MITSUBISHI ELECTRIC

Changes for the Better

Numerical Control (CNC)

Connection and Setup Manual

M800S/M80/E80 Series

IB-1501269(ENG)-S

Introduction

This manual covers the items required for installing, connecting and setting up the Mitsubishi Electric CNC.
Supported models are as follows:

Supported models	Abbreviations in this manual
M800S Series	M850S, M830S
M80 Series	M80 TypeA, M80 TypeB
E80 Series	E80 TypeA, E80 TypeB

Abbreviations in this manual are as follows:

Abbreviations	Supported models
M800, M800 Series	M800S Series
M80, M80 Series	M80 Series
M800/M80, M800/M80 Series	M800S Series/M80 Series
M8, M8 Series	M800S Series/M80 Series/E80 Series

Read this manual thoroughly and understand the product's functions and performance before starting to use.
This manual is written on the assumption that all optional functions are added, but the actually delivered device may not have all functions.
The unit names, cable names and various specifications are subject to change without notice. Please confirm these before placing an order.
Be sure to keep this manual always at hand.

This manual notes a reference chapter as "Chapter: Section: Paragraph".
(Example) For "4.1.1 Environment Conditions inside the Control Panel" :
"General Specifications: Environment Conditions: Environment Conditions inside the Operation"
("4.1.1 Environment Conditions inside the Operation" included in "4.1 Environment Conditions" of "4 General Specifications")

Notes on Reading This Manual

(1) This book is configured as follows.
Refer to the following chapters as necessary.
Installation and connection: Chapter 1 to 15
Setup: Chapter 16 to 36
(2) This manual explains general parameters as viewed from the NC.
For information about each machine tool, refer to manuals issued from the machine tool builder.
If the descriptions relating to "restrictions" and "allowable conditions" conflict between this manual and the machine tool builder's instruction manual, the later has priority over the former.
(3) This manual is intended to contain as much descriptions as possible even about special operations.
The operations to which no reference is made in this manual should be considered "impossible".
(4) This manual is for the machine tool builders who set up the NC system.
(5) Do not connect to the pin described as "NC" on the pin assignment table of the connector.
(6) The characteristic values and numerical values without tolerances mentioned in this manual are representative values.

⚠ CAUTION

⚠ **For items described as "Restrictions" or "Usable State" in this manual, the instruction manual issued by the machine tool builder takes precedence over this manual.**

⚠ **Items that are not described in this manual must be interpreted as "not possible".**

⚠ **This manual is written on the assumption that all the applicable functions are included.**
Some of them, however, may not be available for your NC system.
Refer to the specifications issued by the machine tool builder before use.

⚠ **Refer to the Instruction Manual issued by each machine tool builder for details on each machine tool.**

⚠ **Some screens and functions may differ depending on each NC system (or version), and some functions may not be possible. Please confirm the specifications before starting to use.**

⚠ **Refer to "Smart safety observation" (BNP-C3072-022) for details about the connection with safety observing I/O device.**

⚠ **To protect the availability, integrity and confidentiality of the NC system against cyber-attacks including unauthorized access, denial-of-service (DoS) (*1) attack, and computer virus from external sources via a network, take security measures such as firewall, VPN, and anti-virus software.**
(*1) Denial-of-service (DoS) refers to a type of cyber-attack that disrupts services by overloading the system or by exploiting a vulnerability of the system.

⚠ **Mitsubishi Electric assumes no responsibility for any problems caused to the NC system by any type of cyber-attacks including DoS attack, unauthorized access and computer virus.**

The numerical control unit is configured of the control unit, display unit, operation board (operation panel I/O unit), servo drive unit, spindle drive unit, power supply unit + driver, servomotor, spindle motor, etc.

In this manual, the following items are generically called "controller".
- Control unit
- Display unit
- Operation board (operation panel I/O unit)
- Numerical control unit peripheral devices (input/output unit, safety unit)

In this manual, the following items are generically called "drive unit".
- Servo drive unit
- Spindle drive unit
- Power supply unit + driver

In this manual, the following items are generically called "motor".
- Servo motor
- Spindle motor

Also refer to the manuals on "Manual List" as necessary.

Manual List

Manuals related to M800/M80/E80/C80 Series are listed as follows.
These manuals are written on the assumption that all optional functions are added to the targeted model.
Some functions or screens may not be available depending on the machine or specifications set by MTB. (Confirm the specifications before use.)
The manuals issued by MTB take precedence over these manuals.

Manual	IB No.	Purpose and Contents
M800/M80/E80 Series Instruction Manual	IB-1501274	⬩ Operation guide for NC ⬩ Explanation for screen operation, etc.
C80 Series Instruction Manual	IB-1501453	⬩ Operation guide for NC ⬩ Explanation for screen operation, etc.
M800/M80/E80/C80 Series Programming Manual (Lathe System) (1/2)	IB-1501275	⬩ G code programming for lathe system ⬩ Basic functions, etc.
M800/M80/E80/C80 Series Programming Manual (Lathe System) (2/2)	IB-1501276	⬩ G code programming for lathe system ⬩ Functions for multi-part system, high-accuracy function, etc.
M800/M80/E80/C80 Series Programming Manual (Machining Center System) (1/2)	IB-1501277	⬩ G code programming for machining center system ⬩ Basic functions, etc.
M800/M80/E80/C80 Series Programming Manual (Machining Center System) (2/2)	IB-1501278	⬩ G code programming for machining center system ⬩ Functions for multi-part system, high-accuracy function, etc.
M800/M80/E80 Series Alarm/Parameter Manual	IB-1501279	⬩ Alarms ⬩ Parameters
C80 Series Alarm/Parameter Manual	IB-1501560	⬩ Alarms ⬩ Parameters

Manuals for MTBs (NC)

Manual	IB No.	Purpose and Contents
M800/M80/E80/C80 Series Specifications Manual (Function)	IB-1501505	• Model selection • Outline of various functions
M800/M80/E80/C80 Series Specifications Manual (Hardware)	IB-1501506	• Model selection • Specifications of hardware unit
M800W/M80W Series Connection and Setup Manual	IB-1501268	• Detailed specifications of hardware unit • Installation, connection, wiring, setup (startup/adjustment)
M800S/M80/E80 Series Connection and Setup Manual	IB-1501269	• Detailed specifications of hardware unit • Installation, connection, wiring, setup (startup/adjustment)
C80 Series Connection and Setup Manual	IB-1501452	• Detailed specifications of hardware unit • Installation, connection, wiring, setup (startup/adjustment)
M800/M80/E80 Series PLC Development Manual	IB-1501270	• Electrical design • I/O relation (assignment, setting, connection), field network • Development environment (PLC on-board, peripheral development environment), etc.
M800/M80/E80 Series PLC Programming Manual	IB-1501271	• Electrical design • Sequence programming • PLC support functions, etc.
M800/M80/E80/C80 Series PLC Interface Manual	IB-1501272	• Electrical design • Interface signals between NC and PLC
M800/M80/E80 Series Maintenance Manual	IB-1501273	• Cleaning and replacement for each unit • Other items related to maintenance
C80 Series Maintenance Manual	IB-1501454	• Cleaning and replacement for each unit • Other items related to maintenance

Manuals for MTBs (drive section)

Manual	IB No.	Contents
MDS-E/EH Series Specifications Manual	IB-1501226	• Specifications for power supply regeneration type
MDS-E/EH Series Instruction Manual	IB-1501229	• Instruction for power supply regeneration type
MDS-EJ/EJH Series Specifications Manual	IB-1501232	• Specifications for regenerative resistor type
MDS-EJ/EJH Series Instruction Manual	IB-1501235	• Instruction for regenerative resistor type
MDS-EM/EMH Series Specifications Manual	IB-1501238	• Specifications for multi-hybrid, power supply regeneration type
MDS-EM/EMH Series Instruction Manual	IB-1501241	• Instruction for multi-hybrid, power supply regeneration type
DATA BOOK	IB-1501252	• Specifications of servo drive unit, spindle drive unit, motor, etc.

Manuals for MTBs (Others)

Manual	No.	Purpose and Contents
GOT2000 Series User's Manual (Hardware)	SH-081194ENG	• Outline of hardware such as part names, external dimensions, installation, wiring, maintenance, etc. of GOTs
GOT2000 Series User's Manual (Utility)	SH-081195ENG	• Outline of utilities such as screen display setting, operation method, etc. of GOTs
GOT2000 Series User's Manual (Monitor)	SH-081196ENG	• Outline of each monitor function of GOTs
GOT2000 Series Connection Manual (Mitsubishi Electric Products)	SH-081197ENG	• Outline of connection types and connection method between GOT and Mitsubishi Electric connection devices
GT Designer3 (GOT2000) Screen Design Manual	SH-081220ENG	• Outline of screen design method using screen creation software GT Designer3

■ For M800/M80/E80 Series

Manual	No.	Purpose and Contents
GOT2000 Series Connection Manual (Non-Mitsubishi Electric Products 1)	SH-081198ENG	• Explanation for connection types and connection method between GOT and other company's devices
GOT2000 Series Connection Manual (Non-Mitsubishi Electric Products 2)	SH-081199ENG	
GOT2000 Series Connection Manual (Microcomputers, MODBUS/ Fieldbus Products, Peripherals)	SH-081200ENG	• Explanation for connection types and connection method between GOT and microcomputers, MODBUS/fieldbus products, peripherals
GT SoftGOT2000 Version1 Operating Manual	SH-081201ENG	• Explanation for system configuration, screen configuration and operation method of monitoring software GT SoftGOT2000
GOT2000/GOT1000 Series CC-Link Communication Unit User's Manual	IB-0800351	• Explanation for handling CC-Link communication unit (for GOT2000 series/GOT1000 series)
GX Developer Version 8 Operating Manual (Startup)	SH-080372E	• Explanation for system configuration, installation, etc. of PLC development tool GX Developer
GX Developer Version 8 Operating Manual	SH-080373E	• Explanation for operations using PLC development tool GX Developer
GX Converter Version 1 Operating Manual	IB-0800004	• Explanation for operations using data conversion tool GX Converter
GX Works2 Installation Instructions	BCN-P5999-0944	• Explanation for the operating environment and installation method of GX Works2
GX Works2 Version 1 Operating Manual (Common)	SH-080779ENG	• Explanation for the system configuration of GX Works2 and the functions common to Simple project and Structured project such as parameter setting, operation method for the online function
GX Works2 Version 1 Operating Manual (Simple Project)	SH-080780ENG	• Explanation for methods for such as creating and monitoring programs in Simple project of GX Works2
GX Works2 Version 1 Operating Manual (Simple Project, Function Block)	SH-080984ENG	• Explanation for methods for such as creating function blocks, pasting function blocks to sequence programs, and operating FB library in Simple project of GX Works2
GX Works2 Version 1 Operating Manual (Structured Project)	SH-080781ENG	• Explanation for methods for such as creating and monitoring programs in Structured project of GX Works2
GX Works3 Installation Instructions	BCN-P5999-0391	• Explanation for the operating environment and installation method of GX Works3
MELSEC-Q CC-Link System Master/ Local Module User's Manual	SH-080394E	• Explanation for system configuration, installation, wiring, etc. of master/local modules for CC-Link system

■ For C80 Series

Manual	No.	Purpose and Contents
MELSEC iQ-R Module Configuration Manual	SH-081262	• Outline of system configuration, specifications, installation, wiring, maintenance, etc.
MELSEC iQ-R CPU Module User's Manual (Startup)	SH-081263	• Outline of specifications, procedures before operation, troubleshooting, etc. for CPU module
MELSEC iQ-R CPU Module User's Manual (Application)	SH-081264	• Outline of memory, functions, devices, parameters, etc. for CPU module
MELSEC iQ-R CC-Link IE Field Network User's Manual (Application)	SH-081259	• Explanation for functions, parameter settings, programming, troubleshooting, etc. of the CC-Link IE Field Network function
QCPU User's Manual (Hardware Design, Maintenance and Inspection)	SH-080483	• Outline of specifications, necessary knowledge to configure the system and maintenance-related descriptions for Q series CPU module, etc.
GX Works3 Operating Manual	SH-081215	• Outline of functions, programming, etc.

Reference Manual for MTBs

Manual	No.	Purpose and Contents
M800/M80 Series Smart safety observation Specification manual	BNP-C3072-022	• Explanation for smart safety observation function
C80 Series Smart safety observation Specification manual	BNP-C3077-022	
M800/M80 Series Interactive cycle insertion (Customization) Specification manual	BNP-C3072-121-0003	• Explanation for interactive cycle insertion
M800/M80 Series Synchronous Control Specifications manual	BNP-C3072-074	• Explanation for synchronous control
M800/M80 Series Multiple-Axis Synchronization Control Specifications manual	BNP-C3072-339	• Explanation for multiple-axis synchronization control
M800/M80 Series GOT Connection Specifications manual	BNP-C3072-314	• Explanation for GOT connection
M800/M80 Series PROFIBUS-DP Specification manual	BNP-C3072-118	• Explanation for PROFIBUS-DP communication function
M800/M80 Series EtherNet/IP Specifications manual	BNP-C3072-263	• Explanation for EtherNet/IP
M800/M80 Series FL-net Specifications manual	BNP-C3072-368	• Explanation for FL-net
M800/M80 Series CC-Link (Master/Local) Specification manual	BNP-C3072-089	• Explanation for CC-Link
M800/M80 Series CC-Link IE Field (Master/local) Specifications manual	BNP-C3072-283	• Explanation for CC-Link IE Field
M800/M80 Series CC-Link IE Field Basic Specifications manual	BNP-C3072-337	• Explanation for CC-Link IE Field Basic

Precautions for Safety

Always read this manual and enclosed documents before installation, operation, maintenance and inspection to ensure correct usage. Thoroughly understand the basics, safety information and precautions of the devices before using.
This manual classifies the safety precautions into "DANGER", "WARNING" and "CAUTION".

⚠ **DANGER** **When the user could be subject to imminent fatalities or serious injuries if handling is mistaken.**
⚠ **WARNING** **When the user could be subject to fatalities or serious injuries if handling is mistaken.**
⚠ **CAUTION** **When the user could be subject to injuries or the property could be damaged if handling is mistaken.**

Note that the items under " ⚠ CAUTION" could lead to serious consequences as well depending on the situation. All the items are important and must always be observed.

The following signs indicate prohibition and compulsory.

	**This sign indicates prohibited behavior (must not do).** **For example,  indicates "Keep fire away".**
	**This sign indicated a thing that is pompously (must do).** **For example,  indicates "it must be grounded".**

The meaning of each pictorial sign is as follows.

 **CAUTION**	 **CAUTION rotated object**	 **CAUTION HOT**	 **Danger Electric shock risk**	 **Danger explosive**
 **Prohibited**	 **Disassembly is prohibited**	 **KEEP FIRE AWAY**	 **General instruction**	 **Earth ground**

For Safe Use

Mitsubishi CNC is designed and manufactured solely for applications to machine tools to be used for industrial purposes.
Do not use this product in any applications other than those specified above, especially those which are substantially influential on the public interest or which are expected to have significant influence on human lives or properties.

1. Items related to prevention of electric shocks

⚠ WARNING

⚠ **Do not open or remove the front cover while the power is ON or during operation. The high voltage terminals and charged sections will be exposed, and this could result in electric shocks.**

⚠ **Do not remove the front cover even when the power is OFF, except for the wiring works or periodic inspections. The inside of the controller and drive unit are charged, and this could result in electric shocks.**

⚠ **Always wait at least 15 minutes after turning the power OFF. Then, check the voltage with a tester, etc., before wiring works, inspections or connecting with peripheral devices. Failure to observe this could result in electric shocks.**

⚠ **Earth ground the controller, drive unit and motor according to the local laws. (In Japan, ground the 200V Series input products with Class C or higher protective grounding and the 400V Series input with Class D or higher protective grounding.)**

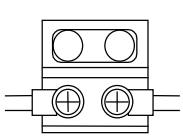
⚠ **All wiring works, maintenance and inspections must be carried out by a qualified technician. Failure to observe this could result in electric shocks. Contact your nearby Service Center for replacing parts and servicing.**

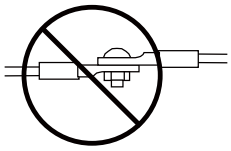
⚠ **Wire the controller, drive unit and motor after installation. Failure to observe this could result in electric shocks.**

⚠ **Do not operate the switches with wet hands. Failure to observe this could result in electric shocks.**

⚠ **Do not damage, apply excessive stress, place heavy things on or sandwich the cables. Failure to observe this could result in electric shocks.**

⚠ **Insulate the power lead using a fixed terminal block. Failure to observe this could result in electric shocks.**





⚠ **Completely turn off the all lines of the power supply externally before wiring.**
Not completely turning off all power could result in electric shock or damage to the product.

⚠ **When turning on the power supply or operating the module after wiring, be sure that the module's terminal covers are correctly attached.**
Not attaching the terminal cover could result in electric shock.

2. Items related to prevention of fire

⚠ CAUTION

- **Install the controller, drive unit, motor and regenerative resistor on non-combustible material. Installation directly on or near combustible materials could result in fires.**
- **If any malfunction in the unit is observed, shut off the power at the unit's power supply side. Continuous flow of large current could result in fires.**
- **Install an appropriate no fuse breaker (NFB) and contactor (MC) on the power input section of the drive unit and configure the sequence that shuts the power off upon drive unit's emergency stop or alarm.**
- **When a breaker is shared for multiple power supply units, the breaker may not function upon short-circuit failure in a small capacity unit. Do not share a breaker for multiple units as this is dangerous.**
- **Incorrect wiring and connections could cause the devices to damage or burn.**

3. Items related to prevention of bodily injury or property damage

⚠ DANGER

- **When transporting or installing a built-in IPM spindle or linear servomotor, be careful so that your hand or property will not be trapped in the motors or other metal objects. Also keep the devices with low magnetic tolerance away from the product.**

⚠ CAUTION

- **Do not apply voltages to the connectors or terminals other than voltages indicated in the connection and setup manual for the controller or specifications manual for the drive unit. Failure to observe this could cause bursting, damage, etc.**
- **Incorrect connections could cause the devices to rupture or damage, etc. Always connect the cables to the indicated connectors or terminals.**
- **Incorrect polarity (+ -) could cause the devices to rupture or damage, etc.**
- **Persons wearing medical devices, such as pacemakers, must stay away from this unit. The electromagnetic waves could adversely affect the medical devices.**
- **Fins on the rear of the unit, regenerative resistor and motor, etc., will be hot during operation and for a while after the power has been turned OFF. Do not touch or place the parts and cables, etc. close to these sections. Failure to observe this could result in burns.**
- **Do not enter the machine's movable range during automatic operation. Keep your hands, feet or face away from the spindle during rotation.**

4. General precautions

Always follow the precautions below. Incorrect handling could result in faults, injuries or electric shocks, etc.

(1) Items related to product and manual

⚠ CAUTION

⚠ For items described as "Restrictions" or "Usable State" in this manual, the instruction manual issued by the machine tool builder takes precedence over this manual.

⚠ Items that are not described in this manual must be interpreted as "not possible".

⚠ This manual is written on the assumption that all the applicable functions are included.
Some of them, however, may not be available for your NC system.
Refer to the specifications issued by the machine tool builder before use.

⚠ Refer to the Instruction Manual issued by each machine tool builder for details on each machine tool.

⚠ Some screens and functions may differ depending on each NC system (or version), and some functions may not be possible. Please confirm the specifications before starting to use.

⚠ Refer to "Smart safety observation" (BNP-C3072-022) for details about the connection with safety observing I/O device.

⚠ To protect the availability, integrity and confidentiality of the NC system against cyber-attacks including unauthorized access, denial-of-service (DoS) (*1) attack, and computer virus from external sources via a network, take security measures such as firewall, VPN, and anti-virus software.
(*1) Denial-of-service (DoS) refers to a type of cyber-attack that disrupts services by overloading the system or by exploiting a vulnerability of the system.

⚠ Mitsubishi Electric assumes no responsibility for any problems caused to the NC system by any type of cyber-attacks including DoS attack, unauthorized access and computer virus.

(2) Transportation and installation

⚠ CAUTION

⚠ Correctly transport the products according to the mass.

⃠ Use motor's suspension bolts to transport the motor itself. Do not use it to transport the motor after installation onto the machine.

⚠ Do not stack the products exceeding the indicated limit.

⚠ Do not hold the cables, shaft or encoder when transporting the motor.

⚠ Do not transport the controller or drive unit by suspending or holding the connected wires or cables.

⚠ Do not hold the front cover when transporting the unit, or the front cover could come off, causing the unit to drop.

⚠ Install on a non-combustible place where the unit's or motor's mass can be withstood according to the instruction manual.

⚠ The motor does not have a complete water-proof (oil-proof) structure. Do not allow oil or water to contact or enter the motor. Prevent the cutting chips from being accumulated on the motor as they easily soak up oil.

⚠ When installing the motor facing upwards, take measures on the machine side so that gear oil, etc., will not enter the motor shaft.

⚠ Do not remove the encoder from the motor. (The encoder installation screw is treated with sealing.)

⚠ Do not allow foreign matters, especially, conductive foreign matters such as screws or metal chips, or combustible foreign matters such as oil, to enter the controller, drive unit or motor. Failure to observe this could result in rupture or damage.

⚠ Do not get on the product or place heavy objects on it.

⚠ Provide prescribed distance between the controller/drive unit and inner surface of the control panel/other devices.

⚠ Do not install or operate the controller, drive unit or motor that is damaged or has missing parts.

⚠ CAUTION

⚠ **Take care not to cut hands, etc. with the heat radiating fins or metal edges.**

⚠ **Do not block the intake/outtake ports of the motor with the cooling fan.**

⚠ **Install the controller's display section and operation board section on the spot where cutting oil will not reach.**

⚠ **The controller, drive unit and motor are precision devices, so do not drop or apply thumping vibration and strong impacts on them.**

⚠ **The controller and drive unit are precision devices, so do not drop or apply strong impacts on them.**

⚠ **Store and use the units according to the environment conditions indicated in each specifications manual.**

⚠ **When disinfectants or insecticides must be used to treat wood packaging materials, always use methods other than fumigation (for example, apply heat treatment at the minimum wood core temperature of 56 °C for a minimum duration of 30 minutes (ISPM No. 15 (2009))).**

If products such as units are directly fumigated or packed with fumigated wooden materials, halogen substances (including fluorine, chlorine, bromine and iodine) contained in fumes may contribute to the erosion of the capacitors.
When exporting the products, make sure to comply with the laws and regulations of each country.

⚠ **Do not use the products in conjunction with any components that contain halogenated flame retardants (bromine, etc). Failure to observe this may cause the erosion of the capacitors.**

⚠ **Securely fix the motor to the machine. The motor could come off during operation if insecurely fixed.**

⚠ **Always install the motor with reduction gear in the designated direction. Failure to observe this could result in oil leaks.**

⚠ **Always install a cover, etc., over the shaft so that the rotary section of the motor cannot be touched during motor rotation.**

⚠ **When installing a coupling to the servomotor shaft end, do not apply impacts by hammering, etc. The encoder could be damaged.**

⚠ **Use a flexible coupling when connecting with a ball screw, etc., and keep the shaft core deviation smaller than the tolerable radial load of the shaft.**

⚠ **Do not use a rigid coupling as an excessive bending load will be applied on the shaft and could cause the shaft to break.**

⚠ **Do not apply a load exceeding the tolerable level onto the motor shaft. The shaft or bearing could be damaged.**

❗ **Before using this product after a long period of storage, please contact the Service Center.**

⚠ **Following the UN recommendations, battery units and batteries should be transported based on the international regulations such as those determined by International Civil Aviation Organization (ICAO), International Air Transport Association (IATA), International Maritime Organization (IMO) and U.S. Department of Transportation (DOT).**

(3) Items related to wiring

⚠ CAUTION

⚠ **Correctly wire this product. Failure to observe this could result in motor runaway, etc.**

⚠ **Incorrect terminal connections could cause the devices to rupture or damage, etc.**

⚠ **Do not install a phase advancing capacitor, surge absorber or radio noise filter on the output side of the drive unit.**

⚠ **Correctly connect the output side (terminal U, V, W). The motor will not run properly if incorrectly connected.**

⚠ **Always install an AC reactor per each power supply unit.**

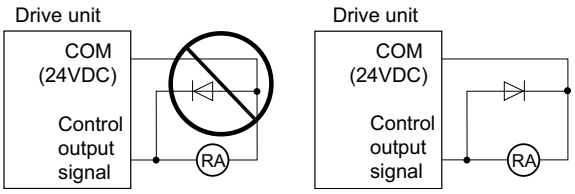
⚠ **Always install an appropriate breaker per each power supply unit. A breaker cannot be shared for multiple power supply units.**

⚠ **Do not directly connect a commercial power supply to the motor. Failure to observe this could result in faults.**

❗ **When using an inductive load such as relays, always connect a diode in parallel to the load as a noise countermeasure.**

❗ **When using a capacitive load such as a lamp, always connect a protective resistor serially to the load to suppress rush currents.**

⚠ **Do not mistake the direction of the surge absorption diode to be installed on the DC relay for the control output signal. If mistaken, the signal will not be output due to fault in the drive unit, and consequently the protective circuit, such as emergency stop, could be disabled.**



🚫 **Do not connect or disconnect the cables between units while the power is ON.**

⚠ **Do not connect or disconnect the PCBs while the power is ON.**

⚠ **Do not pull the cables when connecting/disconnecting them.**

⚠ **Securely tighten the cable connector fixing screw or fixing mechanism. The motor could come off during operation if insecurely fixed.**

⏚ **Always treat the shield cables indicated in the Connection Manual with grounding measures such as cable clamps.**

⚠ CAUTION

⚠ **Separate the signal wire from the drive line or power line when wiring.**

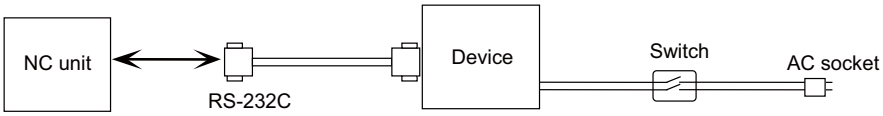
⚠ **Carry out wiring so that there is no possibility of short circuit between wires, nor of dangerous state.**

⚠ **Use wires and cables whose wire diameter, heat resistance level and bending capacity are compatible with the system.**

Ground the device according to the requirements of the country where the device is to be used.

⚠ **Wire the heat radiating fins and wires so that they do not contact.**

⚠ **When using the RS-232C device as a peripheral device, caution must be paid for connector connection/ disconnection. Always use a double-OFF type AC power supply switch on the device side, and connect/ disconnect the connector with the AC power supply on the device side OFF.**



⚠ **Using a stabilized power supply without overcurrent protection may cause the unit's failure due to miswiring of 24V.**

⚠ **12V, 5V, and 3.3V output from connectors are to supply the power for dedicated peripheral devices. Do not use for other equipment to supply the power since we do not guarantee the NC operation by voltage down or noise sneaking.**

When using an inductive load such as a relay, always connect a diode in parallel to the load to prevent a counter-electromotive force.

When the rush current exceeds the maximum output current, always connect a protective resistor serially to the load to suppress rush currents.

⚠ **The wires from the surge absorber should be connected without extensions.**

(4) Set up

⚠ WARNING

Do not cancel the emergency stop before confirming the basic operation.

Always set the stroke end and stored stroke limit. Failure to set this could result in collision with the machine end.

⚠ CAUTION

If the descriptions relating to the "restrictions" and "allowable conditions" conflict between this manual and the machine tool builder's instruction manual. the latter has priority over the former.

The operations to which no reference is made in this manual should be considered "impossible".

**This manual is written on the assumption that all the applicable functions are included.
Some of them, however, may not be available for your NC system.
Refer to the specifications issued by the machine tool builder before use.**

Some screens and functions may differ depending on each NC system (or version), and some functions may not be possible. Please confirm the specifications before starting to use.

If the battery low warning is issued, save the machining programs, tool data and parameters in an input/ output device, and then replace the battery. When the battery alarm is issued, the machining programs, tool data and parameters may have been destroyed. Replace the battery and then reload the data.

Do not adjust the spindle when possible risks associated with adjustment procedures are not thoroughly taken into consideration.

Be careful when touching spindle's rotating section, or your hand may be caught in or cut.

(5) Operation and Adjustments

⚠ CAUTION

If the operation start position is set in a block which is in the middle of the program and the program is started, the program before the set block is not executed. Please confirm that G and F modal and coordinate values are appropriate. If there are coordinate system shift commands or M, S, T and B commands before the block set as the start position, carry out the required commands using the MDI, etc. If the program is run from the set block without carrying out these operations, there is a danger of interference with the machine or of machine operation at an unexpected speed, which may result in breakage of tools or machine tool or may cause damage to the operators.

Under the constant surface speed control (during G96 modal), if the axis targeted for the constant surface speed control moves toward the spindle center, the spindle rotation speed will increase and may exceed the allowable speed of the workpiece or chuck, etc. In this case, the workpiece, etc. may jump out during machining, which may result in breakage of tools or machine tool or may cause damage to the operators.

Check and adjust programs and each parameter before starting operation. Failure to observe this could result in unpredictable operations depending on the machine.

Do not make drastic adjustments or changes in the parameters as the operation could become unstable.

In the explanation on bits, set all bits not used, including blank bits, to "0".

(6) Usage

⚠ CAUTION

⚠ **Use this product within the range of environmental condition described in this manual. Using this product in an environment outside the range could result in electric shock, fire, operation failure, or damage to or deterioration of the product.**

❗ **Install an external emergency stop circuit so that the operation can be stopped and the power turns OFF immediately when unforeseen situation occurs. A contactor, etc., is required in addition to the shutoff function mounted in the controller.**

⚠ **Turn OFF the power immediately if any smoke, abnormal noise or odor is generated from the controller, drive unit or motor.**

🚫 **Only a qualified technician may disassemble or repair this product.**

⚠ **Do not alter.**

⚠ **Use a noise filter, etc. to reduce the effect of electromagnetic disturbances in the case where electromagnetic disturbances could adversely affect the electronic devices used near the drive unit.**

⚠ **Use the drive unit, motor and each regenerative resistor with the designated combination. Failure to observe this could result in fires or faults.**

⚠ **The combination of the motor and drive unit that can be used is determined. Be sure to check the models of motor and drive unit before test operation.**

🚫 **The brakes (electromagnetic brakes) mounted in the servomotor are used for the purpose of holding, and must not be used for normal braking. Also, do not run the motor with the motor brake applied. Motor brake is used for the purpose of holding.**

⚠ **For the system running via a timing belt, install a brake on the machine side so that safety can be ensured.**

⚠ **Be sure to confirm SERVO OFF (or READY OFF) when applying the electromagnetic brake. Also, be sure to confirm SERVO ON prior to releasing the brake.**

❗ **When using the DC OFF type electromagnetic brake, be sure to install a surge absorber on the brake terminal.**

🚫 **Do not connect or disconnect the cannon plug while the electromagnetic brake's power is ON. The cannon plug pins could be damaged by sparks.**

⚠ **After changing programs/parameters, or after maintenance/inspection, always carry out a test operation before starting actual operation.**

⚠ **Use the power that are complied with the power specification conditions (input voltage, input frequency, tolerable time for instantaneous power interruption) indicated in each specifications manual.**

⚠ **When making encoder cables, do not mistake connection. Failure to observe this could result in malfunction, runaway or fire.**

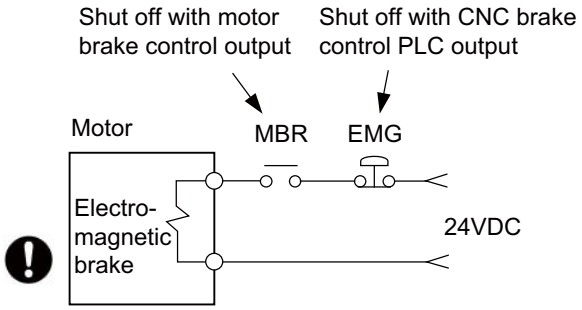
⚠ **Surge absorber to be selected varies depending on input power voltage.**

(7) Troubleshooting

⚠ CAUTION

⚠ **Use a motor with electromagnetic brakes or establish an external brake mechanism for the purpose of holding; this serves as countermeasures for possible hazardous situation caused by power failure or product fault.**

⚠ **Use a double circuit structure for the electromagnetic brake's operation circuit so that the brakes will activate even when the external emergency stop signal is issued.**



⚠ **The machine could suddenly restart when the power is restored after an instantaneous power failure, so stay away from the machine. (Design the machine so that the operator safety can be ensured even if the machine restarts.)**

⚠ **To secure the absolute position, do not shut off the servo drive unit's control power supply when its battery voltage drops (warning 9F) in the servo drive unit side.**

If the battery voltage drop warning alarm occurs in the controller side, make sure to back up the machining programs, tool data and parameters, etc. with the input/output device before replacing the battery. Depending on the level of voltage drop, memory loss could have happened. In that case, reload all the data backed up before the alarm occurrence.

(8) Maintenance, inspection and part replacement

⚠ CAUTION

⚠ **Periodically back up the programs, tool data and parameters to avoid potential data loss. Also, back up those data before maintenance and inspections.**

When replacing the battery on the controller side, the machining programs, tool data and parameters should be backed up with the input/output device beforehand. In case the memory is damaged in replacing the batteries, reload all the data backed up before replacing the battery.

⚠ **The electrolytic capacitor's capacity will drop due to deterioration. To prevent secondary damage due to capacitor's faults, Mitsubishi recommends the electrolytic capacitor to be replaced approx. every five years even when used in a normal environment. Contact the Service Center for replacements.**

⚠ **Do not perform a megger test (insulation resistance measurement) during inspection.**

⚠ **Do not replace parts or devices while the power is ON.**

⚠ **Do not short-circuit, charge, overheat, incinerate or disassemble the battery.**

⚠ **There may be a unit filled with substitute Freon in the heat radiating fins of the 37kW or smaller unit. Be careful not to break the heat radiating fins during maintenance or replacement.**

(9) Disposal

⚠ CAUTION

⚠ **Take the batteries and backlights for LCD, etc., off from the controller, drive unit and motor, and dispose of them as general industrial wastes.**

Do not alter or disassemble controller, drive unit, or motor.

⚠ **Collect and dispose of the spent batteries and the backlights for LCD according to the local laws.**

(10) General precautions

To explain the details, drawings given in the instruction manual, etc., may show the unit with the cover or safety partition removed. When operating the product, always place the cover or partitions back to their original position, and operate as indicated in the instruction manual, etc.

Treatment of waste

The following two laws will apply when disposing of this product. Considerations must be made to each law. The following laws are in effect in Japan. Thus, when using this product overseas, the local laws will have a priority. If necessary, indicate or notify these laws to the final user of the product.

(1) Requirements for "Law for Promotion of Effective Utilization of Resources"
   (a) Recycle as much of this product as possible when finished with use.
   (b) When recycling, often parts are sorted into steel scraps and electric parts, etc., and sold to scrap contractors. Mitsubishi Electric recommends sorting the product and selling the members to appropriate contractors.

(2) Requirements for "Law for Treatment of Waste and Cleaning"
   (a) Mitsubishi Electric recommends recycling and selling the product when no longer needed according to item (1) above. The user should make an effort to reduce waste in this manner.
   (b) When disposing a product that cannot be resold, it shall be treated as a waste product.
   (c) The treatment of industrial waste must be commissioned to a licensed industrial waste treatment contractor, and appropriate measures, including a manifest control, must be taken.
   (d) Batteries correspond to "primary batteries", and must be disposed of according to local disposal laws.

Disposal



(Note) This symbol mark is for EU countries only.
This symbol mark is according to the directive 2006/66/EC Article 20 Information for end-users and Annex II.

Your MITSUBISHI ELECTRIC product is designed and manufactured with high quality materials and components which can be recycled and/or reused.
This symbol means that batteries and accumulators, at their end-of-life, should be disposed of separately from your household waste.
If a chemical symbol is printed beneath the symbol shown above, this chemical symbol means that the battery or accumulator contains a heavy metal at a certain concentration. This will be indicated as follows:
Hg: mercury (0.0005%), Cd: cadmium (0.002%), Pb: lead (0.004%)
In the European Union there are separate collection systems for used batteries and accumulators.
Please, dispose of batteries and accumulators correctly at your local community waste collection/recycling centre.

Please, help us to conserve the environment we live in!

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Handling of our product

(English)
This is a class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

본 제품의 취급에 대해서

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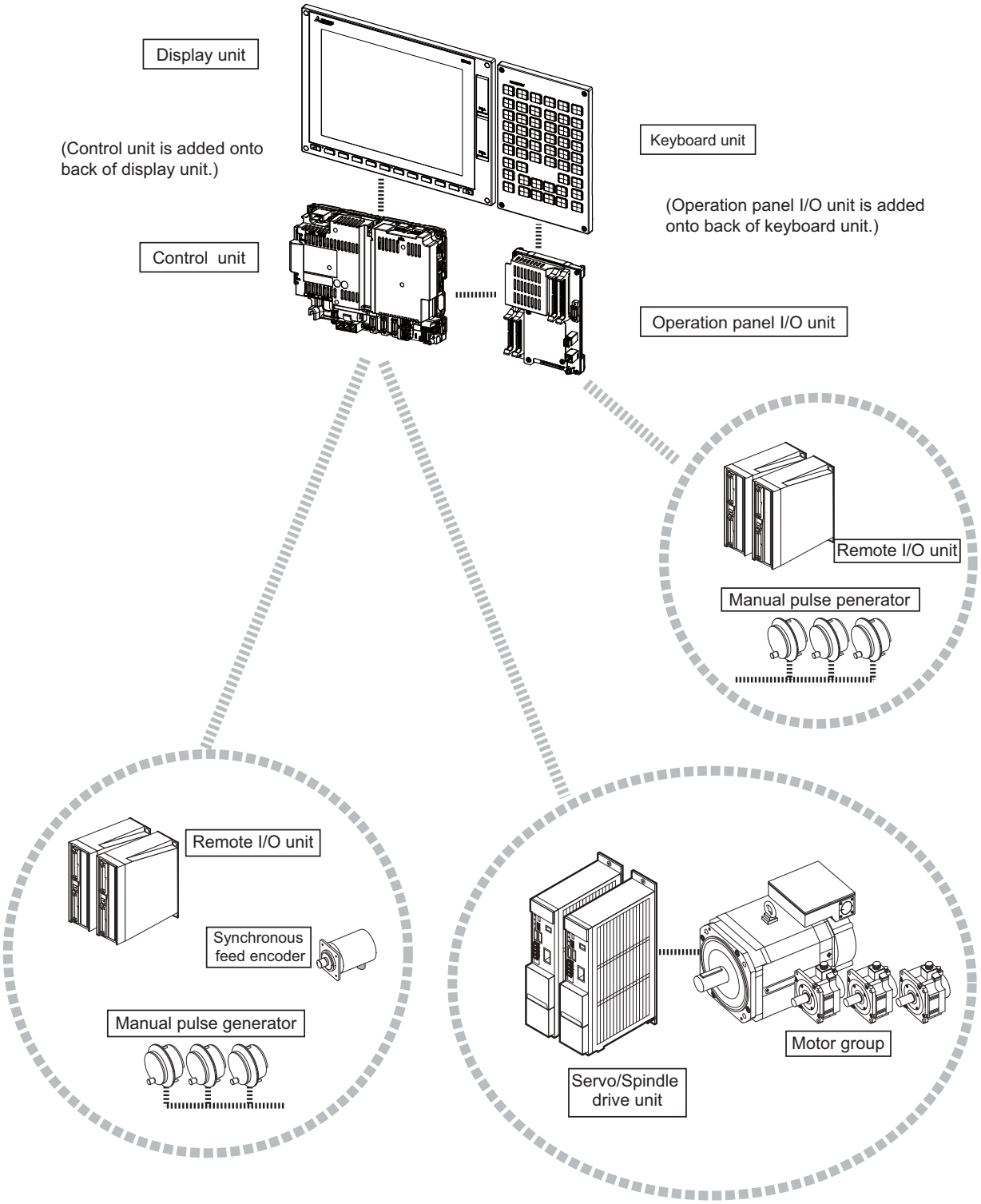
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1

System Basic Configuration

1.1 System Basic Configuration Drawing



(Note) For the drive unit configuration, refer to the Instruction Manual of the drive unit you use.

2

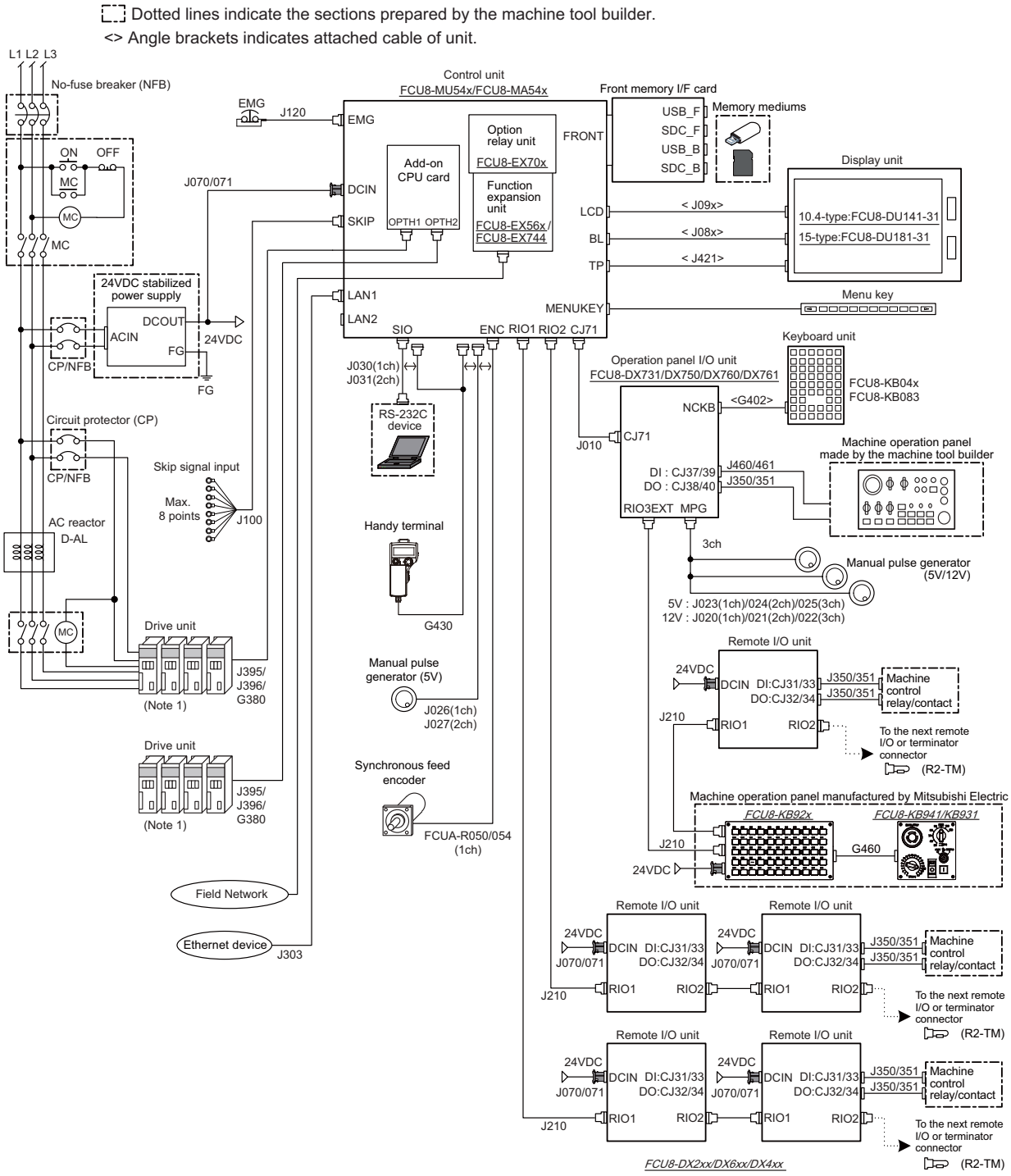
General Connection Diagram

Typical general connection diagrams for respective models are described.
Refer to the following chapters for parts where the connection differs depending on the unit configuration.

2.4 Difference in Connection Depending on the Display Unit
2.5 Connecting an Operation Panel I/O Unit (FCU8-DX834)
2.6 Connecting a Pulse-controlled Inverter [M80/E80]
2.7 Connecting a BiSS Encoder
2.8 Connecting an EcoMonitorLight

2.1 General Connection Diagram [M800S]

When the display unit is FCU8-DU142-31/FCU8-DU182-31, refer to "2.4 Difference in Connection Depending on the Display Unit" for connection of the display unit.



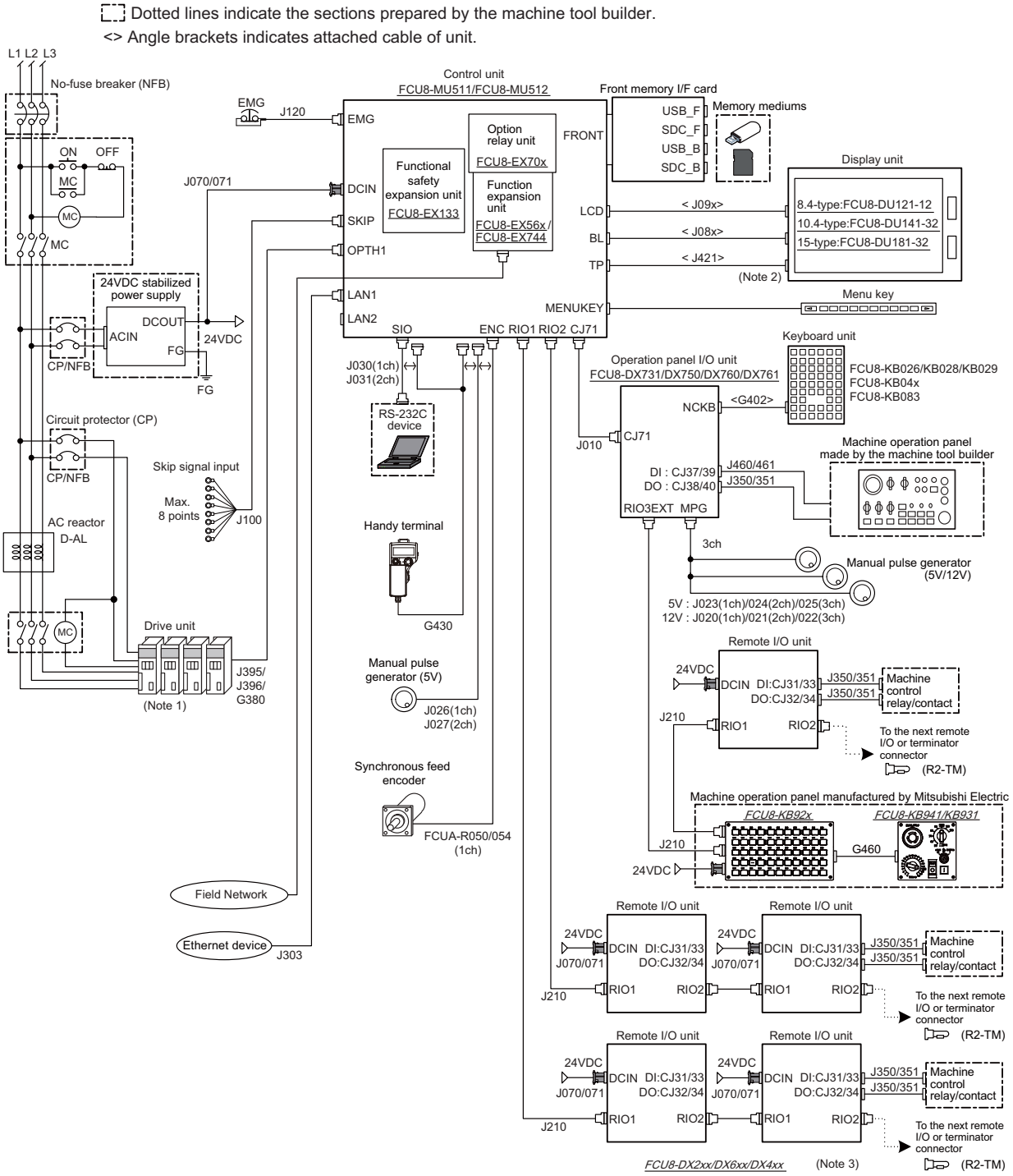
(Note 1) For information on how to connect the drive unit, refer to the drive unit's manual.

(Note 2) For details on connecting to the machine operation panel manufactured by Mitsubishi Electric, refer to the chapter "Connection of Machine Operation Panel".

2.2 General Connection Diagram [M80]

When the display unit is FCU8-DU142-32/FCU8-DU182-32, refer to "2.4 Difference in Connection Depending on the Display Unit" for connection of the display unit.

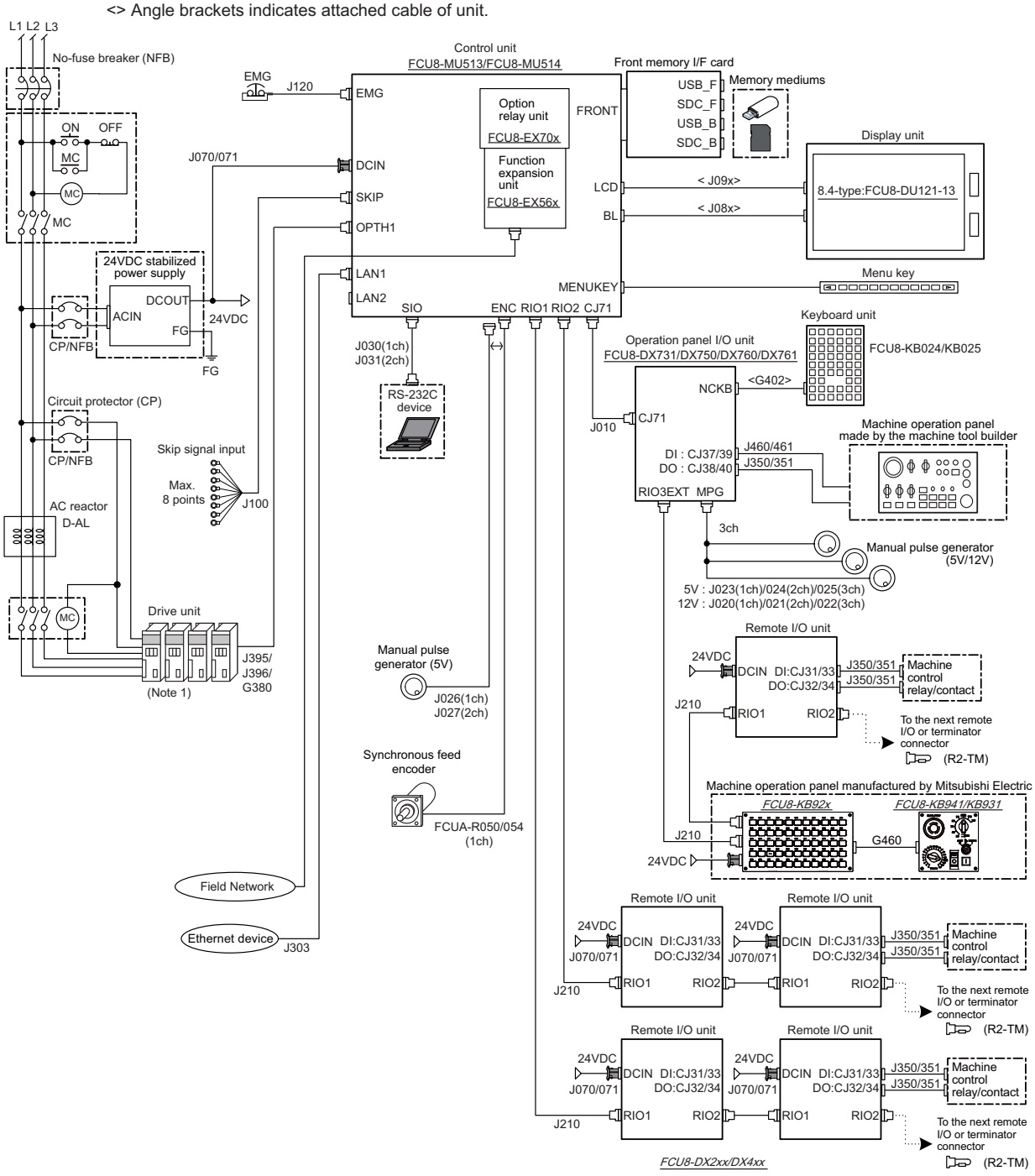
The general connection diagram with smart safety observation function is as below.
Without smart safety observation function, functional safety expansion unit is not installed in the control unit.



(Note 1) For information on how to connect the drive unit, refer to the drive unit's manual.
(Note 2) For the 8.4-type display unit, TP connector is not used.
(Note 3) The safety remote I/O unit is available only when the functional safety expansion unit is mounted.
(Note 4) For details on connecting to the machine operation panel manufactured by Mitsubishi Electric, refer to the chapter "Connection of Machine Operation Panel".

2.3 General Connection Diagram [E80]

Dotted lines indicate the sections prepared by the machine tool builder.
<> Angle brackets indicates attached cable of unit.



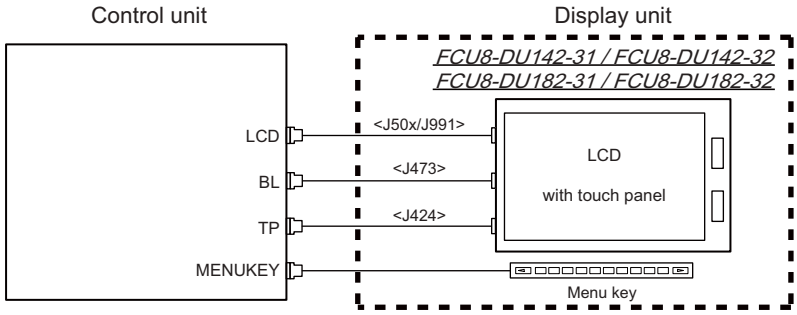
(Note 1) For information on how to connect the drive unit, refer to the drive unit's manual.

(Note 2) For details on connecting to the machine operation panel manufactured by Mitsubishi Electric, refer to the chapter "Connection of Machine Operation Panel".

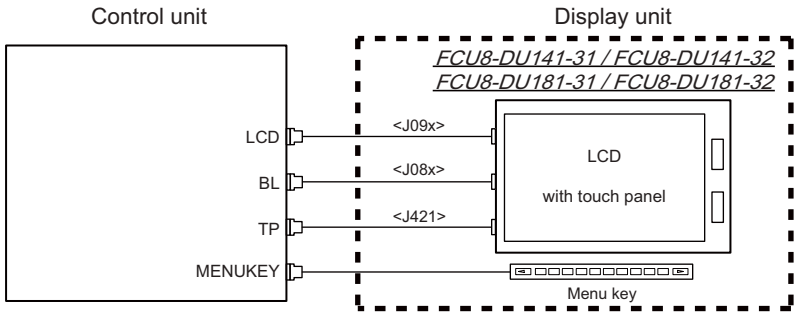
2.4 Difference in Connection Depending on the Display Unit

Cables are different depending on the display unit.
The parts surrounded by the dotted lines in the figures below are different.

[FCU8-DU142-31 / FCU8-DU142-32 / FCU8-DU182-31 / FCU8-DU182-32]



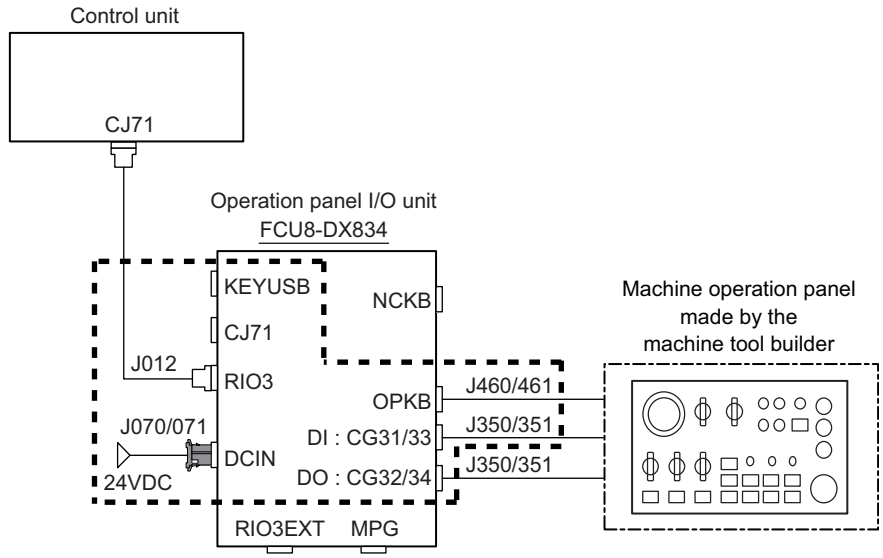
[FCU8-DU141-31 / FCU8-DU141-32 / FCU8-DU181-31 / FCU8-DU181-32]



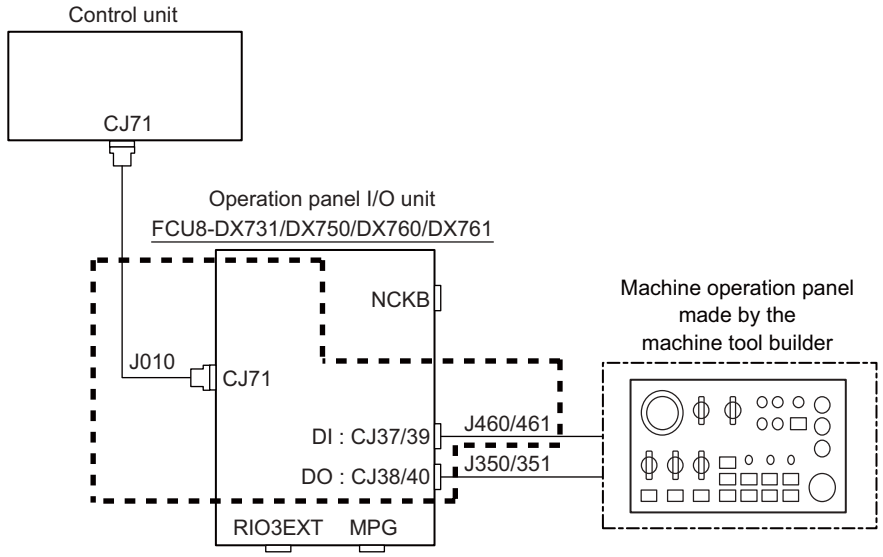
2.5 Connecting an Operation Panel I/O Unit (FCU8-DX834)

Dotted lines indicate the sections which is different from the FCU8-DX731/DX750/DX760/DX761 in FCU8-DX834.

[FCU8-DX834]

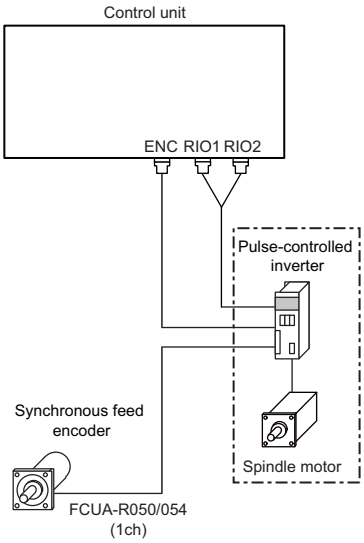


[FCU8-DX731 / FCU8-DX750 / FCU8-DX760 / FCU8-DX761]



2.6 Connecting a Pulse-controlled Inverter [M80/E80]

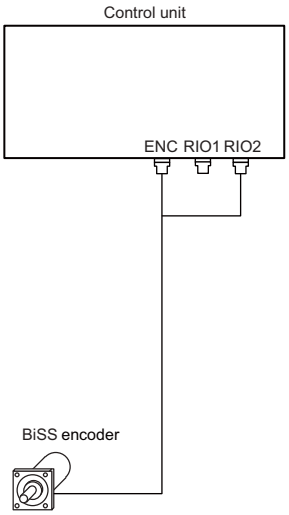
Pulse-controlled inverter refers to an inverter capable of controlling spindle operation through pulse train input.



(Note) When the pulse-controlled inverter is connected, the remote I/O unit cannot be connected to the either of the RIO1 connector or the RIO2 connector.

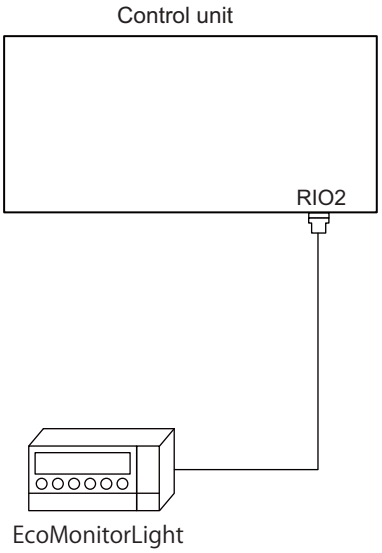
2.7 Connecting a BiSS Encoder

BiSS encoder refers to an encoder compatible with BiSS-C.
Connect the BiSS encoder to the ENC connector and the RIO2 connector of the control unit.



2.8 Connecting an EcoMonitorLight

Connect the EcoMonitorLight to RIO2 of the control unit.



3

List of Configuration

3.1 Control Unit [M800S]

Classification	Type	Components	Remarks
NC functions and display controller For M830S	FCU8-MU542	Base control card Add-on CPU card Front-side memory I/F card	This unit is not compliant with both Export Trade Control Order and Foreign Exchange Order.
NC functions and display controller For M850S	FCU8-MA542	Base control card Add-on CPU card Front-side memory I/F card	This unit is not compliant with Export Trade Control Order, and it is compliant with Foreign Exchange Order.
NC functions and display controller For M830S	FCU8-MU541	Base control card Add-on CPU card Front-side memory I/F card	This unit is not compliant with both Export Trade Control Order and Foreign Exchange Order.
NC functions and display controller For M850S	FCU8-MA541	Base control card Add-on CPU card Front-side memory I/F card	This unit is not compliant with Export Trade Control Order, and it is compliant with Foreign Exchange Order.

3.2 Control Unit [M80]

Classification	Type	Components	Remarks
NC functions and display controller For M80 TypeB	FCU8-MU511	Base control card Front-side memory I/F card	This unit is not compliant with both Export Trade Control Order and Foreign Exchange Order.
NC functions and display controller For M80 TypeA	FCU8-MU512	Base control card Front-side memory I/F card	This unit is not compliant with both Export Trade Control Order and Foreign Exchange Order.
NC functions and display controller For M80 TypeB	FCU8-MU501	Base control card Front-side memory I/F card	This unit is not compliant with both Export Trade Control Order and Foreign Exchange Order.
NC functions and display controller For M80 TypeA	FCU8-MU502	Base control card Front-side memory I/F card	This unit is not compliant with both Export Trade Control Order and Foreign Exchange Order.

3.3 Control Unit [E80]

Classification	Type	Components	Remarks
NC functions and display controller For E80 TypeB	FCU8-MU513	Base control card Front-side memory I/F card	This unit is not compliant with both Export Trade Control Order and Foreign Exchange Order.
NC functions and display controller For E80 TypeA	FCU8-MU514	Base control card Front-side memory I/F card	This unit is not compliant with both Export Trade Control Order and Foreign Exchange Order.

3.4 Display Unit [M800S]

Classification	Type	Components	Remarks
10.4-type color TFT touch panel (VGA:640*480)	FCU8-DU142-31 / FCU8-DU141-31	LCD panel Menu keys Escutcheon Base metal plate Cable Screw cap set	Front side memory I/F is normally equipped with the control unit
15-type color TFT touch panel (XGA:1024*768)	FCU8-DU182-31 / FCU8-DU181-31	LCD panel Menu keys Escutcheon Base metal plate Cable Screw cap set	Front side memory I/F is normally equipped with the control unit

3.5 Display Unit [M80]

Classification	Type	Components	Remarks
8.4-type color TFT (VGA:640*480)	FCU8-DU121-12	LCD panel Menu keys Escutcheon Base metal plate Cable Screw cap set	Front side memory I/F is normally equipped with the control unit
10.4-type color TFT touch panel (VGA:640*480)	FCU8-DU142-32 / FCU8-DU141-32	LCD panel Menu keys Escutcheon Base metal plate Cable Screw cap set	Front side memory I/F is normally equipped with the control unit
15-type color TFT touch panel (XGA:1024*768)	FCU8-DU182-32 / FCU8-DU181-32	LCD panel Menu keys Escutcheon Base metal plate Cable Screw cap set	Front side memory I/F is normally equipped with the control unit

3.6 Display Unit [E80]

Classification	Type	Components	Remarks
8.4-type color TFT (VGA:640*480)	FCU8-DU121-13	LCD panel Menu keys Escutcheon Base metal plate Cable Screw cap set	Front side memory I/F is normally equipped with the control unit

3.7 Keyboard Unit [M800S]

Classification	Type	Components	Remarks
Keyboard for 10.4-type display unit Clear keys	FCU8-KB041	Escutcheon, key switch G402 cable Screw cap set	ONG layout (for L system, XZF)
Keyboard for 10.4-type display unit Clear keys	FCU8-KB046	Escutcheon, key switch G402 cable Screw cap set	ONG layout (for M system/L system, XYZ)
Keyboard for 10.4-type display unit Clear keys	FCU8-KB047	Escutcheon, key switch G402 cable Screw cap set	Full keyboard (for M system/L system) (in tandem)
Keyboard for 10.4-type display unit Clear keys	FCU8-KB048	Escutcheon, key switch G402 cable Screw cap set	ABC layout (for M system/L system)
Keyboard for 15-type display unit Clear keys	FCU8-KB083	Escutcheon, key switch G402 cable Screw cap set	Full keyboard (for M system/L system) (in tandem)

3.8 Keyboard Unit [M80]

Classification	Type	Components	Remarks
Keyboard for 8.4-type display unit Clear keys	FCU8-KB026	Escutcheon, key switch G402 cable Screw cap set	ONG layout (for M system/L system, XYZ)
Keyboard for 8.4-type display unit Clear keys	FCU8-KB028	Escutcheon, key switch G402 cable Screw cap set	ONG layout (for L system, XZF)
Keyboard for 8.4-type display unit Clear keys	FCU8-KB029	Escutcheon, key switch G402 cable Screw cap set	ONG layout (for M system/L system) (in tandem)
Keyboard for 10.4-type display unit Clear keys	FCU8-KB041	Escutcheon, key switch G402 cable Screw cap set	ONG layout (for L system, XZF)
Keyboard for 10.4-type display unit Clear keys	FCU8-KB046	Escutcheon, key switch G402 cable Screw cap set	ONG layout (for M system/L system, XYZ)
Keyboard for 10.4-type display unit Clear keys	FCU8-KB047	Escutcheon, key switch G402 cable Screw cap set	Full keyboard (for M system/L system) (in tandem)
Keyboard for 10.4-type display unit Clear keys	FCU8-KB048	Escutcheon, key switch G402 cable Screw cap set	ABC layout (for M system/L system)
Keyboard for 15-type display unit Clear keys	FCU8-KB083	Escutcheon, key switch G402 cable Screw cap set	Full keyboard (for M system/L system) (in tandem)

3.9 Keyboard Unit [E80]

Classification	Type	Components	Remarks
Keyboard for 8.4-type display unit Sheet keys	FCU8-KB024	Escutcheon, key switch G402 cable Screw cap set	ONG layout (for M system/L system, XYZ)
Keyboard for 8.4-type display unit Sheet keys	FCU8-KB025	Escutcheon, key switch G402 cable Screw cap set	ONG layout (for L system, XZF)

3.10 Operation Panel I/O Unit

Classification	Type	Components	Remarks
DI 24V/0V common input [64 points] DO Source output [48 points] AO Analog output [1 point]	FCU8-DX731	Base card RIO 2.0 terminator connector (R2-TM)	DI: 64-points 24V/0V common type DO: 48-points source type (200mA/point) AO: 1 point Manual pulse generator input: 2ch Control unit I/F Keyboard unit I/F Remote I/O 2.0 I/F RIO occupied stations (fixed): 1, 3, 7 to 12, 20 to 22 RIO extensible stations: 2, 4 to 6, 13 to 19, 23 to 64
DI 24V/0V common input [96 points] DO Source output [64 points]	FCU8-DX750	Base card RIO 2.0 terminator connector (R2-TM)	DI: 96-points 24V/0V common type DO: 64-points source type (200mA/point) Manual pulse generator input: 3ch Control unit I/F Keyboard unit I/F Remote I/O 2.0 I/F RIO occupied stations (fixed): 1 to 3, 7 to 12, 20 to 22 RIO extensible stations: 4 to 6, 13 to 19, 23 to 64
DI 24V/0V common input [96 points] DO Source output [96 points]	FCU8-DX760	Base card Add-on card RIO 2.0 terminator connector (R2-TM)	DI: 96-points 24V/0V common type DO: 96-points source type (200mA/point) Manual pulse generator input: 3ch Control unit I/F Keyboard unit I/F Remote I/O 2.0 I/F RIO occupied stations (fixed): 1 to 4, 7 to 12, 20 to 22 RIO extensible stations: 5, 6, 13 to 19, 23 to 64
DI 24V/0V common input [96 points] DO Source output [64 points] AI Analog input [1 point] AO Analog output [1 point]	FCU8-DX761	Base card Add-on card RIO 2.0 terminator connector (R2-TM)	DI: 96-points 24V/0V common type DO: 64-points source type (200mA/point) AI: 1 point AO: 1 point Manual pulse generator input: 3ch Control unit I/F Keyboard unit I/F Remote I/O 2.0 I/F RIO occupied stations (fixed): 1 to 5, 7 to 12, 20 to 22 RIO extensible stations: 6, 13 to 19, 23 to 64
DI 24V/0V common input [64 points] DO Source output [64 points] Scan input [64 points] Scan output [64 points]	FCU8-DX834	Base card Add-on card RIO 2.0 terminator connector (R2-TM)	DI: 64-points 24V/0V common type DO: 64-points source type (200mA/point) Scan input: 64 points Scan output: 64 points Manual pulse generator input: 3ch Keyboard unit I/F Remote I/O 2.0 I/F RIO occupied stations (fixed): 1 to 4, 7 to 14, 20 to 22 RIO extensible stations: 5, 6, 15 to 19, 23 to 64

(Note) DI: Digital input signals, DO: Digital output signals

3.11 Remote I/O Unit [M800S/M80]

Classification	Type	Components	Remarks
DI 24V/0V common input [32 points] DO Source output [32 points]	FCU8-DX220	Base card RIO 2.0 connector set	DI: 32-points 24V/0V common type Do: 32-points source type (200mA/point) Number of occupied stations: 1
DI 24V/0V common input [64 points] DO Source output [48 points]	FCU8-DX230	Base card RIO 2.0 connector set	DI: 64-points 24V/0V common type DO: 48-points source type (200mA/point) Number of occupied stations: 2
DI 24V/0V common input DO Source output [48 points] AO Analog output [1 point]	FCU8-DX231	Base card RIO 2.0 connector set	DI: 64-points 24V/0V common type DO: 48-points source type (200mA/point) AO: 1 point Number of occupied stations: 2
AI Analog input [4 points] AO Analog output [1 point]	FCU8-DX202	Base card RIO 2.0 connector set	AI : 4 points AO: 1 point Number of occupied stations: 1
DI 0V common input [16 points] DO Source output (large capacity) [8 points]	FCU8-DX213	Base card RIO 2.0 connector set	DI: 16-points 0V common type (3mA/point) DO: 8-points source type (2A/point) Number of occupied stations: 1
DI 0V common input [16 points] DO Source output (large capacity) [8 points]	FCU8-DX213-1	Base card RIO 2.0 connector set	DI: 16-points 0V common type (9mA/point) DO: 8-points source type (2A/point) Number of occupied stations: 1
Safety DI 0V common input [8 points] Safety DO Source output (large capacity) [4 points]	FCU8-DX654	Base card RIO 2.0 connector set	Safety DI: 8-points 0V common type (3mA/point) Safety DO: 4-points source type (2A/point) Number of occupied stations: 2
Safety DI 0V common input [8 points] Safety DO Source output (large capacity) [4 points]	FCU8-DX654-1	Base card RIO 2.0 connector set	Safety DI: 8-points 0V common type (9mA/point) Safety DO: 4-points source type (2A/point) Number of occupied stations: 2
DI 24V/0V common input [32points] DO Source output [32 points] Safety DI 0V common input [8 points] (Note 1) Safety relay output [4 points] (Note 2)	FCU8-DX651	Base card Add-on card RIO 2.0 connector set	DI: 32-points 24V/0V common type Do: 32-points source type (200mA/point) Safety DI: 8-points 0V common type Safety relay: 4-points (non-voltage contact) Relay contact welding detection Number of occupied stations: 3 (Note 1) Safety DI uses 16 points of terminal because of the duplication wiring. (Note 2) Safety relay output uses 8 points of terminal because of the duplication wiring.
Thermistor input [12 points]	FCU8-DX408	Base card RIO 2.0 connector set	Thermistor input: 12 points Number of occupied stations: 3
Multi-analog input [4 points] (Note 3)	FCU8-DX409	Base card RIO 2.0 connector set	Multi-analog input: 4 points (Note 3) Voltage input, current input, thermocouple input and resistance temperature detector input are selected for each CH. Number of occupied stations: 4

(Note) DI: Digital input signals, DO: Digital output signals, AI: Analog input signals, AO: Analog output signals

3.12 Remote I/O Unit [E80]

Classification	Type	Components	Remarks
DI 24V/0V common input [32 points] DO Source output [32 points]	FCU8-DX220	Base card RIO 2.0 connector set	DI: 32-points 24V/0V common type Do: 32-points source type (200mA/point) Number of occupied stations: 1
DI 24V/0V common input [64 points] DO Source output [48 points]	FCU8-DX230	Base card RIO 2.0 connector set	DI: 64-points 24V/0V common type DO: 48-points source type (200mA/point) Number of occupied stations: 2
DI 24V/0V common input DO Source output [48 points] AO Analog output [1 point]	FCU8-DX231	Base card RIO 2.0 connector set	DI: 64-points 24V/0V common type DO: 48-points source type (200mA/point) AO: 1 point Number of occupied stations: 2
AI Analog input [4 points] AO Analog output [1 point]	FCU8-DX202	Base card RIO 2.0 connector set	AI : 4 points AO: 1 point Number of occupied stations: 1
DI 0V common input [16 points] DO Source output (large capacity) [8 points]	FCU8-DX213	Base card RIO 2.0 connector set	DI: 16-points 0V common type (3mA/point) DO: 8-points source type (2A/point) Number of occupied stations: 1
DI 0V common input [16 points] DO Source output (large capacity) [8 points]	FCU8-DX213-1	Base card RIO 2.0 connector set	DI: 16-points 0V common type (9mA/point) DO: 8-points source type (2A/point) Number of occupied stations: 1
Thermistor input [12 points]	FCU8-DX408	Base card RIO 2.0 connector set	Thermistor input: 12 points Number of occupied stations: 3
Multi-analog input [4 points] (Note 3)	FCU8-DX409	Base card RIO 2.0 connector set	Multi-analog input: 4 points (Note 3) Select voltage input, current input, thermocouple and resistance temperature detector input for each ch. Number of occupied stations: 4

(Note) DI: Digital input signals, DO: Digital output signals, AI: Analog input signals, AO: Analog output signals

3.13 Functional Safety Expansion Unit [M80]

Classification	Type	Components	Remarks
Functional safety expansion unit	FCU8-EX133	Add-on card	Smart safety observation

3.14 Function Expansion Unit [M800S/M80]

Classification	Type	Components	Remarks
CC-Link expansion unit	FCU8-EX561	CC-Link I/F PCB	CC-Link 1ch
PROFIBUS-DP master unit	FCU8-EX563	PROFIBUS-DP I/F PCB	PROFIBUS-DP 1ch
CC-Link IE Field Master/local unit	FCU8-EX564	Base card Add-on card	CC-Link IE Field 2ch
EtherNet/IP Scanner/adapter unit	FCU8-EX565	Base card Add-on card	EtherNet/IP 1ch (Only LAN1, LAN2 cannot be used)
FL-net expansion unit	FCU8-EX568	Base card Add-on card	FL-net 1ch (Only LAN1, LAN2 cannot be used)
Vibration cutting expansion unit	FCU8-EX744	Base card	Vibration cutting control

Classification	Type	Components	Remarks
Option Relay Unit	FCU8-EX702	Relay PCB	For function expansion unit 1 slot
Option Relay Unit	FCU8-EX703	Relay PCB	For function expansion unit 2 slots

(Note) To use the function expansion unit, the option relay unit (FCU8-EX70x) is required.

3.15 Function Expansion Unit [E80]

Classification	Type	Components	Remarks
CC-Link expansion unit	FCU8-EX561	CC-Link I/F PCB	CC-Link 1ch
PROFIBUS-DP master unit	FCU8-EX563	PROFIBUS-DP I/F PCB	PROFIBUS-DP 1ch
CC-Link IE Field Master/local unit	FCU8-EX564	Base card Add-on card	CC-Link IE Field 2ch
EtherNet/IP Scanner/adapter unit	FCU8-EX565	Base card Add-on card	EtherNet/IP 1ch (Only LAN1, LAN2 cannot be used)
FL-net expansion unit	FCU8-EX568	Base card Add-on card	FL-net 1ch (Only LAN1, LAN2 cannot be used)

Classification	Type	Components	Remarks
Option Relay Unit	FCU8-EX702	Relay PCB	For function expansion unit 1 slot
Option Relay Unit	FCU8-EX703	Relay PCB	For function expansion unit 2 slots

(Note) To use the function expansion unit, the option relay unit (FCU8-EX70x) is required.

3.16 Manual Pulse Generator

Classification	Type	Components	Remarks
5V Manual Pulse Generator	UFO-01-2Z9	UFO-01-2Z9 (Produced by NIDEC NEMICON)	Input 5VDC 100pulse/rev
12V Manual Pulse Generator	HD60C	HD60C	Input 12VDC 25pulse/rev

3.17 Synchronous Feed Encoder

Classification	Type	Components	Remarks
Synchronous feed encoder	OSE1024-3-15-68	OSE1024-3-15-68	Input 5VDC 1024pulse/rev 6000r/min, 68-square flange
Synchronous feed encoder	OSE1024-3-15-68-8	OSE1024-3-15-68-8	Input 5VDC 1024pulse/rev 8000r/min ,68-square flange
Synchronous feed encoder	OSE1024-3-15-160	OSE1024-3-15-160	Input 5VDC 1024pulse/rev 6000r/min, 160-square flange

3.18 Machine Operation Panel [M800S/M80]

Classification	Type	Components	Remarks
Main panel A (For 8.4-type/15-type display unit)	FCU8-KB921	Escutcheon, key switch control card G054 cable, Screw cap set	MITSUBISHI standard key layout (55 keys) (Standard specification A)
Main panel A (For 8.4-type/15-type display unit)	FCU8-KB922	Escutcheon, key switch control card G054 cable, Screw cap set	Custom specification key layout (55 keys) (Clear key top cover sold separately)
Main panel B (For 10.4-type display unit)	FCU8-KB923	Escutcheon, key switch control card G054 cable, Screw cap set	MITSUBISHI standard key layout (55 keys) (Standard specification A)
Main panel B (For 10.4-type display unit)	FCU8-KB924	Escutcheon, key switch control card G054 cable, Screw cap set	Custom specification key layout (55 keys) (Clear key top cover sold separately)
Main panel A (For 8.4-type/15-type display unit)	FCU8-KB925	Escutcheon, key switch control card G054 cable, Screw cap set	MITSUBISHI standard key layout (55 keys) (Standard specification B)
Main panel B (For 10.4-type display unit)	FCU8-KB926	Escutcheon, key switch control card G054 cable, Screw cap set	MITSUBISHI standard key layout (55 keys) (Standard specification B)
Sub panel A (Common for all display units)	FCU8-KB931	Escutcheon Emergency stop switch, Override switch ON/OFF switch, Screw cap set	MITSUBISHI standard switch specification (Standard specification A)
Sub panel A (Common for all display units)	FCU8-KB941	Escutcheon Emergency stop switch, Override switch ON/OFF switch, Screw cap set	MITSUBISHI standard switch specification (Standard specification B)
Clear key top set	N030C975G51 / N030C975G55	Clear key top cover (20 pcs/60 pcs)	
Set of labels for M7 standard key layout	N939A169G51	Labels for M7 standard key layout (1 sheet)	

3.19 Machine Operation Panel [E80]

Classification	Type	Components	Remarks
Main panel A (For 8.4-type/15-type display unit)	FCU8-KB922	Escutcheon, key switch control card G054 cable, Screw cap set	Custom specification key layout (55 keys) (Clear key top cover sold separately)
Main panel A (For 8.4-type/15-type display unit)	FCU8-KB925	Escutcheon, key switch control card G054 cable, Screw cap set	MITSUBISHI standard key layout (55 keys) (Standard specification B)
Sub panel A (Common for all display units)	FCU8-KB941	Escutcheon Emergency stop switch, Override switch ON/OFF switch, Screw cap set	MITSUBISHI standard switch specification (Standard specification B)
Clear key top set	N030C975G51 / N030C975G55	Clear key top cover (20 pcs/60 pcs)	
Set of labels for M7 standard key layout	N939A169G51	Labels for M7 standard key layout (1 sheet)	

3.20 Handy Terminal

Classification	Type	Components	Remarks
Handy Terminal	HG1T-SB12UH-MK1346-L5		

3.21 Cable Connector Sets

Classification	Type	Components	Remarks
General I/O units (For SKIP,SIO,MPG,AIO)	FCUA-CS000	Connector (10120-3000PE,2pcs), Shell kit (10320-52F0-008,2pcs)	
Emergency stop connector (For EMG)	005057-9403 0016020103 x 3 pcs.	Connector (50-57-9403), Contact (0016020103,3pcs.)	
Connector kit for RIO 2.0 unit	RIO2 CON	Connector (1-1318119-3,2pcs.), Contact (1318107-1,8pcs.), Connector (2-178288-3), Contact (1-175218-5,3pcs)	
24VDC power supply connector (For DCIN)	FCUA-CN220	Connector (2-178288-3), Contact (1-175218-5,3pcs)	
DI/DO connector (For operation panel I/O unit) (For remote I/O unit)	7940-6500SC x 4pcs. 3448-7940 x 4pcs.	Connector (7940-6500SC,4pcs.), Strain relief (3448-7940,4pcs.)	FCU8-DX731
DI connector (For operation panel I/O unit)	7950-6500SC x 2pcs. 3448-7950 x 2pcs.	Connector (7950-6500SC,2pcs.), Strain relief (3448-7950,2pcs.)	FCU8-DX750/760/761
Connector for CJ71	2-1318119-4 1318107-1 x 8pcs.	Connector (2-1318119-4), Contact (1318107-1,8pcs.)	
THERMISTOR connector	37104-2165-000FL 10P	Connector (37104-2165-000FL,10pcs.)	

3.22 Thermistor Sets

Classification	Type	Components	Remarks
Thermistor	PT3C-51F-M2 10P	Thermistor (PT3C-51F-M2,10pcs.)	

3.23 Genuine Memory Card

Classification	Type	Components	Remarks
Exclusive SD cards 1GB	FCU8-SD001G	FCU8-SD001G	1GB capacity
Exclusive SD cards 4GB	FCU8-SD004G	FCU8-SD004G	4GB capacity

3.24 Durable Parts

Durable parts	Part type
Battery for control unit	Q6BAT

(Note) Contact the Service Center, Sales Office or dealer for repairs or part replacement.

3.25 Replacements

Replacements	Part type	Manufacturer
Protection fuse for operation panel I/O	LM50	Daito Communication Apparatus Co., Ltd.
Protection fuse for FCU8-DX220/230/231/651	LM50	Daito Communication Apparatus Co., Ltd.
Protection fuse for FCU8-DX213/654/213-1/654-1	MP63	Daito Communication Apparatus Co., Ltd.
Pair of SD/USB covers for display unit	N031C089G51	-

3.26 List of Cables

[Cable relating to NC]

Type	Application	Available cable length (m)	Max. cable length
FCUA-R050-xM	Synchronous encoder - control unit (straight, with connector)	5	30m
FCUA-R054-xM	Synchronous encoder - control unit (right angle, with connector)	3, 5, 10, 15, 20	30m
G071 LxM	24VDC relay cable for machine operation panel	0.12, 0.5, 1	1m
G123	Cable for emergency stop release	-	-
G430 LxM	Cable for connection to handy terminal	3, 5, 10	10m
G460 LxM	Cable for machine operation panel (Cable between main panel and sub panel)	0.5	0.5m
J010 LxM	Operation panel I/O interface cable	0.5, 1	1m
J012 LxM	Operation panel I/O interface cable (for FCU8-DX834)	0.5, 1	1m
J020 LxM	Manual pulse generator cable (12V): 1ch	1, 2, 3, 5, 7, 10, 15, 20, 30	50m
J021 LxM	Manual pulse generator cable (12V): 2ch	1, 2, 3, 5, 7, 10, 15, 20, 30	50m
J022 LxM	Manual pulse generator cable (12V): 3ch	1, 2, 3, 5, 7, 10, 15, 20, 30	50m
J023 LxM	Manual pulse generator cable (5V): 1ch	1, 2, 3, 5, 7, 10, 15, 20	20m
J024 LxM	Manual pulse generator cable (5V): 2ch	1, 2, 3, 5, 7, 10, 15, 20	20m
J025 LxM	Manual pulse generator cable (5V): 3ch	1, 2, 3, 5, 7, 10, 15, 20	20m
J026 LxM	Manual pulse generator cable (5V): 1ch (for connection to control unit)	1, 2, 3, 5, 7, 10, 15, 20	20m (*)
J027 LxM	Manual pulse generator cable (5V): 2ch (for connection to control unit)	1, 2, 3, 5, 7, 10, 15, 20	20m (*)
J030 LxM	RS-232C I/F cable: 1ch	1, 2, 3, 5, 7, 10	15m (*)
J031 LxM	RS-232C I/F cable: 2ch	1, 2, 3, 5, 7, 10	15m (*)
J070 LxM	24VDC power cable	1, 2, 3, 5, 7, 10, 15	15m
J071 LxM	24VDC power cable (for long distance)	20	20m
J100 LxM	SKIP input cable	1, 2, 3, 5, 7, 10, 15, 20	20m
J120 LxM	Emergency stop cable	1, 2, 3, 5, 7, 10, 15, 20, 30	30m
J121 LxM	Emergency stop cable for machine operation panel	1, 2, 3, 5, 7, 10, 15, 20, 30	30m
J210 LxM	Remote I/O 2.0 communication cable	0.3, 1, 2, 3, 5, 7, 10, 15, 20, 30	50m (*)
J221 LxM	Analog input/output cable (for remote I/O unit)	2, 3, 7	30m
J224 LxM	Analog input/output cable (for operation panel I/O unit)	1, 2, 3, 5, 7, 10, 15, 20	30m
J225 LxM	Analog output cable (for operation panel I/O unit)	1, 2, 3, 5, 7, 10, 15, 20	30m
J303 LxM	LAN straight cable	1, 2, 3, 5, 7, 10, 15, 20, 30	50m
J350 LxM	DI/DO cable (connectors at both ends)	1, 2, 3, 5	50m
J351 LxM	DI/DO cable (connector at one end)	3	50m
J460 LxM	DI/DO cable (connectors at both ends)	1, 2, 3, 5	50m
J461 LxM	DI/DO cable (connector at one end)	3	50m
R2-TM	Terminator for remote I/O interface	-	-

(Note 1) "x" in type columns indicate cable length (unit: m).

(Note 2) Lengths indicated with an asterisk (*) in the max. cable length column indicate the maximum cable length when connecting via other unit.

[Cable Relating to Drive Unit]

Type	Application	Available cable length (m)	Max. cable length
CNP2E-1-xM	Motor side PLG cable Spindle side accuracy encoder TS5690 cable	2, 3, 4, 5, 7, 10, 15, 20, 25, 30	30m
CNP3EZ-2P-xM	Spindle side encoder cable OSE-1024 cable	2, 3, 4, 5, 7, 10, 15, 20, 25, 30	30m
CNP3EZ-3P-xM	Spindle side encoder cable OSE-1024 cable	2, 3, 4, 5, 7, 10, 15, 20, 25, 30	30m
CNV2E-8P-xM	For HG/HG-H, HQ-H, HK/HK-H, HG-JR Motor side encoder cable (for D47/D48/D51/D74/G48) Ball screw side encoder cable (OSA405ET2AS, OSA676ET2AS)	2, 3, 4, 5, 7, 10, 15, 20, 25, 30	30m
CNV2E-9P-xM	For HG/HG-H, HQ-H, HK/HK-H, HG-JR Motor side encoder cable (for D47/D48/D51/D74/G48) Ball screw side encoder cable (OSA405ET2AS, OSA676ET2AS)	2, 3, 4, 5, 7, 10, 15, 20, 25, 30	30m
CNV2E-D-xM	MDS-B-SD unit cable	2, 3, 4, 5, 7, 10, 15, 20, 25, 30	30m
CNV2E-HP-xM	MDS-EX-HR unit cable	2, 3, 4, 5, 7, 10, 15, 20, 25, 30	30m
DG30-xM	Battery cable (For drive unit - Battery box, For drive unit - drive unit)	0.3, 0.5, 1, 2, 3, 5, 7, 10	10m
G380 LxM	Optical communication cable For wiring between drive units (outside panel)	5, 10, 12, 15, 20, 25, 30	30m
J395 LxM	Optical communication cable For wiring between drive units (outside panel) For wiring between NC-drive units	3, 5, 7, 10	10m
J396 LxM	Optical communication cable For wiring between drive units (inside panel)	0.2, 0.3, 0.5, 1, 2, 3, 5	10m
MR-BKS1CBLxMA1-H	<200V Series> Brake cable for HG96 Lead out in direction of motor shaft	2, 3, 5, 7, 10	10m
MR-BKS1CBLxMA2-H	<200V Series> Brake cable for HG96 Lead out in opposite direction of motor shaft	2, 3, 5, 7, 10	10m
MR-BT6V2CBL LxM	Battery cable (MDS-EJ/EJH) (For drive unit - drive unit)	0.3, 1	1m
MR-D05UDL3M-B	STO cable	3	3m
MR-ENE4CBLxM-H-MTH	For HG-H1502 Motor side encoder cable (for D48/D51/D74)	5, 10, 20, 30	30m
MR-PWS1CBLxMA1-H	<200V Series> Power cable for HG96 Lead out in direction of motor shaft	2, 3, 5, 7, 10	10m
MR-PWS1CBLxMA2-H	<200V Series> Power cable for HG96 Lead out in opposite direction of motor shaft	2, 3, 5, 7, 10	10m
SH21 LxM	Power supply communication cable Power backup unit communication cable	0.35, 0.5, 1, 2, 3	30m

(Note 1) "x" in type columns indicate cable length (unit: m).
(Note 2) Lengths indicated with an asterisk (*) in the max. cable length column indicate the maximum cable length when connecting via other unit.

3.27 System Type

Series	Model name	System type	Control unit	Display unit
M800S Series	M850S	FCA850H-8S	FCU8-MA542-001	FCU8-DU182-31/FCU8-DU181-31 (15-type color LCD touchscreen)
		FCA850H-4S		FCU8-DU142-31/FCU8-DU141-31 (10.4-type color LCD touchscreen)
	M830S	FCA830H-8S	FCU8-MU542-001	FCU8-DU182-31/FCU8-DU181-31 (15-type color LCD touchscreen)
		FCA830H-4S		FCU8-DU142-31/FCU8-DU141-31 (10.4-type color LCD touchscreen)
M80 Series	M80 TypeA	FCA80H-8A	FCU8-MU512-001	FCU8-DU182-32/FCU8-DU181-32 (15-type color LCD touchscreen)
		FCA80H-4A		FCU8-DU142-32/FCU8-DU141-32 (10.4-type color LCD touchscreen)
		FCA80P-2A		FCU8-DU121-12 (8.4-type color LCD)
	M80 TypeB	FCA80H-8B	FCU8-MU511-001	FCU8-DU182-32/FCU8-DU181-32 (15-type color LCD touchscreen)
		FCA80H-4B		FCU8-DU142-32/FCU8-DU141-32 (10.4-type color LCD touchscreen)
		FCA80P-2B		FCU8-DU121-12 (8.4-type color LCD)
E80 Series	E80 TypeA	FCA80P-2EA	FCU8-MU514-001	FCU8-DU121-13 (8.4-type color LCD)
	E80 TypeB	FCA80P-2EB	FCU8-MU513-001	FCU8-DU121-13 (8.4-type color LCD)

4

General Specifications

4.1 Environment Conditions [M800S]

4.1.1 Installation Environment Conditions

Item	Unit name		Control unit	Display unit
	Type		FCU8-MU542/MA542 FCU8-MU541/MA541	FCU8-DU142-31 : (10.4-type) FCU8-DU182-31 : (15-type) FCU8-DU141-31 : (10.4-type) FCU8-DU181-31 : (15-type)
General Specifications	Ambient temperature	During operation	0 to 58°C	
		During storage	-20 to 60°C	
	Ambient humidity	Long term	10 to 75% RH (with no dew condensation)	
		Short term	10 to 95% RH (with no dew condensation) (Note 1)	
	Vibration resistance		$4.9m/s^2$ or less	
	Shock resistance		$29.4m/s^2$ or less	
	Working atmosphere		No corrosive gases, dust or oil mist	
	Altitude		Operation/Storage: 1000 meters or less above sea level, Transportation: 13000 meters or less above sea level	
	Power supply voltage		24VDC	FCU8-DU142-31 : 12VDC/5VDC/3.3VDC FCU8-DU182-31 : 12VDC/5VDC/3.3VDC FCU8-DU141-31 : 12VDC/5VDC/3.3VDC FCU8-DU181-31 : 12VDC/5VDC/3.3VDC
				(Supply from Control Unit)
	Current consumption		2.5A	- (Note 2)
	Maximum heating value	(W)	16	FCU8-DU142-31 : 10 FCU8-DU182-31 : 14 FCU8-DU141-31 : 10 FCU8-DU181-31 : 14
	Mass	(kg)	1.1	FCU8-DU142-31 : 1.7 FCU8-DU182-31 : 4.1 FCU8-DU141-31 : 1.7 FCU8-DU181-31 : 4
	Outline dimension W×H×D or W×H	(mm)	239.1×173.4×75	FCU8-DU142-31 : 290×220 FCU8-DU182-31 : 400×320 FCU8-DU141-31 : 290×220 FCU8-DU181-31 : 400×320

(Note 1) "Short term" means roughly within one month.

(Note 2) The current consumption of the display unit is included in that of the control unit.

(Note 3) For the whole NC system, consider the characteristics of the drive units when the altitude is more than 1000 meters above sea level. Refer to the manual of drive unit for details.

(Note 4) When the display unit is mounted on an incline, the inclination angle to place the unit should be 30 degrees or less from the vertical direction.

Item	Unit name		Keyboard unit	Operation panel I/O unit		Machine operation panel
	Type		FCU8-KB041/KB046 : (10.4-type) FCU8-KB047 : (10.4-type/vertical arrangement) FCU8-KB048 : (10.4-type) FCU8-KB083 : (15-type/vertical arrangement)	FCU8-DX731 FCU8-DX750 FCU8-DX760 FCU8-DX761	FCU8-DX834	FCU8-KB921/KB922/KB925 FCU8-KB923/KB924/KB926 FCU8-KB931/KB941
General Specifications	Ambient temperature	During operation	0 to 58°C			
		During storage	-20 to 60°C			
	Ambient humidity	Long term	10 to 75% RH (with no dew condensation)			
		Short term	10 to 95% RH (with no dew condensation) (Note 1)			
	Vibration resistance		$4.9m/s^2$ or less			
	Shock resistance		$29.4m/s^2$ or less			
	Working atmosphere		No corrosive gases, dust or oil mist			
	Altitude		Operation/Storage: 1000 meters or less above sea level, Transportation: 13000 meters or less above sea level			
	Power supply voltage		5VDC (Supply from Control Unit)	5VDC/3.3VDC	24VDC	24VDC (Note 5)
	Current consumption		- (Note 2)		0.3A (Note 6)	0.3A (Note 5)
	Maximum heating value	(W)	1	4 (Note 3)	8 (Note 3)	7.2
	Mass	(kg)	FCU8-KB041/KB046 : 0.8 FCU8-KB047 : 1.3 FCU8-KB048 : 1.4 FCU8-KB083 : 1.5	FCU8-DX731 : 0.3 FCU8-DX750 : 0.4 FCU8-DX760 : 0.5 FCU8-DX761 : 0.5	0.4	FCU8-KB921/KB922/KB925 : 1.1 FCU8-KB923/KB924/KB926 : 1.2 FCU8-KB931/KB941 : 0.5
	Outline dimension W×H	(mm)	FCU8-KB041/KB046 : 140×220 FCU8-KB047 : 290×160 FCU8-KB048 : 230×220 FCU8-KB083 : 400×140	116×179		FCU8-KB921/KB922/KB925 : 260×140 FCU8-KB923/KB924/KB926 : 290×140 FCU8-KB931/KB941 : 140×140

(Note 1) "Short term" means roughly within one month.

(Note 2) The current consumption of the keyboard unit and the operation panel I/O unit (control section) are included in that of the control unit. Current consumption for the I/O circuit needs to be separately calculated based on the number of points used and its load.

(Note 3) For the heating value of the I/O circuit, calculate with the number of points used.

(Note 4) For the whole NC system, consider the characteristics of the drive units when the altitude is more than 1000 meters above sea level. Refer to the manual of drive unit for details.

(Note 5) 24V power input is not required for FCU8-KB931/KB941.

(Note 6) Current consumption for the I/O circuit needs to be separately calculated based on the number of points used and its load.

Item	Unit name		Remote I/O unit					
	Type		FCU8-DX220/ DX230/ DX231	FCU8-DX202	FCU8-DX213/ DX213-1/ DX654/ DX654-1	FCU8-DX408	FCU8-DX409	FCU8-DX651
General Specifications	Ambient temperature	During operation	0 to 58°C					
		During storage	-20 to 60°C					
	Ambient humidity	Long term	10 to 75% RH (with no dew condensation)					
		Short term	10 to 95% RH (with no dew condensation) (Note 1)					10 to 85% RH (with no dew condensation) (Note 1)
	Vibration resistance		4.9m/s^2 or less					
	Shock resistance		29.4m/s^2 or less					
	Working atmosphere		No corrosive gases, dust or oil mist					
	Altitude		Operation/Storage: 1000 meters or less above sea level, Transportation: 13000 meters or less above sea level					
	Power supply voltage		24VDC					
	Current consumption		3.5A (Note 2)	0.3A	0.3A (Note 3)	0.1A	0.2A	3.7A (Note 2)
	Maximum heating value	(W)	8 (Note 4)			3	6 (Note 6)	8 (Note 4)
	Mass	(kg)	0.4			0.2	0.3	0.8
	Outline dimension W×H×D	(mm)	40×175×133	40×175×119	40×175×130	40×175×109	40×175×130	104×175×115

(Note 1) "Short term" means roughly within one month.
(Note 2) This value includes the maximum value of DO external load current (3.2A).
(Note 3) This value does not include DO external load current.
(Note 4) For the heating value of the I/O circuit, calculate with the number of points used.
(Note 5) For the whole NC system, consider the characteristics of the drive units when the altitude is more than 1000 meters above sea level. Refer to the manual of drive unit for details.
(Note 6) The maximum value including the heating value of analog input circuit.

4.1.2 24VDC Stabilized Power Supply Selecting Conditions

Consider the following characteristics for the stabilized power supply, and select the power supply that complies with laws, regulations, or safety standards of the country where the machine will be installed.

Item		Specifications	Remarks
Output	**Voltage**	24VDC	When the stabilized power supply and 24VDC input unit are distant, select the stabilized power supply which is possible to set output voltage 24VDC or more allowing for the influence of voltage down by the cable.
	Voltage fluctuation	±5%	
	Current	-	Calculate the current value as a reference of maximum current consumption for the unit which uses the power supply.
	Ripple noise	0.2V (P-P)	
	Output holding time	min 20ms	Output holding time is decided by loading ratio; however, the stabilized power supply which complies with the specification on the left must be selected during maximum loading.
	Overcurrent output shutoff function	-	Use a power supply having the overcurrent output shutoff function.

⚠ CAUTION

1. Using a stabilized power supply without overcurrent protection may cause the unit's failure due to miswiring of 24V.

4.2 Environment Conditions [M80]

4.2.1 Installation Environment Conditions

Item	Unit name		Control unit	Display unit
	Type		FCU8-MU511/MU512 FCU8-MU501/MU502	FCU8-DU142-32 : (10.4-type) FCU8-DU182-32 : (15-type) FCU8-DU121-12 : (8.4-type) FCU8-DU141-32 : (10.4-type) FCU8-DU181-32 : (15-type)
General Specifications	Ambient temperature	During operation	0 to 58°C	
		During storage	-20 to 60°C	
	Ambient humidity	Long term	10 to 75% RH (with no dew condensation)	
		Short term	10 to 95% RH (with no dew condensation) (Note 1)	
	Vibration resistance		4.9m/s^2 or less	
	Shock resistance		29.4m/s^2 or less	
	Working atmosphere		No corrosive gases, dust or oil mist	
	Altitude		Operation/Storage: 1000 meters or less above sea level, Transportation: 13000 meters or less above sea level	
	Power supply voltage		24VDC	FCU8-DU142-32 : 12VDC/5VDC/3.3VDC FCU8-DU182-32 : 12VDC/5VDC/3.3VDC FCU8-DU121-12 : 12VDC/3.3VDC FCU8-DU141-32 : 12VDC/5VDC/3.3VDC FCU8-DU181-32 : 12VDC/5VDC/3.3VDC
				(Supply from Control Unit)
	Current consumption		2.5A	- (Note 2)
	Maximum heating value	(W)	12	FCU8-DU142-32 : 10 FCU8-DU182-32 : 14 FCU8-DU121-12 : 6 FCU8-DU141-32 : 10 FCU8-DU181-32 : 14
	Mass	(kg)	1.1	FCU8-DU142-32 : 1.7 FCU8-DU182-32 : 4.1 FCU8-DU121-12 : 1.2 FCU8-DU141-32 : 1.7 FCU8-DU181-32 : 4
	Outline dimension W×H×D or W×H	(mm)	239.1×173.4×75	FCU8-DU142-32 : 290×220 FCU8-DU182-32 : 400×320 FCU8-DU121-12 : 260×200 FCU8-DU141-32 : 290×220 FCU8-DU181-32 : 400×320

(Note 1) "Short term" means roughly within one month.

(Note 2) The current consumption of the display unit is included in that of the control unit.

(Note 3) For the whole NC system, consider the characteristics of the drive units when the altitude is more than 1000 meters above sea level. Refer to the manual of drive unit for details.

(Note 4) When the display unit is mounted on an incline, the inclination angle to place the unit should be 30 degrees or less from the vertical direction.

Item	Unit name		Keyboard unit	Operation panel I/O unit		Machine operation panel
	Type		FCU8-KB026/KB028 : (8.4-type) FCU8-KB029 : (8.4-type/vertical arrangement) FCU8-KB041/KB046 : (10.4-type) FCU8-KB047 : (10.4-type/vertical arrangement) FCU8-KB048 : (10.4-type) FCU8-KB083 : (15-type/vertical arrangement)	FCU8-DX731 FCU8-DX750 FCU8-DX760 FCU8-DX761	FCU8-DX834	FCU8-KB921/KB922/KB925 FCU8-KB923/KB924/KB926 FCU8-KB931/KB941
General Specifications	Ambient temperature	During operation	0 to 58°C			
		During storage	-20 to 60°C			
	Ambient humidity	Long term	10 to 75% RH (with no dew condensation)			
		Short term	10 to 95% RH (with no dew condensation) (Note 1)			
	Vibration resistance		$4.9m/s^2$ or less			
	Shock resistance		$29.4m/s^2$ or less			
	Working atmosphere		No corrosive gases, dust or oil mist			
	Altitude		Operation/Storage: 1000 meters or less above sea level, Transportation: 13000 meters or less above sea level			
	Power supply voltage		5VDC (Supply from Control Unit)	5VDC/3.3VDC	24VDC	24VDC (Note 5)
	Current consumption		- (Note 2)		0.3A (Note 6)	0.3A (Note 5)
	Maximum heating value	(W)	1	4 (Note 3)	8 (Note 3)	7.2
	Mass	(kg)	FCU8-KB026/KB028 : 0.75 FCU8-KB029 :1.0 FCU8-KB041/KB046 : 0.8 FCU8-KB047 : 1.3 FCU8-KB048 : 1.4 FCU8-KB083 : 1.5	FCU8-DX731 : 0.3 FCU8-DX750 : 0.4 FCU8-DX760 : 0.5 FCU8-DX761 : 0.5	0.4	FCU8-KB921/KB922/KB925 : 1.1 FCU8-KB923/KB924/KB926 : 1.2 FCU8-KB931/KB941 : 0.5
	Outline dimension W×H	(mm)	FCU8-KB026/KB028 : 140×200 FCU8-KB029 : 260×140 FCU8-KB041/KB046 : 140×220 FCU8-KB047 : 290×160 FCU8-KB048 : 230×220 FCU8-KB083 : 400×140	116×179		FCU8-KB921/KB922/KB925 : 260×140 FCU8-KB923/KB924/KB926 : 290×140 FCU8-KB931/KB941 : 140×140

(Note 1) "Short term" means roughly within one month.

(Note 2) The current consumption of the keyboard unit and the operation panel I/O unit (control section) are included in that of the control unit. Current consumption for the I/O circuit needs to be separately calculated based on the number of points used and its load.

(Note 3) For the heating value of the I/O circuit, calculate with the number of points used.

(Note 4) For the whole NC system, consider the characteristics of the drive units when the altitude is more than 1000 meters above sea level. Refer to the manual of drive unit for details.

(Note 5) 24V power input is not required for FCU8-KB931/KB941.

(Note 6) Current consumption for the I/O circuit needs to be separately calculated based on the number of points used and its load.

Item	Unit name		Remote I/O unit					
	Type		FCU8-DX220/ DX230/ DX231	FCU8-DX202	FCU8-DX213/ DX213-1/ DX654/ DX654-1	FCU8-DX408	FCU8-DX409	FCU8-DX651
General Specifications	Ambient temperature	During operation	0 to 58°C					
		During storage	-20 to 60°C					
	Ambient humidity	Long term	10 to 75% RH (with no dew condensation)					
		Short term	10 to 95% RH (with no dew condensation) (Note 1)					10 to 85% RH (with no dew condensation) (Note 1)
	Vibration resistance		4.9m/s^2 or less					
	Shock resistance		29.4m/s^2 or less					
	Working atmosphere		No corrosive gases, dust or oil mist					
	Altitude		Operation/Storage: 1000 meters or less above sea level, Transportation: 13000 meters or less above sea level					
	Power supply voltage		24VDC					
	Current consumption		3.5A (Note 2)	0.3A	0.3A (Note 3)	0.1A	0.2A	3.7A (Note 2)
	Maximum heating value	(W)	8 (Note 4)			3	6 (Note 6)	8 (Note 4)
	Mass	(kg)	0.4			0.2	0.3	0.8
	Outline dimension W×H×D	(mm)	40×175×133	40×175×119	40×175×130	40×175×109	40×175×130	104×175×115

(Note 1) "Short term" means roughly within one month.
(Note 2) This value includes the maximum value of DO external load current (3.2A).
(Note 3) This value does not include DO external load current.
(Note 4) For the heating value of the I/O circuit, calculate with the number of points used.
(Note 5) For the whole NC system, consider the characteristics of the drive units when the altitude is more than 1000 meters above sea level. Refer to the manual of drive unit for details.
(Note 6) The maximum value including the heating value of analog input circuit.

4.2.2 24VDC Stabilized Power Supply Selecting Conditions

Consider the following characteristics for the stabilized power supply, and select the power supply that complies with laws, regulations, or safety standards of the country where the machine will be installed.

Item		Specifications	Remarks
Output	**Voltage**	24VDC	When the stabilized power supply and 24VDC input unit are distant, select the stabilized power supply which is possible to set output voltage 24VDC or more allowing for the influence of voltage down by the cable.
	Voltage fluctuation	±5%	
	Current	-	Calculate the current value as a reference of maximum current consumption for the unit which uses the power supply.
	Ripple noise	0.2V (P-P)	
	Output holding time	min 20ms	Output holding time is decided by loading ratio; however, the stabilized power supply which complies with the specification on the left must be selected during maximum loading.
	Overcurrent output shutoff function	-	Use a power supply having the overcurrent output shutoff function.

⚠ CAUTION

1. Using a stabilized power supply without overcurrent protection may cause the unit's failure due to miswiring of 24V.

4.3 Environment Conditions [E80]

4.3.1 Installation Environment Conditions

Item	Unit name		Control unit	Display unit
	Type		FCU8-MU513 FCU8-MU514	FCU8-DU121-13 : (8.4-type)
General Specifications	Ambient temperature	During operation	0 to 58°C	
		During storage	-20 to 60°C	
	Ambient humidity	Long term	10 to 75% RH (with no dew condensation)	
		Short term	10 to 95% RH (with no dew condensation) (Note 1)	
	Vibration resistance		4.9m/s^2 or less	
	Shock resistance		29.4m/s^2 or less	
	Working atmosphere		No corrosive gases, dust or oil mist	
	Altitude		Operation/Storage: 1000 meters or less above sea level, Transportation: 13000 meters or less above sea level	
	Power supply voltage		24VDC	12VDC/3.3VDC (Supply from Control Unit)
	Current consumption		2.5A	- (Note 2)
	Maximum heating value	(W)	12	6
	Mass	(kg)	1.1	FCU8-DU121-12 : 1.2 FCU8-DU141-32 : 1.7 FCU8-DU181-32 : 4
	Outline dimension W×H×D or W×H	(mm)	239.1×173.4×75	260×200

(Note 1) "Short term" means roughly within one month.

(Note 2) The current consumption of the display unit is included in that of the control unit.

(Note 3) For the whole NC system, consider the characteristics of the drive units when the altitude is more than 1000 meters above sea level. Refer to the manual of drive unit for details.

(Note 4) When the display unit is mounted on an incline, the inclination angle to place the unit should be 30 degrees or less from the vertical direction.

Item	Unit name		Keyboard unit	Operation panel I/O unit		Machine operation panel
	Type		FCU8-KB024 FCU8-KB025	FCU8-DX731 FCU8-DX750 FCU8-DX760 FCU8-DX761	FCU8-DX834	FCU8-KB922/KB925 FCU8-KB941
General Specifications	Ambient temperature	During operation	0 to 58°C			
		During storage	-20 to 60°C			
	Ambient humidity	Long term	10 to 75% RH (with no dew condensation)			
		Short term	10 to 95% RH (with no dew condensation) (Note 1)			
	Vibration resistance		$4.9m/s^2$ or less			
	Shock resistance		$29.4m/s^2$ or less			
	Working atmosphere		No corrosive gases, dust or oil mist			
	Altitude		Operation/Storage: 1000 meters or less above sea level, Transportation: 13000 meters or less above sea level			
	Power supply voltage		5VDC	5VDC/3.3VDC	24VDC	24VDC (Note 5)
			(Supply from Control Unit)			
	Current consumption		- (Note 2)		0.3A (Note 6)	0.3A (Note 5)
	Maximum heating value	(W)	1	4 (Note 3)	8 (Note 3)	7.2
	Mass	(kg)	0.75	FCU8-DX731 : 0.3 FCU8-DX750 : 0.4 FCU8-DX760 : 0.5 FCU8-DX761 : 0.5	0.4	FCU8-KB922/KB925 : 1.1 FCU8-KB941 : 0.5
	Outline dimension W×H	(mm)	140×200	116×179		FCU8-KB922/KB925 : 260×140 FCU8-KB941 : 140×140

(Note 1) "Short term" means roughly within one month.

(Note 2) The current consumption of the keyboard unit and the operation panel I/O unit (control section) are included in that of the control unit. Current consumption for the I/O circuit needs to be separately calculated based on the number of points used and its load.

(Note 3) For the heating value of the I/O circuit, calculate with the number of points used.

(Note 4) For the whole NC system, consider the characteristics of the drive units when the altitude is more than 1000 meters above sea level. Refer to the manual of drive unit for details.

(Note 5) 24V power input is not required for FCU8-KB941.

(Note 6) Current consumption for the I/O circuit needs to be separately calculated based on the number of points used and its load.

Item	Unit name		Remote I/O unit				
	Type		FCU8-DX220/ DX230/ DX231	FCU8-DX202	FCU8-DX213/ DX213-1	FCU8-DX408	FCU8-DX409
General Specifications	Ambient temperature	During operation	0 to 58°C				
		During storage	-20 to 60°C				
	Ambient humidity	Long term	10 to 75% RH (with no dew condensation)				
		Short term	10 to 95% RH (with no dew condensation) (Note 1)				
	Vibration resistance		4.9m/s^2 or less				
	Shock resistance		29.4m/s^2 or less				
	Working atmosphere		No corrosive gases, dust or oil mist				
	Altitude		Operation/Storage: 1000 meters or less above sea level, Transportation: 13000 meters or less above sea level				
	Power supply voltage		24VDC				
	Current consumption		3.5A (Note 2)	0.3A	0.3A (Note 3)	0.1A	0.2A
	Maximum heating value	(W)	8 (Note 4)			3	6 (Note 6)
	Mass	(kg)	0.4			0.2	0.3
	Outline dimension W×H×D	(mm)	40×175×133	40×175×119	40×175×130	40×175×109	40×175×130

(Note 1) "Short term" means roughly within one month.
(Note 2) This value includes the maximum value of DO external load current (3.2A).
(Note 3) This value does not include DO external load current.
(Note 4) For the heating value of the I/O circuit, calculate with the number of points used.
(Note 5) For the whole NC system, consider the characteristics of the drive units when the altitude is more than 1000 meters above sea level. Refer to the manual of drive unit for details.
(Note 6) The maximum value including the heating value of analog input circuit.

4.3.2 24VDC Stabilized Power Supply Selecting Conditions

Consider the following characteristics for the stabilized power supply, and select the power supply that complies with laws, regulations, or safety standards of the country where the machine will be installed.

Item		Specifications	Remarks
Output	**Voltage**	24VDC	When the stabilized power supply and 24VDC input unit are distant, select the stabilized power supply which is possible to set output voltage 24VDC or more allowing for the influence of voltage down by the cable.
	Voltage fluctuation	±5%	
	Current	-	Calculate the current value as a reference of maximum current consumption for the unit which uses the power supply.
	Ripple noise	0.2V (P-P)	
	Output holding time	min 20ms	Output holding time is decided by loading ratio; however, the stabilized power supply which complies with the specification on the left must be selected during maximum loading.
	Overcurrent output shutoff function	-	Use a power supply having the overcurrent output shutoff function.

⚠ CAUTION

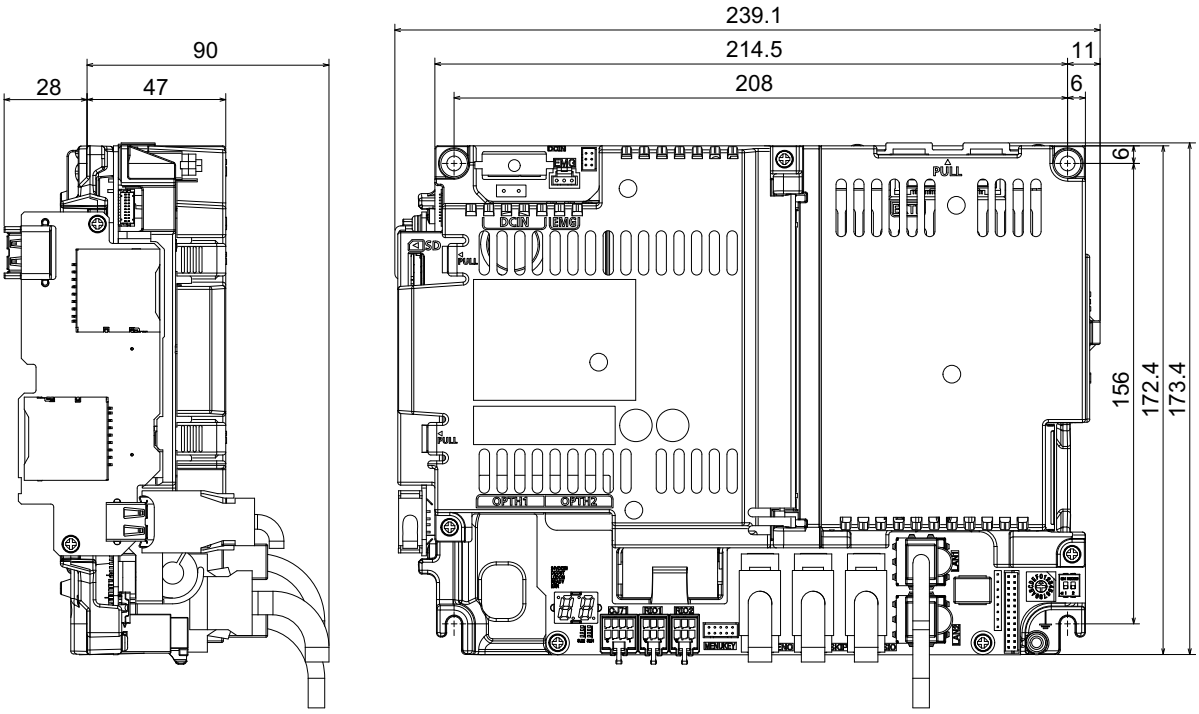
1. Using a stabilized power supply without overcurrent protection may cause the unit's failure due to miswiring of 24V.

4.4 Control Unit [M800S]

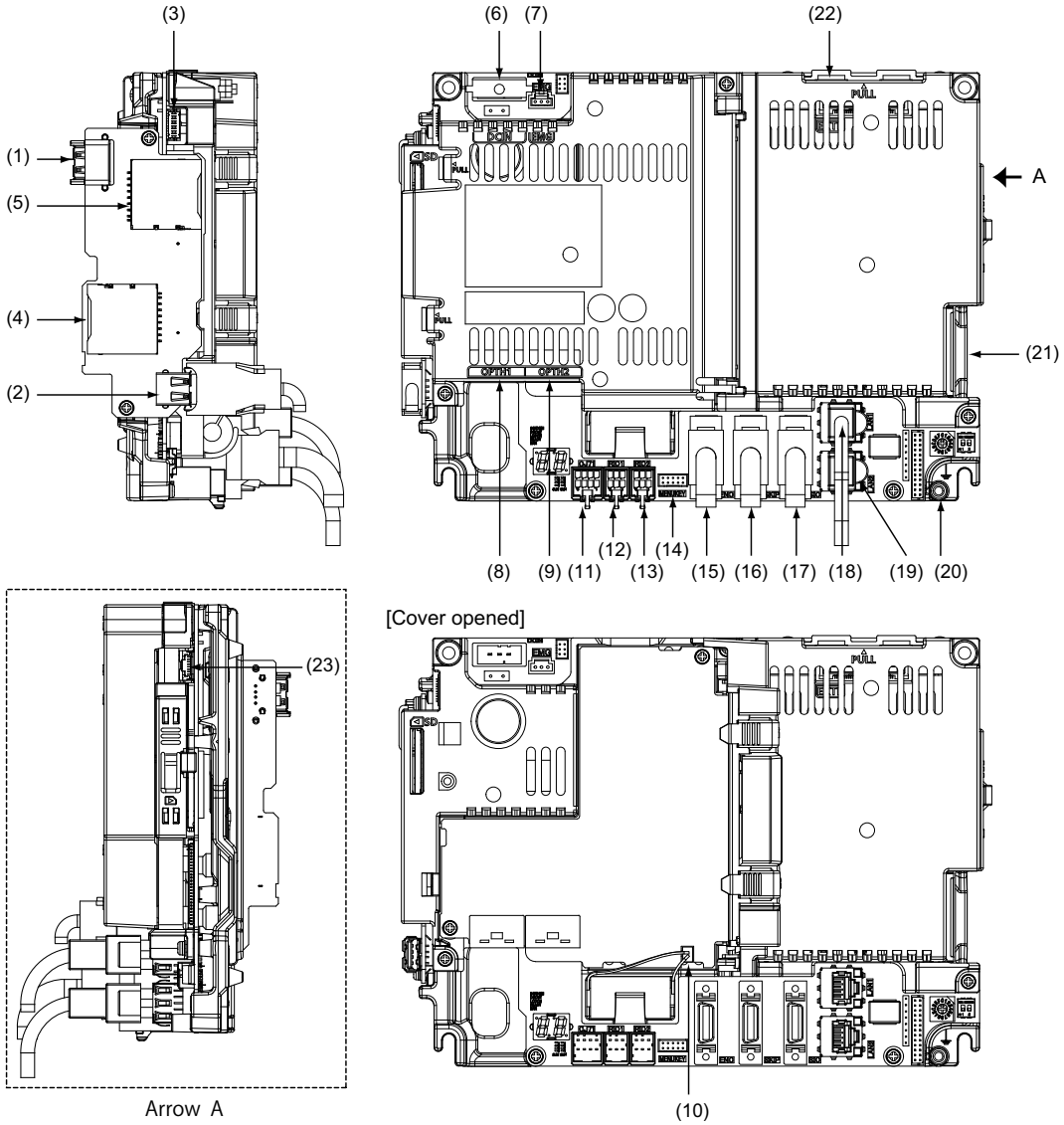
4.4.1 FCU8-MU542 / FCU8-MA542 / FCU8-MU541 / FCU8-MA541

[Outline dimension]

[mm]



[Connector]



No.	Connector name	Function		No.	Connector name	Function
(1)	USB_F	Front-side USB memory I/F		(13)	RIO2	Remote I/O 2.0 communication
(2)	USB_B			(14)	MENUKEY	Menu key I/F
(3)	BL	Display unit backlight I/F		(15)	ENC	Encoder input 1ch (5V manual pulse generator input 2ch)
(4)	SDC_F	Front-side SD card I/F		(16)	SKIP	SKIP input 8 points
(5)	SDC_B	Back-side SD card I/F		(17)	SIO	RS-232C communication 2ch
(6)	DCIN	24VDC input		(18)	LAN1	Ethernet communication
(7)	EMG	External emergency stop input		(19)	LAN2	System reserved
(8)	OPTH1	High-speed optical servo communication		(20)	FG	FG terminal
(9)	OPTH2	High-speed optical servo communication		(21)	LCD	Display unit signal I/F
(10)	BAT	Battery I/F		(22)	EXT_P	Function expansion unit I/F
(11)	CJ71	Operation panel I/O unit I/F		(23)	TP	Touch panel I/F
(12)	RIO1	Remote I/O 2.0 communication				

⚠ CAUTION

⚠ Do not apply any voltage to the connectors other than voltage specified in this manual. Failure to observe this could cause bursting, damage, etc.

⚠ Connect the cables to the designated connectors. Incorrect connections could damage the device.

⚠ 12V, 5V, and 3.3V output from connectors are to supply the power for dedicated peripheral devices. Do not use for other equipment to supply the power since we do not guarantee the NC operation by voltage down or noise sneaking.

(1) USB_F (Front-side USB memory I/F)

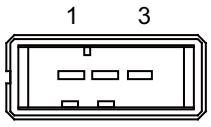
(2) USB_B

(3) BL (Display unit backlight I/F)

(4) SDC_F (Front-side SD card I/F)

(5) SDC_B (Back-side SD card I/F)

(6) DCIN (24VDC input)



1	I	+24V
2		0V
3		FG

<Cable side connector type>

Connector : 2-178288-3
Contact : 1-175218-5
Manufacturer: TE Connectivity

(a) Specifications of power supply

Consider the following characteristics when selecting the stabilized power supply (prepared by machine tool builder). Use a power supply that complies with CE Marking or that follows the safety standards given below.

[Stabilized power supply selection items]

Item		Standard setting
Output	**Voltage fluctuation**	±5% or less of 24VDC
	Ripple noise	200mV (P-P)
Power capacity		Calculate the current value as a reference of maximum current consumption for the unit which uses the power supply.
Output holding time		20ms
Overcurrent protection		Required

[Standards]

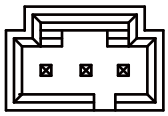
Safety Standards	UL1950, CSA C22.2 No. 234 approved, IEC950 compliant
Noise Terminal Voltage	FCC Class A, VCCI Class A
High Harmonics Current Restrictions	IEC61000-3-2

(Note) 24VDC voltage may drop instantaneously due to rush current at the beginning of 24V power supply to the control unit.
The level of voltage drop depends on the capacity of the power supply. Do not share the power supply with the devices that have alarms to warn the voltage drop.

⚠ CAUTION

1. Using a stabilized power supply without overcurrent protection may cause the unit's failure due to miswiring of 24V.

(7) EMG (External emergency stop input)



3 2 1

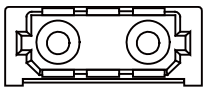
1		FG
2	I	EMG IN
3	O	+24V

<Cable side connector type>

Connector : 50-57-9403
Contact : 0016020103
Manufacturer: MOLEX

(Note) Use this when installing an emergency stop switch in the electric cabinet. Connect a terminator (G123 cable) when not using this connector.

(8) OPTH1 (High-speed optical servo communication 1st ch)
(9) OPTH2 (High-speed optical servo communication 2nd ch)

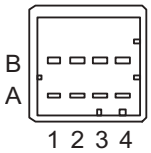


<Cable side connector type>

Connector : LGP-Z0007K
Manufacturer: HONDA TSUSHIN KOGYO

(10) BAT (Battery I/F)

(11) CJ71 (Operation panel I/O unit I/F)



A1	I/O	TXRXD	B1	I/O	TXRXD*
A2	-	+5V	B2	-	+3.3V
A3	-	-	B3	-	0V
A4	-	FG	B4	-	0V

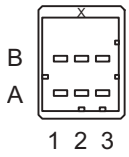
<Cable side connector type>

Connector : 2-1318119-4
Contact : 1318107-1
Manufacturer: TE Connectivity

(12) RIO1 (Remote I/O 2.0 communication 1st channel)

(13) RIO2 (Remote I/O 2.0 communication 2nd channel)

Up to 64 remote I/O stations can be connected.



A			B		
1	I/O	TXRXD	**1**	I/O	TXRXD*
2		NC	**2**		0V
3		FG	**3**		NC

<Cable side connector type>

Connector : 1-1318119-3

Contact : 1318107-1

Manufacturer: TE Connectivity

(a) Connecting a pulse-controlled inverter [M80/E80]

For M80/E80, RIO1 and RIO2 connectors can be used as interfaces to output pulses. With this function, you can connect a pulse-controlled inverter with RS422 interface to M80/E80.

(Note 1) When you use a function with pulse output, remote I/O unit cannot be connected to the RIO1 and RIO2 connectors.

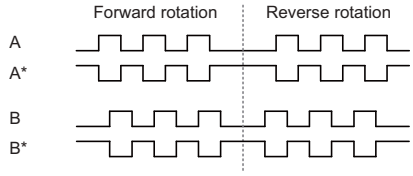
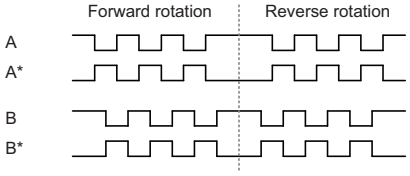
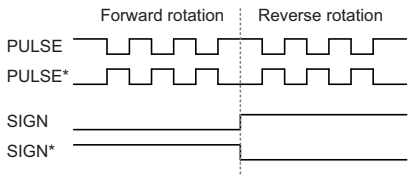
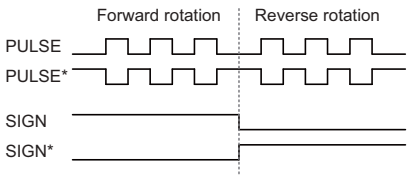
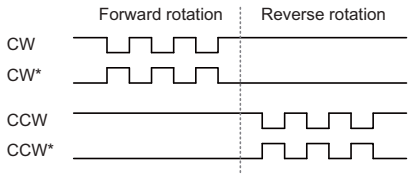
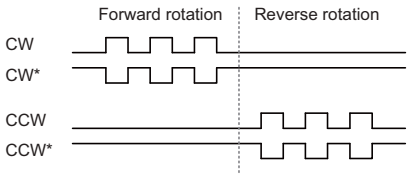
(Note 2) When you use a function with pulse output, BiSS encoder and EcoMonitorLight cannot be connected to the RIO2 connector.

RIO1						RIO2					
A			B			A			B		
1	O	A/PULSE/CW	1	O	A*/PULSE*/CW*	1	O	B/SIGN/CCW	1	O	B*/SIGN*/CCW*
2		NC	2		0V	2		NC	2		0V
3		FG	3		NC	3		FG	3		NC

Pulse output specifications

Number of control axes		One axis
Pulse output mode (Note)		A phase/B phase, PULSE/SIGN, CW/CCW
Pulse output frequency		1 to 4,000,000 pulses per second
Pulse output signal		RS422 differential driver output
Signal voltage	**Differential output voltage**	2.0 V or greater
	Common mode output voltage	3.0 V or less
Output current		250 mA in maximum
Cable wire length		30 meters or less

(Note) The output signal logic type can be selected with the logic selecting function.

Pulse output mode	Positive logic	Negative logic
A phase/B phase		
PULSE/SIGN		
CW/CCW		

(b) Connecting a BiSS encoder

RIO2 connector and ENC connector can be used as BiSS interface. This enables you to connect a BiSS encoder with RS422 interface.

(Note) When the BiSS encoder is connected, the remote I/O unit, the pulse-controlled inverter, and the EcoMonitorLight cannot be connected to the RIO2 connector.

RIO2					
A			B		
1	O	MA+	**1**	O	MA-
2		NC	**2**		0V
3		FG	**3**		NC

<Cable side connector type>

Connector: 1-1318119-3
Contact: 1318108-1
Manufacturer: TE Connectivity

BiSS interface specifications

Connectable number		One piece
Protocol		BiSS C (Note)
Transmission		625 kbps to 5 Mbps
Output signal		RS422 differential driver output
Output signal voltage	**Differential output voltage**	2.0 V or greater
	Common mode output voltage	3.0 V or less
Output current		250 mA in maximum
Input signal		RS422 differential driver input
Input signal voltage	**Differential input voltage**	0.2 V or greater
	Input voltage range	0V to 5.25V
Cable length		30 m or less

(Note) Access to the slave register is not supported.

(c) Connecting an EcoMonitorLight

EcoMonitorLight can be connected to the RIO2 connector.

(Note) When the EcoMonitorLight is connected, the remote I/O unit, the pulse-controlled inverter, and the BiSS encoder cannot be connected to the RIO2 connector.

RIO2					
A			B		
1	I/O	485+	**1**	I/O	485-
2		NC	**2**		NC
3		SLD	**3**		NC

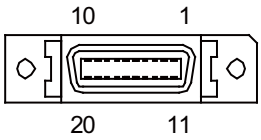
<Cable side connector type>

Connector: 1-1318119-3
Contact: 1318107-1
Manufacturer: TE Connectivity

(14) MENUKY (Menu key I/F)

(15) ENC (Encoder input 1ch, 5V manual pulse generator input 2ch)

Synchronous feed encoder or 5V manual pulse generator can be connected to this connector.



1		0V	**11**		0V
2	I	ENC1Z	**12**	I	ENC1Z*
3	I	ENC1B	**13**	I	ENC1B*
4	I	ENC1A	**14**	I	ENC1A*
5		0V	**15**		0V
6	O	+5V	**16**	O	+5V
7	I	HA2A	**17**	I	HA2B
8	I	HA1A	**18**	I	HA1B
9		NC	**19**		NC
10	O	+5V	**20**	O	+5V

- Connect connector case with FG pattern.

<Cable side connector type>

Plug : 10120-3000PE
Shell : 10320-52F0-008
Manufacturer: 3M

(Note 1) When using the jackscrew M2.6-type 10320-52A0-008 for the shell, do not fasten the screws too tightly otherwise the connector and the PCB may be damaged.
(Manufacturer recommended tightening torque: 0.20±0.05N·m)

(Note 2) Both the synchronous feed encoder and the manual pulse generator can be connected at the same time. (In this case, the cables must be prepared by the machine tool builder.)

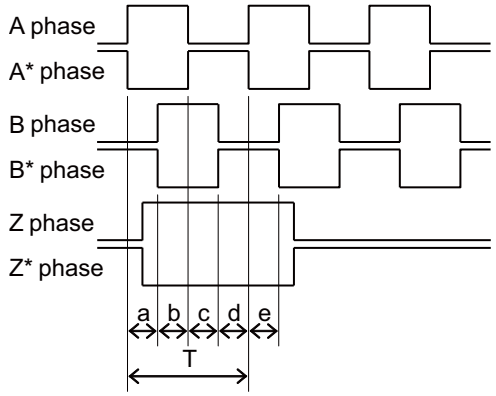
(a) Input for synchronous feed encoder

(Note) When a synchronous feed encoder is connected, a BiSS encoder cannot be connected.

Specification of input part

Number of pulse phases		Three phases (A phase, B phase, a phase difference 90 degrees, Z phase) (Refer to the waveform below.)
Signal output of the encoder		RS422 differential driver output
Signal voltage	**Differential input voltage**	0.2 V or greater
	Input voltage range	0V to 5.25V
Power supply voltage		5VDC±10%
Current consumption		200mA or less
Number of pulses per rotation		1024 pulse/rev (However, any pulse can be set when the external encoder position output I/F function is used.)
Input frequency (rotation speed)		512kHz or less (30000r/min or less) <Note>
Cable length		50m or less

<Note> When the parameter "#1753 cfgPR03/bit2" (Disable extension of encoder input frequency) is "1", the input frequency is 136kHz or less and the rotation speed is 8000r/min or less. However, in M8 Series software version FC or earlier, the input frequency is 136kHz or less and the rotation speed is 8000r/min or less regardless of the parameter setting.

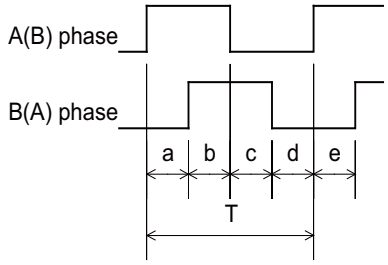


a.b.c.d.e: A phase or B phase rising edge (falling edge) phase difference = T/4 ± T/10

(b) Input for 5V manual pulse generator

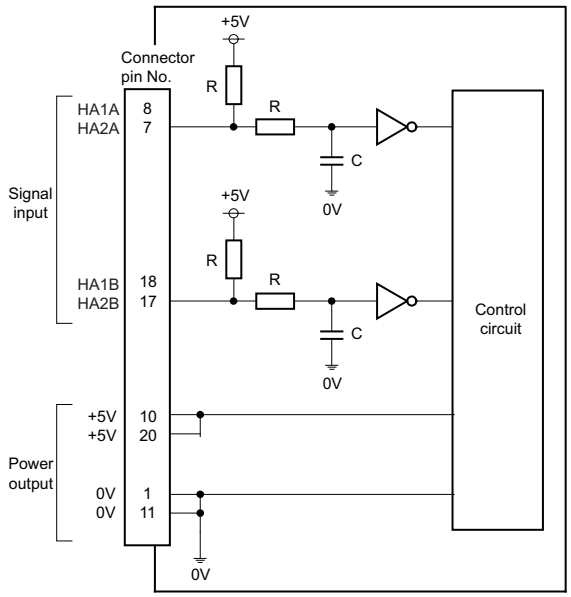
Specification of input part

Number of pulse phases	Two phases (A phase, B phase, a phase difference 90 degrees) (Refer to the waveform below.)
Signal output of manual pulse generator	Voltage output, open collector output
Signal voltage	H level 3.5V to 5.25V L level 0V to 0.5V
Power supply voltage	5VDC±10%
Current consumption	100mA or less
Number of pulses per rotation	25 pulse/rev, 100 pulse/rev
Input frequency (rotation speed)	1kHz or less (2400r/min or less for 25pluse/rev, 600r/min or less for 100pluse/rev)
Cable length	20m or less



a.b.c.d.e: A phase or B phase rising edge (falling edge) phase difference = T/4 ± T/10
T: A or B phase cycle

Input/output circuit



When using the synchronous feed encoder and the manual pulse generator at the same time, connect the manual pulse generator to the operation panel I/O unit or use a distribution cable made by the machine tool builder.

(c) Connecting a BiSS encoder

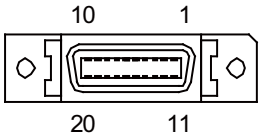
Refer to "(b) Connecting a BiSS encoder" in (13) for the BiSS encoder specifications.

(Note) When the BiSS encoder is connected, the synchronous feed encoder cannot be connected.

1		0V	**11**		0V
2		NC	**12**		NC
3		NC	**13**		NC
4	I	SL+	**14**	I	SL-
5		0V	**15**		0V
6	O	+5V	**16**	O	+5V
7	I	HA2A	**17**	I	HA2B
8	I	HA1A	**18**	I	HA1B
9		NC	**19**		NC
10	O	+5V	**20**	O	+5V

HA1A, HA1B, HA2A, and HA2B are signals for the manual pulse generator.
They are used when the BiSS encoder and the manual pulse generator are connected at the same time.

(16) SKIP (SKIP input 8 points)



1		COM GND	**11**		COM GND
2	I	SKIP IN1	**12**	I	SKIP IN2
3	I	SKIP IN3	**13**	I	SKIP IN4
4		NC	**14**		NC
5		COM GND	**15**		COM GND
6		NC	**16**		NC
7	I	SKIP IN5	**17**	I	SKIP IN6
8	I	SKIP IN7	**18**	I	SKIP IN8
9		NC	**19**		NC
10		NC	**20**		NC

- Connect connector case with FG pattern.

<Cable side connector type>

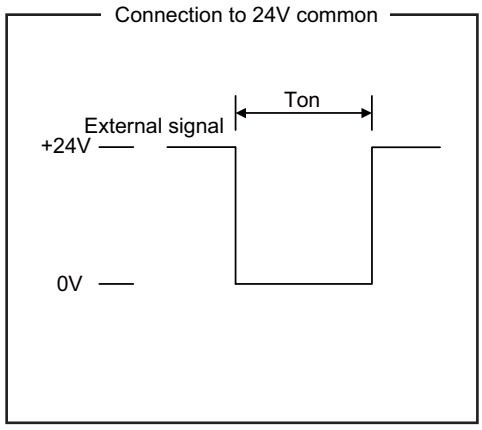
Plug : 10120-3000PE
Shell : 10320-52F0-008
Manufacturer: 3M

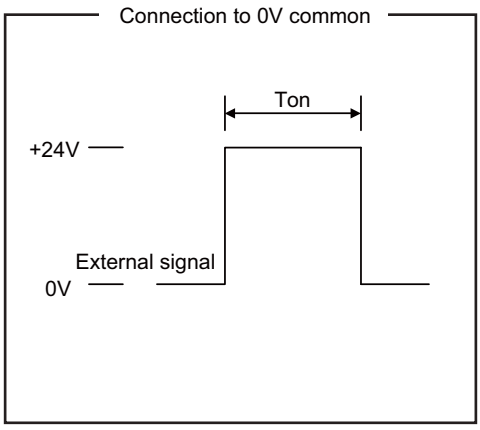
(Note) When using the jackscrew M2.6-type 10320-52A0-008 for the shell, do not fasten the screws too tightly otherwise the connector and the PCB may be damaged.
(Manufacturer recommended tightening torque: 0.20±0.05N·m)

(a) Skip signal input conditions

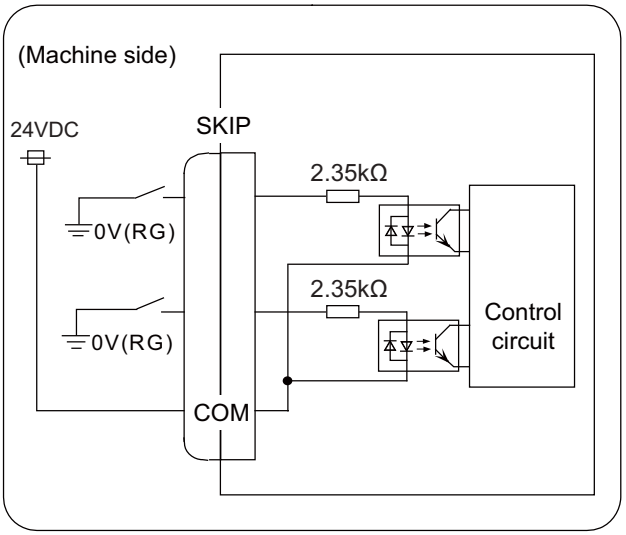
Use the input signal within the following condition ranges.

		24V common	0V common
1	**Input voltage at external contact ON**	6V or less	18V or more, 25.2V or less
2	**Input current at external contact ON**	6mA or more	
3	**Input voltage at external contact OFF**	20V or more, 25.2V or less	4V or less
4	**Input current at external contact OFF**	2mA or less	
5	**Input resistance**	2.35kΩ	
6	**Input signal holding time (Ton)**	2ms or more	
7	**Internal response time**	0.08ms or less	
8	**Machine side contact capacity**	+30V or more, 16mA or more	

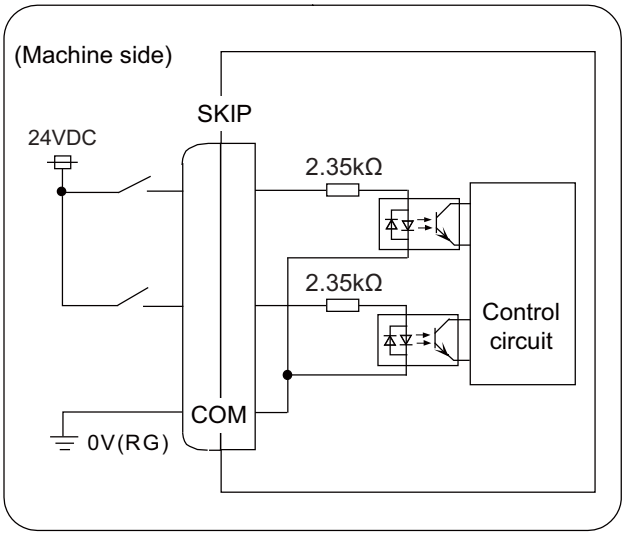




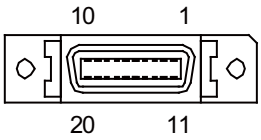
Connection to 24V common



Connection to 0V common



(17) SIO (RS-232C communication 2ch)



1		0V	**11**		0V
2	I	RD1(RXD1)	**12**	O	SD1(TXD1)
3	I	CS1(CTS1)	**13**	O	RS1(RTS1)
4	I	DR1(DSR1)	**14**	O	ER1(DTR1)
5		0V	**15**		0V
6		NC	**16**		NC
7	I	RD2(RXD2)	**17**	O	SD2(TXD2)
8	I	CS2(CTS2)	**18**	O	RS2(RTS2)
9	I	DR2(DSR2)	**19**	O	ER2(DTR2)
10		NC	**20**		NC

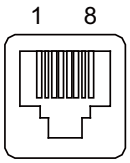
- Connect connector case with FG pattern.

<Cable side connector type>

Plug : 10120-3000PE
Shell : 10320-52F0-008
Manufacturer: 3M

(Note) When using the jackscrew M2.6-type 10320-52A0-008 for the shell, do not fasten the screws too tightly otherwise the connector and the PCB may be damaged.
(Manufacturer recommended tightening torque: 0.20±0.05N·m)

(18) LAN1 (Ethernet communication)



1	I/O	TXRXD0+
2	I/O	TXRXD0-
3	I/O	TXRXD1+
4	I/O	TXRXD2+
5	I/O	TXRXD2-
6	I/O	TXRXD1-
7	I/O	TXRXD3+
8	I/O	TXRXD3-

- Connect connector case with FG pattern.
- Use J303 cable when directly connecting a device such as a personal computer to the unit.

<Cable side connector type>

Connector : J00026A0165
Manufacturer: Japan Telegärtner

(19) LAN2 (System reserved)

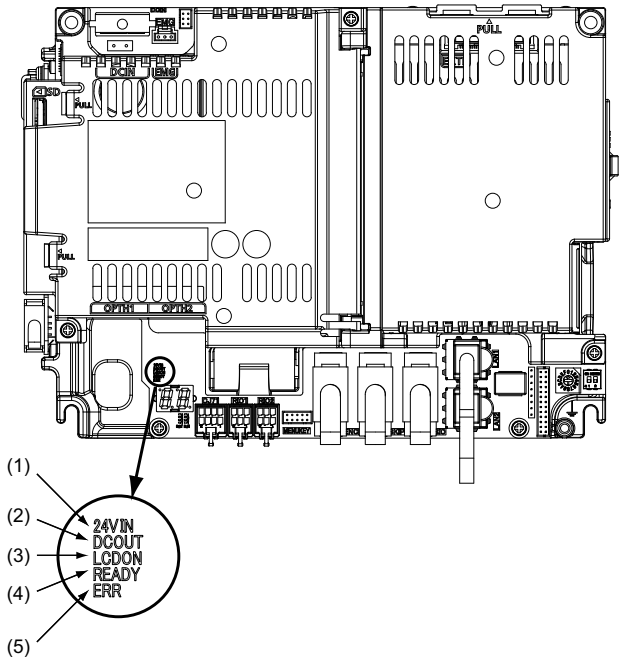
(20) FG (FG terminal)

(21) LCD (Display unit signal I/F)

(22) EXT_P (Function expansion unit I/F)

(23) TP (Touch panel I/F)

[LED]



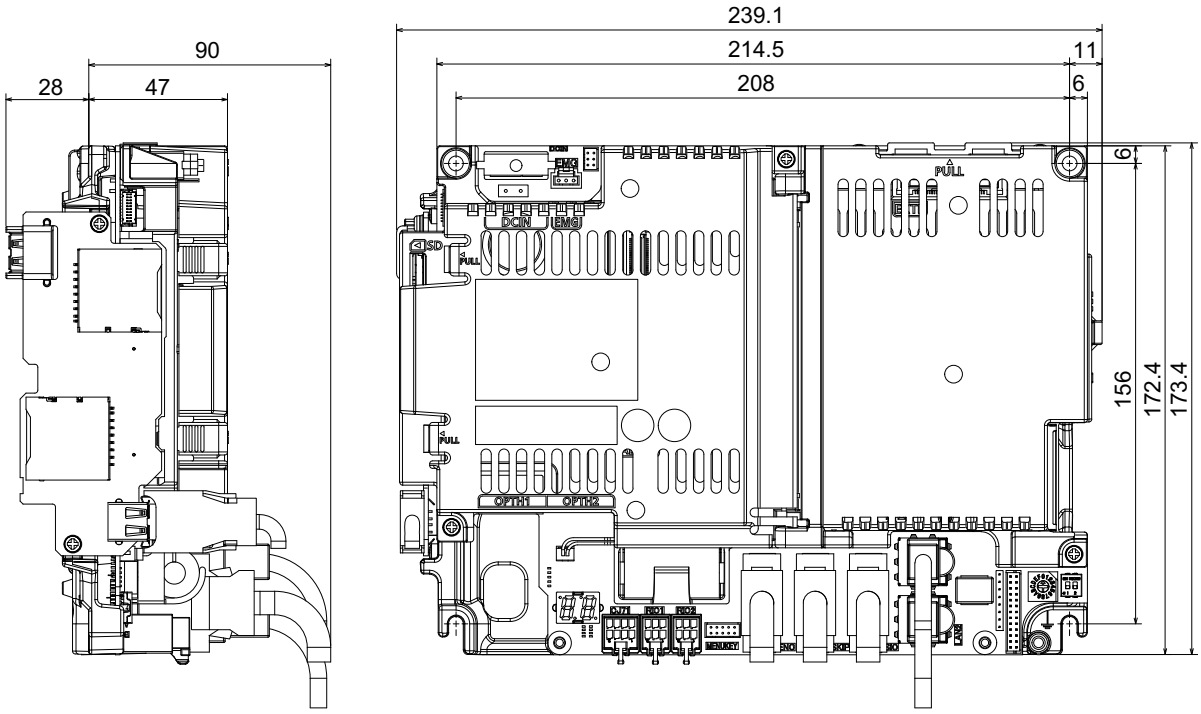
No.	Name	Lamp state	Details
(1)	24VIN	Lit (Green)	24VDC power is being supplied from the external power supply.
		Not lit	The following may have caused an error: - No 24VDC-power supply from the external power supply. - Disconnection of fuse near DCIN connector. - Failure of LED.
(2)	DCOUT	Lit (Green)	Internal voltage is normally output.
		Not lit	The followings may have caused an error: - No 24V-power supply from the external power supply. - Failure in any of the power output circuits. - Failure of LED or IC which helps turn the LED ON.
(3)	LCDON	Lit (Green)	12VDC for the backlight of display unit is normally output.
		Not lit	The followings may have caused an error: - Failure of 12VDC output in control unit. - 24VDC input voltage is +20V or less.
(4)	READY	Lit (Green)	Ready ON state.
		Not lit	Ready OFF state.
(5)	ERR	Lit (Red)	H/W is not operating properly. The followings may have caused an error: - Occurrence of NC watchdog error. - Failure of main CPU card.
		Not lit	H/W is operating properly.

4.5 Control Unit [M80]

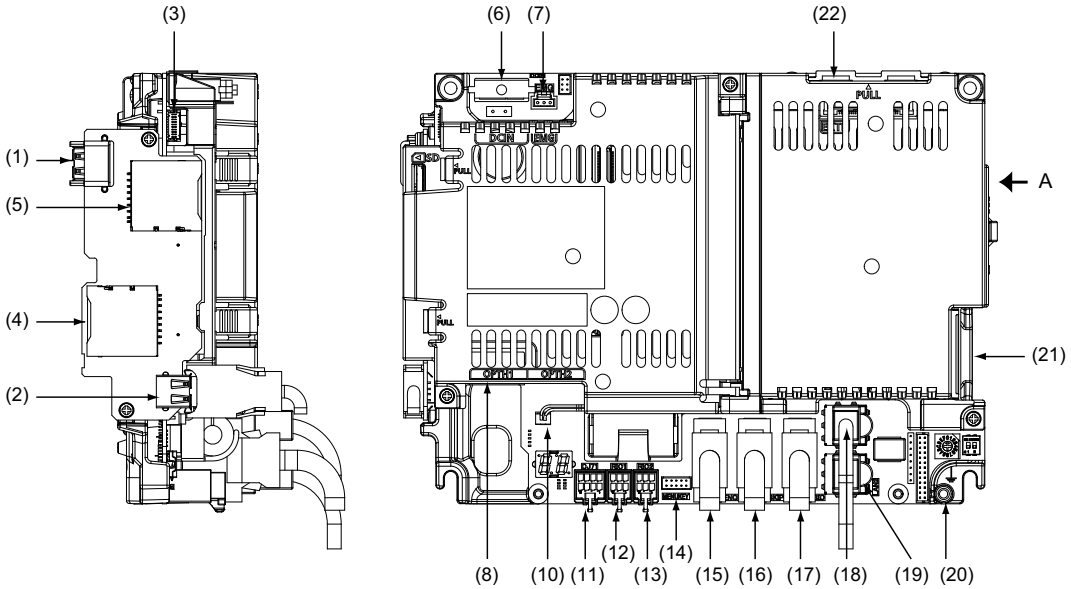
4.5.1 FCU8-MU511 / FCU8-MU512 / FCU8-MU501 / FCU8-MU502

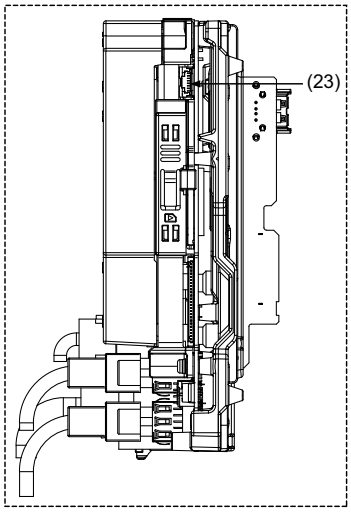
[Outline dimension]

[mm]



[Connector]



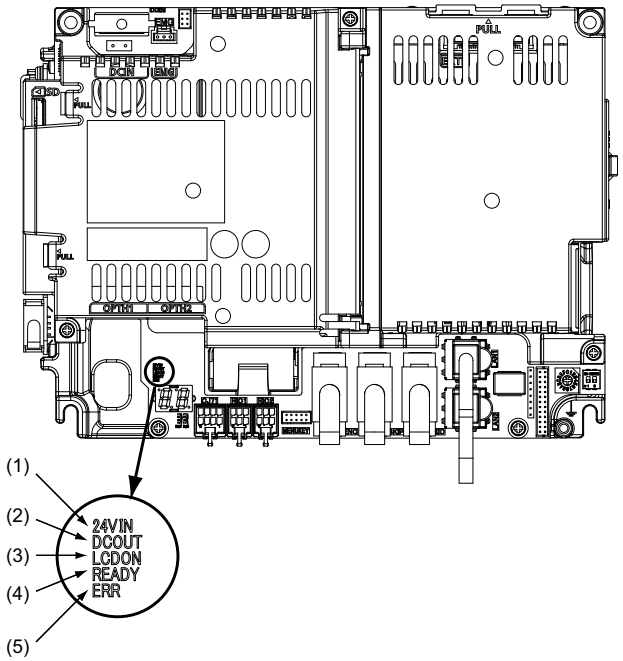


Arrow A

No.	Connector name	Function		No.	Connector name	Function
(1)	USB_F	Front-side USB memory I/F		(13)	RIO2	Remote I/O 2.0 communication
(2)	USB_B			(14)	MENUKEY	Menu key I/F
(3)	BL	Display unit backlight I/F		(15)	ENC	Encoder input 1ch (5V manual pulse generator input 2ch)
(4)	SDC_F	Front-side SD card I/F		(16)	SKIP	SKIP input 8 points
(5)	SDC_B	Back-side SD card I/F		(17)	SIO	RS-232C communication 2ch
(6)	DCIN	24VDC input		(18)	LAN1	Ethernet communication
(7)	EMG	External emergency stop input		(19)	LAN2	System reserved
(8)	OPTH1	High-speed optical servo communication		(20)	FG	FG terminal
(10)	BAT	Battery I/F		(21)	LCD	Display unit signal I/F
(11)	CJ71	Operation panel I/O unit I/F		(22)	EXT_P	Function expansion unit I/F
(12)	RIO1	Remote I/O 2.0 communication		(23)	TP	Touch panel I/F

Refer to "General Specifications: Control Unit [M800S]" for details on the connectors.

[LED]



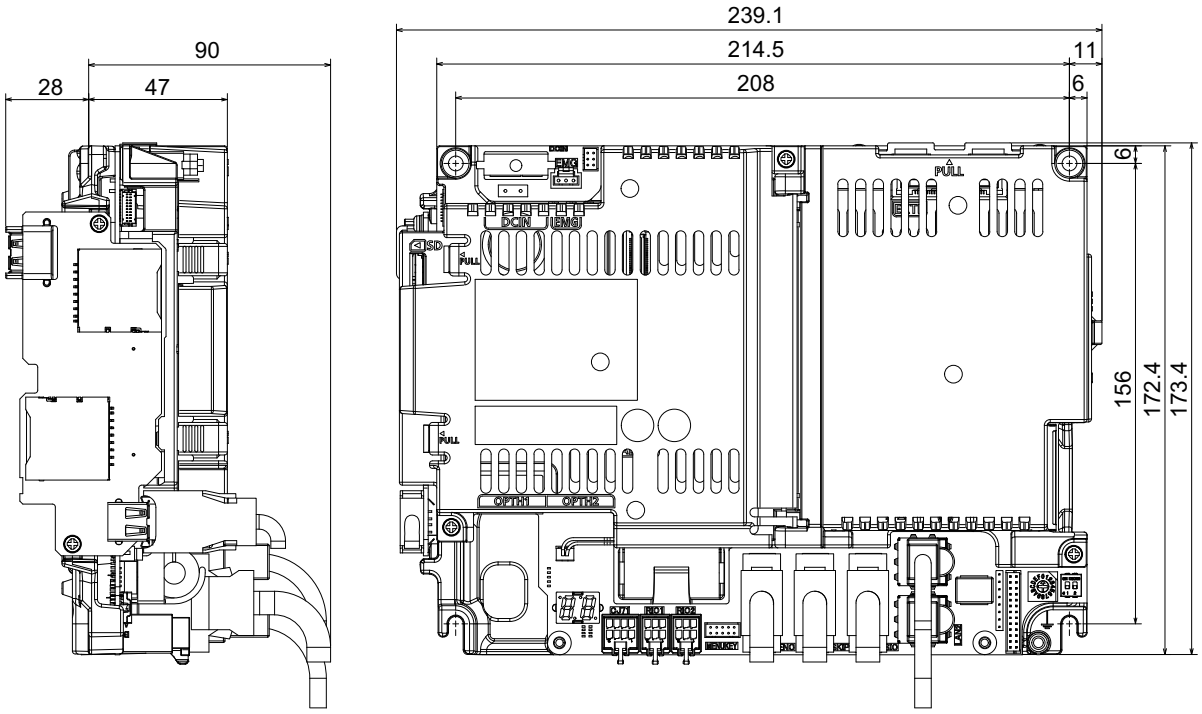
No.	Name	Lamp state	Details
(1)	24VIN	Lit (Green)	24VDC power is being supplied from the external power supply.
		Not lit	The following may have caused an error: - No 24VDC-power supply from the external power supply. - Disconnection of fuse near DCIN connector. - Failure of LED.
(2)	DCOUT	Lit (Green)	Internal voltage is normally output.
		Not lit	The followings may have caused an error: - No 24V-power supply from the external power supply. - Failure in any of the power output circuits. - Failure of LED or IC which helps turn the LED ON.
(3)	LCDON	Lit (Green)	12VDC for the backlight of display unit is normally output.
		Not lit	The followings may have caused an error: - Failure of 12VDC output in control unit. - 24VDC input voltage is +20V or less.
(4)	READY	Lit (Green)	Ready ON state.
		Not lit	Ready OFF state.
(5)	ERR	Lit (Red)	H/W is not operating properly. The followings may have caused an error: - Occurrence of NC watchdog error. - Failure of main CPU card.
		Not lit	H/W is operating properly.

4.6 Control Unit [E80]

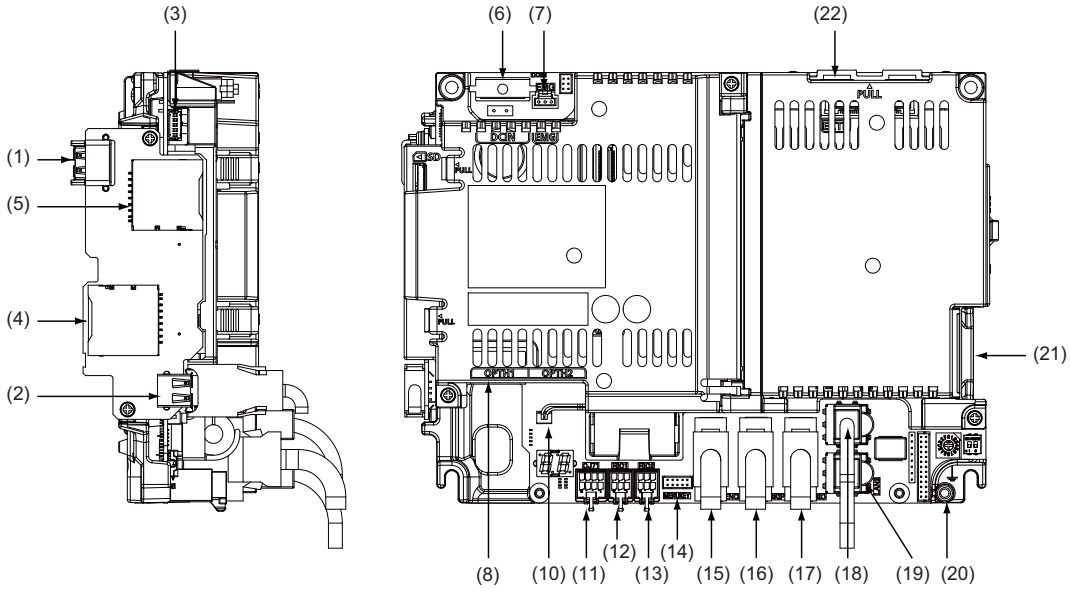
4.6.1 FCU8-MU513 / FCU8-MU514

[Outline dimension]

[mm]



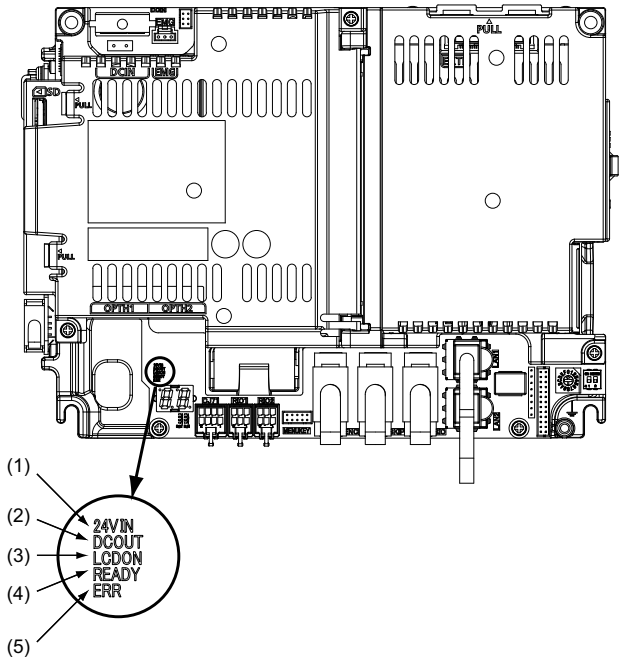
[Connector]



No.	Connector name	Function		No.	Connector name	Function
(1)	USB_F	Front-side USB memory I/F		(13)	RIO2	Remote I/O 2.0 communication
(2)	USB_B			(14)	MENUKEY	Menu key I/F
(3)	BL	Display unit backlight I/F		(15)	ENC	Encoder input 1ch (5V manual pulse generator input 2ch)
(4)	SDC_F	Front-side SD card I/F		(16)	SKIP	SKIP input 8 points
(5)	SDC_B	Back-side SD card I/F		(17)	SIO	RS-232C communication 2ch
(6)	DCIN	24VDC input		(18)	LAN1	Ethernet communication
(7)	EMG	External emergency stop input		(19)	LAN2	System reserved
(8)	OPTH1	High-speed optical servo communication		(20)	FG	FG terminal
(10)	BAT	Battery I/F		(21)	LCD	Display unit signal I/F
(11)	CJ71	Operation panel I/O unit I/F		(22)	EXT_P	Function expansion unit I/F
(12)	RIO1	Remote I/O 2.0 communication				

Refer to "General Specifications: Control Unit [M800S]" for details on the connectors.

[LED]

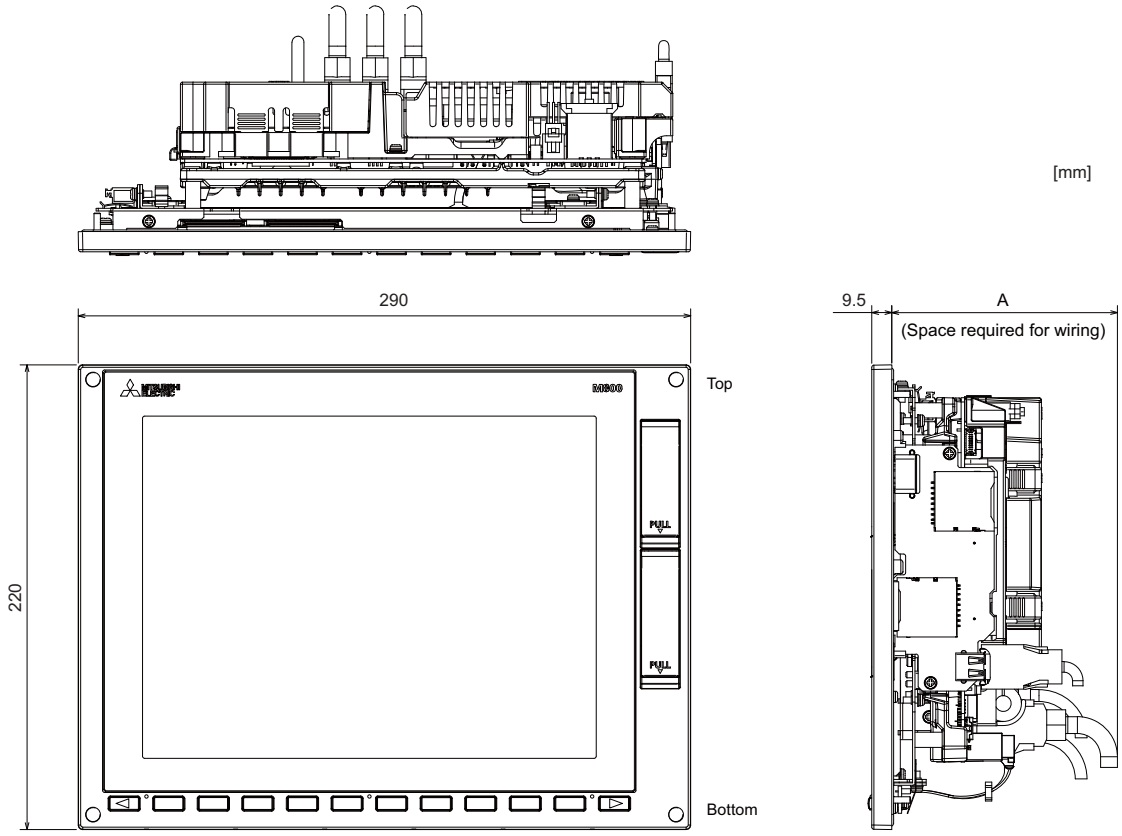


No.	Name	Lamp state	Details
(1)	24VIN	Lit (Green)	24VDC power is being supplied from the external power supply.
		Not lit	The following may have caused an error: - No 24VDC-power supply from the external power supply. - Disconnection of fuse near DCIN connector. - Failure of LED.
(2)	DCOUT	Lit (Green)	Internal voltage is normally output.
		Not lit	The followings may have caused an error: - No 24V-power supply from the external power supply. - Failure in any of the power output circuits. - Failure of LED or IC which helps turn the LED ON.
(3)	LCDON	Lit (Green)	12VDC for the backlight of display unit is normally output.
		Not lit	The followings may have caused an error: - Failure of 12VDC output in control unit. - 24VDC input voltage is +20V or less.
(4)	READY	Lit (Green)	Ready ON state.
		Not lit	Ready OFF state.
(5)	ERR	Lit (Red)	H/W is not operating properly. The followings may have caused an error: - Occurrence of NC watchdog error. - Failure of main CPU card.
		Not lit	H/W is operating properly.

4.7 Display Unit [M800S]

4.7.1 10.4-type (FCU8-DU142-31/FCU8-DU141-31)

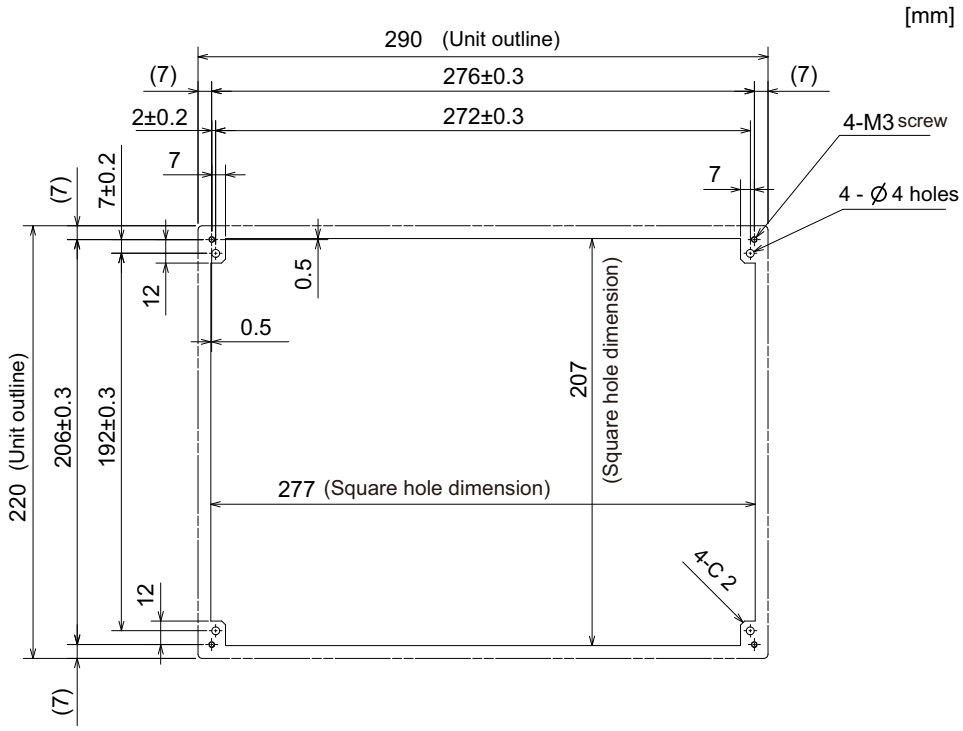
[Outline dimension]



	Option relay unit not mounted	Option relay unit, FCU8-EX702 mounted	Option relay unit, FCU8-EX703 mounted
A (Space required for wiring)	110		114

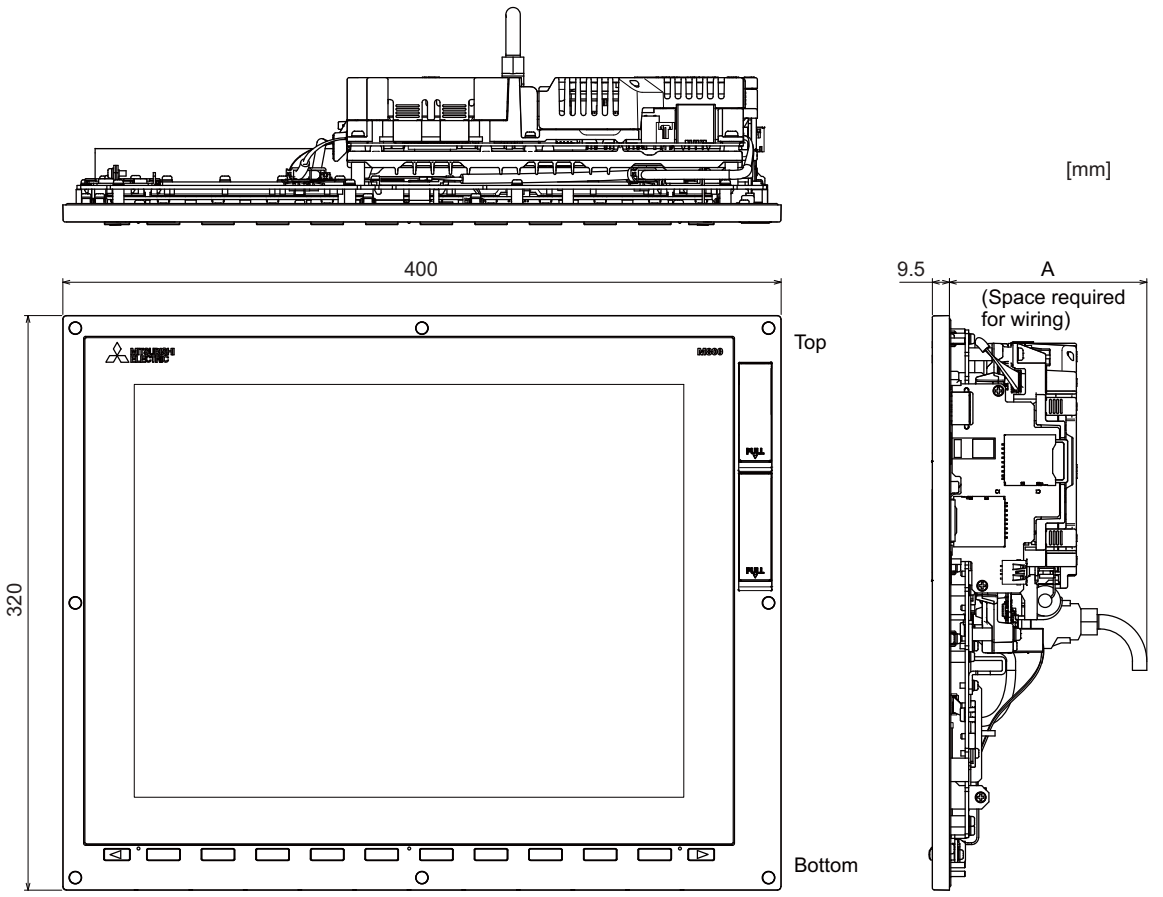
(Note) The figure above shows the state with the control unit mounted.

[Panel cut dimension]



4.7.2 15-type (FCU8-DU182-31/FCU8-DU181-31)

[Outline dimension: FCU8-DU182-31]

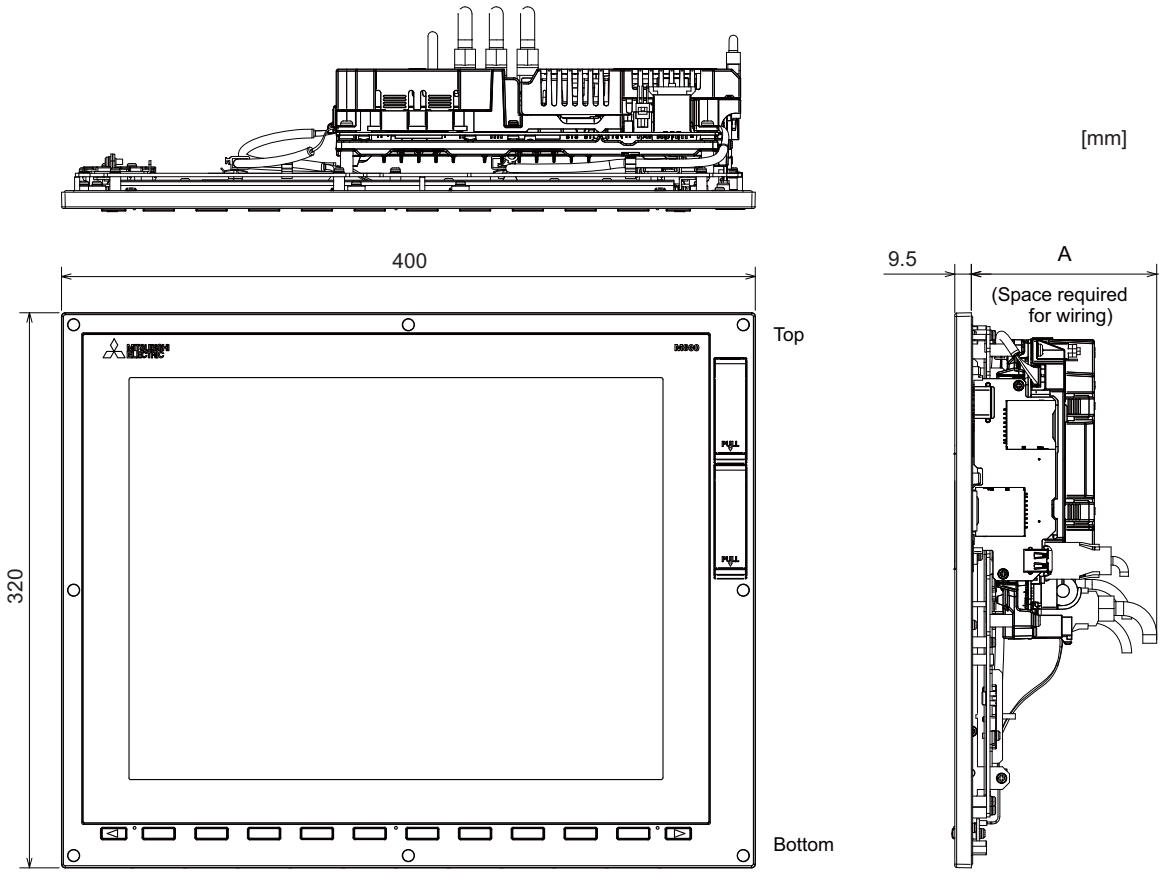


	Option relay unit not mounted	Option relay unit, FCU8-EX702 mounted	Option relay unit, FCU8-EX703 mounted
A (Space required for wiring)	110		114

(Note) The figure above shows the state with the control unit mounted.

