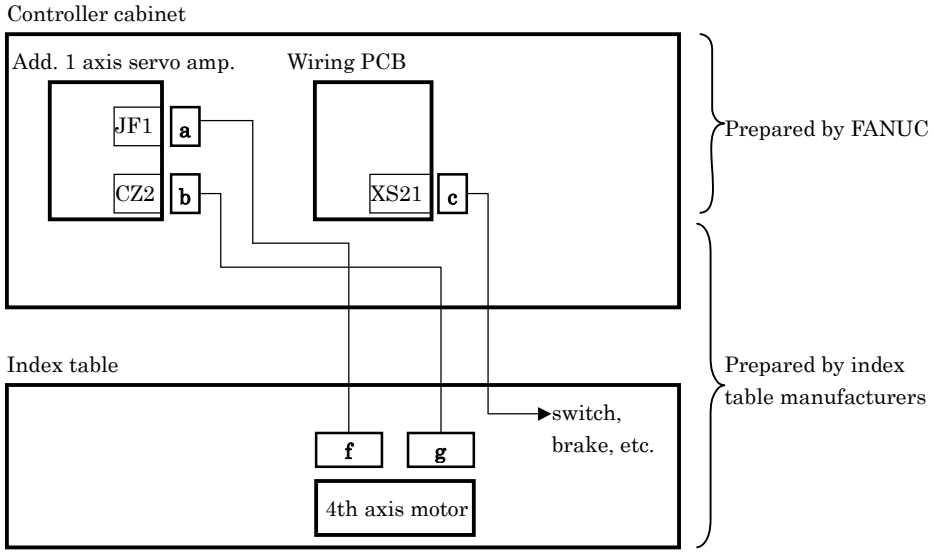


Fig. 22.8 (b) Connection block diagram between the controller cabinet and the index table (Additional 1 axis without additional axis connector unit)

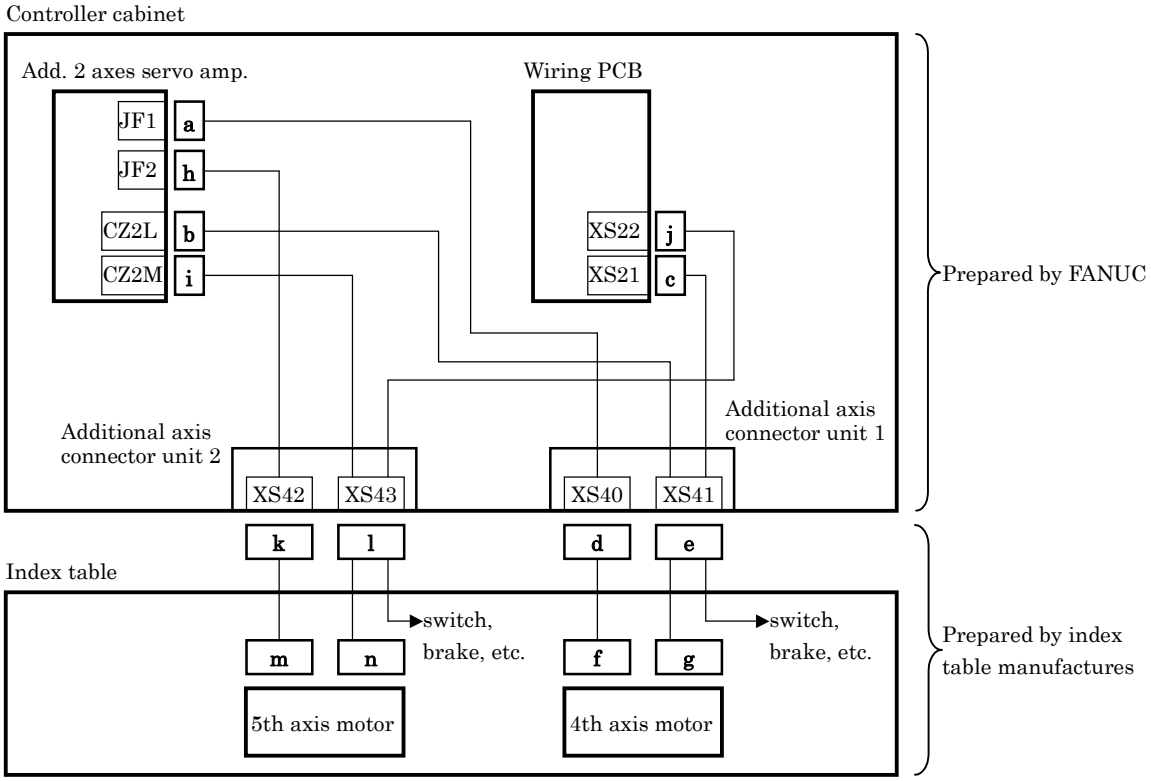


Fig. 22.8 (c) Connection block diagram between the controller cabinet and the index table (Additional 2 axes with additional axis connector units)

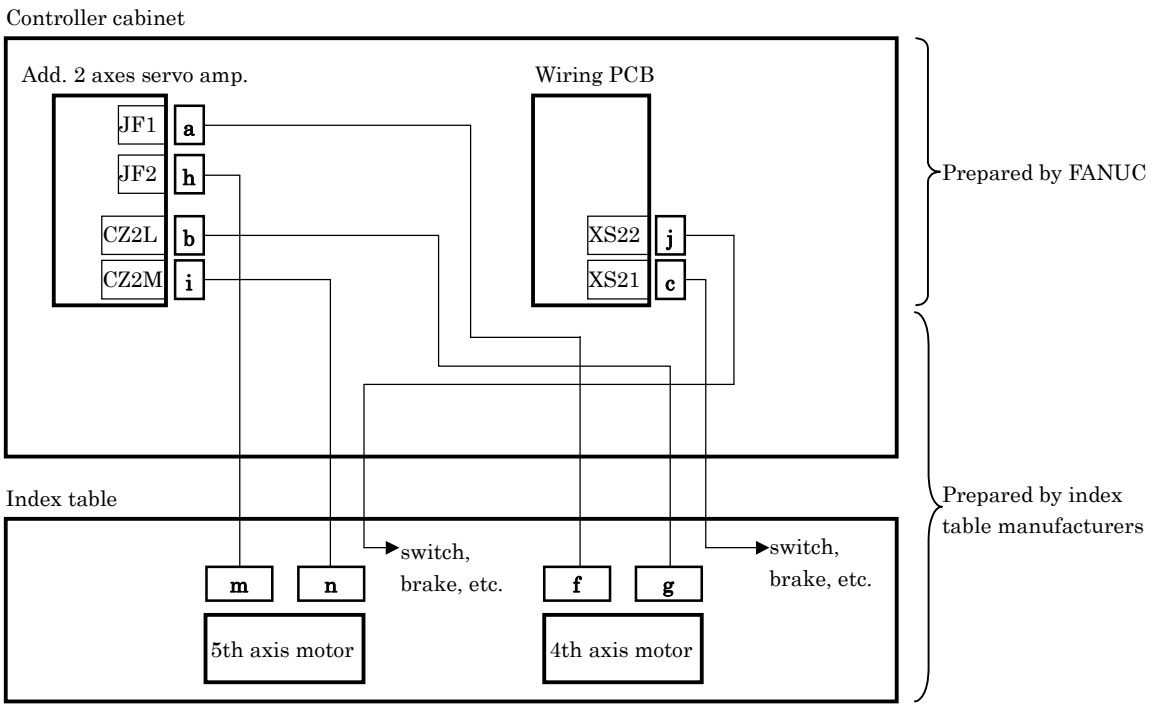


Fig. 22.8 (d) Connection block diagram between the controller cabinet and the index table (Additional 2 axes without additional axis connector units)

Table 22.8 (a) Connector list

Axis	Connector symbols	Purpose
4th axis	JF1, a	Feedback signal cable of the servo motor (joint on the servo amplifier)
	CZ2, CZ2L, b	Power cable of the servo motor (joint on the servo amplifier)
	XS21, c	Input/output signal cable of the index table (switch, brake, etc.. joint on the wiring PCB)
	XS40, d	Feedback signal cable of the servo motor (joint on the additional axis connector unit)
	XS41, e	Power cable of the servo motor and input/output signal cable of the index table (joint on the additional axis connector unit)
	f	Feedback signal cable of the servo motor (joint on the servo motor)
	g	Power cable of the servo motor (joint on the servo motor)
5th axis	JF2, h	Feedback signal cable of the servo motor (joint on the servo amplifier)
	CZ2M, i	Power cable of the servo motor (joint on the servo amplifier)
	XS22, j	Input/output signal cable of the index table (switch, brake, etc.. joint on the wiring PCB)
	XS42, k	Feedback signal cable of the servo motor (joint on the additional axis connector unit)
	XS43, l	Power cable of the servo motor and input/output signal cable of the index table (joint on the additional axis connector unit)
	m	Feedback signal cable of the servo motor (joint on the servo motor)
	n	Power cable of the servo motor (joint on the servo motor)

Additional axis connector unit can be prepared with ordering specification No.s shown in table 4.22.8.1 (b). Note that the specification No.s of the additional axis connector unit differ by each machine's destination.

Table 22.8 (b) Additional axis connector unit

Purpose	FANUC ordering spec. No.	Contents
Add. 1 axis Japan and general export	A04B-0094-J210	・Add. axis connector unit 1 : A04B-0094-D201 ・Other accessories (screws, etc.)
Add. 2 axes Japan and general export	A04B-0094-J211	・Add. axis connector unit 1 : A04B-0094-D201 ・Add. axis connector unit 2 : A04B-0094-D202 ・Other accessories (screws, etc.)
Add. 1 axis for Europe and China	A04B-0094-J238	・Add. axis connector unit 1 : A04B-0094-D203 ・Other accessories (screws, etc.)
Add. 2 axes for Europe and China	A04B-0094-J239	・Add. axis connector unit 1 : A04B-0094-D203 ・Add. axis connector unit 2 : A04B-0094-D204 ・Other accessories (screws, etc.)

Details of cable connector : [a] to [n] are described on the next sections.

ATTENTION
Use water-proof and oil-proof connectors, if coolants or other liquids may adhere to them.

22.8.1 Connectors for feedback signal cables of servo motors

22.8.1.1 Joint on servo amplifier : connector a and h

Note) If additional axis connector units are already assembled, connector a and h are included to them.

No.	Item	Manufacturer	Model No.	Qty.	Note
1	Connector	HIROSE ELECTRIC	FI40-2015S	1	-
2	Connector cover	HIROSE ELECTRIC	FI-20-CV	1	-

22.8.1.2 Joint on additional axis connector unit : connector d and k

Note 1) Connectors differ by each machine's destination.
Note 2) These connectors are prepared by index table manufacturers.

(1) Machines for Japan and general export

No.	Item	Manufacturer	Model No.	Qty.	Note
1	Straight plug	HIROSE ELECTRIC	H/MS3106A 20-29SW(11)	1	Choose one from three listed on the left column.
2	Elbow plug	HIROSE ELECTRIC	H/MS3108B 20-29SW(11)	1	
3	Plug	Japan Aviation Electronics Industry	JA06A-20-29SW-J1-EB	1	

(2) Machines for Europe and China

No.	Item	Manufacturer	Model No.	Qty.	Note
1	Plug	SOURIAU	CL1P3101	1	-
2	Adaptor	SOURIAU	CL103000	1	-
3	Ground contact (solderless type, 0.93 to 1.91mm^2)	SOURIAU	8501 9641	1	For earth wire
4	Soldering type contact (Max.1.91 mm^2)	SOURIAU	CM16PS10MQ	11	Choose one from four listed on the left column.
5	Solderless type contact (0.93 to 2.6 mm^2)	SOURIAU	CM16PC00MQ	11	
6	Solderless type contact (0.93 to 1.91 mm^2)	SOURIAU	CM16PC10MQ	11	
7	Solderless type contact (0.128 to 0.205 mm^2)	SOURIAU	CM16PC30MQ	11	

Spare parts kit : A04B-0094-K203 includes following items.
Item No.1 : 2 pcs., Item No.2 : 2 pcs., Item No.3 : 1 pc., Item No.4 : 35 pcs.

22.8.1.3 Joint on servo motor : connector f and m

Note 1) Connectors differ by each motor model.
Note 2) These connectors are prepared by index table manufacturers.
Note 3) As for each motor model name and model No., please refer to the beginning of this chapter.

(1) Motor model : β0.5/3000

No.	Item	Manufacturer	Model No.	Qty.	Note
1	Housing	TE connectivity	178289-6	1	-
2	Contact	TE connectivity	1-175217-2	11	-

Spare parts kit : A06B-6050-K120 includes following items.
Item No.1 : 1 pc., Item No.2 : 11 pcs.

(2) Motor model : α1/3000 and α2/3000

No.	Item	Manufacturer	Model No.	Qty.	Note
1	Connector	HIROSE ELECTRIC	HDAB-15S	1	-
2	Connector cover	HIROSE ELECTRIC	HDAW-15-CV	1	-

Spare parts kit : A06B-6050-K115 includes following items.
Item No.1 : 3 pcs., Item No.2 : 3 pcs.

(3) Motor model : α3/3000

No.	Item	Manufacturer	Model No.	Qty.	Note
1	Straight plug	HIROSE ELECTRIC	H/MS3106A 20-29SW(11)	1	Choose one from three listed on the left column.
2	Elbow plug	HIROSE ELECTRIC	H/MS3108B 20-29SW(11)	1	
3	Straight plug	Japan Aviation Electronics Industry	JA06A-20-29SW-J1-EB	1	

(4) Motor model : α*i*F1/5000, α*i*F2/5000, α*i*F4/4000, α*i*F8/3000, α*i*S2/5000 and α*i*S4/5000

No.	Item	Manufacturer	Model No.	Qty.	Note
1	Straight connector	Japan Aviation Electronics Industry	JN1DS10SL2	1	Choose one from two listed on the left column.
2	Elbow connector	Japan Aviation Electronics Industry	JN1FS10SL2	1	
3	Contact	Japan Aviation Electronics Industry	JN1-22-22S	8	-

Spare parts kit : A06B-6114-K200#S includes following items.
Item No.1 : 1 pc., Item No.3 : 8 pcs.
Spare parts kit : A06B-6114-K200#E includes following items.
Item No.2 : 1 pcs., Item No.3 : 8 pcs.

22.8.2 Connectors for power cables of servo motors

22.8.2.1 Joint on servo amplifier : connector b and i

Note 1) Connector model differs between 4th axis and 5th axis.
Note 2) If additional axis connector units are already assembled, connector a and h are included to them.

No.	Item	Manufacturer	Model No.	Qty.	Note
1	Housing	TE connectivity	1-917807-2	1	4th axis (connector b)
2	Housing	TE connectivity	3-917807-2	1	5th axis (connector i)
3	Contact	TE connectivity	316040-6	4	-

22.8.2.2 Joint on additional axis connector unit : connector e and l

Note 1) Connectors differ by each machine's destination.
Note 2) These connectors are prepared by index table manufacturers.

(1) Machines for Japan and general export

No.	Item	Manufacturer	Model No.	Qty.	Note
1	Straight plug	HIROSE ELECTRIC	H/MS3106A 22-14S	1	Choose one from three listed on the left column.
2	elbow plug	HIROSE ELECTRIC	H/MS3108B 22-14S	1	
3	Plug	Japan Aviation Electronics Industry	JA06A-22-14S-J1	1	

(2) Machines for Europe and China

No.	Item	Manufacturer	Model No.	Qty.	Note
1	Plug	SOURIAU	CL1P3101	1	-
2	Adaptor	SOURIAU	CL103000	1	-
3	Ground contact (solderless type, 0.93 to 1.91 mm^2)	SOURIAU	8501 9641	1	For earth wire
4	Soldering type contact (Max.1.91 mm^2)	SOURIAU	CM16PS10MQ	11	Choose one from four listed on the left column.
5	Solderless type contact (0.93 to 2.6 mm^2)	SOURIAU	CM16PC00MQ	11	
6	Solderless type contact (0.93 to 1.91 mm^2)	SOURIAU	CM16PC10MQ	11	
7	Solderless type contact (0.128 to 0.205 mm^2)	SOURIAU	CM16PC30MQ	11	

Spare parts kit : A04B-0094-K203 includes following items.
Item No.1 : 2 pcs., Item No.2 : 2 pcs., Item No.3 : 1 pc., Item No.4 : 35 pcs.

22.8.2.3 Joint on servo motor : connector g and n

Note 1) Connectors differ by each motor model.
Note 2) These connectors are prepared by index table manufacturers.
Note 3) As for each motor model name and model No., please refer to the beginning of this chapter.

(1) Motor model : β0.5/3000

No.	Item	Manufacturer	Model No.	Qty.	Note
1	Housing	TE connectivity	3-178129-6	1	-
2	Contact	TE connectivity	1-175217-2	6	-

Spare parts kit : A06B-6050-K119 includes following items.
Item No.1 : 1 pc., Item No.2 : 11 pcs.

(2) Motor model : α1/3000 and α2/3000

No.	Item	Manufacturer	Model No.	Qty.	Note
1	Connector set	TE connectivity	176346-8	1	-

Spare parts kit : A06B-6050-K121 includes 1 pc. of above item.

(3) Motor model : α3/3000

No.	Item	Manufacturer	Model No.	Qty.	Note
1	Straight plug	HIROSE ELECTRIC	H/MS3106A 18-10S(10)	1	Choose one from three listed on the left column.
2	Elbow plug	HIROSE ELECTRIC	H/MS3108B 18-10S(10)	1	
3	Straight plug	Japan Aviation Electronics Industry	JA06A-18-10S-J1-(A72)	1	

(4) Motor model : α*i*F1/5000, α*i*F2/5000, α*i*S2/5000 and α*i*S4/5000

No.	Item	Manufacturer	Model No.	Qty.	Note
1	Straight connector	TE connectivity	1473063-2	1	Choose one from two listed on the left column.
2	Elbow connector	TE connectivity	1473393-2	8	

Spare parts kit : A06B-6114-K220#S includes following items.
Item No.1 : 1 pc.
Spare parts kit : A06B-6114-K220#E includes following items.
Item No.2 : 1 pc.

(5) Motor model : α*i*F4/4000 and α*i*F8/3000

No.	Item	Manufacturer	Model No.	Qty.	Note
1	Straight plug	HIROSE ELECTRIC	H/MS3106A18-10S(10)	1	Choose one from nine listed on the left column.
2	Straight plug	Japan Aviation Electronics Industry	JA06A-18-10S-J1-EB	1	
3	Straight plug	DDK	MS3106A18-10S-B-BSS	1	
4	Elbow plug	HIROSE ELECTRIC	H/MS3108B18-10S(10)	1	
5	Elbow plug	Japan Aviation Electronics Industry	JA08A-18-10S-J1-EB	1	
6	Elbow plug	DDK	MS3108A18-10S-B-BAS	1	
7	Monoblock	HIROSE ELECTRIC	H/MS3106A18-10S(13)	1	
8	Monoblock	Japan Aviation Electronics Industry	JA06A-18-10S-J1(A72)	1	
9	Monoblock	DDK	MS3106A18-10S-B(D190)	1	

22.8.3 Connectors for input/output signal cables of the index table

For the joint on the additional axis connector unit: connectors e and l, see Subsection 22.8.2.2 in this chapter.

22.8.3.1 Joint on the wiring PCB: connectors c and j

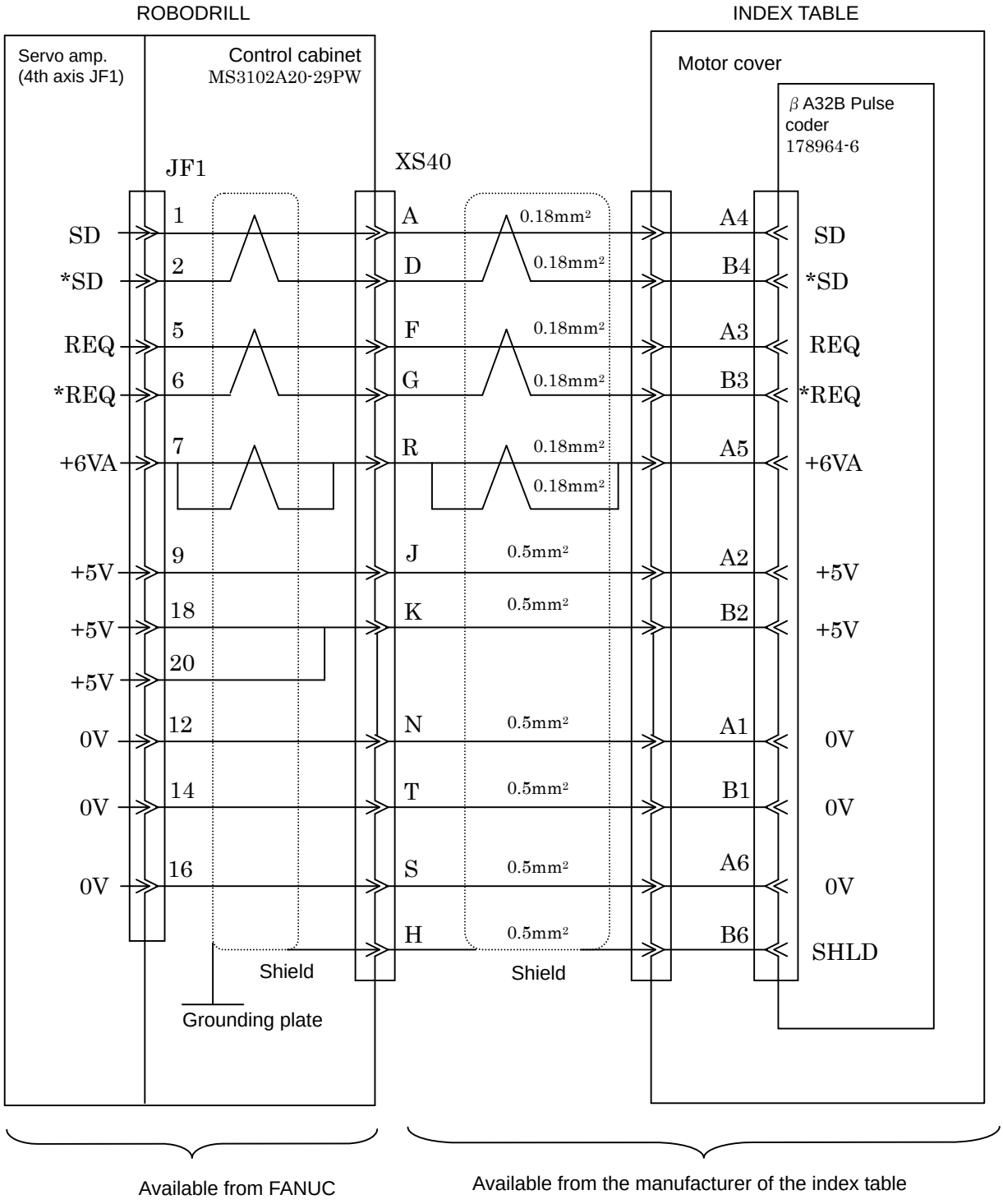
Note 1) If additional axis connector units are already assembled, connector a and h are included to them.

No.	Brand	Manufacturer	Manufacturer model	Qty.	Remarks
1	Housing	J.S.T. Mfg. Co., Ltd.	J21DF-12V-KX	1	-
2	Contact	J.S.T. Mfg. Co., Ltd.	SJ2F-01GF-P1.0	11	-

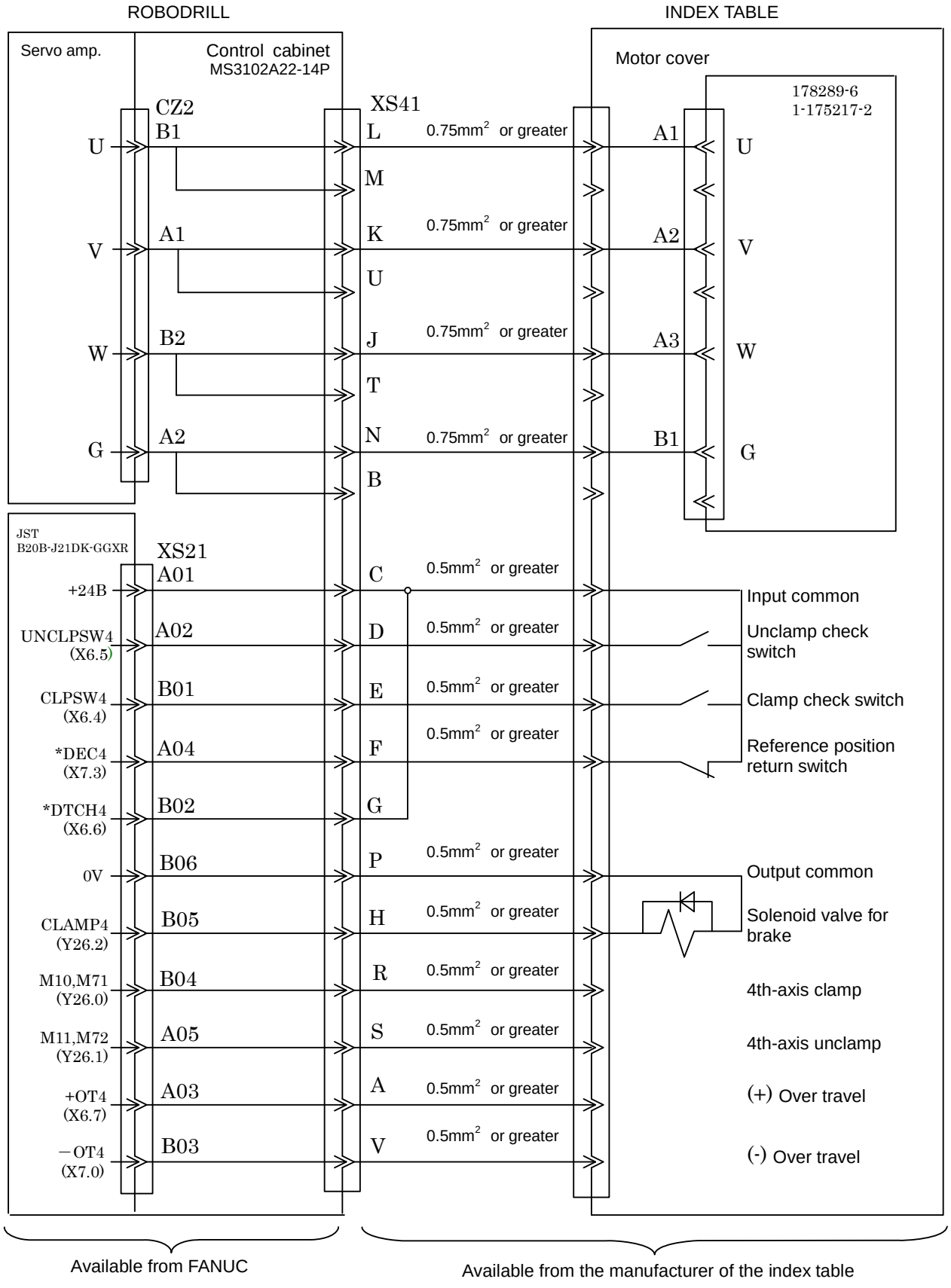
22.8.4 Additional axis cable circuit diagrams (4th axis, machines for Japan and general export)

22.8.4.1 β0.5/3000

(a) Connection of motor feedback signals

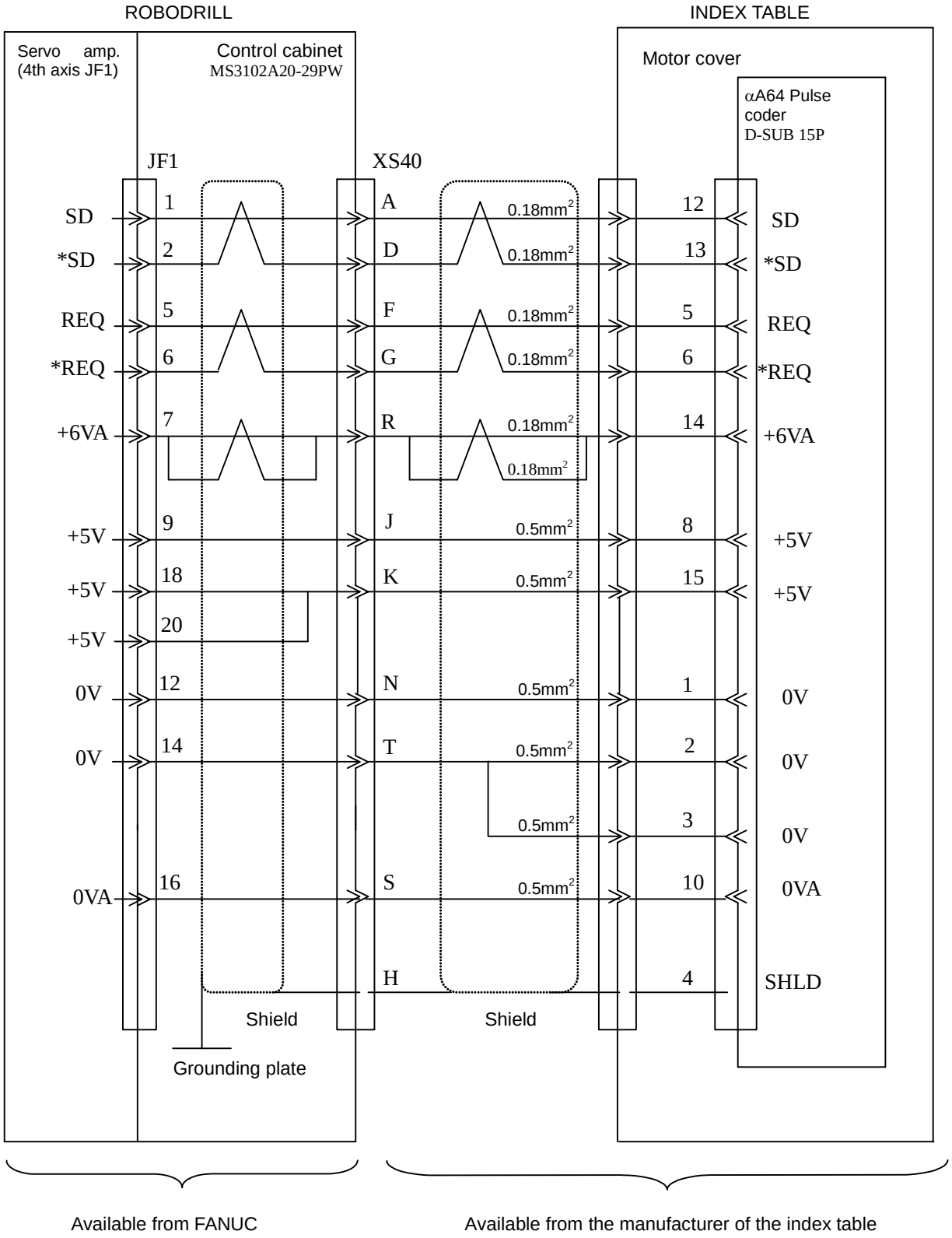


(b) Connection of the motor power and index table input/output signals

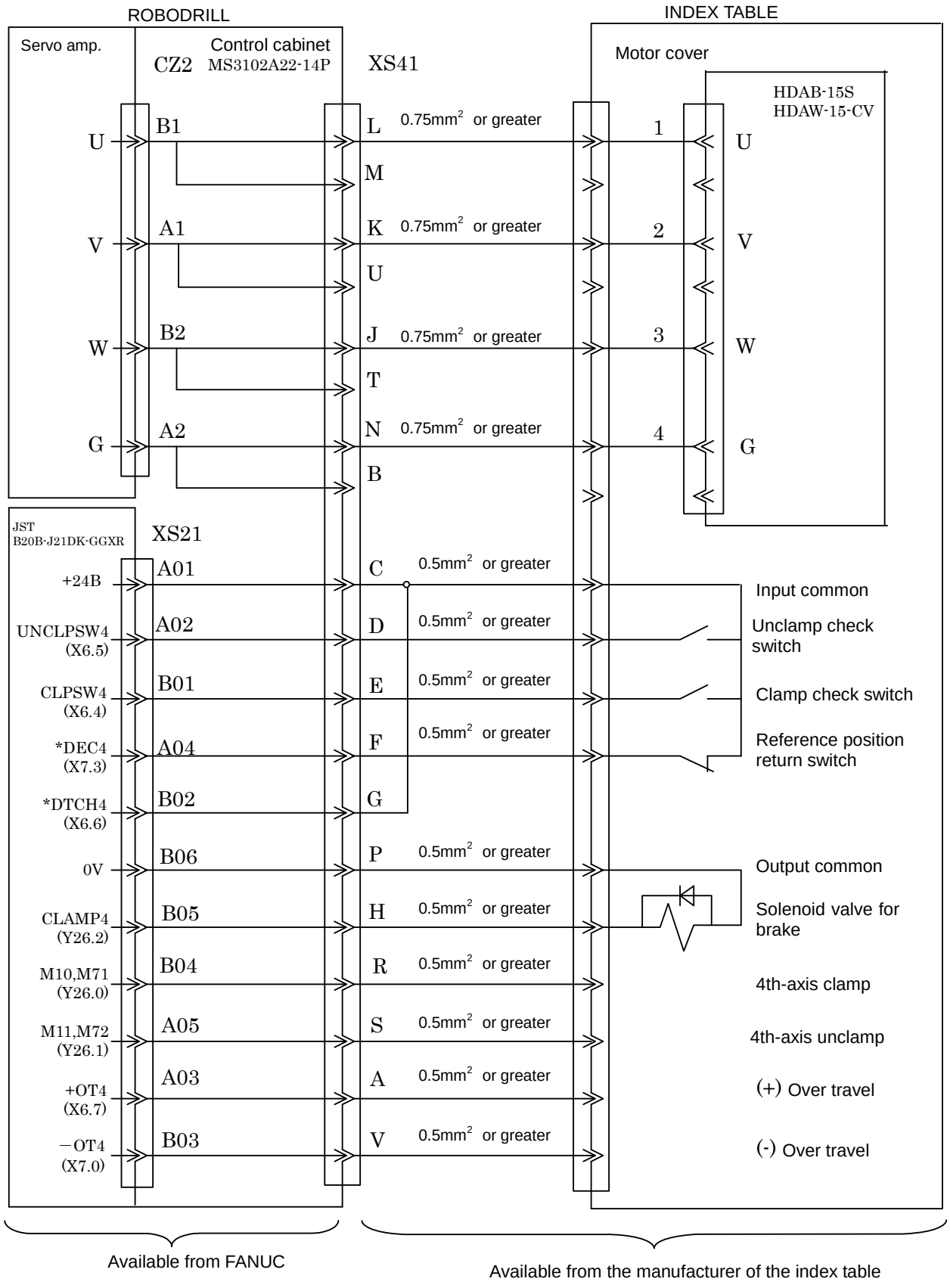


22.8.4.2 α1/3000, α2/3000

(a) Connection of motor feedback signals

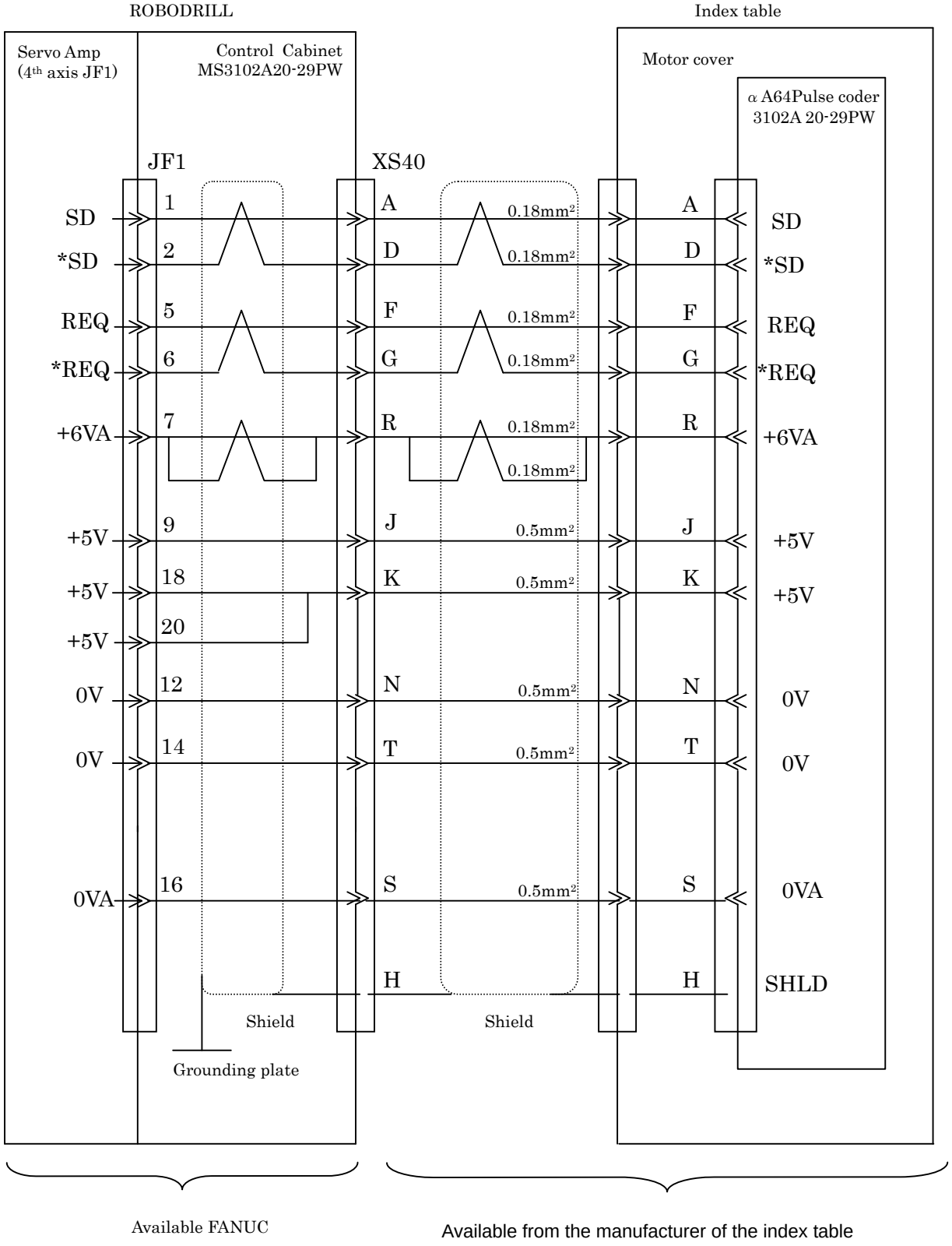


(b) Connection of the motor power and index table input/output signals

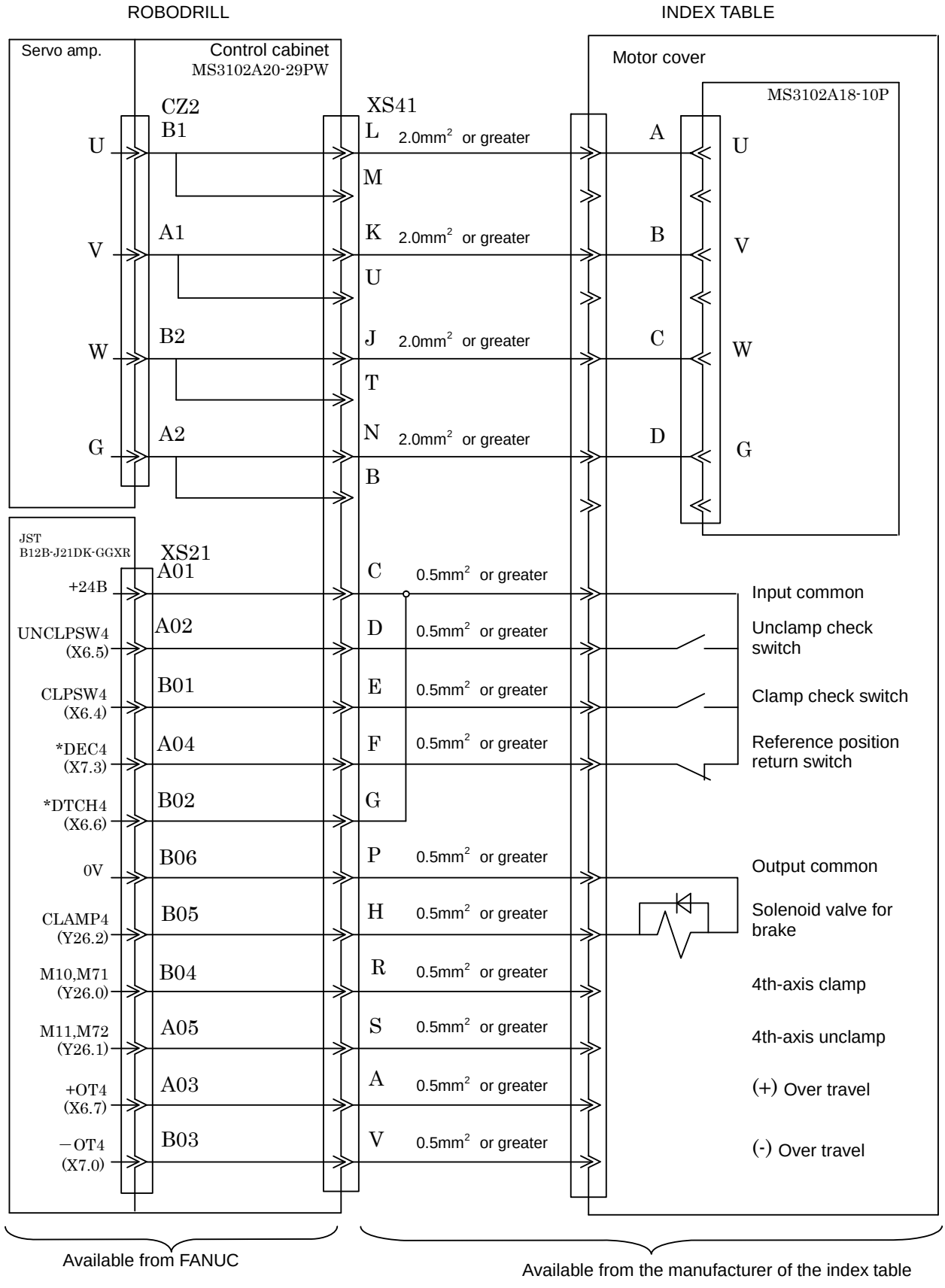


22.8.4.3 α3/3000

(a) Connection of motor feedback signals

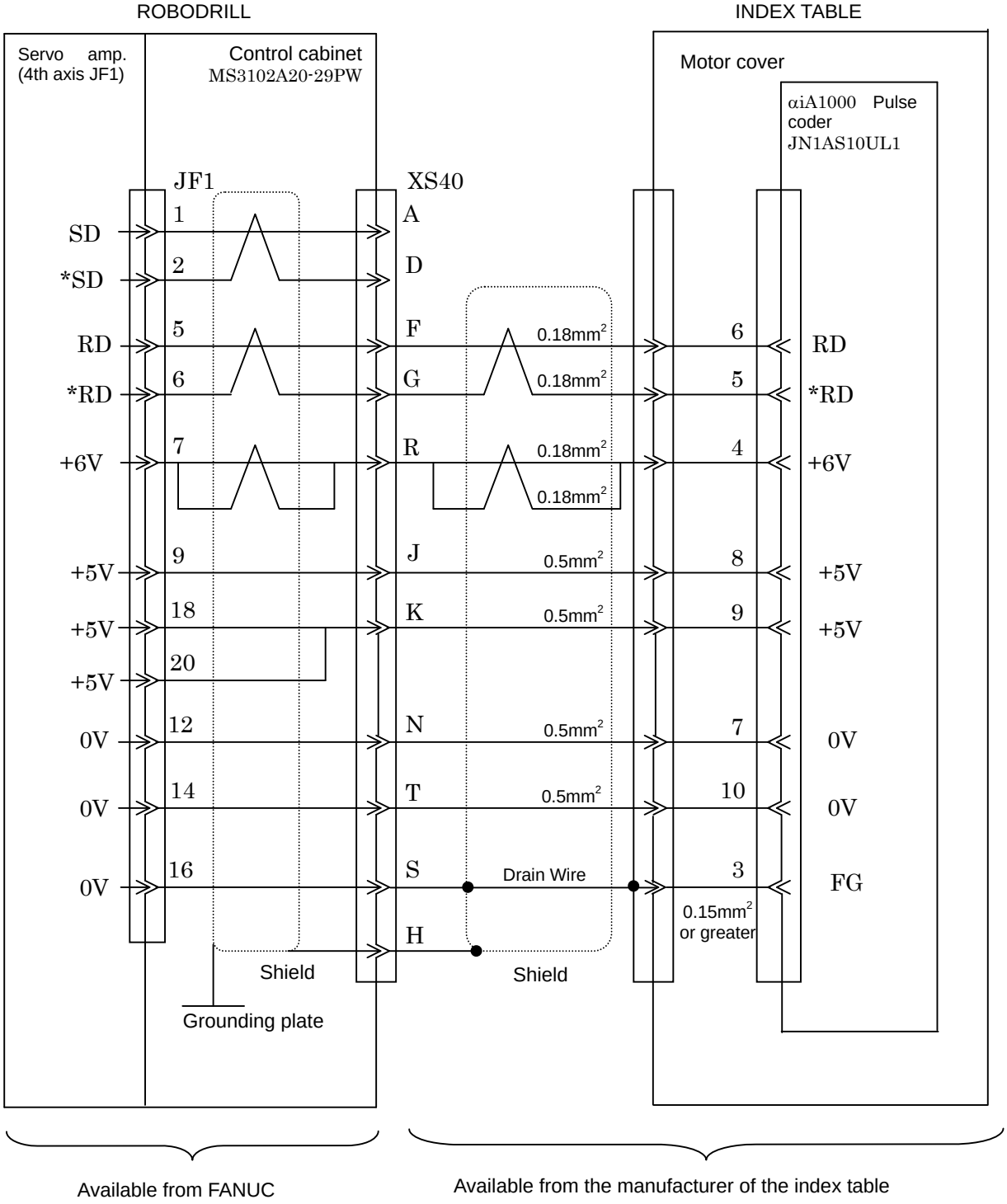


(b) Connection of the motor power and index table input/output signals

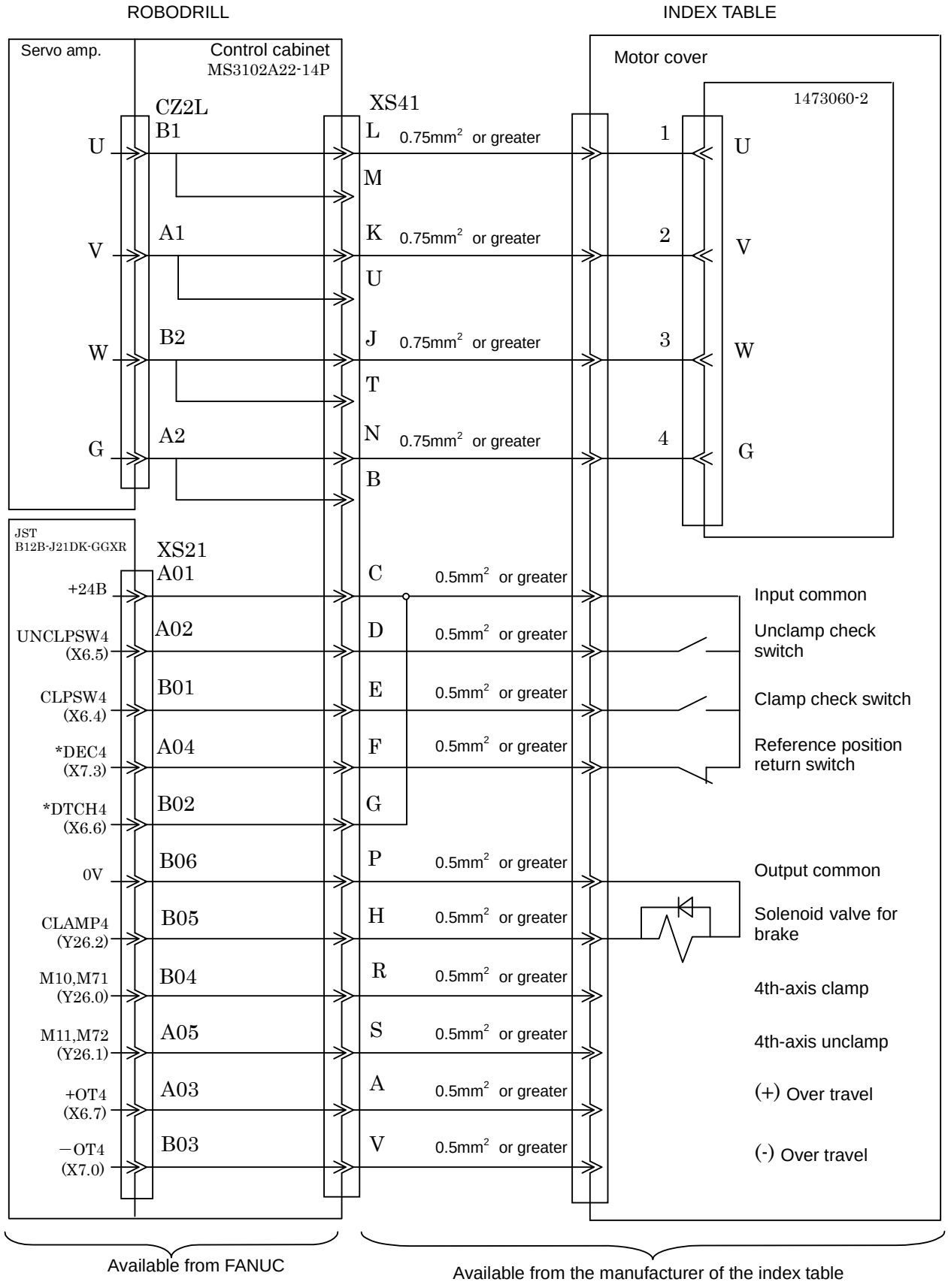


22.8.4.4 αiF1/5000, αiF2/5000, αiS2/5000, αiS4/5000

(a) Connection of motor feedback signals

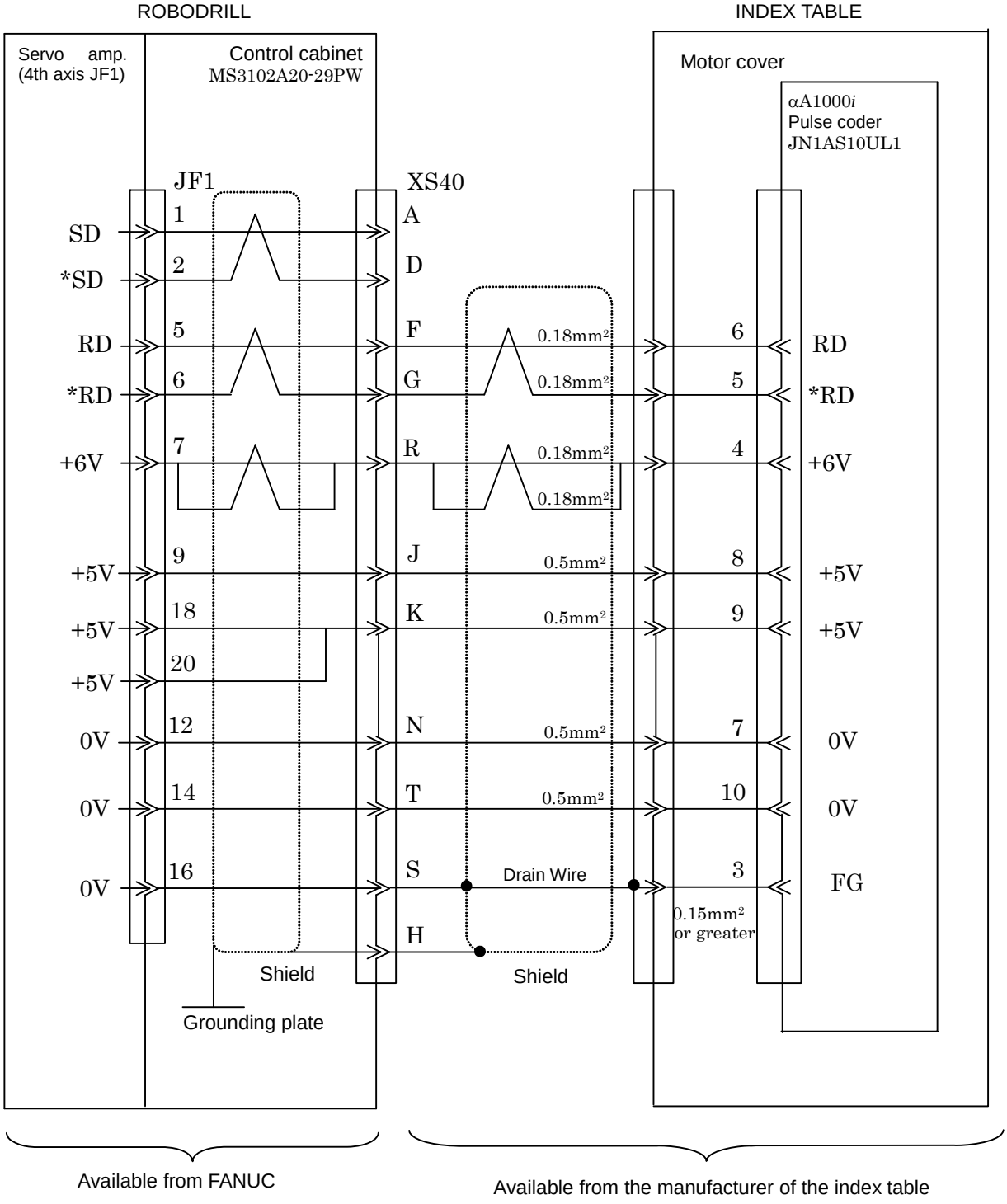


(b) Connection of the motor power and index table input/output signals

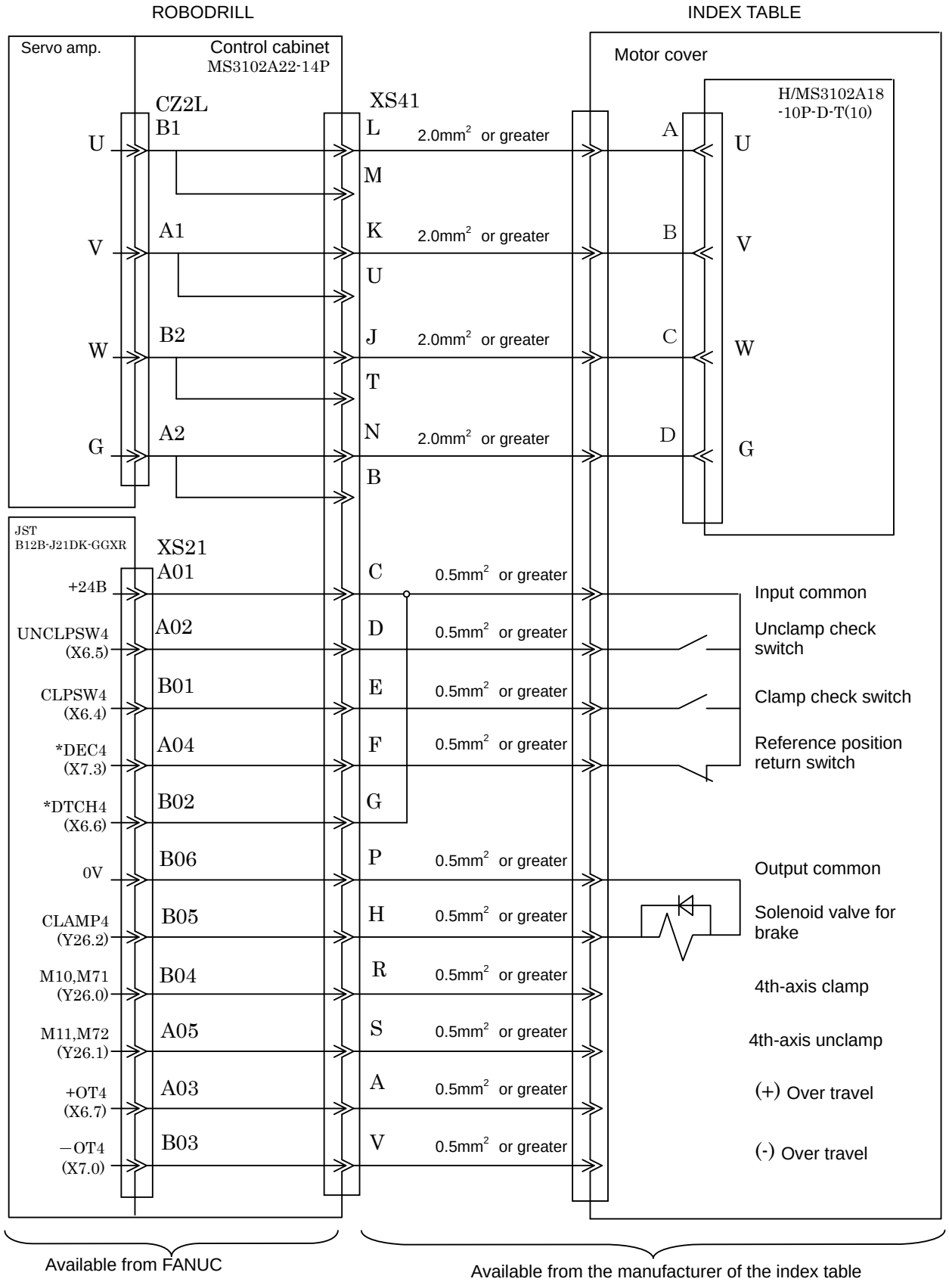


22.8.4.5 αiF4/4000, αiF8/3000

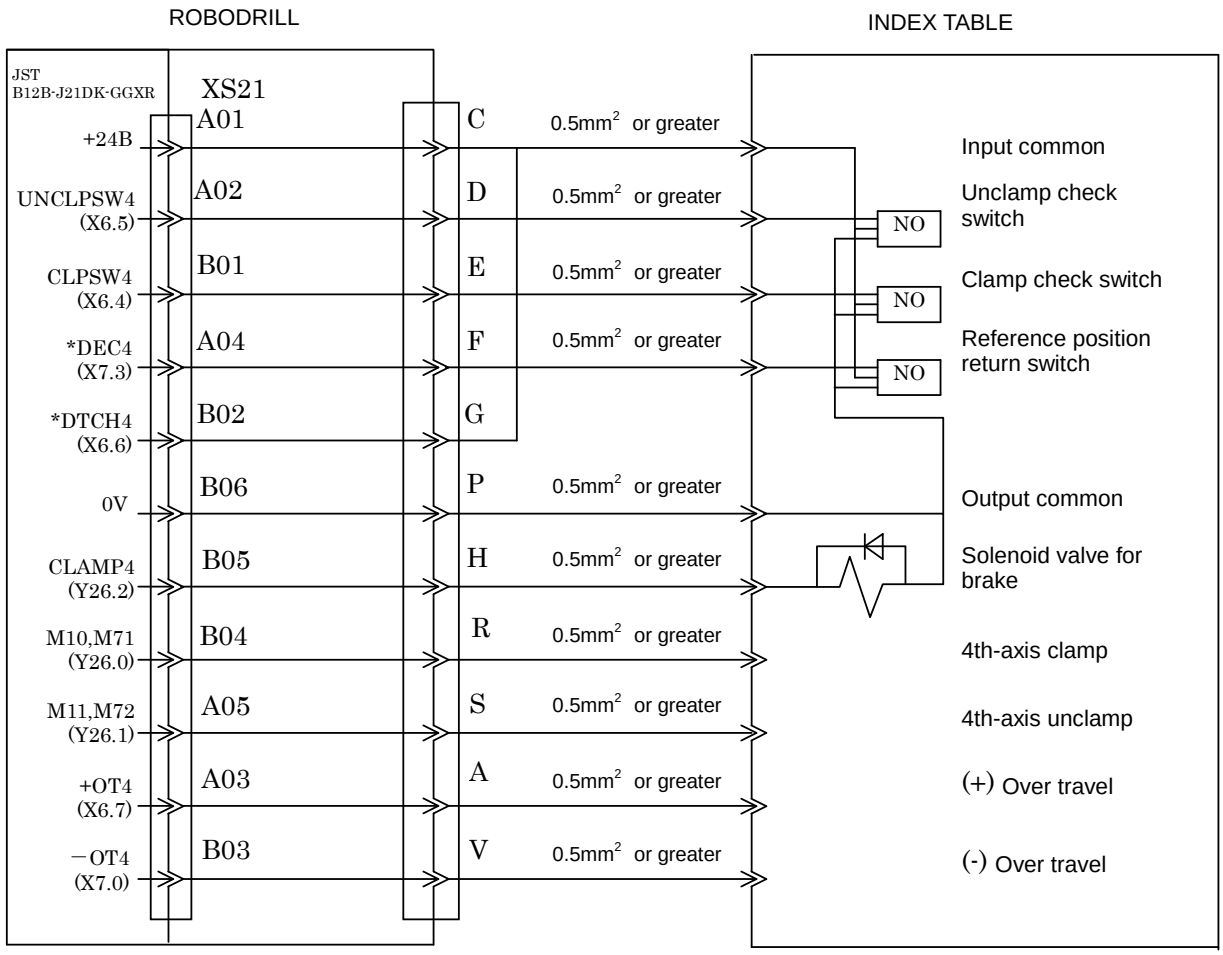
(a) Connection of motor feedback signals



(b) Connection of the motor power and index table input/output signals



22.8.4.6 Using a proximity switch



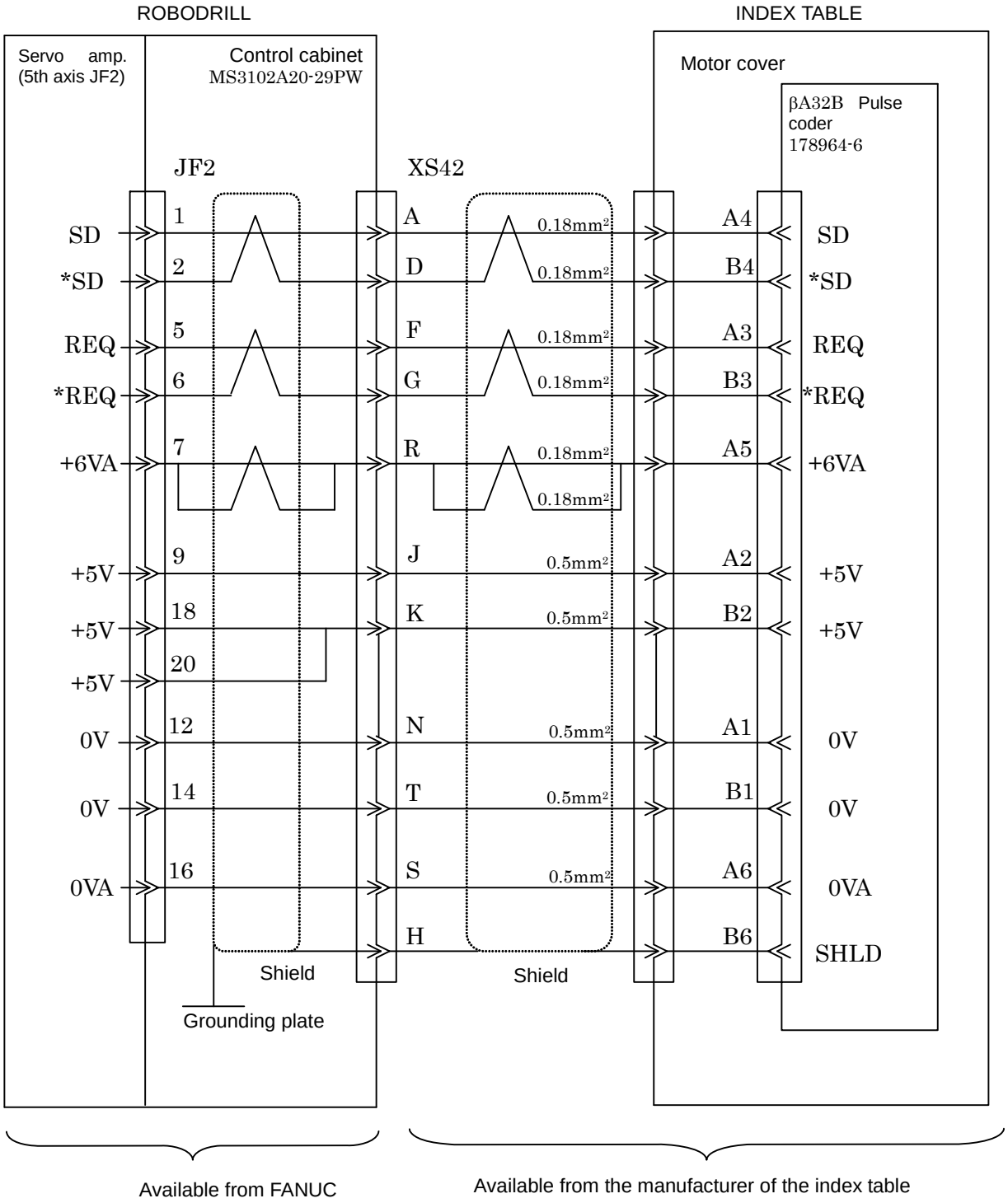
SUPPLEMENT

The 4th–axis detachment signal is used to check the cable connection status. When the level of the *DTCH4 signal falls to 0, the servo motor is deactivated. (Before connecting or disconnecting a cable, first turn the machine off.)
When the 4th–axis detachment signal is not used, the function can be PMC parameter K12#3
= 0: Validates the 4th–axis detachment function.
= 1: Invalidates the 4th–axis detachment function.

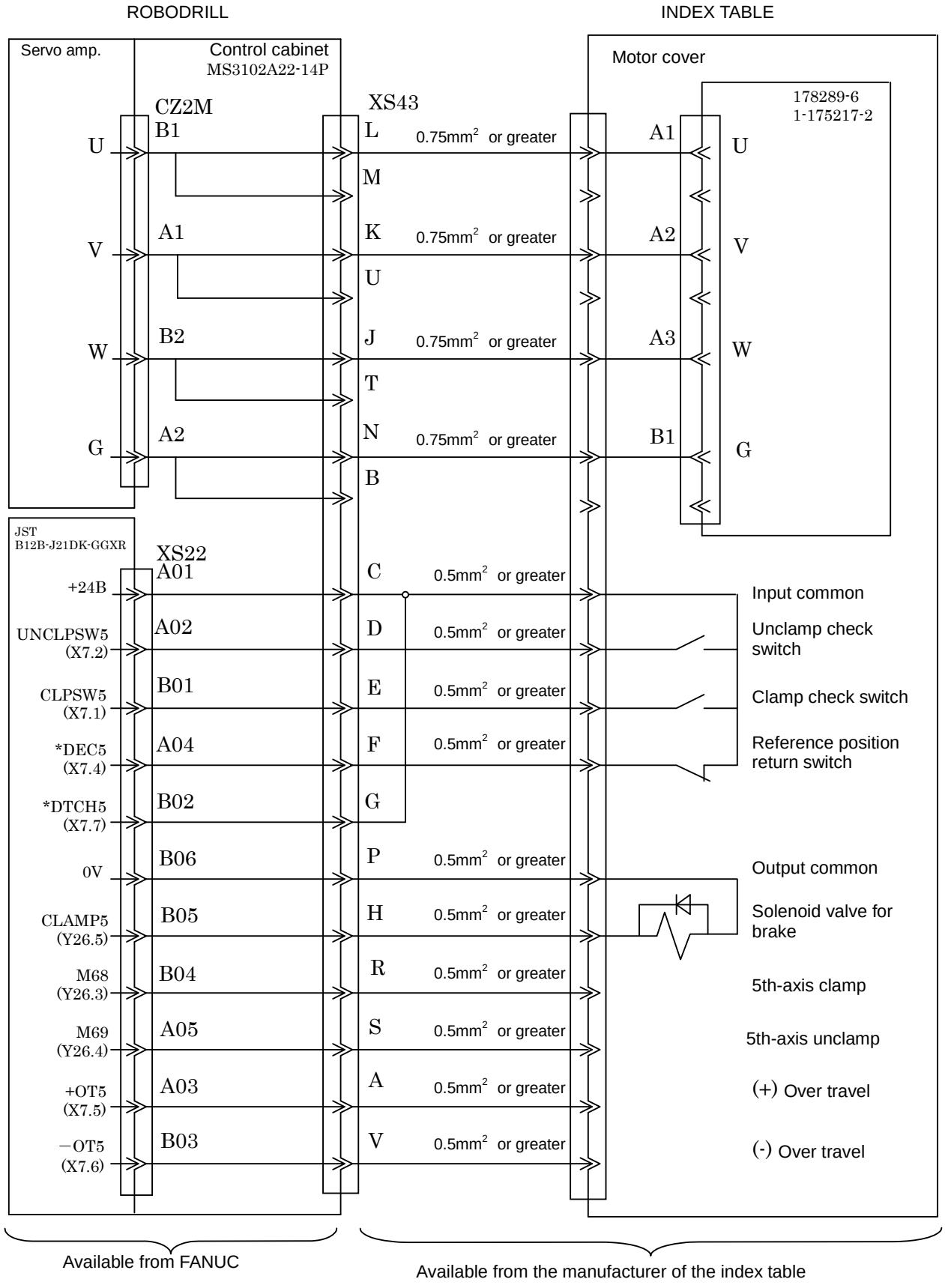
22.8.5 Additional axis cable circuit diagrams (5th axis, machines for Japan and general export)

22.8.5.1 β0.5/3000

(a) Connection of motor feedback signals

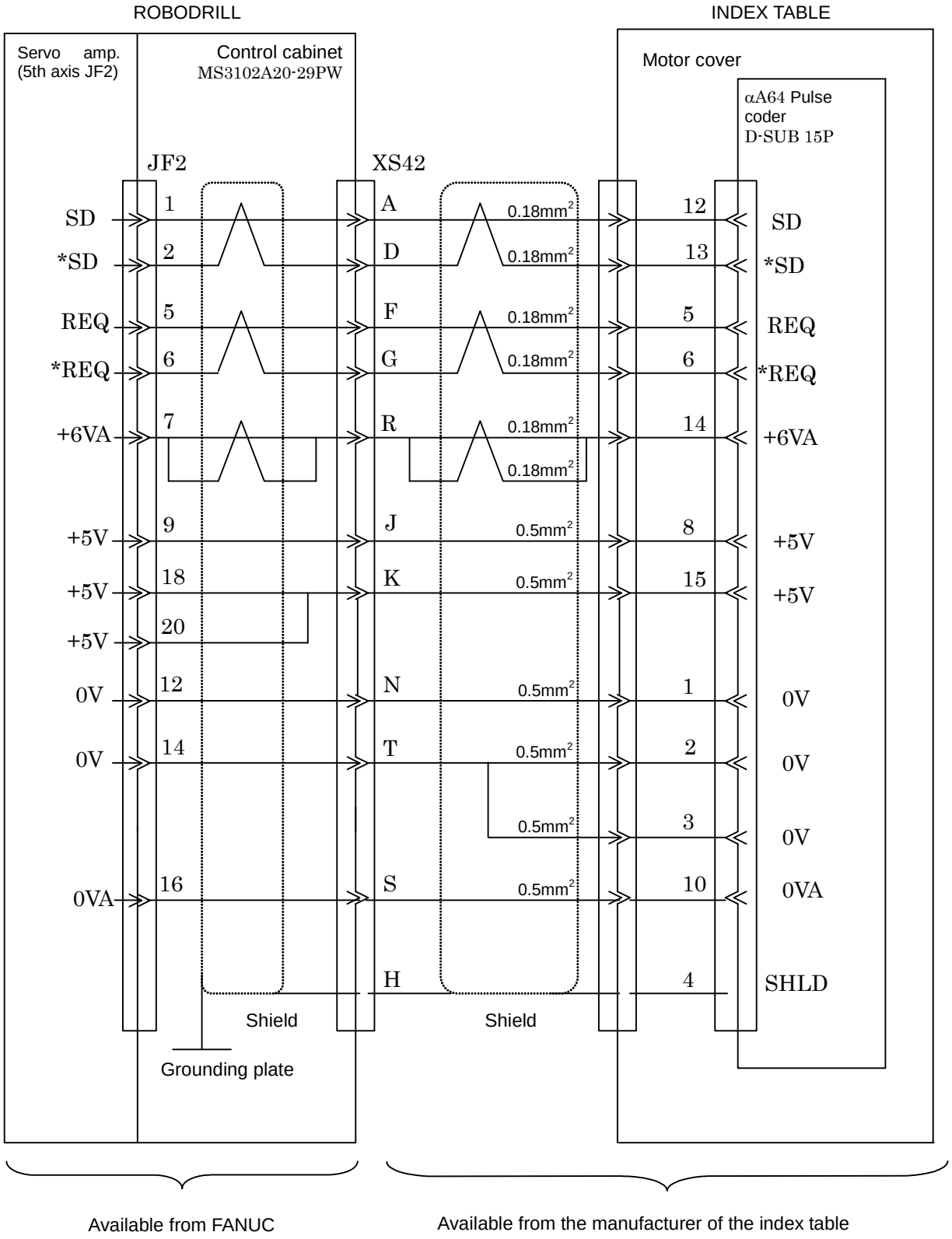


(b) Connection of the motor power and index table input/output signals

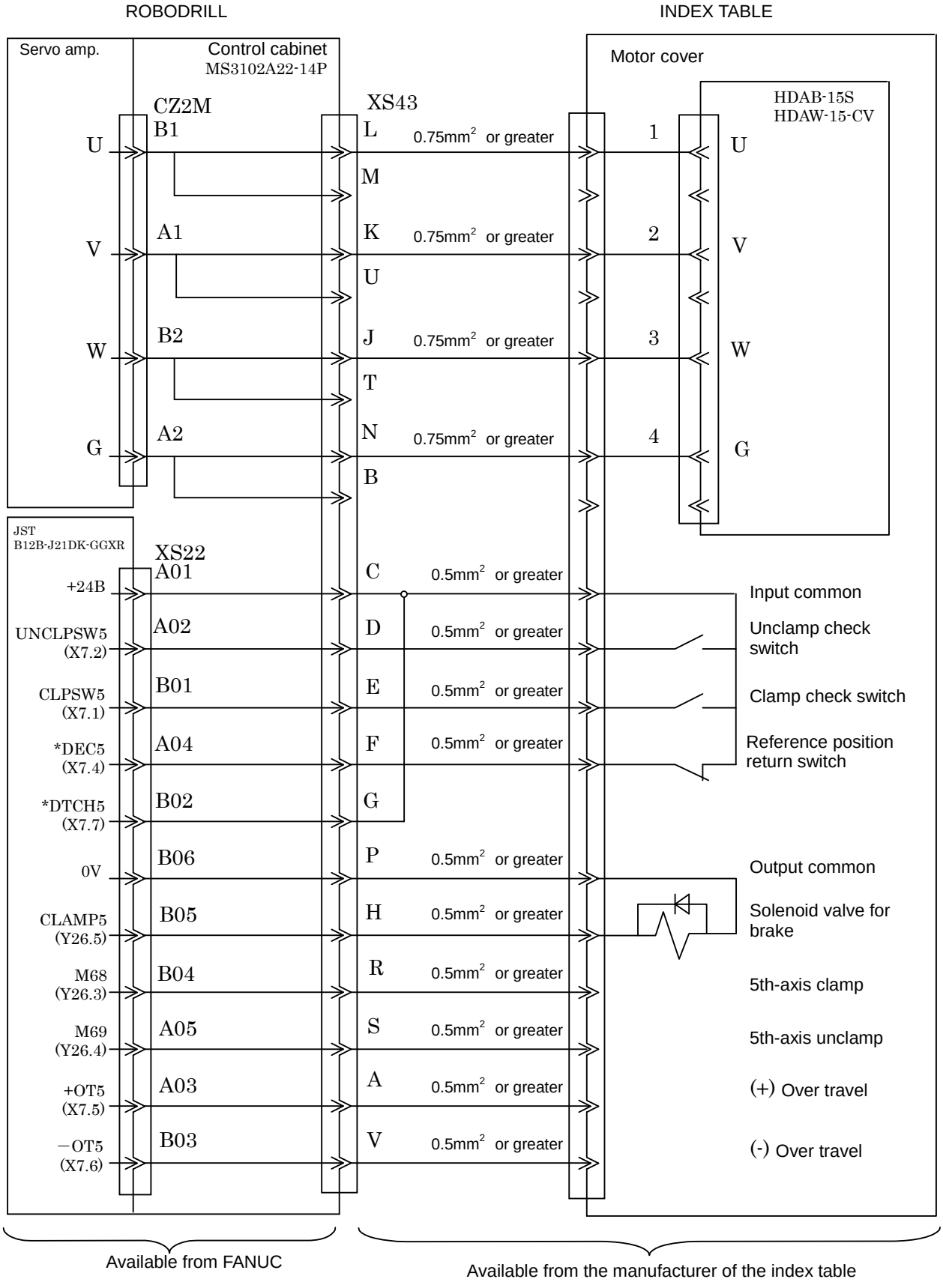


22.8.5.2 α1/3000, α2/3000

(a) Connection of motor feedback signals

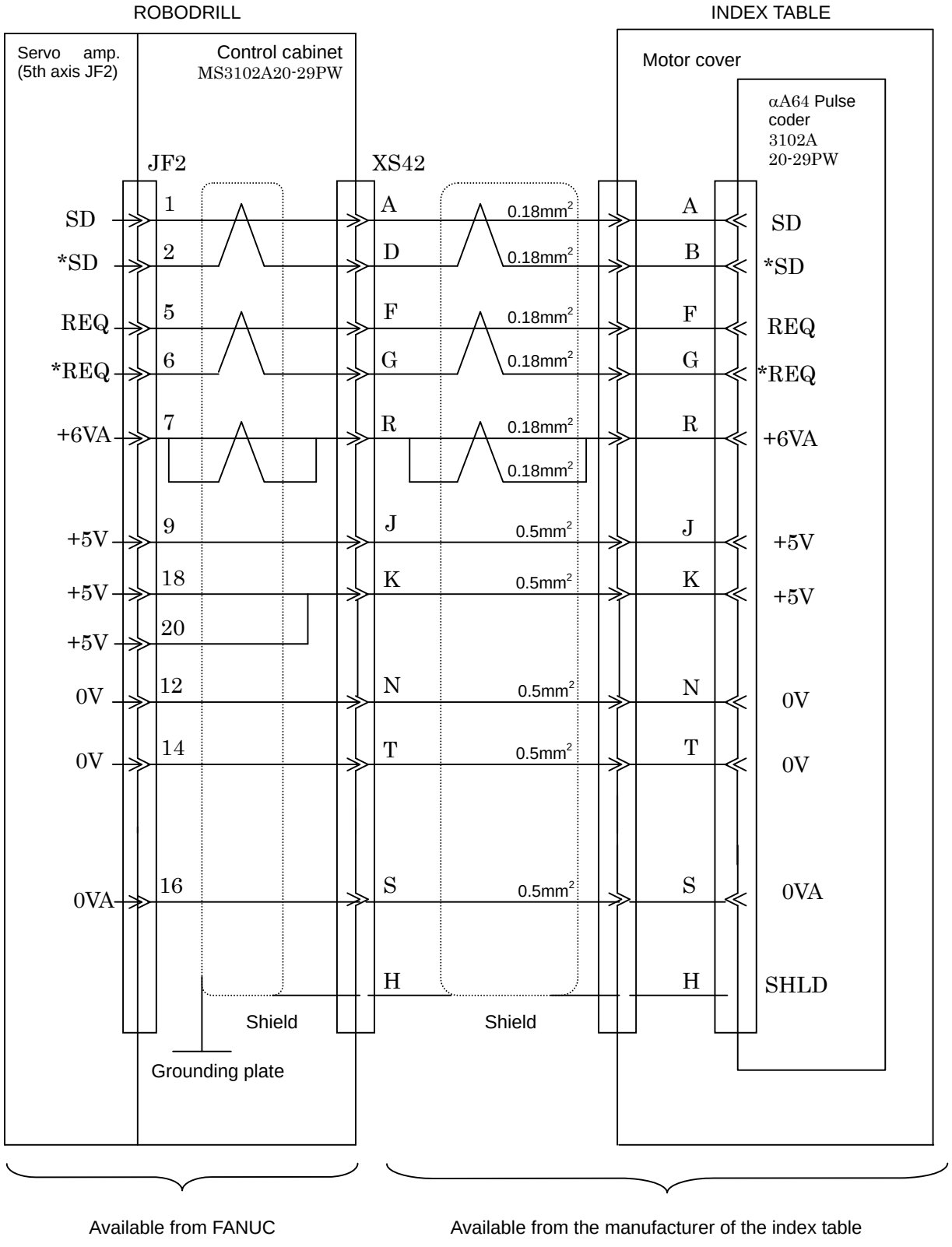


(b) Connection of the motor power and index table input/output signals

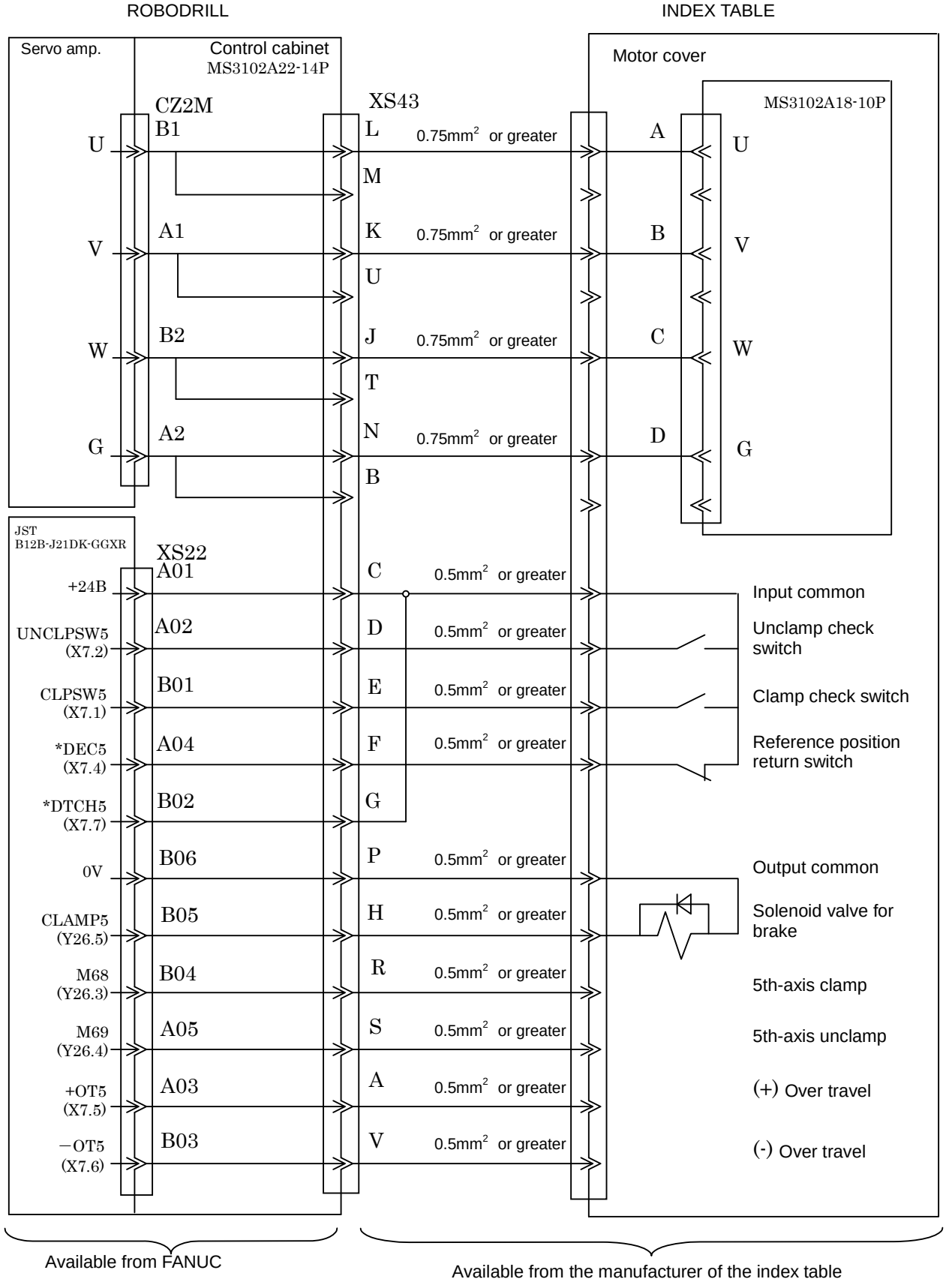


22.8.5.3 α3/3000

(a) Connection of motor feedback signals

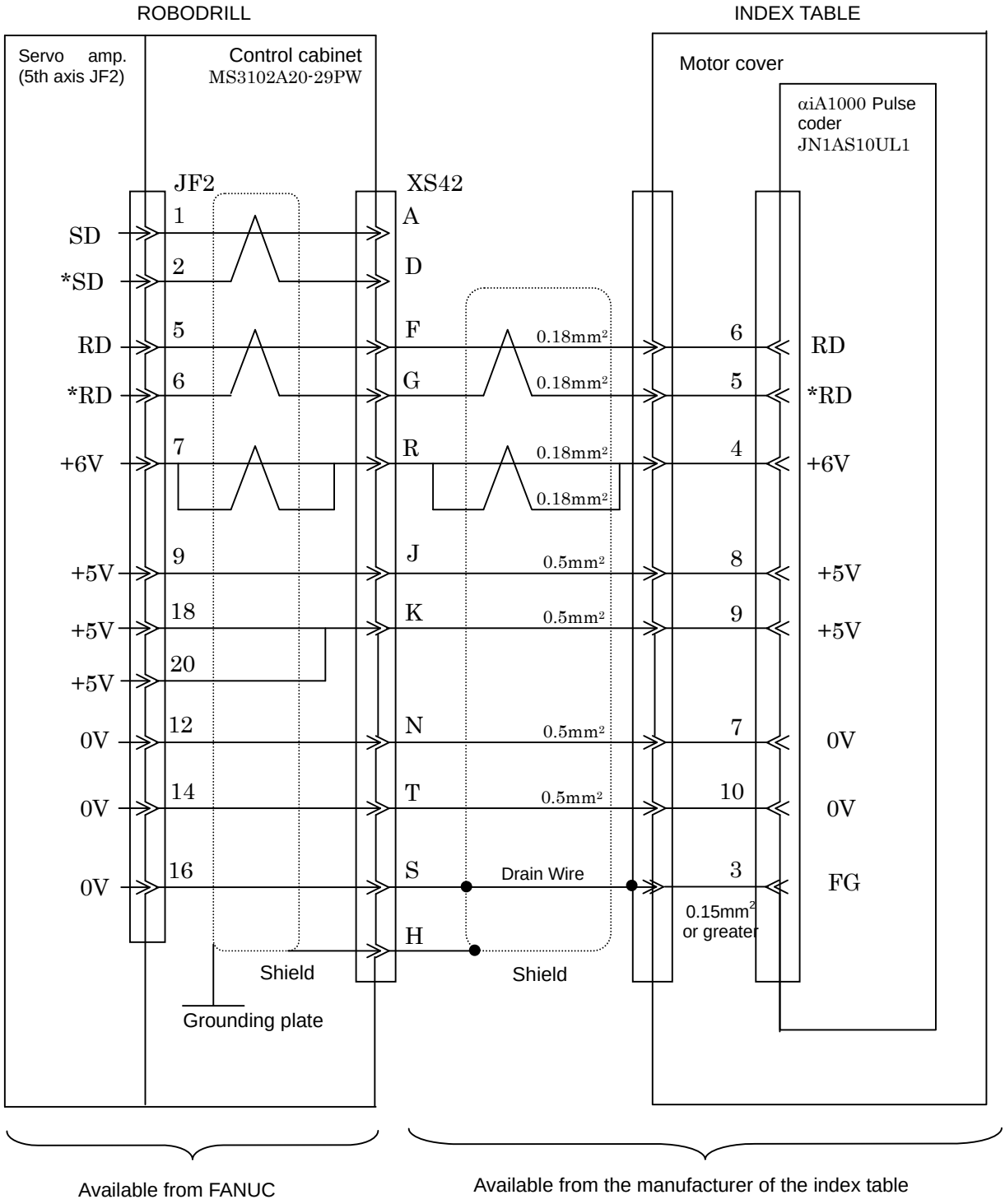


(b) Connection of the motor power and index table input/output signals

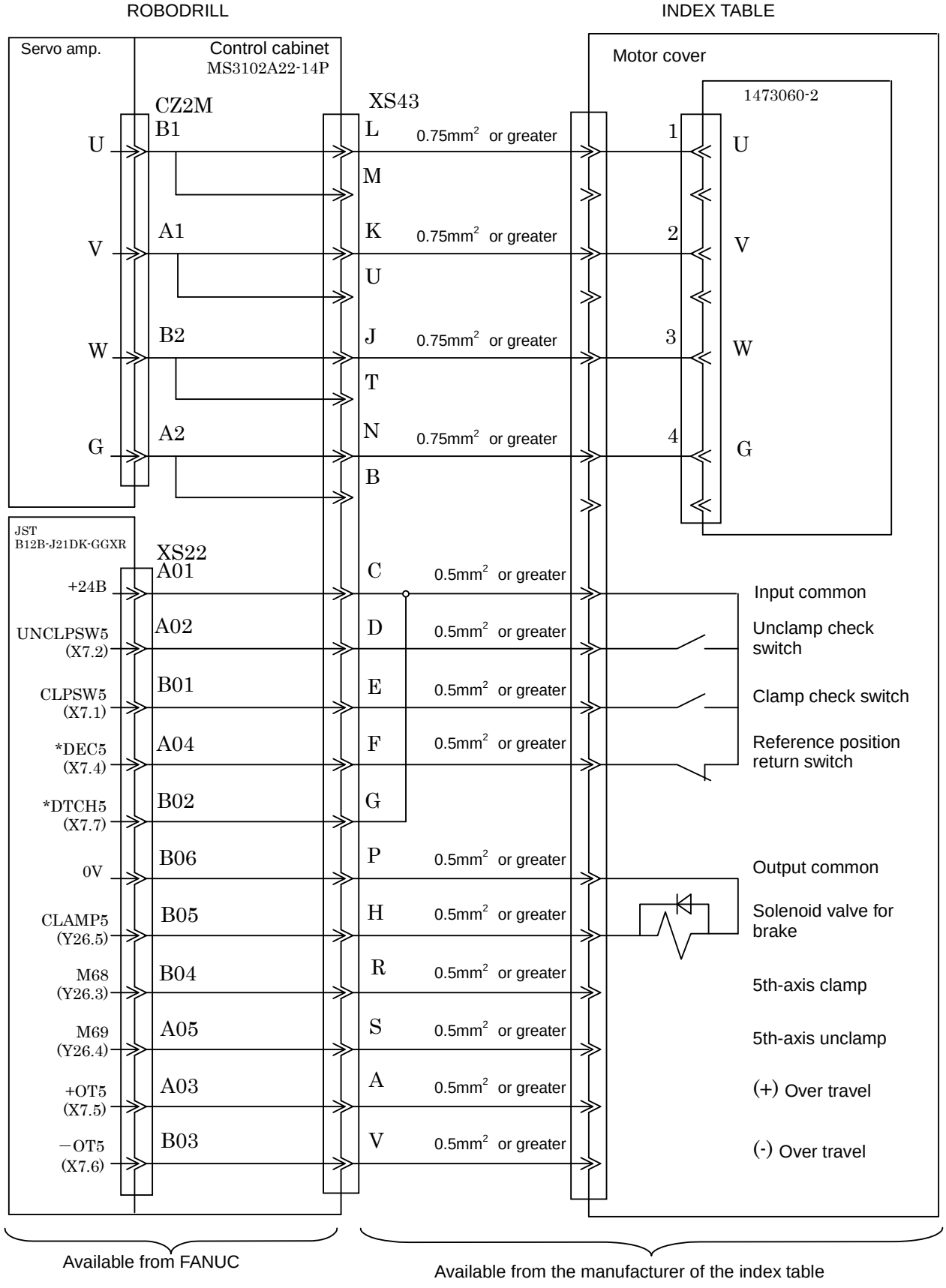


22.8.5.4 αiF1/5000, αiF2/5000, αiS2/5000, αiS4/5000

(a) Connection of motor feedback signals

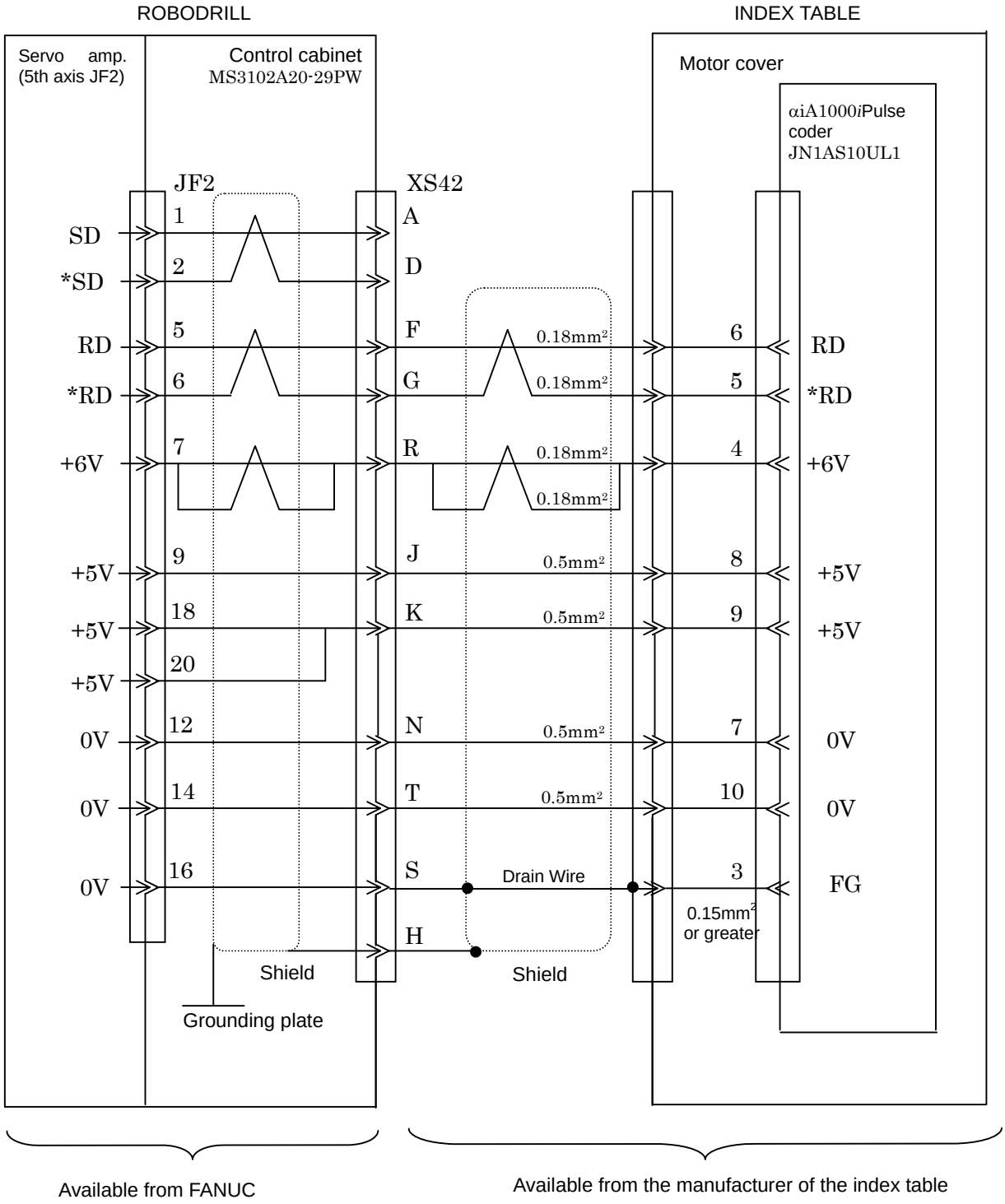


(b) Connection of the motor power and index table input/output signals

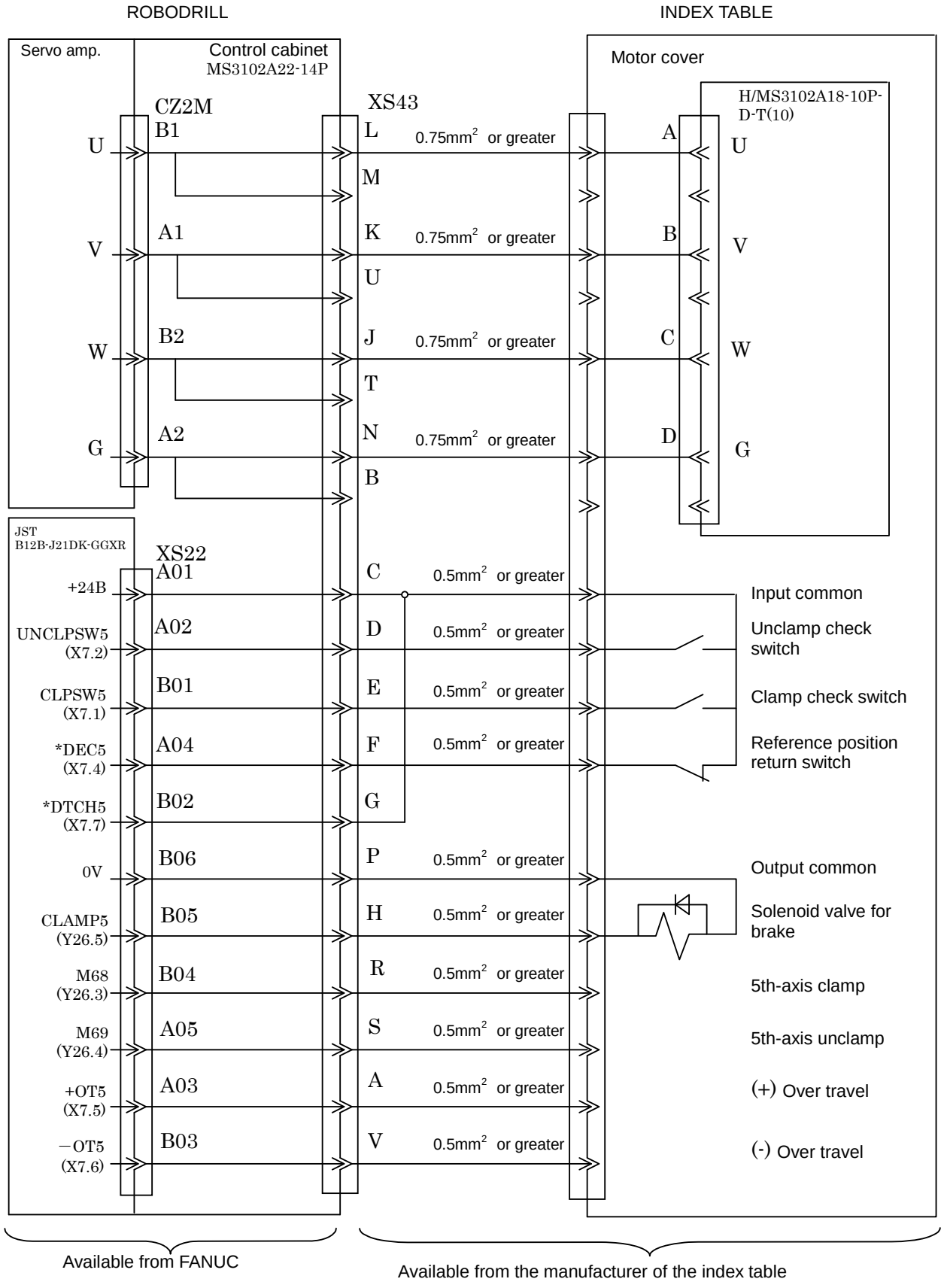


22.8.5.5 αiF4/4000, αiF8/3000

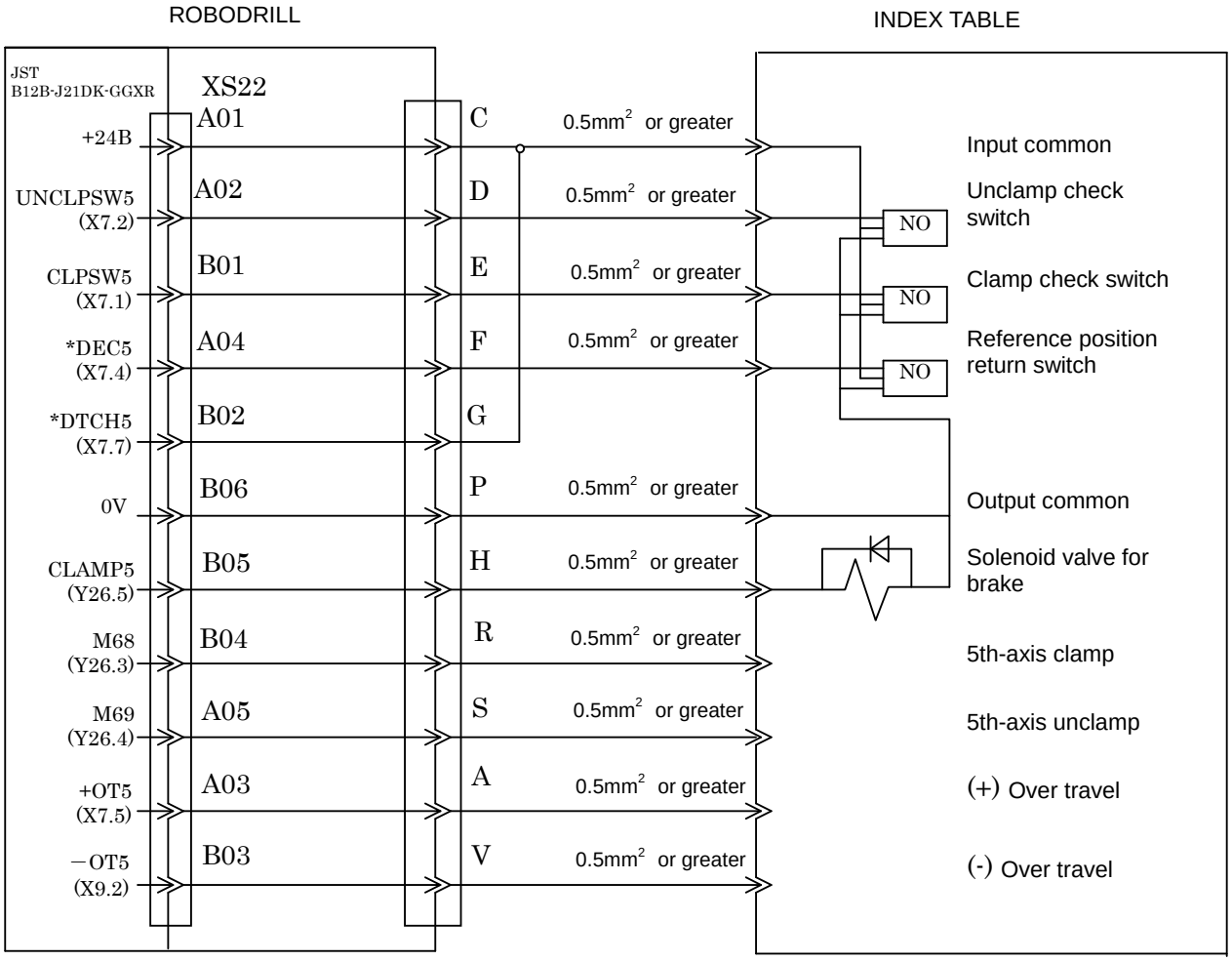
(a) Connection of motor feedback signals



(b) Connection of the motor power and index table input/output signals



22.8.5.6 Using a proximity switch



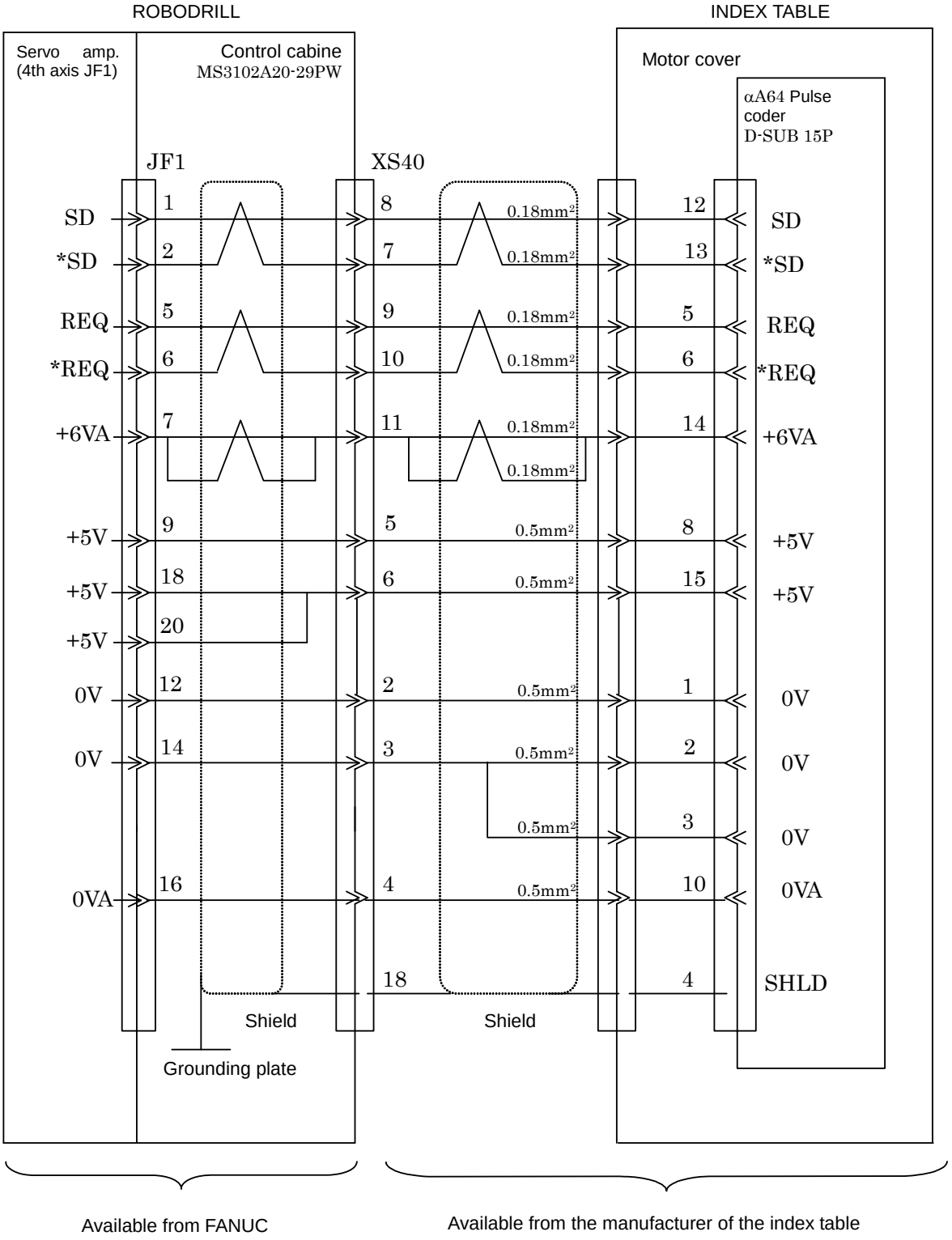
SUPPLEMENT

The 5th-axis detachment signal is used to check the cable connection status. When the level of the *DTCH5 signal falls to 0, the servo motor is deactivated. (Before connecting or disconnecting a cable, first turn the machine off.)
When the 5th-axis detachment signal is not used, the function can be PMC parameter K12#3
= 0: Validates the 5th-axis detachment function.
= 1: Invalidates the 5th-axis detachment function.

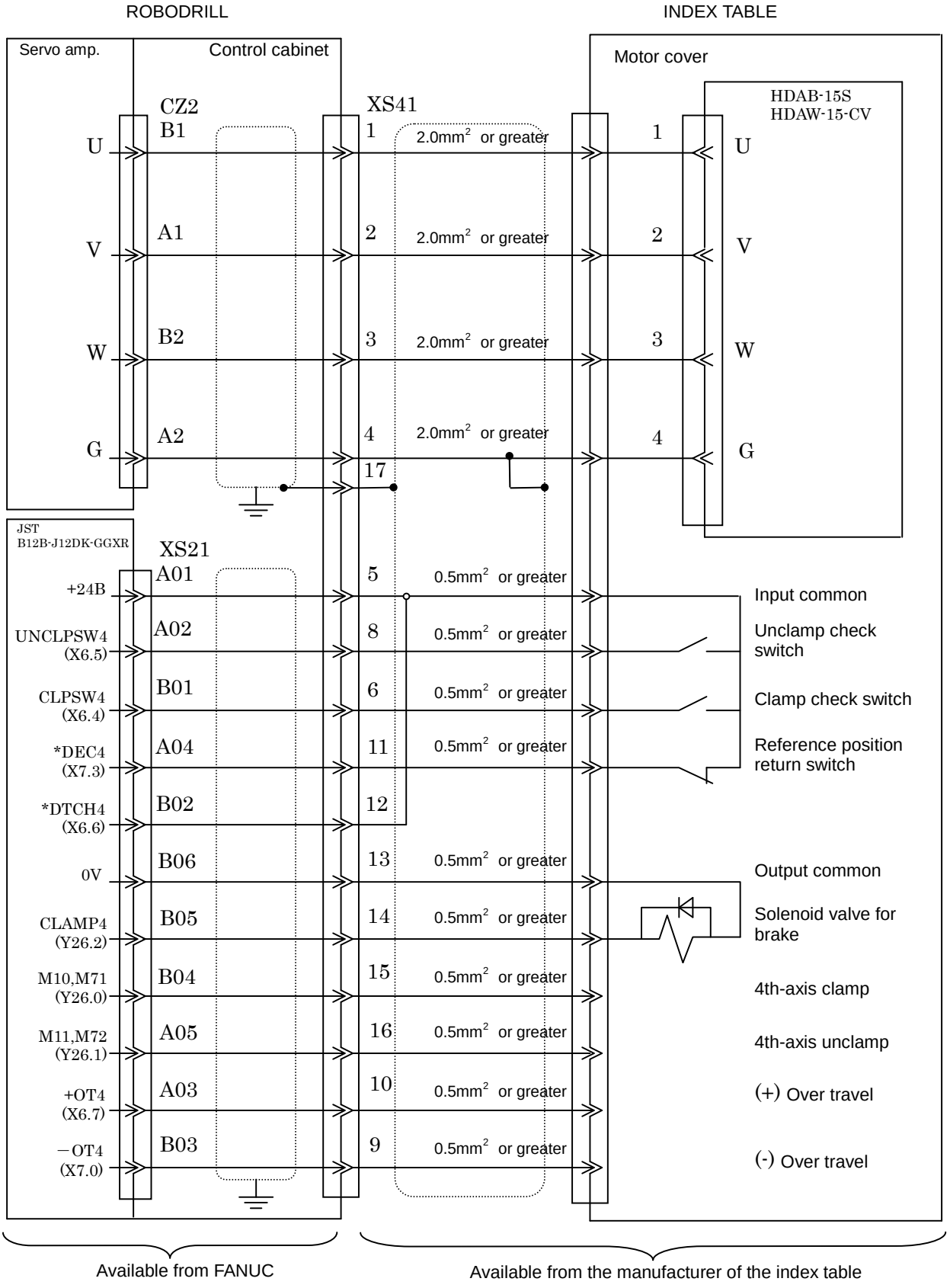
22.8.6 Additional axis cable circuit diagrams (4th axis, machines designed for use in Europe or China)

22.8.6.1 α1/3000, α2/3000

(a) Connection of motor feedback signals

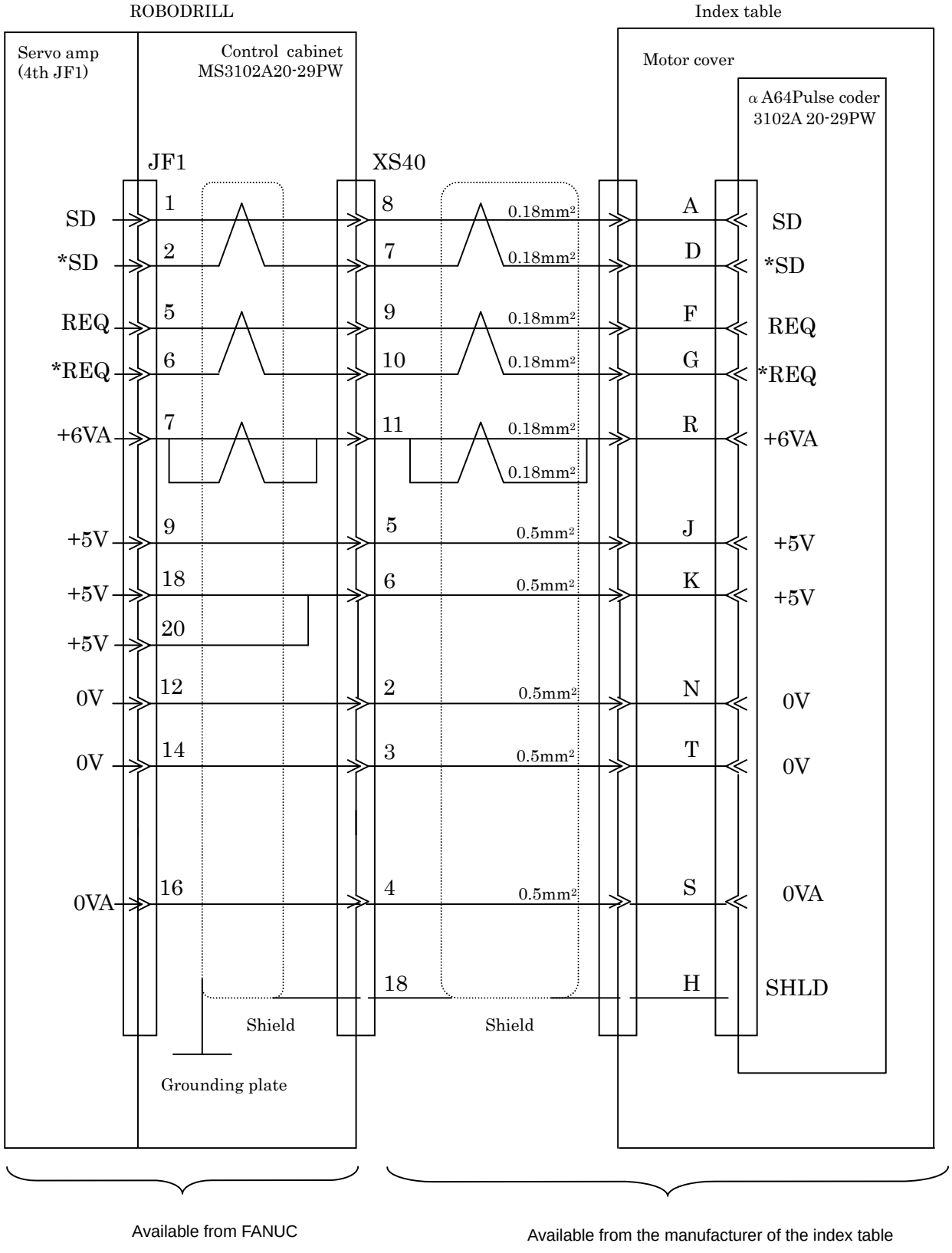


(b) Connection of the motor power and index table input/output signals

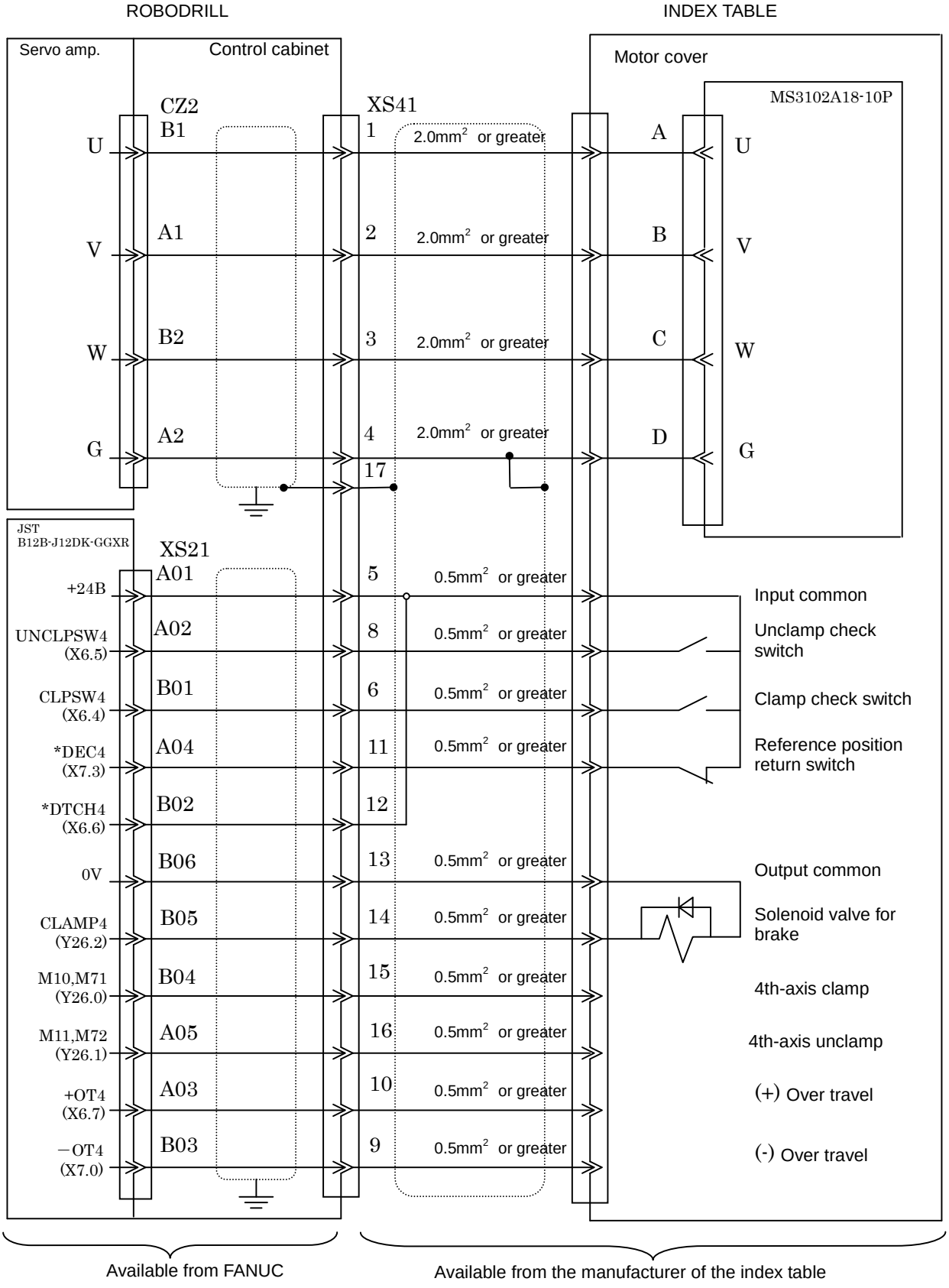


22.8.6.2 α3/3000

(a) Connection of motor feedback signals

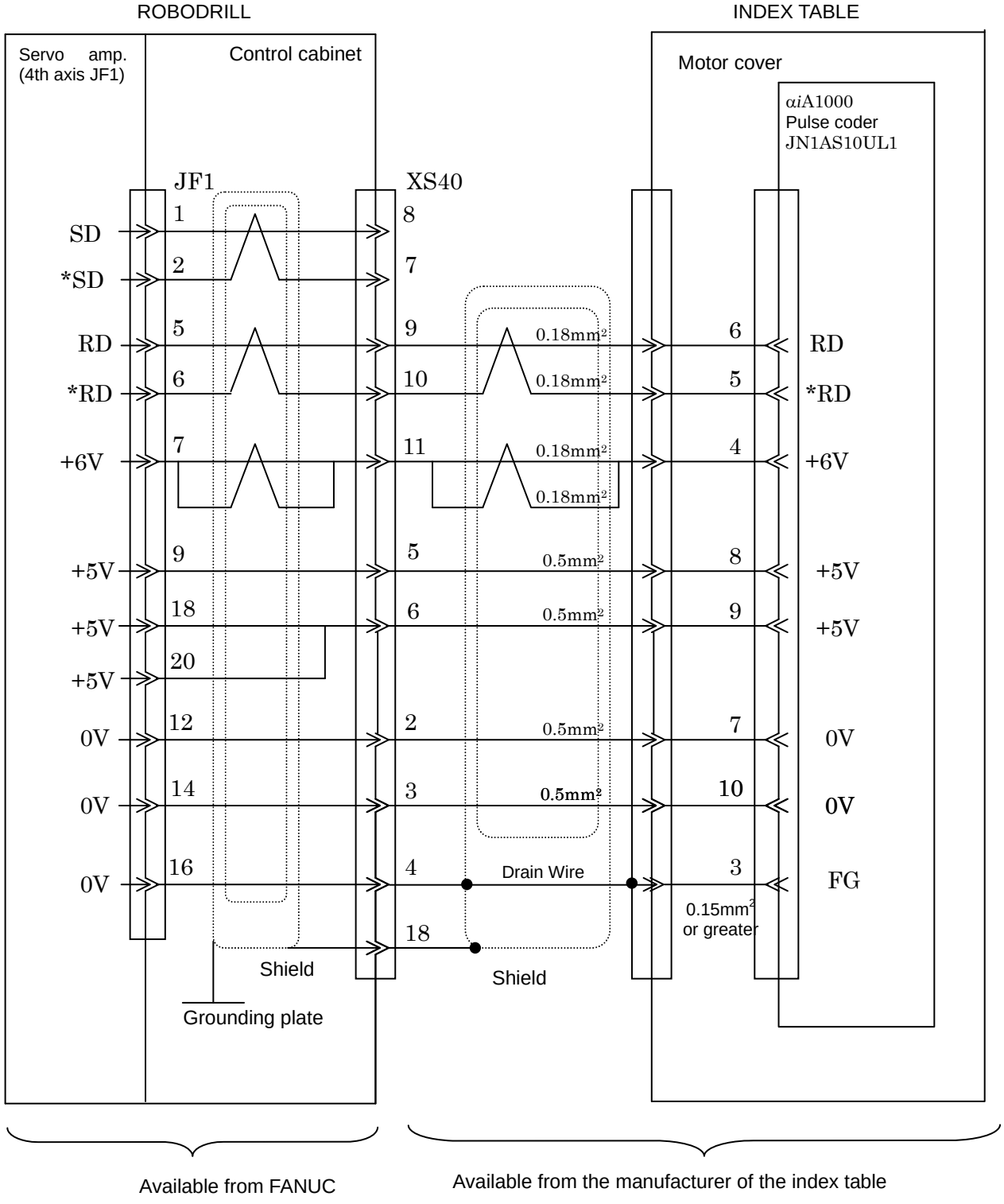


(b) Connection of the motor power and index table input/output signals

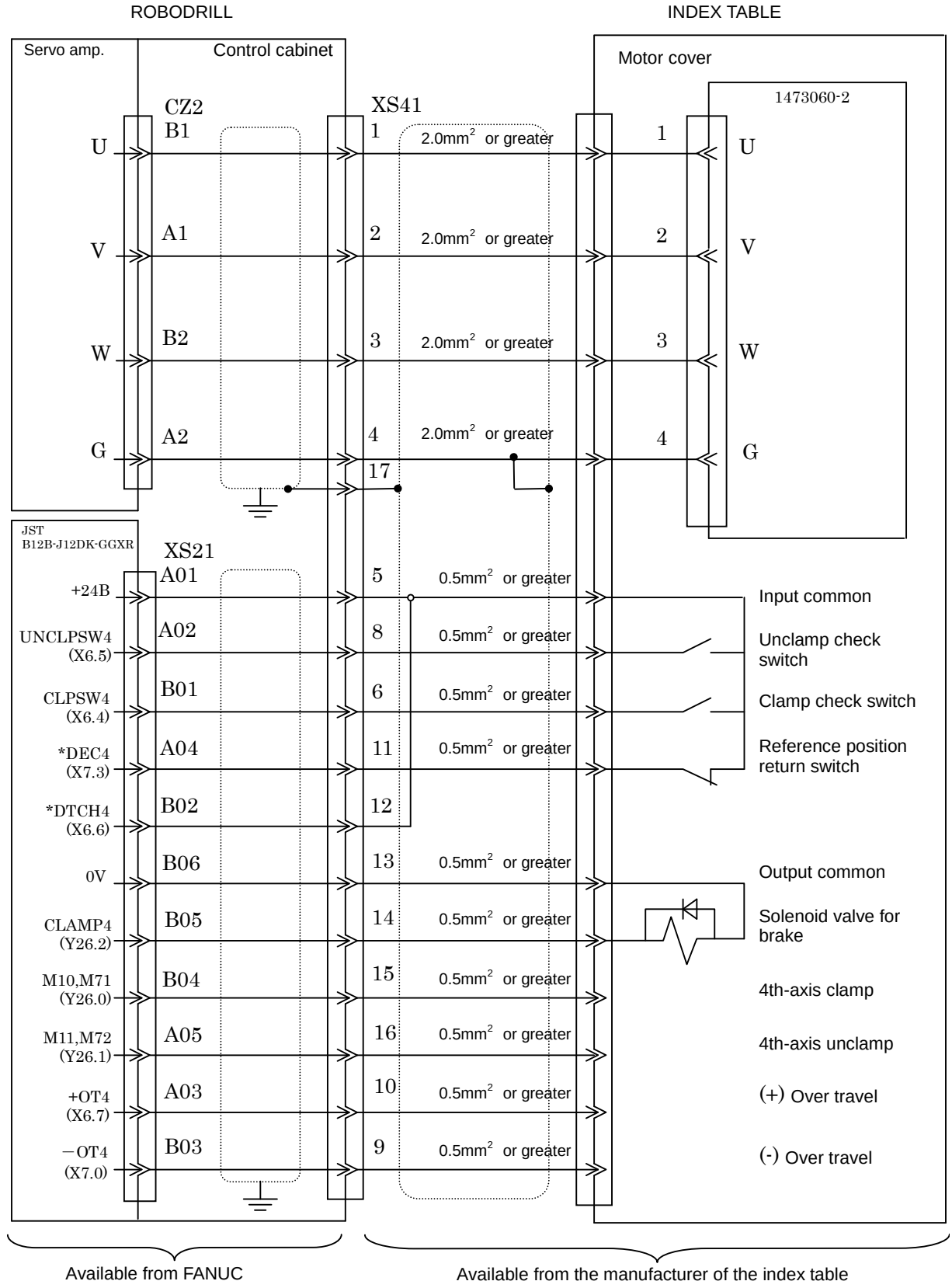


22.8.6.3 αiF1/5000, αiF2/5000, αiS2/5000, αiS4/5000

(a) Connection of motor feedback signals

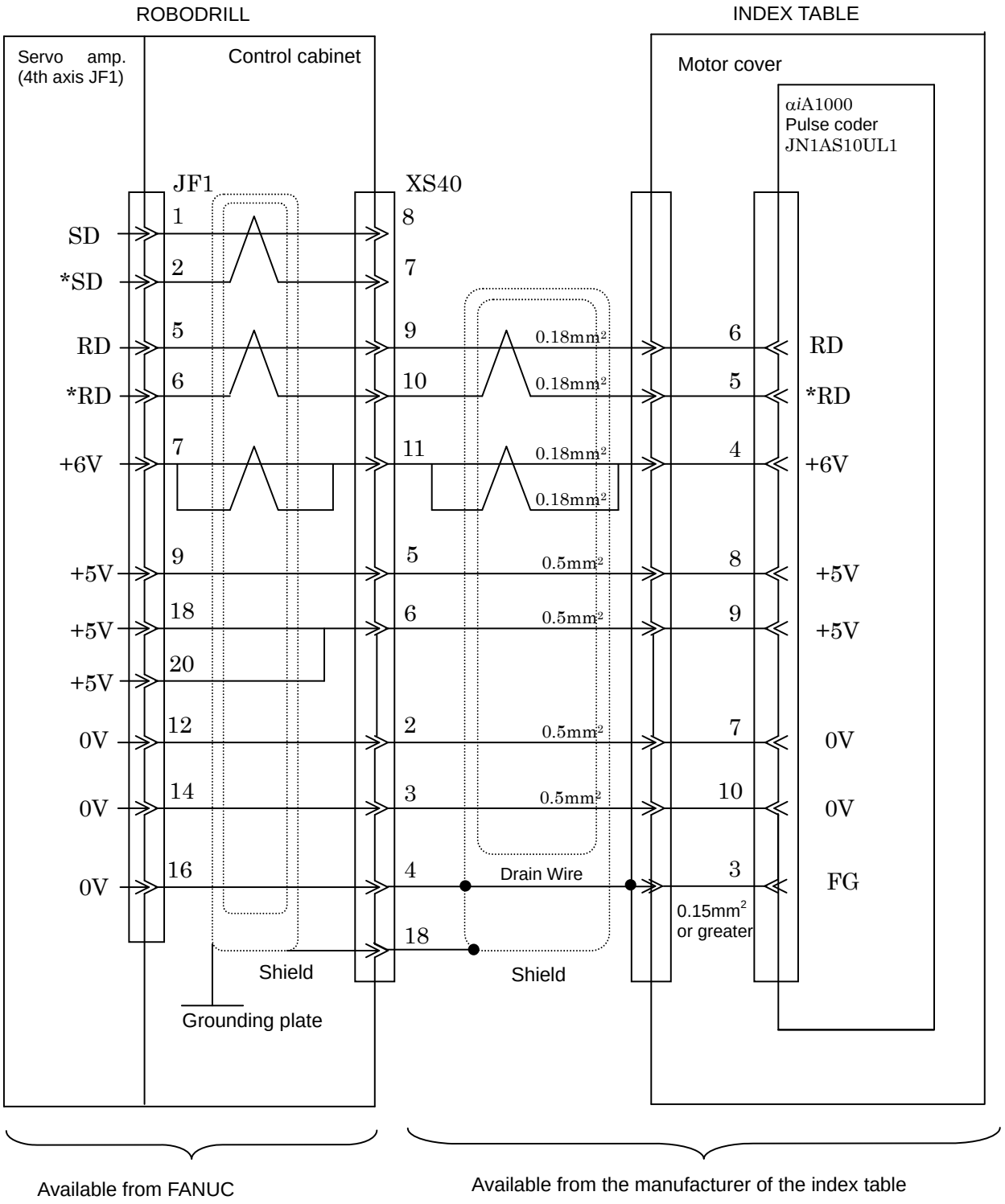


(b) Connection of the motor power and index table input/output signals

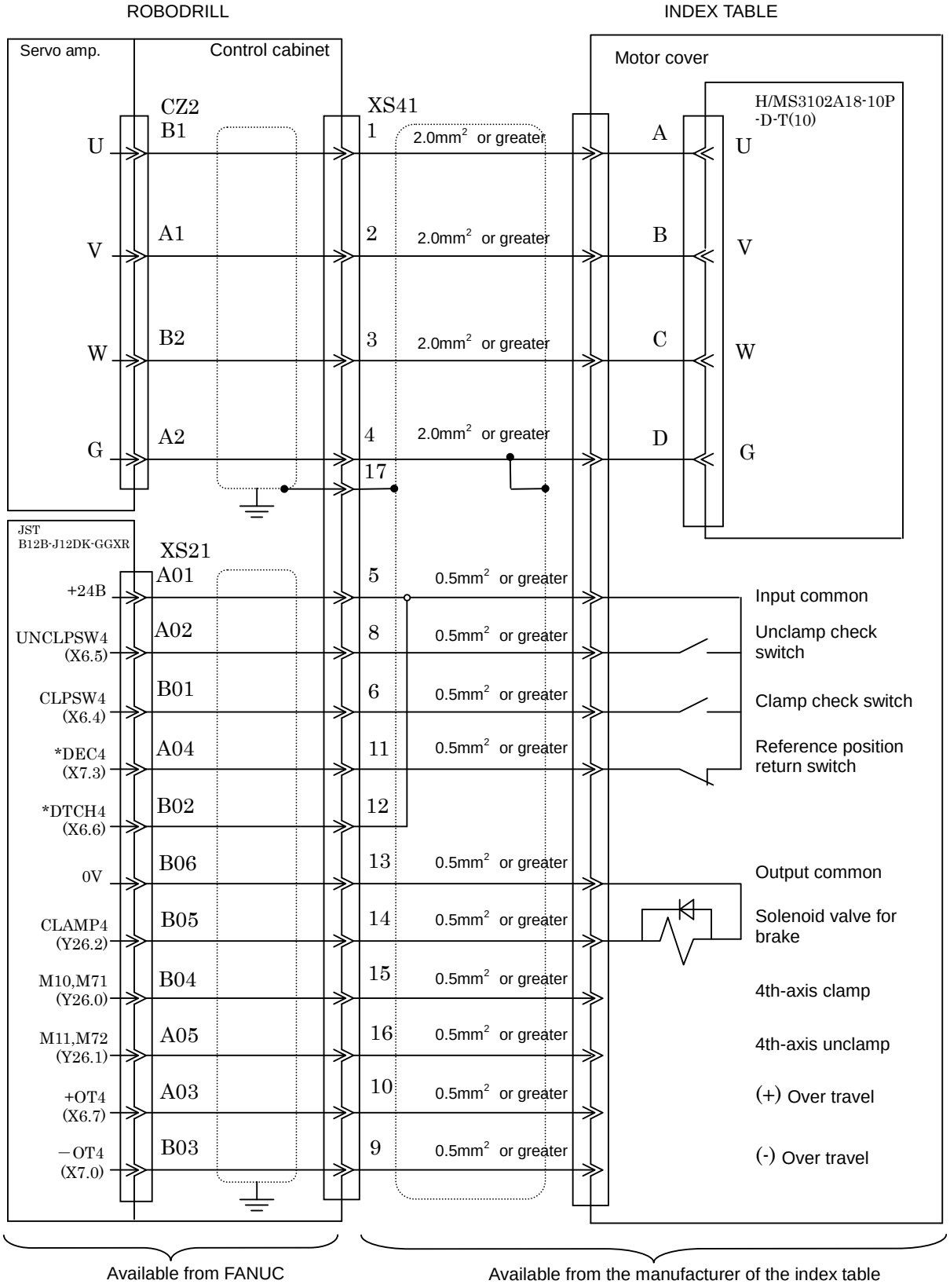


22.8.6.4 αiF4/4000, αiF8/3000

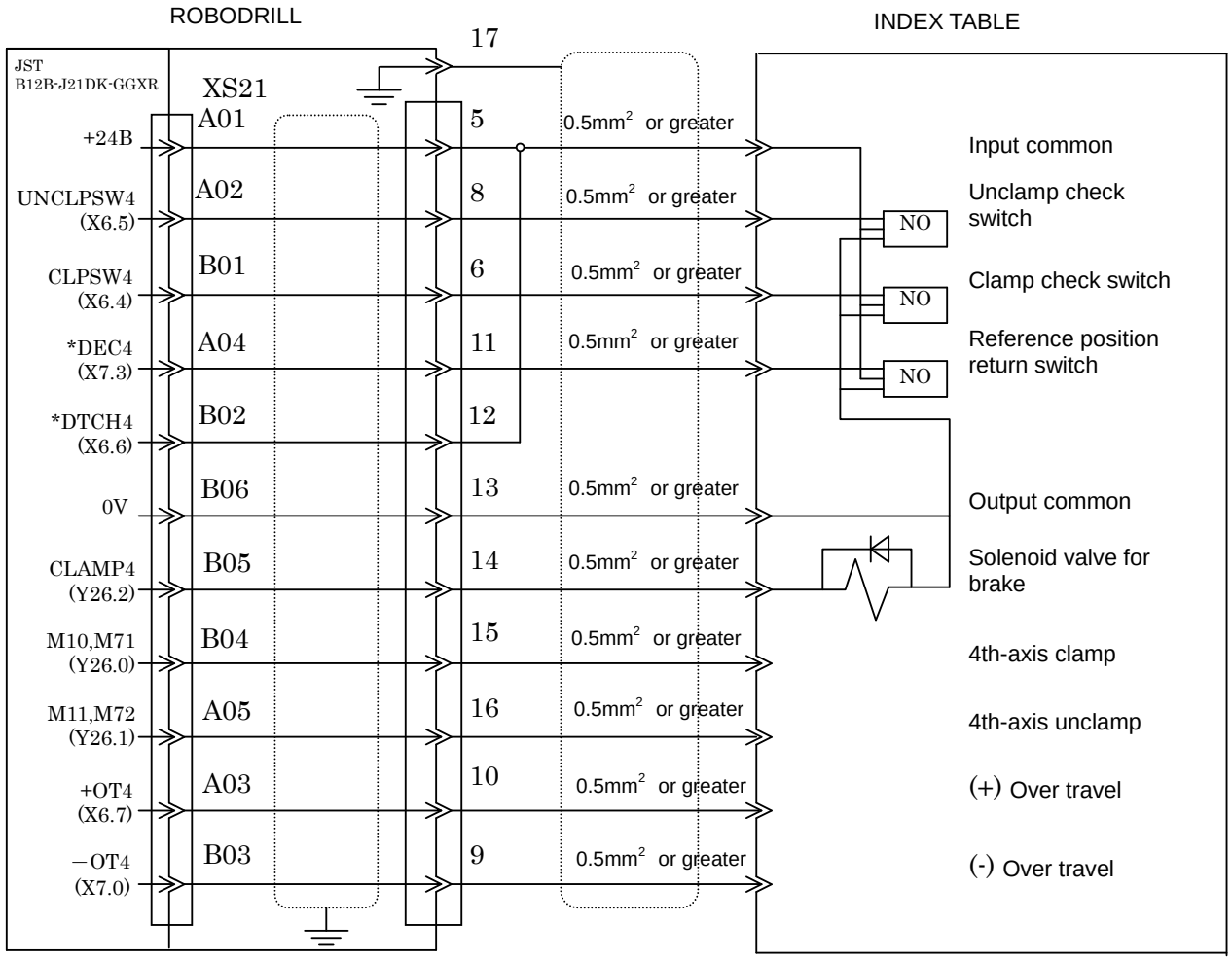
(a) Connection of motor feedback signals



(b) Connection of the motor power and index table input/output signals



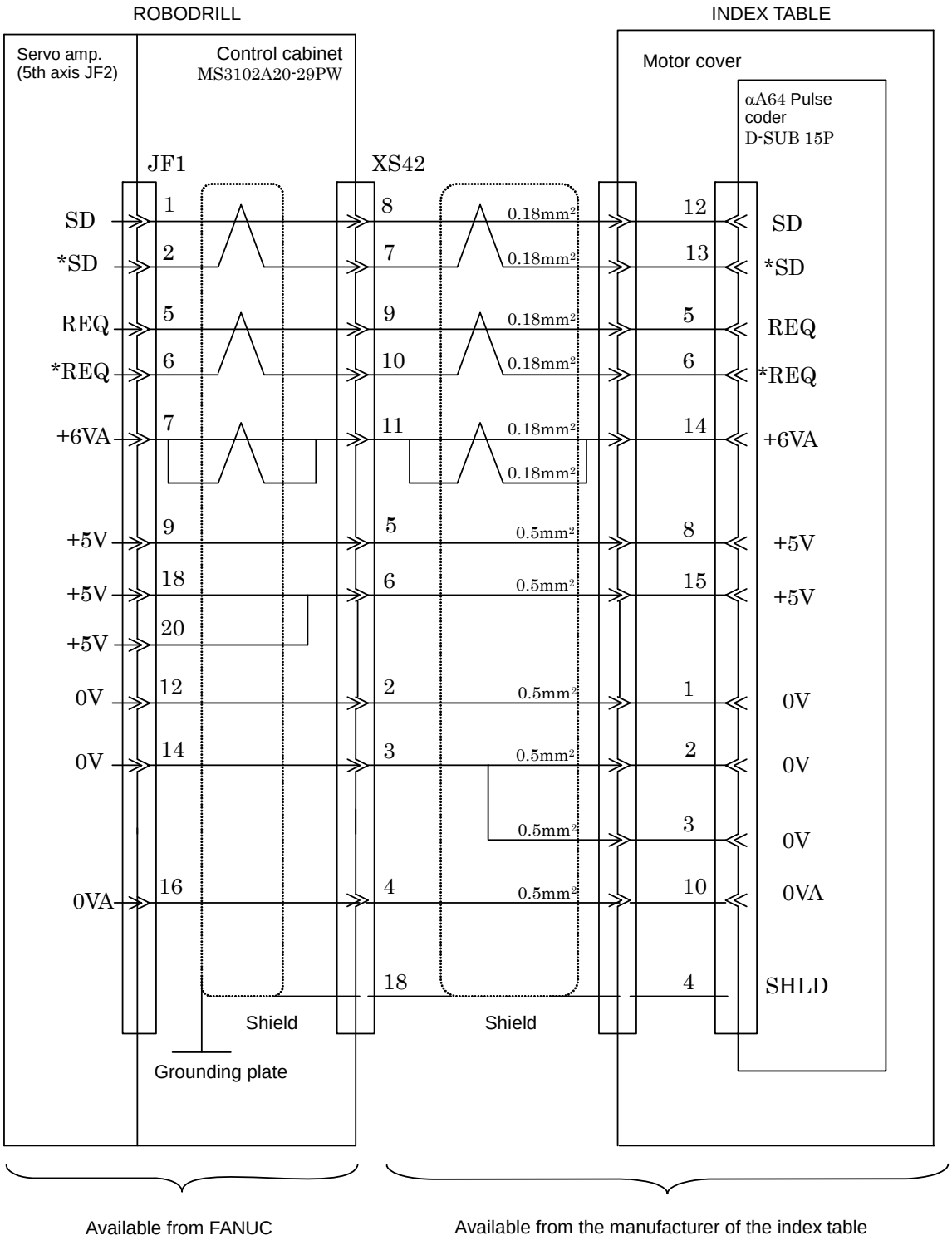
22.8.6.5 Connecting the motor power and input/output signals



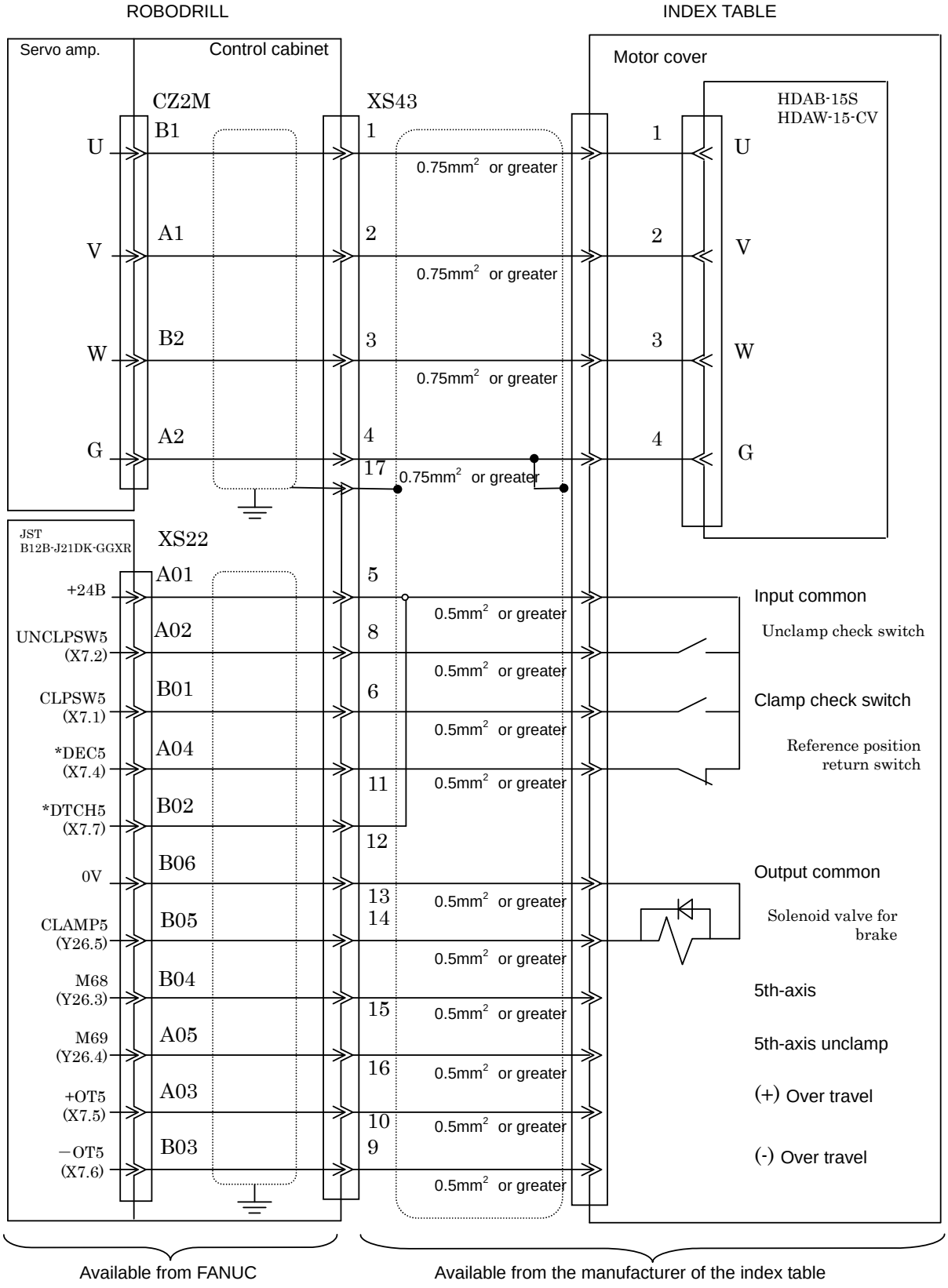
22.8.7 Additional axis cable circuit diagrams (5th axis, machines designed for use in Europe or China)

22.8.7.1 α1/3000, α2/3000

(a) Connection of motor feedback signals

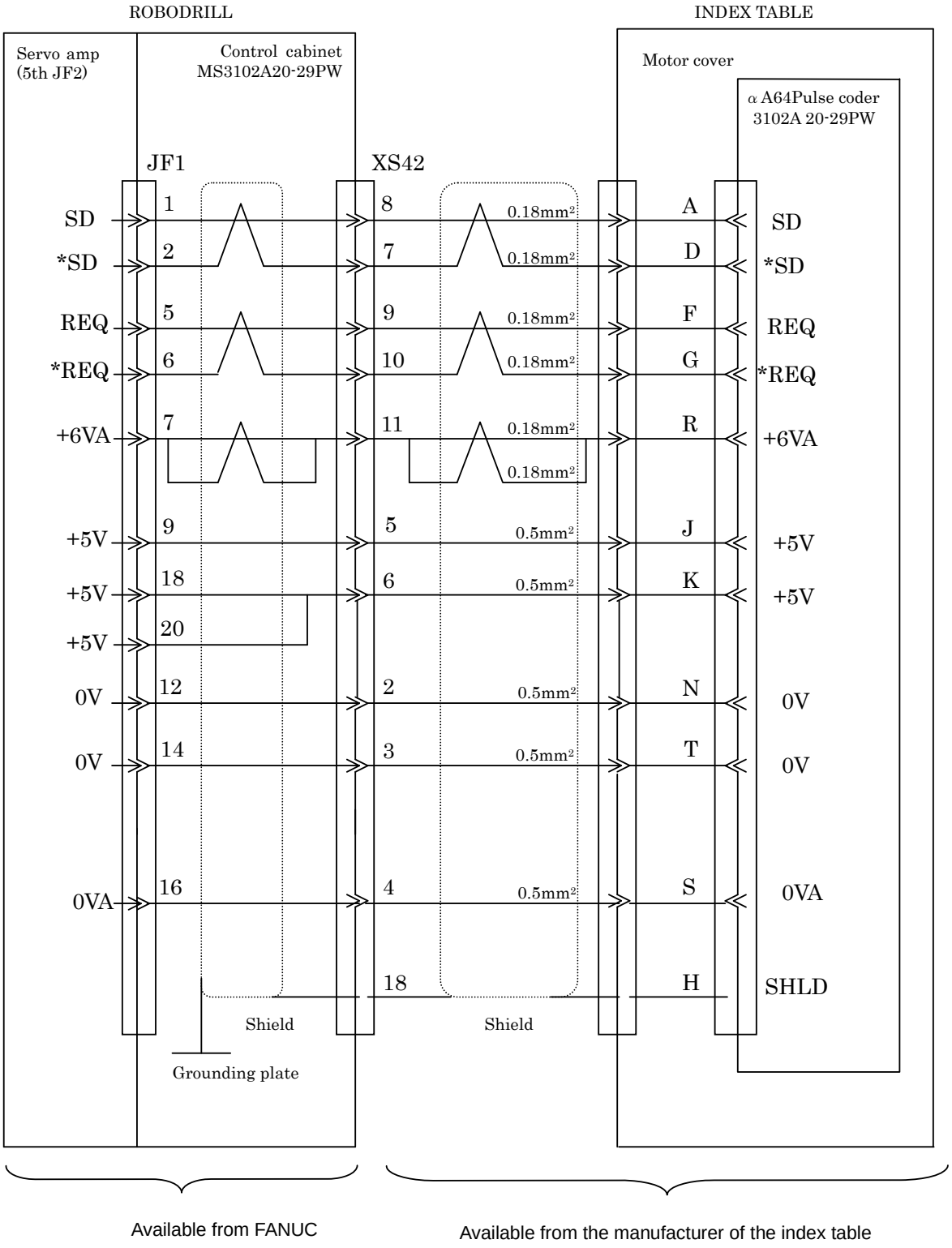


(b) Connection of the motor power and index table input/output signals

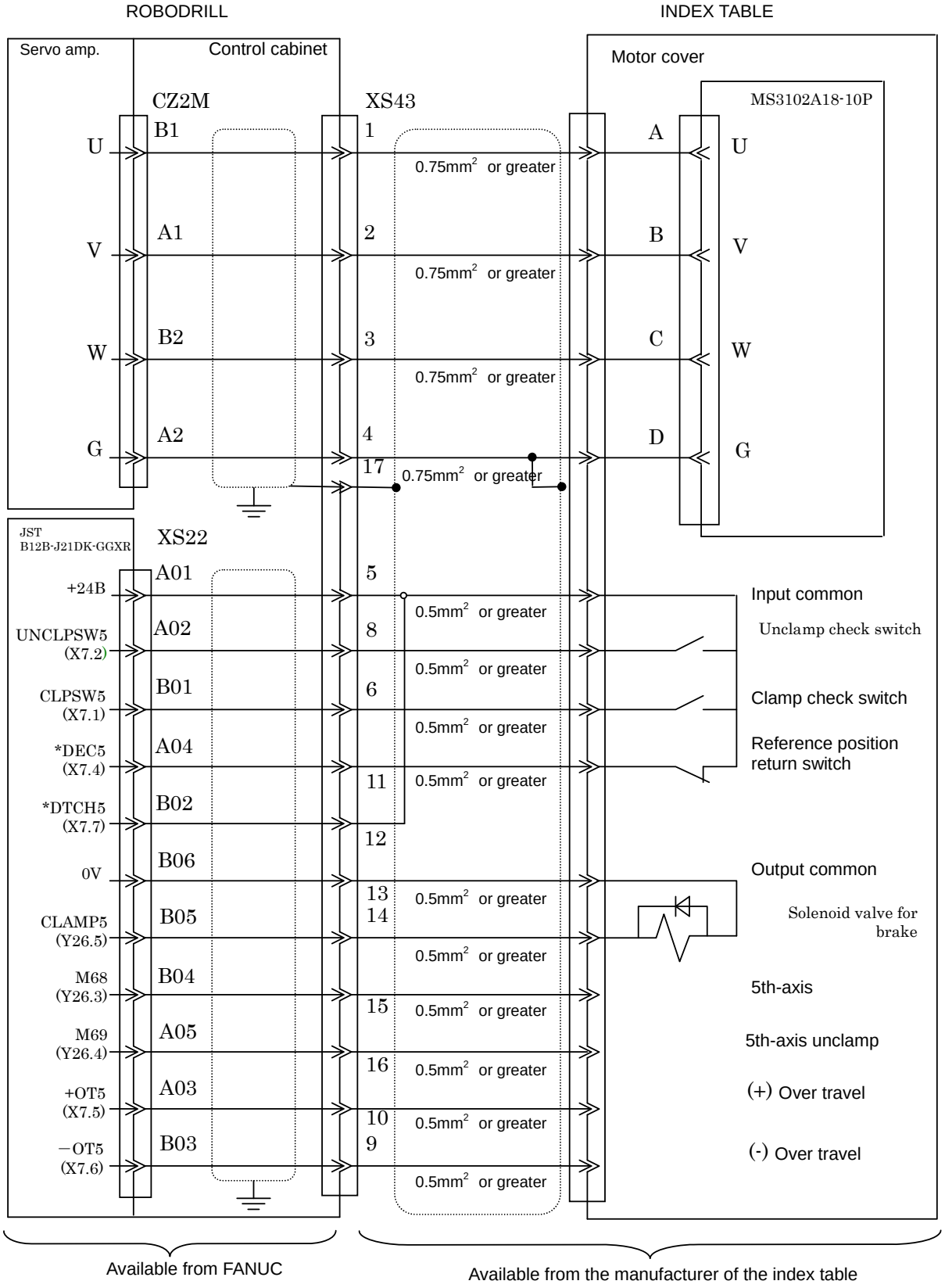


22.8.7.2 α3/3000

(a) Connection of motor feedback signals

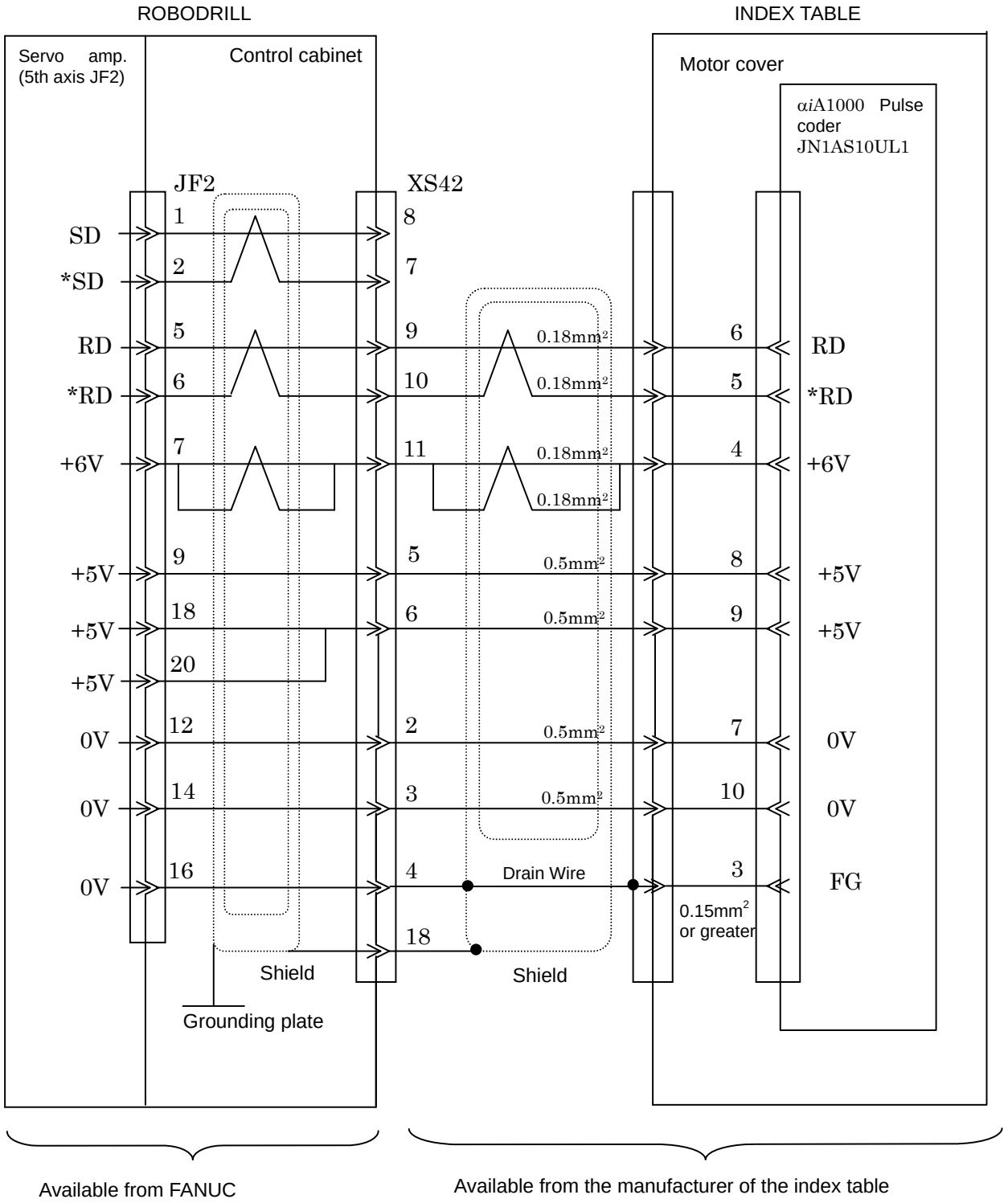


(b) Connection of the motor power and index table input/output signals

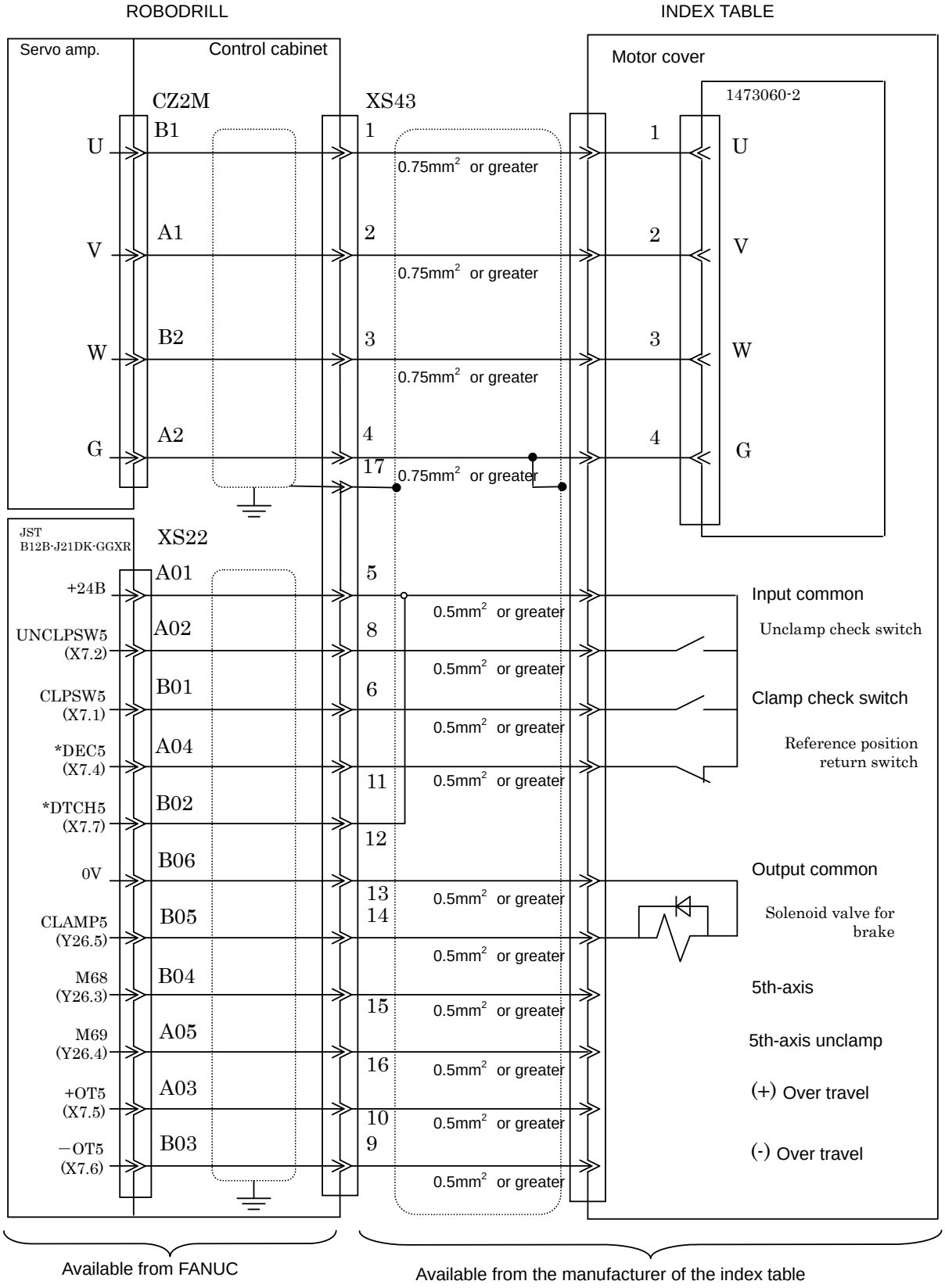


22.8.7.3 αiF1/5000, αiF2/5000, αiS2/5000, αiS4/5000

(a) Connection of motor feedback signals

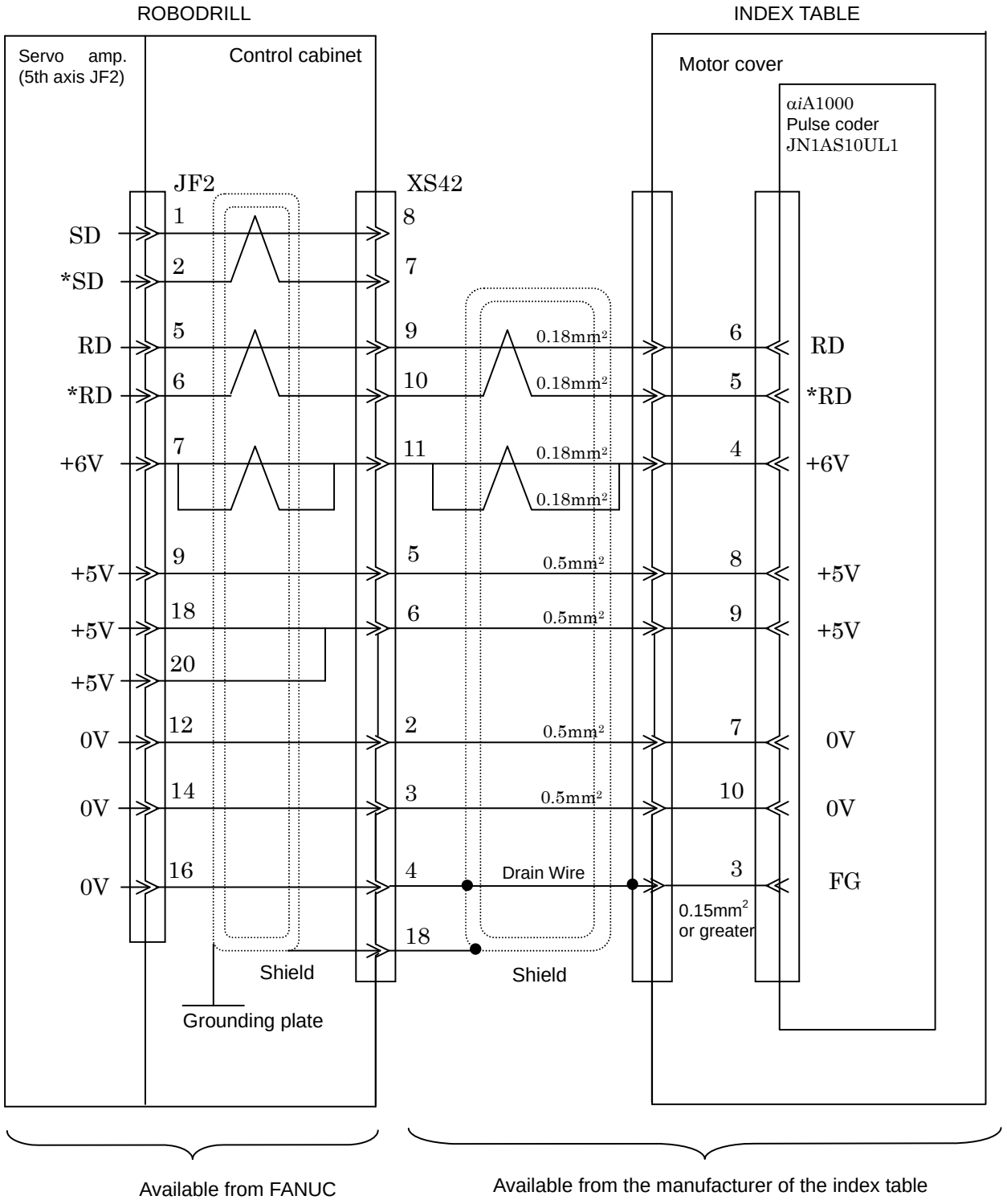


(b) Connection of the motor power and index table input/output signals

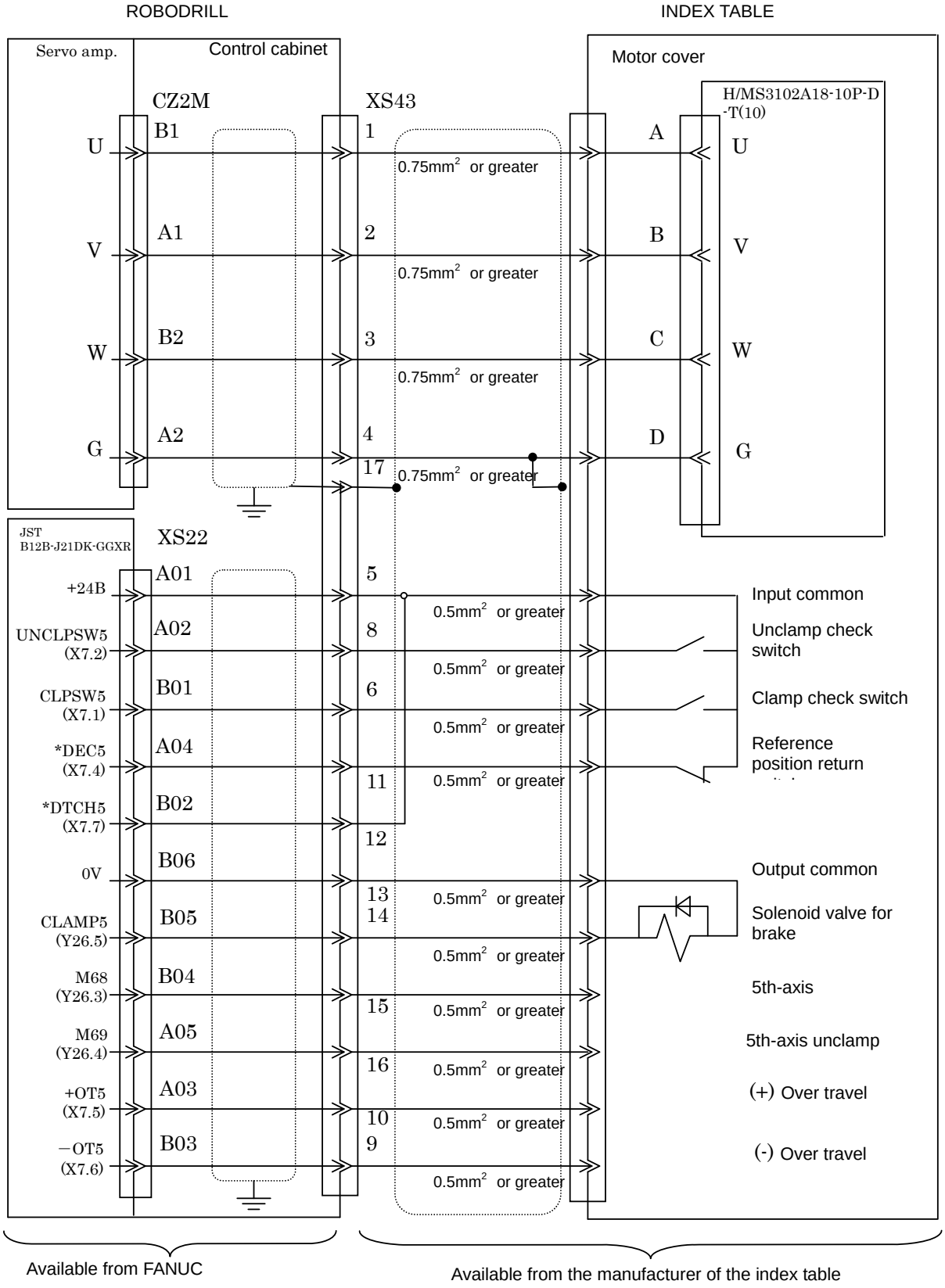


22.8.7.4 αiF4/4000, αiF8/3000

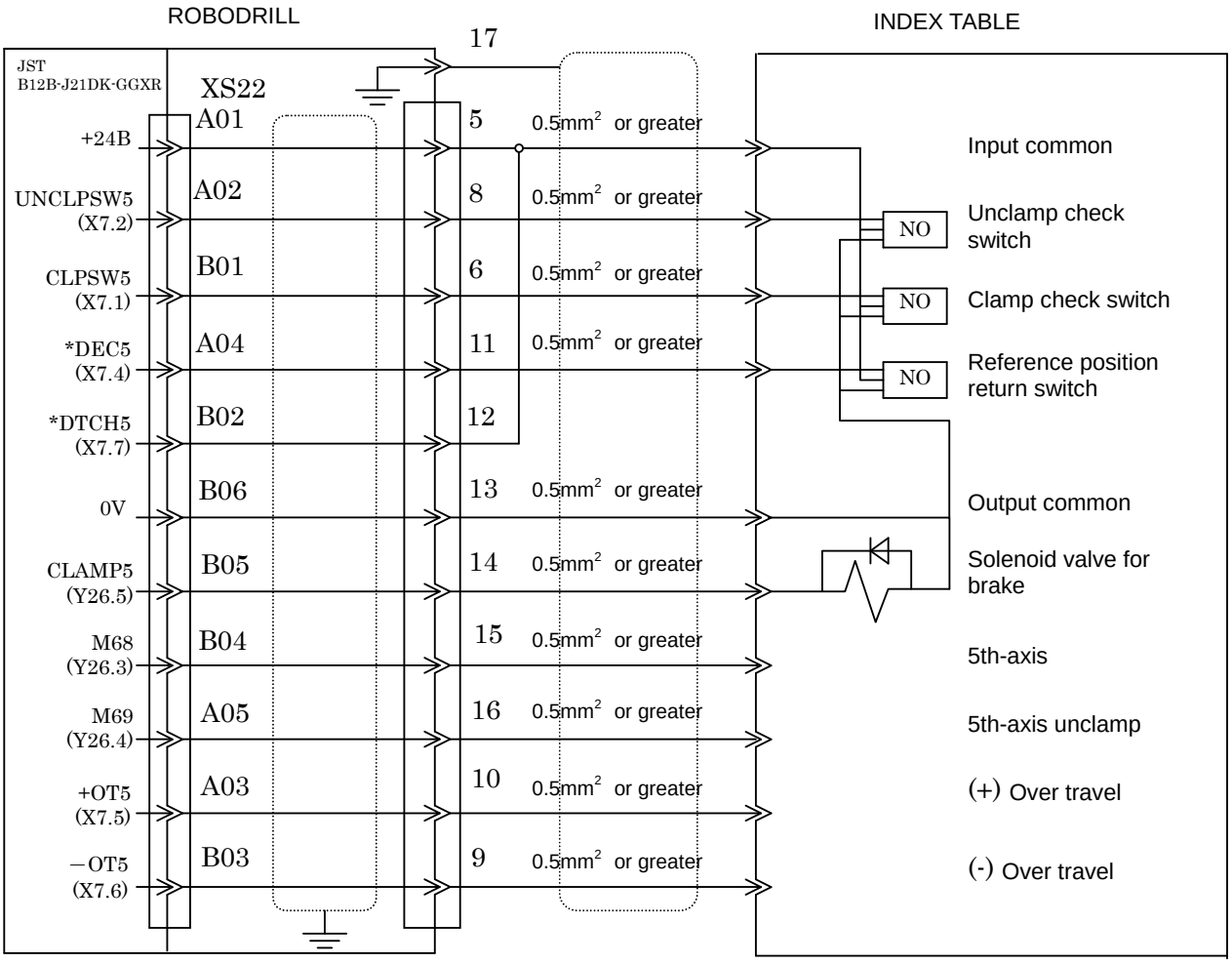
(a) Connection of motor feedback signals



(b) Connection of the motor power and index table input/output signals



22.8.7.5 Using a proximity switch



SUPPLEMENT

The 5th–axis detachment signal is used to check the cable connection status. When the level of the *DTCH5 signal falls to 0, the servo motor is deactivated. (Before connecting or disconnecting a cable, first turn the machine off.) When the 5th–axis detachment signal is not used, the function can be PMC parameter K12#3

= 0: Validates the 5th–axis detachment function.

= 1: Invalidates the 5th–axis detachment function.

23 TOOL LENGTH SWITCH (OPTION)

23.1 OVERVIEW AND NOTES

23.1.1 Overview

The tool length switch is a contact type switch installed on the table or jig. It is used to detect a worn or broken tool.

23.1.2 Notes

(1) When using a tool length switch on the ROBOFDRILL, mount it on its table or jig properly.
(2) Do not modify the tool length switch or its cable.
(3) Before starting to dismount the tool length switch, to detach or attach its cable, or to perform inspection or maintenance work on it, place the circuit breaker of the ROBODRILL main unit in its OFF position and post a sign stating that someone is working on the machine.
(4) Tighten the tool length switch mounting bolts, using an adequate tool.
(5) When mounting the tool length switch, use the mounting brackets that came with it. When using any other mounting brackets, fix the tool length switch using an equivalent method so that it can be mounted properly.
(6) When laying cables and air tubes, give a sufficient sag to them so that they will not be damaged as the machine operates. Their damage may lead to an electrical leakage or short circuit, hence an electrical shock or malfunction.
(7) When using the machine initially, check its operation by keeping its speed low so that it can be stopped at any time.

23.2 SPECIFICATIONS

The table below summarizes the specifications of the tool length switch.

Contact structure	Contact type
Operation mode	NC (normally closed)
Protective structure	IEC IP67
Operating force	3.8 N
Operating position	99.5 mm as measured from the reference plane
Pretravel	$0.5\ ^{+0.2}_{0}$ mm
Overtravel	9.5 mm
Repeatability	1 μm (maximum) * Operation speed: 50 to 200 mm/min

23.3 APPEARANCE

The appearance of the tool length switch is shown below.

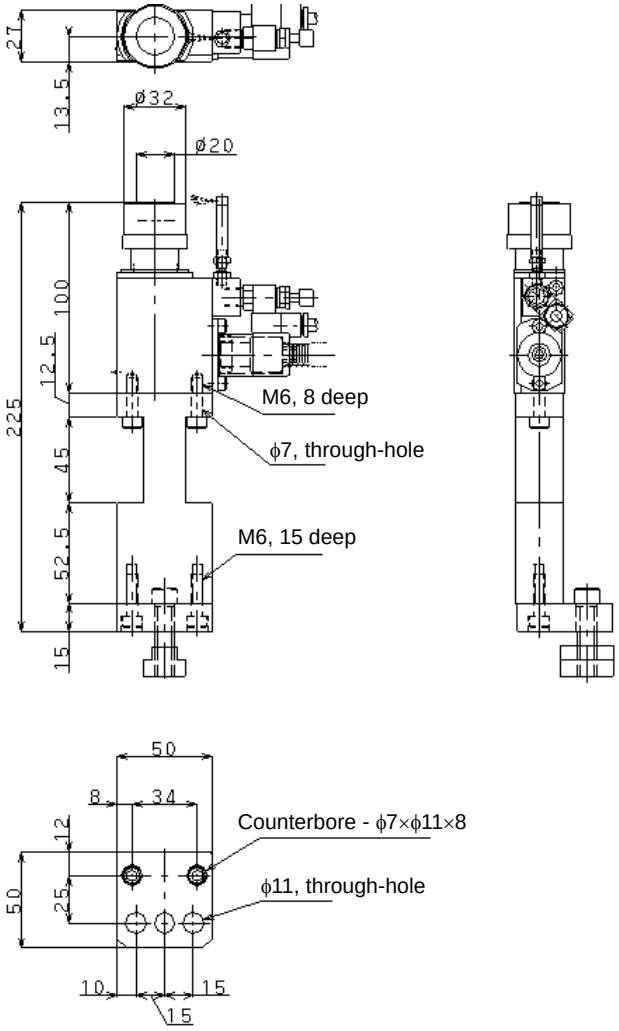


Fig. 23.3.1 (a) Tool length switch appearance

23.4 INSTALLATION

23.4.1 Operating Cautions

> ⚠ **WARNING**
> Before starting to mount the tool length switch, make sue that the main circuit breaker (outside the control unit cabinet) is in its OFF position for safety purposes. In addition, stop supplying air to the machine.

23.4.2 Installation on the Table

(1) Fasten the tool length switch to the ROBODRILL table or jig, using the bolts and T-slot nuts that came with the switch. Before installing the tool length switch, make sure that there is no dirt or bur on the surface where it will be installed.
(2) Fasten the cable and air tube to the outside of the duct of the X-axis motor cable on the left of the table (unless otherwise need), using a cable tie.

23.4.3 Cable and Air Tube Installation

(1) The cable layout is shown below. The mating connectors are XT1-10/+24E and XT1-12/X04.7.

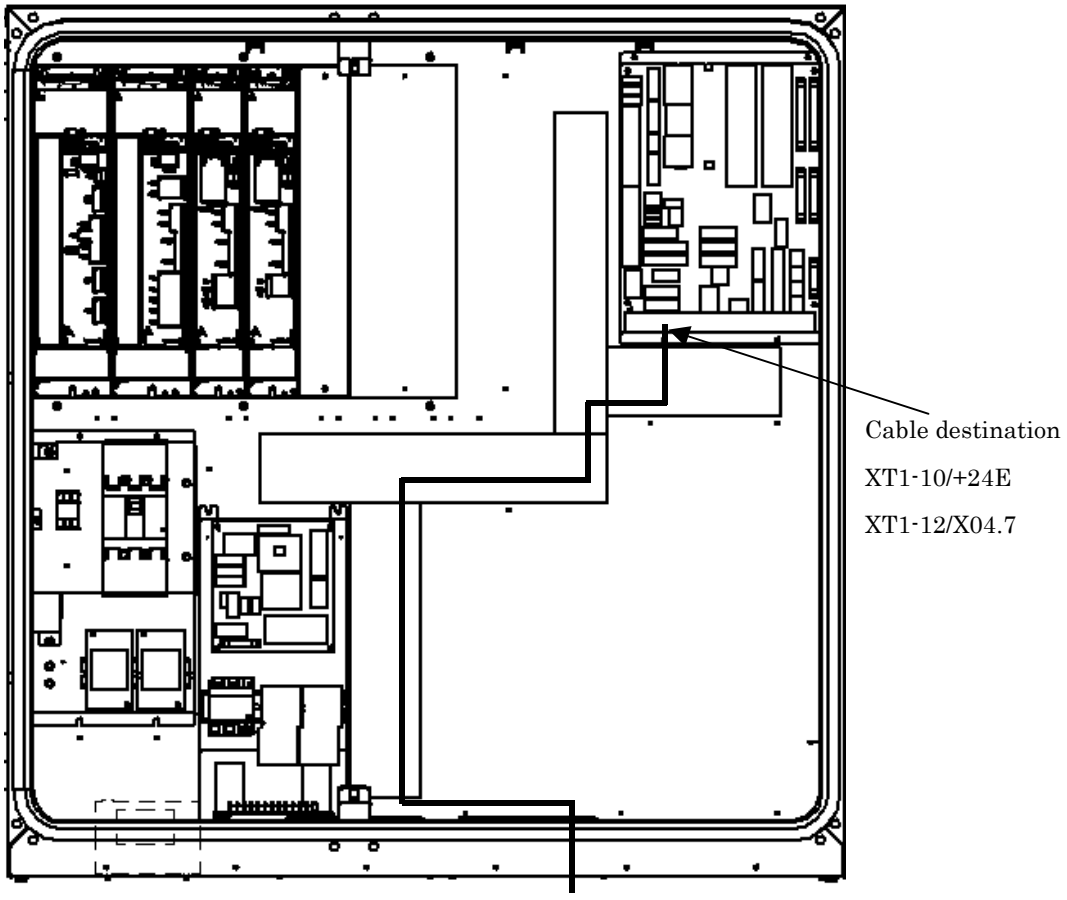


Fig. 23.4.3 (a) Cable layout

(2) As shown below, lay the air tube for blowing air to the sensing surface of the tool length switch above the air circuit of the spindle air blower.

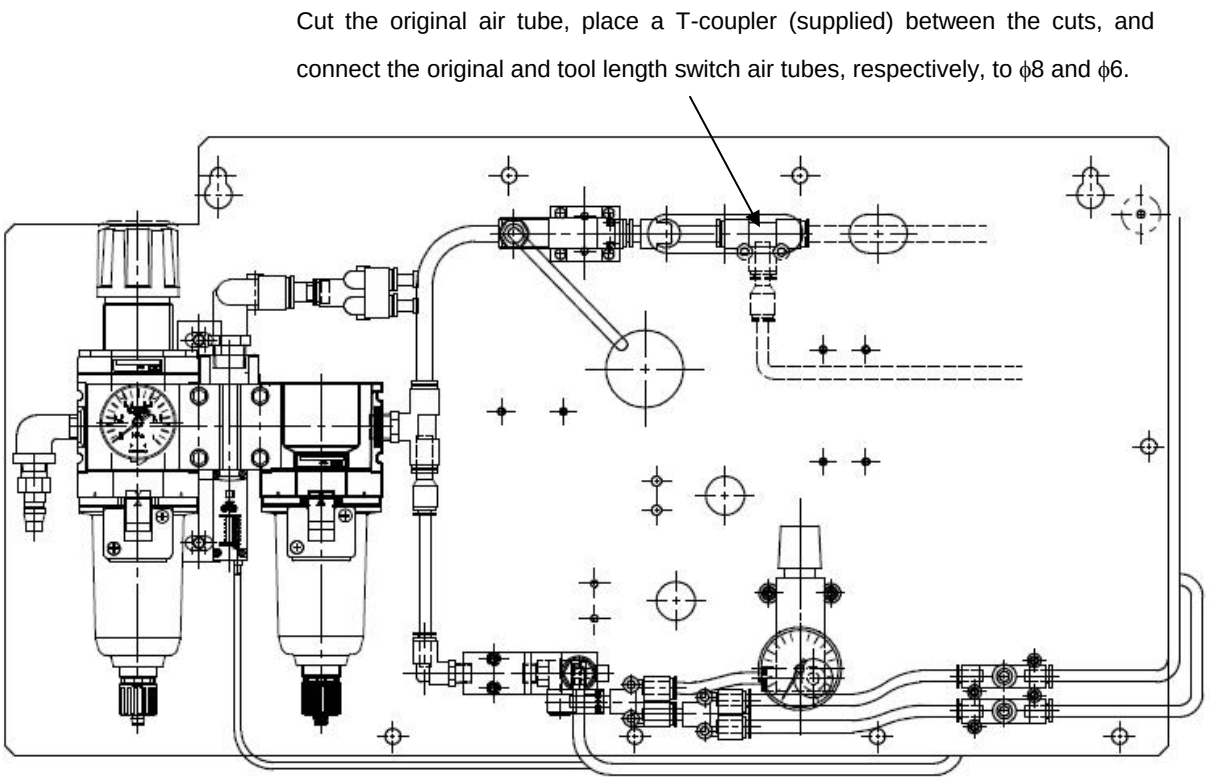


Fig. 23.4.3 (b) Air tube installation

ATTENTION
Start air tube connections exactly at the location specified in the drawing. Starting them at any other location may result in no normal operation being performed, hence a possible failure.

(3) After connecting the cables and air tubes, lay them inside and outside the machine with extra lengths allowed so that the X- and Y-axes can move full-stroke.

(4) Place the knob of the tool length switch speed controller in its full-open position; no adjustment is needed unless otherwise stated.

23.4.4 Operation Check after Installation

(1) Lower the sending surface of the tool length switch to its turn-on position, and confirm that the tool length switch's LED lights.
(2) Once tool exchange has been made on the ROBODRILL main unit, confirm that air comes out from the tool length switch air nozzle.

23.5 PREPARATION FOR MEASUREMENT

(1) Measure the height of the switch
- Select a tool whose tip can reach the surface of the table. Measure the distance from the surface of the table to the switch–on position.
  (a) Place a sheet of paper on the surface of the table. Lower the tool along the Z–axis until the tool tip touches the surface of the table. Record the Z coordinate.

ATTENTION
Do not make any mark on the table.

  (b) Align the tool with the switch and slowly lower the tool along the Z–axis until the LED of the switch lights. Record the Z coordinate.
  (c) Obtain the difference between the Z coordinate of the table surface and the Z coordinate of the switch–on position. Set the difference, as the switch height, in macro variable #900.

(2) Measure the central position of the switch.
- Move the tool along the X–axis and Y–axis so that it is aligned with the center of the switch. Set the machine coordinates in macro variables #901 and #902.

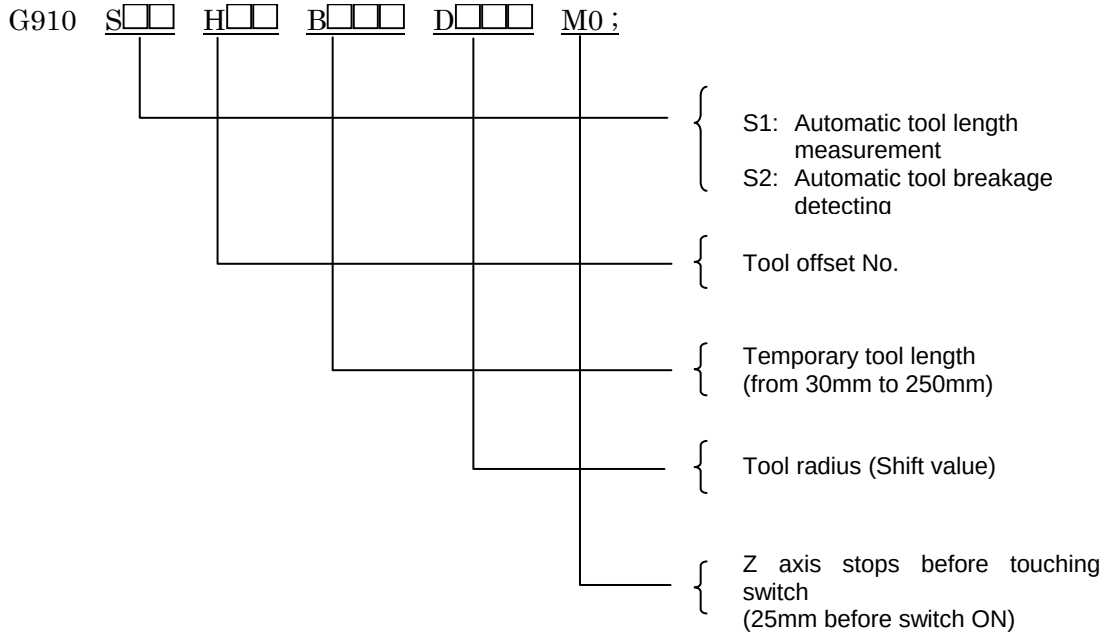
(3) While referring to the operator's manual, set the following macro variables.
- Standard settings without high column

#900 = Switch height, (4)
#901 = X coordinate of switch central position, (5)
#902 = Y coordinate of switch central position, (5)
#903 = 480.0
#904 = 0.5
#905 = 5.0
#906 = 480.0
} Set desired values according the use status.

(4) Mount a tool on the spindle and specify G910 S1.
- G910 S1 H** B***.*
  S1 : The tool length is measured.
  H : Compensation number (The measurement result is input.)
  B : Provisional tool length (Distance between the spindle taper gauge line and the tool tip, as measured with a scale)
- First, perform the measurement slowly with TRVS set to LOW and single block set to ON.
  (a) The tool temporarily stops 25 mm before the switch.
  During the temporary stop, determine the approximate distance.
  (b) During skip (G31) measurement, override is disabled.
- Check that the measured data is set for compensation number (H) after the operation.

(5) Using the same tool, specify G910 S2.
- G910 S2 H**
  S2 : Tool failure is detected.
  The tool length is measured and compared with the previously specified compensation. If the length exceeds the value set in #904, an alarm is issued.
  H : Compensation number (compensation number for which the measured tool length was stored is step 7)
- First, perform measurement slowly with TRVS set to LOW and single block set to ON.
  (a) The tool temporarily stops 5 mm before the switch.
  During the temporary stop, determine the approximate distance.
  (b) During skip (G31) measurement, override is disabled.
- Mount a shorter tool and check that an alarm is issued.

23.6 COMMAND FORMAT



	FORMAT	REMARKS
AUTOMATIC TOOL LENGTH MEASUREMENT	G910S1H___B_____.	Tool length is 250mm, if omit.
	G910S1H___B_____. __D__. _	
	G910S1H___B_____. __D__. __M0	
AUTOMATIC TOOL BREAKAGE DETECTING	G910S2H___	

ATTENTION

1 Temporary tool length B may be set within the range from the actual tool length to the value set in #905 (5 mm assumed when no value is set). If the difference between the actual length and the temporary length exceeds the setting in #905, the tool and the detecting switch may be broken during automatic tool length measurement.
2 The tool length that can be measured may be limited depending on the height of the detecting switch. If the limit is exceeded, the device may not be able to recognize the tool length, and the tool may be broken.

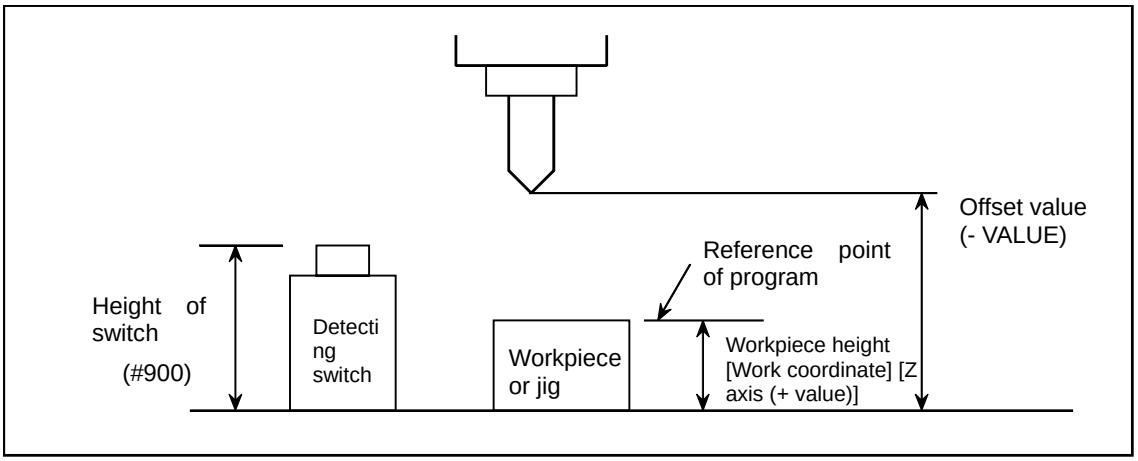
SUPPLEMENT

- The offset value set by automatic tool length measurement must not be changed manually.
- Before specifying automatic tool breakage detection, be sure to confirm that automatic tool length measurement has been completed.

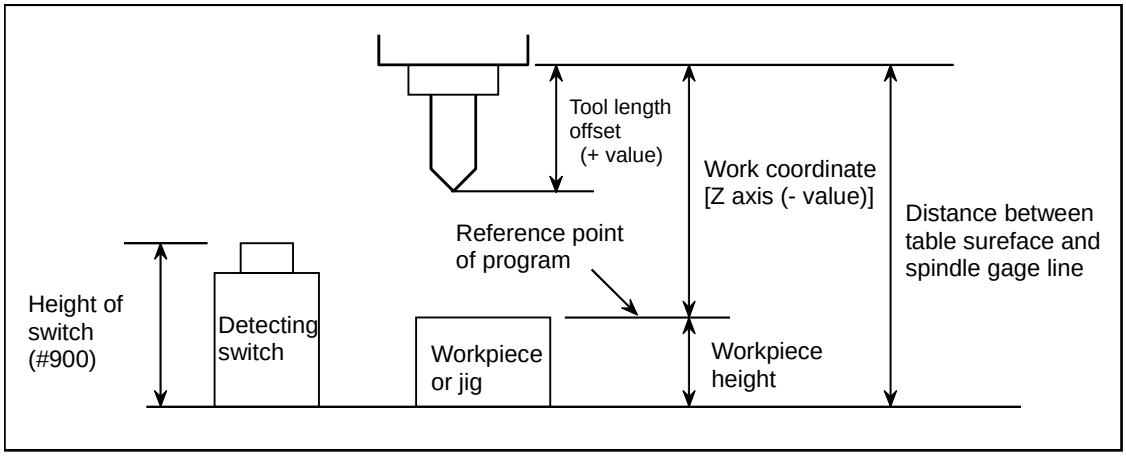
23.7 COMPENSATION METHOD BY USING AUTOMATIC TOOL LENGTH MEASUREMENT

The G43 of tool length measurement is used in following both cases.

(1) In case that offset value is the distance between tool edge and table surface.
(when #903=0, offset is set by "_" value.)

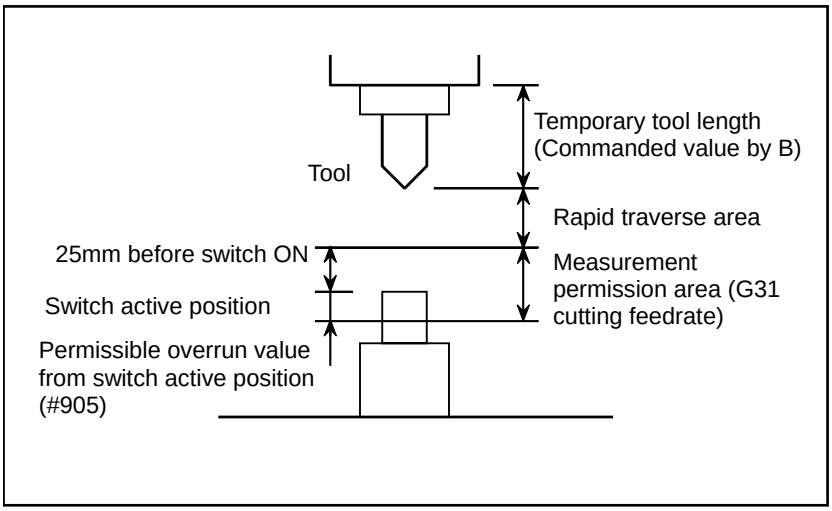


(2) In case that offset value is the tool length (the distance between spindle gage line and tool edge)
(when #903=480, offset is set by "+" value.)
[In case of high column 100mm #903=580]
[In case of high column 200mm #903=680]
[In case of high column 300mm #903=780]



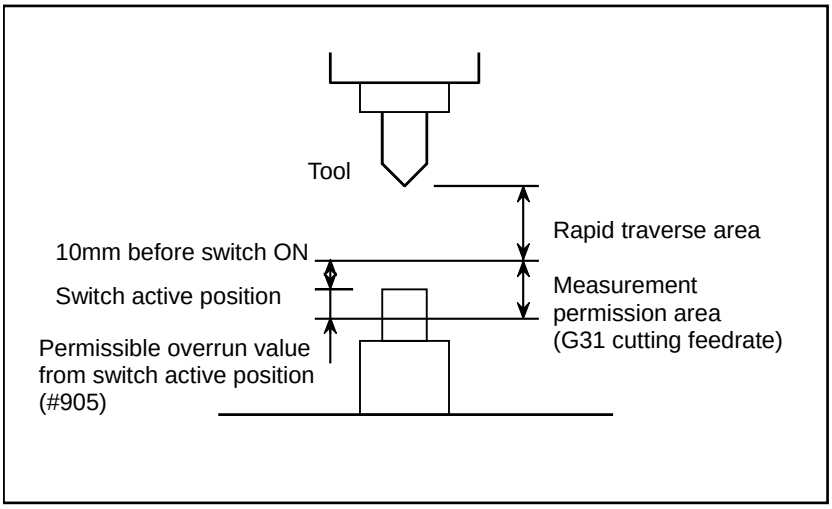
23.8 MEASURING LIMIT

(1) Measuring limit of automatic tool length measurement



SUPPLEMENT
The permission overrun value is 5mm, if #905 is not set.

(2) Measuring limit of automatic tool breakage detect



SUPPLEMENT
The permission overrun value is 5mm, if #905 is no set.

23.9 PARAMETERS AND MACRO VARIABLES

(1) NC parameters

No.6050=910 : G code for calling custom macro with program number O9010. (O9010 is called by G910 command.)

(2) MACRO VARIABLES

#900: Distance between table surface and switch position (not omissible)
The height of detecting switch must be higher than 100mm (from the table surface), and should be under the position that the tool of 250mm length can be measured.

#901: Distance from the position of the origin of the X-axis to the switch (X-axis machine coordinate of the switch position, not omissible)

#902: Distance from the position of the origin of the Y-axis to the switch (Y-axis machine coordinate of the switch position, not omissible)

#903: Selection of usage of tool length measurement (not omissible)
Using G43, offset is set by "_" value: #903=0
Using G44, offset is set by "+" value: #903=480.000 (standard)
In case of high column 100mm, #903=580.000
In case of high column 200mm, #903=680.000
In case of high column 300mm, #903=780.000

#904: Tool breakage detecting tolerance (0.5mm when set "0".)
When the difference between the measuring value of automatic tool length measurement and the measuring value of tool breakage detect exceed the tolerance, the tool broken alarm occurs.

#905: Overrun value from switch ON position (5mm when set "0".)
When the switch is not active until the Z axis going down to the overrun value by measuring with commanded temporary tool length, an alarm occurs.

#906: Distance between table surface and spindle gage line
In case of standard: 480.000
In case of high column 100mm: 580.000
In case of high column 200mm: 680.000
In case of high column 300mm: 780.000

ATTENTION

The settings of #904 and #905 must have the following relationship: #904 $\leq$ #905. If this relationship is not followed, tool breakage detection is not performed normally.

23.10 ALARM MESSAGES AND RELEASING METHOD

(1) Releasing method

Please check the alarm message number and contents.
Alarms can be released by pressing the reset key [//] on the operator's panel.
After releasing alarm, please check and correct the program or setting value according to the contents of message.

(2) Alarm No.3110

DATA ERROR "H" NOT EXIST:
The offset "H" number is not commanded in the program by G910 command.
DATA ERROR "S":
The "S" value is out of range in the program by G910 command.(Please command "S1" or "S2".)
DATA ERROR "B":
The "B" value of the temporary tool length is too small. (Please set it beiger than 30mm(30.000).)
DATA ERROR B TOOL SHORT:
The switch signal is not active until the Z axis going down to the overrun value by automatic tool length measurement.
- The "B" value of the temporary tool length is smaller than actual tool length.
- The setting value of the macro variable #900 or #906 is wrong.
- The switch or its wiring is defective.

SETTING DATA ERROR #900:
The value of the macro variable #900 is not set, or too small. (Height of switch)
SETTING DATA ERROR #901:
No value is set in macro variable #901 (X-coordinate of the switch position).
SETTING DATA ERROR #902:
No value is set in macro variable #902 (Y-coordinate of the switch position).
SETTING DATA ERROR #903:
No value is set in macro variable #903 (selection of usage of the offset compensation value).
SETTING DATA ERROR #906:
No value is set in macro variable #906 (distance between table surface and spindle gage line) or "0" is set.

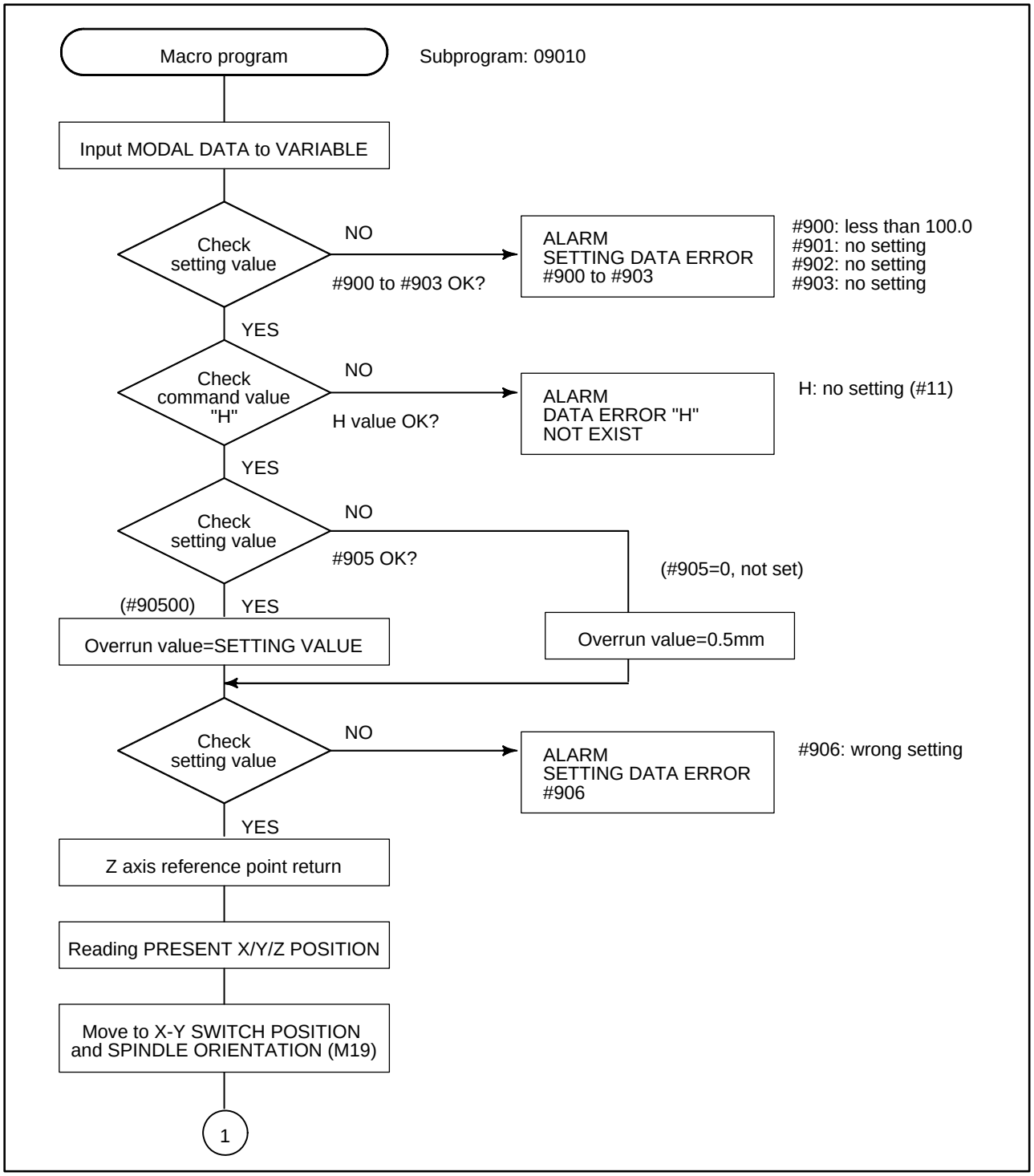
(3) Alarm No.3120

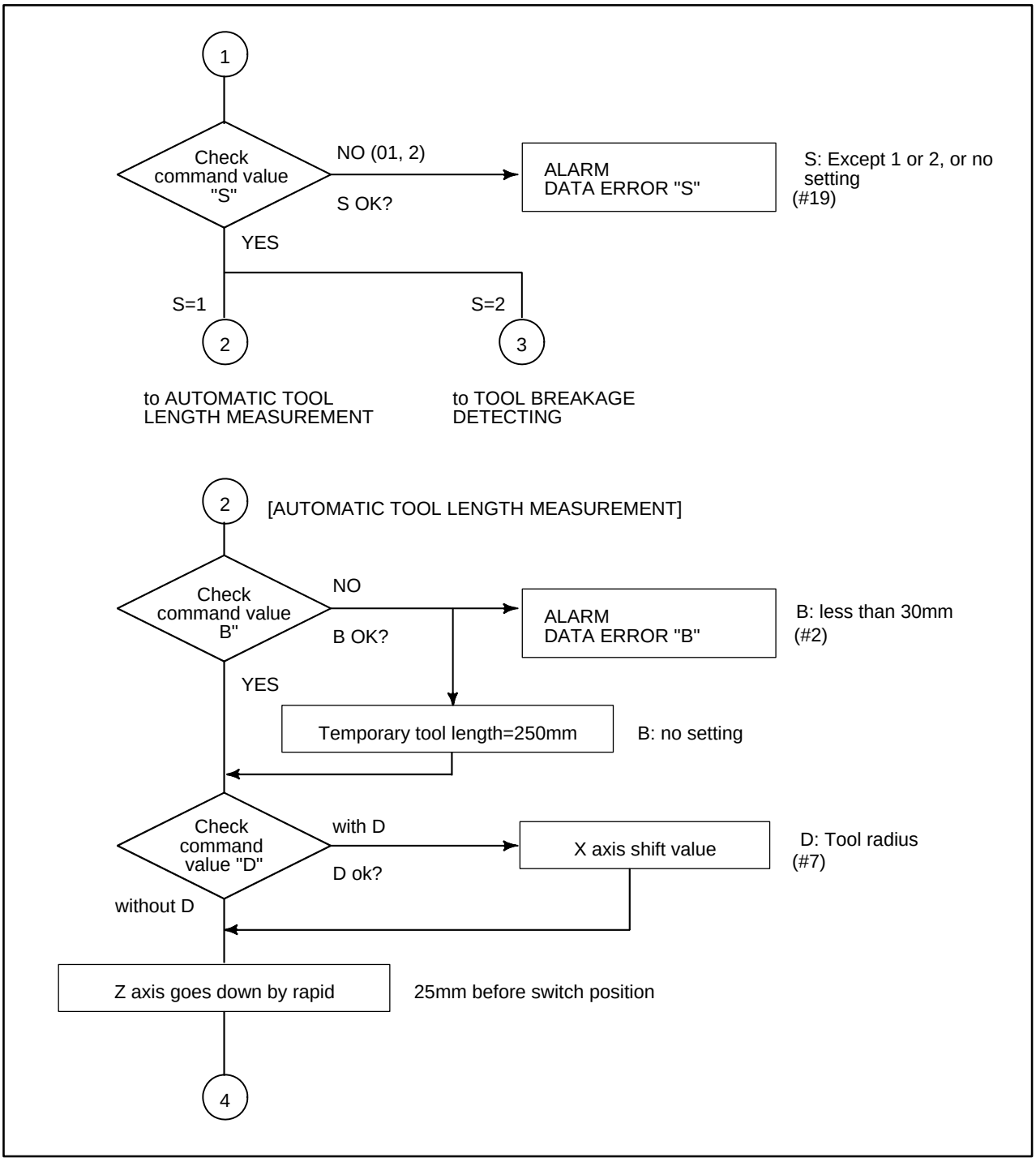
TOOL BROKEN: The tool breakage is detected.
The difference between the measuring value of automatic tool length measurement and the measuring value of tool breakage detect exceed the tolerance (#904).

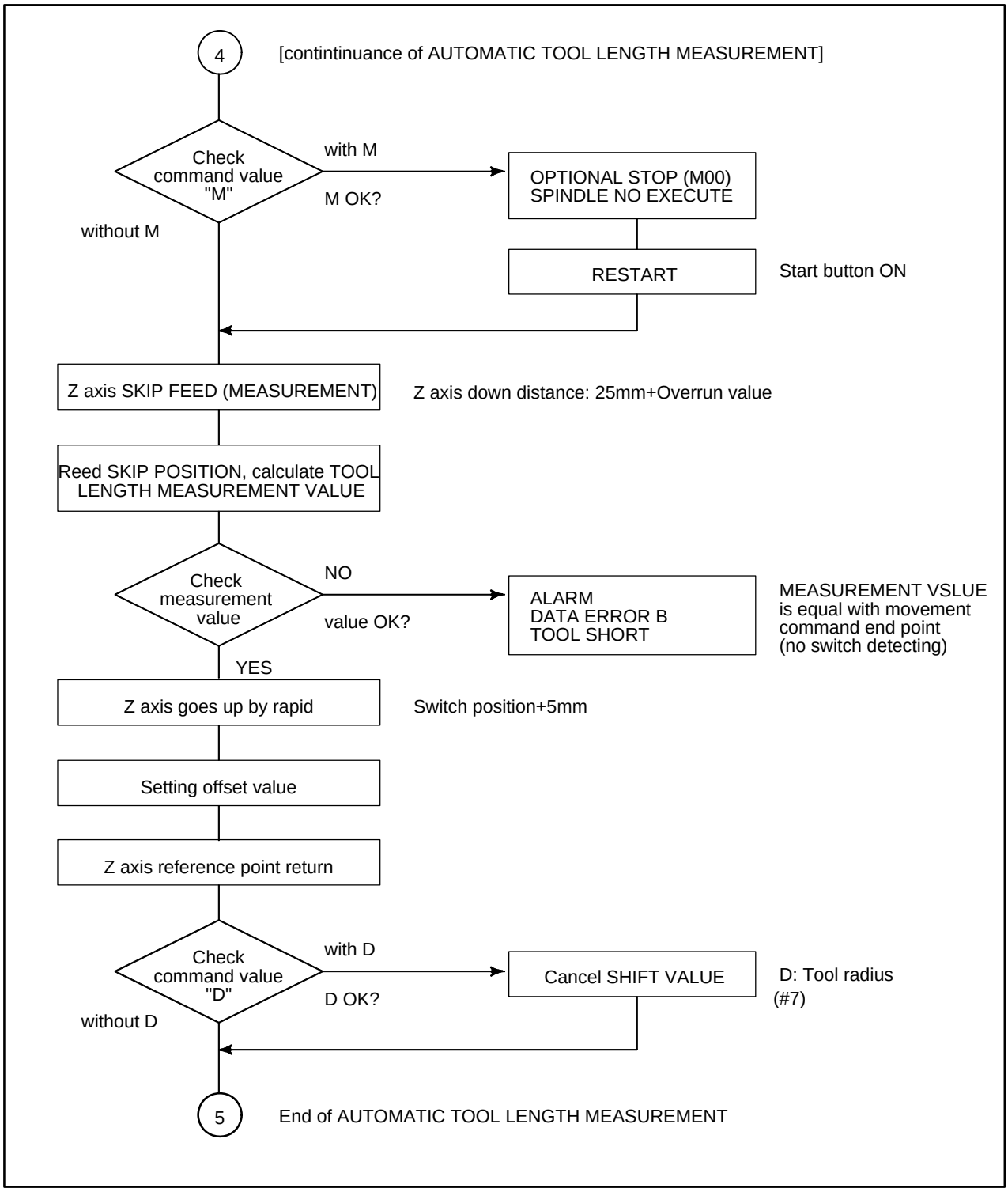
- Please change the broken cutter and carry out automatic tool length measurement.

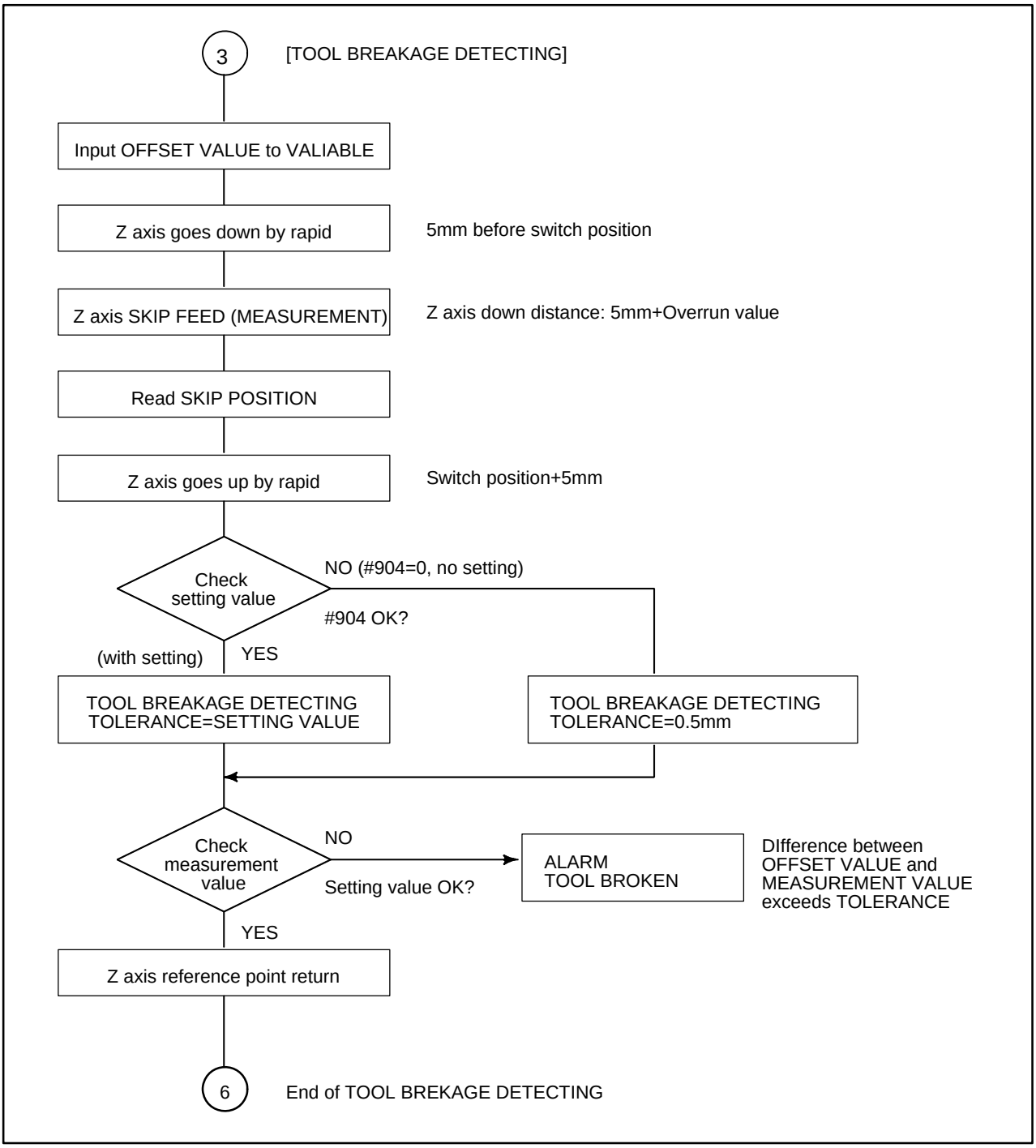
SUPPLEMENT
- If the offset value is changed bigger than the tolerance after execution of tool length measurement, an alarm occurs.
- Please carry out the tool length measurement again after changing cutter.

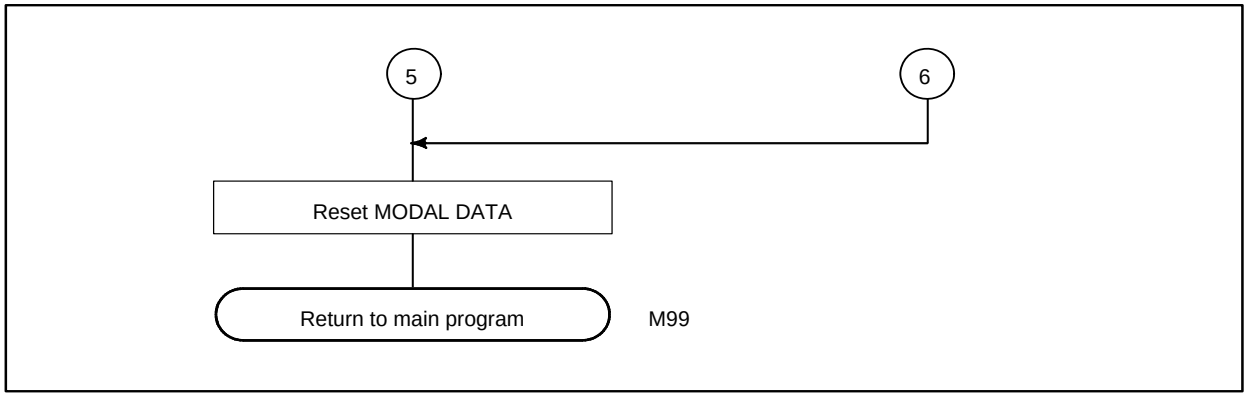
23.11 FLOWCHART




1
Check command value "S"
NO (01, 2)
S OK?
ALARM DATA ERROR "S"
S: Except 1 or 2, or no setting (#19)
YES
S=1
S=2
2
3
to AUTOMATIC TOOL LENGTH MEASUREMENT
to TOOL BREAKAGE DETECTING
2
[AUTOMATIC TOOL LENGTH MEASUREMENT]
Check command value B"
NO
B OK?
ALARM DATA ERROR "B"
B: less than 30mm (#2)
YES
Temporary tool length=250mm
B: no setting
Check command value "D"
with D
D ok?
X axis shift value
D: Tool radius (#7)
without D
Z axis goes down by rapid
25mm before switch position
4


4
[contintinuance of AUTOMATIC TOOL LENGTH MEASUREMENT]
Check command value "M"
with M
M OK?
without M
OPTIONAL STOP (M00)
SPINDLE NO EXECUTE
RESTART
Start button ON
Z axis SKIP FEED (MEASUREMENT)
Z axis down distance: 25mm+Overrun value
Reed SKIP POSITION, calculate TOOL LENGTH MEASUREMENT VALUE
Check measurement value
NO
value OK?
YES
ALARM
DATA ERROR B
TOOL SHORT
MEASUREMENT VSLUE is equal with movement command end point (no switch detecting)
Z axis goes up by rapid
Switch position+5mm
Setting offset value
Z axis reference point return
Check command value "D"
with D
D OK?
without D
Cancel SHIFT VALUE
D: Tool radius (#7)
5
End of AUTOMATIC TOOL LENGTH MEASUREMENT


3
[TOOL BREAKAGE DETECTING]
Input OFFSET VALUE to VALIABLE
Z axis goes down by rapid
5mm before switch position
Z axis SKIP FEED (MEASUREMENT)
Z axis down distance: 5mm+Overrun value
Read SKIP POSITION
Z axis goes up by rapid
Switch position+5mm
Check setting value
NO (#904=0, no setting)
#904 OK?
(with setting)
YES
TOOL BREAKAGE DETECTING TOLERANCE=SETTING VALUE
TOOL BREAKAGE DETECTING TOLERANCE=0.5mm
Check measurement value
NO
Setting value OK?
ALARM TOOL BROKEN
DIfference between OFFSET VALUE and MEASUREMENT VALUE exceeds TOLERANCE
YES
Z axis reference point return
6
End of TOOL BREKAGE DETECTING


5
6
Reset MODAL DATA
Return to main program
M99

23.12 MACRO PROGRAM

```
O9010 (AUTOMATIC TOOL OFFSET) ;
(S.T X500.0 Y400.0 Z330.0+150+HC) ;
(TOOL OFFSET MACRO PROGRAM FOR OFFSET MEMORY B,C VER-4.0) ;
(G910 S* H** B*** D*** M0) ;
(CHANGE PARAMETER NO.6050 DATA 910) ;
;
(START) ;
#30 =#4001 ;
#31 =#4003 ;
IF[#900GE100.0] GOTO10 ;
#3000 =110 (SETTING DATA ERROR #900) ;
N10 ;
IF[#901NE#0] GOTO20 ;
#3000 =110 (SETTING DATA ERROR #901) ;
N20 ;
IF[#902NE#0] GOTO30 ;
#3000 =110 (SETTING DATA ERROR #902) ;
N30 ;
IF[#903NE#0] GOTO40 ;
#3000 =110 (SETTING DATA ERROR #903) ;
N40 ;
IF[#11NE#0] GOTO50 ;
#3000 =110 (DATA ERROR "H" NOT EXIST) ;
N50 ;
;
IF[#905EQ0] GOTO60 ;
IF[#905EQ#0] GOTO60 ;
#24 =#905 ;
GOTO70 ;
N60 ;
#24 =5.0 ;
N70 ;
;
IF[#906EQ480.0] GOTO80 ;
IF[#906EQ580.0] GOTO80 ;
IF[#906EQ680.0] GOTO80 ;
IF[#906EQ780.0] GOTO80 ;
#3000 =110 (SETTING DATA ERROR #906) ;
N80;
;
G91 G28 G00 Z0 ;
#22 =#5043 ;
#20 =#5021 ;
#21 =#5022 ;
G00 X[#901-#20] Y[#902-#21] M19 ; (*1)
IF[#19EQ1] GOTO1000 ;
IF[#19EQ2] GOTO2000 ;
#3000 =110 (DATA ERROR "S") ;
;
N1000 ;
(AUTOMATIC TOOL MEASURING) ;
IF[#2EQ#0] GOTO100 ;
```

```
IF[#2GT30] GOTO110 ;
#3000 =110 (DATA ERROR "B") ;
N100 ;
#2 =250.0 ;
N110 ;
IF[#7EQ#0] GOTO120 ;
G00 X#7 ;
N120 ;
;
G00 Z-[#906-#900-#2-25.0] (*) ;
IF[#13EQ#0] GOTO130 ;
S50 M03 ; (*2)
G04 X0.1 ;
M05 ;
M00 ;
N130 ;
G31 Z-[25.0+#24] F100 (*) ;
#25 =#5063 ;
#26 =#903-[ABS[#22-#25]+#900] ;
IF[[ABC[#906-#900-#2+#24]-[ABS[#22-#25]]] GT 0.001] GOTO160 ;
#3000 =110 (DATA ERROR B TOOL SHORT) ;
N160 ;
Z5.0 ;
G90 G10 L11 P#11 R#26 ;
G91 G28 Z0 ;
IF[#7EQ#0] GOTO3000 ;
G00 X-#7 ;
GOTO3000 ;
;
N2000 ;
(AUTOMATIC TOOL BROKEN) ;
#29 =#[11000+#11] ;
#3 =#29+#900-#903 ;
G00 Z-[ABS[#3]-5.0] (*) ;
G31 Z-[5.0+#24] F200(*) ;
#25 =#5063 ;
Z5.0 ;
IF[#904EQ0] GOTO200 ;
IF[#904EQ#0] GOTO200 ;
#15 =#904 ;
GOTO210 ;
N200 ;
#15 =0.5 ;
N210 ;
IF[ABS[ABS[#3]-ABS[#25-#22]]LT#15] GOTO220 ;
G91 G28 Z0 ;
#3000 =120 (TOOL BROKEN) ;
N220 ;
G91 G28 Z0 ;
;
N3000;
G#30 G#31 M05 ;
M99 ;
```

23.13 USE WITH THE TOUCH PROBE

When the automatic tool length measurement unit is used together with the touch probe by using the multistage skip function, wiring, setting, and program modifications must be made as follows:

(1) Wiring: Tool length switch input signal

Pin No.	Signal address	Connected signal
XT1-05	X4.2	Skip 2

(2) Setting
  (a) NC parameter setting
    (i) Setting for the SKIP signal (X4.7)
    Bit 0 of parameter No. 6202#0 = 1 :
    The SKIP signal is valid for the G31 or G31 P1 command.
    (ii) Setting for the SKIP2 signal (X4.2)
    Bit 1 of parameter No. 6203#1 = 1 :
    The SKIP2 signal is valid for the G31 P2 command.
  (b) Setting for the external interface
  In "X4.2", set "50 (skip 2)".

(3) Program
  Modify the following two lines including the G31 command :
  (a) **G31** Z-[25.0+#24] F100 (*)
  ↓
  G31 P2 Z-[25.0+#24] F100 (*)
  ↓
  (b) **G31** Z-[5.0+#24] F200 (*)
  G31 P2 Z-[5.0+#24] F200 (*)

23.14 MEASURING A TOOL FOR WHICH SPINDLE ROTATION PROHIBITION IS SET

If using the high-speed spindle holder (option), etc., and measuring a tool for which "spindle rotation prohibition" is set using the spindle speed restriction function, change the following portions of a macro program for tool length measurement (O9010) to comments.

(1) M19 → (M19) (*1)
(2) S50 M03 → (S50 M03) (*2)

24 SMALL–HOLE PECK DRILLING CYCLE (OPTION)

24.1 OUTLINE OF THE FUNCTION

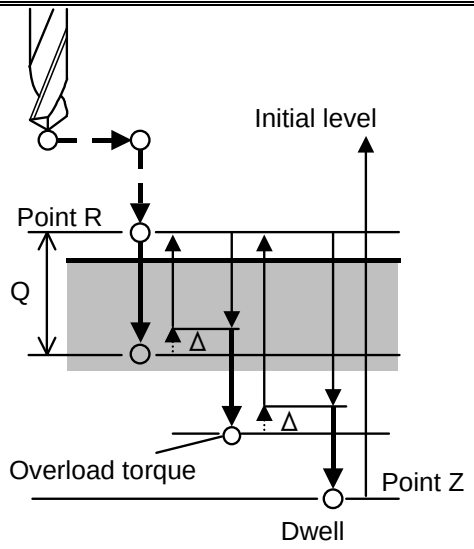
This cycle is a peck drilling cycle that uses an arbor with an overload torque detection feature. Upon reception of an overload torque detection signal (using the skip signal) during drilling, this cycle retracts the tool, changes the spindle speed and cutting feedrate, then resumes drilling.
When the M code set in parameter No. 5163 is specified, the system enters the small-hole peck drilling cycle mode. In this mode, specifying G83 performs the small-hole peck drilling cycle. The small-hole peck drilling cycle mode can be canceled by specifying G80 or a reset operation.

- **Format**

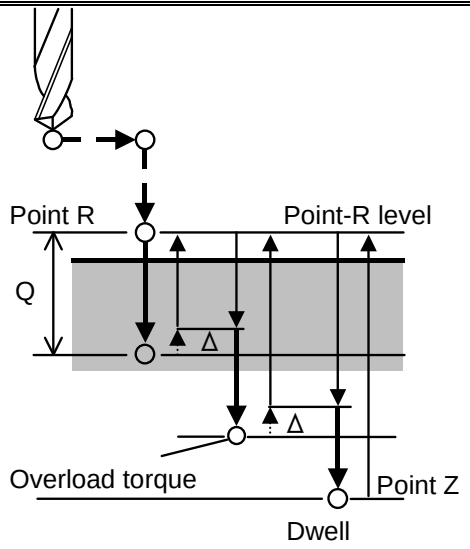
G83 X_ Y_ Z_ R_ Q_ F_ I_ K_ P ;

X_ Y_	**:**	Hole position data
Z_	**:**	Distance from point R to the bottom of the hole
R_	**:**	Distance from the initial level to point R
Q_	**:**	Depth of cut for one drilling operation
F_	**:**	Cutting feedrate
I_	**:**	Advance and return feedrate (the same format as for F) (When this is omitted, the values in parameter Nos. 5172 and 5173 are assumed.)
K_	**:**	The number of repetitions (specified only when the operation must be repeated)
P_	**:**	Dwell time at the bottom of the hole (When this is omitted, P0 is assumed.)

G83 (G98)



G83 (G99)



Δ: Small clearance when the tool is first returned to point R. In the second and subsequent drilling operations, this is the clearance between the tool and the bottom of the hole. (Parameter No. 5174)
Q: Depth of cut for one drilling operation

Indicates the path of a movement at rapid traverse.
Indicates the path of a movement at a programmed cutting feedrate.

Indicates the path of a movement at parameter-set advance and return feedrates in the cycle.

- **Operations that make up the cycle**

* Positioning along the X- and Y-axes
* Positioning to point R along the Z-axis
* Z-axis cutting (first cutting operation, depth of cut Q, incremental)
Return (hole button → small clearance Δ, incremental)
Return (position Δ above hole bottom → point R)
Advancing (point R → point (hole bottom + clearance Δ))
Cutting (second and subsequent operations, depth of cut Q + Δ, incremental)
* Dwell
* Return to point R (or initial point) along the Z-axis = end of the cycle

Return and advance operations are subject to acceleration/deceleration control with the cutting feed acceleration/deceleration time constant. When a return operation is performed, an in-position check is performed at point R.

24.2 USAGE

[Sample program]

```
N01  M03    S___ ;
N02  M□□    ;
N03  G83     X_ Y_ Z_ R_ Q_ F_ I_ K_ P_ ;
N04  X_ Y_ ;
:
:
N10  G80;
```

[Description of commands in each block]

N01 : Specifies forward spindle rotation and spindle speed.
N02 : M code specifying G83 as a small-hole peck drilling cycle.
This M code is set in parameter No. 5163. (Standard setting: M28)
N03 : Specifies the small-hole peck drilling cycle.
Drilling data (except data with addresses K and P) is stored, and drilling is performed.

SUPPLEMENT

G83 is a continuous-state G code. This means that G83 remains unchanged unless another canned cycle is specified or a G code that cancels the current canned cycle is specified.
When the same drilling operation is performed successively, drilling data need only be specified in the first drilling block and need not be specified separately for each block.

N04 : Changes the hole position, and performs the small-hole peck drilling cycle using the same drilling data as N03.
N10 : Cancels the small-hole peck drilling cycle. The M code specified in N02 is also canceled.

24.3 SETTING THE SMALL–HOLE PECK DRILLING CYCLE MODE

In the small-hole peck drilling cycle mode, the drilling cycle can be performed by specifying G83. The mode is entered by specifying the M code set in parameter No. 5163. The mode is canceled by the reset operation or by specifying G80.
The M code does not wait for FIN. So when specifying this M code with another M code in the same block, exercise special care.

(Examples)
M□□ M03 ; → Waits for FIN.
M03 M□□ ; → Does not wait for FIN.

24.4 DETAILED SPECIFICATIONS

(1) This peck drilling cycle is executed by specifying G83 in the small-hole peck drilling cycle mode
(2) The skip signal (X0004.7) is used as the overload torque detection signal. Supply the tooling overload signal to XT1–12. The skip signal is valid (for activating a return) only when the tool is located between the R and Z points and advancing or cutting operation is being performed.

SUPPLEMENT
When an overload torque is detected during an advance operation, a return operation (movement to a point (small clearance Δ + point R)) is performed, then the next advance operation moves the tool to the position at which the return operation by small clearance Δ was completed at the end of the previous drilling operation.

(3) During one G83 cycle, the cutting conditions are changed for each pecking operation (advancing → cutting → return).
The cutting conditions, however, can be kept unchanged by setting bits 1 and 2 of parameter No. 5160.

(a) Changing the cutting federate
The cutting feedrate programmed with an F word is changed for each of the second and subsequent cutting operations. Set two change rates in parameters No. 5166 and No. 5167: One change rate is used when the skip signal is received in the previous cutting operation, and the other is used when no skip signal is received.

Cutting feedrate=F×α

(First operation) α = 1.0
(Second and subsequent operations) $\alpha = \alpha \times \beta \div 100$
where β is the change rate for one operation.
When skip is present during the previous cutting operation: β= b1% (parameter No. 5166)
When skip is not present during the previous cutting operation: β= b2% (parameter No. 5167)

If change rate a for the cutting feedrate is less than the rate set in parameter No. 5168, the cutting feedrate is not changed. The cutting feedrate can be increased to up to the maximum cutting feedrate.

(b) Changing the spindle speed
The spindle speed programmed with an S word is changed for each of the second and subsequent advance operations. Set two change rates in parameter No. 5164 and No. 5165: One change rate is to be used if the skip signal is received in the previous cutting operation, and the other is used if no skip signal is received.

Spindle speed = S × γ

(First operation) γ = 1.0
(Second and subsequent operations) γ = γ × δ ÷ 100
where δ is the change rate for one operation.
When skip is present during the previous cutting operation: δ = d1% (parameter No. 5164)
When skip is not present during the previous cutting operation: δ= d2% (parameter No. 5165)

If the cutting feedrate is clamped to the lower limit, the spindle speed is not changed. The spindle speed can be changed to up to a value equivalent to the maximum value of the S analog data.

(4) Advance and return operations are not treated as rapid traverse positioning but are executed as the same interpolation operation as cutting feed. However, the tool life management function does not increment the tool life count during the advance and return operations.
When the advance and return feedrate is specified at address I, the same format as for address F is used as follows:

G83 I1000 ; (command with no decimal point)
G83 I1000. ; (command with the decimal point)

Both of the above commands set the feedrate to 1000 mm/min. Address I specified in the G83 modal state is in effect until G80 or reset is specified.

SUPPLEMENT
If I is omitted, and parameter No. 5172 (return operation) and No. 5173 (advance operation) are set to 0, the same feedrate as specified in F is assumed.

(5) In the small-hole peck drilling cycle mode, the following can be specified:
- Hole position on the X-, Y-, and additional axes
- Arithmetic and branch operations using custom macros
- Subprogram (such as hole positions) call
- Switching between absolute and incremental modes
- Rotation of the coordinate system
- Scaling command (not valid for depth of cut Q and small clearance d1)
- Dry run
- Feed hold

(6) By setting the single block mode to ON, the machine stops after every return operation. The machine can also be stopped every cycle by setting bit 0 (SBC) of parameter No. 5105.

(7) Feedrate override is enabled for cutting, return, and advance operations during the cycle.

(8) The total number of return operations performed during cutting and the total number of return operations performed upon reception of the overload torque detection signal can be output to the custom macro common variables (#100 to #149) set in parameter No. 5170 and No. 5171. A value beyond the range from 100 to 149 cannot be set in these parameters (parameter No. 5170 and No. 5171).

Parameter (No.5170) : Sets the number of a common variable to which the total number of return operations performed during cutting is output.

Parameter (No.5171) : Sets the number of a common variable to which the total number of return operations performed when the overload torque detection signal is received during cutting is output.

SUPPLEMENT

The total numbers output to common variables of custom macros are cleared to zero when G83 command is issued after the small-hole peck drilling cycle mode is entered.

24.5 RESTRICTION

In the small-hole peck drilling cycle mode, subprogram call command M98P_ must be specified in a block that does not contain any other command.

24.6 RELATED PARAMETERS (STANDARD SETTINGS)

No.	#7	#6	#5	#4	#3	#2	#1	#0	Default
5160						NOL	OLS		00000010

[Input type] Parameter input
[Data type] Bit

#1 OLS When the overload torque detection signal is received, the feedrate and spindle speed are:
0: Not changed.
1: Changed.

#2 NOL When the depth of cut for one drilling operation is reached without receiving the overload torque detection signal, the feedrate and spindle speed are:
0: Not changed.
1: changed.

No.	Data	Default
5163	M code specifying the small-hole peck drilling cycle mode	28

[Input type] Parameter input
[Data type] 2 words
[Valid data range] 1 to 99999999
An M code for specifying the small-hole peck drilling cycle mode is set.

No.	Data	Default
5164	Percentage by which the spindle speed is changed at the start of the next advance operation when the overload torque detection signal is received	90

[Input type] Parameter input
[Data type] Word
[Unit of data] %
[Valid data range] 1 to 255

The percentage by which the spindle speed is changed at the start of the next advance operation after a return operation is performed upon reception of the overload torque detection signal is set.

$S2 = S1 \times d1 \div 100$

S1: Spindle speed before change
S2: Spindle speed after change

Set d1 above in percents (%).

SUPPLEMENT
If 0 is set, the spindle speed is not changed.

No.	Data	Default
5165	Percentage by which the spindle speed is changed at the start of the next advance operation when no overload torque detection signal is received	100

[Input type] Parameter input
[Data type] Word
[Unit of data] %
[Valid data range] 1 to 255

The percentage by which the spindle speed is changed at the start of the next advance operation after a return operation is performed without receiving the overload torque detection signal is set.

$S2=S1\times d2\div 100$

S1: Spindle speed before change
S2: spindle speed after change

Set d2 above in percents (%).

SUPPLEMENT
If 0 is set, the spindle speed is not changed.

No.	Data	Default
5166	Percentage by which the cutting feedrate is changed at the start of the next cutting operation when the overload torque detection signal is received	90

[Input type] Parameter input
[Data type] Word
[Unit of data] %
[Valid data range] 1 to 255

The percentage by which the cutting feedrate is changed at the start of the cutting operation after the return and advance operations are performed upon reception of the overload torque detection signal is set.

$F2=F1\times b1\div 100$

F1: Cutting feedrate before change
F2: Cutting feedrate after change

Set b1 above in percents (%).

SUPPLEMENT
If 0 is set, the spindle speed is not changed.

No.	Data	Default
5167	Percentage by which the cutting feedrate is changed at the start of the next cutting operation when no overload torque detection signal is received	100

[Input type] Parameter input
[Data type] Word
[Unit of data] %
[Valid data range] 1 to 255

The percentage by which the cutting feedrate is changed at the start of the cutting operation after the return and advance operations are performed without receiving the overload torque detection signal is set.

F2=F1×b2÷100

F1: Cutting feedrate before change
F2: Cutting feedrate after change

Set b2 above in percents (%).

SUPPLEMENT
If 0 is set, the spindle speed is not changed.

No.	Data	Default
5168	Lower limit of percentage of cutting feedrate during execution of the small-hole peck drilling cycle	10

[Input type] Parameter input
[Data type] Byte
[Unit of data] %
[Valid data range] 1 to 255

The lower limit of the percentage of the cutting feedrate after a specified cutting feedrate is changed repeatedly is set.

FL=F×b3÷100

F: Specified cutting feedrate
FL: Cutting feedrate after change

Set b3 above in percents (%).

No.	Data	Default
5170	Number of a macro variable to which the total number of return operations during cutting is output	100

[Input type] Parameter input
[Data type] Word
[Valid data range] 100 to 149

The number of a common variable of a custom macro to which the total number of return operations performed during cutting is set. Output to a common variable in the five hundreds is not allowed.

No.	Data	Default
5171	Number of a macro variable to which the total number of return operations initiated by the overload torque detection signal is output	101

[Input type] Parameter input
[Data type] Word
[Valid data range] 100 to 149
The number of a common variable of a custom macro to which the total number of return operations initiated by the overload torque detection signal received during cutting is set. Output to a common variable in the five hundreds is not allowed.

No.	Data	Default
5172	Feedrate at which the tool returns to point R when I is omitted	1000.000

[Input type] Parameter input
[Data type] Real number
[Unit of data] mm/min, inch/min, degrees/min (input unit)
[Least unit of data] As per increment system of the reference axis
[Valid data range] See the standard parameter setting table (C).
(0.0 to +240000.0 for IS-B)
The feedrate at which the tool returns to point R when I is omitted is set.

No.	Data	Default
5173	Feedrate at which the tool advances to a position before the hole bottom when I is omitted	1000.000

[Input type] Parameter input
[Data type] Real number
[Unit of data] mm/min, inch/min, degrees/min (input unit)
[Least unit of data] As per increment system of the reference axis
[Valid data range] See the standard parameter setting table (C).
(0.0 to +240000.0 for IS-B)
The feedrate at which the tool advances to before the bottom of the hole previously drilled when I is omitted is set.

No.	Data	Default
5174	Clearance in the small-hole peck drilling cycle	500

[Input type] Parameter input
[Data type] Real number
[Unit of data] mm, inch (input unit)
[Least unit of data] As per increment system of the reference axis
[Valid data range] Nine digits of the least input increment (see the standard parameter setting table (A).)
(-999999.999 to +999999.999 for IS-B)
Small clearance in the first return to point R or clearance at the bottom of the hole in the second and subsequent cutting operations during the cycle is set.

24.7 DIAGNOSIS DISPLAY

520	**Total number of return operations performed during cutting since G83 is specified**
521	**Total number of return operations initiated by the reception of the overload torque detection signal during cutting since G83 is specified**

SUPPLEMENT

The total numbers output to No. 520 and No. 521 are cleared to zero by a G83 command issued after the small-hole peck drilling cycle mode is entered.

522	**Coordinate value on the drilling axis with which a return operation starts**
523	**Difference between the coordinate value on the drilling axis with which a return operation started previously and the coordinate value on the drilling axis with which a return operation started this time (previous and current operations)**

25 CENTER–THROUGH COOLANT (OPTION)

25.1 SPECIFICATIONS

25.1.1 Coolant Unit

Dimensions (X–axis direction x Y– axis direction x Z–axis direction)	1565 × 895 × 795mm (α-D14(21)M/L*i*A5) 1300 × 1080 × 795mm (α-D14(21)S*i*A5)
Weight of coolant unit	140 kg
Capacity of coolant tank	0.24m^3 (240 L) (α-D14(21)S*i*A5 : 0.16m^3 (160L))
Configuration	Coolant tank
	Chip tray
	External oiling coolant (AC 0.25kW)
	Center–through pump unit
	Control box (for center–through)
Option	Coolant for cleaning inside of the machine (AC 0.40kW) With a shower gun

25.1.2 Center-Through Pump Unit

Coolant pump motor	0.75 kW (directly connected)
Maximum delivery pressure	1.72 MPa (17.5kgf/cm^2)
Rated delivery pressure	1.47 MPa (15kgf/cm^2)
Maximum delivery	0.015m^3/min. (=15L/min.)（50Hz） 0.018m^3/min. (=18L/min.)（60Hz）
Final filtering precision	25μm / 10μm
Filtering system	#100 mesh tank partition plate (with pull–up handle)
	#150 mesh suction filter (mounted on the pump)
	25μm line filter (with clogging detection function based on the pressure differential)
Coolant valve	3–port solenoid valve mounted type Pilot air: 0.24 to 0.49Mpa (2.5 to 5kgf/cm^2)

25.2 NOTES

** Use the center–through coolant under the following conditions only.
See 2-d) "COOLANTS AND LUBRICANTS" in "SAFETY PRECAUTIONS".

25.2.1 Selecting a Coolant

⚠ WARNING

1 Do not use a coolant with a low flash point (category II mineral oil or another type of oil with a flash point lower than 70°C) to prevent the possibility of a fire. Even when using a coolant belonging to category III mineral oil (with a flash point of 70 to 200°C), category IV mineral oil (with a flash point of 200 to 250°C), or flame-retardant oil (with a flash point higher than 250°C), be careful with the use status and method to prevent the possibility of a fire by, for example, preventing the generation of greasy fumes.
2 Do not use a deteriorated coolant or lubricant (grease or oil) because it is very hazardous. For details on the state of a deteriorated coolant or lubricant, contact the manufacturer and preserve or discard it as instructed by the manufacturer.
3 Do not use a coolant or lubricant (grease or oil) that deteriorates polycarbonate, nitrile rubber (NBR), hydrogenated nitrile rubber (HNBR), fluorocarbon rubber, nylon, acrylate resin, or ABS resin. If diluted water includes much residual chlorine, the above materials are deteriorated. Since these materials are used for sealing in this system, sealing becomes incomplete, which may cause an electric shock due to electric leakage or seizing up due to outflow of grease.

(1) The viscosity of an available water–insoluble coolant must be 16mm^2/s (=16 cSt) or less.
(2) Use a water–soluble coolant diluted with water at a high rate of dilution (normally 5 to 15 times).

25.2.2 Coolant Unit

(1) Do not continue blowing dry air to center-through route during machining to prevent the rotary union from being damaged.
(2) When the customer prepares the coolant unit, the following rules must be observed:

(a) Prepare the following pipe fittings:

Coolant unit side	C–8 (JIS B 8363 G3/8 internal thread 30 male sheet)
Spindle side (already mounted on the machine)	

(b) Also prepare a check valve unit and pipes for the machine according to the capacity of the unit.
(c) As the pump capacity, set the maximum pressure to up to 3.0 MPa and the maximum flow rate to up to 0.02m^3/min (=20 L/min.)
(d) See Sections 25.3, "Appearance and Configuration of the Coolant Unit," 25.9, "Center–through Coolant Control (interface specifications)," and 25.10, "ELECTRICAL CIRCUIT DIAGRAM OF CENTER–THROUGH COOLANT CONTROL." Prepare the customer's unit to conform to these sections as closely as possible.
(e) Create an operator's manual, maintenance manual, maintenance drawings, and other documents for the coolant unit and attach them to the drilling machine.
(Note that FANUC cannot provide maintenance for coolant unit provided by the customer.)

25.3 APPEARANCE AND CONFIGURATION OF THE COOLANT UNIT

25.3.1 Appearance of the Coolant Unit

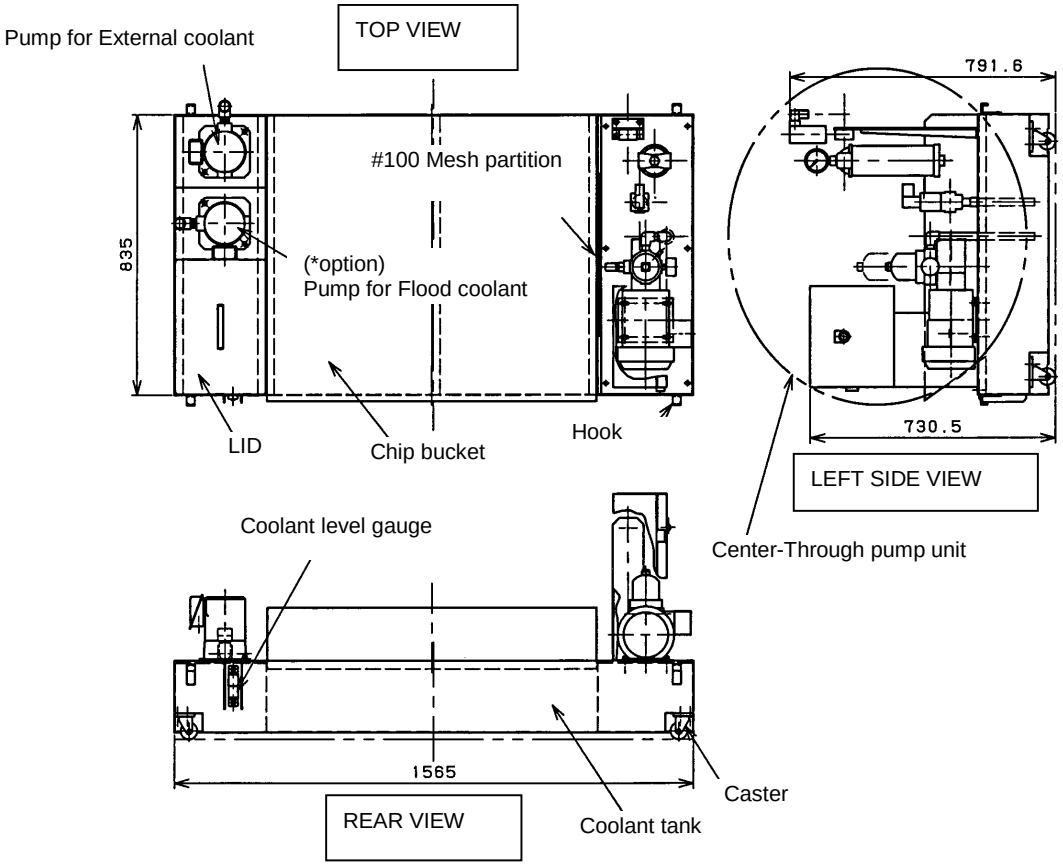


Fig.25.3.1(a) Three faces of coolant (α-D14/21M/L*i*A5)

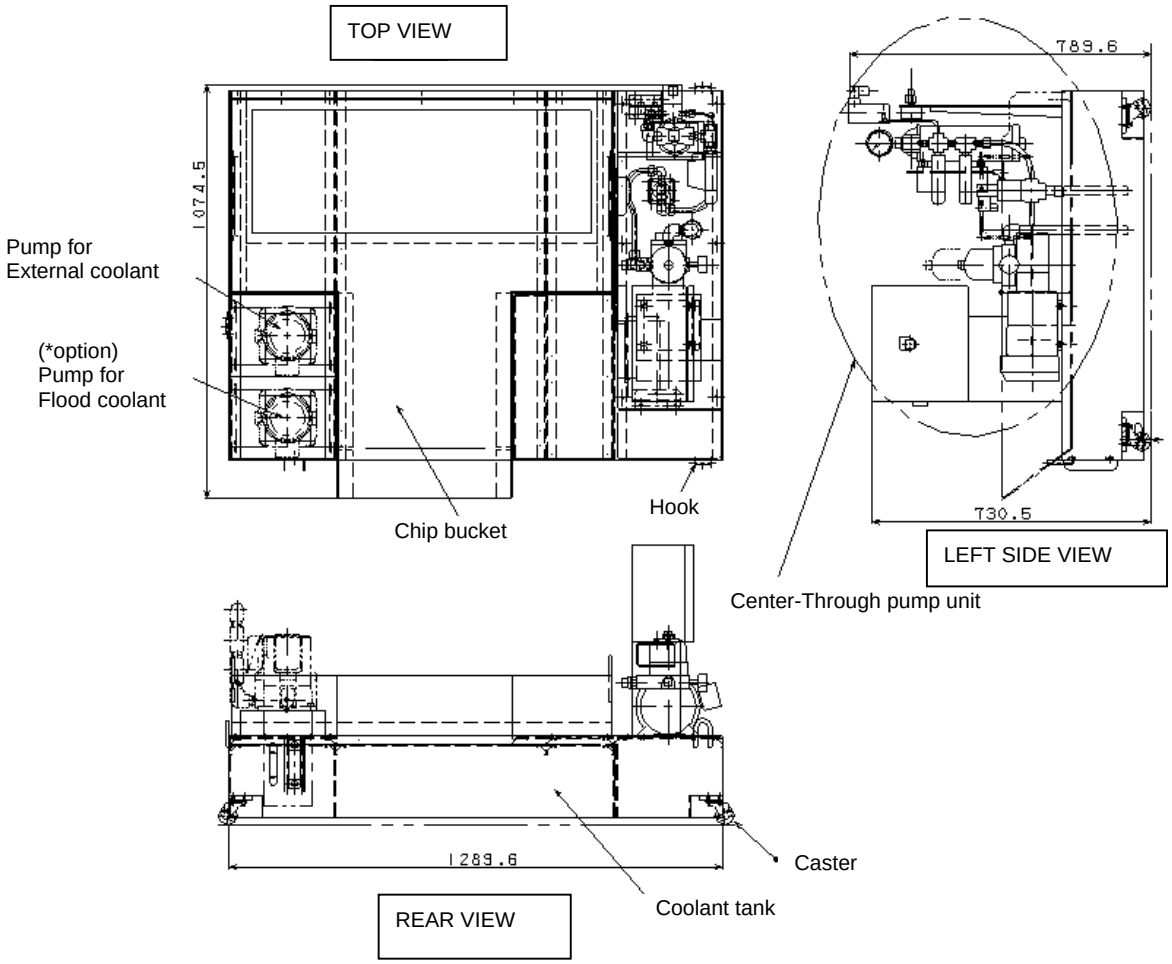


Fig.25.3.1(b) Three faces of coolant (α-D14/21S*i*A5)

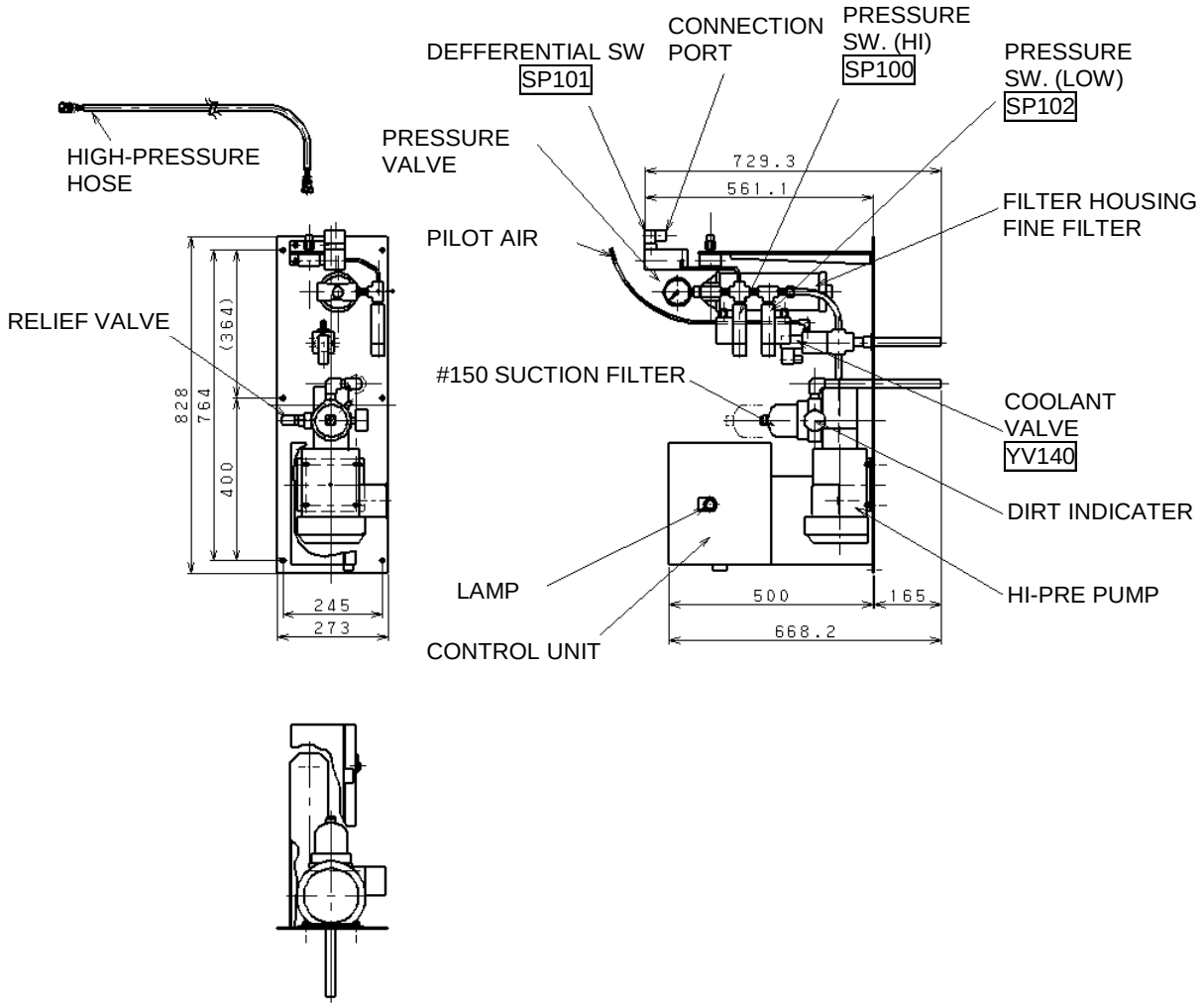


Fig.25.3.1(c) Detail of center–through pump unit

25.3.2 Names and Functions of the Parts

(1) Coolant tank

(a) The coolant tank has casters, a pull–up hook, and level gage (for visual check).
(b) This tank can contain up to $0.24m^3$ (=240L) of coolant.

(2) Control box

(a) The control box contains only a circuit breaker, contacts for starting the pump and coolant valve, and the relay terminal for each detection switch.
(b) The lamp on the front panel indicates whether power is being supplied to the control box. Accordingly, when the circuit breaker in the control box is closed, the lamp on the front panel lights.

(3) Center–through pump

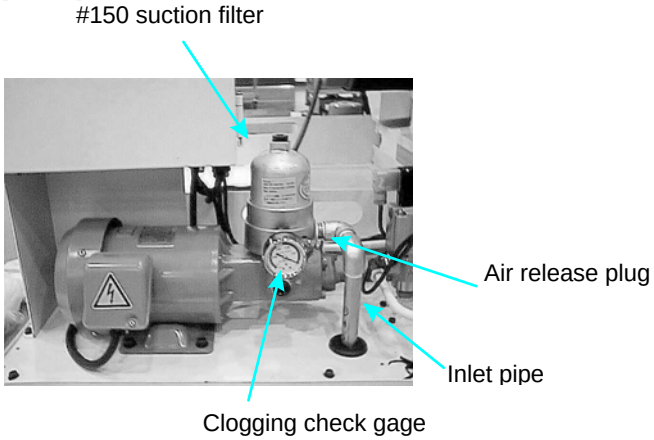


Fig.25.3.2(a) Center–through Pump

(a) The center–through pump is a Tocoloid pump for coolant which is compatible with water–soluble coolants.
(b) The pump is directly connected to the drive motor via a coupling.
(c) The pump contains a relief valve and a #150 mesh (equivalent to 100μm) suction filter (with a clogging check gage and air release plug).
(d) The temperature is monitored.

(4) #100 mesh partition plate (filtering precision of 150 μm or equivalent)

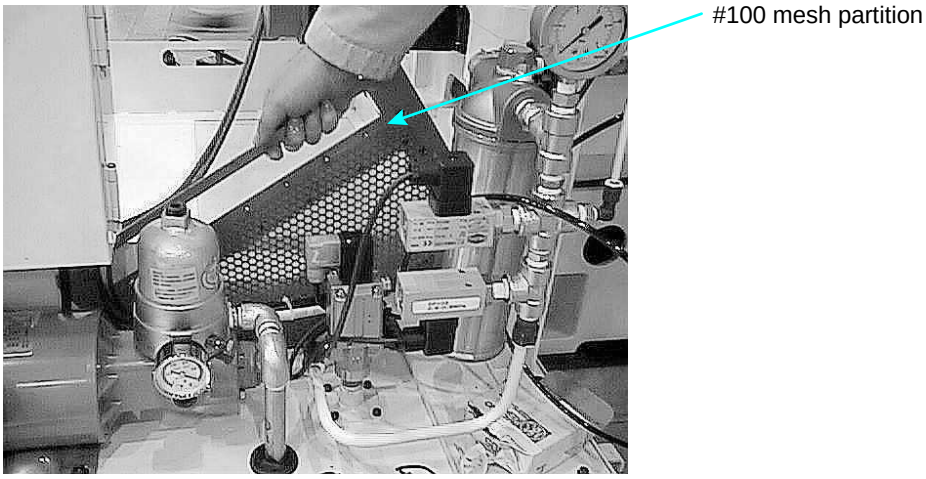


Fig.25.3.2(b) #100 mesh partition

(a) The partition plate separates the chip tray (dirty tank side) from the center-through pump unit (clean tank side).
(b) This plate is not fixed and can be pulled out of the tank simply by lifting the handle.
(c) Periodically check the mesh and remove any chips that have adhered to the net with a brush.

(5) Pressure switch (maximum pressure detection) [SP100]

(a) The set pressure is 2.5 MPa.
(b) This switch detects an abnormally high pump pressure caused by damage to the pump relief valve or some other abnormality.

(6) Pressure switch (minimum pressure detection) [SP102]

(a) The set pressure is 0.3 MPa.
(b) This switch detects a low coolant discharge pressure caused by coolant leakage that may be caused by a loose coupling or an operation error.