[Outline dimension: FCU8-DU181-31]

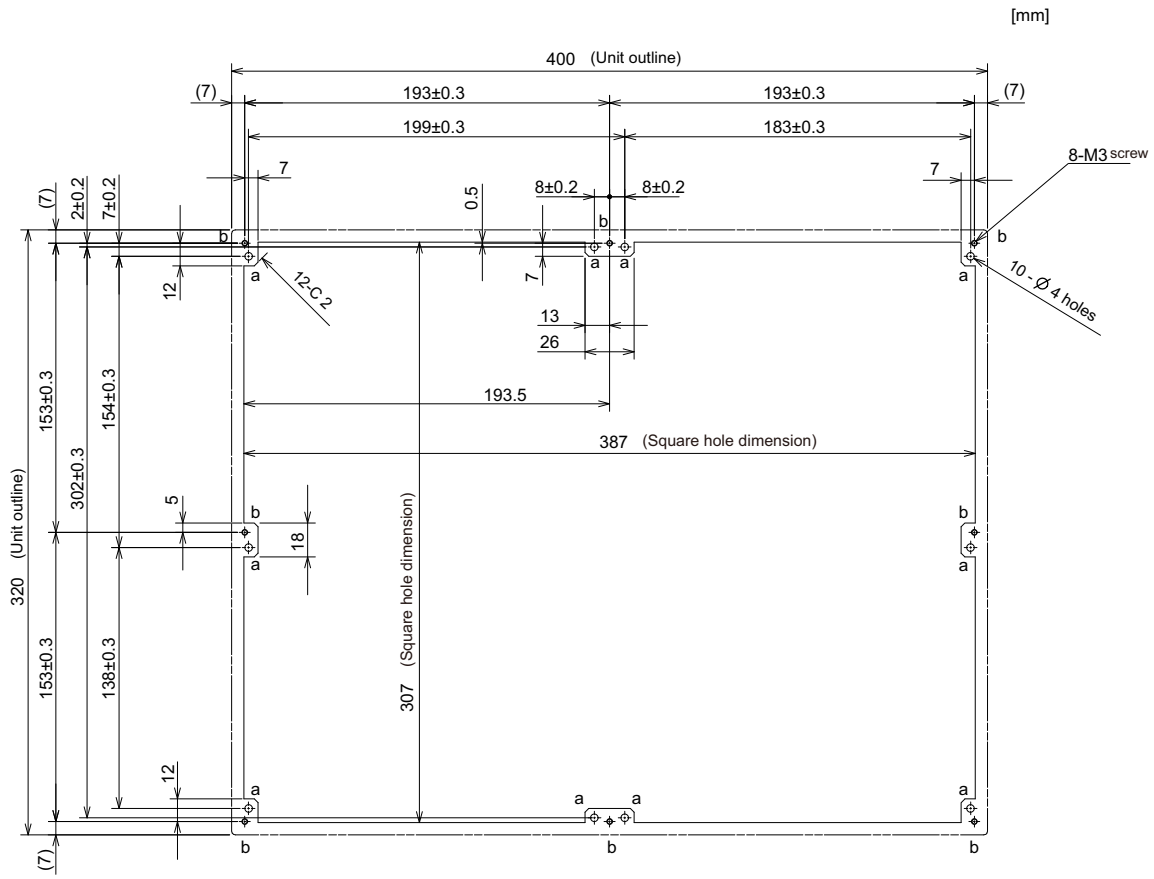
[mm]



	Option relay unit not mounted	Option relay unit, FCU8-EX702 mounted	Option relay unit, FCU8-EX703 mounted
A (Space required for wiring)	110		114

(Note) The figure above shows the state with the control unit mounted.

[Panel cut dimension]



4.7.3 Precautions

[Precautions for handling touchscreen]

(1) Operate the touchscreen with fingers. The touchscreen does not react with nails.
(2) The use of gloves, work gloves, etc. will have effects such as the deterioration of the operation feeling depending on the material and thickness of the gloves.
(3) The initialization process is performed for 3 seconds after the power is turned ON. Do not touch the touchscreen with a finger, hold a palm over, put the conductive objects such as metals on, etc., during the initialization.
(4) If the surface of the touchscreen gets dirt, wipe it off with soft cloth.
(5) Make sure to ground FG terminal of the control unit at one ground point. (Refer to "Installation: Connection of Frame Ground (FG)".) Otherwise, the reaction and usability of the touchscreen will remarkably deteriorate.
(6) Do not place a device which removes static electricity such as an ionizer. The static electricity-removing device may worsen the response and usability of the touchscreen.

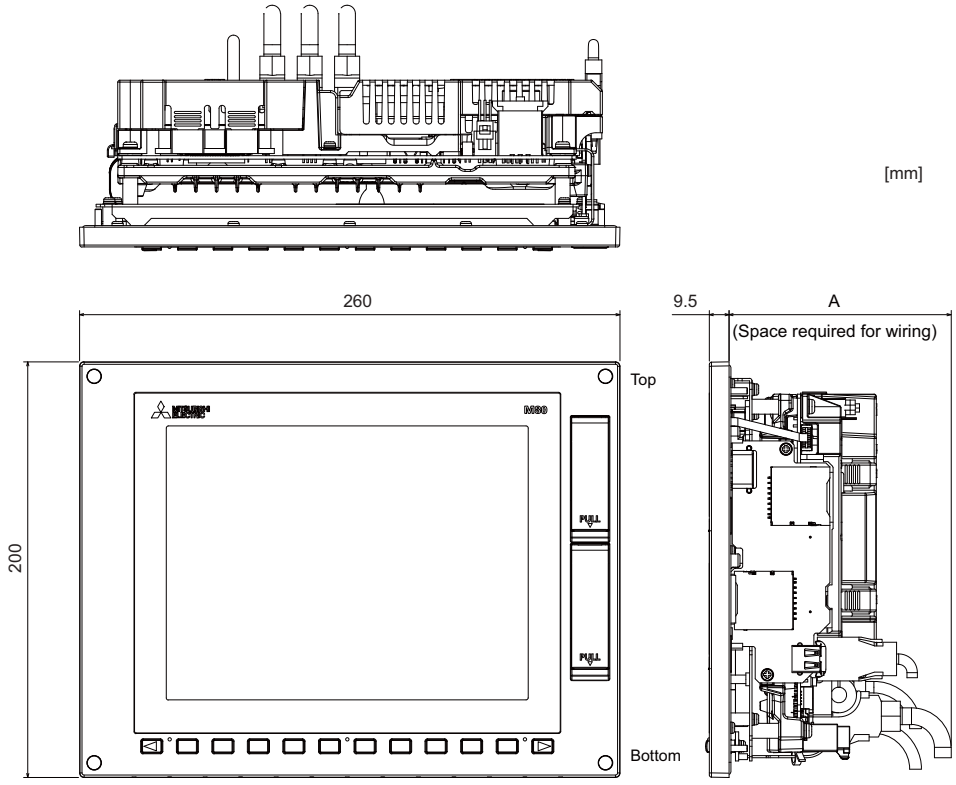
[Characteristic of liquid crystal display panels]

As a characteristic of liquid crystal display panels, bright dots (always lit) and dark dots (never lit) may appear on the panel.
Since liquid crystal display panels comprise a great number of display elements, the appearance of bright and dark dots cannot be reduced to zero.
Variation of liquid crystal display panels may cause differences in color, uneven brightness and flickering.
Note that these phenomena are characteristics of liquid crystal display panels and it does not mean the products are defective or damaged.

4.8 Display Unit [M80]

4.8.1 8.4-type (FCU8-DU121-12)

[Outline dimension]

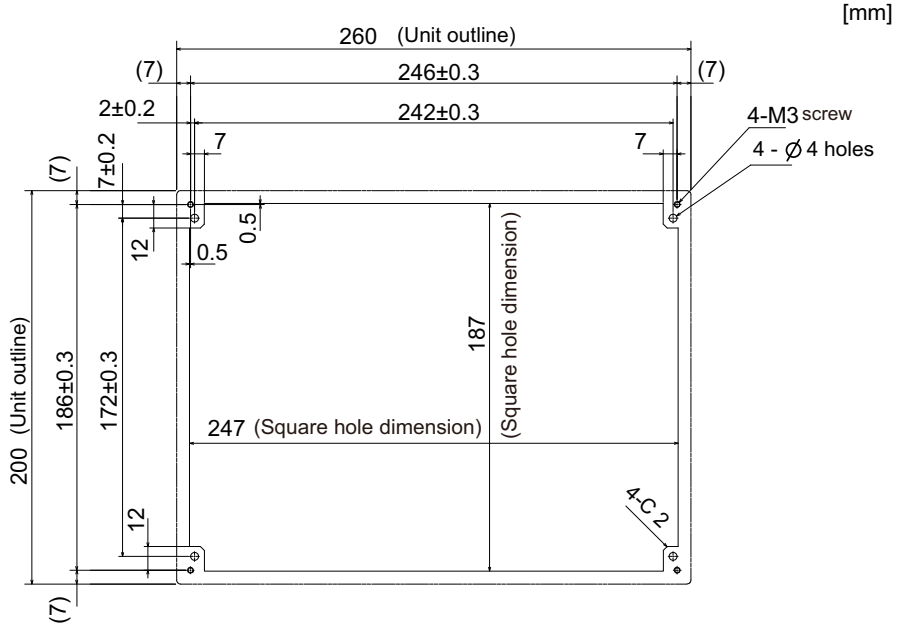


	Option relay unit not mounted	Option relay unit, FCU8-EX702 mounted	Option relay unit, FCU8-EX703 mounted
A (Space required for wiring)	110		114

(Note 1) The 8.4-type display unit is incompatible with the touchscreen.
(Note 2) The figure above shows the state with the control unit mounted.

[Panel cut dimension]

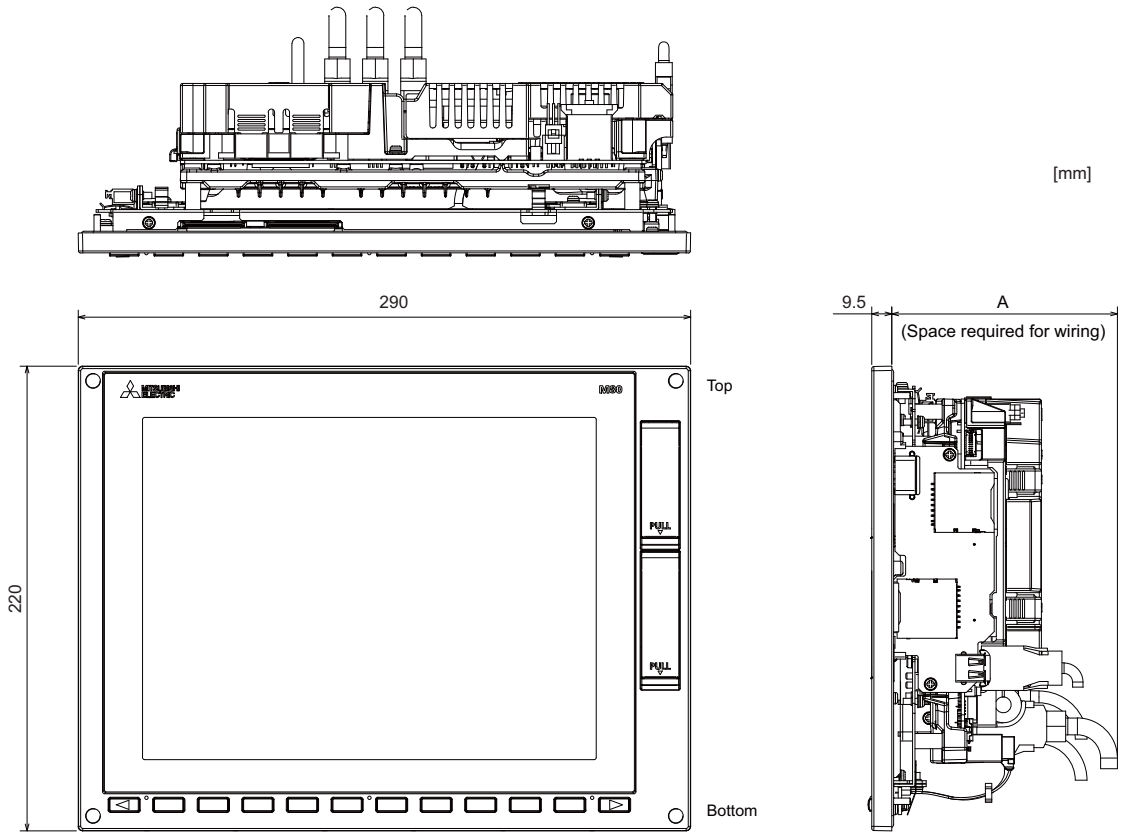
[mm]



4.8.2 10.4-type (FCU8-DU142-32/FCU8-DU141-32)

[Outline dimension]

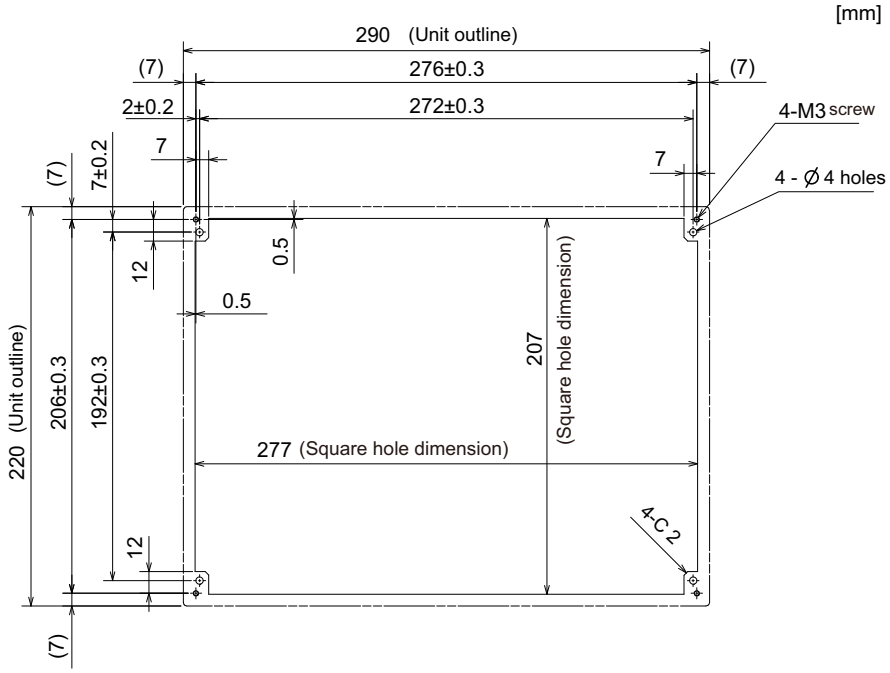
[mm]



	Option relay unit not mounted	Option relay unit, FCU8-EX702 mounted	Option relay unit, FCU8-EX703 mounted
A (Space required for wiring)	110		114

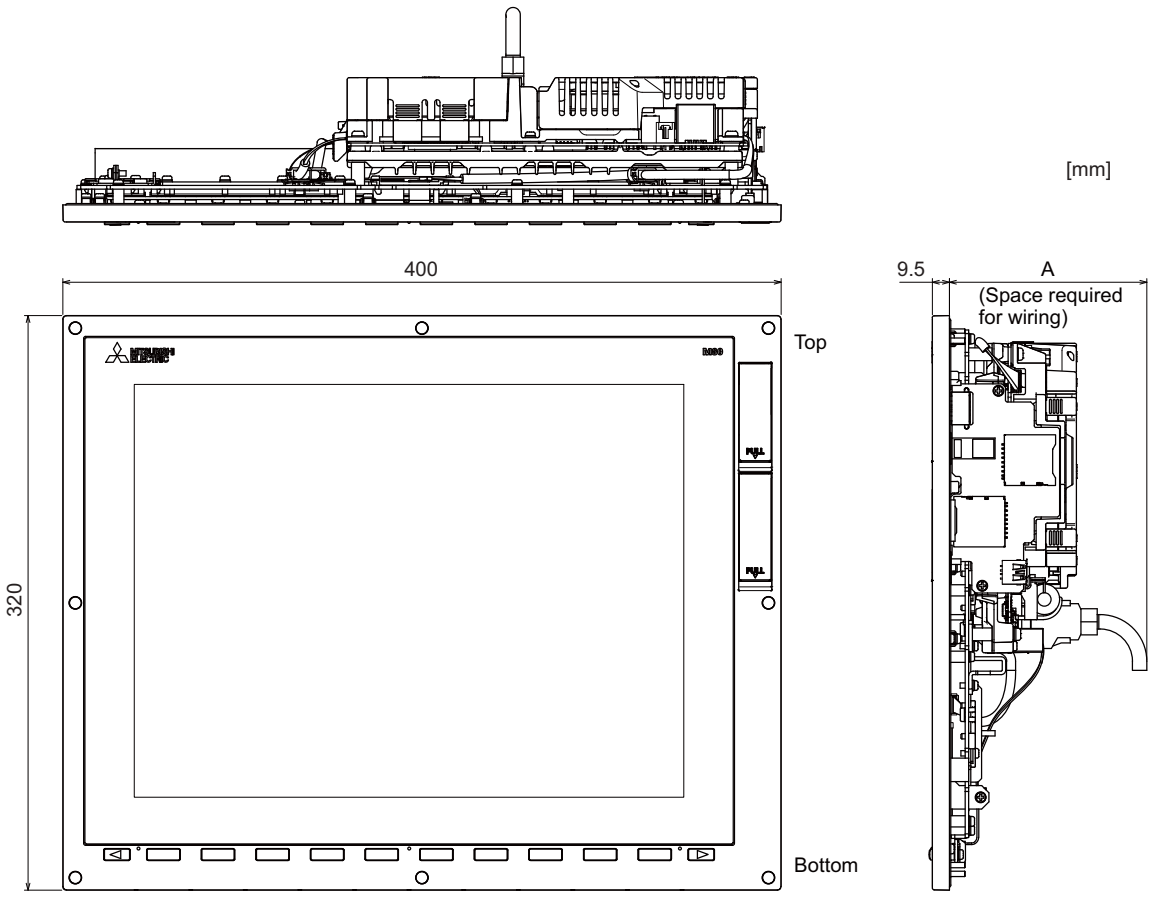
(Note) The figure above shows the state with the control unit mounted.

[Panel cut dimension]



4.8.3 15-type (FCU8-DU182-32/FCU8-DU181-32)

[Outline dimension: FCU8-DU182-32]

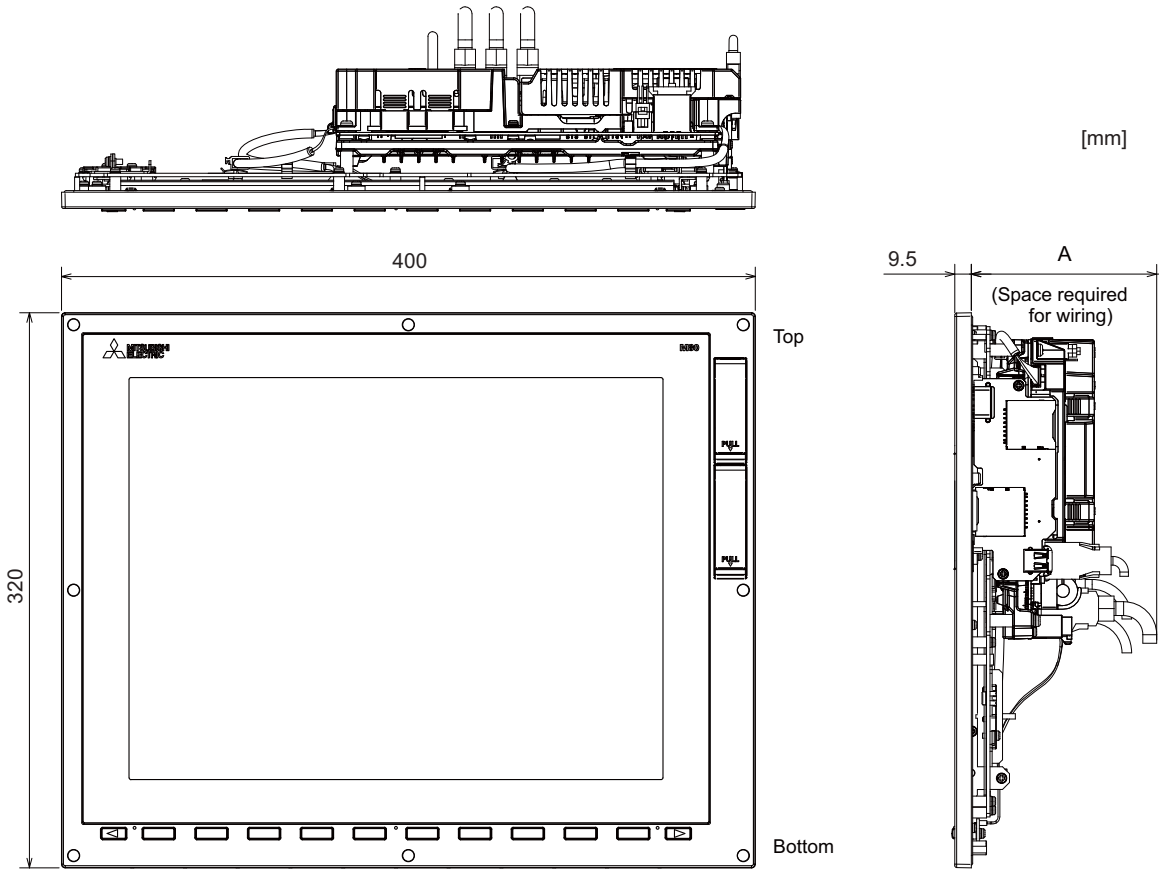


	Option relay unit not mounted	Option relay unit, FCU8-EX702 mounted	Option relay unit, FCU8-EX703 mounted
A (Space required for wiring)	110		114

(Note) The figure above shows the state with the control unit mounted.

[Outline dimension: FCU8-DU181-32]

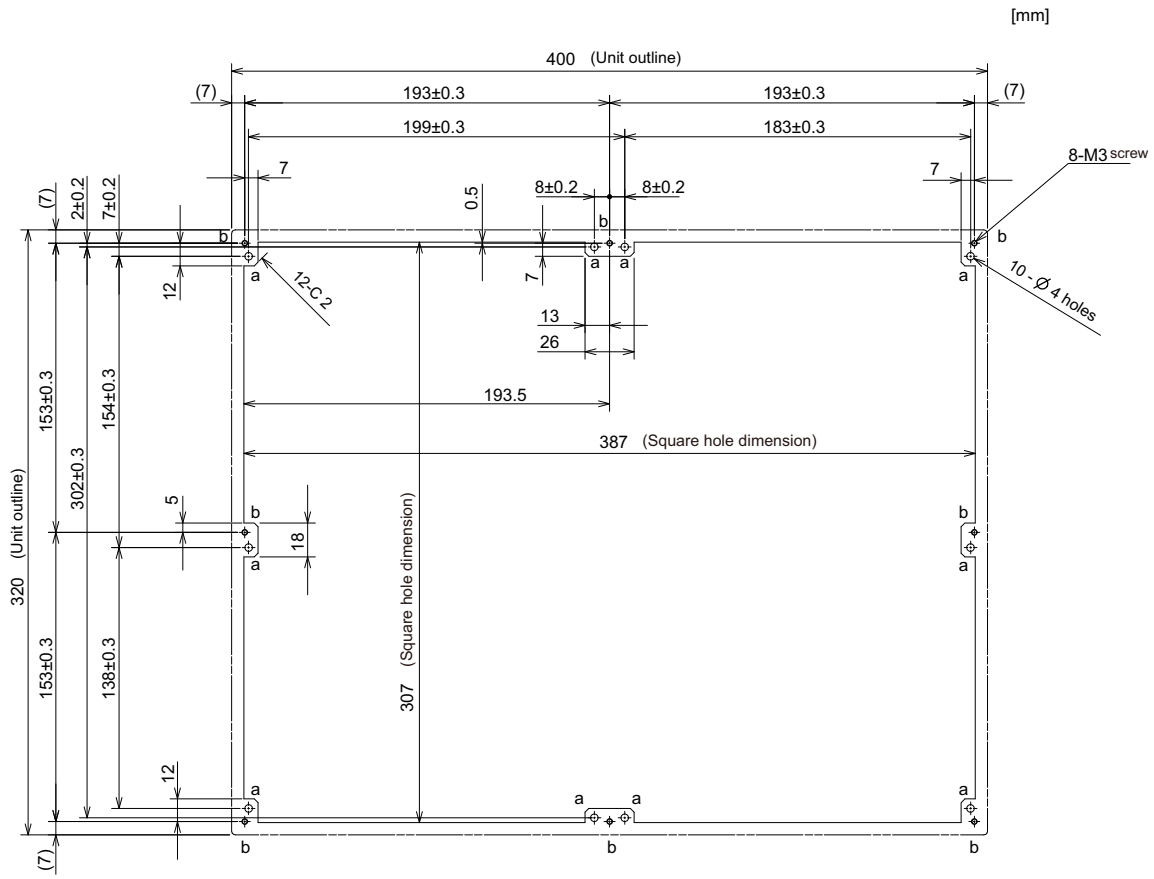
[mm]



	Option relay unit not mounted	Option relay unit, FCU8-EX702 mounted	Option relay unit, FCU8-EX703 mounted
A (Space required for wiring)	110		114

(Note) The figure above shows the state with the control unit mounted.

[Panel cut dimension]



4.8.4 Precautions

[Precautions for handling touchscreen]

(1) Operate the touchscreen with fingers. The touchscreen does not react with nails.
(2) The use of gloves, work gloves, etc. will have effects such as the deterioration of the operation feeling depending on the material and thickness of the gloves.
(3) The initialization process is performed for 3 seconds after the power is turned ON. Do not touch the touchscreen with a finger, hold a palm over, put the conductive objects such as metals on, etc., during the initialization.
(4) If the surface of the touchscreen gets dirt, wipe it off with soft cloth.
(5) Make sure to ground FG terminal of the control unit at one ground point. (Refer to "Installation: Connection of Frame Ground (FG)".) Otherwise, the reaction and usability of the touchscreen will remarkably deteriorate.
(6) Do not place a device which removes static electricity such as an ionizer. The static electricity-removing device may worsen the response and usability of the touchscreen.

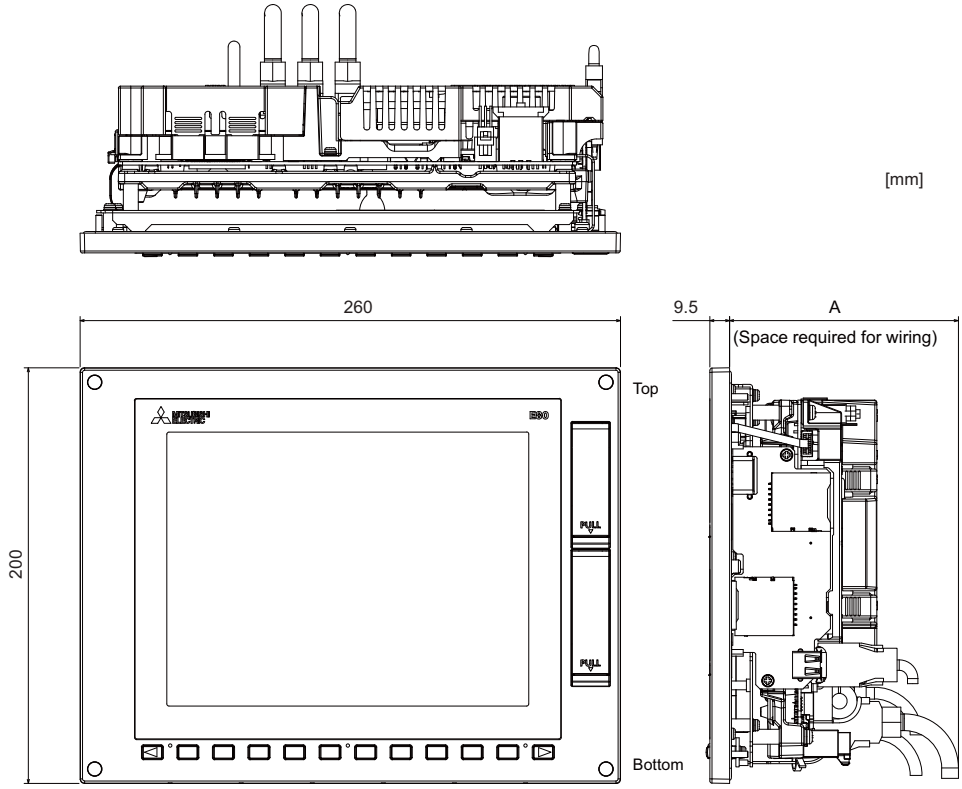
[Characteristic of liquid crystal display panels]

As a characteristic of liquid crystal display panels, bright dots (always lit) and dark dots (never lit) may appear on the panel.
Since liquid crystal display panels comprise a great number of display elements, the appearance of bright and dark dots cannot be reduced to zero.
Variation of liquid crystal display panels may cause differences in color, uneven brightness and flickering.
Note that these phenomena are characteristics of liquid crystal display panels and it does not mean the products are defective or damaged.

4.9 Display Unit [E80]

4.9.1 8.4-type (FCU8-DU121-13)

[Outline dimension]



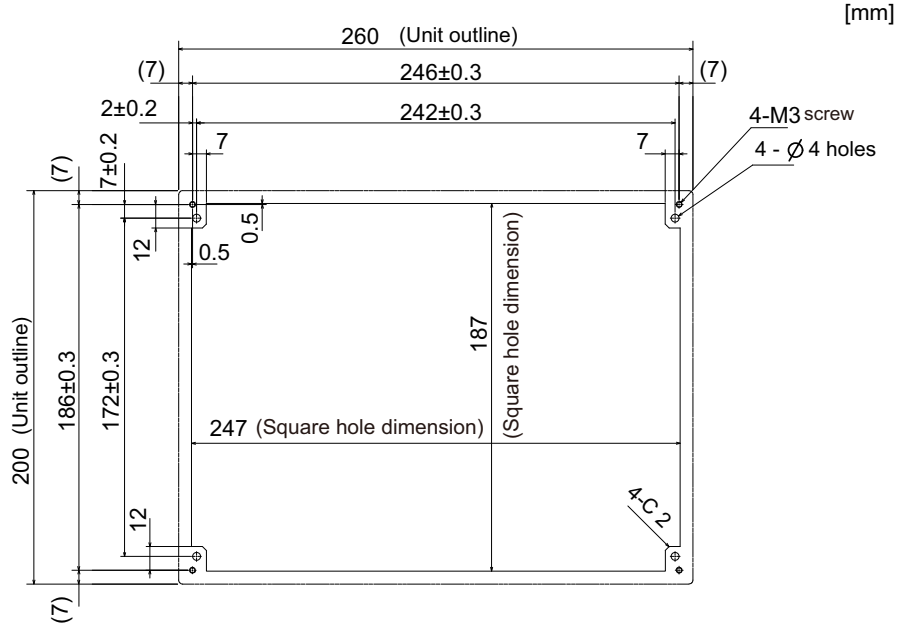
	Option relay unit not mounted	Option relay unit, FCU8-EX702 mounted	Option relay unit, FCU8-EX703 mounted
A (Space required for wiring)	110		114

(Note 1) The 8.4-type display unit is incompatible with the touchscreen.

(Note 2) The figure above shows the state with the control unit mounted.

[Panel cut dimension]

[mm]



4.9.2 Precautions

[Characteristic of liquid crystal display panels]

As a characteristic of liquid crystal display panels, bright dots (always lit) and dark dots (never lit) may appear on the panel.

Since liquid crystal display panels comprise a great number of display elements, the appearance of bright and dark dots cannot be reduced to zero.

Variation of liquid crystal display panels may cause differences in color, uneven brightness and flickering.

Note that these phenomena are characteristics of liquid crystal display panels and it does not mean the products are defective or damaged.

4.10 Keyboard Unit

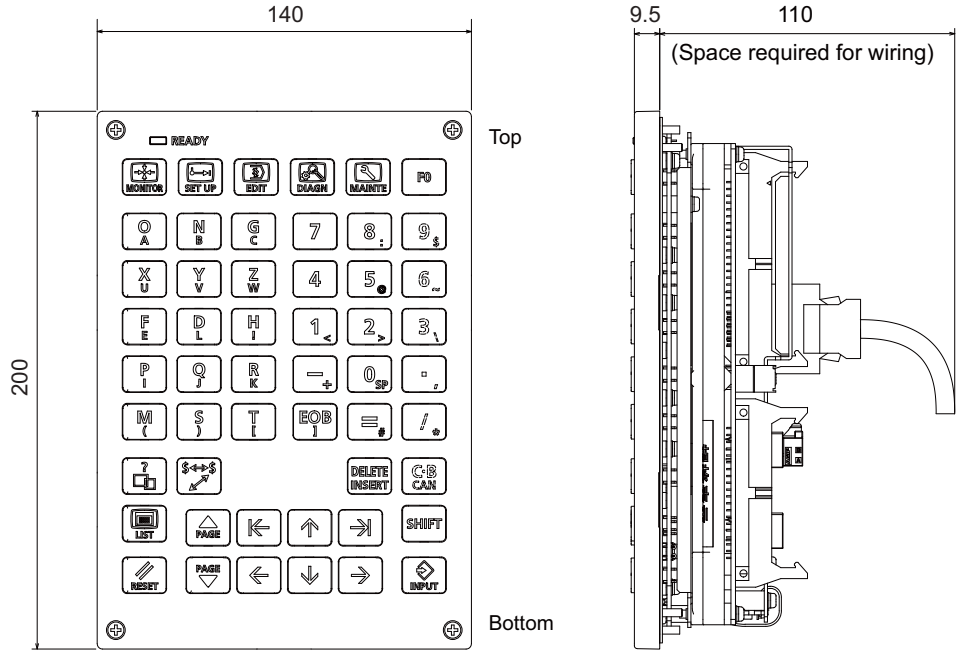
(Note) Do not change the setting for the rotary switch mounted on the keyboard unit.
If the setting is changed, the keyboard will not work.

Type	The initial value of the rotary switch
FCU8-KB026	1
FCU8-KB028	3
FCU8-KB029	0
FCU8-KB041	2
FCU8-KB046	0
FCU8-KB047	0
FCU8-KB048	0
FCU8-KB083	A
FCU8-KB024	5
FCU8-KB025	6

4.10.1 Keyboard for 8.4-type Display Unit (FCU8-KB026)

[Outline dimension]

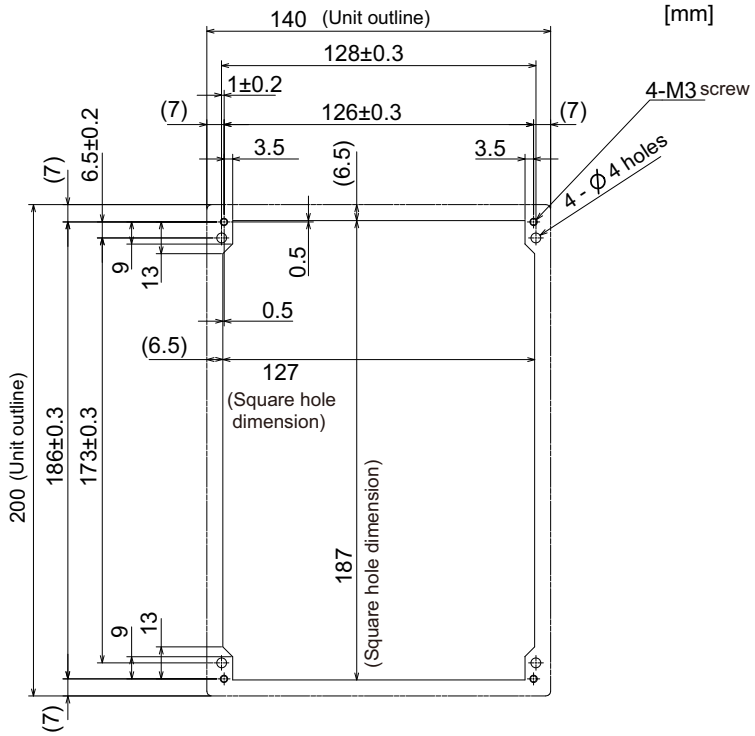
[mm]



(Note) The above side view shows the state with the operation panel I/O unit mounted.

[Panel cut dimension]

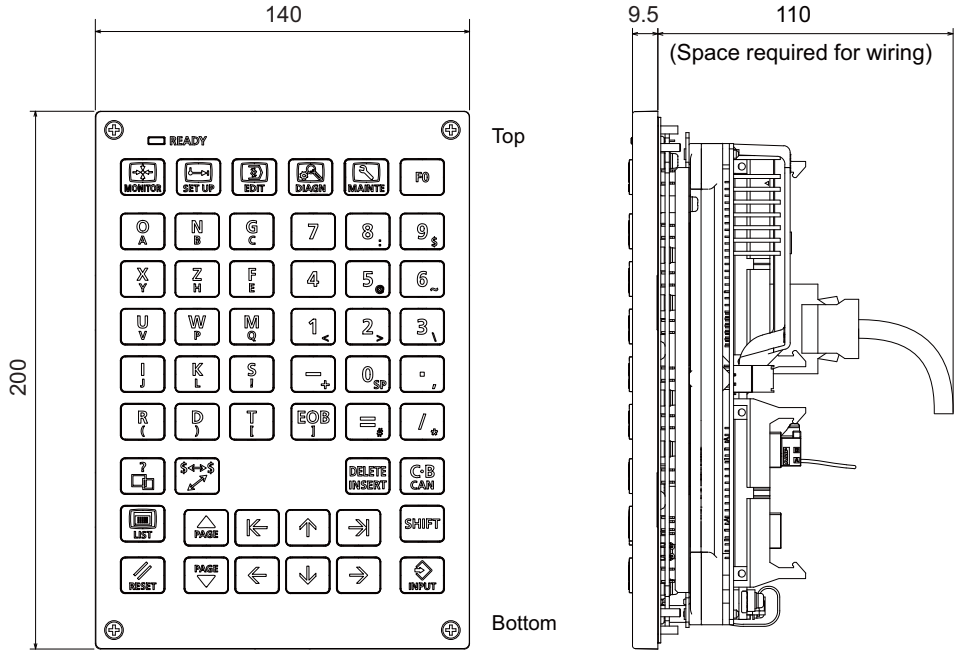
[mm]



4.10.2 Keyboard for 8.4-type Display Unit (FCU8-KB028)

[Outline dimension]

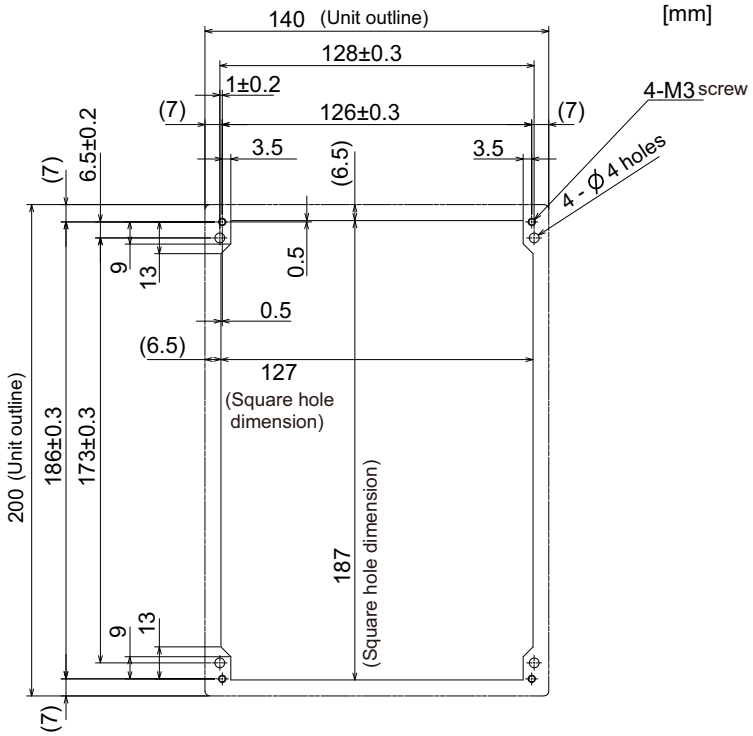
[mm]



(Note) The above side view shows the state with the operation panel I/O unit mounted.

[Panel cut dimension]

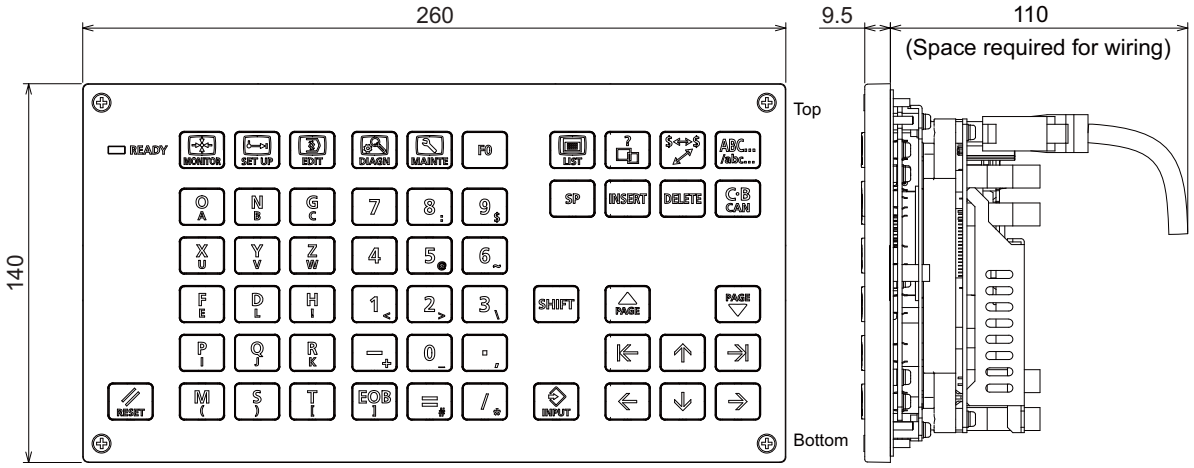
[mm]



4.10.3 Keyboard for 8.4-type Display Unit (FCU8-KB029)

[Outline dimension]

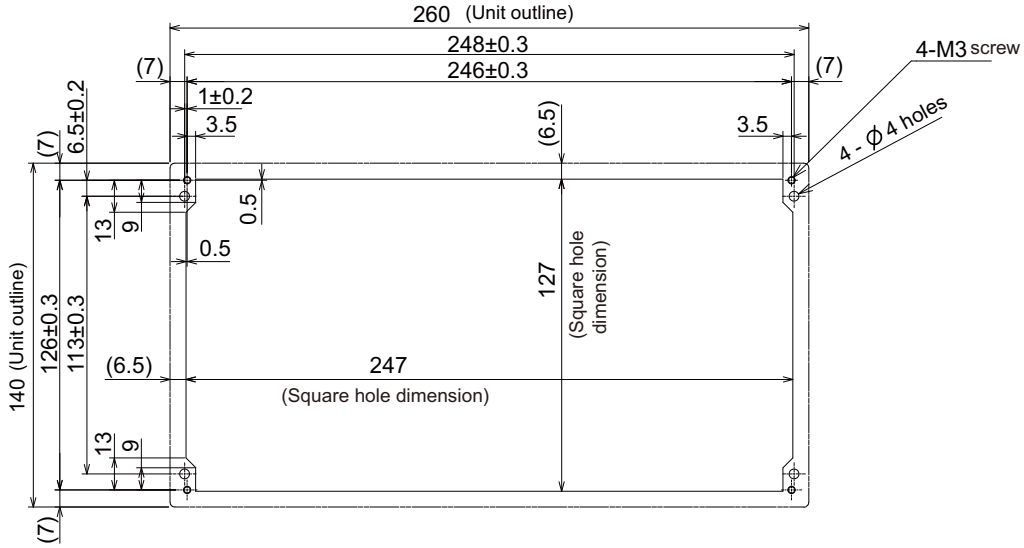
[mm]



(Note) The above side view shows the state with the operation panel I/O unit mounted.

[Panel cut dimension]

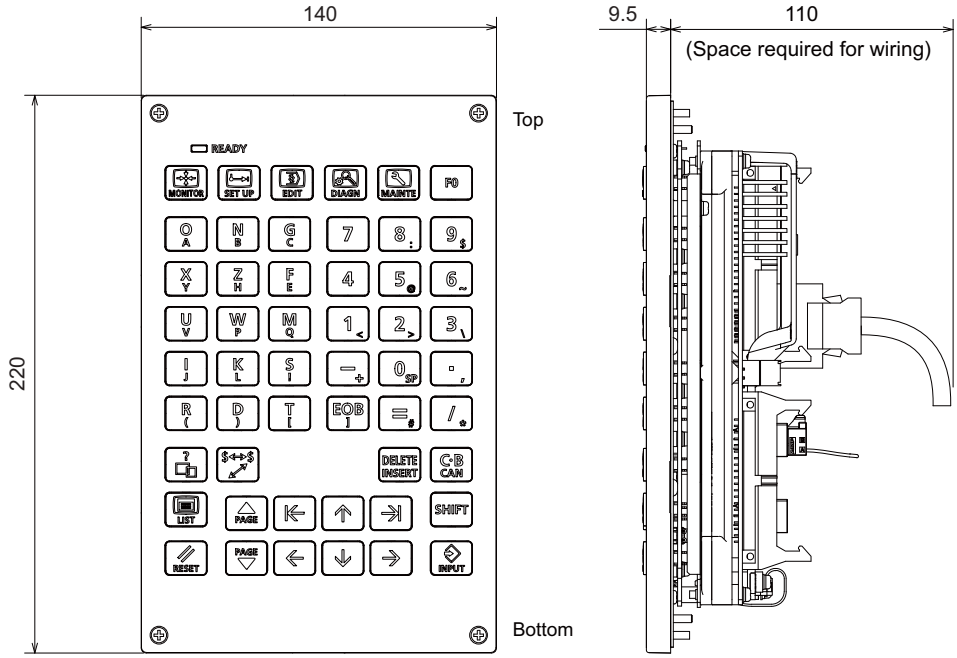
[mm]



4.10.4 Keyboard for 10.4-type Display Unit (FCU8-KB041)

[Outline dimension]

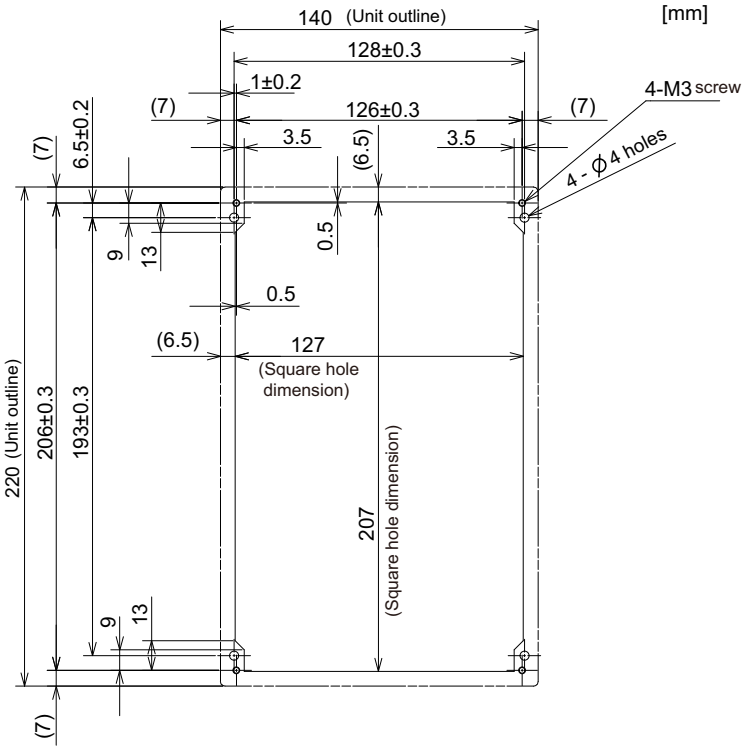
[mm]



(Note) The above side view shows the state with the operation panel I/O unit mounted.

[Panel cut dimension]

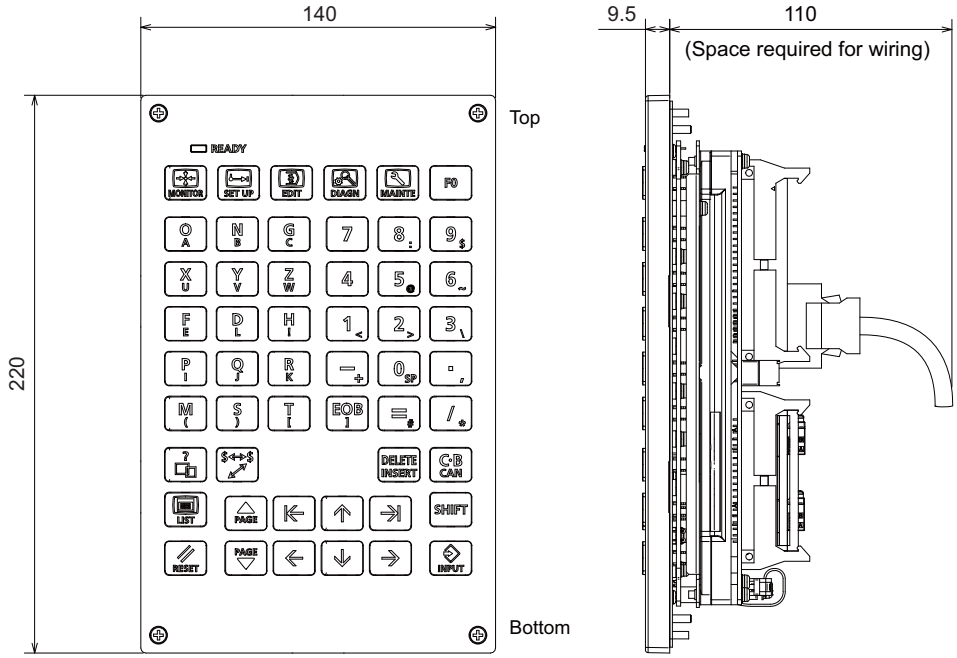
[mm]



4.10.5 Keyboard for 10.4-type Display Unit (FCU8-KB046)

[Outline dimension]

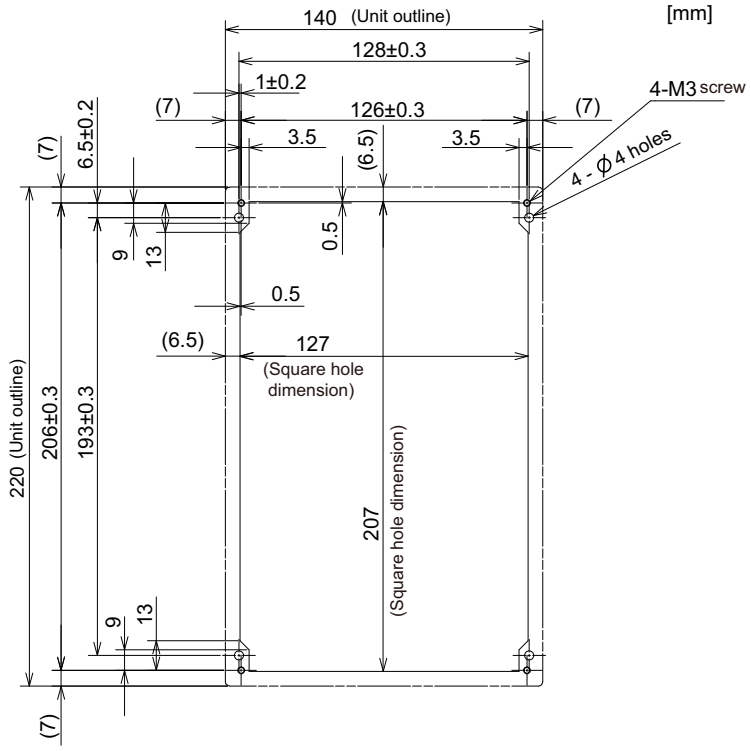
[mm]



(Note) The above side view shows the state with the operation panel I/O unit mounted.

[Panel cut dimension]

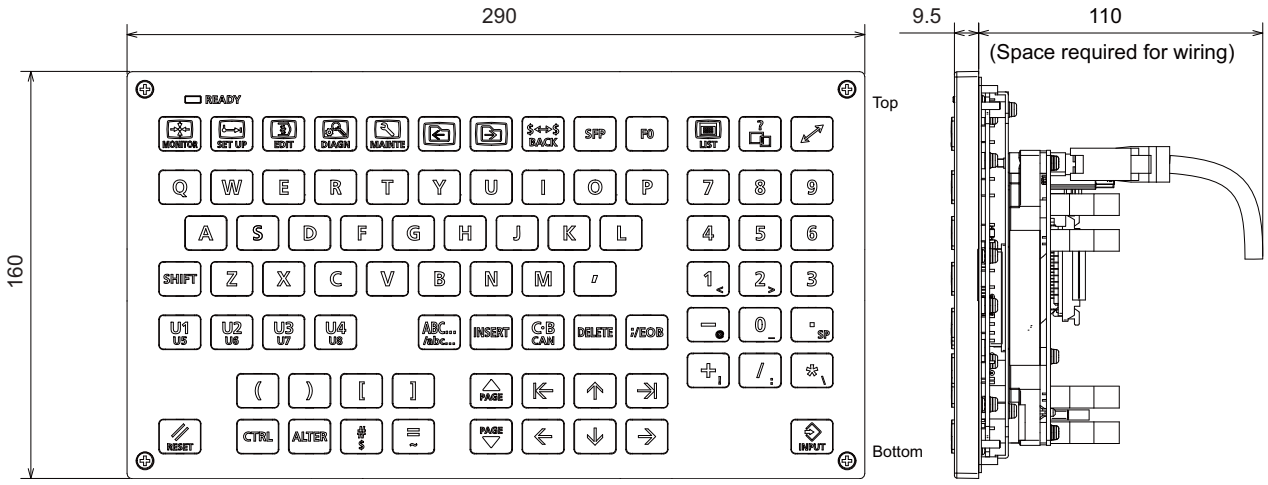
[mm]



4.10.6 Keyboard for 10.4-type Display Unit (FCU8-KB047)

[Outline dimension]

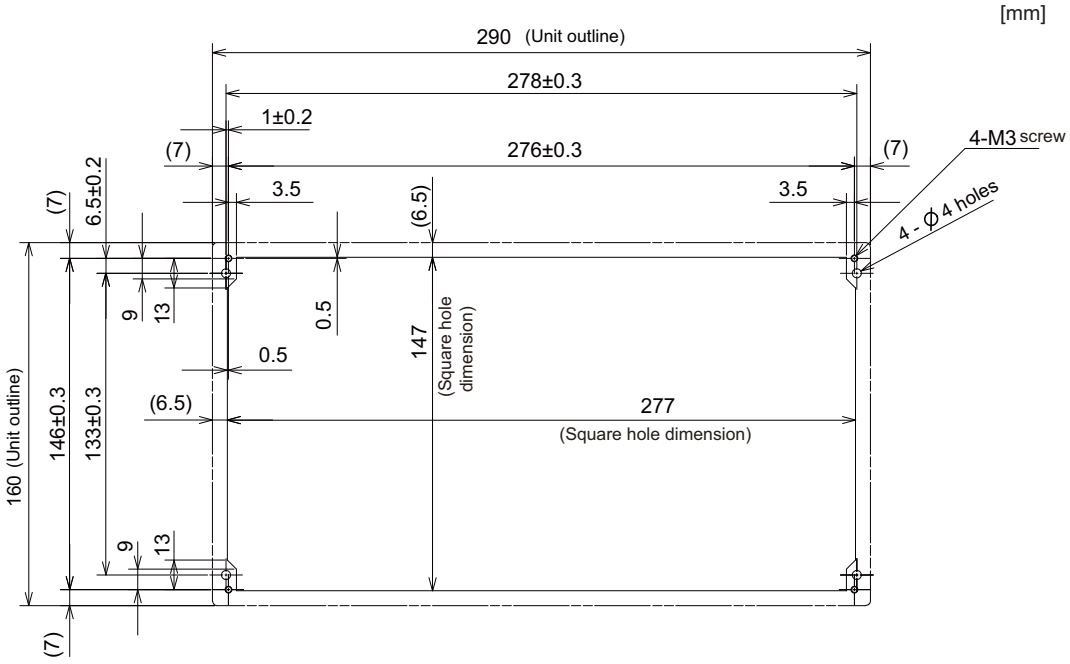
[mm]



(Note) The above side view shows the state with the operation panel I/O unit mounted.

[Panel cut dimension]

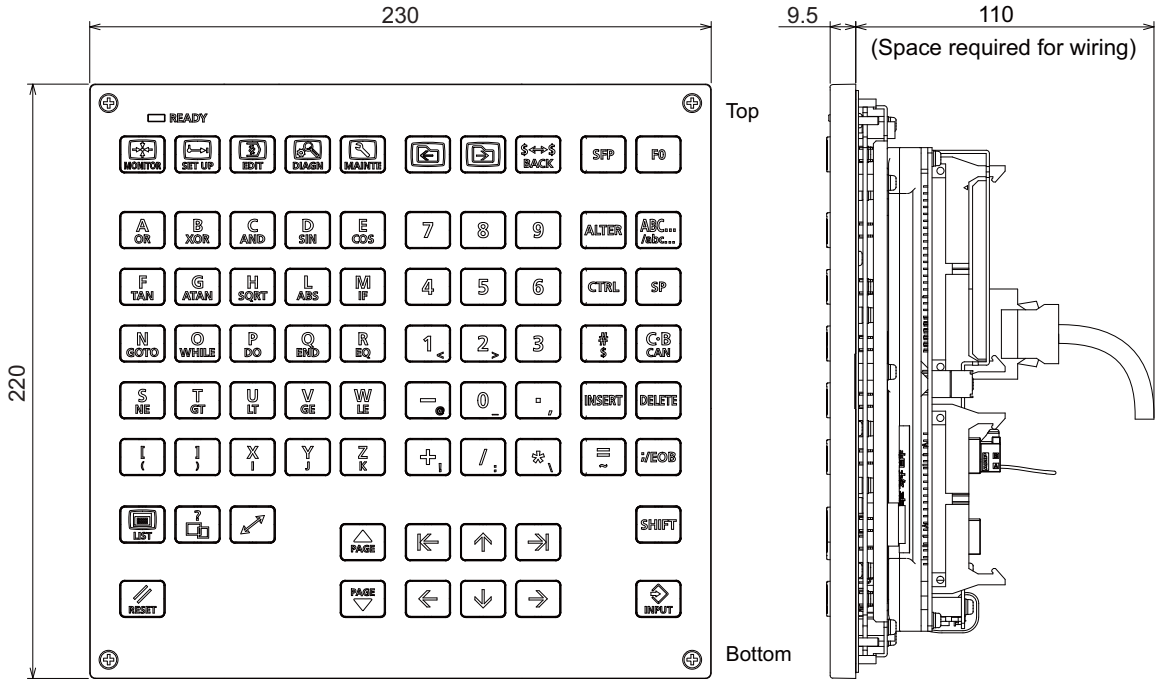
[mm]



4.10.7 Keyboard for 10.4-type Display Unit (FCU8-KB048)

[Outline dimension]

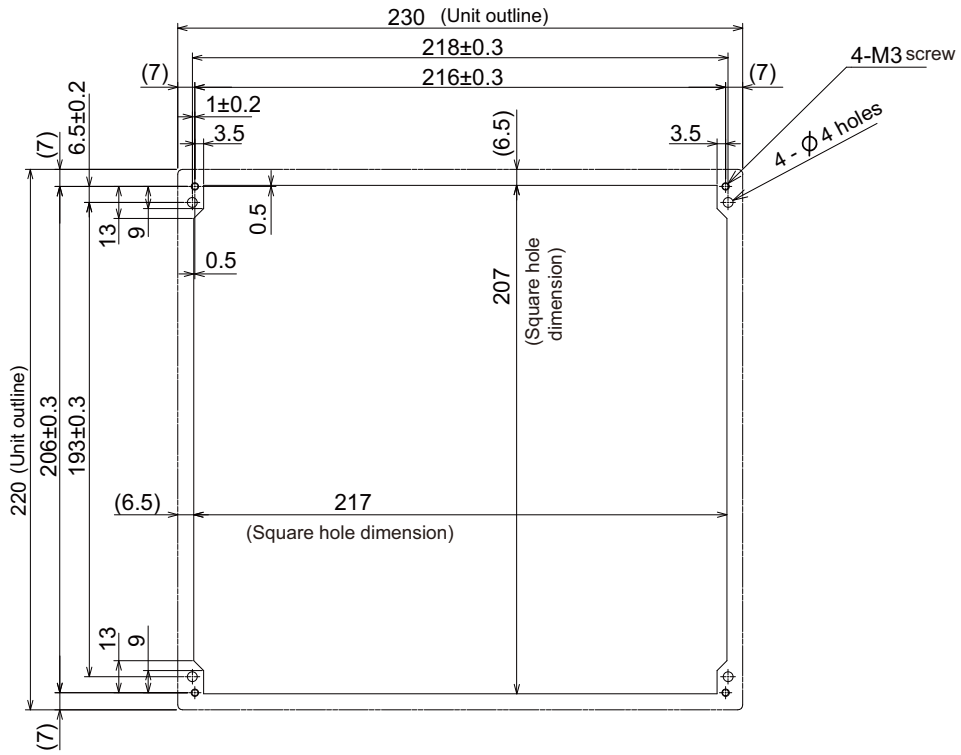
[mm]



(Note) The above side view shows the state with the operation panel I/O unit mounted.

[Panel cut dimension]

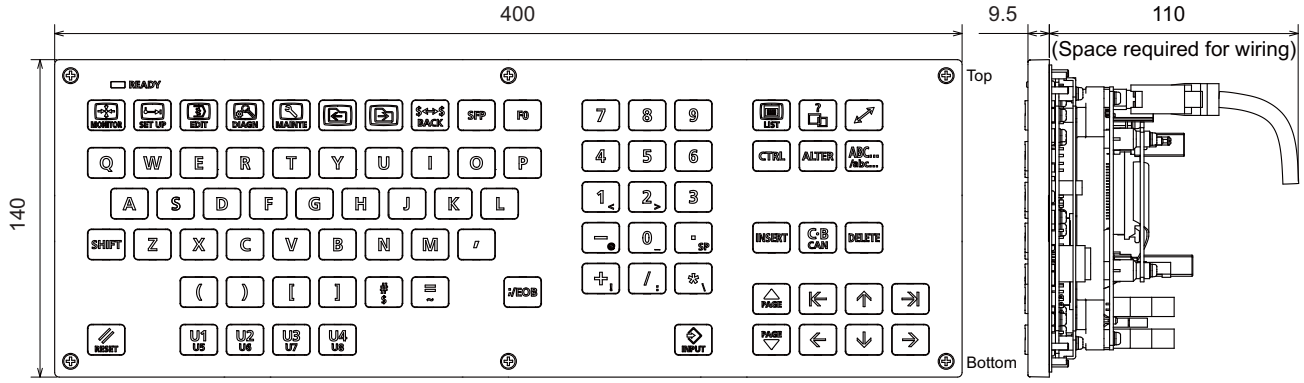
[mm]



4.10.8 Keyboard for 15-type Display Unit (FCU8-KB083)

[Outline dimension]

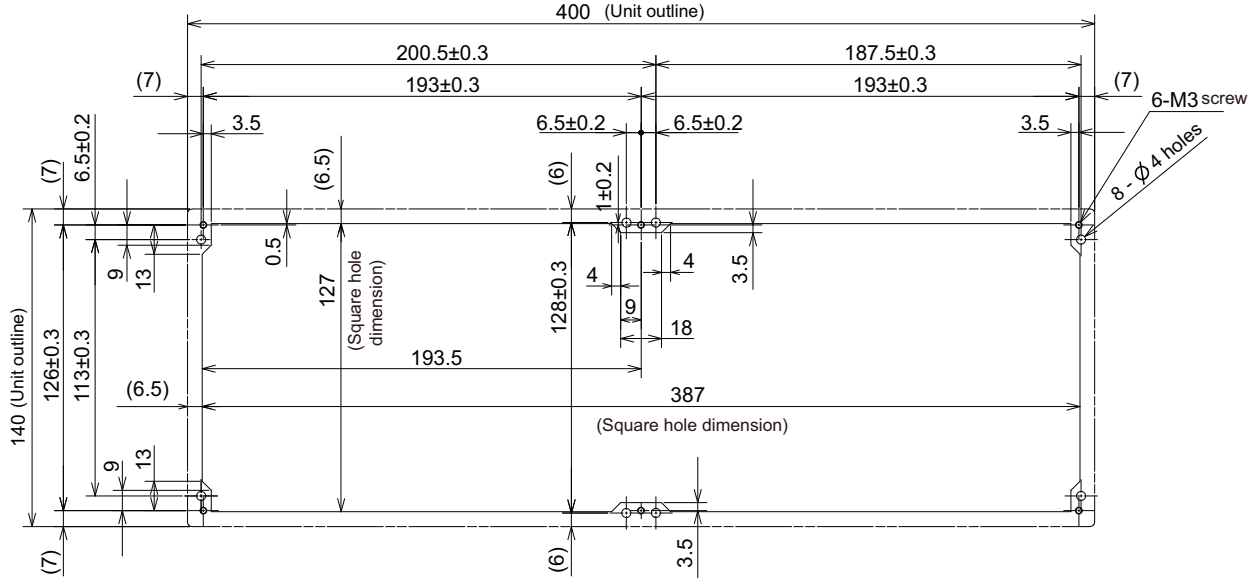
[mm]



(Note) The above side view shows the state with the operation panel I/O unit mounted.

[Panel cut dimension]

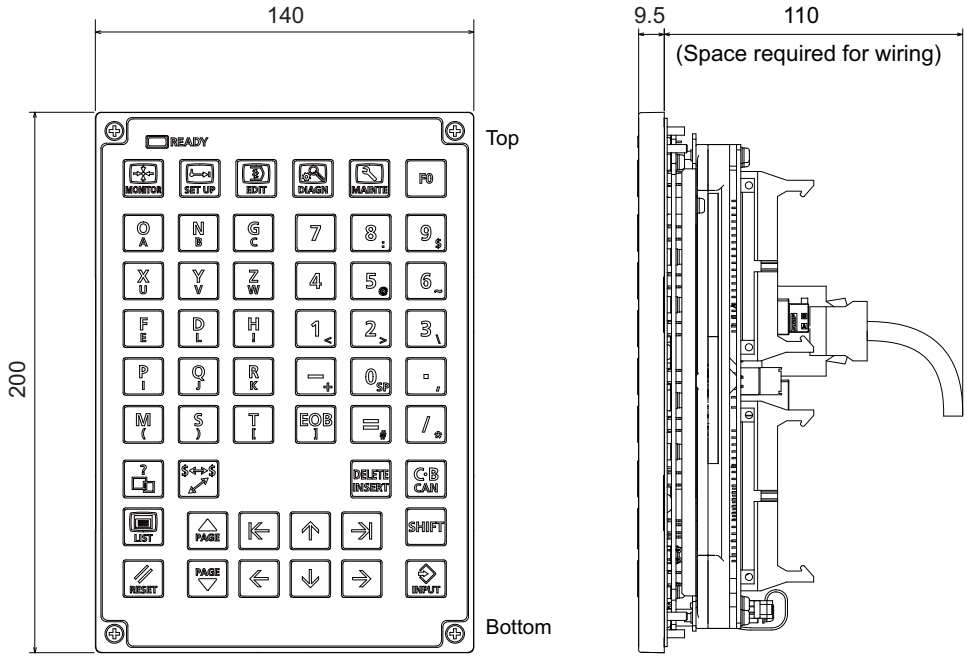
[mm]



4.10.9 Keyboard for 8.4-type Display Unit (FCU8-KB024)

[Outline dimension]

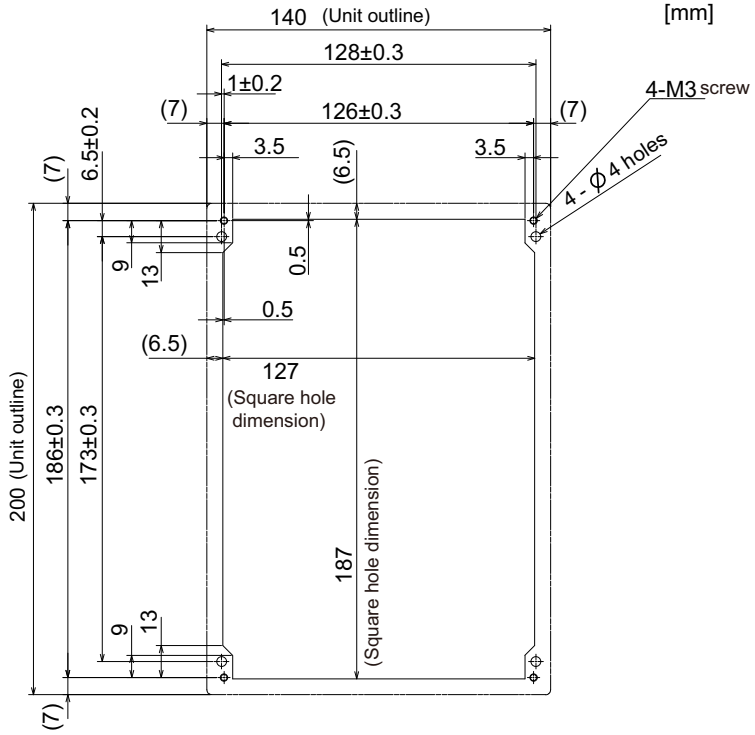
[mm]



(Note) The above side view shows the state with the operation panel I/O unit mounted.

[Panel cut dimension]

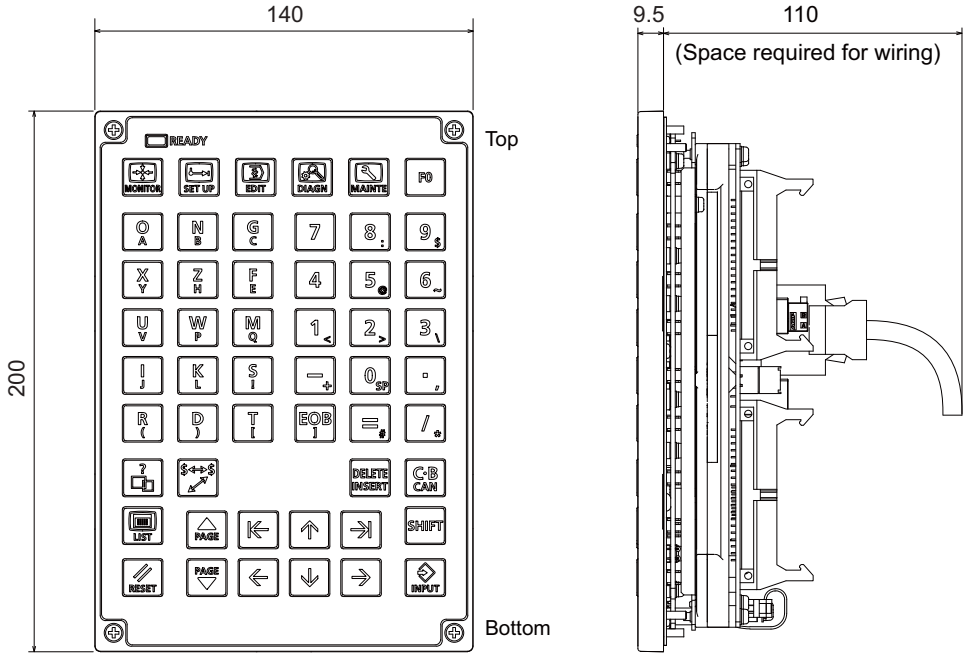
[mm]



4.10.10 Keyboard for 8.4-type Display Unit (FCU8-KB025)

[Outline dimension]

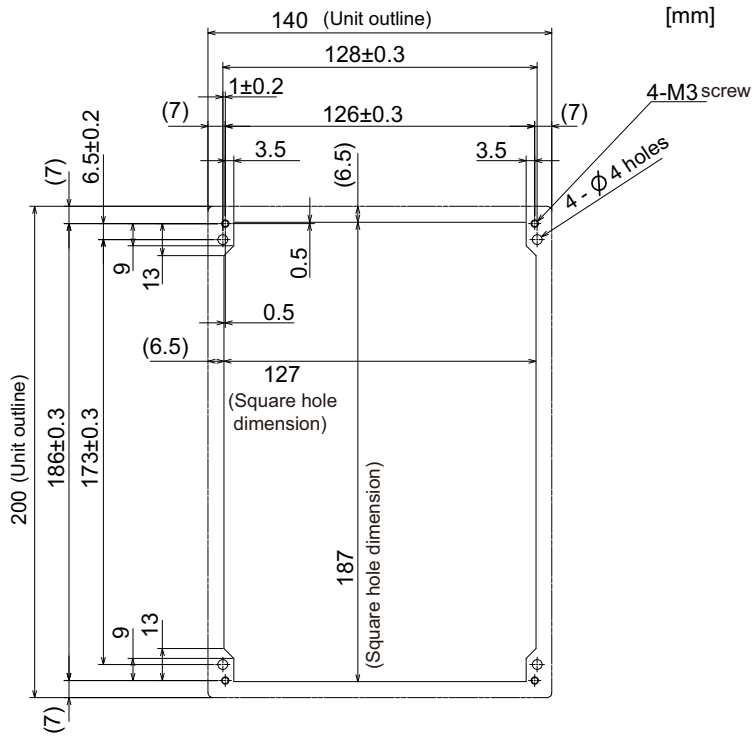
[mm]



(Note) The above side view shows the state with the operation panel I/O unit mounted.

[Panel cut dimension]

[mm]



4.11 Operation Panel I/O Unit

4.11.1 List of Units

Classification	Type	Components	Remarks
DI 24V/0V common input [64 points] DO Source output [48 points] AO Analog output [1 point]	FCU8-DX731 (Note 1)	Base card RIO 2.0 terminator connector (R2-TM)	DI: 64-points 24V/0V common type DO: 48-points source type (200mA/point) AO: 1 point Manual pulse generator input: 2ch Control unit I/F Keyboard unit I/F Remote I/O 2.0 I/F RIO occupied stations (fixed): 1, 3, 7 to 12, 20 to 22 RIO extensible stations: 2, 4 to 6, 13 to 19, 23 to 64
DI 24V/0V common input [96 points] DO Source output [64 points]	FCU8-DX750	Base card RIO 2.0 terminator connector (R2-TM)	DI: 96-points 24V/0V common type DO: 64-points source type (200mA/point) Manual pulse generator input: 3ch Control unit I/F Keyboard unit I/F Remote I/O 2.0 I/F RIO occupied stations (fixed): 1 to 3, 7 to 12, 20 to 22 RIO extensible stations: 4 to 6, 13 to 19, 23 to 64
DI 24V/0V common input [96 points] DO Source output [96 points]	FCU8-DX760	Base card Add-on card RIO 2.0 terminator connector (R2-TM)	DI: 96-points 24V/0V common type DO: 96-points source type (200mA/point) Manual pulse generator input: 3ch Control unit I/F Keyboard unit I/F Remote I/O 2.0 I/F RIO occupied stations (fixed): 1 to 4, 7 to 12, 20 to 22 RIO extensible stations: 5, 6, 13 to 19, 23 to 64
DI 24V/0V common input [96 points] DO Source output [64 points] AI Analog input [1 point] AO Analog output [1 point]	FCU8-DX761	Base card Add-on card RIO 2.0 terminator connector (R2-TM)	DI: 96-points 24V/0V common type DO: 64-points source type (200mA/point) AI: 1 point AO: 1 point Manual pulse generator input: 3ch Control unit I/F Keyboard unit I/F Remote I/O 2.0 I/F RIO occupied stations (fixed): 1 to 5, 7 to 12, 20 to 22 RIO extensible stations: 6, 13 to 19, 23 to 64
DI 24V/0V common input [64 points] DO Source output [64 points] Scan input [64 points] Scan output [64 points]	FCU8-DX834 (Note 2)	Base card Add-on card RIO 2.0 terminator connector (R2-TM)	DI: 64-points 24V/0V common type DO: 64-points source type (200mA/point) Scan input: 64 points Scan output: 64 points Manual pulse generator input: 3ch Keyboard unit I/F Remote I/O 2.0 I/F RIO occupied stations (fixed): 1 to 4, 7 to 14, 20 to 22 RIO extensible stations: 5, 6, 15 to 19, 23 to 64

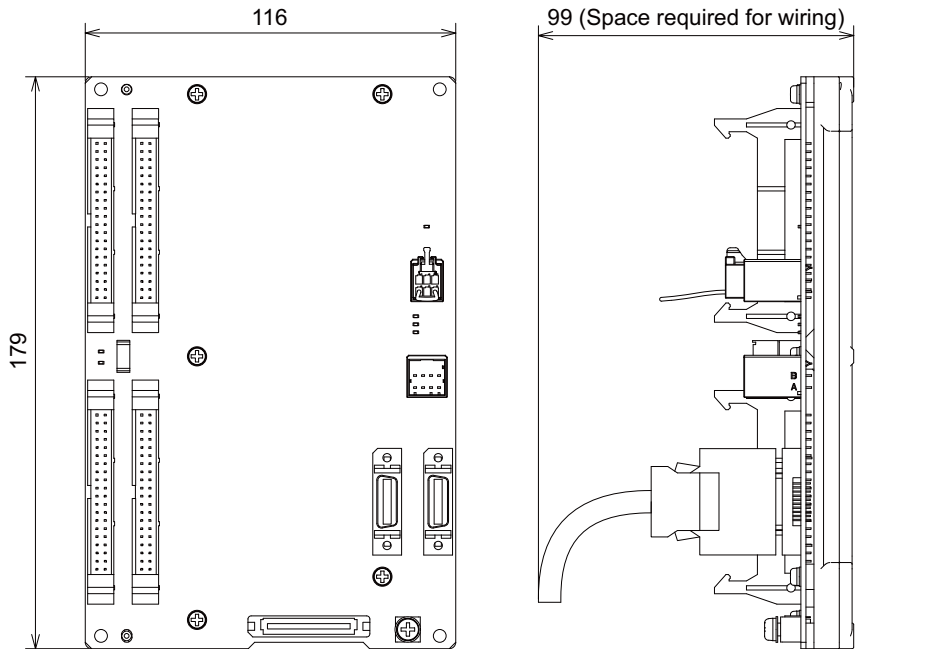
(Note 1) The form of the CG31/CG32/CG35/CG36 connectors on FCU8-DX731 are the same as that of CJ38/CJ40/CJ42 connectors on other units.
Be careful not to connect to a wrong connector.
See the descriptions below for more specific explanation on connections.

(Note 2) The connection method of DO (CG32/CG34) of FCU8-DX834 is different from other operation panel I/O units. Be careful not to connect to a wrong connector. See the descriptions mentioned in the later section for more specific explanation on connections.

4.11.2 FCU8-DX731 / FCU8-DX750 / FCU8-DX760 / FCU8-DX761 / FCU8-DX834

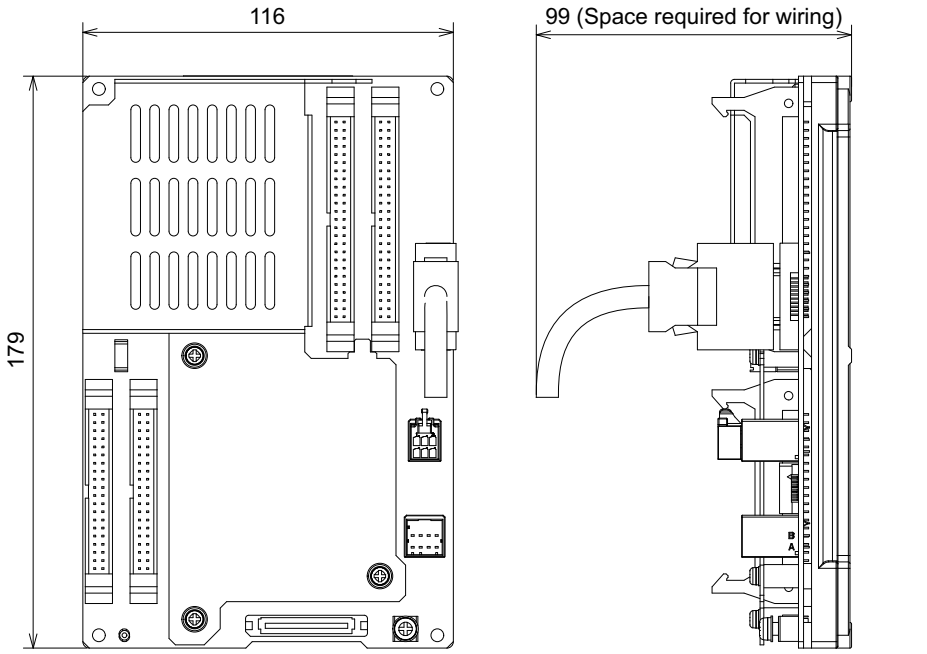
[Outline dimension : FCU8-DX731]

[mm]



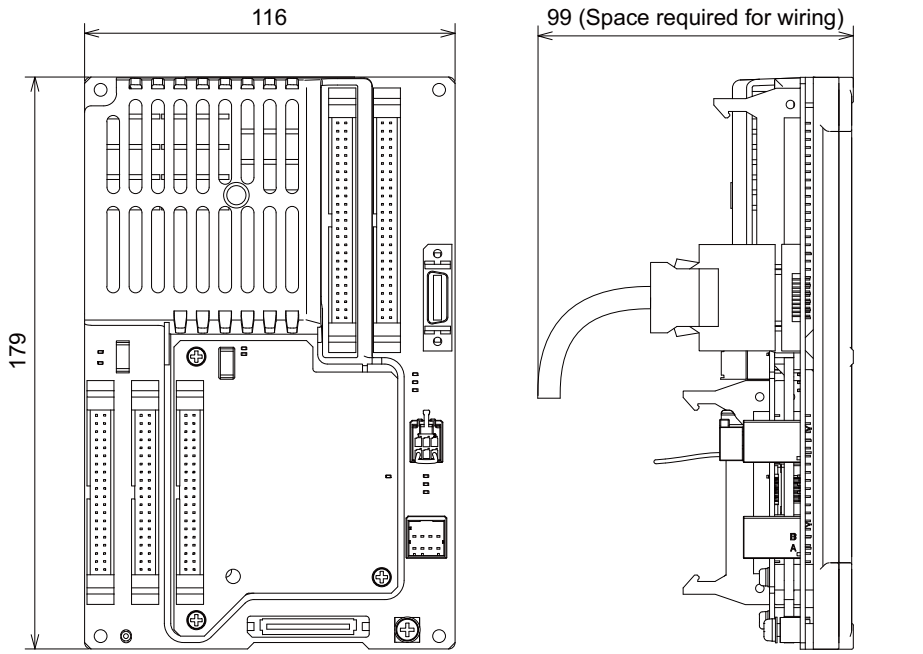
[Outline dimension : FCU8-DX750]

[mm]



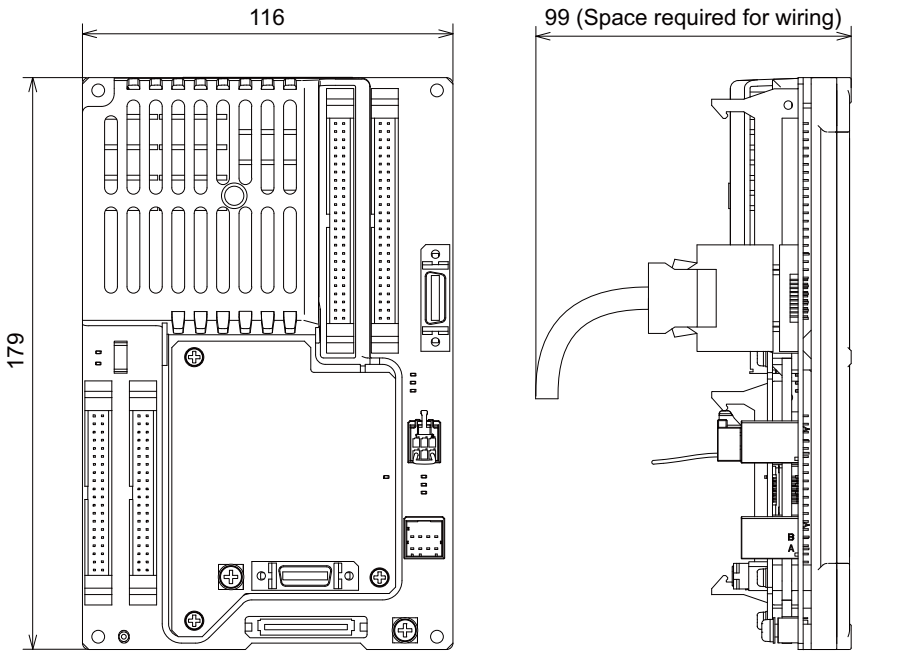
[Outline dimension : FCU8-DX760]

[mm]



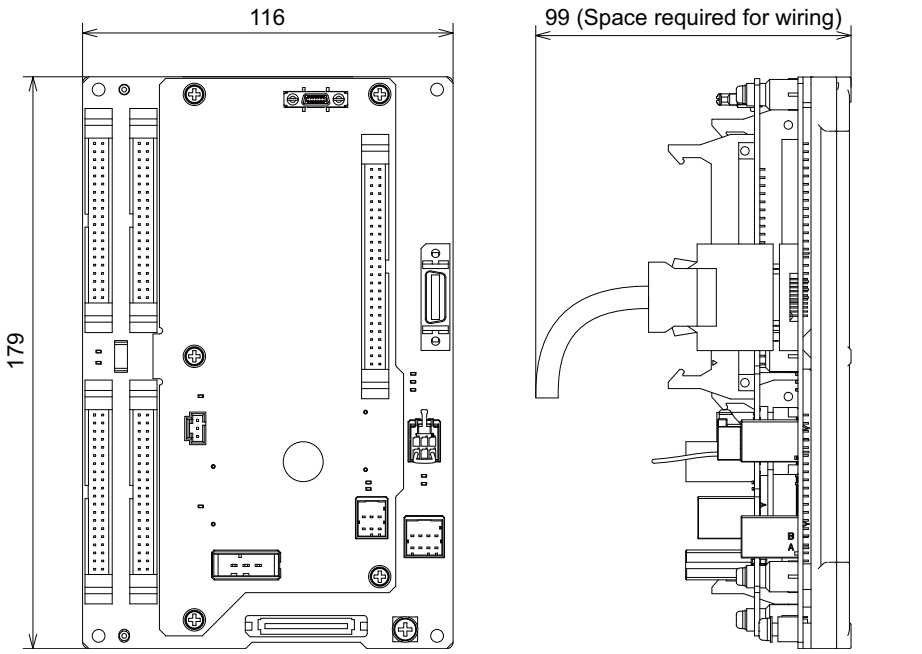
[Outline dimension : FCU8-DX761]

[mm]

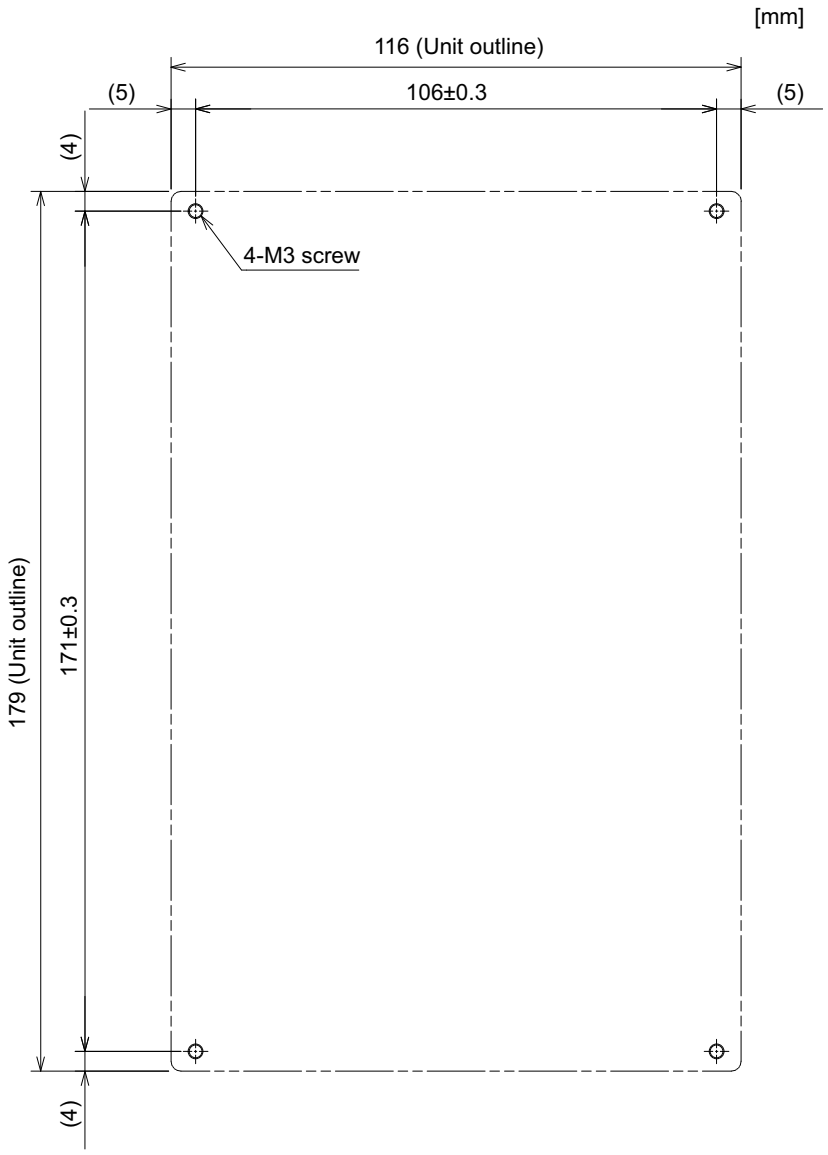


[Outline dimension : FCU8-DX834]

[mm]



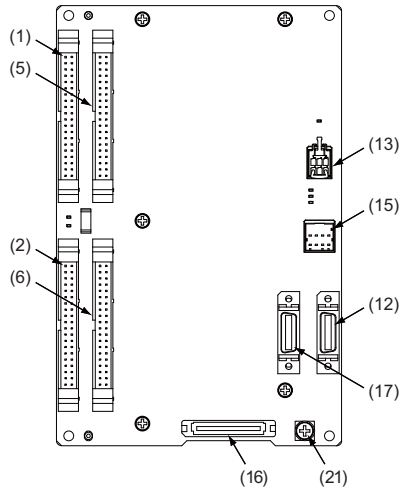
[Installation dimension: FCU8-DX731 / FCU8-DX750 / FCU8-DX760 / FCU8-DX761 / FCU8-DX834]



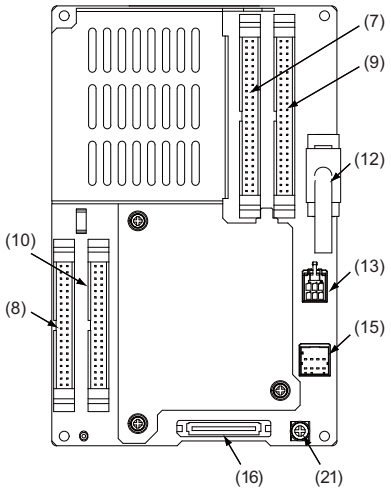
(Note) The unit thickness of the fixed part with screws is 16.6mm.
Select the fixing screws having the length suitable for the thickness.

[Connector]

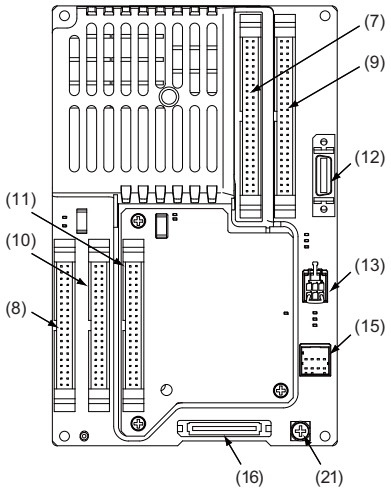
FCU8-DX731



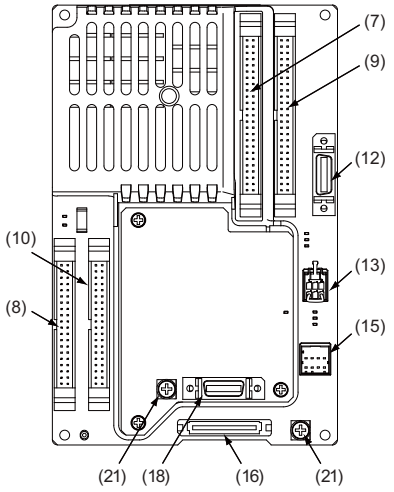
FCU8-DX750



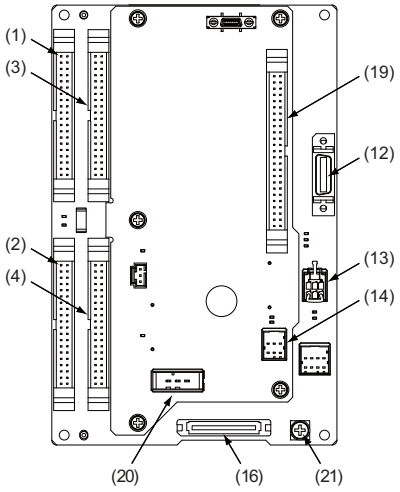
FCU8-DX760



FCU8-DX761



FCU8-DX834



No.	Connector name	Function		No.	Connector name	Function
(1)	CG31	Machine signal input		(12)	MPG	Manual pulse generator input
(2)	CG32	Machine signal output		(13)	RIO3EXT	Remote I/O 2.0 communication
(3)	CG33	Machine signal input		(14)	RIO3	Remote I/O 2.0 communication
(4)	CG34	Machine signal output		(15)	CJ71	Control unit I/F
(5)	CG35	Machine signal input		(16)	NCKB	Keyboard I/F
(6)	CG36	Machine signal output		(17)	AO	Analog output
(7)	CJ37	Machine signal input		(18)	AIO	Analog input Analog output
(8)	CJ38	Machine signal output		(19)	OPKB	Scan input Scan output
(9)	CJ39	Machine signal input		(20)	DCIN	24VDC input
(10)	CJ40	Machine signal output		(21)	FG	FG terminal
(11)	CJ42	Machine signal output				

(Note) The CJ71 connector of FCU8-DX834 is not used.

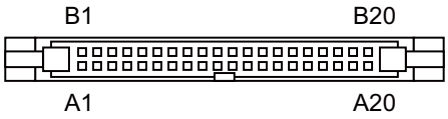
⚠ CAUTION

⚠ Do not apply any voltage to the connectors other than voltage specified in this manual. Failure to observe this could cause bursting, damage, etc.

⚠ Connect the cables to the designated connectors. Incorrect connections could damage the device.

⚠ 12V, 5V, and 3.3V output from connectors are to supply the power for dedicated peripheral devices. Do not use for other equipment to supply the power since we do not guarantee the NC operation by voltage down or noise sneaking.

(1) CG31 (Machine signal input)
Digital input 32 points (1st station)
(3) CG33 (Machine signal input)
Digital input 32 points (2nd station)
(5) CG35 (Machine signal input)
Digital input 32 points (3rd station)



CG31							CG33							CG35						
B			A				B			A				B			A			
20	I	X200	**20**	I	X210		**20**	I	X220	**20**	I	X230		**20**	I	X240	**20**	I	X250
19	I	X201	**19**	I	X211		**19**	I	X221	**19**	I	X231		**19**	I	X241	**19**	I	X251
18	I	X202	**18**	I	X212		**18**	I	X222	**18**	I	X232		**18**	I	X242	**18**	I	X252
17	I	X203	**17**	I	X213		**17**	I	X223	**17**	I	X233		**17**	I	X243	**17**	I	X253
16	I	X204	**16**	I	X214		**16**	I	X224	**16**	I	X234		**16**	I	X244	**16**	I	X254
15	I	X205	**15**	I	X215		**15**	I	X225	**15**	I	X235		**15**	I	X245	**15**	I	X255
14	I	X206	**14**	I	X216		**14**	I	X226	**14**	I	X236		**14**	I	X246	**14**	I	X256
13	I	X207	**13**	I	X217		**13**	I	X227	**13**	I	X237		**13**	I	X247	**13**	I	X257
12	I	X208	**12**	I	X218		**12**	I	X228	**12**	I	X238		**12**	I	X248	**12**	I	X258
11	I	X209	**11**	I	X219		**11**	I	X229	**11**	I	X239		**11**	I	X249	**11**	I	X259
10	I	X20A	**10**	I	X21A		**10**	I	X22A	**10**	I	X23A		**10**	I	X24A	**10**	I	X25A
9	I	X20B	**9**	I	X21B		**9**	I	X22B	**9**	I	X23B		**9**	I	X24B	**9**	I	X25B
8	I	X20C	**8**	I	X21C		**8**	I	X22C	**8**	I	X23C		**8**	I	X24C	**8**	I	X25C
7	I	X20D	**7**	I	X21D		**7**	I	X22D	**7**	I	X23D		**7**	I	X24D	**7**	I	X25D
6	I	X20E	**6**	I	X21E		**6**	I	X22E	**6**	I	X23E		**6**	I	X24E	**6**	I	X25E
5	I	X20F	**5**	I	X21F		**5**	I	X22F	**5**	I	X23F		**5**	I	X24F	**5**	I	X25F
4		NC	**4**		NC		**4**		NC	**4**		NC		**4**		NC	**4**		NC
3		DICOM	**3**		DICOM		**3**		DICOM	**3**		DICOM		**3**		DICOM	**3**		DICOM
2		+24V	**2**		0V		**2**		+24V	**2**		0V		**2**		+24V	**2**		0V
1		+24V	**1**		0V		**1**		+24V	**1**		0V		**1**		+24V	**1**		0V

The input/output assignment is modifiable using a parameter. Refer to "17.6.4.2 Arbitrary Device Assignment" for details.

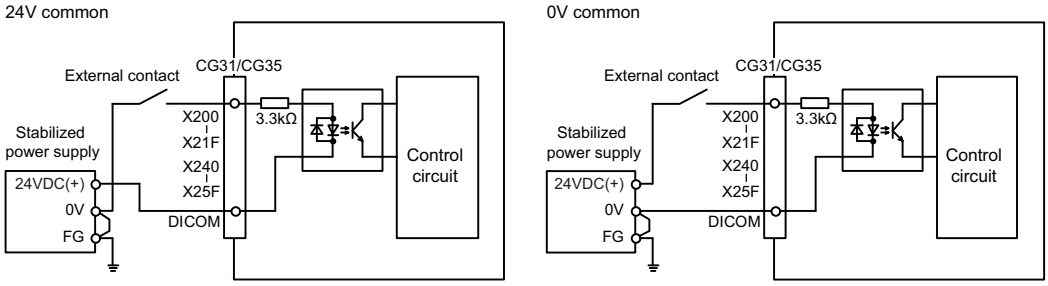
<Cable side connector type>
Connector : XG4M-4030 / 7940-6500SC
Strain relief : XG4T-4004 / 3448-7940
Manufacturer: OMRON / 3M

(a) Outline of digital signal input circuit

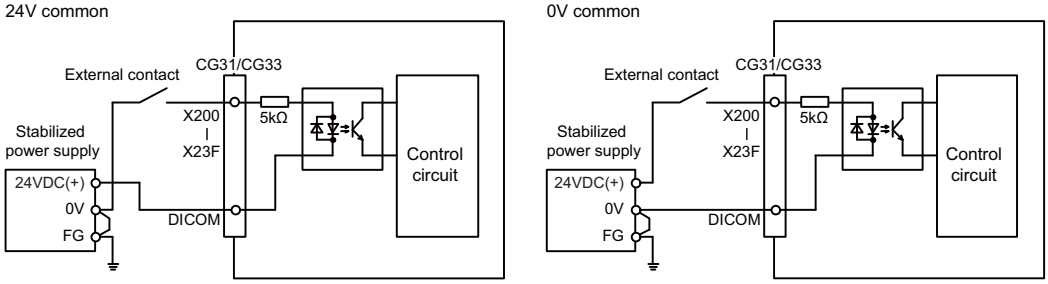
Both 24V common and 0V common connections are allowed in the digital signal input circuit.
Follow the wiring diagram below for each type.

Input circuit

[FCU8-DX731]



[FCU8-DX834]



Input conditions

The input signals must be used within the following condition ranges.

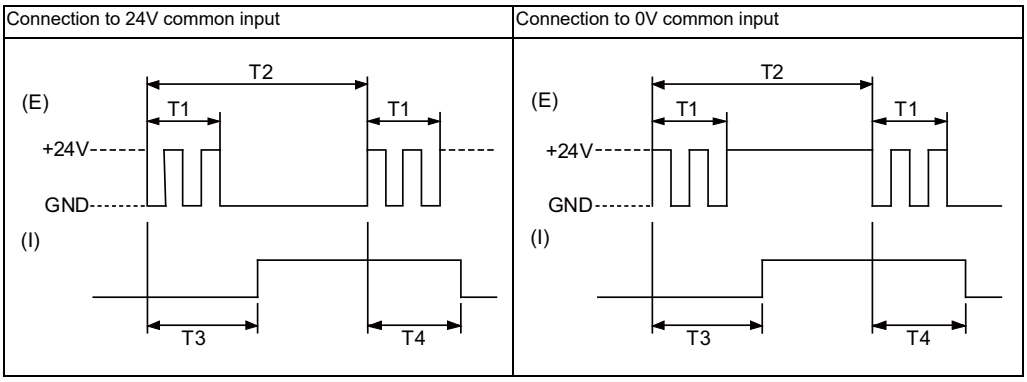
[FCU8-DX731]

		24V common	0V common
1	**Input voltage at external contact ON**	6V or less	18V or more, 25.2V or less
2	**Input current at external contact ON**	5mA or more	
3	**Input voltage at external contact OFF**	20V or more, 25.2V or less	4V or less
4	**Input current at external contact OFF**	1.2mA or less	
5	**Input resistance**	3.3kΩ	
6	**Tolerable chattering time (T1)**	3ms	
7	**Input signal holding time (T2)**	40ms or more (*1)	
8	**Input circuit operation delay time (T3 and T4)**	3 to 16ms	
9	**Machine side contact capacity**	30V or more, 16mA or more	

[FCU8-DX834]

		24V common	0V common
1	**Input voltage at external contact ON**	6V or less	18V or more, 25.2V or less
2	**Input current at external contact ON**	3mA or more	
3	**Input voltage at external contact OFF**	20.2V or more, 25.2V or less	3.8V or less
4	**Input current at external contact OFF**	0.7mA or less	
5	**Input resistance**	5kΩ	
6	**Tolerable chattering time (T1)**	3ms	
7	**Input signal holding time (T2)**	40ms or more (*1)	
8	**Input circuit operation delay time (T3 and T4)**	3 to 16ms	
9	**Machine side contact capacity**	30V or more, 16mA or more	

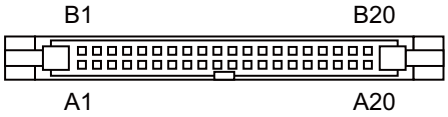
(*1) Note that "40 ms or more" is a guide of the "Input signal holding time". The input signal is recognized only when its "ON" state is held longer than the ladder processing cycle time.



(E) : External signal, (I):Internal signal

(Note) Set the number of DI points that are simultaneously turned ON to be less than half of the total points.
If many points are set to be simultaneously turned ON, operation panel I/O unit may be deteriorated due to the heat.

(2) CG32 (Machine signal output)
Digital output 32 points (1st station)
(4) CG34 (Machine signal output)
Digital output 32 points (2nd station)
(6) CG36 (Machine signal output)
Digital output 16 points (3rd station)
(8) CJ38 (Machine signal output)
Digital output 32 points (1st station)
(10) CJ40 (Machine signal output)
Digital output 32 points (2nd station)
(11) CJ42 (Machine signal output)
Digital output 32 points (4th station)



[FCU8-DX731 / FCU8-DX750 / FCU8-DX760 / FCU8-DX761]

CG32							CG36					
B			A				B			A		
20	O	Y200	**20**	O	Y210		**20**	O	Y240	**20**		NC
19	O	Y201	**19**	O	Y211		**19**	O	Y241	**19**		NC
18	O	Y202	**18**	O	Y212		**18**	O	Y242	**18**		NC
17	O	Y203	**17**	O	Y213		**17**	O	Y243	**17**		NC
16	O	Y204	**16**	O	Y214		**16**	O	Y244	**16**		NC
15	O	Y205	**15**	O	Y215		**15**	O	Y245	**15**		NC
14	O	Y206	**14**	O	Y216		**14**	O	Y246	**14**		NC
13	O	Y207	**13**	O	Y217		**13**	O	Y247	**13**		NC
12	O	Y208	**12**	O	Y218		**12**	O	Y248	**12**		NC
11	O	Y209	**11**	O	Y219		**11**	O	Y249	**11**		NC
10	O	Y20A	**10**	O	Y21A		**10**	O	Y24A	**10**		NC
9	O	Y20B	**9**	O	Y21B		**9**	O	Y24B	**9**		NC
8	O	Y20C	**8**	O	Y21C		**8**	O	Y24C	**8**		NC
7	O	Y20D	**7**	O	Y21D		**7**	O	Y24D	**7**		NC
6	O	Y20E	**6**	O	Y21E		**6**	O	Y24E	**6**		NC
5	O	Y20F	**5**	O	Y21F		**5**	O	Y24F	**5**		NC
4		DOCOM	**4**		DOCOM		**4**		DOCOM	**4**		DOCOM
3		DOCOM	**3**		DOCOM		**3**		DOCOM	**3**		DOCOM
2		DOCOM	**2**		0V		**2**		DOCOM	**2**		0V
1		DOCOM	**1**		0V		**1**		DOCOM	**1**		0V

CJ38							CJ40							CJ42						
B			A				B			A				B			A			
20	O	Y200	**20**	O	Y210		**20**	O	Y220	**20**	O	Y230		**20**	O	Y260	**20**	O	Y270	
19	O	Y201	**19**	O	Y211		**19**	O	Y221	**19**	O	Y231		**19**	O	Y261	**19**	O	Y271	
18	O	Y202	**18**	O	Y212		**18**	O	Y222	**18**	O	Y232		**18**	O	Y262	**18**	O	Y272	
17	O	Y203	**17**	O	Y213		**17**	O	Y223	**17**	O	Y233		**17**	O	Y263	**17**	O	Y273	
16	O	Y204	**16**	O	Y214		**16**	O	Y224	**16**	O	Y234		**16**	O	Y264	**16**	O	Y274	
15	O	Y205	**15**	O	Y215		**15**	O	Y225	**15**	O	Y235		**15**	O	Y265	**15**	O	Y275	
14	O	Y206	**14**	O	Y216		**14**	O	Y226	**14**	O	Y236		**14**	O	Y266	**14**	O	Y276	
13	O	Y207	**13**	O	Y217		**13**	O	Y227	**13**	O	Y237		**13**	O	Y267	**13**	O	Y277	
12	O	Y208	**12**	O	Y218		**12**	O	Y228	**12**	O	Y238		**12**	O	Y268	**12**	O	Y278	
11	O	Y209	**11**	O	Y219		**11**	O	Y229	**11**	O	Y239		**11**	O	Y269	**11**	O	Y279	
10	O	Y20A	**10**	O	Y21A		**10**	O	Y22A	**10**	O	Y23A		**10**	O	Y26A	**10**	O	Y27A	
9	O	Y20B	**9**	O	Y21B		**9**	O	Y22B	**9**	O	Y23B		**9**	O	Y26B	**9**	O	Y27B	
8	O	Y20C	**8**	O	Y21C		**8**	O	Y22C	**8**	O	Y23C		**8**	O	Y26C	**8**	O	Y27C	
7	O	Y20D	**7**	O	Y21D		**7**	O	Y22D	**7**	O	Y23D		**7**	O	Y26D	**7**	O	Y27D	
6	O	Y20E	**6**	O	Y21E		**6**	O	Y22E	**6**	O	Y23E		**6**	O	Y26E	**6**	O	Y27E	
5	O	Y20F	**5**	O	Y21F		**5**	O	Y22F	**5**	O	Y23F		**5**	O	Y26F	**5**	O	Y27F	
4		DOCOM	**4**		DOCOM		**4**		DOCOM	**4**		DOCOM		**4**		DOCOM	**4**		DOCOM	
3		DOCOM	**3**		DOCOM		**3**		DOCOM	**3**		DOCOM		**3**		DOCOM	**3**		DOCOM	
2		DOCOM	**2**		0V		**2**		DOCOM	**2**		0V		**2**		DOCOM	**2**		0V	
1		DOCOM	**1**		0V		**1**		DOCOM	**1**		0V		**1**		DOCOM	**1**		0V	

[FCU8-DX834]

CG32							CG34					
B			A				B			A		
20	O	Y200	**20**	O	Y210		**20**	O	Y220	**20**	O	Y230
19	O	Y201	**19**	O	Y211		**19**	O	Y221	**19**	O	Y231
18	O	Y202	**18**	O	Y212		**18**	O	Y222	**18**	O	Y232
17	O	Y203	**17**	O	Y213		**17**	O	Y223	**17**	O	Y233
16	O	Y204	**16**	O	Y214		**16**	O	Y224	**16**	O	Y234
15	O	Y205	**15**	O	Y215		**15**	O	Y225	**15**	O	Y235
14	O	Y206	**14**	O	Y216		**14**	O	Y226	**14**	O	Y236
13	O	Y207	**13**	O	Y217		**13**	O	Y227	**13**	O	Y237
12	O	Y208	**12**	O	Y218		**12**	O	Y228	**12**	O	Y238
11	O	Y209	**11**	O	Y219		**11**	O	Y229	**11**	O	Y239
10	O	Y20A	**10**	O	Y21A		**10**	O	Y22A	**10**	O	Y23A
9	O	Y20B	**9**	O	Y21B		**9**	O	Y22B	**9**	O	Y23B
8	O	Y20C	**8**	O	Y21C		**8**	O	Y22C	**8**	O	Y23C
7	O	Y20D	**7**	O	Y21D		**7**	O	Y22D	**7**	O	Y23D
6	O	Y20E	**6**	O	Y21E		**6**	O	Y22E	**6**	O	Y23E
5	O	Y20F	**5**	O	Y21F		**5**	O	Y22F	**5**	O	Y23F
4		+24V	**4**		+24V		**4**		+24V	**4**		+24V
3		+24V	**3**		+24V		**3**		+24V	**3**		+24V
2		+24V	**2**		0V		**2**		+24V	**2**		0V
1		+24V	**1**		0V		**1**		+24V	**1**		0V

The input/output assignment is modifiable using a parameter. Refer to "17.6.4.2 Arbitrary Device Assignment" for details.

<Cable side connector type>

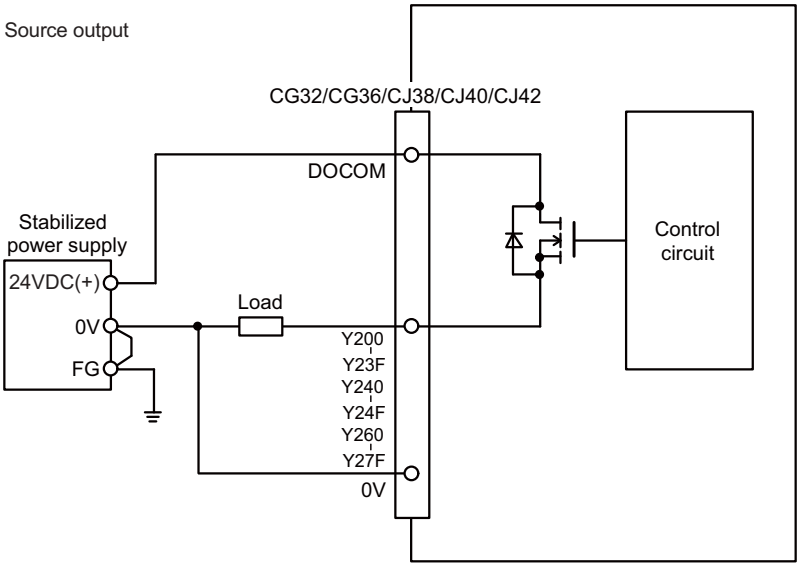
Connector : XG4M-4030 / 7940-6500SC
Strain relief : XG4T-4004 / 3448-7940
Manufacturer: OMRON / 3M

(a) Outline of digital signal output circuit

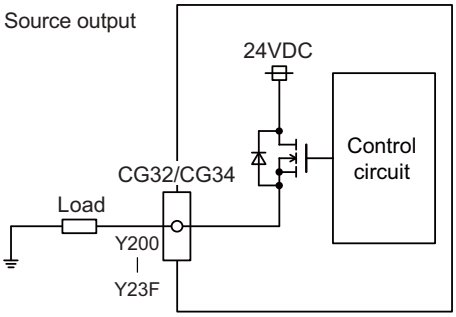
Use within the specification ranges shown below.

Output circuit

[FCU8-DX731 / FCU8-DX750 / FCU8-DX760 / FCU8-DX761]



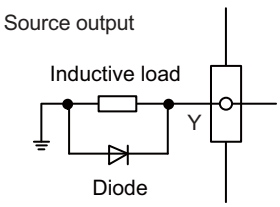
[FCU8-DX834]



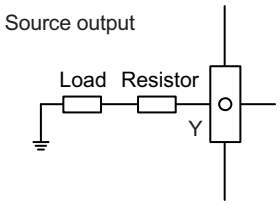
Output conditions

Insulation method	Non-insulation
Rated load voltage	24VDC
Max. output current	0.2A/point [Total output current of whole unit] - For FCU8-DX731/DX750/DX761/DX834: 3.8A or less - For FCU8-DX760: 5.7A or less
Output delay time	40μs

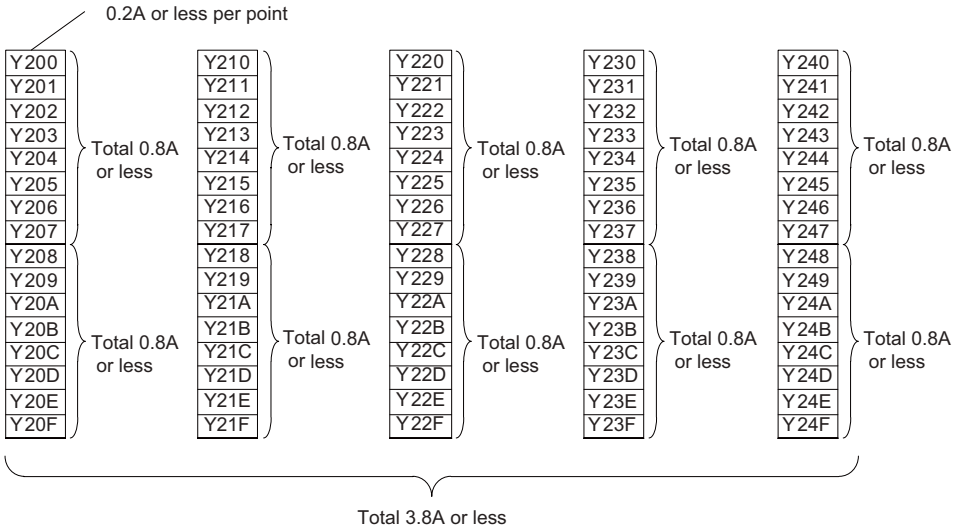
(Note 1) When using an inductive load such as a relay, always connect a diode (voltage resistance 100V or more, twice or more the load current) in parallel to the load.

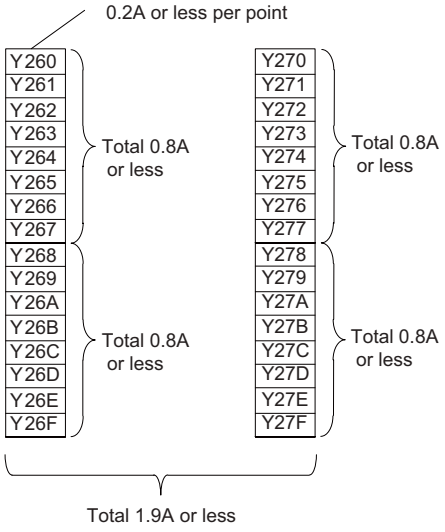


(Note 2) When the rush current exceeds the maximum output current, always connect a protective resistor (R=150Ω) serially to the load to suppress rush currents. Make sure that the current is less than the maximum output current including the momentary current.



(Note 3) Always keep the total sum output current of each Y200 to Y207, Y208 to Y20F, Y210 to Y217, Y218 to Y21F, Y220 to Y227, Y228 to Y22F, Y230 to Y237, Y238 to Y23F, Y240 to Y247, Y248 to Y24F, Y260 to Y267, Y268 to Y26F, Y270 to Y277, and Y278 to Y27F less than 0.8A.





⚠ CAUTION

1. When using an inductive load such as a relay, always connect a diode in parallel to the load to prevent a counter-electromotive force.

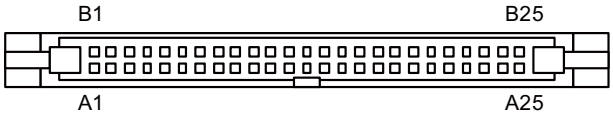
2. When the rush current exceeds the maximum output current, always connect a protective resistor serially to the load to suppress rush currents.

(7) CJ37 (Machine signal input)

Digital input 48 points (1st and 2nd stations)

(9) CJ39 (Machine signal input)

Digital input 48 points (2nd and 3rd stations)



CJ37							CJ39					
B			A				B			A		
25	I	X200	**25**	I	X218		**25**	I	X230	**25**	I	X248
24	I	X201	**24**	I	X219		**24**	I	X231	**24**	I	X249
23	I	X202	**23**	I	X21A		**23**	I	X232	**23**	I	X24A
22	I	X203	**22**	I	X21B		**22**	I	X233	**22**	I	X24B
21	I	X204	**21**	I	X21C		**21**	I	X234	**21**	I	X24C
20	I	X205	**20**	I	X21D		**20**	I	X235	**20**	I	X24D
19	I	X206	**19**	I	X21E		**19**	I	X236	**19**	I	X24E
18	I	X207	**18**	I	X21F		**18**	I	X237	**18**	I	X24F
17	I	X208	**17**	I	X220		**17**	I	X238	**17**	I	X250
16	I	X209	**16**	I	X221		**16**	I	X239	**16**	I	X251
15	I	X20A	**15**	I	X222		**15**	I	X23A	**15**	I	X252
14	I	X20B	**14**	I	X223		**14**	I	X23B	**14**	I	X253
13	I	X20C	**13**	I	X224		**13**	I	X23C	**13**	I	X254
12	I	X20D	**12**	I	X225		**12**	I	X23D	**12**	I	X255
11	I	X20E	**11**	I	X226		**11**	I	X23E	**11**	I	X256
10	I	X20F	**10**	I	X227		**10**	I	X23F	**10**	I	X257
9	I	X210	**9**	I	X228		**9**	I	X240	**9**	I	X258
8	I	X211	**8**	I	X229		**8**	I	X241	**8**	I	X259
7	I	X212	**7**	I	X22A		**7**	I	X242	**7**	I	X25A
6	I	X213	**6**	I	X22B		**6**	I	X243	**6**	I	X25B
5	I	X214	**5**	I	X22C		**5**	I	X244	**5**	I	X25C
4	I	X215	**4**	I	X22D		**4**	I	X245	**4**	I	X25D
3	I	X216	**3**	I	X22E		**3**	I	X246	**3**	I	X25E
2	I	X217	**2**	I	X22F		**2**	I	X247	**2**	I	X25F
1		DICOM	**1**		DICOM		**1**		DICOM	**1**		DICOM

The input/output assignment is modifiable using a parameter. Refer to "17.6.4.2 Arbitrary Device Assignment" for details.

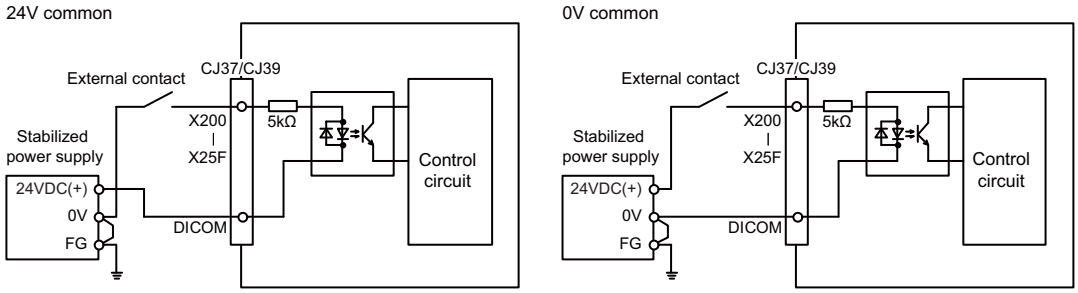
<Cable side connector type>

Connector : XG4M-5030 / 7950-6500SC
Strain relief : XG4T-5004 / 3448-7950
Manufacturer: OMRON / 3M

(a) Outline of digital signal input circuit

Both 24V common and 0V common connections are allowed in the digital signal input circuit.
Follow the wiring diagram below for each type.

Input circuit

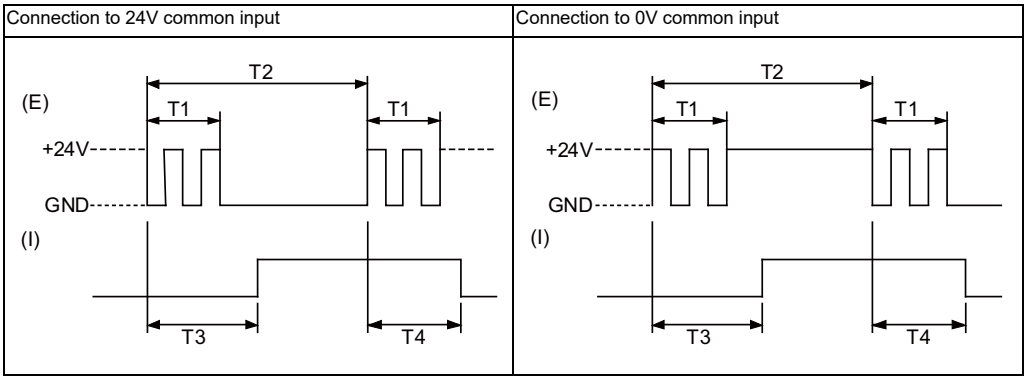


Input conditions

The input signals must be used within the following condition ranges.

		24V common	0V common
1	**Input voltage at external contact ON**	6V or less	18V or more, 25.2V or less
2	**Input current at external contact ON**	3mA or more	
3	**Input voltage at external contact OFF**	20.2V or more, 25.2V or less	3.8V or less
4	**Input current at external contact OFF**	0.7mA or less	
5	**Input resistance**	5kΩ	
6	**Tolerable chattering time (T1)**	3ms	
7	**Input signal holding time (T2)**	40ms or more (*1)	
8	**Input circuit operation delay time (T3 and T4)**	3 to 16ms	
9	**Machine side contact capacity**	30V or more, 16mA or more	

(*1) Note that "40 ms or more" is a guide of the "Input signal holding time". The input signal is recognized only when its "ON" state is held longer than the ladder processing cycle time.

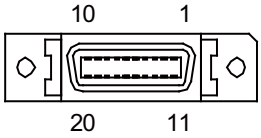


(E) : External signal, (I):Internal signal

(Note) Set the number of DI points that are simultaneously turned ON to be less than half of the total points.
If many points are set to be simultaneously turned ON, operation panel I/O unit may be deteriorated due to the heat.

(12) MPG (Manual pulse generator input)

5V manual pulse generator and 12V manual pulse generator can be connected to this connector.



[FCU8-DX731]

1		0V	**11**		0V
2		NC	**12**		NC
3	I	HA2A	**13**	I	HA2B
4	I	HA1A	**14**	I	HA1B
5		0V	**15**		0V
6	O	+12V	**16**	O	+12V
7		NC	**17**		NC
8		NC	**18**		NC
9		NC	**19**		NC
10	O	+5V	**20**	O	+5V

[FCU8-DX750 / FCU8-DX760 / FCU8-DX761]

1		0V	**11**		0V
2	I	HA3A	**12**	I	HA3B
3	I	HA2A	**13**	I	HA2B
4	I	HA1A	**14**	I	HA1B
5		0V	**15**		0V
6	O	+12V	**16**	O	+12V
7		NC	**17**		NC
8		NC	**18**		NC
9	O	+12V	**19**	O	+5V
10	O	+5V	**20**	O	+5V

- Connect connector case with FG pattern.

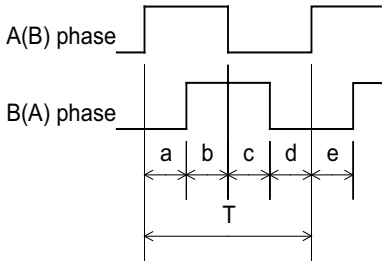
<Cable side connector type>

Plug : 10120-3000PE
Shell : 10320-52F0-008
Manufacturer: 3M

(Note) When using the jackscrew M2.6-type 10320-52A0-008 for the shell, do not fasten the screws too tightly otherwise the connector and the PCB may be damaged.
(Manufacturer recommended tightening torque: 0.20±0.05N·m)

<Specification of input part>

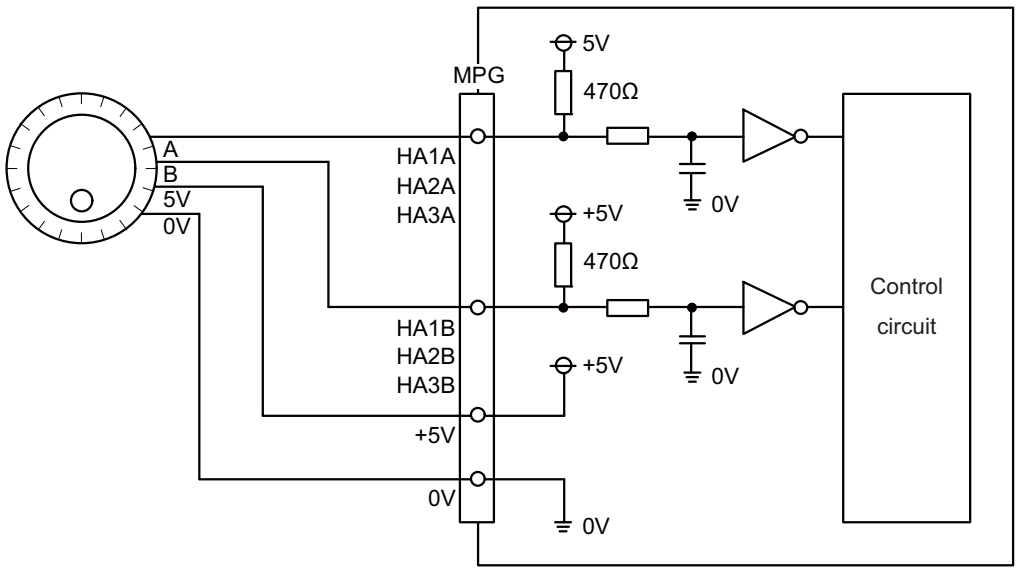
	5V manual pulse generator	12V manual pulse generator
Number of pulse phases	Two phases (A phase, B phase, a phase difference 90 degrees) (Refer to the waveform below.)	
Signal output of manual pulse generator	Open collector output	
Signal voltage	H level 3.5V to 5.25V L level 0V to 0.5V	
Power supply voltage	5VDC±10%	12VDC±10%
Current consumption	100mA or less	
Number of pulses per rotation	25 pulse/rev,100 pulse/rev	
Input frequency (rotation speed)	1kHz or less (2400r/min or less for 25pluse/rev, 600r/min or less for 100pluse/rev)	
Cable length	20m or less	50m or less



a.b.c.d.e: A phase or B phase rising edge (falling edge) phase difference = T/4 ± T/10
T: A or B phase cycle

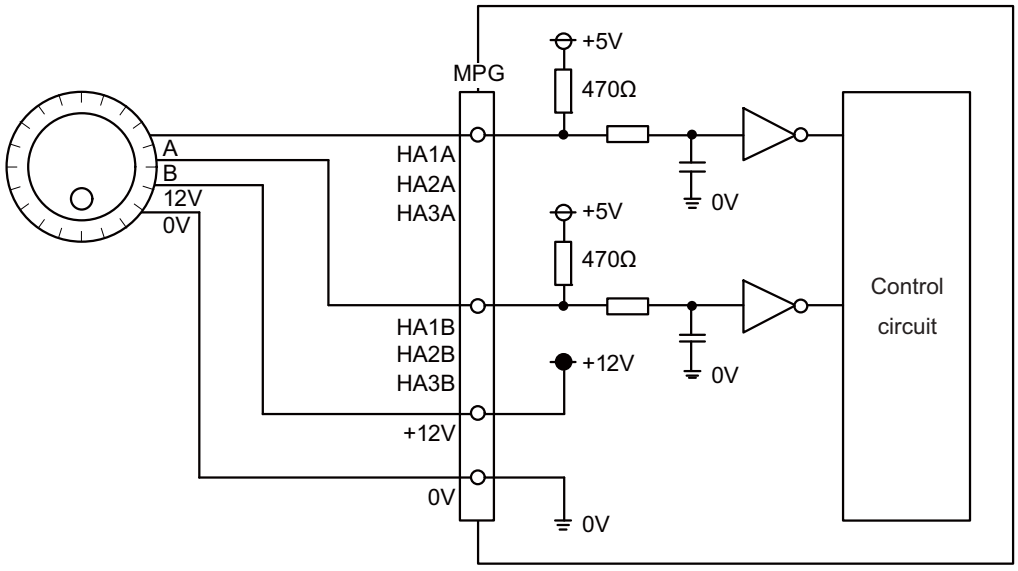
<Input/output circuit>

(a) 5V manual pulse generator



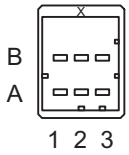
(Note) No HA3A and HA3B in FCU8-DX731.

(b) 12V manual pulse generator



(Note) No HA3A and HA3B in FCU8-DX731.

(13) RIO3EXT (Remote I/O 2.0 communication)
(14) RIO3 (Remote I/O 2.0 communication)



A			B		
1	I/O	TXRXD	**1**	I/O	TXRXD*
2		NC	**2**		0V
3		FG	**3**		NC

<Cable side connector type>

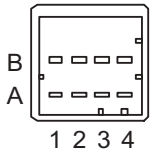
Connector : 1-1318119-3
Contact : 1318107-1
Manufacturer: TE Connectivity

Refer to the following chart for the maximum number of connecting stations and I/O points.

Operation panel I/O unit type	Max. number of stations (RIO3EXT connection)	Max. number of I/O points (RIO3EXT connection)
FCU8-DX731	53 stations (2nd, 4th to 6th, 13th to 19th, and 23rd to 64th stations can be used)	1696 points/ 1696 points
FCU8-DX750	52 stations (4th to 6th, 13th to 19th, and 23rd to 64th stations can be used)	1664 points/ 1664 points
FCU8-DX760	51 stations (5th, 6th, 13th to 19th, and 23rd to 64th stations can be used)	1632 points/ 1632 points
FCU8-DX761	50 stations (6th, 13th to 19th, and 23rd to 64th stations can be used)	1600 points/ 1600 points
FCU8-DX834	49 stations (5th, 6th, 15th to 19th, and 23rd to 64th stations can be used)	1568 points/ 1568 points

(Note 1) Refer to the section "General Specifications: Remote I/O Unit" for the number of occupying stations and I/O points of remote I/O units.

(15) CJ71 (Control unit I/F)



A1	I/O	TXRXD	**B1**	I/O	TXRXD*
A2	-	+5V	**B2**	-	+3.3V
A3	-	-	**B3**	-	0V
A4	-	FG	**B4**	-	0V

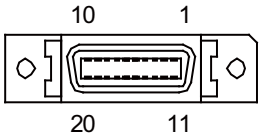
<Cable side connector type>

Connector : 2-1318119-4
Contact : 1318107-1
Manufacturer: TE Connectivity

(16) NCKB (Keyboard I/F)

(17) AO (Analog output)

Analog output can be connected to this connector.



1		0V	**11**		0V
2		NC	**12**		NC
3		NC	**13**		NC
4		NC	**14**		NC
5		0V	**15**		0V
6		NC	**16**		NC
7	O	AO	**17**		NC
8		NC	**18**		NC
9		NC	**19**		NC
10		NC	**20**		NC

- Connect connector case with FG pattern.

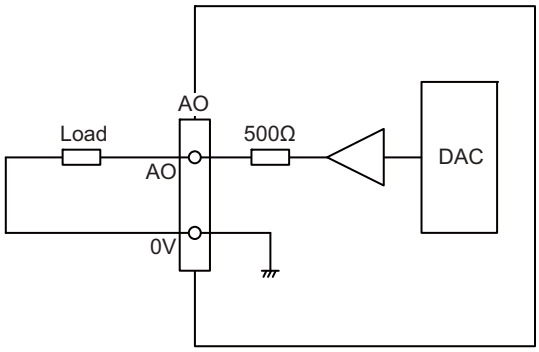
<Cable side connector type>

Plug : 10120-3000PE
Shell : 10320-56F0-008
Manufacturer: 3M

(Note) When using the jackscrew M2.6-type 10320-56S0-008-F for the shell, do not fasten the screws too tightly otherwise the connector and the PCB may be damaged.
(Manufacturer recommended tightening torque: 0.20±0.05N·m)

(a) Outline of analog signal output circuit

Output circuit

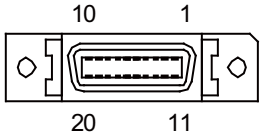


Output conditions

Analog output voltage	-10 to 10V(±5%)
Resolution	10V / 4095 = 2.44mV
Load conditions	External load resistance value 10kΩ or more
Output resistance value	500Ω

(18) AIO (Analog input, Analog output)

Analog input and analog output can be connected to this connector.



1		0V	**11**		0V
2	I	AI0	**12**		NC
3		NC	**13**		NC
4		NC	**14**		NC
5		0V	**15**		0V
6		NC	**16**		NC
7	O	AO	**17**		NC
8		NC	**18**		NC
9		0V	**19**		NC
10		NC	**20**		NC

- Connect connector case with FG pattern.

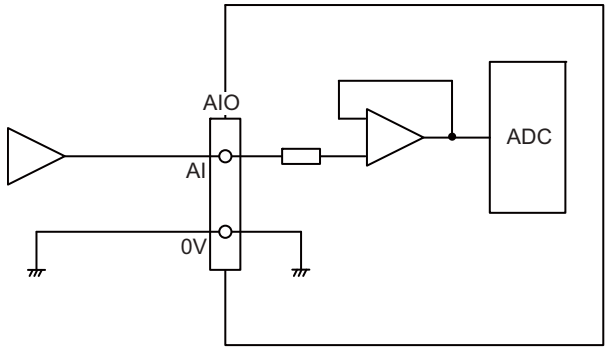
<Cable side connector type>

Plug : 10120-3000PE
Shell : 10320-56F0-008
Manufacturer: 3M

(Note) When using the jackscrew M2.6-type 10320-56S0-008-F for the shell, do not fasten the screws too tightly otherwise the connector and the PCB may be damaged.
(Manufacturer recommended tightening torque: 0.20±0.05N·m)

(a) Outline of analog signal input circuit

Input circuit



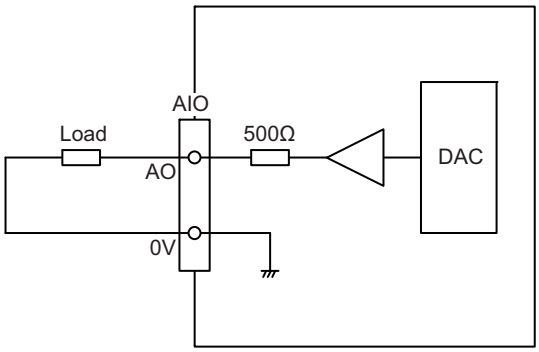
Input conditions

Analog input voltage	-10 to 10V
Max. input rating (Note 1)	±15V
Resolution	|-10 ～ +10V| / 4095 = 4.88mV
Repeatability	Within ±25mV (Note 2)
Tolerance	±0.35V

(Note 1) This indicates the input voltage which must not exceeded even in an instant.
(Note 2) Except when the accuracy is affected by the noise.

(b) Outline of analog signal output circuit

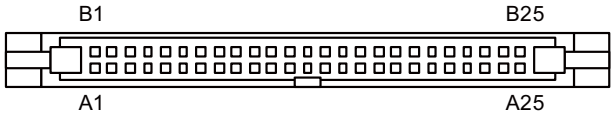
Output circuit



Output conditions

Analog output voltage	-10 to 10V(±5%)
Resolution	10V / 4095 = 2.44mV
Load conditions	External load resistance value 10kΩ or more
Output resistance value	500Ω

(19) OPKB (Scan input, Scan output)



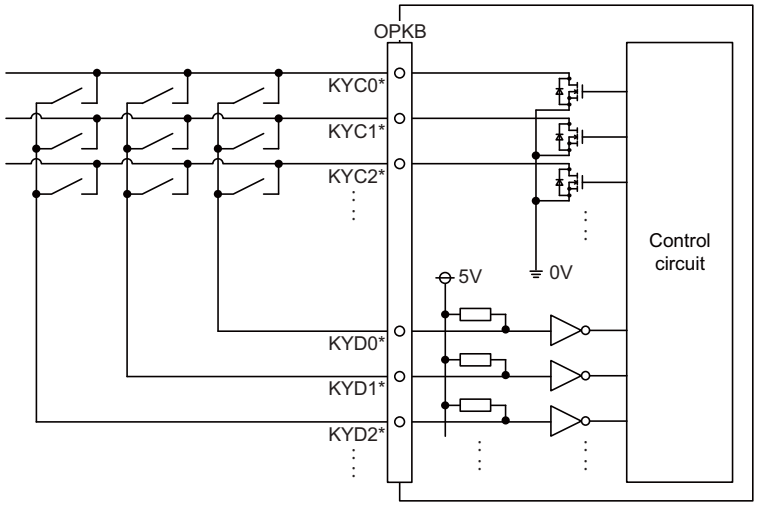
OPKB					
B			A		
25		0V	**25**		0V
24	O	LC3B	**24**	O	LC3A
23	O	LC2B	**23**	O	LC2A
22	O	LC1B	**22**	O	LC1A
21	O	LC0B	**21**	O	LC0A
20	I	LD7B*	**20**	I	LD7A*
19	I	LD6B*	**19**	I	LD6A*
18	I	LD5B*	**18**	I	LD5A*
17	I	LD4B*	**17**	I	LD4A*
16	I	LD3B*	**16**	I	LD3A*
15	I	LD2B*	**15**	I	LD2A*
14	I	LD1B*	**14**	I	LD1A*
13	I	LD0B*	**13**	I	LD0A*
12		0V	**12**		NC
11		NC	**11**		NC
10		NC	**10**	O	NC
9	O	KYC7*	**9**	O	KYC6*
8	O	KYC5*	**8**	O	KYC4*
7	O	KYC3*	**7**	O	KYC2*
6	O	KYC1*	**6**	O	KYC0*
5	I	KYD7*	**5**	I	KYD6*
4	I	KYD5*	**4**	I	KYD4*
3	I	KYD3*	**3**	I	KYD2*
2	I	KYD1*	**2**	I	KYD0*
1		NC	**1**		0V

<Cable side connector type>

Connector : XG4M-5030 / 7950-6500SC
Strain relief : XG4T-5004 / 3448-7950
Manufacturer: OMRON / 3M

(a) Outline of scan input circuit

Input circuit

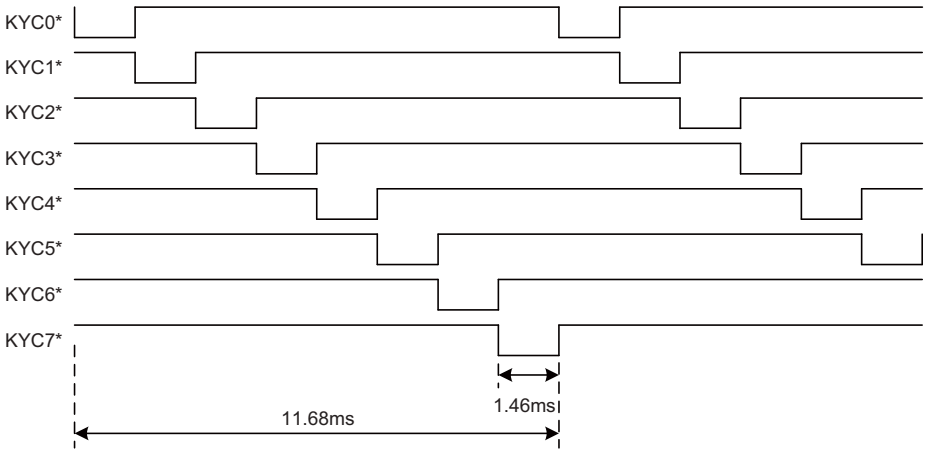


Input conditions

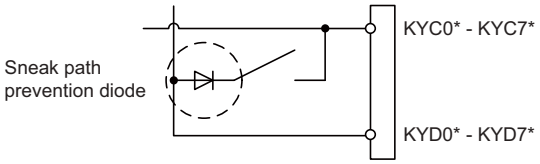
1	**Number of points**	64 points
2	**Configuration**	Matrix of 8 common signals × 8 data signals
3	**Rated voltage**	5 VDC
4	**Minimum applicable load**	1.4 mA per point
5	**Input signal holding time**	11.68 ms or more (*1)

(*1) Note that "11.68 ms or more" is a guide of the "Input signal holding time". The input signal is recognized only when its "ON" state is held longer than the ladder processing cycle time.

The common signals are changed over with scan input as shown in the following drawing. Key input data can be received when the common signal is LOW.
The common signal changeover cycle is 11.68ms, but the input signal will not be recognized unless it is held for the ladder processing cycle time or longer.

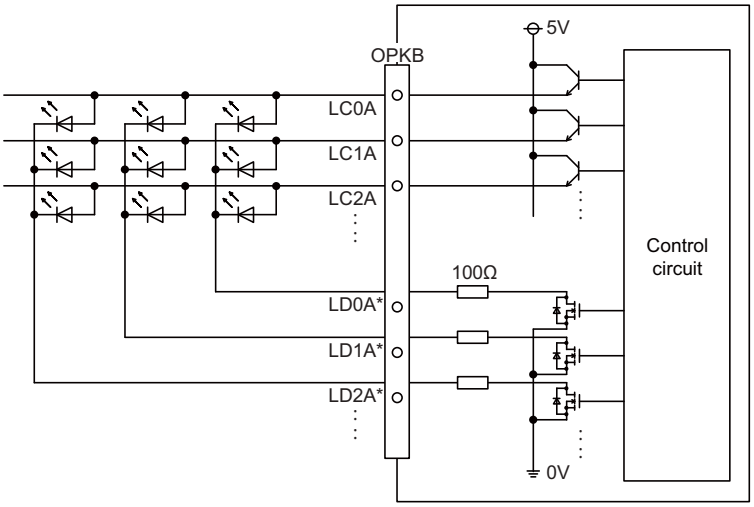


(Note) To perform a scan input, connect a sneak path prevention diode as illustrated below. Input signals may not be read correctly without the sneak path prevention diode.



(b) Outline of scan output circuit

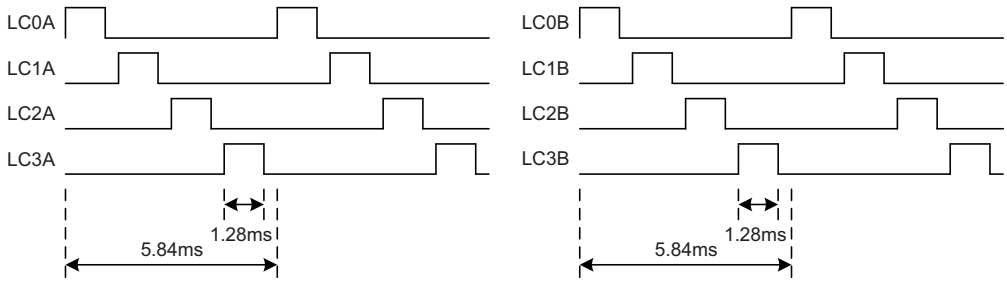
Output circuit



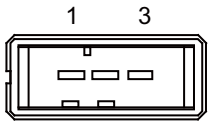
Output conditions

1	**Number of points**	64 points
2	**Configuration**	Matrix of 4 common signals × 4 data signals + 4 common signals × 4 data signals
3	**Rated voltage**	5 VDC
4	**Maximum output current**	23 mA per point

The common signals are switched over with scan output as shown in the following drawing. The LED lights only when the common signal is High. As the common signal, four signals are switched in order, and LED lights once every 5.84 ms for 1.28 ms.



(20) DCIN (24VDC input)



1	I	+24V
2		0V
3		FG

<Cable side connector type>

Connector : 2-178288-3
Contact : 1-175218-5
Manufacturer: TE Connectivity

(a) Specifications of power supply

Consider the following characteristics when selecting the stabilized power supply (prepared by machine tool builder). Use a power supply that complies with CE Marking or that follows the safety standards given below.

[Stabilized power supply selection items]

Item		Standard setting
Output	**Voltage fluctuation**	±5% or less of 24VDC
	Ripple noise	200mV (P-P)
Power capacity		Calculate the current value as a reference of maximum current consumption for the unit which uses the power supply.
Output holding time		20ms
Overcurrent protection		Required

[Standards]

Safety Standards	UL1950, CSA C22.2 No. 234 approved, IEC950 compliant
Noise Terminal Voltage	FCC Class A, VCCI Class A
High Harmonics Current Restrictions	IEC61000-3-2

(Note) 24VDC voltage may drop instantaneously due to rush current at the beginning of 24V power supply to the operation panel I/O unit. The level of voltage drop depends on the capacity of the power supply. Do not share the power supply with the devices that have alarms to warn the voltage drop.

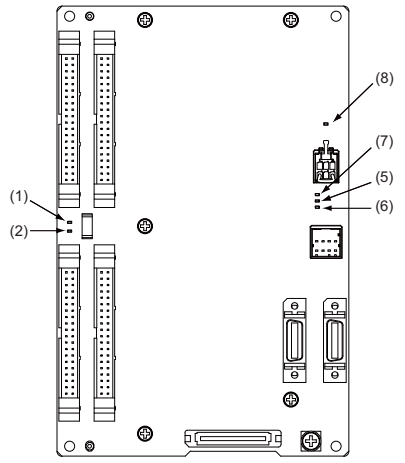
⚠ CAUTION

1. Using a stabilized power supply without overcurrent protection may cause the unit's failure due to miswiring of 24V.

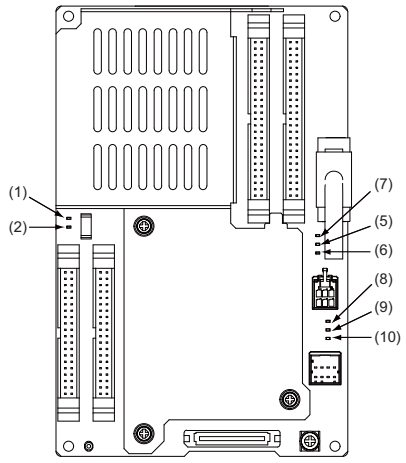
(21) FG (FG terminal)

[LED]

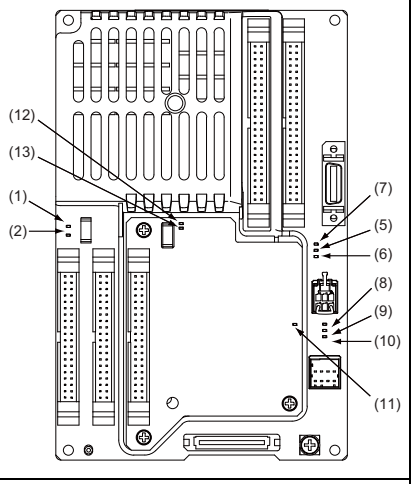
FCU8-DX731



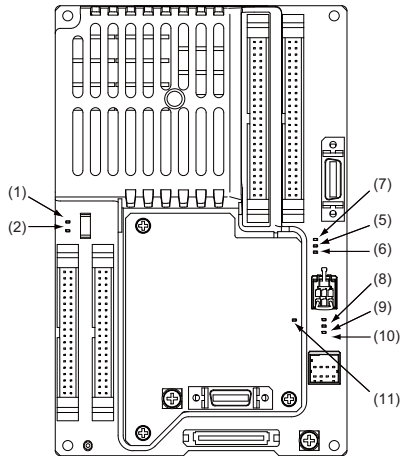
FCU8-DX750



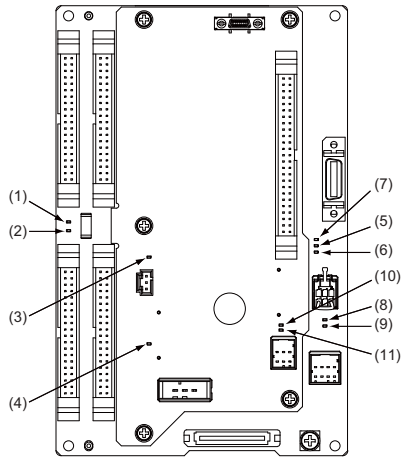
FCU8-DX760



FCU8-DX761



FCU8-DX834



No.	Name	Function	Color	Status		Details
				Normal	At fault	
(1)	FUSE	Fuse status	Green	Lit	Not lit	Not lit when a fuse has been blown out.
(2)	DOCOM	Energization status of 24VDC input (DOCOM) of CG32/CG36/CJ38/CJ40 connector	Green	Lit	Not lit	Lit when a current is applied.
(3)	EMG	Emergency stop input status	Red	Not lit	Lit	Lit when an emergency stop has occurred.
(4)	24VDCIN	Energization status of 24VDC input of DCIN connector	Green	Lit	Not lit	Lit when a current is applied.
(5)	5VIN	5V power supply circuit status	Green	Lit	Not lit	Lit when the circuit is normally operated.
(6)	3VIN	3.3V power supply circuit status	Green	Lit	Not lit	Lit when the circuit is normally operated.
(7)	12VON	12V power supply circuit status	Green	Lit	Not lit	Lit when the circuit is normally operated.
(8)	ALM1	RIO communication error	Red	Not lit	Lit	Lit when RIO communication error has occurred.
(9)	ALM2	RIO communication error	Red	Not lit	Lit	Lit when RIO communication error has occurred.
(10)	ALM3	RIO communication error	Red	Not lit	Lit	Lit when RIO communication error has occurred.
(11)	ALM4	RIO communication error	Red	Not lit	Lit	Lit when RIO communication error has occurred.
(12)	FUSE2	Fuse status	Green	Lit	Not lit	Not lit when a fuse has been blown out.
(13)	DOCOM2	Energization status of 24VDC input (DOCOM) of CJ42 connector	Green	Lit	Not lit	Lit when a current is applied.

4.12 Remote I/O Unit

Types of signals described on the list of units can be input/output from the remote I/O unit (FCU8-DXxxx) according to the type and No. of contacts. Remote I/O units are used by being connected to the control unit or the operation panel I/O unit.
Multiple remote I/O units can be used as long as the total number of occupied stations is 64 or less.

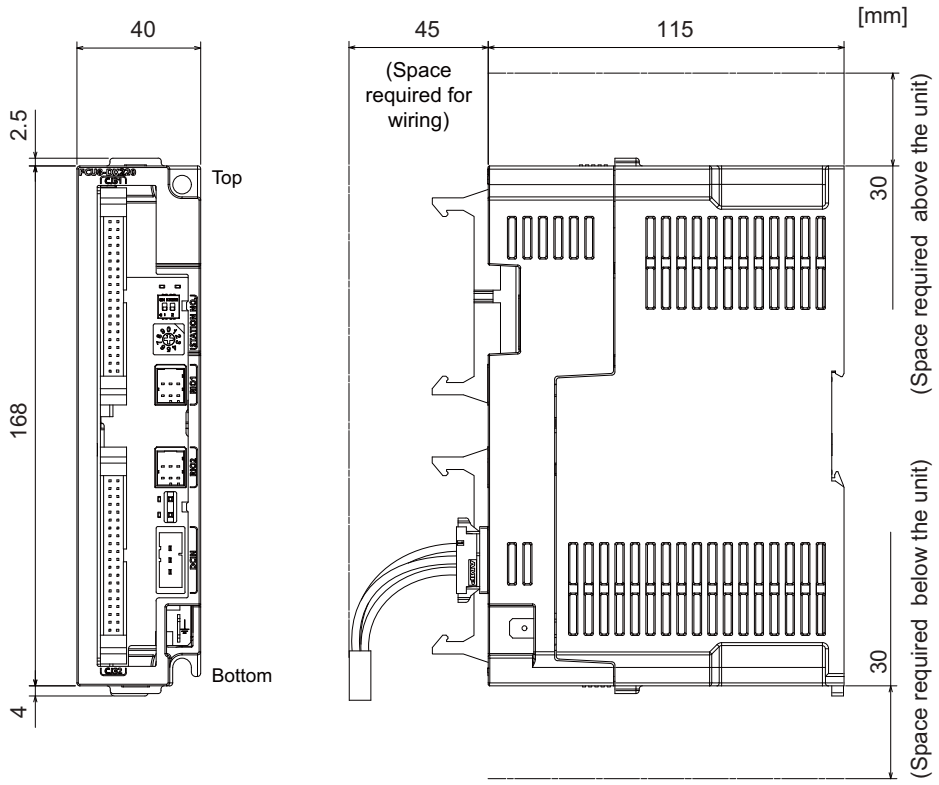
(Note) The maximum connectable number of remote I/O units is 32.

4.12.1 List of Units

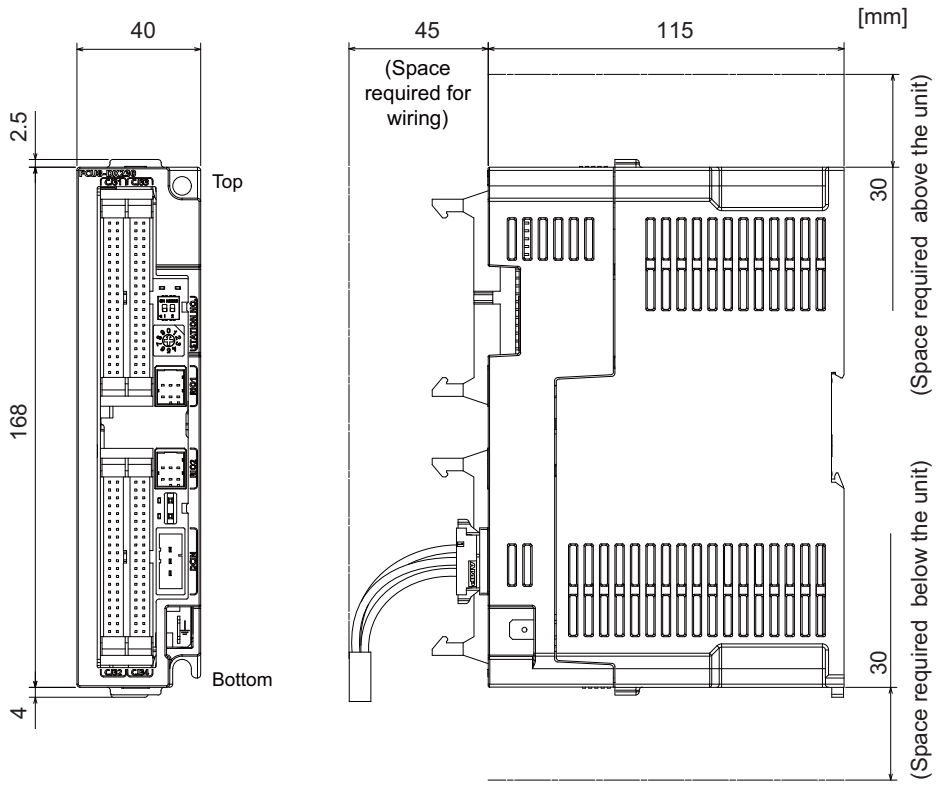
Classification	Type	Components	Remarks
DI 24V/0V common input [32 points] DO Source output [32 points]	FCU8-DX220	Base card RIO 2.0 connector set	DI: 32-points 24V/0V common type Do: 32-points source type (200mA/point) Number of occupied stations: 1
DI 24V/0V common input [64 points] DO Source output [48 points]	FCU8-DX230	Base card RIO 2.0 connector set	DI: 64-points 24V/0V common type DO: 48-points source type (200mA/point) Number of occupied stations: 2
DI 24V/0V common input DO Source output [48 points] AO Analog output [1 point]	FCU8-DX231	Base card RIO 2.0 connector set	DI: 64-points 24V/0V common type DO: 48-points source type (200mA/point) AO: 1 point Number of occupied stations: 2
AI Analog input [4 points] AO Analog output [1 point]	FCU8-DX202	Base card RIO 2.0 connector set	AI : 4 points AO: 1 point Number of occupied stations: 1
DI 0V common input [16 points] DO Source output (large capacity) [8 points]	FCU8-DX213	Base card RIO 2.0 connector set	DI: 16-points 0V common type (3mA/point) DO: 8-points source type (2A/point) Number of occupied stations: 1
DI 0V common input [16 points] DO Source output (large capacity) [8 points]	FCU8-DX213-1	Base card RIO 2.0 connector set	DI: 16-points 0V common type (9mA/point) DO: 8-points source type (2A/point) Number of occupied stations: 1
Safety DI 0V common input [8 points] Safety DO Source output (large capacity) [4 points]	FCU8-DX654	Base card RIO 2.0 connector set	Safety DI: 8-points 0V common type (3mA/point) Safety DO: 4-points source type (2A/point) Number of occupied stations: 2
Safety DI 0V common input [8 points] Safety DO Source output (large capacity) [4 points]	FCU8-DX654-1	Base card RIO 2.0 connector set	Safety DI: 8-points 0V common type (9mA/point) Safety DO: 4-points source type (2A/point) Number of occupied stations: 2
DI 24V/0V common input [32points] DO Source output [32 points] Safety DI 0V common input [8 points] (Note 1) Safety relay output [4 points] (Note 2)	FCU8-DX651	Base card Add-on card RIO 2.0 connector set	DI: 32-points 24V/0V common type Do: 32-points source type (200mA/point) Safety DI: 8-points 0V common type Safety relay: 4-points (non-voltage contact) Relay contact welding detection Number of occupied stations: 3 (Note 1) Safety DI uses 16 points of terminal because of the duplication wiring. (Note 2) Safety relay output uses 8 points of terminal because of the duplication wiring.
Thermistor input [12 points]	FCU8-DX408	Base card RIO 2.0 connector set	Thermistor input: 12 points Number of occupied stations: 3
Multi-analog input [4 points] (Note 3)	FCU8-DX409	Base card RIO 2.0 connector set	Multi-analog input: 4 points (Note 3) Voltage input, current input, thermocouple input and resistance temperature detector input are selected for each CH. Number of occupied stations: 4

4.12.2 FCU8-DX220 / FCU8-DX230 / FCU8-DX231 / FCU8-DX202 / FCU8-DX213 / FCU8-DX213-1 / FCU8-DX654 / FCU8-DX654-1 / FCU8-DX651/ FCU8-DX408 / FCU8-DX409

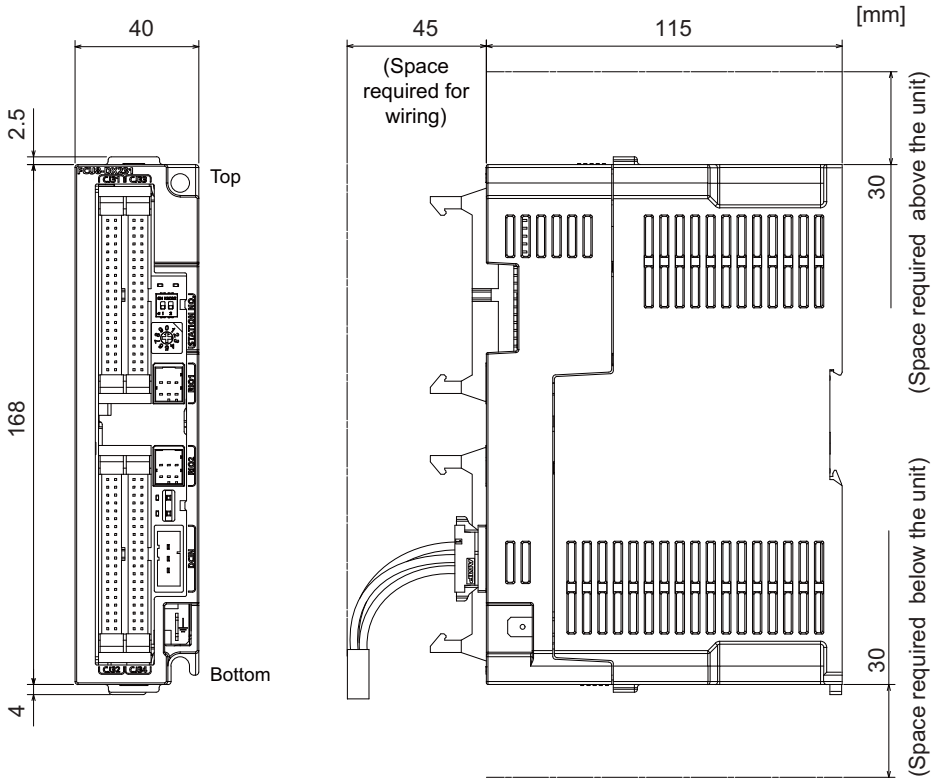
[Outline dimension : FCU8-DX220]



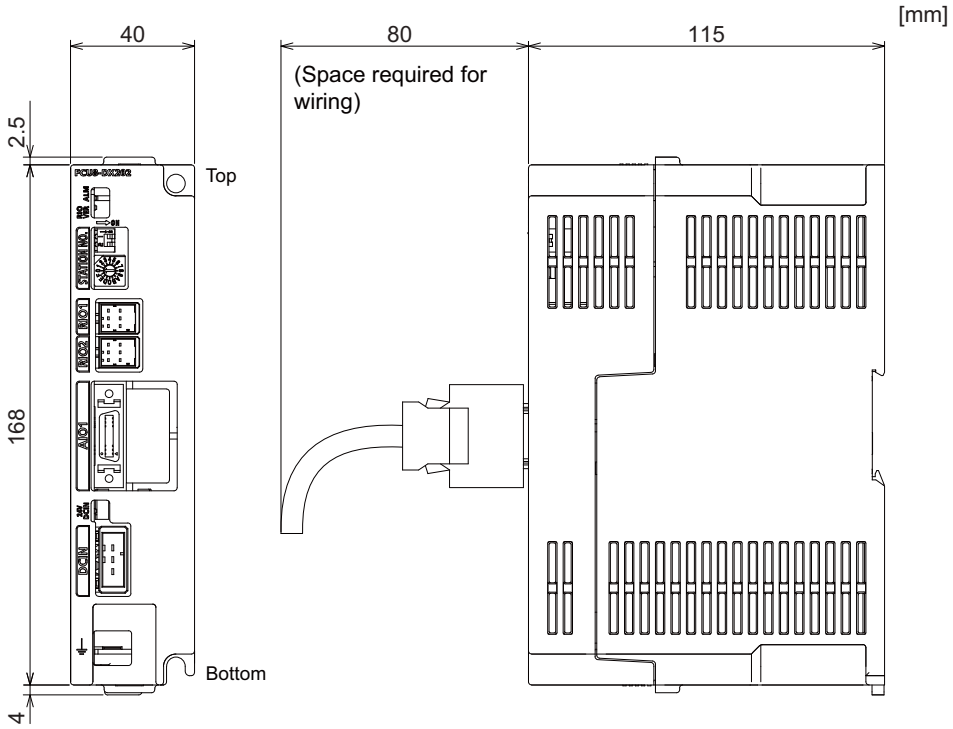
[Outline dimension : FCU8-DX230]



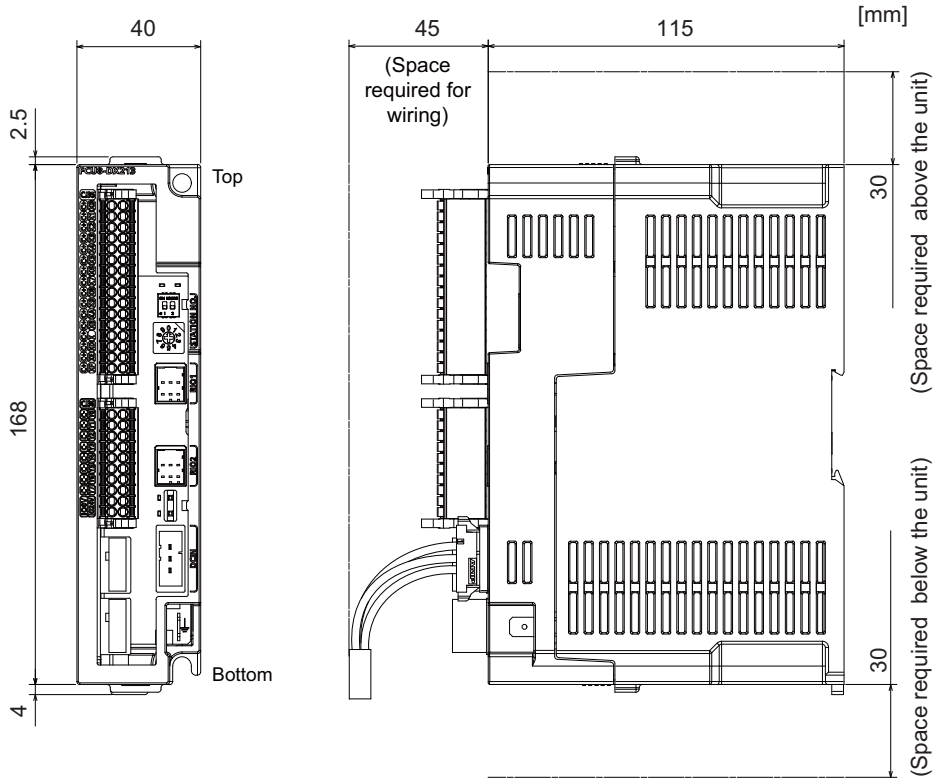
[Outline dimension : FCU8-DX231]



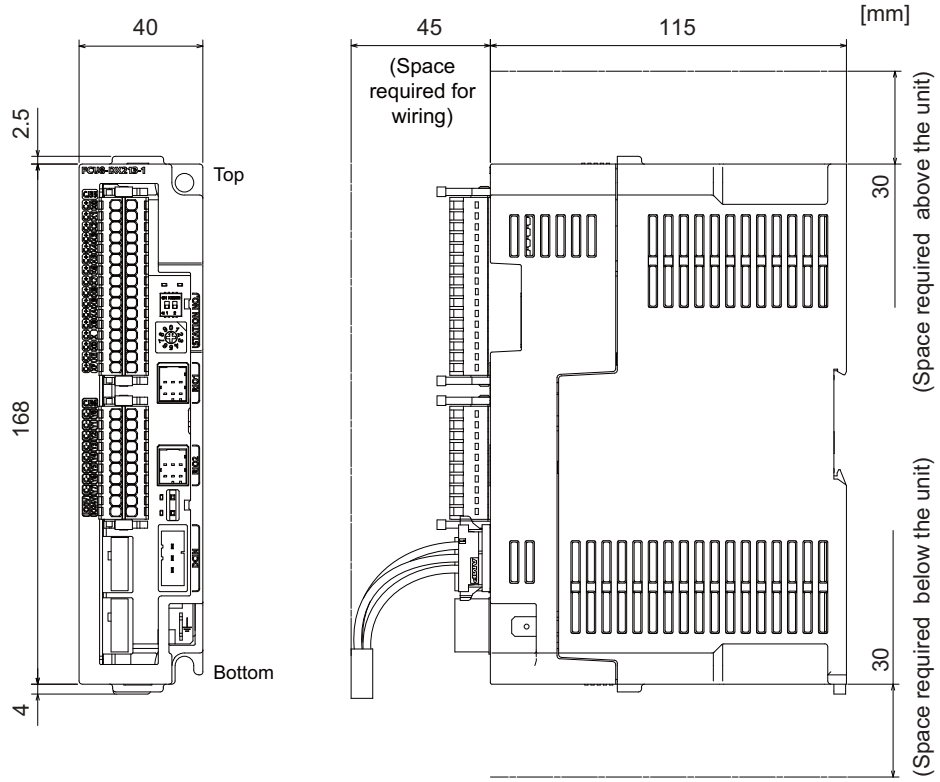
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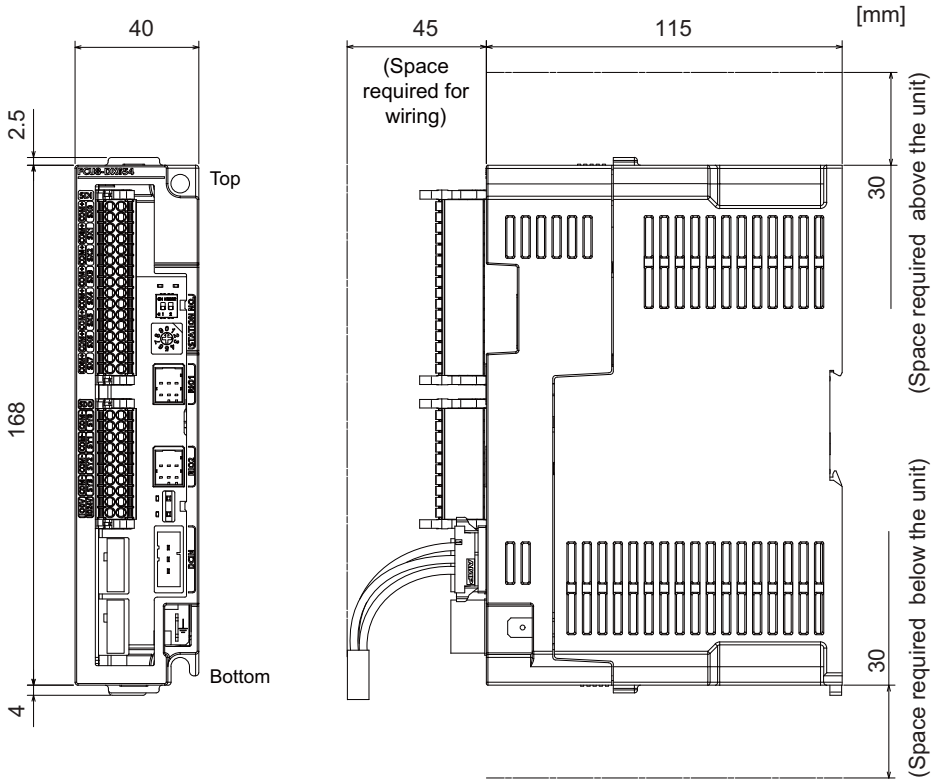
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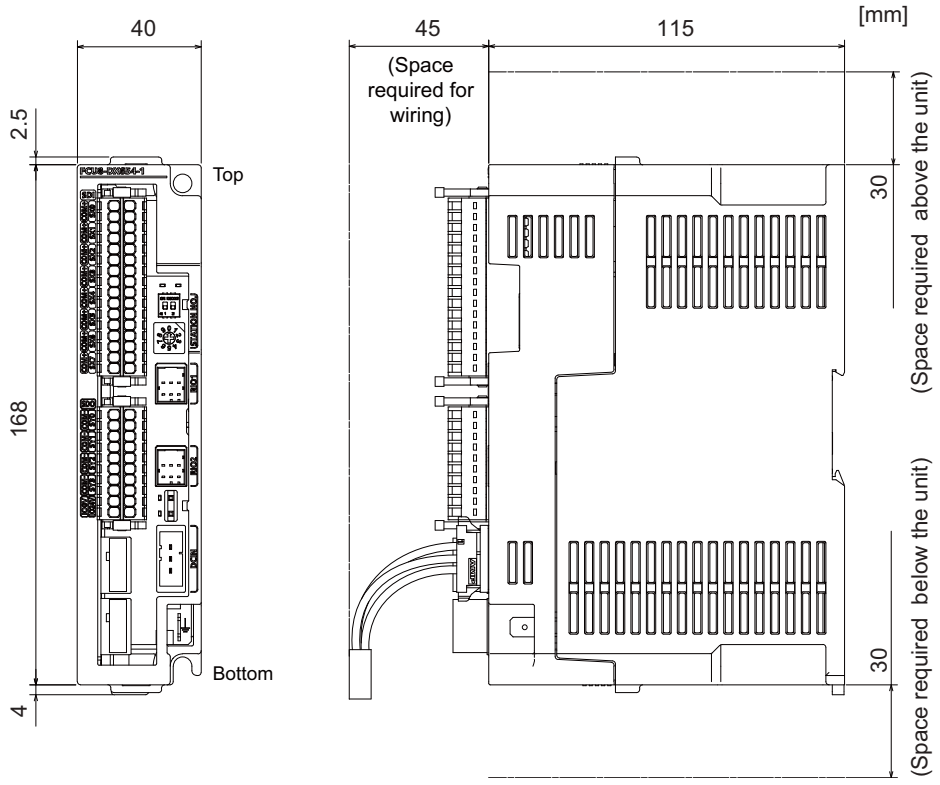
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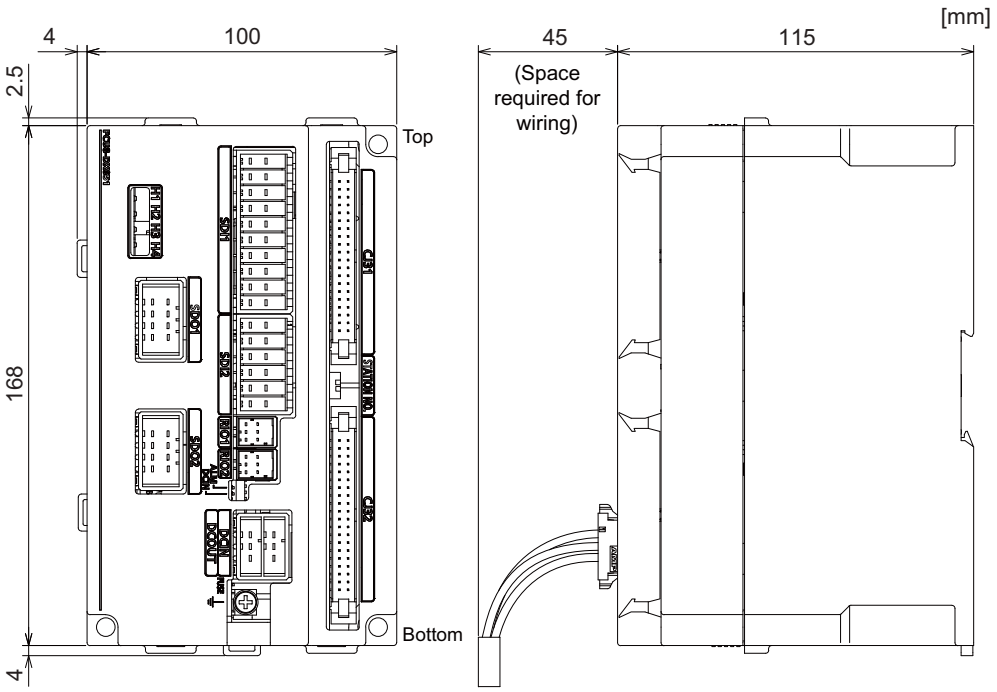
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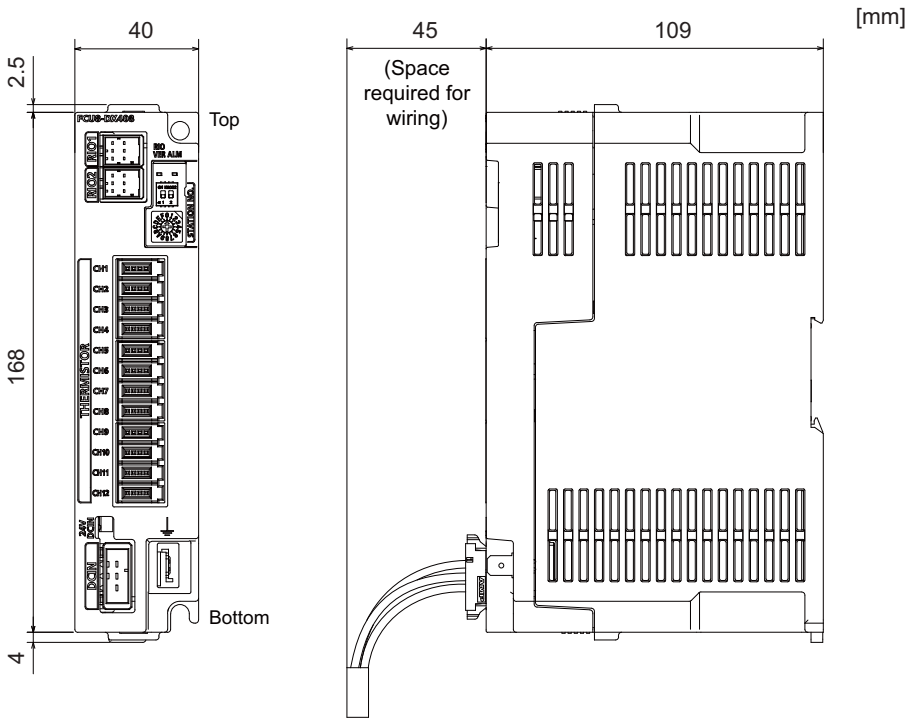
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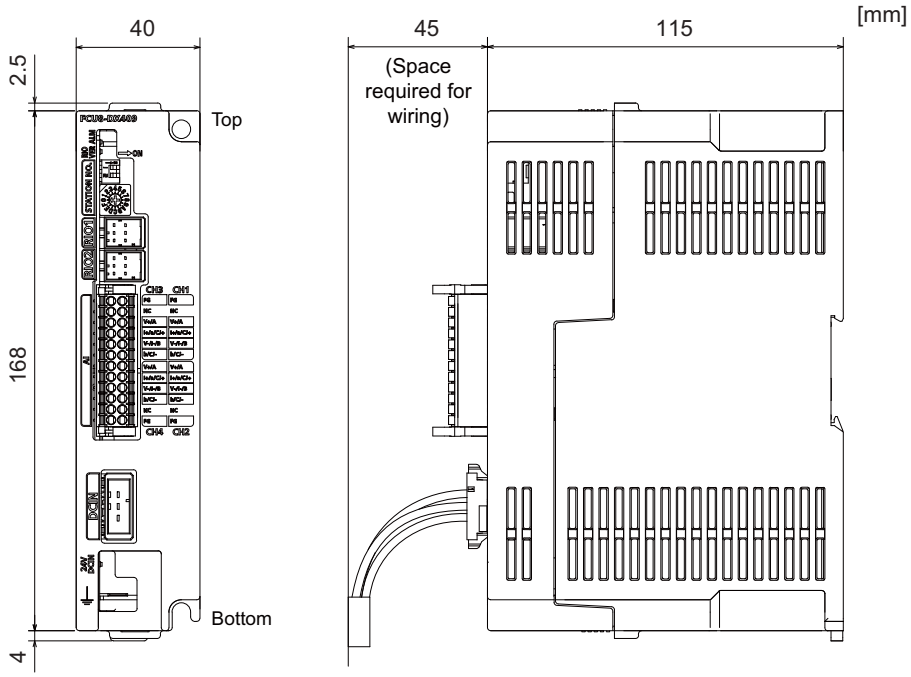
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[Outline dimension : FCU8-DX408]

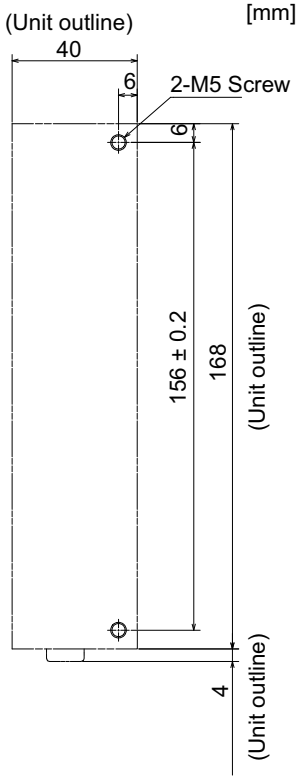


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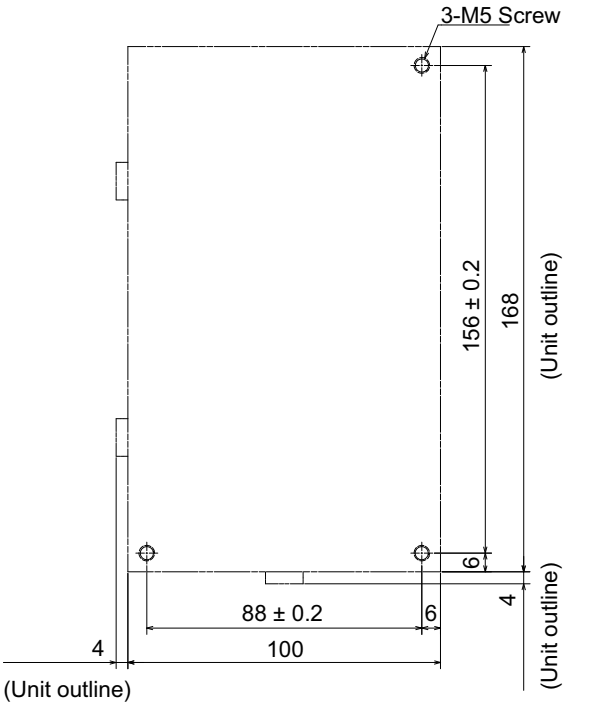
[Installation dimension : FCU8-DX220 / FCU8-DX230 / FCU8-DX231 / FCU8-DX202 / FCU8-DX213 / FCU8-DX213-1 / FCU8-DX654 / FCU8-DX654-1 / FCU8-DX408 / FCU8-DX409]

[mm]



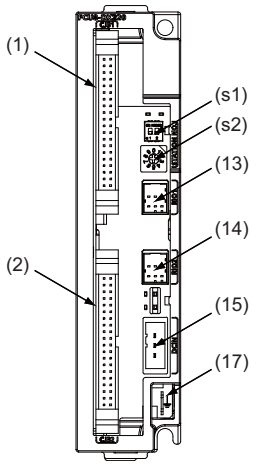
[Installation dimension : FCU8-DX651]

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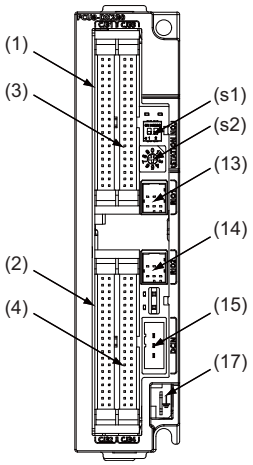


[Connector]

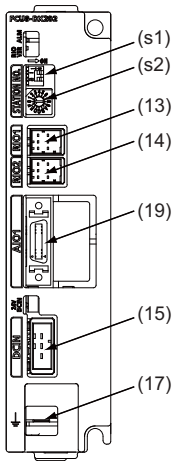
FCU8-DX220



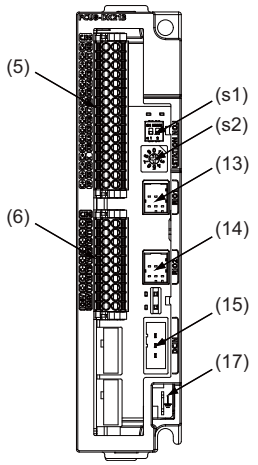
FCU8-DX230 / DX231



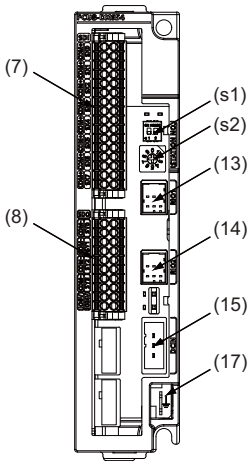
FCU8-DX202



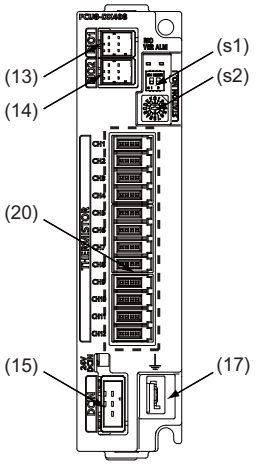
FCU8-DX213 / DX213-1



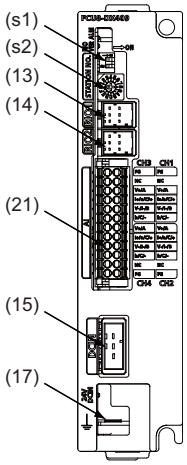
FCU8-DX654 / DX654-1



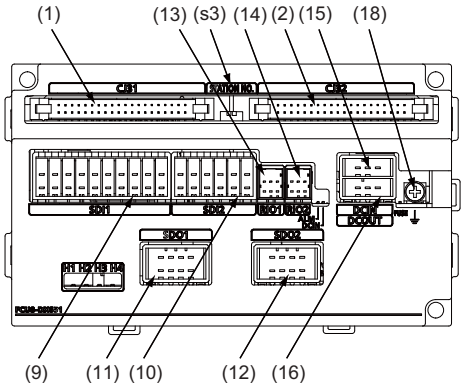
FCU8-DX408



FCU8-DX409



FCU8-DX651



No.	Connector name	Function
(1)	CJ31	Machine signal input
(2)	CJ32	Machine signal output
(3)	CJ33	Machine signal input
(4)	CJ34	Machine signal output
(5)	CJ35	Machine signal input
(6)	CJ36	Machine signal output
(7)	SDI	Safety machine signal input
(8)	SDO	Safety machine signal output
(9)	SDI1	Safety DI input
(10)	SDI2	Safety DI input
(11)	SDO1	Safety relay output

No.	Connector name	Function
(12)	SDO2	Safety relay output
(13)	RIO1	Remote I/O 2.0 communication
(14)	RIO2	Remote I/O 2.0 communication
(15)	DCIN	24VDC input
(16)	DCOUT	24VDC output
(17)	FG	FG terminal
(18)	FG	FG terminal (M4 screw)
(19)	AIO1	Analog input Analog output
(20)	THERMISTOR	Thermistor input
(21)	AI	Multi-analog input

No.	Switch name	Function
(s1)	STATION No.	Station No. group setting switch
(s2)		Station No. setting switch
(s3)		Station No. setting switch

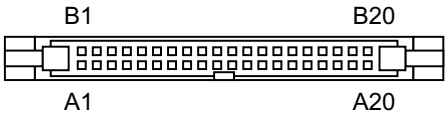
⚠ CAUTION

⚠ Do not apply any voltage to the connectors other than voltage specified in this manual. Failure to observe this could cause bursting, damage, etc.

⚠ Connect the cables to the designated connectors. Incorrect connections could damage the device.

⚠ 12V, 5V, and 3.3V output from connectors are to supply the power for dedicated peripheral devices. Do not use for other equipment to supply the power since we do not guarantee the NC operation by voltage down or noise sneaking.

(1) CJ31 (Machine signal input)
(3) CJ33 (Machine signal input)



CJ31						CJ33					
B			A			B			A		
20	I	X00	**20**	I	X10	**20**	I	X20	**20**	I	X30
19	I	X01	**19**	I	X11	**19**	I	X21	**19**	I	X31
18	I	X02	**18**	I	X12	**18**	I	X22	**18**	I	X32
17	I	X03	**17**	I	X13	**17**	I	X23	**17**	I	X33
16	I	X04	**16**	I	X14	**16**	I	X24	**16**	I	X34
15	I	X05	**15**	I	X15	**15**	I	X25	**15**	I	X35
14	I	X06	**14**	I	X16	**14**	I	X26	**14**	I	X36
13	I	X07	**13**	I	X17	**13**	I	X27	**13**	I	X37
12	I	X08	**12**	I	X18	**12**	I	X28	**12**	I	X38
11	I	X09	**11**	I	X19	**11**	I	X29	**11**	I	X39
10	I	X0A	**10**	I	X1A	**10**	I	X2A	**10**	I	X3A
9	I	X0B	**9**	I	X1B	**9**	I	X2B	**9**	I	X3B
8	I	X0C	**8**	I	X1C	**8**	I	X2C	**8**	I	X3C
7	I	X0D	**7**	I	X1D	**7**	I	X2D	**7**	I	X3D
6	I	X0E	**6**	I	X1E	**6**	I	X2E	**6**	I	X3E
5	I	X0F	**5**	I	X1F	**5**	I	X2F	**5**	I	X3F
4		NC	**4**		NC	**4**		NC	**4**		NC
3		DICOM	**3**		DICOM	**3**		DICOM	**3**		DICOM
2		+24V	**2**		0V	**2**		+24V	**2**		0V
1		+24V	**1**		0V	**1**		+24V	**1**		0V

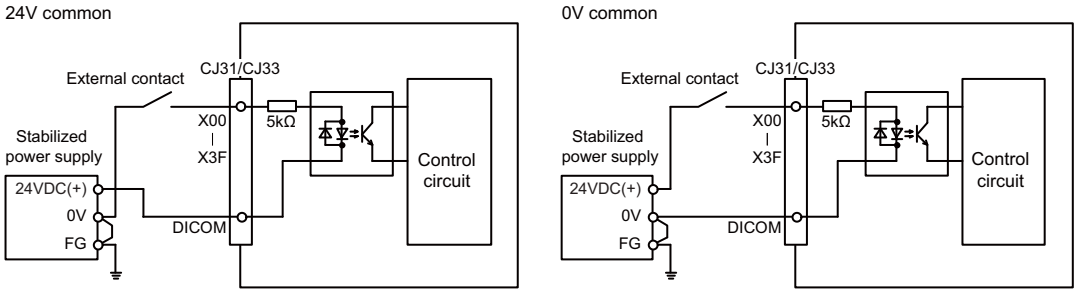
<Cable side connector type>

Connector : XG4M-4030 / 7940-6500SC
Strain relief : XG4T-4004 / 3448-7940
Manufacturer: OMRON / 3M

(a) Outline of digital signal input circuit

Both 24V common and 0V common connections are allowed in the digital signal input circuit.
Follow the wiring diagram below for each type.

Input circuit

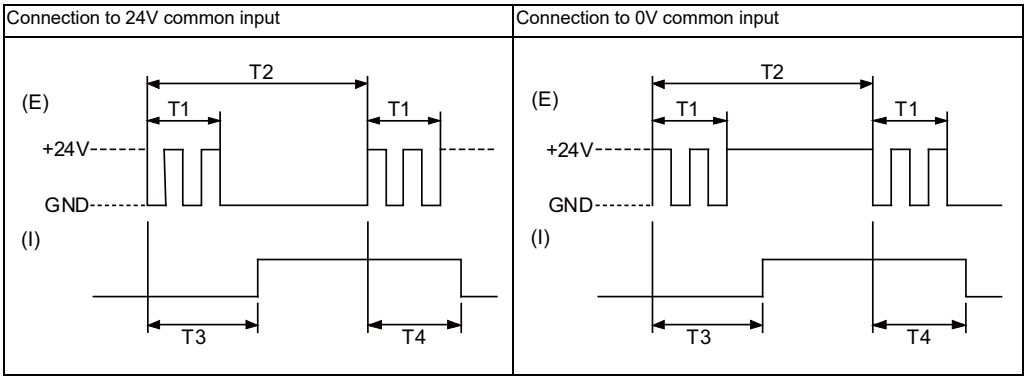


Input conditions

The input signals must be used within the following condition ranges.

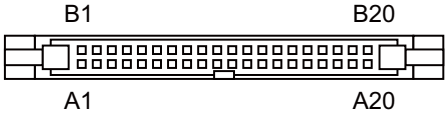
		24V common	0V common
1	**Input voltage at external contact ON**	6V or less	18V or more, 25.2V or less
2	**Input current at external contact ON**	3mA or more	
3	**Input voltage at external contact OFF**	20.2V or more, 25.2V or less	3.8V or less
4	**Input current at external contact OFF**	0.7mA or less	
5	**Input resistance**	5kΩ	
6	**Tolerable chattering time (T1)**	3ms	
7	**Input signal holding time (T2)**	40ms or more (*1)	
8	**input circuit operation delay time (T3 and T4)**	3 to 16ms	
9	**Machine side contact capacity**	30V or more, 16mA or more	

(*1) Note that "40 ms or more" is a guide of the "Input signal holding time". The input signal is recognized only when its "ON" state is held longer than the ladder processing cycle time.



(E) : External signal, (I) : Internal signal

(2) CJ32 (Machine signal output)
(4) CJ34 (Machine signal output)



CJ32							CJ34(FCU8-DX230)							CJ34(FCU8-DX231)					
B			A				B			A				B			A		
20	O	Y00	**20**	O	Y10		**20**	O	Y20	**20**		NC		**20**	O	Y20	**20**		NC
19	O	Y01	**19**	O	Y11		**19**	O	Y21	**19**		NC		**19**	O	Y21	**19**		NC
18	O	Y02	**18**	O	Y12		**18**	O	Y22	**18**		NC		**18**	O	Y22	**18**		NC
17	O	Y03	**17**	O	Y13		**17**	O	Y23	**17**		NC		**17**	O	Y23	**17**		NC
16	O	Y04	**16**	O	Y14		**16**	O	Y24	**16**		NC		**16**	O	Y24	**16**		NC
15	O	Y05	**15**	O	Y15		**15**	O	Y25	**15**		NC		**15**	O	Y25	**15**		NC
14	O	Y06	**14**	O	Y16		**14**	O	Y26	**14**		NC		**14**	O	Y26	**14**		NC
13	O	Y07	**13**	O	Y17		**13**	O	Y27	**13**		NC		**13**	O	Y27	**13**		NC
12	O	Y08	**12**	O	Y18		**12**	O	Y28	**12**		NC		**12**	O	Y28	**12**		NC
11	O	Y09	**11**	O	Y19		**11**	O	Y29	**11**		NC		**11**	O	Y29	**11**		NC
10	O	Y0A	**10**	O	Y1A		**10**	O	Y2A	**10**		NC		**10**	O	Y2A	**10**		NC
9	O	Y0B	**9**	O	Y1B		**9**	O	Y2B	**9**		NC		**9**	O	Y2B	**9**		NC
8	O	Y0C	**8**	O	Y1C		**8**	O	Y2C	**8**		NC		**8**	O	Y2C	**8**		NC
7	O	Y0D	**7**	O	Y1D		**7**	O	Y2D	**7**		NC		**7**	O	Y2D	**7**		NC
6	O	Y0E	**6**	O	Y1E		**6**	O	Y2E	**6**		NC		**6**	O	Y2E	**6**		NC
5	O	Y0F	**5**	O	Y1F		**5**	O	Y2F	**5**		NC		**5**	O	Y2F	**5**		NC
4		NC	**4**		NC		**4**		NC	**4**		NC		**4**	O	AO	**4**		AO*
3		NC	**3**		NC		**3**		NC	**3**		NC		**3**		NC	**3**		NC
2		+24V	**2**		0V		**2**		+24V	**2**		0V		**2**		+24V	**2**		0V
1		+24V	**1**		0V		**1**		+24V	**1**		0V		**1**		+24V	**1**		0V

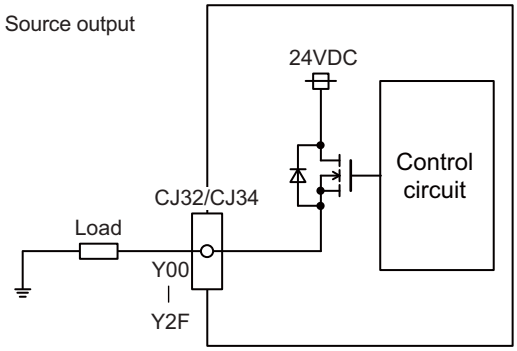
<Cable side connector type>

Connector : XG4M-4030 / 7940-6500SC
Strain relief : XG4T-4004 / 3448-7940
Manufacturer: OMRON / 3M

(a) Outline of digital signal output circuit

Use within the specification ranges shown below.

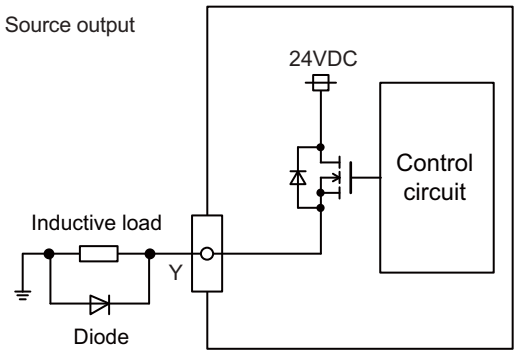
Output circuit



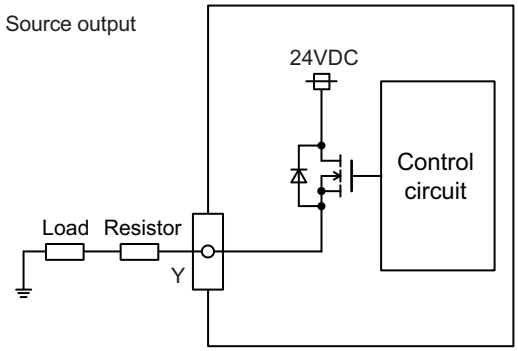
Output conditions

Insulation method	Non-insulation
Rated load voltage	24VDC
Max. output current	0.2A/point 3.2A or less in the whole unit
Output delay time	40μs

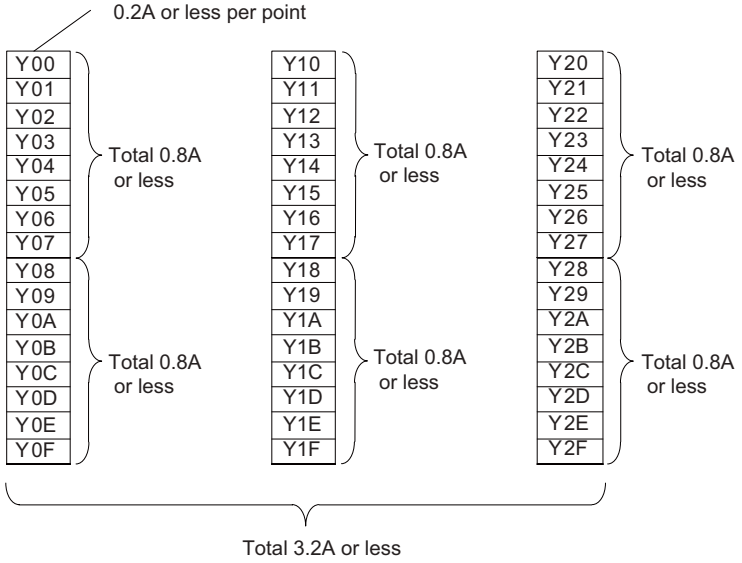
(Note 1) When using an inductive load such as a relay, always connect a diode (voltage resistance 100V or more, twice or more the load current) in parallel to the load.



(Note 2) When the rush current exceeds the maximum output current, always connect a protective resistor (R=150Ω) serially to the load to suppress rush currents. Make sure that the current is less than the maximum output current including the momentary current.



(Note 3) Always keep the total sum of output current of each Y00 to Y07, Y08 to Y0F, Y10 to Y17, Y18 to Y1F, Y20 to Y27, and Y28 to Y2F less than 0.8A.



⚠ CAUTION

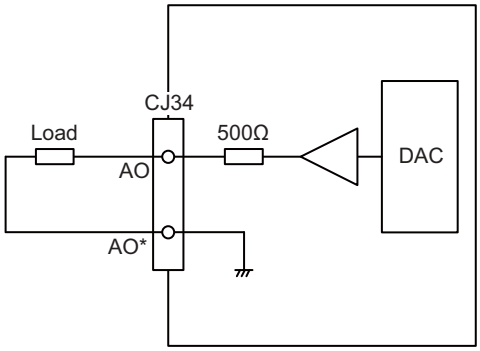
1. When using an inductive load such as a relay, always connect a diode in parallel to the load to prevent a counter-electromotive force.

2. When the rush current exceeds the maximum output current, always connect a protective resistor serially to the load to suppress rush currents.

(b) Outline of analog signal output circuit

The analog signal output circuit can be used only for FCU8-DX231.

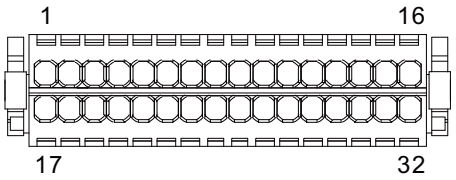
Output circuit



Output conditions

Analog output voltage	-10 to 10V(±5%)
Resolution	10V / 4095 = 2.44mV
Load conditions	External load resistance value 10kΩ or more
Output resistance value	500Ω

(5) CJ35 (Machine signal input)



16	I	X0F	**32**		COMB+
15	I	X0E	**31**		COMA+
14	I	X0D	**30**		COMB+
13	I	X0C	**29**		COMA+
12	I	X0B	**28**		COMB+
11	I	X0A	**27**		COMA+
10	I	X09	**26**		COMB+
9	I	X08	**25**		COMA+
8	I	X07	**24**		COMB+
7	I	X06	**23**		COMA+
6	I	X05	**22**		COMB+
5	I	X04	**21**		COMA+
4	I	X03	**20**		COMB+
3	I	X02	**19**		COMA+
2	I	X01	**18**		COMB+
1	I	X00	**17**		COMA+

<Cable side connector type>

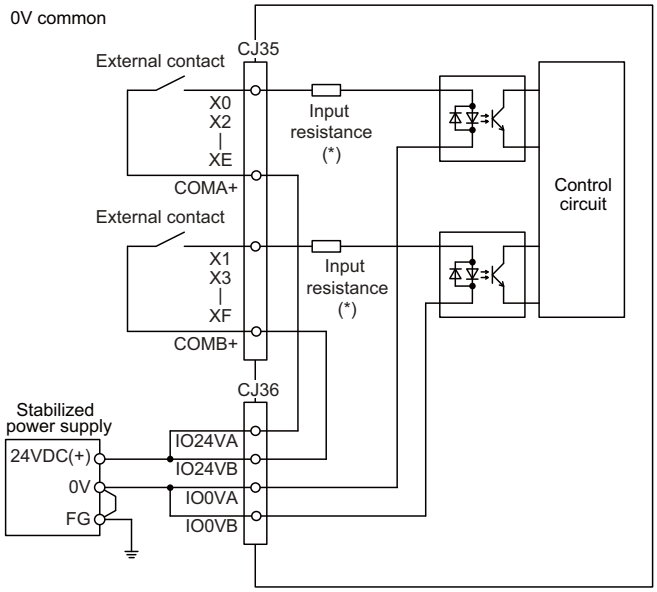
Connector : 713-1116/037-000
Manufacturer: WAGO

(The cable side connector is attached to the unit.)

(a) Outline of digital signal input circuit

Follow the wiring diagram below.

Input circuit

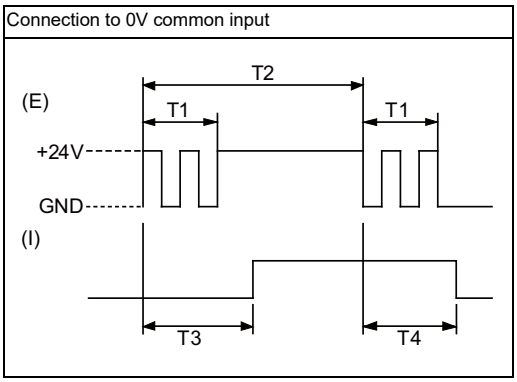


Input conditions

The input signals must be used within the following condition ranges.

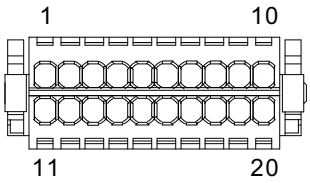
		For DX213	For DX213-1
1	**Input voltage at external contact ON**	18V or more, 25.2V or less	
2	**Input current at external contact ON**	3mA or more	9mA or more
3	**Input voltage at external contact OFF**	3.8V or less	4.0V or less
4	**Input current at external contact OFF**	0.7mA or less	1.5mA or less
5	**Input resistance (*)**	5kΩ	2.2kΩ
6	**Tolerable chattering time (T1)**	3ms	
7	**Input signal holding time (T2)**	40ms or more (*1)	
8	**input circuit operation delay time (T3 and T4)**	3 to 16ms	
9	**Machine side contact capacity**	30V or more, 16mA or more	

(*1) Note that "40 ms or more" is a guide of the "Input signal holding time". The input signal is recognized only when its "ON" state is held longer than the ladder processing cycle time.



(E) : External signal, (I):Internal signal

(6) CJ36 (Machine signal output)



10	I	IO24VB	**20**		IO0VB
9	I	IO24VA	**19**		IO0VA
8	O	Y07	**18**		COMB-
7	O	Y06	**17**		COMA-
6	O	Y05	**16**		COMB-
5	O	Y04	**15**		COMA-
4	O	Y03	**14**		COMB-
3	O	Y02	**13**		COMA-
2	O	Y01	**12**		COMB-
1	O	Y00	**11**		COMA-

<Cable side connector type>

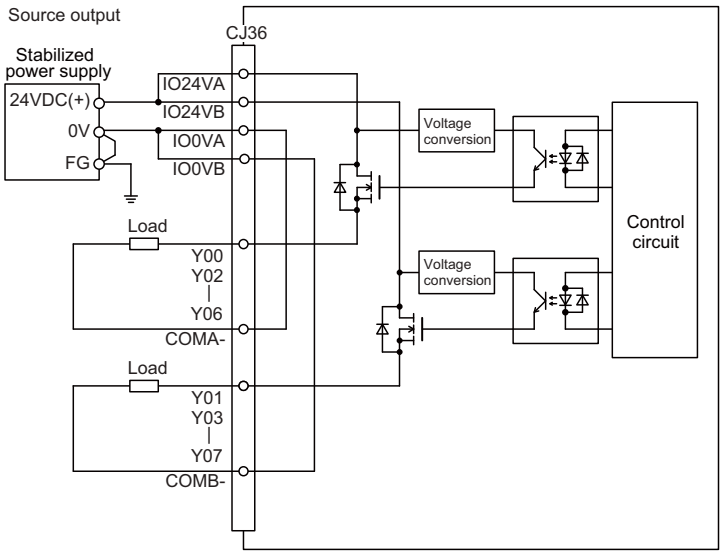
Connector : 713-1110/037-000
Manufacturer: WAGO

(The cable side connector is attached to the unit.)

(a) Outline of digital signal output circuit

Use within the specification ranges shown below.

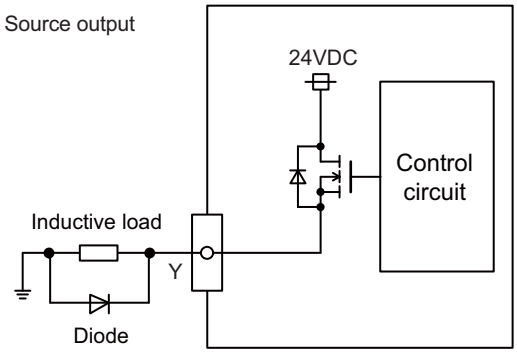
Output circuit



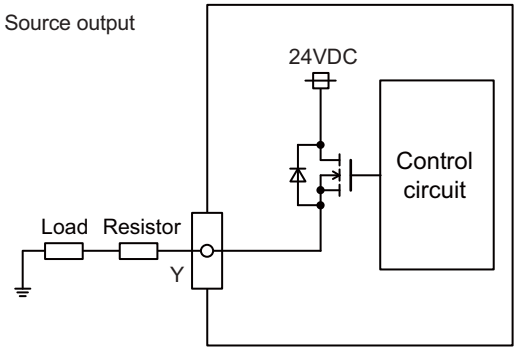
Output conditions

Insulation method	Optocoupler insulation
Rated load voltage	24VDC
Max. output current	2A/point 8A or less in the whole unit
Output delay time	400μs

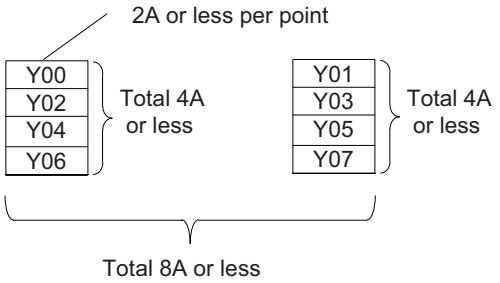
(Note 1) When using an inductive load such as a relay, always connect a diode (voltage resistance 100V or more, twice or more the load current) in parallel to the load.



(Note 2) When the rush current exceeds the maximum output current, always connect a protective resistor (R=150Ω) serially to the load to suppress rush currents. Make sure that the current is less than the maximum output current including the momentary current.



(Note 3) Total output current for each of Y00/Y02/Y04/Y06 and Y01/Y03/Y05/Y07 must be 4A or less.

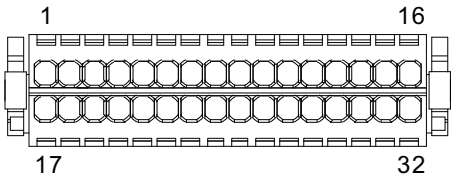


⚠ CAUTION

1. When using an inductive load such as a relay, always connect a diode in parallel to the load to prevent a counter-electromotive force.

2. When the rush current exceeds the maximum output current, always connect a protective resistor serially to the load to suppress rush currents.

(7) SDI (Safety machine signal input)



16	I	SX07B	**32**		COMB+
15	I	SX07A	**31**		COMA+
14	I	SX06B	**30**		COMB+
13	I	SX06A	**29**		COMA+
12	I	SX05B	**28**		COMB+
11	I	SX05A	**27**		COMA+
10	I	SX04B	**26**		COMB+
9	I	SX04A	**25**		COMA+
8	I	SX03B	**24**		COMB+
7	I	SX03A	**23**		COMA+
6	I	SX02B	**22**		COMB+
5	I	SX02A	**21**		COMA+
4	I	SX01B	**20**		COMB+
3	I	SX01A	**19**		COMA+
2	I	SX00B	**18**		COMB+
1	I	SX00A	**17**		COMA+

<Cable side connector type>

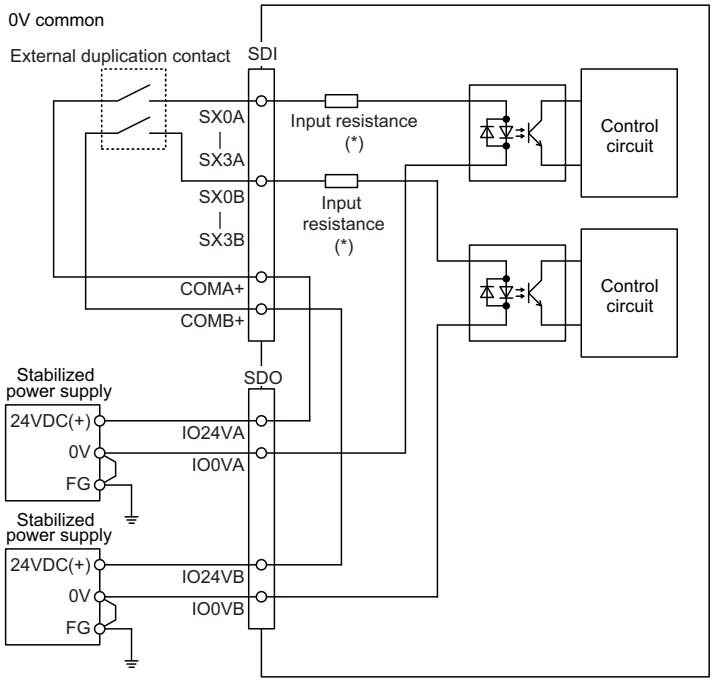
Connector : 713-1116/037-000
Manufacturer: WAGO

(The cable side connector is attached to the unit.)

(a) Outline of digital signal input circuit

Follow the wiring diagram below.

Input circuit

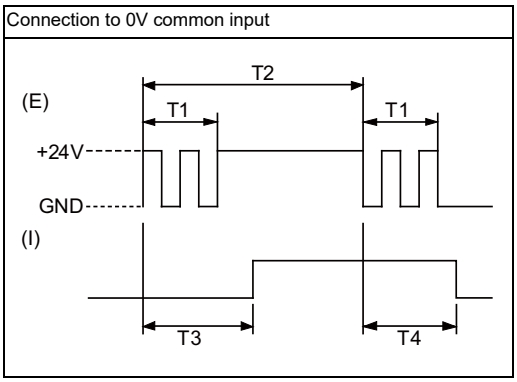


Input conditions

The input signals must be used within the following condition ranges.

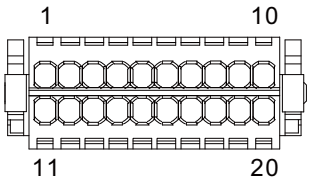
		For DX654	For DX654-1
1	**Input voltage at external contact ON**	18V or more, 25.2V or less	
2	**Input current at external contact ON**	3mA or more	9mA or more
3	**Input voltage at external contact OFF**	3.8V or less	4.0V or less
4	**Input current at external contact OFF**	0.7mA or less	1.5mA or less
5	**Input resistance (*)**	5kΩ	2.2kΩ
6	**Tolerable chattering time (T1)**	3ms	
7	**Input signal holding time (T2)**	40ms or more (*1)	
8	**input circuit operation delay time (T3 and T4)**	3 to 16ms	
9	**Machine side contact capacity**	30V or more, 16mA or more	

(*1) Note that "40 ms or more" is a guide of the "Input signal holding time". The input signal is recognized only when its "ON" state is held longer than the ladder processing cycle time.



(E) : External signal, (I):Internal signal

(8) SDO (Safety machine signal output)



10	I	IO24VB	**20**		IO0VB
9	I	IO24VA	**19**		IO0VA
8	O	SY03B	**18**		COMB-
7	O	SY03A	**17**		COMA-
6	O	SY02B	**16**		COMB-
5	O	SY02A	**15**		COMA-
4	O	SY01B	**14**		COMB-
3	O	SY01A	**13**		COMA-
2	O	SY00B	**12**		COMB-
1	O	SY00A	**11**		COMA-

<Cable side connector type>

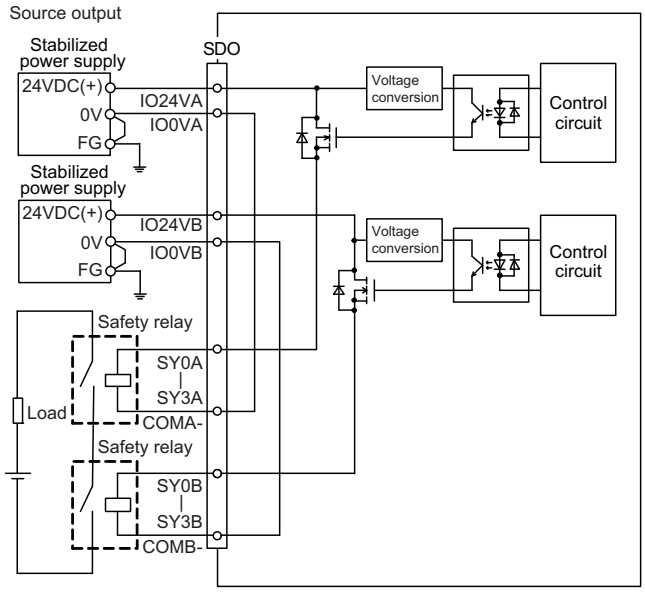
Connector : 713-1110/037-000
Manufacturer: WAGO

(The cable side connector is attached to the unit.)

(a) Outline of digital signal output circuit

Use within the specification ranges shown below.

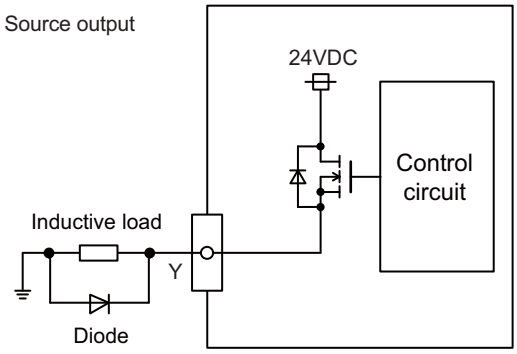
Output circuit



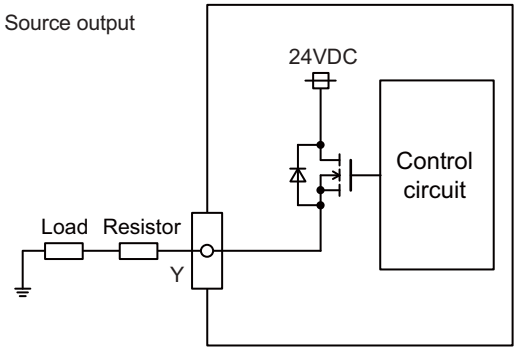
Output conditions

Insulation method	Optocoupler insulation
Rated load voltage	24VDC
Max. output current	2A/point 8A or less in the whole unit
Output delay time	400μs

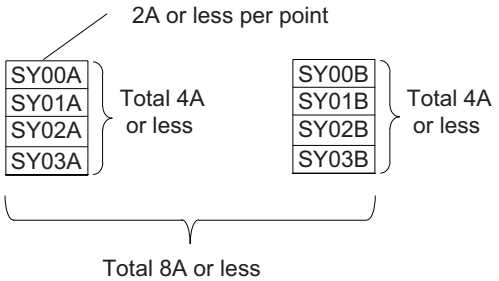
(Note 1) When using an inductive load such as a relay, always connect a diode (voltage resistance 100V or more, twice or more the load current) in parallel to the load.



(Note 2) When the rush current exceeds the maximum output current, always connect a protective resistor (R=150Ω) serially to the load to suppress rush currents. Make sure that the current is less than the maximum output current including the momentary current.



(Note 3) Total output current for each of SY00A to SY03A and SY00B to SY03B must be 4A or less.



⚠ CAUTION

1. When using an inductive load such as a relay, always connect a diode in parallel to the load to prevent a counter-electromotive force.

2. When the rush current exceeds the maximum output current, always connect a protective resistor serially to the load to suppress rush currents.

(9) SDI1 (Safety DI input)



B			A		
10		COM+	**10**	I	SX04B
9		COM+	**9**	I	SX04A
8		COM+	**8**	I	SX03B
7		COM+	**7**	I	SX03A
6		COM+	**6**	I	SX02B
5		COM+	**5**	I	SX02A
4		COM+	**4**	I	SX01B
3		COM+	**3**	I	SX01A
2		COM+	**2**	I	SX00B
1		COM+	**1**	I	SX00A

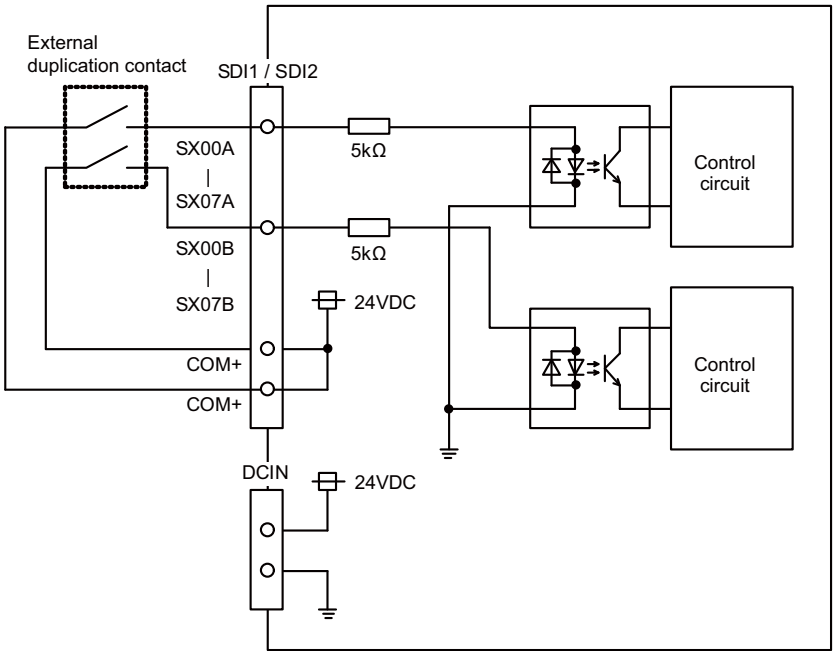
<Cable side connector type>

Connector : 175362-1 (2-pole type)
Connector : 175363-1 (4-pole type)
Connector : 1318095-1 (6-pole type)
Contact : 175218-2
Manufacturer: TE Connectivity

(a) Outline of digital signal input circuit

Follow the wiring diagram below.

Input circuit

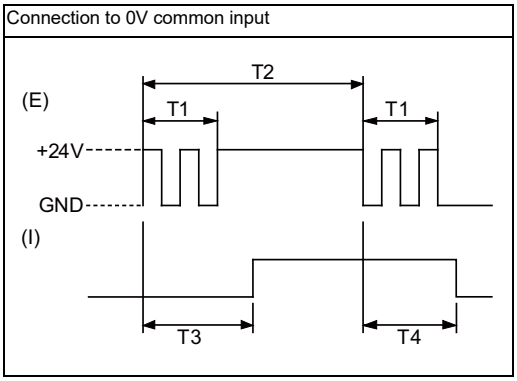


Input conditions

The input signals must be used within the following condition ranges.

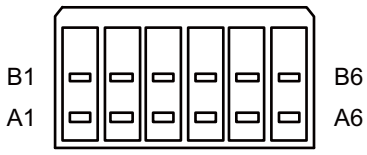
		0V common
1	**Input voltage at external contact ON**	18V or more, 25.2V or less
2	**Input current at external contact ON**	3mA or more
3	**Input voltage at external contact OFF**	3.8V or less
4	**Input current at external contact OFF**	0.7mA or less
5	**Input resistance**	5kΩ
6	**Tolerable chattering time (T1)**	3ms
7	**Input signal holding time (T2)**	40ms or more (*1)
8	**input circuit operation delay time (T3 and T4)**	3 to 16ms
9	**Machine side contact capacity**	30V or more, 16mA or more

(*1) Note that "40 ms or more" is a guide of the "Input signal holding time". The input signal is recognized only when its "ON" state is held longer than the ladder processing cycle time.



(E) : External signal, (I):Internal signal

(10) SDI2 (Safety DI input)



B			A		
6		COM+	**6**	I	SX07B
5		COM+	**5**	I	SX07A
4		COM+	**4**	I	SX06B
3		COM+	**3**	I	SX06A
2		COM+	**2**	I	SX05B
1		COM+	**1**	I	SX05A

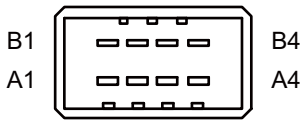
<Cable side connector type>

Connector : 175362-1 (2-pole type)
Connector : 175363-1 (4-pole type)
Connector : 1318095-1 (6-pole type)
Contact : 175218-2
Manufacturer: TE Connectivity

(a) Outline of digital signal input circuit

Refer to "(9) SDI1 (Safety DI input)".

(11) SDO1 (Safety relay output)
(12) SDO2 (Safety relay output)



SDO1						SDO2					
B			A			B			A		
4		SYR03A	**4**		SYR03A	**4**		SYR03B	**4**		SYR03B
3		SYR02A	**3**		SYR02A	**3**		SYR02B	**3**		SYR02B
2		SYR01A	**2**		SYR01A	**2**		SYR01B	**2**		SYR01B
1		SYR00A	**1**		SYR00A	**1**		SYR00B	**1**		SYR00B

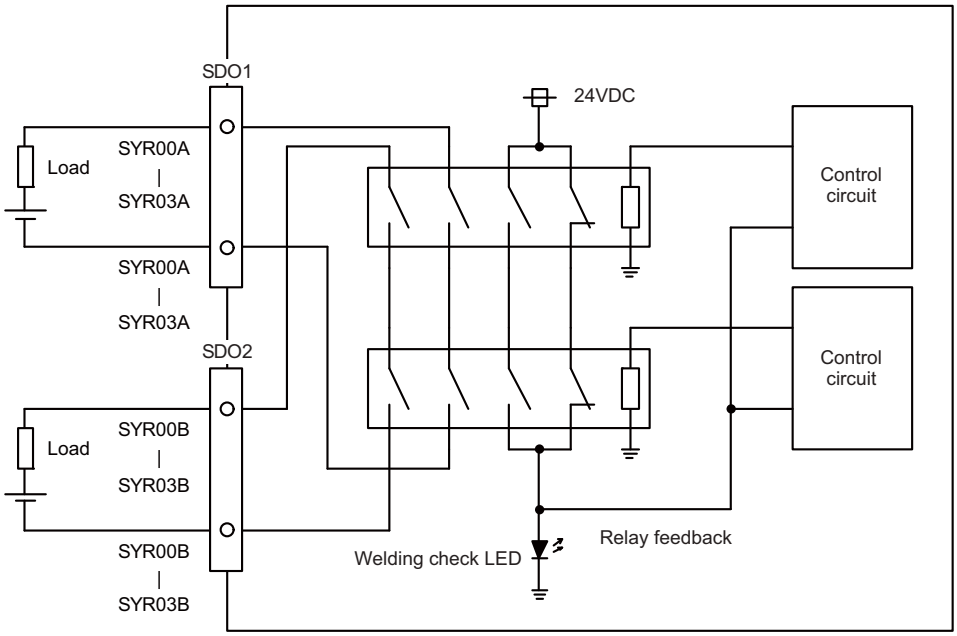
<Cable side connector type>

Connector : 178289-4
Contact : 175218-2
Manufacturer: TE Connectivity

(a) Outline of digital signal output circuit

Use within the specification ranges shown below.

Output circuit



Output conditions

Insulation method	Insulated by relay
Output method	Non-voltage A contact
Contact structure	Forced guide style relay
Rated voltage	250VAC, 125VDC
Rated current	6A
Min. applicable load	1mA, 5VDC
Operation time	20ms or less (contact bounce not included)
Response time	8ms or less (contact bounce not included)
Return time	20ms or less (contact bounce not included)
Life	100,000 times or more with 250VAC 6A resistant load (opening/closing frequency: 20 times/min)
	100,000 times or more with 30VDC 6A resistant load (opening/closing frequency: 20 times/min)
	500,000 times or more with 250VAC 1A resistant load (opening/closing frequency: 30 times/min)
	500,000 times or more with 30VDC 1A resistant load (opening/closing frequency: 30 times/min)
	100,000 times or more with 15AC:240VAC 2A induction load (opening/closing frequency: 20 times/min, cosφ=0.3)
	100,000 times or more with 13DC:24VDC 1A induction load (opening/closing frequency: 20 times/min, L/R=48ms)
Max. operation frequency	20 times/min

Precautions

(1) Influence on the relay life by a connected load

An actual relay life can be substantially shortened depending on the type of a connected load and the characteristics of its inrush current.

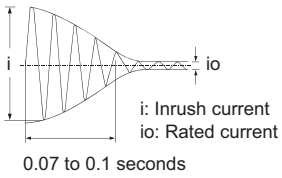
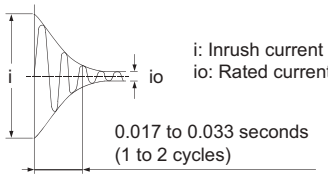
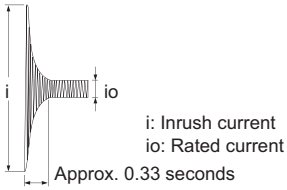
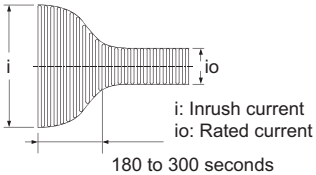
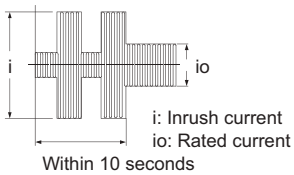
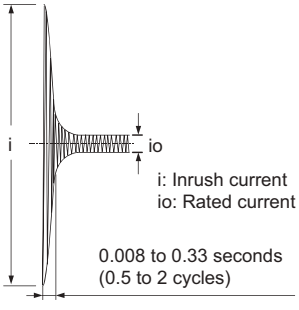
The inrush current generated by a connected load can lead to contact welding of the module. To prevent shortening of the relay life and contact welding, take the following measures:

- Considering the possibility of a high inrush current, select a load so that the inrush current generated by the connected load falls within the range of the rated current of the module.
- Connect a relay capable of withstanding the inrush current, outside the module.

The following table lists the relations between typical loads and each inrush current.

Select a load so that the inrush current, i, and rated current, io, fall within the range of the rated switching current described in the module specifications.

n some loads, the inrush current flows for a long time.

Load type	Waveform	Inrush current i/ rated current io	Waveform	Inrush current i/ rated current io
Inductive load	Load of a solenoid 	Approx. 10 to 20 times	Load of an electromagnetic contactor 	Approx. 3 to 10 times
Lamp load	Load of an incandescent bulb 	Approx. 3 to 10 times	Load of a mercury lamp 	Approx. 3 times (Note 1)
	Load of a fluorescent 	Approx. 5 to 10 times	-	-
Capacitive load	Capacitive load (Note 2) 	Approx. 20 to 40 times	-	-

(Note 1) A typical discharge lamp circuit is configured with a combination of discharge tubes, transformers, choke coils, capacitors and others. Because of this, be especially careful of the case of a high power factor and a low power supply impedance, where the inrush current flowing into the output module can be 20 to 40 times as high as the rated current.

(Note 2) When the wiring is long, be careful with the cable capacity as well.

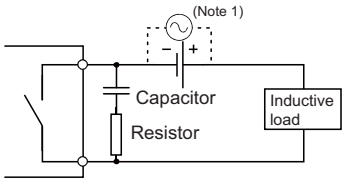
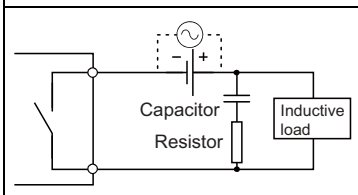
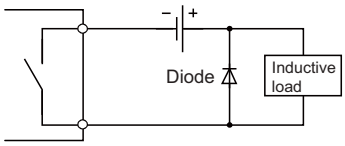
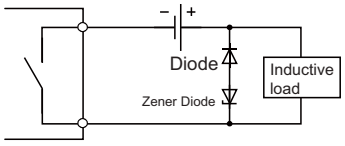
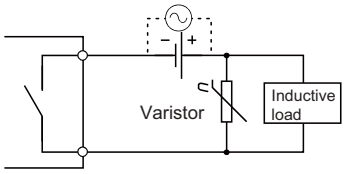
(2) Measures against back EMF

Provide a contact protection circuit for an extended contact life, noise prevention at contact close, and reduction of the carbides and nitric acids formed by an arc discharge.

An incorrect circuit involves a high risk of contact welding.

With the contact protection circuit, the recovery time may be delayed.

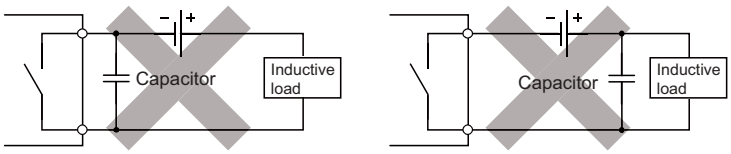
The following table shows typical examples of the contact protection circuit.

Circuit example		Element selection criteria	Remarks
Capacitor + resistance method (CR method)		Estimate the constants of a capacitor and resistance with the following as a guide. Some differences, however, may arise from a variation in the nature and characteristics of the load. - Capacitor: 0.5 to 1 (μF) for a load current of 1A - Resistance: 0.5 to 1 (Ω) for a power supply voltage of 1V Use a capacitor whose withstand voltage is higher than the rated voltage. In an AC circuit, use a capacitor with no polarity.	When a relay or solenoid is used as the load, the recovery time is delayed. A capacitor has the effect of reducing a discharge at contact OFF, while a resistance has the effect of limiting a current at contact ON.
			
Diode method		Use a diode that satisfies the following conditions: - A reverse breakdown voltage is more than ten times as high as the circuit voltage. - A forward current is more than twice as high as the load current.	The recovery time is delayed than the CR method.
Diode + zener diode method		Use a zener diode whose zener voltage is higher than the power supply voltage.	This method is suitable for the case where the diode method results in a substantial delay in the recovery time.
Varistor method		Select a varistor whose cut-off voltage (Vc) satisfies the following conditions: - Vc > power supply voltage×1.5 (V) - Vc > power supply voltage×1.5 (V)× √2 (on AC power supply) Note that selecting an element of a too high Vc leads to a weaker effect.	The recovery time is a little delayed.

(Note 1) On AC power supply, the impedance of the CR needs to be sufficiently higher than that of the load (for preventing errors due to the leakage current of the CR).

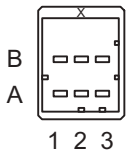
POINT

- Avoid using contact protection circuits like the following. Although highly effective in reducing the arc at current cutoff, a charge current flows into the capacitor when the contact turns on or off, which leads to the risk of contact welding. A DC inductive load, generally considered to be more difficult to open and close than a resistive load, can achieve the same performance of a resistive load in an appropriate configuration of the protection circuit.



Install the protection circuit near the load or contact (module). A long distance between them may inhibit the effect of the protection circuit. As a guide, install it at a distance of no more than 50cm.

(13) RIO1 (Remote I/O 2.0 communication)
(14) RIO2 (Remote I/O 2.0 communication)

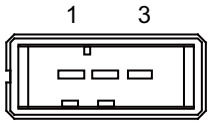


A			B		
1	I/O	TXRXD	**1**	I/O	TXRXD*
2		NC	**2**		0V
3		FG	**3**		NC

<Cable side connector type>

Connector : 1-1318119-3
Contact : 1318107-1 x6
Manufacturer: TE Connectivity

(15) DCIN (24VDC input)

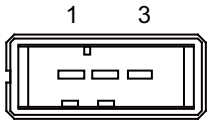


1	I	+24V
2		0V
3		FG

<Cable side connector type>

Connector : 2-178288-3
Contact : 1-175218-5
Manufacturer: TE Connectivity

(16) DCOUT (24VDC output)



1	O	+24V
2		0V
3		FG

<Cable side connector type>

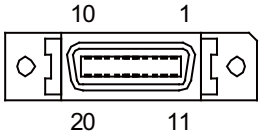
Connector : 2-178288-3
Contact : 1-175218-5
Manufacturer: TE Connectivity

(17) FG (FG terminal)

(18) FG (FG terminal (M4 screw))

(19) AIO1 (Analog input, Analog output)

Analog input and analog output can be connected to this connector.



1		0V	**11**		0V
2	I	AI 0	**12**	I	AI 1
3	I	AI 2	**13**	I	AI 3
4		NC	**14**		NC
5		0V	**15**		0V
6		NC	**16**		NC
7	O	AO	**17**	I	NC
8		NC	**18**		NC
9		0V	**19**		NC
10		NC	**20**		NC

- Connect connector case with FG pattern.

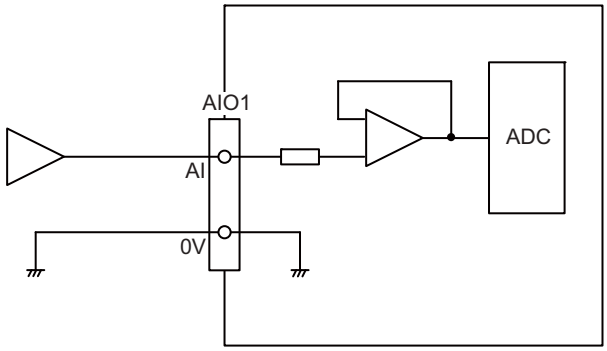
<Cable side connector type>

Plug : 10120-3000PE
Shell : 10320-52F0-008
Manufacturer: 3M

(Note) When using the jackscrew M2.6-type 10320-52A0-008 for the shell, do not fasten the screws too tightly otherwise the connector and the PCB may be damaged.
(Manufacturer recommended tightening torque: 0.20±0.05N·m)

(a) Outline of analog signal input circuit

Input circuit



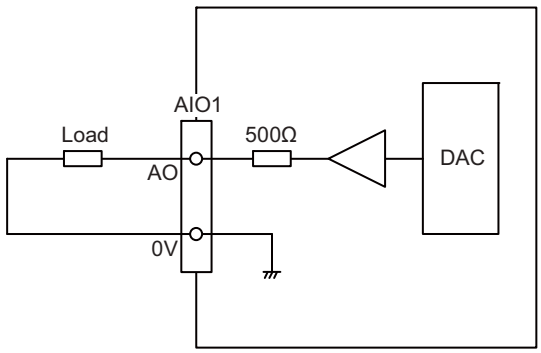
Input conditions

Analog input voltage	-10 to 10V
Max. input rating (Note 1)	±15V
Resolution	|-10 to +10V| / 4095 = 4.88mV
Repeatability	Within ±25mV (Note 2)
Tolerance	±0.35V

(Note 1) This indicates the input voltage which must not exceeded even in an instant.
(Note 2) Except when the accuracy is affected by the noise.

(b) Outline of analog signal output circuit

Output circuit

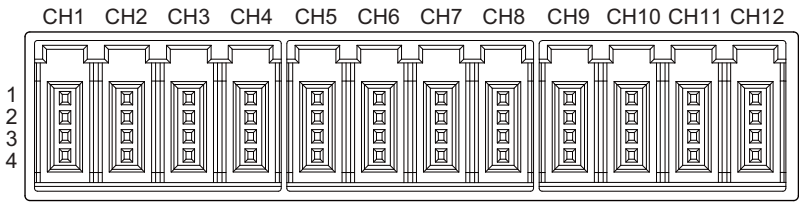


Output conditions

Analog output voltage	-10 to 10V (±5%)
Resolution	10V / 4095 = 2.44mV
Load conditions	External load resistance value 10kΩ or more
Output resistance value	500Ω

(20) THERMISTOR (Thermistor input)

Thermistor can be connected to this connector.



	CH1	CH2	CH3	CH4	CH5	CH6
1	FG	FG	FG	FG	FG	FG
2	NC	NC	NC	NC	NC	NC
3	Thermistor CH1	Thermistor CH2	Thermistor CH3	Thermistor CH4	Thermistor CH5	Thermistor CH6
4	Thermistor CH1	Thermistor CH2	Thermistor CH3	Thermistor CH4	Thermistor CH5	Thermistor CH6

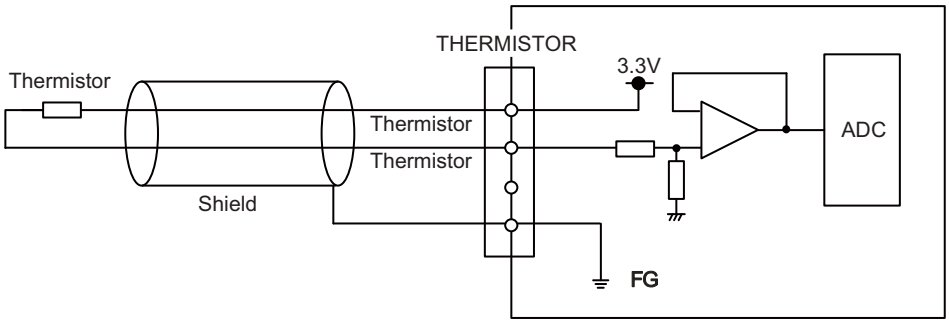
	CH7	CH8	CH9	CH10	CH11	CH12
1	FG	FG	FG	FG	FG	FG
2	NC	NC	NC	NC	NC	NC
3	Thermistor CH7	Thermistor CH8	Thermistor CH9	Thermistor CH10	Thermistor CH11	Thermistor CH12
4	Thermistor CH7	Thermistor CH8	Thermistor CH9	Thermistor CH10	Thermistor CH11	Thermistor CH12

<Cable side connector type>

Connector : 37104-2165-000FL

Manufacturer: 3M

(a) Outline of the thermistor input circuit

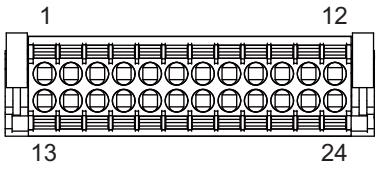


Measurement temperature	-10.0 to +150.0 ℃
Resolution	0.1 ℃
Accuracy	±1.5 ℃ (Measurement temperature -10 to +10 ℃) ±1.0 ℃ (Measurement temperature +10 to +70 ℃) ±1.5 ℃ (Measurement temperature +70 to +110 ℃) ±2.0 ℃ (Measurement temperature +110 to +130 ℃) ±2.5 ℃ (Measurement temperature +130 to +150 ℃)
Thermal responsiveness (Note 1)	This varies depending on the setting of the parameter (#1334). ±10 ℃ /s (When the setting of #1334 is -1) ±20 ℃ /s (When the setting of #1334 is 0) ±45 ℃ /s (When the setting of #1334 is 1) ±90 ℃ /s (When the setting of #1334 is 2)
Disconnection detection function	Provided

(Note 1) This indicates the maximum measurable temperature change amount per unit time. When the temperature change exceeds the described value, it cannot be measured correctly.

(Note 2) Do not connect any thermistor other than PT3C-51F-M2 made by SHIBAURA ELECTRONICS Co., Ltd.

(21) AI (Multi-analog input)



13	CH3	FG	**1**	CH1	FG
14		NC	**2**		NC
15		V+/A	**3**		V+/A
16		I+/a/CJ+	**4**		I+/a/CJ+
17		V-/I-/B	**5**		V-/I-/B
18		b/CJ-	**6**		b/CJ-
19	CH4	V+/A	**7**	CH2	V+/A
20		I+/a/CJ+	**8**		I+/a/CJ+
21		V-/I-/B	**9**		V-/I-/B
22		b/CJ-	**10**		b/CJ-
23		NC	**11**		NC
24		FG	**12**		FG

<Cable side connector type>

Connector : DFMC1,5/12-ST-3,5-LR
Manufacturer: Phoenix Contact

(The cable side connector is attached to the unit.)

(a) Outline of multi-analog input circuit

There are four types of multi-analog input as below:

- Voltage input
- Current input
- Thermocouple input
- Resistance temperature detector input

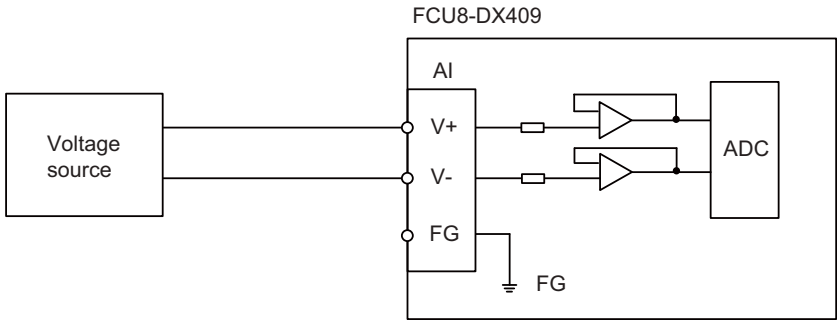
The measurement mode (voltage measurement, current measurement, temperature (thermocouple) measurement and temperature (resistance temperature detector) measurement) can be set for each CH and input corresponding to the mode can be performed.
All CHs (CH1 to CH4) are set to the voltage measurement mode when the machine is delivered.

Precautions

- Input the signal within the appropriate input range for the set measurement mode.
  (Note) Do not input the voltage when the current or temperature (thermocouple or resistance temperature detector) measurement mode is set. This could result in faults of the unit. Pay close attention to the combination of the measurement mode setting and input.
- Running-in is required for about 10 to 15 minutes after the power is ON until the measurement value is stable.
- Do not apply voltage or current from external devices before turning ON the power of multi-analog input unit. This may damage the multi-analog input unit.
  Turn ON the power of the multi-analog input unit and external device at the same time, or wire circuit so that the power supply of the multi-analog input unit is turned ON first.

(a-1) Outline of voltage input circuit

Input circuit



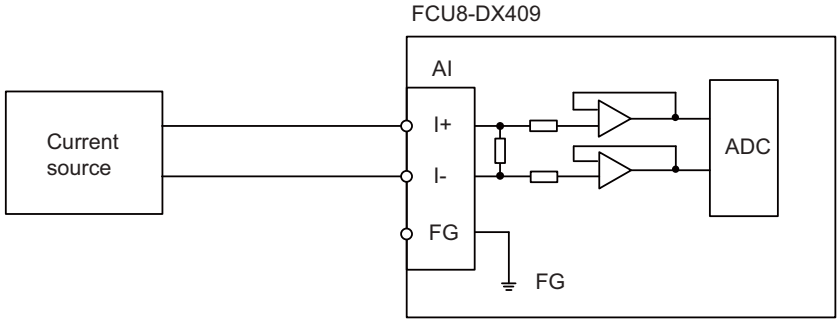
Input conditions

Set the input signal within the range as shown in the conditions below.

Input voltage range	-10V to +10V
Max. input rating	±13V
Resolution	|-10V to +10V| / 64000 = 312.5μV
Max. input delay (AI input to R register output)	40ms
Disconnection detection function	Not provided
Precision	± 0.5%FS (FS : Full Scale)

(a-2) Outline of current input circuit

Input circuit



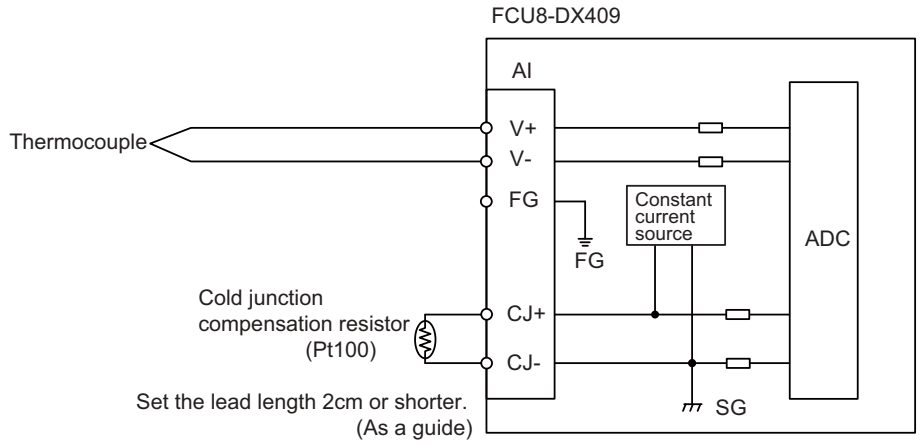
Input conditions

Set the input signal within the range as shown in the conditions below.

Input current range	-20mA to +20mA
Max. input rating	±30mA
Resolution	|-20mA to +20mA| / 32000 = 1.25μA
Input resistance	250Ω
Max. input delay (AI input to R register output)	40ms
Disconnection detection function	Not provided
Precision	±0.5%FS (FS : Full Scale)

(a-3) Outline of thermocouple input circuit

Input circuit



Input conditions

Set the input signal within the range as shown in the conditions below.

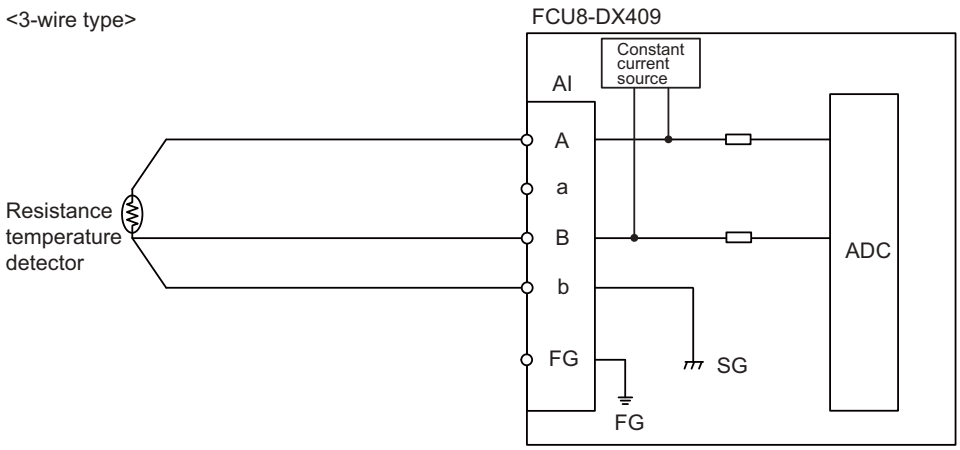
Input temperature range		-40°C to +600°C
Resolution		0.1°C
Cold junction compensation		Use Pt100.
Cold junction compensation precision		±1°C
Max. input delay (AI input to R register output)		40ms
Disconnection detection function		Provided
Precision (Note)	**K type**	± 3°C (Measurement temperature -40 to +150°C)
		± 4°C (Measurement temperature +150 to +300°C)
		± 5°C (Measurement temperature +300 to +450°C)
		± 6°C (Measurement temperature +450 to +600°C)
	J type	± 2.8°C (Measurement temperature -40 to +150°C)
		± 3.8°C (Measurement temperature +150 to +300°C)
		± 4.8°C (Measurement temperature +300 to +450°C)
		± 5.8°C (Measurement temperature +450 to +600°C)

(Note) Refer to "(a-5) Supplement: Overall precision of temperature measurement".

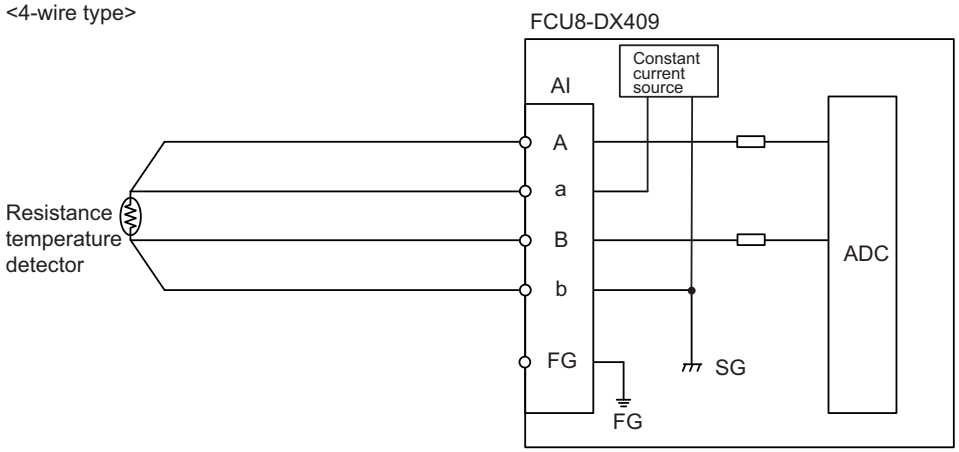
(a-4) Outline of resistance temperature detector input circuit

Input circuit

<3-wire type>



<4-wire type>



Input conditions

Set the input signal within the range as shown in the conditions below.

Input temperature range		-50°C to +300°C
Resolution		0.1°C (Normal mode) or 0.03°C (High resolution mode)
Max. input delay (AI input to R register output)		40ms
Disconnection detection function		Provided
Precision (Note)	**Pt100**	± 1.5°C (Measurement temperature -50 to +150°C)
		± 1.8°C (Measurement temperature +150 to +300°C)
	Pt1000	± 1.8°C (Measurement temperature -50 to +150°C)
		± 2.2°C (Measurement temperature +150 to +300°C)

(Note) Refer to "(a-5) Supplement: Overall precision of temperature measurement".

(a-5) Supplement: Overall precision of temperature measurement

The precision shown in (a-3) and (a-4) is the one attributed to the unit. The thermocouple or resistance temperature detector input to the unit also has precision and the overall precision of temperature measurement is the addition of the precision of unit and the precision of thermocouple or resistance temperature detector.
The precision of unit includes the cold junction compensation precision (± 1°C).

<Calculation example of thermocouple overall precision>

Thermocouple overall precision = Unit precision + thermocouple precision

When K-type or Class2 thermocouple is used, if the measurement point temperature is 100°C, the overall precision is as below.
(Note) According to the thermocouple standard (IEC60584-1), K-type or Class2 thermocouple precision is
"± 2.5 ° C or 0.75% of the measurement temperature, whichever has the greater value"

(Overall precision) = ± 3 [°C] ± 2.5 [°C]
= ± 5.5 [°C]

<Calculation example of resistance temperature detector overall precision>

Resistance temperature detector overall precision = Unit precision + Resistance temperature detector

When Pt100 or ClassA resistance temperature detector is used, if measurement point temperature is 100°C, the overall precision is as below.
(Note) According to the Platinum RTD standard (IEC60751), Pt100 or ClassA precision is
"± (0.15 + 0.002 |t|) [°C] t: Measurement temperature"

(Overall precision) = ± 1. 5 [°C] ± (0.15 + 0.002 × 100) [°C]
= ± 1.85 [°C]

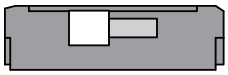
(s1) STATION No. (Station No. group setting switch)



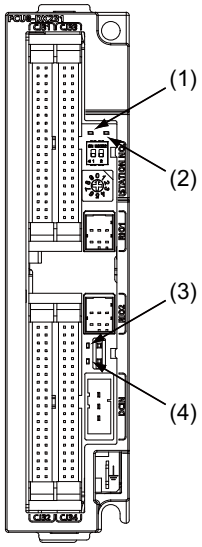
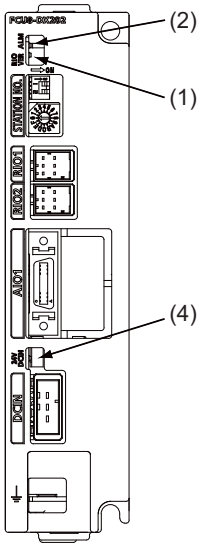
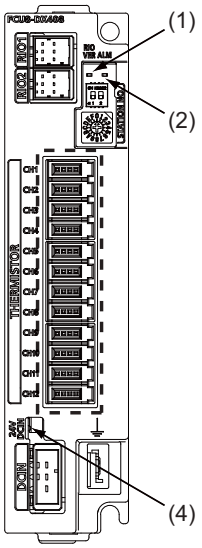
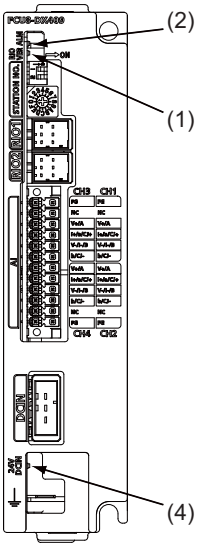
(s2) STATION No. (Station No. setting switch)



(s3) STATION No. (Station No. setting switch)

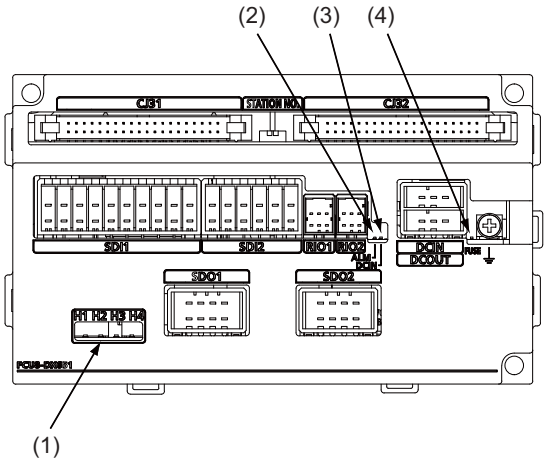


[LED : FCU8-DX220 / FCU8-DX230 / FCU8-DX231 / FCU8-DX202 / FCU8-DX213 / FCU8-DX213-1 / FCU8-DX654 / FCU8-DX654-1 / FCU8-DX408 / FCU8-DX409]

FCU8-DX220 / FCU8-DX230 / FCU8-DX231 / FCU8-DX213 / FCU8-DX213-1 / FCU8-DX654 / FCU8-DX654-1	FCU8-DX202	FCU8-DX408	FCU8-DX409
			

No.	Name	Function	Color	Status		Details
				Normal	At fault	
(1)	RIOVER	RIO communication status	Green	Lit during RIO 2.0 communication Not lit during RIO 1.0 communication		
(2)	ALM	RIO communication error	Red	Not lit	Lit	Lit when RIO communication error has occurred.
(3)	FUSE	Fuse status	Green	Lit	Not lit	Not lit when a fuse has been blown out.
(4)	24VDCIN	Energization status of 24VDC input of DCIN connector	Green	Lit	Not lit	Lit when a current is applied.

[LED : FCU8-DX651]



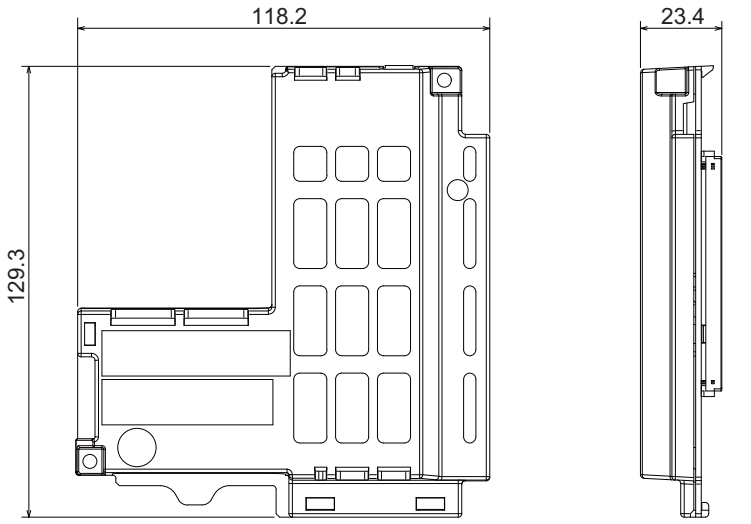
No.	Name	Function	Color	Status		Details
				Normal	At fault	
(1)	H1	Safety relay output SYR00 status	Green	Lit	Not lit	Not lit when a relay has been blown out.
	H2	Safety relay output SYR01 status	Green	Lit	Not lit	Not lit when a relay has been blown out.
	H3	Safety relay output SYR02 status	Green	Lit	Not lit	Not lit when a relay has been blown out.
	H4	Safety relay output SYR03 status	Green	Lit	Not lit	Not lit when a relay has been blown out.
(2)	ALM	RIO communication error	Red	Not lit	Lit	Lit when RIO communication error has occurred.
(3)	DCIN	Energization status of 24VDC input of DCIN connector	Green	Lit	Not lit	Lit when a current is applied.
(4)	FUSE	Fuse status	Green	Lit	Not lit	Not lit when a fuse has been blown out.

4.13 Functional Safety Expansion Unit

4.13.1 Functional Safety Expansion Unit (FCU8-EX133)

[Outline dimension]

[mm]

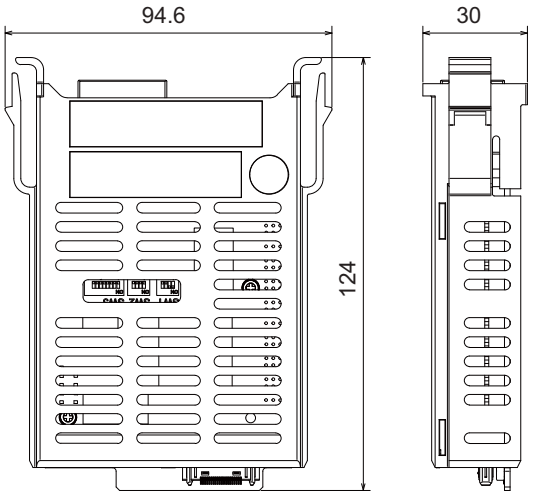


4.14 Function Expansion Unit

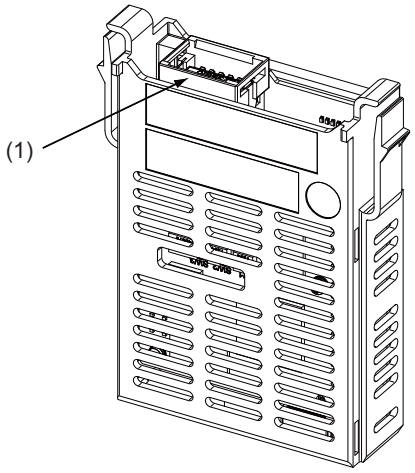
4.14.1 CC-Link (FCU8-EX561)

[Outline dimension]

[mm]



[Connector]



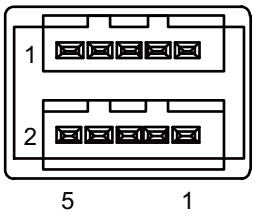
No.	Connector name	Function
(1)	CCL	CC-Link communication

⚠ CAUTION

⚠ Do not apply any voltage to the connectors other than voltage specified in this manual. Failure to observe this could cause bursting, damage, etc.

⚠ Connect the cables to the designated connectors. Incorrect connections could damage the device.

(1) CCL (CC-Link communication)



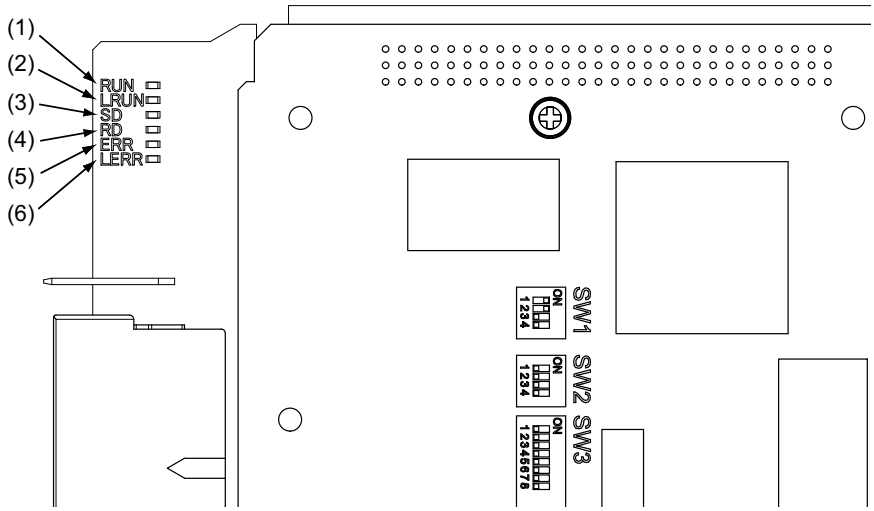
1	I/O	DA
2	I/O	DB
3		DG
4		NC
5		SLD

<Cable side connector type>

Connector : 35505-6000-BOM GF

Manufacturer: 3M

[LED]



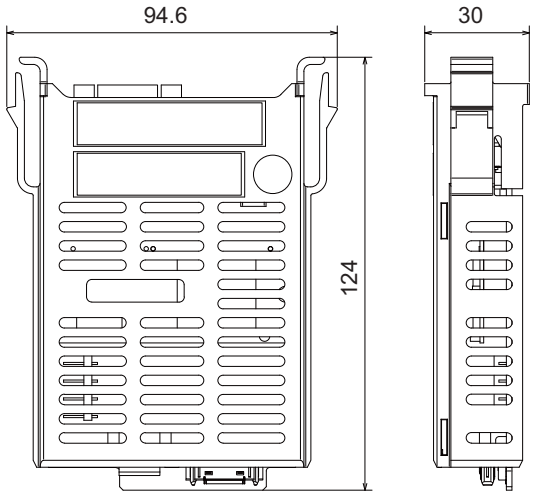
No.	Name	Color	Status	Details
(1)	RUN	Green	Lit	CC-Link module in the normal state
			Not lit	Watchdog timer error
(2)	LRUN	Green	Lit	Data link in process of execution
(3)	SD	Green	Lit	During data transmission
(4)	RD	Green	Lit	During data reception
(5)	ERR	Red	Lit	Switch setting error (LERR is also lit), overlapping of master, parameter error, communication error
			Flashing	Other station data link error (when it is master station)
(6)	LERR	Red	Lit	Data link communication error
			Flashing	Station and mode change during operation

(Note 1) All LED (RUN, LRUN, SD, RD, ERR, LERR) are lit during resetting of the CC-Link module.

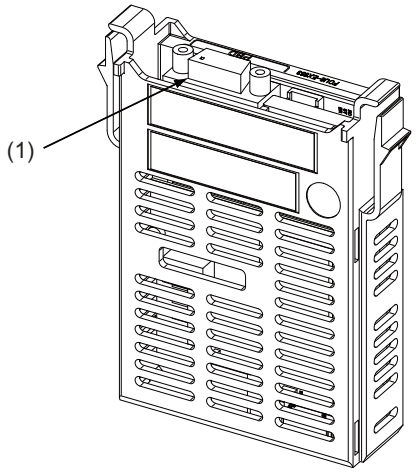
4.14.2 PROFIBUS-DP (FCU8-EX563)

[Outline dimension]

[mm]



[Connector]



No.	Connector name	Function
(1)	PBD	PROFIBUS-DP

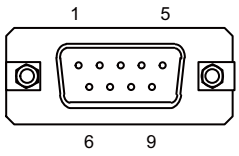
⚠ CAUTION

⚠ Do not apply any voltage to the connectors other than voltage specified in this manual. Failure to observe this could cause bursting, damage, etc.

⚠ Connect the cables to the designated connectors. Incorrect connections could damage the device.

⚠ 5V output from connectors are to supply the power for dedicated peripheral devices. Do not use for other equipment to supply the power since we do not guarantee the NC operation by voltage down or noise sneaking.

(1) PBD (PROFIBUS-DP communication)



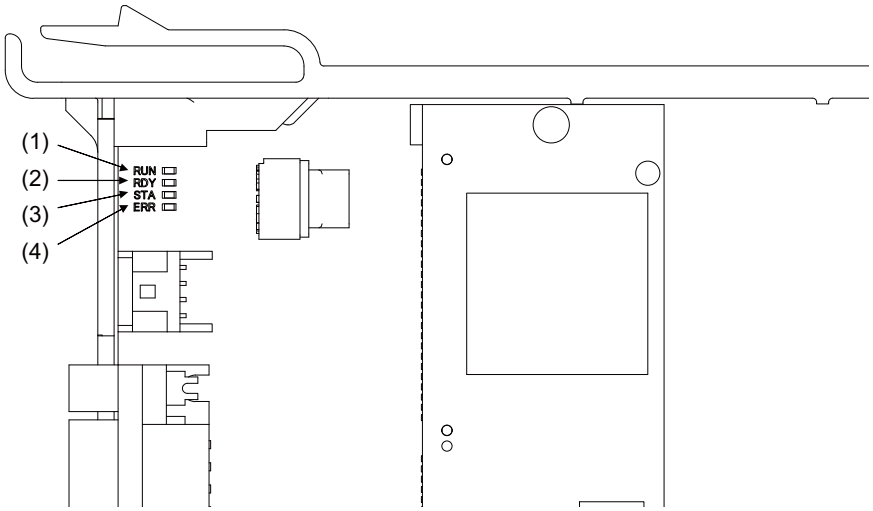
1		NC	**6**		+5V
2		NC	**7**		NC
3	I/O	RXD/TXD-P	**8**	I/O	RXD/TXD-N
4	I/O	CNTR-P	**9**		NC
5		0V			

<Cable side connector type>

Connector : 6GK1 500-0FC10

Manufacturer: Siemens

[LED]



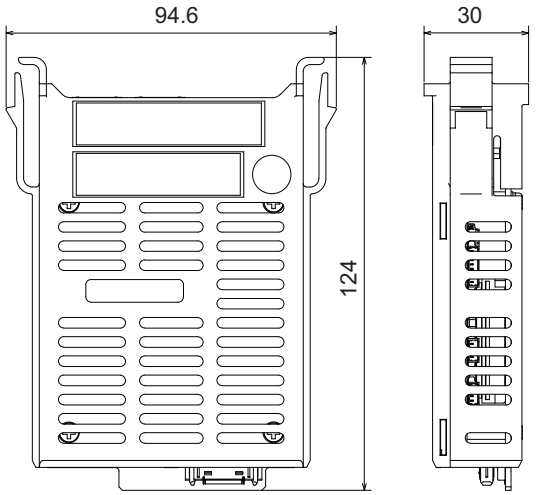
Name	Color	Status	Details
(1) RUN (Green) (2) RDY (Yellow) (Module status)	Green	Lit	Lit when PROFIBUS-DP module is normally operated
	Green/ yellow	Flashing	Boot standby
	Yellow	Lit	Boot error
	-	Lit	No power supply, module failure
(3) STA (Green) (4) ERR (Red) (Communication status)	Green	Lit regularly	Configuration successful, communication unestablished
	Green	Lit randomly	Configuration failure, stuck error
	Green	Lit	Communicating with slave(s)
	Red	Flashing	Communication is interrupted with at least one slave
	Red	Lit	Communication is interrupted with all the slaves

(Note 1) All LED (RUN, RDY, STA and ERR) are lit during the reset of PROFIBUS-DP module.
(Note 2) The status of PROFIBUS-DP module is displayed by the combination of RUN/RDY.
(Note 3) The status of PROFIBUS-DP communication is displayed by the combination of STA/ERR.

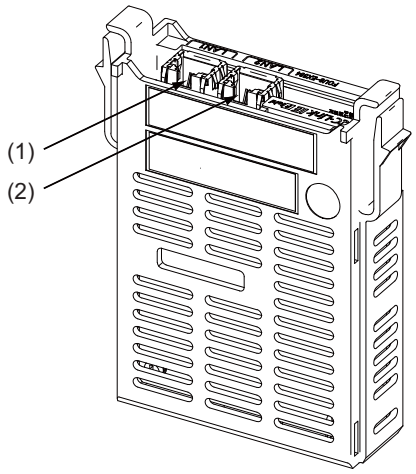
4.14.3 CC-Link IE Field (FCU8-EX564)

[Outline dimension]

[mm]



[Connector]



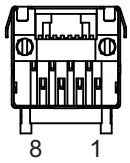
No.	Connector name	Function
(1)	LAN1	CC-Link IE Field communication
(2)	LAN2	

⚠ CAUTION

⚠ Do not apply any voltage to the connectors other than voltage specified in this manual. Failure to observe this could cause bursting, damage, etc.

⚠ Connect the cables to the designated connectors. Incorrect connections could damage the device.

(1) LAN1 (CC-Link IE Field communication 1st channel)
(2) LAN2 (CC-Link IE Field communication 2nd channel)



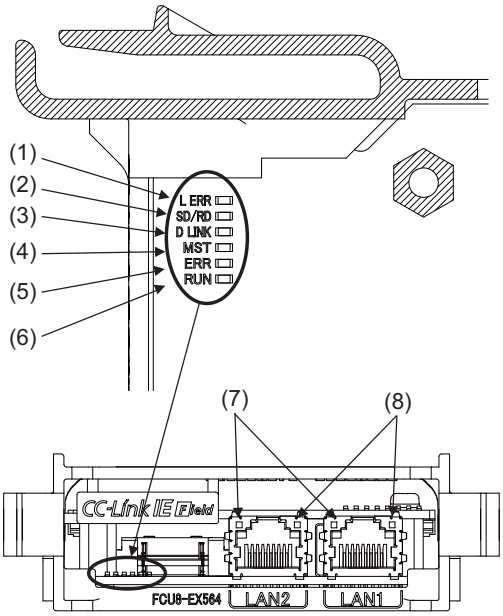
1	I/O	TXRXD0+
2	I/O	TXRXD0-
3	I/O	TXRXD1+
4	I/O	TXRXD2+
5	I/O	TXRXD2-
6	I/O	TXRXD1-
7	I/O	TXRXD3+
8	I/O	TXRXD3-

- Connect connector case with FG pattern.

<Cable side connector type>

Connector : J00026A0165
Manufacturer: Japan Telegartner

[LED]

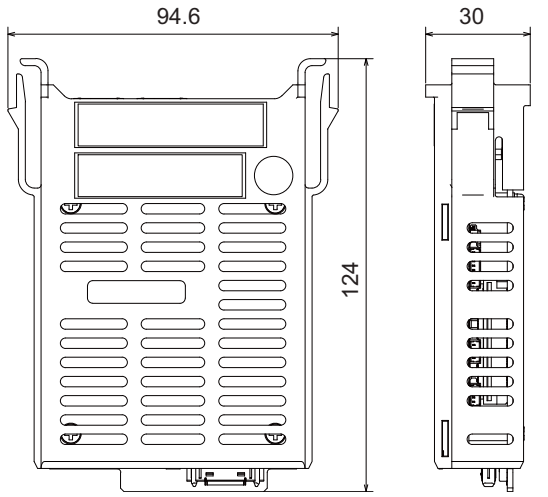


No.	Name	Color	Status	Details
(1)	L ERR	Red	Not lit	Normal data received and loopback not performed
			Lit	Abnormal data received or loopback being performed
(2)	SD/RD	Green	Lit	Data being sent or received
			Not lit	Data not sent nor received
(3)	D LINK	Green	Lit	Data link (cyclic transmission being performed)
			Flashing	Data link (cyclic transmission stopped)
			Not lit	Data link not performed (disconnected)
(4)	MST	Green	Lit	Operating as master station
			Not lit	Operating as local station
(5)	ERR	Red	Not lit	Normal operation
			Flashing (500 ms interval)	A data link faulty station detected
			Flashing (200 ms interval)	Failure occurring
			Lit	Error in all stations detected or occurring
(6)	RUN	Green	Lit	Hardware running normally
			Not lit	Hardware error occurring
(7)	LINK	Green	Lit	Link-up
			Not lit	Link-down
(8)	L ER	Red	Lit	Normal data received and loopback not performed
			Not lit	Abnormal data received or loopback being performed

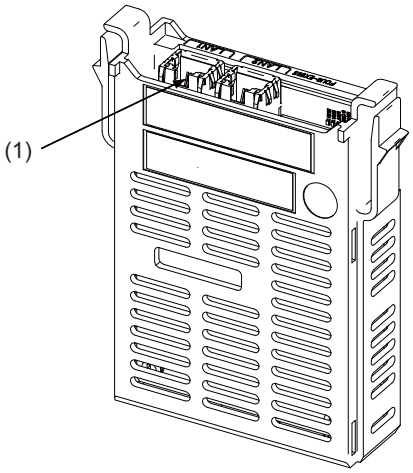
4.14.4 EtherNet/IP (FCU8-EX565)

[Outline dimension]

[mm]



[Connector]



No.	Connector name	Function
(1)	LAN1	EtherNet/IP communication

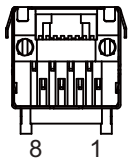
(Note) On this unit, EtherNet/IP function is supported by the "LAN1" port only. LAN2 does not support EtherNet/IP function.

⚠ CAUTION

⚠ Do not apply any voltage to the connectors other than voltage specified in this manual. Failure to observe this could cause bursting, damage, etc.

⚠ Connect the cables to the designated connectors. Incorrect connections could damage the device.

(1) LAN1 (EtherNet/IP communication)



1	O	TXD+	**5**		NC
2	O	TXD-	**6**	I	RXD-
3	I	RXD+	**7**		NC
4		NC	**8**		NC

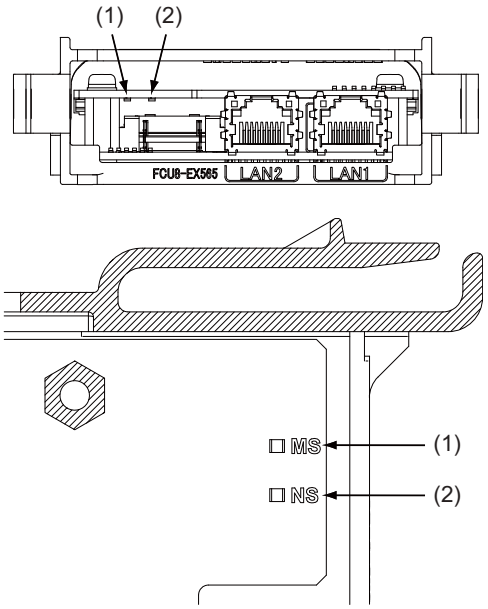
- Connect connector case with FG pattern.

<Cable side connector type>

Connector : J00026A0165

Manufacturer: Japan Telegärtner

[LED]



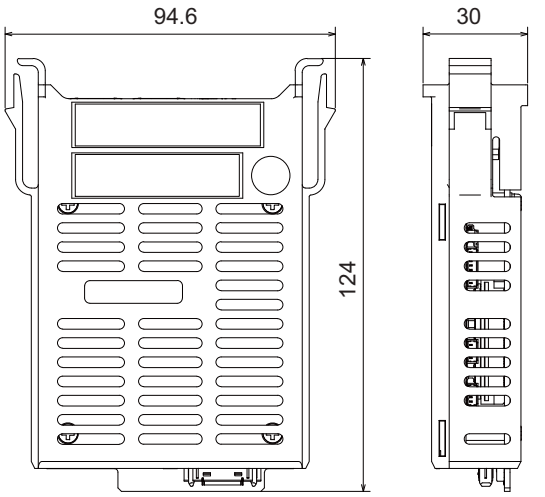
No.	Name	Green LED	Red LED	Details
(1)	MS (Green/Red) (Module status)	Flashing	Flashing	In self-test
		Flashing	Not lit	Waiting for initialization
		Lit	Not lit	Normal operation
		Not lit	Flashing	Recoverable failure
		Not lit	Lit	Unrecoverable failure (The hardware needs to be replaced.)
(2)	NS (Green/Red) (Communication status)	Flashing green/red (alternately)		In self-diagnosis
		Not lit	Not lit	No IP address
		Flashing	Not lit	No connection
		Lit	Not lit	Normal operation
		Not lit	Flashing	Connection time out
		Not lit	Lit	IP address duplication

(Note 1) Ignore LED which is not written in the table above.

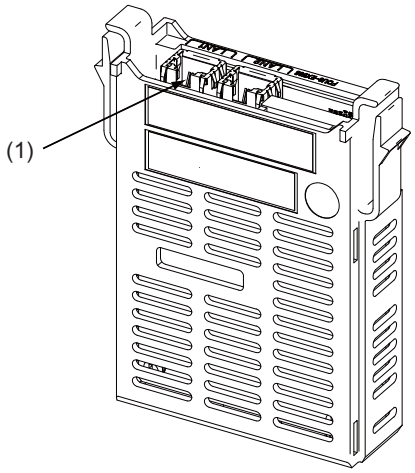
4.14.5 FL-net (FCU8-EX568)

[Outline dimension]

[mm]



[Connector]



No.	Connector name	Function
(1)	LAN1	FL-net communication

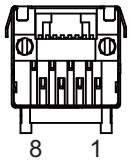
(Note) On this unit, FL-net function is supported by the "LAN1" port only. LAN2 does not support FL-net function.

⚠ CAUTION

⚠ Do not apply any voltage to the connectors other than voltage specified in this manual. Failure to observe this could cause bursting, damage, etc.

⚠ Connect the cables to the designated connectors. Incorrect connections could damage the device.

(1) LAN1 (FL-net communication)



1	O	TXD+	**5**		NC
2	O	TXD-	**6**	I	RXD-
3	I	RXD+	**7**		NC
4		NC	**8**		NC

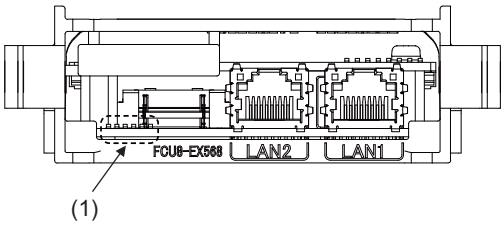
- Connect connector case with FG pattern.

<Cable side connector type>

Connector : J00026A0165

Manufacturer: Japan Telegärtner

[LED]

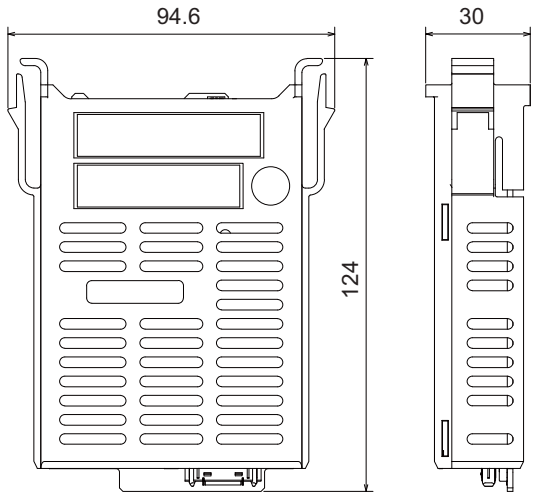


(1) Ignore LED of FCU8-EX568. (This is used by MITSUBISHI.)

4.14.6 Vibration Cutting Expansion Unit (FCU8-EX744)

[Outline dimension]

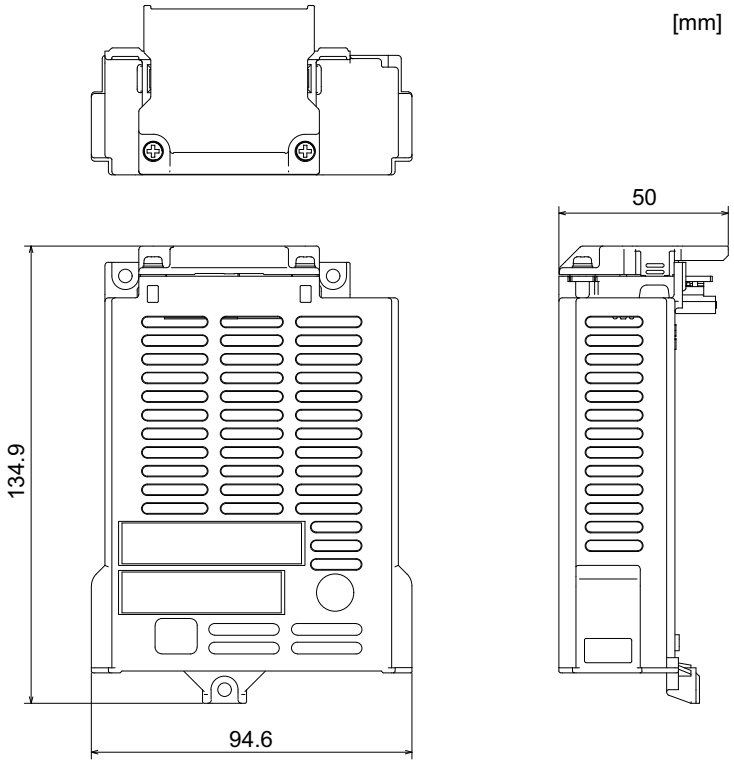
[mm]



4.14.7 Option Relay Unit (FCU8-EX702)

[Outline dimension]

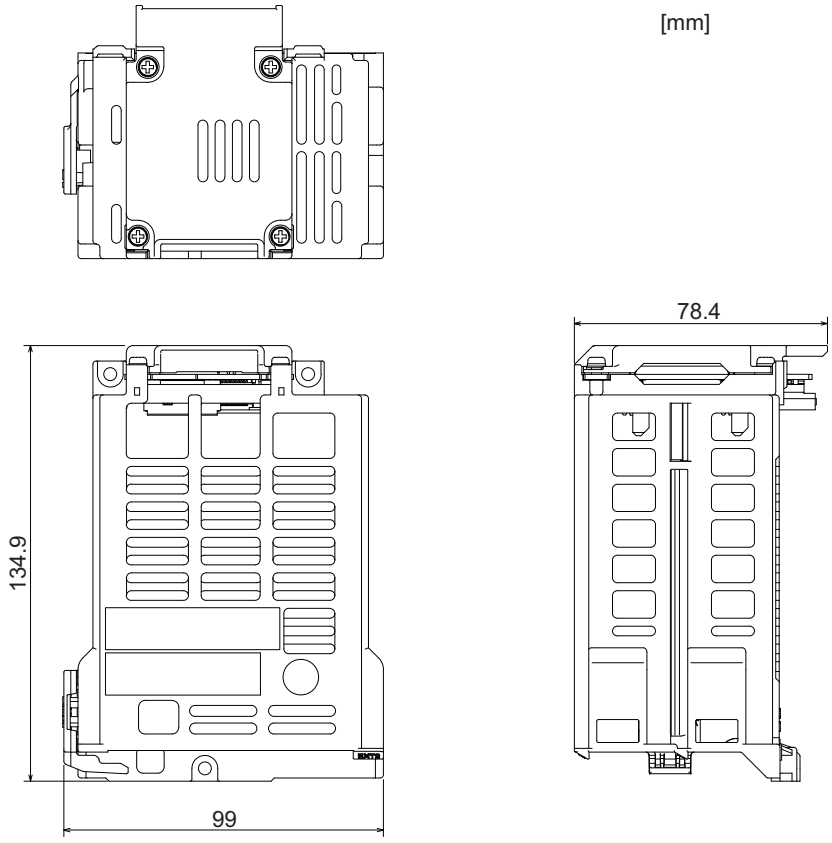
[mm]



4.14.8 Option Relay Unit (FCU8-EX703)

[Outline dimension]

[mm]



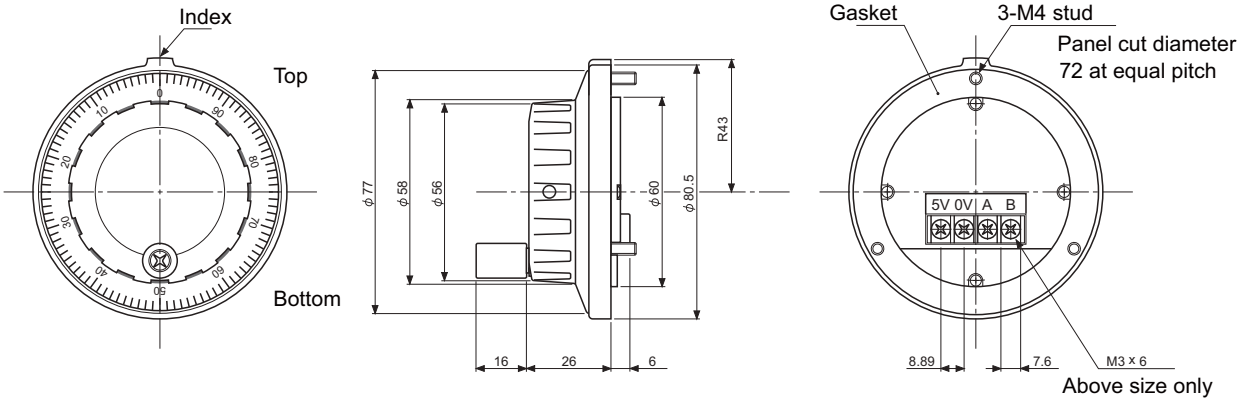
4.15 Manual Pulse Generator

4.15.1 5V Manual Pulse Generator (UFO-01-2Z9)

100 pulse/rev

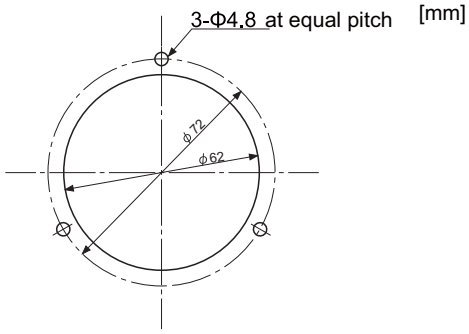
[Outline dimension]

[mm]



[Panel cut dimension]

[mm]



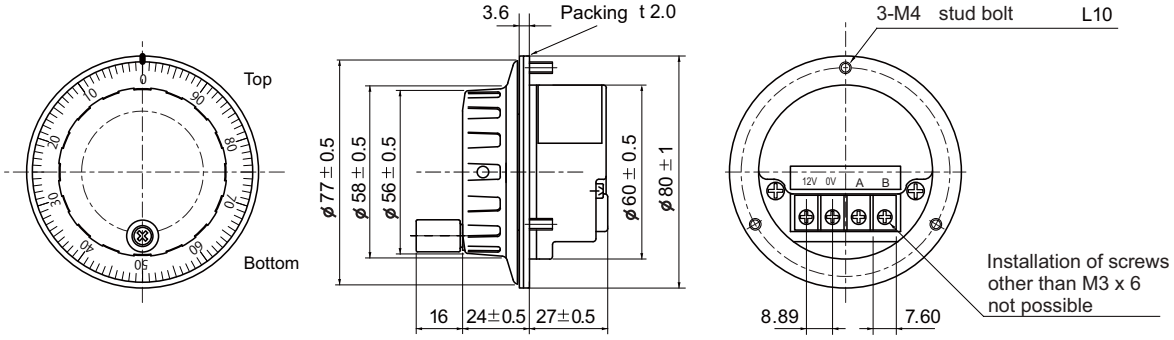
Produced by NIDEC NEMICON CORPORATION

4.15.2 12V Manual Pulse Generator (HD60C)

25 pulse/rev

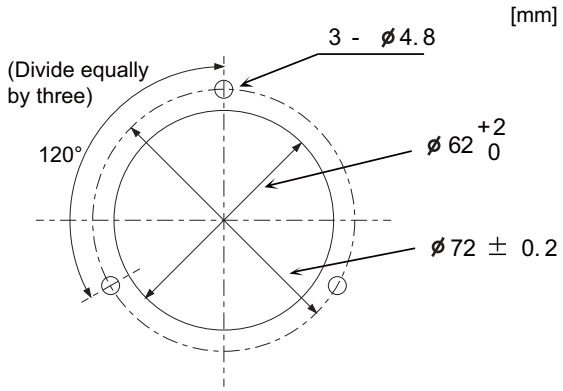
[Outline dimension]

[mm]



[Panel cut dimension]

[mm]

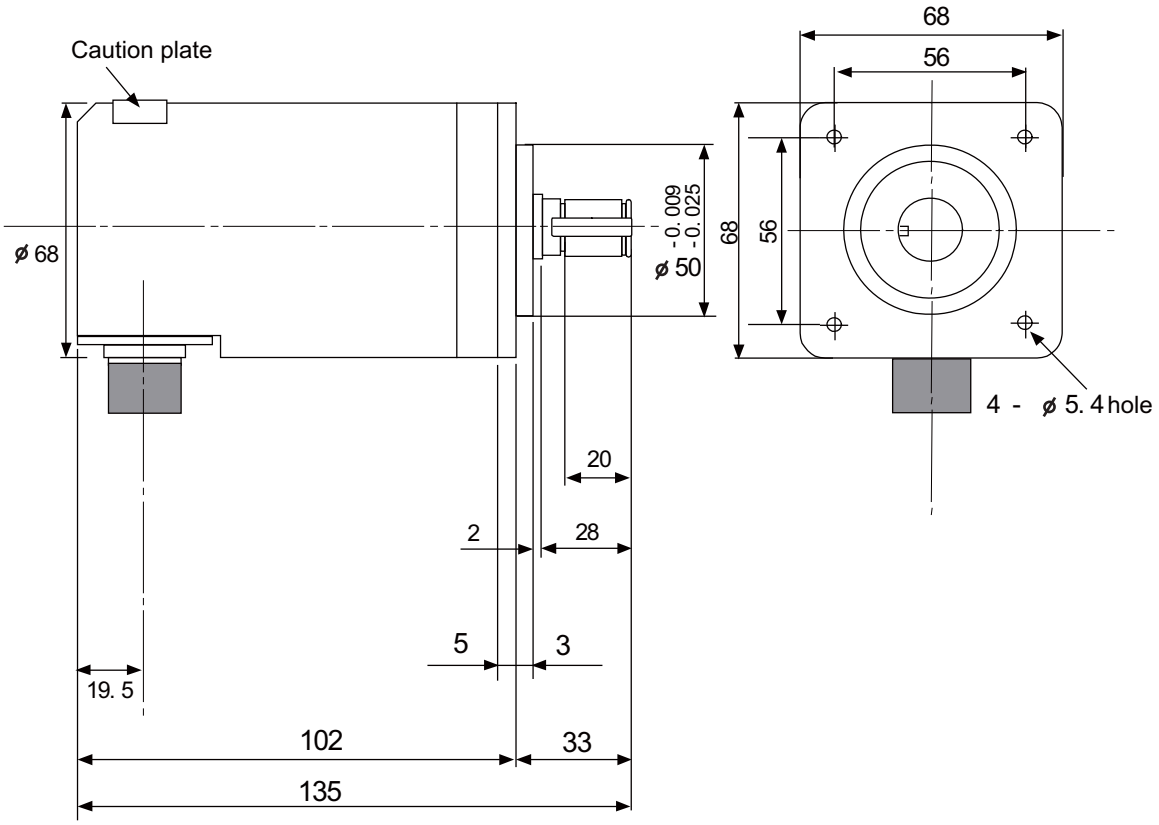


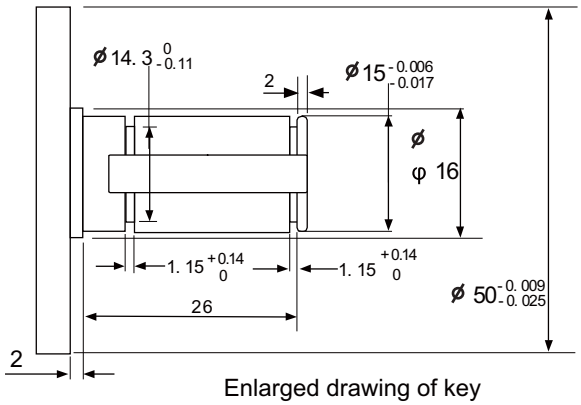
4.16 Synchronous Feed Encoder

4.16.1 Synchronous Feed Encoder (OSE-1024-3-15-68)

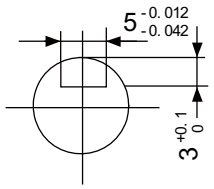
[Outline dimension]

[mm]



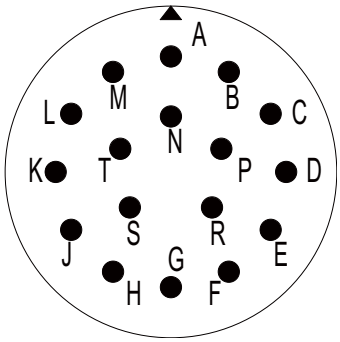


Enlarged drawing of key



Cross section BB
Valid depth of key groove is 21mm

[Connector]



Connector pin assignment

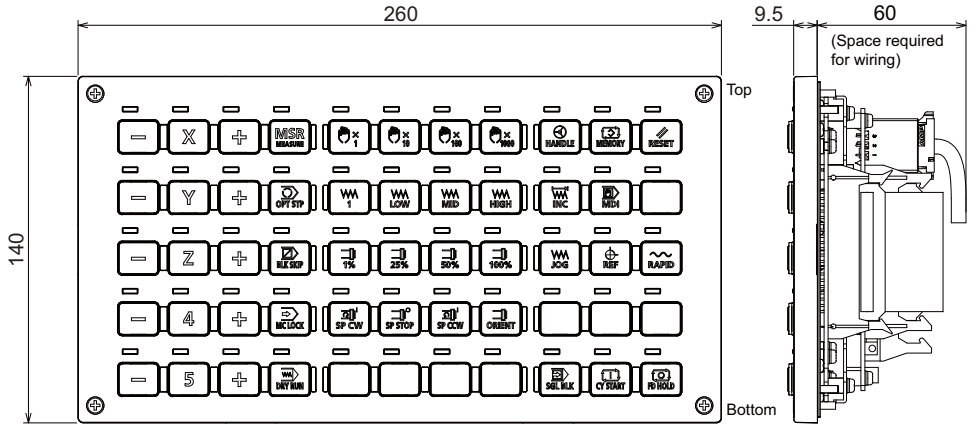
Pin	Function	Pin	Function
A	A phase	**K**	0V
B	Z phase	**L**	-
C	B phase	**M**	-
D	-	**N**	A phase reverse
E	Case grounding	**P**	Z phase reverse
F	-	**R**	B phase reverse
G	-	**S**	-
H	+5V	**T**	-
J	-		

4.17 Machine Operation Panel

4.17.1 Main Panel A , B (FCU8-KB921 / FCU8-KB922 / FCU8-KB925 , FCU8-KB923 / FCU8-KB924 / FCU8-KB926)

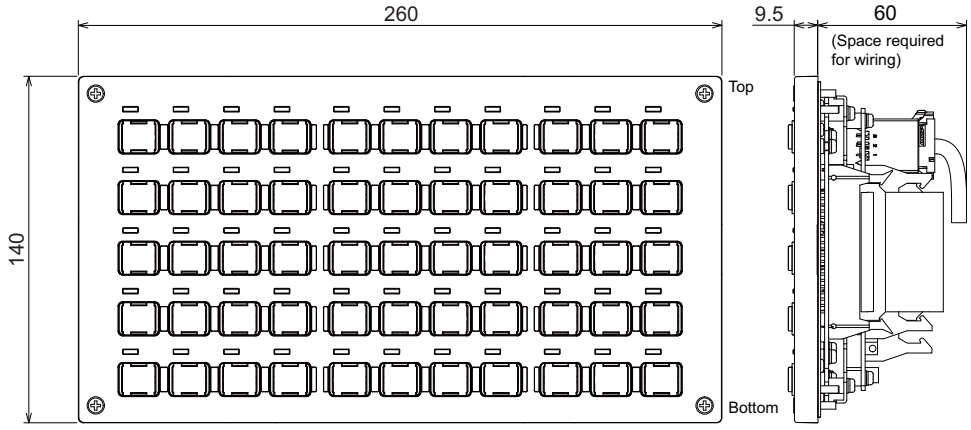
[Outline dimension : FCU8-KB921]

[mm]



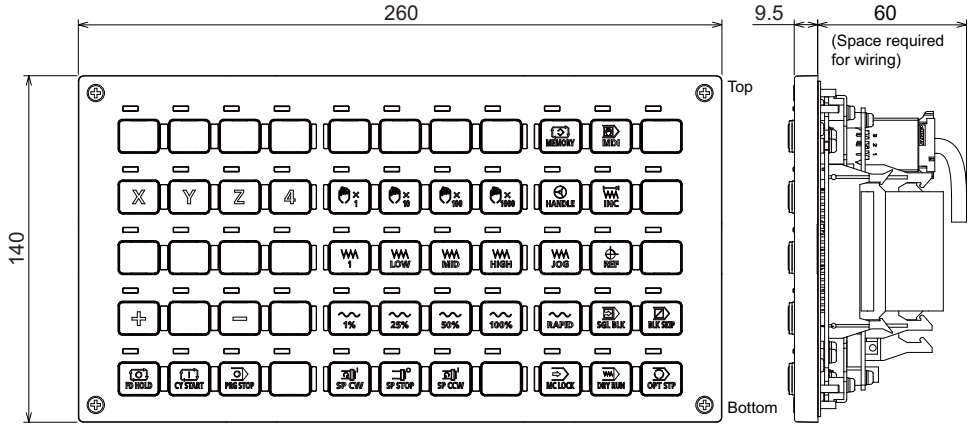
[Outline dimension : FCU8-KB922]

[mm]



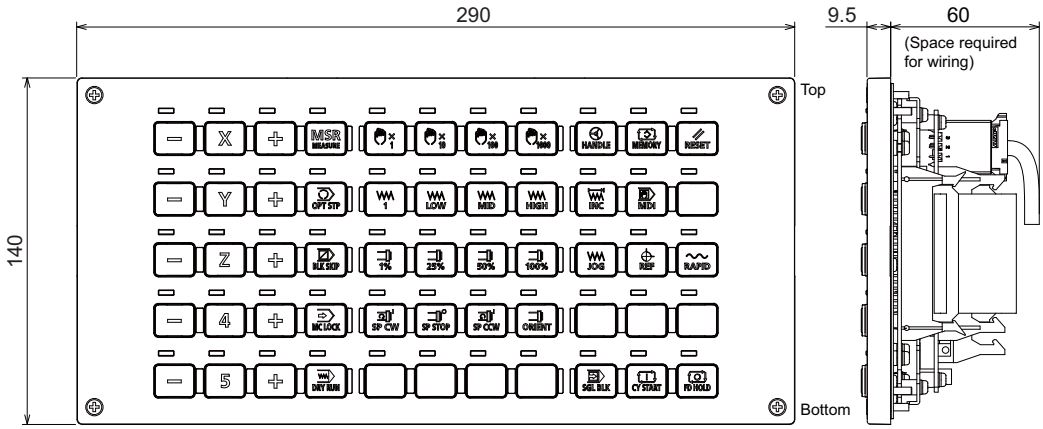
[Outline dimension : FCU8-KB925]

[mm]



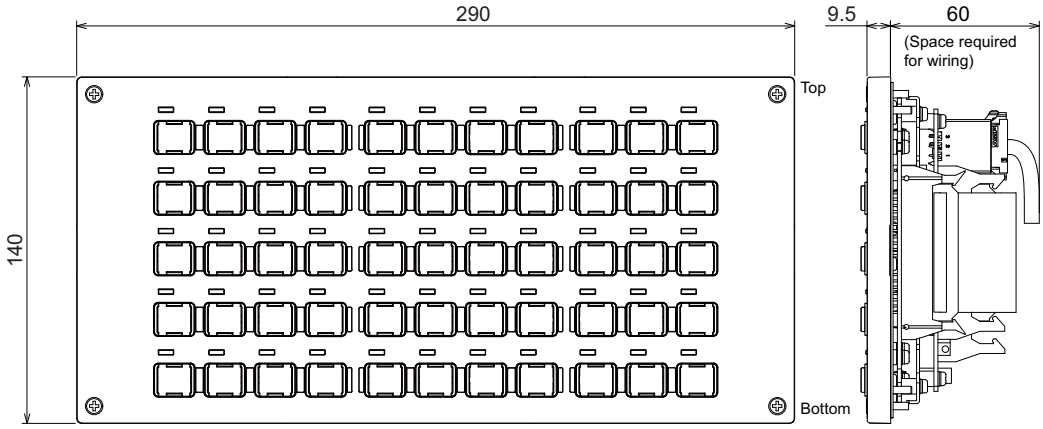
[Outline dimension : FCU8-KB923]

[mm]



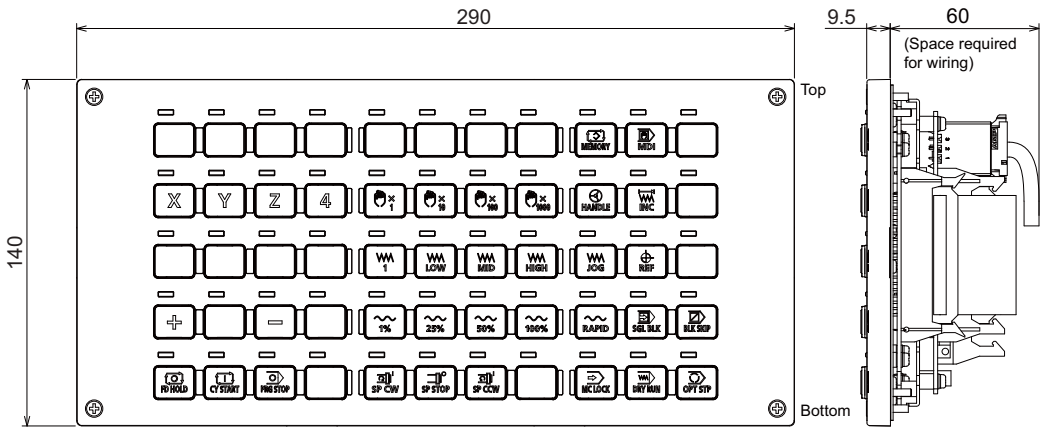
[Outline dimension : FCU8-KB924]

[mm]



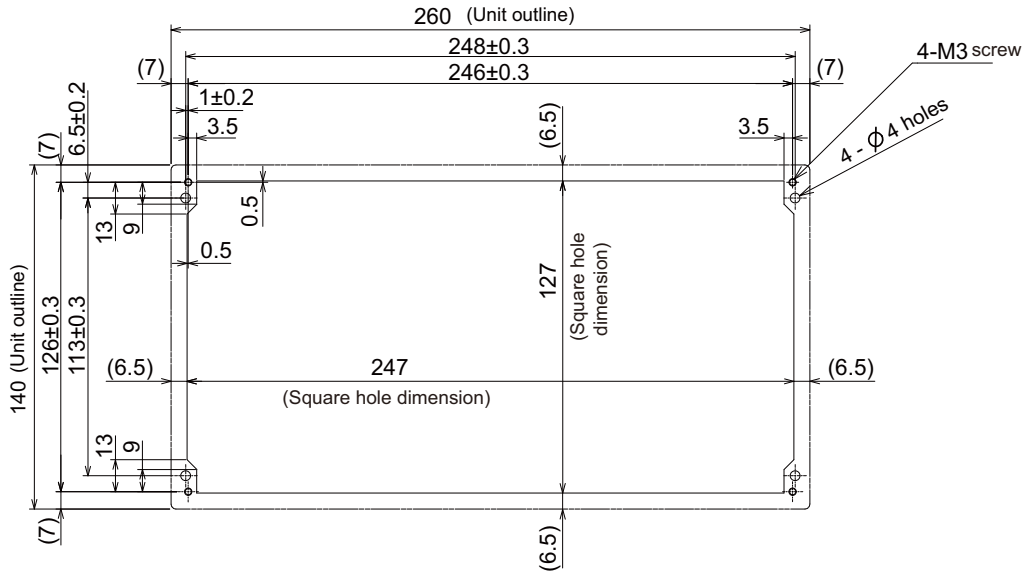
[Outline dimension : FCU8-KB926]

[mm]



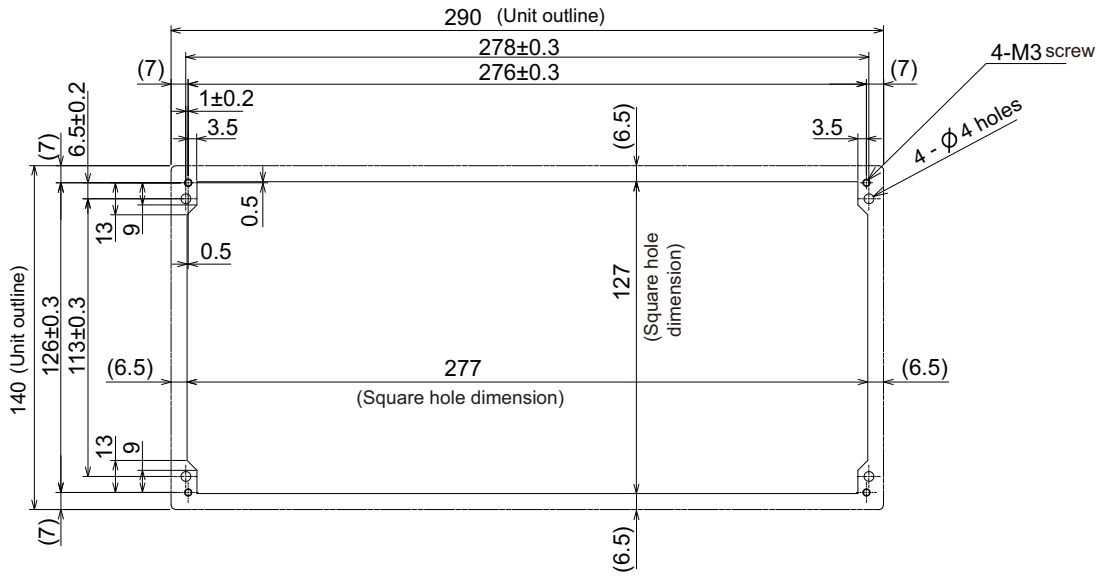
[Panel cut dimension : FCU8-KB921 / FCU8-KB922 / FCU8-KB925]

[mm]

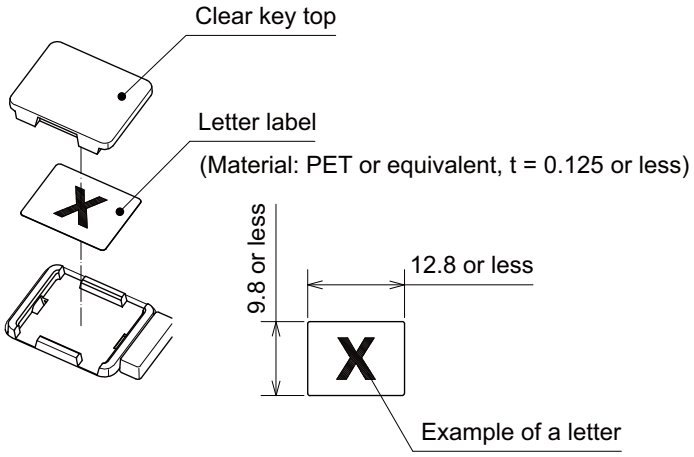


[Panel cut dimension : FCU8-KB923 / FCU8-KB924 / FCU8-KB926]

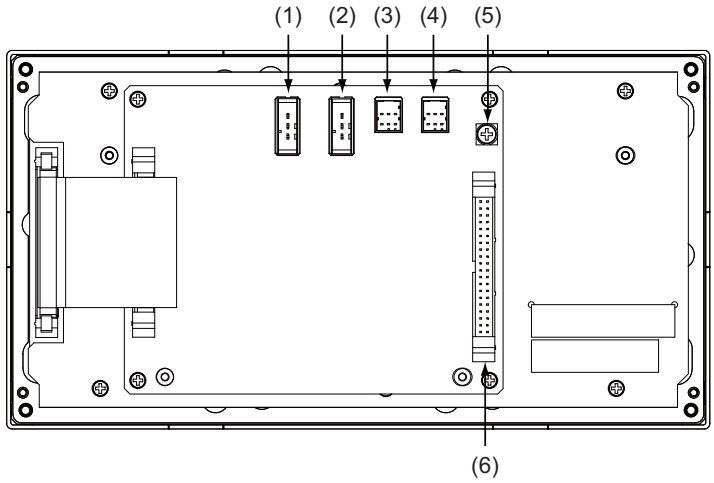
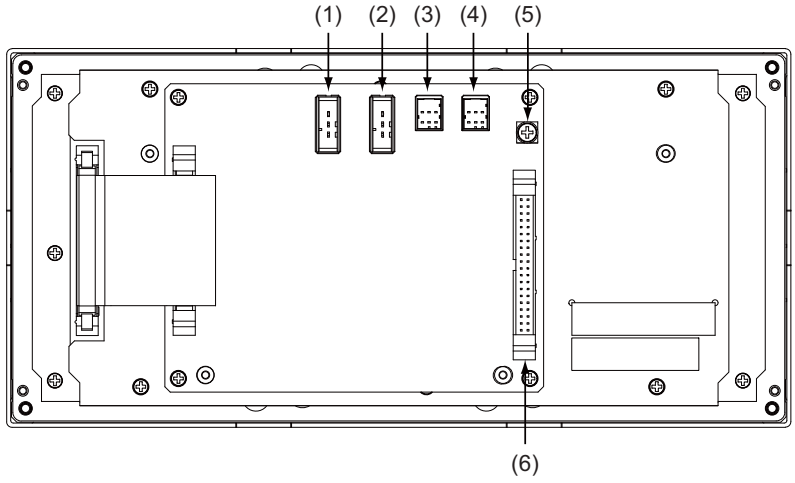
[mm]



[Letter label dimension : FCU8-KB922 / FCU8-KB924]

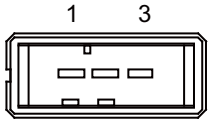


[Connector]

FCU8-KB921 / FCU8-KB922 / FCU8-KB925	
FCU8-KB923 / FCU8-KB924 / FCU8-KB926	

No.	Connector name	Function		No.	Connector name	Function
(1)	DCIN	24VDC input		(4)	RIOOUT	Remote I/O 2.0 communication (relay)
(2)	DCOUT	24VDC output		(5)	FG	FG terminal
(3)	RIOIN	Remote I/O 2.0 communication (input)		(6)	SUBP	Sub panel connection

(1) DCIN (24VDC input)

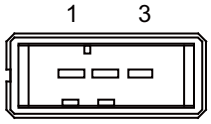


1	I	+24V
2		0V
3		FG

<Cable side connector type>

Connector : 2-178288-3
Contact : 1-175218-5
Manufacturer: TE Connectivity

(2) DCOUT (24VDC output)



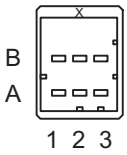
1	O	+24V
2		0V
3		FG

<Cable side connector type>

Connector : 2-178288-3
Contact : 1-175218-5
Manufacturer: TE Connectivity

(3) RIOIN (Remote I/O 2.0 communication (input))
(4) RIOOUT (Remote I/O 2.0 communication (relay))

Up to 64 remote I/O stations can be connected.



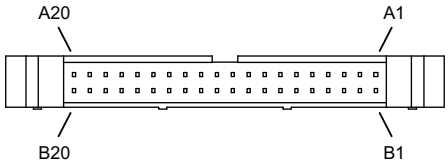
A			**B**		
1	I/O	TXRXD	**1**	I/O	TXRXD*
2		NC	**2**		0V
3		FG	**3**		NC

<Cable side connector type>

Connector : 1-1318119-3
Contact : 1318107-1
Manufacturer: TE Connectivity

(5) FG (FG terminal)

(6) SUBP (Sub panel connection)



B20		NC	A20		NC
B19		NC	A19		NC
B18		NC	A18		NC
B17		NC	A17		NC
B16		0V	A16	I	Spare SW(ZR5$23[5])
B15		0V	A15	I	Spare SW(ZR5$23[4])
B14		0V	A14	I	Spare SW(ZR5$23[3])
B13		0V	A13	I	Memory protection (ZR5$23[2])
B12		NC	A12	I	RSW3_G(ZR5$23[1])
B11	I	RSW3_F(ZR5$22[D])	A11	I	RSW3_E(ZR5$22[F])
B10	I	RSW3_D(0V)	A10	I	RSW3_C(ZR5$23[0])
B9	I	RSW3_B(ZR5$22[E])	A9	I	RSW3_A(ZR5$22[C])
B8		NC	A8	I	RSW2_G(ZR5$22[B])
B7	I	RSW2_F(ZR5$22[7])	A7	I	RSW2_E(ZR5$22[9])
B6	I	RSW2_D(0V)	A6	I	RSW2_C(ZR5$22[A])
B5	I	RSW2_B(ZR5$22[8])	A5	I	RSW2_A(ZR5$22[6])
B4		NC	A4	I	RSW1_G(ZR5$22[5])
B3	I	RSW1_F(ZR5$22[1])	A3	I	RSW1_E(ZR5$22[3])
B2	I	RSW1_D(0V)	A2	I	RSW1_C(ZR5$22[4])
B1	I	RSW1_B(ZR5$22[2])	A1	I	RSW1_A(ZR5$22[0])

RSW1: Cutting override switch
RSW2: Rapid traverse override switch
RSW3: Spare switch

(Note 1) "$" in the device No. varies depending on the channel No. of RIO.
(RIO1 = "0", RIO2 = "2", RIO3 = "4")

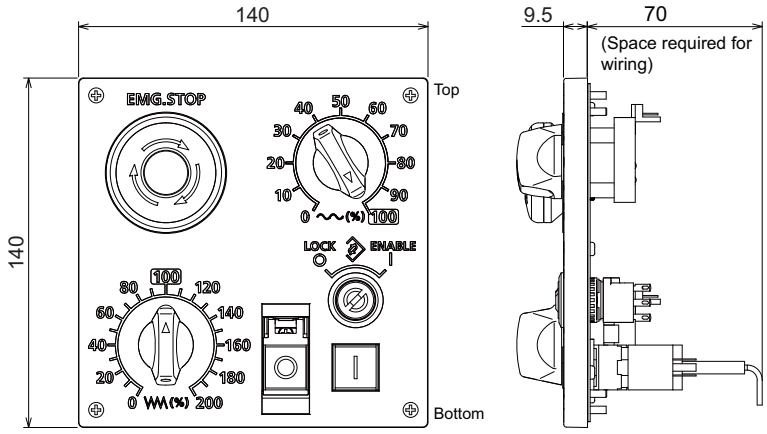
<Cable side connector type>

Connector : HIF3BA-40D-2.54C
Contact : HIF3-2428SC
Manufacturer: Hirose Electric

4.17.2 Sub Panel A (FCU8-KB931 / FCU8-KB941)

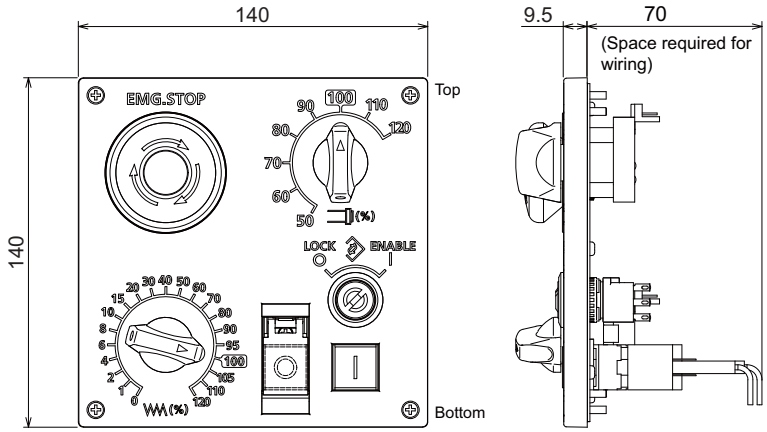
[Outline dimension : FCU8-KB931]

[mm]



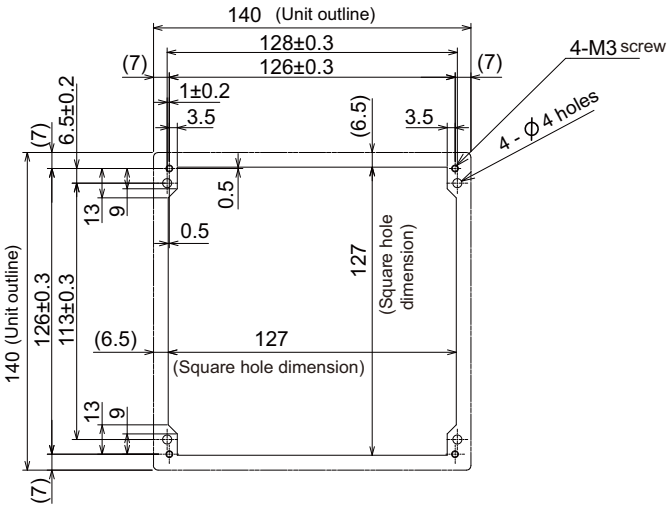
[Outline dimension : FCU8-KB941]

[mm]

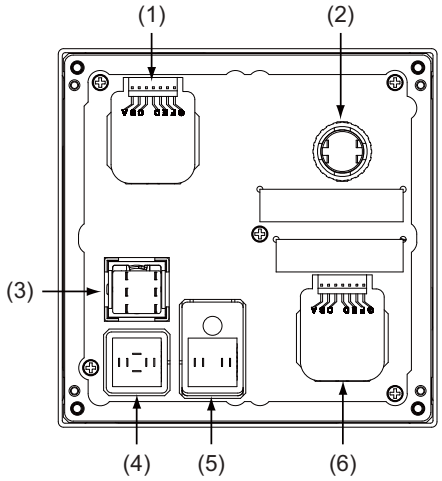


[Panel cut dimension : FCU8-KB931 / FCU8-KB941]

[mm]

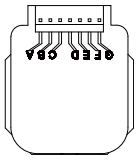


[Connector]



No.	Switch name		No.	Switch name
(1)	Rapid traverse override		(4)	ON switch
(2)	Emergency stop switch		(5)	OFF switch
(3)	Memory protection switch		(6)	Cutting override

(1) Rapid traverse override



A	O	Output signal a
B	O	Output signal c
C	O	Output signal e
D	-	Common terminal
E	O	Output signal d
F	O	Output signal b
G	O	Parity check signal

<Switch type>

Switch : AC09-GY0/10L3B02

Manufacturer: Fuji Electric

Connection : Connector

<Switch side connector type>

Connector : IL-7P-S3EN2

Manufacturer: Japan Aviation Electronics

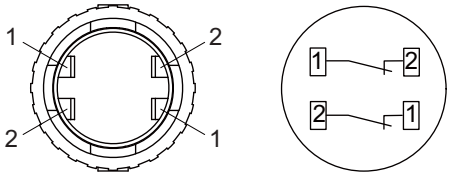
<Cable side connector type>

Connector : IL-7S-S3L-(N)

Contact : IL-C2-10000

Manufacturer: Japan Aviation Electronics

(2) Emergency stop switch



A	O	Contact 1 (B contact)
B	O	Contact 2 (B contact)

<Switch type>

Switch : XA1E-BV4U02TR

Manufacturer: IDEC

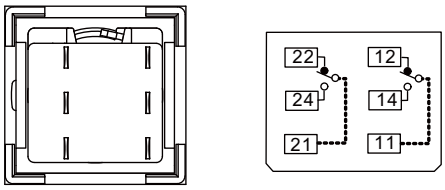
Connection : Terminal

<Cable side connector type>

Connector: Faston terminal #110

Manufacturer: -

(3) Memory protection switch



Contact 2 Contact 1

22	O	Contact 2 (B contact)	**12**	O	Contact 1 (B contact)
24	O	Contact 2 (A contact)	**14**	O	Contact 1 (A contact)
21	-	Contact 2 (Common)	**11**	-	Contact 1 (Common)

<Switch type>

Switch :LB6K-2ST2B

Manufacturer: IDEC

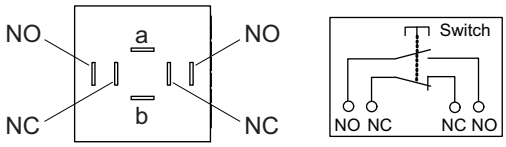
Connection : Terminal

<Cable side connector type>

Connector: Faston terminal #110

Manufacturer: -

(4) ON switch



a	I	Lamp terminal (+)
b	O	Lamp terminal (-)
NO	O	Contact 1 (A contact)
NC	O	Contact 2 (B contact)

(Note) Connect LGCON terminal and ON terminal of G170 cable to NO terminal of ON switch.

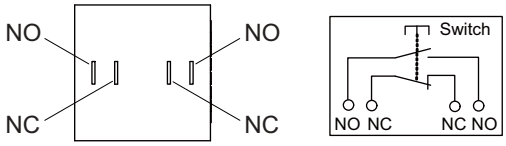
<Switch type>

Switch : AH165-SLW11X3/0063
Manufacturer: IDEC
Connection : Terminal

<Cable side connector type>

Connector: Faston terminal #110
Manufacturer: -

(5) OFF switch



NO	O	Contact 1 (A contact)
NC	O	Contact 2 (B contact)

(Note) Contact LGCOFF terminal and OFF terminal of G170 cable to NO terminal of OFF switch.

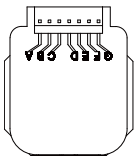
<Switch type>

Switch : AH165-SLB11X3/0063
Manufacturer: IDEC
Connection : Terminal

<Cable side connector type>

Connector: Faston terminal #110
Manufacturer: -

(6) Cutting override



A	O	Output signal a
B	O	Output signal c
C	O	Output signal e
D	-	Common terminal
E	O	Output signal d
F	O	Output signal b
G	O	Parity check signal

<Switch type>

Switch : AC09-GY0/20L3B02

Manufacturer: Fuji Electric

Connection : Connector

<Switch side connector type>

Connector : IL-7P-S3EN2

Manufacturer: Japan Aviation Electronics

<Cable side connector type>

Connector : IL-7S-S3L-(N)

Contact : IL-C2-10000

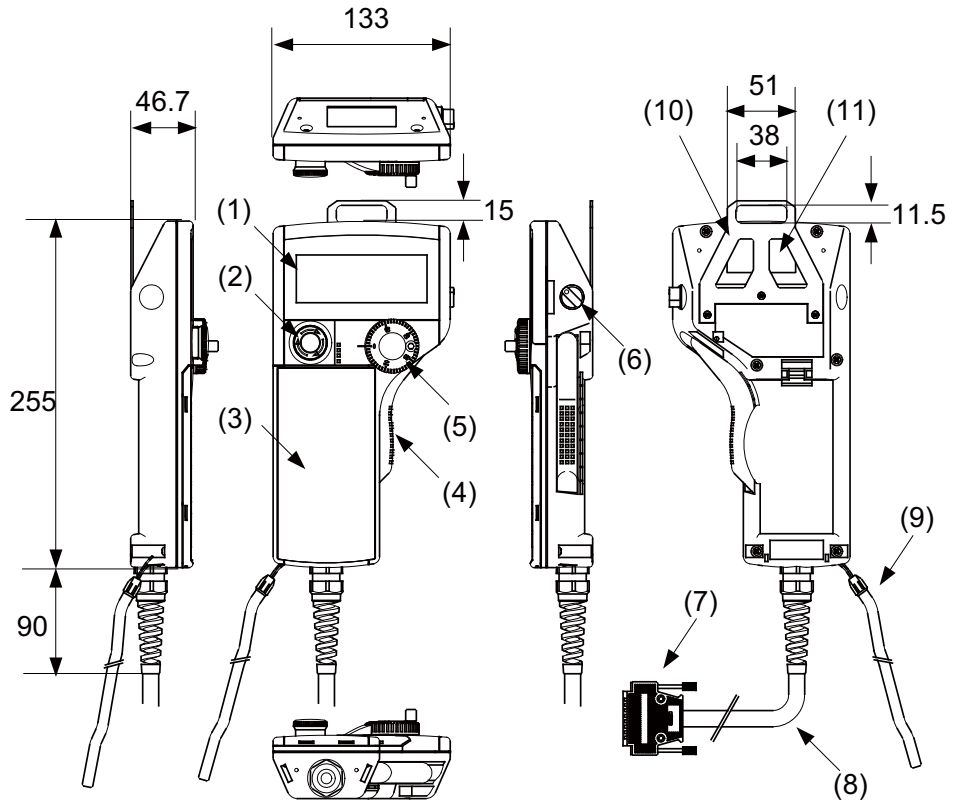
Manufacturer: Japan Aviation Electronics

4.18 Handy Terminal

Item	Unit name		Handy terminal
	Type		HG1T-SB12UH-MK1346-L5
General Specifications	Ambient temperature	During operation	0 to 40 ℃
		During storage	-20 to 60 ℃
	Ambient humidity		Long term: 10 to 75% RH (with no dew condensation)
			Short term: 10 to 95% RH (with no dew condensation) (Note 1)
	Vibration resistance	During operation	9.8m/s^2 [1.0G] or less, 10 to 55Hz
	Shock resistance	During storage	98m/s^2 [10.0G] or less
	Working atmosphere		No corrosive gases, dust or oil mist
Power specifications	Power voltage		24VDC±5% Ripple noise 240mV (P-P)
	Current consumption	(max.)	0.2A
	Instantaneous stop tolerance time		24VDC: 4ms or less
Others	Heating value		4W (max.)
	Mass		0.6kg

(Note 1) "Short term" means within one month.
(Note 2) The unit is an IP65F equivalent.

Dimension and names of parts



No.	Name	Function/ Specification		No.	Name	Function/ Specification
(1)	LCD	Monochrome display with backlight 192(W) × 64(H) dots		(7)	HOST	Host interface connector (DDK: 17JE-23250-02(D8A6))
(2)	SW1	Emergency stop switch Contact rating/ Contact: 24VDC, 1A Contact configuration: 2b contacts (IDEC Corporation: HA1E-V2S2VR)		(8)	-	Host interface cable (5m)
(3)	-	Membrane switch (Note)		(9)	-	Simplified hand strap (IDEC Corporation: HG9Z-PS1)
(4)	SW2	Enable switch Contact rating/ Contact: 24VDC, 50mA Contact configuration: 3 position contact × 2 (OFF-ON-OFF) (IDEC Corporation: HE3B-M2)		(10)	-	Panel hanging fitting (IDEC Corporation: HG9Z-TK1)
(5)	SW4	Manual pulse generator Output: Open collector 4.7kΩ pull-up resistor is connected. (TOKYO SOKUTEIKIZAI CO., LTD: RE19PH50C16RR)		(11)	-	Serial number plate
(6)	SW6	Selector switch				

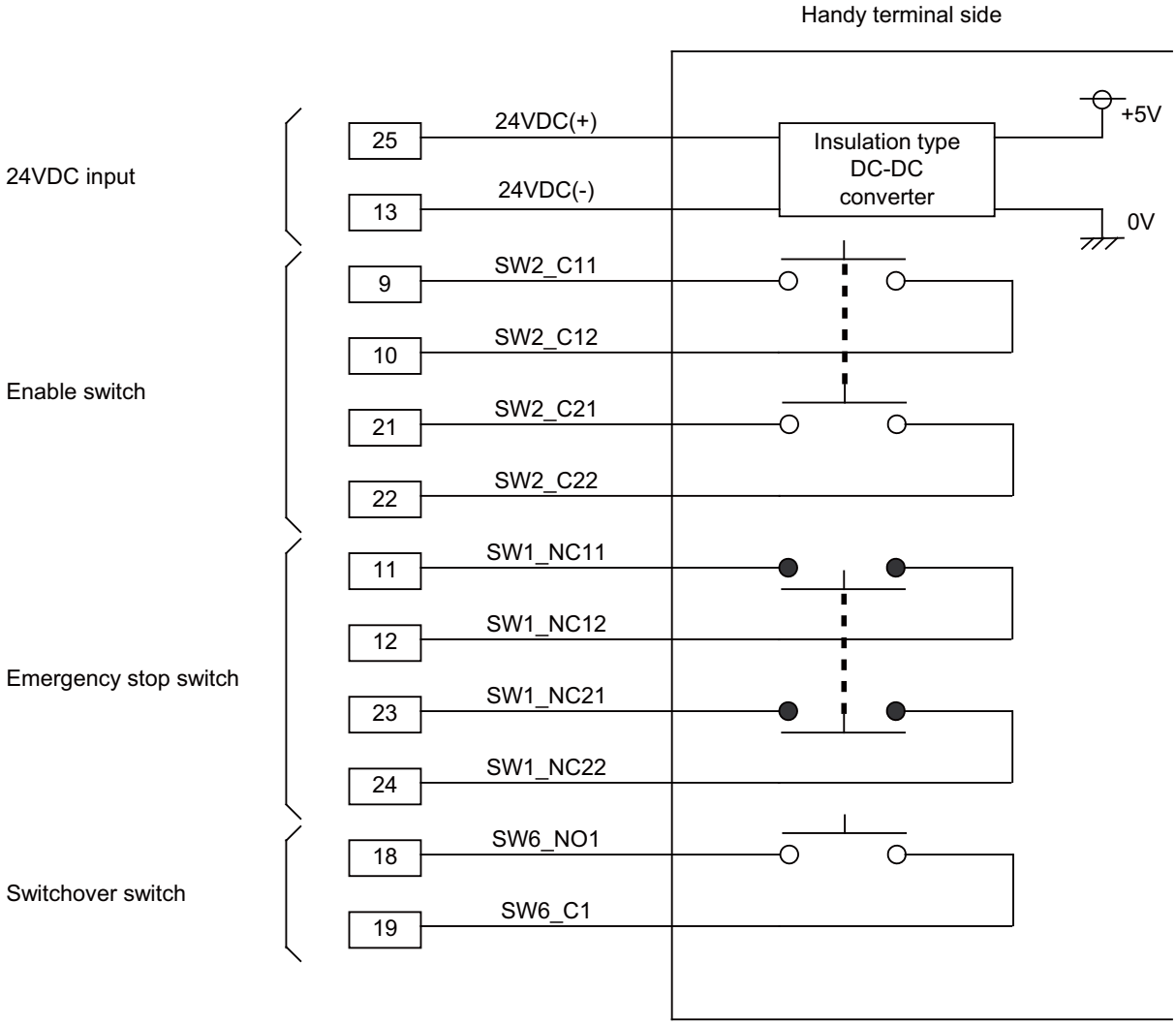
(Note) Do not press multiple switches simultaneously: When three or more switches are pressed simultaneously, unpressed switches are also detected as pressed ones.

Signal explanation

HOST terminal No.	HOST connector signal name	Input/ Output	Function/ Name
1	FG	-	Frame ground
2	Reserved	-	Reserved
3	Reserved	-	Reserved
4	Reserved	-	Reserved
5	Reserved	-	Reserved
6	0V	-	Ground
7	RS(RTS)	O	RS-232C communication signal (Request To Send)
8	CS(CTS)	I	RS-232C communication signal (Clear To Send)
9	SW2_C11	-	Enable switch contact 1 terminal 1
10	SW2_C12	-	Enable switch contact 1 terminal 2
11	SW1_NC11	-	Emergency stop switch contact 1 terminal 1
12	SW1_NC12	-	Emergency stop switch contact 1 terminal 2
13	24VDC(-)	I	24VDC ground
14	SD(TXD)	O	RS-232C communication signal (Send Data)
15	RD(RXD)	I	RS-232C communication signal (Receive Data)
16	HA	O	Manual pulse generator A phase signal
17	HB	O	Manual pulse generator B phase signal
18	SW6_NO1	-	Switchover switch terminal 1
19	SW6_C1	-	Switchover switch terminal 2
20	0V	-	Ground
21	SW2_C21	-	Enable switch contact 2 terminal 1
22	SW2_C22	-	Enable switch contact 2 terminal 2
23	SW1_NC21	-	Emergency stop switch contact 2 terminal 1
24	SW1_NC22	-	Emergency stop switch contact 2 terminal 2
25	24VDC(+)	I	24VDC input

(Note) The input/output goes to/from the handy terminal.

Terminal connections

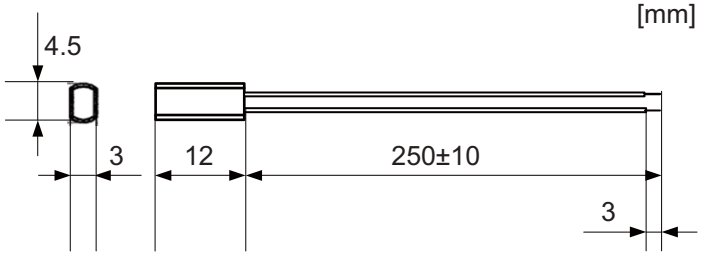


4.19 Thermistor

4.19.1 Thermistor(PT3C-51F-M2)

[Outline dimension]

[mm]



Made by SHIBAURA ELECTRONICS Co., Ltd.

Ambient temperature	-10 to + 190 ℃
Insulation resistance	100MΩ or more at 500VDC [between case and lead wire]

4.20 Exclusive SD Cards

Item		FCU8-SD001G	FCU8-SD004G
Capacity		1GB	4GB
NAND Flash		SLC (Note 1)	
Ambient temperature	During operation	-25 ℃ to +85 ℃	
	During storage	-40 ℃ to +85 ℃	
Ambient humidity	During operation	5% to 95%RH (with no dew condensation)	
	During storage	5% to 95%RH (with no dew condensation)	

(Note 1) SLC stands for Single Level Cell, and it stores one bit data in each memory cell.
This provides longer life span and high product reliability in comparison with MLC (Multi Level Cell), which is commonly applied to SD cards.

(Note 2) Do not touch the terminal part with fingers, etc. when handling the SD cards.
The contamination of the terminal part of SD card causes a contact failure or a trouble.

4.21 Specifications and Precautions of USB/SD/LAN Interface

4.21.1 USB Interface (Memory I/F card)

	M800S / M80
Standards	USB2.0
Data transfer speed (Note)	High Speed (480Mbps) Full Speed (12Mbps) Low Speed (1.5Mbps)
Power supply to USB device	Supply voltage: 5V ± 5% Supply current: Max. 500mA/port
Number of free ports	Front X 1
Max. cable length	5m

(Note 1) Data transfer speed is the theoretical value on the standard, and the actual speed will be inferior to the value listed above. The transfer speed may be restrained depending on the specification of the connected device.

(Note 2) Do not connect the devices other than the USB memory.

(1) Precautions for insertion/removal of USB memory

When inserting/removing an USB memory, turn the MITSUBISHI device's power OFF. Do not pull out the USB memory or turn OFF the power during access to the USB memory. Failure to observe this could cause the memory contents to be erased.

When Inserting/removing a USB memory, be sure to have enough interval to perform that (about 10 seconds or more).

In case of emergency, always perform backups by having your important data duplicate, etc. as MITSUBISHI will not guarantee the broken or lost data.

(2) Precaution for operation with front-side USB memory

A USB memory to be used has to be supported USB2.0 Hi-Speed (480Mbps).

When connecting the USB memory, connect it directly without using the extension cable or USB hub.

Machine vibration may cause the USB memory to fall out depending on environment. Therefore, the operation with the front-side USB memory is required to be performed on your own responsibility.

4.21.2 SD Interface (Memory I/F card)

	M800S / M80
Standards	SD/SDHC (Note)
Transfer speed	According to the connecting SD card
Capacity	32GB
Number of free ports	Front X 1, Rear X 1

(Note) SDXC is not supported.

(1) Precautions for use of commercially available SD card

MITSUBISHI will not provide performance guarantee and maintenance for commercially available SD card, mini SD card or micro SD card (requires converting adapter). In case of using one of them, careful performance check must be required by the machine tool builder.

Commercially available devices may not be compatible with MITSUBISHI units or suitable FA environment for temperature- or noise-wise.

(2) Precautions for insertion/removal of SD card

When inserting/removing an SD card, turn the MITSUBISHI device's power OFF. Do not pull out the card or turn OFF the power during access to the SD card. Failure to observe this could cause the memory contents to be erased.

In case of emergency, always perform backups by having your important data duplicate, etc. as MITSUBISHI will not guarantee the broken or lost data.

4.21.3 LAN Interface (Control Unit)

	M800S/M80
Standards	100BASE-TX / 10BASE-T
Data transfer speed (Note 1)	100Mbps / 10Mbps
Number of free ports	Control unit × 2

(Note 1) Data transfer speed is the theoretical value on the standard, and the actual speed will be inferior to the value listed above. The transfer speed may be restrained depending on the specification of the connected device.

(Note 2) When using half-duplex communication, the response time may become long depending on the connected device.

Use full-duplex communication to connect with the opposite device via a switching HUB.

(1) Precautions for selection of LAN cable

Make sure to select the LAN cables which are "category 5e or above" and "shielded". Cable wire material with double shielded, which is appropriate for FA environment., is recommended.

5

Installation

5.1 Heat Radiation Countermeasures

Please refer to the following method for heat radiation countermeasures.

Example of heat radiation countermeasures

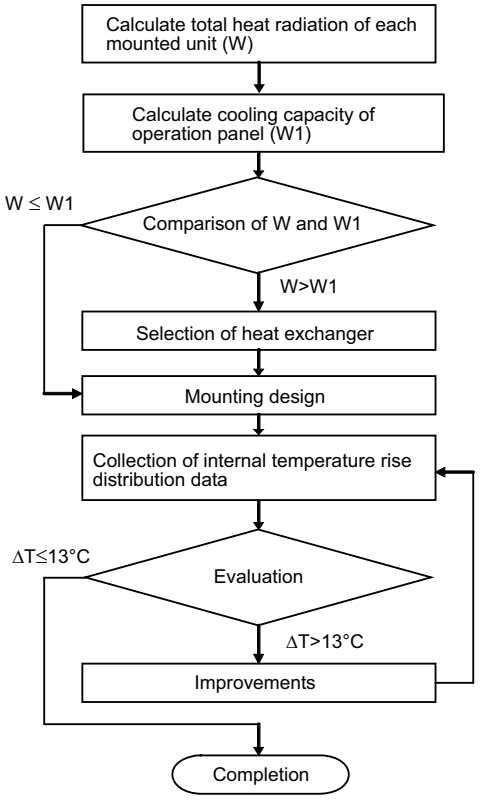
<Hypothetical conditions>

(1) Average internal temperature of operation panel: T ≤ 58°C

(2) Peripheral temperature of operation panel : Ta ≤ 0°C to 45°C

(3) Internal temperature rise value : ΔT = T - Ta (max) = 13°C

Procedures for heat design and verification



<Supplement>

(1) Refer to "General Specification" for the heat generated by each unit.

(2) Enclosed cabinet (thin steel plate) cooling capacity calculation equation

W1 = U × A × ΔT

U: 6 W/m^2°C

A: Effective heat radiation area (m^2) (Area where heat can be radiated from operation panel)

ΔT: Internal temperature rise value (13°C)

(Caution) 8 W/m^2°C can be applied only when the operation panel is so small that the internal temperature stays uniform.

(3) Points of caution for heat radiation countermeasures when designing mounting state

- Consider convection in operation panel (eliminate heat spots)
- Collect hot air at suction port of heat exchanger in operation panel.

(4) Criterion for internal temperature rise distribution data

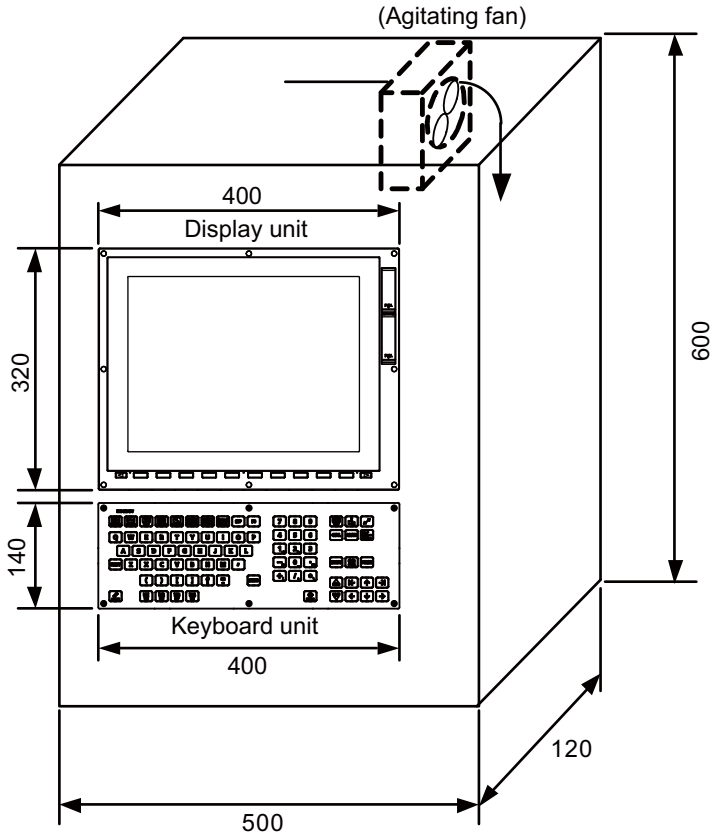
ΔT (average value) ≤ 13°C

ΔTmax (maximum value) ≤ 15°C

R (inconsistency ΔTmax - ΔTmin) ≤ 6°C

(Evaluate existence of heat spots)

The following shows an example of calculation applied to heat radiation countermeasures for the operation panel when 15-type display unit is used. Because heat will accumulate in the upper portions of the unit, install an agitating fan as required.



Calculation example of panel internal heating value

(1) Calculation of unit heating value

(In the case of FCU8-DU182-32 + FCU8-MU511 + FCU8-KB083 + FCU8-DX750)

Heating value (W)

Total heating value of units (W) :

31W (= display unit + control unit + keyboard unit + operation panel I/O unit)

Total heating value (W) by machine input (D1) :

5.5W (= 24V (total heating value when the 48 points are simultaneously turned ON) × 4.8mA × 48)

... 24V (current consumption per point of the operation panel I/O unit DI) divided by 5kΩ ≈ 4.8mA

Total heating value W = 36.5W (31 + 5.5)

(2) Calculation of operation panel cooling capacity

Tolerance value for temperature rise (Δt)

- Panel internal temperature (according to each unit's specification) T ≤ 58°C
- Panel peripheral temperature (according to machine's specification) Ta ≤ 45°C

Tolerance value for internal temperature rise ΔT = 13°C (T - Ta)

Heat radiation area (A)

The surface of the molded unit, which has lower radiation capacity than the metal plate surface, should be excluded for the heat radiation area in principle.

The bottom of the operation panel, which has difficulty in radiating due to the temperature distribution, should also be excluded for the heat radiation area in principle.

Heat radiation area A

$= 0.62\ mm^2\ (\approx\ \underset{(1)}{0.5\times0.12}\ +\ \underset{(2)}{0.6\times0.5\times2}\ +\ \underset{(3)}{0.12\times0.6\times2}\ -\ \underset{(4)}{0.32\times0.4 + 0.14\times0.4}\ )$

(1) Top surface
(2) Front, rear surface
(3) Both sides surface
(4) Unit surface

Operation panel cooling capacity (W1)

Calculate the cooling capacity to keep the temperature rise in the operation panel less than 13°C.

Cooling capacity W1 = 48.4W (6 × A × ΔT)

(3) Comparison of heating value and operation panel cooling capacity

The operation panel cooling capacity is over the heating value, which presumed no need to install the heat exchanger.

(4) Confirmation with the actual machine

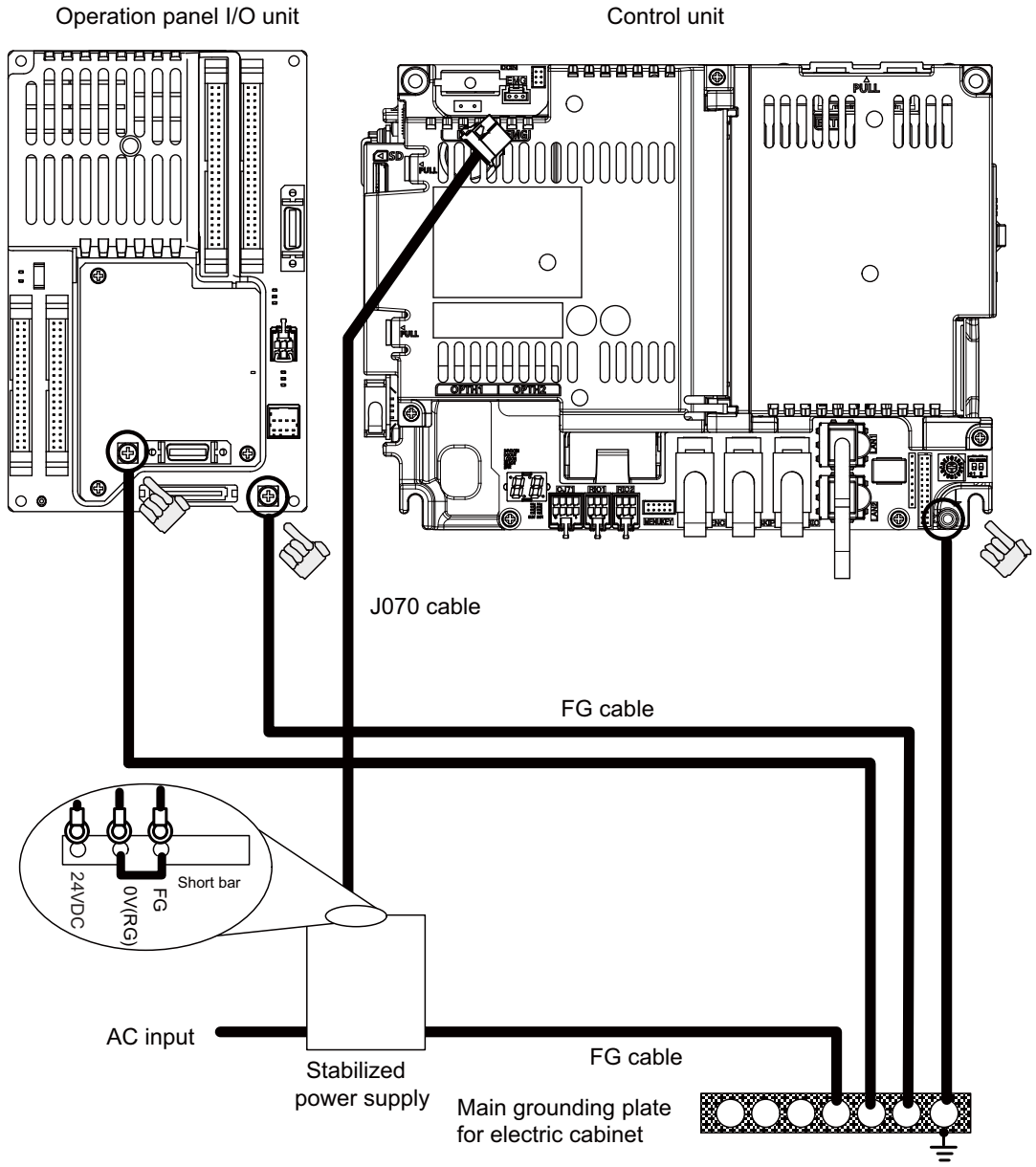
The result of the calculation above is only a rough indication. The actual temperature rise may differ according to the structure of the operation panel.

The actual unit heating value may differ depending on the user's machine specifications or operating environment. Be sure to confirm the temperature rise value in the operation panel when the actual machine is running.

5.2 Noise Countermeasures

5.2.1 Connection of Frame Ground (FG)

The frame should basically be grounded at one ground point.
Connect the control unit and operation panel I/O unit's 0V (RG) to the FG on the +24V stabilized power supply.
(Be sure to ground the ground terminal of the control unit otherwise the influence is exerted on the usability of the touchscreen.)

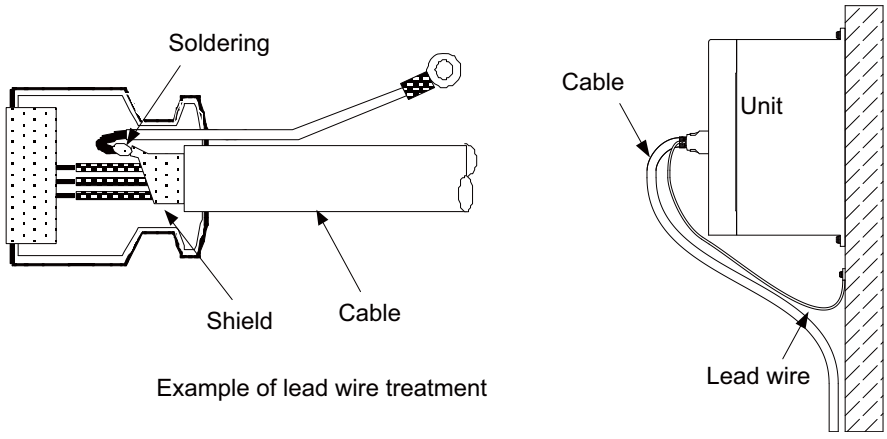


(Note) "24VDC" represents (+) side of 24V stabilized power supply, while "0V(RG)" represents (-) side.
"FG" (Frame Ground) corresponds to the functional earth.

5.2.2 Shield Clamping of Cables

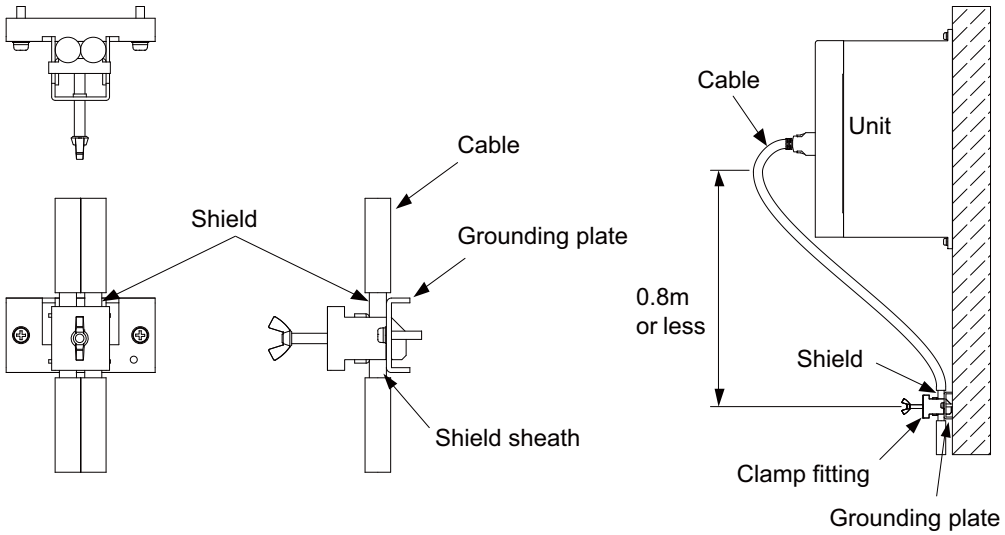
The shield of the shield cable connected to the control unit and drive unit must be connected to the grounding plate to stabilize operation while preventing malfunctioning due to noise.
The shield can be connected to the grounding plate with lead wires or clamp fittings. Refer to the following drawings to treat the shield cable.

[Example of connection with lead wire]



Example of lead wire treatment

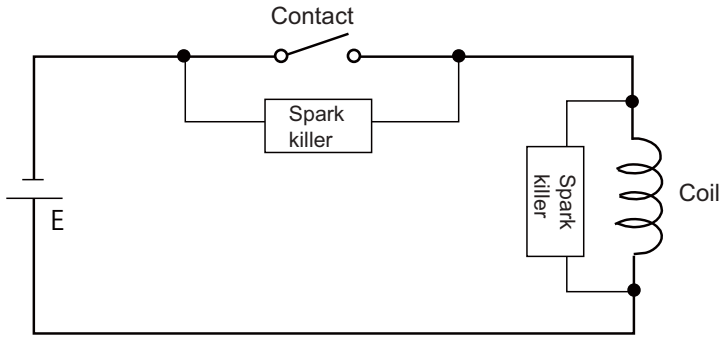
[Example of connection with clamp fitting]



(1) Peel part of the cable sheath and expose the shield as shown in the drawing.
Press the exposed part against the grounding plate with the cable clamp fittings.
(2) If the cable is thin, clamp several together in a bunch.
(3) Use adequate force when tightening the cable so that the wire material is not damaged.
(4) Connect each grounding plate together and ground them at one point.

5.2.3 Connecting Spark Killers

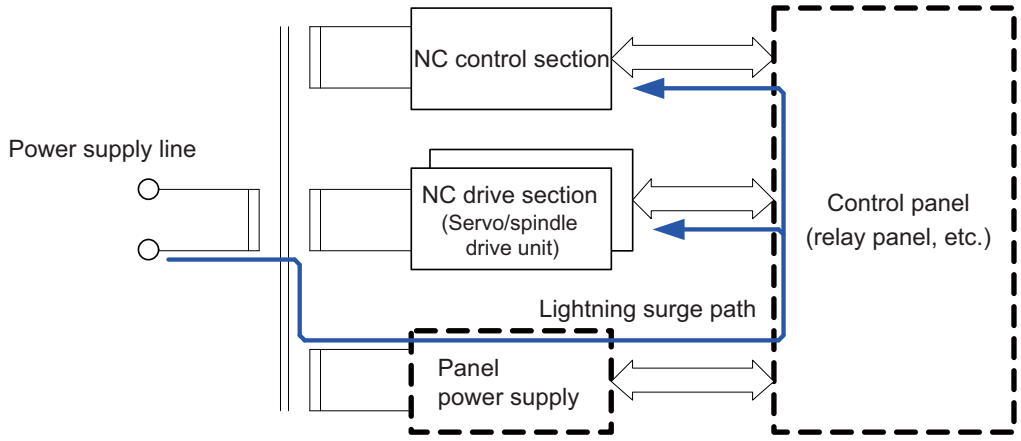
The noise which is generated during the operation of the coil or contact needs to be eliminated.
Connect the spark killers (CR composite element) in the parallel with the coil and the contact for the countermeasure.
The Spark killer is effective in eliminating the noise generated by electromagnetic induction.