(7) Differential pressure switch (line filter clogging detection) [SP101]

(a) This switch detects the pressure difference between the line filter inlet and discharge sides to determine whether the filter has reached the end of its service life.
(b) The setting pressure is Δ0.18 MPa.
(c) This switch has a color ring for visual confirmation. Periodically check the color ring to determine whether the filter needs to be replaced.

(8) Pressure gage (for checking the discharge pressure)

(a) The normal range of coolant discharge pressure is between 1.0 to 2.0 MPa.

(9) Coolant valve [YV140]

(a) The coolant valve is a 3–port valve which contains a solenoid valve (pneumatic). This valve is used to control the direction of the coolant flow.
(b) While power is not supplied, the coolant always returns to the tank.

(10) Air tube (pilot air)

(a) The air tube supplies air to the coolant valve.

(11) Filter housing

(a) An air release plug is mounted on the housing head and a drain plug for draining the coolant is mounted on the bottom of the shell (housing body).
(b) The housing head and shell are connected with a long bolt and nut so that the filter can be replaced easily. The housing is sealed with an O-ring. Filter replacement requires only one adjustable wrench.

(12) Line filter

(a) Always use a genuine FANUC filter.
(b) The nominal filtering precision of the standard filter is 25μm (The filter is factory–mounted).
(c) A filter with a nominal filtering precision of 10μm is also available.

(13) High–pressure hose

(a) This hose is capable of withstanding high pressures and is compatible with both water–soluble and water–insoluble coolant.
(b) Instead of PT screws, high–pressure pipe fittings are used at both

> ⚠ **CAUTION**
> Be careful not to get injured by tools during connection or disconnection of the high-pressure hose.

(14) Check valve and swivel joint

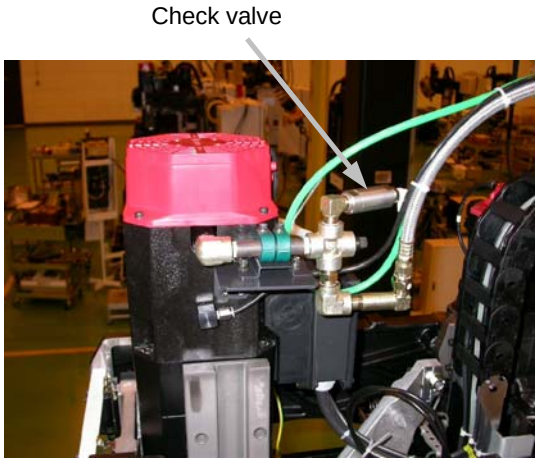


Fig. 25.3.2 (c) Check valve assembly

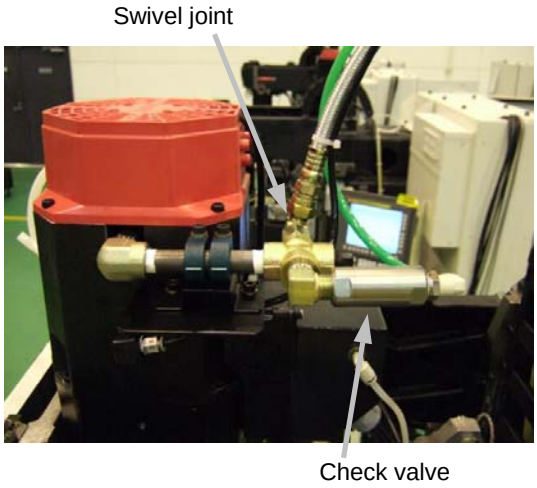


Fig. 25.3.2 (d) Check valve assembly (manufactured in November 2006 or later)

(a) This unit switches between the spindle taper air blow (air) and center-through coolant (liquid).
(b) A rotary joint supports the swivel joint so that the coolant hose is not twisted by movement along the Z-axis.

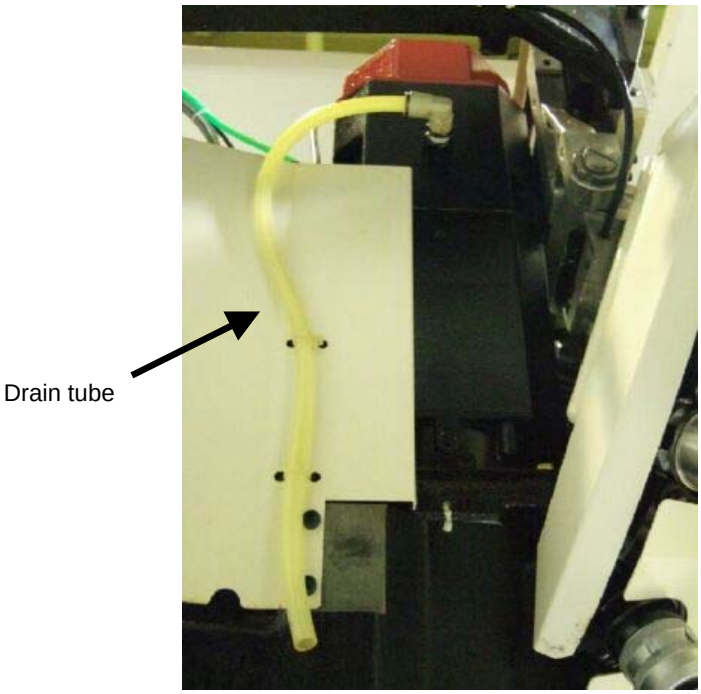


Fig. 25.3.2 (e) Center-through piping (left side)

25.4 INSTALLATION

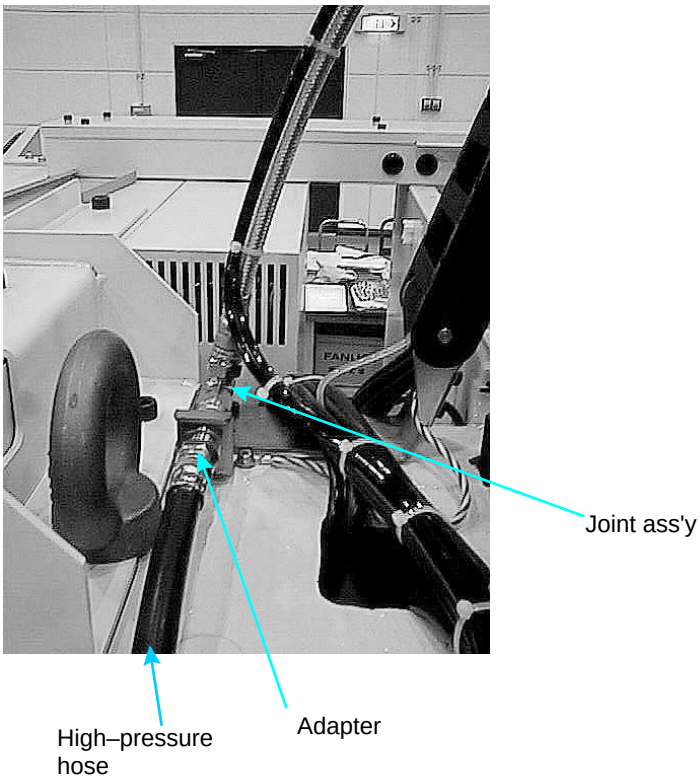
25.4.1 Notes on Installation

> ⚠ **WARNING**
> Before starting disassembly or connection in installation, make sure for safety that the breaker in the controller locker of the drill main body and the breaker in the control box of the coolant unit are turned off and power is not supplied.
> Since the center-through coolant pump is energized by power panel unit XTI of the machine main body, the coolant pump starts operating together with this machine and the operator may get splashed with a coolant.

(1) Before moving the coolant tank, sufficiently drain the coolant.
(2) Before lifting the coolant tank, sufficiently drain the coolant.
(3) Before starting disassembly or connection in installation, make sure for safety that the power breaker of the drill main body and the control box breaker of the coolant unit are turned off and power is not supplied.

25.4.2 Piping

(1) Connect the high–pressure hose to the inlet on the center–coolant unit. No seal tape is used. (Check that there is no foreign matter around the thread and taper section.)



(2) Connect the other end of the hose to the adapter on the joint ass'y on the top part of the column.
(3) Connect the air pipe of the coolant valve for the center–through coolant. Connect a ϕ6 tube to the secondary cheese of the air blow regulator.

25.4.3 Wiring

> ⚠ **WARNING**
> When performing wiring, be sure to turn off the circuit breaker in the controller cabinet at all times. Otherwise, you may be injured or electrically shocked because of an unpredictable motion of the machine.

(1) Connect each signal line. The connection terminal is connector XS17 of wiring PCB.
(2) Connect the power line of the center through coolant pump. The connection terminal is terminal block XT5 on power panel unit.

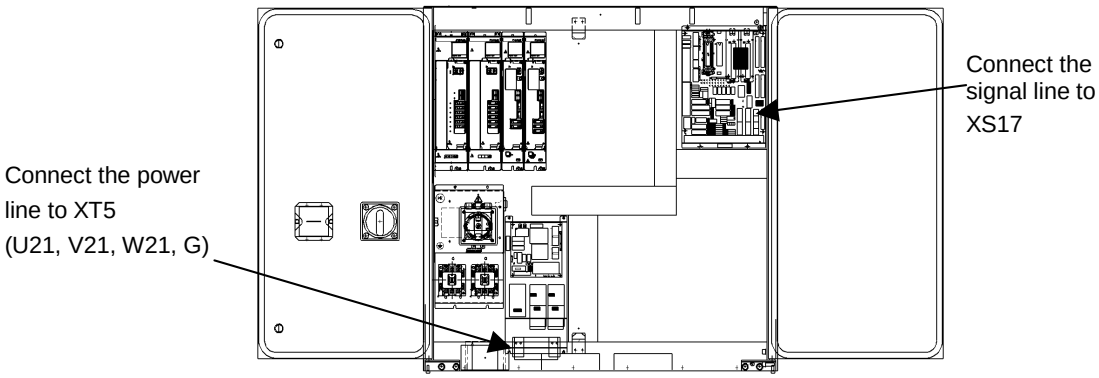


Fig.25.4.3(a) Wiring

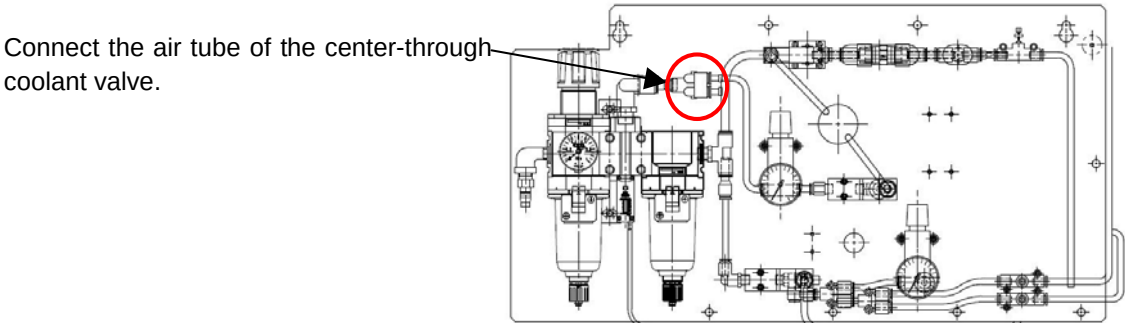


Fig.25.4.3(b) Pilot air piping

25.4.4 Checking Operation after Installation

(1) Clamp a center–through tool on the spindle.
(2) Perform center–through air purge (using the M23 command) in MDI mode and check that air issues from the tool tip. Open the side door of the splash guard and check that air is issued.
(3) A drain (transparent nylon tube) protrudes from the cover on the head of the spindle. Check that the pressure of air discharged from the drain is low. (If air is strongly discharged from the drain, coolant leakage may occur.)
(4) To stop the center-through air purge (M23), specify M9 (or M24), which is also used to stop the coolant.

25.5 OPERATION

25.5.1 Command M Codes

Use the following M codes:

M code	Function	Remarks
M20	Stops the center–through coolant pump.	
M21	Starts the center–through coolant pump.	
M22	Turns the center–through coolant on (outputs the coolant).	
M23	Turns air purge on.	
M09 or M24	Turns the center–through coolant off (stops outputting the coolant). Turns air purge off.	Use of either M24 or M09. Select M24 or M09 using a parameter.

25.5.2 Manual Operation

Specify the above M codes in MDI mode.
The coolant button on the ROBODRILL operator's panel cannot be used (These buttons are dedicated to external coolant).

25.5.3 Commands in a Program

```
O0060
 G80G40G49
 G00G91G28Z0.
 M6T6
 M21     ←  Starts the center–through coolant pump.
 M22     ←  Turns the center–through coolant on (provides coolant to the tool).
 M3S1000
 G90G55Z-150.
 G01Z-200.F500
 G00Z-100.
 M09     ←  Turns the center–through coolant off (stops providing coolant to the tool).
 M02
```

25.6 SCHEDULED MAINTENANCE

25.6.1 Daily Inspection

(1) Inspection before operation
  (a) If the coolant level is low, top it up.
  (b) Check whether any pipes or cables are damaged.
  (c) Draw out the #100 mesh partition plate from the coolant tank and check whether the net is clogged. If the net is clogged with chips, clean it with a brush.

25.6.2 Cleaning the #150 Suction Filter

(1) While the center-through coolant pump is operating, the #150 suction filter in the pump cannot be cleaned or replaced.
(2) The following photo shows the clogging check gage for the #150 suction filter. When this gage indicates 0.05 MPa or more (the needle is to the left of the 12 o'clock position) during coolant pump operation, clean or replace the filter.

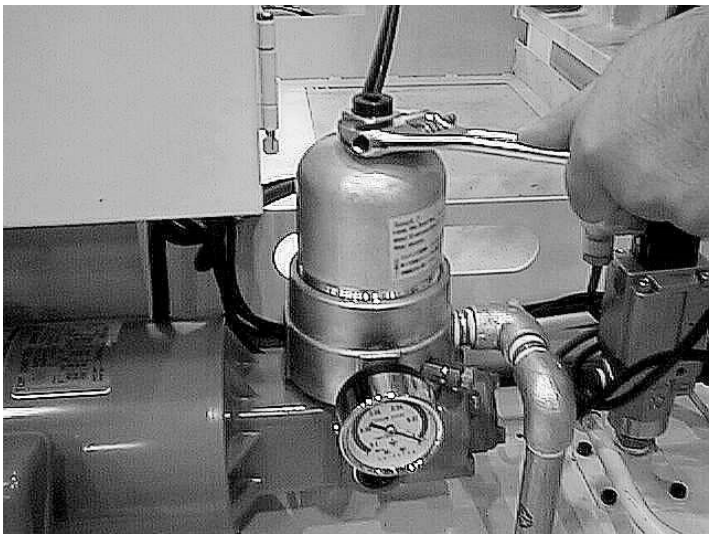


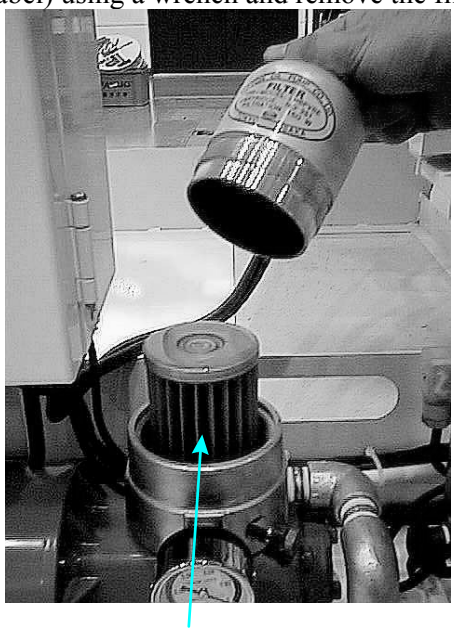
Fig.25.6.2(a) Replacing the filter case

(3) For safety, turn the center–through circuit breaker in the control box off.

> ⚠ **WARNING**
> Before cleaning the suction filter, turn off center-through breaker in the control box.

(4) Before replacing the suction filter, manually turn the air release plug on this side to release any residual pressure inside the filter.

(5) The suction filter is simple to remove. First, turn the width across flat at the top of the aluminum filter case (with the yellow label) using a wrench and remove the filter case.



#150 filter element

Fig.25.6.2(b) #150 filter element

(6) In the filter case, the #150 suction filter is mounted. (The suction filter can easily be removed manually.)
(7) When remounting the cleaned filter, be careful not to mount the filter upside down. (The bottom of the filter has an O-ring.)
(8) Remember to tighten the air release plug.
(9) Remember to turn the circuit breaker in the control box back on.

25.6.3 Replacing the Line Filter

(1) First, for safety, turn the center–through circuit breaker in the control box off.

> ⚠ **WARNING**
> Before replacing the line filter, turn off the center-through breaker in the control box. Otherwise, a coolant may be splattered on the operator due to an unexpected operation.

(a) Before replacing the line filter, turn the drain plug on the lower portion of the filter housing using a wrench first to remove the residual pressure inside the filter.

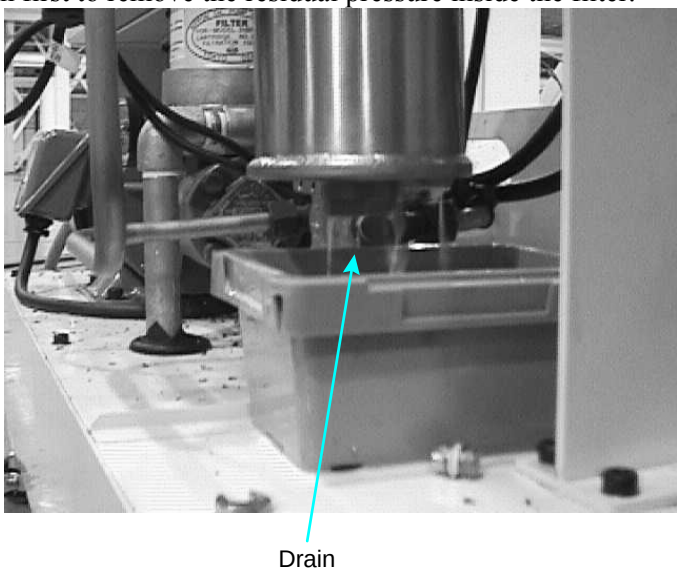


Fig.25.6.3(a) Discharge the coolant of filter housing

(b) The line filter is simple to remove. Turn the box nut on the upper portion of the filter housing using a wrench and remove it. Firmly hold the filter housing to prevent it from falling.

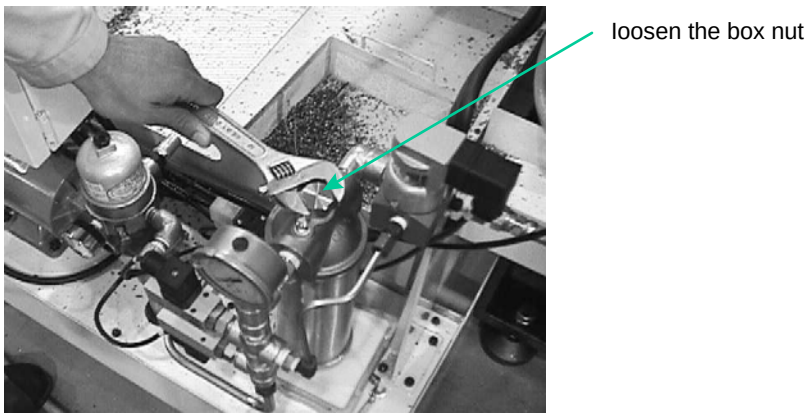


Fig.25.6.3(b) Take filter housing to piece (1)

Fig.25.6.3(c) Take filter housing to piece (2)

(c) Take the filter out of the housing and replace it. (No orientation is specified for the filter.)

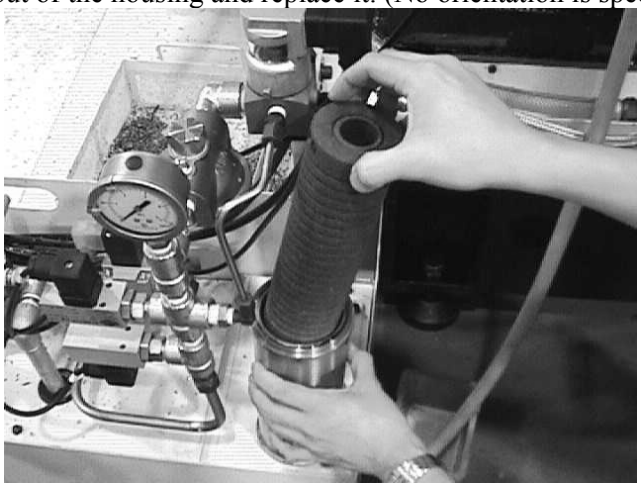


Fig.25.6.3(d) Replace the line filter

(d) When tightening the screw on the filter housing, be careful not to damage the O-ring or another part.
(e) Remember to tighten the screw of the drain plug on the lower portion of the filter housing.
(f) Remember to turn the circuit breaker in the control box back on.

25.6.4 Dry Run after Replacement of the Line Filter

CAUTION
After replacing the line filter, perform a dry run (as described in this subsection) to exhaust air from the center coolant. Otherwise, air enters the filter housing and peripheral piping, generating noise or causing a thin tool to be broken due to insufficient coolant.

(1) Immediately after replacing the filter, perform a dry run as described below.
(a) Mount a center–through tool (tool with a through hole as large as possible, such as a drill at least 6.5 mm in diameter with a through hole) on the spindle.
(b) Execute M23 (spindle air purge) for several minutes to remove foreign matter and coolant from within the pipes and clean them to enable the rotary union to move smoothly.
(c) Perform a dry run with the center–through coolant flowing to remove any air from the filter housing and center–through pump.

25.6.5 Adjusting the Relief Valve

If the pump performance is degraded after prolonged use, make fine adjustment of the pressure as illustrated in the figure below. An improper setting may break the pump. Set the pressure not to exceed 2.0 MPa by checking the pressure gage.

(1) To increase the pressure, rotate (screw down) the pressure adjustment bolt clockwise to contract the spring.
(2) To decrease the pressure, rotate the pressure adjustment bolt counterclockwise to elongate the spring.

Internal structure (VS type)

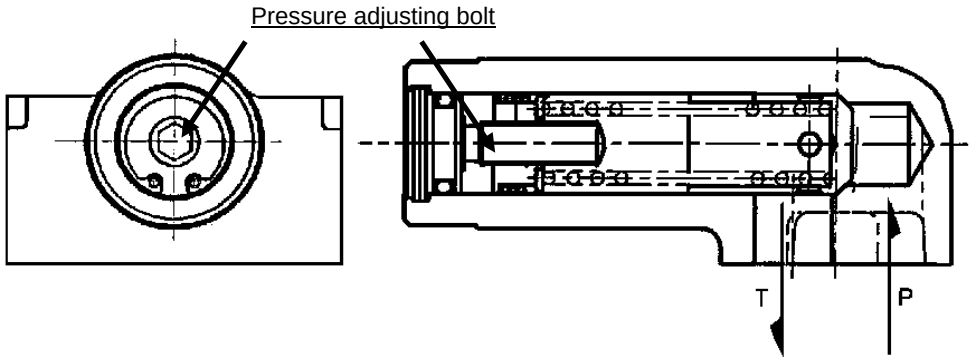
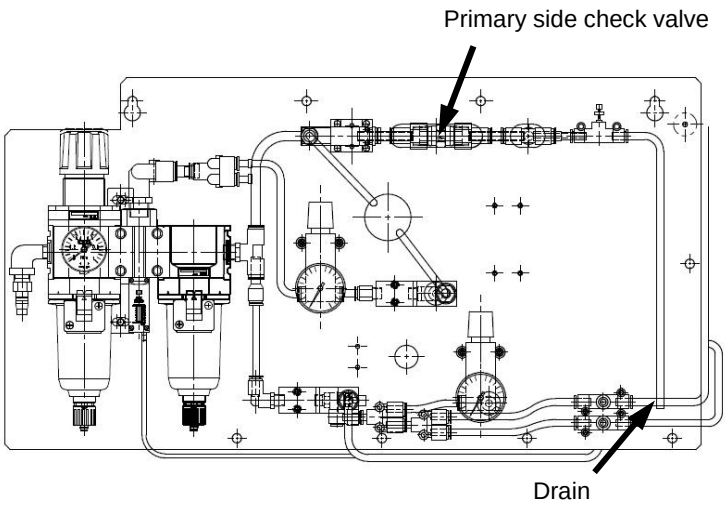


Fig.25.6.5 Structure of the Relief Valve

25.6.6 Checking the Check Valve

(1) Periodically make sure that the coolant does not flow from the drain shown in Fig. 25.6.6 (a).
(2) If the coolant flows from the drain, replace the primary and secondary side check valves shown in Figs. 25.6.6 (a) and 25.6.6 (b).



(Make sure that the coolant does not flow.)

Fig.25.6.6(a) Air unit piping

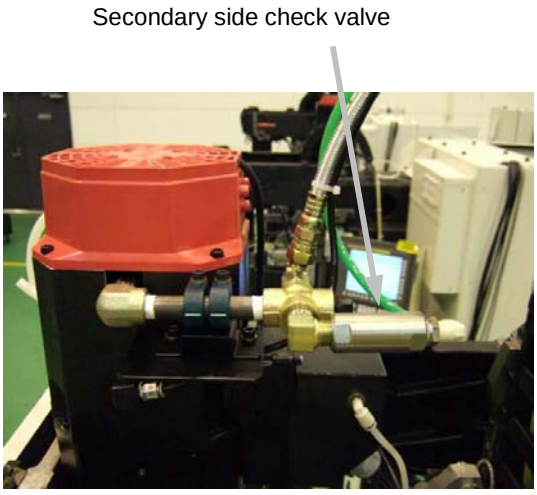


Fig.25.6.6(b) Check valve unit

CAUTION
Do not cover the end of the drain with a plug or another thing.
If the drain is covered, the life of and problem with the secondary side check valve cannot be determined.

25.6.7 Other Maintenance

(1) Perform the following work before relocating the machine or before a long vacation:
(a) Mount a center-through tool (tool with a through hole as large as possible) on the spindle and execute M23 (spindle air purge) for several minutes to remove the coolant from within the spindle.
(b) Use M23 to remove the coolant within the through hole with center-through coolant while replacing the tool used for machining. Also, clean away any sludge from the surface, as well as the fine-grain chips in the gap around the collet.

25.7 MAINTENANCE PARTS

25.7.1 Line Filter

(1) One 25-µm line filter is supplied with the main unit as a spare part.
(2) A 10-µm line filter is also available. However, the service life of this filter is shorter.
(3) To purchase a replacement filter, contact FANUC.

Filtering precision	Product name	Manufacturer specification	FANUC order specification	Remarks
10µm	CUNO FILTER CARTRIDGE	G78-C8-1N	A98L-0005-0145#G78C8-10	Set of 10
25µm	CUNO FILTER CARTRIDGE	G78-F8-1N	A98L-0005-0145#G78F8-10	Set of 10

25.7.2 Other Maintenance Parts

(1) The following parts degrade their performance when used over a long period of time. The ROBODRILL has a function which tracks the total operating time of the center-through coolant and outputs an operator message when these parts have reached the end of their service life. When this message is output, replace the parts. (The actual operating time in the table indicates the cumulative time for the center-through coolant operation cycles.)

Part name	Specification	Required quantity	Life	Remarks
Rotary union	A97L-0203-0168#IDRJ	1	Actual operating time 10000h	Mounted on the upper portion of the spindle motor For replacement, contact the FANUC Service Division.
CT pump	A97L-0203-0037#CTPUMP A97L-0203-0037#CTPUMPCE (CE marking specification)	1	Actual operating time 10000h	Center–through coolant pump (single–motor). Mounted on the coolant tank. The relief pressure has been adjusted. For replacement, contact the FANUC Service Representative.
Check valve	A97L-0203-0286#CV3	1	Actual operating time 10000h	FANUC Service Representative.
	A97L-0203-0286#CV3N	1		

(2) The specifications of other maintenance units related to center–through are listed below.

Part name	Specification	Required quantity	Setting and adjustment	Remarks
Suction filter	A97L-0203-0037#150SCF	1	Not required	#150 suction filter of the pump
#100 partition	A97L-0203-0037#100PTI	1	Not required	#100 mesh partition plate
Coolant valve	A97L-0203-0037#CLTVAL	1	Not required	YV140
Pressure gate	A97L-0203-0037#PRGAUGE	1	Adjusted	
High–pressure hose	A97L-0203-0037#HP-HOSE	1	Not required	
Swivel joint	A97L-0203-0070#SL3406	1	Not required	
SP100	A97L-0203-0037#SP100	1	Adjusted	Pressure switch (high)
SP101	A97L-0203-0037#SP101	1	Adjusted	Differential pressure switch
SP102	A97L-0203-0037#SP102	1	Adjusted	Pressure switch (low)

25.8 CIRCUIT DIAGRAM OF CENTER –THROUGH COOLANT AND COMPRESSED AIR

25.8.1 Coolant Circuit Diagram of Center–Through Coolant Unit

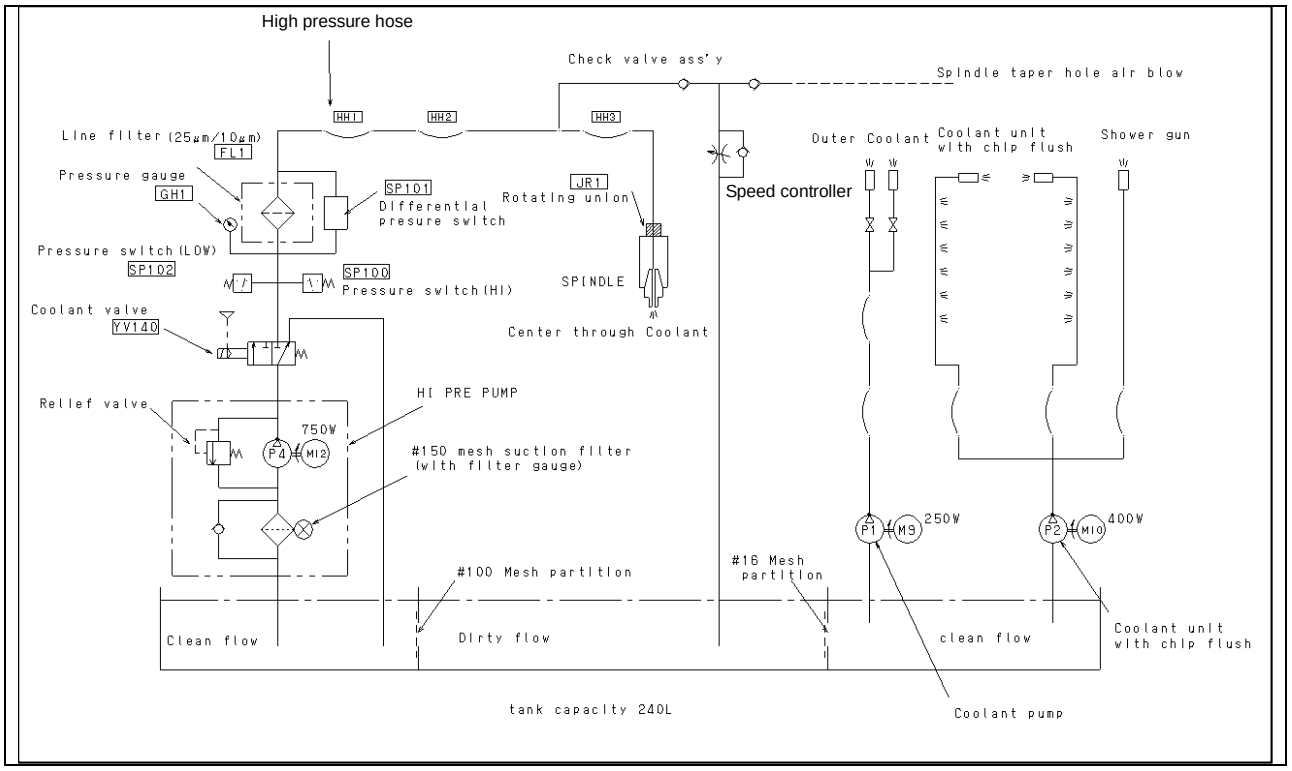


Fig.25.8.1 Coolant circuit diagram

Spindle side adapter (On the column)	A2-9 (JIS B 8363 G3/8 Inner thread with 30° Female taper sheet) G 3/8 Outer thread with 30° Female taper sheet
Coolant unit side adapter	C-8 (JIS B 8363 G3/8 Inner thread with 30° Male taper sheet) G 3/8 Inner thread with 30° Male taper sheet

25.8.2 Compressed Air Circuit Diagram

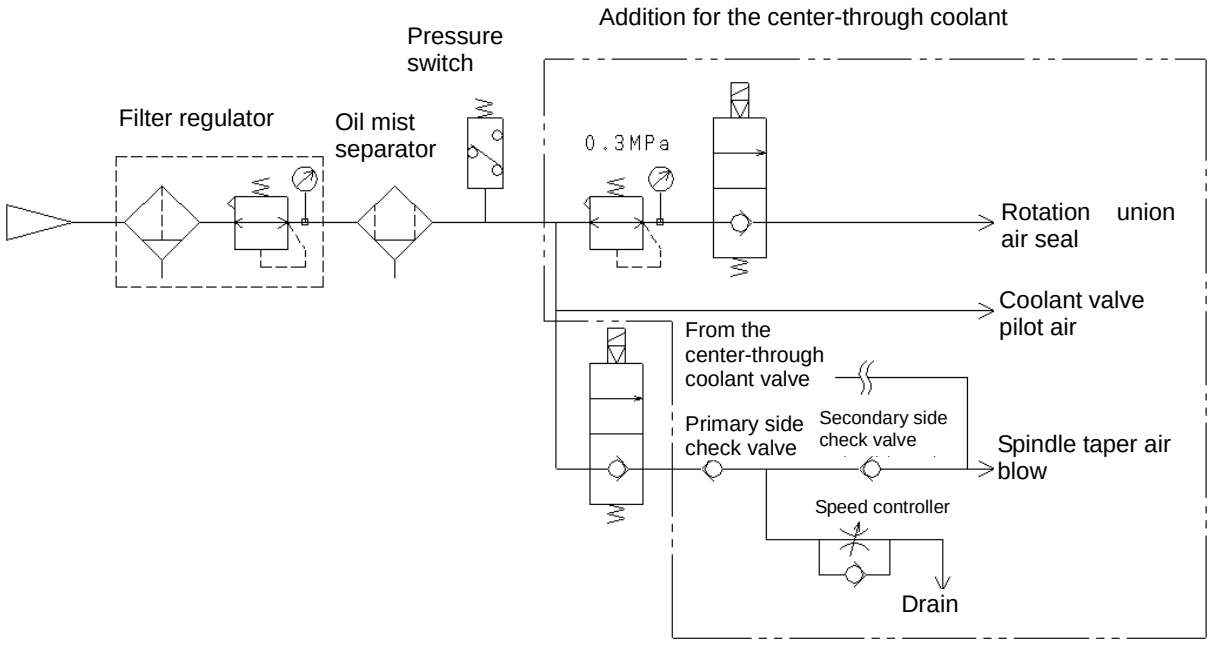


Fig.25.8.2 Compressed Air Circuit Diagram

25.9 CENTER–THROUGH COOLANT CONTROL

25.9.1 Control

The following describes the functions for center-through coolant control.

(1) [Center–through coolant pump]

(a) The center–through coolant pump is started by the M21 command and stopped by the M20 command.
By changing the appropriate setting on the ENERGY SAVING SETTING screen, the pump can be turned ON constantly regardless of the above M code command. In this case, M21/M20 need not be specified in the program.

(b) In the following cases, the pump starts automatically.
- When the mode is changed to automatic, MDI, or remote mode
- When menu operation is determined
- When the start button is pressed

(c) In the following case, the pump stops automatically.
When one minute elapses after the center–through coolant is turned off

(d) When an alarm related to the center–through coolant (alarm number: EX1031, EX1032, EX1033 or EX1035) occurs, the pump stops.

(2) [Center–through coolant]

(a) The center–through coolant is turned on by the M22 command and turned off by the M09 command.

(b) When the M22 command is specified, the center–through coolant pump may stop. In this case, alarm 1034 "Center–through coolant pump not started" is issued.
Start the pump, then specify the command.

(c) If the door is opened during automatic operation, the center–through coolant is turned off.
Upon restart, the center–through coolant is automatically turned on.

(d) When stop by a feed hold is specified during automatic operation, the center–through coolant does not stop. (The CE making specification stops.)

(e) When an alarm related to the center–through coolant (alarm number: EX1031, EX1032, EX1033 or EX1035) occurs, the center–through coolant is turned off.

(f) When the reset key on the ROBODRILL operator's panel is pressed, the center–through coolant is turned off. (Only when keep relay K01#7=1 is specified)

(g) When air purge is specified, the center–through coolant is turned off.

(3) [Air purge]

(a) The air purge is turned on by the M23 command and turned off by the M09 command.

(b) When the air purge is specified, the air is pulse–output. When the tool moves up in the Z–axis direction during ATC operation, air continues to be output regardless of whether the M23 command is specified.

(c) If the door is opened during automatic operation, air purge is turned off. Upon restart, air purge is automatically turned on.

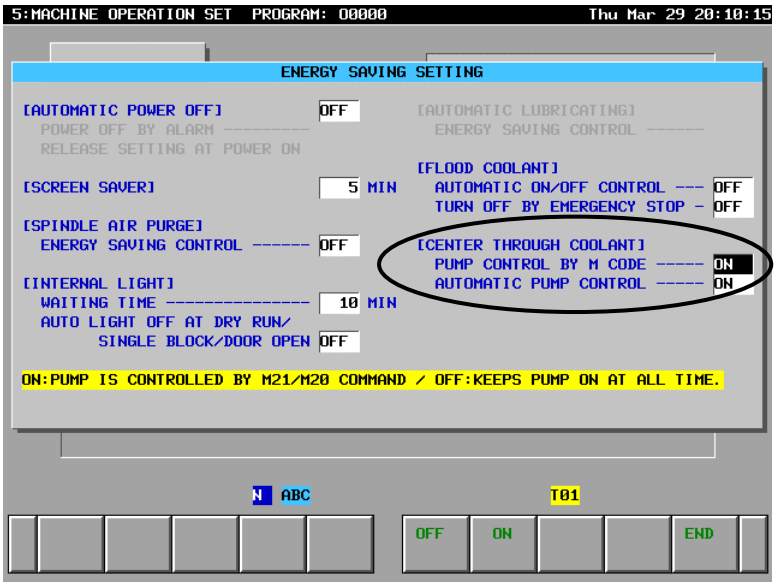
(d) When stop by a feed hold is specified during automatic operation, air purge does not stop. (The CE making specification stops.)

(e) When the reset key on the ROBODRILL operator's panel is pressed, air purge is turned off. (Only when keep relay K01#7=1 is specified)

(f) When center–through coolant, spindle rotation, or rigid tapping is specified, air purge is turned off.

25.9.2 Settings on the ENERGY SAVING SETTING Screen

Settings for the center-through coolant can be changed on the ENERGY SAVING SETTING screen of the electric power consumption monitor. (For details of the ENERGY SAVING SETTING screen, see Section IV 39 "ENERGY SAVING SETTING SCREEN".)



- PUMP CONTROL BY M CODE
  If set to ON, enables the pump to turn ON and OFF by specifying M20 and M21 in the program. If the setting is OFF, the pump remains constantly ON regardless of the M code.
- AUTOMATIC PUMP CONTROL
  If the setting is ON, the pump starts automatically if any of the conditions is met:
  - The mode is changed to automatic, MDI, or remote mode.
  - Menu operation is determined.
  - The start button is pressed.

  The pump stops automatically if the following condition is met:
  - One minute elapses after the center-through coolant is turned off.

25.9.3 Alarm Operator Messages

Number	Message	Cause
EX1031	Abnormal center-through coolant pressure (upper limit)	The viscosity of the coolant is too high. The coolant pump is improperly adjusted.
EX1032	Abnormal center-through coolant pressure (lower limit)	The coolant level is low. The coolant leaks due to a piping error or damaged pipe.
EX1033	Clogging of the center-through coolant filter	The line filter has been clogged for more than 100 hours.
EX1034	Center-through coolant pump not started	M22 is specified when the center-through coolant is not started.
EX1035	Overloading of the center-through coolant motor	The center-through coolant motor is overloaded.
EX1036	Lower limit of the coolant	The coolant level is low.
2017	Lower limit of the coolant	The coolant level is low.
2018	Clogging of the center-through coolant tank filter	The line filter is clogged.
2022	SUCTION FILTER LOADING	The suction filter is clogged.

25.9.4 Parameters

PMC Parameters: Keep Relay

No.	#7	#6	#5	#4	#3	#2	#1	#0
K03		0	0	0				

#4 0: Controls on and off of the center–through coolant pump.
1: The center–through coolant pump is always turned on.

#5 0: Enables automatic on and off of the center–through coolant pump.
1: Disables automatic on and off of the center–through coolant pump.

#6 0: Disables custom control.
1: Enables custom control.

No.	#7	#6	#5	#4	#3	#2	#1	#0
K04				1	1			

#3 0: Displays only operator messages when the coolant is at the lower limit.
1: Displays the operator messages and alarm when the level of the coolant is at the lower limit.

#4 0: Turns the center–through coolant off according to the M09 command.
1: Turns the center–through coolant off according to the M24 command.

No.	#7	#6	#5	#4	#3	#2	#1	#0
K05				1				

#4 0: Disables center–through coolant control.
1: Enables center–through coolant control.

PMC Parameters: Timer

Number	Default	Function
T00	60000	Waiting time until the pump stops after the center–through coolant is turned off
T38	300	Pulse output on time for the air purge
T40	300	Pulse output off time for the air purge
T42	10000	Waiting time until the air seal valve is turned off after the center–through coolant is turned off
T44	2000	Monitoring time for abnormal coolant pressure (upper limit)
T46	1000	Monitoring time for abnormal coolant pressure (lower limit)

PMC Parameters: Counter

Number	Default	Function
C16	100	Filter clogging monitoring time

25.9.5 DI/DO

Make interface connections according to the table below.

Signal name	Address	Connection terminal	Remarks
Center-through coolant pump control	Y5.0	XS17	When this signal is on, the pump operates.
Center-through coolant valve control	Y5.1		When this signal is on, coolant is output.
Abnormal coolant pressure (upper limit) detection	X11.0		This signal is turned off if an abnormal pressure is detected.
Filter clogging detection	X11.1		This signal is turned off if the filter is clogged.
Abnormal coolant pressure (lower limit) detection	X11.2		This signal is turned off if an abnormal pressure is detected.
Overheating center-through coolant pump	X11.3		This signal is turned on if the center-through coolant pump overheats.
Airseal valve control	Y25.6	XS16-A8	When this signal is on, air is output.

25.9.6 Custom Control

The following interface signals are provided for custom PMC. When using a signal marked * in the Remarks column for custom control, specify K03#6=1 (DI signals X11.0 to X11.3 are all ignored).

(System → Custom)

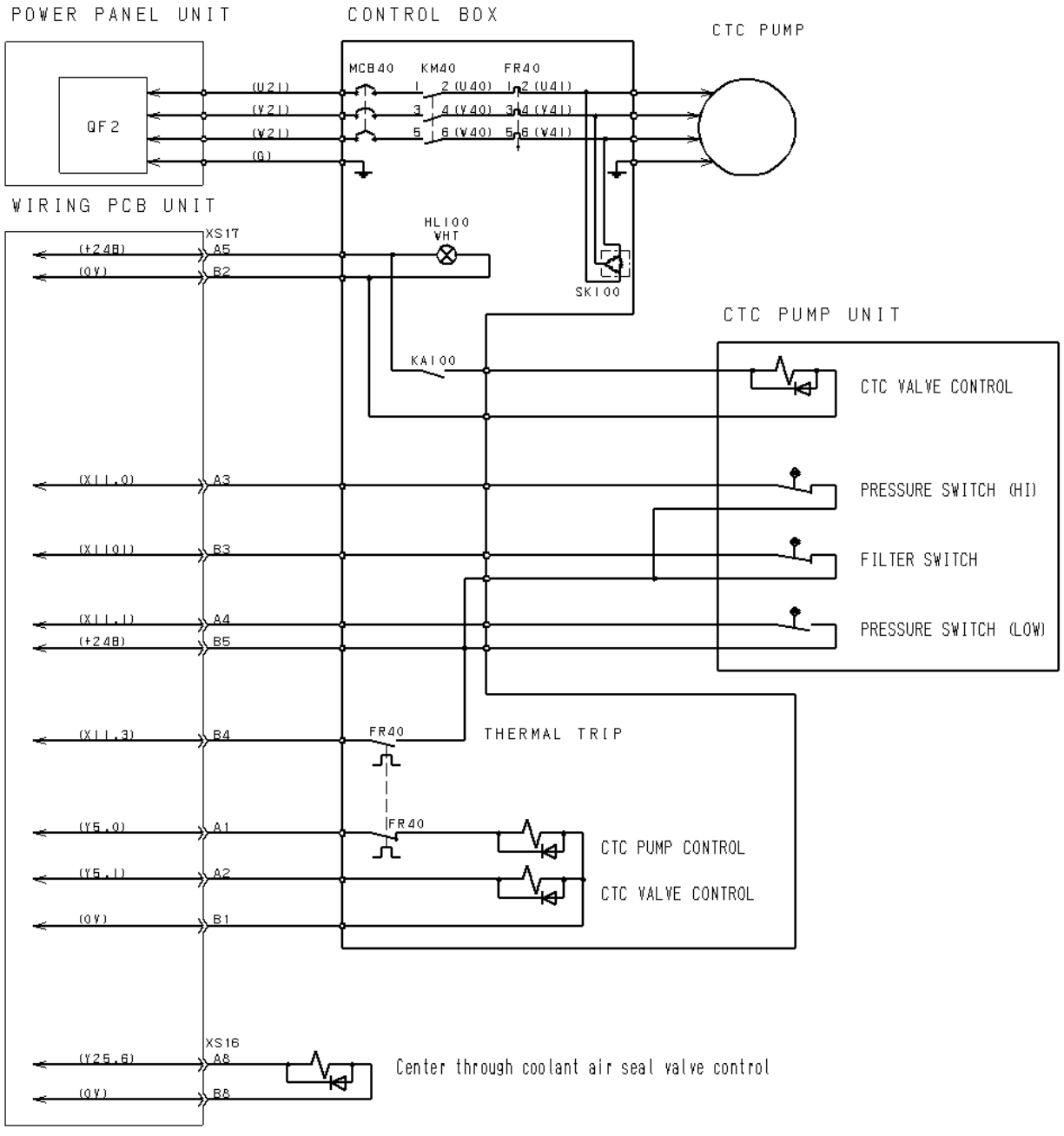
Signal name	Address	Remarks
Center-through coolant pump control	SI24_3 (R1324.3)	This signal is on when the pump is operating.
Center-through coolant valve control	SI24_4 (R1324.4)	This signal is on when the coolant is output.
Air seal valve control	SI24_5 (R1324.5)	This signal is on when air is output.

(Custom → System)

Signal name	Address	Remarks
Coolant lower limit detection	SO18_2 (R1368.2)	When this signal is off, the lower limit is detected.
Abnormal coolant pressure (upper limit) detection	SO18_3 (R1368.3)	When this signal is off, an abnormal pressure is detected. (*)
Filter clogging detection	SO18_4 (R1368.4)	When this signal is off, filter clogging is detected. (*)
Abnormal coolant pressure (lower limit) detection	SO18_5 (R1368.5)	When this signal is off, an abnormal pressure is detected. (*)
Overheating center–through coolant pump	SO18_6 (R1368.6)	When this signal is on, overheat is detected. (*)
Suction Filter clogging detection	SO18_7 (R1368.7)	When this signal is off, filter clogging is detected.
Center-through coolant on/off button	SO19_0 (R1369.0)	This signal is accepted when the pulse has a width of 100 ms or more.
Center-through coolant pump on/off button	SO19_1 (R1369.1)	
Air purge on/off button	SO19_2 (R1369.2)	

25.10 ELECTRIC CONTROL CIRCUIT DIAGRAM OF CENTER THROUGH COOLANT

CTC = Center through coolant



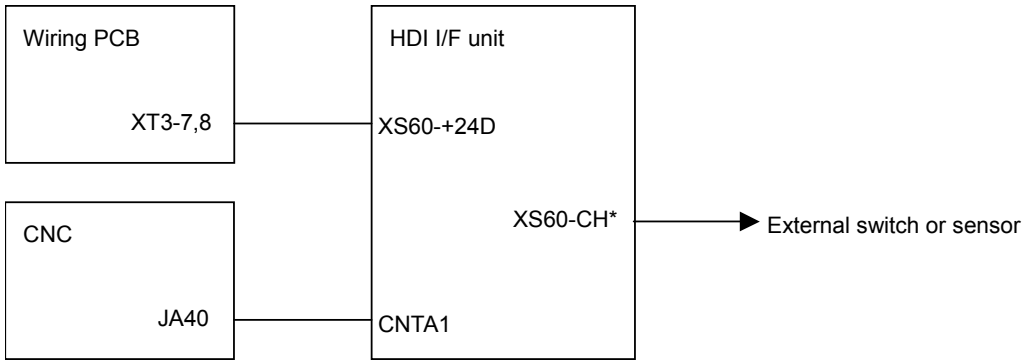
26 HIGH–SPEED SKIP FUNCTION (OPTION)

26.1 OVERVIEW

A skip function that uses a high-speed skip signal (to be connected directly to the CNC not via the PMC) instead of the ordinary skip signal (X4.7) is available. When high-speed skip signals are used, up to eight signals can be input.
In ordinary skip signal input, the detection delay and variation are up to 4 msec. In high-speed skip signal input, the detection delay and variation do not exceed 0.2 msec, so high-speed or high-precision measurement is possible.
For details, refer to the user's manual of the CNC (B-64484EN).

26.2 CONNECTION

26.2.1 Block diagram



26.2.2 Connector Pin Layouts

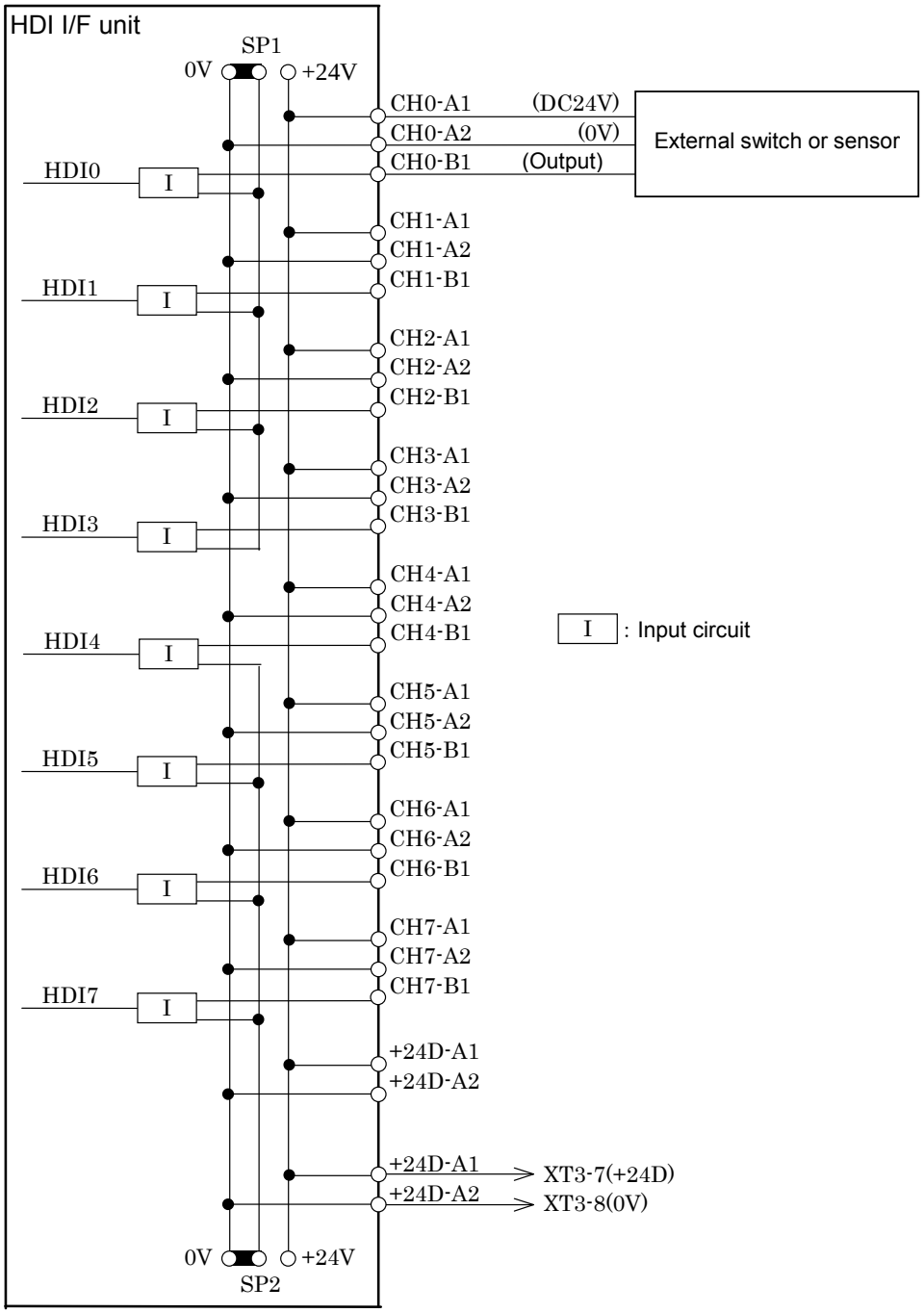
XS60 (JST S30B-J23DK-GGS1LPR)

CH0-A1	+24D	CH0-B1	HDI0
CH0-A2	0V		
CH1-A1	+24D	CH1-B1	HDI1
CH1-A2	0V		
CH2-A1	+24D	CH2-B1	HDI2
CH2-A2	0V		
CH3-A1	+24D	CH3-B1	HDI3
CH3-A2	0V		
CH4-A1	+24D	CH4-B1	HDI4
CH4-A2	0V		
CH5-A1	+24D	CH5-B1	HDI5
CH5-A2	0V		
CH6-A1	+24D	CH6-B1	HDI6
CH6-A2	0V		
CH7-A1	+24D	CH7-B1	HDI7
CH7-A2	0V		
+24D-A1	+24D	+24D-B1	
+24D-A2	0V		
+24D-A1	+24D	+24D-B1	
+24D-A2	0V		

CNTA1 (HONDA PCR-EV20MDT)

1	HDI0	11	HDI1
2	0V	12	0V
3	HDI2	13	HDI3
4	0V	14	0V
5	0V	15	HDI5
6	HDI4	16	0V
7		17	HDI6
8		18	0V
9		19	HDI7
10		20	0V

26.2.3 Circuit Diagrams



Setting terminals SP1 and SP2 can be set to change the common voltage for input circuits (0 or 24 VDC). Use setting terminal SP1 to change the common voltage for CH0 to CH3 and setting terminal SP2 to change the common voltage for CH4 to CH7.

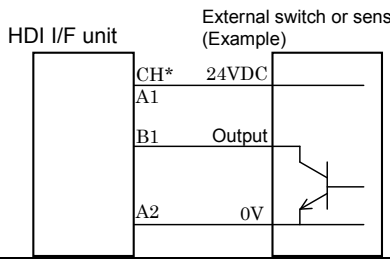
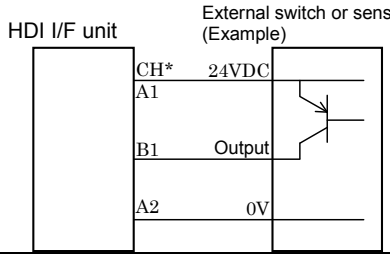
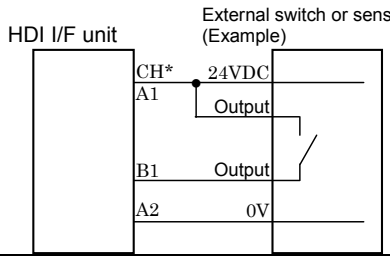
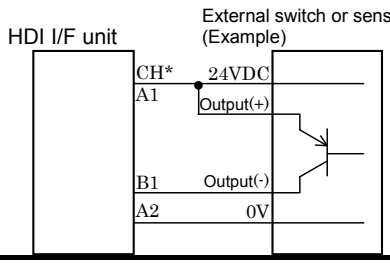
Factory settings

Setting terminal SP1: 0V

Setting terminal SP2: 0V

> ⚠ **WARNING**
> Before setting a setting terminal, wait for several minutes after turning off the power to the machine. Otherwise, there is a risk of an electrical shock or burn injury.

26.2.4 Examples of Connection

External device output circuit	Connection method	Setting terminals SP1 and SP2	Skip signal	
			External device output level	CNC skip signal
・ Sink type ・ Current flow-in type ・ NPN type (open collector)			L→H H→L	1→0 0→1
・ Source type ・ Current flow-out type ・ PNP type (open collector)			L→H H→L	0→1 1→0
・ Relay (dry contact) ・ Photo MOS (no polarity) ・ SSR (no polarity)			L→H H→L	0→1 1→0
・ Photocoupler ・ Photo MOS (with polarity) ・ SSR (with polarity)			L→H H→L	0→1 1→0

As the initial setting, a skip signal is assumed to be input on the rising edge (0 to 1) (this setting can be changed by setting bit 6 of NC parameter No. 6200). For details, see Seciton 26.4, "PARAMETERS".

> **CAUTION**
> 1 The connection method differs depending on the external switch or sensor circuit. Wrong connection may damage the external switch or sensor.
> 2 From the point of view of safety, setting terminals should be set to 0 V where possible. Setting terminals set to 0 V provide a state equivalent to L (low level) input if a cable ground-fault accident occurs.

26.3 Specifications

26.3.1 Ordering information

(1) Unit

	Name	Specification	Description
<1>	HDI I/F	A04B-0102-J209	HDI I/F unit: A04B-0102-C208 HDI I/F-CNC cable [K39]: A660-2042-T375#L5R003 HDI I/F-wiring PCB cable [K164]: A660-8017-T799#L1R503

(2) Connector

	Name	Specification	Remarks
<1>	XS60 cable side Connectors and contacts (S)	A04B-0102-K202#S	10 housings 30 contacts (S)
<2>	XS60 cable side Connectors and contacts (M)	A04B-0102-K202#M	10 housings 30 contacts (M)
<3>	XS60 cable side Connectors and contacts (L)	A04B-0102-K202#L	10 housings 30 contacts (L)
<4>	XS60 screw terminal block	A04B-0102-K202#ST	Screw terminal block
<5>	Crimping tool	A04B-0102-K203#S	For contacts (S)
<6>	Crimping tool	A04B-0102-K203#M	For contacts (M)
<7>	Crimping tool	A04B-0102-K203#L	For contacts (L)

For the manufacturer model number and specification of each connector, see Subsection 26.3.4, "Connectors".

26.3.2 Rating

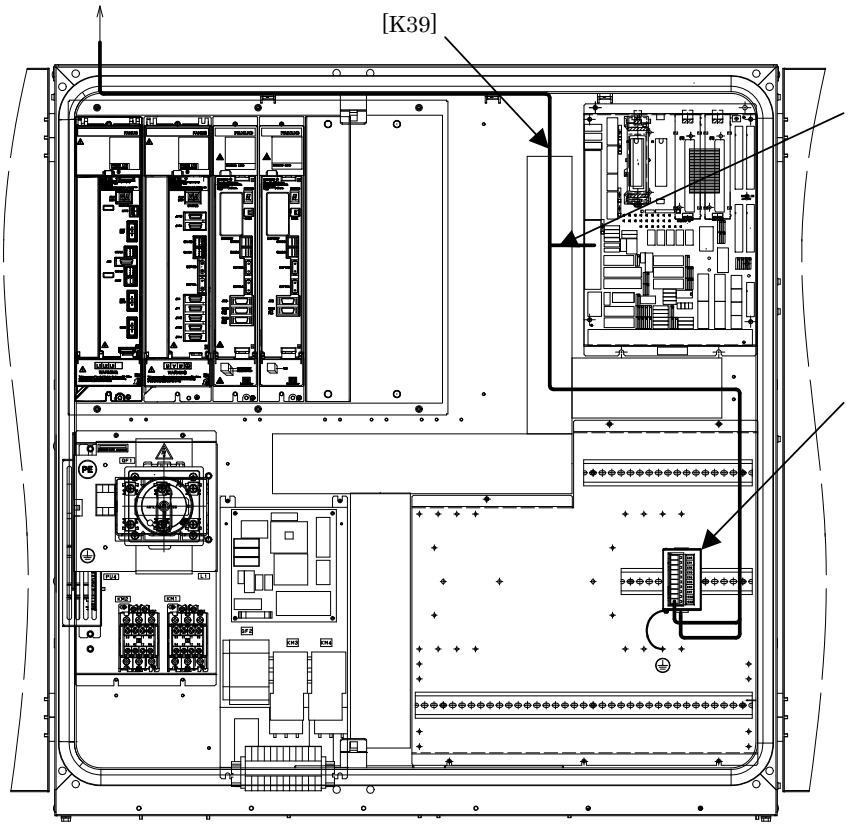
[Input circuit]

Item		Specification	Remarks
Rated voltage		24VDC	
Rated current		7.0mA	Setting terminal 0 V: Flows in the HDI I/F unit. Setting terminal +24 V: Flows from the HDI I/F unit.
High-level (H) voltage and current		At least 15 VDC, at least 4.0 mA	
Low-level (L) voltage and current		Up to 13 VDC, up to 3.3 mA	
Input signal pulse width		At least 0.10 msec	
Response time	CNC skip signal: 0 → 1	Up to 0.15 msec	Total of times required for the HDI I/F and CNC
	CNC skip signal: 1 ← 0	Up to 0.20 msec	

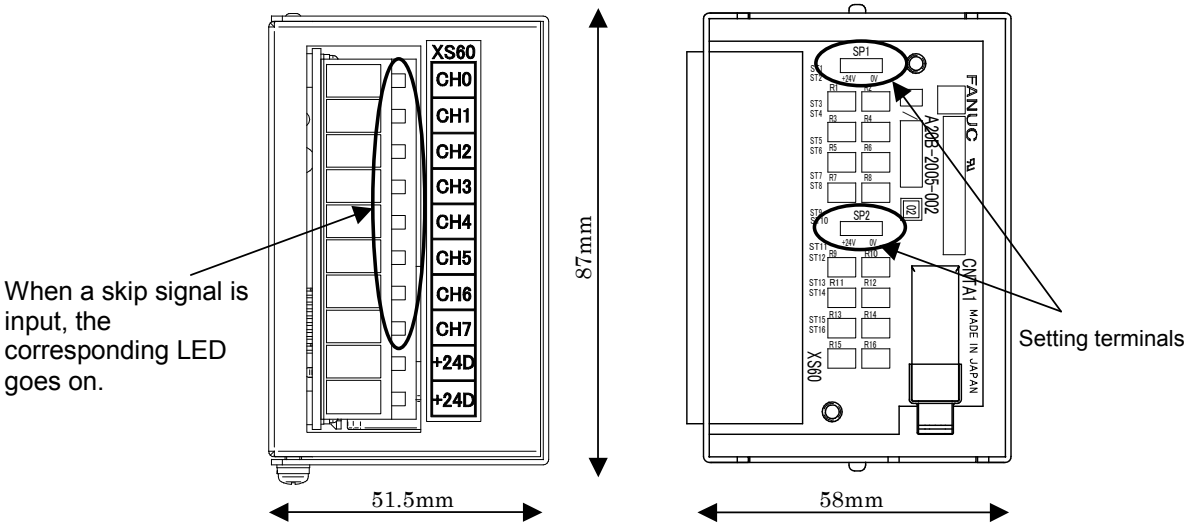
[Output circuit]

Item	Specification	Remarks
Rated voltage	DC24V	
Rated current	Up to 500 mA	Total of currents for 8 channels of the HDI I/F unit

26.3.3 Mounting and dimensions



Layout in the NC cabinet



Front view

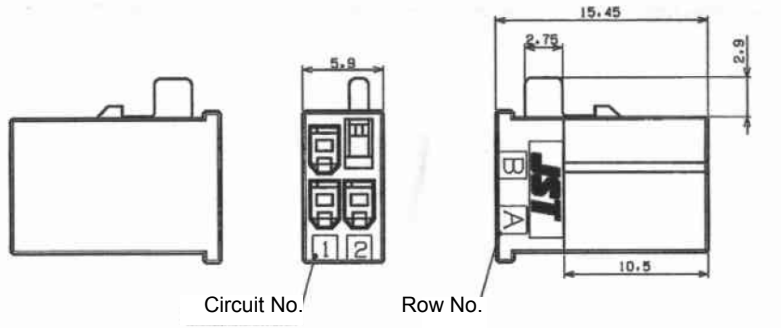
Side view (with the cover removed)

26.3.4 Connectors

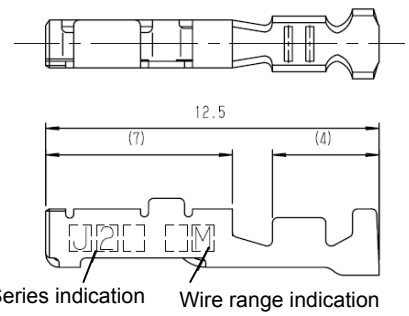
The following table lists XS60 cable side connectors and contacts.
Use a contact and crimping tool suitable for the cable of an external switch or sensor to crimp the connector.
Housings, contacts, and crimping tools are also available from FANUC. For ordering information, see Subsection 26.3.1.

Manufacturer: J.S.T. Mfg. Co., Ltd.

Receptacle housing	Receptacle contact	Nominal	Applicable wire range			Crimping tool
			Conductor area [mm^2]	AWG	Outer diameter of insulating sheath [mm]	
J23CF-03V-KS(1)	SJ2F-002GF-P1.0	S	0.08 to 0.20	28 to 24	0.88 to 1.43	YRK-8851
	SJ2F-01GF-P1.0	M	0.20 to 0.50	24 to 20	1.11 to 1.53	YRK-8861
	SJ2F-21GF-P1.0	L	0.30 to 0.75	-	1.30 to 1.90	YRK-1120



Outline drawing of the receptacle housing



Outline drawing of the receptacle contact

26.4 PARAMETERS

	#7	#6	#5	#4	#3	#2	#1	#0
6200		SRE	SLS	HSS				

[Input type] Parameter input
[Data type] Bit

#4 HSS As the skip signal input in the skip function, a high-speed skip signal is:
0: Not used (The skip signal of ordinary type is used).
1: Used.

#5 SLS As the skip signal input in the multistage skip function, a high-speed skip signal is:
0: Not used (The skip signal of ordinary type is used).
1: Used.

#6 SRE When a high-speed skip signal is used:
0: The signal is assumed to be input on the rising edge ($0 \rightarrow 1$)
1: The signal is assumed to be input on the falling edge ($1 \rightarrow 0$)

	#7	#6	#5	#4	#3	#2	#1	#0
6202	1S8	1S7	1S6	1S5	1S4	1S3	1S2	1S1

[Input type] Parameter input
[Data type] Bit

1S1 to **1S8** Specify which high–speed skip signal to enable for a G31 skip command.
The correspondence between the bits and signals is indicated below. The setting of each bit has the following meaning:
0: Disables the high–speed skip signal corresponding to each bit.
1: Enables the high–speed skip signal corresponding to each bit.

Parameter	High-speed skip signal
1S1	HDI 0
1S2	HDI1
1S3	HDI2
1S4	HDI3
1S5	HDI4
1S6	HDI5
1S7	HDI6
1S8	HDI7

	#7	#6	#5	#4	#3	#2	#1	#0
6207						SFN		

[Input type] Parameter input
[Data type] Bit

#2 SFN When the skip function using a high-speed skip signal (bit 4 of parameter No. 6200 is set to 1) or the multistage skip function is performed, the feedrate is:
0: The feedrate specified by a programmed F code.
1: The feedrate set in parameter No. 6282 to 6285.

SUPPLEMENT
For a skip function that is not a multistage skip function and does not use any high-speed skip signal (NC parameter No. 6200#4 = 0), NC parameter No. 6207#1 (SFP) is set.

6282	Feedrate in a skip function (G31, G31P1)
6283	Feedrate in a skip function (G31P2)
6284	Feedrate in a skip function (G31P3)
6285	Feedrate in a skip function (G31P4)

[Input type] Parameter input
[Data type] Real number
[Unit of data] mm/min
The feedrate in a skip function is set for each G code. These parameters are valid when NC parameter No. 6207#2 (SFN) is set to 1.

SUPPLEMENT
For a skip function that is not a multistage skip function and does not use any high-speed skip signal (NC parameter No. 6200#4 = 0), set parameter 6281.

SUPPLEMENT
For connection when touch probe MP12/OMP40 manufactured by Renishaw plc. is used, see Chapter 30, "TOUCH PROBE CONTROL FUNCTION".

26.5 CHECKING HIGH-SPEED SKIP SIGNALS

The input status of each high-speed skip signal can be checked using the corresponding signal address listed below in the PMC signal status screen.

Signal addresses

	#7	#6	#5	#4	#3	#2	#1	#0
F122	HDO7	HDO6	HDO5	HDO4	HDO3	HDO2	HDO1	HDO0

[Classification] Output signal

[Function] Notifies the PMC of the input status of each high-speed skip signal.
Each signal corresponds to a bit as follows:

High-speed skip signal	Bit name
HDI0	HDO0
HDI1	HDO1
HDI2	HDO2
HDI3	HDO3
HDI4	HDO4
HDI5	HDO5
HDI6	HDO6
HDI7	HDO7

[Output condition] Each bit is set to "1" when:

- The corresponding high-speed skip signal is set to "1".

Each bit is set to "0" when:

- The corresponding high-speed skip signal is set to "0".

27 HIGH–SPEED POSITIONING AND DRILLING CANNED CYCLE FUNCTIONS

27.1 OVERVIEW

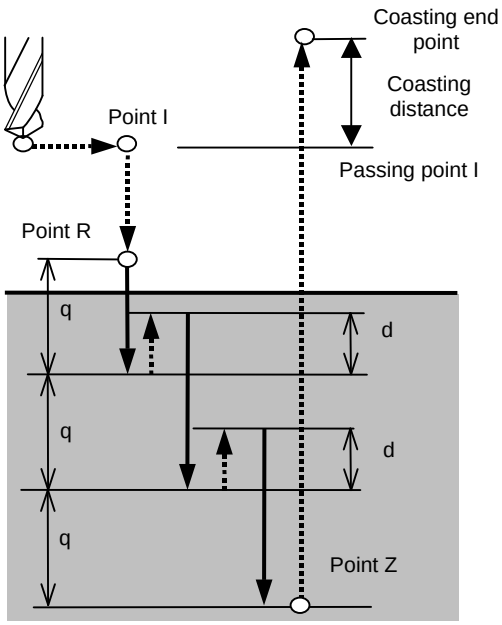
To reduce non–cutting time for machining multiple holes in succession, the drilling cycles provide a coasting distance above point R. A reduced operation time is achieved by rapid traverse overlapping and three–axis (X–/Y–/Z–axis) positioning.
The commands used are the same as the conventional commands G73 and G81 through G83. A coasting distance is specified using parameter No. 5150. A rapid traverse overlapping deceleration ratio used in a canned cycle is common to all axes, and is to be specified in parameter No. 5151.
When NC parameter No. 5104#0 is set to 1, coasting operation is performed in either the initial point return mode or the R point return mode.

27.2 CANNED CYCLES

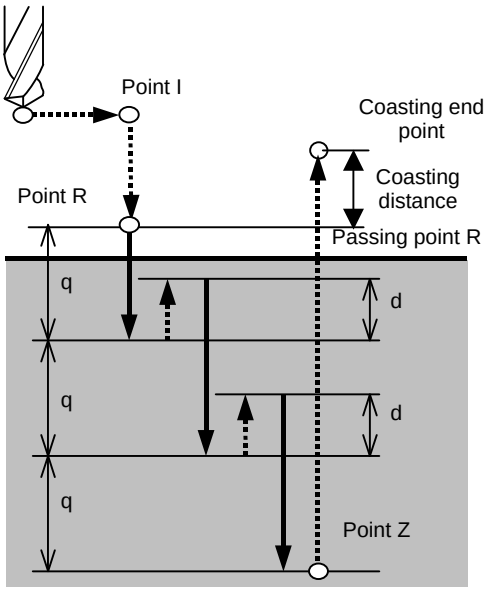
High–speed peck–drilling canned cycle (G73)

G73

G98 MODE



G99 MODE

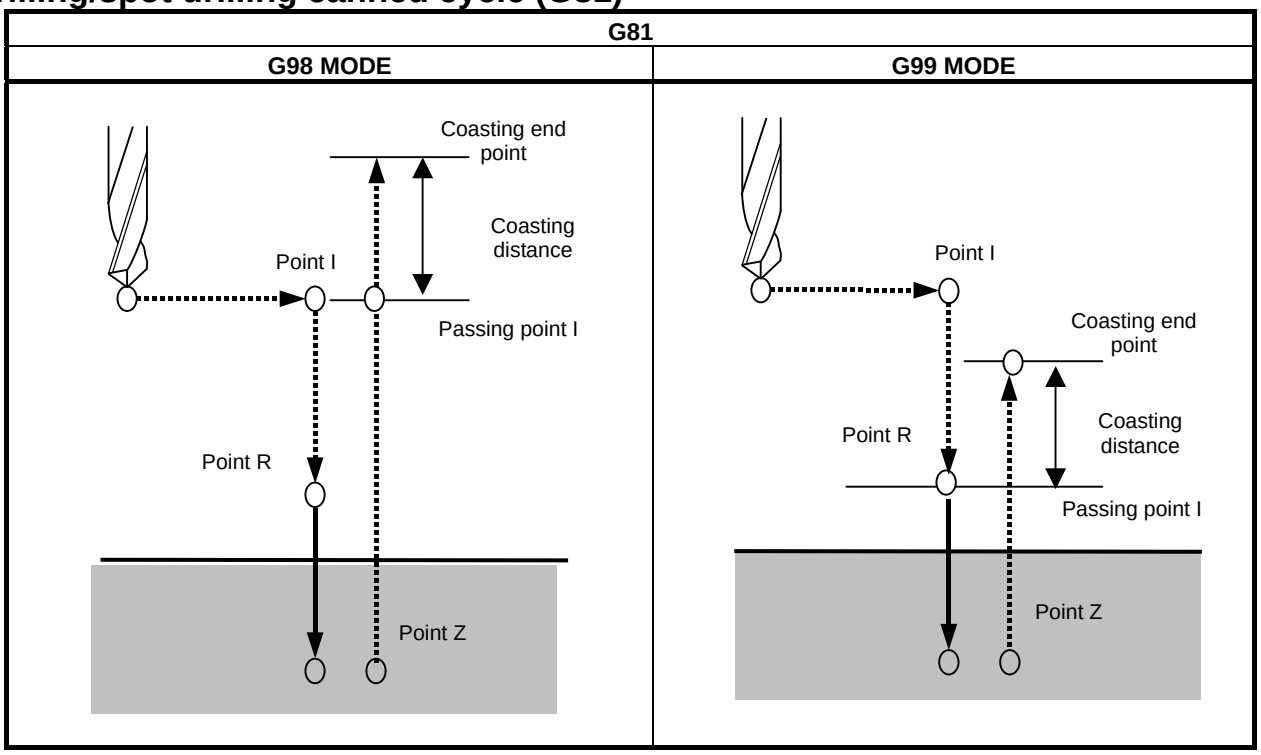


Command format

G73 X_ Y_ Z_ R_ Q_ F_ K_

	X_Y_	: Hole position data
	Z_	: Distance from point R to hole bottom
	R_	: Distance from initial point to point R
	Q_	: Depth of each cut
	F_	: Cutting feedrate
	K_	: Number of repeats

Drilling/spot drilling canned cycle (G81)

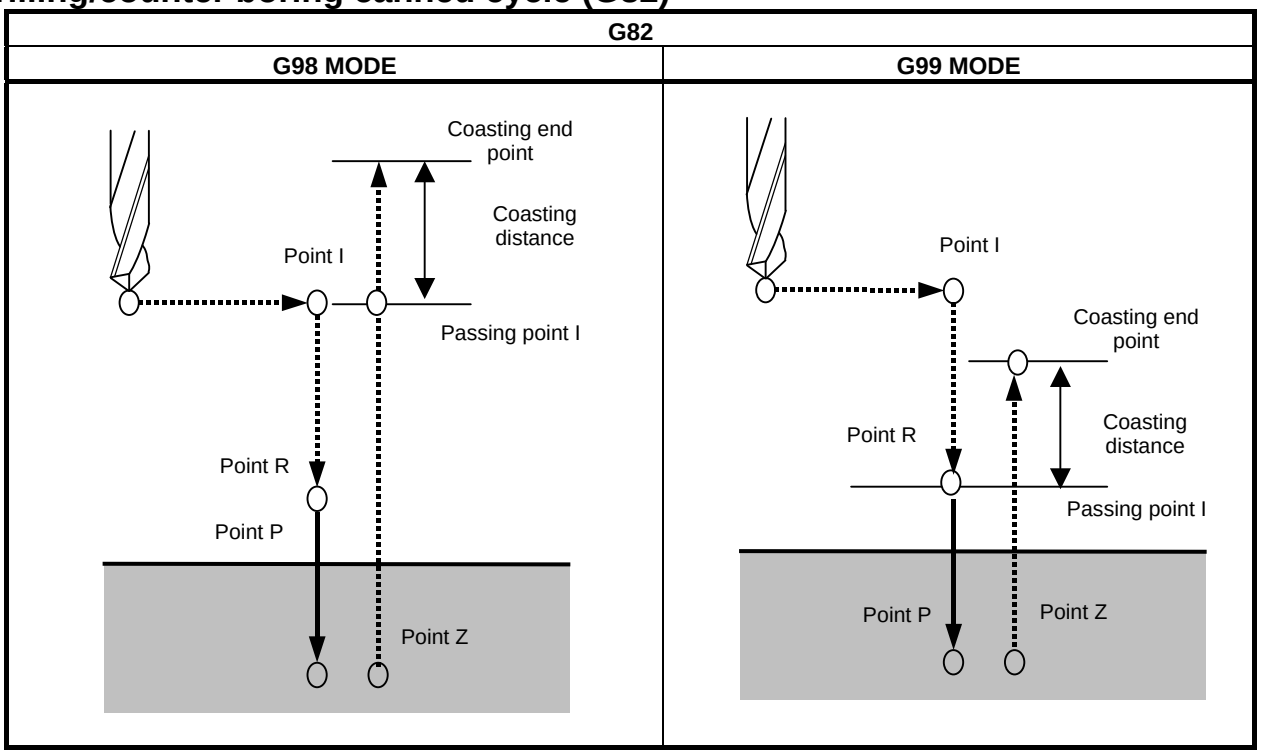


Command format

G81 X_ Y_ Z_ R_ F_ K_

X_Y_ : Hole position data
Z_ : Distance from point R to hole bottom
R_ : Distance from initial point to point R
F_ : Cutting feedrate
K_ : Number of repeats

Drilling/counter boring canned cycle (G82)

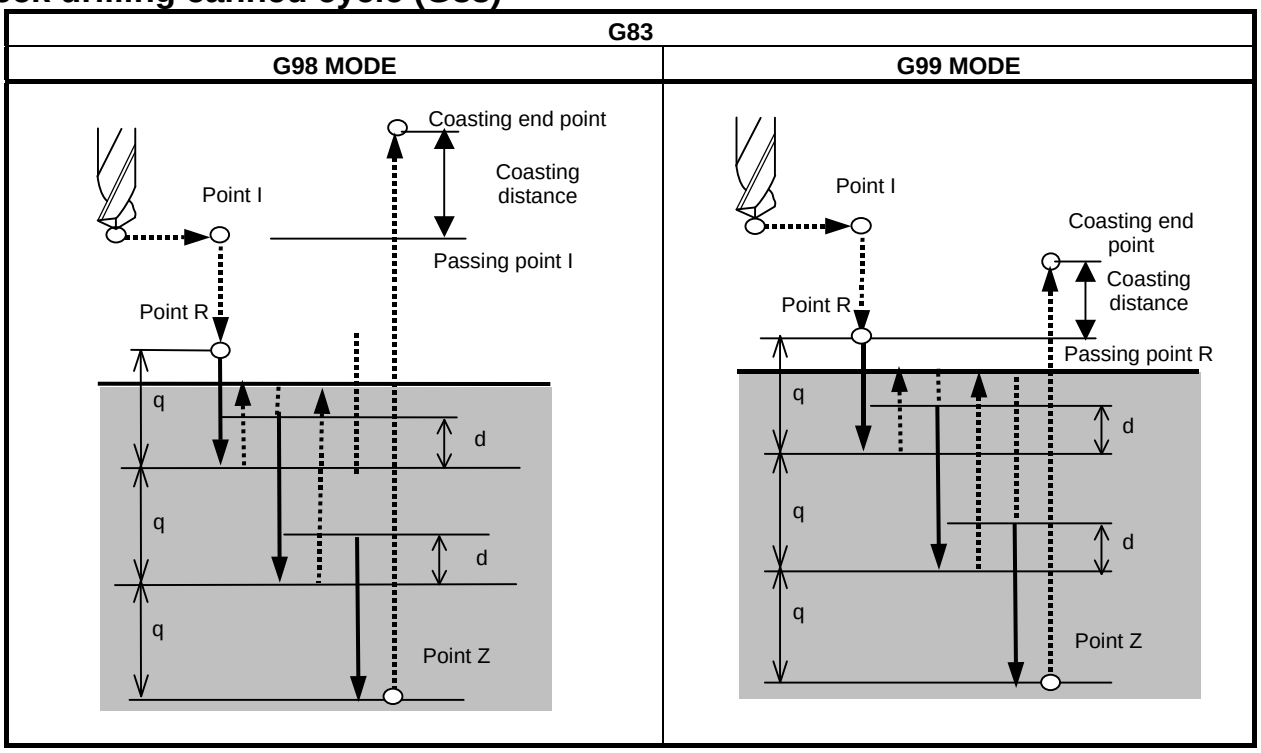


Command format

G82 X_ Y_ Z_ R_ P_ F_ K_

X_Y_	: Hole position data
Z_	: Distance from point R to hole bottom
R_	: Distance from initial point to point R
P_	: Dwell time at hole bottom
F_	: Cutting feedrate
K_	: Number of repeats

Peck drilling canned cycle (G83)



Command format

G83 X_ Y_ Z_ R_ Q_ F_ K_

X_Y_	: Hole position data
Z_	: Distance from point R to hole bottom
R_	: Distance from initial point to point R
Q_	: Depth of each cut
F_	: Cutting feedrate
K_	: Number of repeats

The operations below are performed:

(1) Rapid traverse to XY–specified position
(2) Rapid traverse to point R
(3) Cutting feed from point R to point Z
(4) Rapid traverse from point Z to coasting end point

27.2.1 Differences from Conventional G73 and G81 through G83 Codes

When NC parameter No. 5104#0 is set to 1, G73 and G81 through G83 operate as high-speed positioning and drilling canned cycles. When NC parameter No. 5104#0 is set to 0, these codes operate as the conventional G73 and G81 through G83 cycles.

27.2.2 Retreat Operation

The tool moves in rapid traverse to a coasting end point, which is determined by adding a coasting distance to initial point/point R.

27.2.3 Positioning Operation

Positioning (X–/Y–axis) to the next hole position in the cycle is started by rapid traverse overlapping during retreat operation. At this time, positioning to point R along the Z–axis is also started.

27.2.4 Single–Block Stop

Single–block stop operation is performed at the following points:

(1) Position where positioning to the first hole position is completed
(2) Point R before drilling the first hole
(3) Position (coasting end point) where retreat operation from the bottom of the first hole is completed
(4) Point R before drilling the second hole
(When G98 is specified)
  (a) At the same time when positioning to the second hole position is performed, the tool moves to point I.
  (b) Point R before drilling the second hole
(5) Position (coasting end point) where retreat operation from the bottom of the second hole is completed

If a single–block stop operation is performed at (3) or (5), rapid traverse overlapping is not actuated, but the tool moves up to a coasting end point.

27.2.5 Return to Initial Point/Point R

In either the initial point return mode (G98) or the R point return mode (G99), coasting operation is performed.

27.2.6 Cancellation

When G80 or a G code of group 01 (G00 to G03, G60 (Parameter No. 5431#0=1) is specified, a high–speed positioning and drilling canned cycle is cancelled. At the time of cancellation, the tool is positioned at a coasting end point along the Z–axis.

27.2.7 Rapid Traverse Overlapping

If rapid traverse blocks are specified in succession in a high–speed positioning and drilling canned cycle, rapid traverse overlapping is applied. Parameter No. 5151 is used to specify a rapid traverse overlapping deceleration ratio.
To disable rapid traverse overlapping, set 0 in parameter No. 5151.
In a high–speed positioning and drilling canned cycle, rapid traverse overlapping is enabled even when the move direction is reversed. Set the parameter, taking influences such as a shock to the machine into consideration.

27.3 PARAMETERS

	#7	#6	#5	#4	#3	#2	#1	#0
5104								RDC

[Input type] Parameter input
[Data type] Bit

 # 0 RDC The high–speed positioning and drilling canned cycles are:
0: Disabled.
1: Enabled.

5150	Coasting distance in high-speed positioning and drilling canned cycles

[Input type] Parameter input
[Data type] Real number
[Unit of data] mm, inch (input unit)
[Least unit of data] As per increment system of the reference axis
[Valid data range] 0 or nine digits of the positive least input increment (See the standard parameter setting table (B).)
Set a coasting distance in high-speed positioning and drilling canned cycles.

5151	Gear reduction ratio of overlapping between rapid traverse blocks in high-speed positioning and drilling canned cycles.

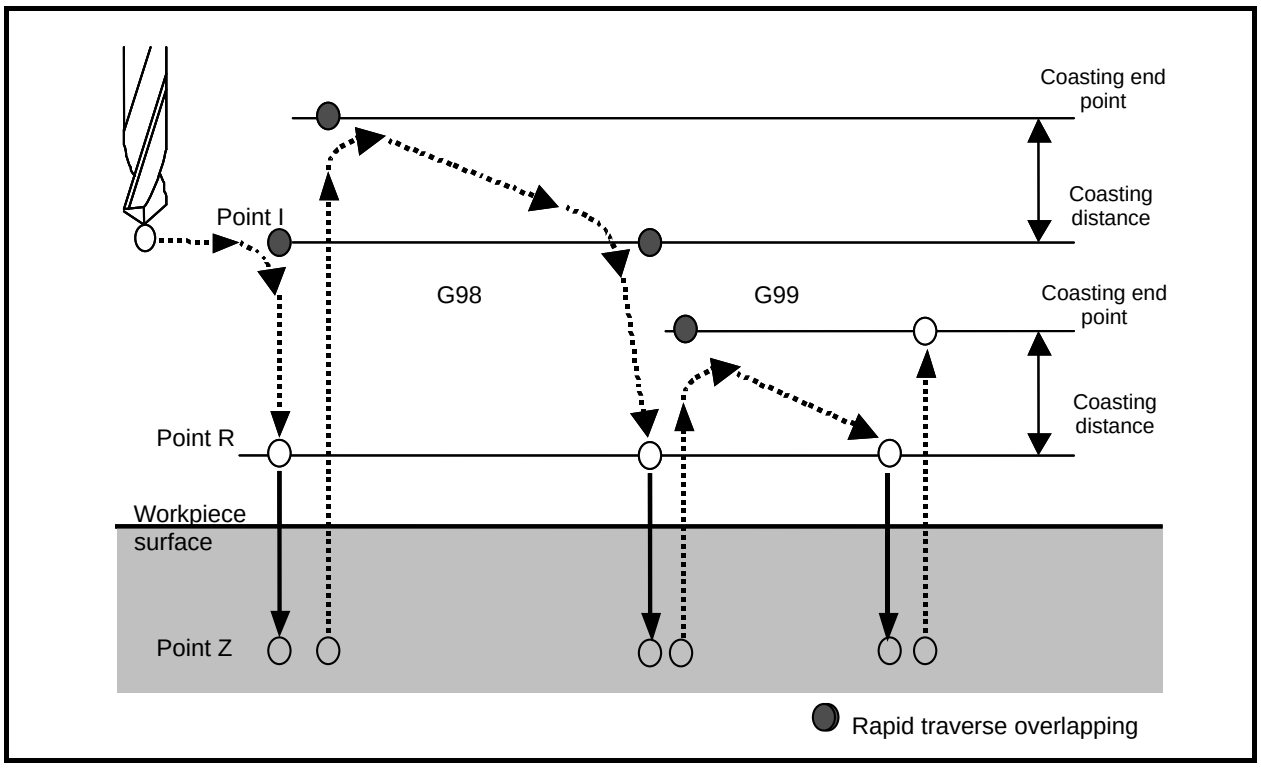
[Input type] Parameter input
[Data type] Byte
[Unit of data] %
[Valid data range] 0 to 100
Set a rapid traverse overlapping deceleration ratio to be used between rapid traverse blocks in a high–speed positioning and drilling canned cycle. During the cycle, this setting is applied to all axes.

SUPPLEMENT
In a high–speed positioning and drilling canned cycle, rapid traverse overlapping is applied even when NC parameter No. 1601#4 is set to 0.
To disable rapid traverse overlapping, set 0 in this parameter.

27.4 NOTES

(1) The high-speed positioning and drilling canned cycles are enabled only when the drilling axis is the Z-axis (NC parameter No. 5101#0 = 0).
(2) Drilling operation is not performed in a block that specifies none of the X-axis, Y-axis, Z-axis, R-axis, and additional axes.
(3) Specify R and Q commands in a block that performs drilling operation. Even when these commands are specified in a block that does not perform drilling operation, they are not stored as modal data.
(4) Do not specify a G code of group 01 (G00 to G03, and so on) in a block that specifies G73, or G81 through G83. Otherwise, G73 or G81 through G83 is canceled.
(5) Tool position offsets are ignored in a canned cycle mode.
(6) When tool amount compensation (G43, G44, or G49) is specified in a high-speed positioning and drilling canned cycle, compensation is applied to positioning to point R and subsequent operations.
(7) NC parameter No. 5104#0 is set to 1, a high-speed positioning and drilling canned cycle is performed in either of the initial point return mode (G98) and the R point return mode (G99).
(8) During the high-speed positioning and drilling canned cycles, rapid traverse overlapping is enabled even if NC parameter No. 1601#4 is set to 0. The gear reduction ratio for rapid traverse overlapping is set in parameter No. 5151.
(9) Set the gear reduction ratio for rapid traverse overlapping in the high-speed positioning and drilling canned cycles in a parameter carefully not to cause a slant retreat operation; otherwise, tool damage or interference can be caused.
(10) In the high-speed positioning and drilling canned cycles, rapid traverse overlapping is applied even when the move direction is reversed. So, consider influences such as an impact to the machine when setting a value in the parameter.
To disable rapid traverse overlapping in the cycles, set 0 in parameter No. 5151.
(11) The high-speed positioning and drilling cycles are enabled in the cycles of G73 and G81 to G83.

27.5 EXAMPLE OF CYCLE OPERATION



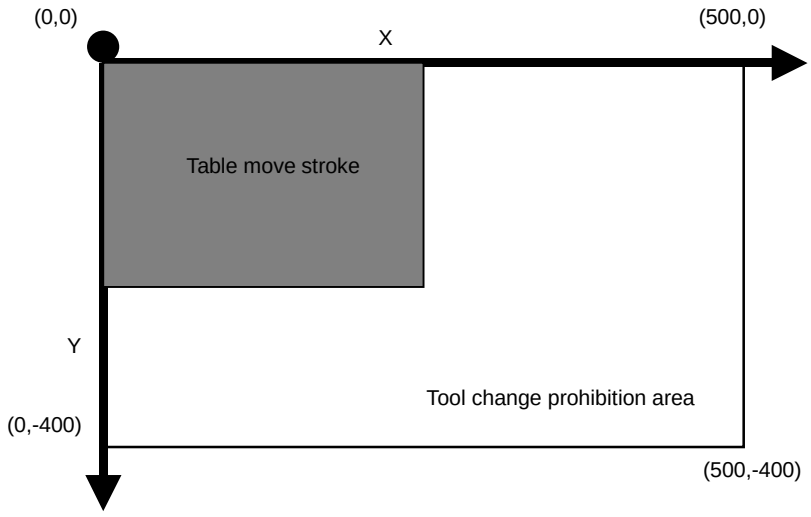
From point R to point Z of the first hole, cutting feed is executed at a specified feedrate value of F. From the hole bottom of the first hole, retreat operation is performed to a coasting end point along the Z–axis, which is determined by adding a parameter–set value to point I or point R. During retreat operation, the tool moves along the X–axis, Y–axis, and Z–axis by rapid traverse overlapping. At this time, rapid traverse of interpolation type is performed, and the tool is positioned at the second hole along a straight path. Then, the cutting feed for the second hole is executed at a specified feedrate value of F. During a high–speed positioning and drilling canned cycle, rapid traverse overlapping is enabled even when the move direction is reversed.

28 TOOL CHANGE PROHIBITION FUNCTION

28.1 OVERVIEW

If the table is not placed at a particular position, tool change operation is prohibited. This function is used, for example, when the tool interferes with a workpiece or jig at the time turret turning in tool change operation.

28.2 SPECIFICATION



∗ The maximum stroke along the X-axis is 700 mm for α-D14/21L*i*A5.
The maximum stroke along the X-axis is 300 mm for α-D14/21S*i*A5.

If the table is placed in the tool change prohibition area (X and Y machine coordinates) in the figure above, tool change operation is prohibited.

- An alarm is issued when the <TOOL CHANGE> button on the operator's panel is pressed in MDI operation.
- An alarm is issued when M06 is specified in automatic operation/MDI operation.
- One tool change prohibition area can be specified by specifying an arbitrary table position (X and Y machine coordinates).

CAUTION
Turret restoration is performed even when the table is within the tool change prohibition area, so be very careful not to allow the tool to interfere with the workpiece and jig.

SUPPLEMENT

If tool change operation and table movement are specified at the same time (Example: G54 X100.Y100.M06 T1), and the table is placed in the tool change prohibition area during turret turning (during tool change operation), tool change operation and table movement gradually stop and an alarm is issued.
Create a machining program so that the table is not placed in the tool change prohibition area at tool change time.
If the machine stops in the state above, perform turret recovery operation. Turret recovery operation is performed even when the table is placed in the tool change prohibition area.

28.3 ALARM

No.	Message	Details
EX1015	TABLE IS PLACED IN TOOL CHANGE PROHIBITION AREA.	An attempt was made to change a tool in the tool change prohibition area. * This alarm can be reset by pressing the RESET key on the operator's panel.

28.4 PARAMETERS

[NC parameters]

No.	
6914	**1**
6915	**2**

This parameter specifies an axis along which to set a tool change prohibition area.
Set 1 (X-axis) for No. 6914 and 2 (Y-axis) for No. 6915.

No.	
6934	Maximum X–axis value for tool change prohibition area
6935	Maximum Y–axis value for tool change prohibition area
6954	Minimum X–axis value for tool change prohibition area
6955	Minimum Y–axis value for tool change prohibition area

This parameter specifies a tool change prohibition area.

(Example) To set a tool change prohibition area of 0 to 250 mm along the X–axis and 0 to –190 mm along the Y–axis

NC parameters	Setting
No.6934	250000
No.6935	99999999
No.6954	-99999999
No.6955	-190000

SUPPLEMENT

To ensure safety, parameter No. 6935 and No. 6954 specify the tool change prohibition area that includes a non-operation area.

[PMC parameter keep relay]

No.	#7	#6	#5	#4	#3	#2	#1	#0
K02	1	*						

K02#7 The tool change prohibition function is
0: disabled.
1: enabled.

K02#6 Specified area is
0: tool change enabled area
1: tool change prohibition area

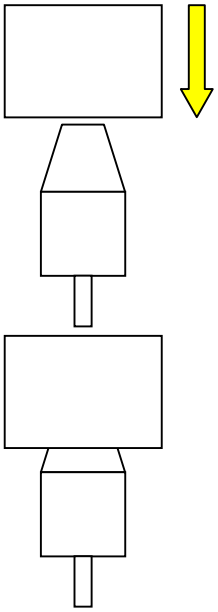
29 SPINDLE AIR BLOW TIME EXTENSION FUNCTION

29.1 OVERVIEW

This function extends the spindle air blow time when tools are changed. This function is useful for removing chips adhered to the taper shank of the tooling.

29.2 SEQUENCE

Tool change sequence:

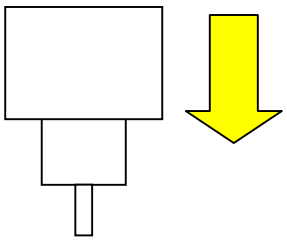


1 In the same manner as the ordinary tool change sequence, the tool rises along the Z-axis, the turret turns, the tool lowers along the Z-axis, and then spindle air blow is started.

2 When the tool lowers along the Z-axis until Z = approx. 40 mm, the rapid traverse rate is switched to LOW. (*1)

3 When tool lowers along the Z-axis until Z = approx. 25 mm, the Z-axis stops moving with the spindle air blow kept output. (*2)

If the specified time has elapsed before the tool lowers along the Z–axis to the specified position, operation 4. takes place.



4. Operation returns to the ordinary tool change sequence.

29.3 PARAMETERS

[NC parameters]

No.	
6919	3

This parameter specifies the axis to be stopped at the time of spindle air blow.
Be sure to set 3 (Z-axis).

No.	
6925	3

This parameter specifies the axis for which the lowering rate is set to LOW at the time of spindle air blow.
Be sure to set 3 (Z-axis).

No.	
6939	25,000 (Standard value)

This parameter specifies the Z-axis stop position at the time of spindle air blow. (*2 Standard value: Z = 25 mm)

No.	
6945	40,000 (Standard value)

This parameter specifies the position at which the Z-axis lowering rate is switched to LOW at the time of spindle air blow.
(*1 Standard value: Z = 40 mm)

No.	
6959	-350,000

This is data related to the Z-axis stop position at the time of spindle air blow.
Be sure to set -350000 (-350 mm).

No.	
6965	-350,000

This is data related to the position at which the Z-axis lowering rate is switched to LOW at the time of spindle air blow.
Be sure to set -350000 (-350 mm).

[PMC parameters (data table)]

D850	Spindle air blow extension time for tool number T1
D851	Spindle air blow extension time for tool number T2
D852	Spindle air blow extension time for tool number T3
D853	Spindle air blow extension time for tool number T4
D854	Spindle air blow extension time for tool number T5
D855	Spindle air blow extension time for tool number T6
D856	Spindle air blow extension time for tool number T7
D857	Spindle air blow extension time for tool number T8
D858	Spindle air blow extension time for tool number T9
D859	Spindle air blow extension time for tool number T10
D860	Spindle air blow extension time for tool number T11
D861	Spindle air blow extension time for tool number T12
D862	Spindle air blow extension time for tool number T13
D863	Spindle air blow extension time for tool number T14
D864	Spindle air blow extension time for tool number T15
D865	Spindle air blow extension time for tool number T16
D866	Spindle air blow extension time for tool number T17
D867	Spindle air blow extension time for tool number T18
D868	Spindle air blow extension time for tool number T19
D869	Spindle air blow extension time for tool number T20
D870	Spindle air blow extension time for tool number T21

These parameters set the extension time for spindle air blow. (Setting on a tool–by–toolbasis)
Specifying 0 does not extend the spindle air blow time. (Ordinary tool change sequence)

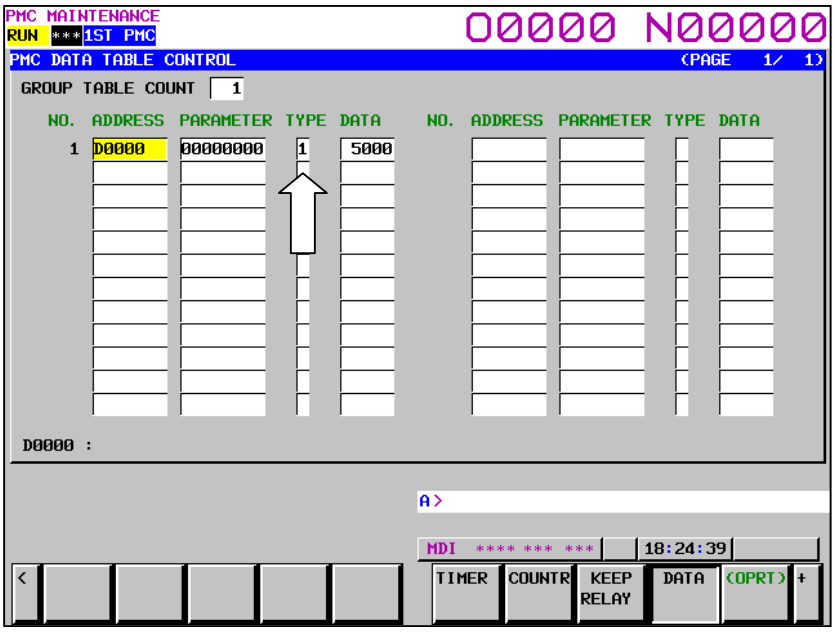
[Data type] 1 byte
[Unit of data] 48 ms
[Valid data range] –128 to 127

When setting is 1 to 127: Setting × 48 ms
When setting is –1 to –128: (256 + setting) × 48 ms

Example 1: When 100 is set: 100 × 48 ms = 4800 ms (4.8 s)
Example 2: When –56 is set: (256 – 56) · 48 ms = 9600 ms (9.6 s)

SUPPLEMENT

The data table display type is factory-set to the word type (D850, D852, D854, and so on). To change the display type to the byte type (displaying D850, D851, D852, and so on), set "TYPE" on the PMC DATA TABLE CONTROL PMC screen to "0".



29.4 SUPPLEMENT

When Z–axis operation stops at the position specified in NC parameter No. 6939, the actually stopped position may vary within 1 mm of the parameter–specified position.

When the Z-axis speed is switched to LOW at the position specified in NC parameter No. 6945, the actually stopped position may vary within 5 to 8 mm of the parameter-specified position.

This function cannot be used with the function for cleaning chips from tapered portions (optional).

30 TOUCH PROBE CONTROL FUNCTION

30.1 OVERVIEW

A touch probe is a touch sensor that is attached to a spindle and used for workpiece alignment, post-machining inspection, and other operations.

30.2 FUNCTION

M17: Turns on the power to the touch probe. Specify this command before the start of measurement.
M18: Turns off the power to the touch probe. Specify this command after the end of measurement. (To save battery power)

To detect signal abnormality due to light interception during a measurement with the touch probe, use the following M codes:

M38: Starts touch probe abnormality detection. (After specifying M17, specify this code before the start of the measurement.)
M39: Ends touch probe abnormality detection. (After the end of the measurement, specify this code before specifying M18.)

Example)

```
O0001
 :
M17                      Turn on the power to the touch probe
 :
G00 G43 Z100.0 H1        Tool length compensation
 :
M38                      Start abnormality detection
G31 G01 Z120.0 F30       Measurement block
M39                      End abnormality detection
G91 G28 Z0               Reference position return along the Z-axis
 :
M18                      Turn off the power to the touch probe
 :
```

SUPPLEMENT

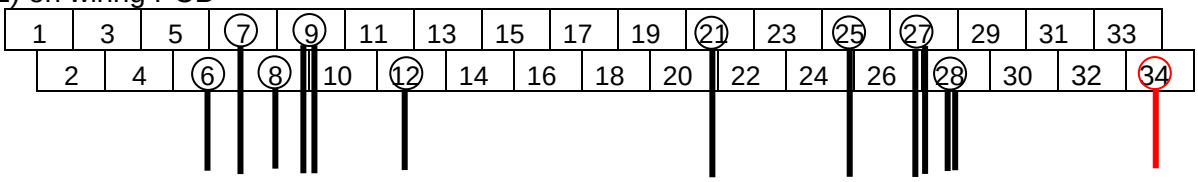
- When specifying the M38 command immediately after the M17 command, provide an interval of about 0.5 seconds between these commands.
- When specifying M17 (or M18) and then M18 (or M17), allow an interval that matches the touch probe specification (for the OMP40, an interval of 1 second).

ATTENTION

The touch probe communicates with the photoreceptor through infrared rays. So, eliminate the obstructions between the touch probe and the photoreceptor before making measurements using this system. An interruption of the signal may interfere with normal measurements.
Note that a malfunction may also occur when there is optical noise from strong external optical sources.

30.3 CONNECTION

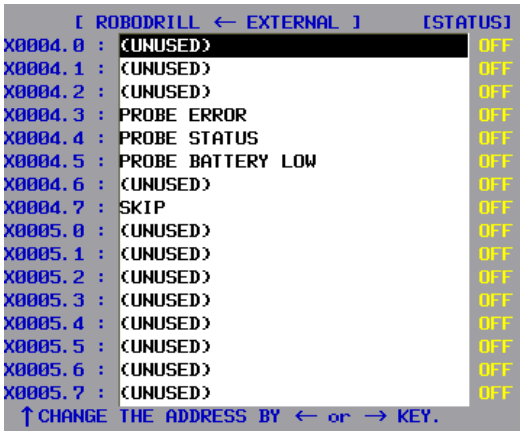
(XT1) on wiring PCB

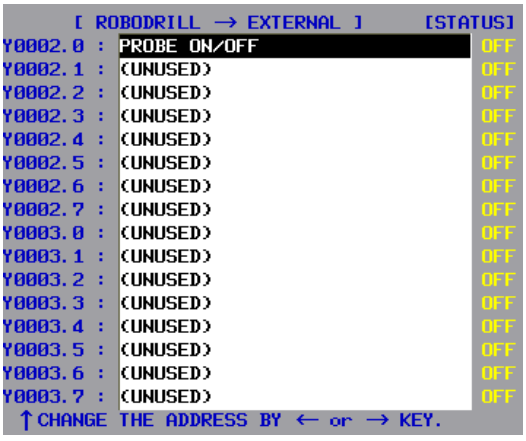


Pin No.	Address	Signal	Line color	Wire mark
XT1-06	X4.3	Probe error	Green	XT1-06
XT1-07	X4.4	Probe status	Light blue	XT1-07
XT1-08	X4.5	Probe battery	Purple	XT1-08
XT1-12	X4.7	Skip	Yellow	XT1-12
XT1-09	(+24E)	Input common	Pink, orange	XT1-09/+24E
XT1-28	(0V)	Input common	Blue, gray	XT1-28/0V
XT1-25	Y2.0	Probe ON/OFF	White	XT1-25
XT1-27	(0V)	Output common	Brown	XT1-27/0V
XT1-21	(+24E)	Power supply	Red	XT1-21/+24E
XT1-27	(0V)	Power supply	Black	XT1-27/0V
XT1-34	(0V)	Ground line (Shield)	Gray, black	XT1-34/0V

30.4 EXTERNAL INTERFACE SIGNAL ASSIGNMENT

Address	Signal name
X4.3	60 : PROBE ERROR
X4.4	58 : PROBE STATUS
X4.5	59 : LOW PROBE BATTERY
X4.7	46 : SKIP
Y2.0	82 : PROBE ON/OFF





30.5 PARAMETERS

[PMC parameter keep relay]

No.	#7	#6	#5	#4	#3	#2	#1	#0
K17						1		

K17#2 0: Disables control of the touch probe.
1: Enables control of the touch probe.

No.	#7	#6	#5	#4	#3	#2	#1	#0
K23								*

K23#0 0: The touch probe is MP12.
1: The touch probe is OMP40.

No.	#7	#6	#5	#4	#3	#2	#1	#0
K32								*

K32#0 0: Does not perform abnormality detection between M38 and M39 with the touch probe manufactured by Renishaw plc. (No alarm is output even when abnormality is detected between M38 and M39.)
1: Performs abnormality detection between M38 and M39 with the touch probe manufactured by Renishaw plc. (An alarm is output when abnormality is detected between M38 and M39.)

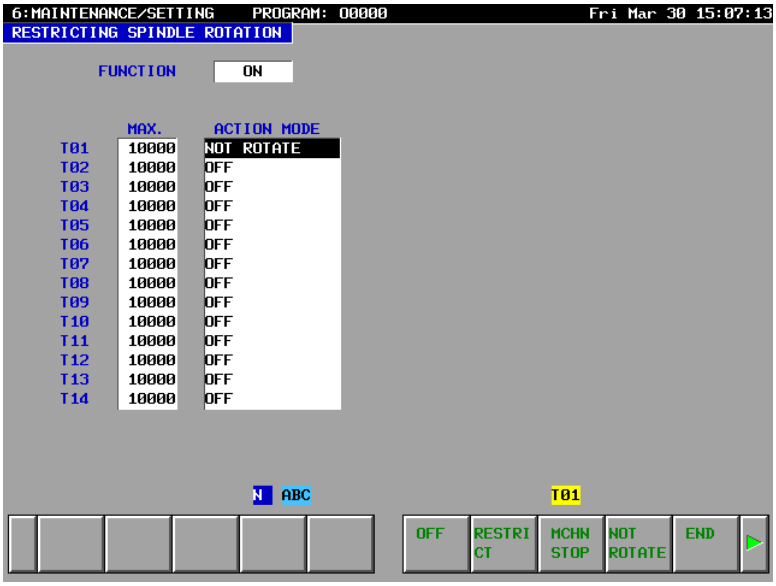
30.6 ALARMS

No.	Message	Description
EX1040	PROBE SYSTEM ERROR	A probe system failure. Check the wire connections, cabling, and external interface settings. The probe or receiving sensor may be defective. If this error occurs during execution of M38, light interception may have occurred between the photoreceptor and the probe. If M38 is specified immediately after the M17 command, provide an interval of about 0.5 seconds between these commands.
EX1041	PROBE ON/OFF ERROR	There is no response to a probe ON/OFF command. Check the probe and receiving sensor orientations, and check whether the probe and receiving sensor window are dirty. This error may be due to a probe switching problem, dead battery, or receiving sensor failure. The required interval for specifying M17 and M18 may not be provided. (OMP40: 1 second)
EX1042	PROBE SIGNAL ERROR	An error signal was output from the probe. Check the wire connections, cabling, and external interface settings. The probe battery may be dead. If this error occurs during execution between M38 and M39, light interception may have occurred between the photoreceptor and the probe.
EX1043	PROBE BATTERY LOW	The voltage of the probe battery has lowered.
EX1053	SPINDLE ROTATION IS PROHIBITED	A spindle rotation was specified with the probe attached to the spindle. While the probe is attached to the spindle, spindle rotation is not permitted. For setting of prohibition of spindle rotation, see Section 30.7.

30.7 SPINDLE ROTATION DISABLE FUNCTION

When the touch probe is attached to the spindle, spindle rotation can be disabled to prevent the touch probe from being damaged using RESTRICTING SPINDLE ROTATION on the 6:MAINTENANCE/ SETTING screen that can be displayed from the QUICK screen.

Example) When the touch probe is mounted on the magazine 1



Set FUNCTION to ON in RESTRICTING SPINDLE ROTATION.
Set NOT ROTATE under ACTION MODE of T01.

When NOT ROTATE is set, the ROBODRILL operates as follows:

- When spindle rotation is specified (by pressing the SPINDLE button on the operator's panel or specifying M3 or M4), alarm EX1053 is indicated and the spindle does not rotate.
- Tool change can be specified.
- Spindle orientation can be specified.

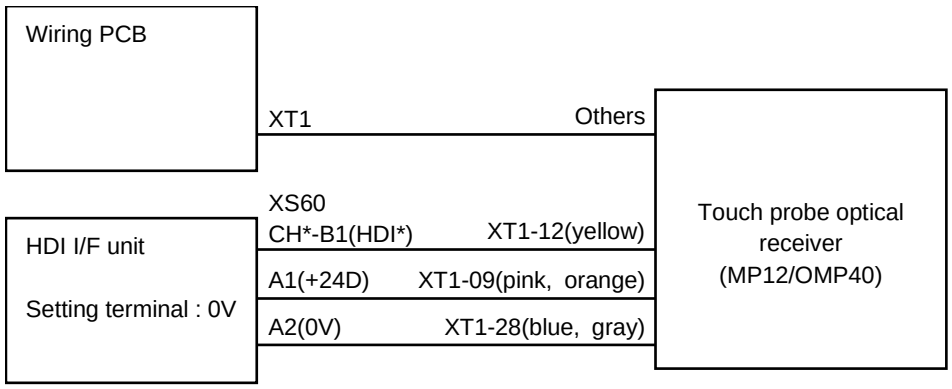
SUPPLEMENT
This function can be used also when the touch probe control function is not used (K17#2 = 0).

30.8 AUTOMATIC TURN–OFF OPERATION OF THE TOUCH PROBE

Usually, the touch probe is automatically turned off each time the power to the ROBODRILL is turned on/off, so that the drain on battery power for the touch probe can be reduced.
However, it is not automatically turned off if the power to the ROBODRILL is turned off immediately after the M17 (or M18) command is specified.

30.9 CONNECTION WHEN THE HIGH-SPEED SKIP FUNCTION IS USED

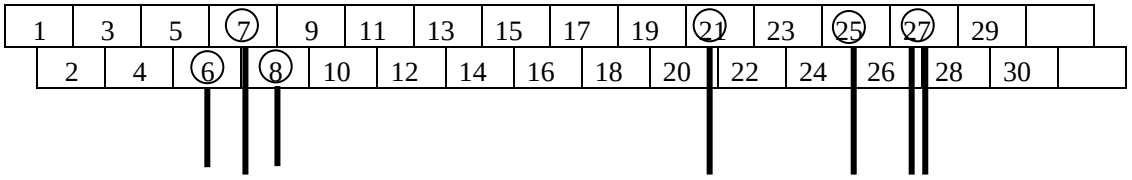
(Block diagram)



To use the high-speed skip function, see the above block diagram and Chapter 26, "HIGH-SPEED SKIP FUNCTION (OPTION)", and perform wiring.

- Connect the receiver to CH0 to CH7 of HDI I/F unit XS60 (CH0, for example, when high-speed skip signal HDI0 is used). Set the setting terminal to 0 V.
- Connect the other wires to terminal block XT1 on the wiring PCB as shown below.

(XT1)



Pin No.	Address	Signal	Line color	Wire mark
XT1-06	X4.3	Probe error	Green	XT1-06
XT1-07	X4.4	Probe status	Light blue	XT1-07
XT1-08	X4.5	Probe battery	Purple	XT1-08
XT1-25	Y2.0	Probe ON/OFF	White	XT1-25
XT1-27	(0V)	Output common	Brown	XT1-27/0V
XT1-21	(+24E)	Power supply	Red	XT1-21/+24E
XT1-27	(0V)	Power supply	Black	XT1-27/0V
XT1-34	(0V)	Ground line (Shield)	Gray, black	XT1-34/0V

SUPPLEMENT

- For the high-speed skip function setting, see Chapter 26, "HIGH-SPEED SKIP FUNCTION (OPTION)".
- The settings other than those related to wiring are the same as when the high-speed skip function is not used. Make the settings with referencing Section 30.4, "EXTERNAL INTERFACE SIGNAL ASSIGNMENT", and Section 30.5, "PARAMETERS".

30.10 MAINTENANCE

Battery replacement

When the touch probe batteries have run out, replace them.
The touch probe uses two thionyl chloride lithium cells (3.6 V) of size 1/2AA. Refer to the applicable manual for the touch probe for explanations about how to replace them.

Ordering information
One set of 2 battery cells A55L-0001-0338#BATTERY

Stylus replacement

If the stylus is damaged, replace it. Replacing it requires touch probe alignment.
Refer to the applicable manual for the touch probe for explanations about how to align the touch probe.

Ordering information
Stylus (ϕ6, 50 mm in length, ceramic shaft) A55L-0001-0338#CE6L50

Others

Refer to the operator's manual for the touch probe for detailed descriptions of how to handle the touch probe.

31 AUTOMATIC FIRE–EXTINGUISHER (OPTION)

If a fire occurs inside the splash guard of the machine, an automatic fire-extinguisher detects the fire by using sensors and ejects a fire-extinguishing agent (you can also eject the fire-extinguishing agent by pressing a manual button); the automatic fire-extinguisher is an auxiliary designed for temporary use in the initial stage of the fire. You cannot expect the automatic fire-extinguisher to completely extinguish the fire.
Upon power-up, the automatic fire-extinguisher starts monitoring.

The ROBODRILL has two types of automatic fire-extinguishers, one for general fires and the other for combustible metal fires (which can also be used for general fires). Which automatic fire-extinguisher is applicable depends on the materials of workpieces to be machined with the ROBODRILL and the type of a coolant (cutting fluid) to be used for machining.

⚠ DANGER

1 Do not machine any combustible metal such as magnesium with a machine equipped with an automatic fire extinguisher for general fires. If the automatic fire extinguisher operates, the agent in the extinguisher reacts with the combustible metal, possibly leading to explosive combustion due to hydrogen gas or vapor explosion.

2 Use a ROBODRILL equipped with an automatic fire extinguisher to machine only the fire extinguishable materials with the extinguisher. If the ROBODRILL is used to machine other materials, the extinguisher cannot be expected to extinguish fire, possibly leading to fire or explosion due to chemical reactions. The fire extinguishable materials of each type of automatic fire extinguisher are listed below.

[Materials available with an automatic fire extinguisher for general fires]

- Resins • Formed plastics • Wood • Fibers
- Water-soluble coolants • Water-insoluble combustible liquids (hazardous materials almost insoluble in water such as kerosene, class 3 petroleum (with an inflammation point of 70°C to 200°C), class 4 petroleum (with an inflammation point of 200°C to 250°C), fire-resistant coolants (with an inflammation point of 250°C or higher), machine oils, and lubricants)

[Materials available with an automatic fire extinguisher for combustible metal fires]

- Hazardous substances belonging to the second category (flammable solids) and third category (spontaneously flammable substances and substances which emit flammable gases when contacting with water) in the hazardous substance categories of the Fire Defense Law (When machining any combustible metal, such as magnesium, aluminum, or titanium, use automatic fire-extinguishers for combustible metals.)
- Resins • Formed plastics • Wood • Fibers
- Water-soluble coolants • Water-insoluble combustible liquids (hazardous materials almost insoluble in water such as kerosene, class 3 petroleum (with an inflammation point of 70°C to 200°C), class 4 petroleum (with an inflammation point of 200°C to 250°C), fire-resistant coolants (with an inflammation point of 250°C or higher), machine oils, and lubricants)
- Water-soluble combustible liquids (such as alcohol)

3 When machining a combustible metal, use an appropriate coolant for machining combustible metals.
If fire breaks out during machining of a combustible metal, in particular, using a water-soluble coolant, the water reacts with the combustible metal, possibly leading to explosive combustion due to hydrogen gas or vapor explosion.

4 When using a mist collector or dust chamber together with a machine tool that machines combustible metals, the mist collector or dust chamber must be specific to combustible metals. Otherwise, a fire or explosion may occur within the mist collector or dust chamber.

5 Do not use any ROBODRILL equipped with an automatic fire extinguisher if the fire-extinguishing agent container is in rust, has flaw or is damaged, or the container cap is loose. The fire extinguisher may burst.

6 On automatic fire extinguishers, do not use any fire-extinguishing agent containers that were produced five or more years ago. Do not improperly discard or leave any fire-extinguishing agent containers or pressurized containers unattained. It is likely that they may burst.

⚠ WARNING

1 When using a mist collector or dust chamber together with the ROBODRILL with an automatic fire extinguisher, be sure to attach a fire prevention dumper to the duct section. Otherwise, fire spark may be inhaled, causing fire spread during occurrence of a fire.
2 Periodically clean the piping and cabling in the machine (the sensors and nozzle in particular). In particular, cut scraps and coolant attached to the sensors and nozzle can prevent the detection of fire or prevent the emission of the fire-extinguishing agent.
3 When machining a combustible workpiece or using a water-insoluble coolant, always monitor the machine status. The automatic fire extinguisher is designed for temporary use for the initial stage of fire. Always monitor the machine status so that an appropriate action can be taken immediately in case fire should break out.
4 During machining using a coolant, be careful to supply a sufficient amount of coolant properly. If the coolant is not supplied normally, sparks, frictional heat, and others may be generated depending on the cutting condition, possibly letting cut scraps of a combustible workpiece or the coolant catch fire. Clean the cut scrap receiver and filter in the coolant tank so that a sufficient amount of coolant is supplied properly and the filter is not clogged. If the amount of the coolant in the coolant tank is insufficient, replenish the coolant in the tank immediately. Periodically check that the coolant pump runs normally.
5 Machining a combustible metal without using any coolant may generate sparks, frictional heat, and others depending on the cutting condition or due to a worn tool, having a high risk of letting cut scraps catch fire.
6 Clean cut scraps from the splash guard to prevent large amounts of cut scraps from being accumulated. If fire occurs when large amounts of cut scraps are accumulated, it may become impossible to distinguish the fire completely with the automatic fire-extinguisher.
7 Do not touch the controller terminals inside the automatic fire-extinguisher panel. Otherwise, there is a risk of an electrical shock.0
8 We recommend you to install a ceiling cover. In case fire should break out, the ceiling cover may be able to prevent or retard the spread of fire to the building, to let the fire die down because of a reduction in the amount of oxygen within the splash guard, and to enhance the effect of the automatic fire extinguisher.
9 Do not touch the controller terminals inside the automatic fire extinguisher panel. It is likely that the fire extinguisher power may be on even if the ROBODRILL circuit breaker is in its off position. Before touching the controller terminals, make sure that the fire extinguisher power is off. Otherwise, there is a risk of an electrical shock.

ATTENTION

1 Never apply impact to or damage the sensor and sensor cable. If impact is applied to the sensor or sensor cable, or the sensor or sensor cable is damaged, the automatic fire-extinguisher can start operating.
2 Do no install a heat source (such as a light or heater) on the periphery of the sensor, nor move a heat source closer to the sensor. Otherwise, the sensor can operate, starting the automatic fire-extinguisher.
3 Do not apply a high impact to the automatic fire-extinguisher. Otherwise, the fire-extinguisher can be damaged or can start operating.
4 Do not modify the automatic fire-extinguisher. Otherwise, the fire-extinguisher may not be able to operate normally.
5 Do not install any automatic fire extinguisher at any location subject to high temperatures and high humidity.
6 When a ceiling cover is to be used as a full cover for the entire machine, be sure to use a mist collector or dust collector with a fire damper. Otherwise, the mist of a coolant may fill the inside of the machine, possibly making the machine get out of order. In addition, hot air from the spindle motor may also fill the inside of the machine, possibly making the machine get out of order.

Spindle specification	Ceiling basic cover	Ceiling full cover
Standard spindle High torque spindle High acceleration spindle	7 m^3/min or more	7 m^3/min or more
High-speed spindle	7 m^3/min or more	13 m^3/min or more

SUPPLEMENT

The protective range of the fire-extinguisher is limited to the inside of the splash guard. It cannot put out any fire outside the protective range (such as coolant tank and mist collector).

• Automatic fire-extinguisher for general fires

Materials to which the automatic fire-extinguisher is applicable

- Resins
- Foamed plastics
- Wood
- Fibers
- Water-soluble coolant (cutting fluid)
- Non-water-soluble combustible liquids (hazardous materials almost insoluble in water such as kerosene, class 3 petroleum (with an inflammation point of 70°C to 200°C), class 4 petroleum (with an inflammation point of 200°C to 250°C), burn-resistant coolant (cutting fluid) (with an inflammation point of 250°C or higher), machine oil, and lubricant)

Materials to which the automatic fire-extinguisher is inapplicable

For materials below, a fire-extinguishing effect cannot be expected.

- Water–soluble combustible liquids (such as methyl alcohol, ethyl alcohol, acetone, isopropyl alcohol, and methyl ethyl ketone, also including hazardous materials slightly soluble in water)

Materials for which the use of the automatic fire-extinguisher is strictly prohibited

- Hazardous substances belonging to the second category (flammable solids) and third category (spontaneously flammable substances and substances which emit flammable gases when contacting with water) in the hazardous substance categories of the Fire Defense Law
  (For all flammable metals, such as magnesium, aluminum, and titanium, use fire-extinguishers for flammable metals.)

⚠ DANGER
With a machine equipped with an automatic fire-extinguisher for general fires, do not machine combustible metals such as magnesium metals. If the automatic fire-extinguisher for general fires operates, a reaction with a combustible metal may occur, possibly causing explosive combustion due to hydrogen gas or vapor explosion.

- **Automatic fire-extinguisher for combustible metal fires**

Materials to which the automatic fire-extinguisher is applicable

- Hazardous substances belonging to the second category (flammable solids) and third category (spontaneously flammable substances and substances which emit flammable gases when contacting with water) in the hazardous substance categories of the Fire Defense Law
  (For all flammable metals, such as magnesium, aluminum, and titanium, use fire-extinguishers for flammable metals.)
- Resins
- Foamed plastics
- Wood
- Fibers
- Water-soluble cutting fluid (cutting lubricant)
- Non-water-soluble combustible liquids (hazardous materials almost insoluble in water such as kerosene, class 3 petroleum (with an inflammation point of 70°C to 200°C), class 4 petroleum (with an inflammation point of 200°C to 250°C), burn-resistant coolant (cutting fluid) (with an inflammation point of 250°C or higher), machine oil, and lubricant)
- Water–soluble combustible liquids (such as methyl alcohol, ethyl alcohol, acetone, isopropyl alcohol, and methyl ethyl ketone, also including hazardous materials slightly soluble in water)

31.1 SPECIFICATIONS

- **Automatic fire-extinguisher for general fires**

Type		Mechanical foam automatic fire-extinguisher					
Protected machine		α-D14/21L*i*A5		α-D14/21M*i*A5		α-D14/21S*i*A5	
Fire for which extinguisher is available		Fire from chips of ABS or any other resin accumulated in bottom, and other fires					
Catalog No.		CSA-9FC					
Part No. (set code)	Attached to left side of machine	CSA9FCE1	CSA9FCE2	CSA9FCE3	CSA9FCE4	CSA9FCE5	CSA9FCE6
	Attached to right side of machine	CSA9FCRE1	CSA9FCRE2	CSA9FCRE3	CSA9FCRE4	CSA9FCRE5	CSA9FCRE6
Fire-extinguishing agent		Mechanical foam (aqueous film forming foam) 9L					
Weight of extinguisher		Approx. 21 kg					
Operating temperature range		0 to +45°C					
Pressurizing gas cartridge		CO_2+N_2 126g (High-pressure gas cartridge)					
Start method		Started by gas generator					
Electrical system protection structure		Complying with IP54					
Power supply	Input voltage	200 V a.c.	100 V a.c.	200 V a.c.	100 V a.c.	200 V a.c.	100 V a.c.
		200V a.c.=200V a.c._15% 50Hz/60Hz _ 100V a.c.= 100V a.c._15% 50Hz/60Hz Note) The power to the automatic fire-extinguisher must not be supplied from the secondary of the main circuit breaker of the machine.					
	Cable protection	Via circuit protector (Use this switch to turn fire-extinguisher on and off.)					
	Power consumption	20 W or less					
	Operation circuit voltage	24 V d.c.					
	Auxiliary power supply	Not connectable					
Start condition	Sensor	Heat sensors (bimetal type) in machine. Started by sensing in one of six sensors.					
	Start push button	Started by pressing push button with seal on operator's panel					
Start-time output	Gas generator	Pressurizing gas cartridge opened					
	Alarm buzzer	Alarm by continuous electronic sound					
	Start indication	STARTER UNIT lamp (red LED) turned on					
	Start notification transmission signal	No-voltage "C" contact _ 1 (rating: 250 V a.c./5A, resistance load)					
Abnormal condition	Power supply	Power not supplied when power cable is disconnected, circuit protector is turned off, fuse blows, and so on					
	Sensor	Sensor circuit disconnection					
	Starter unit	Gas generator already used or circuit disconnected in starter unit					
Output at abnormality	POWER lamp	In case of no power supply, POWER lamp (green LED) goes off.					
	SENSOR lamp	In case of sensor abnormality, SENSOR lamp (green LED) goes off.					
	STARTER UNIT lamp	In case starter unit disconnects or is no longer in use, STARTER UNIT lamp (green LED) goes off.					
	Abnormality notification transmission signal	No-voltage "C" contact _ 1 (rating: 250 V a.c./5A, resistance load)					
Nozzle	Front nozzle	2 square nozzles for extensive spray at 70°, ϕ10 copper pipe connection type					
	Back nozzle	2 square nozzles for extensive spray at 70°, ϕ10 copper pipe connection type					
	Sidewall head	2 20L-type form heads (sidewall type), model MFH-20					
Sensor	Heat sensors 1 to 4	CSA-D40S type: S metal fitting, 4-m 4-conductor electric wire, sensing at 70°C, bimetal type					
	Heat sensors 5	CSA-D40KPR type: P metal fitting, 4-m 4-conductor movable electric wire, sensing at 70°C, bimetal type					
	Heat sensors 6	CSA-D40J1 type: dedicated metal fitting, 4-m 4-conductor electric wire, sensing at 70°C, bimetal type					
Accessories	Replacement part	2 fuses rated at 250 V a.c., 0.5A					
		1 bursting disk for push-button					

- **Automatic fire-extinguisher for combustible metal fires**

Type		Mechanical foam automatic fire-extinguisher					
Protected machine		α-D14/21L*i*A5		α-D14/21M*i*A5		α-D14/21S*i*A5	
Fire for which extinguisher is available		Fire from magnesium or any other combustible metal accumulated in bottom, fire from chips of ABS or any other resin, and other fires					
Catalog No.		RMM-30FA					
Part No. (set code)		RMM30FA E1	RMM30FA E2	RMM30FA E3	RMM30FA E4	RMM30FA E5	RMM30FA E6
Fire-extinguishing agent		Combustible metal fire powder Metalex 30kg					
Weight of extinguisher		Approx. 90 kg					
Operating temperature range		0 to +45°C					
Pressurizing gas cartridge		CO_2 820g (High-pressure gas cartridge)					
Starting gas cartridge		CO_2+N_2 60g					
Start method		Started by gas generator					
Electrical system protection structure		Complying with IP54					
Power supply	Input voltage	200 V a.c.	100 V a.c.	200 V a.c.	100 V a.c.	200 V a.c.	100 V a.c.
		200V a.c.=200V a.c._15% 50Hz/60Hz _ 100V a.c.= 100V a.c._15% 50Hz/60Hz Note) The power to the automatic fire-extinguisher must not be supplied from the secondary of the main circuit breaker of the machine.					
	Cable protection	Via circuit protector (Use this switch to turn fire-extinguisher on and off.)					
	Power consumption	20 W or less					
	Operation circuit voltage	24 V d.c.					
	Auxiliary power supply	Not connectable					
Start condition	Sensor	Heat sensors (bimetal type) in machine. Started by sensing in one of two sensors.					
	Start push button	Started by pressing push button with seal on operator's panel					
Start-time output	Gas generator	Pressurizing gas cartridge opened					
	Alarm buzzer	Alarm by continuous electronic sound					
	Start indication	STARTER UNIT lamp (red LED) turned on					
	Start notification transmission signal	No-voltage "C" contact _ 1 (rating: 250 V a.c./5A, resistance load)					
Abnormal condition	Power supply	Power not supplied when power cable is disconnected, circuit protector is turned off, fuse blows, and so on					
	Sensor	Sensor circuit disconnection					
	Starter unit	Gas generator already used or circuit disconnected in starter unit					
Output at abnormality	POWER lamp	In case of no power supply, POWER lamp (green LED) goes off.					
	SENSOR lamp	In case of sensor abnormality, SENSOR lamp (green LED) goes off.					
	STARTER UNIT lamp	In case starter unit disconnects or is no longer in use, STARTER UNIT lamp (green LED) goes off.					
	Abnormality notification transmission signal	No-voltage "C" contact _ 1 (rating: 250 V a.c./5A, resistance load)					
Injection head (nozzle)	Attached to side	2 nozzles with A-type head for powders, ϕ10 copper pipe connection type					
Sensor	Heat sensors 1 and 2	CSA-D40J2 type: dedicated metal fitting, 10-m 4-conductor electric wire, sensing at 70°C, bimetal 1 type					
Accessories	Replacement part	2 fuses rated at 250 V a.c., 0.5A					
		1 bursting disk for push-button					

31.2 CAUTIONS

** Be sure to use this fire–extinguisher in the conditions described below.

⚠ DANGER

1 Do not machine any combustible metal such as magnesium with a machine equipped with an automatic fire extinguisher for general fires. If the automatic fire extinguisher operates, the agent in the extinguisher reacts with the combustible metal, possibly leading to explosive combustion due to hydrogen gas or vapor explosion.

2 Use a ROBODRILL equipped with an automatic fire extinguisher to machine only the fire extinguishable materials with the extinguisher. If the ROBODRILL is used to machine other materials, the extinguisher cannot be expected to extinguish fire, possibly leading to fire or explosion due to chemical reactions. The fire extinguishable materials of each type of automatic fire extinguisher are listed below.

[Materials available with an automatic fire extinguisher for general fires]

- Resins • Formed plastics • Wood • Fibers
- Water-soluble coolants • Water-insoluble combustible liquids (hazardous materials almost insoluble in water such as kerosene, class 3 petroleum (with an inflammation point of 70°C to 200°C), class 4 petroleum (with an inflammation point of 200°C to 250°C), fire-resistant coolants (with an inflammation point of 250°C or higher), machine oils, and lubricants)

[Materials available with an automatic fire extinguisher for combustible metal fires]

- Hazardous substances belonging to the second category (flammable solids) and third category (spontaneously flammable substances and substances which emit flammable gases when contacting with water) in the hazardous substance categories of the Fire Defense Law (When machining any combustible metal, such as magnesium, aluminum, or titanium, use automatic fire-extinguishers for combustible metals.)
- Resins • Formed plastics • Wood • Fibers
- Water-soluble coolants • Water-insoluble combustible liquids (hazardous materials almost insoluble in water such as kerosene, class 3 petroleum (with an inflammation point of 70°C to 200°C), class 4 petroleum (with an inflammation point of 200°C to 250°C), fire-resistant coolants (with an inflammation point of 250°C or higher), machine oils, and lubricants)
- Water-soluble combustible liquids (such as alcohol)

3 When machining a combustible metal, use an appropriate coolant for machining combustible metals.
If fire breaks out during machining of a combustible metal, in particular, using a water-soluble coolant, the water reacts with the combustible metal, possibly leading to explosive combustion due to hydrogen gas or vapor explosion.

4 When using a mist collector or dust chamber together with a machine tool that machines combustible metals, the mist collector or dust chamber must be specific to combustible metals. Otherwise, a fire or explosion may occur within the mist collector or dust chamber.

⚠ DANGER

5 Do not use any ROBODRILL equipped with an automatic fire extinguisher if the fire-extinguishing agent container is in rust, has flaw or is damaged, or the container cap is loose. The fire extinguisher may burst.
6 On automatic fire extinguishers, do not use any fire-extinguishing agent containers that were produced five or more years ago. Do not improperly discard or leave any fire-extinguishing agent containers or pressurized containers unattained. It is likely that they may burst

⚠ WARNING

1 If the ROBODRILL has an automatic fire extinguisher and a mist or dust collector is used, be sure to install a fire dumper on the duct. Otherwise, if fire breaks out, fire sparks may be drawn into the duct, which may cause the spread of fire.
2 Periodically clean the piping and cabling in the machine (the sensors and nozzle in particular). In particular, cut scraps and coolant attached to the sensors and nozzle can prevent the detection of fire or prevent the emission of the fire-extinguishing agent.
3 When machining a combustible workpiece or using a water-insoluble coolant, always monitor the machine status. The automatic fire extinguisher is designed for temporary use for the initial stage of fire. Always monitor the machine status so that an appropriate action can be taken immediately in case fire should break out.
4 During machining using a coolant, be careful to supply a sufficient amount of coolant properly. If the coolant is not supplied normally, sparks, frictional heat, and others may be generated depending on the cutting condition, possibly letting cut scraps of a combustible workpiece or the coolant catch fire. Clean the cut scrap receiver and filter in the coolant tank so that a sufficient amount of coolant is supplied properly and the filter is not clogged. If the amount of the coolant in the coolant tank is insufficient, replenish the coolant in the tank immediately. Periodically check that the coolant pump runs normally.
5 Machining a combustible metal without using any coolant may generate sparks, frictional heat, and others depending on the cutting condition or due to a worn tool, having a high risk of letting cut scraps catch fire.
6 Clean cut scraps from the splash guard to prevent large amounts of cut scraps from being accumulated. If fire occurs when large amounts of cut scraps are accumulated, it may become impossible to distinguish the fire completely with the automatic fire-extinguisher.
7 Do not touch the controller terminals inside the automatic fire-extinguisher panel. Otherwise, there is a risk of an electrical shock.
8 We recommend you to install a ceiling cover. In case fire should break out, the ceiling cover may be able to prevent or retard the spread of fire to the building, to let the fire die down because of a reduction in the amount of oxygen within the splash guard, and to enhance the effect of the automatic fire extinguisher.
9 Do not touch the controller terminals inside the automatic fire extinguisher panel. It is likely that the fire extinguisher power may be on even if the ROBODRILL circuit breaker is in its off position. Before touching the controller terminals, make sure that the fire extinguisher power is off. Otherwise, there is a risk of an electrical shock.

ATTENTION

1 Never apply impact to or damage the sensor and sensor cable. If impact is applied to the sensor or sensor cable, or the sensor or sensor cable is damaged, the automatic fire-extinguisher can start operating.
2 Do no install a heat source (such as a light or heater) on the periphery of the sensor, nor move a heat source closer to the sensor. Otherwise, the sensor can operate, starting the automatic fire-extinguisher.
3 Do not apply a high impact to the automatic fire-extinguisher. Otherwise, the fire-extinguisher can be damaged or can start operating.
4 Do not modify the automatic fire-extinguisher. Otherwise, the fire-extinguisher may not be able to operate normally.
5 Do not install any automatic fire extinguisher at any location subject to high temperatures and high humidity.
6 When a ceiling cover is to be used as a full cover for the entire machine, be sure to use a mist collector or dust collector with a fire damper. Otherwise, the mist of a coolant may fill the inside of the machine, possibly making the machine get out of order. In addition, hot air from the spindle motor may also fill the inside of the machine, possibly making the machine get out of order.

Spindle specification	Ceiling basic cover	Ceiling full cover
Standard spindle High torque spindle High acceleration spindle	7 m^3/min or more	7 m^3/min or more
High-speed spindle	7 m^3/min or more	13 m^3/min or more

SUPPLEMENT

The protective range of the fire-extinguisher is limited to the inside of the splash guard. It cannot put out any fire outside the protective range (such as coolant tank and mist collector).

31.2.1 Maintenance Inspections

(1) Perform a visual inspection every six months.
Visual inspection: Visual inspection and cleaning of the piping, cabling, sensors, and nozzle
(2) A functional inspection must be performed in the fifth, eighth, and tenth years since the year of manufacturing and every year after the tenth year.
In addition, specified parts must be replaced every five years.

For the functional inspection and parts replacement, contact FANUC.

- Functional inspection:
  Operation test, measurement of gas cartridge weight, and agent tank inspection (charged)
- Parts replacement:
  [Specified parts] (replaced every five years, charged)
  Starter unit, fire-extinguishing agent tank, pressurizing gas cartridge, nozzle head cover and O-ring, and fuses
  [Others] (replaced when inspected, charged)
  Parts in which abnormality is found by inspection

31.2.2 Alarms

(1) Alarm 1068 (Fire–extinguisher is abnormal.)

When this alarm is issued, the machine is placed in the emergency stop state, then decelerates and stops.
The cause of this alarm can be determined by checking the lamps on the cover of the control section of the automatic fire–extinguisher on the rear side of the machine.
If an abnormality occurs, an indicator lamp goes off.

(a) Abnormal power
No power is supplied to the automatic fire–extinguisher because the power cable is disconnected, the circuit protector has been turned off, or the fuse has blown.

(b) Sensor circuit disconnection
A sensor cable is disconnected.

(c) Start notification transmission signal
The gas generator in the starter unit has been used or a cable disconnection occurred in the circuit.

(2) Alarm 1069 (Fire–extinguisher started.)

When this alarm is issued, the machine is placed in the emergency stop state, decelerates, and stops, then the main circuit breaker of the machine is turned off.
This alarm is issued when the automatic fire–extinguisher has started because a sensor detected fire or the manual button was pressed.

31.2.3 Handling after Emission of Fire–Extinguishing Agent

- **Automatic fire-extinguisher for general fires**

> ⚠ **WARNING**
> 1 After operation of the automatic fire-extinguisher for general fires, leave the machine untouched without removing an ejected fire-extinguishing agent until chips and the machine have completely cooled down. You may get burned if you touch hot burned chips. Remove the burned chips and fire-extinguishing agent once they have completely cooled down (you do not feel heat when you hold your hands over the fire-extinguishing agent).

⚠ WARNING

2 When doing cleanup work after operation of the automatic fire-extinguisher, be sure to wear protectors such as protective gloves, goggles, and a mask. Otherwise, during the cleanup work after fire extinction, there is a risk for you to be burned if you carelessly touch hot chips or parts, and there is also a risk for you to be injured if you get a fire-extinguishing agent or chips into your eyes or mouth.

[First-aid actions against fire-extinguishing agent]

Take the actions listed below, immediately contact a doctor, and follow the doctor's directions.

When fire-extinguishing agent was inhaled

- Lie quietly in fresh air.
- Wash the nasal cavity in lukewarm water and gargle the throat.

When fire-extinguishing agent stays on the skin

- Wash away the stain in water or soap-and-water solution.

When fire-extinguishing agent got in the eye

- If the eye contacted any fire-extinguishing agent, wash it down in a large quantity of water and submit to medical treatment.

When fire-extinguishing agent was swallowed down

- If the victim is conscious, have his or her mouth rinsed out in water.
- Burp up and submit to medical treatment quickly.

Protecting personnel providing first aid

- The deliverer shall wear appropriate protective equipment so that he or she will not touch fire-extinguishing agent.

∗ For explanations about how to handle other types of fire-extinguishing agent, refer to the "Material Safety Data Sheet" attached to the automatic fire-extinguisher in use.

3 Before removing the cover of the automatic fire-extinguisher control box, be sure to turn off the circuit breaker of the automatic fire-extinguisher. Removing the cover with the power to the automatic fire-extinguisher kept on may lead to a shock hazard. Keep in mind that turning off the circuit breaker of the ROBODRILL does not remove the power from the automatic fire-extinguisher.

ATTENTION

Once fire-extinguishing agent is sprayed out, remove the ejected fire-extinguishing agent completely, and apply rust preventive oil or grease to the portions where the fire-extinguishing agent was. Leaving any fire-extinguishing agent unremoved can cause the machine to get rusty.

1. If an automatic fire-extinguishing agent for general fires is used, contact the sales company or the service company immediately.
2. Before going to the next step to start the work below, make sure that chips and the machine have completely cooled down.
3. Remove the accumulated chips and fire-extinguishing agent from the machine.
4. Wipe the machine dry with a dry cloth or towel.
5. Apply rust preventive oil or grease to the machine. See 2. d) in “SAFETY PRECAUTIONS", for descriptions of cautions related to grease.

• Automatic fire-extinguisher for combustible metal fires

⚠ DANGER

1 After operation of the automatic fire-extinguisher for combustible metal fires, do not apply water, a coolant, or the like to chips or an ejected fire-extinguishing agent. If you apply water, a water-soluble coolant, or the like to cool hot burned chips or wash off the chips or fire-extinguishing agent, a reaction with a combustible metal may occur, possibly causing an explosion.

⚠ WARNING

1 After operation of the automatic fire-extinguisher for combustible metal fires, leave the machine untouched without removing an ejected fire-extinguishing agent until chips and the machine have completely cooled down. Hot burned chips may reignite on exposure to air. Remove the burned chips and fire-extinguishing agent once they have completely cooled down (you do not feel heat when you hold your hands over the accumulated fire-extinguishing agent).

2 When doing cleanup work after operation of the automatic fire-extinguisher, be sure to wear protectors such as protective gloves, goggles, and a mask. Otherwise, during the cleanup work after fire extinction, there is a risk for you to be burned if you carelessly touch hot chips or parts, and there is also a risk for you to be injured if you get a fire-extinguishing agent or chips into your eyes or mouth.

[First-aid actions against fire-extinguishing agent]

Take the actions listed below, immediately contact a doctor, and follow the doctor's directions.

When fire-extinguishing agent was inhaled

- Lie quietly in fresh air.
- Wash the nasal cavity in lukewarm water and gargle the throat.

When fire-extinguishing agent stays on the skin

- Wash away the stain in water or soap-and-water solution.

When fire-extinguishing agent got in the eye

- If the eye contacted any fire-extinguishing agent, wash it down in a large quantity of water and submit to medical treatment.

When fire-extinguishing agent was swallowed down

- If the victim is conscious, have his or her mouth rinsed out in water.
- Burp up and submit to medical treatment quickly.

Protecting personnel providing first aid

- The deliverer shall wear appropriate protective equipment so that he or she will not touch fire-extinguishing agent.

∗ For explanations about how to handle other types of fire-extinguishing agent, refer to the " Material Safety Data Sheet " attached to the automatic fire-extinguisher in use.

3 Before removing the cover of the automatic fire-extinguisher control box, be sure to turn off the circuit breaker of the automatic fire-extinguisher. Removing the cover with the power to the automatic fire-extinguisher kept on may lead to a shock hazard. Keep in mind that turning off the circuit breaker of the ROBODRILL does not remove the power from the automatic fire-extinguisher.

ATTENTION

Once fire-extinguishing agent is sprayed out, remove the ejected fire-extinguishing agent completely, and apply rust preventive oil or grease to the portions where the fire-extinguishing agent was. Leaving any fire-extinguishing agent unremoved can cause the machine to get rusty.

1. If an automatic fire-extinguishing agent for general fires is used, contact the sales company or the service company immediately.
2. Before going to the next step to start the work below, make sure that chips and the machine have completely cooled down.
3. Remove the accumulated chips and fire-extinguishing agent from the machine. During the removal work, do not apply water, a coolant, or the like to the chips or fire-extinguishing agent. Be extremely careful in removing the fire-extinguishing agent because it contains very small particles, which may penetrate into narrow gaps.
4. Wipe out the remaining fire-extinguishing agent with a dry cloth or towel.
5. Check carefully how the fire-extinguishing agent is dispersed around the ROBODRILL. In particular, if the automatic fire-extinguisher for combustible metal fires is used, the fire-extinguishing agent may be dispersed extensively. Be sure to remove the fire-extinguishing agent if it is dispersed, as in the case of the inside of the machine.
6. Apply rust preventive oil or grease to the machine. See 2. d) in “SAFETY PRECAUTIONS", for descriptions of cautions related to grease.
7. Put the collected chips in a lidded steel container, and store the container in a place where there is no risk of ignition or spread of fire, such as a container warehouse away from the work areas.

31.3 AUTOMATIC FIRE–EXTINGUISHER

31.3.1 Exterior View and Configuration

- **Automatic fire-extinguisher for general fires**

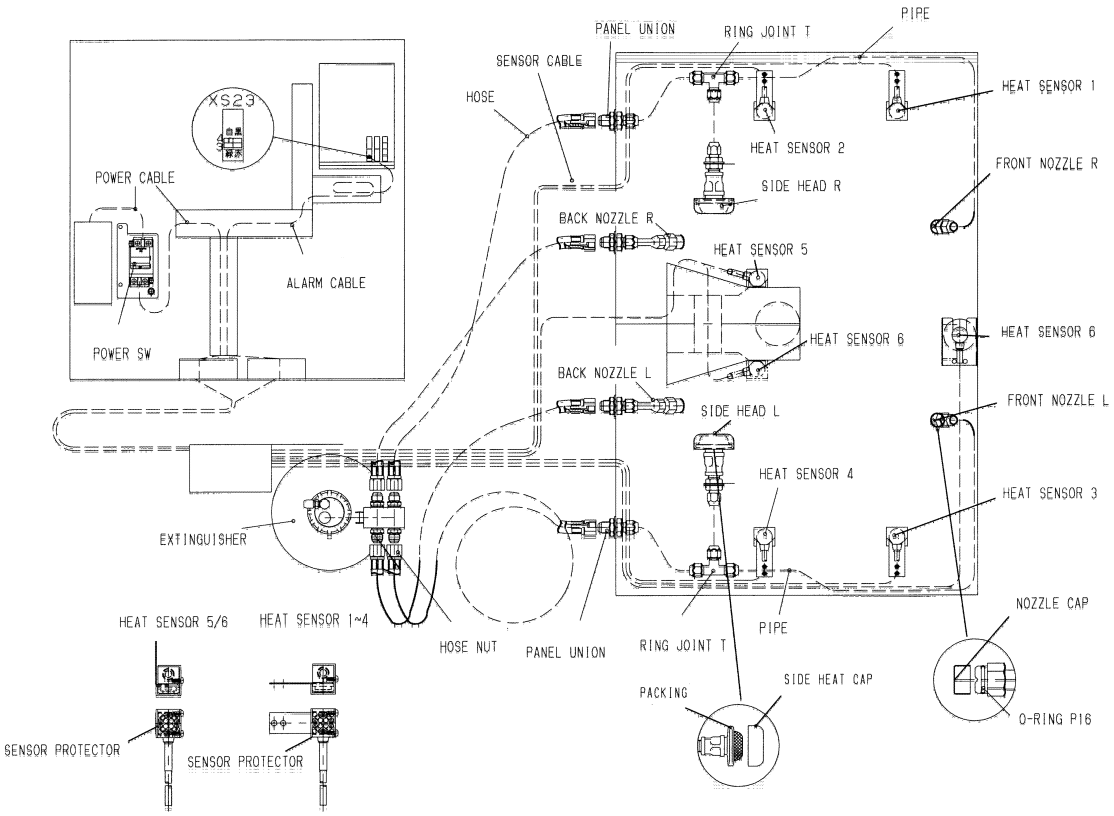


Fig. 31.3.1(a) Configuration of automatic fire–extinguisher for general fires

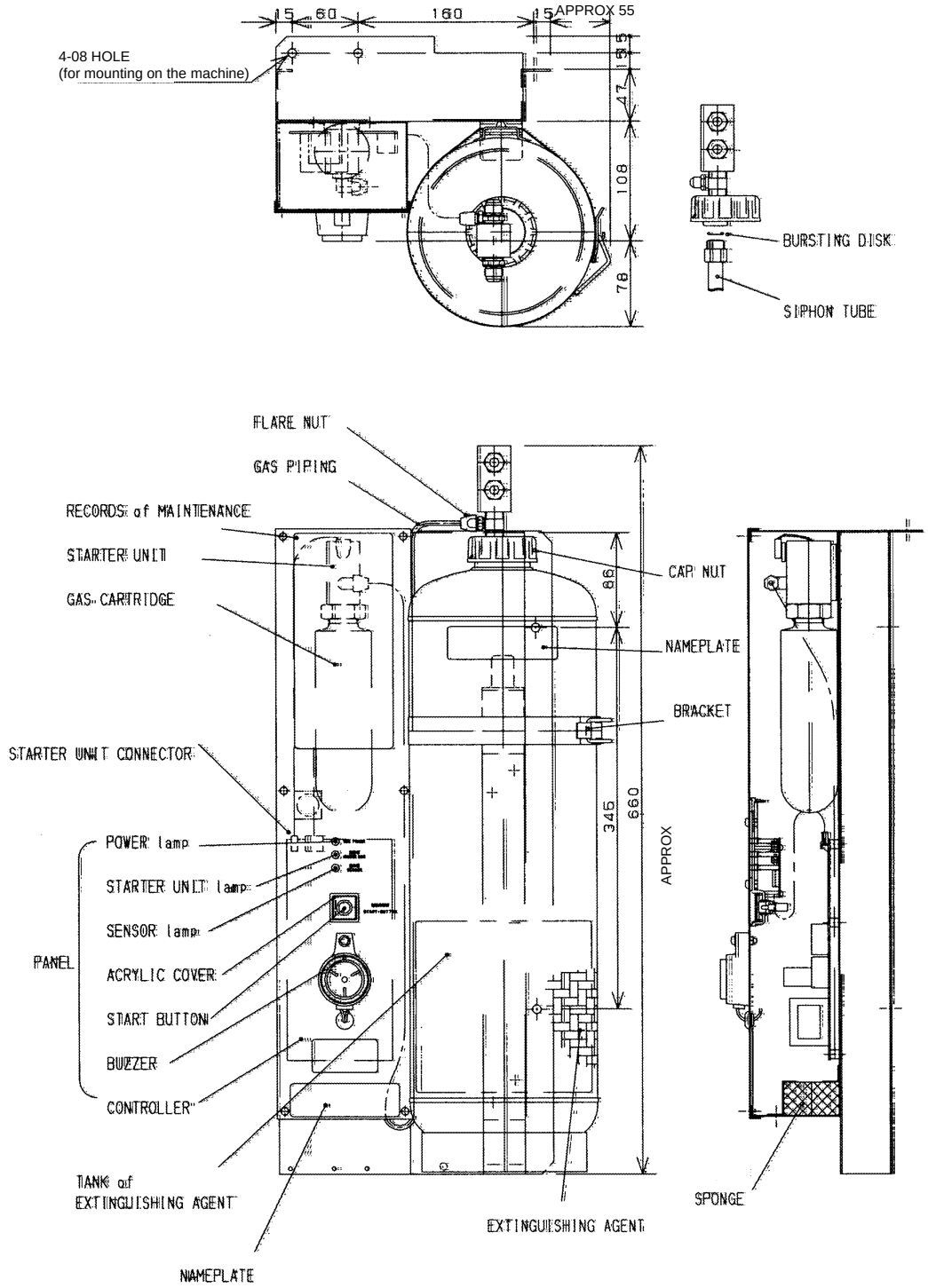


Fig.31.3.1(b) Exterior view of automatic fire-extinguisher for general fires

- **Automatic fire-extinguisher for combustible metal fires**

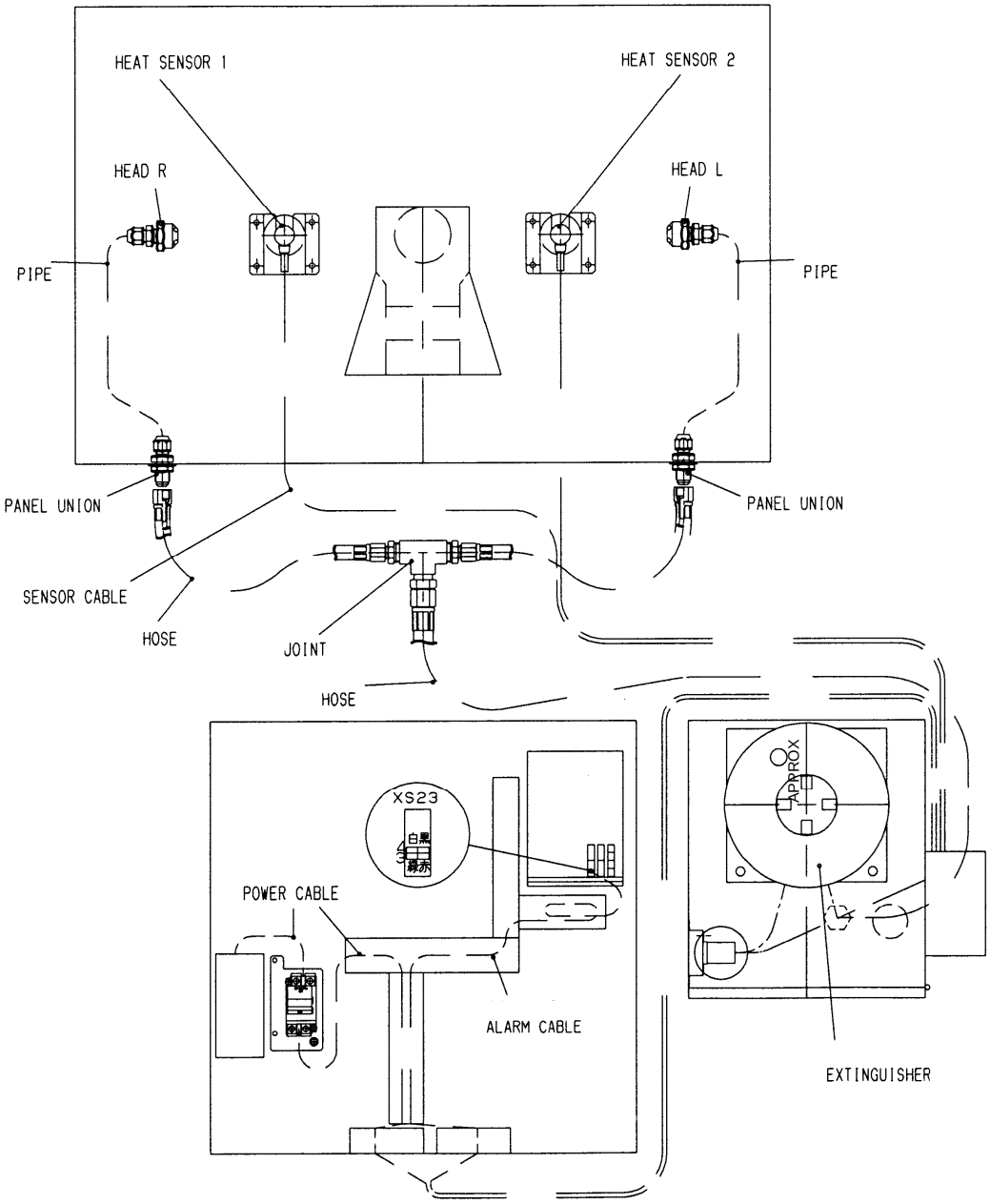


Fig.31.3.1(c) Configuration of automatic fire-extinguisher for combustible metal fires

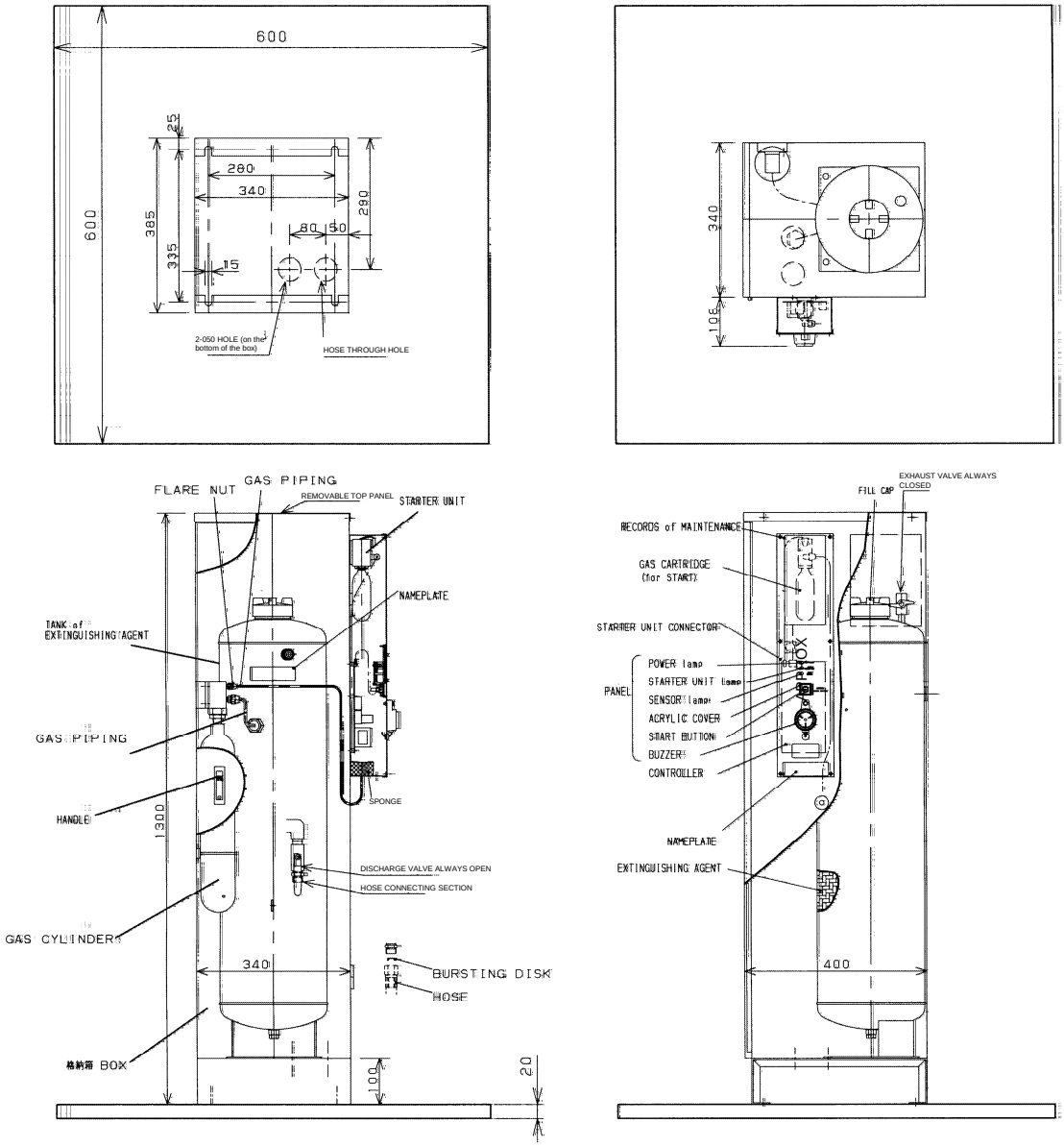


Fig.31.3.1(d) Exterior view of the automatic fire-extinguisher for combustible metal fires

31.3.2 Circuit Protector

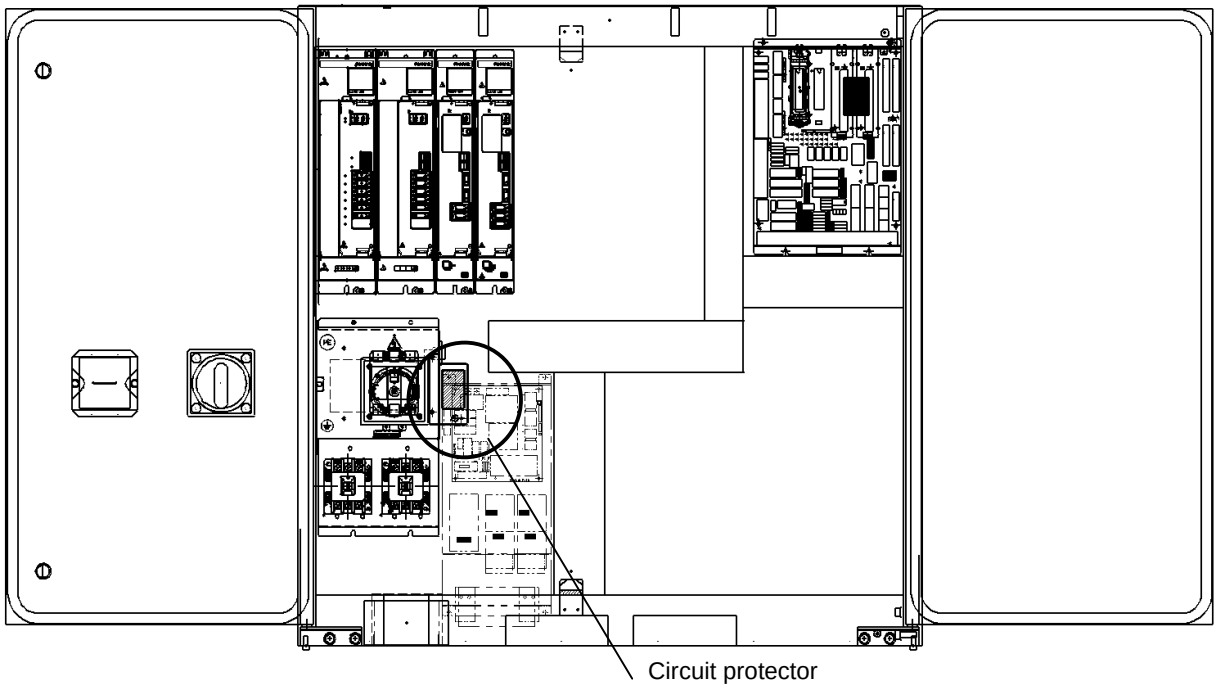


Fig.31.3.2 Circuit protector installation position

31.4 AUTOMATIC FIRE-EXTINGUISHER MAINTENANCE

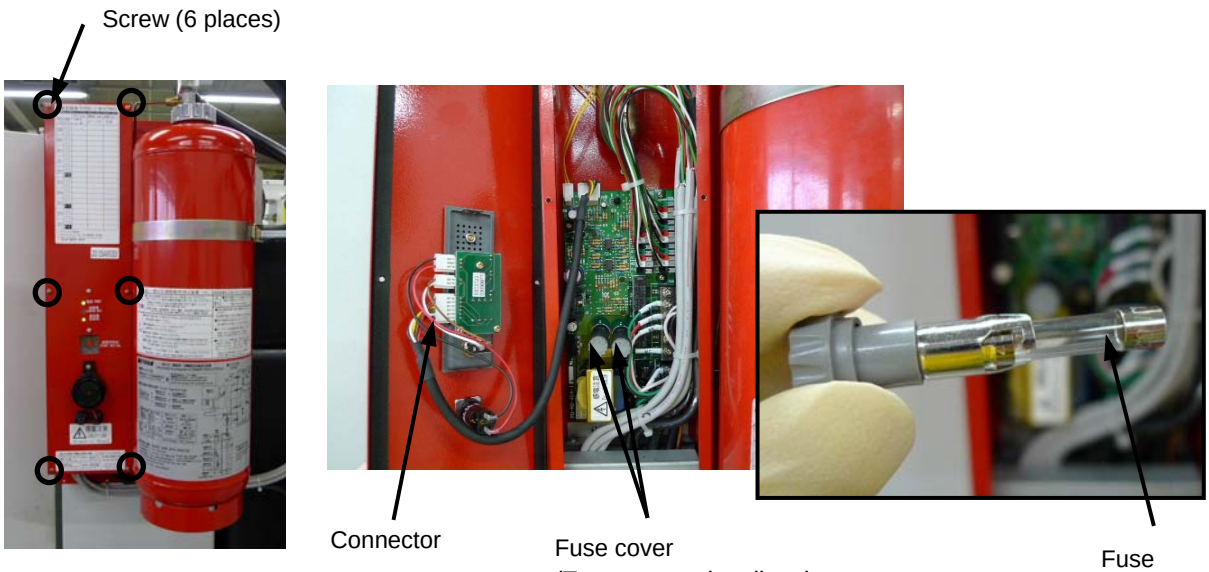
31.4.1 Service Parts Replacement

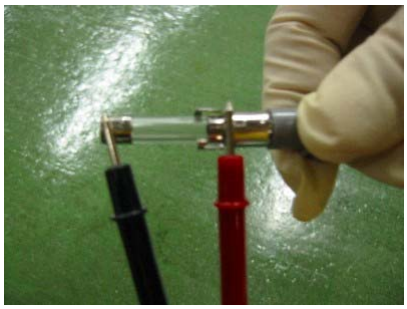
■ Automatic fire-extinguisher for general fires

(1) How to check and replace fuses

If a fuse blows, alarm EX1068, “FIRE EXTINGUISHER IS ABNORMAL.”, occurs on the ROBODRILL, and the power failure lamp on the automatic fire-extinguisher goes out. Check the fuse and replace it according to the following procedure as required.

1 Turn off the circuit breaker of the ROBODRILL.
2 Turn off the circuit protector for the automatic fire-extinguisher.
3 Remove the screws from the automatic fire-extinguisher control box and open the cover.
4 Detach the connectors and grounding wire from the back surface of the cover and detach the cover.
5 Rotate the fuse cover in the direction indicated with an arrow and detach the fuse.
6 Check the fuse for continuity, using a volt-ohm meter.
7 If the fuse is not conductive, replace it with a new one.
8 Put the fuse in place.
9 Re-attach the connectors and grounding wire to the back surface of the cover.
10 Cover the automatic fire-extinguisher control box.
11 Turn on the circuit protector for the automatic fire-extinguisher.
12 Turn on the circuit breaker of the ROBODRILL.





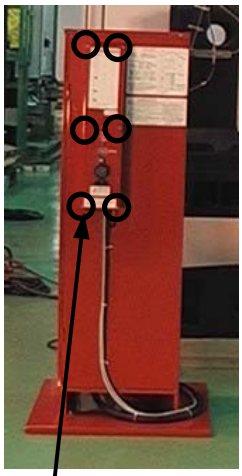
Check fuse for continuity, using volt-ohm meter.

■ Automatic fire-extinguisher for flammable-metal fire

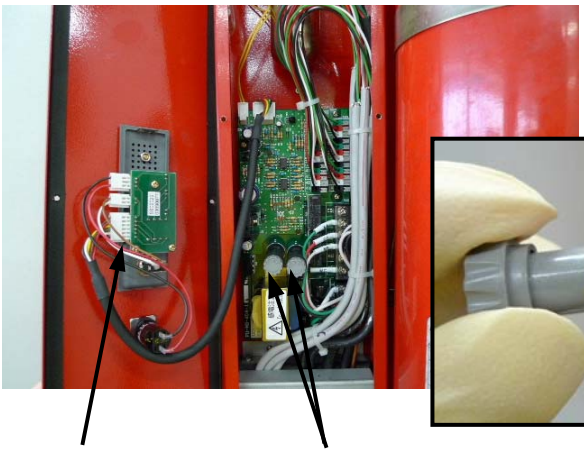
(1) How to check and replace fuses

If a fuse blows, alarm EX1068, “FIRE EXTINGUISHER IS ABNORMAL.”, occurs on the ROBODRILL, and the power failure lamp on the automatic fire-extinguisher goes out. Check the fuse and replace it according to the following procedure as required.

1 Turn off the circuit breaker of the ROBODRILL.
2 Turn off the circuit protector for the automatic fire-extinguisher.
3 Remove the screws from the automatic fire-extinguisher control box and open the cover.
4 Detach the connectors and grounding wire from the back surface of the cover and detach the cover.
5 Rotate the fuse cover in the direction indicated with an arrow and detach the fuse.
6 Check the fuse for continuity, using a volt-ohm meter.
7 If the fuse is not conductive, replace it with a new one.
8 Put the fuse in place.
9 Re-attach the connectors and grounding wire to the back surface of the cover.
10 Cover the automatic fire-extinguisher control box.
11 Turn on the circuit protector for the automatic fire-extinguisher.
12 Turn on the circuit breaker of the ROBODRILL.



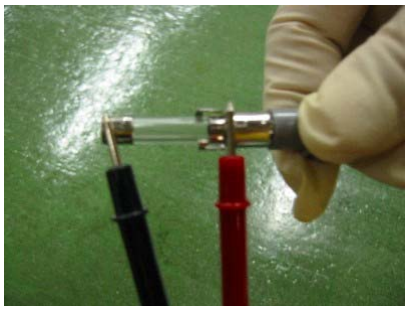
Screw (6 places)



Connector

Fuse cover
(Rotate cover in direction indicated with arrow)

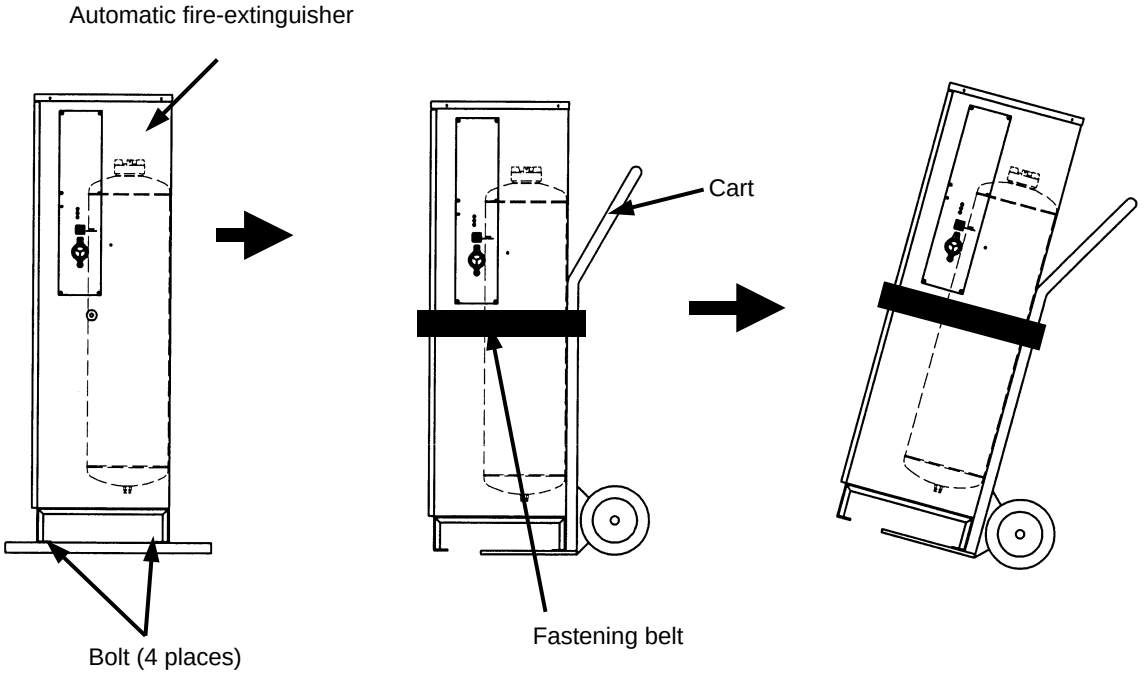
Fuse



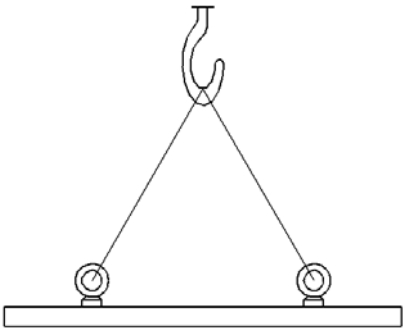
Check fuse for continuity, using volt-ohm meter.

(2) Moving automatic fire-extinguishers for flammable-metal fire from one place to another

1 Detach the wiring and piping from between the ROBODRILL and automatic fire-extinguisher.
2 Screw a plug into the fire-extinguishing agent discharge hole of the automatic fire-extinguisher, from which the piping has been removed, so that no fire-extinguishing agent will leak.
3 Remove the bolts fastening the automatic fire-extinguisher to the base plate.
4 Put the fire-extinguisher on a cart and fasten it to the cart with a belt or the like.
5 Lift the fire-extinguisher with the cart to move it.
6 Attach four M12 eyebolts to the base plate and move it by hoisting it up with a crane.
7 Fasten the fire-extinguisher to the base plate with bolts.
8 Unplug the fire-extinguishing agent discharge hole of the automatic fire-extinguisher.
9 Attach the wiring and piping between the ROBODRILL and automatic fire-extinguisher.



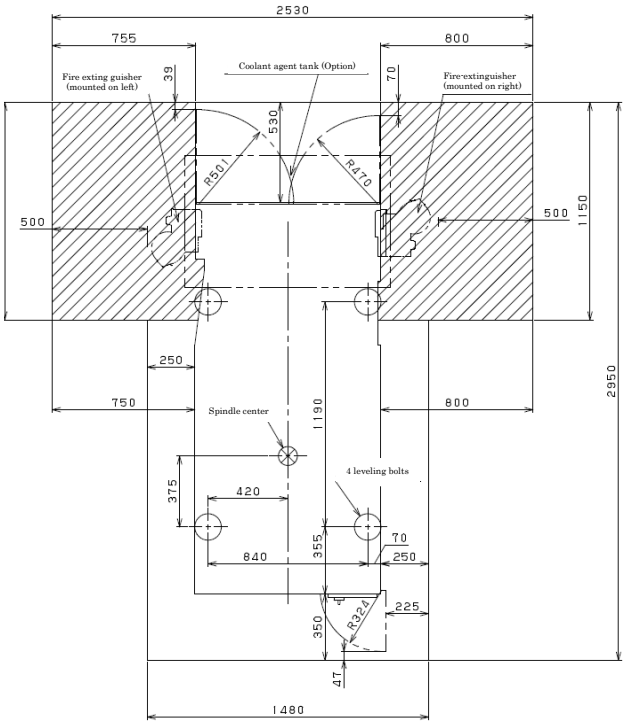
How to move automatic fire-extinguisher



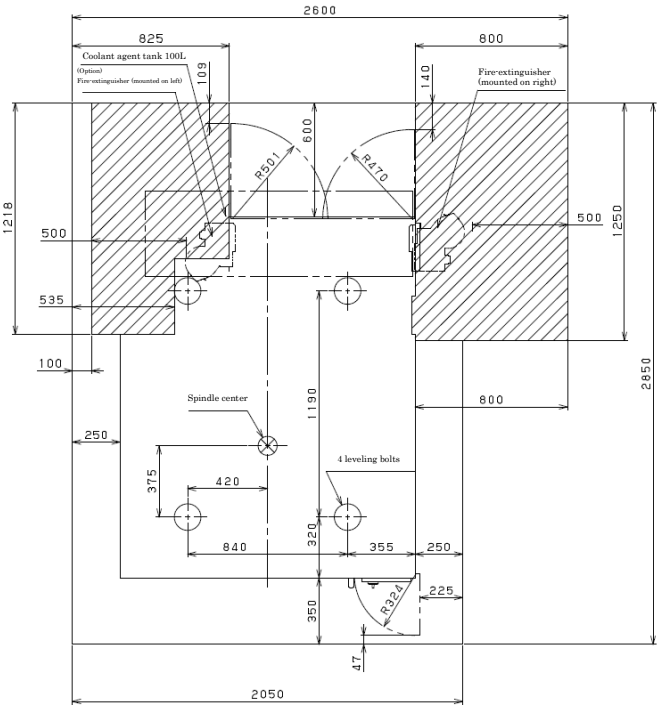
How to move base plate

31.4.2 Maintenance Clearance

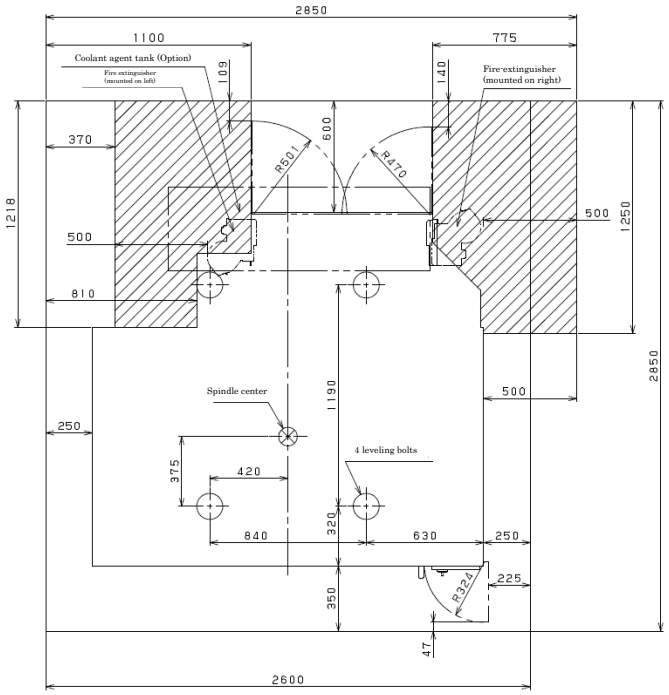
■ Automatic fire-extinguisher for general fires



ROBODRILL α-D14/21S*i*A5

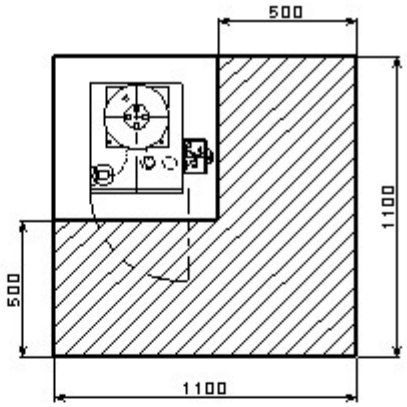


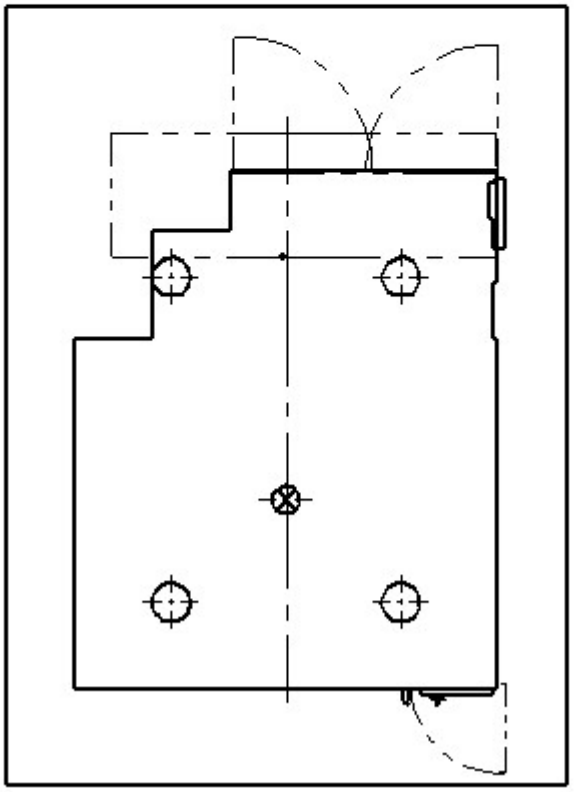
ROBODRILL α-D14/21M*i*A5



ROBODRILL α-D14/21L*i*A5

■ Automatic fire-extinguisher for flammable-metal fire





Common to all models

32 HIGH–SPEED SPINDLE HOLDER INTERFACE

⚠ WARNING

1 Register the number of the tool to be mounted in the parameter and confirm that the parameter setting matches the place in which the high-speed spindle holder is mounted. If the parameter setting differs from the place, safety measures during operation or work by the ROBODRILL become insufficient and injury may occur. For the parameters to be set, see Subsection 32.2.9.

2 To operate the machine with the front door (safety door) of the ROBODRILL left open, make sure that the high-speed spindle motor does not rotate. If the front door is opened with the high-speed spindle motor rotating, injury may occur. Be sure to use the high-speed spindle control amplifier from NAKANISHI Inc. (for the FANUC ROBODRILL). Otherwise, safety is not ensured.

32.1 OVERVIEW

The high-speed spindle specifications are intended to allow you to attach a tooling with a built-in high-speed motor to the spindle of the ROBODRILL, thereby performing high-speed machining of mold and other parts with a holder-type spindle unit capable of small-diameter end milling in which a high speed of 20,000 $min.^{-1}$ or more is required.

32.2 CANNED CYCLES

⚠ WARNING

A high-speed spindle to be installed in the ROBODRILL must satisfy the following specifications. Otherwise, injury may occur because safety apparatus such as an interlock is not installed in this case.

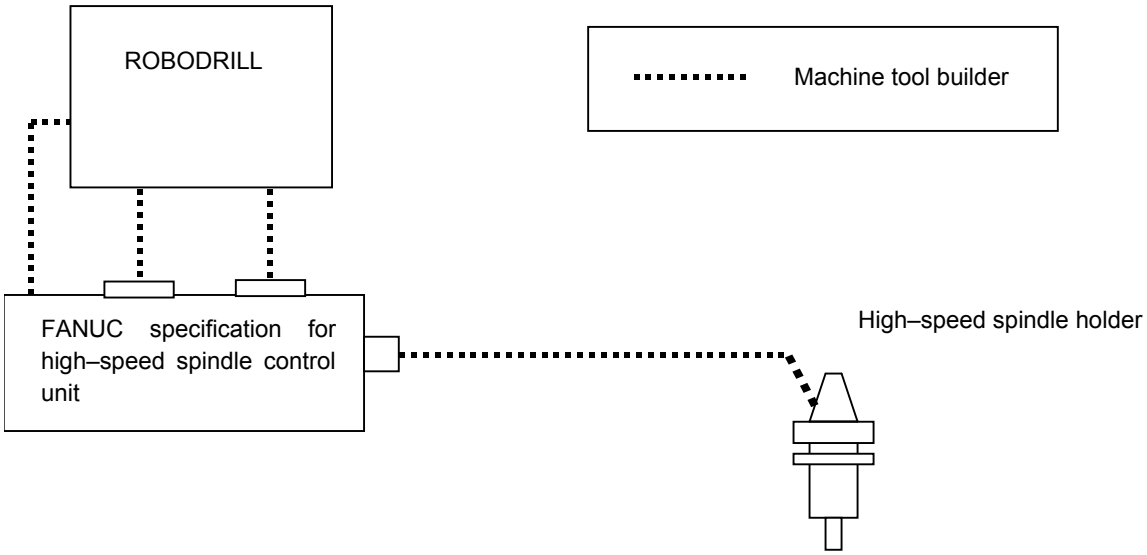
1 Prepare a circuit that shuts down the power between the motor and control unit when the door of the machine is opened.

2 Use a high–speed spindle having a speed detector.

32.2.1 Configuration

On the ROBODRILL side, prepare I/Os for high–speed spindles and an interlock ladder.
The High–speed spindle motor, control unit, and cables must be prepared by the machine tool builder.

Product name:	ASTRO–E500FA manufactured by NAKANISHI INC.
Model number:	NE150–10 (100/200 V a.c.)
	NE150–23 (115/230 V a.c.)
Specification:	ASTRO–E basic unit + 50000 $min.^{-1}$ max. + AT–2 option + safety circuit

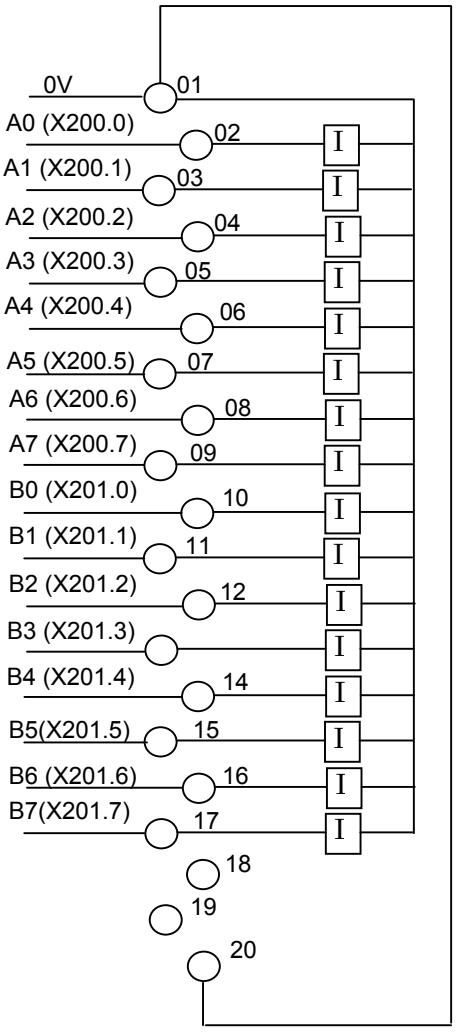


32.2.2 Interface

As the interface between the high–speed spindle control unit and ROBODRILL, I/O Unit–MODEL A is used.

(1) Input module (AID16D): A03B–0826–J104 (current flow–in type)
(2) Output module (AOD16D): A03B–0826–J154 (current flow–out type)
(3) Analog output module (ADA02A): A03B–0826–J052

(1) Input module (AID16D)

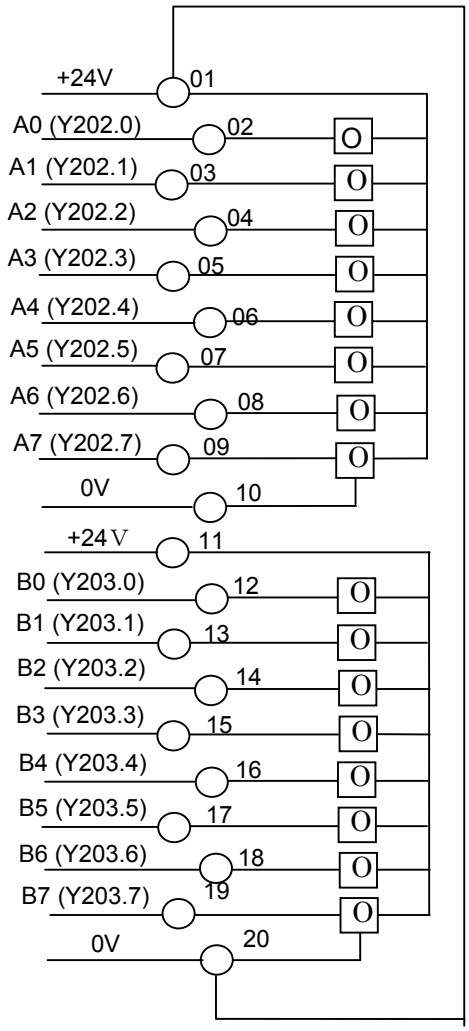


(AID16D)

Addresses

	Slot 1
A0	X 200.0
A1	X 200.1
A2	X 200.2
A3	X 200.3
A4	X 200.4
A5	X 200.5
A6	X 200.6
A7	X 200.7
B0	X 201.0
B1	X 201.1
B2	X 201.2
B3	X 201.3
B4	X 201.4
B5	X 201.5
B6	X 201.6
B7	X 201.7

(2) Output module (AOD16D)



(AOD16D)

Addresses

	Slot 4
A0	Y 202.0
A1	Y 202.1
A2	Y 202.2
A3	Y 202.3
A4	Y 202.4
A5	Y 202.5
A6	Y 202.6
A7	Y 202.7
B0	Y 203.0
B1	Y 203.1
B2	Y 203.2
B3	Y 203.3
B4	Y 203.4
B5	Y 203.5
B6	Y 203.6
B7	Y 203.7

(3) 12–bit analog output module (ADA02A)

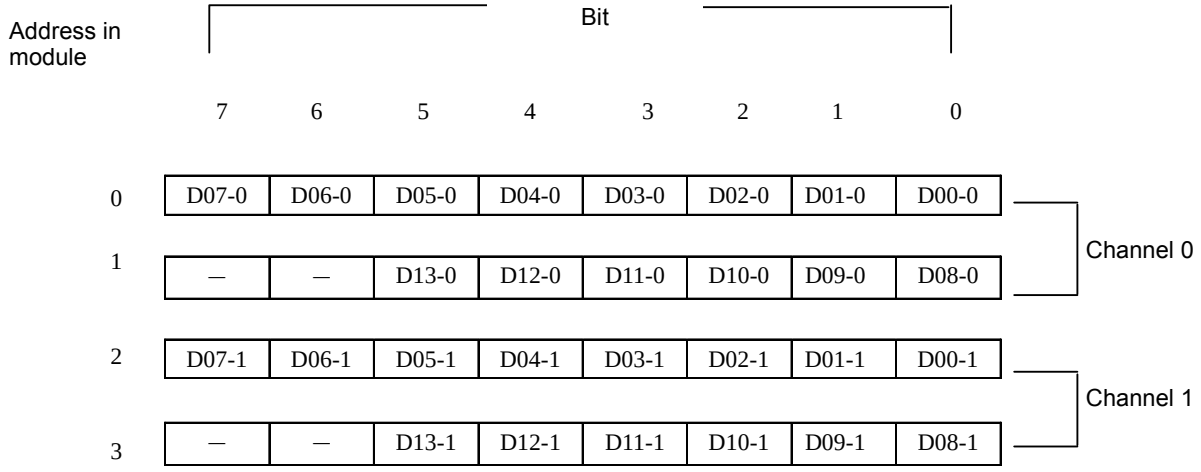
Specifications

Item	Specification
Number of output channels	2 channels/module
Digital input	12–bit binary number (2's complement)
Analog output	- Voltage output –10 V d.c. to +10 V d.c. (external load resistance: 10 kΩ or more) - Current output 0 mA to +20 mA DC (external load resistance: 400 Ω or less) Caution: Whether to use voltage output or current output is selectable.
I/O correspondence	(see table below)
Resolution	Voltage output : 5 mV Current output : 20 μA
Total accuracy	Voltage output : ±0.5% (to full–scale) Current output : ±1% (to full–scale)
Conversion time	1 ms or less Note) The conversion time refers to the time required for conversion just within the module. The actual response time is the conversion time plus the scan time determined depending on the system.
Insulation	Photocoupler insulation (between output signals and base) Insulation is not provided between output channels.
External connection	Detachable terminal block (20 terminals, M3.5 screw terminals)
Number of occupied outputs	32 outputs

Digital input	Analog output	
	Voltage output	Current output
+2000	+10V	+20mA
+1000	+5V	+10mA
0	0	0
-1000	-5V	-
-2000	-10V	-

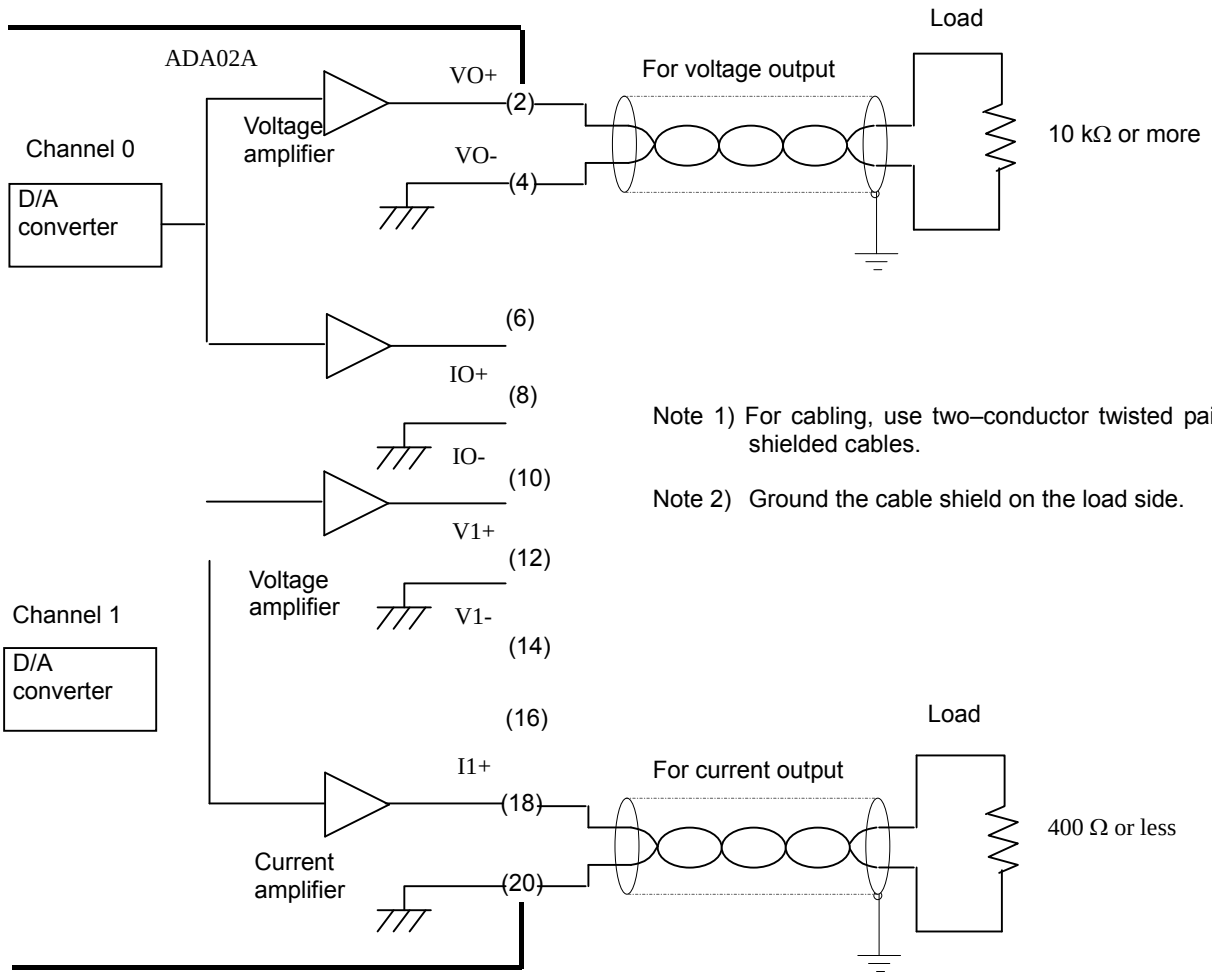
Correspondence between output signals and addresses in the module

By writing a 12–bit digital value at the following address of analog output module ADA02A, a desired voltage or current is output to corresponding analog output.



D00–n (n is 0 or 1) corresponds to a weight of 2^0, and D13–n corresponds to a weight of 2^{13}. D13–n, however, corresponds to the sign bit of a 2's complement representation.

Connecting the analog output module to loads

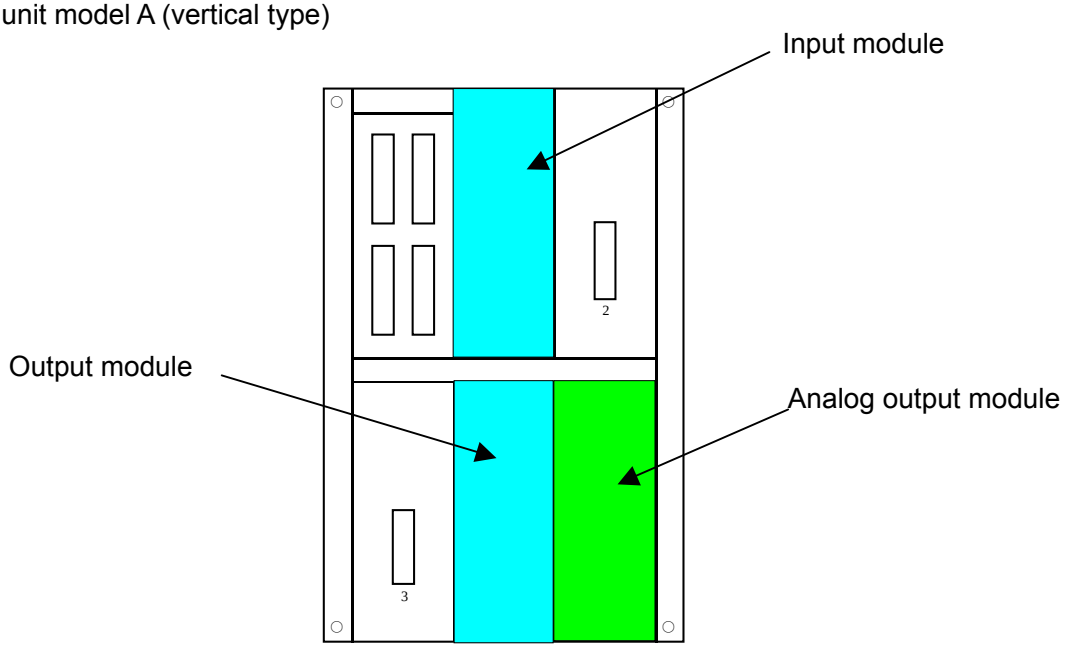


Note 1) For cabling, use two–conductor twisted pair shielded cables.

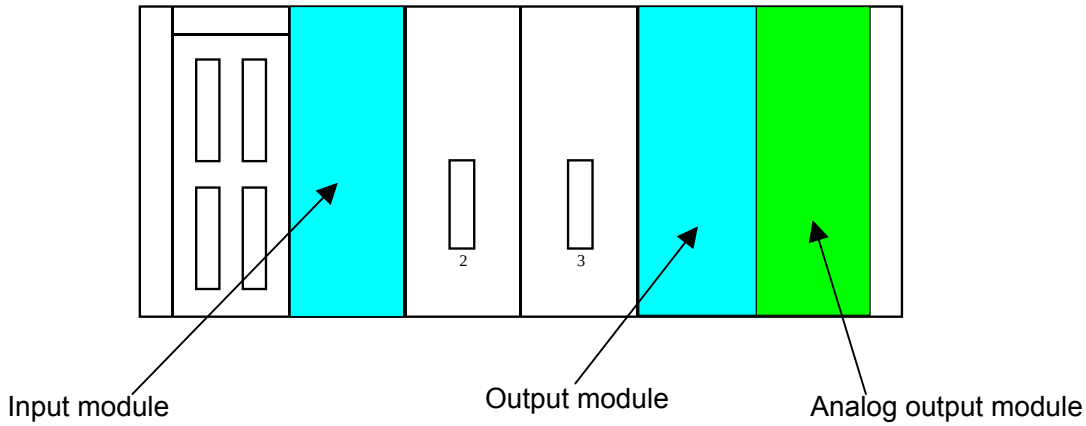
Note 2) Ground the cable shield on the load side.

32.2.3 Installation Locations

I/O unit model A (vertical type)



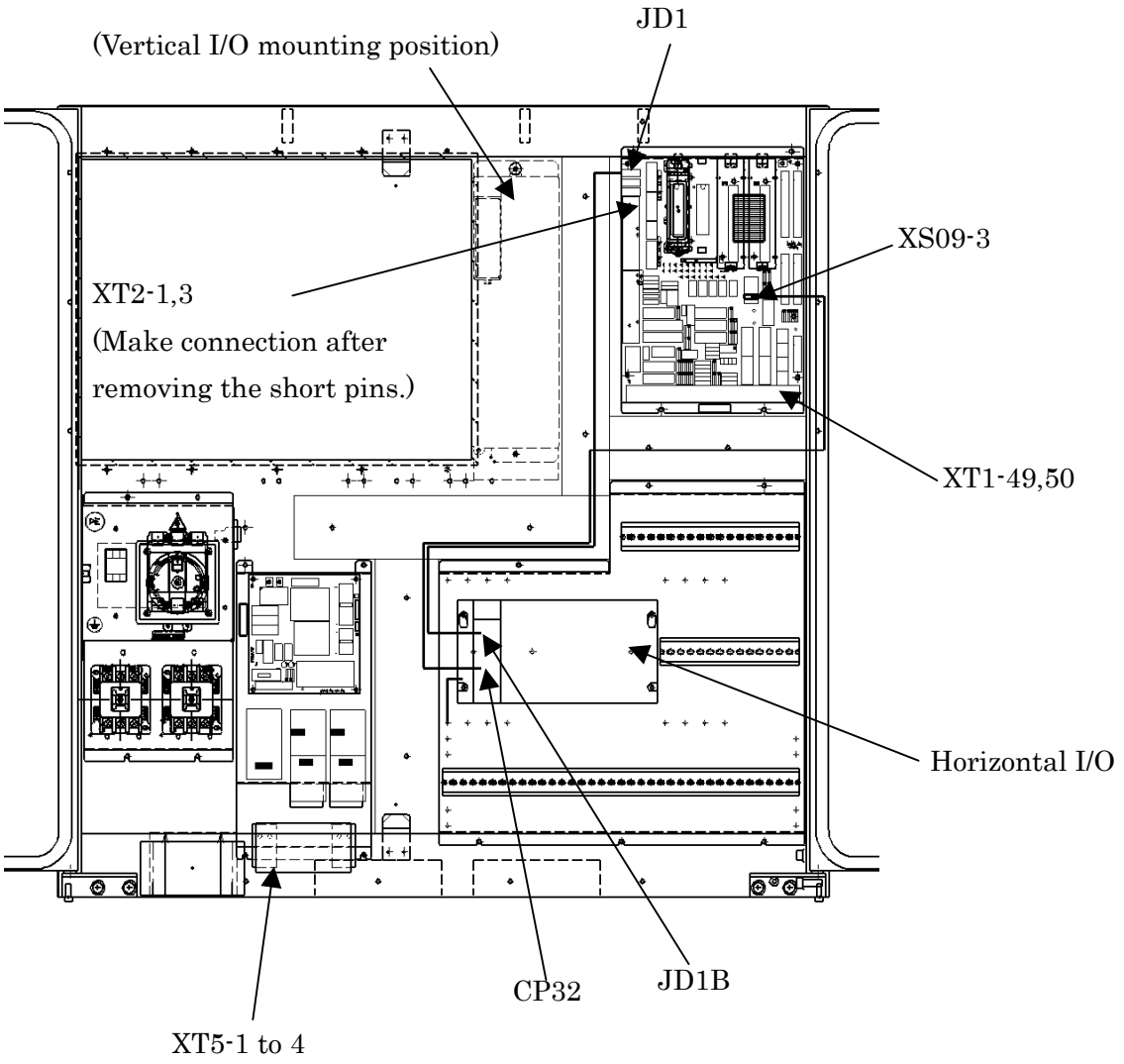
I/O unit model A (horizontal type)



Power connection destination of the ASTRO–E500FA manufactured by NAKANISHI INC.

- Although NAKANISHI's amplifier can operate on AC100 V and AC200V, set **200V a.c.** for the ROBODRILL.
- The power lines must be connected to [XT5–1](U21), [XT5–2](V21), and [XT5–4] (G) of the power panel unit terminal block of the ROBODRILL.
- Connect the DC24V power cable to **49(0V) and 50(+24E) of terminal block XT1 on the wiring PCB** of the ROBODRILL.
- Connect the cables labeled XT3-19 and XT3-20 to **1 and 3(Y6.2a) of terminal block XT2 on the wiring PCB.** Remove the short pins attached to the corresponding positions.

The unit mounting positions and connection points are shown below.



32.2.4 Operation Sequence

(1) When the door is opened, the following steps take place to ensure safety of the operator:
[When the door of the machine is opened]
   (a) The ROBODRILL accepts a door open button input or door open command. (ROBODRILL)
   (b) The high–speed spindle rotation command is turned off. (ROBODRILL)
   (c) The high–speed spindle stops rotating. (High–speed spindle)
   (d) The stop of rotation is detected, then the rotation signal output to the ROBODRILL is turned off. (High–speed spindle)
   (e) After the off state of the rotation signal is confirmed, the power connection signal between the high–speed spindle motor and control unit is turned off. (ROBODRILL)
   (f) The power connection signal turns off the safety relay. (High–speed spindle)
   (g) As the safety relay is turned off, the door lock of the ROBODRILL is released. (ROBODRILL)

(2) To attach the high–speed spindle holder to the spindle or detach the holder from the spindle, follow the steps below.
- Cabling type
   (a) Attach the high–speed spindle holder in the turret.
   (b) Specify a normal tool change to attach the high–speed spindle holder to the spindle.
   (c) Specify an orientation.
   (d) Open the front door, and connect the cable to the high–speed spindle holder.
   (e) Open the front door, and detach the cable from the high–speed spindle holder.
   (f) Issue a tool change command to detach the high–speed spindle holder from the spindle.
- ATC type
   (a) Attach the high–speed spindle holder to the turret so that the connection section is located on the front side.
   (b) By executing a macro program, a tool change is performed, the high–speed spindle holder is attached to the spindle, orientation is performed at that position, and positioning to a connectable position is performed.
   (c) The drill ladder outputs an automatic attachment/detachment connection request, and the high–speed spindle holder and the tool changer are connected by the sequencer for the tool changer.
   (d) When the macro program is executed with the high–speed spindle holder and tool changer connected, a command specifying the same tool number is skipped. When a different tool number is specified, the drill ladder outputs an automatic attachment/detachment disconnection request, and the sequencer for the tool changer detaches the high–speed spindle holder from the tool changer.

32.2.5 Address List

Address	7	6	5	4	3	2	1	0
X200	External command mode	Automatic install/ Uninstall unit is abnormal	Automatic install/ uninstall unit is completely connected	Automatic install/ uninstall unit is completely disconnected	Control unit alarm	Safety relay monitor	Motor's cable is connecting	Spindle is rotating
X201	Manual stop command	Manual countercloc-kwise rotating command	Manual clockwise rotating command	High–speed spindle holder detection		Override 2 to 2	Override 2 to 1	Override 2 to 0
X202								
X203								
Y200								
Y201								
Y202				Request to disconnect automatic install/ uninstall unit	Request to connect automatic install/ uninstall nit	Power connection	Spindle rotating command (counter-clockwise)	Spindle rotating command (clockwise)
Y203								
Y204	Speed rotation speed command 2 to 7	Speed rotation speed command 2 to 6	Speed rotation speed command 2 to 5	Speed rotation speed command 2 to 4	Speed rotation speed command 2 to 3	Speed rotation speed command 2 to2	Speed rotation speed command 2 to 1	Speed rotation speed command 2 to 0
Y205					Speed rotation speed command 2 to 11	Speed rotation speed command 2 to 10	Speed rotation speed command 2 to 9	Speed rotation speed command 2 to 8
Y206								
Y207								

32.2.6 Details of Signals

[Spindle is rotating: X200.0] (high–speed spindle → ROBODRILL)

This signal is on while the high–speed spindle is rotating.

[Motor's cable is connecting: X200.1] (high–speed spindle → ROBODRILL)

This signal is on when the motor cable is connected to the high–speed spindle.

When this signal is on, the tool change, spindle rotation, and spindle orientation operations of the ROBODRILL are inhibited.

[Safety relay monitor: X200.2] (high–speed spindle → ROBODRILL)

This signal is off when the power connection safety relay is on (Y202.2 = ON).

This signal is for detection of a failure in the power connection safety relay.

[Control unit alarm: X200.3] (high–speed spindle → ROBODRILL)

This signal goes on when an alarm is issued in the high–speed spindle control unit. The ROBODRILL is stopped by alarm.

[Automatic install/uninstall unit is completely disconnected: X200.4]
(high–speed spindle → ROBODRILL)

This signal is on when the automatic attachment/detachment unit of the high–speed spindle is connected.

When this signal is on, the tool change, spindle rotation, and spindle orientation operations of the ROBODRILL are inhibited.

[Automatic install/uninstall unit is completely connected: X200.5] (high–speed spindle → ROBODRILL)

This signal is on when the automatic attachment/detachment unit of the high–speed spindle is disconnected.

When this signal is off, the tool change, spindle rotation, and spindle orientation operations of the ROBODRILL are inhibited.

[Automatic install/uninstall unit is abnormal: X200.6] (high–speed spindle → ROBODRILL)

This signal goes on when an alarm is issued in the automatic attachment/detachment unit of the high–speed spindle. The ROBODRILL is stopped by alarm.

[External command mode: X200.7] (high–speed spindle → ROBODRILL)

This signal is on when the operation mode of the automatic attachment/detachment unit controller is EXT (accepting a command from the ROBODRILL).

When this signal is on, the ROBODRILL can specify automatic attachment/detachment of the high–speed spindle.

[Override: X201.0–X201.2] (high–speed spindle → ROBODRILL)

These signals are turned on and off according to the step set with the special rotary switch provided for specifying an override for the high–speed spindle.

The high–speed spindle override (step) is specified with binary data.

The high–speed spindle rotates at a speed obtained by (specified C (speed) value × override value/100).

Step	Override
0	0%
1	30%
2	50%
3	80%
4	100%
5	120%
6	150%
7	200%

[High–speed spindle holder detection: X201.4] (high–speed spindle → ROBODRILL)

This signal posts the status of the high–speed spindle holder detection switch installed in the automatic attachment/ detachment unit.

With this signal, whether the holder attached to the ROBODRILL spindle is for the high–speed spindle is checked.

When the high–speed spindle holder is detected, this signal goes off.

[Manual clockwise rotating command: X201.5, X201.6, X201.7] (high–speed spindle → ROBODRILL)

When a manual operation switch specially provided for the high–speed spindle is pressed, the signal corresponding to the switch is turned on.

The high–speed spindle then rotates in the forward or reverse direction or stops.

These signals function only when the operation mode of the ROBODRILL is the manual mode.

[Spindle rotating command (counterclockwise): Y202.0] (high–speed spindle → ROBODRILL)

This signal goes on when M code M13 or M14 is specified. The signal goes on when manual forward rotation or reverse rotation is specified.

The high–speed spindle rotates in the forward or reverse direction.

The signal is turned off when M15 is specified, when the door lock of the ROBODRILL is released,

when the emergency stop state is entered, when the ROBODRILL spindle rotation is specified, when tool change is specified, when M00, M01, M02, or M30 is specified, and so on.
When an operation is resumed after the operation is interrupted (for example, when the door lock is released during machining), this signal goes on automatically.

[Spindle rotation command (clockwise): Y202.1] (high–speed spindle → ROBODRILL)
When M code M14 or manual reverse rotation is specified, this signal goes on together with the rotation command (Y202.0). (When M13 is specified, this signal does not go on.)
The signal switches the direction of high–speed spindle rotation between forward and reverse directions.

[Power connection: Y202.2] (high–speed spindle → ROBODRILL)
This signal goes on when the door of the ROBODRILL is locked.
When an operation to release the door lock of the ROBODRILL is performed, this signal goes off after the high–speed spindle stops rotating.
When the door lock of the ROBODRILL is released, the power to the high–speed spindle is shut down.

[Request to connect automatic install/uninstall unit: Y202.3] (high–speed spindle → ROBODRILL)
This signal goes on when M code M78 is specified.
The motor cable of the high–speed spindle is connected.

[Request to disconnection automatic install/uninstall unit: Y202.4] (high–speed spindle → ROBODRILL)
This signal goes on when M code M79 is specified while the high–speed spindle is stopped.
The motor cable of the high–speed spindle is disconnected.

[Spindle rotation speed command: Y204.0–Y205.3] (high–speed spindle → ROBODRILL)
Based on the high–speed spindle speed command C and the data specified as an override, a value converted as data for the analog output module is set in binary data form.
Speed command = 2000 × (specified data)/maximum speed of the high–speed spindle
(Example: When M13 C10000 is specified, the maximum speed is 50000 rpm, and an override is 100%)
Speed command = 2000×10000/50000 = 400
Y204 : 10010000
Y205 : 00000001

32.2.7 Command Lists

Function	Command	Command format and remark
High–speed spindle clockwise rotation	M13	M13 C50000 ; (M13 may be specified alone.)
High–speed spindle counterclockwise rotation	M14	M14 C50000 ; (M14 may be specified alone.)
High–speed spindle stop	M15	M15 ; When this command and an axis movement are specified together in the same block, the high–speed spindle stops after the axis movement command is completed.
Rotation speed command	C***	M13 C50000 ; (C may be specified alone.) Neither a decimal point nor a negative value can be specified. A value consisting of up to five digits can be specified.
Connect automatic install/uninstall unit	M78	M78 ;
Disconnect automatic install/uninstall unit	M79	M79 ; When this command is specified while the high–speed spindle is rotating, the high–speed spindle stops rotating.
High–speed spindle holder detection mode ON	M66	M66 ;
High–speed spindle holder detection mode OFF	M67	M67 ;

32.2.8 Alarms and Messages

[Alarms]

No.	Description
EX1053	SPINDLE ROTATION IS PROHIBITED. When the high–speed spindle holder is attached to the ROBODRILL spindle, a ROBODRILL spindle rotation is specified. (When the motor cable of the high–speed spindle is not connected) In the following cases, the holder on the ROBODRILL spindle is regarded as the holder for the high–speed spindle: - The current tool number equals the magazine number for which spindle rotation is prohibited by the spindle speed limitation function on QUICK screen – “6: MAINTENANCE/SETTING” screen. - The tool change macro program for the high–speed spindle determines the holder of the ROBODRILL spindle to be the high–speed spindle holder. - After power–up, the tool change macro program for the high–speed spindle has not been executed even once. - A tool change is made without using the tool change macro program for the high–speed spindle (by specifying an M06 command directly, by pressing the tool change button on the operator's panel, and so on).
EX1056	SPECIAL TOOL IS MOUNTING. When the motor cable of the high–speed spindle is connected, an operation such as a ROBODRILL spindle rotation and tool change is specified. Such operations are inhibited when the motor cable is connected.
EX1057	HIGH–SPEED SP. RELAY IS DEFECT A safety relay in the safety relay box of the high–speed spindle control unit is defective. Check the safety relay, cable connection, and so on
EX1058	CONTROL UNIT ALARM (HIGH–SPEED SP.) An alarm is issued in the high–speed spindle control unit. For details, refer to the operator's manual on the control unit.
EX1059	AUTO CONNECT ALM (HIGH–SPEED SP.) An alarm is issued in the motor cable attachment/detachment unit for the high–speed spindle. Alternatively, a proximity switch for high–speed spindle holder detection is disconnected. For details, refer to the operator's manual supplied by the machine tool builder.
EX1060	CABLE CON. ERROR (HIGH–SPEED SP.) The motor cable was disconnected while the high–speed spindle was rotating. Alternatively, a high–speed spindle rotation is specified when the motor cable is disconnected. Check the motor cable.

[Operator messages]

No.	Description
2026	SWITCH TO EXT MODE ON CONTROLLER. Although the operation mode of the automatic attachment/detachment unit controller is not EXT, M78 or M79 is specified. The ROBODRILL enters the hold stop state. Change the operation mode to EXT, and restart the ROBODRILL operation.

32.2.9 Parameters

[NC parameters]

No.		Setting
3033	Allowable number of digits of specified high–speed spindle speed (5 digits)	5

No.		Setting
3460	High–speed spindle speed command code (C)	67

No.		Setting
4060	Position gain at orientation (High)	300

[PMC parameters]

No.	#7	#6	#5	#4	#3	#2	#1	#0
K22						*	*	1

K22#0 0: The high–speed spindle control function is disabled.
1: The high–speed spindle control function is enabled.

K22#1 0: The high–speed spindle motor cable is of the cabling type.
1: The high–speed spindle motor cable is of the automatic attachment/detachment type

※ Set a value according to the type used.

K22#2 0: The high–speed spindle override function is disabled.
1: The high–speed spindle override function is enabled.

※ Set a value according to the specification.

No.		Setting
D176	maximum speed of the high–speed spindle (*2)	*
D184	Custom macro variable number for storing the tool number currently selected	994
D678	Override value of high–speed spindle override step 0 (0%)	0
D679	Override value of high–speed spindle override step 1 (30%)	30
D680	Override value of high–speed spindle override step 2 (50%)	50
D681	Override value of high–speed spindle override step 3 (80%)	80
D682	Override value of high–speed spindle override step 4 (100%)	100
D683	Override value of high–speed spindle override step 5 (120%)	120
D684	Override value of high–speed spindle override step 6 (150%)	-106
D685	Override value of high–speed spindle override step 7 (200%)	- 55

SUPPLEMENT

*1 To set the data table,
D176: Set TYPE to 2 on the PMC DATA TABLE CONTROL screen.
D679 to D685: Set TYPE to 0 on the PMC DATA TABLE CONTROL screen.
Others: Set TYPE to 1 on the PMC DATA TABLE CONTROL screen.
After that, press the [(OPRT)] soft key, then the [ZOOM] key.

*2 Set a value according to the high–speed spindle used. (When the maximum speed is 50000 rpm, set D176 = 50000.)

32.3 MACRO PROGRAM

Tool change macro program for the high–speed spindle

```
%
O9000(HISP-TOOL-CHANGE 030515)
#150=#4003                    Check modal G (G91/G90)
#151=#4109                    Check modal F
#152=#4119                    Check modal S
#100=#20                      Read next tool number
#101=#1015                    Current special tool attachment status
#102=#1014                    Current special tool connection status
#103=#994                     Current tool number
#104=#19                      Orientation angle
#105=#993                     Specify tool change Z position
IF[#4120EQ0]THEN#103=#990     Because current T code is blank at power–on time (for supporting current
                              software)
IF[#19EQ#0]THEN#104=180.0     To be used when rotation position becomes stable in future (S code
                              omitted)
G80G40M09
G91G28Z0M15
G90G00G53X#991Y#992G49        Specify tool change position (X, Y)
IF[#102EQ1]GOTO200            Connection status: if connected, go to N200
IF[#101EQ1]GOTO200            Attachment status: if attached, go to N200
IF[#100EQ#103]GOTO350         If tool number is same, make skip (completion)
GOTO300                       Otherwise, normal tool change
N200(UN-CLAMP)                <Special tool disconnection processing>
IF[#102EQ0]GOTO250            If special tool is used, and connection is not made, go to 259 (at power–on)
IF[#100EQ#103]GOTO900         If tool number is same, make skip (completion)
G90G00G53Z#105                Move to tool change position (Z)
M79                           Unclamping
G04P200
M19
G04P200
GOTO300
N250                          <If special tool is used, and connection is not made. Mainly at power–on>
G90G00G53Z#105                Move to tool change position (Z)
M19                           When changing another tool
G04P200
N300                          <Perform tool change>
M05
G04P200
G49M06T#100
N350
M66                           <Start of special tool detection mode>
G90G00G53Z#105                Move to tool change position (Z)
M19S#995                      Rotate at high–speed spindle holder detection angle
G04X1.
M67                           <End of special tool detection mode>
```

```
N400(CLAMP)                    <Special tool connection processing>
#101=#1015
IF[#101EQ0]GOTO900             For other than special tool, go to N900
G90G00G53Z#105                 Move to tool change position (Z)
M19S#104                       Rotate to connection position
G04P200
M78                            Perform connection
G04P200
G90G00G53Z0                    Move to machine zero point (Z)
#102=#1014
IF[#102EQ1]GOTO910             Check connection completion
#3000=50(HSP-CONNECT.ERROR)        Alarm
N900
IF[#102EQ1]GOTO910             For special tool, go to last processing
M05                            For general tool, set orientation to off.
N910                           <Last processing>
G90G00G53Z0                    Move to machine zero point (Z)
#990=#994                      Tool number backup
G#150F#151S#152                #990=turret number backup
M99                            #991=Specify tool change position (X).

%                              Blank indicates current position, and zero indicates machine zero point.
                               #992=Specify tool change position (Y).
                                  Blank indicates current position, and zero indicates machine zero point.
                               #993=Specify tool change position (Z)
                                  Blank and zero indicate machine zero point.
```

When custom macro settings are made again on the 3. PARAMETER screen of 6: MAINTENANCE/SETTING of the QUICK screen, the tool change macro program for the high–speed spindle is stored in memory.
(Before performing the above operation, set PMC parameter keep relay K22#0 = 1.)

Tool change command (main)

G65P9000T** ** : Tool number
For every tool, use the above command to perform tool change.

[Macro variable]

#994: Tool number
The tool number (T code) currently selected is stored.

#995: Spindle indexing angle command
An indexing angle of the spindle is set so that whether a high–speed spindle is attached to the ROBODRILL spindle can be checked by a sensor.

#1014: High–speed spindle connection status
When the high–speed spindle motor cable is connected, 1 is set.

#1015: High–speed spindle attached
When a high–speed spindle is attached to the ROBODRILL spindle (the tool number for which spindle rotation is prohibited by the spindle speed limitation function and the current tool number match), 1 is set.

32.4 SUPPLEMENTARIES AND RESTRICTIONS

(1) Spindle orientation
When the high–speed spindle holder is attached to the ROBODRILL spindle, the orientation mode is maintained.
Normally in the ROBODRILL, pressing the reset key or specifying an M code to end machining (M02 or M30) cancels the spindle orientation mode. When the high–speed spindle holder is attached, however, such operations do not cancel the spindle orientation.
When the ROBODRILL is in the emergency stop state, the orientation mode of the spindle is canceled temporarily. When the emergency stop state is released, the spindle enters the orientation mode again.
The spindle orientation mode is canceled by specifying M code M05.
The spindle orientation mode is also canceled by turning off the power to the ROBODRILL.

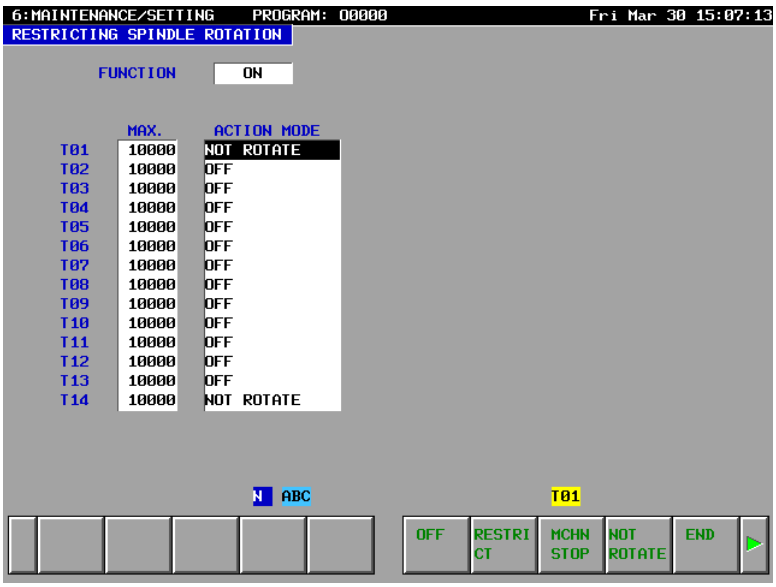
(2) Custom PMC function
The following signals are unavailable:
R1363.6 (SO13_6): Custom macro output signal (#1014)
R1363.7 (SO13_7): Custom macro output signal (#1015)

(3) Automatic attachment/detachment tool change function
(a) When the setting of the high–speed spindle holder for automatic attachment/detachment (K22#1) is made valid, all tool change commands must be issued from the macro program. Tool change for tools other than the high–speed spindle holders must also be specified using the macro program. When a tool change is specified by a manual operation, menu–driven operation, or M06 command (an ordinary tool change command), rotation of the ROBODRILL spindle cannot be specified.
(b) Be sure to install two sensors having a normally closed contact in the tool changer so that these sensors can simultaneously detect the type of the holder attached to the spindle, which is the high–speed spindle holder or ordinary holder.

(4) Setting for the tool mass
If you want to use this function, set TOOL WEIGHT to 3 kg on QUICK screen - 5: MACHINE OPERATION SET screen.

(5) Setting for spindle rotation prohibition
When a high-speed spindle is attached, set spindle rotation prohibition with the spindle speed limitation function on QUICK screen – "6: MAINTENANCE/SETTING" screen.

Example) When a high-speed spindle is attached to T1 and T14



Set RESTRICTING SPINDLE ROTATION to ON.
In the item of ACTION MODE for T01 and T14, set NOT ROTATE.

(6) Making automatic tool length measurements (option)
Making automatic tool length measurements on the high-speed spindle requires changing the tool length measurement macro program. See Section 23.9, “MEASURING A TOOL FOR WHICH SPINDLE ROTATION PROHIBITION IS SET” in Part IV for detailed descriptions.

(7) Others
(a) When a motor cable is connected to the high-speed spindle holder, tool change, spindle rotation, and orientation operations are disabled.

32.5 FANUC ORDERING INFORMATION

To use a high–speed spindle holder, order the following:

(1) I/O unit model A (horizontal type): A04B-0102-J215#HOR
(2) Input module [current flow–in type]
(AID16D): A03B–0826–J104
(3) Output module [current flow–out type]
(AOD16D): A03B–0826–J154
(4) Analog output module (ADA02A): A03B–0826–J052
(5) Mounting plate for options: A04B–0094-J224

32.6 MANUFACTURER MODEL NUMBERS OF OPERATION–PROVEN PRODUCTS

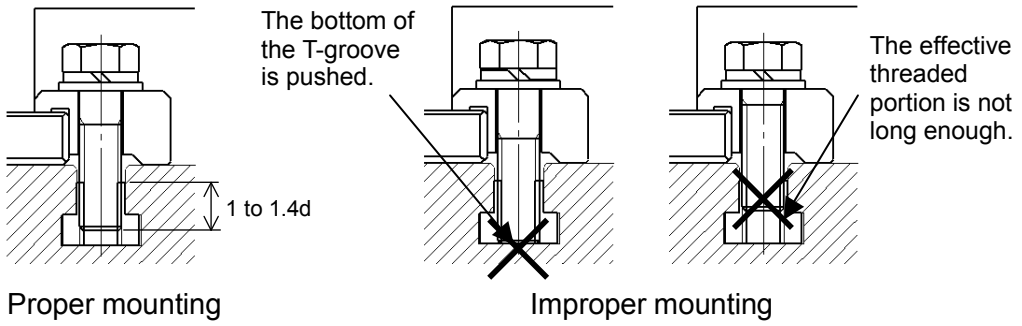
(1) YUKIWA SEIKO INC.
High–speed spindle holder
(a) BT30–HSA50–F01 (BT30)
(b) TQH4640–HSA50–F01 (1/10 taper)
Control amplifier
YJU–F1

(2) RICHMILL MANUFACTURE CO., LTD.
BTL30–ESP6

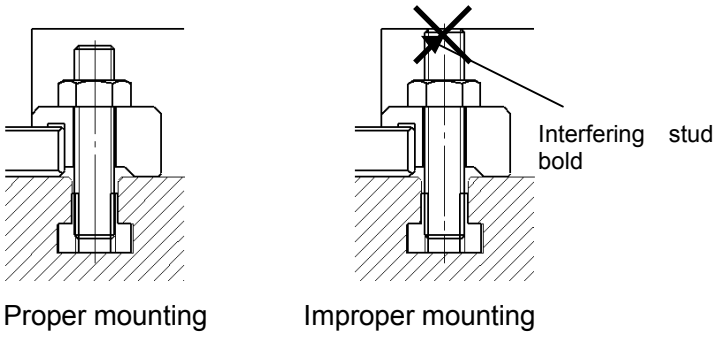
33 DDR (OPTION)

33.1 NOTES

(1) Before starting to use the DDR, correctly install it on the ROBODRILL table. Placing it outside the machine may invite a casualty.
(2) Be very careful not to have your hands, feet, or body pinched or caught in rotating or moving parts.
(3) Do not make alterations without careful consideration.
(4) Before staring dismounting the DDR, detaching or attaching its cables, inspecting, or maintaining it, place the circuit breaker of the ROBODRILL main unit to the OFF position, and indicate that you are working on it.
(5) Do not step on a terminal box or cover, or you may fall down, or the box or cover may get deformed, leading to poor sealing, which will let cutting fluid getting in the machine; hence a trouble or electric leakage.
(6) When moving the DDR from one place to another, use a crane to lift it. Always assure safety. Use an eye bolt when lifting it, and make sure that the eye bolt is screwed fully into it.
(7) Use an appropriate tool to tighten bolts securely. Unless a bolt is tightened properly, the cutting tool may get broken, and the workpiece may come off and fly away.
(8) Avoid using any mounting fixture (option) not appended to the machine. If you do not use a mounting fixture appended to the machine, make sure that the mounting fixture is not set in the improper mounting states indicated below. Otherwise, the cutting tool may get break, and the workpiece may come off and fly away.
   (a) Select a mounting fixture bolt whose threaded portion for catching the T-slot nut's threaded portion is not shorter than the nominal diameter of the bolt and which does not push the bottom of the T-groove.



   (b) When using a stud bolt, install it so that it will not interfere with the chuck or workpiece.

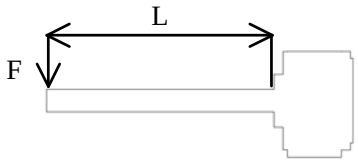


   (c) Fix the DDR to the table of the ROBODRILL at four points securely. Keep its bottom from protruding from the table.

(9) Allow the cables and air hose to sag so that they will not be damaged when the machine works. A broken cable may lead to an electric leakage or short-circuit, which will result in a shock hazard or malfunction. A damaged air hose may lead to an air purge or a clamp mechanism malfunction.
(10) Basically, adjust the air pressure setting to 0.5 MPa. When a pressure different from this value must be set, set a pressure within a range from 0.35 to 0.5 MPa.
(11) Do not place any stuff in a place where it may be caught with a rotating or cutting part. Bumping something against the machine may break it or let the workpiece or cutting tool to come off and fly away, which is very dangerous.
(12) When using the machine for the first time, check for interference by running it at a sufficiently low rotation speed so that you can stop it whenever necessary.
(13) Before starting automatic operation, check the NC program. Check, in particular, for:
  (a) Interference with the workpiece, chuck pawls, or mounting fixture
  (b) Bumping during ATC operation
  (c) Interference with the tool route
  Bumping something against the machine may lead to damage to the machine or let the workpiece or jig come off and fly away.
(14) Do not cut if the jig or workpiece is loose. If cutting is carried out when the retaining force of the jig or chuck is weak, the cutting tool may get broken and the workpiece or jig may come off and fly away, which is very dangerous.
(15) If noise occurs during operation, stop the machine, and make sure that:
  (a) The retaining force of the jig and chuck is sufficient.
  (b) The cutting force is not too strong.
  (c) The main body is mounted properly.
  If cutting is continued when noise is occurring, the cutting tool may get broken, and the workpiece may come off and fly away, which is very dangerous.
(16) HNBR is used for oil sealing, and NBR is used for packing and cord locking. Do not use any cutting fluid that may corrode HNBR or NBR.
(17) Do not process a workpiece that is heavier than the maximum loading capacity; keep the load as light as possible.
(18) When machining a workpiece with a long overhang, support its end not being machined with the tailstock or the support spindle. Otherwise, the workpiece end being machined will sag because of the weight of the workpiece and the cutting load, resulting in the machining precision getting lower.
(19) When using the cradle-shaped jig, tailstock, or support spindle, complete its alignment with the main unit. Too large a misalignment may damage the mechanism.
(20) If the customer gets a unit, such as a rotary joint, ready by himself or herself, the following must be observed.
  (a) The unit meets the specification of the DDR.
  (b) The customer provides the operator’s manual, maintenance manual, and maintenance drawings for the unit and attaches them to the ROBODRILL.
  (FANUC will not maintain any unit prepared by the customer.)
(21) An air purge pressure of 6 kPa or so is always applied to the clamp and unclamp branches in order to prevent foreign matter from getting into the tubes even when there is no air output. When using the clamp/unclamp branch air to run a support spindle produced by a manufacturer other than FANUC, the support spindle should be a double-acting type. To use a single-acting type rather than a double-acting type out of necessity, install a quick release valve unit (ordering information: A04B-0099-J095#STD) manufactured by FANUC, add the same time to the initial values for the timers T140 and T168 (see Subsection 33.11.5) in such a way that the support spindle will start rotating after its brake is released.
(22) The DDR clamp torque is 70 N·m with the air pressure and electric power shut off. If the weight moment caused by a jig exceeds 70 N·m, therefore, it is likely that the DDR axis may rotate with the air pressure and electric power shut off. Be very careful not to have your finger or other things caught in any rotating section.

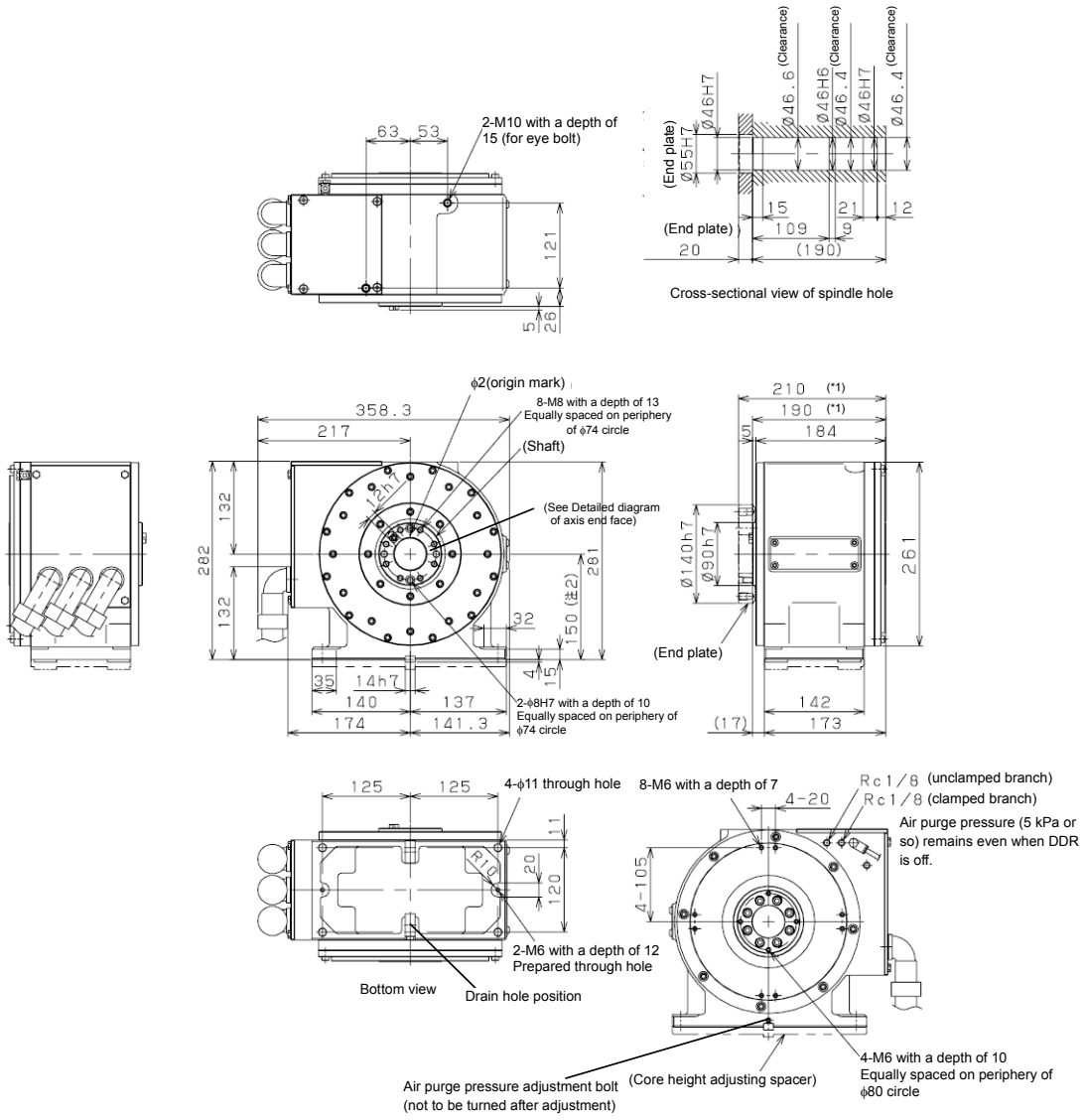
33.2 SPECIFICATION

The following table summarizes the specification of the ROBODRILL DDR.

Drive method	Direct drive
Motor	Synchronous built-in servomotor D*i*S 260/300 Maximum output of 2.8 kW
Cooling method	Not applicable
Continuous rating	50N·m
Maximum torque	260 N·m
Table rotation speed	200 min^{-1}
Detector	Absolute αiCZ sensor 512A
Least input increment	0.001 degrees
Indexing precision	±0.0028 degrees (±10 seconds)
Clamp method	Air pressure + spring
Clamp torque	500 N·m for air pressure of 0.5 MPa 350 N·m for air pressure of 0.35 MPa 70 N·m when air pressure is shut off
Rotating-part inertia	J = 0.06 kg·m^2 (GD2 = 0.24 kg·m^2)
Permissible workpiece inertia	J = 0.99 kg·m^2 (GD2 = 3.99 kg·m^2)
Spindle outside diameter	ϕ90 mm ϕ140 mm when the end plate (option) is mounted
Spindle hole diameter	ϕ46 mm through hole ϕ55 mm when the end plate (option) is mounted
Center height	150 mm
Main-body weight	66 kg
Maximum loading capacity	100 kg
Permissible moment load 	F X L = 600N·m

33.3 EQUIPMENT APPEARANCE AND CONFIGURATION

33.3.1 Equipment Appearance



Note) 1. When the shaft length adjustment option is specified, a spacer is supplied. The spacer is used to adjust the shaft length to 192 or 212 when the end plate is specified.
2. When the center height adjustment option is specified, a spacer is installed. The spacer is used to adjust the center height to 160.

Fig. 33.3.1 (a) DDR appearance

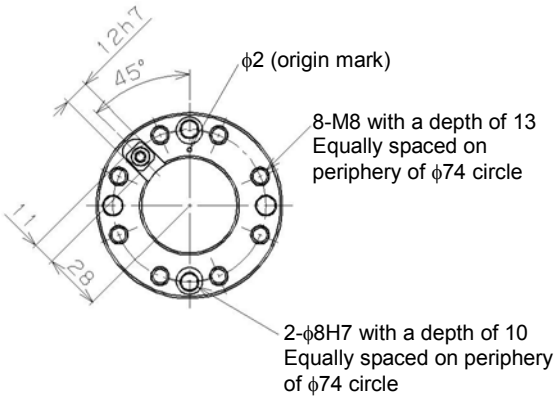


Fig. 33.3.1 (b) Detailed diagram of axis end face

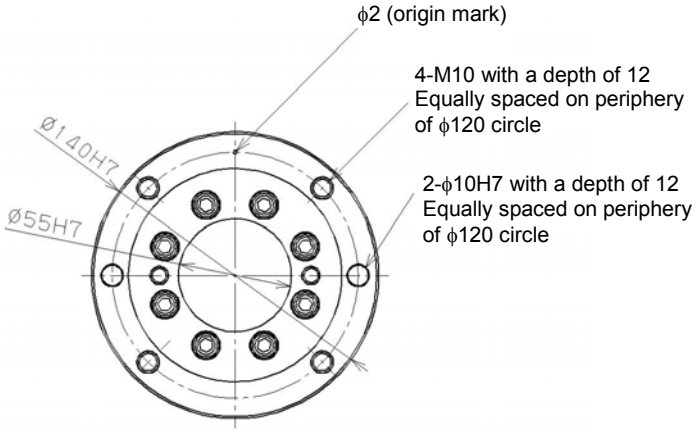


Fig. 33.3.1 (c) End plate dimensions (option)

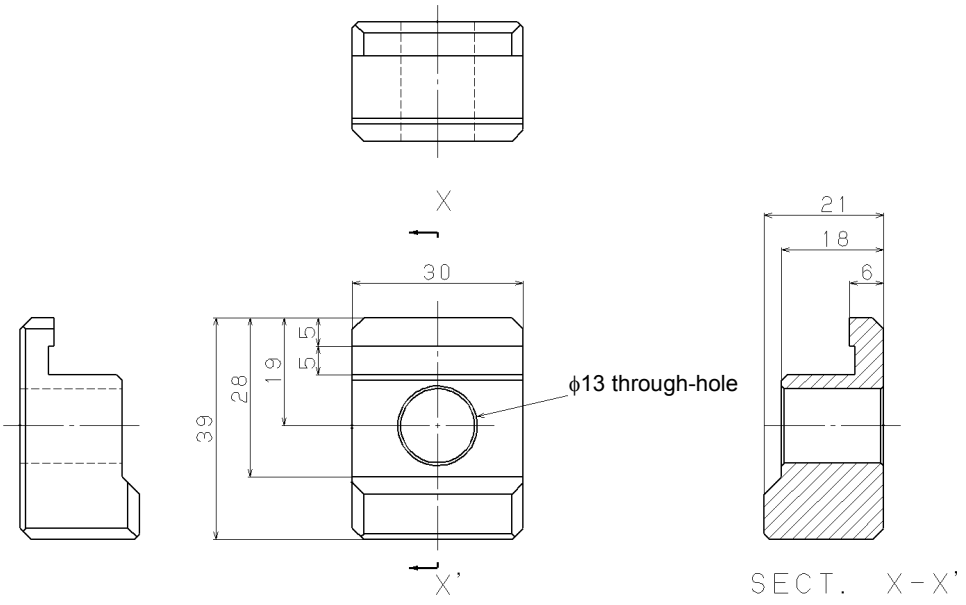


Fig. 33.3.1 (d) Mounting fixture dimensions (option)

33.3.2 Component Names

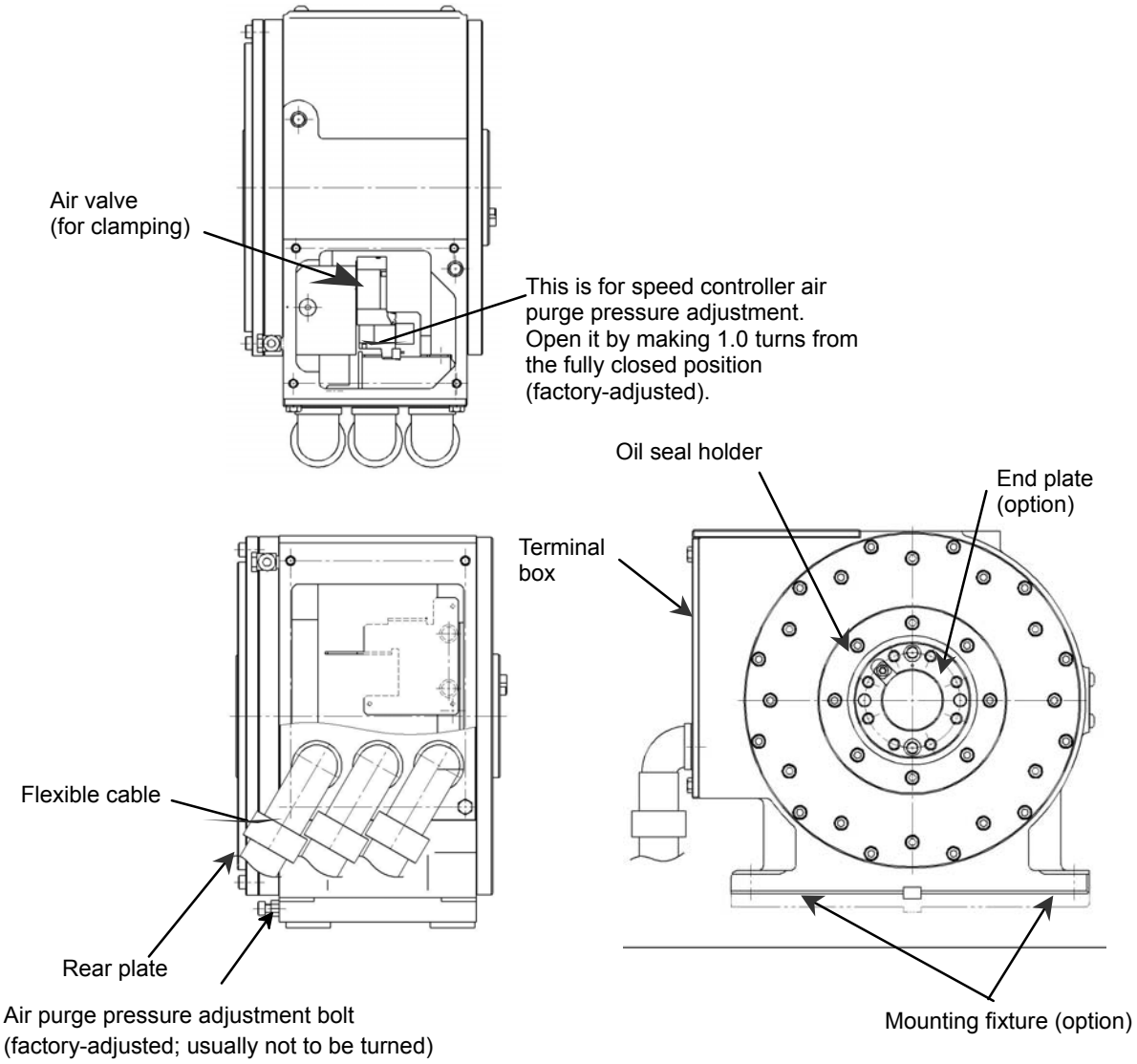


Fig. 33.3.2 Component names

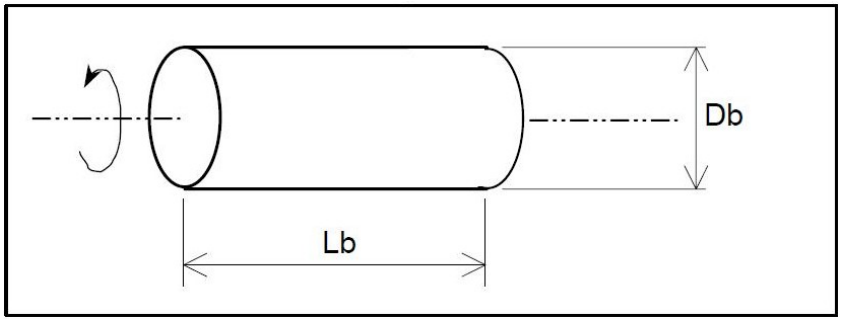
33.3.3 Estimating Inertia

The permissible workpiece inertia is specified for DDR (see Section 33.2, "SPECIFICATION"). It is necessary to check whether the workpiece inertia is below the specified permissible value.

Estimate inertia using the method described below.

Every rotation of an object that results when the drive motor rotates becomes the load inertia of the motor. When estimating inertia, calculate the inertia of each object to be driven and add up the inertias. The basic inertia estimation method is described below.

(1) Inertia of a cylinder



The inertia of a cylinder that rotates around its central axis is given by the equation shown below.

– SI unit –

$$J_b = \frac{\pi \gamma_b}{32} D_b^4 L_b \qquad [kg \cdot m^2]$$

J_b : Inertia [kg·m^2]
γ_b : Weight per unit volume value [kg·m^3]
D_b : Diameter of the cylinder [m]
L_b : Length of the cylinder [m]

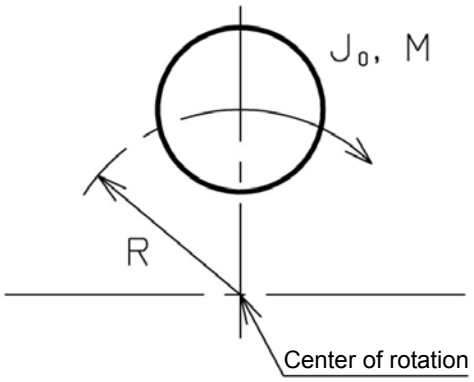
– Gravitational unit –

$$J_b = \frac{\pi \gamma_b}{32 \times 980} D_b^4 L_b \qquad [kgf \cdot cm \cdot s^2]$$

J_b : Inertia [kgf·cm·s^2]
γ_b : Weight per unit volume value [kg·m^3]
D_b : Diameter of the cylinder [cm]
L_b : Length of the cylinder [cm]

$$(1kg \cdot m^2 = \frac{100}{9.8} kgf \cdot cm \cdot s^2)$$

(2) Inertia of a cylinder displaced from the rotation center



The inertia of a cylinder displaced from the rotation center is given by the equation shown below.

$J = J_0 + M R^2$

J_0: Inertia around the cylinder center
M: Weight of the cylinder
R : Rotation radius

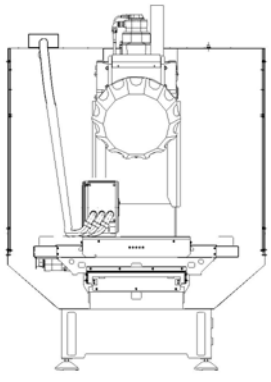
33.4 INSTALLATION

33.4.1 Precautions

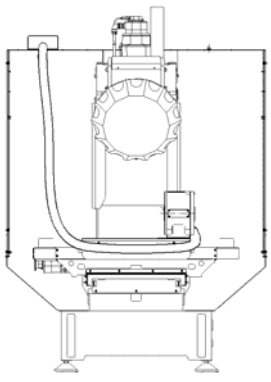
⚠WARNING
Before starting to install wires and tubes, make sure, for safety purposes, that the circuit-breaker in the controller cabinet is in the OFF position and that the electricity and air supplies for the machine are shut off.

33.4.2 Installing on the Table

(1) Place the DDR main unit on the table of the ROBODRILL or on a user-procured jig, and fix it using the bolt and T slot nut accompanying the unit. When mounting the unit, make sure that there is no foreign material or burr on its mating surface.

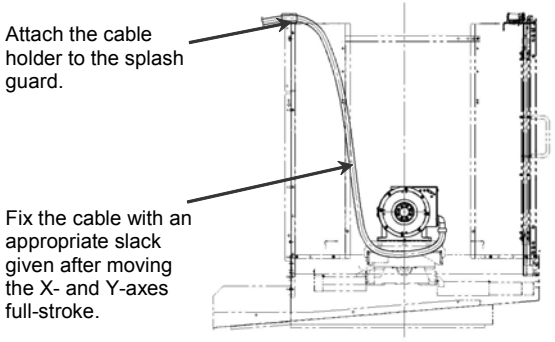


When installed on the left side



When installed on the right side

(2) Attach the cable holder on the upper left section (or upper right section) of the splash guard as viewed from the front of the machine, and lay the cable of the main unit through the upper left section (or upper right section) of the splash guard to the outside of the machine.



33.4.3 Wiring and Air Tubing

> ⚠ **WARNING**
> Before starting to install wires and tubes, make sure, for safety purposes, that the circuit-breaker in the controller cabinet of the drill main unit is in the OFF position and that the electricity and air supplies for the machine are shut off.

(1) The following diagram shows how to connect the amplifier, detection circuit box, and connector connection unit.

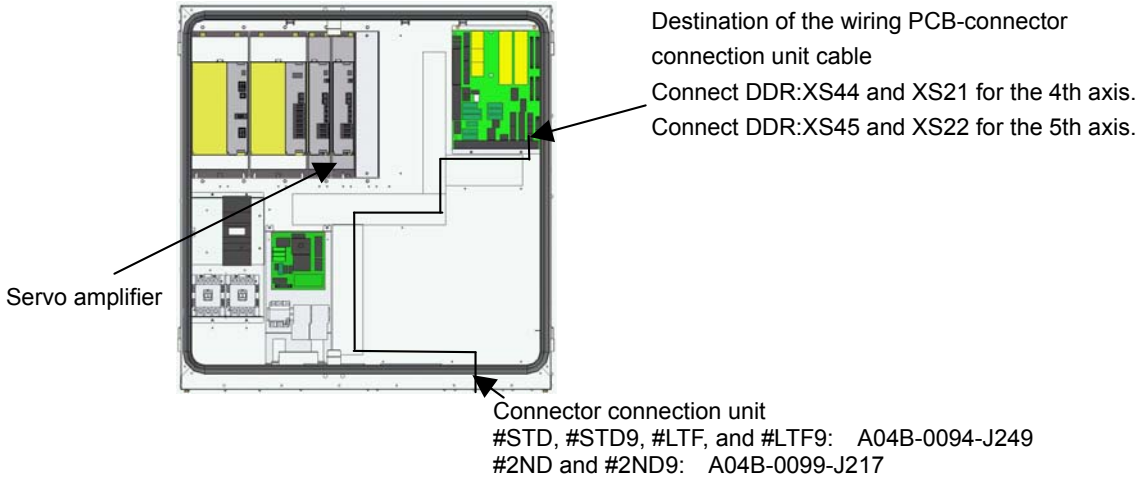
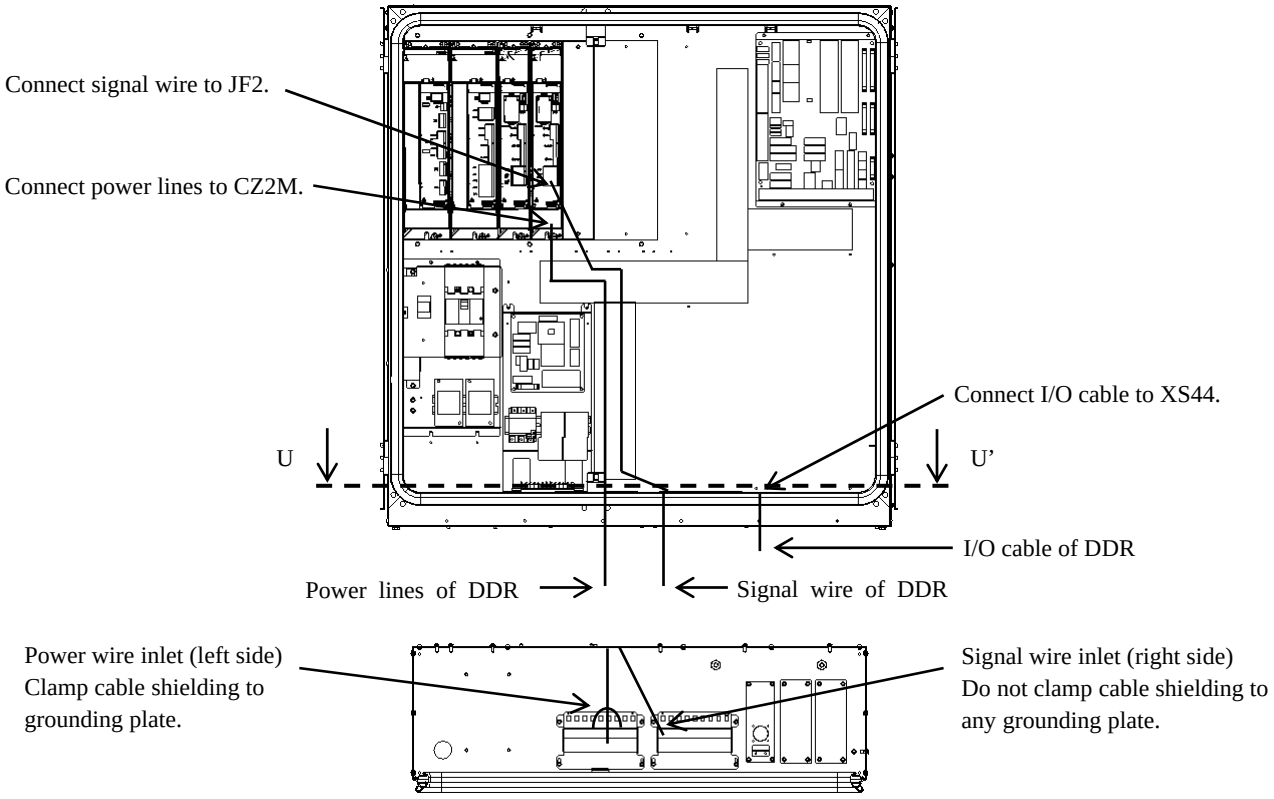


Fig. 33.4.3 (a) Layout of amp, detector circuit, etc.

(2) Connect the I/O cables to the connector connection unit.
(3) Connect the signal and power wires to the servo amplifier. When drawing the cables into the control unit cabinet, be sure to insert the power and signal wires into the inlets, respectively, on the left and right sides while seeing Fig. 33.4.3(b). If they are inserted into the same inlet, it is likely that noise may be induced on the signal wires, leading to a malfunction.
(4) Fix the shielding of the power lines to the left-side grounding plate. The shielding of the signal wire is not exposed. If the shielding of the signal wire is connected to a grounding plate in the NC cabinet, external noise may distort sensor signals. Do not remove the sheath of the shielding of the signal wire that is not exposed or connect the signal wire to a grounding plate.