Spark killer	C : 0.033 to 0.1μF R : 10 to 120Ω

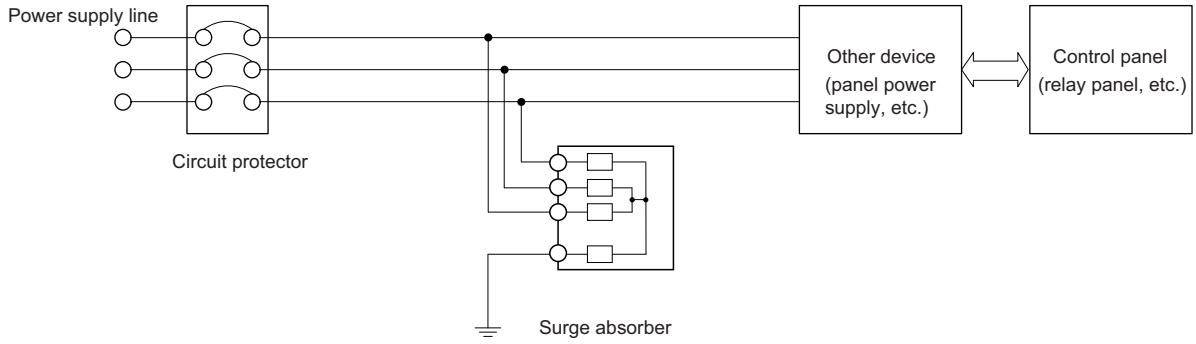
5.2.4 Lightning Surge Protection Countermeasure

Generally, the lightning surge intrudes into the control power supply of device from the power supply line, and the surge may damage the control power supply and the internal circuit.
For protection from the lightning surge, MITSUBUSHI NC unit has the surge absorber for the control power supply of the NC control section and the NC drive section.
However, when there is a device which is not applied with the countermeasure as illustrated below, the lightning surge may intrude through the signal line of the device which is not applied with the countermeasure and may damage the NC device.



Path of damage caused by lightning surge

(1) Protection countermeasure method
Add the surge absorber to the power supply lines as illustrated below for the power supply device, etc., which are separately prepared.
The following two items are needed to protect the whole from surge.
- Surge absorber installation
- Circuit protector installation



Lightning surge countermeasure for three-phase power supply line

(2) Product example of surge absorber
Case of OKAYA ELECTRIC INDUSTRIES surge absorber

Type	Rated Voltage (50/60Hz)	DC Breakdown voltage	Voltage protection level	Normal discharge current	Max. discharge current	Surge current life
RSPD-250-U4	250VAC (Three phase)	700V±25%	1.3kV	8/20μs 2.5kA	8/20μs 5kA	Approx. 300 times 8/20μs-1kA

(Note) Refer to "EMC Installation Guidelines: EMC Countermeasure Parts: Surge Absorber" for the outline, etc. Refer to the manufacturer catalog for detailed characteristics, outline and connection methods of the surge absorber.

5.3 Unit Installation

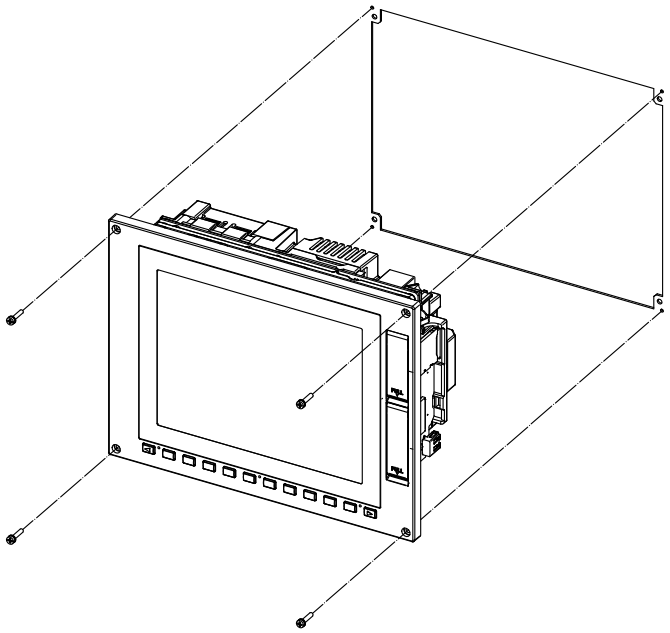
5.3.1 Display Unit

Mount the display unit with the prescribed number of fixing screws.

(Note) Refer to "General Specifications: Display Unit" for the panel cut dimension drawing and the screw hole position.

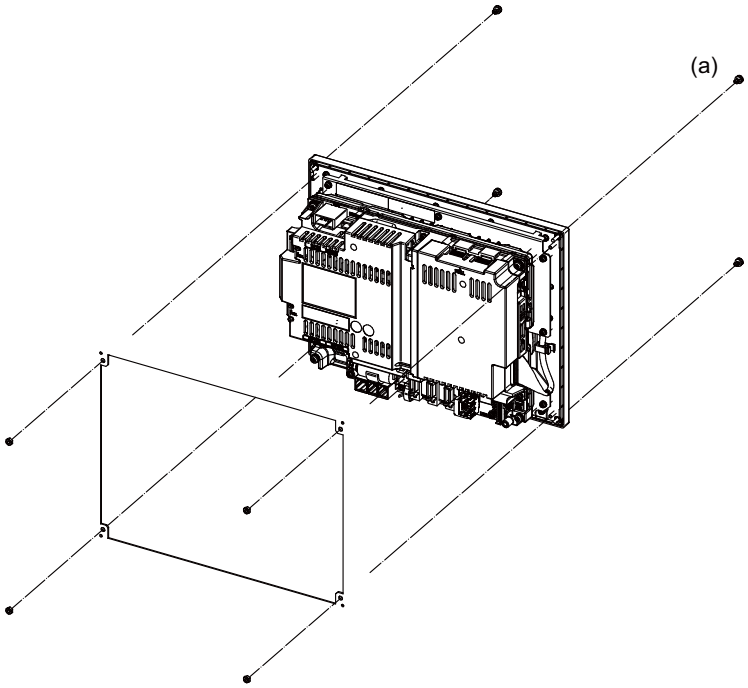
[FCU8-DU121 (8.4-type display unit)]

- Fixed on the front side



Fixing screw: Cheese head screw M3 (4 pcs).
(Fixing screws are provided with the unit.)

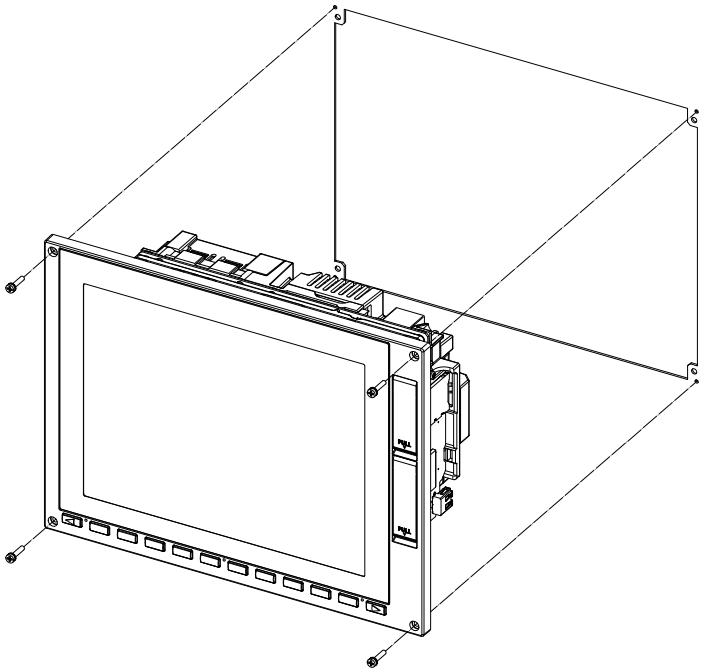
- Fixed on the back side



Fixture: M3 nut (4 pcs).
(4 pcs of the screw caps (a) are provided with the unit.)

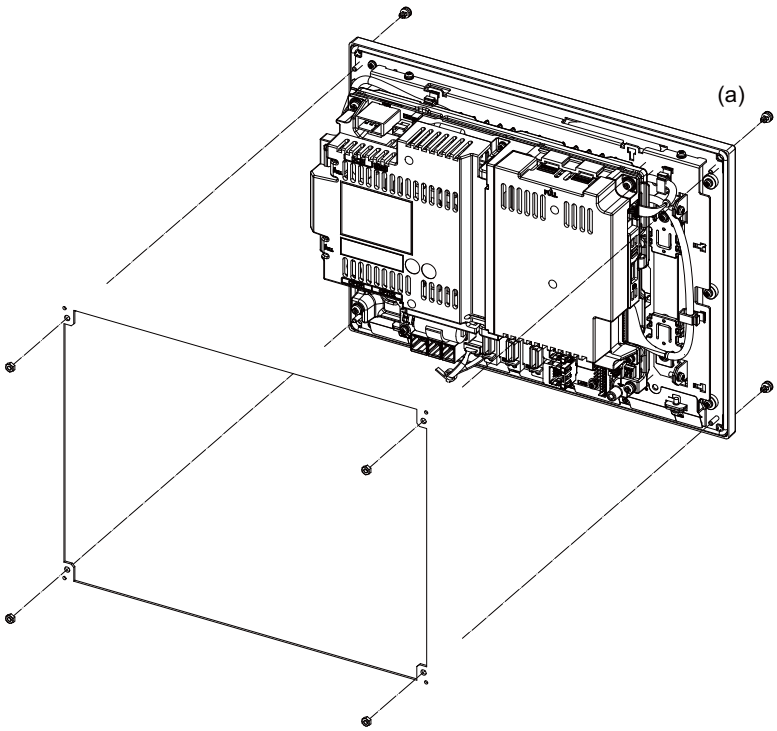
[FCU8-DU142/FCU8-DU141 (10.4-type display unit)]

- Fixed on the front side



Fixing screw: Cheese head screw M3 (4 pcs).
(Fixing screws are provided with the unit.)

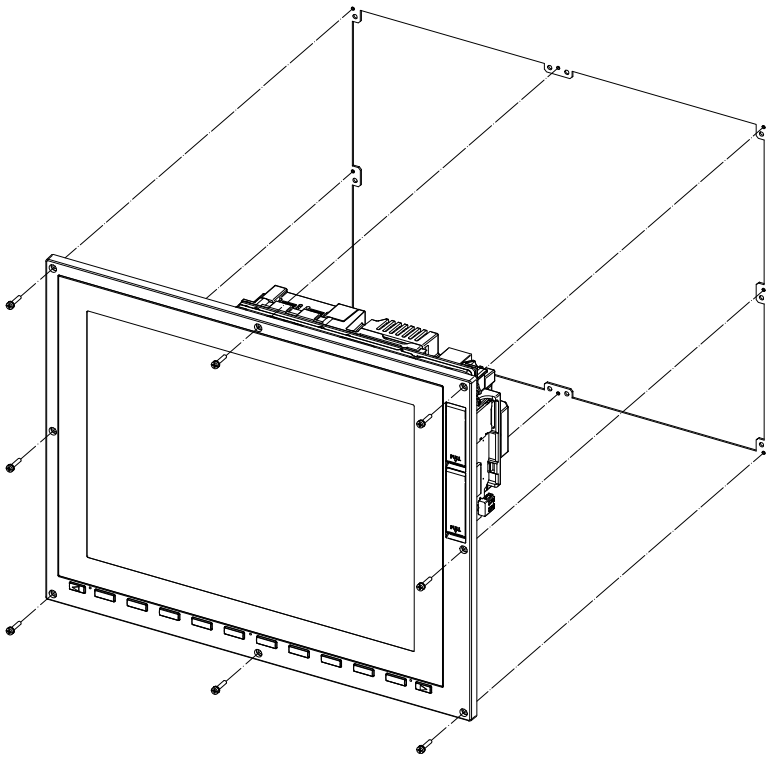
- Fixed on the back side



Fixture: M3 nut (4 pcs).
(4 pcs of the screw caps (a) are provided with the unit.)

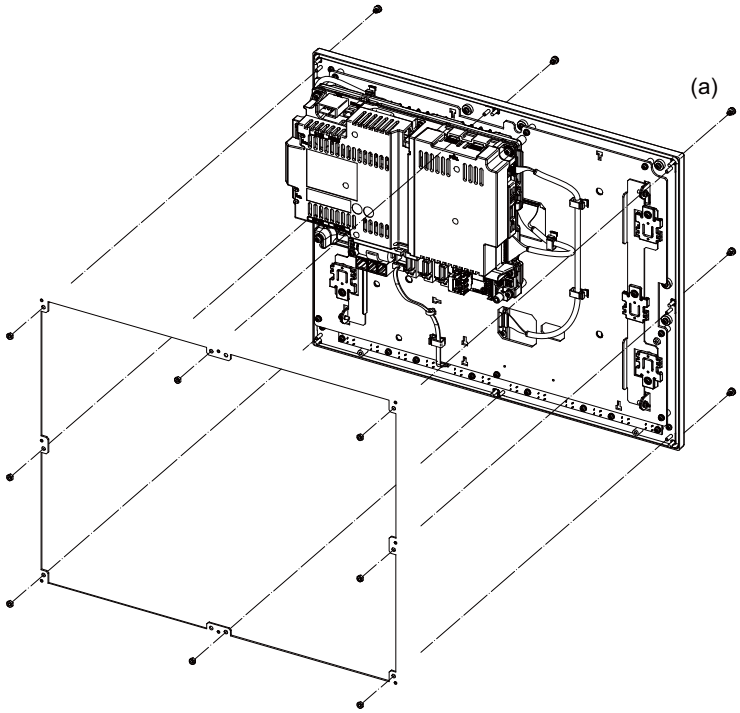
[FCU8-DU182/FCU8-DU181 (15-type display unit)]

- Fixed on the front side



Fixing screw: Cheese head screw M3 (8 pcs).
(Fixing screws are provided with the unit.)

- Fixed on the back side



Fixture: M3 nut (8 pcs).
(8 pcs of the screw caps (a) are provided with the unit.)

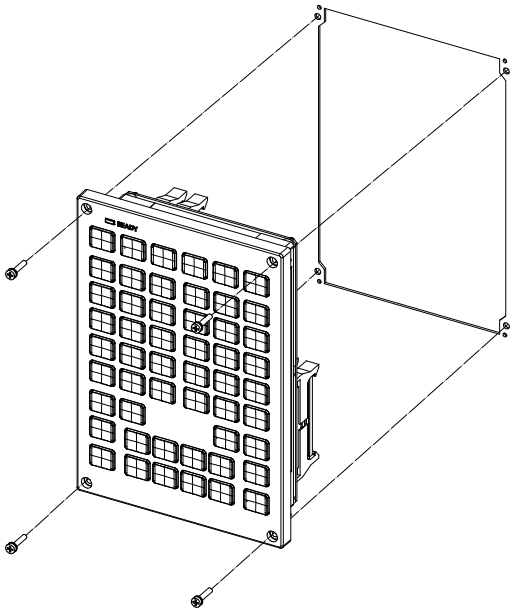
5.3.2 Keyboard Unit

Mount the keyboard unit with the prescribed number of fixing screws.

(Note) Refer to "General Specifications: Keyboard Unit" for the panel cut dimension drawing and the screw hole position.

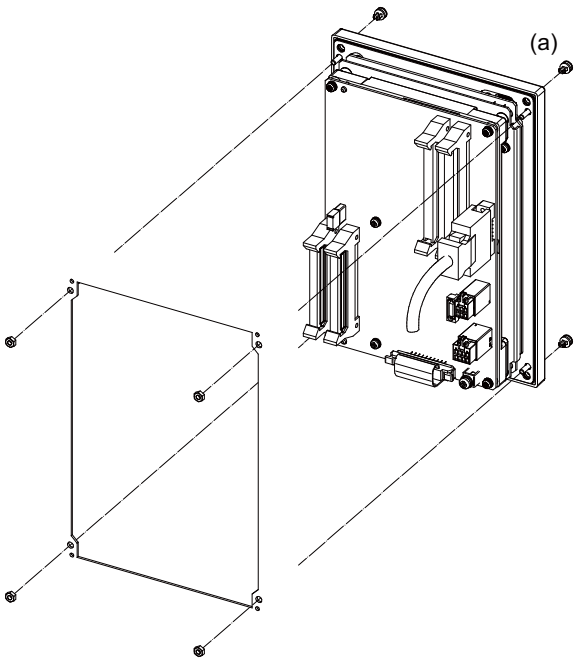
[FCU8-KB024/KB025/KB026/KB028]

- Fixed on the front side



Fixing screw: Cheese head screw M3 (4 pcs).
(Fixing screws are provided with the unit.)

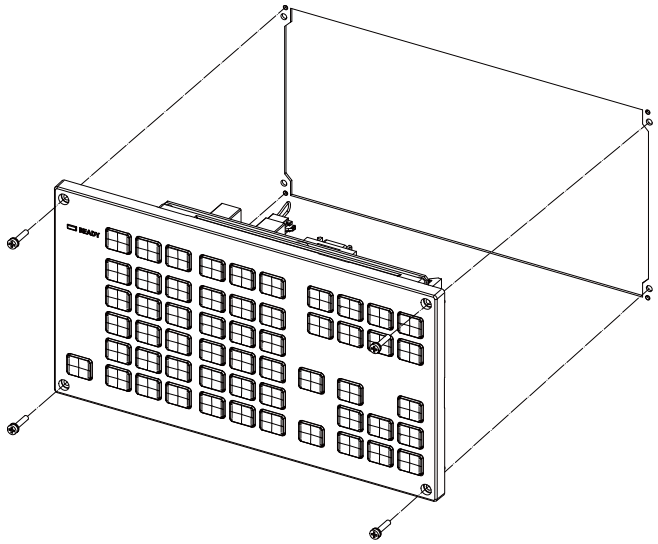
- Fixed on the back side



Fixture: M3 nut (4 pcs).
(4 pcs of the screw caps (a) are provided with the unit.)

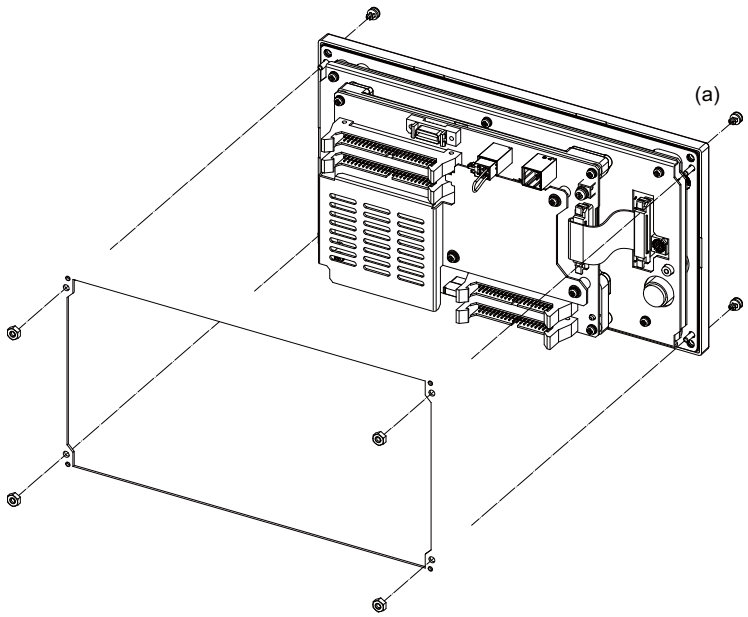
[FCU8-KB029]

- Fixed on the front side



Fixing screw: Cheese head screw M3 (4 pcs).
(Fixing screws are provided with the unit.)

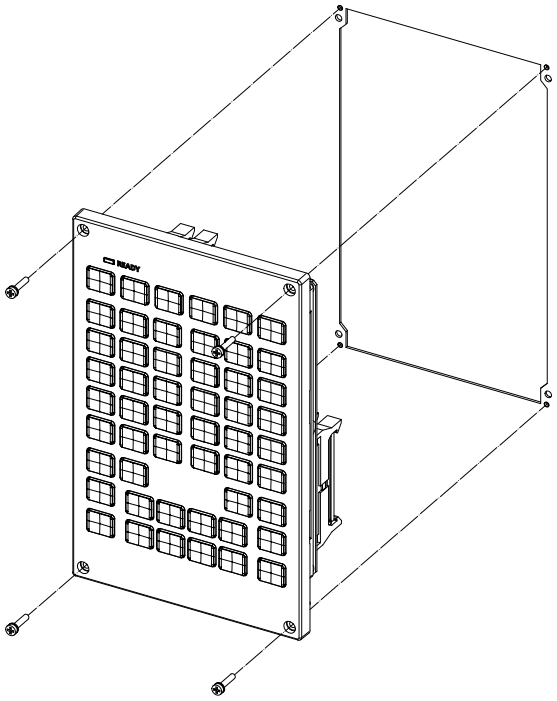
- Fixed on the back side



Fixture: M3 nut (4 pcs).
(4 pcs of the screw caps (a) are provided with the unit.)

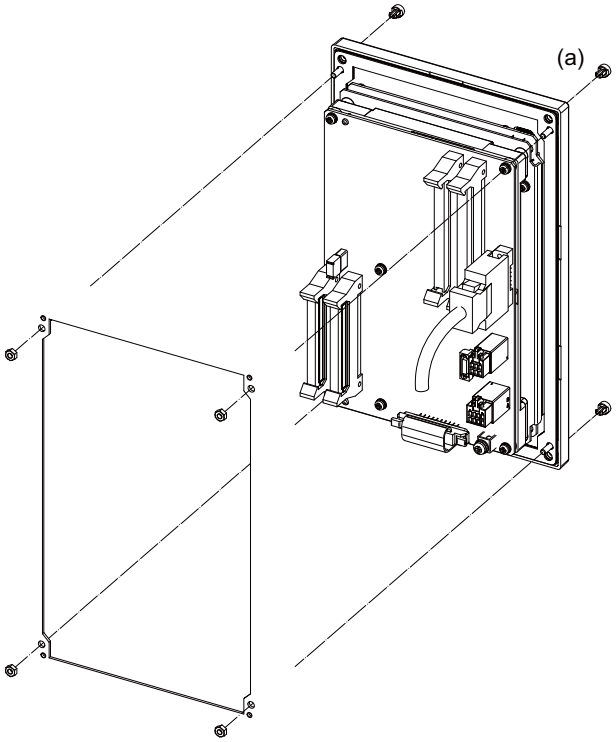
[FCU8-KB041/KB046]

- Fixed on the front side



Fixing screw: Cheese head screw M3 (4 pcs).
(Fixing screws are provided with the unit.)

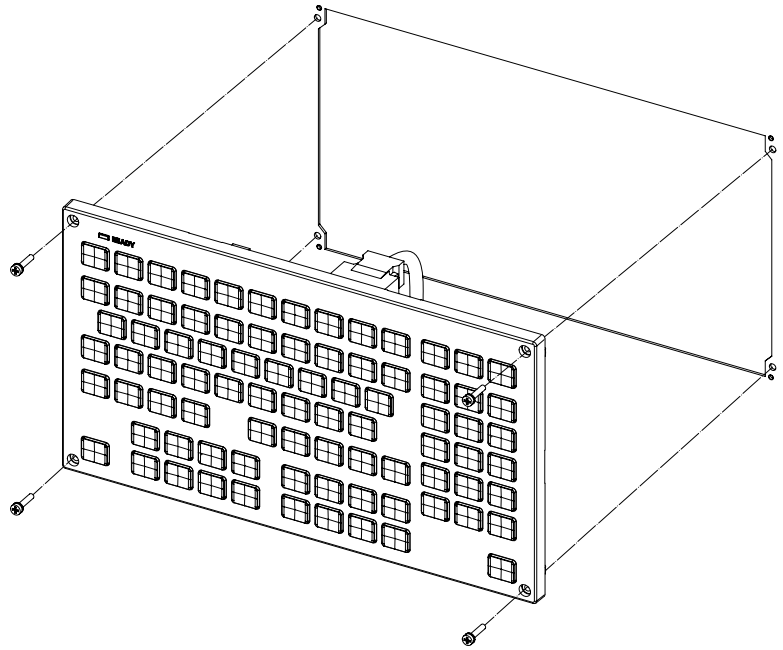
- Fixed on the back side



Fixture: M3 nut (4 pcs).
(4 pcs of the screw caps (a) are provided with the unit.)

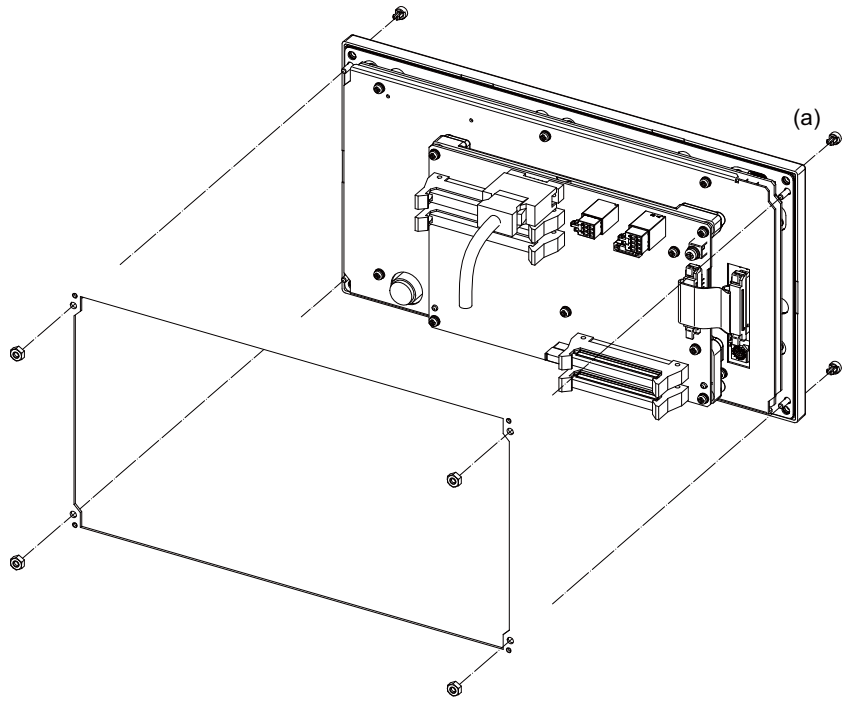
[FCU8-KB047]

- Fixed on the front side



Fixing screw: Cheese head screw M3 (4 pcs).
(Fixing screws are provided with the unit.)

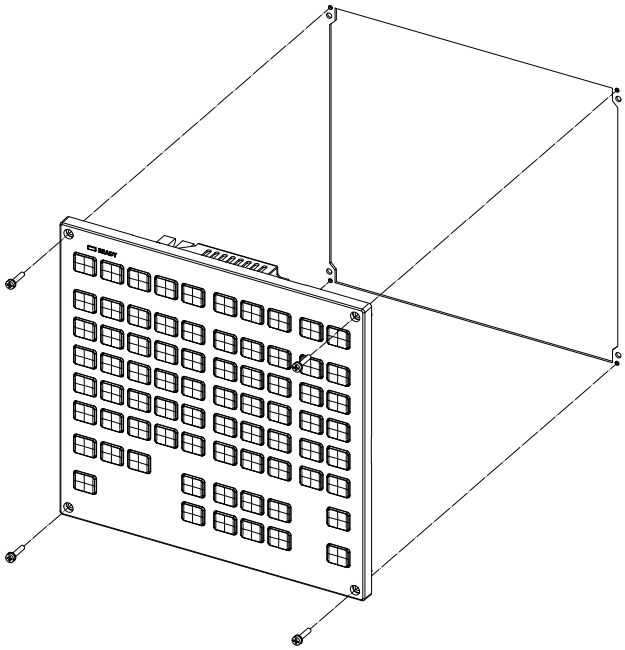
- Fixed on the back side



Fixture: M3 nut (4 pcs).
(4 pcs of the screw caps (a) are provided with the unit.)

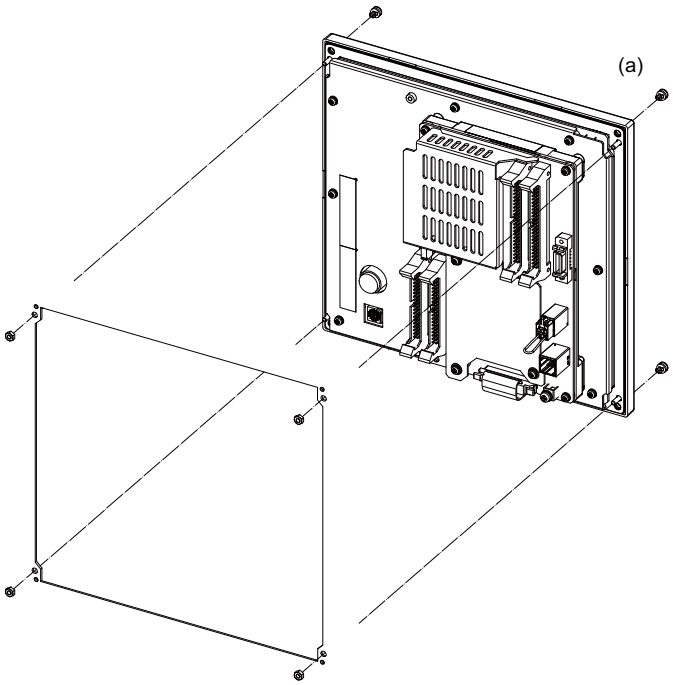
[FCU8-KB048]

- Fixed on the front side



Fixing screw: Cheese head screw M3 (4 pcs).
(Fixing screws are provided with the unit.)

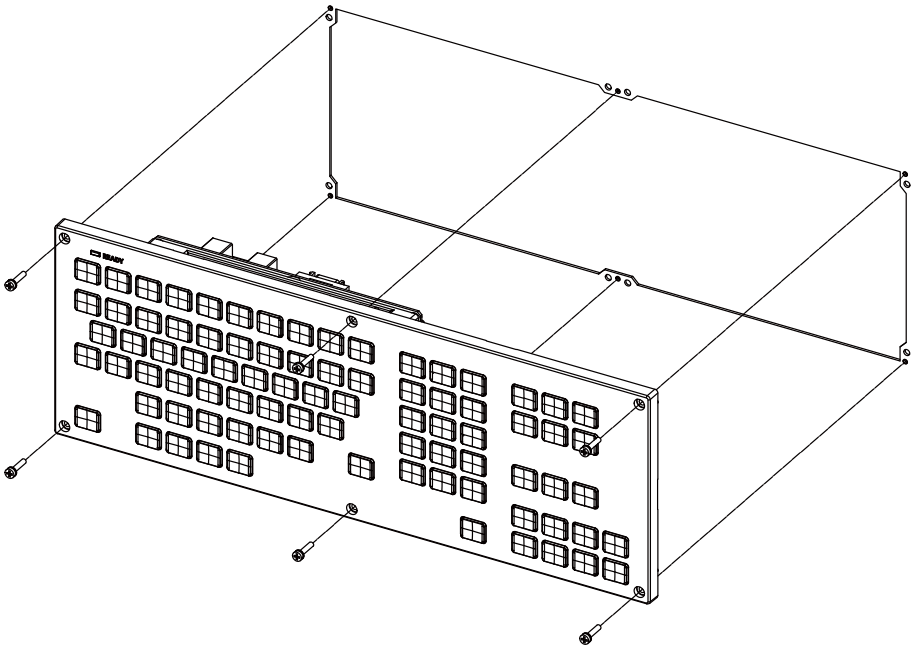
- Fixed on the back side



Fixture: M3 nut (4 pcs).
(4 pcs of the screw caps (a) are provided with the unit.)

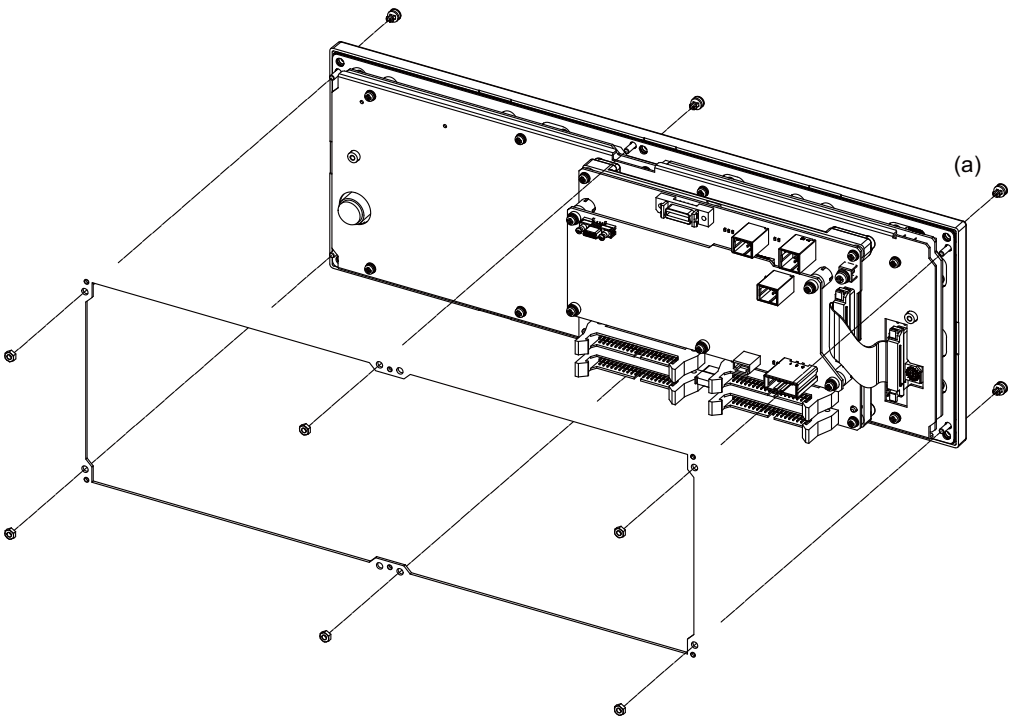
[FCU8-KB083]

- Fixed on the front side



Fixing screw: Cheese head screw M3 (6 pcs).
(Fixing screws are provided with the unit.)

- Fixed on the back side



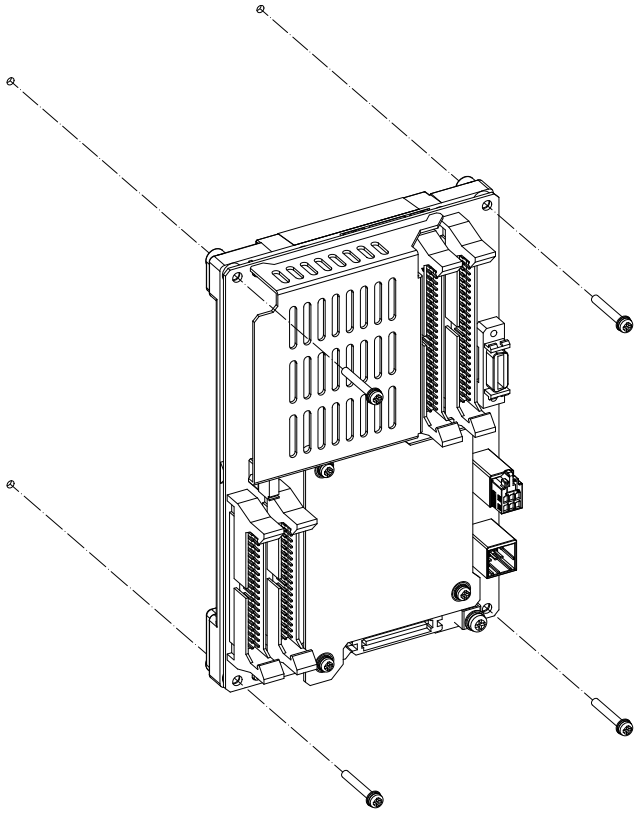
Fixture: M3 nut (6 pcs).
(6 pcs of screw caps (a) are provided with the unit.)

5.3.3 Operation Panel I/O Unit

Mount the operation panel I/O unit with the prescribed number of fixing screws.

(Note) Refer to "General Specifications: Operation Panel I/O Unit" for the installation dimension and the screw hole position.

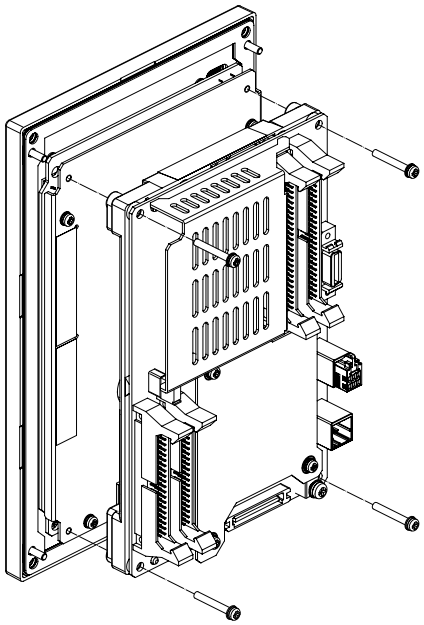
[FCU8-DX731 / FCU8-DX750 / FCU8-DX760 / FCU8-DX761 / FCU8-DX834]



Fixing screw: M3 (4 pcs)

Installation on the back side of the keyboard

Operation panel I/O unit can be installed on the back side of the keyboard.



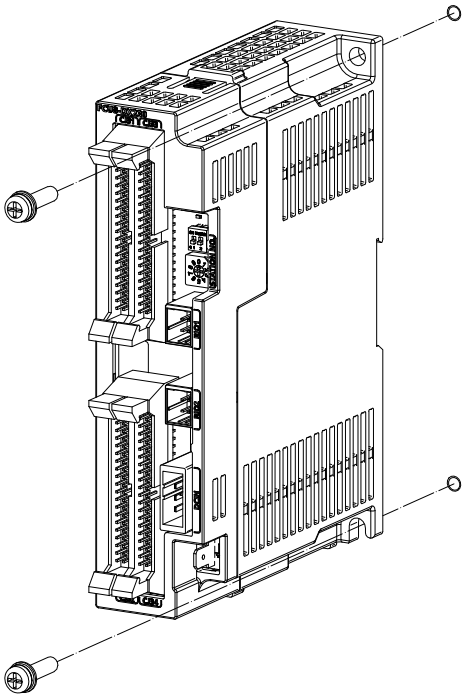
Fixing screw: M3x25 (4 pcs)

5.3.4 Remote I/O Unit

Mount the remote I/O unit with the prescribed number of fixing screws.

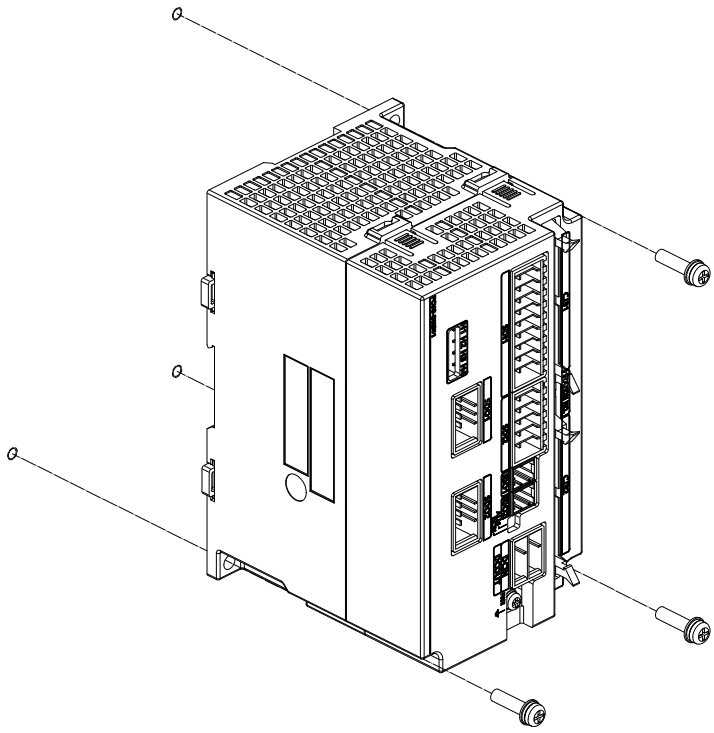
(Note) Refer to "General Specifications: Remote I/O Unit" for the installation dimension and the screw hole position.

[FCU8-DX220 / FCU8-DX230 / FCU8-DX231 / FCU8-DX202 / FCU8-DX213 / FCU8-DX213-1 / FCU8-DX654 / FCU8-DX654-1 / FCU8-DX408 / FCU8-DX409]



Fixing screw: M5 (2pcs)

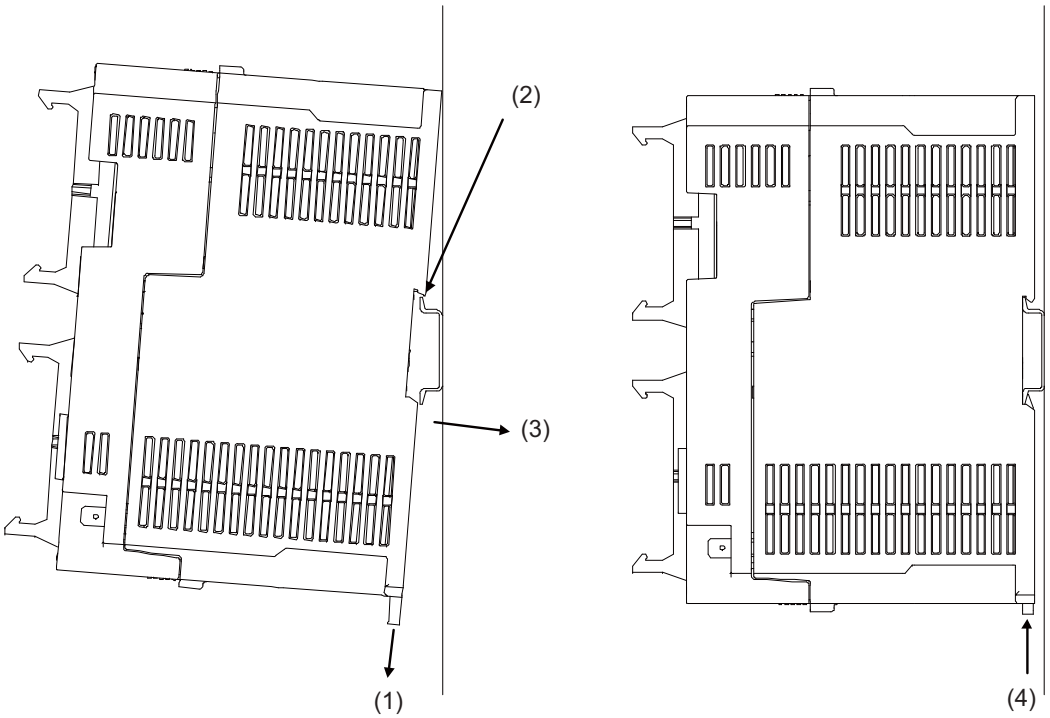
[FCU8-DX651]



Fixing screw: M5 (3pcs)

[Install to DIN rail]

(1) Set down the rail hook.
(2) Hook the upper latch of the unit on the DIN rail.
(3) Push the unit into the rail.
(4) Lock it.

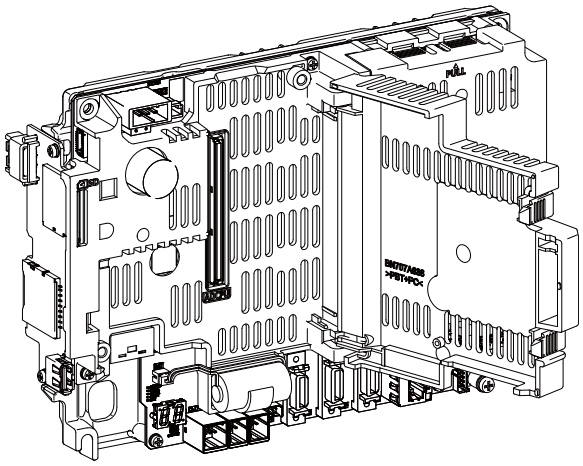


Designate the type below as DIN rail standard
- TH35-7.5Fe : 7.5
- TH35-7.5AL : 7.5
- TH35-15Fe : 15

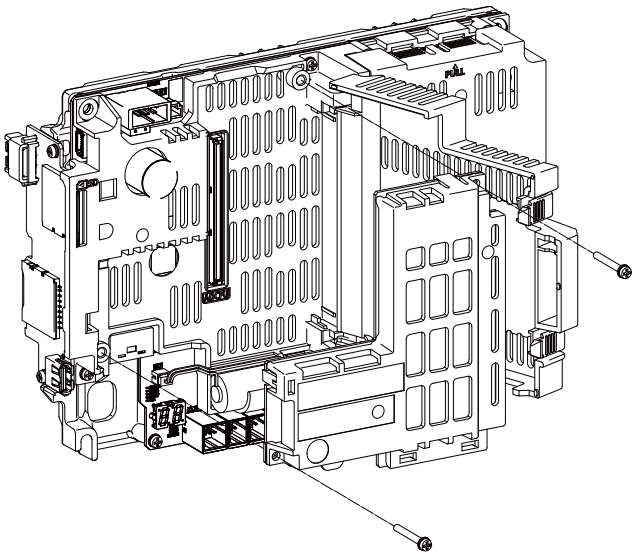
5.3.5 Functional Safety Expansion Unit

Install the functional safety expansion unit as follows:

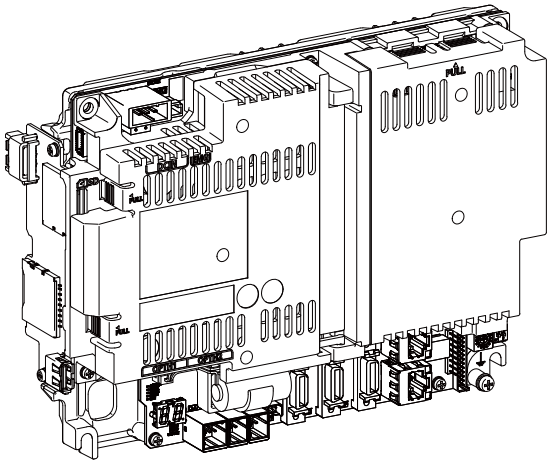
(1) Open the cover of control unit.



(2) Fix the functional safety expansion unit with 2 screws.



(3) Close the cover of control unit.

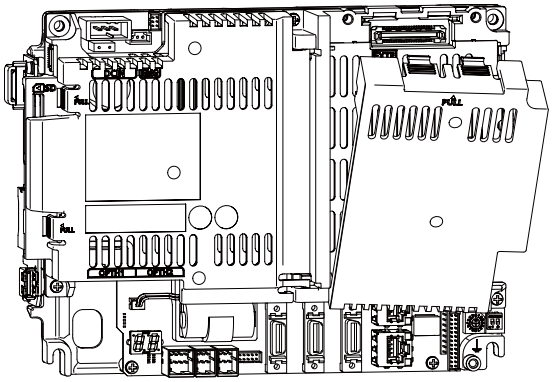


5.3.6 Function Expansion Unit

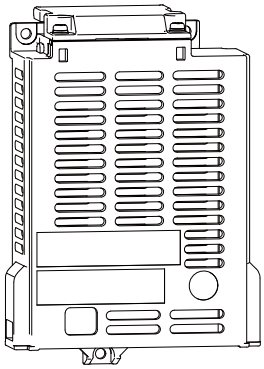
Install the expansion unit as follows:

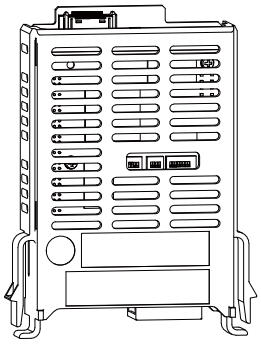
[Option relay unit: FCU8-EX702(1 slot)]

(1) Remove the cover on the back side of control unit.

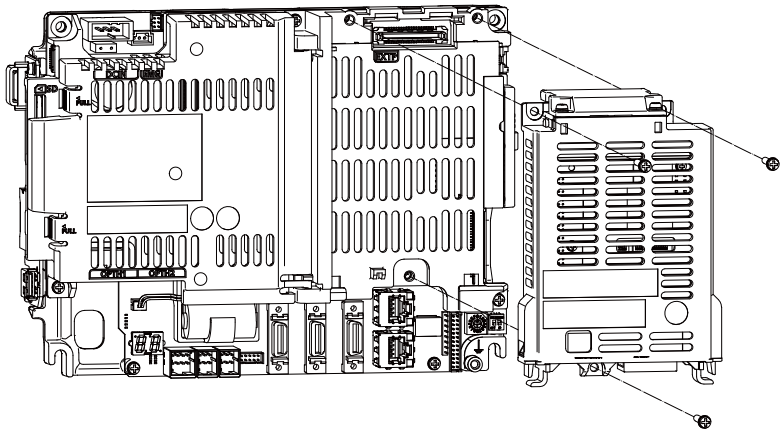


(2) Insert the function expansion unit into FCU8-EX702.



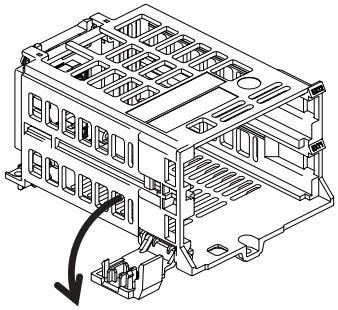


(3) Fix FCU8-EX702 to the control unit with three screws of M3 x 25.

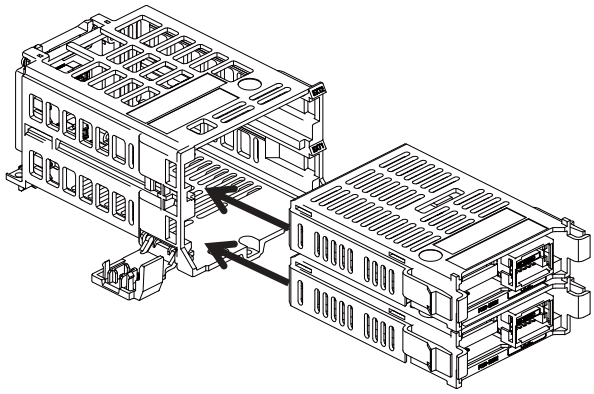


[Option relay unit: FCU8-EX703(2 slot)]

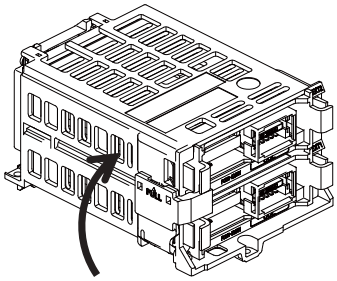
(1) Remove the cover of FCU8-EX703.



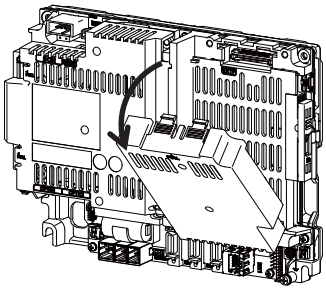
(2) Insert the function expansion unit into FCU8-EX703.



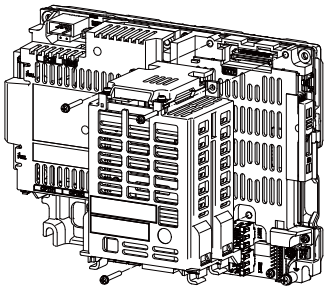
(3) Close the cover of FCU8-EX703.



(4) Remove the cover on the back side of control unit.



(5) Fix FCU8-EX703 to the control unit with three screws of M3 x 25.



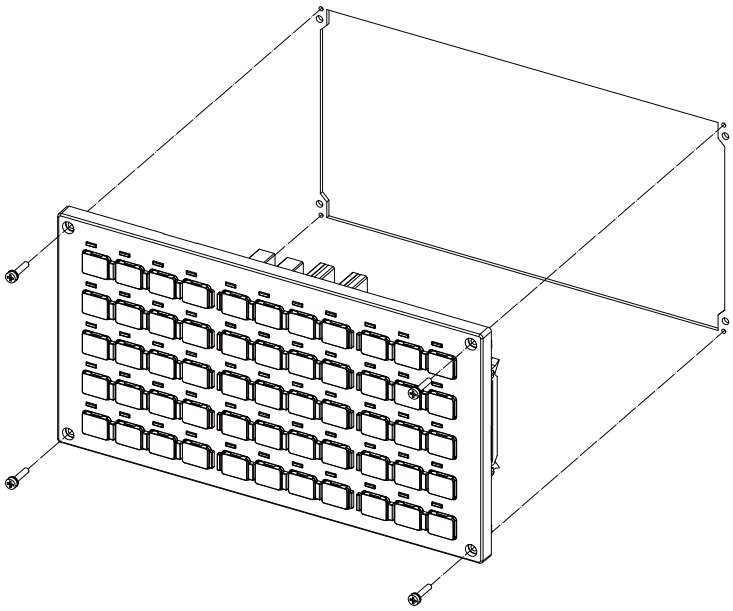
5.3.7 Machine Operation Panel

Mount the machine operation panel (main panel and sub panel) with the prescribed number of fixing screws.

(Note) Refer to "General Specifications: Machine Operation Panel" for the panel cut dimension drawing and the screw hole position.

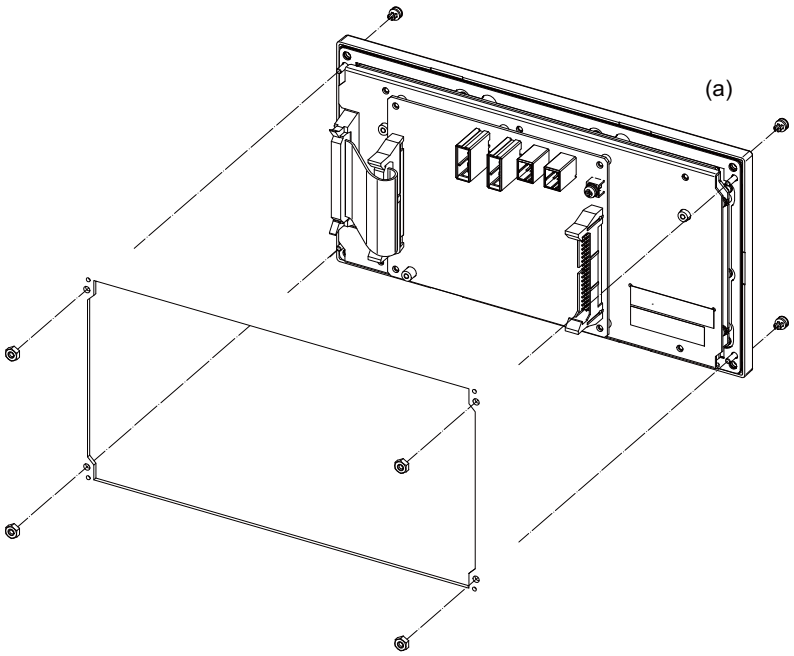
[FCU8-KB921/KB922/KB923/KB924/KB925/KB926]

- Fixed on the front side



Fixing screw: Cheese head screw M3 (4 pcs).
(Fixing screws are provided with the unit.)

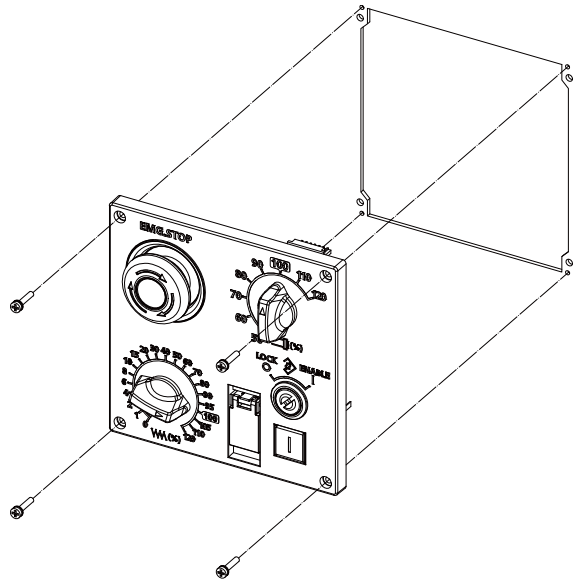
- Fixed on the back side



Fixture: M3 nut (4 pcs).
(4 pcs of the screw caps (a) are provided with the unit.)

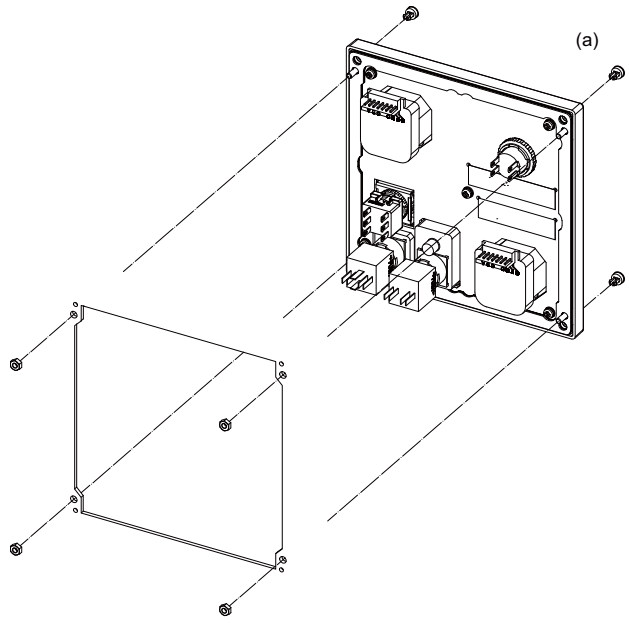
[FCU8-KB931/FCU8-KB941]

- Fixed on the front side



Fixing screw: Cheese head screw M3 (4 pcs).
(Fixing screws are provided with the unit.)

- Fixed on the back side



Fixture: M3 nut (4 pcs).
(4 pcs of the screw caps (a) are provided with the unit.)

6

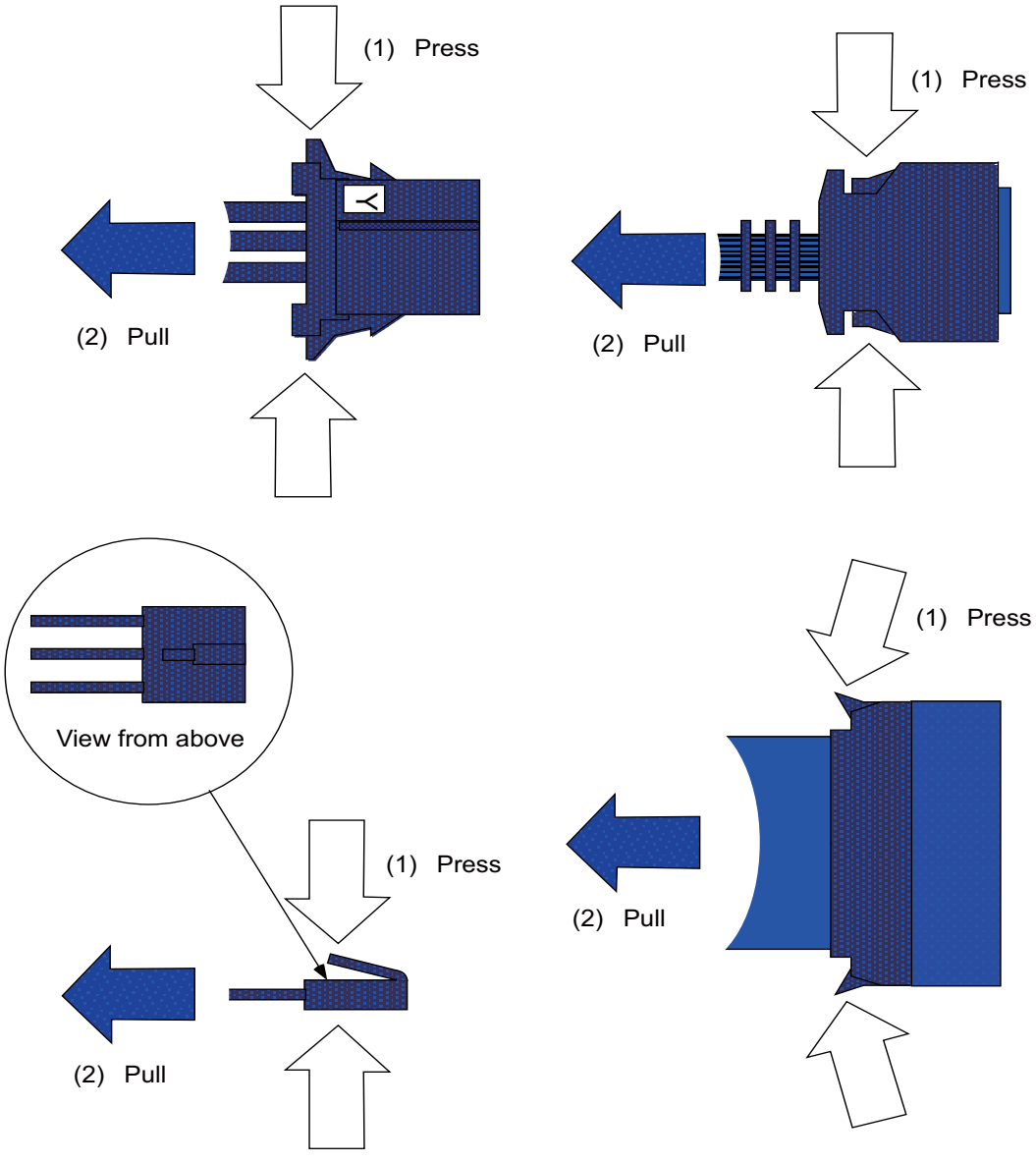
Precautions for Connecting

6.1 Precautions for Wiring

6.1.1 Precautions when Connecting/Disconnecting Cables

If the cable is connected/disconnected without turning the power OFF, the normal unit or peripheral devices could be damaged, and risks could be imposed.
Disconnect each cable with the following procedures.

(a) For the following type of connector, press the tabs with a thumb and forefinger in the direction of the arrow, and pull the connector off.

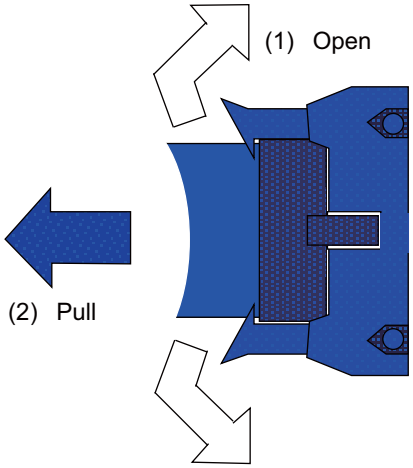


⚠ CAUTION

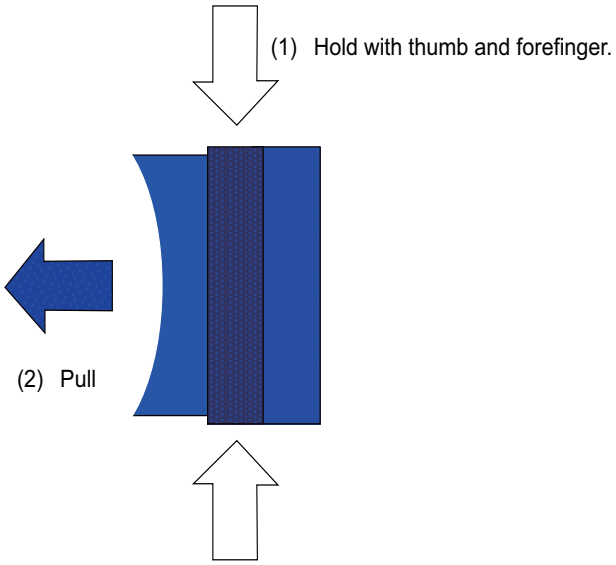
1. Do not connect or disconnect the cables between units while the power is ON.

2. Do not pull the cables when connecting/disconnecting it.

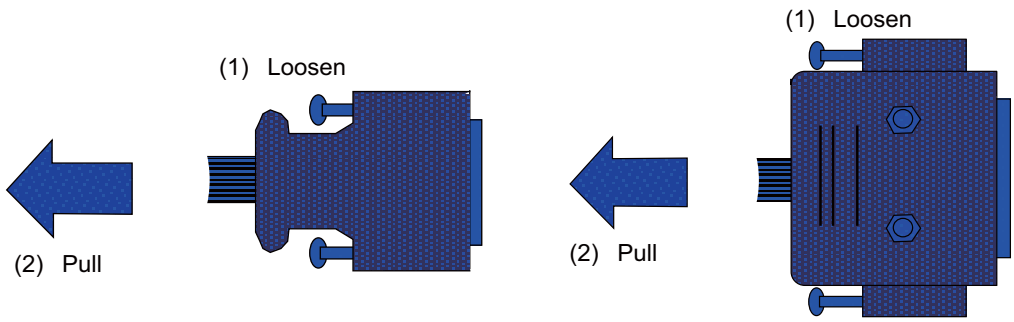
(b) For a flat cable type connector with latches, open the latches in the directions of the arrows, and pull the connector off.



(c) For a flat cable type connector without latches, hold the connector with a thumb and forefinger, and pull the connector off.



(d) For the screw fixed type connector, loosen the two fixing screws, and pull the connector off.

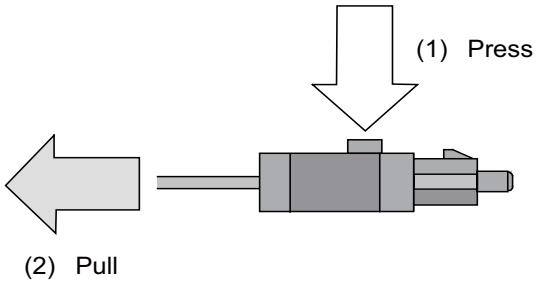


⚠ CAUTION

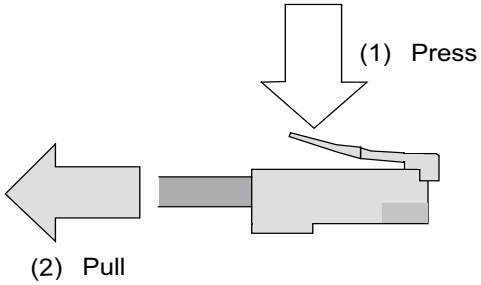
1. Do not connect or disconnect the cables between units while the power is ON.

2. Do not pull the cables when connecting/disconnecting it.

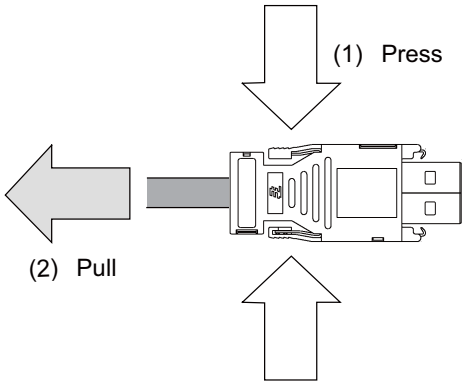
(e) For the optical cable connector, pull off while holding down the lock button.



(f) For the Ethernet connector, pull off while holding down the locked latch.



(g) For the USB connector, pull off while holding down the locked latch.



⚠ CAUTION

1. Do not connect or disconnect the cables between units while the power is ON.

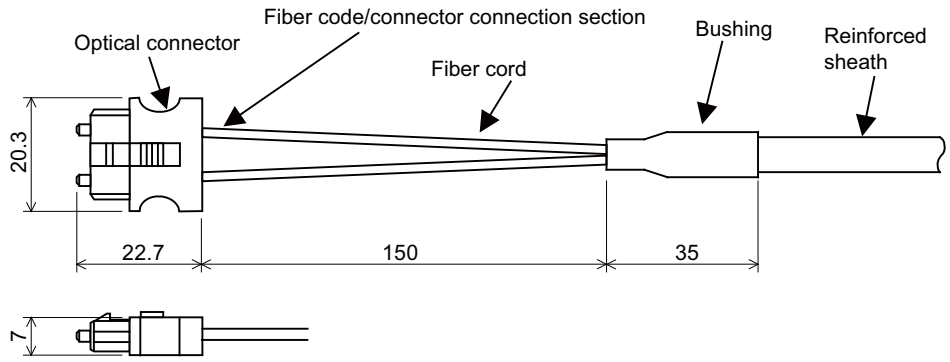
2. Do not pull the cables when connecting/disconnecting it.

6.1.2 Precautions for Using Optical Communication Cable

An optical communication cable is used for communication between the control unit and the drive unit.
Special precautions, differing from the conventional cable, are required when laying and handling the optical communication cable.

(Note) If the cable you use is not Mitsubishi's, malfunctions resulted from connection problems or aged deterioration are not covered under the warranty.

Optical communication cable outline and parts



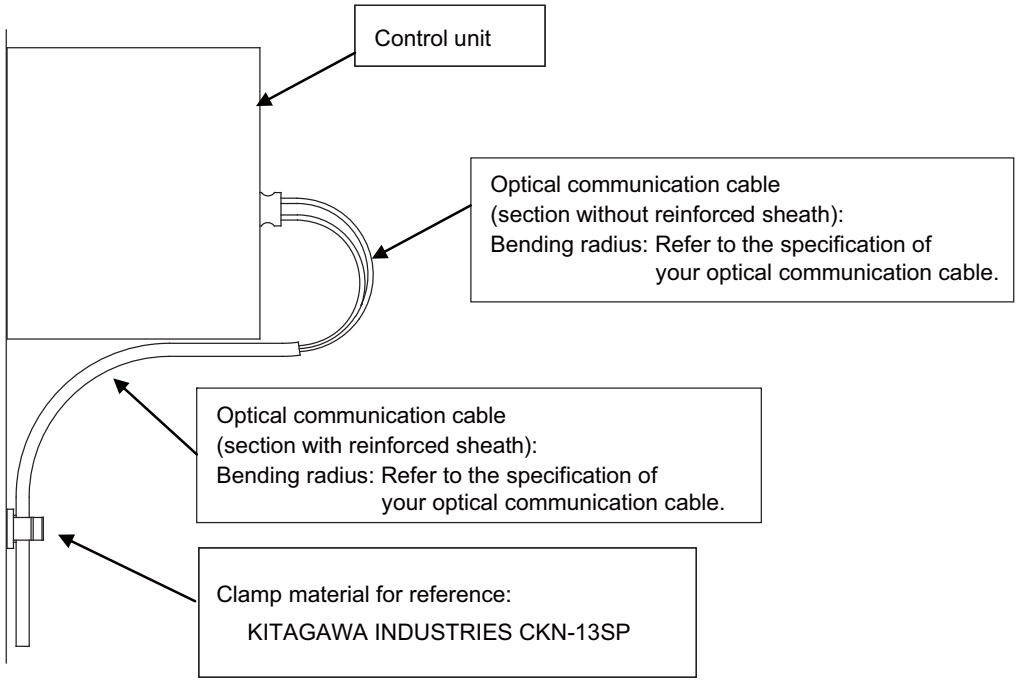
To ensure the system performance and reliability, purchase the optical communication cable from Mitsubishi. A machining drawing is given in "Cable" as reference, but the purchased optical communication cable cannot be cut or connected by the machine tool builder.

Precautions for handling optical communication cable

(1) A protective cap is attached to the optical module and optical communication cable mounted on the PCB when the system is delivered. Leaving this protective cap unattached could result in connection faults from the adherence of dirt and dust. Do not remove the protective cap when not connecting the cable. If dirty, wipe off lightly with a piece of dry gauze, etc. (Do not use solvents such as alcohol as the optical fiber material could melt.)
(2) Hold the connector section when connecting or disconnecting the optical connector. Holding the fiber cord will result in force exceeding the tolerable tension on the fiber cord and connector connection section, and could cause the fiber cord to dislocate from the optical connector thereby inhibiting use.
(3) The optical connector cannot be connected in reversed. Check the connector orientation when connecting the optical communication cable to the optical module. Align the connector lock lever with the lock holes on the PCB's optical module, and press the connector straight in. Confirm that the lock lever connects with the optical module and that a "click" is heard.
(4) When disconnecting the optical communication cable from the PCB, press the lock release buttons on the lock lever, and pull out the cable while holding the connector section. The connector could be damaged if the cable is pulled without pressing down on the lock release buttons.
(5) Do not apply excessive force onto the optical communication cable by stepping on it or dropping tools, etc., on it.

Precautions for laying optical communication cable

(1) Do not apply a force exceeding the cable's tolerable tension. Binding the cables too tight with tie-wraps could result in an increased loss or a disconnection. Use a cushioning material such as a sponge or rubber when bundling the cables and fix so that the cables do not move.
(2) Do not connect the cables with a radius less than the tolerable bending radius. Excessive stress could be applied near the connector connection section and cause the optical characteristics to drop. The cable bending radius should be 10 times or more than the outer diameter at the reinforced sheath, and 20 times or more than the outer diameter at the fiber cord section.
(3) Do not apply torsion to the optical communication cable. Laying a twisted cable could cause the optical characteristics to drop.
(4) When laying the cables in a conduit, avoid applying stress on the fiber cord and connector connection section. Use the tensile end such as a pulling eye or cable grip, etc.
(5) Fix the reinforced sheath with a cable clamp so that the mass of the optical communication cable is not directly applied on the fiber cord and connector connection section.
(6) Never bundle the cables with vinyl tape. The plasticizing material in the vinyl tape could cause the POF cable to break.
(7) Loop the excessive cable with twice or more than the minimum bending radius.



6.1.3 Precautions for Connecting 24V Power Supply

(1) When 24V power is supplied to the unit under the following conditions, welding may occur on the contacts due to rush current; so be careful.

When 24VDC's ON/OFF are directly controlled by a magnetic switch such as relay AND
When heat capacity of the contacts for relay, etc. used to control 24VDC's ON/OFF is small.

6.2 Turning the Power ON/OFF

The diagram below shows the ON/OFF timing of the drive unit power supply (200VAC/400VAC), remote I/O unit power supply (24VDC) and control unit power supply (24VDC).

[Power ON]

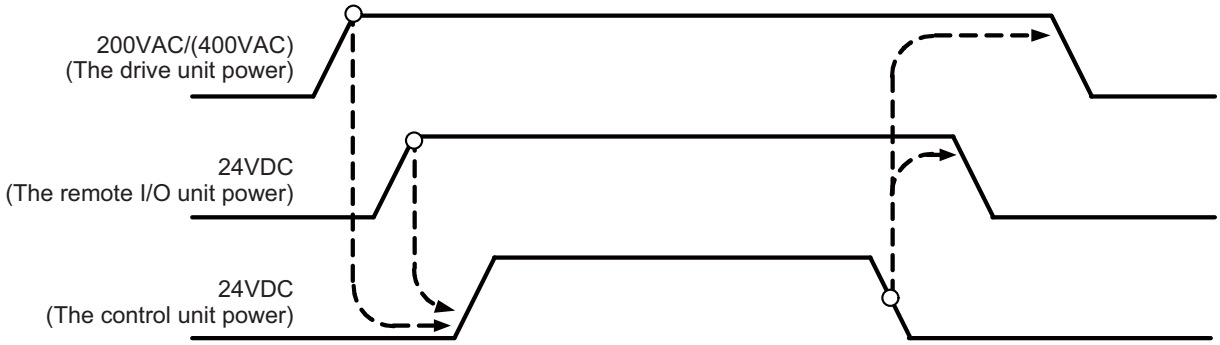
Turn the power ON in the following order; drive unit, remote I/O unit -> control unit

If the control unit is powered ON before the drive unit or remote I/O unit, the initial communication with the drive unit or remote I/O unit may fail and the alarm "Servo communication error" or "Remote I/O unequipped error" may occur.

[Power OFF]

Turn the power OFF in the following order; control unit -> Remote I/O unit, drive unit.

If the remote I/O unit or drive unit is powered OFF before the control unit, the alarm "Remote I/O communication error" may be occurred with the detection of remote I/O unit communication stop, or the alarms "Absolute value data illegal", "Servo communication error", etc., may be occurred by the failure of data acquisition.

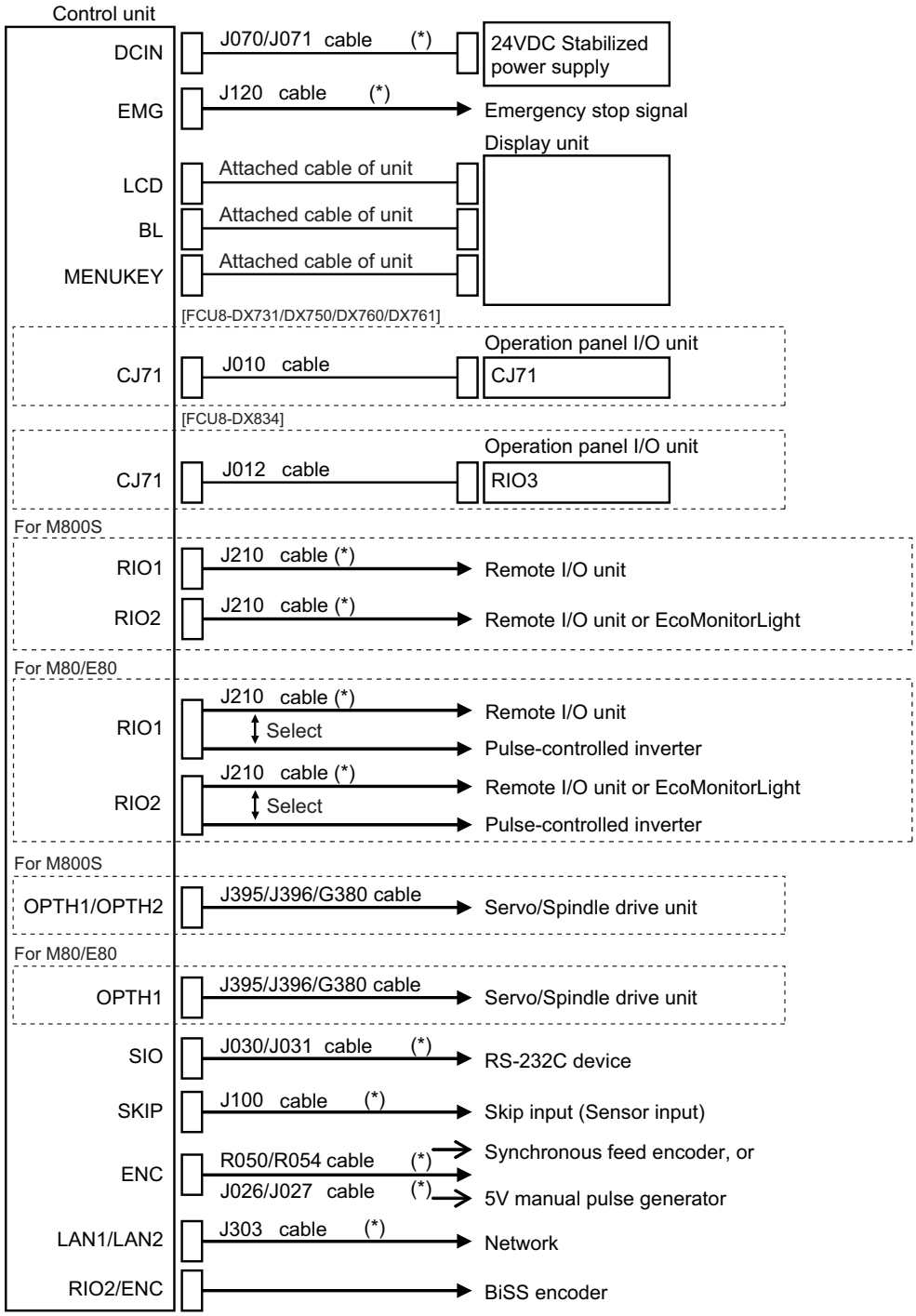


7

Connection of Control Unit

The method for connecting to each unit and device from the control unit is explained in this chapter.

7.1 Control Unit Connection System Drawing

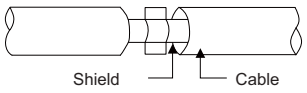


(Note 1) The mounted connector differs depending on the unit. Refer to the following chapter for which of the connector is mounted.
"General specifications: Control Unit [M800S]"
"General specifications: Control Unit [M80]"
"General specifications: Control Unit [E80]"

(Note 2) For the connection of machine operation panel, refer to the chapter "Connection of Machine Operation Panel".

(Note 3) The section indicated with asterisk (*) indicates cable to be wired outside the operation panel.
Since the cable could be affected by the exogenous noise depending on the environment, the following noise countermeasure is recommended.

Expose the cable by removing a part of the cable sheath and use the shield clamp for the exogenous noise countermeasure.



When you cannot use the shield clamp, install a ferrite core as a substitute.

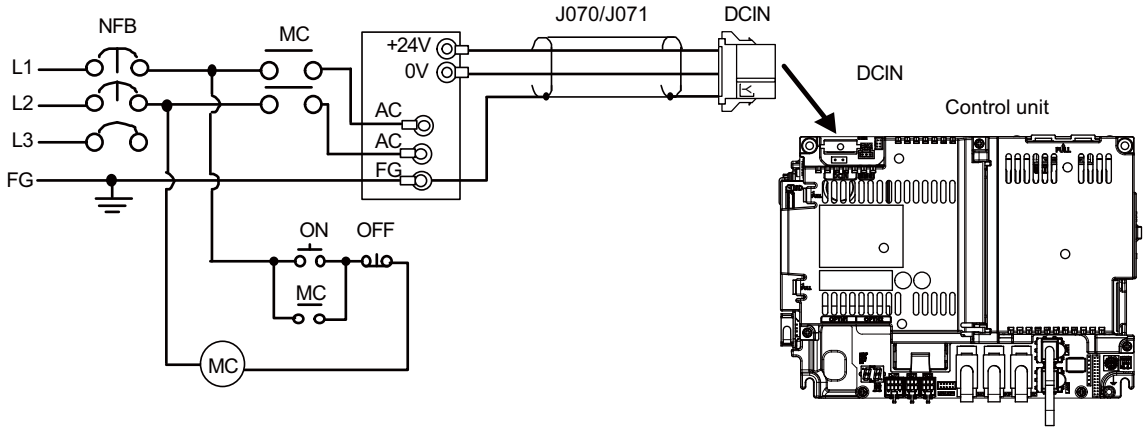
<Related item>

Shield clamp fitting: "EMC Installation Guidelines: EMC Countermeasure Parts: Shield Clamp Fitting"

Ferrite core: "EMC Installation Guidelines: EMC Countermeasure Parts: Ferrite Core"

7.2 Connecting with Power Supply

Connect a general-purpose 24VDC stabilized power supply to the control unit.



(Note 1) Rush current may occur to lead welding on the contacts, when a magnetic switch such as relay directly controls 24VDC's ON/OFF during 24V power supply to the control unit. Use relay with large heat capacity of contacts to control 24VDC's ON/OFF.

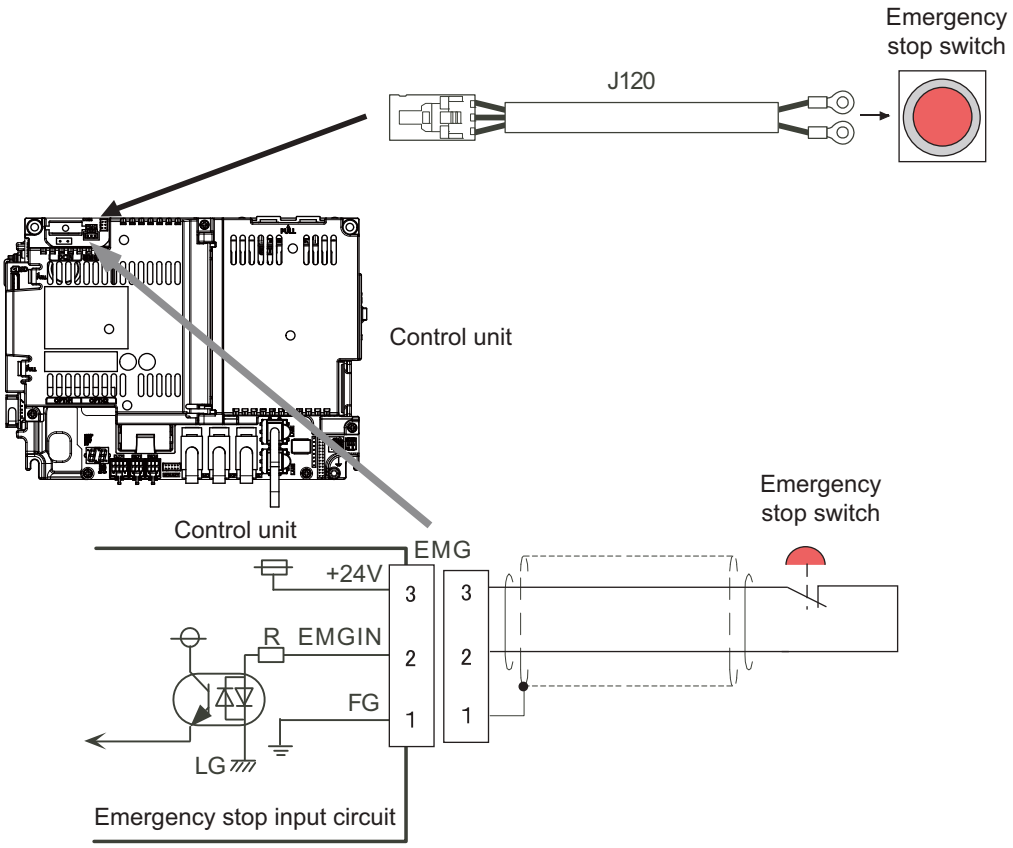
<Related items>

Cable connection drawing: "Cable : J070/J071 Cable"

Connector pin assignment: "General Specifications: Control Unit" (DCIN connector)

7.3 Connecting with Emergency Stop Signal

Connect the emergency stop switch to EMG connector of the control unit.



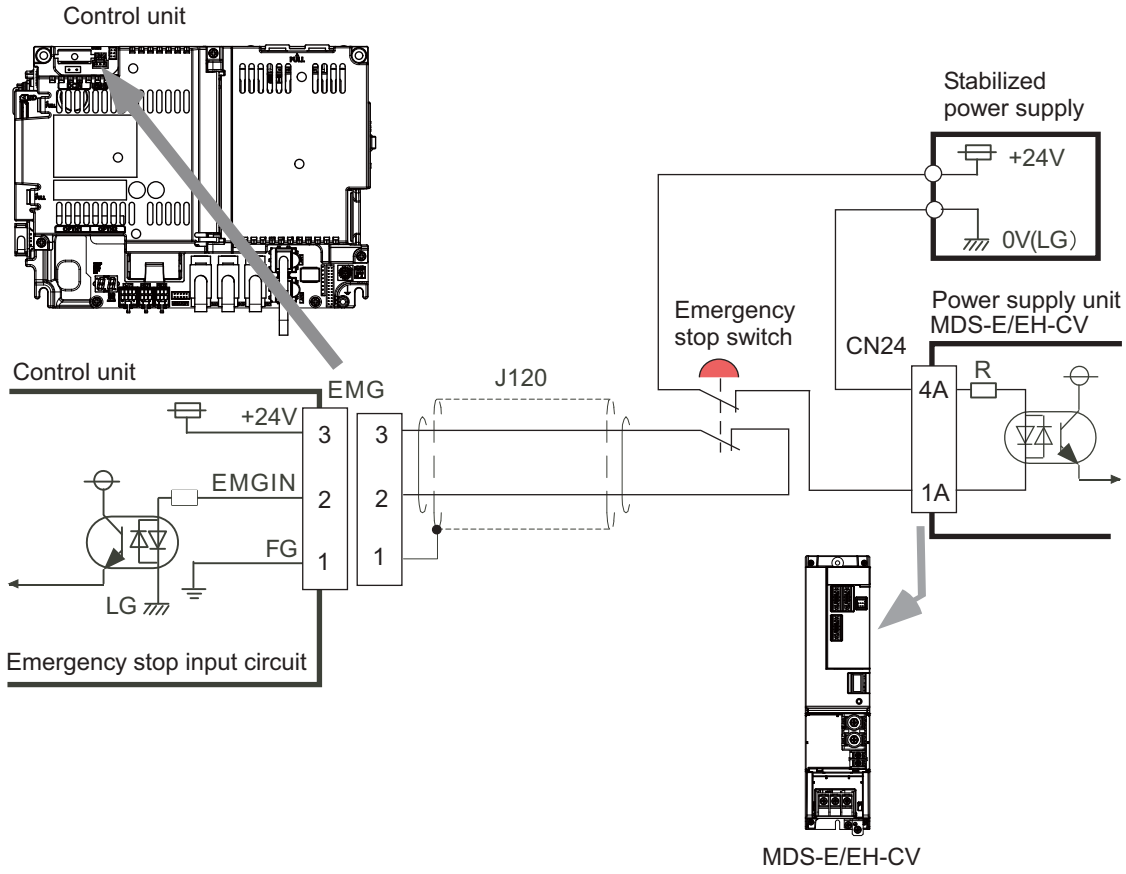
<Related items>

Cable connection drawing: "Cable: J120 Cable"

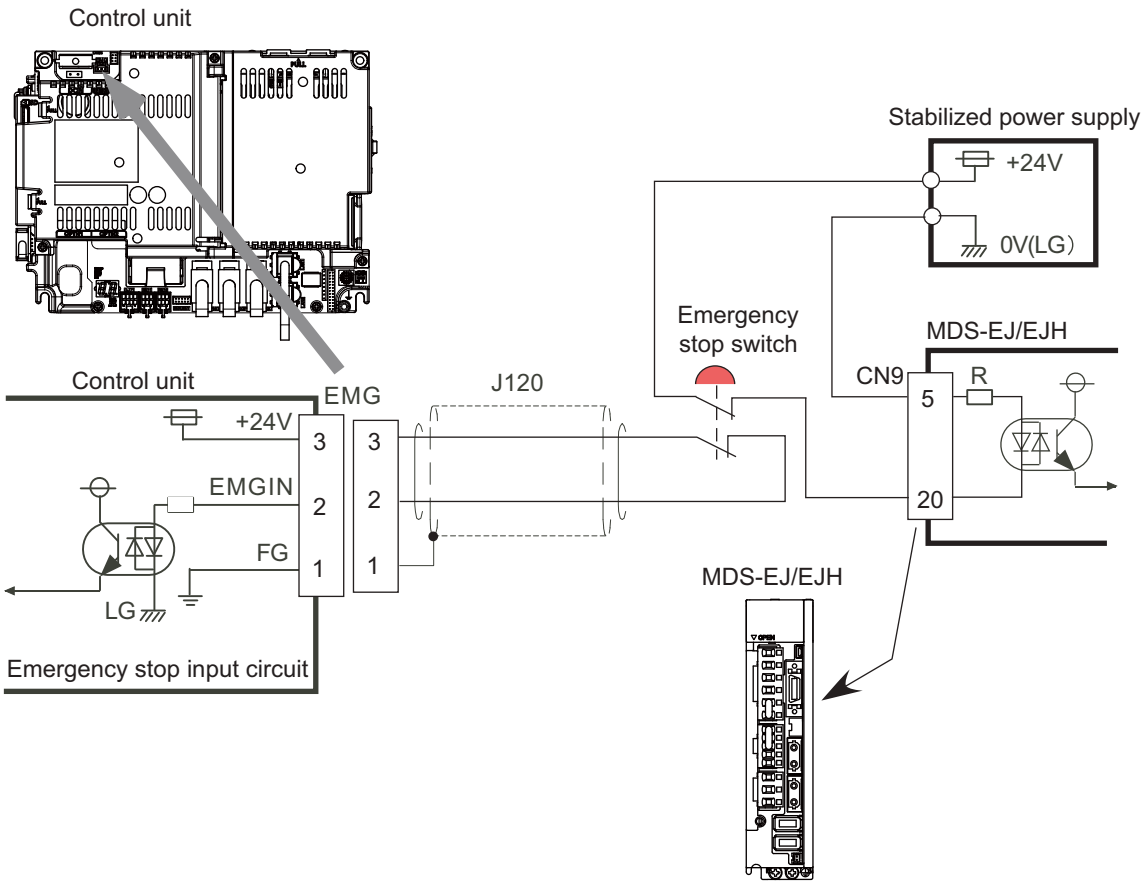
Connector pin assignment: "General Specifications: Control Unit" (EMG connector)

ISO13849-1 (PLd, Cat.3) and IEC62061 (SIL CL2) can be realized by using the safety remote I/O unit (directly wiring the external emergency stop redundantly).
Refer to "Smart safety observation" (BNP-C3072-022) for details.

<Power supply unit (MDS-E/EH-CV) external emergency stop: Example>



<Drive unit (MDS-EJ/EJH) external emergency stop: Example>



<Caution>

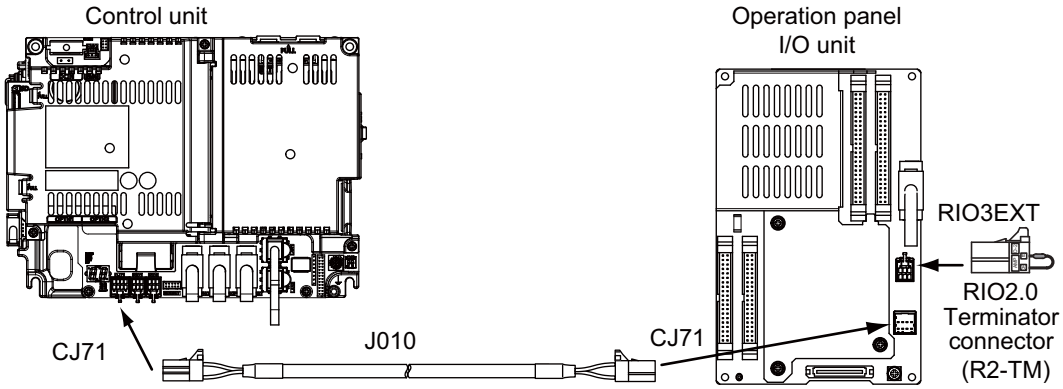
(1) External emergency stop cannot substitute the emergency stop signal which is input to NC.
It is a function which helps the NC emergency stop.

(2) When duplicating emergency stop input, wire the NC emergency stop input and the power supply unit external emergency stop input from the same emergency stop switch.

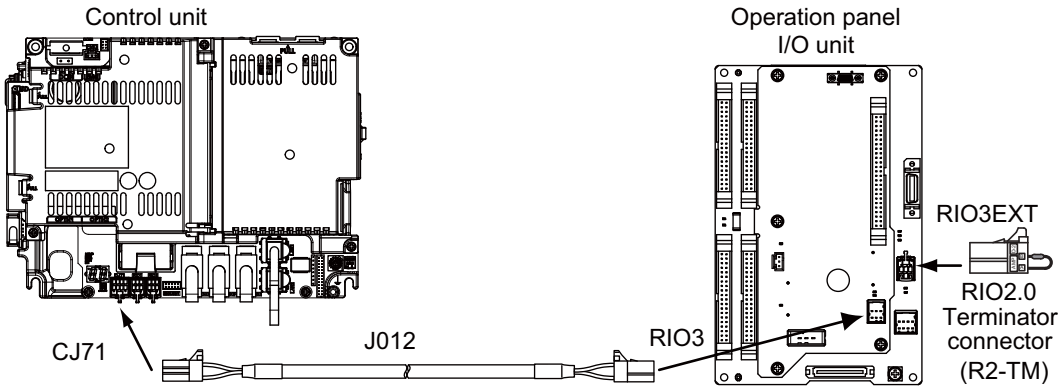
7.4 Connecting with Operation Panel I/O Unit

Connect the operation panel I/O unit to CJ71 connector of the control unit.

[FCU8-DX731 / FCU8-DX750 / FCU8-DX760 / FCU8-DX761]



[FCU8-DX834]



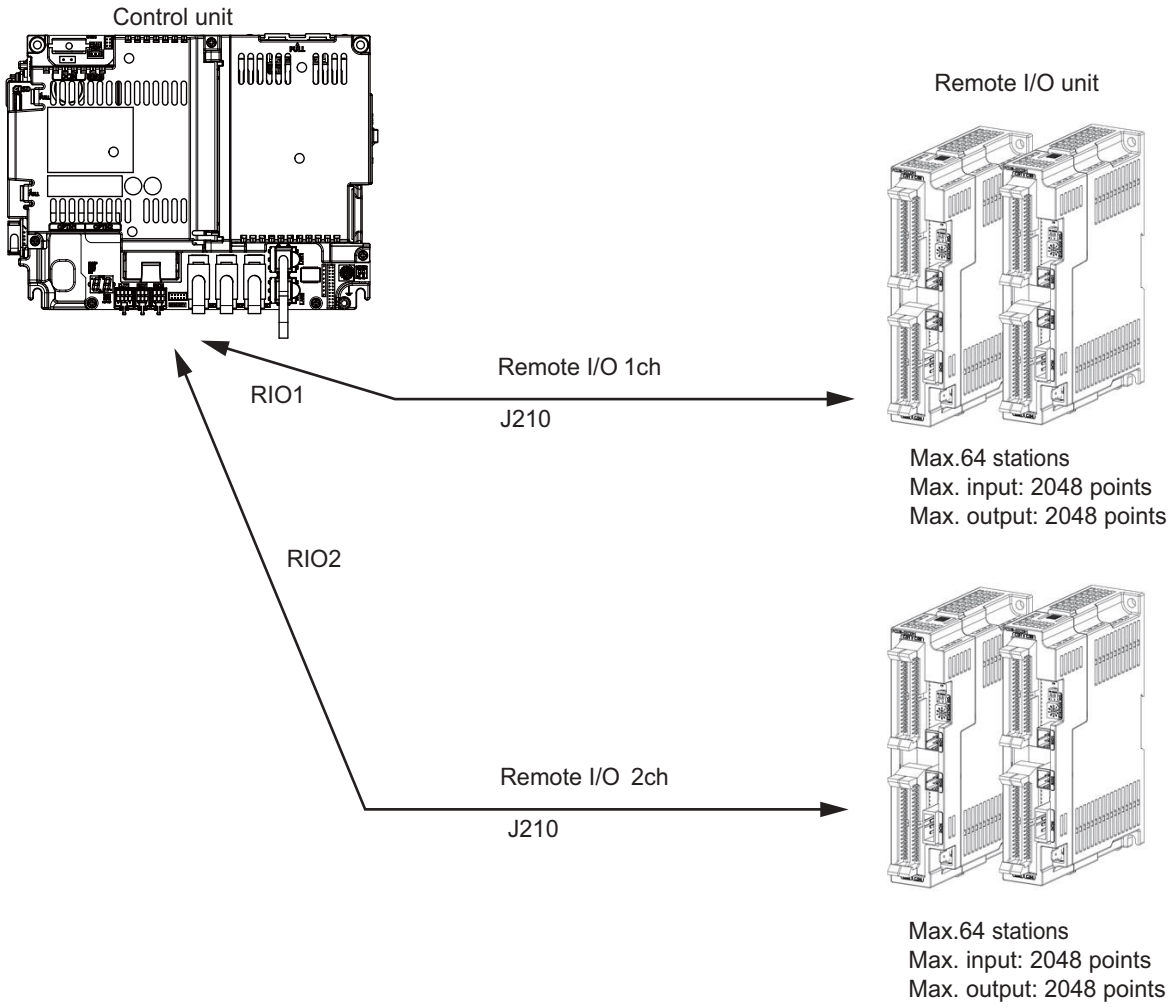
<Related items>

Cable connection drawing: "Cable : J010 Cable" and "Cable : J012 Cable"

Connector pin assignment: "General Specifications: Control Unit" (CJ71 connector)

7.5 Connecting with Remote I/O Unit

Connect the remote I/O unit to RIO1 or RIO2 connector of the control unit.



(Note 1) Connect the J210 cable to the RIO1 or RIO2 connector of the control unit.
Check the connector position with the actual machine.

(Note 2) When you use a function with pulse output, the re mote I/O unit cannot be connected to RIO1 and RIO2 connectors.

<Related items>

Cable connection drawing: "Cable : J210 Cable"

Connector pin assignment: "General Specifications: Control Unit" (RIO1 connector, RIO2 connector)

7.6 Connecting with Drive Unit

Connect the optical communication cables from the NC to the each drive unit so that they run in a straight line from the NC to the drive unit that is a final axis. Note that the number of connected axes is limited by the NC.

(Note) Refer to "Precautions for Using Optical Communication Cable" when handling and wiring optical communication cable.

Cable application table

Cable	Panel internal wiring		Panel external wiring	
	Under 10m	10 to 30m	10m or less	10 to 30m
J396	○	×	×	×
J395	○	×	○	×
G380	○	○	○	○

7.6.1 Connecting with Drive Unit MDS-E/EH Series

7.6.1.1 Connection of Optical Communication Cables

⚠ CAUTION

1. Connect the NC and the drive units by the optical communication cables. The distance between the NC and the final drive unit must be within 30m and the specified bending radius (for wiring inside panel: 25mm, and for wiring outside panel: 50mm) or more.

2. For the main circuit wiring of the drive unit and power supply unit, the drive unit of 200V series is to be wired with MDS-E-CV, and the drive unit of 400V series is to be wired with MDS-EH-CV.

POINT

Axis Nos. are determined by the rotary switch for setting the axis No. (Refer to the manual of drive unit.) The axis No. has no relation to the order for connecting to the NC.

(1) When Using One Power Supply Unit

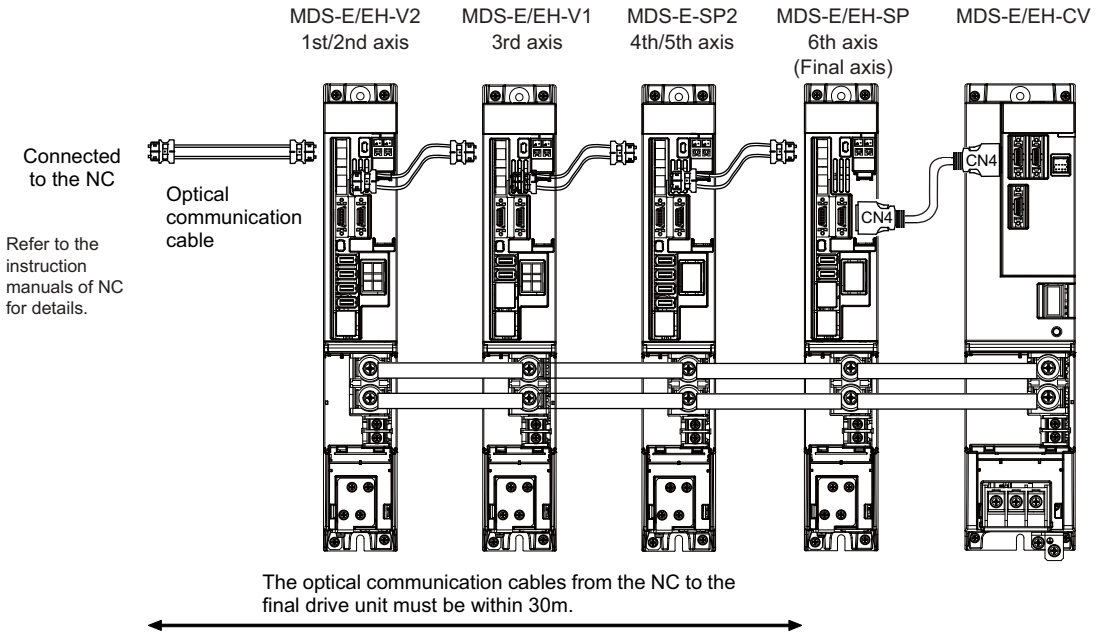
Connect the largest-capacity spindle drive unit to the final axis of the NC communication bus in order to control the power supply unit. The spindle drive unit must be installed adjacent to the power supply unit. In the system with servo only, a servo drive unit for controlling unbalance axis must be installed in the same manner in the same way.

< Connection >

CN1A : CN1B connector on NC or previous stage's drive unit

CN1B : CN1A connector on next stage's drive unit

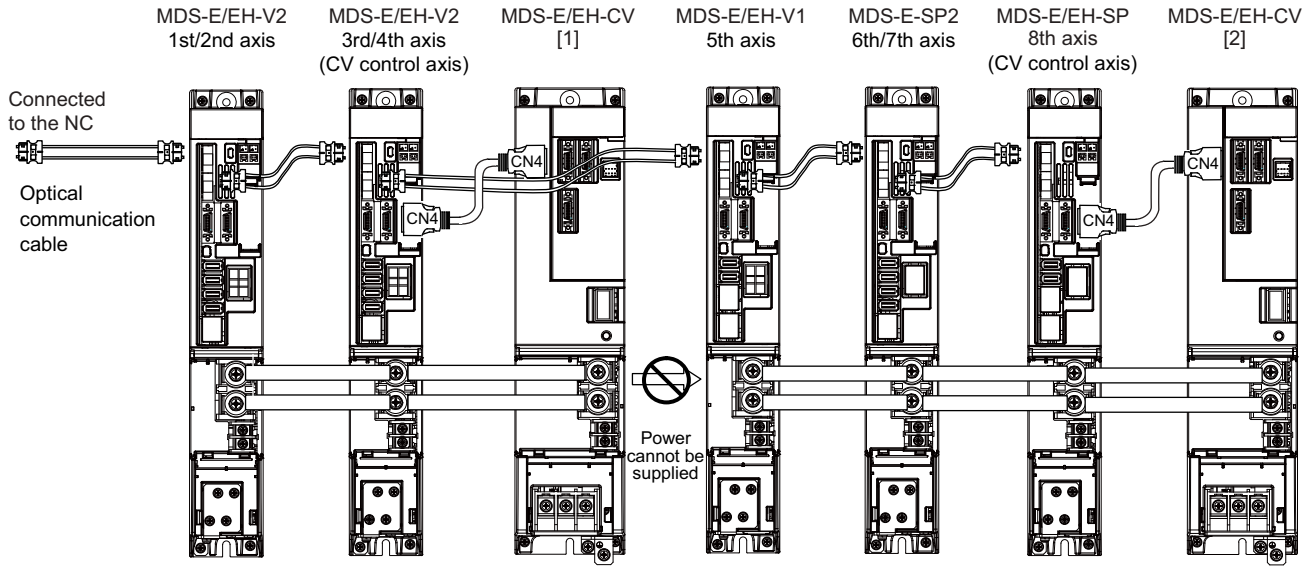
CN4 : Connector for communication between power supply unit (master side) and drive unit



Connection when using one power supply unit

(2) When Using Two or More Power Supply Units within a Single NC Communication Bus System

Two or more power supply units may be required within a single NC communication bus system if the spindle drive unit capacity is large. The drive unit receiving power (L+, L-) from each power supply unit must always have NC communication cable connection at the NC side of each power supply unit. In the NC communication bus connection example below, power supply [1] cannot supply power (L+, L-) to the 5th axis servo drive unit.
For basic connection information, refer to (1).



Connections when using two power supply units within a single NC communication bus system

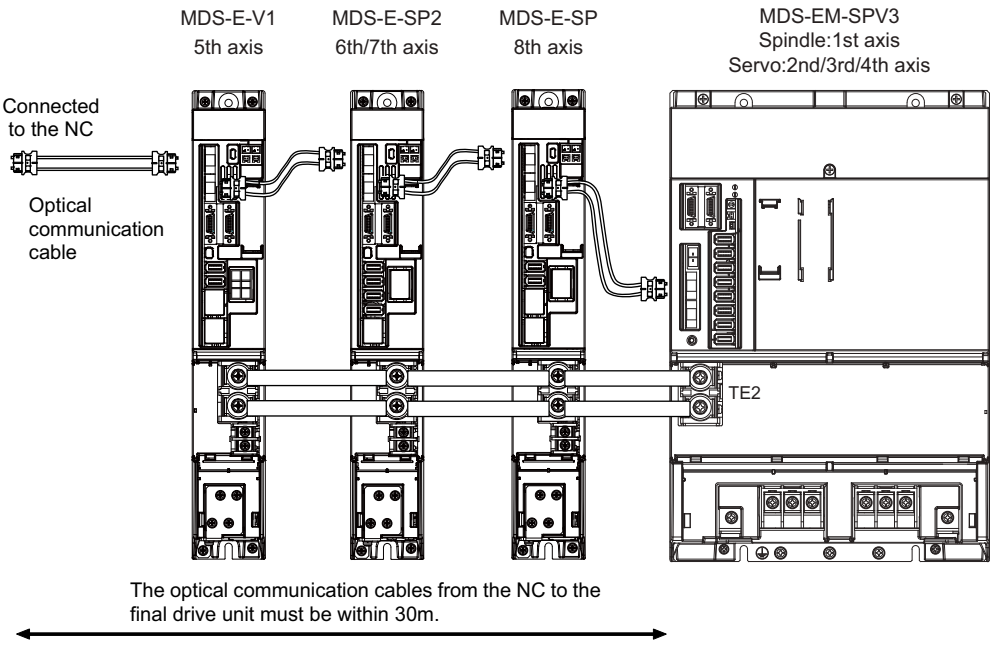
⚠ CAUTION

1. The drive unit receiving power (L+, L-) from each power supply unit must always have NC communication bus connection at the NC side of each power supply unit.

2. If two or more power supply units are connected in the drive system, confirm that the units are not connected with each other through the L+ and L- lines before turning ON the power. Also make sure that the total capacity of the drive units connected to the same power supply unit meets the unit's selected capacity.

(3) When using the additional axis drive unit by supplying power (L+, L-) from MDS-EM/EMH unit

The power (L+, L-) can be supplied to the additional axis drive unit by using the power supply part which is built into MDS-EM/EMH.



When using MDS-EM drive unit together with MDS-E

⚠ CAUTION

1. There is a limit to the combination of the drive unit.
Refer to "7.3 Selection of the Additional Axis Drive Unit" in "MDS-EM/EMH Series Specifications Manual".

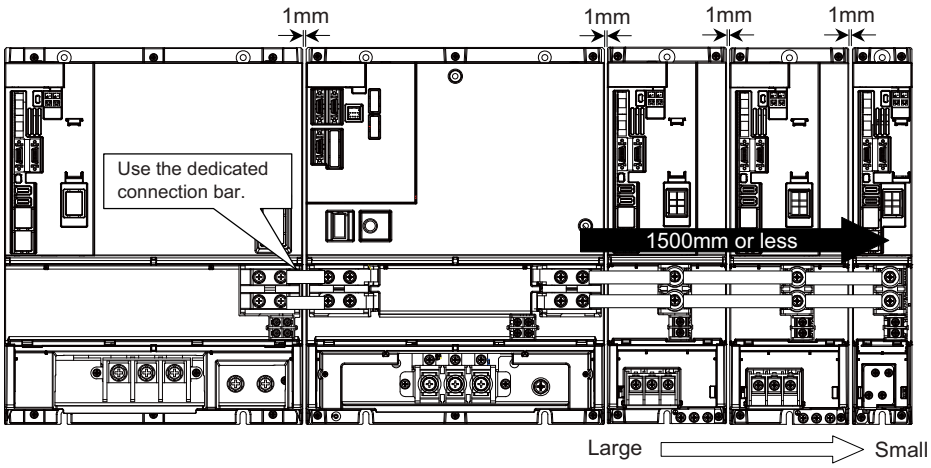
2. When using the additional axis drive unit by supplying power (L+, L-) from MDS-EM/EMH unit, install the optical communication cables in a manner that makes MDS-EM/EMH unit the final axis. Failure to observe this could lead to damage unit.

3. When installing the additional axis unit, install the spindle drive unit with maximum capacity adjacent to the MDS-EM/EMH-SPV3, and connections for other drive units should be such that the total TE2 wiring length is 800mm or less.

7.6.1.2 Drive Unit Arrangement

Arrange the drive units in the following procedure.

(1) Install a power supply unit.
(2) Arrange drive units in order of the nominal current from largest from the right.
(3) In the arrangement, the clearance between the units is 1 mm.
(4) Arrange the drive units with the DC connection length from the power supply unit being 1500mm or less. For the arrangement of 1500mm or more, multiple power supply units are required.
(5) Arrange large capacity drive units at the left of the power supply unit with the clearance between the drive units being 1mm.



Arrange drive units in order of nominal current from largest.

POINT

1. Arrange large capacity drive units at the left of the power supply unit with the clearance between the drive units being 1mm.

2. Power supply units equivalent to the number of large capacity drive units are required.

3. MDS-E-SP-400/640, MDS-EH-SP-200/320/480/600, and MDS-EH-V1-200 are the large capacity drive units.

7.6.2 Connecting with Drive Unit MDS-EM/EMH Series

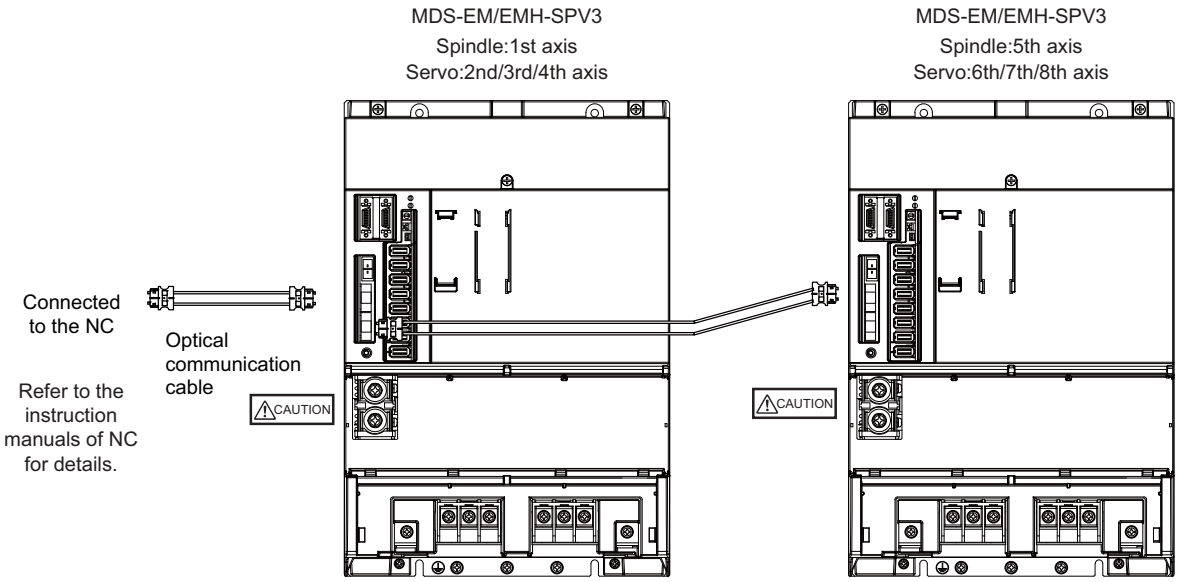
⚠ CAUTION

Connect the NC and the drive units by the optical communication cables. The distance between the NC and the final drive unit must be within 30m and the specified bending radius (for wiring inside panel: 25mm, and for wiring outside panel: 50mm) or more.

POINT

Axis Nos. are determined by the rotary switch for setting the axis No. (Refer to the manual of drive unit.) The axis No. has no relation to the order for connecting to the NC.

(1) When using only MDS-EM/EMH-SPV Series

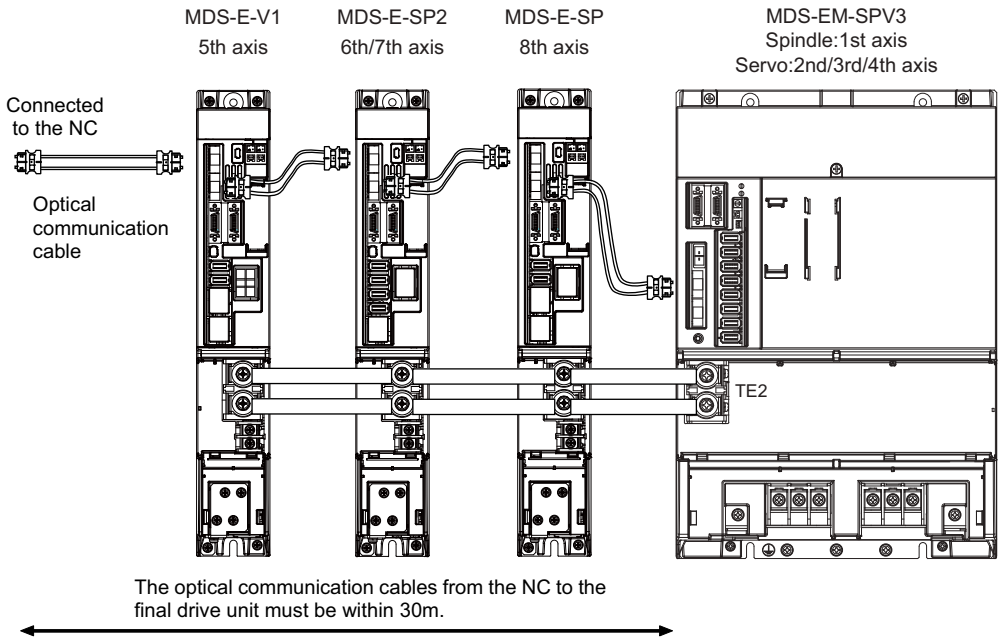


⚠ CAUTION

Confirm that the TE2 (L+, L-) wiring is not connected to other power supply before turning the power ON.

(2) When using the MDS-E/EH unit together

The power (L+, L-) can be supplied to the additional axis drive unit by using the power supply part which is built into MDS-EM/EMH. For the additional axis unit receiving power (L+,L-) from the MDS-EM/EMH unit, the optical cable must be connected at the NC side of the MDS-EM/EMH unit.



When using MDS-EM drive unit together with MDS-E

> **⚠ CAUTION**
>
> **There is a limit to the combination of the drive unit.**
>
> **Refer to "7.3 Selection of the Additional Axis Drive Unit" in "MDS-EM/EMH Series Specifications Manual".**

7.6.3 Connecting with Drive Unit MDS-EJ/EJH Series

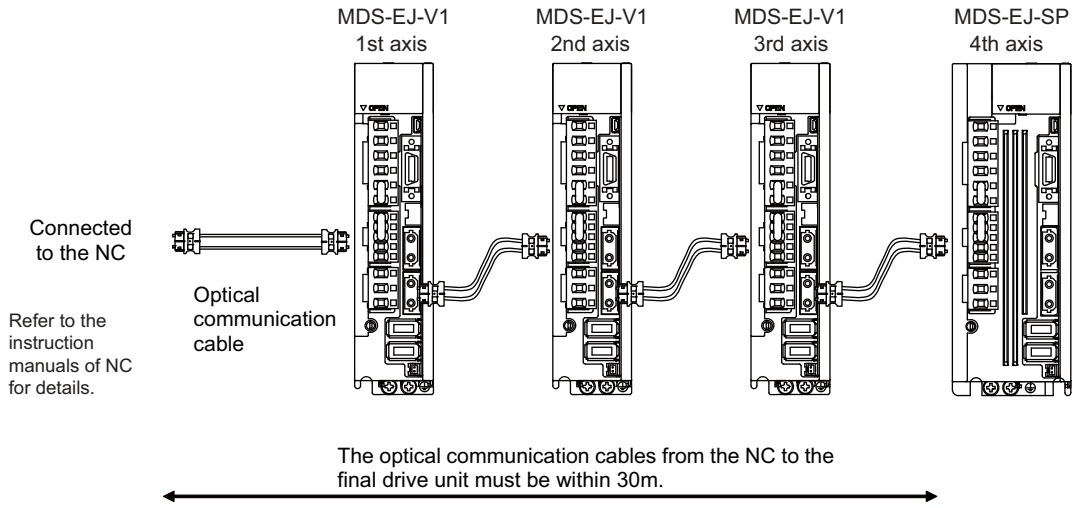
⚠ CAUTION

Connect the NC and the drive units by the optical communication cables. The distance between the NC and the final drive unit must be within 30m and the specified bending radius (for wiring inside panel: 25mm, and for wiring outside panel: 50mm) or more.

POINT

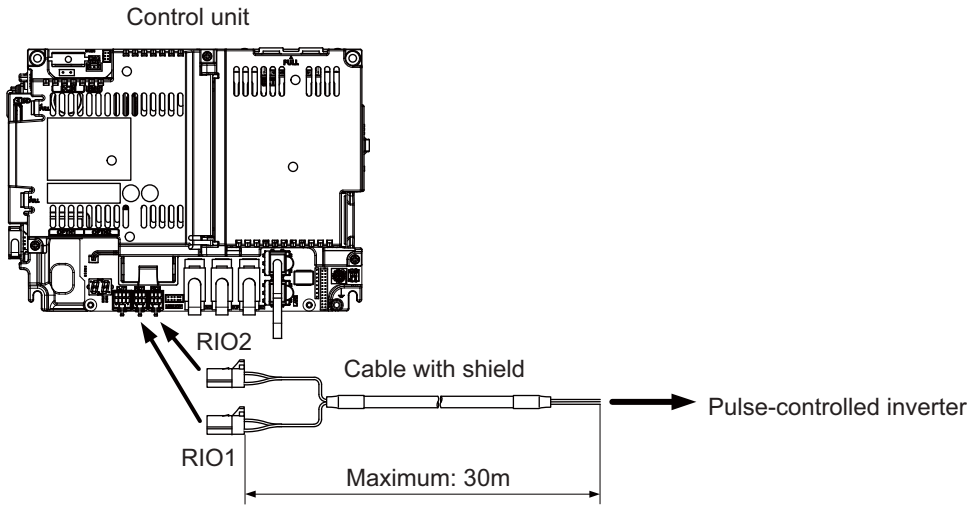
Axis Nos. are determined by the rotary switch for setting the axis No. (Refer to the manual of drive unit.)
The axis No. has no relation to the order for connecting to the NC.

CN1A: CN1B connector on NC or previous stage's drive unit
CN1B: CN1A connector on next stage's drive unit



7.7 Connecting with Pulse-controlled Inverter [M80/E80]

Connect the pulse-controlled inverter to RIO1 and RIO2 connectors of the control unit.



<Recommended wire material>

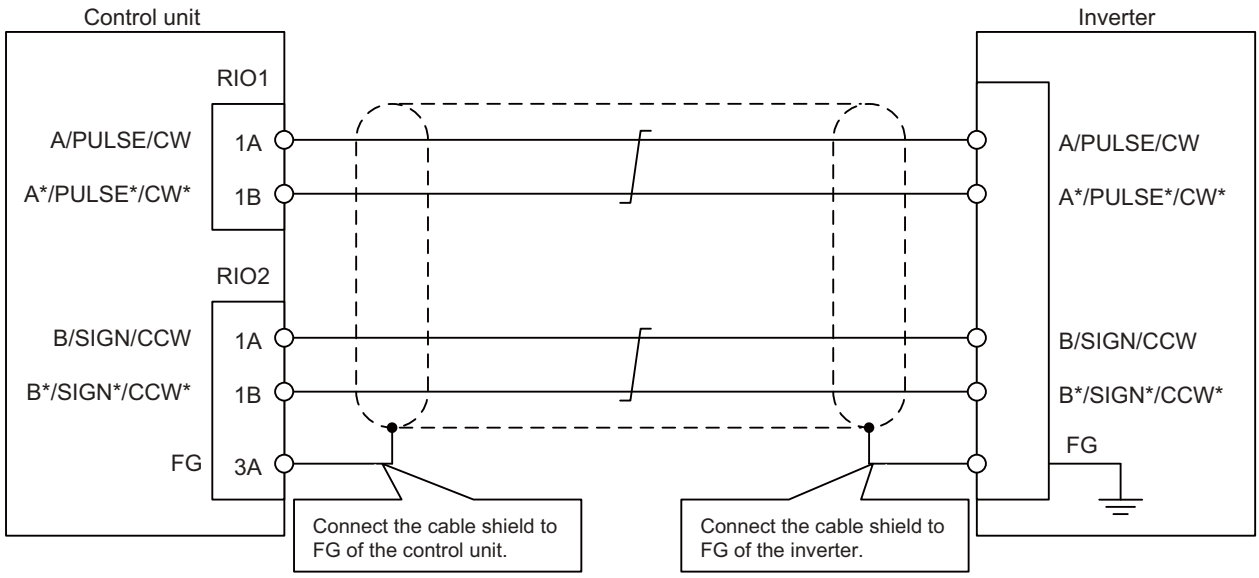
Wire material: HK-SB/20276XL Black LF 2P × 22AWG
Manufacturer: Taiyo Cabletec

<Related items>

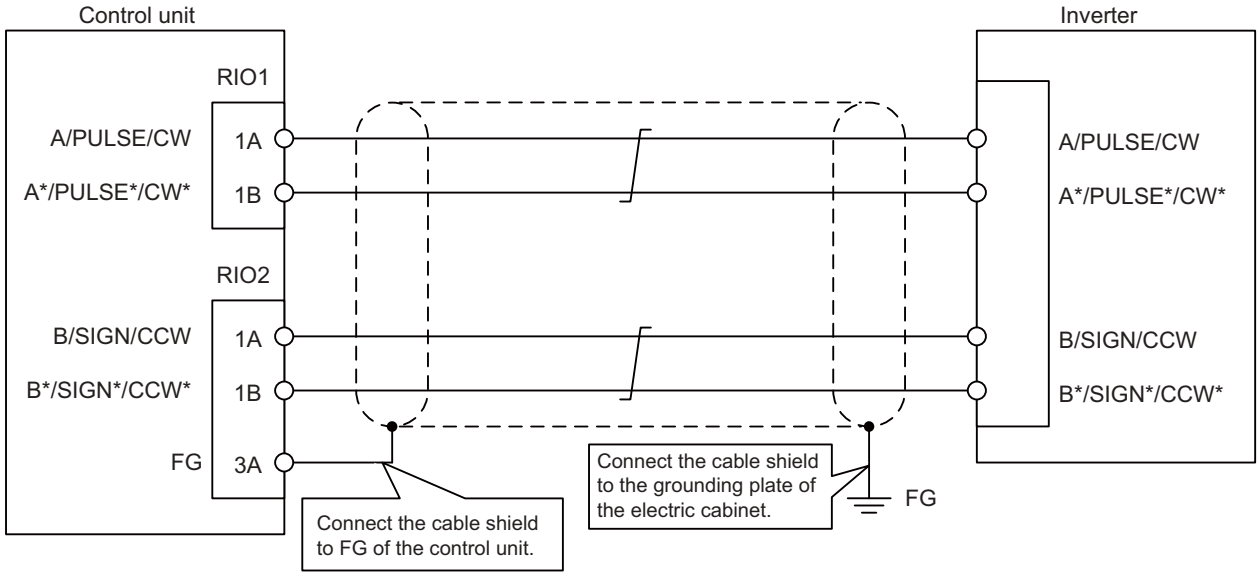
Connector pin assignment: "General Specifications: Control Unit" (RIO1/RIO2 connector)

> ⚠ **Note**
>
> **1. Connect the cable to the designated connector. Incorrect connections could damage the device.**
>
> **2. Do not connect or disconnect the connection cables between each unit while the power is ON.**
>
> **3. Use the cable with shield and ground it in order to reduce the influence of noise.**

[Connecting the inverter with an FG terminal]



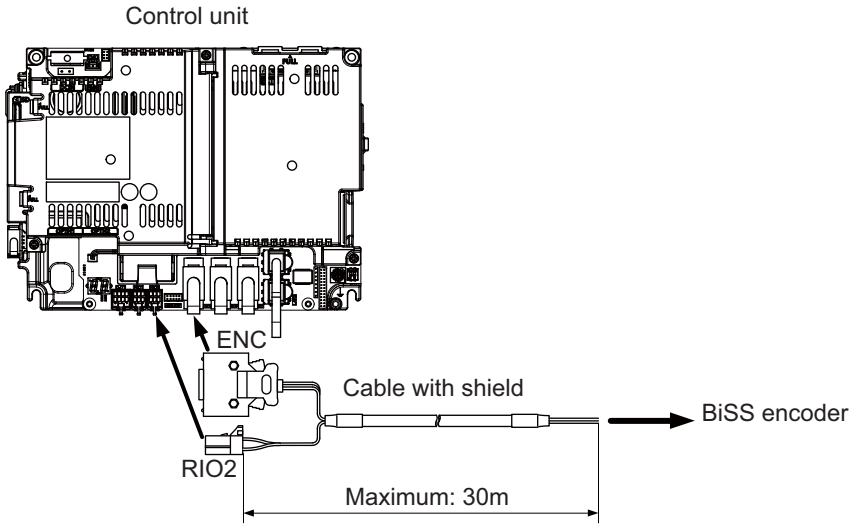
[Connecting the inverter without an FG terminal]



(Note) Connect cable shields to both FG on the control unit and the inverter. When there is no FG terminal on the inverter, use a clamp fitting or other tools to connect to the grounding plate of the electric cabinet.

7.8 Connecting with a BiSS Encoder

Connect the BiSS encoder to RIO2 connector and ENC connector of the control unit.



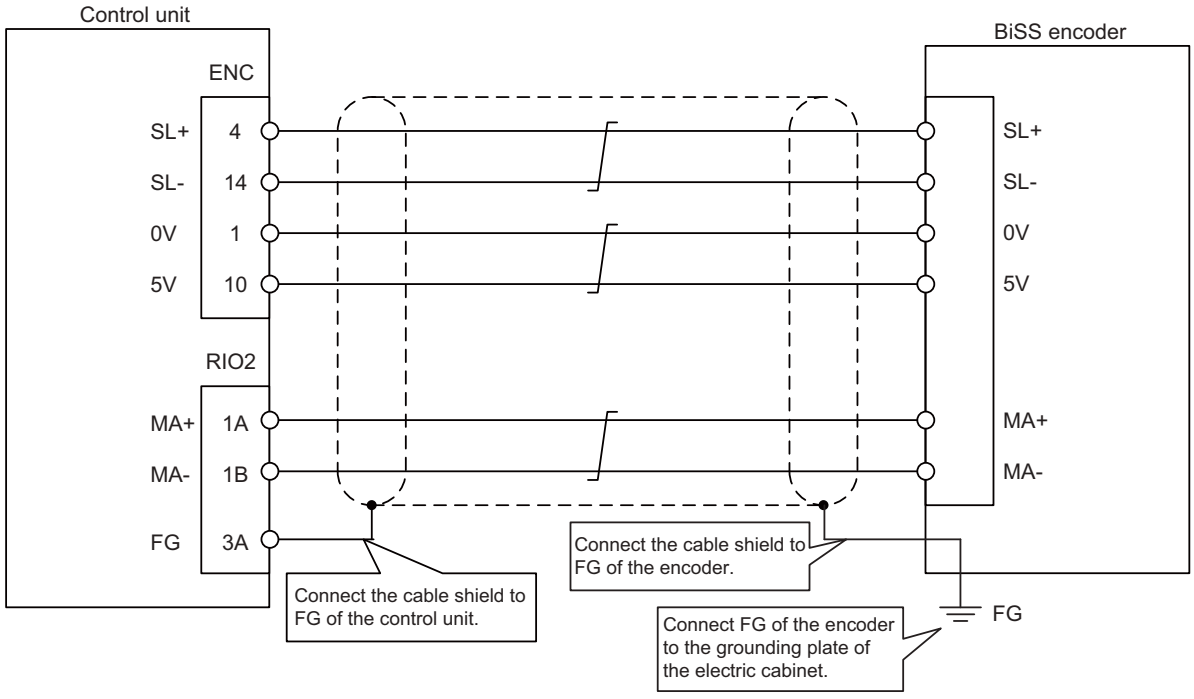
<Recommended wire material>

Wire material: HK-SB/20276XL Black LF 3P × 24AWG

Manufacturer: Taiyo Cabletec

<Related items>

Connector pin assignment: "General Specifications: Control Unit" (RIO1/RIO2 connector)



⚠ Note

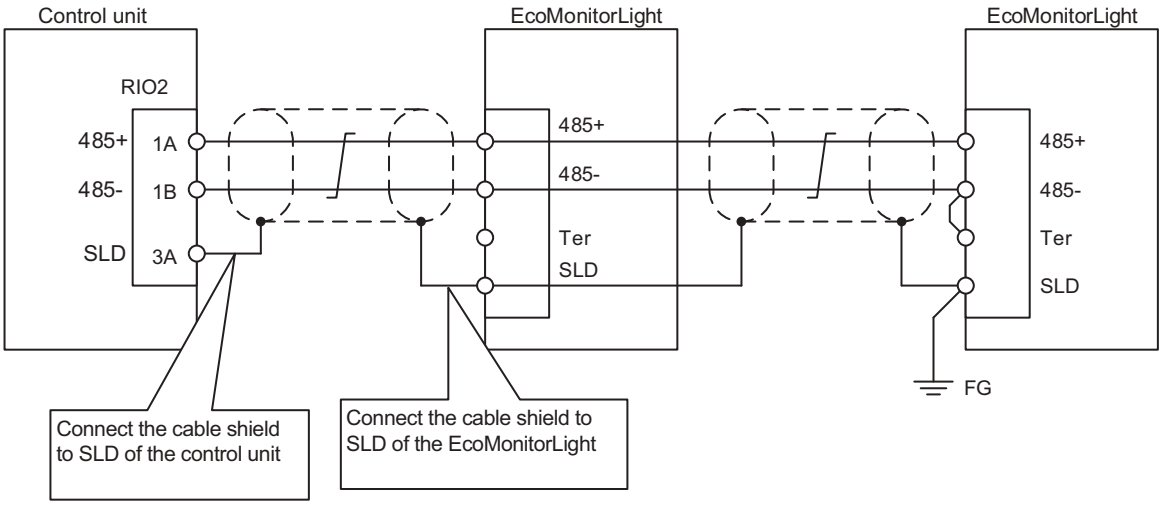
1. Connect the cable to the designated connector. Incorrect connections could damage the device.

2. Do not connect or disconnect the connection cables between each unit while the power is ON.

3. Use the cable with shield and ground it in order to reduce the influence of noise.

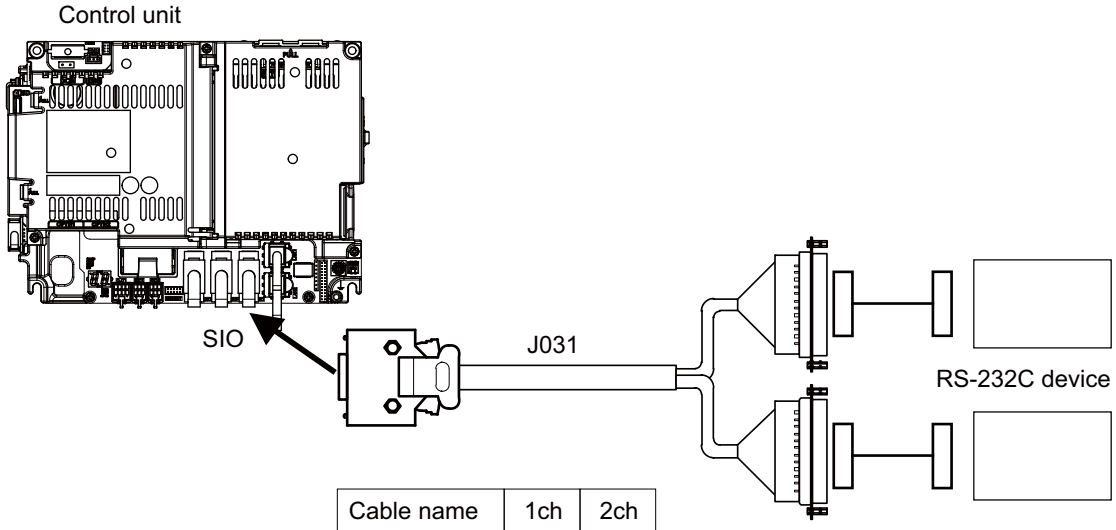
7.9 Connecting with EcoMonitorLight

Connect the EcoMonitorLight to the RIO2 connector of the control unit.



7.10 Connecting with RS-232C Device

(1) Connect the RS-232C device to SIO connector of the control unit.



Cable name	1ch	2ch
J030 cable	○	
J031 cable	○	○

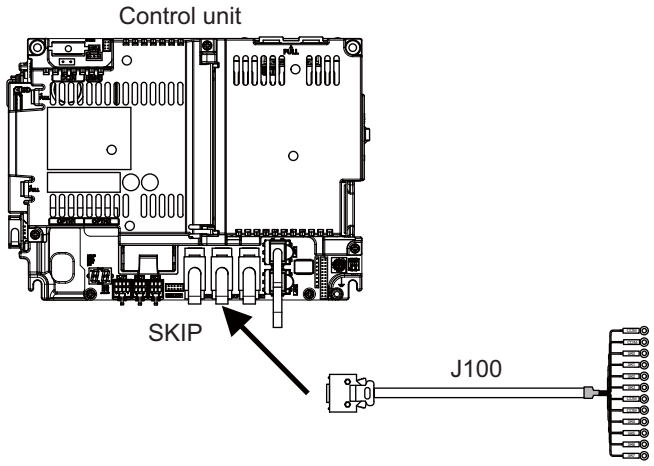
<Related items>

Cable connection drawing: "Cable: J030/J031 Cable"

Connector pin assignment: "General Specifications: Control Unit" (SIO connector)

7.11 Connecting with Skip Signal (Sensor)

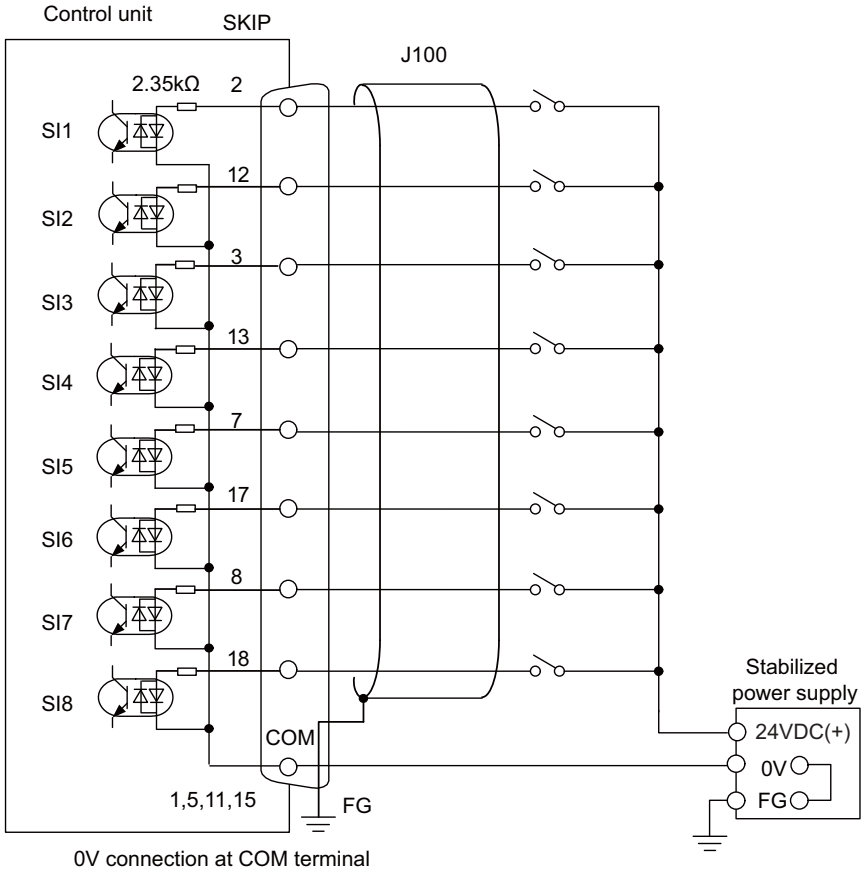
Connect the skip signals to SKIP connector of the control unit.
Skip signals are used for processing high-speed signals. Always shield the cable.



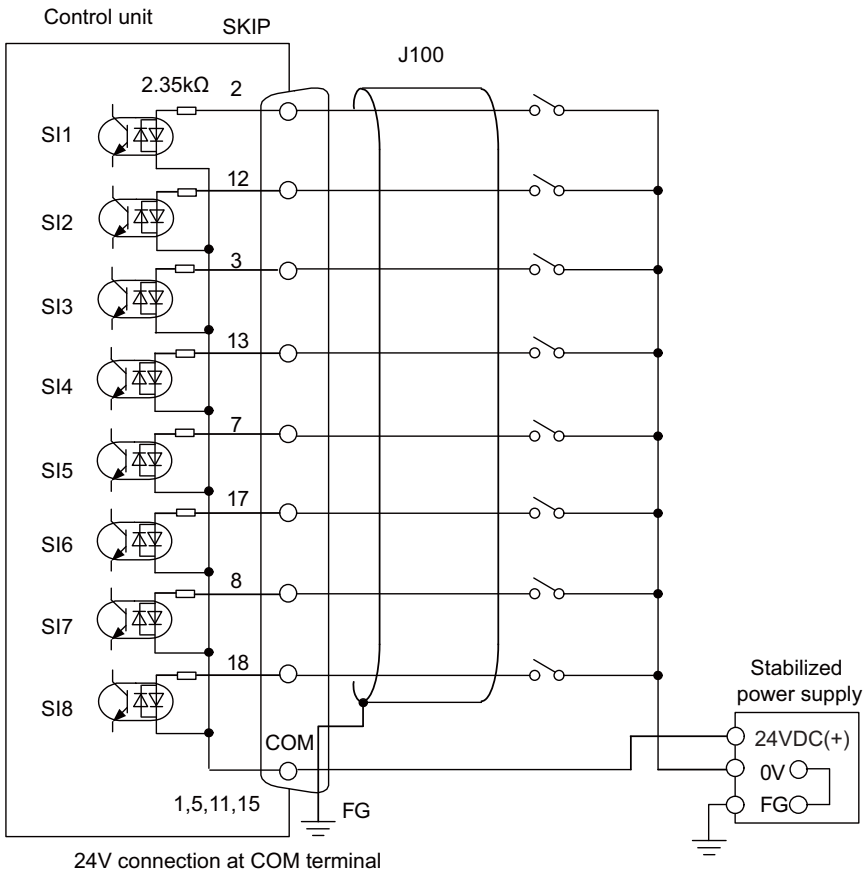
(Note) Connecting the skip signal cable to a wrong connector causes a damage on the control unit when turning ON the skip signal power supply. Confirm the wiring before turning the power ON.

(1) Connection of skip signal cable

<0V connection at COM terminal>



<24V connection at COM terminal>



24V connection at COM terminal

(Note 1) NC recognizes input signals of 2ms or more as the valid skip signals. If machine contacts (relay, etc.) are used, malfunctions will occur due to chattering. Use semiconductor contacts (transistor, etc.).

(Note 2) Fold the cable shield over the sheath, and wrap copper foil tape over it. Connect the wound copper foil tape to GND plate of the connector.

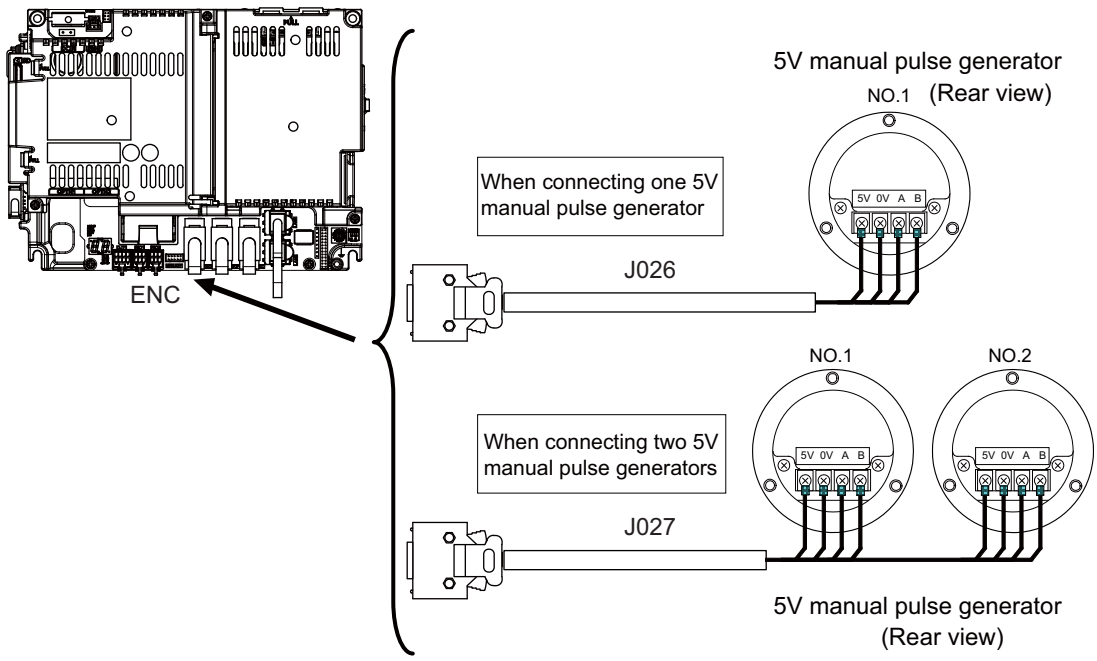
<Related items>

Cable connection drawing: "Cable: J100 Cable"

Connector pin assignment: "General Specifications: Control Unit" (SKIP connector)

7.12 Connecting with Manual Pulse Generator

Connect the 5V power supply type manual pulse generator (2ch) to ENC connector of the control unit.



<Related items>

Cable connection drawing: "Cable: J026/J027 Cable"

Connector pin assignment: "General Specifications: Control Unit" (ENC connector)

When using the synchronous feed encoder and the manual pulse generator at the same time, the cables must be prepared by the machine tool builder.

7.12.1 Handle Numbers

There are two types of the handle numbers assignment: automatic assignment and arbitrary assignment.

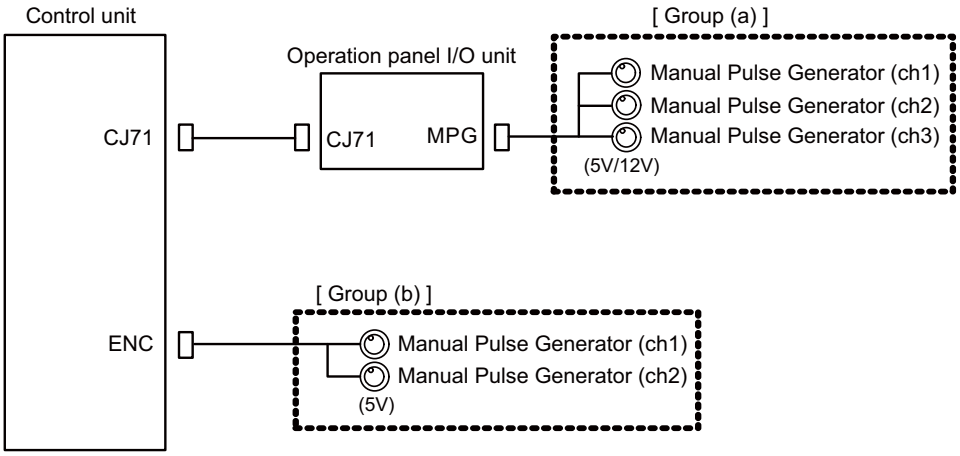
[Automatic assignment]

Set all the parameters from "#1395 H1_pno (1st handle selection)" to "#1397 H3_pno (3rd handle selection)" to "0000".

An example is shown below.

"ENC": Connector on control unit (two channels), "MPG": Connector on operation panel I/O unit (Up to three channels)

Operation panel I/O unit	Handle assignment		
	1st handle	2nd handle	3rd handle
Used	Group (a) ch1	Group (a) ch2	Group (a) ch3
Not used	Group (b) ch1	Group (b) ch2	

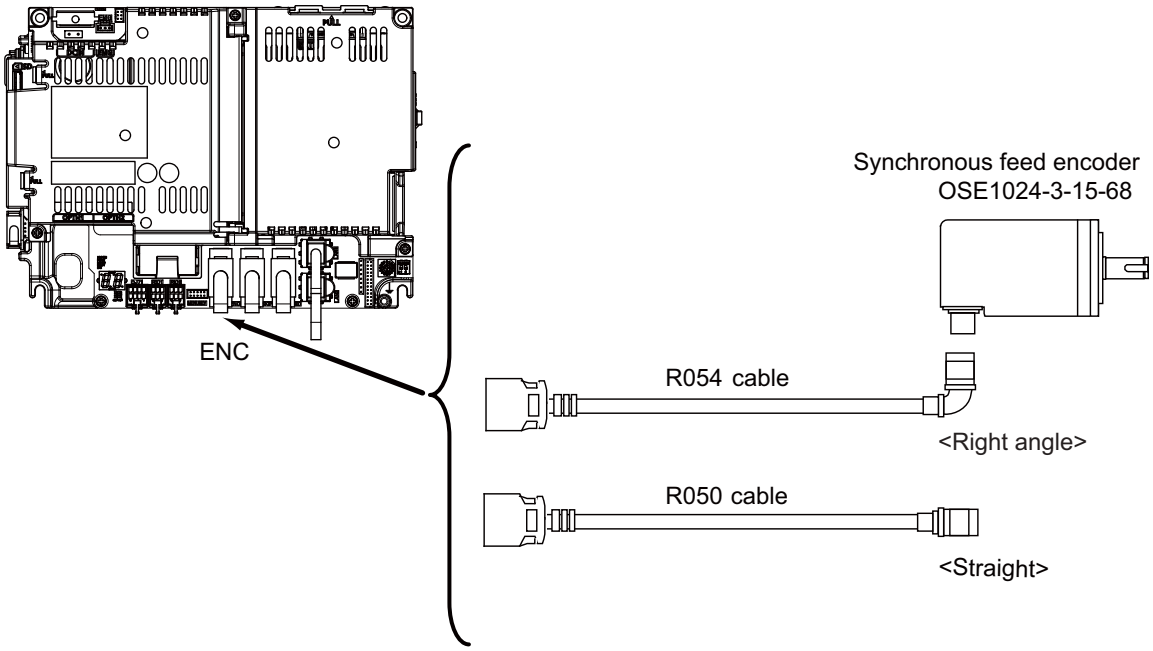


[Arbitrary assignment]

Assign the handle I/F arbitrary according to the setting values of the parameters "#1395 H1_pno (1st handle selection)" to "#1397 H3_pno (3rd handle selection)".

7.13 Connecting with Synchronous Feed Encoder

Connect the synchronous feed encode (1ch) to ENC connector of the control unit.



<Related items>

Cable connection drawing: "Cable: FCUA-R050/R054 Cable"
Connector pin assignment: "General Specifications: Control Unit" (ENC connector)

When using the synchronous feed encoder and the manual pulse generator at the same time, the cables must be prepared by the machine tool builder.

7.14 Connecting I/O Device via Function Expansion Unit

Mount the function expansion unit onto the dedicated slot of the control unit.

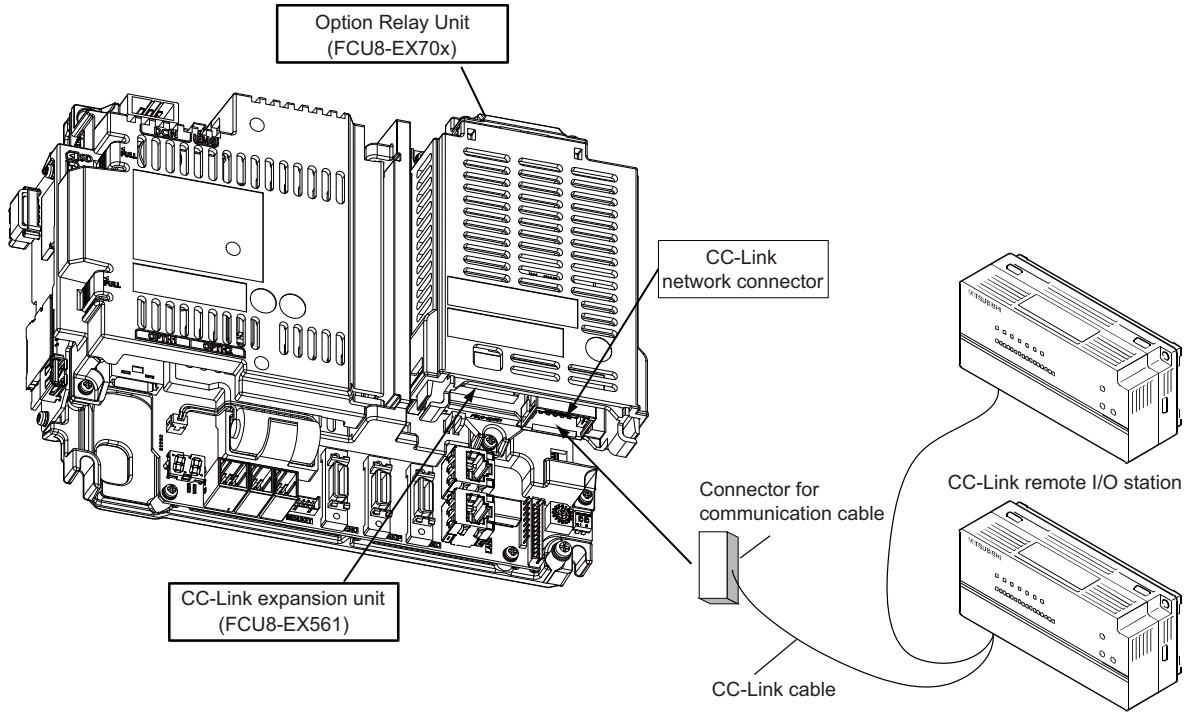
(Note 1) To use the function expansion unit, the option relay unit (FCU8-EX70x) is required.

(Note 2) When the option relay unit FCU8-EX703 (for two slots) is connected, the available combinations of the communication function expansion units for which two slots can be used are as follows.
Any combination not stated below cannot be used.
Either slot can be used.

Case 1	FCU8-EX561 : CC-Link	FCU8-EX561 : CC-Link
Case 2		FCU8-EX563 : PROFIBUS-DP
Case 3		FCU8-EX564 : CC-Link IE Field
Case 4		FCU8-EX565 : EtherNet/IP
Case 5		FCU8-EX568 : FL-net
Case 6	FCU8-EX564 : CC-Link IE Field	FCU8-EX563 : PROFIBUS-DP
Case 7		FCU8-EX564 : CC-Link IE Field
Case 8		FCU8-EX565 : EtherNet/IP
Case 9		FCU8-EX568 : FL-net
Case 10	FCU8-EX565 : EtherNet/IP	FCU8-EX568 : FL-net

7.14.1 Connecting I/O Device via CC-Link

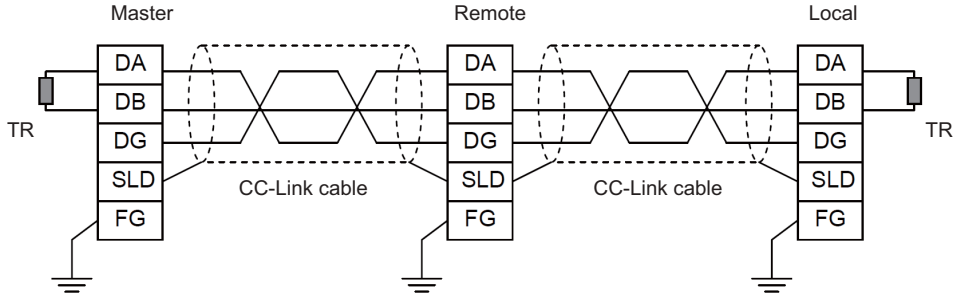
Use the dedicated communication cable for CC-Link network connection. Connect the communication cable to the communication connector of the CC-Link expansion unit.
The connector for the communication cable on the CC-Link expansion unit side is provided with the CC-Link expansion unit.
Use the Ver.1.10-compatible CC-Link dedicated cable as the communication cable. CC-Link system cannot provide its performance with the Ver.1.10-incompatible cable, because it may cause the restrictions such as the reduction of maximum cable length, increment of cable length between stations, and unusability of mixed wire materials from the different manufacturers.
Make sure to attach the terminator to the final station unit.



Prepared by MTB

[Connection of terminator]

Excerpt from “CC-Link cable wiring manual” (published by CC-Link partner association).



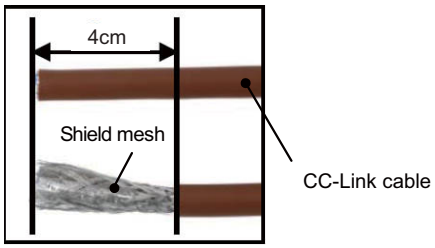
(Note 1) Unless the CC-Link dedicated cable is used, CC-Link system does not guarantee its operation. For the specifications of the CC-Link dedicated cable and the inquiries, see the homepage of the CC-Link Partner Association (http://www.cc-link.org/). (Click "Product Information".)

(Note 2) The value of the terminator that can be used for Ver.1.10-compatible CC-Link dedicated cable is 110Ω.

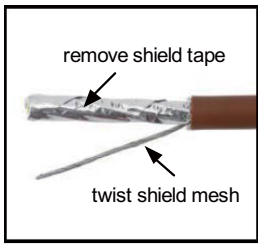
(Note 3) The terminator attaching to the communication connector on the CC-Link expansion unit side is the connector type which has built-in resistance. The communication connector has a two-level structure, however there is no difference in the specification attaching the cable to either one.

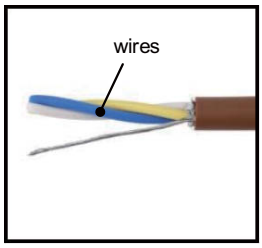
[CC-Link cable connecting procedure]

(1) Remove the sheath of the CC-Link cable about 4cm.

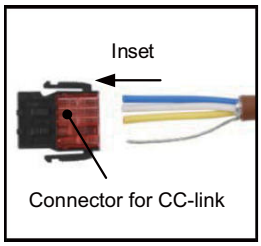


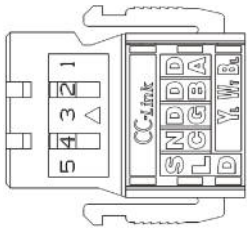
(2) Isolate the shield mesh and the wires coverd with shield tape.
Remove the shield tape from wires.





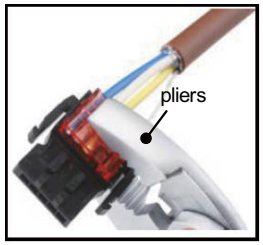
(3) Insert the wires to the connector for CC-Link as below.



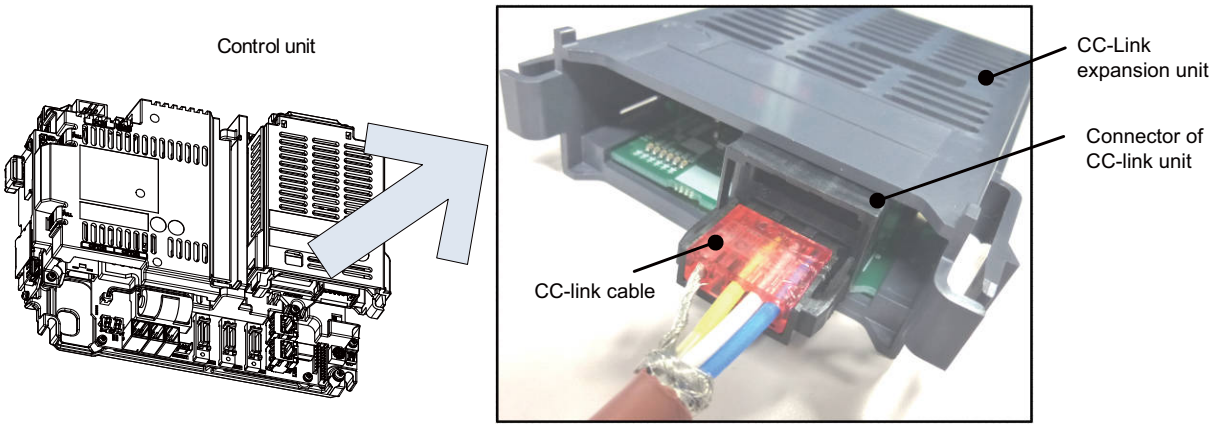


1pin Blue wire (cover notation: DA B)
2pin White wire (cover notation: DB W)
3pin Yellow wire (cover notation: DG Y)
4pin No connect
5pin Shield wire (cover notation: SLD)

(4) Press the connector with the use of a pliers.
Check that the clamp point is flat to the connector for CC-Link.

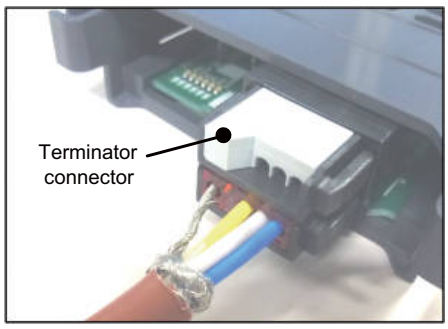


(5) Insert the CC-Link cable into the connector of CC-Link unit.



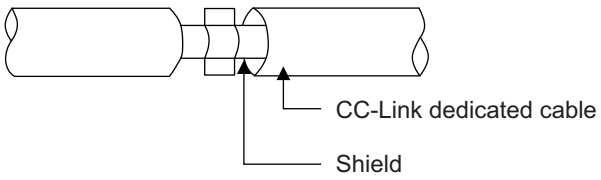
(Note) Connector of CC-Link unit is two-step structure. It is not different even if attach the cable to whichever.

(6) Insert the terminator to the connector of CC-Link unit as in the figure.
In the final station, the terminator connector is required.



[Noise countermeasures of CC-Link dedicated cable]

When the CC-Link expansion unit is being used, expose the cable by removing a part of the cable sheath and use the shield clamp for the exogenous noise countermeasure.



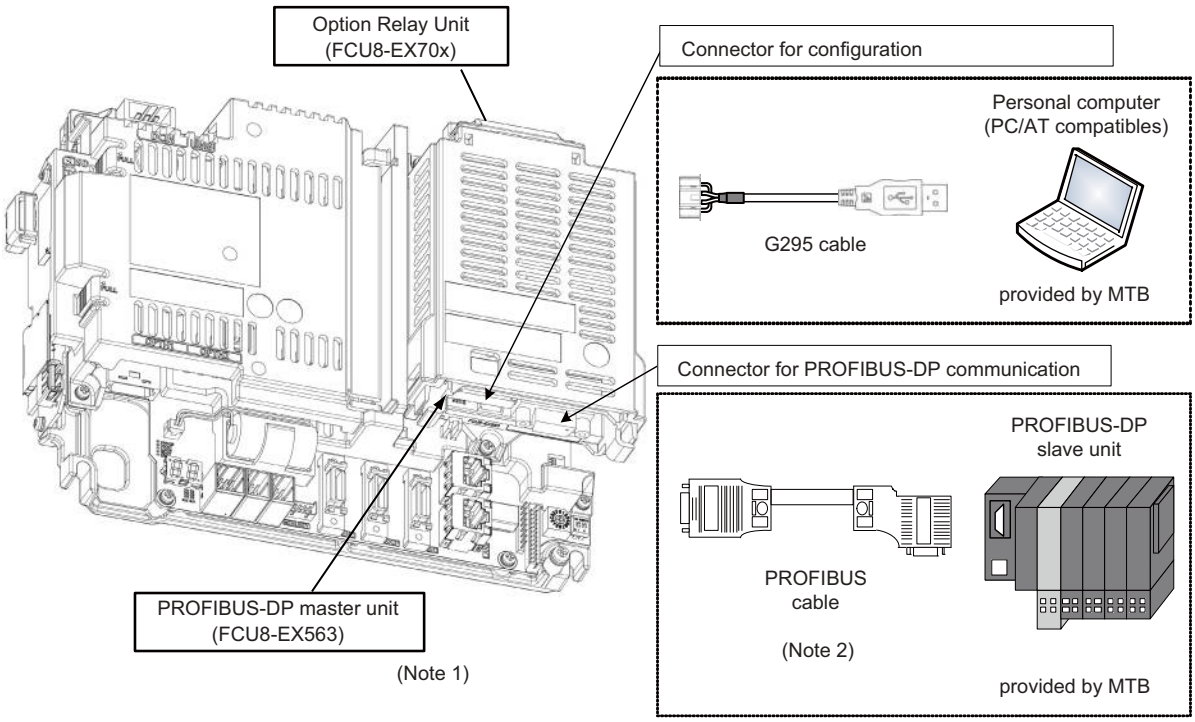
Refer to "4.4 Shield connection to ground" of "CC-Link Cable Wiring Manual" (published by CC-Link partner association) for shield wire grounding for CC-Link dedicated cable.

<Related item>

Shield clamp fitting: "EMC Installation Guidelines: EMC Countermeasure Parts: Shield Clamp Fitting"

7.14.2 Connecting I/O Device via PROFIBUS-DP

The expansion unit FCU8-EX563 functions as a master station of PROFIBUS-DP. Use the PROFIBUS dedicated communication cable for connection to PROFIBUS-DP.
Make sure to attach the terminator to the final station unit of the network. There is a slide switch on the PROFIBUS communication cable for setting the terminator. Turning "ON" the slide switch means attaching the terminator. Make sure to turn "ON" the slide switch for the last station, and to turn "OFF" for other stations.
To use the expansion unit as a master station of PROFIBUS-DP, set the parameter with the configuration software (a tool for parameter setting). When setting the parameter, you need to use the cable G295 to connect the PROFIBUS-DP master unit to the configuration software- installed personal computer (PC/AT compatible machine).
(Note) The communication parameters, etc. at the time of setup are required to be backed up for maintenance.



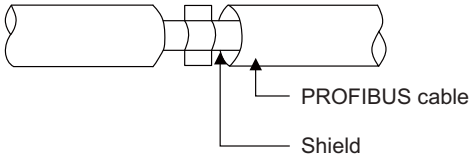
(Note 1) Use the rotary switch of PROFIBUS-DP master unit with the initial value "0".
(Note 2) The performance is not guaranteed unless the PROFIBUS dedicated cable is used. For the specifications of the PROFIBUS dedicated cable or for contact information for any inquiries, see the homepage of PROFIBUS & PROFINET International (PI) (http://www.profibus.com/).

Contact information for inquiries related to the configuration software is as follows.

Hilscher Gesellschaft fur Systemautomation mbH Rheinstrasse 78 D-65795 Hattersheim Germany TEL: +49-6190-9907-0 FAX: +49-6190-9907-50	Contact in Japan: Euro-Far East Co., Ltd Lilas Nogisaka Bldg. #901 Minami Aoyama 1-15-18 Minato-ku, Tokyo 107-0062 JAPAN TEL: 03-3470-8769 FAX: 03-3478-8648

[Countermeasures for PROFIBUS cable noise]

When the PROFIBUS-DP master unit is being used, expo se the cable by removing a part of the cable sheath and use the shield clamp for the exogenous noise countermeasure.



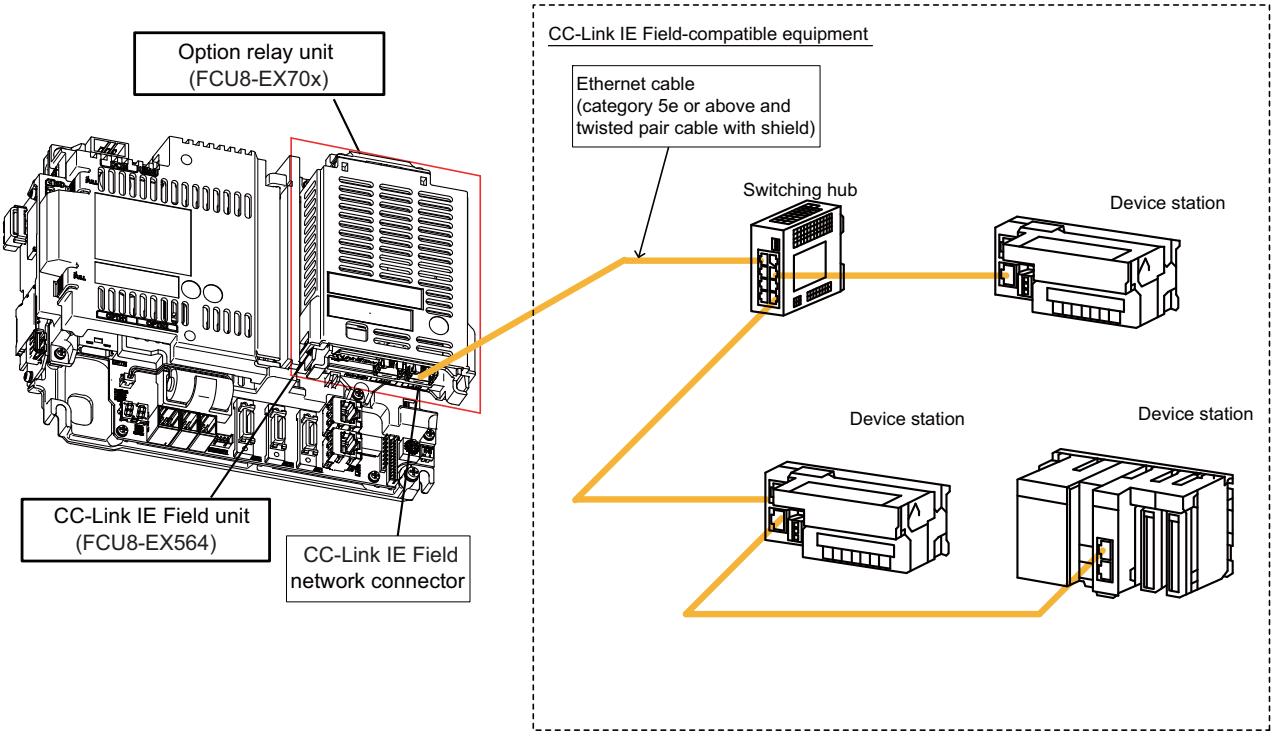
When you cannot use the shield clamp, install a ferrite core as a substitute to PROFIBUS cable (near the expansion unit).

<Related item>

Shield clamp fitting: "EMC Installation Guidelines: EMC Countermeasure Parts: Shield Clamp Fitting"
Ferrite core: "EMC Installation Guidelines: EMC Countermeasure Parts: Ferrite Core"

7.14.3 Connecting I/O Device via CC-Link IE Field

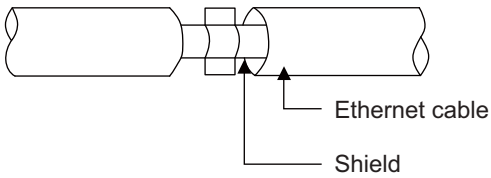
The expansion unit FCU8-EX564 functions as a master station or device station (local station) of CC-Link IE Field.
Connect the CC-Link IE Field-compatible equipment with an ethernet cable (category 5e or above and twisted pair shield cable).
For details, refer to the specifications manual related to CC-Link IE Field (Master/local).



(* Prepared by MTB)

[Noise countermeasures of ethernet cable]

When the CC-Link IE Field unit is being used, expose the cable by removing a part of the cable sheath and use the shield clamp for the exogenous noise countermeasure.



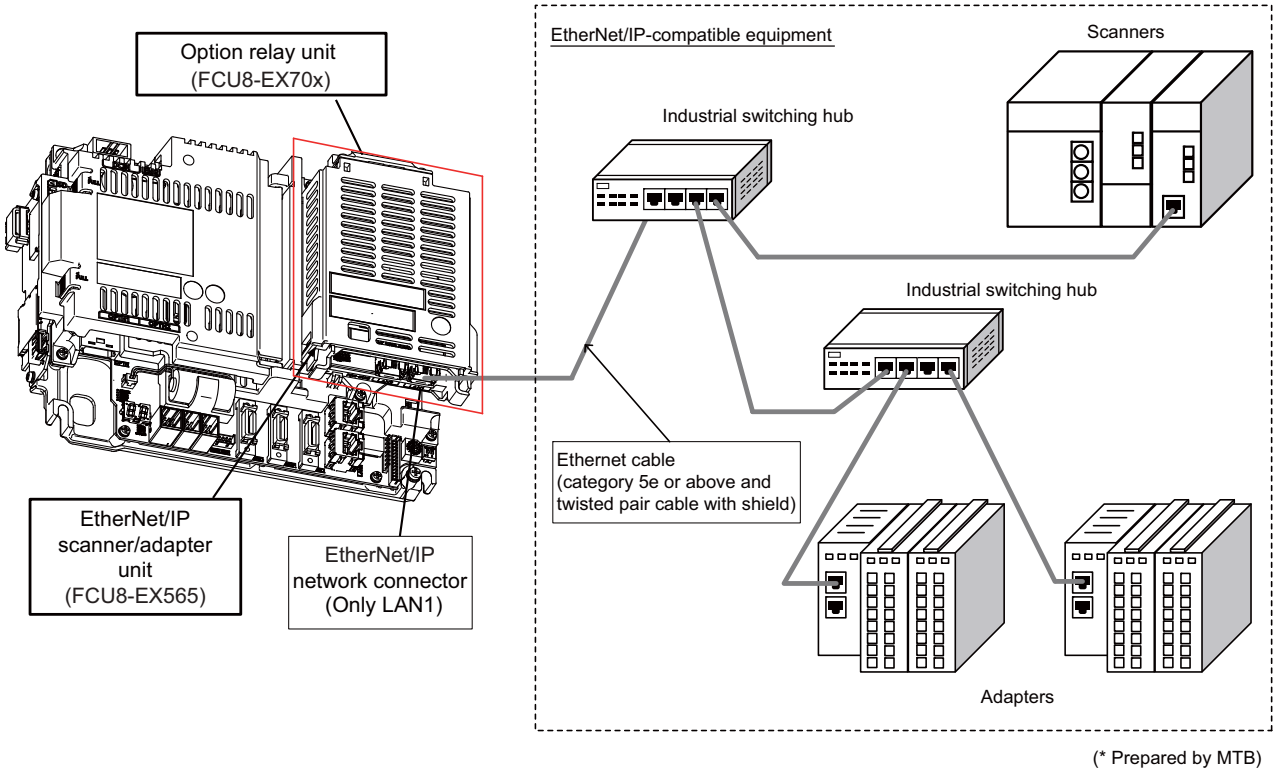
When you cannot use the shield clamp, install a ferrite core as a substitute to ethernet cable (near the expansion unit).

<Related item>

Shield clamp fitting: "EMC Installation Guidelines: EMC Countermeasure Parts: Shield Clamp Fitting"
Ferrite core: "EMC Installation Guidelines: EMC Countermeasure Parts: Ferrite Core"

7.14.4 Connecting I/O Device via EtherNet/IP

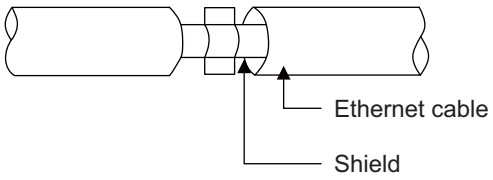
The expansion unit FCU8-EX565 functions as a scanner or an adapter of EtherNet/IP. Connect the EtherNet/IP-compatible equipment with an ethernet cable (category 5e or above and twisted pair shield cable).
For details, refer to the specifications manual related to EtherNet/IP.



(Note 1) EtherNet/IP scanner/adapter unit is equipped with two RJ-45 connectors (LAN1 and LAN2); however, the function of EtherNet/IP is available only on LAN1. Do not connect any cable to LAN2 port.

[Noise countermeasures of ethernet cable]

When the EtherNet/IP scanner/adapter unit is being used, expose the cable by removing a part of the cable sheath and use the shield clamp for the exogenous noise countermeasure.



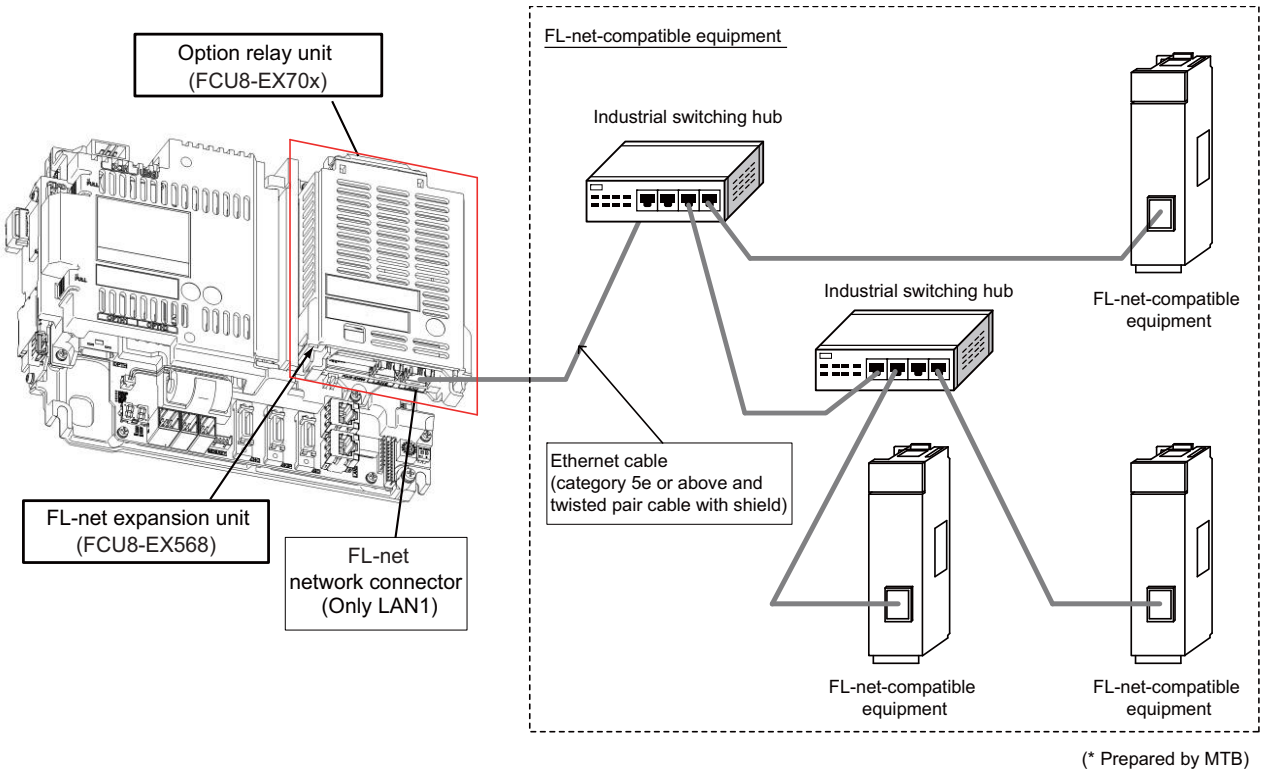
When you cannot use the shield clamp, install a ferrite core as a substitute to ethernet cable (near the expansion unit).

<Related item>

Shield clamp fitting: "EMC Installation Guidelines: EMC Countermeasure Parts: Shield Clamp Fitting"
Ferrite core: "EMC Installation Guidelines: EMC Countermeasure Parts: Ferrite Core"

7.14.5 Connecting I/O Device via FL-net

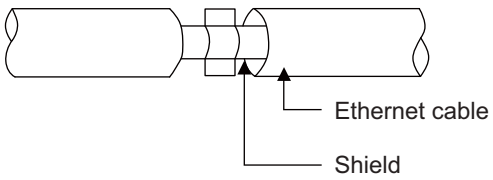
The expansion unit FCU8-EX568 functions as a node of FL-net. Connect the FL-net-compatible equipment with an ethernet cable (category 5e or above and twisted pair shield cable).



(Note 1) FL-net expansion unit is equipped with two RJ-45 connectors (LAN1 and LAN2); however, the function of FL-net is available only on LAN1. Do not connect any cable to LAN2 port.

[Noise countermeasures of ethernet cable]

When the FL-net expansion unit is being used, expose the cable by removing a part of the cable sheath and use the shield clamp for the exogenous noise countermeasure.



When you cannot use the shield clamp, install a ferrite core as a substitute to ethernet cable (near the expansion unit).

<Related item>

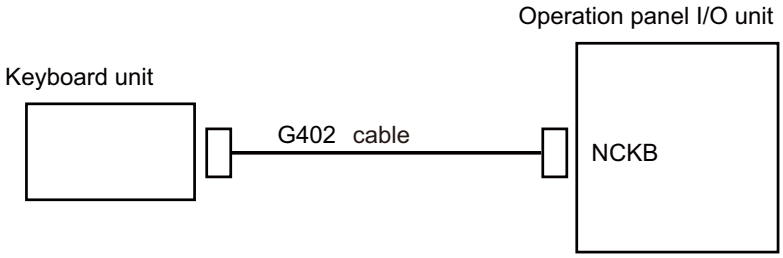
Shield clamp fitting: "EMC Installation Guidelines: EMC Countermeasure Parts: Shield Clamp Fitting"
Ferrite core: "EMC Installation Guidelines: EMC Countermeasure Parts: Ferrite Core"

8

Connection of Keyboard Unit

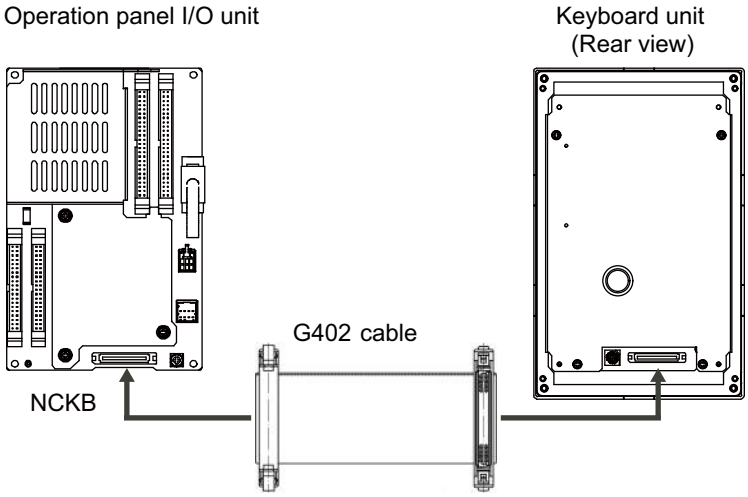
The method for connecting to each unit and device from the keyboard unit is briefly explained in this chapter.

8.1 Keyboard Unit Connection System Drawing



8.2 Connecting with Operation Panel I/O Unit

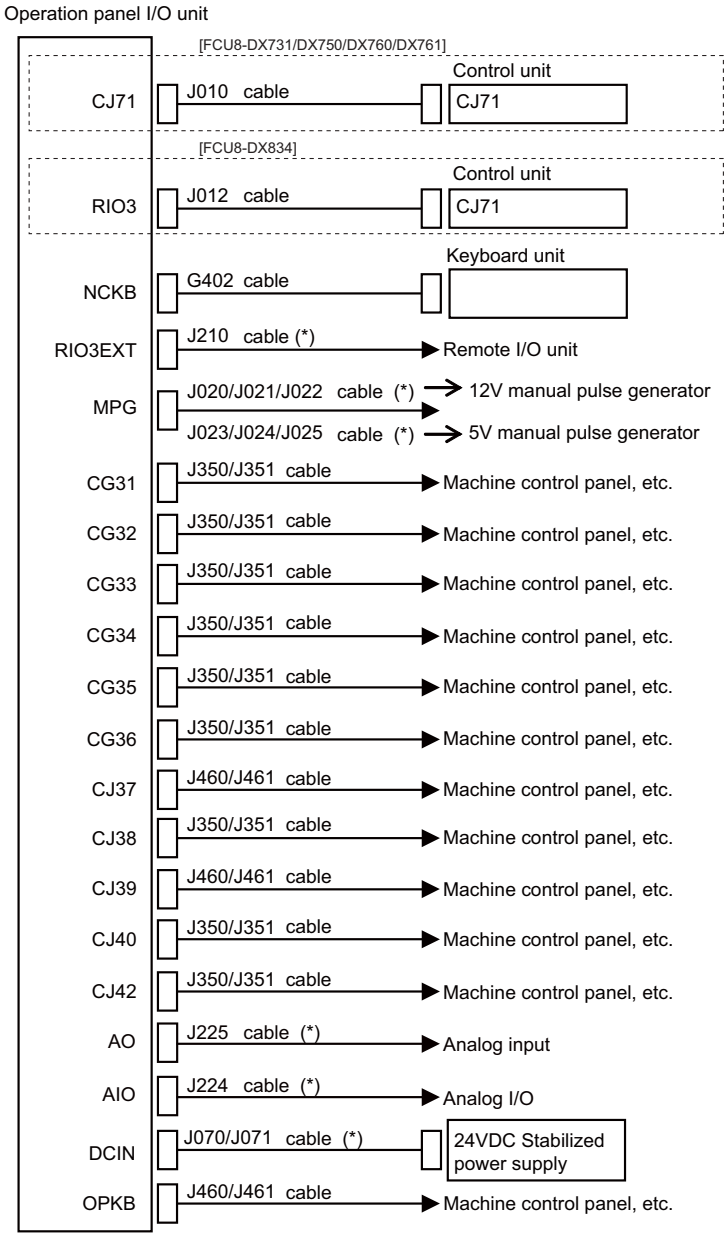
Connect the operation panel I/O unit to connector of the keyboard unit.



9

Connection of Operation Panel I/O Unit

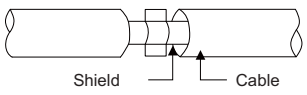
9.1 Operation Panel I/O Unit Connection System Drawing



(Note 1) For the connection of machine operation panel, refer to the chapter "Connection of Machine Operation Panel".

(Note 2) The section indicated with asterisk (*) indicates cable to be wired outside the operation panel.
Since the cable could be affected by the exogenous noise depending on the environment, the following noise countermeasure is recommended.

Expose the cable by removing a part of the cable sheath and use the shield clamp for the exogenous noise countermeasure.



When you cannot use the shield clamp, install a ferrite core as a substitute.

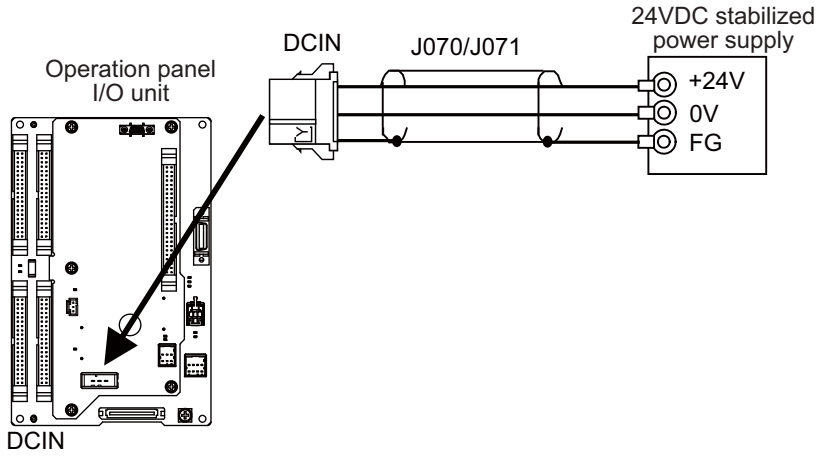
<Related item>

Shield clamp fitting: "EMC Installation Guidelines: EMC Countermeasure Parts: Shield Clamp Fitting"

Ferrite core: "EMC Installation Guidelines: EMC Countermeasure Parts: Ferrite Core"

9.2 Connecting with Power Supply

Connect 24VDC power supply (general-purpose stabilized power supply) to the operation panel I/O unit.



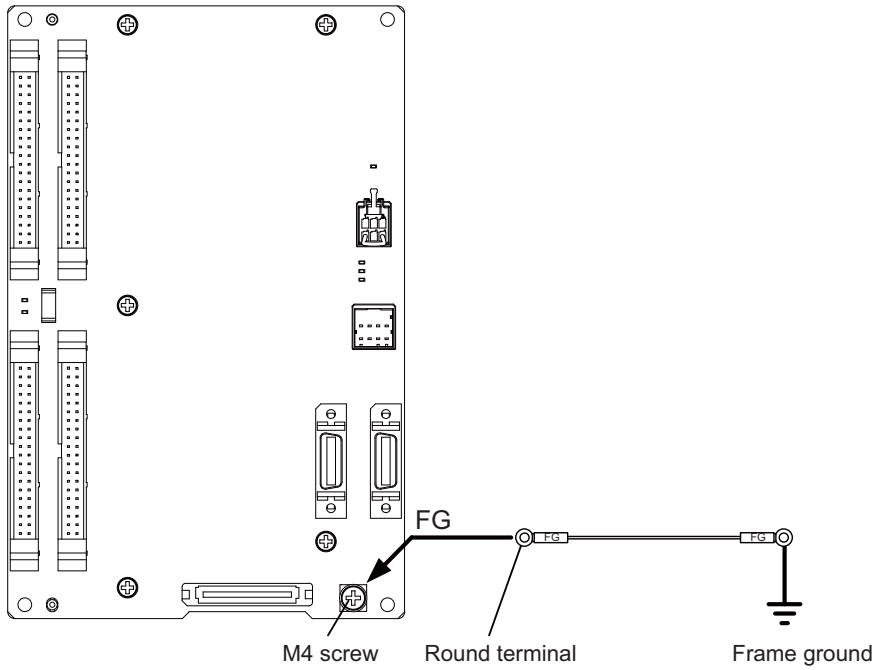
<Related items>

Cable connection drawing: "Cable: J070/J071 Cable"

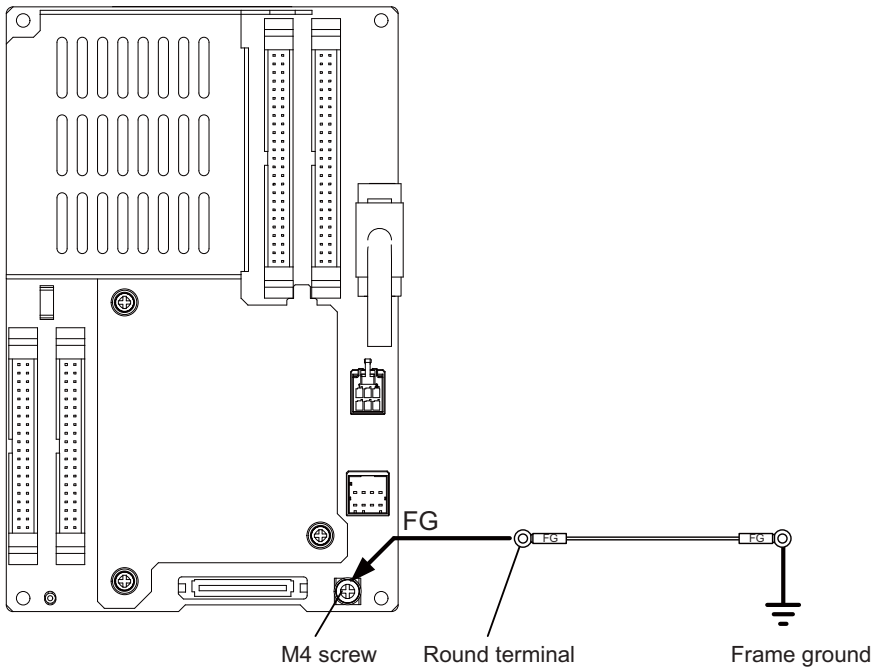
Connector pin assignment: "General Specifications: Operation Panel I/O Unit" (DCIN connector)

9.3 Connecting with Frame Ground

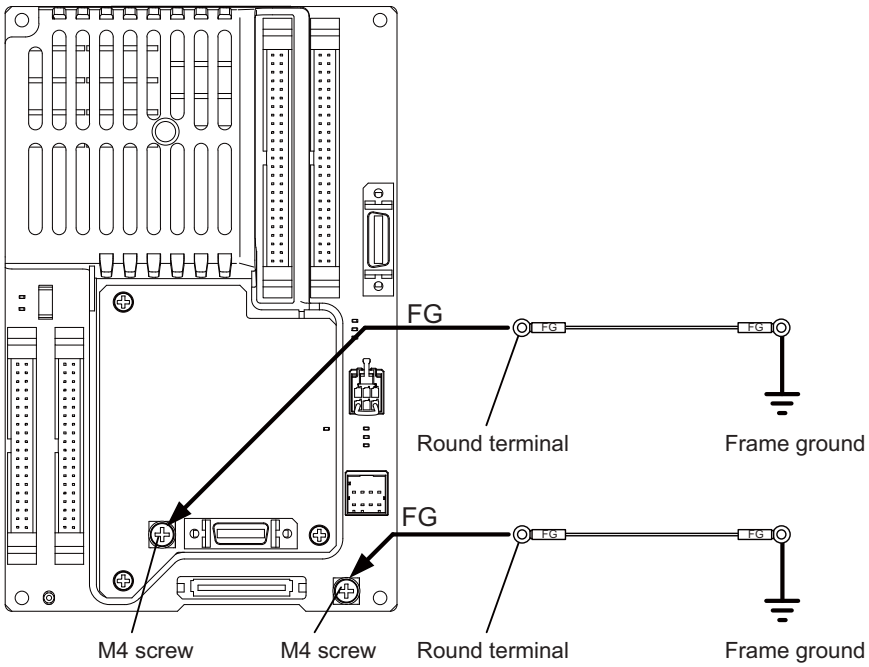
[FCU8-DX731]



[FCU8-DX750 / FCU8-DX760]

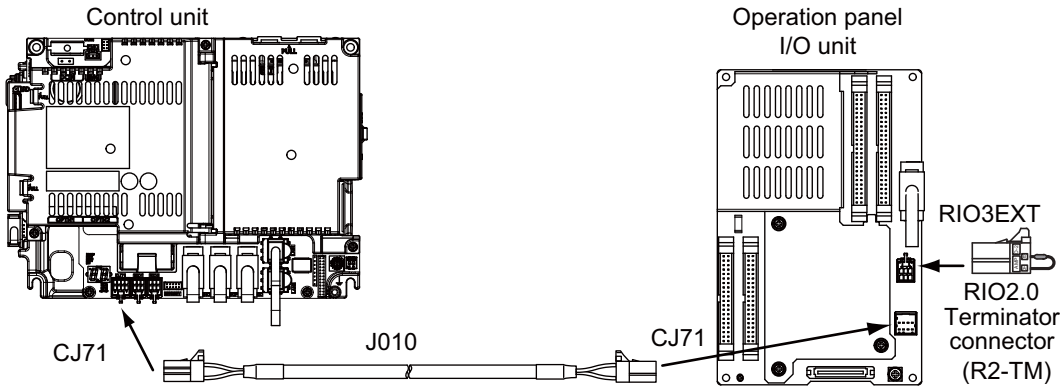


[FCU8-DX761]


FG
FG
FG
Round terminal
Frame ground
FG
FG
FG
M4 screw
M4 screw
Round terminal
Frame ground

9.4 Connecting with Control Unit

Connect the control unit to CJ71 connector of the operation panel I/O unit.



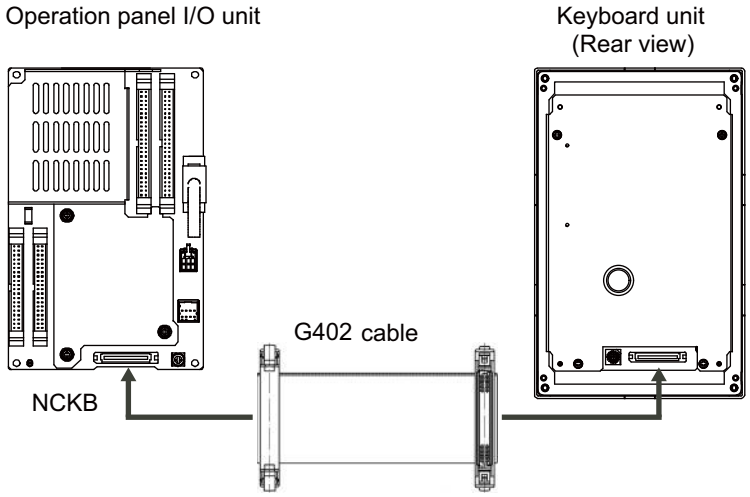
<Related items>

Cable connection drawing: "Cable: J010 Cable"

Connector pin assignment: "General Specifications: Operation Panel I/O Unit" (CJ71 connector)

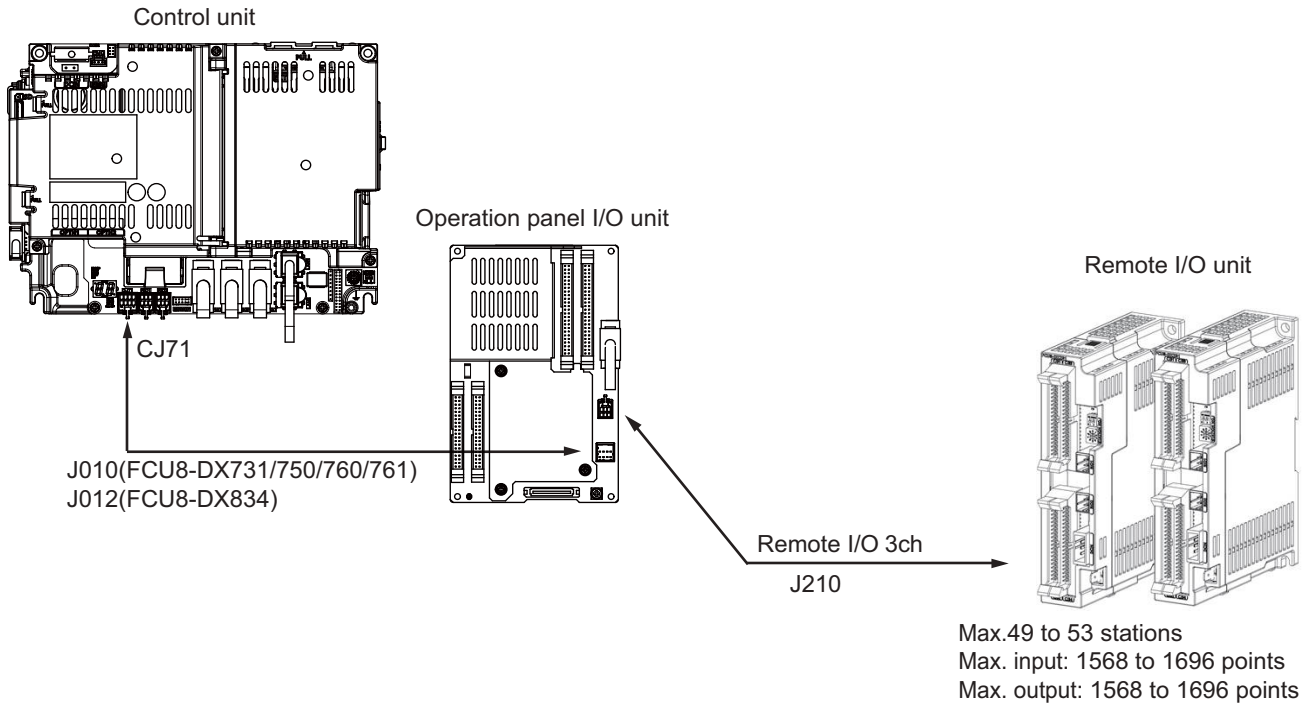
9.5 Connecting with Keyboard Unit

Connect the keyboard unit to NCKB connector of the operation panel I/O unit.



9.6 Connecting with Remote I/O Unit

Connect the remote I/O unit to RIO3EXT connector of the operation panel I/O unit.



Operation panel I/O unit	RIO occupied stations
FCU8-DX731	1, 3, 7 to 12, 20 to 22
FCU8-DX750	1 to 3, 7 to 12, 20 to 22
FCU8-DX760	1 to 4, 7 to 12, 20 to 22
FCU8-DX761	1 to 5, 7 to 12, 20 to 22
FCU8-DX834	1 to 4, 7 to 14, 20 to 22

<Related items>

Cable connection drawing: "Cable: J210 Cable"

Connector pin assignment: "General Specifications: Operation Panel I/O Unit" (RIO3EXT connector)

(Note) The maximum connectable number of remote I/O units is 32.

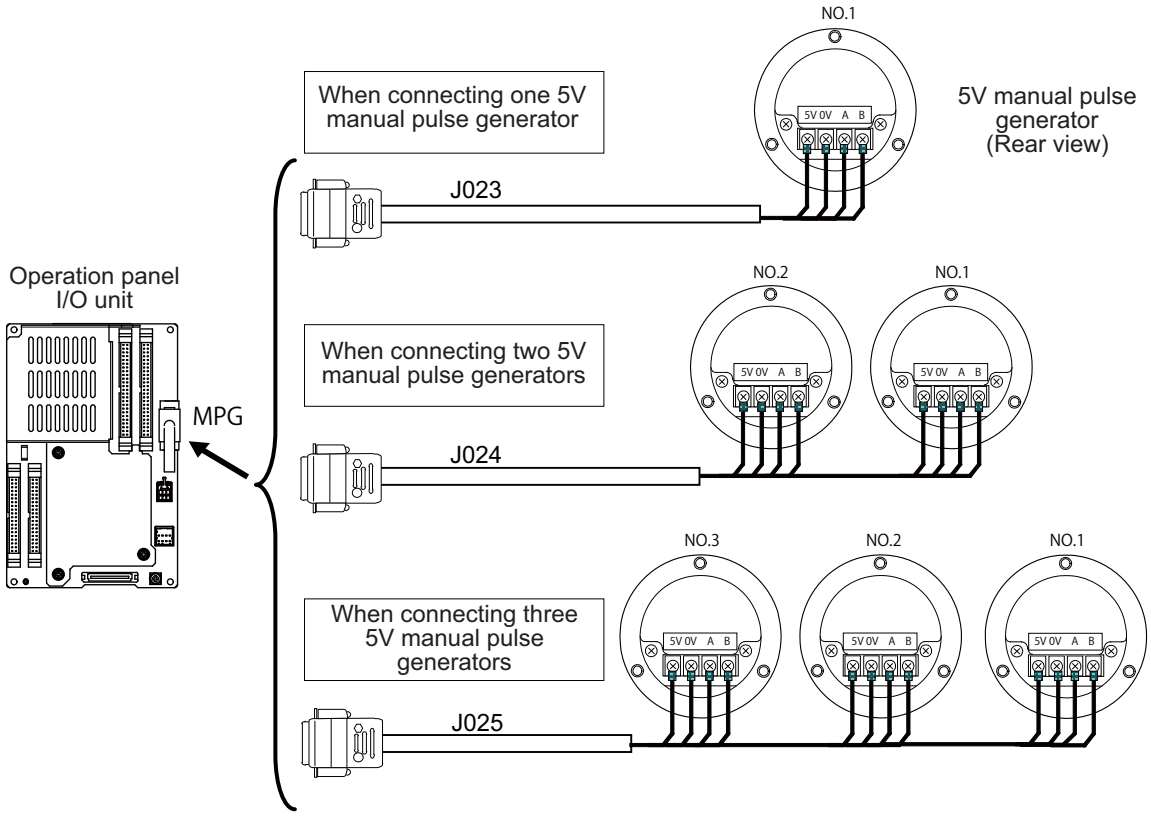
9.7 Connecting with Manual Pulse Generator (MPG)

Connect the manual pulse generator to MPG connector of the operation panel I/O unit.
Both 5V power supply type (UFO-01-2Z9) and 12V power supply type (HD60C) manual pulse generator can be used.
Take the maximum cable length, etc. into consideration when selecting.

(Note) Set one of the following parameters which is suitable for your manual pulse generator.
- 5V manual pulse generator (UFO-01-2Z9) : #1240 set12/bit0 = 1 (100 pulse/rev)
-12V manual pulse generator (HD60C) : #1240 set12/bit0 = 0 (25 pulse/rev)

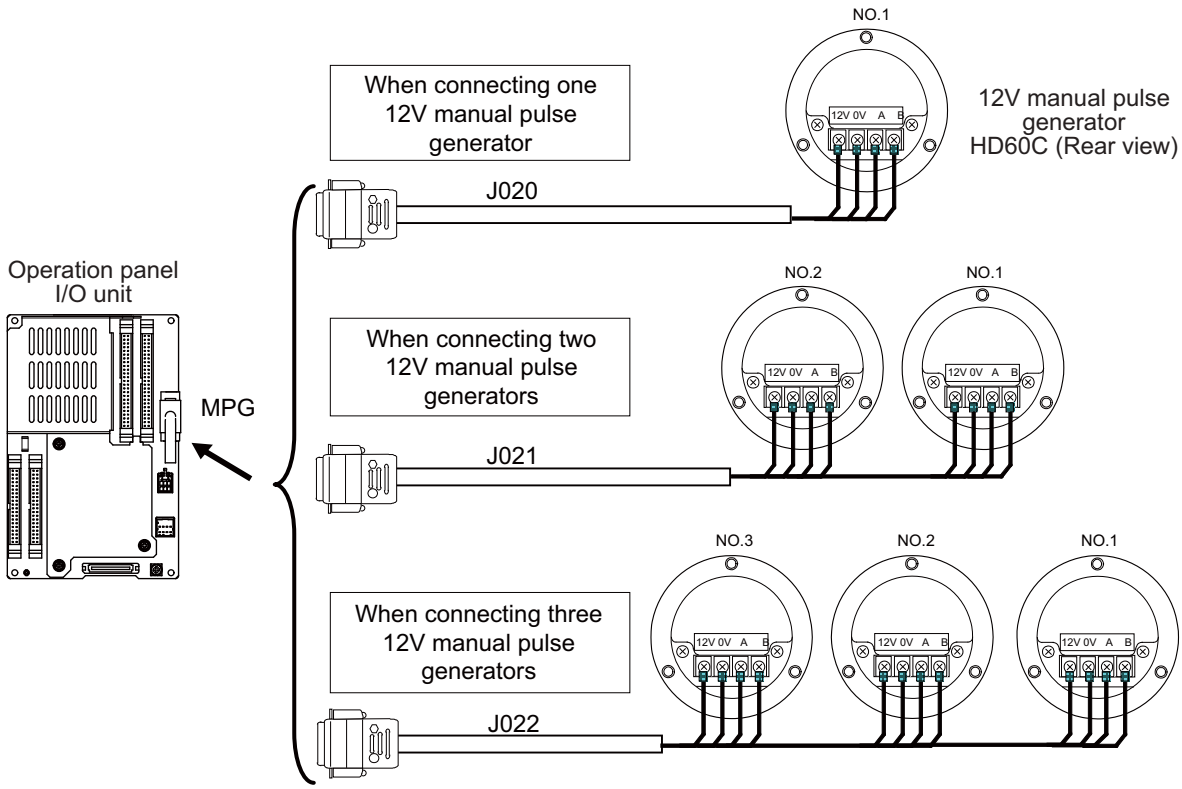
(1) Connecting with 5V manual pulse generator (maximum cable length: 20m)

Connect the 5V manual pulse generator to the connector MPG.



(2) Connecting with 12V manual pulse generator (maximum cable length: 50m)

Connect the 12V manual pulse generator to the connector MPG.



(Note 1) When selecting a manual pulse generator, make sure that its case and 0V terminal are insulated.

(Note 2) Select 25pulse/rev or 100pulse/rev on the parameter screen.

<Related items>

Cable connection drawing: "Cable: J020/J021/J022 Cable" and "Cable: J023/J024/J025 Cable"

Connector pin assignment: "General Specifications: Operation Panel I/O Unit" (MPG connector)

9.7.1 Handle Numbers

There are two types of the handle numbers assignment: automatic assignment and arbitrary assignment.

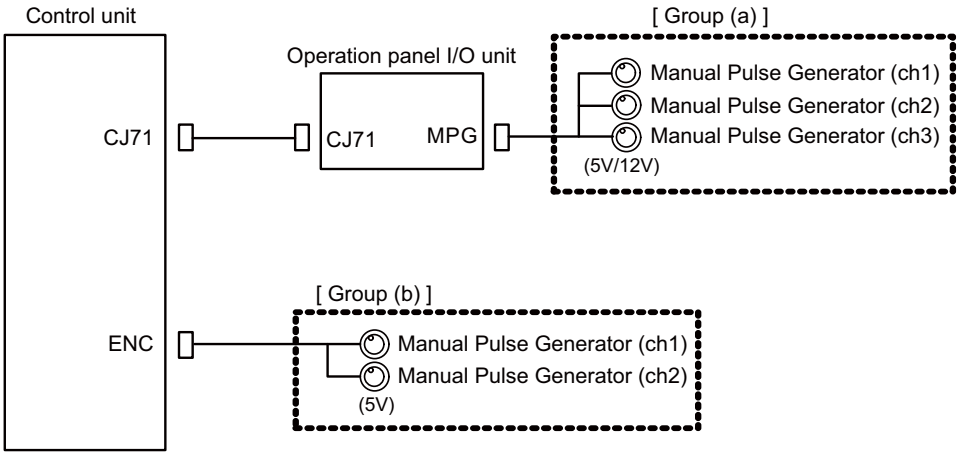
[Automatic assignment]

Set all the parameters from "#1395 H1_pno (1st handle selection)" to "#1397 H3_pno (3rd handle selection)" to "0000".

An example is shown below.

"ENC": Connector on control unit (two channels), "MPG": Connector on operation panel I/O unit (Up to three channels)

Operation panel I/O unit	Handle assignment		
	1st handle	2nd handle	3rd handle
Used	Group (a) ch1	Group (a) ch2	Group (a) ch3
Not used	Group (b) ch1	Group (b) ch2	



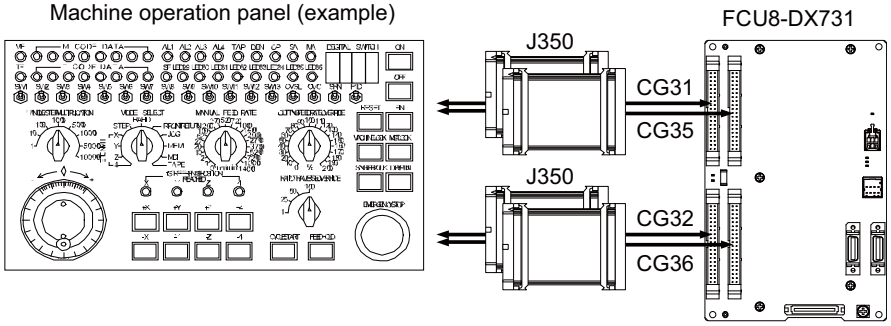
[Arbitrary assignment]

Assign the handle I/F arbitrary according to the setting values of the parameters "#1395 H1_pno (1st handle selection)" to "#1397 H3_pno (3rd handle selection)".

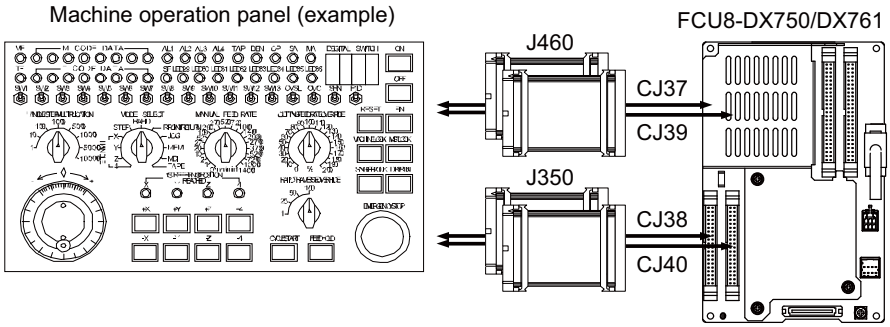
9.8 Connecting with Machine Operation Panel

Connect the machine operation panel to CG31/CG32/CG35/CG36/CJ37/CJ38/CJ39/CJ40/CJ42/OPKB connector of the operation panel I/O unit.

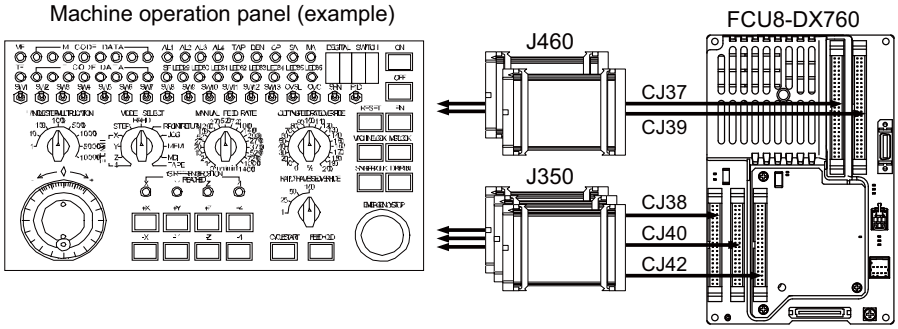
[FCU8-DX731]



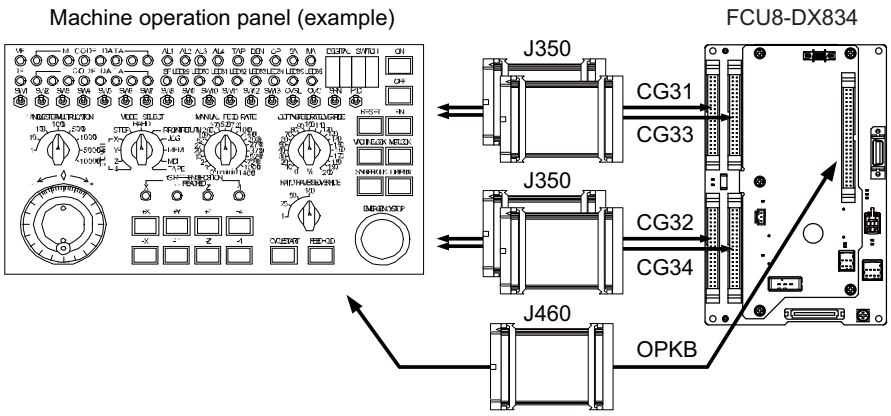
[FCU8-DX750/DX761]



[FCU8-DX760]



[FCU8-DX834]



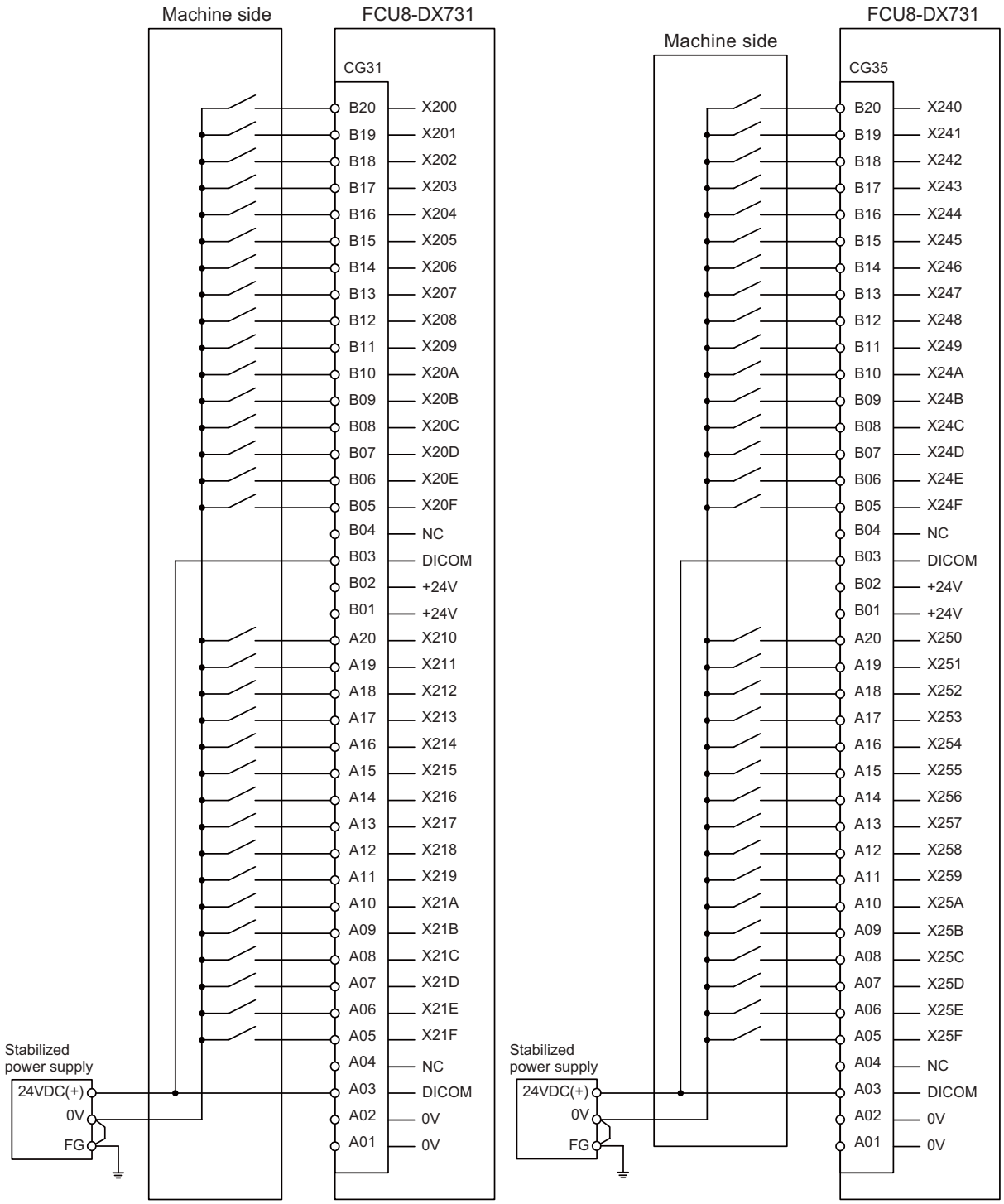
<Related items>

Cable connection drawing: "Cable: J350 Cable", "Cable: J460 Cable"

Connector pin assignment: "General Specifications: Operation Panel I/O Unit" (CG31/CG32/CG35/CG36/CJ37/CJ38/CJ39/CJ40/CJ42/OPKB connector)

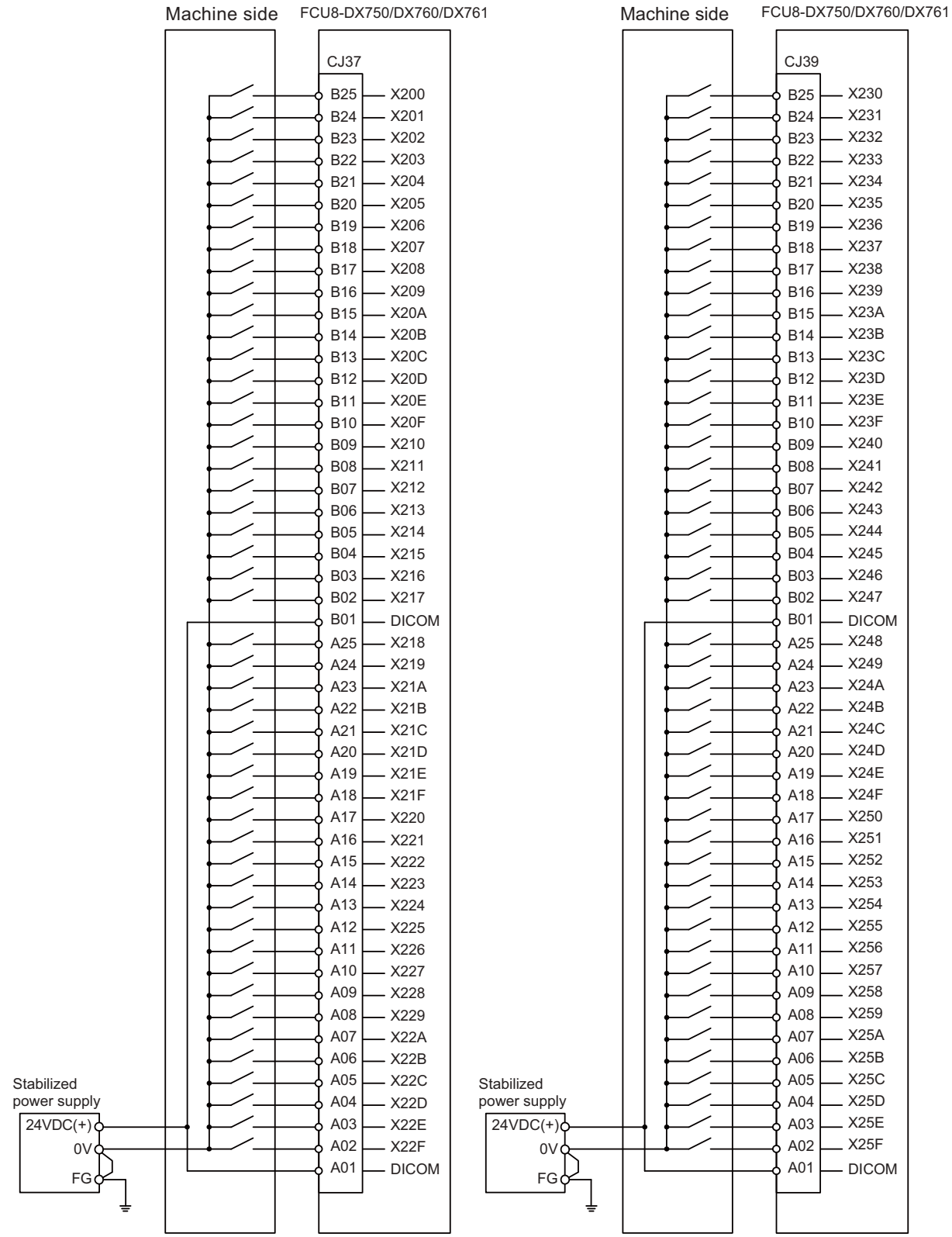
9.8.1 Wiring for 24V Common Input

[FCU8-DX731]



For connection details, refer to the descriptions on machine input connector pin assignment in "(1) CG31 (Machine signal input)" or "(5) CG35 (Machine signal input)" of "General Specifications: Operation Panel I/O Unit".

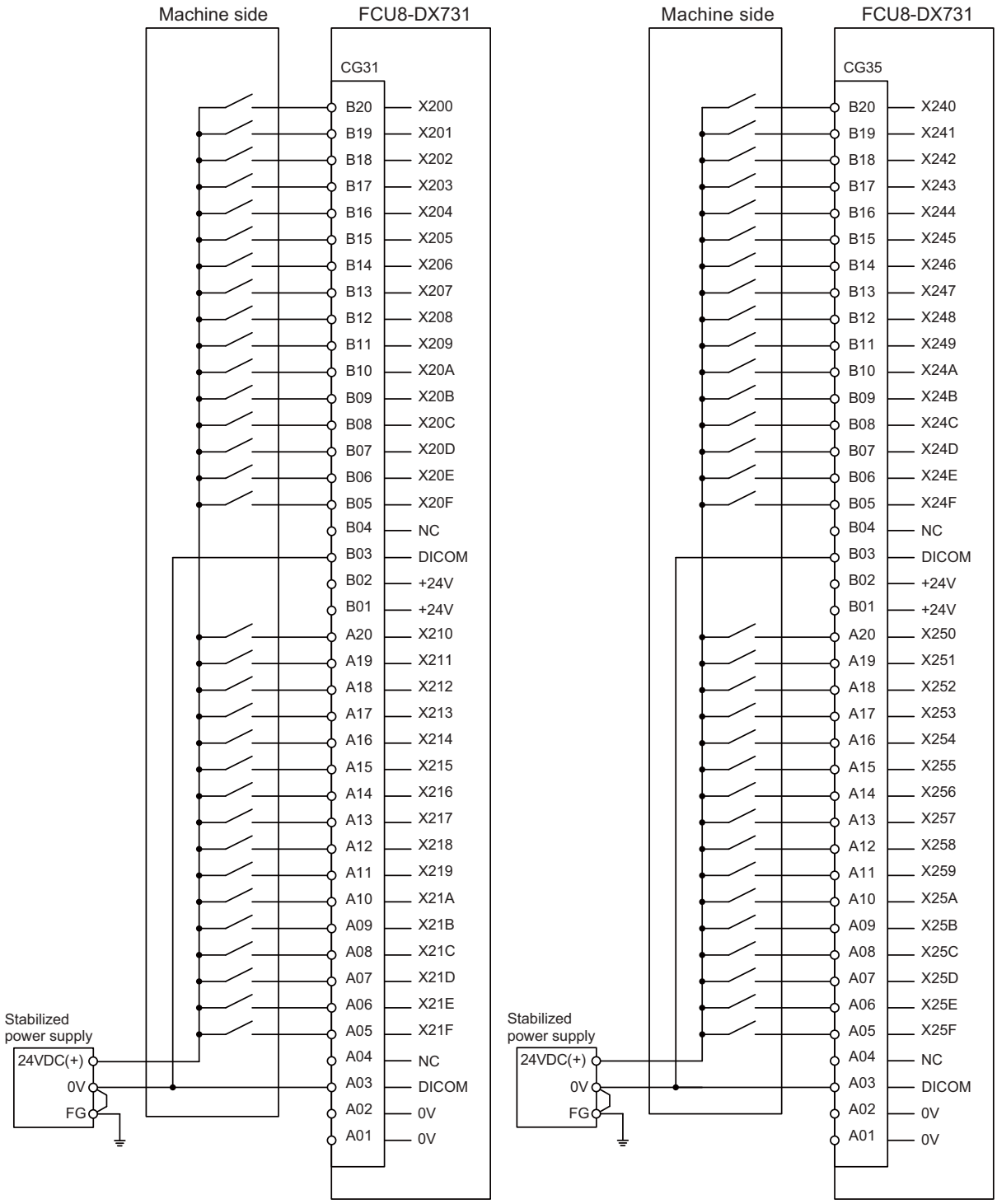
[FCU8-DX750 / FCU8-DX760 / FCU8-DX761]



For connection details, refer to the descriptions on machine input connector pin assignment in "(7) CJ37 (Machine signal input)" or "(9) CJ39 (Machine signal input)" of "General Specifications: Operation Panel I/O Unit".

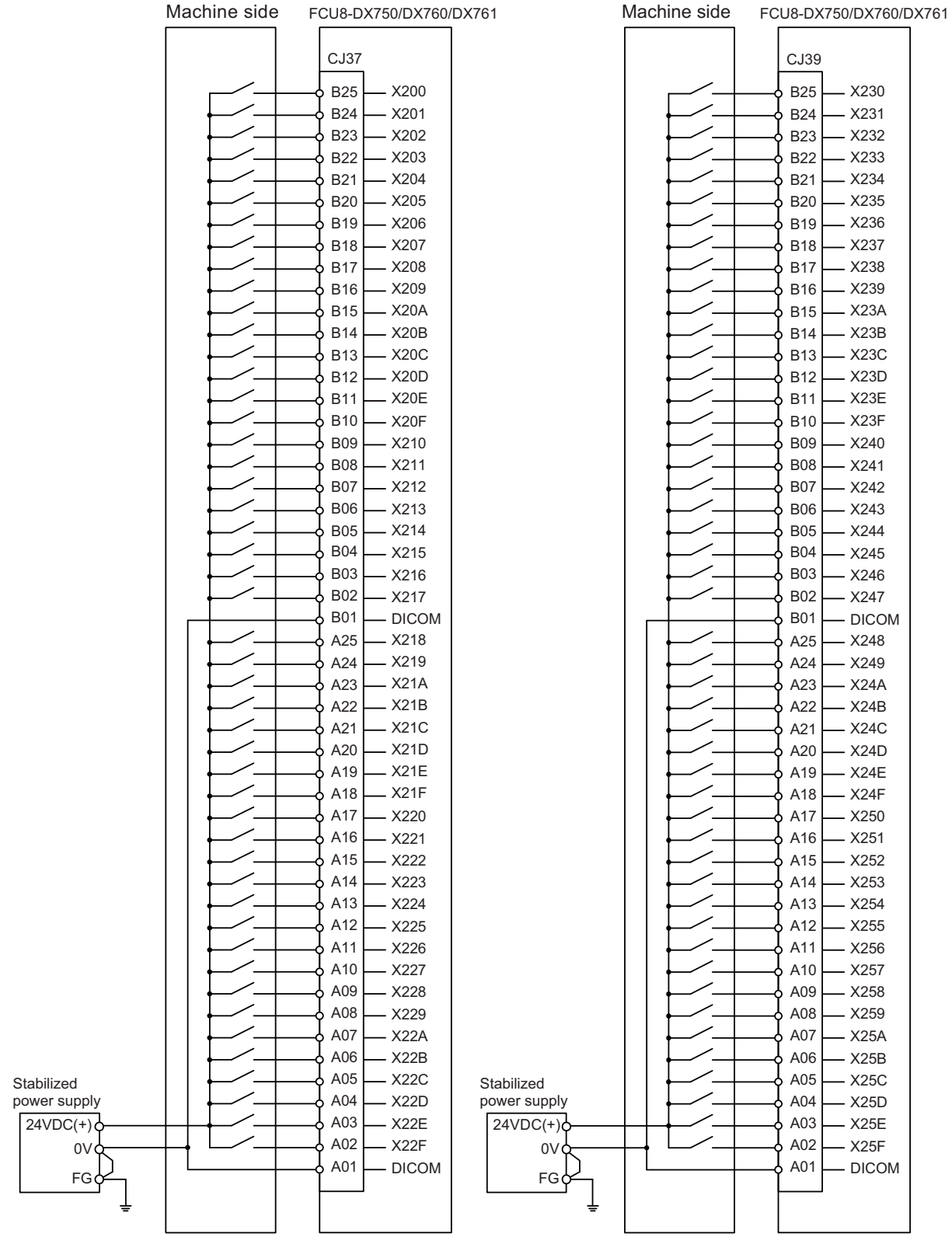
9.8.2 Wiring for 0V Common Input

[FCU8-DX731]



For connection details, refer to the descriptions on machine input connector pin assignment in "(1) CG31 (Machine signal input)" or "(5) CG35 (Machine signal input)" of "General Specifications: Operation Panel I/O Unit".

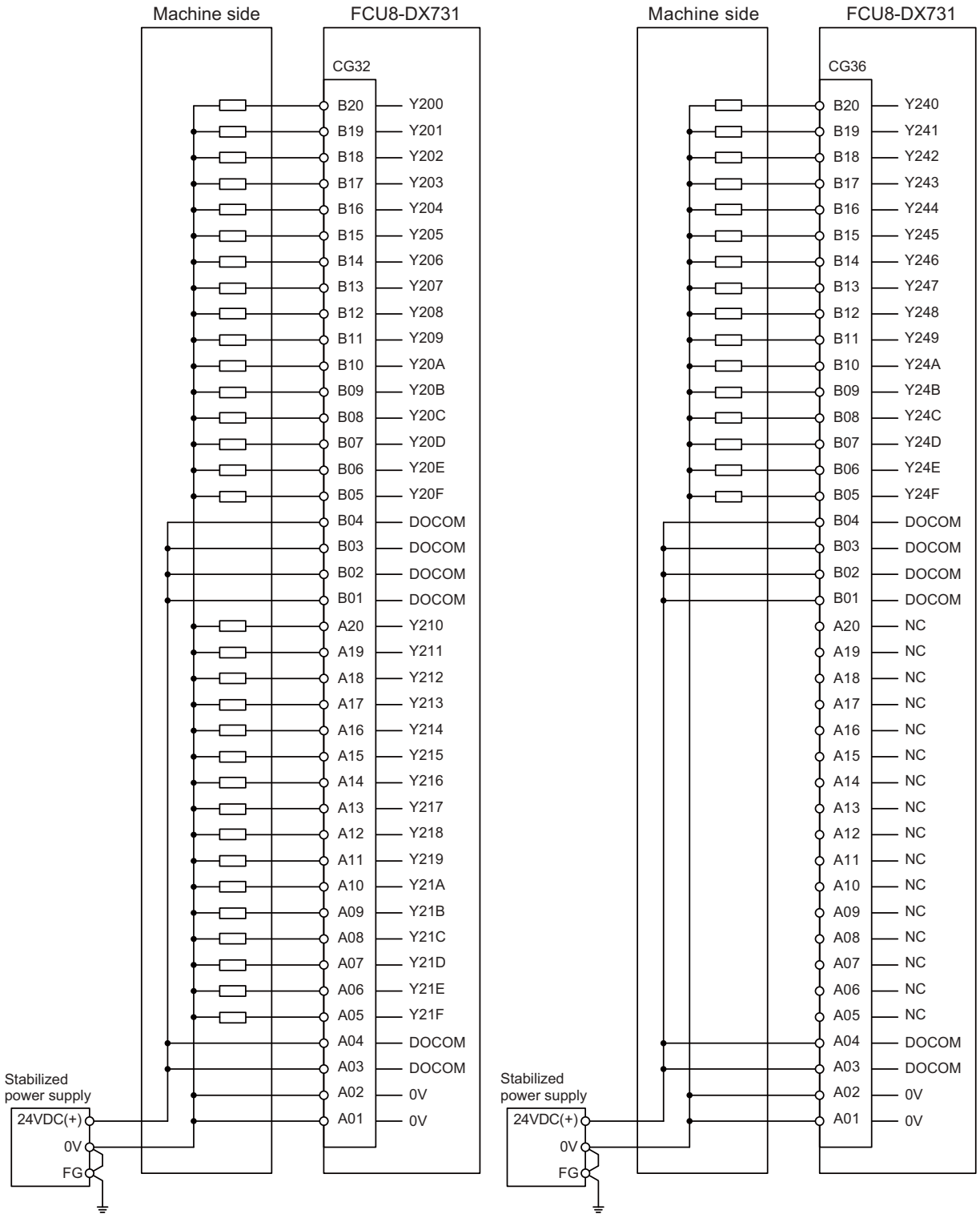
[FCU8-DX750 / FCU8-DX760 / FCU8-DX761]



For connection details, refer to the descriptions on machine input connector pin assignment in "(7) CJ37 (Machine signal input)" or "(9) CJ39 (Machine signal input)" of "General Specifications: Operation Panel I/O Unit".

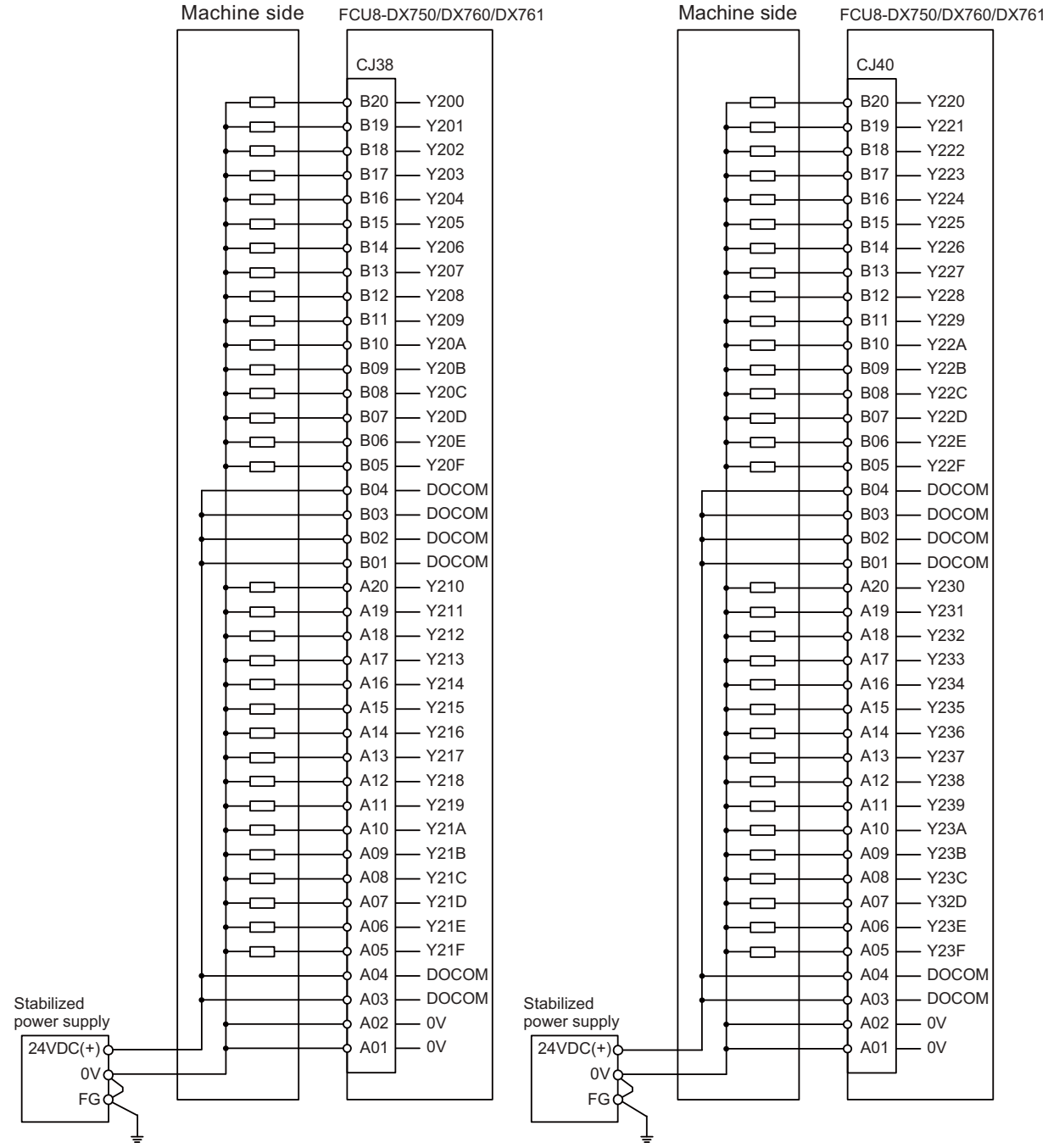
9.8.3 Wiring for Source Type Output

[FCU8-DX731]



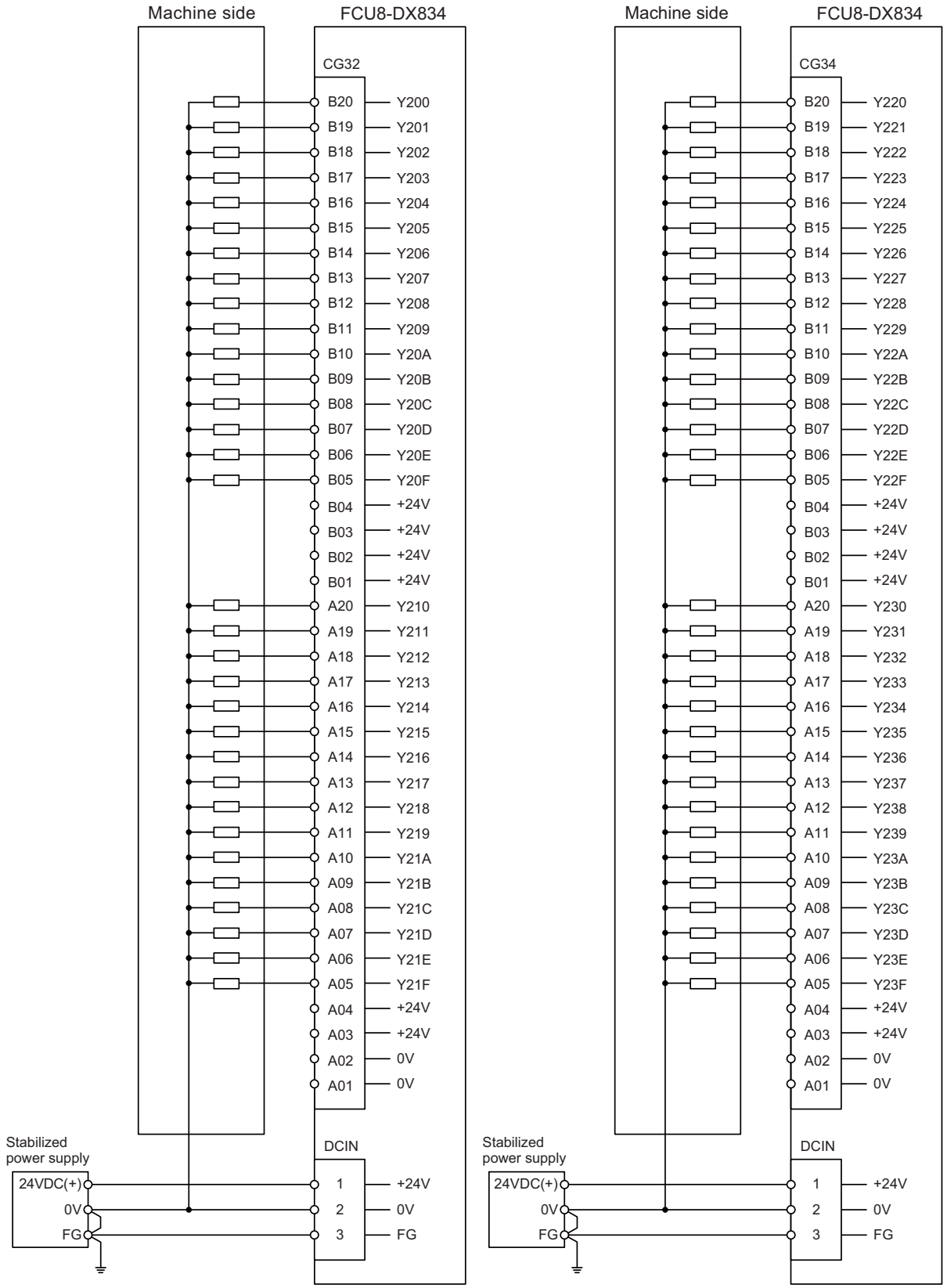
For connection details, refer to the descriptions on machine input connector pin assignment in "(2) CG32 (Machine signal output)" or "(6) CG36 (Machine signal output)" of "General Specifications: Operation Panel I/O Unit".

[FCU8-DX750 / FCU8-DX760 / FCU8-DX761]



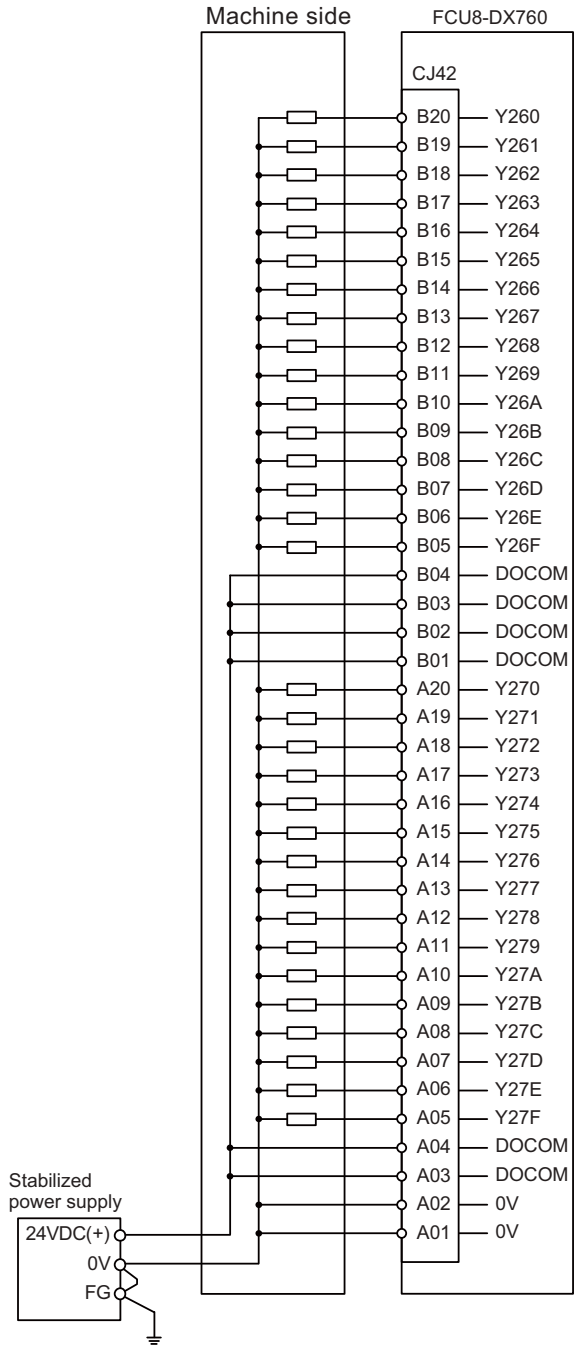
For connection details, refer to the descriptions on machine output connector pin assignment in "(8) CJ38 (Machine signal output)" or "(10) CJ40 (Machine signal output)" of "General Specifications: Operation Panel I/O Unit".

[FCU8-DX834]



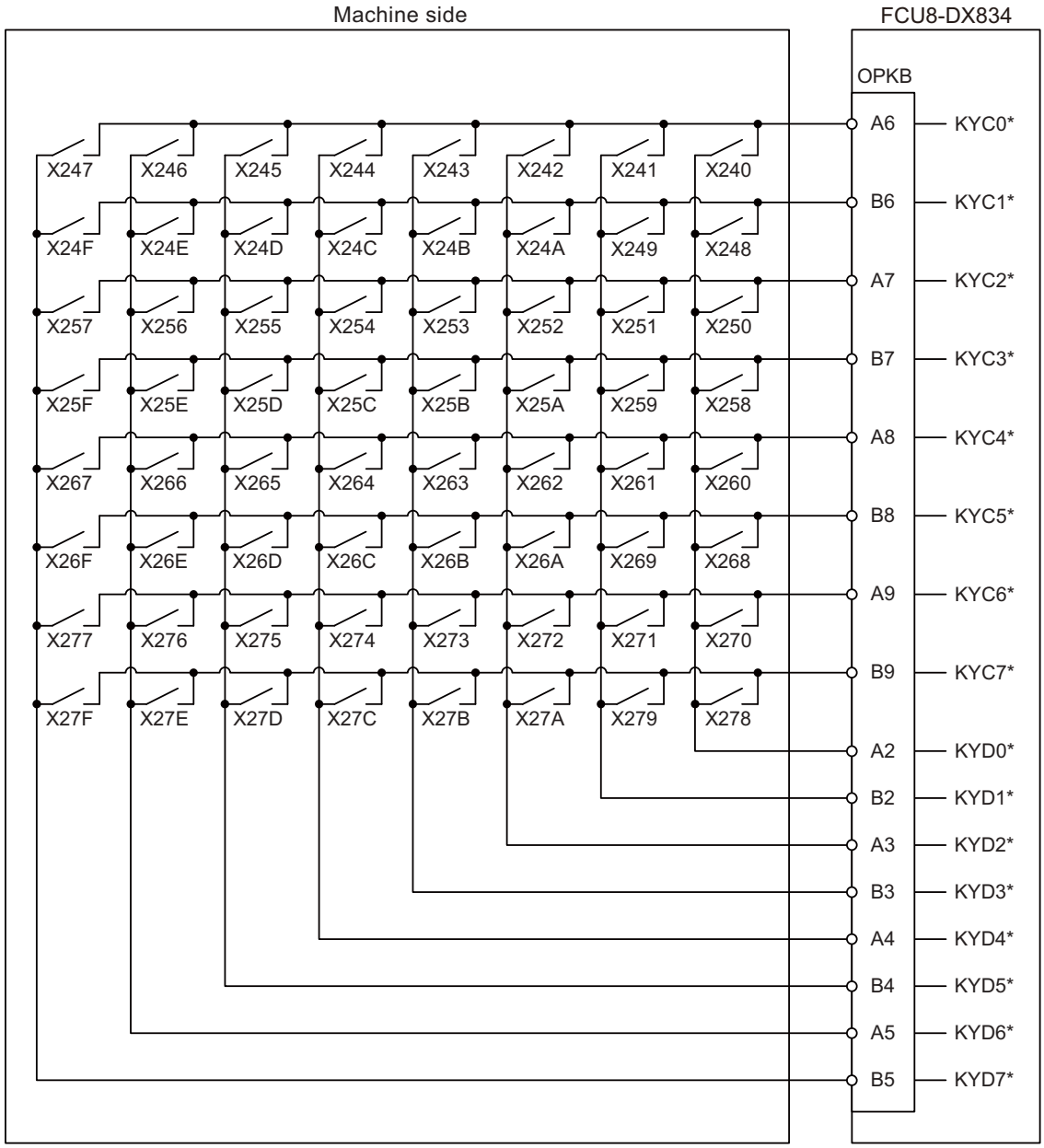
For connection details, refer to the descriptions on machine output connector pin assignment in "(2) CG32 (Machine signal output)" or "(4) CG34 (Machine signal output)" of "General Specifications: Operation Panel I/O Unit".

9.8.4 Example of Wiring CJ42 (FCU8-DX760)



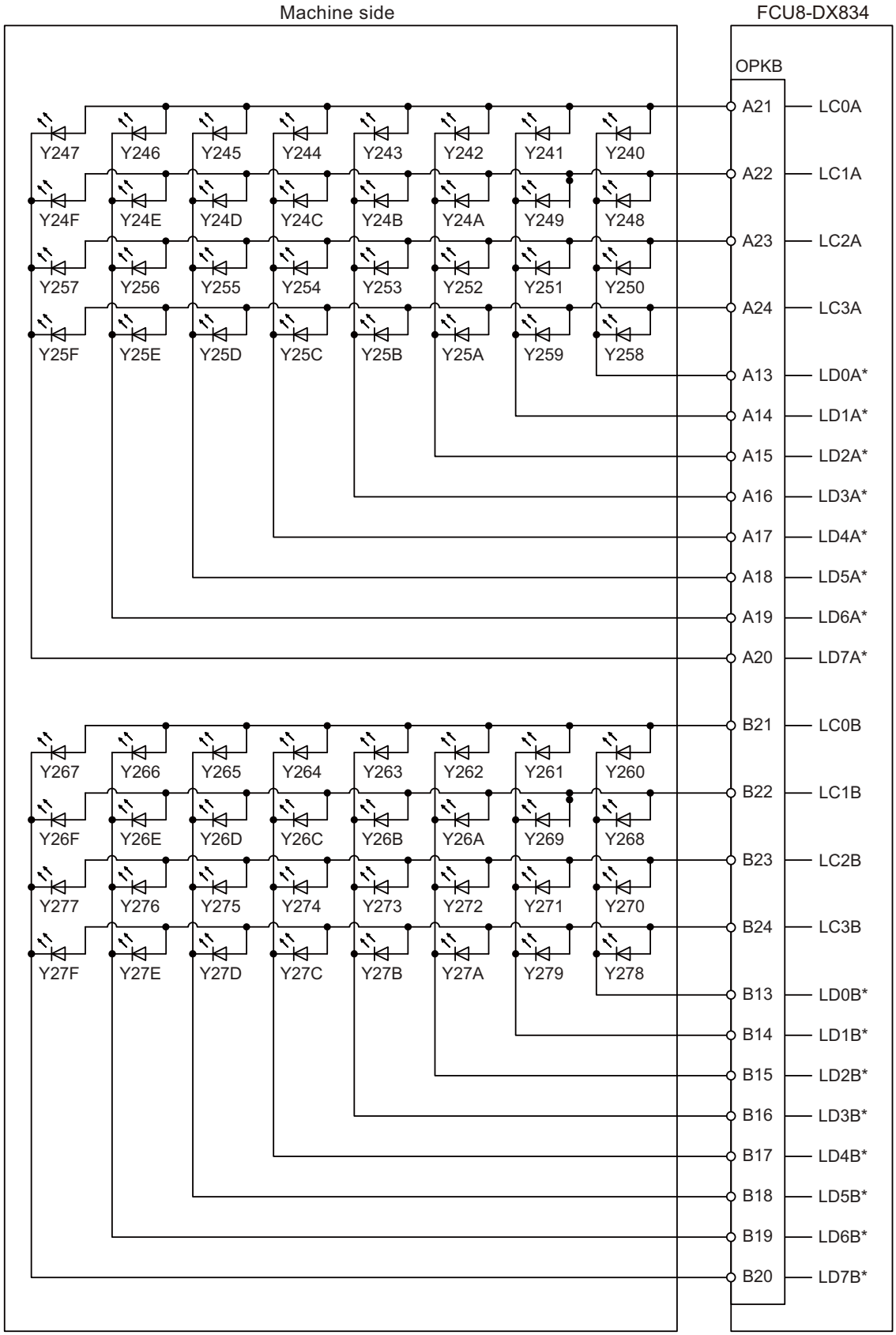
For connection details, refer to the descriptions on machine output connector pin assignment in "(11) CJ42 (Machine signal output)" of "General Specifications: Operation Panel I/O Unit".

9.8.5 Connection with the scan input signal (FCU8-DX834)



For connection details, refer to the descriptions on machine output connector pin assignment in "(19) OPKB (Scan input, Scan output)" of "General Specifications: Operation Panel I/O Unit".

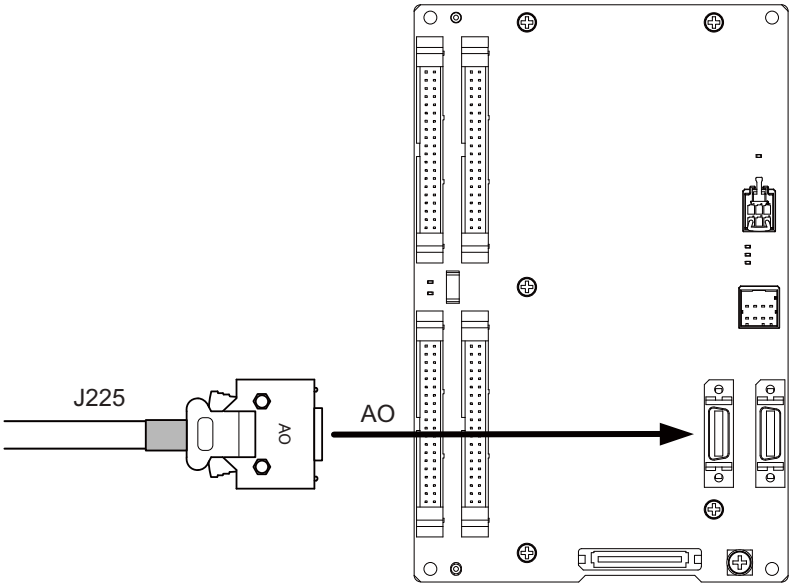
9.8.6 Connection with the scan output signal (FCU8-DX834)



For connection details, refer to the descriptions on machine output connector pin assignment in "(19) OPKB (Scan input, Scan output)" of "General Specifications: Operation Panel I/O Unit".

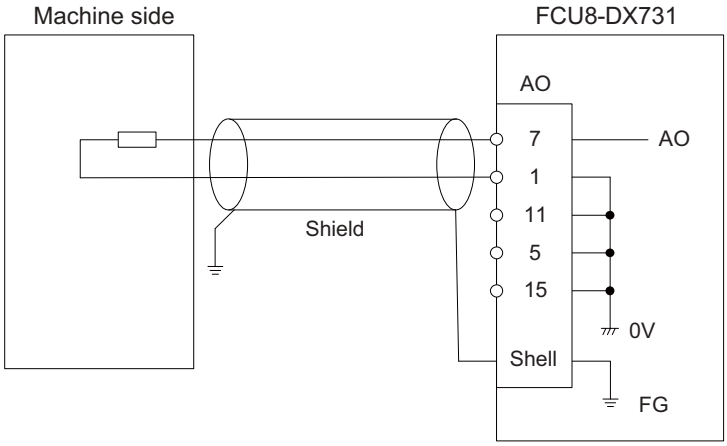
9.9 Connecting with Analog Output Signal (FCU8-DX731)

For the analog output signals, connect J225 cable to the AO connector of FCU8-DX731.
The analog output signals are available to connect up to one point for the input, and up to one point for the output.



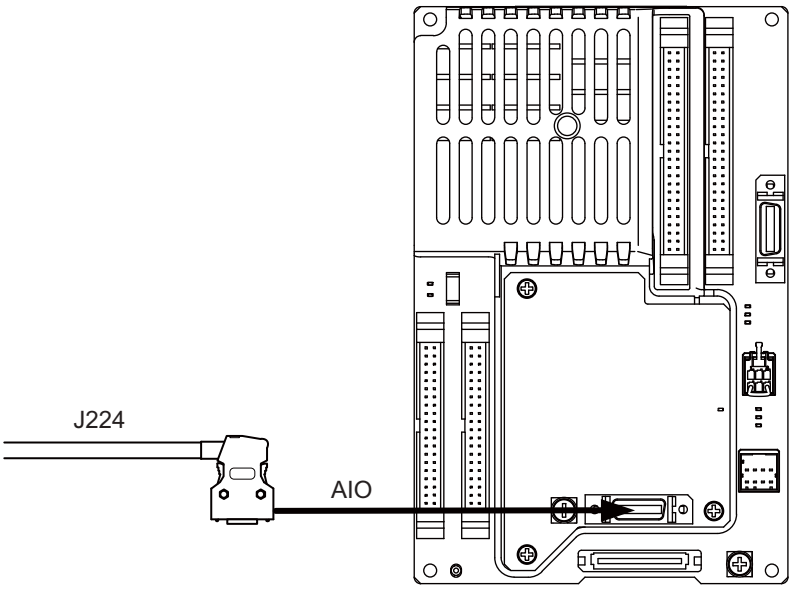
<Related items>

Cable connection drawing: "Cable: J225 Cable"
Connector pin assignment: "General Specifications: Operation Panel I/O Unit" (AO connector)



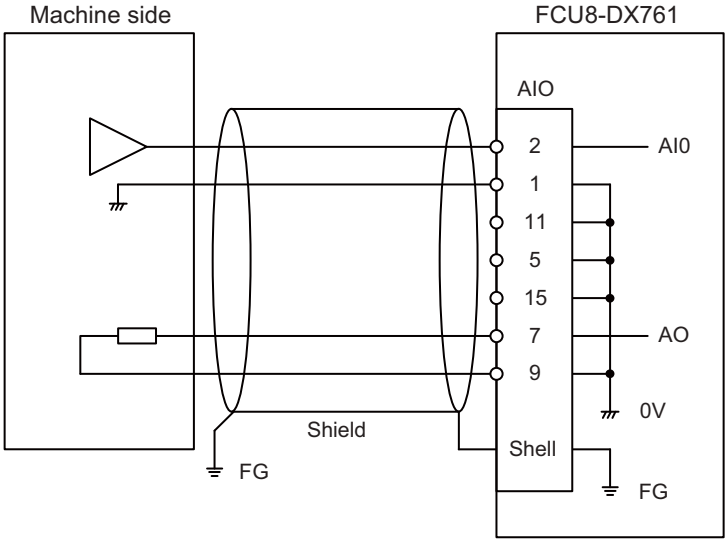
9.10 Connecting with Analog I/O Signal (FCU8-DX761)

For the analog input/output signals, connect J224 cable to the AIO connector of FCU8-DX761.
The analog input/output signals are available to connect up to one point for the input, and up to one point for the output.



<Related items>

Cable connection drawing: "Cable: J224 Cable"
Connector pin assignment: "General Specifications: Operation Panel I/O Unit" (AIO connector)

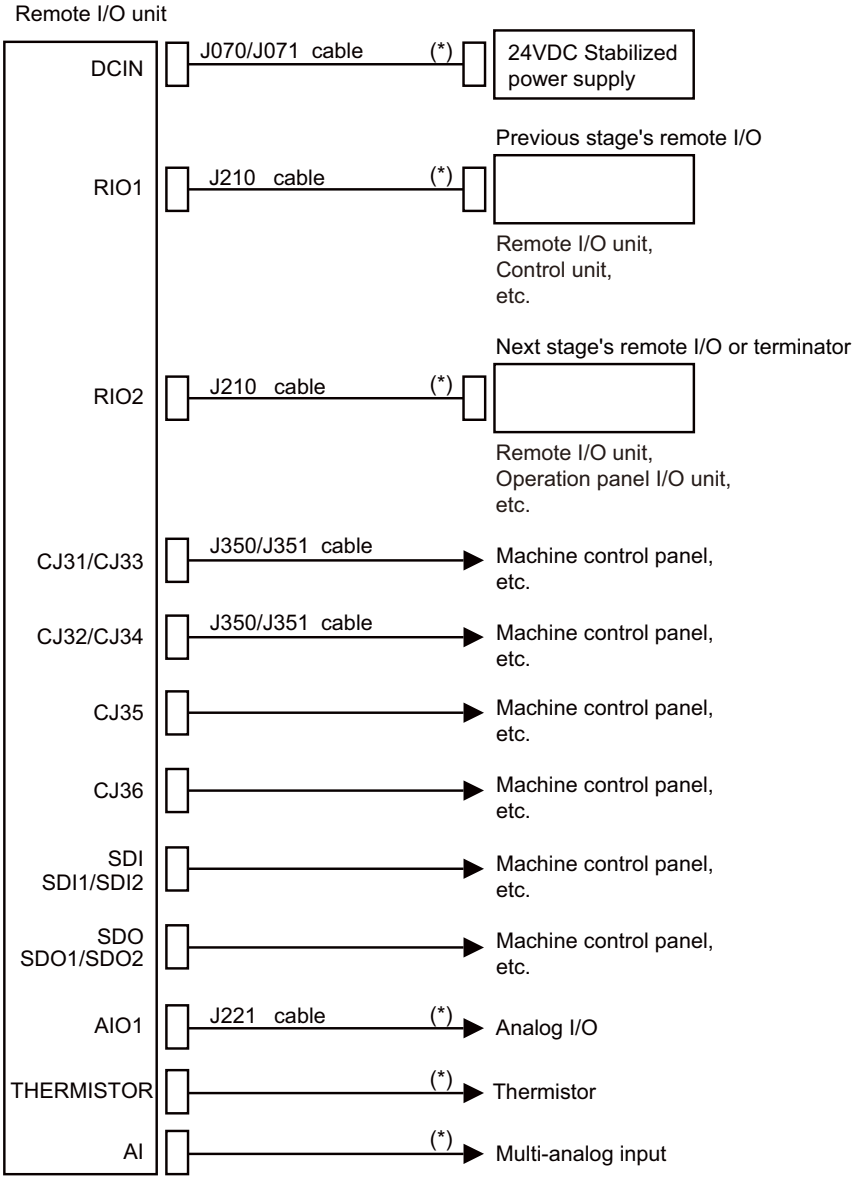


10

Connection of Remote I/O Unit

This chapter describes the connection of the remote I/O unit and machine control signals.

10.1 Remote I/O Unit Connection System Drawing

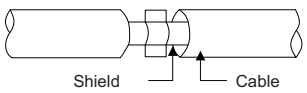


(Note 1) The mounted connector differs depending on the unit. Refer to the following chapter for which of the connector is mounted.
"General Specifications: Remote I/O unit"

(Note 2) For the connection of machine operation panel, refer to the chapter "Connection of Machine Operation Panel".

(Note 3) The section indicated with asterisk (*) indicates cable to be wired outside the electric cabinet.
Since the cable could be affected by the exogenous noise depending on the environment, the following noise countermeasure is recommended.

Expose the cable by removing a part of the cable sheath and use the shield clamp for the exogenous noise countermeasure.



When you cannot use the shield clamp, install a ferrite core as a substitute.

<Related item>

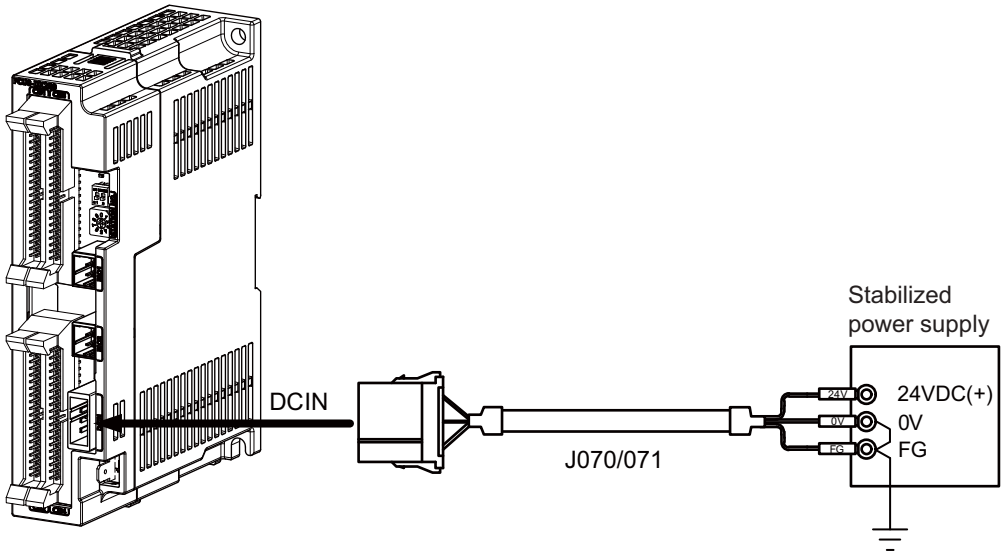
Shield clamp fitting: "EMC Installation Guidelines: EMC Countermeasure Parts: Shield Clamp Fitting"

Ferrite core: "EMC Installation Guidelines: EMC Countermeasure Parts: Ferrite Core"

10.2 Connecting with Power Supply

Connect 24VDC power supply (general-purpose stabilized power supply) to the remote I/O unit.

[FCU8-DX220 / FCU8-DX230 / FCU8-DX231 / FCU8-DX202 / FCU8-DX213 / FCU8-DX213-1 / FCU8-DX654 / FCU8-DX654-1 / FCU8-DX408 / FCU8-DX409]

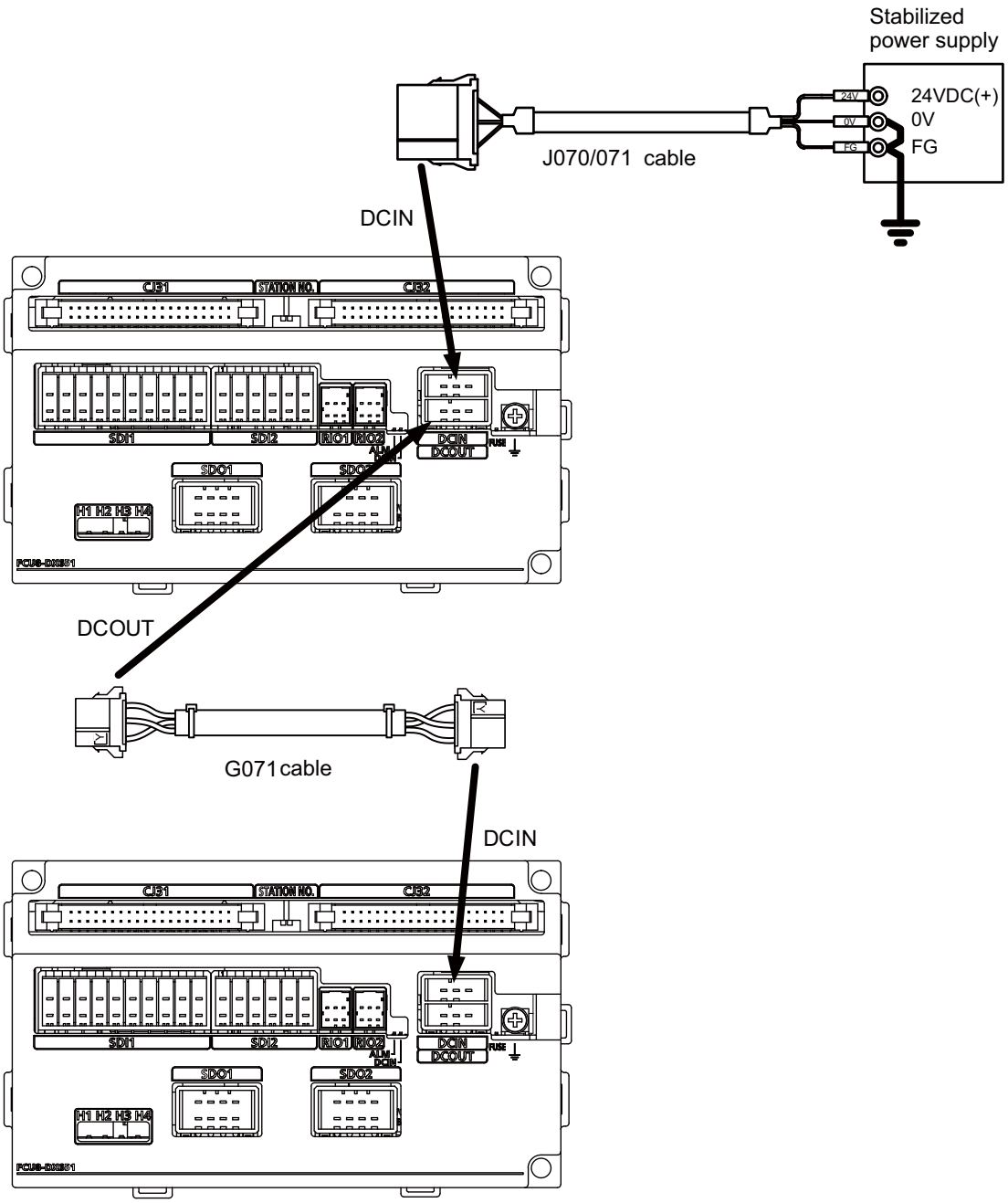


<Related items>

Cable connection drawing: "Cable : J070/J071 Cable"

Connector pin assignment: "General Specifications: Remote I/O Unit" (DCIN connector)

[FCU8-DX651]



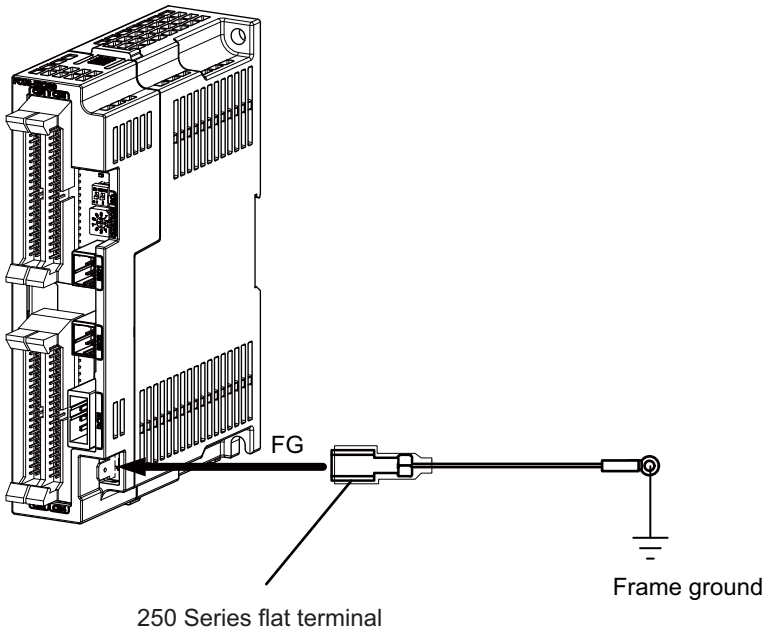
<Related items>

Cable connection drawing: "Cable : J070/J071 Cable", "Cable : G071 Cable"

Connector pin assignment: "General Specifications: Remote I/O Unit" (DCIN connector)

10.3 Connecting with Frame Ground

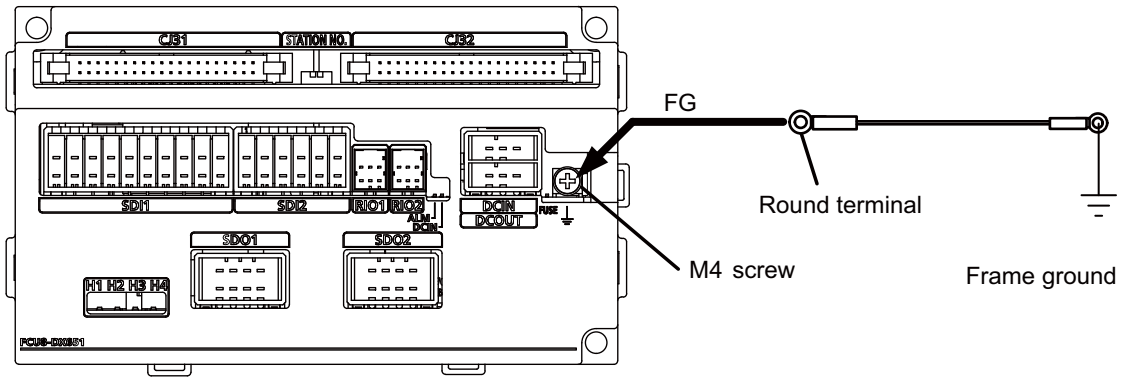
[FCU8-DX220 / FCU8-DX230 / FCU8-DX231 / FCU8-DX202 / FCU8-DX213 / FCU8-DX213-1 / FCU8-DX654 / FCU8-DX654-1 / FCU8-DX408 / FCU8-DX409]



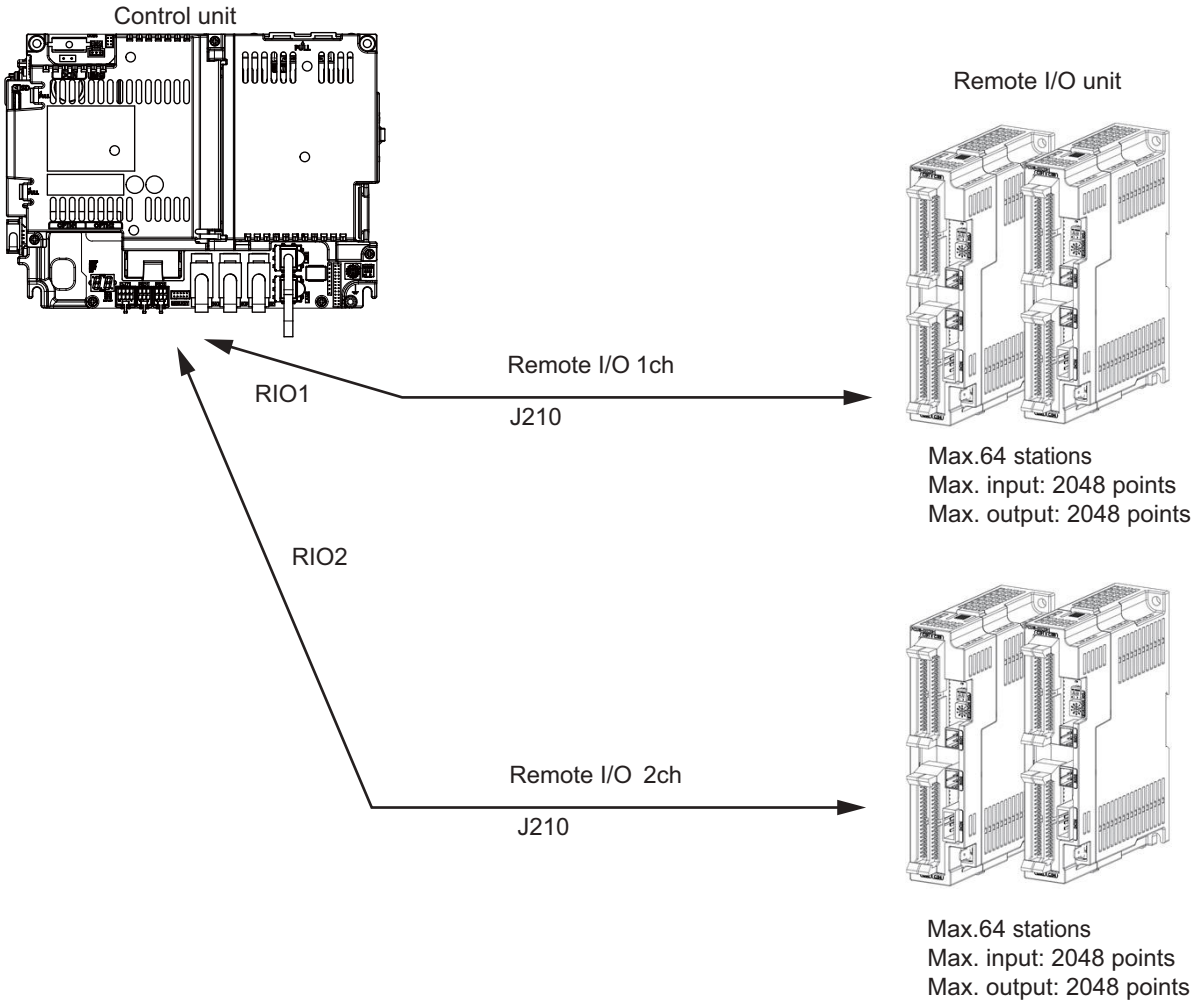
<Flat terminal type>

Flat terminal: 175021-1 / 175023-1
Protection cover: 174817-2
Manufacturer: TE Connectivity

[FCU8-DX651]



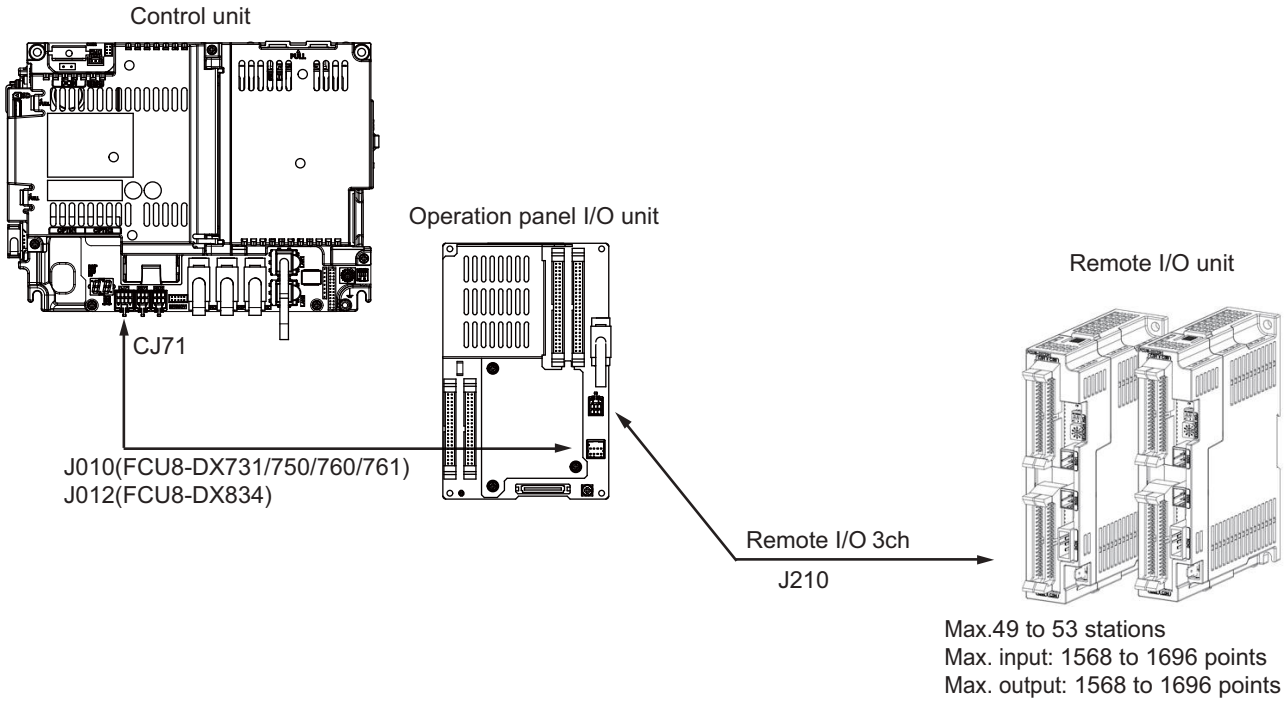
10.4 Connecting with Control Unit



(Note) Connect the J210 cable to the RIO1 or RIO2 connector of the control unit.
Check the connector position with the actual machine.

Refer to the "17.6.2 Connection and Station No. Setting on Remote I/O Unit" for the station No. setting.

10.5 Connecting with Operation Panel I/O Unit



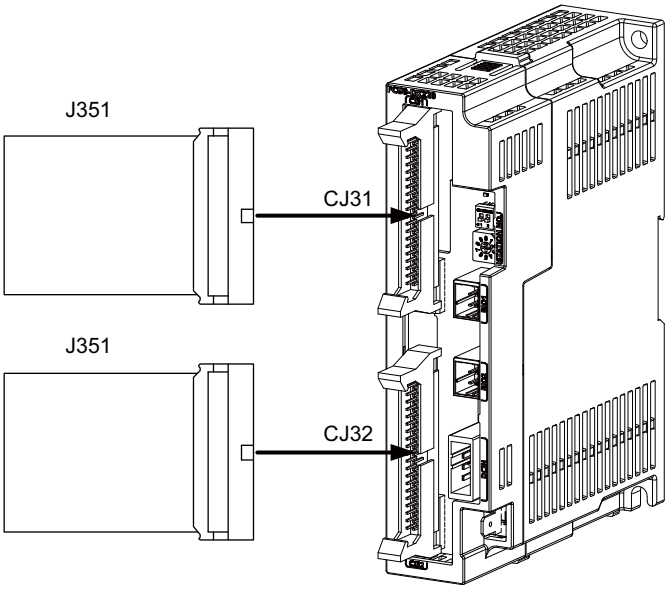
Operation panel I/O unit	RIO occupied stations
FCU8-DX731	1, 3, 7 to 12, 20 to 22
FCU8-DX750	1 to 3, 7 to 12, 20 to 22
FCU8-DX760	1 to 4, 7 to 12, 20 to 22
FCU8-DX761	1 to 5, 7 to 12, 20 to 22
FCU8-DX834	1 to 4, 7 to 14, 20 to 22

Refer to the "17.6.2 Connection and Station No. Setting on Remote I/O Unit" for the station No. setting.

(Note) The maximum connectable number of remote I/O units is 32.

10.6 Connecting with Machine Control Signal (FCU8-DX220 / FCU8-DX230 / FCU8-DX231 / FCU8-DX651)

[FCU8-DX220]

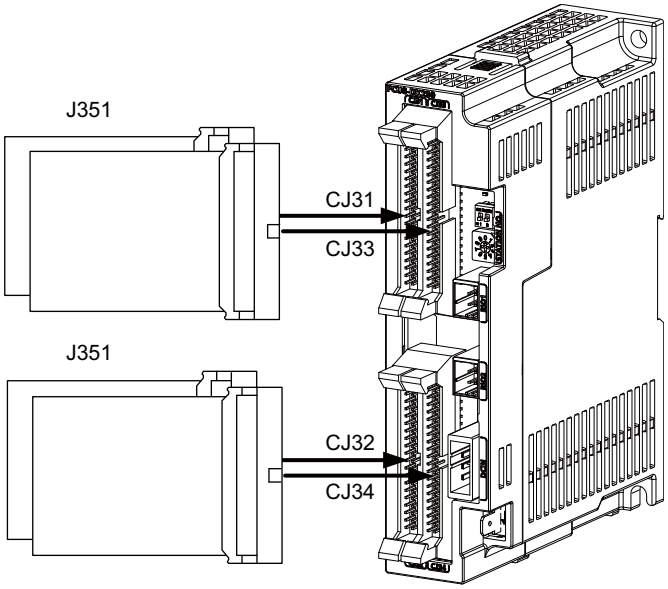


<Related items>

Cable connection drawing: "Cable: J351 Cable"

Connector pin assignment: "General Specifications: Remote I/O Unit" (CJ31/CJ32 connector)

[FCU8-DX230 / FCU8-DX231]



<Related items>

Cable connection drawing: "Cable: J351 Cable"

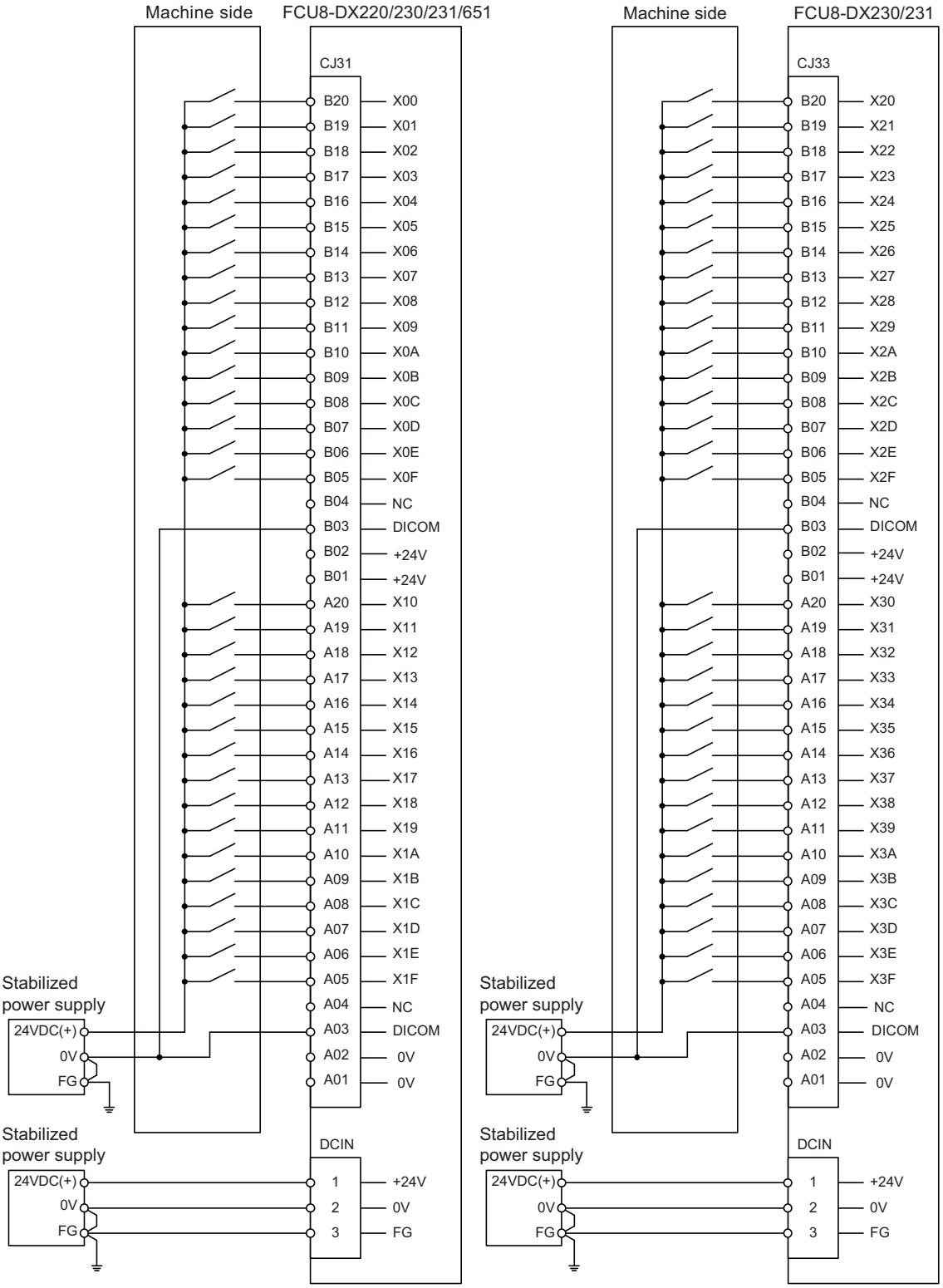
Connector pin assignment: "General Specifications: Remote I/O Unit" (CJ31/CJ32/CJ33/CJ34 connector)

⚠ CAUTION

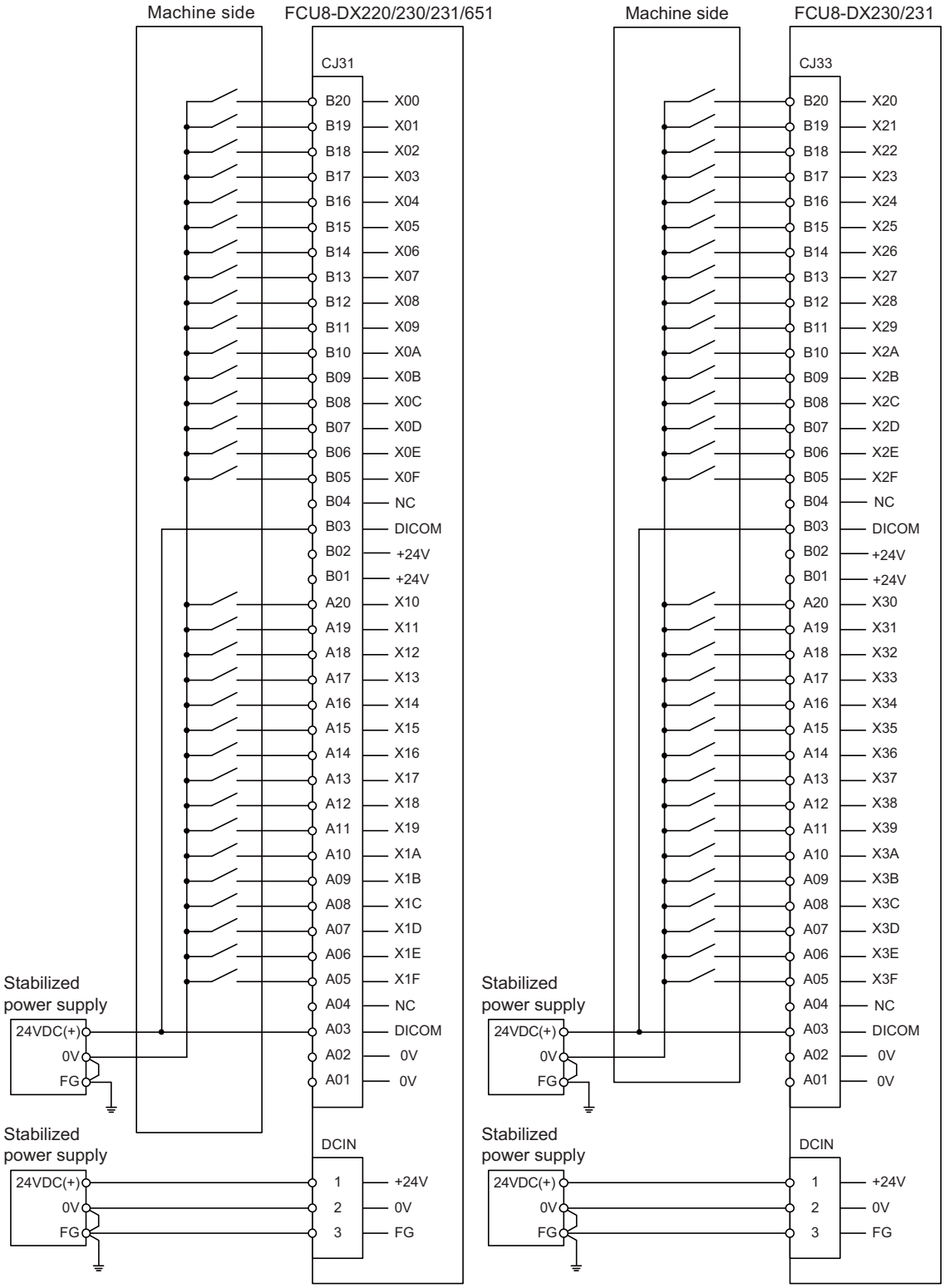
1. Connect the cable to the designated connector. Incorrect connections could damage the device.

2. Do not connect or disconnect the connection cables between each unit while the power is ON.

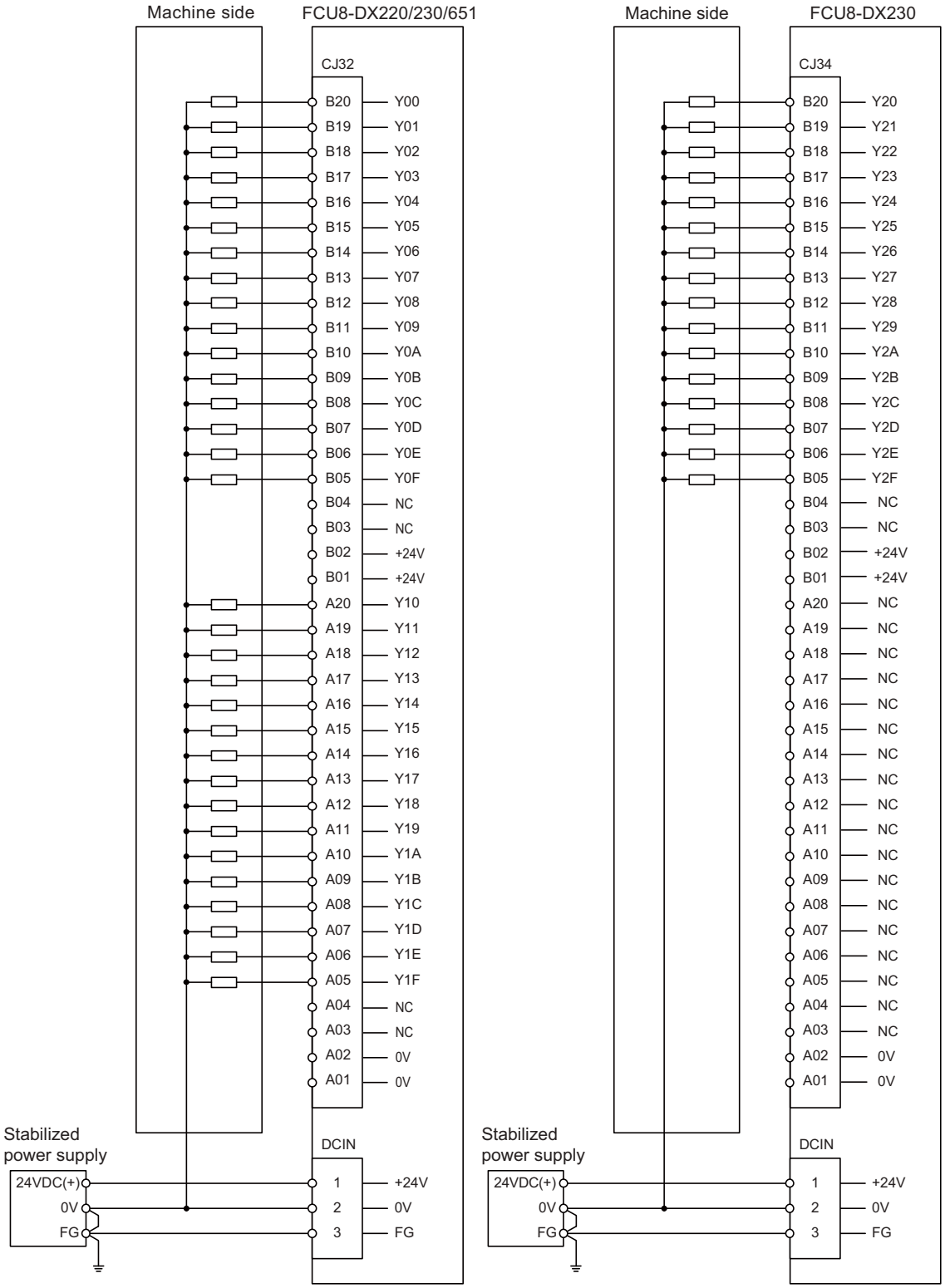
[Machine input 0V common]



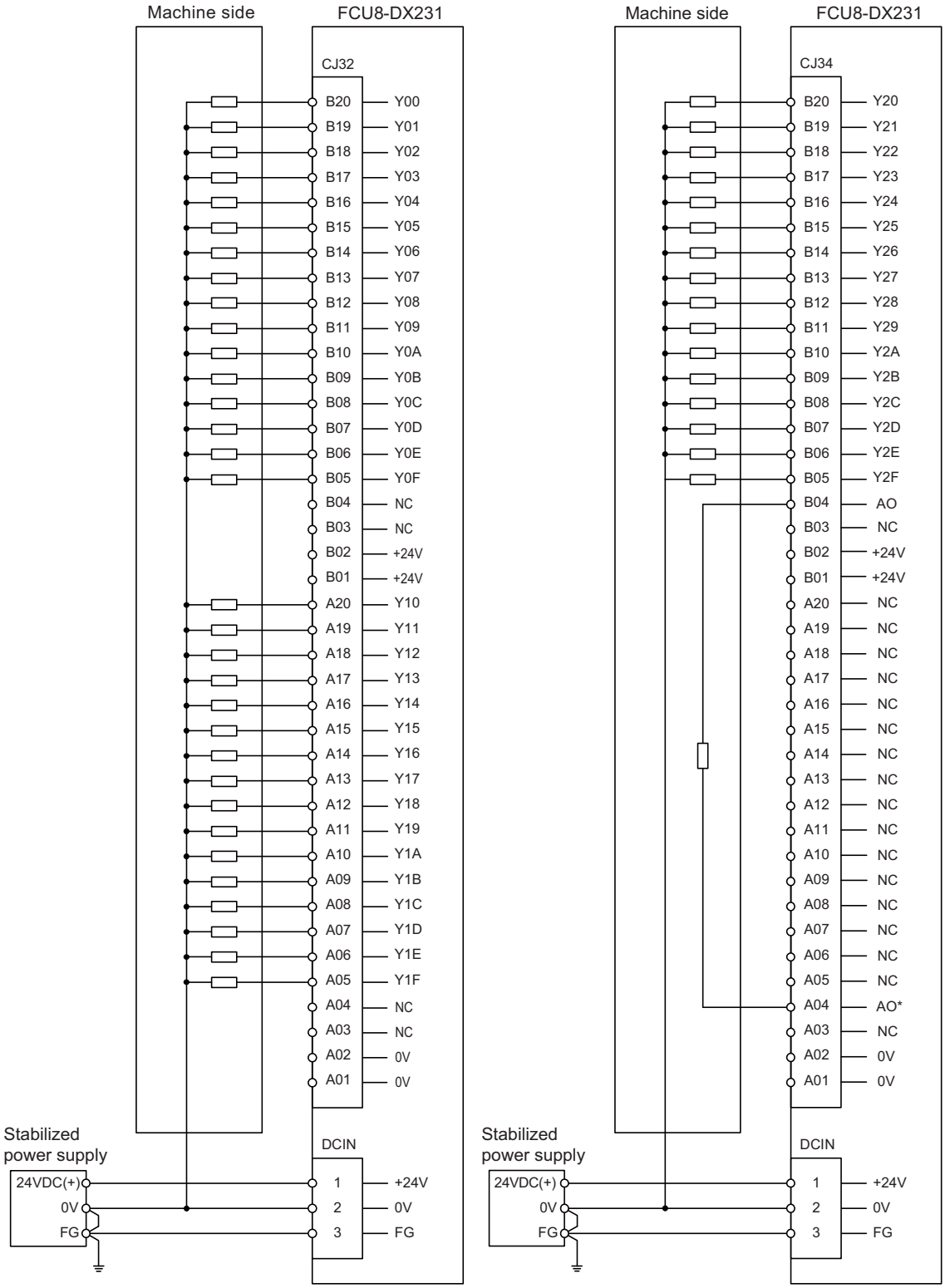
[Machine input 24V common]



[Machine output : FCU8-DX220 / FCU8-DX230 / FCU8-DX651]



[Machine output : FCU8-DX231]



10.7 Connecting with Machine Control Signal (FCU8-DX213 / FCU8-DX213-1 / FCU8-DX654 / FCU8-DX654-1)

[FCU8-DX213 / FCU8-DX213-1 / FCU8-DX654 / FCU8-DX654-1]

<Applicable cable>

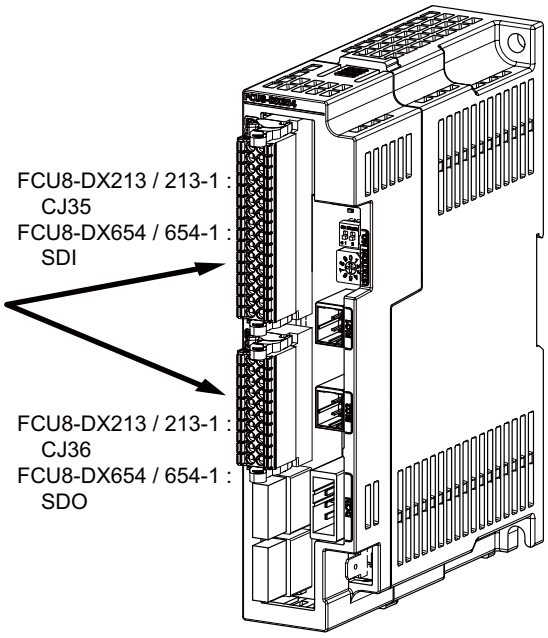
Solid wire	: 0.08 - 1.5 mm^2
Twisted wire	: 0.08 - 1.5 mm^2
Bar terminal with insulation collar	: 0.25 - 0.75 mm^2
Bar terminal without insulation collar	: 0.25 - 1.0 mm^2

<Wire mounting tool type>

Screwdriver	: 210-719
Manufacturer	: WAGO

<Bar terminal type>

Bar terminal	: 216 series
Manufacturer	: WAGO



<Related items>

Connector pin assignment: "General Specifications: Remote I/O Unit" (CJ35/CJ36/SDI/SDO connector)

⚠ CAUTION

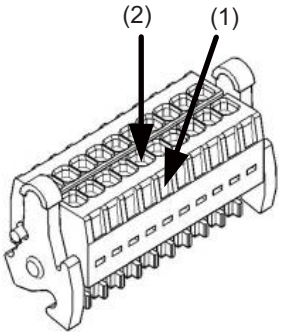
1. Connect the cable to the designated connector. Incorrect connections could damage the device.

2. Do not connect or disconnect the connection cables between each unit while the power is ON.

[Mounting the wire]

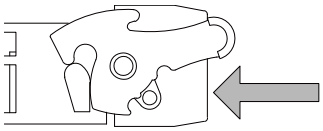
(1) Insert a slotted screwdriver (blade width: 2.5mm).

(2) Insert the wire and then pull the screwdriver out.

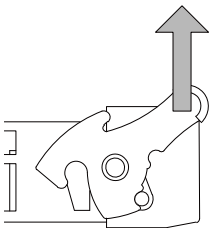


[Mounting the connector]

(1) Push the connector to the lock lever position.

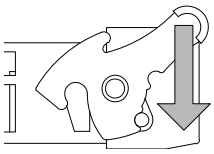


(2) Push the right and left lock levers up simultaneously.

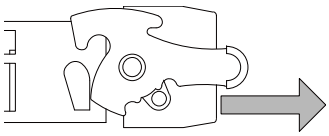


[Removing the connector]

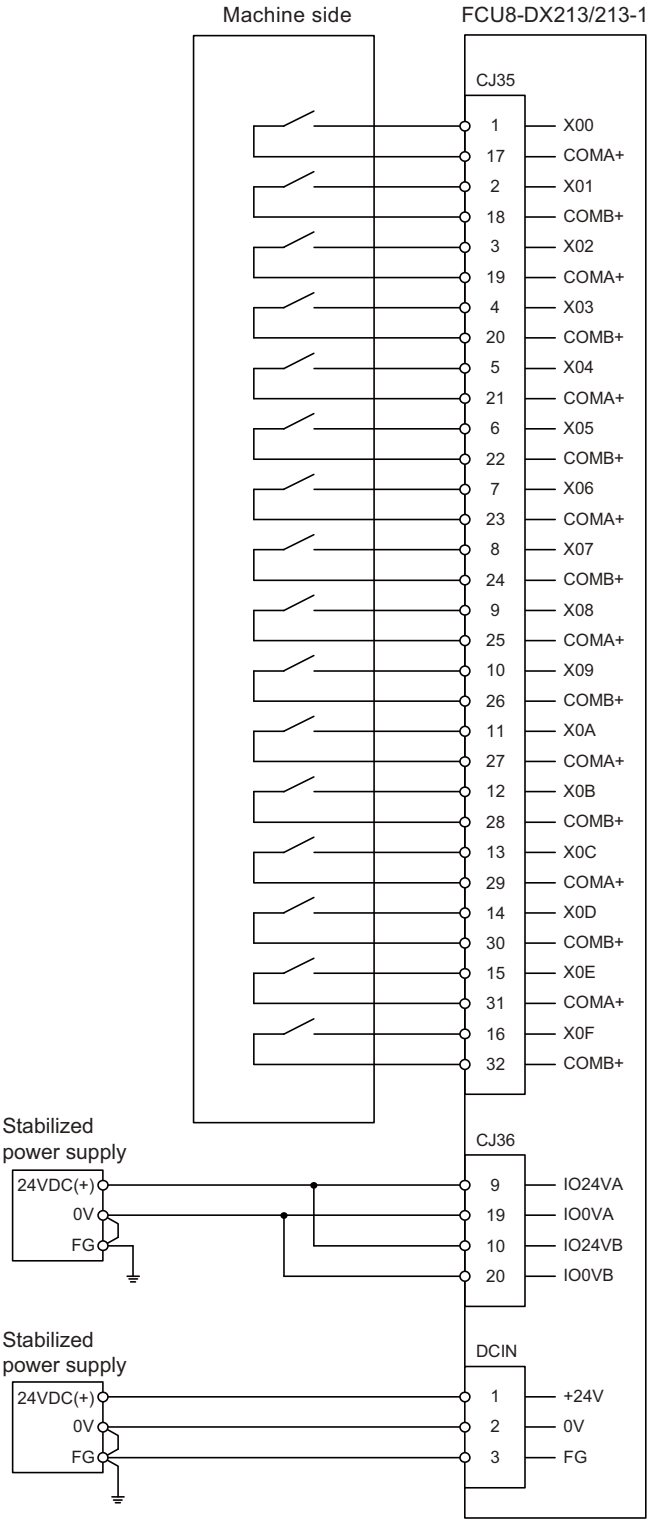
(1) Push the right and left lock levers down simultaneously.



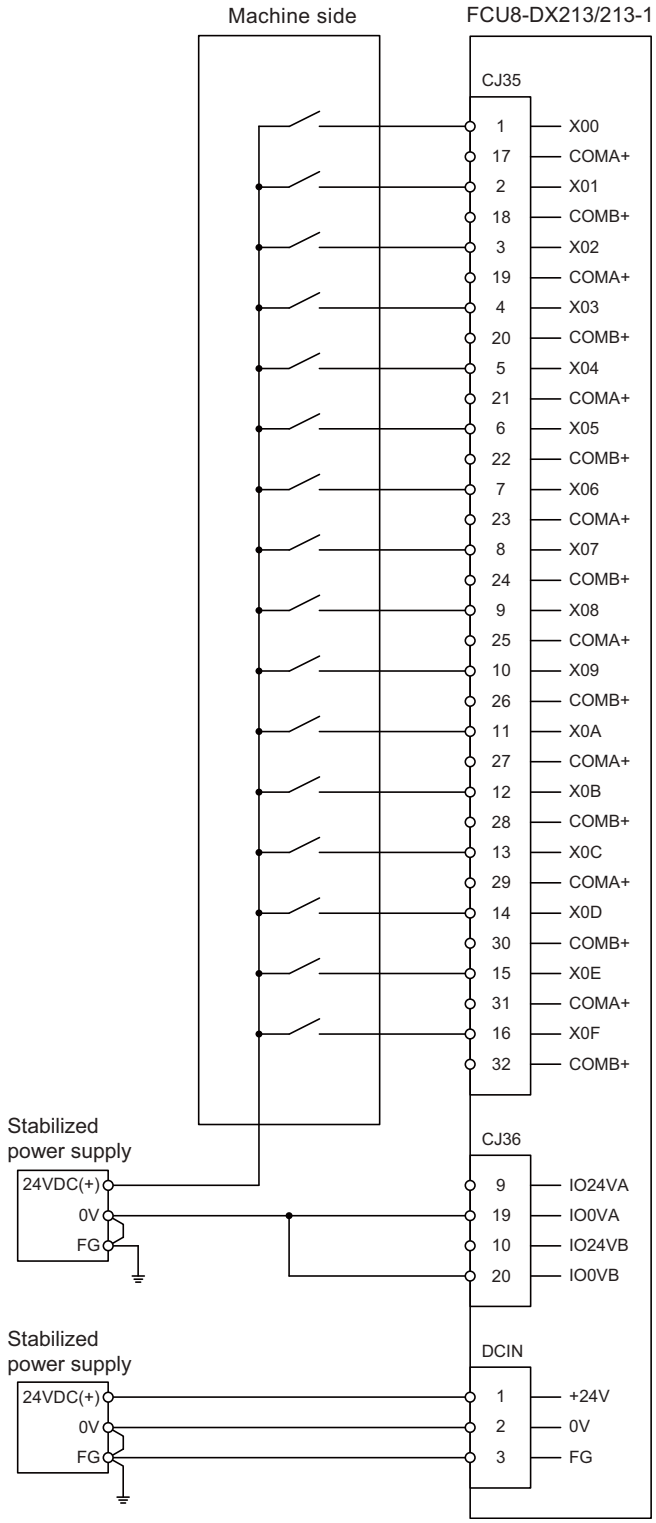
(2) Release the lock and pull the connector out.



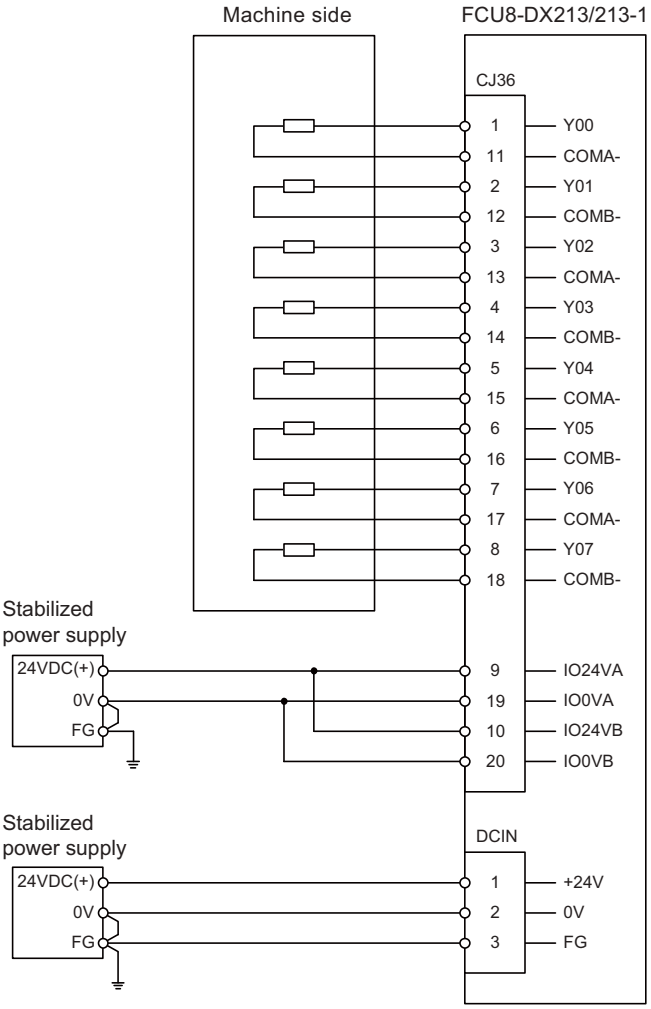
[Machine input (wiring example 1) : FCU8-DX213 / FCU8-DX213-1]



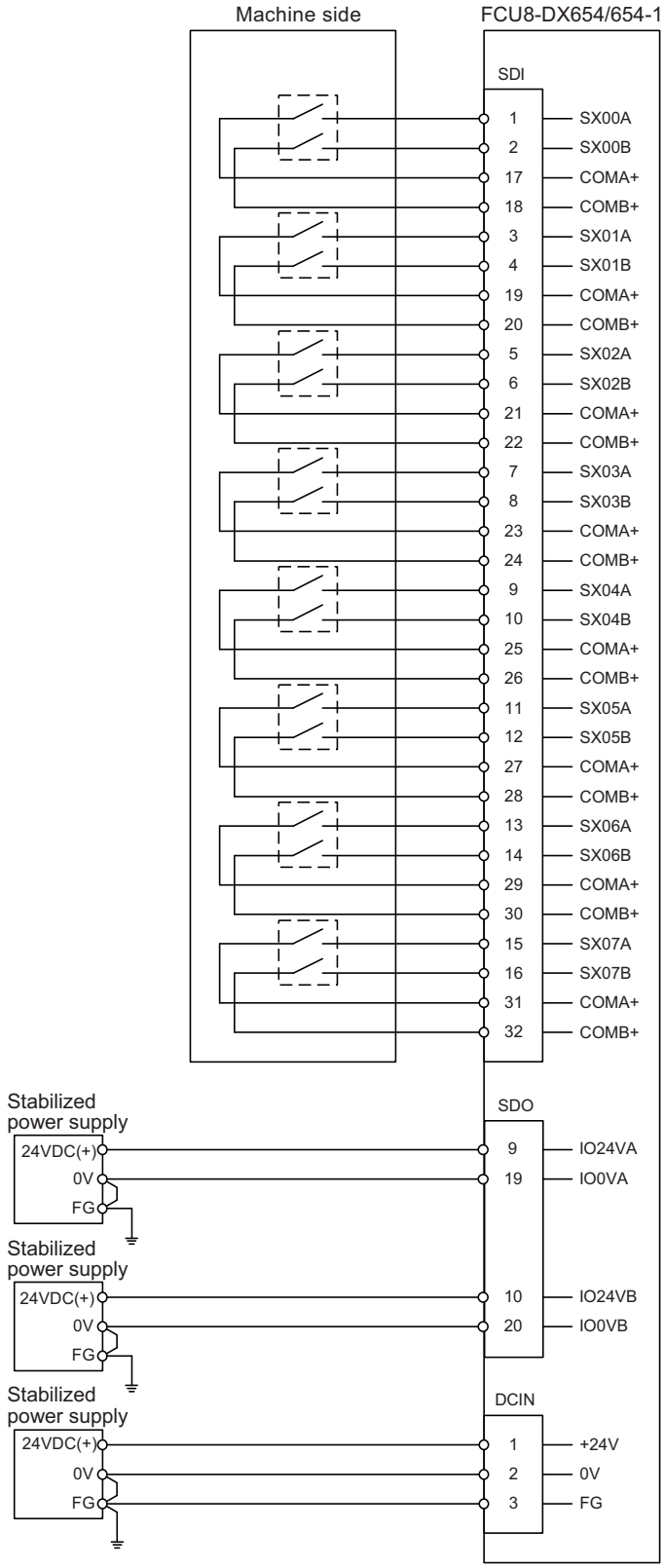
[Machine input (wiring example 2) : FCU8-DX213 / FCU8-DX213-1]



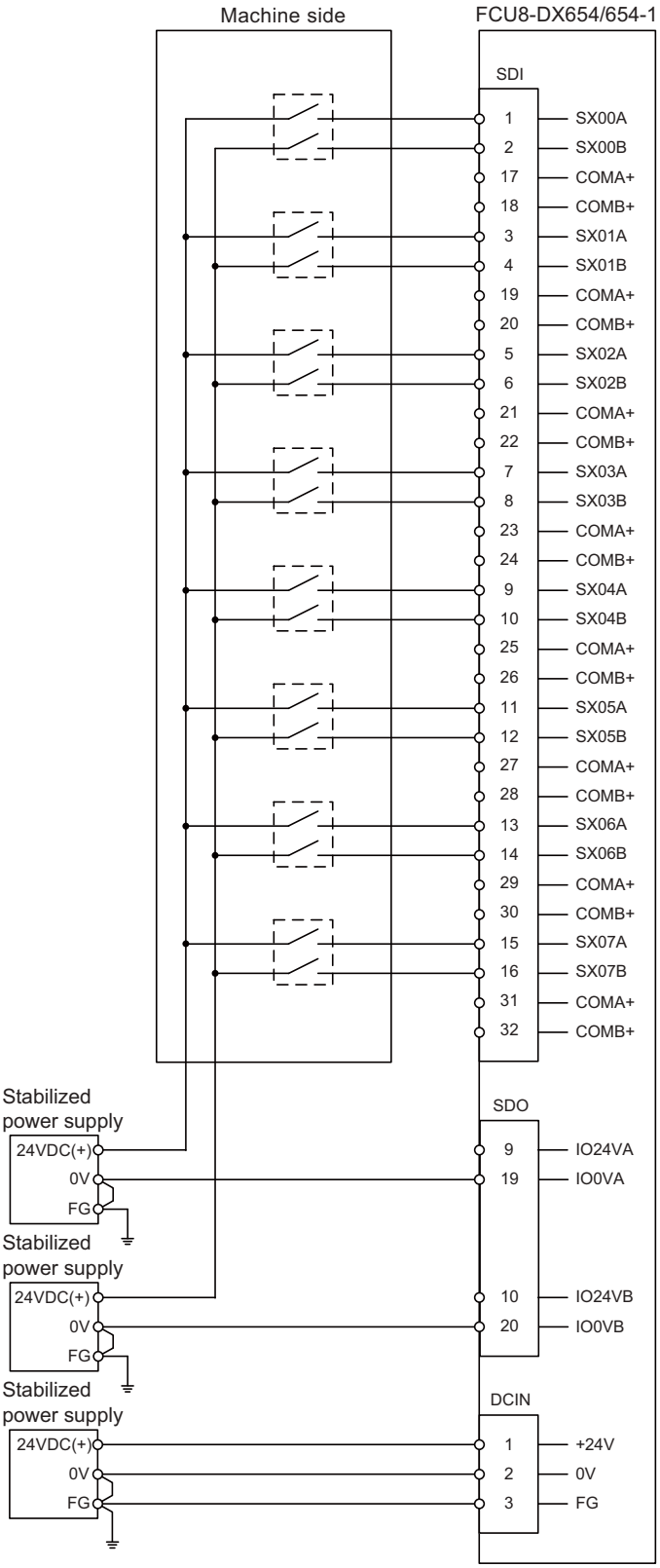
[Machine output : FCU8-DX213 / FCU8-DX213-1]



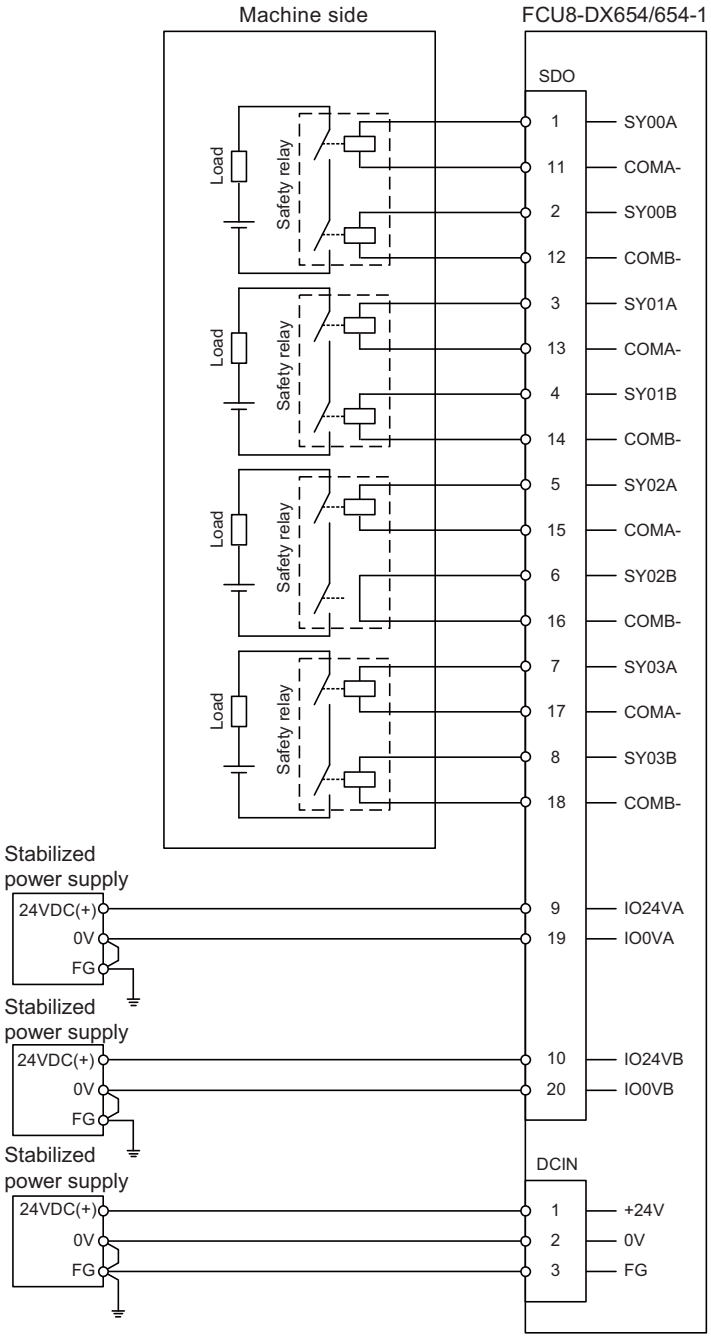
[Safety machine input (wiring example 1) : FCU8-DX654 / FCU8-DX654-1]



[Safety machine input (wiring example 2) : FCU8-DX654 / FCU8-DX654-1]



[Safety machine output : FCU8-DX654 / FCU8-DX654-1]



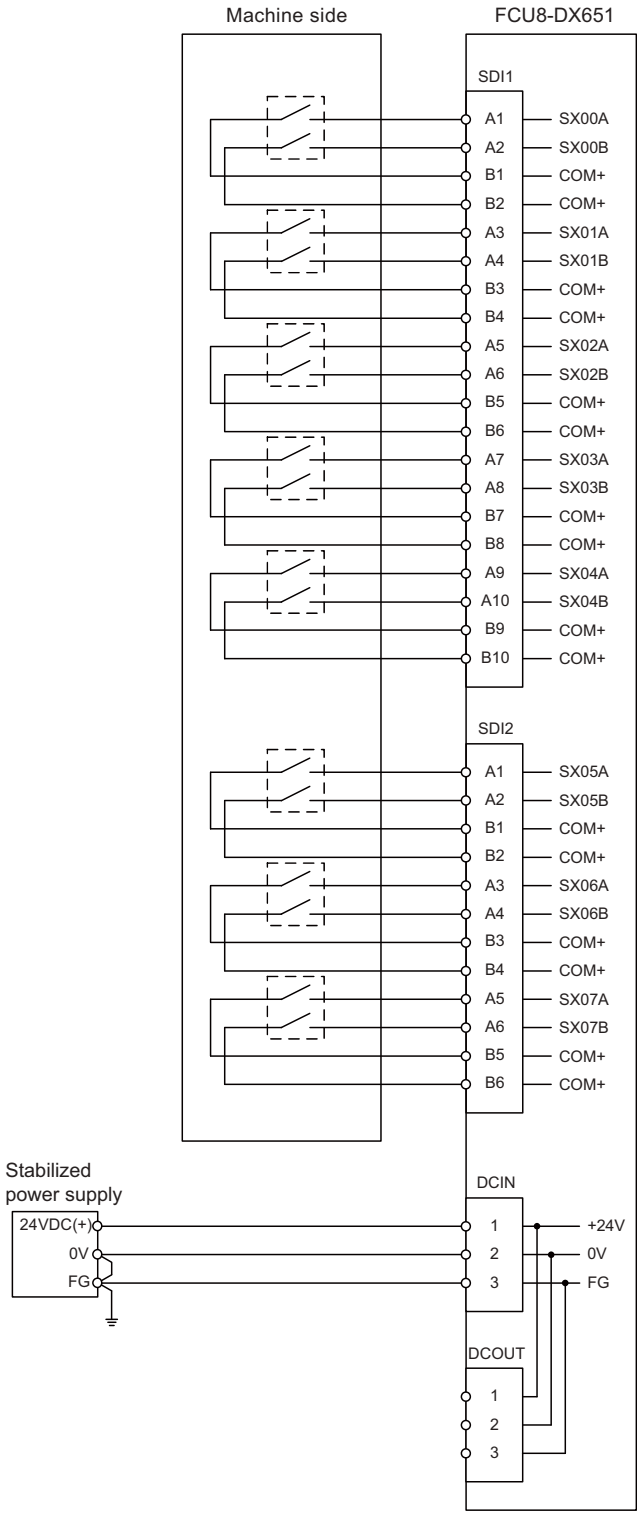
10.8 Connecting with Safety Machine Control Signal (FCU8-DX651)

⚠ CAUTION

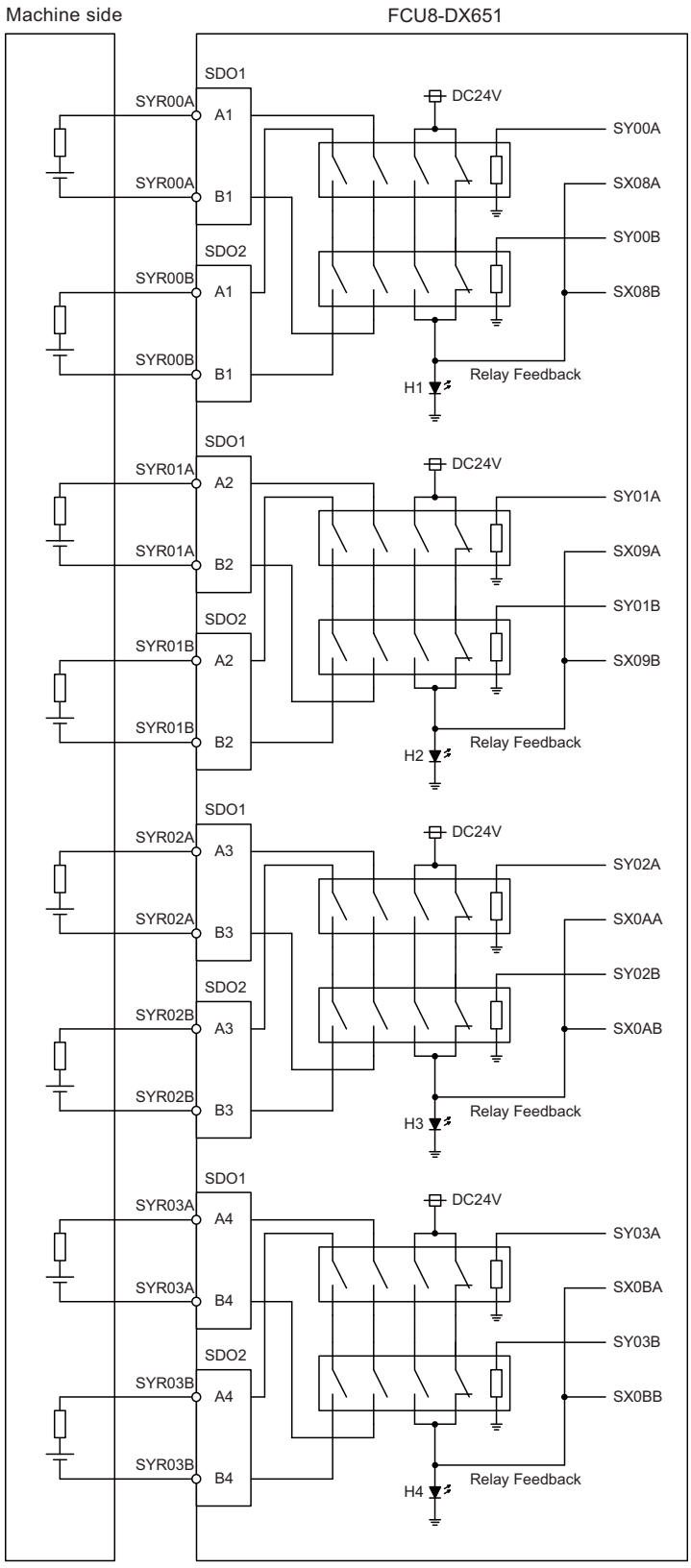
1. Connect the cable to the designated connector. Incorrect connections could damage the device.

2. Do not connect or disconnect the connection cables between each unit while the power is ON.

[Safety DI input]

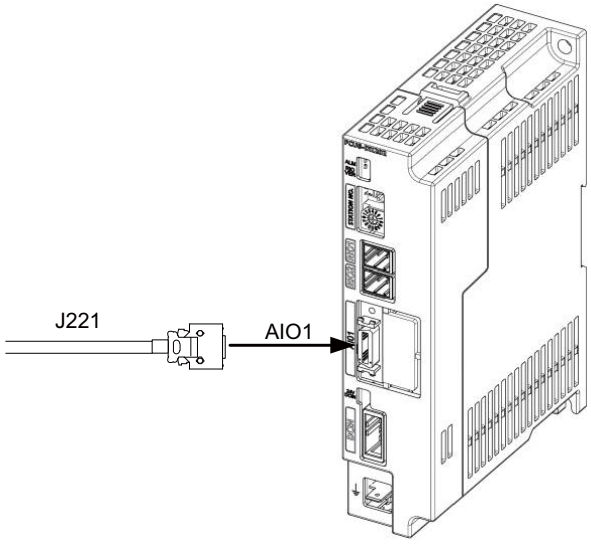


[Safety relay output]



10.9 Connecting with Analog I/O Signal (FCU8-DX202)

For the analog input/output signals, connect J221 cable tothe AIO1 connector of FCU8-DX202. The analog input/output signals are available to connect up to four points for the input, and up to one point for the output.

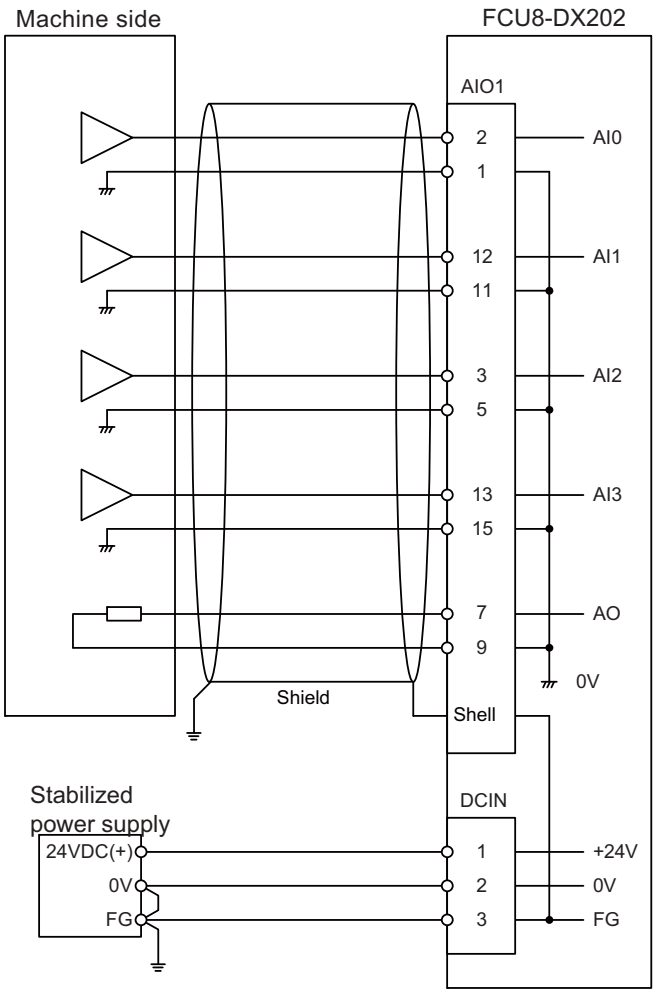


<Related items>

Cable connection drawing: "Cable : J221 Cable"

Connector pin assignment: "General Specifications: Remote I/O Unit" (AIO1 connector)

Input/output circuit



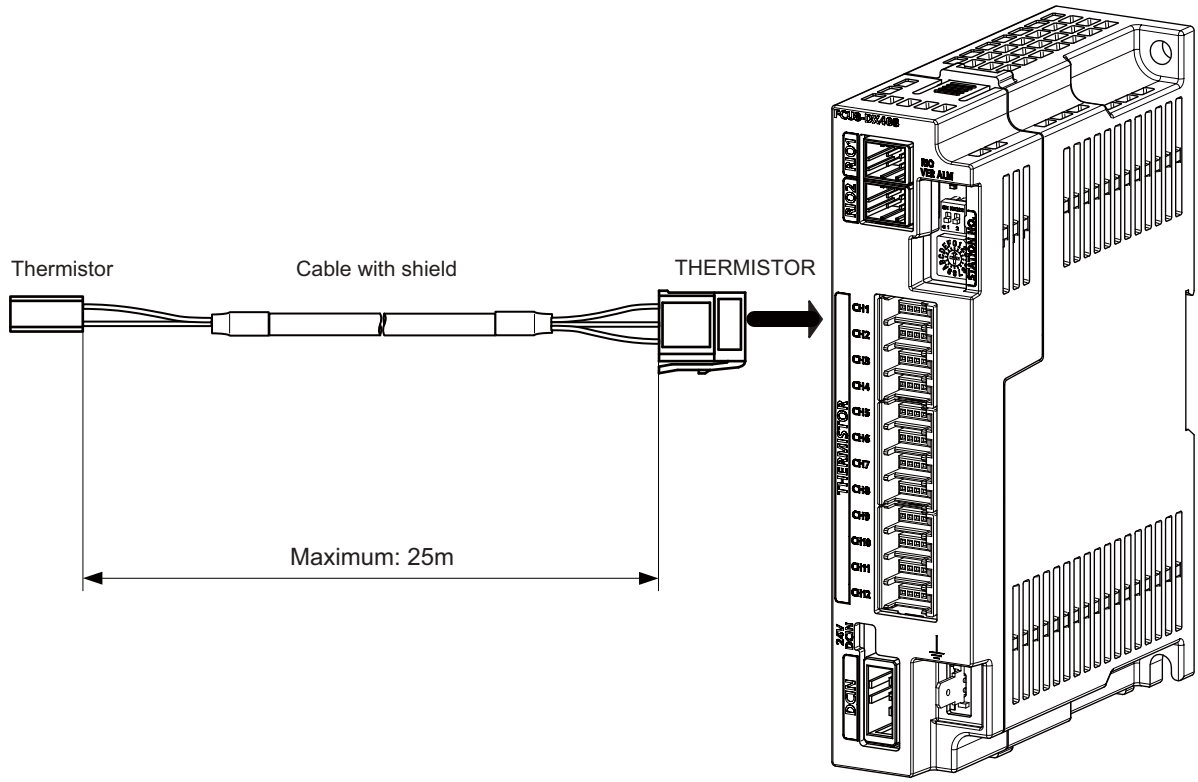
⚠ CAUTION

1. Connect the cable to the designated connector. Incorrect connections could damage the device.

2. Do not connect or disconnect the connection cables between each unit while the power is ON.

10.10 Connecting with Thermistor (FCU8-DX408)

Connect the thermistor with THERMISTOR connector.
The maximum cable length is 25m.
The recommended shield cable is "HK-SB/20276XL, black, LF 1P X 22AWG" made by Taiyo Cabletec.



<Related items>

Connector pin assignment: "General Specifications: Remote I/O Unit" (THERMISTOR connector)

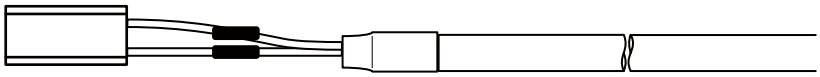
> **⚠ Note**
>
> **1. Connect the cable to the designated connector. Incorrect connections could damage the device.**
>
> **2. Do not connect or disconnect the connection cables between each unit while the power is ON.**
>
> **3. Use the cable with shield and ground it in order to reduce the influence of noise.**

[Thermistor cable connecting procedure]

The thermistor cable has the following configuration:

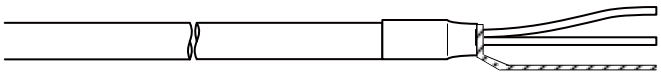
Thermistor	Cable with shield	THERMISTOR connector
		

(1) Solder the thermistor to the shield cable and cover the joint surface with the protection tube.



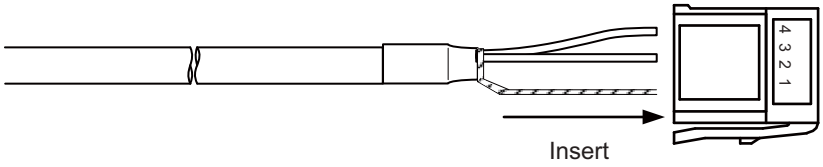
Tube for protection

(2) Twist the shield of the cable or pull out the drain wire.



Twister shield wire
or drain wire

(3) Insert the wire into the THERMISTOR connecter as follows:

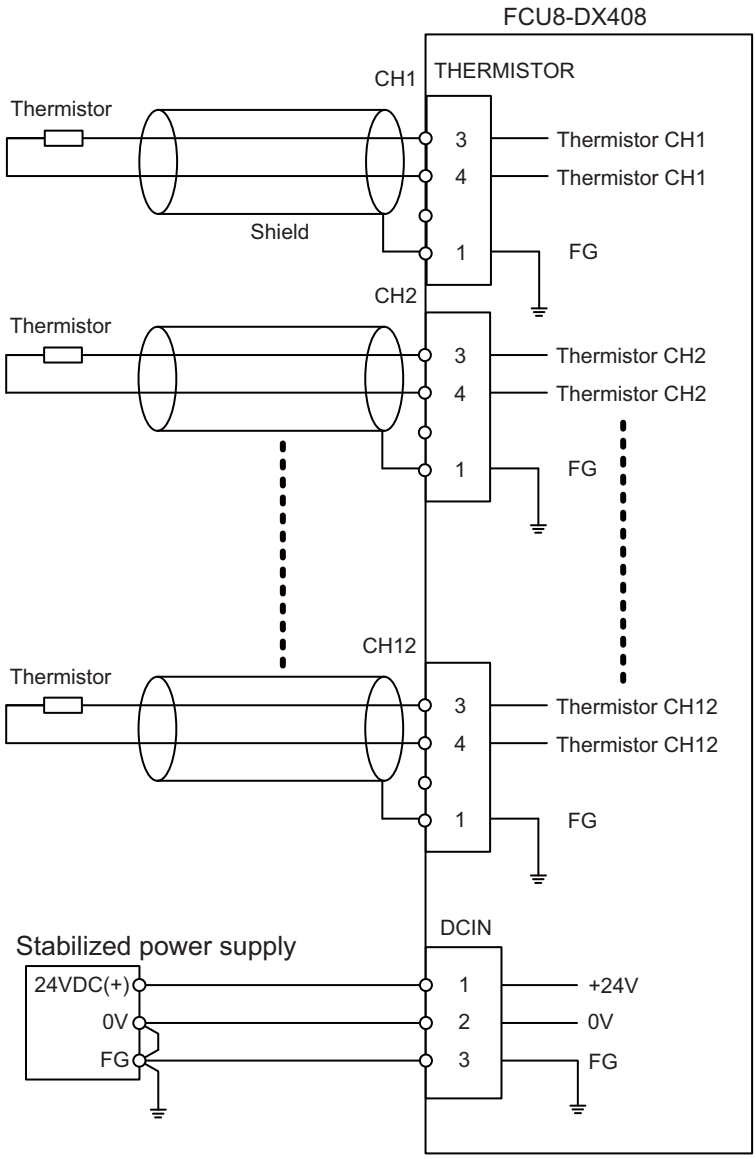


Insert

1 pin: Twisted shield wire or drain wire
2 pin: Not connected.
3 pin: Thermistor
4 pin: Thermistor

(4) Crimp the THERMISTOR connector with pliers.
Make sure the crimp is horizontal.

[Connecting with thermistor:FCU8-DX408]



10.11 Connecting with Multi-analog Input Signal (FCU8-DX409)

There are four types of multi-analog input signals as below:

- Voltage input signal
- Current input signal
- Thermocouple input signal
- Resistance temperature detector input signal

Connect these signals to AI connector.

Up to 4 points of multi-analog input signals (CH1 to CH4) can be connected.

The measurement mode (voltage measurement, current measurement, temperature (thermocouple) measurement and temperature (resistance temperature detector) measurement) can be set for each CH and input corresponding to the mode can be performed.

All CHs (CH1 to CH4) are set to the voltage measurement mode when the machine is delivered.

Prepare the thermocouple, resistance temperature detector and cable with shield.

Precautions

- Input the appropriate signal for the set measurement mode.
  (Note) Do not input the voltage when the current or temperature (thermocouple or resistance temperature detector) measurement mode is set. This could result in faults of the unit. Pay close attention to the combination of the measurement mode setting and input.
- Running-in is required for about 10 to 15 minutes after the power is ON until the measurement value is stable.
- Do not apply voltage or current from external devices before turning ON the power of multi-analog input unit. This may damage the multi-analog input unit.
  Turn ON the power of the multi-analog input unit and external device at the same time, or wire circuit so that the power supply of the multi-analog input unit is turned ON first.

> ⚠ **CAUTION**
>
> **1. Connect the cable to the designated connector. Incorrect connections could damage the device.**
>
> **2. Do not connect or disconnect the connection cables between each unit while the power is ON.**

AI : DFMC1,5/12-ST-3,5-LR (Phoenix Contact)

<Applicable cable>

Solid wire	: 0.2-1.5mm^2
Twisted wire	: 0.2-1.5mm^2
Bar terminal with insulation collar	: 0.25-0.75mm^2
Bar terminal without insulation collar	: 0.25-1.5mm^2
Stripping line length	: 10mm

<Wire mounting tool (driver) type>

Type : SZS 0,4X2,5 VDE

Manufacturer: Phoenix Contact

<Bar terminal type>

Type : AI series

Manufacturer: Phoenix Contact

<Crimp tool type>

Type : CRIMPFOX 6

Manufacturer: Phoenix Contact

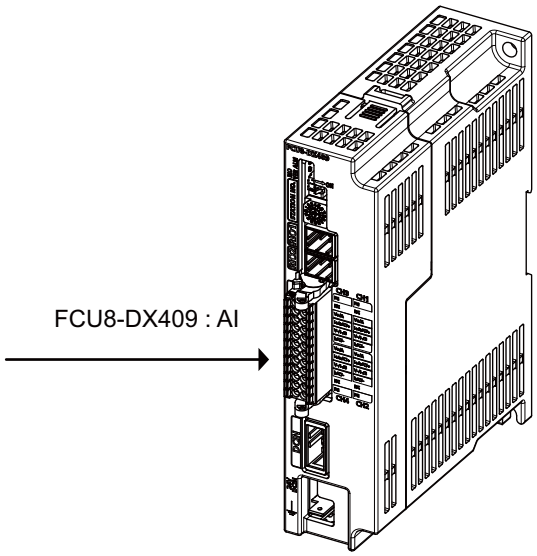
<Recommended cable with shield material>

Type : HK-SB/20276XL LF

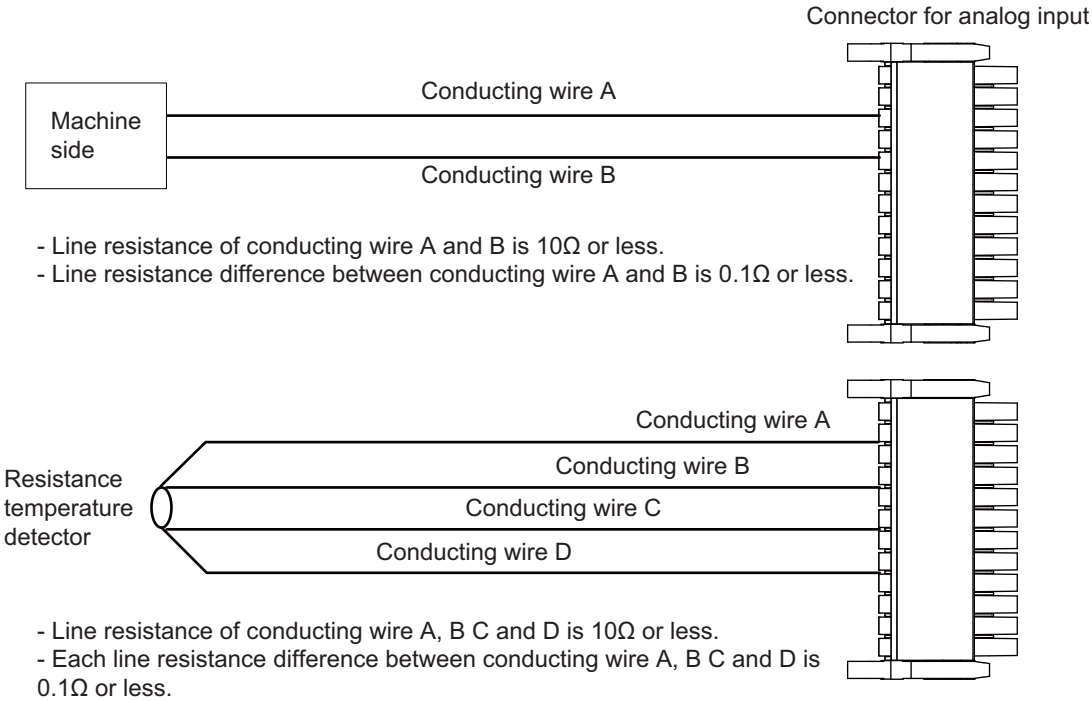
Manufacturer: Taiyo Cabletec

(Select the wire diameter from AI connector specification.)

FCU8-DX409 : AI



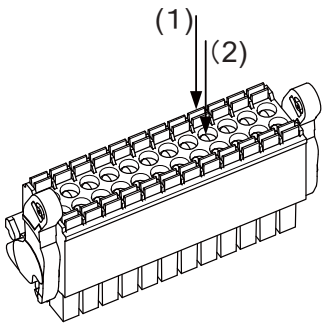
Maximum cable length is 50m. Line resistance is 10Ω or less, and line resistance difference is 0.1Ω or less (see below).



[Mounting the wire]

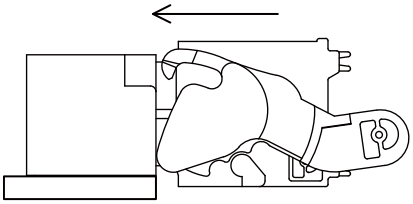
(1) Push in the wire opening lever (orange) using a slotted screwdriver (blade width: 2.5mm).

(2) Insert the wire and then pull the screwdriver out of the wire opening lever.

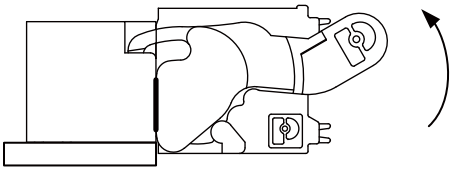


[Mounting the connector]

(1) Push the connector to the lock and release (LR) lever position.

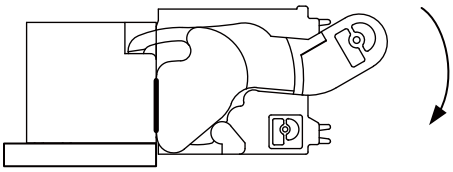


(2) When the connector is pushed in to the end, the LR lever is applied. If the lever is loose, lift up the latch and tighten the lever.

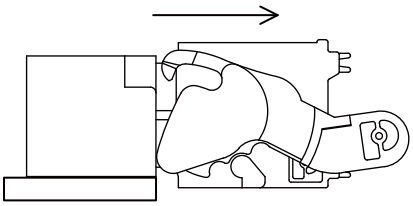


[Removing the connector]

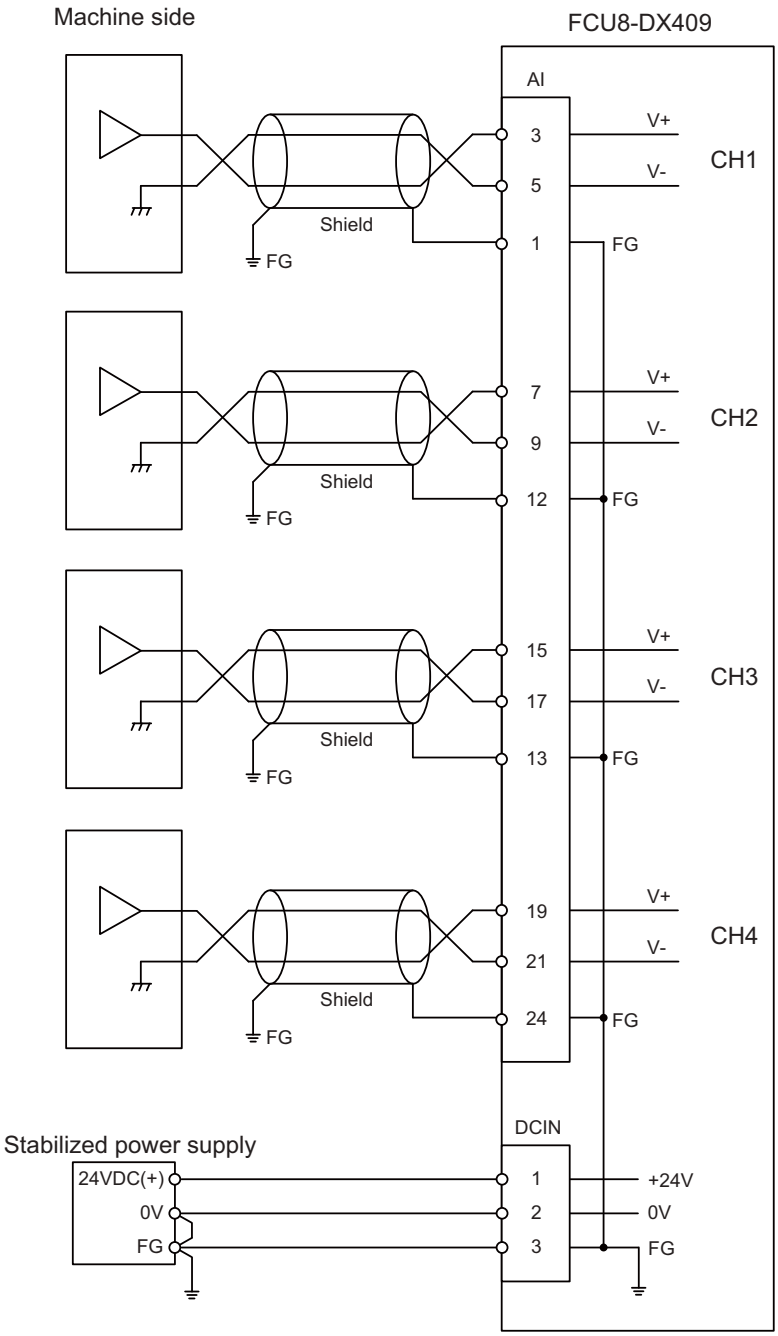
(1) Push the lock and release (LR) levers down simultaneously.



(2) After unlocking (the connector is pushed out by the LR lever and left half-inserted), pull out the connector.

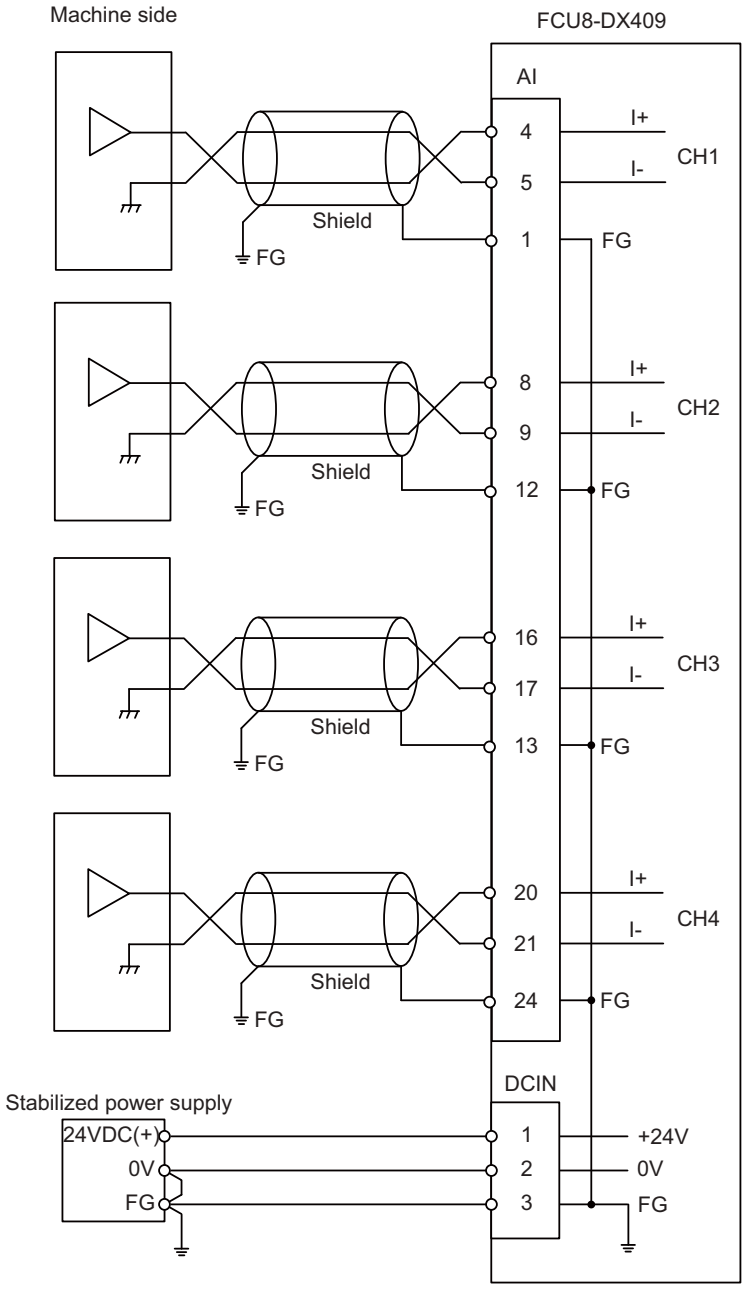


(a) Connecting with the voltage input signal



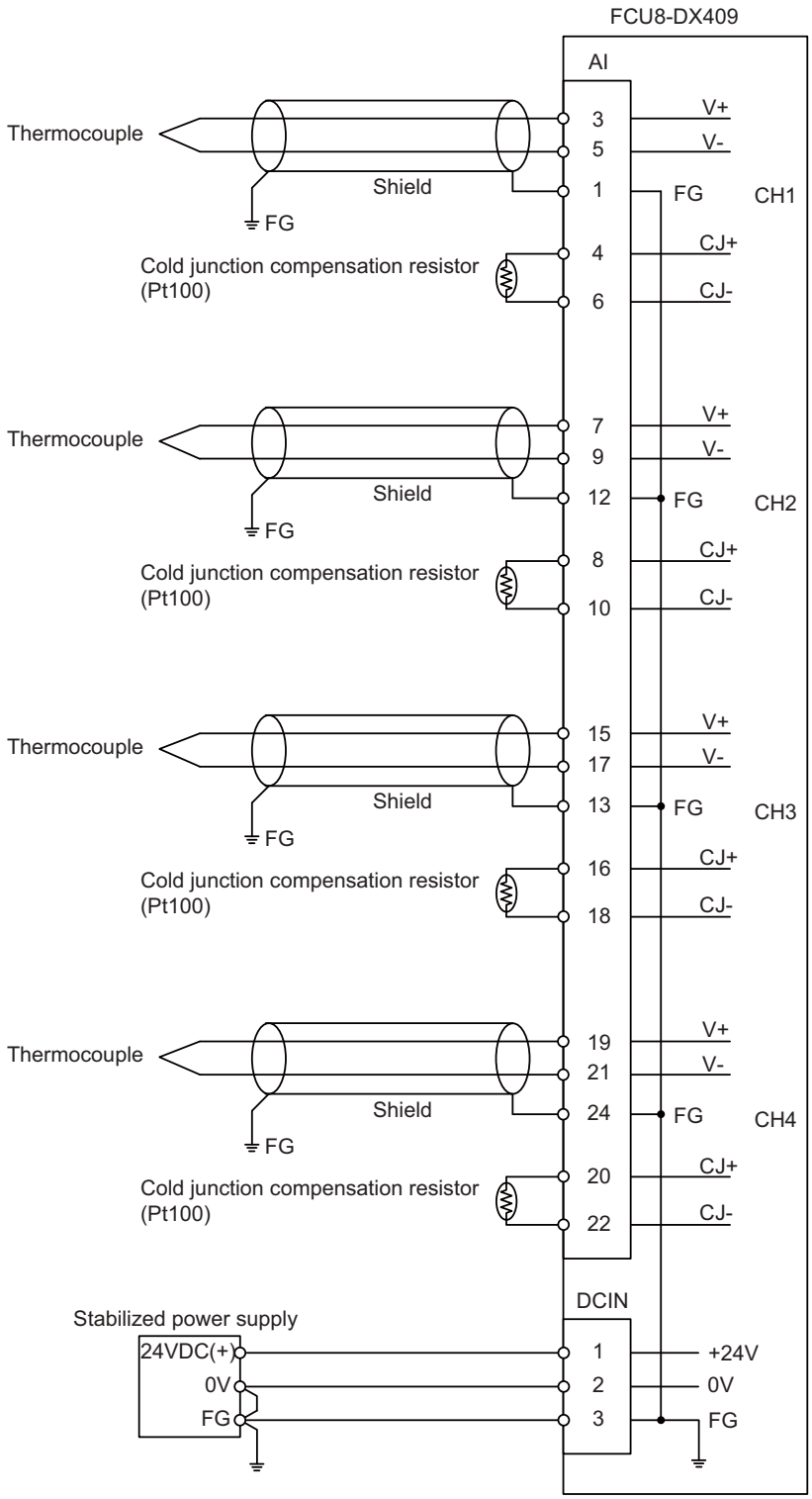
- Use the twisted cable with shield to reduce the influence of noise.
- Connect the shield to FG pin of AI connector. Ground the machine side, too.
- Do not connect or disconnect the cables between units while the power is ON.