(a) Connecting DDR#STD and #STD9



Cross section U-U'

Fig 33.4.3 (b) Connecting DDR#STD and DDR#STD9 main unit cables

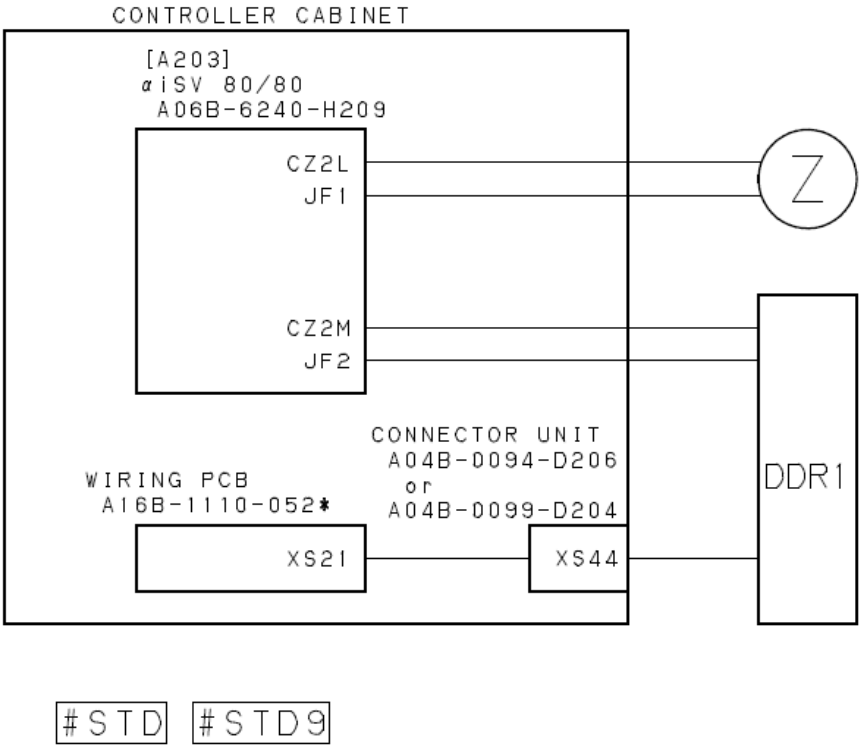
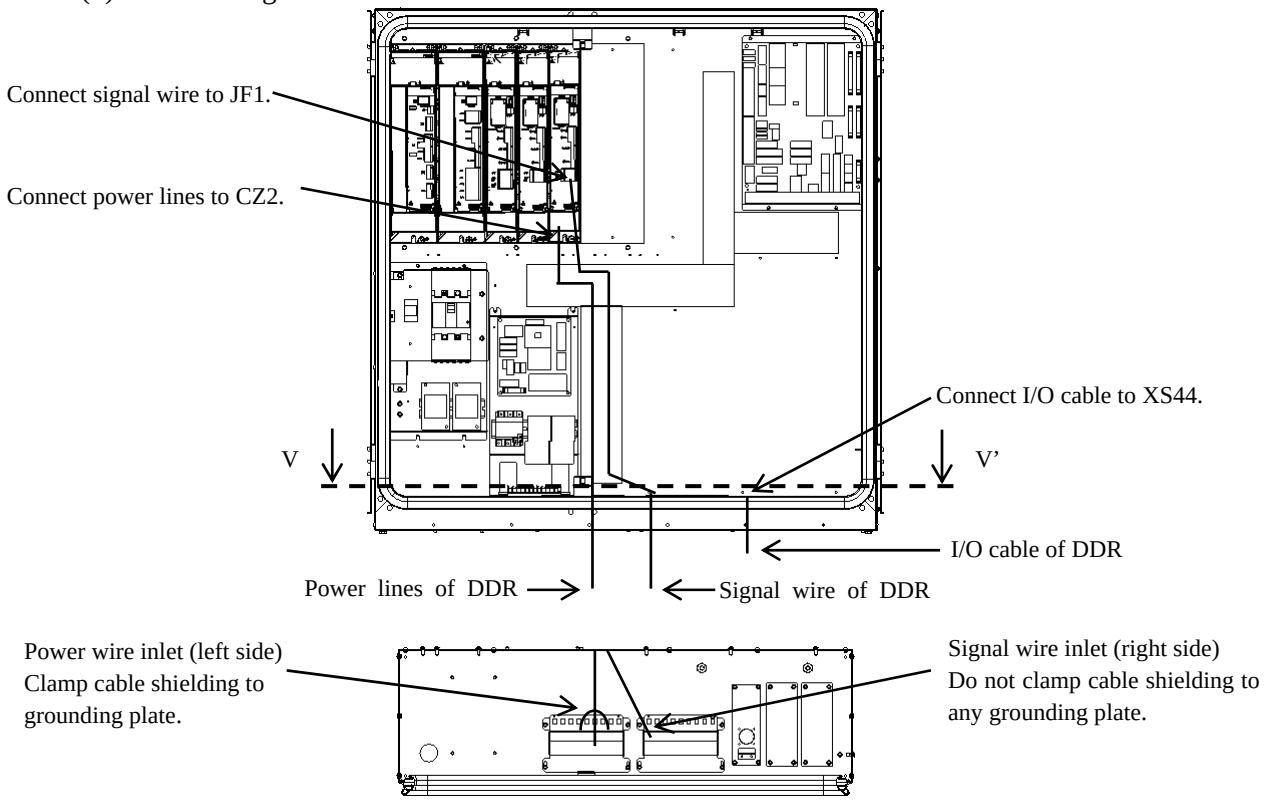


Fig. 33.4.3 (c) Wiring diagram of DDR#STD and DDR#STD9

(b) Connecting DDR#LTF and #LTF9



Cross section V-V'

Fig. 33.4.3 (d) Connecting DDR#LTF and DDR#LTF9 main unit cables

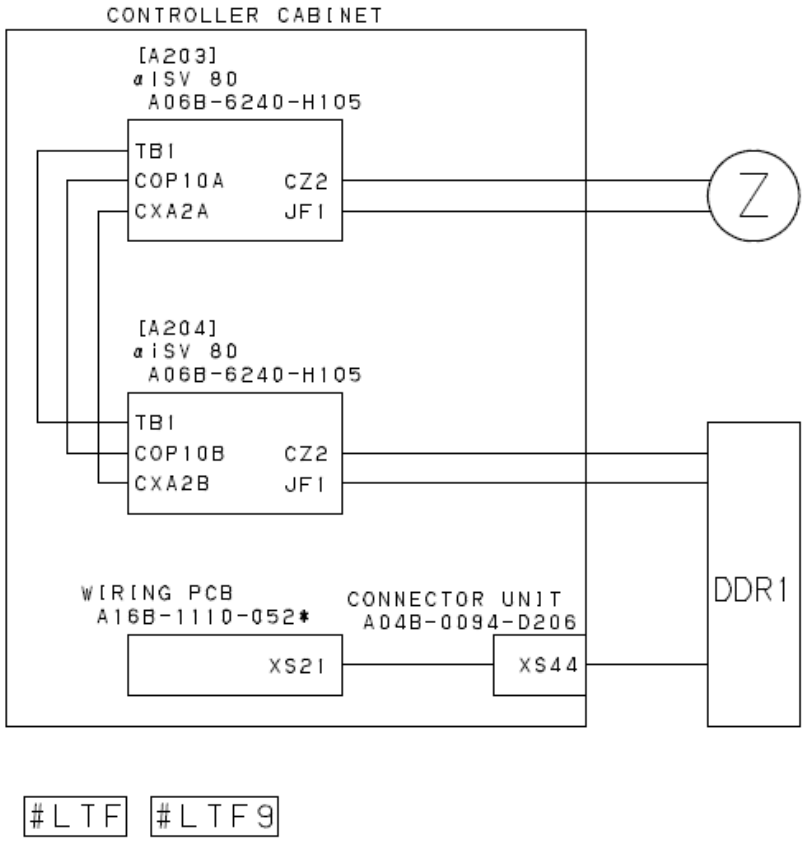
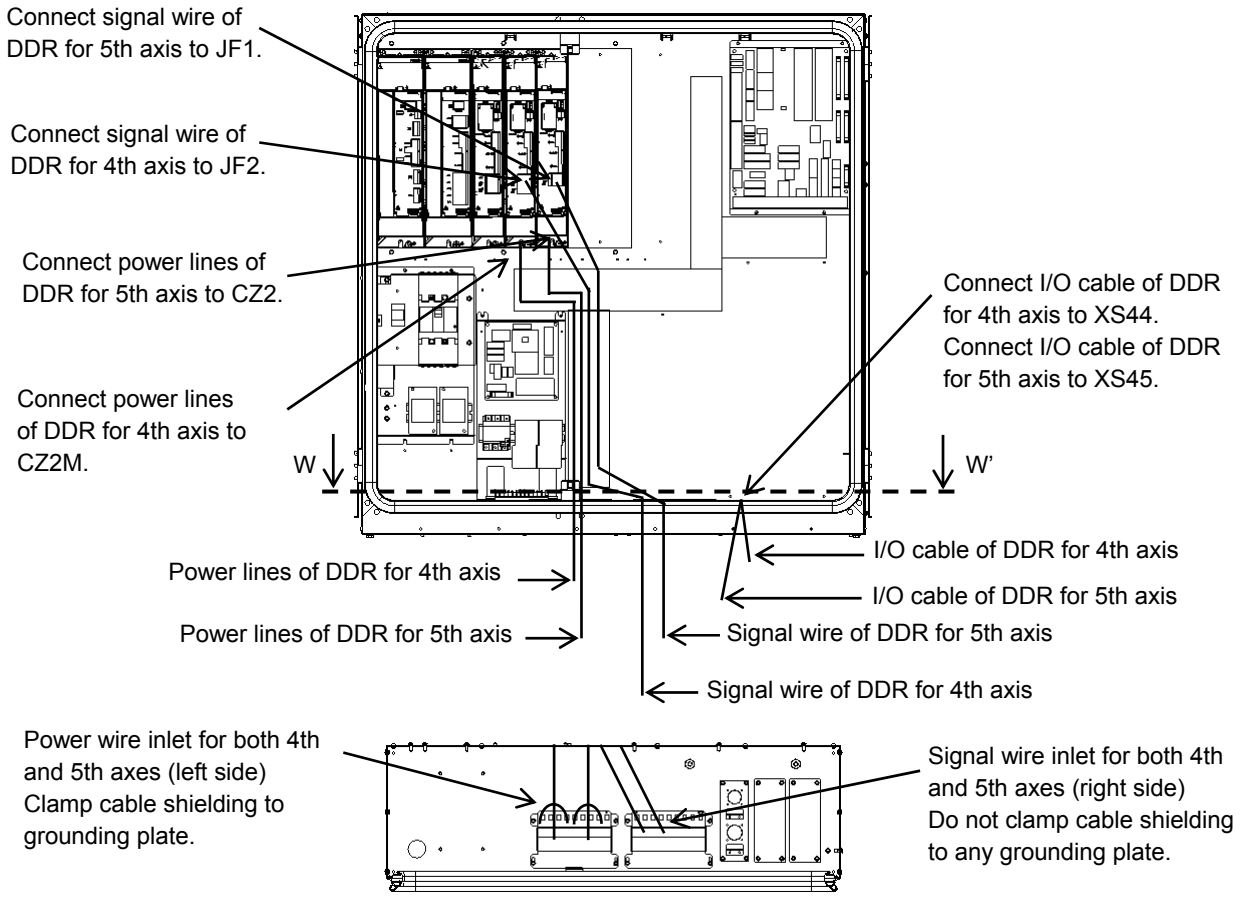


Fig. 33.4.3 (e) Wiring diagram of DDR#LTF and DDR#LTF9

(c) Connecting DDR#2ND



Cross section W-W'

Fig. 33.4.3 (f) Connecting DDR#2ND and DDR#2ND9 main unit cables

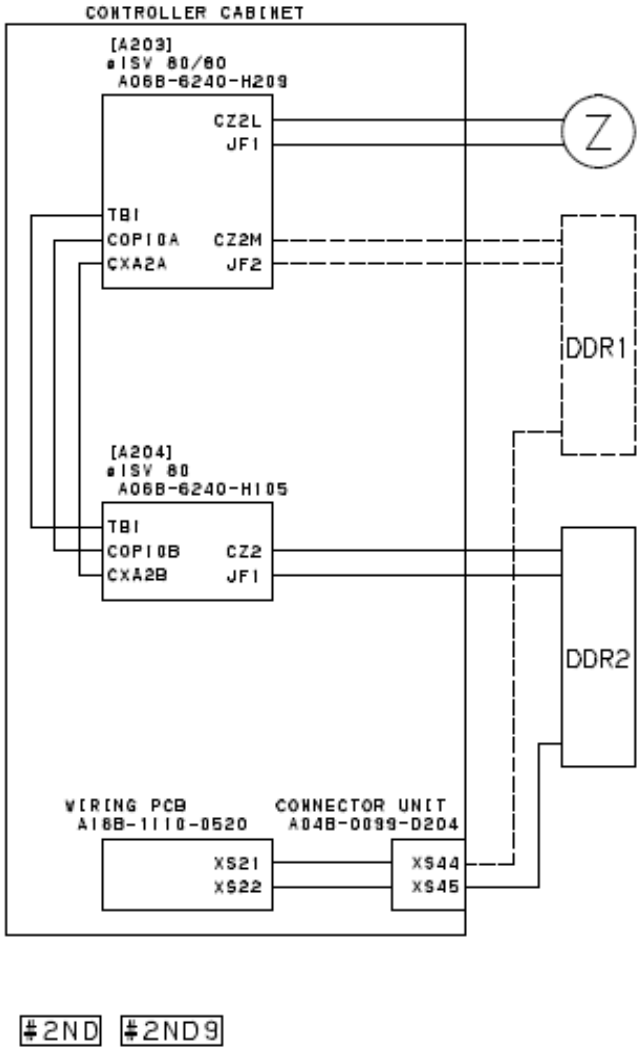


Fig. 33.4.3 (g) Wiring diagram of DDR#2ND and DDR#2ND9

(5) Connect the air tubes to the air unit of the ROBODRILL.

(a) Connecting DDR#STD, DDR#STD9, DDR#LTF, and DDR#LTF9

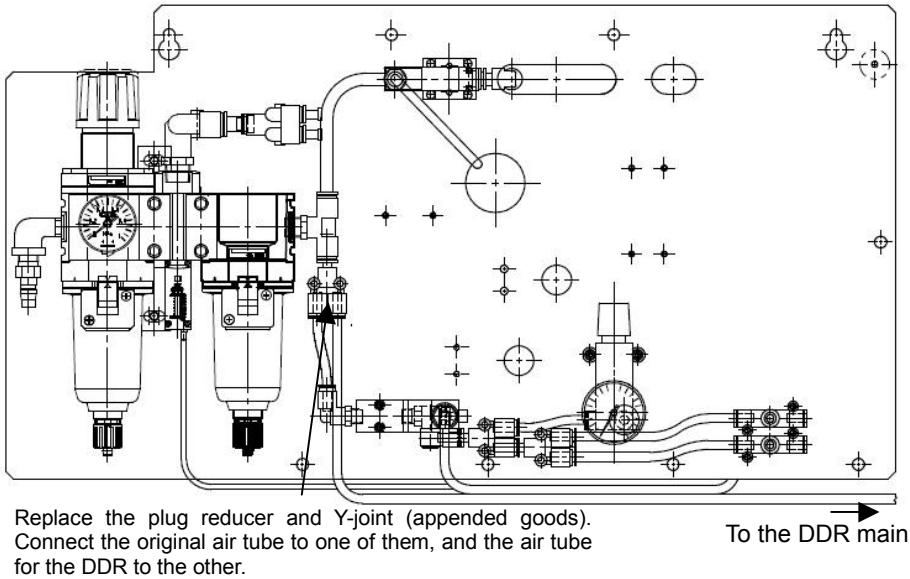


Fig. 33.4.3 (h) Connecting the air tubes of DDR#STD, DDR#STD9, DDR#LTF, and DDR#LTF9

(b) Connecting DDR#2ND and DDR#2ND9

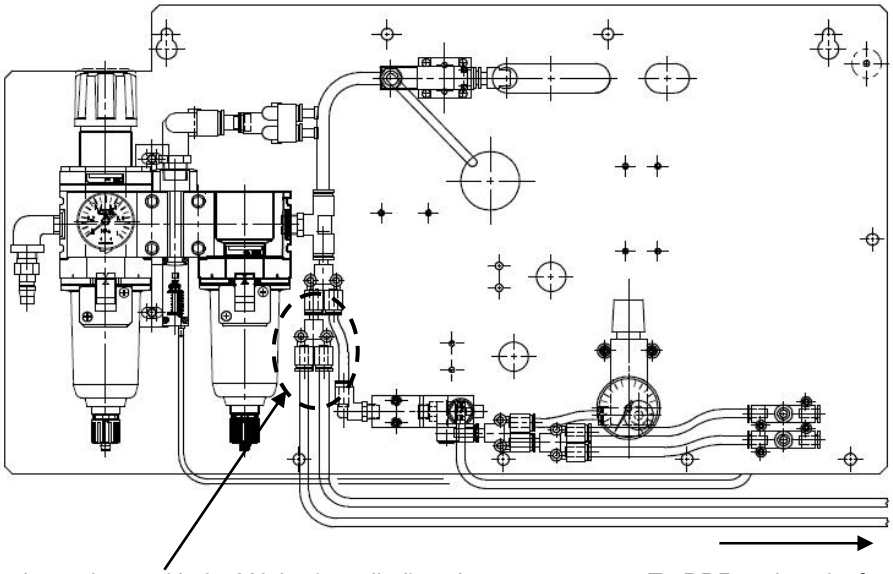


Fig. 33.4.3 (i) Connecting the air tubes of DDR#2ND and DDR#2ND9

CAUTION
Be sure to connect the air tubes at the position shown in the figure. Otherwise, oil, liquid, and foreign matters may get in the DDR, causing a failure in the DDR solenoid valve, clamp mechanism, or another part.

(6) After connecting the cables and air tubes, form the cables and air tubes in the splash guard and on the rear side of the machine, with enough extra lengths of the cables and air tubes secured for X- and Y-axis strokes.

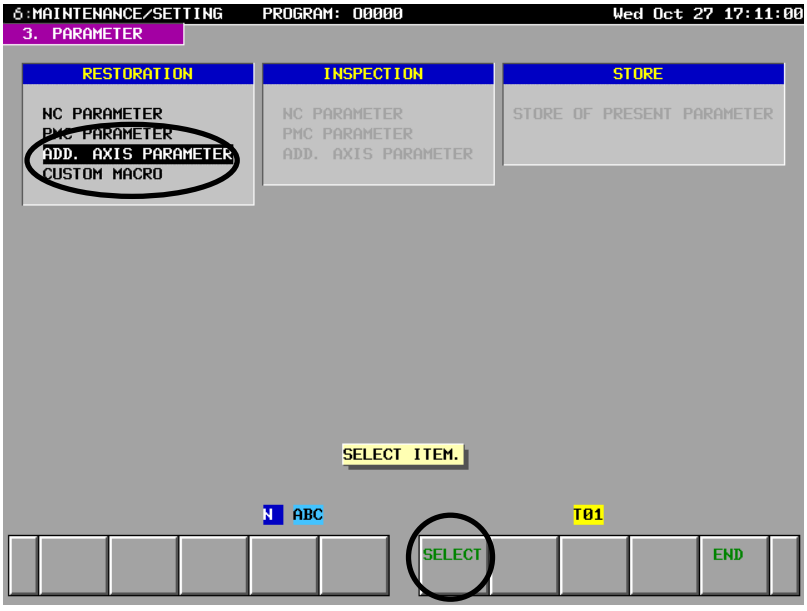
33.4.4 Setting

This chapter assumes the DDR-controlled fourth and fifth axes to be, respectively, the B- and A-axes for the sake of explanation.
(The axes can be renamed according to the setting of parameter No. 1020.)

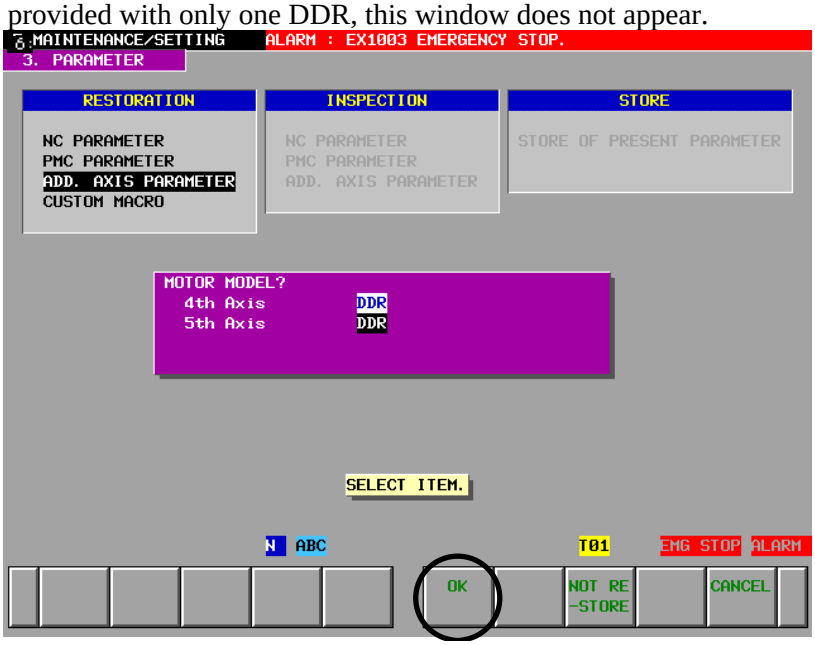
33.4.4.1 Parameter setting

(1) After turning on the power, change the following keep relays.
K32#1=1 (to enable fourth-axis DDR control)
K15#4=0 (to disable DDR260i control)
K02#1=0 (not to shut off servo excitation for fourth-axis clamping)
K03#2=1 (to use fourth-axis clamping and unclamping)
When the machine is provided with two DDRs, change the following keep relays in addition to the above.
K54#4=1（to enable fifth-axis DDR control）
K02#2=0（not to shut off servo excitation for fifth-axis clamping）
K12#1=1（to use fifth-axis clamping and unclamping）

(2) Re-set parameters for the additional axis.
(a) Display QUICK screen - “6: MAINTENANCE/ SETTING” – “3. PARAMETER” screen.
(b) Press the [RESTORE] soft key. The cursor appears in the RESTORE menu.
(c) Press the <EMERGENCY STOP> button.
(d) The cursor moves to “ADD. AXIS PARAMETER”. Press the [SELECT] soft key.

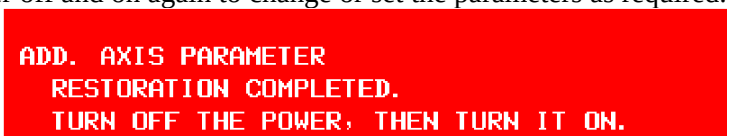


(e) If the machine is provided with two DDRs, select motor models here. In the following window, confirm the motor models for the B- and A-axes, and press the [OK] soft key. If the machine is provided with only one DDR, this window does not appear.



(f) The following window also appears. After confirming the message, press the [EXEC] soft key.

(g) When parameter setting is finished, the following window appears.
Turn the power off and on again to change or set the parameters as required.



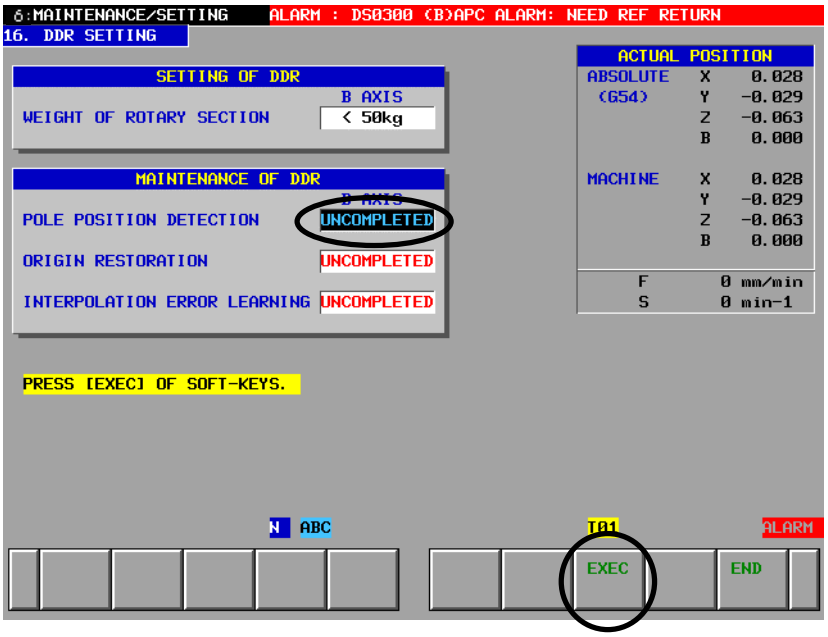
33.4.4.2 Setting method

(1) Perform the pole position detection.

⚠ WARNING

- Perform the pole position detection in the state where no load is applied on the rotation axis of the DDR in the rotation direction due to the weight of a jig. Otherwise, the pole position detection is not performed normally, and the DDR can make an unpredictable movement.
- Before the pole position detection, confirm that K30#4 is set to 0. If K30#4 is set to 1, the pole position detection is not performed normally.

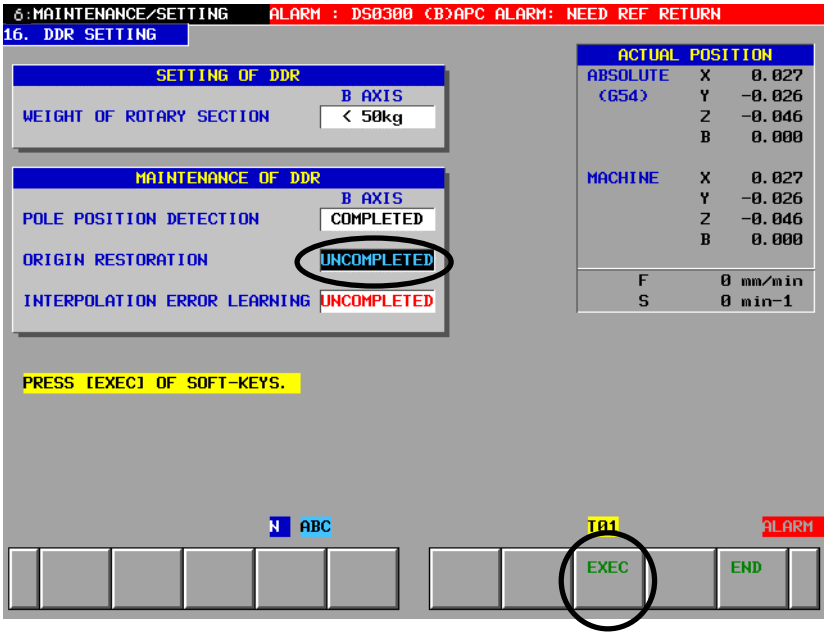
(a) Display QUICK screen – "6: MAINTENANCE/SETTING" - "16. DDR SETTING" screen.
(b) Move the cursor to POLE POSITION DETECTION in "MAINTENAMCE OF DDR", and press the [EXEC] soft key. Perform the pole position detection as directed by the guidance. Upon settlement, "COMPLETED" is displayed at POLE POSITION DETECTION.



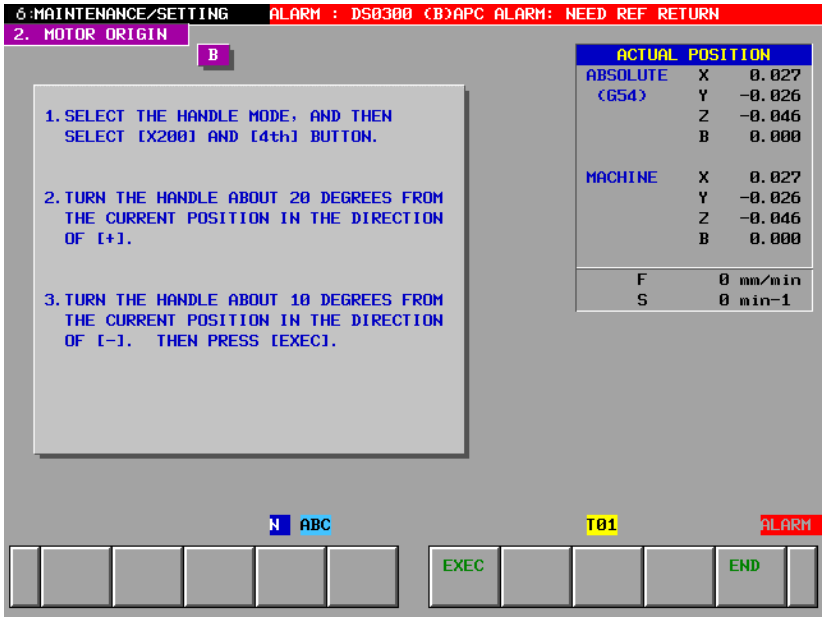
NOTE

Pole position detection may not be completed for a cause such as noise. In such a case, set the value written in the parameter No. 2139 field of the inspection result document in the parameter No. 2139B. Next, turn off the power then turn on the power again. This completes the pole position detection.

(2) Make a reference position return.
(a) After completing pole position detection, turn the power off and on again.
(b) Display QUICK screen – “6: MAINTENANCE/SETTING” - “16. DDR SETTING” screen.
(c) Move the cursor to Reference position return, and press the [EXEC] soft key.

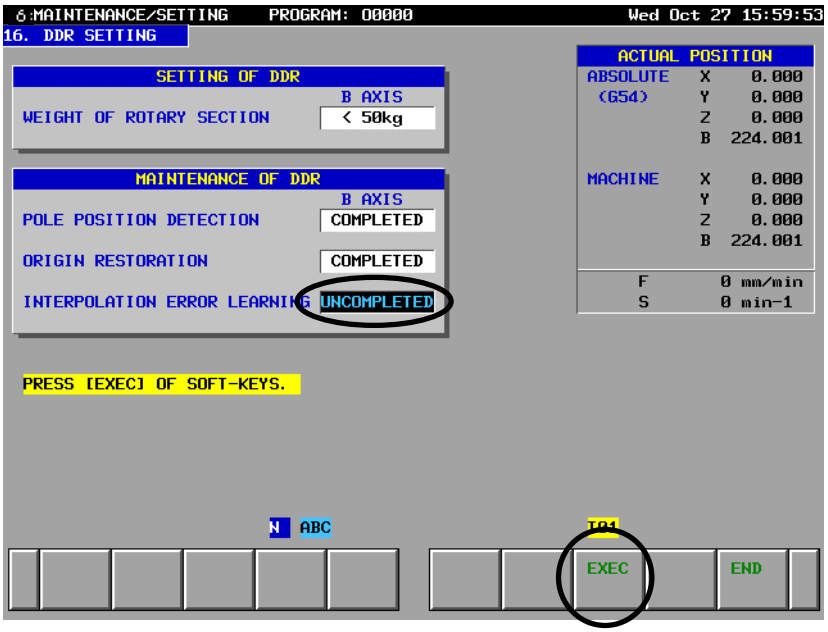


(d) Perform a motor reference position return as directed by the guidance.



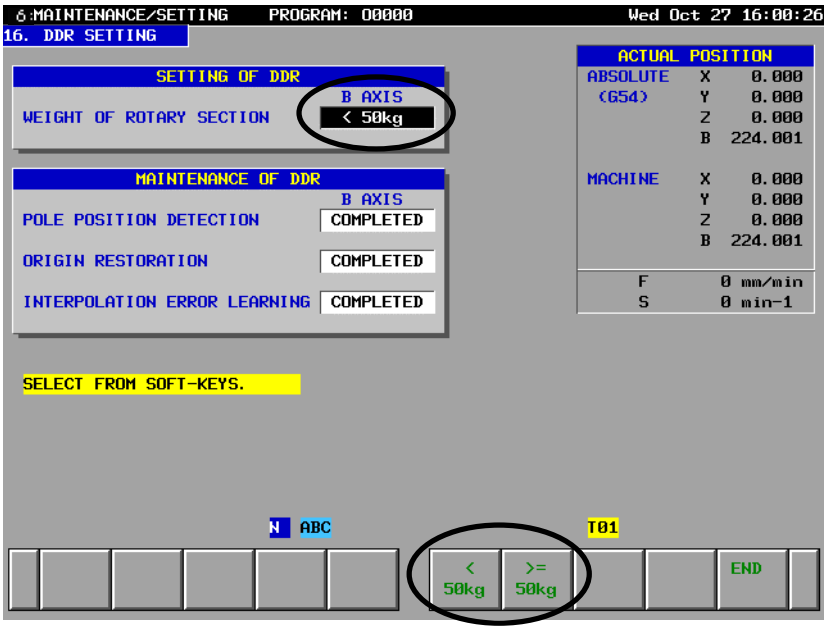
(3) Upon completion of a motor reference position return, the machine becomes operable.

(4) Perform the interpolation error learning for the α*i*CZ sensor.
(a) Move the cursor to Interpolation error learning, and press the [EXEC] soft key.



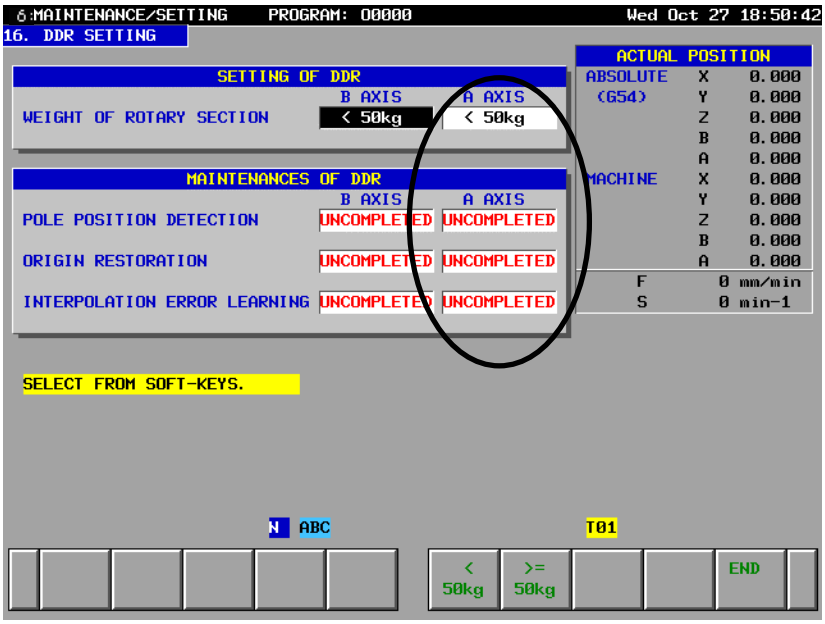
(b) Pressing the Start button as directed by the message causes the axis to make two turns at a speed of 30 min^{-1}, thus completing the interpolation error learning.

(5) Set the weight of rotary section.
(a) Display QUICK screen – “6: MAINTENANCE/SETTING” - “16. DDR SETTING” screen.
(b) Move the cursor to WEIGHT OF ROTARY SECTION in “SETTING OF DDR”, and select the [< 50 kg] or [>= 50 kg] soft key depending on the weight of the jig. If no jig has been mounted, do not select [>= 50 kg]. Otherwise, the main body may oscillate.



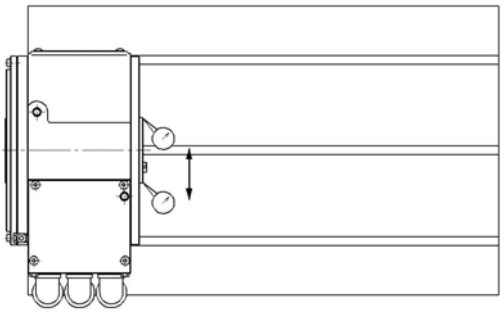
(c) Depending on the jig used, the rotation of the B-axis may cause oscillation. In such a case, change the velocity gain value on the “SERVO MOTOR TUNING” screen. The tuning method is described later.

(6) If the DDR is provided for the fifth axis, items for the A-axis are added on the DDR SETTING screen. Set these items in the same manner as for the B-axis.



33.4.5 Precision Adjustment

(1) Make adjustments so that the end plate surface will be parallel to the Y-axis.



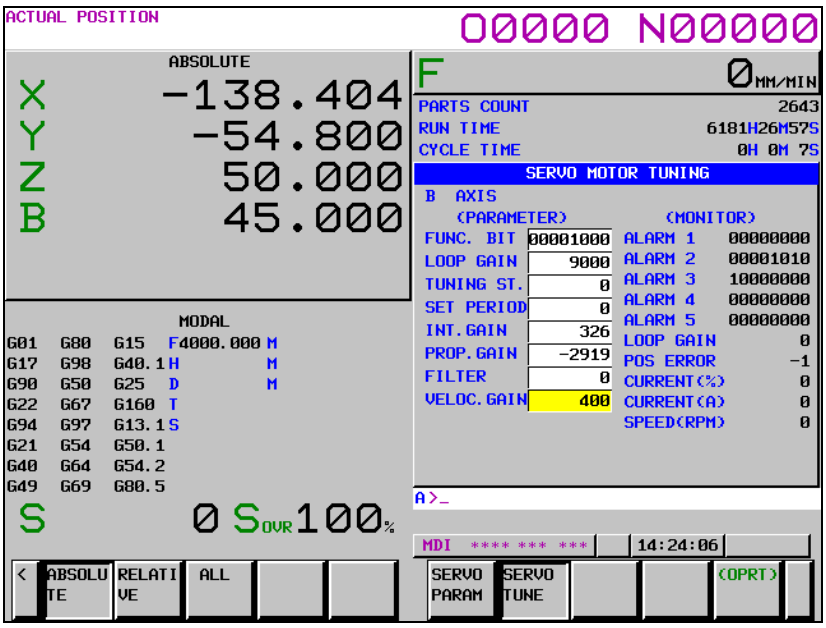
(2) Make grid shift adjustments.
The position of the origin is factory-adjusted to within ±5° from the position shown in Fig. 33.3.1. Set the origin to a necessary angle with the jig and workpiece mounted.
For example, attach a dial indicator to the Z-axis, move the Y-axis manually, and then set parameter No. 1850 to such a value that the reading of the dial gage on either edge of the jig datum plane will become the lowest. Note that changing parameter No. 1850 requires making a reference position return again.

33.4.6 Adjusting the Velocity Gain

For the velocity gain, two default settings (below 50 kg/50 kg or more) are provided. With these default settings alone, however, a problem such as oscillation or unstable operation may arise. In that case, it is necessary to set a value appropriate for the jig in use.

The change method is as follows:

(1) If keep relay K00#6 is 0, set it to 1, and then turn the power off and on again.
(2) Display the SERVO MOTOR TUNING screen by selecting [SYSTEM] → [▷] → [SERVO PARAM] → [SERVO TUNE] in the stated order.



(3) Increase the [VELOC.GAIN] value in steps of 50%.
(4) Increasing the velocity gain gradually may cause the following oscillation phenomena:
- The current value shows signs of disorder.
- The DDR main unit generates vibration noise.
- Positional deviation during stopping becomes large.

(5) Use 70% to 80% of the velocity gain when one of the above oscillation phenomena occurs as the final velocity gain setting.
(6) Perform axis movement, clamping, unclamping, etc. to check that there is no problem with the operation.
(7) Reset keep relay K00#6 to the precious value.

When changing the velocity gain, assign the value of parameter No. 2021 in the data table corresponding to the relevant weight of the rotary section.

Bth axis
Below 50 kg: Data table D138 (factory-set to 256)
50 kg or more: Data table D140 (factory-set to 1024)

Ath axis
Below 50 kg: Data table D188 (factory-set to 256)
50 kg or more: Data table D190 (factory-set to 1024)

In either case, the value setting range is from 256 (200%) to 2560 (technically, up to 32768 can be set).

33.4.7 Resonance Elimination Filter Function

If oscillation or unstable operation still occurs after the velocity gain is adjusted, it is necessary to suppress the oscillation using a resonance elimination filter.

The adjustment method is as follows:

(1) If you know the vibration frequency when the oscillation occurs, set the frequency in parameter No. 2366B(A) (attenuation center frequency) and set a standard value listed in the following table in parameter No. 2367B(A) (attenuation bandwidth).

Resonance frequency	No. 2367B (attenuation bandwidth)
Lower than 150 Hz	Decrease the velocity gain.
150 to 200 Hz	50 Hz or lower
200 to 400 Hz	60 to 100 Hz
400 Hz or higher	100 to 200 Hz

(2) If resonance still occurs after the parameters are set in (1) or if you do not know the vibration frequency, use the values of setting 1 to 7 below that suppress the oscillation to the lowest level when the B(A)-axis is rotated.

	No. 2366B(A)	No. 2367B(A)
Setting 1	200	100
Setting 2	250	100
Setting 3	300	100
Setting 4	350	100
Setting 5	400	150
Setting 6	450	150
Setting 7	500	200

(3) After the resonance elimination filter is set, increase the [VELOC.GAIN] value again until oscillation occurs. Use 70% to 80% of the velocity gain when oscillation occurs as the final velocity gain setting.

(4) Perform axis movement, clamping, unclamping, etc. to check that there is no problem with the operation.

33.4.8 Checking Operations after Installation

(1) Check clamping and unclamping operations.
B-axis: The clamp M code to use is M10 or M71. The unclamp M to use code is M11 or M72.
A-axis: The clamp M code to use is M68 or M171. The unclamp M code to use is M69 or M172.

(2) Make sure that the axis can be smoothly rotated manually when it is unclamped.

33.5 OPERATIONS

This chapter assumes the fourth- and fifth-axis DDRs to be, respectively, the B- and A-axes for the sake of explanation.
(The fourth and fifth axes can be renamed according to the setting of parameter No. 1020.)

(1) How to specify

(a) When using clamping/unclamping
(Clamping/unclamping the B-axis)

```
M72  :  Unclamp
B△△ :  Index
M71  :  Clamp
M70  :  Check clamping (available when K32#2 = 0)
```

Alternatively,

```
M11  :  Unclamp
B△△ :  Index
M10  :  Clamp
```

(Clamping/unclamping the A-axis)

```
M172 :  Unclamp
A△△ :  Index
M171 :  Clamp
M170 :  Check clamping
```

Alternatively,

```
M69  :  Unclamp
B△△ :  Index
M68  :  Clamp
```

(Before starting to move the additional axis for a reference position return, be sure to issue an unclamp command.)
For the difference between the M10/M11, M68/M69 clamp/unclamp command and the M70/M71/M72, M170/M171/M172 clamp/unclamp command, see Section 33.11.

(b) When not using clamping/unclamping
B-axis

```
B△△:  Index
```

A-axis

```
A△△ :  Index
```

(c) Unit of input for additional-axis move command

When using no decimal point	B1(A) ⇨	0.001°
When using a decimal point	B1.(A1.) ⇨	1°

(d) Absolute/incremental command
An absolute/incremental command can be specified, using G90/G91.

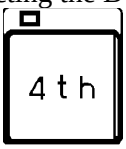
(e) Number of concurrently controlled axes
Among all axes, including the fourth and fifth axes, up to four or five axes can be controlled simultaneously. In manual operation, however, only one axis can be controlled at a time.

(f) Feed rate
Similarly to the X-, Y-, and Z-axes, the B-axis can be controlled with G00/G01.

(2) Manual operation

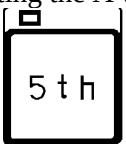
Similarly to the X-, Y-, and Z-axes, the B-axis can be operated in the handle mode.

(Selecting the B-axis)



[Press]

(Selecting the A-axis)



[Press]

33.6 PERIODIC MAINTENANCE

33.6.1 Checking the Insulating Resistance of the Motor

Turn the power for the machine, set its circuit breaker to OFF, and then check the insulating resistances of the motor. The insulating resistances between U and EARTH, between V and EARTH, and between W and EARTH are measured with the power line connector (33.6.1(1)) connected to the DDR driving servo amplifier or the power line connector (33.6.1(2)) within the terminal box of the DDR main body, using a megohmmeter (500 VDC).

Insulating resistance	Go/no-go decision
100 MΩ or higher	Go
10 to 100 MΩ	The insulating resistance has begun to lower. The motor can work with no problem in its performance, but needs periodic inspection.
1 to 10 MΩ	The insulating resistance has lowered. The motor needs special attention and periodic inspection.
Below 1 MΩ	The motor is defective. Contact FANUC.

(1) Method of measurement with the power line connector connected to the amplifier

(a) Remove the power line of the DDR from the amplifier connected to the DDR.

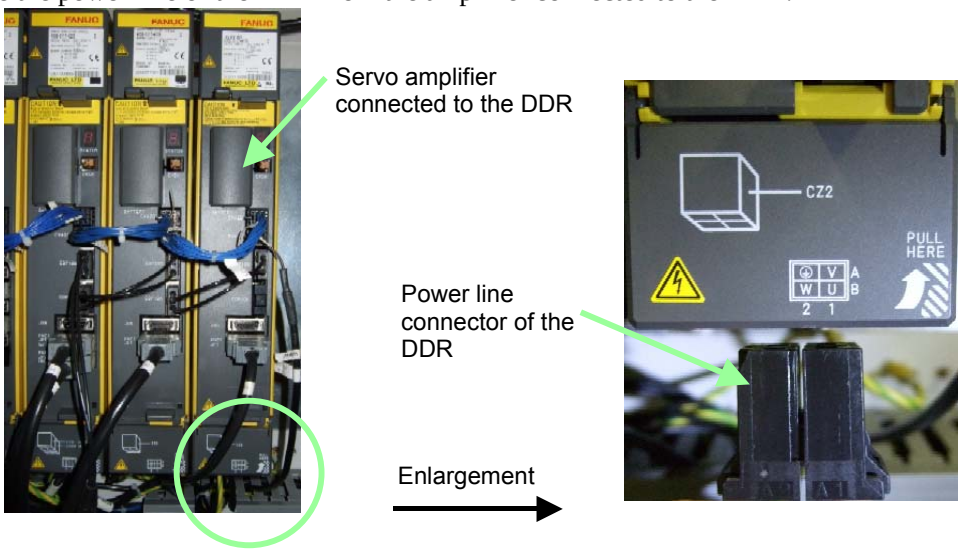


Fig. 33.6.1(a) Positions of the amplifier and power line within the locker

(b) The insulating resistances between U and EARTH, between V and EARTH, and between W and EARTH with the power line connector of the DDR are measured.

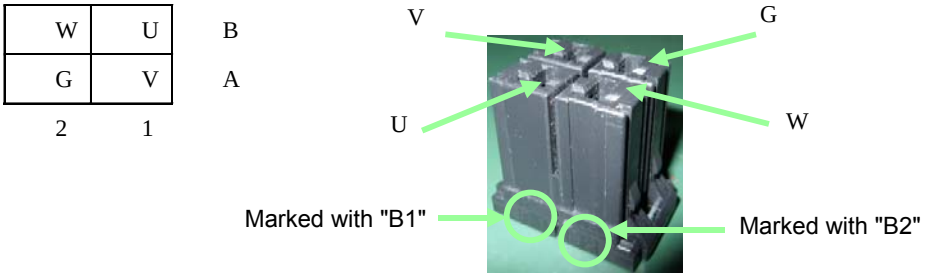


Fig. 33.6.1(b) Pin arrangement of the power line connector of the DDR (viewed from the pin side)

Fig. 33.6.1(c) Measurement of the insulating resistance with the power line connector of the DDR

(2) Method of measurement with the power line connector within the terminal box of the DDR main body

(a) Remove the lid of the terminal box on the upper surface of the DDR and the valve assy. In addition, remove the lid of the terminal box on the side and the power line cable connected to the amplifier.

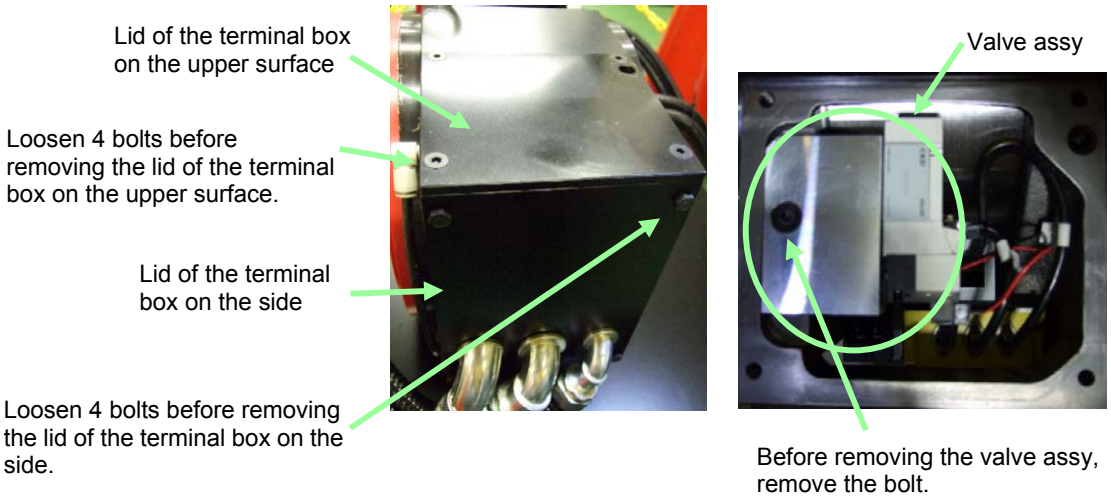


Fig. 33.6.1(d) Removing the lid of the terminal box of the DDR and the valve assy

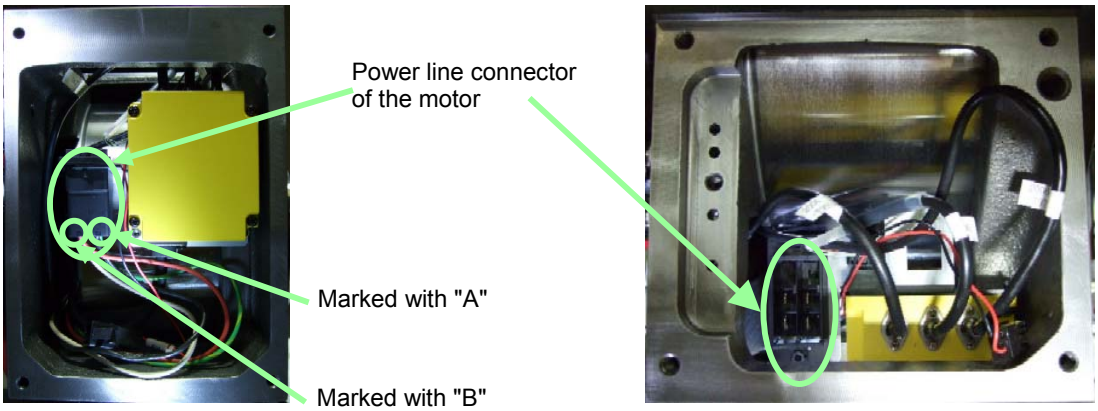


Fig. 33.6.1(e) State in which the lids of the terminal box of the DDR, the valve assy, and the cable connected to the amplifier are removed

(b) Measure the insulating resistances between U and the DDR case, between V and the DDR case, and between W and the DDR case, where U, V, and W are terminals of the power line connector of the motor.

		3
W	G	2
U	V	1
B	A	

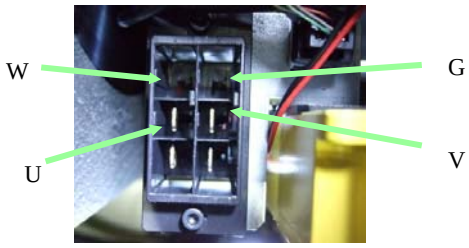


Fig. 33.6.1(f) Pin arrangement of the motor power line connector of the DDR (viewed from the pin side)

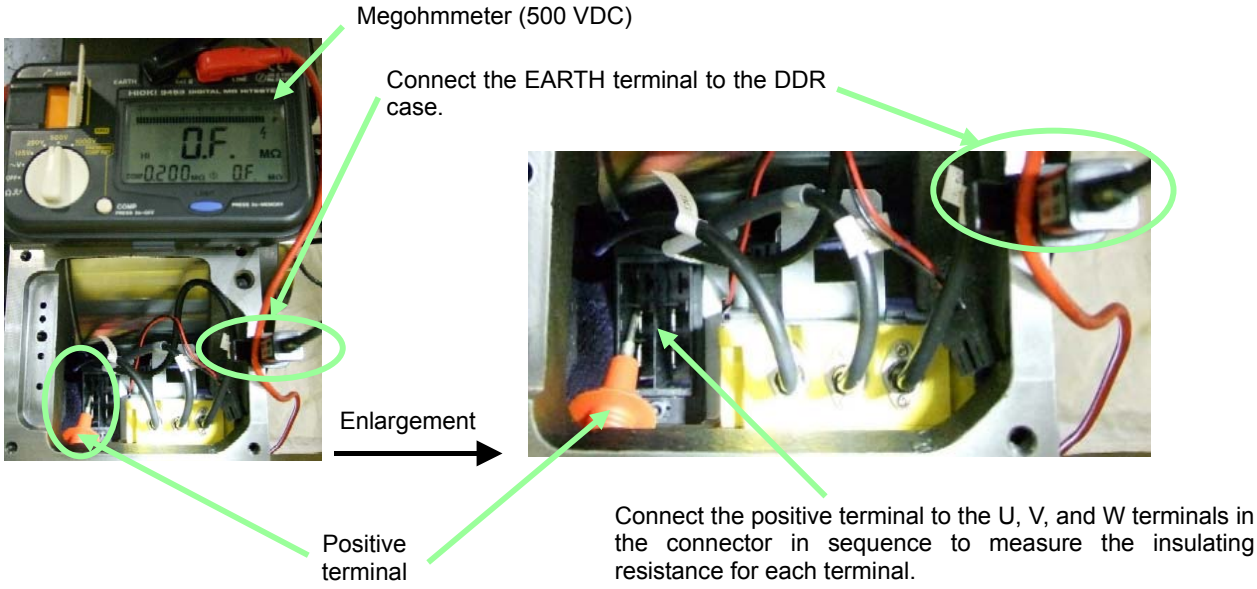


Fig. 33.6.1(g) Measurement of the insulating resistance with the power line connector of the motor

33.6.2 Checking the Internal Pressure

Coolant fluid is kept from getting into the DDR by pressurizing it internally with air purge.
Checking the internal pressure, you can find a lowered pressure (that occurs due to an abnormal condition, such as a worn oil seal or a deteriorated seal washer) early. It is recommended to check the internal pressure periodically and take note of the results. Replace the oil seal and seal washer as required.
Also after you have performed maintenance operations, such as rear plate replacement, check the internal pressure to make sure that you have attached the parts properly.

When checking the internal pressure, make go/no-go decisions as listed below.

Internal pressure	Go/no-go decision
10 kPa or higher	The internal pressure is higher than the rated value. Check to see if the drain hole and its vicinity have been blocked with metal chips or the like and whether the speed controller is abnormal.
2 to 10 kPa	Go
Below 2 kPa	The internal pressure is not sufficiently maintained. Check the sealing parts or adjust the air purge internal pressure, using the air purge pressure adjustment bolt.

Described below are the check method of the internal pressure and the specification of equipment used in checking.

(1) Remove the R1/8 plug and attach an R1/8 elbow joint, as shown in the figure. Also, attach an internal-pressure measuring jig.
(2) Wait for about 2 minutes, until the reading of the pressure sensor settles. Take note of the reading. (A 24V power supply is required separately for the pressure sensor. For details, contact Keyence Corporation.)
(3) Remove the jig, and attach the R1/8 plug as before. Wind seal tape around the R1/8 plug or use the R1/8 plug with a seal agent.

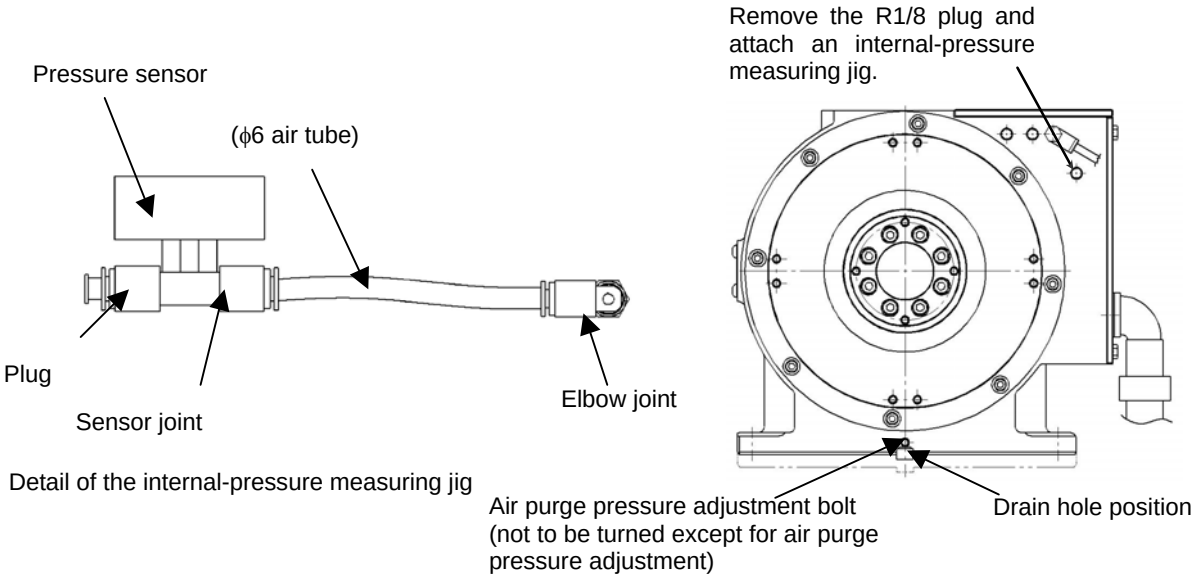


Fig. 33.6.2 Internal pressure measurement method

Item	Specification (maker, model number)	Quantity needed
Pressure sensor (sensor section)	AP-44 made by Keyence Japan, or equivalent	1
Pressure sensor (amp section)	AP-V41AP made by Keyence Japan, or equivalent (A 24V power supply is required separately.)	1
Pressure sensor joint	OP-33157 made by Keyence Japan, or equivalent	1
Plug	GWP6-B made by CKD Corporation, or equivalent (ϕ6 mm)	1
Elbow joint	GWL6-6 made by CKD Corporation, or equivalent (R_c1/8, ϕ6 mm)	1

33.6.3 Checking the Sensor Output Signal

The amplitude and offset of the sensor signal can be checked easily on a CNC diagnosis screen.

(1) Set parameter No. 2151B(A) to 3418 and No. 2153B(A) to 3419.
(2) Confirm that parameters No. 2115B(A) and No. 2152B(A) are 0. Otherwise, set these parameters to "0".
(3) Rotate the DDR at F100 deg/min and check the values of diagnosis information No. 353 and No. 354 on the diagnosis screen.
A display example is shown below:

Example: 1 4 5 5

- 1st digit: Sensor head number
- 2nd digit: Amplitude indicated with level 1 to 9. Normal values are 3 to 7.
- 3rd digit: Phase A offset indicated with level 1 to 9. Normal values are 3 to 7.
- 4th digit: Phase B offset indicated with level 1 to 9. Normal values are 3 to 7.

NOTE
Check the above values while the DDR is rotating. The offset values, in particular, cannot be measured when the DDR is stopped.

(4) If the amplitude falls outside the range of normal values, the mounting position of the sensor should be adjusted again or the sensor should be replaced with a new one because the sensor is considered to be incorrectly adjusted or defective.
(5) If the offset value falls outside the range of normal values, the sensor should be replaced with a new one because the sensor is considered to be defective.
(6) Restore the parameter values changed in (1) and (2) to their original values.

33.6.4 Replacing the Rear Plate

Described below is the rear plate replacement procedure.

> ⚠ **WARNING**
> Before replacement, it is necessary to eliminate the load on the rotation axis of the DDR in the rotation direction applied by the weight of a jig, open the main breaker, and interrupt the air being supplied. Interruption of the air in the state where the load is applied in the rotation direction may rotate the DDR.

(1) If the rotary joint and other parts have not been detached, remove them.
(2) Remove the rear plate mounting bolts (both long black oxide finish type and short SUS type).

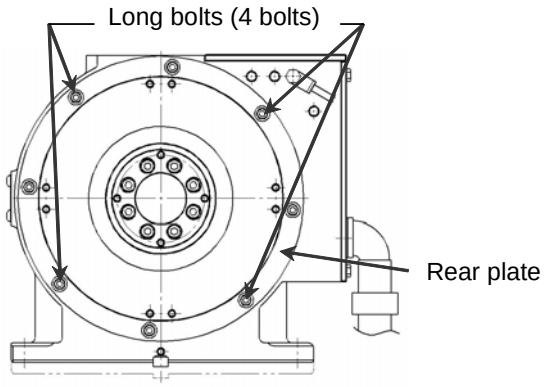


Fig. 33.6.4 (a)

(3) Detach the rear plate.
(4) Wipe off abrasion powder from the surface of the brake disk and from the inside of the cylinder in the mechanism. Be careful not to push in any abrasion powder.

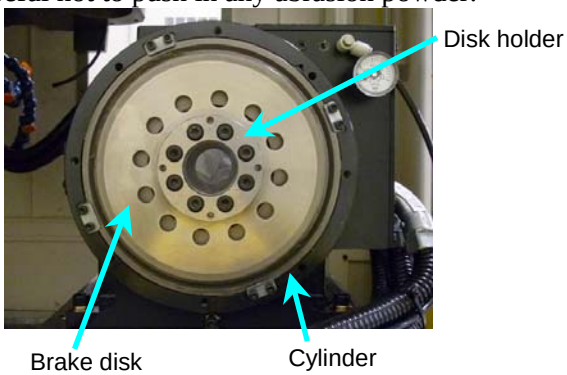


Fig. 33.6.4 (b) View with the rear plate removed

(5) Apply a thin coat of lithium grease (ALVANIA GREASE S2 or equivalent) to the friction surface of the brake disk.
(6) Attach the new rear plate. Pay attention to the phase of the tap for mounting the rear plate jig.
(7) Tighten the four long bolts to fasten the rear plate to the casting. The positions of the bolts are shown below. When tightening the bolts, replace the seal washers with new ones. Also, apply a thin coat of lithium grease to the surfaces of the seal washers.

(8) Tighten the four short bolts. When tightening the bolts, replace the seal washers with new ones. Also, apply a thin coat of lithium grease to the surfaces of the seal washers.

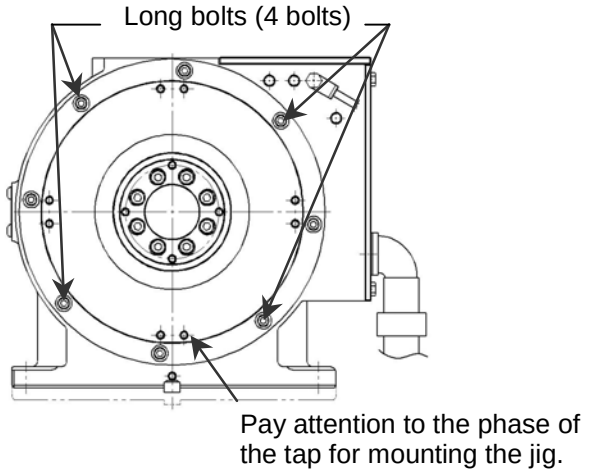


Fig. 33.6.4 (c) Position of the bolts

(9) Supply air and determine whether clamping and unclamping operate normally by instructing M71 and M72.

(10) Put the rotary joint and other parts you removed in replacing the rear plate back to their respective original places.

33.6.5 Replacing the Brake Disk

The friction surface of the brake disk of the clamp mechanism of DDR has a coating. The coating wears out as the clamp is used over a long period of time, possibly leading to a decrease in the clamp torque.

The following procedure can check whether the brake disk is normal.

(1) Change the settings of the keep relay and data table as listed below.
Keep relayK01#5 = 1
Data table D154 = 255 (B-axis) / D192=255(A-axis)
(2) Issue M71 to start a clamping operation.
(3) Select the manual mode, and press the <4th> / <5th> key.
(4) Turn the handle toward the "+" side to set it to 0.050° from the current position.
(5) The brake disk is normal if the load meter reads 500% or higher and if alarm SV0436, "SOFTTHERMAL (OVC)", or EX1089, "DDR OVC (DDR-4) / EX1093 OVC (DDR-5) alarm", occurs within 10 seconds.
(6) Return keep relay K01#5 and data table D154 / (D192) to their respective original values.
(7) Turn the power off and on again.

Described below is the brake disk replacement procedure.

> ⚠ **WARNING**
> Before replacement, it is necessary to eliminate the load on the rotation axis of the DDR in the rotation direction applied by the weight of a jig, open the main breaker, and interrupt the air being supplied. Interruption of the air in the state where the load is applied in the rotation direction may rotate the DDR.

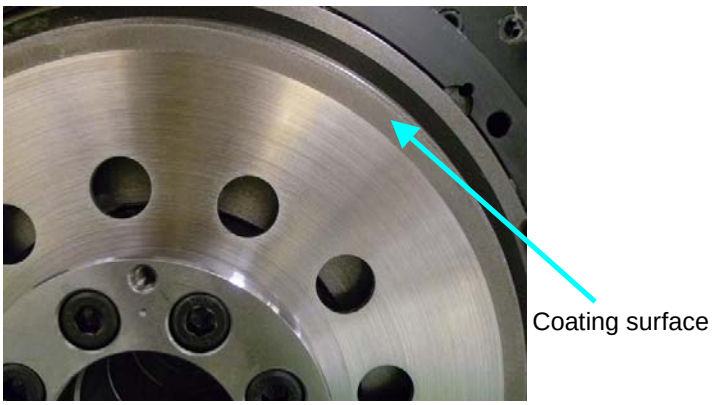


Fig. 33.6.5 (a) Brake disk

(1) If the rotary joint and other parts have not been detached, remove them.
(2) Remove the eight disk holder mounting screws to detach the disk holder.
(3) Remove the rear plate mounting bolts. There are two types of bolt - long ones and short ones; remove bolts of both types.
(4) Detach the rear plate.
(5) Remove the brake disk.

(6) Wipe off abrasion powder from the surface of the piston and from the inside of the cylinder in the mechanism. Be careful not to push in any abrasion powder.

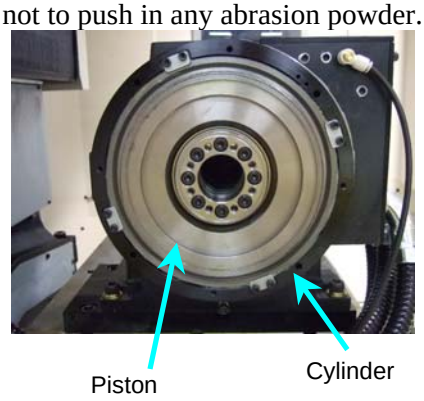
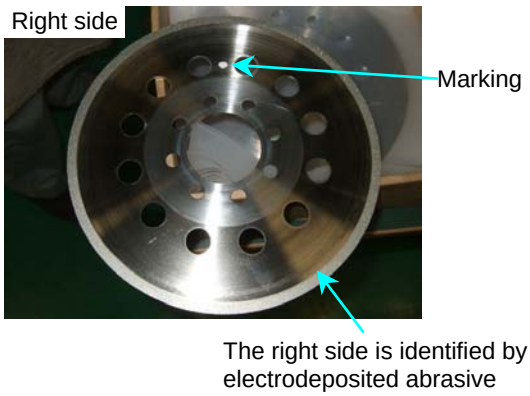
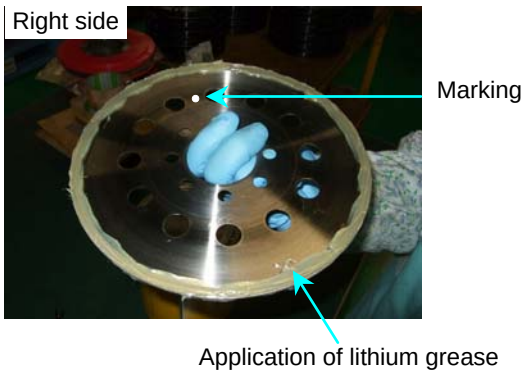


Fig. 33.6.5 (b) View with the brake disk removed

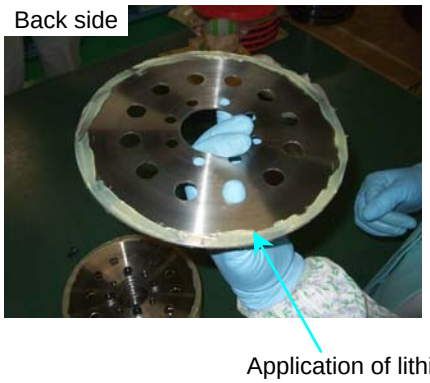
(7) Apply grease to the new brake disk. Before this, carry out marking as shown in the following figure to identify the surface (right side) on which electrodeposited abrasive grains are present when applying lithium grease onto both sides.



(8) Apply lithium grease to the range of electrodeposited grains on the surface (right side).



(9) Apply lithium grease to the range of electrodeposited grains on the surface (back side).



(10) Mount the brake disk to which grease was applied.
(11) Mount the disk holder. When mounting, make sure that the phase of the tap is the same as when the holder was detached.
(12) Mount the new rear plate. Pay attention to the phase of the tap for mounting the rear plate jig.
(13) Tighten the four long bolts to fasten the rear plate to the casting. The positions of the bolts are shown below. When tightening the bolts, replace the seal washers with new ones. Also, apply a thin coat of lithium grease (ALVANIA GREASE S2 or equivalent) to the surfaces of the seal washers.
(14) Tighten the four short bolts. When tightening the bolts, replace the seal washers with new ones. Also, apply a thin coat of lithium grease to the surfaces of the seal washers.

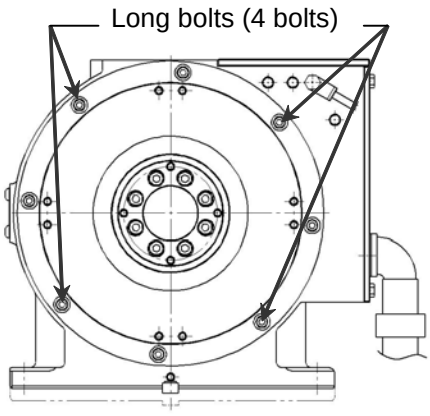


Fig. 33.6.5 (c) Positions of the bolts

(15) Supply air and determine whether clamping and unclamping operate normally by instructing M71 and M72.
(16) Put the rotary joint and other parts you removed in replacing the brake disk back to their respective original places.

33.6.6 Replacing the Oil Seal (Rear Side)

Described below is the rear side oil seal replacement procedure.

> ⚠ **WARNING**
> Before replacement, it is necessary to eliminate the load on the rotation axis of the DDR in the rotation direction applied by the weight of a jig, open the main breaker, and interrupt the air being supplied. Interruption of the air in the state where the load is applied in the rotation direction may rotate the DDR.

(1) If the rotary joint and other parts have not been detached, remove them.
(2) Remove the rear plate mounting bolts. There are two types of bolt - four long ones and four short ones; remove bolts of both types.
(3) Detach the rear plate.
(4) Take out the oil seal from the rear plate, and insert a new oil seal. Before inserting it, apply grease, as shown below. The grease must be lithium grease (ALVANIA GREASE S2 or equivalent). When inserting an oil seal, be careful about the direction.

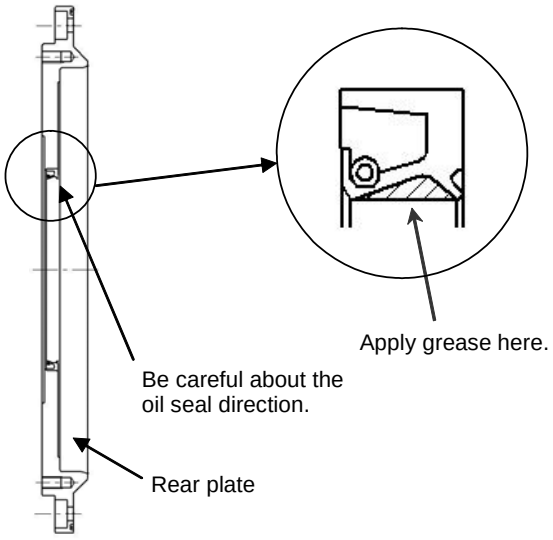


Fig. 33.6.6 Where to apply grease

(5) Mount the rear plate on the main unit. Before tightening the bolts, replace the seal washers for them and apply a thin coat of lithium grease to their surfaces.
(6) Put the rotary joint and other parts you removed in replacing the oil seal back to their respective original places.

33.6.7 Replacing the Oil Seal (Front Side)

Described below is the front side oil seal replacement procedure.

(1) Remove the jig from the shaft or end plate.
(2) If the end plate is mounted, remove it.
(3) Remove the oil seal holder mounting screw.
(4) Detach the oil seal holder.
(5) Take out the oil seal from the oil seal holder, and insert a new oil seal. Before inserting it, apply grease, as shown below. The grease must be lithium grease (ALVANIA GREASE S2 or equivalent). When inserting an oil seal, be careful about the direction.

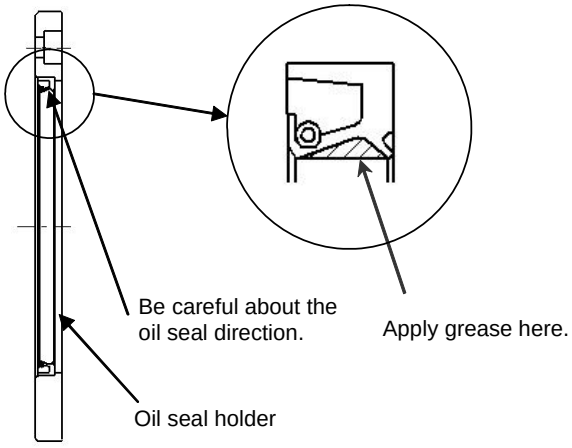


Fig. 33.6.7 Where to apply grease

(6) Mount the oil seal holder on the main unit.
(7) If the end plate has been detached, attach it. When attaching the plate, adjust the inner hole so as to minimize its runout.
(8) Put the jig you removed in replacing the oil seal back to its original place. Adjust the grid shift again as necessary.

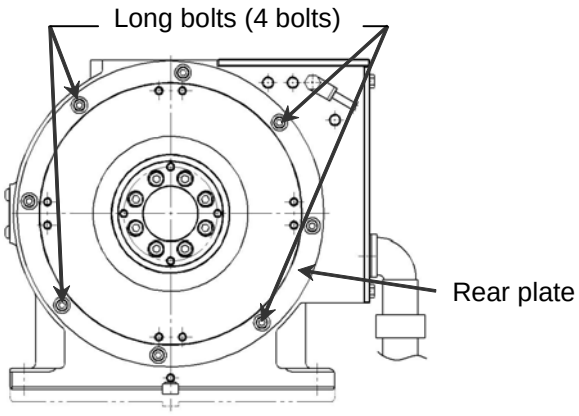
33.6.8 Replacing the Cylinder

Before replacing the cylinder, make sure that the circuit-breaker in the controller cabinet of the drill main body is in the OFF position and that the supply of power and air is shut off.

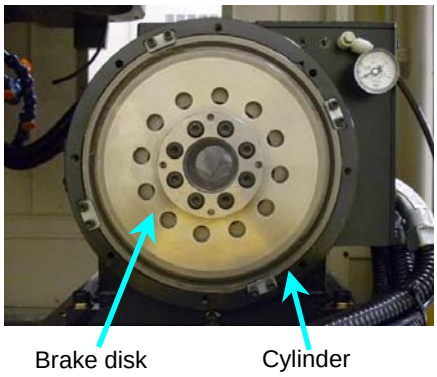
Described below is the cylinder replacement procedure.

> ⚠ **WARNING**
> Before replacement, it is necessary to eliminate the load on the rotation axis of the DDR in the rotation direction applied by the weight of a jig, open the main breaker, and interrupt the air being supplied. Interruption of the air in the state where the load is applied in the rotation direction may rotate the DDR.

(1) If the rotary joint and other parts have not been detached, remove them.
(2) Remove the rear plate mounting bolts. There are two types of bolt - long ones and short ones; remove bolts of both types.

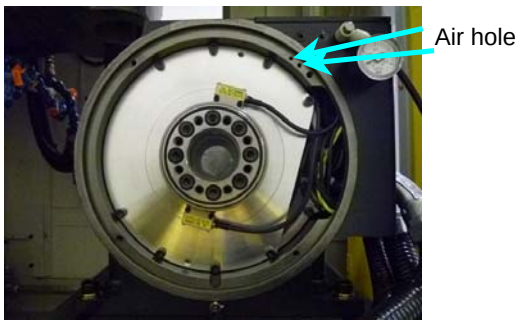


(3) Detach the rear plate.

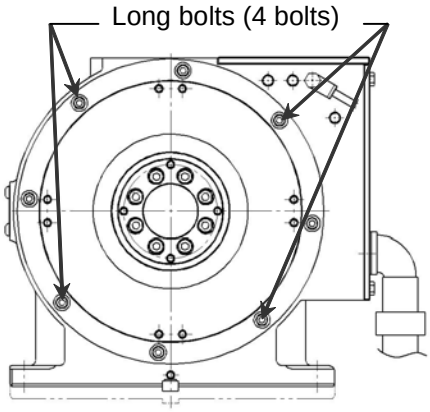


(4) Remove the eight disk holder mounting screw.
(5) Remove the disk holder.
(6) Remove the brake disk.
(7) Remove the cylinder.

(8) Mount the new cylinder. When mounting, be careful about the air hole phase and to prevent the O-ring from falling.



(9) Mount the brake disk and disk holder.
(10) Tighten the eight disk holder mounting bolts provisionally.
(11) Mount the rear plate. Pay attention to the phase of the tap for mounting the rear plate jig.
(12) Tighten the four long bolts to fasten the rear plate to the casting. The positions of the bolts are shown below.



(13) Tighten the four short bolts.
(14) Tighten the disk holder mounting bolts firmly.
(15) After the air supply, turn on the power.
(16) Issue M71 and M72 to check that clamping and unclamping operations are performed normally.
(17) Put the rotary joint and other parts you removed in replacing the cylinder back to their respective original places.

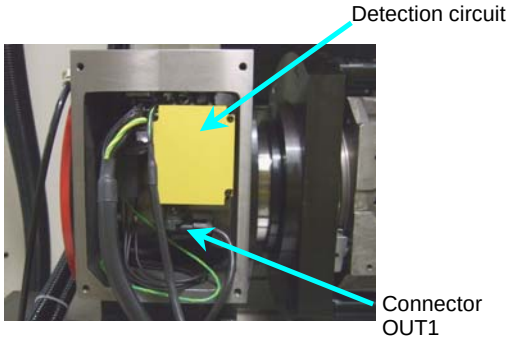
33.6.9 Replacing the Sensor

The αiCZ sensor consists of a sensor gear, a sensor head, and a detection circuit. Each of these components can be replaced individually.
Replacing the sensor involves opening the terminal box and removing the air path. When doing this, therefore, make sure that the circuit-breaker in the controller cabinet of the drill main body is in the OFF position and that the supply of power and air is shut off.

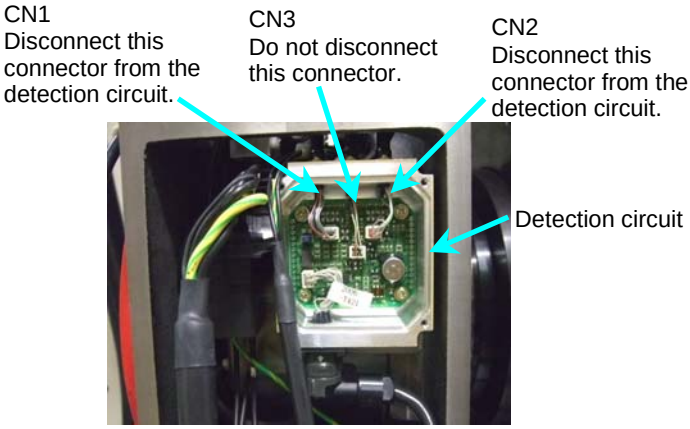
33.6.9.1 Replacing the sensor head

Described below is the sensor head replacement procedure.

(1) If the rotary joint and other parts have not been detached, remove them.
(2) Loosen the eight disk holder mounting screws to remove the disk holder.
(3) Remove the rear plate mounting bolts. Only the four long bolts must be removed.
(4) Remove the unit containing the rear plate, cylinder, and brake disk.
(5) Open the top and side covers of the terminal box, and remove the OUT1 connector connected to the detection circuit.

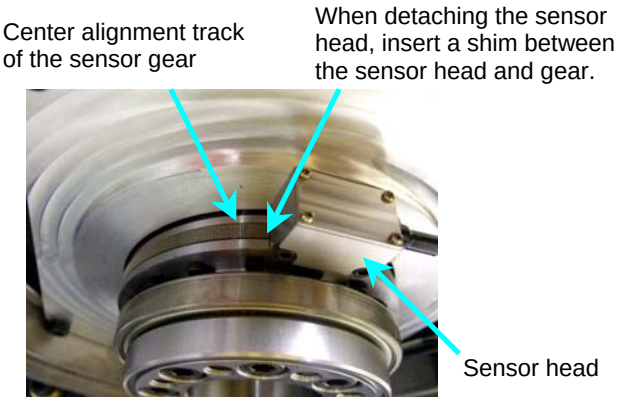


(6) Open the cover of the detection circuit, and pull out the connector of the sensor head to be replaced.

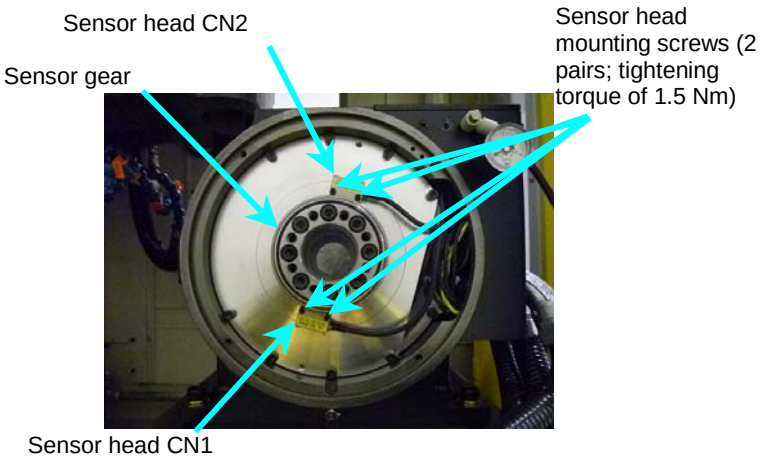


(7) Detach the sensor head from the sensor holder. When detaching, insert a 0.1-mm shim spacer between the sensor and sensor head before removing the screws. The sensor head is magnetized; an attempt to detach the sensor head with nothing inserted between the sensor and sensor head may cause the sensor head to bump against the sensor gear, damaging the sensor surface.

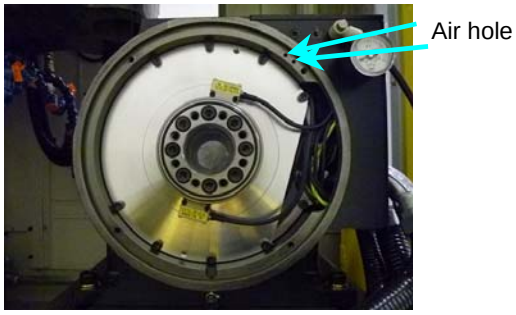
(8) Make sure that there is no sensor gear runout. Measure the center alignment track of the sensor gear. If the sensor gear runout is not less than 20 μm relative to the rotation axis, adjust the sensor gear runout.



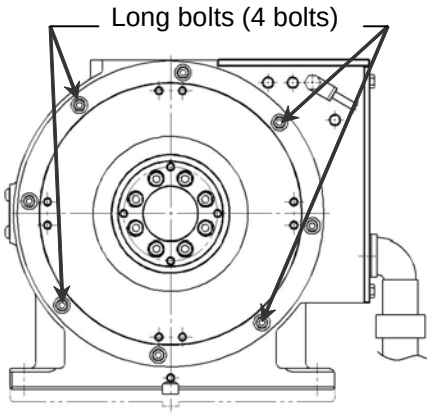
(9) Attach a new sensor head to the sensor holder. When attaching, insert a 0.1-mm shim spacer between the sensor gear and sensor head. The mounting screws are M3, and the tightening torque is 1.5 N·m. Apply a thin layer of LOCTITE 242 to the screws.



(10) Mount the cylinder. Be careful about the cylinder phase (especially, air hole phase). Make sure that the two O-rings for air hole sealing are not displaced and that the tap phase of the shaft is aligned with that of the brake disk.



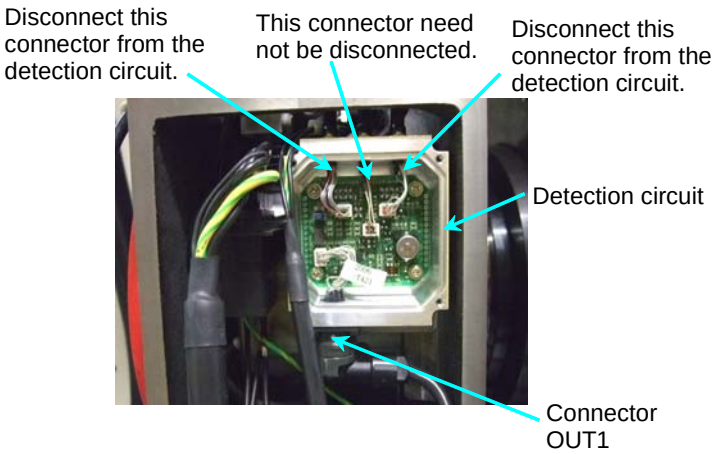
(11) Tighten the four long bolts to fasten the rear plate to the casting. The positions of the bolts are shown below.



(12) Tighten the eight disk holder mounting bolts.
(13) Turn on the power, and supply air.
(14) Change the value of parameter No. 2139B(A) to 0 to perform the pole position detection again.
(15) After turning the power off and then back on, perform the pole position detection.
(16) Make a reference position return.
(17) Issue M71(M171) and M72(M172) to check that clamping and unclamping operations are performed normally.
(18) Put the rotary joint and other parts you removed in replacing the sensor back to their respective original places.

33.6.9.2 Replacing the detection circuit

Described below is the detection circuit replacement procedure.
(1) Remove the top and side covers of the terminal box.
(2) Remove the cover of the detection circuit.
(3) Disconnect two connectors to the sensor head from the detection circuit. When doing this, be careful not to pull the cable. Note that the middle connector does not need to be disconnected.



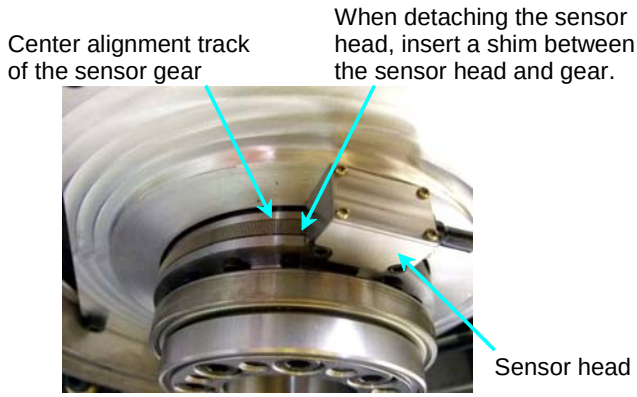
(4) Remove the M3 bolts, and detach the detection circuit from the mounting plate.
(5) Attach a new detection circuit to the mounting plate.
(6) Connect the connectors, disconnected in (3), to the new detection circuit. Be careful not to connect the connectors to the wrong places.
(7) Turn on the power.
(8) Change the value of parameter No. 2139B(A) to 0 to perform the pole position detection again.

(9) After turning the power off and then back on, perform the pole position detection.
(10) Make a reference position return.
(11) Issue M71(M171) and M72(M172) to check that clamping and unclamping operations are performed normally.

33.6.9.3 Replacing the sensor gear

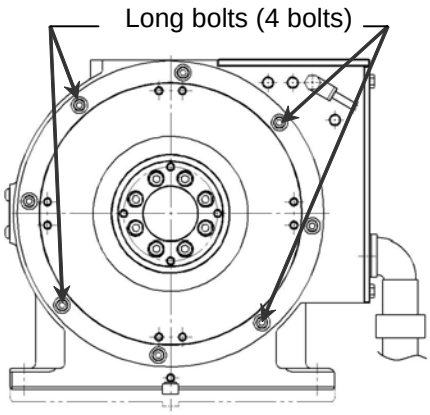
Described below is the sensor gear replacement procedure.

(1) If the rotary joint and other parts have not been detached, remove them.
(2) Loosen the eight disk holder mounting screws to remove the disk holder.
(3) Remove the rear plate mounting bolts. Only the four long bolts must be removed.
(4) Remove the unit containing the rear plate, cylinder, and brake disk.
(5) Remove the disk spacer.
(6) Detach the sensor head from each side temporarily, and move them to a place where they will not hinder the sensor gear replacement work. Before detaching the sensor head, insert a 0.1-mm shim spacer between the sensor head and sensor gear, so as to prevent the components from being damaged.
(7) Detach the sensor gear. The sensor gear is fastened with two types of bolt - hexagonal socket bolt and star-shaped socket bolt. Remove only the hexagonal socket bolt. Removing the star-shaped socket bolt causes the sensor gear to separate, disrupting the adjusted condition of the sensor gear.
(8) Attach a new sensor gear. Adjust the center alignment track so that runout does not exceed 10 μm. The tightening torque of the bolt is 1.3 N·m. Apply LOCTITE 242 to the tip of the screw.



(9) Attach the sensor head, detached temporarily from each side, as before. With a 0.1-mm shim spacer inserted between the sensor head and sensor gear, fasten the sensor head. The tightening torque of the bolt is 1.5 N·m. Apply LOCTITE 242 to the tip of the screw.
(10) Mount the cylinder. Be careful about the cylinder phase (especially, air hole phase). Make sure that the two O-rings for air hole sealing are not displaced and that the tap phase of the shaft is aligned with that of the brake disk.

(11) Tighten the four long bolts to fasten the rear plate to the casting. The positions of the bolts are shown below.



(12) Tighten the eight disk holder mounting bolts.
(13) Turn on the power, and supply air.
(14) Change the value of parameter No. 2139B(A) to 0 to perform the pole position detection again.
(15) After turning the power off and then back on, perform the pole position detection.
(16) Make a reference position return.
(17) Issue M71(M171) and M72(M172) to check that clamping and unclamping operations are performed normally.
(18) Put the rotary joint and other parts you removed in replacing the sensor back to their respective original places.

33.7 DDR-T

DDR-T is also available, which is supplied with peripheral units such as a tail support to easily attach a cradle-shaped jig to it.

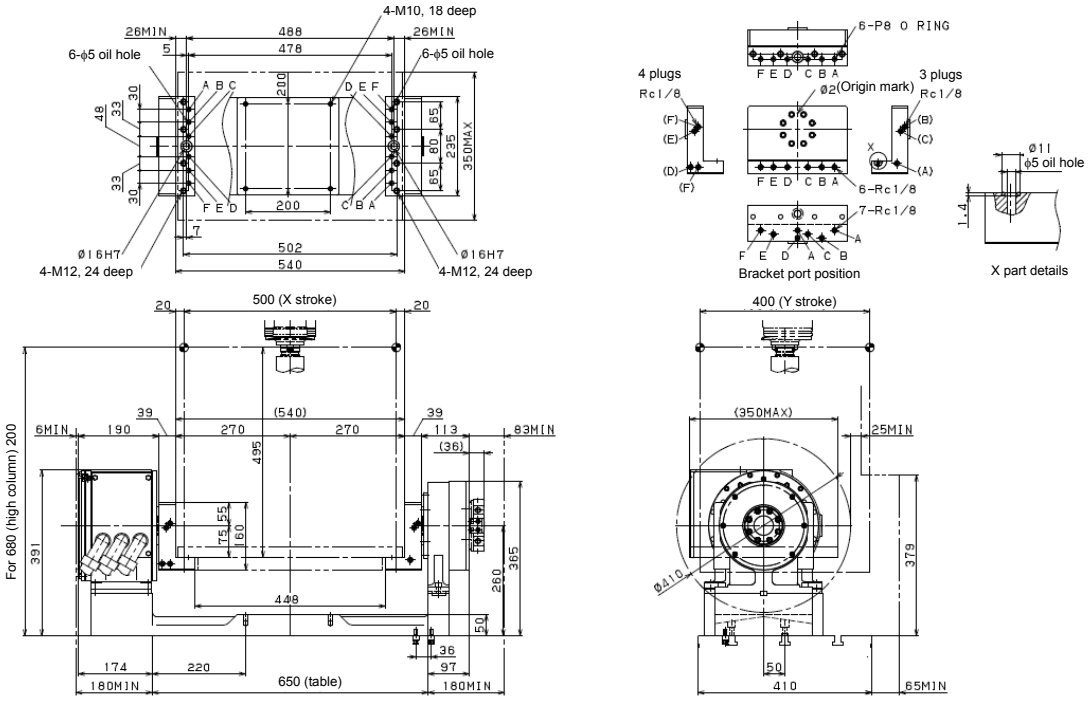
33.7.1 Specification

The following table lists the specification of the DDR-T.

	For X300	For X500	For X700
Drive method	Direct drive		
Cooling method	Not applicable		
Maximum torque	260 N·m		
Maximum table rotation speed	200 min^{-1}		
Cutting feedrate	1 to 30,000 deg/min		
Least input increment	0.001 degrees		
Indexing precision	±0.0028 degrees (±10 seconds)		
Clamp method	Air pressure		
Clamp torque	700 N·m (for an air pressure of 0.5 MPa)		
Spindle outside diameter	φ90 mm		
Spindle hole diameter	φ46 mm		
Turning radius	φ310 mm	φ410 mm	
Number of bracket ports	6 (oil/air)		
Maximum loading capacity	45 kg	100 kg	
Center height	200 mm	260 mm	
Main-body weight	155 kg	190 kg	200 kg

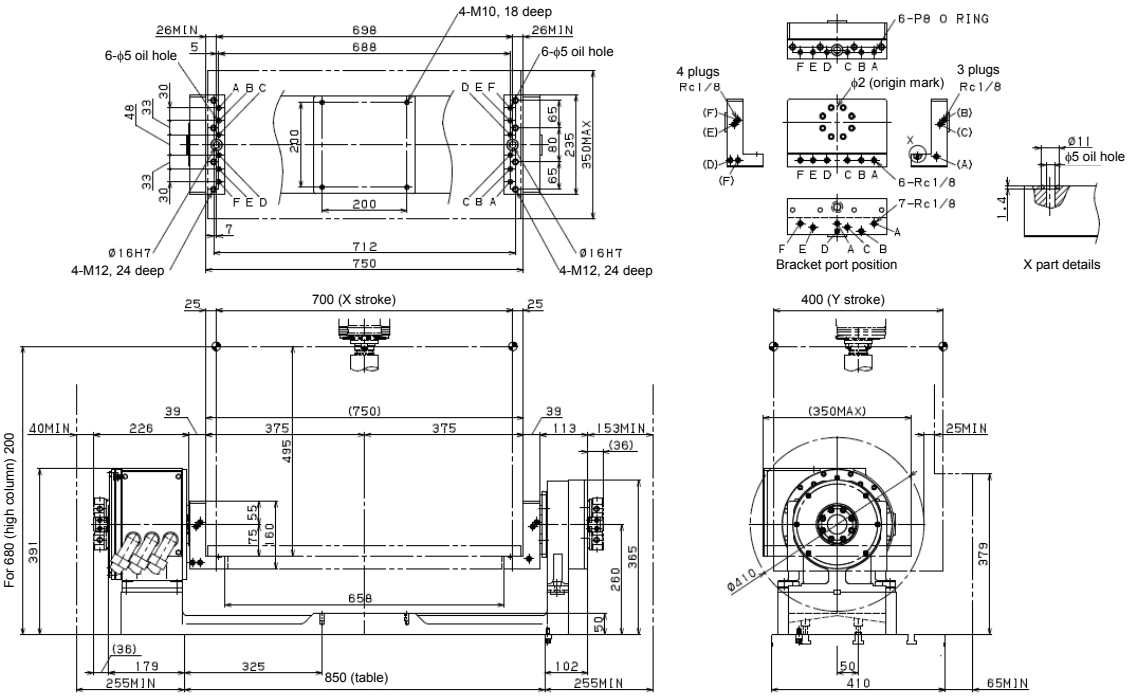
33.7.2 Appearance and Configuration of the DDR-T

This subsection shows the appearance and configuration of the DDR-T.



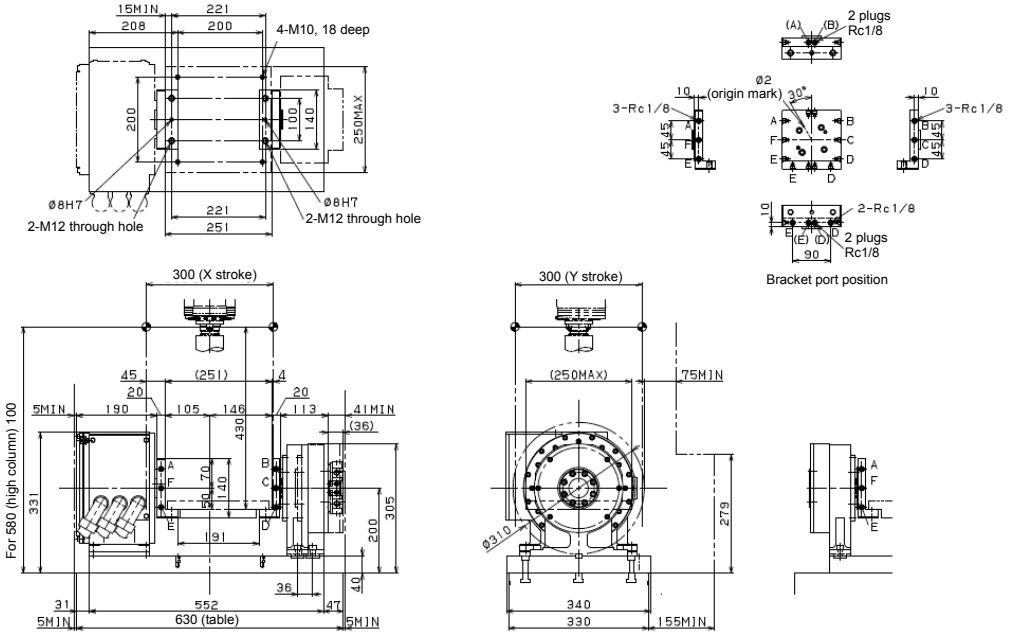
Note) 1. A to F in the figure are port positions when the rotary joint (option) is attached.

Fig. 33.7.2 (a) DDR-T appearance (for X500)



Note) 1. A to F in the figure are port positions when the rotary joint (option) is attached.

Fig. 33.7.2 (b) DDR-T appearance (for X700)



Note) 1. A to F in the figure are port positions when the rotary joint (option) is attached.

Fig. 33.7.2 (c) DDR-T appearance (for X300)

33.7.3 Installing the DDR-T

Described below is how to install the DDR-T.
If you separately purchased a tail support, which is part of the DDR-T, and installed it on the table, be sure to supply purge air at 5 ±2 kPa to the air purge inlet of the tail support. If no purge air is supplied, coolant fluid will get in the inside, leading to a risk of rotation failure, for example.
If the DDR-T is used with the X300, do not attach rotary joints to the both sides of it. If the DDR-T runs with rotary joints attached to the both sides of the DDR-T, they will interfere with the door, probably resulting in the DDR-T and door being damaged.

33.7.3.1 Precautions

> ⚠ **WARNING**
> Before starting to install wires and tubes, make sure, for safety purposes, that the circuit-breaker in the controller cabinet is in the OFF position and that the electricity and air supplies for the machine are shut off.

33.7.3.2 Detailed descriptions of work

(1) Place the DDR-T main unit on the table of the ROBODRILL and fix it at the table position shown in Fig. 33.7.2. When mounting the unit, make sure that there is no foreign material or burr on its mating surface.

(2) If the DDR-T is used with the X500 or X700, determine the position of the DDR-T by pushing the locator against the right end of the table.
For the X500, the mounting position of the locator varies as described below according to whether there is a rotary joint.
There is no rotary joint: Outside screw hole
There is a rotary joint on the support side: Outside screw hole
There is a rotary joint on the DDR side: Center-side screw hole
There is a rotary joint on each side: Center-side screw hole
For the X700, there is only one position for locator installation.

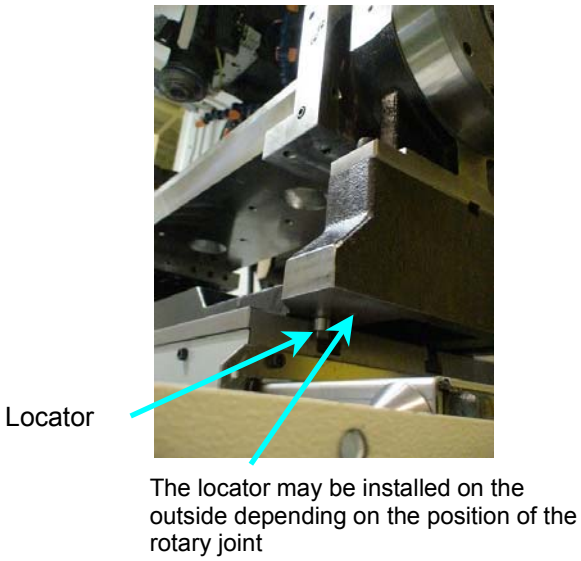


Fig. 33.7.3.2 (a) Locator mounting position

For the X300, use no locator for DDR positioning. Install the DDR by aligning its shaft rear end with the table end surface. If there is a rotary joint on the DDR side, align the rotary joint rear end with the table end face.

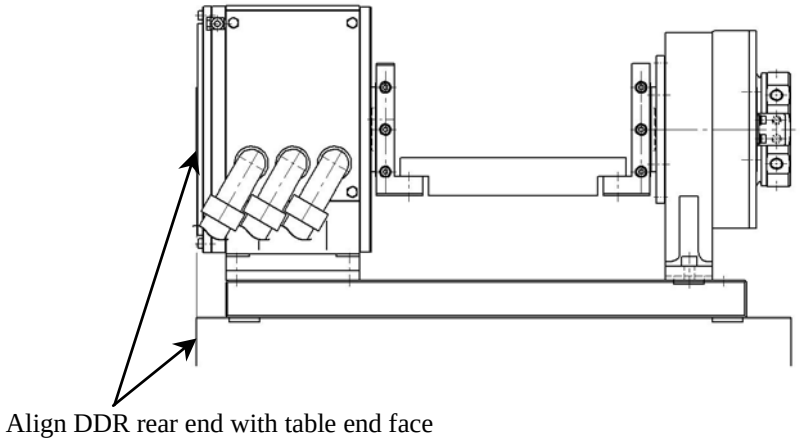


Fig. 33.7.3.2 (b) DDR-T mounting position (for the X300)

(3) After finishing X-direction positioning, fix the DDR-T on the table with the base plate pushed against the column side. Check the mounting precision by placing the DDR shaft in the position shown below and measuring the fluctuation of the swiveling plate while moving the X-axis.

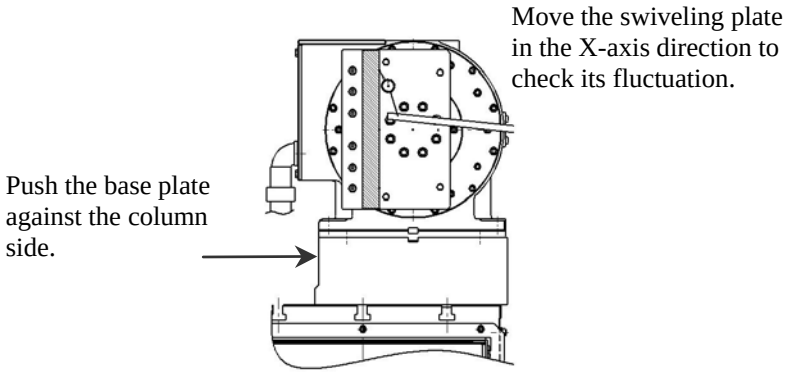


Fig. 33.7.3.2 (c) How to fasten the DDR-T

(4) Attach the cable holder on the upper left (or upper right depending on the location of the DDR-T) of the splash guard as viewed from the front of the machine and run the cables leading from the main unit through the upper left (or upper right) of the splash guard to the outside of the machine.
(5) Connect the signal, power, and IO lines of the DDR-T to the control unit cabinet. See Subsection 33.4.3, “Wiring and Air Tubing” for explanations about what and how to do.
(6) Connect air tube to the air unit of the ROBODRILL. Exchange the plug reducer with the Y joint (supplied) and connect the previous air tube and DDR air tube, respectively, to one side and the other side.

> **⚠WARNING**
> Before starting to install wires and tubes, make sure, for safety purposes, that the circuit-breaker in the controller cabinet is in the OFF position and that the electricity and air supplies for the machine are shut off.

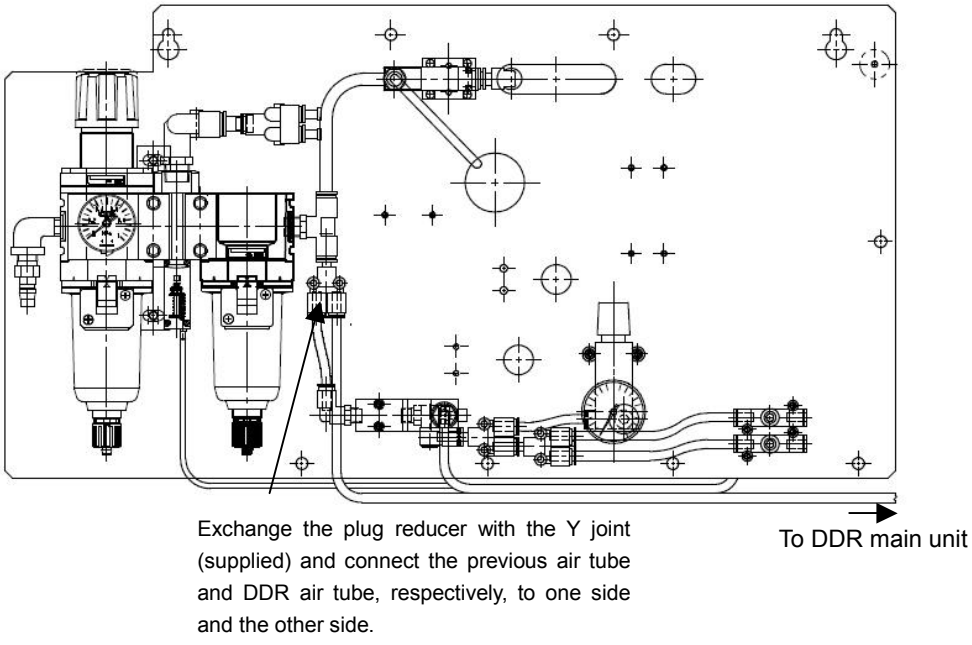


Fig. 33.7.3.2 (d) Air tubing

CAUTION
Be sure to connect the air tube from the position specified in the figure.
Otherwise, oil may get in the DDR, causing a failure.

(7) Using the black tube supplied together with the DDR-T, bifurcate the tube from the air unit to the DDR side and the support side as shown below.
For reference's sake, the colors of the supplied tubes identify their use.
Black tube: Air purge
White tube: Brake air

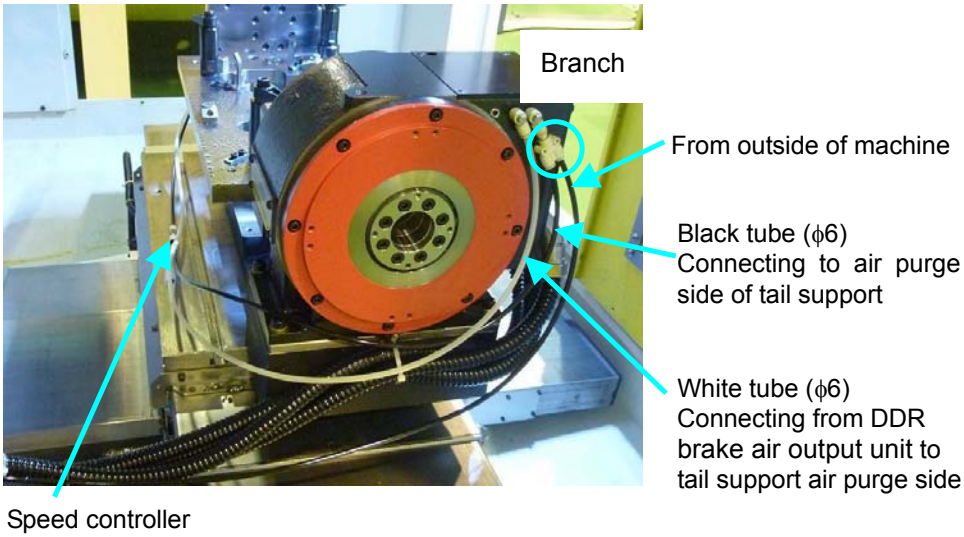


Fig. 33.7.3.2 (e) Air tubing

(8) After bifurcating the tube, attach a speed control in the middle of the tube leading to the support side.
The speed controller inserted in the middle of the black tube is factory-adjusted in such a way that an air purge pressure of 5 ± 2kPa is applied to the inside of the tail support. Be careful not to rotate the adjustment screw of the speed controller when laying wires. If you separately purchased a tail support, always apply an air purge pressure of 5 ± 2kPa to its air purge inlet.

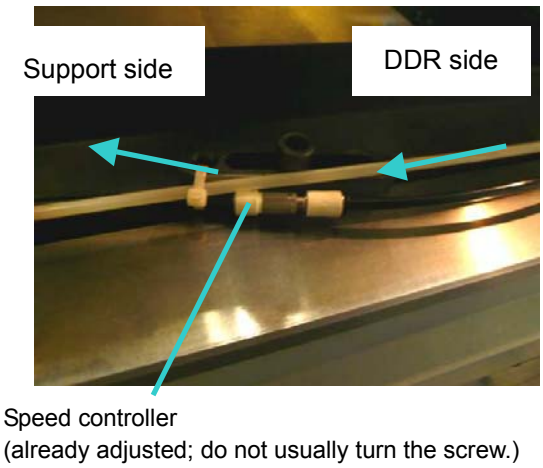


Fig. 33.7.3.2 (f) Attaching speed controllers

(9) After bifurcating, connect the tubes as shown below.

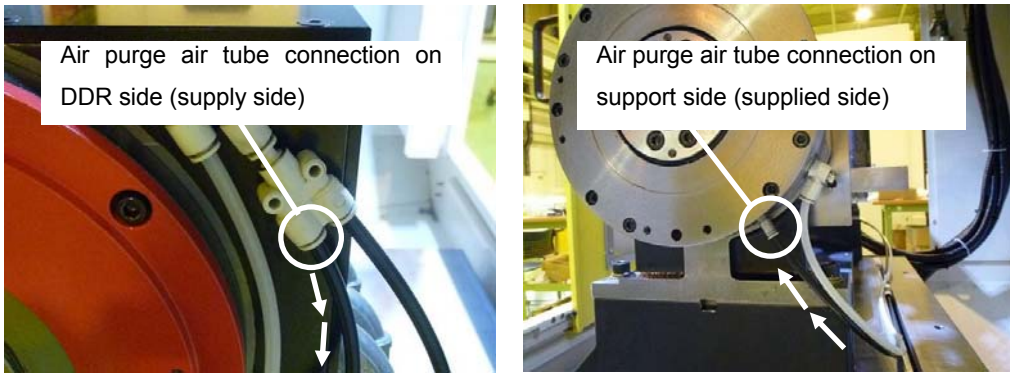


Fig. 33.7.3.2 (g) Air purge air tube (black) connection (DDR side on the left, support side the right)

(10) Connect the white tube as shown below so that brake air can be supplied from the DDR side to the support side.

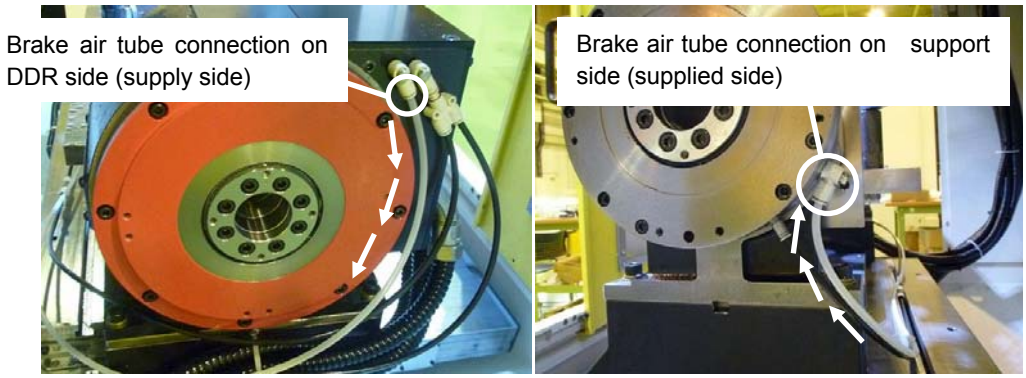


Fig. 33.7.3.2 (h) Brake air tube (white) connection (DDR side on the left, support side on the right)

(11) Adjust the air tube layout. Run the tube from the T slot groove of the table to the support side. If the tube layout is not properly adjusted, it is likely that the tube may hit rotating parts, resulting in the tube being broken. This is dangerous.
(12) Supply air to the air unit.
(13) After turning on the power, follow the items stated in Subsection 33.4.4, “Setting” to Subsection 33.4.8, “Checking Operations after Installation”.

33.8 ROTARY JOINT

The DDR and DDR-T have a dedicated rotary joint. Use the rotary joint properly by following the instructions given in this section.

33.8.1 Specification

The following table summarizes the specification of the rotary joint.

Number of ports	6
Fluid used	Air/machine oil (The passing of cutting fluid is not allowed.)
Maximum pressure	Air pressure 0.5 MPa Hydraulic pressure 5.0 MPa
Pipe thickness	36 mm (addition to the shaft length)
Pipe diameter	Rc1/4
Oil hole diameter	ϕ5 mm (PCD ϕ25 mm; P8 O-ring)
Effective cross-sectional area in the port	ϕ3.5 mm (minimum)
Recommended temperature range of machine oil	15°C to 50°C
Weight	6 kg

CAUTION
- The rotary joint can be attached to a DDR unit or DDR-T tail support to which the shaft length adjustment option is applied.
- The rotary joint specification differs depending on the shaft length of the DDR unit or DDR-T tail support.
  (The end face of the center port is adjusted so that it is 5.000 to 5.050 mm inside from the end face of the DDR unit or DDR-T tail support shaft or end plate.)
- When using oil and air pressures together, provide a drain port between the oil and air pressure ports to open them to the atmosphere.
- Make sure that the overshoot that occurs immediately after hydraulic or air pressure is supplied does not exceed the maximum pressure.
- Cutting fluid must not pass through the rotary joint.

33.8.2 Recommended Brands of Machine Oil

The following table lists the recommended brands of machine oil.

Manufacturer	Product name
JX Nippon Oil&Energy Corporation	FBK OIL RO 32 SUPER MULPUS 32
Exxon Mobil Corp.	Mobil DTE Oil Lite Mobil Hydraulic Oil Lite
Idemitsu Kosan Co., Ltd.	Daphne Hydraulic Fluid 32
Showa Shell Sekiyu K.K.	Shell Tellus S2M32

> ⚠ **DANGER**
> Do not use a low-ignition point machine oil (such as second class petroleum that ignites at below 70°C). Use of such oil may cause fire. The third class petroleum (ignition point: 70°C - 200°C), fourth class petroleum (ignition point: 200°C - 250°C), and fire-retardant machine oil (ignition point: 250°C or higher) may also catch fire. Therefore, due care must be taken as well when handling these types of machine oil.

> **SUPPLEMENT**
> - The recommended viscosity grade of the machine oil is ISO VG32.
> - The machine oil must have a pollution degree of NAS10 or lower.
> - The machine oil must be maintained properly according to the given instructions.

33.8.3 Rotary Joint Appearnace and Configuration

The appearance and configuration of the rotary joint are shown below.

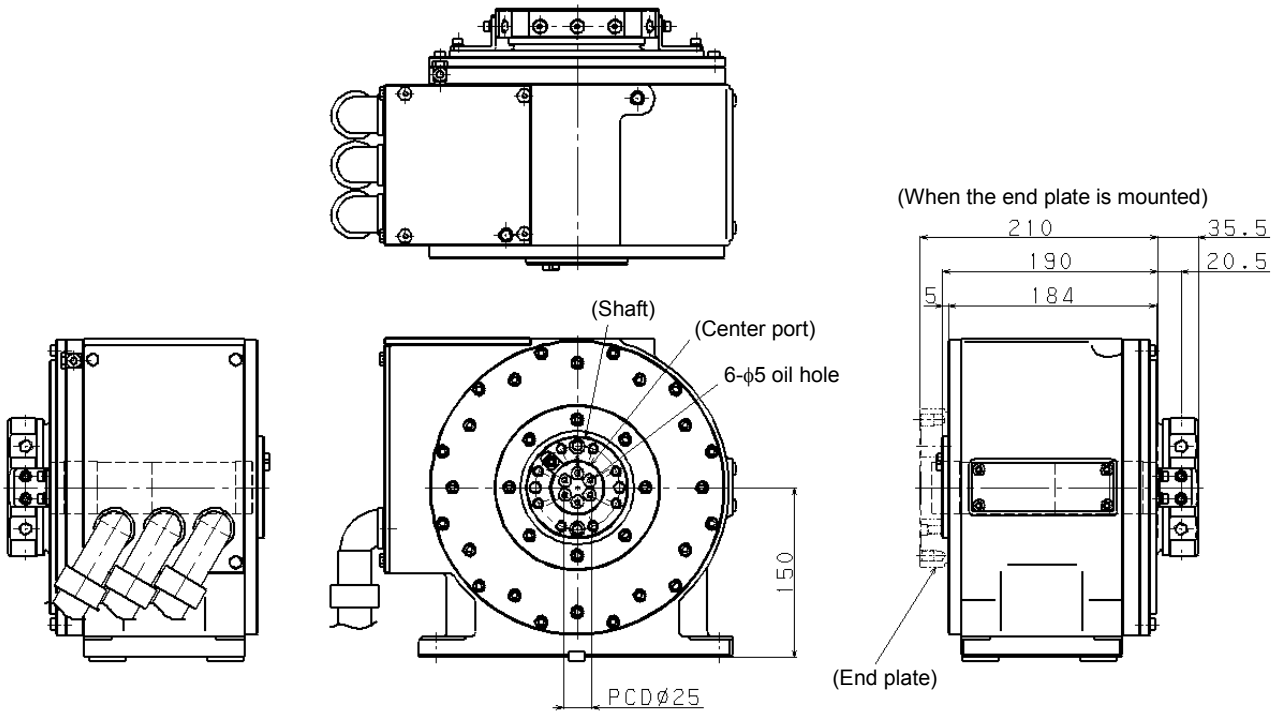
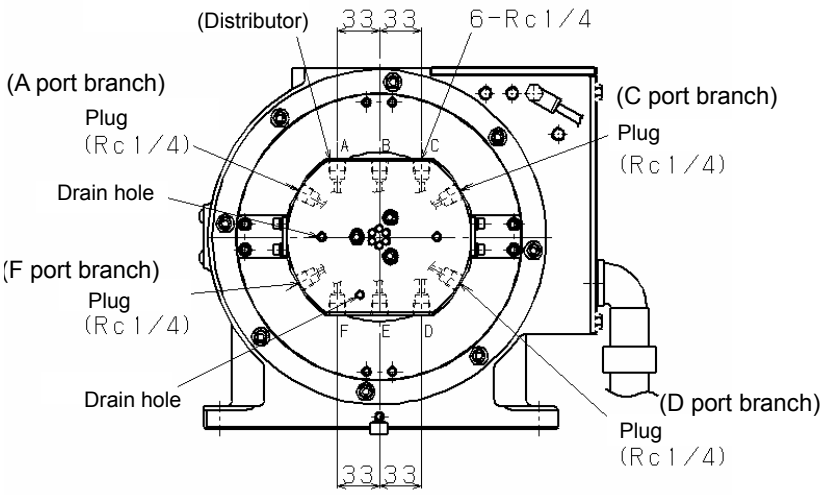


Fig. 33.8.3 (a) Rotary joint appearance



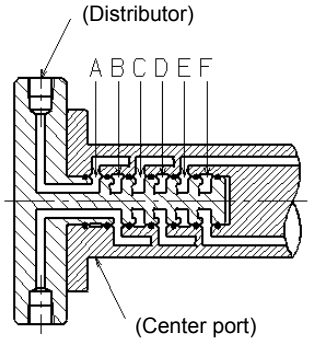
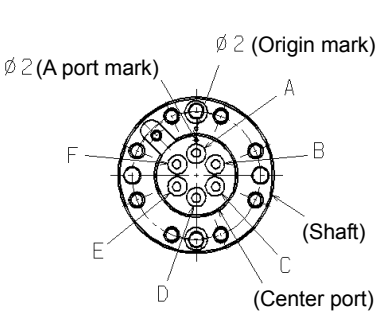
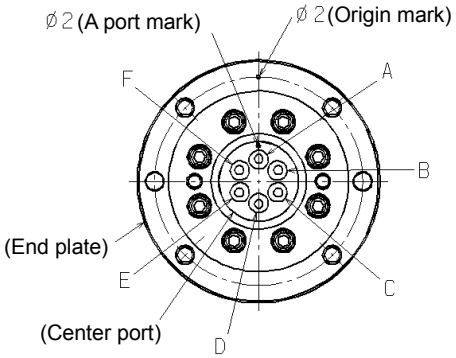


Fig. 33.8.3 (b) Distributor piping diagram **Fig. 33.8.3 (c) Internal layout of each port**



When the end plate is not mounted
For the DDR-T tail support

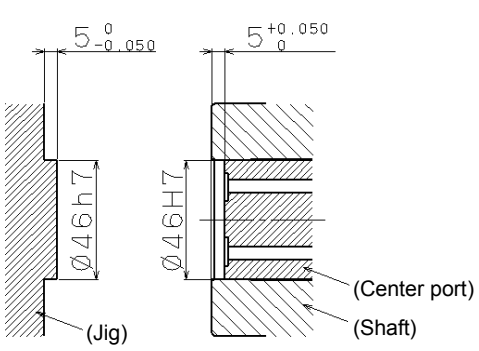


When the end plate (option) is mounted

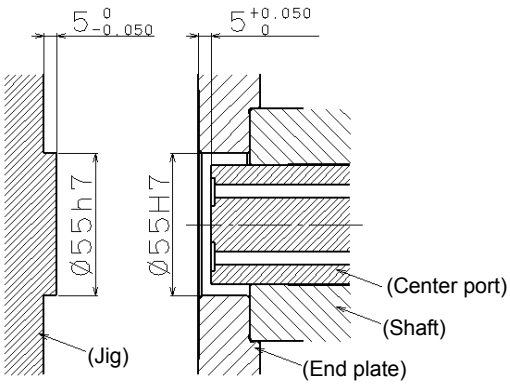
Fig. 33.8.3 (d) Phase of each port

33.8.4 Center Port In/Out Dimensions and Recommended Jig-Side Tolerance

The center port in/out dimensions and recommended jig-side tolerance are shown below.



When the end plate is not mounted
For the DDR-T tail support



When the end plate (option) is mounted

Fig. 33.8.4 (a) Center port in/out dimensions and recommended jig-side tolerance

33.8.5 Rotary Joint Components

The components of the rotary joint are shown below.

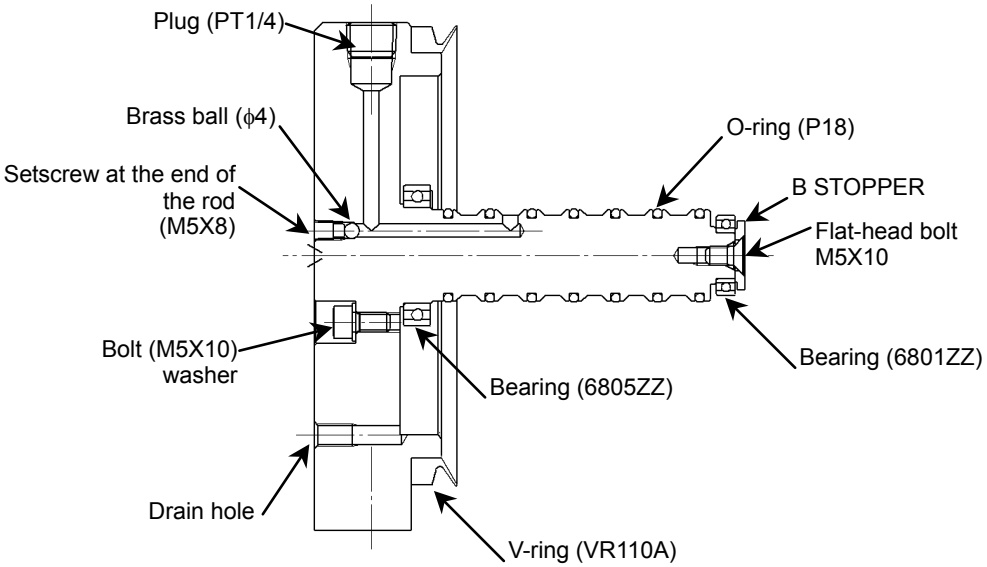


Fig. 33.8.5 (a) Cross-sectional view of the distributor

CAUTION

- The rotary joint has the flow path sealed with a brass ball (ϕ4) pushed in by a setscrew at the end of the rod (M5X8). Do not loosen or remove the setscrew at the end of the rod. Doing so may cause leakage.
- The setscrew at the end of the rod, on which LOCTITE 242 is applied, is pushed against the brass ball and tightened by being turned by 180°.

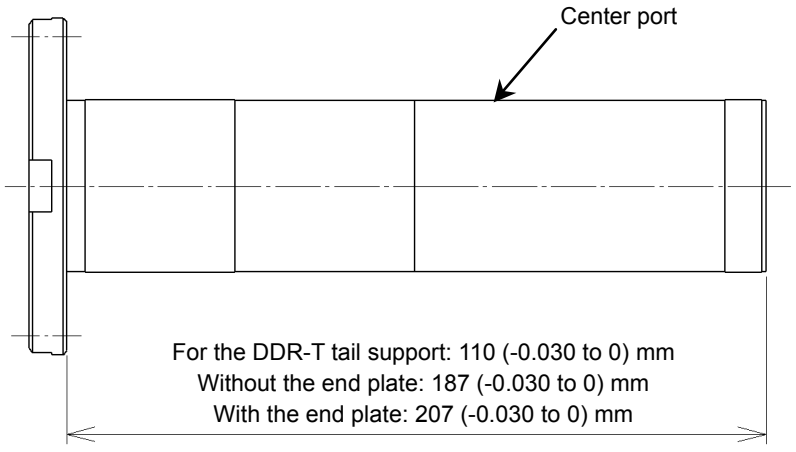
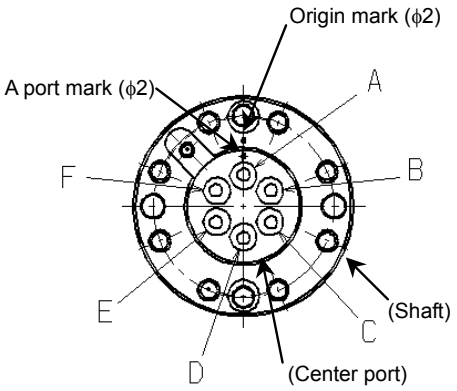


Fig. 33.8.5 (b) Center port appearance and shaft length

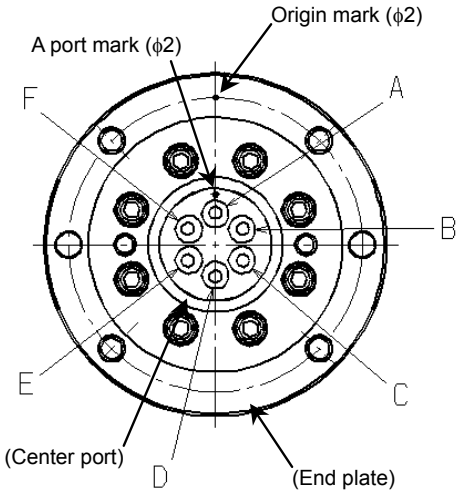
33.8.6 Mounting the Rotary Joint

Described below is the procedure for mounting the rotary joint.

(1) Insert the center port into the shaft of the DDR carefully, making sure that the phase of the A port mark of the center port matches that of the origin mark of the DDR.

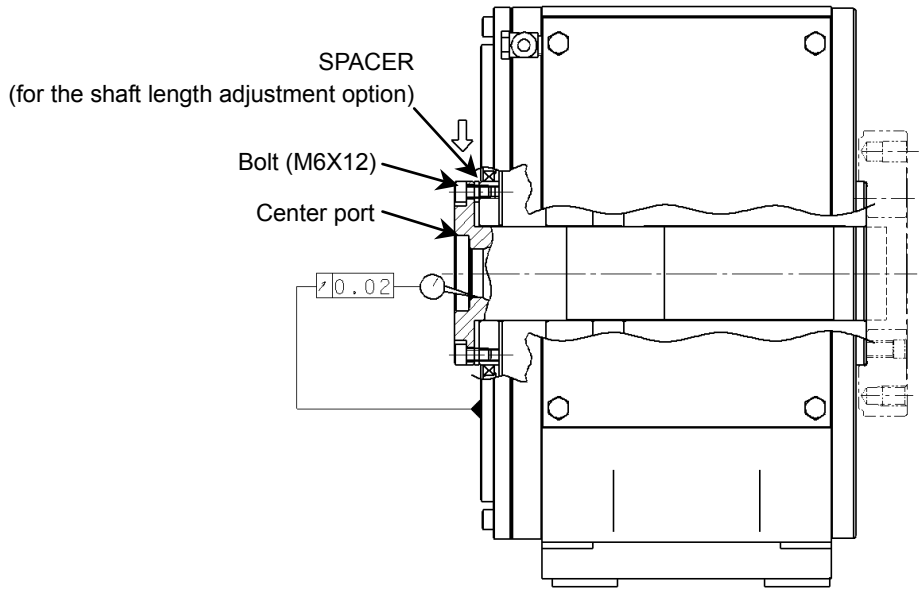


When the end plate is not mounted
For the DDR-T tail support

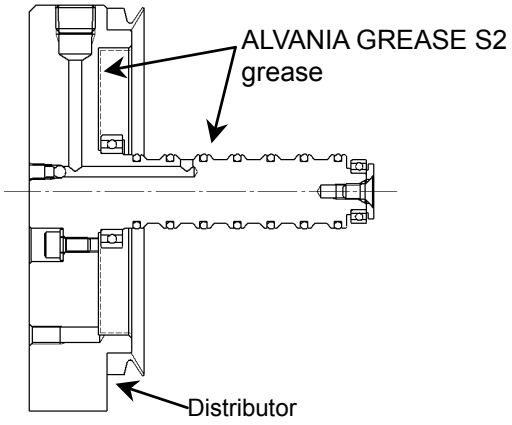


When the end plate (option) is mounted

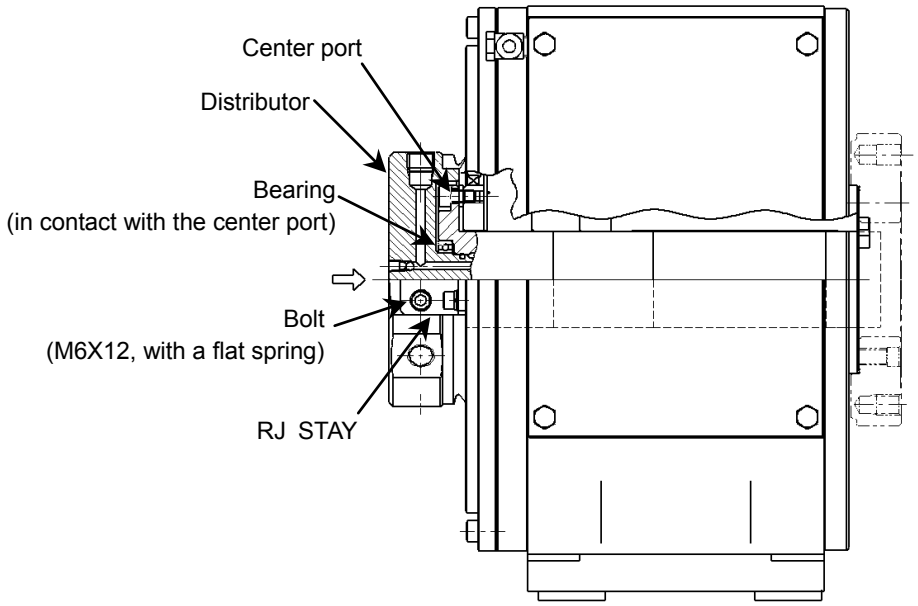
(2) Arrange so that the center port and the DDR unit or DDR-T tail support shaft are mounted concentrically. Rotate the DDR unit or DDR-T tail support and, if there is any inner surface runout for the center port (see below), correct it by hitting the outer circumference with a small hammer via a soft steel pole at the phase where the dial gauge reading becomes maximal. The bolt tightening torque is 14 N·m.



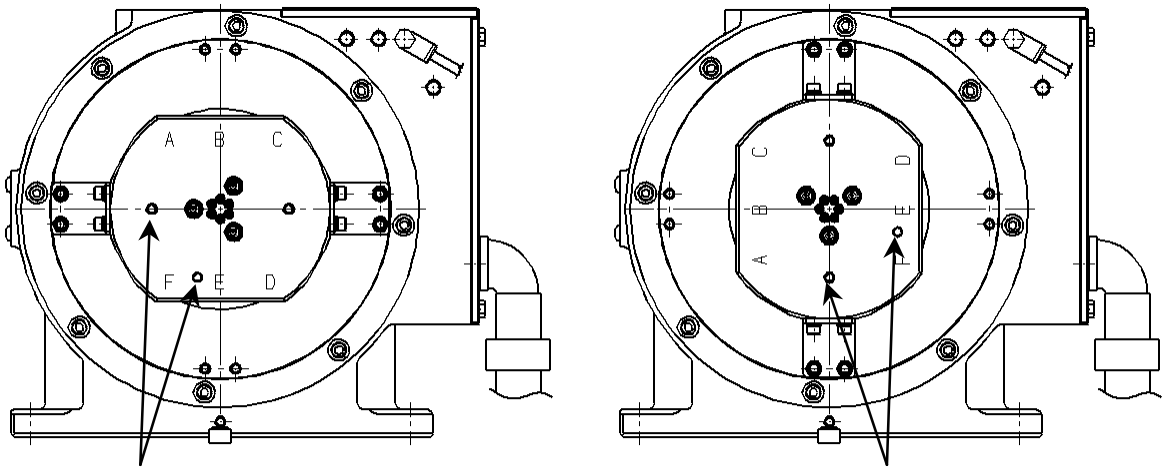
(3) Apply sufficient amounts of ALVANIA GREASE S2 grease to the O-ring and bearing outer circumference of the distributor and the inner circumference of the center port. Also, apply a thin layer of ALVANIA GREASE S2 grease to the inner end face of the distributor.



(4) Insert the distributor into the center port slowly until the bearing of the distributor comes into contact with the center port. Then, fasten the distributor with RJ STAY. The bolt tightening torque is 10 N·m.



(5) Fasten the distributor so that one of its two drain holes is in the bottom side.



Drain holes Drain holes

(6) Turn the DDR unit or DDR-T tail support several times both in the clockwise and counterclockwise directions so that the O-ring of the distributor fits snugly.
(7) Attach six O-rings (P8) to the tip of the center port.

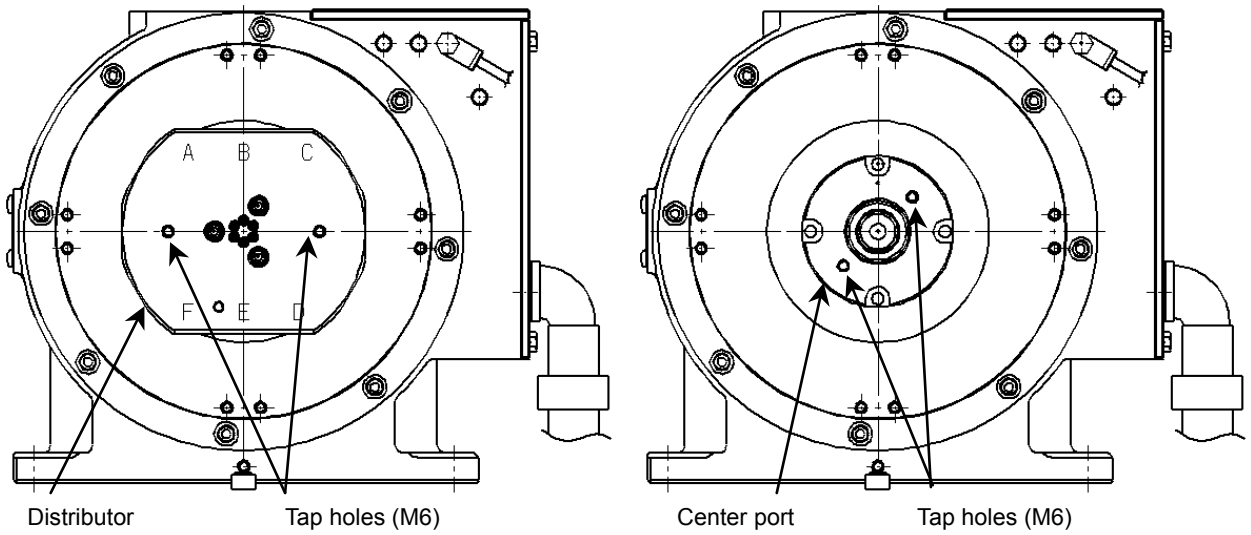
CAUTION
- Perform the procedure carefully so as to prevent the distributor, center port, and O-rings from being damaged.
- Do not block the drain holes with plugs or other materials.

33.8.7 Unmounting the Rotary Joint

Described below is the procedure for unmounting the rotary joint.
Before performing this procedure, make sure that hydraulic or air pressure is not being supplied to the rotary joint.

(1) Check that hydraulic or air pressure is not being supplied to the rotary joint, and disconnect all the pipes to the distributor.
(2) Remove RJ STAY fastening the distributor.
(3) Pull out the distributor slowly.
(4) Remove the bolt fastening the center port, and then pull out the center port slowly from the DDR unit or DDR-T tail support shaft.
(5) Remove the shaft length adjustment option ring.

If you have trouble unmounting the rotary joint, insert bolts into the tap holes shown in the figure below and pull out the joint.



⚠ WARNING
Before unmounting the rotary joint, make sure that hydraulic or air pressure is not being supplied to it.

CAUTION
- Do not let the pull-out bolts penetrate to come into contact with any of the components in the back. Doing so may damage the components.
- Perform the procedure carefully so as to prevent the distributor, center port, and O-rings from being damaged.

33.8.8 Periodic Maintenance of the Rotary Joint

33.8.8.1 Daily inspection

Described below is the daily inspection procedure for the rotary joint.

(1) Check the drain port to see whether there is any oil leakage.
A massive oil leakage indicates that the O-ring may be damaged. If so, replace the O-ring.

(2) Check that there is no abnormal noise while the DDR unit or DDR-T tail support is rotating.
If the abnormal noise stops when you remove the distributor as instructed in Section 33.8.7, "Unmounting the Rotary Joint", one of the likely causes is a damaged bearing of the rotary joint. If the bearing of the rotary joint is explicitly damaged, replace it.

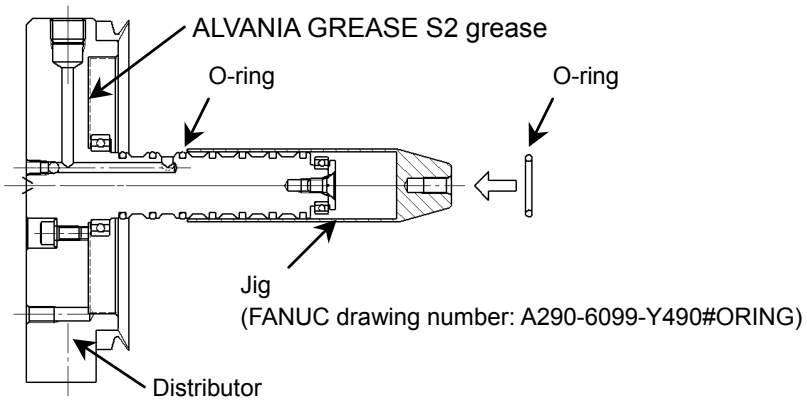
SUPPLEMENT

- After the rotary joint is put into use, a relatively extensive oil leakage may often be observed until the O-ring fits snugly. This phenomenon itself is not abnormal.
- The bearing of the rotary joint can continue to be used even if it gives a certain degree of roughness when rotated individually by hand.

33.8.8.2 Replacing the O-ring

Described below is the O-ring replacement procedure.

(1) Remove the distributor as instructed in Section 33.8.7, "Unmounting the Rotary Joint".
(2) When detaching the O-ring of the distributor, use a small pallet or other similar tool to prevent the O-ring groove from being damaged.
(3) After cleaning the O-ring groove, apply the ALVANIA GREASE S2 grease to the O-ring groove, the new O-ring (P18), and the inner end face of the distributor.
(4) Attach the O-ring by using an appropriate jig so as to prevent it from being damaged.
(5) Apply the ALVANIA GREASE S2 grease to the outer circumference of the O-ring again.
(6) Mount the distributor as instructed in Section 33.8.6, "Mounting the Rotary Joint".



CAUTION

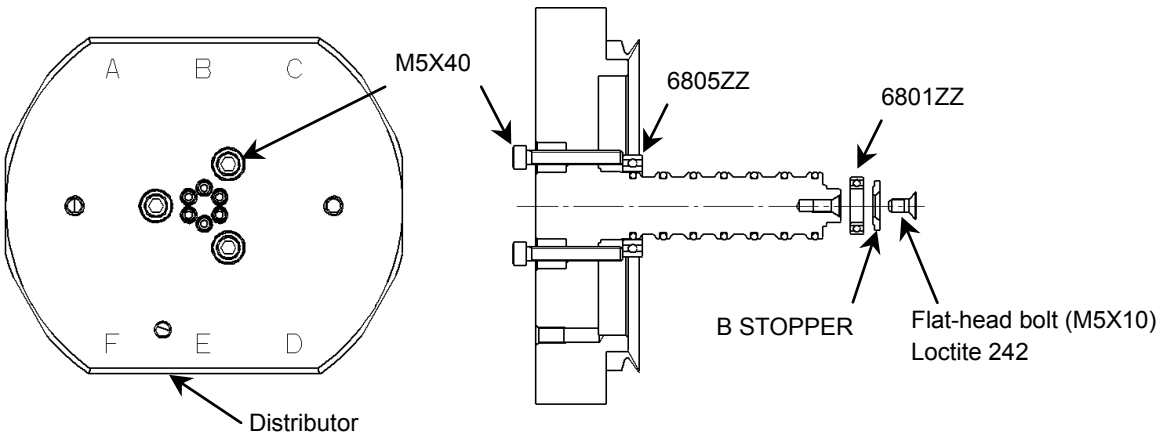
Perform the procedure carefully not to damage the O-ring or O-ring groove.

SUPPLEMENT
- After the O-ring is replaced, a relatively extensive oil leakage may often be observed until the O-ring fits snugly. This phenomenon itself is not abnormal.
- The grease around the O-ring may turn black as the O-ring fits. This phenomenon itself is not abnormal.

33.8.8.3 Replacing the bearing

Described below is the bearing replacement procedure.
If the rotation is not smooth because the bearing is worn or otherwise damaged, replace the bearing. Once you remove the bearing, do not use it again.

(1) Remove the distributor as instructed in Section 33.8.7, "Unmounting the Rotary Joint".
(2) A small-diameter bearing (6801ZZ) can be detached by removing the B STOPPER.
(3) Apply the ALVANIA GREASE S2 grease to the inner ring and shaft of the new bearing (6801ZZ), and attach the bearing by pushing only its inner ring.
(4) Using a flat-head bolt to which LOCTITE 242 is applied, attach the B STOPPER.
(5) A large-diameter bearing (6805ZZ) can be detached by first removing the M5X10 bolt in the counterboring hole of the distributor temporarily and then tightening all the three M5X40 bolts evenly. When done, tighten the M5X10 bolt again.
(6) Apply the ALVANIA GREASE S2 grease to the inner ring and shaft of the new bearing (6805ZZ), and push the bearing all the way until the stopper is contacted, by using the jig that touches only the inner ring (FANUC drawing number: A290-6099-Y490#BRING).
(7) Mount the distributor as instructed in Section 33.8.6, "Mounting the Rotary Joint".



CAUTION
When attaching the bearing, use the jig that touches only the inner ring of the bearing. If a force exceeding the rated load is applied on the outer ring of the bearing when the bearing is attached, the bearing may be damaged.

33.9 MAINTENANCE PARTS

33.9.1 Maintenance Parts Lists

(1) The following table lists the specifications of the DDR maintenance parts.

Parts	Specification	Quantity needed	Setting/ adjustment	Remarks
Rear plate	A290-6099-Y472	1	NA (not applicable)	For fixing rear oil seal
Oil seal holder	A290-6099-Y455	1	NA	For fixing front oil seal
Oil seal	A98L-0041-0006#09010006	2	NA	Oil seal (for both front and rear)
O-ring	A98L-0001-0347#S4	6	NA	Air unit O-ring
O-ring	A98L-0001-0347#S255	1	NA	Rear plate O-ring
O-ring	A98L-0001-0347#S230	1	NA	Oil seal holder O-ring
O-ring	JB-R1AG120	1	NA	End plate O-ring
O-ring	A290-6099-Y475	1	NA	Terminal box O-ring
O-ring	A290-6099-Y478	1	NA	Terminal box O-ring
Seal washer	A30L-0001-0048#6SUS	8	NA	Used for rear plate mounting
Cylinder assembly	A290-6099-V465#STD	1	NA	
Joint	A97L-0201-0606#L6-6-T	1	NA	
Brake disk	A290-6099-Y470	1	NA	
Disk holder	A290-6099-Y471	1	NA	
Air valve	A290-6099-V476#STD	1	Adjusted	For clamping and unclamping
Cable	A04B-0099-H181#STD	1	NA	Including power lines, signal wires, IO cables, and air tubes
Air tube	A97L-0132-0718#55006F	1	NA	5.5-m, ϕ6 black tube
αiCZ sensor	A860-2162-T412	1	Adjusted	Set consisting of the sensor, sensor gear, and detection circuit
Sensor head 1	A860-2162-V002	1	NA	Sensor heads 1 and 2 used in combination
Sensor head 2	A860-2162-V013	1	NA	Sensor heads 1 and 2 used in combination
Detection circuit	A860-2162-V202	1	NA	
Sensor gear	A860-2160-V901	1	NA	
Bearing	A97L-0001-0192#16Z0M0H	1	NA	Support Bearing
Joint	A97L-0201-0606#P68-Y	1	NA	Y joint for air unit
Key	A290-6099-Y463	1	NA	

(2) The following table lists the specifications of the maintenance parts of the DDR rotary joint.

Parts	Specification	Quantity needed	Setting/ adjustment	Remarks
Bearing	A97L-0001-0192#01Z000A	1	NA	6801ZZ, CN clearance
Bearing	A97L-0001-0192#05Z000A	1	NA	6805ZZ, CN clearance
O-ring	JB-R1AP8	6	NA	P8, rank 1 A parts
O-ring	JB-R1AP18	7	NA	P18, rank 1 A parts
V-ring	A98L-0005-0306#VR110	1	NA	VR110A
Setscrew	A97L-0132-0272#5X8B	6	Applicable	M5X8, setscrew at the end of the rod
Ball	A97L-0201-0733#4.0	6	Applicable	ϕ4 brass ball

(3) The following table lists the specifications of the maintenance parts of the DDR-T.

Parts	Specification	Quantity needed	Setting/ adjustment	Remarks
Joint	A97L-0201-0606#P66-Y	1	NA	
Joint	A97L-0201-0606#L6-6-T	1	NA	
Air tube	A97L-0132-0718#18006FW	1	NA	
Air tube	A97L-0132-0718#15006F	1	NA	
Speed controller	A97L-0203-0499#0666	1	Adjustment needed	
Brake disc	A290-6099-Z470	1	NA	
O-ring	JB-R1AP8	12	NA	
Pin	JB-PHB8-0181	2	NA	

33.10 AIR DISTRIBUTION DIAGRAMS

33.10.1 Air Tubing Diagram

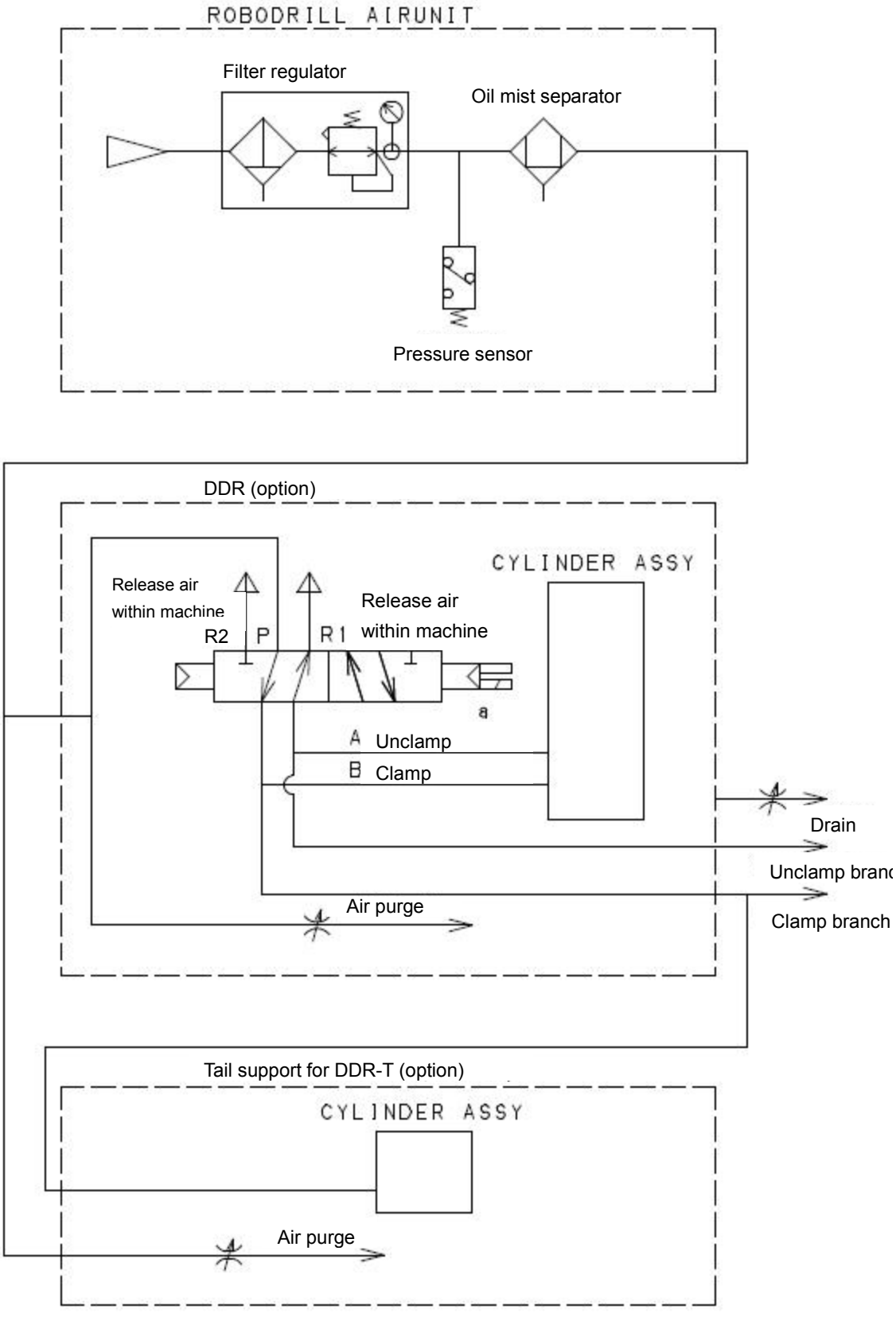


Fig. 33.10.1 Air tubing diagram

CAUTION
- An air purge pressure of 5 kPa is always (even when there is no air output) applied to the DDR-T clamp and unclamp branches in order to prevent extraneous material from getting in the tubes.
- When using support spindles produced by any other manufacturers, do not use the DDR-T clamp or unclamp branch. To clamp or unclamp such support spindles, get an air valve ready separately.

33.11 DDR CONTROL

Described below is each control function of the DDR.

As for the B-axis, that is, the DDR, in the same manner with the X-, Y-, and Z-axes, the machine can be operated only manually if the front door is open; it can run in the handle mode or at or below a travel speed of 600 degrees/min.

33.11.1 Grid Shift

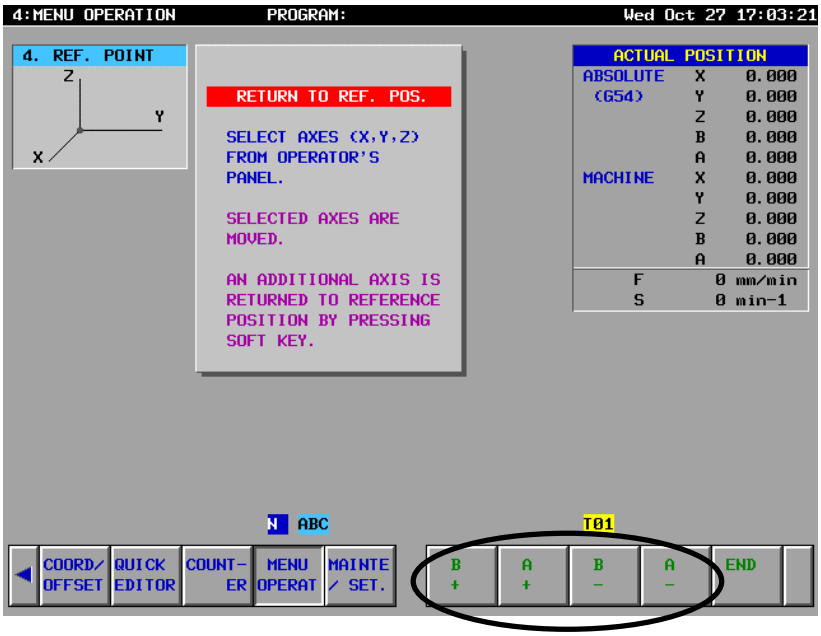
Specifying an amount of grid shift with No. 1850B(A) can shift the reference position (zero point).

SUPPLEMENT
- Once you changed an amount of grid shift, you need to turn the power off and on again.
- Specify a range of 0 to ±180000.
  If you want to shift the table origin by 1°, specify “1000”.

33.11.2 Operations

(1) Reference position return (moving to the machine zero point)

Make a reference position return, using QUICK screen – “4. MENU OPERATION” – “4. REF. POINT” screen.



Pressing the soft key [B+] or [B-] and the soft key [A+] or [A-] makes a reference potion return (shifting to the machine origin), respectively, on the fourth- and fifth-axis DDRs.
(Pressing either the [+] or [-] key causes the axis to move toward the negative side.)
Keep pressing the soft key until a reference position return is completed.

> When a door of the machine is open, the travel speed of the additional axis is limited to within 600 degrees/min.

(2) Inhibiting axis movement (interlocking)

The following restrictions apply to use of B- and A-axis clamping/unclamping.

Clamping:

- X-, Y-, and Z-axes ⇒ Axis movement is not inhibited.
- B- and A-axes ⇒ Axis movement is inhibited.

Unclamping:

- X-, Y-, and Z-axes ⇒ Whether to inhibit axis movement can be specified.
- B- and A-axes ⇒ Axis movement is not inhibited.

(3) Clamping/unclamping

B-axis

Clamp command: M71 (or M10). Unclamp command: M72 (or M11).

To use a clamping/unclamping operation, issue M72 or M11 (unclamp command) before the B-axis starts moving, and M71 or M10 (clamp command) after the B-axis has stopped moving.

A-axis

Clamp command: M171 (or M68). Unclamp command: M172 (or M69).

Likewise, issue M172 or M69 (unclamp command) before the A-axis starts moving, and M171 or M68 (clamp command) after the A-axis has stopped moving.

(4) Clamp check

B-axis

Clamp check: M70 (available only when keep relay K32#2 is 0) When keep relay K32#2 is 1, the clamp check is included in the clamp command M71.

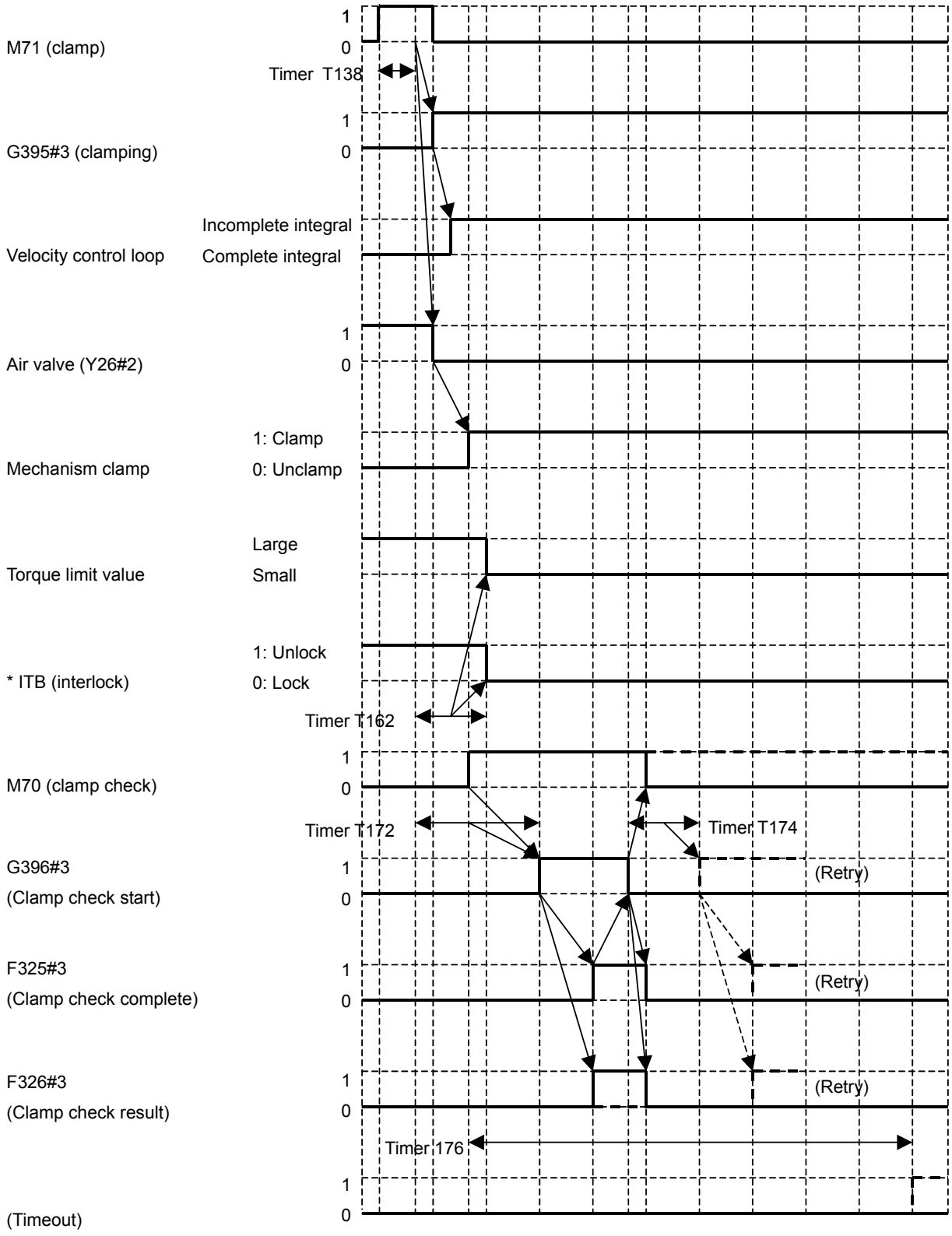
M10 performs the clamp check after the clamping operation, regardless of the value of the keep relay.
To make M71 perform the clamp check after the clamping operation as well, change keep relay K32#2 as described above.
If keep relay K32#2=0, any axis other than the B-axis can be moved immediately after M71 is issued.

A-axis

Clamp check: M170 (available only when keep relay K54#5 is 0) When keep relay K54#5 is 1, the clamp check is included in the clamp command M171.

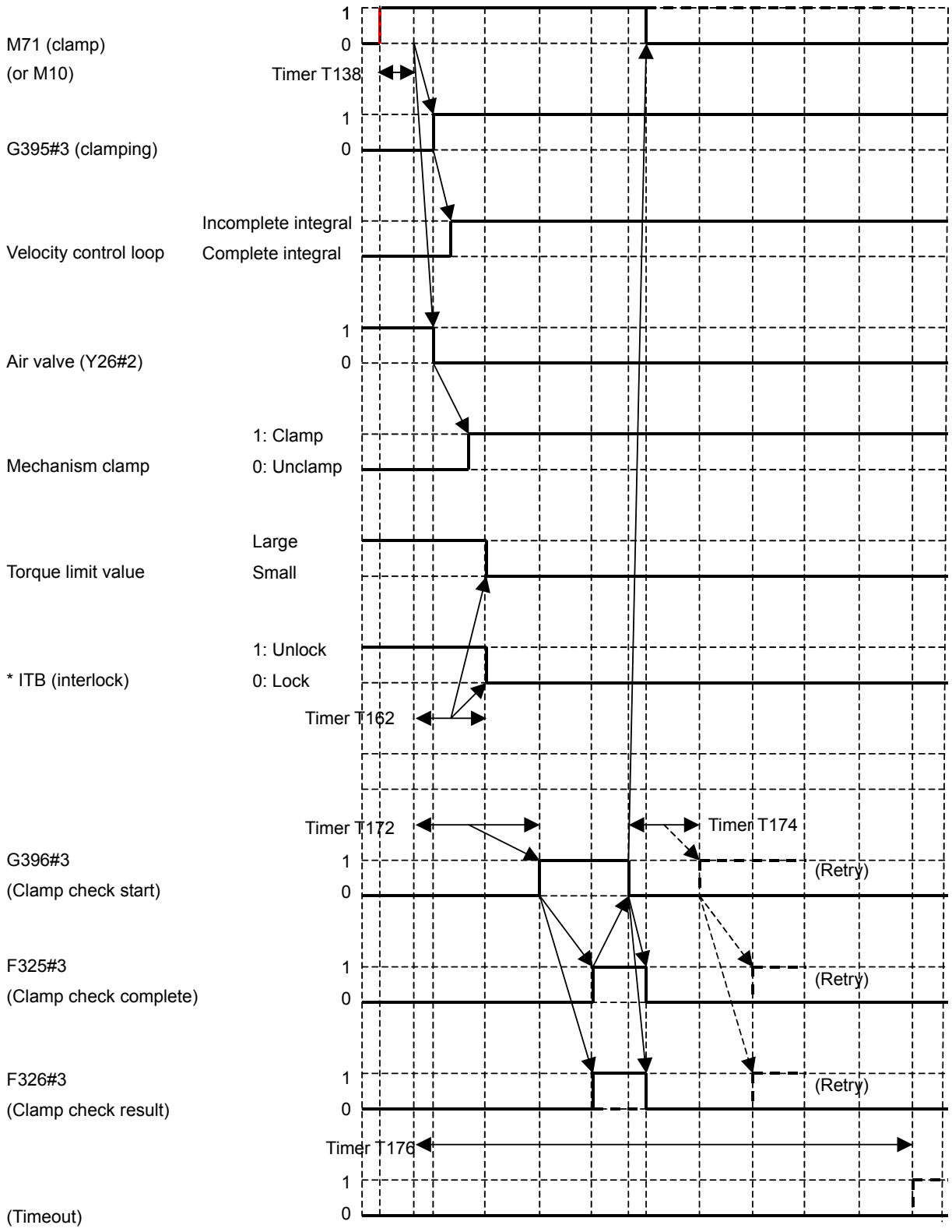
M68 performs the clamp check after the clamping operation, regardless of the value of the keep relay.
To make M171 perform the clamp check after the clamping operation as well, change keep relay K54#5 as described above.
If keep relay K54#5=0, any axis other than the A-axis can be moved immediately after M171 is issued.

Timing chart (Standard setting: When keep relay K32#2=0 is 0, the clamp check signal is specified with M70.)



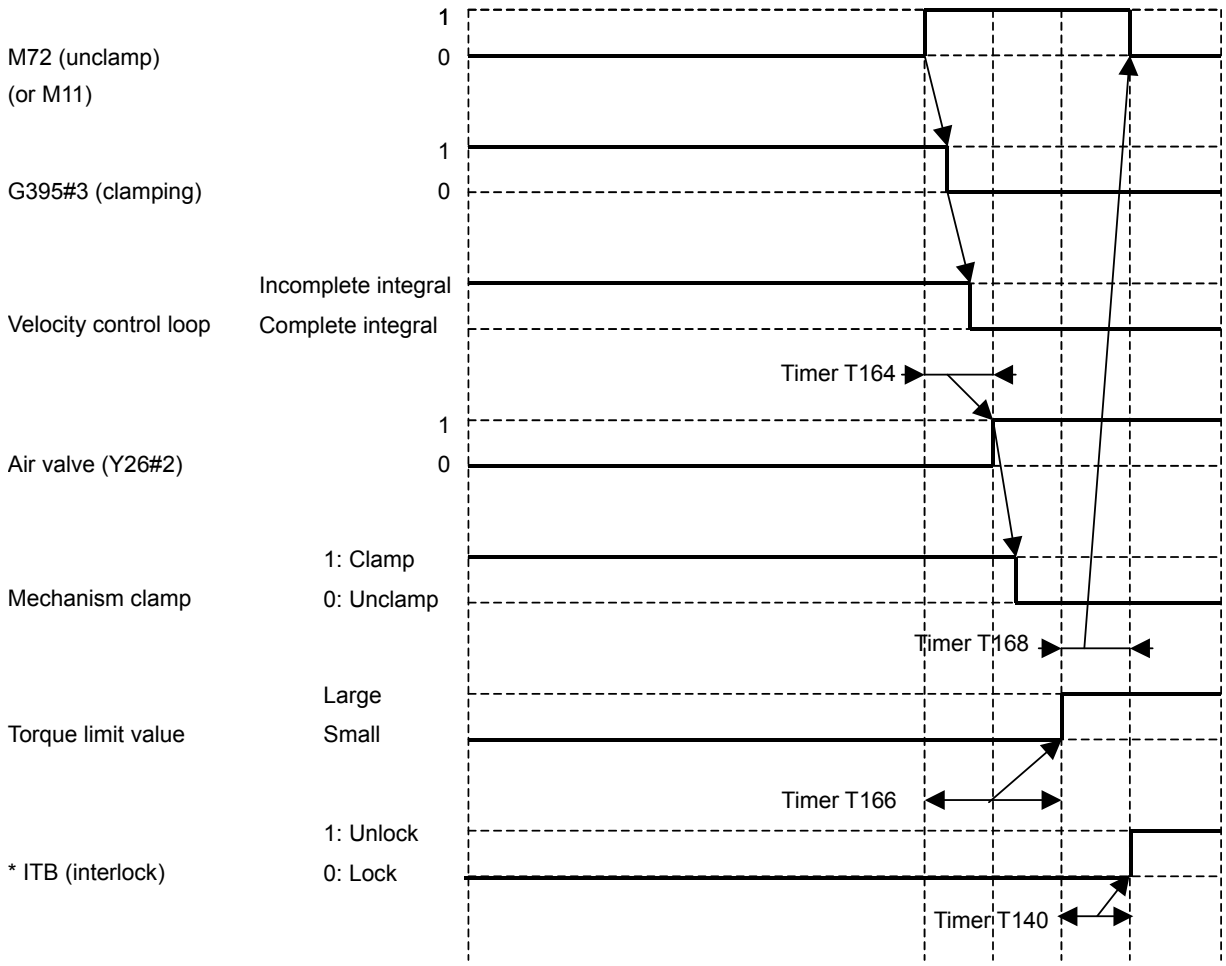
* The solid line indicates that the clamp check is normally completed, and the dotted line indicates that the clamp check is not completed.

Timing chart (When keep relay K32#2=1 is 1, the clamp check is also made with M71.)



* The solid line indicates that the clamp check is normally completed, and the dotted line indicates that the clamp check is not completed.

Timing chart (unclamp)



(5) Detaching

An axis detach parameter is set up automatically so that an axis alarm will not be raised when the power is turned on again after the B-axis I/O cable is removed.

After attaching the I/O cable, turning on the power again automatically resets the axis detach parameter so that the B-axis will become usable.

When detaching the axis, connect the dummy connector, which was removed when connecting DDR, to the connector (JF2) to which the signal wire of the B-axis was connected. Otherwise, an alarm occurs.

33.11.3 Alarms

Code	Message	Cause
PS0302	SETTING THE REFERENCE POSITION WITHOUT DOG IS NOT PERFORMED	In a reference position return without dogs, it is impossible to set up the reference point. The probable causes follow. - In jog feed, the axis was not moved in the direction for a reference position return. - The axis was moved in the direction opposite to that for a manual reference position return.
SV0436	SOFTTHERMAL(OVC)	The digital servo software detected a soft thermal (OVC) error. Check whether an unclamping operation was performed properly when the motor rotated.
SV0366	PULSE MISS(INT)	The built-in pulse coder failed to generate pulses.
SV0367	COUNT MISS(INT)	The built-in pulse coder failed in counting.
SV0368	SERIAL DATA ERROR(INT)	No communication data was received from the built-in pulse coder.
SV0430	SV MOTOR OVERHEAT	The servo motor overheated. Stop the motor until it cools down. If this alarm occurs at startup, check the value of parameter No. 2300.
SV0454	ILLEGAL ROTOR POS DETECT	The pole position detection ended abnormally. Since the motor does not work, the pole position detection cannot be performed. Check wiring, air pressure, etc.
DS0650	POLE DETECTION REQUEST	The pole position detection data is erased a while after the signal wire cable is disconnected. Perform the pole position detection again.
OT0506	OVERTRAVEL(+OT4)	DDR does not have an external overtravel mechanism. Check whether DDR control is enabled.
EX1055	OVERHEAT(DD MOTOR)	Overheat alarm for the DDR260*i*. Not used for the DDR. Check whether DDR260*i* control is disabled (keep relay 15#4 = 0).
EX1088	CLAMP CHECK TIME OVER (DDR-4)	The clamp check did not end within the specified time under DDR(B-axis) control. Check the parameter, air pressure, etc.
EX1089	DDR OVC Alarm (DDR-4)	The OVC level of the DDR (B-axis) exceeded the specified threshold value.
EX1092	CLAMP CHECK TIME OVER (DDR-5)	The clamp check did not end within the specified time under DDR (A-axis) control. Check the parameter, air pressure, etc.
EX1093	DDR OVC Alarm (DDR-5)	The OVC level of the DDR (A-axis) exceeded the specified threshold value.

33.11.4 Diagnosis Messages

Code	Message	Cause
0012	INTERLOCK: 4-AXIS (4-AXIS CLAMP UNFINISHED)	The additional axis is inhibited from moving because it has not been unclamped.
0013	INTERLOCK: 5-AXIS (5-AXIS CLAMP UNFINISHED)	
0090	DETACHED: 4-AXIS	The axis has been detached because the cable has not been connected.
0091	DETACHED: 5-AXIS	
0092	SERVO OFF: 4-AXIS (4-AXIS CLAMP)	The 4th or 5th axis is in the deactivated status.
0093	SERVO OFF: 5-AXIS (5-AXIS CLAMP)	

33.11.5 Parameters

(Parameters)

B: 4-axis A: 5-axis

Code	Setting	Operation
0012B(A)	00000000	bit 7: Specifies whether to detach the axis (0 = not to detach, 1 = to detach).
1005B(A)	10000011	
1006B(A)	00100001	bit 5: Direction of a reference position return (zero point) (0 = +, 1 = -) bit 0: 0 = linear axis, 1 = rotary axis
1007B(A)	00000000	
1008B(A)	00000101	bit 0: The rollover function of the rotary axis: Disabled (0) or enabled (1). bit 1: The rotation direction of the rotary axis: The shortest route is taken (0) or the sign of the specified value is followed (1).
1020B 1020A	66 65	Axis name (66 = B) (65 = A)
1022B(A)	0	
1023B 1023A	5 6	Servo axis number
1220B(A)	0	
1221B(A)	0	
1222B(A)	0	
1223B(A)	0	
1224B(A)	0	
1225B(A)	0	
1226B(A)	0	
1240B(A)	0	
1241B(A)	0	
1242B(A)	0	
1243B(A)	0	
1244B(A)	0	
1250B(A)	0	
1251B(A)	0	
1260B(A)	360000	
1310B(A)	00000000	
1320B(A)	9999.999	Positive-side overtravel
1321B(A)	-9999.999	Negative-side overtravel
1322B(A)	0	
1323B(A)	0	
1324B(A)	0	
1325B(A)	0	

Code	Setting	Operation
1326B(A)	9999.999	
1327B(A)	-9999.999	
1420B(A)	72000.000	Rapid traverse rate
1421B(A)	400.000	
1423B(A)	400.000	
1424B(A)	0	
1425B(A)	400.000	
1427B(A)	600.000	
1428B(A)	0	
1430B(A)	30000.000	Cutting feedrate
1432B(A)	30000.000	Cutting feedrate (for pre-interpolation acceleration/deceleration)
1434B(A)	600.000	
1610B(A)	00010001	
1620B	64	Rapid-traverse time constant (64 for workpiece lighter than 50 kg, 200 for 50 kg or heavier)
1621B(A)	40	Time constant for rapid traverse bell-shaped acceleration/deceleration
1622B(A)	80	Cutting federate time constant
1623B(A)	0	
1624B(A)	60	Time constant for jog feed acceleration/deceleration
1625B(A)	0	
1660B(A)	6250.000	Permissible acceleration for pre-interpolation acceleration/deceleration
1671B(A)	18750.000	Reference acceleration for optimum torque acceleration/deceleration (18750.000 for workpiece lighter than 50 kg, 6000.000 for 50 kg or heavier)
1672	0	Bell-shaped acceleration/deceleration time constant for optimum torque acceleration/ deceleration
1722B(A)	0	
1735B(A)	6250.000	Permissible acceleration for each axis applied by the deceleration function based on the circular interpolation acceleration
1737B(A)	6250.000	Permissible acceleration for each axis applied by the deceleration function based on the AI contour control acceleration
1762B(A)	0	
1763B(A)	0	
1769B(A)	24	
1783B(A)	300000	
1785B(A)	0	
1815B(A)	00110000	
1816B(A)	00000000	Detection multiplication factor (DMR)
1819B(A)	00000001	
1820B(A)	2	Command multiply (CMR)
1821B(A)	360000	Reference counter capacity
1825B(A)	9000	Servo loop gain
1826B(A)	500	Effective area (for in-position check)
1827B(A)	200	Effective area (for in-position check) in cutting feed
1828B(A)	300000	Positioning deviation limit for the axis when moving
1829B(A)	300	Positioning deviation limit for the axis when stopped
1830B(A)	1000	Positioning deviation limit for the axis when servo is off
1832B(A)	83330	
1838B(A)	15000	
1850B(A)	(Adjustment value)	Amount of grid shift (Specify 1000 for a shift of 1°.)
1905B(A)	00000000	
1937B(A)	0	
2000B(A)	00011010	
2001B(A)	00101000	Detector type (AMR)

Code	Setting	Operation
2002B(A)	00000000	
2003B(A)	00001000	
2004B(A)	00000011	
2005B(A)	01000010	Bit 6: Vertical axis brake control is not used (0)/is used (1). Bit 1: The feed-forward function is not used (0)/is used (1).
2006B(A)	00000000	
2007B(A)	01000000	Bit 6: Fine acceleration/deceleration is disabled (0)/enabled (1).
2008B(A)	00000000	
2009B(A)	00000000	
2010B(A)	00000000	
2011B(A)	00000000	
2012B(A)	00000000	
2013B(A)	00000001	Bit 0: HRV3 current control is not used (0)/is used (1).
2014B(A)	00000000	
2015B(A)	00000000	
2016B(A)	00001000	
2017B(A)	10100001	
2020B(A)	427	Motor type
2021B(A)	256	Load inertia ratio (256 for workpiece lighter than 50 kg, 1024 for 50 kg or heavier)
2022B(A)	-111	Direction of motor rotation (111 = CW, -111 = CCW)
2023B(A)	4096	Number of velocity pulses
2024B(A)	6250	Number of position pulses
2040B(A)	790	Current loop integration gain
2041B(A)	-3056	Current loop proportional gain
2042B(A)	-3053	Current loop gain
2043B(A)	180	Velocity loop integration gain (326 for workpiece lighter than 50 kg, 150 for 50kg or heavier)
2044B(A)	-1609	Velocity loop proportional gain
2045B(A)	0	Velocity loop incomplete integral gain
2046B(A)	-8235	Velocity loop gain
2047B(A)	5242	Observer parameter
2048B(A)	0	
2049B(A)	0	
2050B(A)	956	
2051B(A)	510	
2052B(A)	0	
2053B(A)	21	
2054B(A)	0	
2055B(A)	319	
2056B(A)	0	
2057B(A)	0	
2058B(A)	0	
2059B(A)	0	
2060B(A)	7282	
2061B(A)	0	
2062B(A)	32751	Overload protection factor
2063B(A)	214	Overload protection factor
2064B(A)	4	
2065B(A)	666	Overload protection factor
2066B(A)	-10	
2067B(A)	0	
2068B(A)	0	
2069B(A)	250	Velocity feed-forward factor

Code	Setting	Operation
2070B(A)	0	
2071B(A)	0	
2074B(A)	16384	Velocity-dependent current loop gain
2075B(A)	0	
2076B(A)	0	
2077B(A)	0	
2078B(A)	36	Dual position feedback conversion coefficient (numerator)
2079B(A)	50	Dual position feedback conversion coefficient (denominator)
2080B(A)	0	
2081B(A)	0	
2082B(A)	0	
2083B(A)	200	Brake control timer
2084B(A)	36	Flexible feed gear ratio (DMR) (numerator)
2085B(A)	50	Flexible feed gear ratio (DMR) (denominator)
2086B(A)	746	Rated current parameter
2087B(A)	0	
2088B(A)	0	
2089B(A)	0	
2092B(A)	10000	Advanced feed-forward factor
2095B(A)	0	
2098B(A)	0	
2099B(A)	400	
2102B(A)	0	
2103B(A)	0	
2104B(A)	0	
2105B(A)	6478	Torque constant for torque control
2106B(A)	0	
2107B(A)	100	Velocity loop gain override in cutting
2108B(A)	0	
2109B(A)	16	FAD time constant
2110B(A)	773	Magnetic saturation compensation (base/factor)
2111B(A)	2815	Deceleration torque limit (base/factor)
2113B(A)	0	Resonance elimination filter 1: Attenuation center frequency
2115B(A)	0	For internal data output
2119B(A)	20	Variable proportional gain at stop time, stop level
2127B(A)	0	
2128B(A)	12000	Magnetic flux decrease compensation (factor)
2129B(A)	14	Magnetic flux decrease compensation (base/limit)
2133B(A)	0	
2134B(A)	0	
2139B(A)	(Adjustment value)	AMR offset (set up automatically at the pole position detection)
2143B(A)	16	
2144B(A)	9900	
2145B(A)	0	
2151B(A)	4192	For internal data output
2152B(A)	0	For internal data output
2153B(A)	4194	For internal data output
2156B(A)	0	
2162B(A)	0	
2163B(A)	0	
2164B(A)	0	
2165B(A)	85	

Code	Setting	Operation
2177B(A)	0	Resonance elimination filter 1: Attenuation bandwidth
2178B(A)	5000	
2182B(A)	0	
2200B(A)	01100000	
2201B(A)	00000001	
2202B(A)	00000111	
2203B(A)	00000100	
2207B(A)	00001000	
2208B(A)	00000000	
2209B(A)	00010100	
2210B(A)	01000100	bits 6/5: Emergency stop delay timer setting (10 = 200 msec, 00 = 50 msec)
2211B(A)	00001000	
2212B(A)	01000000	
2213B(A)	11100000	bit 7: Specifies whether to enable the pole position detection (0 = disable, 1 = enable).
2229B(A)	00000001	bit 0: Specifies whether to use the AMR offset (0 = not use, 1 = use).
2280B(A)	*1******	bit 6: Specifies whether to check clamp completion by servo software (0 = not check, 1 = check).
2300B(A)	10001110	bit 7: Specifies where to obtain the motor overheat alarm from (0 = pulse coder, 1 = depend on bit 3). bit 3: Specifies where to obtain the motor overheat alarm from (0 = via PMC, 1 = αiCZ detection circuit). bit 2: Specifies whether to use the DD motor (0 = not use, 1 = use).
2301B(A)	00000000	
2326B(A)	500	Disturbance input gain when the clamp check signal is input
2327B(A)	100	Frequency for starting clamp check signal input (100 for lighter than 50 kg, 80 for 50 kg or heavier)
2328B(A)	100	Frequency for ending clamp check signal input (100 for lighter than 50 kg, 80 for 50 kg or heavier)
2329B(A)	1	Number of clamp check signal input measurement points
2334B(A)	150	
2335B(A)	100	
2359B(A)	0	Resonance elimination filter 1: Damping
2360B(A)	1100	Resonance elimination filter 2: Attenuation center frequency
2361B(A)	600	Resonance elimination filter 2: Attenuation bandwidth
2362B(A)	0	Resonance elimination filter 2: Damping
2363B(A)	700	Resonance elimination filter 3: Attenuation center frequency
2364B(A)	200	Resonance elimination filter 3: Attenuation bandwidth
2365B(A)	0	Resonance elimination filter 3: Damping
2366B(A)	0	Resonance elimination filter 4: Attenuation center frequency
2367B(A)	0	Resonance elimination filter 4: Attenuation bandwidth
2368B(A)	0	Resonance elimination filter 4: Damping
2417B(A)	******10	bit 1: Specifies what to do with the velocity control loop integrator at unclamping (0 = not change, 1 = clear to 0). bit 0: Specifies how to regard the velocity control loop integral term during clamping (0 = complete integration, 1 = incomplete integration).
2462B(A)	32740	Incomplete integral gain of the velocity control loop during clamping
2476B(A)	20	Error counter threshold for clamp completion judgment
3004	00000000	bit 5: Specifies whether to use the hard overtravel function for the 4th and 5th axes (0 = use, 1 = not use).
3013B(A)	7	
3014B(A)	3	
3115B(A)	00000000	
3620B(A)	0	
3621B(A)	0	

Code	Setting	Operation
3622B(A)	0	
3623B(A)	0	
3624B(A)	0	
5401B(A)	00000000	
5421B(A)	0	
5440B(A)	0	
6131B(A)	00000000	
6286B(A)	00000001	bit 0: Specifies whether to enable the torque limit override function (0 = disable, 1 = enable).
7510	4	
11242X	64	Per-axis bell-shaped time constant for rapid-traverse acceleration/deceleration before interpolation
11242Y	64	Per-axis bell-shaped time constant for rapid-traverse acceleration/deceleration before interpolation
11242Z	64	Per-axis bell-shaped time constant for rapid-traverse acceleration/deceleration before interpolation
11242B(A)	40	Per-axis bell-shaped time constant for rapid-traverse acceleration/deceleration before interpolation (40 for lighter than 50 kg, 64 for 50 kg or heavier)
13821B(A)	2000.000	
13831B(A)	9999.999	
13832B(A)	-9999.999	
19541B(A)	0	
19542B(A)	0	
19543B(A)	0	
19544B(A)	0	
19545B(A)	0	
19546B(A)	0	
19547B(A)	0	
19548B(A)	0	
19549B(A)	0	
19550B(A)	0	
19551B(A)	0	
19552B(A)	0	
19553B(A)	0	
19554B(A)	0	
19555B(A)	0	
19556B(A)	0	
19557B(A)	0	
19558B(A)	0	
19559B(A)	0	
19560B(A)	0	
19561B(A)	0	
19562B(A)	0	
19563B(A)	0	
19564B(A)	0	
19565B(A)	0	
19566B(A)	0	
19567B(A)	0	
19568B(A)	0	

(PMC parameter for keep relays)

Number		Setting	Operation
B-axis	A-axis		
K01#5	Same as the left	0	0: Interlock is applied to the B-axis (A-axis) when the B-axis (A-axis) is in the clamped state. 1: Interlock is not applied to the B-axis (A-axis) when the B-axis (A-axis) is in the clamped state.
K02#1	K02#2	0	0: Servo-off is not performed during clamping. 1: Servo-off is performed during clamping.
K03#2	K12#1	1	0: B- and A-axes clamping/unclamping is not used. 1: B- and A-axes clamping/unclamping is used.
K03#3	K12#2	0	0: The X-, Y-, and Z-axes are not interlocked when the B- and A-axes is unclamped. 1: The X-, Y-, and Z-axes are interlocked when the B- and A-axes is unclamped.
K12#3	Same as the left	0	0: The detach hard overtravel function for the B- and A-axes is used. 1: The detach hard overtravel function for the B- and A-axes is not used.
K15#4	----	0	0: DDR260*i* control is disabled. 1: DDR260*i* control is enabled.
K30#0	K54#6	0	0: In clamping, servo is turned off after all axes have stopped. 1: In clamping, servo is not turned off after all axes have stopped.
K30#4	K54#7	0	0: At power-on time, the B- and A-axes is placed in the unclamped state. 1: At power-on time, the B- and A-axes is placed in the clamped state.
K32#1	K54#4	1	0: DDR control for the fourth (fifth) axis is disabled. 1: DDR control for the fourth (fifth) axis is enabled.
K32#2	K54#5	0	0: The clamp check is performed with M70 (M170). 1: The clamp check is performed at the same time the clamp command is specified.

(PMC parameters for timers)

Number		Setting	Operation
B-axis	A-axis		
T138	T144	80	Time (in ms) during which the clamp start processing is delayed since B- and A-axes movement
T140	T146	184	Interlock time (in ms) since B- and A-axes unclamping (DDR : 184, DDR-T : 376)
T162	T184	168	Time (in ms) since clamping to torque limit change and interlock (DDR : 168, DDR-T : 200)
T164	T186	0	Time (in ms) before the valve starts to operate at unclamping
T166	T188	120	Time (in ms) before the torque limit is reset to the maximum value at unclamping
T168	T190	0	Time (in ms) before the completion operation is performed after the torque limit is reset to the maximum value at unclamping
T170	T192	60000	Time (in ms) before the servo motor is turned off after all axes are stopped at clamping
T172	T194	168	Time (in ms) from clamping to clamp check start (DDR : 168, DDR-T : 200)
T174	T196	48	Time (in ms) before the clamp recheck
T176	T198	2000	Time (in ms) from the clamp check to timeout

(PMC parameters for data tables)

Number		Setting	Operation
B-axis	A-axis		
D138	D188	256	Load inertia ratio (setting for below 50 kg)
D140	D190	1024	Load inertia ratio (setting for 50 kg or more)
D154	D192	25	Torque limit for clamping (setting range from 0 to 255)
D5894	D5896	95	Threshold for OVC alarm output judgment

33.11.6 DI/DO

The following table lists input/output signals and a connector for them.

Signal	Address	Connector	Remarks
Clamping (4th axis)	Y26.2	XS21	Unclamping when ON
Detaching the 4th axis	X6.6		
Clamping (5th axis)	Y26.5	XS22	Unclamping when ON
Detaching the 5th axis	X7.7		

33.11.7 High-Speed DDR Positioning Function Operating during Tool Change

This function can be used to not only position the DDR at the time of turret indexing during tool change, but also rotate and position the DDR at a high speed while the tool is moving up and down along the Z-axis.

(1) Specification methods

(a) To position only the DDR (4th axis)
Specify M16 T** B** ;.

(b) To position the DDR (4th axis) and the tool along the X- and Y-axes
Specify M16 T** D** E** F** I** J** K** X** Y** B** ;.

Each code is detailed below:

M16: M code for DDR high-speed positioning in tool exchange (macro program O9028 call)
* Be sure to specify this code at the beginning of a block.

T**: Tool number for indexing
<Valid data range: T1 to T14/21, T101 to T114/121>

D**: Workpiece coordinate system selection (G54 to G59)
<Valid data range: D54. to D59./D54.1 can also be specified.>

E**: Absolute/relative specification (G90/G91)
<Valid data range: E90./E91.>

F**: Positioning (G00)
<Valid data range: F00.>

I**: Tool length compensation cancel (G49)
<Valid data range: I49.>

J**: Canned cycle cancel (G80)
<Valid data range: J80.>

K**: Additional workpiece coordinate system specification
(P1 to P48 when G54.1 is used)
<Valid data range: K1. to K48.>

X**: X-axis travel distance/position
<Valid data range: X-999.999 to X999.999>

Y**: Y-axis travel distance/position
<Valid data range: Y-999.999 to Y999.999>

B**: B-axis (4th axis) travel distance (incremental)
<Valid data range: B0.001 to B720.000>

SUPPLEMENT

- Specify each value with a decimal point for other than the M16 or T** command.
- When the I, J, K, D, E, or F code (G49, G80, G54-G59, G90-G91, or G00) is specified in a block before the block containing M16, it is not required to be specified again in the M16 block.
- If the specified value is out of the range, an alarm is issued.
(Example: MC3001 DATA ERROR D=54.-59.)

(2) Clamping/unclamping the B-axis (4th axis)
When this control is specified in the clamped state, the B-axis is automatically unclamped and movement starts. After the end of movement, the B-axis is clamped again.
To complete movement along the B-axis within the tool change time, basically unclamp the B-axis (M11 or M72) before the tool change command and clamp the B-axis again (M10 or M71) after the completion of the tool change.

SUPPLEMENT
- The time required for tool change may become longer depending on the travel distance along the B-axis because unclamping and re-clamping are performed during tool change operation.
- If the tool change command is specified for the same tool, clamping/unclamping does not work.

(3) Restrictions
- The high-speed spindle specification manufactured by YUKIWA cannot be used together with this function.
- Optimum torque acceleration/deceleration is not applied to the B-axis during movement according to this control.
- If the tool change command is specified for an already selected tool number, tool change operation is not performed. After the tool moves to the origin along the Z-axis, it moves along the X- and Y-axes, then rotates about the B-axis.
- This control is usable only with the B-axis (fourth axis).

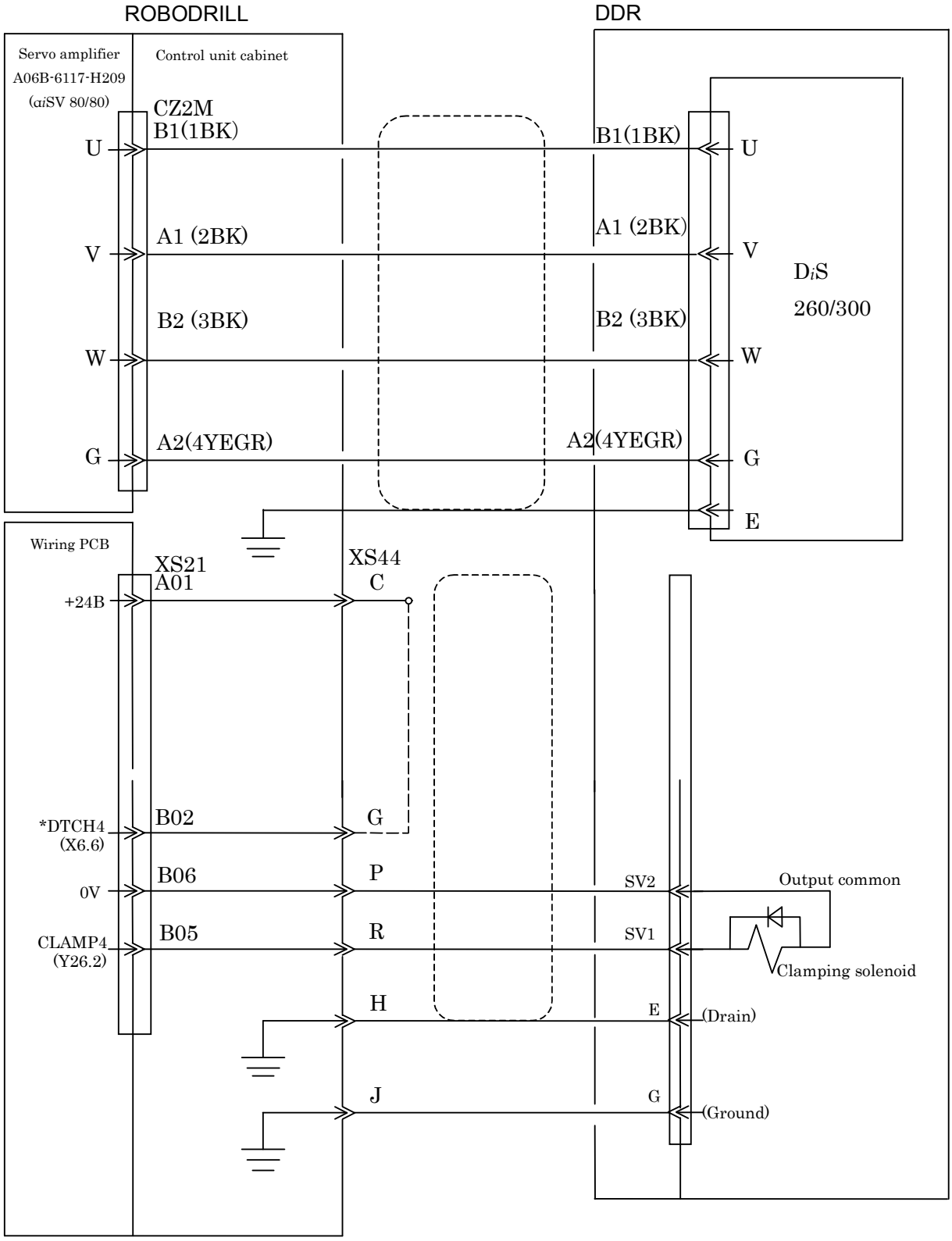
CAUTION
- If the operation is stopped by feed hold and so on during the execution of M16, modal information may remain changed. If the DDR stops during operation, be careful about axis movement after that.
- If tool change operation is stopped by a reset after started, be sure to perform turret recovery.

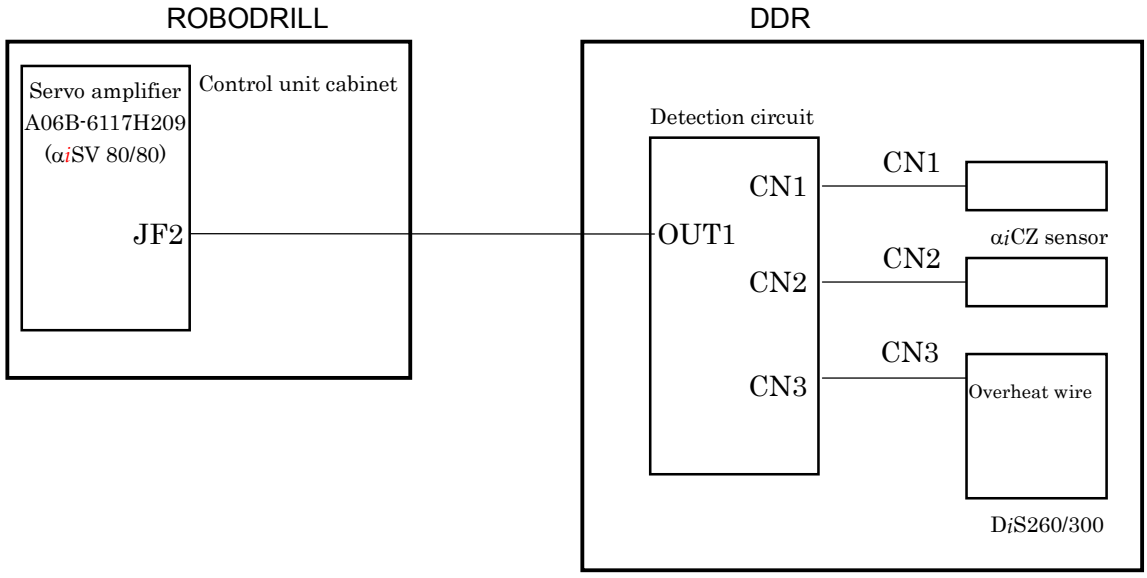
(4) Parameters and macro program
Set PMC parameter K52#0 to 1, set CUSTOM MACRO again on the QUICK screen – "6: MAINTENANCE/SETTING" - "3: PARAMETER" screen, then turn the power off and on again. When the machine starts, the relevant parameters are set automatically and a macro program (O9028) is registered.

The relevant parameters are listed below:
PMC parameters
K52#0 = 1: Enables DDR high-speed positioning in tool exchange.
K15#4 = 0: Disables the DDR260i function.
K32#1 = 1: Enables the DDR function.
NC parameters
N8010(B) = 1: Uses the first PMC axis group.
N3033 = 7: Maximum number of digits of the angular displacement command (C)
N6088 = 16: Value of the M code for calling O9028

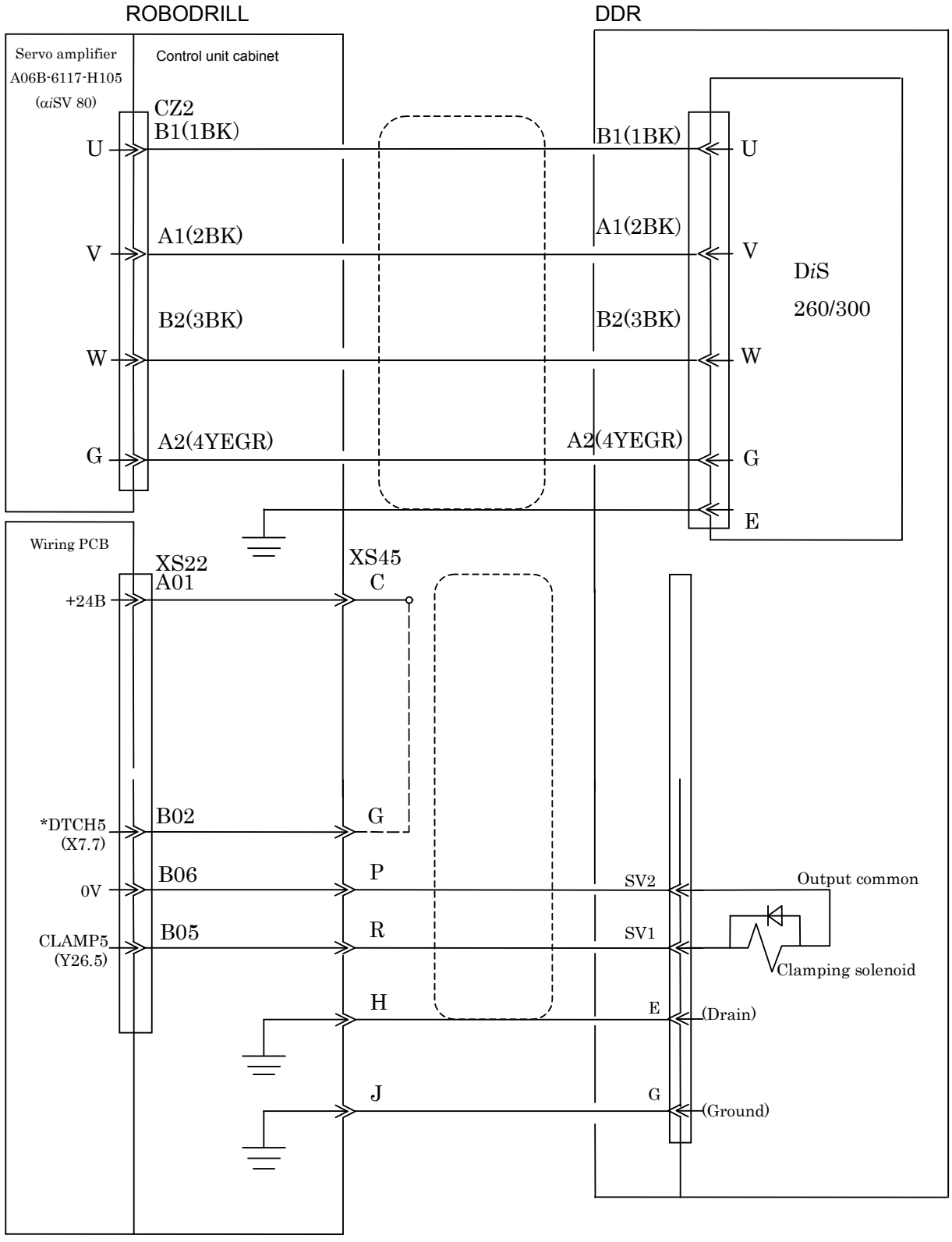
33.12 ELECTRICAL CIRCUIT DIAGRAM FOR DDR CONTROL

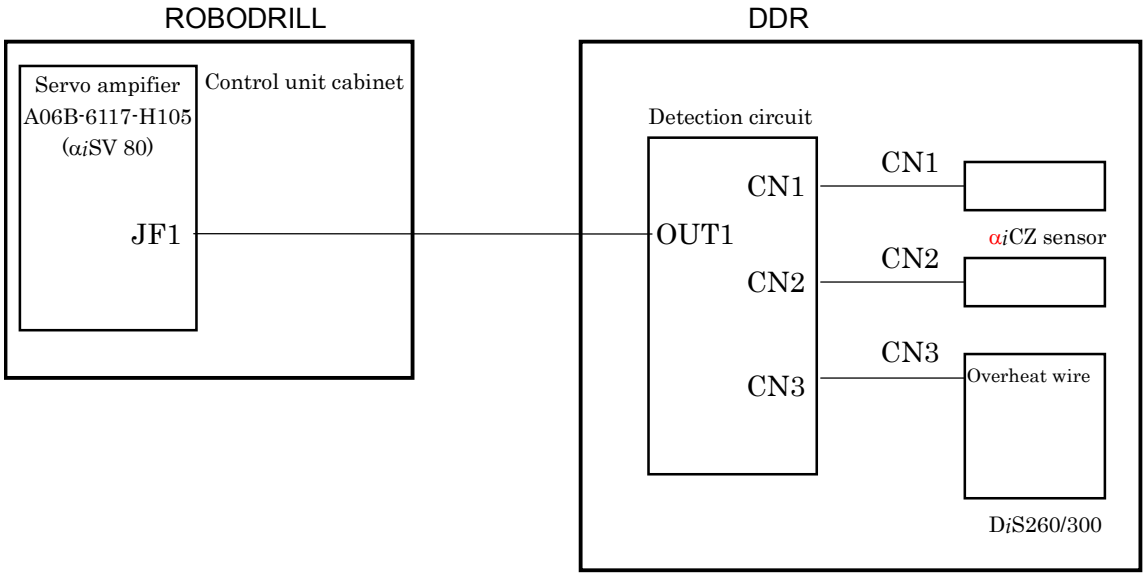
33.12.1 First DDR




ROBODRILL
DDR
Servo amplifier
A06B-6117H209
(αiSV 80/80)
Control unit cabinet
JF2
Detection circuit
OUT1
CN1
CN2
CN3
CN1
CN2
CN3
αiCZ sensor
Overheat wire
DiS260/300

33.12.2 Second DDR





33.13 DDR CONTROL UNIT MOUNTING DIAGRAM

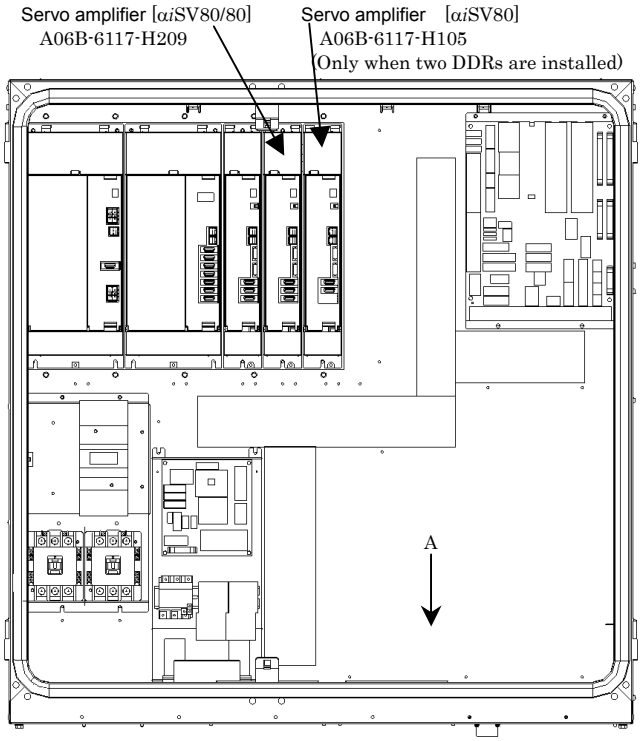


Fig. 33.13 (a) Intra-control unit cabinet mounting drawing 1

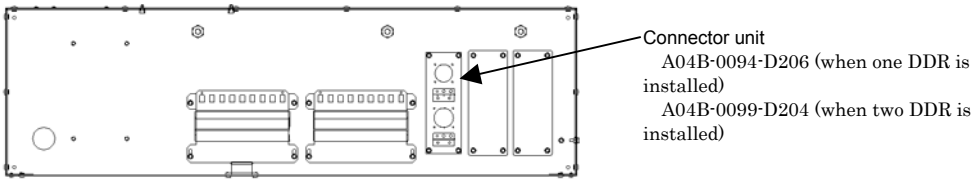


Fig. 33.13 (b) Intra-control unit cabinet mounting drawing 2 (view from arrow A)

34 TOOL MANAGEMENT FUNCTION (OPTION)

34.1 OVERVIEW

The tool management function for the ROBODRILL was created by improving the optional tool management function of the FANUC Series 31*i*-B/B5 for use with the ROBODRILL.
For details on the tool management function, refer to the "FANUC Series 31*i*-B/B5 Users' Manual (B-64484EN)".
This chapter mainly describes ROBODRILL-specific usages and notes on the tool management function.

34.2 SETTING DATA

The tool management function is used to set two types of data: tool management data and magazine management tables.
To display the setting screen, follow the procedure below.

(1) On the NC screen, press

+ the page key or

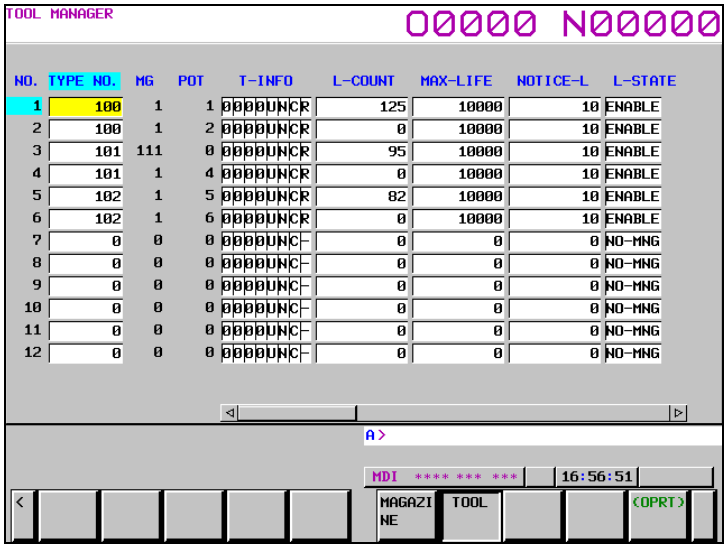
.

(2) Press the soft key at the right end several times until the [TOOL MANAGER] soft key appears and then press [TOOL MANAGER].

To set data, press the [EDIT] soft key. When the setting is completed, press [END].

[TOOL MANAGER]
Tool management data is registered for each tool using a tool management data number.
Optionally, the following sets of tool management data can be used.

64 sets of tool management functions	Total of 64 sets
240 sets of tool management functions	Total of 240 sets
1000 sets of tool management functions	Total of 1000 sets



SUPPLEMENT
The number 111 in the MG field indicates that the tool is located at the spindle position.

Data stored for each tool management data number is described in detail below.

• Tool type number (T code)

Item	Description
Data length	4 bytes
Data ranges	0, 1 to 99,999,999

• Tool information

Item	Description
Data length	1 byte (flag data)
#0 RGS	0: Tool management data is invalid (-). 1: Tool management data is valid (R).
#1 TIM	0: Life count type is number count (C). 1: Life count type is time count (T).
#2 BDT	0: Normal tool (N) 1: Large diameter tool (B) * A large diameter tool cannot be used in the ROBODRILL.
#3 LOC	0: Data access is enabled (U). 1: Data access is disabled (L).
#4 SEN	When the tool life state is "Life management is not made.": 0: This tool is not to be searched for (0). 1: This tool is to be searched for. (1).
#5 to #7	Reserved.

SUPPLEMENT
- Tool management data for which RGS is set to 0 is treated as unregistered even if another item is set to a value.
- Tools of the same type must have the same life count type. The check function can be used to determine whether tools of the same type have the same life count type.

• Tool life counter

Item	Description
Data length	4 bytes
Data unit	Count specification: times Time specification: seconds
Data range	Count specification: 0 to 99,999,999 times Time specification: 0 to 3,599,999 seconds (999 hours 59 minutes 59 seconds)

This counter indicates the accumulated count, that is, the use count (time). The remaining life value is the maximum tool life minus the tool life counter.

• Maximum tool life value

Item	Description
Data length	4 bytes
Data unit	Count specification: times Time specification: seconds
Data range	Count specification: 0 to 99,999,999 times Time specification: 0 to 3,599,999 seconds (999 hours 59 minutes 59 seconds)

• Prenoticed life value

Item	Description
Data length	4 bytes
Data unit	Count specification: times Time specification: seconds
Data range	Count specification: 0 to 99,999,999 times Time specification: 0 to 3,599,999 seconds (999 hours 59 minutes 59 seconds)

• Tool life state

Item	Description
Data length	1 byte
Data details	NO-MNG (Life management is not made.) ENABLE (The tool is not used or being used and its life remains.) OVER (The life expired.) DAMAGE (Treated as an expired tool.)

SUPPLEMENT

If all tools with the tool type number specified by the T code are at the end of their lives, alarm PS5317 occurs. When the tool is present at the spindle position, however, the tool is selected and machining is continued.

• Spindle speed (S)

Item	Description
Data length	4 bytes
Data unit	min^{-1}
Data range	1 to 99,999

• Feedrate (F)

Item	Description
Data length	4 bytes
Data unit	mm/min, inch/min, deg/min, mm/rev, inch/rev
Data range	0 to 99,999,999

• Tool length compensation number (H)

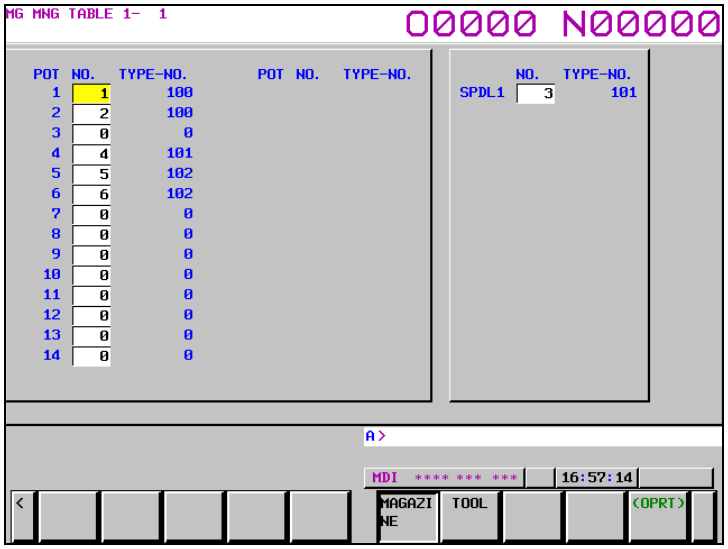
Item	Description
Data length	2 bytes
Data range	0 to 999

• Tool diameter compensation number (D)

Item	Description
Data length	2 bytes
Data range	0 to 999

[MG MNG TABLE]

The state in which tools are stored in the magazine is managed by the magazine management table.



A tool management data number is used to set which tool is attached for a pot number and spindle position.
A data number of 0 indicates that no tool is attached.

34.3 SPECIFICATION METHOD

A method of specifying a tool change with the tool management function is shown below.

M06 T*** ; (*** indicates a tool type number.)

Another method of specifying a tool change is shown below. In this method for specifying a tool change, however, the tool management function does not operate, so the tool life is not counted.

M06 Pn ; (n-th tool clockwise from the current tool)
M06 ;
Tool change button on the operator's panel

34.4 INTERNAL PROCESSING BY M06

When any of "M06 T*** ;", "M06 Pn ;", and "M06 ;" is specified, the following processing is performed by the execution macro in the control unit.

(1) For M06 T*** ;
The shortest life tool with the tool type number specified by T*** is searched for and the number of the pot in which the tool is included is stored in system variable #8499. Then, the following processing is performed.
G80 G40; --- Cancels the canned cycle and tool diameter compensation.
G49 M06 T#8499 ; --- Cancels tool length compensation and makes a change to the selected tool.
M35 ; --- Counts the life of the tool management function.
If the parameters (K31#0, 1, 2, 3) described later are set, the S, F, H, and D codes set as tool management data of the selected tool can be executed.

(2) For M06 Pn ;
Only the following processing is performed and the tool management function does not operate.
G80 G40; --- Cancels the canned cycle and tool diameter compensation.
G49 M06 Pn ; --- Cancels tool length compensation and makes a change to the n-th tool clockwise from the current tool.

(3) For M06 ;
Only the following processing is performed and the tool management function does not operate.
G80 G40; --- Cancels the canned cycle and tool diameter compensation.
G49 M06 ; --- Cancels tool length compensation and makes a change to the tool next to the current one clockwise.

34.5 PARAMETERS

[NC parameters]

No.	Data
9048	P-CODE macro number of execution macro

Generally, set this parameter to 1.
To specify "T" of the "M06 T***;" command to a turret number, not a tool type number, set this parameter to 0. However, the tool management function does not operate.

NOTE
Turn the power off and back on again for the set parameter to take effect.

No.	#7	#6	#5	#4	#3	#2	#1	#0
13204								

#6 The tool management function conforms to:
0: Standard specification.
1: ROBODRILL-specific specification.
Be sure to set this parameter to 1.

No.	
13220	Number of valid tools in tool management data

[Data range] 0 to 64 (An option can be added to increase the upper limit to 240 or 1000.)
This parameter specifies the number of valid tools in tool management data.

NOTE
Turn the power off and back on again for the set parameter to take effect.

No.	
13222	Number of data items of the first magazine

Set this parameter to 14 or 21 depending on the machine specification (number of tools).

NOTE
Turn the power off and back on again for the set parameter to take effect.

No.	
13223	First pot number of the first magazine

Be sure to set this parameter to 1.

NOTE
Turn the power off and back on again for the set parameter to take effect.

No.	
13250	Number of valid spindles

Be sure to set this parameter to 1.

NOTE
Turn the power off and back on again for the set parameter to take effect.

No.	
13268	Life counter M code

Be sure to set this parameter to 35.

[PMC parameter keep relay]

No.	#7	#6	#5	#4	#3	#2	#1	#0
K31								

#0 During a tool change by the tool management function, S set as tool management data is:
0: Not specified automatically.
1: Specified automatically.

#1 During a tool change by the tool management function, F set as tool management data is:
0: Not specified automatically.
1: Specified automatically.

#2 During a tool change by the tool management function, H set as tool management data is:
0: Not specified automatically.
1: Specified automatically.

#3 During a tool change by the tool management function, D set as tool management data is:
0: Not specified automatically.
1: Specified automatically.

NOTE
Turn the power off and back on again for the set parameter to take effect.

34.6 NOTES

(1) The following functions cannot be used.
- Tool life management function
- Tool change on the menu operation screen on the QUICK screen
- Macro call by M06
- AI tool monitor function (optional)
- Signals related to the tool life management and AI tool monitor of the custom PMC function
- Signals related to the tool life management and AI tool monitor of the external interface function

(2) The tool change command must be specified in an independent block.
That is, the tool change command cannot be specified together with another command (such as the axis movement command) in one block.

(3) M06 must be specified at the beginning of a block.
If a command such as "T*** M06 ;" is executed, an alarm (PS0127: DUPLICATE NC, MACRO STATEMENT.) occurs.

(4) When turret recovery is performed or an alarm occurs during execution of the tool change command, check the pot numbers and the tool management number set in the spindle position on the magazine management table screen.

(5) If a tool change command (M06T***;) using the tool management function is executed, the S, F, H, and D codes set in tool management data may be automatically specified depending on the settings of the parameters (bits 0 to 3 of K31). The other tool change commands ("M06 Pn ;", "M06 ;", and tool change button) do not specify the S, F, H, and D codes. Check the states of the S, F, H, and D codes carefully.

35 PERIODICAL MAINTENANCE SCREEN

35.1 OVERVIEW

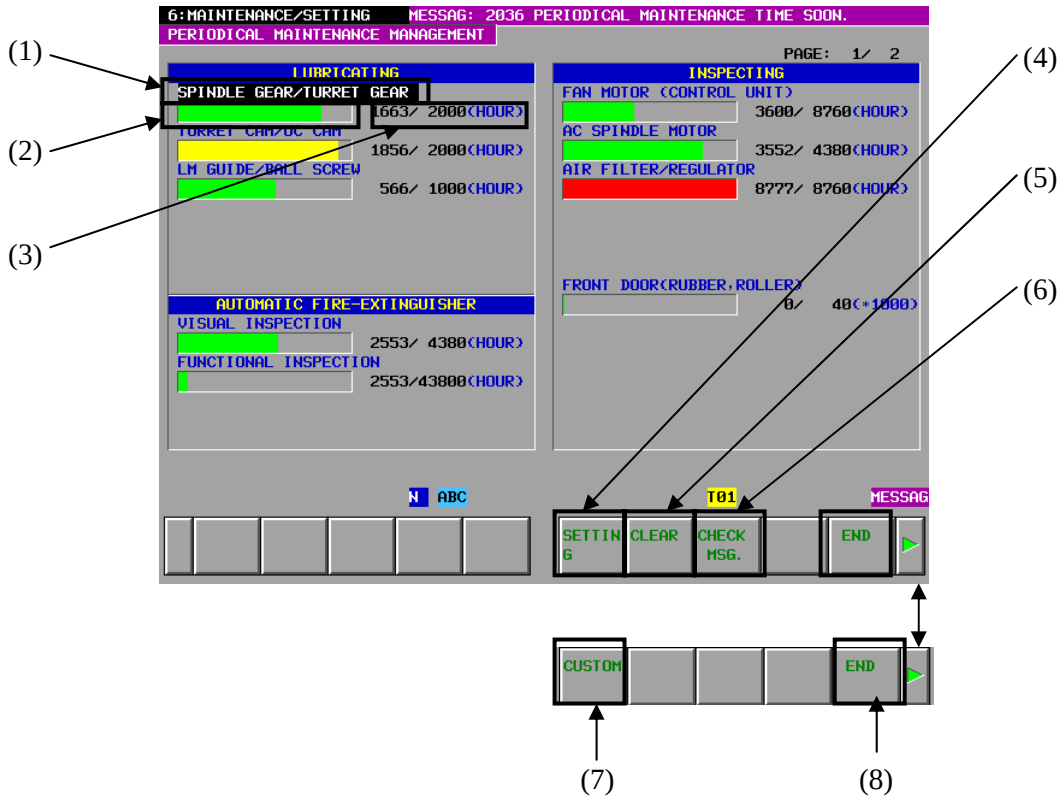
The periodical maintenance function counts values, such as a machine operation time and the number of tool changes, for those items including greasing and consumable part replacement that need to be periodically performed to maintain the ROBODRILL. When the value for an item has reached the maintenance interval set for the item, the function posts the necessity of maintenance operation, by outputting an alarm or operator message. By setting a "WARNING" value, an advance message can be output to post that the time for performing a maintenance operation is coming soon.
For details of periodical maintenance and maintenance part replacement, see Part V, "MAINTENANCE", and refer to the MAINTENANCE MANUAL (B-85315EN).
This chapter describes the configuration of the periodical maintenance screen and the method of using the screen.

35.2 EXPLANATION OF THE SCREEN

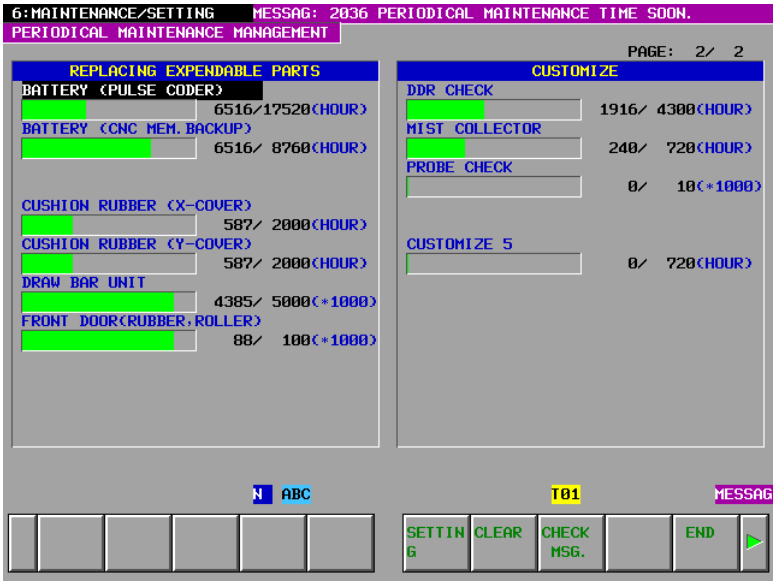
35.2.1 Main Screen

By entering <5> then < INPUT > on QUICK screen – "6: MAINTENANCE/SETTING" screen, the PERIODICAL MAINTENANCE screen (main screen) below is displayed. On this screen, the elapse of time can be checked, a counted cumulative value can be cleared, and an advance message can be erased. The main screen consists of two pages, and the page key on the operator's panel can be used for switching between the two screens.

<Page 1>



<Page 2>



SUPPLEMENT

"CUSTOMIZE" in the right section on page 2 is displayed only when a customized item is added (for details of customized items, see Section 35.4, “CUSTOMIZING THE PERIODICAL MAINTENANCE SCREEN”).

(1) Periodical maintenance item name

An item for which periodical maintenance needs to be performed is displayed.

(2) Graphic display of a cumulative value

For each periodical maintenance item, a cumulative value after the previous maintenance operation (after the previous cumulative value was cleared) is graphically displayed. As a cumulative value increases, the color of the graph changes from green to yellow (advance message display) to red (indicating that the maintenance interval has arrived and periodical maintenance is needed).

(3) Cumulative value/maintenance interval

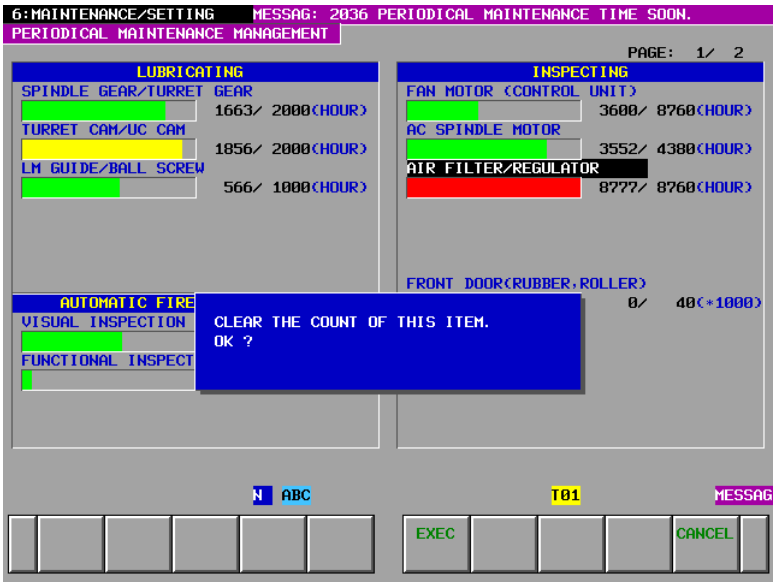
For each periodical maintenance item, a cumulative value counted after the previous maintenance operation (after the previous cumulative value was cleared) and an interval for periodical maintenance (maintenance interval) are displayed. When a cumulative value has reached the maintenance interval, an alarm or operator message is output according to the setting to post that maintenance is needed.

(4) [SETTING] soft key

(see Subsection 35.2.2, “SETTING DETAILS Screen.”) The SETTING DETAILS screen corresponding to the periodical maintenance item on which the cursor is presently placed is displayed.

(5) CLEAR

The [CLEAR] soft key clears the cumulative value of the periodical maintenance item on which the cursor is presently placed. Use this soft key after completion of periodical maintenance.
Pressing the [CLEAR] soft key displays the window shown below. To clear the cumulative value, press the [EXEC] soft key. To cancel clearing of the cumulative value, press the [CANCEL] soft key.



(6) [CHECK MSG.] soft key

The display of an advance message is acknowledged by moving the cursor to the periodical maintenance item (with the graph displayed in yellow) whose cumulative value has reached a value for advance message display then pressing the [CHECK MSG.] soft key. When an advance message acknowledgement operation has been performed for all periodical maintenance items with the graph displayed in yellow, the advance message is erased.

(7) [CUSTOM] soft key

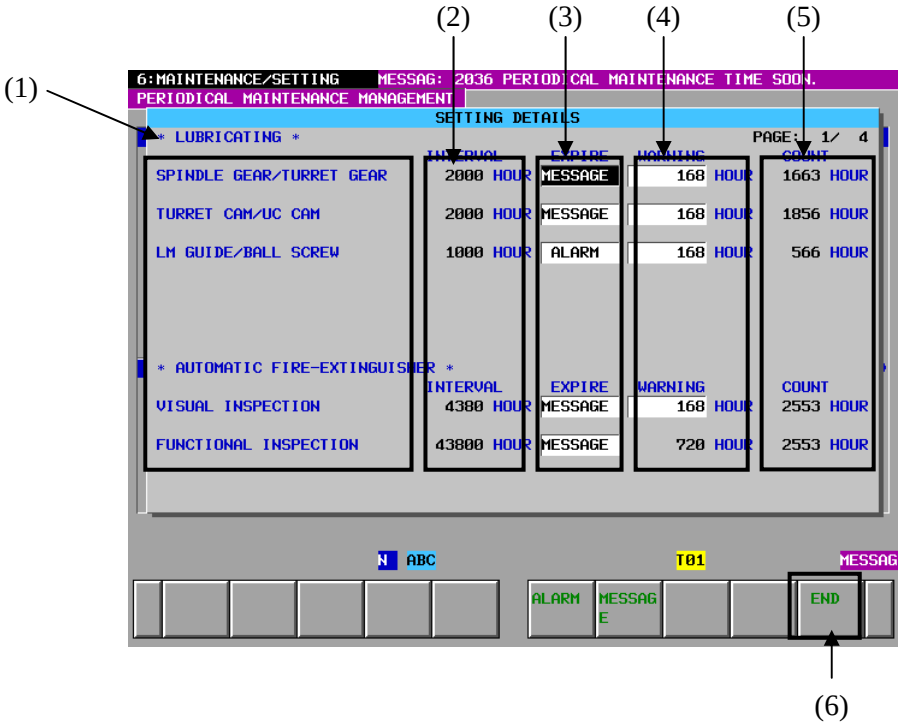
The [CUSTOM] soft key displays the PERIODICAL MAINTENANCE SCREEN CUSTOMIZE window. For details of customizing the screen, see Section 35.4, “CUSTOMIZING THE PERIODICAL MAINTENANCE SCREEN.”

(8) END

The [END] soft key closes the PERIODICAL MAINTENANCE screen and returns the screen display to MAINTENANCE/ SETTING screen.

35.2.2 SETTING DETAILS Screen

Pressing the [SETTING] soft key on the main screen displays the SETTING DETAILS screen shown below. On this screen, a method of notification used when a cumulative value has reached the maintenance interval, a value for displaying an advance message, and a maintenance interval can be set and confirmed.
By using the page key on the operator's panel, the user can switch between the pages without returning to the main screen.



(1) Periodical maintenance item name
An item for which periodical maintenance needs to be performed is displayed.

(2) INTERVAL
A periodical maintenance interval is displayed.

(3) EXPIRE
A method of notification used when a cumulative value has reached the maintenance interval can be set. A method can be selected by choosing from the soft keys.

- ALARM
  The arrival of the time when periodical maintenance is needed is posted by displaying the alarm "EX1085 PERIODICAL MAINTENANCE TIME.". Until the alarm is reset, the machine cannot be operated.
- MESSAGE
  The arrival of the time when periodical maintenance is needed is posted by displaying the operator message "2037 PERIODICAL MAINTENANCE TIME.".

SUPPLEMENT
The alarm is displayed when the following conditions are satisfied:
- When machining has ended with M00, M01, M02, or M30
- When automatic operation is not performed

(4) WARNING
A time (count) before a cumulative value reaches the maintenance interval can be set to display an advance message. When a cumulative value has reached the value (value for advance message display) obtained by subtracting a set value from the maintenance interval, the operator message "2036 PERIODICAL MAINTENANCE TIME SOON." is displayed.

(5) COUNT
For each maintenance item, a cumulative value counted after the previous maintenance operation (after the previous cumulative value was cleared) is displayed.

(6) END
The [END] soft key closes the SETTING DETAILS screen and returns the screen display to the main screen.

35.3 LIST OF PERIODICAL MAINTENANCE ITEMS

35.3.1 Lubricating

Listed below are those items which must be greased periodically. If an automatic lubricating system is in use, it is necessary to inspect the flexible hoses.

Periodical maintenance item name	Value counted	Maintenance interval	Advance notice (Initial value, remaining value)	
SPINDLE GEAR/TURRET GEAR	Programmed operation time	2,000 hours	168 hours	(*1)
TURRET CAM/UC CAM	Programmed operation time	2,000 hours	168 hours	(*1)
LM GUIDE/BALL SCREW	Time of power ON	1,000 hours	168 hours	(*2), (*3)
CHECK LUBRICATING HOSE	Programmed operation time	4,000 hours	168 hours	(*4), (*5)

*1 See "(7) Greasing turret and spindle gears", in Subsection 2.1.1, "Standard Greasing", in Part V of the OPERATOR'S MANUAL for details.
*2 This item is displayed only if no automatic lubrication system (option) is in use.
*3 See "(1) X axis ball screw", "(2) Y axis ball screw", "(3) Z axis ball screw", "(4) X axis LM guides", "(5) Y axis LM guides", and "(6) Z axis LM guide" in Subsection 2.1.1, "Standard Greasing", in Part V of the OPERATOR'S MANUAL for details.
*4 This item is displayed only if any automatic lubrication system (option) is in use.
*5 For details, refer to Subsection 3.16.2, "Replacing the Flexible Hose", in Section 3.16, "AUTOMATIC OIL LUBRICATION (OPTION)", in Part I or Subsection 3.17.2, "Replacing the Flexible Hoses", in Section 3.17, "AUTOMATIC GREASE LUBRICATION (OPTION)", in Part I in the Maintenance Manual.

35.3.2 Automatic Fire-Extinguisher

The table below indicates the automatic fire-extinguisher inspection items. The items are displayed only when an automatic fire-extinguisher (optional) is used.

Periodical maintenance item name	Value counted	Maintenance interval	Advance notice (Initial value, remaining value)	
VISUAL INSPECTION	Time of Power ON plus power OFF	4,380 hours	168 hours	(*1)
FUNCTIONAL INSPECTION	Time of Power ON plus power OFF	(*2)	720 hours	(*1), (*3)

*1 For details on a periodical inspection and functional inspection, see Subsection 31.2.1, "Maintenance Inspections" in Chapter 31, "AUTOMATIC FIRE-EXTINGUISHER (OPTION)" in Part IV of the OPERATOR'S MANUAL.
*2 Conduct a functional inspection on the automatic fire-extinguisher in the 5th year, 8th year, and 10th year after installation and every year after the 10th year. The screen displays a time (in hours) remaining until the next functional inspection needs to be performed.
When conducting a functional inspection, contact your FANUC service center.
*3 The maintenance interval and advance notice value for the functional inspection of the automatic fire-extinguisher cannot be modified.

35.3.3 Inspecting

The table below indicates the items to be periodically inspected.

Periodical maintenance item name	Value counted	Maintenance interval	Advance notice (Initial value, remaining value)	
FAN MOTOR (CONTROL UNIT)	Time of power ON	8,760 hours	168 hours	(*1)
AC SPINDLE MOTOR	Time of power ON plus power OFF	4,380 hours	168 hours	(*2)
AIR FILTER/REGULATOR	Time of power ON	8,760 hours	168 hours	(*3)
CENTER-THROUGH PARTS	Time of center-through coolant pump ON	3,000 hours	168 hours	(*4), (*5)
CYLINDER (AUTOMATIC DOOR)	Time of power ON	8,760 hours	168 hours	(*6), (*7)
FRONT DOOR (RUBBER, ROLLER)	Number of times that the front door opens/closes	40,000 times (for auto door,100,000 times)	1,000 times	(*8)
DRYER (FILTER FOR DRYER)	Time of power ON	8,760 hours	168 hours	(*9), (*10)

*1 See Section 2.3, "INSPECTING THE FAN MOTORS IN THE CONTROL UNIT", in Part V of the OPERATOR'S MANUAL, or refer to Section 10.6, "REPLACING A FAN MOTOR", or Subsection 10.16.4, "Replacing a Fan Motor", in Part II of the MAINTENANCE MANUAL (B-85315EN) for details.
*2 See Section 2.4, "MAINTENANCE OF AC SPINDLE MOTOR", in Part V of the OPERATOR'S MANUAL for details.
*3 See Section 2.5, "REPLACING THE FILTER REGULATOR AND OIL FILTER MANTLE (ELEMENT)", in Part V of the OPERATOR'S MANUAL for details.
*4 Displayed only when center-through coolant (optional) is used
*5 See Section 25.6, "SCHEDULED MAINTENANCE", in Chapter 25, "CENTER-THROUGH COOLANT (OPTION)", in Part IV of the OPERATOR'S MANUAL or refer to Section 3.24, "CENTER-THROUGH COOLANT SPECIFICATIONS", in Part I of the MAINTENANCE MANUAL (B-85315EN) for details.
*6 Displayed only when an automatic door (optional) is used
*7 Refer to Section 3.15, "REPLACING THE AUTOMATIC DOOR AIR CYLINDER", in Part I of the MAINTENANCE MANUAL (B-85315EN) for details.
*8 For details, refer to Section 3.8, "REPLACING THE BEARING ROLLER FOR THE SPLASH GUARD DOOR" and Section 3.9, "REPLACING THE CUSHION RUBBERS FOR THE SPLASH GUARD DOOR" in Part I of the MAINTENANCE MANUAL (B-85315EN).
*9 This item is displayed only when the air dryer is used.
*10 For details, refer to "REPLACING THE FILTER OF THE AIR DRYER" in the OPERATOR'S MANUAL.

35.3.4 Replacement of Consumable Parts

The table below indicates the items for which consumable parts need to be replaced periodically.

Periodical maintenance item name	Value counted	Maintenance interval	Advance notice (Initial value, remaining value)	
BATTERY (PULSE CODER)	Time of power ON plus power OFF	17,520 hours	168 hours	(*1)
BATTERY (CNC MEM. BACKUP)	Time of power ON plus power OFF	8,760 hours	168 hours	(*2)
INTERNAL LIGHT	Time of fluorescent lamp ON within the machine	6,000 hours	168 hours	(*3),(*4)
CUSHION RUBBER (X-COVER)	Programmed operation time	2,000 hours	168 hours	(*5)
CUSHION RUBBER (Y-COVER)	Programmed operation time	2,000 hours	168 hours	(*6)
DRAW BAR UNIT	Number of tool changes	5,000,000	20,000	(*7)
FRONT DOOR (RUBBER, ROLLER)	Number of front door open/close operations	100,000	1,000	(*8)
CENTER-THROUGH PARTS	Time of center-through coolant pump ON	10,000 hours	168 hours	(*9),(*10)

*1 See Subsection 2.6.1.1, "Battery for separate absolute pulse coders (6 VDC)", in Section 2.6.1, "Battery", in Part V of the OPERATOR'S MANUAL or refer to Section 10.8, "REPLACING THE BATTERY FOR SEPARATE ABSOLUTE PULSE CODERS", in Part II of the MAINTENANCE MANUAL (B-85315EN) for details.

*2 See Subsection 2.6.1.2, "Replacing the battery for CNC memory backup", in Section 2.6.1, "Battery", in Part V of the OPERATOR'S MANUAL or refer to Section 10.5, "REPLACING THE BATTERY", in Part II of the MAINTENANCE MANUAL (B-85315EN) for details.

*3 This item is displayed when fluorescent lamps are in use provided that internal lamps (option) are enabled.

*4 See Subsection 2.6.3, "Fluorescent Lamp in the Inside Light Unit", in Part V of the OPERATOR'S MANUAL or refer to Section 3.19, "REPLACING THE INSIDE LIGHT UNIT AND FLUORESCENT LAMP", in Part I of the MAINTENANCE MANUAL (B-85315EN) for details.

*5 See Subsection 2.6.4.1, "X-axis telescopic covers", in Subsection 2.6.4, "Checking the Cushion Rubbers Used for the X/Y-Axis Telescopic Covers", in Part V of the OPERATOR'S MANUAL for details.

*6 See Subsection 2.6.4.2, "Y-axis telescopic cover", in Subsection 2.6.4, "Checking the Cushion Rubbers Used for the X/Y-Axis Telescopic Covers", in Part V of the OPERATOR'S MANUAL for details.

*7 Refer to Section 3.2, "REPLACING THE DRAW BAR UNIT", in Part I of the MAINTENANCE MANUAL (B-85315EN) for details. When replacing the draw bar unit, contact your local FANUC service center or have the work done by personnel trained in ROBODRILL maintenance, in order to ensure safety as well as to prevent the machine performance and accuracy from being compromised.

*8 Refer to Section 3.8, "REPLACING THE BEARING ROLLER FOR THE SPLASH GUARD DOOR", and Section 3.9, "REPLACING THE CUSHION RUBBERS FOR THE SPLASH GUARD DOOR", in Part I of the MAINTENANCE MANUAL (B-85315EN) for details.

*9 Displayed only when center-through coolant (optional) is used.

*10 See Section 25.6, "SCHEDULED MAINTENANCE", in Chapter 25, "CENTER-THROUGH COOLANT (OPTION)", in Part IV of the OPERATOR'S MANUAL or refer to Section 3.24, "CENTER-THROUGH COOLANT SPECIFICATIONS", in Part I of the MAINTENANCE MANUAL (B-85315EN) for details.

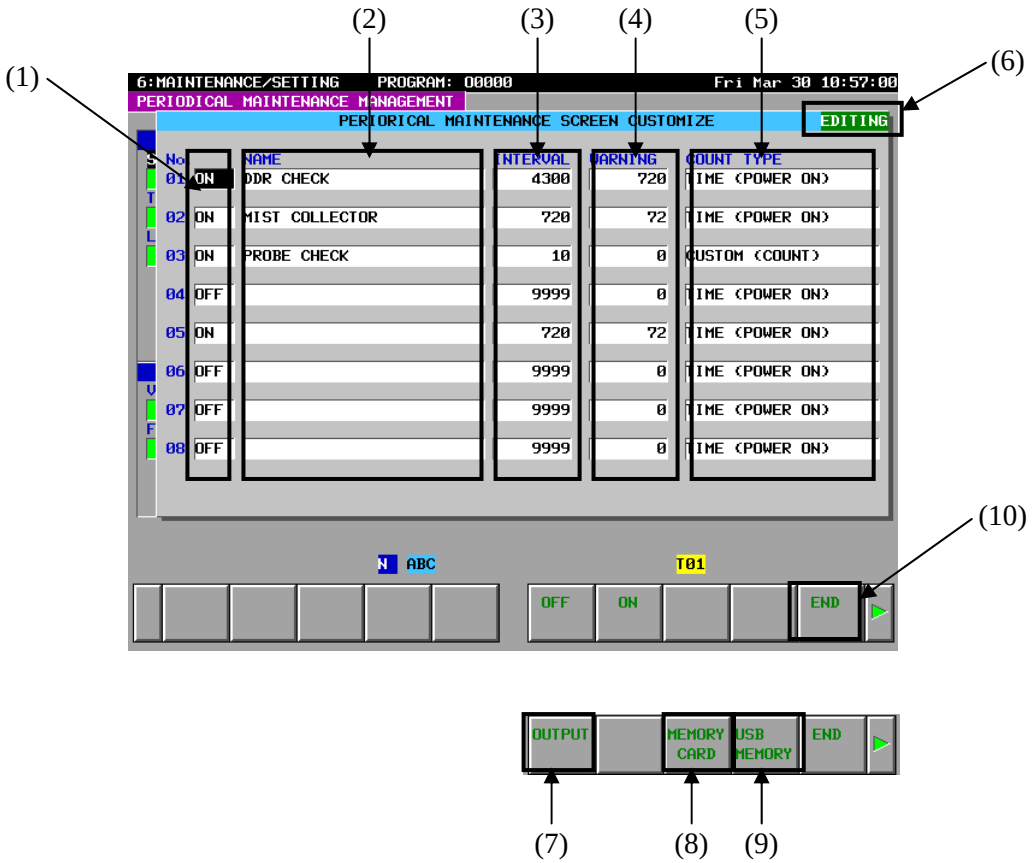
35.4 CUSTOMIZING THE PERIODICAL MAINTENANCE SCREEN

In addition to the standard periodical maintenance items ROBODRILL provides, up to eight user-specific items (customized items) can be used.

SUPPLEMENT
Memory all clear operation initializes each customized item setting.

35.4.1 Periodical Maintenance Screen Customize Window

Pressing the [CUSTOM] soft key on the main screen displays the PERIODICAL MAINTENANCE SCREEN CUSTOMIZE window shown below.



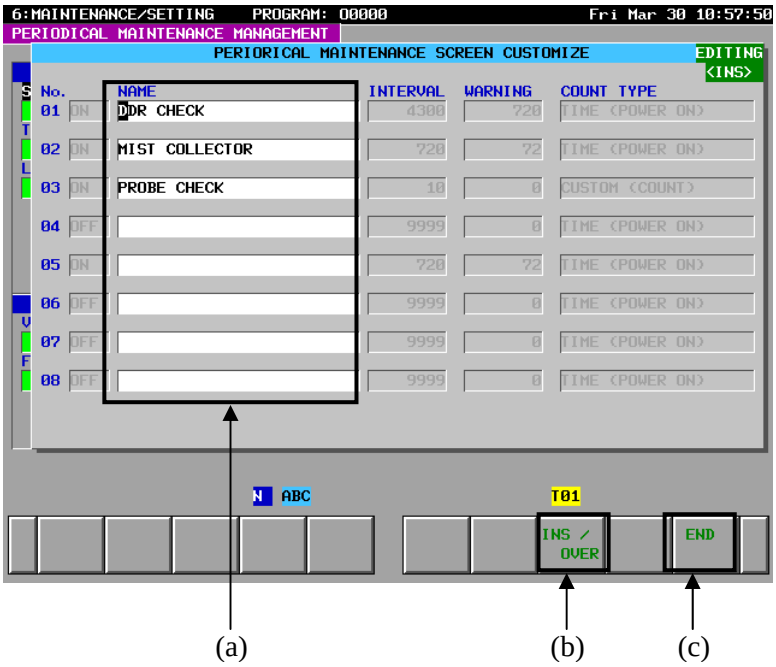
(1) ON/OFF of each customized item
For each customized item, whether to use it is displayed.
Placing the cursor displays the following soft keys:

Pressing the [ON] or [OFF] soft key selects whether to use the relevant item. Each item for which [ON] is selected is displayed on the main screen and SETTING DETAILS screen to count a cumulative value and display an alarm or operator message when required.

(2) Customized item name

The name of each customized item set is displayed.
Positioning the cursor displays the following soft keys:

Pressing the [EDIT NAME] soft key changes the screen as shown below. On this screen, you can rename the relevant customized item.



(a) Customized item name

The name of each customized item is displayed.
You can move the cursor using cursor keys and set any desired name consisting of alphanumeric characters and symbols.

(b) [INS/OVER] soft key

Pressing this soft key switches between the insert and overwrite modes.
The currently selected mode is displayed at the upper right of the window.

(c) [END] soft key

The [END] soft key terminates customized item name editing.

SUPPLEMENT

When the “NAME” field for an item is left blank, “CUSTOMIZE x” (x: Customized item number) is displayed on the main screen and SETTING DETAILS screen.

(3) INTERVAL

The “INTERVAL” setting is displayed for each customized item. You can position the cursor on a desired item and enter a numeric value from the operator’s panel to change the setting.
When a cumulative value has reached the “INTERVAL” setting, an alarm or operator message is output to notify that periodical maintenance is needed.

SUPPLEMENT
- The initial value is “9999”.
- A value smaller than the “WARNING” setting cannot be set.
- You can set a value in hours when a time is counted or in units of 1000 when the number of times is counted.

(4) WARNING

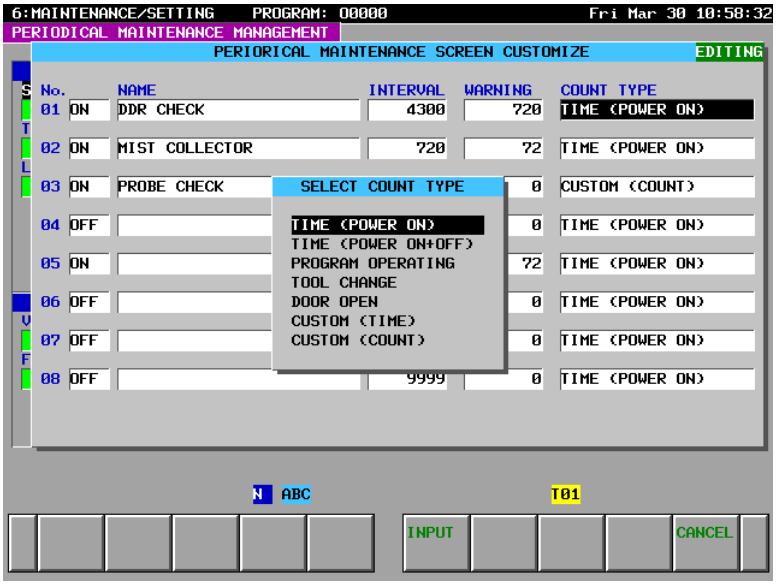
The “WARNING” setting is displayed for each customized item. You can position the cursor on a desired item and enter a numeric value from the operator’s panel to change the setting.
When a cumulative value has reached the value obtained by subtracting the “WARNING” setting from the maintenance interval, an advance message is displayed.

SUPPLEMENT
- The initial value is “0”.
- A value greater than the “INTERVAL” setting cannot be set.
- You can set a value in hours when a time is counted or in units of 1000 when the number of times is counted.

(5) COUNT TYPE

The cumulative value count type setting is displayed for each customized item.
Positioning the cursor displays the following soft keys:

Pressing the [SELECT] soft key displays the following window:



Place the cursor on the count type you want to set and enter the [INPUT] soft key to change the count type. Pressing the [CANCEL] soft key closes the window without changing the setting.
For details of the count type, see Subsection 35.4.2, “Detailed Description of Count Types.”

(6) “EDITING” display

If you change a customized item setting, “EDITING” is displayed.

(7) [OUTPUT] soft key

Pressing the [OUTPUT] soft key outputs the setting of each customized item to a memory card. For the format of the output file, see Subsection 35.4.3, “PERIODICAL MAINTENANCE Screen Customize File.”

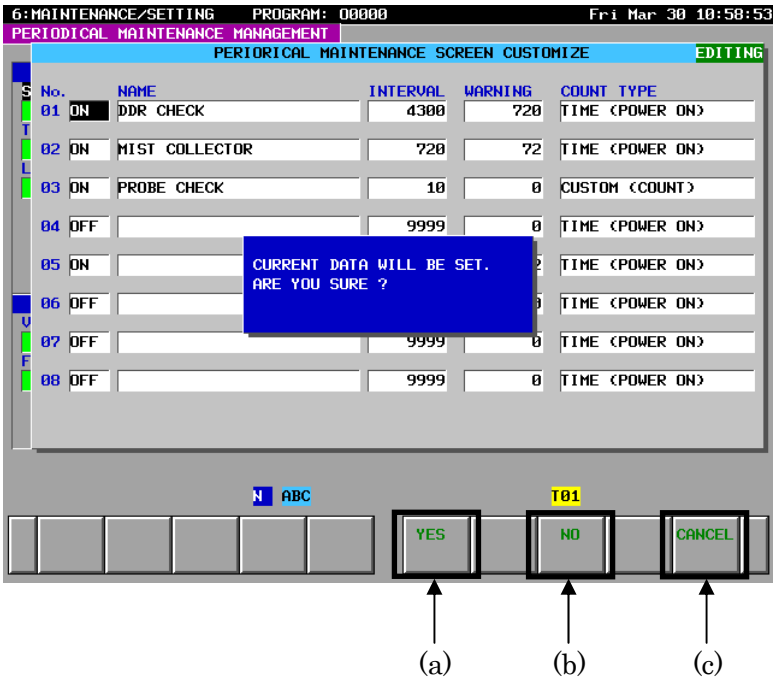
(8) [MEMORY CARD] soft key

(9) [USB MEMORY] soft key

The [USB MEMORY] soft key lists files in the memory card and the USB memory.
A file created in the specified format is read from the corresponding external memory so that the setting of each customized item can be changed. For the format of the file, see Subsection 36.4.3, “PERIODICAL MAINTENANCE Screen Customize File.”

(10) [END] soft key

The [END] soft key closes the PERIODICAL MAINTENANCE SCREEN CUSTOMIZE window.
If the setting of a customized item has been changed, the following window is displayed:



(a) [YES] soft key

The [YES] soft key saves changes and closes the PERIODICAL MAINTENANCE SCREEN CUSTOMIZE window.

(b) [NO] soft key

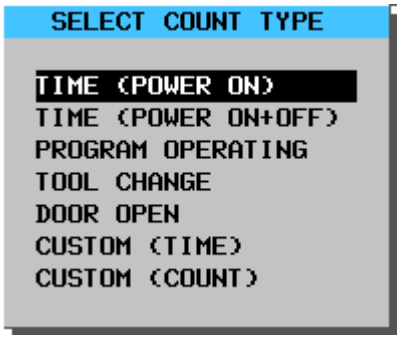
The [NO] soft key closes the PERIODICAL MAINTENANCE SCREEN CUSTOMIZE window without saving changes.

(c) [CANCEL] soft key

The [CANCEL] soft key restores the state before the [END] soft key is pressed and continues editing.

35.4.2 Detailed Description of Count Types

You can select one of the following seven cumulative value count types:



(1) TIME (POWER ON)
Counts the time during which the power to the ROBODRILL is on.

(2) TIME (POWER ON+OFF)
Counts the elapsed time after the previous maintenance operation, regardless of whether the power is on or off.

(3) PROGRAM OPERATING
Counts the time during which the program is operating.

(4) TOOL CHANGE
Counts the number of tool changes.

(5) DOOR OPEN
Counts the number of front door open/close operations.

(6) CUSTOM (TIME)

(7) CUSTOM (COUNT)
You can use the following custom signal prepared for each customized item to count a cumulative value according to a desired condition:

R1373#0 (SO23_0):	Custom signal for counting for “Customized Item 1”
R1373#1 (SO23_1):	Custom signal for counting for “Customized Item 2”
R1373#2 (SO23_2):	Custom signal for counting for “Customized Item 3”
R1373#3 (SO23_3):	Custom signal for counting for “Customized Item 4”
R1373#4 (SO23_4):	Custom signal for counting for “Customized Item 5”
R1373#5 (SO23_5):	Custom signal for counting for “Customized Item 6”
R1373#6 (SO23_6):	Custom signal for counting for “Customized Item 7”
R1373#7 (SO23_7):	Custom signal for counting for “Customized Item 8”

When “CUSTOM (TIME)” is selected, the time during which the above corresponding custom signal is on is counted.
When “CUSTOM (COUNT)” is selected, the number of times the above corresponding custom signal changes from off to on is counted.

CAUTION
- If you want to use “CUSTOM (TIME)” or “CUSTOM (COUNT)” as the count type, create a custom ladder to turn the corresponding custom signal on and off.
- If you want to count a cumulative value using “CUSTOM (COUNT),” create a custom ladder so that the corresponding custom signal is kept on for about 500 msec. If the signal is kept on for a short period, the number of times the signal changes from off to on may not be counted.

35.4.3 Periodical Maintenance Screen Customize File

Pressing the [OUTPUT] soft key outputs the setting of each customized item to a memory card in the following format. Reading a file created in the following format using the [MEMORY CARD] soft key changes the setting of each customized item.

<File name>

You can set any desired name consisting of eight characters as its file name and three characters as its extension.

<Format>

```
%                                    (1)
#CUSTOM1=1,                          (2)
#NAME=”CUSTOMIZE 1”,                 (3)
#INTERVAL=9999,                      (4)
#WARNING=0,                          (5)
#COUNT=0,                            (6)
#CUSTOM2=0,
  :
#CUSTOM8=1,
#NAME=”CUSTOMIZE 8”,
#INTERVAL=9999,
#WARNING=0,
#COUNT=0,
#END                                 (7)
%                                    (1)
```

(1) %

Specify % at the beginning and end of the file.

(2) #CUSTOM?=?,

Specify the number of a customized item and whether to use the item.
A number following “#CUSTOM” is a customized item number. The values set for (3) to (6) are set for the customized item having the specified number until the next “#CUSTOM?=?” is read.
The number following “=“ specifies whether to use the customized item. Specify 0 when you do not want to use the customize item or 1 when you want to use it.

(3) #NAME=“******”,**

Specify the name of the customized item.
Specify any desire name following “#NAME=“ with enclosing it by double quotation marks (“). A customized item name can consist of up to 25 one-byte characters.
You can also display two-byte characters by setting them using a customize file.

CAUTION

- Specify two-byte Japanese characters in JIS code when used.
- Simplified Chinese characters and Russian characters can be set. Use GB2312 code for simplified Chinese characters and Cyrillic character code (CP1251) for Russian characters.
- Some two-byte characters cannot be displayed by the CNC.
- If the language of an input two-byte character differs from the ROBODRILL display language, the name may not be displayed correctly.

(4) #INTERVAL=?,

Set the maintenance interval.
Set the maintenance interval value (1 to 32767) following "#INTERVAL=".

SUPPLEMENT

- A value smaller than the "WARNING" setting cannot be set. If a smaller value is specified, the "WARNING" setting is automatically set to 0.
- To count a time, set a value in hours. To count the number of times, set a value in units of 1000.

(5) #WARNING=?,

Set the advance notice (remaining) value.
Set the advance notice (remaining) value (0 to 32767) following "#WARNING=".

SUPPLEMENT

- A value greater than the maintenance interval cannot be set. If a greater value is specified, a value of 0 is automatically set.
- To count a time, set a value in hours. To count the number of times, set a value in units of 1000.

(6) #COUNT=?,

Specify the count type.
Specify the count type you want to use following "#COUNT=" with the corresponding number listed below:

0: Time of power on
1: Time of power on plus power off
2: Program operation time
3: Number of tool changes
4: Number of door open/close operations
5: Custom signal (time)
6: Custom signal (count)

(7) #END

When "#END" is found, data read operation ends.

SUPPLEMENT

In a file used for reading the setting, all items are not required to be set if "#CUSTOM?=?" and "#END" are specified. For example, when the following file is created and read, the maintenance interval of customized item 5 is changed to 10000, the advance notice (remaining) value is changed to 100, and other settings are not changed.

```
%
#CUSTOM5=1,
#INTERVAL=10000,
#WARNING=100,
#END
%
```

35.5 PARAMETERS

[PMC parameter Keep Relay]

No.	#7	#6	#5	#4	#3	#2	#1	#0
K09								

#1 When the power is turned off then back on after an advance message is acknowledged, the advance message is:
0: Not displayed.
1: Displayed (The advance message needs to be acknowledged again).

#2 The PERIODICAL MAINTENANCE SCREEN CUSTOMIZE window:
0: Can be displayed.
1: Cannot be displayed.

SUPPLEMENT
- Even when keep relay K09#2 is set to 1, a customized item for which “ON” is set is displayed on the main screen and SETTING DETAILS screen to count a cumulative value and post the periodical maintenance time.

35.6 SCREEN DISPLAYED WHEN THE POWER IS TURNED ON

By selecting MAINTENANCE on QUICK screen – “6: MAINTENANCE/SETTING” - [FUNCTIONS] - INITIAL SCREEN (POWER ON), the PERIODICAL MAINTENANCE screen can be displayed when the power is turned on (The first page of the main screen is displayed).

35.7 RESTRICTIONS

- The maintenance interval and advance notice value for the item of FUNCTIONAL INSPECTION cannot not be modified, and the cumulative value of the same item cannot be cleared.
  The cumulative value can be cleared, together with the alarm and message, only when the cumulative value has reached the advance message display value or maintenance interval.

36 MACHINING MODE SETTING FUNCTION

Selecting one of the machining modes, where the precision/speed and smoothing levels vary from one machining mode to another, according to the type of machining to perform enables the most suitable setting to be made for the machining type. A maximum of three user-specific machining modes can be added.

36.1 MACHINING MODE

The machining mode can be selected from the following six machining modes.

N mode: Standard setting for ROBODRILL
HP mode: Setting to enable machining that is precise and faithful to program commands (longer cycle time)
HQ mode: Setting to put emphasis on surface smoothness (longer cycle time)
SP mode: Intermediate mode between HP mode (high precision) and S mode (high speed)
SQ mode: Intermediate mode between HQ mode (surface smoothness) and S mode (high speed)
S mode: Setting to shorten the cycle time most

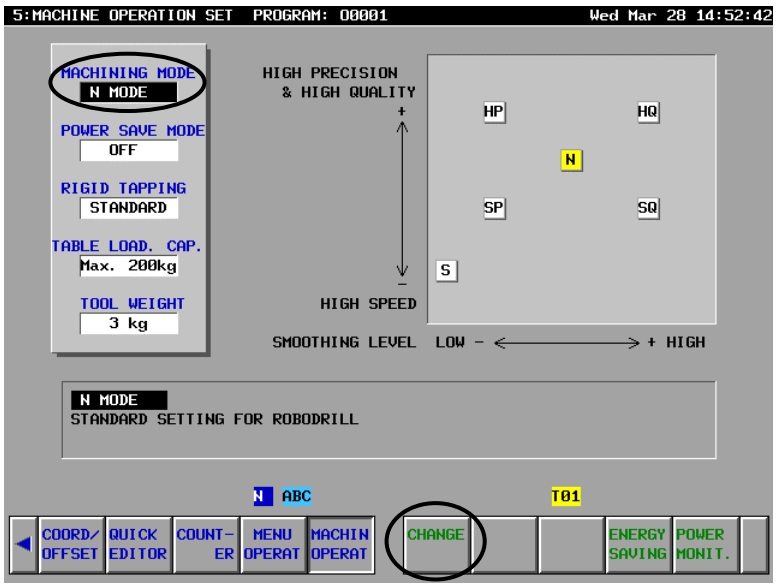
A maximum of three user-specific machining modes can be added other than the above six modes.