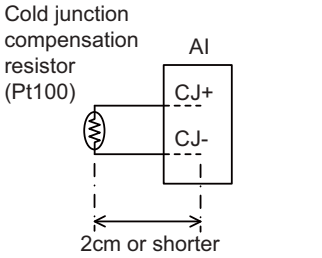
(b) Connecting with the current input signal



- Use the twisted cable with shield to reduce the influence of noise.
- Connect the shield to FG pin of AI connector. Ground the machine side, too.
- Do not connect or disconnect the cables between units while the power is ON.

(c) Connecting with the thermocouple input signal





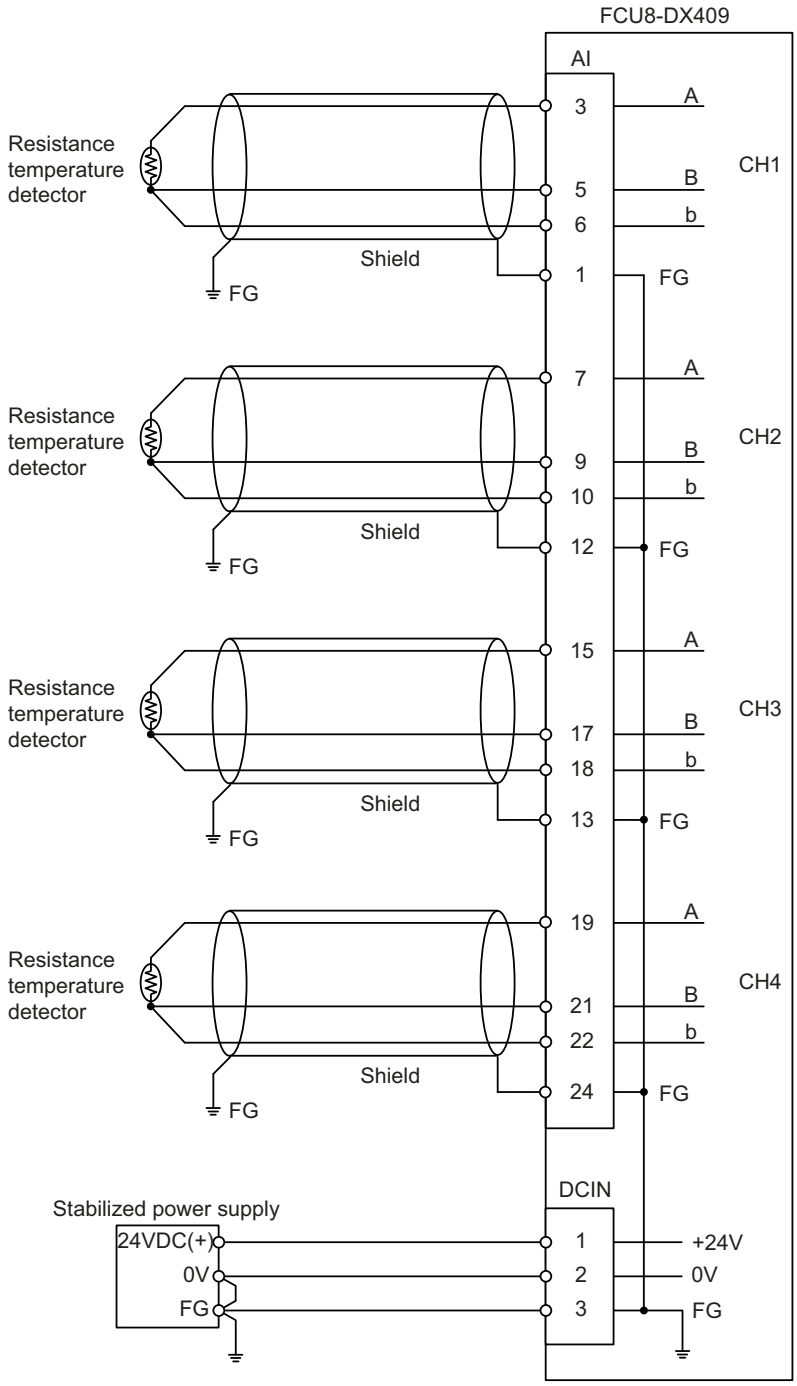
Set the lead length 2cm or shorter including the length to insert to AI connector. (As a guide)

- Connect the shield to FG pin of AI connector. Ground the thermocouple tip side, too.
- Do not connect or disconnect the cables between units while the power is ON.
- Keep the lead length of cold junction compensation resistor as short as possible (2 cm or shorter as a guide).

(d) Connecting with the resistance temperature detector input signal

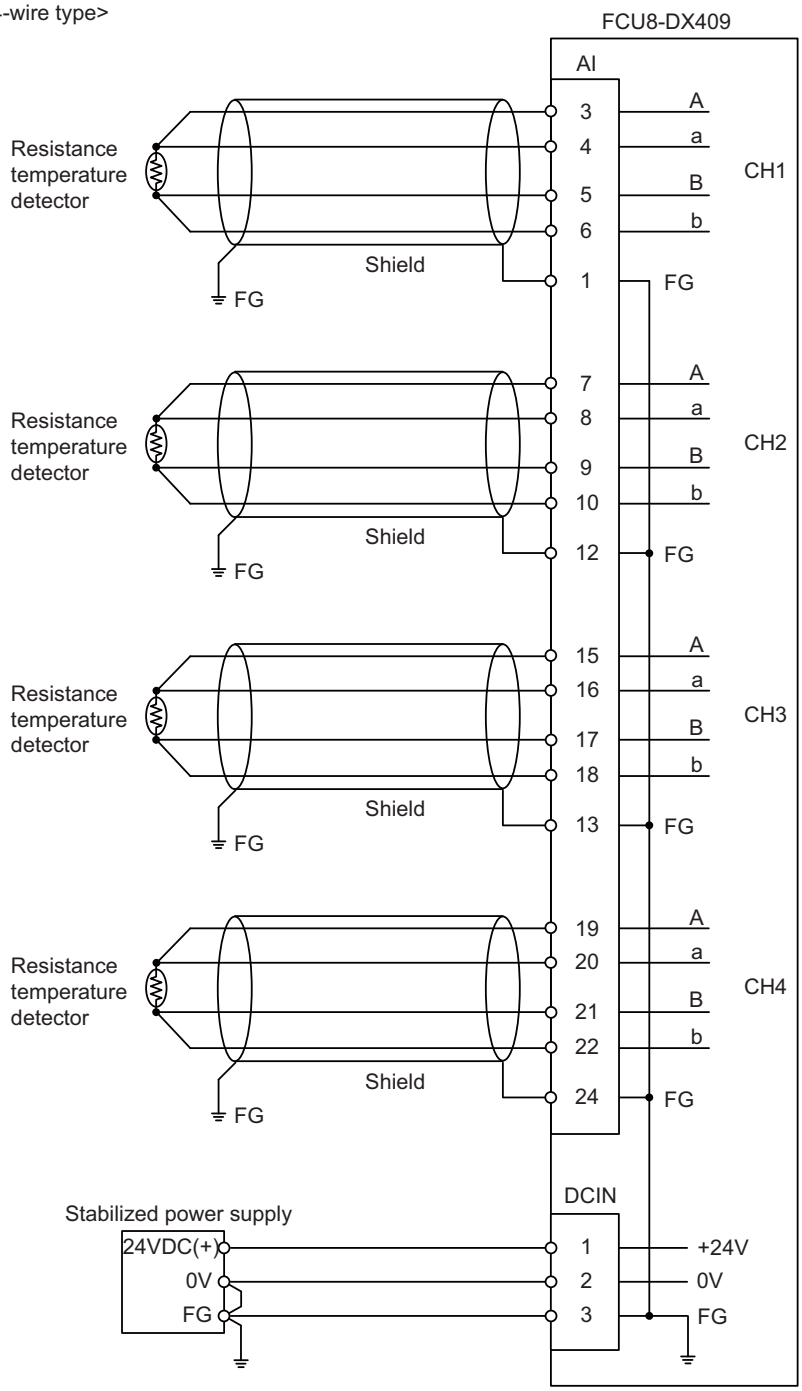
There are 3-wire type and 4-wire type for the connecting method of resistance temperature detector.

<3-wire type>



- Use the twisted cable with shield to reduce the influence of noise.
- Connect the shield to FG pin of AI connector. Ground the cold junction compensation resistor side, too.
- Do not connect or disconnect the cables between units while the power is ON.

<4-wire type>



- Use the twisted cable with shield to reduce the influence of noise.
- Connect the shield to FG pin of AI connector. Ground the cold junction compensation resistor side, too.
- Do not connect or disconnect the cables between units while the power is ON.

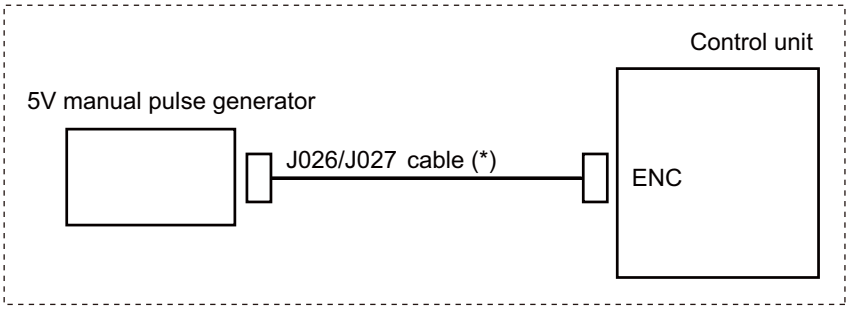
11

Connection of Manual Pulse Generator

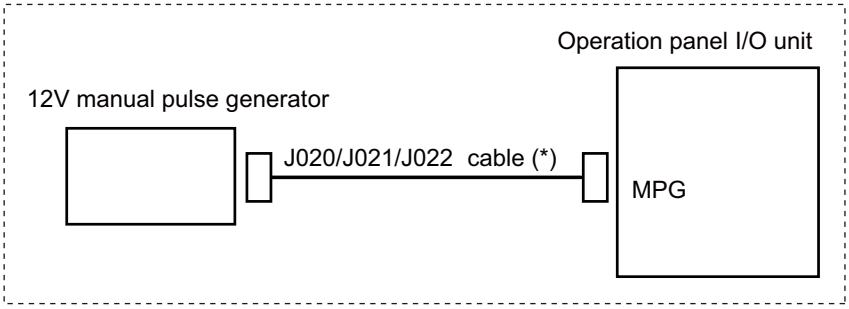
The method for connecting to each unit and device from the manual pulse generator is briefly explained in this chapter.

11.1 Manual Pulse Generator Connection System Drawing

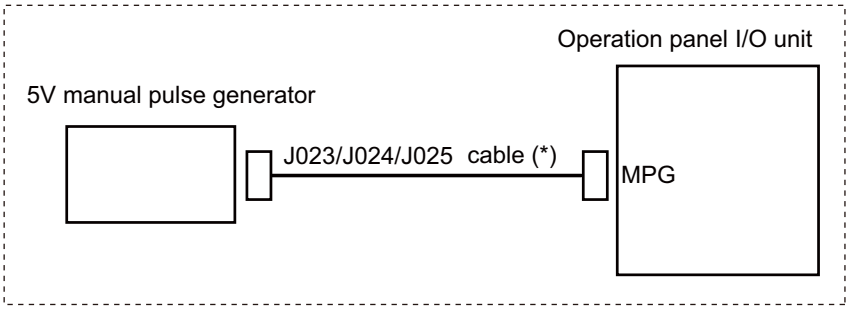
Connecting to control unit (5V)



Connecting to operation panel I/O unit (12V)

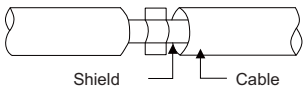


Connecting to operation panel I/O unit (5V)



(Note 1) The section indicated with asterisk (*) indicates cable to be wired outside the operation panel.
Since the cable could be affected by the exogenous noise depending on the environment, the following noise countermeasure is recommended.

Expose the cable by removing a part of the cable sheath and use the shield clamp for the exogenous noise countermeasure.



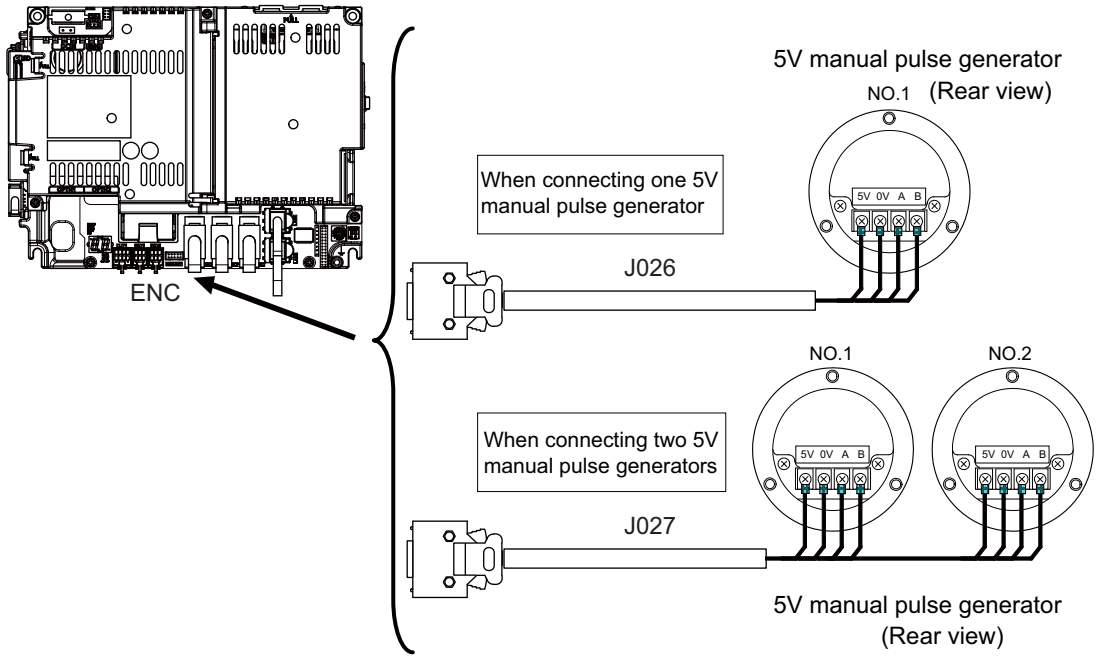
When you cannot use the shield clamp, install a ferrite core as a substitute.

<Related item>

Shield clamp fitting: "EMC Installation Guidelines: EMC Countermeasure Parts: Shield Clamp Fitting"

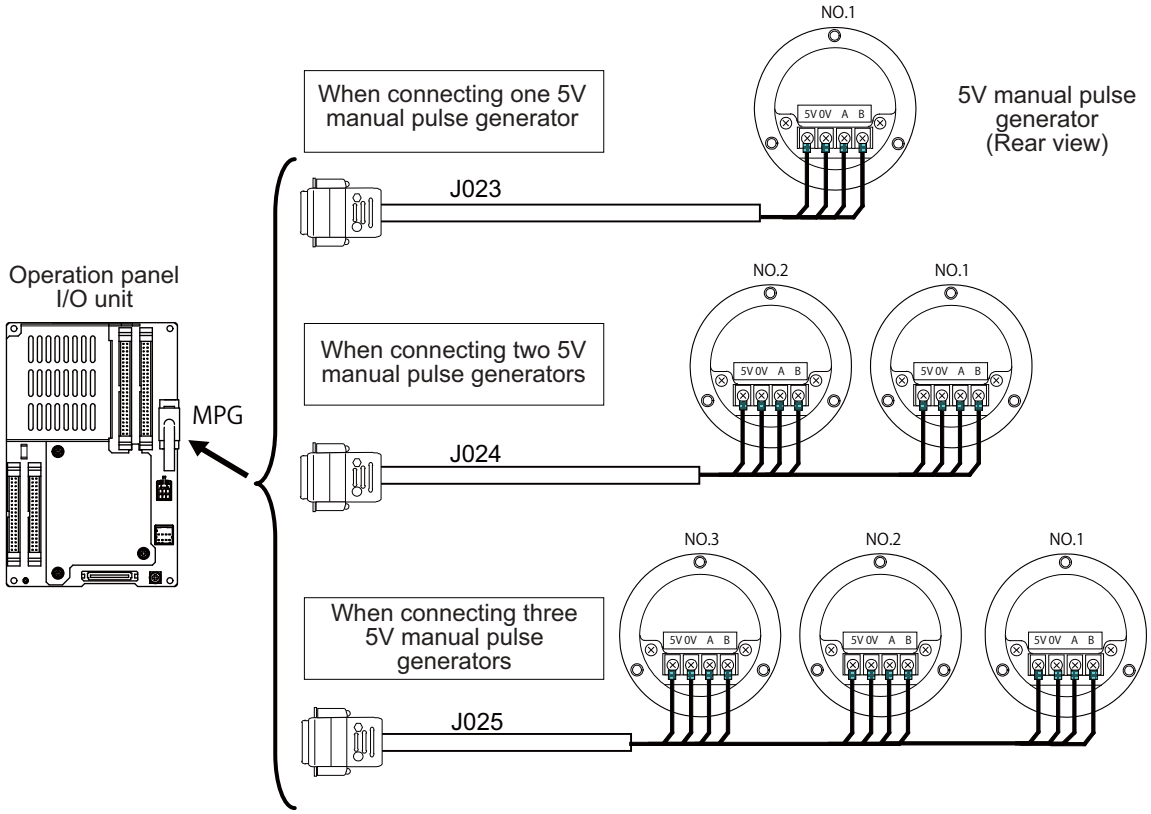
Ferrite core: "EMC Installation Guidelines: EMC Countermeasure Parts: Ferrite Core"

11.2 Connecting with Control Unit

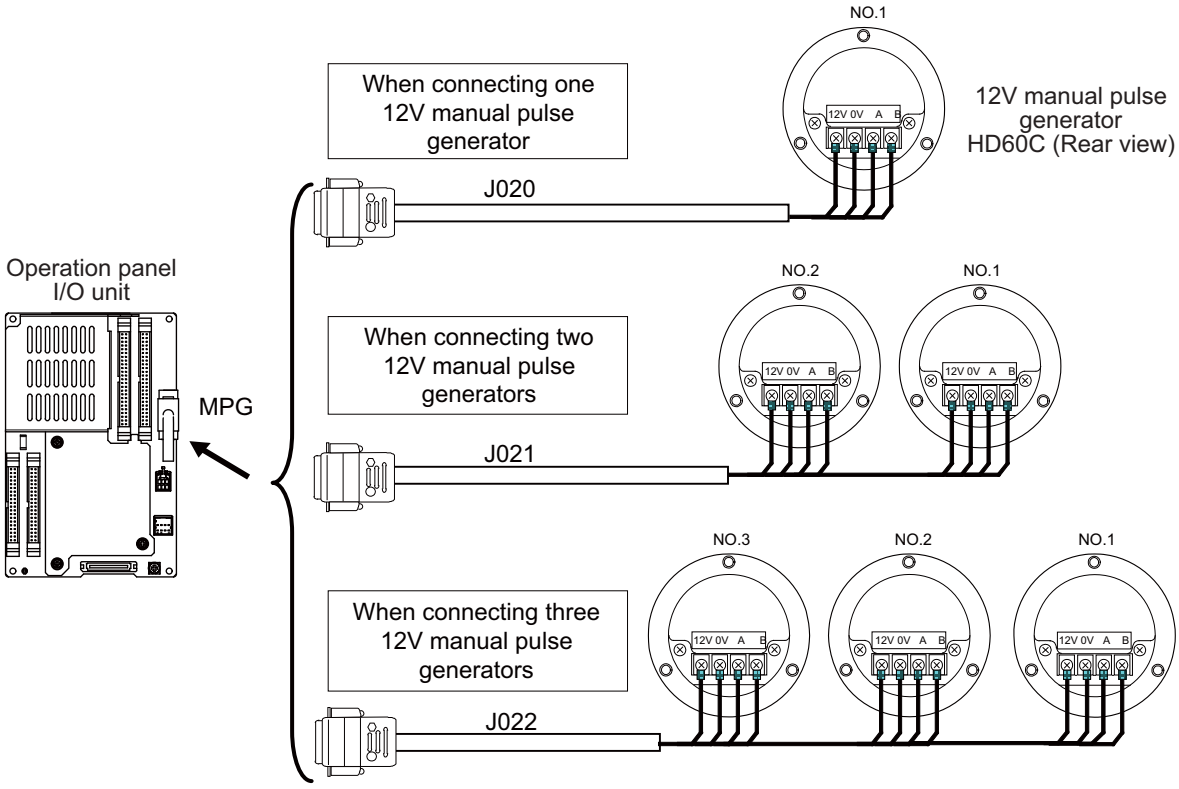


11.3 Connecting with Operation Panel I/O Unit

(1) 5V manual pulse generator (maximum cable length: 20m)



(2) 12V manual pulse generator (maximum cable length: 50m)



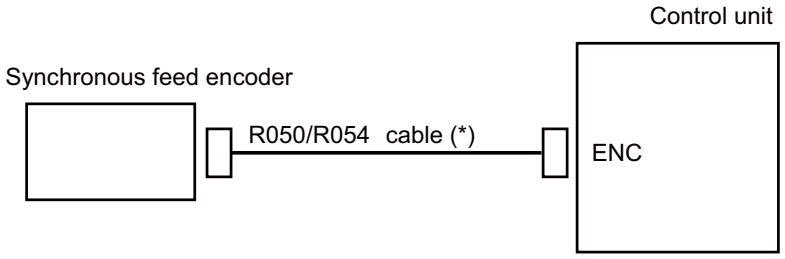
(Note 1) When selecting a manual pulse generator, make sure that its case and 0V terminal are insulated.
(Note 2) Select 25pulse/rev or 100pulse/rev on the parameter screen.

12

Connection of Synchronous Feed Encoder

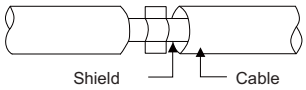
The method for connecting to each unit and device from the synchronous feed encoder is explained in this chapter.

12.1 Synchronous Feed Encoder Connection System Drawing



(Note 1) The section indicated with asterisk (*) indicates cable to be wired outside the operation panel.
Since the cable could be affected by the exogenous noise depending on the environment, the following noise countermeasure is recommended.

Expose the cable by removing a part of the cable sheath and use the shield clamp for the exogenous noise countermeasure.



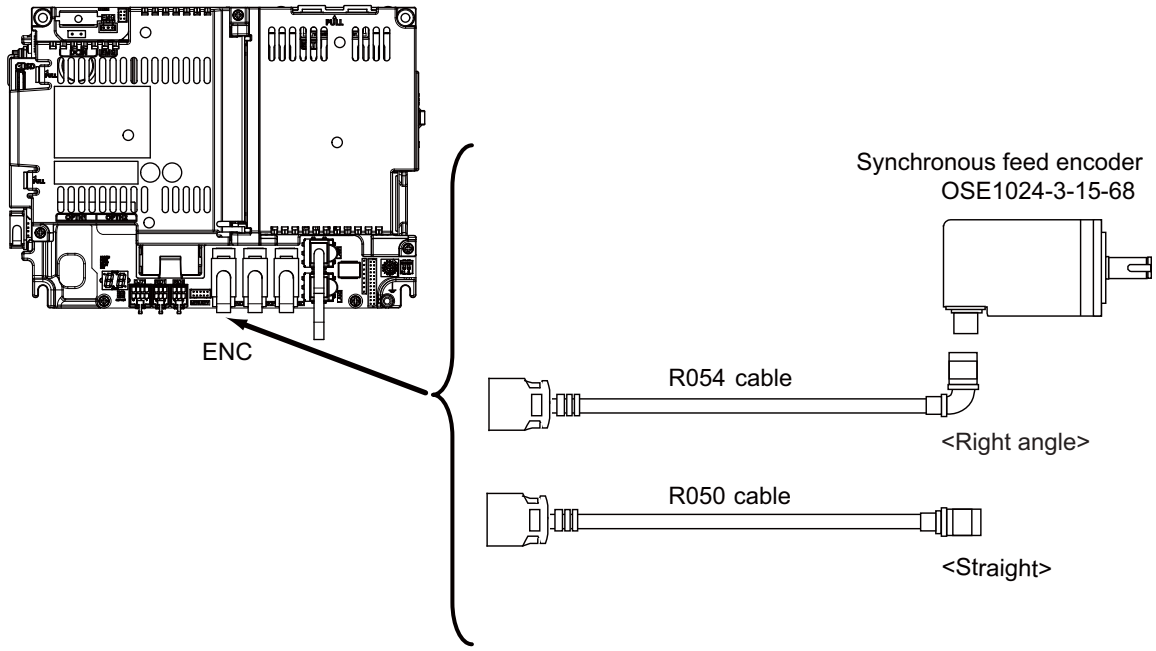
When you cannot use the shield clamp, install a ferrite core as a substitute.

<Related item>

Shield clamp fitting: "EMC Installation Guidelines: EMC Countermeasure Parts: Shield Clamp Fitting"

Ferrite core: "EMC Installation Guidelines: EMC Countermeasure Parts: Ferrite Core"

12.2 Connecting with Control Unit

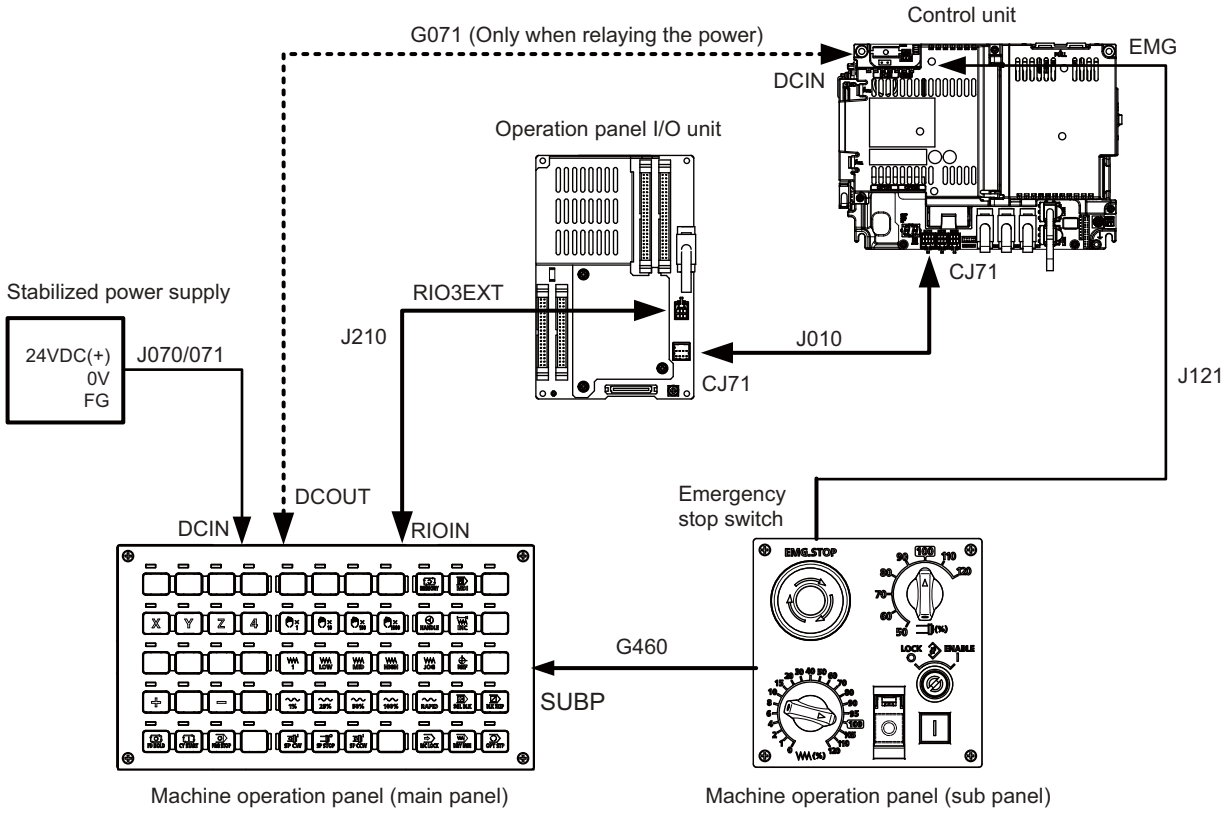


13

Connection of Machine Operation Panel

This chapter briefly explains how to connect the machine operation panel manufactured by Mitsubishi Electric to each unit and device.

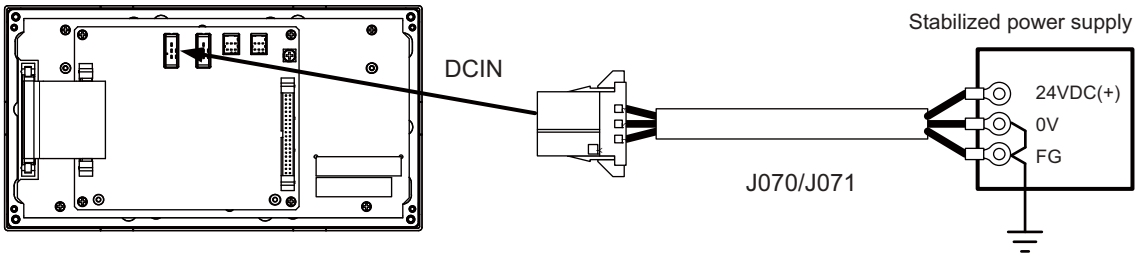
13.1 Machine Operation Panel Connection System Drawing



13.2 Connecting with Power Supply

Connect 24VDC power supply (general-purpose stabilized power supply) to the main panel of the machine operation panel.

[FCU8-KB921/KB922/KB923/KB924/KB925/KB926]



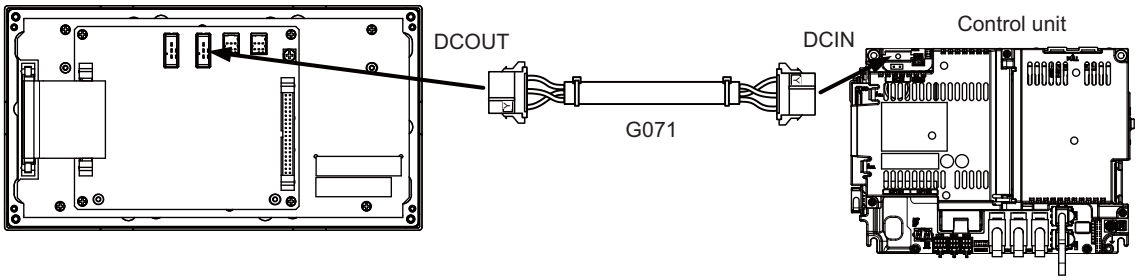
<Related items>

Cable connection drawing: "Cable: J070/J071 Cable"

Connector pin assignment: "General Specifications: Machine Operation Panel: Main Panel A,B" (DCIN connector)

When sharing the 24VDC power supply with the control unit, connect a 24VDC relay cable.

[FCU8-KB921/KB922/KB923/KB924/KB925/KB926]



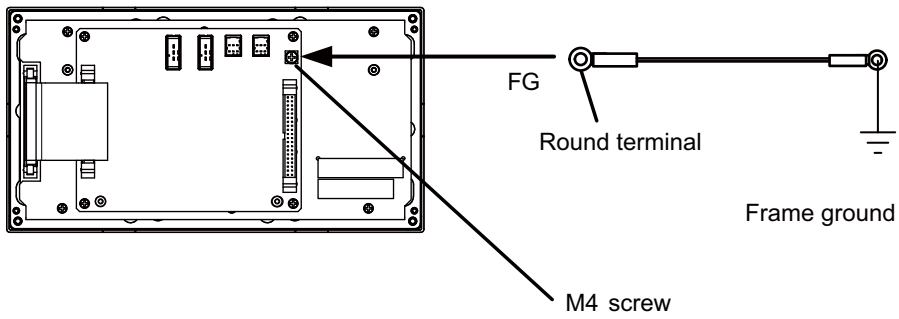
<Related items>

Cable connection drawing: "Cable: G071 Cable"

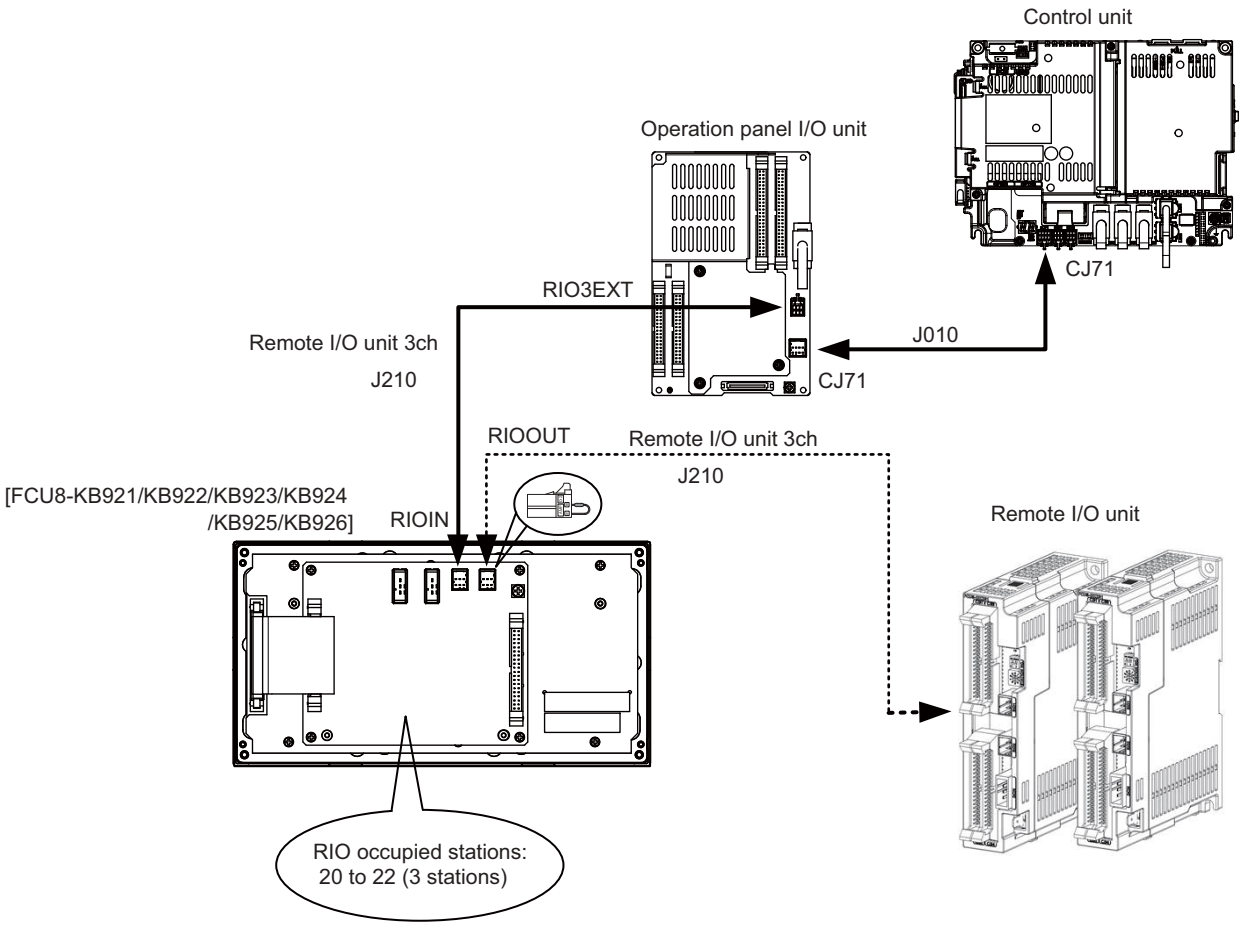
Connector pin assignment: "General Specifications: Machine Operation Panel: Main Panel A,B" (DCOUT connector)

13.3 Connecting with Frame Ground

[FCU8-KB921/KB922/KB923/KB924/KB925/KB926]



13.4 Connecting with Operation Panel I/O Unit



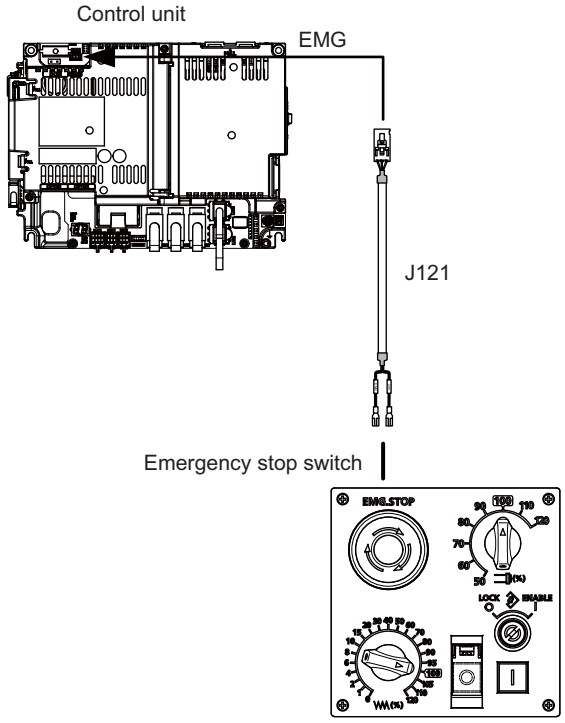
When the remote I/O unit on the next stage is not relayed, connect the R2-TM terminal.

<Related items>

Cable connection drawing: "Cable: J010 Cable", "Cable: J210 Cable"

Connector pin assignment: "General Specifications: Machine Operation Panel: Main Panel A,B" (RIOIN/RIOOUT connector)

13.5 Connecting Emergency Stop Switch



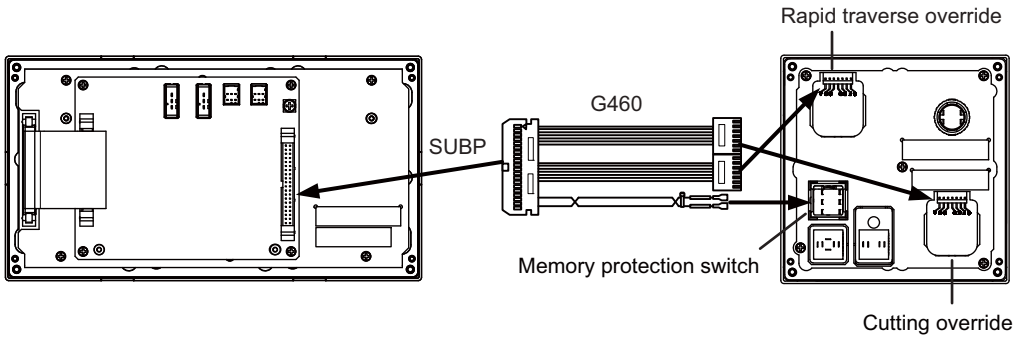
Machine operation panel (sub panel)

<Related items>

Cable connection drawing: "Cable: J121 Cable"

Connector pin assignment: "General Specifications: Machine Operation Panel: Sub Panel A" (emergency stop switch)

13.6 Connecting with Sub Panel



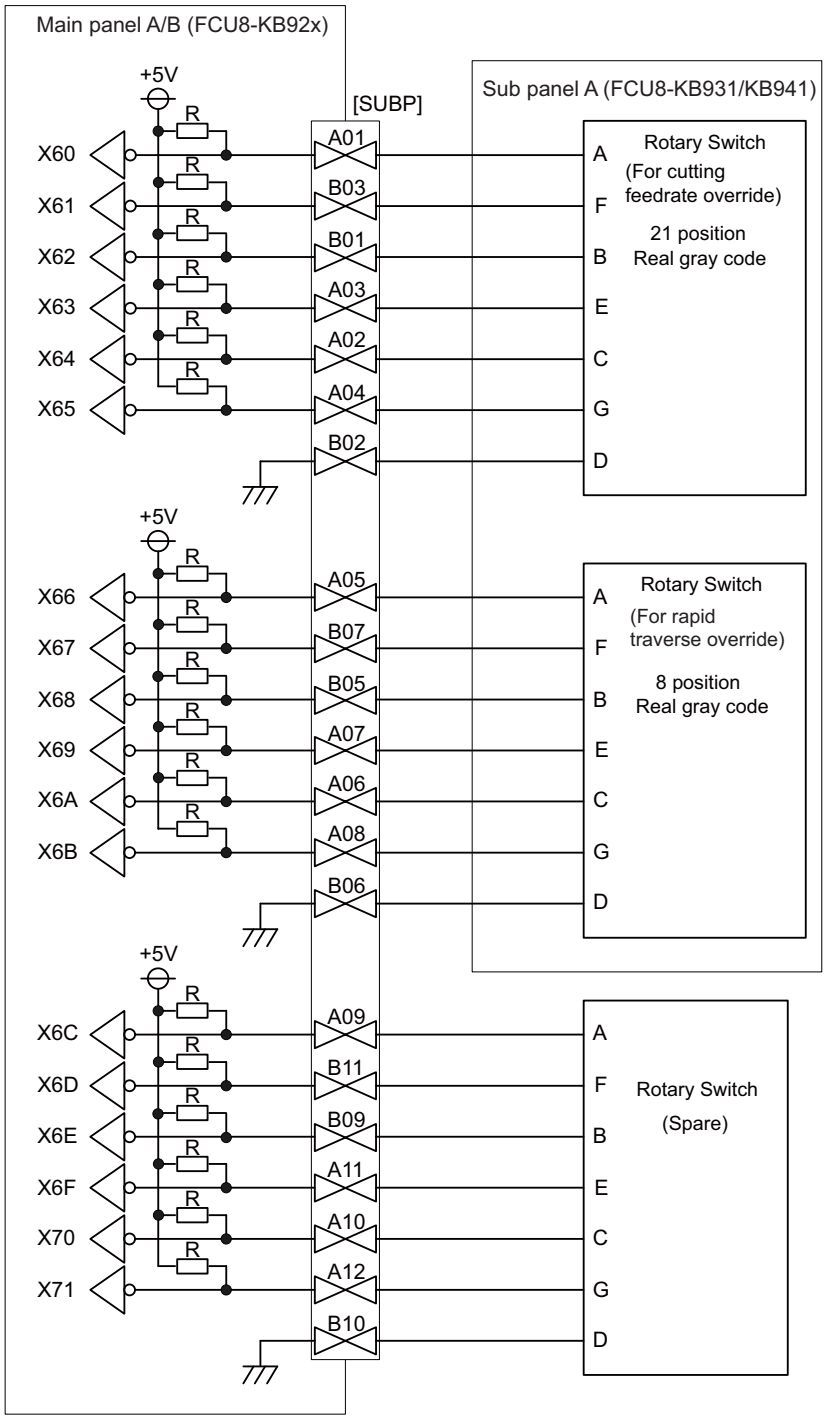
<Related items>

Cable connection drawing: "Cable: G460 Cable"

Connector pin assignment: "General Specifications: Machine Operation Panel: Main Panel A,B" (SUBP connector)

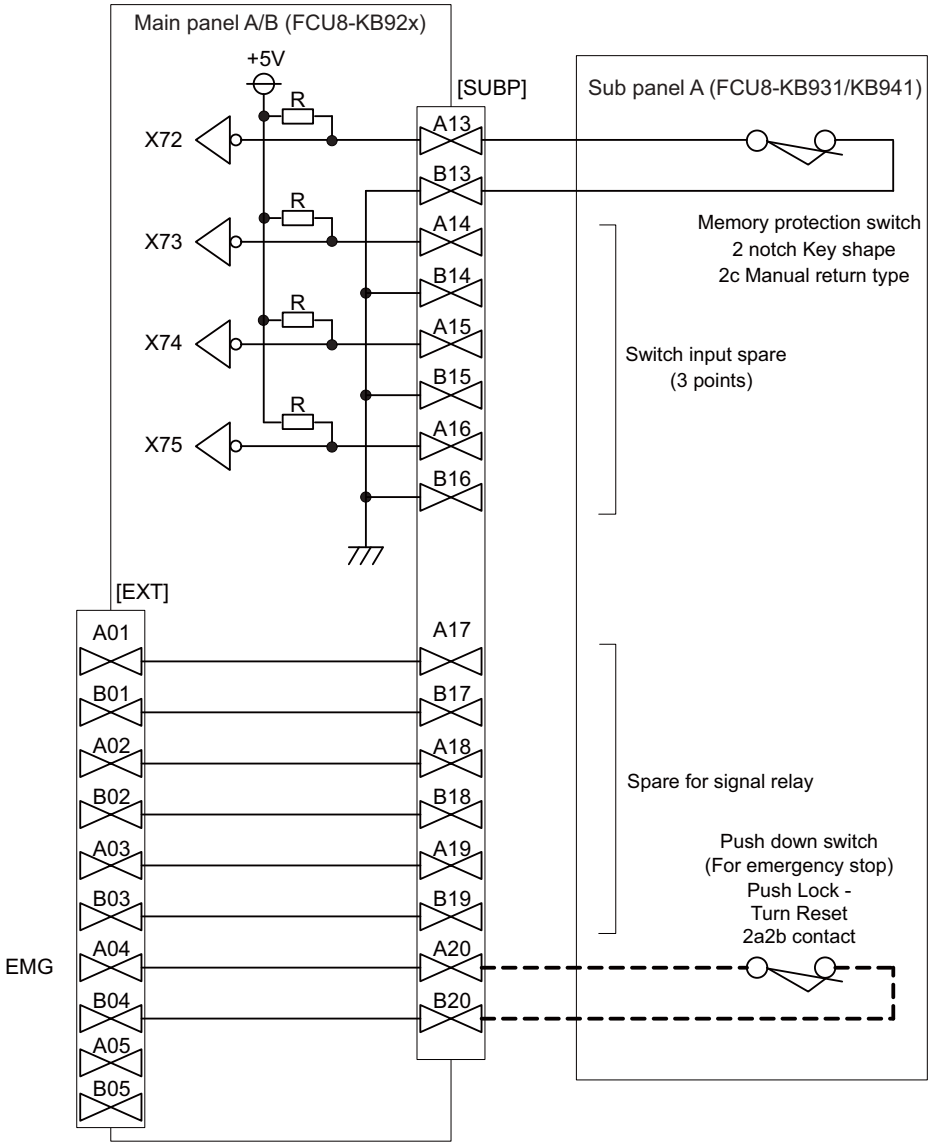
Connector pin assignment: "General Specifications: Machine Operation Panel: Sub Panel A" (rapid traverse override, cutting override, memory protection switch)

<Wiring of rotary switch (SUBP)>



(Note 1) Use the special lead wire with a connector for wiring of rotary switch.
Lead wire with a connector: ACX011-705 (7 terminals, 0.5m) Fuji Electric
(Note 2) A09 to 12 and B09 to 11 of SUBP are spares, so they do not need wiring.
(Note 3) Select a rotary switch which guarantees 5V/1mA.
(Note 4) Length of cables must be 0.5m or shorter.
(Note 5) The numbers in the above diagram do not indicate the actual device numbers.

<Wiring of other switches (SUBP)>



(Note 1) Wirings for memory protection switches must be directly soldered to terminals or use tab terminals (110 series).

(Note 2) When wiring the emergency stop switch, the crimp terminal must be fastened with thread.

(Note 3) For NCs whose control unit and display unit are integrated, wire the emergency stop switch directly to the EMG connector of the control unit. (Use J121 cable)
For a separated-type NC, wire it directly to the EMG connector of the operation panel I/O unit.

(Note 4) Select a rotary switch which guarantees 5V/1mA.

(Note 5) Length of cables must be 0.5m or shorter.

(Note 6) The numbers in the above diagram do not indicate the actual device numbers.

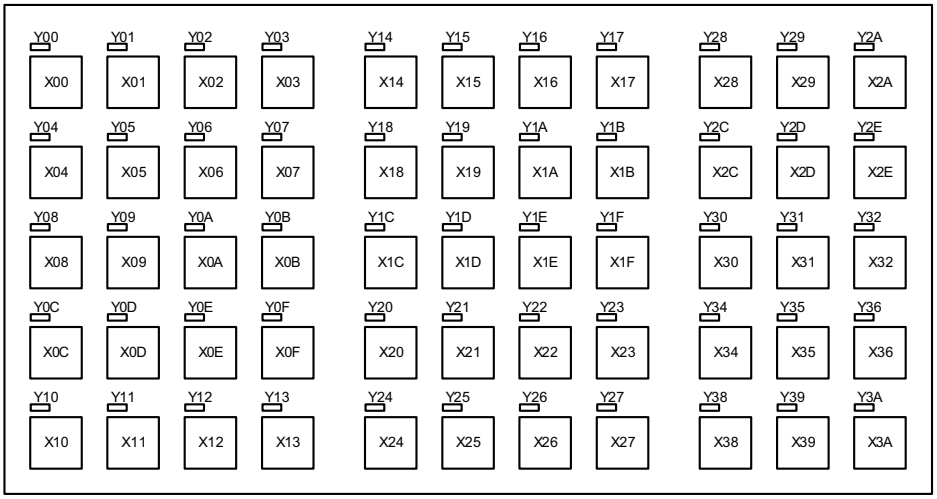
13.7 Software Interface

Station Nos. of the machine operation panel RIOs are fixed. Device Nos. such as switch and LED on the machine operation panel are fixed as follows:

Channel No.	No	Device		Function
RIO1	#1	20th station	Input: ZR5022/ZR5023	[Input] Reading switch data of the sub panel
	#2	21st station	Input: ZR5024/ZR5025	[Input] Reading key data of the main panel (55 points) [Output] LED lighting control (55 points)
			Output: ZR6024/ZR6025	
	#3	22nd station	Input: ZR5026/ZR5027	
			Output: ZR6026/ZR6027	
RIO2	#1	20th station	Input: ZR5222/ZR5223	[Input] Reading switch data of the sub panel
	#2	21st station	Input: ZR5224/ZR5225	[Input] Reading key data of the main panel (55 points) [Output] LED lighting control (55 points)
			Output: ZR6224/ZR6225	
	#3	22nd station	Input: ZR5226/ZR5227	
			Output: ZR6226/ZR6227	
RIO3	#1	20th station	Input: ZR5422/ZR5423	[Input] Reading switch data of the sub panel
	#2	21st station	Input: ZR5424/ZR5425	[Input] Reading key data of the main panel (55 points) [Output] LED lighting control (55 points)
			Output: ZR6424/ZR6425	
	#3	22nd station	Input: ZR5426/ZR5427	
			Output: ZR6426/ZR6427	

(1) Main panel (key switch/LED)

Main panel is equipped with 55 switches and 55 LEDs.
I/O devices are assigned to the switches and LEDs as illustrated below.
(The numbers given in the drawing represent the positions, not the device Nos.)



(Note 1) If the stations of machine operation panel and other remote I/O unit overlap, all the connections of the overlapping stations are invalidated and cannot be used. Stations which do not overlap can be used.

<Device No. of key switches>

Key switch	Device	Key switch	Device
X00	ZR5$24[0]	X20	ZR5$26[0]
X01	ZR5$24[1]	X21	ZR5$26[1]
X02	ZR5$24[2]	X22	ZR5$26[2]
X03	ZR5$24[3]	X23	ZR5$26[3]
X04	ZR5$24[4]	X24	ZR5$26[4]
X05	ZR5$24[5]	X25	ZR5$26[5]
X06	ZR5$24[6]	X26	ZR5$26[6]
X07	ZR5$24[7]	X27	ZR5$26[7]
X08	ZR5$24[8]	X28	ZR5$26[8]
X09	ZR5$24[9]	X29	ZR5$26[9]
X0A	ZR5$24[A]	X2A	ZR5$26[A]
X0B	ZR5$24[B]	Not used	ZR5$26[B]
X0C	ZR5$24[C]	X2C	ZR5$26[C]
X0D	ZR5$24[D]	X2D	ZR5$26[D]
X0E	ZR5$24[E]	X2E	ZR5$26[E]
X0F	ZR5$24[F]	Not used	ZR5$26[F]
X10	ZR5$25[0]	X30	ZR5$27[0]
X11	ZR5$25[1]	X31	ZR5$27[1]
X12	ZR5$25[2]	X32	ZR5$27[2]
X13	ZR5$25[3]	Not used	ZR5$27[3]
X14	ZR5$25[4]	X34	ZR5$27[4]
X15	ZR5$25[5]	X35	ZR5$27[5]
X16	ZR5$25[6]	X36	ZR5$27[6]
X17	ZR5$25[7]	Not used	ZR5$27[7]
X18	ZR5$25[8]	X38	ZR5$27[8]
X19	ZR5$25[9]	X39	ZR5$27[9]
X1A	ZR5$25[A]	X3A	ZR5$27[A]
X1B	ZR5$25[B]	Not used	ZR5$27[B]
X1C	ZR5$25[C]	Not used	ZR5$27[C]
X1D	ZR5$25[D]	Not used	ZR5$27[D]
X1E	ZR5$25[E]	Not used	ZR5$27[E]
X1F	ZR5$25[F]	Not used	ZR5$27[F]

(Note 1) "$" in the device No. varies depending on the channel No. of RIO.
(RIO1 = "0", RIO2 = "2", RIO3 = "4")

(Note 2) While the key switch is pressed, "1" is input in the ZR device.

<Device No. of LED>

LED	Device		LED	Device
Y00	ZR6$24[0]		Y20	ZR6$26[0]
Y01	ZR6$24[1]		Y21	ZR6$26[1]
Y02	ZR6$24[2]		Y22	ZR6$26[2]
Y03	ZR6$24[3]		Y23	ZR6$26[3]
Y04	ZR6$24[4]		Y24	ZR6$26[4]
Y05	ZR6$24[5]		Y25	ZR6$26[5]
Y06	ZR6$24[6]		Y26	ZR6$26[6]
Y07	ZR6$24[7]		Y27	ZR6$26[7]
Y08	ZR6$24[8]		Y28	ZR6$26[8]
Y09	ZR6$24[9]		Y29	ZR6$26[9]
Y0A	ZR6$24[A]		Y2A	ZR6$26[A]
Y0B	ZR6$24[B]		Not used	ZR6$26[B]
Y0C	ZR6$24[C]		Y2C	ZR6$26[C]
Y0D	ZR6$24[D]		Y2D	ZR6$26[D]
Y0E	ZR6$24[E]		Y2E	ZR6$26[E]
Y0F	ZR6$24[F]		Not used	ZR6$26[F]
Y10	ZR6$25[0]		Y30	ZR6$27[0]
Y11	ZR6$25[1]		Y31	ZR6$27[1]
Y12	ZR6$25[2]		Y32	ZR6$27[2]
Y13	ZR6$25[3]		Not used	ZR6$27[3]
Y14	ZR6$25[4]		Y34	ZR6$27[4]
Y15	ZR6$25[5]		Y35	ZR6$27[5]
Y16	ZR6$25[6]		Y36	ZR6$27[6]
Y17	ZR6$25[7]		Not used	ZR6$27[7]
Y18	ZR6$25[8]		Y38	ZR6$27[8]
Y19	ZR6$25[9]		Y39	ZR6$27[9]
Y1A	ZR6$25[A]		Y3A	ZR6$27[A]
Y1B	ZR6$25[B]		Not used	ZR6$27[B]
Y1C	ZR6$25[C]		Not used	ZR6$27[C]
Y1D	ZR6$25[D]		Not used	ZR6$27[D]
Y1E	ZR6$25[E]		Not used	ZR6$27[E]
Y1F	ZR6$25[F]		Not used	ZR6$27[F]

(Note 1) "$" in the device No. varies depending on the channel No. of RIO.
(RIO1 = "0", RIO2 = "2", RIO3 = "4")

(2) Sub panel

Sub panel is equipped with cutting override, rapid traverse override, memory protection switch and emergency stop switch. Direct wiring is available for the emergency stop switch, and device numbers for the other switches are assigned as listed below:

(a) Cutting override (6bit)

Setting value	Device					
	ZR5$22[0]	ZR5$22[1]	ZR5$22[2]	ZR5$22[3]	ZR5$22[4]	ZR5$22[5]
0	0	0	0	0	0	0
10	1	0	0	0	0	1
20	1	1	0	0	0	0
30	0	1	0	0	0	1
40	0	1	1	0	0	0
50	1	1	1	0	0	1
60	1	0	1	0	0	0
70	0	0	1	0	0	1
80	0	0	1	1	0	0
90	1	0	1	1	0	1
100	1	1	1	1	0	0
110	0	1	1	1	0	1
120	0	1	0	1	0	0
130	1	1	0	1	0	1
140	1	0	0	1	0	0
150	0	0	0	1	0	1
160	0	0	0	1	1	0
170	1	0	0	1	1	1
180	1	1	0	1	1	0
190	0	1	0	1	1	1
200	0	1	1	1	1	0

(b) Rapid traverse override (6bit)

Setting value	Device					
	ZR5$22[6]	ZR5$22[7]	ZR5$22[8]	ZR5$22[9]	ZR5$22[A]	ZR5$22[B]
0	0	0	0	0	0	0
10	1	0	0	0	1	0
20	1	1	0	0	0	0
30	0	1	0	0	1	0
40	0	1	1	0	0	0
50	1	1	1	0	1	0
60	1	0	1	0	0	0
70	0	0	1	0	1	0
80	0	0	1	1	0	0
90	1	0	1	1	1	0
100	1	1	1	1	0	0

(c) Memory protection switch (1bit)

Setting value	Device
	ZR5$23[2]
LOCK	0
ENABLE	1

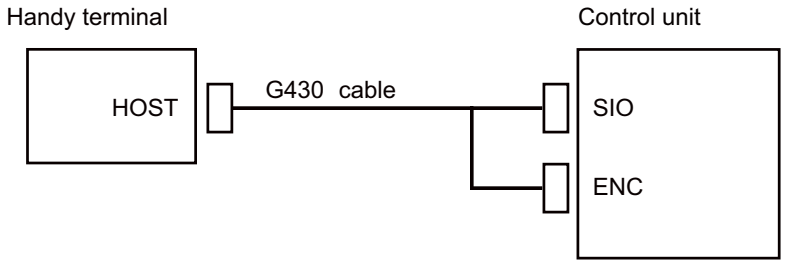
(Note 1) "$" in the device No. varies depending on the channel No. of RIO.
(RIO1 = "0", RIO2 = "2", RIO3 = "4")

14

Connection of Handy Terminal

This chapter briefly explains how to connect the handy terminal to each unit and device.

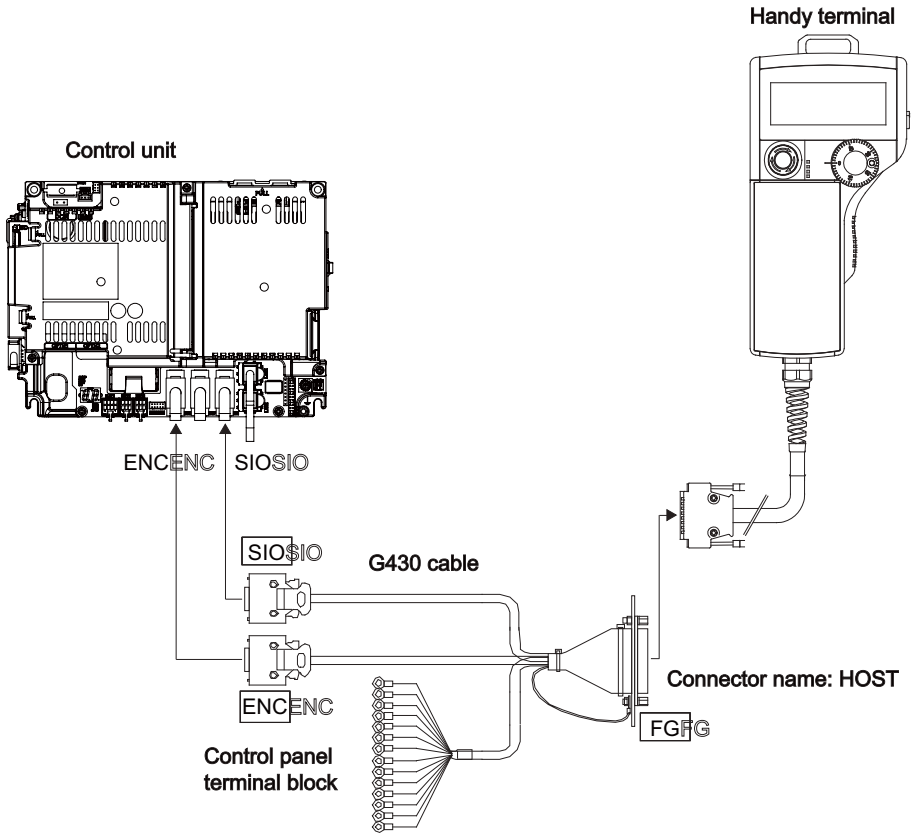
14.1 Handy Terminal Connection System Drawing



(Note 1) Connect the HOST connector of the G430 cable to the grounding plate.

14.2 Connecting with Control Unit

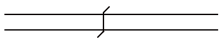
Connect the handy terminal to SIO connector and ENC connector of the control unit.
Also, connect the emergency stop switch (SW1), enable switch (SW2), selector switch (SW) and 24VDC input to the control panel terminal block.



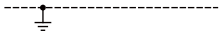
15

Cable

15.1 Symbols for Writing Cable Drawings

(1)  indicates twisted pair.

(2)  indicates the shield sheath.

(3)  indicates shield clamping to the grounding plate.

(4) In the cable drawings, the partner of the twisted pair cable is given a priority, so please be aware that the pin No. of the connectors at both ends are not necessarily in sequential order.

(5) Equivalent parts can be used for the connector, contact and wire material.

(6) The tolerances of the cables provided by MITSUBISHI are as follows:

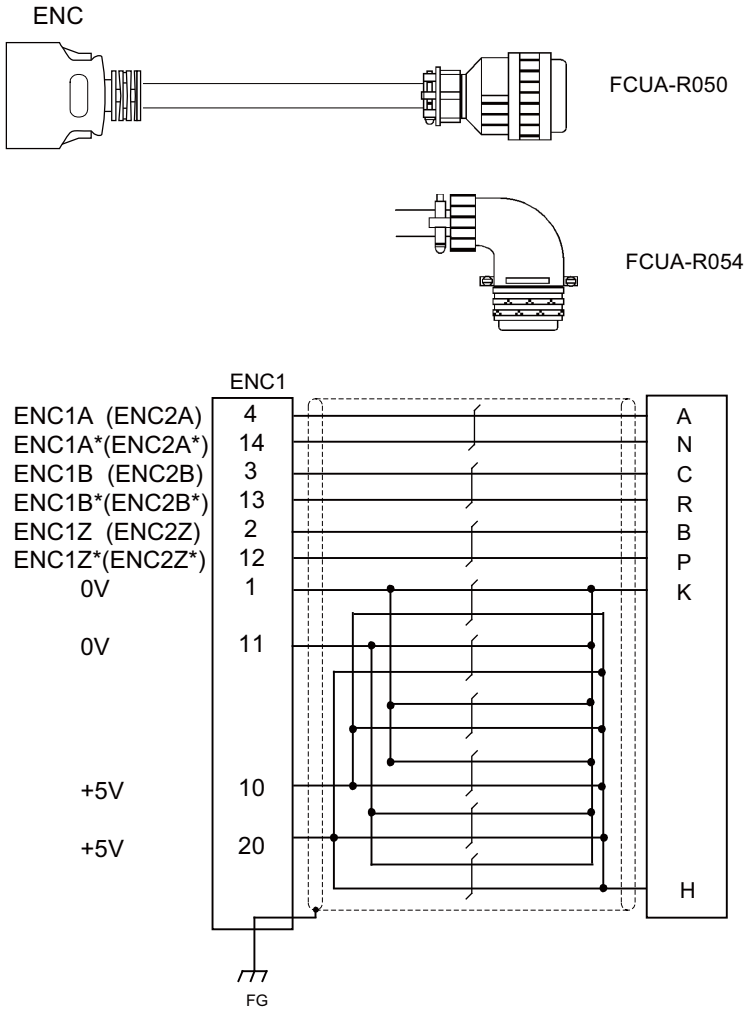
Cable length (mm)	Tolerances (mm)
～ 600	±30
601 ～ 1000	±50
1001 ～ 5000	±100
5001 ～ 10000	±150
10001 ～ 15000	±200
15001 ～ 20000	±300

15.2 Cable Relating to NC

15.2.1 FCUA-R050/R054 Cable

Max. cable length: 30m

Application: Synchronous encoder - control unit



[ENC1]
Plug: 10120-3000PE
Shell: 10320-52F0-008
Manufacturer: 3M

Wire material: UL1061-2464 AWG24 × 12P
Manufacturer: Oki Electric Cable

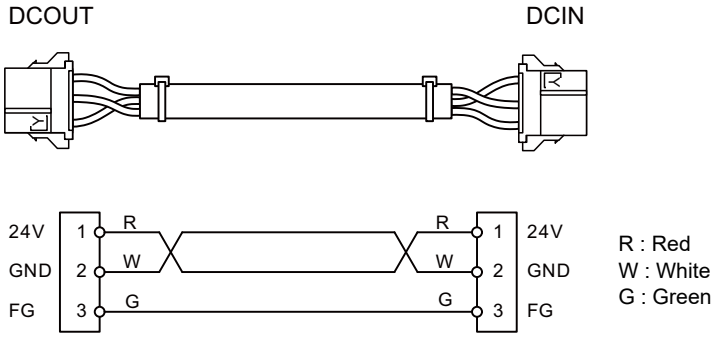
[FCUA-R050 cable]
Connector: MS3106B20-29S
Cable clamp: MS3057-12A
Manufacturer: ITT Cannon
[FCUA-R054 cable]
Connector: MS3108B20-29S
Cable clamp: MS3057-12A
Manufacturer: ITT Cannon

(Note) Fold the cable shield over the sheath, and wrap copper foil tape over it. Connect the wound copper foil tape to GND plate of the connector.

15.2.2 G071 Cable

Max. cable length: 1m

Application: 24VDC relay cable for machine operation panel



[DCOUT]
Connector: 2-178288-3
Contact: 1-175218-5 x 3
Manufacturer: TE Connectivity

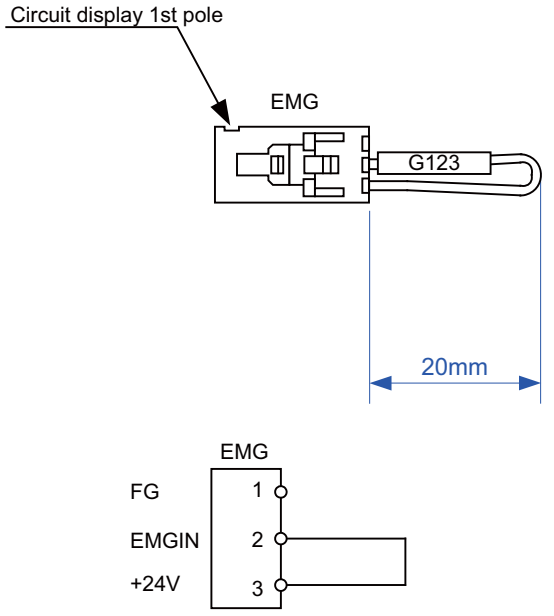
Wire material: UL1264 AWG16
(Red, White, Green)

[DCIN]
Connector: 2-178288-3
Contact: 1-175218-5 x 3
Manufacturer: TE Connectivity

(Note) These cables are available only when wired to a same control panel.

15.2.3 G123 Cable

Application: Cable for emergency stop release



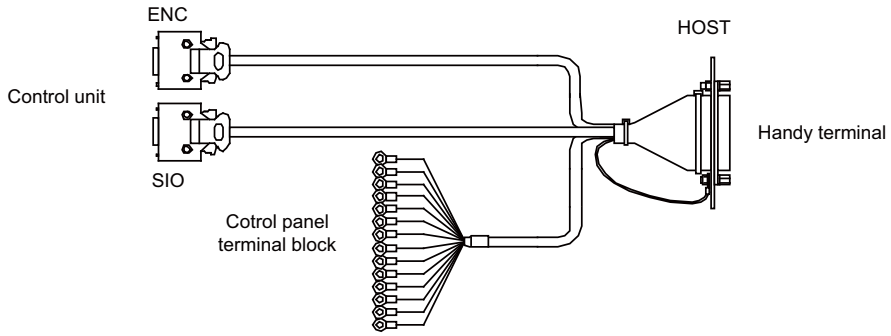
Wire material : UL1007 AWG22

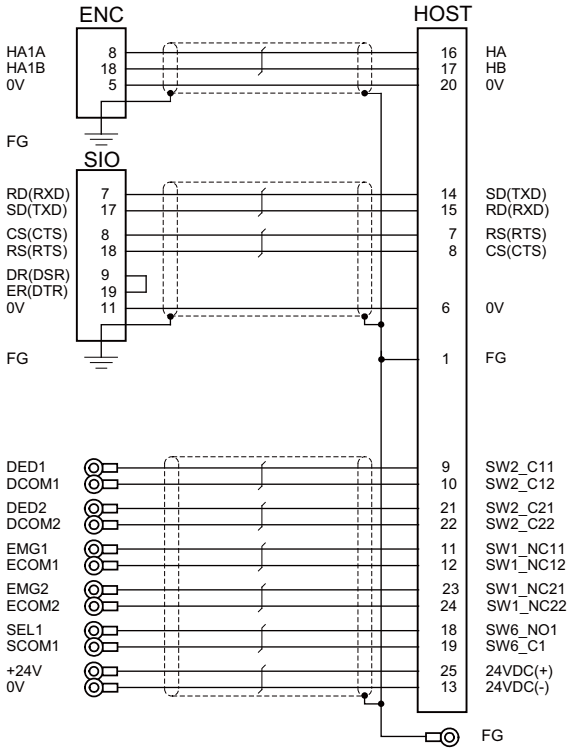
[EMG]
Connector : 50-57-9403
Contact : 0016020103
Manufacturer : MOLEX

15.2.4 G430 Cable

Max. cable length: 10m

Application: For connection to handy terminal





[ENC][SIO]
Plug: 10120-3000PE
Shell: 10320-52F0-008
Manufacturer: 3M
Wire material: UL1061-2464 AWG28 × 3P
Manufacturer: Oki Electric Cable

[Control panel terminal block]
Crimp terminal: R1.25-3.5
Manufacturer: JST
Wire material: UL1061-2464 AWG24 × 8P
Manufacturer: Oki Electric Cable

FG terminal
Crimp terminal: V1.25-4
Manufacturer: JST
Wire material: UL1061-2464 AWG18 (Green)
Manufacturer: Oki Electric Cable

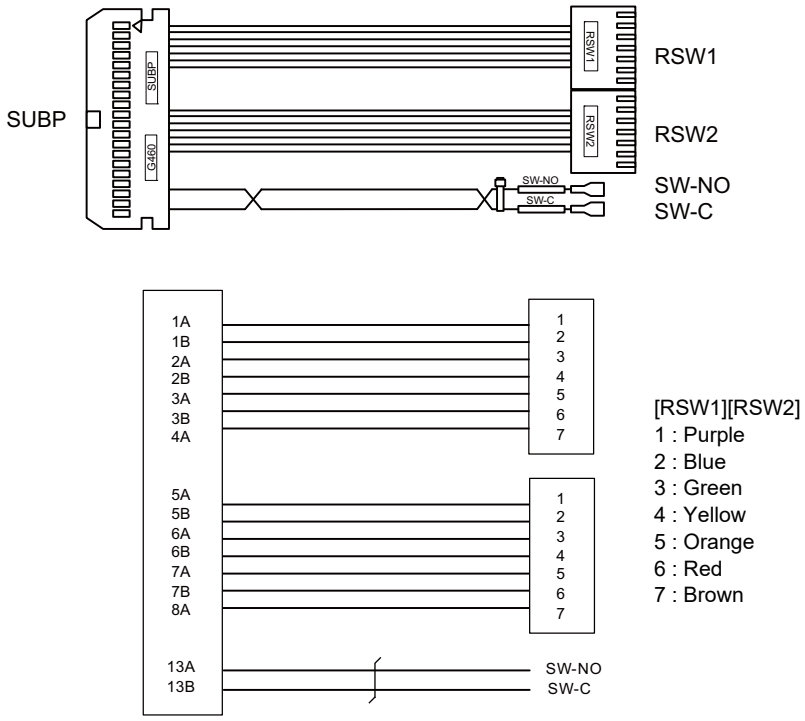
[HOST]
Plug: CDB-25S
Contact: CD-SC-221 × 21
Manufacturer: Hirose Electric

(Note) Fold the cable shield over the sheath, and wrap copper foil tape over it.
Connect the wound copper foil tape to GND plate of the connector.

15.2.5 G460 Cable

Max. cable length: 0.5m

Application: Cable for machine operation panel (cable between main panel and sub panel)



[SUBP]
Connector: HIF3BA-40D-2.54C
Contact: HIF3-2428SC x 16
Manufacturer: Hirose Electric

Wire material: UL1007 AWG24
(Red, Black)

[RSW1][RSW2]
Connector with cable : ACX011-705 x 2
Contact: 1-175218-5 x 3
Manufacturer: Fuji Electric

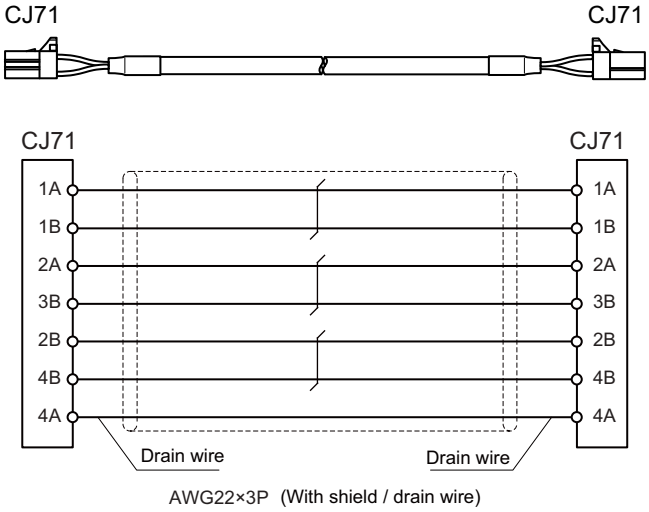
[SW-NO][SW-C]
Connector: STO-01T-110N
Manufacturer: JST

(Note) Coat the connector [SW-NO][SW-C] with an insulation.

15.2.6 J010 Cable

Max. cable length: 1m

Application: Operation panel I/O interface cable



[CJ71]
Connector : 2-1318119-4
Contact : 1318107-1
Manufacturer: TE Connectivity

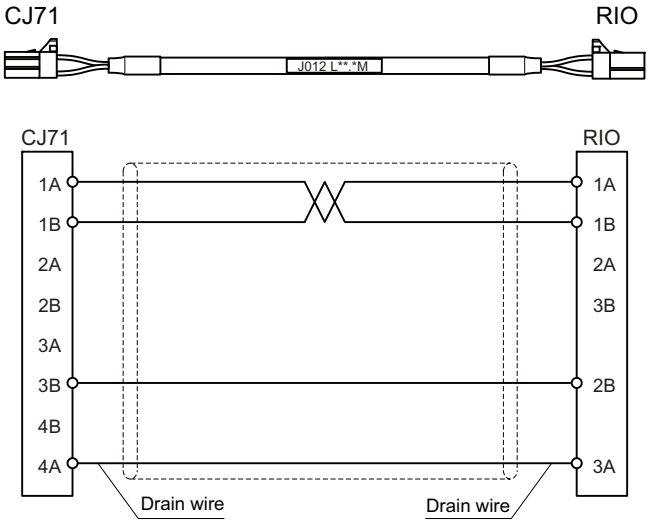
Wire material : HRZEV-SB-A(20276) AWG22×3P
Manufacturer: DYDEN

(Note) Use the wire material of which impedance characteristics is 110Ω.

15.2.7 J012 Cable

Max. cable length: 1m

Application: Operation panel I/O interface cable (for FCU8-DX834)



[CJ71]
Connector : 2-1318119-4
Contact : 1318107-1 (1318105-1)
Manufacturer: TE Connectivity

Wire material : HK-SB/20276XL Black LF 2P×22AWG
Manufacturer: Taiyo Cabletec

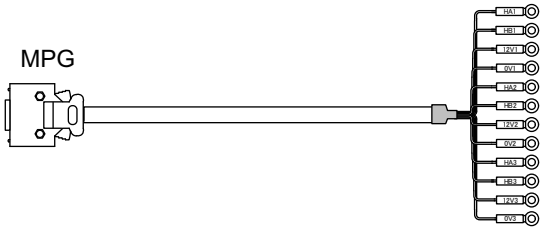
[RIO]
Connector : 1-1318119-3
Contact : 1318107-1
Manufacturer: TE Connectivity

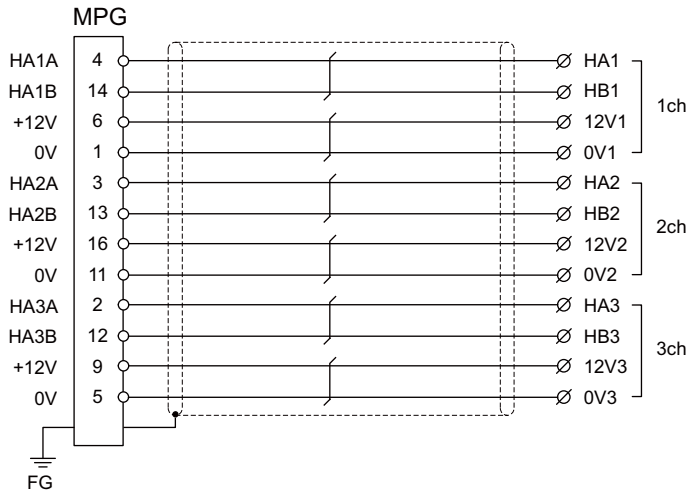
(Note) Use the wire material of which impedance characteristics is 110Ω.

15.2.8 J020/J021/J022 Cable

Max. cable length: 50m

Application: Manual Pulse Generator cable (12V)





[MPG]
Connector: 10120-3000PE
Case: 10320-52F0-008
Manufacturer: 3M

Wire material: UL2464 U-TKVVBS AWG24 × 6P
Manufacturer: Tatsuta Tachii Electric Cable

[1ch][2ch][3ch]
Crimp terminal: R1.25-3 × 12
Manufacturer: JST

Cable name	1ch	2ch	3ch
J020 cable	○		
J021 cable	○	○	
J022 cable	○	○	○
○ : Usable channel Unconnectable to control unit side			

(Note 1) Fold the cable shield over the sheath, and wrap copper foil tape over it. Connect the wound copper foil tape to GND plate of the connector.

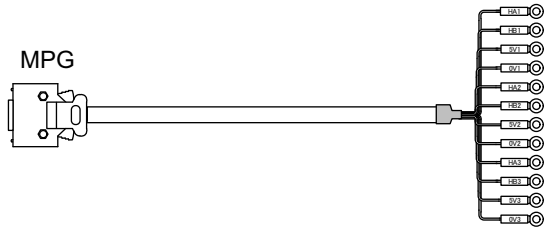
(Note 2) The cables for 1ch and 2ch are compatible with F320 or F321 cable of the conventional model.

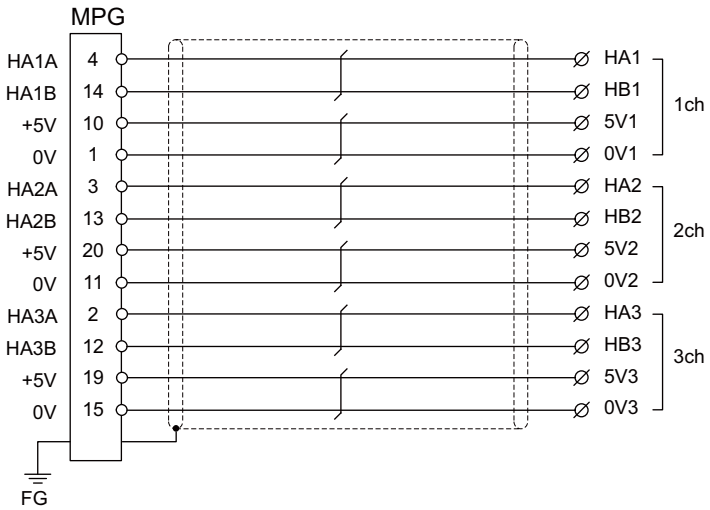
(Note 3) When using the jackscrew M2.6-type 10320-52A0-008 for the shell, do not fasten the screws too tightly otherwise the connector and the PCB may be damaged.
(Manufacturer recommended tightening torque: 0.20±0.05N·m)

15.2.9 J023/J024/J025 Cable

Max. cable length: 20m

Application: Manual Pulse Generator cable (5V)





[MPG]
Connector: 10120-3000PE
Case: 10320-52F0-008
Manufacturer: 3M

Wire material: UL2464 U-TKVVBS AWG22 × 6P
Manufacturer: Tatsuta Tachii Electric Cable

[1ch][2ch][3ch]
Crimp terminal: R1.25-3 × 12
Manufacturer: JST

Cable name	1ch	2ch	3ch
J023 cable	○		
J024 cable	○	○	
J025 cable	○	○	○
○ : Usable channel Unconnectable to control unit side			

(Note 1) Fold the cable shield over the sheath, and wrap copper foil tape over it. Connect the wound copper foil tape to GND plate of the connector.

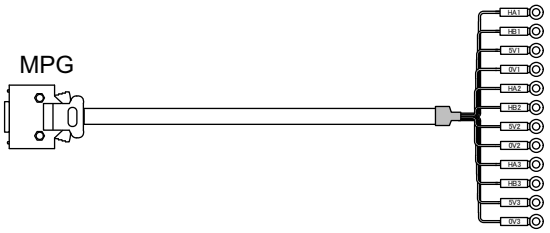
(Note 2) The cables for 1ch and 2ch are compatible with F023 or F024 cable of the conventional model.

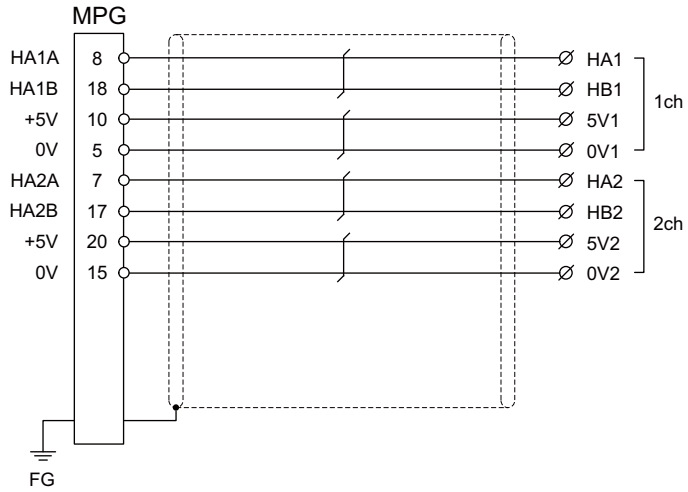
(Note 3) When using the jackscrew M2.6-type 10320-52A0-008 for the shell, do not fasten the screws too tightly otherwise the connector and the PCB may be damaged.
(Manufacturer recommended tightening torque: 0.20±0.05N·m)

15.2.10 J026/J027 Cable

Max. cable length: 20m (the maximum length of the cable when connected to the control unit via other units)

Application: Manual Pulse Generator cable (5V)





[MPG]
Connector: 10120-3000PE
Case: 10320-52F0-008
Manufacturer: 3M

Wire material: UL2464 U-TKVVBS AWG22 × 6P
Manufacturer: Tatsuta Tachii Electric Cable

[1ch][2ch]
Crimp terminal: R1.25-3 × 8
Manufacturer: JST

Cable name	1ch	2ch
J026 cable	○	
J027 cable	○	○
○ : Usable channel Unconnectable to operation board side		

(Note 1) Fold the cable shield over the sheath, and wrap copper foil tape over it. Connect the wound copper foil tape to GND plate of the connector.

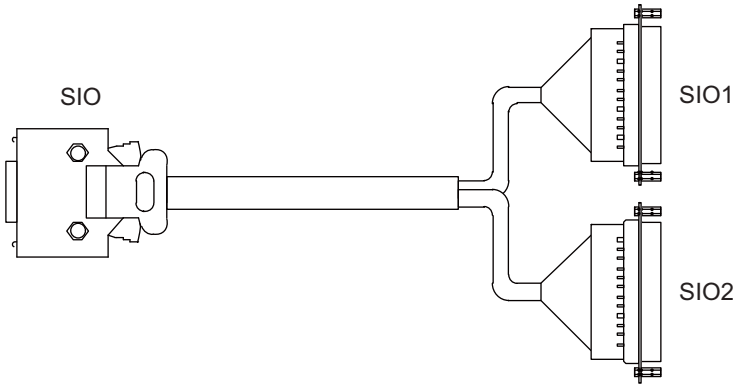
(Note 2) The cables are compatible with G023 or G024 cable of the conventional model.

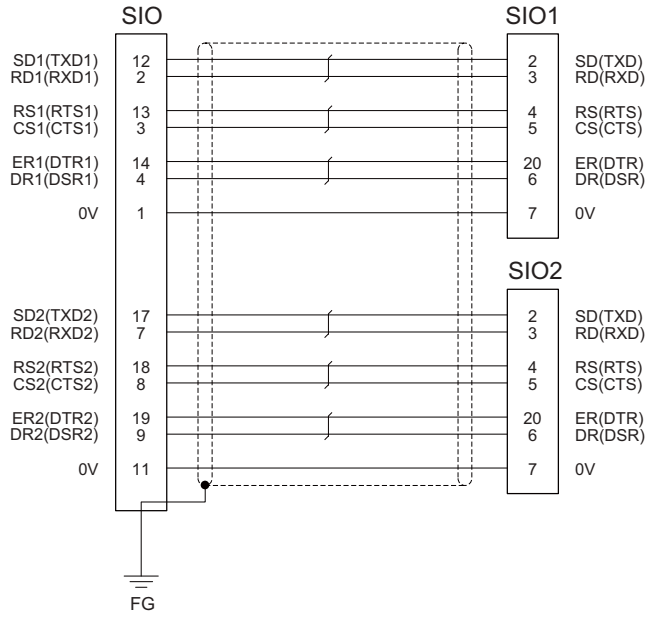
(Note 3) When using the jackscrew M2.6-type 10320-52A0-008 for the shell, do not fasten the screws too tightly otherwise the connector and the PCB may be damaged.
(Manufacturer recommended tightening torque: 0.20±0.05N·m)

15.2.11 J030/J031 Cable

Max. cable length: 15m (the maximum length of the cable when connected to the control unit via other units)

Application: RS232C I/F cable





[SIO]
Connector: 10120-3000PE
Case: 10320-52F0-008
Manufacturer: 3M

Wire material: 2464C BIOS-CL3-26 07P
Manufacturer: Bando Electric Wire

[SIO1][SIO2]
Connector: CDB-25S
Contact: CD-SC-111
Lock nut: HD-LNA
Manufacturer: Hirose Electric

Cable name	SIO1	SIO2
J030 cable	○	
J031 cable	○	○
○ : Usable channel		

(Note 1) Fold the cable shield over the sheath, and wrap copper foil tape over it.
Connect the wound copper foil tape to GND plate of the connector.

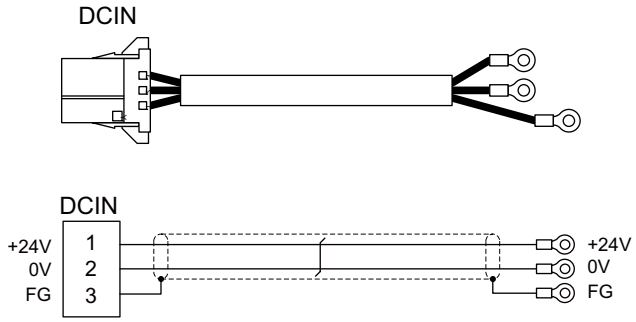
(Note 2) Signal names in parentheses "( )" are generally used.

(Note 3) When using the jackscrew M2.6-type 10320-52A0-008 for the shell, do not fasten the screws too tightly otherwise the connector and the PCB may be damaged.
(Manufacturer recommended tightening torque: 0.20±0.05N·m)

15.2.12 J070/J071 Cable

Max. cable length: 15m(J070) / 20m(J071)

Application: 24VDC power cable



[DCIN]
Connector : 2-178288-3
Contact: : 1-175218-5
Manufacturer: TE Connectivity

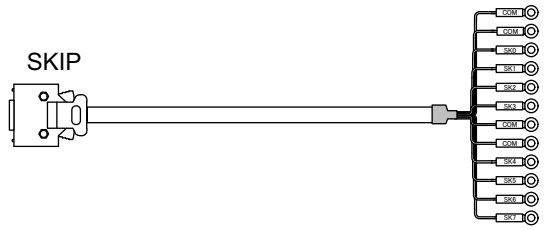
[J070 cable]
Wire material : 2464C BIOS-CL3-16 02C × 16AWG(26/0.26)
Manufacturer: BANDO DENSEN

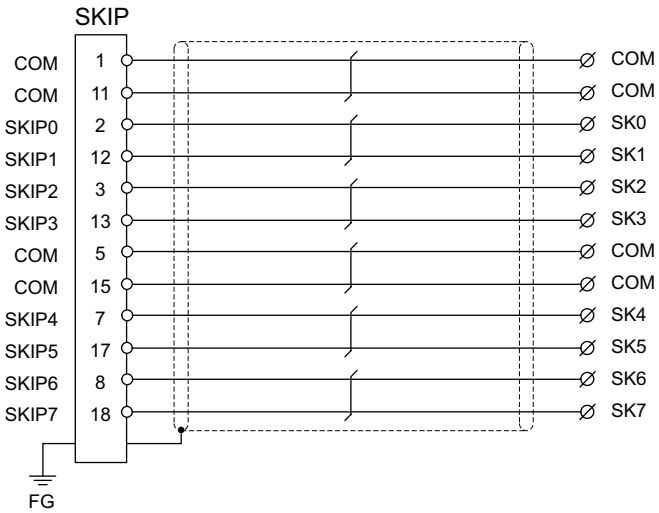
[J071 cable]
Wire material :
UL2464-SB TEW 2×14AWG(41/0.26)LF Black × White
Manufacturer: Hitachi Metals

Crimp terminal : R1.25-4 × 3
Manufacturer: JST

15.2.13 J100 Cable

Max. cable length: 20m
Application: Skip





[SKIP]
Connector: 10120-3000PE
Case: 10320-52F0-008
Manufacturer: 3M

Wire material: UL2464 U-TKVVBS AWG24 × 6P
Manufacturer: Tatsuta Tachii Electric Cable

Crimp terminal: R1.25-3.5 × 12
Manufacturer: JST

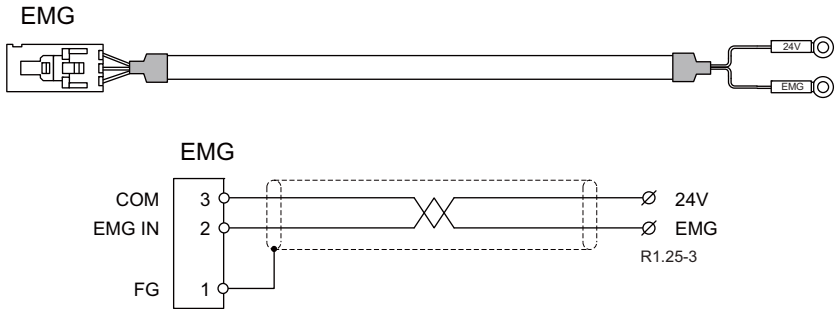
(Note 1) Fold the cable shield over the sheath, and wrap copper foil tape over it. Connect the wound copper foil tape to GND plate of the connector.

(Note 2) When using the jackscrew M2.6-type 10320-52A0-008 for the shell, do not fasten the screws too tightly otherwise the connector and the PCB may be damaged.
(Manufacturer recommended tightening torque: 0.20±0.05N·m)

15.2.14 J120 Cable

Max. cable length: 30m

Application: Emergency stop cable



[EMG]
Connector : 50-57-9403
(former model number: 51030-0330)
Contact : 0016020103
(former model number: 50084-8129)
Manufacturer: MOLEX

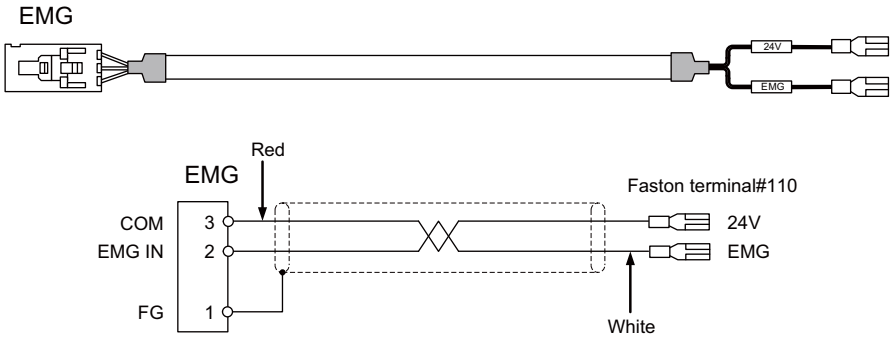
Wire material :
2464C BIOS-CL3-22 01P
Manufacturer: BANDO DENSEN

Crimp terminal : R1.25-3 × 2
Manufacturer: JST

15.2.15 J121 Cable

Max. cable length: 30m

Application: Emergency stop cable for machine operation panel



[EMG]
Connector : 50-57-9403
Contact : 0016020103
Manufacturer: MOLEX

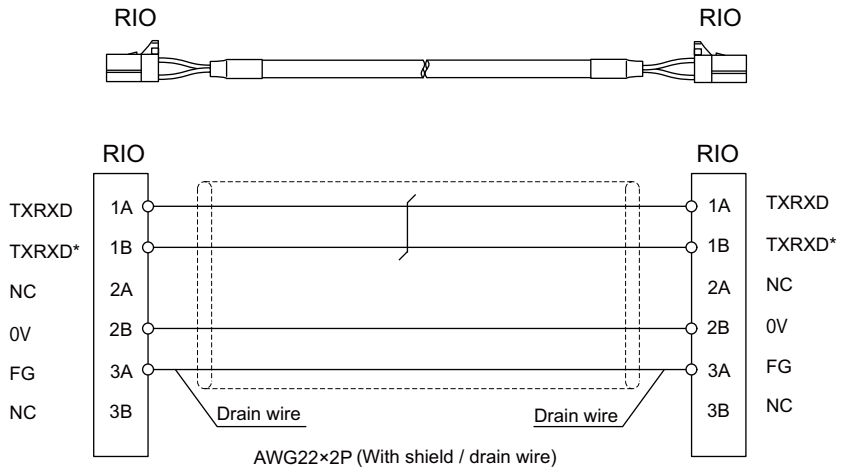
Wire material :
2464C BIOS-CL3-22 01P
Manufacturer: BANDO DENSEN

Crimp terminal : Faston terminal #110 with insulating coating

15.2.16 J210 Cable

Max. cable length: 50m

Application: Remote I/O 2.0 communication cable



[RIO]
Connector : 1-1318119-3
Contact : 1318107-1
Manufacturer: TE Connectivity

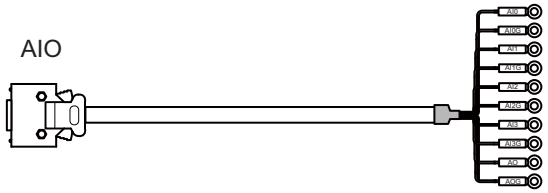
Wire material : HK-SB/20276XL Black LF 2P × 22AWG
Manufacturer: Taiyo Cabletec

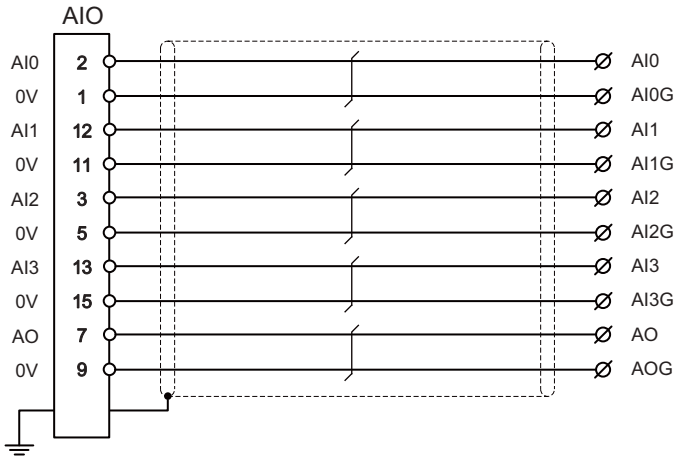
(Note 1) Use the wire material of which impedance characteristics is 110Ω.

15.2.17 J221 Cable

Max. cable length: 30m

Application: Analog input/output cable (for remote I/O unit)





[AIO]
Connector: 10120-3000PE
Case: 10320-52F0-008
Manufacturer: 3M

Wire material: UL2464 U-TKVVBS AWG24 × 6P
Manufacturer: Tatsuta Tachii Electric Cable

Crimp terminal: R1.25-3.5 x 10
Manufacturer: JST

(Note 1) Fold the cable shield over the sheath, and wrap copper foil tape over it. Connect the wound copper foil tape to GND plate of the connector.

(Note 2) When using the jackscrew M2.6-type 10320-52A0-008 for the shell, do not fasten the screws too tightly otherwise the connector and the PCB may be damaged.
(Manufacturer recommended tightening torque: 0.20±0.05N·m)

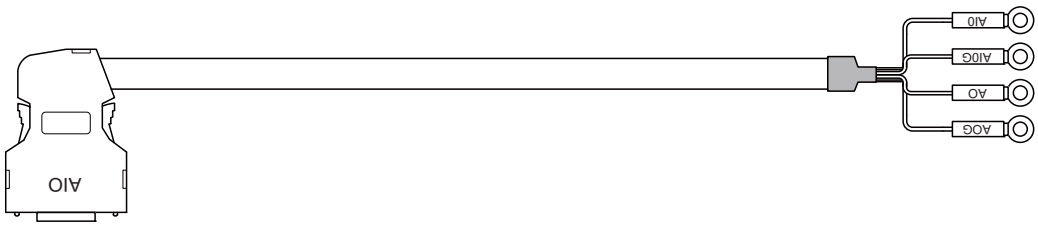
(Note 3) FCUA-R031 cable of the conventional models is also available to use.

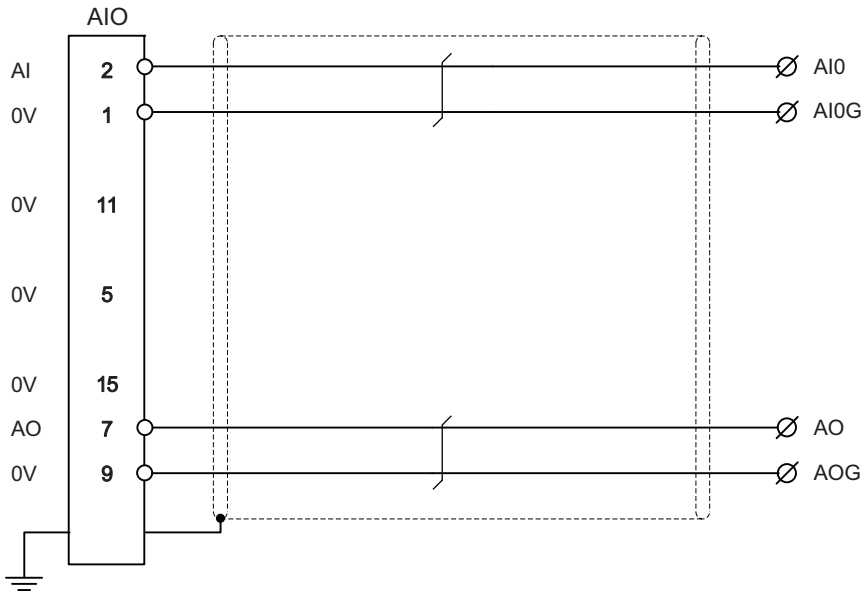
(Note 4) For FCUA-R031, AOG and AI3G share the pin #15. For J221, however, AOG uses the pin #9.

15.2.18 J224 Cable

Max. cable length: 30m

Application: Analog input/output cable (for operation panel I/O unit)





[AIO]
Connector: 10120-3000PE
Case: 10320-56F0-008
Manufacturer: 3M

Wire material: UL2464 U-TKVVBS AWG24 × 2P
Manufacturer: Tatsuta Tachii Electric Cable

Crimp terminal: R1.25-3.5 x 10
Manufacturer: JST

(Note 1) Fold the cable shield over the sheath, and wrap copper foil tape over it.
Connect the wound copper foil tape to GND plate of the connector.

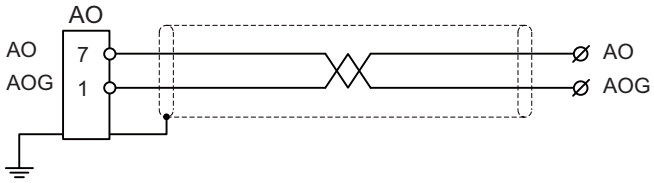
(Note 2) When using the jackscrew M2.6-type 10320-56S0-008-F for the shell, do not fasten the screws too tightly otherwise the connector and the PCB may be damaged.
(Manufacturer recommended tightening torque: 0.20±0.05N·m)

15.2.19 J225 Cable

Max. cable length: 30m

Application: Analog output cable (for operation panel I/O unit)





[AO]
Connector: 10120-3000PE
Case: 10320-52F0-008
Manufacturer: 3M

Wire material: UL2464 U-TKVVBS AWG24 × 1P
Manufacturer: Tatsuta Tachii Electric Cable

Crimp terminal: R1.25-3.5 x 2P
Manufacturer: JST

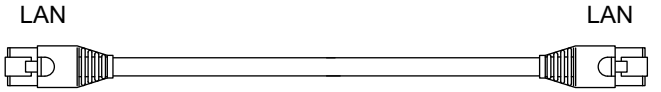
(Note 1) Fold the cable shield over the sheath, and wrap copper foil tape over it. Connect the wound copper foil tape to GND plate of the connector.

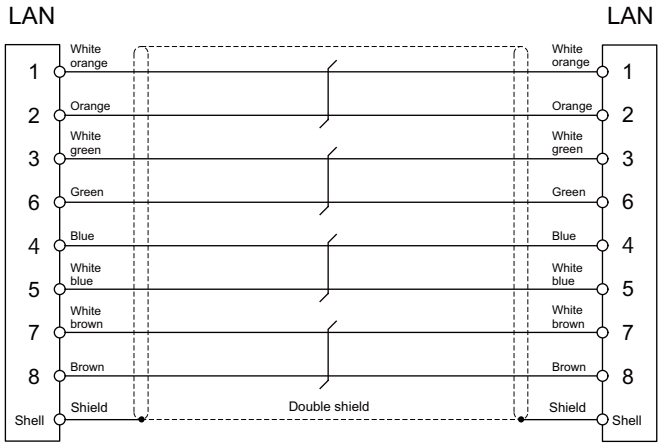
(Note 2) When using the jackscrew M2.6-type 10320-52A0-008 for the shell, do not fasten the screws too tightly otherwise the connector and the PCB may be damaged.
(Manufacturer recommended tightening torque: 0.20±0.05N·m)

15.2.20 J303 Cable

Max. cable length: 50m

Application: LAN straight cable





[LAN]
Connector : J00026A0165
Boot : B00080F0090
Manufacturer: JAPAN Telegärtner

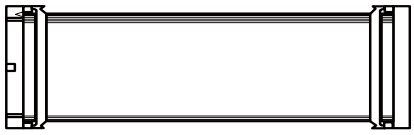
Wire material: FANC-IEF-SB 24AWG × 4P
Manufacturer: Kuramo Electric

15.2.21 J350 Cable

Max. cable length: 50m

Application: DI/DO

CG31,CG32,CG35,CG36,
CJ31,CJ32,CJ33,CJ34,
CJ38,CJ40,CJ42



[CG31,CG32,CG35,CG36,CJ31,CJ32,CJ33,CJ34,CJ38,CJ40,CJ42]

Connector: XG4M-4030 / 7940-6500SC
Strain relief: XG4T-4004 / 3448-7940
Manufacturer: OMRON / 3M

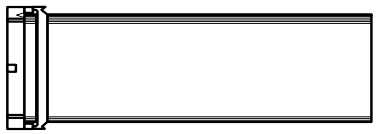
Wire material: UL2651 AWG28x40 (FLEX-S(40)-7/0.127 7030 2651P)
Manufacturer: Oki Electric Cable

15.2.22 J351 Cable

Max. cable length: 50m

Application: DI/DO

CG31,CG32,CG35,CG36,
CJ31,CJ32,CJ33,CJ34,
CJ38,CJ40,CJ42



[CG31,CG32,CG35,CG36,CJ31,CJ32,CJ33,CJ34,CJ38,CJ40,CJ42]

Connector: XG4M-4030 / 7940-6500SC
Strain relief: XG4T-4004 / 3448-7940
Manufacturer: OMRON / 3M

Wire material: UL2651 AWG28x40 (FLEX-S(40)-7/0.127 7030 2651P)
Manufacturer: Oki Electric Cable

15.2.23 J460 Cable

Max. cable length: 50m

Application: DI/DO

CJ37,CJ39



[CJ37,CJ39]
Connector: XG4M-5030 / 7950-6500SC
Strain relief: XG4T-5004 / 3448-7950
Manufacturer: OMRON / 3M

Wire material: UL2651 AWG28x50 (FLEX-S(50)-7/0.127 7030 2651P)
Manufacturer: Oki Electric Cable

(Note) This cable is used to connect the operation panel I/O unit.

15.2.24 J461 Cable

Max. cable length: 50m

Application: DI/DO

CJ37,CJ39



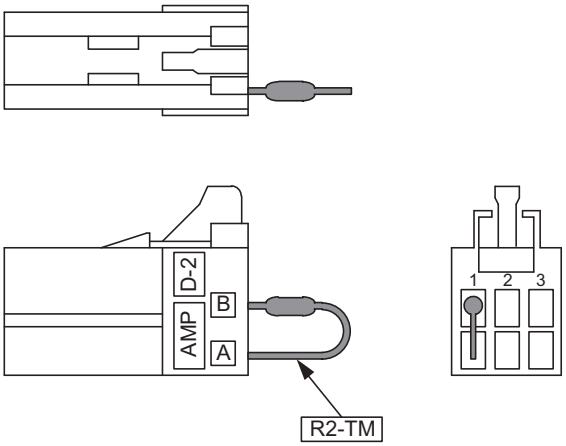
[CJ37,CJ39]
Connector: XG4M-5030 / 7950-6500SC
Strain relief: XG4T-5004 / 3448-7950
Manufacturer: OMRON / 3M

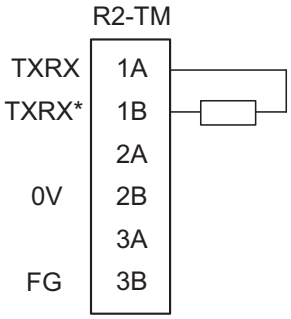
Wire material: UL2651 AWG28x50 (FLEX-S(50)-7/0.127 7030 2651P)
Manufacturer: Oki Electric Cable

(Note) This cable is used to connect the operation panel I/O unit.

15.2.25 R2-TM Terminator Connector

Application: Terminator for remote I/O interface





[R2-TM]
Connector: 1-1318119-3
Contact: 1318108-1
Manufacturer: TE Connectivity
Resistor: 110Ω 1/4W

(Note 1) The parts used shall be Mitsubishi recommended parts. Equivalent parts may be used providing they are compatible with the specifications.
(Note 2) Cover the 110Ω terminator with a black insulation tube.
(Note 3) Stamp the connector name "R2-TM" in white on the rear of the connector.

15.3 Cable Relating to Drive Unit

15.3.1 Cable Wire and Assembly

(1) Cable wire

The specifications of the wire used for each cable, and the machining methods are shown in this section. Mitsubishi uses the cables shown in the tables below. When manufacturing the encoder cable and battery connection cable, use the wires shown below or equivalent products.

(a) Heat resistant specifications cable

Wire type (other manufacturer's product)	Finish outer diameter	Sheath material	No. of pairs	Wire characteristics					
				Configuration	Conductive resistor	Withstand voltage	Insulation resistance	Heat resistance temperature	Flexibility
BD20288 Compound 6-pair shielded cable Specification No. Bangishi-17145 (Note 1)	8.7mm	Heat resistant PVC	2 (0.5mm^2)	100 strands/ 0.08mm	40.7Ω/km or less	500VAC/ 1min	1000MΩ/km or more	105°C	70 × 10^4 times or more at R200
			4 (0.2mm^2)	40 strands/ 0.08mm	103Ω/km or less				

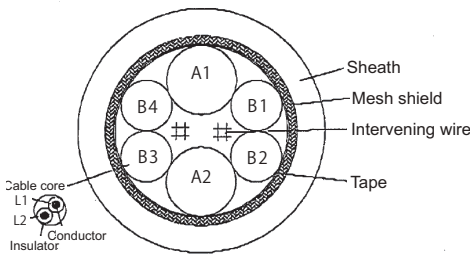
(b) General-purpose heat resistant specifications cable

Wire type (other manufacturer's product)	Finish outer diameter	Sheath material	No. of pairs	Wire characteristics					
				Configuration	Conductive resistor	Withstand voltage	Insulation resistance	Heat resistance temperature	Flexibility
BD20032 Compound 6-pair shielded cable Specification No. Bangishi-16903 Revision No. 3 (Note 1)	8.7mm	PVC	2 (0.5mm^2)	100 strands/ 0.08mm	40.7Ω/km or less	500VAC/ 1min	1000MΩ/ km or more	60°C	100 × 10^4 times or more at R200
			4 (0.2mm^2)	40 strands/ 0.08mm	103Ω/km or less				

(Note 1) Bando Electric Wire (http://www.bew.co.jp/)

(Note 2) The Mitsubishi standard cable is the (a) Heat resistant specifications cable. When the working environment temperature is low and so higher flexibility is required, use the (b) General-purpose heat resistant specifications cable.

Compound 6-pair cable structure drawing

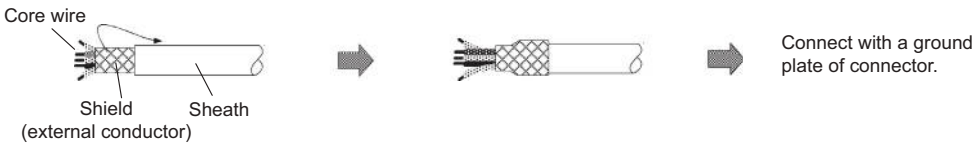


Core identification

Pair No.	Insulator color	
	L1	L2
A1 (0.5mm^2)	Red	White
A2 (0.5mm^2)	Black	White
B1 (0.2mm^2)	Brown	Orange
B2 (0.2mm^2)	Blue	Green
B3 (0.2mm^2)	Purple	White
B4 (0.2mm^2)	Yellow	White

(2) Cable assembly

Assemble the cable with the cable shield wire securely connected to the ground plate of the connector.



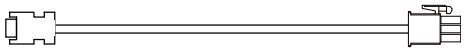
15.3.2 CNP2E-1 Cable

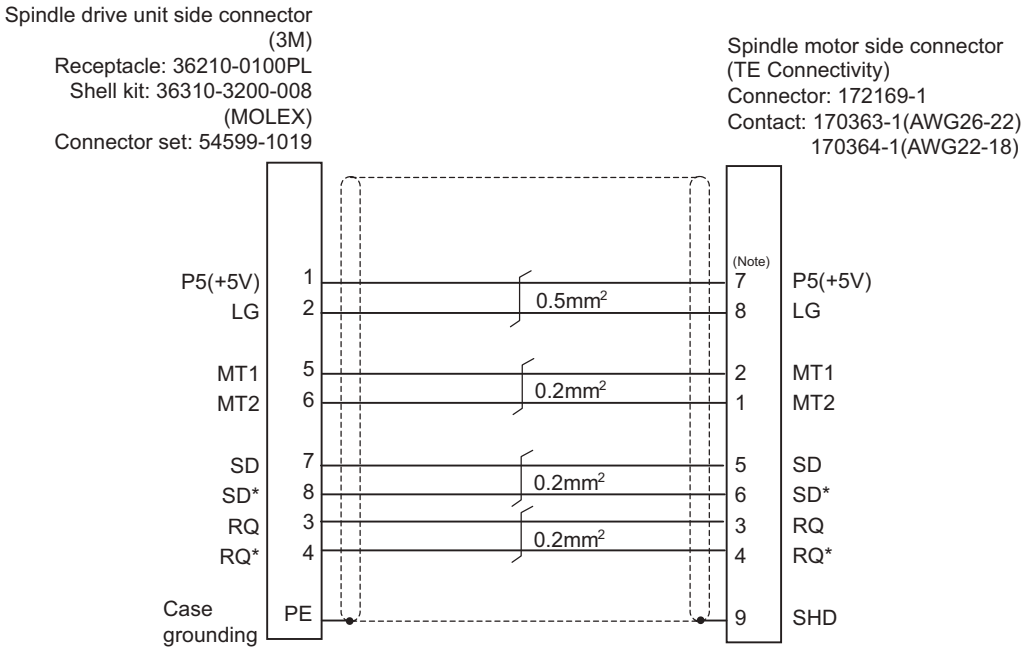
Max. cable length: 30m

Application: Motor side PLG cable

Spindle side accuracy encoder

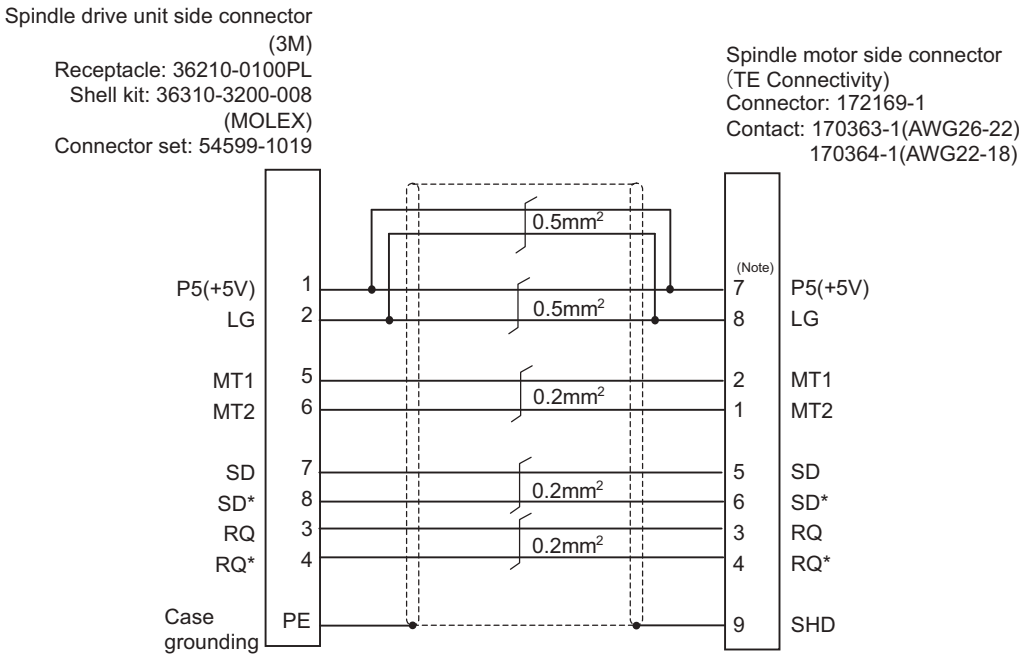
TS5690 cable





(Note) For the pin "7" or "8", use the contact "170364-1".
For the other pins, use the contact "170363-1".

<Cable connection diagram (for 15m or less)>



(Note) For the pin "7" or "8", use the contact "170364-1".
For the other pins, use the contact "170363-1".

<Cable connection diagram (for 15m to 30m)>

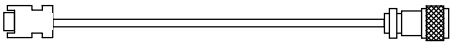
15.3.3 CNP3EZ-2P/CNP3EZ-3P Cable

Max. cable length: 30m

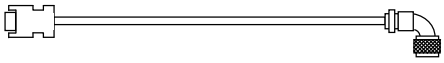
Application: Spindle side encoder cable

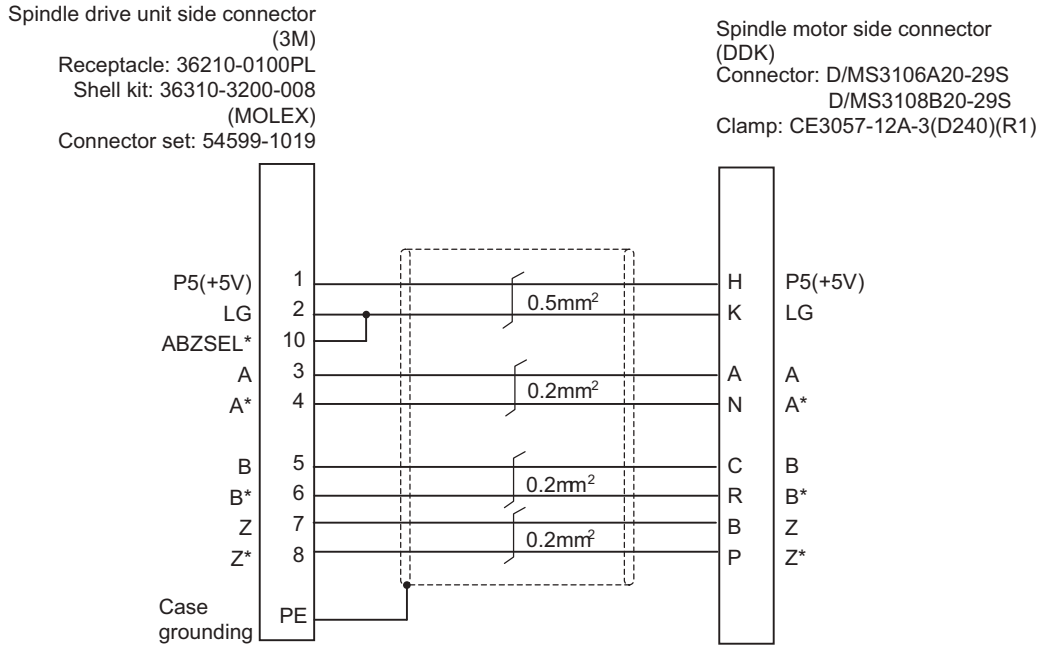
OSE-1024 cable

CNP3EZ-2P (Straight)

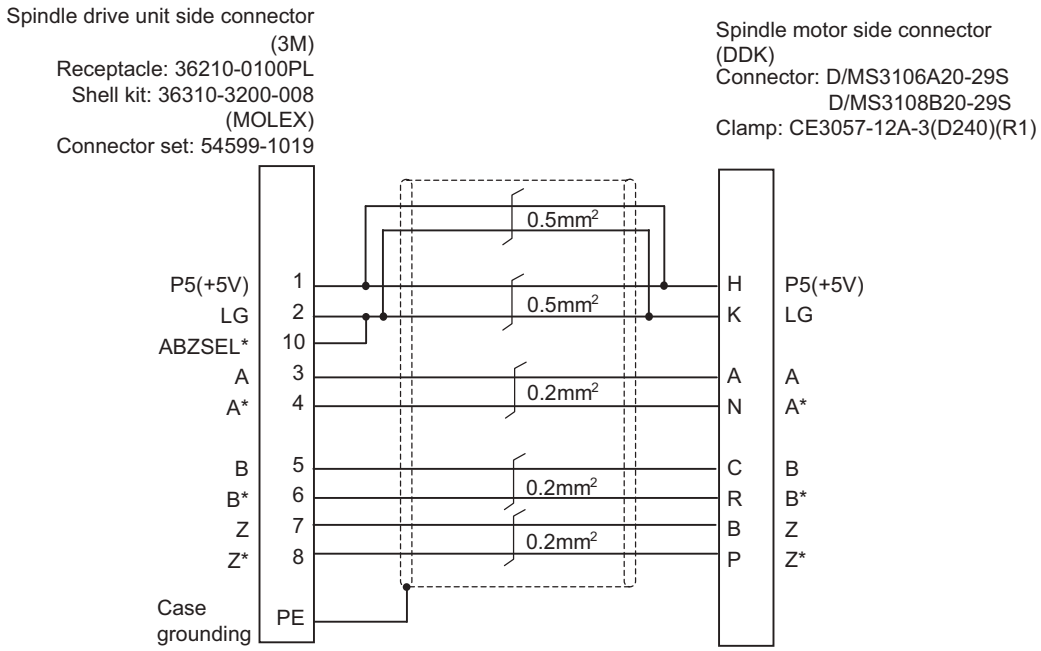


CNP3EZ-3P (Angle)





<Cable connection diagram (for 15m or less)>

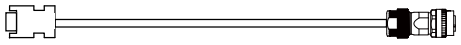


<Cable connection diagram (for 15m to 30m)>

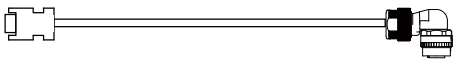
15.3.4 CNV2E-8P/CNV2E-9P Cable

Max. cable length: 30m

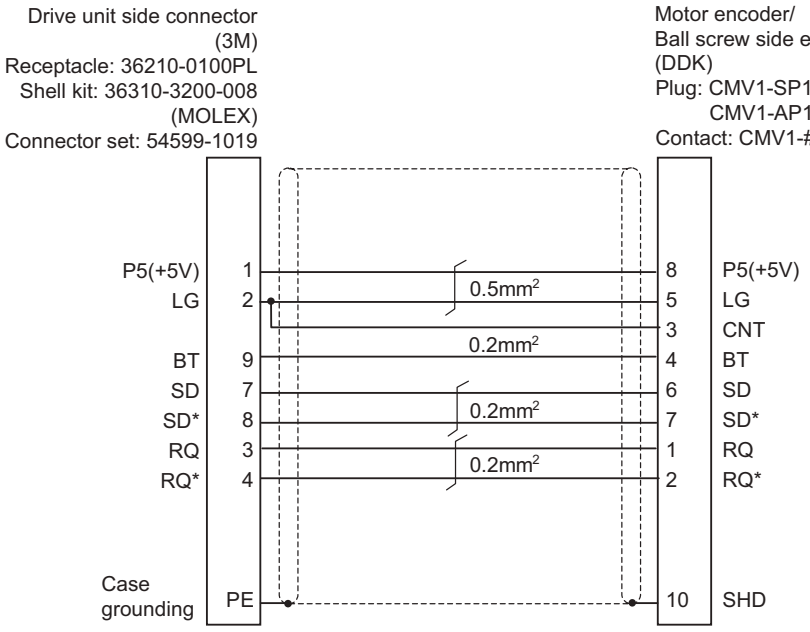
Application: For HG/HG-H, HQ-H, HK/HK-H, HG-JR Motor side encoder cable (for D47/D48/D51/D74/G48)
Ball screw side encoder cable (OSA405ET2AS, OSA676ET2AS)
CNV2E-8P (Straight)



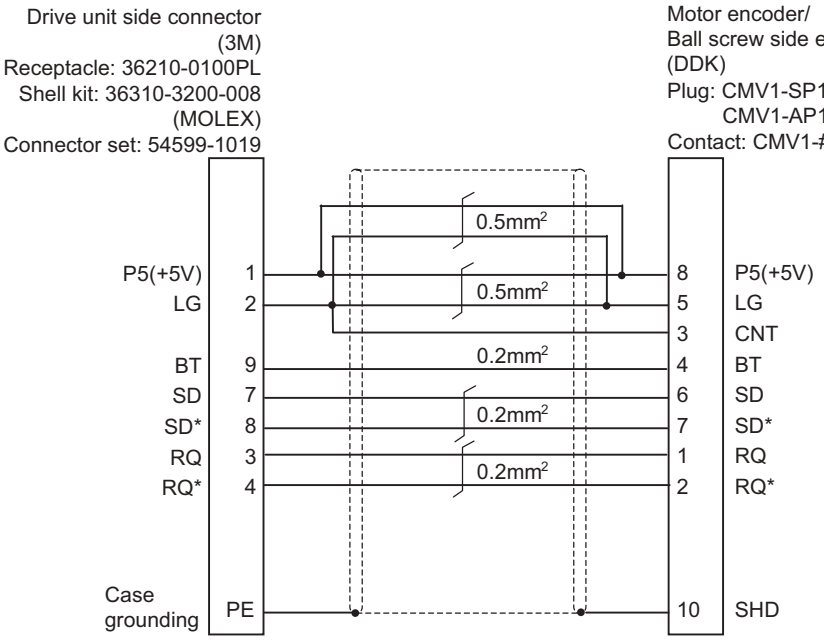
CNV2E-9P (Angle)



[HG(-H), HQ-H Series]

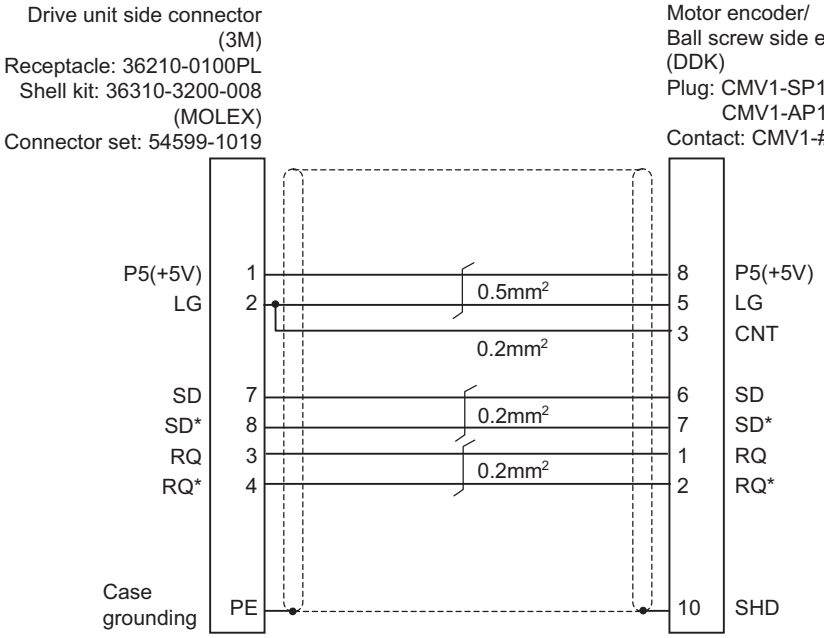


<Cable connection diagram (for 15m or less)>

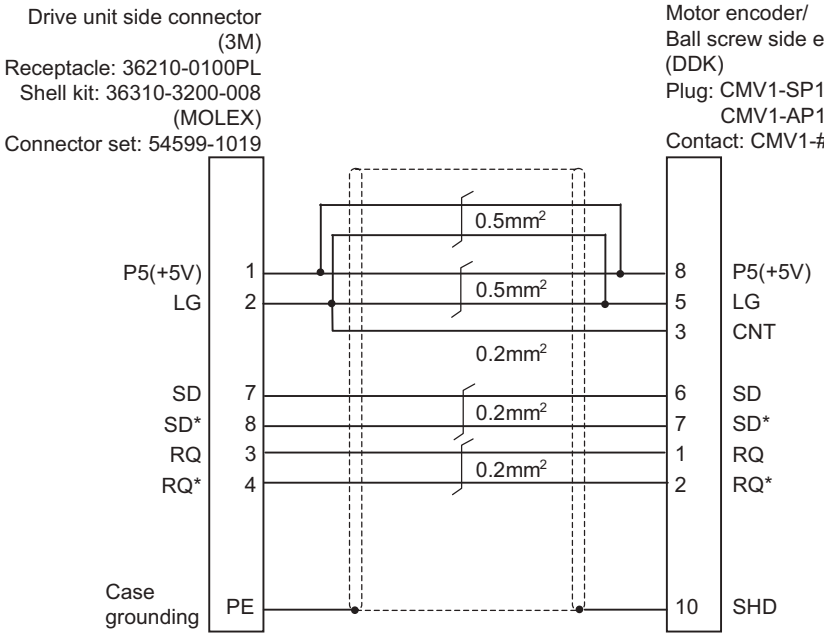


<Cable connection diagram (for 15m to 30m)>

[HK(-H) Series]



<Cable connection diagram (for 15m or less)>



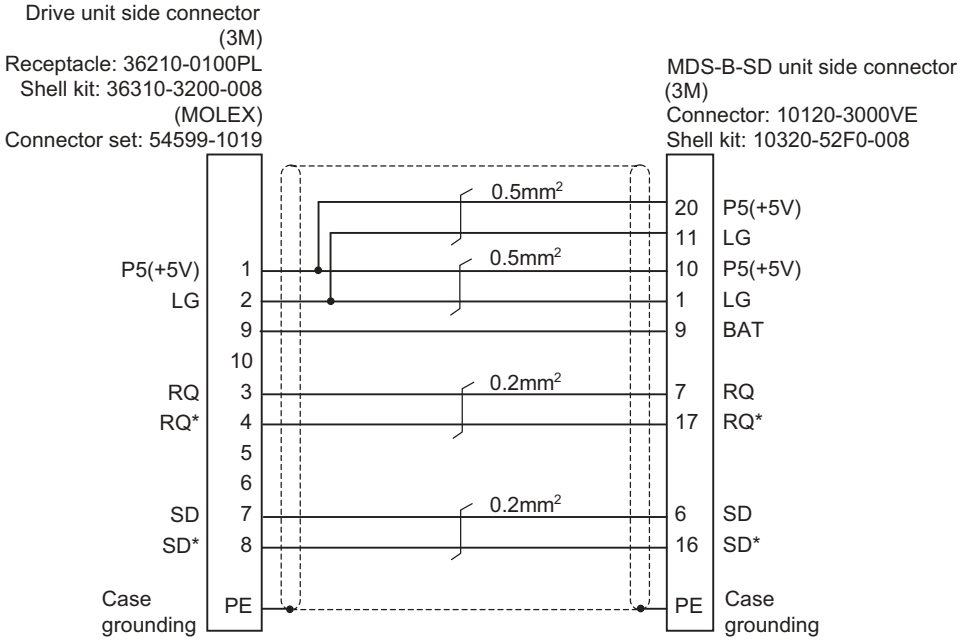
<Cable connection diagram (for 15m to 30m)>

15.3.5 CNV2E-D Cable

Max. cable length: 30m

Application: MDS-B-SD unit cable





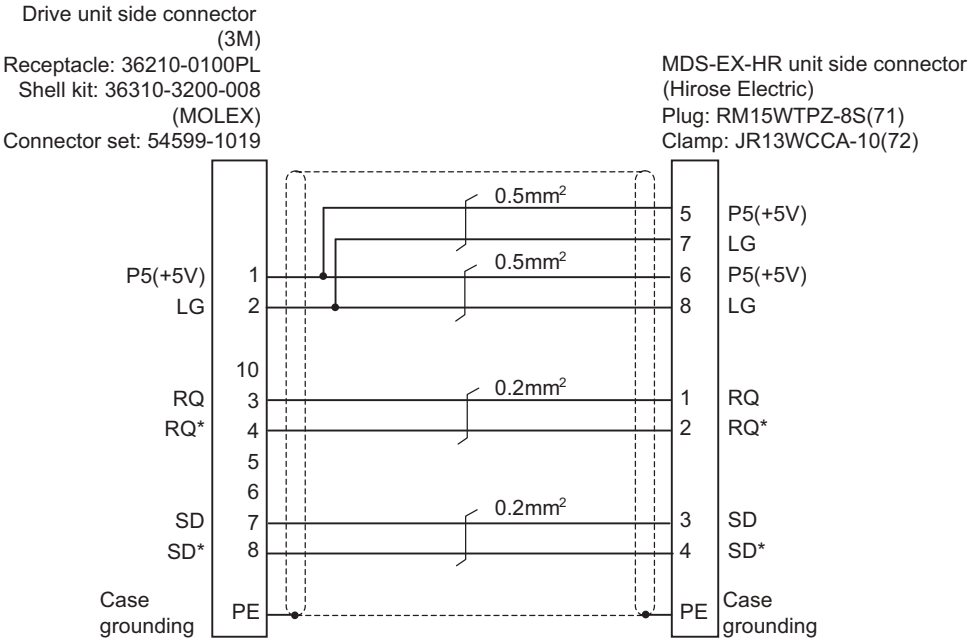
<Cable connection diagram>

15.3.6 CNV2E-HP Cable

Max. cable length: 30m

Application: MDS-EX-HR unit cable





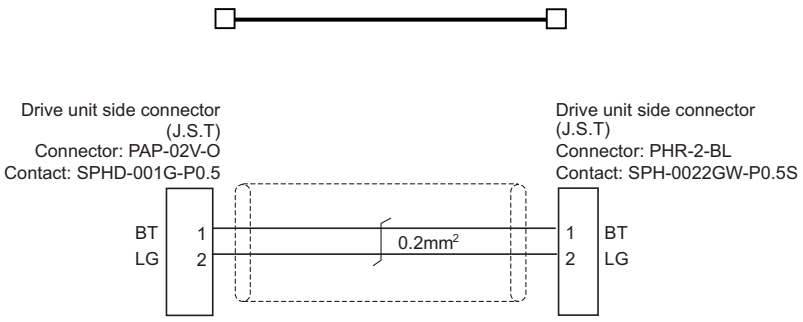
<Cable connection diagram>

15.3.7 DG30 Cable

Max. cable length: 10m

Application: Battery cable

(drive unit - battery box, drive unit - drive unit)



15.3.8 G380 Cable

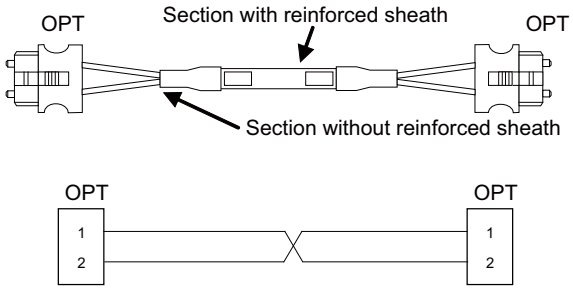
Max. cable length: 30m

Application: Optical communication cable

for wiring between drive units (outside panel)

for optical communication repeater unit

Use when the cable length is 10m or more to 30m or less.



[OPT]
Connector: 1123445-1
Manufacturer: TE Connectivity

Wire material: Hard clad type PCF optic cable
Manufacturer: Oki Electric Cable

Cable	Minimum bending radius: R
2-core cable (section with reinforced sheath)	50mm
2-core cable (section without reinforced sheath)	25mm

(Note 1) Binding the cables too tight with tie-wraps could result in an increased loss or a disconnection. Use a cushioning material such as a sponge or rubber when bundling the cables and fix so that the cables do not move. (Clamp material for reference: KITAGAWA INDUSTRIES CKN-13SP)

(Note 2) Never bundle the cables with vinyl tape. The plasticizing material in the vinyl tape could cause the PCF cable reinforced sheath to damage.

(Note 3) Loop the excessive cable with twice or more than the minimum bending radius.

15.3.9 J395 Cable

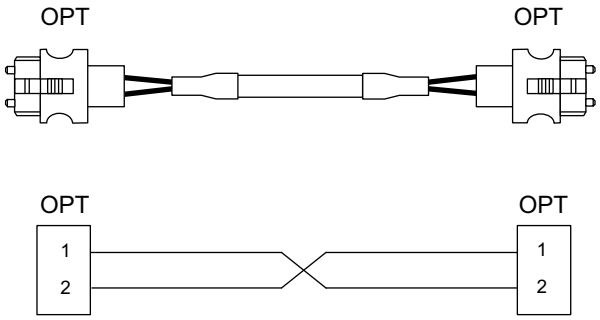
Max. cable length: 10m

Application: Optical communication cable

for wiring between drive units (outside panel)

for wiring between NC-drive units

Use when wiring outside of the panel with a cable of 10m or less.



[OPT]
Connector: LGP-Z0007PK
Manufacturer: HONDA TSUSHIN KOGYO

Wire material: PFDU-CL1002-22E60VT
Manufacturer: TORAY

Cable	Minimum bending radius: R
2-core cable (section with reinforced sheath)	50mm
2-core cable (section without reinforced sheath)	30mm

(Note 1) Binding the cables too tight with tie-wraps could result in an increased loss or a disconnection. Use a cushioning material such as a sponge or rubber when bundling the cables and fix so that the cables do not move. (Clamp material for reference: KITAGAWA INDUSTRIES CKN-13SP)

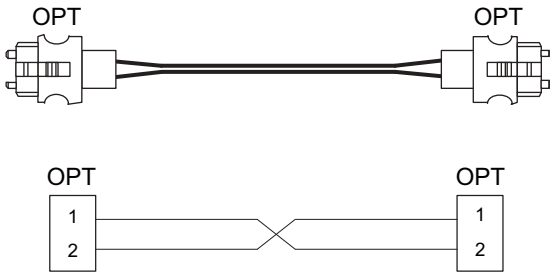
(Note 2) Never bundle the cables with vinyl tape. The plasticizing material in the vinyl tape could cause the POF cable to break.

(Note 3) Loop the excessive cable with twice or more than the minimum bending radius.

15.3.10 J396 Cable

Max. cable length: 10m

Application: Optical communication cable
for wiring between drive units (inside panel)
Use when wiring in the panel with a cable of 10m or less.



[OPT]
Connector: LGP-Z0007PK
Manufacturer: HONDA TSUSHIN KOGYO

Wire material: PFDU-CD1002-18E22T
Manufacturer: TORAY

Cable	Minimum bending radius: R
2-core parallel cord	30mm

(Note 1) Binding the cables too tight with tie-wraps could result in an increased loss or a disconnection. Use a cushioning material such as a sponge or rubber when bundling the cables and fix so that the cables do not move. (Clamp material for reference: KITAGAWA INDUSTRIES CKN-13SP)

(Note 2) Never bundle the cables with vinyl tape. The plasticizing material in the vinyl tape could cause the POF cable to break.

(Note 3) Loop the excessive cable with twice or more than the minimum bending radius.

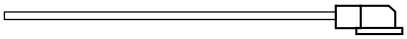
15.3.11 MR-BKS1CBL-A1-H / MR-BKS1CBL-A2-H Cable

Max. cable length: 10m

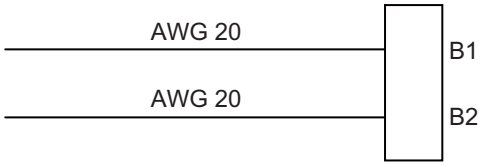
Application: <200V Series> Brake cable for HG96

MR-BKS1CBL-A1-H (load side angle)

MR-BKS1CBL-A2-H (reverse load side angle)



Servo motor brake connector
(Japan Aviation Electronics)
Connector: JN4FT02SJ1-R
Hood, Socket insulator,
Bushing and Ground nut
Contact: ST-TMH-S-C1B-100(A534G)
Crimp tool: CT160-3TMH5B



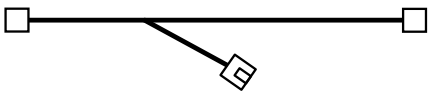
<Cable connection diagram>

15.3.12 MR-BT6V2CBL Cable

Max. cable length: 1m

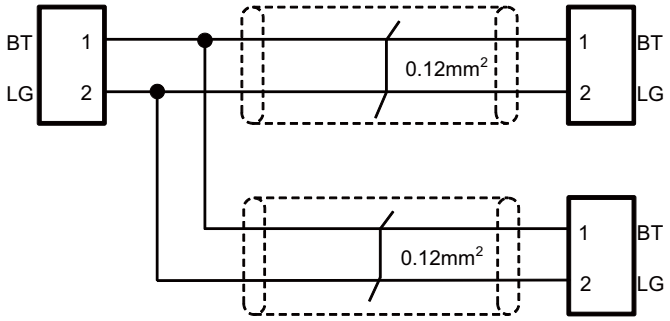
Application: Battery cable (MDS-EJ/EJH)

(drive unit - drive unit)



Drive unit side connector
(J.S.T)
Connector: PAP-02V-O
Contact: SPHD-001G-P0.5

Drive unit side connector
(J.S.T)
Connector: PAP-02V-O
Contact: SPHD-001G-P0.5



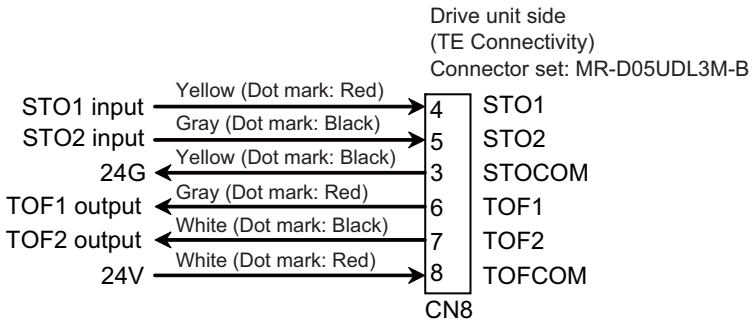
Battery unit side connector
(J.S.T)
Connector: PALR-02VF
Contact: SPAL-001T-P0.5

15.3.13 MR-D05UDL3M-B Cable

Max. cable length: 3m

Application: STO cable



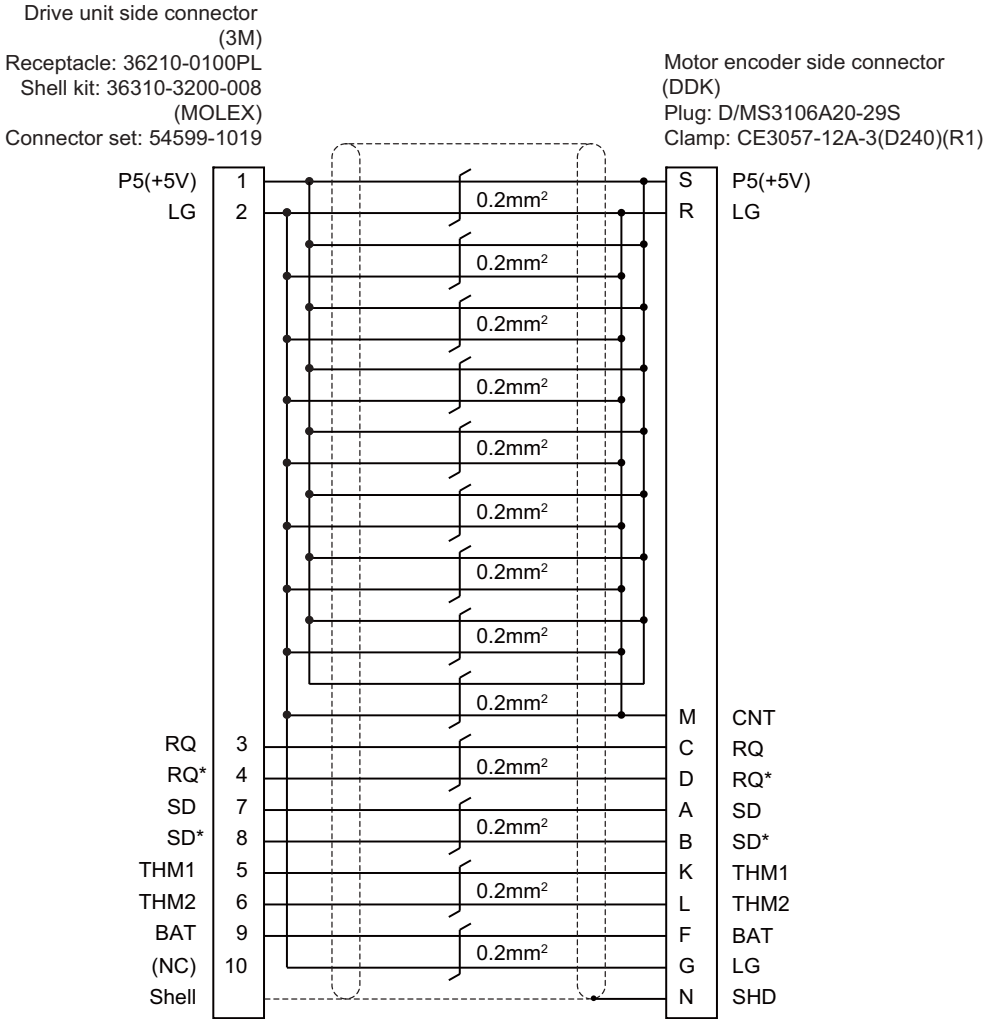


15.3.14 MR-ENE4CBL-H-MTH Cable

Max. cable length: 30 m

Application: For HG-H1502 Motor side encoder cable (for D48/D51/D74)





<Cable connection diagram>

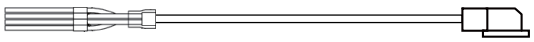
15.3.15 MR-PWS1CBL-A1-H / MR-PWS1CBL-A2-H Cable

Max. cable length: 10m

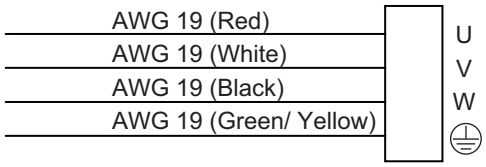
Application: <200V Series> Power cable for HG96

MR-PWS1CBL-A1-H (load side angle)

MR-PWS1CBL-A2-H (reverse load side angle)



Servo motor power supply connector
(Japan Aviation Electronics)
Connector: JN4FT04SJ1-R
Hood, Socket insulator,
Bushing and Grand nut
Contact: ST-TMH-S-C1B-100(A534G)
Crimp tool: CT160-3TM5B



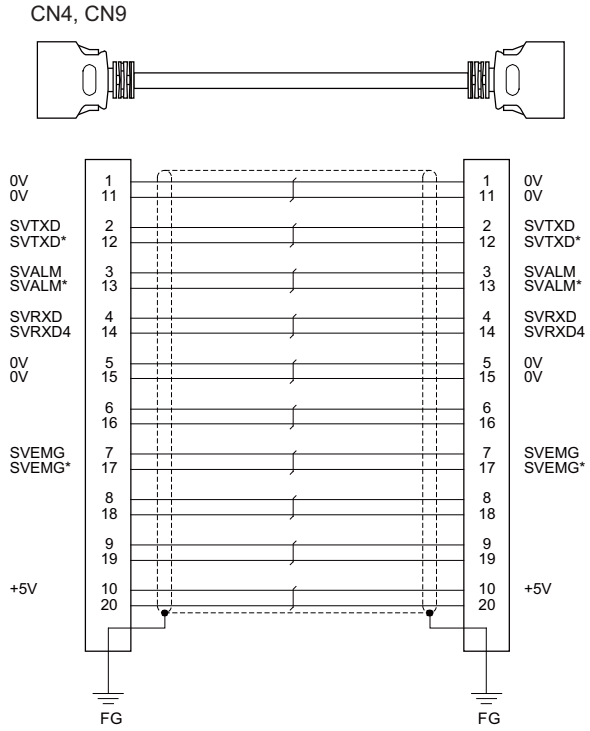
<Cable connection diagram>

15.3.16 SH21 Cable

Max. cable length: 30m

Application: Power supply communication cable

Power backup unit communication cable



[CN4,CN9]
Plug: 10120-3000PE
Shell: 10320-52F0-008
Manufacturer: 3M

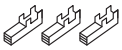
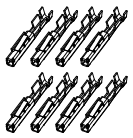
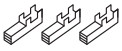
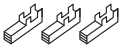
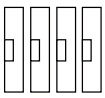
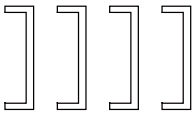
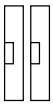
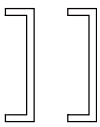
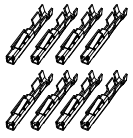
Wire material: UL20276 AWG28×10P
Manufacturer: Toyokuni Electric Cable

Plug: 10120-3000PE
Shell: 10320-52F0-008
Manufacturer: 3M

(Note 1) Fold the cable shield over the sheath, and wrap copper foil tape over it. Connect the wound copper foil tape to GND plate of the connector.

(Note 2) When using the jackscrew M2.6-type 10320-52A0-008 for the shell, do not fasten the screws too tightly otherwise the connector and the PCB may be damaged.
(Manufacturer recommended tightening torque: 0.20±0.05N·m)

15.4 List of Cable Connector Sets

Type	Application	Package contents	
FCUA-CS000	General I/O units (For SKIP,SIO,MPG,AIO)	Connector (3M) 10120-3000PE x 2pcs. 	Shell kit (3M) 10320-52F0-008 x 2pcs. 
005057-9403 0016020103 x 3 pcs.	Emergency stop connector (For EMG)	Connector (MOLEX) 50-57-9403 x 1pc. 	Gold contact (MOLEX) 0016020103 x 3 pcs. 
RIO2 CON	Connector kit for RIO 2.0 unit	Connector (TE Connectivity) 1-1318119-3 x 2pcs.  Connector (TE Connectivity) 2-178288-3 x 1pc. 	Contact (TE Connectivity) 1318107-1 x 8pcs.  Contact (TE Connectivity) 1-175218-5 x 3pcs. 
FCUA-CN220	24VDC power supply connector (For DCIN)	Connector (TE Connectivity) 2-178288-3 x 1pc. 	Contact (TE Connectivity) 1-175218-5 x 3pcs. 
7940-6500SC x 4pcs. 3448-7940 x 4pcs.	DO connector (for operation panel I/O unit) DI/DO connector (for remote I/O unit)	Connector (3M) 7940-6500SC x 4pcs. 	Strain relief (3M) 3448-7940 x 4pcs. 
7950-6500SC x 2pcs. 3448-7950 x 2pcs.	DI connector (for operation panel I/O unit)	Connector (3M) 7950-6500SC x 2pcs. 	Strain relief (3M) 3448-7950 x 2pcs. 
2-1318119-4 1318107-1 x 8pcs.	Connector for CJ71	Connector (TE Connectivity) 2-1318119-4 x 1pc. 	Contact (TE Connectivity) 1318107-1 x 8pcs. 
37104-2165-000FL 10P	THERMISTOR connector (For thermistor input unit)	Connector (3M) 37104-2165-000FL x 10pcs. 	

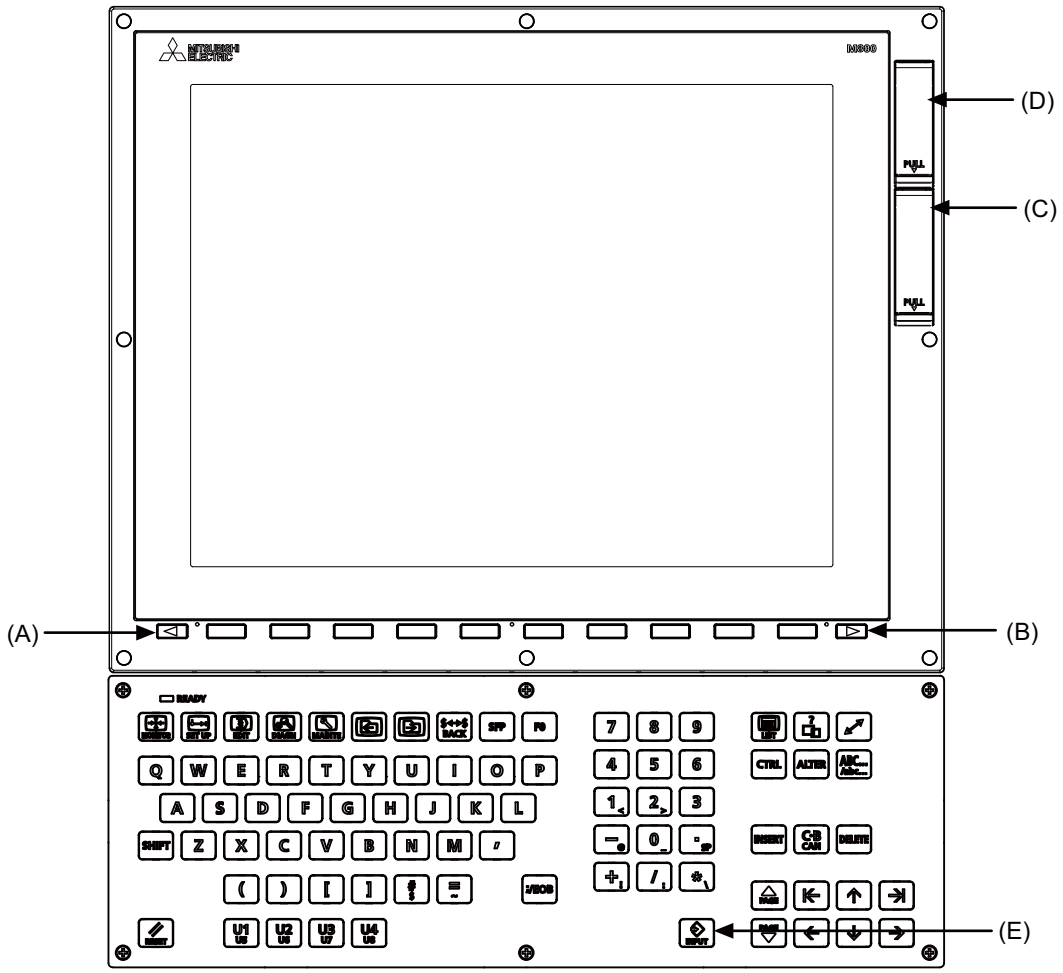
16

Setup Outline

16.1 Hardware Configuration

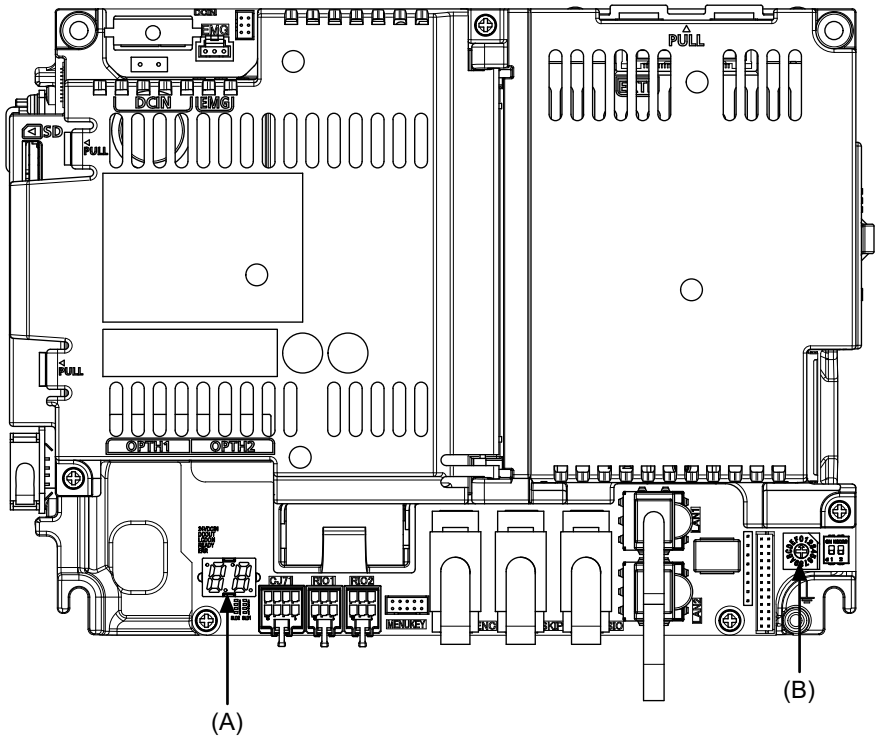
The following shows the hardware names used in this manual.

[Example of 15-type]

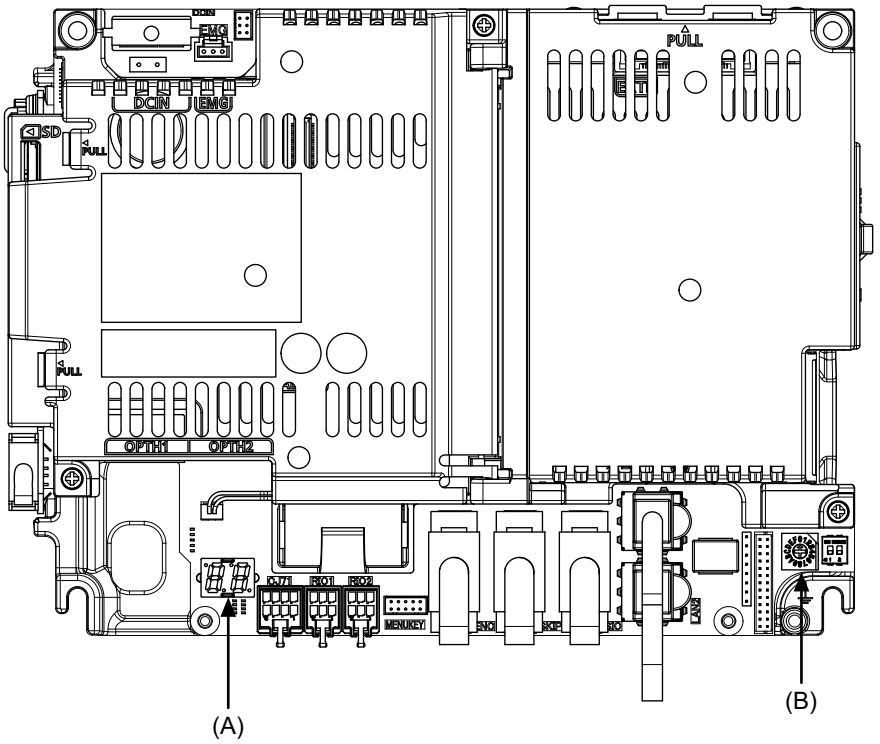


(A) Cancel key
(B) Menu changeover key
(C) Front-side SD card I/F
(D) USB Interface
(E) [INPUT] key

[M800S]



[M80/E80]



(A) 7-segment LED
(B) Rotary switch

16.2 Flow of Initial Setup

The following flow chart shows the procedures of the initial setup.

(Note) When setting up with backup files, refer to the chapter of "Data Backup and Restoration".

⚠ WARNING

Do not cancel the emergency stop before confirming the basic operation.

Start

Confirming the connection between control unit and peripheral devices

Points
Is the power supply within a specified range?
Is the power supply polarity correct?
Is the connection of the motor power cable and the encoder cable correct?
Is the grounding correct?

Connecting and Setting the Hardware — **Refer to section 17**

Carry out the connecting and setting of drive units, batteries and remote I/O units.
Initialize the NC Internal data (SRAM).

Setting Up with M80/800S SETUP INSTALLER — **Refer to section 18**

Install the custom data (G code guidance data),
start-up screen and user cycle.
If you do not need the installation, go to the next section.

Setting the machine parameters (1) — **Refer to section 19.1 to 19.2**

Selecting the NC system type and displayed language.
Setting the parameters for the system specifications.

Formatting the NC memory — **Refer to section 19.2**

Setting the machine parameters (2) — **Refer to section 19.3**

Setting the parameters for the machine specifications.

Setting Date and Time — **Refer to section 19.4**

Set the date and time on the integrated time screen.

Sequence Program Writing — **Refer to section 20**

Write the created sequence program to NC's ROM using GX Developer or GX Works2.

Confirming the Basic Operation — **Refer to section 21**

Confirm input/output of signals, alarm display and manual operation.

Setting the Position Detection System — **Refer to section 22**

Carry out the setting for establishing the reference position (zero point).

Setting the Stored Stroke Limit — **Refer to section 23**

Set the tool entry prohibited range.

Setting the Machine Error Compensation — **Refer to section 24**

Set the memory-type pitch error compensation, the memory-type relative position error compensation, and the bidirectional pitch error compensation.

Setting the Position Switches — **Refer to section 25**

Set the position switches.

Setting the Backash Compensation — **Refer to section 26**

Set the backlash compensation and the backlash compensation II.

Confirming the Spindle Operation — **Refer to section 27**

Confirm that the spindle operates properly in manual/MDI operation.
Confirm the spindle rotation speed as well.

Setting the Handy Terminal — **Refer to section 28**

Input the customized data for the handy terminal.
(Note) This procedure is required only when connecting the handy terminal.

Inputting the machining program — **Refer to the Instruction Manual**

End

For other settings, refer to the following chapters:
- Setting the Deceleration Check
- Synchronous Control and Multiple-axis Synchronization Control
- OMR Control
- Variable Torsion Compensation
- Adjust S-analog Screen
- Device Open Parameter Screen
- SRAM Open Parameter Screen
- Data Backup and Restoration

When using the system lock, refer to the chapter of "Appendix 1: Setting the System Lock".
When using the protection setting, refer to the chapter of "Appendix 2: Protection Setting".

17

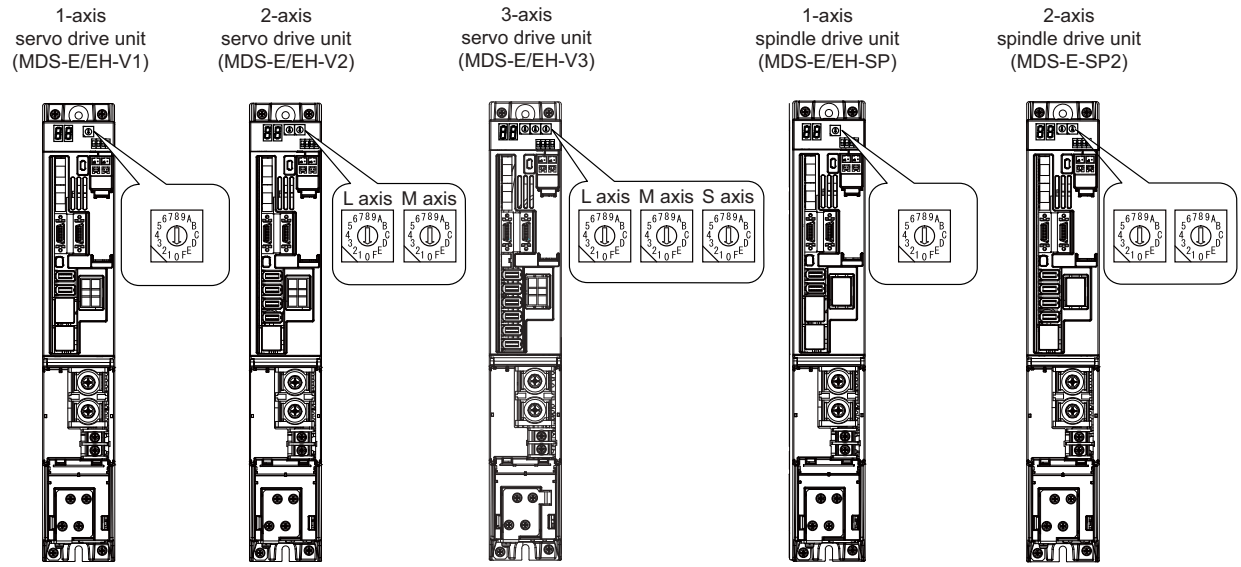
Setting the Hardware

17.1 Setting Drive Unit MDS-E/EH Series

17.1.1 Setting the Rotary Switch

Set the axis number with the rotary switch.

<Drive unit>

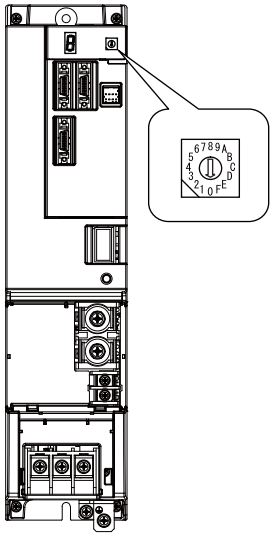


MDS-E/EH-V1/V2/SP, MDS-E/EH-V3/SP2 setting

Rotary switch setting	AXIS NO.
0	1st axis
1	2nd axis
2	3rd axis
3	4th axis
4	5th axis
5	6th axis
6	7th axis
7	8th axis
8	9th axis
9	10th axis
A	11th axis
B	12th axis
C	13th axis
D	14th axis
E	15th axis
F	16th axis

<Power supply unit>

Power supply unit
(MDS-E/EH-CV)

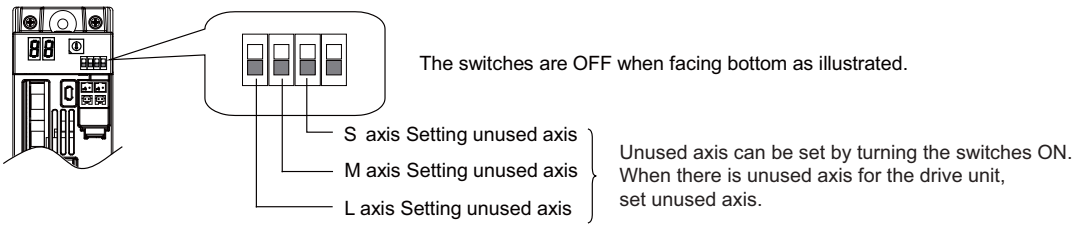


MDS-E/EH-CV setting

Rotary switch setting	Setting items
0	Normal setting
1 ～ 3	Setting prohibited
4	External emergency stop setting
5 ～ F	Setting prohibited

17.1.2 Setting DIP Switch

As a standard setting, turn the all DIP switches OFF.



> **⚠ CAUTION**
>
> **An axis set unused is not included in the functional safety.**

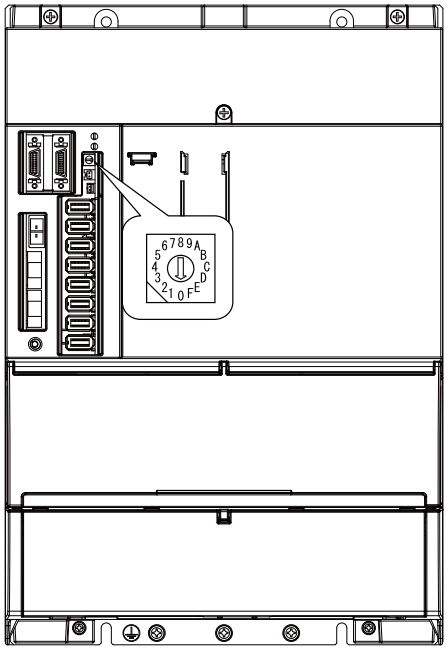
17.2 Setting Drive Unit MDS-EM/EMH Series

17.2.1 Setting the Rotary Switch

Set the axis number with the rotary switch.

< Drive unit >

Multi axis unit
(MDS-EM/EMH-SPV3)



MDS-EM/EMH-SPV3 setting

Rotary switch setting	Axis configuration	Spindle	Servo		
			L-axis	M-axis	S-axis
0	Spindle + Servo 3 axes	1st axis	2nd axis	3rd axis	4th axis
1		5th axis	6th axis	7th axis	8th axis
2		9th axis	10th axis	11th axis	12th axis
3		13th axis	14th axis	15th axis	16th axis
4	Spindle + Servo 2 axes	1st axis	2nd axis	3rd axis	-
5		5th axis	6th axis	7th axis	-
6		9th axis	10th axis	11th axis	-
7		13th axis	14th axis	15th axis	-
8	Setting impossible	-	-	-	-
9	Setting impossible	-	-	-	-
A	Setting impossible	-	-	-	-
B	Setting impossible	-	-	-	-
C	Setting impossible	-	-	-	-
D	Setting impossible	-	-	-	-
E	Setting impossible	-	-	-	-
F	Setting impossible	-	-	-	-

⚠ CAUTION

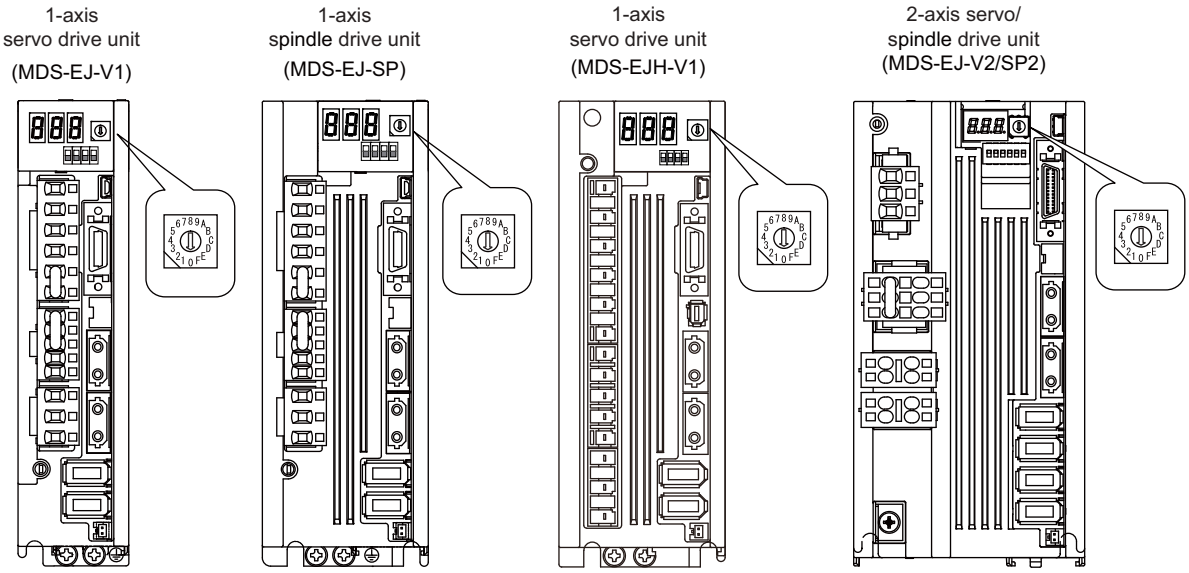
The axis configuration "Spindle + Servo 2 axes" is the state where the servo axis S is disabled.

Set the NC parameter (#1021) according to the axis numbers.

17.3 Setting Drive Unit MDS-EJ/EJH Series

17.3.1 Setting the Rotary Switch

Set the axis number with the rotary switch.



MDS-EJ/EJH-V1, MDS-EJ-SP setting

Rotary switch setting	AXIS NO.
0	1st axis
1	2nd axis
2	3rd axis
3	4th axis
4	5th axis
5	6th axis
6	7th axis
7	8th axis
8	9th axis
9	10th axis
A	11th axis
B	12th axis
C	13th axis
D	14th axis
E	15th axis
F	16th axis

MDS-EJ-V2/SP2 setting

Rotary switch setting	AXIS NO.	
	L axis	M axis
0	1st axis	2nd axis
1	2nd axis	3rd axis
2	3rd axis	4th axis
3	4th axis	5th axis
4	5th axis	6th axis
5	6th axis	7th axis
6	7th axis	8th axis
7	8th axis	9th axis
8	9th axis	10th axis
9	10th axis	11th axis
A	11th axis	12th axis
B	12th axis	13th axis
C	13th axis	14th axis
D	14th axis	15th axis
E	15th axis	16th axis
F	Setting prohibited	

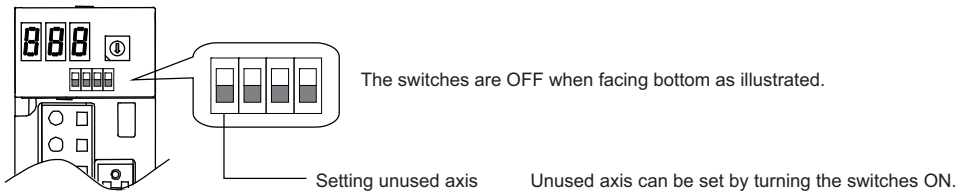
(Note 1) As for 2-axis drive unit, one rotary switch sets the L and M axes to the consecutive axis Nos.

(Note 2) As for 2-axis drive unit, the rotary switch setting "F" is prohibited.

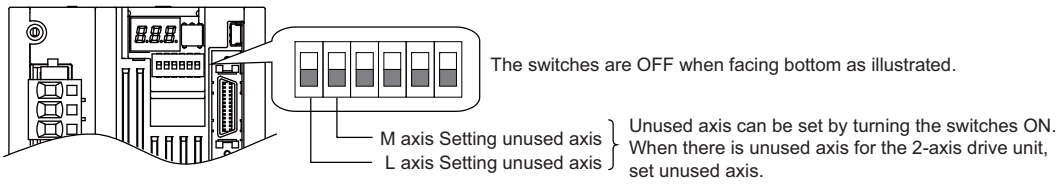
17.3.2 Setting the DIP Switch

As a standard setting, turn the all DIP switches OFF.

MDS-EJ/EJH-V1, MDS-EJ-SP setting



MDS-EJ-V2/SP2 setting



> **⚠ CAUTION**
>
> **An axis set unused is not included in the functional safety.**

17.4 Setting Up without Connecting to the Motor/Drive Units at the Setup of Drive Unit

When connecting the motor or drive unit after setting up the system, set the axis data beforehand to enable the operation without the motor or drive unit. The following shows the procedures.

Setting Up without Connecting to the Motor

The axis detachment can be used for servo axis. The detachment function cannot be used for spindle.

(1) Set the drive unit rotary switch and "#1021 mcp_no" for the axis that is not connected to the motor.
(2) Set the parameter "#1070 axoff" to "1" for the axis that is not connected to the motor.
(3) Do (a) or (b).
    (a) Set parameter "#8201 AX. RELEASE" to "1" for the axis that is not connected to the motor.
    (b) Turn ON the control axis detach signal (Y780) for the axis that is not connected to the motor.

Setting Up without Connecting to the Drive Unit

Set the following parameters.

(1) Set "#1021 mcp_no" (for the servo axis) or "#3031 smcp_no" (for the spindle) to the axis or the spindle that is not connected to the drive unit.
(2) Set the following parameters to the axis that is not connected to the drive unit.
    For the servo axis: Set "#2018 no_srv" to "1".
    For the spindle: Set "#3024 sout" to "0".

(Note) After connecting to the drive unit, make sure to set "#2018 no_srv" to "0" and "#3024 sout" to "1".

17.5 Connecting the Batteries

17.5.1 Control Unit Battery

⚠ **The battery is not connected when the machine is delivered. Be sure to connect the battery before starting up.**

A lithium battery in the control unit battery holder retains parameter settings, machining programs and the like, which requires to be backed up at the power OFF.