L7 mode: User-specific machining mode 1
L8 mode: User-specific machining mode 2
L9 mode: User-specific machining mode 3

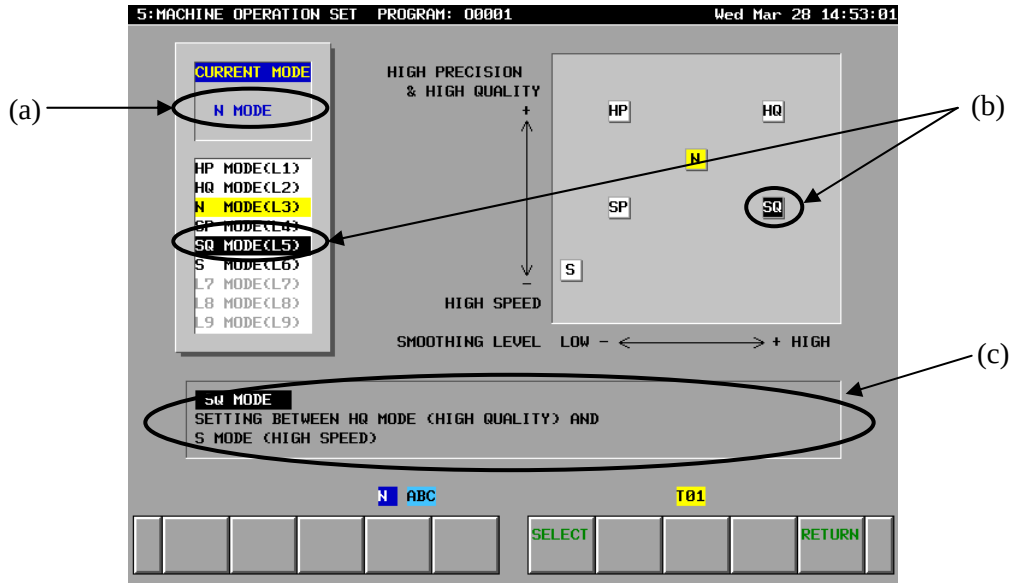
36.2 OPERATION METHOD

36.2.1 Machining mode setting

(1) Display QUICK screen "5.MACHINE OPRATION SET".
(2) Place the cursor on "MACHINING MODE", and press the [CHANGE] soft key.



(3) The following window appears.



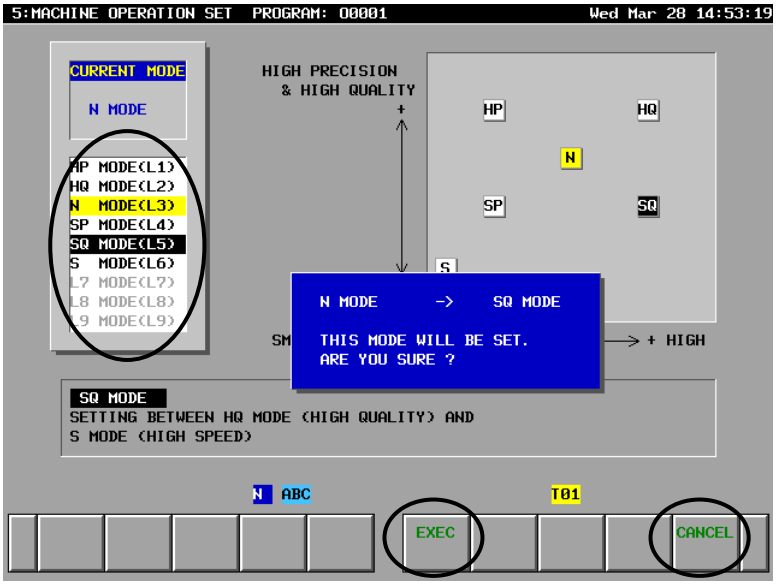
<Explanation of the window>

(a) The machining mode that is currently set is displayed.

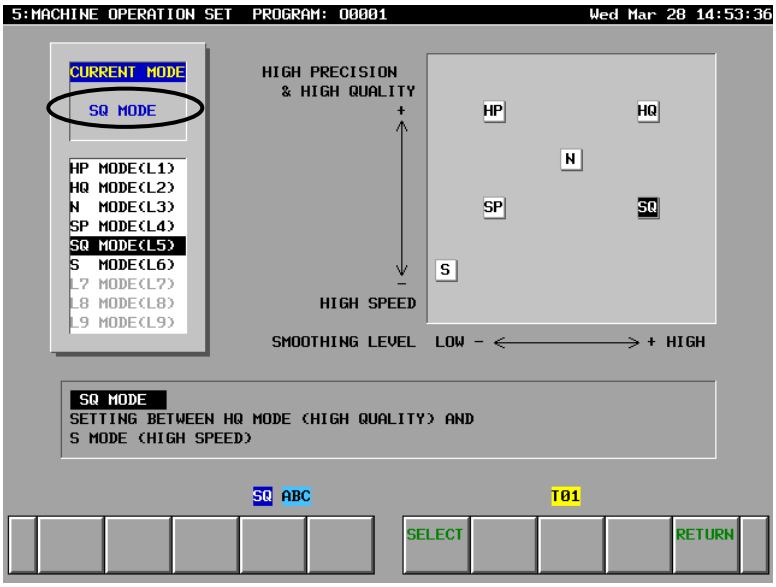
(b) The cursor moves as directed with the cursor keys on the operator's panel.

(c) The description of the machining mode currently selected with the cursor is displayed.

(4) Place the cursor on the machining mode you want to set, and press the [SELECT] soft key. The following message appears. If you want to change the mode setting, press the [EXEC] soft key. If you do not, press the [CANCEL] soft key.



(5) Pressing the [EXEC] soft key sets the selected machining mode.



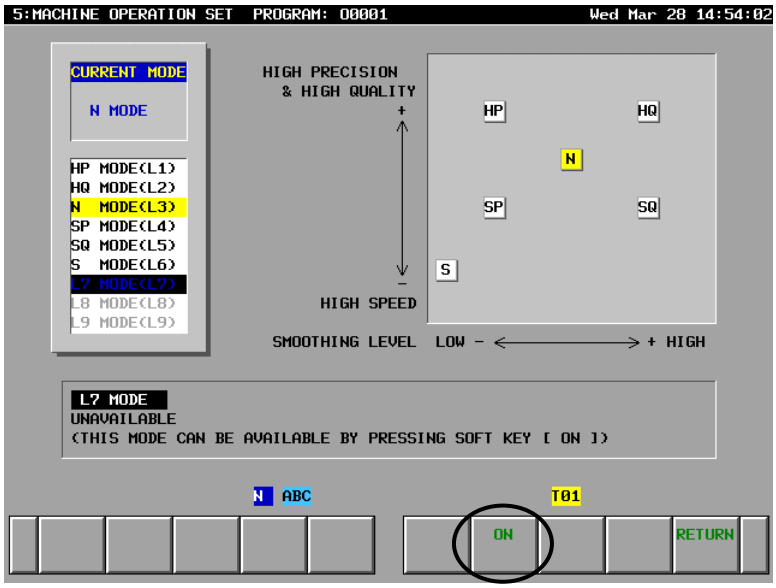
SUPPLEMENT

- The machining mode setting is not cleared even if the power is turned off.
- If machining is in progress or the program protection key is set to "ON", the machining mode cannot be changed from the QUICK screen.

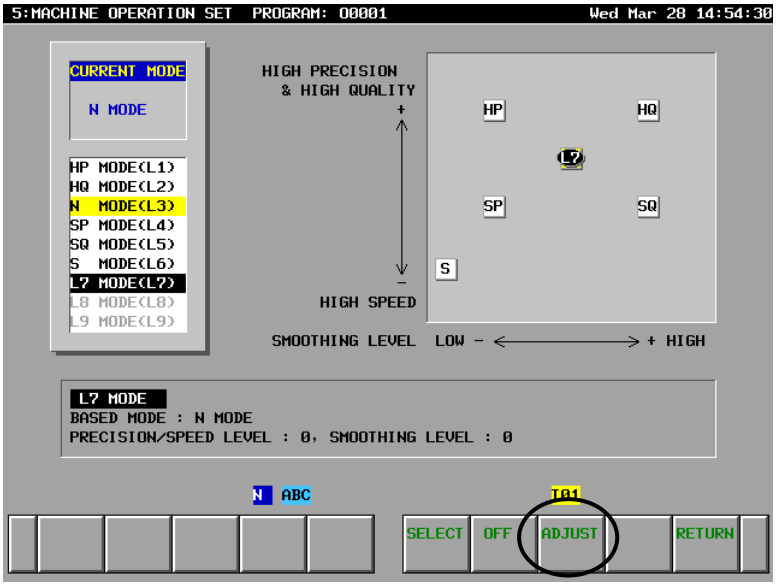
36.2.1.1 Adding and tuning machining modes (L7 to L9)

Using the L7 to L9 modes enables the users to add their own machining modes.

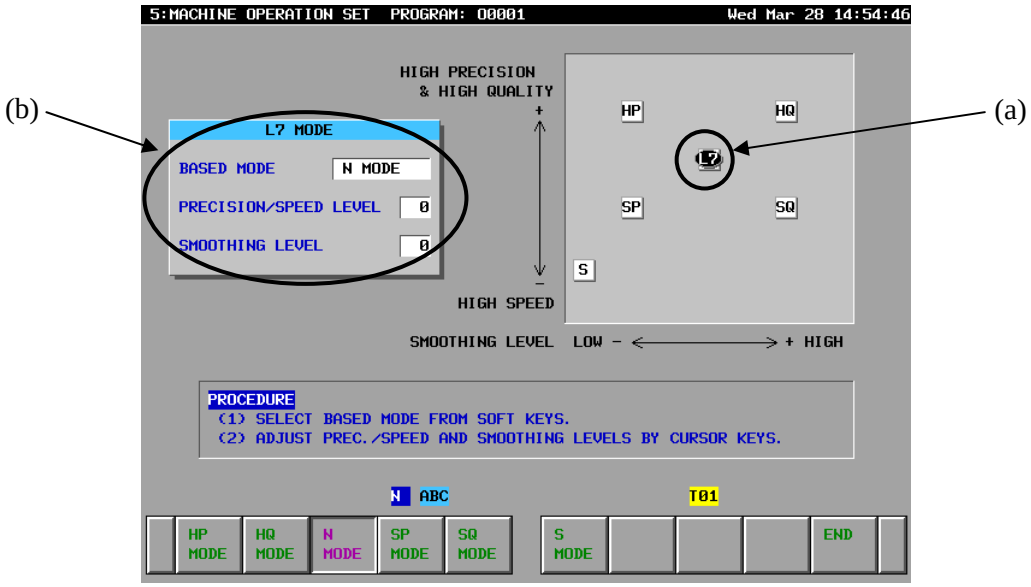
(1) Move the cursor to a disabled mode (whose mode name is displayed in gray) and press the [ON] soft key. The mode is enabled and is displayed in the graph.



(2) Placing the cursor on an added mode displays the soft keys shown below. Press the [ADJUST] soft key. Pressing the [OFF] soft key disables the mode.



(3) Pressing the [ADJUST] soft key displays the following screen.



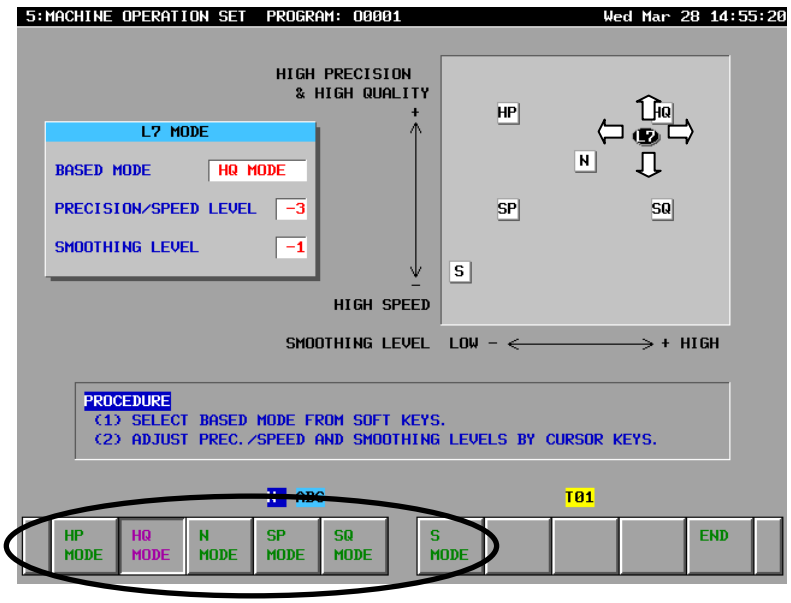
<Explanation of the window>

(a) This is the mode being currently tuned.

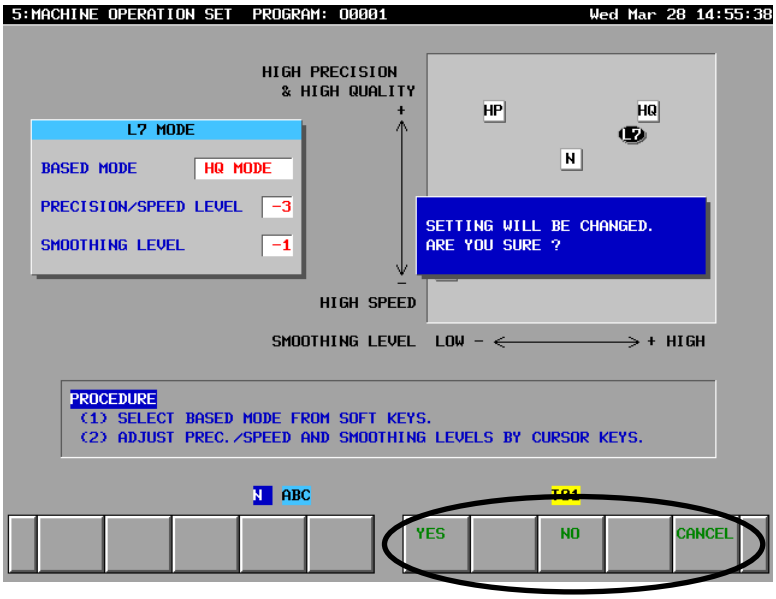
(b) The reference mode and tuning level values are displayed.

Window title:	The name of the mode being currently tuned.
Reference mode:	Mode turning is carried out based on this mode, which can be selected using a soft key.
Precision/speed level:	This value is plotted along the vertical axis of the graph (-3 to +3). The larger the value, the higher is the machining precision, and the smaller the value, the higher is the machining speed.
Smoothing level:	This value is plotted along the horizontal axis of the graph (-3 to +3). The larger the value, the greater importance is attached to the smoothness of the machined surface, and the smaller the value, the greater importance is attached to the precision of the machined profile.

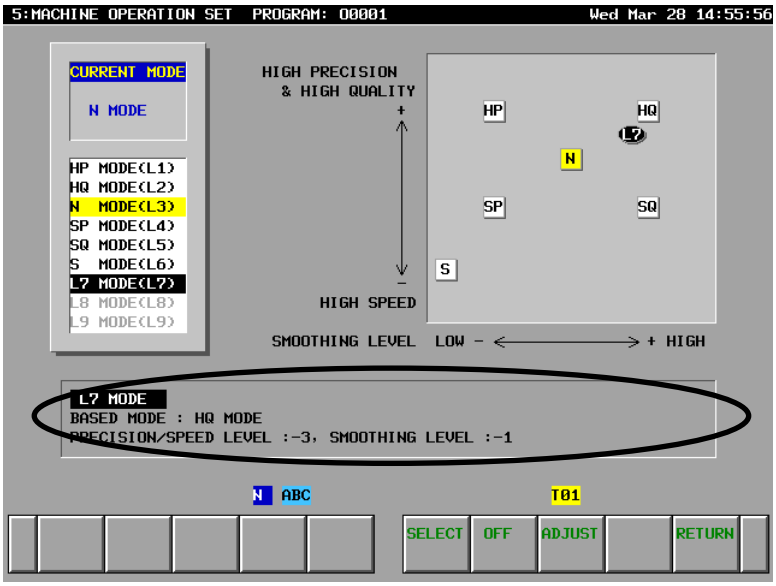
(4) Select which mode to use as a tuning reference, using a soft key, and specify the precision/speed level and the smoothing level, using, respectively, the up (↑) or down (↓) cursor key and the right (→) or left (←) cursor key. Upon completion of tuning, press the [END] soft key.



(5) The following message appears. Press the [YES] soft key to save changes, press the [NO] soft key to end the processing without saving changes, or press the [CANCEL] soft key to continue editing.



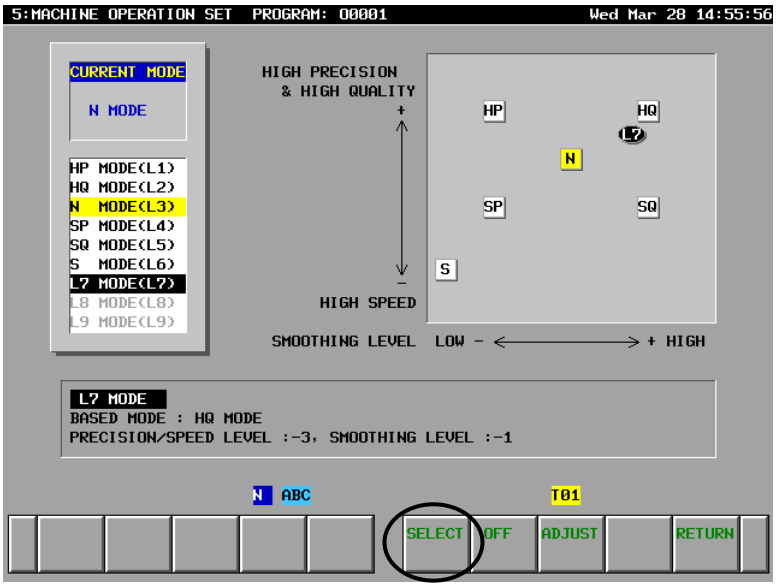
(6) Placing the cursor on any of the L7 to L9 modes lets you check the reference mode, precision/speed level, and smoothing level of the selected mode.



SUPPLEMENT

- The position of the L7 to L9 modes on the graph represents their relationship with their reference mode. The positional relationship on the graph may not match the result of actual machining if the selected mode is compared with any mode other than the reference mode.

(7) When setting any of the L7 to L9 modes, move the cursor to that mode, and press the [SELECT] soft key. The following message appears. Upon confirmation, press the [EXEC] or [CANCEL] soft key whichever is desired.



36.3 PROGRAM-DIRECTED MACHINING MODE SETTING

You can specify M31 in the MEM or MDI mode to set the machining mode.

<Format>

M31 L_ ;

L_: Machining mode to be set

- L1: HP mode (setting to enable machining that is precise and faithful to program commands)
- L2: HQ mode (setting to put emphasis on surface smoothness)
- L3: N mode (standard setting for the ROBODRILL)
- L4: SP mode (intermediate mode between HP and S)
- L5: SQ mode (intermediate mode between HQ and S)
- L6: S mode (setting to shorten the cycle time most)
- L7: L7 mode (user-specific machining mode 1)
- L8: L8 mode (user-specific machining mode 2)
- L9: L9 mode (user-specific machining mode 3)

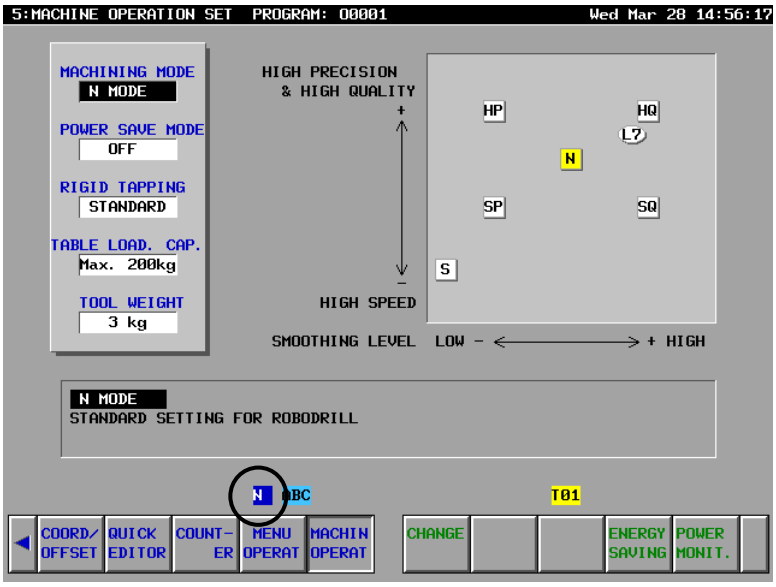
SUPPLEMENT

- Be sure to specify “M31 L_ ;” in a block that does not contain any other command.
- Be sure to specify “M31” at the beginning of a block.
  If a command such as “L_ M31 ;” is executed, an alarm “PS0127: DUPLICATE NC, MACRO STATEMENT.” occurs.
- “M31 L_ ;” must be specified in a state where a canned cycle is cancelled. Specifying “M31 P_ ;” in the canned cycle mode issues alarm "MC3130 DURING CANNED CYCLE".
- If any of the L7 to L9 modes is disabled when specified or if a value other than L1 to L9 is specified, the alarm “MC3130 DATA ERROR L” is issued.
- Once set, the machining mode is not cleared even after the end of the program.
- Specifying “M31 L_ P_” enables the power saving mode to be set up together with the machining mode. However, if either L_ or P_ value is out of range, neither the machining mode nor the power saving mode is re-set up. See Chapter 40, “POWER SAVING MODE” in Part IV for detailed descriptions of the power saving mode.

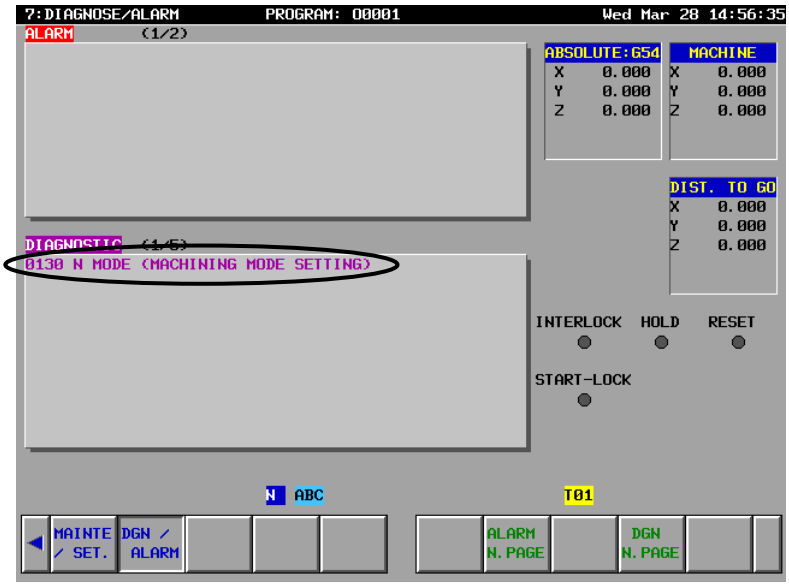
36.4 CHECKING THE CURRENT MACHINING MODE

36.4.1 QUICK Screen

In the lower left part of the QUICK screen, a symbol representing the current machining mode is displayed.



Also, the "7: DIAGNOSE/ALARM" screen displays the current machining mode as the diagnostic data.



36.4.2 Common to CNC Screen and QUICK Screen

Pressing the

key on the operator's panel displays the ALARM/DIAGNOSTIC window at the center of the screen. In this window, the current machining mode is displayed as the diagnostic data (this can be displayed both on the CNC screen and QUICK screen).

SUPPLEMENT

If the current setting does not match any machining mode, no symbol or diagnostic information representing the current machining mode is displayed.

37 MANUAL GUIDE *i*

ROBODRILL comes standard with MANUAL GUIDE *i*, which allows you to create a machining program, check the program using animations, and perform machining setup and actual machining - all on a single screen. For details of MANUAL GUIDE *i*, refer to the "MANUAL GUIDE *i* For MACHINING CENTER System OPERATOR'S MANUAL (B-63874EN-2)".
This chapter describes the functions customized exclusively for ROBODRILL (fixed form sentences, M code menu, and guidance message display) and how to create a program using MANUAL GUIDE *i*.

37.1 FIXED FORM SENTENCES

MANUAL GUIDE *i* allows you to input preset combinations of machining program statements (fixed form sentences) through a simple procedure. ROBODRILL offers a standard set of frequently used fixed form sentences, which you can use without doing any registration work.

37.1.1 Fixed Form Sentence List

By default, ROBODRILL provides the fixed form sentences listed below.

37.1.1.1 Fixed form sentences that can be inserted using the [START] soft key

Name	Fixed form sentence
INITIAL SETTING	G80 G40 M09 ; G91 G28 Z0 M05 ; G49 ;
TOOL CHANGE	G80 G40 M09 ; G49 M06 T? ; D? (TOOL DATA) ; G90 G00 G? X? Y? M03 S? ; G43 Z? H? M08 ;
WORK OFFSET (G54-G59)	G90 G00 G? (ENTER WORK OFFSET G54-G59) ;
ADDITIONAL WORK OFFSET	G90 G00 G54.1 P? (ENTER ADDITIONAL WORK OFFSET NO. 1-48) ;
LINEAR INTERPOLATION	G01 X? Y? F? ;
G10 WORK OFFSET	G10 L2 P? X? Y? Z? (P=0-6) ;
G10 ADD WORK OFFSET	G10 L20 P? X? Y? Z? (P=1-48) ;
G10 TOOL OFFSET	G10 L? P? R? (L10=H-GEOM, L11=H-WEAR, L12=D-GEOM, L13=D-WEAR) ;

37.1.1.2 Fixed form sentences that can be inserted using the [END] soft key

Name	Fixed form sentence
END	M05 ; M09 ; G80 G40 ; G00 G91 G28 Z0 ; G49 ; M30 ;
HOME Z AXIS	(HOME Z AXIS) ; G00 G91 G28 Z0 M09 ; G49 G90 M05 ;
HOME X AND Y AXIS	(HOME X AND Y AXIS) ; G00 G91 G28 X0 Y0 ; G90 ;
END PROGRAM/RESET TO TOP	(END PROGRAM/RESET TO BEGINNING) ; M30 ;
STOP PROGRAM W/O RESET	(STOP PROGRAM W/O RESET) ; M00 ;
OPTIONAL STOP W/O RESET	(OPTIONAL STOP W/O RESET) ; M01 ;
REPEAT PROGRAM	(REPEAT PROGRAM) ; M99 ;
GOTO BLOCK	(GOTO BLOCK N?) ; M99 P? ;

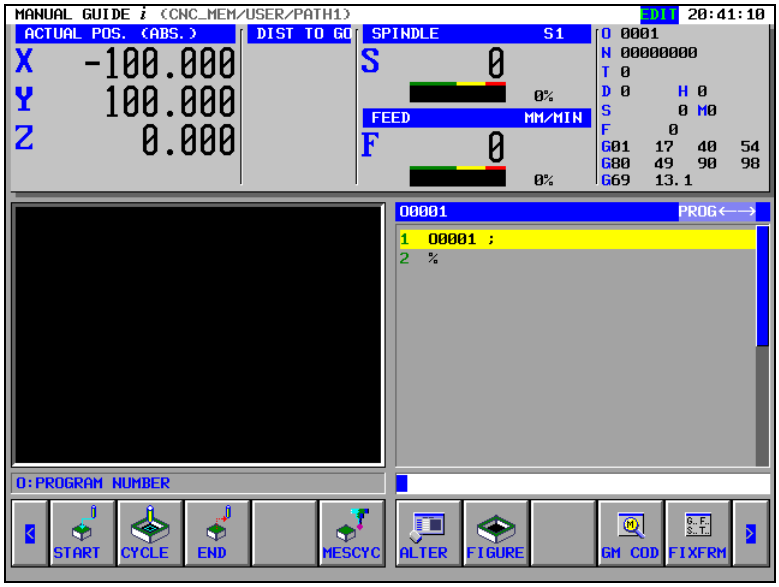
37.1.2 Fixed Form Sentence Insertion Procedure

37.1.2.1 When using the [START] or [END] soft key

(1) Press GRAPH in the CNC screen, or press · GRAPH and then N PAGE, to switch to the MANUAL GUIDE *i* screen.

(2) Press EDIT on the operator's panel to switch to the edit mode.

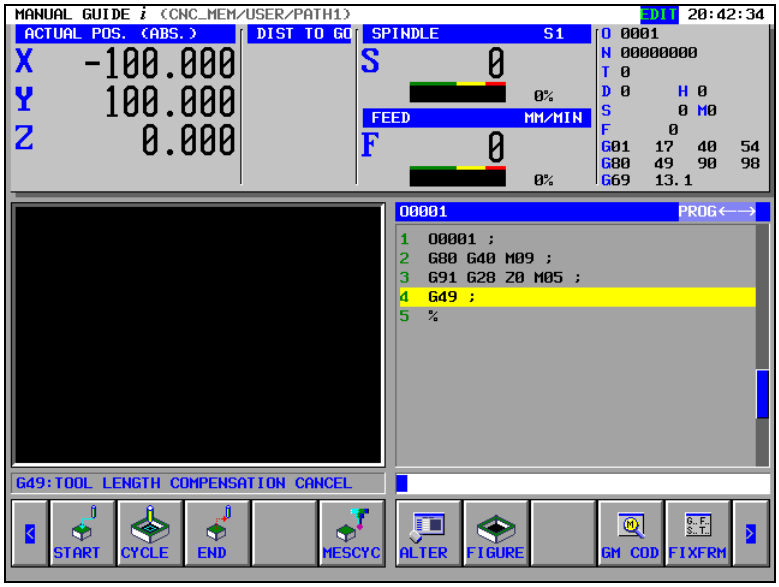
(3) Press the [>] soft key on the right end several times until the screen displays the soft keys shown below.



(4) Press the [START] or [END] soft key (shown below is the screen displayed when [START] is pressed).

(5) With the "START" tab displayed (or the "END" tab when [END] was pressed), place the cursor on the fixed form sentence you want to insert, by using the cursor keys on the operator's panel.

(6) Press the [INSERT] soft key. The selected fixed form sentence is inserted into the program.



SUPPLEMENT

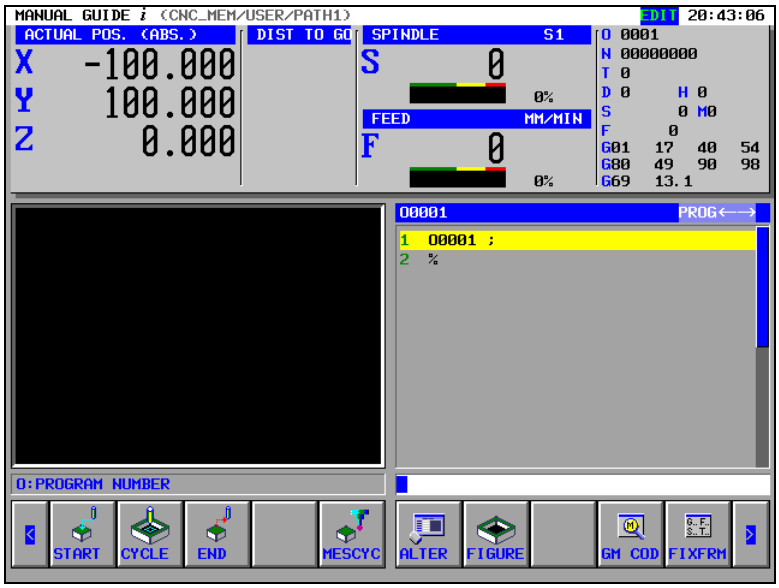
- The selected fixed form sentence is inserted after the word on which the cursor is currently placed.

37.1.2.2 When using the [FIXFRM] soft key

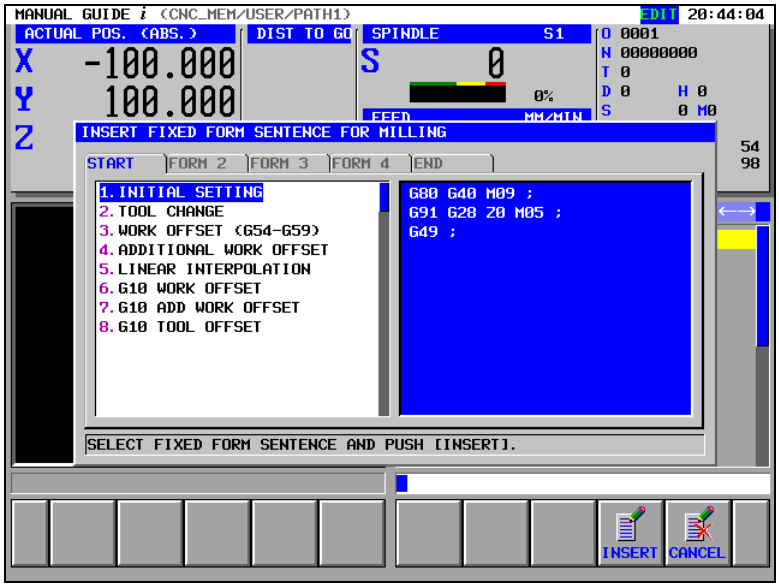
(1) Press GRAPH in the CNC screen, or press · GRAPH and then N PAGE, to switch to the MANUAL GUIDE *i* screen.

(2) Press EDIT on the operator's panel to switch to the edit mode.

(3) Press the [>] soft key on the right end several times until the screen displays the soft keys shown below.



(4) Press the [FIXFRM] soft key. The following window is displayed.

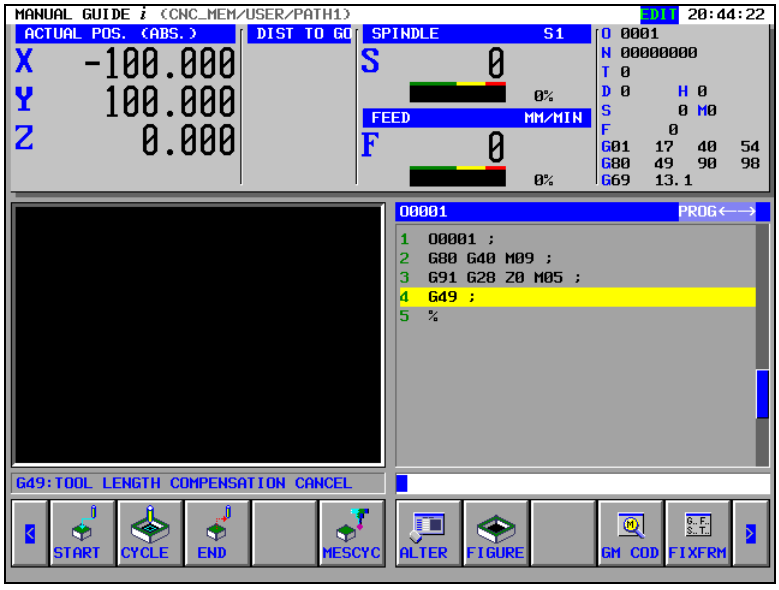


(5) Switch tabs by using the left or right cursor key to select the "START" or "END" tab.

SUPPLEMENT

By default, no fixed form sentences are provided in the "FORM 2", "FORM 3", and "FORM 4" tabs.

(6) Press the [INSERT] soft key. The selected fixed form sentence is inserted into the program.



SUPPLEMENT

The selected fixed form sentence is inserted after the word on which the cursor is currently placed.

37.1.3 Initializing Fixed Form Sentences to a Standard Ones

Fixed form sentences can be initialized to the factory-set status.

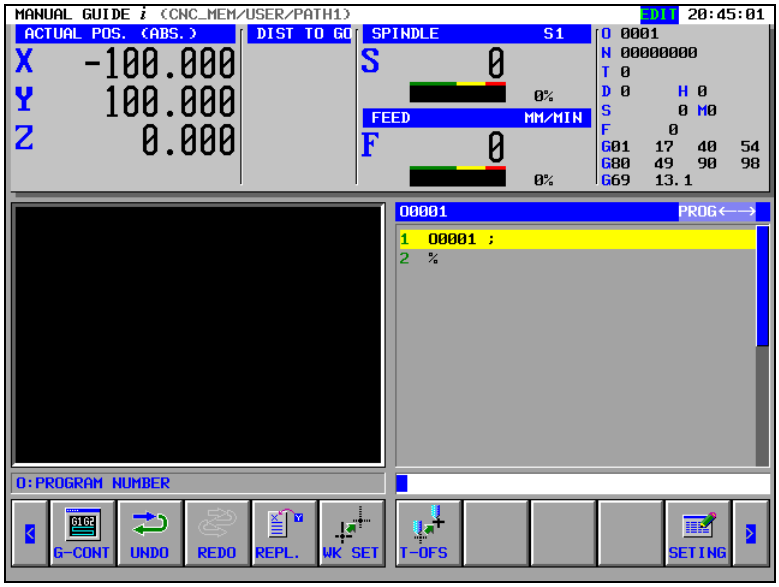
CAUTION

- Fixed form sentences can be added and changed. For information about how to edit fixed form sentences, refer to the MANUAL GUIDE *i* For MACHINING CENTER System OPERATOR'S MANUAL (B-63874EN-2). Initializing fixed form sentences deletes all those fixed form sentences added and changed after shipment.
- If you have changed the display language, be sure to initialize fixed form sentences with the selected language displayed on the screen. If initialization is not performed, sentences may not be displayed properly.

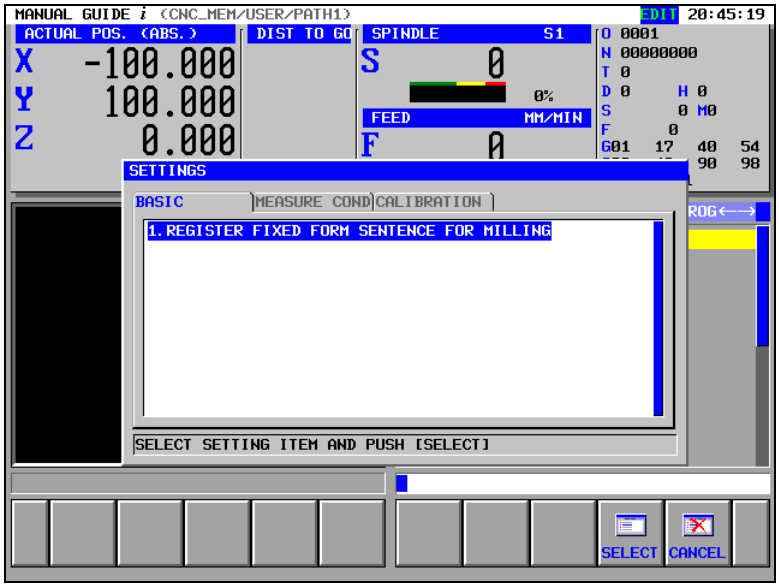
(1) Press GRAPH in the CNC screen, or press • GRAPH and then N PAGE, to switch to the MANUAL GUIDE *i* screen.

(2) Press EDIT on the operator's panel to switch to the edit mode.

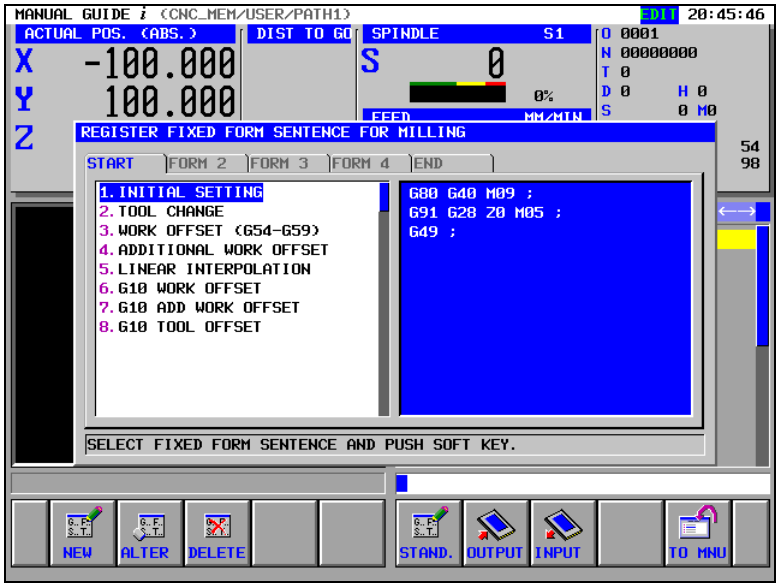
(3) Press the [>] soft key on the right end several times until the screen displays the soft keys shown below.



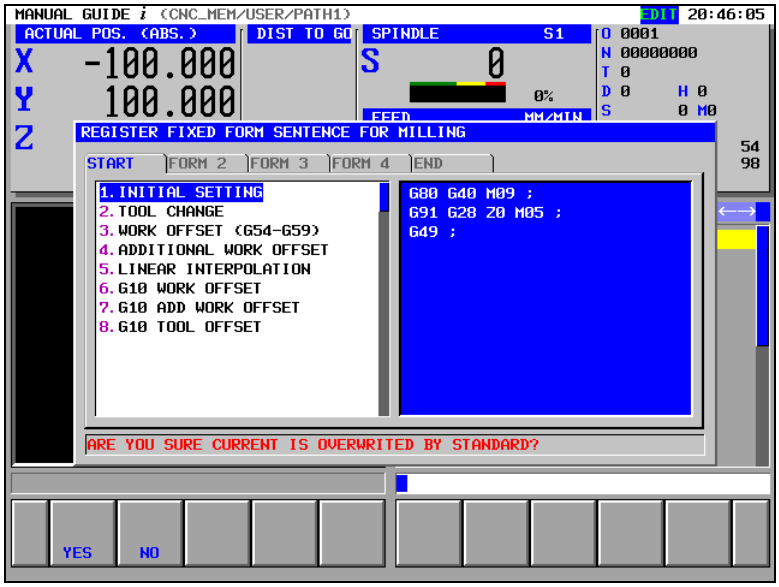
(4) Press the [SETING] soft key. The following window is displayed.



(5) By using the cursor keys on the operator's panel, display the [BASIC] tab. With the cursor placed on "REGISTER FIXED FORM SENTENCE FOR MILLING", press the [SELECT] soft key. The following window is displayed.



(6) Press the [STAND.] soft key. When the following window is displayed, press the [YES] soft key. The fixed form sentences are initialized, and the display is refreshed.



37.2 M CODE MENU

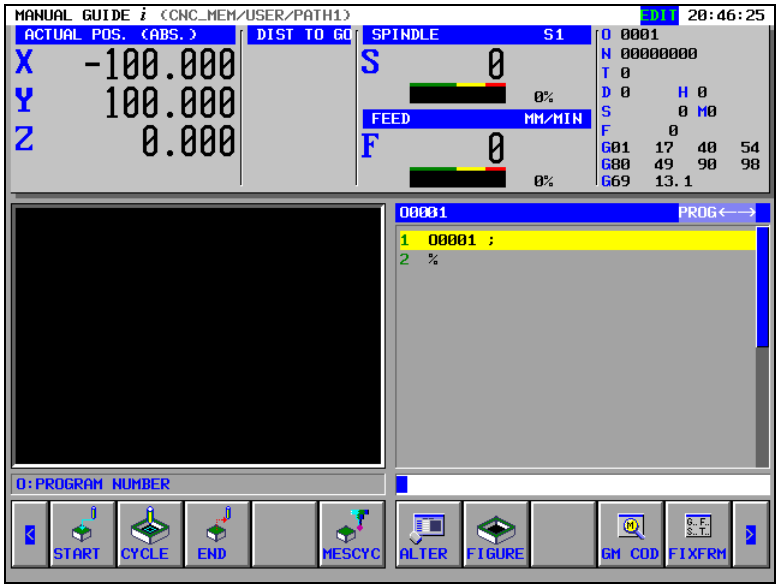
The M code menu of MANUAL GUIDE *i* allows you to insert any of the preset M codes into a program through a simple procedure.
With ROBODRILL, G codes can also be inserted in addition to M codes. For the M codes that can be inserted, see Subsection 2.2.3, "Miscellaneous Function (M Function)", in Part IV. For the G codes that can be inserted, see Appendix C, "G CODES".

37.2.1 Inserting a G Code or M Code

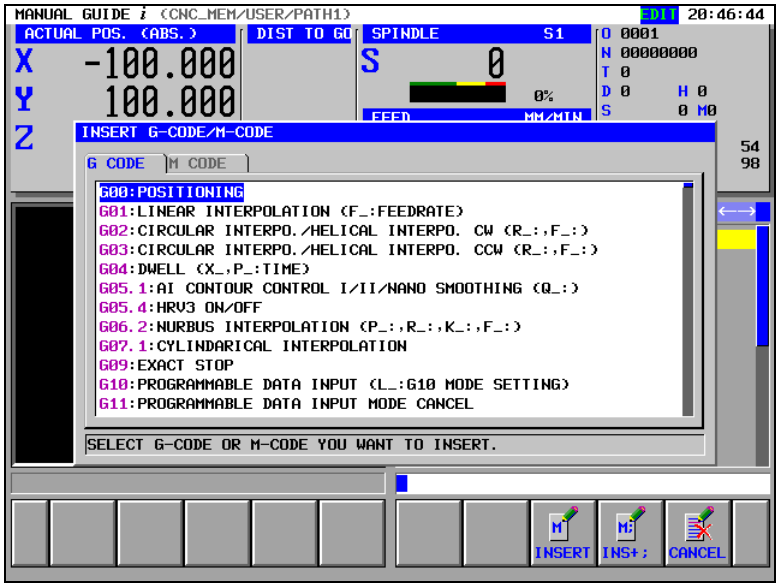
(1) Press GRAPH in the CNC screen, or press · GRAPH and then N PAGE, to switch to the MANUAL GUIDE *i* screen.

(2) Press EDIT on the operator's panel to switch to the edit mode.

(3) Press the [>] soft key on the right end several times until the screen displays the soft keys shown below.

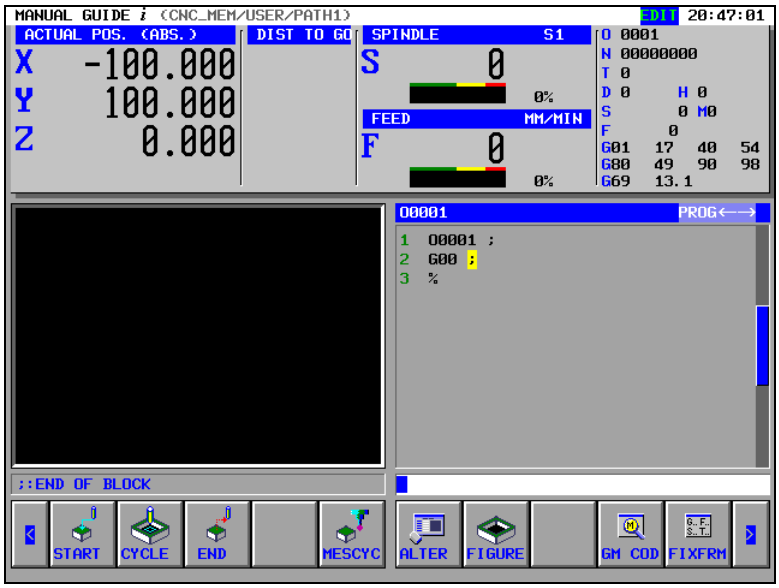


(4) Press the [GM COD] soft key. The following window is displayed.



(5) Switch tabs by using the left or right cursor key on the operator's panel. To insert a G code, select the [G CODE] tab. To insert an M code, select the [M CODE] tab.

(6) By using the up or down cursor key on the operator's panel, place the cursor on the G code or M code you want to insert. Then, press the [INSERT] or [INS+;] soft key. The selected G code or M code is inserted into the program (shown in the photo below is an example displayed when [INS+;] is selected).

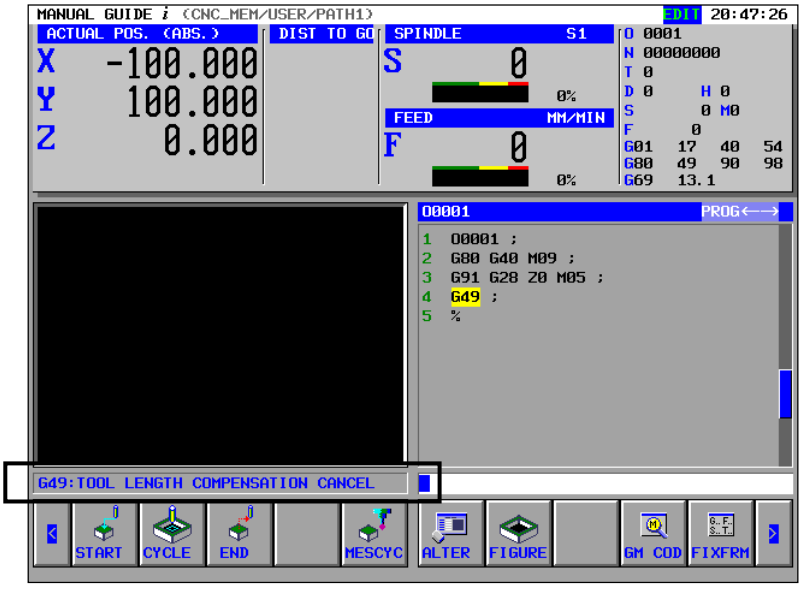


SUPPLEMENT

- If you press the [INSERT] soft key, only the selected G code or M code is inserted. If you press the [INS+;] soft key, the selected G code or M code is inserted with a semicolon (;) appended at the end.
- The selected G code or M code is inserted after the word on which the cursor is currently placed.

37.3 GUIDANCE MESSAGE

When you are editing a program with MANUAL GUIDE *i*, the meaning of the word on which the cursor is currently placed is displayed in the lower left part of the screen (guidance message).
The content of such a guidance message is exclusively intended for ROBODRILL.

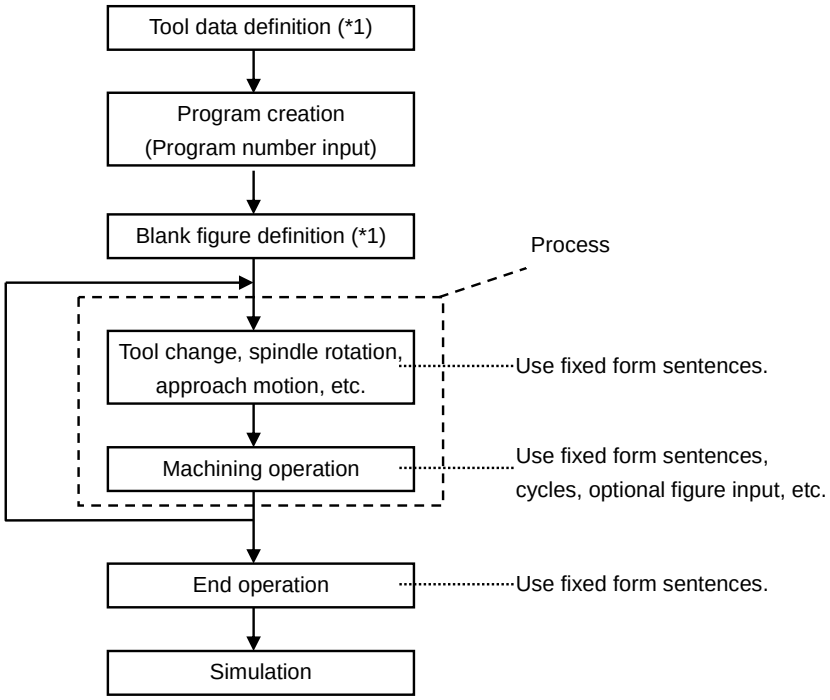


37.4 EXAMPLES OF THE PROGRAMMING OPERATION

This section describes the flow of programming using MANUAL GUIDE *i* with the ROBODRILL, by giving a couple of examples.

37.4.1 Flow of Programming

The flow of programming is outlined below.



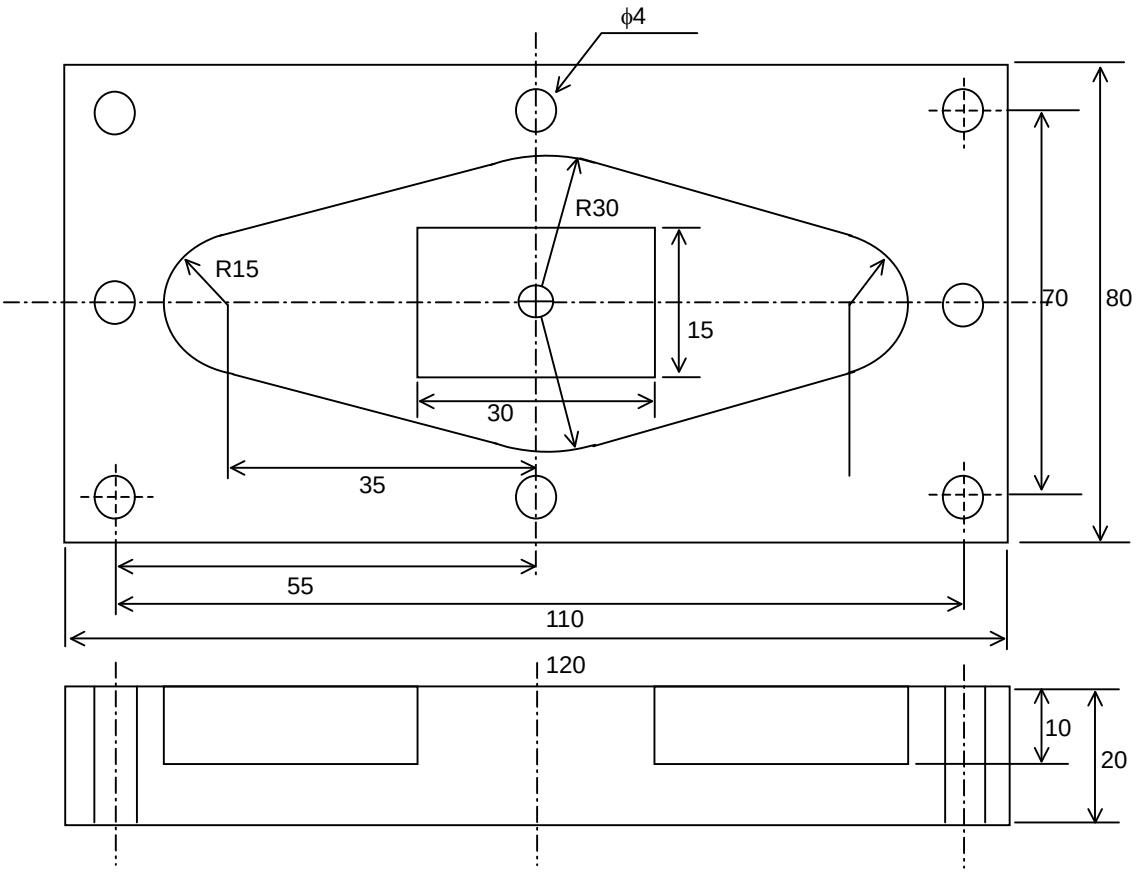
*1: If simulation is not performed, "blank figure definition" and "tool data definition" are unnecessary.

The programming operation is described below using two examples.

37.4.2 Operation Example 1 (Outer Wall Contouring, Pocketing, and Drilling)

Blank: 130 × 90 × 30

First process: Rough outer wall contouring using a ϕ8 flat end mill (T01)
Second process: Rough pocketing using a ϕ8 flat end mill (T01)
Third process: Finishing pocketing (bottom and side) using a ϕ6 flat end mill (T02)
Fourth process: Drilling using a ϕ4 drill (T03)



The following descriptions assume that the workpiece coordinate system and tool offset are properly set.

37.4.2.1 Tool Data Definition

Define the tools to be used for machining. Here, assign the ϕ8 flat end mill (T1) used for the first and second processes, ϕ6 flat end mill (T2) used for the third process, and ϕ4 drill (T3) used for the fourth process in tool compensation numbers 001, 002, and 003, respectively.

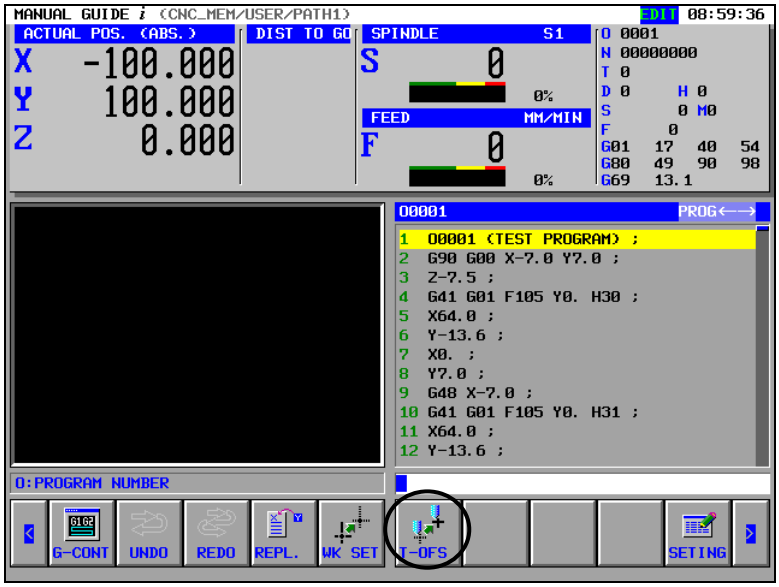
SUPPLEMENT
If simulation is not performed, the tool data definition procedure described below does not need to be carried out.

(1) Press

on the operator's panel to switch to the edit mode.

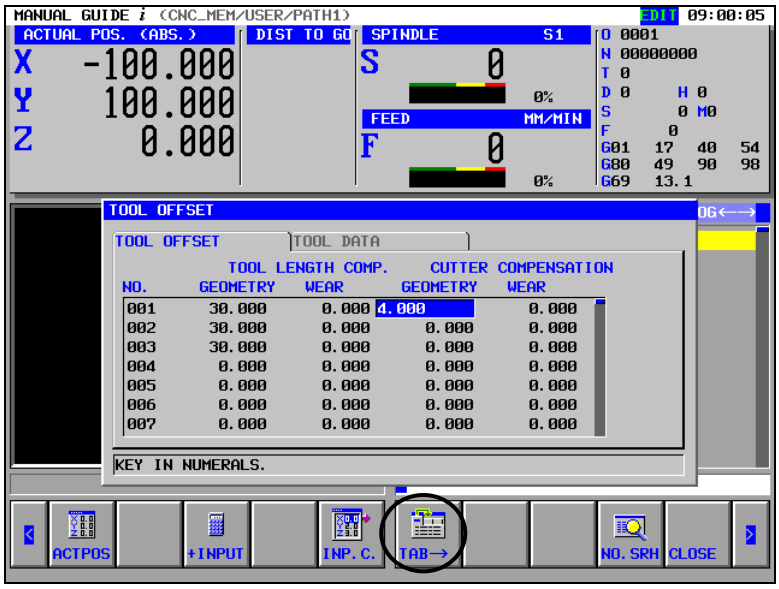
(2) Press the [>] soft key on the right end several times until the screen displays the soft keys shown below.

(3) Press the [T-OFS] soft key.



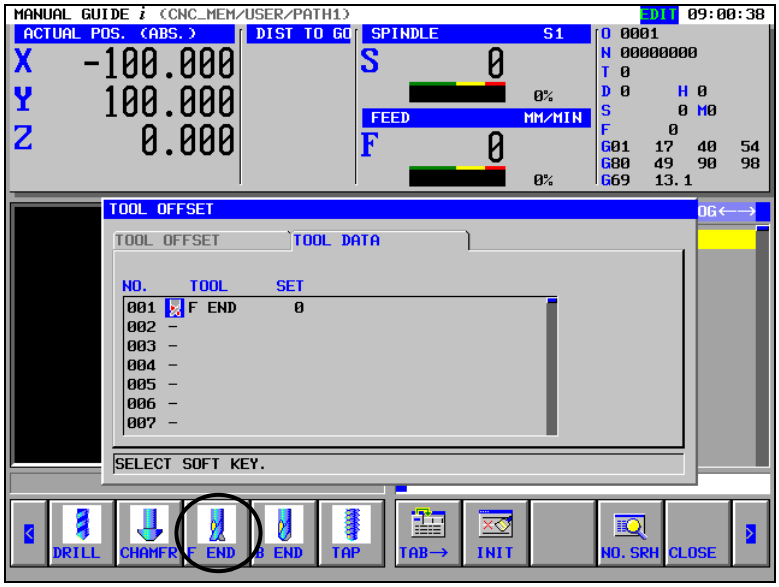
(4) Assign the ϕ8 flat end mill (T1) to tool compensation number 001. Display the "TOOL OFFSET" tab, and enter the tool radius in the "GEOMETRY" field in "CUTTER COMPENSATION" as in the screen shown below (here, enter "4.0").

SUPPLEMENT
It is assumed that the tool length offset is properly set.

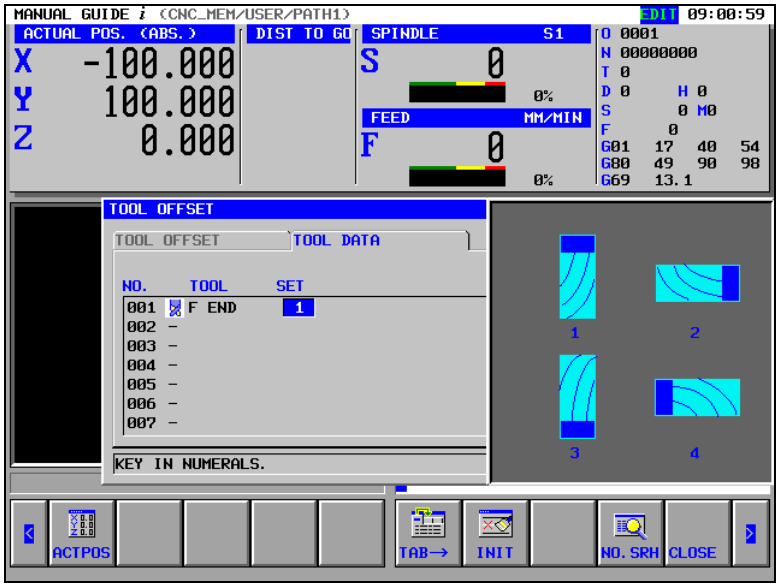


(5) Display the "TOOL DATA" tab by pressing the right cursor key <→> on the operator's panel several times or pressing the [TAB→] soft key.

(6) Press the [F END] soft key to define the flat end mill.

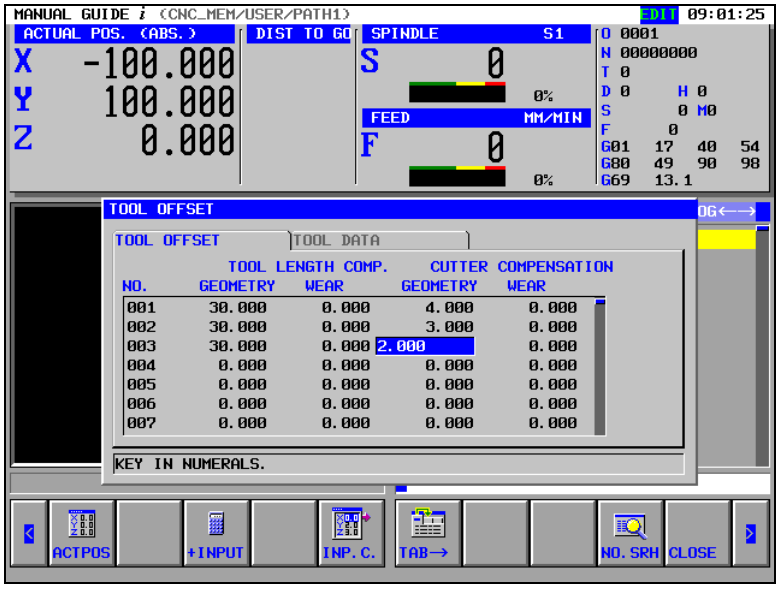


(7) Press the right cursor key <→> on the operator's panel twice to place the cursor on "SET", and enter a number to specify the tool setting direction.

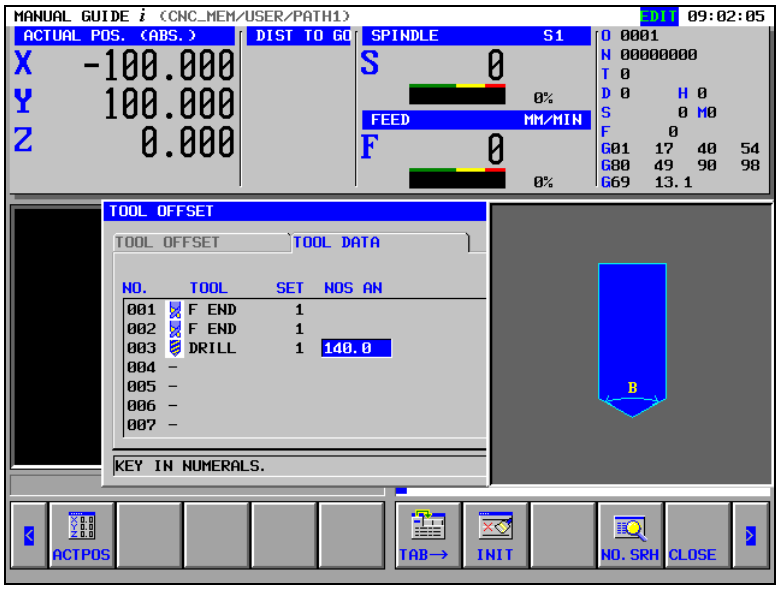


This completes the assignment of the ϕ8 flat end mill (T1) to tool compensation number 001. Define the remaining tools in the same way.

(8) Display the "TOOL OFFSET" tab, and enter the tool diameter (radius) in the "GEOMETRY" field in "CUTTER COMPENSATION" as in the screen shown below.



(9) Display the "TOOL DATA" tab, and define the tool as in the screen shown below. If you select "DRILL" as the tool type, the "NOS AN" field appears. Set the nose angle as in the screen shown below.



(10) Taking these steps defines the tool data in tool compensation numbers 001 to 003. By inserting "D1" to "D3" into the program, you can define these tools.

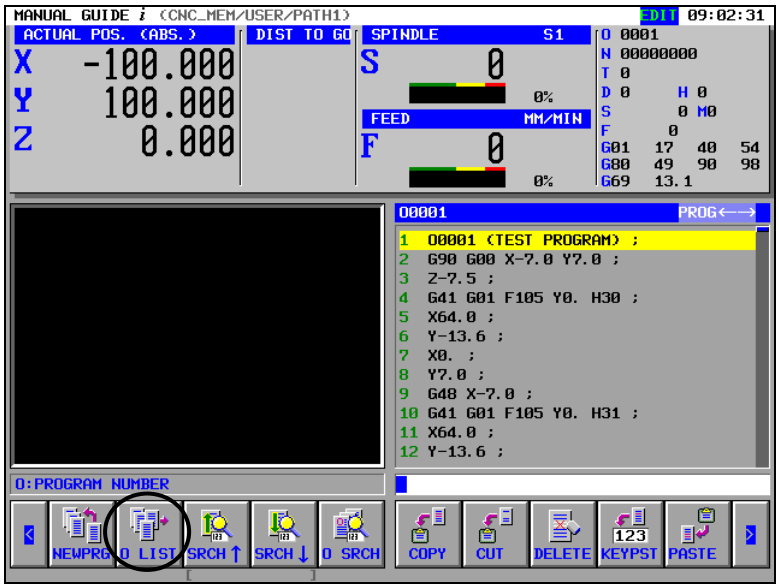
SUPPLEMENT

By placing the cursor on the "TOOL" field of the "TOOL DATA" tab, you can edit the tool name. Use this feature in such cases as when you have two or more tools of the same kind and want to have each of them individually identified.

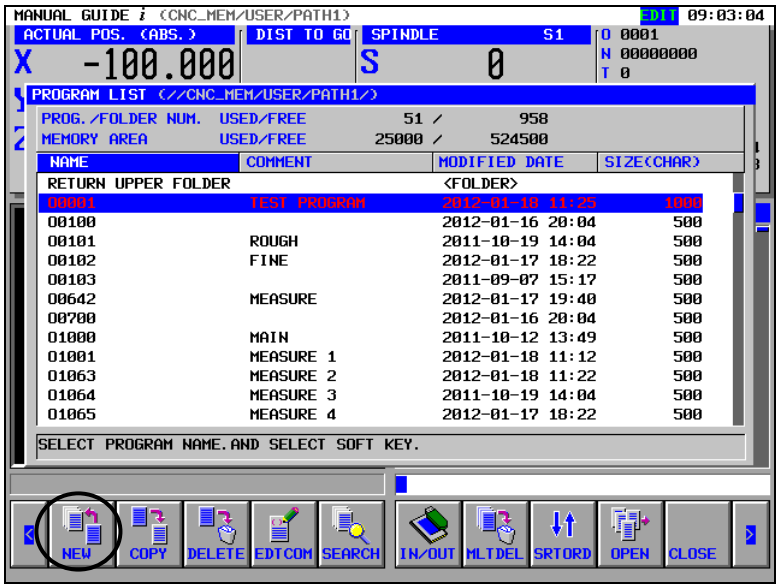
(11) Press the [CLOSE] soft key to close the window.

37.4.2.2 Program Creation

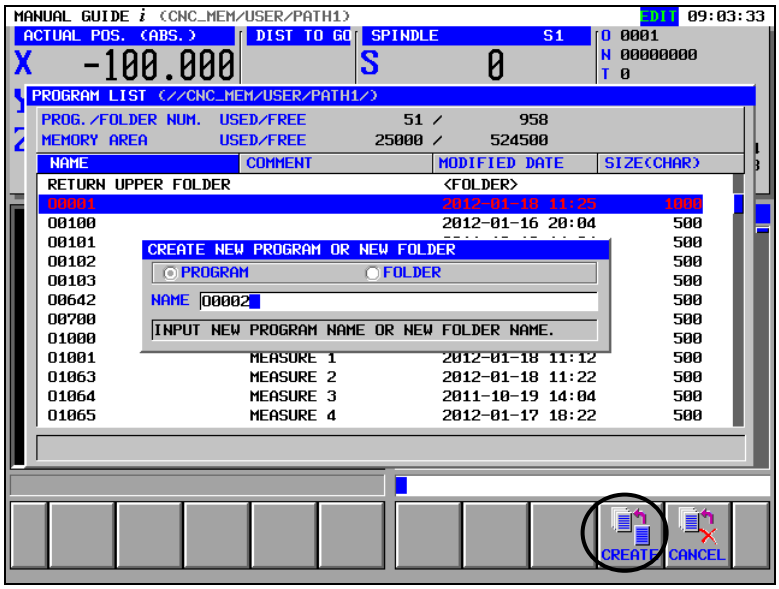
(1) Press the [O LIST] soft key.



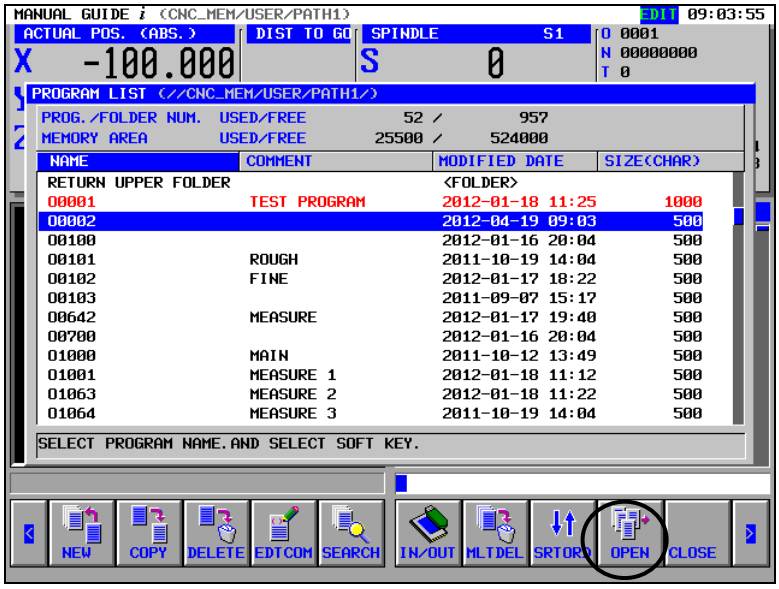
(2) Press the [NEW] soft key.



(3) Enter the name of the program you want to create, and press the [CREATE] soft key or the <INPUT> key on the operator's panel (a program named "O0002" is being created in the example shown in the photo below).



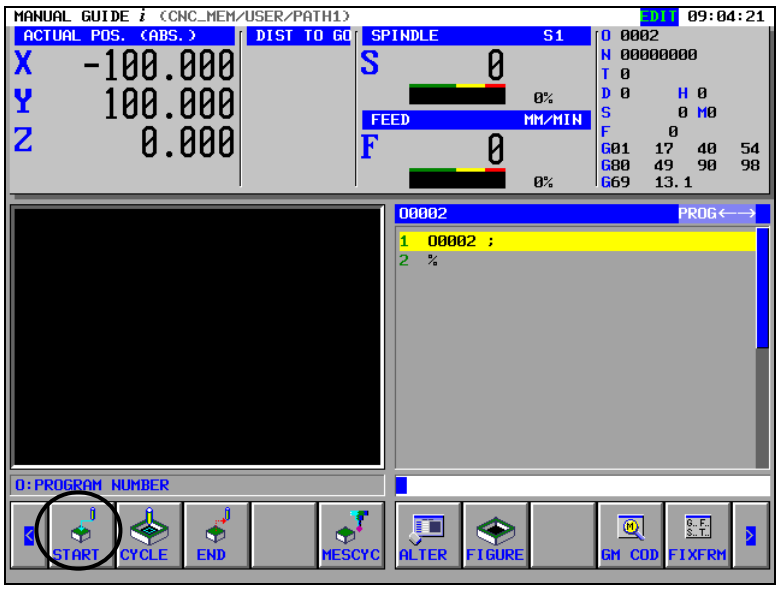
(4) Place the cursor on the created program in the PROGRAM LIST window, and press the [OPEN] soft key or the <INPUT> key on the operator's panel.



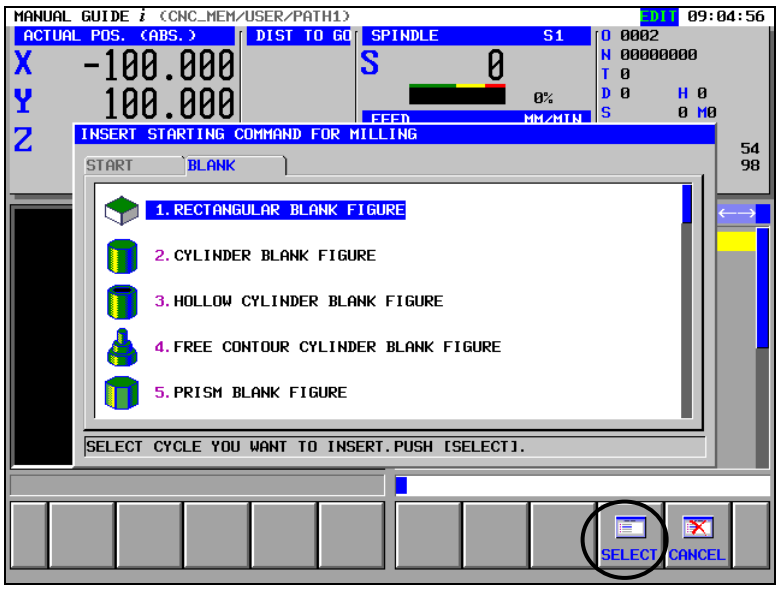
37.4.2.3 Blank Figure Definition

SUPPLEMENT
If simulation is not performed, the blank figure definition procedure described below does not need to be carried out.

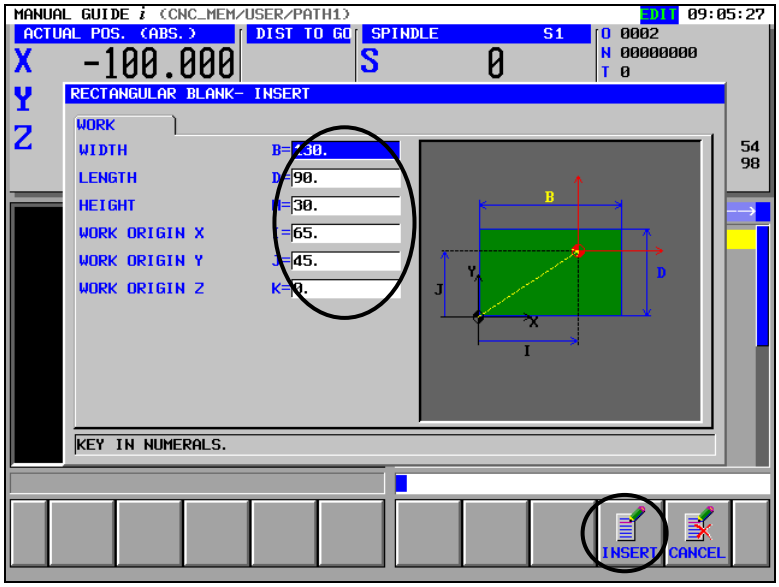
(1) Press the [>] soft key on the right end several times until the screen displays the soft keys shown below.
(2) Press the [START] soft key.



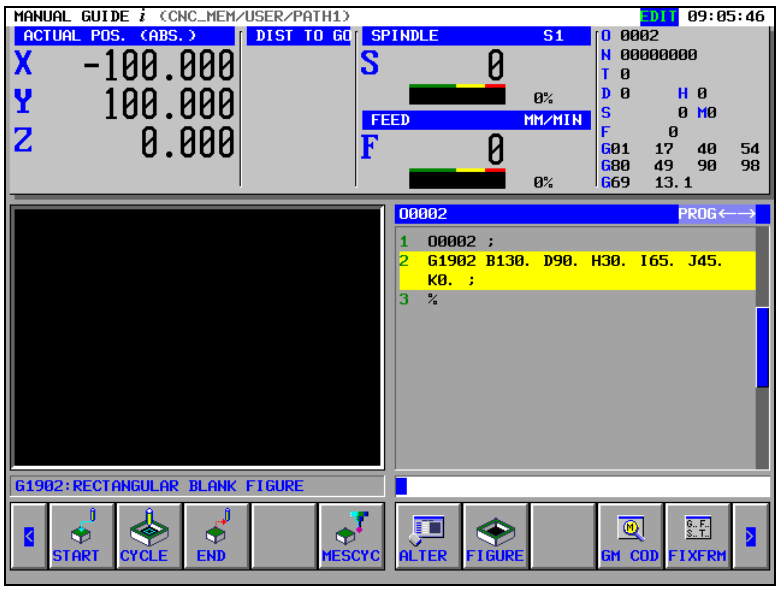
(3) Display the "BLANK" tab by pressing the right cursor key <→> on the operator's panel. Place the cursor on "1. RECTANGULAR BLANK FIGURE", and press the [SELECT] soft key or the <INPUT> key on the operator's panel.



(4) Enter the blank figure dimensions and workpiece origin, as shown below, and press the [INSERT] soft key.



(5) The blank figure definition block is inserted into the program.

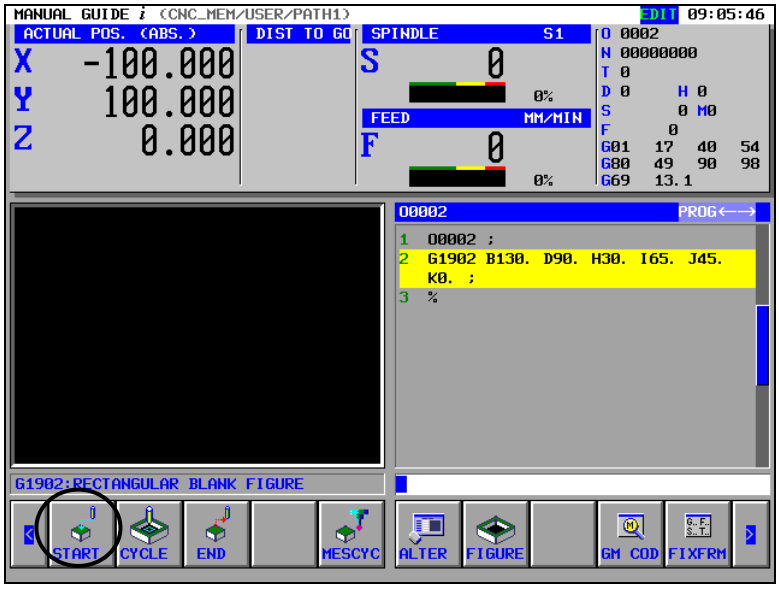


37.4.2.4 First Process (Rough outer wall contouring) Input

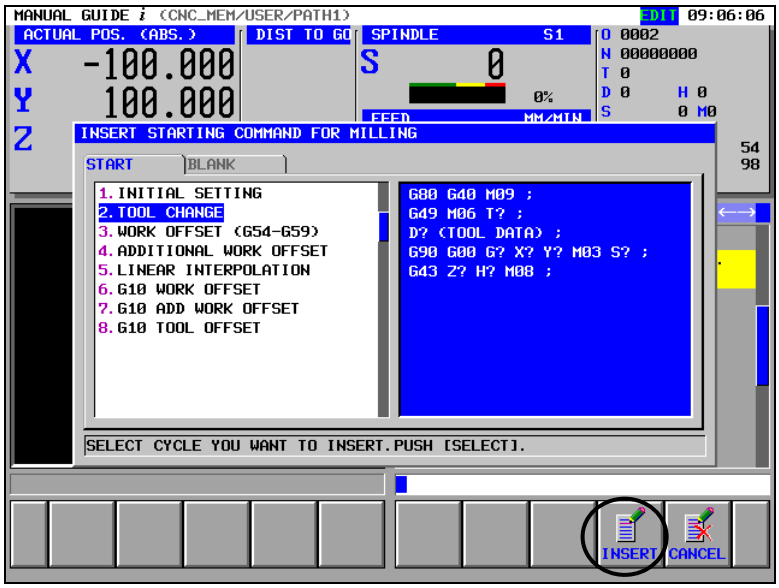
(1) Tool change/Spindle rotation/Approach motion

While commands for tool change, spindle rotation, and approach motion to the machining start point, etc. can be input manually one by one using G and M codes, it is more convenient to use fixed form sentences.

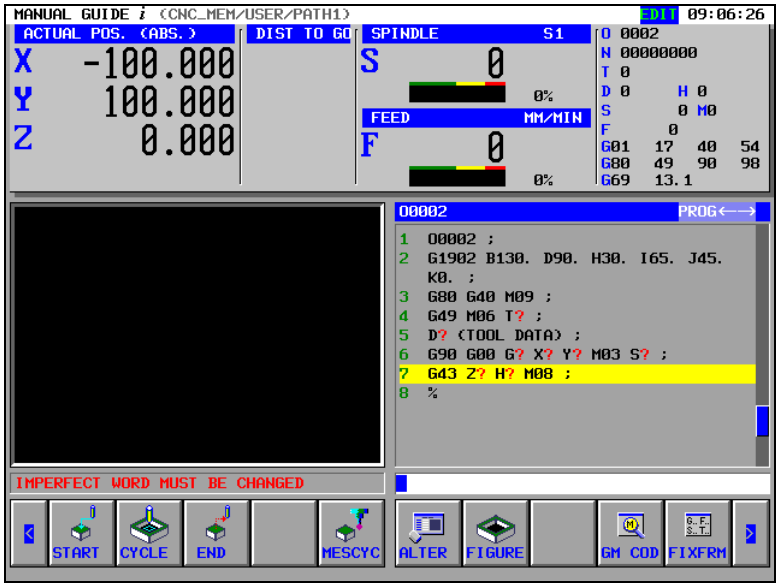
(1) Press the [>] soft key on the right end several times until the screen displays the soft keys shown below.
(2) Press the [START] soft key.



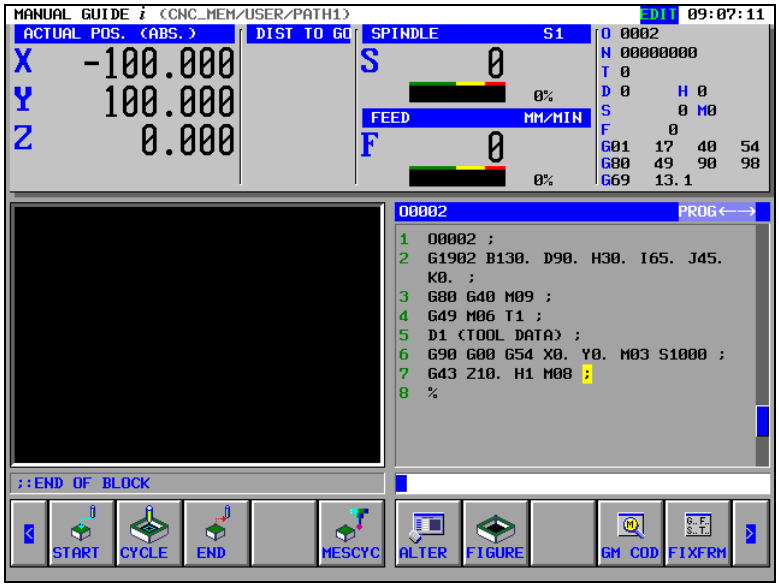
(3) Place the cursor on "2. TOOL CHANGE" in the "START" tab, and press the [INSERT] soft key or the <INPUT> key on the operator's panel.



(4) The selected fixed form sentence is inserted. Undecided values are represented by "?", as in the screen shown below.



(5) Place the cursor on an address for which "?" is displayed, enter a value, and then press the <ALTER> key on the operator's panel. For example, place the cursor on "T?", and enter "1" and press <ALTER>. Doing so inputs tool number "T1". (Address "T" does not need to be input.) After entering data, return the cursor to the EOB position at the end of the program.



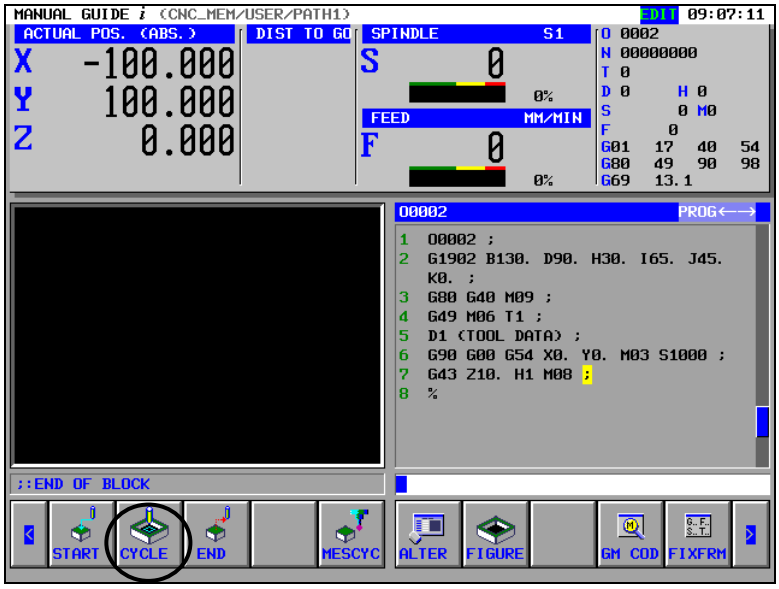
SUPPLEMENT

In the screen shown above, "D1" on the fifth line of the program is a tool compensation number (see Subsection 37.4.2.1). For "G?" on the sixth line, workpiece coordinate system "G54" is input

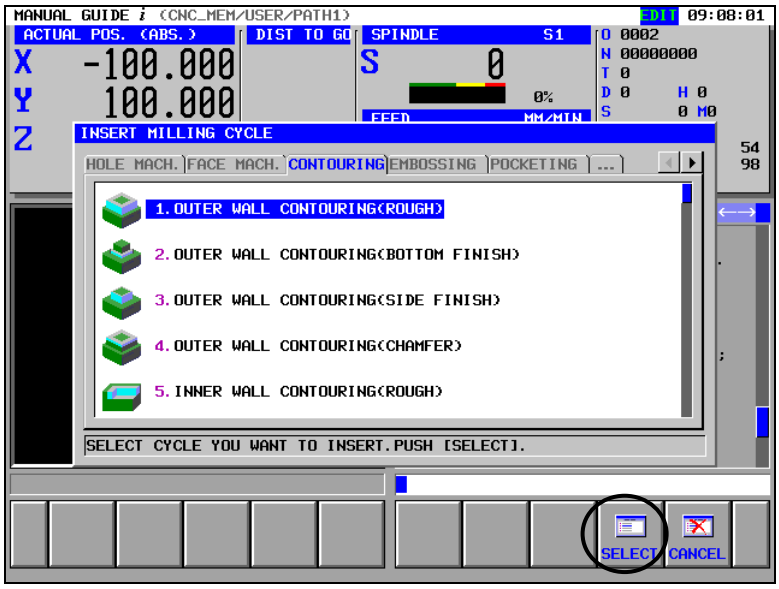
(2) Machining Operation

First process: Specify rough outer wall contouring using a flat end mill for rough machining (T01). Enter the machining type, cutting conditions, etc.

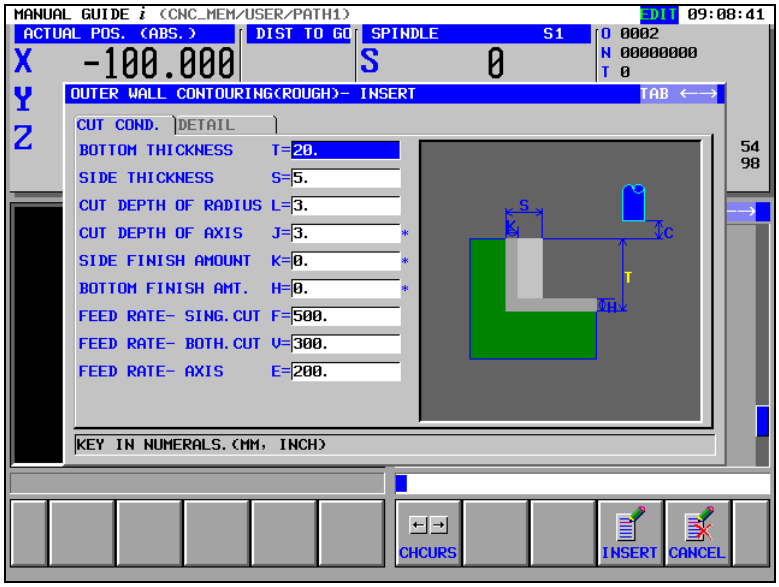
(1) Next, press the [CYCLE] soft key.



(2) Press the right cursor key <→> on the operator's panel twice to display the "CONTOURING" tab and, with the cursor on "1. OUTER WALL CONTOURING (ROUGH)", press the [SELECT] soft key or the <INPUT> key on the operator's panel.



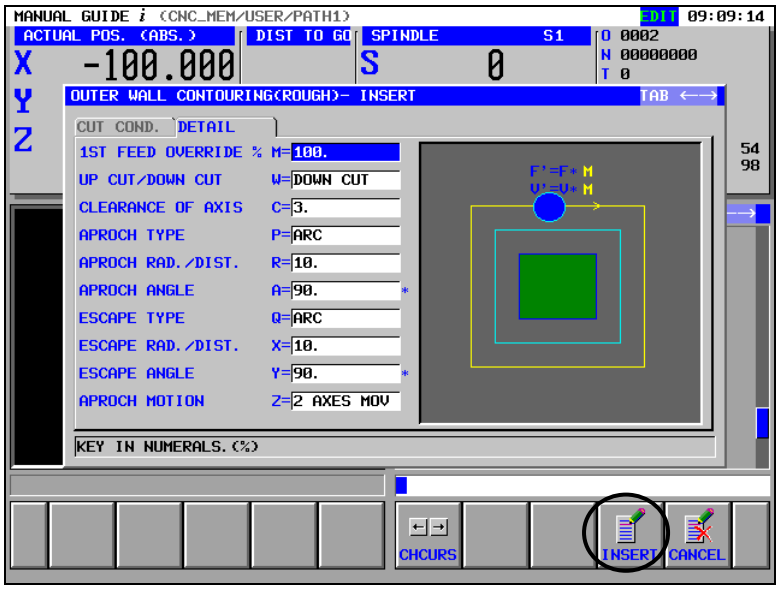
(3) Display the "CUT COND." tab, and enter data in each field.



SUPPLEMENT

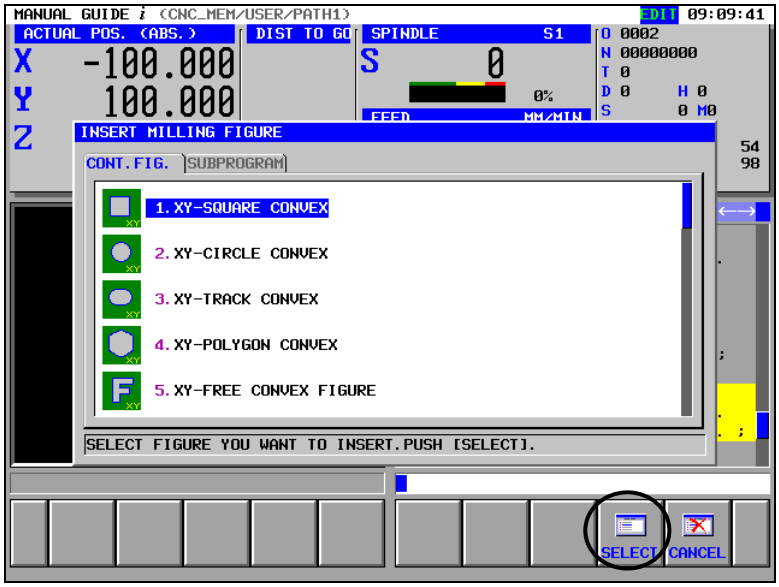
For some data items, "*" is displayed to the right of their input fields. If the user does not fill in the input field, a standard value is automatically set.

(4) Display the "DETAIL" tab, and enter data in each field.

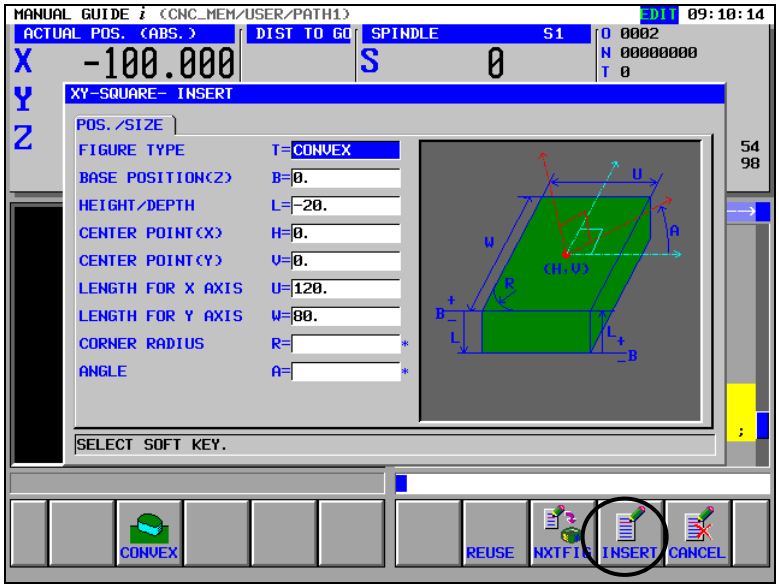


(5) Press the [INSERT] soft key.
The rough outer wall contouring cycle is inserted into the program, and then the contour figure selection window is displayed.

(6) Place the cursor on "1. XY-SQUARE CONVEX" in the "CONT. FIG." tab, and press the [SELECT] soft key or the <INPUT> key on the operator's panel.



(7) Enter data in each field as in the screen shown below, and press the [INSERT] soft key. The contour figure definition block is inserted into the program.



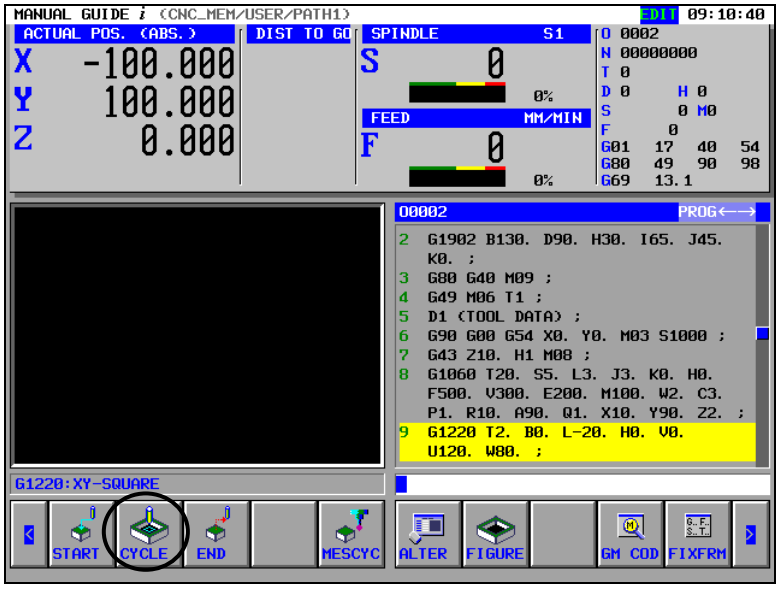
37.4.2.5 Second Process (Rough pocketing) Input

Second process: Specify rough pocketing using a flat end mill for rough machining (T01). Since the same tool as the first process is used, it is not necessary to perform tool change and other pertinent operations.

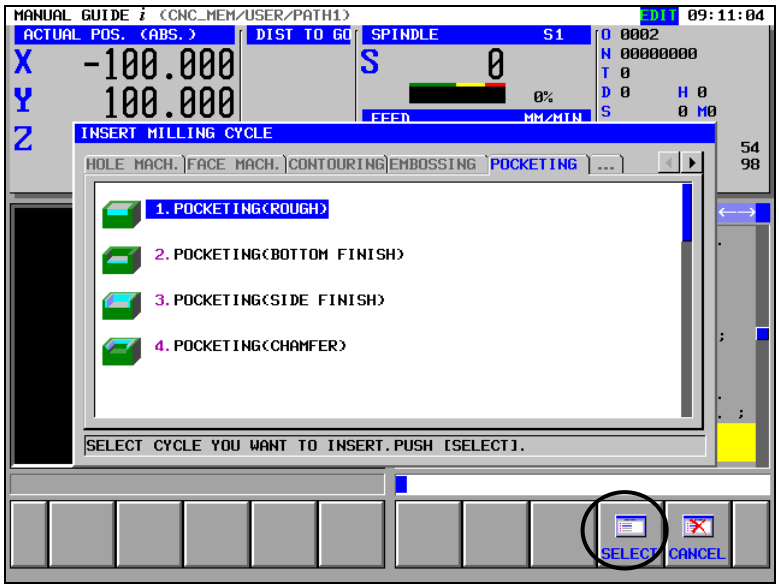
Enter the machining type, cutting conditions, etc.

(1) Machining Operation

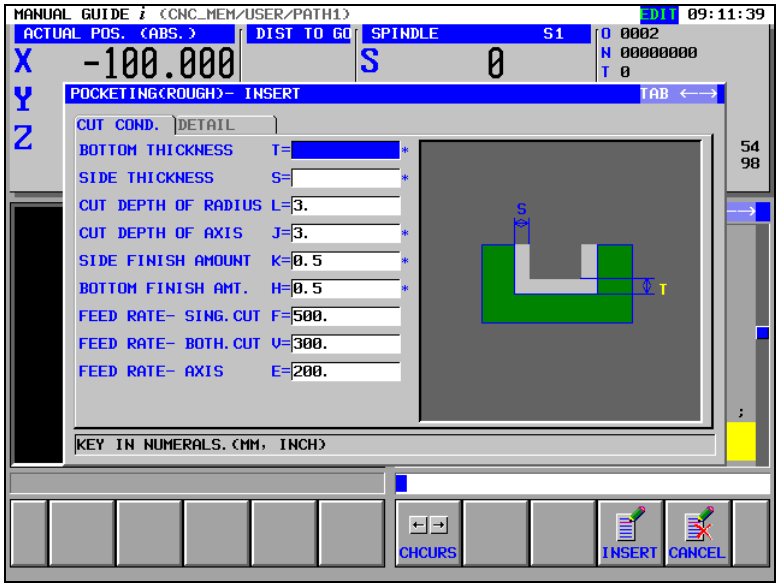
(1) Next, press the [CYCLE] soft key.



(2) Press the right cursor key <→> on the operator's panel four times to display the "POCKETING" tab and, with the cursor on "1. POCKETING(ROUGH)", press the [SELECT] soft key or the <INPUT> key on the operator's panel.



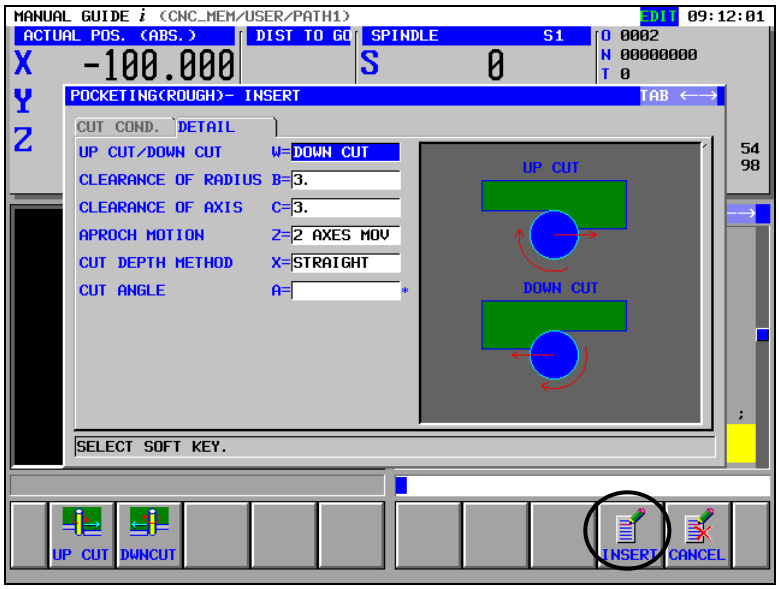
(3) Display the "CUT COND." tab, and enter data in each field.



SUPPLEMENT

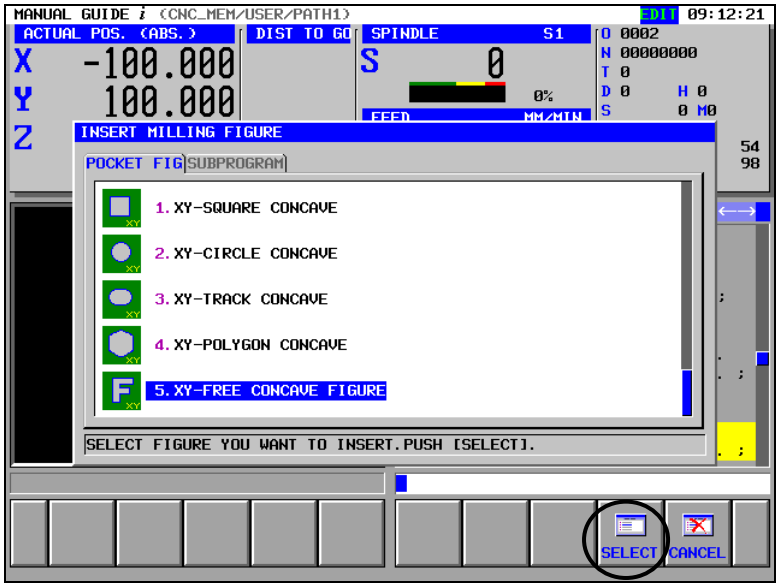
For some data items, "*" is displayed to the right of their input fields. If the user does not fill in the input field, a standard value is automatically set.

(4) Display the "DETAIL" tab, and enter data in each field.

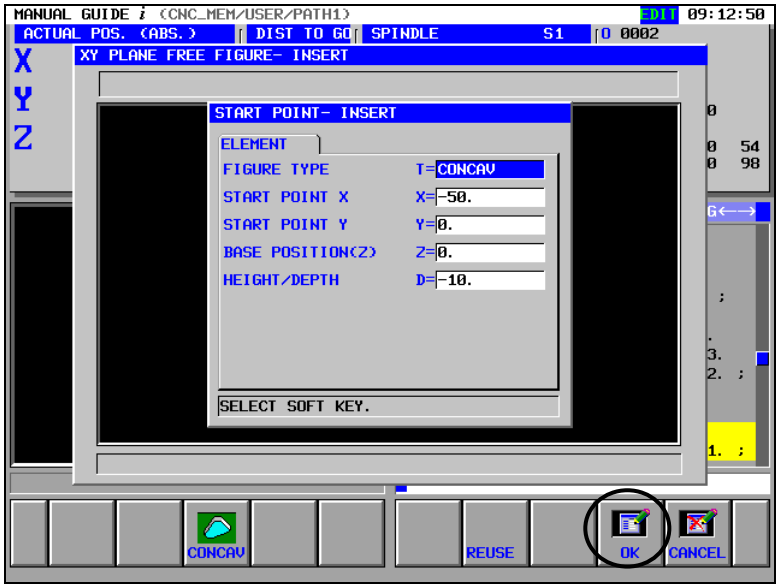


(5) Press the [INSERT] soft key.
The rough pocketing cycle is inserted into the program, and then the pocket figure selection window is displayed.

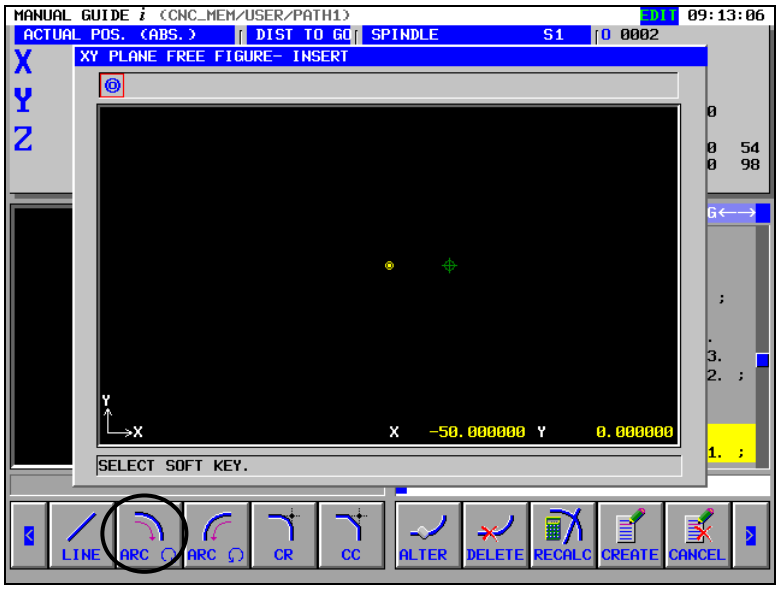
(6) Place the cursor on "5. XY-FREE CONCAVE FIGURE" in the "POCKET FIG" tab, and press the [SELECT] soft key or the <INPUT> key on the operator's panel.



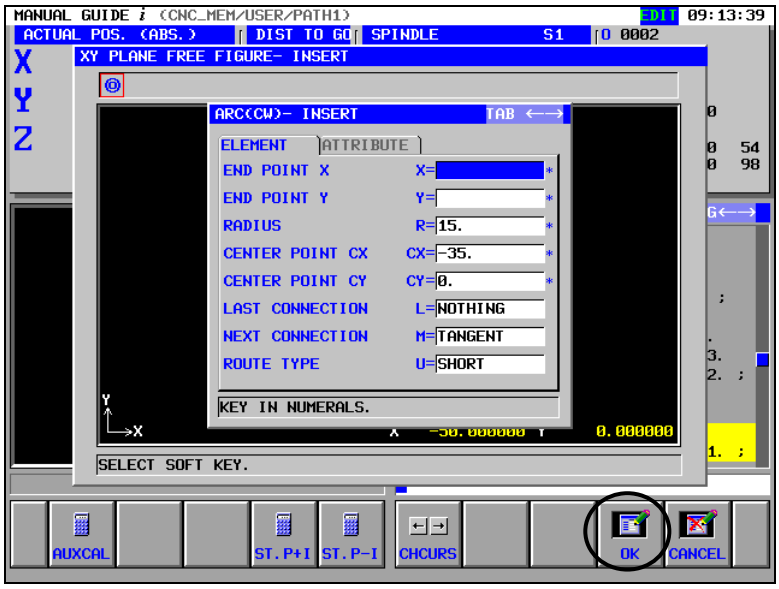
(7) In the "START POINT - INSERT" window, set data as shown below, and then press the [OK] soft key.



(8) Press the [ARC ↻] soft key.



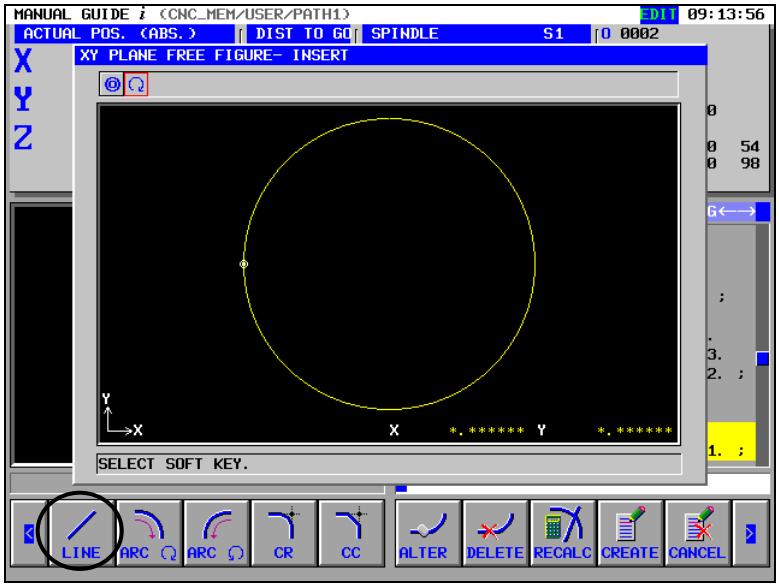
(9) In the "ARC(CW) - INSERT" window, set data as shown below, and then press the [OK] soft key.



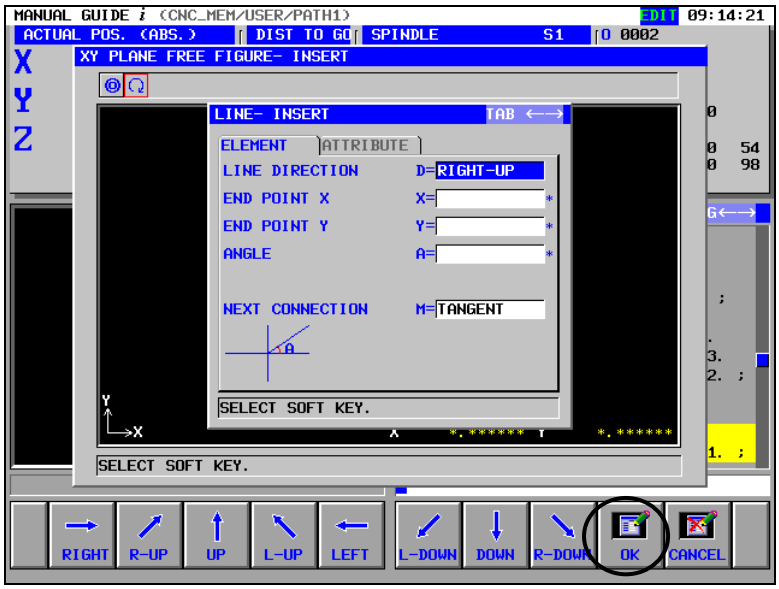
SUPPLEMENT

The end point is not known; do not input it. It is automatically determined as the next figure is input.

(10) Press the [LINE] soft key.



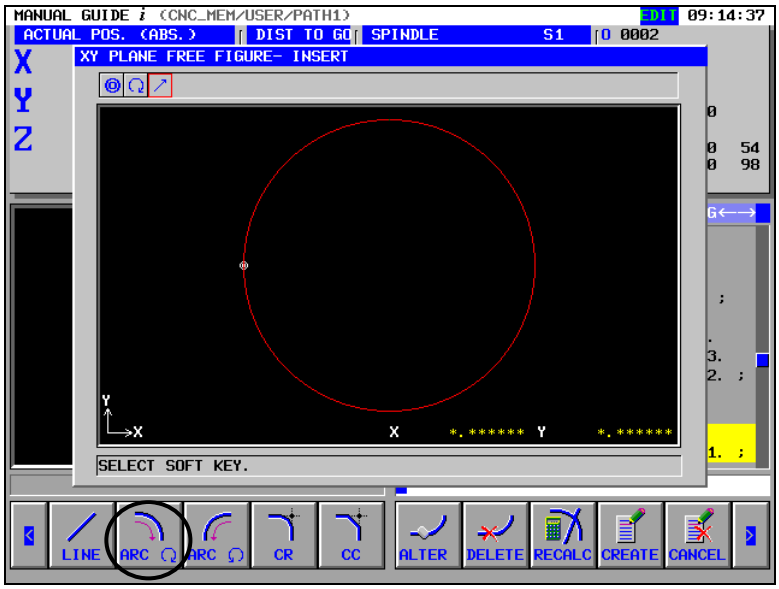
(11) In the "LINE - INSERT" window, set data as shown below, and then press the [OK] soft key.



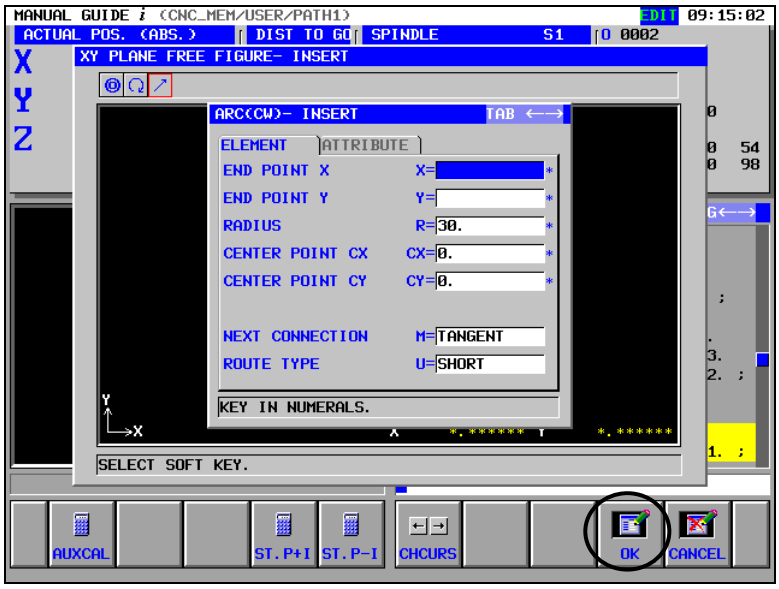
SUPPLEMENT

The start point of the line coincides with the end point of the preceding figure. The end point and angle are not known; do not input them. They are automatically determined as the next figure is input.

(12) Press the [ARC ↻] soft key.



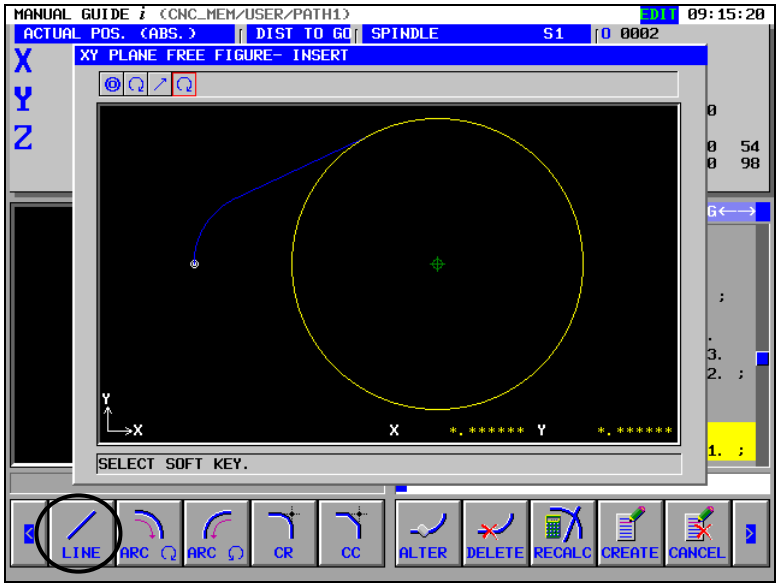
(13) In the "ARC(CW) - INSERT" window, set data as shown below, and then press the [OK] soft key.



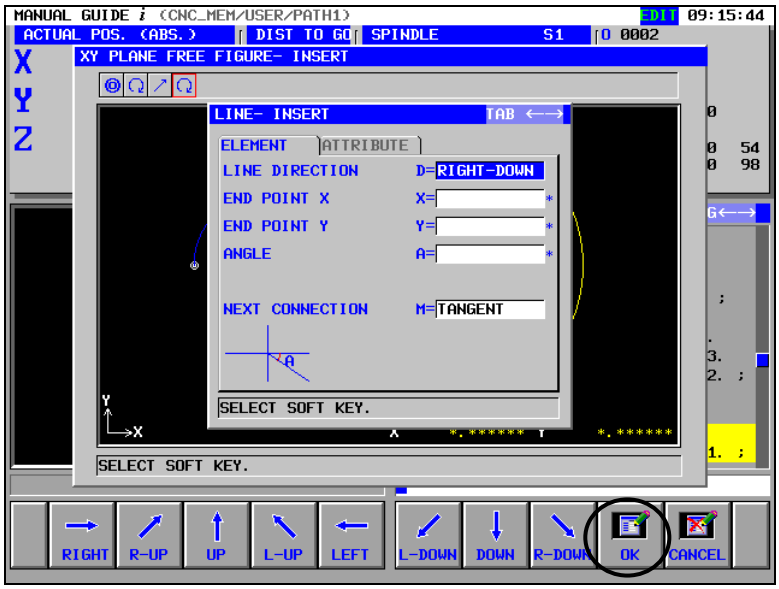
SUPPLEMENT

The end point is not known; do not input it. It is automatically determined as the next figure is input.

(14) Press the [LINE] soft key.



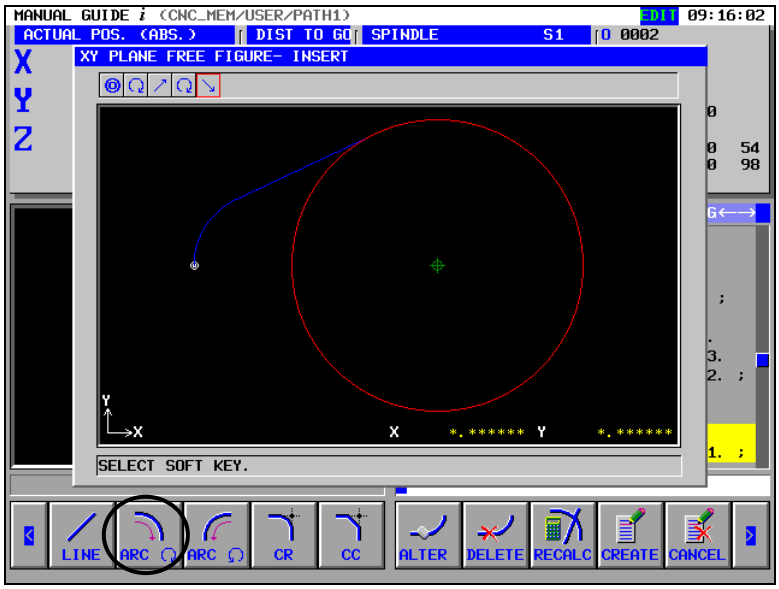
(15) In the "LINE - INSERT" window, set data as shown below, and then press the [OK] soft key.



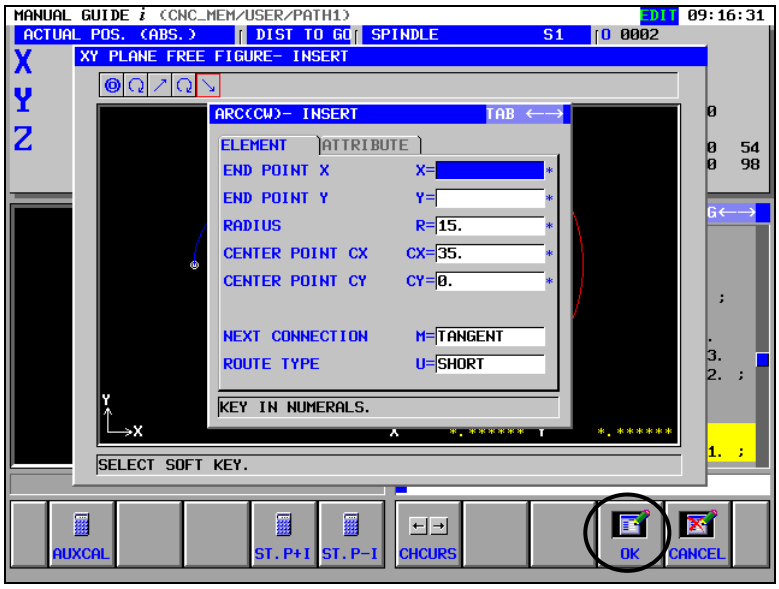
SUPPLEMENT

The start point of the line coincides with the end point of the preceding figure. The end point and angle are not known; do not input them. They are automatically determined as the next figure is input.

(16) Press the [ARC ↻] soft key.



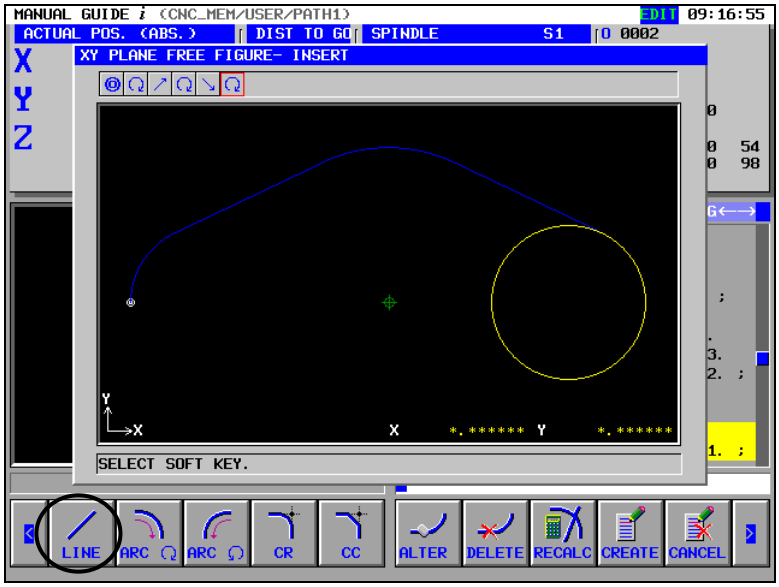
(17) In the "ARC(CW) - INSERT" window, set data as shown below, and then press the [OK] soft key.



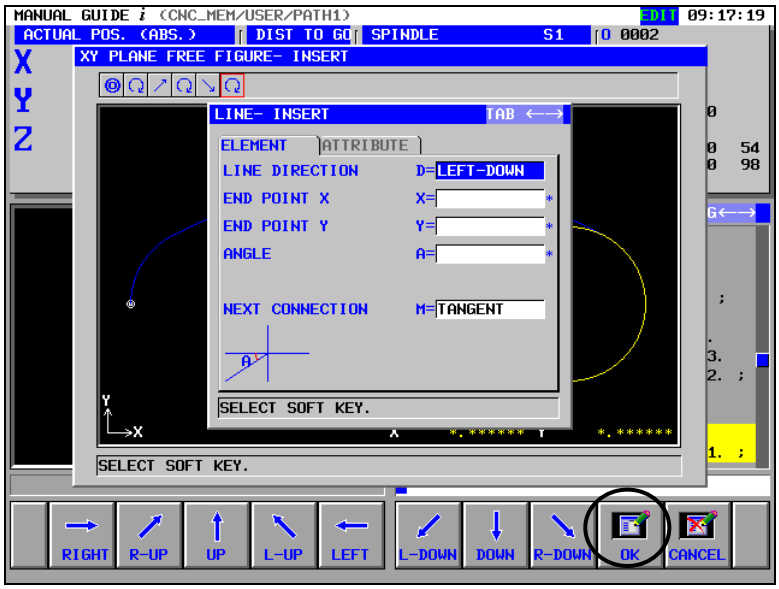
SUPPLEMENT

The end point is not known; do not input it. It is automatically determined as the next figure is input.

(18) Press the [LINE] soft key.



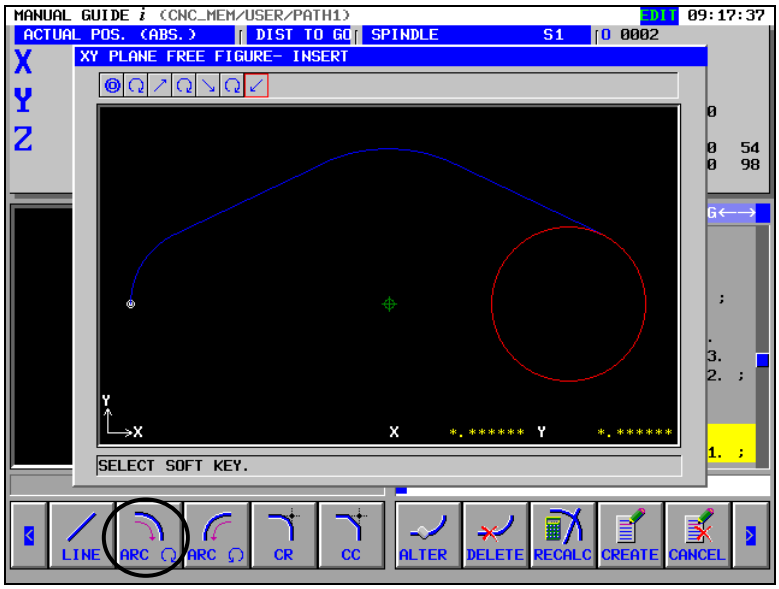
(19) In the "LINE - INSERT" window, set data as shown below, and then press the [OK] soft key.



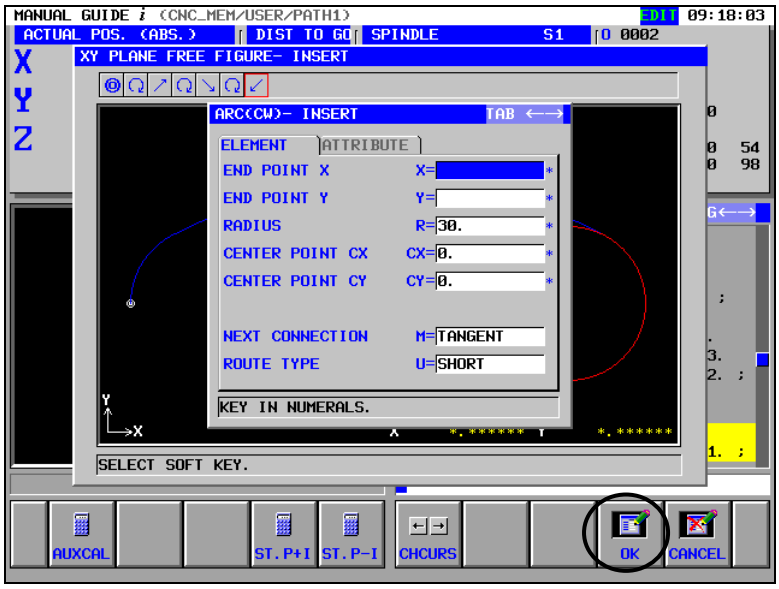
SUPPLEMENT

The start point of the line coincides with the end point of the preceding figure. The end point and angle are not known; do not input them. They are automatically determined as the next figure is input.

(20) Press the [ARC ↻] soft key.



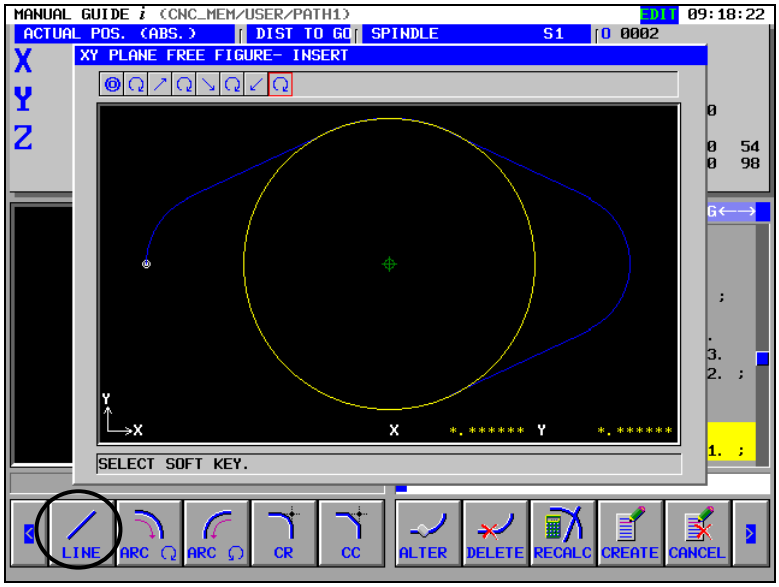
(21) In the "ARC(CW) - INSERT" window, set data as shown below, and then press the [OK] soft key.



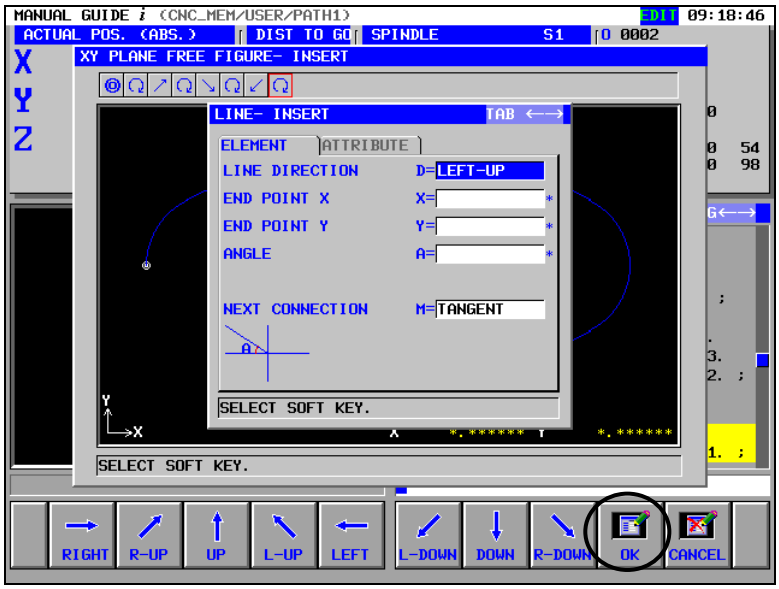
SUPPLEMENT

The end point is not known; do not input it. It is automatically determined as the next figure is input.

(22) Press the [LINE] soft key.



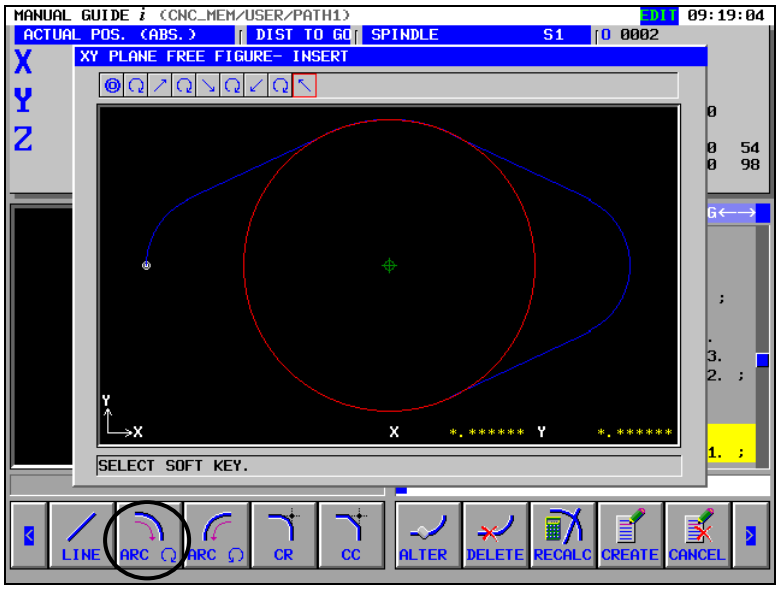
(23) In the "LINE - INSERT" window, set data as shown below, and then press the [OK] soft key.



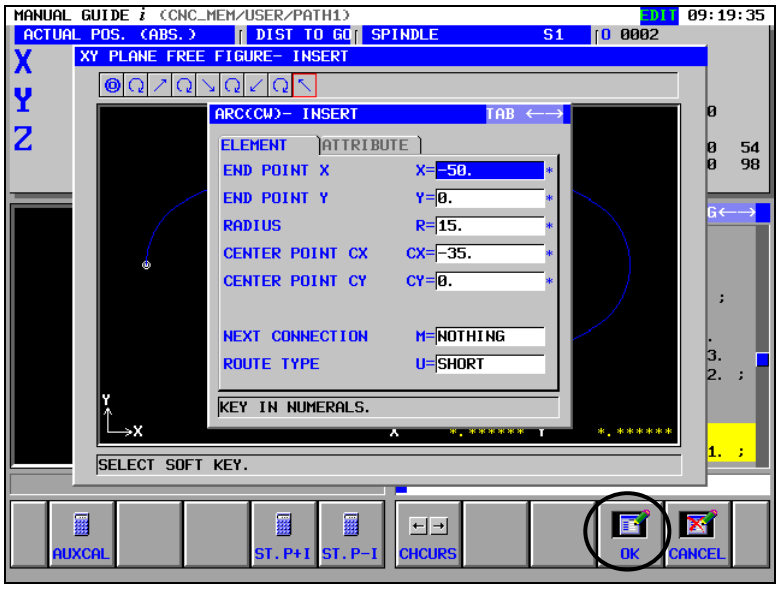
SUPPLEMENT

The start point of the line coincides with the end point of the preceding figure. The end point and angle are not known; do not input them. They are automatically determined as the next figure is input.

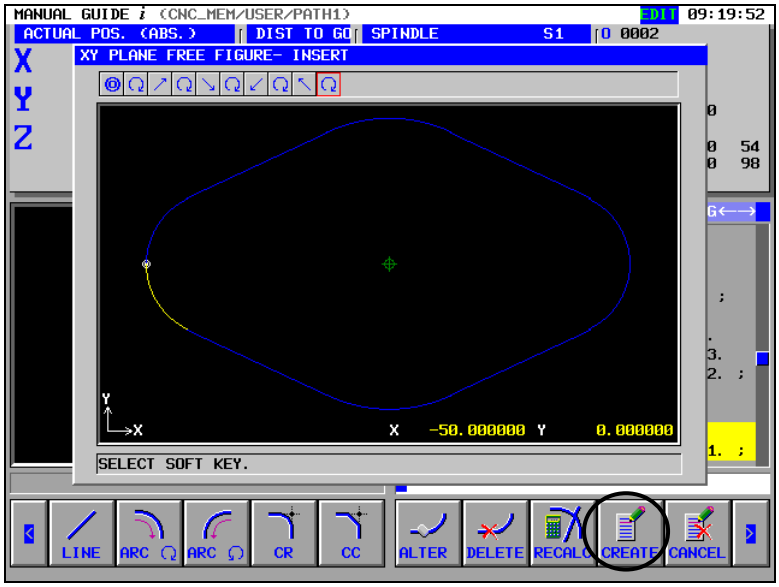
(24) Press the [ARC ↻] soft key.



(25) In the "ARC(CW) - INSERT" window, set data as shown below, and then press the [OK] soft key.

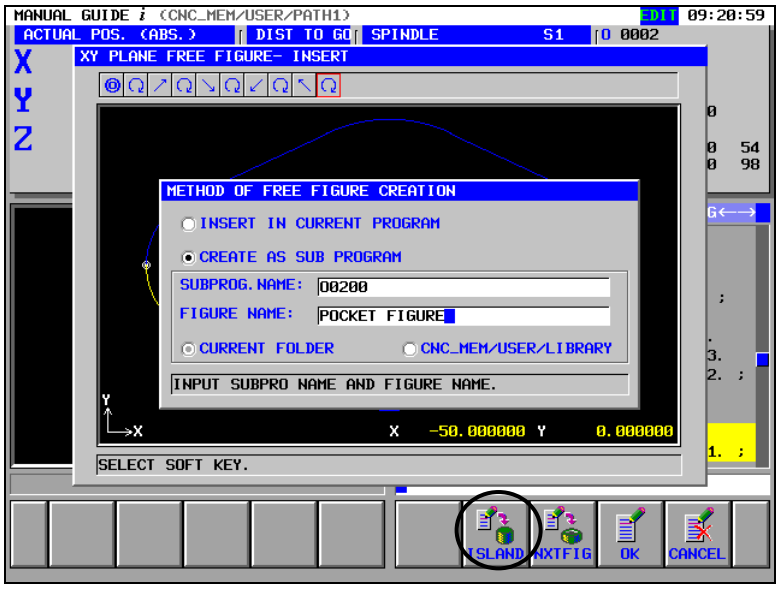


(26) This completes a pocket figure block.



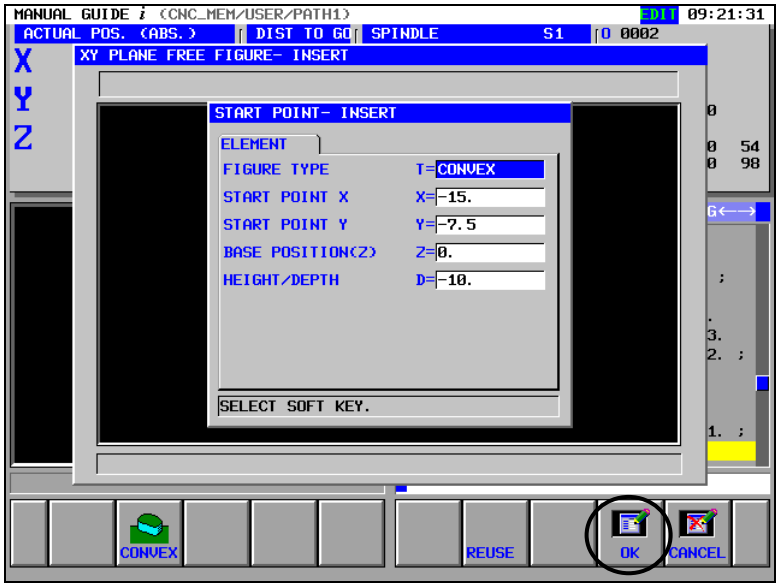
A figure block can be saved not only directly into the program being created but also as a separate subprogram.
Since the registered figure blocks can be used also for finishing, they are saved as subprograms in this program example.

(27) Press the [CREATE] soft key.
(28) Select "CREATE AS SUB PROGRAM" by pressing the down cursor key <↓> on the operator's panel. Enter "O8200" in "SUBPROG. NAME" and "POCKET FIGURE" in "FIGURE NAME", and then press the [ISLAND] soft key.

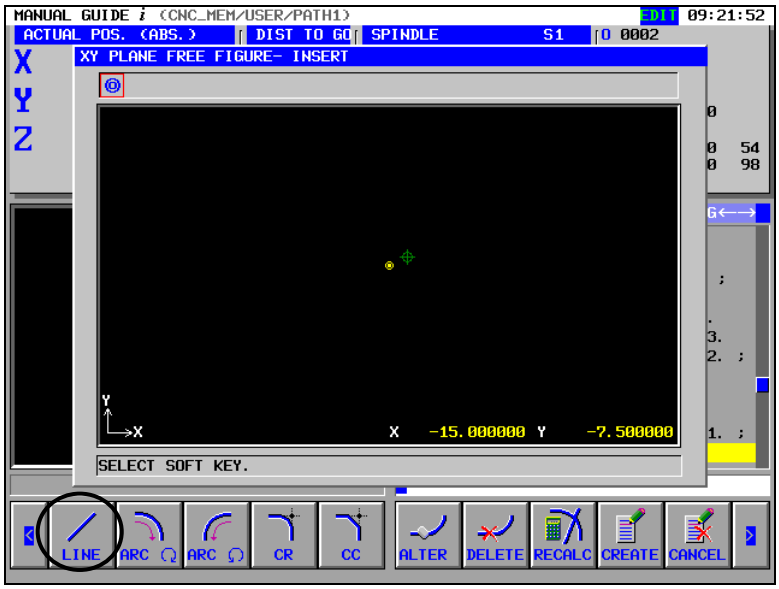


Since the pocket has an island, input island figure data next.

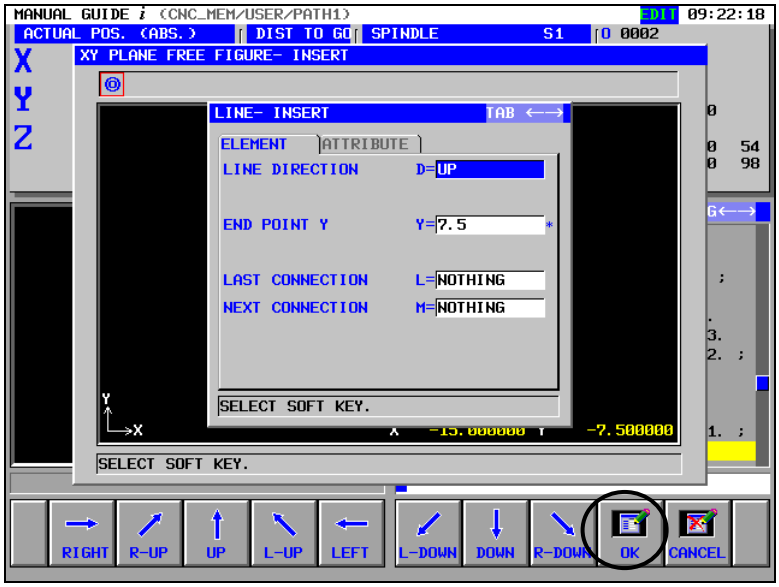
(29) Set data as shown below, and then press the [OK] soft key.



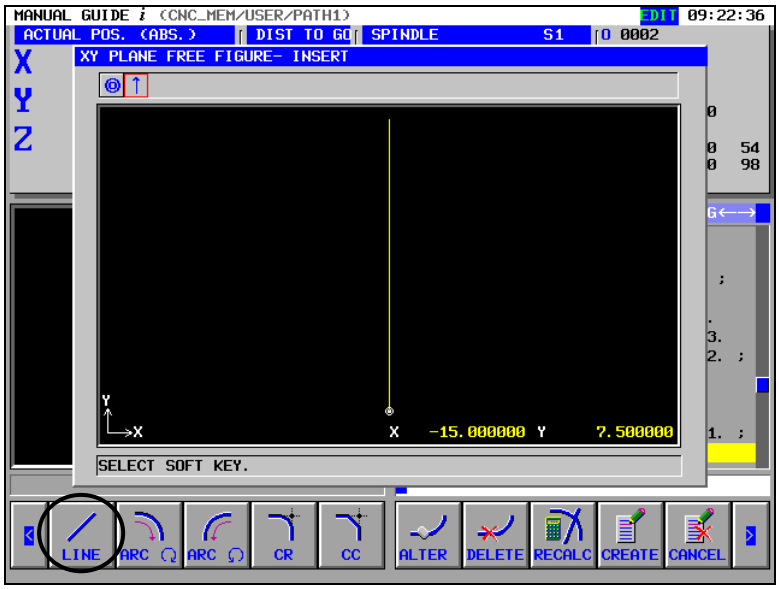
(30) Press the [LINE] soft key.



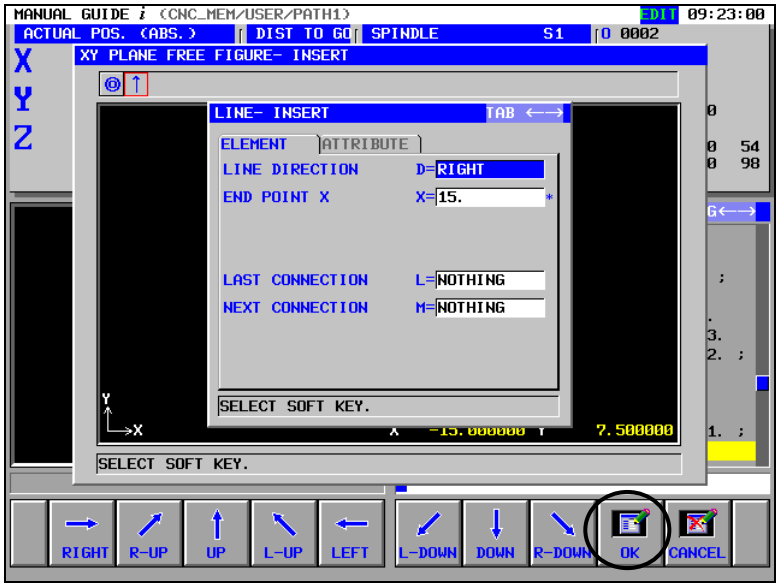
(31) In the "LINE - INSERT" window, set data as shown below, and then press the [OK] soft key.



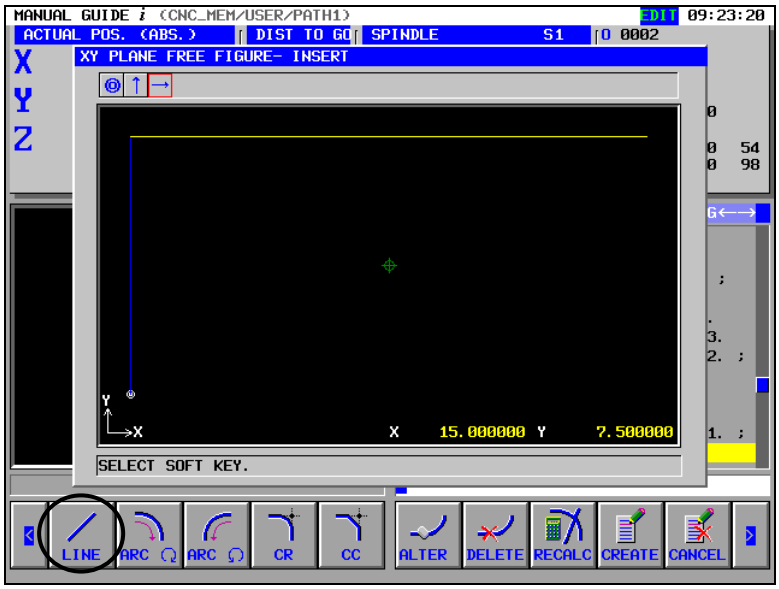
(32) Press the [LINE] soft key.



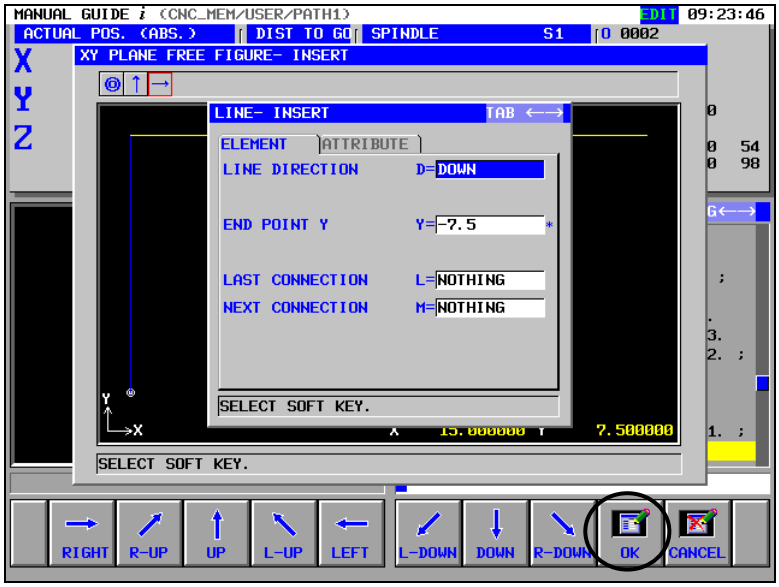
(33) In the "LINE - INSERT" window, set data as shown below, and then press the [OK] soft key.



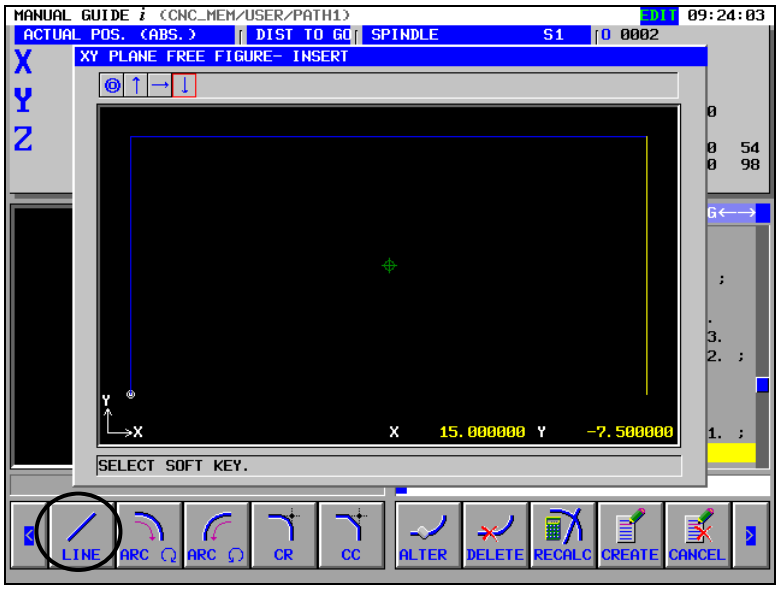
(34) Press the [LINE] soft key.



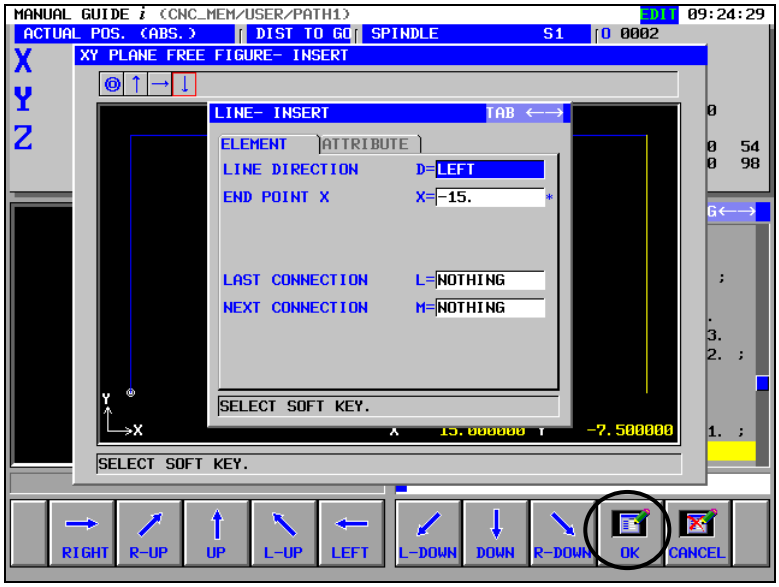
(35) In the "LINE - INSERT" window, set data as shown below, and then press the [OK] soft key.



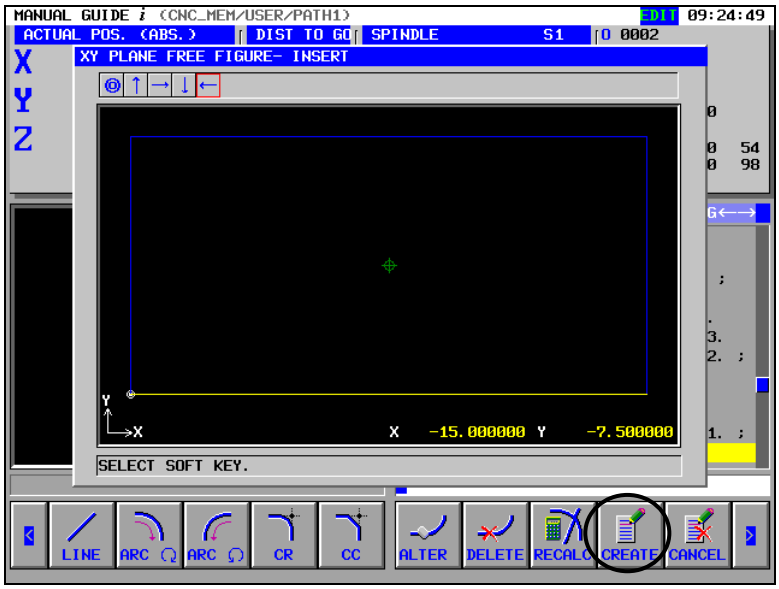
(36) Press the [LINE] soft key.



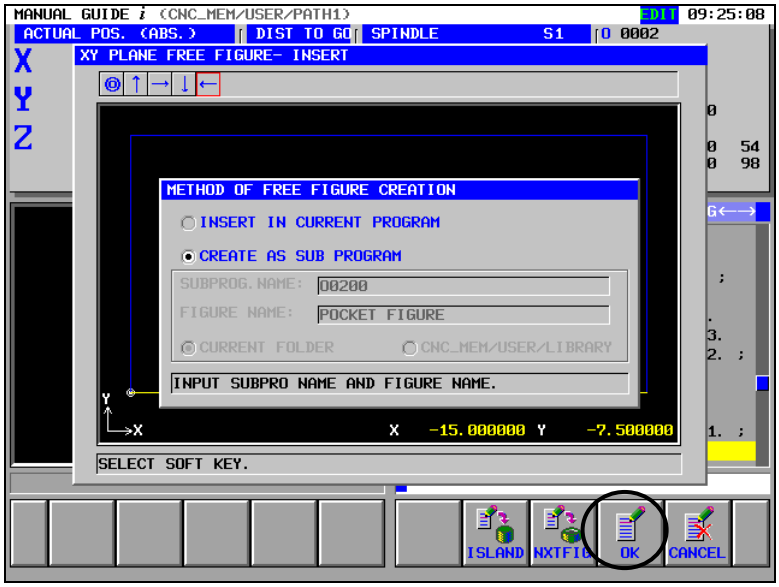
(37) In the "LINE - INSERT" window, set data as shown below, and then press the [OK] soft key.



(38) Press the [CREATE] soft key.



(39) Press the [OK] soft key.

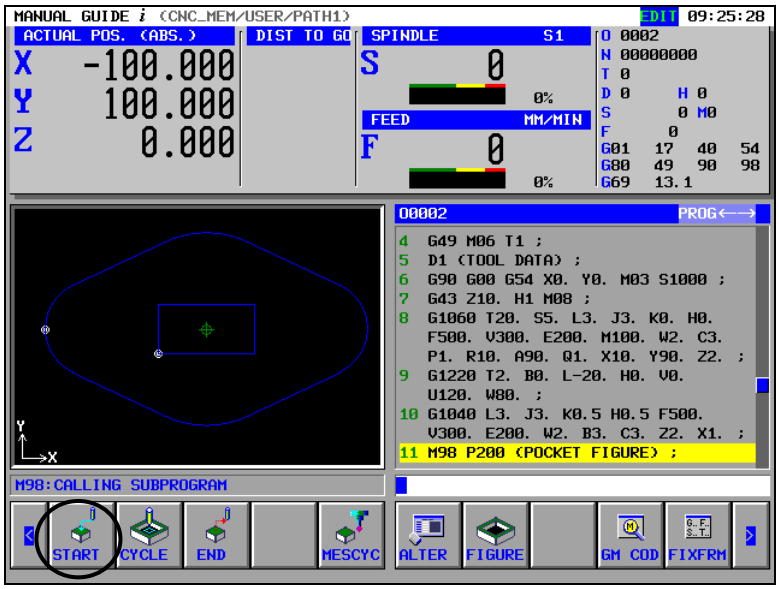


37.4.2.6 Third Process (Finish pocketing) Input

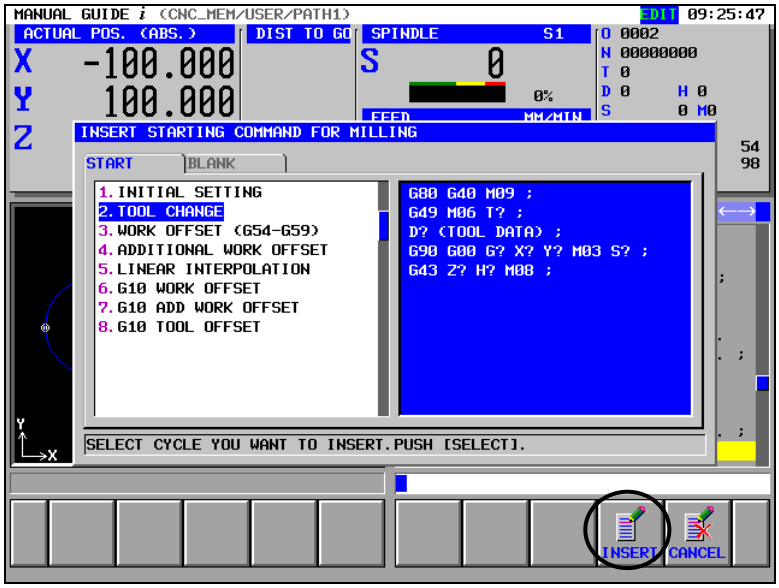
(1) Tool change/Spindle rotation/Approach motion

While commands for tool change, spindle rotation, and approach motion to the machining start point, etc. can be input manually one by one using G and M codes, it is more convenient to use fixed form sentences.

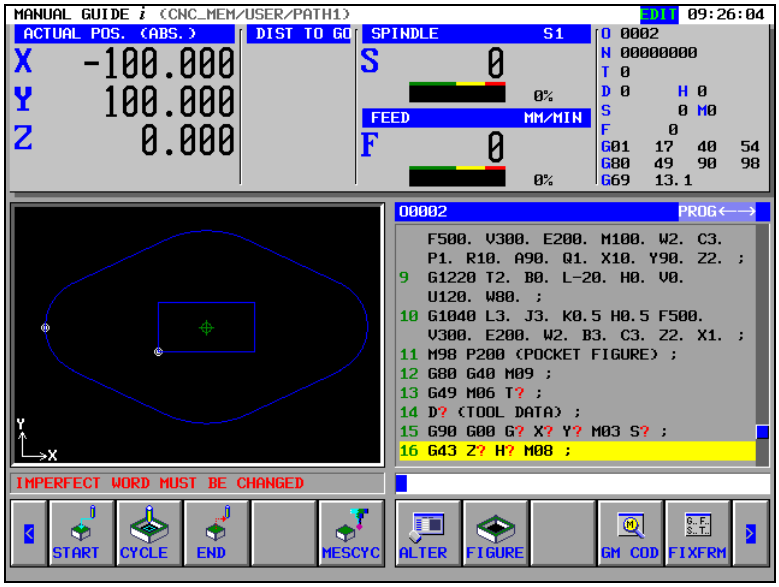
(1) Press the [START] soft key.



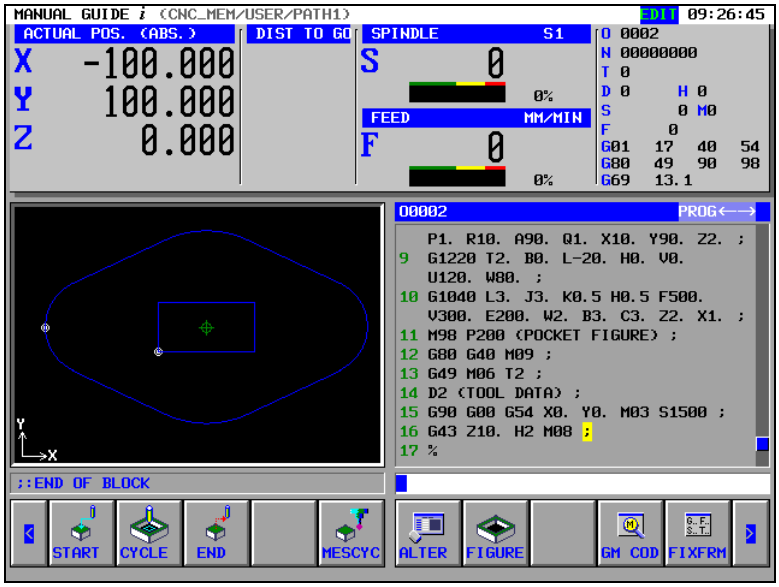
(2) Place the cursor on "2. TOOL CHANGE" in the "START" tab, and press the [INSERT] soft key or the <INPUT> key on the operator's panel.



(3) The selected fixed form sentence is inserted. Undecided values are represented by "?", as shown below.



(4) Place the cursor on an address for which "?" is displayed, enter a value, and then press the <ALTER> key on the operator's panel. For example, place the cursor on "T?", and enter "2" and press <ALTER>. Doing so inputs tool number "T2". (Address "T" does not need to be input.) After entering data, return the cursor to the EOB position at the end of the program.



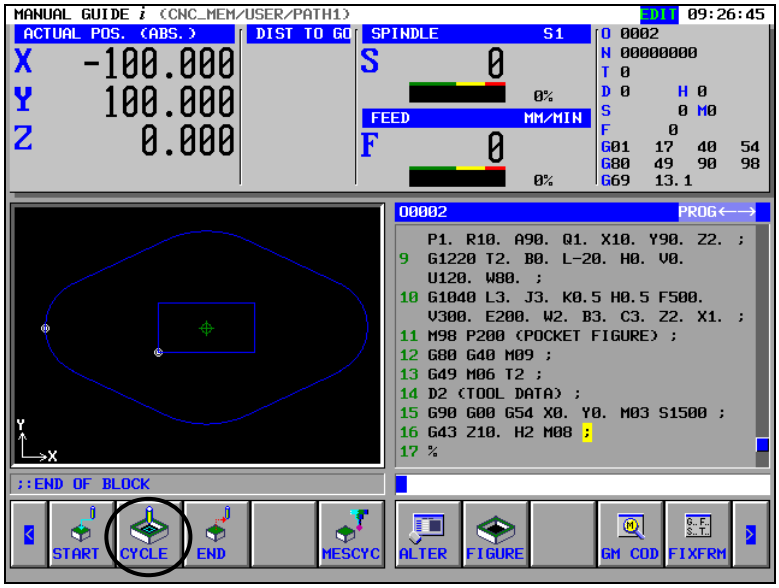
SUPPLEMENT

In the screen shown above, "D2" on the 14th line of the program is a tool compensation number (see Subsection 37.4.2.1). For "G?" on the 15th line, workpiece coordinate system "G54" is input.

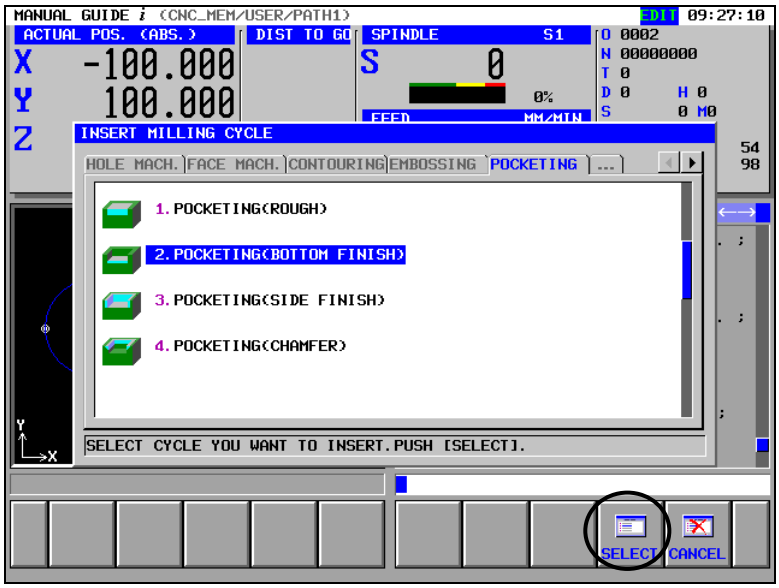
(2) Machining Operation

Third process: Specify finish bottom and side pocketing using a flat end mill for finishing (T02).

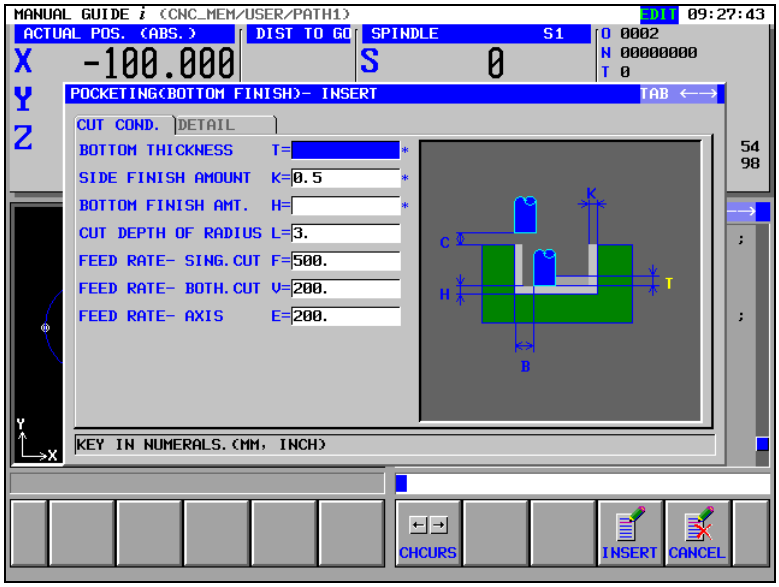
(1) Enter data for bottom finish pocketing. Press the [CYCLE] soft key.



(2) Press the right cursor key <→> on the operator's panel four times to display the "POCKETING" tab and, with the cursor on "2. POCKETING(BOTTOM FINISH)", press the [SELECT] soft key or the <INPUT> key on the operator's panel.



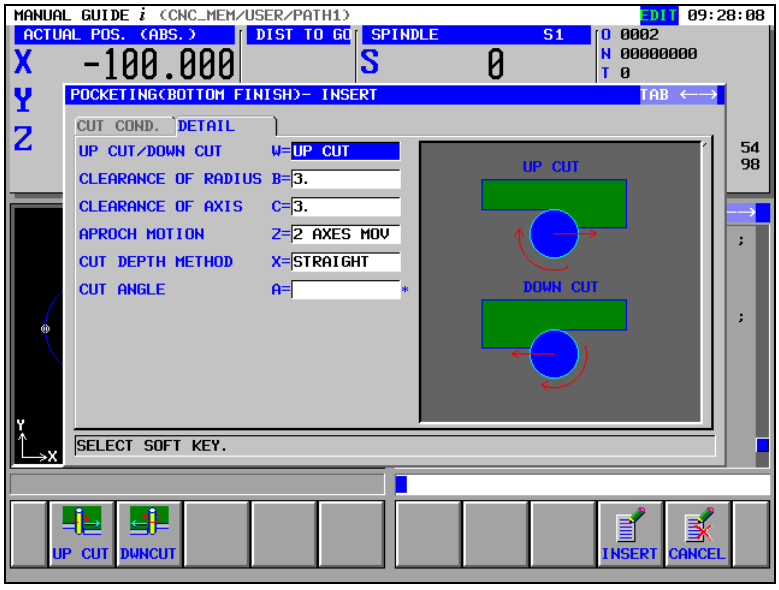
(3) Display the "CUT COND." tab, and enter data in each field.



SUPPLEMENT

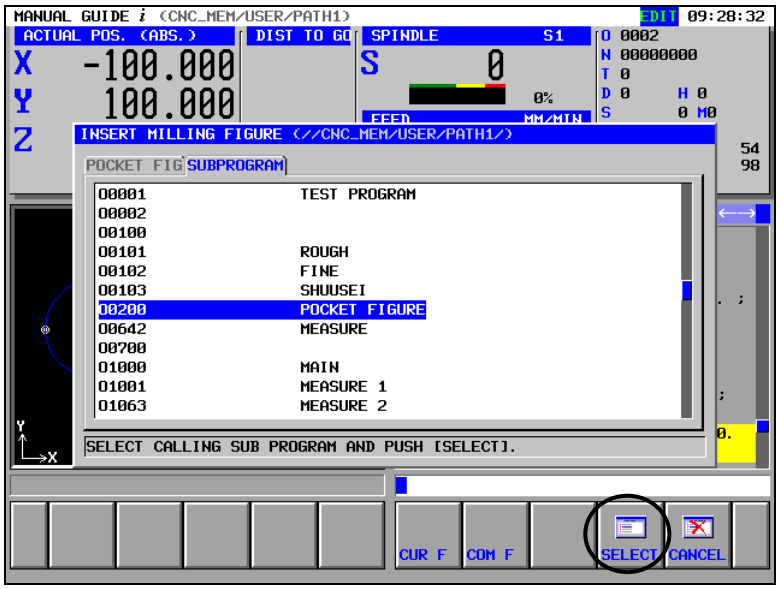
For some data items, "*" is displayed to the right of their input fields. If the user does not fill in the input field, a standard value is automatically set.

(4) Display the "DETAIL" tab, and enter data in each field.

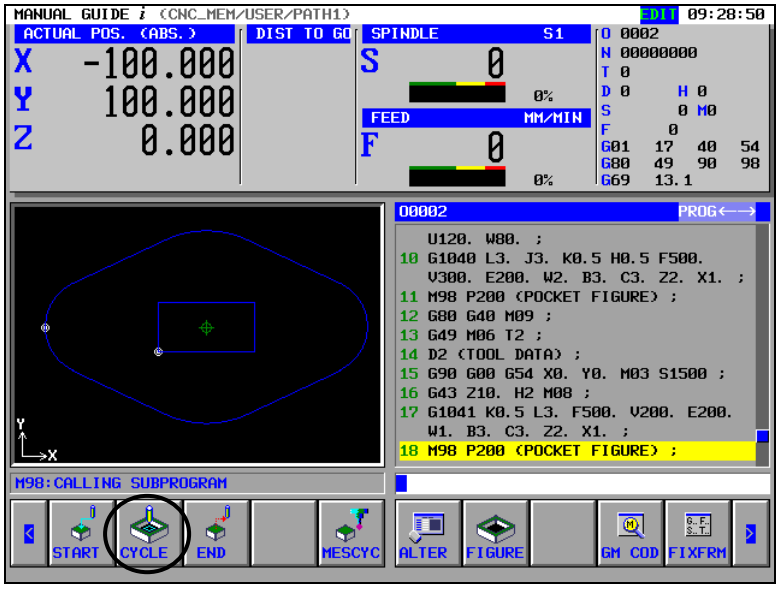


(5) Press the [INSERT] soft key.
The finish bottom pocketing cycle is inserted into the program, and then the figure selection window is displayed.

(6) Press the right cursor key <→> on the operator's panel to display the "SUBPROGRAM" tab. Since the subprogram previously input for rough machining can be used, place the cursor on "O8200" and press the [SELECT] soft key or the <INPUT> key on the operator's panel. This completes the input of the data for finish bottom pocketing.

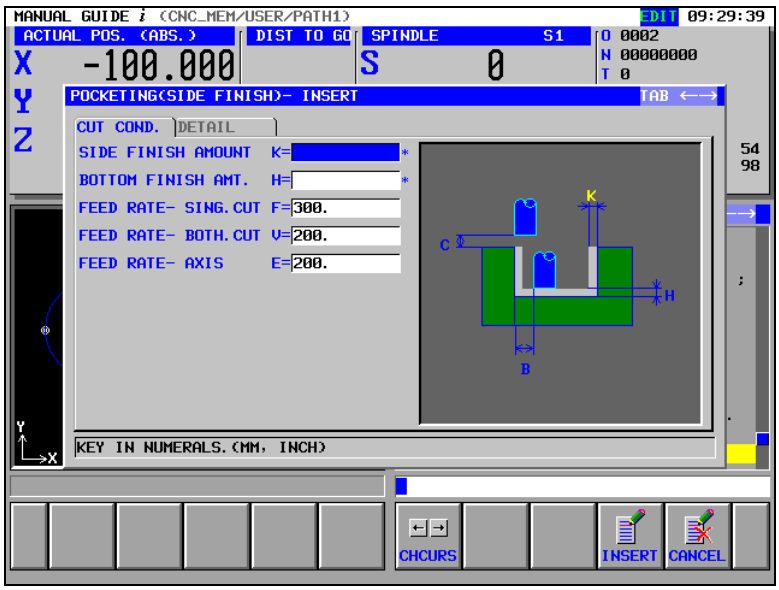


(7) Next, enter data for finish side pocketing. Then, press the [CYCLE] soft key.

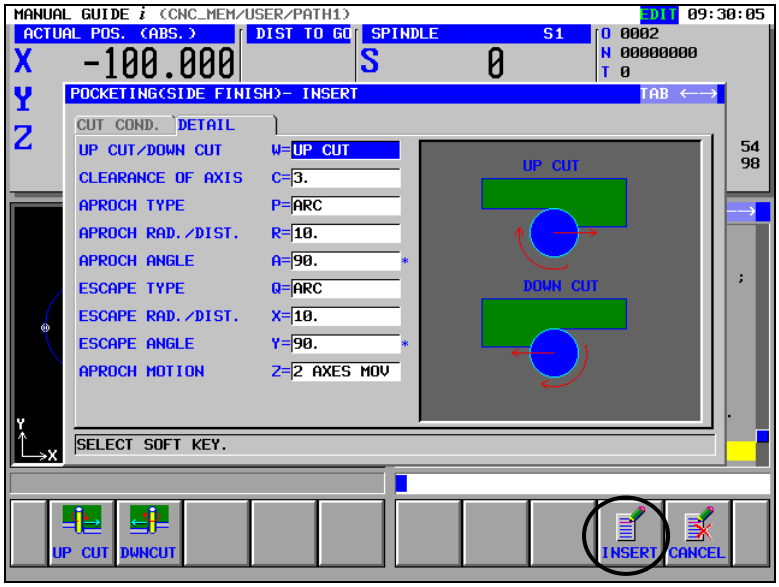


(8) Press the right cursor key <→> on the operator's panel four times to display the "POCKETING" tab and, with the cursor on "3. POCKETING(SIDE FINISH)", press the [SELECT] soft key or the <INPUT> key on the operator's panel.

(9) Display the "CUT COND." tab, and enter data in each field.

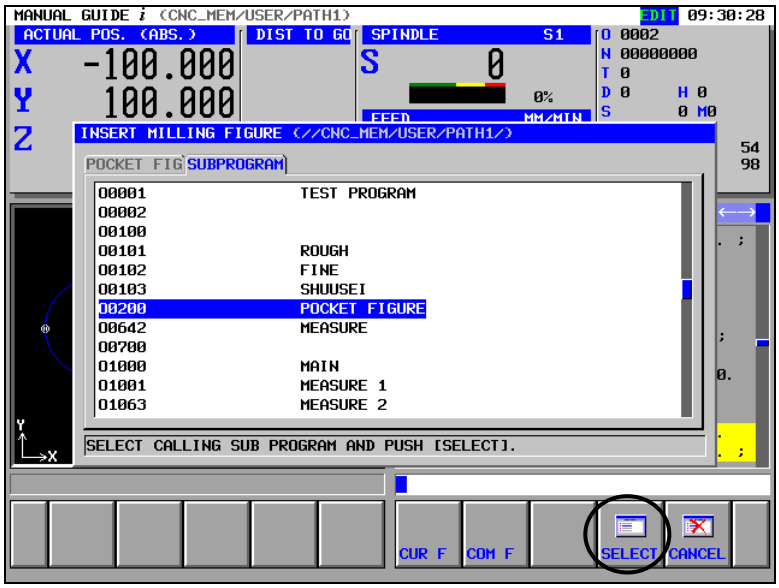


(10) Display the "DETAIL" tab, and enter data in each field.



(11) Press the [INSERT] soft key.
The finish side pocketing cycle is inserted into the program, and then the figure selection window is displayed.

(12) Press the right cursor key <→> on the operator's panel to display the "SUBPROGRAM" tab. Since the subprogram previously input for rough machining can be used, place the cursor on "O8200" and press the [SELECT] soft key or the <INPUT> key on the operator's panel. This completes the input of the data for finish side pocketing.

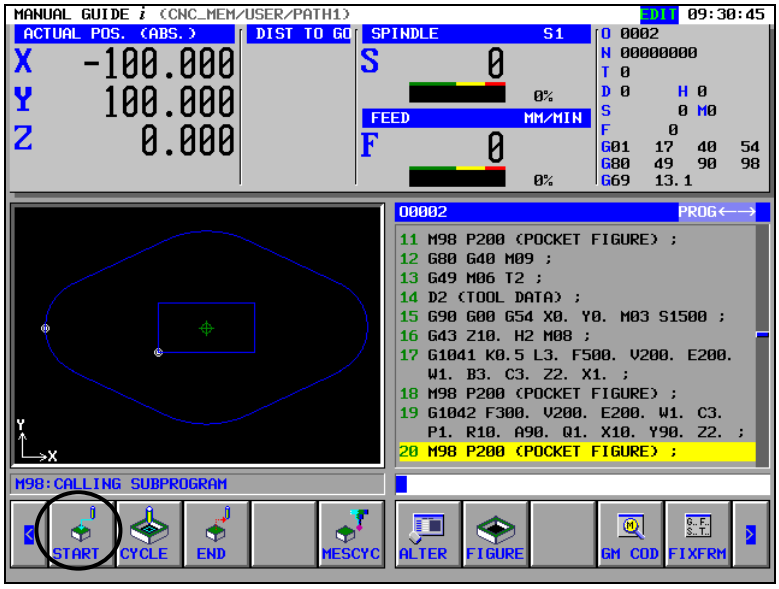


37.4.2.7 Fourth Process (Drilling) Input

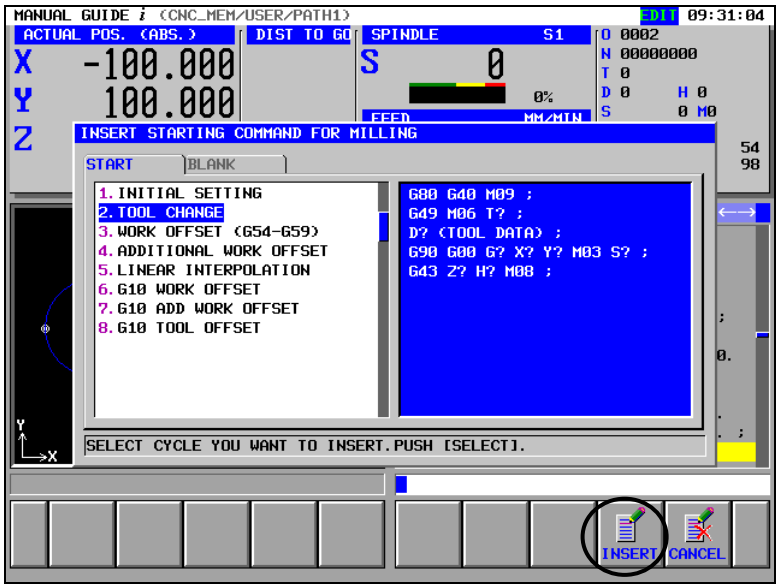
(1) Tool change/Spindle rotation/Approach motion

While commands for tool change, spindle rotation, and approach motion to the machining start point, etc. can be input manually one by one using G and M codes, it is more convenient to use fixed form sentences.

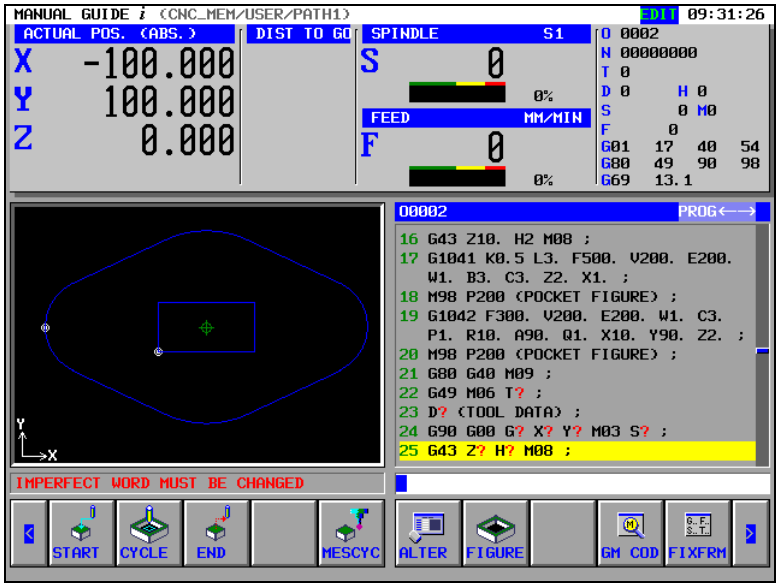
(1) Press the [>] soft key on the right end several times until the screen displays the soft keys shown below.
(2) Press the [START] soft key.



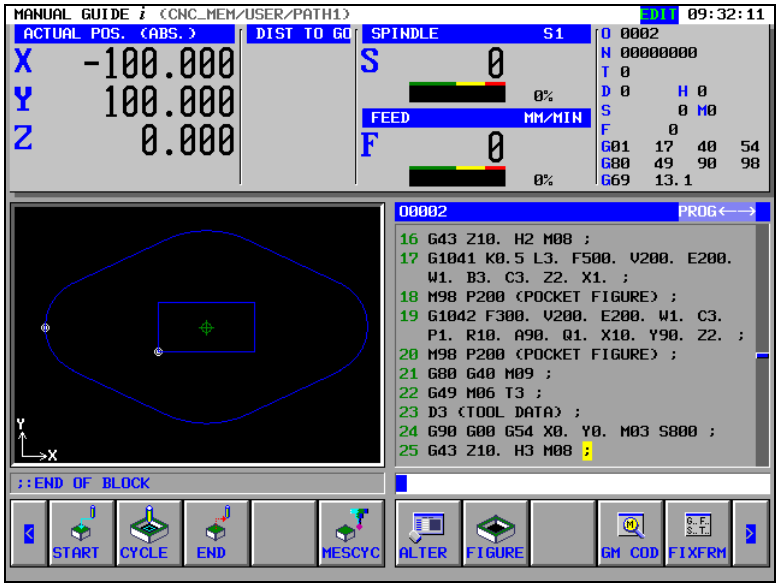
(3) Place the cursor on "2. TOOL CHANGE" in the "START" tab, and press the [INSERT] soft key or the <INPUT> key on the operator's panel.



(4) The selected fixed form sentence is inserted. Undecided values are represented by "?", as shown below.



(5) Place the cursor on an address for which "?" is displayed, enter a value, and then press the <ALTER> key on the operator's panel. For example, place the cursor on "T?", and enter "3" and press <ALTER>. Doing so inputs tool number "T3". (Address "T" does not need to be input.) After entering data, return the cursor to the EOB position at the end of the program.



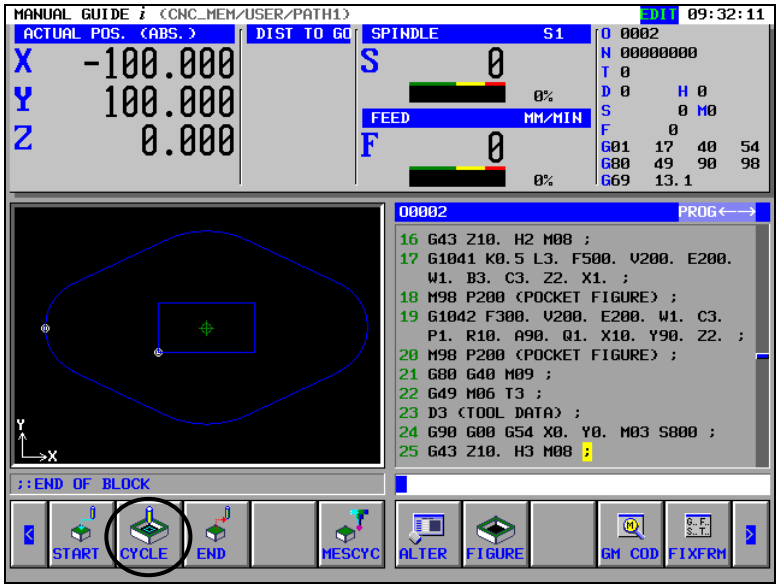
SUPPLEMENT

In the screen shown above, "D3" on the 23th line of the program is a tool compensation number (see Subsection 37.4.2.1). For "G?" on the 24th line, workpiece coordinate system "G54" is input.

(2) Machining Operation

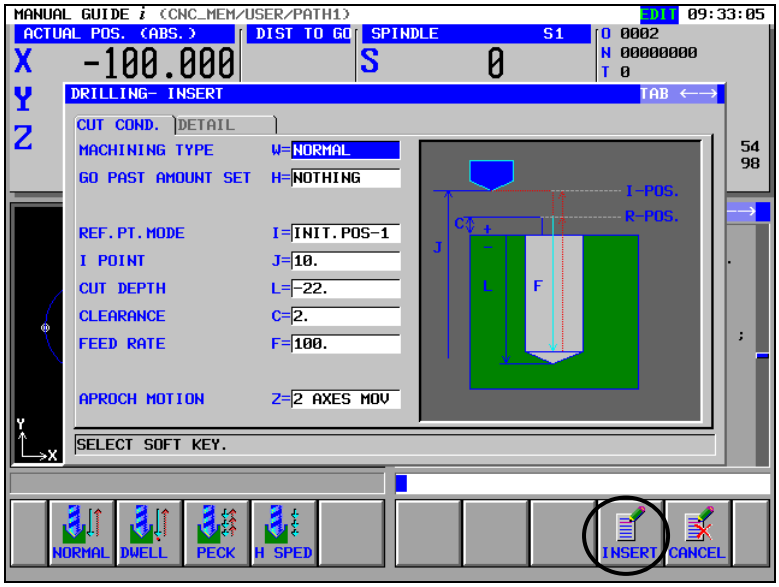
Fourth process: Specify drilling using a drill (T03).

(1) Press the [CYCLE] soft key.



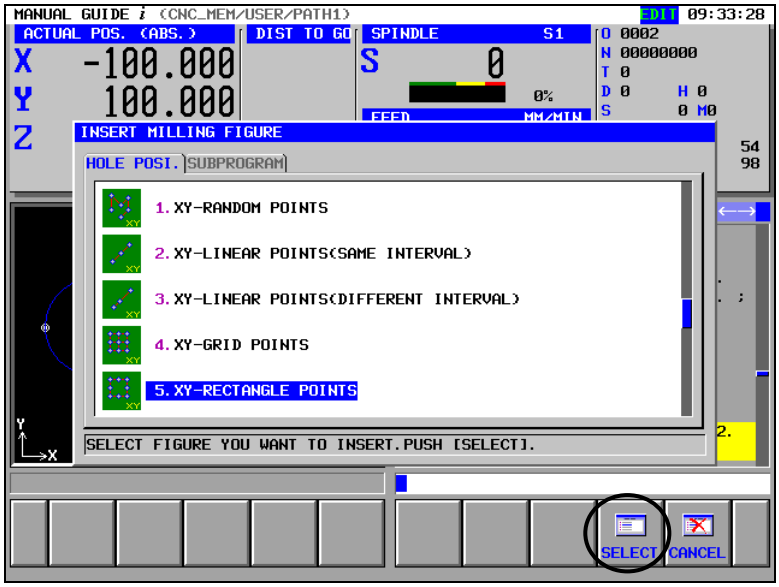
(2) Place the cursor on "2. DRILLING" in the "HOLE MACH." tab, and press the [SELECT] soft key or the <INPUT> key on the operator's panel.

(3) Display the "CUT COND." tab, and enter data in each field.

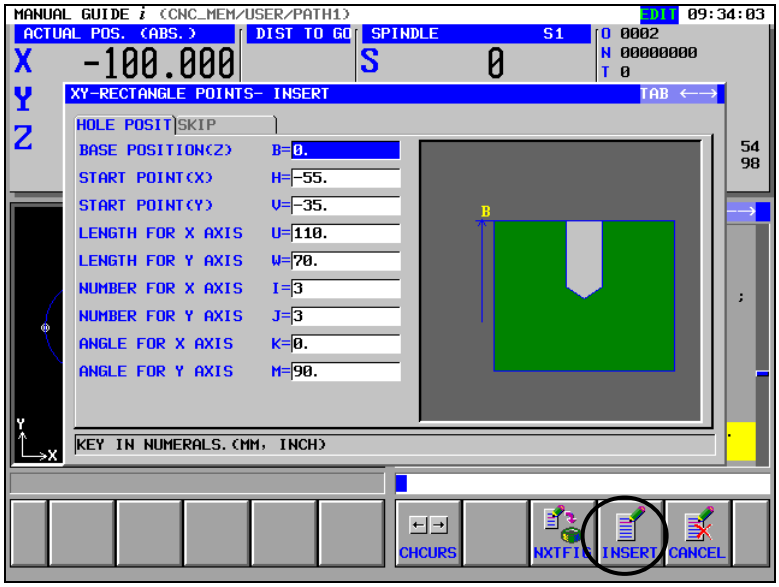


(4) Press the [INSERT] soft key.
The drilling cycle is inserted into the program, and then the hole position selection window is displayed.

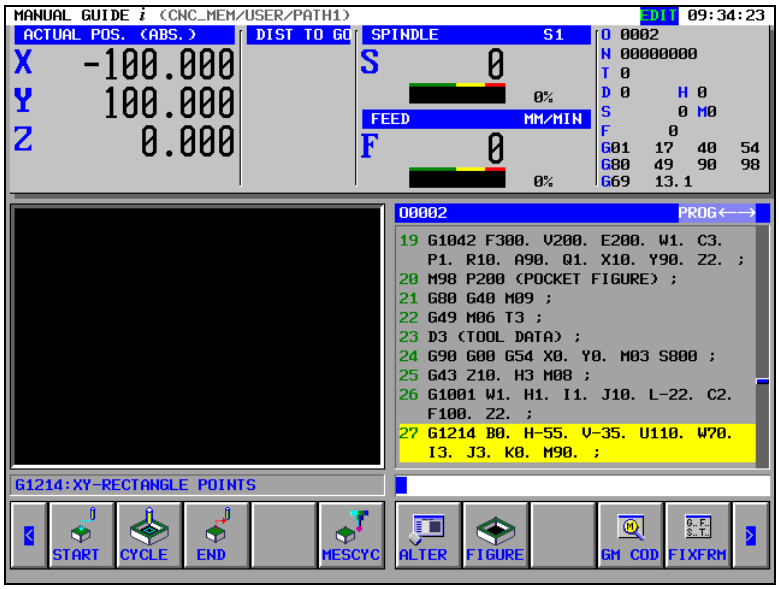
(5) Place the cursor on "5. XY-RECTANGLE POINTS" in the "HOLE POSI." tab, and press the [SELECT] soft key or the <INPUT> key on the operator's panel.



(6) Enter data in the "HOLE POSIT" tab as shown below, and press the [INSERT] soft key.

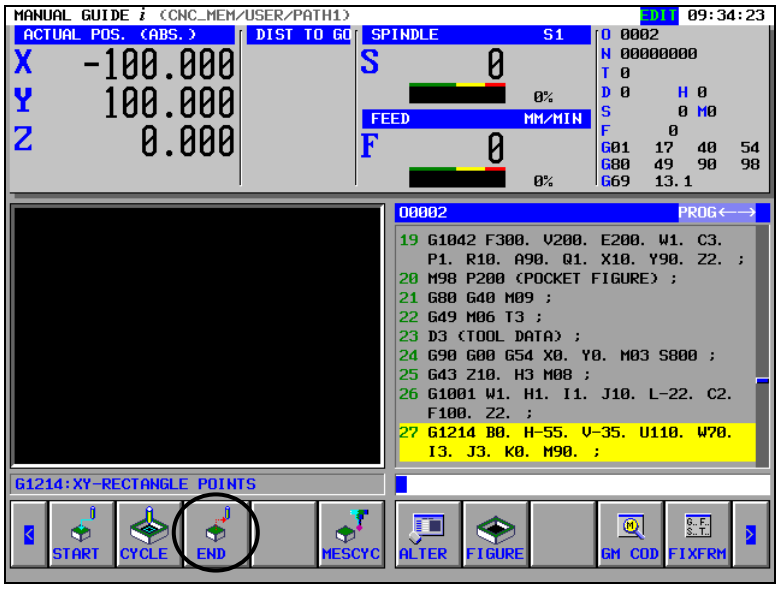


(7) The machining cycle is inserted into the program.

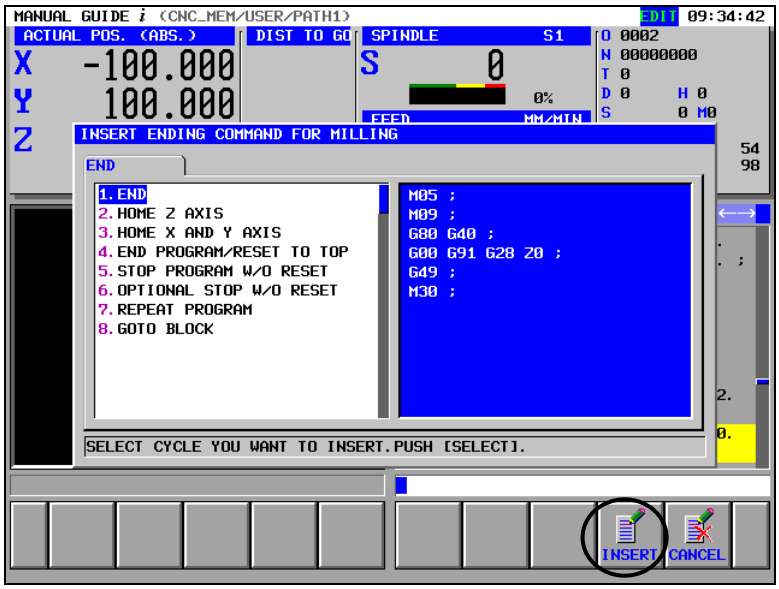


37.4.2.8 End Processing Input

(1) Press the [>] soft key on the right end several times until the screen displays the soft keys shown below.
(2) Press the [END] soft key.



(3) Place the cursor on "1. END", and press the [INSERT] soft key or the <INPUT> key on the operator's panel.



(4) The end operation is inserted. This completes the program.

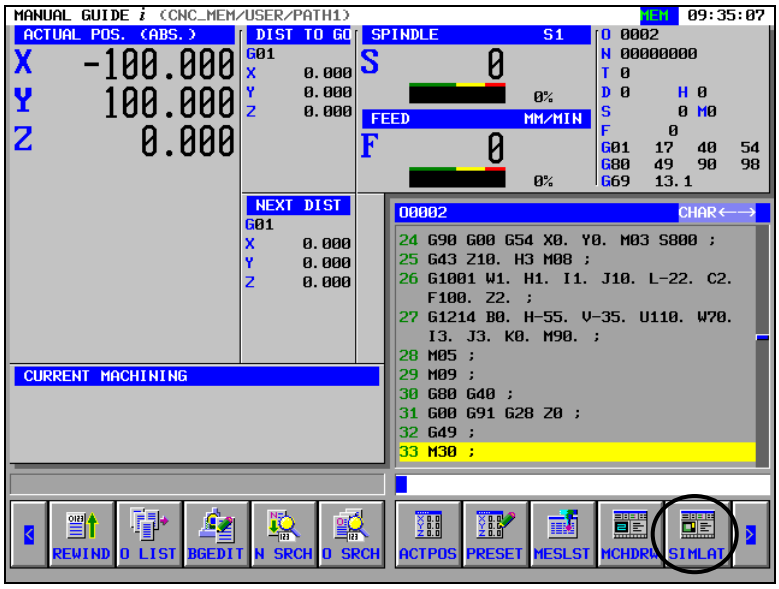
37.4.2.9 Program Check

(1) Press

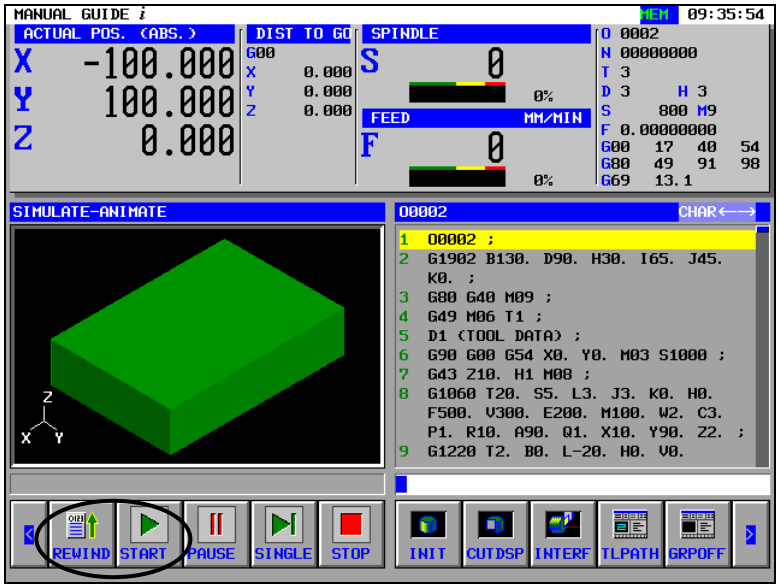
on the operator's panel, and select the MEM mode.

(2) Press the [>] soft key on the right end several times until the screen displays the soft keys shown below.

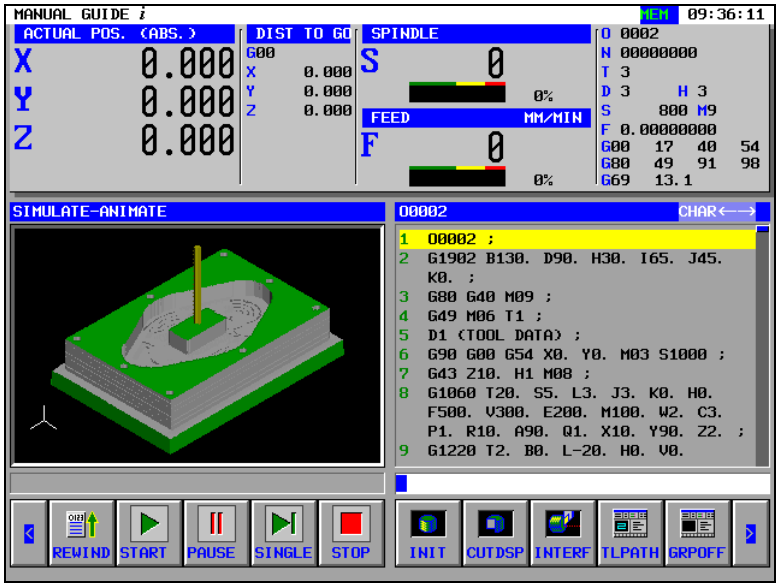
(3) Press the [SIMLAT] soft key.



(4) Next, press the [REWIND] soft key and then the [START] soft key.



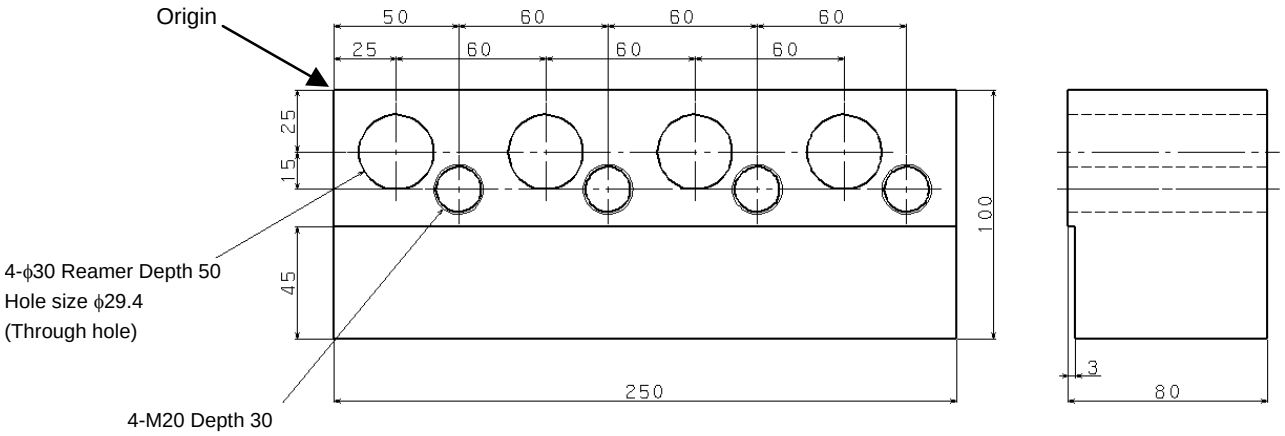
(5) Simulation starts. An animation lets you check how machining is performed.



37.4.3 Operation Example 2 (Milling, Drilling, Chamfering, Reaming, and Tapping)

Blank: 250 × 100 × 80

First process: Facing using a ϕ50 face mill (T01)
Second process: Drilling using a ϕ29.4 drill (T02) (reaming prepared hole)
Third process: Drilling using a ϕ17.5 drill (T03) (tapping prepared hole)
Fourth process: Chamfering using a chamfering tool (T04)
Fifth process: Reaming using a ϕ30 reamer (T05)
Sixth process: Tapping using a M20 tap (T06)



The following descriptions assume that the workpiece coordinate system and tool offset are properly set.

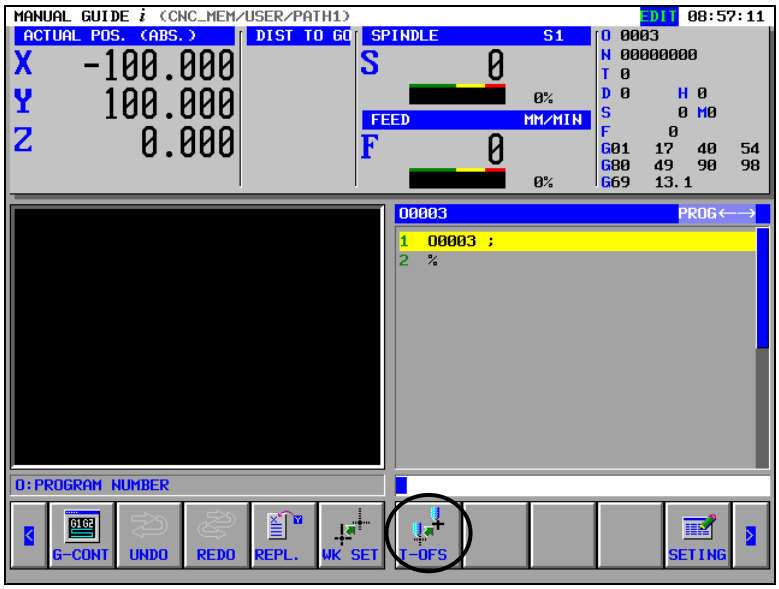
37.4.3.1 Tool data definition

Define the tools to be used for machining. Here, assign the tools to tool compensation numbers 001 to 006, respectively.

First process: ϕ50 face mill (T01)
Second process: ϕ29.4 drill (T02)
Third process: ϕ17.5 drill (T03)
Fourth process: Chamfering tool (T04)
Fifth process: ϕ30 reamer (T05)
Sixth process: M20 tap (T06)

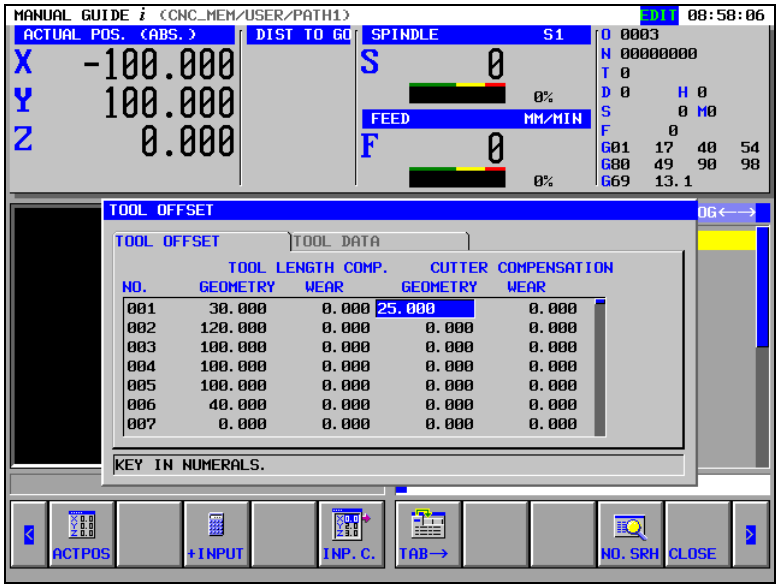
SUPPLEMENT
If simulation is not performed, the tool data definition procedure described below does not need to be carried out.

(1) Press the [>] soft key on the right end several times until the screen displays the soft keys shown below.
(2) Press the [T-OFS] soft key.



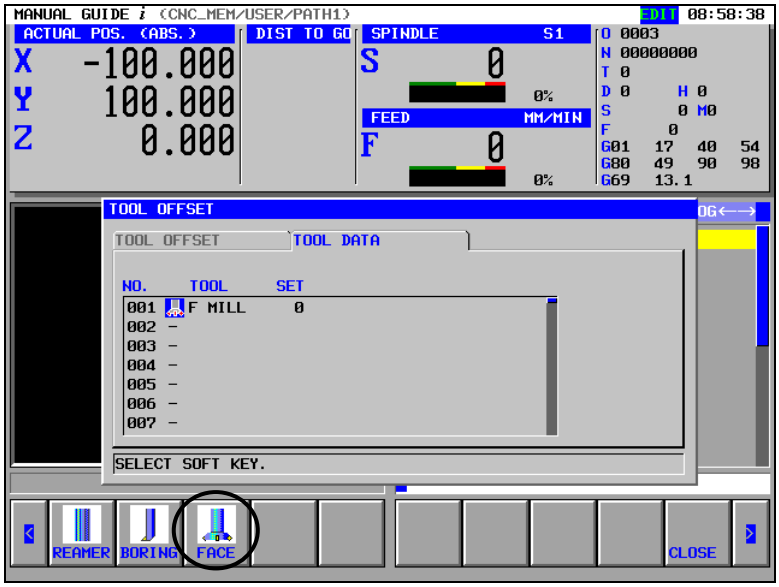
(3) Assign the ϕ50 face mill (T1) to tool compensation number 001. Display the "TOOL OFFSET" tab, and enter the tool radius in the "GEOMETRY" field in "CUTTER COMPENSATION" (here, enter "25.0").

SUPPLEMENT
It is assumed that the tool length offset is properly set.

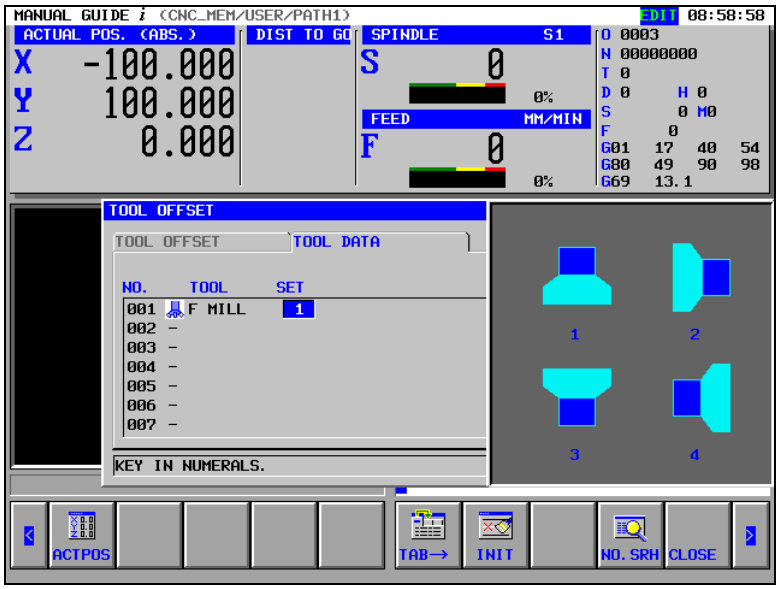


(4) Display the "TOOL DATA" tab by pressing the right cursor key <→> on the operator's panel several times or pressing the [TAB→] soft key.

(5) Press the [FACE] soft key to define the face mill.

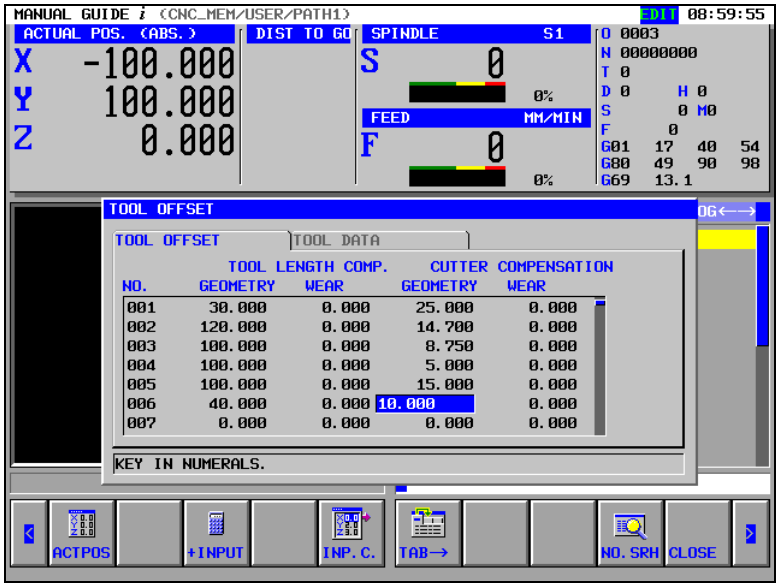


(6) Press the right cursor key <→> on the operator's panel twice to place the cursor on "SET", and enter a number to specify the tool setting direction.

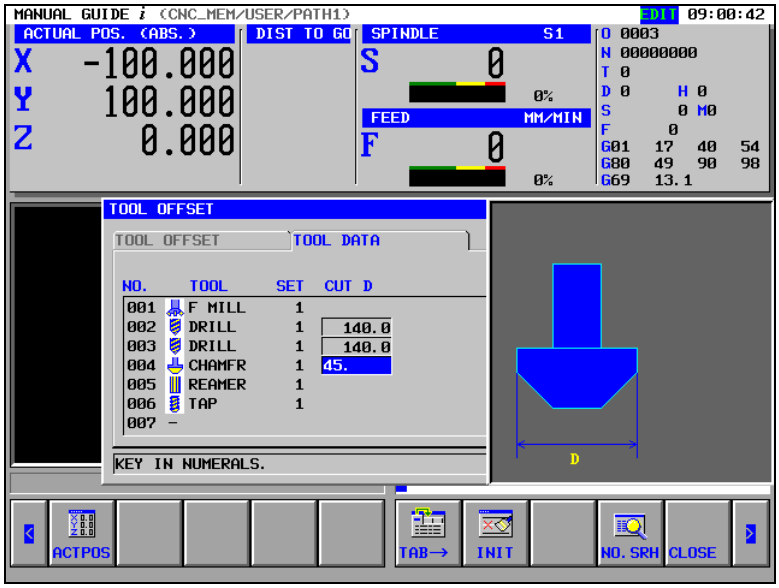


This completes the assignment of the face mill (T1) to tool compensation number 001. Define the remaining tools in the same way.

(7) Display the "TOOL OFFSET" tab, and enter the tool diameter (radius) in the "GEOMETRY" field in "CUTTER COMPENSATION" as in the screen shown below.



(8) Display the "TOOL DATA" tab, and define the tool as in the screen shown below. If you select "DRILL" in the "TOOL" field, the "NOS AN" field appears. If "CHAMFR" is selected, the "CUT D" field appears. Set the values as in the screen shown below.



(9) Taking these steps defines the tool data in tool compensation numbers 001 to 006. By inserting "D1" to "D6" into the program, you can define these tools.

SUPPLEMENT

By placing the cursor on the "TOOL" field of the "TOOL DATA" tab, you can edit the tool name. Use this feature in such cases as when you have two or more tools of the same kind and want to have each of them individually identified.

(10) Press the [CLOSE] soft key to close the window.

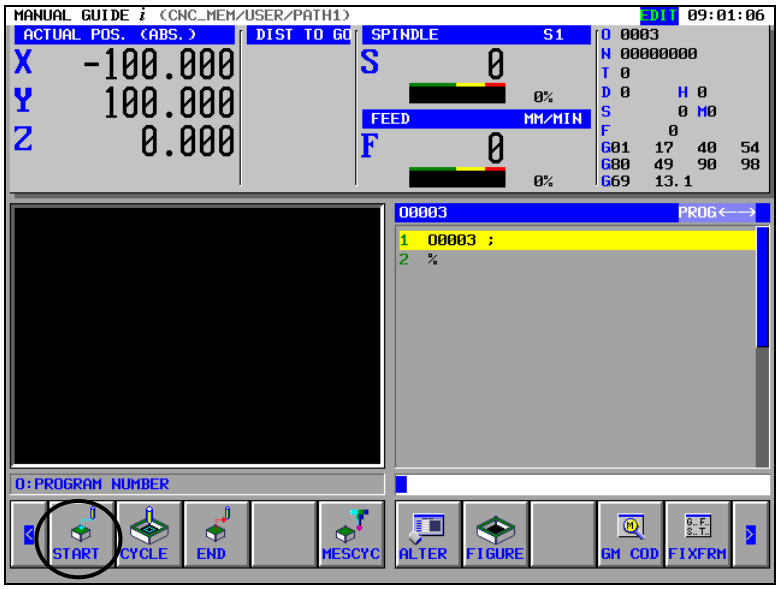
37.4.3.2 Program Creation

See Subsection 37.4.2.2, "Program creation".

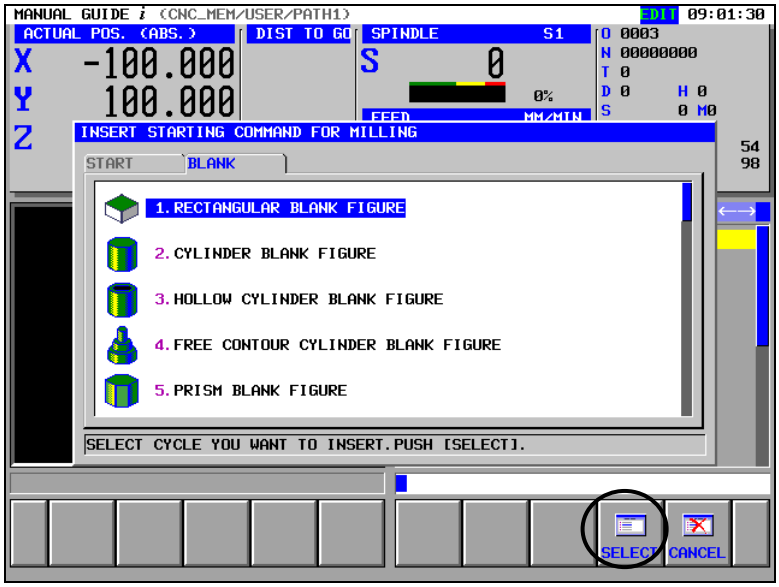
37.4.3.3 Blank Figure Definition

SUPPLEMENT
If simulation is not performed, the blank figure definition procedure described below does not need to be carried out.

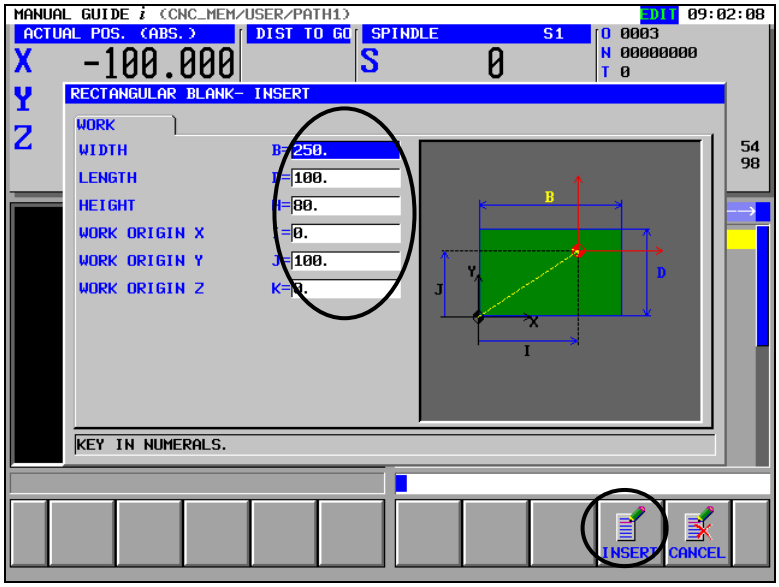
(1) Press the [>] soft key on the right end several times until the screen displays the soft keys shown below.
(2) Press the [START] soft key.



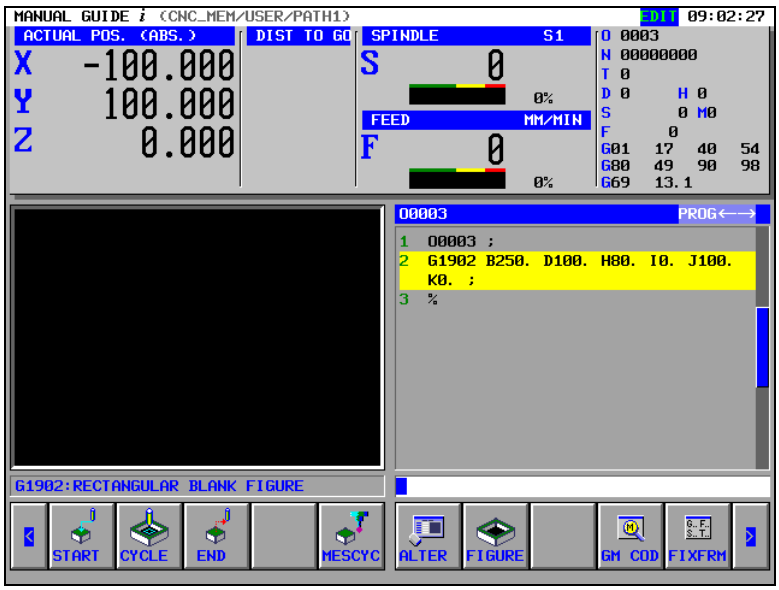
(3) Display the "BLANK" tab by pressing the right cursor key <→> on the operator's panel. Place the cursor on "1. RECTANGULAR BLANK FIGURE", and press the [SELECT] soft key or the <INPUT> key on the operator's panel.



(4) Enter the blank figure dimensions and workpiece origin, as shown below, and press the [INSERT] soft key.



(5) The blank figure definition block is inserted into the program.

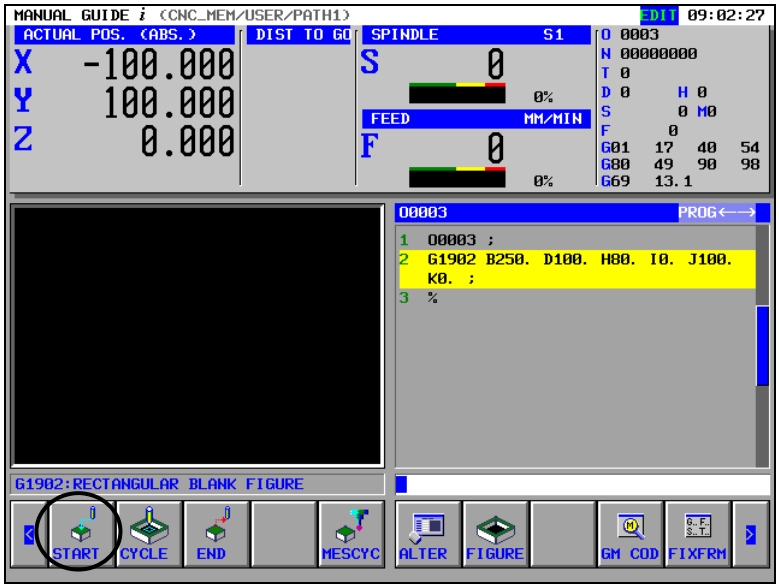


37.4.3.4 First Process (Facing) Input

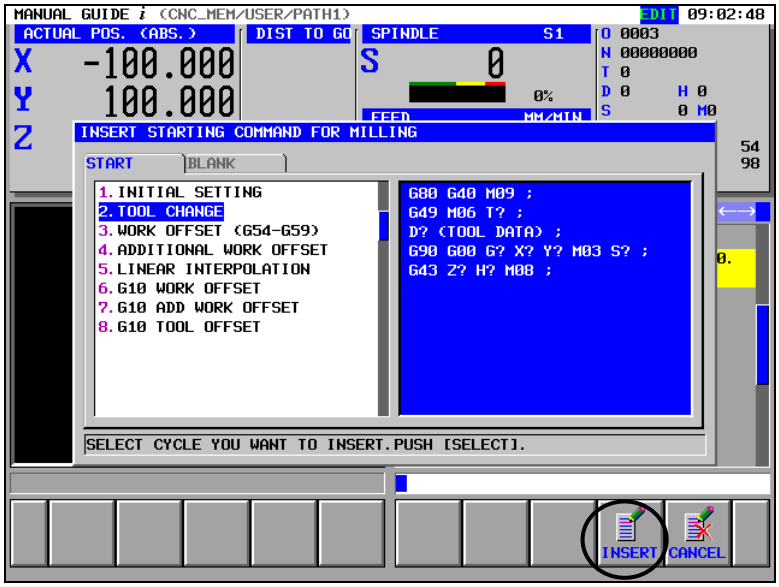
(1)Tool change/Spindle rotation/Approach motion

While commands for tool change, spindle rotation, and approach motion to the machining start point can be input manually one by one using G and M codes, it is more convenient to use fixed form sentences.

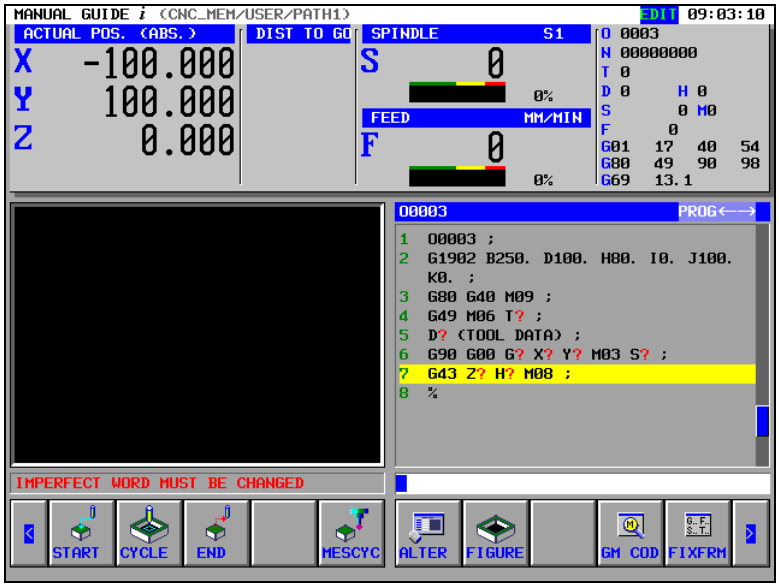
(1) Press the [>] soft key on the right end several times until the screen displays the soft keys shown below.
(2) Press the [START] soft key.



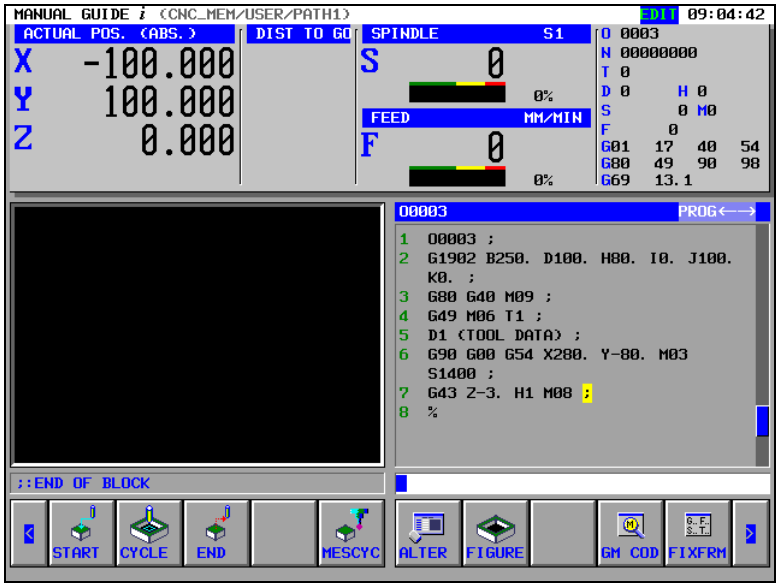
(3) Place the cursor on "2. TOOL CHANGE" in the "START" tab, and press the [INSERT] soft key or the <INPUT> key on the operator's panel.



(4) The selected fixed form sentence is inserted. Undecided values are represented by "?", as shown below.



(5) Place the cursor on an address for which "?" is displayed, enter a value, and then press the <ALTER> key on the operator's panel. For example, place the cursor on "T?", and enter "1" and press <ALTER>. Doing so inputs tool number "T1". (Address "T" does not need to be input.) After entering data, return the cursor to the EOB position at the end of the program.



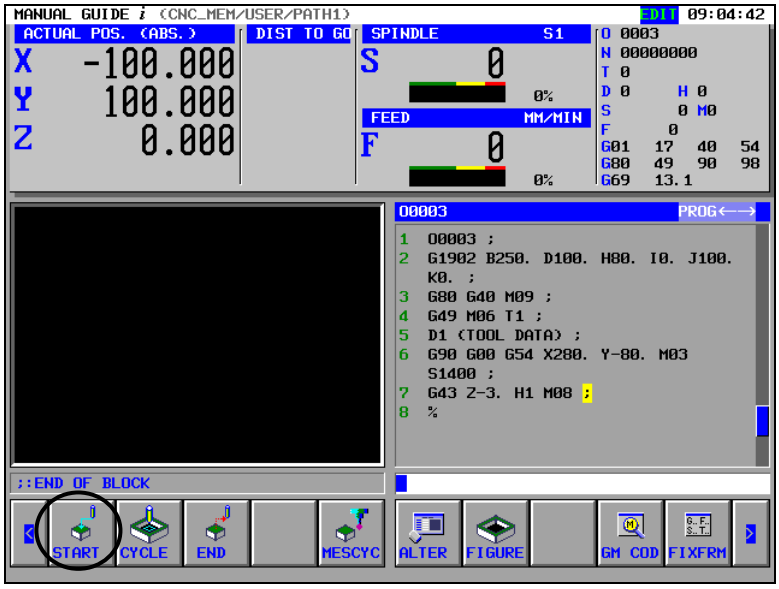
SUPPLEMENT

In the screen shown above, "D1" on the fifth line of the program is a tool compensation number (see Subsection 37.4.3.1). For "G?" on the sixth line, workpiece coordinate system "G54" is input.

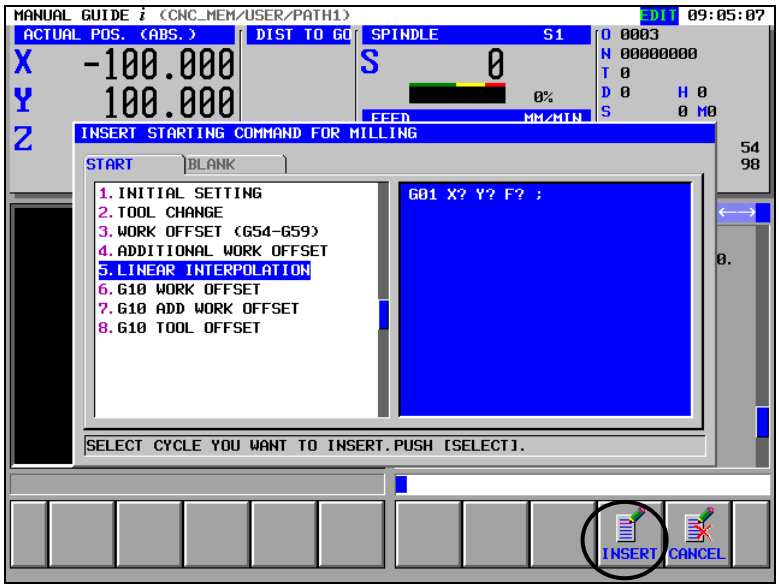
(2) Machining Operation

First process: Specify facing using a ϕ50 face mill (T01).
This is a simple machining operation; use a fixed form sentence instead of a cycle.

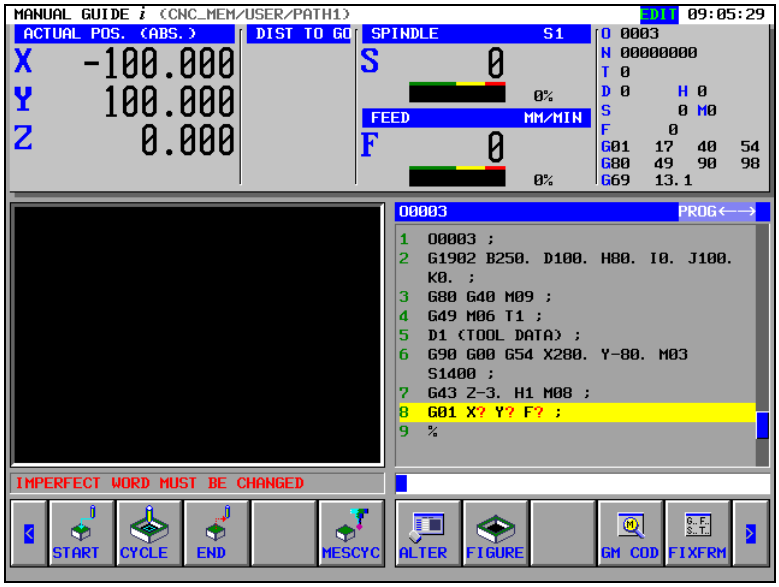
(1) Press the [>] soft key on the right end several times until the screen displays the soft keys shown below.
(2) Press the [START] soft key.



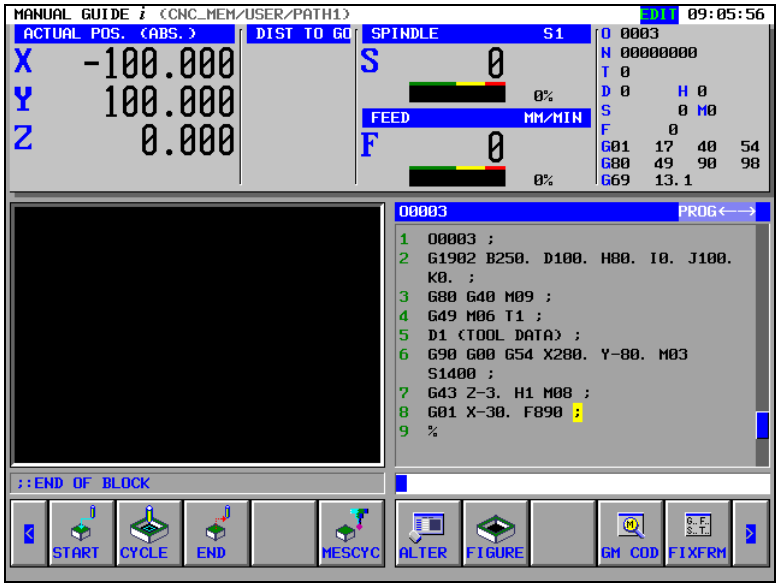
(3) Place the cursor on "5. LINEAR INTERPOLATION" in the "START" tab, and press the [INSERT] soft key or the <INPUT> key on the operator's panel.



(4) The selected fixed form sentence is inserted. Undecided values are represented by "?", as shown below.



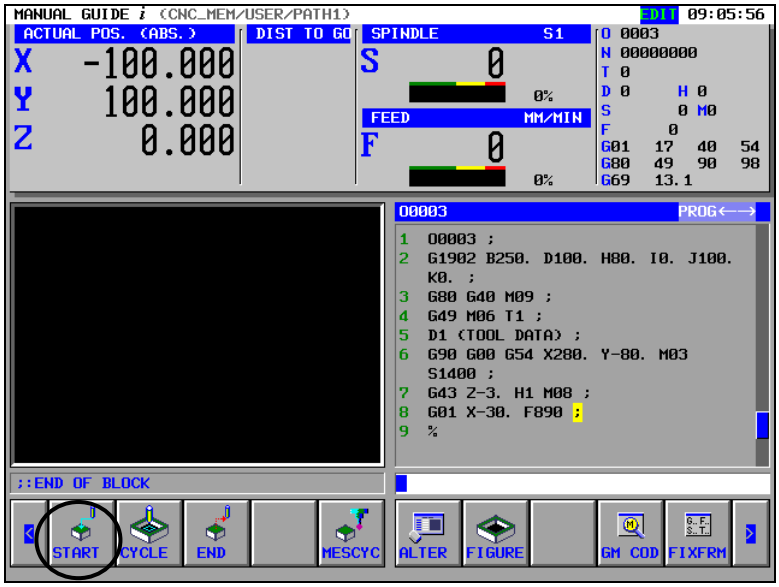
(5) Place the cursor on "X?", and enter "-30." and press <ALTER>. Since the Y axis is not to be moved, place the cursor on "Y?" and press the <DELETE> key on the operator's panel. Also, place the cursor on "F?", and enter "890" and press <ALTER>.
After entering data, return the cursor to the EOB position at the end of the program.



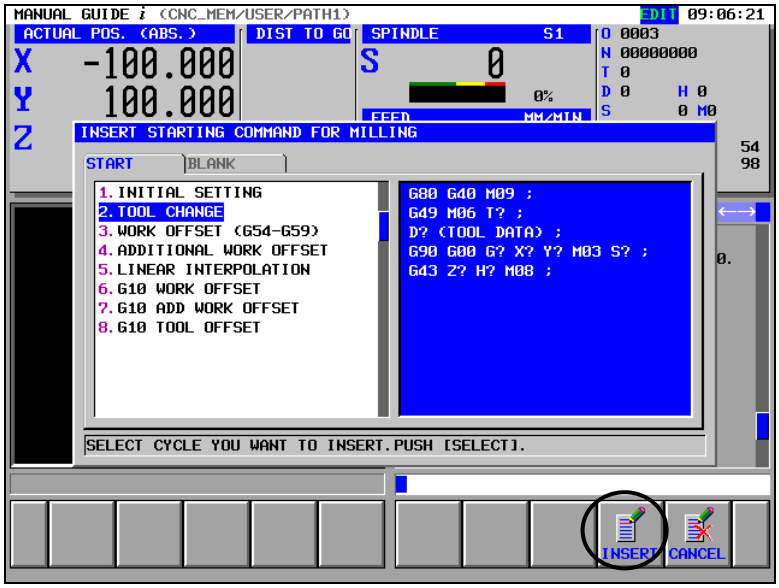
37.4.3.5 Second Process (Drilling) Input

(1) Tool change/Spindle rotation/Approach motion

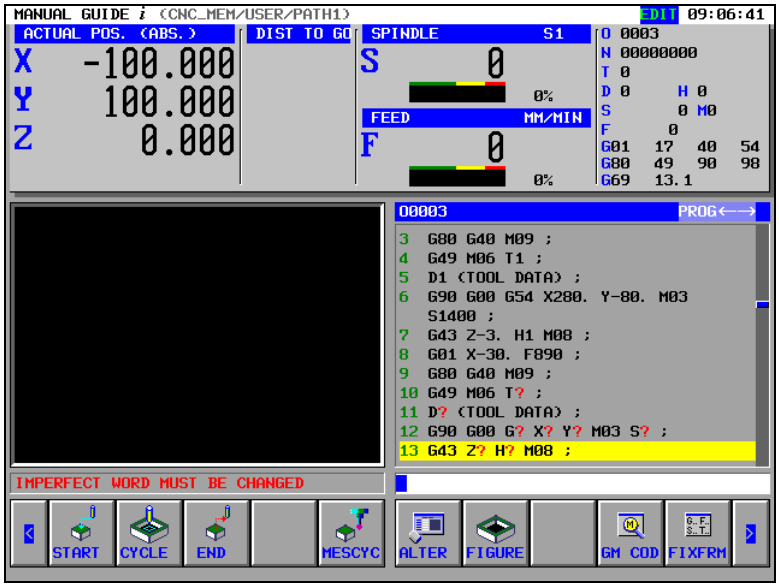
(1) Press the [>] soft key on the right end several times until the screen displays the soft keys shown below.
(2) Press the [START] soft key.



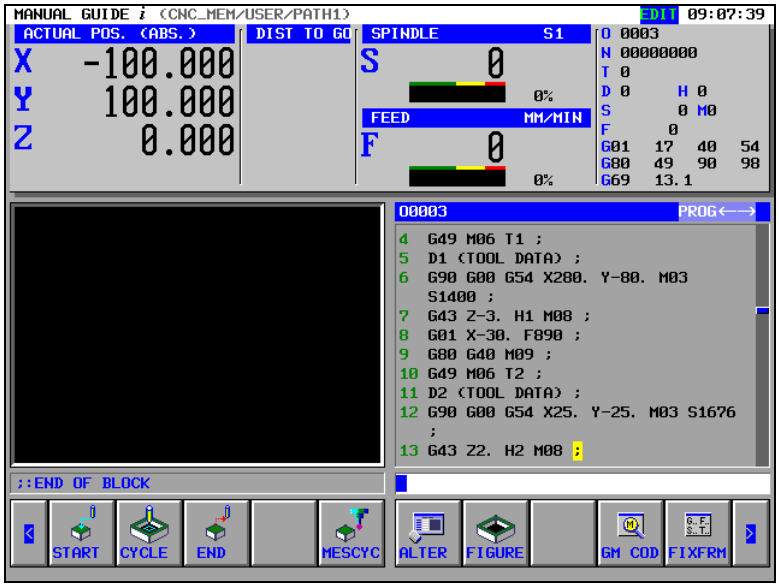
(3) Place the cursor on "2. TOOL CHANGE" in the "START" tab, and press the [INSERT] soft key or the <INPUT> key on the operator's panel.



(4) The selected fixed form sentence is inserted. Undecided values are represented by "?", as shown below.



(5) Place the cursor on an address for which "?" is displayed, enter a value, and then press the <ALTER> key on the operator's panel. For example, place the cursor on "T?", and enter "2" and press <ALTER>. Doing so inputs tool number "T2". (Address "T" does not need to be input.) After entering data, return the cursor to the EOB position at the end of the program.



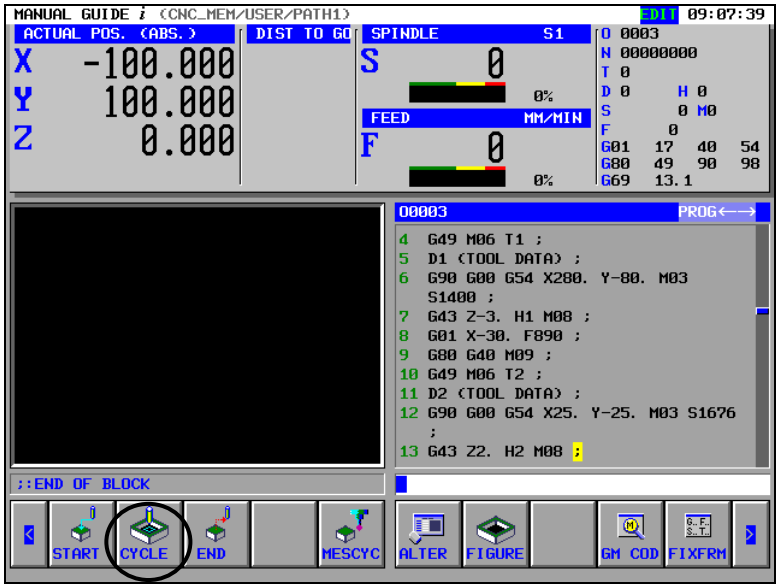
SUPPLEMENT

In the screen shown above, "D2" on the 11th line of the program is a tool compensation number (see Subsection 37.4.3.1). For "G?" on the 12th line, workpiece coordinate system "G54" is input.

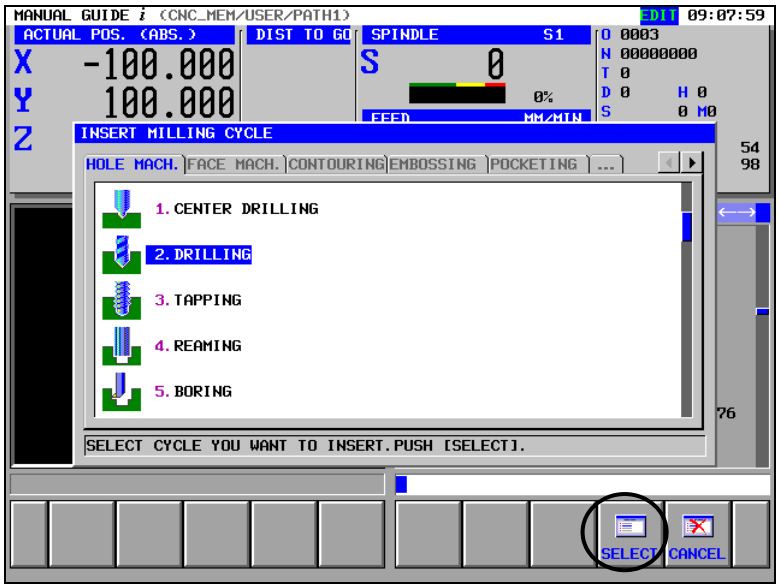
(2) Machining Operation

Second process: Specify drilling using a ϕ29.4 drill (T02) (reaming prepared hole). Enter the machining type, cutting conditions, etc.

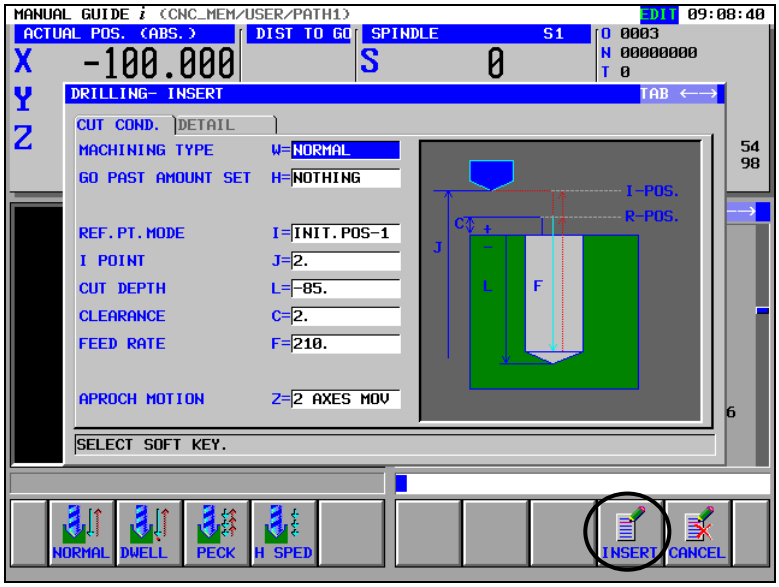
(1) Press the [CYCLE] soft key.



(2) Place the cursor on "2. DRILLING" in the "HOLE MACH." tab, and press the [SELECT] soft key or the <INPUT> key on the operator's panel.

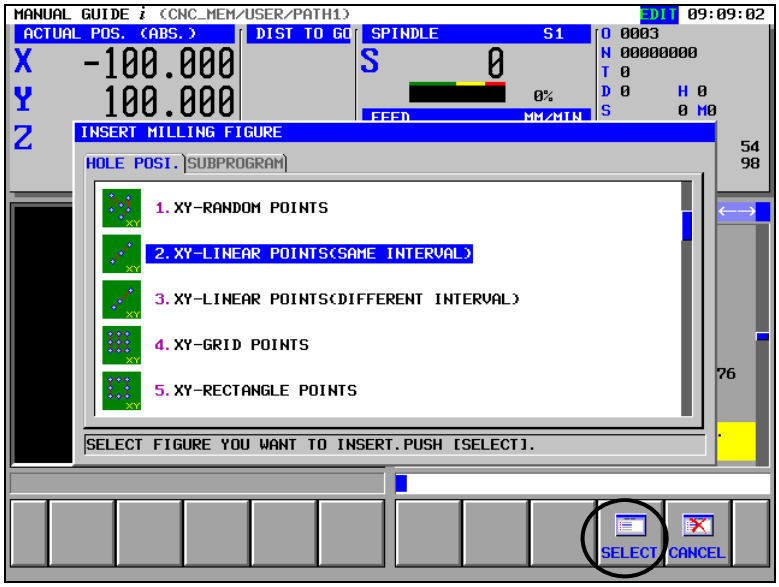


(3) In the "CUT COND." tab, enter data in each field.

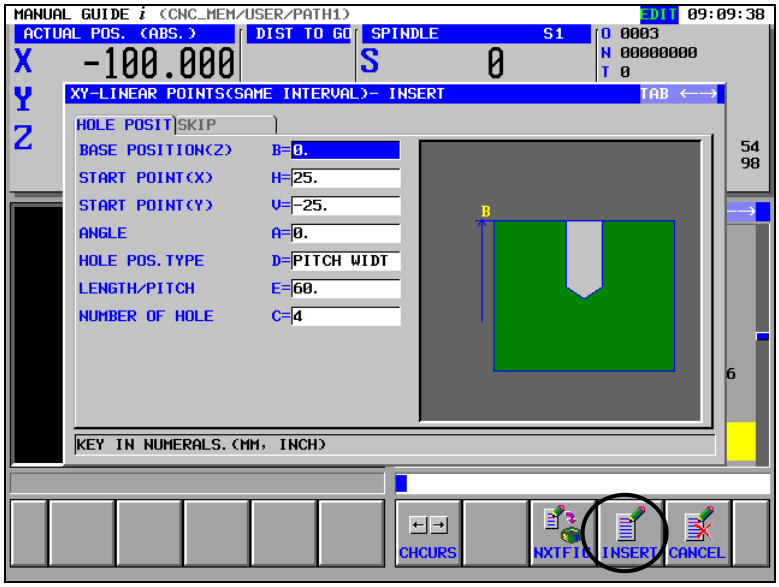


(4) Press the [INSERT] soft key.
The drilling cycle is inserted into the program, and then the hole position selection window is displayed.

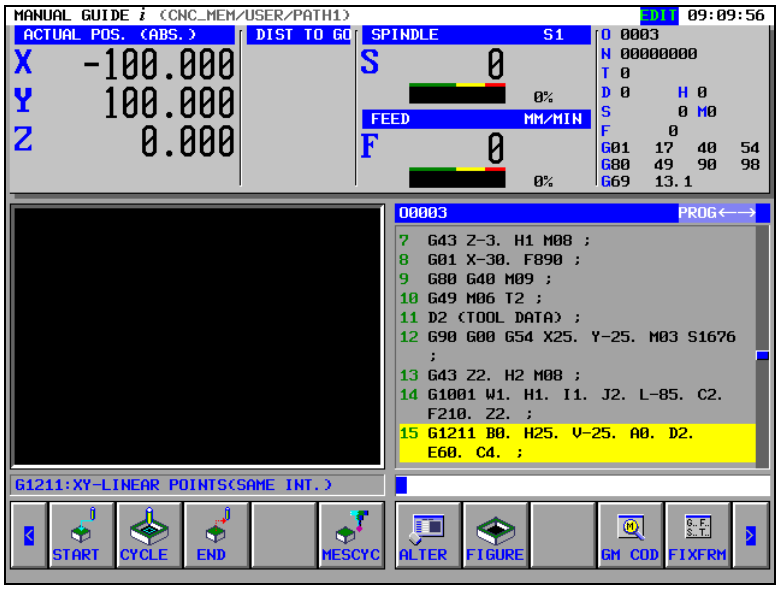
(5) Place the cursor on "2. XY-LINEAR POINTS(SAME INTERVAL)" in the "HOLE POSI." tab, and press the [SELECT] soft key or the <INPUT> key on the operator's panel.



(6) In the "HOLE POSIT" tab, enter data as shown below, and press the [INSERT] soft key.



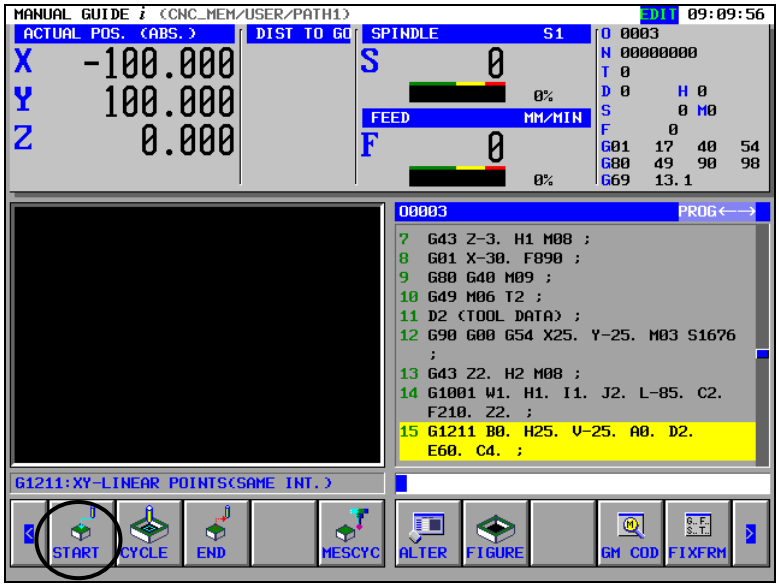
(7) The hole position block is inserted into the program.



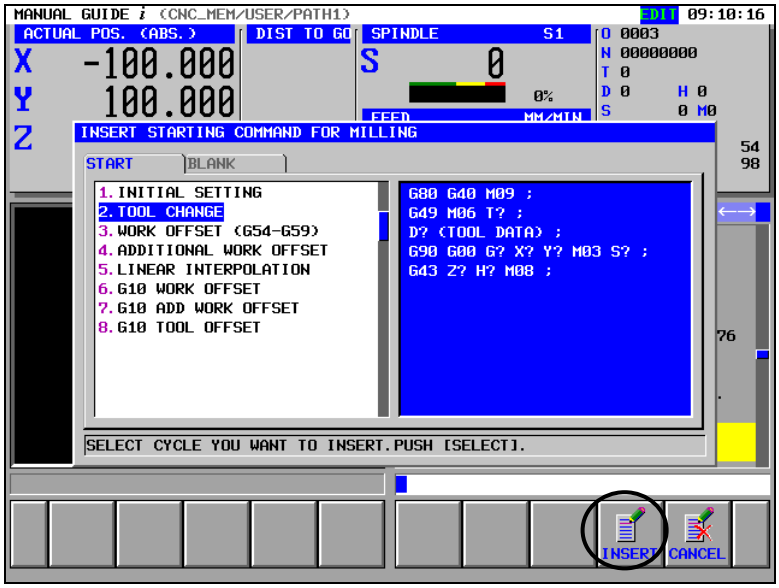
37.4.3.6 Third Process (Drilling) Input

(1) Tool change/Spindle rotation/Approach motion

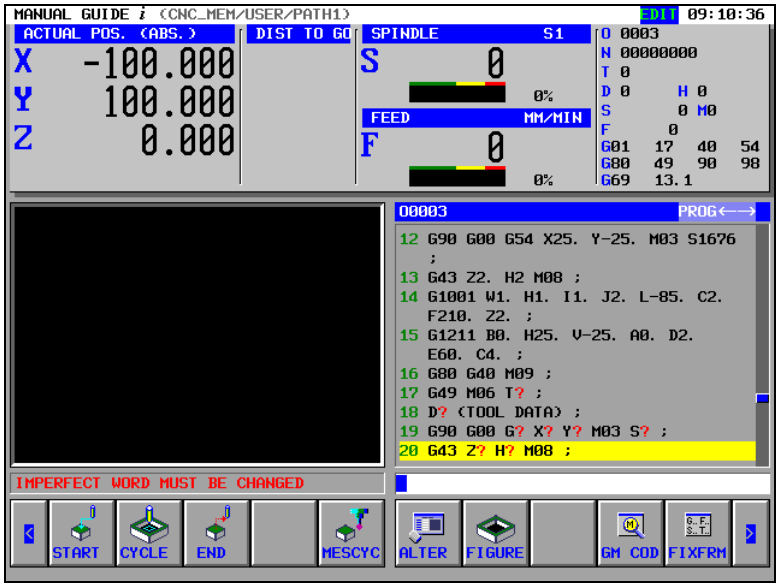
(1) Press the [>] soft key on the right end several times until the screen displays the soft keys shown below.
(2) Press the [START] soft key.



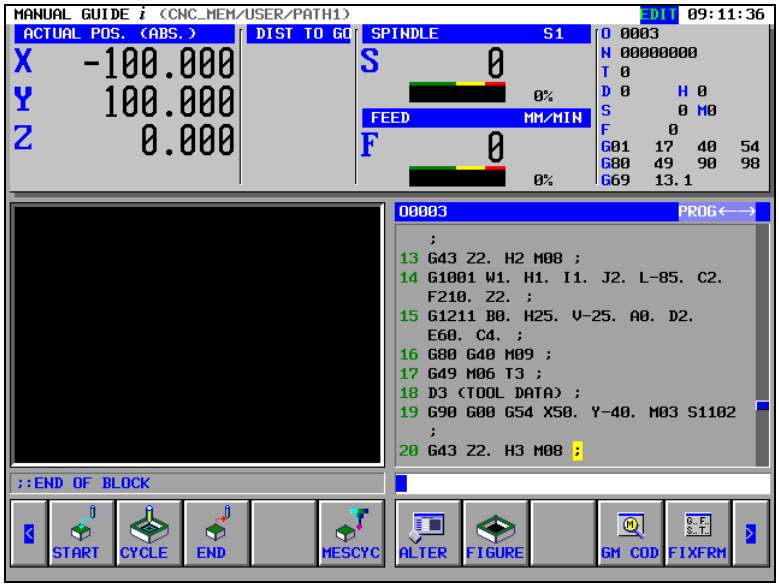
(3) Place the cursor on "2. TOOL CHANGE" in the "START" tab, and press the [INSERT] soft key or the <INPUT> key on the operator's panel.



(4) The selected fixed form sentence is inserted. Undecided values are represented by "?", as shown below.



(5) Place the cursor on an address for which "?" is displayed, enter a value, and then press the <ALTER> key on the operator's panel. For example, place the cursor on "T?", and enter "3" and press <ALTER>. Doing so inputs tool number "T3". (Address "T" does not need to be input.) After entering data, return the cursor to the EOB position at the end of the program.



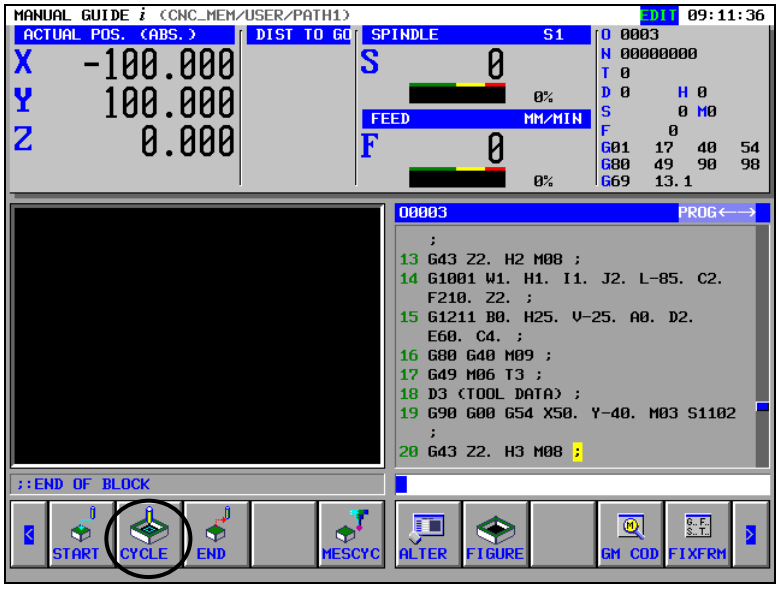
SUPPLEMENT

In the screen shown above, "D3" on the 18th line of the program is a tool compensation number (see Subsection 37.4.3.1). For "G?" on the 19th line, workpiece coordinate system "G54" is input.

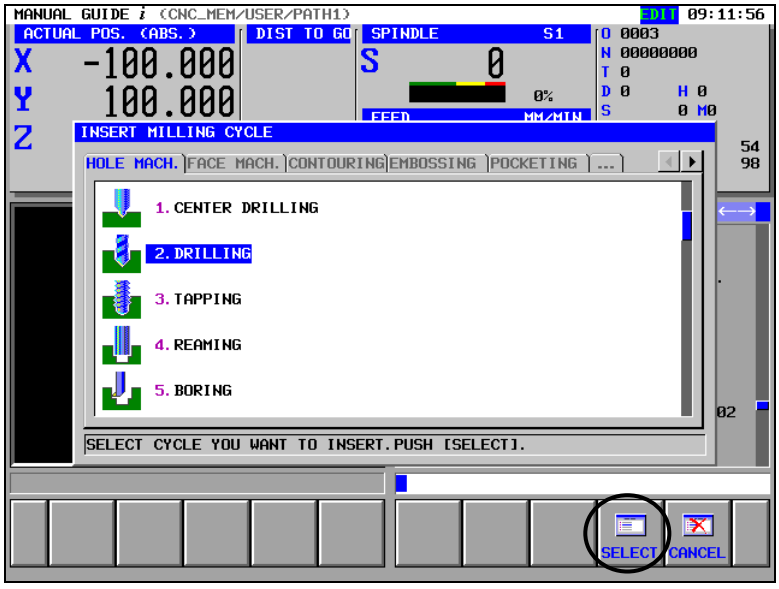
(2) Machining Operation

Third process: Specify drilling using a ϕ17.5 drill (T03) (tapping prepared hole).

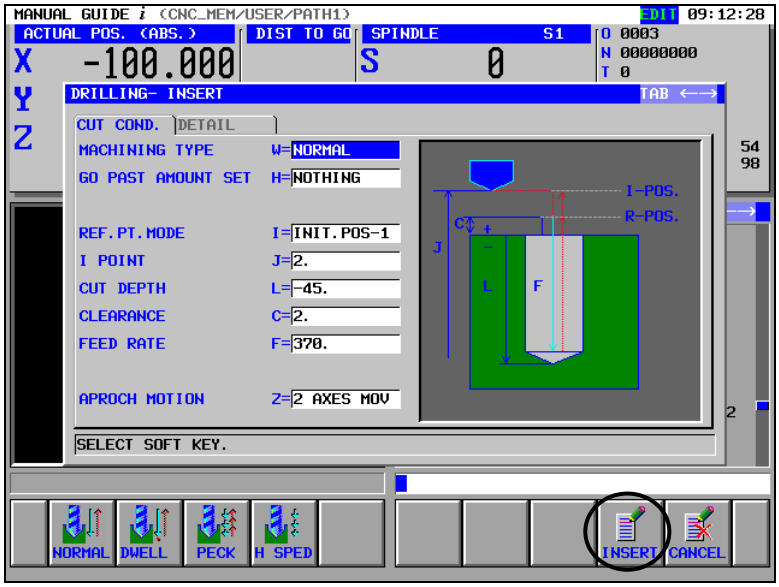
(1) Press the [CYCLE] soft key.



(2) Place the cursor on "2. DRILLING" in the "HOLE MACH." tab, and press the [SELECT] soft key or the <INPUT> key on the operator's panel.

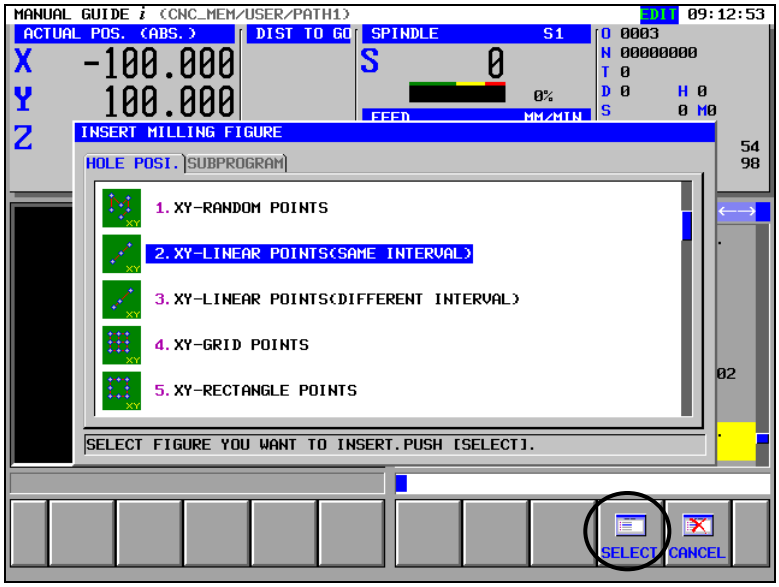


(3) In the "CUT COND." tab, enter data in each field.

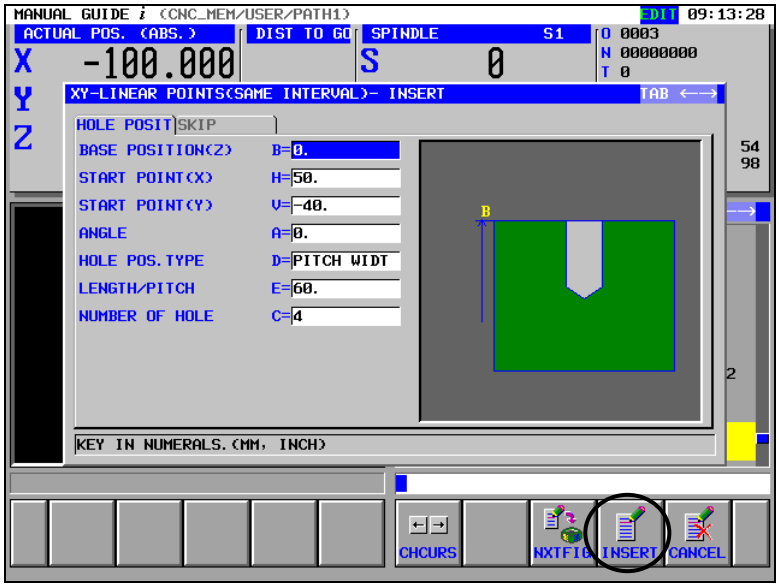


(4) Press the [INSERT] soft key.
The drilling cycle is inserted into the program, and then the hole position selection window is displayed.

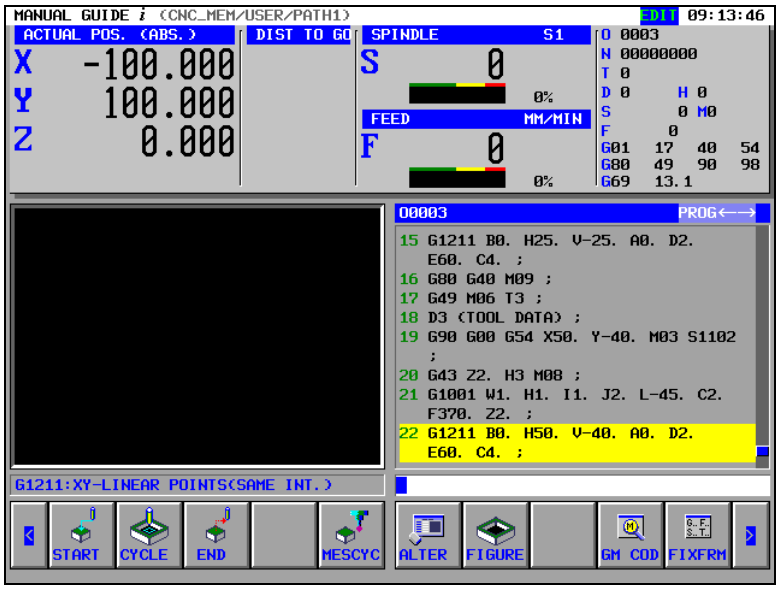
(5) Place the cursor on "2. XY-LINEAR POINTS(SAME INTERVAL)" in the "HOLE POSI." tab, and press the [SELECT] soft key or the <INPUT> key on the operator's panel.



(6) In the "HOLE POSIT" tab, enter data as shown below, and press the [INSERT] soft key.



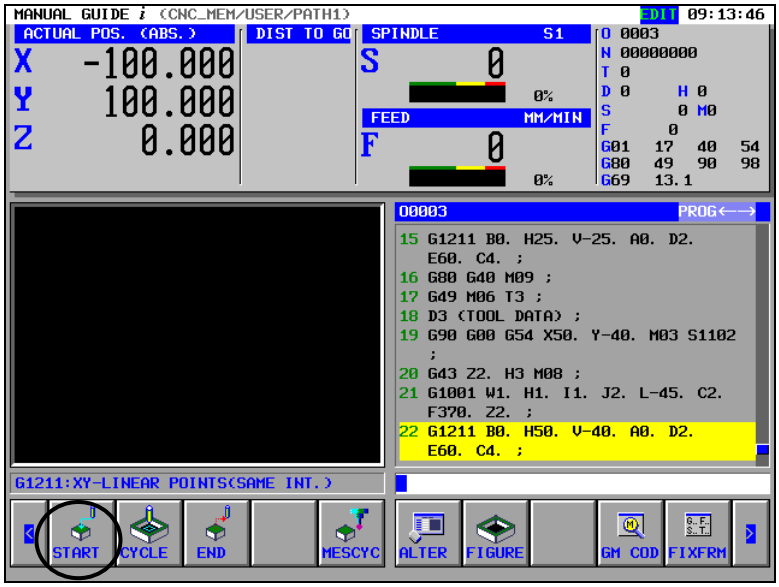
(7) The hole position block is inserted into the program.



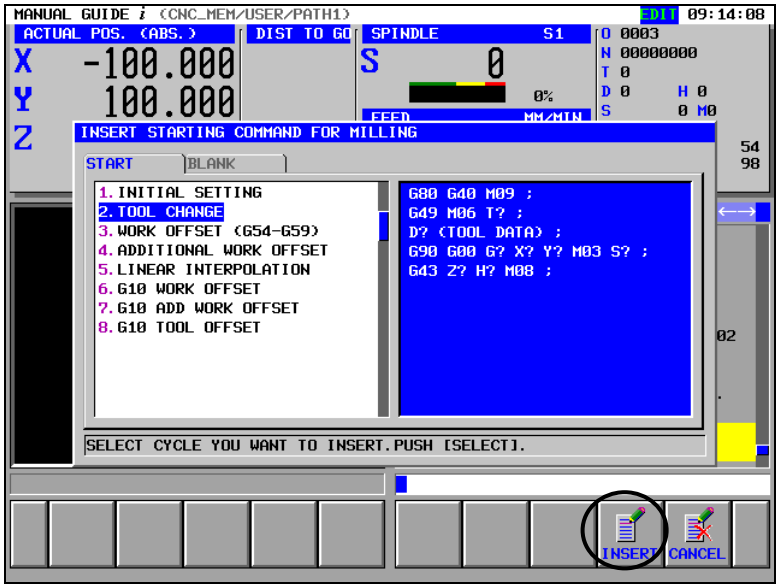
37.4.3.7 Fourth Process (Chamfering) Input

(1)Tool change/Spindle rotation/Approach motion

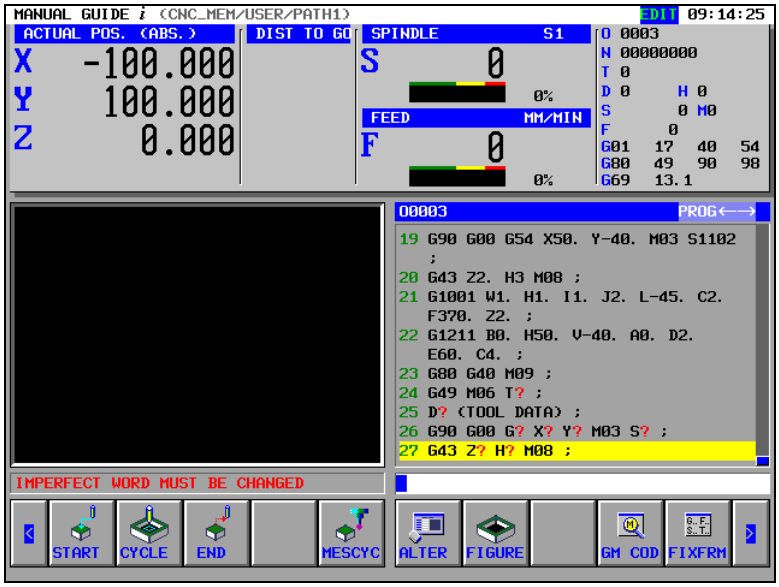
(1) Press the [>] soft key on the right end several times until the screen displays the soft keys shown below.
(2) Press the [START] soft key.



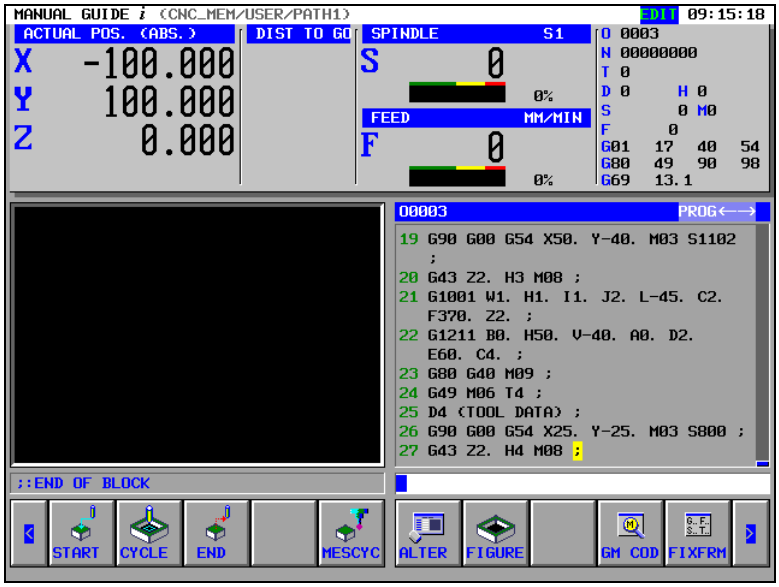
(3) Place the cursor on "2. TOOL CHANGE" in the "START" tab, and press the [INSERT] soft key or the <INPUT> key on the operator's panel.



(4) The selected fixed form sentence is inserted. Undecided values are represented by "?", as shown below.



(5) Place the cursor on an address for which "?" is displayed, enter a value, and then press the <ALTER> key on the operator's panel. For example, place the cursor on "T?", and enter "4" and press <ALTER>. Doing so inputs tool number "T4". (Address "T" does not need to be input.) After entering data, return the cursor to the EOB position at the end of the program.



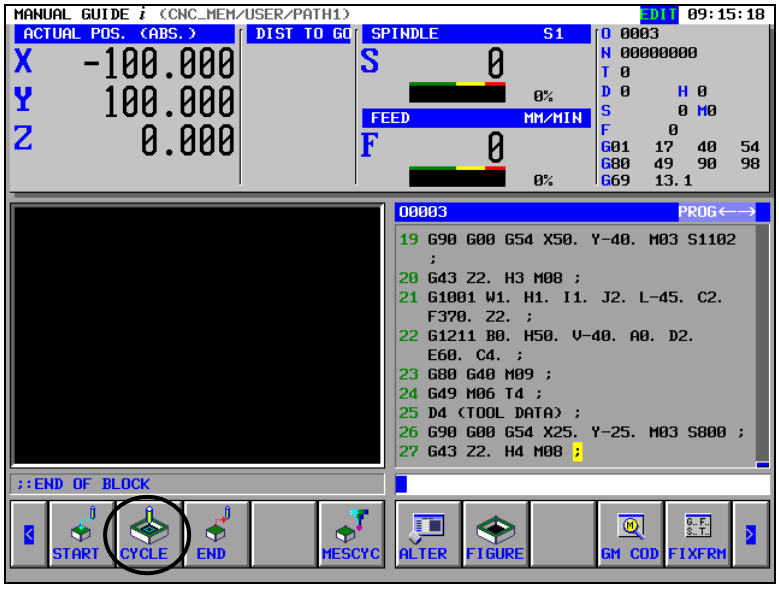
SUPPLEMENT

In the screen shown above, "D4" on the 25th line of the program is a tool compensation number (see Subsection 37.4.3.1). For "G?" on the 26th line, workpiece coordinate system "G54" is input.

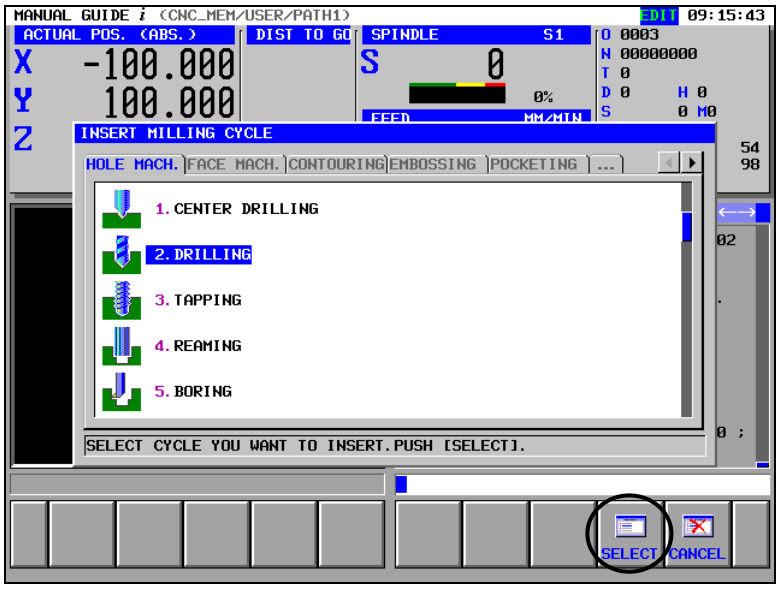
(2) Machining Operation

Fourth process: Specify chamfering using a chamfering tool (T04).
First, input data for the chamfering of the reaming prepared hole.

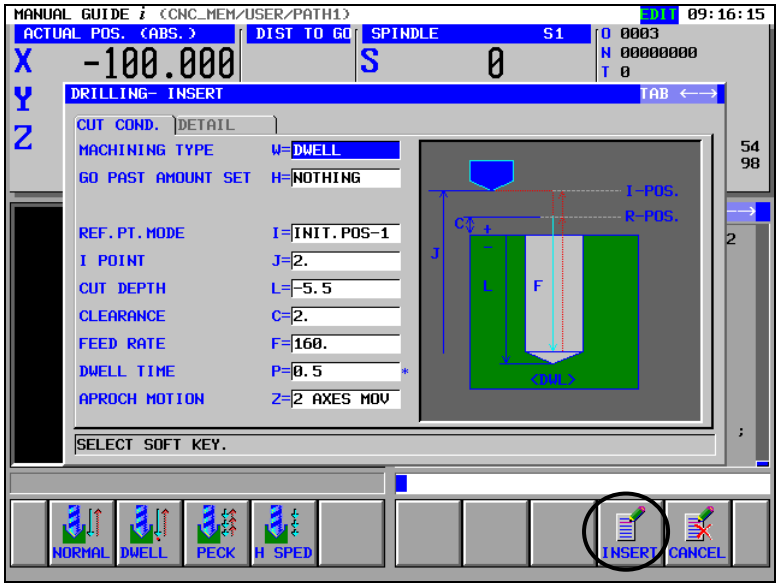
(1) Press the [CYCLE] soft key.



(2) Place the cursor on "2. DRILLING" in the "HOLE MACH." tab, and press the [SELECT] soft key or the <INPUT> key on the operator's panel.



(3) In the "CUT COND." tab, enter data in each field.

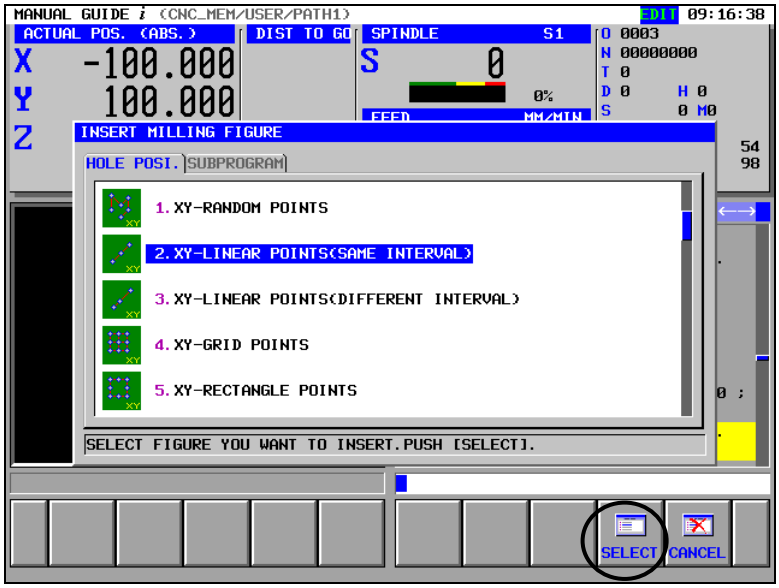


SUPPLEMENT

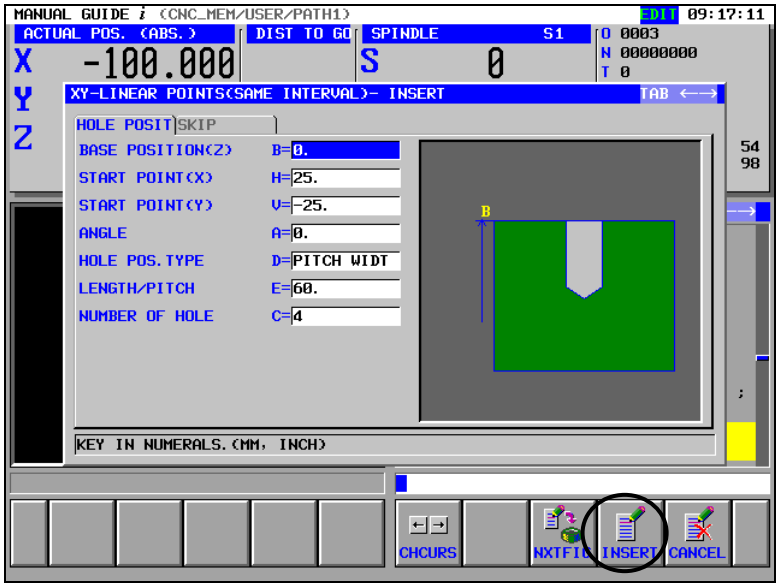
For some data items, "*" is displayed to the right of their input fields. If the user does not fill in the input field, a standard value is automatically set.

(4) Press the [INSERT] soft key.
The drilling cycle is inserted into the program, and then the hole position selection window is displayed.

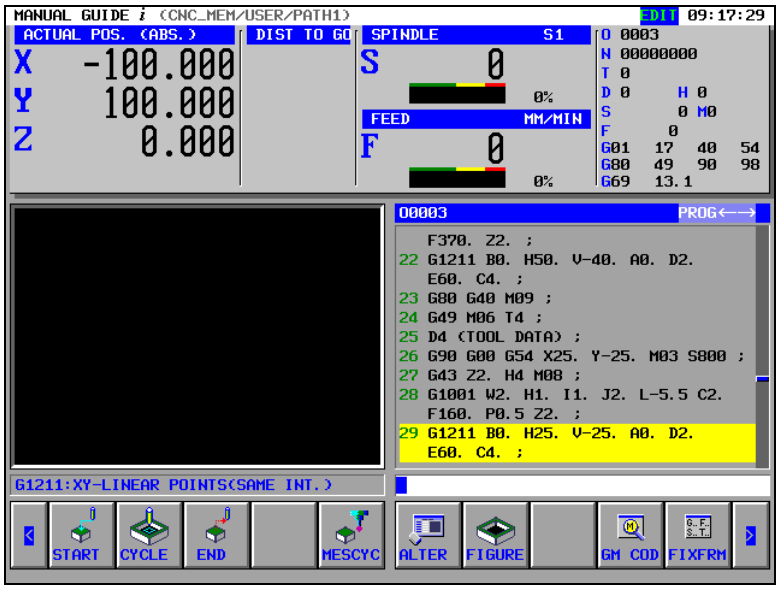
(5) Place the cursor on "2. XY-LINEAR POINTS(SAME INTERVAL)" in the "HOLE POSI." tab, and press the [SELECT] soft key or the <INPUT> key on the operator's panel.



(6) In the "HOLE POSIT" tab, enter data as shown below, and press the [INSERT] soft key.



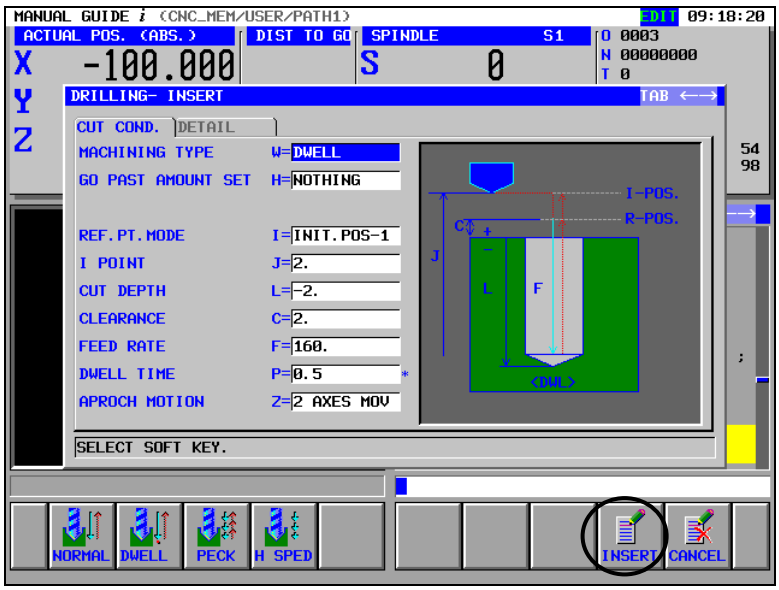
(7) The hole position block is inserted into the program.



(8) Next, input data for the chamfering of the tapping prepared hole. Next, press the [CYCLE] soft key.

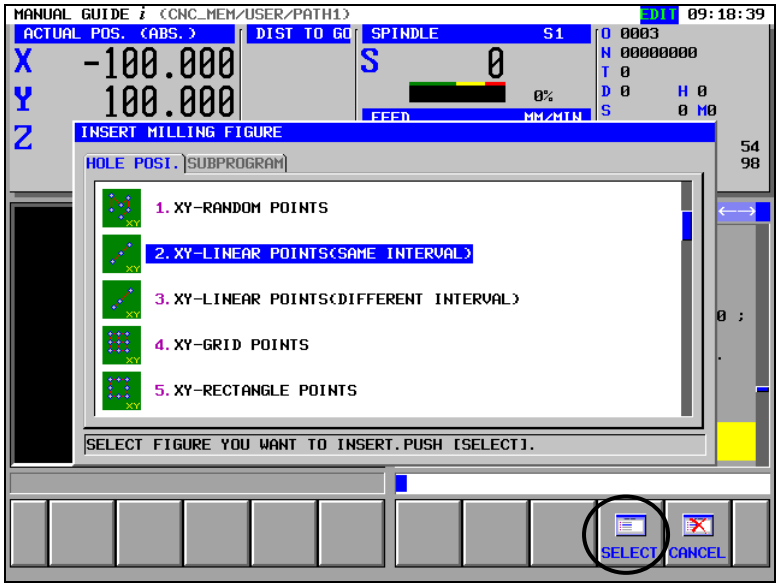
(9) Place the cursor on "2. DRILLING" in the "HOLE MACH." tab, and press the [SELECT] soft key or the <INPUT> key on the operator's panel.

(10) In the "CUT COND." tab, enter data in each field.

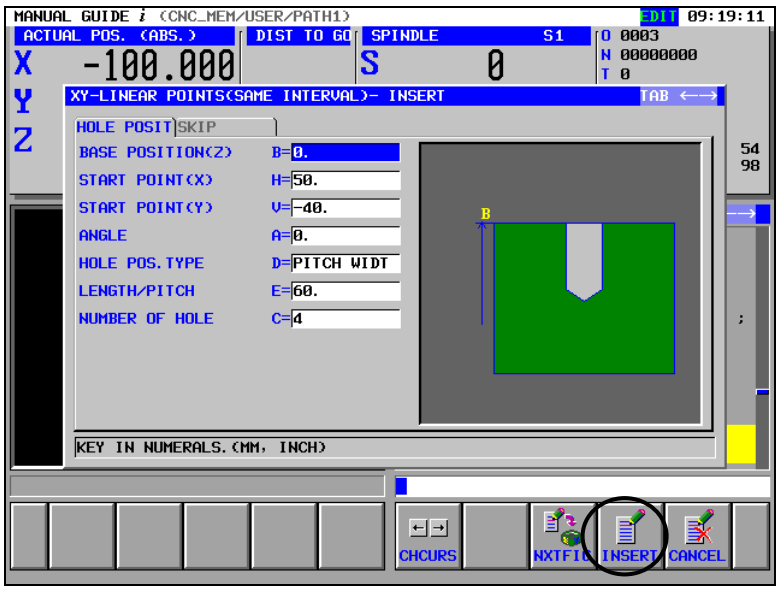


(11) Press the [INSERT] soft key.
The drilling cycle is inserted into the program, and then the hole position selection window is displayed.

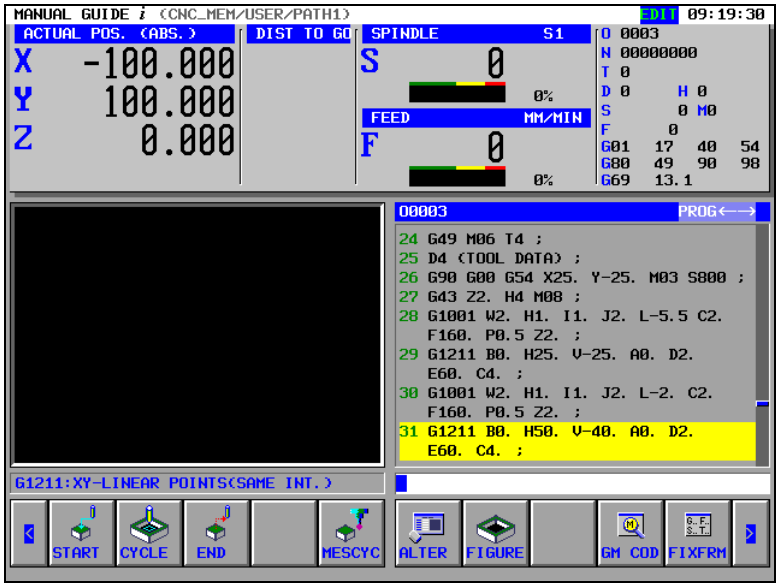
(12) Place the cursor on "2. XY-LINEAR POINTS(SAME INTERVAL)" in the "HOLE POSI." tab, and press the [SELECT] soft key or the <INPUT> key on the operator's panel.



(13) In the "HOLE POSIT" tab, enter data as shown below, and press the [INSERT] soft key.



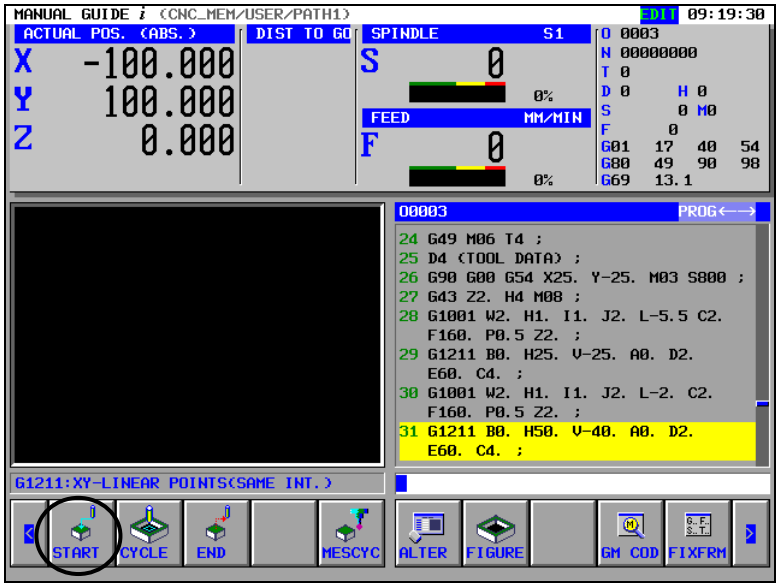
(14) The hole position block is inserted into the program.



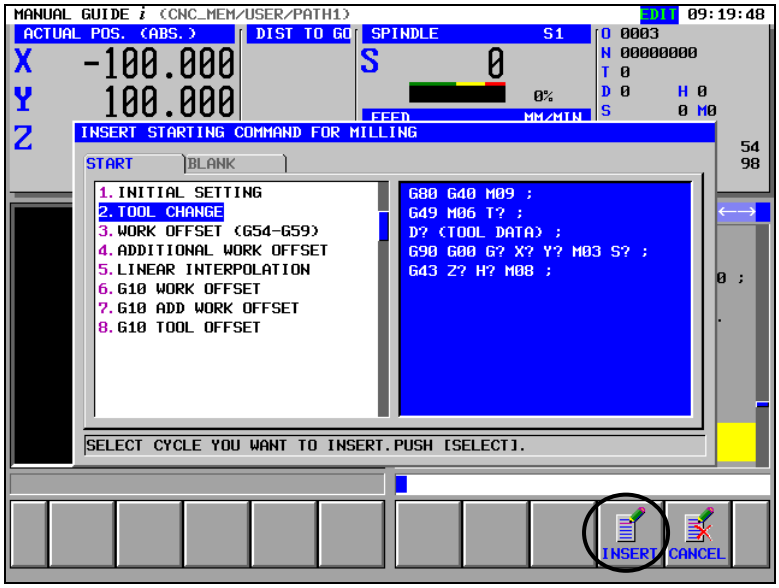
37.4.3.8 Fifth Process (Reaming) Input

(1) Tool change/Spindle rotation/Approach motion

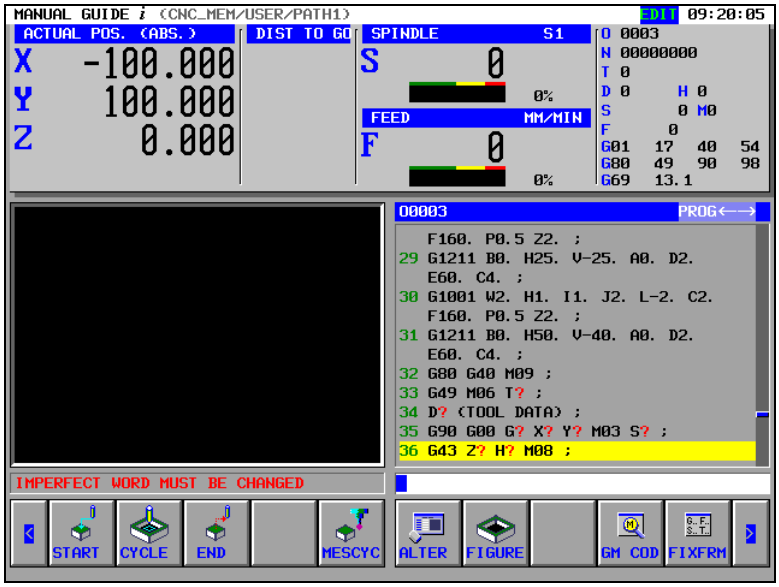
(1) Press the [>] soft key on the right end several times until the screen displays the soft keys shown below.
(2) Press the [START] soft key.



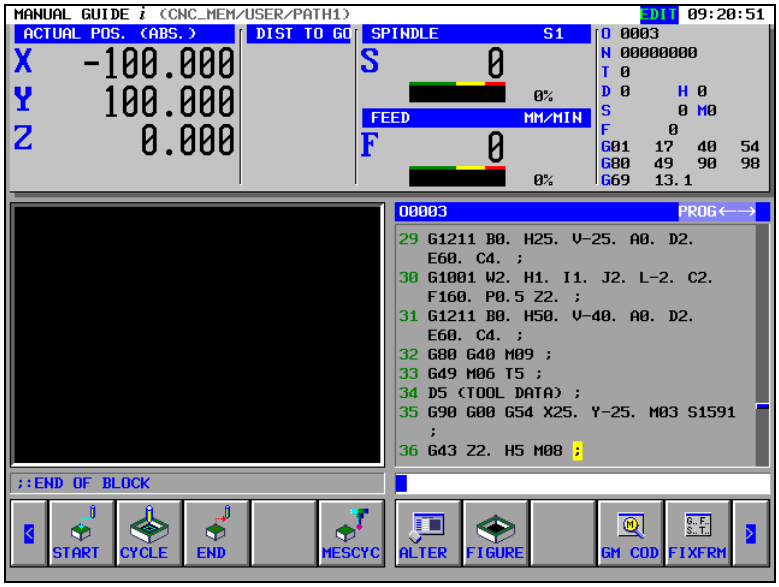
(3) Place the cursor on "2. TOOL CHANGE" in the "START" tab, and press the [INSERT] soft key or the <INPUT> key on the operator's panel.



(4) The selected fixed form sentence is inserted. Undecided values are represented by "?", as shown below.



(5) Place the cursor on an address for which "?" is displayed, enter a value, and then press the <ALTER> key on the operator's panel. For example, place the cursor on "T?", and enter "5" and press <ALTER>. Doing so inputs tool number "T5". (Address "T" does not need to be input.) After entering data, return the cursor to the EOB position at the end of the program.



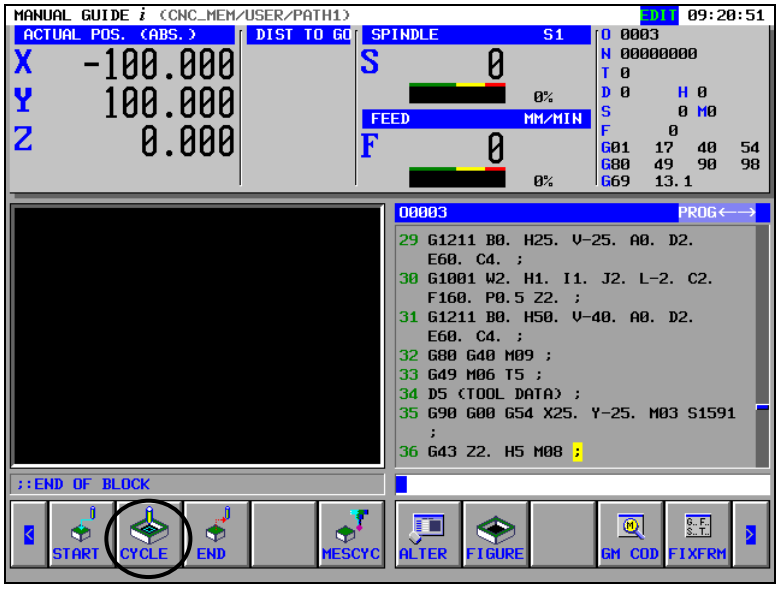
SUPPLEMENT

In the screen shown above, "D5" on the 34th line of the program is a tool compensation number (see Subsection 37.4.3.1). For "G?" on the 35th line, workpiece coordinate system "G54" is input.

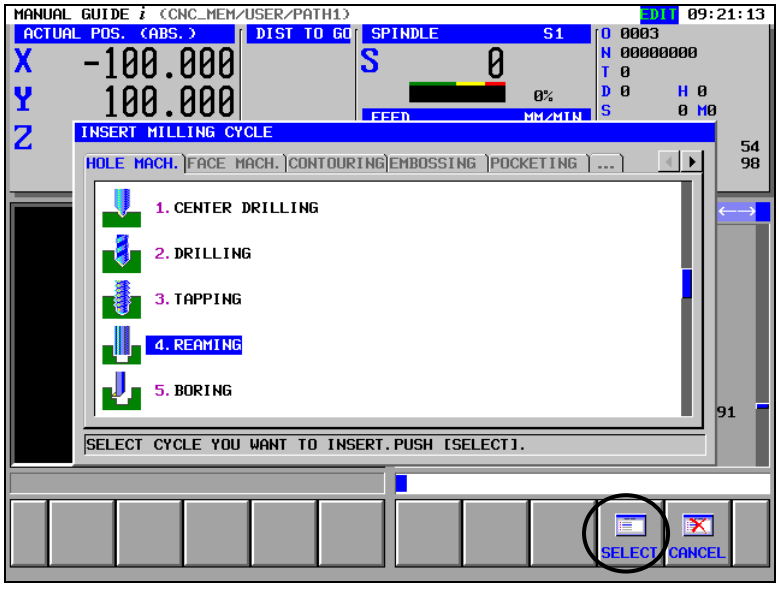
(2) Machining Operation

Fifth process: Specify reaming using a ϕ30 reamer (T05).

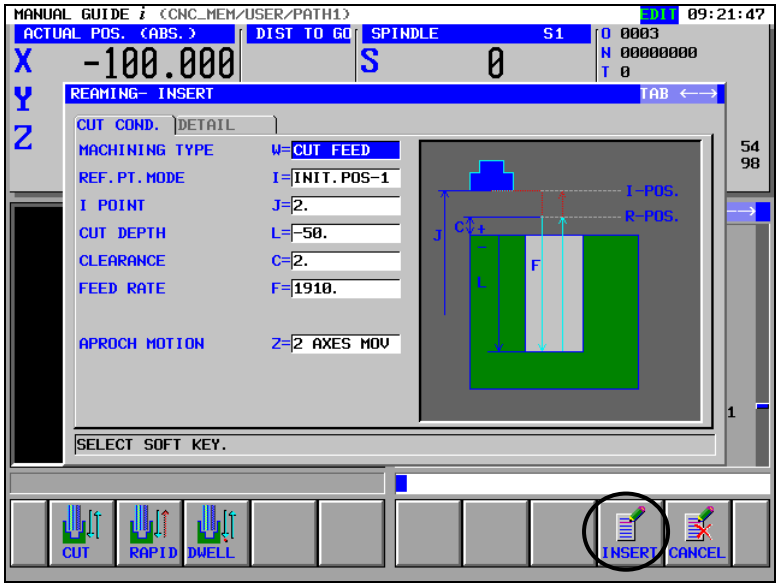
(1) Press the [CYCLE] soft key.



(2) Place the cursor on "4. REAMING" in the "HOLE MACH." tab, and press the [SELECT] soft key or the <INPUT> key on the operator's panel.

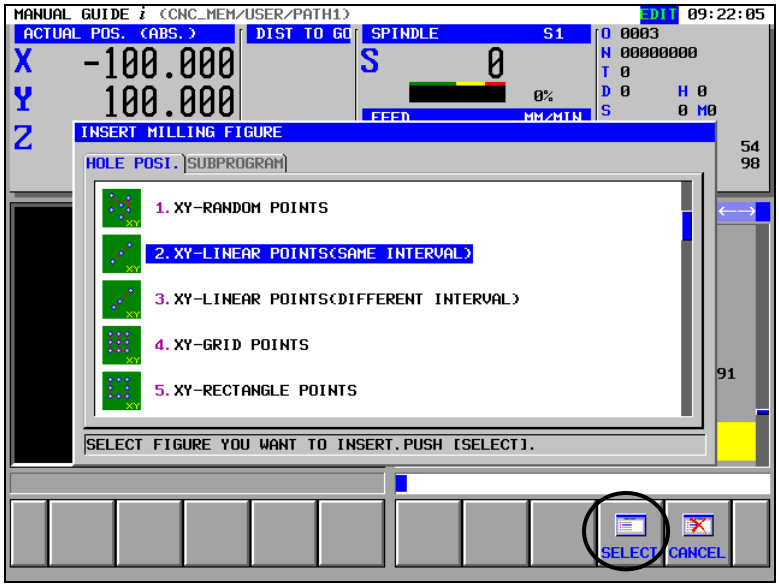


(3) In the "CUT COND." tab, enter data in each field.

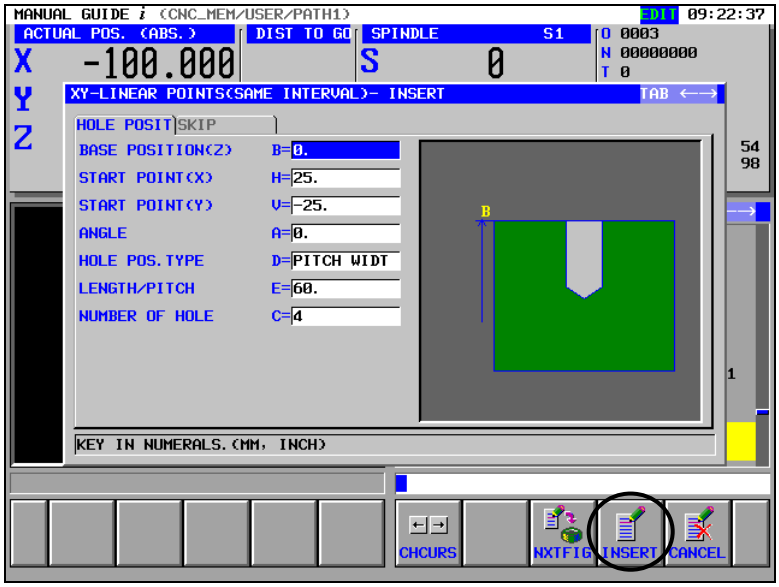


(4) Press the [INSERT] soft key.
The reaming cycle is inserted into the program, and then the hole position selection window is displayed.

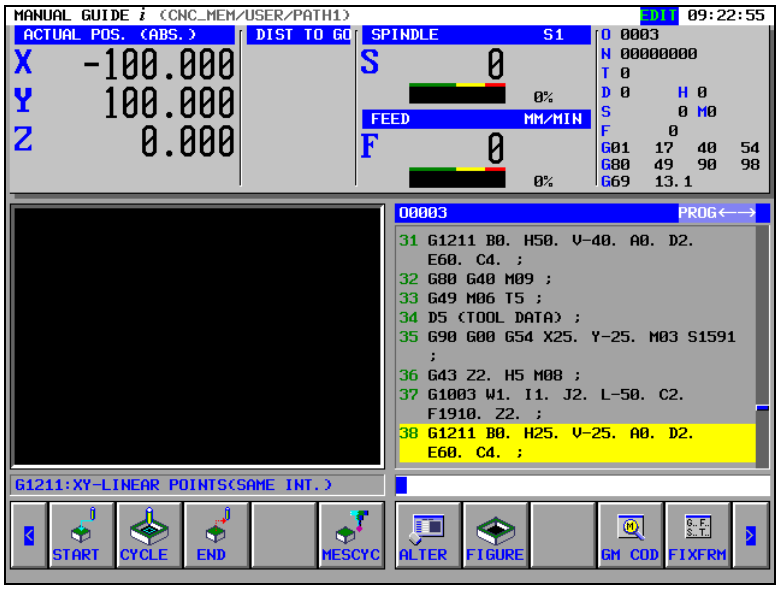
(5) Place the cursor on "2. XY-LINEAR POINTS(SAME INTERVAL)" in the "HOLE POSI." tab, and press the [SELECT] soft key or the <INPUT> key on the operator's panel.



(6) In the "HOLE POSIT" tab, enter data as shown below, and press the [INSERT] soft key.



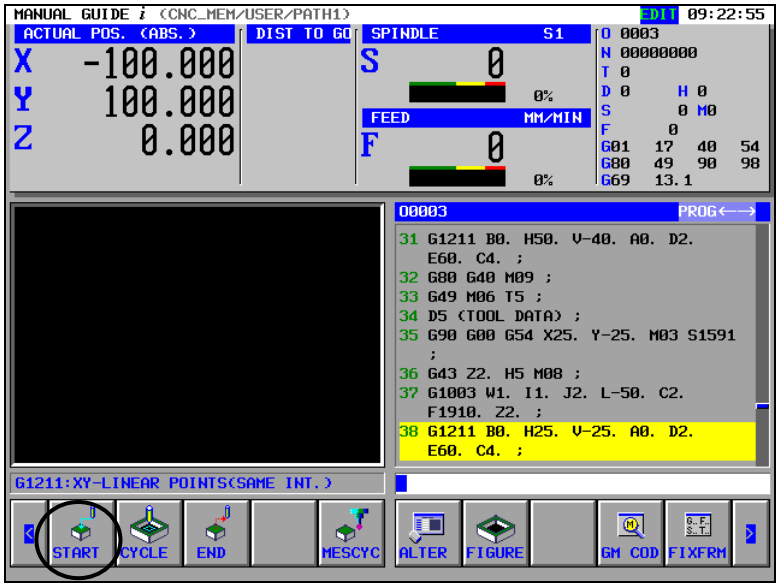
(7) The hole position block is inserted into the program.



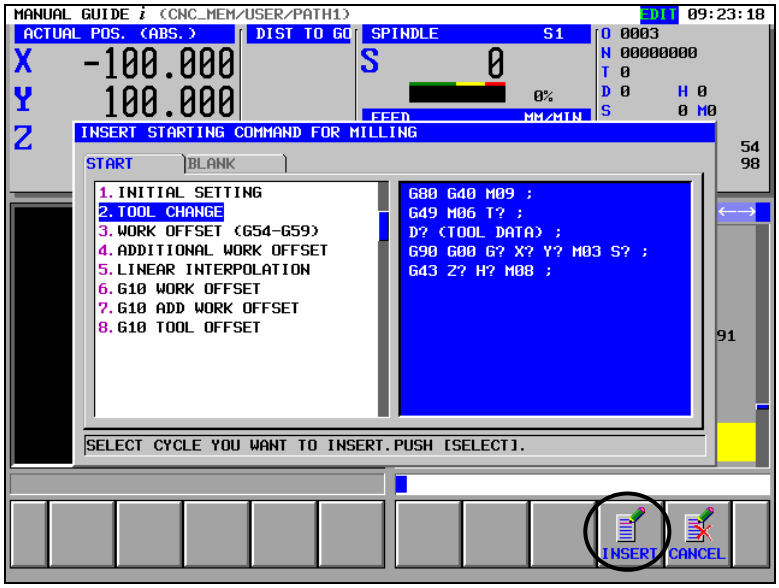
37.4.3.9 Sixth Process (Tapping) Input

(1) Tool change/Spindle rotation/Approach motion

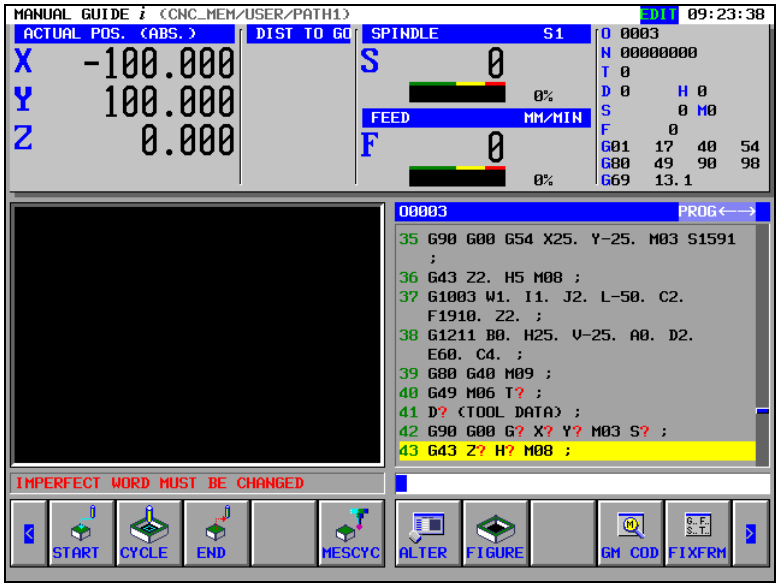
(1) Press the [>] soft key on the right end several times until the screen displays the soft keys shown below.
(2) Press the [START] soft key.



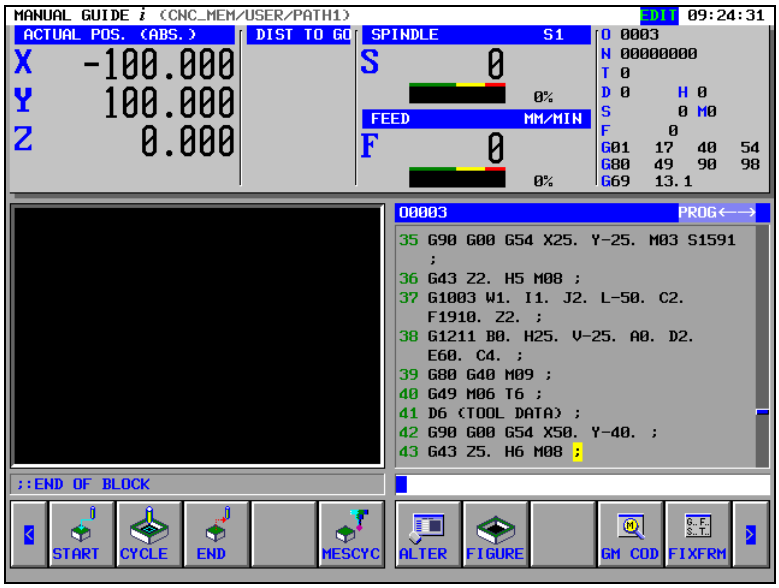
(3) Place the cursor on "2. TOOL CHANGE" in the "START" tab, and press the [INSERT] soft key or the <INPUT> key on the operator's panel.



(4) The selected fixed form sentence is inserted. Undecided values are represented by "?", as shown below.



(5) Place the cursor on an address for which "?" is displayed, enter a value, and then press the <ALTER> key on the operator's panel. For example, place the cursor on "T?", and enter "6" and press <ALTER>. Doing so inputs tool number "T6". (Address "T" does not need to be input.) Since spindle rotation is not specified for tapping, delete "M03" and "S?".
After entering data, return the cursor to the EOB position at the end of the program.



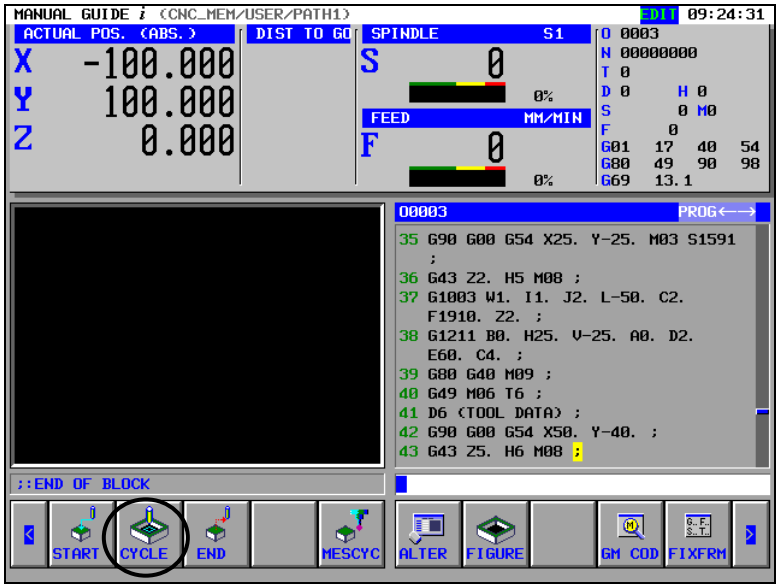
SUPPLEMENT

In the screen shown above, "D6" on the 41st line of the program is a tool compensation number (see Subsection 37.4.3.1). For "G?" on the 42nd line, workpiece coordinate system "G54" is input.

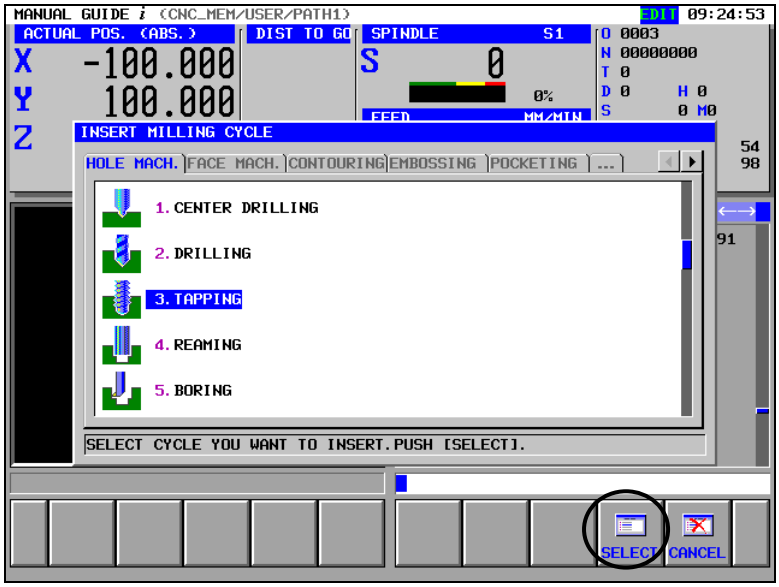
(2) Machining Operation

Sixth process: Specify tapping using an M20 tap (T06).

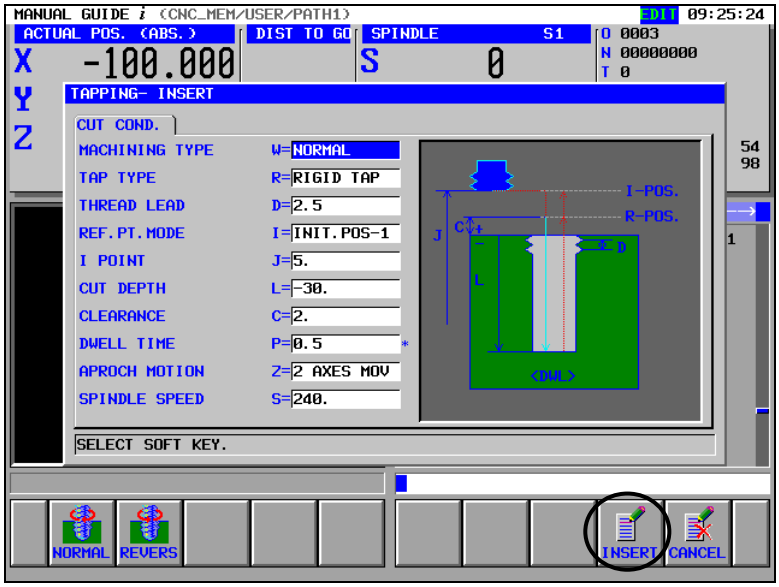
(1) Press the [CYCLE] soft key.



(2) Place the cursor on "3. TAPPING" in the "HOLE MACH." tab, and press the [SELECT] soft key or the <INPUT> key on the operator's panel.



(3) In the "CUT COND." tab, enter data in each field.

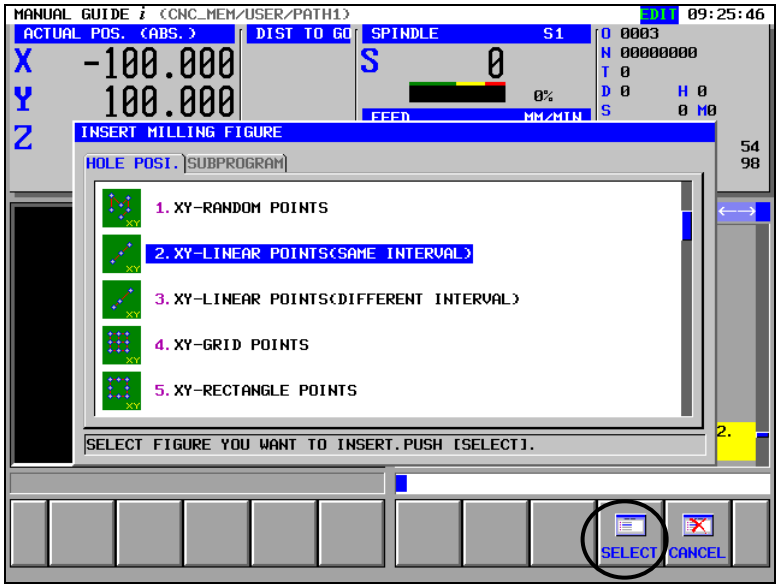


SUPPLEMENT

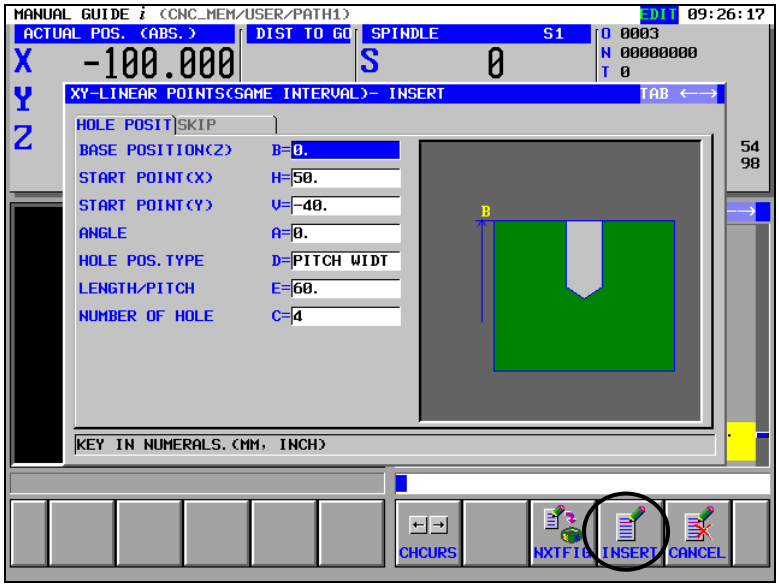
For some data items, "*" is displayed to the right of their input fields. If the user does not fill in the input field, a standard value is automatically set.

(4) Press the [INSERT] soft key.
The tapping cycle is inserted into the program, and then the hole position selection window is displayed.

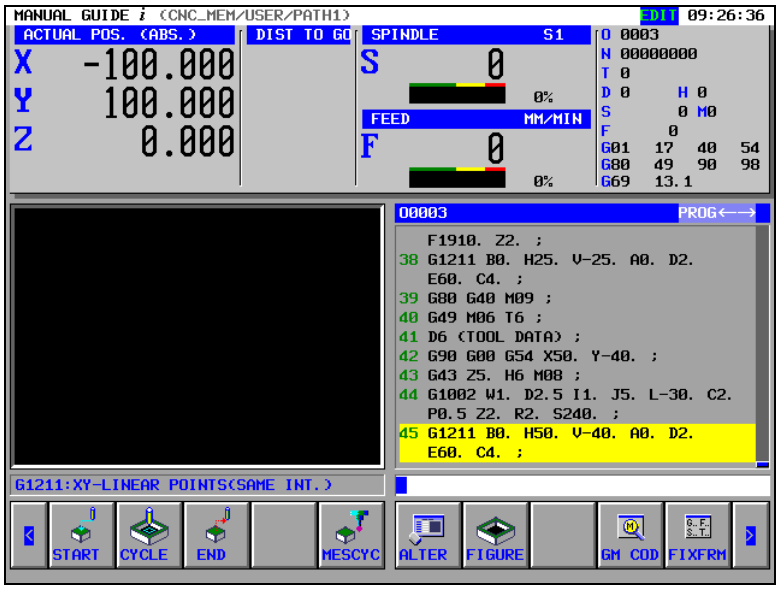
(5) Place the cursor on "2. XY-LINEAR POINTS(SAME INTERVAL)" in the "HOLE POSI." tab, and press the [SELECT] soft key or the <INPUT> key on the operator's panel.



(6) In the "HOLE POSIT" tab, enter data as shown below, and press the [INSERT] soft key.

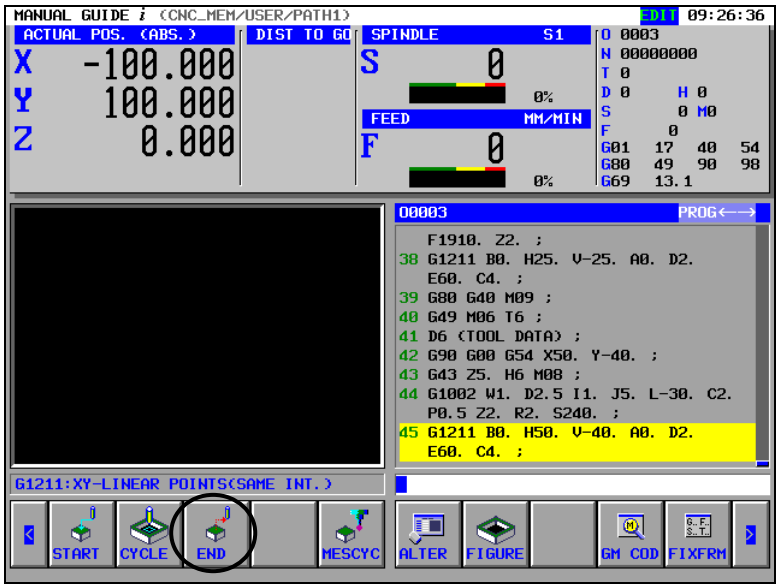


(7) The hole position block is inserted into the program.

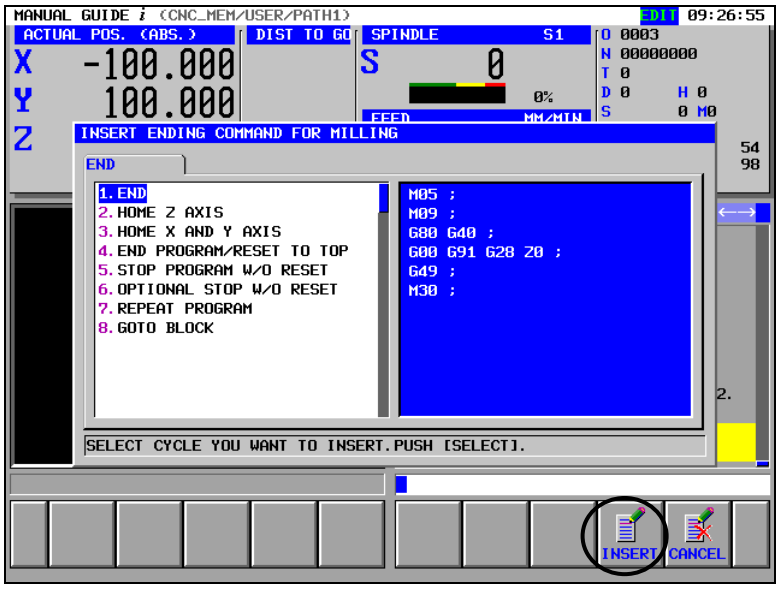


37.4.3.10 End Processing Input

(1) Press the [END] soft key.



(2) Place the cursor on "1. END", and press the [INSERT] soft key or the <INPUT> key on the operator's panel.

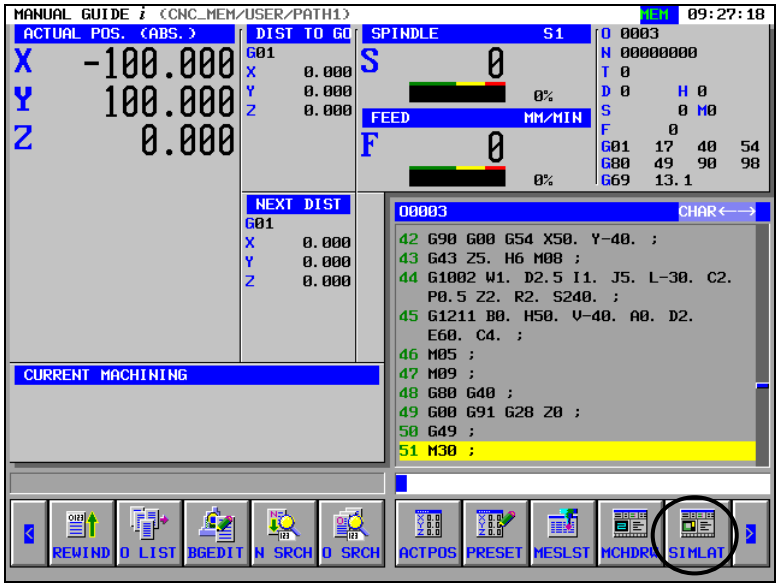


(3) The end operation is inserted. This completes the program.

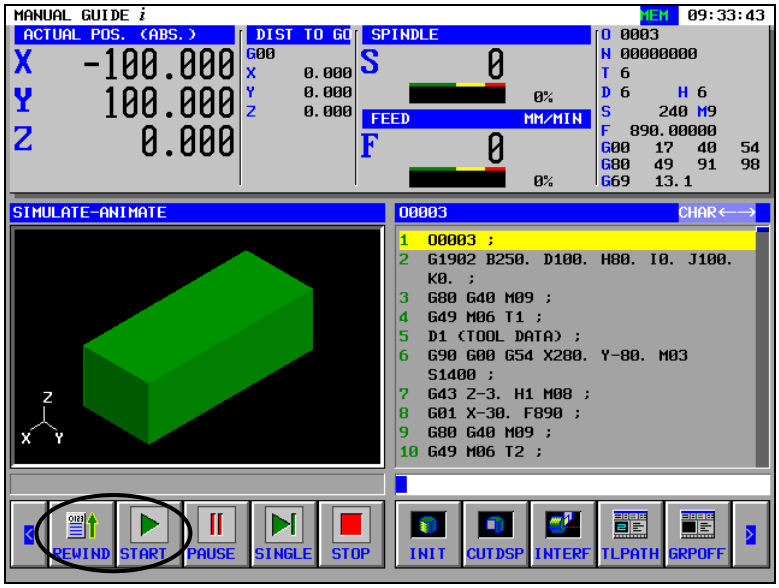
37.4.3.11 Program Check

(1) Press on the operator's panel, and select the MEM mode.

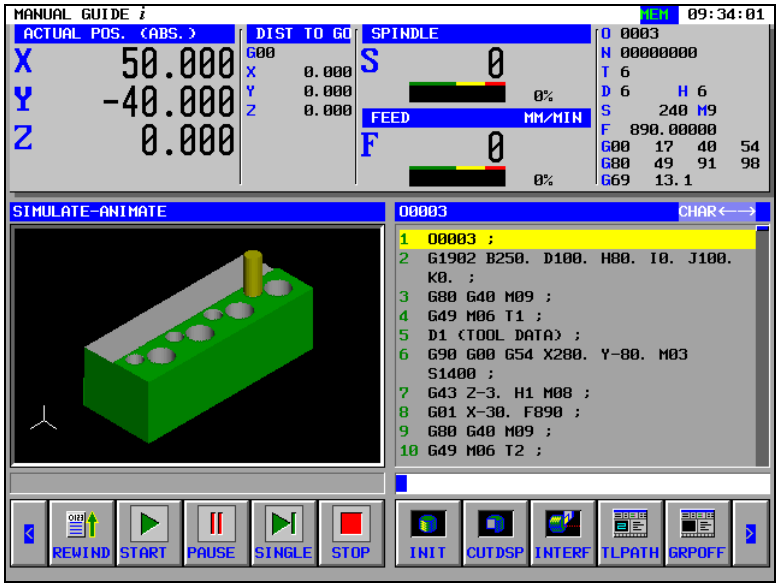
(2) Press the [SIMLAT] soft key.



(3) Next, press the [REWIND] soft key and then the [START] soft key.



(4) Simulation starts. An animation lets you check how machining is performed.



38 ELECTRIC POWER CONSUMPTION MONITOR

38.1 OVERVIEW

The ELECTRIC POWER CONSUMPTION MONITOR displays power consumed by the ROBODRILL with numeric values and as a graph. It can also measure power consumed during a certain period. Measured power consumption data is saved in the CNC and can be output to a memory card.

SUPPLEMENT

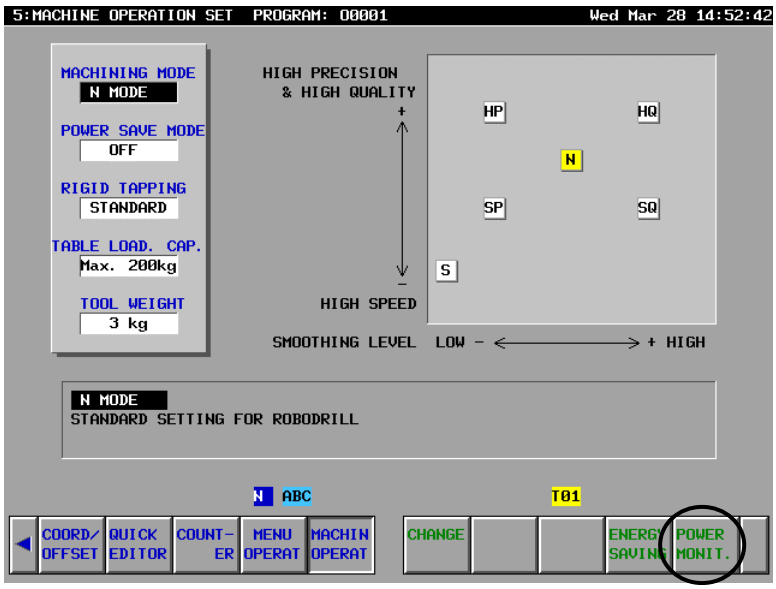
- When using additional axis control, set parameters appropriate for the additional axis motor and amplifier you use (see Subsection 38.7.2, “Additional Axis Parameters”).

38.2 ELECTRIC POWER CONSUMPTION SCREEN

38.2.1 Displaying the ELECTRIC POWER CONSUMPTION Screen

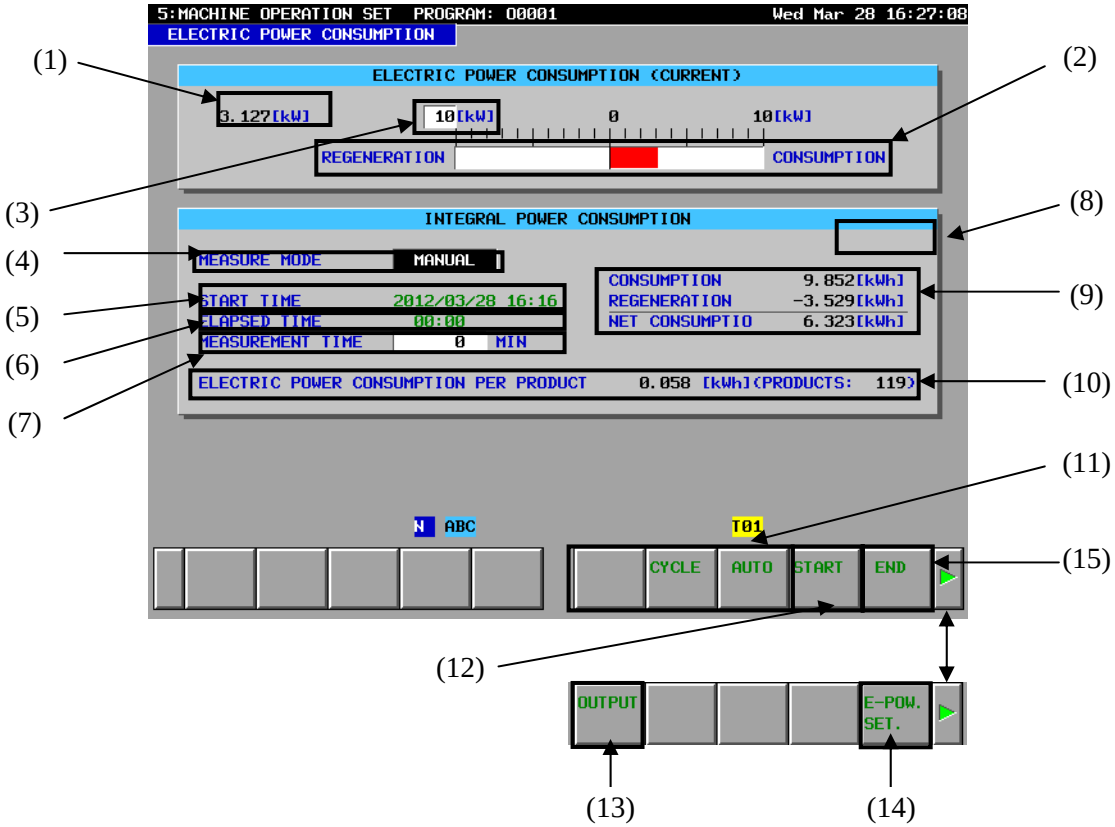
The ELECTRIC POWER CONSUMPTION screen can be displayed using the procedure below:

(1) Display the QUICK screen. Pressing the [MACHIN OPERAT] soft key and display "5.MACHINE OPERATION SET" screen.
(2) Pressing the [POWER MONIT.] soft key displays the “ELECTRIC POWER CONSUMPTION” screen shown below.



38.2.2 Detail of the ELECTRIC POWER CONSUMPTION Screen

The ELECTRIC POWER CONSUMPTION screen consists of the following items:



(1) ELECTRIC POWER CONSUMPTION (CURRENT)
The power currently consumed by the ROBODRILL is displayed.

(2) Current power consumption graph
The power currently consumed by the ROBODRILL is displayed as a graph. The power consumption is displayed rightward from the position of 0 in red. The regenerative power is displayed leftward in green.

(3) Maximum value in the current power consumption graph
The maximum value in the current power consumption graph is displayed. Positioning the cursor and entering a numeric value changes the maximum value.
(Valid setting range: 1 to 100 [kW])

(4) MEASURE MODE
The selected integral measurement mode is displayed. Positioning the cursor and pressing a soft key selects one of the following integral measurement modes:

- Manual mode: The measurement of the integral power consumption is started/stopped manually.
- 1-cycle mode: The integral power consumption during one program cycle is measured.
- Auto mode: At power-on, the measurement of the integral power consumption is automatically started.

For details of each integral measurement mode, see Section 38.3, “INTEGRAL MEASUREMENT MODES.”

(5) START TIME
The date and time when the measurement of the integral power consumption started are displayed.

(6) ELAPSED TIME
The elapsed time after the measurement of the integral power consumption started is displayed.

(7) MEASUREMENT TIME/RESET TIME
The measurement time is displayed when the manual mode is selected. The reset time setting is displayed when the auto mode is selected. Nothing is displayed when the 1-cycle mode is selected. Positioning the cursor and entering a numeric value sets the measurement time or reset time. For details of the measurement time and reset time, see Section 38.3, “INTEGRAL MEASUREMENT MODES.”

(8) “MEASURING” display
During the measurement of the integral power consumption, “MEASURING” is displayed in this position.

(9) Integral power consumption
The measured integral power consumption, regenerative power, and net power consumption are displayed.

(10) ELECTRIC POWER CONSUMPTION PER PRODUCT/PRODUCTS
The number of produces machined during the measurement of the integral power consumption and the power consumed by machining one product are displayed. For details, see Section 38.4, “ELECTRIC POWER CONSUMPTION PER PRODUCT.”

(11) Soft keys for selecting integral measurement modes
When the measurement of the integral power consumption is stopped, positioning the cursor on “MEASURE MODE” displays the soft keys corresponding to the modes that are not selected. Pressing these soft keys change the integral measurement mode.

(12) [START]/[STOP] soft key
When the measurement of the integral power consumption is stopped, the [START] soft key is displayed. During the measurement of the integral power consumption, the [STOP] soft key is displayed. These soft keys start and stop the measurement of the integral power consumption (when the 1-cycle mode is selected, the [START] soft key is not displayed).

(13) [OUTPUT] soft key
Pressing the rightmost soft key [>] displays the [OUTPUT] soft key. The [OUTPUT] soft key outputs integral power consumption data saved in the CNC to a memory card. For details, see Subsection 38.5.2, “Outputting Integral Power Consumption Data”

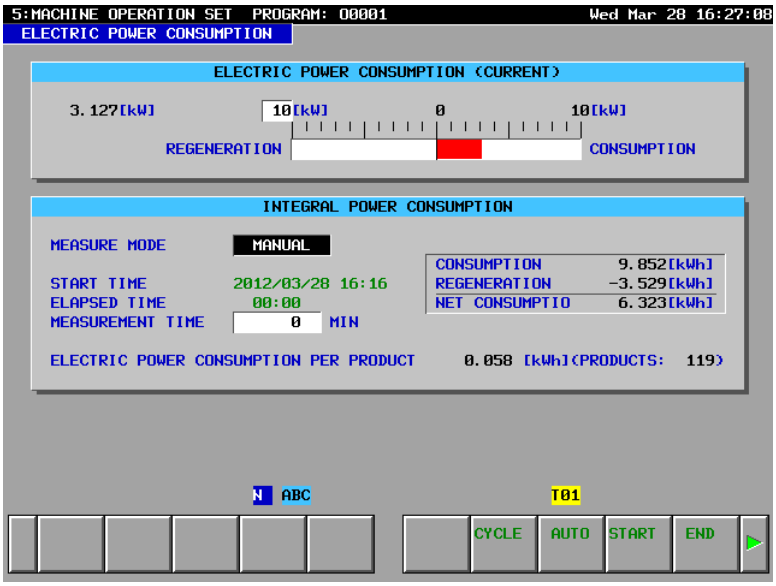
(14) [E-POW. SET] soft key
Pressing the rightmost soft key [>] displays the [E-POW. SET] soft key. The [E-POW. SET] soft key displays the ELECTRIC POWER CONSUMPTION window, which is used to make settings about displaying of the power consumption of units other than ROBODRILL standard options or external units such as a mist collector when the unit is connected. For details, see Section 38.6, "ELECTRIC POWER CONSUMPTION SETTING WINDOW".

(15) [END] soft key
The [END] soft key terminates ELECTRIC POWER CONSUMPTION screen and displays the MACHINE OPERATION SET screen.

38.3 INTEGRAL MEASUREMENT MODES

38.3.1 Manual Mode

In the manual mode, the measurement of the integral power consumption is started or stopped by pressing the [START] or [STOP] soft key. You can set a value for “MEASUREMENT TIME” to measure the integral power consumption from the start of the measurement until the set time has elapsed.



38.3.1.1 Setting the Measurement Time

Positioning the cursor on “MEASUREMENT TIME” and entering a numerical value set the time for measuring the integral power consumption. You can set a measurement time between 0 and 1440 (= 24 hours) in minutes.

SUPPLEMENT
When the measurement time setting is 0, measurement is stopped 24 hours after the start of the measurement.

38.3.1.2 Measurement start/stop conditions

<Measurement start condition>

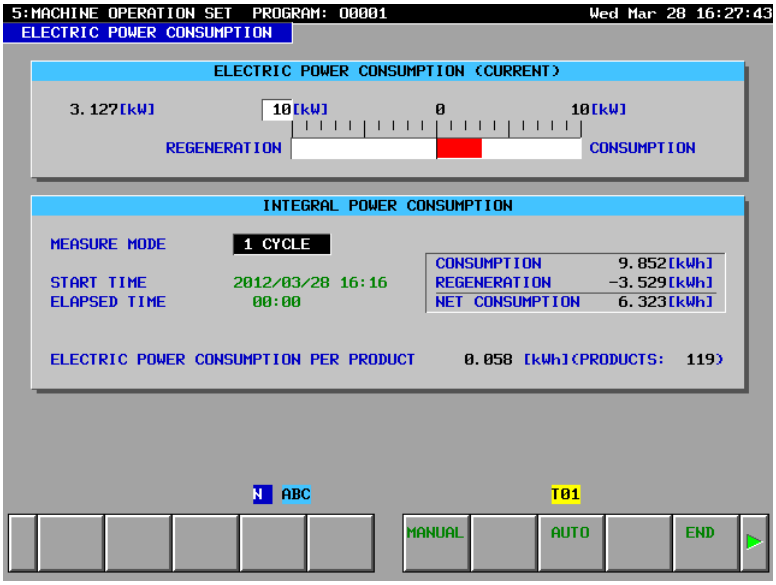
- The [START] soft key is pressed.

<Measurement stop conditions>

- The [STOP] soft key is pressed.
- The set “MEASUREMENT TIME” has elapsed.
- From the start of measurement, 24 hours have elapsed.

38.3.2 1-Cycle Mode

In the 1-cycle mode, the power consumed during one program cycle is measured. In this mode, the [START] soft key is not displayed.



38.3.2.1 Measurement start/stop conditions

<Measurement start condition>

- The program starts.

<Measurement stop conditions>

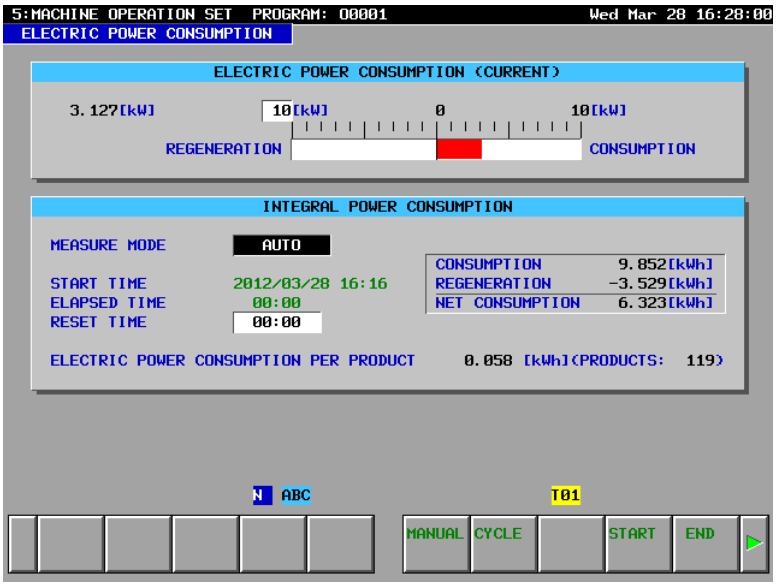
- The program is terminated by the M02 or M30 command.
- The CNC enters the reset state.
- The [STOP] soft key is pressed.

SUPPLEMENT

- When the mode is changed to the 1-cycle mode after the program starts, the measurement of the integral power consumption is not started. Next time the program starts, measurement is started.
- In the following conditions, the measurement of the integral power consumption is not stopped:
  - The program is stopped by the M00 or M01 command.
  - M99 is specified.
  - The program enters the feed hold or stopped state by the STOP button on the operator's panel or operation mode change.

38.3.3 Auto Mode

In the auto mode, the measurement of the integral power consumption is automatically started at power-on. Setting a value for “RESET TIME” resets the integral power consumption at the predetermined time.



38.3.3.1 Setting the Reset Time

Positioning the cursor on “RESET TIME” and entering a numerical value set the time when the integral power consumption is reset. To set the reset time, enter a time from 00:00 to 23:59 with a 4-digit number (for example, to set 8:30 a.m., enter 0830 using the numeric keypad on the operator’s panel and press the <INPUT> key).
At the reset time, the following processing is automatically performed and measurement is restarted:

- Saves integral power consumption data (see Section 38.5, “SAVING AND OUTPUTTING INTEGRAL POWER CONSUMPTION DATA”).
- Clears the integral power consumption, regenerative power, net power consumption, power consumption per product, and number of products.
- Set the measurement start time again and clears the elapsed time.

38.3.3.2 Measurement start/stop conditions

<Measurement start conditions>

- The power is turned on.
- The [START] soft key is pressed.

<Measurement stop condition>

- The [STOP] soft key is pressed.

38.4 ELECTRIC POWER CONSUMPTION PER PRODUCT

The number of products machined during the measurement of the integral power consumption can be counted to calculate and display the power consumed by machining one product.
The number of products is counted in the following conditions:

- M02 or M30 (program end) is specified.
- M91 (product control counter 1 count up) or M92 (product control counter 2 count up) is specified.

The number of products is reset to 0 at the start of the measurement of the integral power consumption.

SUPPLEMENT
- The maximum number of countable products is 9999.
- If the number of products exceeds 9999, the power consumption per product is not displayed precisely.

38.5 SAVING AND OUTPUTTING INTEGRAL POWER CONSUMPTION DATA

Measured integral power consumption data is stored in the CNC memory and can be output to a memory card.

38.5.1 Saving of Integral Power Consumption Data

Integral power consumption data is automatically saved into the CNC memory in the following conditions:

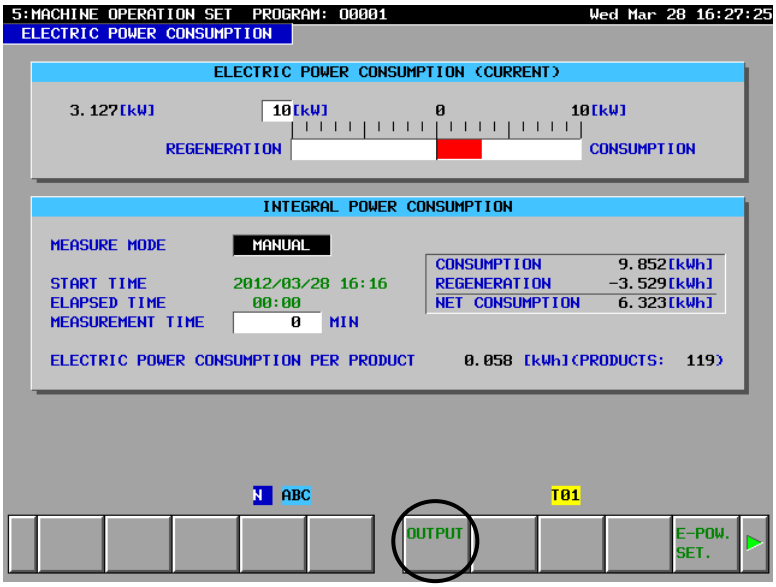
- The measurement of the integral power consumption stops.
- The integral power consumption is reset (when the auto mode is selected).
- The power is turned off during the measurement of the integral power consumption (at the next power-on).

SUPPLEMENT
Up to 101 data items are saved. When the number of data items exceeds 101, the oldest data is deleted sequentially.

38.5.2 Outputting Integral Power Consumption Data

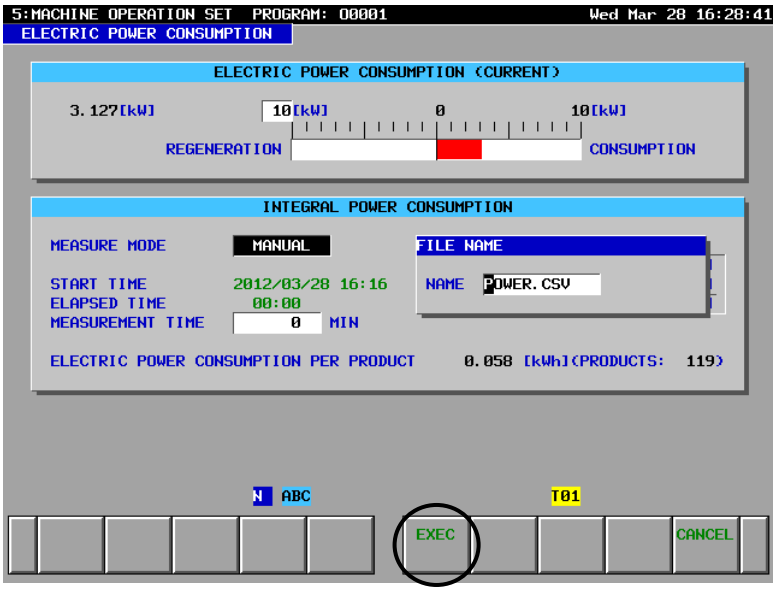
To output saved integral power consumption data to a memory card or USB memory

(1) Press the rightmost soft key [>] to display the [OUTPUT] soft key.
(2) Press the [OUTPUT] soft key.



(3) When either a memory card or USB memory is connected, the connected medium is automatically selected. When both of them are connected, select the medium to which the data is output by pressing one of the following soft keys that appear.

(4) The FILE NAME window is displayed. Enter an output file name (initial value is "POWER.CSV").



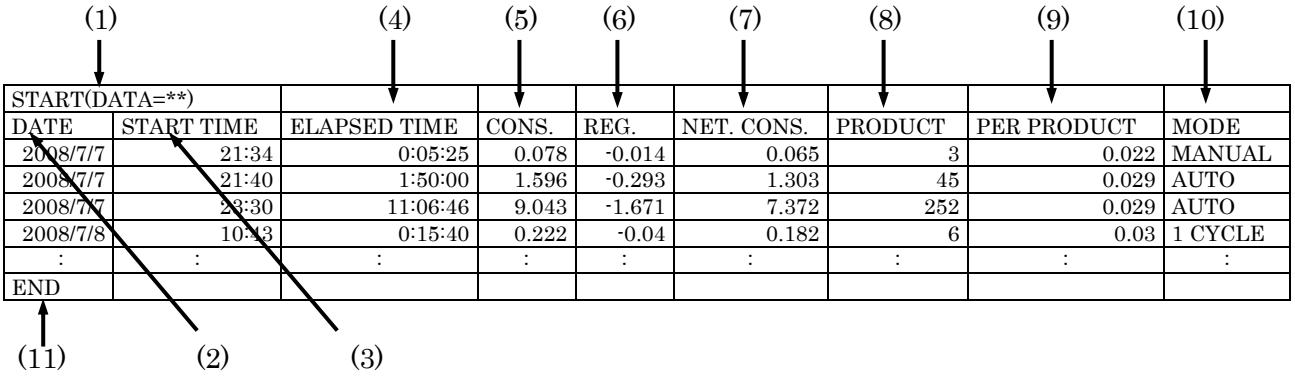
(5) To output data, press the [EXEC] soft key. To cancel output, press the [CANCEL] soft key.
(6) When the [EXEC] soft key is pressed, a file having the name entered in (3) is created in the memory card or USB memory and integral power consumption data is output.

SUPPLEMENT

- If no integral power consumption data is saved, “NO DATA” is displayed and the FILE NAME window is not displayed.
- If the memory card contains a file having the same name, “FILE ALREADY EXIST” is displayed and data is not output.
- Integral power consumption data is kept saved in the CNC after output to a memory card. When keep relay K52#6 is set to 1, integral power consumption data saved in the CNC is all deleted after data is output to a memory card.

38.5.3 Format of Integral Power Consumption Data

Integral power consumption data is output to a memory card in the following format.



START(DATA=**)								
DATE	START TIME	ELAPSED TIME	CONS.	REG.	NET. CONS.	PRODUCT	PER PRODUCT	MODE
2008/7/7	21:34	0:05:25	0.078	-0.014	0.065	3	0.022	MANUAL
2008/7/7	21:40	1:50:00	1.596	-0.293	1.303	45	0.029	AUTO
2008/7/7	23:30	11:06:46	9.043	-1.671	7.372	252	0.029	AUTO
2008/7/8	10:43	0:15:40	0.222	-0.04	0.182	6	0.03	1 CYCLE
:	:	:	:	:	:	:	:	:
END								

(1) START(DATA=)**
Written at the beginning of output data. The number following “DATA=“ indicates the number of output integral power consumption data items.

(2) DATE
Date when the measurement of the integral power consumption started

(3) START TIME
Time when the measurement of the integral power consumption started

(4) ELAPSED TIME
Time during which the integral power consumption is measured

(5) CONS. (CONSUMPTION)
Integral power consumption (Unit: kWh)

(6) REG. (REGENARATION)
Integral regenerative power (Unit: kWh)

(7) NET. CONS. (NET CONSUMPTION)
Net integral power consumption (sum of integral power consumption and integral regenerative power (Unit: kWh)

(8) PRODUCT
Number of products machined during the measurement of the integral power consumption

(9) PER PRODUCT
Integral power consumption per product (Unit: kWh)

(10) MODE
Integral measurement mode selected when data was saved

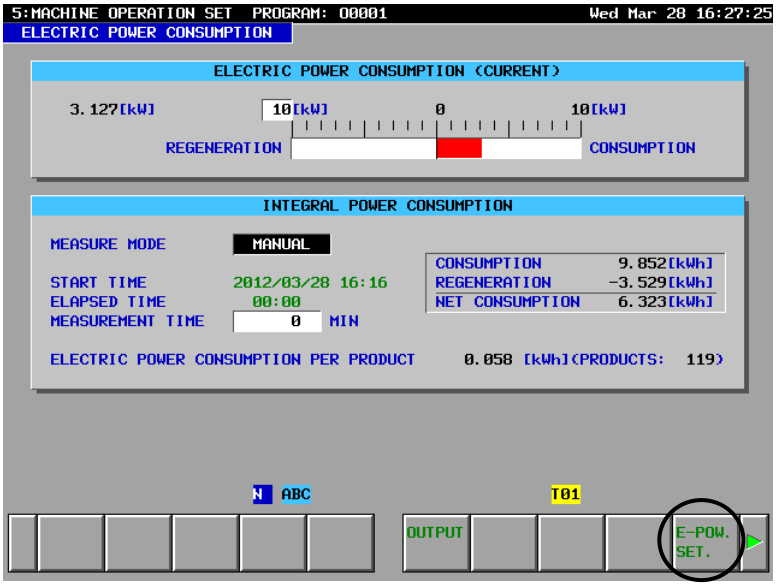
(11) END
Written at the end of output data

38.6 ELECTRIC POWER CONSUMPTION SETTING WINDOW

The ELECTRIC POWER CONSUMPTION MONITOR calculates and displays the power consumption of units (such as the coolant pump and internal light) prepared as options of the ROBODRILL as well as the power consumption of the servo motor and spindle motor.
Depending on the type of machining, however, units different from those prepared as options or units not prepared as options may be used.
In such a case, if the power consumption of units to be used is set in the electric power consumption setting window, the power consumption of the units can be calculated and displayed on the screen.

38.6.1 How to Display the Electric Power Consumption Setting Window

(1) Press the rightmost soft key [>] to display the [E-POW. SET] soft key.

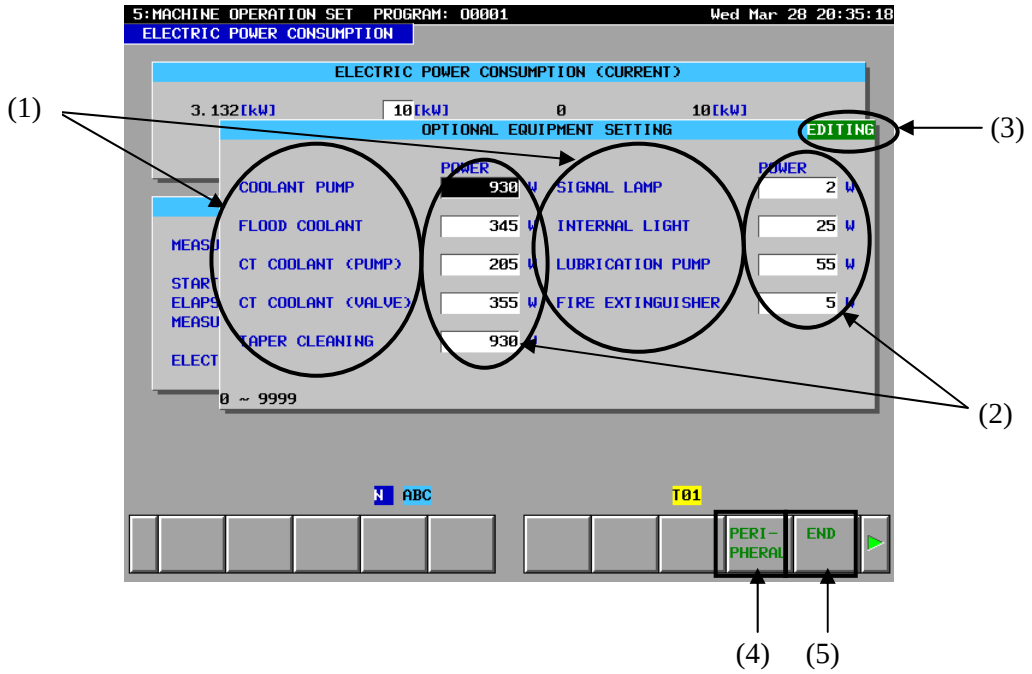


(2) Press the [E-POW. SET] soft key. The electric power consumption setting window appears.
The electric power consumption setting window consists of two windows: the OPTIONAL EQUIPMENT SETTING window and the PERIPHERAL EQUIPMENT SETTING window.
The [PERIPHERAL] and [OPTIONAL] soft keys can be used to switch between these windows.

38.6.2 OPTIONAL EQUIPMENT SETTING Window

When units such as the coolant pump and internal light prepared as options of the ROBODRILL are replaced with non-standard units, the power consumption of the units can be changed.

38.6.2.1 Window configuration



(1) Names of optional units
The names of units prepared as options of the ROBODRILL are displayed. The names of units that are not used are indicated in gray.

(2) Power consumption of optional units
The power consumption of units to be used is displayed. The power consumption of the units that come standard is usually displayed.
To change the power consumption of the unit on which the cursor is placed, input a value using numeral keys of the operator's panel and press the <INPUT> key.

(3) Indication of "EDITING"
When an item of the OPTIONAL EQUIPMENT SETTING window or the PERIPHERAL EQUIPMENT SETTING window is being edited, "EDITING" is indicated.

(4) [PERIPHERAL] key
This item displays the PERIPHERAL EQUIPMENT SETTING window.

(5) [END] key
This item finishes editing and closes the electric power consumption setting window.

38.6.2.2 Optional units for which power consumption can be changed

In the OPTIONAL EQUIPMENT SETTING window, the power consumption of the following nine items can be changed.

(1) COOLANT PUMP
This item sets the amount of power consumed by the pump during discharging of coolant.

(2) FLOOD COOLANT
This item sets the amount of power consumed by the pump during discharging of machine cleaning coolant.

(3) CT COOLANT (PUMP)

(4) CT COOLANT (VALVE)
This item sets the amount of power consumed by the pump for center-through coolant.
The amount of power consumed to drive the pump can be set separately from the amount of power that increases or reduces during opening or closing of the valve.

(5) TAPER CLEANING
This item is set when the taper cleaning pump is used.
This item sets the amount of power consumed during taper cleaning.

(6) SIGNAL LAMP
This item sets the amount of power consumed when one signal lamp is on.

(7) INTERNAL LIGHT
This item sets the amount of power consumed when the internal light is on.

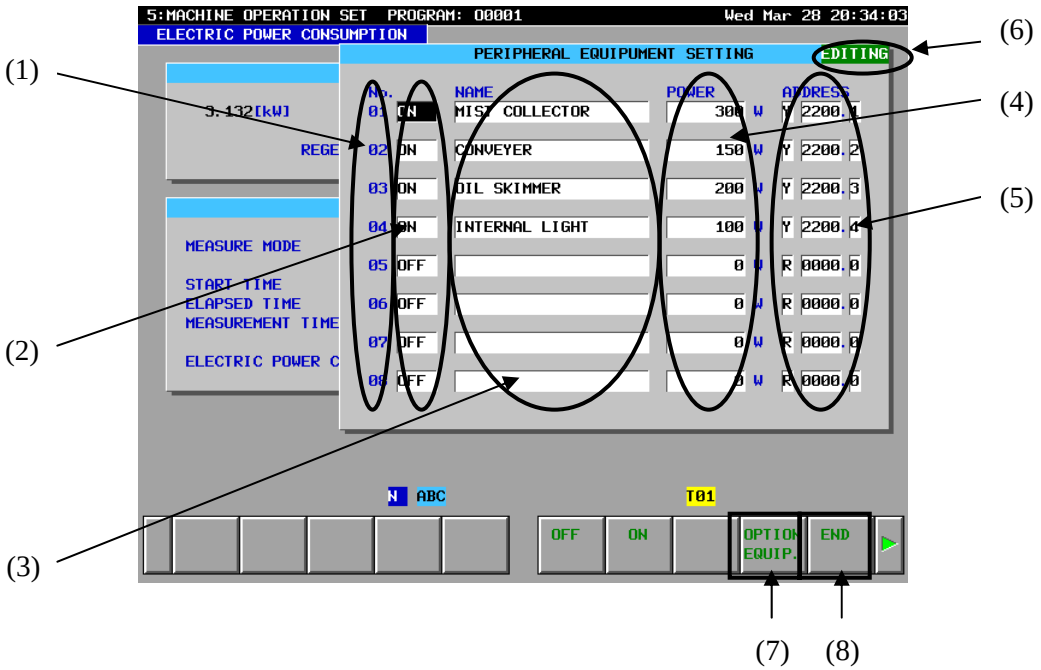
(8) LUBRICATION PUMP
This item sets the amount of power consumed by the pump during lubrication with oil or grease.

(9) FIRE EXTINGUISHER
This item sets the amount of power consumed by the auto fire extinguisher during standby.

38.6.3 PERIPHERAL EQUIPMENT SETTING Window

When using units that are not options of the ROBODRILL, it is possible to calculate the power consumption of a maximum of eight peripheral units by setting the power consumption of the units and the addresses of the signals for turning on or off the units.

38.6.3.1 Window configuration



(1) Numbers of peripheral units

This item sets the number of the peripheral unit for which power consumption is calculated.
The power consumption can be calculated for a maximum of eight peripheral units.

(2) Enabling (ON) or disabling (OFF) the calculation of the power consumption of peripheral units

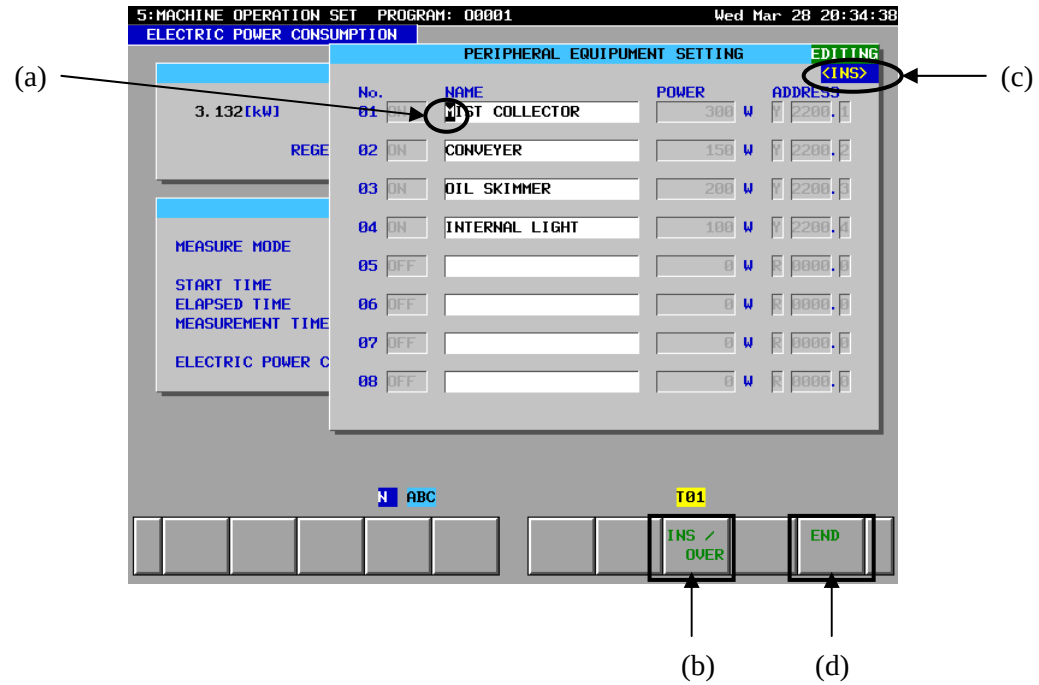
This item enables or disables the calculation of the power consumption of peripheral units.
Moving the cursor to the item displays the following soft keys.

[OFF] : Disables the calculation of the power consumption of the set peripheral unit.
[ON] : Enables the calculation of the power consumption of the set peripheral unit.

(3) Names of the peripheral units

This item sets the names of peripheral units.
Moving the cursor to the item displays the following soft keys.

Pressing the [EDIT NAME] soft key displays the following screen in which the names of peripheral units can be edited.



(a) Cursor
Characters can be entered in the position in which the cursor is located.
The cursor can be moved by the cursor keys of the operator's panel.

(b) [INS/OVER] key
This item changes the character input mode.
Pressing this soft key switches between insertion mode and overwrite mode.

(c) Input mode indication
The current input mode is indicated.

(d) [END] key
This item finishes editing the names of peripheral units.

(4) Power consumption of peripheral units
This item sets the power consumption of peripheral units.
To set it, enter a value with numeral keys of the operator's panel and press the <INPUT> key.
The range of valid values is between 0 to 9999, inclusive.

(5) Reference addresses
The item sets the addresses of signals for turning on or off peripheral units.
The power consumption is added when the signal corresponding the set address is on.

(a) Symbol of a reference address
Moving the cursor to the symbol of a reference address displays the following soft keys.

Pressing the [Y], [X], or [R] soft key sets the corresponding symbol.

(b) Number of a reference address

(c) Bit of a reference address
Entering a value with numeral keys of the operator's panel and pressing the <INPUT> key set the number and bit of the reference address for the item to which the cursor is moved.
The range of valid numbers is between 0 to 9999, inclusive; the range of valid bits is between 0 to 7, inclusive.

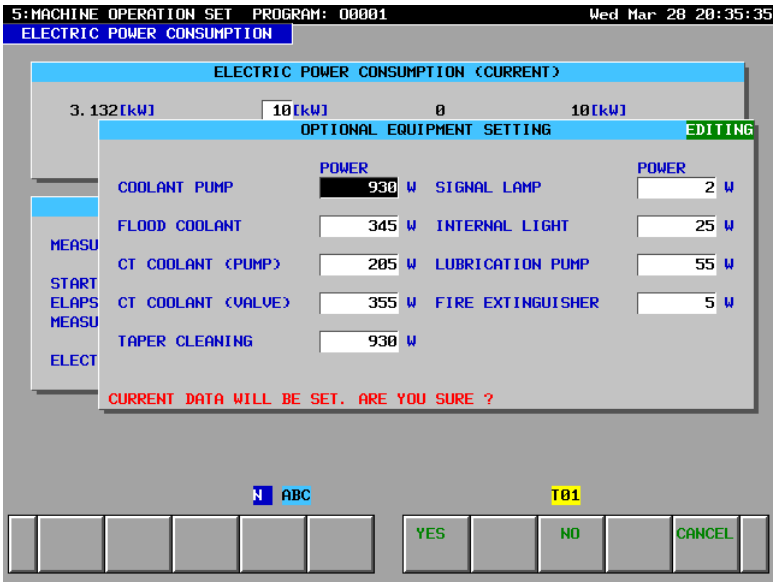
(6) Indication of "EDITING"
While an item of the OPTIONAL EQUIPMENT SETTING window or the PERIPHERAL EQUIPMENT SETTING window is edited, "EDITING" is indicated.

(7) [OPTION EQUIP.] key
This item displays the OPTIONAL EQUIPMENT SETTING window.

(8) [END] key
This item finishes editing and closes the electric power consumption setting window.

38.6.4 Finishing the Electric Power Consumption Setting Window

When "EDITING" appears during closing of the electric power consumption setting window with the [END] soft key, the message and soft keys are displayed as shown in the following screen.



[YES] : Saves changes and closes the window.
[NO] : Closes the window without saving changes.
[CANCEL] : Continues editing without closing the window.

38.6.5 Inputting and Outputting Set Power Consumption Data

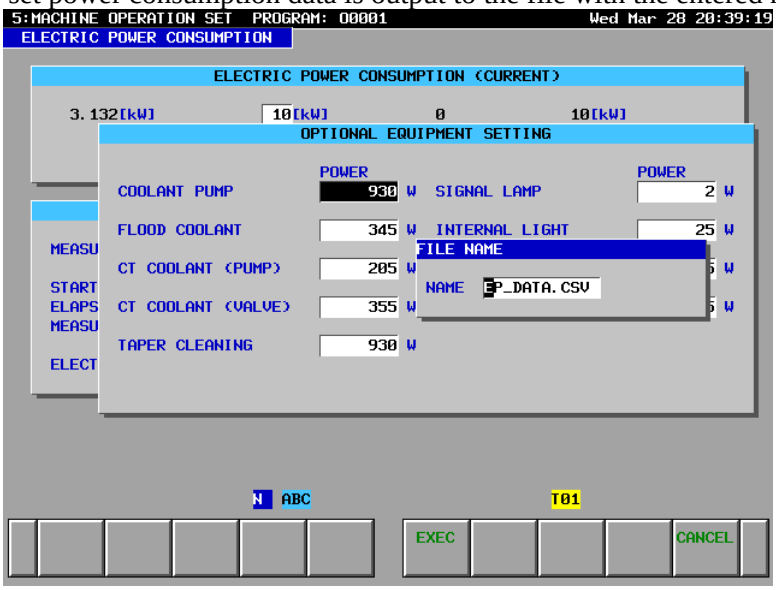
Data set in the electric power consumption setting window can be output to an external unit or data can be input from an external unit to the POWER CONSUMPTION SETTING window.

38.6.5.1 Outputting set power consumption data

(1) Press the rightmost soft key ▷ to shift to next soft key group. The following soft keys are displayed.

(2) Press the [OUTPUT] soft key.
(3) When either a memory card or a USB memory is mounted, the mounted memory medium is automatically selected. When both of them are mounted, select the destination memory using the following soft keys that appear.

(4) The FILE NAME window appears. Enter the name of the destination file and press the [EXEC] soft key. The set power consumption data is output to the file with the entered name.



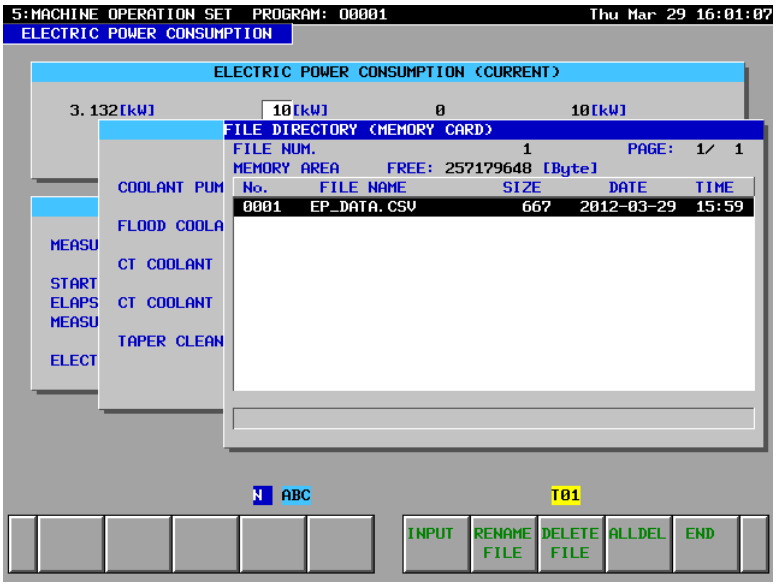
SUPPLEMENT

1 If the [OUTPUT] soft key is pressed when "EDITING" appears, a message stating "CURRENT DATA WILL BE SET. ARE YOU SURE ?" and soft keys [YES], [NO], and [CANCEL] are displayed. Press [YES] to save changes and output data, press [NO] to output data without saving changes, or press [CANCEL] to stop outputting data and continue editing.
2 The default output file name is "EP_DATA.CSV".

38.6.5.2 Entering set power consumption data

(1) Press the rightmost soft key [>] to shift to the next soft key group. The following soft keys are displayed.

(2) Press the [MEMORY CARD] or [USB MEMORY] soft key. A list of the selected memory media appears.

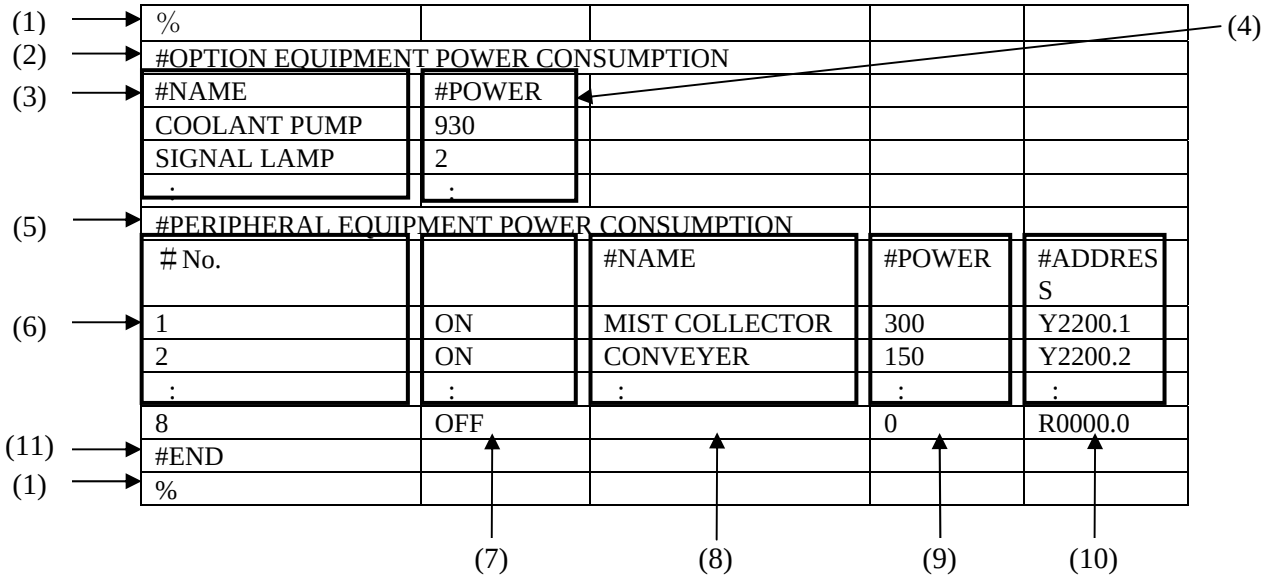


(3) Move the cursor to the destination file and press the [INPUT] soft key. The data listed is input to the file.

38.6.5.3 Format of set power consumption data

Set power consumption data is output in the following format. Data in the following format can be set in the electric power consumption setting window.

SUPPLEMENT
The following shows an example of opening an output file with spreadsheet software such as EXCEL. When an output file is opened in the text format, cells are separated by commas.



	%				
	#OPTION EQUIPMENT POWER CONSUMPTION				
	#NAME	#POWER			
	COOLANT PUMP	930			
	SIGNAL LAMP	2			
	:	:			
	#PERIPHERAL EQUIPMENT POWER CONSUMPTION				
	#No.		#NAME	#POWER	#ADDRESS
	1	ON	MIST COLLECTOR	300	Y2200.1
	2	ON	CONVEYER	150	Y2200.2
	:	:	:	:	:
	8	OFF		0	R0000.0
	#END				
	%				

(1) %
Data is preceded and followed by %.

(2) "#OPTION EQUIPMENT POWER CONSUMPTION"
The data between this item and "#PERIPHERAL EQUIPMENT POWER CONSUMPTION" is set in the OPTIONAL EQUIPMENT SETTING window.

(3) Names of optional units (OPTIONAL EQUIPMENT SETTING window)
This item indicates the names of units for which the power consumption can be set in the OPTIONAL EQUIPMENT SETTING window. Units should be described as described below.

Indication in the window	Indication in the output file
COOLANT PUMP	COOLANT PUMP
FLOOD COOLANT	FLOOD COOLANT
CT COOLANT (PUMP)	CT COOLANT (PUMP)
CT COOLANT (VALVE)	CT COOLANT (VALVE)
TAPER CLEANING	TAPER CLEANING
SIGNAL LAMP	SIGNAL LAMP
INTERNAL LIGHT	INTERNAL LIGHT
LUBRICATION PUMP	LUBRICATION PUMP
FIRE EXTINGUISHER	FIRE EXTINGUISHER

(4) Power consumption of optional units (OPTIONAL EQUIPMENT SETTING window)
This item indicates the power consumption (W) of units that can be set in the OPTIONAL EQUIPMENT SETTING window.

(5) "#PERIPHERAL EQUIPMENT POWER CONSUMPTION"
The data between this item and "END" is set in the PERIPHERAL EQUIPMENT SETTING window.

(6) Numbers of peripheral units (PERIPHERAL EQUIPMENT SETTING window)
This item indicates the numbers of units to be set in the PERIPHERAL EQUIPMENT SETTING window.

(7) Enabling or disabling the calculation of the power consumption of peripheral units (PERIPHERAL EQUIPMENT SETTING window)
This item specifies whether to enable or disable the calculation of power consumption for each of peripheral units with numbers listed. Set this item to ON when power consumption is calculated; set it to OFF when power consumption is not calculated.

(8) Names of peripheral units (PERIPHERAL EQUIPMENT SETTING window)
This item indicates the names of the peripheral units set in the PERIPHERAL EQUIPMENT SETTING window. The names consist of only alphanumerals of up to 20 half-size characters.

(9) Power consumption of peripheral units (PERIPHERAL EQUIPMENT SETTING window)
This item indicates the power consumption (W) of peripheral units that were set in the PERIPHERAL EQUIPMENT SETTING window.

(10) Addresses for checking whether peripheral units are ON or OFF (PERIPHERAL EQUIPMENT SETTING window)
This item indicates addresses for checking whether peripheral units are ON or OFF. Specify a number and bit, which are delimited by a period, after an address symbol.

(11) "#END"
This item finishes the input of set power consumption data.

38.7 RELATED PARAMETERS

38.7.1 PMC Parameters

Keep relay

	#7	#6	#5	#4	#3	#2	#1	#0
K52								

#7 The power consumption monitor function is:
0: not displayed.
1: displayed.

SUPPLEMENT
For the changes of this parameter to take effect, turn off and back on the power.

#6 After integral power consumption data is output to a memory card, it is:
0: Kept saved in the memory.
1: Cleared.

#5 At power-on, the result of the previous measurement of the integral power consumption is:
0: Not cleared.
1: Cleared.

38.7.2 Additional Axis Parameters

When using an additional axis, set parameters according to the values listed in the following tables.

Parameters determined by the type of motor

No. / Motor	No.2281		No.2468
	#1	#0	
β0.5/3000	1	1	3809
α1/3000	1	1	7086
α2/2000	1	1	9994
α2/3000	1	1	5652
α3/3000	1	0	2335
α6/2000	1	0	2662
α*i* F1/5000 (α1/5000*i*)	1	1	5734
α*i* F2/5000 (α2/5000*i*)	1	0	4506
α*i* S2/5000 (α2/5000*i*s)	1	0	5734
α*i* S4/5000 (α4/5000*i*s)	1	0	2499
α*i* F4/4000 (α4/4000*i*)	1	0	1638
α*i* F8/3000 (α8/3000*i*)	1	0	2089
D*i* S60/400	1	0	13844
D*i* S85/400	1	0	5304
D*i* S110/300	1	0	3277
D*i* S150/300	1	0	7373
D*i* S260/300	1	0	1905
DDR	1	0	1905

SUPPLEMENT

Re-setting additional-axis parameters on the QUICK screen causes the parameters suitable for the motor to use to be set automatically.

Parameters determined by the type of amplifier

Amplifier / No.		No. 2469	No. 2490
α*i*SV20	4 (B) axis	832	397
α*i*SV40	4 (B) axis	832	339
α*i*SV80	4 (B) axis	832	352
α*i*SV20/20	4 (B) axis	608	397
	5 (A) axis	608	397
α*i*SV20/40	4 (B) axis	608	397
	5 (A) axis	608	339
α*i*SV40/40	4 (B) axis	672	339
	5 (A) axis	672	339
α*i*SV40/80	4 (B) axis	672	339
	5 (A) axis	672	352
α*i*SV80/80	4 (B) axis	672	352
	5 (A) axis	672	352

SUPPLEMENT

If the amplifier configuration in use is non-standard, it is likely that re-setting additional-axis parameters in the QUICK screen may result in no normal parameter setting being made.

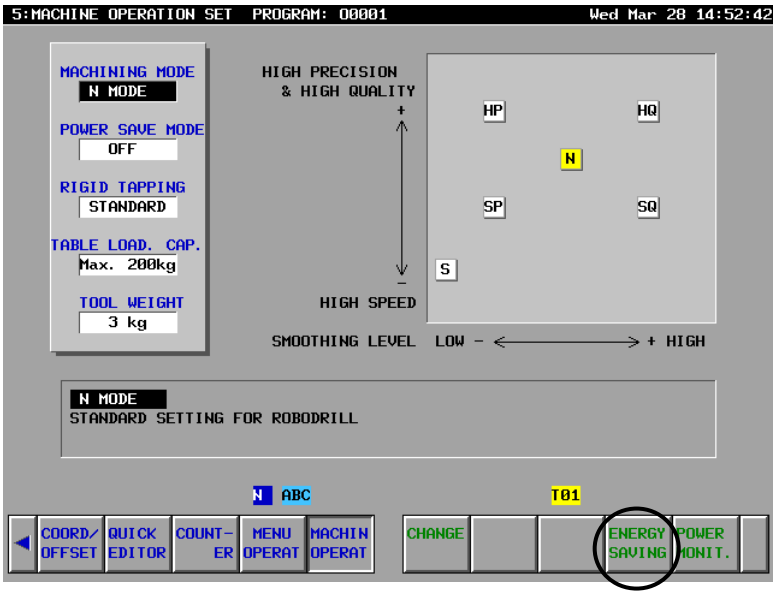
39 ENERGY SAVING SETTING SCREEN

Various energy saving settings such as automatic power interruption and a screen saver can be made on this screen.

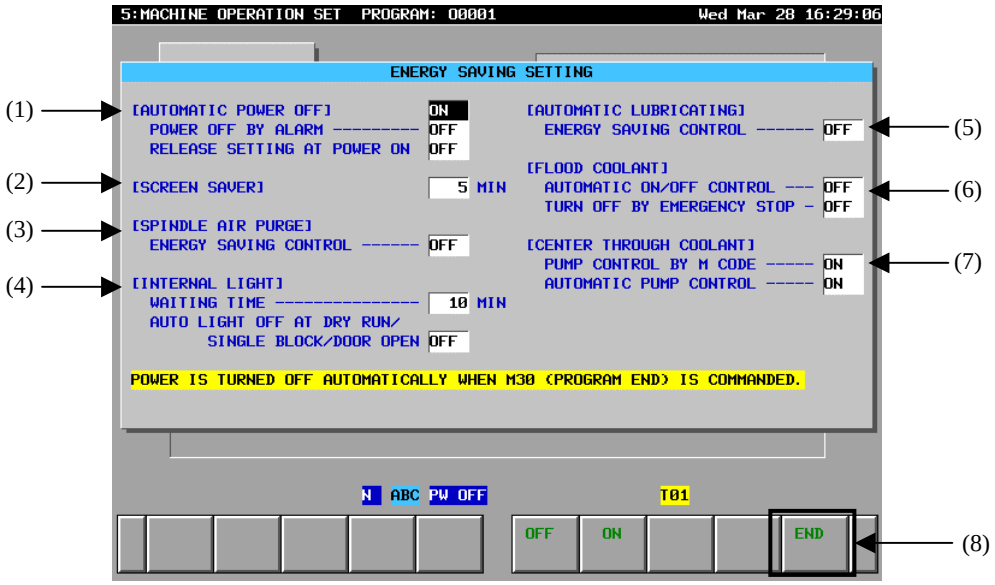
SUPPLEMENT
The amount of power consumption reduced depends on the use condition.

39.1 DISPLAYING THE ENERGY SAVING SETTING SCREEN

(1) Press the [MACHIN OPERAT] soft key on the QUICK screen to display "5: MACHINE OPERATION SET".
(2) Press the [ENERGY SAVING] soft key. The ENERGY SAVING SETTING screen appears.



39.2 Details of the ENERGY SAVING SETTING Screen



(1) AUTOMATIC POWER OFF

Sets the conditions required to execute the automatic power off function (For information on the automatic power off function, see Chapter 16, "AUTOMATIC POWER SUPPLY SHUT-OFF" in Part IV).

- AUTOMATIC POWER OFF
  When the cursor is moved to the field at the right of "[AUTOMATIC POWER OFF]", automatic power off can be enabled or disabled by the corresponding soft key. When this function is set to “ON”, the CNC is automatically powered off approximately 5 seconds after M30 is specified in the program. (This is the same as vertical soft key [AUTO. PW OFF] of the standard operator's panel or the <AUTO. P OFF> key of the full key operator's panel.)

SUPPLEMENT

- Automatic power off does not operate in M02.
- In a machine with automatic breaker interruption (option) and automatic extinguishing unit (option), the breaker of the controller trips. To turn on the power again, turn the breaker off and back on again.
- For 70 seconds after power-on, automatic power off does not function.
- The automatic power off disable signal (SO20_4: R1370.4) is turned ON in a custom PMC, automatic power off does not operate even if the setting is ON.

- POWER OFF BY ALARM (see SUPPLEMENT)
  When this item is set to “ON”, automatic power off operates in the case of an alarm as well
- RELEASE SETTING AT POWER ON (see SUPPLEMENT)
  When this item is set to “ON”, the automatic power off setting is forcibly set to OFF during power-on.

SUPPLEMENT

"POWER OFF BY ALARM" and "RELEASE SETTING AT POWER ON" are displayed only when automatic power off is set to “ON”.

(2) SCREEN SAVER

The time that elapses before the screen saver starts. A value of up to 127 minutes can be set in units of one minute. Set this item to 0 when the screen saver is not used.

If the following conditions are all satisfied in a set period of time, the screen is cleared to protect the LCD.

- No keys (excluding some keys) on the operator's panel or soft keys are operated.
- No alarms or operator messages are issued.
- The single block mode and dry run mode are set to OFF.

If one of the following conditions is satisfied when the screen is deleted, the screen is drawn again.

- Any key (excluding some keys) on the operator's panel or a soft key is operated.
- An alarm or operator message is issued.

(3) SPINDLE AIR PURGE

The ROBODRILL provides air purging to prevent foreign matters such as coolant and dust particles from adhering to the spindle. This item sets the conditions for turning ON or OFF spindle air purging.

- ENERGY SAVING CONTROL

  When this item is set to “ON”, spindle air purging turns OFF approximately five minutes after the following conditions are all satisfied.

  - The coolant and center through coolant are turned OFF.
  - Automatic (memory, remote) operation and MDI operation are completed.

  If any of the following operations is performed when spindle air purging is turned OFF, spindle air purging is turned ON again.

  - The coolant and center through coolant are started.
  - Automatic (memory, remote) operation and MDI operation are performed.
  - One minute elapses after air purging is turned OFF. (In this case, air purging is turned OFF again after approximately five seconds.)

  When “OFF” is set, spindle air purging is always ON.

(4) INTERNAL LIGHT (see SUPPLEMENT)

Makes settings of the automatic light off function of the internal light.

- WAITING TIME

  When no keys (see CAUTION) on the operator's panel are operated for a set period of time, the internal light automatically turns OFF. A value of up to 9999 minutes can be set in units of one minute. To disable the automatic light off of the internal light, set this item to 0.

- AUTO LIGHT OFF AT DRY RUN/SINGLE BLOCK/DOOR OPEN

  When this item is set to “ON”, if the dry run mode and single block mode are ON or the door is open, the internal light automatically turns off.

SUPPLEMENT

The above item is displayed only for machines for which the internal light (option) is enabled.

CAUTION

These keys are sheet keys excluding numeric, Alter, Insert, Delete, Cancel, Input, Edit, Cursor, Page, Reset, QUICK/NC, Alphabet, and Alarm/status.

(5) AUTOMATIC LUBRICATING

Makes settings related to oil automatic lubrication control (option) and grease automatic lubrication control (option) (For details on the settings related to automatic lubricating control, see "LUBRICATION (Option)" in Subsection 1.3.4, "Maintenance/Setting" in Part IV).

- ENERGY SAVING CONTROL
  When this item is set to “ON”, even if the set "LUBRICATION INTERVAL (TIME)" elapses, lubrication is not performed when the axis stops. When the axis moves after the “LUBRICATION INTERVAL (TIME)" elapses, the pump drives lubrication. (This is the same as the "CONTROL OF ENERGY CONSERVATION" item of "14. LUBRICATION" on the MAINTENANCE/SETTING screen.)

SUPPLEMENT
This item is displayed only for machines for which oil automatic lubrication control (option) or grease automatic lubrication control (option) is enabled.

(6) FLOOD COOLANT (see SUPPLEMENT)

Sets the method of controlling the machine cleaning coolant.

- AUTOMATIC ON/CONTROL
  When this item is set to “ON”, the machine cleaning coolant is stopped 1 minute after completion of program operation and MDI operation. When program operation is restarted or the start button on the operator's panel is pressed, the machine cleaning coolant is restarted.
- TURN OFF BY EMERGENCY STOP
  When this item is set to “ON”, the machine cleaning coolant is stopped in the emergency stop state.

SUPPLEMENT
The above item is displayed only for machines for which machine cleaning coolant (option) is enabled.

(7) CENTER THROUGH COOLANT (see SUPPLEMENT)

Sets the method of controlling the center through coolant.

- PUMP CONTROL BY M CODE
  When this item is set to “ON”, whether the center through coolant pump is turned ON/OFF can be specified by an M code.
  M20: Stops the center through coolant pump
  M21: Starts the center through coolant pump
  When this item is set to “OFF”, the center through coolant pump is always turned ON regardless of the above M code.
- AUTOMATIC PUMP CONTROL (see SUPPLEMENT)
  When this item is set to “ON”, the center through coolant pump starts automatically if one of the following conditions is satisfied.
  - When a shift to the automatic mode, MDI mode, or remote mode is made
  - When menu operation is accepted
  - When the start button on the operator's panel is pressed

  The center through coolant pump stops automatically when the following condition is satisfied.
  - When one minute elapses after the center through coolant is disabled.

SUPPLEMENT

- The above item is displayed only for machines for which the center through coolant (option) is enabled.
- The "AUTOMATIC PUMP CONTROL" item is displayed only when "PUMP CONTROL BY M CODE" is set to “ON”.

(8) [END] key
Closes the ENERGY SAVING SETTING screen and return to MACHINE OPERATION SET screen.

40 POWER SAVING MODE

40.1 OVERVIEW

Reduction in motor acceleration/deceleration achieves the configuration that focuses on reduction in power consumption rather than machining time.

SUPPLEMENT
The amount of power consumption reduced depends on the use condition.

Standard mode (power saving mode disabled): Standard ROBODRILL setting
Power saving mode: Setting focusing on reduction in power consumption (machining time extended)

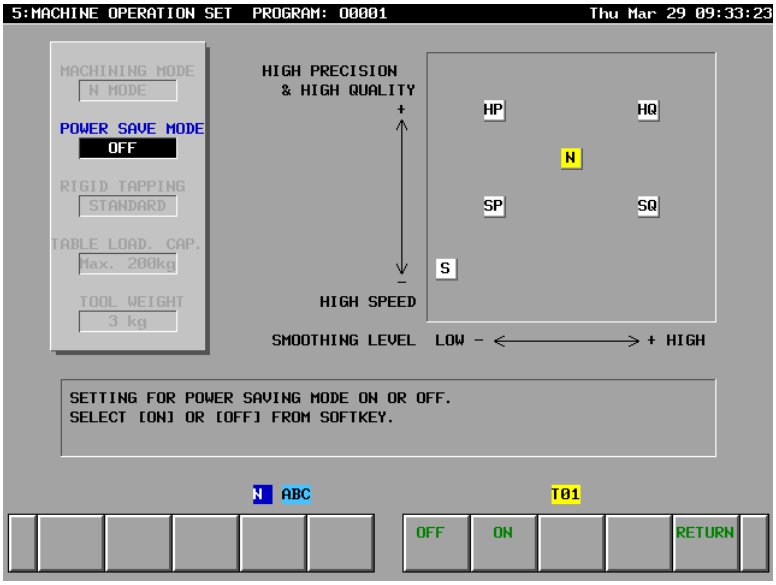
40.2 SETTING METHOD

There are the following two methods for setting the power saving mode.

(1) Setting the power saving mode on the QUICK screen
(2) Setting the power saving mode using a program command

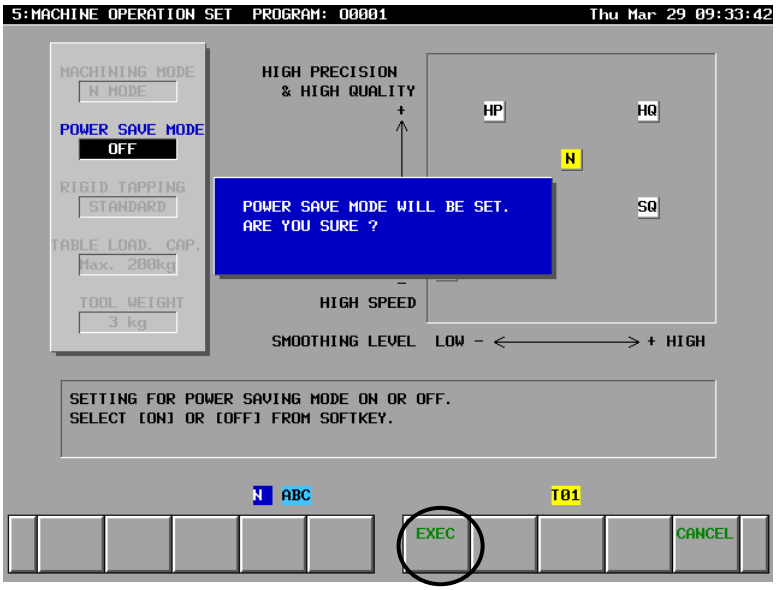
40.2.1 Setting the Power Saving Mode on the QUICK Screen

(1) Display QUICK screen "5: MACHINE OPERATION SET".
(2) Position the cursor on the "POWER SAVE MODE" item, using the cursor keys on the operator's panel, and press soft key [CHANGE]. The following screen appears.



(3) Press soft key [ON] or [OFF] to change modes.
[OFF]: Standard mode
[ON]: Power saving mode

(4) When a mode change is made, the following window appears. To make a mode change, press soft key [EXEC].



40.2.2 Setting the Power Saving Mode Using a Program Command

To set the power saving mode, specify "M31P_" in the MEM mode or MDI mode.

<Format>

M31 P_ ;

P_ : Mode to be set

P0 : Standard mode

P1 : Power saving mode

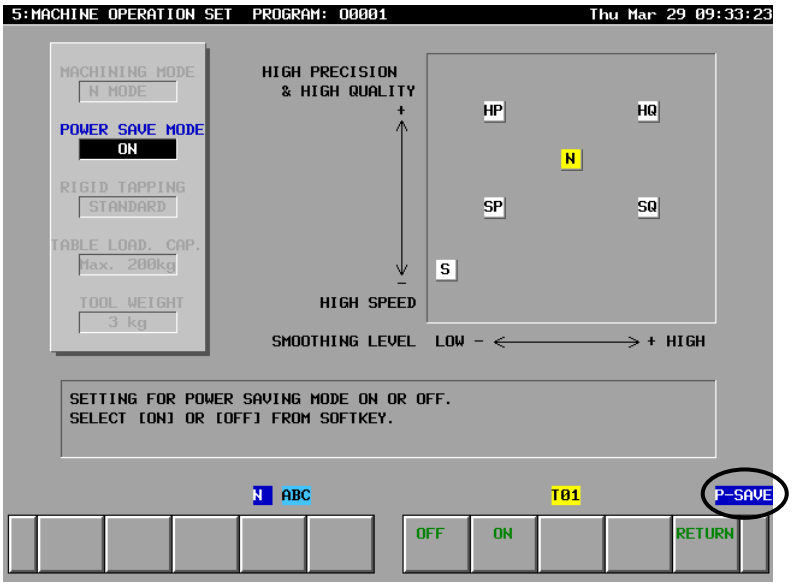
SUPPLEMENT

- "M31 P_ ;" must be specified in a single block.
- "M31" must be specified at the beginning of a block. Specifying a command such as "P_ M31 ;" issues an alarm saying "PS0127: DUPLICATE NC, MACRO STATEMENT ".
- "M31 P_ ;" must be specified in a state where a canned cycle is cancelled. Specifying "M31 P_ ;" in the canned cycle mode issues alarm "MC3130 DURING CANNED CYCLE".
- If no P code is specified or a value other than P0 or P1 is specified, alarm "MC3130 DATA ERROR P" is issued.
- A changed mode is not cleared even after completion of the program.
- Specifying "M31 L_ P_" enables setting of the machining mode concurrently with the machining mode. If L_ or P_ falls outside the range, however, none of these modes are changed. For details on the machining mode, see Chapter 36, "MACHINING MODE SETTING FUNCTION" in Part IV.

40.3 CHECKING THE CURRENT MODE

40.3.1 QUICK Screen

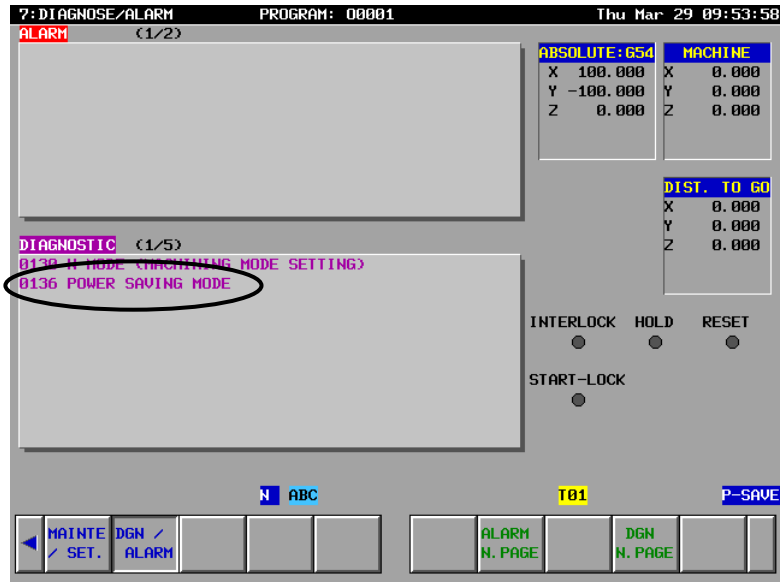
When the power saving mode is set, "P-SAVE" is displayed in the lower-right of the QUICK screen.



SUPPLEMENT

P-SAVE is not displayed when an alarm or operator message is issued.

In addition, diagnose information "0136 POWER SAVING MODE" is displayed on the "7: DIAGNOSE/ALARM" screen.



40.3.2 Indication Common to the CNC Screen and QUICK Screen

Pressing the

key on the operator's panel displays the ALARM DIAGNOSTIC window at the center of the screen. When the power saving mode is set, "0136 POWER SAVING MODE" is displayed in the window as diagnostic information (on the CNC screen and QUICK screen).

40.4 NOTES ON USING THE POWER SAVING MODE

Keep the following in mind when using the power saving mode.

(1) Tapping when the power saving mode is set
Since output during spindle acceleration/deceleration is limited when the power saving mode is set, an alarm may be issued in large diameter tapping due to lack of spindle output power. In this case, specify the M31 P0 command, which turns off the power saving mode, before tapping.

(2) Use of the rigid tapping learning control function (option)
In the rigid tapping learning control mode, the power saving mode is canceled temporarily.

41 TOOL RUNOUT DETECTION FUNCTION （OPTION）

41.1 TOOL RUNOUT DETECTION FUNCTION

This function is intended to measure the runout of the tool, using the ATC Run-out Detection System (eddy-current sensor and controller) made by TOKYO SEIMITSU CO., LTD., thereby detecting any chippings that are trapped and preventing machining defects from occurring.
The geometry of the flange of the tooling with no chippings trapped is registered in advance (tool registration), and this data is compared with the geometry of the tool measured immediately before machining (runout measurement), thereby calculating the amount of runout. If this amount of runout exceeds the specified value, it is judged that chippings are trapped and an alarm is displayed.

41.1.1 Specification Method

To perform tool registration and runout measurement, specify and execute the following M codes in MDI or MEM mode, with the target tool being attached to the spindle.

M132: Tool registration
M133: Runout measurement

41.1.2 Notes and Restrictions

(1) Check that no chippings are present on the tapered part of the tooling before performing M132 (tool registration)
(2) If a new tooling is mounted to the turret or if the tool (blade) attached to the tooling is changed, perform M132 (tool registration).
(3) Execute M133 (runout measurement) in the state in which the spindle is stopped immediately after a tool change, before performing processing.
(4) Specify M132 and M133 in independent blocks.

41.1.3 PARAMETERS

[PMC parameter Keep Relay]

	#7	#6	#5	#4	#3	#2	#1	#0
K55			*	0	1			

#3 The tool runout detection function is:
0: Disabled.
1: Enabled. (Setting)

#4 Alarms (EX1094 and EX1095) for tool runout measurement are:
0: Enabled. (Setting)
1: Disabled.

#5 If M132/M133 is specified when the tool runout detection function is disabled,
0: An alarm (EX1097) is issued.
1: The command is ignored to proceed to the next machining program.

41.1.4 Alarm Indication

If errors occur during the execution of M132 and M133, the following alarms are output.

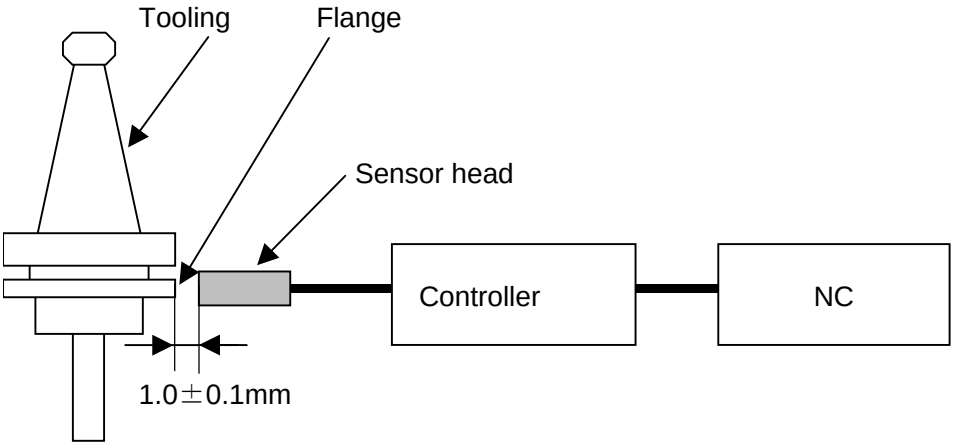
No.	Message	Description and necessary action
EX1094	M132 OR M133 ERROR	If [D5920#0 = 1] The controller for runout detection has not yet been started. Check whether the controller is turned on.
		If [D5920#1 = 1] When M132 or M133 was specified, the spindle did not reach 600 revolutions per min. A probable cause is that the spindle is defective.
		If [D5920#2 = 1] The judgment completion signal did not turn ON two or more seconds after the speed was posted to the controller. Check whether the connection between the controller and NC is cut off.
		If [D5920#3 = 1] The judgment completion signal did not turn ON two or more seconds after the tool registration or runout measurement start signal was turned ON. Check whether the connection between the controller and NC or between the sensor head and controller is not cut off.
		If [D5920#4 = 1] The tooling was not found when an attempt was made to perform runout measurement. Check whether the tooling is attached. If the tooling is attached, check whether the gap between the sensor and flange is within the normal range.
		If [D5920#5 = 1] A sensor error was detected during tool registration or runout measurement. Check the following: ・No chippings adhere to the sensor head. ・The gap between the sensor and flange is within the normal range. ・The connection between the sensor head and controller is not cut off.
		If [D5920#6 = 1] An attempt was made to measure a tooling the No. of which was not registered, or an attempt was made to perform runout measurement with a speed different from the one specified during tool registration. Perform tool registration before specifying runout measurement. If tool registration has already been performed, a probable cause is that the spindle is defective.
		If [D5920#7 = 1] An attempt was made to register another tool when 32 tools had already been registered.
EX1095	TOOL RUNOUT ERROR (TOO)	During runout measurement, runout greater than the specified threshold occurred. The tool number is displayed at the end of the message. Check whether chippings are trapped in the tapered part of the tooling.
EX1096	PROGRAM ERROR (M132/M133)	M132/M133 was specified at the same time as another M code. Specify M132/M133 independently.
EX1097	TOOL RUNOUT DETEC. IS NOT WORK.	An attempt was made to execute M132/M133 when the tool runout detection function was disabled (K55#3 = 0). To suppress the output of the alarm, set K55#3 to 1.

SUPPLEMENT

If alarm EX1094 is generated, check the signal state of the data table D5920 for the PMC parameter. The details of the alarm differ depending on the signal state. At the time M132/M133 is executed again, all bits of D5920 are set to OFF.

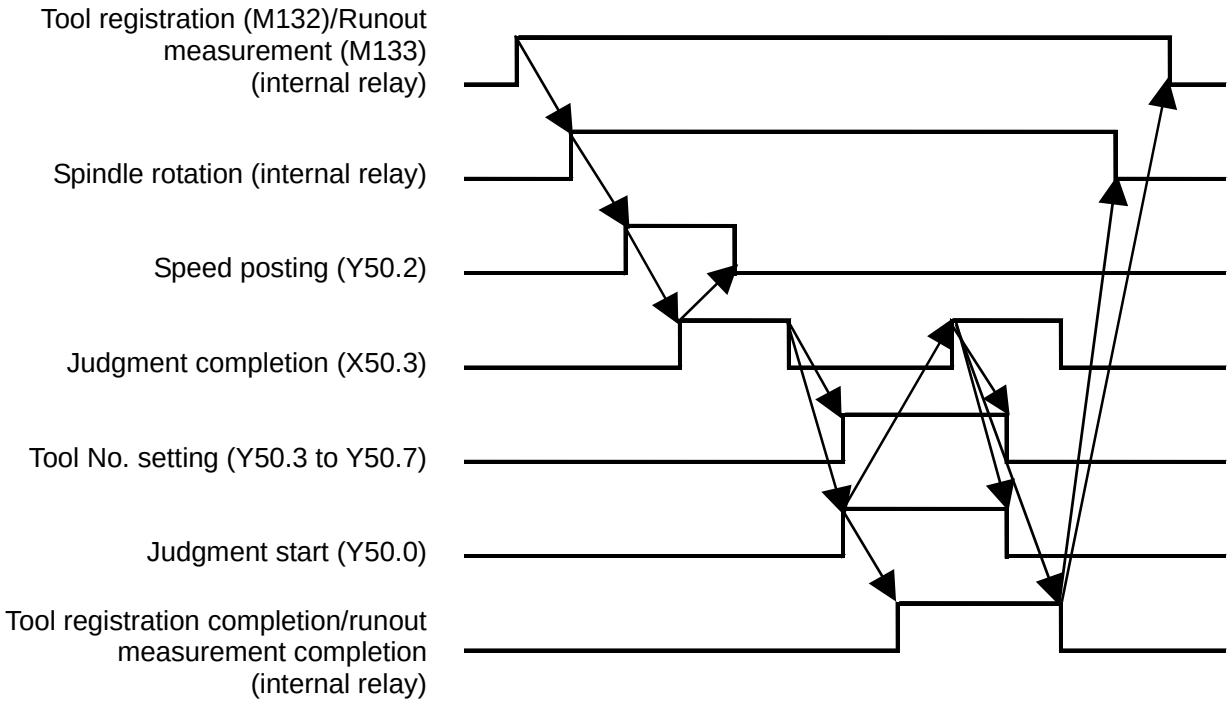
41.1.5 Structure

Install the sensor head at the position 1.0 ±0.1 mm from the flange of the tooling. Connect the sensor to the NC via the controller.



41.1.6 Timing Chart

Both tool registration and runout measurement have an operating time of about 0.3 second.



41.1.7 Interface

Interface signals between the controller for runout detection and the NC are as listed below.

Input			Output		
Line color/ No.	Address	Description	Line color/ No.	Address	Description
Pink 1	Y50.0	Judgment start	Yellow 4	X50.0	Runout acceptable
Pink 2	Y50.1	Tool registration	Yellow 5	X50.1	Runout unacceptable
Pink 3	Y50.2	Speed posting	Yellow 6	X50.2	No tool found
Pink 4	Y50.3	Data No.1	Yellow 7	X50.3	Judgment completed
Pink 5	Y50.4	Data No.2	Yellow 8	X50.4	Measurement ready
Pink 6	Y50.5	Data No.4	Yellow 9	X50.5	Sensor error
Pink 7	Y50.6	Data No.8	Yellow 10	X50.6	Data mismatch
Pink 8	Y50.7	Data No.16	Green 1	X50.7	Data FULL
Pink 9	Y51.0	Data No.32			
Pink 10	Y51.1	Data No.64			
Yellow 1	Y51.2	Data No.128			
Yellow 2	Y51.3	Data No.256			

To perform retry and other operations using custom PMC if an alarm is generated, the following signals are offered.

SI (system→custom) signals

Tool registration/runout measurement time error signal: SI82_0(R1432.0)
High tool runout signal: SI82_1(R1432.1)

41.2 TOOL RUNOUT DETECTION RETRY FUNCTION

This function is intended to increase the operating rate of the machine by ejecting chippings and performing runout measurement again if an excessive runout of the tool is detected using the tool runout detective function, without causing an alarm stop immediately.

The retry function operates with a macro program called with an M code. If an excessive runout of the tool is detected, this macro program ejects chippings with the taper cleaning function or the air blow function associated with a tool change and then performs runout measurement again. If the runout of the tool is excessive even after this operation reaches the upper limit on the number of retries, an alarm is issued.

41.2.1 Specification Method

To use the tool runout detection retry function, specify and execute the following M code in MDI or MEM mode, with the target tool being attached to the spindle.

M133: Tool runout detection retry function

This M code calls the macro program (O9023).

41.2.2 Macro program (O9023)

```
%
O9023(TOOL RUNOUT DETECTION VER1.0)
#1=#3939                                  (Selected tool number)
#2=0                                      (Retry counter)
#3=#910                                   (Number of tools)
#4=#911                                   (Upper limit on the number of retries)

N100                                      (Tool runout measurement)
M133
M12
IF[#1006EQ1]GOTO400                       (If the runout is normal, go to N400.)
IF[#2GE#4]GOTO300                         (If the number of retries reaches the upper limit, go to N300.)
#5=#1+1                                   (Adjacent tool number)
M12
IF[#5LE#3]GOTO200
#5=1

N200                                      (Chipping ejection)
G49M06T[#5]                               (Tool change to the adjacent tool)
G49M06T[#1]                               (Tool change to the original tool)
#2=#2+1                                   (Increment the retry count by +1.)
GOTO100

N300                                      (Error message output)
IF[#1007EQ1]GOTO320                       (For a runout measurement time error, go to N320.)
N310#3000=2(TOOL RUNOUT ERROR)            (Excessive tool runout error)
N320#3000=3(TOOL RUNOUT DETECTION ERROR)  (Measurement time error)

N400                                      (End)
M99                                       (Return to the caller.)
%
```

SUPPLEMENT

The following macro variables are automatically turned ON/OFF with the system-side Ladder program.

#1006: Turned ON if the runout is found normal as a result of runout measurement.

#1007: Turned ON if a runout measurement time error occurs.

41.2.3 Notes and Restrictions

(1) Execute this function in the state where the spindle is stopped immediately after a tool change, before performing machining.

(2) If an excessive runout is detected, a tool change is made to the tool adjacent on the right to eject chippings first, and then a tool change is made to the original tooling.

(3) In the macro program (O9023), G49 is specified and, therefore, tool length compensation may be canceled.

(4) If using the taper chipping cleaning function to eject chippings, enable the taper chipping cleaning function before using the retry function.

(5) Specify M133 in an independent block. If it is specified simultaneously as another M code, only M133 is executed.

(6) If an alarm is generated during a tool change, the tool number after the recovery may differ from the tool number before runout measurement. Check the tool number carefully when restarting machining.
(7) As an example of creating a macro program, O9023 is offered. Before use, change the macro program and the macro variables according to the use.
(8) If this function is used, macro variables #1006 and #1007 are controlled by the system-side Ladder program and, therefore, they cannot be used from a custom Ladder program.

41.2.4 Parameters and Macro Variables

If using this function, check and set the following parameters and macro variables.

[NC parameters]

No.	Data
6083	133

Value of the M code to call O9023
Set 133.

[PMC parameter keep relay]

	#7	#6	#5	#4	#3	#2	#1	#0
K55				1	1			

#3 The tool runout detective function is:
0: Disabled.
1: Enabled. (Setting)

#4 Alarms (EX1094 and EX1095) for tool runout measurement are:
0: Enabled. (Setting)
1: Disabled.

[Macro variable]

#910 = Number of tools depending on the machine specification (14 or 21)
#911 = Upper limit on the number of retries (initial setting: 2)

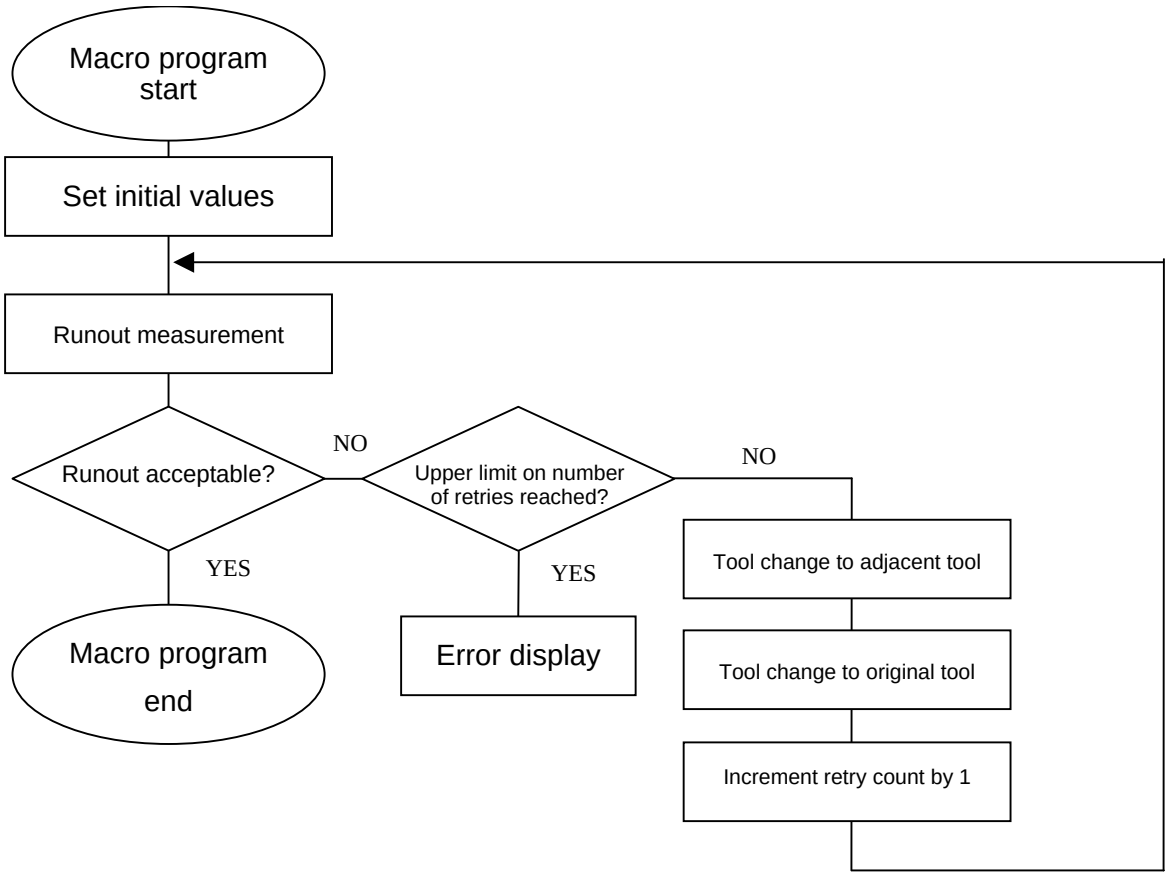
SUPPLEMENT
The NC parameters and macro variables necessary for this function are automatically set and registered by resetting the custom macro with K55#4 being set to 1 and then turning off the power and back on.

41.2.5 Alarm indication

The following alarms may be output if the number of retries reaches the upper limit.

No.	Message	Error description
MC3002	TOOL RUNOUT ERROR	The tool runout was excessive.
MC3003	TOOL RUNOUT DETECTION ERROR	An error (such as a sensor error) occurred during runout measurement.

41.2.6 Flowchart



42 CUSTOM OPERATOR'S PANEL FUNCTION

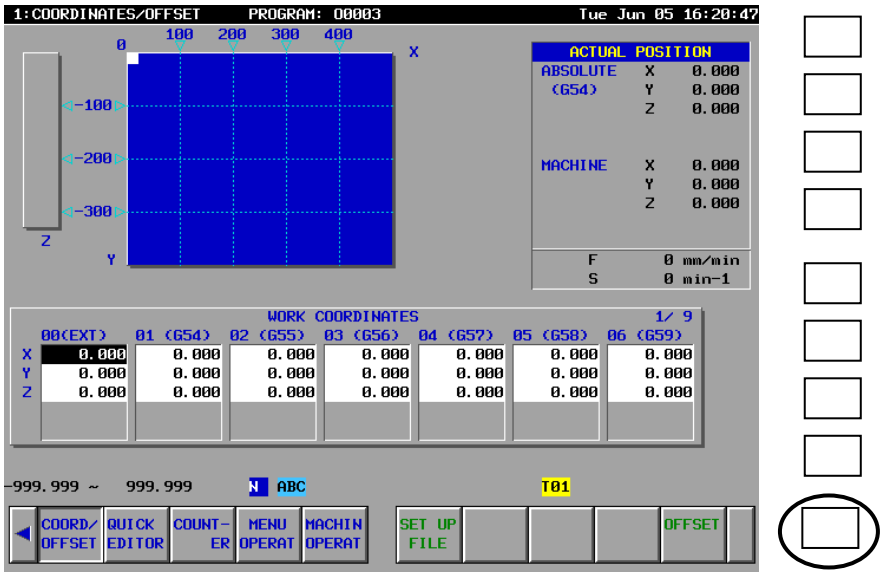
42.1 OVERVIEW

This function is intended to create switches and lamps on the QUICK screen to check the states of and operate jigs and external devices.
Usually, if an additional external device is to be installed, it is necessary to mount an additional operator's panel to check the state of and operate the device, but by using this function, switches and lamps can be easily placed on the screen.

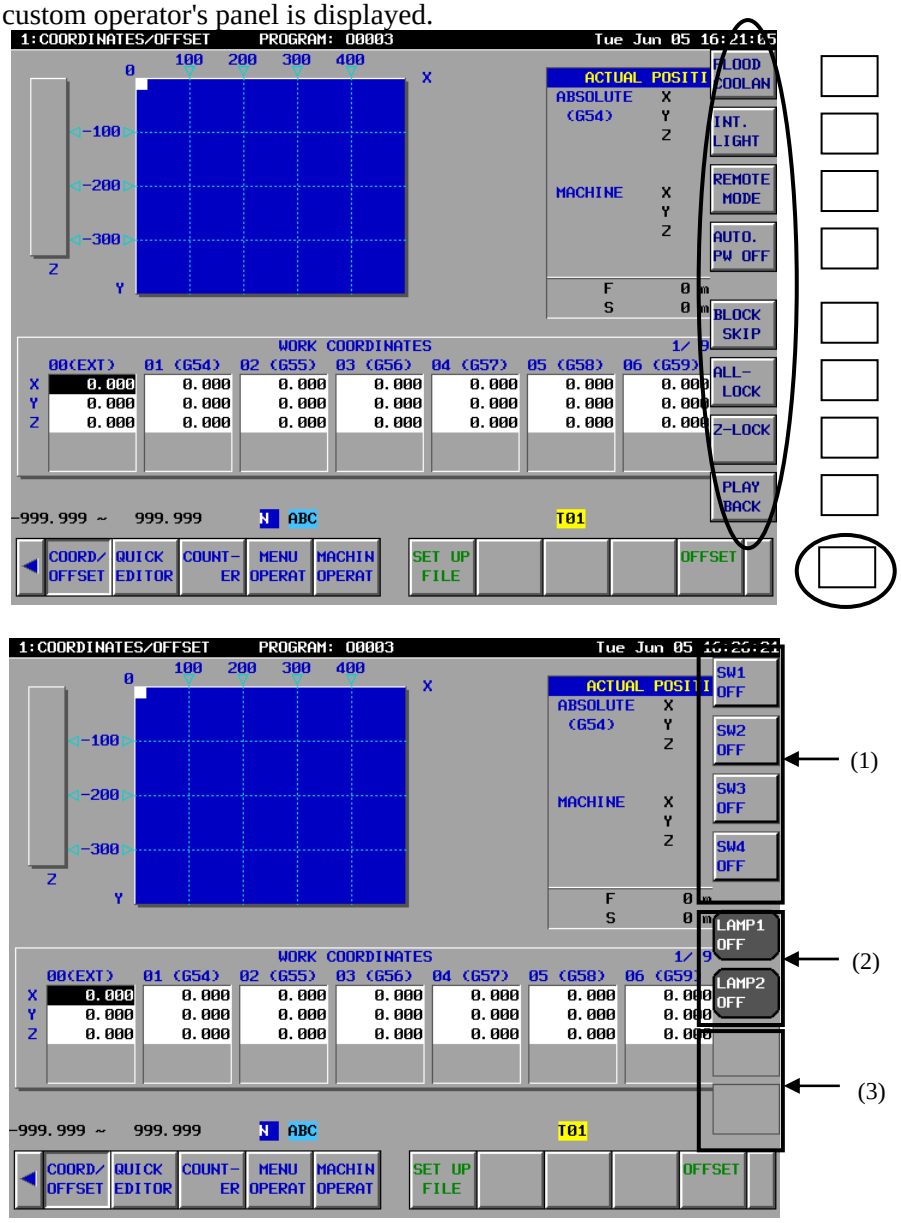
42.2 DISPLAYING AND OPERATING THE CUSTOM OPERATOR'S PANEL

The custom operator's panel can be displayed with the procedure below.

(1) Press the button below in the same way as that to display vertical soft keys on the QUICK screen.



(2) Vertical soft keys for making the various settings of the machine are displayed. Press the button again, and the custom operator's panel is displayed.



The custom operator's panel consists of eight elements that correspond to vertical soft keys, and each element is set as either a switch or a lamp. Each element can be enabled/disabled. If disabled, an element cannot be displayed or operated.

(1) Switch
Each time the corresponding soft key is pressed, the specified signal is switched between ON and OFF.

(2) Lamp
The ON/OFF state of the specified signal can be checked.

(3) If disabled
The signal cannot be turned ON/OFF, and its state cannot be displayed.

SUPPLEMENTS

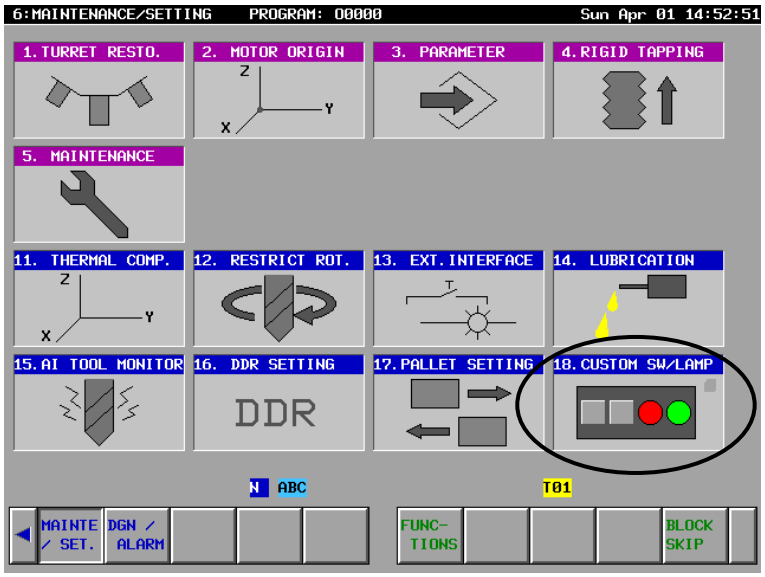
- If, on the setting screen of the custom operator's panel, the display is set to "PRI-ORITY", the custom operator's panel is displayed before the vertical soft keys for making the various settings of the machine. (See Subsection 42.3.2, "Details of the Custom Operator's Panel Setting Screen".)
- If, on the setting screen of the custom operator's panel, all switches/lamps 1 to 8 are disabled, the custom operator's panel is not displayed.
- If the custom operator's panel function is disabled (Keep relay K56#2 = 1), the custom operator's panel is not displayed. (See Section 42.6, "RELATED PARAMETERS".)

42.3 CUSTOM OPERATOR'S PANEL SETTING SCREEN

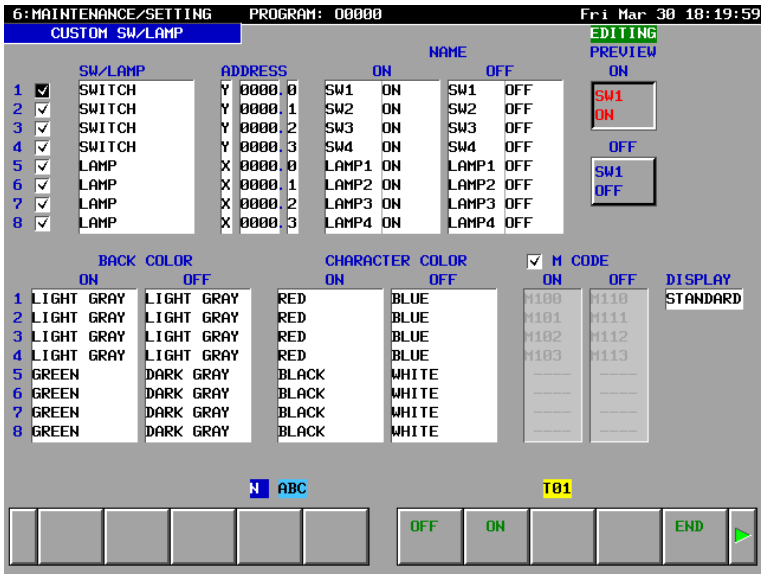
42.3.1 Displaying the Custom Operator's Panel Setting Screen

The custom operator's panel setting screen can be displayed with the procedure below.

(1) Display QUICK screen "6.MAINTENANCE/SETTING".

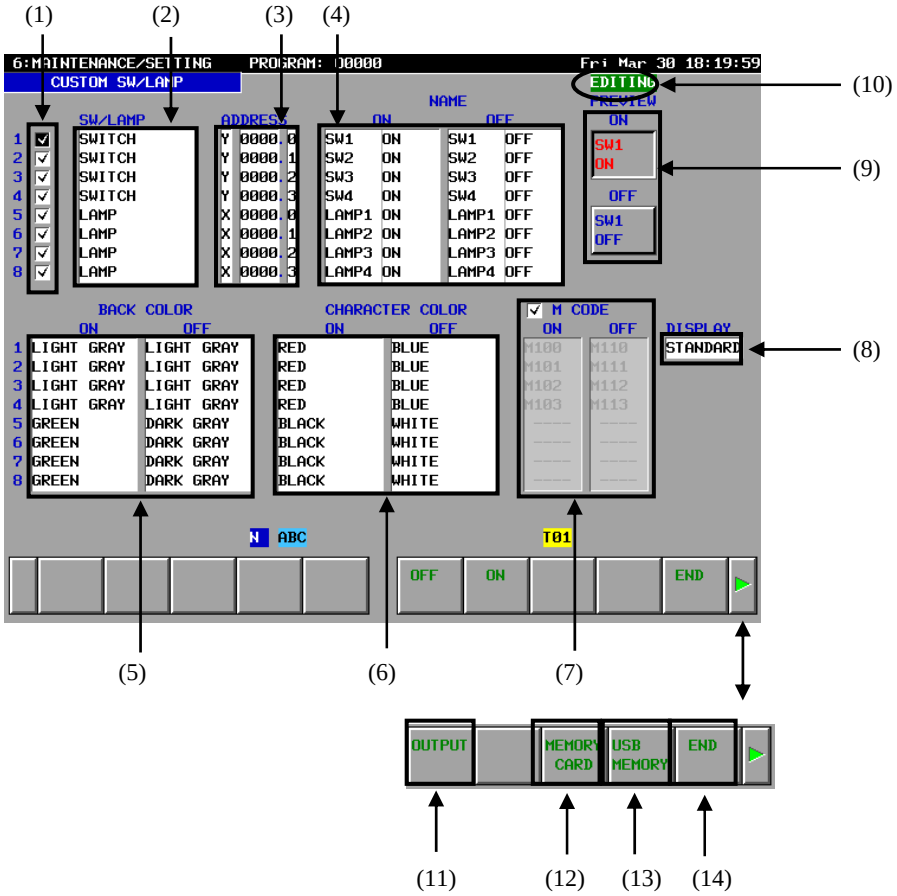


(2) Enter "18" to display the custom operator's panel function setting screen.



42.3.2 Details of the Custom Operator's Panel Setting Screen

The custom operator's panel setting screen is configured as shown below.
Switches/lamps 1 to 8 correspond to the top to bottom vertical soft keys.
On the custom operator's panel setting screen, various settings can be made on these eight switches/lamps.



(1) Enable/Disable
Enable or display the display and operation of a switch/lamp.

Position the cursor on a check box, and the following soft keys are displayed.

By pressing soft key [OFF] or [ON], the switch/lamp can be disabled or enabled.

(2) SW/LAMP

Specify whether to use an item as a switch or as a lamp.
Position the cursor on a switch/lamp item, and the following soft keys are displayed.

By pressing soft key [SW] or [LAMP], the item can be specified as being used as switch or a lamp.

SUPPLEMENT

If an X address is set, the item cannot be used as a switch. Set another type of address before pressing [SW].

(3) ADDRESS

Set an address type, address number, and bit number.
Position the cursor to an address type, and the following soft keys are displayed.

By pressing soft key [X],[Y],[R],[D], or [K], an address type can be selected.
The settings of the address number and address bit number can be changed by entering values from the operator's panel.

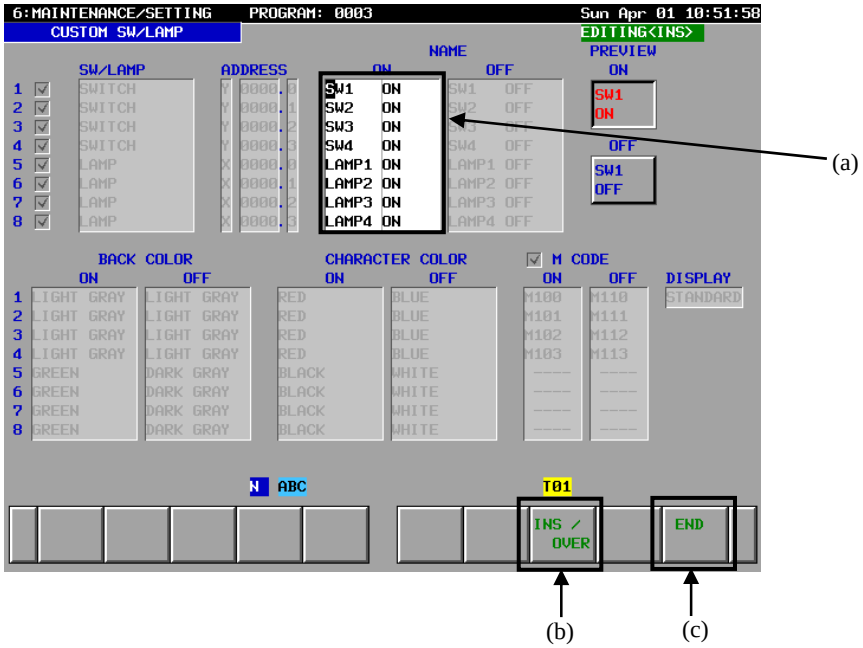
SUPPLEMENTS

- If a switch is selected, an X address cannot be set, so soft key [X] is not displayed.
- Do not set the Y address used with the external interface function. The Y address used with this function must be set to "UNUSED" on the external interface setting screen. (See Section 14.2, SETTING INPUT/OUTPUT SIGNALS AND FUNCTIONS".

(4) NAME

Set the names of a switch/lamp in the ON/OFF states. Position the cursor, and the following soft keys are displayed.

Press soft key [EDIT NAME], and the screen switches to the one shown below, so that the switch/lamp names can be changed.



(a) Switch/lamp name

Set a switch/lamp name.

The cursor can be moved by using the cursor keys. Any names can be set using numbers, alphabetic characters, and symbols.

SUPPLEMENT

Editing cannot be ended if a two-byte character remains entered between sixth and seventh single-byte characters.

(b) [INS/OVER] key

It is possible to switch between insert and overwrite modes.

The currently selected mode is displayed near the upper right of the screen.

(c) [END] key

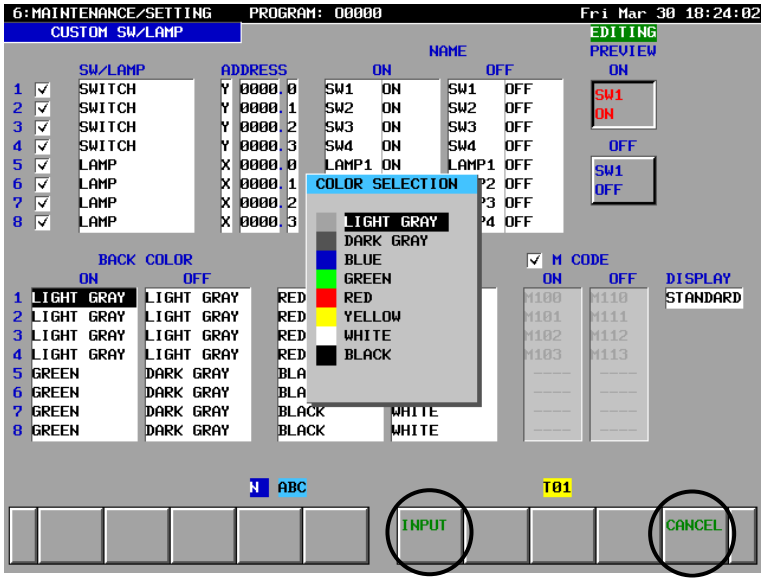
This key is used to end switch/lamp name editing.

(5) BACK COLOR

(6) CHARACTER COLOR

Set the background colors and character colors of a switch/lamp in the ON/OFF states. Position the cursor, and the following soft keys are displayed.

Press soft key [SELECT], and the following window is displayed, so that the colors can be changed.



By positioning the cursor on the color to change and pressing soft key [INPUT], the color can be changed. Pressing soft key [CANCEL] causes the window to close without changing the setting.

(7) M CODE

Enable or disable switches to be turned ON/OFF with M codes. (See Section 42.5, "M CODE CONTROL OVER SWITCHES".)

Position the cursor on the check box, and the following soft keys are displayed.

By pressing soft key [OFF] or [ON], it is possible to enable or disable switches to be turned ON/OFF with M codes.

In the control is disabled, " ---- " is displayed, and if enabled, M codes are displayed.

The M codes to turn ON/OFF the individual switches are fixed, as listed below.

Switch	M code to turn it ON	M code to turn it OFF
1	M100	M110
2	M101	M111
3	M102	M112
4	M103	M113
5	M104	M114
6	M105	M115
7	M106	M116
8	M107	M117

SUPPLEMENTS

- To enable M code control over switches, M100 to M129 must be set to "UNUSED" with the external interface function. (See Section 14.2, "SETTING INPUT/OUTPUT SIGNALS AND FUNCTIONS".)
- If an item is set as a lamp, M code control is disabled (" ---- ").
- Check the two points above if M code control is not enabled.

(8) DISPLAY

DISPLAY indicates the order of displaying the vertical soft key and the custom operator's panel. Position the cursor on it, and the following soft keys are displayed.

By pressing soft key [STAN-DARD] or [PRI-ORITY], change the vertical soft key display order.

(a) If STAN-DARD is set

"No display" → "Keys for making the various settings of the machine" → "Custom operator's panel" → "No display" → ...

(b) If PRI-ORITY is set

"No display" → "Custom operator's panel" → "Keys for making the various settings of the machine" → "No display" → ...

(9) PREVIEW

The names of the switch/lamp in both ON and OFF states that has the number on which the cursor is positioned are displayed.

(10) EDITING

If any setting of the custom operator's panel is changed, "EDITING" is displayed.

(11) [OUTPUT] key

The settings of the custom operator's panel can be output to a memory card. For details of the format of the file to be output, see Subsection 42.4.3, "Format of Custom Operator's Panel Setting Data".

(12) [MEMORY CARD] key

(13) [USB MEMORY] key

These keys display a list of files in a memory card and a USB memory stick.

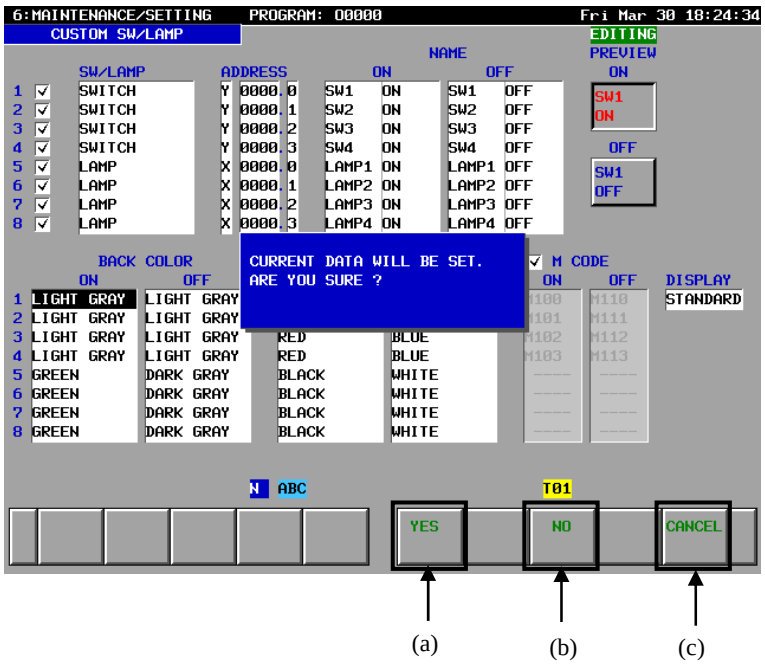
A file created in a prescribed format can be read from either member card or USB memory stick to change the settings of the custom operator's panel.

For details of the file format, see Subsection 42.4.3, "Format of Custom Operator's Panel Setting Data".

(14) [END] key

This key ends the custom operator's panel setting screen.

If the setting of any item is changed, the following window is displayed.



(a) Soft key [YES]

Saves the changes and ends the custom operator's panel setting screen.

(b) Soft key [NO]
Ends the custom operator's panel setting screen without saving the changes.

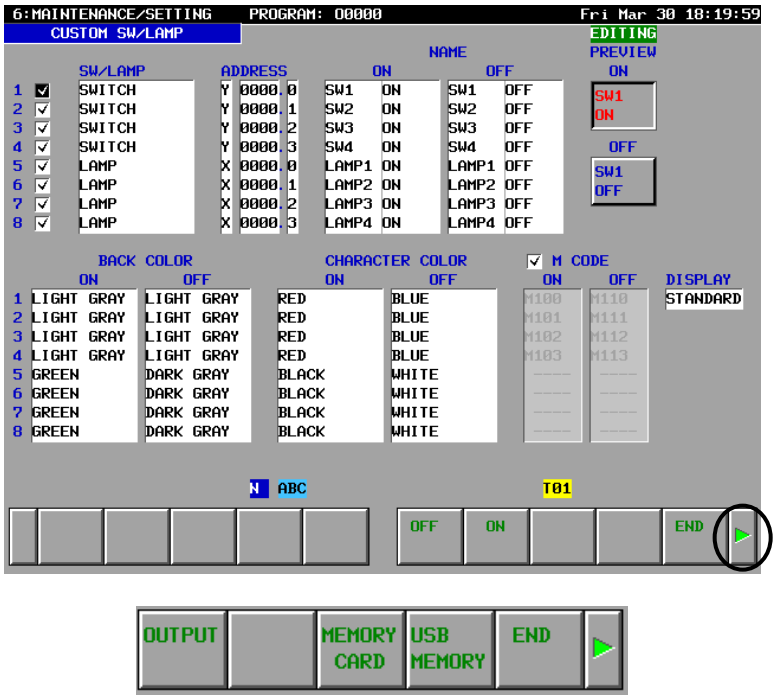
(c) Soft key [CANCEL]
Returns the screen to the state before the [END] key was pressed, so you editing can be continued.

42.4 INPUTTING/OUTPUTTING CUSTOM OPERATOR'S PANEL SETTING DATA

Custom operator's panel data that has been set can be output to a memory card and a USB memory stick. The output data file can be edited and input to the ROBODRILL.

42.4.1 Outputting Custom Operator's Panel Setting Data

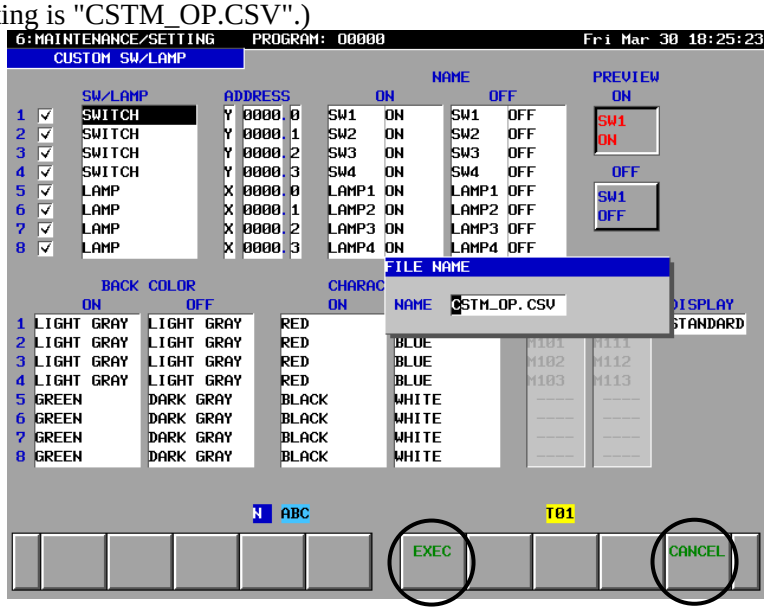
(1) Press rightmost soft key to display soft key [OUTPUT].



(2) Press soft key [OUTPUT].

(3) If only either of a memory card and a USB memory stick is inserted, the connected type of memory is automatically selected. If both are connected, the following soft keys are displayed; select the type of memory to which to output data.

(4) The file name input window is displayed; enter the name of the file to output. (The initial setting is "CSTM_OP.CSV".)



(5) To output data, press soft key [EXEC]. To cancel the output, press soft key [CANCEL].

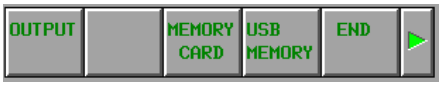
(6) If soft key [EXEC] is pressed, custom operator's panel setting data is output to the memory card with the file name entered in (4).

SUPPLEMENT

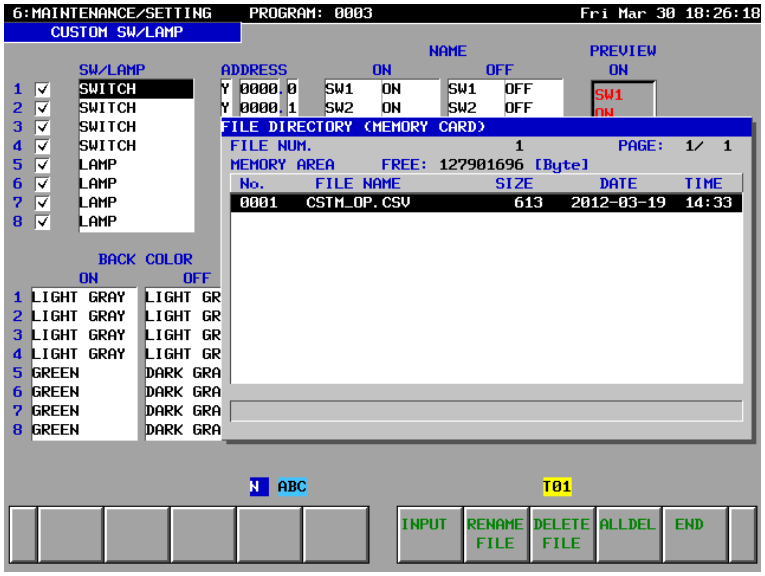
If a file with the same name exists in the memory card or stick, "FILE ALREADY EXIST" is displayed, and the data is not output.

42.4.2 Inputting Custom Operator's Panel Setting Data

(1) Press rightmost soft key [▷] to switch soft keys. The following soft keys are displayed.



(2) Press soft key [MEMORY CARD] or [USB MEMORY]. A list of files in the selected memory type is displayed.

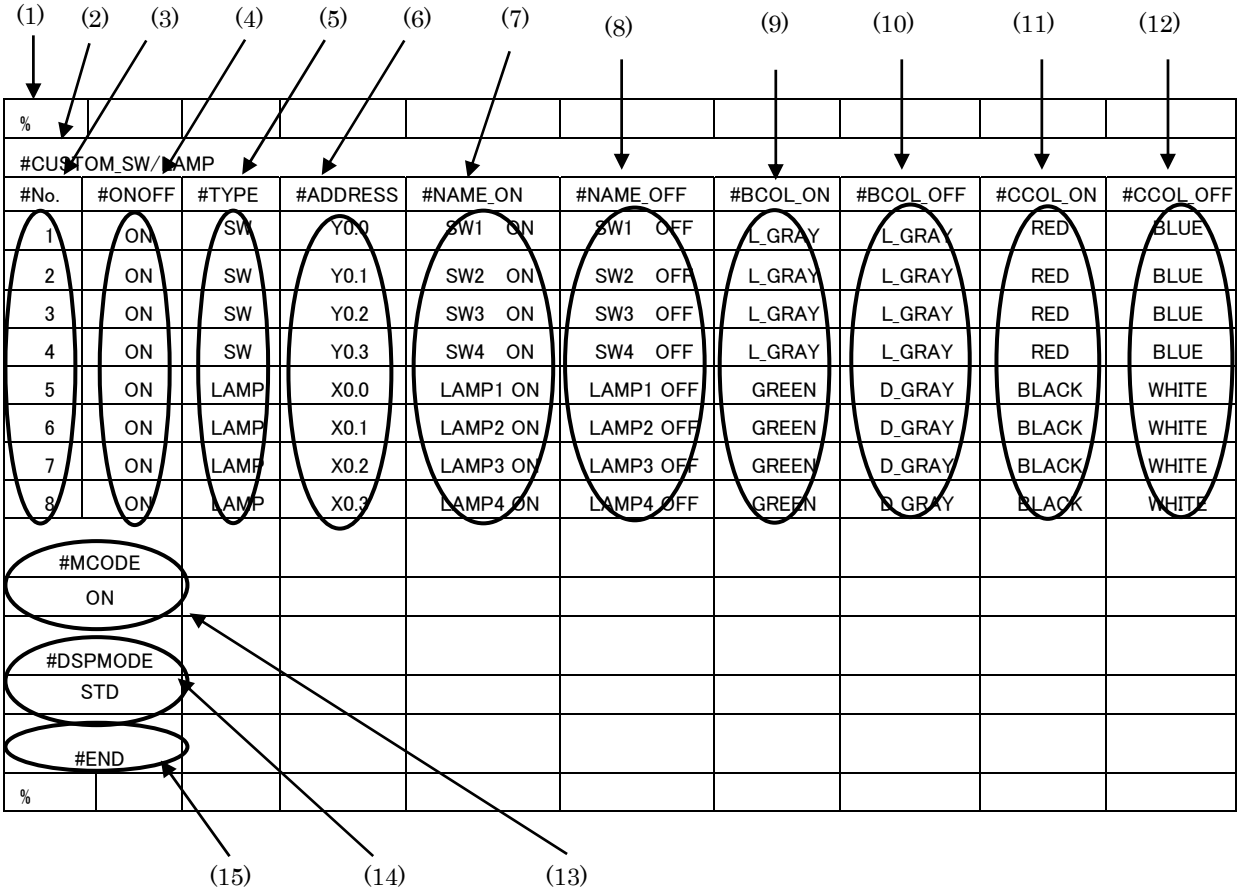


(3) Position the cursor on the file to input, and press soft key [INPUT]. The data contained in the file is input.

42.4.3 Format of Custom Operator's Panel Setting Data

Custom operator's panel setting data is output in the following format. By inputting data created in the following format, the custom operator's panel can be set.

SUPPLEMENT
The following shows an example of an output file opened with spreadsheet software such as Excel. If a file is opened in text format, cells are displayed, separated by a "," (comma).



(1) %
Write "%" at the beginning and end of data.

(2) #CUSTOM_SW/LAMP
Indicate that the setting data is for the custom operator's panel.

(3) #No.
Switch/lamp numbers. They correspond to numbers 1 to 8 on the custom operator's panel setting screen.

(4) #ONOFF
Enable/disable switches/lamps. (ON: Enabled, OFF: Disabled)

(5) #TYPE

Write either SW or LAMP (SW: Switch, LAMP: Lamp)

(6) #ADDRESS

Write the addresses to operate or check with switches/lamps. Write an address type, followed by a number and a bit number, separated by a "." (period).
The range of addresses that can be set is as given below.

Address type	Addresses that can be set
X	X0.0 to X5.7, X200.0 to X327.7
Y	Y0.0 to Y3.7, Y200.0 to Y327.7
R	R2000.0 to R2999.7
D	D7000.0 to D7999.7
K	K35.0 to K44.7

SUPPLEMENTS

- If SW is set as #TYPE, do not write an X address.
- X200.0 to X327.7 and Y200.0 to Y327.7 are options.
- Do not write a Y address used with the external interfaces. (See Section 14.2, "SETTING INPUT/OUTPUT SIGNALS AND FUNCTIONS".)

(7) #NAME_ON

(8) #NAME_OFF

Set the names of a switch or a lamp in the ON and OFF states. (Up to 12 single-byte alphanumeric characters can be used.)

SUPPLEMENT

- If using Japanese two-byte characters, write them in JIS code.
- Simplified Chinese characters and Russian characters can be set. Use GB2312 code for simplified Chinese characters and Cyrillic character code (CP1251) for Russian characters.
- Some two-byte characters cannot be displayed on the CNC.
- If the language of an input two-byte character differs from the ROBODRILL display language, the name may not be displayed correctly.
- If a two-byte character is input as the sixth and seventh bytes, the character is automatically shifted back by one byte.

(9) #BCOL_ON

(10) #BCOL_OFF

(11) #CCOL_ON

(12) #CCOL_OFF

Set the background colors and the character colors of a switch or a lamp in the ON and OFF state.

Color	Indication in the output file
Gray (light)	L_GRAY
Gray (dark)	D_GRAY
Blue	BLUE
Green	GREEN
Red	RED
Yellow	YELLOW
White	WHITE
Black	BLACK

(13) #MCODE

Specify whether to use M codes. (ON: Use, OFF: Not use)

(14) #DSPMODE

Specify the order of displaying the custom operator's panel and vertical soft key. (STD: "Standard", PRI: "Priority")

For details of the display order, see Subsection 42.3.2, "Details of the Custom Operator's Panel Setting Screen".

(15) #END

End the input of custom operator's panel setting data.

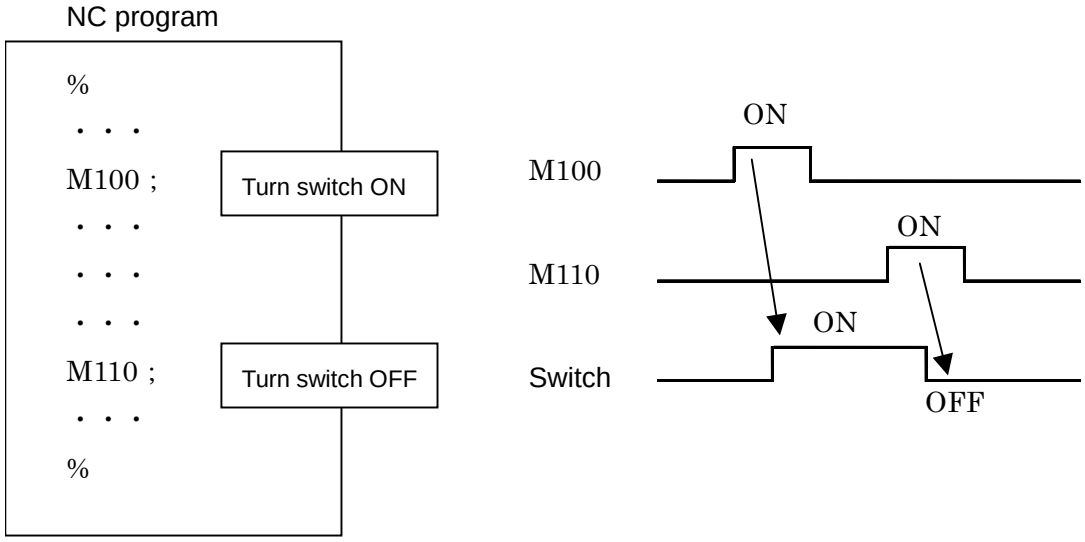
SUPPLEMENT

- If M100 to M129 are set to "USED" with the external interface function, turning any of the M codes ON and inputting it does not turn the corresponding switch/lamp ON.
- If a two-byte character is input as the sixth and seventh bytes of a switch or lamp name, the character is automatically shifted back by one byte.

42.5 M CODE CONTROL OVER SWITCHES

By specifying an M code corresponding to a switch in an NC program, the switch can be turned ON/OFF. The M code for turning each switch ON/OFF can be checked on the custom operator's panel setting screen.

After turning the signal ON/OFF, such an M code automatically proceeds to the next block.



SUPPLEMENT

- To enable M code control over switches, M100 to M129 must be set to "UNUSED" with the external interface function. (Section 14.2, "SETTING INPUT/OUTPUT SIGNALS AND FUNCTIONS")
- An M code cannot be set for a lamp. At the time an M code is set for a lamp, M code control is disabled.
- In the same block, do not specify an M code for turning the same switch ON/OFF more than once.

42.6 RELATED PARAMETERS

[PMC parameter Keep Relay]

No.	#7	#6	#5	#4	#3	#2	#1	#0
K56								

#2 The custom operator's panel function is:
0: Enabled.
1: Disabled.

43 LEARNING CONTROL FOR PARTS CUTTING B (OPTION)

43.1 OVERVIEW

The Learning Control for Parts Cutting B enables high precision to be achieved by minimizing a synchronization error between the spindle and the Z-axis during tapping.
With the Learning Control for Parts Cutting B, rigid tapping within a specified range can be learned by inserting a learning start command (M75 P (tapping number)) and a learning end command (M75 P0) in the tapping program. For each tapping pitch, length, and spindle rotation, specify a tapping number. For one workpiece, up to 24 tapping numbers can be specified. Learning data generated by learning can be stored in the nonvolatile memory of the CNC or an external personal computer for reuse.

43.2 SPECIFICATIONS

Total learning time
16 seconds (when bit 6 of parameter No. 2442 is set to 1)
Tapping figure
Up to 24 types/workpiece

43.3 PROGRAMMING

Learning Control for Parts Cutting B can be turned on/off with the commands indicated below. This function is enabled when rigid tapping is performed in the state where Learning Control for Parts Cutting B is turned on.

M75 P_ ;	**Learning Control for Parts Cutting B ON**
P_ :	Tapping number (1 to 24)
M75 P0 ;	**Learning Control for Parts Cutting B OFF**

SUPPLEMENT
- You can expect for this function also to reduce the cycle time.

When another tapping number needs to be specified in the state where Learning Control for Parts Cutting B is ON, Learning control for parts cutting B OFF need not be specified.
Specify Learning control for parts cutting B ON, tapping numbers, and Learning Control for Parts Cutting B OFF as indicated below.

```
G94 ;
G00 X100. Y100. ;
M75 P1 ;          Learning Control for Parts Cutting B ON.  Tapping number 1 is specified.
M29 S4000 ;       Rigid tapping mode ON
G84 Z-100. R-20. F4000 ;  Learning Control for Parts Cutting B is enabled.  Tapping number is 1.
M75 P2 ;          Tapping number 2 is specified.
X120. Y100. Z-50. ;  Learning Control for Parts Cutting B is enabled.  Tapping number is 2.
Y120. ;           Learning Control for Parts Cutting B is enabled.  Tapping number is 2.
G80 ;             Canned cycle ends.
M75 P0 ;          Learning Control for Parts Cutting B OFF
```

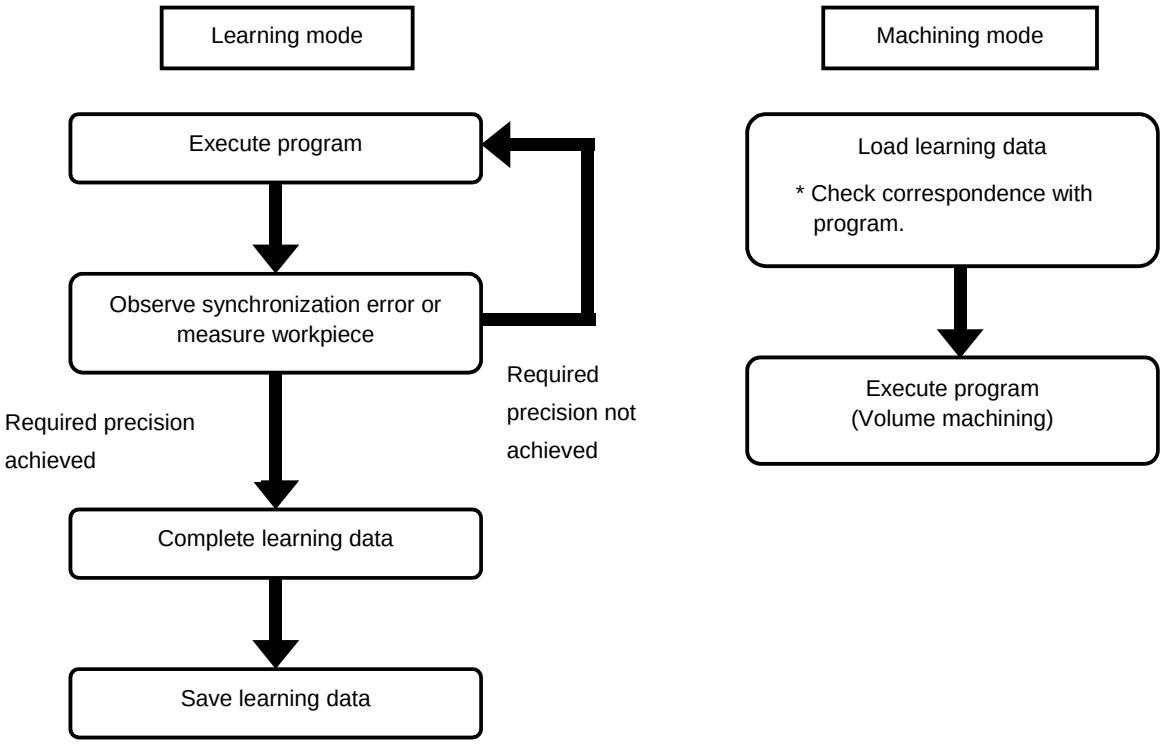
SUPPLEMENT

- Specify the first Learning Control for Parts Cutting B ON command in the block immediately before the M29 S_; command.
- Do not specify the Learning Control for Parts Cutting B OFF command during the canned cycle mode.

43.4 METHOD OF USAGE

Learning Control for Parts Cutting B can be used only when the same workpiece is machined many times. Rigid tapping learning control cannot be used when a workpiece is machined only once.
When Learning Control for Parts Cutting B is used, learning data is created by repeating the execution of a program several times in the learning mode then volume machining is performed by switching to the machining mode.

For details, see Section 43.6, "OPERATION DETAILS".



43.5 SCREEN FOR LEARNING CONTROL FOR PARTS CUTTING B

The screen for Learning Control for Parts Cutting B can display execution state, parameter settings, learning data input/output, and a waveform similar to a Y-Time graph of the Servo Guide Mate. Display the screen by performing the operations below.

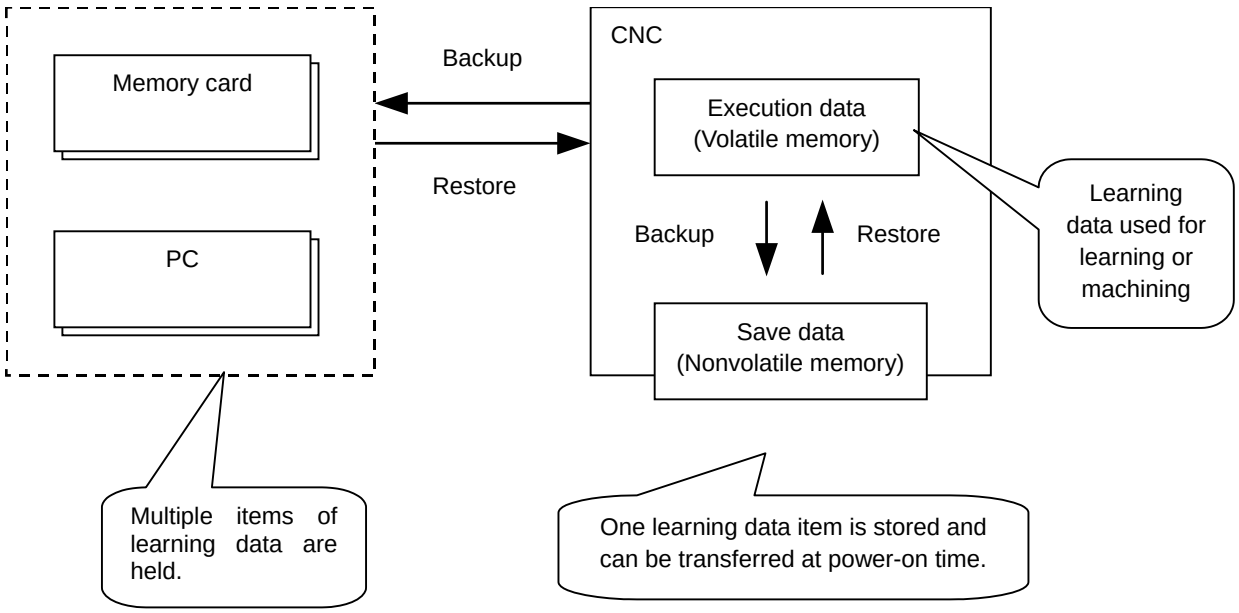
(1) Enter [0] and press the page key, or press the [SYSTEM] key.
(2) Press the rightmost soft key several times to display the [RIGID LEARN] soft key.
(3) Press the [RIGID LEARN] soft key.
(4) The [MONITR], [EXEC DATA], and [SAVE DATA] soft keys are displayed. Pressing these soft keys display the following screens:

[MONITR]:
Displays the monitor screen. Two pages of screens are available. The page key can be used for switching between the two screens. Monitor screen 1 displays the execution state of Learning Control for Parts Cutting B. Monitor screen 2 is used to set learning parameters. At the center of the screen, a waveform similar to a Y-Time graph of the Servo Guide Mate is displayed.

[EXEC DATA]:
Displays the execution data screen. On execution data (detailed later), operations such as data display, data transfer (punch/read/ backup), and data clear can be performed.

[SAVE DATA]:
Displays the save data screen. On save data (detailed later), operations such as data display and data transfer (restore) can be performed.

Learning data used for learning control is stored in the volatile memory of the CNC, and this data is referred to as execution data. Execution data needs to be saved to the nonvolatile memory of the CNC, a memory card, or a personal computer before the power to the CNC is turned off. The nonvolatile memory can store one learning data item, and such data is referred to as save data. Save data can be automatically transferred when the power to the CNC is turned on.
When reusing learning data created before, restore the learning data from the nonvolatile memory, memory card, or personal computer.

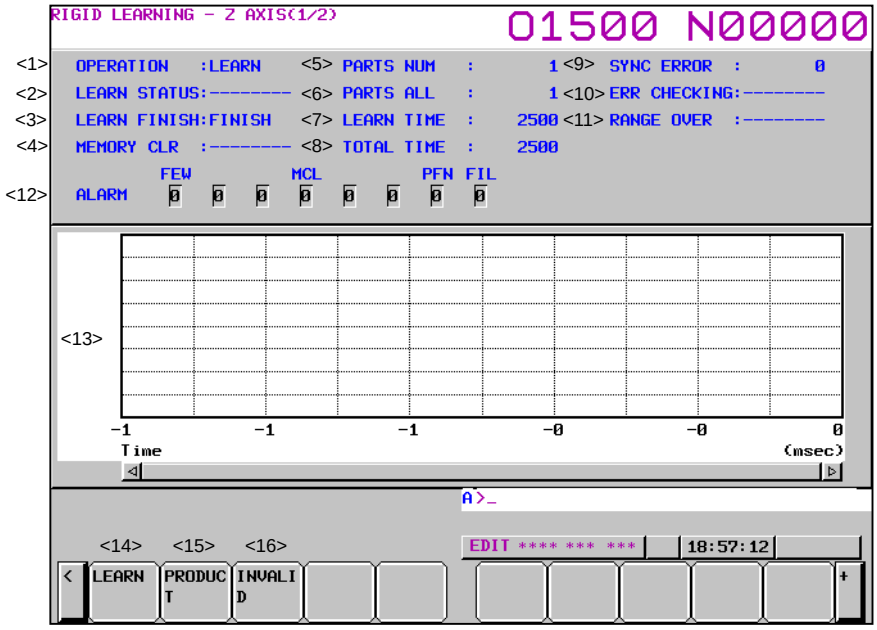


When an attempt is made to transfer (punch/read/backup/restore) learning data from the execution data screen or save data screen, the transfer is terminated with the warning "THE TRANSFER CANNOT BE EXECUTED." in any of the following cases:

A learning axis is not set correctly.
Learning data is being transferred or cleared.
Learning Control for Parts Cutting B is being exercised.
No transferable learning data is available.

Each screen is detailed below.

43.5.1 Monitor Screen 1



<1> OPERATION: Displays LEARN, PRODUCT, or INVALID.
<2> LEARN STATUS: Displays LEARNING while learning is in progress,
<3> LEARN FINISH: Displays FINISH when the execution data is identical to the saved learning data, for example, when learning data has been saved or saved learning data has been restored.
<4> MEMORY CLR: Displays CLR while learning data is being cleared.
<5> PARTS NUM: Displays a specified tapping number.
<6> PARTS ALL: Displays a maximum tapping number. This number returns to 0 when learning data is cleared or saved learning data is restored.
<7> LEARN TIME: Displays a learning time (msec) for a tapping number. This value returns to 0 when learning data is cleared or saved learning data is restored.
<8> TOTAL TIME: Displays the sum of LEARN TIMEs (msec). This value returns to 0 when learning data is cleared or saved learning data is restored.
<9> SYNC ERROR: Displays a rigid tapping synchronization error (No. 0456 on the diagnosis screen).
<10> ERR CHECKING: Displays CHECK while error monitoring is in progress.
<11> RANGE OVER: Displays OVER when a synchronization error beyond the set range is observed in error monitoring (latched until the next learning operation starts).

<12> ALARM: Displays details of a learning-related alarm detected.
FIL: An alarm was detected by a band filter check.
PFN: A tapping number not within the allowable range was detected.
MCL: An alarm was issued in memory clear operation.
FEW: An alarm was issued due to insufficient memory.

<13> Waveform display: Displays a waveform similar to a Y-Time graph of the Servo Guide Mate. Make settings necessary for waveform display on the Servo Guide Mate screen.
(For details, see Subsection 43.6.3, "Setting for Waveform Display".)

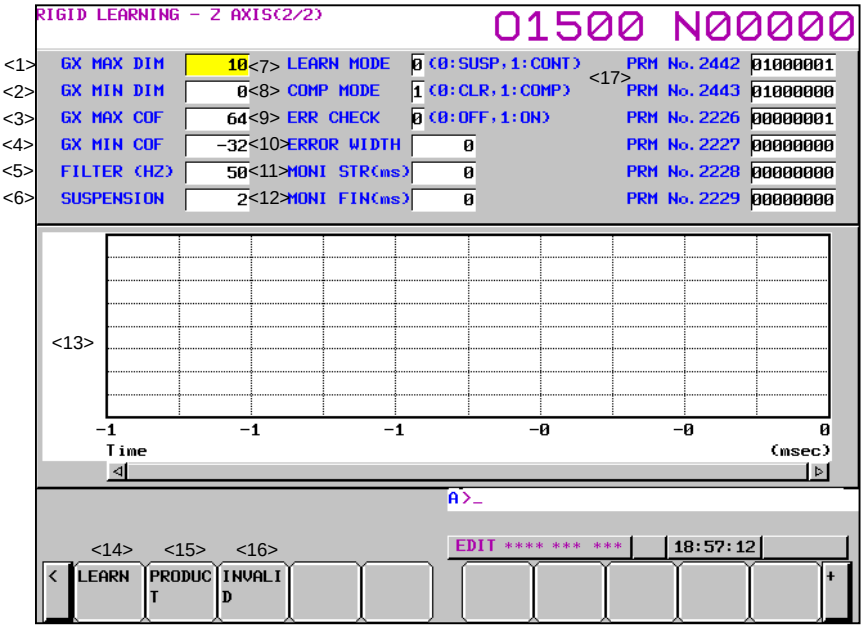
<14> LEARN: Selects the learning mode.

<15> PRODUCT: Selects the machining mode.

<16> INVALID: Disables learning.

SUPPLEMENT
<14> and <15> are valid when no operation is performed on any axis and learning is not in progress.

43.5.2 Monitor Screen 2



<1> GX MAX DIM: Set the maximum number of dimensions of the dynamic characteristics compensation element Gx (parameter No. 2526). By default, 10 is set.

<2> GX MIN DIM: Set the minimum number of dimensions of the dynamic characteristics compensation element Gx (parameter No. 2527). By default, 0 is set.

<3> GX MAX COF: Set the maximum coefficient of the dynamic characteristics compensation element Gx (parameter No. 2528). By default, 64 is set.

<4> GX MIN COF: Set the minimum coefficient of the dynamic characteristics compensation element Gx (parameter No. 2529). By default, -32 is set.

<5> FILTER (HZ): Set the band of the band limit filter (parameter No. 2512). By default, 50 is set.

<6> SUSPENSION: Set the number of learning suspensions (parameter No. 2513). Set 2 for the learning mode. Set 0 for the machining mode.

<7> LEARN MODE: Set a learning mode (bit 4 of parameter No. 2443). Usually, set 0.

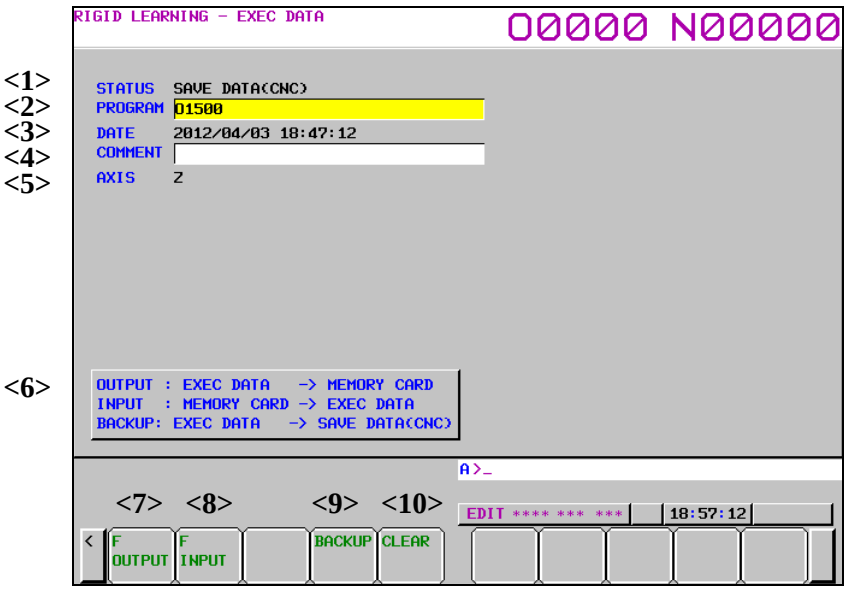
<8> COMP MODE: Set a compensation mode (bit 6 of parameter No. 2443). Usually, set 1.

<9> ERR CHECK: Set error monitoring (bit 1 of parameter No. 2227). Set 1 to perform error monitoring. (By default, 0 is set.)

<10> ERROR WIDTH: Set the monitoring width of synchronization error (parameter No. 2550) in the detection unit.
<11> MONI STR (ms): Set error monitoring start time (parameter No. 2551).
<12> MONI FIN (ms): Set error monitoring end time (parameter No. 2552).
<13> Waveform display: Displays a waveform similar to a Y-Time graph of the Servo Guide Mate. On the Servo Guide Mate screen, make settings necessary for waveform display.
(For details, see Subsection 43.6.3, "Setting for Waveform Display".)
<14> LEARN: Selects the learning mode.
<15> PRODUCT: Selects the machining mode.
<16> INVALID: Disables learning.
<17> Function parameters: Set the function bits related to learning. By default, the parameters are set as follows:

	#7	#6	#5	#4	#3	#2	#1	#0
No.2442	0	1	0	0	0	0	0	1
No.2443	0	1	0	0	0	0	0	0
No.2226	0	0	0	0	0	0	0	1
No.2227	0	0	0	0	0	0	0	0
No.2228	0	0	0	0	0	0	0	0
No.2229	0	0	0	0	0	0	0	0

43.5.3 Execution Data Screen



<1> STATUS: Displays the state of execution data.

NO DATA:	There is no data.
CLEARING:	Data is being cleared.
WRITING:	Data is being written (under learning).
UPDATED DATA:	Data writing is completed (not saved yet).
TRANSFERRING (***%):	Data is being transferred. *** represents the rate of transfer completed.
SAVE DATA (CNC):	Same learning data as saved to the CNC
SAVE DATA (CARD):	Same learning data as saved to the memory card
SAVE DATA (PC):	Same learning data as saved to the PC

<2> PROGRAM: Displays the name of the program corresponding to execution data. This item is automatically set when learning is executed.

<3> DATE: Displays the date and time of updating of execution data. This item is automatically set when learning is executed.

<4> COMMENT: Enter a comment.

<5> AXIS: Displays the name of a learning axis. Usually, Z is displayed.

<6> Explanation: Displays the explanation of soft keys.

<7> F OUTPUT: Punches execution data to the memory card.

<8> F INPUT: Reads execution data from the memory card.

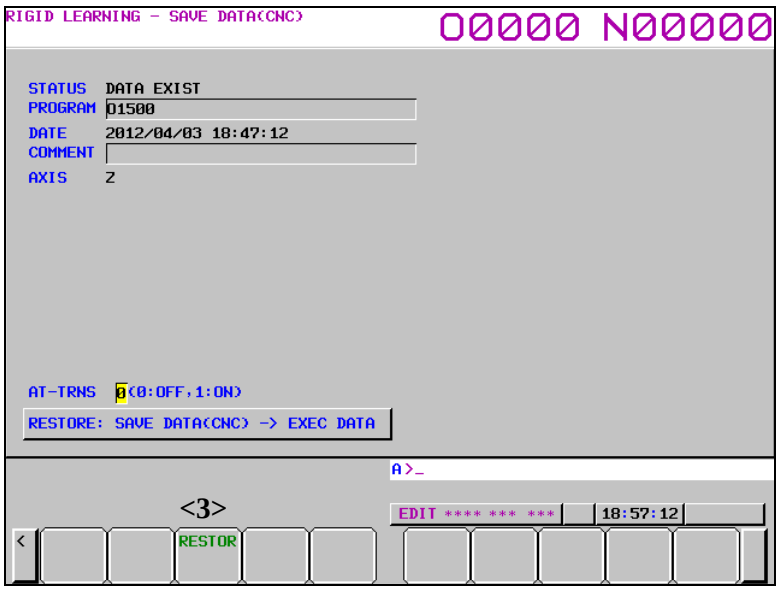
<9> BACKUP: Saves execution data to the nonvolatile memory.

<10> CLEAR: Clears execution data.

SUPPLEMENT

- Perform punch and read operations in the EDIT mode or in the emergency stop state. Perform a reset operation to stop execution.
- Backup operation cannot be executed while learning is in progress, execution data is being cleared, or learning data is being transferred. Press the [STOP] soft key to stop backup operation.

43.5.4 Save Data Screen



<1> STATUS: Displays the state of save data.

NO DATA:
There is no data.

DATA EXIST:
There is data.

TRANSFERRING (***%):
Data is being transferred.
*** represents the rate of transfer completed.

<2> AT-TRNS: Set whether to automatically transfer save data to execution data when the power is turned on.

<3> RESTOR: Transfers save data to execution data.

SUPPLEMENT

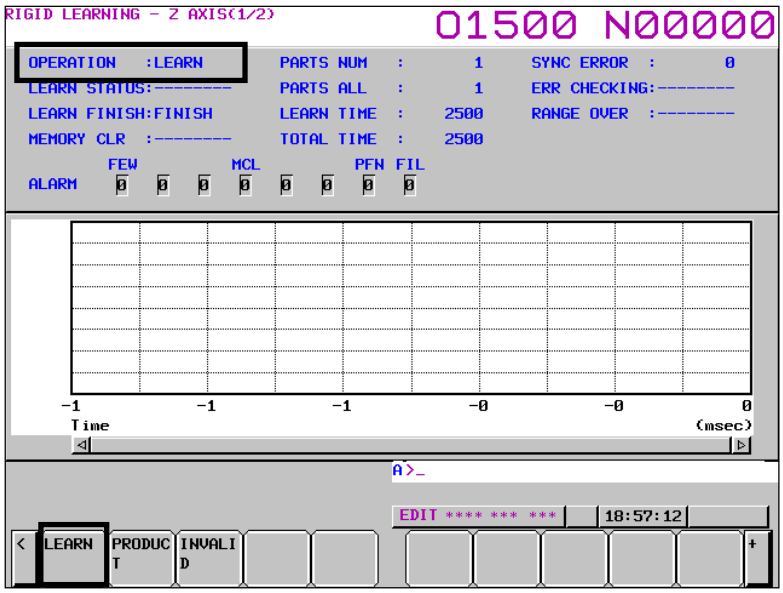
Restore operation cannot be performed while learning is in progress, execution data is being cleared, or learning data is being transferred. Press the [STOP] soft key to stop restore operation.

The other items are the same as for the execution data screen.

43.6 OPERATION DETAILS

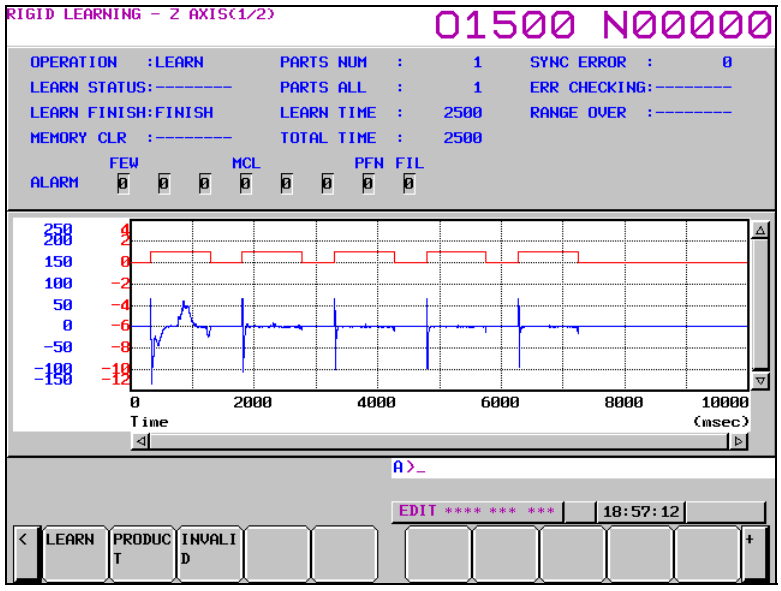
43.6.1 Learning Mode Operation

(1) Switch the operation mode to the learning mode on the monitor screen.

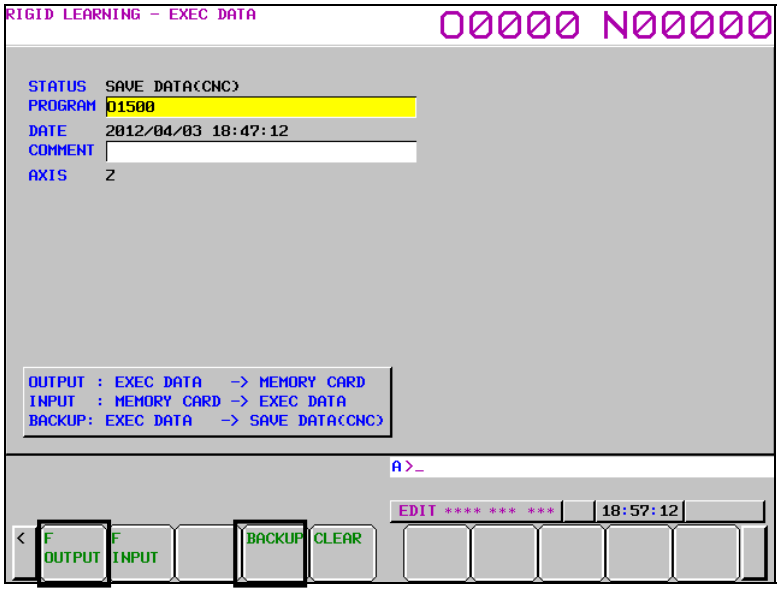


(2) Execute a program including commands for Learning Control for Parts Cutting B ON and OFF. The specified range is learned and learning data is created.

(3) When the program has been executed three to five times repeatedly, the synchronization error converges. Check that the required precision has been achieved, by observing the synchronization error (see Subsection 43.6.3, "Setting for Waveform Display" for the method of waveform display) or making a workpiece measurement.

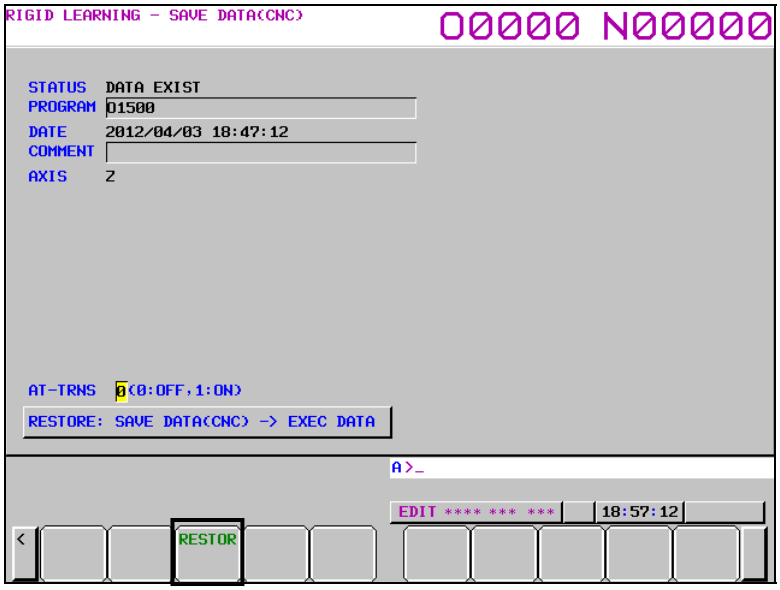


(4) Switch the screen display to the execution data screen then save the learning data. Press [F OUTPUT] to save the learning data to the memory card. Press [BACKUP] to save the learning data to the nonvolatile memory of the CNC. Next, press the [EXEC] soft key to start saving of the learning data.

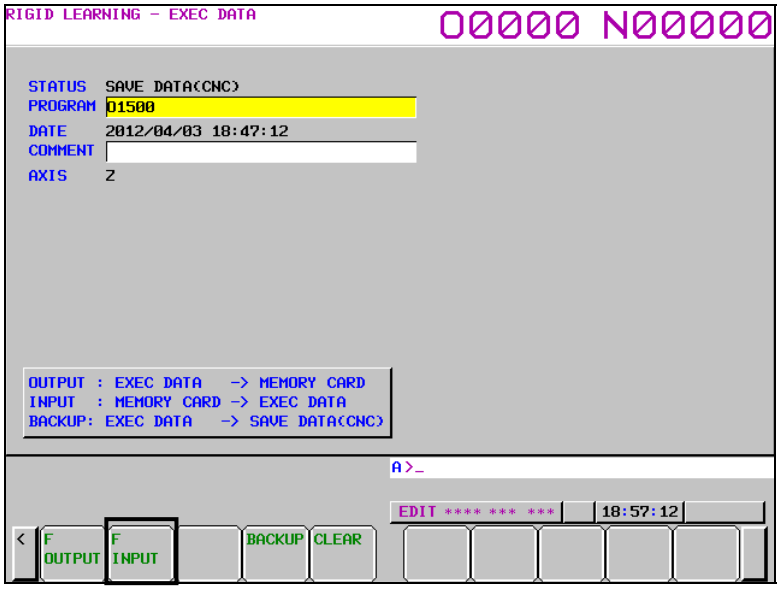


43.6.2 Machining Mode Operation

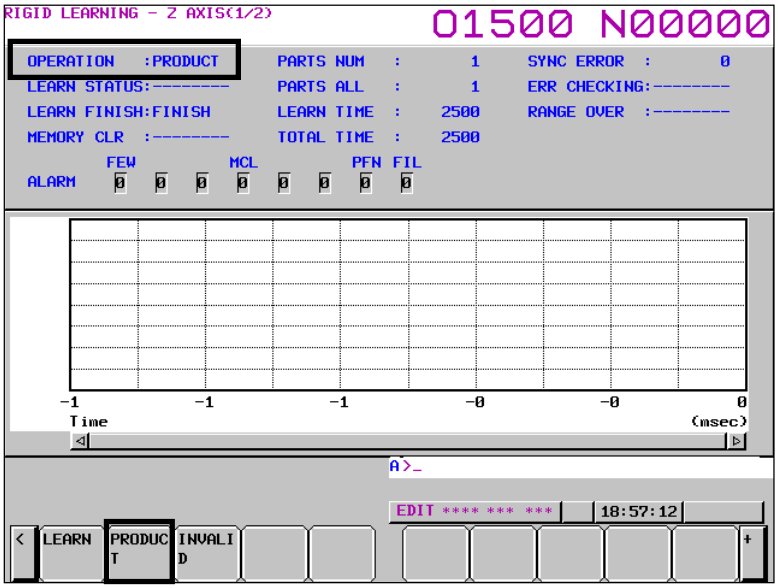
(1) Saved learning data can be loaded. When data saved to the nonvolatile memory of the CNC is to be loaded, press the [RESTOR] soft key on the save data screen then press the [EXEC] soft key.



(2) When data saved to the memory card is to be loaded, press the [F INPUT] soft key on the execution data screen then press the [EXEC] soft key.



(3) Switch the operation mode to the machining mode on the monitor screen.



(4) Execute the program for volume machining.

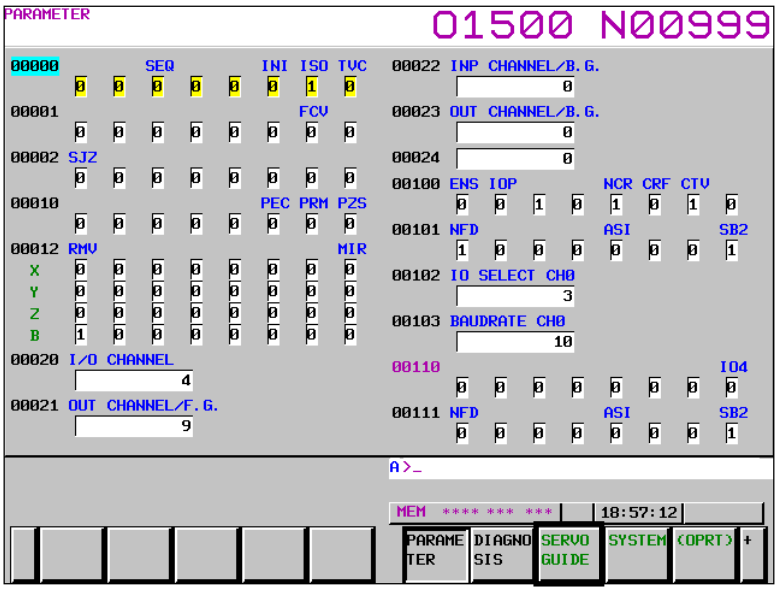
CAUTION

If there is no correspondence between learning data and the NC program, an unpredictable movement can occur. Be sure to check the correspondence between learning data and the NC program.

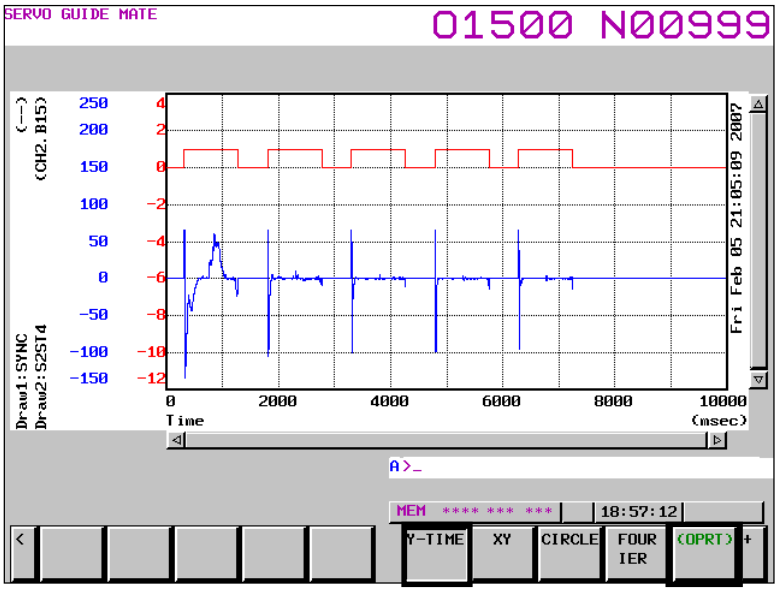
43.6.3 Setting for Waveform Display

A setting for displaying a synchronization error waveform and in-learning flag waveform can be made. The Servo Guide Mate setting screen is used for setting.

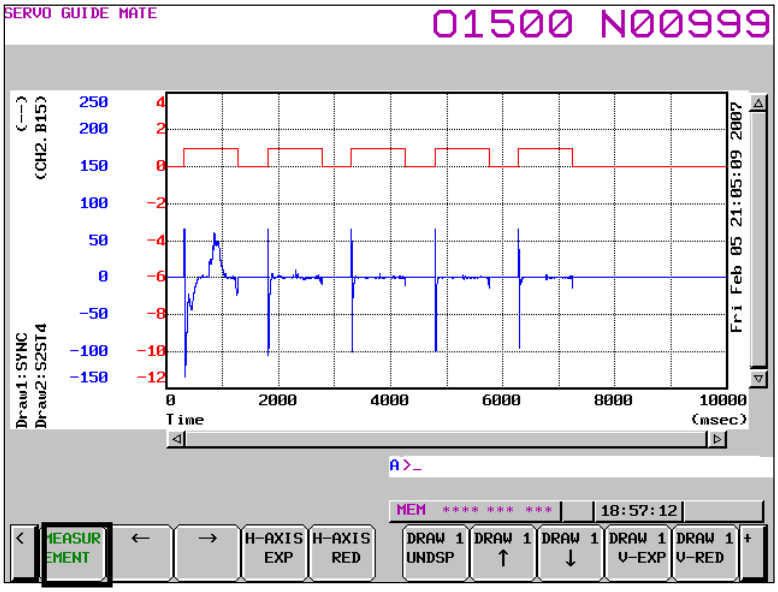
(1) Enter [0] and press the page key, or press the [SYSTEM] key to display the parameter screen. Press the [SERVO GUIDE] soft key.



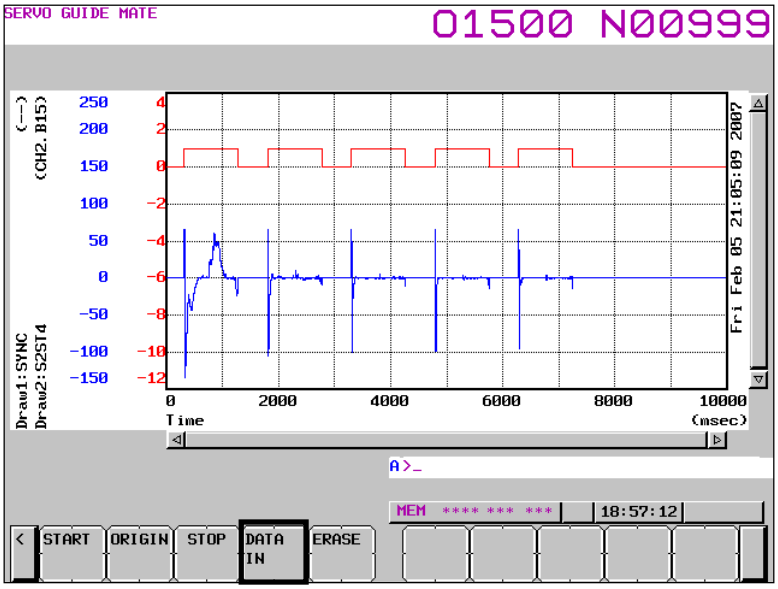
(2) Press the [Y-TIME] soft key then press the [(OPRT)] soft key.



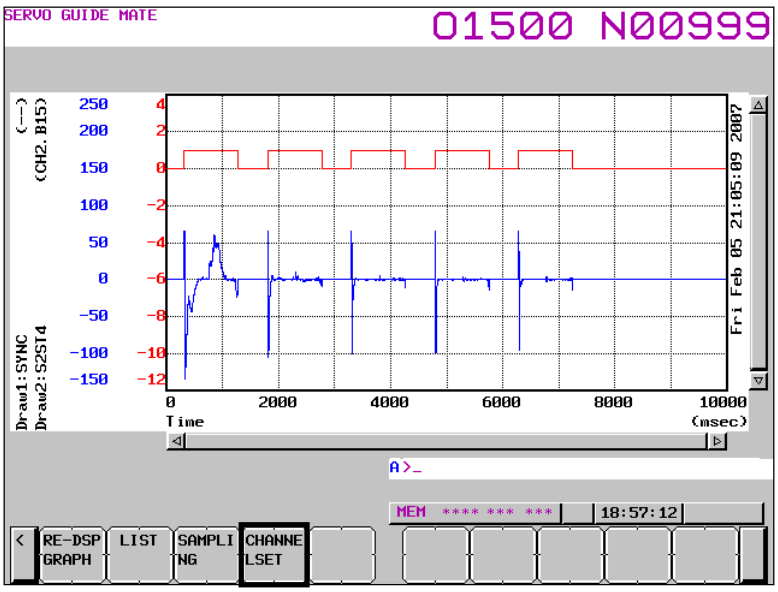
(3) Press the [MEASUREMENT] soft key.



(4) Press the [DATA IN] soft key.



(5) Press the [CHANNELSET] soft key.



(6) The SET CHANNEL screen shown below is displayed. On the screen, set a synchronization error for CH1. Set an in-learning flag for CH2. Enter parameters as shown on the screen.

Synchronization error

Enter 3 (Z-axis) in the item of AXIS for CH1.

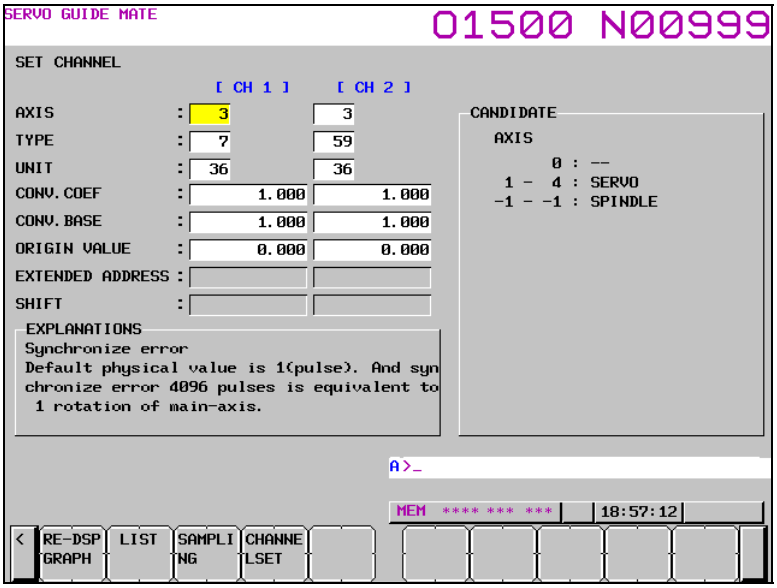
Enter 7 (SYNC) in the item of TYPE for CH1.

In-learning flag

Enter 3 (Z-axis) in the item of AXIS for CH2.

Enter 59 (S2ST4) in the item of TYPE for CH2.

The other items are automatically set.



(7) Press the page key several times to display the OPERATION & GRAPH screen (GRAPH MODE (Y-TIME)) shown below. On the screen, set a synchronization error for Draw 1. Set an in-learning flag for Draw 2. Set parameters as shown on the screen.

Synchronization error

Enter 2 (YT) in the item of OPERATION for Draw 1.

Enter 1 (CH for which a synchronization error is set) in the item of INPUT 1 for Draw 1.

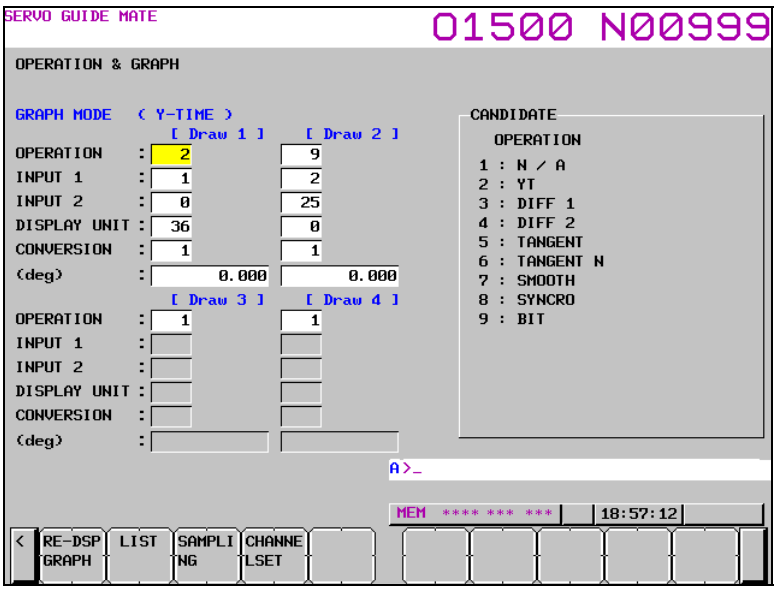
In-learning flag

Enter 9 (BIT) in the item of OPERATION for Draw 2.

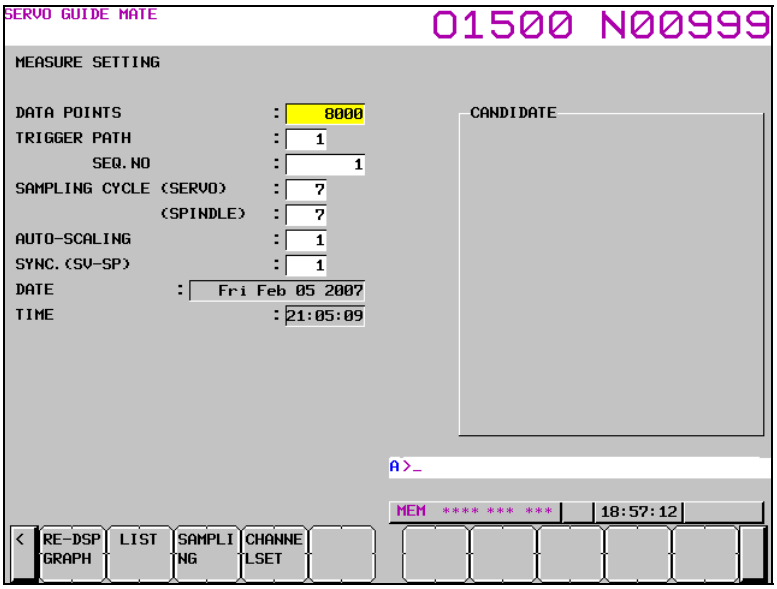
Enter 2 (CH for which an in-learning flag is set) in the item of INPUT 1 for Draw 2.

Enter 25 (BIT15) in the item of INPUT 2 for Draw 2.

The other items are automatically set.

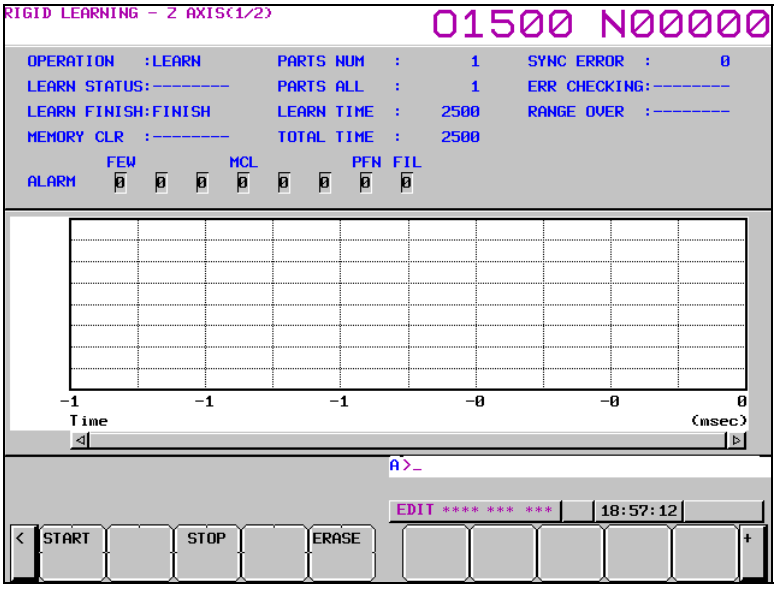


(8) Press the page key several times to display the MEASURE SETTING screen shown below. Set parameters such as DATA POINTS and SAMPLING CYCLE.



- DATA POINTS:
  Set a numerical value from 1 to 10000. A set value represents the number of data items measured. The number of data points multiplied by a sampling cycle equals a data measurement time. If a sampling cycle set for the servo axis differs from a sampling cycle set for the spindle, the number of data points for a shorter sampling cycle is meant.
- TRIGGER PATH, SEQ. NO:
  Set a measurement start trigger with a path number and sequence number. Enter 1 in TRIGGER PATH. Enter a number from 0 to 99999 in SEQ. NO. If 0 is entered, a measurement is started immediately when the [MEASUREMENT] soft key and [START] soft key are pressed in this order.
- SAMPLING CYCLE:
  Set a sampling cycle separately for each of the servo axis and spindle by using a numeric value. The specifiable values are displayed on the right side of the screen.
- AUTO-SCALING:
  Set whether to perform auto-scaling for each measurement, by using a numeric value. The specifiable numbers are: 1 (= Not executed), 2 (= Executed only once), and 3 (= Executed each time).
- SYNC.(SV-SP):
  Enter 1 (= Not selected). (This item is not used for rigid tapping learning control.)

(9) When displaying a synchronization error waveform, display the monitor screen dedicated to learning control for parts cutting B then press the rightmost soft key to display the [MEASUREMENT] soft key. Next, press the [MEASUREMENT] soft key. The soft keys shown on the screen below are displayed.



(10) Press the [START] soft key. When the screen displays "Now Sampling...", execute the program. Upon comp of measurement, a synchronization error waveform and in-learning flag waveform are displayed.

CAUTION

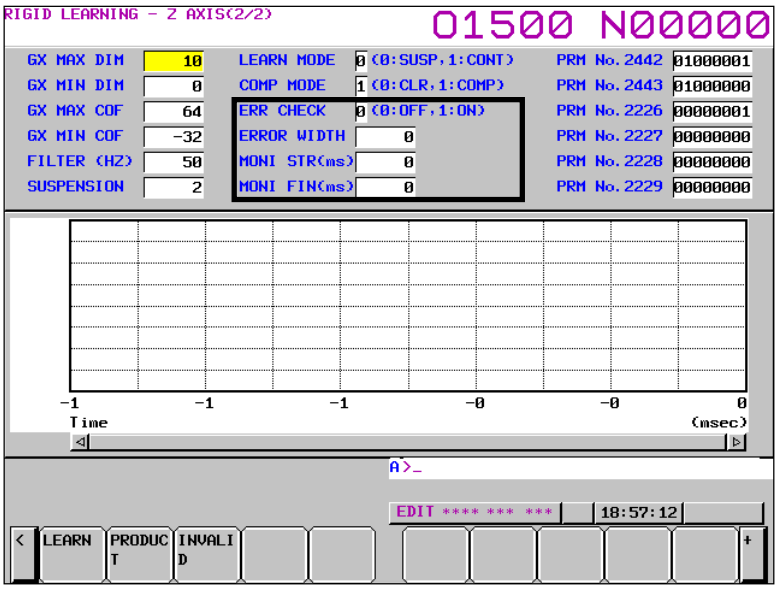
A synchronization error displayed by the setting above is a spindle-converted synchronization error. To display a Z-axis-converted synchronization error, enter the following value in the item of CONV. COEF on the SET CHANNEL screen:

- CONV. COEF = (10000 × Screw pitch [mm])/ 4096

43.6.4 Synchronization Error Monitoring

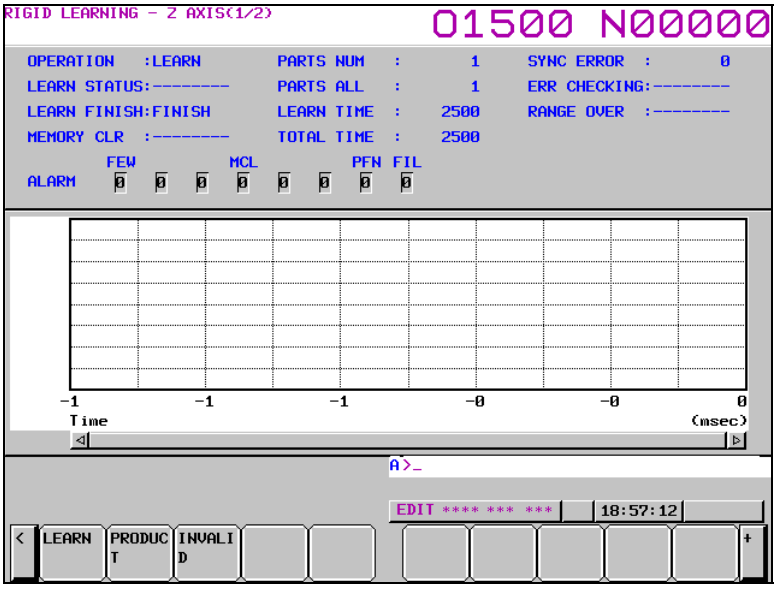
A synchronization error can be monitored. This function is useful for checking the convergence of synchronization error at the time of learning data creation or for making a simplified workpiece precision check in volume machining.

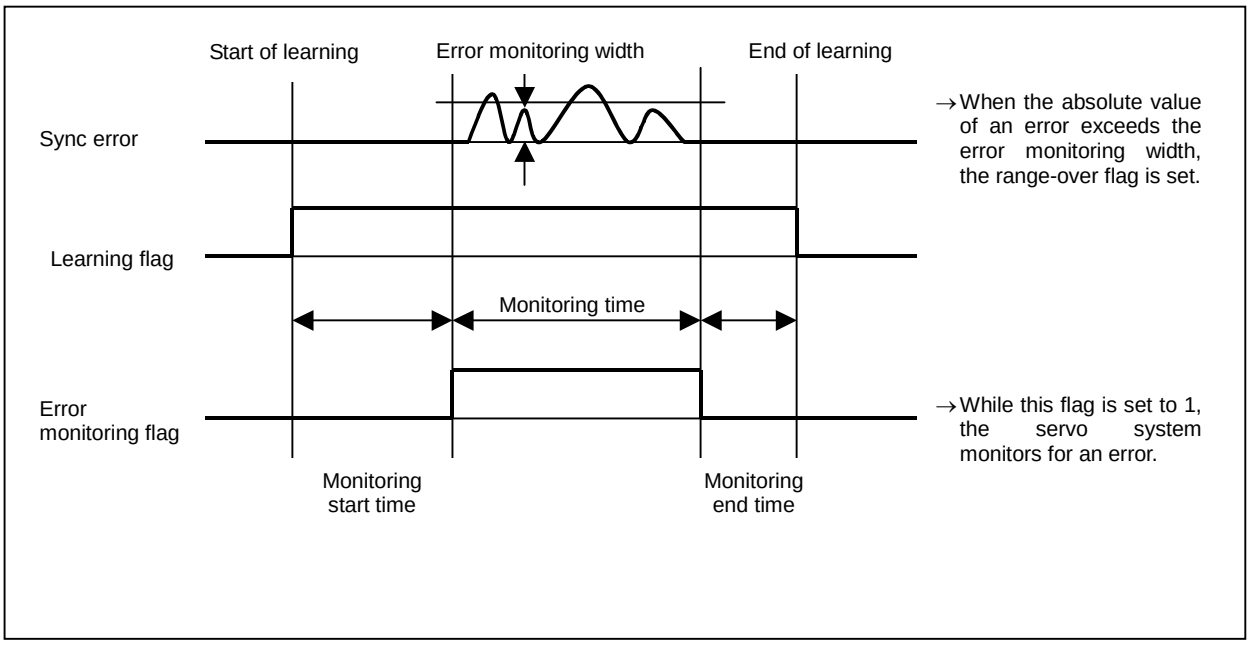
(1) Set the parameters indicated below on monitor screen 2.



Set 1 in ERR CHECK (bit 1 of parameter No. 2227).
Set a synchronization error monitoring width in ERROR WIDTH (parameter No. 2550).
Enter a Z-axis-converted value.
When 0 is set, error monitoring is not performed.
Set MONI STR (parameter No. 2551) and MONI FIN (parameter No. 2552).
At the start and end of rigid tapping, physical movement is disabled, resulting in a larger synchronization error. These portions are irrelevant to tapping precision. So, set a monitoring start time and monitoring end time to exclude these portions from synchronization error monitoring.

(2) During error monitoring, CHECK is displayed in the item of ERR CHECKING on monitor screen 1. When a synchronization error larger than the set error monitoring width is observed, OVER is displayed in the item of RANGE OVER.





CAUTION

If the error monitoring width is exceeded even once while the error monitoring flag is set to 1, the range-over flag is latched to 1 (not cleared until the learning flag is switched from 0 to 1).

43.7 RELATED PARAMETERS (DEFAULT SETTINGS)

[NC parameter]

No.	Axis	#7	#6	#5	#4	#3	#2	#1	#0	Default
2019	Z								RIGIDL	00000001

#0 RIGIDL Learning Control for Parts Cutting B is:
0: Disabled.
1: Enabled.

CAUTION
After this parameter is modified, the power must be turned off then back on for the modification to become effective.

No.	Axis	#7	#6	#5	#4	#3	#2	#1	#0	Default
2226	Z								QUCKST	00000001

#0 QUCKST Learning control is started:
0: When the learning flag is turned on and the command ≠ 0.
1: Immediately when the learning flag is turned on.

No.	Axis	#7	#6	#5	#4	#3	#2	#1	#0	Default
2227	Z							ERRCHE		00000000

#1 ERRCHE Error monitoring is:
0: Not enabled.
1: Enabled.

No.	Axis	#7	#6	#5	#4	#3	#2	#1	#0	Default
2442	Z		FRC1WD						ERRSEL	01000001

#0 ERRSEL The learning target is:
0: Positional deviation.
1: Synchronization error (Learning Control for Parts Cutting B).

CAUTION
Be sure to set this parameter to 1.

#6 FRC1WD Learning data for HRV2 is:
0: 2 words.
1: 1 word (default).

CAUTION
Be sure to set this parameter to 1.

No.	Axis	#7	#6	#5	#4	#3	#2	#1	#0	Default
2443	Z		ICM		LCON					01000000

#4 LCON The learning mode is set to:
0: Suspension mode.
1: Continuation mode.

CAUTION
When the number of learning suspensions (parameter No. 2513) is 0 in the learning suspension mode, the learning mode is not changed (machining mode).

#6 ICM The compensation data mode is:
0: Not set. (Learning data is cleared.)
1: Set. (Learning data is preserved.)

No.	Axis			Default
2512	Z	FBND	Band limit filter band (Hz)	50

[Valid data range] 0 to 350 (in steps of 25)
To maintain the stability of the system, band limitation is applied to the learning controller. Usually, set a maximum value that does not cause vibration. If the speed command includes a frequency component exceeding FBND, the deviation corresponding to the component does not converge.

CAUTION
When 0 is set in this parameter, learning is not performed. (Learning control can be disabled without turning off the power.)

No.	Axis			Default
2513	Z	BRCT	Number of learning suspensions (cycles)	2

[Valid data range] 0 to 32767
Setting = 0 : In the suspension mode, learning data is not updated.
Setting ≠ 0 : Learning data is updated.

To create learning data, set a value (2 by default) other than 0. After the error converges to 0, 0 is usually set in this parameter so that learning data is not updated. When continuing learning to suppress influences such as changes due to aging, maintain the setting of 2.

No.	Axis			Default
2526	Z	GODMX	Maximum number of dimensions of the dynamic characteristics compensation element Gx	10

[Valid data range] 0 to 20

No.	Axis			Default
2527	Z	GODMN	Minimum number of dimensions of the dynamic characteristics compensation element Gx	0

[Valid data range] 0 to GODMX

No.	Axis			Default
2528	Z	GCOEF	Maximum coefficient of the dynamic characteristics compensation element Gx	64

[Valid data range] 0 to 128

No.	Axis			Default
2529	Z	EXGXK2	Minimum coefficient of the dynamic characteristics compensation element Gx	-32

[Valid data range] -128 to 0

SUPPLEMENT
When 0 is set in this parameter, (No. 2529) = 32 - (No. 2528) internally.

The dynamic characteristics compensation element Gx consists of GODMX (No. 2526), GODMN (No. 2527), GCOEF (No. 2528), and EXGXK2 (No. 2529). For Gx adjustment, change the values of GODMX and GODMN.

No.	Axis		Default
2535	Z	Number of manual thin-out operations	0

[Valid data range] 0 to 4
Learning data is thinned out by 2^n.

CAUTION
When 2 is set in this parameter, the total learning time is increased by a factor of 4 but the precision can degrade.

No.	Axis			Default
2550	Z	LERRLV	Error monitoring level	0

[Valid data range] 0 to 32767

CAUTION
When 0 is set in this parameter, error monitoring is not performed.

No.	Axis		Default
2551	Z	ERMOST Error monitoring start time (msec)	0

[Valid data range] 0 to 32767

No.	Axis		Default
2552	Z	ERMOFN Error monitoring end time (msec)	0

[Valid data range] 0 to 32767

This error monitoring function is useful for checking the convergence of synchronization error at the time of learning data creation or for making a simplified workpiece precision check in volume machining.

No.	Axis		Default
2554	Z	Parameter for rigid tapping synchronization error (msec)	0

[Unit of data] msec
[Valid data range] 0 to 24

Usually, parameter No. 2554 is not modified.

No.	#7	#6	#5	#4	#3	#2	#1	#0	Default
10345								PWT	00000000

#0 PWT At power-on time, save data is:
0: Not automatically transferred to execution data.
1: Automatically transferred to execution data.

No.	#7	#6	#5	#4	#3	#2	#1	#0	Default
10346			LFO	LRO	LIP	LCC	LSS	LIG	00000000

#0 LIG The Learning Control for Parts Cutting B start command and end command (G5.6/G5.5) are:
0: Valid.
1: Invalid.

#1 LSS Signal-based switching of the operation mode for Learning Control for Parts Cutting B is:
0: Invalid.
1: Valid.

#2 LCC If an improper signal operation is performed during Learning Control for Parts Cutting B:
0: Rigid tapping learning is stopped with PS0460.
1: The learning stop signal LNSTP<F0526#4> is set to 1 to disable learning control then a feed hold stop occurs.

#3 LIP In-position checking during Learning Control for Parts Cutting B is:
0: Invalid.
1: Valid.

#4 LRO Rapid traverse override signal checking during Learning Control for Parts Cutting B is:
0: Invalid.
1: Valid.

#5 LFO Feedrate override signal checking during Learning Control for Parts Cutting B is:
0: Invalid.
1: Valid.

[DIAGNOSIS INFORMATION]

No.	Axis	#7	#6	#5	#4	#3	#2	#1	#0
3540	Z			FIN	MOD	CLR	RNG	ERR	LRN

#0 LRN Learning Control for Parts Cutting B is:
0: Not executed.
1: Being executed.

#1 ERR Error monitoring is:
0: Not executed.
1: Being executed.

#2 RNG In error monitoring:
0: No range-over occurred.
1: A range-over occurred.

#3 CLR Execution data is:
0: Not cleared.
1: Being cleared.

#4 MOD The operation mode is:
0: Machining mode.
1: Learning mode.

#5 FIN Learning data is:
0: Not completed.
1: Completed.

No.	
3542	Tapping number for learning control for parts cutting B

This parameter indicates a tapping number for Learning Control for Parts Cutting B. This parameter is updated when the Learning Control for Parts Cutting B ON command (M75 P_) is specified.

No.	
3543	Total number of tapping numbers for learning control for parts cutting B

This parameter indicates the total number of tapping numbers for Learning Control for Parts Cutting B. After saved learning data is restored or execution data is cleared, this parameter is cleared to 0 then indicates the maximum tapping number of the Learning Control for Parts Cutting B ON command (M75 P_).

No.	Axis	
3544	Z	Learning time for each part under learning control for parts cutting B (msec)

This parameter indicates a learning time for each part under Learning Control for Parts Cutting B. This parameter indicates 0 at the first updating of learning data. When a second or subsequent Learning Control for Parts Cutting B ON command (M75 P_) is specified, the learning time of the specified part is indicated.