Battery	Q6BAT
Battery cumulative data holding time	45,000 hours (At 0 to 45°C. The life will be shorter if the temperature is high.)
Battery life	Approx. 5 years (from date of battery manufacture)

[Precautions for handling battery]

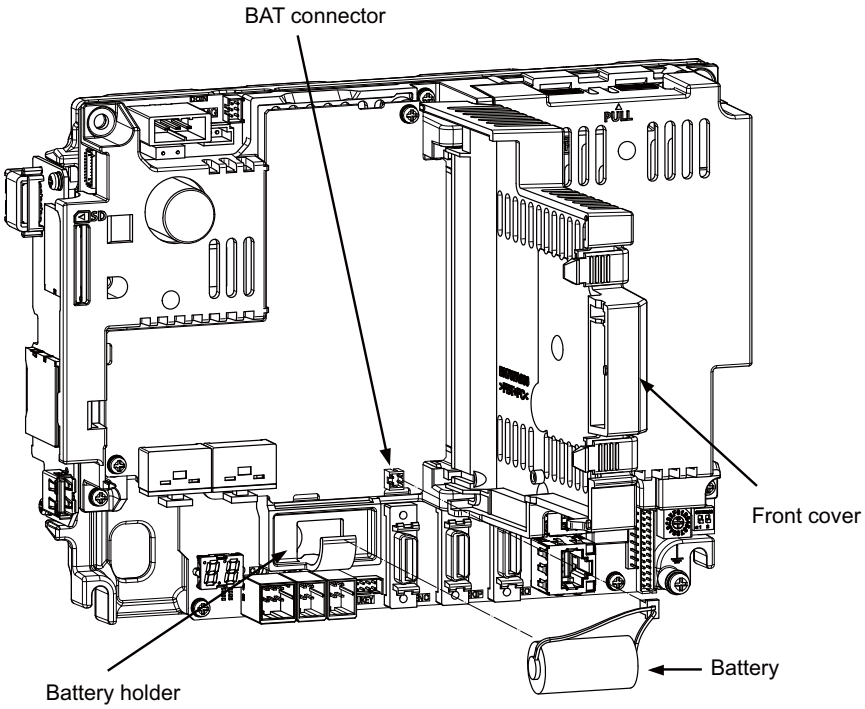
(1) Do not disassemble the battery.
(2) Do not place the battery in flames or water.
(3) Do not pressurize and deform the battery.
(4) This is a primary battery so do not charge it.

> ⚠ **CAUTION**
>
> **Do not short-circuit, charge, overheat, incinerate or disassemble the battery.**

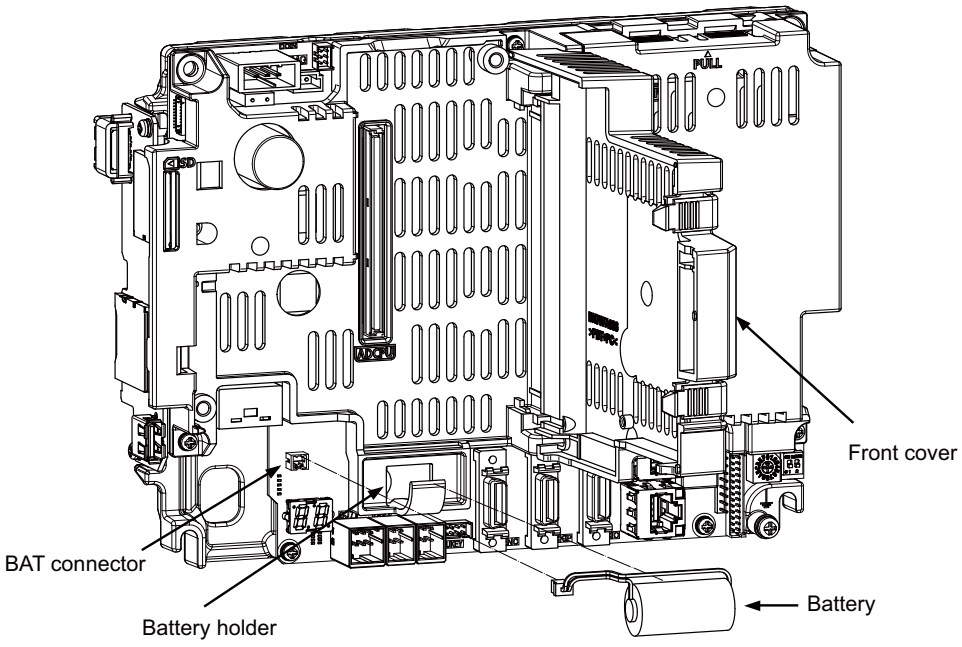
[Installation method]

(1) Check that the machine power is turned OFF. (If the power is not OFF, turn it OFF.)
(2) Confirm that the control unit LED, 7-segment display, etc., are all OFF.
(3) Open the front cover of the control unit.
(4) Fit the new battery into the battery holder.
(5) Insert the connector connected to the new battery into the BAT connector. Pay attention to the connector orientation: do not insert backwards.
(6) Close the front cover of the control unit. At this time, confirm that the cover is closed by listening for the "click" sound when the latch catches.

[M800S]



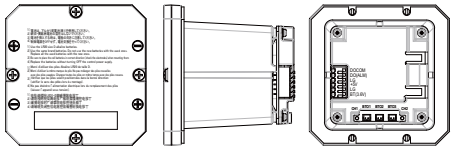
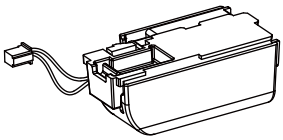
[M80/E80]



17.5.2 Servo Drive Unit Battery

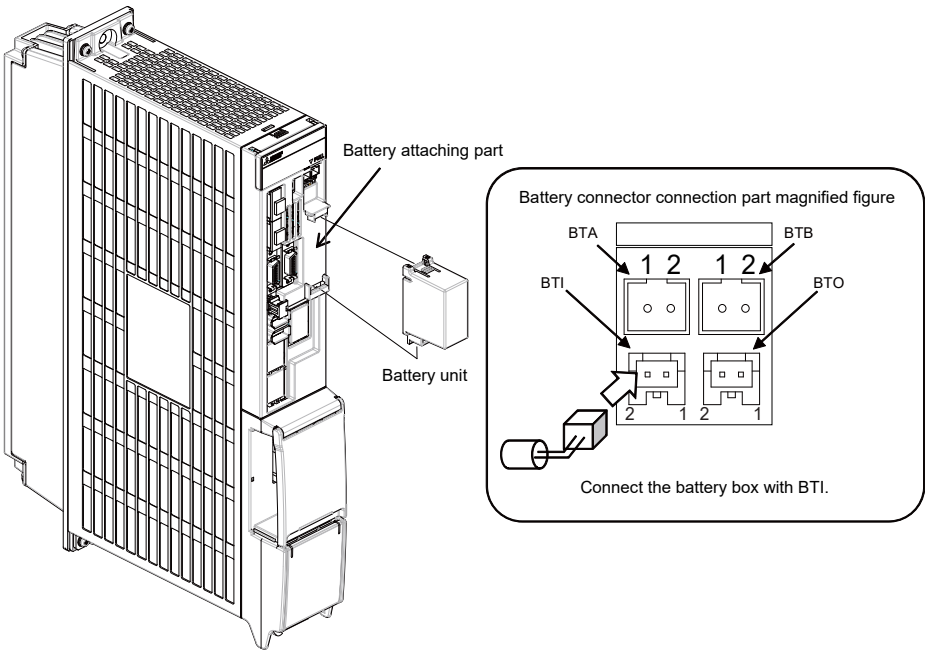
(Note) The battery connection is not necessary unless the drive unit employs absolute position detection. (Spindle drive unit does not require the battery, because the unit does not employ absolute position detection.)

There are batteries as shown below. Refer to the drive unit's specification manual for details.

Type		MDS-BAT6V1SET	MDSBTBOX-LR2060	MR-BAT6V1SET
Installation type		Drive unit installation	Control panel installation	Drive unit installation
Hazard class		Not applicable	Not applicable	Not applicable
Number of connectable axes		Up to 3 axes	Up to 8 axes	Up to 3 axes
Change method		Battery option change	Battery change	Battery option change
Appearance				
Compatible model	E/EH	○	○	-
	EM	-	○	○
	EJ/EJH	-	○	○

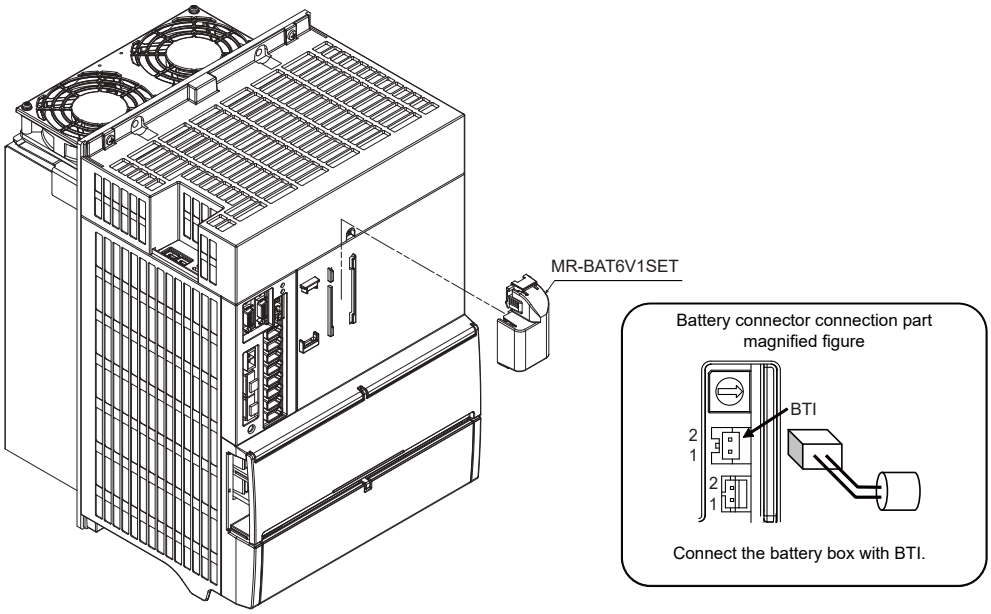
MDS-E/EH-Vx

Connect the battery connector to the connector BTI of the drive unit.



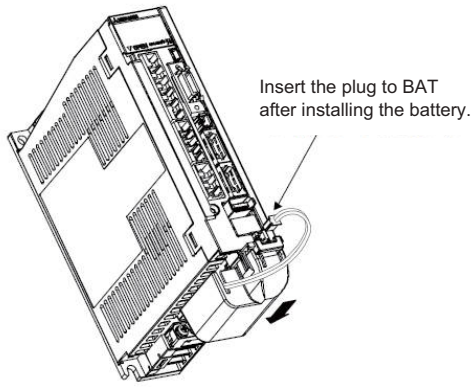
MDS-EM

Connect the battery connector to the connector BTI of the drive unit.

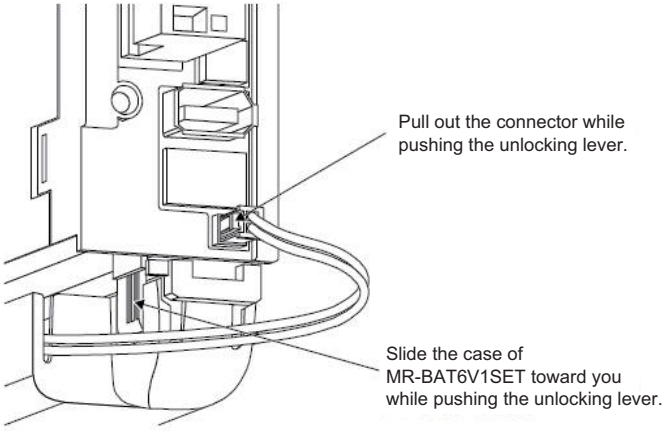


MDS-EJ/EJH-Vx

Connect the battery connector to the connector BAT of the drive unit.



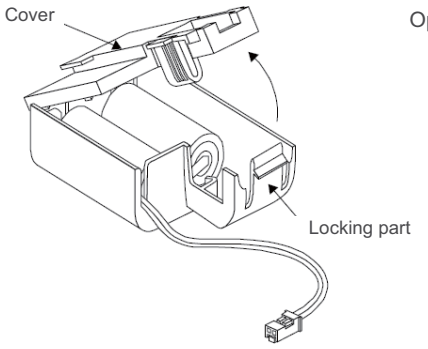
Installation



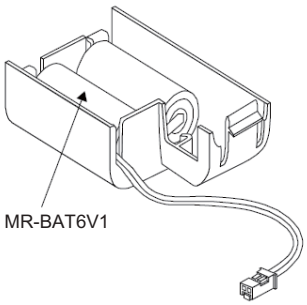
Removal

Replacing the built-in battery

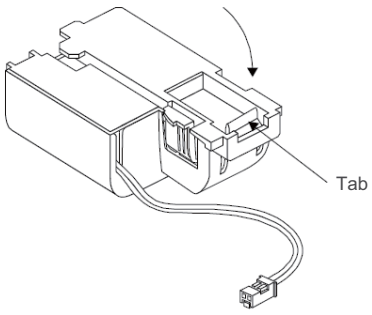
MR-BAT6V1SET that reached the end of the life can be reused by replacing the MR-BAT6V1 battery.



Open the cover while pushing the locking part.



Replace the built-in battery with a new battery for MR-BAT6V1.

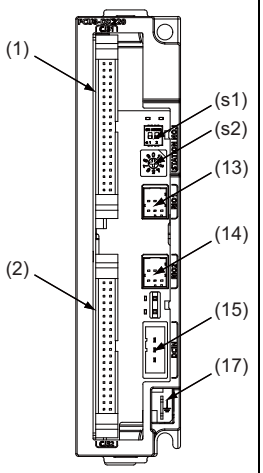
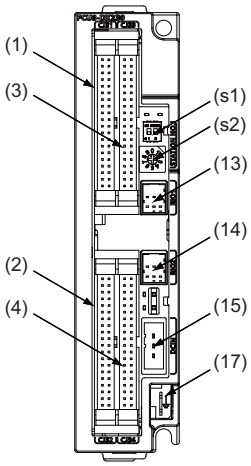
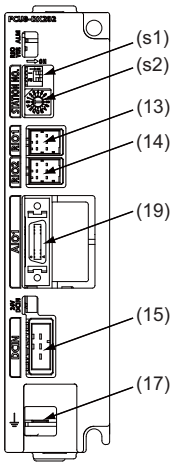
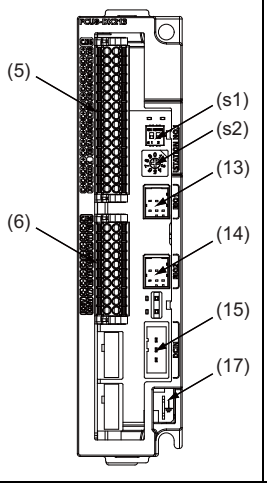
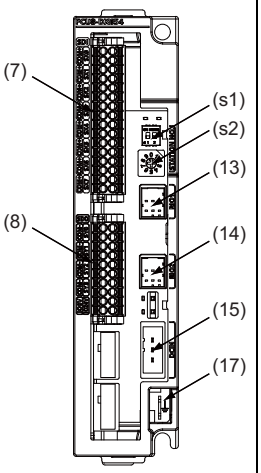


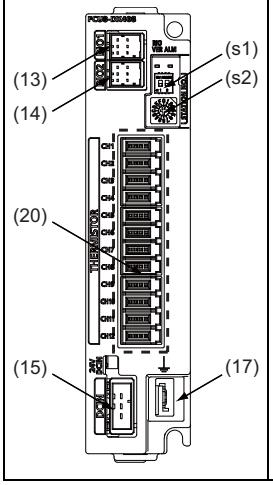
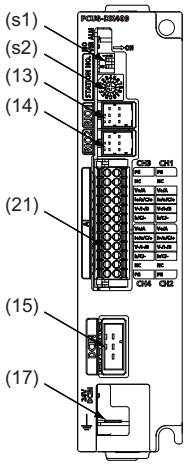
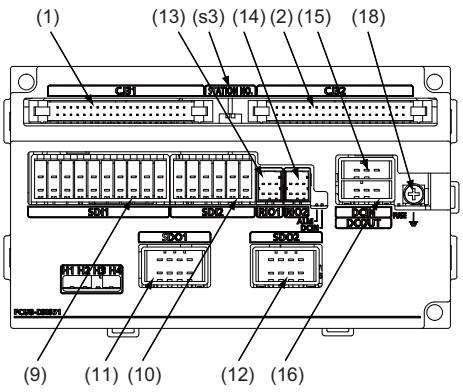
Close the cover by pushing until it is fixed with the tab of the locking part.

17.6 Connecting and Setting the Remote I/O Unit

17.6.1 Outline of the Remote I/O Unit

The specification varies for each remote I/O unit. Each unit has one or two rotary switch(es) for unit No. setting, which links the device Nos. (with X/Y).

FCU8-DX220	FCU8-DX230 / DX231	FCU8-DX202	FCU8-DX213 / DX213-1	FCU8-DX654 / DX654-1
				

FCU8-DX408	FCU8-DX409	FCU8-DX651
		

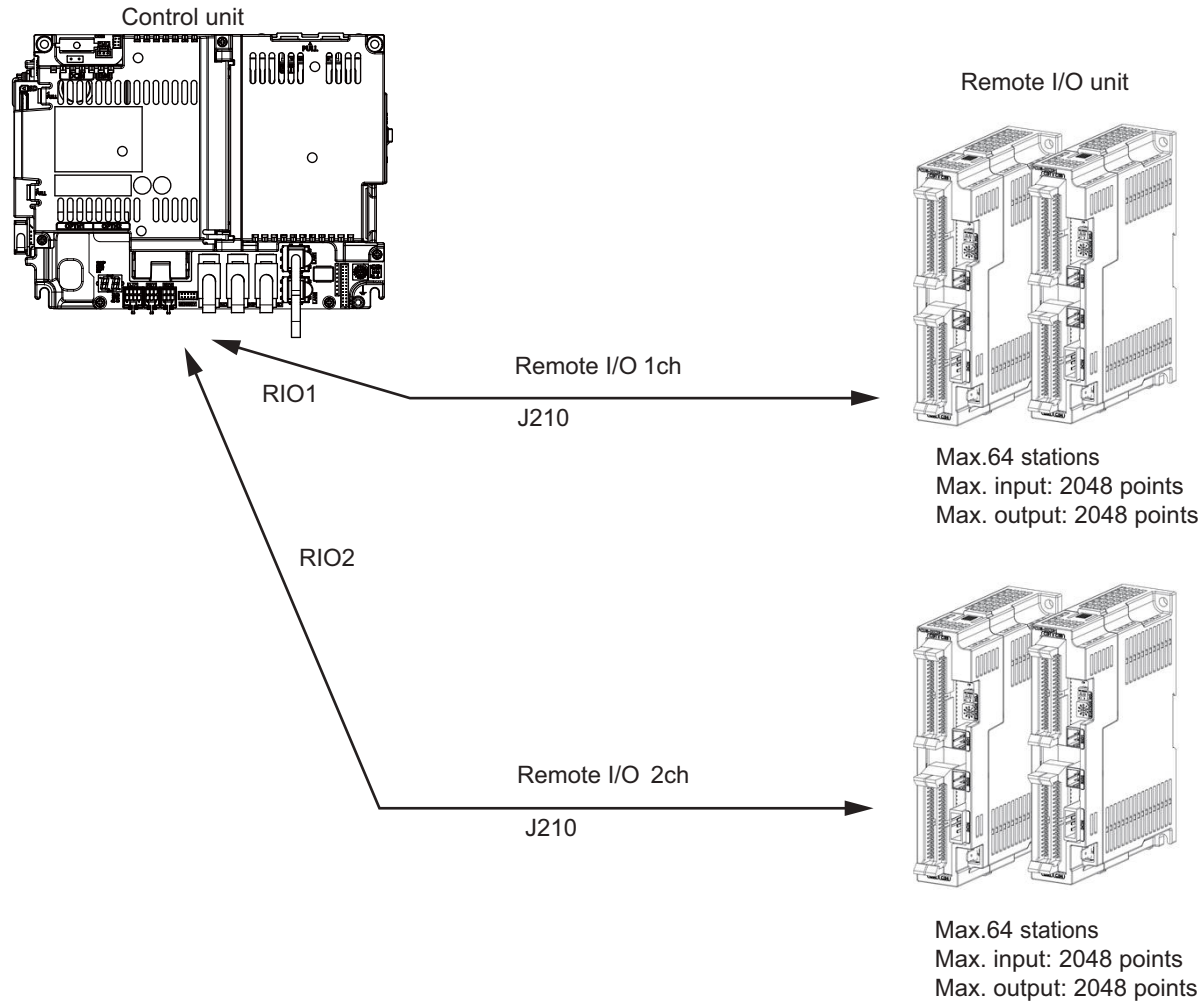
No.	Connector name	Function		No.	Connector name	Function
(1)	CJ31	Machine signal input		(12)	SDO2	Safety relay output
(2)	CJ32	Machine signal output		(13)	RIO1	Remote I/O 2.0 communication
(3)	CJ33	Machine signal input		(14)	RIO2	Remote I/O 2.0 communication
(4)	CJ34	Machine signal output		(15)	DCIN	24VDC input
(5)	CJ35	Machine signal input		(16)	DCOUT	24VDC output
(6)	CJ36	Machine signal output		(17)	FG	FG terminal
(7)	SDI	Safety machine signal input		(18)	FG	FG terminal (M4 screw)
(8)	SDO	Safety machine signal output		(19)	AIO1	Analog input Analog output
(9)	SDI1	Safety DI input		(20)	THERMISTOR	Thermistor input
(10)	SDI2	Safety DI input		(21)	AI	Multi-analog input
(11)	SDO1	Safety relay output				

No.	Switch name	Function
(s1)	STATION No.	Station No. group setting switch
(s2)		Station No. setting switch
(s3)		Station No. setting switch

Unit type	Machine control signals that can be handled	Total	Number of occupied stations
FCU8-DX220	Digital input signal (DI)	32 points	1
	Digital output signal (DO)	32 points	
FCU8-DX230	Digital input signal (DI)	64 points	2
	Digital output signal (DO)	48 points	
FCU8-DX231	Digital input signal (DI)	64 points	2
	Digital output signal (DO)	48 points	
	Analog output (AO)	1 point	
FCU8-DX202	Analog input signal (AI)	4 points	1
	Analog output signal (AO)	1 point	
FCU8-DX213 / DX213-1	Digital input signal (DI)	16 points	1
	Digital output signal (DO)	8 points	
FCU8-DX654 / DX654-1	Safety digital input signal (DI)	8 points	2
	Safety digital output signal (DO)	4 points	
FCU8-DX651	Digital input signal (DI)	32 points	3
	Digital output signal (DO)	32 points	
	Safety digital input signal (DI)	8 points	
	Safety digital output signal (DO)	4 points	
FCU8-DX408	Thermistor input (THERMISTOR)	12 points	3
FCU8-DX409	Multi-analog input (Multi AI)	4 points	4

17.6.2 Connection and Station No. Setting on Remote I/O Unit

When connecting directly to the control unit

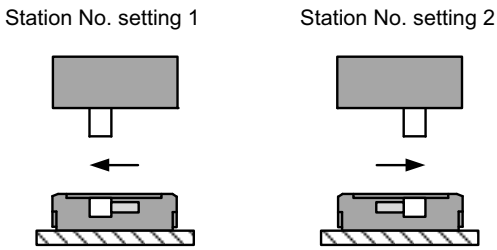


(Note) Connect the J210 cable to the RIO1 or RIO2 connector of the control unit.
Check the connector position with the actual machine.

(Note 1) A remote I/O unit has two slide switches (station No. group setting switches) and one rotary switch (station No. setting switch) for station No. setting, which link the device Nos. (with X/Y). Set the slide switches and the rotary switch as follows.

Slide switch		Rotary switch	Station No.			
1	2		FCU8-DX213/ DX213-1/ DX220/DX202	FCU8-DX230/ DX231/ DX654/DX654-1	FCU8-DX408	FCU8-DX409
OFF	OFF	0	1	1,2	1,2,3	1,2,3,4
		1	2	2,3	2,3,4	2,3,4,5
		2	3	3,4	3,4,5	3,4,5,6
		:	:	:	:	:
		F	16	16,17	16,17,18	16,17,18,19
OFF	ON	0	17	17,18	17,18,19	17,18,19,20
		1	18	18,19	18,19,20	18,19,20,21
		2	19	19,20	19,20,21	19,20,21,22
		:	:	:	:	:
		F	32	32,33	32,33,34	32,33,34,35
ON	OFF	0	33	33,34	33,34,35	33,34,35,36
		1	34	34,35	34,35,36	34,35,36,37
		2	35	35,36	35,36,37	35,36,37,38
		:	:	:	:	:
		F	48	48,49	48,49,50	48,49,50,51
ON	ON	0	49	49,50	49,50,51	49,50,51,52
		1	50	50,51	50,51,52	50,51,52,53
		2	51	51,52	51,52,53	51,52,53,54
		:	:	:	:	:
		F	64	64,1	64,1,2	64,1,2,3

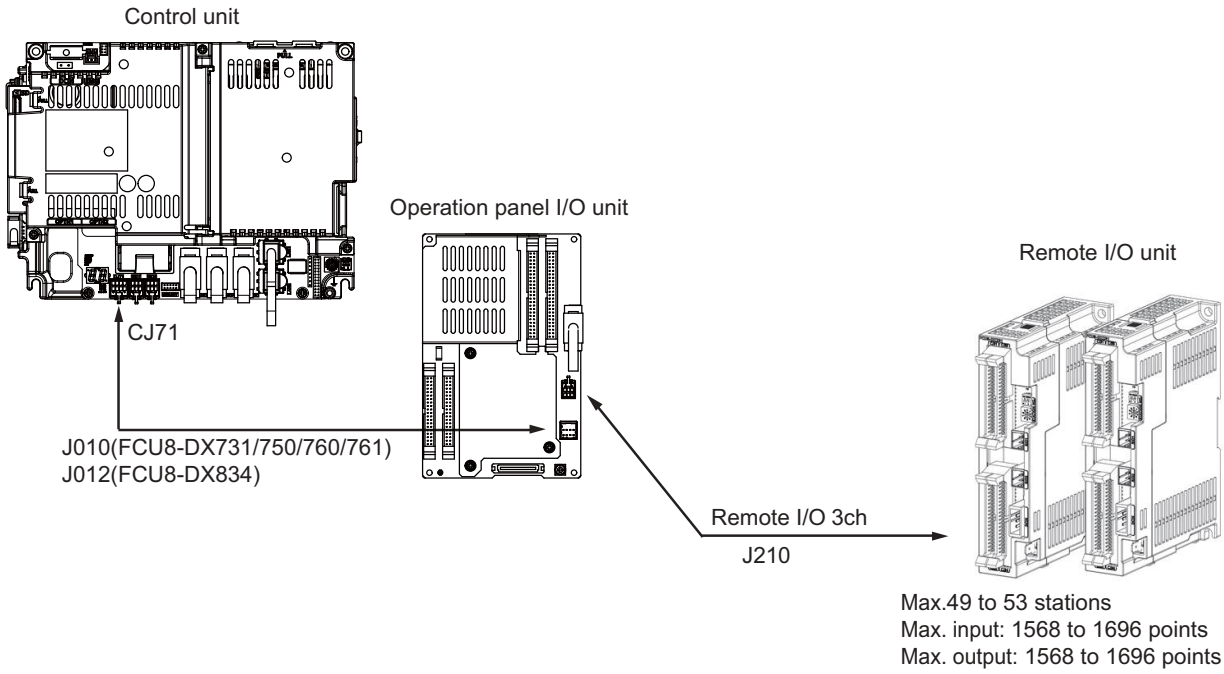
The station Nos. of FCU8-DX651 can be set in two ways according to the slide switch (station No. setting switch). Set the knob to the left for the station No. setting 1 and to the right for the station No. setting 2.



Device	Station No. setting 1	Station No. setting 2
DI/DO	Station No. 1	Station No. 4
Safety DI (SX00A to SX07A) /Safety relay output (SY00A to SY03A) /Relay feedback (SX08A to SX0BA)	Station No. 2	Station No. 5
Safety DI (SX00B to SX07B) /Safety relay output (SY00B to SY03B) /Relay feedback (SX08B to SX0BB)	Station No. 3	Station No. 6

(Note 2) Refer to "17.6.4 PLC Device Assignment of Digital Signal (DI/DO)" for device No. assignment.

When connecting to the operation panel I/O unit



Operation panel I/O unit	RIO occupied stations	Extensible stations
FCU8-DX731	1, 3, 7 to 12, 20 to 22	2, 4 to 6, 13 to 19, 23 to 64
FCU8-DX750	1 to 3, 7 to 12, 20 to 22	4 to 6, 13 to 19, 23 to 64
FCU8-DX760	1 to 4, 7 to 12, 20 to 22	5, 6, 13 to 19, 23 to 64
FCU8-DX761	1 to 5, 7 to 12, 20 to 22	6, 13 to 19, 23 to 64
FCU8-DX834	1 to 4, 7 to 14, 20 to 22	5, 6, 15 to 19, 23 to 64

(Note 1) Refer to "17.6.4 PLC Device Assignment of Digital Signal (DI/DO)" for device No. assignment.
(Note 2) The maximum connectable number of remote I/O units is 32.

17.6.3 Station No. Setting when Using Multiple Remote I/O Units

Multiple remote I/O units can be used, as long as the total No. of occupied stations connected with serial links is eight or less. (four/five or less when connected to the operation panel I/O unit).

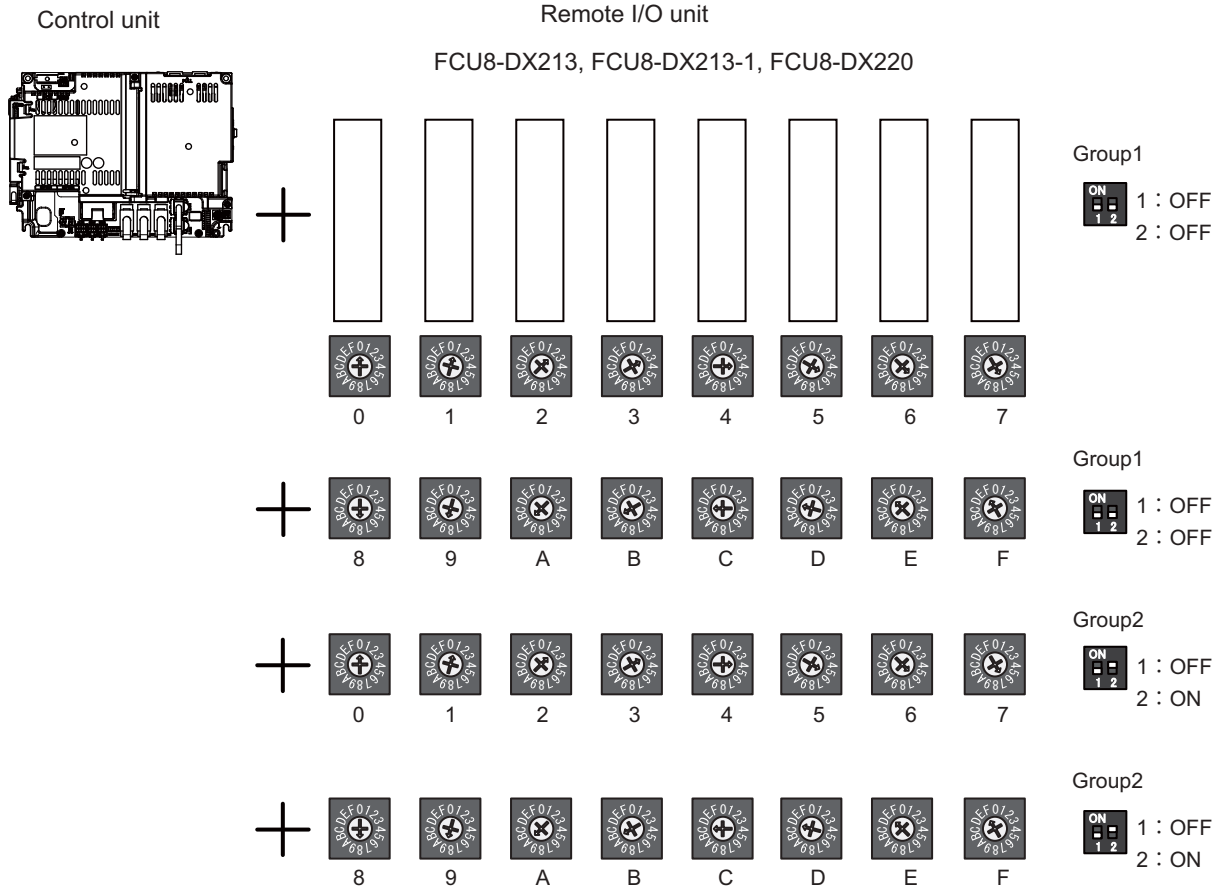
Unit type	Number of occupied stations
FCU8-DX220	1
FCU8-DX230	2
FCU8-DX231	2
FCU8-DX202	1
FCU8-DX213 / DX213-1	1
FCU8-DX654 / DX654-1	2
FCU8-DX651	3
FCU8-DX408 (Note 2)	3
FCU8-DX409 (Note 3)	4

When using multiple remote I/O units, a characteristic station No. must be set for each unit. A unit has the station No. group setting switches and the station No. setting switch. These switches must be set to the characteristic station No. which is not duplicate with the occupied stations of the operation panel I/O unit.

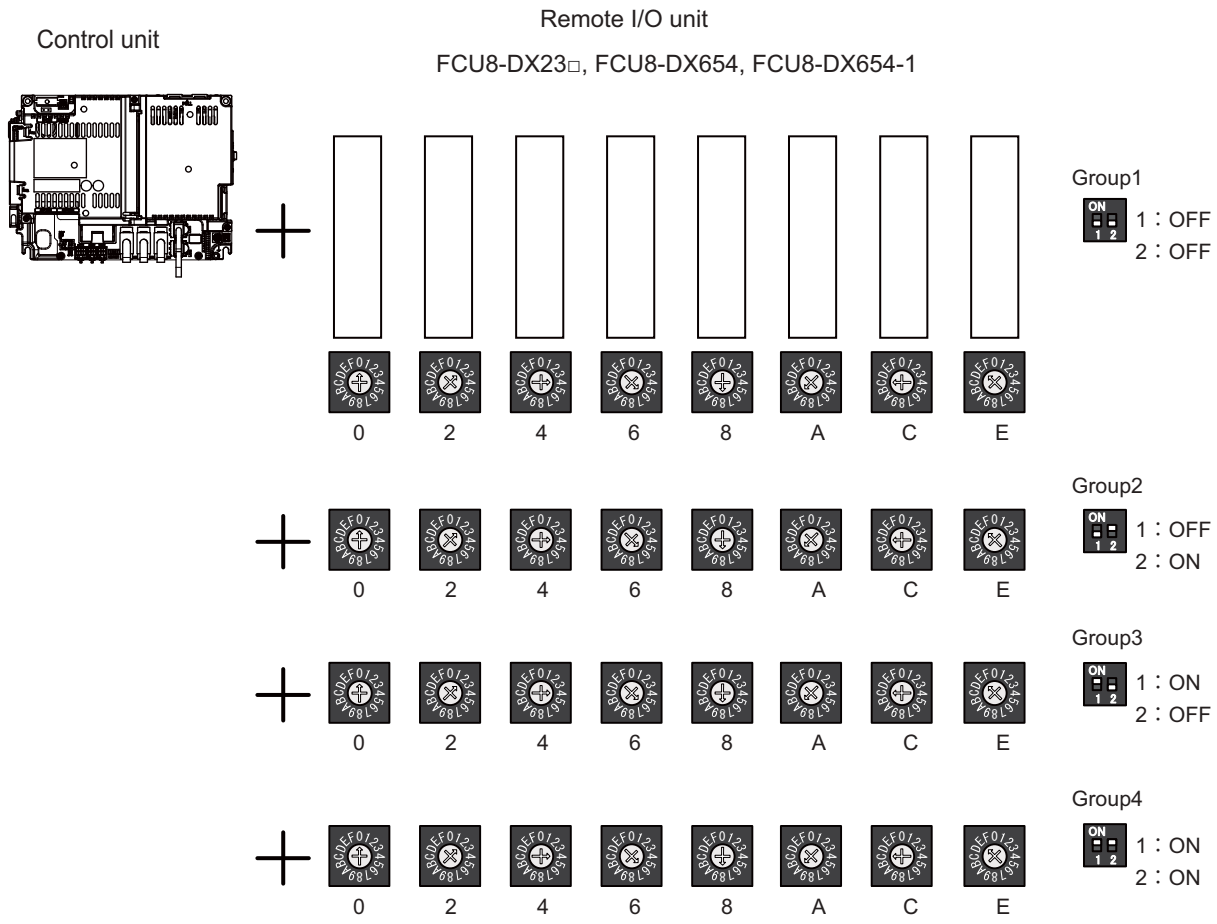
(Note 1) The maximum connectable number of remote I/O units is 32 per channel.
(Note 2) Only one FCU8-DX408 unit can be connected in the entire system.
(Note 3) The maximum connectable number of FCU8-DX409 is four.

When connecting directly to the control unit

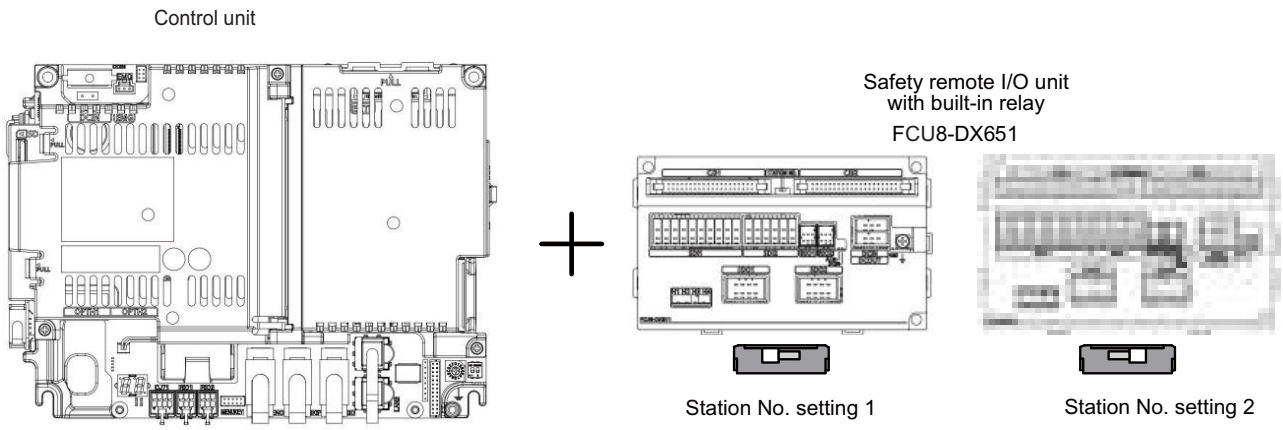
Setting example 1



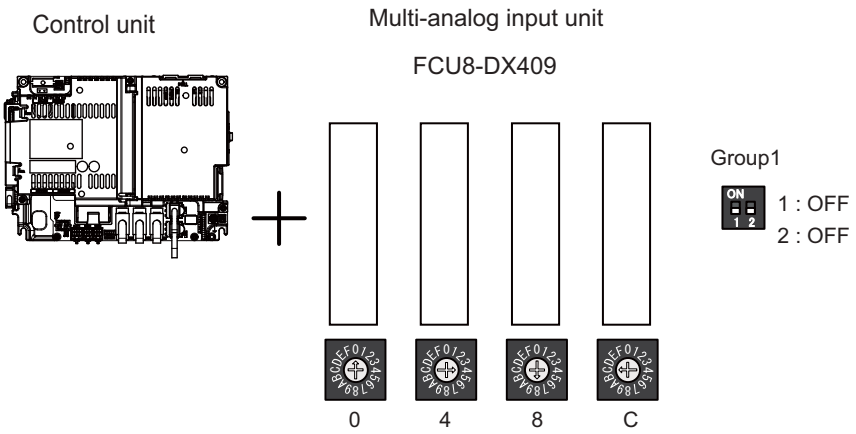
Setting example 2



Setting example 3



Setting example 4



When connecting to the operation panel I/O unit

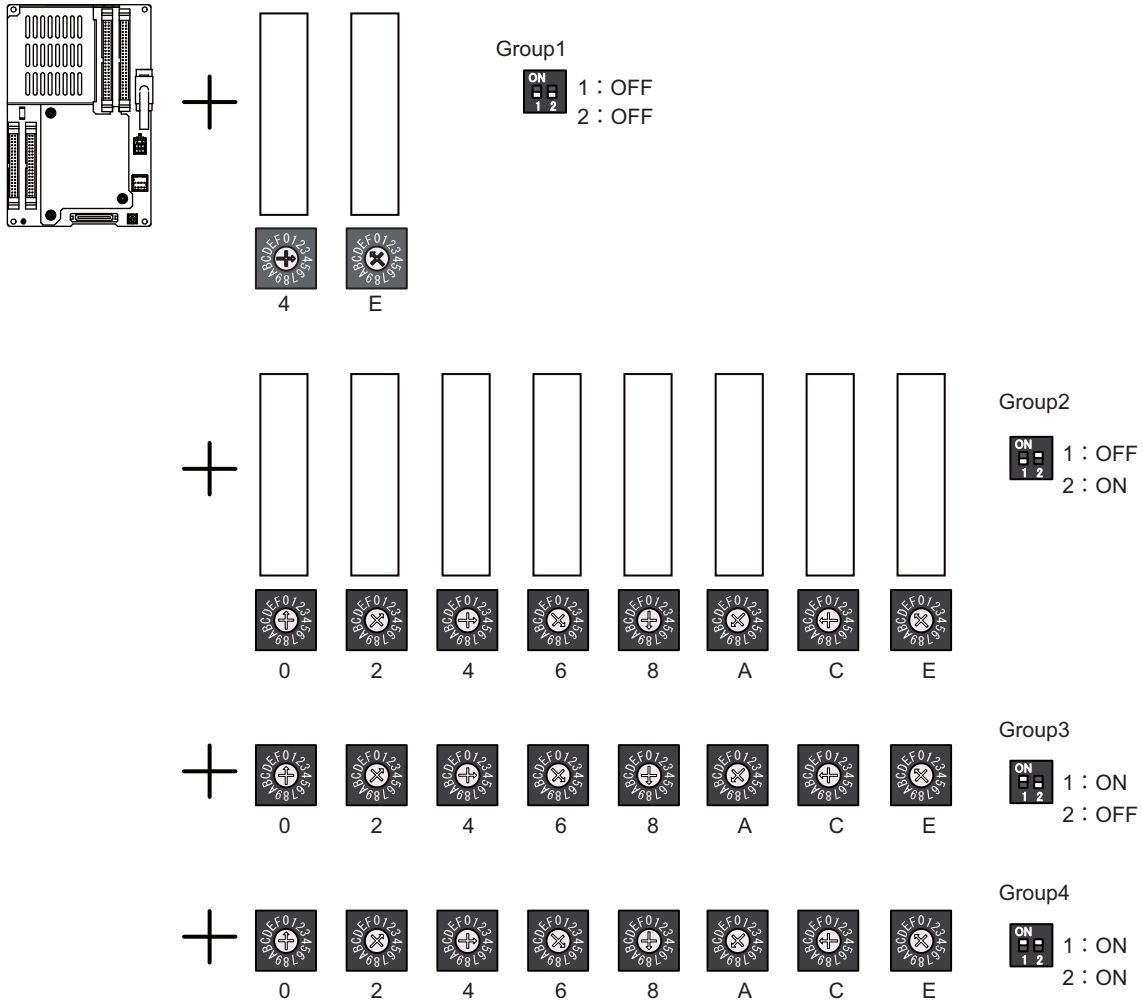
Operation panel I/O unit occupies 9 to 11 stations among station No. 1 to 64.
Therefore, RIO3 can occupy up to 50 to 53 stations, as shown below.

Operation panel I/O unit type	Max. number of stations (RIO3 connection)	Max. number of I/O points (RIO3 connection)
FCU8-DX731	53 stations	Input:1696 points, Output:1696 points
FCU8-DX750	52 stations	Input:1664 points, Output:1664 points
FCU8-DX760	51 stations	Input:1632 points, Output:1632 points
FCU8-DX761	50 stations	Input:1600 points, Output:1600 points
FCU8-DX834	49 stations	Input:1568 points, Output:1568 points

Setting example 1

Operation panel I/O unit

Remote I/O unit
FCU8-DX23□, FCU8-DX654, FCU8-DX654-1



(Note) The maximum connectable number of remote I/O units is 32.

17.6.4 PLC Device Assignment of Digital Signal (DI/DO)

The input/output signals (analog signal, DI/DO, etc.) are assigned to the PLC devices, and the digital signals (DI/DO) can be assigned to the arbitrary PLC devices by the parameters.
Either "Fixed device assignment" which automatically assigns the signals to fixed PLC devices defined by the system or "Arbitrary device assignment" which user can assign the signals the arbitrary PLC devices by the parameters can be selected by setting the RIO assignment parameter "#53001 RIO dev assign (selection of RIO device assignment method)".

[Fixed device assignment] (Parameter "#53001 RIO dev assign" is set to "0".)

Settings are not required because the assignment to the fixed PLC devices are automatically performed.
Refer to "17.6.4.1 Fixed Device Assignment" for details.

[Arbitrary device assignment] (Parameter "#53001 RIO dev assign" is set to "1".)

Set the PLC devices which are assigned to the DI/DO of each remote I/O unit station by the parameters.
Refer to "17.6.4.2 Arbitrary Device Assignment" for details.

17.6.4.1 Fixed Device Assignment

(1) By setting the parameter "#53001 RIO dev assign" to "0", the PLC device assignment method, which is to be used for input/output of each remote I/O unit station, will be the fixed device assignment.

(2) PLC devices assigned for each remote I/O unit station at the time of the fixed device assignment are as follows:

		Station No.							
Channel No.		1	2	…	8	9	…	63	64
RIO1	Input device	X0000 to X001F	X0020 to X003F	…	X00E0 to X00FF	ZR5000 / ZR5001	…	ZR5108 / ZR5109	ZR5110 / ZR5111
	Output device	Y0000 to Y001F	Y0020 to Y003F	…	Y00E0 to Y00FF	ZR6000 / ZR6001	…	ZR6108 / ZR6109	ZR6110 / ZR6111
RIO2	Input device	X0100 to X011F	X0120 to X013F	…	X01E0 to X01FF	ZR5200 / ZR5201	…	ZR5308 / ZR5309	ZR5310 / ZR5311
	Output device	Y0100 to Y011F	Y0120 to Y013F	…	Y01E0 to Y01FF	ZR6200 / ZR6201	…	ZR6308 /ZR6309	ZR6310 / ZR6311
RIO3	Input device	X0200 to X021F	X0220 to X023F	…	X02E0 to X02FF	ZR5400 / ZR5401	…	ZR5508 / ZR5509	ZR5510 / ZR5511
	Output device	Y0200 to Y021F	Y0220 to Y023F	…	Y02E0 to Y02FF	ZR6400 / ZR6401	…	ZR6508 / ZR6509	ZR6510 / ZR6511

(Note) Do not use the input/output signals of the system-occupied stations of RIO3 and operation panel I/O unit-connected channels.

(3) A part of PLC devices assigned for each station of remote I/O units can input/output signals with PLC high speed by setting the high-speed input/output specification parameters or R registers.
   (a) The devices for inputting/outputting signals with PLC high speed can be set individually for the high-order and the low-order per 16 points for DI and DO of each remote I/O unit station.
   (b) Only devices of the first to eighth stations for each remote I/O channel can input/output signals with PLC high speed. The devices of the ninth to 64th stations input/output with PLC medium speed.
   (c) The parameter and R register numbers for the high-speed input/output designation are as follows:

		Station No.			
Channel No.		1 to 4		5 to 8	
		Parameter No.	R register No.	Parameter No.	R register No.
RIO1	High-speed input specification	# 6457	R7828 low-order	# 6458	R7828 high-order
	High-speed output specification	# 6461	R7830 low-order	# 6462	R7830 high-order
RIO2	High-speed input specification	# 6459	R7829 low-order	# 6460	R7829 high-order
	High-speed output specification	# 6463	R7831 low-order	# 6464	R7831 high-order
RIO3	High-speed input specification	# 6465	R7832 low-order	# 6466	R7832 high-order
	High-speed output specification	# 6473	R7836 low-order	# 6474	R7836 high-order

(Note 1) The above parameters are invalid when the devices have been assigned arbitrarily.
(Note 2) Refer to "PLC Programming Manual" for details of the setting method.

17.6.4.2 Arbitrary Device Assignment

Parameter setting for device arbitrary assignment

(1) By setting the parameter "#53001 RIO dev assign" to "1", the assignment method for PLC devices to be used for input/output of each remote I/O unit station becomes arbitrary device assignment.

(2) For arbitrary device assignment, set the PLC devices for input and output to DI/DO (32 points) of each remote I/O unit station by the parameters. Also, set the assignment of the operation panel I/O unit.

(3) Turn the power OFF and ON to enable arbitrary device assignment after the parameter settings.

(4) Set the input/output device assignment and high-speed input/output specification by the parameters for each station of all remote units which have DI/DO function (except safety DI/DO). If all stations have not been set, the alarm "Y05 Initial parameter error" will be issued when the power turns ON.

	Parameter set No. (Note 1)								
Name	#1	…	#64	#65	…	#128	#129	…	#182
Target channel No. #n	#53011	…	#53641	#53651	…	#54281	#54291	…	#54821
Target station No. #n (Note 2)	#53012	…	#53642	#53652	…	#54282	#54292	…	#54822
DI device name #n	#53013	…	#53643	#53653	…	#54283	#54293	…	#54823
DI device No. #n	#53014	…	#53644	#53654	…	#54284	#54294	…	#54824
DO device name #n	#53015	…	#53645	#53655	…	#54285	#54295	…	#54825
DO device No. #n	#53016	…	#53646	#53656	…	#54286	#54296	…	#54826
High-speed input specification #n	#53017	…	#53647	#53657	…	#54287	#54297	…	#54827
High-speed output specification #n	#53018	…	#53648	#53658	…	#54288	#54298	…	#54828

(Note 1) A set of RIO assignment parameters consists of eight parameters (from target channel number to high-speed output specification) for one station.

(Note 2) Arbitrary device assignment cannot be performed for the system-occupied stations of RIO3 and operation panel I/O unit-connected channels.

(5) The PLC devices that are valid for arbitrary device assignment are as follows:

PLC device	Word/Bit	Input	Output	Assignable range	PLC device No. format
X	Bit	○	-	X0000 to X05FF However, X400 to X5FF is invalid when PROFIBUS specification is added.	Hexadecimal
Y	Bit	-	○	Y0000 to Y05FF However, Y400 to Y5FF is invalid when PROFIBUS specification is added.	Hexadecimal
ZR	Word	○	○	ZR5000 to ZR5999 (for input) ZR6000 to ZR6999 (for output)	Decimal

(Note 1) Duplication check is not performed between the PLC devices which are set with machine input/output signal other than the remote I/O such as CC-Link or PROFIBUS and PLC devices which are set with arbitrary device assignment. If the PLC devices have duplicated, NC or PLC ladder can not be carried out correctly. When using machine input/output signal other than the remote I/O, make sure to confirm that the PLC devices do not duplicate the PLC devices set with arbitrary device assignment.

(Note 2) Assignment cannot be performed for the devices corresponding to the system-occupied stations of RIO3. If you connect the operation panel to any channel other than RIO3, assignment is also disabled for the devices corresponding to the system-occupied stations of the said channel.

(6) Even when the RIO assignment parameters are set in the remote I/O unit stations which have the analog input/output and safety DI/DO functions, the input/output is not carried out to the set PLC devices.

(7) Up to 24 stations can be specified for high-speed input/output specification each for input and output. If 25 or more stations are specified, the alarm "Y05 Initial parameter error" will be issued.

(8) High-speed input/output specification can be set by R registers below as well as the RIO assignment parameters.

		Station No.							
Channel No.		1 to 8	9 to 16	17 to 24	25 to 32	33 to 40	41 to 48	49 to 56	57 to 64
RIO1	High-speed input specification	R30544 low-order	R30544 high-order	R30545 low-order	R30545 high-order	R30546 low-order	R30546 high-order	R30547 low-order	R30547 high-order
	High-speed output specification	R30560 low-order	R30560 high-order	R30561 low-order	R30561 high-order	R30562 low-order	R30562 high-order	R30563 low-order	R30563 high-order
RIO2	High-speed input specification	R30548 low-order	R30548 high-order	R30549 low-order	R30549 high-order	R30550 low-order	R30550 high-order	R30551 low-order	R30551 high-order
	High-speed output specification	R30564 low-order	R30564 high-order	R30565 low-order	R30565 high-order	R30566 low-order	R30566 high-order	R30567 low-order	R30567 high-order
RIO3	High-speed input specification	R30552 low-order	R30552 high-order	R30553 low-order	R30553 high-order	R30554 low-order	R30554 high-order	R30555 low-order	R30555 high-order
	High-speed output specification	R30568 low-order	R30568 high-order	R30569 low-order	R30569 high-order	R30570 low-order	R30570 high-order	R30571 low-order	R30571 high-order

(Note 1) Turn the power OFF and ON after the R register settings to enable the settings.

(Note 2) One bit of each R register is equivalent to one station. The high-speed input/output specification can be performed by turning ON the R register bits of the stations to be input or output with PC high speed. To output the 10th station of RIO1 at high speed, for instance, turn bit9 of R30544 ON.

(Note 3) High-speed input/output designation is disabled for the system-occupied stations of RIO3 and operation panel I/O unit-connected channels. Even when the bit6 to bitD of R30552 and R30568 are turned ON, they will be invalid.

(Note 4) The above settings are invalid with fixed device assignment.

(9) In the following cases, the alarm "Y05 Initial parameter error" will be issued when the power is turned ON. The number of the RIO assignment parameter with illegal setting state will be displayed.

(a) The value outside the range of setting has been set to the RIO assignment parameter (except "#53001 RIO dev assign").

(b) Two or more stations of the target channel No. and the target station No. are set redundantly to the RIO assignment parameters.

(Example)

The power is turned ON in a state where the 1st and 2nd station of RIO1 are set redundantly to the RIO assignment parameter #1 to #5 as shown in the table below. (Both the 1st and 2nd stations are connected to NC control unit.)

Parameter set No.#n	Target channel No. #n (parameter No.)	Target station No. #n (parameter No.)	Setting state
1	1 (#53011)	0 (#53012)	RIO1 1st station is set
2	1 (#53021)	1 (#53022)	RIO1 2nd station is set
3	1 (#53031)	1 (#53032)	RIO1 2nd station is set
4	1 (#53041)	0 (#53042)	RIO1 1st station is set
5	1 (#53051)	0 (#53052)	RIO1 1st station is set

Result:

The parameter number (53031) of "Target channel #3" will be displayed on the alarm "Y05 Initial parameter error". Duplication error of RIO1 second station will be detected first because the RIO assignment parameter is checked from the top. Between the parameter set #2 and #3 to which second station of RIO1 are set, parameter set #3 which is the latter will be displayed as the alarm.

(c) A PLC device outside the assignable range has been set to the RIO assignment parameter.

(d) 25 or more stations have been specified with the high-speed input or output with the RIO assignment parameters.

(e) The RIO assignment parameters have not been specified to the remote I/O unit stations with DI/DO functions (except safety DI/DO) that are connected to NC.

(f) Two or more stations of the PLC devices are set redundantly to the RIO assignment parameters.

(Note) However, these (a) to (f) will not be issued with the alarm "Y05 Initial parameter error" in the following cases:

- "0" has been set to the target channel.
- Remote I/O unit with DI/DO function are not connected to the station which has been specified with the target channel and station number.
- The parameter "#1238 set10/bit3" is ON (the input from RIO is ignored).

(Example)

The power is turned ON in a state where the X100 and X200 of PLC device are set redundantly to the RIO assignment parameter #1 to #5 as shown in the table below. (All stations which has been set to the RIO assignment parameters #1 to #5 are connected to NC control unit.)

Parameter set No. #n	DI device name #n (parameter No.)	DI device No. #n (parameter No.)	Setting state
1	X (#53013)	100 (#53014)	X100 is set
2	X (#53023)	200 (#53024)	X200 is set
3	X (#53033)	200 (#53034)	X200 is set
4	X (#53043)	100 (#53044)	X100 is set
5	X (#53053)	100 (#53054)	X100 is set

Result:

The parameter number (53034) of "DI device No. #3" will be displayed on the alarm "Y05 Initial parameter error". Duplication error of X200 will be detected first because the RIO assignment parameter is checked from the top. Between the parameter set #2 and #3 to which the X200 are set, parameter set #3 which is the latter will be displayed as the alarm.

Operating parameter setting screen

(1) RIO assignment parameter setting rule

(a) For arbitrary device assignment, assign PLC devices to all stations which are connected to the remote units with DI/DO function. Devices can be assigned in random order for arbitrary device assignment. It is unnecessary to assign in order of the target channels, target station numbers, PLC devices, etc.

(b) Set the PLC device numbers after setting the PLC device names. A setting error occurs if PLC number is input when the PLC device name is in the unset (blank) state. When a PLC device name is changed, PLC device number of the same parameter set number is cleared to zero.

(c) When setting the bit devices, set the DI and DO device numbers in increments of 32 points. A setting error occurs if device number is not a multiple of 32 (20 for hexadecimal).

(d) When setting the word devices, set the DI and DO device numbers in increments of two words (32 bits). A setting error occurs if the device number is odd.

(e) Set the target channels to "0" for the parameter sets which are not set for device assignment. The setting state of the parameter sets to which "0" has been set for the target channel will not be checked.

(f) The RIO assignment parameter setting values are retained even when the fixed device assignment and arbitrary device assignment are switched.

(2) RIO assignment parameter setting state check

(a) The RIO assignment parameter setting state can be checked without rebooting the power by setting the RIO assignment parameter "Device Setting Check" to "1" when performing the arbitrary device assignment.
The RIO assignment parameter setting state will not be checked at the fixed device assignment.

(b) The RIO assignment parameter settings cannot be valid only by inputting "1" to "Device Setting Check". To enable the arbitrary device assignment, turn the power OFF and ON after the RIO assignment parameter settings.

(c) The value of "Device Setting Check" goes back to "0" after the check for the RIO parameter setting state is completed.

(d) The RIO assignment parameter setting state of each remote I/O unit station with the analog input/output and safety DI/DO functions will not be checked.

(e) The setting state of the parameter set which has been set as the station unconnected to the NC control unit will not be checked.

(f) The setting state of the parameter sets of which the target channel number has been set to "0" will not be checked.

17.6.5 Thermistor Input Interface

(1) By connecting the remote I/O unit with thermistor, up to 12 points of thermistor input are available.
For details on the unit which has thermistor input function, refer to "General Specifications: Remote I/O Unit".

(2) Up to 12 points of thermistor are detected in the ascending order of the channel No. and station No. of the remote I/O unit. The file registers which output the temperature information are assigned to the inputs (thermistor input n (TIn)), but are not assigned to the 13th or later thermistor input. The relationship between thermistor inputs and file registers is as follows:
[PLC input signal]
Through the interface you can read the temperature sensed by a thermistor connected to the designated connector of thermistor input-equipped remote I/O unit.

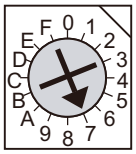
Channel	File register	Data update cycle
TI0	ZR13028	The thermistor voltage acquired with the thermistor input-equipped remote I/O unit is input after converted to a temperature value per PLC medium-speed cycle. One station of remote I/O has 4 thermistor inputs, thus 4 PLC medium-speed cycles are required for the inputs of one station.
TI1	ZR13029	
TI2	ZR13030	
TI3	ZR13031	
TI4	ZR13032	
TI5	ZR13033	
TI6	ZR13034	
TI7	ZR13035	
TI8	ZR13036	
TI9	ZR13037	
TI10	ZR13038	
TI11	ZR13039	

17.7 Initializing the NC Internal Data (SRAM)

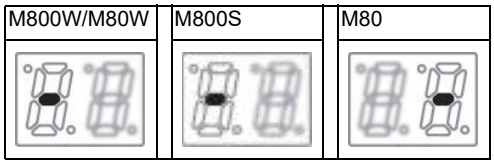
The initialization does not affect the settings of the option parameters.

(Note) The DIP switches next to the rotary switch are for our adjustment. Do not change them after the shipment. Normally the switches No. 1 and 2 are in OFF state (downward).

(1) With the NC power OFF, turn the rotary switch to "7" . Then, turn the power ON.

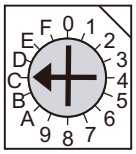


(2) Turn the power OFF after one of the two 7-segment LEDs (see below) displays "-" (hyphen).



(Note) Ignore the display on the side not marked with "-" in the above 7-segment LED displays.

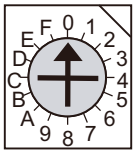
(3) Change the rotary switch to "C" and then turn the power ON.



(4) The 7-segment LED display changes as "08." "00" "01" - - - "08". When it shows "0y", SRAM clear is completed (it takes 8 seconds).

(5) Turn the NC power OFF.

(6) Turn the rotary switch to "0" again.



(7) Turn the power ON again.

(Note 1) After the initializing and the NC power ON, the IP address is initialized as follows.
<Base specification parameter>
#1934 Local IP address: 192.168.100. 1
Failure to communicate with the screen may be caused by inconsistency between the parameter value and the "C:\WINDOWS\melcfg.ini" setting value. Confirm that "C:\WINDOWS\melcfg.ini" is set as shown below.

Last line of C:\WINDOWS\melcfg.ini

```
...
[HOSTS]
TCP1=192.168.100.1,683
```

(Note 2) The initial screen after the initialization is displayed in English. Refer to "Selecting the NC System Type and Displayed Language" for how to set a language to display.

18

Setting Up with M80/800S SETUP INSTALLER

(Note) M80/800S SETUP INSTALLER is used to install language data other than Japanese and English, as well as custom screens.
If you do not need the installation, go to the next section.

You can install the following data with M80/800S SETUP INSTALLER.

(1) Custom data
- Custom screen
- PLC alarm guidance

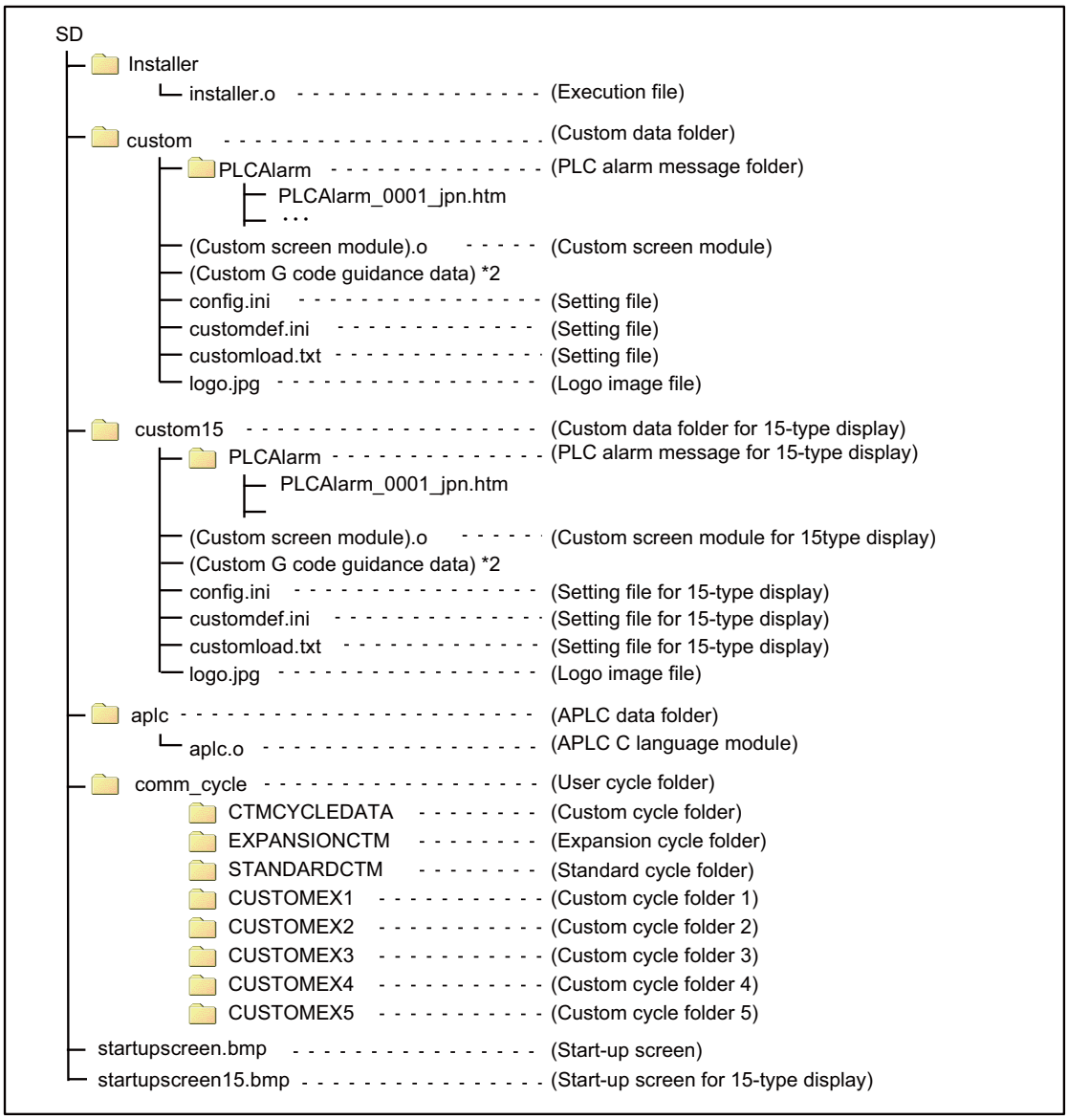
(2) Custom startup screen

(3) APLCdata

An SD card is used for the installation.
MITSUBISHI will not provide performance guarantee and maintenance for commercially available SD card. In the case of using a commercially available SD card, careful performance check must be required by the machine tool builder. Commercially available devices may not be compatible with MITSUBISHI units or suitable FA environment for temperature or noise-wise.

18.1 Activate M80/800S SETUP INSTALLER

(1) Write the data for M80/800S SETUP INSTALLER into an SD card.
The data configuration is as illustrated below.



*1 Custom data setting files

config.ini	:	Setting file for registering custom screen and G code guidance folder
customdef.ini	:	Setting file for registering custom screens to menu and function buttons on standard screen
customload.txt	:	Setting file for registering the object data name and load sequence

*2 Custom G code guidance data
Store the custom G code guidance data in the G code guidance folder set with config.ini.

*3 Start-up screen

- Install the bitmap file of the initial screen to be displayed at power ON.
- Select "24-bit color" for colors. (Displayed by reducing to 16-bit color (RGB565).)
  For an 8.4-type display unit or a 10.4-type display unit, select "640 * 440". For a 15-type display unit, select "1024 * 728".
- Name the startup screen file "startupscreen.bmp" for an 8.4-type display unit or a 10.4-type display unit, or "startupscreen15.bmp" for a 15-type display unit.

*4 APLC C language module

- The size of APLC C language module must be 120KB or less.

*5 User cycle

For details of user cycle, refer to "M800/M80 Series Interactive Cycle Insertion (Customization) Specification manual" (BNP-C3072-121-0003).

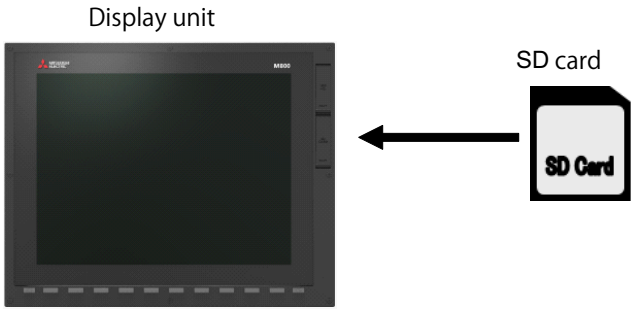
*6 Data storage capacity

Storage capacity of the installation data is as follows:

Install data	Data storage size	General description
Custom data (*)	12MB or less	Size on disk
User cycle (*)	20MB or less	
APLC C language module (aplc.o)	120KB or less	Module size

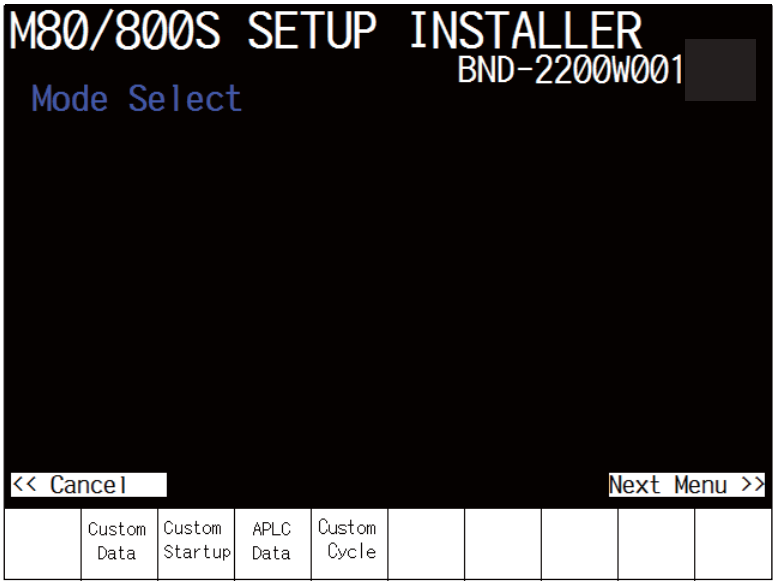
* For custom screen module, the capacity limit is up to 6MB.
* Storage capacity is calculated on built-in memory; thus, it may be different from the data size on installation medium.

(2) Insert an SD card of the M80/800S SETUP INSTALLER into the front-side SD interface.



(3) Turn ON the power while pressing ◁ Return key.

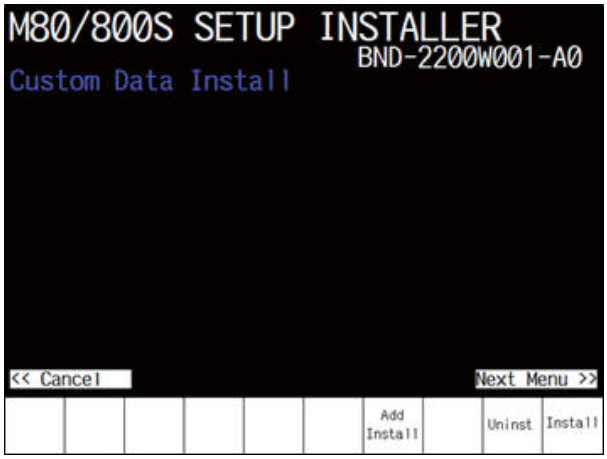
-> Some time after the start-up screen is opened, "M80/800S SETUP INSTALLER" is activated with a beep sound.



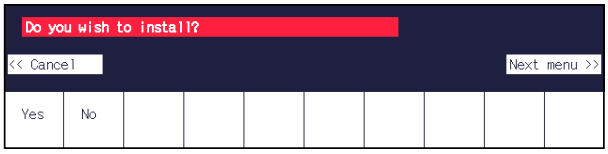
18.2 Install Custom Screen

Carry out the procedures of this section to register custom screens. When you use standard screens only, there is no need to carry out the procedure.

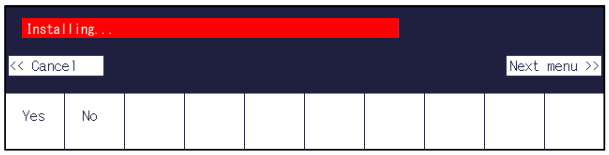
(1) Push the [Custom Data] menu.
-> The screen is changed to the custom data installation screen.



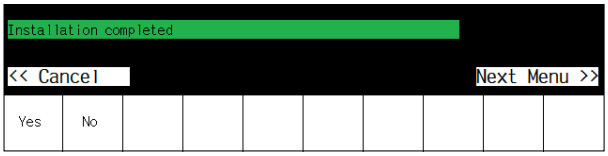
(2) Push the [Install] menu.
(For additional installation, press [Add Install].)



(3) When a confirmation message appears, push the [Yes] menu.
(Note) Do not power OFF during installation.



(4) When installation is finished, "Installation completed" appears.



(Note 1) When an additional custom screen is installed, files (directories) other than the custom data setting files (Config.ini, customdef.ini, customload.txt) are overwritten. For the custom data setting files, the description is added if there is no duplicated data in every section. However, if the registration information (items in the section, such as screen No. offset value, menu position on the custom screen, function buttons, etc.) is duplicated, the "Installation error." message appears and the installation is not performed. For details of each section, refer to "NC Desginer2 Instruction Manual".

(Note 2) To uninstall the custom screen data, press the [Uninst] menu instead of [Install] in the step (2). Note, however, that both "Custom screen", "PLC alarm message" and "Logo image file" are uninstalled by the uninstallation operation.

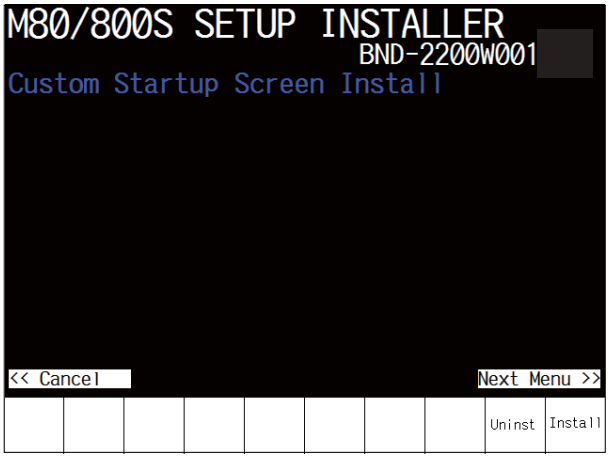
(Note 3) The size of custom data must be 12MB or less. If it exceeds 12MB, the following message appears and the installation fails.
"Installation Error. Please check the file size."

(Note 4) Installation or uninstallation is not executed when the [Yes] menu is pressed continuously after the previous installation or uninstallation operation. Push ◁ Return key to return to the initial screen and start the procedure again.

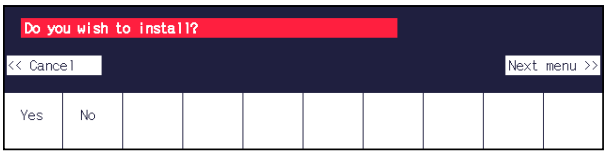
18.3 Install Start-up Screen

Carry out the procedures of this section to register custom start-up screen. When you use standard start-up screen, there is no need to carry out the procedures.

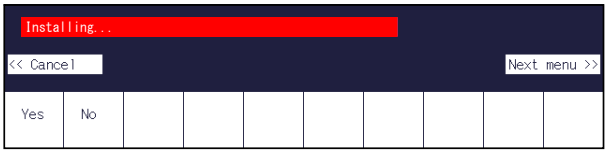
(1) Push the [Custom Startup] menu.
-> The screen is changed to the start-up screen installation screen.



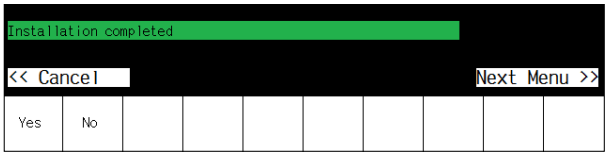
(2) Push the [Install] menu.



(3) When a confirmation screen appears, push the [Yes] menu.
(Note) Do not power OFF during installation.



(4) When installation is finished, "Installation completed" appears.

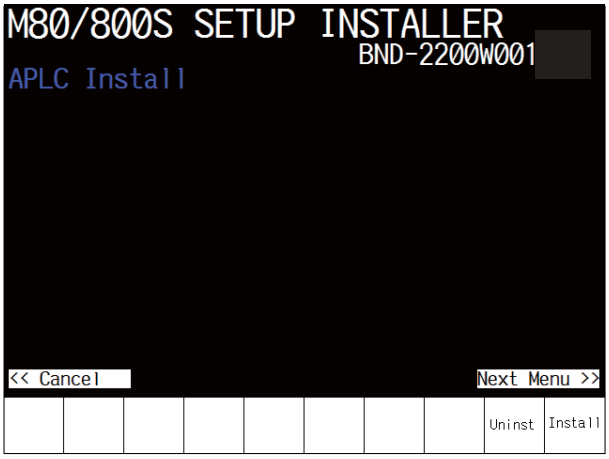


(Note 1) To uninstall the start-up screen data, push the [Uninst] menu instead of [Install] in the step (2).
(Note 2) Installation or uninstallation is not executed when the [Yes] menu is pressed continuously after the previous installation or uninstallation operation. Push ◁ Return key to return to the initial screen and start the procedure again.

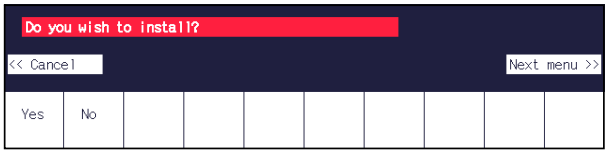
18.4 Install APLC C Language Module

Carry out the procedures of this section to register APLC C language module. When you do not use APLC C language module, there is no need to carry out the procedure.

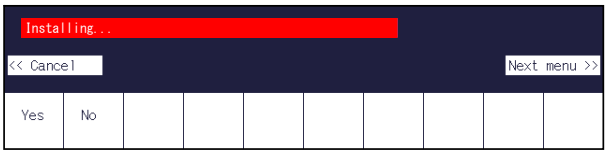
(1) Push the [APLC Data] menu.
-> The screen is changed to APLC C language module installation screen.



(2) Push the [Install] menu.



(3) When a confirmation screen appears, push the [Yes] menu.
(Note) Do not power OFF during installation.



(4) When installation is finished, "Installation completed" appears.

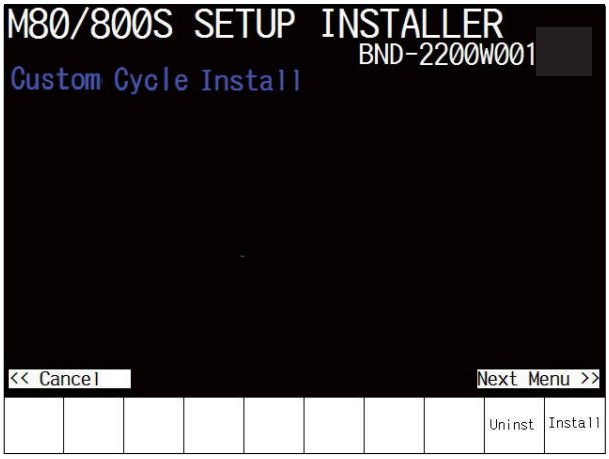


(Note 1) To uninstall the APLC data, push the [Install] menu instead of [Uninst] in the step (2).
(Note 2) Installation or uninstallation is not executed when the [Yes] menu is pressed continuously after the previous installation or uninstallation operation. Push Return key to return to the initial screen and start the procedure again.

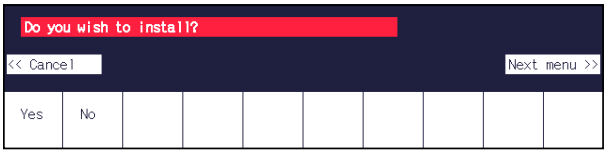
18.5 Install User Cycle

Carry out the procedures of this section to register user cycle. When you do not use user cycle, there is no need to carry out the procedure.

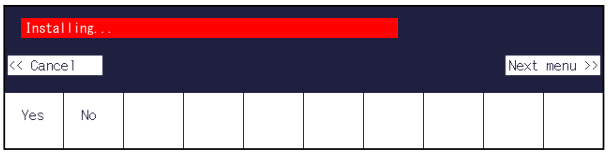
(1) Push the [Custom Cycle] menu.
-> The screen is changed to user cycle installation screen.



(2) Push the [Install] menu.



(3) When a confirmation screen appears, push the [Yes] menu.
(Note) Do not power OFF during installation.



(4) When installation is finished, "Installation completed" appears.



(Note 1) To uninstall the user cycle, push the [Install] menu instead of [Uninst] in the step (2).
(Note 2) The size of user cycle must be 20MB or less. If it exceeds 20MB, the following message appears and the installation fails.
"Installation Error. Please check the file size."
(Note 3) Installation or uninstallation is not executed when the [Yes] menu is pressed continuously after the previous installation or uninstallation operation. Push ◁ Return key to return to the initial screen and start the procedure again.

19

Setting the Parameters and Date/Time

> **⚠ WARNING**
>
> **Confirm the emergency stop state before carrying out the steps in this chapter.**

Refer to the section of "Alarm/Parameter Manual" for the details of the parameters.
You can also refer to the parameter guidance display.
Normally, the initial setting of NC is performed with NC Configrator2.
NC Configurator2 is a tool for supporting the parameter setting of NC.
For the details, refer to "NC Configurator2 Instruction Manual"(IB-1501046).

19.1 Selecting the NC System Type and Displayed Language

When employing the lathe system, set the parameter as follows.

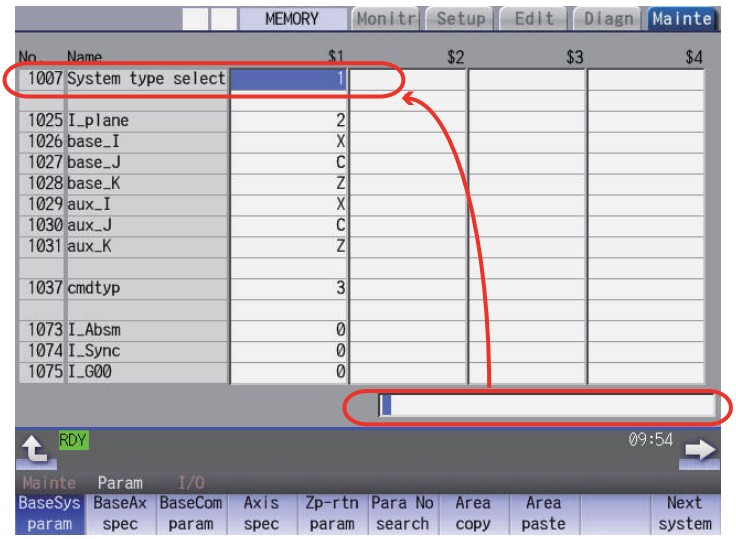
(1) On the Mainte screen, select [Mainte] and then [Psswd input].
Enter the machine tool builder password in the setting area and press the [INPUT] key.
(Note 1) To enter the character "A", press the shift key and then "A" key. Do not press both keys at the same time.
(Note 2) The entered password is displayed as "*****".

(2) Go back to the Mainte screen and select [Param].

(3) Select [Para Nosearch]. Enter "1043" in the setting area and press the [INPUT] key.
Select the language to be displayed.

(4) Select [Para Nosearch]. Enter "1007" in the setting area and press the [INPUT] key.
The screen changes to the base system parameters screen. The cursor moves to the "#1007 System type select" field.

(5) Enter "1" in the setting area and press the [INPUT] key. (0: Machining center system 1: Lathe system)



(6) Turn the power OFF and ON.

19.2 Setting the Parameters for the System Specifications

(1) On the Mainte screen, select [Mainte] and then [Psswd input]. Enter the machine tool builder password in the setting area and press the [INPUT] key.

(2) Go back to the Mainte screen.Then select [Param].
Set the parameters according to the system specifications.

"#1001 SYS_ON(System validation setup)"
"#1002 axisno(Number of axes)"
"#1003 iunit(Input setup unit)"
"#1004 ctrl_unit(Control unit)"
"#1005 plcunit(PLC unit)"
"#1006 mcmpunit(Machine error compensation unit)"
"#1037 cmdtyp(Command type)"
"#1039 spinno(Number of spindles)"
"#1155 DOOR_m"...Set to "100".
"#1156 DOOR_s"... Set to "100".
"#1511 DOORPm(Signal input device 1 for door interlock II: for each system)"
"#1512 DOORPs(Signal input device 2 for door interlock II: for each system)"

(3) After turning the power OFF and ON, select [Mainte] on the maintenance screen, switch the menu by the Menu change button and then select [Format].

(4) When "Input the password" is displayed, enter the machine tool builder password in the setting area and then press [INPUT] key.

(5) When "Format NC memory? (Y/N)" is displayed, press "Y". "Format complete" will be displayed.

(6) Turn the power ON again and select [Mainte] --> [Psswd input] on the maintenance screen. Enter the machine tool builder password in the setting area and press the [INPUT] key.
Select [Param] again on the Mainte screen. Set the following parameters.
"#1010 srvunit(Output unit(servo))"
"#1013 axname(Axis name)"
(Note) When the arbitrary axis exchange control is valid, set the axis names in "#12071 adr_abs[1]" to "#12078 adr_abs[8]".
"#1021 mcp_no(Drive unit I/F channel No. (servo)))"

Set the following parameters as needed.
"#1014 incax(Incremental command axis name)"
(Note) When the arbitrary axis exchange control is valid, set the incremental command axis name in "#12079 adr_inc[1]" to "#12086 adr_inc[8]".
"#1015 cunit(Command unit)"
"#1017 rot(Rotational axis)"
"#1018 ccw(Motor CCW)"
"#1019 dia(Diameter specification axis)"
"#1020 sp_ax(Spindle interpolation)"
"#1022 axname2(2nd axis name)"

(7) Turn the power OFF and ON.

19.3 Setting the Parameters for the Machine Specifications

(1) On the Mainte screen, select [Mainte] and then [Psswd input]. Enter the machine tool builder password in the setting area and press the [INPUT] key.
(Note 1) To enter the character "A", press the shift key and then "A" key. Do not press both keys at the same time.

(2) Go back to the Mainte screen.Then select [Param].
Set the parameters according to the machine specifications. Setting of the following parameters is necessary.

Base system parameters

"#1025 I_plane (Initial plane selection)"
"#1026 base_I (Base axis I)"
"#1027 base_J (Base axis J)"
"#1028 base_K (Base axis K)"
"#1029 aux_I (Flat axis I)"
"#1030 aux_J (Flat axisJ)"
"#1031 aux_K (Flat axis K)"

Base axis specification parameters

"#1603 PLCdev_no (Axis device assignment No.)"
(Note) Set this in one of the following cases:
- When the system has five ore more part systems
- When the number of axes in the part system is nine or more
- When you want to change the assignment of axis device

[Device]

$1	$2	$3	$4	
(1)	(9)	(17)	(25)	Axis 1
(2)	(10)	(18)	(26)	Axis 2
(3)	(11)	(19)	(27)	Axis 3
(4)	(12)	(20)	(28)	Axis 4
(5)	(13)	(21)	(29)	Axis 5
(6)	(14)	(22)	(30)	Axis 6
(7)	(15)	(23)	(31)	Axis 7
(8)	(16)	(24)	(32)	Axis 8

(Note) The device Nos corresponding to (1) to (32) differ depending on device type.

Configuration example for seven part systems (Number of axes per part system: 8, 1, 1, 1, 1, 1, 3)
(Assumed to use the device of each part system in the ladder as follows:)
$1 Axis 1 [Axis 1] → (1), $1 Axis 2 [Axis 2] → (2),
$1 Axis 3 [Axis 3] → (3), $1 Axis 4 [Axis 4] → (4),
$1 Axis 5 [Axis 5] → (5), $1 Axis 6 [Axis 6] → (6),
$1 Axis 7 [Axis 7] → (7), $1 Axis 8 [Axis 8] → (8),
$2 Axis 1 [Axis 9] → (9), $3 Axis 1 [Axis 10] → (10),
$4 Axis 1 [Axis 11] → (11), $5 Axis 1 [Axis 12] → (12),
$6 Axis 1 [Axis 13] → (13), $7 Axis 1 [Axis 14] → (14),
$7 Axis 2 [Axis 15] → (15), $7 Axis 3 [Axis 16] → (16)
(Note) (17) to (32) are unused areas.

Parameter setting value (For the above configuration example):

	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7	Axis 8
#1603	1	2	3	4	5	6	7	8
	Axis 9	Axis 10	Axis 11	Axis 12	Axis 13	Axis 14	Axis 15	Axis 16
#1603	9	10	11	12	13	14	15	16

Base common parameters

"#1041 I_inch (Initial state (inch))"
"#1042 pcinch (PLC axis command (inch))"
"#1239 set11/bit1 (Handle I/F selection)"
"#1240 set12/bit0 (Handle input pulse)"

Axis specification parameter

"#2001 rapid (Rapid traverse rate)"
"#2002 clamp (Cutting feedrate for clamp function)"
"#2003 smgst (Acceleration and deceleration modes)"
"#2004 G0tL (G0 time constant)"
"#2005 G0t1(G0 time constant(primary delay)"
"#2007 G0tL (G1 time constant)"
"#2008 G1t1(G1 time constant (primary delay))"

Spindle specification parameter

"#3001 slimt1 (Limit rotation speed (Gear: 00))"
"#3002 slimt2 (Limit rotation speed (Gear: 01))"
"#3003 slimt3 (Limit rotation speed (Gear: 10))"
"#3004 slimt4 (Limit rotation speed (Gear: 11))"
"#3005 smax1 (Maximum rotation speed (Gear: 00))"
"#3006 smax2 (Maximum rotation speed (Gear: 01))"
"#3007 smax3 (Maximum rotation speed (Gear: 10))"
"#3008 smax4 (Maximum rotation speed (Gear: 11))"
"#3023 smini (Minimum rotation speed)"
"#3024 sout (Spindle connection)"
"#3031 smcp_no (Drive unit I/F channel No.(spindle))"
"#3109 zdetspd (Z phase detection speed)"

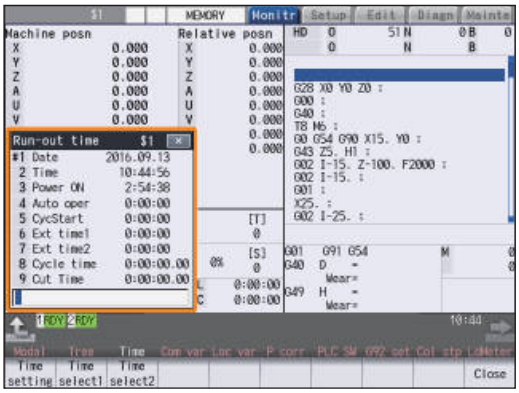
Set the servo parameters according to the instruction manual for your drive. Set the spindle parameters according to "Parameter setting list".

(3) Turn the power OFF and ON.

19.4 Setting Date and Time

(1) Select [Time] on the Monitr screen.

(2) Select [Time setting] on the integrated time screen.
The time setting mode is entered. The cursor appears at the "#1 Date" position in the Run-out time display.



(3) Set the date and time to "#1 Date" and "#2 Time" respectively.
(4) Select [Selfdia] on the diagn screen.
(5) Select [Battery clear] on the self diagn screen, and set the battery used years to "0".
(Note) If battery used years is not cleared, passed years from default date (2014/4/1) will be displayed on battery used years.

20

Sequence Program Writing

Sequence program writing is executed by connecting a personal computer, in which GX Developer or GX Works2 has been installed, to the control unit.
Refer to the "PLC Development Manual" for details.

20.1 Writing Sequence Program using the SD Card

Save the sequence program in an SD card and write the data to NC using the external file operations on PLC onboard.

20.2 Setting the Ethernet Communication

20.2.1 Confirming the IP Address for CNC

Confirm the IP address set for the CNC. IP address is set to the following parameter.

Basic common parameter	Item	Content	Setting example
#1926	Global IP address	IP address for CNC seen from an external source	192.168.200.1
#1927	Global Subnet mask	Subnet mask of #1926	255.255.255.0

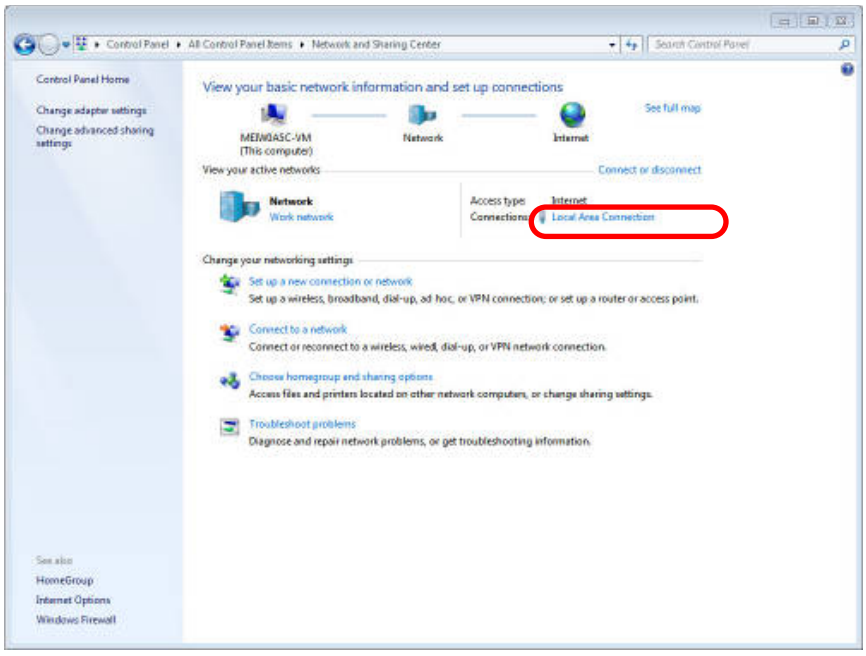
The case of when the initial value "192.168.200.1" after SRAM clear has been set is explained as an example in this chapter.

20.2.2 Setting the IP Address for PC Side

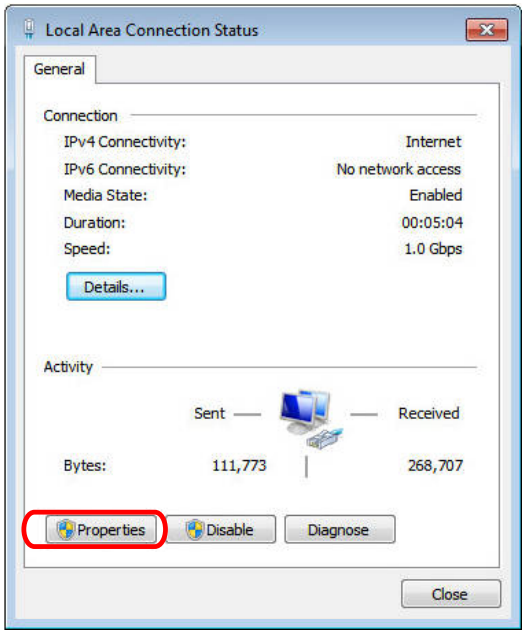
For the personal computer for which GX Developer or GX Works2 is available, IP address has to be set within the same subnet mask as CNC unit.

(1) Select [Start] - [Control Panel] - [Network and Internet] - [Network and Sharing Center] from task bar.

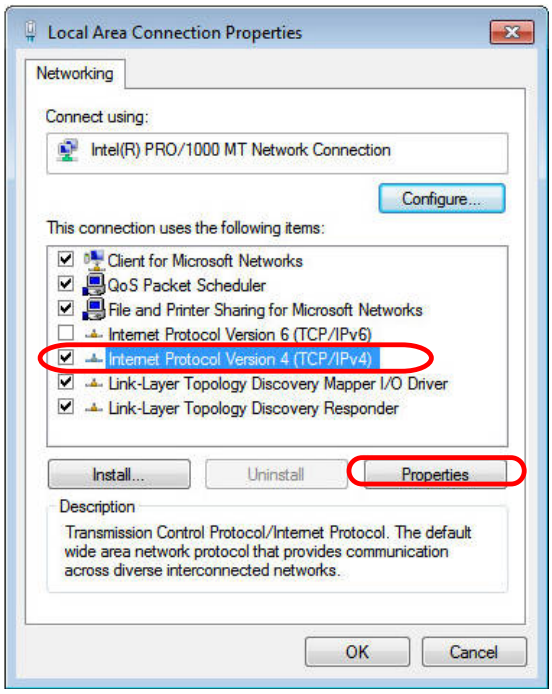
(2) "Network and Sharing Center" is displayed. Click [Local Area Connection].



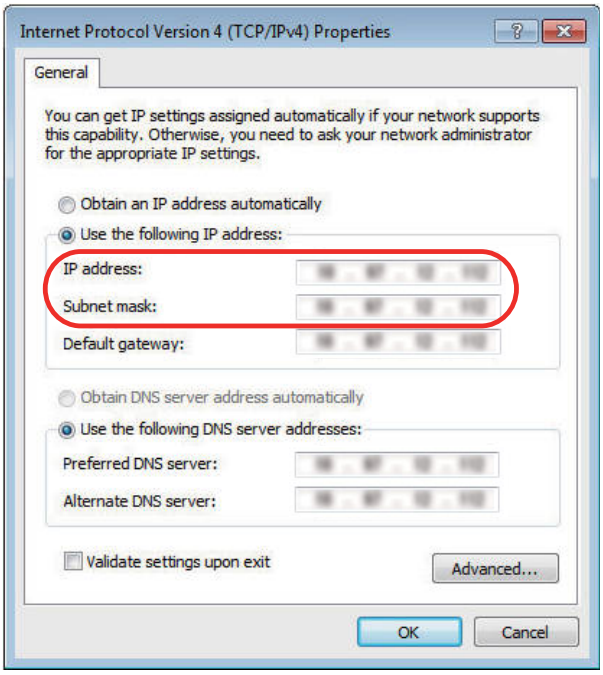
(3) "Local Area Connection Status" is displayed. Click [Properties].



(4) Click "Internet Protocol Version 4 (TCP/IPv4)" on the [Networking] tab, and then click [Properties].



(5) Take a note of the displayed IP address and subnet mask.



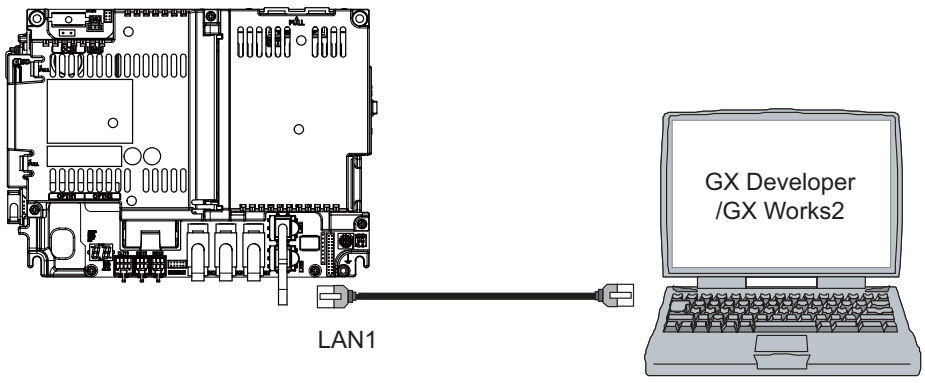
(6) Set the following addresses. (Note)
(Example) IP address: 192.168.200.2
Subnet mask: 255.255.255.0

(Note) In the section "20.2.1 Confirming the IP Address for CNC", set an IP address in the range of "192.168.200.1" to "192.168.200.254", but do not use "192.168.200.1".
Note that when other CNC and devices are connected on the same network, be careful not to duplicate the address with other CNC and devices.

(7) Click [OK] and close all the windows.

20.3 Connecting the Control Unit and a Personal Computer

Connect a personal computer, which has GX Developer or GX Works2 installed, to the control unit.



(Note 1) It is recommended to use GX Developer Version 8.114U (SW8D5C-GPPW) and later.
(Note 2) It is recommended to use GX Works2 Version 1.570U and later.
(Note 3) Carry out the Ethernet communication setting (IP address and so on) on the personal computer before connecting it to NC.

20.4 Setting the Communication with GX Developer

To create the machine sequence and user safety sequence of the CNC, use the Mitsubishi Electric FA engineering software GX Developer, which is the PLC development tool for the Mitsubishi PLC MELSEC Series.

Machine sequence:	Control circuit created to control the machine tools (ladder circuit)
User safety sequence:	Control circuit of the safety-related I/O observation created with the smart safety observation function (ladder circuit)

When using GX Works2, refer to "Setting the Communication with GX Works2".

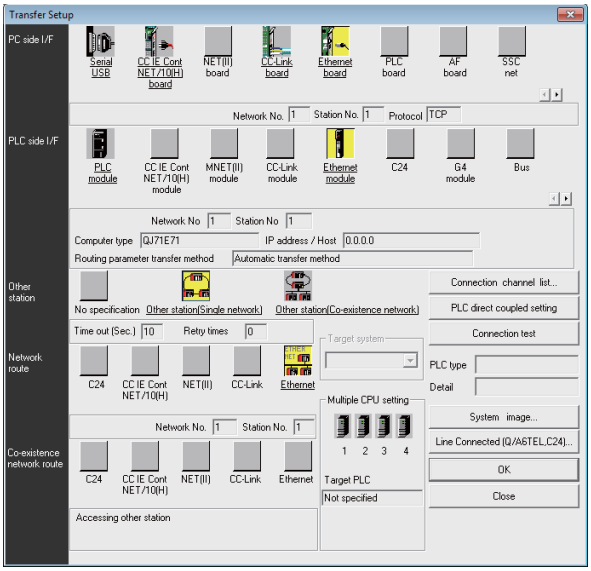
(1) Perform the following operations with GX Developer to start the setup screen.
[Online] -> [Transfer setup...]

(2) Set the following items in order.
(a) For the machine sequence

Setting item		Setting content	Remark
PC side I/F		Ethernet board	
	Network No.	1	*1
	Station No.	1	*1
	Protocol	TCP	*1
PLC side I/F		Ethernet unit	
	Type name	QJ71E71	*2
	Station No.	1	*2
	IP address	IP address of CNC	*2
	Routing parameter conversion method	Automatic conversion method	*2
Other station		Other station (Single network)	
	Time out check (sec.)	Arbitrary time (from about 10 sec.)	*3
	Number of retry	0	*3
Network communication path		Ethernet	
	Access to the Ethernet unit that is set with PLC side I/F		*4

*1: The setting items are displayed by double-clicking the Ethernet board selection field.
*2: The setting items are displayed by double-clicking the Ethernet unit selection field.
*3: The setting items are displayed by double-clicking the other station (Single network) selection field.
*4: The setting items are displayed by double-clicking the Ethernet unit selection field.

■SW8D5C-GPPW setting screen

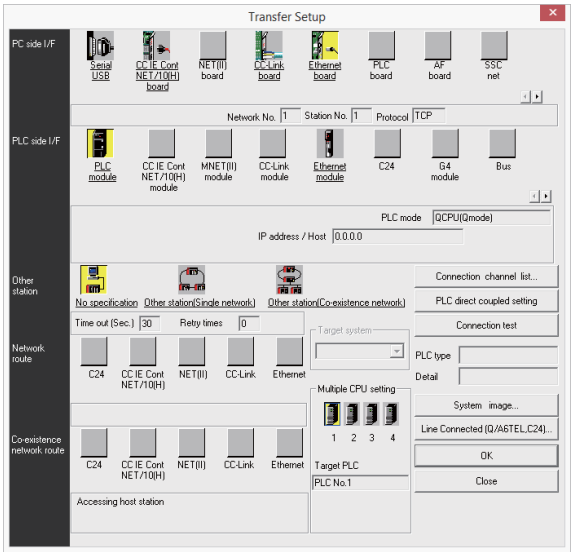


(b) For the user safety sequence

Setting item		Setting content	Remark
PC side I/F		Ethernet board	
	Network No.	1	*1
	Station No.	1	*1
	Protocol	TCP	*1
PLC side I/F		CPU unit	
	CPU mode	QCPU (Q mode)	*2
	Ethernet port direct connection	Not check	*2
	IP address	IP address of CNC	*2
Other station		No other station designated	
	Time out check (sec.)	Arbitrary time (Approx. 10 sec. or more)	*3
	Number of retry	0	*3
Multi CPU			
	For the user safety sequence 1, select No. 1.		
	For the user safety sequence 2, select No. 2.		

*1: The setting items are displayed by double-clicking the Ethernet board selection field.
*2: The setting items are displayed by double-clicking the CPU unit selection field.
*3: The setting items are displayed by double-clicking the other station (Single network) selection field.

■SW8D5C-GPPW setting screen



(3) Press the [Connection test] button after completing the setting.
If the connection has succeeded, the message "Successfully connected with the Q26UDHCPU." will be displayed and the multiple CPU connection status will be displayed at the bottom of the message. This display indicates connection status for each project.

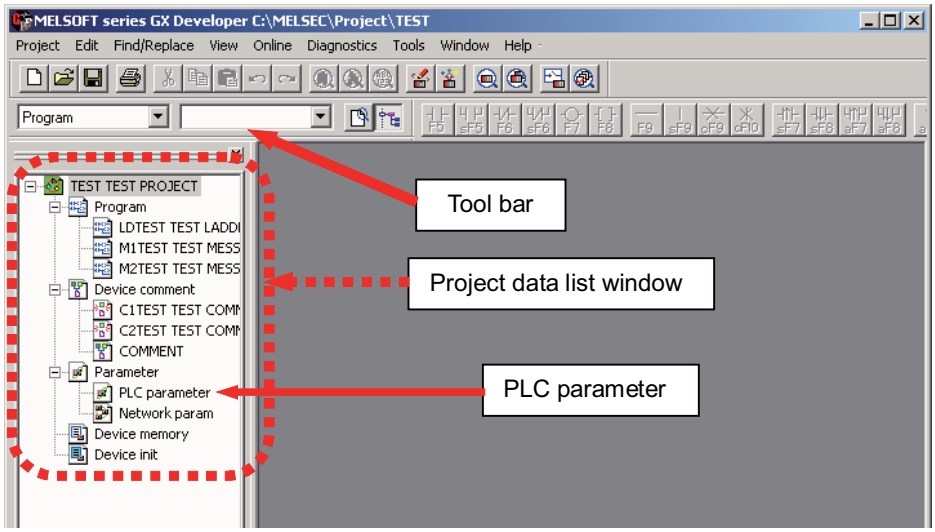
20.5 Setting the Parameters on GX Developer

(Note) There are two methods of ladder programming; independent program method and multi-program method, which makes differences in parameter settings. An incorrect parameter setting in the ladder programming may cause a write error.
For details of the parameter settings, refer to the "PLC Development Manual".

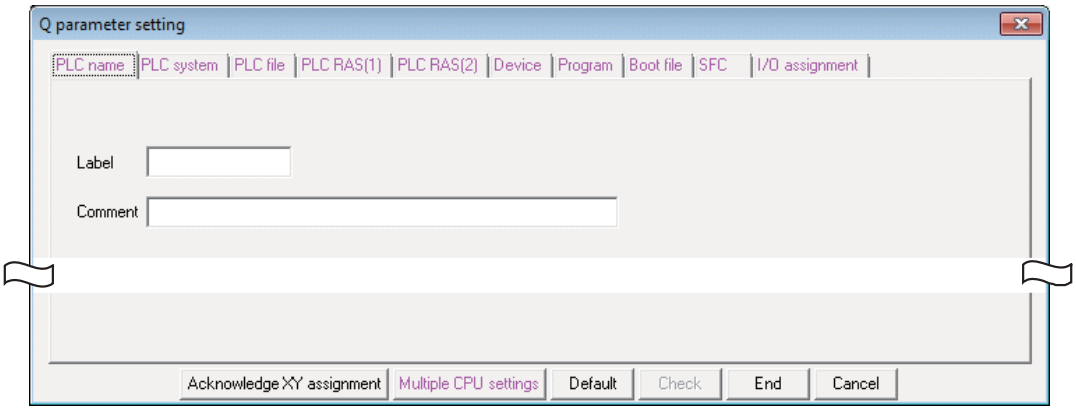
20.5.1 Parameter Setting Screen

(1) Displaying the project data list and parameter setting screen
Display the "Project data list" window with the following operations. Double-click on "PLC parameter" to open the parameter setting screen. The same operation can be carried out by designating the data type "Parameter" and the data name "PLC parameter" from the tool bar.

[View] -> [Project data list] and then double-click "PLC parameter".



(2) Displaying the parameter setting screen
Perform the following operations to display the parameter setting screen. The characters of tab in "red" show that the settings are the initial values.



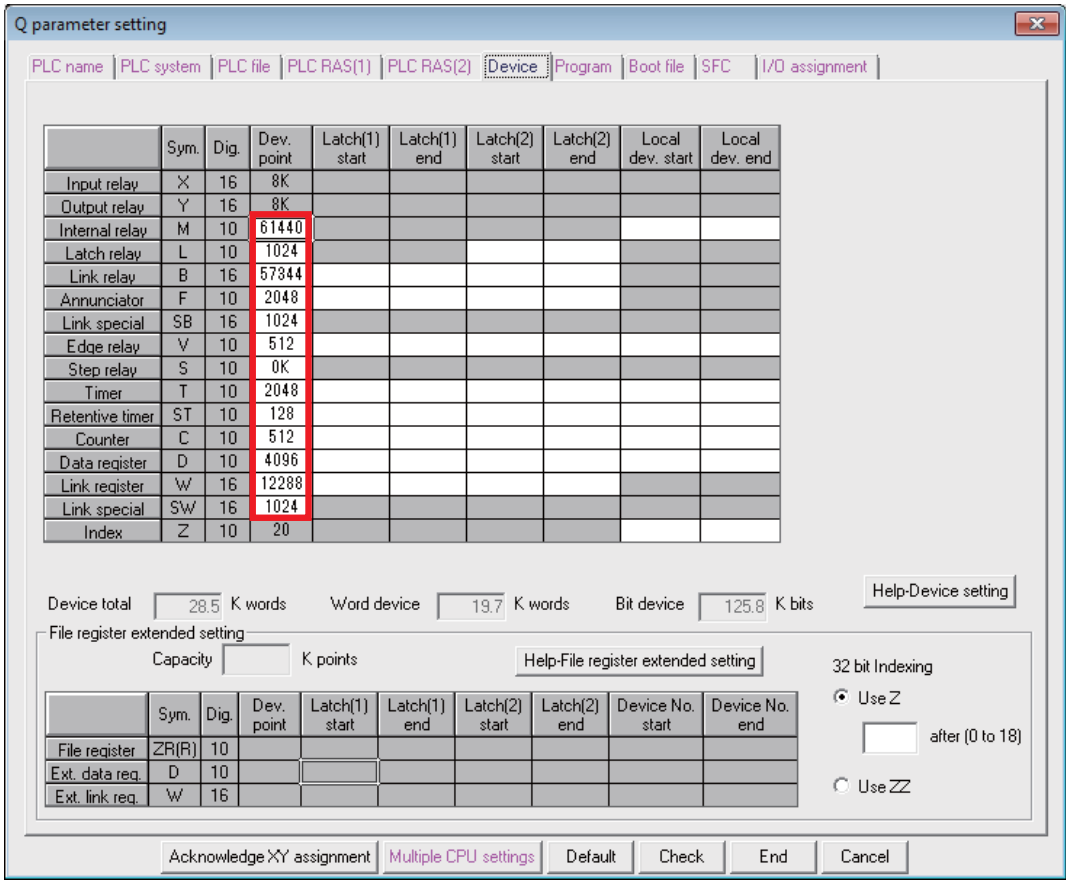
20.5.2 Setting the Number of Device Points

After creating a sequence program management area (project), the number of device points to be used in the project must be set first. This operation is required every time when a new project is created.
For details on each setting item, refer to the "PLC Programming Manual".

(Note) If this operation is not performed, an error occurs when a sequence program is downloaded to a CNC controller.

(1) Select the tab [Device].
The device range usable for each project changes in the multi-project environment. Input the points "number of device points + number of common points" which have been set on "Device setting screen of built-in PLC built-in editing function" as the number of device points for the parameters.
An error occurs when the number of device points is wrong.

(2) Input the numerical values for device points on the screen below and click [End].
Set the number of device points ("number of device points + number of common points" which has been set at the device setting screen of built-in PLC built-in editing function) in the section in red square below. The number should match the currently connected project. After the setting for the number of device points is completed, press "End" to finish the edit.



(Note) If a value other than the designated values is input, an error occurs at the download to a CNC controller.

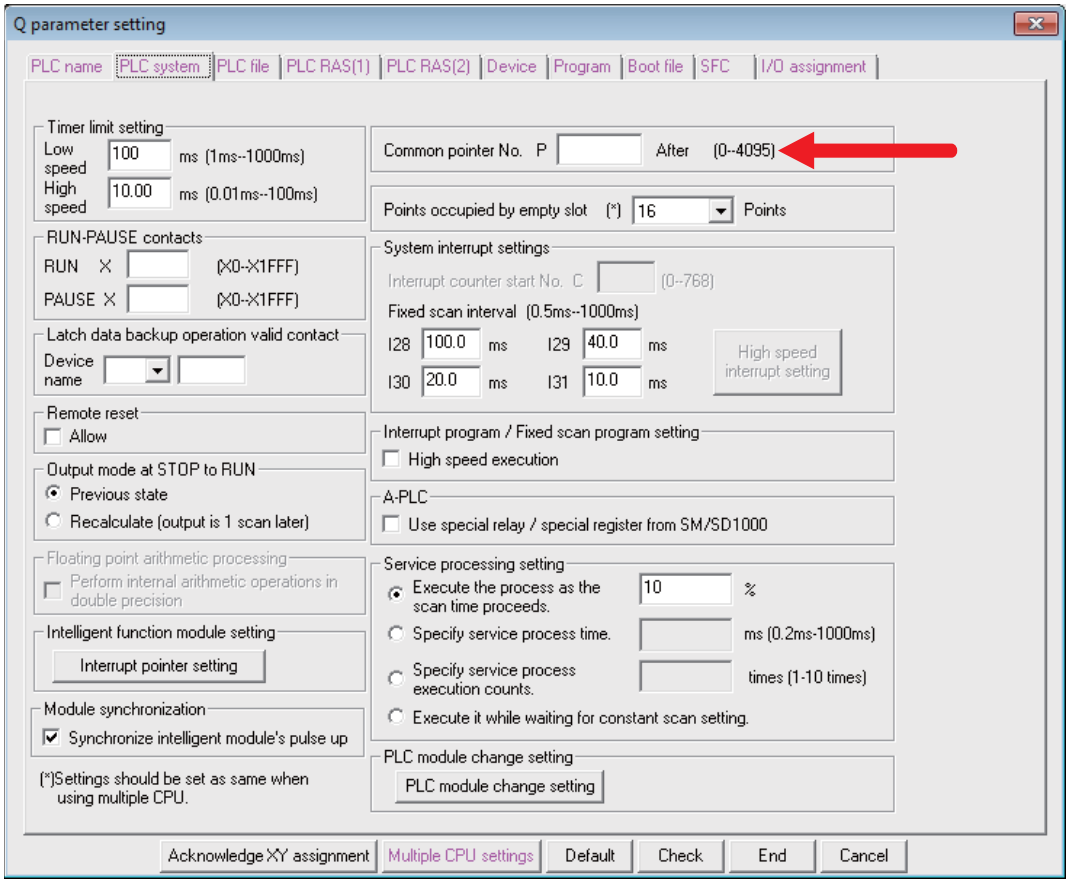
20.5.3 Setting the Number of Common Pointer Points

The number of common pointer points for each sequence program must be set for creating the sequence program with the multi-program method. This operation is required every time when a new project is created, and the parameter file must be written to the CNC controller.

(Note) When common pointer No. is not set, "P1800" is set.

(1) Select the tab "PLC system".

(2) Input the value for "Common pointer No." on the screen below and click [End].



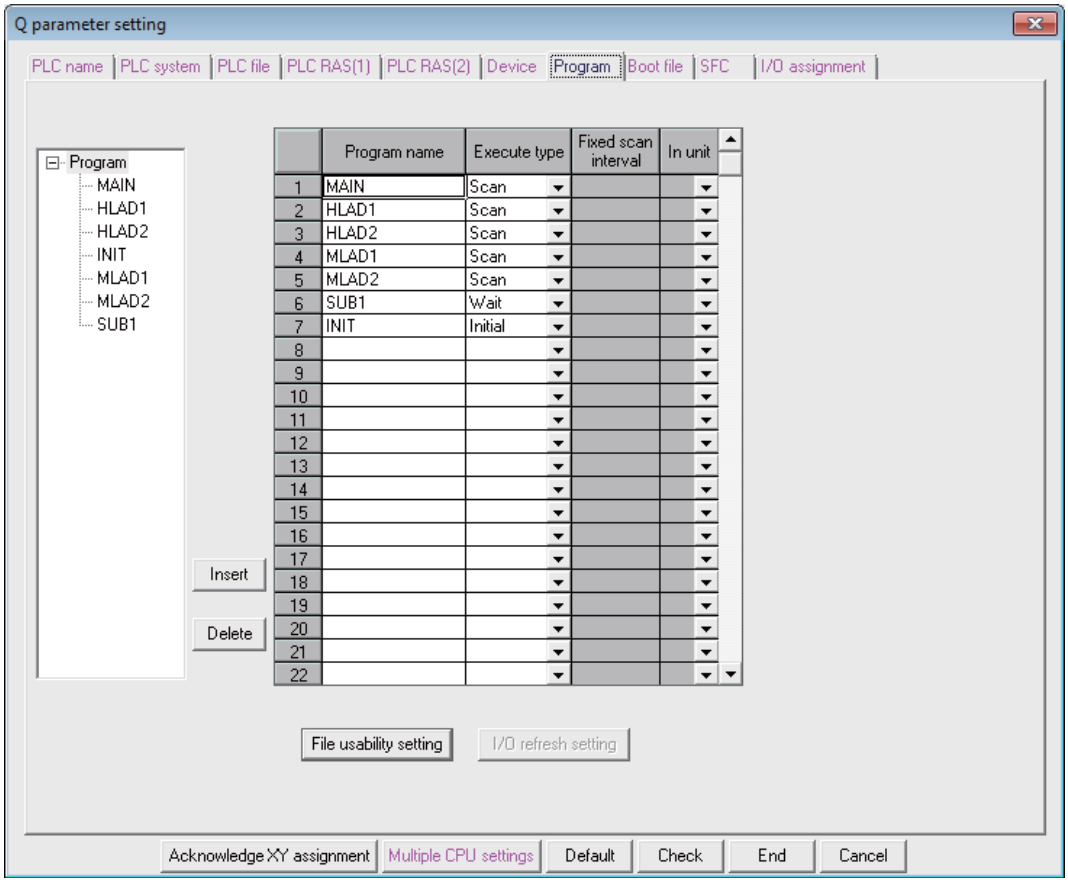
20.5.4 Setting the Program Execution Order

When creating the sequence programs with the multi-program method, the execution method and execution order of each sequence program must be set. This operation is carried out before the sequence program is executed with the CNC controller. The parameter file must be written to the CNC controller.
For details on each setting item, refer to the "PLC Programming Manual".

(Note) If this operation is not completed when using the multi-program method, an error will occur when RUN is executed in the sequence program.

(1) Select the [Program] tab

(2) Select the sequence program name to be registered for execution from the program list on the left of the following screen, and then press the "Insert" button. Select the execution mode from the registration program list on the right side. After registering all sequence programs to be executed, click on [End].



20.6 Writing a Sequence Program with GX Developer

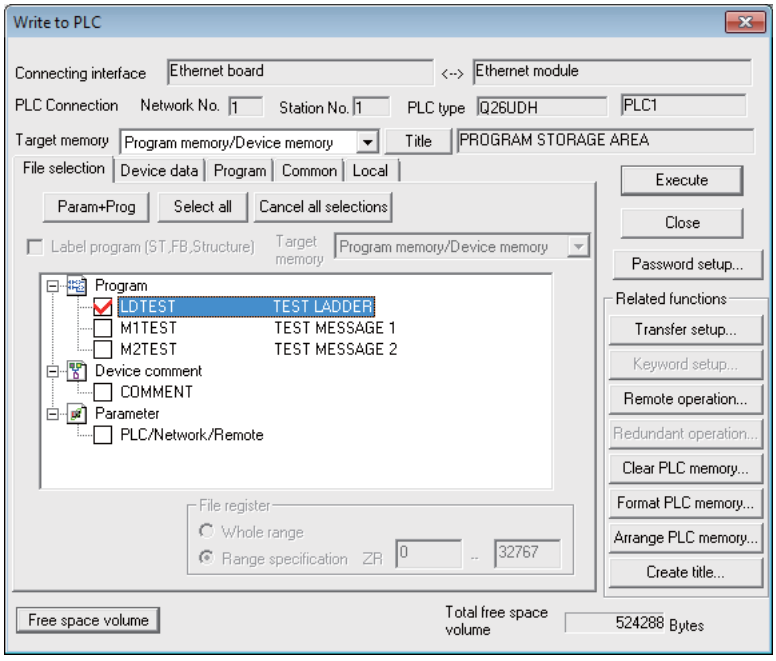
(Note) This operation is for performing writing in the temporary storage area of CNC (RAM inside CNC). The temporary storage area (RAM inside CNC) does not hold data after the power is turned OFF. If the data need to be held even after the power OFF, write the sequence program in ROM inside CNC following the procedure described in "Writing a Sequence Program to ROM with GX Developer".

[Operation procedure for a project "without labels"]

The following is the operation procedure for a project in which labels are not used.

(1) Perform the following operation with GX Developer to start the operation screen.
[Online] -> [Write to PLC...]

(2) Select a sequence program file for writing in the [File selection] tab of the screen below and click [Execute]. RUN/STOP for PLC can be commanded on [Remote operation...] of "Related functions".



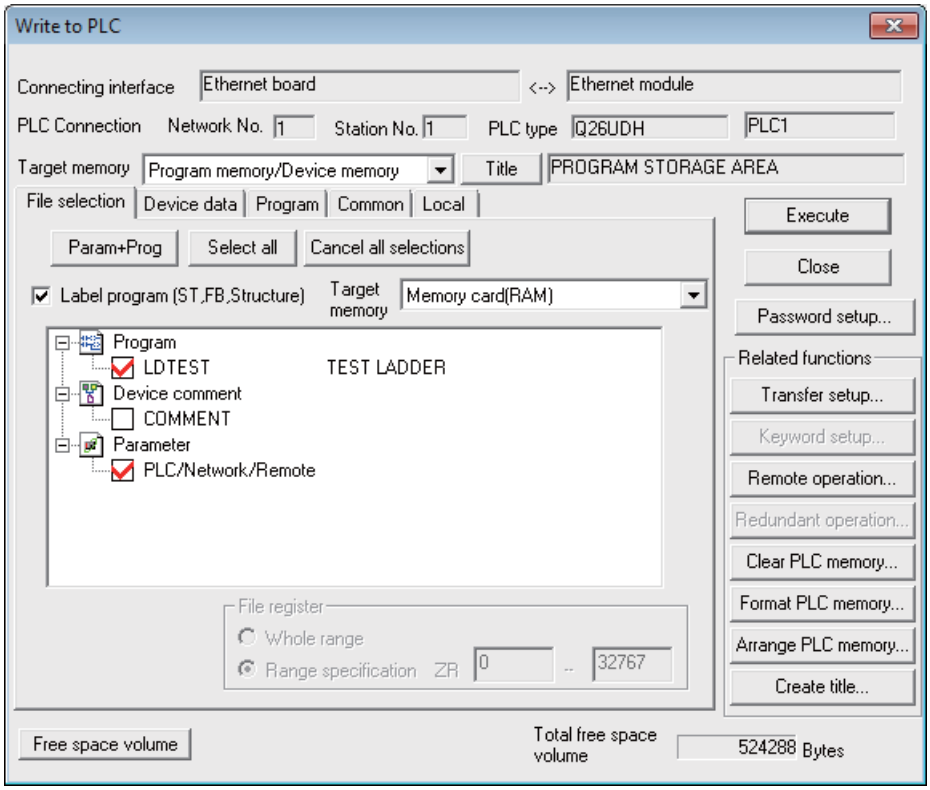
(Note) Only "Program memory/Device memory" is valid for "Target memory".
Do not carry out the setting for other tabs than [File selection] ([Device data], [Program], [Common], [Local]).

[Operation procedure for a project "with labels"]

The following is the operation procedure for label programming.

(1) Perform the following operation from GX Developer to start the operation screen.
[Online] -> [Write to PLC]

(2) On the following screen, choose the sequence program file to be written from the [File selection] tab and click [Execute].
PLC RUN/STOP can be commanded with [Remote operation] under "Related functions".



(Note 1) As [Target memory] for writing sequence programs, only "Program memory/Device memory" is valid.

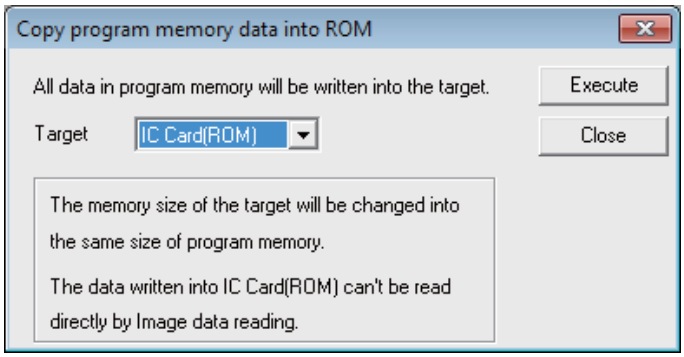
(Note 2) Do not set the other tabs ([Device data], [Program], [Common], [Local]) than [File selection].

(Note 3) As [Target memory] for writing label programs, only "Program memory/Device memory" or "Memory card(RAM)" is valid.
When writing label programs, one "symbolic information file" is written to NC.

20.7 Writing a Sequence Program to ROM with GX Developer

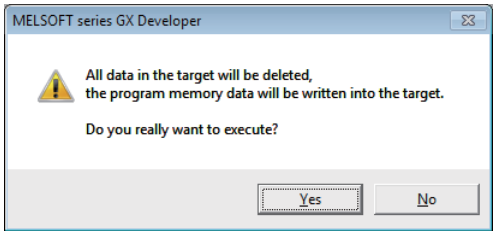
[Operation procedure]

(1) Perform the following operation with GX Developer to start the operation screen.
[Online] -> [Write to PLC (Flash ROM)] -> [Copy program memory data into ROM]

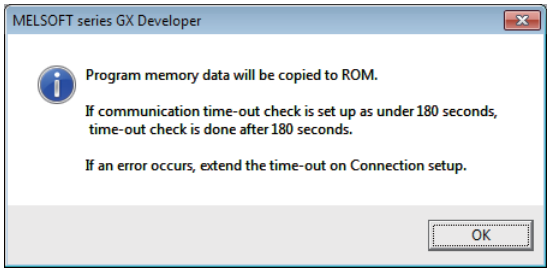


(Note) Only "IC Card (ROM)" is valid for "Target".

(2) Click [Execute] and the dialog below is displayed.

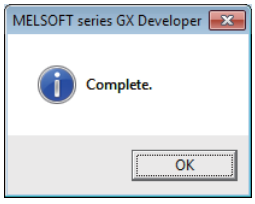


(3) Click [Yes] and the dialog below is displayed.



(Note) Once "OK" is clicked on the dialog above, PLC program of ROM inside CNC on the CNC controller is overwritten/deleted. Confirm sufficiently before the execution.

(4) When the execution is completed, the dialog below is displayed. Click [OK].



20.8 Setting the Communication with GX Works2

To create the machine sequence and user safety sequence of the CNC, use the Mitsubishi Electric FA engineering software GX Works2, which is the PLC development tool for the Mitsubishi PLC MELSEC Series.

Machine sequence:	Control circuit created to control the machine tools (ladder circuit)
User safety sequence:	Control circuit of the safety-related I/O observation created with the smart safety observation function (ladder circuit)

When using GX Developer, refer to "Setting the Communication with GX Developer".

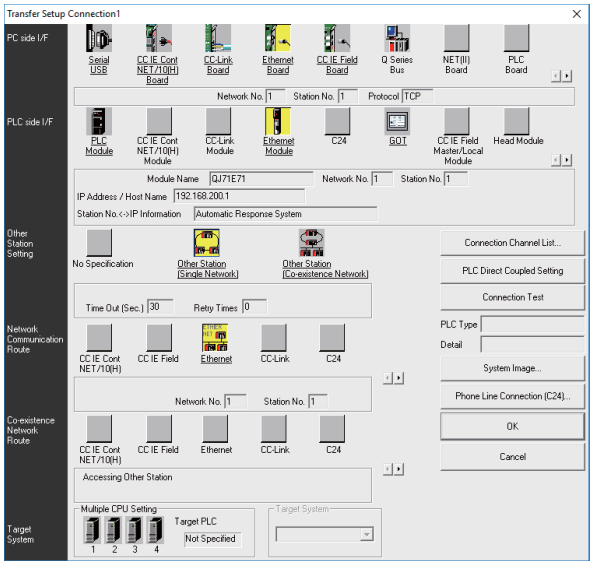
(1) Start the setting screen by the following operation in the navigation window on GX Works2.
Select [Connection Destination], then double-click [Current Connection].

(2) Set the following items in the order of the list.
(a) For the machine sequence

Item		Setting	Note
PC side I/F		Ethernet Board	
	Network No.	1	(*1)
	Station No.	1	(*1)
	Protocol	TCP	(*1)
PLC side I/F		Ethernet Module	
	Type name	QJ71E71	(*2)
	Station No.	1	(*2)
	IP Address	IP address of CNC	(*2)
	IP Input Format	DEC.	(*2)
	Station No. <-> IP information	Automatic Response System	(*2)
Other Station Setting		Other Station (Single Network)	
	Check at communication time (sec.)	Any time period (from about 10 seconds)	(*3)
	Retry times	0	(*3)
Network Communication Route Detailed setting of Ethernet			
	Access to Ethernet module set on PCL side I/F		(*4)

(*1) Double-click [Ethernet Board] to display the setting item.
(*2) Double-click [Ethernet Module] to display the setting item.
(*3) Double-click [Other Station (Single network)] to display the setting item.
(*4) Double-click [Ethernet] to display the setting item.

■Transfer Setup Connection 1 screen



(b) For the user safety sequence

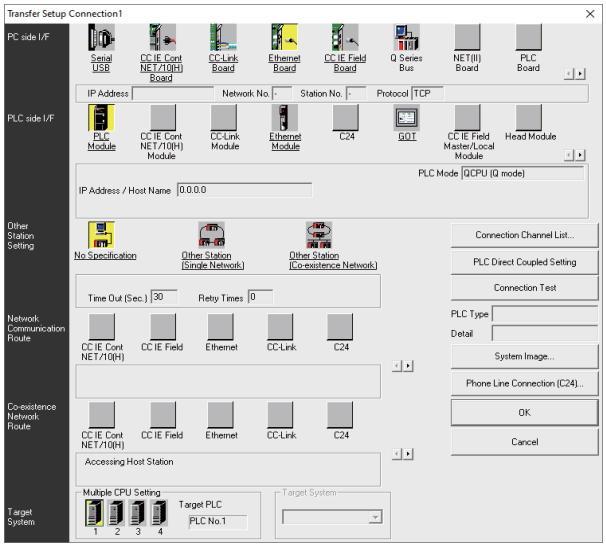
Item		Setting	Note
PC side I/F		Ethernet Board	
	Network No.	1	(*1)
	Station No.	1	(*1)
	Protocol	TCP	(*1)
PLC side I/F		CPU unit	
	CPU mode	QCPU (Q mode)	(*2)
	Ethernet: direct port connection and connection via hub selection	Connection via hub	(*2)
	IP address	IP address of CNC	(*2)
	IP input format	Decimal	(*2)
Other station setting		No other station specified	
	Check at communication time (sec.)	Arbitrary time (approximately 10 seconds and longer)	(*3)
	Retry times	0	(*3)
Multi CPU designated			
	Select the first machine for the user safety sequence 1. Select the second machine for the user safety sequence 2.		

(*1) Double-click [Ethernet Board] to display the setting item.

(*2) Double-click [Ethernet Module] to display the setting item.

(*3) Double-click [Other Station (Single network)] to display the setting item.

■Transfer Setup Connection 1 screen



(3) After setting the connection, press [Connection Test].
If connection is successful, the message "Connected with Q26UDHCPU" is displayed with the multi-CPU connection status underneath, which indicates the connection status of each project.

20.9 Setting the Parameters on GX Works2

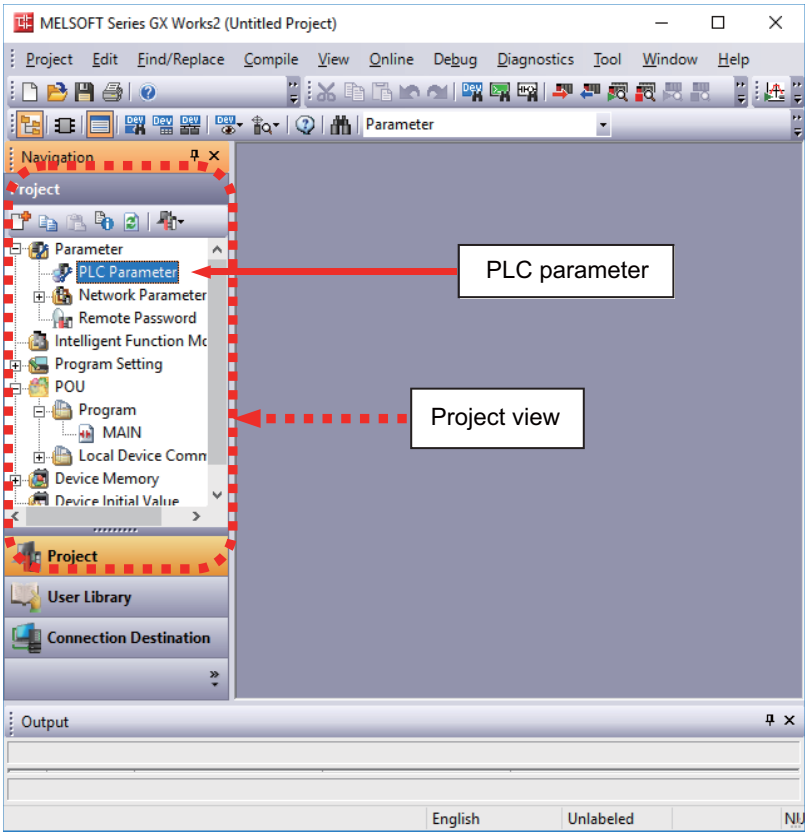
(Note) There are two methods of ladder programming; independent program method and multi-program method, which makes differences in parameter settings. An incorrect parameter setting in the ladder programming may cause a write error.
For details of the parameter settings, refer to the "PLC Development Manual".

20.9.1 Parameter Setting Screen

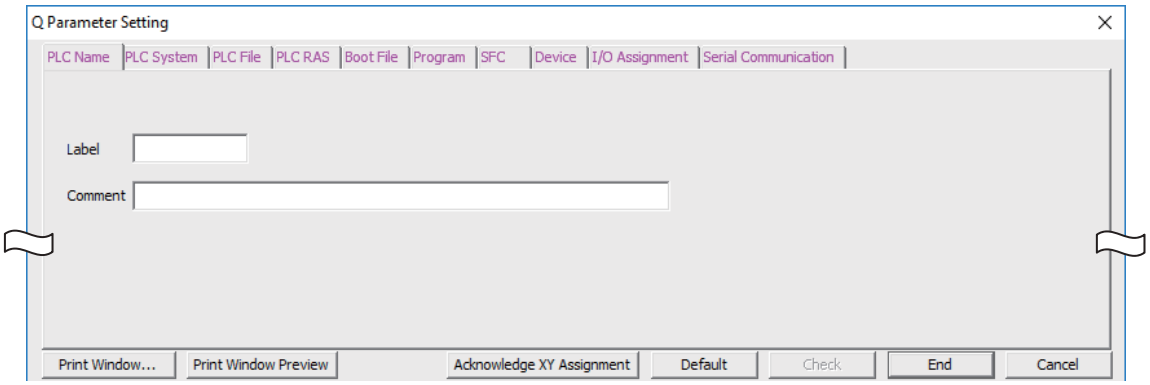
(1) Displaying parameter setting screen

To open the parameter setting screen, display the project view on the navigation window by the following operation. Expand the tree by double-clicking [Parameter], and double-click [PLC Parameter].

[Project] -> Double-click [Parameter] -> Double-click [PLC Parameter]



The above operation opens the following parameter setting screen. Tab names in red indicate that the initial values are set.



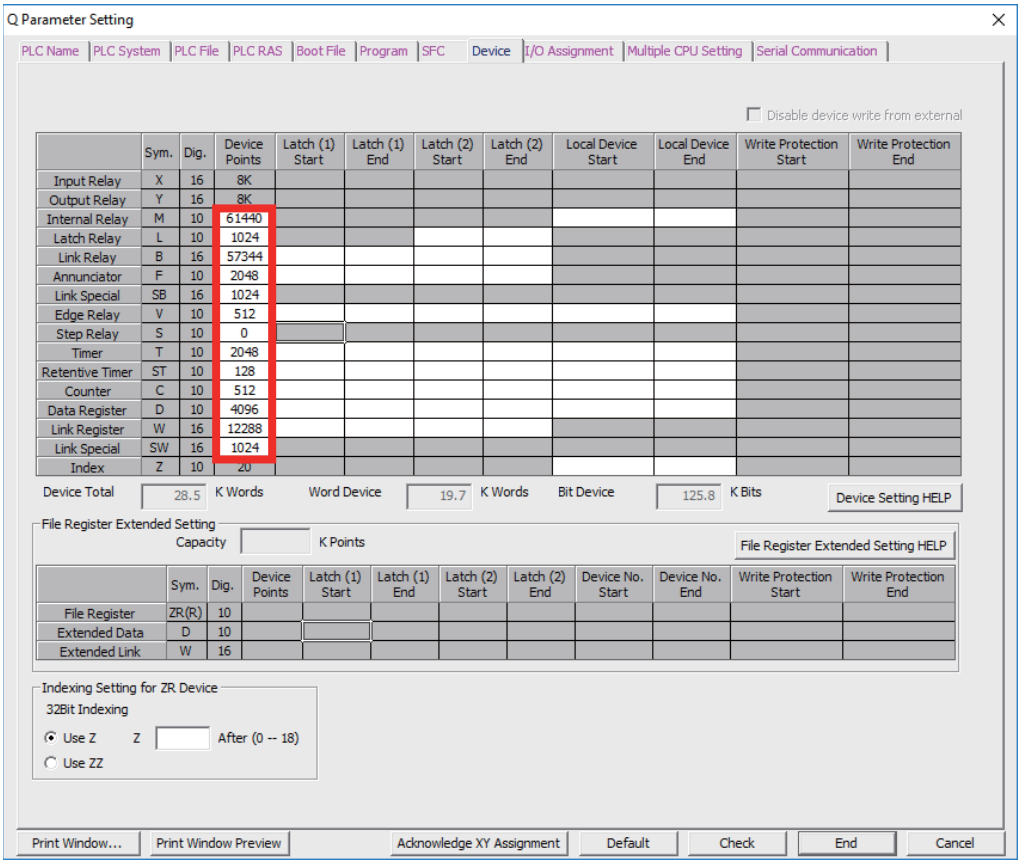
20.9.2 Setting Device Points

After creating an area (project) to manage sequence programs, set the number of the device points used in the project. This operation is required every time a new project is created.
For details on each setting item, refer to the "PLC Programming Manual".

(Note) Without this operation, an error occurs when sequence programs are downloaded to the CNC controller.

(1) Select the Device tab.
Populate the device points in the parameter with the numbers of device points + common points that are set on the device setting screen in built-in PLC (built-in edit function). Setting wrong device points incurs an error. The range of devices that can be used in each project varies in multi-project environment.

(2) Enter the device points, and click [End] on the following screen.
Enter the number of devices in the project currently connected to inside the red line indicated in the figure below. When all device points are set, press [End] to end editing.



(Note) If the wrong number is set, downloading to the CNC controller fails with an error.

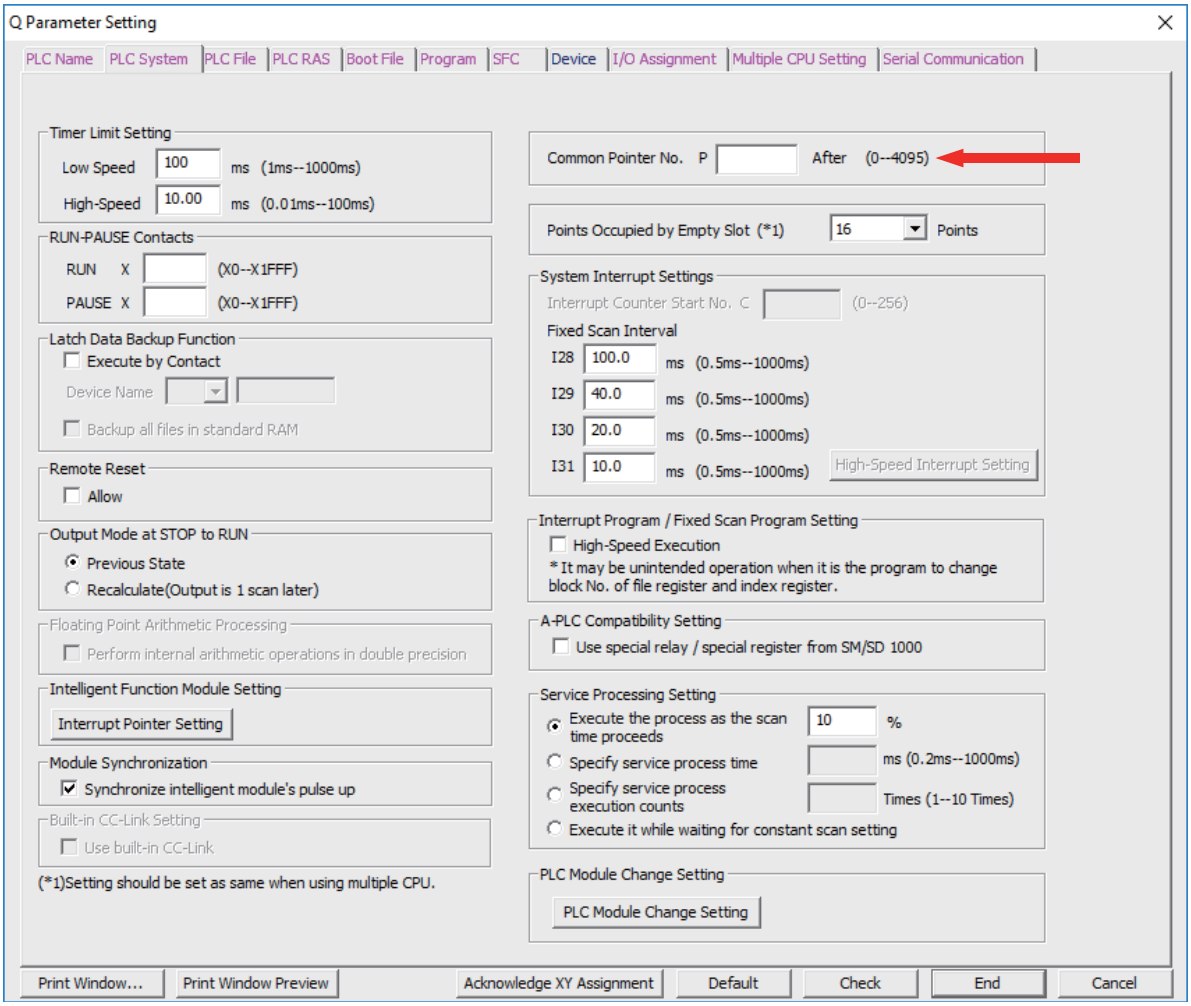
20.9.3 Setting Common Pointer No.

Set the pointer No. common to sequence programs when creating sequence programs in multi-program method. This operation is required every time a new project is created, and parameter files must be written to the CNC controller.

(Note) When not set, Common Pointer No. is set as P1800.
When a simple project (with labels) or a structured project is newly created, or when "Project Type" is changed to any of the said project, "2048" is automatically set to "Common Pointer No." as the default value if its setting has been blank.

(1) Select the PLC System tab.

(2) Set a numeric value in [Common Pointer No.], and click [End] on the following screen.



20.9.4 Setting Program Executing Order

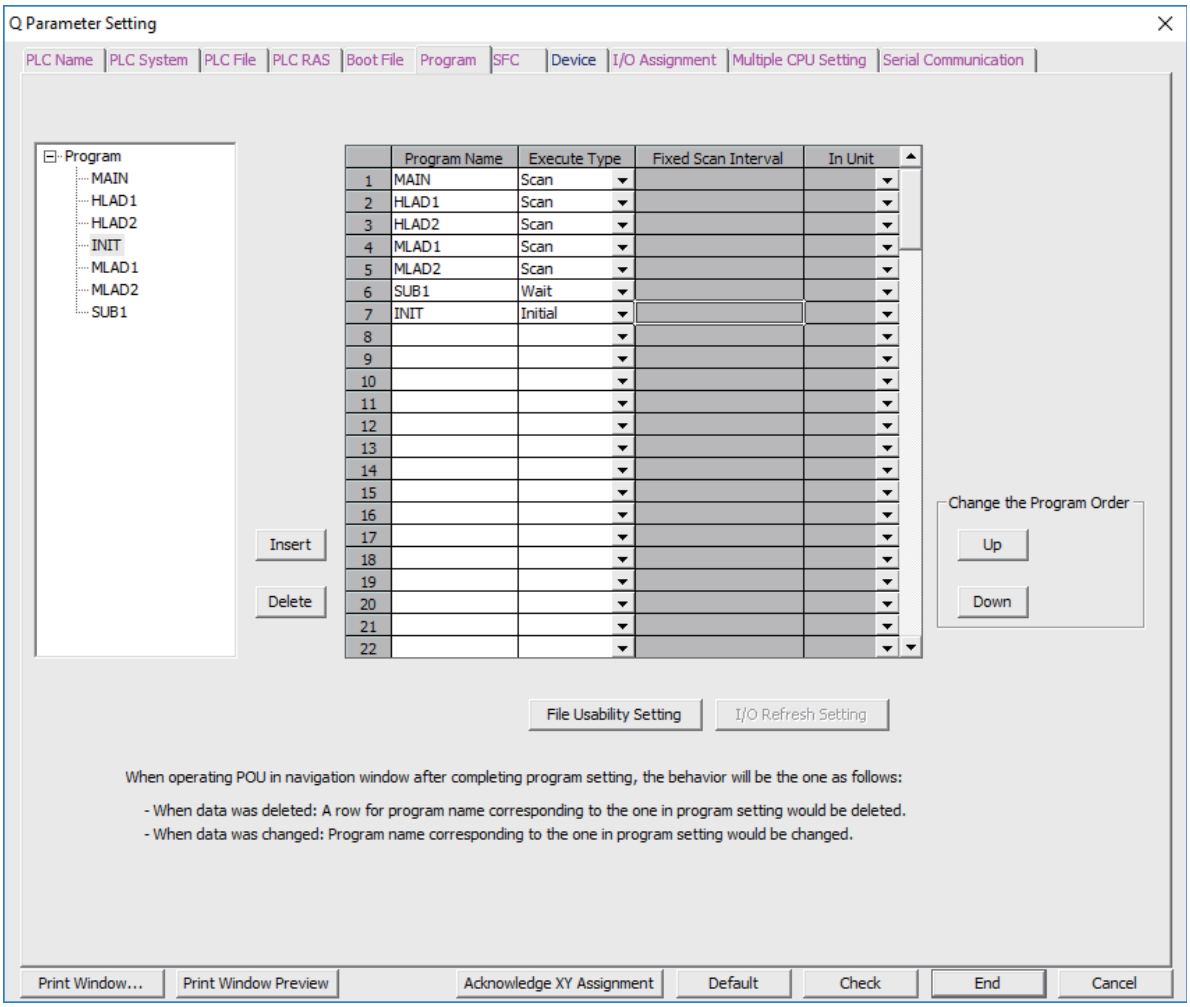
When creating sequence programs in multi-program method, set the execution method and execution order of sequence programs. This operation is required before a sequence program is executed on the CNC controller, and parameter files must be written to the CNC controller.

(Note) Without this operation, an error occurs on the RUN of sequence programs when multi-program method is in use.

(1) Select the Program tab.

(2) Select the name of the sequence program to be registered for execution from the program list on the left side of the following screen, and press [Insert]. Select the execution mode from the registered program list on the right side.

(3) After registering all sequence programs to execute, click [End].



20.10 Writing a Sequence Program with GX Works2

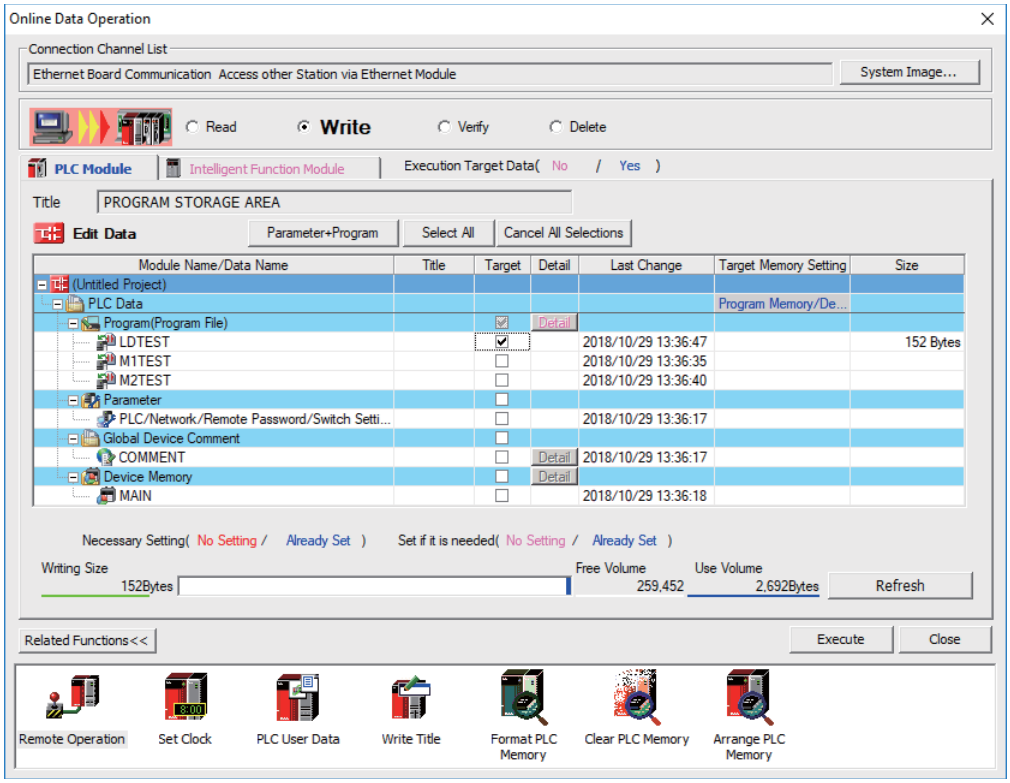
(Note) This operation writes data to the temporary storage in the CNC (RAM in CNC). Data in temporary storage (RAM in CNC) are not retained after power OFF. To retain data after power OFF, write sequence programs to the ROM in the CNC according to "Writing a Sequence Program to ROM with GX Works2".

[Operating procedure for simple projects (without labels)]

The following is the operation procedure for a project in which labels are not used.

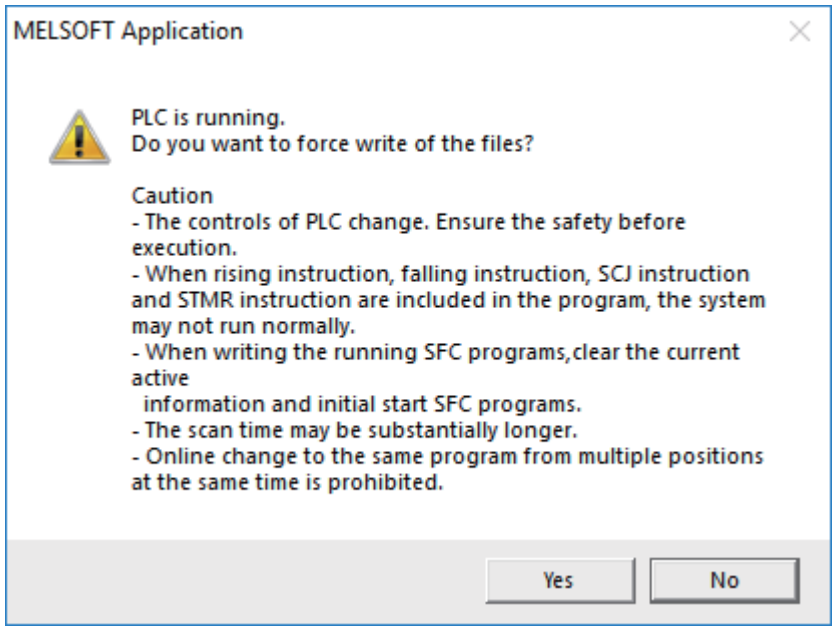
(1) Start the operation screen by the following operation on GX Works2.
[Online] -> [Write to PLC]

(2) Select [Program Memory/Device Memory] in [Target Memory Setting] of PLC data on the following screen. Select write sequence program files, and click [Execute].
RUN/STOP of PLC can be instructed by selecting [Related Functions] - [Remote Operation].

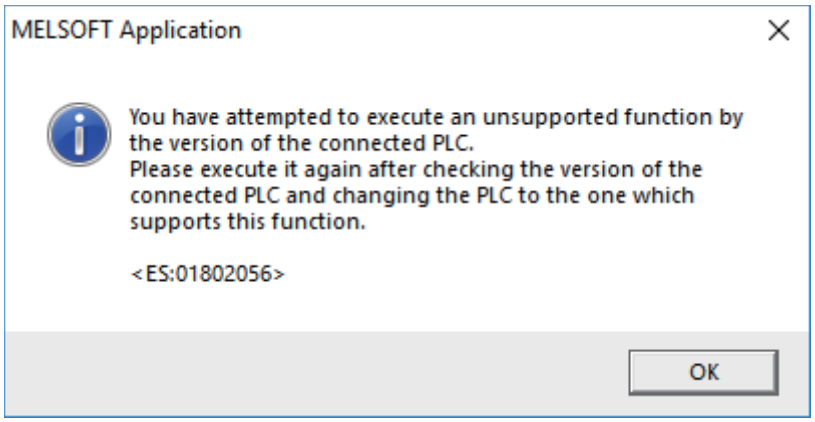


(Note1) [Program Memory/Device Memory] is the only valid option for [Target Memory Setting].

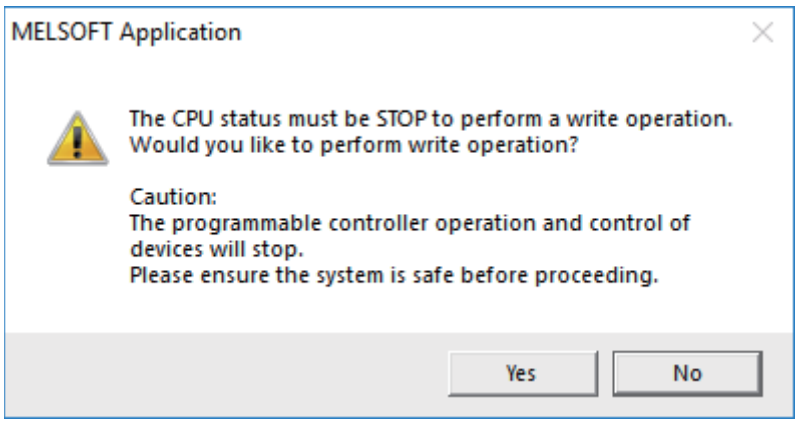
(Note2) If an attempt is made to remove the check from parameter and write sequence programs during PLC is running, the prompt "PLC is running. Do you want to force write of the files?" is displayed.



The CNC only supports writing during RUN from the [Compile] menu; if [Yes] is clicked, an error dialog is displayed and sequence programs are not written.



Click [No], and click [Yes] to the prompt: "The CPU status must be STOP to perform a write operation. Would you like to perform write operation?"

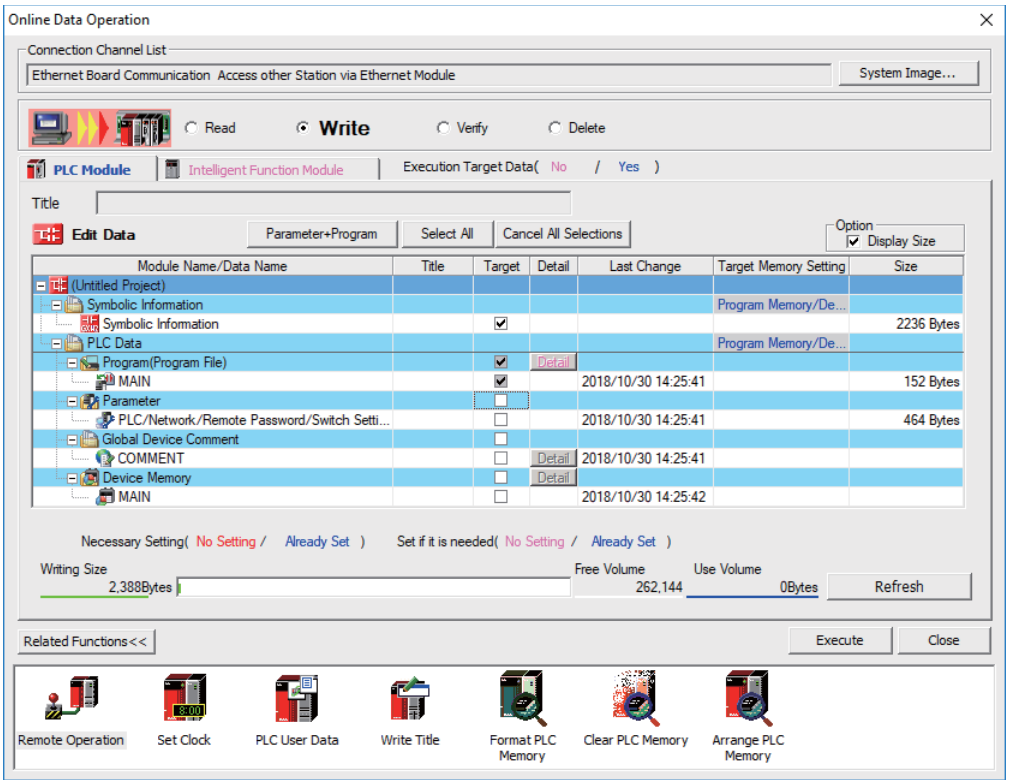


[Operating procedure for simple projects (with labels)]

The operating procedure when "use label" is set is described below.

(1) Start the operation screen by the following operation on GX Works2.
[Online] -> [Write to PLC]

(2) Select [Program Memory/Device Memory] in target memory setting for symbolic information on the following screen.
Select [Program Memory/Device Memory] in the target memory setting for PLC data.
Click [Parameter+Program], and then click [Execute].
RUN/STOP of PLC can be instructed by selecting [Related Functions] - [Remote Operation].



(Note1) Program Memory/Device Memory] is the only valid option for [Target Memory Setting].

(Note2) Since device memory cannot be written to the CNC controller, unselect the checkbox for device memory.

(Note3) Make sure to write parameters at the same time when the symbolic information is to be written. If parameters are not written, the project has not been compiled when the symbolic information is read.

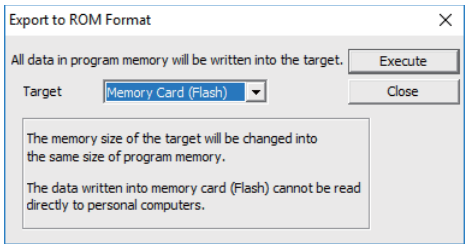
(Note4) If an attempt is made to remove the check from the parameter and to write sequence programs while PLC is running, the prompt "PLC is running. Do you want to force write of the files?" is displayed. The CNC only supports writing during RUN from the [Compile] menu; if [Yes] is clicked, an error dialog is displayed and sequence programs are not written.
Click [No], and click [Yes] to the prompt "The CPU status must be STOP to perform a write operation. Would you like to perform write operation?" is displayed.

20.11 Writing a Sequence Program to ROM with GX Works2

(*) Write operation to the ROM is not necessary for the user safety sequence.

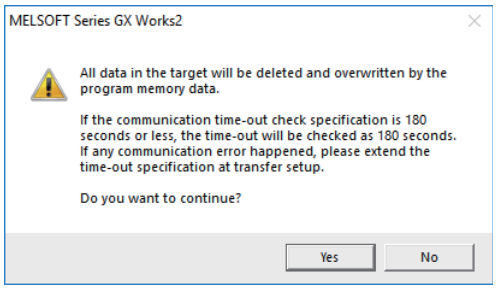
[Operation procedure]

(1) Start the operation screen by the following operation on GX Works2.
[Online] -> [Export to ROM Format]



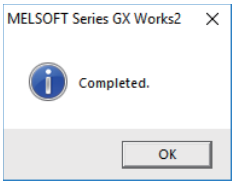
(Note) Only [memory card (Flash)] is valid as [Target].

(2) Click [Execute] to display the following dialog, and click [Yes].



(Note) When [Yes] is clicked in the above dialog, sequence program files on the ROM in the CNC the CNC controller are overwrite and deleted. This should be done with extreme caution.

(3) Writing is completed when the following dialog is displayed. Click [OK].



20.12 Setting the PLC Parameters

Select [Bit select] on the Mainte screen and set the bit selection parameters from #6449 to #6452.
See the following table for details of the parameters.

	Symbol name	7	6	5	4	3	2	1	0
0	#6449 R7824 L	Control unit thermal alarm on	Setting and display unit thermal mgmt valid ■	-	Battery alarm / warning detection disabled	Counter C retention	Integrated timer ST retention	PLC counter program valid	PLC timer program valid
1	#6450 R7824 H	-	External alarm message display ■	Alarm/ operator change ■	Full screen display of message ■	-	Operator message valid	0 F method 1 R method	Alarm message valid
2	#6451 R7825 L	-	-	-	-	-	Built-in edit function edit invalid ■	-	Built-in edit function edit valid ■
3	#6452 R7825 H	-	Branch destination label check valid	-	Serial handy terminal communica-tion valid	-	-	-	-

(Note 1) Be sure to set the bits indicated "-" and blanks to "0".
(Note 2) Functions marked with "■" may not be available for some machine types.

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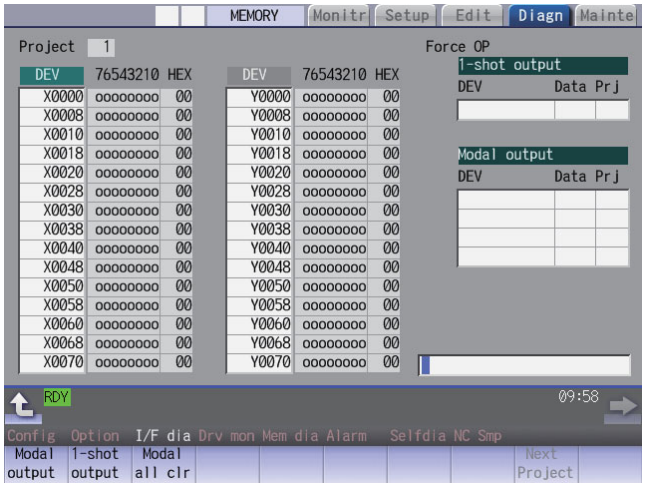
Confirming the Basic Operation

21.1 Checking Inputs/Outputs and Alarms

(1) Checking the input signals

(a) Select [I/F dia] on the Diagn screen.

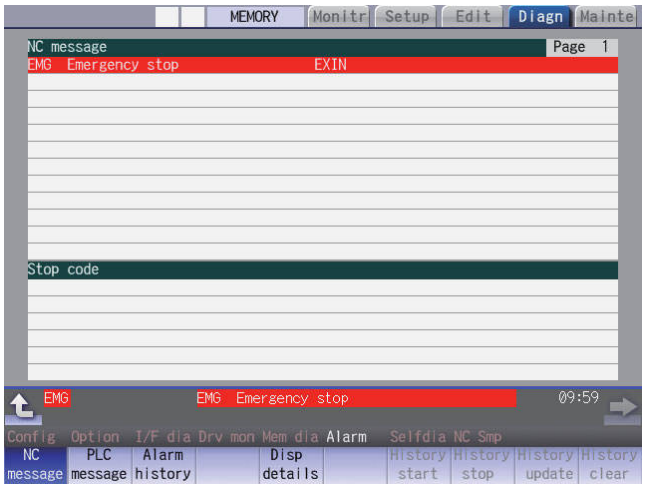
(b) Confirm that signals turn ON/OFF properly on the IF Diagnosis screen.



(2) Checking the alarm display

(a) Select [Alarm] on the Diagn screen.

(b) Check any other alarm than "Emergency stop EXIN" displayed on the Alarm screen.



21.2 Confirming Manual Operation

21.2.1 Using the Manual Pulse Generator

(1) Select the handle mode.

(2) Set the handle feed magnification to a minimum value.

(3) Cancel the emergency stop. Confirm the operation status displays "RDY". (Note 2)
(Note 1) If any abnormal noise or vibration occurs, execute an emergency stop and take a measure against vibration. (Refer to "First Measure Against Vibration".)
(Note 2) If there is a keyboard, it can also be confirmed with the READY lamp ON.

(4) Select an axis and turn the manual pulse generator by one scale. Confirm the direction and the amount of the movement on the current position display.
If the display is not correct, check parameters, PLC programs and devices' connections.

(5) Turn the manual pulse generator and confirm the direction and the amount of the machine's movement.
If the display is not correct, check parameters.
(Related parameters: "#1018 ccw (Motor CCW)", "#2201 SV001(PC1) (Motor side gear ratio)", "#2202 SV002(PC2) (Machine side gear ratio)", "#2218 SV018(PIT) (Ball screw pitch)" and so on)
(Note) Take care of the machine's movement range during the operation.

(6) Check the rest of the axes for each with the same operation as above.

21.2.2 Using JOG Feed

(1) Select JOG mode.

(2) Set the manual feed rate to 100mm/min.

(3) Cancel the emergency stop. Confirm the operation status displays "RDY". (Note 2)
(Note 1) If any abnormal noise or vibration occurs, execute an emergency stop and take a measure against vibration. (Refer to "First Measure Against Vibration".)
(Note 2) If there is a keyboard, it can also be confirmed with the READY lamp ON.

(4) Select an axis, press the JOG feed button and move the axis to safe area. Confirm the direction and the amount of the movement on the current position display.
If the display is not correct, check parameters, PLC programs and devices' connections.

(5) Confirm the direction and the amount of machine's movement.
If the display is not correct, check parameters.
(Related parameters: "#1018 ccw (Motor CCW)", "#2201 SV001(PC1) (Motor side gear ratio)", "#2202 SV002(PC2) (Machine side gear ratio)", "#2218 SV018(PIT) (Ball screw pitch)" and so on)
(Note) Take care of the machine's movement range during the operation.

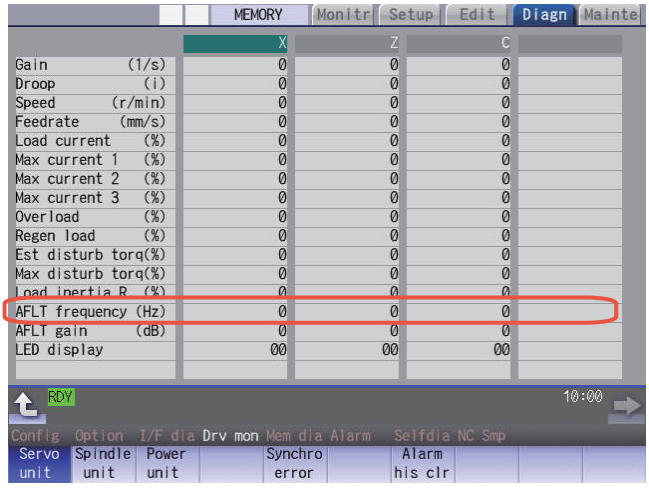
(6) Check the rest of the axes for each with the same operation as above.

21.3 Servo Simplified Adjustment

21.3.1 First Measure Against Vibration

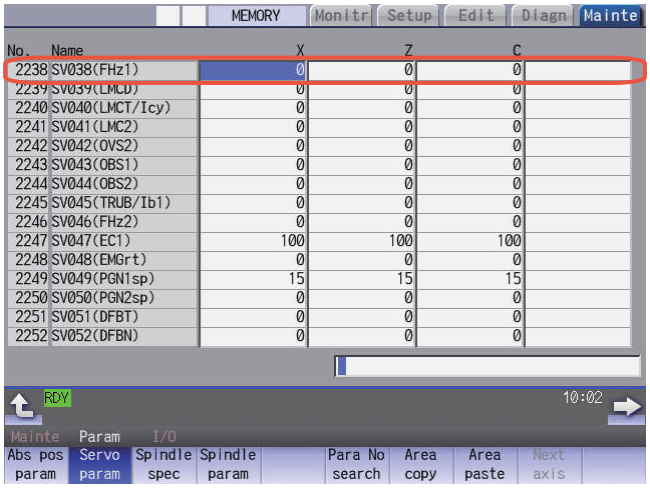
Setting the filter can reduce the vibration.

(1) Select [Drv mon] and then [Servo unit] on the Diagn screen. See the displayed value in "AFLT frequency".



(Note) The screen above is when NC parameters have default values.

(2) Select [Param] and then [Servo param] on the Mainte screen. Set the AFLT frequency value you saw at (1) to "#2238 SV038 FHz1 (Notch filter frequency 1)".

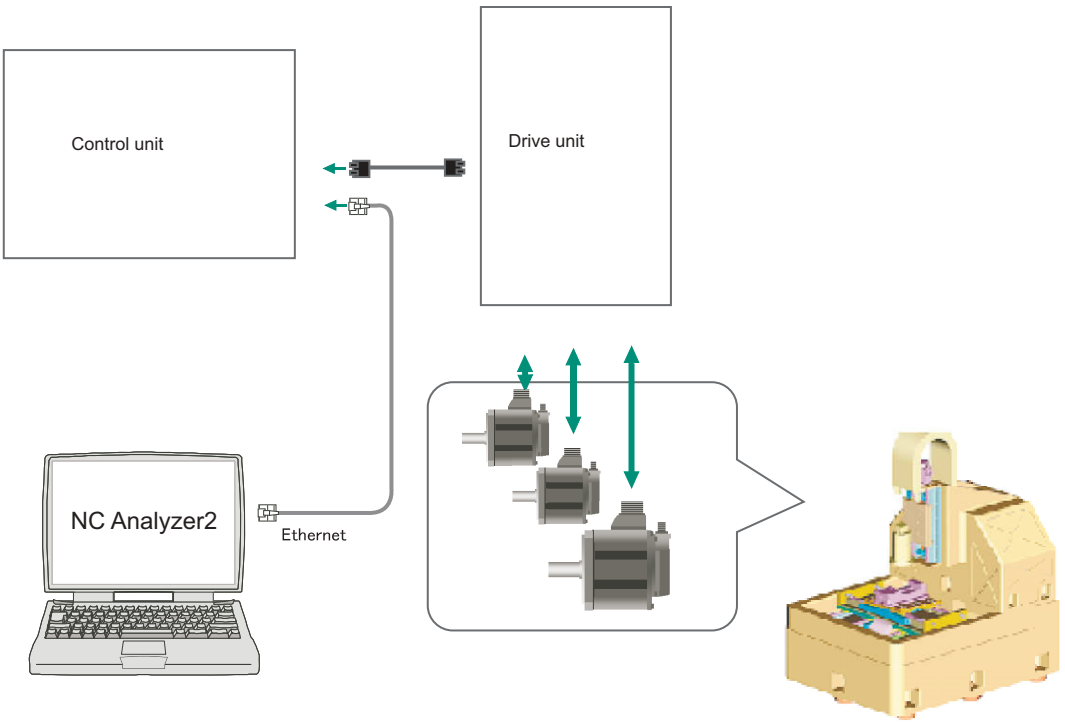


(Note) The screen above is when NC parameters have default values.

If the vibration is not reduced by the measure, refer to the manuals of the drive unit you are using.

21.3.2 NC Analyzer2

Servo parameters can be automatically adjusted by measuring and analyzing the machine characteristics. Measurement and analysis are conducted by driving the motor using machining programs for adjustment or vibration signals. Various data can also be sampled.



<Functions>

Adjustment wizard	Description
Velocity loop gain adjustment	Automatically adjusts velocity loop gain and resonance filters.
Lost motion adjustment	Adjusts the lost motion automatically for the delay in responsecaused when the direction of the machine rotates is reversed.

Measurement and adjustment	Description
Frequency response measurement	Measures the frequency response of speed loop for the designated axis. The result will be output as frequency response waveform.
Reciprocation acceleration/ deceleration measurement	Measures the reciprocation acceleration/deceleration for the designated axis. The result will be output as time-series waveform. (*1)
Roundness measurement	Measures the roundness for the designated axis. The result will be output as roundness waveform. (*1)
Synch tap error measurement	Measures the synchronous tap error for the designated axis. The result will be output as time-series waveform.(*1)
Spindle acceleration/deceleration measurement	Measures the spindle acceleration/deceleration for the designated axis. The result will be output as time-series waveform. (*1)
Spindle orientation measurement	Measures the spindle orientation for the designated axis. The result will be output as time-series waveform.(*1)
Spindle C-axis measurement	Executes the reciprocation acceleration/deceleration measurement of spindle C axis with specified axis. The result will be output as time-series waveform. (*1)
Spindle synchronization measurement	Executes an arbitrary machining program with specified axis, and measures spindle synchronization by using that data. The result will be output as time-series waveform.
PLC axis acceleration/deceleration measurement	Executes an arbitrary machining program with specified axis, and measures PLC axis acceleration/deceleration by using that data. The result will be output as time-series waveform.
Arbitrary path measurement (*2)	Executes an arbitrary machining program with specified two axes. The result will be output as arbitrary path measurement waveform. (*1)

(*1) For the measurement, create a program by the program creation function or use an arbitrary machining program.
(*2) Two or more NC axes in the same system are needed.

For details, refer to "NC Analyzer2 Instruction Manual" (IB-1501501326).

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Setting the Position Detection System

There are two kinds of position detection system: one is "relative position detection", which establishes the reference position (zero point) at every CNC power-ON; the other is "absolute position detection", which allows to start the operation without establishing the reference position (zero point) again after the CNC power-ON.

22.1 Adjusting the Absolute Position Detection System

There are four types of the absolute position zero point initial setting: "marked point alignment method", "marked point alignment method II", "machine end stopper method", and "dog-type".
Set the parameter "#2049 type (Absolute position detection method)" for the type and method of absolute position zero point initial setting.
The required components differ depending on the detection method.

Method	Required component	Basic position	#2049 type	#2059 zerbas	Reference
Marked point alignment method I	None	The first grid point which is returned from the position where the mark is aligned.	2	1	22.1.1
Marked point alignment method II	None	The position where the marks are aligned.	4	0	22.1.2
Machine end stopper method	Machine end stopper	The position where the table is pushed against the machine end stopper.	1	0	22.1.3 22.1.4
		The first grid pointed which is returned from the position where the table is pushed against the machine end stopper.	1	1	
Dog type	Dog, dog-sensor	The first grid point after the dog OFF.	3	0	22.1.5

[Characteristics of each method]

(1) Marked point alignment method I

Align the table side's mark and the machine side's mark.
The first grid point which is returned from the marks are aligned is determined as the basic position.
Because the first grid point which is returned from the marks are aligned is determined as the basic position, the reproducibility is kept even the position information is lost due to runnning out of battery etc.

(2) Marked point alignment method II

Align the table side's mark and the machine side's mark.
The position where the marks are aligned is determined as the basic position.
Because the position where the marks are alinged is determined as the basic position, the reproductivity is low if the position information is lost due to running out of battery etc.

(3) Machine end stopper method

Push the table against the machine end stopper.
[When #2059 zerbas = 0]
The position where the table is pushed against the machine end stopper is determined as the basic position.
[When #2059 zerbas = 1]
The first grid point which is returned from the position where the table is pushed against the machine end stopper is determined as the basic position.

There are two types of the machine end stopper method: automatic initialization and manual initialization.
When the automatic initialization is applied, the axis travels automatically after the JOG is started.
When the manual initialization is applied, the axis travels by handle mode or JOG mode while confirming each operation.

(4) Dog method

This method requires a dog sensor.
Move the table until the dog is kicked, and the first grid point after the dogOFF is determined as the basic position.

22.1.1 Marked Point Alignment Method I

(1) Preparations
Set the parameters on the Abs pos param screen.

→ #2049 type (absolute position detection method): 2
(marked point alignment method I)
#2050 absdir (basic point of Z direction): 0 or 1
#2059 zerbas (select zero point parameter and basic point): 0
The parameters other than "#2049 type" can also be set on Absolute position setting screen.

(2) Turn the power OFF and ON.
(Only when "#2049 type" is specified again.)

The following are the operations on the absolute position setting screen. (Select [Mainte] - [To Abs pos])

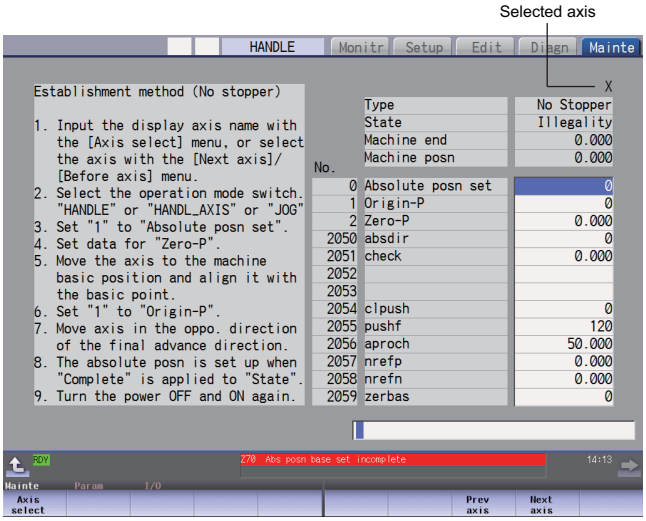
(3) Select an axis to set the absolute position.