No.	Axis	
3560	Z	Learning time for all parts under learning control for parts cutting B(msec)

This parameter indicates a learning time for all parts under Learning Control for Parts Cutting B. This parameter indicates 0 at the first updating of learning data. When a second or subsequent Learning Control for Parts Cutting B ON command (M75 P_) is specified, the learning time of the specified parts is indicated.

43.8 ALARMS

No.	Message	Description
PS0380	LEARN DATA TRANS ERROR (HARD)	• The size of DRAM is insufficient. • The FROM does not allow a learning data file to be created.
PS0381	LEARN DATA TRANS ERROR (NC)	• Learning data not matching the setting of parameter No. 1023, No. 2510, or No. 2511 was transferred. • Learning data including a mismatching learning axis name was transferred. • An attempt to transfer learning data failed.
PS0382	LEARN DATA TRANS ERROR (SERVO)	• An attempt to transfer learning data failed (SERVO).
PS0383	LEARN DATA TRANS ERROR (SUM CHK)	• An attempt to transfer learning data failed (sum check).
PS0385	LEARN DATA TRANS ERROR (INTERRUPT)	• Learning data transfer was interrupted by a power failure.
PS0464	ABOUT LEARNING CONTROL FOR RIGID TAPPING	• An improper signal operation was performed at the start of learning or during learning. • A tapping number not within the allowable range was specified.
PS0465	ILLEGAL LEARNING DATA	• Learning data not corresponding to the program was selected.

43.9 RESTRICTIONS

The restrictions indicated below are imposed on Learning Control for Parts Cutting B.

(1) Applicable workpieces
Learning Control for Parts Cutting B can be used only when the same workpiece is machined many times. Learning Control for Parts Cutting B cannot be used when a workpiece is machined only once.
Feed per minute (learning control of time synchronization type) is supported. Feed per revolution is not supported presently.

(2) Handling of parts
If workpieces of the same figure are machined at different speeds, each workpiece is treated as a different part.
If workpieces of the same figure have different cutting resistances, each workpiece may be treated as a different part from the viewpoint of precision.

(3) NC program and learning data checking
At the start of learning, the main program and the main program information (directory name and program name) included in learning data are checked. If the correspondence is invalid, PS0461 is output.

(4) Signal operation
The same operation pattern needs to be used for execution of a learning portion. During learning, do not operate the following input signals that change the operation pattern:
- Interlock, feed hold, machine lock, dry run, single block, override, etc.

(5) Learning data transfer
Do not modify parameters while a learning data transfer operation (punch/read/backup/restore) is being performed.

(6) Learning data transfer time
For learning data transfer time, use the table below as reference information. The time of transfer using a memory card may vary, depending on the memory card used.

	Transfer mode	Transfer time
<1>	Execution data → Save data	About 8 sec
<2>	Execution data ← Save data	About 3 sec
<3>	Execution data → Memory card	About 5 sec
<4>	Execution data ← Memory card	About 7 sec
<5>	Execution data → PC	About 8 sec
<6>	Execution data ← PC	About 8 sec

V. MAINTENANCE

1 DAILY MAINTENANCE

The following table shows the maintenance jobs described in Chapter 5 and the persons who are qualified to do the jobs. For descriptions of the operator, person in charge of routine maintenance and preventive maintenance, and maintenance engineer, see PREFACE.

Qualified personnel	Job allowed
Operator	Jobs described in Section V-1, "DAILY MAINTENANCE".
Person in charge of routine maintenance and preventive maintenance	Jobs not described in Subsections 2.6.1 (1), 2.6.1.2, and 2.6.3 of the jobs in Section V.2, "PERIODICAL MAINTENANCE"
Maintenance engineer	Jobs described in Subsections 2.6.1 (1), 2.6.1.2, and 2.6.3 of the jobs in Section V.2, "PERIODICAL MAINTENANCE"

1.1 DAILY CHECK–UP

For safety use of the product, make the following checkups before using the machine.

1.1.1 Cleaning

Before turning on the power to the machine, clean the machine as follows.

(1) Remove cut scraps from the area surrounding the spindle, in particular, the keys and gear.
(2) Wipe the tapered portion of the tool attached to the turret and the tapered portion of the spindle clean. Remove the chippings adhering to the grip.

(3) Spray oil (CRC–556 or equivalent) on the top of the table and the telescopic covers.
(4) Wipe the entire operator's panel with a soft cloth. If the operator panel is severely soiled, clean it with a neutral detergent and then wipe it with a dry cloth.

1.1.2 Replenishing the Tank with Coolant

⚠ WARNING

1 Do not use a coolant with a low flash point (category II mineral oil or another type of oil with a flash point lower than 70°C) to prevent the possibility of a fire. Even when using a coolant belonging to category III mineral oil (with a flash point of 70 to 200°C), category IV mineral oil (with a flash point of 200 to 250°C), or flame-retardant oil (with a flash point higher than 250°C), be careful with the use status and method to prevent the possibility of a fire by, for example, preventing the generation of greasy fumes or applying a coolant rightly at the cutting point.
2 Do not use a deteriorated coolant or lubricant (grease or oil) because it is very hazardous. For details on the state of a deteriorated coolant or lubricant, contact the manufacturer and preserve or discard it as instructed by the manufacturer.
3 Do not use a coolant or lubricant (grease or oil) that deteriorates polycarbonate, nitrile rubber (NBR), hydrogenated nitrile rubber (HNBR), fluorocarbon rubber, nylon, or acryl ate resin, ABS resins. If diluted water includes much residual chlorine, the above materials are deteriorated. Since these materials are used for sealing in this system, sealing becomes incomplete, which may cause an electric shock due to electric leakage or seizing up due to outflow of grease.
4 Always keep a sufficient amount of a coolant. If a coolant is insufficient, a fire due to a rise in temperature may be caused or the cutting tool or workpiece may be broken.

ATTENTION

1 Manage the coolant according to the directions from its manufacturer properly as for its pH, the way its undiluted solution is mixed with dilution water, the salinity concentration of the dilution water, and the frequency at which the coolant is replaced. Otherwise, the machine may get rust or corroded, leading to trouble on the machine.
2 Do not use the coolants as described below because they may affect the machine adversely and cause a failure.
- Coolant containing sulfur with a high reactivity: Some coolants contain sulfur with a high reactivity. If they enter the inside of the machine, they corrode metals such as cupper or silver, thereby causing components to fail.
- Synthetic coolant with a high permeability: Some coolants containing polyalkylene glycol have a high permeability and may cause insulation degradation, poor lubrication, or a component failure when entering the inside of the machine.
- Water-soluble coolant with a high alkalinity: Some coolants containing alkanolamine for raising its pH have a pH of 10 or higher. If these coolants adhere for an extended period of time, materials of resin may degrade due to chemical reactions.
- Coolant containing chlorine: Some coolants containing chlorine (for example, chloride components, such as chlorinated paraffin) affect materials such as resin and rubber badly, leading to possible defective parts.

A coolant goes down gradually as it is used. A water-soluble coolant, in particular, goes down by a substantial amount a day because of water evaporation. At the beginning of every workday, be sure to check the amount of the coolant. If it is low, replenish or dilute it with water.

A coolant gage is on the rear side surface of the tank.
Replenish the tank with the coolant so that the value indicated by the indicator does not exceed H.
Use the cut scrap receiver when pouring additional coolant or water in the tank.
Water-soluble coolant must be diluted with water in advance and poured into the tank via the cut scrap receiver. If water is directly poured via the cut scrap receiver, rust may be formed on the perimeter.

ATTENTION

1 Skim off oil on the coolant in the tank frequently to remove oil from the coolant completely. If the amount of oil in coolant is reduced, the amount of sludge to be generated can be reduced.
2 Keep the coolant fresh all the time. New coolant emulsifies the oil in sludge again with its surfactant property, having a certain effect of cleaning sludge attached to the machine.

For details on coolants, see 2d "COOLANTS AND LUBRICANTS" in "SAFETY PRECAUTIONS, I-7 "COOLANT", and III-8 "COOLANT SUPPLY".

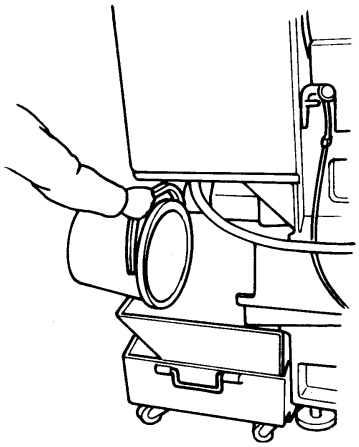


Fig.1.1.2 Daily Maintenance (1)

1.1.3 Inspecting Cutters

Check whether the tools set in the turret correspond correctly to the tool numbers marked on the turret, whether the tools are broken, and whether the tools are entwined with cut scraps.
Respecify the offset amount and replace the tool that is worn out with a new one as required.

1.1.4 Inspecting Each Section

Before applying power, double-check that the machine is normal.
For countermeasures against abnormalities, refer to the maintenance manual.

(1) Are the telescopic covers damaged?
(2) Is there any foreign matter on the table or telescopic covers?
(3) Are the tools firmly mounted on the turret?
(4) Is the jig firmly secured to the table?
(5) Have cut scraps collected inside the machine?
(6) Does the coolant tank contain enough coolant?
(7) Is the amount of grease and lubricant for the lubricating pump is sufficient? (In the case of the automatic lubricant unit)
(8) Is there cloud or foreign matter such as chippings in lubricant in the tank of the lubricating pump? (In the case of the automatic oil lubrication)

1.2 WORK AT CLOSING TIME

1.2.1 Removing Cut Scraps

If cut scraps are left in the machine, the mechanical section will be damaged because the cut scraps gather in the mechanical section.
To prevent this, be sure to remove the cut scraps in the machine everyday at closing time according to the following procedure. Before removing them, however, turn off the power to the machine for safety.

> ⚠ **WARNING**
> Before performing work at closing time, be sure to turn off the power.
> Otherwise, the operator may get injured by an unexpected operation.

(1) Sweep away the cut scraps off the turret and the area surrounding the spindle.

> **ATTENTION**
> Remove metal chips and other extraneous materials from the cooling air vents (both intake and exhaust) of the spindle motor to secure air flow, using a brush.

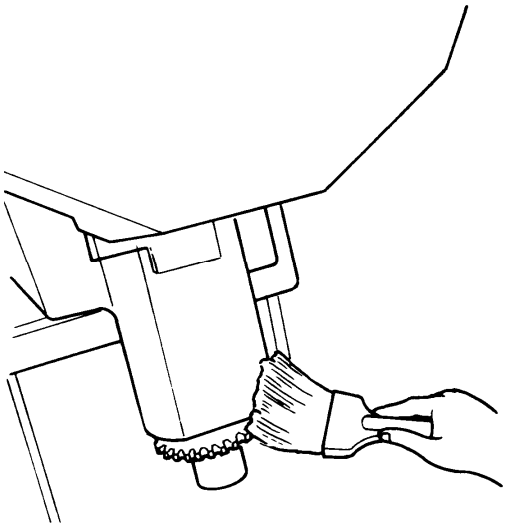


Fig.1.2.1(a) Daily Maintenance (2)

(2) Remove the cut scraps from the Z–axis cover and the surrounding area.

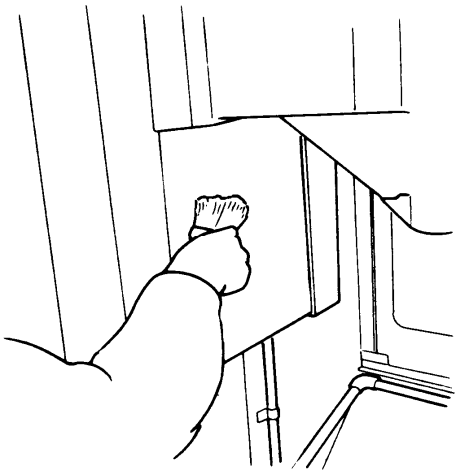
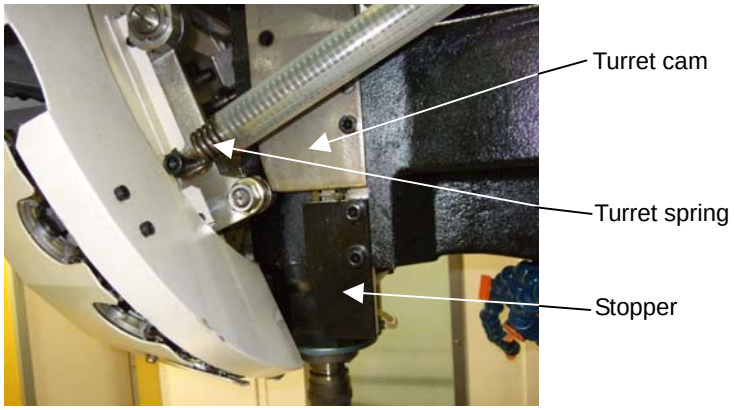


Fig.1.2.1(b) Daily Maintenance (3)

(3) Brush off chippings on the turret cam, stopper, and turret spring.

ATTENTION
If chippings adhering to the vicinity of the turret are left for an extended period of time, the turret mechanical unit may be damaged.



(4) Brush chips on the door rail under the front door.

ATTENTION
If chips are left on the door rail, the door may not be opened and closed normally or the bearing roller may be broken.

(5) Sweep away the other cut scraps.
(6) Sweep away the cut scraps on the table.
(7) Sweep away the cut scraps on the X–axis telescopic cover.
(8) Sweep away the cut scraps on the Y–axis telescopic cover to the right and left.

(9) Remove the cut scraps that have collected under the Y–axis telescopic cover (at the front).

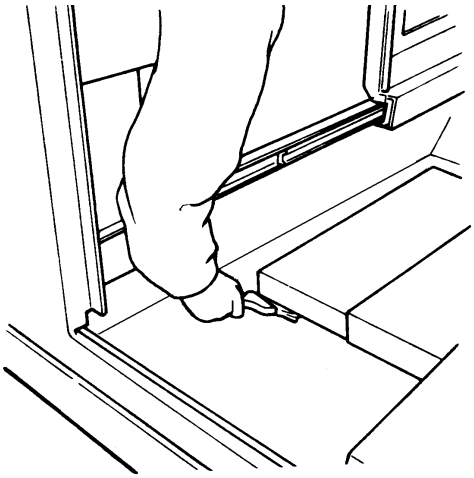


Fig.1.2.1(c) Daily Maintenance (4)

(10) When the moving lubrication unit is selected, brush chips on the lubrication flexible hose at the far right of the table.
(11) Sweep away the cut scraps along the slope of the head groove.
(12) If the machine is equipped with the coolant unit, sweep away the cut scraps into the cut scrap receiver.
(13) If cut scraps are accumulated in the coolant tank, remove them.

1.2.2 Cleaning

After turning off the power, clean the machine in the same way as for starting work.

1.2.3 Inspecting Each Section

Inspect each section of the machine in the same way as for starting work.

1.2.4 Cleaning the Coolant Tank

When the coolant unit is provided, remove the chips on the chip tray when the day's work is finished or chips are accumulated.
If necessary, move the coolant tank toward the back of the machine for easier maintenance and then sweep the chips into a dust pan using a scoop or brush.
Before cleaning, wear gloves to prevent possible injury to fingers.

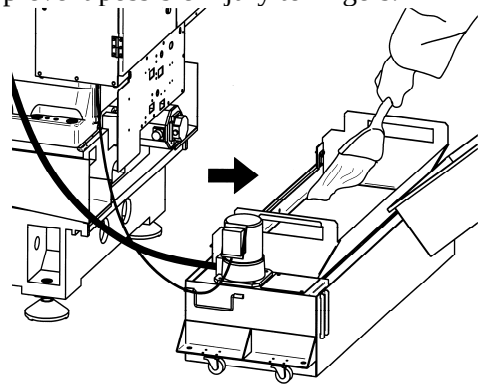


Fig. 1.2.4 (a) Cleaning the chip tray

When chips are accumulated in the tank or coolant is replaced, remove the chip tray and clean the inside of the tank.

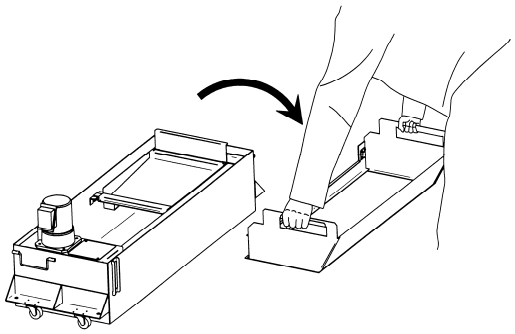


Fig. 1.2.4 (b) Removing the chip tray

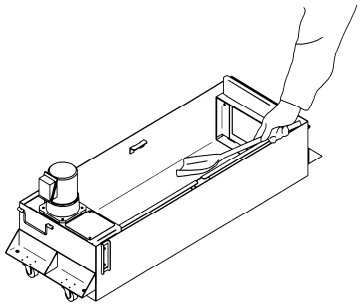


Fig. 1.2.4 (c) Cleaning the inside of the tank

1.2.5 Spindle Run–in

Immediately after a machine is installed, when the spindle has not been rotated for about one week or longer, or when a spindle unit component (such as the shaft and motor) has been replaced, the spindle must be run in.

The spindle run-in program is stored in the "//CNC_MEM/SYSTEM/" folder as program number O9050. To make spindle run-in, execute program O9050.
It takes about four hours for the 10000 min^{-1} specification (Standard spindle, High torque spindle, High acceleration spindle) or about five hours for the 24000 min^{-1} specification (High speed spindle) until spindle run-in is completed.

ATTENTION

For both the 10000 min^{-1} specification and the 24000 min^{-1} specification, the calculated life of the spindle in normal operating conditions is approximately 10000 hours in maximum continuous rotation operation.
Since the actual life greatly depends on the use condition such as the cutting load and machining heat conductivity, however, the spindle may be broken in a relatively short time.
If abnormal noise, vibration, or an abnormal temperature rise is detected, contact the nearest FANUC technical center.
The guarantee period of the spindle is restricted by that of the machine body.

1.2.6 X-/Y-/Z-Axis Run-in

At the closing time of every workday, reciprocate all axes (X-, Y-, and Z-axes) several times full-stroke so that lubricating oil (or grease) will run through the ball screws and LM guides entirely. If the machine is equipped with an automatic lubricating unit, manually operate (by means of the lubricating pump button or “ON” on the maintenance screen) the lubricating pump once or twice, and then reciprocate all axes (X-, Y-, and Z-axes) several times full-stroke. If the machine is equipped with an automatic greasing unit, it is unnecessary to operate the lubricating pump.

When it is expected that the machine will be left unused for about a week or longer, apply grease to the LM guides, ball screws, and telescopic covers (including the YR cover) of all axes entirely for rust prevention purposes. The type of grease to be used on the LM guides and ball screws, see "Recommended Lubricants" in "PERIODICAL MAINTENANCE".

2 PERIODICAL MAINTENANCE

Cautions

Only a "person in charge of routine maintenance and preventive maintenance" or a "maintenance engineer" is allowed to carry out periodic maintenance.

For information about a "person in charge of routine maintenance and preventive maintenance", see Section 2.2, "Person in charge of routine maintenance and preventive maintenance" in PREFACE. For a "maintenance engineer", see Section 2.3, "Maintenance Engineer" in PREFACE. Each "person in charge of routine maintenance and preventive maintenance" and each "maintenance engineer" must check his or her jobs that may be done.
Periodic maintenance involves removing a fixed cover with a tool or working with a controller door open. It is dangerous for ordinary operators to do such jobs. Ordinary operators must not carry out periodic maintenance.

Cautions to be observed before starting maintenance work

⚠ WARNING

1 An unpredictable motion of the machine can cause personal injuries or electric shocks. So, observe the following.
   - Before removing the cover for maintenance, be sure to turn off the circuit breaker of the controller cabinet door of the machine.
   - Before installation or maintenance of each option, turn off the circuit breaker of the controller cabinet door and the circuit breaker of each option.
   - When turning on the power with the cover removed for maintenance, check that there is no other person near the machine.

2 When replacing a maintenance part, be sure to turn off the circuit breaker of the controller cabinet door. (This requirement is not applied to the battery for a separate absolute pulse coder. (See Subsection 2.6.1.1 in Part V.)) Otherwise, the replaced part can be damaged, and an electric shock can occur.

3 Be sure to turn off the power at the main circuit breaker before starting maintenance work such as fuse and battery replacement with the controller cabinet door opened. Otherwise, an electric shock can occur.

4 During maintenance work, provide an indication for warning near the circuit breaker of the controller cabinet door so that no persons other than the person carrying output maintenance work turn on the power.

5 There may remain voltages at components in the controller cabinet even after the main circuit breaker is turned off. Such voltages can cause an electric shock. Only a person with a sufficient knowledge of electricity is allowed to touch the inside of the controller cabinet.

⚠ WARNING

6 For safety, carry out periodic maintenance as described below. A machine fault can cause an injury.
   * Grease the spindle nose gear and turret gear (See Subsection 2.1.1, "Standard Greasing".): Check the tooth surfaces and supply grease semiannually.
   * Grease the LM guide blocks (not necessary when the automatic lubricating unit (option) or automatic greasing unit (option) is used.) (See Subsection 2.1.1, "Standard Greasing".): Every 1000 operation hours
   * Grease the ball screws (not necessary when the automatic lubricating unit (option) or automatic greasing unit (option) is used.) (See Subsection 2.1.1, "Standard Greasing".): Every 1000 operation hours
   * Make sure that coolant is not discharged from the drain on the air unit of the center-through coolant (optional) (See Subsection 25.6.6, "Checking the Check Valve".): Every 1000 operation hours
   * Replace the drawbar unit (Refer to the maintenance manual.): Every 5,000,000 times of tool change
   * Supply lubricant to the automatic lubricating unit (option) (See Subsection 2.1.3, "Automatic Lubricating Unit".): When the level of lubricant in the pump is low
   * Replace the grease cartridge of the automatic greasing unit (option) (See Subsection 2.1.4, "Automatic Greasing Unit".): When the grease level low alarm is issued
   * Check the fan motors of the control unit (See Section 2.3, "INSPECTING THE FAN MOTORS IN THE CONTROL UNIT".): Once a year
   * Check the AC spindle motor (See Section 2.4, "MAINTENANCE OF AC SPINDLE MOTOR".): Once every six months
   * Check and clean the inside of the X-/Y-/Z-axis drive sections (saddle, bed, and column) and their covers. (Refer to the applicable maintenance manual for explanations about how to remove the covers.): Once every six months
   * Replace the filter regulator and oil filter mantle (element) (See Section 2.5, "REPLACING THE FILTER REGULATOR AND OIL FILTER MANTLE (ELEMENT)".): Every year (6000 hours) or pressure drop of 0.1 MPa [guideline]

⚠ WARNING

* Replace consumable parts (See Section 2.6, "REPLACING EXPENDABLE PARTS".):

Battery for separate absolute pulse coders:
Once a year

Battery for CNC memory backup:
When the warning message BAT blinks on the LCD screen

Fuse:
When the small window of a fuse unit becomes white

Fluorescent lamp:
When it is burned out or begins blinking

Cushion rubber for an X/Y-axis telescopic cover:
When it begins making an abnormal sound
(Recommendation: Every 2000 operation hours)

Y-axis rear cover:
When an opening is found in the wiper
(Recommendation: Every 2000 operation hours)

Cushion rubber for the front door:
When it comes off or is damaged
(Recommendation: Every 100,000 times of door opening/closing operations)

Bearing roller for the front door:
When it malfunctions or makes an abnormal sound in door opening/closing operation.
(Recommendation: Every 100,000 times of door opening/closing operations)

⚠ WARNING

* Confirm the safety equipment and safety functions (Once every six months)

Inspection item	Inspection method	Inspection details
Front door electromagnetic lock switch	• Set the ROBODRILL to the manual mode and press the door open/close key.	• Make sure that an electromagnetic lock is released and the front door can be opened.
	• Press the door open/close key when the ROBODRILL is in program operation.	• Make sure that an electromagnetic lock is not released and the front door cannot be opened.
Safe speed	• Operate each axis and the spindle with the front door open.	• Make sure that the motion speed of each axis is less than 2 m/min. • Make sure that the rotation speed of the spindle is less than 100 min-1.
Spindle rotation control during spindle maintenance (only for the CE specification)	• Press the spindle rotation key and spindle speed override key: 100% with the front door open.	• Make sure that the spindle rotates only when both the spindle rotation key and the spindle speed override key: 100% are pressed. • Make sure that one of the keys is released, the spindle stops rotating.
Emergency stop function	• Press the emergency stop button when the ROBODRILL stops.	• Make sure that each axis and the spindle can operate only when the emergency stop button is released. • The Z-axis does not drop.
	• Press the emergency stop button when the ROBODRILL is in program operation.	• Make sure that each axis and the spindle stop immediately. • The Z-axis does not drop.

Cautions to be observed during maintenance work

⚠ DANGER

1 Before opening the safety door, make sure that the Z-axis (spindle head) does not come down. The Z-axis comes down once in a long while because of the Z-axis brake failing to work. After the door is opened, pay attention to the possible falling of the Z-axis. During maintenance under the Z-axis, place a wooden block between the table and Z-axis so that the Z-axis will not come down even if the brake fails to work.

2 When opening the front door after the power is turned off, make sure that the spindle is not rotating. If the power is turned off while the spindle is rotating, control cannot be exercised to stop the spindle. In this case, the spindle keeps rotating by coasting, so you may be injured because chips can scatter or the spindle can touch you.

⚠ WARNING

1 When making electric checks with the cover removed, you may be electrically shocked. Be sure to use an electrically insulated tool (such as a plastic screwdriver).
2 Only maintenance engineers are allowed to replace the battery for CNC memory backup and the fluorescent lamp inside the machine. Persons in charge of routine maintenance and preventive maintenance are not allowed to do such work. If a person with no sufficient knowledge does such work, the safety unit may not function normally and the machine may make an unpredictable motion, resulting in an injury or electric shock.
3 Note that even if the circuit breaker of the controller cabinet door is turned off, the power on the primary side of the circuit breaker is not turned off. Keep in mind that the following units may be connected to the primary side of the circuit breaker:
   1) External power supply transformer (if provided)
   2) Non-standard peripheral unit (if provided)
4 When working at a high elevation, use a ladder and secure a footing to reduce a possibility of falling. If you clamber up the machine or get on an object not intended for use as a step (such as a chair or desk), you may lose balance, resulting in an accident.
5 Be careful not to touch the components of the machine indicated below while the power is on or for a while after the power is turned off. Otherwise, you may be burned because those components may be heated. When you need to touch those components, wear a protector such as heat-resistant gloves.
   - Power line
   - Heat generating sections (such as a transformer and heat sink) in the controller cabinet
6 Be careful not to touch the components of the machine indicated below during operation or for a while after the end of operation. Otherwise, you may be burned because those components may be heated. When you need to touch those components, wear a protector such as heat-resistant gloves.
   - Servo motor for each axis (X-axis, Y-axis, Z-axis, additional axis)
   - Spindle motor
   - Coolant motor
7 When replacing maintenance parts, observe the descriptions in this manual. If an unsuitable part is used or an incorrect method of replacement is used, the machine can malfunction and cause an injury.

Cautions to be observed at the end of maintenance work

⚠ WARNING

1 When turning on the power to operate the machine during or after maintenance work, make sure that no tools are left inside the machine. Otherwise, a tool can be blown to hit a human.
2 After completion of maintenance work, reinstall all components including screws removed for maintenance. Otherwise, the safety unit may not function, the machine can make a wrong motion, or an electric shock can occur, resulting in an injury.
3 When a cable is disconnected, do not turn on the power to the machine. Otherwise, an electric shock can occur.

2.1 LUBRICATING EACH SECTION

⚠ WARNING

1 Coolants and lubricants (grease or oil) are harmful. Observe the precautions indicated below. For other precautions and actions to be taken when you directly touch or take in suck a coolant or lubricant, follow the instructions provided on the product package or MSDS by each supplier.
- Do not inhale vapor and mist.
- Do not touch coolants and lubricants directly by the skin (especially by a wound).
- Use protective goggles to prevent any coolant or lubricant from getting in your eyes.
- Do not swallow coolants and lubricants.

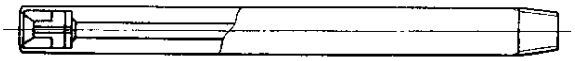
2 Do not use rotten coolants and lubricants (grease and oil). They become very harmful when they get rotten. For the state of a coolant or lubricant considered to be rotten, contact the supplier. Store or dispose of rotten coolant or lubricant according to the instructions of the supplier.

⚠ CAUTION

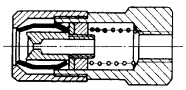
If a lubricant (grease or oil) is spilled on the floor, wipe it off immediately. A spilled lubricant makes the floor very slippery, so that you may fall and get injured.

SUPPLEMENT

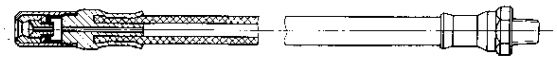
Use a grease gun with a straight–type greasing rod (10 to 13 in diameter). The chuck type cannot be used.



Straight–type



Chuck–type



Hose–type

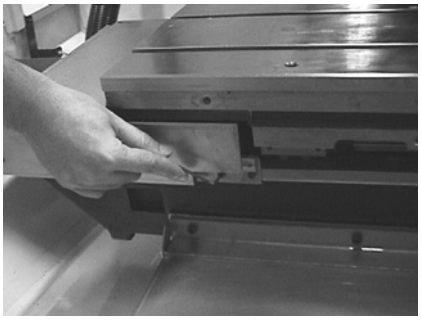
2.1.1 Standard Greasing

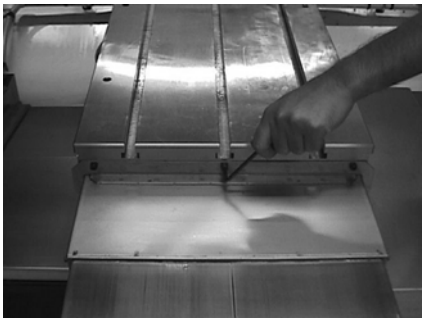
> ⚠ **WARNING**
> When greasing, turn off the power. Otherwise, you may get injured due to an unpredictable machine motion.

(1) X axis ball screw

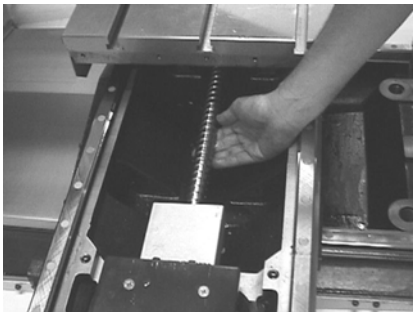
Lubricate grease to the X axis ball screw as described below.
Move the table to the "+" or "–" stroke end of the X axis and remove the cover on the side of the table.

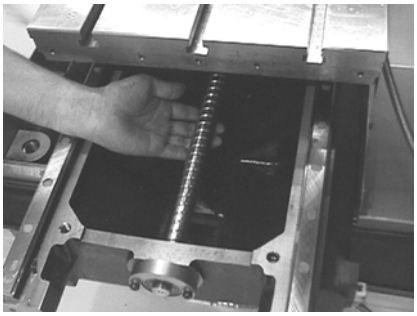
(a) Detach the X-axis telescopic cover (Refer to the applicable maintenance manual for explanations about how to detach and attach the cover).





(b) Move the X-axis to the positive or negative end full-stroke, and apply a specified amount (thin coat) of grease to the ball screw, and wipe off any excess (not necessary for the automatic oil lubricating system (option) and automatic grease lubricating system (option)).





(c) Clean the inside of the X-axis drive section (saddle), and check the X-axis telescopic cover.

> **ATTENTION**
> 1 Remove any chips from the inside of the saddle. Leaving them unremoved may cause trouble.
> 2 Check the X-axis telescopic cover (See “Checking X-/Y-axis telescopic covers”).

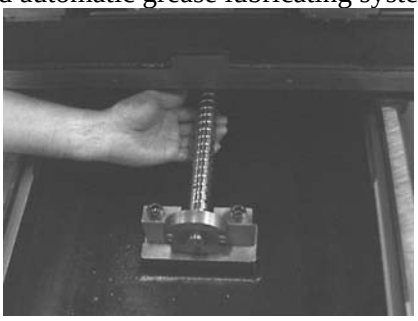
(d) Attach the X-axis telescopic cover.

(2) Y axis ball screw

Lubricate grease to the Y axis ball screw as described below.

(a) Detach the Y-axis telescopic cover (For explanations about how to detach/attach it, refer to the applicable maintenance manual).

(b) Move the Y-axis in the positive or negative direction full-stroke, and apply a specified amount (thin coat) of grease to the ball screw, and wipe off any excess (not necessary for the automatic oil lubricating system (option) and automatic grease lubricating system (option)).



(c) Clean the inside of the Y-axis drive section (bed), and check and clean the Y-axis telescopic cover.

ATTENTION
1 Remove any chips from the inside of the bed. Leaving them unremoved may cause trouble.
2 Check the Y-axis telescopic cover. (See “Checking X-/Y-axis telescopic covers”.)

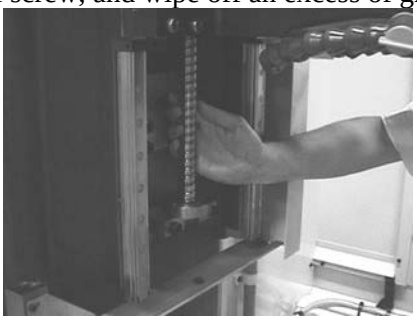
(d) Attach the Y-axis telescopic cover.

(3) Z axis ball screw

Lubricate grease to the Z axis ball screw as described below.

(a) Detach the Z-axis cover (Refer to the applicable maintenance manual for explanations about how to detach and attach the cover).

(b) Thinly apply grease to the ball screw, and wipe off an excess of grease.



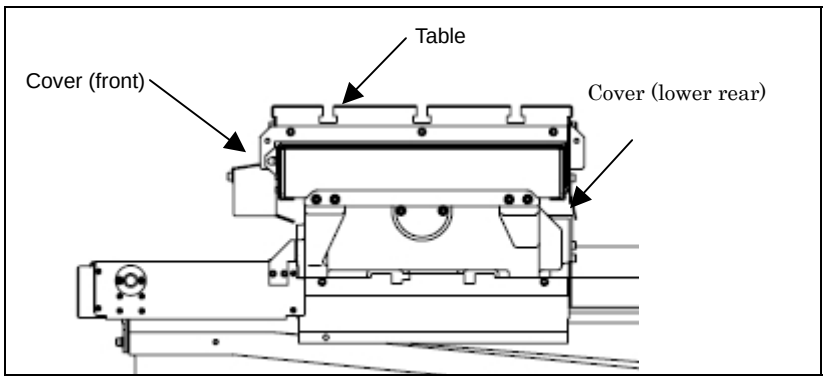
(c) Clean the inside of the Z-axis drive section (column), and check and clean the Z-axis cover.

ATTENTION
1 Remove any chips from the inside of the column. Leaving them unremoved may cause trouble.
2 Check the Z-axis cover (See “Checking X-/Y-/Z-axis covers”).

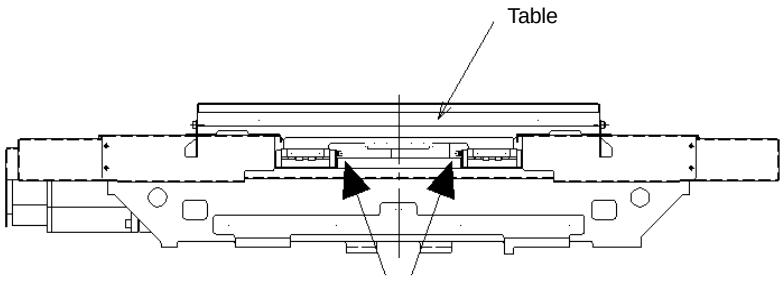
(4) X axis LM guides

Lubricate grease to the X axis LM guides as described below.

(a) Remove the covers on the front and rear of the table. For the procedure for removing the table front cover, refer to the procedure for removing the X-axis telescopic cover in the maintenance manual. For the rear side, remove only the lower cover shown in the figure below.



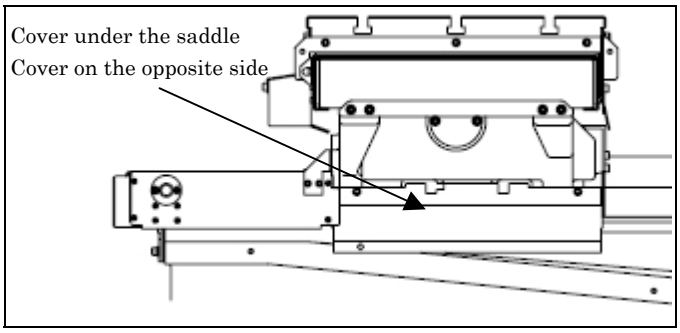
(b) Apply grease to the four LM blocks of the X-axis and wipe off any excess. Be careful not to loosen the nipple during greasing.



Lubricate by grease gun

(5) Y axis LM guides

(a) Remove the left and right covers under the saddle (only for the ROBODRILL α-D14/21M*i*A5)



(b) Apply grease to the four LM blocks of the Y-axis under the saddle and wipe off any excess. Be careful not to loosen the nipple during greasing.

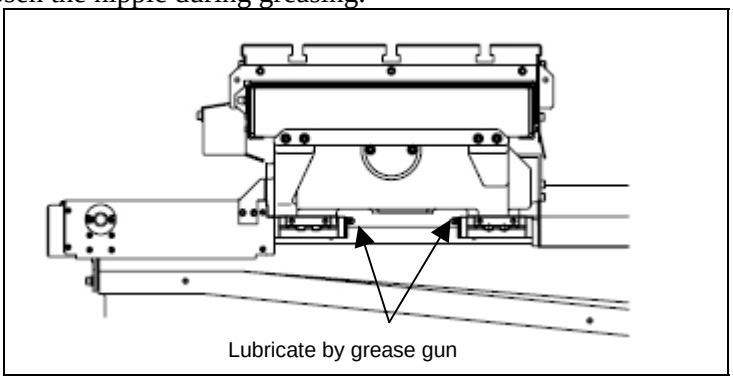


Fig.2.1.1(a) ROBODRILL α-D14/21M*i*A5

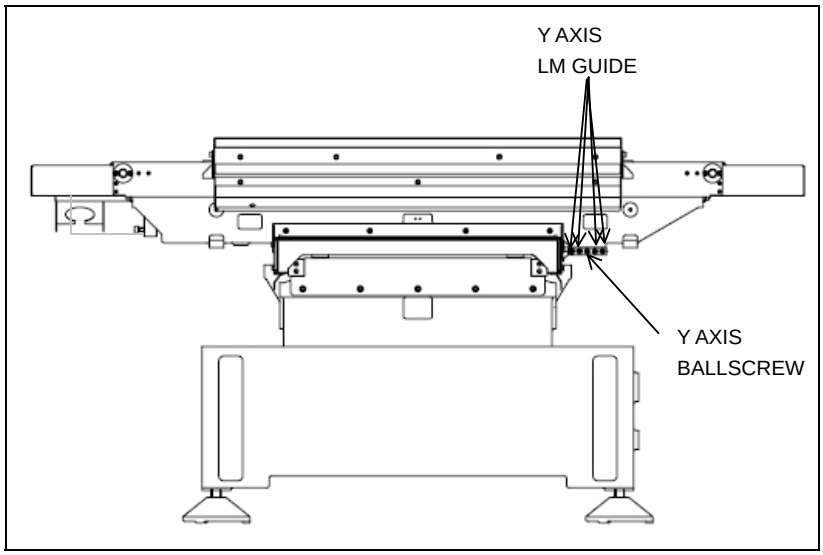


Fig.2.1.1(b) ROBODRILL α-D14/21L*i*A5

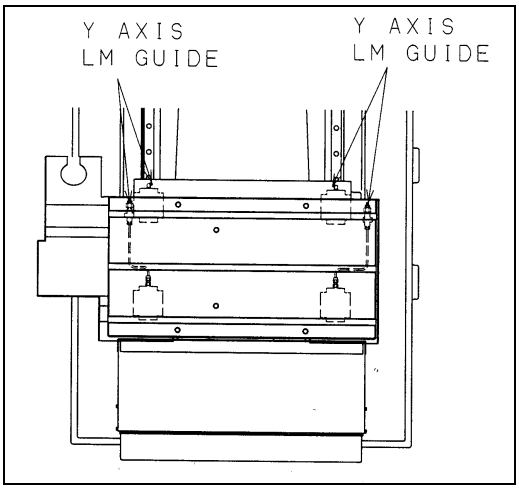


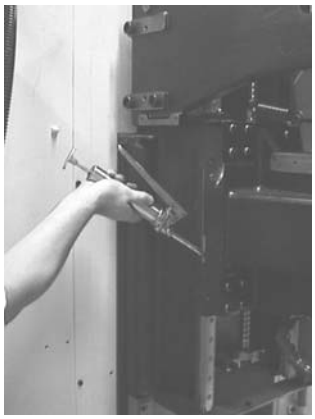
Fig.2.1.1(c) ROBODRILL α-D14/21S*i*A5

(6) Z axis LM guide

Lubricate grease to the Z axis guide as described below.

(a) Remove the cover from the turret support and the cover from the bottom of the spindle head.

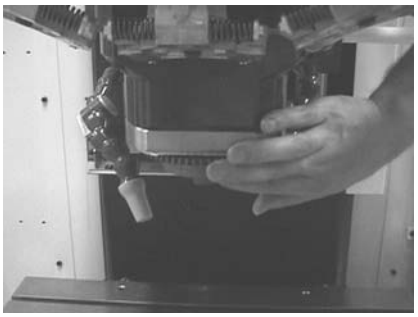
(b) Move the Z-axis to the minus side and apply a specified amount of grease to the LM guide with a grease gun and wipe off any excess (not necessary for the automatic oil lubricating system (option) and automatic grease lubricating system (option)). Be careful not to loosen the nipple during greasing.



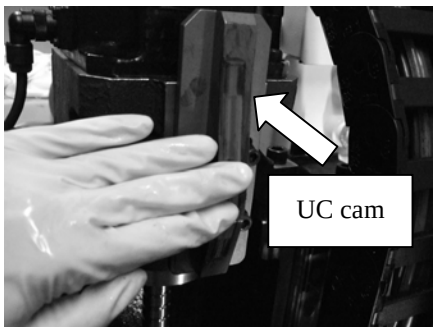
(7) Greasing turret and spindle gears

According to the following procedure, apply grease to the turret and spindle gear.

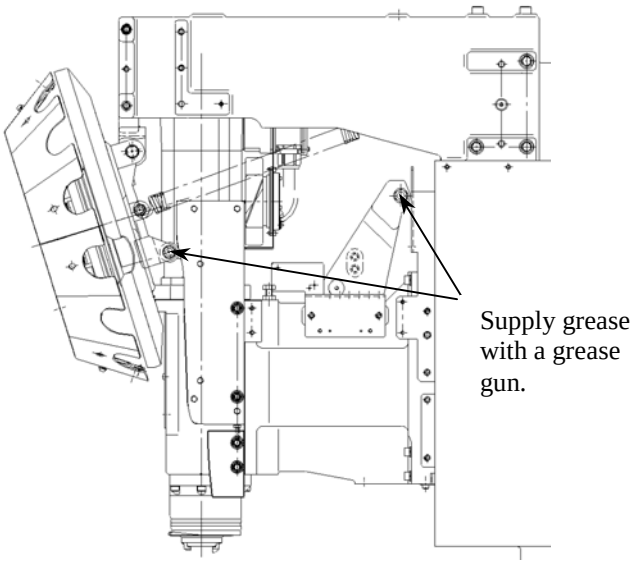
(a) Apply grease to the spindle gear.



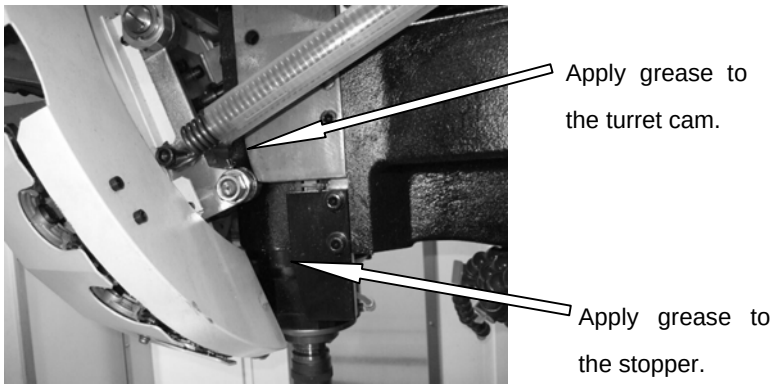
Remove the cover under the spindle head and apply grease to the cam (UC cam) before the Z-axis motor.



(b) Supply grease to the grease nipple of the cam follower indicated by an arrow in the figure below (ALVANIA S2 is recommended). Supply grease at two or more times while moving the Z-axis up and down until grease is output from the end face of the cam follower. Wipe off the excessive grease.



(c) Apply grease to the turret cam and stopper.



(d) Upon completion of the application of grease, change tools to rotate the turret at least one round or more for complete lubrication.

2.1.2 Centralized Greasing Piping (Option)

For the machine for which centralized greasing piping is specified optionally, apply the specified amount of grease to the ball screws and LM guides of each axis using the grease gun through the grease inlets specified by the arrows. Wipe the excessive grease from the LM guides and ball screws.

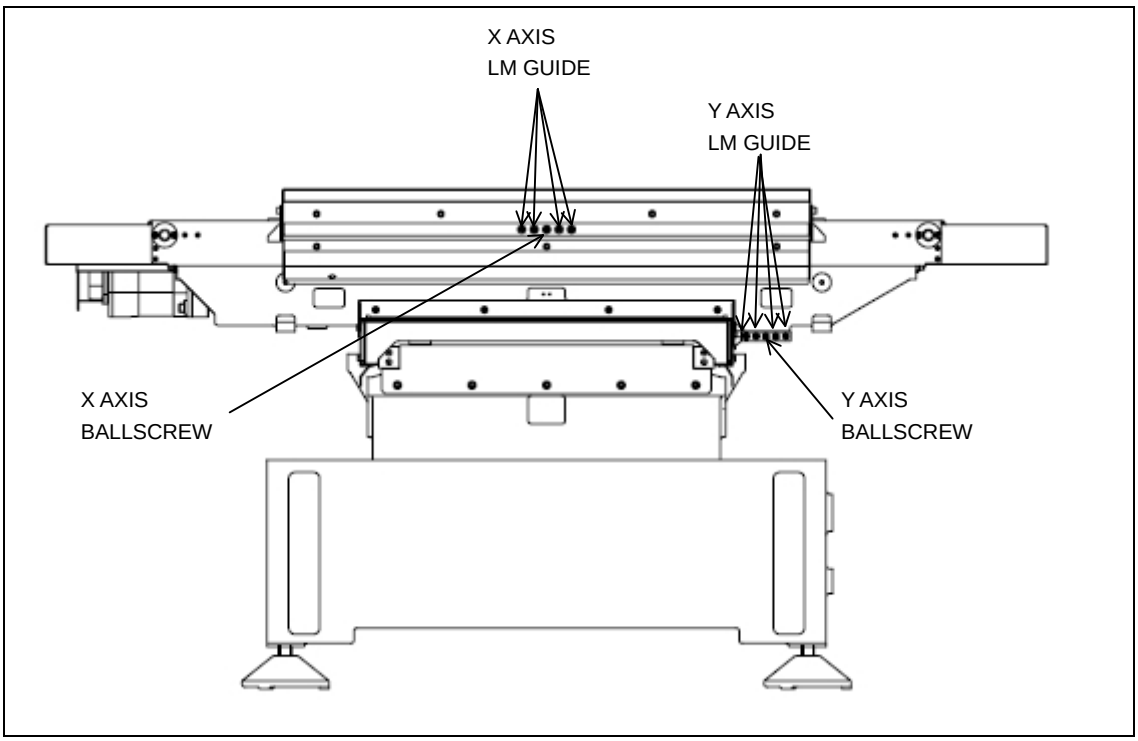


Fig.2.1.2(a) ROBODRILL α-D14/21M/L*i*A5

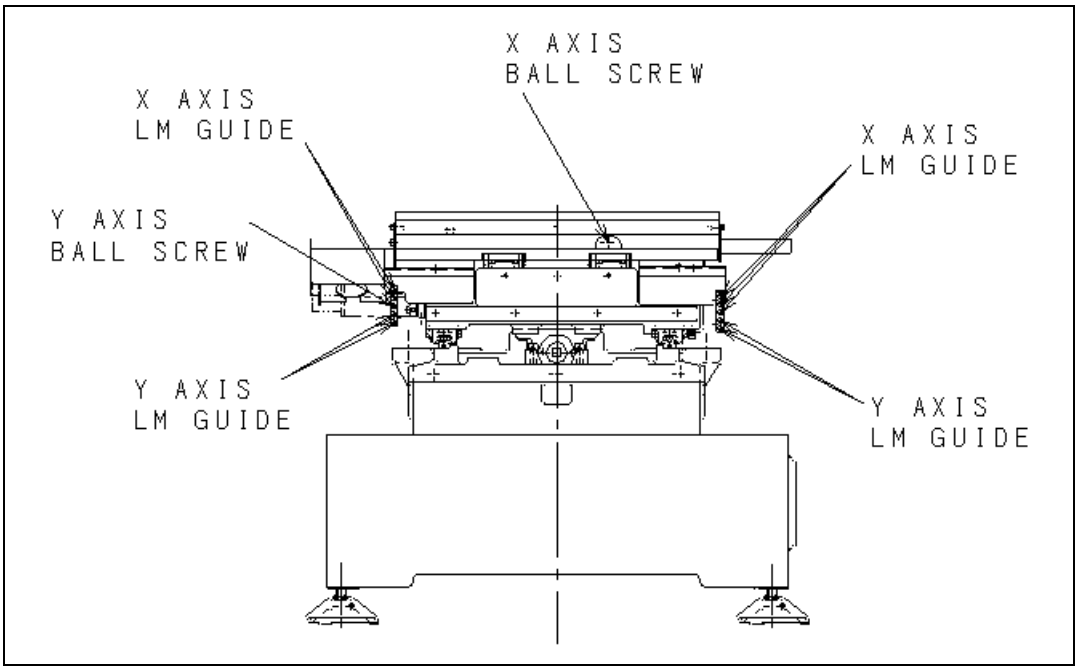


Fig.2.1.2(b) ROBODRILL α-D14/21S*i*A5

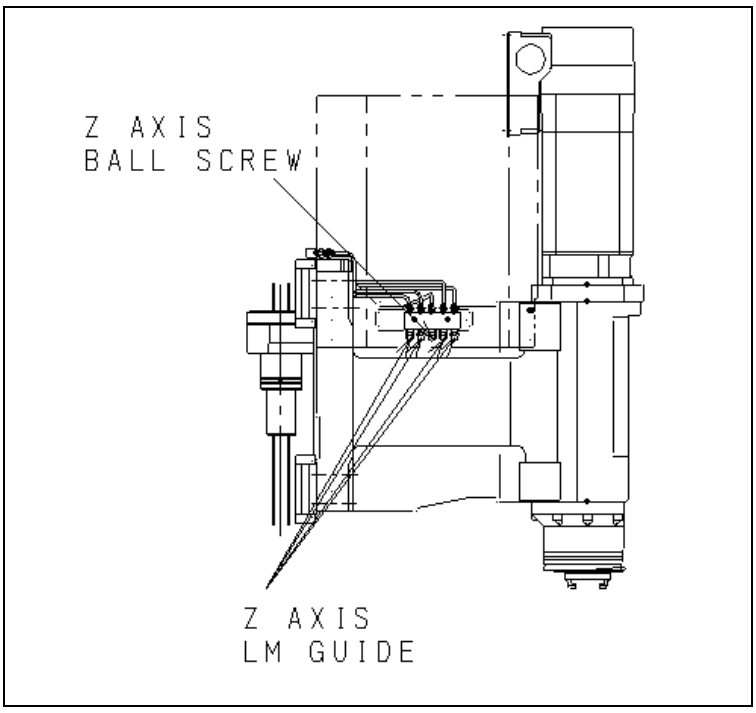


Fig.2.1.2(c) Z-axis

2.1.3 Automatic Oil Lubricating System (Option)

If the optional concentrated lubrication with intermittent oiling system is specified for the machine, the ball screws and LM guides of each axis are lubricated automatically and periodically. Greasing in 2.1.1 is therefore not required for these screws and guides. (However, it is necessary to check and clean the inside of the X-/Y-/Z-axis drive sections (saddle/bed/column) and their covers. It is also necessary to grease the spindle gears, cam surfaces, and cam followers as described in (7) in Subsection 2.1.1 of Part V.)
In concentrated lubrication, as soon as the power is turned on, the oil pump supplies lubricant to the ball screws and LM guides of each axis.
Before the amount of lubricant in the oil tank reaches a low level, replenish the oil tank with a lubricant shown in the following table:

ATTENTION
1 Use the following brands, sliding surface oil with a viscosity grade of VG68, as lubricant. Otherwise, the ball screw or LM guide may be damaged due to lubrication failure.
2 Lubricant must be clean. Do not use a container to which coolant, hydraulic fluid, or chippings adhere, for lubrication. If there is cloud or foreign matter such as chippings in lubricant in the tank of the oil pump, clean the inside of the tank. The cleaning procedure is described in the maintenance manual. Cloud or chippings in lubricant may cause a pump failure or pipe clogging.
3 Never apply additives to lubricant. Otherwise, a pump failure or pipe clogging may occur.

Table.2.1.3 Recommended Brands of Lubricant

Product	Manufacturer
Mobil Vactra Oil No. 2 (SLC)	Mobil Sekiyu K.K.
UNIWAY EV 68	JX Nippon Oil & Energy
Shell Tonna S 3M 68	Showa Shell Sekiyu K.K.

SUPPLEMENT
1 The tank has a capacity of approximately 1800cm^3=1.8L. The feeding amount of the tank is 0.66 cc/10 minutes. (When energy saving control is off) If any of the axes moves the specified distance within 10 minutes, however, lubricant is supplied regardless of the elapsed time.
2 Before the machine is shipped, a small amount of lubricant (Mobil Vactra Oil No.2) has already been supplied to the tank for leakage and feeding tests.
3 It is recommended to use Mobil Vactra Oil No. 2 (SLC), which is excellent at coolant-resistant detergent properties and sludge resistance under strict service conditions, such as mass production.

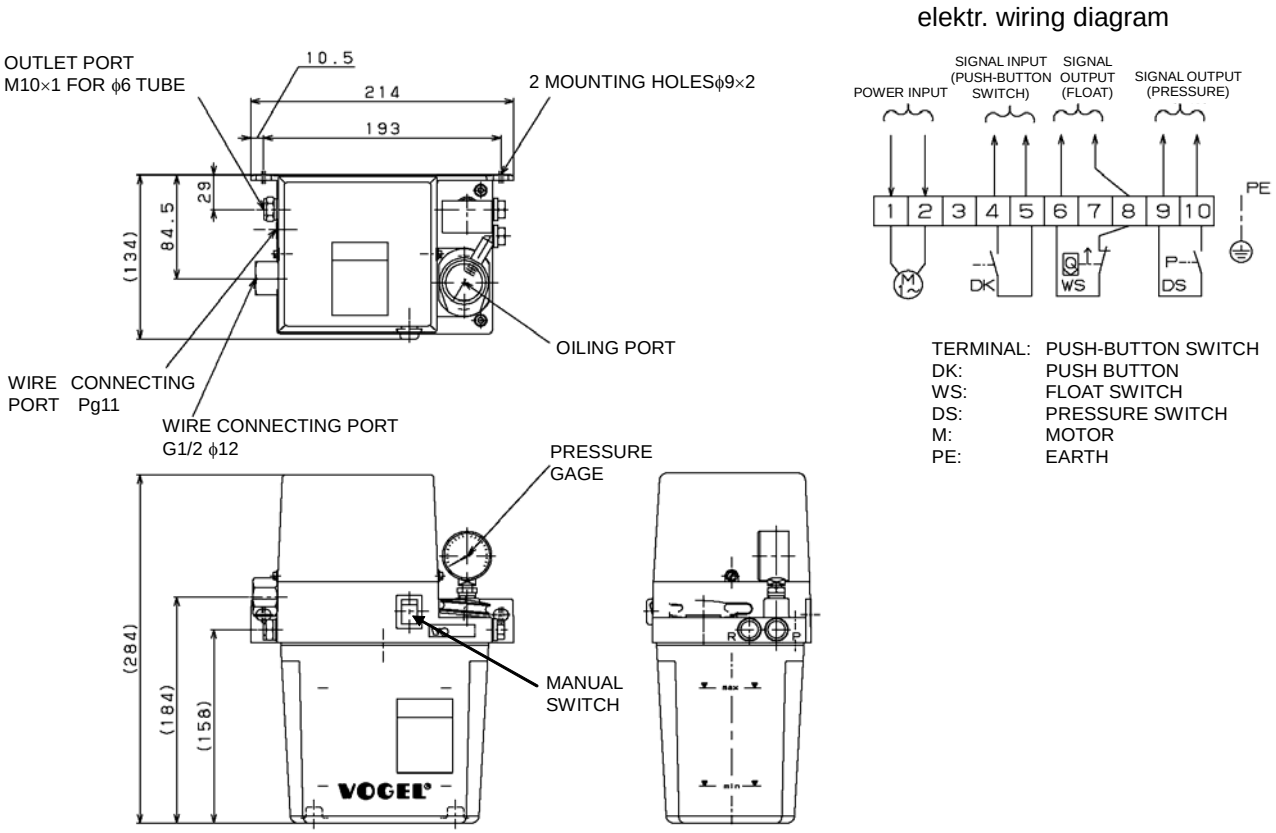


Fig.2.1.3 External Diagram and Elektr. wiring diagram.

2.1.4 Automatic Grease Lubricating System (Option)

For the machine for which the automatic greasing unit is specified optionally, the ball screws and LM guides of each axis are automatically greased periodically. Therefore, standard greasing described in Subsection 2.1.1 is not required (However, it is necessary to check and clean the inside of the X-/Y-/Z-axis drive sections (saddle/bed/column) and their covers. It is also necessary to grease the spindle gears, cam surfaces, and cam followers as described in (7) in Subsection 2.1.1 of Part V.)
The automatic greasing unit automatically applies grease to the ball screws and LM guides of each axis upon power-on.
If the grease level low alarm is issued, replace the cartridge grease with specified cartridge grease. For the replacement method, see "(1) Replacing the cartridge grease".

Table 2.1.4 Specified cartridge grease

Product specification	Manufacturer
FANUC specification: A90L-0001-0534#LHL3007 (LUBE specification: LHL300-7, volume 700cm^3 = 700mL)	LUBE
FANUC specification: A90L-0001-0534#LHL3004S (LUBE specification: LHL300-4S, volume 400cm^3 = 400mL)	LUBE

ATTENTION

1 After replacing the cartridge grease, loosen the air release plug on the front of the pump, start the pump with the manual button, and release air.
The cartridge has a semi-hermetic structure, but the pressure rise failure alarm is issued if air enters the pump.
2 Use only the specified cartridge grease. Otherwise, the lubricating system fails, possibly causing serious damage to the machine.
3 Do not use cartridge grease which was used once or to which grease was added. After attaching new cartridge grease, do not remove it from the pump until it is exhausted. Otherwise, air or foreign matter enters the cartridge, pump, or piping and the lubricating system fails, possibly causing serious damage to the machine.
4 Remove any excessive grease from the inside of the X-/Y-/Z-axis drive sections (saddle/bed/column) and their covers once about every half a year. (Refer to the applicable maintenance manual for explanations about how to detach the covers.)
Leaving the excessive grease unremoved may cause trouble.

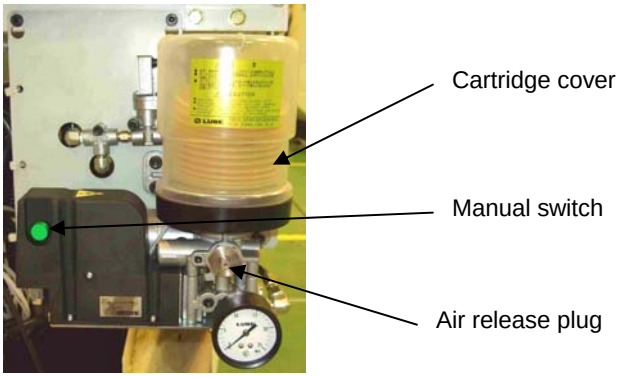
SUPPLEMENT

1 The feed amount is 1.6 cc/4 hours (when energy saving control is off). If any of the axes moves the specified distance within 4 hours, however, grease is supplied regardless of the elapsed time.
2 The cartridge grease is attached during shipment for greasing the piping, a leak test, and a feed test.
3 When the automatic greasing unit option is attached, the ambient temperature during operation should be kept at 5°C to 45°C.

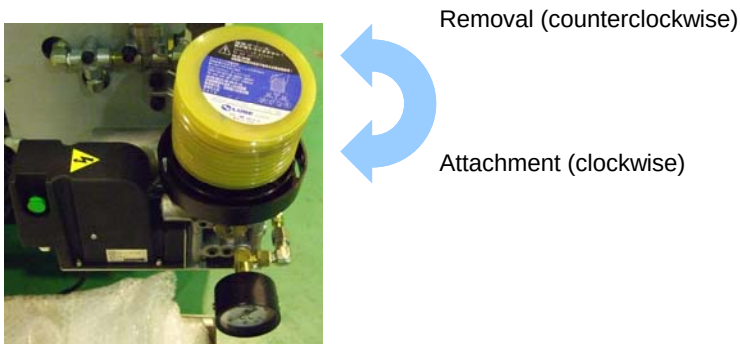
(1) Replacing the cartridge grease

Follow the procedure below to replace the cartridge grease.

(a) Remove the cartridge cover.



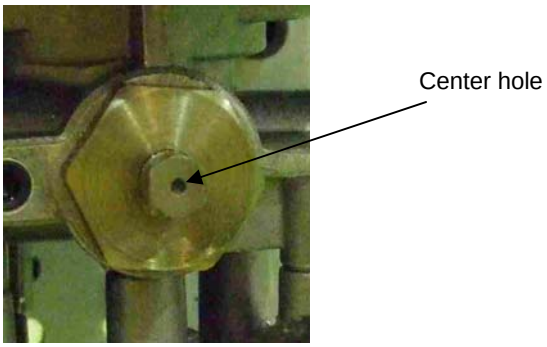
(b) Remove the cartridge grease by turning it counterclockwise.



(c) Attach new cartridge grease. At this time, insert the cartridge grease into the pump until the inside plug of the cartridge grease is removed and then screw it clockwise securely. Do not remove the inside plug before screwing the cartridge grease.

(d) Loosen the air release plug (with an 8-mm wrench).

(e) Press and hold the manual switch to operate the pump until only grease is output from the center hole of the plug after air is output.



(f) Tighten the air release plug manually and then turn it two-thirds of a turn.

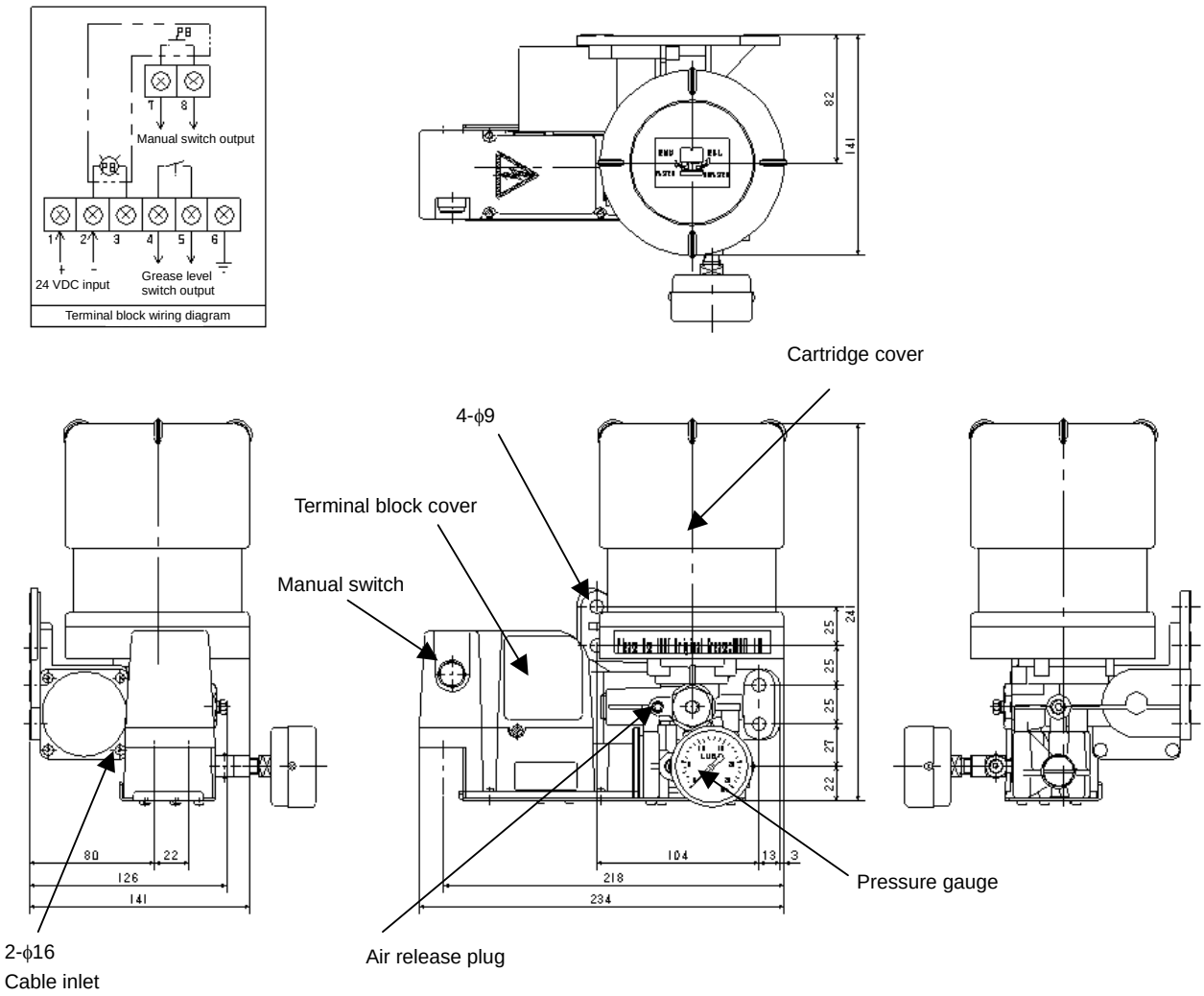


Fig.2.1.4 Appearance and connection drawings

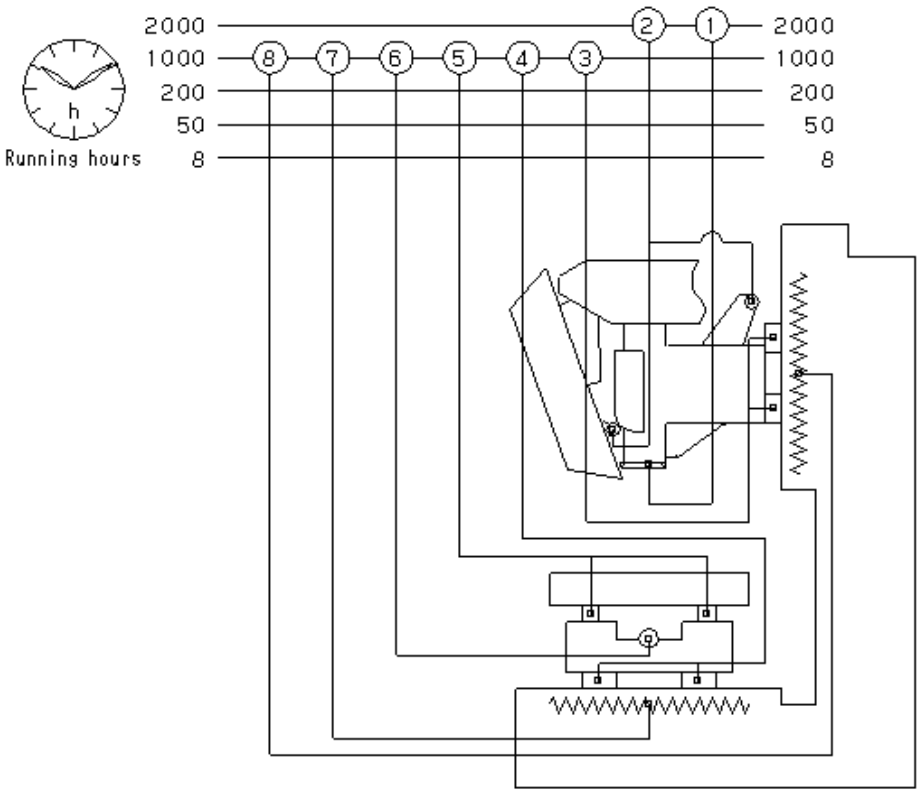
2.1.5 Greasing and Oiling Interval

Replenish grease and oil at the intervals indicated on the plate on the machine.

ATTENTION

1 The interval of greasing or oiling shown in the label is only a guide. This interval is reduced depending on the lubricant used or the use status of the machine.
2 (1) The amount of grease applied to the X-, Y-, and Z-axis LM guides in standard greasing is a total of the amount of grease applied to the four points of each LM guide block. The amount of grease applied to each point is 25 ml.
3 (2) The amount of grease applied to the X-, Y-, and Z-axes in central greasing piping is a total of the amount of grease applied to the four points of each LM guide block and one point of each ball screw. The amount of grease applied to each point is 20 ml.
4 If old grease is output from the LM block or ball screw nut, greasing is performed correctly in the standard greasing and central greasing piping.
5 In the automatic oil lubricating system and automatic grease lubricating system, periodically check the output of lubricant or oil from the LM block or ball screw nut.
6 If there is an oil layer and no biting flaw on the LM guide or the ball rolling surface of the ball screw, the interval and amount of greasing or oiling is appropriate.
7 If there is rust on the metal surface, the amount of greasing or oiling may be insufficient. Review the interval and amount of greasing or oiling.

(1) Standard greasing

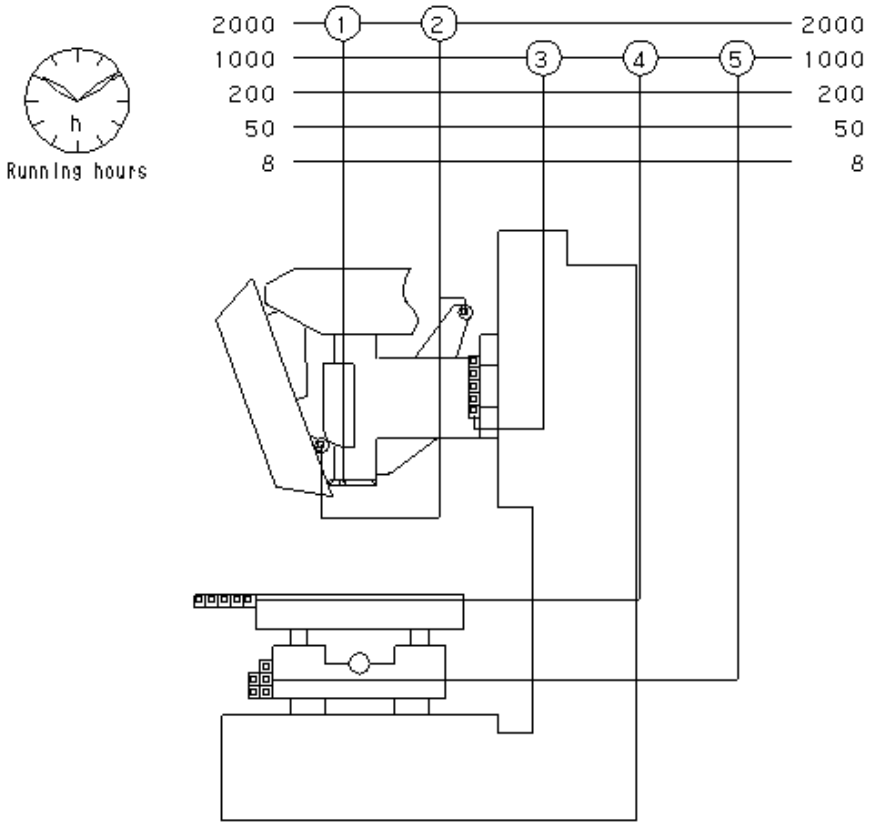


CAUTION. CLEAN ALL POINTS BEFORE LUBRICATING AND REMOVE OLD OR EXCESS LUBRICANT

Machine component	Spindle gear	Turret cam follower	Z-axis LM guide	Y-axis LM guide	X-axis LM guide	X-axis ball screw	Y-axis ball screw	Z-axis ball screw
Action point No.	1	2	3	4	5	6	7	8
Symbol of action / Nature of action								
Check								
Check and fill if necessary								
Operate								
Replenish	2000	2000	1000	1000	1000	1000	1000	1000
Clean or replace								
Change								
Lubricant designation	XM2	XM2	XM2	XM2	XM2	XM2 (*1)	XM2 (*1)	XM2 (*1)
Reservoir capacity(ml)	–	–	–	–	–	–	–	–
Supply(ml)	10	2	100	100	100	10	10	10

Notice: NULTENP LRL No.3(KYODO YUSHI) is recommended for the points marked (*1).

(2) Centralized greasing piping

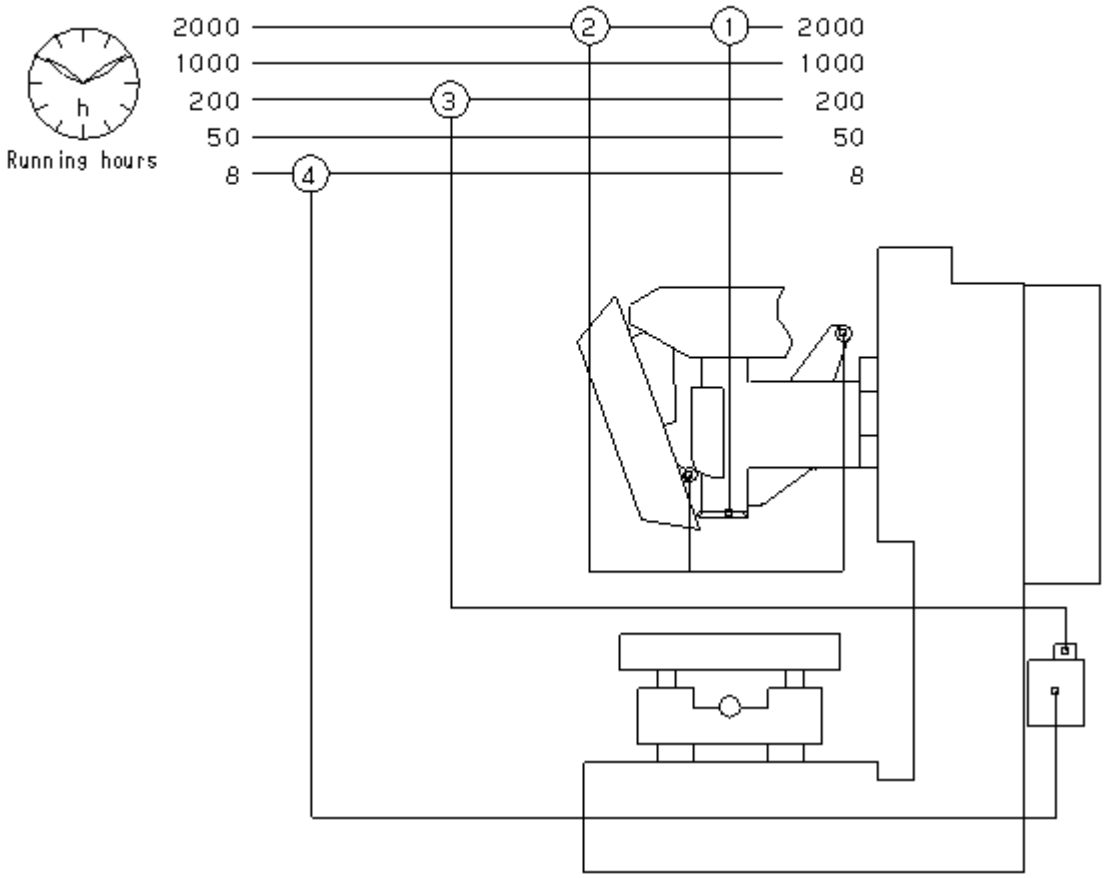


CAUTION. CLEAN ALL POINTS BEFORE LUBRICATING AND REMOVE OLD OR EXCESS LUBRICANT

Machine component	Spindle gear	Turret cam follower	Z-axis lubricating points	X-axis lubricating points	Y-axis lubricating points
Action point No.	1	2	3	4	5
Symbol of action / Nature of action					
Check					
Check and fill if necessary					
Operate					
Replenish	2000	2000	1000	1000	1000
Clean or replace					
Change					
Lubricant designation	XM2	XM2	XM2 (*1)	XM2 (*1)	XM2 (*1)
Reservoir capacity(ml)	–	–	–	–	–
Supply(ml)	10	2	100	100	100

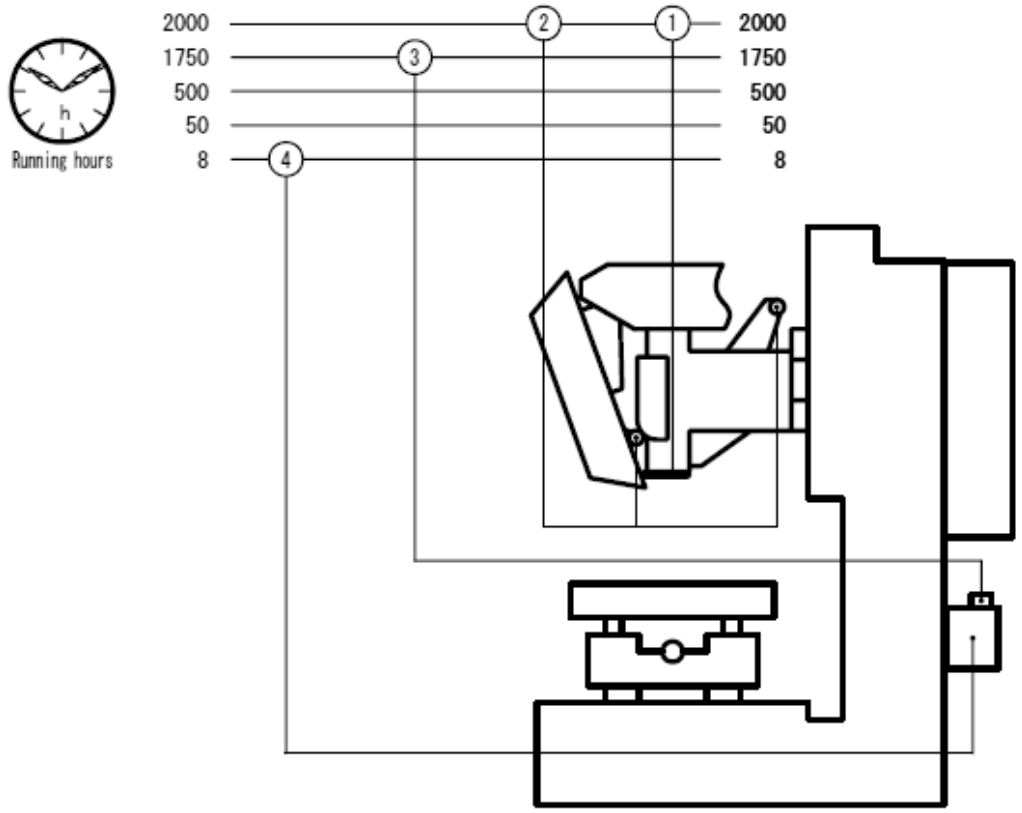
Notice: (*1) NULTENP LRL No.3 (KYODO YUSHI) is recommended for ball screw.

(3) Automatic oil lubricating system



Machine component	Spindle gear	Turret cam follower	Lubricating system	
Action point No.	1	2	3	4
Symbol of action / Nature of action				
Check				8
Check and fill if necessary				
Operate				
Replenish	2000	2000	200	
Clean or replace				
Change				
Lubricant designation	XM2	XM2	G68	
Reservoir capacity(all	–	–	1800	
Supply(ml)	10	2	1300	

(4) Automatic grease lubricating system



Mechanical component	Spindle gear	Turret cam follower	Lubricating system	
Action point No.	1	2	3	4
Symbol of action / Nature of action				
Check (h)				8
Check and fill if necessary (h)				
Operate (h)				
Replenish (h)	2000	2000	1750	
Clean or replace (h)				
Change (h)				
Lubricant designation	XM2	XM2	A90L-0001-0534#LHL3007	
Reservoir capacity (ml)	–	–	700	
Supply (ml)	10	2	Replacing the cartridge grease (Cautions 1, 2, 3)	

Take following cautions. Fail to follow any of these cautions may cause serious damages of the machine due to the trouble of the lubrication system.

Cautions

1. When you replace the grease cartridge, make sure to discharge air by starting the pump after loosening the discharge plug in front of the pump. (Refer to the operator's manual.)
2. Use the specified cartridge grease only.
3. Replacing the grease cartridge with the partly-used or refilled one is prohibited.
   After replacing with the new one, do not remove the grease cartridge from the pump until it is completely used up.

2.2 SPECIFIED BRANDS OF LUBRICANT

⚠ WARNING

Do not use coolants and lubricants (grease and oil) that can change the properties of polycarbonate, nitrile rubber (NBR), hydrogenated nitrile rubber (HNBR), fluororubber, nylon, and acrylic resin, ABS resins. The properties of these materials can also be changed when diluent water contains a large amount of residual chlorine. Because this machine uses these materials as sealing materials, use of such a coolant, lubricant, or diluent water can degrade the sealing effect. Degraded sealing can cause current leakage, resulting in an electric shock. Degraded sealing can also cause grease to leak and be burnt in.

⚠ CAUTION

If a coolant or lubricant (grease or oil) not recommended is used, check the instruction of the supplier and carefully check the condition and method of use. Otherwise, the human body, machine, and environment can be adversely affected.

ATTENTION

Even when using a recommended coolant or lubricant (grease or oil), be sure to follow the instruction of the supplier. Depending on the use method, the machine components and painting can be adversely affected.

2.2.1 Recommended Lubricants (Grease and Oil)

FANUC recommends the lubricants listed below.

Brand	Manufacturer	Component to be lubricated	Timing of application
Shell Gadus S2 V220 1	SHOWA SHELL SEKIYU K. K.	GUIDE RAIL TURRET CAM TURRET CAM FOLLOWER SPINDLE NOSE GEAR	At the time of maintenance
Shell Gadus S2 V220 2			
MULTEMP LRL NO. 3	KYODO YUSHI	BALL SCREW (X, Y, Z)	
MOLY HD GREASE	SUMICO	SPINDLE DISK SPRINGS	When exchanging Disk springs
Sumiplex PS NO. 1	SUMICO	TURRET MECHANISM INSIDE	When overhauling Turret mechanism
LGSP1	SKF	SPINDLE BEARING	When exchanging Spindle bearings

FANUC recommends the following grease if the machine is provided with the centralized greasing piping (option).

Brand	Manufacturer	Component to be lubricated	Timing of application
Shell Gadus S2 V220 1	SHOWA SHELL SEKIYU K. K.	GUIDE RAIL (X, Y, Z) BALL SCREW (X, Y, Z)	At the time of maintenance
LUBER FS-2	LUBER		

For automatic oil lubrication (option), the following sliding surface oil with an ISO viscosity grade of VG68 is recommended.

Brand	Manufacturer	Component to be lubricated	Timing of application
Vactra Oil No. 2 (SLC)	Mobil Sekiyu K.K	GUIDE RAIL (X, Y, Z) BALL SCREW (X, Y, Z)	Before the amount of lubricant in the oil tank reaches the low level
UNIWAY EV68	JX Nippon Oil & Energy		
Shell Tonna S3 M 68	SHOWA SHELL SEKIYU K.K.		

Use the following cartridge grease for automatic grease lubricating system (option).

Product specification	Manufacturer	Component to be greased	Timing of application
FANUC specification: A90L-0001-0534#LHL3007 (LUBE specification: LHL300-7, volume 700cm^3=700 mL)	LUBE	LM guides (X, Y, Z) Ball screws (X, Y, Z)	When the grease level low alarm is issued
FANUC specification: A90L-0001-0534#LHL3004S (LUBE specification: LHL300-4S, volume 400cm^3=400 mL)			

FANUC recommends the rust inhibitor below.

Brand	Manufacturer	Component to be lubricated	Timing of application
ANTIRUST P-2800	JX Nippon Oil & Energy	GUIDE RAIL (X, Y, Z) TAPERED PORTION OF THE SPINDLE TABLE SURFACE	At the time of packing, transportation, and storage.

2.2.2 Specified Lubricants

To use a lubricant not listed below, contact its manufacturer directly.

(1) Rust inhibitor

JIS category	Solvent dilution type rust inhibitor	Petrolatum type rust inhibitor
	NP-1	NP-6
JX Nippon Oil & Energy		ANTIRUST P-3600
N·S LUBRICANTS	RUST COAT 102	

(2) Industrial grease

Category		Mobil Sekiyu K.K.	SHOWA SHELL SEKIYU K.K.
Grease for centralized greasing piping	Lithium-based	Mobilux EP1	ALVANIA GREASE No.1

2.3 INSPECTING THE FAN MOTORS IN THE CONTROL UNIT

Fan motors are consumable items. The fan motors for the amplifiers (common power supply, spindle amplifier, and servo amplifier) and CNC need to be maintained and replaced periodically (once a year).

2.3.1 Specified inspection criteria

(1) The fan motors rotate normally.
(2) Abnormal vibration or unusual sound does not occur.
(3) Dust or oil mist does not adhere to the motors.

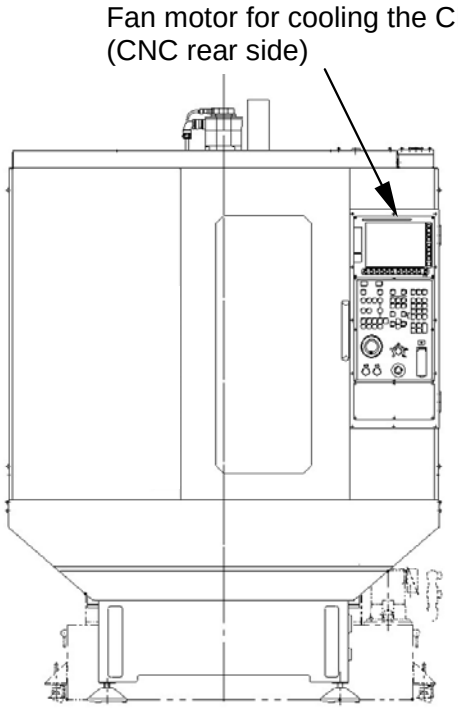
If a fan or air intake gets dirty, the amplifier or CNC may fail. Be sure to clean the fans during periodical inspection.

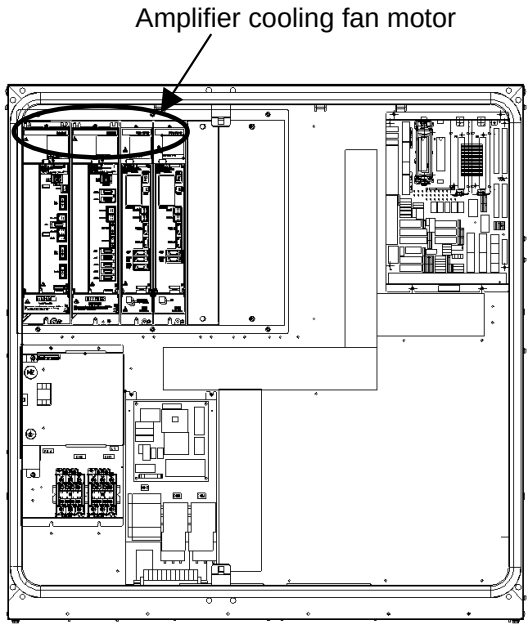
> ⚠ **WARNING**
> Be sure to turn off the power when inspecting the fan motors in the control unit. Otherwise, you may get injured due to an unpredictable motion.

2.3.2 Cleaning the fan unit

Remove dust and mist adhered to the fan motor with a dry waste cloth.
If dirt such as stuck mist can hardly be removed, wipe it off with a cloth soaked with neutral detergent and lightly wrung. Be careful not to allow the detergent to enter the inside of the rotor of the fan motor and other electrical sections.

2.3.3 Fan motor locations



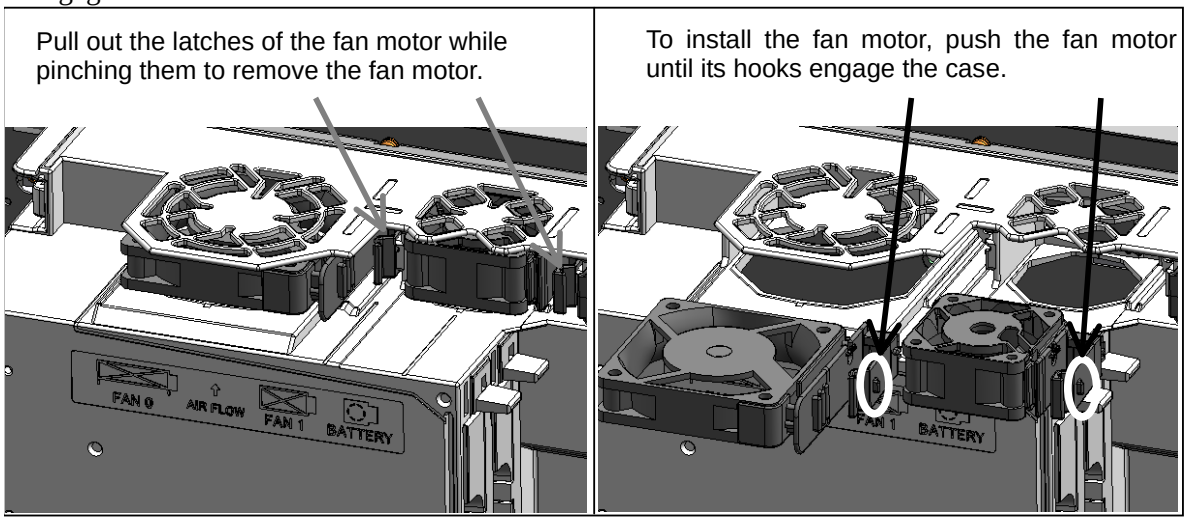


Inside of the control unit cabinet

2.3.4 Fan motor for cooling the CNC

2.3.4.1 Replacing the fan motor

1 Before replacing the fan motor, be sure to turn off the power of the machine (control unit).
2 Remove the fan motor installed in the case. Pinch the latches of the fan motor to unlock the hooks engaging the case and pull the fan motor.
3 Install a new fan motor in the case. After the installation, make sure that the hooks of the fan motor engage the case.



2.3.4.2 Specification numbers of fan motors

Symbols of fan motors	Specification numbers of fan motors	
	Option 1 slot	Option 2 slot
FAN0	A90L-0001-0567#A	A90L-0001-0567#B
FAN1	A90L-0001-0566#A	A90L-0001-0566#A
FAN0 + FAN1	A02B-0323-K124	A02B-0323-K125

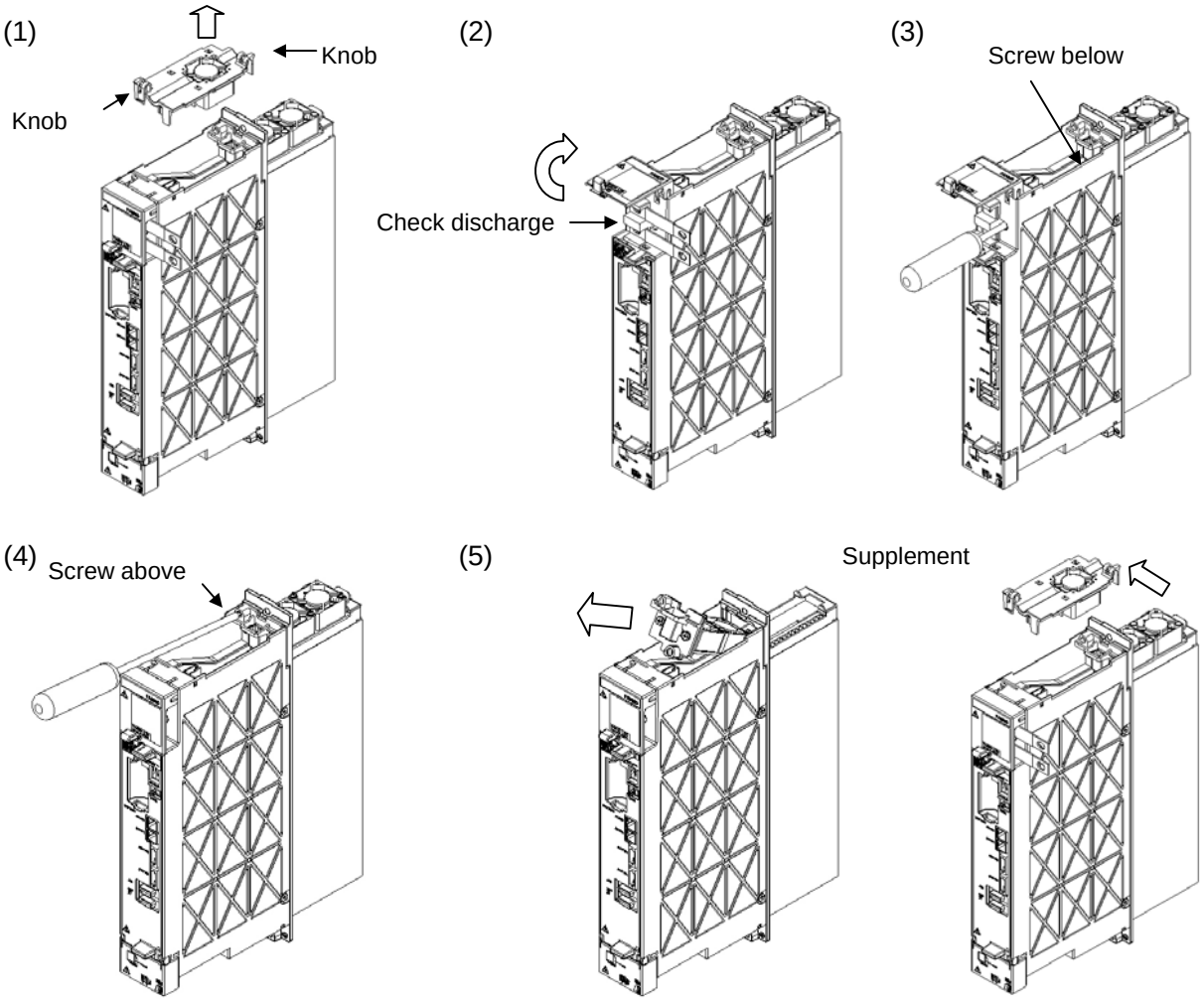
2.3.5 Fan Motors for Cooling Amplifiers

The method of removing the fan motor varies with the width of the amplifier. The widths of amplifiers are shown below.

Width of an amplifier	Type	Specification number
60mm	Servo amplifier	A06B-6240-H103, H104, H105, A06B-6240-H205, H206, H207, H208, H209
90mm	Common power supply	A06B-6200-H011
	Spindle amplifier	A06B-6220-H011#H600, A06B-6220-H015#H600
150mm	Common power supply	A06B-6200-H026
	Spindle amplifier	A06B-6220-H030#H600

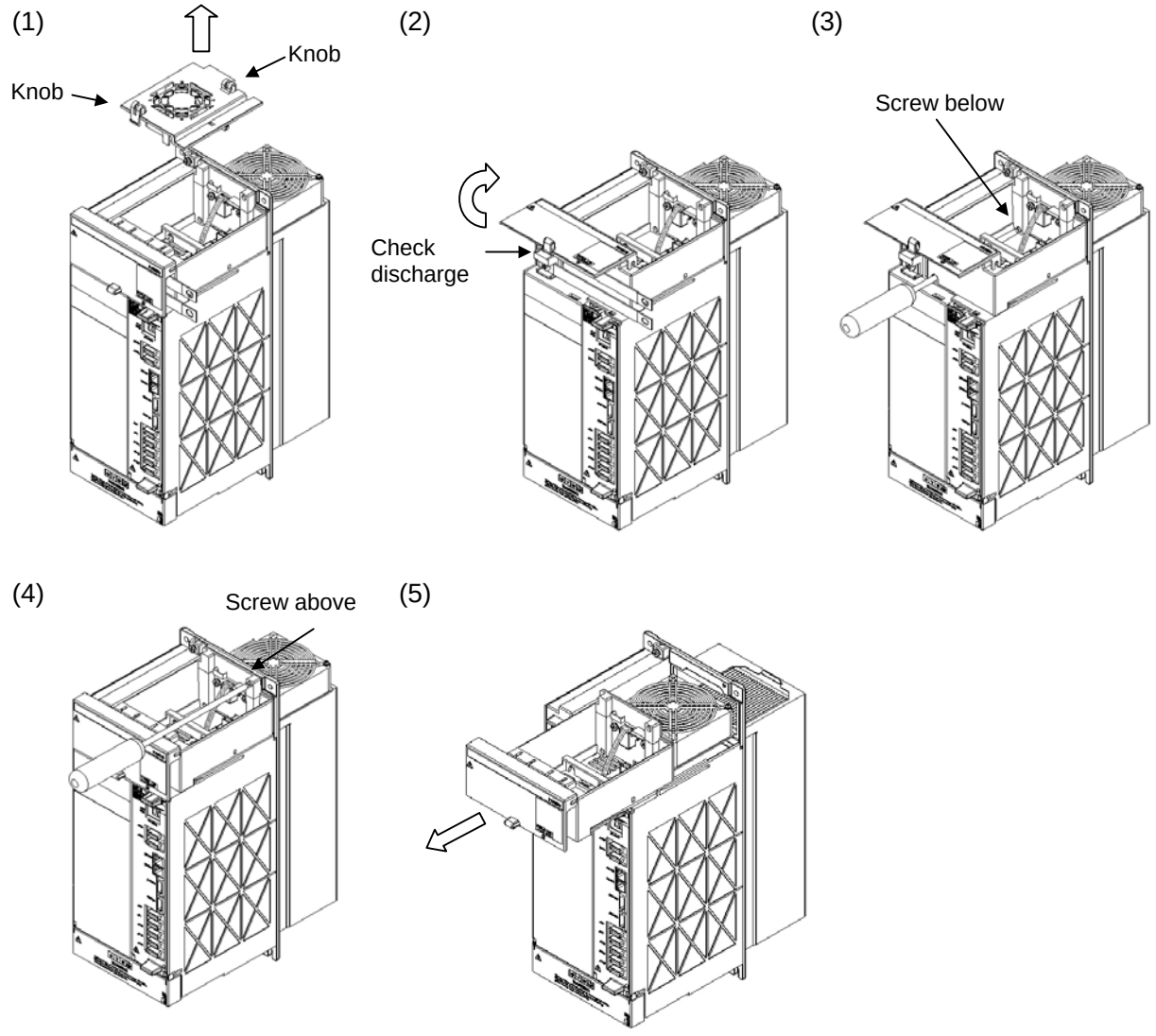
2.3.5.1 Replacing the fan unit for the 60mm-width amplifier and 90mm-width amplifier

1 Pinch the two knobs of the internal cooling fan unit and pull it upward.
(The internal cooling fan unit has been removed.)
2 Release the open/close lock of the DC link terminal block cover, open the cover of the DC link terminal block, make sure that the DC link has discharged (the LED turns off), and remove the DC link short bar.
3 Insert the screwdriver into the opening on the side of the DC link terminal block and loosen the screw below the radiator cooling fan unit.
4 Loosen the screw (for the 60mm-width amplifier) or the two screws (for the 90mm-width amplifier) above the radiator cooling fan unit.
5 Pull the radiator cooling fan unit (the radiator cooling fan unit has been removed).
6 To install the fan unit, perform the above procedure reversely.
Supplement: If the engagement position of the connector is misaligned during installation of the internal fan unit, it is difficult to install the internal fan unit. In this case, install the internal fan unit while pressing the projection at the back of the internal fan unit to the left.



2.3.5.2 Replacing the fan unit for the 150mm-width amplifier

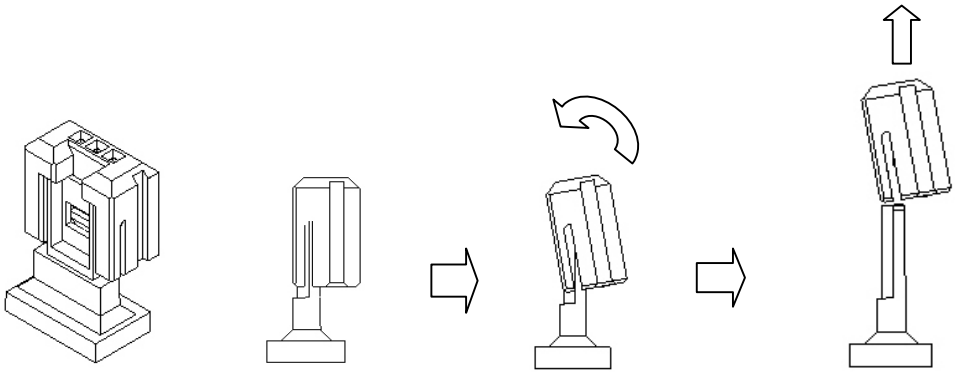
1 Pinch the two knobs of the internal cooling fan unit and pull it upward.
(The internal cooling fan unit has been removed.)
2 Release the open/close lock of the DC link terminal block cover, open the cover of the DC link terminal block, make sure that the DC link has discharged (the LED turns off), and remove the DC link short bar.
3 Insert the screwdriver into the opening on the side of the DC link terminal block and loosen the screw below the radiator cooling fan unit.
4 Loosen the screw above the radiator cooling fan unit.
5 Pull the radiator cooling fan unit (the radiator cooling fan unit has been removed).
6 To install the fan unit, perform the above procedure reversely.



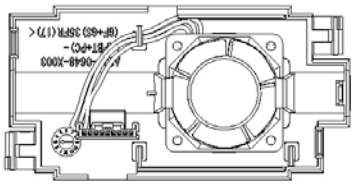
2.3.5.3 Removing the fan motor from the internal cooling fan unit

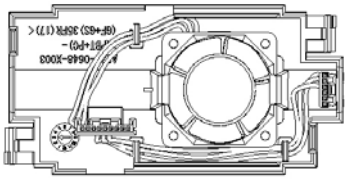
1 Remove one or two connectors from the case (see below for details).
2 Remove the fan motor from the case.

Twist the connector a little in the arrow direction so that the left and right resin bars are bent and the engagement of the center projections is released.
When the connector is pulled upward while being twisted, it can be freed from the case.

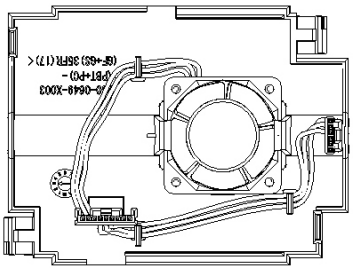


Internal cooling fan unit for 60mm width (two types with different connectors)

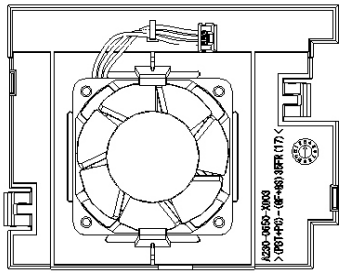




Internal cooling fan unit for 90mm width



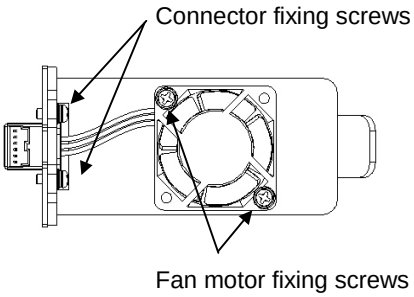
Internal cooling fan unit for 150mm width

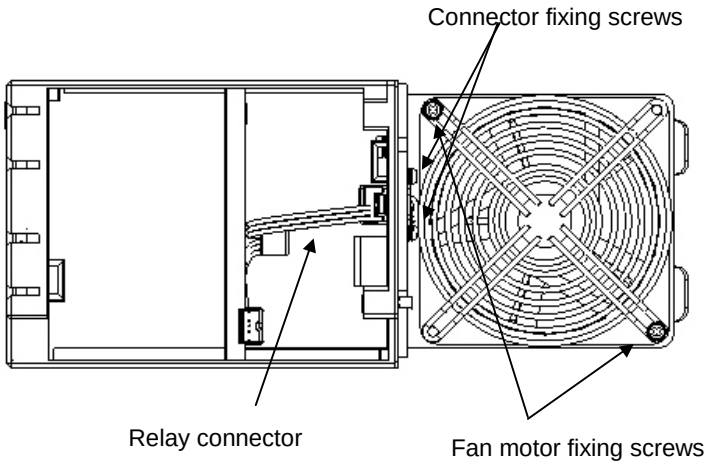


When replacing the fan motors, note the orientation (the identification plate faces upward during installation in the amplifier) of the fan motor body and the orientation of the connector.

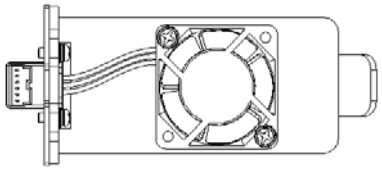
2.3.5.4 Removing the fan motor from the radiator cooling fan unit

1 For 150mm width, remove the relay connector from the fan connector. (The 60mm-width and 90mm-width radiator fan units have no relay connector.)
2 Remove the two or four screws that secure the fan motor.
3 Remove the two screws that secure the connector of the fan motor.

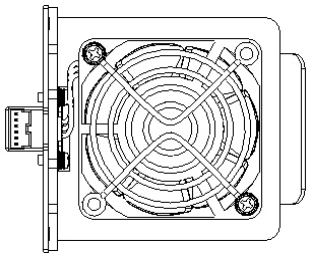




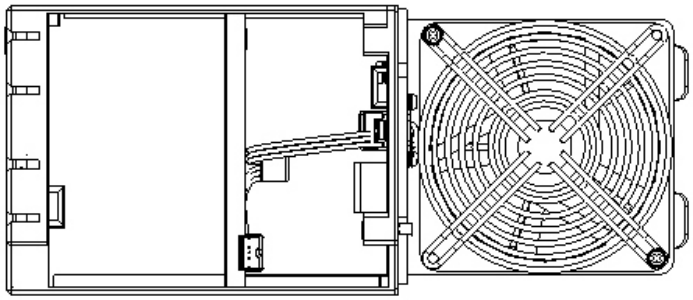
Radiator cooling fan unit for 60mm width



Radiator cooling fan unit for 90mm width



Radiator cooling fan unit for 150mm width



When replacing the fan motors, note the orientation (the identification plate faces upward during installation in the amplifier) of the fan motor body and the orientation of the connector.

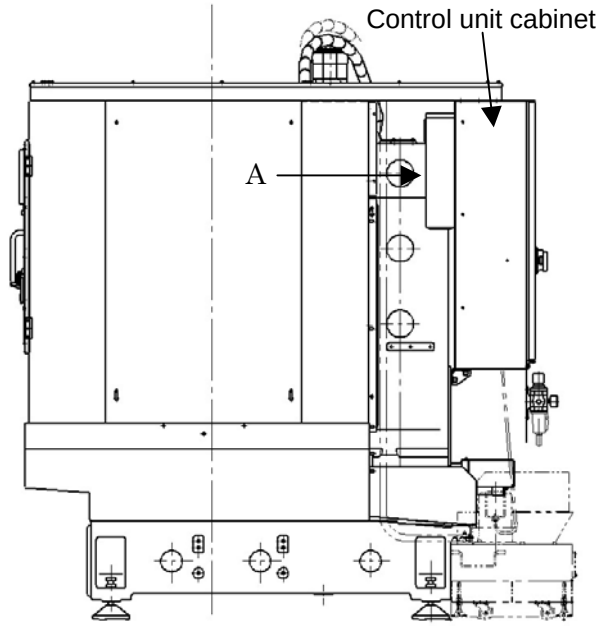
2.3.5.5 Specification numbers of fan units and fan motors

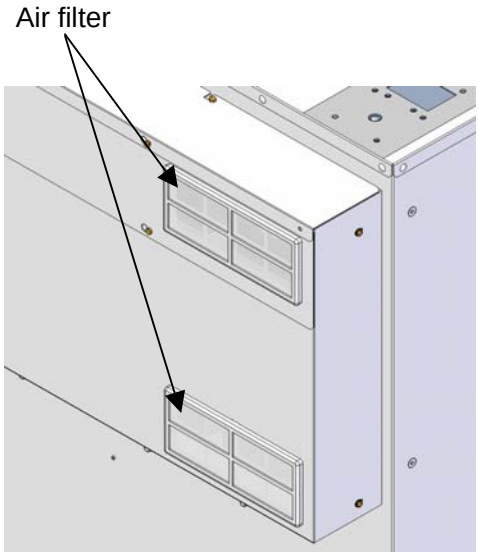
Width of amplifier	Type	Specification number of amplifier	Specification number of fan unit and fan motor	
			Internal cooling fan unit (fan motor only)	Radiator cooling fan unit (fan motor only)
60mm	Servo amplifier	A06B-6240-H103 A06B-6240-H104 A06B-6240-H105 A06B-6240-H205 A06B-6240-H206	A06B-6200-C606 (A90L-0001-0580#A)	
		A06B-6240-H207 A06B-6240-H208 A06B-6240-H209	A06B-6200-C607 (A90L-0001-0580#B)	A06B-6200-C601 (A90L-0001-0575#A)
90mm	Common power supply Spindle amplifier	A06B-6200-H011	A06B-6200-C609 (A90L-0001-0580#B)	A06B-6200-C603 (A90L-0001-0576)
		A06B-6200-H015		
	Common power supply	A06B-6220-H011#H600 A06B-6220-H015#H600		
150mm	Spindle amplifier	A06B-6200-H026	A06B-6200-C610 (A90L-0001-0581)	A06B-6200-C604 (A90L-0001-0577)
	Servo amplifier	A06B-6220-H026#H600 A06B-6220-H030#H600		

Normally, the fan motor should be maintained on a stand alone basis. When the plastic cover of the fan installation unit is broken, a fan unit should be ordered. The fan unit consists of the fan motor and fan motor installation cover.

2.3.6 Cleaning and Replacing the Air Filters

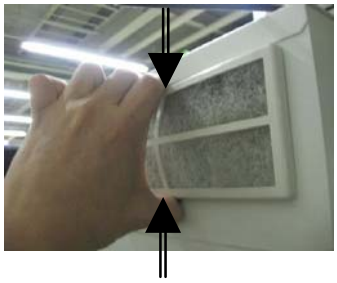
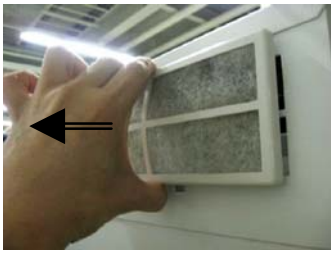
Air filters are attached to the control unit cabinet at the locations shown below.



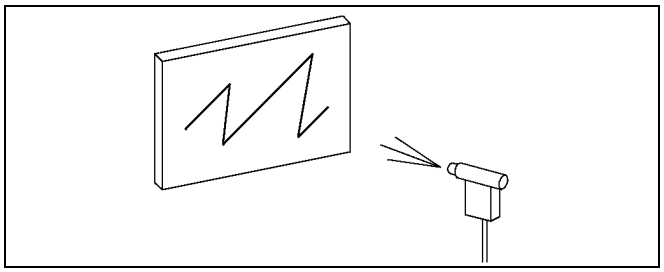


Details of portion A

Follow the procedure below to detach each air filter.

(1) While folding the filter cover at its middle with your fingers,	
(2) Pull the cover straight toward you.	
Note) Do not force to pull out the filter cover in its tilted state. Otherwise, the filter cover may break.	

(3) Blow air to the both surfaces of the filter to remove any grit and dust from them.



(4) When the filter is dirty extremely, wash it with a solution of water and neutral detergent, and rinse it with fresh water, then allow it dry naturally.
Alternatively, replace it with a new filter (use only the specified filter).

Ordering specification of the air filter
A04B–0094–K202 (set of 6)

2.4 MAINTENANCE OF AC SPINDLE MOTOR

The table below gives a summary of periodical maintenance.

Semiannuary maintenance (at least once a year)	(1) Cleaning(Fan, air intake openings, and fan protection net) (2) Noise and vibration check

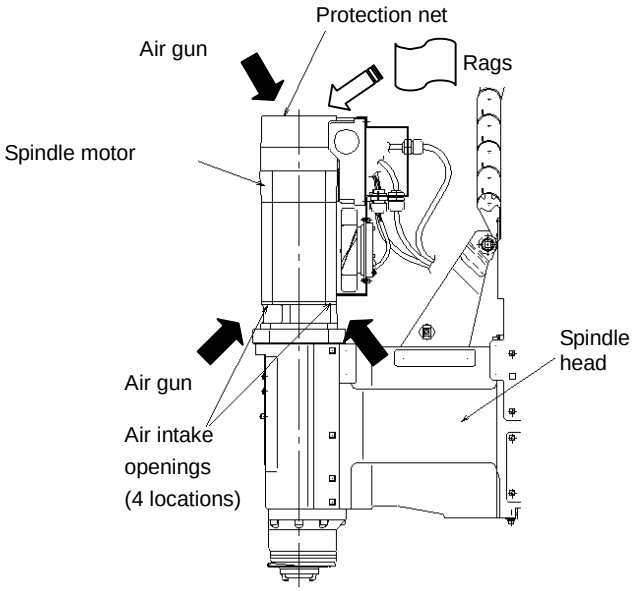
⚠ WARNING
When checking the AC spindle motor, turn off the main circuit breaker. Otherwise, you may get injured due to an unpredictable motion.

(1) Cleaning

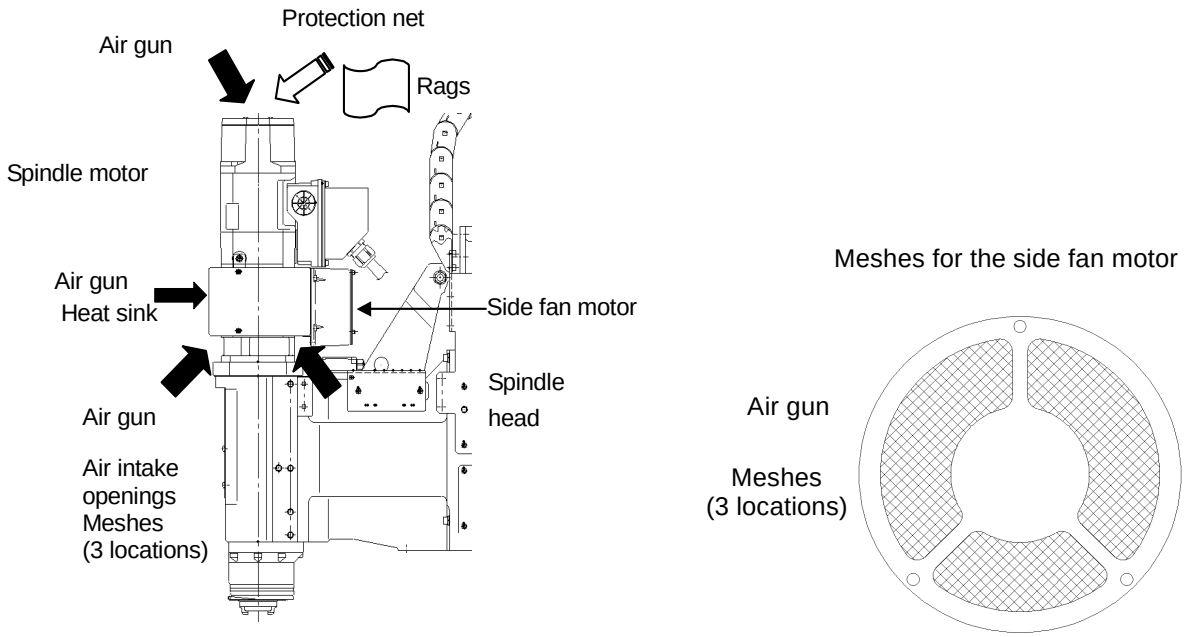
Dirt on the fan, air intake opening, fan protection net, or meshes of the side fan motor may cause the spindle motor to overheat. Periodically clean them to prevent the motor from overheating.
Follow the procedure below to clean the spindle motor section:

(a) Lower the Z-axis to a position around machine coordinate -250 mm in the manual mode by taking care not to make the tool interfere with any item such as the jig mounted on the table, then turn off the main circuit breaker.
(b) Open the front door with the LOCK/UNLOCK key.
(c) Remove dirt from the fan, air intake openings, and fan protection net as much as possible with an air gun. Then, wipe off dirt with rags and brushes.
(d) When High acceleration spindle or High speed spindle is used, remove the meshes from the side fan motor then remove dirt from the cover and meshes of the side fan motor as much as possible with an air gun. After cleaning, reinstall the meshes as originally installed.
(e) When a ROBODRILL genuine ceiling cover is in use, move, in the manual mode, the Z-axis down to a machine coordinate value of about -250 mm while keeping it from interfering with jigs and tools mounted on the table, and then turn off the main circuit breaker.
(f) Using an air gun from above the ROBODRILL, blow off any grit and dust from the fan, air inlet, and protective net as much as possible. After that, wipe off any remaining grit and dirt using a cloth or brush. If you need to use a stepladder during this work, wear a helmet and pay attention to safety sufficiently.

⚠ CAUTION
When cleaning the AC spindle motor, wear protectors such as a mask, protective goggles, and hat to protect against dirt and dust.
When using a stepladder during this work, wear a helmet and pay attention to safety sufficiently.



Standard spindle and High torque spindle



High acceleration spindle and High speed spindle

(2) Noise and vibration check

If there is an abnormality in a spindle motor bearing, abnormal noise or vibration may be produced. Check the noise and vibration when the spindle motor is running.

2.5 REPLACING THE FILTER REGULATOR AND OIL FILTER MANTLE (ELEMENT)

⚠ WARNING

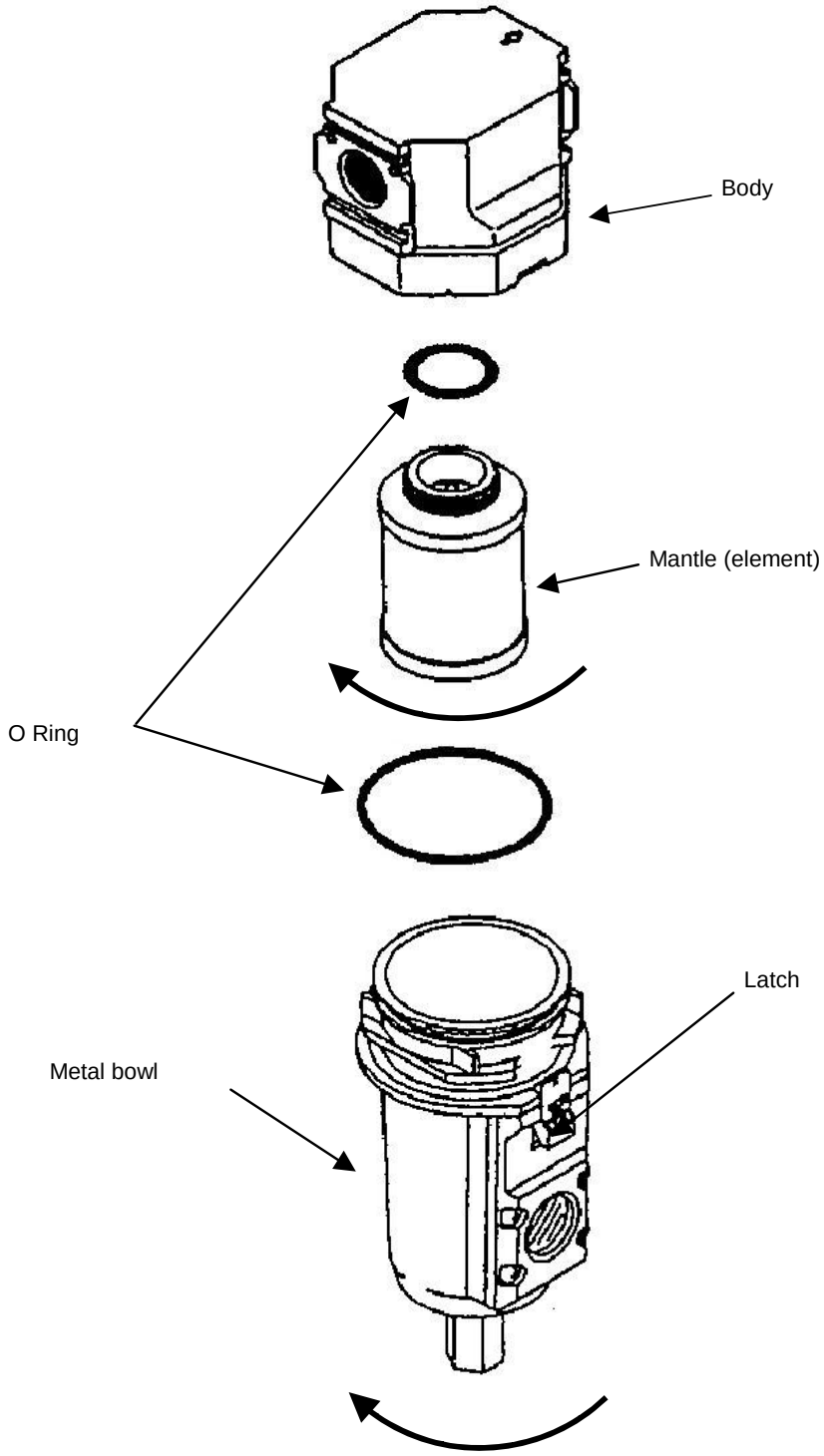
1 Before starting auto drain maintenance, turn off the main circuit breaker. Otherwise, you may get injured due to an unpredictable motion.
2 Before removing the bowl, stop compressed air supply to remove any residual pressure and make sure that there is no pressure inside the bowl. If there remains compressed air, the bowl can be blown, resulting in human injury or death.
3 Do not remove the bowl guard. If the bowl is destructed, broken pieces can scatter, resulting in human injury or death.

ATENTION

1 Before operating the machine after maintenance work, make sure that the given functions can be performed satisfactorily and that there is no external leakage.
2 When removing and installing the mantle (element), do not hold the central portion. Otherwise, the mantle may be destructed or may not be able to function normally.

The mantle (element) is a consumable item. Replace it periodically to maintain its cleanness. It is not reusable even after washed.
Replace the mantle with a new one once a year (6000 hours) or when the pressure drops by 0.1 MPa as a guideline.

(1) While holding down the latch, remove the bowl by turning the bowl in the arrow direction.
(2) Remove the mantle by turning it in the arrow direction.
(3) Reverse the procedure for reinstallation.
(4) Upon completion of reinstallation, check that the latch is seated in the concave portion of the body before supplying compressed air.


Body
Mantle (element)
O Ring
Latch
Metal bowl

2.6 REPLACING EXPENDABLE PARTS

2.6.1 Battery

(1) Absolute Pulsecoder battery replacement
(2) CNC memory backup battery replacement

2.6.1.1 Absolute Pulsecoder battery replacement

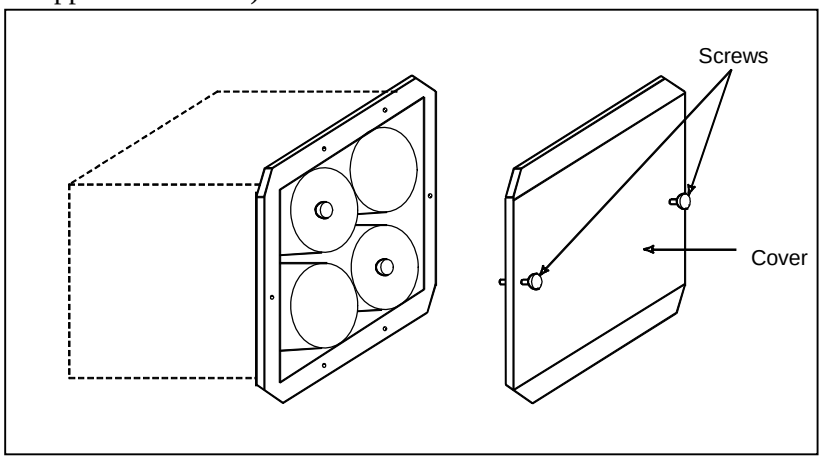
One battery unit can maintain current position data for six absolute pulse coders for a year.
When the voltage of the battery becomes low, APC alarms 3n6 to 3n8 (+axis name) are displayed on the CRT display. When APC alarm 3n7 is displayed, replace the battery as soon as possible.

If the voltage of the battery becomes any lower, the current positions for the pulse coders can no longer be maintained. Turning on the power to the control unit in this state causes APC alarm 300 (reference position return request alarm) to occur. Return the tool to the reference position after replacing the battery.

It is recommended that the battery should be replaced annually even if an APC alarm does not occur.

Replacing batteries

Obtain four commercially available alkaline batteries (size D).
(1) Turn on the power to the machine.
(2) Loosen the screws of the battery case and remove the cover.
(3) Replace the dry batteries in the case.
Note the polarity of the batteries as shown in the figure below (orient two batteries one way and the other two in the opposite direction).



(4) After installing the new batteries, replace the cover.
(5) Turn off the power to the machine.

⚠ WARNING
Use specified alkaline batteries (size D) and replace them in the correct way. If a battery is installed in a wrong way, it can explode, causing you to get injured.

ATTENTION
Replace batteries while the power is on. Note that if batteries are replaced when the power is off, the stored absolute position is lost.

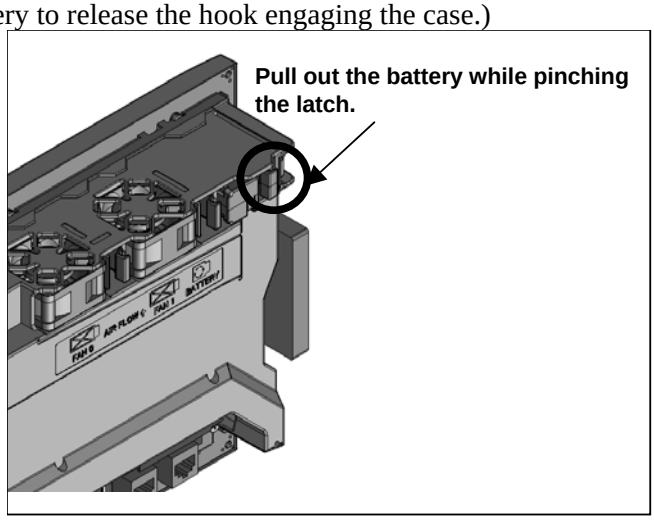
2.6.1.2 CNC memory backup battery replacement

Offset data and system parameters are stored in the SRAM of the control unit. The power supply of the SRAM is backed up by the memory backup battery installed in the control unit. Therefore, even if the main power is interrupted, no data is lost.
When the voltage of the battery drops, alarm message "BAT" blinks on the screen of the display unit and the battery alarm signal is output to the PMC. If the alarm blinks or is output, the battery should be replaced as soon as possible (within one week as a guide). However, how long the battery can be used after issuance of the alarm depends on the system structure.
If the voltage of the battery further drops, the memory cannot be backed up. When the power of the control unit is turned on in such a state, a system alarm occurs because data in the memory is lost. The battery should be replaced and then data in the memory should be all cleared and input again.
Therefore, FANUC recommends that the battery should be replaced annually even if a battery alarm does not occur.

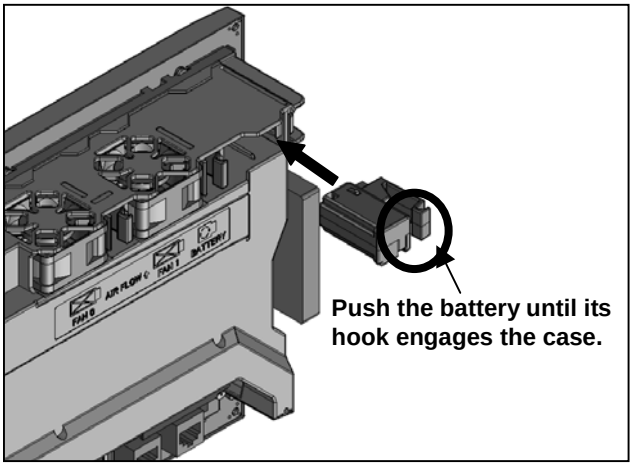
NOTE
During shipment from FANUC, the lithium battery is installed in the control unit as standard. This battery can back up the data in the memory for one year.

Replacing the lithium battery

Prepare a new lithium battery (ordering information: A02B-0323-K102) in advance.
<1> Turn on the power of the machine (control unit) for about 30 seconds and then turn off it.
<2> Pull out the lithium battery installed in the back of the control unit. (Pull it out while pinching the latch of the lithium battery to release the hook engaging the case.)



<3> Install the new lithium battery prepared in advance. (Push the lithium battery until its hook engages the case.) Make sure that the hook securely engages the case.



⚠ WARNING
The lithium battery may explode unless it is correctly replaced.
Be sure to use the specified lithium battery (A02B-0323-K102).

⚠ CAUTION
Steps <1> to <3> must be done within 30 minutes.
If the battery is removed for an extended period of time, data in the SRAM may be lost.
Save the data in the SRAM before replacement. This enables recovery of the data in the SRAM easy if it is lost.

NOTE
The replaced battery should be correctly discarded as factory wastes according to the law etc. specified by the country in which the machine is installed or by the local government that exercises jurisdiction over the installation place. Before discarding it, insulate terminals with vinyl tape etc. to prevent them from being short-circuited.

2.6.2 Fuse

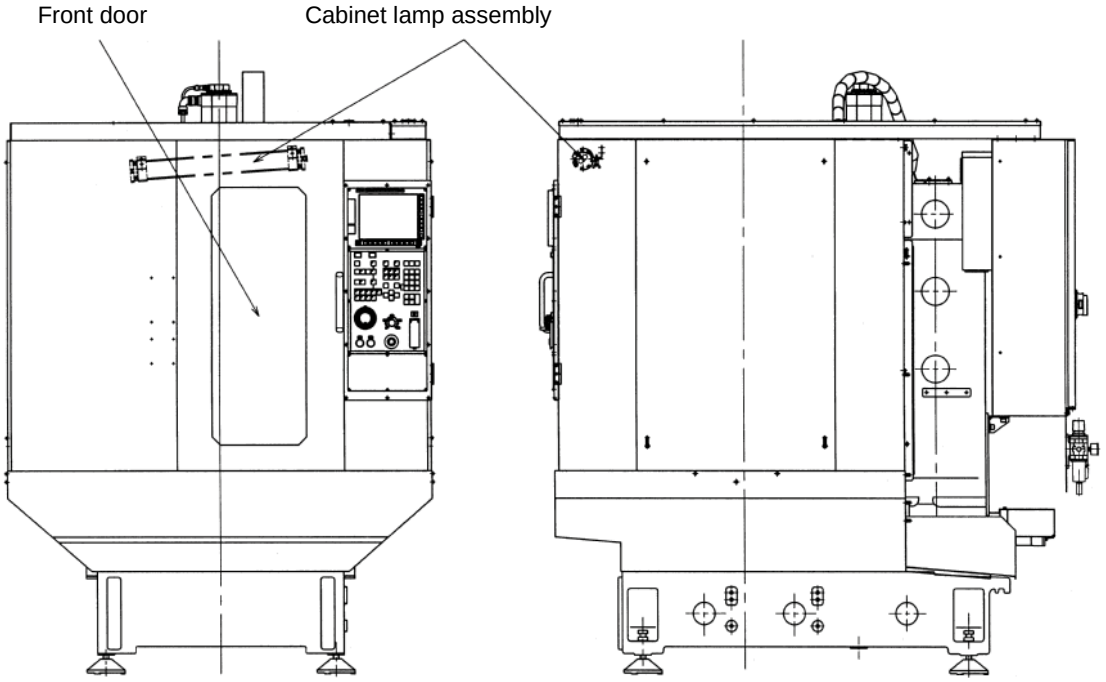
If the small window of the fuse unit is white, the fuse has blown.
Disconnect the fuse unit and replace the fuse unit with a new one.

⚠ WARNING
When replacing the fuse, turn off the main circuit breaker. Otherwise, you can get electrically shocked.

2.6.3 Fluorescent Lamp in the Inside Light Unit

The inside light unit is located on the back of the front door as shown in the figure below.

Fluorescent lamp: FANUC specification A49L–0001–0070#A
IEC7004-82 OSRAM DULUX L24W/840



(1) Turn off the main circuit breaker.

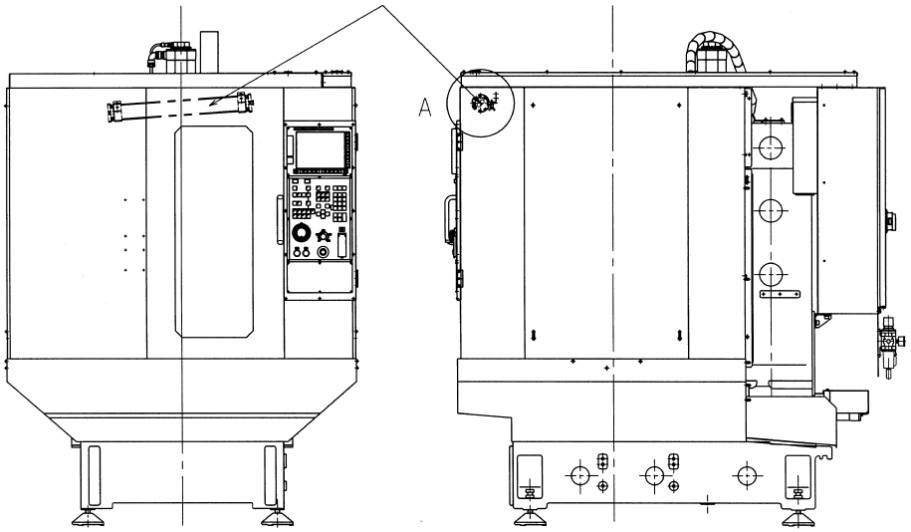
> ⚠ **WARNING**
> When replacing the fluorescent lamp, turn off the main circuit breaker. Otherwise, you can get electrically

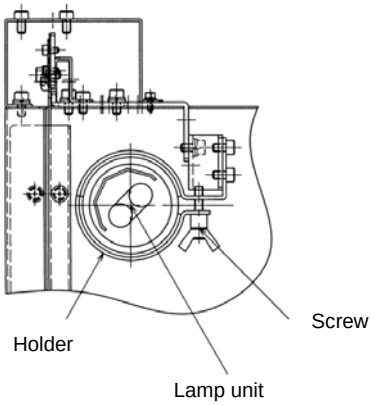
(2) Release the door lock and open the front door. (See Section 5.4 in III, "Opening and Closing Doors when the Power Is Off.")
(3) Remove the screws from the two holders, then remove the inside light unit from the holders.
(4) Slide the cover, then take out the contents of the inside light unit from the glass tube.
(5) Use a tool having a thin tip to disengage the part for fixing the fluorescent lamp as shown in the view from B.
(6) Turn and pull out the old fluorescent lamp as shown in the view from C with the red button held down.
(7) Push in and mount a new fluorescent lamp as shown in the view from D with the red button held down.
(8) Put the contents of the inside light unit back in the glass tube and mount the cover.
(9) Mount the inside light unit on the two holders.

⚠ CAUTION

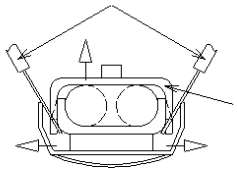
1 The life of a fluorescent lamp is about 6,000 hours. The life depends on the ambient environment. When the fluorescent lamp is burned out or begins blinking, replace it immediately. If you work under dim lighting, you may get injured inadvertently.
2 When replacing the fluorescent lamp, be careful not to cut yourself with any metal sheet in the inside light unit.

Cabinet : A49L–0001–0070#SLCE124



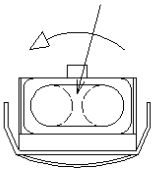


Tool with a thin tip

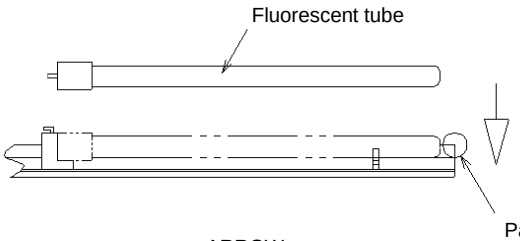


ARROW B

Fluorescent tube



ARROW C



ARROW

2.6.4 Checking the Cushion Rubbers Used for the X/Y/Z-Axis Telescopic Covers

> ⚠ **WARNING**
> Before inspecting the X/Y/Z-axis telescopic covers, be sure to turn off the power. Otherwise, an unexpected motion may cause injury.

2.6.4.1 X-axis telescopic covers

(a) (X cover R, X cover L) (α-D14/21M/L*i*A5)

Check the left and right X-axis telescopic covers for the following:

For the replacement procedure, refer to the maintenance manual.

(1) Damaged cushion rubbers and stopper rubbers (stands)
Insert your hand under the telescopic cover to check that the cushion rubbers and stopper rubbers are not damaged.
Two cushion rubbers and two stopper rubbers are provided for each of the left and right stands.
If cushion rubbers are damaged, replace them with new ones. If they are left unchanged, the telescopic cover and splash guard may be damaged.

(2) Damaged cushion rubbers (in the telescopic cover)
Move the table so that the telescopic cover to be inspected is shrunk at a maximum. Further push the movable part of the shrunk telescopic cover manually and inspect whether the depth of push is normal. As shown in the figure below, one cushion rubber is provided for each of the left and right X-axis telescopic covers.
If a cushion rubber is damaged, remove the telescopic cover and replace the cushion rubber.

(3) Worn or damaged wiper
If the wiper is worn or damaged, replace the main body of the telescopic cover.
If the wiper is left unchanged, many chippings enter the saddle, thereby causing a failure.

(4) Deformed plate
If many portions of the metal plate are deformed, replace the main body of the telescopic cover or the main body of the stand.
If the metal plate is left unchanged, the telescopic cover and splash guard may be damaged.

(5) Worn or damaged spring or spring post
If the spring or spring post is worn or damaged, replace it.

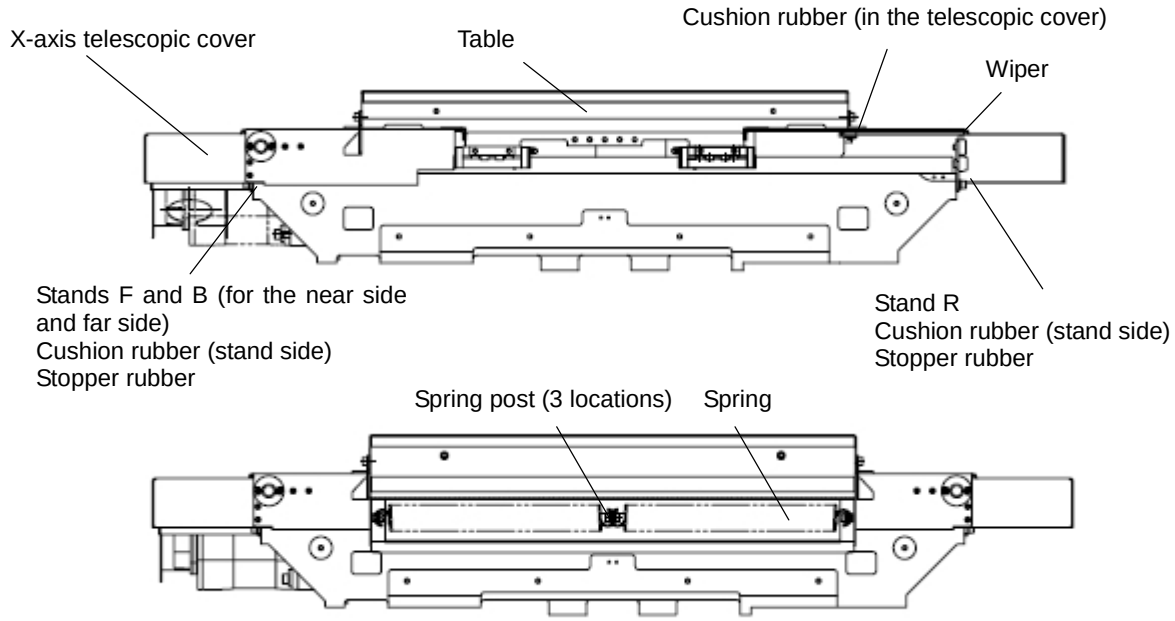


Fig. 2.6.4.1(a) Components

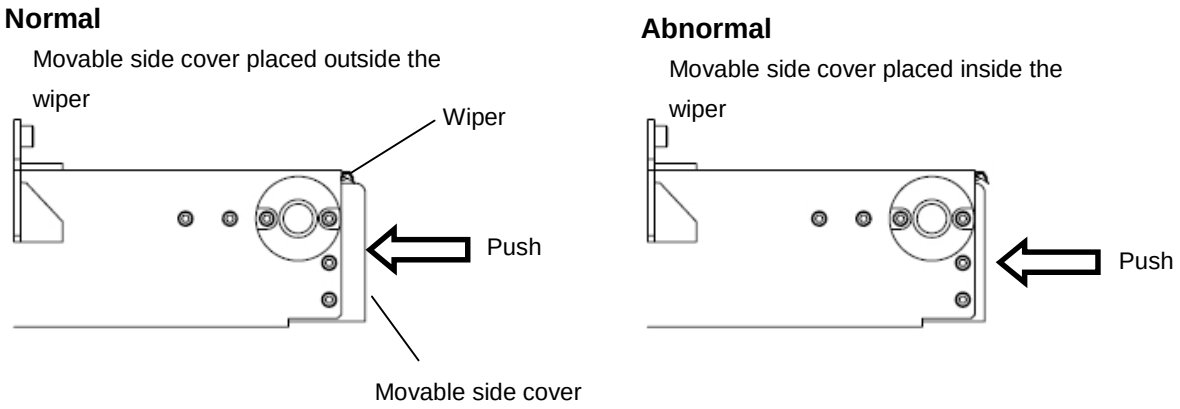


Fig. 2.6.4.1(b) Inspection of cushion rubber (in the telescopic cover)

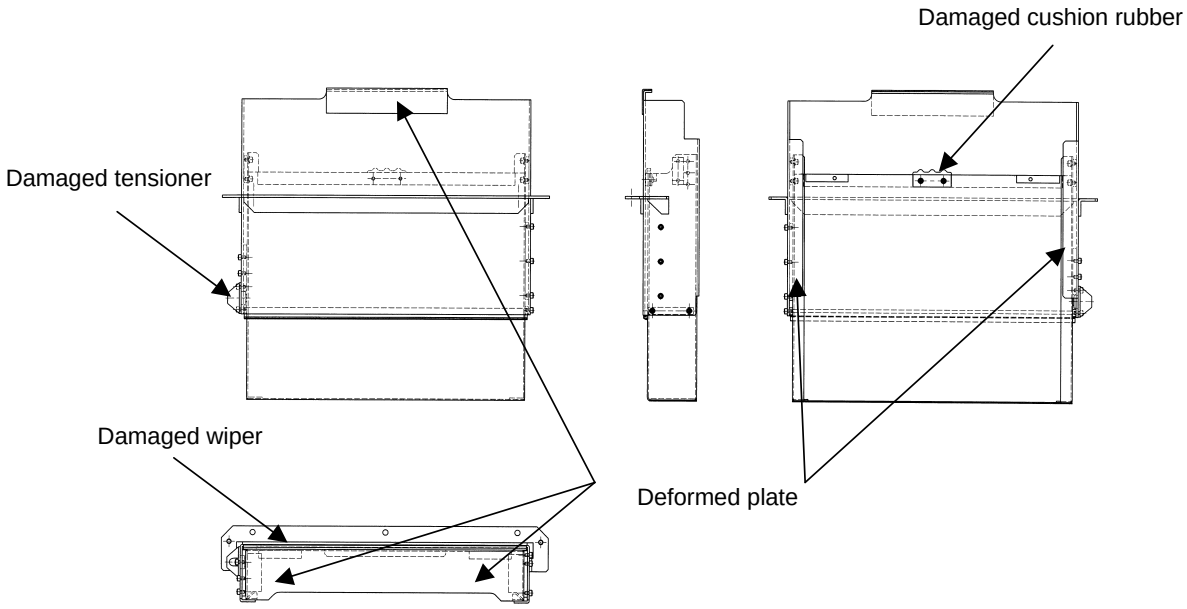


Fig. 2.6.4.1 (c) Checking X-axis telescopic covers

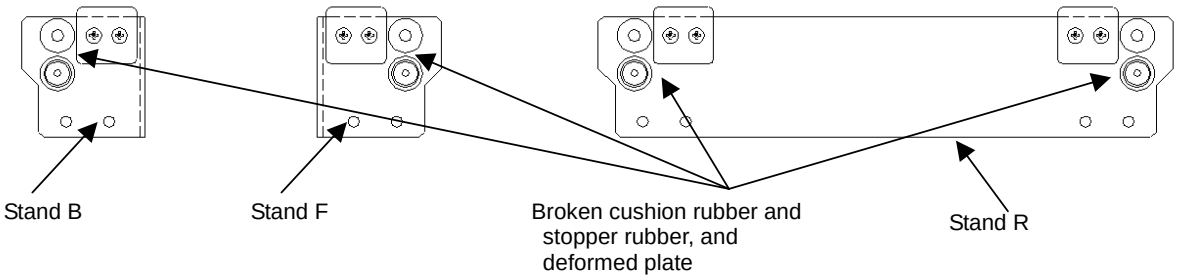


Fig. 2.6.4.1 (d) Checking stands

(b) (X cover R) (α-D14/21S*i*A5)

Check the right X-axis telescopic cover for the items indicated below.

Loosen the mounting bolt then remove and check the telescopic cover. For the removal and installation procedure, refer to the maintenance manual.

(1) Damaged cushion rubber (saddle R)

Check that the cushion rubbers of saddle R are not damaged. Three cushion rubbers are provided for each stand.

If a cushion rubber is damaged, replace it with a new one. If a damaged cushion rubber continues to be used, the telescopic cover and splash guard can be damaged.

(2) Damaged cushion rubber (telescopic cover)

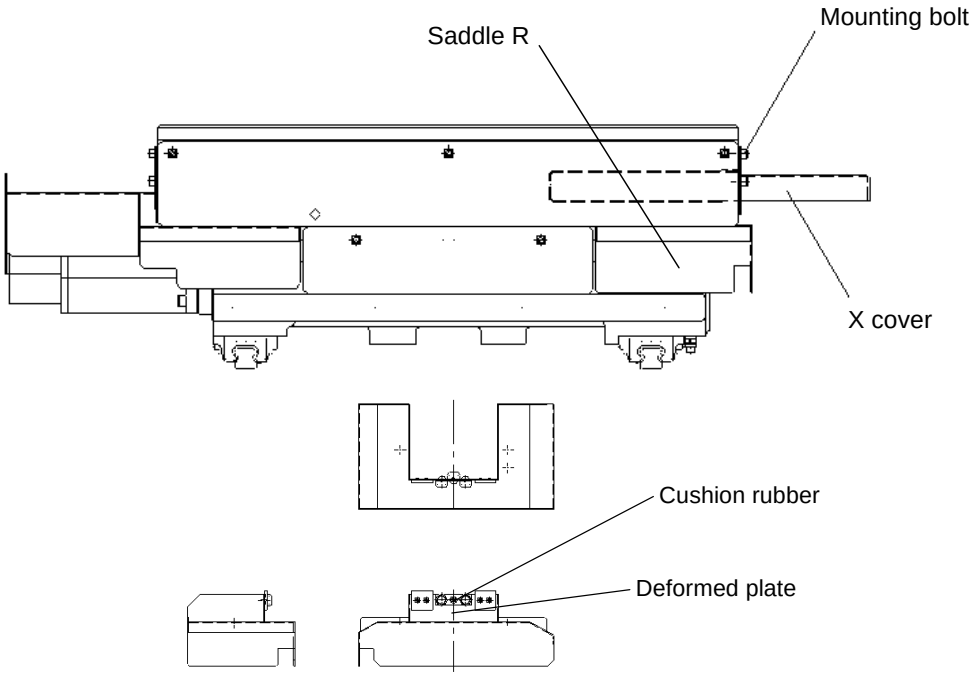
If the cushion rubber is damaged, replace the telescopic cover itself with a new one. For telescopic cover replacement, refer to the maintenance manual. If a damaged cushion rubber continues to be used, the telescopic cover and splash guard can be damaged.

(3) Damaged wiper

If the wiper is damaged, replace the telescopic cover itself with a new one. For telescopic cover replacement, refer to the attached replacement procedure.

If a damaged wiper continues to be used, a large quantity of chips can get into the saddle, resulting in a failure.

(4) Deformed plate
If a plate is deformed, replace the telescopic cover itself or saddle R with a new one. For telescopic cover replacement, refer to the maintenance manual.
If a deformed plate continues to be used, the telescopic cover and splash guard can be damaged.



2.6.4.2 Y-axis telescopic cover

Check the Y-axis telescopic cover for the items indicated below.
Loosen the flange fixing bolt then remove and check the telescopic cover. For the removal and installation procedure, refer to the maintenance manual.

(1) Damaged cushion rubbers and stopper rubbers (stands)
If a cushion rubber or stopper rubber is damaged, replace it with a new one.

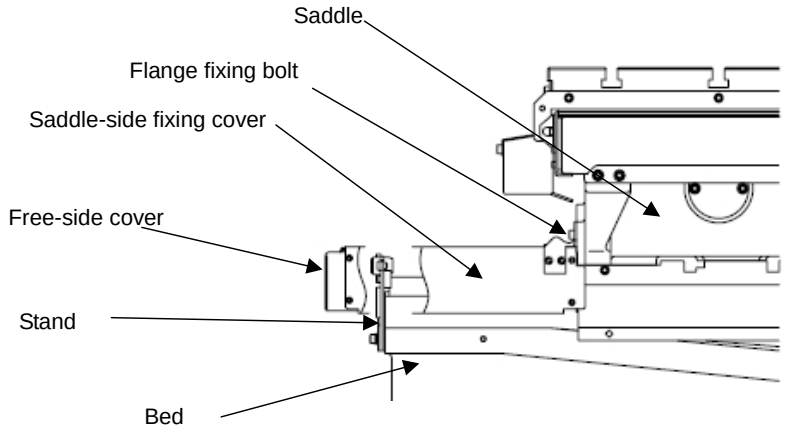
(2) Damaged cushion rubber (in the telescopic cover)
If a cushion rubber is damaged, replace it with a new one.
When checking the cushion rubber, remove the free-side cover from the fixing cover. The free-side cover can be extracted by removing the left and right brass parts(*1) on the flange side. At the time of reinstallation, be sure to use screw adhesive with a middle level of adhesion (LOCTITE 242 is recommended).

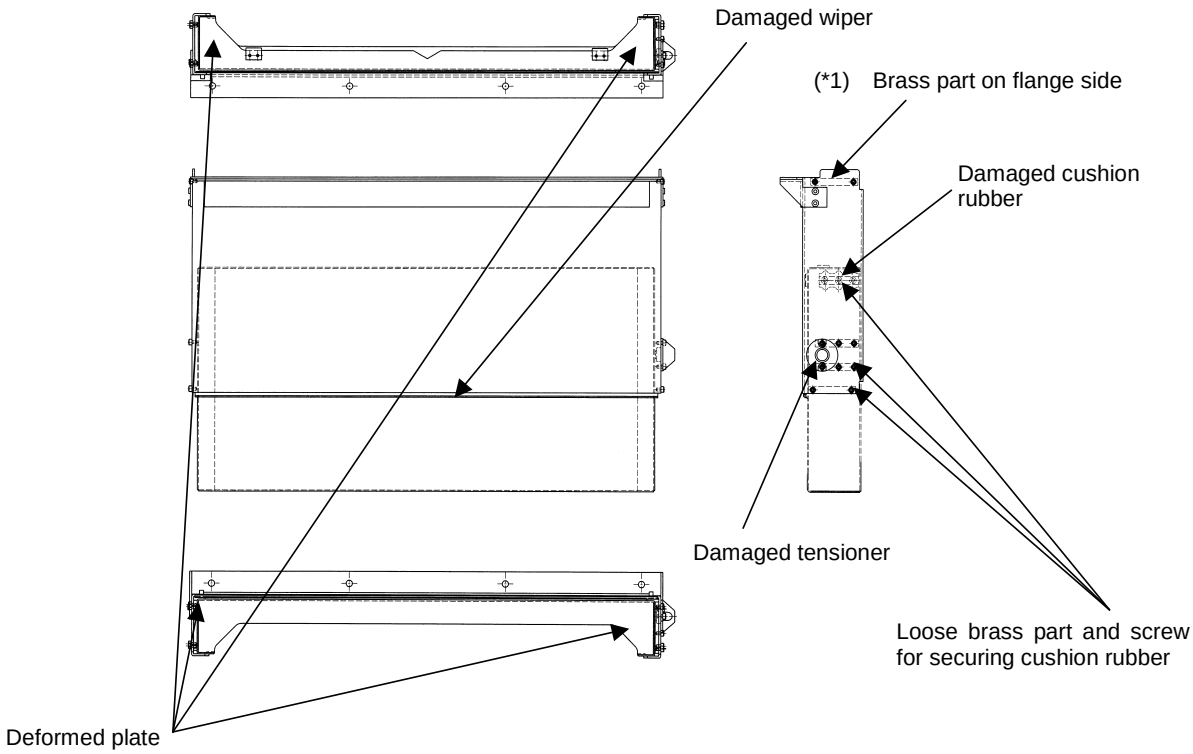
(3) Damaged wiper
If a wiper is damaged, replace the telescopic cover itself with a new one. For the method of replacement, refer to the maintenance manual.
If the brass part and the screw for securing the cushion rubber are loosen, tighten them again.
In this case, be sure to use a middle-level screw adhesive (LOCTITE 242 is recommended).

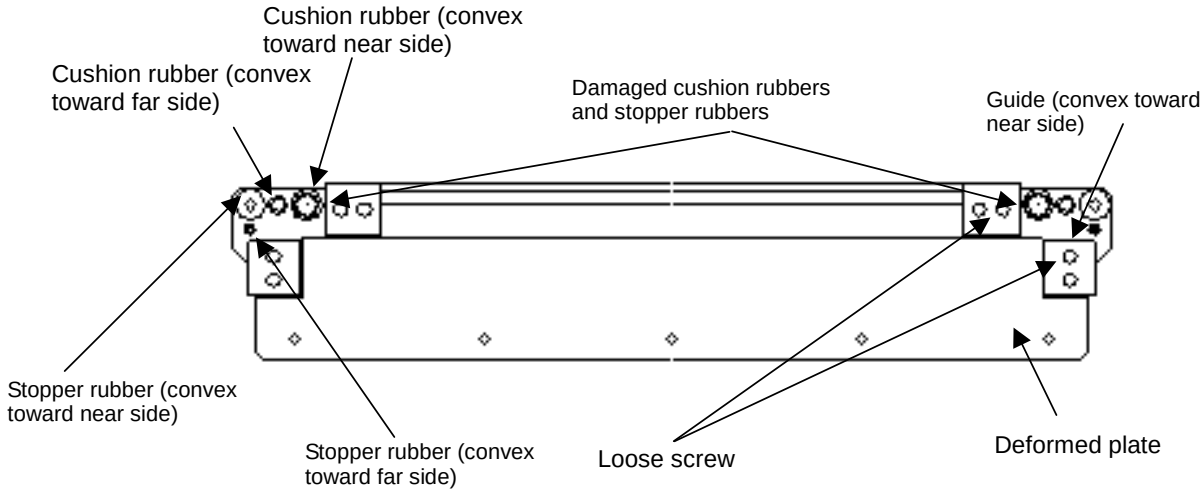
(4) Deformed plate
If a plate is deformed, replace the telescopic cover itself with a new one. For the method of replacement, refer to the maintenance manual.

(5) Damaged tensioner
If a tensioner is damaged, replace the telescopic cover itself.
For telescopic cover replacement, refer to the maintenance manual.

* Pay attention to the installation direction of YC STAND. Install YC STAND so that the guide faces the front of the machine.


Saddle
Flange fixing bolt
Saddle-side fixing cover
Free-side cover
Stand
Bed

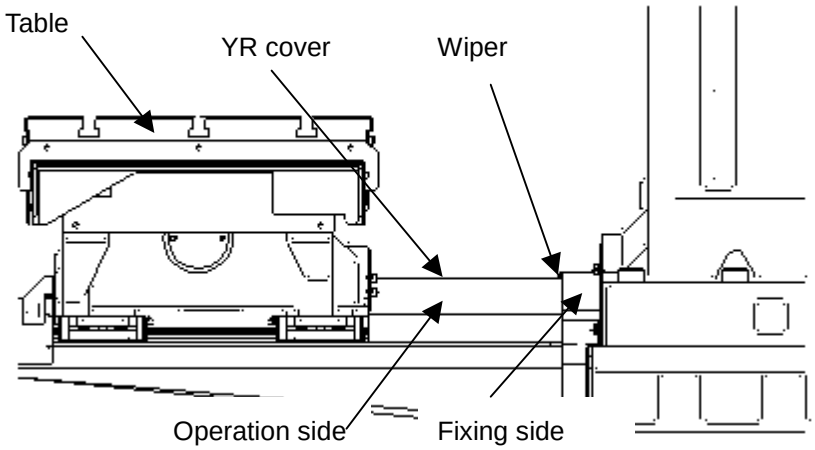

Damaged wiper
(*1) Brass part on flange side
Damaged cushion rubber
Damaged tensioner
Loose brass part and screw for securing cushion rubber
Deformed plate


Cushion rubber (convex toward near side)
Cushion rubber (convex toward far side)
Damaged cushion rubbers and stopper rubbers
Guide (convex toward near side)
Stopper rubber (convex toward near side)
Stopper rubber (convex toward far side)
Loose screw
Deformed plate

2.6.5 Checking the Y-Axis Rear Cover

> ⚠ **WARNING**
> Before inspecting the Y-axis rear cover, be sure to turn off the power.
> Otherwise, an unexpected motion may cause injury.

(1) Worn wiper or plate
Check that there is no gap between the fixing and operation sides of the YR cover. If there is one, replace the YR cover. For the replacement procedure, refer to the applicable maintenance manual.

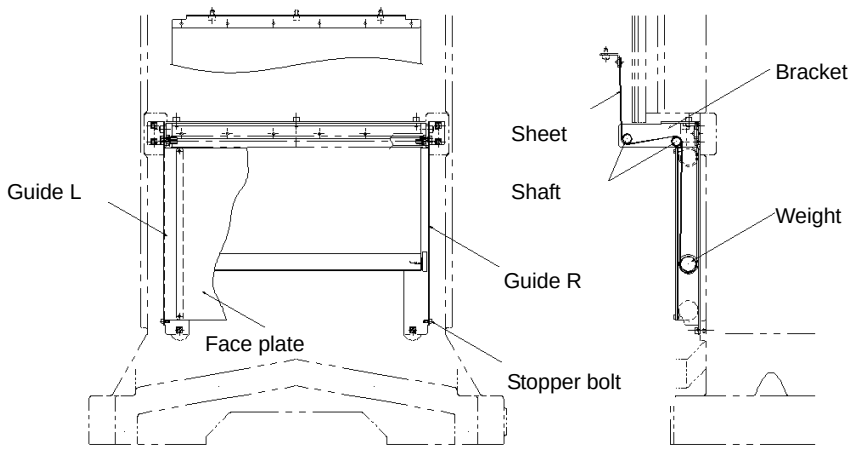


2.6.6 Checking the Z-Axis Cover and Z-Axis Metal Cover

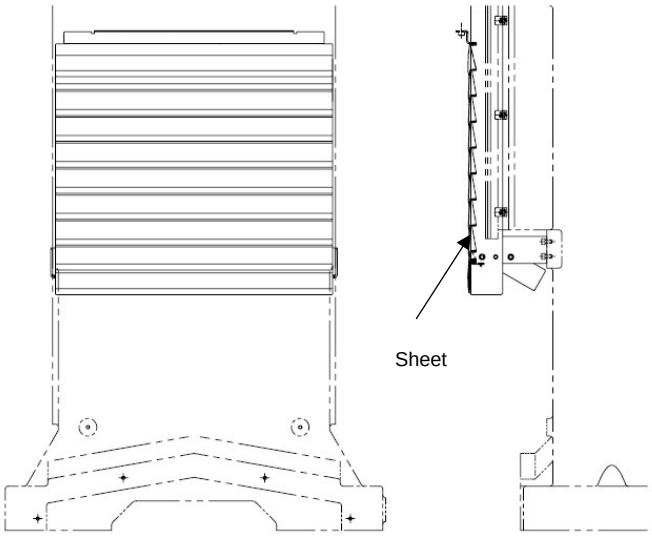
> ⚠ **WARNING**
> Before inspecting the Z-axis covers, be sure to turn off the power. Otherwise, an unexpected motion may cause injury.

(1) Broken sheet
Check that the Z-axis cover sheet is intact. If it is not, replace the Z-axis cover. For the replacement procedure, refer to the applicable maintenance manual.

(2) Chip or lubricating grease accumulated on the cover
If any chip or lubricating grease is accumulated on the inside of the Z-axis cover and its sheet, remove it. Leaving it unremoved may lead to a cover malfunction and a broken cover.



Z-axis cover



Z-axis metal cover

2.7 CLEANING OF THE SURROUNDINGS OF THE TURRET

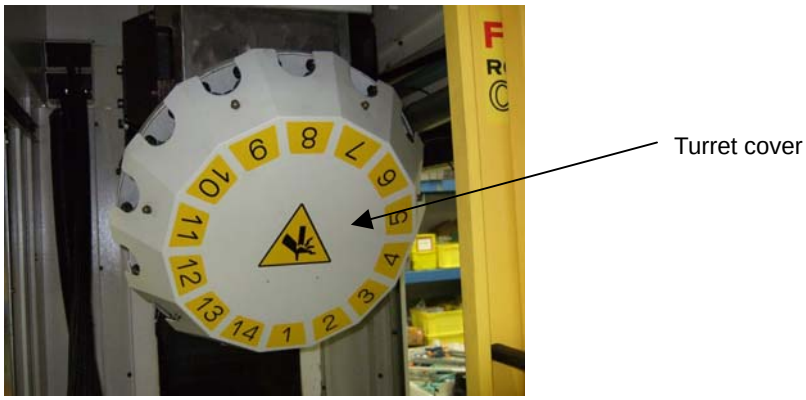
> ⚠ **WARNING**
> Before removing the turret cover, remove all tools attached to the turret.
> Be careful not to suffer an injury due to a dropping tool or dangerous tool during removal of the turret cover.

> ⚠ **CAUTION**
> During this work, put on protective equipment for protecting against dirt and dust, such as a mask, protective goggles, and a cap.

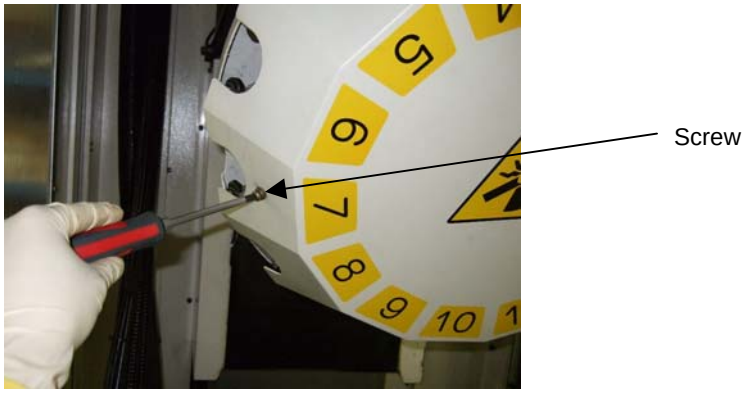
> **ATTENTION**
> Clean the turret periodically. Otherwise, tools may not be exchanged normally or the tool exchange mechanical unit may be damaged.
> Clean the turret frequently, especially in machining in which many chippings rise into the air.

1 Cleaning the inside of the turret

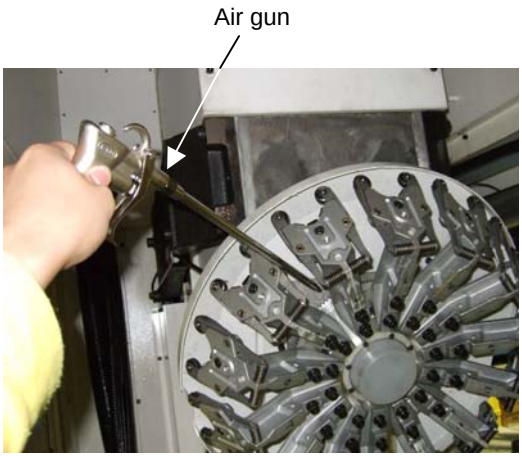
(1) Remove all tools attached to the turret.

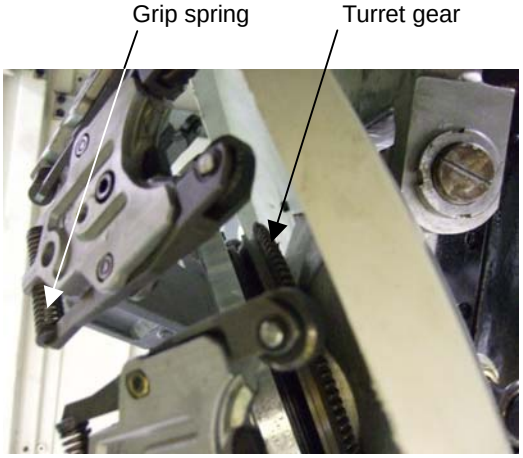


(2) Remove the seven screws fixing the turret cover while holding the turret cover so that it does not drop.



(3) Blow off the chippings on the turret with an air gun.
Carefully blow off the chippings especially on the turret gear and grip spring.
In addition, blow off the chippings on the back of the turret cover.

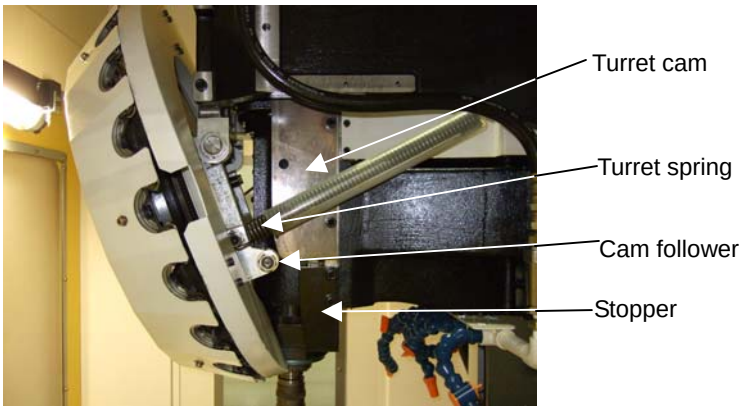




(4) Attach the turret cover.
At this time, check the tool number printed on the turret cover.

2 Cleaning the side of the turret

(1) Remove the chippings on the turret cam and the cam follower rolling surface of the stopper using an air gun or cotton waste. Also remove the chippings on the spindle gear and turret spring.
Next, apply grease to the turret cam, cam follower rolling surface of the stopper, and spindle gear (recommended grease: Alvania S2).



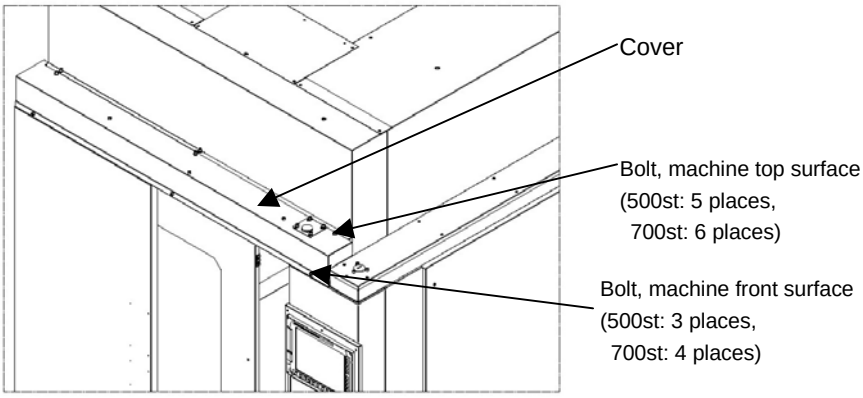
2.8 CHECKING AND CLEANING THE FRONT DOOR

2.8.1 Checking and Cleaning the Door Rail and Automatic Air Cylinder (Option)

ATTENTION

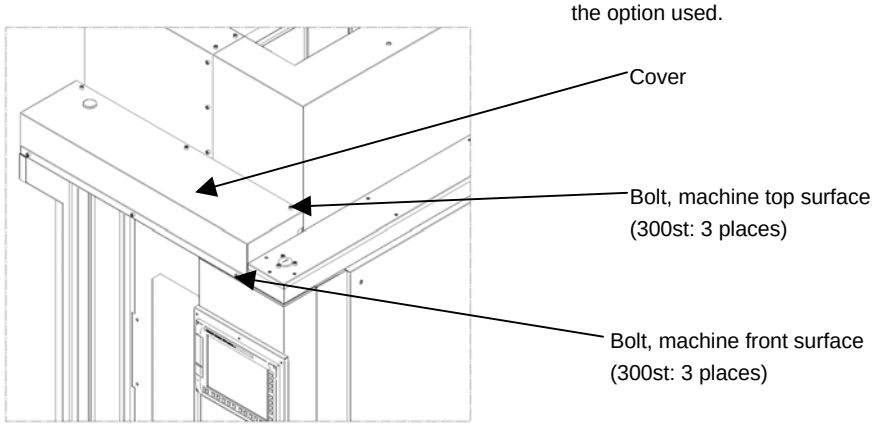
Leaving any chips unremoved for a long period may prevent the door from opening/closing smoothly. If the door is an automatic type, an alarm may be issued when the door opens and closes. Clean the door rail periodically. If the machining involved is a type that causes a large amount of chips to stir up, in particular, clean it frequently.

(1) Remove the bolts from the top of the door, and detach the cover.



α-D14/21M/L*i*A5

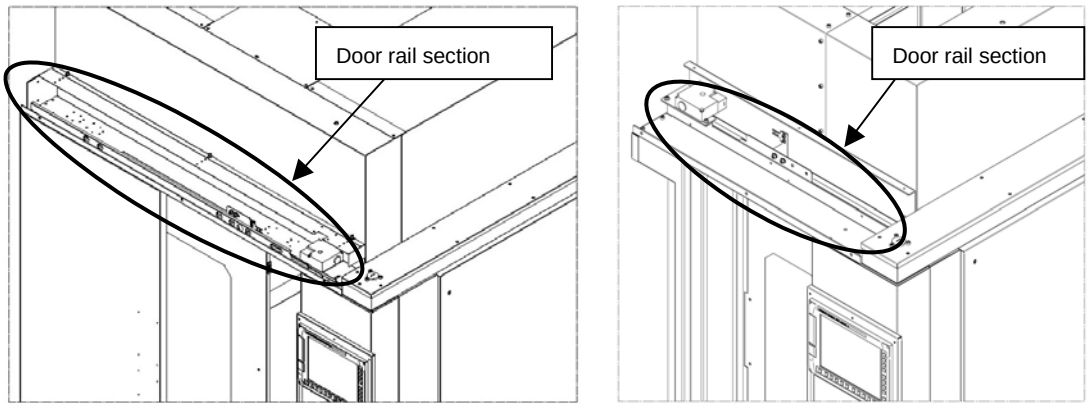
* Details of the structure vary depending on the option used.



α-D14/21S*i*A5

Fig. 2.8.1(a) Detaching the cover

(2) Check the door rail. If any chip or coolant is found on it, remove it, using a cloth or air gun. Also check the condition of the door roller. If any roller is found to be worn or fail to rotate smoothly, replace it while referring to the applicable maintenance manual.

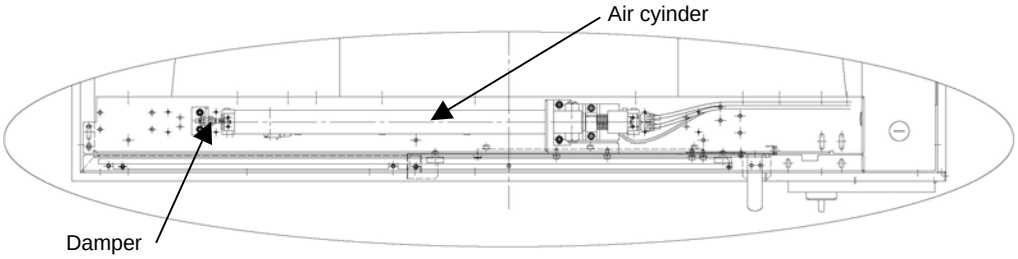


α-D14/21M/L*i*A5 α-D14/21S*i*A5

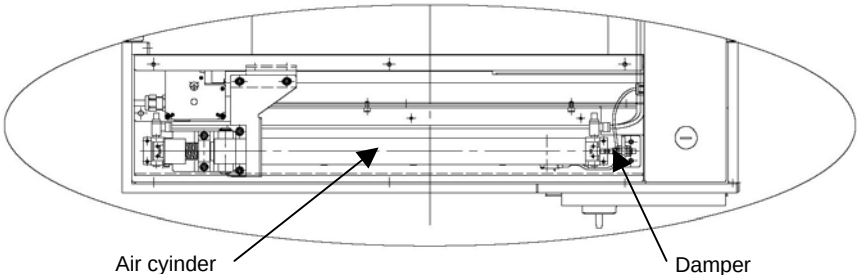
Fig. 2.8.1(b) Cleaning the door rail

(3) If the door involved is an automatic type, it has an air cylinder and damper in its door rail section. Check that there is no anomaly, for example, there is no air leakage from the air cylinder and door stops at each stroke end normally. Also check that the damper has an appropriate press resistance and returns correctly.
Open/close the front door, and check that the required one-way open/close time as measured from the related command is 2 to 2.5 seconds (α-D14(21)M*i*A5: 1 door, S*i*A5: 2 doors), 2.5 to 3 seconds (α-D14(21)M*i*A5: 2 doors), 3 to 3.5 seconds (α-D14(21)L*i*A5: 1 door), or 3.5 to 4 seconds (α-D14(21)L*i*A5: 2 doors).
If any anomaly is found, make adjustments or parts replacement while referring to the applicable maintenance manual.

> ⚠ **CAUTION**
> When operating the automatic door with the cover removed, be careful not to jam your fingers in the door.



α-D14/21M/L*i*A5 door rail section



α-D14/21S*i*A5 door rail section

Fig. 2.8.1(c) Checking the automatic door air cylinder

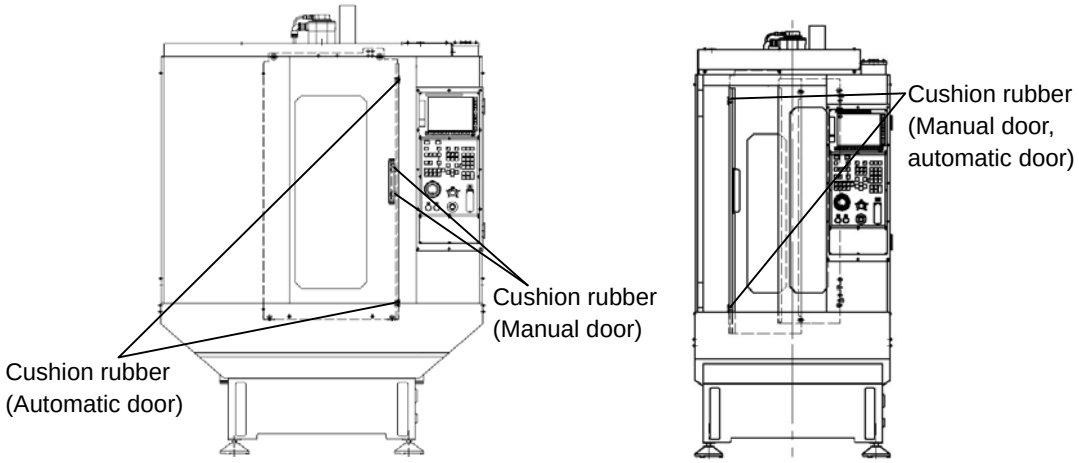
(4) Put the cover back in its original place.

2.8.2 Checking the Cushion Rubber

ATTENTION

When opening/closing the front door, do so slowly (at 300mm/sec or slower). Slamming it shut may shorten the service life of the cushion rubber.

The front door is provided with a cushion rubber at the location shown in the following diagram in order to mitigate shocks that may be caused by closing it. The cushion rubber is a consumable item. Check for a broken or missing cushion rubber periodically. If there is such an anomaly in the cushion rubber, replace it promptly while referring to the applicable maintenance manual.

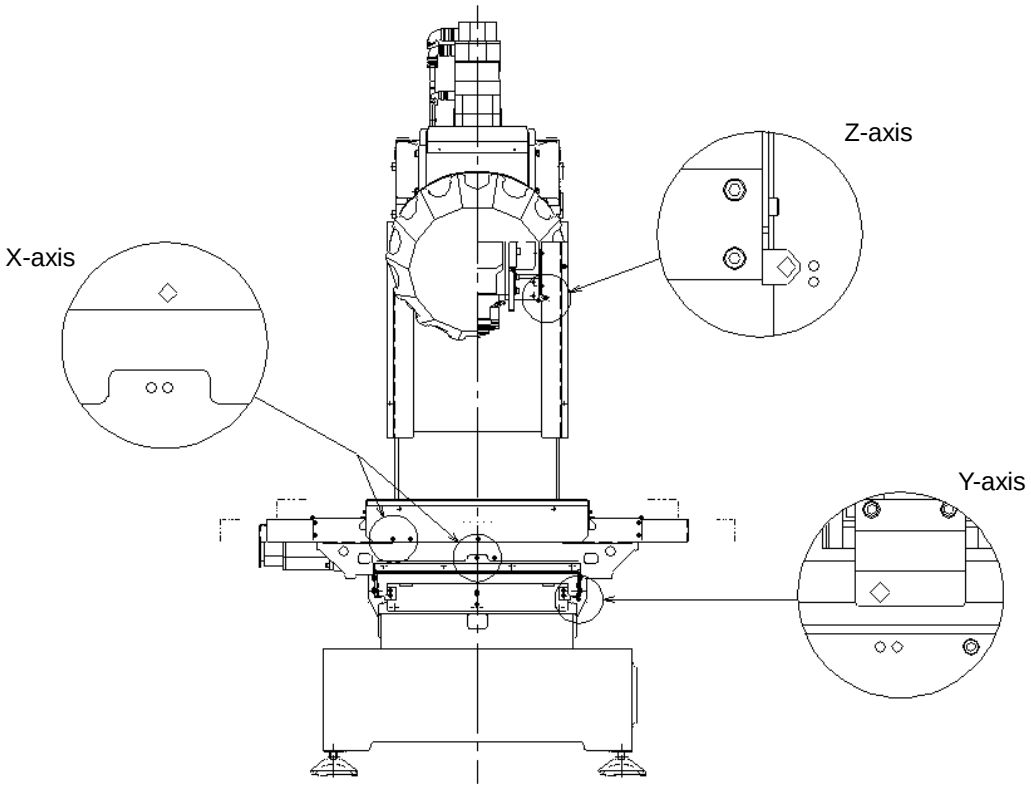


α-D14/21M/L*i*A5 α-D14/21S*i*A5

Fig. 3.8.2 Cushion rubber location

3 SERVO MOTOR ORIGIN RESTORATION

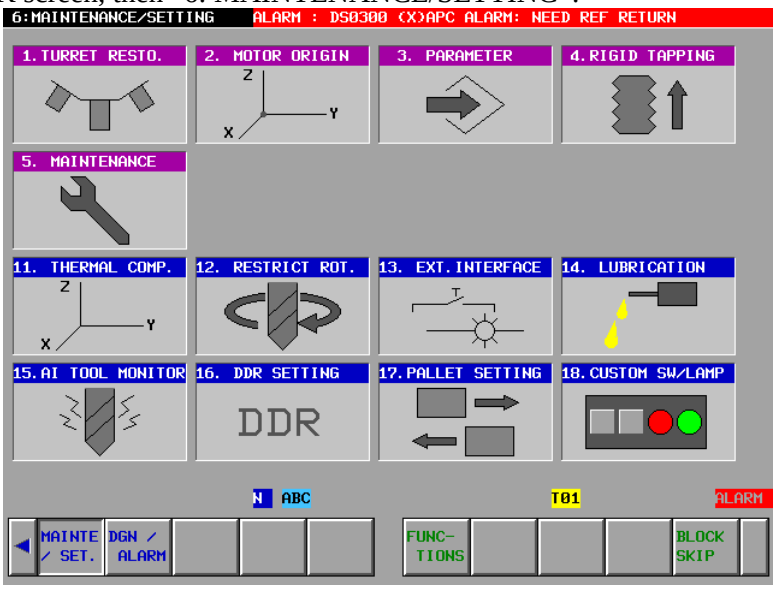
When the pulse coder connector of the servo motor is reconnected after disconnection, for example, the position of the origin will be lost, causing an alarm to be issued to request servo motor origin return. In such a case, servo motor origin return must be performed. (Here, manual origin return operation is generally referred to as origin restoration.) Origin restoration is based on the marks provided on the X-axis, Y-axis, and Z-axis. (See the figure below.)



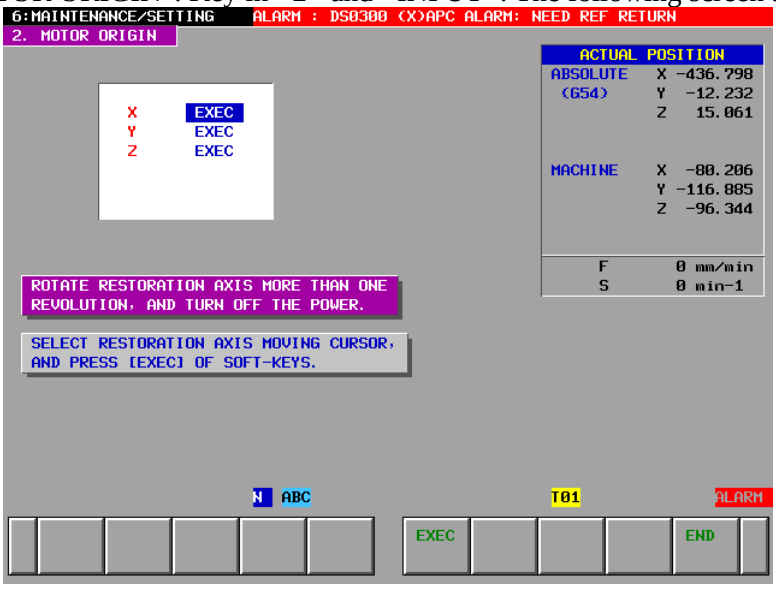
Follow the procedure below.

(1) First, select handle mode. Next, turn the handle through one or more turns along a desired restoration axis (12 mm or more along the each axis). Then, turn the machine power off, then back on again.

(2) Display QUICK screen, then “6: MAINTENANCE/SETTING”.

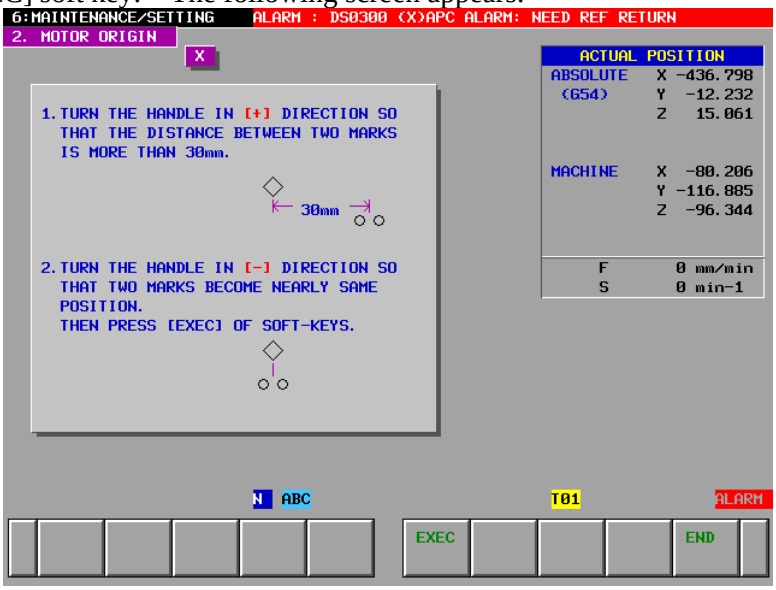


(3) Select “2. MOTOR ORIGIN”. Key in <2> and <INPUT>. The following screen appears.

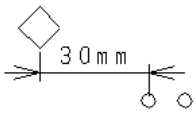


(4) With the cursor, select an axis to be recovered.
The message "In the handle mode, make one rotation or more on an axis to be recovered ..." is displayed.
This operation is not necessary if this operation is already done in step (1).

(5) Press the [EXEC] soft key. The following screen appears.

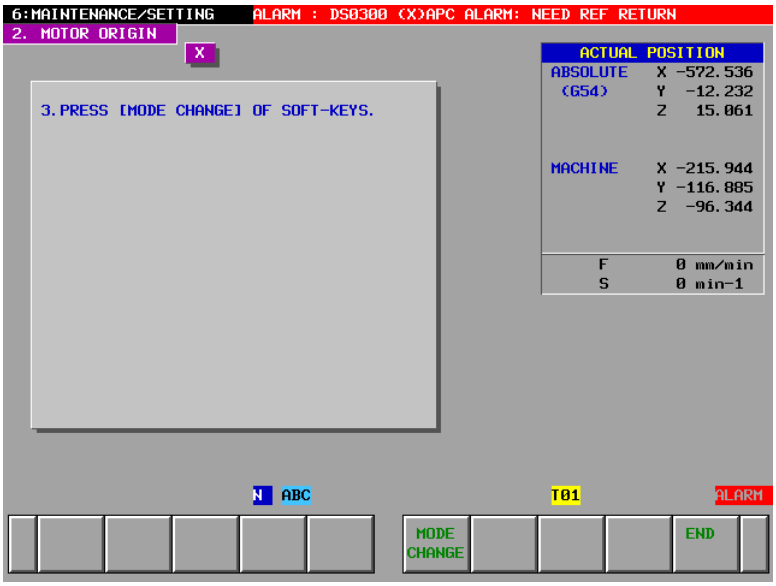


(6) Separate the diamond mark from the notch mark by at least 30 mm, according to guidance 1. This operation is not required if the two marks are already separated by 30 mm or more.

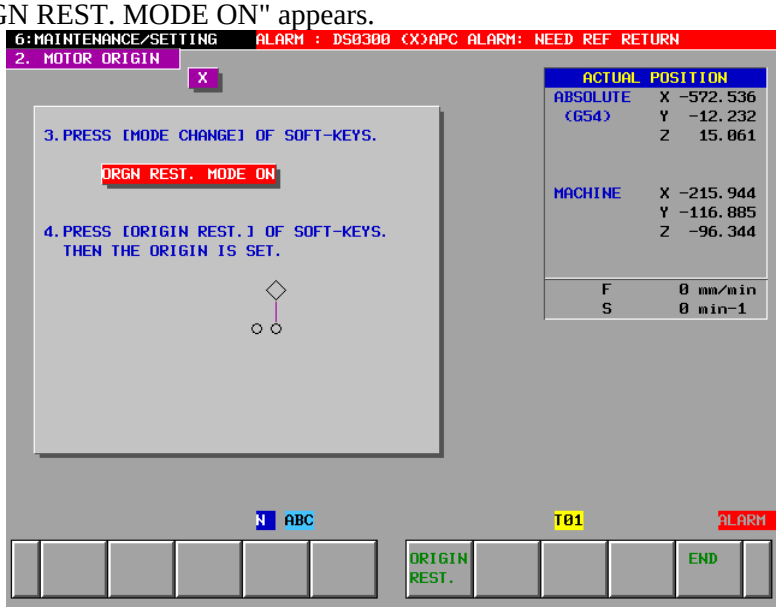


(7) Turn the handle in the negative (–) direction in handle mode until the diamond mark is aligned with the notch mark, then press the [EXEC] soft key, according to guidance 2.

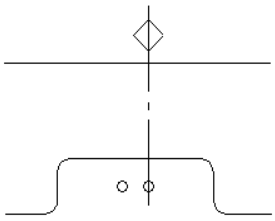
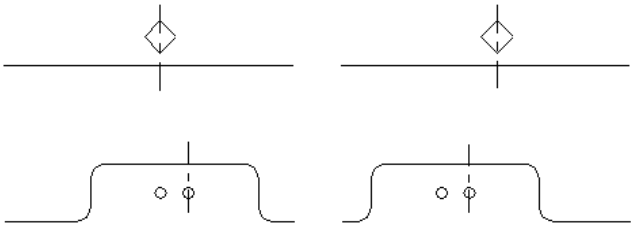
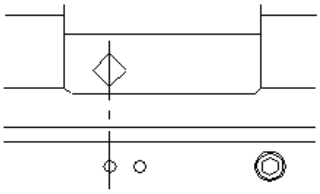
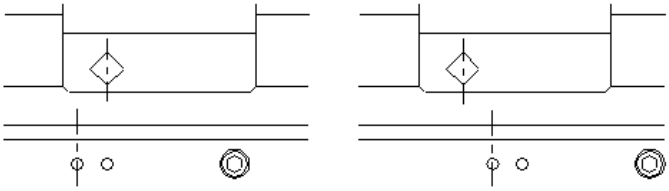
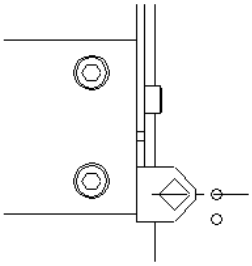
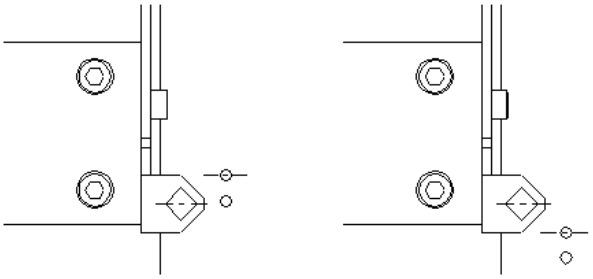
Carefully move the tool along the X– and Y–axes so that the rhombus mark is always between the two circles.
Press the [EXEC] soft key. The following screen appears.



(8) On the displayed screen, press the [MODE CHANGE] soft key according to guidance 3. The message "ORGN REST. MODE ON" appears.



(9) Press the [ORIGIN REST.] soft key, according to guidance 4. This operation causes a very slight movement along the axis to establish the origin. Check that the two diamond marks are precisely aligned with each other after this operation. If the marks are not so aligned, the position of the origin may be displaced. In such a case, contact your local FANUC service center.

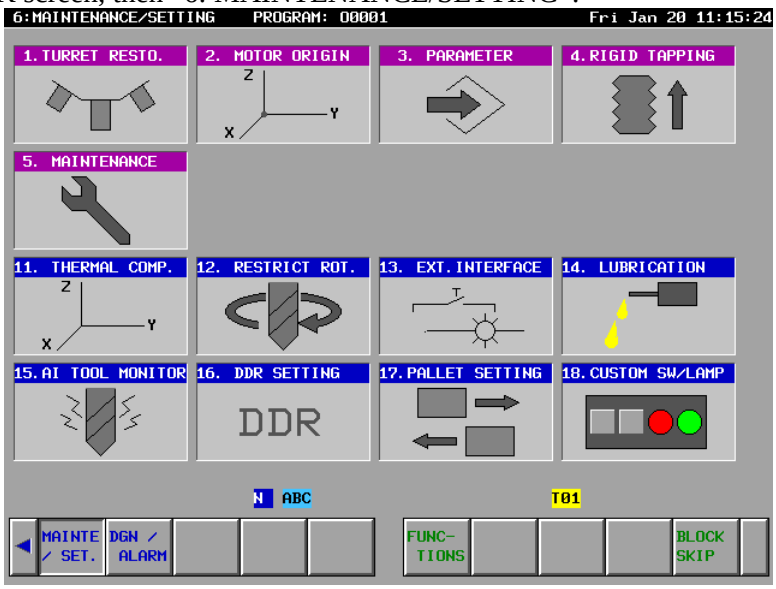
	Correct origin position	**Incorrect origin position**
X-axis	The rhombus mark is aligned with the right circle. 	The rhombus mark is not aligned with the right circle. 
Y-axis	The rhombus mark is aligned with the left circle. 	The rhombus mark is not aligned with the left circle. 
Z-axis	The rhombus mark is aligned with the upper circle. 	The rhombus mark is not aligned with the upper circle. 

(10) Display the alarm screen by pressing the <RESET> key, then check that the origin return request alarm for the origin restoration axis has been cleared. To perform origin restoration for another axis, repeat the above procedure.

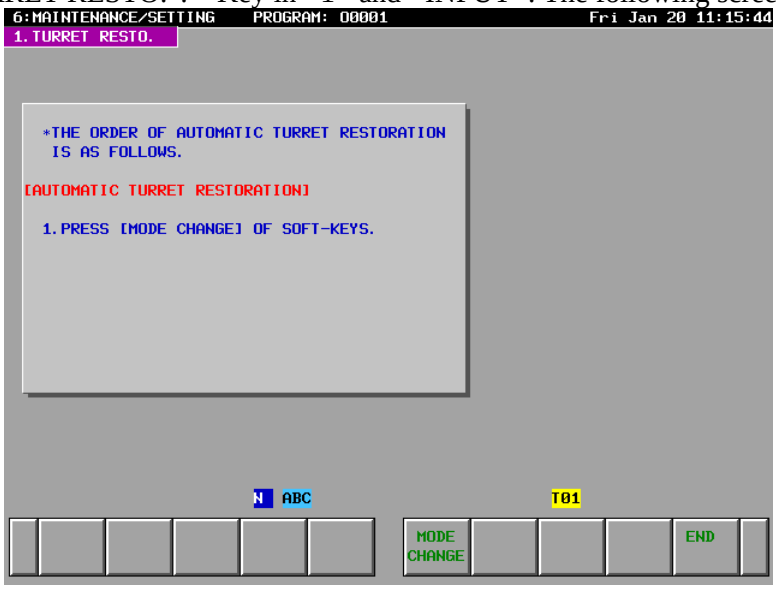
4 AUTOMATIC TURRET RESTORATION

The ROBODRILL features a turret restoration function, which enables the automatic restoration of the normal state if a tool change operation should be interrupted or upon the issue of an alarm during or after tool change. If a problem related to tool replacement occurs, you can use this function to restore the system to the normal status in most cases. You can also perform operations according to the instructions displayed on the screen to complete restoration easily.
Follow the procedure below.

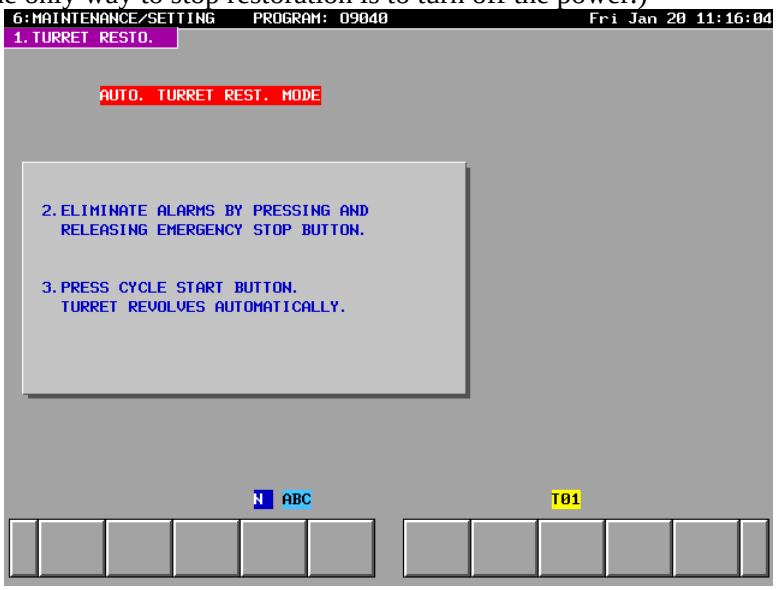
(1) Display QUICK screen, then “6: MAINTENANCE/SETTING”.



(2) Select “1. TURRET RESTO.”. Key in <1> and <INPUT>. The following screen is displayed:

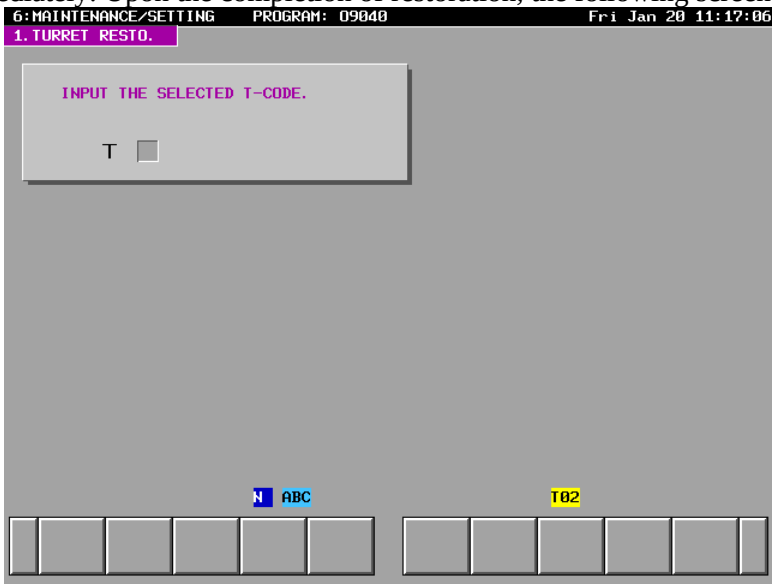


(3) Press the [MODE CHANGE] soft key, according to guidance 1. The following screen appears. To help ensure successful restoration, the mode is fixed after this point, thus disabling any unnecessary operations. (The only way to stop restoration is to turn off the power.)

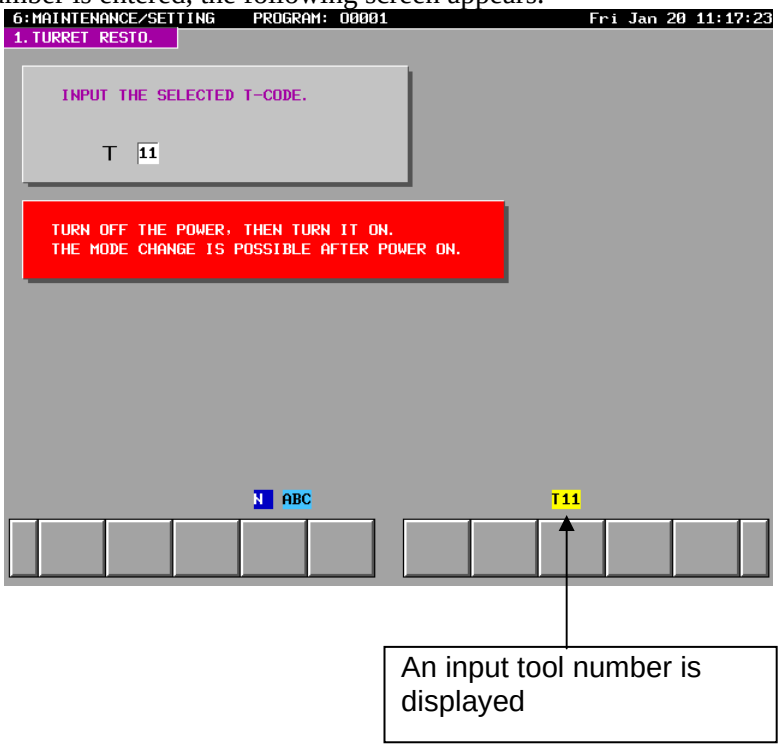


(4) Clear any alarm by pressing the <EMERGENCY STOP> button, according to guidance 2. (The alarm is released.)

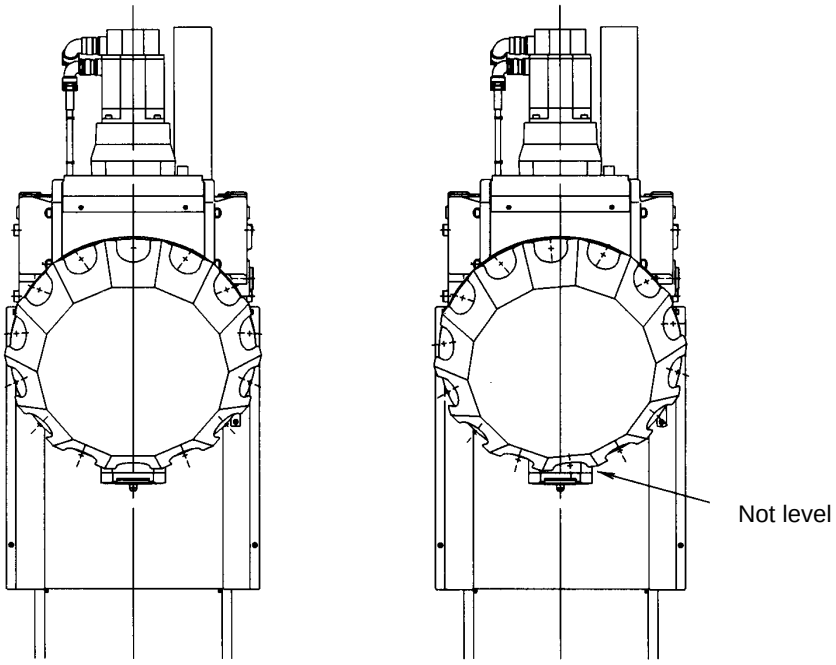
(5) After checking that the program number displayed at the top of the screen is O9040, press the cycle start button, according to guidance 3. Then, restoration starts. If any unusual sound is heard, stop the operation immediately. Upon the completion of restoration, the following screen appears.



(6) Check and enter the selected tool number. When the tool number located at the bottom of the turret is “11”, press <1> → <1> → <INPUT> key.
When a tool number is entered, the following screen appears.



(7) Turn the power off, then back on again, according to the message. If, however, the lowest side of the turret is not level, as shown below, when restoration is completed, a mechanical problem is involved. In such a case, contact your local FANUC service center.



SUPPLEMENT

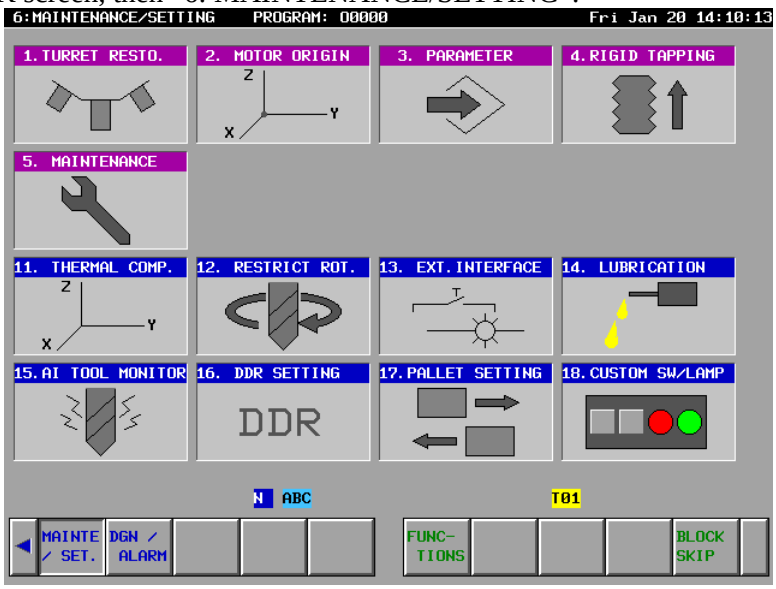
If the pull stud is broken, the broken pull stud will be left inside the spindle. This prevents an arbor from being clamped to the spindle. To enable restoration from the state where the pull stud is broken, first perform turret restoration without attaching an arbor. Next, check that the broken pull stud has dropped out of the spindle taper hole. Then, attach a tool to the turret and perform another turret restoration operation.

5 PARAMETER RESET, CHECK, AND REGISTRATION FUNCTIONS

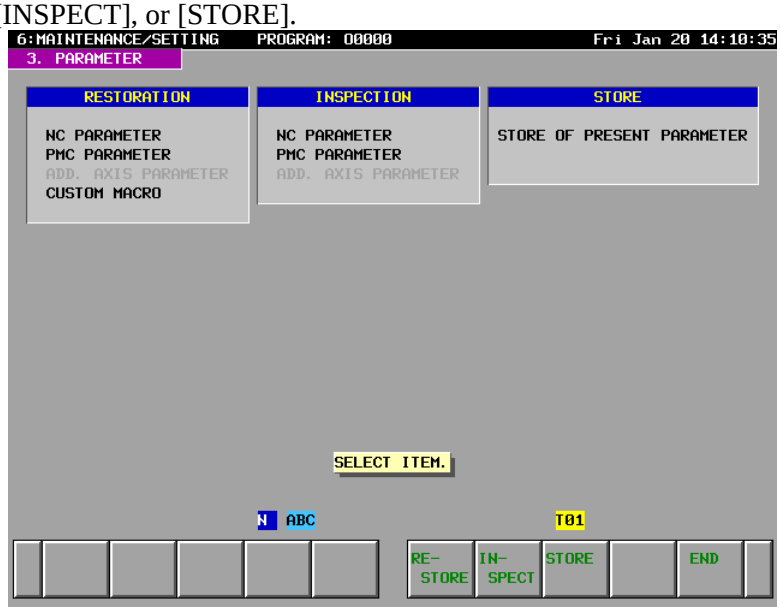
Factory–set data for various types of parameters is saved in non–volatile memory.
If parameter data is erased due to a problem such as the exhausted CNC battery, you can use the saved data to simply restore factory–set data. This is called the parameter reset function. You can also compare the saved parameter data with the parameter data currently set for the ROBODRILL and list the results. This is called the parameter check function.
After changing parameter data, you can save it in non–volatile memory.
This is called the parameter registration function.

5.1 BASIC OPERATION

(1) Display QUICK screen, then “6: MAINTENANCE/SETTING”.

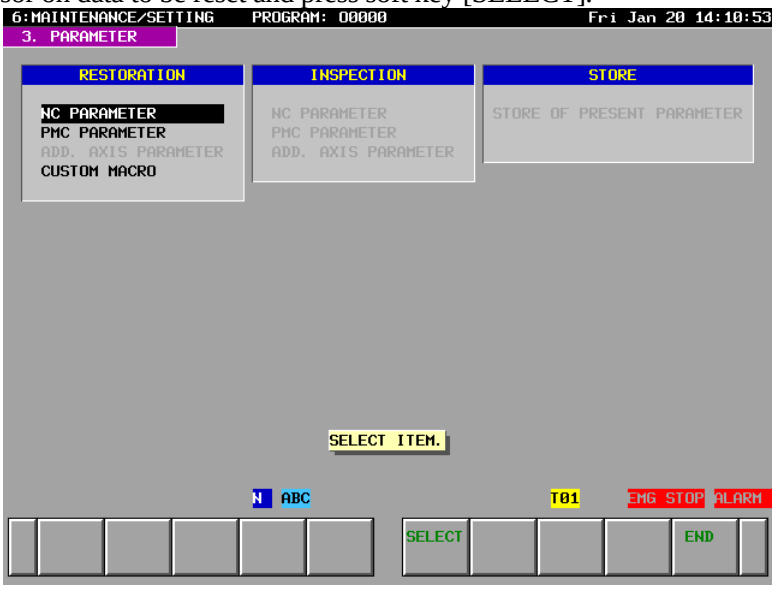


(2) Select “3. PARAMETER”. Key in <3> and <INPUT>. The following screen appears. Press soft key [RESTORE], [INSPECT], or [STORE].

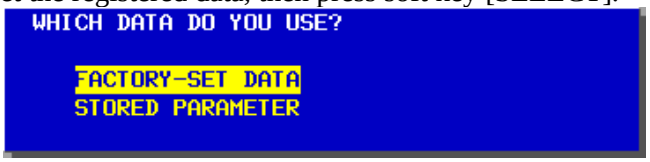


5.2 RESETTING PARAMETERS

(1) Press the <EMERGENCY STOP> button.
Position the cursor on data to be reset and press soft key [SELECT].

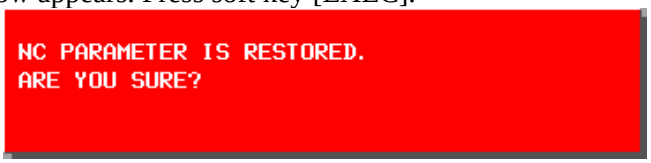


(2) If you have registered your data, the following window appears.
Position the cursor on “FACTORY–SET DATA” to set factory–set data or on “STORED PARAMETER” to set the registered data, then press soft key [SELECT].



If you have not registered your data, this window does not appear (The factory–set data is set).

(3) The following window appears. Press soft key [EXEC].



(4) When the following window appears, reset operation is complete.
Turn the power off, then on again.

(5) Check that the parameter settings are the same as the values listed in the data sheet (parameters) supplied with the machine.
Perform motor reference position return.

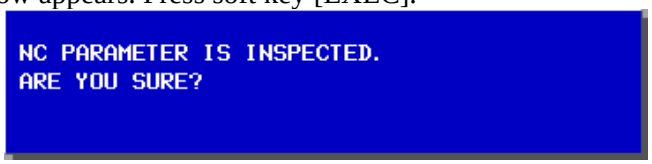
5.3 CHECKING PARAMETERS

(1) Position the cursor on data to be checked and press soft key [SELECT].

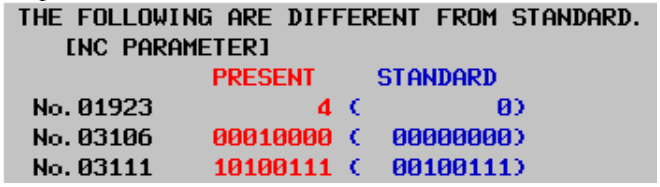
(2) If you have registered your data, the following window appears.
Position the cursor on the “FACTORY–SET DATA” to compare the current data with the factory–set data or on the “STORED PARAMETER” to compare it with the registered data, then press soft key [SELECT].

If you have not registered your data, this window does not appear (The current data is compared with the factory–set data).

(3) The following window appears. Press soft key [EXEC].

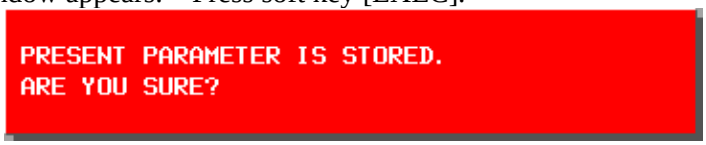


(4) When the check is complete with different data found, a window as shown below appears:

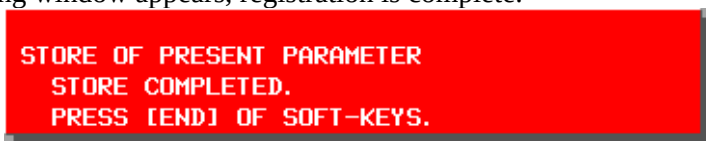


5.4 REGISTERING PARAMETERS

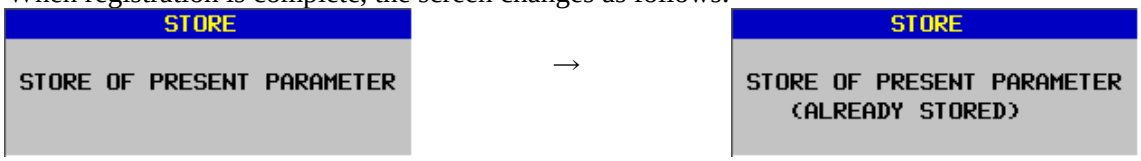
(1) The following window appears. Press soft key [EXEC].



(2) When the following window appears, registration is complete.



When registration is complete, the screen changes as follows:



(Before registration) **(After registration)**

ATTENTION

Never turn off the power during data registration. Otherwise, the nonvolatile memory is destructed.

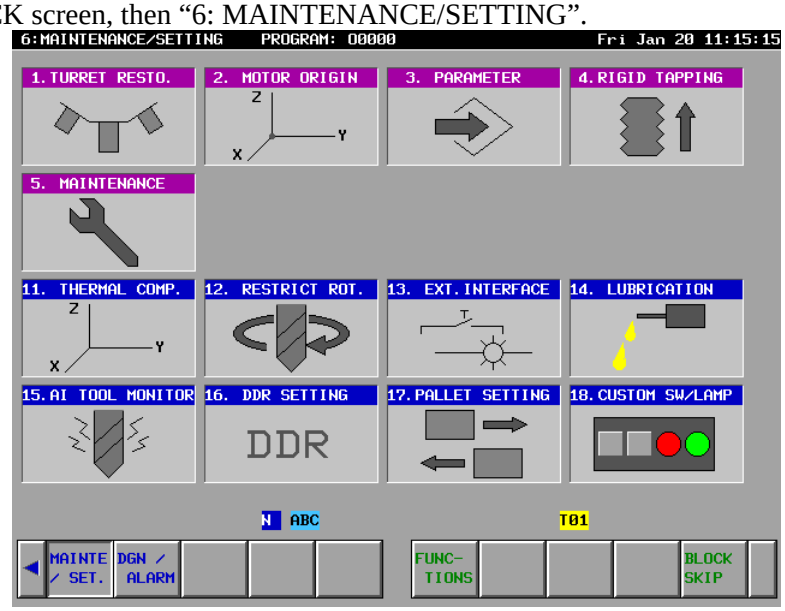
SUPPLEMENT

- NC parameters, PMC parameters, and pitch error data are registered. Machining programs and setup data such as offset data are not registered.
- If the nonvolatile memory is faulty or destructed, registered data is lost. As a precaution, it is recommended to back up data such as parameter data by using the Handy File or memory card.
  If a modification is made to a parameter, describe the modification in the data sheet delivered with the machine.

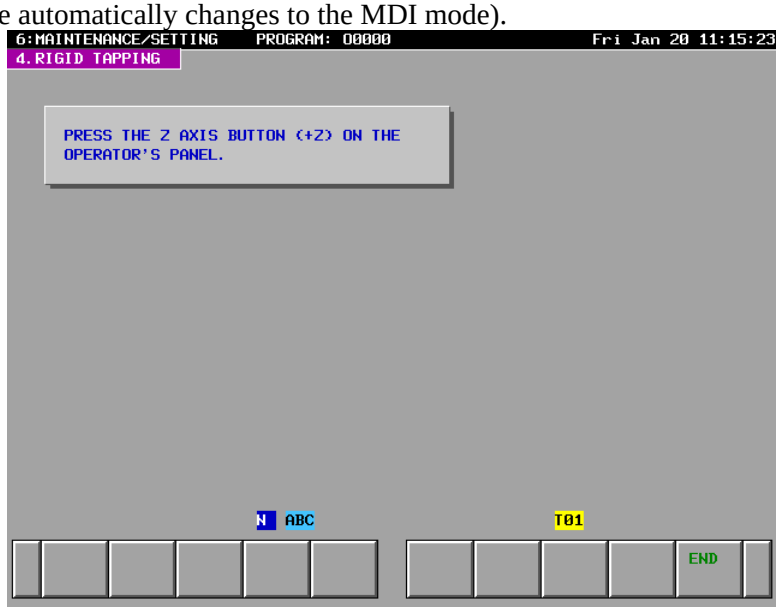
6 RIGID TAPPING RETURN FUNCTION

If a tap bites into the workpiece and the machine stops due to an abnormality such as an operator error or power failure, the tap can be pulled out up to a position near point R.

(1) Display QUICK screen, then “6: MAINTENANCE/SETTING”.



(2) Select “4.RIGID TAPPING”. Key in <4> and <INPUT>. The following screen appears (The operation mode automatically changes to the MDI mode).



Press the Z AXIS button on the operator's panel. Rigid tapping return operation is executed.

SUPPLEMENT

- When the Z AXIS button is released during return operation, the operation stops. To restart the operation, press the Z AXIS button again.
- If rigid tapping stops at emergency stop or due to a power failure, the position of the spindle is lost.
  For this reason, after return operation, the relationship between the spindle and Z AXIS positions is not guaranteed.
- By rigid tapping return operation which stops at emergency stop or due to a power failure, then restarts, the tap may not completely be pulled out from the workpiece. In this case, set the amount of return (α) (NC parameter No. 5382). By this operation, the tap is returned by the amount (α).
- The CNC internally executes a return program to perform tapping return operation.
  For this reason, when tapping return operation is performed, modal information may partly be changed.
- When the single block function is on or the front door is open, the screen is not switched and rigid tapping return operation cannot be performed.

APPENDIX

A DIMENSIONS OF THE MACHINE

A.1 SHAPE AND DIMENSIONS OF THE MACHINE

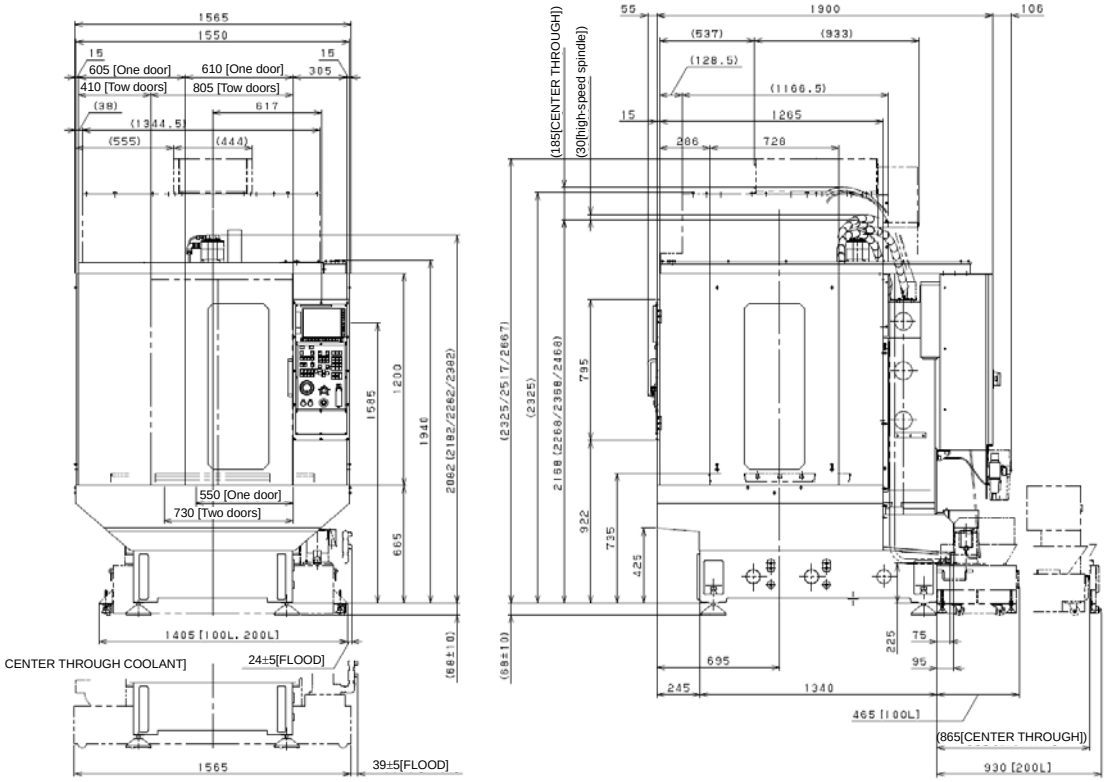


Fig. A.1 (a) Shape and dimensions of the machine (α-D14/21M*i*A5)

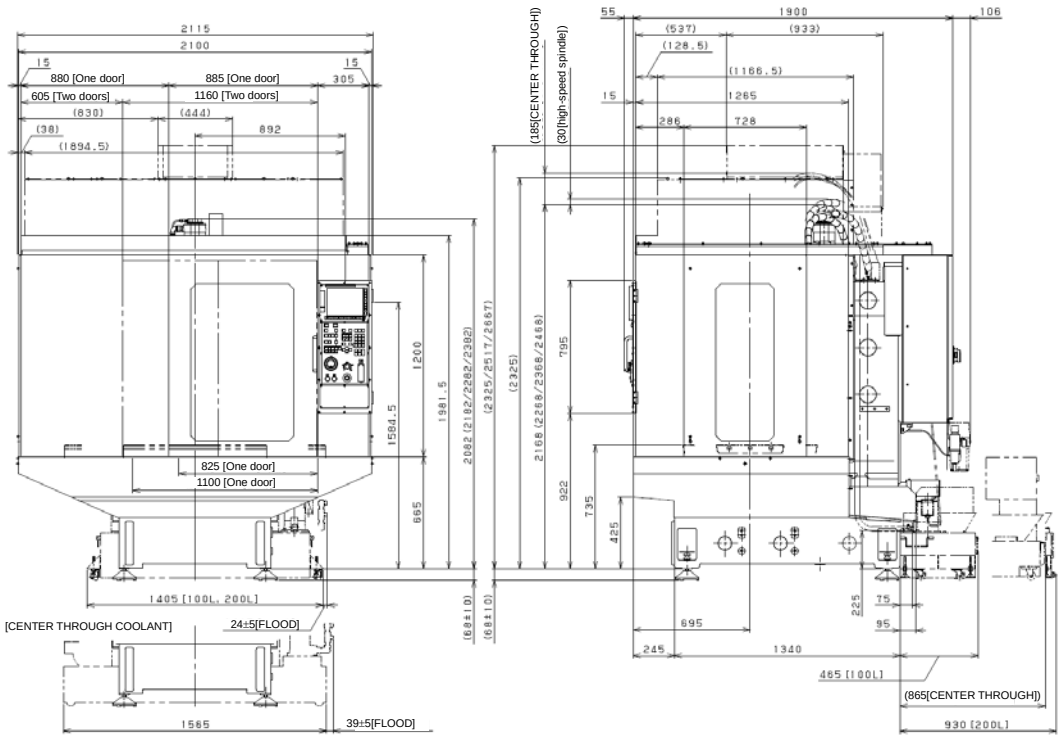


Fig. A.1 (b) Shape and dimensions of the machine (α-D14/21L*i*A5)

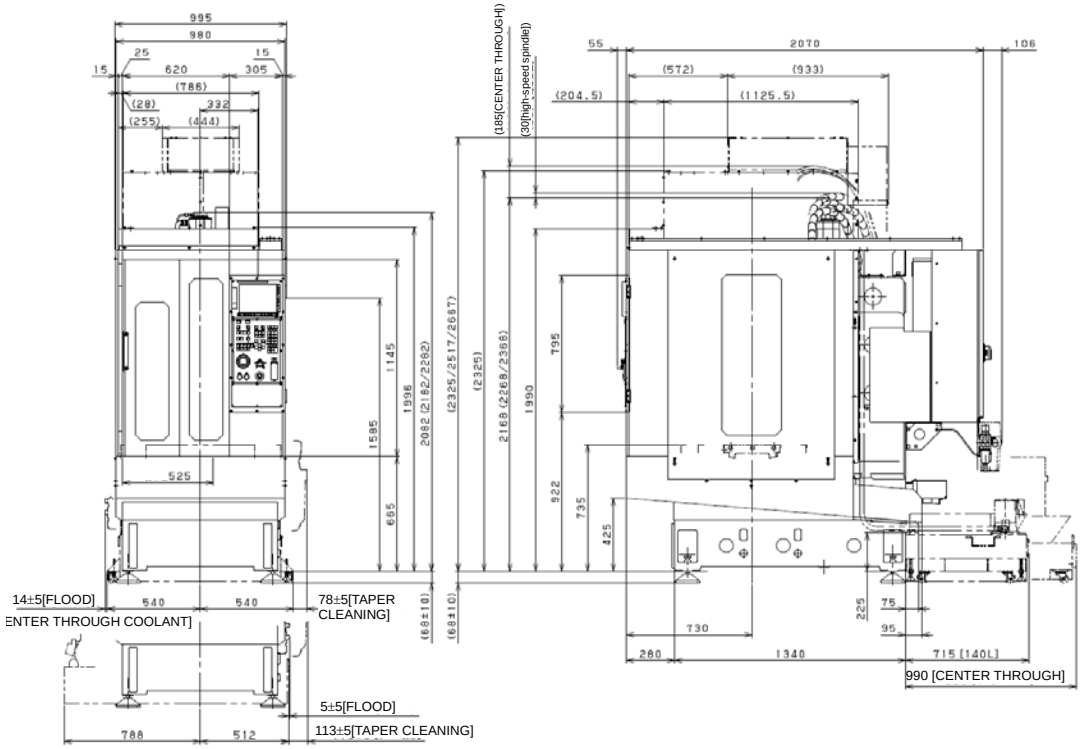
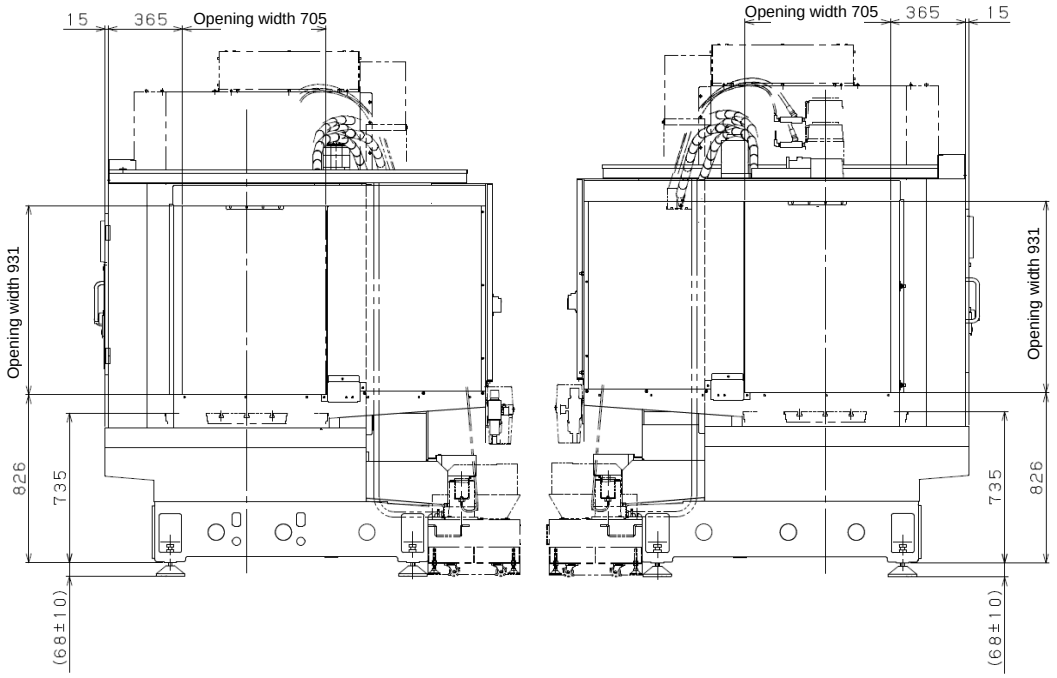
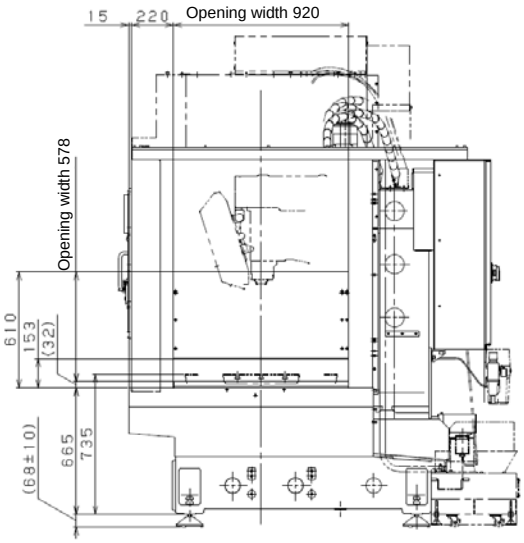


Fig. A.1 (c) Shape and dimensions of the machine (α-D14/21S*i*A5)



Automatic door on the right side (for robot) **Automatic door on the left side (for robot)**



Automatic door on the right side (for pallet changer)

Fig. A.1(d) Machine appearance and dimensions of openings of automatic door on the side (α-D14/21M/L*i*A5)

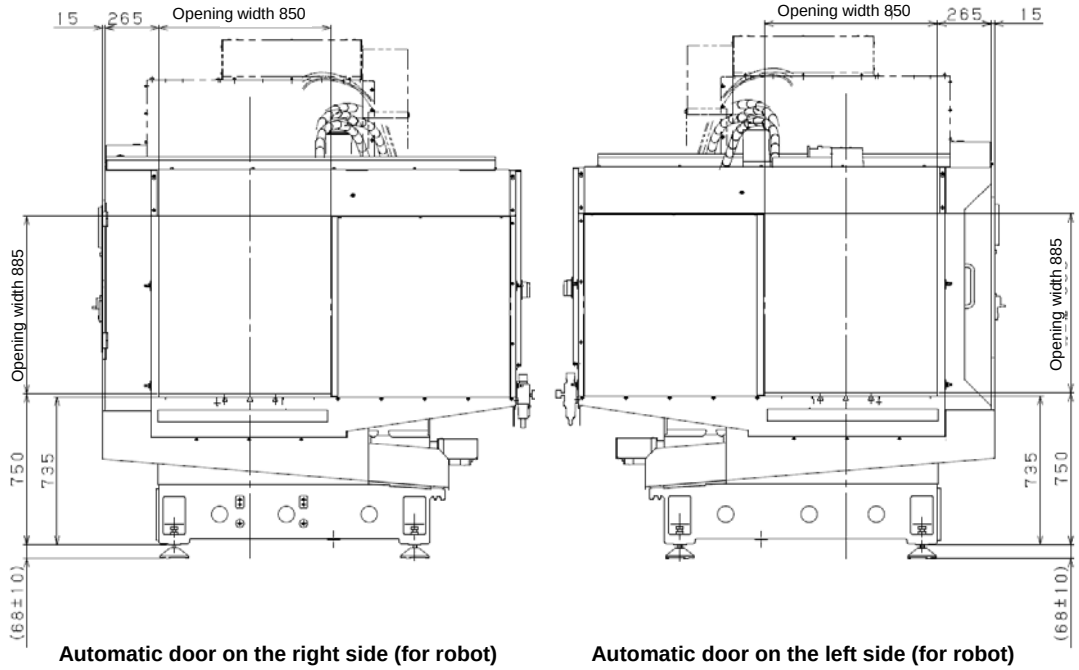


Fig. A.1(e) Machine appearance and dimensions of openings of automatic door on the side (α-D14/21S*i*A5)

A.2 DIMENSIONS OF THE TABLE SURFACE AND T GROOVE (NOMINAL WIDTH: 14)

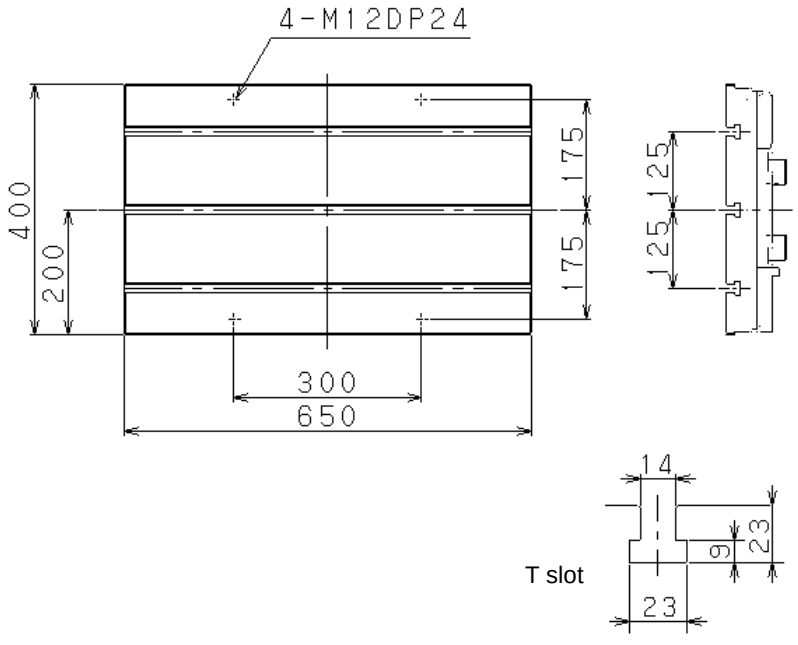


Fig. A.2(a) Dimensions of the table surface and T groove (nominal width: 14) (α-D14/21M*i*A5)

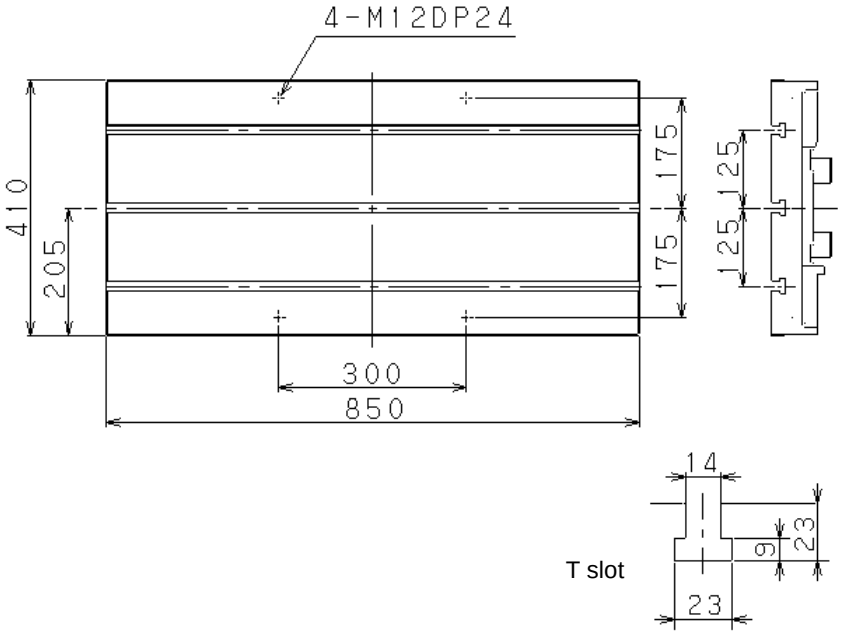


Fig. A.2(b) Dimensions of the table surface and T groove (nominal width: 14) (α-D14/21L*i*A5)

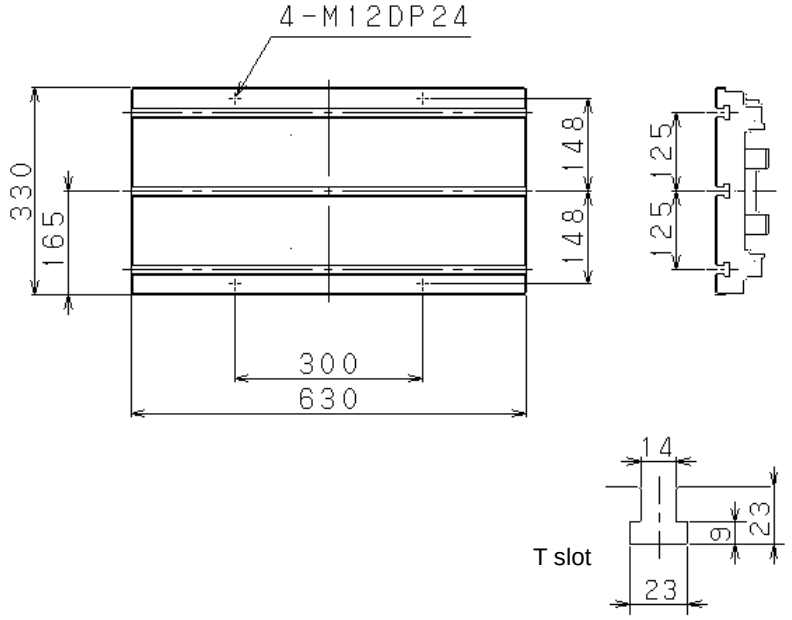
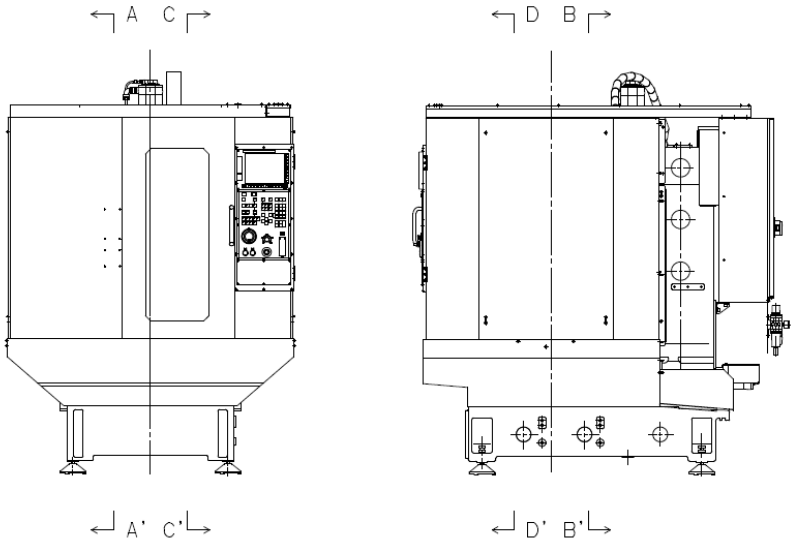
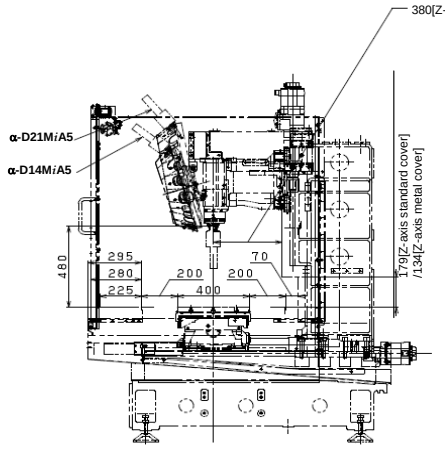


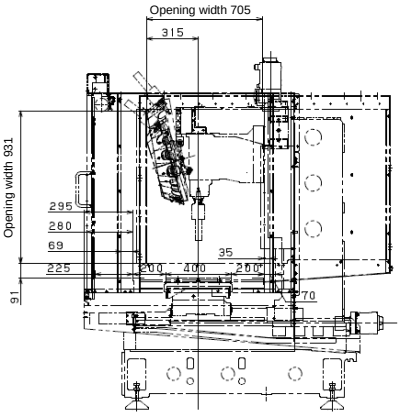
Fig. A.2(c) Dimensions of the table surface and T groove (nominal width: 14) (α-D14/21S*i*A5)

A.3 DIMENSIONS OF THE INSIDE OF THE SPLASH GUARD

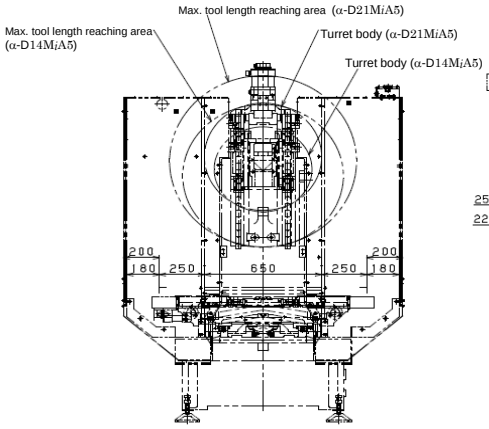




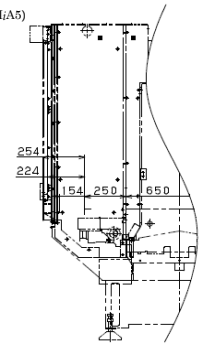
SECT A-A'



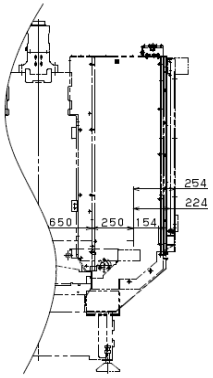
SECT A-A'
For the automatic door on the left side (for robot)



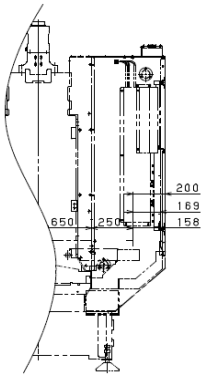
SECT B-B'



SECT B-B'
For the automatic door on the left side (for robot)



SECT B-B'
For the automatic door on the right side (for robot)



SECT B-B'
For the automatic door on the right side (for pallet changer)

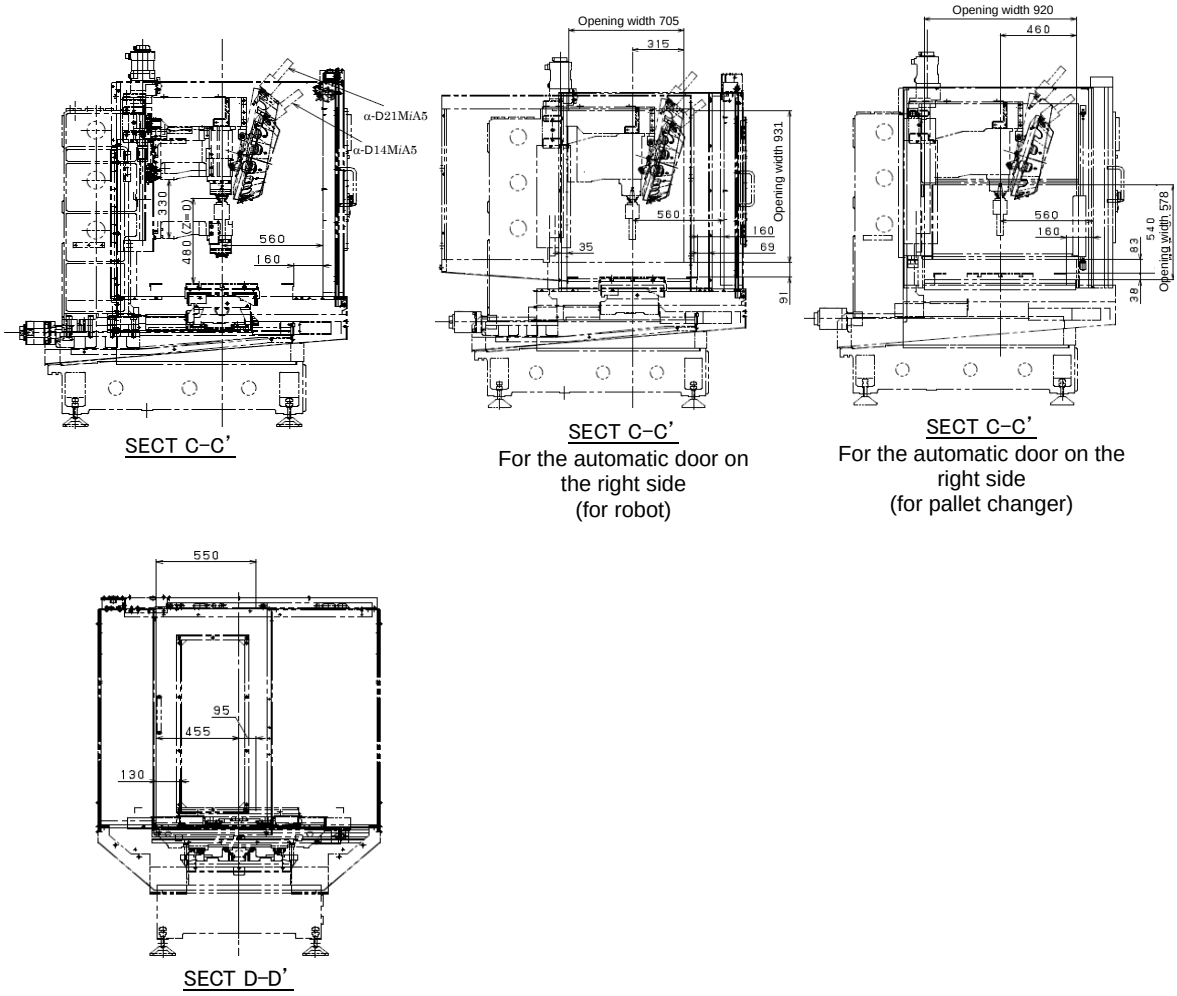
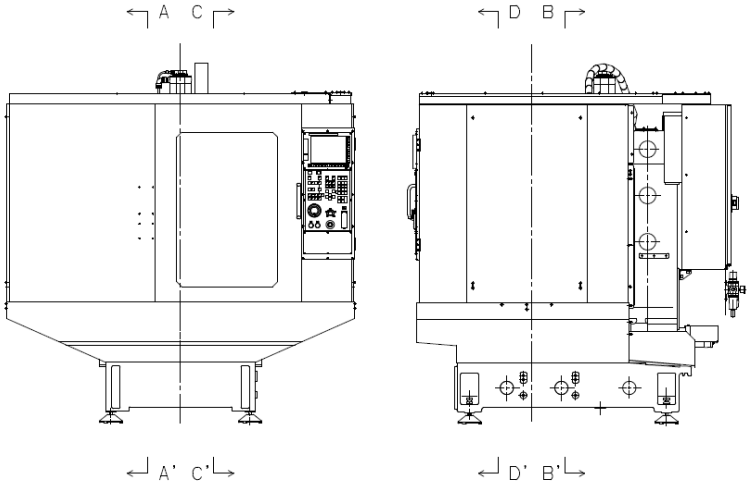
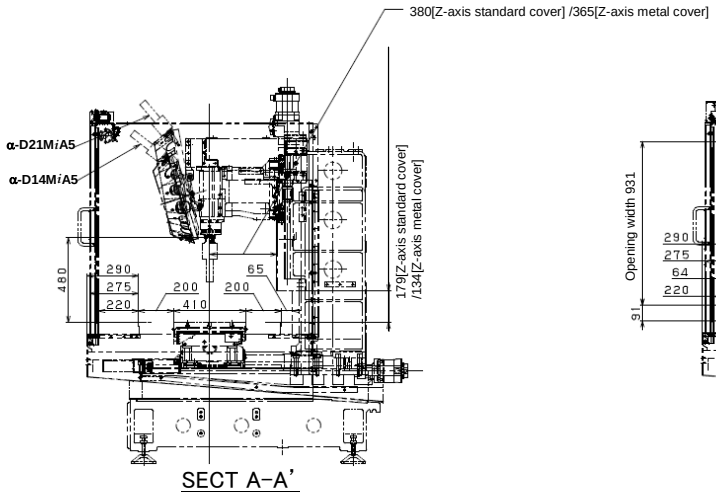
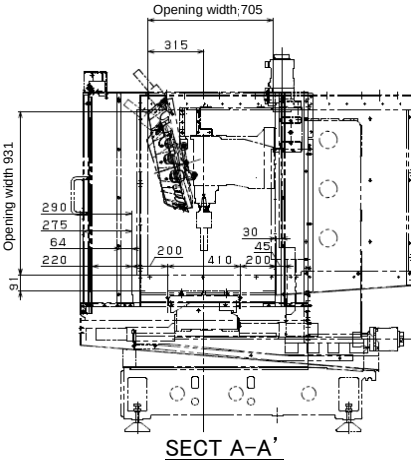


Fig. A.3 (a) Internal dimensions of splash guard (α-D14/21M*i*A5)

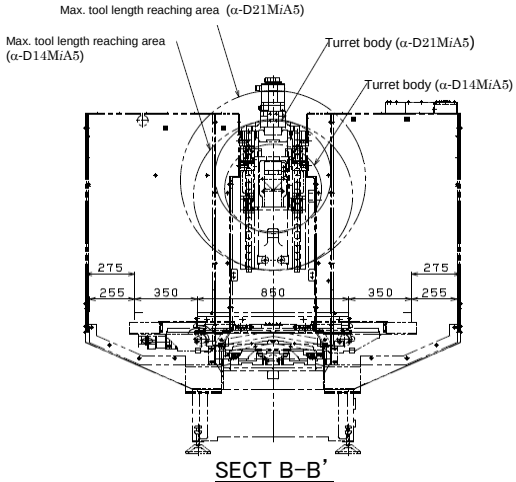




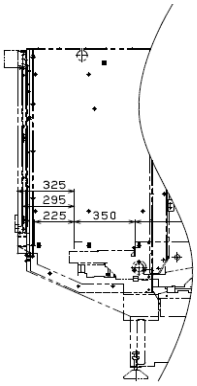
SECT A–A'



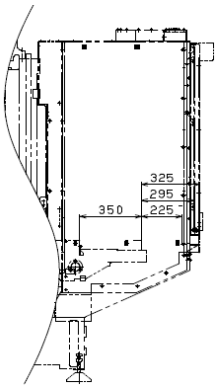
SECT A–A'
For the automatic door on the left side
(for robot)



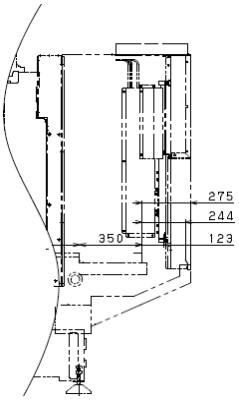
SECT B–B'



SECT B–B'
For the automatic door on the left side
(for robot)



SECT B–B'
For the automatic door on the right side
(for robot)



SECT B–B'
For the automatic door on the right side
(for pallet changer)

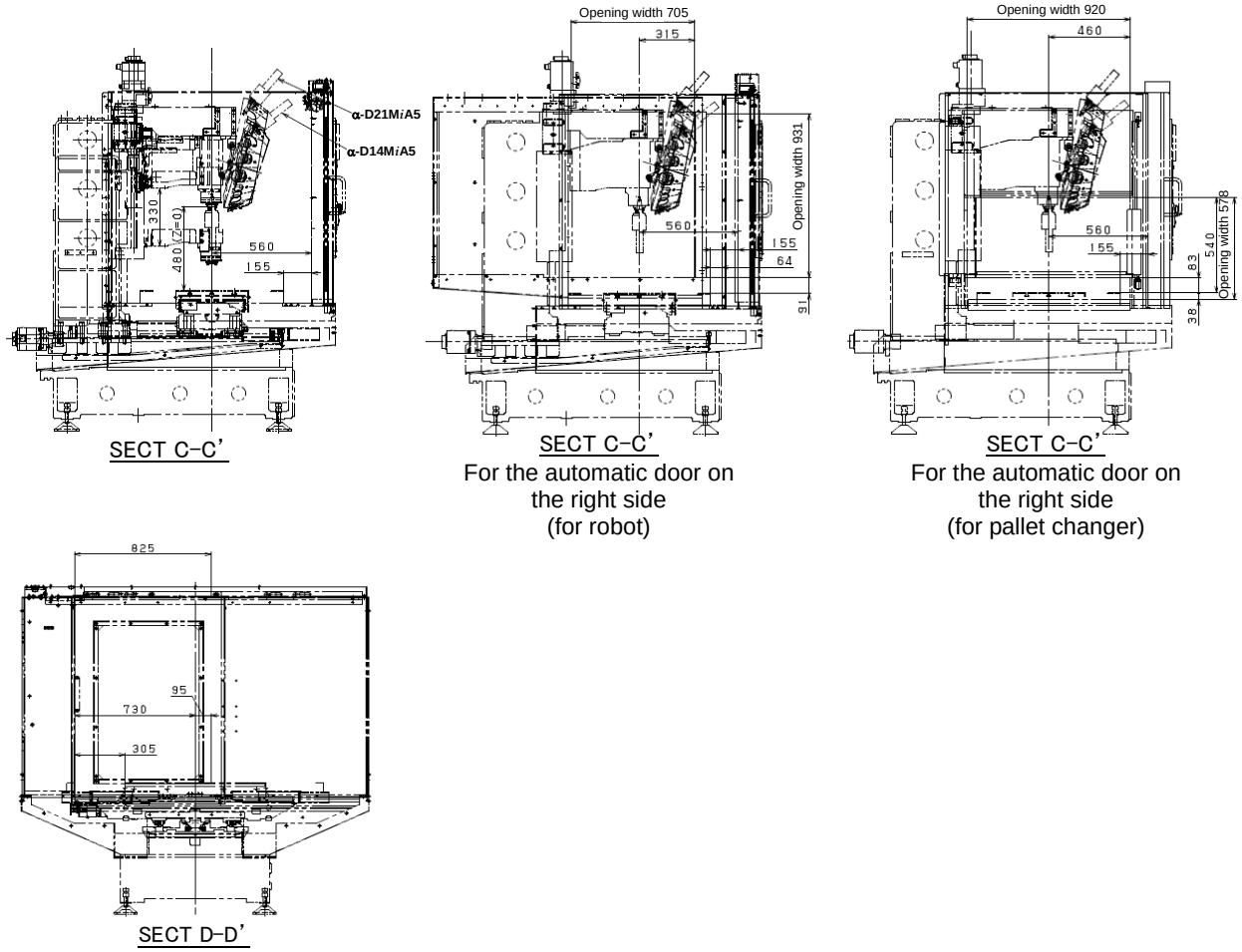
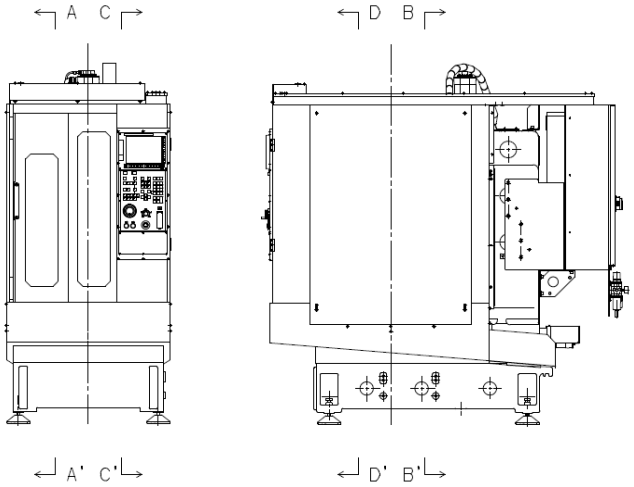
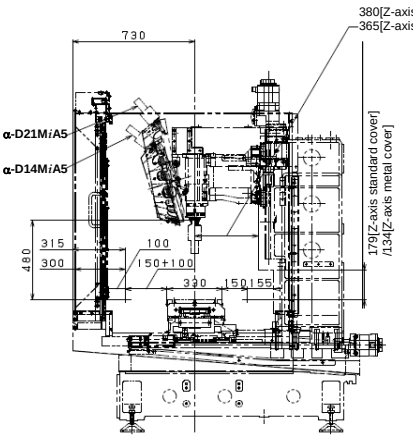
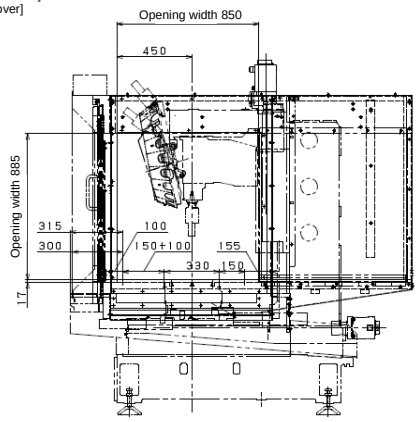


Fig. A.3 (b) Internal dimensions of splash guard (α-D14/21L*i*A5)

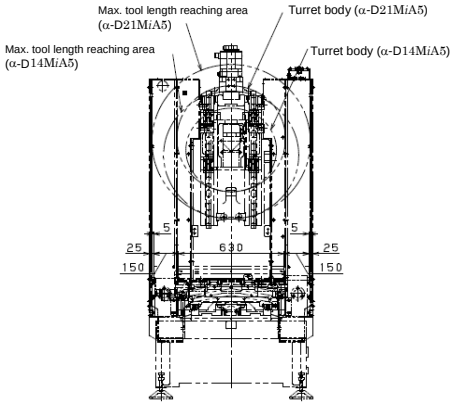




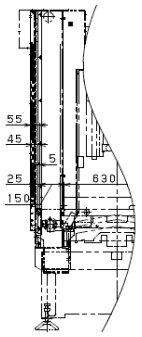
SECT A–A'



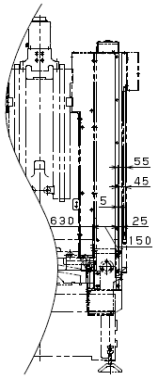
SECT A–A'
For the automatic door on the left side
(for robot)



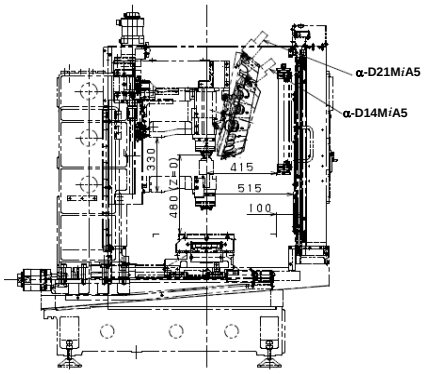
SECT B–B'



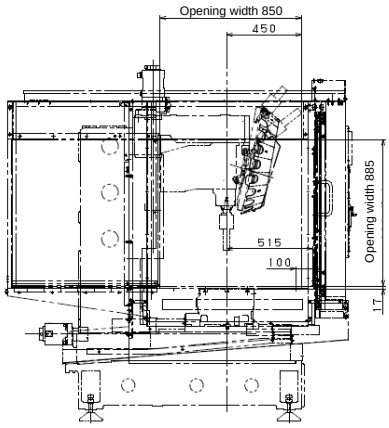
SECT B–B'
For the automatic door
on the left side
(for robot)



SECT B–B'
For the automatic door
on the right side
(for robot)

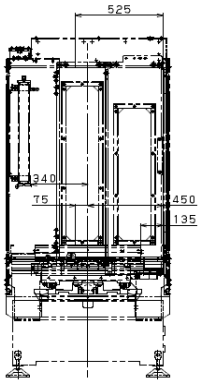


SECT C–C'



SECT C–C'

For the automatic door on the left side
(for robot)



SECT D–D'

Fig. A.3 (c) Internal dimensions of splash guard (α-D14/21S*i*A5)

A.4 DIMENSIONS OF THE SYSTEM AROUND THE COOLANT OUTLETS

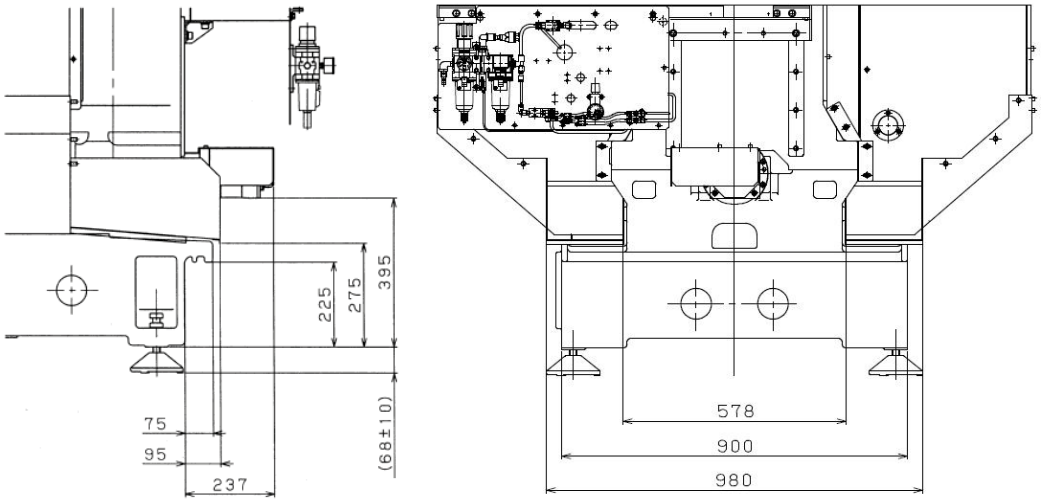


Fig. A.4(a) Dimensions of the system around the coolant outlets (α-D14M/L*i*A5, D21M/L*i*A5)

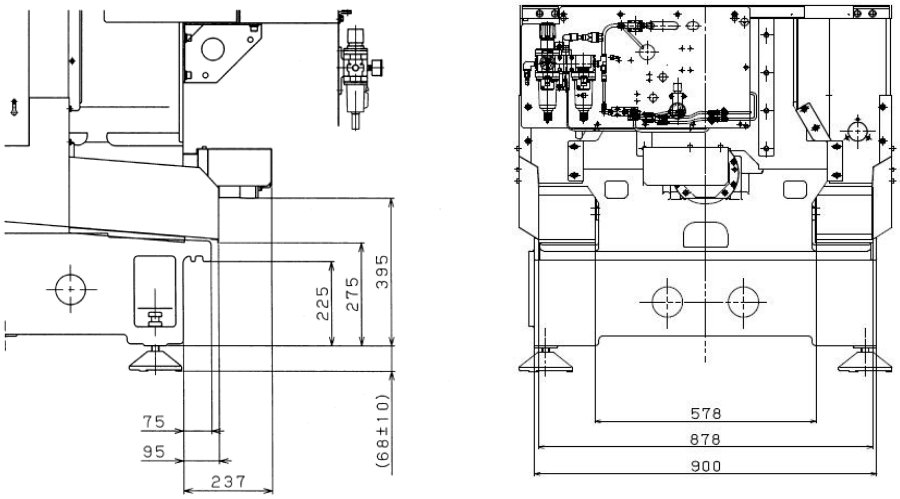


Fig. A.4(b) Dimensions of the system around the coolant outlets (α-D14/21S*i*A5)

A.5 DIMENSIONS OF THE END OF THE SPINDLE

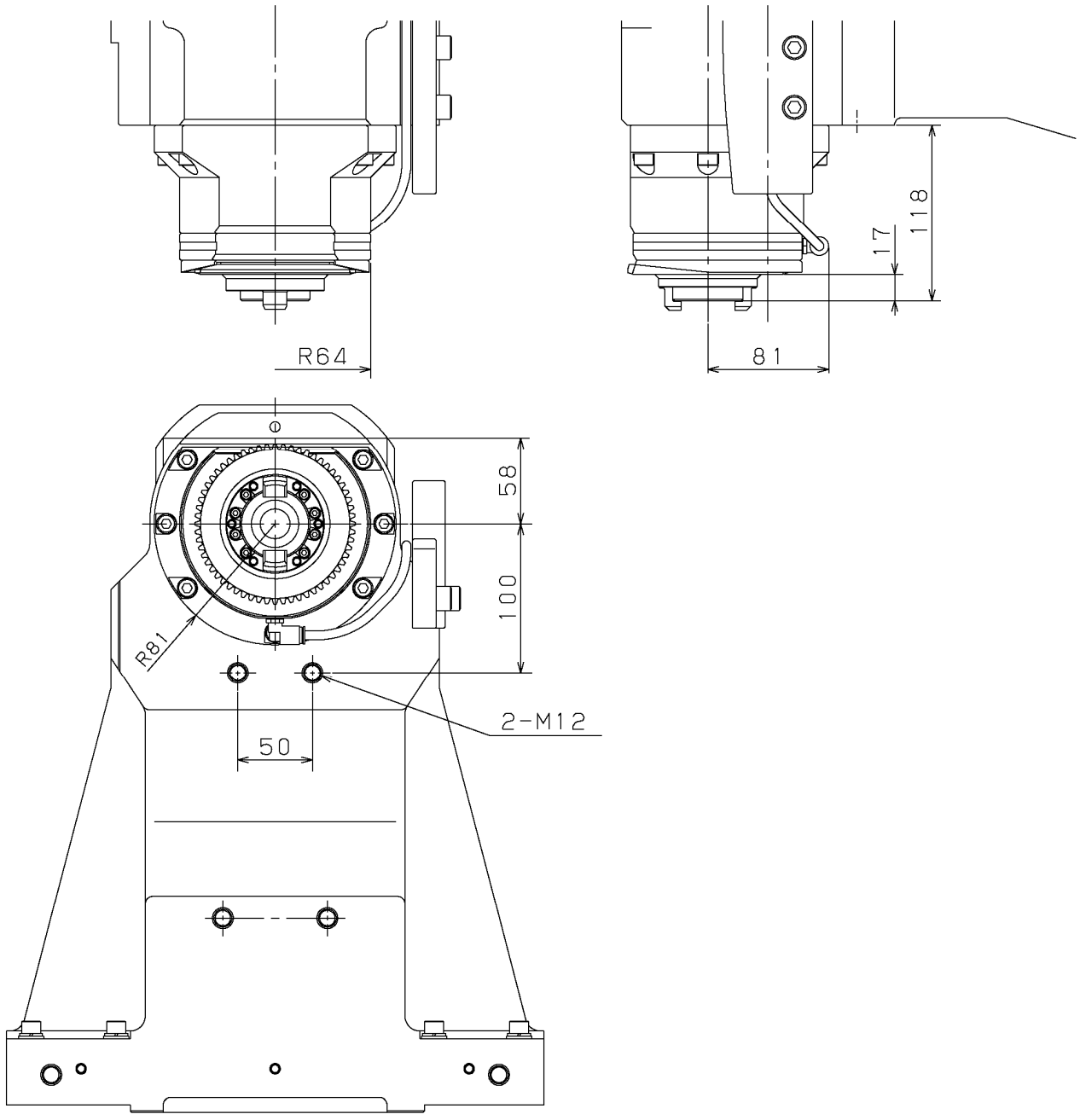
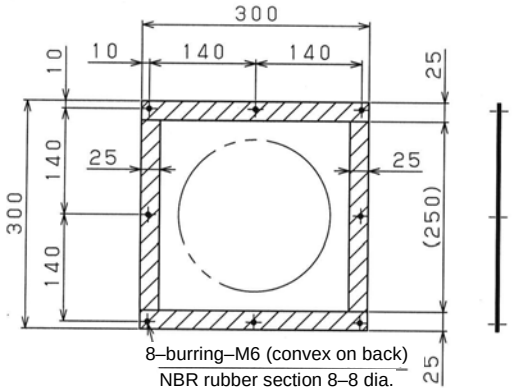


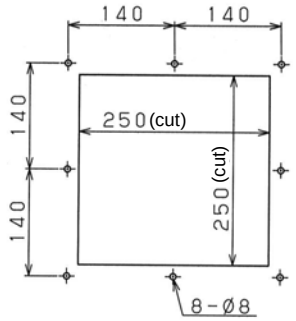
Fig. A.5 Dimensions of the end of the spindle

A.6 MIST COLLECTOR MOUNTING HOLE DIMENSIONS



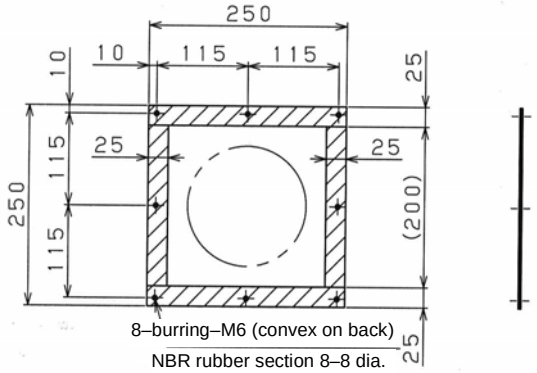
Note) Adhere NBR rubber 70° t2 to the portion indicated by shading after coating.

Dimensions of mist collector duct mounting sheet metal



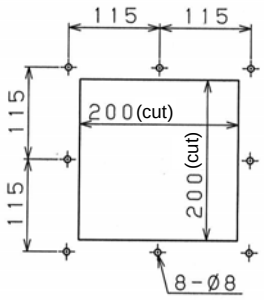
Sheet metal mounting hole dimensions.

Fig. A.6(a) α-D14M/L*i*A5, D21M/L*i*A5



Note) Adhere NBR rubber 70° t2 to the portion indicated by shading after coating.

Dimensions of mist collector duct mounting sheet metal



Sheet metal mounting hole dimensions.

Fig. A.6(b) α-D14/21S*i*A5

B G CODES

For the preparatory function, a number following address G determines the meaning of the command in the concerned block. G codes are divided into the following two types.

Type	Description
One-shot G code	G code effective only in the block in which it is specified
Modal G code	G code effective until another G code is specified in the same group

(Example) G01 and G00 are modal G codes.

```
G01 X_  ;
    Z_  ;   } G01 is effective in this range.
    X_  ;
G00 Z_  ;
    X_  ;   } G00 is effective in this
G01 X_  ;
```

G code	Group	Function
*G00	01	Positioning
*G01		Linear interpolation
G02		Circular interpolation/Helical interpolation CW
G03		Circular interpolation/Helical interpolation CCW
G04	00	Dwell
G05		AI contour control (High-precision contour control compatible command)
G05.1		AI contour control I AI contour control II (option) Nano smoothing (option)
G05.4		HRV3 on/off
G06.2	01	NURBS interpolation (option)
G07.1 (G107)	00	Cylindrical interpolation (option)
G08		AI contour control (advanced preview control compatible command)
G09		Exact stop
G10		Programmable data input
G11		Programmable data input mode cancel
*G15	17	Polar coordinate command cancel (option)
G16		Polar coordinate command (option)
*G17	02	XY plane selection
*G18		ZX plane selection
*G19		YZ plane selection
G20	06	Input in inch
G21		Input in mm
*G22	04	Stored stroke check ON
G23		Stored stroke check OFF
G27	00	Reference point return check
G28		Automatic return to reference point
G29		Automatic return from reference point
G30		Second reference position return Third and fourth reference position return (option)
G31		Skip function
G37	00	Automatic tool length measurement (option)
G38		Cutter and tool-nose radius compensation, vector retention
G39	00	Cutter and tool-nose radius compensation, corner circular interpolation
*G40	07	Cutter and tool-nose radius compensation cancel

G code	Group	Function
G41		Cutter and tool-nose radius compensation left
G41.2		3-dimensional cutter compensation, left (type 1) (option)
G41.3		3-dimensional cutter compensation (leading edge offset) (option)
G41.4		3-dimensional cutter compensation, left (type 1) (FS16*i* compatible command) (option)
G41.5		3-dimensional cutter compensation, left (type 1) (FS16*i* compatible command) (option)
G41.6		3-dimensional cutter compensation, left (type 2) (option)
G42		Cutter and tool-nose radius compensation right
G42.2		3-dimensional cutter compensation, right (type 1) (option)
G42.4		3-dimensional cutter compensation, right (type 1) (FS16*i* compatible command) (option)
G42.5		3-dimensional cutter compensation, right (type 1) (FS16*i* compatible command) (option)
G42.6		3-dimensional cutter compensation, right (type 2) (option)
G43	08	Tool length compensation + direction
G44		Tool length compensation - direction
G43.4		Tool tip control (type 1) (option)
G43.5		Tool tip control (type 2) (option)
G45	00	Tool position offset extension (option)
G46		Tool position offset reduction (option)
G47		Tool position offset two–hold extension (option)
G48		Tool position offset two–hold reduction (option)
*G49	08	Tool length compensation/tool tip control cancel (option)
*G50	11	Scaling cancel (option)
G51		Scaling (option)
*G50.1	22	Programmable mirror image cancel (option)
G51.1		Programmable mirror image (option)
G52	00	Local coordinate system setting
G53		Machine coordinate system selection
*G54	14	Work coordinate system 1 setting
G54.1		Additional workpiece coordinate system selection
G55		Work coordinate system 2 setting
G56		Work coordinate system 3 setting
G57		Work coordinate system 4 setting
G58		Work coordinate system 5 setting
G59		Work coordinate system 6 setting
G54.2	23	Rotary table dynamic fixture offset (option)
G60	00/01	One direction positioning (option)
G61	15	Exact stop mode
G62		Automatic corner override
*G64		Cutting mode
G65	00	Macro call
G66	12	Macro modal call A
G66.1		Macro modal call B
*G67		Cancel of macro modal call A/B
G68	16	Coordinate system rotation/3-dimensional coordinate system conversion (option)
*G69		Coordinate system rotation cancel/3-dimensional coordinate system conversion cancel (option)
G72.1	00	Figure copying (rotation copy) (option)
G72.2		Figure copying (linear copy) (option)
G73	09	Peck drilling cycle
G74	09	Counter tapping cycle
G76		Fine boring cycle
*G80		Canned cycle cancel

G code	Group	Function
G81		Drilling cycle, spot boring
G82		Drilling cycle, counter boring cycle
G83		Peck drilling cycle
G84		Tapping cycle
G85		Boring cycle
G86		Boring cycle
G87		Back boring cycle
G88		Boring cycle
G89		Boring cycle
*G90	03	Absolute command
*G91		Incremental command
G92	00	Workpiece coordinate system setting
G92.1		Workpiece coordinate system preset
G93	05	Inverse time feed (option)
*G94		Feed per minute
G95		Feed per revolution
*G98	10	Return to initial point in canned cycle
G99		Return to R point in canned cycle
G107	00	Cylindrical interpolation (option)

SUPPLEMENT

1 When the clear state (NC parameter No. 3402#6 (CLR)) is set at power-on or reset, the modal G codes are placed in the states described below:
   (1) The modal G codes are placed in the states marked with an asterisk (*) in the table.
   (2) G20 and G21 remain unchanged when the clear state is set at power-on or reset.
   (3) Which status G22 or G23 is set at power-on can be set by NC parameter No. 3402#7 (G23). However, G22 and G23 remain unchanged when the clear state is set at reset.
   (4) Which status G00 or G01 is set can be set by NC parameter No. 3402#0 (G01).
   (5) Which status G90 or G91 is set can be set by NC parameter No. 3402#3 (G91).
   (6) Which status G17, G18, or G19 is set can be set by NC parameter No. 3402#1 (G18), #2 (G19).
2 G codes in group 00 other than G10 and G11 are one-shot G codes.
3 When a G code not listed in the G code list is specified, or a G code that has no corresponding option is specified, an alarm (PS0010) is displayed.
4 Multiple G codes can be specified in the same block when each G code belongs to a different group. If multiple G codes that belong to the same group are specified in the same block, only the last G code specified is effective.
5 When a G code belonging to group 01 is specified in a hole machining canned cycle, the hole machining canned cycle is cancelled. This means that the state set by specifying G80 is set.
   Note that the G codes in group 01 are not affected by a G code specifying a hole machining canned cycle.
6 G codes are displayed for each group number.
7 The group of G60 is switched according to the setting of NC parameter No. 5431#0 (MDL). (When the MDL bit is set to 0, group 00 is selected. When the MDL bit is set to 1, group 01 is selected.)
8 Do not specify any P code that does not specify an additional workpiece coordinate system in the block in which G54 or G54.1 is specified.
   Example) G54 M98 P2 ;

C OPERATION

Classification	Function	Program protect key	Setting parameter write = 1	Mode	Function button	Operation
Clear	Memory all clear			At power-on	IPL	In IPL MENU screen initiated by < - > + < . >, select <3> CLEAR FILE. In FILE CLEAR MENU, "CLEAR FILE NUMBER?" is displayed. Select <1> ALL FILE (*). "CLEAR FILE OK?" is displayed. Enter <1>. When "FILE CLEAR EXECUTING: END" is displayed, this operation is completed.
				At power-on	——	<RESET> + <DELETE> "ALL FILE INITIALIZE OK?" is displayed. Select <1>. "NC SYSTEM TYPE (0)?" is displayed. Enter <1>.
	Parameter clear			At power-on	IPL	<- > + <•> (Follow the same steps as for the memory all clear operation, and in (*), select <2> PARAMETER.)
	Offset clear			At power-on	IPL	<- > + <•> (Follow the same steps as for the memory all clear operation, and in (*), select <3> OFFSET FILE.)
	Program clear			At power-on	IPL	<- > + <•> (Follow the same steps as for the memory all clear operation, and in (*), select <4> PROGRAM/DIRECTORY FILE.)
Reset	Resetting operation time			——	Current position	[(OPRT)] → [TIME:0] → [EXEC]
	Resetting number of machined parts			——	Current position	[(OPRT)] → [TIME:0] → [EXEC]

Classification	Function	Program protect key	Setting parameter write = 1	Mode	Function button	Operation
Data input from MDI	Inputting NC parameters		○	MDI or emergency stop	Parameter	"Parameter write = 1" Parameter No. → [NO.SRH] Data → <INPUT> "Parameter write = 0" → <RESET>
	Offset value	○		——	Offset	Offset No. → [NO.SRH] Offset data → <INPUT>
	Inputting setting	○		Mode	Setting	Setting No. → [NO.SRH] Data → <INPUT>
	Inputting PMC parameters Timer Counter Keep relay		○	MDI or emergency stop	PMC maintenance	Select [TIMER], [COUNTER], or [KEEPRL]. Parameter No. → [NO.SRH] Data → <INPUT>
	Inputting PMC parameters Data table		○	MDI or emergency stop	PMC maintenance	Select [DATA]. [(OPRT)] → [ZOOM] Parameter No. → [NO.SRH] Data → <INPUT>
	Tool length measurement			HND mode	Current position ³ Offset	<>POS] (Displaying relative coordinates) < Z > + < O > → [PRESET] or < Z > → [ORIGIN] → [EXEC] to reset the coordinate value on the Z-axis to 0. → Move the tool to the measurement position. <OFFSET/SETTING> (Displaying offset screen) → Offset No. → [NO.SRH] → <Z> → [INP.C.]
Data input from External I/O	Inputting NC parameters		○	EDIT or emergency stop	Parameter	[(OPRT)] → [F INPUT] → Enter file name → [EXEC] (When the file name is "CNC-PARA.TXT", the file name does not need to be entered.)
	Inputting PMC parameters		○	Emergency stop	PMC maintenance	[I/O] (PMC) = Use <←> and <→> for selection (Device) = Use <←> and <→> for selection (Function) = Select "READ" Enter (file No.) or (file name) → [EXEC]
	Inputting offset data	○		EDIT mode	Offset	[(OPRT)] → [F INPUT] → Enter file name → [EXEC] (When the file name is "TOOLOFST.TXT", the file name does not need to be entered.)

Classification	Function	Program protect key	Setting parameter write = 1	Mode	Function button	Operation
Data input from External I/O	Inputting programs	○		EDIT mode	PROG or program directory	[(OPRT)] → [+] → [F INPUT] → File name → [F SET] (When file name is "ALL-PROG.TXT", [F SET] may be omitted.) Program No. → [P SET] (When all programs in file are read, [P SET] may be omitted.) → [EXEC]
Data output from External I/O	Outputting NC parameters			EDIT mode	Parameter	[(OPRT)] → [F OUTPUT] → Enter file name → [EXEC] (When no file name is entered, the file name is "CNC-PARA.TXT".)
	Outputting PMC parameters			EDIT mode	PMC mainte-nance	[I/O] (PMC) = Use <←> and <→> for selection (Device) = Use <←> and <→> for selection (Function) = Select "WRITE" (Kind of Data) = Select "PARAMETER" Enter (file name) → [EXEC]
	Outputting offset data			EDIT mode	Offset	[(OPRT)] → [F OUTPUT] → Enter file name → [EXEC] (When no file name is entered, the file name is "TOOLOFST.TXT".)
	Outputting programs			EDIT mode	PROG or program directory	[(OPRT)] → [+] → [F OUTPUT] File name → [F SET] (When [F SET] is omitted, output file name is "ALL-PROG.TXT") Program No. → [P SET] (When [P SET] is omitted, all programs are output.) → [EXEC]
Search	Searching for program No.			MEM or EDIT mode	PROG	< O > → Program No. → [(OPRT)] → [PROGRM SEARCH] or < O > → Program No. → <↓>
	Searching for sequence No.			EDIT mode	PROG	< N > → Sequence No. → [(OPRT)] → [LINE SEARCH]
	Searching for address word			EDIT mode	PROG	Data to be searched for → [(OPRT)] → [SEARCH] or Data to be searched for → <↓ > or <↑> cursor
	Searching for address only			EDIT mode	PROG	Address to be searched for → [(OPRT)] → [SEARCH] or Address to be searched for → <↓> or <↑> cursor
	Searching for offset No.			——	Offset	Offset No. → [NO.SRH]

Classification	Function	Program protect key	Setting parameter write = 1	Mode	Function button	Operation
Search	Searching for diagnosis No.			——	Diagnosis	Diagnosis No. → [NO.SRH]
	Searching for parameter No.			——	Parameter	Parameter No. → [NO.SRH]
Program editing	Displaying memory usage			——	Program directory	
	Deleting all programs in the current folder	○		EDIT mode	PROG or program directory	On the program screen, < O > → -9999 → <DELETE> → [EXEC] or on the program directory screen, < O > → -9999 → [(OPRT)] → [DELETE] → [EXEC]
	Deleting one program	○		EDIT mode	PROG or program directory	On the program screen, < O > → Program No. → <DELETE> → [EXEC] or on the program directory screen, move the cursor to the program to be deleted → [(OPRT)] → [DELETE] → [EXEC]
	Deleting blocks	○		EDIT mode	PROG	[EOB(;)] for the number of blocks to be deleted → <DELETE>
	Deleting a word	○		EDIT mode	PROG	Move the cursor to the word to be deleted, then <DELETE>
	Altering a word	○		EDIT mode	PROG	Move the cursor to the word to be altered, then enter new data → <ALTER>
	Inserting a word	○		EDIT mode	PROG	Move the cursor to the word immediately before the insertion position, then enter new data → <INSERT>
	Moving a block	○		EDIT mode	PROG	Move the cursor to the beginning of the block to be moved → [SELECT] → Move the cursor to select a range → [CUT] → Move the cursor to the destination → [PASTE]
	Copying a block	○		EDIT mode	PROG	Move the cursor to the beginning of the block to be copied → [SELECT] → Move the cursor to select a range → [COPY] → Move the cursor to the destination → [PASTE]
Play back	NC data input			EDIT or HND mode	PROG	On QUICK screen, set vertical soft key [PLAY BACK] to on. Move the machine → <X>, <Y>, or <Z> → <INSERT> → (NC data → <INSERT>) → [EOB] → <INSERT>

Classification	Function	Program protect key	Setting parameter write = 1	Mode	Function button	Operation
Tool change	Changing tools			MDI mode	——	<TOOL CHANGE> key
Coolant	Applying coolant			After Power-on	——	<COOLANT> key
Flood coolant	Applying flood coolant			After Power-on	——	On QUICK screen, set vertical soft key [FLOOD COOLAN] to on.
INTERNAL LIGHT	Turning on the light in the machine			After Power-on	——	On QUICK screen, set vertical soft key [INT. LIGHT] to on.

D ALARM LIST

D.1 ALARM LIST (CNC)

(1) Alarms on program and operation (PS alarm)
(2) Background edit alarms (BG alarm)
(3) Communication alarms (SR alarm)

SUPPLEMENT
Alarm numbers are common to all these alarm types.
Depending on the state, an alarm is displayed as in the following examples:
PS"alarm number" Example: PS0003
BG"alarm number" Example: BG0085
SR"alarm number" Example: SR0001

Number	Message	Description
0001	TH ERROR	A TH error was detected during reading from an input device. The read code that caused the TH error and how many statements it is from the block can be verified in the diagnostics screen.
0002	TV ERROR	An error was detected during the single–block TV error. The TV check can be suppressed by setting TVC parameter No. 0000#0 to "0".
0003	TOO MANY DIGIT	Data entered with more digits than permitted in the NC instruction word. The number of permissible digits varies according to the function and the word.
0004	INVALID BREAK POINT OF WORDS	NC word(s) address + numerical value not in word format. This alarm is also generated when a custom macro does not contain a reserved word, or does not conform to the syntax.
0005	NO DATA AFTER ADDRESS	NC word(s) address + numerical value not in word format. This alarm is also generated when a custom macro does not contain a reserved word, or does not conform to the syntax.
0006	ILLEGAL USE OF MINUS SIGN	A minus sign (–) was specified at an NC instruction word or system variable where no minus signal may be specified.
0007	ILLEGAL USE OF DECIMAL POINT	A decimal point (.) was specified at an address where no decimal point may be specified, or two decimal points were specified.
0009	IMPROPER NC-ADDRESS	An illegal address was specified, or parameter 1020 is not set.
0010	IMPROPER G-CODE	1) An unusable G code is specified. 2) The continuous circle motion-based groove cutting option parameter is not effective. 3) The continuous circle motion-based groove cutting enable signal is "0".

Number	Message	Description
0011	FEED ZERO (COMMAND)	1) The cutting feedrate instructed by an F code has been set to 0. 2) This alarm is also generated if the F code instructed for the S code is set extremely small in a rigid tapping instruction as the tool cannot cut at the programmed lead. 3) During continuous circle motion-based groove cutting, correct Q or F value is not specified or the acceleration clamp value for continuous circle motion in parameter No. 3490 is invalid.
0014	CAN NOT COMMAND G95	A synchronous feed is specified without the option for threading / synchronous feed. Modify the program.
0015	TOO MANY SIMULTANEOUS AXES	A move command was specified for more axes than can be controlled by simultaneous axis control. Either add on the simultaneous axis control extension option, or divide the number of programmed move axes into two blocks.
0020	OVER TOLERANCE OF RADIUS	An arc was specified for which the difference in the radius at the start and end points exceeds the value set in parameter No. 3410. Check arc center codes I, J and K in the program. The tool path when parameter No. 3410 is set to a large value is spiral.
0021	ILLEGAL PLANE SELECT	The plane selection instructions G17 to G19 are in error. Reprogram so that same 3 basic parallel axes are not specified simultaneously. This alarm is also generated when an axis that should not be specified for plane machining is specified, for example, for circular interpolation or involute interpolation. To enable programming of 3 or more axes, the helical interpolation option must be added to each of the relevant axes.
0022	R OR I,J,K COMMAND NOT FOUND	The command for circular interpolation lacks arc radius R or coordinate I, J, or K of the distance between the start point to the center of the arc.
0025	CIRCLE CUT IN RAPID (F0)	F0 (rapid traverse in inverse feed or feed specified by an F code with 1–digit number) was specified during circular interpolation (G02, G03) or involute interpolation (G02.2, G03.2).
0027	NO AXES COMMANDED IN G43/G44	No axis is specified in G43 and G44 blocks for the tool length offset type C. Offset is not canceled but another axis is offset for the tool length offset type C. Multiple axes were specified for the same block when the tool length compensation type is C.
0028	ILLEGAL PLANE SELECT	The plane selection instructions G17 to G19 are in error. Reprogram so that same 3 basic parallel axes are not specified simultaneously. This alarm is also generated when an axis that should not be specified for plane machining is specified, for example, for circular interpolation or involute interpolation. To enable programming of 3 or more axes, the helical interpolation option must be added to each of the relevant axes.
0029	ILLEGAL OFFSET VALUE	Illegal offset No.
0030	ILLEGAL OFFSET NUMBER	An illegal offset No. was specified. This alarm is also generated when the tool shape offset No. exceeds the maximum number of tool offset sets in the case of tool offset memory B.

Number	Message	Description
0031	ILLEGAL P COMMAND IN G10	The relevant data input or option could not be found for the L No. of G10. No data setting address such as P or R was specified. An address command not concerned with data setting was specified. An address varies with the L No. The sign or decimal point of the specified address is in error, or the specified address is out of range.
0032	ILLEGAL OFFSET VALUE IN G10	In setting an offset amount by G10 or in writing an offset amount by system variables, the offset amount was excessive.
0033	NO INTERSECTION AT CUTTER COMPENSATION	The intersection cannot be obtained by the intersection calculation in cutter or tool-nose radius compensation. Modify the program.
0034	NO CIRC ALLOWED IN STUP/EXT BLK	In cutter or tool-nose radius compensation, a startup or cancellation is performed in the G02 or G03 mode. Modify the program.
0035	CAN NOT COMMANDED G31	1) G31 cannot be specified. This alarm is generated when a G code (such as for cutter or tool-nose radius compensation) of group 07 is not canceled. 2) A torque limit skip was not specified in a torque limit skip command (G31P98 or P99). Specify the torque limit skip in the PMC window or the like. Or, specify the torque limit override by address Q.
0037	CAN NOT CHANGE PLANE IN G41/G42	The compensation plane G17/G18/G19 was changed during cutter or tool-nose radius compensation. Modify the program.
0038	INTERFERENCE IN CIRCULAR BLOCK	Overcutting will occur in tool radius/tool nose radius compensation because the arc start point or end point coincides with the arc center. Modify the program.
0039	CHF/CNR NOT ALLOWED IN G41,G42	Chamfering or corner R was specified with a start-up, a cancel, or switching between G41 and G42 in G41 and G42 commands (cutter compensation or tool nose radius compensation). The program may cause overcutting to occur in chamfering or corner R. Modify the program.
0041	INTERFERENCE IN CUTTER COMPENSATION	In cutter or tool-nose radius compensation, excessive cutting may occur. Modify the program.
0042	G45/G48 NOT ALLOWED IN CRC	Tool offset (G45 to G48) is commanded in tool compensation or three-dimensional cutter compensation. Modify the program.
0043	ILLEGAL T-CODE COMMAND	On a system with a DRILL-MATE ATC installed, M06 is not specified in a block that specifies a T code. Alternatively, a T code beyond the allowable range is specified.
0044	G27-G30 NOT ALLOWED IN FIXED CYC	One of G27 to G30 is commanded in canned cycle mode. Modify the program.
0045	ADDRESS Q NOT FOUND (G73/G83)	In a high-speed peck drilling cycle (G73) or peck drilling cycle (G83), the amount of each-time cutting is not specified by address Q, or Q0 is specified. Modify the program.
0046	ILLEGAL REFERENCE RETURN COMMAND	A command for a return to the second, third or fourth reference position is error. (The address P command is in error.) Although an option for a return to the third or fourth reference position was not set, 3 or 4 was specified in address P.
0047	ILLEGAL AXIS SELECT	Two or more parallel axes (in parallel with a basic axis) have been specified upon start-up of three-dimensional tool compensation or three-dimensional coordinate conversion.
0048	BASIC 3 AXIS NOT FOUND	Start-up of three-dimensional tool compensation or three-dimensional coordinate conversion has been attempted, but the three basic axes used when Xp, Yp, or Zp is omitted are not set in parameter No. 1022.

Number	Message	Description
0049	ILLEGAL COMMAND(G68,G69)	When 3-dimensional coordinate conversion (G68 or G69) was specified, the tool compensation was not canceled. Or, programs of 3-dimensional coordinate conversion (G68, G69) and tool compensation (G43, G44 or G49) were not nested. Or, the 3-dimensional coordinate conversion was specified during the tool length compensation and another tool length compensation was specified.
0050	CHF/CNR NOT ALLOWED IN THRD BLK	Chamfering or corner R is commanded in the thread cutting block. Modify the program.
0051	MISSING MOVE AFTER CNR/CHF	Improper movement or the move distance was specified in the block next to the chamfering or corner R block. Modify the program.
0052	CODE IS NOT G01 AFTER CHF/CNR	The block next to the chamfering or corner R block is not G01 (or vertical line). Modify the program.
0053	TOO MANY ADDRESS COMMANDS	In the chamfering and corner R commands, two or more of I, J, K and R are specified.
0054	NO TAPER ALLOWED AFTER CHF/CNR	A block in which chamfering in the specified angle or the corner R was specified includes a taper command. Modify the program.
0055	MISSING MOVE VALUE IN CHF/CNR	In chamfering or corner R block, the move distance is less than chamfer or corner R amount. Modify the program.
0056	NO END POINT & ANGLE IN CHF/CNR	In direct dimension drawing programming, both an end point and an angle were specified in the block next to the block in which only an angle was specified (Aa). Modify the program.
0057	NO SOLUTION OF BLOCK END	Block end point is not calculated correctly in direct dimension drawing programming. Modify the program.
0058	END POINT NOT FOUND	Block end point is not found in direct dimension drawing programming. Modify the program.
0060	SEQUENCE NUMBER NOT FOUND	[External data input/output] The specified number could not be found for program number and sequence number searches. Although input/output of a pot number of tool data or offset input was requested, no tool number was input after power on. The tool data corresponding to the entered tool number could not be found. [External workpiece number search] The program corresponding to the specified workpiece number could not be found. [Program restart] In the program restart sequence number specification, the specified sequence number could not be found.
0061	P OR Q COMMAND IS NOT IN THE MULTIPLE REPETIVE CYCLES BLOCK	Address P or Q is not specified in multiple repetitive cycle (G70, G71, G72, or G73) command.
0062	THE CUTTING AMOUNT IS ILLEGAL IN THE ROUGH CUTTING CYCLE	A zero or a negative value was specified in a multiple repetitive canned rough-cutting cycle (G71 or G72) as the depth of cut.
0063	THE BLOCK OF A SPECIFIED SEQUENCE NUMBER IS NOT FOUND	The sequence number specified by addresses P and Q in multiple repetitive cycle (G70, G71, G72, or G73) command cannot be searched.
0064	THE FINISHING SHAPE IS NOT A MONOTONOUS CHANGE(FIRST AXES)	In a shape program for the multiple repetitive canned rough-cutting cycle (G71 or G72), the command for the first plane axis was not a monotonous increase or decrease.
0065	G00/G01 IS NOT IN THE FIRST BLOCK OF SHAPE PROGRAM	In the first block of the shape program specified by P of the multiple repetitive canned cycle (G70, G71, G72, or G73), G00 or G01 was not specified.

Number	Message	Description
0066	UNAVAILABLE COMMAND IS IN THE MULTIPLE REPETIVE CYCLES BLOCK	An unavailable command was found in a multiple repetitive canned cycle (G70, G71, G72, or G73) command block.
0067	THE MULTIPLE REPETIVE CYCLES IS NOT IN THE PART PROGRAM STORAGE	A multiple repetitive canned cycle (G70, G71, G72, or G73) command is not registered in a tape memory area.
0069	LAST BLOCK OF SHAPE PROGRAM IS AN ILLEGAL COMMAND	In a shape program in the multiple repetitive canned cycle (G70, G71, G72, or G73), a command for the chamfering or corner R in the last block is terminated in the middle.
0070	NO PROGRAM SPACE IN MEMORY	The memory area is insufficient. Delete any unnecessary programs, then retry.
0071	DATA NOT FOUND	1) The address to be searched was not found. 2) The program with specified program number was not found in program number search. 3) In the program restart block number specification, the specified block number could not be found. Check the data.
0072	TOO MANY PROGRAMS	The number of registered programs exceeded 1000. Delete unnecessary programs and execute program registration again.
0073	PROGRAM NUMBER ALREADY IN USE	The commanded program number has already been used. Change the program number or delete unnecessary programs and execute program registration again.
0074	ILLEGAL PROGRAM NUMBER	The program number is other than 1 to 9999. Modify the program number.
0075	PROTECT	An attempt was made to register a program whose number was protected. In program matching, the password for the encoded program was not correct. An attempt was made to select a program being edited in the background as the main program. An attempt was made to call a program being edited in the background as a subprogram.
0076	PROGRAM NOT FOUND	The specified program is not found in the subprogram call, macro call or graphic copy. The M, G, T or S codes are called by a P instruction other than that in an M98, G65, G66, G66.1 or interrupt type custom macro, and a program is called by a No. 2 auxiliary function code. This alarm is also generated when a program is not found by these calls.
0077	TOO MANY SUB,MACRO NESTING	The total number of subprogram and macro calls exceeds the permissible range. Another subprogram call was executed during an external memory subprogram call.
0078	SEQUENCE NUMBER NOT FOUND	The specified sequence No. was not found during sequence number search. The sequence No. specified as the jump destination in GOTO— and M99P— was not found.
0079	PROGRAM NOT MATCH	The program in memory does not match the program stored on tape. Multiple programs cannot be matched continuously when NC parameter No. 2200#3 is set to “1”. Set NC parameter No. 2200#3 to “0” before executing a match.

Number	Message	Description
0080	G37 MEASURING POSITION REACHED SIGNAL IS NOT PROPERLY INPUT	When the tool length measurement function (G37) is performed, a measuring position reached signal goes 1 in front of the area determined by the ε value specified in parameter No.6254. Alternatively, the signal does not go 1.
0081	G37 OFFSET NO. UNASSIGNED	The tool length measurement function (G37) is specified without specifying an H code. Correct the program.
0082	G37 SPECIFIED WITH H CODE	The tool length measurement function (G37) is specified together with an H code in the same block. Correct the program.
0083	G37 IMPROPER AXIS COMMAND	An error has been found in axis specification of the tool length measurement function (G37). Alternatively, a move command is specified as an incremental command. Correct the program.
0085	OVERRUN ERROR	The next character was received from the I/O device connected to RS232C interface 1 before it could read a previously received character. An overrun error, parity error, or framing error occurred during reading by RS232C interface 1. The number of bits of input data does not match, the baud rate is incorrectly set, or the specification number of an I/O device is incorrect.
0086	DR OFF	During I/O process by RS232C interface 1, the data set ready input signal of the I/O device (DR) was OFF. Possible causes are an I/O device not turn on, a broken cable, and a defective printed circuit board.
0087	BUFFER OVERFLOW	During a read by RS232C interface 1, although a read stop command was issued, more than 10 characters were input. The I/O device or printed circuit board was defective.
0090	REFERENCE RETURN INCOMPLETE	1) The reference position return cannot be performed normally because the reference position return start point is too close to the reference position or the speed is too slow. Separate the start point far enough from the reference position, or specify a sufficiently fast speed for reference position return. 2) An attempt was made to set the zero position for the absolute position detector by return to the reference position when it was impossible to set the zero point. Rotate the motor manually at least one turn, and set the zero position of the absolute position detector after turning the CNC and servo amplifier off and then on again.
0091	MANUAL REFERENCE POSITION RETURN IS NOT PERFORMED IN FEED HOLD	Manual return to the reference position cannot be performed when automatic operation is halted. Perform the manual return to the reference position when automatic operation is stopped or reset.
0092	ZERO RETURN CHECK (G27) ERROR	The axis specified in G27 has not returned to zero. Reprogram so that the axis returns to zero.
0094	P TYPE NOT ALLOWED (COORD CHG)	P type cannot be specified when the program is restarted. (After the automatic operation was interrupted, the coordinate system setting operation was performed.) Perform the correct operation according to the User's manual.
0095	P TYPE NOT ALLOWED (EXT OFS CHG)	P type cannot be specified when the program is restarted. (After the automatic operation was interrupted, the external workpiece offset amount changed.) Perform the correct operation according to the User's manual.

Number	Message	Description
0096	P TYPE NOT ALLOWED (WRK OFS CHG)	P type cannot be specified when the program is restarted. (After the automatic operation was interrupted, the workpiece offset amount changed.) Perform the correct operation according to the User's manual.
0097	P TYPE NOT ALLOWED (AUTO EXEC)	P type cannot be directed when the program is restarted. (After power ON, after emergency stop or alarms 0094 to 0097 reset, no automatic operation is performed.) Perform automatic operation.
0098	G28 FOUND IN SEQUENCE RETURN	A command of the program restart was specified without the reference position return operation after power ON or emergency stop, and G28 was found during search. Perform the reference position return.
0099	MDI EXEC NOT ALLOWED AFT. SEARCH	After completion of search in program restart, a move command is given with MDI.
0109	FORMAT ERROR IN G08	A value other than 0 or 1 was specified after P in the G08 code, or no value was specified.
0110	OVERFLOW :INTEGER	An integer went out of range during arithmetic calculations.
0111	OVERFLOW :FLOATING	A decimal point (floating point number format data) went out of range during arithmetic calculations.
0112	ZERO DIVIDE	An attempt was made to divide by zero in a custom macro.
0113	IMPROPER COMMAND	A function which cannot be used in custom macro is commanded. Modify the program.
0114	ILLEGAL EXPRESSION FORMAT	The format used in an expression in a custom macro statement is in error. The parameter tape format is in error.
0115	VARIABLE NO. OUT OF RANGE	A number that cannot be used for a local variable, common variable, or system variable in a custom macro is specified. In the EGB axis skip function (G31.8), a non-existent custom macro variable number is specified. Or, the number of custom macro variables used to store skip positions is not sufficient. Alternatively, the header data in high-speed cycle machining is improper. This alarm is issued in the following cases. 1) The header corresponding to the specified call machining cycle number is absent. 2) The value of cycle connection information falls outside the allowable range (0 to 999). 3) The number of data items in the header falls outside the allowable range (1 to 65535). 4) The storage start data variable number of executable data falls outside the allowable ranges (#20000 to #85535/#200000 to #986431/#2000000 to #3999999). 5) The storage end data variable number of executable data falls outside the allowable ranges (#85535/#986431/#3999999). 6) The storage start data variable number of executable data is the same as the variable number used by the header.
0116	WRITE PROTECTED VARIABLE	An attempt was made in a custom macro to use on the left side of an expression a variable that can only be used on the right side of an expression.
0118	TOO MANY BRACKET NESTING	Too many brackets "[ ]" were nested in a custom macro. The nesting level including function brackets is 5.
0119	ARGUMENT VALUE OUT OF RANGE	The value of an argument in a custom macro function is out of range.
0122	TOO MANY MACRO NESTING	Too many macro calls were nested in a custom macro.
0123	ILLEGAL MODE FOR GOTO/WHILE/ DO	A GOTO statement or WHILE–DO statement was found in the main program in the MDI or DNC mode.

Number	Message	Description
0124	MISSING END STATEMENT	The END instruction corresponding to the DO instruction was missing in a custom macro.
0125	MACRO STATEMENT FORMAT ERROR	The format used in a macro statement in a custom macro is in error.
0126	ILLEGAL LOOP NUMBER	DO and END Nos. in a custom macro are in error, or exceed the permissible range (valid range: 1 to 3).
0127	DUPLICATE NC,MACRO STATEMENT	An NC statement and macro statement were specified in the same block.
0128	ILLEGAL MACRO SEQUENCE NUMBER	The specified sequence No. could not be found for sequence number search. The sequence No. specified as the jump destination in GOTO-- and M99P-- could not be found.
0129	USE 'G' AS ARGUMENT	G is used as an argument in a custom macro call. G can be specified as an argument only in an every-block call (G66.1).
0130	NC AND PMC AXIS ARE CONFLICTED	The NC command and the PMC axis control command were conflicted. Modify the program or ladder.
0136	SPOS AXIS - OTHER AXIS SAME TIME	The spindle positioning axis and another axis are specified in the same block.
0137	M-CODE & MOVE CMD IN SAME BLK.	The spindle positioning axis and another axis are specified in the same block.
0138	SUPERIMPOSED DATA OVERFLOW	The total distribution amount of the CNC and PMC is too large during superimposed control for PMC axis control.
0139	CANNOT CHANGE PMC CONTROL AXIS	The PMC axis was selected for the axis for which the PMC axis is being controlled.
0140	PROGRAM NUMBER ALREADY IN USE	In the background, an attempt was made to select or delete the program being selected in the foreground. Perform the correct operation for the background edition.
0141	CAN NOT COMMAND G51 IN 3-D OFFSET	G51 (Scaling ON) is commanded in the three-dimensional tool offset mode. Modify the program.
0142	ILLEGAL SCALE RATE	The scaling rate is 0 times or 10000 times or more. Modify the setting of the scaling rate. (G51P_ … or G51I_J_K_ … or parameter (No. 5411 or 5421))
0143	COMMAND DATA OVERFLOW	An overflow occurred in the storage length of the CNC internal data. This alarm is also generated when the result of internal calculation of scaling, coordinate rotation and cylindrical interpolation overflows the data storage. It also is generated during input of the manual intervention amount.
0144	ILLEGAL PLANE SELECTED	The coordinate rotation plane and arc or tool radius·tool nose radius compensation plane must be the same. Modify the program.
0145	ILLEGAL USE OF G12.1/G13.1	The axis No. of plane selection parameter No. 5460 (linear axis) and No. 5461(axis of rotation) in the polar coordinate interpolation mode is out of range (1 to number of controlled axes).
0146	ILLEGAL USE OF G-CODE	The modal G code group contains an illegal G code in the polar coordinate interpolation mode or when a mode was canceled. Only the following G codes are allowed: G40, G50, G69.1 An illegal G code was specified while in the polar coordinate interpolation mode. The following C codes are not allowed: G27, G28, G30, G30.1, G31 to G31.4, G37 to G387.3, G52, G92, G53, G17 to G19, G81 to G89, G68 In the 01 group, G codes other than G01, G02, G03, G02.2 and G03.2 cannot be specified.

Number	Message	Description
0148	SETTING ERROR	Automatic corner override deceleration rate is out of the settable range of judgment angle. Modify the parameters (No.1710 to No.1714).
0149	FORMAT ERROR IN G10L3	In tool life management data registration (G10L3 to G11), an address other than Q1, Q2, P1, or P2, or an unusable address is specified.
0150	ILLEGAL LIFE GROUP NUMBER	The tool group number exceeded the maximum allowable value. The tool group number (P after specification of G10 L3;) or the group number given by the tool life management T code in a machining program.
0151	GROUP NOT FOUND AT LIFE DATA	A tool group specified in a machining program is not specified in tool life management data.
0152	OVER MAXIMUM TOOL NUMBER	An attempt was made to register more tools in a group than the maximum number of tools that could be registered.
0153	T-CODE NOT FOUND	In tool life data registration, no T code is registered in a block where one should be. Alternatively, M06 is independently specified for tool change system D. Modify the program.
0154	NOT USING TOOL IN LIFE GROUP	• For a tool management command H99 or D99 is specified when no tool management data number is assigned to the spindle position. Correct the program. • For a tool life management command When no tool belonging to the group is used, the H99 or D99 command, or H or D code set in parameter No. 13265 or No. 13266 is specified.
0155	ILLEGAL T-CODE COMMAND	A T code in the same machining program block as for M06 does not correspond to the tool group currently in use. Modify the program.
0156	P/L COMMAND NOT FOUND	No P or L command is specified at the beginning of a program for specifying a tool group. Modify the program.
0157	TOO MANY TOOL GROUPS	In tool life management data registration, the number of P (group number) and L (tool life) blocks in which groups are specified exceeds the maximum number of groups.
0158	TOOL LIFE VALUE OUT OF RANGE	An attempt was made to specify too great a value as tool life. Correct the setting.
0159	ILLEGAL TOOL LIFE DATA	Too life management data was collapsed for some reason. Register the tool group and the tool data for the tool group again, using G10L3; or an MDI input.
0160	MISMATCH WAITING M-CODE	A waiting M-code is in error. 1) When different M codes are specified for path 1 and path 2 as waiting M codes without a P command. 2) When the waiting M codes are not identical even though the P commands are identical 3) When the waiting M codes are identical and the P commands are not identical (This occurs when a P command is specified with binary value.) 4) When the number lists in the P commands contain a different number even though the waiting M codes are identical (This occurs when a P command is specified by combining path numbers.) 5) When a waiting M code without a P command (2-path waiting) and a waiting M code with a P command (3-or-more-path waiting) were specified at the same time 6) When a waiting M code without a P command was specified for 3 or more paths.

Number	Message	Description
0161	ILLEGAL P OF WAITING M-CODE	P in a waiting M-code is incorrect. 1) When address P is negative 2) When a P value inappropriate for the system configuration was specified 3) When a waiting M code without a P command (2-path waiting) was specified in the system having 3 or more paths.
0163	ILLEGAL COMMAND IN G68/G69	G68 and G69 are not independently commanded in balance cut. An illegal value is commanded in a balance cut combination (address P).
0169	ILLEGAL TOOL GEOMETRY DATA	Incorrect tool figure data in interference check. Set correct data, or select correct tool figure data.
0175	ILLEGAL G07.1 AXIS	An axis which cannot perform cylindrical interpolation was specified. More than one axis was specified in a G07.1 block. An attempt was made to cancel cylindrical interpolation for an axis that was not in the cylindrical interpolation mode. For the cylindrical interpolation axis, set not “0” but one of 5, 6 or 7 (parallel axis specification) to parameter No. 1022 to instruct the arc with axis of rotation (ROT parameter No. 1006#1 is set to “1” and parameter No. 1260 is set) ON.
0176	ILLEGAL G-CODE USE(G07.1 MODE)	A G code was specified that cannot be specified in the cylindrical interpolation mode. This alarm also is generated when a 01 group G code was in the G00 mode or code G00 was instructed. Cancel the cylindrical interpolation mode before instructing code G00.
0177	CHECK SUM ERROR (G05)	A checksum error occurred.
0178	ILLEGAL COMMAND G05	An invalid value is specified in parameter No. 7501#4, #5, #6 or G05 is specified in one of the following modes: • Hypothetical axis interpolation (G07) • Cylindrical interpolation (G07.1) • Polar coordinate interpolation (G12.1) • Polar coordinate command (G16) • Spindle speed change detection (G26) • Cutter and tool-nose radius compensation (G41/G42) • Normal direction control (G41.1/G42.1) • Scaling (G51) • Programmable mirror image (G51.1) • Coordinate system rotation (G68) • Canned cycle (G81 to G89) • Constant surface speed control (G96) • Macro interrupt (M96)
0179	PARAM. (NO.7510) SETTING ERROR	The number of controlled axes set by the parameter No. 7510 exceeds the maximum number. Modify the parameter setting value. The distribution of high-speed cycle machining or high-speed binary program operation stopped.
0190	ILLEGAL AXIS SELECTED (G96)	An illegal value was specified in P in a G96 block or parameter No. 3770.
0194	SPINDLE COMMAND IN SYNCHRO-MODE	A Cs contour control mode, spindle positioning command, or rigid tapping mode was specified during the spindle synchronous control mode or simple spindle synchronous control mode.
0197	C-AXIS COMMANDED IN SPINDLE MODE	The program specified a movement along the Cs-axis when the Cs contour control switching signal was off.
0199	MACRO WORD UNDEFINED	Undefined macro word was used. Modify the custom macro.

Number	Message	Description
0200	ILLEGAL S CODE COMMAND	In the rigid tap, an S value was out of range or was not specified. The parameter (Nos. 5241 to 5243) setting is an S value which can be specified for the rigid tap. Correct the parameters or modify the program.
0201	FEEDRATE NOT FOUND IN RIGID TAP	The command F code for a cutting feedrate is a zero. If the value of F command is much smaller than that of the S command, when a rigid tap command is specified, this alarm is generated. This is because cutting is not possible by the lead specified by the program.
0202	POSITION LSI OVERFLOW	In the rigid tap, spindle distribution value is too large. (System error)
0203	PROGRAM MISS AT RIGID TAPPING	In the rigid tap, position for a rigid M code (M29) or an S command is incorrect. Modify the program.
0204	ILLEGAL AXIS OPERATION	In the rigid tap, an axis movement is specified between the rigid M code (M29) block and G84 (or G74) block. Modify the program.
0205	RIGID MODE DI SIGNAL OFF	Although a rigid M code (M29) is specified in rigid tapping, the rigid mode DI signal (DGN G061.0) is not ON during execution of the G84 (or G74) block. Check the PMC ladder diagram to find the reason why the DI signal is not turned on.
0206	CAN NOT CHANGE PLANE (RIGID TAP)	Plane changeover was instructed in the rigid mode. Modify the program.
0207	RIGID DATA MISMATCH	The specified distance was too short or too long in rigid tapping.
0210	CAN NOT COMMAND M198/M99	1) The execution of an M198 or M99 command was attempted during scheduled operation. Alternatively, the execution of an M198 command was attempted during DNC operation. Modify the program. 2) The execution of an M99 command was attempted by an interrupt macro during pocket machining in a multiple repetitive canned cycle.
0212	ILLEGAL PLANE SELECT	The direct drawing dimensions programming is commanded for the plane other than the Z-X plane. Correct the program.
0213	ILLEGAL COMMAND IN SYNCHRO-MODE	In feed axis synchronization control, the following errors occurred during the synchronous operation. 1) The program issued the move command to the slave axis. 2) The program issued the manual operation (jog feed or incremental feed) to the slave axis. 3) The program issued the automatic reference position return command without specifying the manual reference position return after the power was turned on.
0214	ILLEGAL COMMAND IN SYNCHRO-MODE	Coordinate system is set or tool compensation of the shift type is executed in the synchronous control. Correct the program.
0217	DUPLICATE G51.2(COMMANDS)	G51.2 is further commanded in the G51.2 mode. Modify the program.
0218	NOT FOUND P/Q COMMAND	P or Q is not commanded in the G51.2 block, or the command value is out of the range. Modify the program. For a polygon turning between spindles, more information as to why this alarm occurred is indicated in diagnosis data No. 471.
0219	COMMAND G51.2/G50.2 INDEPENDENTLY	G51.2 and 50.2 were specified in the same block for other commands. Modify the program in another block.
0220	ILLEGAL COMMAND IN SYNCHR-MODE	In the synchronous operation, movement is commanded by the NC program or PMC axis control interface for the synchronous axis. Modify the program or check the PMC ladder.
0221	ILLEGAL COMMAND IN SYNCHR-MODE	Polygon machining synchronous operation and axis control or balance cutting are executed at a time. Modify the program.

Number	Message	Description
0222	DNC OP. NOT ALLOWED IN BG-EDIT	Input and output are executed at a time in the background edition. Execute a correct operation.
0224	ZERO RETURN NOT FINISHED	Reference position return has not been performed before the automatic operation starts. Perform reference position return only when the parameter ZRNx (No. 1005#0) is set to 0.
0230	R CODE NOT FOUND	Depth of cut R is not specified in the G161 block. Alternatively, a negative value is specified for R. Modify the program.
0231	ILLEGAL FORMAT IN G10 L52	Errors occurred in the specified format at the programmable-parameter input.
0232	TOO MANY HELICAL AXIS COMMAND	Three or more axes were specified as helical axes in the helical interpolation mode. Five or more axes were specified as helical axes in the helical interpolation B mode.
0233	DEVICE BUSY	When an attempt was made to use a unit such as that connected via the RS-232-C interface, other users were using it.
0241	ILLEGAL FORMAT IN G02.2/G03.2	The end point of an involute curve on the currently selected plane, or the center coordinate instruction I, J or K of the corresponding basic circle, or basic circle radius R was not specified.
0242	ILLEGAL COMMAND IN G02.2/G03.2	An illegal value was specified in the involute curve. The coordinate instruction I, J or K of the basic circle on the currently selected plane or the basic circle radius R is "0", or the start and end points are not inside the basic circle.
0243	OVER TOLERANCE OF END POINT	The end point is not positioned on the involute curve that passes through the start point, and this error exceeds the permissible error limit (parameter No. 5610).
0245	T-CODE NOT ALLOWED IN THIS BLOCK	One of the G codes, G50, G10, G04, G28, G28.2, G29, G30, G30.2, G30.1 and G53, which cannot be specified in the same block as a T code, was specified with a T code.
0247	THE MISTAKE IS FOUND IN THE OUTPUT CODE OF DATA.	When an encrypted program is output, EIA is set for the output code. Specify ISO.
0250	TOOL CHANGE ILLEGAL Z AXIS COMMAND	A Z-axis move command was performed in the same block for M06 command.
0251	TOOL CHANGE ILLEGAL T COMMAND	An unusable T code was specified in M06Txx.
0253	G05 CAN NOT BE COMMANDED	A binary operation was specified during advanced preview control mode.
0300	ILLEGAL COMMAND IN SCALING	An illegal G code was specified during scaling. Modify the program.
0301	RESETTING OF REFERENCE RETURN IS INHIBITED	Although parameter IDGx (No. 1012#0) was set to 1 to inhibit the reference position from being set again for a return to the reference position without a dog, an attempt was made to perform a manual return to the reference position.
0302	SETTING THE REFERENCE POSITION WITHOUT DOG IS NOT PERFORMED	The reference position could not be set for a return to the reference position without a dog. Possible causes are: 1) The axis was not moved in the direction of a return to the reference position for jog feeding. 2) The axis was moved in the direction opposite to the direction of a manual return to the reference position. 3) Since the one-rotation signal sent from the position detector is not detected, the grid for manual reference position return is not established. (Diagnostic data No. 0201#6 must be 1.)

Number	Message	Description
0303	REFERENCE POSITION RETURN IS NOT PERFORMED	When the setting of a reference position at any position was possible in Cs contour control (parameter CRF (No. 3700#0) = 1), a G00 command was issued for the Cs contour axis without a return to the reference position after the serial spindle was switched to Cs contour control mode. Perform a reference position return with a G28 command before issuing a G00 command.
0304	G28 IS COMMANDED WITHOUT ZERO RETURN	Although a reference position was not set, an automatic return to the reference position (G28) was commanded.
0305	INTERMEDIATE POSITION IS NOT ASSIGNED	Although a G28 (automatic return to the reference position), G30 (return to the second, third, or fourth reference position), or G30/1 (return to the floating reference position) command was not issued after power-up, G29 (return from the reference position) was commanded.
0306	MISMATCH AXIS WITH CNR/CHF	The correspondence between the moving axis and the I, J, or K command is incorrect in a block in which chamfering is specified.
0307	CAN NOT START REFERENCE RETURN WITH MECHANICAL STOPPER SETTING	An attempt was made to set a butt-type reference position for an axis for which to use the function to set a reference position without a dog.
0308	G72.1 NESTING ERROR	G72.1 was specified again during G72.1 rotation copying.
0309	G72.2 NESTING ERROR	G72.2 was specified again during G72.2 parallel copying.
0310	FILE NOT FOUND	The specified file could not be found during a subprogram or macro call.
0311	CALLED BY FILE NAME FORMAT ERROR	An invalid format was specified to call a subprogram or macro using a file name.
0312	ILLEGAL COMMAND IN DIRECT DRAWING DIMENSIONS PROGRAMMING	Direct input of drawing dimensions was commanded in an invalid format. An attempt was made to specify an invalid G code during direct input of drawing dimensions. Two or more blocks not to be moved exist in consecutive commands that specify direct input of drawing dimensions. Although non-use of commas (,) (parameter No. 3405#4 = 1) was specified for direct input of drawing dimensions, a comma was specified.
0313	ILLEGAL LEAD COMMAND	The variable-lead threading increment specified in address K exceeds the specified maximum value in variable-lead threading. Or, a negative lead value was specified.
0314	ILLEGAL SETTING OF POLYGONAL AXIS	An axis was specified invalidly in polygon turning. [For polygon turning] • A tool rotation axis is not specified. [For polygon turning between spindles] • Valid spindles are not specified. (Parameter Nos. 7640 to 7643) • A spindle other than the serial spindle. • A spindle is not connected. [For concurrent use of polygon turning and polygon turning with two spindles] • In the polygon turning mode, the value of parameter No. 7605 (selecting the type of polygon turning) was changed • An attempt is made to use a spindle used for polygon turning also for polygon turning with two spindles.
0315	ILLEGAL NOSE ANGLE COMMAND IS IN THE THREAD CUTTING CYCLE	An invalid tool tip angle is specified in a multiple repetitive canned threading cycle (G76).

Number	Message	Description
0316	ILLEGAL CUTTING AMOUNT IS IN THE THREAD CUTTING CYCLE	A minimum depth of cut higher than the thread height is specified in a multiple repetitive canned threading cycle (G76).
0317	ILLEGAL THREAD COMMAND IS IN THE THREAD CUTTING CYCLE	A zero or a negative value is specified in a multiple repetitive canned threading cycle (G76) as the thread height or the depth of cut.
0318	ILLEGAL RELIEF AMOUNT IS IN THE DRILLING CYCLE	Although an escape direction is set in a multiple repetitive canned cutting-off cycle (G74 or G75), a negative value is specified for Δd.
0319	THE END POINT COMMAND IS ILLEGAL IN THE DRILLING CYCLE	Although the Δi or Δk travel distance is set to 0 in a multiple repetitive canned cutting-off cycle (G74 or G75), a value other than 0 us specified for a U or W.
0320	ILLEGAL MOVEMENT AMOUNT/CUTTING AMOUNT IS IN THE DRILLING CYCLE	A negative value is specified in a multiple repetitive canned cutting-off cycle (G74 or G75) as Δi or Δk (travel distance/the depth of cut).
0321	ILLEGAL REPEATED TIME IS IN THE PATTERN REPEATING CYCLE	A zero or a negative value is specified in a multiple repetitive canned closed loop cycle (G73) as a repeated time.
0322	FINISHING SHAPE WHICH OVER OF STARTING POINT	An invalid shape which is over the cycle starting point is specified in a shape program for a multiple repetitive canned rough-cutting cycle (G71 or G72).
0323	THE FIRST BLOCK OF SHAPE PROGRAM IS A COMMAND OF TYPE Ⅱ	Type II is specified in the first block of the shape program specified by P in a multiple repetitive canned rough-cutting cycle (G71 or G72). Z (W) command is for G71. X (U) command is for G72.
0324	THE INTERRUPTION TYPE MACRO WAS DONE IN THE MULTIPLE REPETIVE CYCLES	An interruption type macro was issued during the multiple repetitive canned cycle (G70, G71, G72, or G73).
0325	UNAVAILABLE COMMAND IS IN SHAPE PROGRAM	A usable command was issued in a shape program for a multiple repetitive canned cycle (G70, G71, G72, or G73).
0326	LAST BLOCK OF SHAPE PROGRAM IS A DIRECT DRAWING DIMENSIONS	In a shape program in the multiple repetitive canned cycle (G70, G71, G72, or G73), a command for direct input of drawing dimensions in the last block is terminated in the middle.
0327	MODAL THAT MULTIPLE REPETIVE CYCLES CANNOT BE DONE	A multiple repetitive canned cycle (G70, G71, G72, or G73) was commanded in a modal state in which a multiple repetitive canned cycle could not be commanded.
0328	ILLEGAL WORK POSITION IS IN THE TOOL NOSE RADIUS COMPENSATION	The specification for the blank side for a tool-nose radius compensation (G41 or G42) is incorrect in a multiple repetitive canned cycle (G71 or G72).
0329	THE FINISHING SHAPE IS NOT A MONOTONOUS CHANGE(SECOND AXES)	In a shape program for the multiple repetitive canned rough-cutting cycle (G71 or G72), the command of the second plane axis was not a monotonous increase or decrease.
0330	ILLEGAL AXIS COMMAND IS IN THE TURNING CANNED CYCLE	An axis other than the plane is specified n a canned cycle(G90, G92, or G94).
0331	ILLEGAL AXIS NUMBER IN AX[]	An illegal value is specified for an AX[ ] axis number.
0332	ILLEGAL AXIS ADDRESS IN AXNUM[]	An illegal value is specified for an AXNUM[ ] axis address.
0333	TOO MANY SPINDLE COMMANDS	Multiple spindle commands could be found in the same block in using an expansion spindle name. Only one spindle could be commanded in the same block.
0334	INPUT VALUE OUT OF EFFECTIVE RANGE	An offset data which was out of the effective range was specified. (malfunction prevention function)
0335	PLURAL M CODE	Multiple M codes are commanded simultaneously in a block for a wait function with peripheral devices by an M code.

Number	Message	Description
0336	TOOL COMPENSATION COMMANDED MORE TWO AXES	For a tool length compensation C, an attempt was made to command the offset to other axes without canceling the offset. Or, for a tool length compensation C, multiple axes are specified in G43 or G44 block.
0337	EXCESS MAXIMUM INCREMENTAL VALUE	The command value exceeded the maximum amount of incremental. (malfunction prevention function)
0340	ILLEGAL RESTART(NANO SMOOTHING)	With manual absolute turned on, an attempt was made to restart the operation in nano smoothing mode after performing the manual interaction.
0341	TOO MANY COMMAND BLOCK (NANO SMOOTHING)	There are more blocks than can be commanded consecutively in nano smoothing mode.
0342	CUSTOM MACRO INTERRUPT ENABLE IN NANO SMOOTHING	A custom macro interrupt was enabled in nano smoothing mode. Or, nano smoothing mode was commanded with a custom macro interrupt enabled.
0343	ILLEGAL COMMAND IN NANO SMOOTHING	G43, G44, or G49 was commanded during a nano smoothing.
0344	CANNOT CONTINUE NANO SMOOTHING	An illegal command or operation by which a nano smoothing could not be continued was performed.
0345	TOOL CHANGE ILLEGAL Z AXIS POS	A tool change position on the Z-axis is incorrect.
0346	TOOL CHANGE ILLEGAL TOOL NUM	A tool change position is not set.
0347	TOOL CHANGE ILLEGAL COMMAND IN SAME BLK.	Tool changing is commanded twice or more in the same block.
0348	TOOL CHANGE Z AXIS POS NOT ESTABLISHED	A tool change spindle on the Z-axis is not set.
0349	TOOL CHANGE SPINDLE NOT STOP	A tool change spindle stop is not stopped.
0350	PARAMETER OF THE INDEX OF THE SYNCHRONOUS CONTROL AXIS SET ERROR.	An illegal synchronization control axis number (parameter No. 8180) is set.
0351	BECAUSE THE AXIS IS MOVING, THE SYNC CONTROL IS CAN'T BE USED.	While the axis being subject to synchronization control was moving, an attempt was made to start or cancel the synchronization control by a synchronization control axis selection signal.
0352	SYNCHRONOUS CONTROL AXIS COMPOSITION ERROR.	This error occurred when: 1) An attempt was made to perform synchronization control for the axis during a synchronization, composition, or superposition. 2) An attempt was made to synchronize a further great-grandchild for a parent-child-grandchild relation. 3) An attempt was made to operate synchronization control although a parent-child-grandchild relation was not set.
0353	THE INSTRUCTION WAS DONE FOR THE AXIS WHICH WAS NOT ABLE TO MOVE.	This error occurred when: [For synchronization] 1) A move command was issued to the axis for which parameter No. 8163#7NUMx is set to 1. 2) A move command was issued to the slave axis. [For composition] 1) A move command was issued to the axis for which parameter No. 8163#7NUMx is set to 1. 2) A move command was issued to the axis for which parameter No. 8162#7MUMx is set to 1.

Number	Message	Description
0354	THE G28 WAS INSTRUCTED IN WITH THE REF POS NOT FIXED IN SYNC MODE	This error occurred when G28 was specified to the master axis being parking during synchronization control, but an axis reference position is not set for the slave axis.
0355	PARAMETER OF THE INDEX OF THE COMPOSITE CONTROL AXIS SET ERROR.	An illegal composite control axis number (parameter No. 8183) is specified.
0356	BECAUSE THE AXIS IS MOVING, THE COMP CONTROL IS CAN'T BE USED.	While the axis being subject to composite control was moving, an attempt was made to start or cancel the composite control by a composite control axis selection signal.
0357	COMPOSITE CONTROL AXIS COMPOSITION ERROR.	This error occurred when an attempt was made to perform composite control for the axis during a synchronization, composition, or superposition.
0359	THE G28 WAS INSTRUCTED IN WITH THE REF POS NOT FIXED IN COMP MODE	This error occurred when G28 was specified to the composite axis during composite control, but a reference position is not set to the other part of the composition.
0360	PARAMETER OF THE INDEX OF THE SUPERPOS CONTROL AXIS SET ERROR.	An illegal superposition control axis number (parameter No. 8186) is specified.
0361	BECAUSE THE AXIS IS MOVING, THE SUPERPOS CONTROL IS CAN'T BE USED.	While the axis being subject to superposition control was moving, an attempt was made to start or cancel the superposition control by a superposition control axis selection signal.
0362	SUPERPOSITION CONTROL AXIS COMPOSITION ERROR.	This error occurred when: 1) An attempt was made to perform superposition control for the axis during a synchronization, composition, or superposition. 2) An attempt was made to synchronize a further great-grandchild for a parent-child-grandchild relation.
0363	THE G28 WAS INSTRUCTED IN TO THE SUPERPOS CONTROL SLAVE AXIS.	This error occurred when G28 was specified to the superposition control slave axis during superposition control.
0364	THE G53 WAS INSTRUCTED IN TO THE SUPERPOS CONTROL SLAVE AXIS.	This error occurred when G53 was specified to the slave axis being moved during superposition control.
0365	TOO MANY MAXIMUM SV/SP AXIS NUMBER PER PATH	The maximum control axis number or maximum control spindle number which could be used within a path was exceeded. (For a loader path, this alarm is generated if the number of axis per path is set to 5 or greater.)
0366	IMPROPER G-CODE IN TURRET METHOD	When the turret change tools method was selected (parameter No. 5040#3 (TCT) = 0), G43, G43.1, G43.4, G43.5, or G43.7 was commanded.
0367	3-D CONV. WAS COMMANDED IN SYNC MODE AS THE PARAMETER PKUx (NO.8162#2) IS 0.	A three-dimensional coordinate conversion was commanded during synchronization control when the parameter PKUx (No.8162#2) was 0.
0368	OFFSET REMAIN AT OFFSET COMMAND	1) When the ATC change tools method was selected (parameter TCT(No.5040#3)=1) during G43, G43.1, G43.4, or G43.5 mode, G43.7 was commanded. Or, G43, G43.1, G43.4, or G43.5 was commanded during G43.7 mode. 2) After the setting of parameter No. 5040#3 (TCT) was changed in a state in which tool offset remained, the tool offset command was specified.
0369	G31 FORMAT ERROR	1) No axis is specified or tow or more axes are specified in the torque limit switch instruction (G31P98/P99). 2) The specified torque Q value in the torque limit switch instruction is out of range. The torque Q range is 1 to 254. 3) The high-speed continuous skip option is not present.

Number	Message	Description
0370	G31P/G04Q ERROR	1) The specified address P value for G31 is out of range. The address P range is 1 to 4 in a multistage skip function. 2) The specified address Q value for G04 is out of range. The address Q range is 1 to 4 in a multistage skip function. 3) P1-4 for G31, or Q1-4 for G04 was commanded without a multistage skip function option.
0371	ILLEGAL FORMAT IN G10 OR L50	In a command format for a programmable parameter input, an attempt was made to change the parameter for an encryption (No. 3220), key (No. 3221), or protection range (No.3222 or No.3223) as a "the encryption function for the key and program." Modify the program.
0372	REFERENCE RETURN INCOMPLETE	An attempt was made to perform an automatic return to the reference position on the orthogonal axis before the completion of a return to the reference position on the angular axis. However, this attempt failed because a manual return to the reference position during angular axis control or an automatic return to the reference position after power-up was not commanded. First, return to the reference position on the angular axis, then return to the reference position on the orthogonal axis.
0373	ILLEGAL HIGH-SPEED SKIP SIGNAL SELECTED	In the skip commands (G31, G31P1 to G31P4) and dwell commands (G04, G04Q1 to G04Q4), the same high-speed signal is selected in different paths.
0374	ILLEGAL REGISTRATION OF TOOL MANAGER(G10)	G10L75 or G10L76 data was registered during the following data registration: • From the PMC window. • From the FOCAS2. • By G10L75 or G10L76 in another system. Command G10L75 or G10L76 again after the above operation is completed.
0375	CAN NOT ANGULAR CONTROL (SYNC:MIX:OVL)	Angular axis control is disabled for this axis configuration. 1) When some related axes under angular axis control are not in synchronous control mode or when one angular axis is not paired with the other angular axis or one Cartesian axis is not paired with the other Cartesian axis in synchronous control 2) When some related axes under composite control are not in composite control mode or when one angular axis is not paired with the other angular axis or one Cartesian axis is not paired with the other Cartesian axis in composite control 3) When related axes under angular axis control is switched to superposition control mode1)
0376	SERIAL DCL: ILLEGAL PARAMETER	1) When Parameter No.1815#1 is set to "1", parameter No.2002#3 is set to "0" 2) The absolute-position detection function is enabled. (Parameter No.1815#5 is set to "1".)
0387	ILLEGAL RTM DI/DO VAR	There is no DI/DO variable that has a specified signal address (alphabet, number).
0389	ILLEGAL RTM SIGNAL BIT	Bits other than bits 0 to 7 cannot be specified with a DI/DO signal.
0390	ILLEGAL MACRO VAR	A macro variable which was not supported by the real time custom macro function was used.
0391	RTM BRANCH OVER	The number of branches supported with real time custom macros was exceeded.

Number	Message	Description
0392	TOO MANY SENTENCE CONTROL	Many reserved words (ZONCE, ZEDGE, ZWHILE, ZDO, ZEND, G65, M99) for RTM control were used in a real time macro command.
0393	NO SENTENCE CONTROL	In a real time macro command, there is no data to be assigned.
0394	ILLEGAL SENTENCE CONTROL	The matching of reserved words (ZONCE, ZEDGE, ZWHILE, ZDO, ZEND, G65, M99) for RTM control is incorrect.
0395	ILLEGAL NC WORD CONTROL	Control code G65 or M99 for calling a subprogram or returning from a subprogram is not coded correctly.
0396	ILLEGAL RTM SENTENCE CONTROL	In other than a real time macro command, a reserved word (ZONCE, ZEDGE, ZWHILE, ZDO, or ZEND) for RTM control is used.
0397	RTM BUFFER OVER	There is no buffer available for real time macro commands. Too many blocks read in advance are buffered as triggers used by real time macro commands.
0398	ID OVER IN BUFFER	In blocks read in advance, there are too many real time macro commands with the same ID.
0399	ID EXECUTION IN SAME TIME	An attempt was made to execute real time macro commands with the same ID by using the same NC statement as a trigger.
0400	ONESHOT CMDOVER	Too many one-shot real time macro commands are specified.
0401	EXEC CMD NUM OVER IN SAME TIME	The number of real time macro commands that can be executed simultaneously was exceeded
0402	ILLEGAL TOKEN FOR RTM	A token, variable, or function that is not supported by the real time custom macro function was detected.
0403	ACCESS TO RTM PROTECT VAR	An attempt was made to access a protected variable.
0404	RTM ERROR	An error related to a real time macro command occurred.
0406	CODE AREA SHORTAGE	The storage size of the real time macro area is insufficient.
0407	DOULE SLASH IN RTM MODE	In the compile mode, an attempt was made to set the compile mode again.
0408	G90 IS NOT PERMITTED	The absolute command cannot be specified.
0409	ILLEGAL AXIS NO	An invalid axis number is specified.
0410	MIDDLE POINT IS NOT ZERO	An intermediate point other than 0 is specified with G28.
0411	SIMULTANEOUSLY AXES OVER	The maximum number of axes that can be controlled simultaneously was exceeded.
0412	ILLEGAL G CODE	An unusable G code was used.
0413	ILLEGAL ADDRESS	An unusable address was used.
0414	ILLEGAL PMC AXIS NO.	An invalid PMC axis number is specified.
0415	GROUP IS IN USE	The group to which the specified axis belongs is already in used.
0416	UNABLE TO USE THE AXIS	The specified axis cannot be used.
0417	AXIS IS UNABLE TO MOVE	The specified axis is placed in the inoperative state.
0418	ILLEGAL FEED SETTING	An incorrect feedrate is set.
0419	ILLEGAL DISTANCE SETTING	A travel distance beyond the specifiable range is specified.
0420	CONSTANT NUMBER P	A subprogram is specified not by using a constant.
0421	ILLEGAL ARGUMENT G54	With G65, an invalid argument, L, is used.
0422	ILLEGAL ARGUMENT G54	With G65, an invalid argument is used.
0423	NO PMC AXIS CONTROL OPTION	The option for PMC axis control is missing.
0424	MULTIPLE AXES IN ONE GROUP	Multiple axes are using one group.
0425	ONE AXIS USE MULTIPLE GROUPS	One axis is using multiple groups.
0429	ILLEGAL COMMAND IN G10.6	When retract was started in a threading block, a retract command had been issued for the long axis direction of threading.
0430	TOOL LIFE PAIRS ZERO	A value of 0 is specified in the tool life management pair quantity parameter No. 6813.
0431	ILLEGAL T/R DATA OF TOOL LIFE	Any group number (T) or the remaining life setting (R) is invalid.

Number	Message	Description
0432	UNAVAILABLE POSTURE IN TPC	A command specifying an impossible tool posture was issued in tool posture control. Review the machine configuration and command. In circular interpolation or helical interpolation under tool posture control, a command to reverse the tool posture with respect to the interpolation plane was specified. Review the machine configuration and command.
0436	ILLEGAL PARAMETER IN WSC	A parameter for workpiece installation error compensation is invalid. 1) Three basic axes are not specified in parameter No. 1022.
0437	ILLEGAL COMMAND IN WSC	An invalid command is specified for workpiece installation error compensation. 1) A G code that cannot be specified is specified in the workpiece installation error compensation mode. 2) When workpiece installation error compensation is started, the modal state is invalid. 3) G54.4 is not independently specified. 4) P is not specified in the G54.4 command block. Alternatively, a numeric value beyond the allowable range is specified following P. 5) Workpiece installation error compensation is specified more than once.
0438	ILLEGAL PARAMETER IN TOOL DIRC CMP	If, on a 5-axis machine, either of the two cases below applies, a parameter is illegal. 1) The setting is such that tool direction compensation is performed if workpiece setting error compensation is performed (parameter No. 11200#0 (RCM) = 1). 2) Tool center point retention type tool axis direction control (G53.6) is performed. • Acc./Dec. before interpolation is disabled. Set parameter No. 1660. • Acc./Dec. before rapid traverse interpolation is disabled. Set parameter No. 1401#1, parameter No. 1950#5, and parameter No. 1671. • A machine configuration parameter No. 19680 to No. 19714 is invalid. • The axis specified in parameter No. 19681 or No. 19686 is not a rotation axis. • Three basic axes are not specified in parameter No. 1022. • In tool length compensation during workpiece setting error compensation, parameter No. 5006#6 (TOS) is 0 and parameter No. 11400#2 (TOP) is 0. Set either parameter to 1.
0439	ILLEGAL COMMAND IN TOOL DIRC CMP	An invalid command is specified for workpiece installation error compensation with a 5-axis machine (when tool direction compensation is performed according to the setting parameter No. 11200#0 (RCM) to 1). • A G code that cannot be specified is specified. • The starting modal state is invalid. • An axis not concerned with 5-axis machining is specified. • The absolute coordinates of the rotation axis could not be obtained in the start block of workpiece installation error compensation or tool tip control.

Number	Message	Description
0441	DUPLICATE PATH TABLE	The same Path Table numbers exist. Example) <AXIS_TABLE_1234_X1> and <TIME_TABLE_1234_X1> exist. <AXIS_TABLE_0001_M> and <TIME_TABLE_0001_M> exist.
0442	PATH TABLE COMMAND EXCES ERR	1) At the start of the Path Table Operation, the difference between the actual axis position and the start command at the Path Table exceeds the parameter No.11101. 2) At the start of the Path Table Operation, the difference between the actual spindle speed and the start command of spindle speed at the Path Table exceeds the parameter No.11102.
0443	PTRDY SIGNAL IS OFF	Even though the Path Table Ready signal PTRDY <Fn519.6> is "0", the Path Table Operation is started. Retry Path Table Operation after Path Table conversion.
0444	ILLEGAL PATH TABLE M-CODE	M/P/Q code for starting the Path Table operation is not correct.
0445	ILLEGAL AXIS OPERATION	A positioning command is specified in the rotation control mode. Check the SV rotation control mode signal.
0446	ILLEGAL COMMAND IN G96.1/G96.2/G96.3/G96.4	G96.1, G96.2, G96.3, or G96.4 is specified in the same block as for other commands. Modify the program.
0447	ILLEGAL SETTING DATA	The rotation tool axis setting is invalid. Check the parameters for the spindle control function with the servo motor.
0451	ILLEGAL AUXILIARY FUNCTION TABLE COMMAND	When M code is output, the ladder of the PMC does not execute the completion processing of the previous M code.
0452	ILLEGAL PATH TABLE OPERATION	In Path Table Operation, the following problems occurred. - Skip command is not correct. - The connection of the Path Table is not correct. - Path Table Operation is not correct for other reason. etc.
0459	ALL PARALLEL AXES IN PARKING	All the axes specified during automatic operation are parking.
0460	ILLEGAL TORCH AXIS NUMBER	The axis number specified in parameter No. 5490 (torch control axis) exceeds the number of controlled axes.
0461	ILLEGAL SETTING OF ROTATE AXIS FOR TORCH	The parameter setting (parameter No. 1006#0 = 1) of the rotation axis is not applied to the torch turning axis.
0492	3DCHK FIG. ILLEGAL: [String1]	The figure data of [Target name] specified for built-in 3D interference check is invalid.
0493	3DCHK AXIS ILLEGAL: [String1]	The move axis data of [Target name] specified for built-in 3D interference check is invalid.
0494	3DCHK FUNCTION INVALID	Built-in 3D interference check function is disabled by parameter No. 10930#0 (ICE).
0495	3DCHK TOO MANY FIGURE	The total number of shapes included in all interference check targets except the tool exceeds 23.
0496	ILLEGAL P,Q COMMAND IN G22.2	As for G22.2 command, parameter P or Q is out of range or not specified. Please correct G22.2 command.
0497	CANNOT MAKE TOOL FIGURE BY TOOL MANAGEMENT	According to parameter No.10930#2 (ICT), though the tool figure should be automatically made by using the tool management function, the option for the tool management function is not available.
0501	THE COMMANDED M-CODE CAN NOT BE EXECUTED	The M code specified in parameter No. 11631 to 11646 was specified in other than an execution macro, macro interrupt, macro call using a G or M code, or subprogram call using a T, S, or second auxiliary function code.
0502	ILLEGAL G-CODE	1) A G code unavailable in the inter-path flexible synchronous mode was specified. 2) A G code unavailable in the advanced superimposition state was specified.

Number	Message	Description
0503	ILLEGAL MODAL IN SUPERIMPOSED MODE	Modal state of a G code that cannot be superimposed.
0507	ILLEGAL PARAMETER(NO.7526)	The address of the R signal for the high-speed cycle machining operation information output function is invalid. 1) The specified R signal address is invalid. 2) The start address is not a multiple of 4 (0, 4, 8, ...). 3) A 36-byte area is not allocated.
0508	G code to need G90(PAC)	In parallel axis control, a G code requiring an absolute command (G90) in the block immediately before was specified.
0511	CS HI-SPEED SWITCHING FORMAT ERROR	The format of Cs contour control high speed switching is invalid.
0512	IMPOSSIBLE COMMAND FOR CS HI-SPEED SWITCHING	The following commands cannot be specified in Cs contour control high speed switching: 1) Move command not for high-speed cycle machining 2) Synchronous/composite control, superimposed control 3) Spindle command synchronous control 4) Simple spindle electronic gear box 5) Manual reference position return
0513	CS HI-SPEED SWITCHING SETTING ERROR	The setting for Cs contour control high speed switching is invalid. Possible causes are: 1) An M code value for Cs contour control high speed switching is used for multiple Cs contour control axes. 2) FIN is returned for the M code for high-speed switching of Cs contour control when the Cs contour control high speed switching completion signal CSMCx does not become 1. 3) The spindle software does not support the spindle control switching function for high-speed cycle machining.
0514	ILLEGAL COMMAND IN FLEXIBLE PATH AXIS ASSIGNMENT	1) An assignment command in flexible path axis assignment was issued for an axis yet to be removed. 2) The P, Q, R, I, J, K, or L value specified by G52.1, G52.2, or G52.3 is invalid. 3) The value of the parameter No. 11560 is duplicated. 4) An attempt was made to execute a removal command (G52.1) for an axis already removed. 5) An attempt was made to exchange axes having different settings of bit 1 (FAN) of parameter No. 11562. 6) An attempt was made to perform flexible path axis assignment without canceling the offset.
0515	ILLEGAL FORMAT IN SMOOTH TCP(G43.4L1)	An illegal command was specified in Rotation axes compensation (G43.4L1). 1) An illegal command was specified in a Rotation axes control start block. 2) An invalid value was specified with address "L". 3) A value other than 0 and 1 was specified with address “L”. 4) G10.8 was specified at the same time.
0516	ILLEGAL PARAMETER IN SMOOTH TCP(G43.4L1)	A parameter related to in Rotation axes compensation (G43.4L1) is illegal.
0517	SETTING ERROR AMOUNT IS OUT OF RANGE	An attempt was made to start workpiece setting error compensation when a rotation direction setting error was outside the range set in the corresponding parameter No. 11753 to 11758.

Number	Message	Description
0520	ILLEGAL FORMAT IN G10.8L1	An illegal command was specified to change a tolerance of in Rotation axes compensation (G43.4L1). 1) A negative value was specified as a tolerance. - Specify positive values as addresses "α" and "β". 2) An invalid P value was specified. - Specify either 0 or 1 as address "P". 3) Address P is specified together with addresses "α" and "β". - Specify only either address "P" or "addresses "α" and "β". 4) An invalid address was specified. - In G10.8L1, only L, P, α, β, O, N, and M can be specified. 5) Another G code was specified at the same time. - Specify G10.8L1 alone. 6) G10.8 was specified in Rotation axes compensation mode (G43.4L1), but address "L" is not specified or the value of address "L" is not 1. - In Rotation axes compensation mode (G43.4L1), only G10.8L1 can be specified.
0521	ILLEGAL USAGE OF G10.8L1	Modal information used when specifying G10.8L1 contains an error. 1) The system is not in Rotation axes compensation mode. - G10.8L1 can be specified in Rotation axes compensation mode only. 2) The system is in Rotation axes compensation mode, but the command is not linear interpolation (G01). - G10.8L1 can be specified only during linear interpolation (G01).
0523	ILL. COMMAND IN HIGH-SPEED S-TCP	An illegal command was specified during Smooth control (G43.4P3). 1) An command G43.4 P3 was specified without option of High-speed Smooth TCP.
0527	ILLEGAL DATA IN PITCH ERROR	In the effective pitch error compensation points that is decided by considering the setting of the parameters, the difference between two consecutive data exceeds the range of -128 to +127. Please correct the pitch error compensation data or change the parameter.
0533	ILL. PARAM IN HIGH-SPEED S-TCP	A parameter related to Smooth control (G43.4P3) is illegal. 1) When setting the following, Smooth control (G43.4P3) was commanded. - the rotation axis is a hypothetical axis - PRM.IA1,IA2(19696#0,1) - the inclination angle (PRM.19683,19688) - the reference angle RA,RB (PRM.19698,19699)
0601	ILLEGAL AXIS COMMAND FOR SERVO MOTOR SPINDLE	The move command was executed to the servo axes for spindle use of the spindle control with servo motor. Modify the program.
1001	AXIS CONTROL MODE ILLEGAL	The axis control mode is invalid.
1013	ILLEGAL POS. OF PROGRAM NO.	Address O or N is specified in an unavailable position (such as a position following a macro statement).
1014	ILLEGAL FORMAT OF PROGRAM NO.	Address O or N is not followed by a number.
1016	EOB NOT FOUND	EOB (End of Block) code is missing at the end of a program input in the MDI mode.

Number	Message	Description
1059	COMMAND IN BUFFERING MODE	The manual intervention compensation request signal MIGET became "1" when an advanced block was found during automatic operation. To input the manual intervention compensation during automatic operation, a sequence for manipulating the manual intervention compensation request signal MIGET is required in an M code instruction without buffering.
1077	PROGRAM IN USE	An attempt was made in the foreground to execute a program being edited in the background. The currently edited program cannot be executed, so end editing and restart program execution.
1079	PROGRAM FILE NOT FOUND	The program of the specified file No. is not registered in an external device. (external device subprogram call)
1080	DUPLICATE DEVICE SUB PROGRAM CALL	Another external device subprogram call was made from a subprogram after the subprogram called by the external device subprogram call.
1081	EXT DEVICE SUB PROGRAM CALL MODE ERROR	The external device subprogram call is not possible in this mode.
1090	PROGRAM FORMAT ERROR	A lowercase alphabetic character is found in other than an NC program statement comment section, program name, or folder name.
1091	DUPLICATE SUB-CALL WORD	More than one subprogram call instruction was specified in the same block.
1092	DUPLICATE MACRO-CALL WORD	More than one macro call instruction was specified in the same block.
1093	DUPLICATE NC-WORD & M99	An address other than O, N, P or L was specified in the same block as M99 during the macro modal call state.
1095	TOO MANY TYPE-2 ARGUMENT	More than ten sets of I, J and K arguments were specified in the type–II arguments (A, B, C, I, J, K, I, J, K, ...) for custom macros.
1096	ILLEGAL VARIABLE NAME	An illegal variable name was specified. A code that cannot be specified as a variable name was specified. [#_OFSxx] does not match the tool offset memory option configuration.
1097	TOO LONG VARIABLE NAME	The specified variable name is too long.
1098	NO VARIABLE NAME	The specified variable name cannot be used as it is not registered.
1099	ILLLEGAL SUFFIX [ ]	A suffix was not specified to a variable name that required a suffix enclosed by [ ]. A suffix was specified to a variable name that did not require a suffix enclosed by [ ]. The value enclosed by the specified [ ] was out of range.
1100	CANCEL WITHOUT MODAL CALL	Call mode cancel (G67) was specified even though macro continuous–state call mode (G66) was not in effect.
1101	ILLEGAL CNC STATEMENT IRT.	An interrupt was made in a state where a custom macro interrupt containing a move instruction could not be executed.
1115	READ PROTECTED VARIABLE	An attempt was made in a custom macro to use on the right side of an expression a variable that can only be used on the left side of an expression.
1120	ILLEGAL ARGUMENT FORMAT	The specified argument in the argument function (ATAN, POW) is in error.
1124	MISSING DO STATEMENT	The DO instruction corresponding to the END instruction was missing in a custom macro.

Number	Message	Description
1125	ILLEGAL EXPRESSION FORMAT	The description of the expression in a custom macro statement contains an error. A parameter program format error. The screen displayed to enter periodic maintenance data or item selection menu (machine) data does not match the data type.
1128	SEQUENCE NUMBER OUT OF RANGE	The jump destination sequence No. in a custom macro statement GOTO instruction was out of range (valid range: 1 to 99999999).
1131	MISSING OPEN BRACKET	The number of left brackets " [" is less than the number of right brackets "] " in a custom macro statement.
1132	MISSING CLOSE BRACKET	The number of right brackets "] " is less than the number of left brackets " [" in a custom macro statement.
1133	MISSING '='	An equal sign (=) is missing in the arithmetic calculation instruction in a custom macro statement.
1134	MISSING ','	A delimiter "," is missing in a custom macro statement.
1137	IF STATEMENT FORMAT ERROR	The format used in the IF statement in a custom macro is in error.
1138	WHILE STATEMENT FORMAT ERROR	The format used in the WHILE statement in a custom macro is in error.
1139	SETVN STATEMENT FORMAT ERROR	The format used in the SETVN statement in a custom macro is in error.
1141	ILLEGAL CHARACTER IN VAR. NAME	The SETVN statement in a custom macro contacts a character that cannot be used in a variable name.
1142	TOO LONG V-NAME (SETVN)	The variable name used in a SETVN statement in a custom macro exceeds 8 characters.
1143	BPRNT/DPRNT STATEMENT FORMAT ERROR	The format used in the BPRINT statement or DPRINT statement is in error.
1144	G10 FORMAT ERROR	The G10 L No. contains no relevant data input or corresponding option. Data setting address P or R is not specified. An address not relating to the data setting is specified. Which address to specify varies according to the L No. The sign, decimal point or range of the specified address are in error.
1145	G10.1 TIME OUT	The response to a G10.1 instruction was not received from the PMC within the specified time limit.
1146	G10.1 FORMAT ERROR	The G10.1 instruction format is in error.
1152	G31.9/G31.8 FORMAT ERROR	The format of the G31.9 or G31.8 block is erroneous in the following cases: 1) The axis was not specified in the G31.9 or G31.8 block. 2) Multiple axes were specified in the G31.9 or G31.8 block. 3) The P code was specified in the G31.9 or G31.8 block.
1153	CANNOT USE G31.9	G31.9 cannot be specified in this modal state. This alarm is also generated when G31.9 is specified when a group 07 G code (e.g. cutter compensation) is not canceled.
1160	COMMAND DATA OVERFLOW	An overflow occurred in the position data within the CNC. This alarm is also generated if the target position of a command exceeds the maximum stroke as a result of calculation such as coordinate conversion, offset, or introduction of a manual intervention amount.
1180	ALL PARALLEL AXES IN PARKING	All of the axis specified for automatic operation are parked.

Number	Message	Description
1196	ILLEGAL DRILLING AXIS SELECTED	An illegal axis was specified for drilling in a canned cycle for drilling. If the zero point of the drilling axis is not specified or parallel axes are specified in a block containing a G code in a canned cycle, simultaneously specify the parallel axes for the drilling axis.
1200	PULSCODER INVALID ZERO RETURN	The grid position could not be calculated during grid reference position return using the grid system as the one–revolution signal was not received before leaving the deceleration dog. This alarm is also generated when the tool does not reach a feedrate that exceeds the servo error amount preset to parameter No. 1841 before the deceleration limit switch is left (deceleration signal *DEC returns to "1").
1202	NO F COMMAND AT G93	F codes in the inverse time specification mode (G93) are not handled as modal, and must be specified in individual blocks.
1223	ILLEGAL SPINDLE SELECT	1) An attempt was made to execute an instruction that uses the spindle although the spindle to be controlled has not been set correctly. 2) Interpolation type rigid tapping was specified in a path in which the Cs contour control function is not enabled.
1282	ILLEGAL COMMAND IN 3-D OFFSET	An illegal G code was specified in the three–dimensional tool offset mode.
1283	ILLEGAL IJK IN 3-D OFFSET	When bit 0 (ONI) of parameter No. 6029 is set to 1, I, J, and K commands are specified without the decimal point in three–dimensional tool compensation mode.
1298	ILLEGAL INCH/METRIC CONVERSION	An error occurred during inch/metric switching.
1300	ILLEGAL ADDRESS	The axis No. address was specified even though the parameter is not an axis–type while loading parameters or pitch error compensation data from a tape or by entry of the G10 parameter. Axis No. cannot be specified in pitch error compensation data.
1301	MISSING ADDRESS	The axis No. was not specified even though the parameter is an axis–type while loading parameters or pitch error compensation data from a tape or by entry of the G10 parameter. Or, data No. address N, or setting data address P or R are not specified.
1302	ILLEGAL DATA NUMBER	A non–existent data No. was found while loading parameters or pitch error compensation data from a tape or by entry of the G10 parameter. An invalid address R value is specified in a pattern program for each machining purpose on the high–speed high–precision setting screen. This alarm is also generated when illegal word values are found.
1303	ILLEGAL AXIS NUMBER	An axis No. address exceeding the maximum number of controlled axes was found while loading parameters from a tape or by entry of the G10 parameter.
1304	TOO MANY DIGIT	Data with too many digits was found while loading parameters or pitch error compensation data from a tape.
1305	DATA OUT OF RANGE	Out–of–range data was found while loading parameters or pitch error compensation data from a tape. The values of the data setting addresses corresponding to L Nos. during data input by G10 was out of range. This alarm is also generated when NC programming words contain out–of–range values.

Number	Message	Description
1306	MISSING AXIS NUMBER	A parameter which requires an axis to be specified was found without an axis No. (address A) while loading parameters from a tape.
1307	ILLEGAL USE OF MINUS SIGN	Data with an illegal sign was found while loading parameters or pitch error compensation data from a tape, or by entry of the G10 parameter. A sign was specified to an address that does not support the use of signs.
1308	MISSING DATA	An address not followed by a numeric value was found while loading parameters or pitch error compensation data from a tape.
1329	ILLEGAL MACHINE GROUP NUMBER	A machine group No. address exceeding the maximum number of controlled machine groups was found while loading parameters from a tape or by entry of the G10 parameter.
1330	ILLEGAL SPINDLE NUMBER	A spindle No. address exceeding the maximum number of controlled spindles was found while loading parameters from a tape or by entry of the G10 parameter.
1331	ILLEGAL PATH NUMBER	A path No. address exceeding the maximum number of controlled path was found while loading parameters from a tape or by entry of the G10 parameter.
1332	DATA WRITE LOCK ERROR	Could not load data while loading parameters, pitch error compensation data and work coordinate data from tape.
1333	DATA WRITE ERROR	Could not write data while loading data from tape.
1360	PARAMETER OUT OF RANGE (TLAC)	Illegal parameter setting (Set value is out of range).
1361	PARAMTER SETTING ERROR 1 (TLAC)	Illegal parameter setting (axis of rotation setting).
1362	PARAMETER SETTING ERROR 2 (TLAC)	Illegal parameter setting (tool axis setting).
1370	PARAMETER SETTING ERROR (DM3H-1)	Out–of–range data was set during setting of the three–dimensional handle feed parameter.
1371	PARAMETER SETTING ERROR (DM3H-2)	An illegal axis of rotation was set during setting of the three–dimensional handle feed parameter.
1372	PARAMETAR SETTING ERROR (DM3H-3)	An illegal master axis was set during setting of the three–dimensional handle feed parameter.
1373	PARAMETER SETTING ERROR (DM3H-4)	An illegal parallel axis or twin table was set during setting of the three–dimensional handle feed parameter.
1470	G40.1 –G42.1 PARAMETER MISS	A parameter setting related to normal direction control is illegal. The axis number of a normal direction controlled axis is set in parameter No. 5480, but that axis number is in the range of the number of controlled axes. The axis set as a normal direction controlled axis is not set as a rotation axis (parameter No. 1006#0 (ROTx)) = 1 and No.1022=0).
1471	ILLEGAL COMMAND IN G40.1 –G42.1	A G code that cannot be specified is specified in the normal direction control mode.
1508	DUPLICATE M-CODE (INDEX TABLE REVERSING)	A function to which the same code as this M code is set exists. (index table indexing)
1509	DUPLICATE M-CODE (SPOS AXIS ORIENTATION)	A function to which the same code as this M code is set exists. (spindle positioning, orientation)
1510	DUPLICATE M-CODE (SPOS AXIS POSITIONING)	A function to which the same code as this M code is set exists. (spindle positioning, positioning)
1511	DUPLICATE M-CODE (SPOS AXIS RELEASE)	A function to which the same code as this M code is set exists. (spindle positioning, mode cancel)
1531	ILLEGAL USE OF DECIMAL POINT (F-CODE)	When the feedrate instruction contains valid data below the decimal point, the alarm is set and the F code contains valid data below the decimal point.

Number	Message	Description
1532	ILLEGAL USE OF DECIMAL POINT (E-CODE)	When the feedrate instruction contains valid data below the decimal point, the alarm is set and the E code contains valid data below the decimal point.
1533	ADDRESS F UNDERFLOW (G95)	The feedrate for the hole drilling axis calculated from the F and S codes is too slow in the feed per single rotation mode (G95).
1534	ADDRESS F OVERFLOW (G95)	The feedrate for the hole drilling axis calculated from the F and S codes is too fast in the feed per single rotation mode (G95).
1535	ADDRESS E UNDERFLOW (G95)	The feedrate for the hole drilling axis calculated from the E and S codes is too slow in the feed per single rotation mode (G95).
1536	ADDRESS E OVERFLOW (G95)	The feedrate for the hole drilling axis calculated from the E and S codes is too fast in the feed per single rotation mode (G95).
1537	ADDRESS F UNDERFLOW (OVERRIDE)	The speed obtained by applying override to the F instruction is too slow.
1538	ADDRESS F OVERFLOW (OVERRIDE)	The speed obtained by applying override to the F instruction is too fast.
1539	ADDRESS E UNDERFLOW (OVERRIDE)	The speed obtained by applying override to the E instruction is too slow.
1540	ADDRESS E OVERFLOW (OVERRIDE)	The speed obtained by applying override to the E instruction is too fast.
1541	S-CODE ZERO	"0" has been instructed as the S code.
1542	FEED ZERO (E-CODE)	"0" has been instructed as the feedrate (E code).
1543	ILLEGAL GEAR SETTING	The gear ratio between the spindle and position coder, or the set position coder number of pulses is illegal in the spindle positioning function.
1544	S-CODE OVER MAX	The S command exceeds the maximum spindle rotation number.
1548	ILLGAL AXIS MODE	The spindle positioning axis/Cs contour control axis was specified during switching of the controlled axis mode.
1561	ILLEGAL INDEXING ANGLE	The specified angle of rotation is not an integer multiple of the minimum indexing angle.
1564	INDEX TABLE AXIS - OTHER AXIS SAME TIME	The index table indexing axis and another axis have been specified in the same block.
1567	INDEX TABLE AXIS DUPLICATE AXIS COMMAND	Index table indexing was specified during axis movement or on an axis for which the index table indexing sequence was not completed.
1580	ENCODE ALARM (PSWD&KEY)	When an attempt was made to read a program, the specified password did not match the password on the tape and the password on tape was not equal to 0. When an attempt was made to punch an encrypted tape, the password was not in the range 0 to 99999999. The password parameter is No. 3220.
1581	ENCODE ALARM (PARAMETER)	When an attempt was made to output an encrypted tape, the output code parameter was set to EIA. Set parameter No. 0000#1 (ISO) to “0”. An incorrect instruction was specified for program encryption or protection. This alarm is generated if an attempt is made to perform program editing, deletion, or range-specified output in the protected range in the lock state. Or, a program outside the protected range is specified in rage specification output in the unlock state. The protected range is defined from the program No. preset by parameter No. 3222 up to the program No. preset to parameter No. 3223. When both parameters are set to “0”, the protected range becomes O9000 to O9999.

Number	Message	Description
1590	TH ERROR	A TH error was detected during reading from an input device. The read code that caused the TH error and how many statements it is from the block can be verified in the diagnostics screen.
1591	TV ERROR	An error was detected during the single–block TV error. The TV check can be suppressed by setting TVC parameter No. 0000#0 to "0".
1592	END OF RECORD	The EOR (End of Record) code is specified in the middle of a block. This alarm is also generated when the percentage at the end of the NC program is read. For the program restart function, this alarm is generated if a specified block is not found.
1593	EGB PARAMETER SETTING ERROR	Error in setting a parameter related to the EGB 1) The setting of parameter No. 2011#0 (SYN), is not correct. 2) The slave axis specified with G81 is not set as a rotation axis. (parameter No. 1006#0 (ROT)) 3) Number of pulses per rotation (Parameter No. 7772, No. 7773 or parameter No. 7782, 7783) is not set. 4) For a hobbing-machine-compatible command, parameter No. 7710 is not specified. 5) The slave axis specified with G81 for the spindle EGB is set as the slave axis for the simple spindle EGB. 6) No signal-based EGB synchronization ratio (parameters Nos. 7784 and 7785) has been set.
1594	EGB FORMAT ERROR	Error in the format of the block of an EGB command 1) T (number of teeth) is not specified in the G81 block. 2) In the G81 block, the data specified for one of T, L, P, and Q is out of its valid range. 3) n the G81 block, only one of P and Q is specified. 4) In the G81.5 block, there is no command for the master or slave axis. 5) In the G81.5 block, data out of the specified range is specified for the master or slave axis.
1595	ILL-COMMAND IN EGB MODE	During synchronization with the EGB, a command that must not be issued is issued. 1) Slave axis command using G27, G28, G29, G30,G30.1, G33, G53, etc. 2) Inch/metric conversion command using G20, G21, etc. 3) Synchronization start command using G81 or G81.5 when parameter No. 7731#3 (ECN) is 0 4) For the slave axis of the spindle EGB, the Cs contour control mode is not selected.
1596	EGB OVERFLOW	An overflow occurred in the calculation of the synchronization coefficient.
1597	EGB AUTO PHASE FORMAT ERROR	Format error in the G80 or G81 block in EGB automatic phase synchronization 1) R is outside the permissible range. 2) In the spindle EGB, reference position return is not performed for the master axis before G81R2 is specified.
1598	EGB AUTO PHASE PARAMETER SETTING ERROR	Error in the setting of a parameter related to EGB automatic phase synchronization 1) The acceleration/deceleration parameter is not correct. 2) The automatic phase synchronization parameter is not correct.

Number	Message	Description
1805	ILLEGAL COMMAND	[I/O Device] An attempt was made to specify an illegal command during I/O processing on an I/O device. [G30 Zero Return] The P address Nos. for instructing No. 2 to No. 4 zero return are each out of the range 2 to 4. [Single Rotation Dwell] The specified spindle rotation is "0" when single rotation dwell is specified. [Three–dimensional Tool Offset] A G code that cannot be specified was specified in the three–dimensional tool offset mode. Scaling instruction G51, skip cutting G31 and automatic tool length measurement G37 were specified.
1806	DEVICE TYPE MISS MATCH	An operation not possible on the I/O device that is currently selected in the setting was specified. This alarm is also generated when file rewind is instructed even though the I/O device is not a FANUC Cassette.
1807	PARAMETER SETTING ERROR	An I/O interface option that has not yet been added on was specified. The external I/O device and baud rate, stop bit and protocol selection settings are erroneous.
1808	DEVICE DOUBLE OPENED	An attempt was made to open a device that is being accessed.
1809	ILLEGAL COMMAND IN G41/G42	Specified direction tool length compensation parameters are incorrect. A move instruction for an axis of rotation was specified in the specified direction tool length compensation mode.
1820	ILLEGAL DI SIGNAL STATE	1) When movement along all axes in the path containing an axis to be preset with the joint workpiece coordinate system preset signal was not stopped or the signal was being specified, the signal was turned on. 2) When the M code for performing preset with the joint workpiece coordinate system preset signal was specified, the signal was not turned on. 3) The miscellaneous function lock function is enabled. 4) When parameter No. 3001#6 (PGS) was 0 (when the M, S, T, and B codes are not output in the high-speed program check mode), the M code for turning the joint workpiece coordinate system preset signal on was specified in the high-speed program check mode.
1823	FRAMING ERROR(1)	The stop bit of the character received from the I/O device connected to RS232C interface 1 was not detected.
1830	DR OFF(2)	The data set ready input signal DR of the I/O device connected to RS232C interface 2 turned OFF.
1832	OVERRUN ERROR(2)	The next character was received from the I/O device connected to RS232C interface 2 before it could read a previously received character.
1833	FRAMING ERROR(2)	The stop bit of the character received from the I/O device connected to RS232C interface 2 was not detected.
1834	BUFFER OVERFLOW(2)	The NC received more than 10 characters of data from the I/O device connected to RS232C interface 2 even though the NC sent a stop code (DC3) during data reception.
1889	ILLEGAL COMMAND IN G54.3	An illegal command was issued in G54.3 block. 1) An attempt was made to command G54.3 in a mode in which it cannot be accepted. 2) The command was not issued in a single block.

Number	Message	Description
1892	ILLEGAL PARAMETER IN G43.3	A parameter related to nutating rotary head tool length compensation is incorrect.
1893	ILLEGAL PARAMETER IN G44.9	A parameter related to spindle unit compensation is incorrect.
1898	ILLEGAL PARAMETER IN G54.2	An illegal parameter (Nos. 7580 to 7588) was specified for fixture offset.
1912	V-DEVICE DRIVER ERROR (OPEN)	An error occurred during device driver control.
1919	FATAL ERROR(USB MEMORY)	A fatal error occurred in the USB file system. To restore the file system, turn the power off.
1924	UNEXPECTED ERROR(USB MEMORY)	An unexpected error occurred in the USB file system.
1925	ILLEGAL PATH/FILE(USB MEMORY)	An invalid path or file name was specified.
1926	ACCESS DENIED(USB MEMORY)	The USB memory could not be accessed.
1927	DEVICE IN FORMATTING(USB MEMORY)	The USB memory is being formatted.
1928	DEVICE NOT FOUND(USB MEMORY)	No USB memory is inserted. Check the connection.
1932	DEVICE IS FULL(USB MEMORY)	The capacity of the USB memory is insufficient.
1937	RECOGNITION ERROR(USB MEMORY)	The format of the USB memory is invalid. Format the USB memory in FAT or FAT32 format. If the alarm is still issued, replace the USB memory.
1938	END OF FILE FOUND(USB MEMORY)	The end of file was detected before EOR(%) was read. The file may be damaged.
1939	UNDEFINED ERROR(USB MEMORY)	An undefined error occurred.
1951	DEVICE IS BUSY(USB MEMORY)	The USB memory is busy.
1952	TOO MANY FILES(USB MEMORY)	The maximum number of files that can be opened concurrently is exceeded.
1953	REMOVED IN ACCESSING(USB MEMORY)	The USB memory was removed while being accessed.
1954	PATH/FILE EXIST(USB MEMORY)	The specified path or file already exists.
1955	PATH/FILE NOT FOUND(USB MEMORY)	The specified path or file is not found.
1956	DEVICE OVERCURRENT(USB MEMORY)	Overcurrent was detected in the USB memory. Replace the USB memory.
1957	PARITY ERROR(USB MEMORY)	A parity error occurred in the USB memory. Turn the power to the CNC off.
1960	ACCESS ERROR (MEMORY CARD)	Illegal memory card accessing This alarm is also generated during reading when reading is executed up to the end of the file without detection of the EOR code.
1961	NOT READY (MEMORY CARD)	The memory card is not ready.
1962	CARD FULL (MEMORY CARD)	The memory card has run out of space.
1963	CARD PROTECTED (MEMORY CARD)	The memory card is write–protected.
1964	NOT MOUNTED (MEMORY CARD)	The memory card could not be mounted.
1965	DIRECTORY FULL (MEMORY CARD)	The file could not be generated in the root directory for the memory card.
1966	FILE NOT FOUND (MEMORY CARD)	The specified file could not be found on the memory card.
1967	FILE PROTECTED (MEMORY CARD)	The memory card is write–protected.
1968	ILLEGAL FILE NAME (MEMORY CARD)	Illegal memory card file name
1969	ILLEGAL FORMAT (MEMORY CARD)	Check the file name.
1970	ILLEGAL CARD (MEMORY CARD)	This memory card cannot be handled.
1971	ERASE ERROR (MEMORY CARD)	An error occurred during memory card erase.
1972	BATTERY LOW (MEMORY CARD)	The memory card battery is low.

Number	Message	Description
1973	FILE ALREADY EXIST	A file having the same name already exists on the memory card.
1990	SPL:ILLEGAL AXIS COMMAND	The axis specified by the smooth interpolation (G5.1Q2) is illegal.
1993	SPL:CAN'T MAKE VECTOR	The end point and the 2 previous points are the same in generation of the 3–dimensional tool offset vector by the end point for smooth interpolation.
1995	ILLEGAL PARAMETER IN G41.2/G42.2	The parameter settings (parameter Nos. 6080 to 6089) for determining the relationship between the axis of rotation and the rotation plane are incorrect.
1999	ILLEGAL PARAMETER IN G41.3	The parameter settings (parameter Nos. 6080 to 6089) for determining the relationship between the axis of rotation and the rotation plane are incorrect.
2002	NO KNOT COMMAND (NURBS)	Knot has not been specified, or a block not related to NURBS interpolation was specified in the NURBS interpolation mode.
2003	ILLEGAL AXIS COMMAND (NURBS)	An axis not specified as a control point was specified in the No. 1 block.
2004	ILLEGAL KNOT	There is an insufficient number of knot individual blocks.
2005	ILLEGAL CANCEL (NURBS)	The NURBS interpolation mode was turned OFF even though NURBS interpolation was not completed.
2006	ILLEGAL MODE (NURBS)	A mode that cannot be paired with the NURBS interpolation mode was specified.
2007	ILLEGAL MULTI-KNOT	Nested knots for each level can be specified for the start and end points.
2032	EMBEDDED ETHERNET/DATA SERVER ERROR	The embedded Ethernet or data server function returned an error. For details, check the error message screen of the embedded Ethernet or data server.
2038	WRONG COMMUNICATION COMBINATION	The combination of the hardware and the software about communication function is wrong. The detail information is indicated to diagnosis information 4400 and 4401.
2051	#200-#499ILLEGAL P-CODE MACRO COMMON INPUT (NO OPTION)	An attempt was made to enter a custom macro common variable not existing in the system.
2052	#500-#549P-CODE MACRO COMMON SELECT (CANNOT USE SETVN)	The variable name cannot be entered. The SETVN command cannot be used with the P-CODE macro common variables #500 to #549.
2053	THE NUMBER OF #30000 IS UNMATCH	An attempt was made to enter a P-CODE-only variable not existing in the system.
2054	THE NUMBER OF #40000 IS UNMATCH	An attempt was made to enter an extended P-CODE-only variable not existing in the system.
2060	ILLEGAL PARAMETER IN G43.4/G43.5	The parameter for the pivot tool length compensation is incorrect.

Number	Message	Description
2061	ILLEGAL COMMAND IN G43.4/G43.5	An illegal command was specified in tool center point control. 1) A rotation axis command was specified in tool center point control (type 2) mode. 2) With a table rotary type or mixed-type machine, a I, J, or K command was specified in the tool center point control (type 2) command (G43.5) block. 3) A command that does not move the tool center point (only a rotation axis is moved) was specified for the workpiece in the G02 mode. 4) G43.4 or G43.5 was specified in the tool center point control mode. 5) When the workpiece coordinate system is set as the programming coordinate system (parameter No. 19696#5 (WKP) is 1), G02 or G03 was specified while the rotation axis was not perpendicular to the plane.
2070	G02.1/ G03.1 FORMAT ERROR	1) The format is invalid. 2) The specified arc exceeds the interpolation enable range.
4010	ILLEGAL REAL VALUE OF OBUF :	The real value for an output buffer is in error.
5006	TOO MANY WORD IN ONE BLOCK	The number of words in a block exceeds the maximum. The maximum is 26 words. However, this figure varies according to NC options. Divide the instruction word into two blocks.
5007	TOO LARGE DISTANCE	Due to compensation, point of intersection calculation, interpolation or similar reasons, a movement distance that exceeds the maximum permissible distance was specified. Check the programmed coordinates or compensation amounts.
5009	PARAMETER ZERO (DRY RUN)	The dry run feedrate parameter No. 1410 or maximum cutting feedrate parameter No. 1422 for each axis has been set to 0. The parameter for the maximum cutting feedrate for each axis is No. 1432 if acceleration/deceleration before interpolation is enabled and No. 1430 otherwise. Functions that cause acceleration/deceleration before interpolation include AI contour control, tool center point control, and workpiece setting error compensation.
5010	END OF RECORD	The EOR (End of Record) code is specified in the middle of a block. This alarm is also generated when the percentage at the end of the NC program is read.
5011	PARAMETER ZERO (CUT MAX)	The maximum cutting feedrate parameter No. 1430 has been set to 0. The parameter is No. 1432 if acceleration/deceleration before interpolation is enabled and No. 1430 otherwise. Functions that cause acceleration/deceleration before interpolation include AI contour control, tool center point control, and workpiece setting error compensation.
5014	TRACE DATA NOT FOUND	A transfer could not be made because of no trace data.
5015	NO ROTATION AXIS	No rotation axis was found in a handle feed in the tool axis direction or in the tool axis right angle direction.
5016	ILLEGAL COMBINATION OF M CODES	M codes which belonged to the same group were specified in a block. Alternatively, an M code which must be specified without other M codes in the block was specified in a block with other M codes.
5018	POLYGON SPINDLE SPEED ERROR	In G51.2 mode, the speed of the spindle or polygon synchronous axis either exceeds the clamp value or is too small. The specified rotation speed ratio thus cannot be maintained. For polygon turning between spindles: More information as to why this alarm occurred is indicated in DGN No. 0471.

Number	Message	Description
5020	PARAMETER OF RESTART ERROR	The setting of parameter No. 7310 for specifying the order of the axes on which to move to the machining restart position in a dry run is invalid. The valid range is from 1 to the number of controlled axes.
5043	TOO MANY G68 NESTING	Three-dimensional coordinate conversion has been specified three or more times. To perform another coordinate conversion, perform cancellation, then specify the coordinate conversion.
5044	G68 FORMAT ERROR	Errors for three-dimensional coordinate conversion command are: 1) No I, J, or K command was issued in three-dimensional coordinate conversion command block. (without coordinate rotation option) 2) All of I, J, or K command were 0 in three-dimensional coordinate conversion command block. 3) No rotation angle R was not commanded in three-dimensional coordinate conversion command block.
5046	ILLEGAL PARAMETER (S-COMP)	The setting of a parameter related to straightness compensation contains an error. Possible causes include: 1) A non-existent axis number is set in a moving or compensation axis parameter. 2) More than 128 pitch error compensation points are set between the furthest points in the negative and position regions. 3) The straightness compensation point numbers do not have correct magnitude relationships. 4) No straightness compensation point is found between the furthest pitch error compensation point in the negative region and that in the positive region. 5) The compensation per compensation point is either too large or too small.
5050	ILL-COMMAND IN G81.1 MODE	During chopping, a move command has been issued for the chopping axis.
5058	G35/G36 FORMAT ERROR	A command for switching the major axis has been specified for circular threading. Alternatively, a command for setting the length of the major axis to 0 has been specified for circular threading.
5060	ILLEGAL PARAMETER IN G02.3/G03.3	The axis parameter setting to perform an exponential interpolation is in error. Parameter No. 5641: A liner axis number for performing an exponential interpolation Parameter No. 5642: A rotation axis number for performing an exponential interpolation The settable value is 1 to the number of control axes, but it must not be duplicated.
5061	ILLEGAL FORMAT IN G02.3/G03.3	The exponential interpolation command (G02.3/G03.3) has a format error. The command range for address I or J is -89.0 to -1.0 or +1.0 to +89.0. No I or J is specified or out-of -range value is specified. No address R, or 0 is specified.
5062	ILLEGAL COMMAND IN G02.3/G03.3	The value specified in an exponential interpolation command (G02.3/03.3) is illegal. A value that does not allow exponential interpolation is specified. (For example, the value for In is 0 or negative.)

Number	Message	Description
5064	DIFFERRENT AXIS UNIT	Circular interpolation has been specified on a plane consisting of axes having different increment systems.
5065	DIFFERRENT AXIS UNIT(PMC AXIS)	Axes having different increment systems have been specified in the same DI/DO group for PMC axis control. Modify the setting of parameter No. 8010.
5066	RESTART ILLEGAL SEQUENCE NUMBER	A sequence number from 7000 to 7999 was read during the search for the next number in a restart program for the back or restart function.
5068	FORMAT ERROR IN G31P90	No travel axis was specified. Two or more travel axes were specified.
5073	NO DECIMAL POINT	No decimal point has been specified for an address requiring a decimal point.
5074	ADDRESS DUPLICATION ERROR	The same address has been specified two or more times in a single block. Alternatively, two or more G codes in the same group have been specified in a single block.
5085	SMOOTH IPL ERROR 1	A block for specifying smooth interpolation contains a syntax error.
5110	IMPROPER G-CODE (AICC MODE)	A G code that cannot be specified is specified in the AI contour control mode.
5115	ILLEGAL ORDER (NURBS)	There is an error in the specification of the rank.
5116	ILLEGAL KNOT VALUE (NURBS)	Monotone increasing of knots is not observed.
5117	ILLEGAL 1ST CONTROL POINT (NURBS)	The first control point is incorrect. Or, it does not provide continuity from the previous block.
5118	ILLEGAL RESTART (NURBS)	After manual intervention with manual absolute mode set to on, NURBS interpolation was restarted.
5122	ILLEGAL COMMAND IN SPIRAL	A spiral interpolation or conical interpolation command has an error. Specifically, this error is caused by one of the following: 1) L = 0 is specified. 2) Q = 0 is specified. 3) R/, R/, C is specified. 4) Zero is specified as height increment. 5) Zero is specified as height difference. 6) Three or more axes are specified as the height axes. 7) A height increment is specified when there are two height axes. 8) Q is specified when radius difference = 0. 9) Q < 0 is specified when radius difference > 0. 10) Q > 0 is specified when radius difference < 0. 11) A height increment is specified when no height axis is specified.
5123	OVER TOLERANCE OF END POINT IN SPIRAL	The difference between a specified end point and the calculated end point exceeds the allowable range (parameter 3471).
5124	CAN NOT COMMAND SPIRAL	A spiral interpolation or conical interpolation was specified in any of the following modes: 1) Scaling 2) Polar coordinate interpolation 3) In tool radius·tool nose radius compensation mode, the center is set as the end point.
5130	NC AND SUPERIMPOSE AXIS CONFLICT	In the PMC superposition axis control, the NC command and The PMC axis control command were conflicted. Modify the program and the ladder.
5131	NC COMMAND IS NOT COMPATIBLE	The PMC axis control and three-dimensional coordinate conversion or a polar coordinate interpolation were specified simultaneously.

Number	Message	Description
5132	CANNOT CHANGE SUPERIMPOSED AXIS	The superposition axis was selected for the axis for which the PMC superposition axis is being controlled.
5155	NOT RESTART PROGRAM BY G05	When learning control/preview repetitive control was enabled, an attempt was made to use feed hold or interlock to stop high-speed cycle machining/high-speed binary operation. Neither feed hold nor interlock can be used in such a case.
5195	DIRECTION CAN NOT BE JUDGED	Measurement is invalid in the tool compensation measurement value direct input B function. [For 1-contact input] 1) The recorded pulse direction is not constant. - The machine is at a stop in the offset write mode. - The servo power is off. - Pulse directions are diverse. 2) The tool is moving along the two axes (X-axis and Y-axis). [For the movement direction discrimination specification] 1) The recorded pulse direction is not constant. - The machine is at a stop in the offset write mode. - The servo power is off. - Pulse directions are diverse. 2) The tool is moving along the two axes (X-axis and Z-axis). 3) The direction indicated by the tool compensation write signal does not match the movement direction of the axis.
5196	ILLEGAL AXIS OPERATION	During HPCC or during the execution of a 5-axis-related function, an unavailable function was used.
5199	ILLEGAL FINE TORQUE SENSING PARAMETER	The setting of a fine torque sensing parameter is invalid. - An invalid controlled axis number is set as the target axis.
5219	CAN NOT RETURN	Manual intervention and return cannot be performed during execution of 3-dimensional coordinate system conversion, tilted working plane command, tool center point control, or work setting error compensation.
5220	REFERENCE POINT ADJUSTMENT MODE	In case of distance coded linear scale I/F, the reference point auto setting parameter (No.1819#2) is set to "1". Move the machine to reference position by manual operation and execute manual reference return.
5242	ILLEGAL AXIS NUMBER	A master axis number or a slave axis number was not set correctly when the flexible synchronization control mode was turned from off to on during automatic operation. In inter-path flexible synchronous control, this alarm is issued in either of the following cases. (The alarm is issued at the start of inter-path flexible synchronous control.) 1) The axis number of the master or slave axis is incorrect. 2) The master and slave axis settings make a loop.
5243	DATA OUTRANGE	When the flexible synchronous control mode was turned on during automatic operation, the gear ratio was not set correctly.

Number	Message	Description
5244	TOO MANY DI ON	1) When an attempt was made to change the flexible synchronous control status, the select signal was not turned on or off after the execution of the M code. 2) An attempt was made to turn flexible synchronous control on or off without stopping the tool along all axes. (Except when automatic phase synchronization for flexible synchronous control is used) 3) Flexible synchronous control was turned off in any of the following function modes: • Tool tip control • Tilted working plane command • 3-dimensional cutter compensation • workpiece installation error compensation
5245	OTHER AXIS ARE COMMANDED	1) The synchronous mode was turned on for a flexible synchronous control group in which a PMC axis was specified as the master axis not during automatic operation. 2) When a non-PMC axis was specified as the master axis of a flexible synchronous control group, an attempt was made to turn the synchronous mode on for a synchronous control group in which a PMC axis was specified as the master axis. 3) The master and slave axes as synchronous axes overlap the EGB dummy axis. 4) Master and slave synchronous axes overlap with a chopping axis. 5) Master and slave synchronous axes overlap with a related axis under angular axis control. 6) Master and slave synchronous axes overlap with a related axis under composite control. 7) Master and slave synchronous axes overlap with a related axis under superposition control. 8) A slave synchronous axis overlaps with a related axis under synchronous control. 9) The reference position return mode was turned on (or was on).
5255	G12.4/G13.4 FORMAT ERROR	The specified P, I, and K are incorrect or I is less than K.
5256	G12.4/G13.4 EXECUTION ERROR	1) In continuous circle motion-based groove cutting mode, a command other than G01, G02, G03, G04, G90, G91, and auxiliary functions is specified. 2) In a mode that cannot be used, the continuous circle motion-based groove cutting command is specified.
5257	G41/G42 NOT ALLOWED IN MDI MODE	Cutter compensation or tool nose radius compensation was specified in MDI mode. (Depending on the setting of the parameter MCR (No. 5008#4))
5303	TOUCH PANEL ERROR	The touch panel is not connected correctly, or the touch panel cannot be initialized when the power is turned on. Correct the cause then turn on the power again.

Number	Message	Description
5305	ILLEGAL SPINDLE NUMBER	In a spindle select function by address P for a multiple spindle control, 1) Address P is not specified. 2) Parameter No.3781 is not specified to the spindle to be selected. 3) An illegal G code which cannot be commanded with an S_P_; command is specified. 4) A multi spindle cannot be used because the parameter EMS (No. 3702#1) is 1. 5) The spindle amplifier number of each spindle is not specified in parameter No. 3717. 6) A command is specified for a prohibited spindle (parameter No. 11090). 7) An invalid value is specified in parameter No. 11090.
5312	ILLEGAL COMMAND IN G10 L75/76/77	One of formats in G10L75, G10L76, or G10L77 to G11 commands is in error, or the command value is out of data range. Modify the program.
5316	TOOL TYPE NUMBER NOT FOUND	A tool with the specified tool-type number could not be found. Modify the program or register the tool.
5317	ALL TOOL LIFE IS OVER	The lives of all tools with the specified tool-type number have expired. Replace the tool.
5320	DIA/RAD. MODE CAN'T BE SWITCHED	In any of the following states, diameter/radius specification was switched: 1) When a buffered program is being executed 2) When a movement is being made on the axis
5324	REFERENCE RETURN INCOMPLETE	Manual reference position return cannot be performed during three-dimensional coordinate conversion, execution of the tilted working plane command, or workpiece setting error compensation.
5329	M98 AND NC COMMAND IN SAME BLOCK	A subprogram call which is not a single block was commanded during canned cycle mode. Modify the program.
5339	ILLEGAL FORMAT COMMAND IS EXECUTED IN SYNC/MIX/OVL CONTROL.	1) An invalid P, Q, or L value is specified for G51.4, G50.4, G51.5, G50.5, G51.6, or G50.6. 2) A duplicate value is specified in parameter No. 12600.
5346	RETURN TO REFERENCE POINT	The coordinate system for a Cs contour control axis is not established. Execute the manual reference position return. 1) An attempt was made to establish the coordinate system for the Cs-axis for which the Cs-axis reference position establishment state signal CSPENx was 0. 2) The spindle amplifier did not transfer position information. 3) The system was in the servo-off state at the start of the establishment of the coordinate system of the Cs-axis. 4) The Cs-axis was under synchronous or superposition control. 5) The system entered the emergency stop state during the establishment of the coordinate system. 6) An attempt was made to cancel composite control for the Cs-axis for which the coordinate system was being established. 7) An attempt was made to start synchronous, composite, or superposition control for the Cs-axis for which the coordinate system was being established.

Number	Message	Description
5360	TOOL INTERFERENCE CHECK ERROR	This alarm is issued when interference with another tool is caused by a data modification based on G10 data input or file inputting or when an attempt is made to modify the tool figure data of a tool registered in the cartridge.
5361	ILLEGAL MAGAZINE DATA	Tools stored in the cartridge are interfering with each other. Reregister the tools in the cartridge, or modify the tool management data or tool figure data. If this alarm is issued, no tool interference check is made when tools are registered in the cartridge management table. Moreover, empty pot search operation does not operate normally. If this alarm is issued, the power must be turned off before operation is continued.
5362	CONVERT INCH/MM AT REF-POS	An inch/metric conversion was performed at a position other than the reference position. Perform an inch/metric conversion after returning to the reference position.
5364	ILLEGAL COMMAND IN PROGRAM CHECK	1) A G code that could not be specified was specified in the high-speed program check mode. 2) The angular axis control or customer's board option is enabled. 3) One of the following operations was performed: • Chopping operation in the high-speed program check mode • Start of the high-speed program check mode during chopping operation • High-speed cycle machining in the high-speed program check mode • Reference position return for an axis for which the reference position is not established in the high-speed program check mode 4) PMC axis selection signal EAX*<G0136> was changed in the high-speed program check mode. 5) G10 was specified for parameter No. 3454#3 (PGR) in the high-speed program check mode. 6) G10 was specified for parameter No. 3001#6 (PGS) in the high-speed program check mode.
5365	NOT CHANGE OF PROGRAM CHECK MODE	High-speed program check input signal PGCK<Gn290.5> was changed when the program was being executed.
5372	IMPROPER MODAL G-CODE (G53.2)	In a block in which G53.2 is specified, a G code in group 01 other than G00 and G01 is specified. Or, G53.2 is specified when the modal G code in group 01 is in a state other than the G00 and G01 states.
5373	ARGUMENT CONVERSION ERROR	For outputting a target MDI program for program restart, a macro call argument cannot be converted to a 9-digit number.
5374	FSC MODE MISMATCH IN RESTART	The current flexible synchronous mode differs from the flexible synchronous mode specified in a programmed command in the program restart block.
5375	FSC MODE CAN NOT CHANGED	The flexible synchronous mode was changed during the execution of program restart.
5376	FSC SLAVE AXIS CAN NOT COMMANDED	In the flexible synchronous mode, a command was specified for the slave axis.
5377	INVALID COMMAND AFTER FSC OFF	After the flexible synchronous mode was canceled, an incremental command was specified before an absolute command for the axis specified as the slave axis.
5378	INVALID RESTART BLOCK	The block specified as the restart block after the flexible synchronous mode was canceled was not a block after an absolute command for the axis specified as the slave axis.
5379	WRITE PROTECTED TO SLAVE AXIS	The parameter for a slave axis for feed axis synchronization control cannot be directly specified.

Number	Message	Description
5381	INVALID COMMAND IN FSC MODE	Either of the following commands was specified: 1) When the reference position was not established for the master axis of flexible synchronous control, the G28 command was specified for the master axis. 2) The G27, G28, G29, G30, G30.1, or G53 command was specified for a slave axis.
5384	RETRACT FOR RIGID CANNOT BE CMD	In retraction for rigid tapping by the G30 command, different coordinate system modes are used at the stop of rigid tapping and in retraction for rigid tapping.
5391	CAN NOT USE G92	Workpiece coordinate system setting G92 (or G50 for the lathe system G-code system A) cannot be specified. 1) After tool length compensation was changed by tool length compensation shift type, G92 was specified when no absolute command is present. 2) G92 was specified in the block in which G49 is present.
5406	G41.3/G40 FORMAT ERROR	1) The G41.3 or G40 block contains a move command. 2) The G41.3 block contains a G or M code that suppresses buffering.
5407	ILLEGAL COMMAND IN G41.3	1) In the G41.3 mode, a G code of group 01 other than G00 and G01 is specified. 2) In the G41.3 mode, an offset command (a G code of group 07) is specified. 3) The block next to G41.3 (startup) specifies no movement.
5408	G41.3 ILLEGAL START_UP	1) In a mode of group 01 other than G00 and G01, G41.3 (startup) is specified. 2) The included angle between the tool vector and move vector is 0 or 180 degrees at the time of startup.
5420	ILLEGAL PARAMETER IN G43.4/G43.5	A parameter related to tool center point control is illegal. 1) Acceleration/deceleration before interpolation is disabled. Set parameter No. 1660. 2) Rapid traverse acceleration/deceleration before interpolation is disabled. Set parameter No. 1401#1, parameter No. 19501#5, parameter No. 1671, and parameter No. 1672. 3) The AI contour control I or AI contour control II option is absent. Set parameter No. 11260#2 (AAI) to 0.

Number	Message	Description
5421	ILLEGAL COMMAND IN G43.4/G43.5	An illegal command was specified in tool center point control. 1) A rotation axis command was specified in tool center point control (type 2) mode. 2) With a table rotary type or mixed-type machine, an I, J, K command was specified in the tool center point control (type 2) command (G43.5) block. 3) A command that does not move the tool center point (only a rotation axis is moved) was specified for the workpiece in the G02 mode. 4) When the workpiece coordinate system is set as the programming coordinate system (parameter No. 19696#5 (WKP) is 1), G02 or G03 was specified while the rotation axis was not perpendicular to the plane. 5) A G code that could not be specified was specified in the tool tip control mode. 6) When tool tip control was specified, the modal state was invalid. 7) If, in tool center point control mode, any of the following conditions is met, an axis not related to tool center point control (non 5-axis machining control axis) is specified: • The option, the expansion of axis move command in tool center point control, is not provided. • The number of non 5-axis machining control axes exceeds the maximum number of axes that can be specified. • Nano smoothing or NURBS interpolation is performed. 8) When parameter No. 11200#0 (RCM) is set to 0 to disable tool direction compensation, tool center point control is specified during the workpiece setting error compensation/tilted working plane command mode. 9) When tool posture control is enabled under tool center point control (type 2), a command is specified to set a tool posture near a singular point. (This alarm may be suppressed with parameter No. 19696#3 (NPC).) Check the machine configuration and specification. 10) When tool posture control is enabled under tool center point control (type 1), a rotary axis angular displacement that disables tool posture control is specified. Check the machine configuration and specification. 11) During tool center point control (type 2) or tool posture control, nano smoothing or NURBS interpolation is specified. Check the specification. 12) For nano smoothing in tool center point control (type 1), only linear axes are specified as axes for nano smoothing. Specify rotation axes. 13) In a state in which the shift of a mirror image remains, tool center point control, tool posture control, or the cutting point command is specified. 14) It is intervened with an MDI command during a single block stop in high-speed smooth TCP mode.
5422	EXCESS VELOCITY IN G43.4/G43.5	An attempt was made to make a movement at an axis feedrate exceeding the maximum cutting feedrate by tool center point control.
5424	ILLEGAL TOOL DIRECTION	The rotation axis position for specifying the tool axis direction is not $\pm 90^\circ \times n$ (n = 0, 1, 2, ...).
5425	ILLEGAL OFFSET VALUE	The offset number is incorrect.

Number	Message	Description
5430	ILLEGAL COMMAND IN 3-D CIR	In a modal state in which three-dimensional circular interpolation cannot be specified, a three-dimensional circular interpolation (G02.4/G03.4) is specified. Alternatively, in three-dimensional circular interpolation mode, a code that cannot be specified is specified.
5432	G02.4/G03.4 FORMAT ERROR	A three-dimensional circular interpolation command (G02.4/G03.4) is incorrect.
5433	MANUAL INTERVENTION IN G02.4/G03.4 (ABS ON)	In three-dimensional circular interpolation mode (G02.4/G03.4), manual intervention was made when the manual absolute switch was on.
5435	PARAMETER OUT OF RANGE (TLAC)	Illegal parameter setting (Set value is out of range). Check parameters Nos. 19655, 19656, 19657, and 1022.
5436	ILLEGAL PARAMETER SETTING OF ROTARY AXIS(TLAC)	Illegal parameter setting (axis of rotation setting).
5437	ILLEGAL PARAMETER SETTING OF MASTER ROTARY AXIS(TLAC)	Illegal parameter setting (master axis of rotation setting).
5445	CAN NOT COMMAND MOTION IN G39	Corner circular interpolation (G39) of cutter compensation or tool nose radius compensation is not specified alone but is specified with a move command.
5446	NO AVOIDANCE AT G41/G42	Because there is no interference evade vector, the interference check evade function of cutter compensation or tool nose radius compensation cannot evade interference.
5447	DANGEROUS AVOIDANCE AT G41/G42	The interference check evade function of cutter compensation or tool nose radius compensation determines that an evade operation will lead to danger.
5448	INTERFERENCE TO AVD. AT G41/G42	In the interference check evade function of cutter compensation or tool nose radius compensation, a further interference occurs for an already created interference evade vector.
5456	TOO MANY G68.2 NESTING	Tilted working plane command G68.2 was specified more than once. To perform another coordinate conversion, perform cancellation, then specify the coordinate conversion.
5457	G68.2 FORMAT ERROR	A G68.2 format error occurred.
5458	ILLEGAL USE OF G53.1/G53.6	1) G53.1 was specified before the G68.2 command. 2) G53.1/G53.6 is not independently specified. 3) The solution angle for the rotation axis with which the tool axis direction is controlled in the +Z direction in the feature coordinate system is nonexistent. 4) When tool direction compensation was not performed (parameter No. 11200#0 (RCM) was 0), G53.1 was specified in the workpiece installation error compensation mode. 5) No tool is specified with a G53.6 command.

Number	Message	Description
5459	MACHINE PARAMETER INCORRECT	1) A machine configuration parameter (parameter No. 19665 to No.19667 or 19680 to 19714 or No.12321) is illegal. 2) The axis which is specified in parameter No.19681 or No.19686 is not a rotation axis. 3) The basic three axes are not specified in the parameter No.1022. 4) In tool center point control (type 2) or three-dimensional cutter compensation (type 2) or tilted working plane command, the end point of rotation axis can not exist within the region specified by parameters No.19741 to No.19744. 5) In tool center point control (type 2) or three-dimensional cutter compensation (type 2), the end point of rotation axis can not exist. Check the machine configuration and the program. 6) Tool center point control (type 2) or three-dimensional cutter compensation (type 2) is specified when hypothetical axis is used. 7) Tool center point control (type 2) or three-dimensional cutter compensation (type 2) is specified when the programming coordinate system is the workpiece coordinate system. 8) If a parameter for setting a 5-axis machining function, the reference rotation axis position, is to be set in the machine coordinate system (parameter No. 19754#7 (SPM) = 1), an inclined rotary axis is used.

Number	Message	Description
5460	ILLEGAL USE OF 3-DIMENSIONAL CUTTER COMPENSATION	1) In the three-dimensional cutter compensation (except the tool side offset function for a tool rotation type machine), a move command other than G00/G01 is specified. 2) With a table rotation type machine, when parameter No. 19746#1 (PTD) is set to 1, a plane selection is made with an axis other than the basic three axes at the start of three-dimensional cutter compensation. 3) When parameter No. 19607#1 (SPG) is set to 1, there is a discrepancy between the machine type set in parameter No. 19680 and a G code specifying three-dimensional cutter compensation (G41.2, G42.2, G41.4, G42.4, G41.5, or G42.5). 4) With a machine that is not of the tool rotation type, G41.3 is specified. 5) When parameter No. 19696#5 (WKP) is set to 0, and parameter No. 19746#4 (TBP) is set to 0, three-dimensional cutter compensation and tool center point control for machining are used at the same time. 6) A rotation axis command is specified in the cutter compensation (type 2) mode for machining. 7) With a table rotation type or mixed type machine, IJK is specified in a block that specifies three-dimensional cutter compensation (type 2) (G41.6/G42.6). 8) An illegal G code is specified in the three-dimensional cutter compensation. 9) When three-dimensional cutter compensation is specified, the modal state is illegal. 10) When the table coordinate system is set as the programming coordinate system, table rotation then three-dimensional cutter compensation are specified after the start of tool center point control for machining. 11) There is a difference in type1/type 2 specification between three-dimensional cutter compensation and tool center point control for machining. 12) When three-dimensional cutter compensation and tool center point control for machining are used at the same time, one of these functions that is specified earlier than the other is canceled earlier.
5461	ILLEGAL USE OF G41.2/G42.2/G41.5/G42.5	A move command other than G00 or G01 was performed during three-dimensional cutter compensation in a mixed-type machine.
5462	ILLEGAL COMMAND (G68.2/G69)	1) When G68.2 or G69 is specified, the modal state is invalid. 2) A G code that cannot be specified is specified in the G68.2 mode. 3) When G68.2 or G69 is specified, the offset vector for cutter or tool-nose radius compensation is not canceled.
5463	ILLEGAL PARAMETER IN 3-DIMENSIONAL CUTTER COMPENSATION	A parameter related to three-dimensional cutter compensation is illegal. 1) Acceleration/deceleration before interpolation is disabled. Set parameter No. 1660. 2) Rapid traverse acceleration/deceleration before interpolation is disabled. Set parameter No. 1401#1 (LRP), parameter No. 19501#5 (FRP), and parameter Nos. No.1671 and 1672.

Number	Message	Description
5464	ILLEGAL COMMAND IN G43.8/G43.9	An illegal value is specified with the cutting point command of tool center point control. 1) A value is specified that causes the angle formed by the tool length offset direction and the direction perpendicular to the cutting surface to exceed 90 degrees. 2) The tool radius offset is less than the corner-R offset. 3) On a tool rotation type machine, manual intervention is performed on the rotation axis.

(4) Parameter writing alarm (SW alarm)

Number	Message	Description
SW0100	PARAMETER ENABLE SWITCH ON	The parameter setting is enabled (parameter No. 8900#0 (PWE) is set to "1"). To set the parameter, turn this parameter ON. Otherwise, set to OFF.

(5) Servo alarms (SV alarm)

Number	Message	Description
SV0001	SYNC ALIGNMENT ERROR	In feed axis synchronization control, the amount of compensation for synchronization exceeded the parameter (No. 8325) setting value. This alarm occurs for a master or slave axis.
SV0002	SYNC EXCESS ERROR ALARM 2	In feed axis synchronization control, the amount of synchronization error exceeded the parameter (No. 8332) setting value. When the synchronization is not completed after power-up, the determination is made by the parameter value (No. 8332) multiplied by the parameter (No. 8330) multiplier. This alarm occurs only for a slave axis only.
SV0003	SYNCHRONOUS/COMPOSITE/SUPERIMPOSED CONTROL MODE CAN'T BE CONTINUED	Since as axis in synchronization, composition, or superposition mode caused a servo alarm, the mode could not be continued, If one of the axes in a mode causes a servo alarm, all axes relating to the axis enter the servo-off state. This alarm is generated to enable the cause of the servo-off state to be checked.
SV0004	EXCESS ERROR (G31)	The amount of positional deviation during torque limit skip command operation exceeded the limit value of the parameter No.6287.
SV0005	SYNC EXCESS ERROR (MCN)	In feed axis synchronization control, for synchronization, the difference value of the machine coordinate between a master and slave axes exceeded the parameter (No. 8314) setting value. This alarm occurs for a master or slave axis.
SV0010	SV OVERHEAT	Amplifier internal overheat
SV0011	SV MOTOR OVER CURRENT(SOFT)	The digital servo software detected an abnormal specified value. Possible causes include an unconnected power cable, cable disconnection (open phase), and short-circuit.
SV0012	SV DRIVE OFF CIRCUIT FAILURE	The two drive off inputs are not in the same status or a drive off circuit error occurred.
SV0013	SV CPU BUS FAILURE	An error was found in CPU bus data in the amplifier.
SV0014	SV CPU WATCH DOG	An error occurred in CPU operation in the amplifier.
SV0015	SV LOW VOLT DRIVER	The driver power supply voltage has dropped in the amplifier. Possible causes include improper insertion of the control PC board and amplifier failure.

Number	Message	Description
SV0016	SV CURRENT DETECT ERROR	An error was found in motor current detection data in the amplifier. Possible causes include improper insertion of the control PC board and amplifier failure.
SV0017	SV INTERNAL SERIAL BUS FAILURE	An error occurred in serial bus communication in the amplifier. Possible causes include improper insertion of the control PC board and amplifier failure.
SV0018	SV ROM DATA FAILURE	An error was found in ROM data in the amplifier.
SV0019	PS GROUND FAULT	A ground fault occurred in the motor, power cable, or amplifier.
SV0020	PS GROUND FAULT	A ground fault occurred in the motor, power cable, or amplifier.
SV0021	PS OVERCURRENT 2	Overcurrent flowed in the input circuit.
SV0022	PS OVERCURRENT 3	Overcurrent flowed in the input circuit.
SV0023	PS OVERCURRENT 4	Overcurrent flowed in the input circuit.
SV0024	PS SOFT THERMAL	A load higher than the rating was applied.
SV0025	PS OVER VOLT. DC LINK 2	Overvoltage of the DC link section
SV0026	PS OVER VOLT. DC LINK 3	Overvoltage of the DC link section
SV0027	PS OVER VOLT. DC LINK 4	Overvoltage of the DC link section
SV0028	PS LOW VOLT. DC LINK 2	The DC link voltage has dropped.
SV0029	PS LOW VOLT. DC LINK 3	The DC link voltage has dropped.
SV0030	PS LOW VOLT. DC LINK 4	The DC link voltage has dropped.
SV0031	PS ILLEGAL PARAMETER	An invalid value is set for a PS control parameter.
SV0032	PS CONTROL AXIS ERROR 1	An invalid value is set for parameter No. 2557.
SV0033	PS CONTROL AXIS ERROR 2	An invalid value is set for parameter No. 2557.
SV0034	PS HARDWARE ERROR	A PS hardware error was detected.
SV0301	APC ALARM: COMMUNICATION ERROR	Since the absolute-position detector caused a communication error, the correct machine position could not be obtained. (data transfer error) The absolute-position detector, cable, or servo interface module is thought to be defective.
SV0302	APC ALARM: OVER TIME ERROR	Since the absolute-position detector caused an overtime error, the correct machine position could not be obtained. (data transfer error) The absolute-position detector, cable, or servo interface module is thought to be defective.
SV0303	APC ALARM: FRAMING ERROR	Since the absolute-position detector caused a framing error, the correct machine position could not be obtained. (data transfer error) The absolute-position detector, cable, or servo interface module is thought to be defective.
SV0304	APC ALARM: PARITY ERROR	Since the absolute-position detector caused a parity error, the correct machine position could not be obtained. (data transfer error) The absolute-position detector, cable, or servo interface module is thought to be defective.
SV0305	APC ALARM: PULSE ERROR	Since the absolute-position detector caused a pulse error, the correct machine position could not be obtained. The absolute-position detector or cable is thought to be defective.
SV0306	APC ALARM: OVER FLOW ERROR	Since the amount of positional deviation overflowed, the correct machine position could not be obtained. Check to see the parameter No. 2084 or No. 2085.
SV0307	APC ALARM: MOVEMENT EXCESS ERROR	Since the machine moved excessively, the correct machine position could not be obtained.
SV0360	ABNORMAL CHECKSUM(INT)	The checksum alarm occurred on the built–in Pulsecoder.
SV0361	ABNORMAL PHASE DATA(INT)	The phase data abnormal alarm occurred on the built–in Pulsecoder.

Number	Message	Description
SV0363	ABNORMAL CLOCK(INT)	The clock alarm occurred on the built–in Pulsecoder.
SV0364	SOFT PHASE ALARM(INT)	A digital servo soft detected an abnormality on the built in Pulsecoder.
SV0365	BROKEN LED(INT)	The digital servo software detected abnormal data on the built–in Pulsecoder.
SV0366	PULSE MISS(INT)	A pulse error occurred on the built–in Pulsecoder.
SV0367	COUNT MISS(INT)	A count error occurred on the built–in Pulsecoder.
SV0368	SERIAL DATA ERROR(INT)	The communications data could not be received from the built–in Pulsecoder.
SV0369	DATA TRANS. ERROR(INT)	A CRC error or stop bit error occurred in the communications data from the built–in Pulsecoder.
SV0380	BROKEN LED(EXT)	Separate detector error
SV0381	ABNORMAL PHASE (EXT)	An abnormal alarm in the position data occurred on the separate detector.
SV0382	COUNT MISS(EXT)	A count error occurred on the separate detector.
SV0383	PULSE MISS(EXT)	A pulse error occurred on the separate detector.
SV0384	SOFT PHASE ALARM(EXT)	The digital servo software detected abnormal data on the separate detector.
SV0385	SERIAL DATA ERROR(EXT)	The communications data could not be received from the separate detector.
SV0386	DATA TRANS. ERROR(EXT)	A CRC error or stop bit error occurred in the communications data from the standalone detector.
SV0387	ABNORMAL ENCODER(EXT)	An abnormality occurred on a separate detector. For more information, contact the scale manufacturer.
SV0401	IMPROPER V_READY OFF	Although the ready signal (PRDY) of the position control was ON, the ready signal (VRDY) of the velocity control was OFF.
SV0403	CARD/SOFT MISMATCH	The combination of the axis control card and servo software is invalid. Possible causes are: - The axis control card is invalid. - The servo software installed in the flash memory is invalid.
SV0404	IMPROPER V_READY ON	Although the ready signal (PRDY) of the position control was OFF, the ready signal (VRDY) of the velocity control was ON.
SV0407	EXCESS ERROR	The difference value of the amount of positional deviation for the synchronization axis exceeded the setting value. (during synchronization control only)
SV0409	DETECT ABNORMAL TORQUE	An abnormal load was detected on the servo motor, or during Cs axis or spindle positioning. The alarm can be canceled by RESET.
SV0410	EXCESS ERROR (STOP)	The amount of positional deviation during stopping exceeded the parameter (No. 1829) setting value.
SV0411	EXCESS ERROR (MOVING)	The amount of positional deviation during traveling became excessive than the parameter setting value.
SV0413	LSI OVERFLOW	The counter for the amount of positional deviation overflowed
SV0415	MOTION VALUE OVERFLOW	The velocity exceeding the travel velocity limit was commanded.

Number	Message	Description
SV0417	ILL DGTL SERVO PARAMETER	A digital serve parameter setting is incorrect. When diagnosis information No. 203#4 is 1, the servo software detected an invalid parameter. Check diagnosis information No. 352 and determine the cause. When diagnosis information No. 203#4 is 0, the CNC software detected an invalid parameter. Possible causes are listed below. (See diagnosis information No. 0280.) 1) The value specified for the motor model number (parameter No. 2020) is beyond the allowable range. 2) A valid value (111 or -111) is not specified for the motor rotation direction (parameter No. 2022). 3) An invalid value such as 0 or less is specified for the number of velocity feedback pulses per rotation (parameter No. 2023). 4) An invalid value such as 0 or less is specified for the number of position feedback pulses per rotation (parameter No. 2024).
SV0420	SYNC TORQUE EXCESS	In feed axis synchronization control, for synchronization, the difference value of torque between a master and slave axes exceeded the parameter (No. 2031) setting value. This alarm occurs for a master axis.
SV0421	EXCESS ERROR(SEMI-FULL)	The difference between the feedback from the semi and full sides exceeded the setting of parameter No.1729.
SV0422	EXCESS VELOCITY IN TORQUE	In torque control, the commanded permissible velocity was exceeded.
SV0423	EXCESS ERROR IN TORQUE	In torque control, the total permissible move value specified as a parameter was exceeded.
SV0430	SV MOTOR OVERHEAT	The servo motor has overheated.
SV0431	PS OVERLOAD	Overheat
SV0432	PS LOW VOLT. CONTROL	Low control power supply voltage
SV0433	PS LOW VOLT. DC LINK	Low DC link voltage
SV0434	SV LOW VOLT CONTROL	Low control power supply voltage
SV0435	SV LOW VOLT DC LINK	Low DC link voltage
SV0436	SOFTTHERMAL(OVC)	The digital servo software detected a software thermal (OVC).
SV0437	PS OVERCURRENT	Overcurrent on the input circuit section
SV0438	SV ABNORMAL CURRENT	Motor overcurrent
SV0439	PS OVER VOLT. DC LINK	DC link overvoltage
SV0440	PS EXCESS-REGENERATION2	Excessive regenerative discharge
SV0441	ABNORMAL CURRENT OFFSET	The digital servo software detected an abnormality in the motor current detection circuit.
SV0442	PS PRE-CHARGE FAILURE	Error in the spare charge circuit for the DC link
SV0443	PS INTERNAL FAN FAILURE	Internal cooling fan failure
SV0444	SV INTERNAL FAN FAILURE	Internal cooling fan failure
SV0445	SOFT DISCONNECT ALARM	The digital servo software detected a disconnected Pulsecoder.
SV0446	HARD DISCONNECT ALARM	The hardware detected a disconnected built–in Pulsecoder.
SV0447	HARD DISCONNECT(EXT)	The hardware detected a disconnected separate detector.
SV0448	UNMATCHED FEEDBACK ALARM	The sign of the feedback signal from the standalone detector is opposite to that from the feedback signal from the built–on Pulsecoder.
SV0449	SV IPM ALARM	The intelligent power module (IPM) detected an alarm.
SV0453	SPC SOFT DISCONNECT ALARM	Software disconnection alarm of the built-in Pulsecoder. Turn off the power to the CNC, then remove and insert the Pulsecoder cable. If this alarm is issued again, replace the Pulsecoder.

Number	Message	Description
SV0454	ILLEGAL ROTOR POS DETECT	The magnetic pole detection function terminated abnormally. The magnetic pole could not be detected because the motor did not run.
SV0456	LLEGAL CURRENT LOOP	An attempt was made to set the current loop that could not be set. The amplifier pulse module in use does not comply with HIGH SPEED HRV. Or, requirements to control are not satisfied in the system.
SV0458	CURRENT LOOP ERROR	The specified current loop differs from the actual current loop.
SV0459	HI HRV SETTING ERROR	For two axes whose servo axis numbers (parameter No. 1023) are consecutively even and odd numbers, HIGH SPEED HRV control is possible for one axis and impossible for the other.
SV0460	FSSB DISCONNECT	The FSSB connection was discontinued. Probable causes are: 1) The FSSB connection cable was disconnected or broken. 2) The amplifier was turned off . 3) In the amplifier, the low-voltage alarm occurred.
SV0462	SEND CNC DATA FAILED	The correct data could not be received on a slave side because of the FSSB communication error.
SV0463	SEND SLAVE DATA FAILED	The correct data could not be received in the servo software because of the FSSB communication error.
SV0465	READ ID DATA FAILED	A read of the ID information for the amplifier has failed at power-on.
SV0466	MOTOR/AMP. COMBINATION	The maximum current of an amplifier is different to that of a motor. Probable causes are: 1) The connection command for an amplifier is incorrect. 2) The parameter (No.2165) setting is incorrect
SV0468	HI HRV SETTING ERROR(AMP)	An attempt was made to set up HIGH SPEED HRV control for use when the controlled axis of an amplifier for which HIGH SPEED HRV control could not be used.
SV0474	EXCESS ERROR(STOP:SV)	The servo detected that the amount of positional deviation for the n-axis in the stopped state exceeded the setting (parameter No. 1839 or 1842).
SV0475	EXCESS ERROR(MOVE:SV)	The servo detected that the amount of positional deviation for the n-axis in the traveling state exceeded the setting (parameter No. 1838 or 1841).
SV0476	ILLEGAL SPEED CMD.(SV)	The servo detected that the speed specified in the velocity command exceeded the safety speed (parameter No. 13821 to 13824 in the position control mode or parameter No. 13826 to 13829 in the velocity control mode) for the n-axis during safety monitoring (when the safety monitoring request signal *VLDVx was 0). Run within the safety speed.
SV0477	ILLEGAL MACHINE POS.(SV)	The servo detected that the machine position was outside the safety area (range specified in parameter No. 13831 to 13838) for the n-axis during safety monitoring (when the safety monitoring request signal *VLDVx was 0). Run within the safety area. The machine position is checked only for an axis for which the reference position has been established. It is not checked for any axis for which the reference position has not been established.

Number	Message	Description
SV0478	ILLEGAL AXIS DATA(SV)	The servo detected that an error occurred during axis data transfer for the n-axis. If the alarm is issued because of the configuration change of the servo amplifier, perform axis number setting operation for the servo amplifier (set parameter No. 2212#4 for the relevant axis to 1, then set the bit back to 0, and turn the power to the entire system off). If you use a multiaxis amplifier, performing the above operation only once may not clear the alarm. In this case, repeat the same operation for the axis for which the alarm is still issued until it is cleared. If the alarm is issued for a case other than the above, replace the servo amplifier.
SV0481	SAFETY PARAM ERROR(SV)	The servo detected that a safety parameter error occurred for the n-axis.
SV0484	SAFETY FUNCTION ERROR(SV)	The servo detected a safety function error for the n-axis. 1) The servo or CNC detected that the servo did not execute the safety function. 2) The result of the safety function check by the servo is not the same as that of the check by the CNC. 3) An error occurred in the servo CPU test. 4) An error occurred in the servo RAM check.
SV0488	SELF TEST OVER TIME	The MCC block test was not completed within the set time (parameter No. 1946). Check the MCC contact.
SV0489	SAFETY PARAM ERROR(CNC)	The CNC detected that a safety parameter error occurred for the n-axis.
SV0490	SAFETY FUNCTION ERROR(CNC)	A CNC safety function error occurred for the n-axis. 1) The servo detected that the CNC did not execute the safety function. 2) The result of the safety function check by the CNC is not the same as that of the check by the servo.
SV0494	ILLEGAL SPEED CMD.(CNC)	The CNC detected that the speed specified in the velocity command exceeded the safety speed (parameter No. 13821 to 13824 in the position control mode or parameter No. 13826 to 13829 in the velocity control mode) for the n-axis during safety monitoring (when the safety monitoring request signal *VLDVx was 0). Run within the safety speed.
SV0495	ILLEGAL MACHINE POS.(CNC)	The CNC detected that the machine position was outside the safety area (range specified in parameter No. 13831 to 13838) for the n-axis during safety monitoring (when the safety monitoring request signal *VLDVx was 0). Run within the safety area. The machine position is checked only for an axis for which the reference position has been established.
SV0496	ILLEGAL AXIS DATA(CNC)	The CNC detected that an error occurred during axis data transfer for the n-axis. If the alarm is issued because of the configuration change of the servo amplifier, perform axis number setting operation for the servo amplifier (set parameter No. 2212#4 for the relevant axis to 1, then set the bit back to 0, and turn the power to the entire system off). If you use a multiaxis amplifier, performing the above operation only once may not clear the alarm. In this case, repeat the same operation for the axis for which the alarm is still issued until it is cleared. If the alarm is issued for a case other than the above, replace the servo amplifier.

Number	Message	Description
SV0498	AXIS NUMBER NOT SET(CNC)	The CNC detected that the axis number of the n-axis was not set in the servo amplifier. The axis number is automatically set. Turn the power to the entire system off.
SV0600	SV DC LINK OVER CURRENT	DC link overcurrent.
SV0601	SV EXTERNAL FAN FAILURE	Radiator cooling fan failure.
SV0602	INV. OVERHEAT	The servo amplifier radiator has overheated.
SV0603	INV. IPM ALARM(OH)	The intelligent power module (IPM) detected an overheat alarm.
SV0604	AMP COMMUNICATION ERROR	The communication between Servo Amplifier (SV) and Common Power Supply (PS) is in error.
SV0605	PS EXCESS-REGENERATION1	Excessive motor regenerative power
SV0606	PS EXTERNAL FAN FAILURE	External radiator cooling fan failure
SV0607	PS IMPROPER INPUT POWER	An abnormality was found with the input power supply.
SV0646	ABNORMAL ANALOG SIGNAL (EXT)	Error in the analog 1 Vp-p output in the separate detector. The separate detector, cable, or separate detector interface unit is thought to be defective.
SV0652	TEMP.ERROR	Communication between the separate detector interface unit and temperature sensor was disconnected.
SV0654	DB RELAY FAILURE	A failure occurs in the dynamic brake relay of the servo amplifier. Replace the amplifier.
SV1025	V_READY ON (INITIALIZING)	The ready signal (VRDY) of the velocity control which should be OFF is ON while the servo control is ON.
SV1026	ILLEGAL AXIS ARRANGE	The parameter for servo axis arrange is not set correctly. 1) Parameter No. 1023 (servo axis number of each axis) is set to a negative value or a duplicate value. 2) The settings for parameter No. 1023 (servo axis number of each axis) were made with a certain setting skipped among 1 to 6, 9 to 14, or 17 to 22. 3) A setting of a multiple of 8 or a multiple of 8 minus 1 was made.
SV1055	ILLEGAL TANDEM AXIS	In tandem control, the setting of the parameter No. 1023 is incorrect. In tandem control, the setting of the parameter TDM (No.1817#6) is incorrect.
SV1067	FSSB:CONFIGURATION ERROR (SOFT)	An FSSB configuration error occurred (detected by software). The connected amplifier type is incompatible with the FSSB setting value.
SV1068	DUAL CHECK SAFETY ALARM	The dual check safety function issued an alarm that turned the MCC of the entire system off.
SV1069	EXCESS ERROR(SERVO OFF:CNC)	The CNC detected that the amount of positional deviation for the n-axis in the servo-off state exceeded the setting (parameter No. 1840).
SV1070	EXCESS ERROR(SERVO OFF:SV)	The servo detected that the amount of positional deviation for the n-axis in the servo-off state exceeded the setting (parameter No. 1840).
SV1071	EXCESS ERROR(MOVE:CNC)	The CNC detected that the amount of positional deviation for the n-axis in the traveling state exceeded the setting (parameter No. 1838 or 1841).
SV1072	EXCESS ERROR(STOP:CNC)	The CNC detected that the amount of positional deviation for the n-axis in the stopped state exceeded the setting (parameter No. 1839 or 1842).
SV1100	S-COMP. VALUE OVERFLOW	The amount of compensation for the straightness exceeded a maximum value of 32767.
SV5134	FSSB:OPEN READY TIME OUT	In the initialization, the FSSB could not be in an open ready sate. The axis card is thought to be defective.

Number	Message	Description
SV5136	FSSB:NUMBER OF AMP. IS INSUFFICIENT	The number of amplifier identified by the FSSB is insufficient than the number of control axes. Or, the setting of the number of axes or the amplifier connection is in error.
SV5137	FSSB:CONFIGURATION ERROR	An FSSB configuration error occurred. The connecting amplifier type is incompatible with the FSSB setting value.
SV5139	FSSB:ERROR	Servo initialization has not completed successfully. It is probable that an optical cable failed or a connection between the amplifier and another module failed.
SV5197	FSSB:OPEN TIME OUT	The FSSB could not be opened although the CNC permitted the opening of the FSSB. Check the connection between the CNC and the amplifier.
SV5311	FSSB:ILLEGAL CONNECTION	Different current loops (HRV) are set for FSSB lines. Specify the same current loop for the FSSB lines.

(6) Overtravel alarms (OT alarm)

Number	Message	Description
OT0500	+ OVERTRAVEL (SOFT 1)	Exceeded the positive side stored stroke check 1.
OT0501	- OVERTRAVEL (SOFT 1)	Exceeded the negative side stored stroke check 1.
OT0502	+ OVERTRAVEL (SOFT 2)	Exceeded the positive side stored stroke check 2. Or, in the chuck tail stock barrier, an entry to the inhibited area was made during movement in the positive direction.
OT0503	- OVERTRAVEL (SOFT 2)	Exceeded the negative side stored stroke check 2. Or, in the chuck tail stock barrier, an entry to the inhibited area was made during movement in the negative direction.
OT0504	+ OVERTRAVEL (SOFT 3)	Exceeded the positive side stored stroke check 3.
OT0505	- OVERTRAVEL (SOFT 3)	Exceeded the - side stored stroke check 3.
OT0506	+ OVERTRAVEL (HARD)	The stroke limit switch in the positive direction was triggered. This alarm is generated when the machine reaches the stroke end. When this alarm is not generated, feed of all axes is stopped during automatic operation. During manual operation, only the feed of the axis on which the alarm occurred is stopped.
OT0507	- OVERTRAVEL (HARD)	The stroke limit switch in the negative direction was triggered. This alarm is generated when the machine reaches the stroke end. When this alarm is not generated, feed of all axes is stopped during automatic operation. During manual operation, only the feed of the axis on which the alarm occurred is stopped.
OT0508	INTERFERENCE:+	A tool moving in the positive direction along the n axis has fouled another tool post.
OT0509	INTERFERENCE:-	A tool moving in the negative direction along the n axis has fouled another tool post.
OT0510	+ OVERTRAVEL (PRE-CHECK)	The tool exceeded the limit in the negative direction during the stroke check before movement.
OT0511	- OVERTRAVEL (PRE-CHECK)	The tool exceeded the limit in the positive direction during the stroke check before movement.
OT0514	(n) INTERFERENCE:+	The positive side of the n-axis caused interference in the rotation area interference check.
OT0515	(n) INTERFERENCE:-	The negative side of the n-axis caused interference in the rotation area interference check.

Number	Message	Description
OT0518	(n)+: INTERFERE ([Target name 1],[Target name 2])	A check made for interference between [Target name1] and [Target name2] detected interference on the + side of axis n. n represents the name of the axis with which an alarm is issued.
OT0519	(n)-: INTERFERE ([Target name 1],[Target name 2])	A check made for interference between [Target name1] and [Target name2] detected interference on the - side of axis n. n represents the name of the axis with which an alarm is issued.
OT1710	ILLEGAL ACC. PARAMETER (OPTIMUM TORQUE ACC/DEC)	The permissible acceleration parameter for the optimum torque acceleration/deceleration is in error. A possible cause is either of the following: 1) The ratio of a negative acceleration to a positive acceleration is not more than the limit value. 2) The time to reduce to a velocity of 0 exceeded the maximum time.

(7) Memory file alarms (IO alarm)

Number	Message	Description
IO1001	FILE ACCESS ERROR	The resident–type file system could not be accessed as an error occurred in the resident–type file system.
IO1002	FILE SYSTEM ERROR	The file could not be accessed as an error occurred in the CNC file system.
IO1030	CHECK SUM ERROR	The checksum of the CNC part program storage memory is incorrect.
IO1032	MEMORY ACCESS OVER RANGE	Accessing of data occurred outside the CNC part program storage memory range.
IO1104	OVER MAXIMUM TOOL LIFE PAIRS	An attempt was made to exceed the maximum number of tool life management pairs allowable in the system. Modify the maximum number of pairs specified in parameter No. 6813.

(8) Alarms requiring power to be turned off (PW alarm)

Number	Message	Description
PW0000	POWER MUST BE OFF	A parameter was set for which the power must be turned OFF then ON again.
PW0001	X-ADDRESS(*DEC) IS NOT ASSIGNED.	The X address of the PMC could not be assigned correctly. This alarm may occur in the following case: 1) During the setting of parameter No. 3013, the X address could not be assigned correctly for the deceleration dog (*DEC) for a return to the reference position.
PW0002	PMC address is not correct(AXIS).	The address to assign the axis signal is incorrect. This alarm may occur in the following case: 1) The parameter No.3021 setting is incorrect.
PW0003	PMC address is not correct (SPINDLE).	The address to assign the spindle signal is incorrect. This alarm may occur in the following case: 1) The parameter No.3022 setting is incorrect.
PW0004	SETTING THE LOADER SYSTEM PATH IS NOT CORRECT.	The loader system could not be assigned correctly. The parameter No. 984 setting is incorrect. 1) The number of loader systems and the number of systems specified to the loader system in the parameter No. 984#0(LCP) does not match. 2) The parameter No. 984#0 of the system 1 is set to 1.
PW0006	POWER MUST BE OFF (ILL-EXEC-CHK)	The malfunction prevention function detected an alarm to require the power off.

Number	Message	Description
PW0007	X-ADDRESS(SKIP) IS NOT ASSIGNED	The X address of PMC could not be assigned correctly. Possible causes are: 1) During the set of parameter No. 3012, the skip signal of the X address was not assigned correctly. 2) During the set of parameter No. 3019, the address other than the skip signal of the X address was not assigned correctly.
PW0008	CPU SELF TEST ERROR(DCS PMC)	On the DCS PMC 1) An error was detected in CPU self-diagnosis. 2) An error was detected in the RAM check function.
PW0009	CPU SELF TEST ERROR(PMC)	On the PMC 1) An error was detected in CPU self-diagnosis. 2) An error was detected in the RAM check function.
PW0010	SAFE I/O CROSS CHECK ERROR(DCS PMC)	On the DCS PMC, a system-defined safety DI/DO error was detected in the I/O cross check function.
PW0011	SAFE I/O CROSS CHECK ERROR(PMC)	On the PMC, a system-defined safety DI/DO error was detected in the I/O cross check function.
PW0012	USER I/O CROSS CHECK ERROR(DCS PMC)	On the DCS PMC, a user-defined safety DI/DO error was detected in the I/O cross check function.
PW0013	USER I/O CROSS CHECK ERROR(PMC)	On the PMC, a user-defined safety DI/DO error was detected in the I/O cross check function.
PW0014	CPU TEST ALARM (CNC)	An error occurred in the CNC CPU test.
PW0015	SAFETY PARAM ERROR	The CNC detected that an error occurred in a safety parameter which was not of the servo axis type or spindle axis type.
PW0016	RAM CHECK ERROR	A CNC RAM check error was detected.
PW0017	INEXECUTION OF SAFETY FUNCTIONS	The safety function was not executed normally in the CNC.
PW0018	CRC CHECK ERROR	A CNC CRC check error occurred.
PW0036	ILLEGAL SETTING FOR SERVO MOTOR SPINDLE	The parameter setting for the servo axes for spindle use of the spindle control with servo motor is illegal. 1) The servo axes number for spindle use has exceeded 4 axes. 2) Servo axes number for spindle use are fewer than the axes number of designation of servo axes for spindle use. 3) The servo axes for spindle use is not set as a spindle control with servo motor axis. 4) The servo axes for spindle use is not set as a rotation axis.. 5) The servo axis number (parameter No.1023) is a negative value.
PW0050	POWER MUST BE OFF (INITIALIZED COMMUNICATION)	When the power is turned on, the hardware of the communication function was initialized. The power must be turned off to be effective. This alarm may occur in the following cases: - When the option board is added or replaced - When the software option is changed

Number	Message	Description
PW1102	ILLEGAL PARAMETER (I-COMP.)	The parameter for setting slope compensation is incorrect. This alarm occurs in the following cases: 1) When the number of pitch error compensation points on the axis on which slope compensation is executed exceeds 128 between the most negative side and most positive side 2) When the size relationship between the slope compensation point Nos. is incorrect 3) When the slope compensation point is not located between the most negative side and most positive side of pitch error compensation 4) When the compensation per compensation point is too small or too great.
PW1103	ILLEGAL PARAMETER (S-COMP.128)	The parameter for setting 128 straightness compensation points or the parameter compensation data is incorrect,
PW1104	ILLEGAL PARAMETER (3-D MACHINE POSITION COMPENSATION.)	A parameter for setting 3-dimensional machine position compensation is incorrect.
PW1105	ILLEGAL PARAMETER (3DR-COMP)	Parameter setting for three-dimensional rotary error compensation is wrong. One of the following may be the cause. 1) The designation for rotary axes is wrong. 2) The number of the total compensation points is larger than 7812. 3) The designation for machine type is wrong. 4) The designation for compensation axis is wrong. 5) The setting for compensation number of reference point is wrong. 6) The setting for compensation interval is wrong.
PW5046	ILLEGAL PARAMETER (S-COMP.)	The parameter for setting straightness compensation is incorrect. Possible causes are: 1) A nonexistent axis number is specified in a moving or compensation axis parameter. 2) More than 128 pitch error compensation points are set between the furthest points in the negative and positive regions. 3) The straightness compensation point numbers do not have correct magnitude relationships. 4) No straightness compensation point is found between the furthest pitch error compensation point in the negative region and that in the positive region. 5) The compensation per compensation point is too large or too small.
PW5390	R-ADDRESS SETTING IS ILLEGAL	An invalid PMC R address setting range or start address was specified in parameter No. 13541 or 13542.

(9) Spindle alarms (SP alarm)

Number	Message	Description
SP0740	RIGID TAP ALARM : EXCESS ERROR	The positional deviation of the stopped spindle has exceeded the set value during rigid tapping.
SP0741	RIGID TAP ALARM : EXCESS ERROR	The positional deviation of the moving spindle has exceeded the set value during rigid tapping. The synchronous error range has exceeded the set value.
SP0742	RIGID TAP ALARM : LSI OVERFLOW	An LSI overflow has occurred for the spindle during rigid tapping.

Number	Message	Description
SP0752	SPINDLE MODE CHANGE ERROR	This alarm is generated if the system does not properly terminate a mode change. The modes include the Cs contour control, spindle positioning, rigid tapping, and spindle control modes. The alarm is activated if the spindle control unit does not respond correctly to the mode change command issued by the NC.
SP0754	ABNORMAL TORQUE	An abnormal load was detected in a spindle motor. The alarm can be canceled by RESET.
SP0755	SAFETY FUNCTION ERROR	The CNC CPU detected that the safely function of the n-th spindle was not executed. Alternatively, the result of a CNC safety function check did not match the result of a spindle safety function check.
SP0756	ILLEGAL AXIS DATA	The CNC CPU detected an error during transfer of spindle data in the nth spindle. When this alarm is issued because the configuration of the spindle amplifiers was changed, set the spindle number for the spindle amplifier (set parameter No. 4541#7 to 1 and then 0, and turn the power to the entire system off).
SP0757	SAFETY SPEED OVER	The CNC CPU detected that during safety monitoring (when safety monitoring request signal *VLDPs is 0), the spindle motor speed was greater than the safety speed (parameter No. 4372, 4438, 4440, or 4442) on the n-th spindle. Operate within the safety speed.
SP1202	SPINDLE SELECT ERROR	In a multi spindle control, the spindle number other than the valid spindle number was selected by a position coder select signal. An attempt was made to select the spindle number of the system having no valid spindle.
SP1210	TOOL CHANGE SP MOTION OVERFLOW	The amount of distribution to a spindle is too much. (specific to the FANUC ROBODRILL)
SP1211	TOOL CHANGE SP ORTN EXCESS ERROR	During a tool change, a too much orientation error was detected for the spindle (specific to the FANUC ROBODRILL).
SP1212	TOOL CHANGE SP MOVE EXCESS ERROR	During a tool change, a too much moving error was detected for the spindle (specific to the FANUC ROBODRILL).
SP1213	TOOL CHANGE SP STOP EXCESS ERROR	During a tool change, a too much stop error was detected for the spindle (specific to the FANUC ROBODRILL).
SP1214	TOOL CHANGE SP ILLEGAL SEQUENCE	During changing tools, an abnormal spindle sequence was detected (specific to the FANUC ROBODRILL).
SP1220	NO SPINDLE AMP.	Either the cable connected to a serial spindle amplifier is broken, or the serial spindle amplifier is not connected.
SP1221	ILLEGAL MOTOR NUMBER	The spindle No. and the motor No. are incorrectly matched.
SP1224	ILLEGAL SPINDLE-POSITION CODER GEAR RATIO	The spindle–position coder gear ratio was incorrect.
SP1225	CRC ERROR (SERIAL SPINDLE)	A CRC error (communications error) occurred in communications between the CNC and the serial spindle amplifier.
SP1226	FRAMING ERROR (SERIAL SPINDLE)	A framing error occurred in communications between the CNC and the serial spindle amplifier.
SP1227	RECEIVING ERROR (SERIAL SPINDLE)	A receive error occurred in communications between the CNC and the serial spindle amplifier.
SP1228	COMMUNICATION ERROR (SERIAL SPINDLE)	A communications error occurred between the CNC and the serial spindle amplifier.
SP1229	COMMUNICATION ERROR SERIAL SPINDLE AMP.	A communications error occurred between serial spindle amplifiers (motor Nos. 1 and 2, or motor Nos. 3–4).
SP1231	SPINDLE EXCESS ERROR (MOVING)	The position deviation during spindle rotation was greater than the value set in parameters.

Number	Message	Description
SP1232	SPINDLE EXCESS ERROR (STOP)	The position deviation during spindle stop was greater than the value set in parameters.
SP1233	POSITION CODER OVERFLOW	The error counter/speed instruction value of the position coder overflowed.
SP1234	GRID SHIFT OVERFLOW	Grid shift overflowed.
SP1240	DISCONNECT POSITION CODER	The analog spindle position coder is broken.
SP1241	D/A CONVERTER ERROR	The D/A converter for controlling analog spindles is erroneous.
SP1243	ILLEGAL SPINDLE PARAMETER SETTING (GAIN)	The setting for the spindle position gain is incorrect.
SP1244	MOTION VALUE OVERFLOW	The amount of distribution to a spindle is too much
SP1245	COMMUNICATION DATA ERROR	A communication data error was detected on the CNC.
SP1246	COMMUNICATION DATA ERROR	A communication data error was detected on the CNC.
SP1247	COMMUNICATION DATA ERROR	A communication data error was detected on the CNC.
SP1252	ILLEGAL SPINDLE PARAMETER SETTING (TANDEM)	Setting of parameter No.4597 is invalid. Possible causes are : 1) A value that is larger than the maximum number of controlled spindle axes is set in parameter No.4597. 2) A negative value except for –1 is set in parameter No.4597. 3) Relationship of master axis and slave axis that is set in parameter No.4597 is illegal. 4) When the spindle amplifier that is not applicable the function is used, a value except for 0 is set in parameter No.4597.
SP1700	SAFETY PARAM ERROR	The CNC detected that a safety parameter error occurred for the n-th spindle.
SP1969	SPINDLE CONTROL ERROR	An error occurred in the spindle control software.
SP1970	SPINDLE CONTROL ERROR	Initialization of spindle control ended in error.
SP1971	SPINDLE CONTROL ERROR	An error occurred in the spindle control software.
SP1972	SPINDLE CONTROL ERROR	An error occurred in the spindle control software.
SP1974	ANALOG SPINDLE CONTROL ERROR	An error occurred in the spindle control software.
SP1975	ANALOG SPINDLE CONTROL ERROR	A position coder error was detected on the analog spindle.
SP1976	SERIAL SPINDLE COMMUNICATION ERROR	The amplifier No. could not be set to the serial spindle amplifier.
SP1977	SERIAL SPINDLE COMMUNICATION ERROR	An error occurred in the spindle control software.
SP1978	SERIAL SPINDLE COMMUNICATION ERROR	A time–out was detected during communications with the serial spindle amplifier.
SP1979	SERIAL SPINDLE COMMUNICATION ERROR	The communications sequence was no longer correct during communications with the serial spindle amplifier.
SP1980	SERIAL SPINDLE AMP. ERROR	Defective SIC–LSI on serial spindle amplifier
SP1981	SERIAL SPINDLE AMP. ERROR	An error occurred during reading of the data from SIC–LSI on the analog spindle amplifier side.
SP1982	SERIAL SPINDLE AMP. ERROR	An error occurred during reading of the data from SIC–LSI on the serial spindle amplifier side.
SP1983	SERIAL SPINDLE AMP. ERROR	Could not clear on the spindle amplifier side.
SP1984	SERIAL SPINDLE AMP. ERROR	An error occurred during re–initialization of the spindle amplifier.
SP1985	SERIAL SPINDLE CONTROL ERROR	Failed to automatically set parameters
SP1986	SERIAL SPINDLE CONTROL ERROR	An error occurred in the spindle control software.
SP1987	SERIAL SPINDLE CONTROL ERROR	Defective SIC–LSI on the CNC

Number	Message	Description
SP1988	SPINDLE CONTROL ERROR	An error occurred in the spindle control software.
SP1989	SPINDLE CONTROL ERROR	An error occurred in the spindle control software.
SP1996	ILLEGAL SPINDLE PARAMETER SETTING	The spindle was assigned incorrectly. Check to see the following parameter. (No.3716 or 3717)
SP1998	SPINDLE CONTROL ERROR	An error occurred in the spindle control software.
SP1999	SPINDLE CONTROL ERROR	An error occurred in the spindle control software.

(10) Overheat alarms (OH alarm)

Number	Message	Description
OH0700	LOCKER OVERHEAT	CNC cabinet overheat
OH0701	FAN MOTOR STOP	Abnormal PCB cooling fan motor
OH0704	OVERHEAT	Spindle overheat due to spindle speed change detection. 1) In heavy cutting, check the cutting condition. 2) Check whether the tool becomes difficult to use in cutting. 3) The spindle amplifier may be defective.

(11) Other alarms (DS alarm)

Number	Message	Description
DS0001	SYNC EXCESS ERROR (POS DEV)	In feed axis synchronization control, the difference in the amount of positional deviation between the master and slave axes exceeded the parameter (No. 8323) setting value. This alarm occurs for a master or slave axis.
DS0002	SYNC EXCESS ERROR ALARM 1	In feed axis synchronization control, the difference in the amount of synchronization between the master and slave axes exceeded the parameter (No. 8331) setting value. This alarm occurs only for the slave axis.
DS0003	SYNCHRONIZE ADJUST MODE	The system is in the synchronize adjust mode.
DS0004	EXCESS MAXIMUM FEEDRATE	The malfunction prevention function detected the command in which a value exceeding the maximum speed was specified.
DS0005	EXCESS MAXIMUM ACCELERATION	The malfunction prevention function detected the command in which a value exceeding the maximum acceleration was specified.
DS0006	ILLEGAL EXECUTION SEQUENCE	The malfunction prevention function detected an invalid execution sequence.
DS0007	ILLEGAL EXECUTION SEQUENCE	The malfunction prevention function detected an invalid execution sequence.
DS0008	ILLEGAL EXECUTION SEQUENCE	The malfunction prevention function detected an invalid execution sequence.
DS0009	ILLEGAL EXECUTION SEQUENCE	The malfunction prevention function detected an invalid execution sequence.
DS0010	ILLEGAL REFERENCE AREA	The malfunction prevention function detected an invalid reference area.
DS0011	ILLEGAL REFERENCE AREA	The malfunction prevention function detected an invalid reference area.
DS0012	ILLEGAL REFERENCE AREA	The malfunction prevention function detected an invalid reference area.
DS0013	ILLEGAL REFERENCE AREA	The malfunction prevention function detected an invalid reference area.
DS0014	TOOL CHANGE DETECT MACHINE LOCK	A machine lock is turned on for the Z axis for which the tool is being changed.
DS0015	TOOL CHANGE DETECT MIRROR IMAGE	A mirror image is turned on for the Z axis for which the tool is being changed.

Number	Message	Description
DS0016	SERIAL DCL:FOLLOW-UP ERROR	1) The value specified in parameter No. 1883 or No. 1884 is beyond the allowable range. 2) The distance (detection unit) between the current position and reference position when the origin is established exceeds ±2147483647. Correct the current position or reference position so that this symptom does not occur.
DS0017	SERIAL DCL:REF-POS ESTABLISH ERR	The travel distance at FL feedrate when the origin is established exceeds the setting of parameter No. 14010.
DS0018	SERIAL DCL:MISMATCH(SSYNC CTRL)	A linear scale with the reference position is used for one of master and slave axes for feed axis synchronization control and a linear scale without the reference position is used for the other. In this configuration, set the feed axis synchronization control selection signal (SYNC<Gn138> or SYNCJ<Gn140>) to 0 to establish the reference position.
DS0019	SERIAL DCL:MISMATCH(ANGL-AXIS)	In angular axis control, a linear scale with the reference position is used for one of the angular or perpendicular axes and a linear scale without the reference position is used for the other. Angular axis control cannot be used in such a configuration.
DS0020	REFERENCE RETURN INCOMPLETE	An attempt was made to perform an automatic return to the reference position on the perpendicular axis before the completion of a return to the reference position on the angular axis. However, this attempt failed because a manual return to the reference position during angular axis control or an automatic return to the reference position after power-up was not commanded. First, return to the reference position on the angular axis, then return to the reference position on the perpendicular axis.
DS0022	DUAL CHECK SAFETY IS NOT WORKED	Parameter No. 1902#6 (DCE) has set the Dual Check Safety function to be disabled.
DS0023	ILLEGAL PARAMETER (I-COMP VAL)	The parameter for setting slope compensation is invalid. The compensation per compensation point is too large or too small.
DS0024	UINT SIGNAL WAS ILLEGALLY INPUT	On angular axis control, one of the angular/perpendicular axes is the scale with ref-pos, and the other of them is not the scale with ref-pos. Such system is not admired.
DS0025	G60 CANNOT BE EXECUTED	One direction positioning cannot be executed because the mirror image status when the one direction positioning block is read in advance differs from that when the execution of the block is started. Modify the program.
DS0026	MISMATCH OF ANGULAR AXIS (D.C.S)	On angular axis control, one of the angular/perpendicular axes is the scale with ref-pos, and the other of them is not the scale with ref-pos. Such system is not admired.
DS0027	MISMATCH OF SYNCHRONOUS AXIS (D.C.S)	Master/slave axes of feed axis synchronization control, one of them is the linear scale with distance-coded reference marks, and the other of them is not the linear scale with distance-coded reference marks. Please establish reference position with the input signal SYNCn<G138>, SYNCJn<G140> or parameter setting to 0.
DS0029	UNAVAILABLE ROT AXIS MOVE IN TPC	In tool posture control, the movement about the rotation axis goes beyond the operation range specified in parameter No. 19741 to 19744). Check the machine configuration and command.

Number	Message	Description
DS0030	TOOL DIRC CMP IMPOSSIBLE	With a 5-axis machine, to perform workpiece installation error compensation or tool tip control in the tilted working plane command mode, when tool direction compensation is performed according to the setting of parameter No. 11200#0 (RCM) to 1, the rotation axis position cannot be obtained.
DS0050	TOO MANY SIMULTANEOUS AXES	A movement was performed along more axes than can be controlled by simultaneous axis control. Check whether a command in the program is specified for more axes than can be controlled by simultaneous axis control.
DS0059	SPECIFIED NUMBER NOT FOUND	[External data I/O] 1) The No. specified for a program No. or sequence No. search could not be found. 2) There was an I/O request issued for a pot No. or offset (tool data), but either no tool numbers have been input since power ON or there is no data for the entered tool No. 3) There is no tool data that corresponds to the input tool number. [External workpiece No. search] 1) The program corresponding to the specified workpiece No. could not be found.
DS0070	SUPERIMPOSE FOR HIGH-SPEED CYCLE CANNOT BE USED	Superimposed control for high-speed cycle machining is not enabled. Alternatively, the status is not the advanced superimposition state.
DS0071	START OR RELEASE CANNOT BE DONE	1) To start or cancel the inter-path flexible synchronous mode, the tool must be stopped along all axes. 2) To start or cancel advanced superimposition, movement along axes must stop.
DS0072	MANUAL REFERENCE RETURN CANNOT BE DONE	Manual reference position return cannot be performed in the advanced superimposition state.
DS0131	TOO MANY MESSAGE	An attempt was made to display an external operator message or external alarm message, but five or more displays were required simultaneously.
DS0132	MESSAGE NUMBER NOT FOUND	An attempt to cancel an external operator message or external alarm message failed because the specified message number was not found.
DS0133	TOO LARGE NUMBER	A value other than 0 to 4095 was specified as the external operator message or the external alarm message number.
DS0300	APC ALARM: NEED REF RETURN	A setting to zero position for the absolute position detector (association with reference position and the counter value of the absolute position detector) is required. Perform the return to the reference position. This alarm may occur with other alarms simultaneously. In this case, other alarms must be handled first.
DS0306	APC ALARM: BATTERY VOLTAGE 0	The battery voltage of the absolute position detector has dropped to a level at which data can no longer be held. Or, the power was supplied to the Pulsecoder for the first time. The battery or cable is thought to be defective. Replace the battery with the machine turned on.
DS0307	APC ALARM: BATTERY LOW 1	The battery voltage of the absolute position detector has dropped to a level at which a replacement is required. Replace the battery with the machine turned on.
DS0308	APC ALARM: BATTERY LOW 2	The battery voltage of the absolute position detector dropped to a level at which a replacement was required in the past. (including during power off) Replace the battery with the machine turned on.

Number	Message	Description
DS0309	APC ALARM: REF RETURN IMPOSSIBLE	An attempt was made to set the zero point for the absolute position detector by MDI operation when it was impossible to set the zero point. Rotate the motor manually at least one turn, and set the zero position of the absolute position detector after turning the CNC and servo amplifier off and then on again.
DS0310	NOT ON RETURN POINT	The return position recorded during retraction is not reached during recovery. The position may be displaced during recovery due to a machine lock or mirror image. Perform the operation again after making a reset.
DS0405	ZERO RETURN END NOT ON REF	The axis specified in automatic zero return was not at the correct zero point when positioning was completed. Perform zero return from a point whose distance from the zero return start position to the zero point is 2 or more revolutions of the motor. Other probable causes are: - The positional deviation after triggering the deceleration dog is less than 128. - Insufficient voltage or malfunctioning Pulsecoder.
DS0608	SV COOLING FAN FAILURE	Internal agitating fan failure.
DS0609	SV RADIATOR FAN FAILURE	Radiator cooling fan failure.
DS0610	PS INTERNAL FAN FAILURE	Internal agitating fan failure.
DS0611	PS EXTERNAL FAN FAILURE	External radiator cooling fan failure.
DS0612	PS OVERLOAD	Overheat
DS0613	PS IMPROPER INPUT POWER	Input power supply fault
DS0651	ACC.ERROR	Communication between the separate detector interface unit and acceleration sensor was disconnected.
DS1120	UNASSIGNED ADDRESS (HIGH)	The upper 4 bits (EIA4 to EIA7) of an external data I/O interface address signal are set to an undefined address (high bits).
DS1121	UNASSIGNED ADDRESS (LOW)	The lower 4 bits (EIA0 to EIA3) of an external data I/O interface address signal are set to an undefined address (low bits).
DS1124	OUTPUT REQUEST ERROR	OUTPUT REQUEST ERROR An output request was issued during external data output, or an output request was issued for an address that has no output data.
DS1128	DI.EIDLL OUT OF RANGE	The numerical value input by external data input signals EID0 to EID31 has exceeded the permissible range.
DS1130	SEARCH REQUEST NOT ACCEPTED	No requests can be accepted for a program No. or a sequence No. search as the system is not in the memory mode or the reset state.
DS1131	EXT-DATA ERROR (OTHER)	[External Data I/O] An attempt was made to input tool data for tool offset by a tool No. during loading by the G10 code.
DS1150	A/D CONVERT ALARM	A/D converter malfunction
DS1184	PARAMETER ERROR IN TORQUE	An invalid parameter was set for torque control. The torque constant parameter is set to "0".
DS1185	OVER MAXIMUM FEED	The maximum cutting feedrate or rapid traverse feedrate was exceeded in G54.3.

Number	Message	Description
DS1448	ILLEGAL PARAMETER (D.C.S)	The setting value of parameter for reference marks is satisfied the following any conditions. 1) The absolute-position detection function is enabled. 2) Either parameter 1821 (mark-1 interval) or parameter 1882 (mark-2 interval) is set to 0. 3) Parameters 1821 and 1882 have identical settings. 4) The difference between the settings made for parameters 1821 and 1882 is greater than or equal to twice either setting. 5) The setting value of parameters 1883 and 1884 are over the valid data range.
DS1449	REFERENCE MARKS ARE DIFFERENT FROM PARAMETER	In case of distance coded linear scale I/F, the actual interval of reference marks is different from parameter (No.1821,1882) setting value.
DS1450	ZERO RETURN NOT FINISHED	1st reference position return (CDxX7 to CDxX0: 17h (Hex)) was specified when the manual reference position return was not executed with the reference position return function enabled (parameter ZRN (No. 1005#0) set to "0").
DS1451	IMPROPER PMC AXIS COMMAND	The PMC axes cannot be controlled in this state.
DS1512	EXCESS VELOCITY	The feedrate of the linear axis during polar coordinate interpolation exceeded the maximum cutting feedrate.
DS1514	ILLEGAL MOTION IN G12.1 MODE	In a hypothetical axis direction compensation during the polar coordinate interpolation mode, an attempt is made to travel to the area in which the travel cannot be made.
DS1553	EXCESS VELOCITY IN G43.4/G43.5	The axis rate attempted to exceed the maximum cutting feedrate and travel by the pivot tool length compensation.
DS1710	ILLEGAL ACC. PARAMETER (OPTIMUM TORQUE ACC/DEC)	There are errors in the parameters of permissible acceleration for Optimum Torque Acceleration/Deceleration. One of the following is the cause. 1) The ratio of the acceleration for deceleration to the acceleration for the acceleration is lower than the limited value. 2) The time to decelerate to 0 is larger than the maximum.
DS1711	ILLEGAL ACC. PARAMETER (RIGID TAPPING OPTIMUM ACC/DEC)	The permissible acceleration parameter for rigid tapping optimum acceleration/deceleration contains an error. The cause is one of the following: 1) The ratio of the deceleration to the acceleration is less than 1/3. 2) The time required to slow down to a speed of 0 exceeds the maximum. 3) The maximum acceleration (parameters Nos. 11421 to 11424) is 0.
DS1931	MACHINE PARAMETER INCORRECT	One of parameters Nos. 19665 to 19667 and Nos.19680 to 19744 used to configure the machine contains an error.
DS1932	DI.THML SIGNAL ON	One of the parameters used to configure the machine is rewritten while the tool direction thermal displacement compensation function is enabled.
DS1933	NEED REF RETURN (SYNC:MIX:OVL)	The relation between a machine coordinate of an axis in synchronization, composition, or superposition control, and the absolute, or relative coordinate was displaced. Perform the manual return to the reference position.
DS2003	ILLEGAL USE FOR SERVO MOTOR SPINDLE	The servo axes for spindle use of the spindle control with servo motor was used by the following functions. 1) PMC axis control 2) Chopping

Number	Message	Description
DS5340	PARAMETER CHECK SUM ERROR	Since a parameter was changed, the parameter checksum did not match the reference checksum. Set the original value to the parameter or set the reference checksum again.
DS5387	CAN NOT START REFERENCE RETURN WITH MECHANICAL STOPPER SETTING	The slave axis is not within the in-position width, for example, when the distance between the mechanical stoppers for the master and slave axes is larger than the withdrawal distance specified in parameter No. 7181 or 7182 for the master axis. Adjust the position of the mechanical stoppers or the setting of parameter No. 7181 or 7182.
DS5550	AXIS IMMEDIATE STOP	The movement along an axis was stopped immediately by the axis immediate stop function.

(12) Malfunction prevention function alarms (IE alarm)

Number	Message	Description
IE0001	+ OVERTRAVEL (SOFT 1)	The malfunction prevention function detected that stored stroke check 1 on the positive side was exceeded.
IE0002	- OVERTRAVEL (SOFT 1)	The malfunction prevention function detected that stored stroke check 1 on the negative side was exceeded.
IE0003	+ OVERTRAVEL (SOFT 2)	The malfunction prevention function detected that stored stroke check 2 on the positive side was exceeded.
IE0004	- OVERTRAVEL (SOFT 2)	The malfunction prevention function detected that stored stroke check 2 on the negative side was exceeded.
IE0005	+ OVERTRAVEL (SOFT 3)	The malfunction prevention function detected that stored stroke check 3 on the positive side was exceeded.
IE0006	- OVERTRAVEL (SOFT 3)	The malfunction prevention function detected that stored stroke check 3 on the negative side was exceeded.
IE0007	EXCESS MAXIMUM REV. DATA	The malfunction prevention function detected the command in which a value exceeding the maximum speed was specified.
IE0008	ILLEGAL ACC/DEC	The malfunction prevention function detected the acceleration/deceleration error.

D.2 DUAL CHECK SAFETY ALARM

The following alarms, which are related to the dual check safety function that ensures machine safety, may occur.

Number	Message	Description
PW0010	SAFE I/O CROSS CHECK ERROR(DCS PMC)	The 2-path safe I/O signal monitoring function detected inconsistencies between signals for more than a certain period of time. (G/F signals)
PW0011	SAFE I/O CROSS CHECK ERROR(PMC)	
PW0012	USER I/O CROSS CHECK ERROR(DCS PMC)	The 2-path safe I/O signal monitoring function detected inconsistencies between signals for more than a certain period of time. (X/Y signals)
PW0013	USER I/O CROSS CHECK ERROR(PMC)	
SV0476	ILLEGAL SPEED CMD.(SV)	It was detected that the velocity specified in the velocity command exceeded the safe speed with the door open on the n-axis. (Related parameter No. 1434)
SV0494	ILLEGAL SPEED CMD.(CNC)	
SV1068	DUAL CHECK SAFTY ALARM	The dual check safety function issued an alarm that turns the MCC of the entire system off.
SP0757	SAFTY SPEED OVER	It was detected that the motor speed of the spindle exceeded the safe speed with the door open on the spindle. (Maximum speed when the door is open: 200 min^{-1})
SP9016	SAFTY SPEED OVER	

When one of the above alarms occurs, open the dual check safety screen described below and check alarm information or other data.

In particular, when one of alarms PW0010 to PW0013 occurs, open the cross check data screen and check and note the data displayed on the alarm information screen (1/5).

When the same alarm occurs after the power is tuned on again, inform FANUC of details of the alarm and details of alarm information of dual check safety indicated on the alarm screen and the situation in which the alarm occurs (how the alarm occurs).

For other alarms related to dual check safety, refer to Section 11.29 in Part II in the "FUNUC ROBODRILL α-D14*i*A5/D21*i*A5 Series Maintenance Manual (B-85315EN)".

D.2.1 Diagnosis Using the Dual Check Safety Function

The diagnosis screen for the maintenance operation of the Dual Check Safety function is displayed in the group of [SYSTEM] screens.
The operation to select the Dual Check Safety diagnosis screen is as a follows:

(For the operator's panel of full keyboard type)
Press the

key.

(For the operator's panel of standard type)
Press the

+

or

.

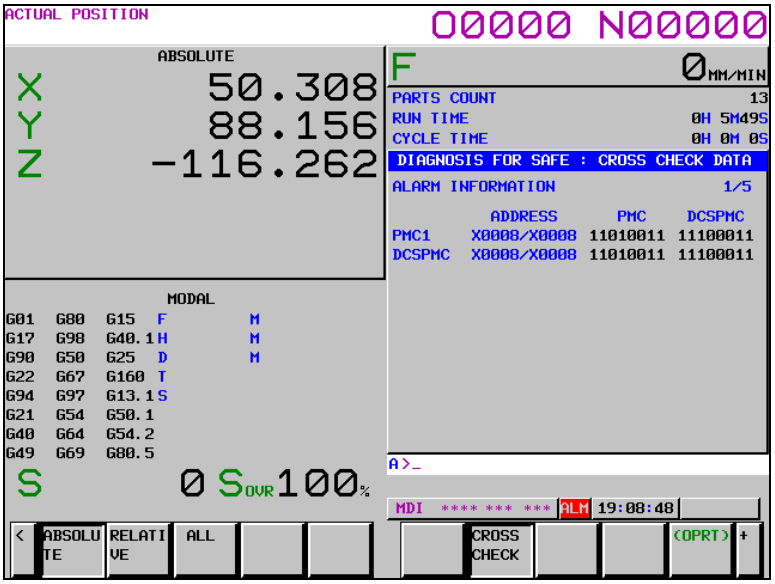
Press the continuous menu key [+] key several times then the [DUAL CHECK] soft key is displayed.
Press the [DUAL CHECK] soft key then the Dual Check Safety diagnosis screen is displayed.

This screen displays the signal state in the event of a safety-related alarm, as well as other relevant information such as the cause of the alarm.

D.2.2 CROSS CHECK DATA Screen

The CROSS CHECK DATA screen displays

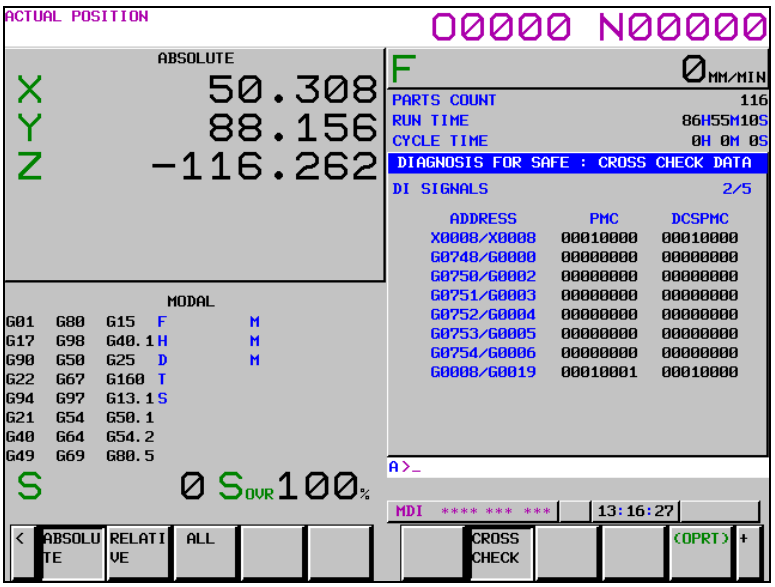
(1) "ALARM INFORMATION" screen
Press the [CROSS CHECK] soft key then the screen shown below appears.
This screen shows the DI/DO status when the cross check alarm occurs.



(2) "DI SIGNAL STAUS" screen

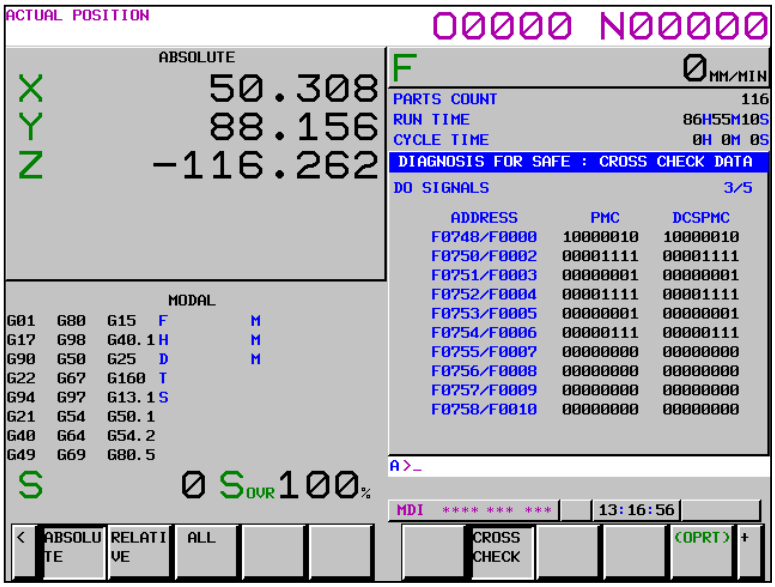
Press the

key and select the second page. The screen shown below appears. This screen shows the current DI status. If there is difference of DI state between PMC and DCS PMC, "#" is displayed on the left side of the address.



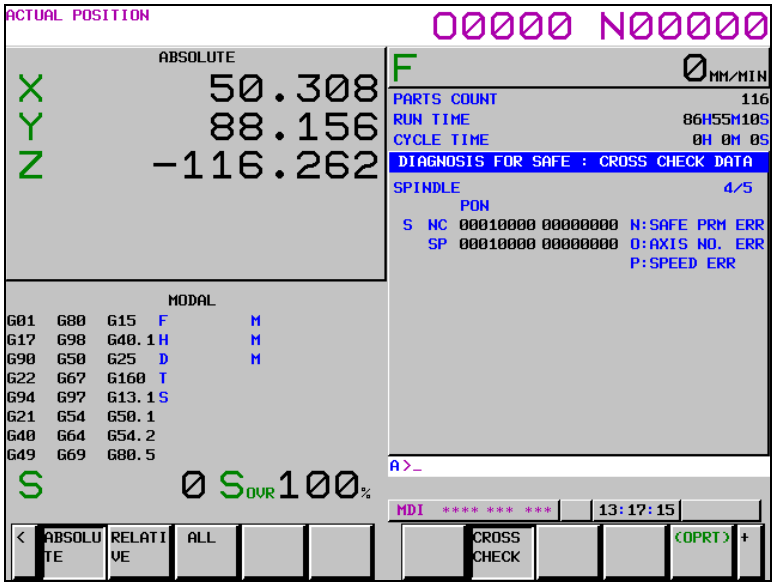
(3) “DO SIGNAL STATUS” screen

Press the N. PAGE key and select the third page. The screen shown below appears. This screen shows the current DO status. If there is difference of DO state between PMC and DCS PMC, "#" is displayed on the left side of the address.



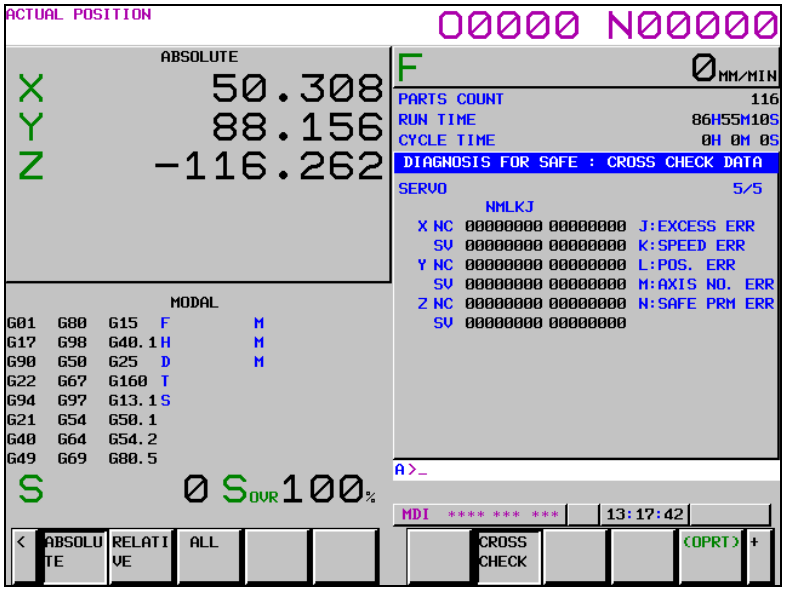
(4) “SPINDLE STATUS” screen

Press the N. PAGE key and select the fourth screen. The screen shown below appears. When the judging result of safety function of CNC is not the same as other CPU, the cross check alarm occurs. This screen shows the cause of cross check alarm related to a spindle.



(5) “SERVO STATUS” screen

Press the N. PAGE key and select the fifth page. The screen shown below appears. When the judging result of safety function of CNC is not the same as other CPU, the cross check alarm occurs. This screen shows the cause of cross check alarm related to a servo motor.

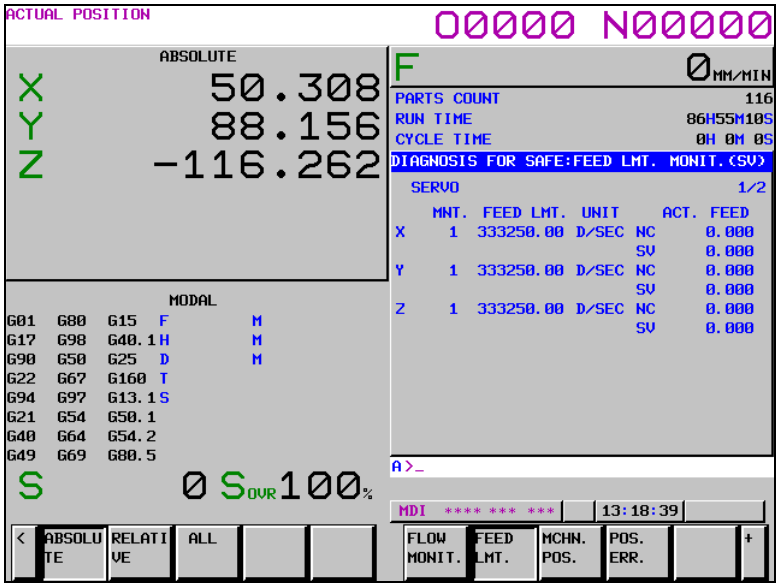


D.2.3 Feed Limit Monitoring Screen

(1) SERVO

The data that are related to the safety limitation feed of the servo and the Dual Check Safety function are displayed.

Press the [FEED LMT.] soft key. The screen shown below appears.



The following items (a) to (d) are displayed for every servo axis.

(a) MNT. 0:Not Monitoring / 1:Monitoring

(b) FEED LMT. In the safety limitation feed 1 to 4 (Set by the parameter No.13821 to No.13829), the safety limit feed that is selected by the Safety speed/Safety Position Selection signal A,B(SVAx, SVBx) is displayed

(c) UNIT Unit of feed (Position control:D/sec Velocity control:min^{-1})

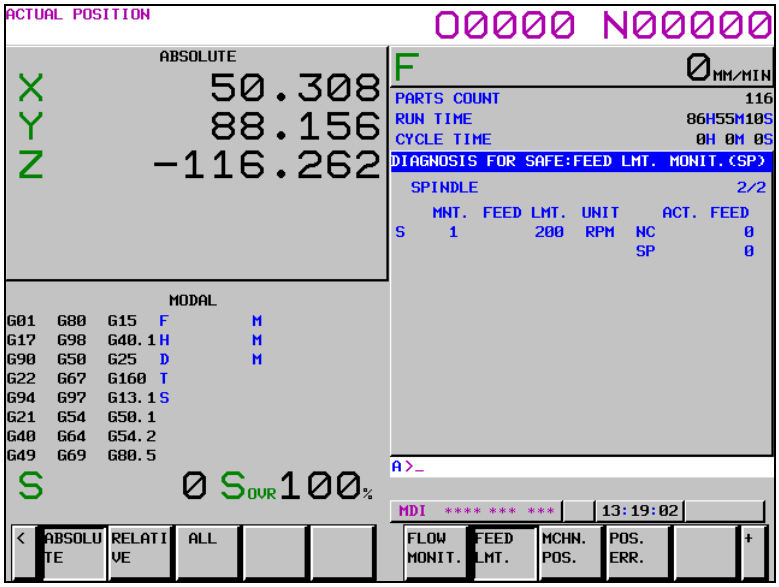
(d) ACT. FEED Current actual feed rate (NC side and Servo side)

(2) SPINDLE

The data that are related to the safety limitation feed of the spindle and the Dual Check Safety function are displayed.

Press the

key, the screen of the Safety limitation feed of the spindle shown below appears.



The following items (a) to (d) are displayed for every spindle axis.

(a) MNT. 0:Not Monitoring / 1:Monitoring

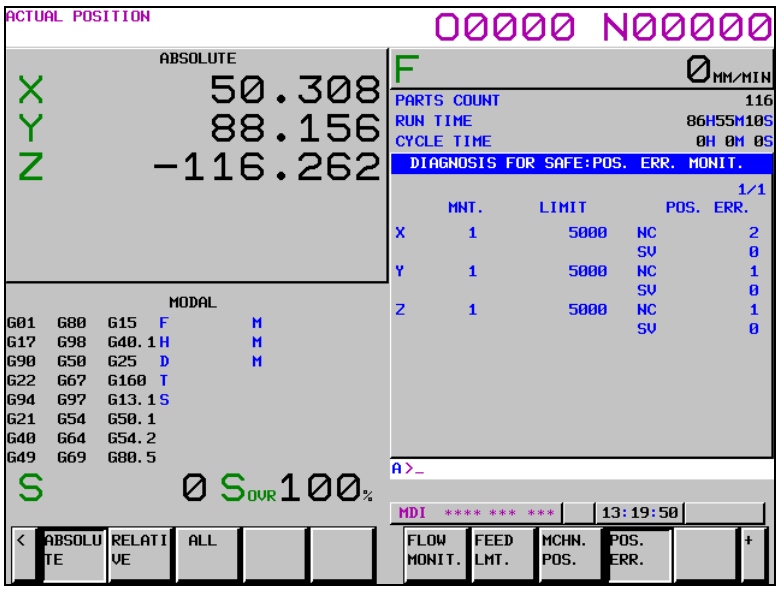
(b) FEED LMT. In the Safety feed limit 1 to 4 (Set by the parameter No.4372, No.4438, No.4440 to No.4442), the safety limit feed that is selected by the Safety speed/Safety Position Selection signal A,B (SPAx, SPBx) is displayed

(c) UNIT Unit of the feed (min^{-1})

(d) ACT. FEED Current actual feed rate(NC side and Spindle side)

D.2.4 Safety Position Error Monitoring Screen

The data that are related to the safety position error monitoring of the Dual Check Safety function are displayed.
Press the [POS. ERR.] soft key. The screen shown below appears.



The following items (a) to (c) are displayed for every servo axis.

(a) MNT. 0:Not Monitoring / 1:Monitoring/-: The reference position is not established

(b) LIMIT In the safety positioning error, the limit values corresponding to the current state (Stopping/Moving/Servo off) are displayed.

(c) POS. ERR. Current positioning error (NC side and Servo side)

D.3 ALARM LIST (PMC)

D.3.1 Messages That May Be Displayed on the PMC Alarm Screen

The following table lists the PMC alarm messages that may be displayed on the PMC alarm screen.

Alarm message	Faulty location/corrective action	Contents
ER01 PROGRAM DATA ERROR	(1) Enter the sequence program again. (2) If this error recurs even after you have entered the sequence program again, the error may be due to a hardware fault. In that case, contact us.	The sequence program is invalid.
ER02 PROGRAM SIZE OVER	(1) Reduce the size of the sequence program. (2) Contact us, and specify a ladder step count option that allows you to set a larger program size.	The sequence program is too large. The sequence program is invalid.
ER03 PROGRAM SIZE ERROR (OPTION)	(1) Reduce the size of the sequence program. (2) Contact us, and specify a ladder step count option that allows you to set a larger program size.	The sequence program exceeds the size specified by the ladder step count option.
ER04 PMC TYPE UNMATCH	Change the sequence program so that it specifies the adequate PMC type, by using the programmer.	The PMC type specified in the sequence program does not match the type of the PMC actually in use.
ER07 NO OPTION(LADDER STEP)	Contact us, and specify a ladder step count option that allows you to set a larger program size.	No ladder step count option is found.
ER08 OBJECT UNMATCH	Contact us.	An unsupported function is used in the sequence program.
ER09 PMC LABEL CHECK ERROR. PLEASE TURN ON POWER AGAIN WITH PRESSING 'O'&'Z'. (CLEAR PMC SRAM)	(1) Turn on the power of the CNC again, by holding down the 'O' and 'Z' keys at the same time. (2) Replace the backup batteries.	The nonvolatile memory of the PMC system needs to be initialized in such cases as when you have changed the PMC model.
ER17 PROGRAM PARITY	(1) Enter the sequence program again. (2) If this error recurs even after you have entered the sequence program again, the error may be due to a hardware fault. In that case, contact us.	The parity of the sequence program is invalid.
ER18 PROGRAM DATA ERROR BY I/O	Enter the sequence program again.	An interrupt was specified while the sequence program was being read.
ER19 LADDER DATA ERROR	Display the LADDER DIAGRAM EDITOR screen again, and terminate the editing operation by pressing the [EXIT] soft key.	A function key was pressed during the editing of the ladder program, causing a switch to the CNC screen.
ER22 NO PROGRAM	Enter the sequence program again.	The sequence program is empty.
ER27 LADDER FUNC. PRM IS OUT OF RANGE	Correct the sequence program; change the parameter number specified in a functional instruction to a value that is within the allowable range.	An out-of-range parameter number is specified in the TMR, TMRB, CTR, CTRB, DIFU, or DIFD functional instruction.
ER33 I/O Link ERROR(CHn) (Note 3)	Contact us; replace the faulty hardware.	The LSI for the I/O Link is faulty.

Alarm message	Faulty location/corrective action	Contents
ER34 I/O Link ERROR(CHn Gxx) (NOte 1) (Note 3)	(1) Check the cable connections to the devices of group xx. (2) Check whether the power of each I/O device has been turned on before the CNC. (3) Replace any device of group xx in which the PMC control module is embedded.	An I/O device communication error occurred on the slave side of group xx.
ER35 TOO MUCH OUTPUT DATA IN GROUP(CHn Gxx) (NOte 1) (Note 3)	Reduce the output data count of group xx.	The output data count of I/O Link group xx exceeds the upper limit (33 bytes). Alternatively, the output data count of I/O Link *i* group xx exceeds the upper limit (65 bytes by default or 29 bytes for the safety I/O device). The superfluous data is regarded as invalid.
ER36 TOO MUCH INPUT DATA IN GROUP(CHn Gxx) (Note 1) (Note 3)	Reduce the input data count of group xx.	The input data count of I/O Link group xx exceeds the upper limit (33 bytes). Alternatively, the input data count of I/O Link *i* group xx exceeds the upper limit (65 bytes by default or 29 bytes for the safety I/O device). The superfluous data is regarded as invalid.
ER37 TOO MUCH SLOT IN BASE(CHn) (Note 3)	Correct the slot number to a value of 10 or less.	The slot number for the I/O Link exceed the upper limit (10). The slot number larger than 11 is regarded as invalid.
ER38 MAX SETTING OUTPUT DATA OVER(CHn Gxx) (Note 1) (Note 3)	Reduce the total amount of output data of all groups to 128 bytes or less. For I/O Link *i*, reduce the total amount of output data of all groups to 256 bytes or less.	The I/O area for the I/O Link is insufficient. (The area allocated to the group xx and later on the output side is regarded as invalid.) Alternatively, for I/O Link *i*, the I/O area is insufficient when the high-speed mode is not selected for the transfer cycle.
ER39 MAX SETTING INPUT DATA OVER(CHn Gxx) (Note 1) (Note 3)	Reduce the total amount of input data of all groups to 128 bytes or less. For I/O Link *i*, reduce the total amount of output data of all groups to 256 bytes or less.	The I/O area for the I/O Link is insufficient. (The area allocated to the group xx and later on the input side is regarded as invalid.) Alternatively, for I/O Link *i*, the I/O area is insufficient when the high-speed mode is not selected for the transfer cycle.
ER43 PROGRAM DATA ERROR (PT/NT)	<1> Store sequence program which is compiled again after recompilations using FANUC LADDER-III. <2> If you see the same alarm again after <1>, contact us.	The sequence program is invalid.。

Alarm message	Faulty location/corrective action	Contents
ER44 INCOMPATIBLE HARDWARE (EXTENDED PMC LADDER INSTRCTION FUNCTION)	Contact us. Replace it with a hardware unit that supports the extended PMC ladder instruction function.	This hardware structure does not support the extended PMC ladder instruction function.
ER45 NO OPTION(FUNCTON BLOCK)	Add a required function block option.	No function block option is specified
ER46 MESSAGE DATA UPDATE ERROR. PLEASE TRUN OFF POWER AFTER SAVING DATA.	Save the corrected sequence program or message data for multi-language display to F-ROM. Moreover, turn the power off/on.	The message data in the sequence program or the message data for multi-language display cannot be updated. It is necessary to turn off/on the power. The ladder program cannot be executed when this alarm occurs.
ER47 ILLEGAL OVERRIDE FUNCTION SETTING (TOO MANY PMC PATHS)	The “override mode” of the forced I/O function is available for up to three paths simultaneously. Make the “override mode” of the forced I/O function for several PMC paths and restart the CNC.	The “override mode” of the forced I/O function is enabled for four or more PMC paths.
ER48 STEP SEQUENCE TIME OVER(xxH)	On the time monitoring setting screen, delete the setting that exceeded the set time.	The step sequence activation time exceeded the time set on the time monitoring screen.
ER50 PMC EXECUTION ORDER ERROR	Check CNC parameter Nos. 11900 to 11904.	The set execution order of the multi-PMC function is invalid.
ER51 PMC EXECUTION PERCENTAGE ERROR	Check CNC parameter Nos. 11905 to 11909.	The set execution percentage of the multi-PMC function is invalid.
ER52 I/O Link CHANNEL ASSIGNMENT ERROR (Note 3)	Check CNC parameter Nos. 11910 to 11912.	The I/O Link channel assignment to the PMC system is invalid.
ER54 NC-PMC I/F ASSIGNMENT ERROR	Check CNC parameter Nos. 11920 to 11929.	The interface assignment between NC and PMC is invalid.
ER55 LEVEL1 EXECUTION CYCLE ERROR	Check CNC parameter No. 11930.	The set ladder level 1 execution cycle is invalid.
ER57 MULTI PATH PMC I/F ASSIGNMENT ERROR	Check CNC parameter No. 11932.	Assignment of PMC path interface is illegal.
ER58 PMC MEMORY TYPE SETTING ERROR	Check CNC parameter Nos. 11940 to 11944.	Setting of the PMC memory type is illegal.
ER60 I/O Link i ERROR(CHn) (Note 3)	Contact us; replace the faulty hardware.	The LSI for the I/O Link *i* is faulty.
ER61 I/O Link i ERROR(CHn Gxx) (Note 1) (Note 3)	(1) Check the cable connections to the devices of group xx. (2) Check whether the power of each I/O device has been turned on before the CNC. (3) Replace any device of group xx in which the PMC control module is embedded.	An I/O device communication error occurred on the slave side of group xx.
ER62 I/O Link i DCS ERROR (Note 3)	Contact us; replace the faulty hardware.	The LSI for the I/O Link *i* DCS is faulty.

Alarm message	Faulty location/corrective action	Contents
ER63 I/O Link CHANNEL SETTING ERROR (Note 3)	(1) Change the communication system so that its channel structure has a smaller number of I/O points. The communication system of each channel is specified by bit 0 or 1 of NC parameter No. 11933. (2) The channel that is not used should be disabled by setting bit 5 or 6 of NC parameter No. 11933 to 1.	The number of I/O points has exceeded 4096/4096. For the I/O Link, the points are 1024/1024 per channel. For I/O Link *i*, they are 2048/2048 per channel.
ER64 I/O Link i TOO MANY CONNECTED GROUPS(CHn) (Note 3)	Reduce the number of connected I/O devices to 24 or less.	In CHn, 25 or more I/O devices are connected.
ER65 I/O Link i TOO MANY SLOTS(CHn) (Note 3)	Reduce the number of connected I/O device modules to 256 or less.	In CHn, 257 or more slots of I/O device modules are connected.
ER66 I/O Link i PMC ADDRESS OVERLAPPED (PMCm X(Y)nnnn) (Note 3)	Enter the PMC address or size again so that any address is not used by multiple PMCs that share PMC memory.	I/O Link *i* assignment data is allocated at the PMCm X(Y)nnnn address and X(Y)nnnn address of the PMC for which the PMC memory share mode is set.
ER67 I/O Link i TOO MANY SAFETY I/O GROYPS (Note 3)	Reduce the group number of safety I/O.	The total group number of safety I/O in PMC paths exceed 4 or the total group number of safety I/O in DSCPMC exceed 4 for I /O Link *i*.
ER68 I/O Link i TOO MANY ASSIGNMENTS IN HIGH SPEED MODE (CHn,Gyy) (Note 1) (Note 3)	When a high-speed mode group is present in a transfer cycle of I/O Link *i*, a modification is made with reference to Subsection 3.6.4, "Transfer Cycle" so that each group fits in the 4-divided transfer timing.	In CHn, assignment could not be made to group yy and following because the transfer capacity limit was exceeded in transfer timing assignment processing when the high-speed mode of I/O Link *i* is used.
ER69 I/O Link i ASSIGNMENT ADDRESS INVALID(CHn Gyy) (Note 2) (Note 3)	Modify I/O Link *i* assignment data.	I/O Link *i* assignment data for group yy in CHn contains a nonexistent PMC path address. (Alternatively, the address of the M-NET converter is assigned.)
ER70 PMC ADDRESS BLOCK OVERLAPPED BETWEEN I/O Link AND I/O Link i(PMCm X(Y)nnnn) (Note 3)	(1) Delete the relevant I/O Link *i* assignment or change the assignment address. (2) Change the PMC address block of the relevant I/O Link channel. (Machine signal interface setting) (3) Check the I/O Link communication mode. (NC parameter No. 11933#0, #1) (4) Check the setting of the I/O Link *i* assignment selection function.	The I/O Link and I/O Link *i* are assigned to the same PMC address block.
ER71 I/O Link i STATUS ALARM LENGTH OVER IN GROUP(CHn Gxx) (Note 1)	Modify the I/O device configuration so that the total length of status alarm data does not exceed 64 bytes.	The total length of status alarm data for I/O device modules connected to group xx of CHn exceeds the limit (64 bytes).
ER89 EDITING I/O CONFIGURATION DATA IS NOT COMPLETED	Complete the editing of I/O configuration data.	I/O configuration data is invalid because it is being edited.

Alarm message	Faulty location/corrective action	Contents
ER90 TOO LARGE I/O CONFIGURATION DATA (Note 3)	Reduce the size of the I/O configuration file.	I/O configuration data is larger than the save area.
ER91 I/O CONFIGURATION DATA PARITY (Note 3)	(1) Enter the I/O configuration file again. (2) If this error still occurs after reentry, a hardware failure may occur. Contact us.	The parity of I/O configuration data is invalid.
ER92 I/O CONFIGURATION DATA ERROR BY I/O	Enter the I/O configuration file again.	Reading the I/O configuration file was interrupted.
ER93 UNSUPPORTED I/O CONFIGURATION DATA (Note 3)	Modify the type of I/O configuration data and enter the data again.	I/O configuration data is of an unrecognizable type.
ER94 I/O CONFIGURATION DATA ERROR (Note 3)	Compile the I/O configuration data using FL-III again and enter it again.	A data structure error was found in I/O configuration data.
ER95 IO DEVICE MISMATCH(CHn) (Note 3)	When this alarm is issued with a machine which has operated normally, possible causes are: (1) The communication cable is broken or a connection failure occurs in the cable. (2) The power to an I/O device is off or is turned on too late. (3) A failure occurs in an I/O device. (4) When the power to the CNC is turned off, then on again, the power to an I/O device is kept on. When turning the power to the CNC off, then on again, be sure to turn the power to all I/O devices off, then on. When this alarm is issued during debugging of a sequence program, there are the following possible causes in addition to the above: (5) The connected I/O device configuration (type, sequence, or number of units) is invalid. (6) An invalid I/O device configuration is registered. When this alarm is issued, any inconsistent I/O device can be checked in the “I/O Device Monitor screen”.	This alarm is issued when the I/O devices actually connected to the CNC is inconsistent with the I/O device configuration registered in the I/O device connection diagnosis screen. All I/O devices connected to the channel for which this alarm was issued are not linked. The ladder program is run even when this alarm is issued.
ER96 I/O Link MAX GROUP OVER (CHn) (Note 3)	(1) Check the PMC paths and addresses of blocks 1 and 2 in channel n in the CONFIG PARAM screen. (2) Check the total number of groups in blocks 1 and 2 in I/O module allocation setting. (3) Check the parameter setting for the Selectable I/O Link assignment function.	When 2-path allocation for the I/O Link channel is used, the total number of groups in blocks 1 and 2 exceeds 16. All I/O devices connected to the channel for which this alarm was issued are not linked. The ladder program is run even when this alarm is issued.

Alarm message	Faulty location/corrective action	Contents
ER97 I/O Link FAILURE(CHn Gxx) (Note 1) (Note 3)	When this alarm is issued with a machine which has operated normally, possible causes are: (1) The communication cable from group yy-1 to group yy is broken or a connection failure occurs in the cable. (2) The power to an I/O device in group yy or following is off or is turned on too late. (3) A failure occurs in an I/O device in group yy or yy-1. (4) When the power to the CNC is turned off, then on again, the power to an I/O device is kept on. When turning the power to the CNC off, then on again, be sure to turn the power to all I/O devices off, then on. When this alarm is issued during debugging of a sequence program, there are the following possible causes in addition to the above: (5) The number of groups of connected I/O devices is invalid. (6) The I/O module allocation setting is invalid. (7) The parameter setting for the I/O Link assignment data selection function is invalid. (8) The machine signal interface is invalid. When this alarm is issued, details can be checked in the “I/O Device Monitor screen”.	This alarm is generated if the number of I/O units is insufficient. This alarm is generated if the number of I/O units, set with the I/O module allocation and I/O link allocation selection functions differs from the number of I/O units actually connected to the CNC. All I/O devices connected to the channel for which this alarm was issued are not linked. The ladder program runs regardless of the occurrence of this alarm.
WN02 OPERATE PANEL ADDRESS ERROR	Correct the Series 0 operator's panel address that is set in the PMC system parameter.	The Series 0 operator's panel address that is set in the PMC system parameter is invalid.
WN03 ABORT NC-WINDOW/EXIN	Correct the ladder program and turn on the power of the CNC again. For details, see Section 4.15.	The ladder program was stopped while communication was in progress between CNC and PMC. This alarm may cause the WINDR, WINDW, EXIN, and DISPB functional instructions to malfunction.
WN07 LADDER SP ERROR (STACK)	Correct the sequence program so that the subprogram has eight or fewer levels of nesting.	There are too many levels of nesting (levels more than 8) for the CALL or CALLU functional instruction to call the subprogram.

Alarm message	Faulty location/corrective action	Contents
WN09 SEQUENCE PROGRAM IS NOT WRITTEN TO FLASH ROM	If you want to use a changed sequence program again next time you power on the system, write the sequence program to flash ROM. If you have made any unwanted change to the sequence program by mistake, read the original sequence program from flash ROM.	You have changed the sequence program using the LADDER DIAGRAM EDITOR screen or DATA I/O screen, but you have not yet written the changed sequence program to flash ROM. If you shut down the system without writing the changed sequence program to flash ROM, the changes you have made will be nowhere next time you turn on the power.
WN10 NO OPTION (STEP SEQUENCE)	(1) Add the step sequence option. (2) Arrange so that the step sequence subprogram will not be called.	No step sequence option was found when the system attempted to execute a step sequence.
WN11 INCOMPATIBLE FUNCTION	Re-compile the program, using FANUC LADDER-III or a ladder editing package.	There is a functional instruction that does not conform to this PMC.
WN57 OVERRIDE FUNCTION IS ACTIVE	The Override function is for debugging only. So, please disable the function when shipping the machine.	The Override function is activated.
WN58 UNSUPPORTED FUNCTION	Modify the program, using the built-in ladder editing function.	There is an unsupported functional instruction. This instruction was not processed.
WN59 MESSAGE FILE SYMBOL UNDEFINED	Correct the error in the message file for multi-language display.	In the message file for multi-language display, a symbol that does not exist in the ladder is defined.
WN60 MESSAGE FILE SYMBOL INVALID	Correct the error in the message file for multi-language display.	In the message file for multi-language display, a symbol other than an A address is defined.
WN61 MESSAGE FILE ADDRESS DUPLICATE	Correct the error in the message file for multi-language display.	An A address is defined more than once in a symbol and an address or in symbols.
WN62 MESSAGE FILE NUMBER ERROR	Correct the error in the message file for multi-language display.	For the same A address, the message number in the ladder differs from that in the message file for multi-language display.
WN63 MESSAGE FILE IS NOT WRITTEN TO FLASH ROM	If you want to use the current message file for multi-language display the next time you turn on the power, write the message file to the flash ROM.	On the data I/O screen, the message data for multi-language display was changed, but the changed message data for multi-language display is not yet written to the flash ROM. The changed message data for multi-language display will be lost the next time the power is turned on.
WN64 MESSAGE FILE SIZE OVER	(1) Reduce the message file for multi-language display. (2) Contact us, and specify an option of a larger size.	The message file for multi-language display is larger than the program storage area. The message file for multi-language display is illegal.
WN65 MESSAGE FILE MISMATCH	Contact us.	An unsupported function is used in the message file for multi-language display.

Alarm message	Faulty location/corrective action	Contents
WN66 MESSAGE FILE PARITY	(1) Re-enter the message file for multi-language display. (2) If this error recurs even after you have entered the sequence program again, the error may be due to a hardware fault. In that case, contact us.	The parity of the message file for multi-language display is illegal.
WN67 MESSAGE FILE ERROR BY I/O	Re-enter the message file for multi-language display.	Reading the message file for multi-language display was interrupted.
WN68 I/O CONFIGURATION DATA IS NOT WRITTEN TO FLASH ROM	If you want to use changed I/O configuration data again next time you power on the system, write the I/O configuration data to flash ROM.	You have changed I/O configuration data using the I/O configuration data editing or DATA I/O screen, but you have not yet written the changed I/O configuration data to flash ROM. If you shut down the system without writing the changed I/O configuration data to flash ROM, the changes you have made will be nowhere next time you turn on the power.
WN69 I/O Link i DO ALARM (CHn Gxx Syy zz : PMCm Ybbb = **H) (Note 1)	Check DO of the relevant device.	The DO alarm (ex. a short circuit with the ground) occurs at “zz” bytes of slot “yy” of group “xx” in channel “n”. Y “bbbb” of PMC path ”m” is the address at which the alarm occurred. DCSPMC Y”bbbb” is the address for DCSPMC. Display of “PMC*Y****” is the case of occurrence of unassigned address. The “**H” shows some bits at which the alarm occurs by hexadecimal. (Ex. “PMC1Y115=28H” shows the alarm occurs at Y115.3 and Y115.5 in PMC1. “28H” means “00101000” in binary.) For details on alarm information of I/O devices, refer to the "Connection Manual (Hardware)" (B-64483EN for the 30*i*/31*i*/32*i*-B or B-64523 for the 35*i*-B).
WN70 I/O Link i STATUS ALARM (CHn Gxx Syy zz = **H) (Note 1)	Check the alarm information of applied I/O device.	The status alarm except for the DO alarm occurs at “zz” bytes of slot “yy” of group “xx” in channel “n”. The “**H” shows some bits at which the alarm occurs by hexadecimal. For details on alarm information of I/O devices, refer to the "Connection Manual (Hardware)" (B-64483EN for the 30*i*/31*i*/32*i*-B or B-64523 for the 35*i*-B).

NOTE
1 The displayed group number in ER34, ER35, ER36, ER38, ER39, ER61, ER68, ER71, ER97,WN69 and WN70 is wiring number of I/O device.
2 The group number displayed in ER69 is the number of I/O Link i assignment data.
3 When some PMC alarms related to I/O Link and I/O Link i occur, all of I/O devices in all of channels do not be liked with the CNC.

D.3.2 PMC System Alarm Messages

SYS_ALM199 error messages (PMC general)

Alarm message	Faulty location/corrective action	Contents
PC004 CPU INVALID INSTRUCTION -----< ERROR POSITION >----- MAIN BOARD ----------	This alarm may be due to a main board fault.	A CPU error occurred in the PMC system.
PC006 CPU INVALID SLOT INSTRUCTION -----< ERROR POSITION >----- MAIN BOARD ----------		
PC009 CPU ADDRESS ERROR -----< ERROR POSITION >----- MAIN BOARD ----------		
PC010 DMA ADDRESS ERROR -----< ERROR POSITION >----- MAIN BOARD ----------		
PC012 CPU USER BREAK EXCEPTION -----< ERROR POSITION >----- MAIN BOARD ----------		
PC030 RAM PARITY PC030 S-RAM PARITY -----< ERROR POSITION >----- MAIN BOARD ----------		A RAM parity error occurred in the PMC system.
PC060 BUS ERROR -----< ERROR POSITION >----- MAIN BOARD ----------		A bus error occurred in the PMC system.
PC070 ILLEGAL LADDER SPE (PMCm) PC070 LADDER SPE(PMCm) -----< ERROR POSITION >----- MAIN BOARD ----------		A stack error occurred with the SPE functional instruction of the ladder program of m path.
PC071 ILLEGAL LADDER FBE (PMCm) -----< ERROR POSITION >----- MAIN BOARD ----------		A stack error occurred with the FBE instruction of the ladder program of path m.

Alarm message	Faulty location/corrective action	Contents
PC072 STACK OVERFLOW (TASK:xx) PC072 STACK OVERFLOW (INT:xx) -----< ERROR POSITION >----- MAIN BOARD ----------	This alarm may be due to a main board fault.	A stack error occurred (detected by the software).
PC080 SYSTEM EMERGENCY -----< ERROR POSITION >----- MAIN BOARD ----------		System emergency state of the PMC LSI.
PC090 SYSTEM EMERGENCY (SOFTWARE) PC090 NON MASKABLE INTERRUPT (SOFTWARE) PC090 NON MASKABLE INTERRUPT (UNKNOWN) -----< ERROR POSITION >----- MAIN BOARD ----------		An NMI event occurred in the PMC control software for an unknown reason.
PC093 UNEXPECTED INTERRUPT (xx) -----< ERROR POSITION >----- MAIN BOARD ----------		An interrupt occurred in the PMC control software for an unknown reason.
PC094 UNEXPECTED TRAP EXCEPTION (xx) -----< ERROR POSITION >----- MAIN BOARD ----------		A trap exception of unknown cause occurred with the PMC management software.
PC095 MESSAGE CRC ERROR (PMCm) -----< ERROR POSITION >----- MAIN BOARD ----------		A RAM check error occurred.
PC096 LADDER CODE ERROR (___) -----< ERROR POSITION >----- MAIN BOARD ----------		
PC097 LADDER CRC ERROR (PMCm) -----< ERROR POSITION >----- MAIN BOARD ----------		
PC098 PMC SOFTWARE CRC ERROR PC098 PMC SOFTWARE ECC ERROR (_____:_) -----< ERROR POSITION >----- MAIN BOARD ----------		
PC501 CNC/PMC INTERFACE ERROR (PATHx) -----< ERROR POSITION >----- MAIN BOARD ----------		The read or write operation between CNC and PMC failed.

SYS_ALM197 error messages (PMC general)

Alarm message	Faulty location/corrective action	Contents
PC070 ILLEGAL LADDER SPE (DCSPMC) -----< ERROR POSITION >----- CPU CARD ----------	This alarm may be due to a CPU card fault.	A stack error occurred with the SPE functional instruction of the ladder program of DCSPMC.
PC071 ILLEGAL LADDER FBE (DCSPMC) -----< ERROR POSITION >----- CPU CARD ----------		A stack error occurred with the FBE instruction of the ladder program of DCSPMC
PC095 MESSAGE CRC ERROR (PMCm) (DCSPMC) -----< ERROR POSITION >----- CPU CARD ----------		A RAM check error occurred.
PC097 LADDER CRC ERROR (DCSPMC) -----< ERROR POSITION >----- CPU CARD ----------		
PC173 WATCH-DOG ALARM(CNC<->CLB) -----< ERROR POSITION >----- C LANGUAGE BOARD ----------	One possible cause is that the C language board is defective.	The C language board does not operate.

SYS_ALM196 error messages (PMC watchdog)

Alarm message	Faulty location/corrective action	Contents
PC073 WATCH-DOG ALARM(CNC<->PMC) -----< ERROR POSITION >----- MAIN BOARD ----------	This alarm may be due to a main board fault.	The PMC CPU is not running.

SYS_ALM195 error messages (related to the I/O Link)

Alarm message	Faulty location/corrective action	Contents
PC050 I/O LINK ER1 CHn:GRxx:yy COMMUNICATION ALARM AT CHn : GROUP xx -----< ERROR POSITION >----- CHn / GROUPxx ----------	(1) Check the I/O device of group “xx” in channel “n”: – Instantaneous power failure – Unstable power line (2) Check the I/O Link cable between JD1B of group “xx” and JD1A of group “xx-1” – faulty wiring – incomplete contact (3) The I/O Link device of group “xx” in channel “n” is faulty.	An I/O Link communication error occurred. “n” is a channel number (1 to 3). “xx” is a group number (0 to 15). “yy” is a internal error code. This error occurs when the communication with the device of group “xx” in channel “n” is stopped. The causes are as follows: – Instantaneous power failure, unstable voltage or unstable power line of the device – Faulty wiring or incomplete contact of communication cable – Faulty device Please note that It may not show an accurate group number with some conditions of the problem.

Alarm message	Faulty location/corrective action	Contents
PC051 I/O LINK ER2 CHn:yy:xx:ww:vv COMMUNICATION ALARM AT CHn -----< ERROR POSITION >----- CHn ----------	(1) When you use an I/O Unit-Model A, no base extension unit is connected corresponding to an I/O assignment data. Check connection of I/O devices and I/O assignment data. (2) When you use Power Mate as I/O Link slave device and/or Servo Motor Beta series I/O Link option, some system alarm occurs in such devices. (3) A Communication may be influenced by noise. Check the ground wire and the shield of the communication cables. (4) The output of the I/O Link devices is short-circuited. (5) The power of the I/O Link master and/or slave devices is faulty. – Instantaneous power failure – Unstable power line (6) Incomplete contact of the communication cable (7) Faulty wiring of the communication cable (8) Check the grounding of the shield wire of the earth terminal or the communication cable of I/O devices. (9) I/O Link devices are faulty. (10) I/O Link master is faulty. n=1,2: main board n=3: CPU card	An I/O Link communication error occurred. “n” is a channel number (1 to 3). “yy”, “xx”, “ww” and “vv” are internal error code. There are various causes as for this error.

SYS_ALM194 error messages (related to the I/O Link *i*)

Alarm message	Faulty location/corrective action	Contents
PC052 I/O LINK I PMC LSI RAM PARITY ERROR -----< ERROR POSITION>---------- MAIN BORAD ----------	Change the main board.	A RAM parity error occurred in PMC LSI on the main board.
PC053 I/O LINK I SLAVE LSI RAM PARITY ERROR -----< ERROR POSITION >----- CHn / UNITy(GROUPx) : “unit name” (Note 1) ----------	Change the I/O device of the unit.	A RAM parity error occurred in “y”th unit (group “x”) of channel “n”.

Alarm message	Faulty location/corrective action	Contents
PC054 I/O LINK I ABNORMAL POWER SUPPLY -----< ERROR POSITION >----- CHn / UNITy(GROUPx) : “unit name” (Note 1) ----------	Check the power supply of the I/O unit.	A power disconnection alarm occurred in the “y”th unit (group “x”) of channel “n”.
PC055 I/O LINK I I/O LINK I SENDING DATA FAILURE -----< ERROR POSITION >----- CHn / CNC <-> UNIT1(GROUP0) CNC : MAIN BOARD UNIT1 : “unit name” (Note 1) ----------	Check whether there is a possibility that noise is inserted between the CNC and 1st unit. Check the ground status of the slave device and the contact of the connection cable.	A communication error occurred between the CNC and 1st unit (group 0) of channel “n”.
PC055 I/O LINK I I/O LINK I SENDING DATA FAILURE -----< ERROR POSITION >----- CHn / UNITy-1(GROUPx-1) <-> UNITy(GROUPn) UNITy –1 : “unit name” (Note 1) UNITy : “unit name” (Note 1) ----------	Check whether there is any noise is inserted between the “y-1”th unit (group “x-1”) and “y”th unit (group “x”). Check the ground status of the slave device and the contact of the the connection cable.	A communication error occurred between the “y-1”th unit (group “x-1”) and the “y”th unit (group “x”) of channel “n”.
PC056 I/O LINK I I/O LINK I DISCONNECTION -----< ERROR POSITION >----- CHn / CNC <-> UNIT1(GROUP0) CNC : MAIN BOARD UNITy : “unit name” (Note 1) ----------	Check whether there is disconnection or incomplete contact for the cable between the CNC and 1st unit (group 0).	Connection error occurred between the CNC and 1st unit (group 0) of channel “n”.
PC056 I/O LINK I I/O LINK I DISCONNECTION -----< ERROR POSITION >----- CHn / UNITy-1(GROUPx-1)<-> UNITy(GROUPn) UNITy –1 : “unit name” (Note 1) UNITy : “unit name” (Note 1) ----------	Check whether there is disconnection or incomplete contact of the cable between the “y-1”th unit (group “x-1”) and “y”th unit (group “x”).	Connection error occurred between the “y-1”th unit (group “x-1”) and “y”th unit (group “x”) of channel “n”.
PC057 I/O LINK I SAFETY I/O ALARM -----< ERROR POSITION >----- UNITy : “unit name” (Note 1) ----------	Change the I/O device of the unit. If the error still occurs, change the main boad.	A hardware failure of the safety I/O occurred between the CNC and the “y”th unit.
PC058 I/O LINK I SLAVE LSI EXTERNAL ALARM -----< ERROR POSITION >----- CHn / UNITy(GROUPx) : “unit name” (Note 1) ----------	Change the I/O device of the unit.	A hardware failure occurred on the “y”th unit (group “x”) of channel “n”.

NOTE
1 When the unit name of the connected I/O device is unknown, its hardware ID is displayed.
2 For some I/O devices, one unit such as a safety I/O unit may consist of two groups. If a connection failure occurs between groups containing units of the same type, PC058 instead of PC056 indicating a connection failure occurs as a unit failure.

D.3.3 Operation Errors

Error messages that may be displayed on the PMC LADDER DIAGRAM VIEWER screen

Alarm message	Faulty location/corrective action	Contents
INPUT INVALID	Input a valid address or numeric value.	The input address or numeric value is invalid.
LADDER PROGRAM IS PROTECTED BY PASSWORD.	Enter the password.	The screen cannot be displayed because the program is protected by the password.
ILLEGAL SUBPROGRAM NAME	Input an existent subprogram number or symbol.	A nonexistent subprogram number or symbol is specified.
SYMBOL UNDEFINED	Input a defined symbol or bit address.	An undefined symbol character string is specified.
THE NET IS NOT FOUND		The specified net is not found.
THE ADDRESS IS NOT FOUND		The specified address is not found.
THE FUNCTIONAL INSTRUCTION IS NOT FOUND		The specified functional instruction is not found.
WRITE COIL NEEDS BIT ADDRESS	Specify a bit address for the write coil search.	You entered a byte address when specifying an address used for the write coil search.
SOME NETS ARE DISCARDED	The system cannot pick up all the nets. Choose the nets to pick up, by using the LADDER DIAGRAM VIEWER display screen, and then perform the net pickup operation manually.	The system failed to pick up all the nets because there were 128 nets or more to be picked up.
PROGRAM IS BEING MODIFIED.	Disconnect the online communication with FANUC LADDER-III. Stop other applications from accessing the ladder data.	The ladder data cannot be displayed because online communication with FANUC LADDER-III is in progress or another application is accessing the ladder data.
THIS FUNCTION IS PROTECTED	Cancel the protection by the programmer protection function or 8-level protection function.	This function is protected by the programmer protection function or 8-level protection function.
CANNOT EDIT FUNCTION BLOCK	Edit the program using FANUC LADDER-III.	An attempt was made to edit an FB main program.

Error messages that may be displayed on the PMC LADDER DIAGRAM EDITOR screen

Alarm message	Faulty location/corrective action	Contents
THIS NET IS PROTECTED		When you are editing data on a per-subprogram basis, you cannot edit the subprogram frame nets (END1, END2, END3, SP, and SPE).
TOO LARGE DATA TO COPY	Reduce the range of data to copy. Perform the copy operation several times, copying a smaller range of data at a time.	The selected range of data exceeds the size of the copy buffer.
TOO LARGE DATA TO PASTE	Reduce the size of data to paste.	An attempt was made to paste data whose size exceeded the free space of the sequence program.

Alarm message	Faulty location/corrective action	Contents
BIT ADDRESS IS REQUIRED	Make sure that the address types match for the alteration operation.	An attempt was made to alter a bit address to a byte address.
BYTE ADDRESS IS REQUIRED	Make sure that the address types match for the alteration operation.	An attempt was made to alter a byte address to a bit address.
ILLEGAL PMC ADDRESS	Check the address to be input, and then enter it correctly.	- A character string was entered that was unacceptable as a PMC address. - A wildcard (*) was specified in an inappropriate manner. - Ether "OLD ADDRESS" or "NEW ADDRESS" was not entered.
THIS ADDRESS IS READ-ONLY	Enter a write-permitted address.	- An attempt was made to alter a write coil address to a write-prohibited bit address. - An attempt was made to alter an address set in an output parameter of a functional instruction to a write-prohibited bit address.
THE ADDRESS TYPE ARE MISMATCHED	Check the types of the address in "OLD ADDRESS" and "NEW ADDRESS" and, if necessary, enter the correct address or addresses.	The type of the addresses in "OLD ADDRESS" does not match that in "NEW ADDRESS".
***** DOSE NOT HAVE SYMBOL	Define symbol data in "OLD ADDRESS".	No symbol data is defined in "OLD ADDRESS".
***** ALREADY HAS SYMBOL	Specify the address for which symbol data is not defined as "NEW ADDRESS".	Symbol data is already defined in "NEW ADDRESS".
CANNOT CUT FUNCTION BLOCK	Use FANUC LADDER-III to edit function block. Cut nets which do not include any function block.	An attempt was made to cut a net containing a function block.
CANNOT COPY FUNCTION BLOCK	Use FANUC LADDER-III to edit function block. Cut nets which do not include any function block.	An attempt was made to copy a net containing a function block.
CANNOT EDIT FUNCTION BLOCK	Edit the program using FANUC LADDER-III.	An attempt was made to edit an FB main program.
CANNOT INPUT AT THIS SCREEN	Set the address in the NET EDITOR screen.	An attempt was made to set an address to the output section in a function block which is omitted.
CANNOT EDIT INPUT/OUTPUT PARAM ADDRESS		The input section of the input/output parameter in a function block cannot be edited.
NO CONSTANT TO PARAMETER OF PLURAL TYPE		No constant can be set when multiple input parameters are specified for a function block.

Error messages that may be displayed on the PMC LADDER DIAGRAM EDITOR screen (when updating)

Alarm message	Faulty location/corrective action	Contents
OVERLAPPED COM	If COME is missing, add it in proper position. If the COM is unnecessary, remove it.	There is no COME that corresponds to this COM.
END IN COM END1 IN COM END2 IN COM	If COME is missing, add it in proper position. If COM is unnecessary, remove it.	END,END1,END2, or END3 is found between COM and COME.
JMPE IN COM	JMPE and corresponding JMP must have same COM/COME status. Review JMP range and COM range, to adjust not to overlap with each other: it is possible that one range includes the other completely.	JMPE is found between COM and COME, and JMP and corresponding JMPE have different COM/COME status.
SP/SPE IN COM	If COME is missing, add it in proper position. If the COM is unnecessary, remove it.	SP or SPE is found between COM and COME.
COME WITHOUT COM	If COM is missing, add it in proper position. If the COME is unnecessary, remove it.	There is no COM that corresponds to this COME.
COME NOT FOUND AFTER COM	If COME is missing, add it in proper position. If the COM is unnecessary, remove it.	There is no COME that corresponds to this COM.
DUPLICATE CTR NUMBER (WARN)	If some of them are unnecessary, remove them. If all of them are necessary, assign other number to parameter of them to make them unique. (If two or more instructions with same parameter number will never be active simultaneously at one time, the Ladder program has a possibility to work correctly, however, it is recommended from safety and maintenance points of view, that all these instructions should have different parameter number with each other.)	Plural CTRs have the same number as their parameter. (This is warning.)
ILLEGAL CTR NUMBER	If unnecessary, remove it. Assign correct number not to exceed the maximum number defined by each PMC model.	CTR has parameter number that is out of range.
DUPLICATE DIFU/DIFD NUMBER (WARN)	If some of them are unnecessary, remove them. If all of them are necessary, assign other number to parameter of them to make them unique. (If two or more instructions with same parameter number will never be active simultaneously at one time, the Ladder program has a possibility to work correctly, however, it is recommended from safety and maintenance points of view, that all these instructions should have different parameter number with each other.)	Plural DIFUs or DIFDs have the same number as their parameter. (This is warning.)

Alarm message	Faulty location/corrective action	Contents
ILLEGAL DIFU/DIFD NUMBER	If unnecessary, remove it. Assign correct number not to exceed the maximum number defined by each PMC model.	DIFU or DIFD has parameter number that is out of range.
NO END NO END1 NO END2 NO END3	Add END, END1, END2 or END3 in proper position.	END, END1, END2 or END3 is not found.
DUPLICATE END1 DUPLICATE END2 DUPLICATE END3	Remove extra END1, END2 or END3.	Multiple END1, END2 or END3 are found.
GARBAGE AFTER END GARBAGE AFTER END2 GARBAGE AFTER END3	Remove unnecessary nets, and move necessary nets to proper position so that they will be executed.	There are some nets after END, END2 or END3, which will not be executed.
OVERLAPPED JMP	If JMPE is missing, add it in proper position. If the JMP is unnecessary, remove it.	There is no JMPE that corresponds to this JMP.
JMP/JMPE TO BAD COM LEVEL	JMP and corresponding JMPE must have same COM/COME status. Review JMP range and COM range, to adjust not to overlap with each other: it is possible that one range includes the other completely.	JMP and corresponding JMPE have different COM/COME status.
COME IN JMP	COME and corresponding COM must have same JMP/JMPE status. Review COM range and JMP range, to adjust not to overlap with each other: it is possible that one range includes the other completely.	COME is found between JMP and JMPE, and COM and corresponding COME have different JMP/JMPE status.
END IN JMP END1 IN JMP END2 IN JMP END3 IN JMP	If JMPE is missing, add it in proper position. If JMP is unnecessary, remove it.	END,END1,END2, or END3 is found between JMP and JMPE.
SP/SPE IN JMP	If JMPE is missing, add it in proper position. If the JMP is unnecessary, remove it.	SP or SPE is found between JMP and JMPE.
JMPB OVER COM BORDER	JMPB and its destination must have same COM/COME status. Review range of JMPB and COM range, to adjust not to overlap with each other: it is possible that one range includes the other completely.	JMPB and its destination differ in COM/COME status.
JMPB OVER LEVEL	JMPB can only jump to the same program level, or within a subprogram. If the JMPB is unnecessary, remove it. If LBL for the JMPB is missing, add it in proper position. If it should be JMPC, correct it.	JMPB jumps to different program level.
LBL FOR JMPB NOT FOUND	If JMPB is unnecessary, remove it. If LBL is missing, add it in proper position.	Can not find proper LBL for JMPB.

Alarm message	Faulty location/corrective action	Contents
JMPC IN BAD LEVEL	JMPC is used to jump from a subprogram to level 2. If the JMPC is unnecessary, remove it. If it should be JMPB or JMP, correct it.	JMPC is used in other than subprogram.
LBL FOR JMPC NOT FOUND	If JMPC is unnecessary, remove it. If LBL is missing, add it in proper position: JMPC jumps into level 2.	Can not find proper LBL for JMPC.
LBL FOR JMPC IN BAD LEVEL	JMPC is used to jump from a subprogram to level 2. If the JMPC is unnecessary, remove it. If another LBL of same L-address that the JMPC is intended to jump exists in the subprogram, assign different L-address to these two LBLs. If it should be JMPB or JMP, correct it.	Destination of JMPC is not level 2.
JMPC INTO COM	LBL for JMPC must be located out of any COM and COME pair. If the JMPC is unnecessary, remove it. If the LBL is located wrong, move it to correct position. If the L-address of JMPC is wrong, correct it.	JMPC jumps to LBL between COM and COME.
JMPE WITHOUT JMP	If JMP is missing, add it in proper position. If the JMPE is unnecessary, remove it.	There is no JMP that corresponds to this JMPE.
JMPE NOT FOUND AFTER JMP	If JMP is missing, add it in proper position. If the JMPE is unnecessary, remove it.	There is no JMP that corresponds to this JMPE.
TOO MANY LBL	Remove unnecessary LBLs. If this error still occurs, adjust the construction of program to use less LBLs.	There are too many LBLs.
DUPLICATE LBL	If some of these LBLs are unnecessary, remove them. If all of these LBLs is necessary, assign other L-addresses to them to make all LBLs unique.	Same L-address is used in plural LBLs.
OVERLAPPED SP	If SPE is missing, add it in proper position. If the SP is unnecessary, remove it.	There is no SPE that corresponds to this SP.
SPE WITHOUT SP	If SP is missing, add it in proper position. If the SPE is unnecessary, remove it.	There is no SP that corresponds to this SPE.
SPE NOT FOUND AFTER SP	If SPE is missing, add it in proper position. If the SP is unnecessary, remove it.	There is no SPE that corresponds to this SP.
END IN SP	If SPE is missing, add it in proper position. If END is in wrong place, move it to proper position.	END is found between SP and SPE.
DUPLICATE P ADDRESS	If some of these SPs are unnecessary, remove them. If all of these SPs is necessary, assign other P-addresses to them to make all SPs unique.	Same P-address is used in plural SPs.

Alarm message	Faulty location/corrective action	Contents
DUPLICATE TMRB/TMRBF NUMBER (WARN)	If some of them are unnecessary, remove them. If all of them are necessary, assign other number to parameter of them to make them unique. (If two or more instructions with same parameter number will never be active simultaneously at one time, the Ladder program has a possibility to work correctly, however, it is recommended from safety and maintenance points of view, that all these instructions should have different parameter number with each other.)	Plural TMRBs/TMRBFs have the same number as their parameter. (This is warning.)
ILLEGAL TMRB/TMRBF NUMBER	If unnecessary, remove it. Assign correct number not to exceed the maximum number defined by each PMC model.	TMRB/TMRBF has parameter number that is out of range.
DUPLICATE TMR NUMBER (WARN)	If some of them are unnecessary, remove them. If all of them are necessary, assign other number to parameter of them to make them unique. (If two or more instructions with same parameter number will never be active simultaneously at one time, the Ladder program has a possibility to work correctly, however, it is recommended from safety and maintenance points of view, that all these instructions should have different parameter number with each other.)	Plural TMRs have the same number as their parameter. (This is warning.)
ILLEGAL TMR NUMBER	If unnecessary, remove it. Assign correct number not to exceed the maximum number defined by each PMC model.	TMR has parameter number that is out of range.
NO SUCH SUBPROGRAM	If it calls wrong subprogram, correct it. If the subprogram is missing, create it.	Subprogram that is called by CALL/CALLU is not found.
UNAVAILABLE INSTRUCTION	Confirm that this ladder program is correct one. If this program is correct one, all these unsupported instructions have to be removed.	Unsupported instruction for this PMC model is found.
SP IN BAD LEVEL	SP can be used at top of a subprogram. Correct it so that no SP exists in other place.	SP is found in wrong place.
LADDER PROGRAM IS BROKEN	This ladder program must be all cleared once, and remake ladder program.	Ladder program may be broken by some reason.
NO WRITE COIL	Add proper write coil.	Write coil is necessary, but is not found.
CALL/CALLU IN BAD LEVEL	CALL/CALLU must be used in Level 2 or in subprograms. Do not use any other places.	CALL/CALLU is used in wrong place.

Alarm message	Faulty location/corrective action	Contents
SP IN LEVEL3	If END3 is located wrong, move it to correct position. If the SP is unnecessary, remove it.	SP is found in level 3.
CS/CM/CE IN COM	If COME is missing, add it in proper position. If the COM is unnecessary, remove it.	CS, CM, or CE is found between COM and COME.
CS/CM/CE IN BAD LEVEL	CS/CM/CE must be used in Level 2 or in subprograms. Do not use any other places.	CS/CM/CE is used in wrong place.
CM/CE WITHOUT CS	If CS is missing, add it in proper position. If the CM/CE is unnecessary, remove it.	There is no CS that corresponds to this CM/CE.
INSTRUCTION EXCEPT CM IN CS	If CE is missing, add it in proper position. If the CS/CE is unnecessary, remove it.	After an CS instruction, there was an instruction other than CM before an CE instruction came.
OVERLAPPED CS	If CS is missing, add it in proper position. If the CM/CE is unnecessary, remove it.	There is no CE that corresponds to this CS.
FB BODY PROGRAM IS BROKEN	Delete the entire ladder program and create it again.	The FB main program is corrupted.

Error messages that may be displayed on the PMC NET EDITOR screen

Alarm message	Faulty location/corrective action	Contents
ILLEGAL FUNCTIONAL INSTRUCTION NAME	Specify the name of an available functional instruction.	The entered name of functional instruction is invalid.
TOO MANY FUNCTION IN ONE NET	Only one functional instruction is allowed to constitute a net. If necessary, divide the net into plural nets.	Too many functional instructions are in one net.
TOO LARGE NET	Divide the net into plural nets so that step number in a net may become small.	Net is too large. When a net is converted into the object, the net exceeds 256 steps.
NO INPUT FOR OPERATION	Coil without input, or coil connected to output of functional instruction that has no output, causes this error. If coil is not necessary, remove it. If necessary, connect it to meaningful input.	No signal is provided for logical operation.
OPERATION AFTER FUNCTION IS FORBIDDEN	Output of functional instruction can not be connected to a contact, nor to conjunction with other signal that will be implemented by logical-or operation.	No logical operation with functional instruction output is permitted, except write coils.
WRITE COIL IS EXPECTED	Write coil is not found even if it is expected. Add proper write coil to the net.	Write coil is expected, but not found.
BAD COIL LOCATION	Coil can be located only at rightmost column. Any coil located at other place must be erased once, and place necessary coils in correct place.	Coil is located in bad position.
SHORT CIRCUIT	Find contact with terminals connected by short circuit, and correct connections.	Some contacts are connected with short circuit.

Alarm message	Faulty location/corrective action	Contents
FUNCTION AFTER DIVERGENCE IS FORBIDDEN	Functional instruction can not be used in output section of net. If necessary, divide the net into plural nets.	Functional instruction is used in output section of net.
ALL COIL MUST HAVE SAME INPUT	Left terminals of all coils in a net must be connected to same input point.	When a net contains more than one coil, the coils should not have any contact beside them affects only of the coils.
BAD CONDITION INPUT	Check the connection of all condition inputs of the functional instruction. Especially for functional instruction that has more than one condition input, check if connections to condition inputs interfere with each other.	Some condition input of functional instruction is not connected correctly.
NO CONNECTION	Find gap that is expected to be connected, and correct the connection.	There is signal connected to nowhere.
NET IS TOO COMPLICATED	Examine every connection, and find unnecessarily bending connection, or coils that are connected to different point.	Net is too complicated to analyze.
PARAMETER IS NOT SUPPLIED	Enter all of the relay addresses, and parameters of functional instructions.	Relay with blank address, or blank parameter of functional instruction, is found.
TOO LARGE DATA FOR NET-EDITOR	Use the [NEXT NET] soft key to change the net subject to net editing	The limit on the net editing screen was exceeded.
TOO MANY FUNCTIONS FOR NET-EDITOR	Use the [NEXT NET] soft key to change the net subject to net editing	The number of functional instructions exceeded the limit on the net editing screen.
BAD DIAGRAM STRUCTURE	Check whether the connection shape of each relay or functional instruction is correct.	The circuit is too complicated to analyze.
NOT SUPPORT ENHANCED LADDER DIAGRAM	Replace the functional instruction with a functional instruction supporting an enhanced ladder diagram. Alternatively, use a net which does not use the enhanced ladder diagram function.	A ladder diagram using an enhanced ladder diagram function contains a functional instruction which does not support an enhanced ladder diagram.
TOO COMPLICATED CIRCUIT AROUND FUNCTION	Connect the circuit to which a branch is made according to the control condition of a functional instruction to the right bus line without merging it to the output circuit of the functional instruction. See X.xx.	The circuit around a functional instruction is too complicated to analyze.
CONNECT OUTPUT TO COIL DIRECTLY	Connect a coil immediately following the functional instruction.	No coil is connected immediately following a functional instruction.
SINGLE COIL IS EXPECTED	Only one coil can be connected to this functional instruction.	More than one coil is connected to a functional instruction to which only one coil can be connected.
INVALID CIRCUIT FOR FB PARAMETER	Specify a contact or coil for the parameter of the function block.	A functional instruction is connected for a parameter of a function block.
NO CONNECTION	Connect the broken connection.	The connection is broken.

Alarm message	Faulty location/corrective action	Contents
PARAMETER IS NOT SUPPLIED	Set an address.	No address is set to the coil at the input or output section of a function block.
CAN NOT PLACE FB AND FUNCTION IN ONE NET	Delete the functional instruction placed in the same net as for the function block.	A functional instruction is placed in the same net as for a function block.
NO ASSIGNMENT TO FB CONTACT	Set a contact.	No contact is set in the input section of the BOOL type of a function block.

Error messages that may be displayed on the TITLE DATA EDITOR screen

Alarm message	Faulty location/corrective action	Contents
TOO MANY CHARACTERS	Make sure that the entered character string is within the allowable input length.	The number of characters in the entered character string exceeds the allowable input length. Some of the characters are discarded.
PROGRAM IS BEING MODIFIED.	Disconnect the online communication with FANUC LADDER-III. Stop other applications from accessing the title data.	The title data cannot be displayed because online communication with FANUC LADDER-III is in progress or another application is accessing the title data.
THIS FUNCTION IS PROTECTED	Cancel the protection by the programmer protection function or 8-level protection function.	This function is protected by the programmer protection function or 8-level protection function.

Error messages that may be displayed on the SYMBOL & COMMENT DATA EDITOR screen

Alarm message	Faulty location/corrective action	Contents
TOO MANY CHARACTERS	Make sure that the entered address is within the allowable input length.	The number of characters in the entered address exceeds the allowable address input length.
ADDRESS IS REQUIRED	Enter data in a batch correctly, as instructed in "(2) Editing a set of symbol and comment data" in Subsection 9.2.2.	No address was entered during the batch input of address, symbol, and comment data using the SYMBOL & COMMENT EDITOR screen.
ILLEGAL PMC ADDRESS	Enter an address correctly.	The specified address is invalid, or the entered address character string contains a space or spaces.
THE ADDRESS ALREADY HAS AN ENTRY	Specify another address.	An already registered address was entered.
THE SYMBOL NAME IS ALREADY USED	Specify another symbol.	An already registered symbol was entered.
PMC ADDRESS MUST BE ENTERED	Enter a PMC address in the ADDRESS field.	No PMC address was entered when new symbol/comment data is registered.
TOO LONG SYMBOL NAME	Make sure that the symbol consists of 16 characters or less.	The entered symbol exceeds the specified number of characters.
TOO LONG COMMENT STRING	Make sure that the comment consists of 30 characters or less.	The entered comment exceeds the specified number of characters.
THE STRING IS NOT FOUND	Specify another character string for the search.	The search was done for the specified character string but did not find it.
OUT OF SPACE	Create free space for the sequence program, by deleting unnecessary ladder or message data.	The symbol/comment editing area has no free space.

Alarm message	Faulty location/corrective action	Contents
PROGRAM IS BEING MODIFIED.	Disconnect the online communication with FANUC LADDER-III. Stop other applications from accessing the symbol/comment data.	The symbol/comment data cannot be displayed because online communication with FANUC LADDER-III is in progress or another application is accessing the symbol/comment data.
THIS FUNCTION IS PROTECTED	Cancel the protection by the programmer protection function or 8-level protection function.	This function is protected by the programmer protection function or 8-level protection function.
BAD SYMBOL NAME	Change the symbol name.	The symbol name is invalid.
CANNOT EDIT ADDRESS AUTO ASSIGNED SYMBOL	Use FANUC LADDER-III to change the symbol.	The symbol whose PMC address is assigned automatically by compiling FANUC LADDER-III, can not edit.
ILLEGAL DATA TYPE	Enter a correct data type.	The specified data type is invalid.
ILLEGAL PROGRAM NAME	Enter a correct program name.	The specified program is invalid.
LINE FEED IS NOT AVAILABLE IN THIS DATA	Line feed code can be entered in comment data only. Do not enter it in other data.	Line feed code cannot be entered in this data.
LINE FEED IS NOT AVAILABLE IN THIS MODE	Enter Line feed code in the insert or overwrite mode.	Line feed code cannot be entered in this mode.
NO SYMBOL. PROGRAM SETTING IS IGNORED	Symbol name is required for local symbol.	The specified program is ignored because no symbol is specified.
NOTHING TO PASTE	You need to copy or cut character strings before you paste them.	You try to paste character strings without copying or cutting ones.
TOO LARGE DATA TO PASTE	Shorten the character string to copy or cut.	The character strings is too long to copy or cut.
UNAVAILABLE CHARACTERS WAS OMITTED.	Do not copy or cut characters which cannot be used at pasted position.	The characters which can not be used at pasted position, were omitted.

Error messages that may be displayed on the MESSAGE DATA EDITOR screen

Alarm message	Faulty location/corrective action	Contents
INPUT INVALID	Enter ";" in the 5th digit position in the batch message input process.	The format of message number is missing. The delimiter code - semicolon (;) - was not entered in the batch message input process.
ILLEGAL NUMBER	Enter a four-digit number as the message number.	The entered message number contains any nonnumeric character, or a number shorter than four digits was entered.
THE NUMBER IS OUT OF RANGE	Make sure that the entered message number with path number is in the range between 1000 and 4095. Another message number is in the range between 1000 and 9999.	The entered message number is out of range.
CLOSING "@" IS NOT FOUND	When entering kana or other Japanese characters, make sure that they are enclosed within a pair of @ signs.	One of the @ sign pair is missing.
BAD NUMBER OF CHARACTERS IN "@-@"	Enter a character string correctly between a pair of @ signs.	The number of characters entered between the pair of @ signs is not even.
ILLEGAL CHARACTER IN "@-@"	Enter a character string correctly between a pair of @ signs.	One or more invalid character codes exist between the pair of @ signs.

Alarm message	Faulty location/corrective action	Contents
BAD NUMBER OF CHARACTERS FOR 2-BYTE CODE	Enter a two-byte code correctly between @02 and 01@.	The number of characters in the two-byte code (characters entered between @02 and 01@) is not a multiple of four.
ILLEGAL 2-BYTE CODE	Enter a two-byte code correctly between @02 and 01@.	The two-byte code (characters entered between @02 and 01@) contains one or more characters other than the JIS codes.
CLOSING CONTROL CODE "01" IS NOT FOUND	Enter the closing control code.	The two-byte code (characters entered between @02 and 01@) lacks the closing control code (01).
CONTROL CODE "XX" IS REPEATED	Remove any repeated control code.	The starting control code (02), closing control code (01), and/or umlaut code (0D) is repeated.
CLOSING "]" IS NOT FOUND	Make sure that the "[" and "]" codes are entered in pairs.	The delimiter codes for numerical data are not entered in pairs.
BAD NUMERICAL DATA FORMAT	Specify the numerical data correctly.	The format of the numerical data is invalid.
BAD PMC ADDRESS FOR NUMERICAL DATA	Enter an available address.	The address section of the numerical data is invalid.
PROGRAM IS BEING MODIFIED.	Disconnect the online communication with FANUC LADDER-III. Stop other applications from accessing the message data.	The message data cannot be displayed because online communication with FANUC LADDER-III is in progress or another application is accessing the message data.
THIS FUNCTION IS PROTECTED	Cancel the protection by the programmer protection function or 8-level protection function.	This function is protected by the programmer protection function or 8-level protection function.

Error messages that may be displayed on the I/O MODULE EDITOR screen

Alarm message	Faulty location/corrective action	Contents
GROUP NUMBER IS TOO LARGE	Specify 15 or a smaller value as the group number.	The entered group number is too large.
BASE NUMBER IS TOO LARGE	Specify base number 0 for I/O Unit-B (##, #1 - #10).	The entered base number is too large.
SLOT NUMBER IS TOO LARGE	Specify 30 or a smaller value as the slot number for I/O Unit-B (##, #1 - #10). For other I/O units, specify 10 or a smaller value.	The entered slot number is too large.
SLOT NUMBER IS TOO SMALL	Specify 0 or a large value as the slot number for I/O Unit-B (##, #1 - #10). For other I/O units, specify 1 or a larger value.	The entered slot number is too small.
I/O UNIT NAME MISMATCH	Check the I/O unit name or address.	The input I/O unit is assigned to the Y address, or the output I/O unit is assigned to the X address.
ILLEGAL I/O UNIT NAME	Enter an I/O unit that is listed in Tables 3.2 (a) to 3.2 (c) in Chapter 3.	The entered I/O unit name is invalid.

Alarm message	Faulty location/corrective action	Contents
NOT ENOUGH SPACE	Enter the data again after creating free space by deleting the data allocated behind the current cursor position or by other adequate means.	There is not enough free address space for the size of the I/O unit you are going to assign. This error also occurs if you attempt to assign the I/O unit to an already allocated address space.
PROGRAM IS BEING MODIFIED.	Disconnect the online communication with FANUC LADDER-III. Stop other applications from accessing the I/O module data.	The I/O module data cannot be displayed because online communication with FANUC LADDER-III is in progress or another application is accessing the I/O module data.
THIS FUNCTION IS PROTECTED	Cancel the protection by the programmer protection function or 8-level protection function.	This function is protected by the programmer protection function or 8-level protection function.

Error messages that may be displayed on the I/O CONFIGURATION EDITOR (I/O Link *i* assignment) screen

Alarm message	Faulty location/corrective action	Contents
TOO MANY GROUPS (CHx)	Delete any unnecessary group, then create a new group.	A new group cannot be created because the maximum number of groups per channel is exceeded.
TOO MANY SLOTS (CHx)	Delete any unnecessary slot, then create a new slot.	A new slot cannot be created because the maximum number of slots per channel (256 slots) is exceeded.
TOO MANY SLOTS IN A GROUP (CHx, Gyy)	Delete any unnecessary slot, then create a new slot.	A new slot cannot be created because the maximum number of slots per channel (32 slots) is exceeded.
NO SLOT	Add a slot.	There is no slot in group Gxx.
SLOT NUMBER IS REQUIRED	Enter a slot number.	No slot number is entered for a slot.
SLOT NUMBER DUPLICATE	Change the slot number used more than once.	More than one slot data item having the same slot number is found in the same group.
CAN NOT DELETE MPG SLOT	Turn the MPG flag off in the group setting screen.	No MPG slot can be deleted in the slot setting screen.
ILLEGAL SLOT NUMBER	Enter a slot number not greater than 32.	The entered slot number is greater than 32.
ILLEGAL PMC ADDRESS	Enter a correct PMC address again.	The entered PMC address is invalid. Alternatively, no PMC address is entered.
ILLEGAL SIZE	Enter a correct size again.	The entered size is outside the PMC address range. Alternatively, a value of 0 is entered as the size.
SLOT HAS NO ASSIGNMENT	Enter a PMC address and size.	For a slot, a PMC address or size is not entered for both DI and DO.
ILLEGAL COMMENT	Enter a correct comment again.	An entered comment does not conform to the extended symbol and comment format.
PMC ADDRESS OVERLAPPED (PMCm X(Y)nnnn)	Enter the PMC address or size so that it is set only once.	Address PMCm X(Y)nnnn is also assigned to another slot in I/O Link *i* assignment data.

Alarm message	Faulty location/corrective action	Contents
TOO MANY OUTPUT POINTS (CHx, Gyy)	Reduce the number of output points of the group.	The number of output points of the I/O Link *i* group set for Gyy of CHx exceeds the upper limit (65 bytes by default or 29 bytes for the safety I/O device).
TOO MANY INPUT POINTS (CHx, Gyy)	Reduce the number of input points of the group.	The number of input points of the I/O Link *i* group set for Gyy of CHx exceeds the upper limit (65 bytes by default or 29 bytes for the safety I/O device).
TOO MANY OUTPUT POINTS (CHx)	Reduce the number of output points in the channel.	Warning message. The number of I/O Link *i* output points set in CHx exceeds the upper limit.
TOO MANY INPUT POINTS (CHx)	Reduce the number of input points in the channel.	Warning message. The number of I/O Link *i* input points set in CHx exceeds the upper limit.
TOO MANY CHARACTERS	Enter a comment within the input field.	The number of characters in an entered comment exceeds the input width.
THE ADDRESS IS NOT FOUND		The specified address is not found.
INPUT INVALID	Enter a correct numeric value.	A numeric value is invalid.
I/O CONFIG DATA IS BROKEN	Enter an I/O configuration file again.	I/O Link *i* assignment data is invalid.
TOO MANY SAFETY I/O GROUPS	Reduce the number of I/O Link *i* safety I/O groups.	Warning message. More than four I/O Link *i* safety I/O groups are specified either on the PMC or DCS side in the entire system.
TOO MANY ASSIGNMENTS (H.SPEED)(CHn,Gyy)	When a group in the high-speed transfer cycle mode is connected to I/O Link *i*, correct assignment so that the assignment for each group is performed within the quartered transfer timing with referencing Subsection 3.6.4 “Transfer Cycle”.	Warning message. In CHn, group yy and following exceed the transfer capacity limit in transfer timing assignment processing when the high-speed mode of I/O Link *i* is used.
BASIC GROUP INVALID	Correct the number of basic groups for the I/O assignment selection function of I/O Link *i*.	The number of basic groups for the I/O assignment selection function of I/O Link *i* is invalid.
UNAVAILABLE ADDRESS FOR DCSPMC	Use addresses X0/Y0 and following.	Addresses X200/Y200, X400/Y400, or X600/Y600 and following are assigned to a group for which DCSPMC is specified for the PMC path.
THIS DATA IS BEING MODIFIED	Disconnect the online communication with FANUC LADDER-III. Stop other applications from accessing the I/O configuration data.	I/O configuration data cannot be displayed because online communication with FANUC LADDER-III is in progress or another application is accessing the I/O configuration data.

Alarm message	Faulty location/corrective action	Contents
INTERNAL ERROR(0xCxxxxxxx)		This alarm occurs due to the following causes. - No MPG slot is present in the group with MPG. - An MPG slot is present in the group without MPG. - Multiple MPG slots are present in the group. - The value of safety I/O is invalid. - The maximum number of characters allowed for a comment has been exceeded.

Error messages that may be displayed on the SYSTEM PARAMETER screen

Alarm message	Faulty location/corrective action	Contents
INPUT INVALID	Enter a numerical value correctly, as instructed in Section 9.8.	The entered numerical value or its input format is invalid.
SYMBOL UNDEFINED	Enter a defined symbol or bit address.	An undefined symbol character string was entered.
PROGRAM IS BEING MODIFIED.	Disconnect the online communication with FANUC LADDER-III. Stop other applications from accessing the system parameter data.	The system parameter data cannot be displayed because online communication with FANUC LADDER-III is in progress or another application is accessing the system parameter data.
THIS FUNCTION IS PROTECTED	Cancel the protection by the programmer protection function or 8-level protection function.	This function is protected by the programmer protection function or 8-level protection function.

Error messages that may be displayed on the SIGNAL STATUS screen

Alarm message	Faulty location/corrective action	Contents
INPUT INVALID	Enter a numerical value correctly, as instructed in "Screen operations using other keys" in Subsection 7.3.	The entered numerical value or its input format is invalid.
SYMBOL UNDEFINED	Enter a defined symbol or bit address.	An undefined symbol character string was entered.
THIS FUNCTION IS PROTECTED	Cancel the protection by the programmer protection function or 8-level protection function.	This function is protected by the programmer protection function or 8-level protection function.

Error messages that may be displayed on the PMC PARAM screen

Alarm message	Faulty location/corrective action	Contents
INPUT INVALID	Enter a numerical value correctly, as instructed in Section 7.3.	The entered numerical value or its input format is invalid.
MUST BE IN EMERGENCY STOP OR IN MDI MODE	Set the NC to the MDI mode or emergency state.	The NC is not in the MDI mode or emergency stop state.
PWE MUST BE ON	Set “PWE” to 1 on the NC setting screen.	“PWE” is 0 on the NC setting screen.
EITHER PWE OR KEY4 MUST BE ON	Set “PWE” to 1 on the NC setting screen or set the program protect signal (KEY4) to 1.	“PWE” is 0 on the NC setting screen. In addition, the program protect signal (KEY4) is also 0.
THIS FUNCTION IS PROTECTED	Cancel the protection by the programmer protection function or 8-level protection function.	This function is protected by the programmer protection function or 8-level protection function.

Error messages that may be displayed on the SIGNAL TRACE screen

Alarm message	Faulty location/corrective action	Contents
TRACE FUNCTION IS ALREADY IN USE.	Wait until FANUC LADDER-III or some other application finishes using the trace function before executing it.	FANUC LADDER-III or some other application is currently using the trace function.
NO SAMPLING ADDRESS.	Specify a bit address as a sampling address in the trace parameter.	No sampling address is specified in the trace parameter.
NO STOP TRIGGER ADDRESS.	Specify a bit address as the stop trigger address in the trace parameter.	The stop trigger address is not specified in the trace parameter.
NO SAMPLING TRIGGER ADDRESS.	Specify a bit address as the sampling trigger address in the trace parameter.	The sampling trigger address is not specified in the trace parameter.
USB MEMORY IS USED BY OTHER FUNCTION.	Terminate another function that is using the USB memory, then perform operation again.	The USB memory is being used by another function.
USB MEMORY IS NOT READY.	Check whether a USB memory is inserted.	No USB memory is inserted.
USB MEMORY IS FULL.	Delete any unnecessary files and allocate a required capacity.	The USB memory is full.
USB MEMORY HAS BEEN REMOVED	Insert the USB memory, then execute input/output operation again.	A USB memory is removed while it is being accessed.
USB MEMORY IS NOT FORMATTED	Replace the USB memory with another one.	The inserted USB memory cannot be recognized.
USB HARDWARE ERROR (xxxxxxxxxx)	Replace the USB memory with another one. If this error still occurs after replacement, contact us, and report the displayed message correctly.	This error occurs due to a USB hardware failure. An error code is indicated in parentheses.
INTERNAL ERROR (xxxxxxxxxx)	Contact the FANUC service center, and report the displayed message correctly.	An error due to an internal factor occurred. An error code is indicated in parentheses.

Error messages that may be displayed on the trace setting screen

Alarm message	Faulty location/corrective action	Contents
INPUT INVALID	Enter a numerical value that is within the specified data range of the relevant trace parameter.	A nonnumeric value or an out-of-range parameter value was entered.
SYMBOL UNDEFINED	Enter a defined symbol or bit address.	An undefined symbol character string was entered.
BIT ADDRESS IS REQUIRED	Specify a bit address as the stop or sampling trigger address.	A byte address was specified as the stop or sampling trigger address.
INVALID STOP TRIGGER ADDRESS.	Enter a PMC signal address that can be used as the stop trigger address.	The bit address entered as the stop trigger address is invalid.
INVALID SAMPLING TRIGGER ADDRESS.	Enter a PMC signal address that can be used as the sampling trigger address.	The bit address entered as the sampling trigger address is invalid.
UNSUPPORTED TRACE SETTING FILE	This file cannot be handled. Set data in the TRACE SETING screen.	An attempt was made to read a trace setting file that could not be handled.

Alarm message	Faulty location/corrective action	Contents
INVALID SETTING VALUE (LINE %d)	Output the trance setting file again. Alternatively, set data in the TRACE SETING screen.	An invalid setting is found. The file may be damaged.
SAMPLING TIME/FRAME WAS ADJUSTED	Check the data on the TRACE SETING screen.	The values are adjusted according to the read data. (This is warning.)
UNKNOWN SETTING WAS SKIPPED(LINE %d)	Check the read trace data.	An unknown trace setting item is found and ignored. (This is warning.)
INVALID SAMPLING ADDRESS WAS FOUND	Check the read trace data.	An invalid sampling address is found. (This is warning.)
TOO MANY SAMPLING ADDRESSES	Check the read trace data.	The number of sampling addresses exceeds the upper limit. (This is warning.)
THE FILE IS NOT TRACE SETTING FILE	This file cannot be read. Specify a correct file.	An attempt was made to read a file which was not a trace setting file.
FILE NAME CONTAINS RESERVED WORD.	Correct file name.	“FORFANUC” cannot be used in the top of the file name.
USB MEMORY IS USED BY OTHER FUNCTION.	Terminate another function that is using the USB memory, then perform operation again.	The USB memory is being used by another function. Another function is formatting the USB memory.
USB MEMORY IS NOT READY.	Check whether a USB memory is inserted.	No USB memory is inserted.
USB MEMORY HAS BEEN REMOVED	Insert the USB memory, then execute input/output operation again	A USB memory is removed while it is being accessed.
USB MEMORY IS NOT FORMATTED	Replace the USB memory with another one.	The inserted USB memory cannot be recognized.
FILE NAME IS INVALID.	Correct the file name.	An invalid character is found in a file name.
FOLDER NAME CANNOT BE SPECIFIED.	A folder name is specified. Specify an appropriate file name.	An attempt was made to read or write a folder.
USB MEMORY DATA CHECK ERROR	An error was detected by the USB memory data check function. This file cannot be input.	When the file was input with the USB memory data check function enabled, a checksum error was detected.
CHECKSUM DATA FILE NOT FOUND.	Enable the USB memory data check function and output the file again.	When the file was input with the USB memory data check function enabled, the checksum data file was not found.
USB HARDWARE ERROR (xxxxxxxxxx)	Replace the USB memory with another one. If this error still occurs after replacement, contact the FANUC service center, and report the displayed message correctly.	This error occurs due to a USB hardware failure. An error code is indicated in parentheses.
INTERNAL ERROR (xxxxxxxxxx)	Contact the FANUC service center, and report the displayed message correctly.	An error due to an internal factor occurred. An error code is indicated in parentheses.

Error messages that may be displayed on the I/O diagnosis screen

Alarm message	Faulty location/corrective action	Contents
ENTER STRING TO SEARCH.	First enter a string, and then you can search for it.	No search string is specified.

Alarm message	Faulty location/corrective action	Contents
I/O DIAGNOSIS FUNCTION IS NOT SUPPORTED	To use the I/O diagnosis function, update the PMC system software.	The I/O diagnosis function cannot be used because the PMC system software is older.
INPUT INVALID	Check the entered string.	The entered string is invalid.
LADDER PROGRAM IS BROKEN	Check the PMC alarm screen, and reload the program.	The program is corrupted.
NO GROUP FORMAT.	Specify “GROUP DISPLAY” on the I/O diagnosis (setting) screen.	The group display is not set.
PROGRAM IS BEING MODIFIED.	Retry after completing the function that is currently using the program.	The program cannot be referenced because it is being used by another function.
REACHED TO THE END OF SYMBOL DATA.	To make another search, specify a string again.	The entire data has been searched.
SYMBOL ORDER IS NOT AVAILABLE.	Use FANUC LADDER-III to convert the program into an enhanced version.	The format of this program does not support sorting and display data in symbol order.
THE GROUP IS NOT FOUND	Check the specified group.	The specified group is not found.
FORCING IS PROTECTED ON THIS PATH.	Cancel the programmer protection function.	The forced I/O function is protected for the PMC path currently selected.
THE STRING IS NOT FOUND	Check the specified string.	The specified string is not found.

D.3.4 I/O Communication Error Messages

The error messages that may appear on the I/O screen and their meanings and actions are listed below.

Error messages displayed during memory card I/O operation

Alarm message	Faulty location/corrective action	Contents
MEMORY CARD IS NOT READY.	Check whether a memory card is installed.	No memory card is installed.
MEMORYCARD IS FULL.	Delete files to create available space.	There is no available space in the memory card.
MEMORYCARD IS WRITE PROTECTED	Release the write protection of the memory card.	The memory card is write-protected.
MEMORYCARD IS NOT FORMATTED	Format the memory card.	The memory card cannot be recognized.
TOO MANY FILES IN MEMORYCARD	Delete unnecessary files to reduce the number of files.	There are too many files.
FILE NOT FOUND	On the list screen, check the file name or file number.	The specified file cannot be found.
FILE IS READ-ONLY.	Check the attributes of the file.	Write to the specified file is not permitted.
FILE NAME IS INVALID.	Specify the file name in MS-DOS form.	The file name is illegal.
COULD NOT FORMAT MEMORY CARD.	The NC cannot format this memory card. Use another unit such as a personal computer to format the memory card.	The memory card cannot be formatted.
UNSUPPORTED MEMORYCARD	Replace the memory card with another one.	This memory card is not supported.
CAN NOT DELETE FILE	Check the attributes of the file.	An error occurred when a file was deleted from the memory card.
MEMORYCARD BATTERY ALARM.	Replace the battery of the memory card.	The battery of the memory card has become weak.
THIS FILE NAME IS ALREADY USED	Change the file name to another one.	The file name is already used.
MEMORYCARD ACCESS ERROR	Replace the memory card with another one.	The memory card cannot be accessed.

Alarm message	Faulty location/corrective action	Contents
DIFFERENCE FOUND		File comparison detected a mismatch.
MEMORYCARD IS LOCKED BY OTHER FUNCTION	Wait until the PMC user completes processing, then retry.	Another PMC user is using the memory card.
MEMORY CARD HEADER ROM DATA ID IS ILLEGAL	This file cannot be read. Check the type of the file.	An attempt was made to read a file, but its ROM data ID was illegal.
FILE NUMBER CAN NOT SELECTED	If the file does not exist, the key entry is invalid. If this error occurs even when the cursor is placed at a file name, contact the FANUC service center.	The file number cannot be selected.
THE FILE NUMBER DOES NOT EXIST	Check the total number of files on the list screen.	The entered file number is not present. The entered number exceeds the total number of files.
FILE NUMBER IS RESTRICTED TO "128"	Enter a numeric value not exceeding 128.	A value up to 128 can be entered as the file number.
MEMORY CARD IS USED BY OTHER FUNCTION.	Retry after terminating the other function that is currently using the memory card.	Some other function is currently using the memory card.
MEMORY CARD IS WRITE PROTECTED.	Cancel the write protection of the memory card, or use another memory card that is not write protected.	The memory card is write protected.
UNSUPPORTED MEMORY CARD.	Use another memory card.	This is an unsupported type of memory card.
COULD NOT DELETE FILE.	Check the read/write permission attribute of the file.	The file cannot be deleted.
TRACE FILE NUMBER IS OVER	Delete unnecessary old trace result file or files.	No more trace result file can be created because the maximum trace result file number (file extension) has been reached.
UNSUPPORTED TRACE SETTING FILE	This file cannot be handled. Set data in the TRACE SETING screen.	An attempt was made to read a trace setting file that could not be handled.
INVALID SETTING VALUE (LINE %d)	Output the trance setting file again. Alternatively, set data in the TRACE SETING screen.	An invalid setting is found. The file may be damaged.
SAMPLING TIME/FRAME WAS ADJUSTED	Check the data on the TRACE SETING screen.	The values are adjusted according to the read data. (This is warning.)
UNKNOWN SETTING WAS SKIPPED (LINE %d)	Check the read trace data.	An unknown trace setting item is found and ignored. (This is warning.)
INVALID SAMPLING ADDRESS WAS FOUND	Check the read trace data.	An invalid sampling address is found. (This is warning.)
TOO MANY SAMPLING ADDRESSES	Check the read trace data.	The number of sampling addresses exceeds the upper limit. (This is warning.)
INTERNAL ERROR (xxxxxxxxxx)	Contact the FANUC service center, and report the displayed message correctly.	An error due to an internal factor occurred. Details on the error are displayed in parentheses.

Error messages displayed during USB memory I/O operation

Alarm message	Faulty location/corrective action	Contents
FILE NAME CONTAINS RESERVED WORD.	Correct file name.	“FORFANUC” cannot be used in the top of the file name.
USB MEMORY HAS BEEN REMOVED	Insert the USB memory, then execute input/output operation again.	A USB memory is removed while it is being accessed.
USB MEMORY IS NOT READY.	Check whether a USB memory is inserted.	No USB memory is inserted.
USB MEMORY IS USED BY OTHER FUNCTION.	Terminate another function that is using the USB memory, then perform operation again.	The USB memory is being used by another function.
THIS FILE NAME IS ALREADY USED. OVERWRITE IT?	Follow the message, and overwrite the file or specify another file name to write data.	An existing file name is specified as the write destination.
FILE NOT FOUND	Check the file name or number on the file list screen.	The specified file is not found.
USB MEMORY IS FULL.	Delete any unnecessary files and allocate a required capacity.	The USB memory is full.
FILE IS READ-ONLY.	Specify another file or check the file attribute and delete the read-only attribute.	The specified file is read-only.
USB MEMORY IS NOT FORMATTED	Replace the USB memory with another one.	The inserted USB memory cannot be recognized.
FILE NAME IS INVALID.	Correct the file name.	An invalid character is found in a file name.
DIFFERENCE FOUND		File comparison detected a mismatch.
THE FILE NUMBER DOES NOT EXIST	Check the total number of files on the list screen.	The entered file number is not present. The entered number exceeds the total number of files.
FILE NUMBER IS RESTRICTED TO "128"	Enter a numeric value not exceeding 128.	A value up to 128 can be entered as the file number.
FOLDER CANNOT BE SPECIFIED.	(1) The specified number indicates a folder. Enter an appropriate number. (2) No folder can be selected in the file list screen.	(1) The specified number indicates a folder. (2) An attempt was made to select a folder in the file list screen.
THIS FILE CANNOT BE SPECIFIED.	(1) The file name corresponding to the specified file number consists of more than 32 characters. Enter an appropriate number. (2) No file having a file name consisting of more than 32 characters can be selected in the file list screen.	(1) The file name corresponding to the specified file number consists of more than 32 characters. (2) An attempt was made to select a file having a file name consisting of more than 32 characters.
USB HARDWARE ERROR (xxxxxxxxxx)	Replace the USB memory with another one. If this error still occurs after replacement, contact the FANUC service center, and report the displayed message correctly.	This error occurs due to a USB hardware failure. An error code is indicated in parentheses.
INTERNAL ERROR (xxxxxxxxxx)	Contact the FANUC service center, and report the displayed message correctly.	This error occurs due to an internal factor. An error code is indicated in parentheses.

Error messages displayed during flash ROM I/O operation

Alarm message	Faulty location/corrective action	Contents
NOT IN EMG STOP MODE	Place the system in the emergency stop state.	The system is not in the emergency stop state.
INVALID SEQUENCE PROGRAM	Check the program.	The transfer program is illegal.
DIFFERENCE FOUND		A file comparison detected a mismatch.
FLASH ROM IS LOCKED BY OTHER FUNCTION	Wait until the PMC user completes processing, then retry.	Another PMC user is using the flash ROM.
FLASH ROM HEADER ROM DATA ID IS ILLEGAL	This file cannot be read. Check the type of the file.	An attempt was made to read a file, but its ROM data ID was illegal.
FLASH ROM IS USED BY OTHER FUNCTION.	This file cannot be read. Check the type of the file.	The ROM data ID of the file you attempted to read is invalid.
INTERNAL ERROR (xxxxxxxxxx)	Contact the FANUC service center, and report the displayed message correctly.	An error due to an internal factor occurred. Details on the error are displayed in parentheses.

Error messages displayed during FLOPPY or other input/output device I/O operation.

Alarm message	Faulty location/corrective action	Contents
ILLEGAL PMC PARAMETER FORMAT	Specify a file of the PMC parameter format. Also, check the specified file to see whether its content is not disrupted.	The specified file is not of the PMC parameter format.
ILLEGAL HANDY FILE FORMAT	Specify a file of the handy file format. Also, check the specified file to see whether its content is not disrupted.	The specified file is not of the handy file format.
UNKNOWN FILE FORMAT	Specify file of recognizable format such as PMC parameter format, or check the contents of the file.	Can not recognize the format of specified file.
FILE NAME OR FILE NUMBER IS REQUIRED	Specify file name or file number for the operation.	Need file name or file number to identify file to read, compare, or delete.
COMMUNICATION TIMEOUT	Check the communication parameters such as baud rate, and retry to communicate.	Communication with the I/O device has been timeout.
I/O DEVICE IS NOT ATTACHED OR IN ERROR STATUS	Check the power of I/O device is ON. Check the I/O device is connected. Check the cable that connects I/O device with PMC is correct one. If some error has occurred in I/O device, solve it.	Any I/O device is not connected, or some error has occurred in it.
RECEIVED BAD DATA: CHECK THE COMMUNICATION PARAMETERS	Check the PMC's communication parameters such as baud rate match the ones of I/O device.	Invalid data has been received.
RECEIVED DATA HAS OVERRUN	Check the communication parameters about flow control.	Too many data have received at once.
OTHERS FUNCTION IS USING THIS CHANNEL	Use the other channel, or stop the function.	Others function is using this channel.
BAD COMMUNICATION PARAMETER	Check the communication parameters such as baud rate.	Setting parameters of communication are not correct.
OTHER FUNCTION IS USING I/O FUNCTION	Wait until function that using I/O function do finish, or stop the function.	Another function such as FANUC LADDER-III is using I/O function.

Alarm message	Faulty location/corrective action	Contents
UNKNOWN HANDY FILE FORMAT DATA	Check the file.	The received data is not a program of the PMC system or is a program of some other incompatible type.
ILLEGAL BAUD RATE SETTING	Set a valid baud rate.	The set baud rate is invalid.
ILLEGAL CHANNEL NUMBER	Set a valid channel number.	The set channel number is invalid.
ILLEGAL PARITY BIT SETTING	Set a valid parity bit.	The set parity bit is invalid.
ILLEGAL STOP BIT SETTING	Set a valid stop bit.	The set stop bit is invalid.
ILLEGAL WRITE CODE SETTING	Set a valid output code.	The set output code is invalid.
SEQUENCE PROGRAM IS IN USE BY ONLINE FUNCTION	Wait until On-line function, do finish the using I/O function. In general, both of I/O function and On-line function should not be used at the same time.	Can not input/output of sequence program, because On-line function is using sequence program.

Common error messages that may be displayed on individual devices during the I/O operations

Alarm message	Faulty location/corrective action	Contents
ERROR OCCURS IN SEQUENCE PROGRAM.	Check the PMC alarm screen and correct the indicated program error accordingly.	Data cannot be output because there is an error in the ladder program.
UNKNOWN DATA TYPE	Check the file.	The PMC type of the input data is unknown.
MUST BE IN EMERGENCY STOP	Set the NC to the emergency stop state.	The NC is not in the emergency stop state when the PMC parameter is read.
PWE MUST BE ON	Set PWE to 1 on the NC setting screen.	PWE on the NC setting screen is 0 during reading from the PMC parameter.
MUST BE IN EDIT MODE	Set the NC to the EDIT mode.	The NC is not the EDIT mode during writing to the PMC parameter.
THIS FUNCTION IS NOT ALLOWED	Check the settings.	The setting required to use this function is not present.
PMC PARAMETER IS LOCKED BY OTHER FUNCTION	Retry after terminating the other function that is currently using the PMC parameter.	The PMC parameter is currently used by some other function and cannot be referenced by this function.
THIS DEVICE IS USED BY OTHER FUNCTION	Retry after terminating the other function that is currently using the specified device.	The specified device is currently used by some other function and cannot be used by this function.
PMC PARAMETER IS PROTECTED BY OTHER FUNCTION	Retry after terminating the other function that is currently using the PMC parameter.	The PMC parameter is currently used by some other function and cannot be changed by this function.
LADDER TYPE UNMATCH	Specify a program of a valid type.	The specified program is of a different type and cannot be read.
TOO LARGE SEQUENCE PROGRAM.	Check the file. Or, change to a step number option that allows you to set a larger program size.	The ladder program is too large to read.
SEQUENCE PROGRAM IS USED BY OTHER FUNCTION.	Retry after terminating the other function that is currently displaying the ladder program.	The ladder program is currently used by some other function and cannot be referenced by this function.

Alarm message	Faulty location/corrective action	Contents
INVALID I/O CONFIGURATION DATA	Read correct I/O configuration file.	Invalid I/O configuration data was read and any of the following operations was performed: - Writing it to the memory card - Comparing it with a memory card file USB - Writing it to flash ROM -Comparing it with flash ROM
TOO LARGE I/O CONFIGURATION DATA	Check the I/O configuration file.	The I/O configuration file is too large to read.
/O CONFIGURATION DATA IS USED BY OTHER FUNCTION	Terminate another function that is using the I/O configuration data, then execute operation again.	I/O configuration data is being used by another function (such as FANUC LADDER-III).

D.4 ALARM LIST (SERIAL SPINDLE)

When a serial spindle alarm occurs, the following number is displayed on the CNC.

NOTE

*1 Note that the meanings of the Spindle Amplifier (SP) indications differ depending on which LED, the red or yellow LED, is on. When the red LED is on, the Spindle Amplifier (SP) indicates a 2-digit alarm number. When the yellow LED is on, the SP indicates an error number that designates a sequence problem (for example, when a rotation command is entered with the emergency stop state not released).
See "Error Codes (Serial Spindle)."

*2 For information about serial spindle alarms for numbers that are not listed below, refer to the following documents according to the actual spindle motor to be connected.
- FANUC AC SPINDLE MOTOR αi series MAINTENANCE MANUAL (B-65285EN)
- Technical reports etc.

Number	Message	SP indication (*1)	Faulty location and remedy	Description
SP9001	MOTOR OVERHEAT	01	1) Check and correct the peripheral temperature and load status. 2) If the cooling fan stops, replace it.	The internal temperature of the motor exceeds the specified level. The motor is used in excess of the continuous rating, or the cooling component is abnormal.
SP9002	EX DEVIATION SPEED	02	1) Check and correct the cutting conditions to decrease the load. 2) Correct parameter No. 4082.	The motor speed cannot follow a specified speed. An excessive motor load torque is detected. The acceleration/deceleration time in parameter No. 4082 is insufficient.
SP9003	DC-LINK FUSE IS BROKEN	03	1) Replace the spindle amplifier (SP). 2) Check the motor insulation status.	The Power Supply becomes ready (00 is indicated), but the DC link voltage is too low in the Spindle Amplifier (SP). The fuse in the DC link section in SP is blown. (The power device is damaged or the motor is ground-fault.)
SP9004	PS IMPROPER INPUT POWER		Check the condition of the power input to the common power supply (PS).	The power supply (PS) detected a power supply failure. (Power Supply alarm 14)
SP9006	THERMAL SENSOR DISCONNECT	06	1) Check and correct the parameter. 2) Replace the feedback cable.	The temperature sensor of the motor is disconnected.

Number	Message	SP indication (*1)	Faulty location and remedy	Description
SP9007	OVER SPEED	07	Check for a sequence error. (For example, check whether spindle synchronization was specified when the spindle could not be turned.)	The motor speed has exceeded 115% of its rated speed. When the spindle axis was in position control mode, positional deviations were accumulated excessively (SFR and SRV were turned off during spindle synchronization.)
SP9009	OVERHEAT MAIN CIRCUIT	09	1) Improve the heat sink cooling status. 2) If the heat sink cooling fan stops, replace the Spindle Amplifier (SP).	The temperature in the power semiconductor cooling radiator is abnormally high.
SP9010	LOW VOLT INPUT POWER	10	1) Replace the cable. 2) Replace the spindle amplifier control printed circuit board.	The control power supply voltage of the spindle amplifier (SP) is low.
SP9011	PS OVER VOLT. DC LINK		1) Check the selected Power Supply (PS). 2) Check the input power voltage and change in power during motor deceleration. If the voltage exceeds 253 VAC (for the 200-V system) or 530 VAC (for the 400-V system), improve the power supply impedance.	Overvoltage of the DC link section of the Power Supply (PS) was detected. (Power Supply alarm indication: 07) PS selection error. (The maximum output specification of the PS is exceeded.)
SP9012	OVERCURRENT POWER CIRCUIT	12	1) Check the motor insulation status. 2) Check the spindle parameters. 3) Replace the spindle amplifier (SP).	The motor output current is abnormally high. A motor-specific parameter does not match the motor model. Poor motor insulation
SP9013	CPU DATA MEMORY FAULT	13	Replace the spindle amplifier (SP) control printed circuit board.	Abnormality in a Spindle Amplifier (SP) control circuit component is detected. (RAM within the Spindle Amplifier (SP) is abnormal.)
SP9014	SOFTWARE SERIES MISMATCH	14	Replace the spindle software.	A Spindle Amplifier (SP) that is not registered in the spindle software is used.
SP9015	SPINDLE SWITCHING FAULT	15	1) Check and correct the ladder sequence. 2) Replace the switching MCC.	The switch sequence in spindle switch/output switch operation is abnormal. The switching MCC contact status check signal and command do not match.
SP9016	RAM ERROR	16	Replace the spindle amplifier (SP) control printed circuit board.	A failure was detected on a part in the spindle amplifier (SP) control circuit (RAM for external data is abnormal.)

Number	Message	SP indication (*1)	Faulty location and remedy	Description
SP9017	ID NUMBER PARITY ERROR	17	Replace the spindle amplifier.	Abnormality in Spindle Amplifier (SP) ID data is detected.
SP9018	SUMCHECK ERROR PROGRAM ROM	18	Replace the spindle amplifier (SP) control printed circuit board.	A failure was detected on a part in the spindle amplifier (SP) control circuit (Program ROM data is abnormal.)
SP9019	EXCESS OFFSET CURRENT U	19	Replace the spindle amplifier.	A failure was detected on a part in the spindle amplifier (SP) control circuit (The initial value for the U phase current detection circuit is abnormal.)
SP9020	EXCESS OFFSET CURRENT V	20	Replace the spindle amplifier.	A failure was detected on a part in the spindle amplifier (SP) control circuit (The initial value of the V phase current detection circuit is abnormal.)
SP9021	POS SENSOR POLARITY ERROR	21	Check and correct the parameters. (No.4000#0, No.4001#4)	The polarity parameter setting of the position sensor is wrong.
SP9022	SP AMP OVER CURRENT	22	1) Review operation conditions (acceleration/ deceleration and cutting) to reduce the load. 2) Check and correct the parameters.	A Spindle Amplifier (SP) overload current was detected.
SP9024	SERIAL TRANSFER ERROR	24	1) Place the CNC-to-spindle cable away from the power cable. 2) Replace the cable.	The CNC power is turned off (normal power-off or broken cable). An error is detected in communication data transferred to the CNC.
SP9027	DISCONNECT POSITION CODER	27	Replace the cable.	The spindle position coder (connector JYA3) signal is abnormal.
SP9029	OVERLOAD	29	Check and correct the load status.	Excessive load has been applied continuously for a certain period of time. (This alarm is issued also when the motor shaft has been locked in the excitation state.)
SP9030	PS OVERCURRENT		Check and correct the power supply voltage.	Overcurrent is detected in Power Supply (PS) main circuit input. (Power Supply alarm indication: 01) Unbalanced power supply. PS selection error (The maximum PS output specification is exceeded.)
SP9031	MOTOR LOCK	31	1) Check and correct the load status. 2) Replace the motor sensor cable (JYA2).	The motor cannot rotate at a specified speed. (A level not exceeding the SST level for the rotation command has existed continuously.)

Number	Message	SP indication (*1)	Faulty location and remedy	Description
SP9032	SIC-LSI RAM FAULT	32	Replace the spindle amplifier (SP) control printed circuit board.	A failure was detected on a part in the spindle amplifier control circuit (The LSI device for serial transfer is abnormal.)
SP9033	PS PRE-CHARGE FAILURE		1) Check and correct the power supply voltage. 2) Replace the common power supply (PS).	Charging of direct current power supply voltage in the power circuit section is insufficient when the magnetic contractor is turned on (such as open phase and defective charging resistor). (Power Supply alarm indication: 05)
SP9034	ILLEGAL PARAMETER	34	Correct a parameter value according to FANUC AC SPINDLE MOTOR αi series PARAMETER MANUAL (B-65280EN). If the parameter number is unknown, connect the spindle check board, and check the indicated parameter.	Parameter data exceeding the allowable limit is set.
SP9036	OVERFLOW ERROR COUNTER	36	Check whether the position gain value is too large, and correct the value.	An error counter overflow occurred.
SP9037	ILLEGAL SETTING VELOCITY DETECTOR	37	Correct the parameter value according to FANUC AC SPINDLE MOTOR αi series PARAMETER MANUAL (B-65280EN).	The setting of the parameter for the number of pulses in the speed detector is incorrect.
SP9041	ILLEGAL 1REV SIGN OF POSITION CODER	41	1) Check and correct the parameter. 2) Replace the cable.	1) The 1-rotation signal of the spindle position coder (connector JYA3) is abnormal. 2) Parameter setting error
SP9042	NO 1REV SIGN OF POSITION CODER	42	Replace the cable.	The 1-rotation signal of the spindle position coder (connector JYA3) is disconnected.
SP9043	DISCONNECT POSITION CODER DEF. SPEED	43	Replace the cable.	The position coder signal (connector JYA3S) for differential speed in the submodule SW is abnormal.
SP9046	ILLEGAL 1REV SIGN OF SCREW CUT	46	1) Check and correct the parameter. 2) Replace the cable. 3) Re-adjust the BZ sensor signal.	The 1-rotation signal in threading is abnormal.

Number	Message	SP indication (*1)	Faulty location and remedy	Description
SP9047	ILLEGAL SIGNAL OF POSITION CODER	47	1) Replace the cable. 2) Correct the cable layout (vicinity of the power line).	The A/B phase signal of the spindle position coder (connector JYA3) is abnormal. The relationship between the A/B phase and 1-rotation signal is incorrect (Pulse interval mismatch).
SP9049	DEF. SPEED IS OVER VALUE	49	Check whether the calculated differential speed value exceeds the maximum motor speed.	In differential speed mode, the speed of the other spindle converted to the speed of the local spindle has exceeded the allowable limit (the differential speed is calculated by multiplying the speed of the other spindle by the gear ratio).
SP9050	SYNCRONOUS VALUE IS OVER SPEED	50	Check whether the calculated value exceeds the maximum motor speed.	In spindle synchronization, the speed command calculation value exceeded the allowable limit (the motor speed is calculated by multiplying the specified spindle speed by the gear ratio).
SP9051	PS LOW VOLT. DC LINK		1) Check and correct the power supply voltage. 2) Replace the MC.	Input voltage drop was detected. (Common power supply (PS) alarm indication = 04) (Momentary power failure or poor MCC contact)
SP9052	ITP FAULT 1	52	1) Replace the spindle amplifier (SP) control printed circuit board. 2) Replace the main board or additional spindle board in the CNC.	An abnormality is detected in the interface between the CNC and spindle amplifier (the ITP signal stopped).
SP9053	ITP FAULT 2	53	1) Replace the spindle amplifier (SP) control printed circuit board. 2) Replace the main board or additional spindle board in the CNC.	An abnormality is detected in the interface between the CNC and spindle amplifier (the ITP signal stopped).
SP9054	OVERCURRENT	54	Review the load state.	An overload current was detected.
SP9055	ILLEGAL POWER LINE	55	1) Replace the magnetic contactor. 2) Check and correct the sequence.	The power line state signal of the magnetic contactor for selecting a spindle or output is abnormal.
SP9056	COOLING FAN FAILURE	56	Replace the internal cooling fan.	The internal cooling fan stopped.

Number	Message	SP indication (*1)	Faulty location and remedy	Description
SP9057	PS EXCESS-REGENERATION2		1) Decrease the acceleration/deceleration duty. 2) Check the cooling condition (peripheral temperature). 3) If the cooling fan stops, replace the resistor. 4) If the resistance is abnormal, replace the resistor.	An overload was detected in the regenerative resistance. (Common power supply alarm indication = 16) Thermostat operation or short-time overload was detected. The regenerative resistor was disconnected, or an abnormal resistance was detected.
SP9058	PS OVERLOAD		1) Check that the common power supply (PS) is cooled properly. 2) Replace the common power supply (PS) as required.	The temperature of the heat sink of the common power supply (PS) is abnormally high. (Common power supply alarm indication = 03)
SP9059	PS INTERNAL FAN FAILURE		Replace the common power supply (PS) as required.	The common power supply (PS) internal cooling fan motor has stopped. (Common power supply alarm indication = 02)
SP9061	SEMI-FULL ERROR EXCESS	61	Check parameter settings.	The error between the semi-closed and full-closed sides when the dual position feedback function is used is too large.
SP9065	SERIAL SPINDLE ALARM	65	1) Check parameter settings. 2) Check sensor connections and signals. 3) Check power line connections.	The move distance is too long when the magnetic pole is confirmed (synchronization spindle)
SP9066	COM. ERROR BETWEEN SP AMPS	66	1) Replace the cable. 2) Check and correct the connection.	An error was found in communication (connector JX4) between Spindle Amplifiers (SP).
SP9067	FSC/EGB COMMAND ERROR	67	Check the sequence (reference position return command).	In the spindle EGB mode, reference position return was specified.
SP9069	SAFETY SPEED OVER	69	1) Check the specified speed. 2) Check parameter settings. 3) Check the sequence.	In the state in which safety speed monitoring was enabled, the system detected that the motor speed exceeded the safety speed or detected an error during a free-run stop.

Number	Message	SP indication (*1)	Faulty location and remedy	Description
SP9070	ILLEGAL AXIS DATA	70	1) When this alarm is issued because the configuration of the spindle amplifiers (SPs) was changed, set the spindle number for the spindle amplifier (parameter No. 4541#7 to 1 and then 0, and turn the power to the entire system off). 2) Replace the spindle amplifier.	An error was detected during transfer of spindle data of a spindle.
SP9071	SAFETY PARAMETER ERROR	71	1) Input the safety parameter again. 2) Replace the spindle amplifier (SP) control printed circuit board.	An error was detected in an axis parameter check.
SP9072	MISMATCH RESULT OF MOTOR SPEED CHECK	72	1) Replace the spindle amplifier (SP) control printed circuit board. 2) Replace the main board or additional spindle board in the CNC.	A mismatch was detected between the safety speed check results of the Spindle Amplifier (SP) and those of the CNC.
SP9073	MOTOR SENSOR DISCONNECTED	73	1) Replace the feedback cable. 2) Check the shield processing. 3) Check and correct the connection. 4) Adjust the sensor.	The motor sensor feedback signal is not present. (Connenctor JYA2)
SP9074	CPU TEST ERROR	74	Replace the spindle amplifier (SP) control printed circuit board.	An error was detected in a CPU test.
SP9075	CRC ERROR	75	Replace the spindle amplifier (SP) control printed circuit board.	An error was detected in a ROM CRC test.
SP9076	INEXECUTION OF SAFETY FUNCTIONS	76	Replace the spindle amplifier (SP) control printed circuit board.	It was detected that no safety function was executed on the spindle amplifier (SP).
SP9077	MISMATCH RESULT OF AXIS NUMBER CHECK	77	1) Replace the spindle amplifier (SP) control printed circuit board. 2) Replace the main board or additional spindle board in the CNC.	A mismatch was detected between the axis number check results of the Spindle Amplifier (SP) and those of the CNC.
SP9078	MISMATCH RESULT OF SAFETY PARAMETER CHECK	78	1) Replace the spindle amplifier (SP) control printed circuit board. 2) Replace the main board or additional spindle board in the CNC.	The result of a safety parameter check by the spindle amplifier (SP) conflicts with that of a safety parameter check by the CNC.

Number	Message	SP indication (*1)	Faulty location and remedy	Description
SP9079	INITIAL TEST ERROR	79	Replace the spindle amplifier (SP) control printed circuit board.	An error was detected in the initial test for the spindle amplifier (SP).
SP9080	ALARM AT THE OTHER SP AMP.	80	Remove the alarm cause on the spindle amplifier (SP) communicating with the spindle amplifier (SP) of interest.	An alarm occurred on the associated spindle amplifier (SP) in communication between spindle amplifiers.
SP9081	1-ROT MOTOR SENSOR ERROR	81	1) Check and correct the parameter. 2) Replace the feedback cable. 3) Adjust the sensor.	The one-rotation signal of the motor sensor cannot be correctly detected. (Connenctor JYA2)
SP9082	NO 1-ROT MOTOR SENSOR	82	1) Replace the feedback cable. 2) Adjust the sensor.	The one-rotation signal of the motor sensor is not generated. (Connenctor JYA2)
SP9083	MOTOR SENSOR SIGNAL ERROR	83	1) Replace the feedback cable. 2) Adjust the sensor.	An irregularity was detected in a motor sensor feedback signal. (Connenctor JYA2)
SP9084	SPNDL SENSOR DISCONNECTED	84	1) Replace the feedback cable. 2) Check the shield processing. 3) Check and correct the connection. 4) Check and correct the parameter. 5) Adjust the sensor.	The spindle sensor feedback signal is not present. (Connenctor JYA4)
SP9085	1-ROT SPNDL SENSOR ERROR	85	1) Check and correct the parameter. 2) Replace the feedback cable. 3) Adjust the sensor.	The one-rotation signal of the spindle sensor cannot be correctly detected. (Connenctor JYA4)
SP9086	NO 1-ROT SPNDL SENSOR	86	1) Replace the feedback cable. 2) Adjust the sensor.	The one-rotation signal of the spindle sensor is not generated. (Connenctor JYA4)
SP9087	SPNDL SENSOR SIGNAL ERROR	87	1) Replace the feedback cable. 2) Adjust the sensor.	An irregularity was detected in a spindle sensor feedback signal. (Connenctor JYA4)
SP9088	COOLING RADI FAN FAILURE	88	Replace the Spindle Amplifier radiator cooling fan.	The radiator cooling fan stopped.
SP9089	SUB MODULE SM (SSM) ERROR	89	1) Check the connection between the spindle amplifier (SP) and submodule SM (SSM). 2) Replace the submodule SM(SSM). 3) Replace the spindle amplifier (SP) control printed circuit board.	Submodule SM (SSM) error (synchronous spindle).

Number	Message	SP indication (*1)	Faulty location and remedy	Description
SP9090	UNEXPECTED ROTATION	90	1) Check magnetic pole detection operation. 2) Check whether the rotor and sensor are aligned correctly.	Unexpected rotation of the synchronous spindle motor was detected.
SP9091	POLE POSITION COUNT MISS	91	Replace the motor sensor cable.	Count error of the magnetic pole position of the synchronous spindle motor
SP9092	OVER SPEED TO VELOCITY COMMAND	92	Check the sequence (whether SFR or SRV is turned on and off in the position control mode).	The motor speed exceeds the overspeed level corresponding to the velocity command.
SP9110	AMP COMMUNICATION ERROR	b0	1) Replace the communication cable between Spindle Amplifier (SP) and Power Supply (PS). 2) Replace the Spindle Amplifier (SP) or Power Supply (PS) control printed circuit board.	Communication error between Spindle Amplifier (SP) and Power Supply (PS)
SP9111	PS LOW VOLT. CONTROL		Replace the common power supply (PS) control printed circuit board.	Low converter control power supply voltage (Power Supply indication : 06)
SP9112	PS EXCESS-REGENERATION1		1) Check the regenerative resistance. 2) Check the motor selection. 3) Replace the common power supply (PS).	Excessive converter regenerative power (Power Supply indication : 08)
SP9113	PS EXTERNAL FAN FAILURE		Replace the external radiator cooling fan for Power Supply (PS).	Stopped the external radiator cooling fan for Power Supply (PS) (Power Supply indication : 10)
SP9114	PS CONTROL AXIS ERROR 1	b4	Set parameter No. 4657 to 0.	Invalid parameter
SP9115	PS CONTROL AXIS ERROR 2	b5	Set parameter No. 4657 to other than 0.	Invalid parameter
SP9120	COMMUNICATION DATA ERROR	C0	1) Replace the communication cable between the CNC and spindle amplifier (SP). 2) Replace the spindle amplifier (SP) control printed circuit board. 3) Replace the main board or additional spindle board in the CNC.	Communication data alarm

Number	Message	SP indication (*1)	Faulty location and remedy	Description
SP9121	COMMUNICATION DATA ERROR	C1	1) Replace the communication cable between the CNC and spindle amplifier (SP). 2) Replace the spindle amplifierb (SP) control printed circuit board. 3) Replace the main board or additional spindle board in the CNC.	Communication data alarm
SP9122	COMMUNICATION DATA ERROR	C2	1) Replace the communication cable between the CNC and spindle amplifier (SP). 2) Replace the spindle amplifierb (SP) control printed circuit board. 3) Replace the main board or additional spindle board in the CNC.	Communication data alarm
SP9123	SPINDLE SWITCH CIRCUIT ERROR	C3	Replace the submodule SW(SSW).	Submodule SW (SSW) error (spindle switching)
SP9124	LEARNING CTRL ROTATION CMD ERROR	C4	1) Correct the velocity command. 2) Correct the setting of the learning period parameter (No. 4425).	A velocity that could not be used for learning control was specified in time-based learning control.
SP9125	LEARNING CTRL COMP ORDER ERROR	C5	Correct the settings of the parameters for the maximum and minimum orders of dynamic characteristic compensation elements for learning control (Nos. 4427 and 4428).	An order outside the allowable range was specified for dynamic characteristic compensation elements.
SP9127	LEARNING CTRL PERIOD ERROR	C7	Correct the setting of the parameter for the number of divisions per period for learning control (No. 4425).	In angle-based learning control, the reference angle period is invalid.
SP9128	SP SYNC VELOCITY ERROR EXCESS	C8	1) Check the sequence (whether SFR or SRV is turned off or on in position control). 2) Check and correct the load status. 3) Check the parameter setting.	In spindle synchronous control, velocity error exceeds the setting.
SP9129	SP SYNC POSITION ERROR EXCESS	C9	1) Check the sequence (whether SFR or SRV is turned off or on in position control). 2) Check and correct the load status. 3) Check the parameter setting.	In spindle synchronous control, position error exceeds the setting.

Number	Message	SP indication (*1)	Faulty location and remedy	Description
SP9130	TORQUE TANDEM POLARITY ERROR	d0	Check the setting of the parameter for the rotation direction (No. 4353#2).	In tandem control, the rotation directions of the master and slave motors are invalid.
SP9131	SPINDLE TUNING FUNCTION ALARM	d1	Check the message displayed by SERVO GUIDE.	Spindle tuning function alarm
SP9132	SER.SENSOR DATA ERROR	d2	1) Replace the feedback cable. 2) Replace the sensor. 3) Replace the spindle amplifier (SP).	Serial data error between a serial sensor and spindle amplifier (SP)
SP9133	SER.SENSOR TRANSFER ERROR	d3	1) Replace the feedback cable. 2) Replace the sensor. 3) Replace the spindle amplifier (SP).	Serial data error between a serial sensor and spindle amplifier (SP)
SP9134	SER.SENSOR SOFT PHASE ERROR	d4	1) Check and correct the sensor parameter setting. 2) Take action against noise. 3) Replace the sensor.	The change in serial sensor positional data is too large.
SP9135	SAFETY SPEED ZERO ERROR(SP)	d5	Perform operation within the safety speed zero range.	The motor position exceeded the safety speed zero monitoring width.
SP9136	MISMATCH RESULT OF SAFETY SPEED ZERO CHECK(SP)	d6	Replace the spindle amplifier (SP) control printed circuit board.	The Spindle Amplifier (SP) speed zero determination result did not match the CNC speed zero determination result.
SP9137	SP DEVICE COMMUNICATION ERROR	d7	Replace the spindle amplifier (SP) control printed circuit board.	Device communication error in the spindle amplifier (SP)
SP9138	CURRENT LIMIT SETTING ERROR	d8	Check the parameter.	The current limit level setting is out of the specified range.
SP9139	SER.SENSOR PULSE MISS	d9	Replace the sensor.	An error occurred in the serial sensor interpolation circuit.
SP9140	SER.SENSOR COUNT MISS	E0	1) Take action against noise. 2) Replace the sensor.	The number of feedback pulses per one-rotation signal of the serial sensor is outside the specified range.
SP9141	SER.SENSOR NO 1-ROT SIGNAL	E1	1) Check and correct the sensor parameter setting. 2) Replace the sensor.	The serial sensor is not placed in the status in which the one-rotation signal has been detected.
SP9142	SER.SENSOR ABNORMAL	E2	Replace the sensor.	A serial sensor error occurred.
SP9143	CS HIGH SPEED CHANGE CMD ERROR	E3	Check the sequence.	A command was issued though the one-rotation signal had not been detected.
SP9144	CURRENT DETECT CIRCUIT ERROR	E4	Replace the spindle amplifier (SP).	An error was found in the current detection circuit.
SP9145	LOW VOLTAGE DRIVER	E5	Replace the spindle amplifier (SP).	The driver circuit voltage has dropped.

Number	Message	SP indication (*1)	Faulty location and remedy	Description
SP9146	SP:INTERNAL OVERHEAT	E6	1) Check that the temperature in the power magnetics cabinet is within the specification range. 2) If this alarm is issued immediately after power-on, replace the spindle amplifier (SP).	The internal temperature of the spindle amplifier (SP) exceeds the specified value.
SP9147	SP:GROUND FAULT	E7	Replace the motor or amplifier.	A ground fault occurred in the motor or amplifier.
SP9148	AXIS NUMBER NOT SET	E8	Turn off the power of the entire system.	The axis number of the spindle (SP) is not set.
SP9149	EXT.CURRENT FB U-OFFSET	E9	Replace the spindle amplifier (SP) control printed circuit board.	A fault was detected in a component of the spindle amplifier (SP).
SP9150	EXT.CURRENT FB V-OFFSET	F0	Replace the spindle amplifier (SP) control printed circuit board.	A fault was detected in a component of the spindle amplifier (SP).
SP9151	FILTER MODULE ERROR	F1	Replace the filter module.	A failure was detected in the filter module.
SP9152	EXT.CUR.FB DISCONNECT	F2	Replace the cable (JYA4).	A break was detected in the external current sensor.
SP9153	SP NO FAILURE	F3	Check the parameter.	No hardware failure was detected as a result of a self-check.
SP9154	PHASE OPEN	F4	Replace the motor.	A failure was detected in the motor.
SP9155	FAILURE OF SP (OPEN)	F5	Replace the spindle amplifier (SP).	A failure was detected in the spindle amplifier (SP).
SP9156	FAILURE OF CURRENT CTRL.	F6	Replace the spindle amplifier (SP) control printed circuit board.	A fault was detected in a component of the spindle amplifier (SP).
SP9157	FAILURE OF SP (SHORT)	F7	Replace the spindle amplifier (SP).	A fault was detected in a component of the spindle amplifier (SP).
SP9200	PS GROUND FAULT		Replace the motor or amplifier.	A ground fault occurred in the motor or amplifier. (Common power supply indication = 09)
SP9201	PS OVERCURRENT 2		Replace the common power supply (PS).	Overcurrent was detected in the main circuit input in the power supply (PS). (Power Supply (PS) alarm indication: 11)
SP9202	PS OVERCURRENT 3		Replace the common power supply (PS).	Overcurrent was detected in the main circuit input in the power supply (PS). (Power Supply (PS) alarm indication: 12)

Number	Message	SP indication (*1)	Faulty location and remedy	Description
SP9203	PS OVERCURRENT 4		Replace the common power supply (PS).	Overcurrent was detected in the main circuit input in the power supply (PS). (Power Supply (PS) alarm indication: 13)
SP9204	PS SOFT THERMAL		Review the current condition.	Overload was detected in the power supply (PS). (Power Supply (PS) alarm indication: 15)
SP9205	PS OVER VOLT. DC LINK 2		Replace the common power supply (PS).	Overvoltage was detected in the DC link section. (Power Supply (PS) alarm indication: 17)
SP9206	PS OVER VOLT. DC LINK 3		Replace the common power supply (PS).	Overvoltage was detected in the DC link section. (Power Supply (PS) alarm indication: 18)
SP9207	PS OVER VOLT. DC LINK 4		Replace the common power supply (PS).	Overvoltage was detected in the DC link section. (Power Supply (PS) alarm indication: 19)
SP9208	PS LOW VOLT.DC LINK2		Replace the common power supply (PS).	Voltage drop was detected in the DC link section. (Power Supply (PS) alarm indication: 20)
SP9209	PS LOW VOLT.DC LINK3		Replace the common power supply (PS).	Voltage drop was detected in the DC link section. (Common Power Supply (PS) alarm indication: 21)
SP9210	PS LOW VOLT.DC LINK4		Replace the common power supply (PS).	Voltage drop was detected in the DC link section. (Power Supply (PS) alarm indication: 22)
SP9211	PS ILLEGAL PARAMETER		Change the parameter to an appropriate value.	An invalid value was set in a parameter for controlling the power supply (PS). (Power Supply (PS) alarm indication: 23)
SP9212	PS HARDWARE ERROR		Replace the common power supply (PS).	A hardware error was detected in the power supply (PS). (Power Supply (PS) alarm indication: 24)

D.5 ERROR CODES (SERIAL SPINDLE)

NOTE *1

When the yellow LED is on, the spindle amplifier (SP) indicates an error code, using a 2-digit number. The error code is displayed with CNC diagnostic data No. 0710.

If the red LED is on, a serial spindle alarm number is displayed, which has a different meaning.
→ See the list of serial spindle alarms (SP alarms).

SP indication (*1)	Faulty location and remedy	Description
01	Neither *ESP (emergency stop signal, which can be either an input signal or common power supply (PS) contact signal) nor MRDY (machine ready signal) is input, but SFR (clockwise rotation command)/SRV (counterclockwise rotation command)/ORCM (orientation command) is input.	Check the *ESP and MRDY sequence. For MRDY, pay attention to the parameter setting regarding the use of the MRDY signal (parameter No. 4001#0).
03	The parameter settings are such that a position sensor is not used (position control not performed) (parameter No. 4002#3, 2, 1, 0 = 0, 0, 0, 0), but a Cs contour control command is input. In this case, the motor is not excited.	Check the parameter settings.
04	The parameter settings are such that a position sensor is not used (position control not performed) (parameter No.4002#3, 2, 1, 0 = 0, 0, 0, 0), but a servo mode (rigid tapping, spindle positioning, etc.) or spindle synchronization command is input. In this case, the motor is not excited.	Check the parameter settings.
05	The orientation function option parameter is not specified, but ORCM (orientation command) is input.	Check the orientation function parameter settings.
06	The output switching control function option parameter is not specified, but low-speed characteristic winding is selected (RCH = 1).	Check the output switching control function parameter settings and the power line state check signal (RCH).
07	A Cs contour control command is input, but SFR (clockwise rotation command)/SRV (counterclockwise rotation command) is not input.	Check the sequence.
08	A servo mode (rigid tapping, spindle positioning, etc.) control command is input, but SFR (clockwise rotation command)/SRV (counterclockwise rotation command) is not input.	Check the sequence.
09	A spindle synchronization command is input, but SFR (clockwise rotation command)/SRV (counterclockwise rotation command) is not input.	Check the sequence.

SP indication (*1)	Faulty location and remedy	Description
10	A Cs contour control command is input, but another mode (servo mode, spindle synchronization, or orientation) is specified.	Do not switch to another mode during a Cs contour control command. Before moving to another mode, cancel the Cs contour control command.
11	A servo mode (rigid tapping, spindle positioning, etc.) command is input, but another mode (Cs contour control, spindle synchronization, or orientation) is specified.	Do not switch to another mode during a servo mode command. Before moving to another mode, cancel the servo mode command.
12	A spindle synchronization command is input, but another mode (Cs contour control, servo mode, or orientation) is specified.	Do not switch to another mode during a spindle synchronization command. Before moving to another mode, cancel the spindle synchronization command.
13	An orientation command is input, but another mode (Cs contour control, servo mode or spindle synchronization control) is specified.	Do not switch to another mode during an orientation command. Before moving to another mode, cancel the orientation command.
14	Both SFR (clockwise rotation command) and SRV (counterclockwise rotation command) are input at the same time.	Issue either of them.
16	The parameter settings are such that the differential speed control function is not used (parameter No. 4000#5 = 0), but DEFMD (differential speed mode command) is input.	Check the parameter settings and differential speed mode command.
17	The speed detector parameter settings (parameter No. 4011#2, 1, 0) are not valid. There is no corresponding speed detector.	Check the parameter settings.
18	The parameter settings are such that a position sensor is not used (position control not performed (parameter No. 4002#3, 2, 1, 0), but position coder system orientation is issued.	Check the parameter settings and the input signal.
19	The magnetic sensor orientation command is input, but another mode (Cs contour control, servo mode or spindle synchronization control) is specified.	Do not switch to another mode during an orientation command. Before moving to another mode, cancel the orientation command.
21	The tandem operation command was input in the spindle synchronization control enable state.	Input the tandem operation command when spindle synchronization control is canceled.
22	Spindle synchronization control was specified in the tandem operation enable state.	Specify spindle synchronization control when torque tandem operation is canceled.
23	The tandem operation command is input without the required option.	Torque tandem control requires a CNC software option. Check the option.
24	If index is performed continuously in position coder system orientation, an incremental operation is performed first (INCMD = 1), then an absolute position command (INCMD = 0) is input.	Check INCMD (incremental command). If an absolute position command is to follow, be sure to perform absolute position command orientation first.
26	The parameter settings are such that both spindle switch and three-stage speed range switch are used.	Check the parameter settings and the input signal.
29	The parameter settings are such that the shortest-time orientation function is used (parameter No. 4018#6 = 0, Nos. 4320 to 4323 $\neq$ 0).	In the αi series spindle amplifier, the shortest-time orientation function cannot be used. The use of the optimum orientation function is recommended.

SP indication (*1)	Faulty location and remedy	Description
30	The magnetic pole has not been detected, but a command is input.	In the magnetic pole undetected state (EPFIXA = 0), the motor cannot be driven even when a command is input. Input a command in the magnetic pole detected state (EPFIXA = 1). When EPFSTR is set to 1, any command is ignored and this error is displayed even in the magnetic pole detected state. After the completion of magnetic pole detection, set EPFSTR to 0.
31	The hardware configuration is such that the spindle FAD function cannot be used. In this case, the motor is not activated.	Check the CNC model. With the FS30i series, the spindle FAD function is not used.
32	S0 is not specified in the velocity mode, but the disturbance input function is enabled (parameter No. 4395#7 is set to 1).	Specify S0 in the velocity mode before enabling the disturbance input function (parameter No. 4395 #7to 1).
33	The hardware configuration is such that the spindle EGB function cannot be used. In this case, the motor is not activated.	Check the CNC model.
34	Both the spindle FAD function and the spindle EGB function are enabled. In this case, the motor is not activated.	The two functions cannot be used at the same time. Enable either function only.
35	Spindle Amplifier (SP) ID information cannot be obtained.	Replace the spindle amplifier with one with correct ID information.
36	The submodule SM (SSM) is faulty.	For action to be taken, refer to the FANUC AC SPINDLE MOTOR □i series PARAMETER MANUAL (B-65280EN).
37	The current loop setting (No. 4012) has been changed.	Check the setting of parameter No. 4012, and turn the power off, then on again.
38	A parameter related to communication between spindle amplifiers is specified incorrectly. Alternatively, a function unavailable with the torque tandem function is set.	Check the parameter.
39	Although SFR (forward rotation command), SRV (reverse rotation command), or ORCM (orientation command) is input, DSCN (disconnection detection disable signal) is input.	Check the sequence. Do not input DSCN (disconnection detection disable signal) during the input of a command which excites the motor.
43	A setting which does not support the □iCZ sensor (serial) is used.	Check the parameter settings.
44	The spindle amplifier does not support the control period setting.	Check the setting of parameter No. 4012.

NOTE

*2 Common power supply contact signal
(between ESP1 and ESP2 on the common power supply)
Contact open: Emergency stop
Contact closed: Normal operation

D.6 MACHINE ALARMS (EX ALARMS)

Number	Message Contents	Remedy	Remarks
EX1000	POWER FAILURE BACKUP MODULE ALM An alarm related to the power failure backup module was detected.	The possible causes are as follows: – The power failure backup module is faulty. – The cable for connecting the power failure backup module is connected incorrectly or broken. – The wiring PCB or the I/O module on the wiring PCB unit is faulty. – Parameter setting error (The I/O module on the wiring PCB unit is disabled. The power failure backup module is not installed, but is enabled by the parameter.)	
EX1001	FUSE IS BLOWN (F4 to F8) A fuse on the wiring PCB has blown.	After checking the circuit, replace the fuses.	FU4 to FU8 X10.7 :Fuse Monitor
EX1002	EXT. EMERGENCY STOP SIGNAL ON The emergency stop signal input from external equipment was off. During use of the external emergency stop signal for the external interface, an error occurred in the external equipment, and the emergency stop signal input was off.	Using the control unit in the external equipment, check whether an alarm is raised while the external equipment is connected. When no error occurs in the external equipment, check the status of external equipment connection. Eliminating the alarm raised in the external equipment automatically eliminates the machine alarm.	Select QUICK screen, “6:MAINTENANCE/SETTING” screen, “5:EXT.INTERFACE”, [FUNCTIONS], then EXTERNAL EMG STOP.
EX1003	EMERGENCY STOP The emergency stop button was pressed.	Check whether the emergency stop button is pressed. If the emergency stop button is pressed, investigate the reason, then release the button. Releasing the emergency stop button automatically eliminates the machine alarm. If the emergency stop button is in the normal state, but the alarm persists, contact FANUC Technical Center.	
EX1004	DOOR OPEN/CLOSE SW IS DEFECTIVE There is something wrong in a limit switch to detect whether the automatic door is open. There is something wrong in a limit switch of splash guard door interlock. A signal indicating a closed door state and signal indicating an open door state are both on.	Replace and adjust the proximity switches for detecting whether the automatic door is open or closed.	X10.0: For checking open state X10.1: For checking closed state

Number	Message Contents	Remedy	Remarks
EX1005	PROGRAM ERROR (NO TOOL) The spindle rotation command was issued while no tool is mounted on the spindle. The spindle can be rotated only while a tool is mounted. (If the system settings are such that no alarm is issued, even when no tool is mounted on the spindle)	Rotate the spindle with a tool mounted on the spindle.	X10.4: For checking tool clamping
EX1006	SPINDLE HAS NO TOOL The tool arbor fell free during machining. Alternatively, there may be a tool clamp switch failure or a broken cable.	If no tool is attached to the spindle, attach a tool to the spindle. Excessive load may be applied during machining, allowing the tool to come off momentarily. Check the machining conditions.	
EX1007	PROGRAM ERROR (M19) The rigid tapping (M29) was performed during spindle positioning (M19).	Spindle positioning cannot be specified during rigid tapping. Correct the program.	
EX1008	AUTO DOOR TOTAL TIME OVER The open/close mechanism of the front automatic door or side automatic door (for the robot system) is abnormal. When the automatic door open/close option is provided, the operation time from the specification of door open/close operation until operation is completed exceeds the setting. This may be caused by incorrect setting of the door open/close operation time or maladjustment of the door open/close mechanism (the air pressure, the air damper of the flow control valve, and the proximity switch).	Check whether the open/close operation of the automatic doors is completed within the following period : Front automatic door : Approximately Front automatic door : 4 seconds Side automatic door : Approximately Side automatic door : 2 seconds Check the timer setting in a PMC parameter.	Standard timer value T20=6000 T94=2104
EX1009	TCZ LIMIT SW IS DEFECTIVE The tool change area detection switch may be defective. The tool change area has been detected during an operation other than tool change or turret recovery. (The switch contacts has opened.). When the tool change area detection switch is activated by the dog in the tool change area, both of the switch contacts are opened.	Check the operation of the tool change area detection switch by moving lits lever. The switch status is as follows under the normal status: TCZ=X6.0 In the tool exchange area | Out of the tool exchange area TCZ: 0 | 1	X6.3: Tool change area check
EX1010	TOOL BREAKAGE WAS DETECTED The tool damage detection function (AI monitor function) detected a failure. This alarm is generated when: The current spindle load exceeds a specified damage level value during drilling. A spindle load value greater than or equal to the rated value cannot be detected during drilling.	Replace or check the cutter. Alternatively, check the set spindle load damage level value.	When tool damage is detected, an automatic return to the Z-axis reference point occurs.
EX1011	ALL TOOL IN SAME GROUP ARE USED The tool life management function detected that the operating life of all tools in the same group expired.	Replace the cutter. Alternatively, clear the tool information on the tool life management screen.	

Number	Message Contents	Remedy	Remarks
EX1012	IN THE TOOL CHANGE AREA The Z-axis stopped in the tool change area (+area).	Perform turret recovery operation.	
EX1013	AI TOOL MONITOR DATA ERROR The programmed data rewrite function (AI tool monitor function) detected an out-of-range or invalid command error.	Check the command.	
EX1014	APC ALARM An alarm related to the KAWATATEC pallet changer occurred.	Refer to the operation manual for the KAWATATEC pallet changer.	This alarm is specific to KAWATATEC APC.
EX1015	TOOL CHANGE INHIBIT AREA A tool exchange command was issued when the table was in an area where it might interfere with the pallet changer cables. The position switch is used to monitor the interference area.	Refer to the operation manual for the KAWATATEC pallet changer. The NC parameters for specifying a prohibition area are as follows: X-axis: No. 6914, No. 6934, No. 6954 Y-axis: No. 6915, No. 6935, No. 6955	Keep relay K02#6 K02#7
EX1016	MAIN CONTACTOR IS WELDING Although the emergency stop state of the ROBODRILL has been cancelled, the main contactor fails to turn on despite the lapse of a preset interval. Alternatively, the main contactor fails to turn off even though the ROBODRILL has entered the emergency stop state.	Press and release the emergency stop button, while checking whether X8.3 is set to 1 and 0, respectively. If the bit can be set to 1 and 0 by pressing and releasing the emergency stop button, replace the main contactor.	X8.3: MCC Monitor
EX1017	SPINDLE KEY IS DEFECTIVE The spindle key on the operator's panel is ON continuously for 5 seconds or more. The operator's panel may be defective.	If you are holding down the spindle key, release the key. Replace the operator's panel.	X26.0: Spindle key
EX1018	TCZ SWITCH IS WELDING The tool exchange area detection switch may have malfunctioned. Alternatively, the dog or parameter setting may be incorrect. The alarm occurs under the following condition. During tool change, the tool has been detected as being outside the tool change area, even though was still within the area. (The tool change area detection switch has closed. Or, the tool change area dog is worn.) The TCZ switch has been closed (indicating that the tool is outside the tool change area) while the position switch is outside the specified range.	Check the parameter values for the position switch with the data sheet. Check that the tool exchange area switch operate normally. Under the normal condition, the switch should receive the inputs listed below. TCZ = X6.3 • Make sure that the two contacts of the tool exchange area detection switch work at 15 ± 2 mm on the Z–axis.	Related parameters: No.6938 No.6958 X6.3: Tool exchange area check
	The cables for the tool exchange area detection switch may be defective or connected incorrectly.	• Check the cables. Replace them if necessary.	

	In the tool exchange area	Out of the tool exchange area
TCZ	0	1

Number	Message Contents	Remedy	Remarks
EX1019	"SPINDLE IS DEFECTIVE" In the emergency stop state (with the spindle stopped), the spindle stop state could not be detected. Alternatively, in the turret recovery mode, the spindle rotated at a speed higher than the specified value.	The CNC or spindle is considered to be faulty. Check the timer setting in a PMC parameter. After turning the circuit breaker off then on, turn on the power again. If the alarm is still issued, contact the FANUC technical center serving your locality. When a spindle-related alarm has been issued or when the spindle is coasting, ignore this alarm.	Standard timer value T58 = 4000
EX1020	"KA16 RELAY IS DEFECTIVE." A relay for the safety circuit is abnormal. When the servo contactor control (Y6.0) and MCC off-relay monitor (X8.7) are in the following state, an alarm is issued 1 second later: Y6.0 = 0 and X8.7 = 0 or Y6.0 = 1 and X8.7 = 1	Replace the wiring PCB in the control unit cabinet.	
EX1021	"KA17 RELAY IS DEFECTIVE." A relay for the safety circuit is abnormal. When the Z-axis brake control (Y6.1) and Z-axis relay monitor (X8.6) are in the following state, an alarm is issued 1 second later: Y6.1 = 0 and X8.6 = 0 or Y6.1 = 1 and X8.6 = 1		
EX1022	KA01 RELAY IS DEFECTIVE. A relay for controlling the emergency stop is abnormal. When the emergency stop input (X8.4) and emergency stop relay monitor (X8.5) are in the following state, an alarm is issued 1 second later: Y8.4 = 0 and X8.5 = 0 or Y8.4 = 1 and X8.5 = 1		
EX1023	KA12 RELAY IS DEFECTIVE. A relay for the safety circuit is abnormal. When the operation ready input (X9.0) and operation ready relay monitor (X10.6) are in the following state, an alarm is issued 1 second later: X9.0 = 0 and X10.6 = 0 or X9.0 = 1 and X10.6 = 1		
EX1024	KA15 RELAY IS DEFECTIVE. A relay for the safety circuit is abnormal. When the electromagnetic lock door open switch monitor (X8.1) and electromagnetic lock door open switch relay monitor (X9.2) are in the following state, an alarm is issued 1 second later: X8.1 = 0 and X9.2 = 0 or X8.1 = 1 and X9.2 = 1		

Number	Message Contents	Remedy	Remarks
EX1025	FUSE IS BLOWN.(F1-F3) A fuse on the power panel PCB has blown.	Check the circuit, and replace the fuses.	FU1 to FU3 X11.4: Fuse monitor
EX1026	"DOOR CAN NOT UNLOCK." Although the release of the door lock is specified, the door lock cannot be released.	Pressure may be applied to the front door, preventing the pin of the lock mechanism from being removed. When releasing the door lock, be careful not to exert force to the door by, for example, pulling the handle or leaning against the door.	
EX1028	OIL LEVEL IS LOWER THAN LIMIT. The oil level in the centralized lubricant tank is low.	Add oil.	X6.0: (detection of low oil level) is set to 0. (See Supplement.)
EX1029	KA31 OR KM1 RELAY IS DEFECTIVE. When the off check of the hydraulic unit magnetic contactor and the relay monitor of the KA31 are in the following state, an alarm is issued 1 second later. (Y6.4 = 1, Y202.5 = 0, X16.5 = 1) or (Y202.5 = 1, X16.5 = 0) Y202.5:Hydraulic unit drive output Y6.4: Hydraulic unit MCC off check output X16.5: KA31 relay monitor	When the alarm occurs again after turning the power off and back on, contact FANUC.	This alarm is specific to KAWATATEC APC.
EX1030	DOOR OPEN/CLOSE SW IS DEF.(APC) When both the side door and the safety door of the palette changer are open, an alarm is issued 40 milliseconds later. X16.1: Side electromagnetic lock state monitor X16.2: Side door open/close monitor When X16.1 =0 and X16.2 = 0, an alarm is issued 40 milliseconds later.	When the alarm occurs again after turning the power off and back on, contact FANUC.	
EX1031	C.T.COOL. PRESSURE ALM (UPPER) The coolant viscosity is too high. The coolant pump is not adjusted properly.	Check the coolant viscosity. If the viscosity is too high, change the coolant. Adjust the pressure of the center-through pump. If the alarm is still issued after the above actions are applied, check whether there is a switch problem or faulty cabling.	X11.0: Detection of upper pressure limit
EX1032	C.T.COOL. PRESSURE ALM (LOWER) The coolant level is low. There is coolant leakage due to the use of the wrong piping or damage to the piping.	Add coolant. Check the piping, and repair any loose or damaged joints if any. The pump has malfunctioned. Replace it. If the above alarm is still issued after the above actions are applied, check whether there is a switch problem or faulty wiring.	X11.2: Detection of lower pressure limit
EX1033	FILTER LOADING (C.T.COOLANT) The line filter has been clogged for more than 100 hours.	Replace the line filter. If the alarm is still issued after the filter is replaced, check whether there is a switch problem or faulty wiring.	X11.1: Detection of clogged state

Number	Message Contents	Remedy	Remarks
EX1034	NOT READY C.T.COOLANT PUMP M22 is specified before the center-through pump starts.	There is a program error. Correct the program. Specify M21 before the block containing M22.	
EX1035	C.T.COOLANT MOTOR OVERHEAT The center-through coolant motor is overloaded.	Check the following items, and take appropriate action: Check whether idling is performed. Check whether the set pressure is too high. Check whether the suction filter is clogged and whether there is any leakage from the suction pipe. Check whether there is any leakage from the pump. If the pump leaks, replace the pump.	X11.3: Detection of overload
EX1036	COOLANT LOWER LIMIT The coolant level is low.	Add coolant. If the alarm is still issued after coolant is added, check whether there is a switch problem or faulty wiring.	Custom SO18_2: Detection of coolant lower limit (See Supplement.)
EX1037	TIME OVER (M CODE) The M code operation time exceeds the specified value (standard: 30 s).	Check the peripheral equipment corresponding to the M code command that caused the time-out alarm.	
EX1038	"DUST CATCHER ALARM." An alarm is issued in the dust collector.	Refer to the manual on the dust collector.	
EX1039	"CYCLE START SIGNAL IS DEFECTIVE." The start button was pressed at the end of a program or when operation stopped.	The start button must be pressed only when needed. The start button (X21.6) may be faulty.	Keep relay K06#5
EX1040	PROBE SYSTEM ERROR The probe system is defective.	Check the wire connections, cabling, and external interface settings. The probe or receiving sensor may be defective.	Keep relay K17#2
EX1041	PROBE ON/OFF ERROR There is no response to a probe ON/OFF command.	Check the probe and receiving sensor orientations, and check whether the probe and receiving sensor window are dirty. This error may be due to a probe switching problem, dead battery, or receiving sensor failure. The necessary interval may not be taken when M17 and M18 are specified.	
EX1042	PROBE SIGNAL ERROR An error signal was output from the probe.	Check the wire connections, cabling, and external interface settings. The probe battery may be dead.	Keep relay K17#2
EX1043	PROBE BATTERY LOW The voltage of the probe battery has lowered.	Replace the battery.	
EX1047	INTERNAL FAN STOP (SERVO AMP.) The fan installed on the top of the servo amplifier case stopped.	Replace the fan.	

Number	Message Contents	Remedy	Remarks
EX1048	KA34 RELAY IS DEFECTIVE. Robot interface side automatic door open/close check relay KA34 is defective. When (X16.7 = 1, X17.5 = 1) or (X16.7 = 0, X17.5 = 0) is satisfied, an alarm is issued 1 second later. X16.7: Side door switch monitor X17.5: KA34 relay monitor	When the alarm occurs again after turning the power off and back on, contact FANUC.	
EX1049	INTERNAL FAN STOP (PWR SUPPLY) The cooling fan in the power supply (common power supply) stopped.	Replace the fan.	
EX1050	KA35-36 RELAY IS DEFECTIVE. Safety gate check relay KA35 or KA36 is defective. When (X17.6 = 1, X17.7 = 0) or (X17.6 = 0, X17.7 = 1) is satisfied, an alarm is issued 1 second later. X17.6: KA35 relay monitor X17.7: KA36 relay monitor	When the alarm occurs again after turning the power off and back on, contact FANUC.	
EX1051	OVERHEAT (POWER SUPPLY) An overheat condition occurred in the power supply (common power supply).	While leaving the power on, stop the machine for a while to let the machine cool down. Turn off the power then back on to release the alarm. Check the machining program to decrease the load on the machine.	
EX1052	OVERHEAT (SERVO AMP.) The servo amplifier is overheated.		
EX1053	SPINDLE ROTATION IS PROHIBITED • A special tool is attached to the spindle. • The side automatic door is open. • Although spindle rotation is inhibited by the custom PMC, a spindle rotation is specified.	In these conditions, spindle rotation is inhibited. The attachment of a special tool means: • The current T code indicates that NOT ROTATE is specified by the RESTRICTING SPINDLE ROTATION function on the 6: MAINTENANCE/SETTING screen selected from the QUICK screen. • The tool currently attached to the spindle is determined to be a high-speed holder by the switches installed in the high-speed spindle unit.	
EX1054	SIDE DOOR SW IS DEFECTIVE. When the safety gate is open and the cylinder switch of the side automatic door (for the robot interface) is turned on, an alarm is issued. (X16.6 = 1, X16.7 = 1, X10.2 = 1) X16.6: KA35 relay monitor X16.7: Side door switch monitor X10.2: Side door open cylinder switch	When the alarm occurs again after turning the power off and back on, contact FANUC.	
EX1055	OVERHEAT (DD MOTOR) The DD motor of the DDR260*i* has overheated. (X6.7 = 0)	Check the machining program to decrease the load on the machine. When this alarm is issued for the DDR, check keep relay K15#4.	Keep relay K15#4

Number	Message Contents	Remedy	Remarks
EX1056	SPECIAL TOOL IS MOUNTING When the motor cable of the high-speed spindle is connected, a spindle rotation or tool change is specified.	When the motor cable is connected, these operations are inhibited.	
EX1057	HIGH SPEED SP. RELAY IS DEFECT The safety relay in the high-speed spindle control unit is defective. This alarm is issued 200 msec later when the power connection output (Y202.2) and the relay monitor (X200.2) are as follows: Y202.2 = 1, X200.2 = 1 or Y202.2 = 0, X200.2 = 0	Check the safety relay and cable connection.	
EX1058	CONTROL UNIT ALM (HIGH SPEED SP) Alarm in the high-speed spindle control unit.	For details, refer to the operator's manual on the control unit.	
EX1059	AUTO CONNECT ALM (HIGH SPEED SP) Alarm in the high-speed spindle motor cable attachment/detachment unit.	Refer to the operator's manual provided by the machine tool builder.	
EX1060	CABLE CON. ERROR (HIGH SPEED SP) The motor cable was disconnected during high-speed spindle rotation. Alternatively, when the motor cable was disconnected, a high-speed spindle rotation was specified.	Check the motor cable of the high-speed spindle.	
EX1061	ROBOT IS IN SERVICE A spindle rotation or tool change is specified while the robot is in service.	These operations are inhibited while the robot is in service.	
EX1062	OPERATION MODE WAS CHANGED The system/stand-alone mode switch was operated during ROBODRILL operation.	Do not operate the system/stand-alone mode switch during operation.	
EX1063	KA37 RELAY IS DEFECTIVE. Robot interface teaching mode relay KA37 is defective. When (Y7.2 = 1, X16.6 = 1) or (Y7.2 = 0, X16.6 = 0) is satisfied, an alarm is issued 1 second later. Y7.2: Teaching mode control X16.6: Teaching mode relay monitor	When the alarm occurs again after turning the power off and back on, contact FANUC.	Robot Interface
EX1064	KA38 RELAY IS DEFECTIVE. Robot interface additional front door switch relay KA38 is defective. When (X8.1 = 1, X17.1 = 1, X17.3 = 1), (X8.1 = 0, X17.1 = 0), or (X17.1 = 0, X17.3 = 0) is satisfied, an alarm is issued 10 seconds later. X8.1: Electromagnetic lock door open switch monitor X17.1: Additional front door switch relay X17.3: Robot power on state	When the alarm occurs again after turning the power off and back on, contact FANUC.	Robot Interface
EX1065	KA39 RELAY IS DEFECTIVE. Robot interface power monitor relay KA39 is defective. When (X17.0 = 1) is satisfied, an alarm is issued 1 second later. X17.0: Robot interface power monitor	When the alarm occurs again after turning the power off and back on, contact FANUC.	Robot Interface

Number	Message Contents	Remedy	Remarks
EX1066	PRESSURE RISE ERROR (LUBRI.) The pressure switch is not turned on within 60 seconds after the centralized lubrication pump starts operating.	Check the centralized lubrication pump and piping.	X6.1: Detection of pressure (See Supplement.)
EX1067	PRESSURE RELIEF ERROR (LUBRI.) At the end of the pause period of the centralized lubrication pump, the pressure switch is kept on.	Check the centralized lubrication pump.	X6.1: Detection of pressure (See Supplement.)
EX1068	FIRE EXTINGUISHER IS ABNORMAL. 1) Abnormal power No power is supplied to the fire-extinguisher because the power cable is disconnected, the circuit protector has been turned off, or the fuse has blown. 2) Sensor circuit disconnection A sensor cable is disconnected. 3) Start notification transmission signal The gas generator in the starter unit has been used or a cable disconnection occurred in the circuit.	Check that power is supplied to the fire extinguisher. Also check the power supply cable, the circuit protector in the control unit cabinet, and the fuse in the fire extinguisher control box. If the alarm cannot be removed even after any failure found in the above checks is removed, contact FANUC.	X18.2 is set to 1.
EX1069	FIRE EXTINGUISHER STARTED. The fire-extinguisher has started because a sensor detected fire or the manual button was pressed.	Contact FANUC. If fire-extinguishing agent is not removed, rust will be generated in the machine. Wash off the fire-extinguishing agent with water thoroughly, then apply rust proof oil and grease to the machine.	X18.3 is set to 0.
EX1070	GREASE CARTRIDGE EXCHANGE. An alarm occurs after greasing is performed twice in the state where a reduction in the grease level is detected.	Replace the grease cartridge.	X6.0 (detection of low oil level) is set to 1.
EX1071	LUBRICATION HAS STOPPED. After the lubricating device was forcibly stopped, 24 hours have elapsed.	After the lubricating device was forcibly stopped, 24 hours have elapsed. To clear this alarm, turn the power off.	
EX1072	OVER THE MAXIMUM SPINDLE SPEED. The spindle speed exceeded the limit set on the 6: MAINTENANCE/SETTING screen selected from the QUICK screen.	There is a possibility of an operation error or programming error. Check the operation and program.	
EX1073	INTERNAL FAN STOP (SPINDLE AMP.) The fan located in the upper section of the spindle amplifier case has stopped.	Replace the fan.	
EX1074	OVERHEAT (SPINDLE) The spindle temperature becomes high.	Check the machining program to decrease the load on the machine.	
EX1076	KA32 RELAY IS DEFECTIVE. Front door open check relay KA32 is defective. When (X8.1 = 1, X16.4 = 1) or (X8.1 = 0, X16.4 = 0) is satisfied, an alarm is issued 1 second later. X8.1: Front door electromagnetic lock open monitor X16.4: Front door electromagnetic lock open relay monitor	When the alarm occurs again after turning the power off and back on, contact FANUC.	This alarm is specific to KAWATATEC APC.

Number	Message Contents	Remedy	Remarks
EX1077	KA33 RELAY IS DEFECTIVE. Side door electromagnetic lock switch check relay KA33 is defective. When (X16.1 = 1, X16.3 = 1) or (X16.1 = 0, X16.3 = 0) is satisfied, an alarm is issued 1 second later. X16.1: Side door electromagnetic lock open/close monitor X16.3: Side door electromagnetic lock open relay monitor	When the alarm occurs again after turning the power off and back on, contact FANUC.	This alarm is specific to KAWATATEC APC.
EX1078	KA32 DCS RELAY IS DEFECTIVE. Front door open check relay KA32 is defective. When (X8.1 = 1, X7.4 = 1) or (X8.1 = 0, X7.4 = 0) is satisfied, an alarm is issued 1 second later. X8.1: Front door electromagnetic lock open monitor X7.4: Front door electromagnetic lock open relay monitor	When the alarm occurs again after turning the power off and back on, contact FANUC.	This alarm is specific to KAWATATEC APC.
EX1079	KA33 DCS RELAY IS DEFECTIVE. Side door electromagnetic lock switch check relay KA33 is defective. When (X7.1 = 1, X7.3 = 1) or (X7.1 = 0, X7.3 = 0) is satisfied, an alarm is issued 1 second later. X7.1: Side door electromagnetic lock open/close monitor X7.3: Side door electromagnetic lock open relay monitor	When the alarm occurs again after turning the power off and back on, contact FANUC.	
EX1080	KA18 DCS RELAY IS DEFECTIVE. The relay for the safety circuit is defective. When (Y8.0 = 1, X8.7 = 1) or (Y8.0 = 0, X8.7 = 0) is satisfied, an alarm is issued 1 second later. Y8.0: Servo contactor control X8.7: MCC off relay monitor	When the alarm occurs again after turning the power off and back on, contact FANUC.	
EX1081	KA19 DCS RELAY IS DEFECTIVE. The relay for the safety circuit is defective. When (Y8.1 = 1, X8.6 = 1) or (Y8.1 = 0, X8.6 = 0) is satisfied, an alarm is issued 1 second later. Y8.1: Z-axis brake control X8.6: Z-axis brake relay monitor	When the alarm occurs again after turning the power off and back on, contact FANUC.	
EX1082	KA02 DCS RELAY IS DEFECTIVE. The relay for emergency stop control is defective. When (X8.4 = 1, X8.5 = 1) or (X8.4 = 0, X8.5 = 0) is satisfied, an alarm is issued 1 second later. X8.4: Emergency stop input X8.5: Emergency stop relay monitor	When the alarm occurs again after turning the power off and back on, contact FANUC.	

Number	Message Contents	Remedy	Remarks
EX1083	KA12 DCS RELAY IS DEFECTIVE. The relay for the safety circuit is defective. When (X9.0 = 1, X8.2 = 1) or (X9.0 = 0, X8.2 = 0) is satisfied, an alarm is issued 1 second later. X9.0: Operation preparation input X8.2: Operation preparation relay monitor	When the alarm occurs again after turning the power off and back on, contact FANUC.	
EX1084	KA15 DCS RELAY IS DEFECTIVE. The relay for the safety circuit is defective. When (X8.1 = 1, X9.2 = 1) or (X8.1 = 0, X9.2 = 0) is satisfied, an alarm is issued 1 second later. X8.1: Electromagnetic lock door open switch monitor X9.2: Electromagnetic lock door open switch relay monitor	When the alarm occurs again after turning the power off and back on, contact FANUC.	
EX1085	PERIODICAL MAINTENANCE TIME. The time of periodical maintenance has come for one or more items indicated on the MAINTENANCE of the 6: MAINTENANCE/SETTING screen selected from the QUICK screen.	Carry out the periodical maintenance and clear the counter.	
EX1088	CLAMP CHECK TIME OVER (DDR-4) In DDR (4th axis) control, clamp check processing has not been completed within the specified time.	Check the parameter and air pressure.	
EX1089	DDR OVC alarm (DDR-4) The OVC level of DDR (4th axis) exceeded the threshold.	Perform clamping to stop DDR for a long time.	
EX1090	ROTATION SPEED ERROR.(DDR) The specified rotation speed is too large in the DDR continuous rotation function.	Correct the C command in "M36 C**;".	
EX1091	DDR ROTATION STOP The DDR continuous rotation function stopped working (continuous rotation ended) due to an open front door, a clamp request, or a low air pressure.	Remove the alarm cause, and restart machining from the beginning of the program.	
EX1092	CLAMP CHECK TIME OVER (DDR-5) DDR (5-axis) control failed to finish a clamp check within the specified time.	Check the parameter and air pressure.	
EX1093	DDR OVC ALARM(DDR-5) The DDR (5-axis) OVC level exceeded the specified threshold value.	When you are going to keep the DDR at stop for a long period, be sure to clamp the axis.	
EX1094	M132 OR M133 ERROR A failure occurred during measurement of tool registration/runout measurement.	For details, see Subsection 41.1.4, "Alarm Indication" in Part IV.	
EX1095	TOOL RUNOUT ERROR(T[I220,R590]) The runout caused during measurement was larger than the set threshold. The tool number is indicated at the end of the message.	Check if chippings adhere to the tapered part of the tooling.	
EX1096	PROGRAM ERROR (M132/M133) M132 or M133 was instructed together with another M code.	Instruct M132 or M133 separately from another M code.	

Number	Message Contents	Remedy	Remarks
EX1097	TOOL RUNOUT DETEC. IS NOT WORK. M132 or M133 was executed when the tool runout detective function was disabled (K55#3=0).	To suppress alarms, set K55#3 to 1.	

SUPPLEMENT

These alarms are detected when:

- The power is turned on (the servo system is started) or
- Machining is complete (M00, M01 (the M01 stop button on the operator's panel is on), M02, M30, M60, M61, M62, M63, M64, or M65 is specified).

E OPERATOR MESSAGES, DIAGNOS MESSAGES

E.1 OPERATOR MESSAGES

Number	Message Contents	Remedy	Remarks
2000	COOLANT MOTOR OVERHEAT The thermal relay for the coolant motor on the relay and interface unit was tripped. (The coolant motor overheated.) When the motor rotates rapidly and overheats because of insufficient coolant, or and when the motor does not move because the inside of the motor is clogged with cuttings, excessive load is applied to the motor, and the current of the motor increases. A current greater than the specified current flows through the MCC (magnetic conductor) that controls the coolant motor. The thermal relay is then activated, raising the alarm. This alarm may also be raised when the load to the coolant motor increases because the viscosity of the coolant is high. The alarm is also raised when the rated current of the motor is high during use of the FANUC standard coolant unit.	Close the splash guard door. Turn off the coolant unit and wait a while until the coolant motor has cooled off. Check the level gage in the coolant unit. If the coolant tank is short of coolant, replenish the coolant. Check whether the coolant motor is running. If the motor is not running, or if an unusual sound is heard while it is running, the inside of the motor requires cleaning, or the motor must be replaced. When cuttings or similar materials accumulate on the bottom of the coolant tank, clean the inside of the tank. Use a coolant with the lowest possible viscosity. When using concentrated coolant, dilute it down to a solution suitable for the workpiece to be machined. When a unit other than the FANUC standard coolant unit is used, check the permissible current range for the coolant control MCC, then use a motor whose rated current is in the specified range. Since there is a difference between the rated output (W) of the motor and the current value (A) during normal operation, the rated current of the motor must be correct when the motor is used. Also check the value of the current used to start the motor. Turn off the power to release the tripped thermal relay in the coolant control MCC. Turning on the power again automatically eliminates the alarm.	Permissible current range for the MCC for the coolant motor: 2.0 A max. Normal setting: 1.5 A X 20.4:Overload
2001	THE DOOR OF THE SPLASH GUARD IS OPEN. The front door is not locked.	Close the front door.	
2002	AIR PRESSURE LOW The air supply pressure for the regulator is low.	Check the pressure regulating valve and air supply source of the regulator. Check the air hose connection.	X10.5: Low air pressure Keep relay K12#0

Number	Message Contents	Remedy	Remarks
2003	TIME OVER (M100-M109) A command between M100 and M109 was specified, but the external device did not send the corresponding operation completion signal within the predetermined period.	Check the external device. Alternatively, change the input monitoring period for the operation completion signal (QUICK screen – "6: MAINTENANCE/SETTING" – "13: EXT. INTERFACE" – M CODE OUTPUT)	
2004	DOOR LOCK IS RELEASED BY FORCE The electromagnetic lock switch on the upper portion of the front door is released.	Use a Phillips screwdriver to set the electromagnetic lock switch to LOCK. Even when the electromagnetic lock switch is set to LOCK, the message is displayed if the front door is stopped immediately before being completely closed. However, the message thus output does not represent a failure.	
2006	TURN OFF THE POWER Adjustment parameters were set.	Turn off the power.	
2007	OVERHEAT (EXTERNAL TRANSFORMER) The external transformer is overheated.	Stop operation until the external transformer is cooled. When the external transformer is overheated, spindle rotation, coolant output, intra-machine cleaning coolant output are turned off. Programmed operation is disabled.	X20.6: Overheat detection. Set to 0 at the time of overheat.

Number	Message Contents	Remedy	Remarks
2008	THE FLOOD COOLANT MOTOR THERMAL RELAY ON THE POWER PANEL PCB OPERATED (FLOOD COOLANT MOTOR OVERHEAT) The thermal relay for the flood coolant motor on the relay and interface PCB was tripped. (The flood coolant motor overheated.) When the motor rotates rapidly and overheats because of insufficient coolant, or when the motor does not move because the inside of the motor is clogged with cuttings, excessive load is applied to the motor, and the current of the motor increases. A current greater than the specified current flows through the MCC (magnetic conductor) that controls the flood coolant motor. The thermal relay is then activated, raising the alarm. This alarm may also be raised because the viscosity of the coolant is high when the load to the coolant motor increases. The alarm is also raised when the rated current of the motor is high during use of the FANUC standard flood coolant unit.	Turn off the coolant unit and wait a while until the coolant motor has cooled off. Check the oil level gage in the coolant unit. If the coolant tank is short of the coolant, replenish the coolant. Check whether the flood coolant motor is running. If the motor is not running, or if an unusual is heard while it is running, the inside of the motor requires cleaning, or the motor must be replaced. When cuttings or similar materials accumulate on the bottom of the coolant tank, clean the inside of the tank. Use the coolant whose viscosity is as low as possible. Before using concentrated coolant, dilute it down to a solution suitable for the workpiece to be machined. When a unit other than the FANUC standard flood coolant unit is used, check the permissible current range for the flood coolant control MCC, then use a motor whose rated current is in the specified range. Since there is a difference between the rated output (W) of the motor and the current value (A) during normal operation, the rated current of the motor must be correct when the motor is used. Also check the value of the current used to start the motor. Turn off the power to release the tripped thermal relay in the flood coolant control MCC. Turning on the power again automatically eliminates the alarm.	Permissible current range for the MCC for the flood coolant motor: 2.5 A max. Normal setting: 2.2 A X 20.5:Overload
2009	SPINDLE SHOULD BE TURNED BEFORE CYCLE Y START After the spindle rotation was stopped because program operation was halted, program operation was restarted without restarting the spindle rotation.	Before restarting the program, set manual mode, and turn the spindle. Then, set automatic mode, and press the cycle start button.	
2010	OIL'S LEVEL IS LOWER THAN LIMIT There is little central lubricant oil left.	Add oil. If there is sufficient oil, check the cable connection for oil level detection or the setting of keep relay K12#5.	X6.0: Detection of low oil level Keep relay K12#5
2011	THE PROTECTOR IS OFF. (QF2) QF2 has tripped.	The center-through coolant motor may be overloaded.	In the tripped state: X11.5=0
2012	THE PROTECTOR IS OFF. (QF4) QF4 has tripped.	The taper cleaning coolant motor may be overloaded.	In the tripped state: X11.6=0

Number	Message Contents	Remedy	Remarks
2013	EXECUTING TOOL ESCAPE The tool breakage detection subfunction of the AI tool monitor function was activated. The cutter is automatically returned to the reference position along the Z-axis.	Wait until the cutter has returned to the reference position.	
2014	TEACHING MODE. Teaching mode signal X16.6 is 0. The teaching mode is selected because custom SO17_0 = 1 (K19#0 = 1) or robot standard package X225.7 = 1 (K19#0 = 0).	To perform normal operation, release the teaching mode.	Robot Interface
2015	PRODUCTION IS COMPLETED The PRODUCTION COUNT has reached or exceeded the PLANNED PRODUCTION COUNT specified on the PRODUCTION MANAGEMENT FUNCTION screen (a QUICK screen).	Reset the production count.	
2016	SAFETY GATE IS OPEN. X17.6 = 1 or X17.7 = 1		Robot Interface
2017	COOLANT LOWER LIMIT The coolant level is low.	Add coolant.	Custom SO18_2: Detection of coolant lower limit
2018	FILTER LOADING (C.T.COOL. TANK) The line filter is clogged. An abnormality was detected in the leakage detection module.	Replace the line filter.	X11.1: Filter clogged state
2022	SUCTION FILTER LOADING The suction filter of the center through coolant pump is clogged.	Replace the suction filter.	Custom SO18_7: Filter clogged state
2023	CONFIRM GAP SW. OF THE PALETTE. The seat signal of the palette was turned off. X201.2 = 0	Refer to the manual of KAWATATEC palette changer.	With pallet changer manufactured by KAWATATEC
2024	PRESS A PALLET SET UP WHEN READY Machining is completed.	Set workpieces in each pallet, then press the setup button on the pallet changer operator's panel. After pallets are changed, machining is restarted.	
2025	PRESS B PALLET SET UP WHEN READY Machining is completed.		
2026	SWITCH TO EXT MODE ON CONTROLLER When the operation mode of the automatic attachment/detachment unit controller for the high-speed spindle is not EXT, M78 or M79 is specified. The ROBODRILL enters the hold stop state.	Change the controller operation mode to EXT, then restart the ROBODRILL operation.	
2027	GREASE LEVEL IS LOWER THAN LIMIT. Grease for central lubrication has run low.	Prepare a new grease cartridge.	
2028	THE CENTRAL LUBRICATION IS MAINTENANCE MODE. The lubrication maintenance mode is effective.	To start the device, set K13#6 to 0.	

Number	Message Contents	Remedy	Remarks
2029	REACH THE LIMIT SPINDLE SPEED. The spindle speed exceeded the limit set by the RESTRICTING SPINDLE SPEED function on the “6: MAINTENANCE/ SETTING” screen selected from the QUICK screen.	There is a possibility of an operation error or programming error. Check the operation and program.	
2030	EXTERNAL FAN STOP (SERVO AMP.) The fan over the radiation fin of the servo amplifier has stopped.	Replace the fan.	
2031	EXTERNAL FAN STOP (PWR SUPPLY) A fan placed on the radiation fin of the power supply (common power supply) has stopped.		
2032	EXTERNAL FAN STOP (SPINDLE AMP.) The fan over the radiation fin of the spindle amplifier has stopped.		
2033	CAN NOT OPEN THE FRONT DOOR. (SIDE DOOR IS OPEN) An attempt was made to open the front door with the side door open.	Close the side door and then open the front door.	Robot Interface
2034	CAN NOT OPEN THE SIDE DOOR. (FRONT DOOR IS OPEN) An attempt was made to open the side door with the front door open.	Close the front door and then open the side door.	Robot Interface
2035	THE PROTECTOR IS OFF. (QF1B) X11.7 is 0.	Check the XS04-7 short pin on the power panel printed circuit board.	TOYOTA interface
2036	PERIODICAL MAINTENANCE TIME SOON. The time of advance notice has come for one or more items on the “”6: MAINTE-NANCE/SETTING” screen selected from the QUICK screen.	The time of periodical maintenance is approaching. Make a preparation for the periodical maintenance.	
2037	PERIODICAL MAINTENANCE TIME. The time of periodical maintenance has come for one or more items on the “6: MAINTENANCE/SETTING” screen selected from the QUICK screen.	Carry out the periodical maintenance and clear the counter.	
2039	CENTRAL LUBRICATION HAS STOPPED. The central lubricating device is forcibly stopped.	After the completion of the repair of the central lubricating device, turn the power on again.	

E.2 DIAGNOS MESSAGES

Number	Message	Detailed
0001 to 0005	INTERLOCK: n-AXIS (COSTOM PMC) n: X, Y, Z, 4, or 5	Axis movement is inhibited by the custom PMC. Keep relay K14#5 is set to 1.
0006 to 0011	INTERLOCK: n-AXIS (m-AXIS CLAMP UNFINISHED) n: X, Y, or Z m: 4 or 5	Because the additional axis is not yet clamped, axis movement is inhibited. Keep relay K03#3 is set to 1. (When m = 4) Keep relay K12#2 is set to 1. (When m = 5)
0012 to 0013	INTERLOCK: m-AXIS (m-AXIS UNCLAMP UNFINISHED) m: 4 or 5	Because the additional axis is not yet unclamped, the movement on the additional axis is inhibited. Keep relay K03#2 is set to 1. (When m = 4) Keep relay K12#1 is set to 1. (When m = 5)
0014 to 0016	INTERLOCK: n-AXIS (PALLET CHANGER) n: X, Y, or Z	Axis movement is inhibited by the pallet changer.
0017	INTERLOCK: Z-AXIS (TOOL CHANGE AREA)	Because the Z-axis is in the tool change area, axis movement is inhibited.
0019	INTERLOCK: ALL AXES (PROGRAM STOP)	Because program operation is halted by operation such as door open operation, axis movement is inhibited.
0020	INTERLOCK: ALL AXES (SPINDLE SPEED CHECK)	Because program operation is halted, and the spindle speed is below the specified speed, axis movement is inhibited.
0021	INTERLOCK: ALL AXES (EXTERNAL SIGNAL)	Because a signal from a peripheral device is OFF, axis movement is inhibited. The use of all-axis interlock, indicated by selecting QUICK screen, ” 6: MAINTENAN-CE/SETTING”, “13: EXT. INTERFACE”, then FUNCTION SELECTION, is specified.
0022	INTERLOCK: ALL AXES (POWER OFF)	Because the power OFF button has been pressed on the operator's panel, axis movement is inhibited.
0023	INTERLOCK: ALL AXES (ROBOT IS IN SERVICE)	Because the robot is in service, axis movement is inhibited.
0030	HOLD (SPINDLE STOP BUTTON)	Because the spindle rotation/stop button is pressed on the operator's panel, program operation is disabled.
0031	HOLD (DOOR OPENED)	Because the door is not locked, program operation is disabled.
0032	HOLD (FLOOD COOLANT MOTOR OVERHEAT)	Because the thermal relay for the coolant motor for cleaning the inside of the machine trips, program operation is disabled.
0033	HOLD (FEED HOLD BUTTON)	Because the stop button is pressed on the operator's panel, program operation is disabled.
0034	HOLD (COOLANT MOTOR OVERHEAT)	Because the thermal relay for the coolant motor trips, program operation is disabled.
0035	HOLD (M00, M01, STOP)	M00 or M01 is specified, so program operation is currently stopped.
0036	HOLD (PRODUCTION COMPRETED)	In the production management function on QUICK screen, the following condition is detected, so program operation is currently stopped: Scheduled production quantity x production quantity Keep relay K07#5 is set to 1.
0037	HOLD (HOST COMPUTER)	Program operation is currently stopped by a command from the host computer. Keep relay K03#1 is set to 1.

Number	Message	Detailed
0038	HOLD (EXTERNAL SIGNAL)	Because a signal from a peripheral device is OFF, program operation is disabled. The use of external feed hold, indicated by selecting QUICK screen, “6: MAINTE-NANCE/ SETTING”, “13: EXT. INTERFACE”, then FUNCTION SELECTION, is specified.
0039	HOLD (CUSTOM PMC)	Program operation is inhibited by the custom PMC. Keep relay K14#7 is set to 1.
0040	HOLD (M100-M109)	Because a command from M100 to M109 was specified and the completion signal was not input within the defined time, program operation is currently stopped. The output type, indicated by selecting QUICK screen, “6: MAINTENANCE/SETTING”, “13: EXT. INTERFACE”, then M CODE OUTPUT, is the FIN type.
0041	HOLD (MANUAL OPERATION MODE)	Because manual mode is set, program operation is disabled.
0042	HOLD (POWER OFF)	Because the power OFF button has been pressed on the operator's panel, program operation is disabled.
0043	HOLD (DUST CATCHER)	Because the signal from the dust collector is OFF, program operation is disabled.
0045	HOLD (ADJUSTABLE MODE)	The system is now in turret adjustment mode. Keep relay K11#0 is set to 1.
0046	HOLD (AIR PRESSURE LOW)	Because the air pressure supplied to the regulator is low, program operation is disabled.
0047	HOLD (EXTERNAL TRANSFORMER OVERHEAT)	The external transformer is overheated. Programmed operation is disabled.
0048	HOLD (QF2 TRIP)	Because QF2 trips, program operation is disabled.
0050	RESET (EXTERNAL SIGNAL)	Because a signal from a peripheral device is ON, reset operation is being performed.
0051	RESET (CUSTOM PMC)	The custom PMC outputs the reset command.
0052	RESET (HOST COMPUTER)	According to the command from the host computer, reset operation is being performed. Keep relay K03#1 is set to 1.
0060	EMERGENCY STOP (OPERATOR'S PANEL)	The system is in the emergency stop state because the emergency stop button has been pressed on the operator's panel.
0061	EMERGENCY STOP (EXTERNAL SIGNAL)	Because a signal from a peripheral device is OFF, the system is in the emergency stop state. The use of the external emergency stop function, indicated by selecting QUICK screen, “6: MAINTENAN-CE/SETTING”, “13: EXT. INTERFACE”, then FUNCTION SELECTION, is specified.
0062	EMERGENCY STOP (CUSTOM PMC)	According to the command from the custom PMC, the emergency stop state has been entered. Keep relay K14#6 is set to 1.
0063	EMERGENCY STOP (TOOL UNCLAMP)	No tool is attached to the spindle, so the system is in the emergency stop state. Keep relay K01#0 is set to 0.
0064	EMERGENCY STOP (PALLET CHANGER)	According to the command from the pallet changer, the emergency stop state has been entered.
0065	EMERGENCY STOP (SPINDLE ALARM)	Because an alarm is issued in the spindle, the system is in the emergency stop state.
0066	EMERGENCY STOP (AUTO.DOOR SWITCH IS DEFECTIVE)	Because of abnormality in the automatic door, the system is in the emergency stop state.
0067	EMERGENCY STOP (UNREADY)	Because the operation ready signal is not input, the system is in the emergency stop state.
0068	EMERGENCY STOP (POWER FAILURE BACKUP MODULE)	Because of a power failure, the system is in the emergency stop state.

Number	Message	Detailed
0069	EMERGENCY STOP (DOOR OPENED)	When the remote operation mode key on the operator's panel is effective, the front door is open.
0070	EMERGENCY STOP (TURRET RECOVERY)	Because automatic turret restoration is being performed, the system is in the emergency stop state.
0080	START-LOCK (DOOR OPENED)	Because the door is not locked, program operation cannot be started.
0081	START-LOCK (SERVO UNREADY)	Because the servo system is not ready, program operation cannot be started.
0082	START-LOCK (LUBRICATION MAINTENANCE MODE)	Because of the lubrication maintenance mode (K13#6 = 1), program operation cannot be started.
0083	START-LOCK (HOST COMPUTER)	A command to inhibit start was issued from the host PC, so the start disable state has been entered. (Drill monitor function)
0084	START-LOCK (POWER FAILURE BACKUP MODULE)	Because the power failure backup module is not ready, program operation cannot be started.
0085	START-LOCK (AUTOMATIC POWER OFF)	Because the automatic power cut-off function is operating, program operation cannot be started.
0086	START-LOCK (PRODUCTION COMPLETED)	Because production is completed, program operation cannot be started.
0087	START-LOCK (FAILED TO SELECT PROGRAM)	In turret recovery operation, because program O9040 is not selected, program operation cannot be started.
0088	START-LOCK (ROBOT IS IN SERVICE)	Because the robot is in service, program operation cannot be started.
0089	START-LOCK (SIDE DOOR OPENED)	Because the side automatic door is open, program operation cannot be started.
0090 to 0091	DETACHED: m-AXIS m: 4 or 5	The signal line of the m-th axis (additional axis) is not connected, so the m-th axis is in the detach state (axis disconnection). Keep relay K12#3 is set to 0.
0092 to 0093	SERVO OFF: m-AXIS m: 4 or 5	Because the m-th axis (additional axis) is clamped, the axis is in the servo off state (excitation OFF). Keep relay K02#1 is set to 1. (When m = 4) Keep relay K02#2 is set to 1. (When m = 5)
0110	START SIGNAL ON	This message appears for about one second when the start of operation is specified in automatic or MDI mode.
0111 to 0115	MIRROR IMAGE ON: n-AXIS n: X, Y, Z, 4, or 5	The mirror image function for the n-th axis is activated.
0116	FEEDRATE OVERRIDE 0%	The feedrate override is set to 0%.
0117	JOG FEEDRATE OVERRIDE 0%	The jog override is set to 0%.
0118	MACHINE LOCK ON	The All-axis lock function is activated. On corresponding soft key selected from the QUICK screen, [ALL-LOCK] is set to "ON".
0119	Z-AXIS LOCK ON	The Z-axis lock function is activated. On corresponding soft key selected from the QUICK screen, [Z-LOCK] is set to "ON".
0120	IN REMOTE OPERATION	The remote operation mode is selected. On corresponding soft key selected from the QUICK screen, [REMOTE MODE] is set to "ON". (For the standard type operator's panel) The <REMOTE> key on the operator's panel is ON. (For the full keyboard type operator's panel)
0121	START COMMAND WAS IGNORED. (OPERATOR'S PANEL)	The custom PMC is programmed so that the start button is disabled.
0122	TOOL CHANGE OF MODE IS PROHIBITED.	Keep relay K08#2 is set to 1.

Number	Message	Detailed
0123	A CHANGE OF MODE IS PROHIBITED.	On FUNCTION SELECTION in “6: MAINTENANCE/ SETTING” selected from the QUICK screen, "MODE SELECTION LOCK" is set to "ON". (For the CE specification only)
0124	THE OPERATOR'S PANEL IS UNAVAILABLE.	Keep relay K16#0 is set to 1, and the use of the operator's panel of the ROBODRILL is inhibited by the custom PMC.
0125	THE CUTTING OVERRIDE SWITCH IS UNAVAILABLE.	A cutting feed override is specified by the custom PMC or the like. Keep relay K14#1 is set.
0126	THE SPINDLE OVERRIDE BUTTON IS UNAVAILABLE.	A spindle override is specified by the custom PMC or the like. Keep relay K14#1 is set.
0130 to 0135	** MODE (MACHINING MODE SETTING) **: N, HP, HQ, SP, SQ, S	The ** mode is selected with the machining mode set function.
0136	POWER SAVING MODE	The power saving mode is set.
0137 to 0139	** MODE (MACHINING MODE SETTING) **: L7, L8, L9	A customize mode (L7, L8, or L9) is set by the machining mode setting function.
0140	SPINDLE ROT. IS PROHIBITED (CUSTOM PMC)	Spindle rotation is disabled by the custom PMC (SO9.6).
0141	SPINDLE ROT. IS PROHIBITED (SIDE DOOR OPENED)	Because the automatic side door is open, spindle rotation is disabled.
0142	SPINDLE ROT. IS PROHIBITED (SPECIAL TOOL)	Spindle rotation is disabled by the setting on the QUICK screen – “6: MAINTENANCE/SETTING” – “12: RESTRICT ROT.”
0143	SPINDLE ROT. IS PROHIBITED (TEACHING MODE)	Spindle rotation is prohibited because the teaching mode is selected.
0150	EXTERNAL EMERGENCY STOP WORKED.	This message is displayed when alarm 1002 is issued. The message will disappear when the operation mode changes or when operation starts.
0151	EMERGENCY STOP WORKED.	This message is displayed when alarm 1003 is issued. The message will disappear when the operation mode changes or when operation starts.
0152	OVERHEATED (COOLANT MOTOR)	This message is displayed when operator message 2000 is displayed. The message will disappear when the operation mode changes or when operation starts.
0153	DOOR WAS OPENED.	This message is displayed when operator message 2001 is displayed. The message will disappear when the operation mode changes or when operation starts.
0154	AIR PRESSURE WAS LOW.	This message is displayed when operator message 2002 is displayed. The message will disappear when the operation mode changes or when operation starts.
0155	OVERHEATED (EXTERNAL TRANSFORMER)	This message is displayed when operator message 2007 is displayed. The message will disappear when the operation mode changes or when operation starts.
0156	OVERHEATED (FLOOD COOLANT MOTOR)	This message is displayed when operator message 2008 is displayed. The message will disappear when the operation mode changes or when operation starts.

F PMC PARAMETERS

[Timer]

No.	Address	Default	Function
1	T 00	60000	Standby time until the center-through coolant pump stops automatically.
2	T 02	60000	Wait time until coolant for cleaning the inside of the machine stops automatically
3	T 04	300000	Wait time until spindle air purge stops
4	T 06	300000	Wait time until alarm output 2 (for buzzer) stops
5	T 08		
6	T 10		
7	T 12		
8	T 14		
9	T 16	272	Wait time from door lock until operation starts
10	T 18	1000	Start button ON time from automatic door closure until operation starts
11	T 20	6000	Automatic door total time
12	T 22	120	For checking automatic door close
13	T 24	144	M81, M82 output duration
14	T 26	104	Wait time until automatic door lock is released
15	T 28	48	For spindle speed zero detection
16	T 30	0	For adjustment of rigid tapping mode setting
17	T 32	48	Spindle activation completed in rigid tap mode
18	T 34	96	For monitoring the switch of tool exchange area.
19	T 36	200	For checking automatic door close
20	T 38	296	Center-through coolant air purge pulse output ON time
21	T 40	296	Time during which air blow pulse output is OFF
22	T 42	10000	Air seal valve OFF delay
23	T 44	5000	Monitoring time for abnormal coolant pressure (upper limit)
24	T 46	3000	Monitoring time for abnormal low coolant pressure (lower limit)
25	T 48	1000	Delay from issue of a servo alarm until the spindle stops
26	T 50	30000	M code monitoring time
27	T 52	0	(Reservation)
28	T 54	0	Spindle restart check before operation
29	T 56	800	Spindle restart check
30	T 58	4000	For spindle abnormality detection (only for the CE marking specification)
31	T 60	5000	Wait time until power is turned off automatically
32	T 62	480	For external reset adjustment
33	T 64		
34	T 66	5000	Time for monitoring low air pressure condition
35	T 68	48	Tool unclamp state monitoring delay time
36	T 70	60000	Spindle air purge restart wait time
37	T 72	5000	Spindle air purge execution time at restart
38	T 74	248	Spindle load monitor start delay after decrease in the feedrate
39	T 76	48	For judging the spindle load warning level
40	T 78	1000	For monitoring attained spindle speed
41	T 80	2000	Door lock operation monitoring time
42	T 82	2000	Wait time from a single-block stop until the door is unlocked.
43	T 84	104	Alarm 1006 ignore time after tool change completion
44	T 86	744	Blinking ON time for state indication and so forth
45	T 88	736	Blinking OFF time for state indication and so forth
46	T 90		(Not used)
47	T 92		(Not used)
48	T 94	2104	Operation monitoring time for side automatic door

No.	Address	Default	Function
49	T 96	104	Waiting time from cycle stop command to movement command during system operation or reference position return
50	T 98	104	Waiting time from cycle stop command to movement command during manual robot operation
51	T 100	15000	Centralized lubrication pump driving time
52	T 102		(Reservation)
53	T 104		(Reservation)
54	T 106	2000	Delay time for turning off the circuit breaker for automatic fire-extinguisher
55	T108	15000	Centralized lubrication pump driving time (oil, in the forced driving mode)
56	T110	5000	(Reservation)
57	T112	60000	(Reservation)
58	T114	2104	(Reservation)
59	T116	0	Time from the unlocking of the front door until P-OFF is enabled at power-off
60	T118	504	Air blow time during clamping by KAWATATEC palette changer
61	T120	96	Timer 1 for DDR (time from M71 until FIN is returned)
62	T122	0	Timer 2 for DDR (time from M72 until unclamping is performed)
63	T124	120	Timer 3 for DDR (time from M72 until the torque limit reverts to 100%)
64	T126	80	Timer 4 for DDR (time from when torque limit reverts to 100% until FIN is returned)
65	T128	96	(Reservation)
66	T130	96	(Reservation)
67	T132	2104	(Reservation)
68	T134	60000	Timer 5 for DDR (time until servo is turned off after all axes are stopped during clamping)
69	T136	0	(Reservation)
70	T138	80	(Reservation)
71	T140	80	(Reservation)
72	T142	0	(Reservation)
73	T144	0	(Reservation)
74	T146	0	(Reservation)
75	T148		Coolant level detection (warning)
76	T150		Coolant level detection (machine stop)
77	T152	0	(Reservation)
78	T154	0	Fourth-axis clamping confirmation delay time (DD motor)
79	T156	0	Fourth-axis unclamping confirmation delay time (DD motor)
80	T158	0	Fifth-axis clamping confirmation delay time (DD motor)
81	T160	0	Fifth-axis unclamping confirmation delay time (DD motor)
82	T162	168	Fourth-axis DDR timer 1 (time from clamping to torque limit change and interlock)
83	T164	0	Fourth-axis DDR timer 2 (time until valve operation starting in unclamping)
84	T166	120	Fourth-axis DDR timer 3 (time until a maximum torque limit is resumed in unclamping)
85	T168	0	Fourth-axis DDR timer 4 (time until completion processing since a maximum torque limit in unclamping is resumed)
86	T170	60000	Fourth-axis DDR timer 5 (time until servo-off since all axes have stopped in clamping)
87	T172	168	Fourth-axis DDR timer 6 (time from clamping to clamping check start)
88	T174	48	Fourth-axis DDR timer 7 (time until the start of re-confirmation of clamping)
89	T176	2000	Fourth-axis DDR timer 8 (time from clamping confirmation to time-out)
90	T178	496	DDR continuous rotation function (time until a low air pressure is detected)
91	T180	40	M03 FIN delay
92	T182	40	M04 FIN delay

No.	Address	Default	Function
93	T184	168	Fifth-axis DDR timer 1 (time from clamping to torque limit change and interlock)
94	T186	0	Fifth-axis DDR timer 2 (time until valve operation starting in unclamping)
95	T188	120	Fifth-axis DDR timer 3 (time until a maximum torque limit is resumed in unclamping)
96	T190	0	Fifth-axis DDR timer 4 (time until completion processing since a maximum torque limit in unclamping is resumed)
97	T192	60000	Fifth-axis DDR timer 5 (time until servo-off since all axes have stopped in clamping)
98	T194	168	Fifth-axis DDR timer 6 (time from clamping to clamping check start)
99	T196	48	Fifth-axis DDR timer 7 (time until the start of re-confirmation of clamping)
100	T198	2000	Fifth-axis DDR timer 8 (time from clamping confirmation to time-out)

[Counter]

No.	Address	Default	Function
1	C 00	0	(Not used)
	C 02	0	(Not used)
2	C 04	0	(Not used)
	C 06	0	(Not used)
3	C 08	20	Preset number of spindle axis override stages
	C 10	****	Current number of spindle axis override stages
4	C 12	10	Preset value for the time allowed before the internal light goes off automatically.
	C 14	****	Current value for the time allowed before the internal light goes off automatically.
5	C 16	100	Preset value of monitoring time for clogged-filter alarm
	C 18	****	Current value of monitoring time for clogged-filter alarm
6	C 20	0	(Not used)
	C 22	0	(Not used)
7	C 24	0	(Not used)
	C 26	0	(Not used)
8	C 28	3	(Reservation)
	C 30	****	(Reservation)
9	C 32	0	(Not used)
	C 34	0	(Not used)
10	C 36	0	(Not used)
	C 38	0	(Not used)
11	C 40	0	(Not used)
	C 42	0	(Not used)
12	C 44	0	(Not used)
	C 46	0	(Not used)
13	C 48	0	(Not used)
	C 50	0	(Not used)
14	C 52	0	(Not used)
	C 54	0	(Not used)
15	C 56	0	(Not used)
	C 58	0	(Not used)
16	C 60	0	(Not used)
	C 62	0	(Not used)
17	C 64	0	(Not used)
	C 66	0	(Not used)
18	C 68	0	(Not used)
	C 70	0	(Not used)
19	C 72	3	Preset value for external equipment control
	C 74	0	Current value for external equipment control
20	C 76	10	Preset number of feedrate deceleration stages
	C 78	****	Current number of feedrate deceleration stages

[Keep relay] (A circle indicates the default)

Address	Setting	Function
K00#0	○ 0	Uses the high–speed interface for M/S/T/B code processing
	1	Uses the standard interface for M/S/T/B code processing
K00#1	○ 0	On QUICK EDITOR, the up and down arrow keys move the cursor only up and down.
	1	On QUICK EDITOR, the up and down arrow keys move the cursor up and down, then to the first position of the line.
K00#2	○ 0	Automatic setting of work coordinate screen is X and Y axis
	1	Automatic setting of work coordinate screen is X, Y and Z axis
K00#3	0	Does not OFF Flood coolant at emergency stop
	○ 1	OFF flood coolant at emergency stop
K00#4	0	
	1	
K00#5	○ 0	Disables the alarm/diagnostic window automatic display function.
	1	Enables the alarm/diagnostic window automatic display function.
K00#6	○ 0	Uses the simplified NC-SYSTEM screen configuration.
	1	Does not use the simplified NC-SYSTEM screen configuration.
K00#7	0	Does not restart the coolant after changing the tool
	○ 1	Restarts the coolant after changing the tool

Address	Setting	Function
K01#0	0	Outputs an alarm at tool unclamp
	○ 1	Does not output an alarm at tool unclamp
K01#1	○ 0	Executes an even parity check
	1	Executes an odd parity check
K01#2	○ 0	The spindle does not stop when the all-axis interlock signal is off
	1	The spindle stops when the all-axis interlock signal is off
K01#3	○ 0	Turret release is disabled if the program is in the protected state
	1	Turret release is enabled if the program is in the protected state
K01#4	○ 0	The override values are initialized when power is turned on
	1	The override values are not initialized when power is turned on
K01#5	○ 0	(Reservation)
	1	
K01#6	○ 0	When the COORDINATES/OFFSET screen is being displayed, pressing the menu operation button causes screen switching.
	1	When the COORDINATES/OFFSET screen is being displayed, pressing the menu operation button does not cause screen switching.
K01#7	○ 0	Pressing the reset key does not stop the spindle or coolant
	1	Pressing the reset key stops the spindle and coolant

[Keep relay] (A circle indicates the default)

Address	Setting	Function
K02#0	0	Neither operator message 2010 is treated as alarm
	○ 1	Both operator messages 2010 are treated as alarm
K02#1	○ 0	Does not deactivate the fourth axis in the clamp state
	1	Deactivates the fourth axis in the clamp state
K02#2	○ 0	Does not deactivate the fifth axis in the clamp state
	1	Deactivates the fifth axis in the clamp state
K02#3	○ 0	M63 does not turn on the machine status output (with KAWATATEC APC)
	1	M63 turns on the machine status output (with KAWATATEC APC)
K02#4	○ 0	(Reservation)
	1	
K02#5	○ 0	Use the position switch signal 1, 2, 3, 4, 5 of external interface.
	1	Use the position switch signal 1, 2, 3, 4, 7 of external interface.
K02#6	○ 0	A tool exchange enabled area is set up using the position switch
	1	A tool exchange disabled area is set up using the position switch
K02#7	○ 0	The tool exchange disabled area setting function is disabled.
	1	The tool exchange disabled area setting function is enabled.

Address	Setting	Function
K03#0	0	Energy saving control is exercised for spindle air purge operation.
	○ 1	Spindle air purge operation is turned on at all times.
K03#1	○ 0	Disables the interface for the automatic laser measurement test.
CAUTION)	1	Enables the interface for the automatic laser measurement test.
K03#2	○ 0	Does not use the fourth–axis clamp/unclamp command
	1	Uses the fourth–axis clamp/unclamp command
K03#3	○ 0	Enables movement along the X–, Y–, and Z–axes in the fourth–axis unclamp state
	1	Disables movement along the X–, Y–, or Z–axes in the fourth–axis unclamp state
K03#4	○ 0	Performs ON/OFF control of the center-through coolant pump.
	1	Keeps the center-through coolant pump ON at all times.
K03#5	○ 0	Enables automatic control of the center-through coolant pump.
	1	Disables automatic control of the center-through coolant pump.
K03#6	○ 0	Disables control of the center-through coolant pump by the custom PMC.
	1	Enables control of the center-through coolant pump by the custom PMC.
K03#7	○ 0	(Reservation)
	1	

CAUTION
For K03#1, be sure to set 0.

[Keep relay] (A circle indicates the default)

Address	Setting	Function
K04#0	○ 0	(Reservation)
	1	
K04#1	○ 0	(Reservation)
	1	
K04#2	○ 0	(Reservation)
	1	
K04#3	○ 0	When the coolant oil level becomes low, a message is just displayed.
	1	When the coolant oil level becomes low, cycle termination occurs and an alarm is displayed.
K04#4	○ 0	Center-through coolant air purge is turned off by M09.
	1	Center-through coolant air purge is turned off by M24.
K04#5	○ 0	Outputs the parity check signal to contact a
	1	Outputs the parity check signal to contact b
K04#6	○ 0	When production is completed, an operator message is displayed.
	1	When production is completed, no operator message is displayed.
K04#7	○ 0	Does not monitor the M code operation time.
	1	Monitors the M code operation time.

Address	Setting	Function
K05#0	○ 0	(Reservation)
	1	
K05#1		(Factory–adjusted according to the specifications of the machine)
K05#2		(Factory–adjusted according to the specifications of the machine)
K05#3		(Factory–adjusted according to the specifications of the machine)
K05#4	0	Disables center-through coolant control.
	1	Enables center-through coolant control.
K05#5		(Factory–adjusted according to the specifications of the machine)
K05#6		(Factory–adjusted according to the specifications of the machine)
K05#7		(Factory–adjusted according to the specifications of the machine)

Address	Setting	Function
K06#0	○ 0	Displays a message when the door is opened by M00
	1	Does not display a message when the door is opened by M00
K06#1	○ 0	Displays an operator message when the door is opened
	1	Does not display an operator message when the door is opened
K06#2	○ 0	Does not stop alarm output 2 automatically.
	1	Stops alarm output 2 automatically.
K06#3	○ 0	Does not automatically stop coolant for cleaning the inside of the machine.
	1	Automatically stops coolant for cleaning the inside of the machine.
K06#4	○ 0	Specifies M06 in TOOL CHANGE selected from MENU OPERATION.
	1	Does not specify M06 in TOOL CHANGE selected from MENU OPERATION.
K06#5	○ 0	Disables the cycle start signal check function.
	1	Enables the cycle start signal check function.
K06#6	○ 0	Does not turn on the DMMC signal at remote operation.
	1	Turns on the DMMC signal at remote operation.
K06#7	○ 0	Outputs the auto mode signal in a mode other than manual mode
	1	Outputs the auto mode signal in AUTO mode

[Keep relay] (A circle indicates the default)

Address	Setting	Function
K07#0	○ 0	Does not light the feed hold lamp in the operation stop state
	1	Lights the feed hold lamp in the operation stop state
K07#1	○ 0	Enables the external door control signal in a mode other than AUTO mode
	1	Always enables the external door control signal
K07#2	○ 0	The remote mode is set for remote operation.
	1	The remote mode is set for direct operation.
K07#3	○ 0	Does not restart coolant/air blow at a restart of operation.
	1	Restarts coolant/air blow at a restart of operation.
K07#4	○ 0	Turns the M83 output OFF at the end of a cycle.
	1	Does not turn the M83 output OFF at the end of a cycle.
K07#5	○ 0	Does not stop operation upon the completion of machining by M91 or M92
	1	Disables the stop operation by M91 or M92 upon the completion of machining
K07#6	○ 0	Does not cancel the screen saver when the door is opened.
	1	Cancels the screen saver when the door is opened.
K07#7	○ 0	Disables the side automatic door adjustment function
CAUTION)	1	Enables the side automatic door adjustment function

CAUTION
For K07#7, be sure to set 0.

Address	Setting	Function
K08#0	○ 0	The internal light is turned on or off according to the setting on the screen.
	1	The internal light is turned on or off according to an external signal.
K08#1	○ 0	ON the block skip function on the operator's panel screen setting.
	1	ON the block skip signal on the external signal.
K08#2	○ 0	Enables the tool change button on the operator's panel.
	1	Disables the tool change button on the operator's panel.
K08#3	○ 0	Enables activation of the single block function from the machine operator's panel
	1	Enables activation of the single block function by the input of an external signal
K08#4	○ 0	Enables activation of the dry run function from the machine operator's panel
	1	Enables activation of the dry run function by the input of an external signal
K08#5	○ 0	Does not use feed by single-digit F code.
	1	Uses feed by single-digit F code.
K08#6	○ 0	Turns off warning–level or breakage–level detection output upon a reset
	1	Turns off warning–level or breakage–level detection output upon a reset or when the tool is changed
K08#7	○ 0	Enables a warning level and destruction level to be detected and output when the AI tool monitor function is used.
	1	Enables a warning level and destruction level to be detected and output, regardless of whether the AI tool monitor function is used.

[Keep relay] (A circle indicates the default)

Address	Setting	Function
K09#0	○ 0	Disallows the maintenance interval to be changed on the PERIODICAL MAINTENANCE screen.
	1	Allows the maintenance interval to be changed on the PERIODICAL MAINTENANCE screen.
K09#1	○ 0	Does not display a notice message during power-on after confirmation of the notice message.
	1	Displays a notice message during power-on after confirmation of the notice message.
K09#2	○ 0	Allows the change PERIODICAL MAINTENANCE screen
	1	Disallows the change PERIODICAL MAINTENANCE screen
K09#3	0	
	1	
K09#4	0	
	1	
K09#5	0	
	1	
K09#6	○ 0	(Reservation)
	1	
K09#7	○ 0	(Reservation)
	1	

Address	Setting	Function
K10#0	○ 0	Disables the hard copy function.
	1	Enables the hard copy function.
K10#1	○ 0	(For adjustment)
	1	
K10#2	○ 0	(For adjustment)
	1	
K10#3	○ 0	Lamp checking function OFF
	1	Lamp checking function ON
K10#4	○ 0	(Reservation)
	1	
K10#5	○ 0	(Reservation)
	1	
K10#6	○ 0	(Reservation)
	1	
K10#7	○ 0	(For adjustment)
	1	

[Keep relay] (A circle indicates the default)

Address	Setting	Function
K11#0	○ 0	Makes turret adjustment mode invalid.
	1	Makes turret adjustment mode valid.
K11#1	○ 0	The door is not unlocked at single-block operation stop time.
	1	The door is unlocked at single-block operation stop time.
K11#2	○ 0	Enables the automatic door open/close button, regardless of the operation mode.
	1	Enables the automatic door open/close button in the manual mode only.
K11#3	○ 0	Enables spindle rotation when the door is unlocked.
	1	Disables spindle rotation when the door is unlocked.
K11#4	○ 0	When a special tool is mounted, spindle orientation is enabled.
	1	When a special tool is mounted, spindle orientation is disabled.
K11#5	○ 0	(Reservation)
	1	
K11#6	○ 0	(For adjustment)
	1	
K11#7	○ 0	The door is not unlocked with M00/M01.
	1	The door is unlocked with M00/M01.

Address	Setting	Function
K12#0	0	The air pressure drop signal is normally open.
	○ 1	The air pressure drop signal is normally closed.
K12#1	○ 0	Does not use the fifth–axis clamp/unclamp command
	1	Uses the fifth–axis clamp/unclamp command
K12#2	○ 0	Enables movement along the X–, Y–, and Z–axes in the fifth–axis unclamp state
	1	Disables movement along the X–, Y–, and Z–axes in the fifth–axis unclamp state
K12#3	○ 0	Uses the detach function and overtravel function for the fourth and fifth axes
	1	Does not use the detach function and overtravel function for the fourth and fifth axes
K12#4		(Factory–adjusted according to the specifications of the machine)
K12#5		(Reservation)
K12#6	0	The door will not be unlocked when M02 or M30 is executed
	○ 1	The door will be unlocked when M02 or M30 is executed.
K12#7	○ 0	Door lock control A
	1	Door lock control B

Address	Setting	Function
K13#0	○ 0	(Reservation)
	1	
K13#1	○ 0	Does not turn on the start button and automatic operation in-progress signal while the automatic door is being opened and closed.
	1	Turns on the start button and automatic operation in-progress signal while the automatic door is being opened and closed.
K13#2	○ 0	The automatic door is closed when the start button is released.
	1	The automatic door is closed when the start button is pressed.
K13#3	○ 0	Disables spindle soft start.
	1	Enables spindle soft start (NC4030: Increasing speed/second).
K13#4	○ 0	(Reservation)
	1	
K13#5	○ 0	(For adjustment)
	1	
K13#6	○ 0	(For adjustment)
	1	
K13#7	○ 0	(For adjustment)
	1	

[Keep relay] (A circle indicates the default)

Address	Setting	Function
K14#0	○ 0	Enables custom PMC editing.
	1	Disables custom PMC editing.
K14#1	○ 0	The custom PMC function does not control spindle and cutting feed overrides.
	1	The custom PMC function controls spindle and cutting feed overrides.
K14#2	○ 0	Turns on SI8.0 in the MEM mode/remote mode.
	1	Turns on SI8.0 in the MEM mode.
K14#3	○ 0	Uses the additional axis clamp control signal as standard.
	1	Assigns the additional axis clamp control signal with the custom PMC function.
K14#4	○ 0	Does not allow the custom PMC function to control the coolant for cleaning the inside of the machine.
	1	Allows the custom PMC function to control the coolant for cleaning the inside of the machine.
K14#5	○ 0	Does not execute axis interlock control using the custom PLC function
	1	Executes axis interlock control using the custom PLC function
K14#6	○ 0	Does not execute emergency stop control using the custom PLC function
	1	Executes emergency stop control using the custom PLC function
K14#7	○ 0	Does not execute feed hold control using the custom PLC function
	1	Executes feed hold control using the custom PLC function

Address	Setting	Function
K15#0		(Factory–adjusted according to the specifications of the machine)
K15#1		(Factory–adjusted according to the specifications of the machine)
K15#2		(Factory–adjusted according to the specifications of the machine)
K15#3	○ 0	(Reservation)
	1	
K15#4		(Factory–adjusted according to the specifications of the machine)
K15#5		(Factory–adjusted according to the specifications of the machine)
K15#6	○ 0	(Reservation)
	1	
K15#7	○ 0	Does not use the custom PLC function
	1	Uses the custom PLC function

[Keep relay] (A circle indicates the default)

Address	Setting	Function
K16#0	○ 0	Disables the operator's panel disable function.
	1	Enables the operator's panel disable function.
K16#1	○ 0	While the operator's panel is in the disabled state, the M01 stop button is also disabled.
	1	While the operator's panel is in the disabled state, the M01 stop button is enabled.
K16#2	○ 0	While the operator's panel is in the disabled state, the door open/close button is also disabled. (For CE mark specifications only)
	1	While the operator's panel is in the disabled state, the door open/close button is enabled. (For CE mark specifications only)
K16#3	○ 0	While the operator's panel is disabled, spindle rotation and coolant supply are canceled.
	1	While the operator's panel is disabled, spindle rotation and coolant supply are not canceled.
K16#4	○ 0	While the operator's panel is disabled, the block skip button is disabled.
	1	While the operator's panel is disabled, the block skip button is enabled.
K16#5		
K16#6		
K16#7		

Address	Setting	Function
K17#0	○ 0	(Reservation)
	1	
K17#1		
K17#2	○ 0	Renishaw's touch probe is not controlled.
	1	Renishaw's touch probe is controlled.
K17#3		(Factory–adjusted according to the specifications of the machine)
K17#4		(Factory–adjusted according to the specifications of the machine)
K17#5		(Factory–adjusted according to the specifications of the machine)
K17#6		(Reservation)
K17#7		(Reservation)

[Keep relay] (A circle indicates the default)

Address	Setting	Function
K18#0	○ 0 1	(Reservation)
K18#1	○ 0 1	(Reservation)
K18#2	○ 0 1	(Reservation)
K18#3	○ 0 1	(Reservation)
K18#4	○ 0 1	(Reservation)
K18#5	○ 0 1	(Reservation)
K18#6	○ 0 1	(Reservation)
K18#7	○ 0 1	(Reservation)

Address	Setting	Function
K19#0	○ 0 1	The teaching signal is not controlled by custom PMC. The teaching signal is controlled by custom PMC.
K19#1	○ 0 1	Does not invert position switch signal PSW14. Inverts position switch signal PSW14.
K19#2	○ 0 1	Does not invert position switch signal PSW15. Inverts position switch signal PSW15.
K19#3	○ 0 1	(Reservation)
K19#4	○ 0 1	(Reservation)
K19#5	○ 0 1	(Reservation)
K19#6	○ 0 1	(Reservation)
K19#7	○ 0 1	(Reservation)

Address	Setting	Function
K20#0	○ 0 1	(Reservation)
K20#1	○ 0 1	(Reservation)
K20#2	○ 0 1	(Reservation)
K20#3	○ 0 1	(Reservation)
K20#4	○ 0 1	(Reservation)
K20#5	○ 0 1	(Reservation)
K20#6	○ 0 1	(Reservation)
K20#7	○ 0 1	(Reservation)

[Keep relay] (A circle indicates the default)

Address	Setting	Function
K21#0	○ 0	(Reservation)
	1	
K21#1	○ 0	The robot for the robot system uses the five-axis specification.
	1	The robot for the robot system uses the six-axis specification.
K21#2	○ 0	One ROBODRILL unit is connected in the robot system.
	1	Two ROBODRILL units are connected in the robot system.
K21#3	○ 0	The robot service request signal is output when the safety gate is open.
	1	The robot service request signal is output regardless of the safety gate status.
K21#4	○ 0	The peripheral equipment ready signal is not used.
	1	The peripheral equipment ready signal is used.
K21#5	○ 0	System operation can be started when the side automatic door is closed.
	1	System operation can be started regardless of the side automatic door status.
K21#6	○ 0	A service request is output at a program end.
	1	No service request is output at a program end.
K21#7	○ 0	Master (robot system)
	1	Slave (robot system)

Address	Setting	Function
K22#0	○ 0	The high-speed spindle interface function is disabled.
	1	The high-speed spindle interface function is enabled.
K22#1	○ 0	The high-speed spindle cable is of the cabling type.
	1	The high-speed spindle cable is of the automatic attachment/detachment type.
K22#2	○ 0	The high-speed spindle cable override function is disabled.
	1	The high-speed spindle cable override function is enabled.
K22#3	○ 0	(Reservation)
	1	
K22#4		
K22#5	0	The old specification is used for the continuous line specification of QUICK EDITOR.
	○ 1	The new specification is used for the continuous line specification of QUICK EDITOR.
K22#6	0	The tool replacement position cannot be selected in tool change on the MENU OPERATION screen.
	○ 1	The tool replacement position can be selected in tool change on the MENU OPERATION screen.
K22#7	0	Programs are not displayed alphabetically by name in PROGRAM LIST of QUICK EDITOR.
	○ 1	Programs are displayed alphabetically by name in PROGRAM LIST of QUICK EDITOR.

[Keep relay] (A circle indicates the default)

Address	Setting	Function
K23#0	○ 0	Renishaw's touch probe is MP12.
	1	Renishaw's touch probe is OMP40.
K23#1	○ 0	When the door is opened, energy saving control for the internal lamps is canceled unconditionally.
	1	When the door is opened, energy saving control for the internal lamps is canceled if the manual mode is set.
K23#2	○ 0	At the time of dry run, single operation mode, and door open operation, energy saving control for the internal lamps does not performed.
	1	At the time of dry run, single operation mode, and door open operation, energy saving control for the internal lamps is performed.
K23#3	○ 0	(Reservation)
	1	
K23#4	○ 0	Energy saving control for the centralized lubrication pump is disabled.
	1	Energy saving control for the centralized lubrication pump is enabled.
K23#5	○ 0	(Reservation)
	1	
K23#6	○ 0	(Reservation)
	1	
K23#7	○ 0	(Reservation)
	1	

Address	Setting	Function
K24#0	○ 0	When the emergency stop button of the ROBODRILL is pressed, the robot enters the emergency stop state.
	1	When the emergency stop button of the ROBODRILL is pressed, the robot does not enter the emergency stop state.
K24#1	○ 0	After cycle stop, M61 does not function.
	1	After cycle stop, M61 functions.
K24#2	○ 0	After system stop, M61 does not function.
	1	After system stop, M61 functions.
K24#3	○ 0	At system start, the robot and ROBODRILL start up at the same time.
	1	At system start, the ROBODRILL starts up after the robot supplies a workpiece.
K24#4	○ 0	At cycle stop, no service request signal is output.
	1	At cycle stop, a service request signal is output.
K24#5	○ 0	M52 and M53 can be used regardless of the system operation mode.
	1	Only in the system mode, M52 and M53 can be used.
K24#6	○ 0	Only when system operation is started, a ROBODRILL program number search is made.
	1	When operation is started in the system mode, a ROBODRILL program number search is made.
K24#7	○ 0	(Reservation)
	1	

[Keep relay] (A circle indicates the default)

Address	Setting	Function
K25#0	○ 0	Cycle stop is not controlled by custom PMC.
	1	Cycle stop is controlled by custom PMC.
K25#1	○ 0	System stop is not controlled by custom PMC.
	1	System stop is controlled by custom PMC.
K25#2	○ 0	Robot reset is not controlled by custom PMC.
	1	Robot reset is controlled by custom PMC.
K25#3	○ 0	System start is not controlled by custom PMC.
	1	System start is controlled by custom PMC.
K25#4		
K25#5		
K25#6		
K25#7		

Address	Setting	Function
K26#0	○ 0	(Factory-adjusted according to the specifications of the machine)
	1	
K26#1	○ 0	Control of spindle taper cleaning by coolant is one-shot processing.
	1	Control of spindle taper cleaning by coolant is modal processing.
K26#2	○ 0	Taper cleaning coolant is not discharged during indexing of a tool.
	1	Taper cleaning coolant is discharged during indexing of a tool.
K26#3	○ 0	The air purge function is placed under the conventional-type control.
	1	The air purge function is placed under the new-type control (air purge is turned on only when the Z-axis goes down).
K26#4	○ 0	Machining coolant is not discharged during changing of a tool.
	1	Machining coolant is discharged during changing of a tool (enabled when K26#0 = 0 and K00#7 = 1).
K26#5	○ 0	The number of coolant pumps used for taper cleaning and machining is 1.
	1	The number of coolant pumps used for taper cleaning and machining is 2.
K26#6	0	Disables the spindle overheat detection function.
	○ 1	Enables the spindle overheat detection function.
K26#7	○ 0	Enables the electromagnetic door unlock function.
	1	Disables the electromagnetic door unlock function.

Address	Setting	Function
K27#0	○ 0	(Reservation)
	1	
K27#1	○ 0	(Reservation)
	1	
K27#2	○ 0	FIN output during fourth axis clamping has servo-off.
	1	FIN output during fourth axis clamping does not have servo-off.
K27#3	○ 0	FIN output during fifth axis clamping has servo-off.
	1	FIN output during fifth axis clamping does not have servo-off.
K27#4	○ 0	(Reservation)
	1	
K27#5	○ 0	(Reservation)
	1	
K27#6	○ 0	(For adjustment)
	1	
K27#7	○ 0	(Reservation)
	1	

[Keep relay] (A circle indicates the default)

Address	Setting	Function
K28#0	○ 0 1	(Reservation)
K28#1	○ 0 1	(Reservation)
K28#2	○ 0 1	(Reservation)
K28#3	○ 0 1	(Reservation)
K28#4	○ 0 1	(Reservation)
K28#5	○ 0 1	(Reservation)
K28#6	○ 0 1	(Reservation)
K28#7	○ 0 1	(Reservation)

Address	Setting	Function
K29#0	○ 0 1	(Reservation)
K29#1	0 ○ 1	(Reservation)
K29#2	○ 0 1	(Reservation)
K29#3		(Reservation)
K29#4	○ 0 1	(Reservation)
K29#5	○ 0 1	(Reservation)
K29#6		(For adjustment)
K29#7	○ 0 1	(Reservation)

Address	Setting	Function
K30#0	○ 0 1	In fourth-axis DDR control, servo is turned off after all axes have stopped in clamping. In fourth-axis DDR control, servo is not turned off after all axes have stopped in clamping.
K30#1	0 1	(Reservation)
K30#2	0 1	(Reservation)
K30#3	○ 0 1	(Reservation)
K30#4	0 1	In fourth-axis DDR control, the axes are unclamped when power is turned on. In fourth-axis DDR control, the axes are clamped when power is turned on.
K30#5	0 1	(Reservation)
K30#6	0 1	(Reservation)
K30#7	0 1	(Reservation)

[Keep relay] (A circle indicates the default)

Address	Setting	Function
K31#0	○ 0	In tool exchange using the tool management function, the set S is not automatically specified.
	1	In tool exchange using the tool management function, the set S is automatically specified.
K31#1	0	In tool exchange using the tool management function, the set F is not automatically specified.
	1	In tool exchange using the tool management function, the set F is automatically specified.
K31#2	0	In tool exchange using the tool management function, the set H is not automatically specified.
	1	In tool exchange using the tool management function, the set H is automatically specified.
K31#3	○ 0	In tool exchange using the tool management function, the set D is not automatically specified.
	1	In tool exchange using the tool management function, the set D is automatically specified.
K31#4	0	
	1	
K31#5	0	
	1	
K31#6	0	
	1	
K31#7	0	
	1	

Address	Setting	Function
K32#0	0	(Reservation)
	○ 1	
K32#1	0	DDR control for the fourth axis is disabled.
	1	DDR control for the fourth axis is enabled.
K32#2	0	In fourth-axis DDR control, M70 is used for a clamp check.
	1	In fourth-axis DDR control, a clamp check is made when a clamp command is issued (compatibility mode).
K32#3	0	In fourth-axis DDR control, the DDR-T is not used.
	1	In fourth-axis DDR control, the DDR-T is used.
K32#4	○ 0	(Reservation)
	1	
K32#5	○ 0	(Reservation)
	1	
K32#6	0	
	1	
K32#7	○ 0	The 1% rapid traverse override function (M47) is disabled.
	1	The 1% rapid traverse override function (M47) is enabled.

[Keep relay] (A circle indicates the default)

Address	Setting	Function
K33#0	0 1	(Reservation)
K33#1	0 1	(Reservation)
K33#2	0 1	(Reservation)
K33#3	0 1	(Reservation)
K33#4	0 1	(Reservation)
K33#5	0 1	(Reservation)
K33#6	0 1	(Reservation)
K33#7	0 1	(Factory-adjusted according to the specifications of the machine)

Address	Setting	Function
K34#0	0 1	(Factory-adjusted according to the specifications of the machine)
K34#1	0 1	(Factory-adjusted according to the specifications of the machine)
K34#2	0 1	
K34#3	0 1	(Reservation)
K34#4	0 1	(Factory-adjusted according to the specifications of the machine)
K34#5	0 1	(Reservation)
K34#6	0 1	
K34#7	0 1	(Reservation)

[Keep relay] (A circle indicates the default)

Address	Setting	Function
K50#0	0	Fourth-axis index control using the DD motor is disabled.
	1	Fourth-axis index control using the DD motor is enabled.
K50#1	0	In fourth-axis index control using the DD motor, overheat control is executed.
	1	In fourth-axis index control using the DD motor, overheat control is not executed.
K50#2	0	In fourth-axis index control using the DD motor, the clamp signal is not inverted.
	1	In fourth-axis index control using the DD motor, the clamp signal is inverted.
K50#3	0	In fourth-axis index control using the DD motor, the pole position detection is disabled.
	1	In fourth-axis index control using the DD motor, the pole position detection is enabled.
K50#4	0	In fourth-axis index control using the DD motor, the overtravel function for the fourth axis is enabled.
	1	In fourth-axis index control using the DD motor, the overtravel function for the fourth axis is disabled.
K50#5	0	In fourth-axis index control using the DD motor, a timer is not used for clamp/unclamp check processing.
	1	In fourth-axis index control using the DD motor, a timer is used for clamp/unclamp check processing.
K50#6	0	(Reservation)
	1	
K50#7	0	(Reservation)
	1	

Address	Setting	Function
K51#0	0	Fifth-axis index control using the DD motor is disabled.
	1	Fifth-axis index control using the DD motor is enabled.
K51#1	0	In fifth-axis index control using the DD motor, overheat control is executed.
	1	In fifth-axis index control using the DD motor, overheat control is not executed.
K51#2	0	In fifth-axis index control using the DD motor, the clamp signal is not inverted.
	1	In fifth-axis index control using the DD motor, the clamp signal is inverted.
K51#3	0	In fifth-axis index control using the DD motor, the pole position detection is disabled.
	1	In fifth-axis index control using the DD motor, the pole position detection is enabled.
K51#4	0	In fifth-axis index control using the DD motor, the overtravel function for the fourth axis is enabled.
	1	In fifth-axis index control using the DD motor, the overtravel function for the fourth axis is disabled.
K51#5	0	In fifth-axis index control using the DD motor, a timer is not used for clamp/unclamp check processing.
	1	In fifth-axis index control using the DD motor, a timer is used for clamp/unclamp check processing.
K51#6	0	(Reservation)
	1	
K51#7	0	(Reservation)
	1	

[Keep relay] (A circle indicates the default)

Address	Setting	Function
K52#0	0	DDR high-speed positioning is disabled.
	1	DDR high-speed positioning is enabled.
K52#1	0	The improved ATC sequence is disabled.
	○ 1	The improved ATC sequence is enabled.
K52#2	○ 0	(Reservation)
	1	
K52#3	0	(Reservation)
	1	
K52#4	0	(Reservation)
	1	
K52#5	○ 0	The electric power consumption monitor does not clear the result of the previous measurement of power consumption at power-on.
	1	The electric power consumption monitor clears the result of the previous measurement of power consumption at power-on.
K52#6	○ 0	The electric power consumption monitor keeps data in the CNC after outputting it to a memory card.
	1	The electric power consumption monitor clears data after outputting it to a memory card.
K52#7	0	Does not use the power consumption monitor function
	○ 1	Uses the power consumption monitor function

Address	Setting	Function
K53#0	0	(Reservation)
	1	
K53#1	0	(Reservation)
	1	
K53#2	0	(Reservation)
	1	
K53#3	0	The LED goes on upon the completion of second reference position return.
	1	The LED blinks upon the completion of second reference position return.
K53#4	0	(Reservation)
	1	
K53#5	0	(Reservation)
	1	
K53#6	0	(Reservation)
	1	
K53#7	0	(Reservation)
	1	

[Keep relay] (A circle indicates the default)

Address	Setting	Function
K54#0	0	The internal light option is not used (the relevant soft key is not displayed).
	1	The internal light option is used (the relevant soft key is displayed).
K54#1	0	The type of the internal light is fluorescent.
	1	The type of the internal light is LED.
K54#2	0	The machine cleaning coolant is not used (the relevant soft key is not displayed).
	1	The machine cleaning coolant is used (the relevant soft key is displayed).
K54#3	0	In fifth-axis DDR control, the DDR-T is not used.
	1	In fifth-axis DDR control, the DDR-T is used.
K54#4	0	Fifth-axis DDR control is disabled.
	1	Fifth-axis DDR control is enabled.
K54#5	0	In fifth-axis DDR control, M170 is used for a clamp check.
	1	In fifth-axis DDR control, a clamp check is made when a clamp command is issued (compatibility mode).
K54#6	0	In fifth-axis DDR control, servo is turned off after all axes have stopped in clamping.
	1	In fifth-axis DDR control, servo is not turned off after all axes have stopped in clamping.
K54#7	0	In fifth-axis DDR control, the axes are unclamped when power is turned on.
	1	In fifth-axis DDR control, the axes are clamped when power is turned on.

Address	Setting	Function
K55#0	0	The machining mode customization function is disabled.
	○ 1	The machining mode customization function is enabled.
K55#1	0	(Reservation)
	1	
K55#2	0	(Reservation)
	1	
K55#3	○ 0	The tool runout detective function is disabled.
	1	The tool runout detective function is enabled.
K55#4	○ 0	The tool runout measurement alarms (EX1094 and EX1095) are enabled.
	1	The tool runout measurement alarms (EX1094 and EX1095) are disabled.
K55#5	○ 0	If M132/M133 is specified when the tool runout detective function is disabled, an alarm is issued.
	1	If M132/M133 is specified when the tool runout detective function is disabled, it is ignored and the ROBODRILL proceeds to the next block of the machining program.
K55#6	○ 0	The manual second reference position return function is disabled.
	1	The manual second reference position return function is enabled.
K55#7	○ 0	The first reference position is used for the completion signal for reference position return along the X-axis to the fifth axis when the custom PMC or external interface function is used.
	1	The second reference position is used for the completion signal for reference position return along the X-axis to the fifth axis when the custom PMC or external interface function is used.

[Keep relay] (A circle indicates the default)

Address	Setting	Function
K56#0	0	(Reservation)
	1	
K56#1	○ 0	The air dryer is not used.
	1	The air dryer is used.
K56#2	○ 0	The custom operator's panel function is enabled.
	1	The custom operator's panel function is disabled.
K56#3	0	
	1	
K56#4	0	
	1	
K56#5	0	
	1	
K56#6	0	
	1	
K56#7	0	
	1	

Address	Setting	Function
K57#0	0	(Reservation)
	1	
K57#1	0	
	1	
K57#2	0	
	1	
K57#3	0	
	1	
K57#4	0	
	1	
K57#5	0	
	1	
K57#6	0	
	1	
K57#7	0	
	1	

[Data table] (A circle indicates the default)

Address	Default	Function
D 0	11	Number of feed deceleration stages in the warning level
D 2	130	Constant for calculating the warning level
D 4	****	Constant for calculating the breakage level
D 6	11	Constant for calculating the breakage level
D 8	0	Constant for calculating the breakage level
D 10	****	No-load level
D 12	0	(For adjustment)
D 14	0	(For adjustment)
D 16		
D 18		
D 20	155	Override of feed deceleration stage 0
D 22	165	Override of feed deceleration stage 1
D 24	173	Override of feed deceleration stage 2
D 26	179	Override of feed deceleration stage 3
D 28	183	Override of feed deceleration stage 4
D 30	185	Override of feed deceleration stage 5
D 32	187	Override of feed deceleration stage 6
D 34	189	Override of feed deceleration stage 7
D 36	191	Override of feed deceleration stage 8
D 38	193	Override of feed deceleration stage 9
D 40	195	Override of feed deceleration stage 10
D 42	0	Magazine number for which no alarm is issued at tool unclamp time
D 44	3000	Interval at which center through coolant pump operation time is monitored
D 46	96	Used for adjustment of additional axis reference position return
D 48		
D 50	****	Time constant T1 used for bell-shaped acceleration/deceleration in rapid traverse for the X-axis (when the table load capacity is up to 200 kg) [NC parameter No. 1620X]
D 52	****	Time constant T1 used for bell-shaped acceleration/deceleration in rapid traverse for the Y-axis (when the table load capacity is up to 200 kg) [NC parameter No. 1620Y]
D 54	****	Time constant T2 used for bell-shaped acceleration/deceleration in rapid traverse for the X-axis (when the table load capacity is up to 200 kg) [NC parameter No. 1621X]
D 56	****	Time constant T2 used for bell-shaped acceleration/deceleration in rapid traverse for the Y-axis (when the table load capacity is up to 200 kg) [NC parameter No. 1621Y]
D 58	****	Time constant T1 used for bell-shaped acceleration/deceleration in rapid traverse for the X-axis (when the table load capacity is up to 100 kg) [NC parameter No. 1620X]
D 60	****	Time constant T1 used for bell-shaped acceleration/deceleration in rapid traverse for the Y-axis (when the table load capacity is up to 100 kg) [NC parameter No. 1620Y]
D 62	****	Time constant T2 used for bell-shaped acceleration/deceleration in rapid traverse for the X-axis (when the table load capacity is up to 100 kg) [NC parameter No. 1621X]
D 64	****	Time constant T2 used for bell-shaped acceleration/deceleration in rapid traverse for the Y-axis (when the table load capacity is up to 100 kg) [NC parameter No. 1621Y]
D 66	****	Time constant T1 used for bell-shaped acceleration/deceleration in rapid traverse for the Z-axis (when the tool weight is 3 kg) [NC parameter No. 1620Z]
D 68	****	Time constant T2 used for bell-shaped acceleration/deceleration in rapid traverse for the Z-axis (when the tool weight is 3 kg) [NC parameter No. 1621Z]
D 70	****	Time constant T1 used for bell-shaped acceleration/deceleration in rapid traverse for the Z-axis (when the tool weight is 2 kg) [NC parameter No. 1620Z]
D 72	****	Time constant T2 used for bell-shaped acceleration/deceleration in rapid traverse for the Z-axis (when the tool weight is 2 kg) [NC parameter No. 1621Z]
D 74	****	Rapid traverse rate for the X-axis (when the table load capacity is up to 200 kg) [NC parameter No. 1420X: Unit: m/min]
D 76	****	Rapid traverse rate for the Y-axis (when the table load capacity is up to 200 kg) [NC parameter No. 1420Y: Unit: m/min]

Address	Default	Function
D 78	****	Rapid traverse rate for the X-axis (when the table load capacity is up to 100 kg) [NC parameter No. 1420X: Unit: m/min]
D 80	****	Rapid traverse rate for the Y-axis (when the table load capacity is up to 100 kg) [NC parameter No. 1420Y: Unit: m/min]
D 82	****	Rapid traverse rate for the Z-axis (when the tool weight is 3 kg) [NC parameter No. 1420Z: Unit: m/min]
D 84	****	Rapid traverse rate for the Z-axis (when the tool weight is 2 kg) [NC parameter No. 1420Z: Unit: m/min]
D 86	****	Reference allowable acceleration for optimum torque acceleration/deceleration for the X-axis (when the table load capacity is up to 200 kg) [NC parameter No. 1671X]
D 88	****	Reference allowable acceleration for optimum torque acceleration/deceleration for the Y-axis (when the table load capacity is up to 200 kg) [NC parameter No. 1671Y]
D 90	****	Reference allowable acceleration for optimum torque acceleration/deceleration for the X-axis (when the table load capacity is up to 100 kg) [NC parameter No. 1671X]
D 92	****	Reference allowable acceleration for optimum torque acceleration/deceleration for the Y-axis (when the table load capacity is up to 100 kg) [NC parameter No. 1671Y]
D 94	****	Reference allowable acceleration for optimum torque acceleration/deceleration for the Z-axis (when the tool weight is 3 kg) [NC parameter No. 1671Z]
D 96	****	Reference allowable acceleration for optimum torque acceleration/deceleration for the Z-axis (when the tool weight is 2 kg) [NC parameter No. 1671Z]
D138	256	Fourth-axis DDR control (NC-PRM No.2021, below 50kg)
D140	1024	Fourth-axis DDR control (NC-PRM No.2021, 50kg or above)
D150		DDR torque limit 1
D152		DDR torque limit 2
D154	25	Fourth-axis DDR control (torque limit in clamping)
D160	****	Time constant T1 used for bell-shaped acceleration/deceleration in rapid traverse for the X-axis (when the table load capacity is up to 300 kg) [NC parameter No. 1620X]
D162	****	Time constant T1 used for bell-shaped acceleration/deceleration in rapid traverse for the Y-axis (when the table load capacity is up to 300 kg) [NC parameter No. 1620Y]
D164	****	Time constant T2 used for bell-shaped acceleration/deceleration in rapid traverse for the X-axis (when the table load capacity is up to 300 kg) [NC parameter No. 1621X]
D166	****	Time constant T2 used for bell-shaped acceleration/deceleration in rapid traverse for the Y-axis (when the table load capacity is up to 300 kg) [NC parameter No. 1621Y]
D168	****	Rapid traverse rate for the X-axis (when the table load capacity is up to 300 kg) [NC parameter No. 1420X: Unit: m/min]
D170	****	Rapid traverse rate for the Y-axis (when the table load capacity is up to 300 kg) [NC parameter No. 1420Y: Unit: m/min]
D172	****	Reference allowable acceleration for optimum torque acceleration/deceleration for the X-axis (when the table load capacity is up to 300 kg) [NC parameter No. 1671X]
D174	****	Reference allowable acceleration for optimum torque acceleration/deceleration for the Y-axis (when the table load capacity is up to 300 kg) [NC parameter No. 1671Y]
D188	256	Fifth-axis DDR control (NC-PRM No.2021, below 50kg)
D190	1024	Fifth-axis DDR control (NC-PRM No.2021, 50kg or above)
D192	25	Fifth-axis DDR control (torque limit in clamping)
D226	****	Time constant T1 used for bell-shaped acceleration/deceleration in rapid traverse for the X-axis (when the table load capacity is up to 250 kg) [NC parameter No. 1620X]
D228	****	Time constant T1 used for bell-shaped acceleration/deceleration in rapid traverse for the Y-axis (when the table load capacity is up to 250 kg) [NC parameter No. 1620Y]
D230	****	Time constant T2 used for bell-shaped acceleration/deceleration in rapid traverse for the X-axis (when the table load capacity is up to 250 kg) [NC parameter No. 1621X]
D232	****	Time constant T2 used for bell-shaped acceleration/deceleration in rapid traverse for the Y-axis (when the table load capacity is up to 250 kg) [NC parameter No. 1621Y]
D234	****	Rapid traverse rate for the X-axis (when the table load capacity is up to 250 kg) [NC parameter No. 1420X: Unit: m/min]

Address	Default	Function
D236	****	Rapid traverse rate for the Y-axis (when the table load capacity is up to 250 kg) [NC parameter No. 1420Y: Unit: m/min]
D238	****	Reference allowable acceleration for optimum torque acceleration/deceleration for the X-axis (when the table load capacity is up to 250 kg) [NC parameter No. 1671X]
D240	****	Reference allowable acceleration for optimum torque acceleration/deceleration for the Y-axis (when the table load capacity is up to 250 kg) [NC parameter No. 1671Y]
D514	600	Centralized oil lubrication: Lubrication interval (time)
D516	****	Centralized oil lubrication: Lubrication interval (distance)
D518	4	Centralized grease lubrication: Lubrication interval (time)
D520	1380	Centralized grease lubrication: Lubrication interval (distance)
D522	0	Centralized oil/grease lubrication: Remaining repetitive lubrication count after lubrication has not been performed for a long time
D524	****	Centralized oil lubrication: Repetitive lubrication interval (time)
D526	****	Centralized grease lubrication: Repetitive lubrication interval (time)
D612	****	Rigid tapping operation setting: Setting for [LOW HEAT] (NC-PRM 11421)
D614	****	Rigid tapping operation setting: Setting for [STANDARD] (NC-PRM 11421)
D616	****	Rigid tapping operation setting: Setting for [HIGH SPEED] (NC-PRM 11421)
D678	0	Override value at high-speed spindle override step 0
D679	30	Override value at high-speed spindle override step 1
D680	50	Override value at high-speed spindle override step 2
D681	80	Override value at high-speed spindle override step 3
D682	100	Override value at high-speed spindle override step 4
D683	120	Override value at high-speed spindle override step 5
D684	-106	Override value at high-speed spindle override step 6
D685	-55	Override value at high-speed spindle override step 7
D850	0	T1 spindle taper air blow extension time
D851	0	T2 spindle taper air blow extension time
D852	0	T3 spindle taper air blow extension time
D853	0	T4 spindle taper air blow extension time
D854	0	T5 spindle taper air blow extension time
D855	0	T6 spindle taper air blow extension time
D856	0	T7 spindle taper air blow extension time
D857	0	T8 spindle taper air blow extension time
D858	0	T9 spindle taper air blow extension time
D859	0	T10 spindle taper air blow extension time
D860	0	T11 spindle taper air blow extension time
D861	0	T12 spindle taper air blow extension time
D862	0	T13 spindle taper air blow extension time
D863	0	T14 spindle taper air blow extension time
D864	0	T15 spindle taper air blow extension time
D865	0	T16 spindle taper air blow extension time
D866	0	T17 spindle taper air blow extension time
D867	0	T18 spindle taper air blow extension time
D868	0	T19 spindle taper air blow extension time
D869	0	T20 spindle taper air blow extension time
D870	0	T21 spindle taper air blow extension time

G RECOMMENDED COMPACT FLASH CARDS

Purchase specification	Memory capacity	Remark
A02B-0281-K601	128 MB	CF card
A02B-0213-K211	256 MB	CF card
A02B-0213-K212	1 GB	CF card
A02B-0303-K150 or A04B-0094-K204	-	Compact flash card adapter

CAUTION

Above cards can be used in α-D*i*A5 series only.
In other series, these cards can be physically inserted in the memory card slot, but when one of these cards is inserted in the slot, the memory card or the CNC control unit may be electrically destroyed at power-on. Use special care when handling these cards.

SUPPLEMENT

- Above cards are recommended for data input/output and for PCMCIA port automatic operation. Operation for other applications is not guaranteed.
- FANUC cannot guarantee operation with cards other than the above.
- When using these cards, attach a compact flash card adapter.

Using the compact flash card adapter

(1) Mounting

- Mount a compact flash card on the compact flash card adapter (called the CF adapter below).
- Confirm that lock lever A is in the up position and insert the CF adapter on which a compact flash card is mounted into the memory card interface.
- Push lock lever A down.
- Close the door of the memory card interface.

SUPPLEMENTS

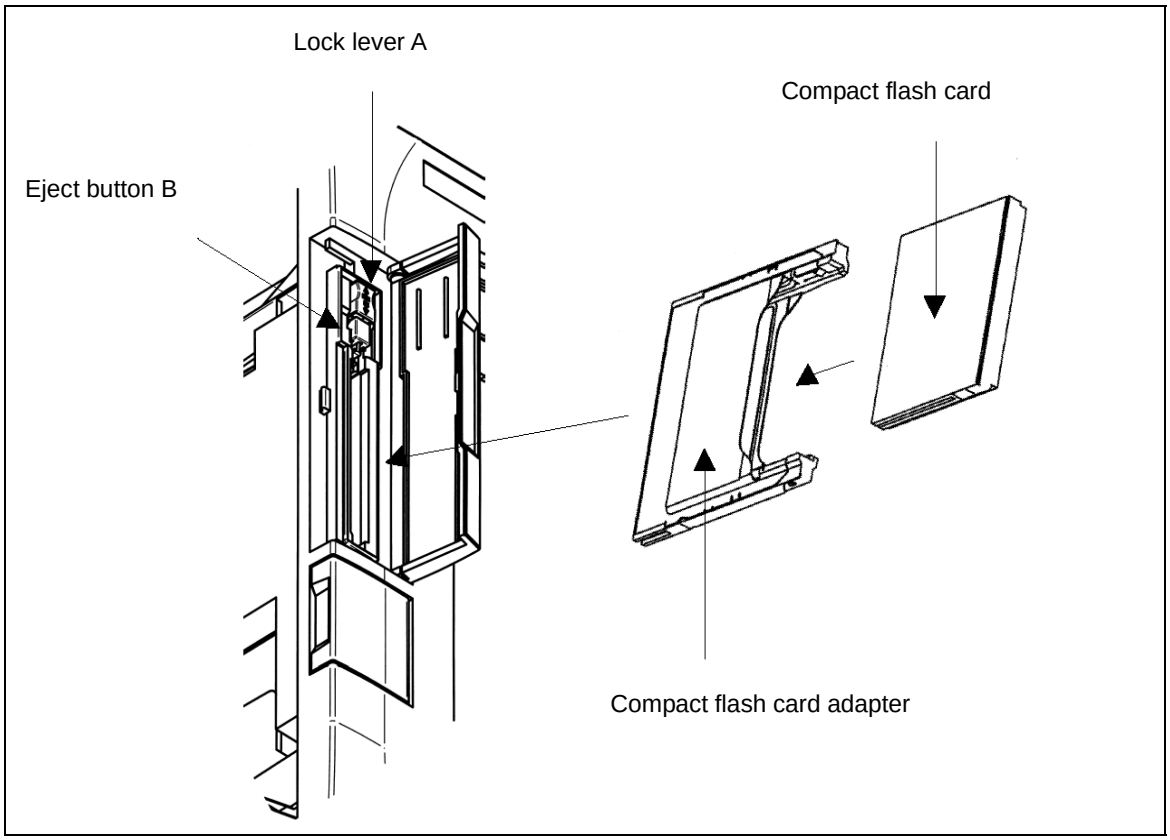
1 Before starting continuous operation with a compact flash card mounted, be sure to push lock lever A and close the door of the memory card interface.
2 The lock function is effective only when the CF adapter is used.
3 Insert the CF adapter with the label side facing the screen.

(2) Removal

- Open the door of the memory card interface.
- Push lock lever A up.
- Press eject button B once. The button pops up.
- Press eject button B again. The CF adapter is ejected.
- Pick the CF adapter with your fingers and pull it out.
- Close the door of the memory card interface.

SUPPLEMENTS

When the lock lever is in the down position (the door is locked), the eject button cannot be pressed.



H USB FUNCTION

H.1 OVERVIEW

Setting NC parameter No. 0020 to 17 selects a USB memory as the data input/output destination.
Basic specifications of the USB function are listed below.

- The USB function supports the FAT12, FAT16, FAT32, and VFAT file systems.
- It can handle up to six folder levels under the root folder.
- Up to 32 ASCII code characters (alphanumeric characters) are available for a file or folder name.

⚠ WARNING
A commercially available USB memory does not have sufficient reliability in the FA environment. When a part program, a parameter, etc. are input or output to a USB memory, those data might be damaged and there is a possibility that a serious accident or loss occurs.
Therefore, set parameter No.11505#0 (ISU) to input or output data to a USB memory using ISO codes unless data is input using ASCII codes.

NOTE
1 Do not turn off CNC or do not remove the USB memory during accessing the USB memory. The USB memory may be damaged.
2 There is a USB memory not designed for the long preservation of data. Therefore, do not use a USB memory by the long preservation purpose of data, and back up important data to the personal computer.
3 When empty capacity of the USB memory decreases or the number of files in the USB memory increases, it might take time to the input or output operation. In this case, input or output after deleting an unnecessary file in the USB memory.
4 Any USB memory that is not physically formatted cannot be formatted on the CNC. Format a USB memory to be used for the first time with FAT or FAT32 without specifying the Quick Format option on the personal computer.

H.2 RESTRICTIONS

There are the following restrictions on the USB function.

- Use a USB memory conforming to USB Ver. 1.0.

CAUTION
The operation of a commercially available USB memory is not always guaranteed. Some USB memories have a low access rate.
Before using a USB memory, fully check its operation.

- Only one USB memory can be recognized. (No USB hub can be recognized.)
- DNC operation cannot be performed using a program in a USB memory.
- Schedule operation cannot be performed using a program in a USB memory.
- A program in a USB memory device cannot be called using an external subprogram call (M198).
- "Memory Card Program Operation/Editing" cannot be applied to a USB memory.

H.3 USB FUNCTION MAINTENANCE

H.3.1 Maintenance Screen for the USB Function

A maintenance screen is available for the USB function.
The maintenance screen enables you to display the USB memory status and format a USB memory.

H.3.1.1 Displaying the maintenance screen

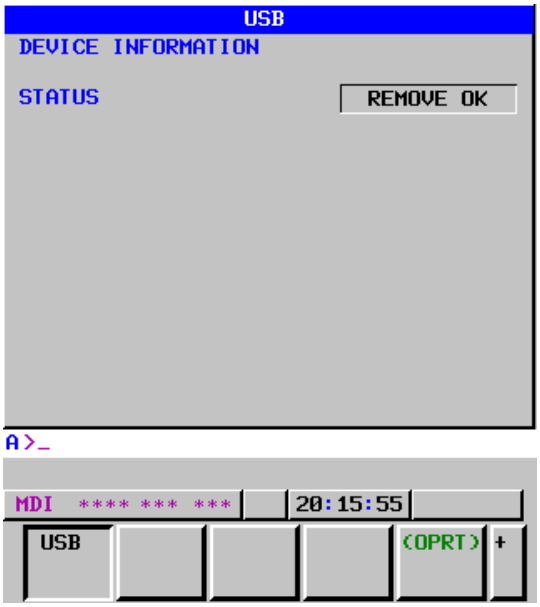
1 Press the

function key or

, then

on the operator's panel.

2 Press the [USB] soft key to display the following "USB maintenance screen" (if the [USB] soft key is not displayed, press the forward menu key).



USB maintenance screen

H.3.1.2 Display item

The status of the USB memory is displayed as listed in the table below.

Status	Description
------	No USB memory is inserted.
REMOVE OK	A USB memory is inserted and no data is input or output. The USB memory can be removed and data can be input and output.
ACCESSING	The USB memory is being accessed and cannot be removed.
FORMATTING	The USB memory is being formatted and cannot be removed.
FORMAT OK	The USB memory has been formatted normally. It can be removed and data can be input and output.
FORMAT NG	Formatting of the USB memory terminated abnormally. Replace the USB memory with another one.
ERROR	An unrecoverable error occurred and the USB memory port is unavailable.

⚠ CAUTION
When the USB memory is in the status in which it cannot be removed (ACCESSING or FORMATTING), do not turn the power to the CNC off or remove the USB memory. Otherwise, the USB memory may be damaged.

CAUTION
If "ERROR" is displayed for "STATUS", check the message displayed on the USB LOG screen to determine the cause and remove that cause. After that, turn the power to the CNC off, then on again.

H.3.1.3 Formatting a USB memory

1 Press the [(OPRT)] soft key to display the [FORMAT] soft key.

2 Press the [FORMAT] soft key, then the [EXECUTE] soft key to start formatting.

⚠ CAUTION
While a USB memory is being formatted, do not turn the power to the CNC off or remove the USB memory.
Otherwise, the USB memory may be damaged.

CAUTION
1 It may take time to format a USB memory depending on its capacity and manufacturer type. Once started, formatting on the CNC cannot be canceled.
2 Formatting a USB memory erases all files in the USB memory.
3 Any USB memory that is not physically formatted cannot be formatted on the CNC. Format a USB memory to be used for the first time with "FAT" or "FAT32" without specifying the Quick Format option on the personal computer.

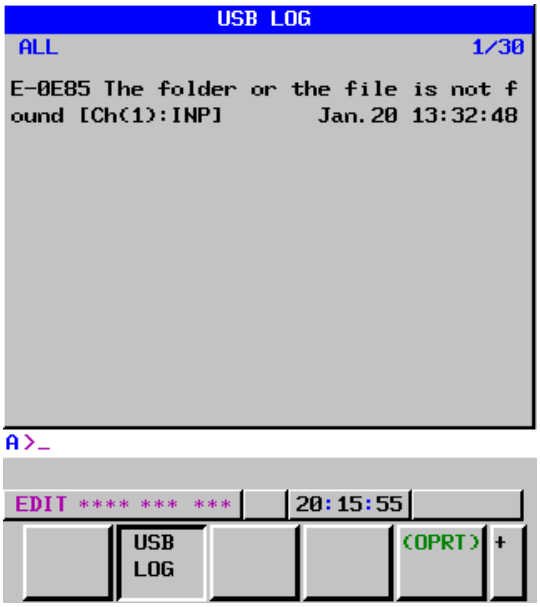
H.3.2 Log Screen of the USB Function

This screen displays the log of the USB function.

H.3.2.1 Displaying the log screen

1 Press the MESSAGE function key or —, then N. PAGE on the operator's panel.

2 Press the [USB LOG] soft key to display "USB LOG" for the USB function (if the soft key is not displayed, press the forward menu key).



Log screen

The newest error log appears at the top of the screen. The date and time when an error occurred are displayed at the right end of the line. The format of date and time data is "MMM.DD hh:mm:ss" where MMM represents a month, DD represents a day, hh represents hours, mm represents minutes, and ss represents seconds.

To clear the log, press the [(OPRT)] soft key, then the [CLEAR] soft key.

H.3.2.2 Errors and log messages

CAUTION
A detail log message "[Ch(n):XXX]" may be output together with a log message. If the problem is not solved, contact FANUC with the log message and detail log message.

Error No.	Log message	Description and necessary action
E-0E02	The number of the opening files is over	Up to 60 files can be opened concurrently.
E-0E03	The finding file is being executed	More than one file cannot be searched for simultaneously. An attempt may have been made to start a search for a file before a search for another file terminates.
E-0E04	The searched file is not found	The file/folder specified for a search is not found in the folder with the specified full path.
E-0E05	The drive name is wrong	Only drive A can be specified.
E-0E06	FORFANUC cannot be used	In a full path specification, "FORFANUC" cannot be specified as the first eight characters of the root folder name, for example, "A:\FORFANUC(any-character-string)\...".
E-0E07	The number of the folder layers is over	Up to six folder levels can be recognized. Possible causes are listed below: ・ To create or delete a folder or get a file list, a folder at the seventh level is specified for the full path. For example, the following full path specification is invalid: "A:\DIR1\DIR2\DIR3\DIR4\DIR5\DIR6\DIR7". ・ To delete a file, rename a folder/file, open a file, search for a file, or input/output a file, a file at the seventh level is specified for the full path. For example, the following full path specification is invalid: "A:\DIR1\DIR2\DIR3\DIR4\DIR5\DIR6\DIR7\ABC".
E-0E08 E-0E09 E-0E0A	USB device is being accessed	Formatting is disabled. Possible causes are listed below: ・ A file is open. [E-0E08] ・ A file is being searched for. [E-0E09] ・ The USB device is being accessed for a reason other than the above. [E-0E0A]
E-0E0E E-0E0F E-0E13 E-0E14	USB device was removed when accessing	Possible causes are listed below: ・ The USB device was removed while a file was open. After the device is connected again, an attempt is made to write or close a file, or perform other file operation. In this case, the file reliability is not guaranteed. [E-0E0E, E-0E13] ・ The USB device was removed while a file was being searched for. After the device is connected again, an attempt is made to continue or terminate the file search. [E-0E0F, E-0E14]

Error No.	Log message	Description and necessary action
E-0E12	(No message)	While a file list was being obtained, sorting failed. Another application (such as the C language executor) may have add or delete a folder/file. Refresh the file list display screen.
E-0E40	USB device is not inserted	The USB device is not recognized. Possible causes are listed below: ・ No USB device is inserted or an attempt was made to access the USB device before it was recognized. ・ The USB device was removed while it was being accessed.
E-0E41	USB device is being formatted	While a USB device was being formatted, an attempt was made to perform another operation for the device. After the termination of formatting, perform the operation.
E-0E80	The specified folder or file is wrong	Possible causes are listed below: ・ The specified full path begins with "(blank)". ・ The specified full path contains a nonexistent folder. ・ The specified full path contains a non-ASCII code. ・ An existing folder is specified with a full path for opening, inputting, or outputting a file. ・ An existing folder is specified with a full path for deleting a file.
E-0E81	The file exists in the specified folder	To delete a folder, a folder containing a file is specified.
E-0E82 E-0E83	The root folder cannot be deleted	The root folder cannot be deleted.
E-0E84	The folder or the file already exists	Possible causes are listed below: ・ An attempt is made to rename a folder/file, but an existing folder/file has the name after change. ・ An attempt is made to open a file to write data, but there is a file having the same name and the file is write-protected.
E-0E85	The folder or the file is not found	Possible causes are listed below: ・ To delete a file or rename a folder/file, a nonexistent folder/file is specified with the full path. ・ To open a file to read data or input data to a file, a nonexistent file is specified with the full path.
E-0E86	USB device has no space	Processing cannot be continued because the USB device space is insufficient.
E-0E87	USB device is broken	The USB device cannot be recognized normally. Format the USB device with "FAT" or "FAT32" without specifying the Quick Format option on the personal computer again. If this error still occurs, replace the USB device with another one.

Error No.	Log message	Description and necessary action
E-0E88	Access is denied	Possible causes are listed below: ・ To delete a folder/file, a write-protected folder/file is specified. ・ To delete a file, an already open file is specified. ・ To open a file, an already open file is specified (an attempt is made to open a file duplicately). ・ An attempt was made to read a file opened for writing data. ・ An attempt was made to write a file opened for reading data.
E-0E8D	Access exceeded the file size	An attempt was made to access an invalid location for setting a file pointer.
E-0F40	Overcurrent occurred	The USB device may be damaged. If this error occurs, turn the power to the CNC off, then on again. If this error frequently occurs, replace the USB device with another one.
E-0F41	Parity Error occurred	The main board may be damaged. If this error occurs, turn the power to the CNC off, then on again. If this error frequently occurs, replace the main board with a new one.
E-XXXX	(No message)	Internal error. Contact FANUC with the error number.

I EMBEDDED ETHERNET FUNCTION

This chapter describes the specifications of the embedded Ethernet function.

I.1 EMBEDDED ETHERNET PORT AND PCMCIA ETHERNET CARD

The embedded Ethernet function can be used by selecting one of two types of devices: the embedded Ethernet port and PCMCIA Ethernet card.
The PCMCIA Ethernet card is to be inserted into the memory card slot for temporary communication.

⚠ CAUTION

1 When using the embedded Ethernet function for the first time, set an IP address and other items carefully as instructed by the network administrator, then perform a sufficient communication test.
Note that an incorrect IP address or other setting may cause a communication failure on the entire network.
Note that if a communication failure occurs and the use of the system is continued, a communication failure may intermittently occur in the FOCAS2/Ethernet or FTP transfer function, resulting in a CNC system error.
2 A unit such as a PC situated in the same network can increase the communication processing load on the CNC even if the unit is not communicating with the CNC.
Avoid connecting the CNC to a factory-wide network. Use a router or the like to separate the network including the CNC from the other networks.

ATTENTION

1 Use the PCMCIA Ethernet card designated by FANUC. General Ethernet cards available on the market cannot be used.
2 The PCMCIA Ethernet card is used for FANUC LADDER- III or a servo guide.
3 Use the PCMCIA Ethernet card just for temporary communication as described above. Avoid using the card for continuous communication.
4 The PCMCIA Ethernet card is inserted into a memory card slot, with a part of the card left uninserted. When using the PCMCIA Ethernet card, take great care not to damage the card by hitting the protruding part of the card.
When the card becomes unnecessary, remove the card immediately, in order to prevent any damage to the card.

I.2 SETTING UP THE EMBEDDED ETHERNET FUNCTION

This section describes the setting of parameters for the embedded Ethernet function.

I.2.1 Parameter Setting of the FOCAS2/Ethernet Function

This subsection describes the settings required to operate the FOCAS2/Ethernet function.

Notes on using the FOCAS2/Ethernet function for the first time

SUPPLEMENT
1 When running user's original application software created by using the FOCAS2/Ethernet function, use the built-in Ethernet port.
2 The FOCAS2/Ethernet function allows up to five FOCAS2/Ethernet clients to be connected to one CNC.
3 Concurrent access by multiple applications or personal computers may overload the CNC, reducing the communication speed.

Operation on the FOCAS2/Ethernet setting screen

On the Ethernet parameter setting screen, set the parameters for operating the FOCAS2/Ethernet function.

Procedure

(1) Press

and

key (for the standard type operator's panel) or the function key

(for the full keyboard type operator's panel)..
(2) Press the rightmost soft key several times until the [EMBED] and [PCMCIA LAN] soft keys are displayed.
(3) To display the Ethernet Setting screen for the embedded Ethernet port or the PCMCIA Ethernet card, press soft key [EMBED] or [PCMCIA LAN], respectively.
(4) Press soft keys [COMMON] and [FOCAS2] and then enter parameters for the items that appear.

SUPPLEMENT
1 The parameters for the embedded Ethernet port and the parameters for the PCMCIA Ethernet card are independent of each other.
2 The settings of the FOCAS2/Ethernet function for the PCMCIA Ethernet card are made when a connection to the Servo Guide and FANUC LADDER-III is established.

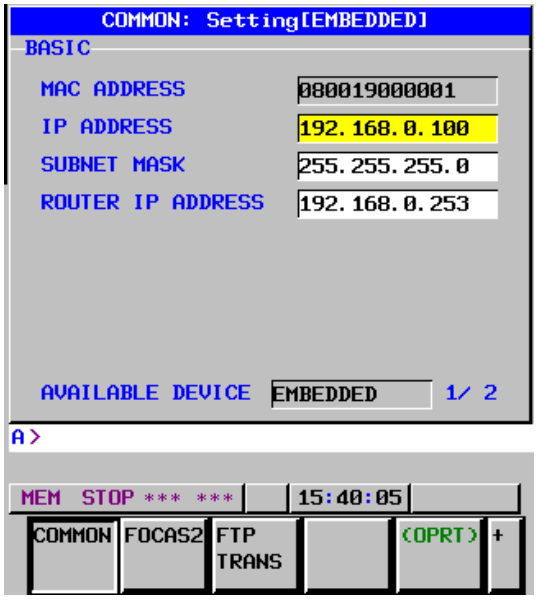
Settings of the FOCAS2/Ethernet function

Settings on the COMMON screen

Item	Description
IP ADDRESS	Specify the IP address of the embedded Ethernet. (Example of specification format: "192.168.0.100")
SUBNET MASK	Specify a mask address for the IP addresses of the network. (Example of specification format: "255.255.255.0")
ROUTER IP ADDRESS	Specify the IP address of the router. Specify this item when the network contains a router. (Example of specification format: "192.168.0.253")

Display items on the COMMON screen

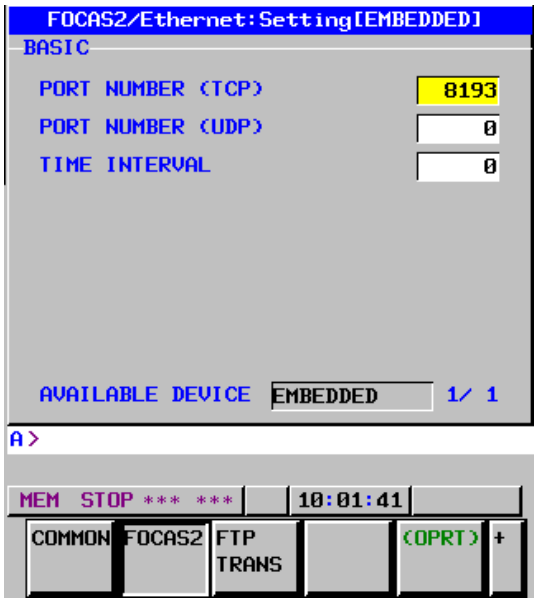
Item	Description
MAC ADDRESS	Embedded Ethernet MAC address
AVAILABLE DEVICE	Enabled device of the embedded Ethernet. Either the embedded Ethernet port or the PCMCIA Ethernet card is displayed.



COMMON screen

FOCAS2/Ethernet setting items

Item	Description
PORT NUMBER (TCP)	Specify a port number to be used with the FOCAS2/Ethernet function. The valid input range is 5001 to 65535.
PORT NUMBER (UDP)	Set this item to 0 when it is used as the FOCAS2/Ethernet function.
TIME INTERVAL	Set this item to 0 when it is used as the FOCAS2/Ethernet function.



FOCAS2 screen

SUPPLEMENT

1 When a connection to the *i* CELL is established, set the UDP port number and time interval above as described in the FANUC CIMPLICITY *i* CELL Operator's Manual (B-75074).
2 The unit of the time interval is 10 ms. The allowable range is between 10 and 65535. A time interval less than 100ms cannot be set.
3 Decreasing the time interval setting increases the communication load and can affect the network performance.
Example)
If the interval is set to 100 (100 x 10 ms = 1 second), broadcast data is sent every 1 second.

Initial setting of the PCMCIA Ethernet card

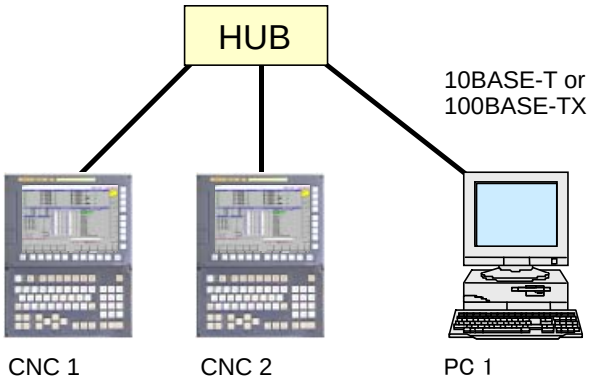
The PCMCIA Ethernet card is factory-set to the following default values, for ease of connection with a servo guide or FANUC LADDER-III.

IP ADDRESS: 192.168.1.1
SUBNET MASK: 255.255.255.0
ROUTER IP ADDRESS: None
PORT NUMBER (TCP): 8193
PORT NUMBER (UDP): 0
TIME INTERVAL: 0

If a specified IP address is changed to a blank (space), the specified setting is reset to the default value. The built-in Ethernet port does not have a default value.

Example of setting the FOCAS2/Ethernet function

The following shows a setting example required for the FOCAS2/Ethernet function to operate.
In this example, one personal computer is connected to two CNCs through FOCAS2/Ethernet.



	CNC 1	CNC 2
IP address	192.168.0.100	192.168.0.101
Subnet mask	255.255.255.0	255.255.255.0
Router IP address	None	None
TCP port number	8193	8193
UDP port number	0	0
Time interval	0	0

→ The Ethernet parameter screen is used for setting.

		PC 1
IP address		192.168.0.200
Subnet mask		255.255.255.0
Default gateway		None
CNC 1	NC IP address	192.168.0.100
	NC TCP port number	8193
CNC 2	NC IP address	192.168.0.101
	NC TCP port number	8193

→ "Microsoft TCP/IP property" of the personal computer (Windows2000/XP/Vista/7) is used for setting.

→ The arguments of the data window library function cnc_allclibhndl3 are used for setting.

I.2.2 Setting Parameters for the FTP File Transfer Function

This section describes the settings required for the FTP file transfer function to operate using the embedded Ethernet function.

Notes on using the FTP file transfer function for the first time

SUPPLEMENT
1 When using the FTP file transfer function, use the built-in Ethernet port.
2 The number of FTP communications to which one CNC can be connected using the FTP file transfer function is one.

Operation on the FTP file transfer setting screen

On the Ethernet setting screen, set the parameters for operating the FTP file transfer function.

Procedure

(1) Press

and a

key (for the standard type operator's panel) or the function key

(for the full keyboard type operator's panel)..
(2) Press the rightmost soft key several times until the [EMBED] and [PCMCIA LAN] soft keys are displayed.
(3) By pressing the [EMBED] soft key, the Ethernet Setting screen for the embedded Ethernet port is displayed.
(4) Press soft keys [COMMON] and [FTP TRANS] and then enter parameters for the items that appear.

SUPPLEMENT
The parameters for the embedded Ethernet port and the parameters for the PCMCIA Ethernet card are independent of each other.
If the [PCMCIA LAN] soft key is pressed, the PCMCIA Ethernet card can be set up. However, the card setup is carried out for maintenance and is not necessary usually.

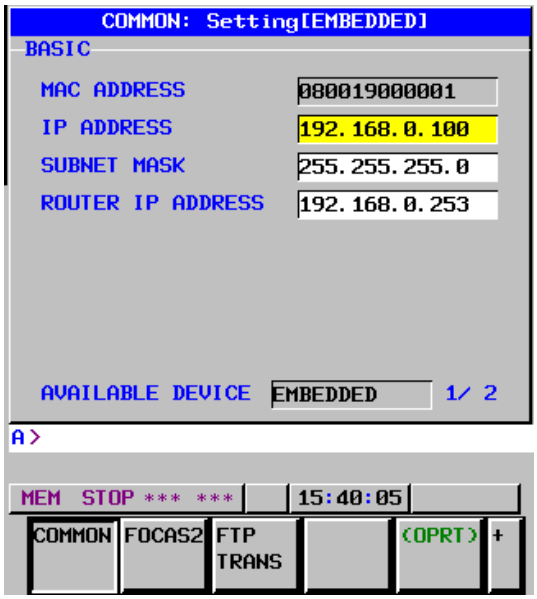
Settings for the FTP file transfer function

- **Settings on the COMMON screen**

Item	Description
IP ADDRESS	Specify the IP address of the embedded Ethernet. (Example of specification format: "192.168.0.100")
SUBNET MASK	Specify a mask address for the IP addresses of the network. (Example of specification format: "255.255.255.0")
ROUTER IP ADDRESS	Specify the IP address of the router. Specify this item when the network contains a router. (Example of specification format: "192.168.0.253")

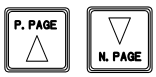
- **Display items on the COMMON screen**

Item	Description
MAC ADDRESS	Embedded Ethernet MAC address
AVAILABLE DEVICE	Enabled device of the embedded Ethernet. Either the embedded Ethernet port or the PCMCIA Ethernet card is displayed.

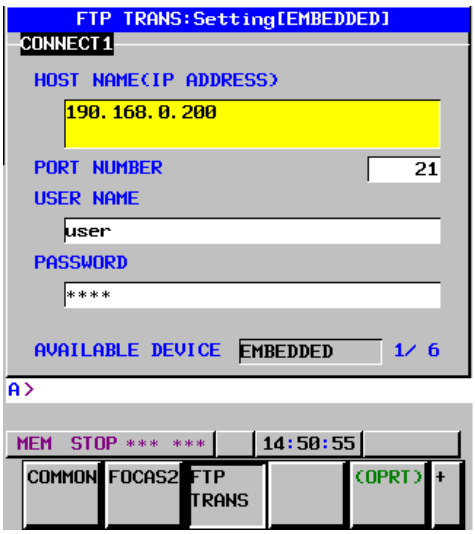


COMMON screen

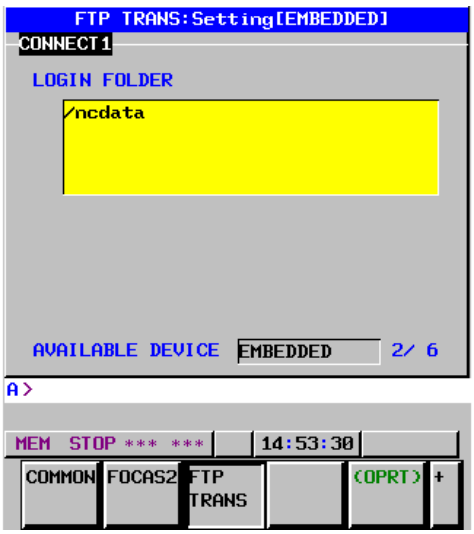
Settings on the FTP transfer screen

Page keys 

can be used to make settings for the three host computers for connection destinations 1 to 3.



FTP transfer screen (1st page)



FTP transfer screen (2nd page)

Item	Description
HOST NAME	Specify the IP address of the host computer. (Example of specification format: "192.168.0.200")
PORT NUMBER	Specify a port number to be used with the FTP file transfer function. An FTP session is used, so that "21" is to be specified usually.
USERNAME	Specify a user name to be used for logging in to the host computer with FTP. (Up to 31 characters can be specified.)
PASSWORD	Specify a password for the user name specified above. (Up to 31 characters can be specified.) Be sure to set a password.
LOGIN FOLDER	Specify a work folder to be used when logging in to the host computer. (Up to 127 characters can be specified.) If nothing is specified, the home folder specified in the host computer becomes the log-in folder.

Changing the host computer to be connected for the FTP file transfer function

Select a destination.

(1) Pressing the [(OPRT)] soft key causes soft key [HOST SELECT] to be displayed. Pressing this soft key causes soft keys [CONECT 1], [CONECT 2], and [CONECT 3] to be displayed.

(2) Depending on the host computer to be connected, press soft key [CONECT 1], [CONECT 2], or [CONECT 3]. Destination 1, 2, or 3 is highlighted in the screen title field. The computer corresponding to the highlighted destination is selected as the target computer to be connected.

When destination 1 is selected

Related NC parameters

The NC parameters related to the FTP file transfer function are described below.

0020	I/O CHANNEL : Input/output device selection

[Data type] Byte
[Valid data range] 9: Select the embedded Ethernet as the input/output device.

For built-in Ethernet port

	#7	#6	#5	#4	#3	#2	#1	#0
14880							PCH	

[Data type] Bit
#1 PCH At the start of communication of the FTP file transfer function, checking for the presence of the FTP server using PING is:
0: Performed.
1: Not performed.

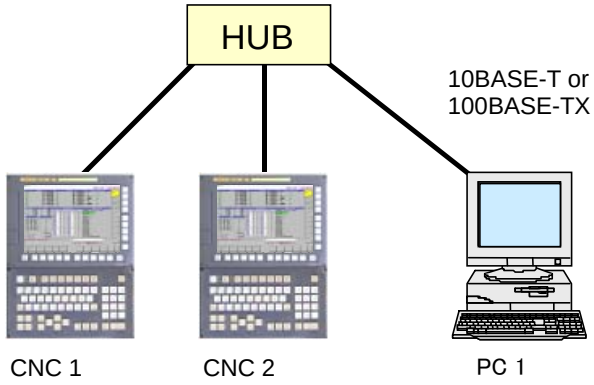
SUPPLEMENT

Usually, set “Performed (0)”.
When the presence of the FTP server is not checked using PING (this parameter is set to 1), it may take several tens of seconds until an error (absence of the FTP server in the network) can be recognized.
For mainly security reasons, a personal computer may be set so that it does not respond to the PING command. When this function is to communicate with such a personal computer, set “Not performed” (1).

Example of setting the FTP file transfer function

The following shows a setting example required for the FTP file transfer function to operate.
(WindowsXP Professional is used as the OS for the personal computer).
In this example, one personal computer is connected to two CNCs through the FTP file transfer function.

- On Personal Computer 1, the FTP server function operates.
- On CNC 1 and CNC 2, the FTP client operates as the FTP file transfer function.



		CNC 1	CNC 2
IP address		192.168.0.100	192.168.0.101
Subnet mask		255.255.255.0	255.255.255.0
Router IP address		None	None
Connection host 1	Port number	21	21
	IP address	192.168.0.200	192.168.0.200
	User name	user	user
	Password	user	user
	Login DIR	None	None
NC parameter No. 20		9	9

The Ethernet parameter screen is used for setting.

The parameter screen is used for setting.

	PC 1
IP address	192.168.0.200
Subnet mask	255.255.255.0
Default gateway	None
User name	user
Password	user
Login DIR	Default

"Microsoft TCP/IP property" of the personal computer (WindowsXP) is used for setting.

"User acount of the personal computer (WindowsXP) is used for setting.

"Internet service manager" of the personal computer (WindowsXP) is used for setting.

I.2.3 Setting Up the DNS/DHCP Function

The DHCP/DNS function is set up by using the COMMON screen (detail) and NC parameters.

I.2.3.1 Setting up DNS

This subsection describes the procedure for setting up a DNS.

Procedure

(1) Enable the DNS client function, with reference to "Related NC Parameters," which will be seen later.
(2) Set up the DNS server of the host computer.
(3) Connect the host computer on which the DNS server runs (called the DNS server below), restart the CNC, and press

and a

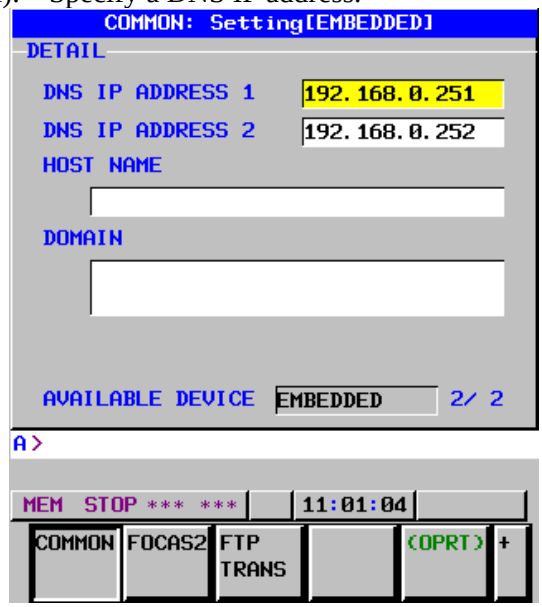
key, or function key

.
(4) Press soft keys [EMBED] and [COMMON] in that order. The COMMON screen (detail) appears.
(5) Enter the IP address of the DNS server in the corresponding DNS IP address field.

COMMON screen

After pressing soft key [COMMON], press either page key

to call a desired data server common setting screen (detail). Specify a DNS IP address.



COMMON screen (detail)

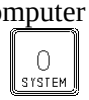
Display item

Item	Description
DNS IP ADDRESS 1, 2	Up to two DNS IP addresses can be specified. The CNC searches for the DNS server using DNS IP addresses 1 and 2 in that order.

I.2.3.2 Setting up DHCP

This subsection describes the procedure for setting up a DHCP.

Procedure

(1) Enable the DHCP client function, with reference to "Related NC Parameters," which will be seen later.
(2) Set up the DHCP server of the host computer.
(3) Connect the host computer on which the DHCP server runs (called the DHCP server below), restart the CNC, and press 

and a

key, or function key

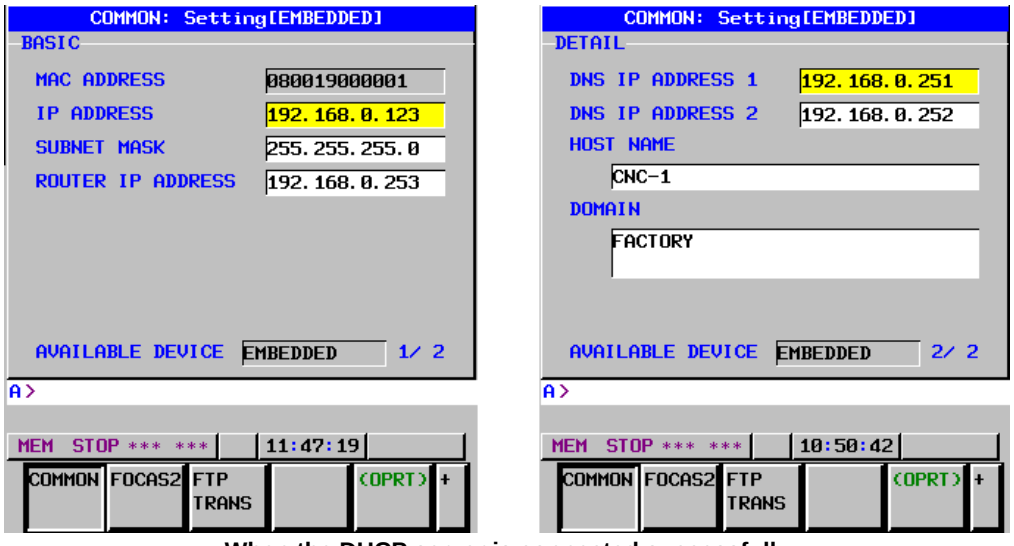
.
(4) Press soft keys [EMBED] and [COMMON] in that order. The COMMON screen appears.
(5) If the DHCP function of the CNC has been enabled and if the DHCP server is connected successfully, the DHCP server automatically specifies the following items.
- IP ADDRESS
- SUBNET MASK
- ROUTER IP ADDRESS
- DNS IP ADDRESS
- DOMAIN

If the DHCP server cannot be connected, "DHCP ERROR" is displayed in each field.
(6) If the DNS function has also been enabled and if the DHCP server and the DNS server work together (if the DNS server supports dynamic DNS), enter a host name.

COMMON screen

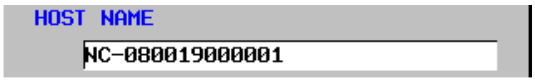
After pressing soft key [COMMON], press either page key

to call a desired Ethernet common setting screen (basic, detail).
If the DHCP server is connected successfully and if the setting data can be obtained, the screen is displayed as shown below.



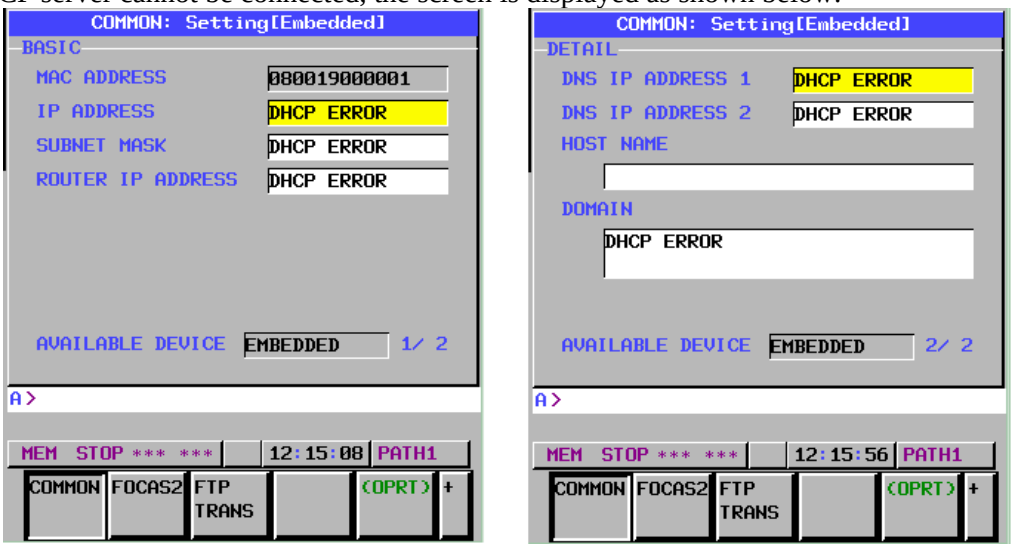
When the DHCP server is connected successfully

If the host name is not specified, the CNC automatically assigns a host name in the "NC-<MAC-address>" format.



Example of automatically assigned host name

If the DHCP server cannot be connected, the screen is displayed as shown below.



When the DHCP server cannot be connected

Check item

Item	Description
IP ADDRESS	If the DHCP server is connected successfully, the items obtained from the DHCP server are displayed. If the DHCP server cannot be connected, "DHCP ERROR" is displayed.
SUBNET MASK	
ROUTER IP ADDRESS	
DNS IP ADDRESS 1,2	
DOMAIN	

Setting item

Item	Description
HOST NAME	Enter the host name of the CNC. If a DHCP server and a DNS server work together, the DHCP server notifies the DNS server of this host name. If the host name is left blank, a host name is automatically assigned in the "NC-<MAC-address>" format. Example of automatically assigned host name: NC-080019000001

Display item

Item	Description
MAC ADDRESS	MAC address of embedded Ethernet

Related NC parameters

For built-in Ethernet port

	#7	#6	#5	#4	#3	#2	#1	#0
14880		DHC	DNS		D1ET			

[Data type] Bit

 # 5 DNS The DNS client function is:
0: Not used.
1: Used.

 # 6 DHC The DHCP client function is:
0: Not used.
1: Used.

 # 3 D1ET When the DHCP function is used:
0: The default parameters for the FOCAS1/Ethernet function are specified.
PORT NUMBER (TCP) 8193
PORT NUMBER (UDP) 0
TIME INTERVAL 0
1: The default parameters for *i* CELL are specified.
PORT NUMBER (TCP) 8193
PORT NUMBER (UDP) 8192
TIME INTERVAL 50

A change in these parameters becomes effective after the power is turned off and on or after the embedded Ethernet function is restarted.

I.3 SWITCHING BETWEEN THE EMBEDDED ETHERNET DEVICES

There are two types of embedded Ethernet devices: the embedded Ethernet port and PCMCIA Ethernet card.
Screen operation is required to switch between these two types of devices.

Procedure

(1) Press

and a

key (for the standard type operator's panel) or the function key

(for the full keyboard type operator's panel).
(2) Press the rightmost soft key several times until the [EMBED] and [PCMCIA LAN] soft keys are displayed.
(3) Press soft key [EMBED] or [PCMCIA LAN], press soft key [COMMON], and then press [(OPRT)] to display soft key [EMB/PCMCIA].
(4) Pressing soft key [EMB/PCMCIA] switches between enabled devices.

SUPPLEMENT
Information on a switched device is stored in nonvolatile memory.
On the next power-up, the device last selected can be used as is.

I.4 EMBEDDED ETHERNET OPERATIONS

I.4.1 FTP File Transfer Function

The operation of the FTP file transfer function is described below.

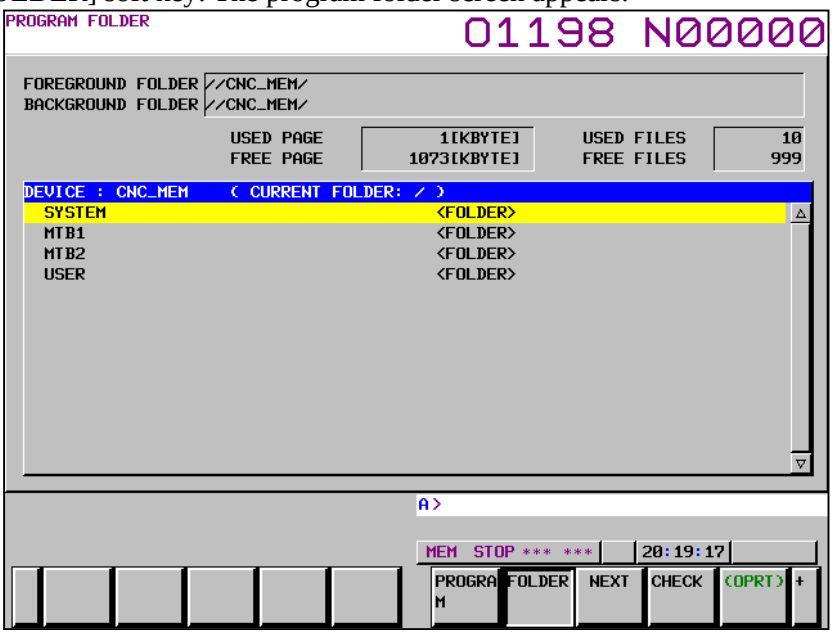
Host file list display

A list of the files held on the host computer is displayed.

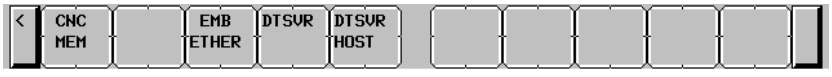
Procedure

(1) Press 2 PROG and a ▽ N. PAGE key (for the standard type operator's panel) or the function key PROG (for the full keyboard type operator's panel).

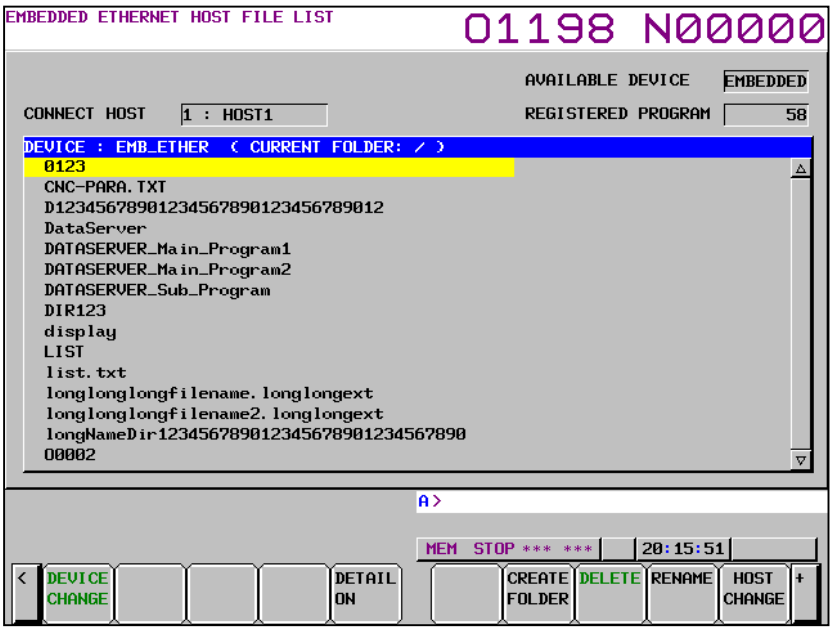
(2) Press the [FOLDER] soft key. The program folder screen appears.



(3) Press soft keys [(OPRT)] and [DEVICE CHANGE] in that order. The soft keys for selectable devices appear.



(4) Press soft key [EMB ETHER]. The program directory screen is changed to the contents of the hard disk on the host computer (embedded Ethernet host file list screen). On this screen, you can operate files.



Embedded Ethernet host file list screen

SUPPLEMENT

When using the FTP file transfer function, check that the valid device is the embedded Ethernet port.
The two conditions below determine a connection destination on the host file list screen:
(1) Check that the valid device is the embedded Ethernet port. Make a selection in "DEVICE SELECTION" on the Ethernet setting screen.
(2) A host computer can be selected from connection destinations 1, 2, and 3. Make a selection according to the [HOST] soft key described later.

(5) When a list of files is larger than one page, the screen display can be switched using the page keys

.

Display item

AVAILABLE DEVICE

The currently selected device is displayed.
Check that the embedded Ethernet port is selected currently.

CONNECT HOST

Number of the currently connected host of the host computer

REGISTERED PROGRAM

The number of programs in the current folder.

DEVICE

Current device. When the embedded Ethernet host file list is selected, “EMB_ETHER” is displayed.

CURRENT FOLDER

Current work folder in the host computer

FILE LIST

Information of the files and folders in the host computer

I.4.1.1 Displaying and operating the file list

REFRESH, DETAIL ON, DETAIL OFF

Update the file list data or change the file list type.
(1) Press soft key [REFRESH] to update the file list data.
(2) Press soft key [DETAIL ON] to display only file names.
(3) Press soft key [DETAIL OFF] to display file attributes, sizes, dates, and file names.

SUPPLEMENT
The items displayed in the detailed list depend on the FTP server setting on the host computer.

Moving a folder

Move a folder.
(1) Select a folder you want to move using cursor keys and .
(2) Press soft key [INPUT].

CREATE FOLDER

Create a new folder.
(1) Move to a folder in which you want to create a new folder.
(2) Enter a folder name.
(3) Press soft key [CREATE FOLDER].

DELETE

Delete a file or folder.
(1) Select a file or folder you want to delete using cursor keys and .
(2) Press soft key [DELETE].
- To execute the deletion, press soft key [EXEC].
- To cancel the deletion, soft key [CANCEL].

DELETE (multiple files)

Delete multiple files at a time.
(1) Press soft key [SELECT START].
(2) Select a file or folder you want to delete using cursor keys and .
(3) Press soft key [SELECT].
The selected file is highlighted.
Repeat steps 2 and 3 for each file you want to delete.
(4) Press soft key [DELETE].
- To execute the deletion, press soft key [EXEC].
- To cancel the deletion, soft key [CANCEL].

RENAME

Rename a file or folder.

(1) Select a file or folder you want to rename using cursor keys and .

(2) Enter a new file or folder name.
(3) Press soft key [RENAME].

SEARCH

Search the current work folder for a file.
(1) Enter a file name.
(2) Press soft key [SEARCH].

HOST CHANGE

Change the connected host computer.
(1) Press soft key [HOST CHANGE].
The connected host number changes from 1 to 2 to 3, then back to 1.

Inputting an NC program

Input a file (NC program) stored in the host computer to the CNC storage memory.

(1) Display the embedded Ethernet host file list screen.
(2) Press soft key [(OPRT)].
(3) Press soft key [F INPUT].
(4) Position the cursor on the file to be input and press [F GET] or enter the input file name from the keyboard and press soft key [F SET].
If the file name is omitted, default file name "ALL-PROG.TXT" is used.

(5) Enter a program name from the keyboard and press soft key [P SET].
For operation performed when [F SET] and [P SET] are omitted, see the table below.

[F SET]	[P SET]	Input file name	Input program	Input program name
-	-	ALL-PROG.TXT	All programs in "ALL-PROG.TXT"	Saved file name
-	○	ALL-PROG.TXT	First program in "ALL-PROG.TXT"	Program name set using [P SET]
○	-	File name set using [F SET]	All programs in the file specified using [F SET]	Saved file name
○	○	File name set using [F SET]	First program in the file specified using [F SET]	Program name set using [P SET]

(6) Press soft key [EXEC].

Outputting an NC program

Output a file (NC program) stored in the CNC storage memory to the host computer.

(1) Display the embedded Ethernet host file list screen.
(2) Press soft key [(OPRT)].
(3) Press soft key [F OUTPUT].
(4) Enter the name of a program to be output from the keyboard and press soft key [P SET]. To specify an output file name, enter the file name from the keyboard and press soft key [F SET].
If the output file name and output program name are omitted, all programs in the foreground folder are output to "ALL-PROG.TXT".
For operation performed when [F SET] and [P SET] are omitted, see the table below.

[F SET]	[P SET]	Output file name	Output program
-	- or O-9999	ALL-PROG.TXT	All programs in the foreground folder that are displayed in PROGRAM LIST
-	○	ALL-PROG.TXT	Program in the NC memory that is set using [P SET]
○	- or O-9999	File name set using [F SET]	All programs in the foreground folder that are displayed in PROGRAM LIST
○	○	File name set using [F SET]	Program in the NC memory that is set using [P SET]

(5) Press soft key [EXEC].

I.5 RESTART OF THE EMBEDDED ETHERNET

Communication using the embedded Ethernet can be restarted.

Procedure

(1) Press

and a

key (for the standard type operator's panel) or the function key

(for the full keyboard type operator's panel).
(2) Press the rightmost soft key several times until the [EMBED] and [PCMCIA LAN] soft keys are displayed.
(3) Press soft key [EMBED] or [PCMCIA LAN], press soft key [COMMON], and then press [(OPRT)] to display soft key [EMB/PCMCIA].
(4) Pressing soft key [RSTART] resets embedded Ethernet communication and then restarts it.

SUPPLEMENT
1 Pressing soft key [RSTART] forcibly interrupts communication even when it is in progress.
2 This function makes a restart by software. An actual restart may be impossible under some conditions.

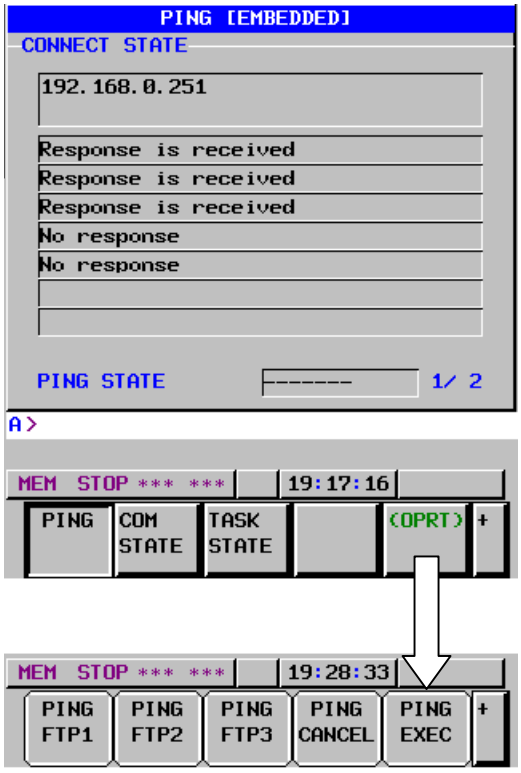
I.6 MAINTENANCE SCRESSN FOR EMBEDDED ETHERNET FUNCTION

With the embedded Ethernet function, a dedicated maintenance screen is available.
The maintenance screen enables operations to be checked when the embedded Ethernet function operates abnormally.

Displaying and operating the PING screen

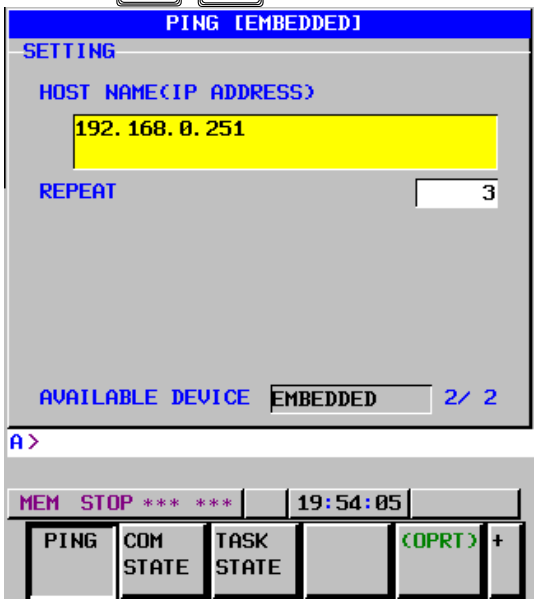
Procedure

(1) Press SYSTEM and a N. PAGE key (for the standard type operator's panel) or the function key SYSTEM (for the full keyboard type operator's panel).
(2) Press the rightmost soft key ▷ several times until the [EMBED] and [PCMCIA LAN] soft keys are displayed.
(3) By pressing the [EMBED] soft key, the Ethernet Setting screen for the embedded Ethernet is displayed.
By pressing the [PCMCIA LAN] soft key, the Ethernet Setting screen for the PCMCIA Ethernet card can be set.
(4) Press soft key [PING] and then press [(OPRT)].
(5) To send the PING command to connection destination 1 for FTP file transfer, press soft key [PING FTP1]. Similarly, to send the PING command to connection destination 2 or 3, press [PING FTP2] or [PING FTP3], respectively.



PING connection status screen

(7) To send the PING command to the desired destination, enter the address of the destination on the PING setting screen. (Page keys P. PAGE N. PAGE are used for switching.)



PING connection status screen

(7) After entering the address and the REPEAT count, press the soft key [PING]. The specified number of PING commands are sent to the specified destination.
(8) To cancel the PING command currently being sent, press soft key [PING CANCEL].

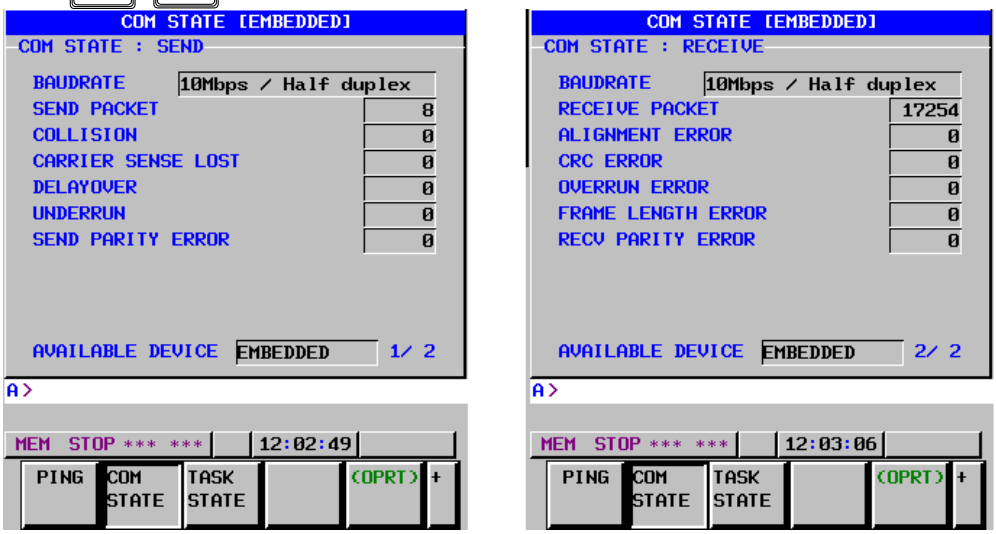
Displaying Communication status screen

Procedure

(1) Press 0 SYSTEM and a N. PAGE key (for the standard type operator's panel) or the function key SYSTEM (for the full keyboard type operator's panel).
(2) Press the rightmost soft key ▷ several times until the [EMBED] and [PCMCIA LAN] soft keys are displayed.
(3) By pressing the [EMBED] soft key, the Ethernet Setting screen for the embedded Ethernet is displayed.
By pressing the [PCMCIA LAN] soft key, the Ethernet Setting screen for the PCMCIA Ethernet card can be set.

(4) To display the communication status of the embedded Ethernet, press soft key [COM STATE].
Page keys

can be used to switch between the sending state and the receiving state.



Communication status screen

Display items

Item	Description
BAUDRATE	Communication speed and communication system Communication speed: 100Mbps or 10Mbps Communication system: Full duplex or Half duplex --------: Not connected to the HUB
SEND PACKET	Number of sent packets
COLLISION CARRIER SENSE LOST DELAYOVER UNDERRUN SEND PARITY ERROR	Number of detected packet send errors
RECEIVE PACKET	Number of received packets
ALIGNMENT ERROR CRC ERROR OVERRUN ERROR FRAME LENGTH ERROR RECV PARITY ERROR	Number of detected packet receive errors
AVAILABLE DEVICE	Enabled device of the embedded Ethernet. Either the embedded Ethernet port or the PCMCIA Ethernet card is displayed.

Displaying a software status screen

Procedure

(1) Press

and a

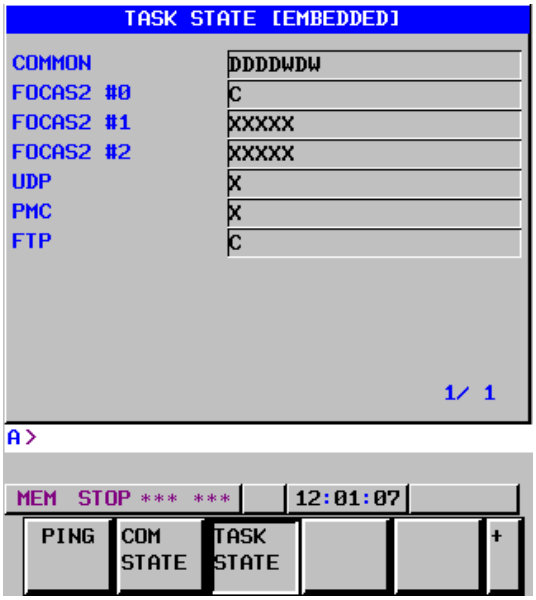
key (for the standard type operator's panel) or the function key

(for the full keyboard type operator's panel).

(2) Press the rightmost soft key several times until the [EMBED] and [PCMCIA LAN] soft keys are displayed.

(3) To display the Ethernet Setting screen for the embedded Ethernet port or the PCMCIA Ethernet card, press soft key [EMBED] or [PCMCIA LAN], respectively.

(4) Pressing soft key [TASK STATUS] causes the task status of the embedded Ethernet function to be displayed.



Software status screen

The following symbols are used.

	Symbol and meaning
FOCAS2 #0	C: Waiting for a connection from the host W: Data processing in progress (1) D: Data processing in progress (2) N: FOCAS2 out of service
FOCAS2 #1,#2	W: Data processing in progress (1) D: Data processing in progress (2) X: Not yet executed
UDP	W: Data processing in progress (1) D: Data processing in progress (2) X: Not yet executed
PMC	W: Data processing in progress (1) D: Data processing in progress (2) X: Not yet executed
FTP	C: Execution wait W: Data processing in progress (1) D: Data processing in progress (2) X: Not yet executed

I.7 LOG SCREEN OF THE EMBEDDED ETHERNET FUNCTION

This screen displays the log of the embedded Ethernet function.

CAUTION
If alarm SR2032, "EMBEDDED ETHERNET/DATA SERVER ERROR" is issued during data transfer using the embedded Ethernet function, check the detail error message on the log screen of the embedded Ethernet function.

Displaying the log screen

Procedure

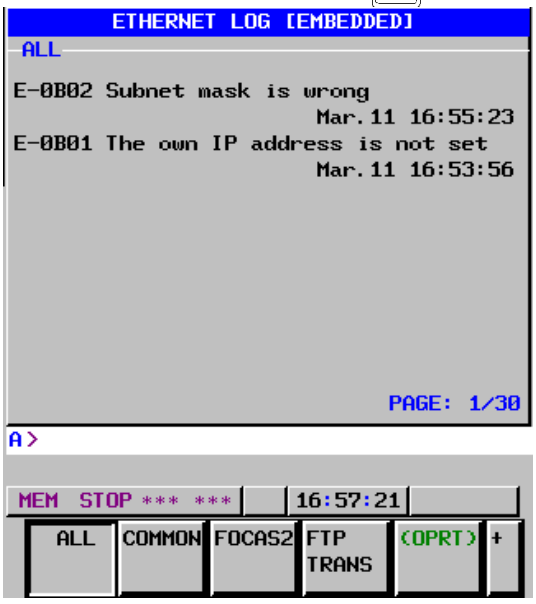
(1) Press

and a

key (for the standard type operator's panel) or the function key

(for the full keyboard type operator's panel).

(2) Press the [EMBED LOG] soft key to display the log screen for the built-in Ethernet port or the [PCMCIA LOG] soft key to display the log screen for the PCMCIA Ethernet card. (When these soft keys are not displayed, press the rightmost soft key several times.)



LOG screen

The newest error log appears at the top of the screen. The date and time when an error occurred are displayed at the right end of the line. The format of date and time data is “MMM.DD hh:mm:ss” where MMM represents a month, dd represents a day, hh represents hours, mm represents minutes, and ss represents seconds.
The date and time of the upper item shown above is August 4, 13:57:23.

To clear the log, press soft keys [(OPRT)] and [CLEAR] in that order.

The log for each function can be displayed by using soft keys on the embedded Ethernet log screen.

(1) Soft key [ALL]
Displays all log related to the embedded Ethernet.
(2) Soft key [COMMON]
Displays the log related to the parameter settings of the embedded Ethernet function and the basic communication function.
(3) Soft key [FOCAS2]
Displays the log related to the FOCAS2/Ethernet function.
(4) Soft key [FTP TRANS]
Displays the log related to FTP file transfer.

Error and message

Error No.	Log message	Description and necessary action
E-0118 E-0119	Error occurred while wait for FOCAS2 pdu	A communication error has occurred because of any of the following: The network quality has been lowered to such a level that data cannot be received from a PC at the other end. The communication channel has been logically shut down. Software running on a PC at the other end has logically shut down the communication channel. The Ethernet cable has been disconnected.
E-011A	All communication paths are busy	All the FOCAS2/Ethernet communication channels are busy.
E-0200	Received message from FTP server	A message sent by the FTP server is directly displayed.
E-0202	Connection failed with FTP server	Software of the FTP server may not be running. Start the software of the FTP server. Alternatively, the FTP server may not respond to the PING command to improve security (using firewall or the like). Set bit 1 of NC parameter No. 14880 to 1 and connect the FTP server again.
E-0207	The router is not found	The specified IP address of the router may be wrong. Alternatively, the router may be turned off. Check whether the IP address of the router has been correctly specified and whether the router is turned on.

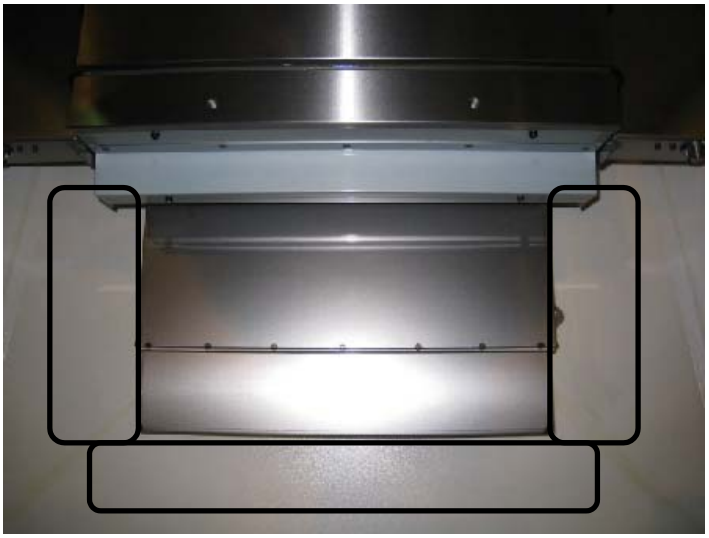
Error No.	Log message	Description and necessary action
E-0208	The FTP server is not found	The specified IP address of the FTP server may be wrong. Alternatively, the FTP server may be turned off. Check whether the IP address of the FTP server has been correctly specified and whether the FTP server is turned on. Alternatively, the FTP server may not respond to the PING command to improve security (using firewall or the like). Set bit 1 of NC parameter No. 14880 to 1 and connect the FTP server again.
E-020B	Cannot login into FTP server	Check whether a correct user name and password are specified when logging into the FTP server.
E-020C	The parameters of FTP server are wrong	Check whether a correct user name and password are specified when logging into the FTP server.
E-020D	Changing a work folder of host failed	Check the work folder logging into the FTP server.
E-041A	Frame transmission failed (TCP)	A communication error has occurred because of any of the following: ・ The network quality has been lowered to such a level that data cannot be received from a PC at the other end. ・ The communication channel has been logically shut down. ・ Software running on a PC at the other end has logically shut down the communication channel. ・ The Ethernet cable has been disconnected. ・ Data is not reached at the other end due to firewall or the like.
E-0901	Cannot read MAC address	The MAC address is not written in the hardware. Alternatively, the hardware has been damaged.
E-0A06	Network is too busy	An excessive amount of data is flowing over the network. One possible solution is to divide the network.
E-0B00	The own IP address is wrong	Specify a correct IP address in the designated format.
E-0B01	The own IP address is not set	Specify an IP address.
E-0B02	Subnet mask is wrong	Specify a correct subnet mask in the designated format.
E-0B03	Subnet mask is not set	Specify a subnet mask.
E-0B04	Router IP address is wrong	There may be class disagreement between the IP address of the local node and the IP address of the router.
E-0B05	IP address of DNS server is wrong	There may be class disagreement between the IP address of the local node and the IP address of the DNS server.
E-0B06	The own host name is wrong	Check whether a correct host name is specified.
E-0B07	The own domain name is wrong	Check whether a correct domain name is specified.
E-0B08	TCP port number is wrong	A value beyond the permissible setting range may be specified.
E-0B09	UDP port number is wrong	A value beyond the permissible setting range may be specified.

Error No.	Log message	Description and necessary action
E-0B0B	IP address of remote FTP server is wrong	Specify a correct IP address in the designated format.
E-0B0C	Port NO of a remote FTP server is wrong	A value beyond the permissible setting range may be specified.
E-0B0D	User name of remote FTP server is wrong	The specified user name may contain a prohibited character.
E-0B0E	Password of remote FTP server is wrong	The specified password may contain a prohibited character.
E-0B0F	Login folder of remote FTP srv is wrong	The specified log-in folder name may contain a prohibited character.
E-0B18	Cannot set because DHCP is available	To allow a set-up, disable the DHCP client function.
E-0B19 E-0B1A	Embedded Ethernet hardware isn't found	The software or hardware of embedded Ethernet function cannot be recognized. Check whether the software has been incorporated. Check whether the hardware is sound.
E-XXXX	(No message)	An internal error has occurred. Make a notification of the error number.

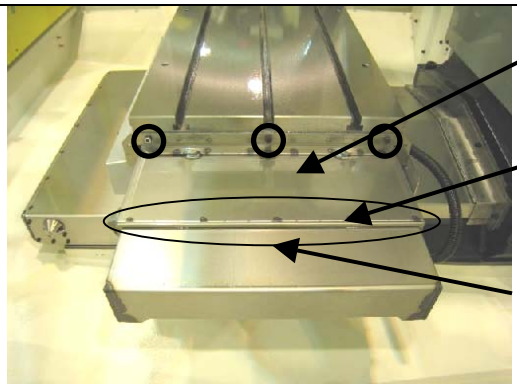
J NOTES ON SETUP

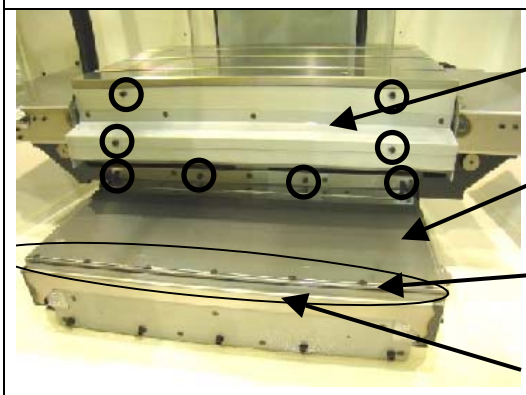
[Installation of jigs and peripheral units]

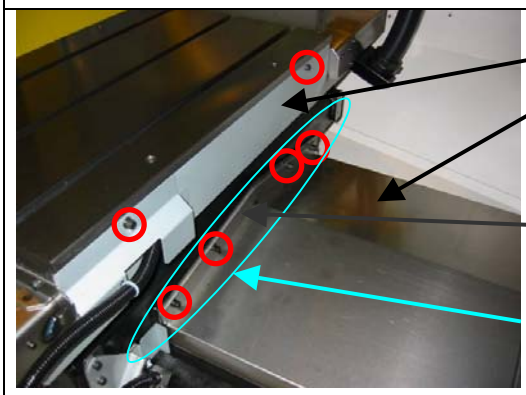
When installing jigs and peripheral units, keep the following in mind.

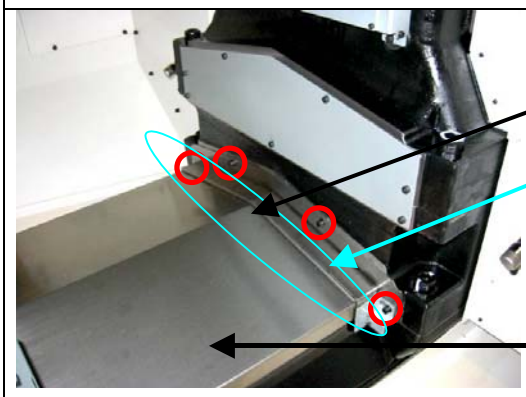
The front surface of the ceiling cover needs to be removed when the door roller or automatic door cylinder is maintained, so consideration must be given during installation of peripheral units so that the front surface can be easily removed. If a mounting bolt projects in the cover, it may interference with and break the internal door open/close mechanism.	
A jig or peripheral unit installed in the machine must not prevent coolant or chips from being discharged. If chips accumulate in the area shown in the figure, they are likely to enter the inside of the bed.	

1. The covers and mounting bolts in the figures need to be removed and attached during maintenance, so consideration must be given during installation of jigs or peripheral units so that the covers and mounting bolts can be easily removed.
2. Do not splash coolant over the edge of the cover shown in the figure directly from the coolant nozzle by aiming at it. A large amount of coolant may get into the drive section, leading to poor lubrication in the LM guides and ball screws, depending on the momentum of the splash. Exercise enough care not only when using the ROBODRILL genuine coolant nozzle but also when using a user-added one.









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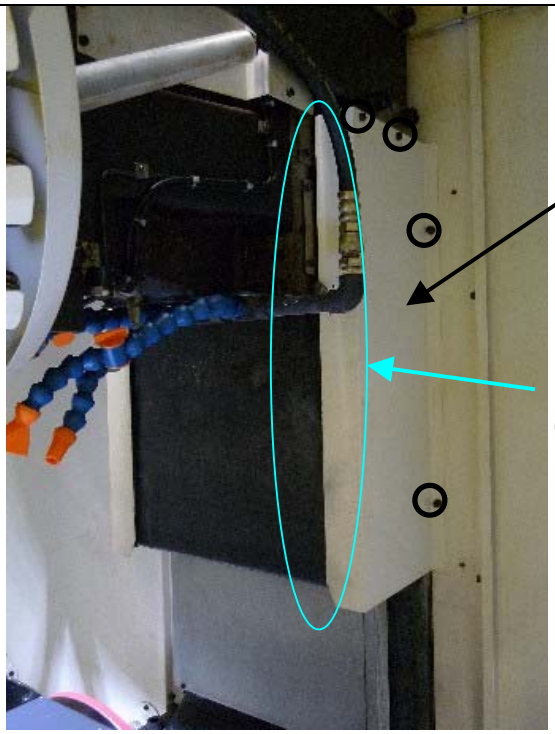
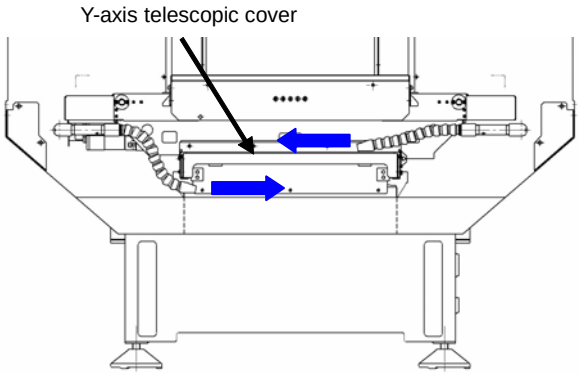
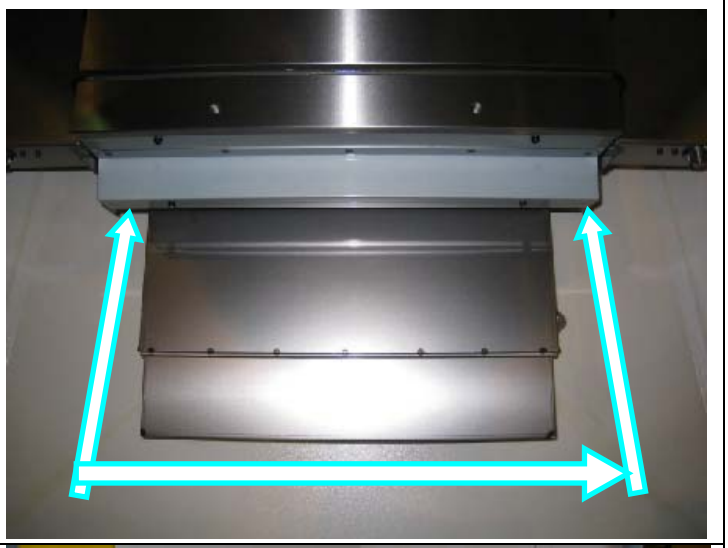


Be careful not to install a peripheral unit or mounting bolt in the area shown in the figure. Otherwise, the peripheral unit or mounting bolt may prevent the door from fully opening or may impact and break the door.

[Flow path of coolant in machine cleaning]

When installing the machine cleaning coolant, keep the following in mind.

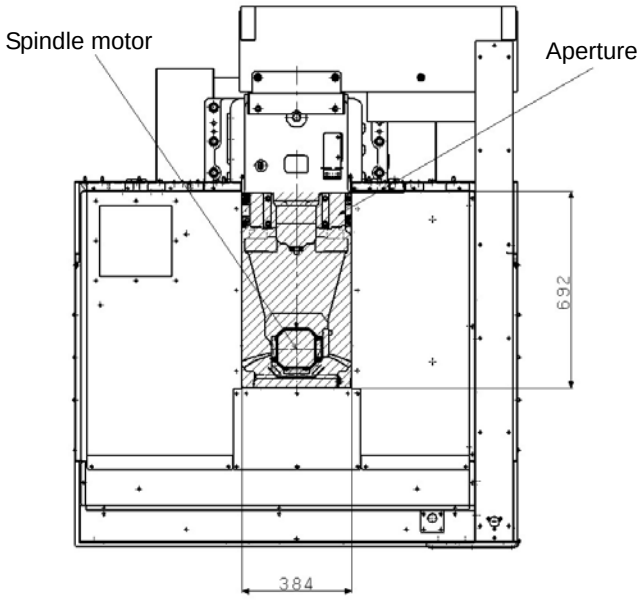
When installing the machine cleaning coolant, which is a FANUC option, adjust the nozzle so that coolant flows on and under the Y-axis telescopic cover, as indicated by the arrows in this figure, and prevent chips from accumulating under the Y-axis telescopic cover.	
When the customer installs the machine cleaning coolant, the nozzle position and valve need to be adjusted so that coolant flows as indicated by the arrows in the figure. Note that stagnation of coolant or an obstruction causes chips to accumulate.	
Be careful to prevent chips from accumulating inside the front door. If chips accumulate in this area, the door cannot be opened completely. Accordingly, flush the chips using the machine cleaning coolant or the like.	

[Installation of a ceiling cover]

When creating a ceiling cover, prevent a temperature rise in the machine as described below.
A significant temperature rise in the machine may cause a spindle malfunction.

- For an open ceiling cover
  For an open ceiling cover, set an aperture above the spindle motor as shown in the figure at right to prevent the coolant mist or hot exhaust of the spindle motor from filling inside the machine.
  Also install a mist collector or dust collector with the following capacity for each machine. At this time, be sure to use a special mist collector or dust collector for a machine that machines inflammable metal.
  Common to all spindle specifications: 7 m^3/min or more

- For an enclosed ceiling cover
  Be sure to install a mist collector or dust collector with the following capacity for each machine to prevent the coolant mist or hot exhaust of the spindle motor from filling inside the machine. At this time, use a special mist collector or dust collector for a machine that machines inflammable metal.
  Standard, high torque, or high acceleration spindle: 7 m^3/min or more
  High-speed spindle: 13 m^3/min or more



Remark: The upper limit of temperature in the machine is approximately the outside air temperature plus 5°C.

K DECLARATION OF CONFORMITY

DECLARATION OF CONFORMITY

Name of Company : FANUC CORPORATION

Address : 3580 Komanba,Shibokusa,Oshino-Mura
Minamitsuru-Gun Yamanashi Prefecture
401-0597 Japan

Type Designation : FANUC ROBODRILL α-D14S*i*A / D14M*i*A / D14L*i*A
: FANUC ROBODRILL α-D21S*i*A / D21M*i*A / D21L*i*A

Kind of product : MACHINING CENTER

The above product referred to in this declaration conforms with the following directives:

Machinery Directive : 2006/42/EC (Applied the following standards)

EN12100-1 and EN12100-2 (Type-A Norm,Safety of machinery)
EN60204-1:2006 (Type-B Norm,Electrical equipment of machines)
EN 12417-1:2001+A1:2006 (Type-C Norm,Machine tools-Safety-Machining centers)

EMC Directive : 2004/108/EC (Applied the following standards)

Emission) EN 50370-1:2005
EN55011:1998+A1+A2:2001(Group 1,ClassA)
Immunity) EN 50370-2:2003

Low Voltage Directive : 2006/95/EC (Applied the following standards)

EN60204-1:2006,applied as far as related to the safety Objectives of Annex I of the above directive.

Note :
This declaration becomes invalid if technical or operational modifications are Introduced without the manufacture's consent.

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