There are two methods to select an axis.

- Select the menu [Axis select], enter the axis name in the input area then press [INPUT]. (For the axis name, input the name set to the parameter "#1022 axname2" (2nd axis name).)

- Press the menu [Prev axis] and [Next axis] to switch the axis.

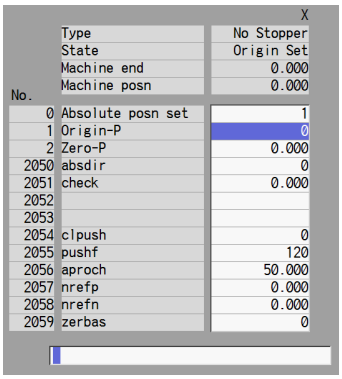
→



(4) Select "HANDLE" or "JOG" for the mode selection of machine operation switch.

(5) Confirm that the cursor is placed on "Absolute posn set", input "1" in the input area and press the [INPUT] key.

→ The input value is registered in the "Absolute posn set" area.
State: [Origin set]



(6) Move the axis to mechanical basic position.

(7) Move the cursor to "Origin-P" with the [↑] and [↓] keys.
Input "1" in the input area and press the [INPUT] key.

→ The input value is registered in the "Origin-P" area.
State: [Ret. Ref. P.]
Machine end: Distance between the mechanical basic position and the first grid point

(8) Move the axis in the direction designated with the absolute position parameter "#2050 absdir".

(9) The axis stops when it reached the first grid point.

→ State: [Complete]
Machine position: Current machine position

(10) Set the "Zero-P".

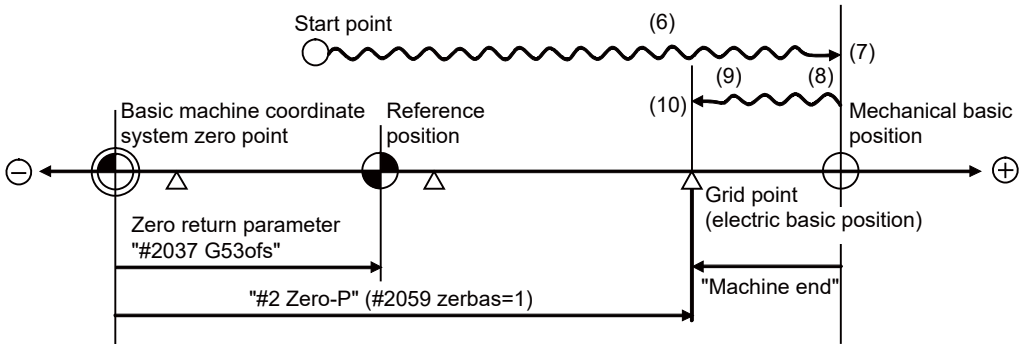
Move the cursor to "Zero-P" with the [↑] and [↓] keys. Input the distance from the basic machine coordinate zero point to the grid point immediately preceding the basic position in the input area then press [INPUT].

Setting "Zero-P"

When the machine is set up for the first time or when the grid point has changed because of replacement of motor and encoder, set the distance from the basic machine coordinate system zero point from the grid point (electric basic position) to "Zero-P". (When you set mechanical reference position as basic machine coordinate system zero point, set the display value of "Machine end" to "Zero-P".)

When you perform zero point initial setting due to the disappearance of the absolute position, the grid point (electric basic position) does not change; therefore, there is no need to set "Zero-P" again.

The zero point initial setting is now complete. After initializing all axes, turn the power OFF and ON.



- (6) to (10) in this diagram indicate steps of the operation procedure.

(Note 1) To change just the basic machine coordinate zero point, set "#0 Absolute posn set" and "#2 Zero-P", and then turn the power OFF and ON.

(Note 2) If aligning the axis on the marked point is attempted without passing the grip point once after turning the power ON, the operation message "Not passed on grid" will appear. Return to a point before the last grid, and then repeat from step of aligning the axis on the marked point.

(Note 3) If the first grid point is covered by the grid mask (#2028 grmask) as a result of return to the electric basic position in the step (8), the axis stops at the next grid point.
Note that reference position shift amount (#2027 G28sft) is invalid.

(Note 4) Confirm the "absdir" setting if the machine does not move in the direction of "#2050 absdir" in the step (8). The machine will move only in the positive direction when set to "0", and the negative direction when set to "1".

22.1.2 Marked Point Alignment Method II

(1) Preparations
Set the parameters on the Abs pos param screen.

→ #2049 type (absolute position detection method): 4
(marked point alignment method II)
#2059 zerbas (zero return parameter): 0
The parameters other than “#2049 type” can also be set in Absolute position setting screen.

(2) Turn the power OFF and ON.
(Only when "#2049 type" is specified again.)

The following are the operations on the absolute position setting screen. (Select [Mainte] - [To Abs pos])

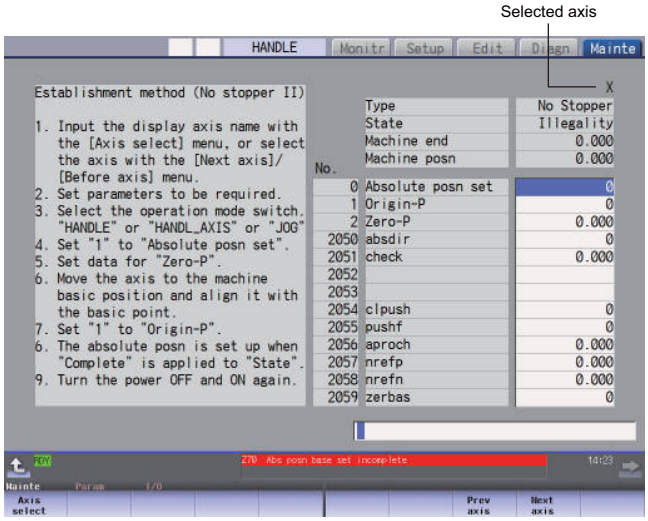
(3) Select an axis to set the absolute position.

There are two methods to select an axis.

- Select the menu [Axis select], enter the axis name in the input area then press [INPUT]. (For the axis name, input the name set to the parameter "#1022 axname2" (2nd axis name).)

- Press the menu [Prev axis] and [Next axis] to switch the axis.

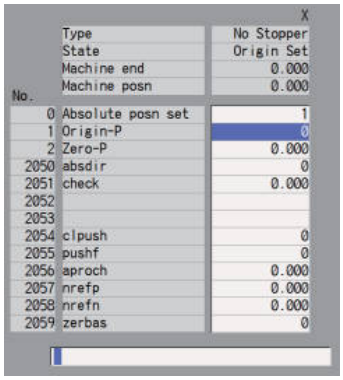
→



(4) Select "HANDLE" or "JOG" for the machine operation switch.

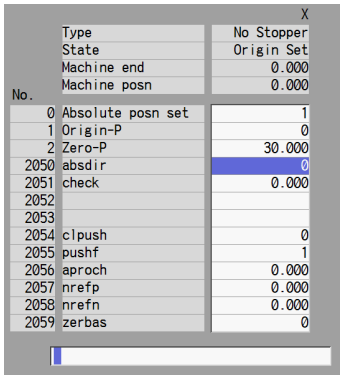
(5) Confirm that the cursor is placed on "Absolute posn set", input "1" in the input area and press the [INPUT] key.

→ The input value is registered in the "Absolute posn set" area.
State: [Origin set]



(6) Move the cursor to "Zero-P" with the [↑] and [↓] keys.
Enter the value in the input area of "Zero-P" and press the [INPUT] key.

→ The input value is registered in the "Zero-P" area.



(7) Move the axis to the mechanical basic position.

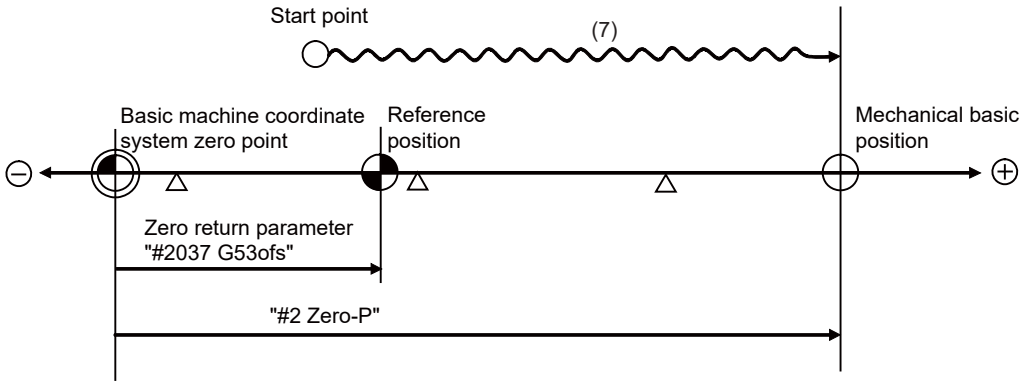
(8) Move the cursor to "Origin-P" with the [↑] and [↓] keys.
Input "1" in the input area and press the [INPUT] key.

➡ The input value is registered in the "Origin-P" area.
State: [Complete]
Machine end: 0.000
Machine position: Value set for "Zero-P"

X

No.		Type	No Stopper
		State	Complete
		Machine end	0.000
		Machine posn	0.000
0	Absolute posn set		1
1	Origin-P		1
2	Zero-P		30.000
2050	absdir		0
2051	check		0.000
2052			
2053			
2054	clpush		0
2055	pushf		0
2056	aproch		0.000
2057	nrefp		0.000
2058	nrefn		0.000
2059	zerbas		0

The zero point initial setting is now complete. After initializing all axes, turn the power OFF and ON.



(Note 1) To change just the basic machine coordinate zero point, set "#0 Absolute posn set" and "#2 Zero-P", and then turn the power OFF and ON.

22.1.3 Machine End Stopper Method: Automatic Initialization

(1) Preparations
Set the parameters on the Abs pos param screen.

#2049 type (absolute position detection method): 1 (stopper method)
#2054 clpush (current limit): 0 to 100 (*1)
#2055 pushf (push speed): 1 to 999
#2056 aproch (approach point): 0 to 999.999
#2059 zerbas (select zero point parameter and basic point): 0 or 1 (*2)
The parameters other than “#2049 type” can also be set on Absolute position setting screen.

(2) Turn the power OFF and ON.
(Only when "#2049 type" is specified again.)

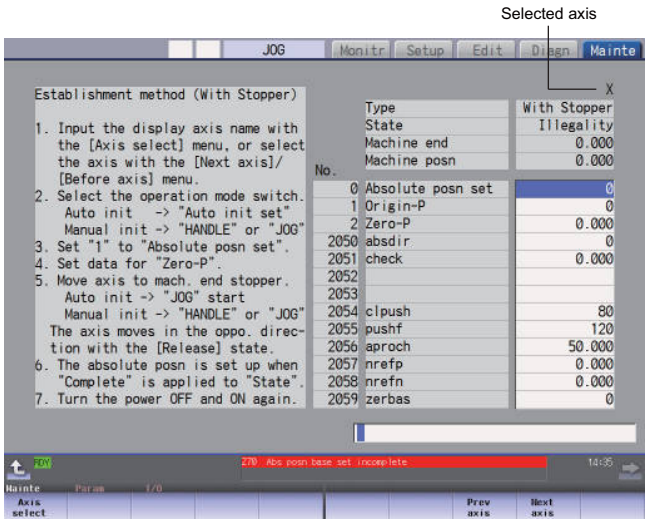
The following are the operations on the absolute position setting screen. (Select [Mainte] - [To Abs pos])

(3) Select an axis to set the absolute position.

There are two methods to select an axis.

- Select the menu [Axis select], enter the axis name in the input area then press [INPUT]. (For the axis name, input the name set to the parameter "#1022 axname2" (2nd axis name).)

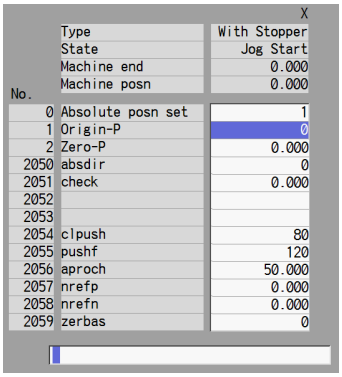
- Press the menu [Prev axis] and [Next axis] to switch the axis.



(4) Select the "Auto init set" mode of machine operation switch.

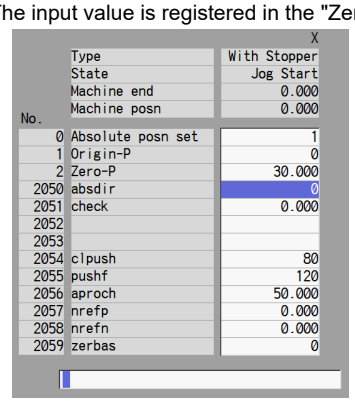
(5) Confirm that the cursor is placed on "Absolute posn set", input "1" in the input area and press the [INPUT] key.

The input value is registered in the "Absolute posn set" area.



(6) [When the parameter "#2059 zerbas" is set to "0"]
Set "Zero-P" here. (*2)
Move the cursor to "Zero-P" with the [↑] and [↓] keys.
Input the distance from the basic machine coordinate zero point to the basic position in the input area, and press the [INPUT] key.

The input value is registered in the "Zero-P" area.

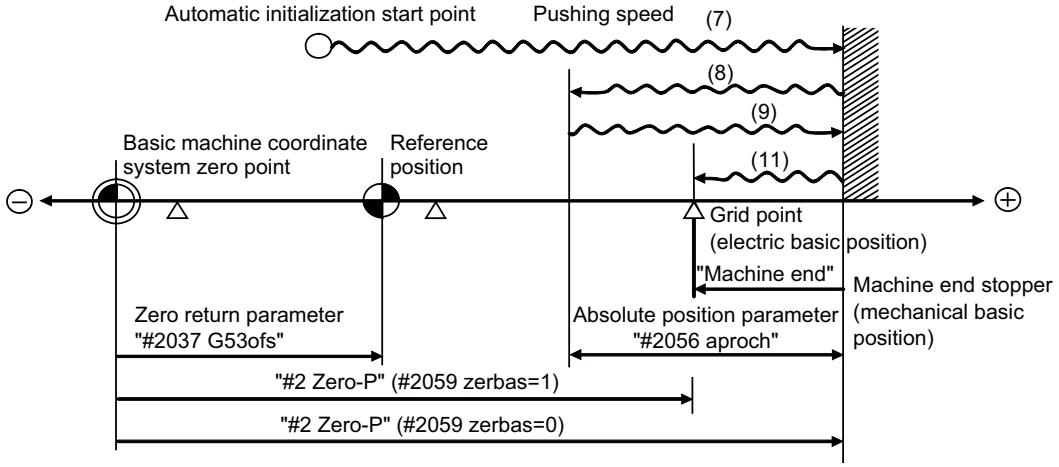


(7)	Start JOG operation. The axis moves toward the machine end stopper at the pushing speed (#2055 pushf).	➡	State: [Stopper1]
(8)	After the axis pushes against the machine end stopper and the current reaches its limit continually during given time period, the axis returns toward the approach point at the pushing speed.	➡	State: [Zero-P. Rel.]
(9)	After the axis arrives at the approach point, the axis moves toward the machine end stopper at the pushing speed.	➡	State: [Stopper2]
(10)	[When the parameter "#2059 zerbas" is set to "0"] The axis pushes against the machine end stopper and stops when the current reaches its limit.	➡	State: [Complete] Machine end: 0.000 Machine position: Current machine position
	[When the parameter "#2059 zerbas" is set to "1"] When the axis pushes against the machine end stopper and the current reaches its limit, the axis reverses and moves at the pushing speed (#2055 pushf). Then the axis stops at the first grid point. Move the cursor to "Zero-P" with the [↑] and [↓] keys. Input the distance from basic machine coordinate system zero point to the grid point immediately preceding the basic position then press [INPUT].	➡	State: [Complete] Machine end: Distance from the machine end stopper to position immediately preceding the grid point Machine position: Current machine position

The zero point initial setting is now complete. After initializing all axes, turn the power OFF and ON.

(*1) Low current limit value may prevent the basic movement of the axis. Do not set such a low value.
Set an appropriate value taking into account the acceleration torque and the friction torque.
When the current limit value is set too low, the servo error 3E (magnetic pole position detection error) may occur.

(*2) Depending on the setting value of the parameter "#2059 zerbas", the value set for "Zero-P" differ as shown in the following figure.



- (7) to (11) in this diagram indicate steps of the operation procedure.

(Note 1) To change just the basic machine coordinate zero point, set "#0 Absolute posn set" and "#2 Zero-P", and then turn the power OFF and ON.

(Note 2) If pressing against the machine end is attempted without passing the grip point once after turning the power ON, the operation message "Not passed on grid" will appear. Return to a point before the last grid, and then repeat from step of pressing against the machine end stopper.

(Note 3) If the first grid point is covered by the grid mask (#2028 grmask) as a result of return to the electric basic position in the step (11), the axis stops at the next grid point.
Note that reference position shift amount (#2027 G28sft) is invalid.

(Note 4) Acceleration/deceleration during movement at the specified push speed is performed in smoothing-off (stepfeed) mode.

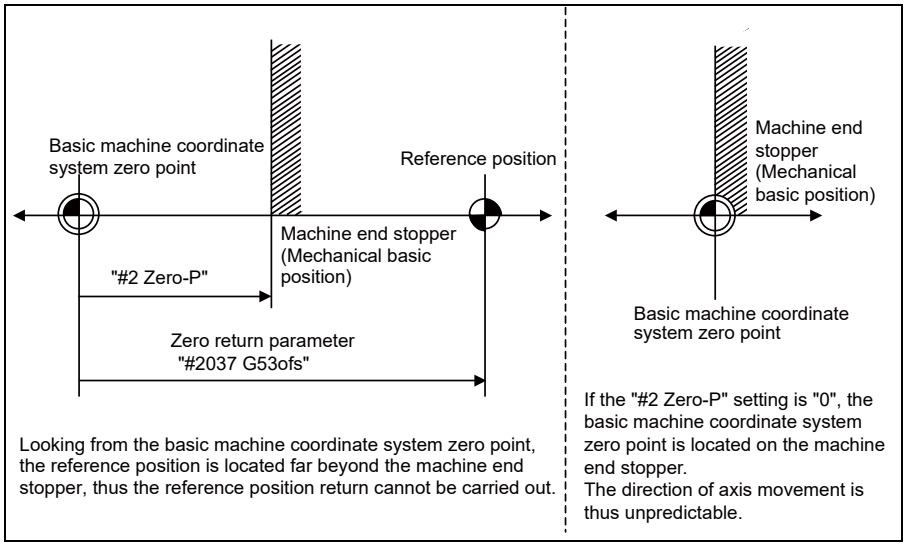
(Note 5) If "0" is specified for "#2056 aproch" of the absolute position parameters, the machine zero point is regardedas the approach point.

(Note 6) Automatic initialization is interrupted if one of the following events occurs. If it is interrupted, [State] indicates "Jog Start" (after selecting the "Auto init set" mode if it is caused by mode change), so restart operation from the step of JOG-start.
- An absolute position detection alarm occurs.
- Operation preparation signal turns OFF.
- The mode is changed.
- The system is reset.

If [State] is "Complete" before automatic initialization is started, "State" returns to "Complete" when power is turned OFF and ON again without restarting the operation.

(Note7) Automatic initialization cannot be started in the following cases. The operation message "Can't start" will appear if starting is attempted.
- When "#0 Absolute posn set" is not set.
- When the "#2 Zero-P" setting is inappropriate.
- When the absolute position parameter "#2055 pushf" is not set.
- When "Z71 Abs encoder failure 0005" has occurred.

Supplementing one of the points above, "Zero-P" setting is inappropriate when "#2 Zero-P" is smaller than the "#2037 G53ofs" or when "#2 Zero-P" is set to "0" as shown below.



22.1.4 Machine End Stopper Method: Manual Initialization

(1) Preparations
Set the parameters on the Abs pos param screen.

→ #2049 type (absolute position detection method): 1 (stopper method)
#2054 clpush (current limit): 0 to 100 (*1)
#2059 zerbas (select zero point parameter and basic point): 0 or 1 (*2)
The parameters other than "#2049 type" can also be set on Absolute position setting screen.

(2) Turn the power OFF and ON.
(Only when "#2049 type" is specified again.)

The following are the operations on the absolute position setting screen. (Select [Mainte] - [To Abs pos])

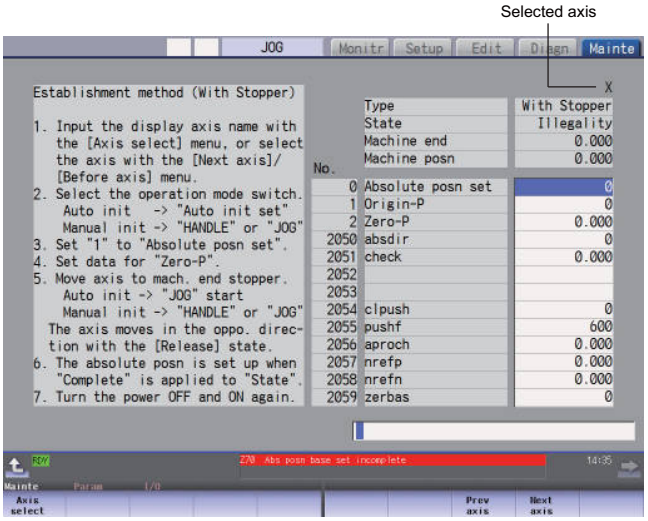
(3) Select an axis to set the absolute position.

There are two methods to select an axis.

- Select the menu [Axis select], enter the axis name in the input area then press [INPUT]. (For the axis name, input the name set to the parameter "#1022 axname2" (2nd axis name).)

- Press the menu [Prev axis] and [Next axis] to switch the axis.

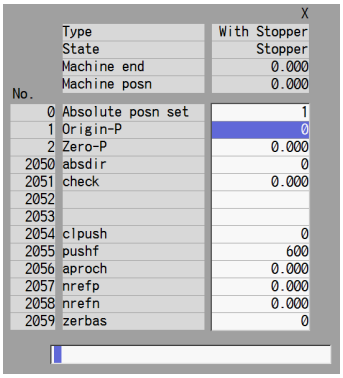
→



(4) Select "HANDLE" or "JOG" for the mode selection of machine operation switch.

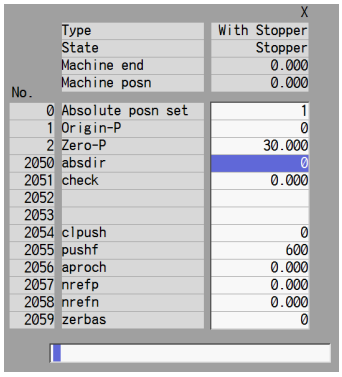
(5) Confirm that the cursor is placed on "Absolute posn set", input "1" in the input area and press the [INPUT] key.

→ The input value is registered in the "Absolute posn set" area.



(6) [When the parameter "#2059 zerbas" is set to "0"]
Set "Zero-P" here. (*2)
Move the cursor to "Zero-P" with the [↑] and [↓] keys.
Input the distance from the basic machine coordinate zero point to the basic position in the input area, and press the [INPUT] key.

→ The input value is registered in the "Zero-P" area.



(7) Press the axis against the machine end stopper.
→ State: [Stopper]
Machine end: Distance between the machine end stopper and the grid point immediately before the stopper

(8) [When the parameter "#2059 zerbas" is set to "0"]
The axis pushes against the machine end stopper and stops when the current reaches its limit.
→ State: [Complete]
Machine end: 0.000
Machine position: Current machine position

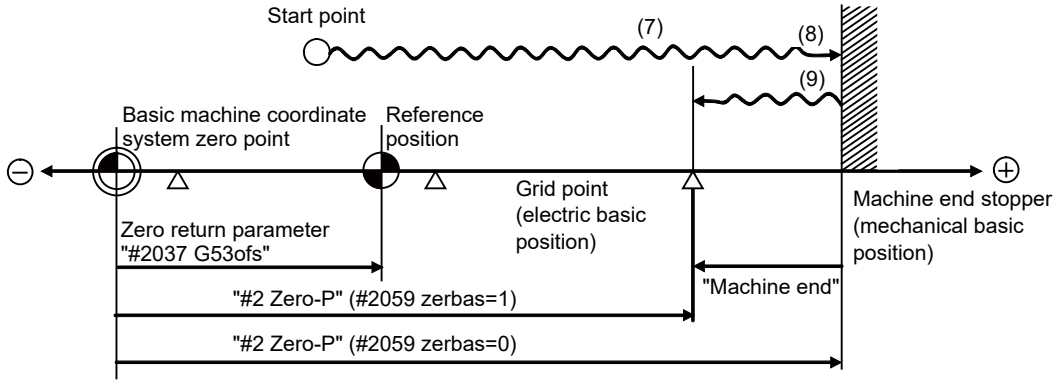
[When the parameter "#2059 zerbas" is set to "1"]
When the axis pushes against the machine end stopper and the current reaches its limit, the axis reverses and moves at the pushing speed (#2055 pushf). Then the axis stops at the first grid point.

Move the cursor to "Zero-P" with the [↑] and [↓] keys. Input the distance from basic machine coordinate system zero point to the grid point immediately preceding the machine end stopper then press [INPUT].
→ State: [Complete]
Machine end: Distance from the machine end stopper to position immediately preceding the grid point
Machine position: Current machine position

The zero point initial setting is now complete. After initializing all axes, turn the power OFF and ON.

(*1) Low current limit value may prevent the basic movement of the axis. Do not set such a low value.
Set an appropriate value taking into account the acceleration torque and the friction torque.
When the current limit value is set too low, the servo error 3E (magnetic pole position detection error) may occur.

(*2) Depending on the setting value of the parameter "#2059 zerbas", the value set for "Zero-P" differ as shown in the following figure.



- (7) to (9) in this diagram indicate steps of the operation procedure.

(Note 1) To change just the basic machine coordinate zero point, set "#0 Absolute posn set" and "#2 Zero-P", and then turn the power OFF and ON.

(Note 2) If pressing against the machine end is attempted without passing the grip point once after turning the power ON, the operation message "Not passed on grid" will appear. Return to a point before the last grid, and then repeat from step of pressing against the machine end stopper.

(Note 3) If the first grid point is covered by the grid mask (#2028 grmask) as a result of return to the electric basic position in the step (9), the axis stops at the next grid point.
Note that reference position shift amount (#2027 G28sft) is invalid.

22.1.5 Dog-type

(1) Preparations
Set the parameters on the Abs pos param screen.

→ #2049 type (absolute position detection method): 3 (dog-type)
The parameters for the approach speed and grid mask amount etc. need to be adjusted.

(2) Turn the power OFF and ON.
(Only when "#2049 type" is specified again.)

The following are the operations on the absolute position setting screen. (Select [Mainte] - [To Abs pos])

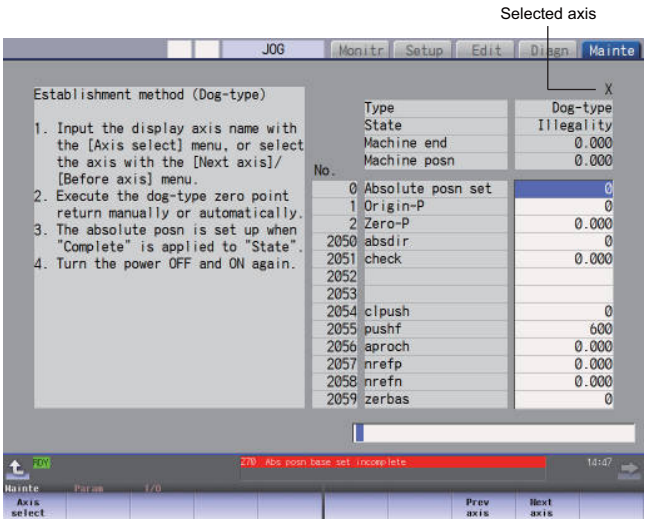
(3) Select an axis to set the absolute position.

There are two methods to select an axis.

- Select the menu [Axis select], enter the axis name in the input area then press [INPUT]. (For the axis name, input the name set to the parameter "#1022 axname2" (2nd axis name).)

- Press the menu [Prev axis] and [Next axis] to switch the axis.

→



(4) Execute the manual or automatic dog-type zero point return.

→ State: [Zero-P. Rel.]
Machine position: Current machine position

(5) The axis arrives at the zero point.

→ State: [Complete]
Machine position: 0.000

The zero point initial setting is now complete. After initializing all axes, turn the power OFF and ON.

(Note 1) If the dog-type reference position return is interrupted by resetting, the previous state ("Complete" or "Illegality") will display in the [State] column.

(Note 2) With dog-type reference position return, reference position return can be executed again even if the [State] is "Complete".

22.1.6 Setting the Grid Interval and the Reference Encoder for Grid Interval

Set the parameters "#2041 grspcref (reference encoder for grid interval)" and "#2029 grspc (grid interval)" according to the machine configuration.

(1) For semi-closed loop control
Set "0" (grid interval by the motor-side) to the reference encoder for grid interval.
Set the grid interval same value as the ball screw pitch.
If the reference encoder for grid interval is set to "1" (grid interval by the machine-side), the grid interval will be required to set the moving amount calculation value per a motor rotation ("#2201 SV001 PC1" / "2202 SV002 PC2" x "#2218 SV018 PIT").

(2) For full-closed loop control
Set "1" (grid interval by the machine-side) to the reference encoder for grid interval.
Set the grid interval same value as the Z phase pitch.
If the reference encoder for grid interval selection is set to "0" (grid interval by the motor-side), the grid interval will be required to set the moving amount calculation value per Z phase pitch ("2202 SV002 PC2" / "#2201 SV001 PC1" x the Z phase pitch of the machine-side).

Parameter settings of "Specify an encoder grid interval" and "Reference encoder for grid interval"

Loop control	#2041 grspcref Reference encoder for grid interval	#2029 grspc Grid interval	Calculation for the grid interval
Semi-closed	0: grid interval by the motor-side	same value as the ball screw pitch	unnecessary
	1: grid interval by the machine-side	calculation value of "#2201 SV001 PC1" / "#2202 SV002 PC2" x "#2218 SV018 PIT"	necessary
Full-closed	0: grid interval by the motor-side	calculation value of "2202 SV002 PC2" / "#2201 SV001 PC1" x the Z phase pitch of the machine-side	necessary
	1: grid interval by the machine-side	same value as the Z phase pitch	unnecessary

* If the grid interval is set to "0", the ball screw pitch (#2218 SV018 PIT) will be used instead of the grid interval.

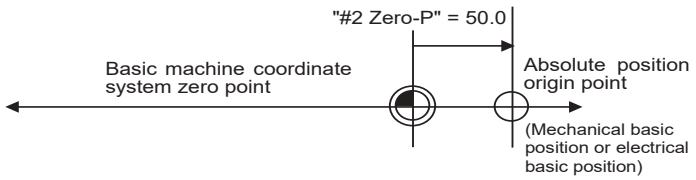
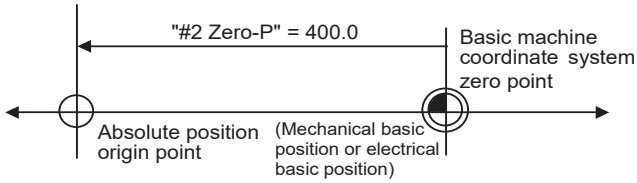
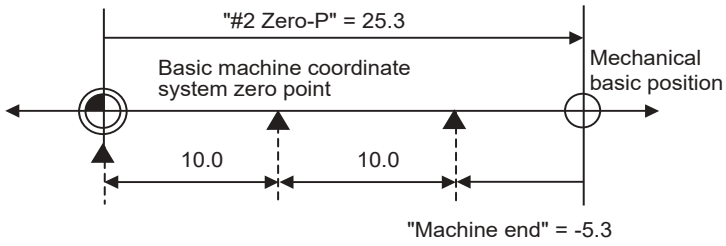
22.1.7 Precautions Common for the Initialization Operation

(1) The "#0 Absolute posn set" parameter (axis for which zero point is to be initialized) can be set simultaneously for all axes or individually for each axis.
(2) The "#0 Absolute posn set" parameter cannot be turned OFF with the keys. It is turned OFF when the power is turned ON again.
(3) "#2 ZERO-P" can be set at any time as long as "#0 Absolute posn set" is set to "1".
(4) The grid point must be passed at least once after turning the power ON before initializing the zero point. If the grid point has not been passed, the operation message "Not passed on grid" will appear at the "Machine posn".
(5) When the absolute position is established, the required data will be stored in the memory.

22.1.8 Precautions Common for the Dogless-type Absolute Position Encoder

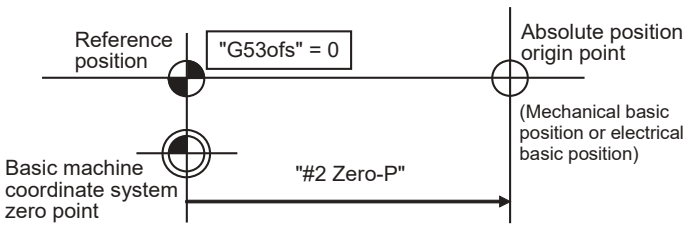
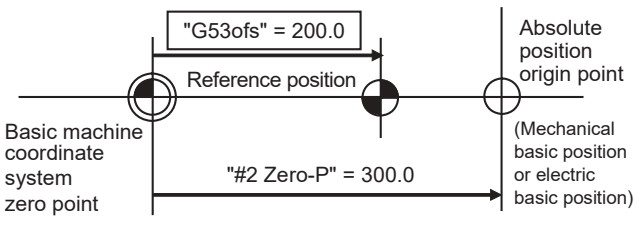
(1) Example of setting "#2 Zero-P" parameter

For the "#2 Zero-P" parameter, set the coordinate value of the absolute position origin point (mechanical basic position or electrical basic position" looking from the basic machine coordinate system zero point.

(Example 1) To set the zero point at 50.0mm before absolute position origin point on + end	
(Example 2) To set the zero point at 400.0mm before the machine basic position or absolute position origin point on - end.	
(Example 3) To set the basic machine coordinate system zero point on the grid point, calculate the "#2 Zero-P" parameter setting value as shown below using the value displayed at "Machine end". "Machine end" shows the distance from the mechanical basic position to the previous grid point. (Note that when setting the electrical basic position coordinate value in "#2 Zero-P", the "Machine end" value does not need to be considered.)	
To set the third gird point as the zero point when the "Machine end"display is -5.3 at the + end basic position. (Example of 10.0mm grid interval.)	

(2) Setting the reference position

The reference position can be set as shown below by setting the "#2037 G53ofs".

(Example 1) To set the reference position to the same position as the basic machine coordinate system zero point.	
(Example 2) To set the reference position at a position 200.0mm to the + side from the basic machine coordinate zero point. (To set the basic machine coordinate system zero point 300.0mm front of the absolute position origin point.)	

(3) When an MPI scale made by Mitsubishi Heavy Industries Machine Tool Co., Ltd. is used, set the zero point return parameters so that Z phase of the MPI scale becomes the grid point (electric basic position), and then perform zero point initialization setting.

22.2 Adjustment of Reference Position Return in Relative Position Detection System

22.2.1 Dog-type Reference Position Return Operation

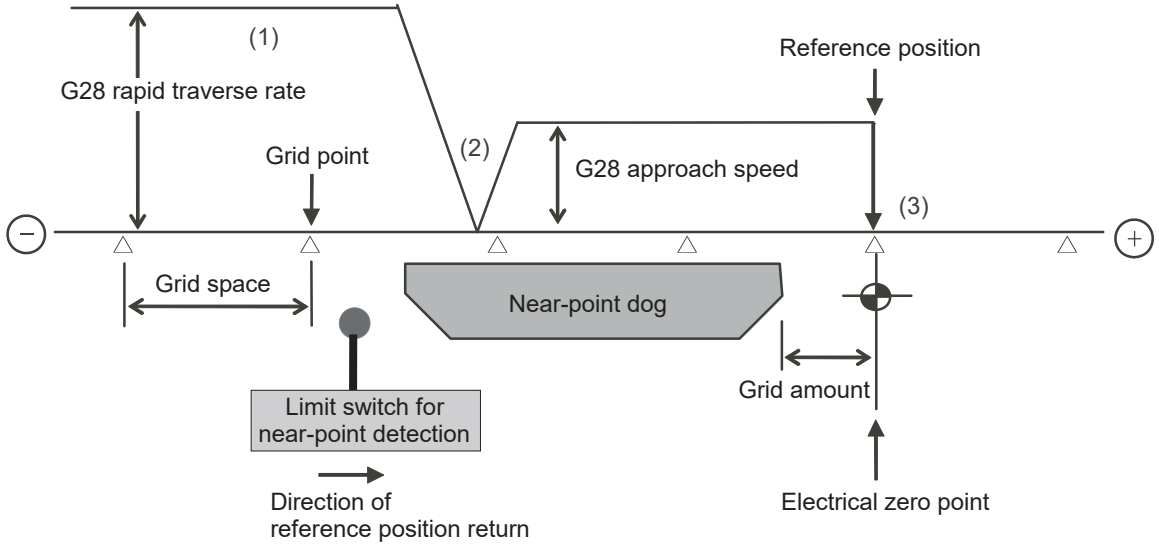
In the dog-type reference position return, the axis moves as follows:

(1) Starts moving at G28 rapid traverse rate.

(2) Decelerates to stop when the near-point dog is detected during the movement. Then, resumes moving at G28 approach speed.

(3) Stops at the first grid point after leaving the near-point dog.

This grid point, where the axis stopped at (3), is called the electrical zero point. Normally, this electrical zero point is regarded as the reference position.



The first reference position return after turning the power ON is carried out with the dog-type reference position return. The second and following returns are carried out with either the dog-type reference position return or the high-speed reference position return, depending on the parameter.
High-speed reference position return is a function that directly positions to the reference position saved in the memory without decelerating at the near-point dog.

(Note) If reference position return has never been executed after turning the power ON and a movement command other than G28 is executed, the program error (P430) will occur.

22.2.2 Dog-type Reference Position Return Adjustment Procedures

Adjust the dog-type reference position return with the following steps.

(1) Select [Param] menu from the maintenance screen, and then select zero point parameter screen by pressing the page up/down keys.
The [zero point parameter] screen appears.

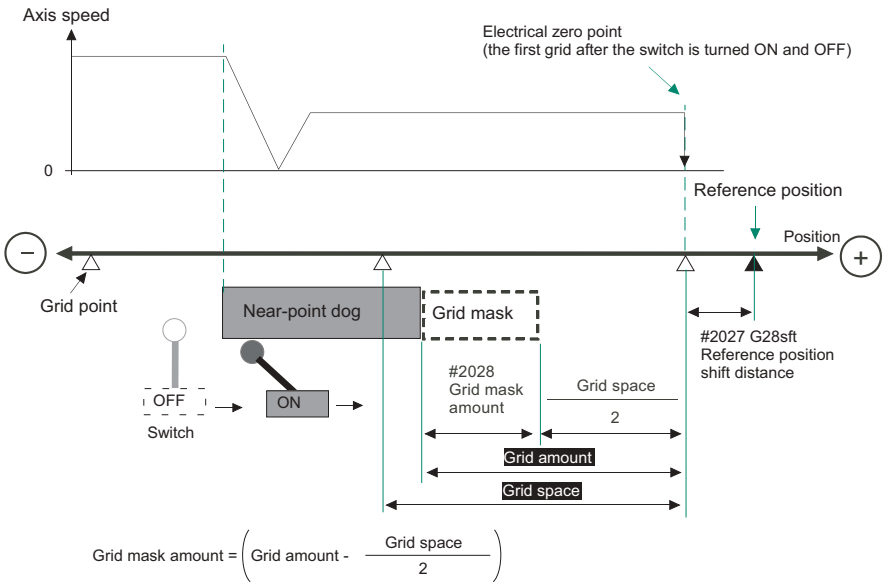
(2) Set the following parameters to "0" on the [zero point parameter] screen.
Reference position shift amount (#2027 G28sft)
Grid mask amount (#2028 grmask)

(3) Turn the power OFF and ON, and then execute reference position return.
(Note) Use the switches on the machine operation panel to command "reference position return mode" and operate the axis movement. The GOT project and the panel switches are made by the machine tool builder.

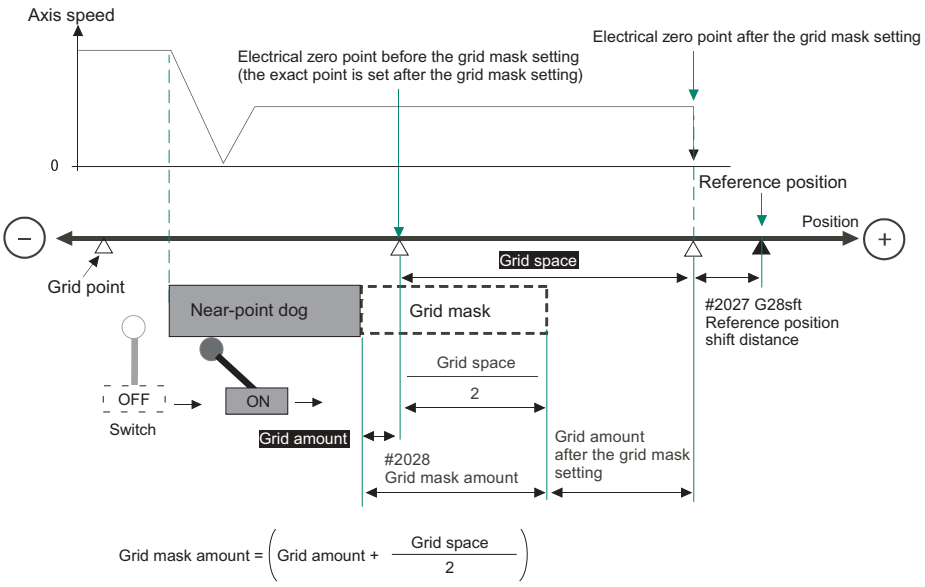
(4) Select [Drv mon] screen from the diagnosis screen, and display the drive monitor screen. Feed the page and check "Grid space" and "Grid amnt".

(5) Determine the grid mask amount according to the state as shown below.

■ When $\frac{\text{Grid space}}{2}$ is smaller than the grid amount



■ When $\frac{\text{Grid space}}{2}$ is larger than the grid amount



(6) Set the determined grid mask amount for "#2028 grmask" of the [ZERO-RTN PARAM] screen.

(7) Turn the power OFF and ON, and then execute reference position return.

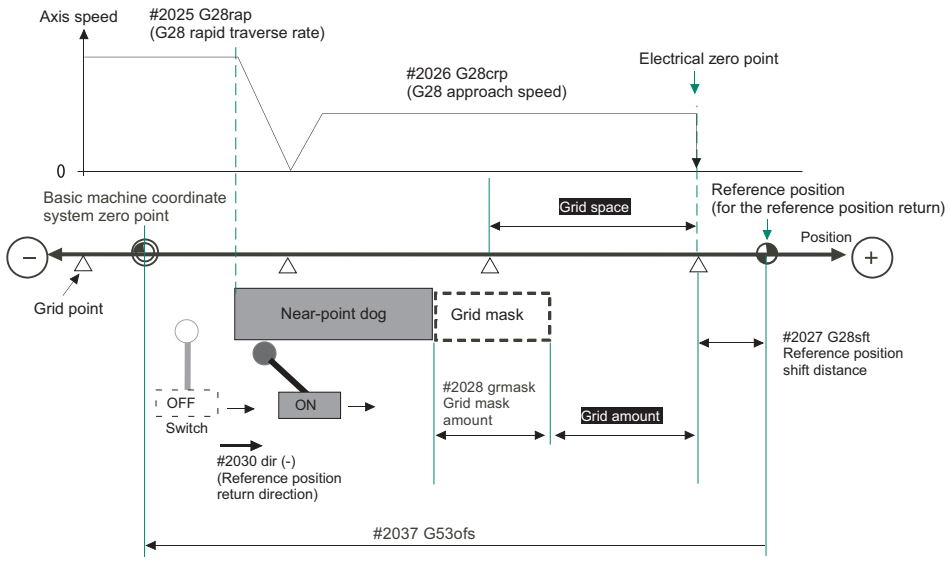
(8) Confirm the grid space and grid amount values on DRIVE MONITOR screen.
If the grid amount value is approximately half of the grid space, the grid mask amount has been set correctly. If the value is not approximately half, repeat the procedure from step (1).

(9) Set the reference position shift amount (#2027 G28sft).
To designate the electrical zero point as reference position, set "#2027 G28sft" to "0".

(10) Turn the power OFF and ON, and then execute the reference position return.
(Note) The axis moves at the speed of "#2025 G28rap G28 rapid traverse rate".
The parameter "#2025 G28rap G28 rapid traverse rate" is usually set the maximum speed, which makes the high-speed movement in the 2nd reference position return and later. Take extra care for the safe axis movement.

(11) Set the machine coordinate system offset amount (#2037 G53ofs).

[Terms and parameters related to the dog-type reference position return]



Electrical zero point
The first grid point after the dog OFF.
If the grid point is at the position where the near-point dog is kicked OFF, the position of electrical zero point may be at the grid point where the dog is kicked OFF or at the next grid point because of the delay of the limit switch operation. This causes a deviation of reference position by the amount of the grid space.
Setting the grid mask amount ("#2028 grmask") prevents this deviation.

Reference position
The base for position and coordinate.
The axis is positioned to this position by the manual reference position return command or G28 command in the machining program.
The position is determined by shifting from the electrical zero point by the amount of "#2027 G28sft Reference position shift amount".

Grid point
The position encoder has a Z-phase that generates one pulse per rotation. The 0-point position of this Z-phase is the grid point.
Thus, there is a grid point per rotation of the position encoder, and the machine has many grid points at a regular pitch.
The grid point can be set at intervals of grid space by setting the grid space (#2029 grspc). Thus, multiple grid points can be set per encoder rotation.

Grid amount
The grid amount is the distance from where the near-point detection limit switch leaves the near-point dog to the grid point (electrical zero point) as the dog-type reference position return is executed.
The grid amount can be confirmed on the DRIVE MONITOR screen.
After setting the grid mask, the grid amount shows the distance from the grid mask OFF to the grid point.

G28 rapid traverse rate (#2025 G28rap)
Set the feedrate for dog-type reference position return in manual operation and the automatic operation.
The rapid traverse rate (#2001 rapid) is applied for the feedrate during the high-speed reference position return.

G28 approach speed (#2026 G28crp)
Set the approach speed to the reference position after decelerating to a stop by the near-dog detection. Since the approach speed is accelerated and decelerated in steps (no-acceleration/deceleration), the mechanical shock, etc. could occur if the speed is too large. The G28 approach speed should be set between 100 and 300 mm/min., or within 500 mm/min. at the fastest.

Reference position shift amount (#2027 G28sft)
When shifting the reference position from the electrical zero point, set the shift amount.
The shifting direction can be set only in the reference position return direction.
If the reference position shift amount is "0", the grid point (electrical zero point) will be the reference position.

Grid mask amount (#2028 grmask)
The first grid point after the dog OFF is regarded as the electrical zero point.
If the grid point is at the position where the near-point dog is kicked OFF, the position of electrical zero point may be at the grid point where the dog is kicked OFF or at the next grid point because of the delay of the limit switch operation. This causes a deviation of reference position by the amount of the grid space. Thus, the position that the dog is kicked OFF needs to be at the approximate center of the grid space.
Adjustments are made by setting the grid mask amount or changing the near-point dog.
Setting the grid mask has the same effect as lengthening the near-point dog. Refer to the previous procedures for setting the grid mask amount.

Grid space (#2029 grspc)
Set the distance between grids.
Set either the ball screw pitch value (#2218 PIT) or the movement amount per motor rotation as the normal grid space.
To make the grid space smaller, set a divisor of the grid space.

<Calculation method for movement amount per motor rotation>

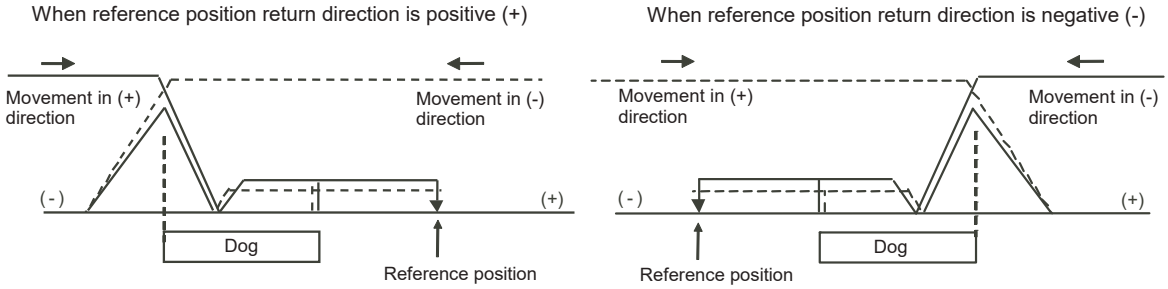
(1) When linear feed mechanism is a ball screw:
The movement amount per motor rotation = the motor side gear ration / the machine side gear ratio x the ball screw pitch
(2) When linear feed mechanism is a rack and pinion:
The movement amount per motor rotation = the motor side gear ration / the machine side gear ratio x number of pinion gear teeth x the rack pitch
(3) For the rotary axis:
The movement angle per motor rotation = the motor side gear ration / the machine side gear ratio x 360

Reference position return direction (#2030 dir (-))

The direction of the (axis) movement, after the dog-type reference position return is executed and the limit switch kicks the dog and decelerate to stop, is set to either positive "0" or negative "1".

Set "0" if the reference position is in the positive direction from the near-point dog.

Set "1" if the reference position is in the negative direction from the near-point dog.



Axis with no reference position (#2031 noref)

Set the axis to carry out dog-type reference position return and the axis for absolute position detection to "0".

Set the axis without carrying out reference position return during the relative position detection to "1".

Machine coordinate system offset (#2037 G53ofs)

Set the amount to shift the basic machine coordinate system zero point position from the reference position.

When "0" is set, the reference position will be the position of the basic machine coordinate system zero point.

In "G53ofs" parameter, set the position of the reference position looking from the basic machine coordinate system zero point with the coordinates of basic machine coordinate system. By the reference position return after the power is turned ON, the machine position will be set and the basic machine coordinate system will be established.

Selection of grid display type (#1229 set01/bit6)

Select the grid display type on DRIVE MONITOR screen during dog-type reference position return.

0: Distance from dog OFF to electric zero point (including the grid mask amount)

1: Distance from dog OFF to electric zero point (excluding the grid mask amount)

23

Setting the Tool Entry Prohibited Range

Following functions are available for setting a tool entry prohibited range to detect over travels (OT).

(1) Stroke end
The axis movement is restricted by the signal that detects the stroke ends.

(2) Stored stroke limit
Prohibited ranges are set with parameters.



When stroke end is set, the axis will move the distance required to decelerate and stop after the limit switch is activated.
When stored stroke limit is set, the axis will stop before the prohibited range of the stored stroke limit including the deceleration distance.
For safety, set the stroke end and also, the stored stroke limit.

⚠ WARNING

Stroke end (H/W OT) and stored stroke limit (S/W OT) must always be set. If not, the tool may hit the machine end.

23.1 Stroke End

The axis movement is restricted by the signal that detects the stroke ends.
Signal device No. is allocated by the following parameters.
Parameter "#2074" and "#2075" will be valid only when "#1226 aux10/bit" is set to "1".

#1226 aux10/bit5: Set to "1" (assigning the dog signal is valid).
#2074 H/W OT+: Set the input device for assigning the OT (+) signal. (Setting range 0000 to 02FF (Hexadecimal))
#2075 H/W OT-: Set the input device for assigning the OT (-) signal. (Setting range 0000 to 02FF (Hexadecimal))

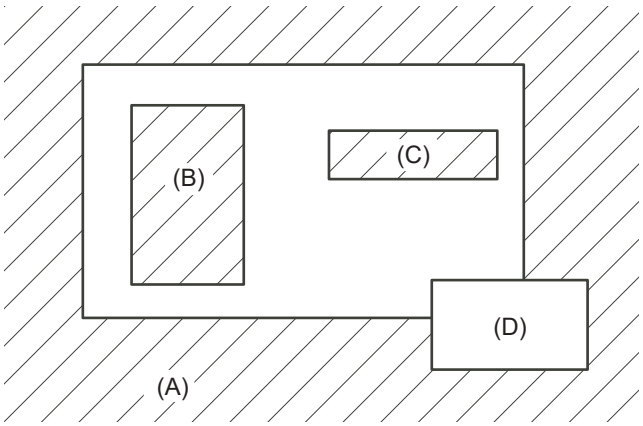
(Note 1) When "OT IGNORED" (R248) signal is set to ON, the stroke end signal associated with a specific control axis can be ignored.

(Note 2) When parameter "#1226 aux10/bit5" is set to "1", do not set the same device No. to #2073 to #2075. Setting the same device No. may cause the emergency stop. However, the device number will not be checked for the axis which is set the signal to ignore (R248,R272).

23.2 Stored Stroke Limit

23.2.1 Outline

Three tool entry prohibited ranges can be set with stored stroke limit I, stored stroke limit II, IIB and stored stroke limit IB.
Part of the prohibited range on the outside of stored stroke limit I can turn into a moveable range with stored stroke limit IC.
Set the parameters to select the entry prohibited range, stored stroke limit II or IIB.
(II: Prohibits entering outside the range IIB: Prohibits entering inside the range)



: Moveable range

: Prohibited range

(A): Prohibited range by stored stroke limit I
(B): Prohibited range by stored stroke limit IIB
(C): Prohibited range by stored stroke limit IB
(D): Moveable range by stored stroke limit IC

If the axis is moving over the set range, an alarm will appear and the axis will decelerate to a stop.
If the prohibited range is entered and an alarm occurs, movement will be possible only in the direction opposite the entry direction.

Valid Conditions of Stored Stroke Limit

When using the relative position detection system, the stored stroke limit is invalid until the reference position return is completed after the power is turned ON.
The stored stroke limit can be validated even if the reference position return is not yet completed, by setting "#2049 type (Absolute position detection method)" to "9".

(Note) If the absolute position detection is valid when using the absolute position detection system, the stored stroke limit will be validated immediately after the power is turned ON.

Stored Stroke Limit Coordinates

The stored stroke limit check is carried out in the basic machine coordinate system established by the reference position return.
When the stored stroke limit has been validated while the reference position return has not been completed, the stored stroke limit check is executed with the basic machine coordinate system at the time of last power-OFF as temporary one.
When the 1st dog-type reference position return is completed after the power is turned ON, the proper coordinate system is established.

(Note) While the reference position return has not been completed, only the manual and handle feed mode allow the axis movement. Automatic operation is validated after the reference position return is completed.

⚠ CAUTION

Always set the stored stroke limit. Failure to set this could result in collision with the machine end.

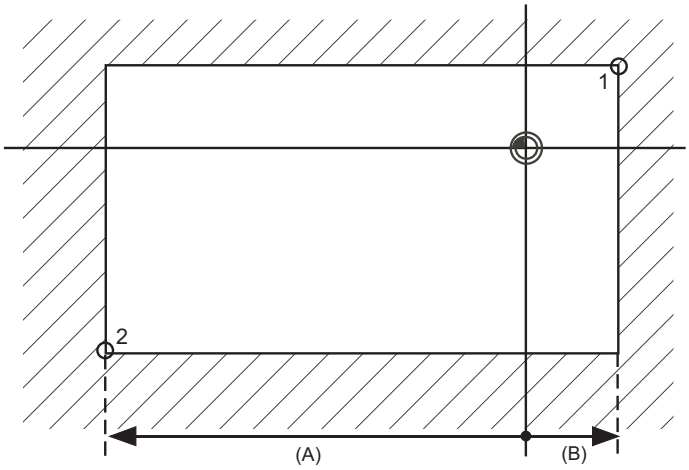
The stored stroke limits I, II, IIB, IB and IC are handled as follows.

Type	Prohibited range	Description		Range setting parameters	Validating conditions
I	Outside	- Set by the machine tool builder. - When used with II, the confined range designated by the two functions becomes the movement valid range.		"#2013 OT - (Soft limit I -)" "#2014 OT + (Soft limit I +)"	- Reference position return is completed. - #2013 and #2014 are not set to the same value.
II	Outside	- Set by the user. - Select II or IIB with the parameters.	- "#8210 OT-INSIDE" = "0" - Used with I.	"#8204 OT-CHECK-N" "#8205 OT-CHECK-P"	- Reference position return is completed. - #8204 and #8205 are not set to the same value. - "#8202 OT-CHECK OFF" = "0"
IIB	Inside		- "#8210 OT-INSIDE" = "1"		
IB	Inside	- Set by the machine tool builder.		"#2061 OT_1B- (Soft limit IB-)" "#2062 OT_1B+ (Soft limit IB +)"	- Reference position return is completed. - #2061 and #2062 are not set to the same value.
IC	Outside	- Set by the machine tool builder.		"#2061 OT_1B- (Soft limit IB-)" "#2062 OT_1B+ (Soft limit IB +)"	- Reference position return is completed. - #2061 and #2062 are not set to the same value. - "#2063 OT_1Btype (Soft limit IB type)" = "2"

- The stroke check will not be executed when both maximum and minimum value are set to the same value.
- This function is valid after the reference position return if the system does not apply the absolute position detection system.
- Before the machine enters the prohibited range, an error "M01 Operation error 0007" (S/W stroke end) will occur, and the machine movement will stop. The alarm can be reset by moving the erroneous axis in the opposite direction.
- During automatic operation, if an alarm occurs with even one axis, all axes will decelerate to a stop.
- During manual operation, only the axis that caused the alarm will decelerate to a stop.
- The axis will always stop at a position before the prohibited range.
- The distance between the prohibited range and stop position will depend on the feedrate, etc.

23.2.2 Stored Stroke Limit I

This is a stroke limit function used by the machine tool builder. The boundary is set with the parameters ("#2013 OT - (Soft limit I -)" and "#2014 OT + (Soft limit I +)"). The outside of the set boundary is the prohibited range. The outside of the set boundary is the prohibited range.
When used with the stored stroke limit II function, the confined range designated by the two functions becomes the moveable range.



: Moveable range

: Prohibited range

(A): Set value for (-) side
(B): Set value for (+) side
Point 1: "#2014 OT+ (Soft limit I +)" and
Point 2: "#2013 OT- (Soft limit I -)" are set with the coordinate values in the basic machine coordinate system.

(Note 1) This function will be invalid if the same value excluding "0" is set for both "#2013 OT -" and "#2014 OT +".

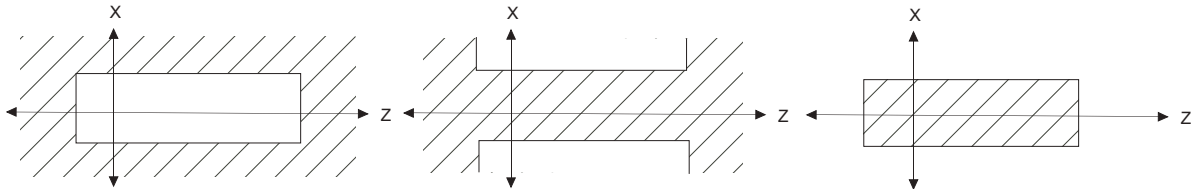
23.2.3 Stored Stroke Limit II

The boundary is set with the axis parameters "#8204 OT-CHECK-N" and "#8205 OT-CHECK-P" or with program commands. Either the inside or the outside of the set boundary is the prohibited range. Whether the inside or outside of the range is prohibited is determined by "#8210 OT-INSIDE". When the inside is selected, this function is called stored stroke limit IIB.

When using program commands, entry of the tool into the prohibited range is prohibited with G22, and entry into the prohibited range is enabled with G23. The stored stroke limit II can be invalidated for each axis with setting "#8202 OT-CHECK OFF" to "1".

Prohibited range

X: Outside Z: Outside　　X: Inside Z: Outside　　X: Inside Z: Inside

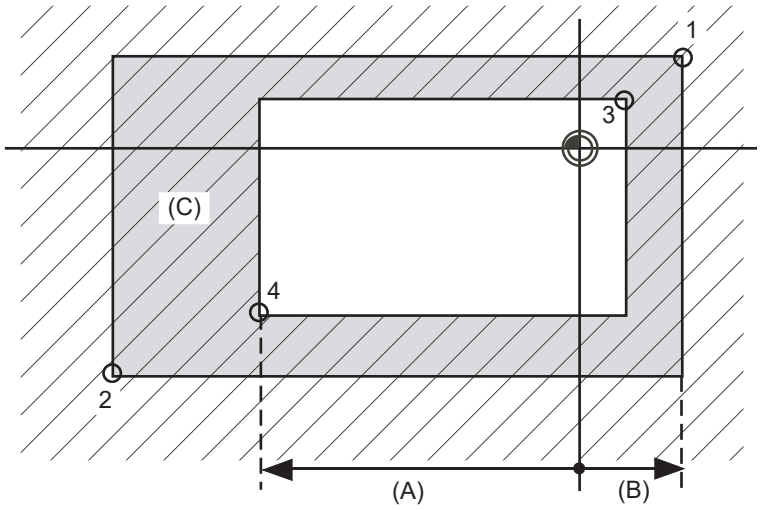


: Moveable range

: Prohibited range

(1) Stored stroke limit II (When prohibited range is on outside)

When used with the stored stroke limit I function, the narrow range designated by the two types becomes the movement valid range.



: Moveable range

: Prohibited range

(A): Set value for (-) side

(B): Set value for (+) side

(C): Prohibited range by stored stroke limit II

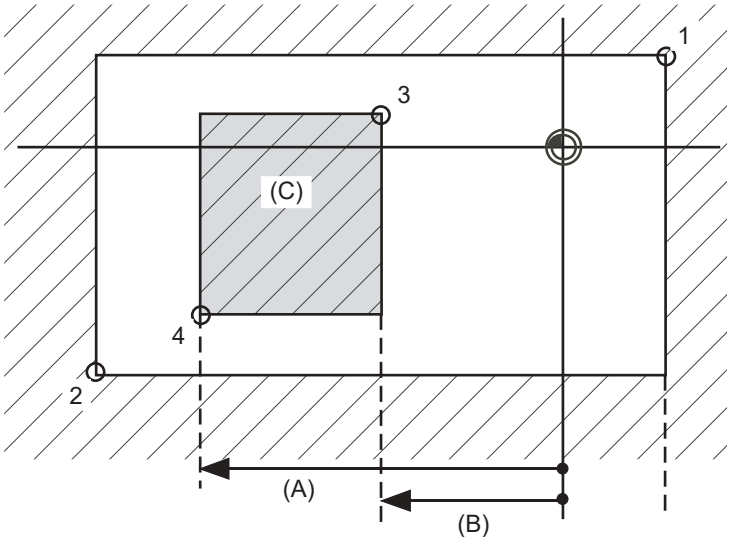
Point 3: "#8205 OT-CHECK-P" and

Point 4: "#8204 OT-CHECK-N" are set with the coordinate values in the basic machine coordinate system.

Points 1 and 2 are the prohibited range set with stored stroke limit I.

(2) Stored stroke limit IIB (When prohibited range is on inside)

A range except for that of the stored stroke limit I becomes the movement prohibited range.



: Moveable range

: Prohibited range

(A): Set value for (-) side

(B): Set value for (+) side

(C): Prohibited range by stored stroke limit IIB

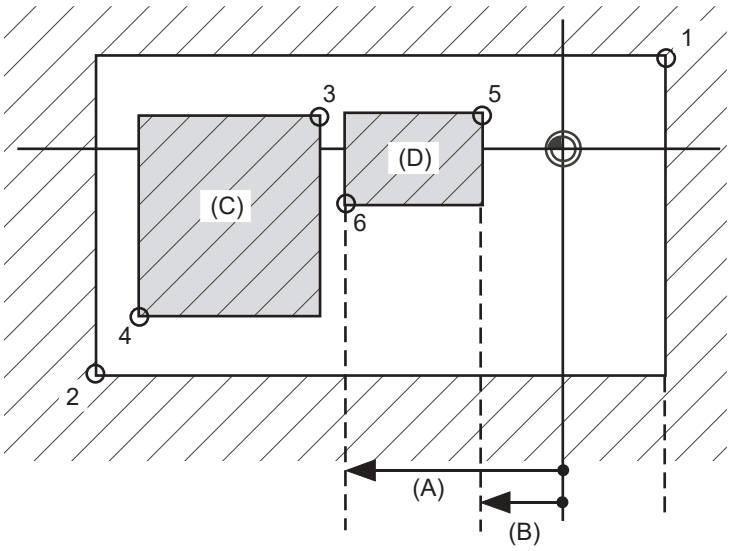
Point 3: "#8205 OT-CHECK-P" and

Point 4: "#8204 OT-CHECK-N" are set with the coordinate values in the basic machine coordinate system.

Points 1 and 2 are the prohibited range set with stored stroke limit I.

23.2.4 Stored Stroke Limit IB

The boundary is set for each axis with the axis parameters "#2061 OT_1B-" and "#2062 OT_1B+". The inside of the set boundary is the prohibited range.



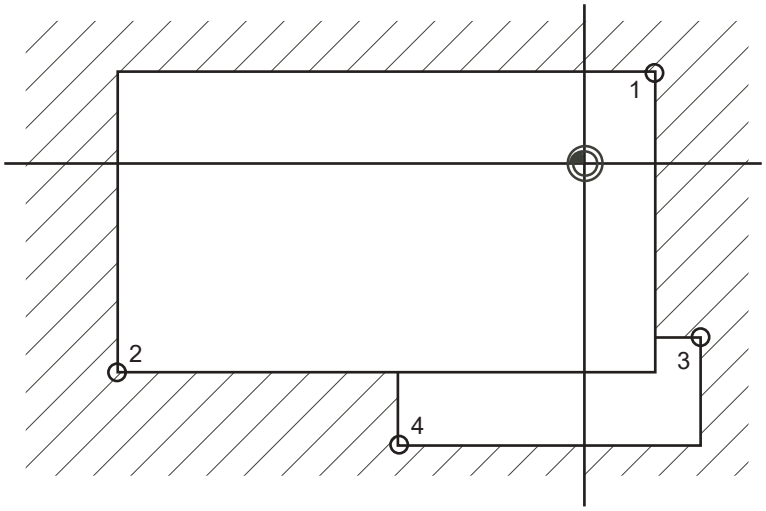
: Moveable range

: Prohibited range

Point 5: "#2062 OT_1B+ (Soft limit IB+)" and
Point 6: "#2061 OT_1B- (Soft limit IB-)" are set with the coordinate values in the basic machine coordinate system.
(A): Set value for (-) side
(B): Set value for (+) side
(C): Prohibited range by stored stroke limit II
(D): Prohibited range by stored stroke limit IB
Points 1 and 2 are the prohibited range set with stored stroke limit I.
Points 3 and 4 are the prohibited range set with stored stroke limit IIB.

23.2.5 Stored Stroke Limit IC

The boundary is set for each axis with the axis parameters "#2061 OT_1B-" and "#2062 OT_1B+". The inside of the set boundary is the machine movement valid range.
This is valid when the axis parameter "#2063 OT_1Btype (Soft limit IB type)" is set to "2". Cannot be used with soft limit IB.



: Moveable range

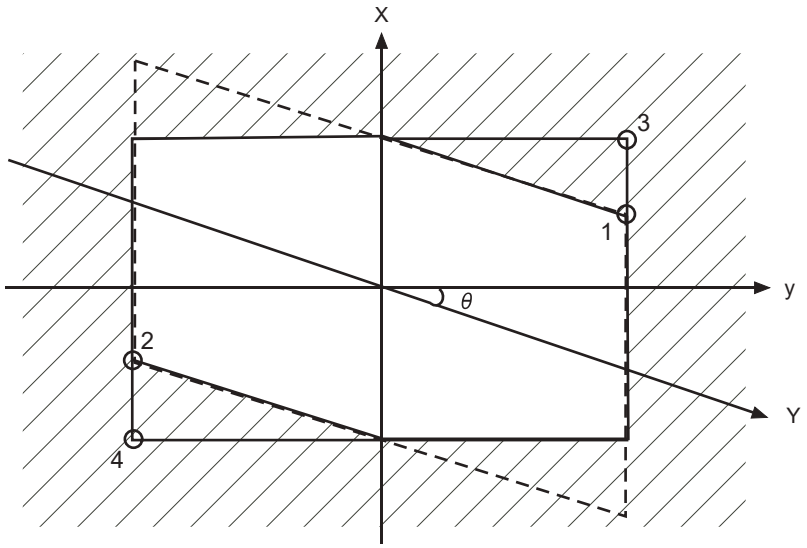
: Prohibited range

Point 3: "#2062 OT_1B+ (Soft limit IB+)" and
Point 4: "#2061 OT_1B- (Soft limit IB-)" are set with the coordinate values in the basic machine coordinate system.
Points 1 and 2 are the prohibited range set with stored stroke limit I.

23.2.6 Movable Range during Inclined Axis Control

By setting "#2063 OT_1Btype" to "3", the inclined axis control axis can be checked with the program coordinates using the stored stroke limit IB/IC range setting ("#2061" and "#2062"). The stored stroke limit IB and IC cannot be used together at this time.

By using this function with stored stroke limit I, the check can be carried out simultaneously with the actual axis and program coordinate value. In this case, the range that does not fit into either of the following two prohibited ranges will be the movable range.



: Moveable range

: Prohibited range

Point 3: "#2062 OT_1B+ (Soft limit IB+)" and

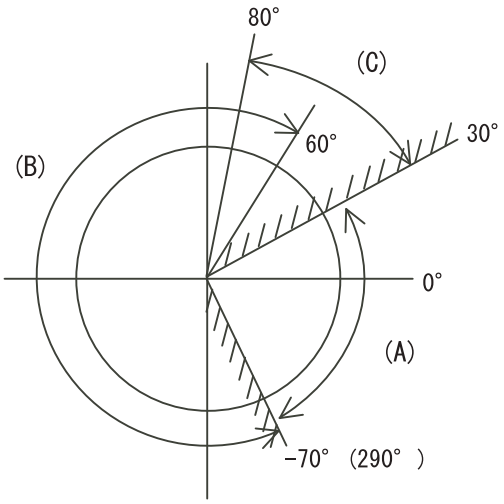
Point 4: "#2061 OT_1B- (Soft limit IB-)" are set with the coordinate values in the basic machine coordinate system.

Points 1 and 2 are the prohibited range set with stored stroke limit I.

23.2.7 Stored Stroke Limit for Rotation Axis

Stored stroke limits I and II are used as the stored stroke limit for the rotation axis. The area between the maximum and minimum values of the prohibited range's parameters, which does not contain the 0 point of the basic machine coordinate system, is the entry prohibited range.
The prohibited range parameters for the rotary axis can be set to establish "maximum value" < "minimum value" ("#2014 OT+" < "#2013 OT-", "#8205 OT-CHECK-P" < "#8204 OT-CHECK-N"). This will be handled the same as if "maximum value" > "minimum value" ("#2014 OT+" > "#2013 OT-", "#8205 OT-CHECK-P" > "#8204 OT-CHECK-N").

(Example) Stored stroke limit I (maximum value and minimum value of prohibited range parameter)
#2013 OT -: -70.000°
#2014 OT +: 60.000°
Stored stroke limit II (maximum value and minimum value of prohibited range parameter)
#8204 OT-CHECK-N: 30.000°
#8205 OT-CHECK-P: 80.000°



(A): Moveable range
(B): Prohibited range by stored stroke limit I
(C): Prohibited range by stored stroke limit II

(Note) Do not use stored stroke limits IB, IIB or IC. Invalidate stored stroke limits IB, IIB and IC by setting the parameters as shown below.
#8210 OT INSIDE: 0 (stored stroke limit II valid, IIB invalid)
#2061, #2062 set to same value (stored stroke limits IB and IC invalid)

23.2.8 Changing the Area for the Stored Stroke Limit I

The range of the stored stroke limit I can be changed to the value set to R register for each axis. When "Stored stroke limit I change request" signal is turned ON, the range of stored stroke limit changes. Changing the area for the stored stroke limit I is also possible during automatic operation. Also, the current settings for the stored stroke limit I can be checked by with the R register values.
Refer to "PLC Programming Manual" and "PLC Interface Manual" for details.

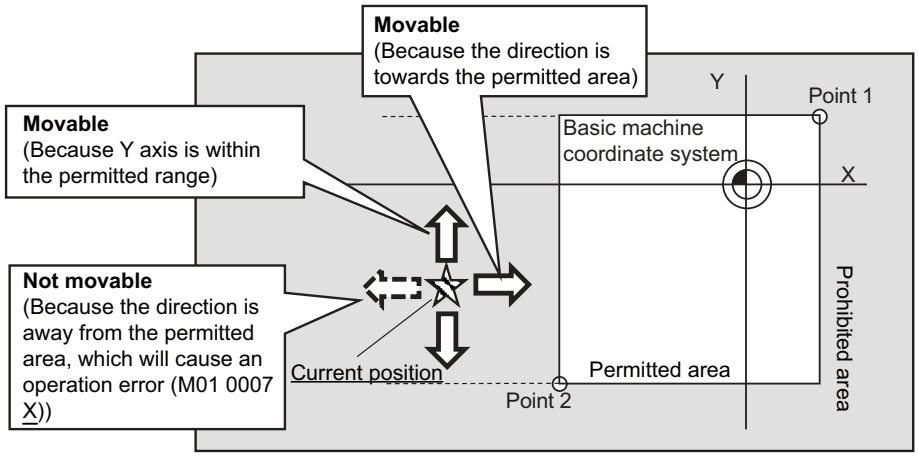
23.2.9 Behavior in Prohibited Area

23.2.9.1 Stored stroke limits I, IC, and II

When the tool has entered the prohibited area of stored stroke limit I, IC, or II, an operation error (M01 0007) occurs. When the operation error occurs, only the axis that is within the prohibited range is prevented from moving away from the permitted area.

In the example below, the X coordinate of the current position is within the prohibited range. So the movement in the X(-) direction is disabled because the direction is not towards the permitted area.

The Y coordinate of the current position is within the permitted range. So the movement in the Y direction is permitted within the permitted range even though the tool is inside of the prohibited area.

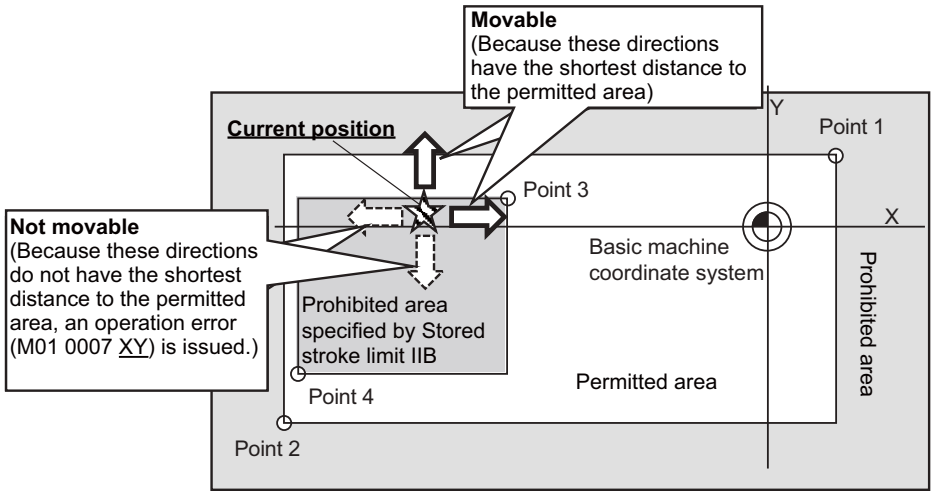


23.2.9.2 Stored stroke limits IB and IIB

For stored stroke limits IB and IIB, movement of the tool within the prohibited area can be disabled through the parameter "#1711 cfg11/bit1" (disabling movement in prohibited area of stored stroke limit IB/IIB).

When this parameter is on, each axis is allowed to move only in the direction that has the shorter distance to the permitted area. When an attempt is made to move an axis in the direction that has the longer distance to the permitted area, an operation error (M01 0007) is issued, which disables the movement.

The alarm can be canceled through NC reset or by moving the axis in the direction that has the shorter distance to the permitted area. The function of disabling movement in the prohibited area is supported by stored stroke limits IB and IIB. The function does not apply to the prohibited area of stored stroke limit I, IC or II.

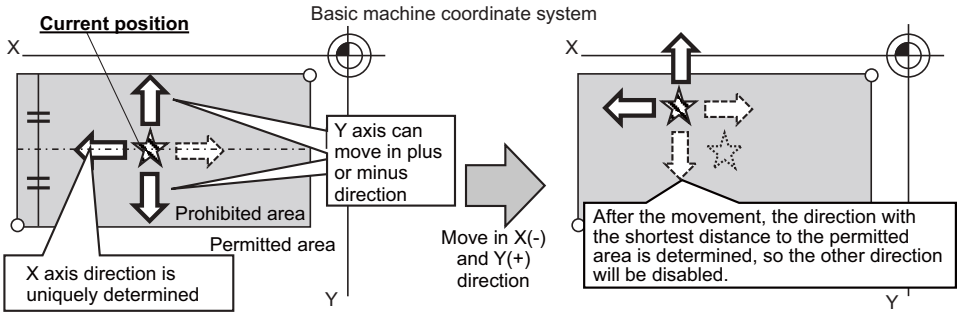


Precautions

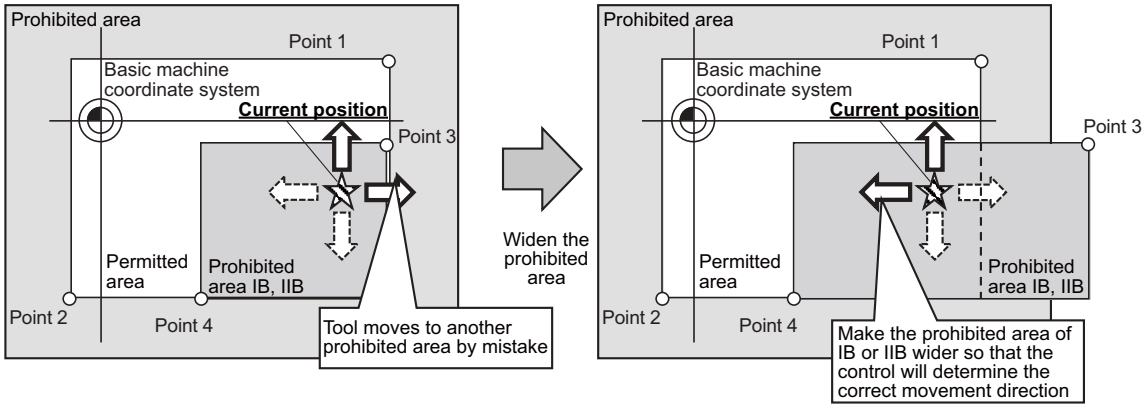
(1) The function of disabling movement in the prohibited area works while the tool is within the prohibited area of stored stroke limit IB or IIB.
The function does not disable any movement within the permitted area (including the boundary).

(2) All the axes for which the function disables movement are indicated in the alarm guidance.

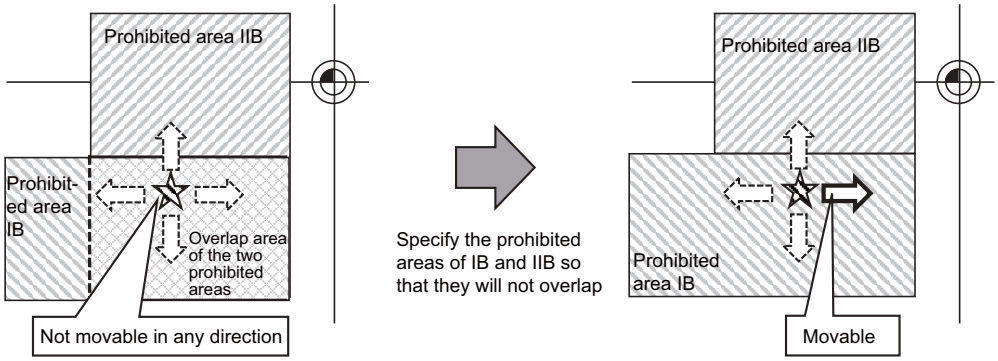
(3) If the tool is at the center of the prohibited area, as illustrated below, the distance to the permitted area in the positive direction is equal to that in the negative direction. In this case the tool can move in both directions. Note that when the direction that has the shorter distance to the permitted area is uniquely determined as a result of the tool movement, the function will disable movement in all the directions except for the said direction.



(4) If this function is used together with the stored stroke limit function that does not support this function, the tool may be allowed to move towards the prohibited area of the combined stored stroke limit function, as illustrated below. To prevent this, it is recommended to set the ranges of stored stroke limit IB and IIB to be large enough.



(5) As illustrated below, when stored stroke limit IB and IIB are used together, and the tool enters the overlap of the two prohibited areas, movement of the tool may be disabled. To prevent this, configure settings so that the prohibited areas of stored stroke limit IB and IIB will not overlap with each other. (If the tool has entered both prohibited areas due to an incorrect setting, disable stored stroke limit IIB to move the tool.)



23.2.10 Precautions

(1) If the maximum value and minimum value of the stored stroke limit's prohibited range are set to the same value, the following will occur.
   (a) When the maximum value and minimum value are set to "0", if the outside is the prohibited range, the entire range will be prohibited. If the inside is the prohibited range, the entire range will be the moveable range.
   (b) If data other than 0 is set for the maximum value and minimum value, the entire range will be the moveable range.

(2) The stored stroke limit IC is valid when the axis parameter #2063 is changed. If changed during automatic operation, the function will be validated after the smoothing for all axes reaches 0.

(3) Make sure that the lower limit value of the stored stroke limit IC setting value is "smaller than the upper limit value".

(4) To set the inside of the specified range as a prohibited range, set the parameters as follow:
EX. There are 2 methods to set 10° to 70° as a prohibited range.
[Method 1]
Set "70" to parameter "#2013 OT-" and "370" to parameter "#2014 OT+".
[Method 2]
Set "370" to parameter "#2013 OT-" and "70" to parameter "#2014 OT+".

24

Setting the Machine Error Compensation

24.1 Memory-type Pitch Error Compensation/Memory-type Relative Position Error Compensation

24.1.1 Outline

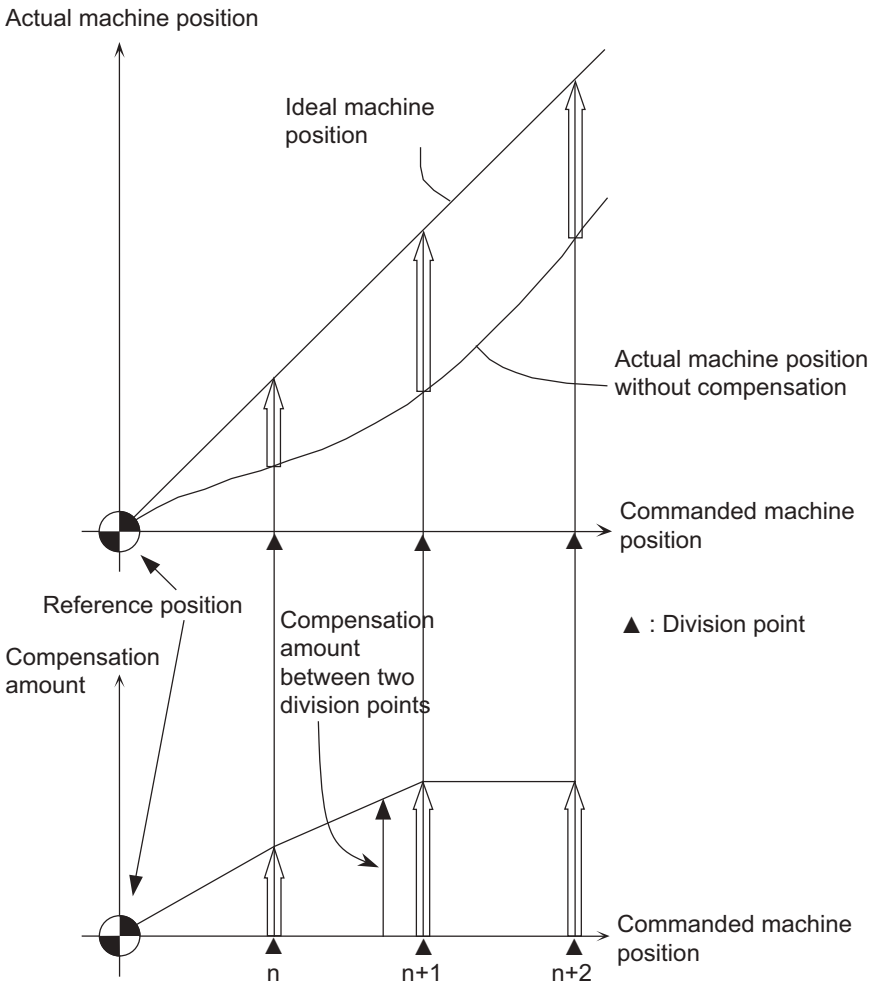
(1) Memory-type pitch error compensation

According to the specified parameters, this method compensates an axis feed error caused by a ball screw pitch error, etc.

You can set compensation amount for each division point obtained by equally dividing the machine coordinates based on the reference position. (See the figure below.)

The compensation amount can be set by either the absolute or incremental amount method. Select the method with "#4000 Pinc".

Machine position between division points "n" and "n+1" is smoothly compensated by the linear approximation of the compensation amount.



Relationship between the compensation amount and machine position

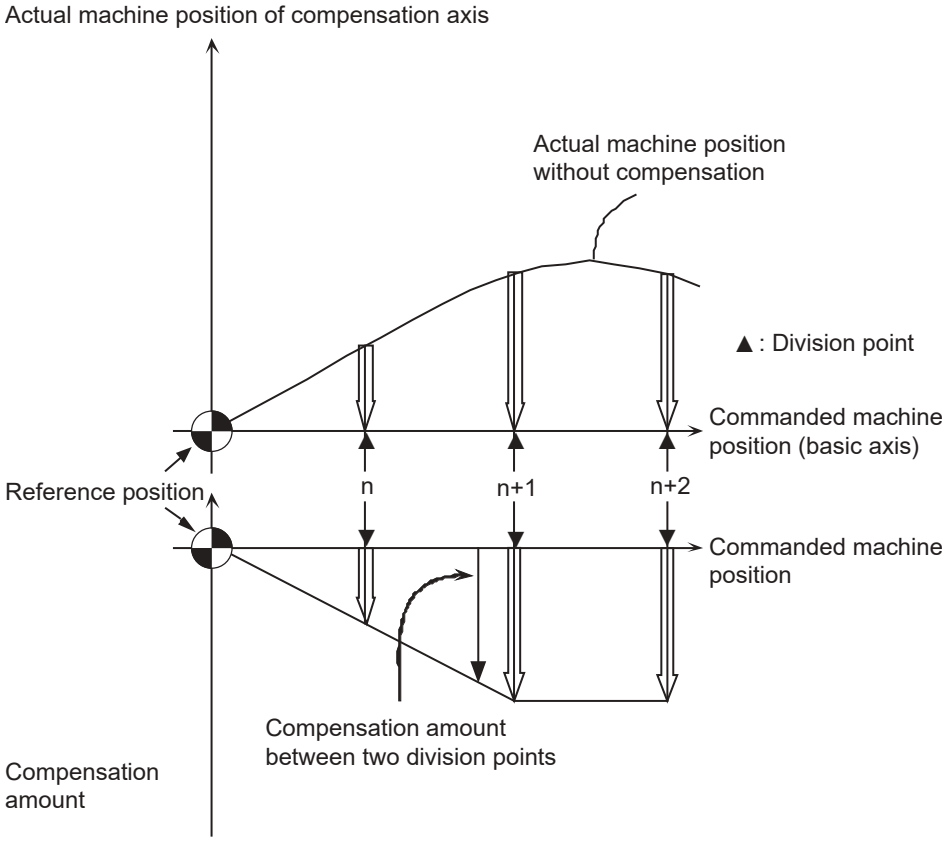
(2) Memory-type relative position error compensation

This function compensates the relative position error between two orthogonal axes caused by deflection of the moving according to the specified parameters.

You can set compensation amount in the compensated axis direction for each division point obtained by equally dividing the machine coordinates of the basic axis. (See the figure below.)

"Basic axis" refers to the one axis of two orthogonal axes on which relative position compensation is made. This axis is used as the criterion for relative-error measurement. "Compensation axis" refers to the coordinate axis that is orthogonal to the basic axis. The compensation is actually made for this coordinate axis.

Machine position between division points "n" and "n+1" is smoothly compensated by the linear approximation of the compensation amount.



Relationship between the compensation amount and machine position

24.1.2 Setting Compensation Data

There are two methods for setting the compensation data: absolute amount method and incremental amount method.

"#4000 Pinc" 0 : Absolute amount method
1 : Incremental amount method

(1) Absolute amount method

When you feed an axis from the reference position to each division point, calculate and set the compensation amount using the following formula.

Compensation amount = (Commanded position - Actual machine position) × 2

The unit of compensation amount depends on the setting of machine error compensation unit (parameter "#1006 mcmpunit").

The following shows examples when the parameter #1006 is set to "B".

(Example 1) Feeding an axis from the reference position to the position moved by +100 mm (See the left figure below.)

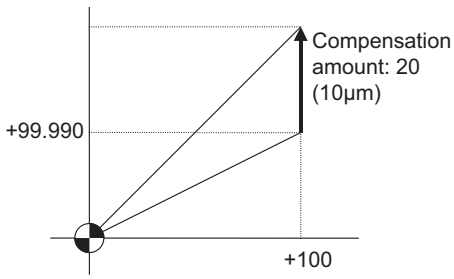
When the actual machine position is 99.990 mm, the compensation amount at the position moved by +100 mm is "20".

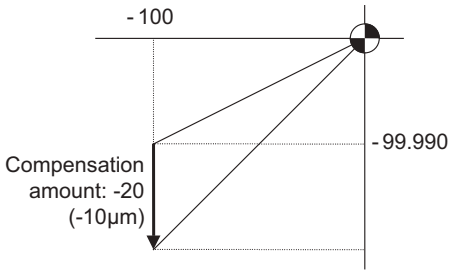
(100000 - 99990) × 2 = 20

(Example 2) Feeding an axis from the reference position to the position moved by -100 mm (See the right figure below.)

When the actual machine position is -99.990 mm, the compensation amount at the position moved by -100 mm is "-20".

(-100000 - (-99990)) × 2 = -20





(2) Incremental amount method

The compensation amount at the division point "n" is calculated for the axis that moves by "interval between division points" specified with #4007. The formula for calculating the compensation amount differs depending on whether the division point "n" is on the positive side or the negative side from the reference position.

[On the positive side]

Actual travel amount = (Actual machine position of division point "n")
- (Actual machine position of division point "n-1") (See the left figure below.)

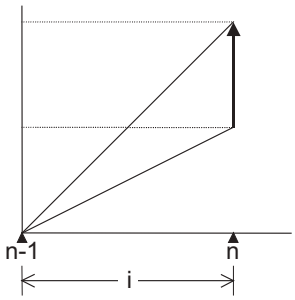
Compensation amount = (Interval between division points - Actual travel amount) × 2

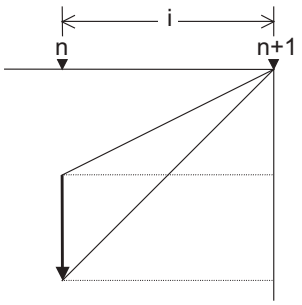
[On the negative side]

Actual travel amount = (Actual machine position of division point "n")
- (Actual machine position of division point "n+1") (See the left figure below.)

Compensation amount = (Interval between division points + Actual travel amount) × 2

In both cases, the unit of compensation amount depends on the setting of the machine error compensation unit (parameter "#1006 mcmpunit").





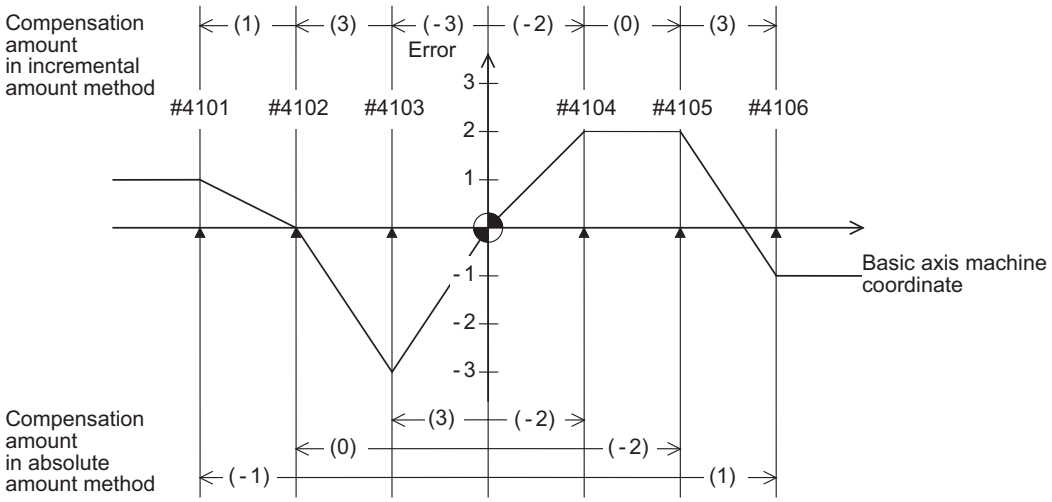
n : Division point compensation number
i : Division interval

Unit of compensation amount : Machine error compensation unit (#1006)
Range of compensation amount : -128 to 127

24.1.3 Setting Method

24.1.3.1 Using a Linear Axis as Basic Axis

(1) When "mdvno" or "pdvno" exists at both ends of "rdvno"

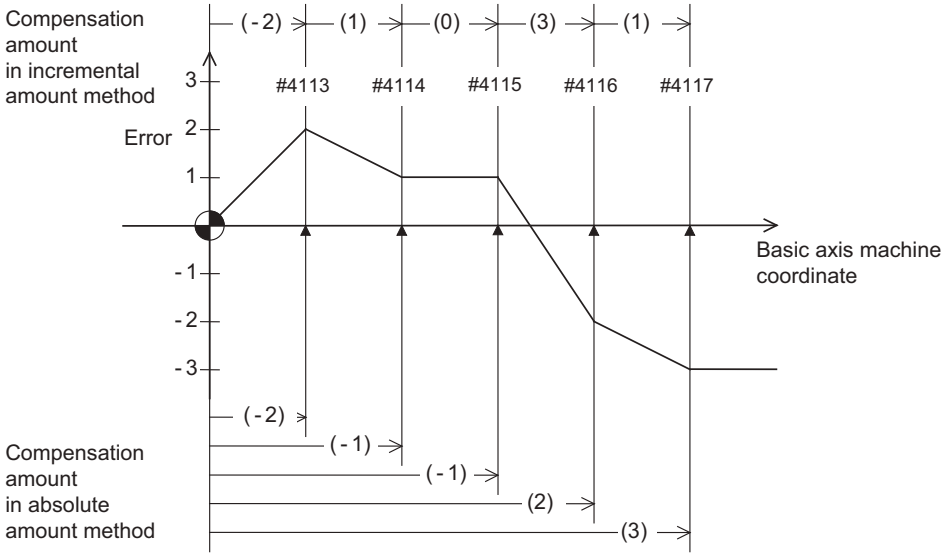


Division point number		#4101	#4102	#4103	#4104	#4105	#4106
Specified machine position		-300.000	-200.000	-100.000	100.000	200.000	300.000
Real machine position		-299.999	-200.000	-100.003	100.002	200.002	299.999
Compensation amount	Incremental amount method	2	6	-6	-4	0	6
	Absolute amount method	-2	0	6	-4	-4	2

rdvno	4103
mdvno	4101
pdvno	4106
spcdv	100.000

The compensation beyond the setting range ("mdvno" to "pdvno") will be based on the compensation amount at "mdvno" or "pdvno".

(2) When the range compensated is only the positive range

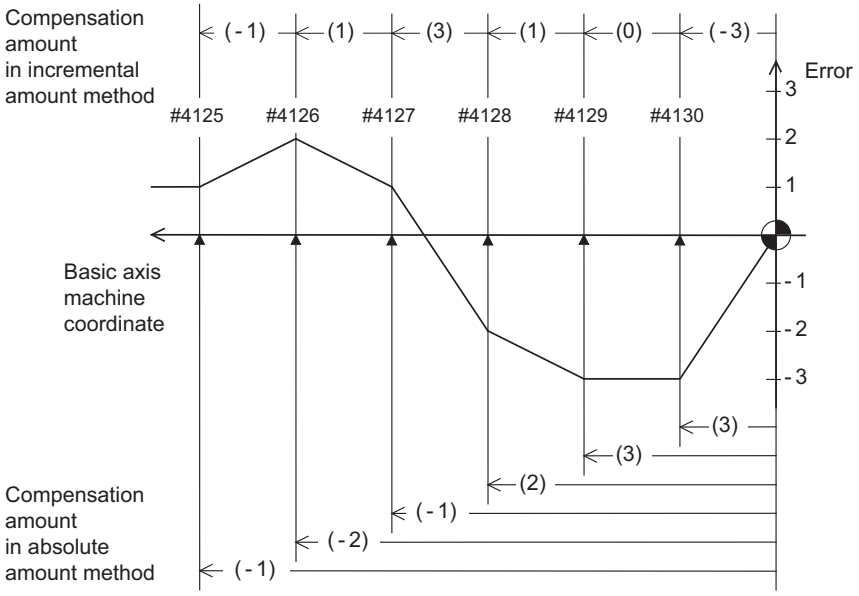


Division point number		#4113	#4114	#4115	#4116	#4117
Compensation amount	Incremental amount method	-4	2	0	6	2
	Absolute amount method	-4	-2	-2	4	6

rdvno	4112
mdvno	4113
pdvno	4117

When the machine position is beyond "pdvno", the compensation will be based on the compensation amount at "pdvno". If the machine position is on the negative side in this case, no compensation will be executed.

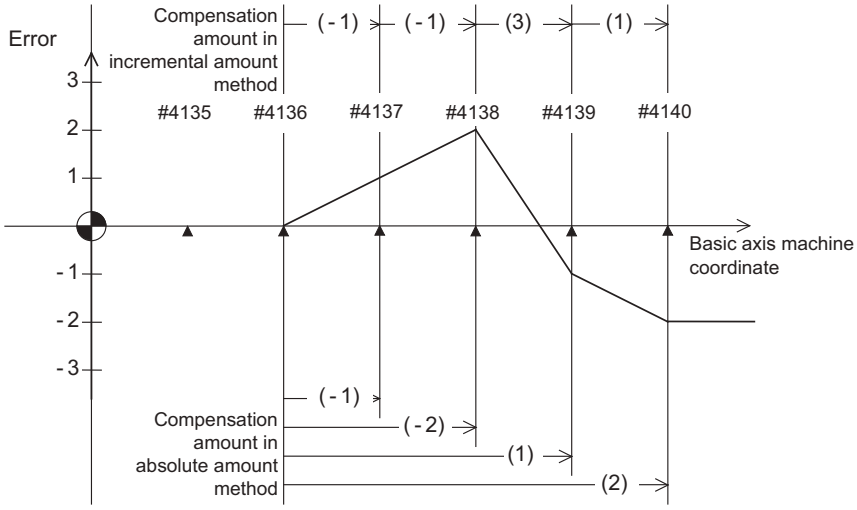
(3) When the range compensated is only the negative range



Division point number		#4125	#4126	#4127	#4128	#4129	#4130		rdvno	4130
Compensation amount	Incremental amount method	-2	2	6	2	0	-6		mdvno	4125
	Absolute amount method	-2	-4	-2	4	6	6		pdvno	4130

When the machine position is beyond "mdvno", the compensation will be based on the compensation amount at "mdvno".

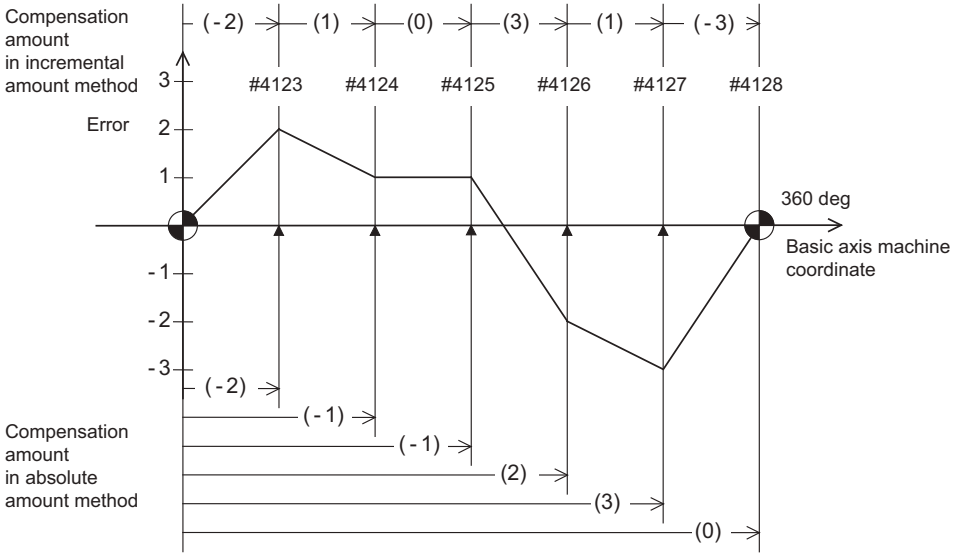
(4) When compensation is executed in a range that contains no reference position



Division point number		#4135	#4136	#4137	#4138	#4139	#4140		rdvno	4134
Compensation amount	Incremental amount method			-2	-2	6	2		mdvno	4136
	Absolute amount method			-2	-4	2	4		pdvno	4140

In this case, the compensation is executed in the range from "mdvno" to "pdvno".
This setting is also applied to the compensation executed in an range in which a machine position is negative and a reference position is not included.

24.1.3.2 Using a Rotary Axis as Basic Axis



Division point number		#4123	#4124	#4125	#4126	#4127	#4128		rdvno	4122
Compensation amount	**Incremental amount method**	-4	2	0	6	2	-6		mdvno	4123
	Absolute amount method	-4	-2	-2	4	6	0		pdvno	4128

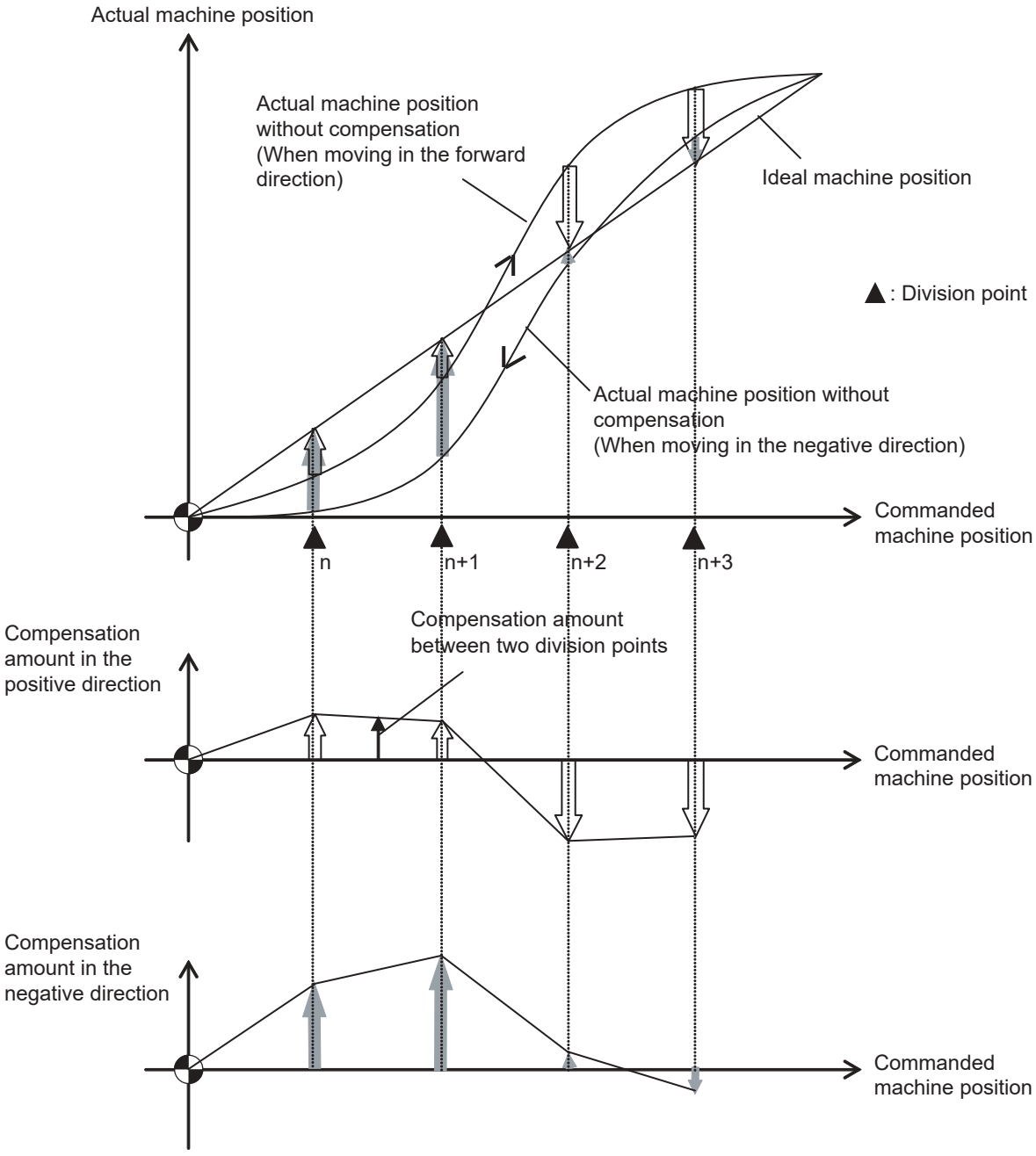
The sum of the compensation amounts set with the incremental amount method is always "0".

In the absolute amount method, the compensation amount at the terminal point (360 degrees) is always "0".

24.2 Bidirectional pitch error compensation

24.2.1 Outline

Compensation amounts can be set respectively for the movement in positive and negative directions, and compensation can be made for each direction. This method will reduce the difference between the path in the positive direction and path in the negative direction.
You can set the compensation amount for each division point obtained by equally dividing the machine coordinates based on the reference position. (See the figure below.)
The compensation amount can be set by either the absolute or incremental amount method. Select the method with "#4000 Pinc".
Machine position between division points "n" and "n+1" is smoothly compensated by the linear approximation of the compensation amount.



Relationship between the compensation amount and machine position

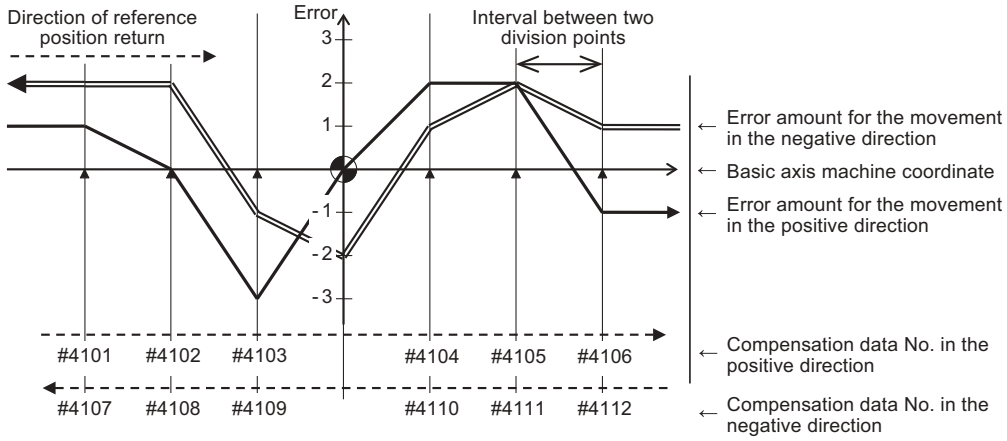
24.2.2 Setting Method

24.2.2.1 When the basic axis is a linear axis

This section describes how to set bidirectional pitch error data by taking the linear axis having a pitch error such as illustrated below as an example.

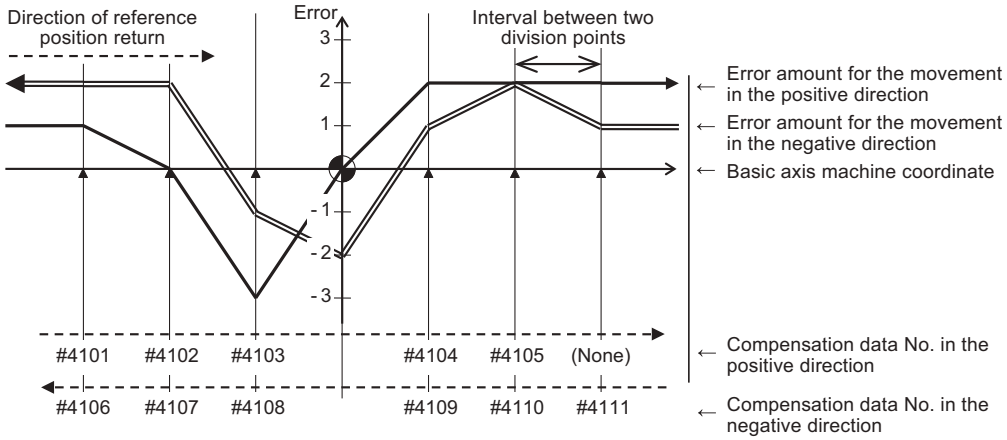
Allocating compensation No.

As shown in the figure below, compensation range is divided into equal intervals based on the reference position, and compensation data Nos. are allocated for each movement in positive and negative directions.
For both positive and negative directions, numbers are allocated from the division point on the most negative side toward the positive side. (The figure shows an example of allocating #4101 to # 4106 in the positive direction and #4107 to #4112 in the negative direction.)
No compensation data No. is allocated to the reference position.



Bidirectional pitch error (linear axis)

Make sure to allocate the same number of compensation data to division points for positive and negative directions. When the odd number of compensation data are set, compensation points allocated to the positive direction become one point less than that of the negative direction. For example, in the following figure, the division point indicated with "(None)" has no allocated compensation No. Accordingly, the compensation data of the previous compensation No. (#4105) is also used for the division point indicated with "(None)".



Bidirectional pitch error having odd number of compensation points (linear axis)

Setting parameters

(1) Set setting method for compensation amount to "#4000 Pinc".

#4000 setting value	Setting method
0 (absolute amount method)	This method sets the difference between the commanded position and the actual machine position of each division point as the compensation amount.
1 (incremental amount method)	This method sets the difference between the commanded travel amount and the actual travel amount when the axis moved from the adjacent division point as the compensation amount.

(2) Set the axis name to be compensated to "#4001 cmpax". Set the same axis name to "#4002 drcax" as well.

(3) Among the division points in the positive direction, set the compensation No. of the division point which is one point far from the reference position in the negative direction to "#4003 rdvno".

(4) Set the first and the last compensation Nos. allocated to division points to the parameters "#4004 mdvno" and "#4005 pdvno".

(5) Set the compensation magnification to "#4006 sc".

(6) Set the interval between two division points to "#4007 spcdv".

(7) Set "#4008 twopc" to "1". The function bidirectional pitch error compensation is enabled.

(8) For "#4009 refcmp", set the following compensation amounts after the measuring the actual machine position in "Setting pitch error compensation data".

[When the parameter "#2023 dir (-)" is set to "0"]

Compensation amount =

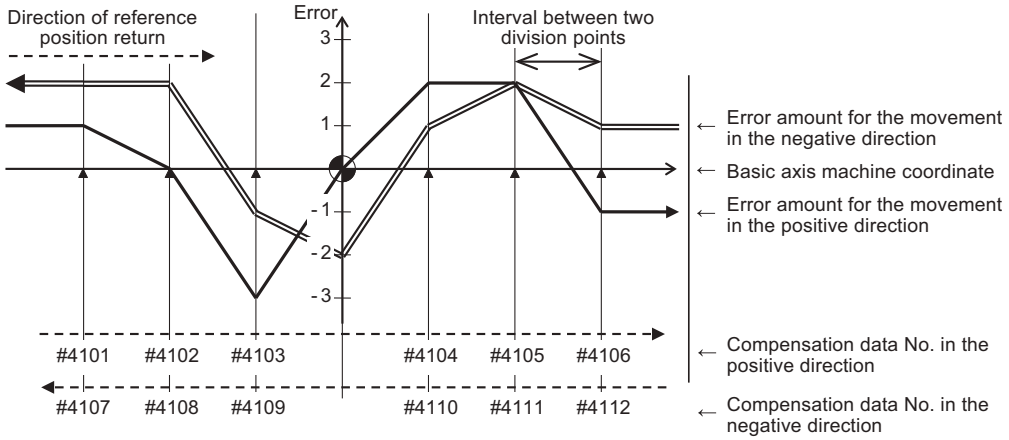
- (Actual machine position for the reference position when the direction of travel is negative) × 2

[When the parameter "#2023 dir (-)" is set to "1"]

Compensation amount =

- (Actual machine position for the reference position when the direction of travel is positive) × 2

In both cases, the unit of compensation amount depends on the setting of the machine error compensation unit (parameter "#1006 mcmpunit").



Bidirectional pitch error (linear axis)

[Parameter setting]

Parameter	#4001	#4002	#4003	#4004	#4005	#4006	#4007	#4008	#4009
	cmpax	drcax	rdvno	mdvno	pdvno	sc	spcdv	twopc	refcmp
Setting value	X	X	4103	4101	4112	1	10.000	1	4

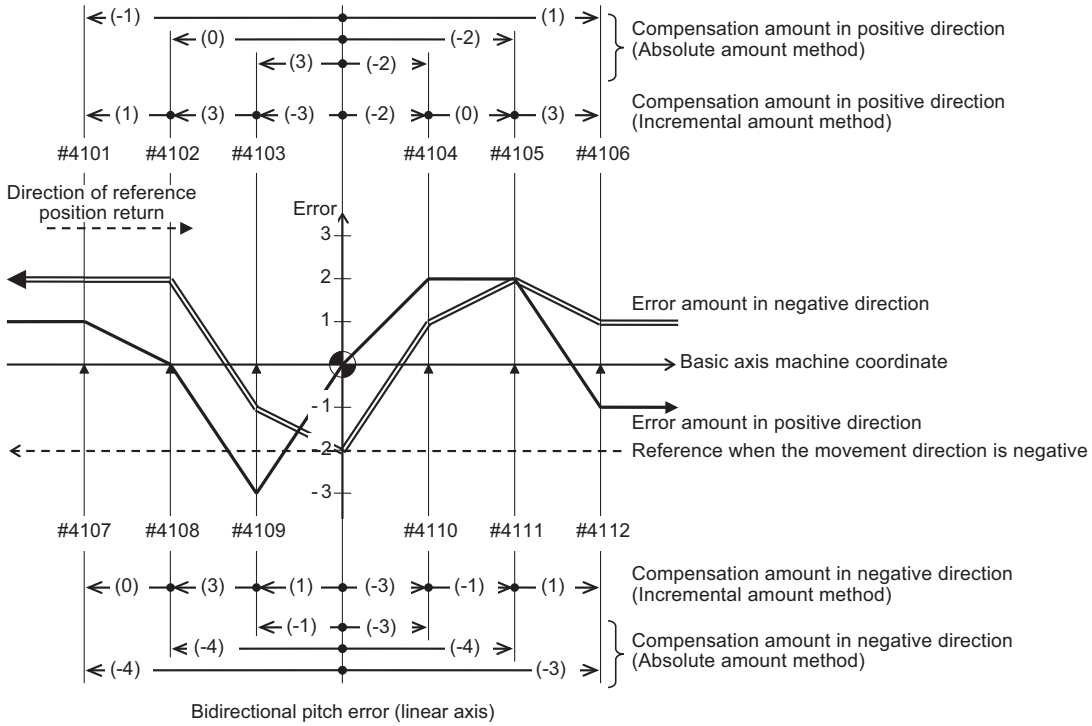
Setting pitch error compensation data

(1) Move the axis to positive or negative direction, then measure and record actual machine position of each division point. Calculate compensation amount for each division point based on the actual machine position.

#4000 setting value	Calculation method of compensation amount (*1)
0 (Absolute amount method)	Compensation amount = (Commanded machine position - Actual machine position) × 2
1 (Incremental amount method)	Calculate compensation amount at the division point "n" when the position moved by "interval between two division points" which was set to #4007. The calculation formula of the compensation amount differs depending on whether the division point "n" is on positive side or negative side from the reference position. [On the positive side] Actual travel amount = (Actual machine position of division point "n") - (Actual machine position of division point "n-1") Compensation amount = (Interval between two division points - Actual travel amount) × 2 [On the negative side] Actual travel amount = (Actual machine position of division point "n") - (Actual machine position of division point "n+1") Compensation amount = (Interval between two division points + Actual travel amount) × 2

(*1) Compensation amount unit depends on the setting of the machine error compensation unit (parameter "#1006 mcmpunit").

(2) Set the calculated compensation amount to the parameter of compensation No. allocated to each division point.



Bidirectional pitch error (linear axis)

[Compensation amount settings]

Movement direction		Positive						Negative					
Compensation data No.		#4101	#4102	#4103	#4104	#4105	#4106	#4107	#4108	#4109	#4110	#4111	#4112
Compensation amount	Incremental amount method	-2	0	6	-4	-4	2	-8	-8	-2	-6	-8	-6
	Absolute amount method	2	6	-6	-4	0	6	0	6	2	-6	-2	2

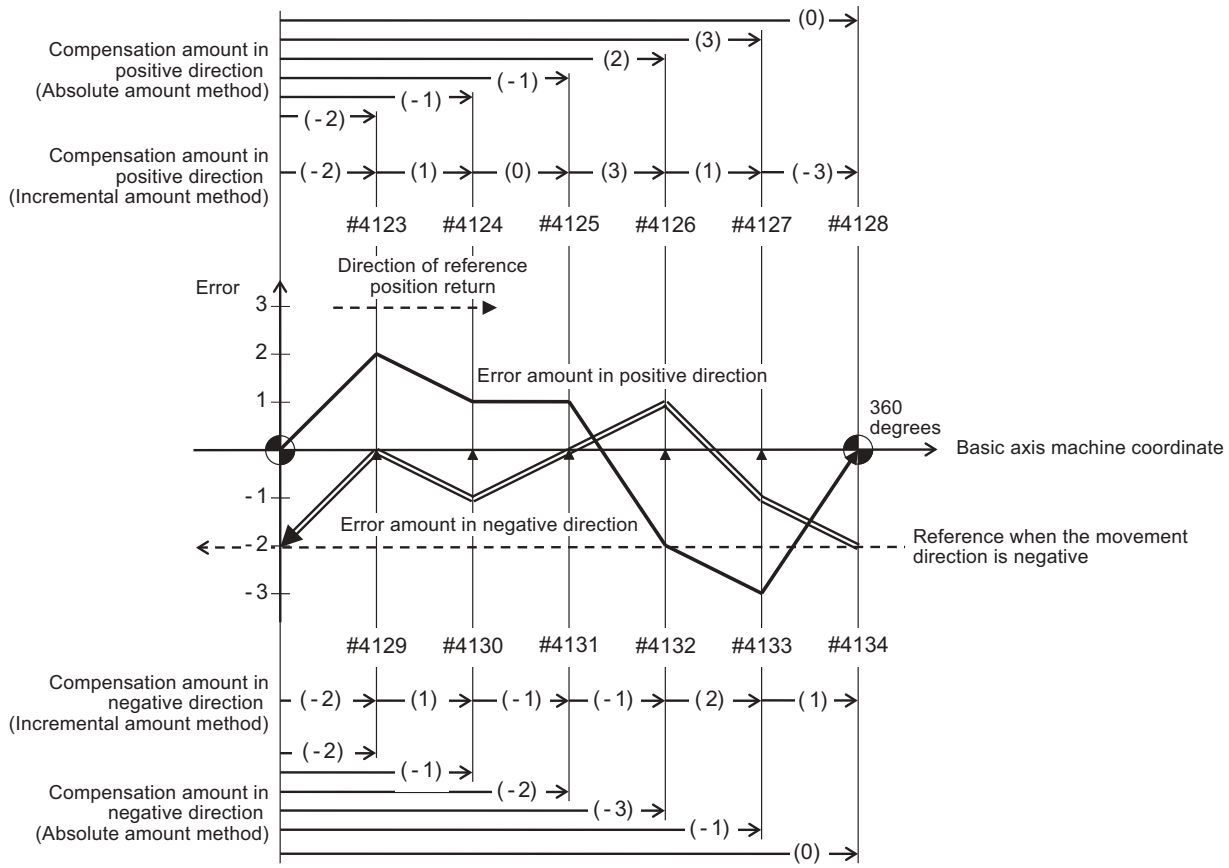
24.2.2.2 When the basic axis is a rotary axis

This section describes how to set bidirectional pitch error data by taking a rotary axis having a pitch error such as illustrated below as an example.

Set the pitch error compensation data for an rotary axis in the same way as a linear axis.

However, note the following points.

- Set the interval between two division points so that the last division point will be 360 degrees.
- The sum of compensation amount being set in the incremental amount method will always be "0".
- The compensation amount of the last point in the absolute amount method (360 degrees) will always be "0".



Bidirectional pitch error (rotary axis)

[Parameter settings]

Parameter	#4001	#4002	#4003	#4004	#4005	#4006	#4007	#4008	#4009
	cmpax	drcax	rdvno	mdvno	pdvno	sc	spcdv	twopc	refcmp
Setting value	C	C	4122	4123	4134	1	60.000	1	4

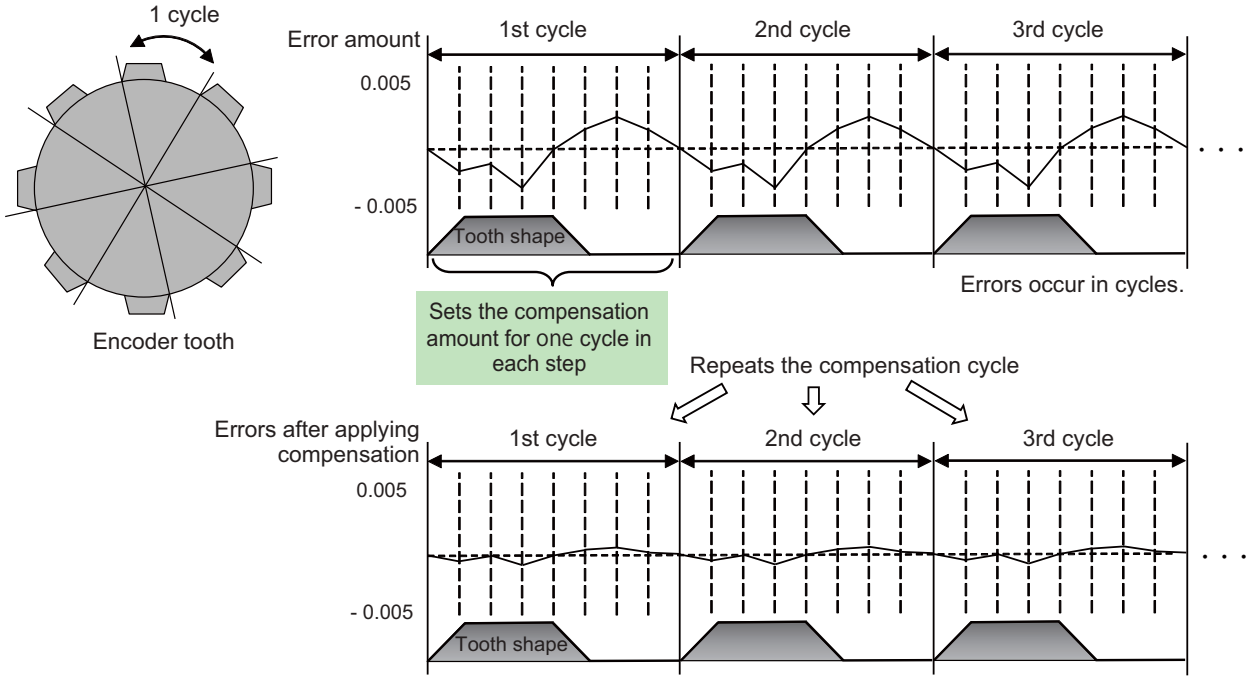
[Compensation amount settings]

Division point No.		#4123	#4124	#4125	#4126	#4127	#4128	#4129	#4130	#4131	#4132	#4133	#4134
Compensation amount	Incremental amount method	-4	-2	-2	4	6	0	-4	-2	-4	-6	-2	0
	Absolute amount method	-4	2	0	6	2	-6	-4	2	-2	-2	4	2
Movement direction		Positive						Negative					

24.3 Cyclic Error Compensation

24.3.1 Outline

When the machine operation induces certain cyclic errors, this function compensates a series of cyclic errors by setting the compensation amount for a single cycle.
Short-pitched compensation is possible for the errors occurring due to the tooth shape of the encoder.
You can set the period of the error cycle, the number of steps in the cycle (up to 128 steps), and the compensation amount at each step by the parameter.



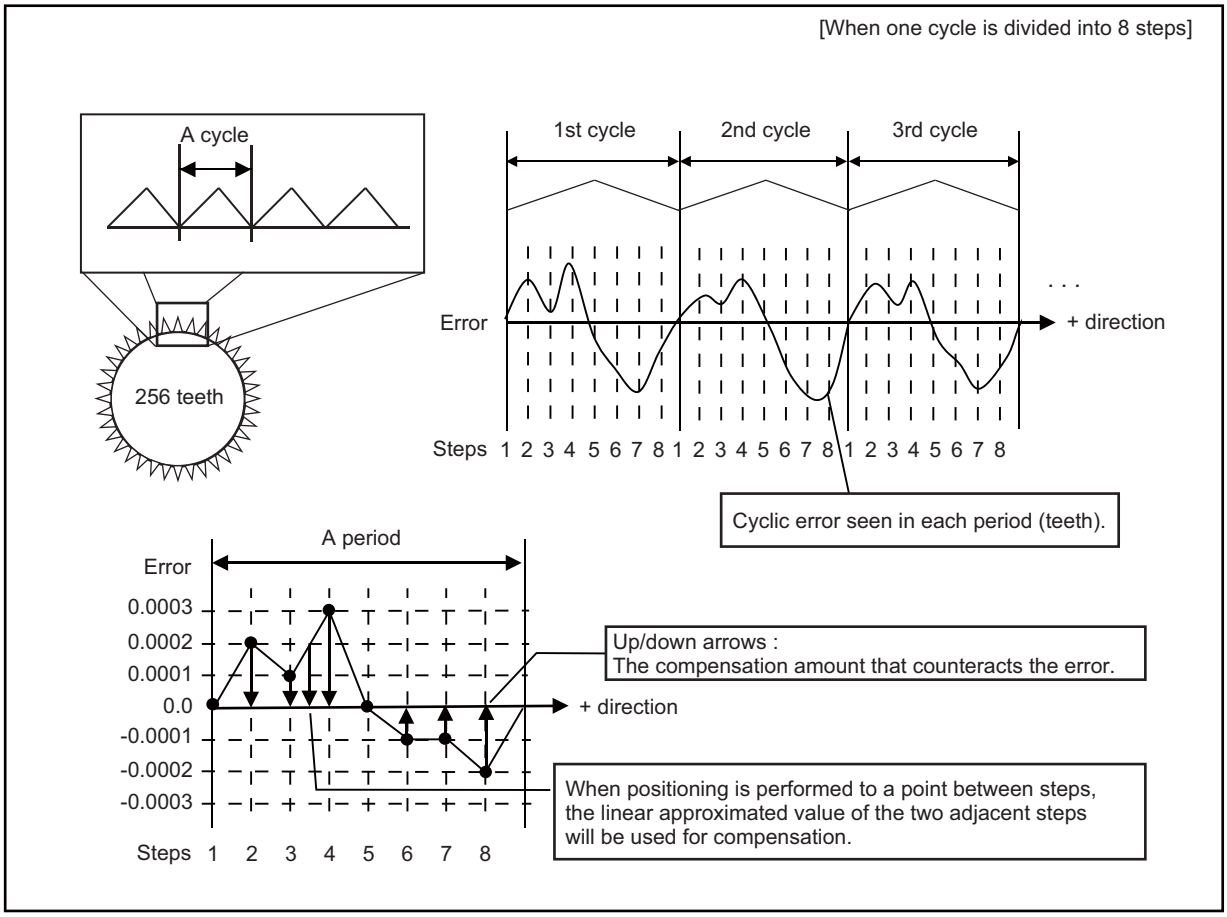
[Enabling Conditions]

- The cyclic error compensation specifications must be enabled, and the parameter "#2585 Cyccmp" (Enable cyclic error compensation) must be set to "1".
- This function is only available in CNC-controlled axes. It is not available in PLC-controlled axes.
  Switch to C axis mode for spindle position control when applying this function to the spindle.
- This function is only available in rotary axes. It is not available in linear axes.
  The parameters related to the rotary axis must be as follows;

Parameter	Setting value
#1017 rot (rotary axis)	1
#2218 PIT (ball screw pitch)	360
#2070 div_RT (rotational axis division count)	360 or 0

24.3.2 Setting Method

This function divides one error cycle into multiple steps and compensates at each step. Positions between steps are also compensated by the linear approximation of the values at each step.
For example, as shown in the figure below, when similar errors occur at each tooth of a gear with 256 teeth, one tooth is regarded as one cycle, and the compensation amount at each step within a cycle is specified. Specify a value that counteracts the effect of the errors to the compensation amounts. By using the same compensation amounts for each tooth, the errors of the whole gear can be compensated.



Before setting parameters, refer to the next section "Error Measurement" for measuring errors.

(1) The compensation amount is the value whose sign is reversed to counteract the effect of the errors.
(2) Set compensation amounts as absolute values. Do not set relative values.
(3) The compensation amounts stored in the locations specified from "Cyclic error compensation: initial number of compensation" (#2586 Cycstnum) to "Cyclic error compensation: number of divisions" (#2587 Cycdv) are used.
(Note) This parameter setting uses the parameters that are also used by memory-type pitch error compensation (#4101-5999, #44001-47712). Ensure that no parameter overlapping occurs when choosing the number of the parameter.
(4) The unit of this compensation amount is 1/10000°.

Parameter Setting Example

This section takes the example shown in the figure on the previous page (When the gear has 256 teeth and one cycle is divided into 8 steps) to describe the parameter setting procedure.

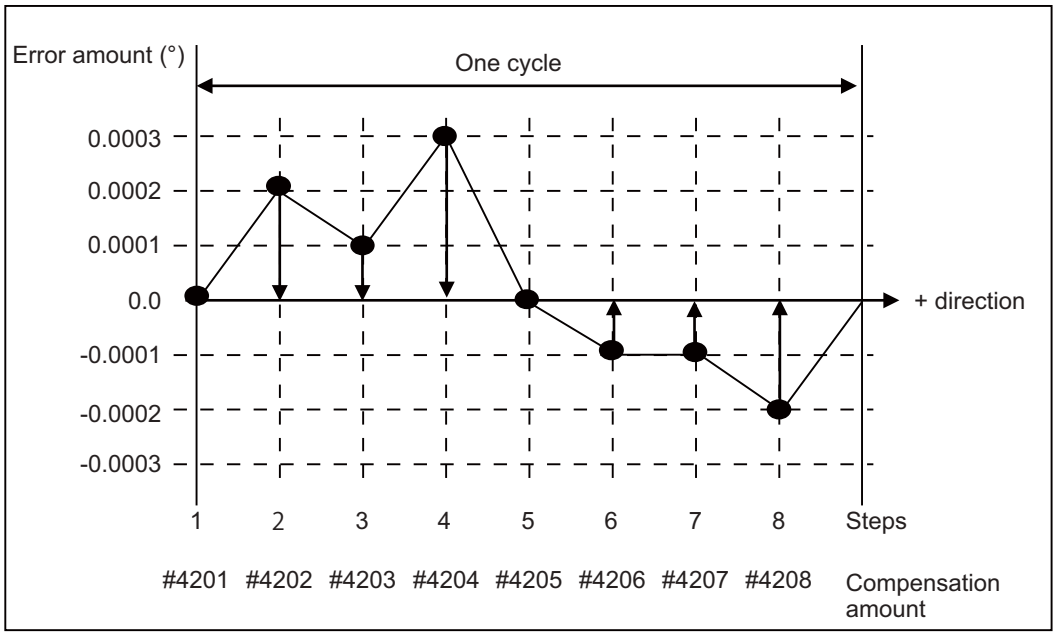
< Axis specifications parameters >

Parameter		Setting value	Details
#2585	Enable cyclic error compensation	1	Compensation enabled.
#2586	Cyclic error compensation: initial number of compensation	4201	Starts from the parameter #4201.
#2587	Cyclic error compensation: number of divisions	8	Occupies eight parameters. (One-error cycle is divided into 8 steps.)
#2588	Cyclic error compensation: cycle constant	256	One gear has 256 cycles.

< Error data >

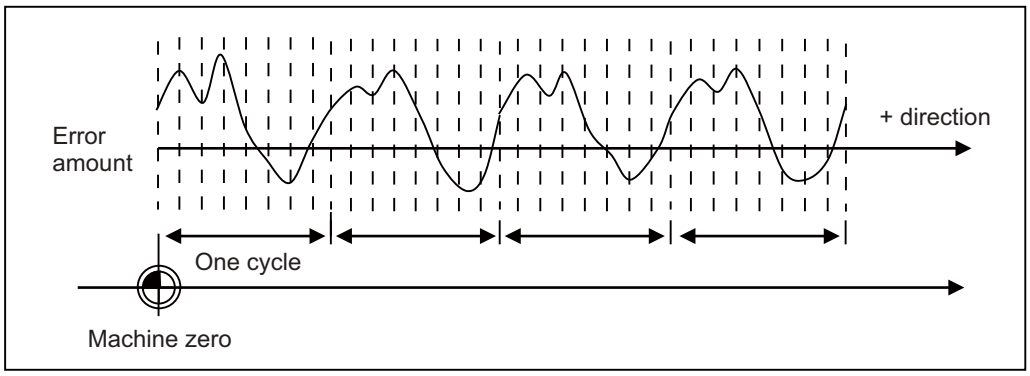
Step No.	#4201	#4202	#4203	#4204	#4205	#4206	#4207	#4208
Value configured (Compensation amount)	0	-2	-1	-3	0	1	1	2

< Compensation amount setting example (When one cycle is divided into 8 steps) >



24.3.3 Error Measurement

This function performs compensation based on the position deviation related to the machine zero. When you measure errors, disable all types of compensation (such as pitch error compensation, backlash compensation), and also the functions accompanied by the offset of the coordinate system such as workpiece coordinate system offset. Then start the measurement with the start point of the error cycle matching the machine zero.
For machines that configure the reference position shift distance (#2027 G28sft), first set the value of #2027 prior to measuring the error.



24.3.4 Precautions

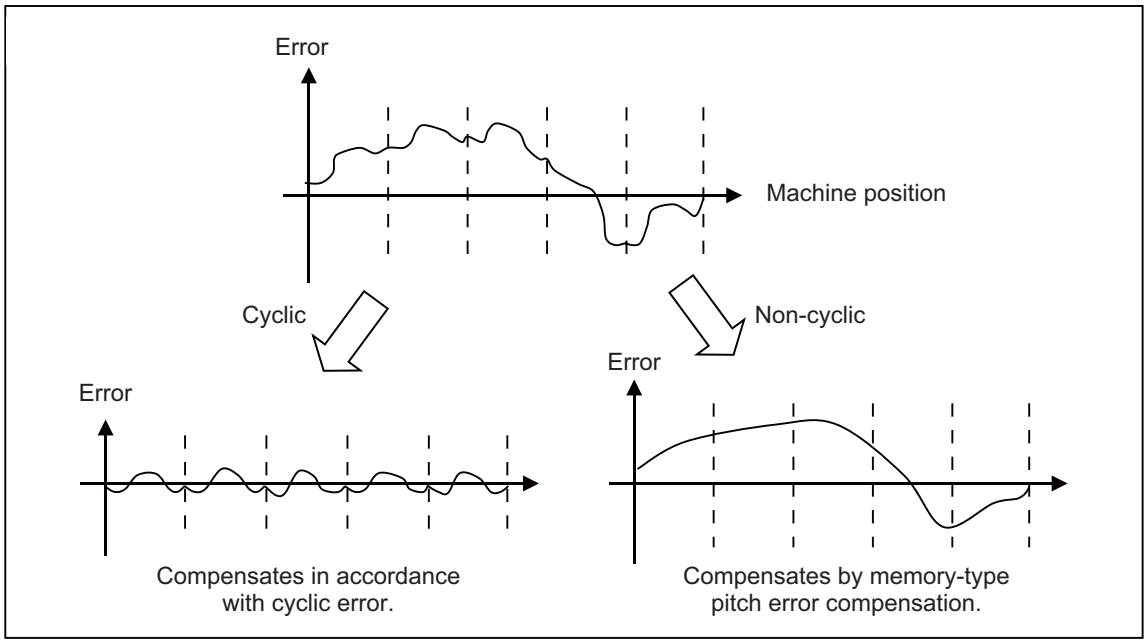
(1) The updates regarding the compensation amount of this function are immediately reflected to the operation. Note that large compensation amounts might cause sudden machine vibration.
(2) This function starts compensating after the zero point is established.
When the zero point has not been established, this function is not available even if the parameter is set to Enabled.
(3) As changing the reference position shift distance (#2027 G28sft) changes the position of the machine zero, compensation amounts need to be configured again.
When the coordinate system offset has been performed for functions such as workpiece coordinate system offset and reference position #1 (#2037 G53ofs), it is not necessary to configure the compensation amounts again if each of them have already been appropriately configured relative to the machine zero.
(4) This function uses the same parameters as functions such as memory-type pitch error compensation when configuring compensation amounts (#4101-#5999). Ensure that no parameters are set incorrectly.
(5) When the settings used exceed the parameter setting range in "Cyclic error compensation: initial number of compensation" (#2586 Cycstnum) and "Cyclic error compensation: number of divisions" (#2587 Cycdv), the compensation configured for the axis is not enabled.
Example: Compensation start No. is 5995, and division No. is 16 .
(exceeds the range of parameter number, #5999)

24.3.5 Relation with Other Functions

(1) Memory-type Pitch Error Compensation

This function can be used simultaneously with the memory-type pitch error compensation.

As shown in the figure below, when the error profile consists of both cyclic errors and non-cyclic errors, a higher accuracy of compensation can be achieved by combining the memory-type pitch error compensation and this function.



25

Setting the Position Switches

25.1 Outline

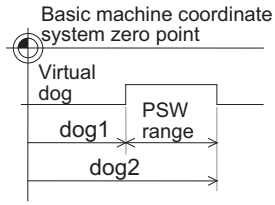
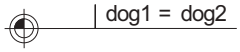
Position switches (PSW) are used as alternatives for the dog switches provided on the machine axis. Virtual dog switches can be used by specifying axis names and conditions of virtual dog positions. This function outputs a signal to the PLC interface when the machine reaches the specified area. The virtual dog switches are called "position switches" (PSW).

Position switch Nos. of PSW1 to PSW24 and signal devices

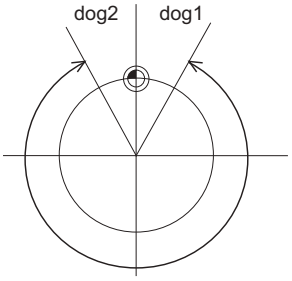
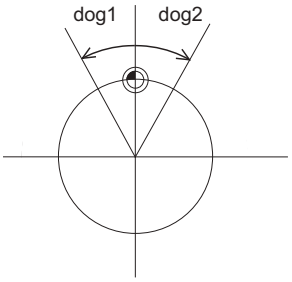
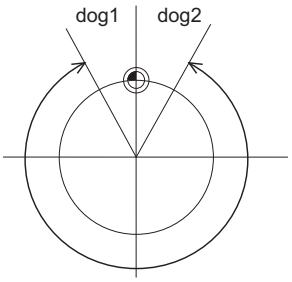
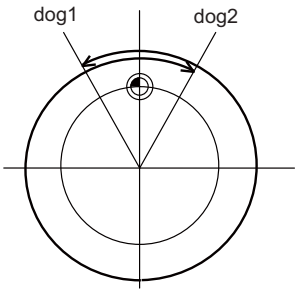
	<axis>	<dog1>	<dog2>	<check>	Part system 1	Part system 2
PSW1	#7501	#7502	#7503	#7504	X1D00	X1D20
PSW2	#7511	#7512	#7513	#7514	X1D01	X1D21
PSW3	#7521	#7522	#7523	#7524	X1D02	X1D22
PSW4	#7531	#7532	#7533	#7534	X1D03	X1D23
:	:	:	:	:	:	:
PSW24	#7731	#7732	#7733	#7734	X1D17	X1D37

Position switches (PSW1 - PSW24) are used to set virtual dog coordinates (dog1 and dog2) on the coordinate axes, whose names are preset with <axis>, as alternatives for the dog switches provided on the machine axis.
When the machine reaches the specified area, a signal is output to the corresponding device of the PLC interface.
Whether the machine has moved into the area specified with the position switches can be judged at high speed by setting parameters.
To judge the entry of the machine to the area, set parameters to select which type of position to be used for each position switch from the following: commanded machine position or feed back position from encoder.
For description of the parameter, refer to "Alarm/Parameter Manual".

25.2 Setting and Operation Examples of dog1 and dog2

Settings of dog1 and dog2	Positions of dog1 and dog2	Description	
dog1 < dog2		A signal is output when the machine reaches between dog1 and dog2.	
dog1 > dog2		A signal is output when the machine reaches between dog2 and dog1.	
dog1 = dog2		A signal is output when the machine is at dog1 (dog2).	

For rotary axes

Settings of dog1 and dog2	Positions of dog1 and dog2		Description
dog1 < dog2		(Example) dog1 = 30.000 dog2 = 330.000	A signal is output when the machine reaches between dog1 and dog2.
		(Example) dog1 = -30.000 dog2 = 30.000	Signal is output in the same manner even if dog1 is in the negative area.
dog1 > dog2		(Example) dog1 = 330.000 dog2 = 30.000	A signal is output when the machine reaches between dog2 and dog1.
dog1 ≦ 0 and 360 ≦ dog2		(Example) dog1 = -30.000 dog2 = 390.000	A signal is always output when the angle of dog1 and dog2 is within a range of 0 to 360 degrees.

25.3 Canceling the Position Switch

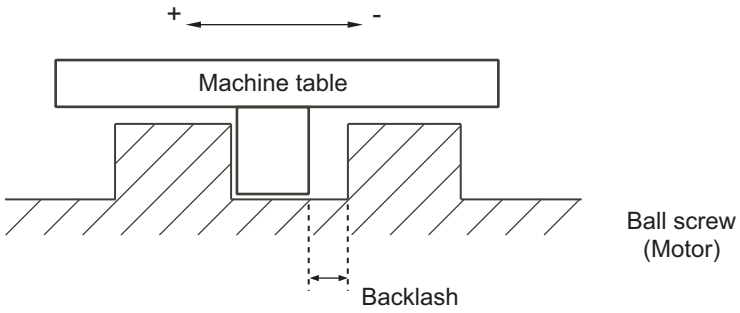
Enter a position switch number to be canceled (#75*1) in "# ( )" and a slash in "DATA ( )" on the setting field, then press the [INPUT] key. Axis name of the specified position switch will be deleted, and the position switch is disabled. However, the data in <dog1> and <dog2> are still retained in a memory. To enable the position switch again, only an axis name is required for setting.

26

Setting the Backlash Compensation

26.1 Backlash Compensation

Travel amount of a machine table may become less than the commanded amount due to the error (backlash) caused by reversal of the direction of the axis.
The backlash compensation is a function which automatically adds compensation amount to the travel amount when the direction of the axis is reversed.



There are two types of backlash compensation as follows.

(1) G0 backlash (#2011 G0back)
Compensation amount that is used when an axis moved at the rapid traverse speed (G0).
Compensation amount is also measured at rapid traverse speed.

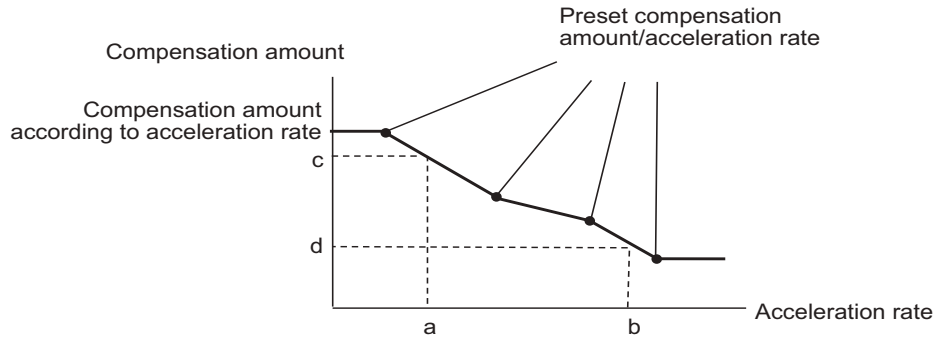
(2) G1 backlash (#2012 G1back)
Compensation amount that is used when an axis moved at cutting feedrate (G1, G2, G3).
Compensation amount to be set is measured using the most commonly used feedrate.

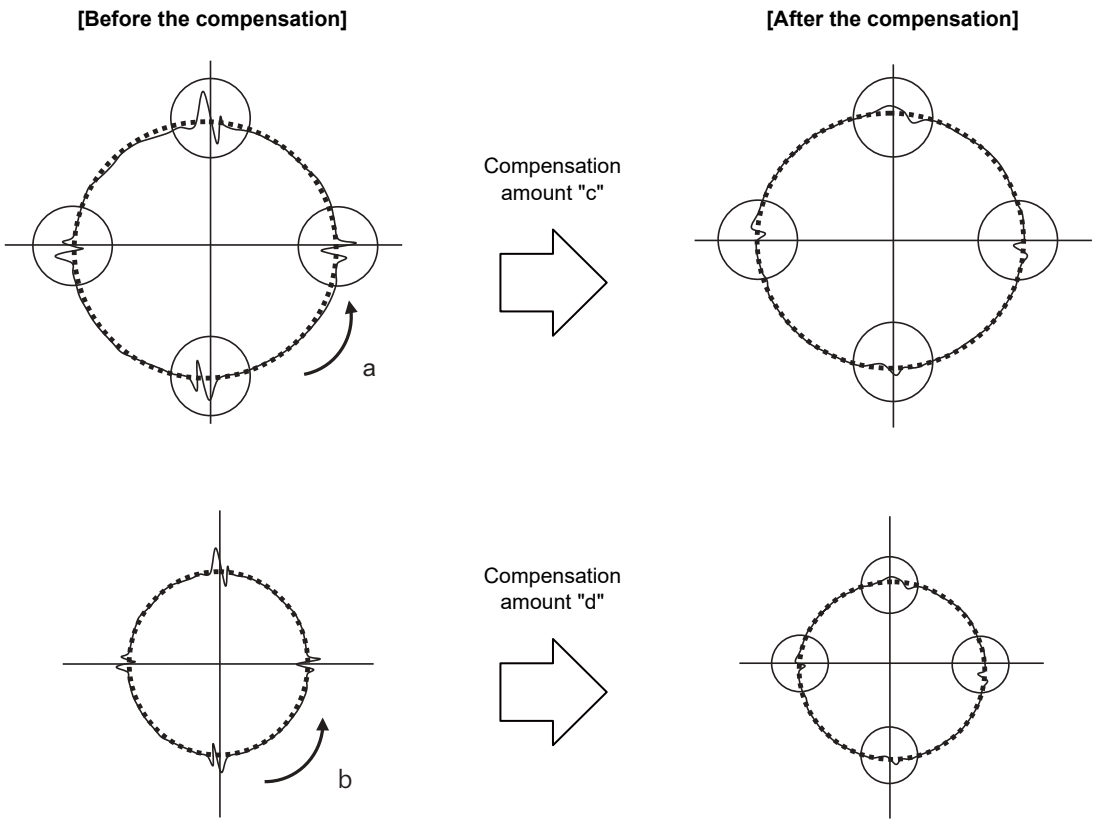
26.2 Backlash Compensation II

This function reduces quadrant error caused by the backlash when the traversing direction is reversed in machines where semi-closed loop control is implemented.

Acceleration rate at axis direction reversal varies depending on the change of circular radius and commanded speed at machining.
The most appropriate compensation amount also changes at the point. Accordingly, in the function "backlash compensation II", up to four compensation amounts are set for each axis for each different acceleration rate, and compensation amounts are calculated corresponding to each acceleration rate. Through the above procedures, quadrant projections are suppressed.

Compensation based on the acceleration rate at a direction reversal improves machining accuracy. For the range between the acceleration rates defined in parameters, the error is compensated using the compensation amount obtained through linear interpolation.





26.2.1 Enabling Conditions for Backlash Compensation II

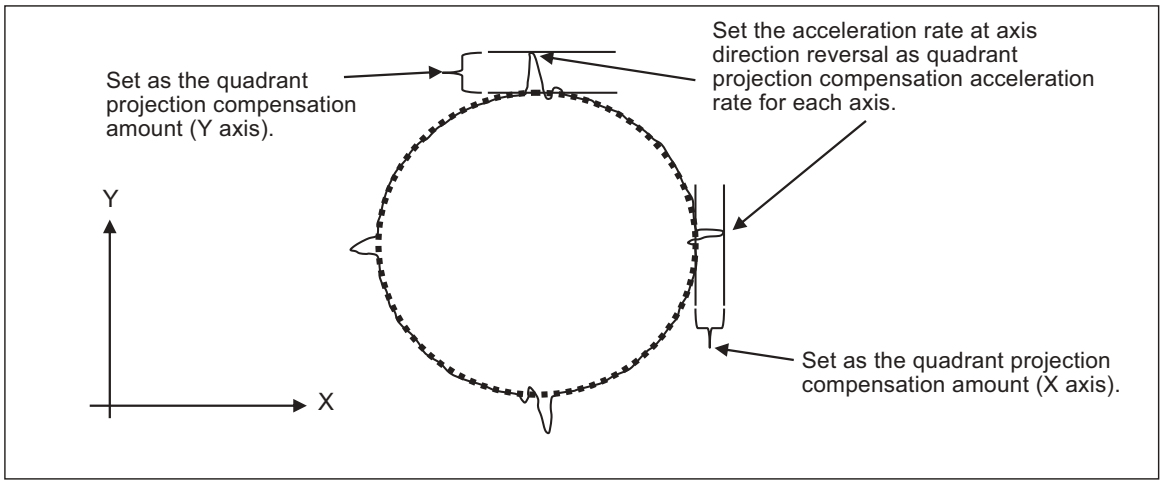
Backlash compensation II is enabled when all the following conditions are satisfied.

(1) Backlash compensation II option is ON.
(2) Parameter "#14360 valBL2" (backlash compensation II valid) is ON.
(3) Parameter "#14361 BL2_a1" (backlash compensation II acceleration rate 1) is other than "0".

Backlash compensation II can be specified valid/invalid status for each axis.

26.2.2 Procedure of Setting Backlash Compensation II

To set backlash compensation II parameters, measure up to four acceleration rates and quadrant projection sizes at axis direction reversal, changing settings such as circular radius and commanded speed.
Set the compensation patterns measured when a direction of the axis reversed to backlash compensation II acceleration rate 1 to 4 and backlash compensation amount II 1 to 4.



Setting acceleration rate and compensation amount

26.2.2.1 Setting the backlash compensation II acceleration rate

For the backlash compensation II acceleration rate, set the acceleration rate ($\mu m/s^2$) at reversal of direction of the axis on which compensation to be performed.
Up to four backlash compensation II acceleration rates can be set for each axis.

Backlash compensation II acceleration rate 1: "#14361 BL2_a1"
Backlash compensation II acceleration rate 2: "#14363 BL2_a2"
Backlash compensation II acceleration rate 3: "#14365 BL2_a3"
Backlash compensation II acceleration rate 4: "#14367 BL2_a4"

Set the backlash compensation II acceleration rate 1 to 4 in ascending order.
When the number of compensation patterns is less than four, set "0" for the parameters of the acceleration rates which are not used.
For example, when there are three compensation patterns, set the parameter "#14367 BL2_a4" to "0".

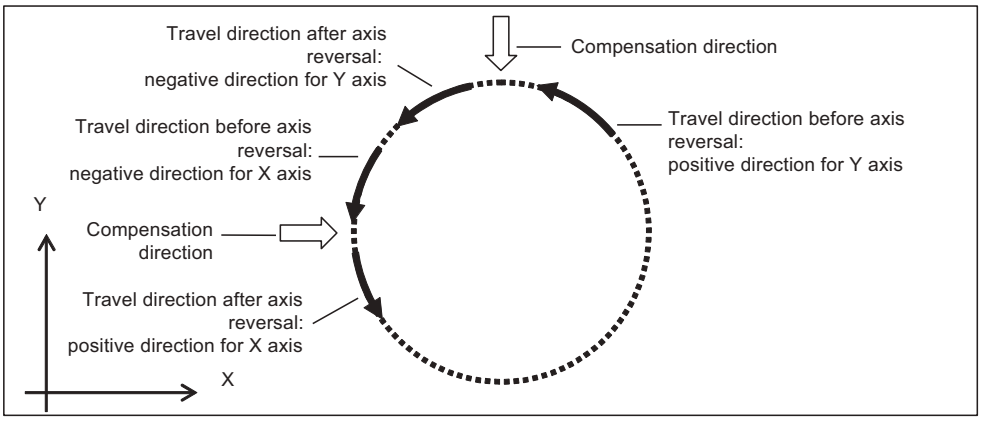
26.2.2.2 Setting compensation amount of backlash compensation II

For the backlash compensation II compensation amount, set the size of projection which is generated at axis direction reversal.
For the unit of compensation amount, follow the setting of "#1006 mcmpunit" (Machine error compensation unit).

Backlash compensation II compensation amount 1: "#14362 BL2_c1"
Backlash compensation II compensation amount 2: "#14364 BL2_c2"
Backlash compensation II compensation amount 3: "#14366 BL2_c3"
Backlash compensation II compensation amount 4: "#14368 BL2_c4"

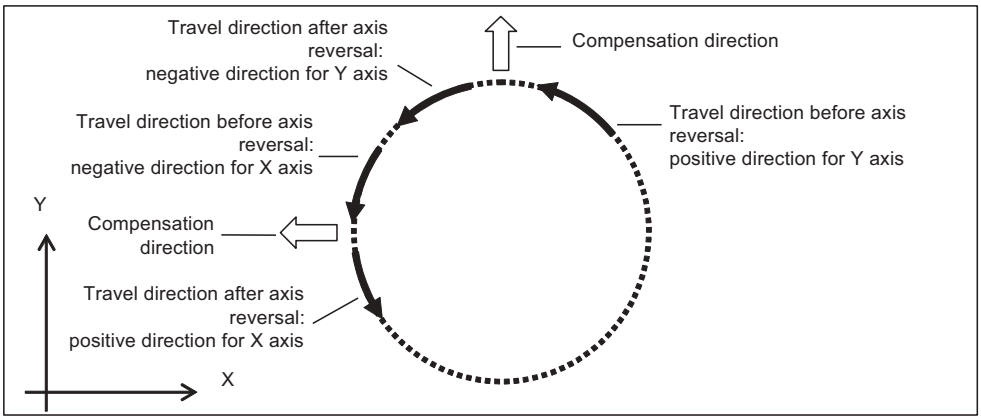
Set compensation amounts corresponding to acceleration rates which have been set in the previous chapter "Setting the backlash compensation II acceleration rate" for the parameters above.
For example, set a compensation amount which corresponds to backlash compensation II acceleration rate 2 for "#14364 BL2_c2.".

When a positive value is set as the compensation amount, compensation is performed in the travel direction of the axis after axis reversal.



Compensation direction with a compensation amount set to a positive value

When a negative value is set as a compensation amount, compensation is performed in the travel direction of the axis before axis reversal.



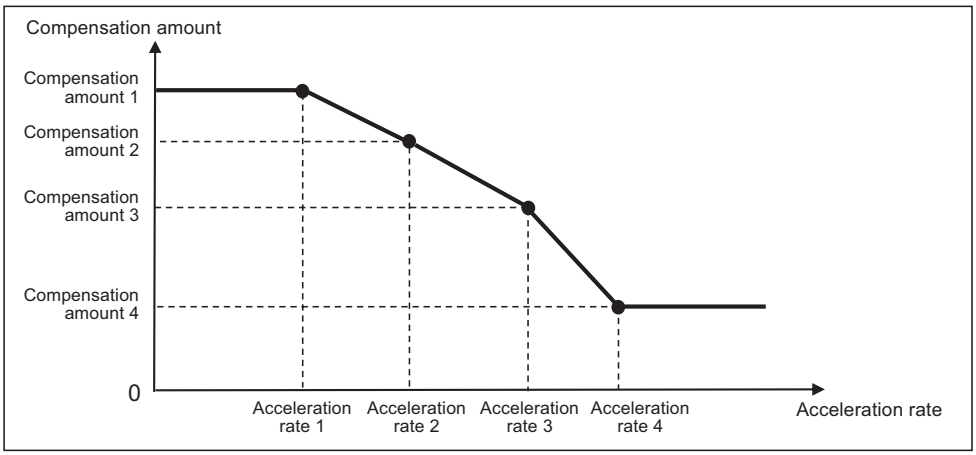
Compensation direction with a compensation amount set to a negative value

26.2.2.3 Precautions for setting parameters

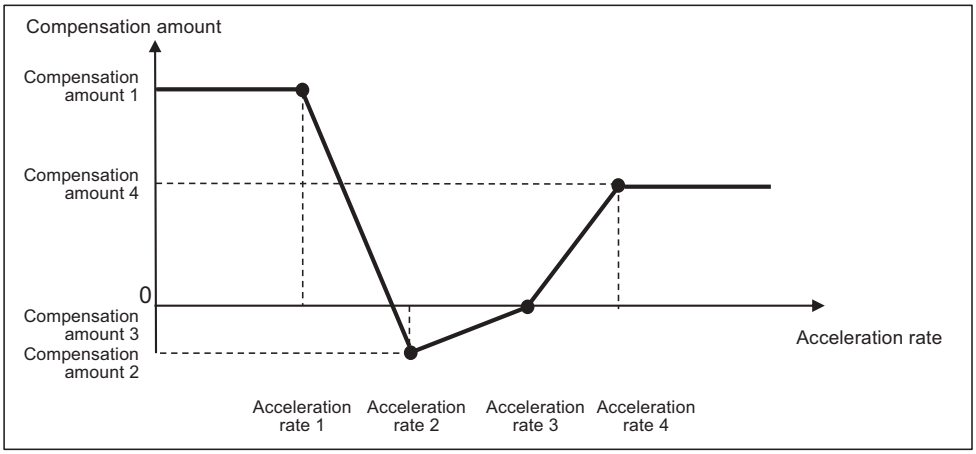
For the backlash compensation II acceleration rates, set a value greater than "0" from acceleration rate 1 to 4 in ascending order.
Parameters are enabled when the backlash compensation II acceleration rates are set in ascending order.
The following describes the relationship between setting patterns and parameters to be enabled.

(1) When the value of acceleration rate 1 is greater than "0", and the values of acceleration rate 1 to 4 are in ascending order

The following shows the setting which has four measured compensation patterns.
Acceleration rate 1 to 4 and compensation amount 1 to 4 are all valid, and these values are used for calculating the compensation amounts.



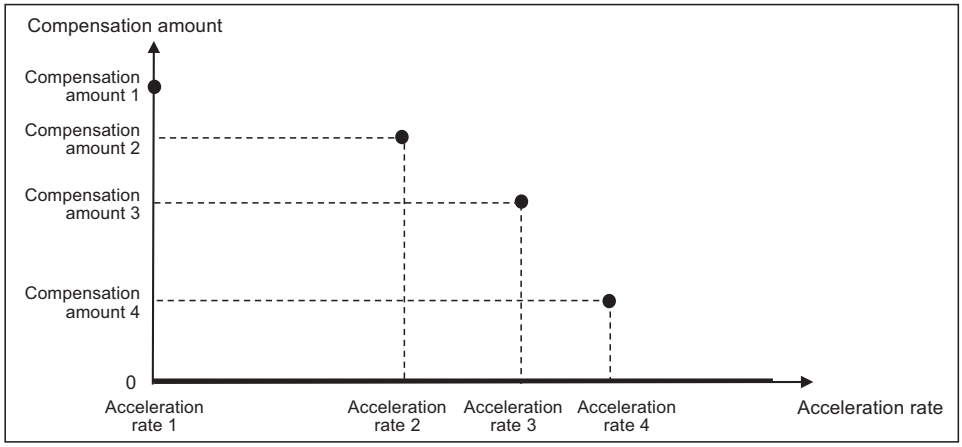
Note that compensation amount may not be in ascending order because the value increase or decrease depending on the acceleration rate. "0" and negative values can also be set as illustrated below.



When compensation amounts are not in ascending order

(2) When the acceleration rate 1 is set to "0"

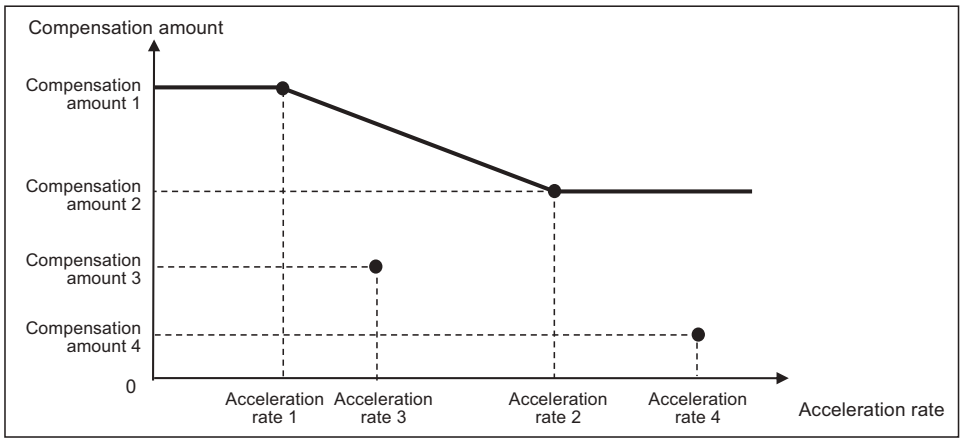
Backlash compensation II is disabled.
Quadrant projection compensation is not performed on the axis, and the compensation amount is handled as "0".



(3) When part of setting values of acceleration rate 1 to 4 are set in ascending order

Parameters are enabled when the corresponding acceleration rates are set in ascending order.
Parameters are disabled and not used for calculating compensation amount when the corresponding acceleration rates are not set in ascending order.
For example, when acceleration rate 1 and 2 are set in ascending order but the value of acceleration rate 3 is smaller than that of acceleration rate 2, the settings will be as follows.

- Acceleration rate 1 and 2, and compensation amount 1 and 2 are valid.
- Acceleration rate 3 and 4, and compensation amount 3 and 4 are invalid.



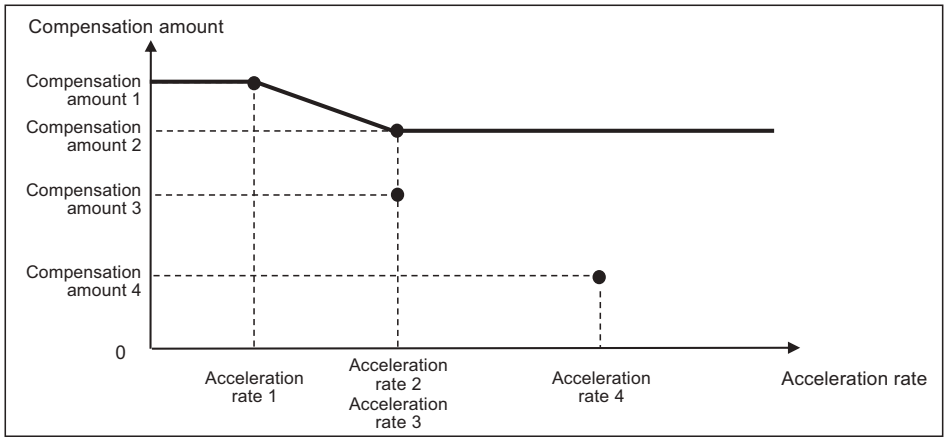
When the number of measured compensation patterns are less than four, compensation is carried out for the compensation patterns which are measured by setting "0" to acceleration rates corresponding to compensation patterns which have not been measured yet.
For example, when there are two compensation patterns, "0" is set to the acceleration rate 3.

(4) When the same values are set to consecutive acceleration rates

Ascending order in acceleration rate setting refers to the case where subsequent values become greater than the previous ones. Therefore, as same as (3), when the acceleration rates are no longer arranged in ascending order, corresponding parameters are disabled; accordingly, the compensation amounts are not calculated.

For example, when acceleration rate 1 and 2 are in ascending order but acceleration rate 3 is equal to acceleration rate 2, the settings will be as follows.

- Acceleration rate 1 and 2, and compensation amount 1 and 2 are valid.
- Acceleration rate 3 and 4, and compensation amount 3 and 4 are invalid.



27

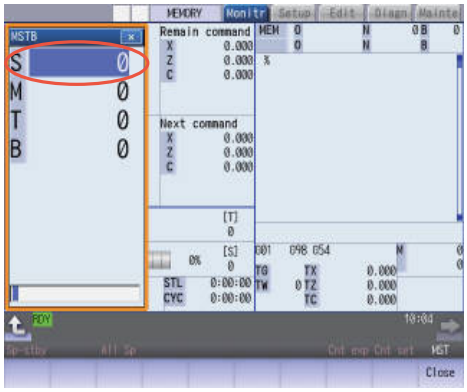
Confirming the Spindle Operation

Confirm that the spindle operates properly in manual/MDI operation. Confirm the spindle rotation speed as well.

> ⚠ **CAUTION**
>
> **1. Do not adjust the spindle when possible risks associated with adjustment procedures are not thoroughly taken into consideration.**
>
> **2. Be careful when touching spindle's rotating section, or your hand may be caught in or cut.**

27.1 In Manual Operation (with Manual Numerical Command)

(1) Select [MST] on the Monitr screen. Enter a spindle rotation speed (ex. 100r/min) in "S" field.



(2) Enter "3" in "M" field to rotate the spindle.

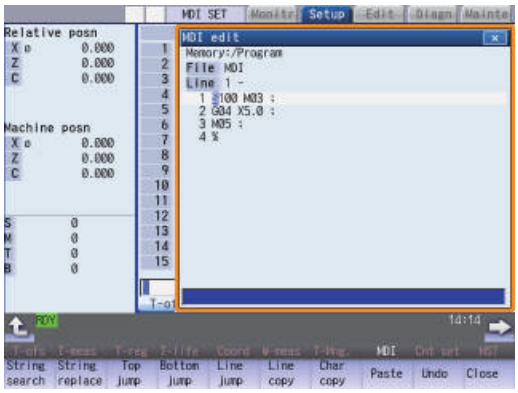
(3) Check the rotation speed of the spindle motor while the spindle is rotating. Refer to the section of "Confirming the Rotation Speed".

(4) After checking the rotation speed, set "M" to "5" or press the spindle stop button to stop the spindle rotation.

27.2 In MDI Operation

(1) Select MDI mode.

(2) Select [MDI] on the Setup screen. Enter a program to issue an S command.



Program example (to rotate the spindle at 100r/min for 5 seconds)

```
S100 M03 ;
G04 X5.0 ;
M05 ;
```

Press the [INPUT] key after entering the program.

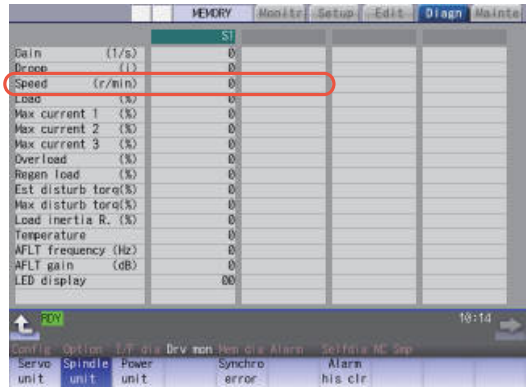
(3) Press the automatic start button.

(4) Check the rotation speed of the spindle motor while the spindle is rotating. Refer to the section of "Confirming the Rotation Speed".

27.3 Confirming the Rotation Speed

(1) Select [Drv mon] and then [Spindle unit] on the Diagn screen.

(2) Check the rotation speed of the spindle motor. (To obtain the spindle rotation speed, apply the gear ratio to the motor's rotation speed.)



(Note) If the vibration is not reduced by the measure, refer to the manuals of the servo drive unit.

28

Setting the Handy Terminal

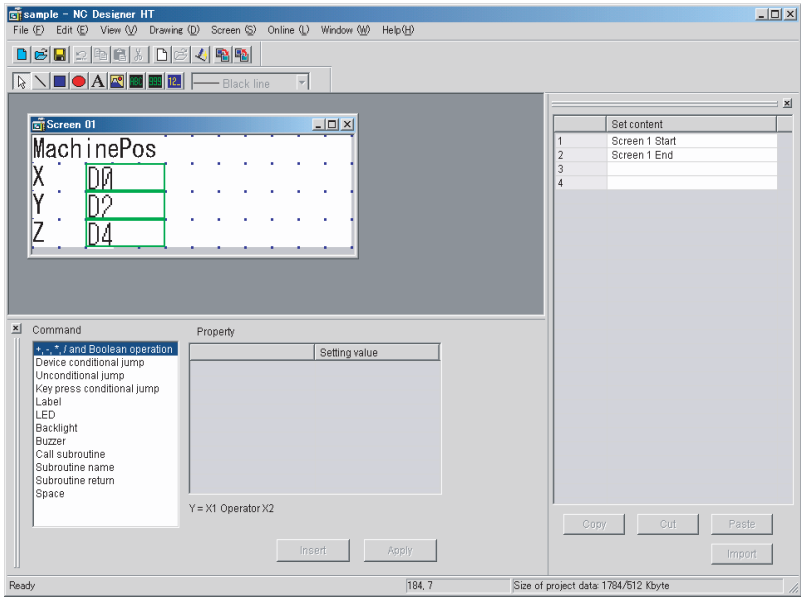
It is necessary to customize the display part composition, the key input, the communication condition with NC, etc. to connect the handy terminal (HG1T-SB12UH-MK1346-L*).
Create the customized data with "NC Designer HT" and download it to the handy terminal.

There are two methods to input customized data for the handy terminal.
(1) Connecting a personal computer and the handy terminal and inputting the data from "NC Designer HT"
(2) Connecting NC and the handy terminal and inputting the data from a SD card

28.1 Inputting the Data from a Personal Computer

Create a project data (*.p1t), which is handled as customized data, with the customized data creation tool "NC Designer HT". Then download it to the handy terminal.

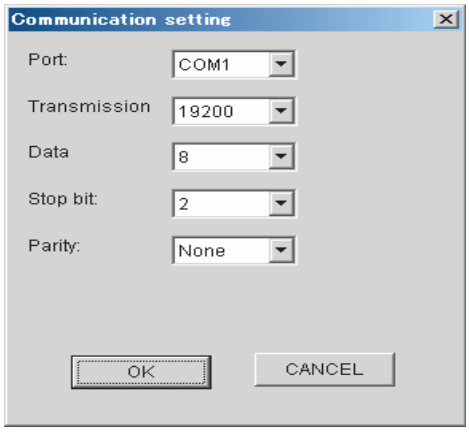
(1) Start the customized data creation tool "NC Designer HT" to create the project data (*.p1t).



(2) Connect a personal computer and the handy terminal via serial RS-232C.

(3) Select [Online] - [Communication setting] from the menu of "NC Designer HT" and confirm the communication condition is as follows.

Port: Personal computer port
Transmission: 19200 [bps]
Data length: 8 [bit]
Stop bit: 2
Parity: None



(4) Select [Online] - [Download] from the menu of "NC Designer HT".

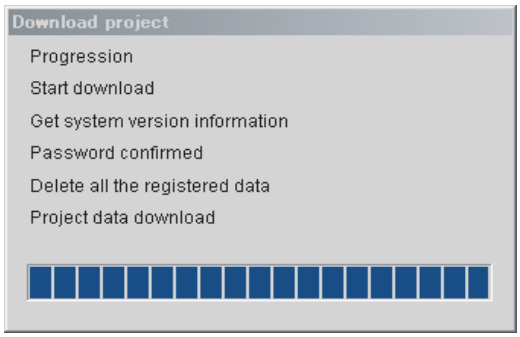
(5) The following dialog box is displayed. Select "Yes".



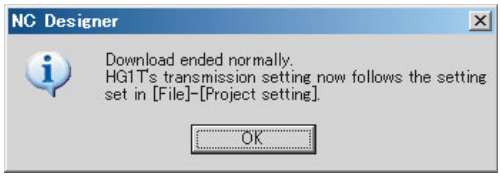
(6) If a password has been set to the downloaded customized data, the "Input password" dialog box will be displayed. Input the password and select "OK".



(7) The customized data will be downloaded to the handy terminal.



(8) When the download has been completed, the following dialog box will be displayed.



28.2 Inputting the Data from NC

Create a download data (handy.cod) from a project data (*.p1t) created with "NC Designer HT", then download it to the handy terminal.

(1) Start the customized data creation tool "NC Designer HT" to create a project data (*.p1t).

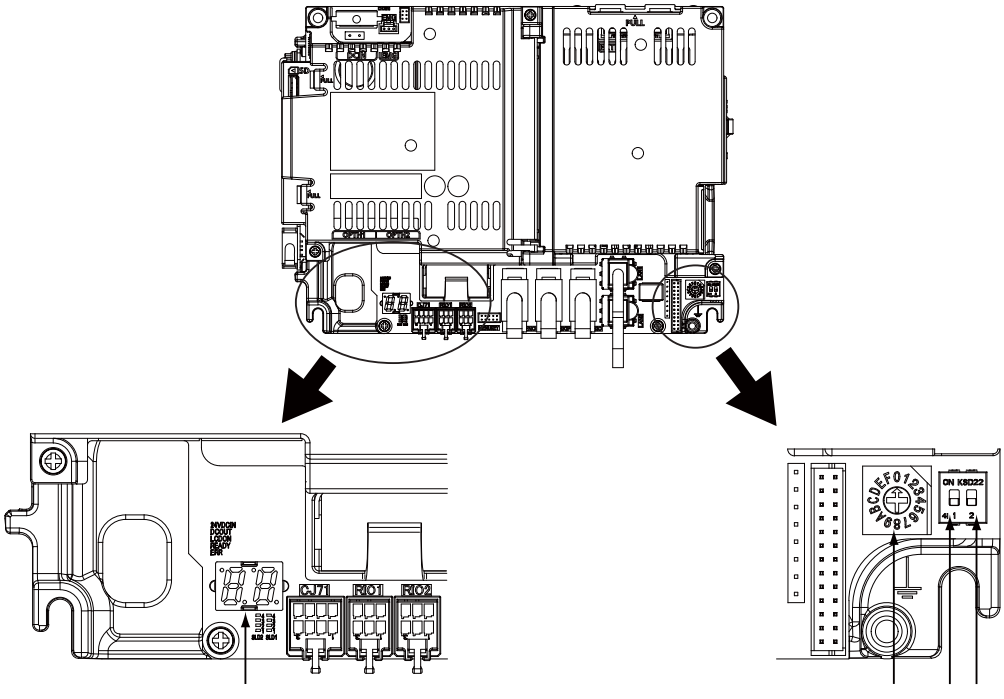
(2) Select [File] - [Writing download data] from the menu of "NC Designer HT" and save the data as download data named "handy.cod" in the root directory of the SD card.

(3) Insert the SD card used in (2) into the control unit.

(4) Set the password currently set in the handy terminal to the parameter "#11011 Handy TERM. PW.".
(Note) When you download for the first time or the password for the present custom data of the handy terminal is invalid, leave the parameter blank.

(5) Turn OFF the NC and then connect the handy terminal to SIO connector on the control unit.

(6) Set the rotary switch on the control unit to "5".
Confirm that the DIP switches 1 and 2 are OFF. If they are ON, turn them OFF. (Normally, the DIP switches are OFF.)



(a)	LED	(c)	DIP switch 1
(b)	Rotary switch	(d)	DIP switch 2

(7) Turn ON the NC again. (*)

(8) When the display of LED on the control unit becomes "En", turn OFF the NC.

(9) Remove the SD card and return the rotary switch.

(*) Operating status is displayed by the LED on the control unit.

Lo ... Loading

En ... Complete without error

n1 - n7 ... Complete with error

When the download is completed with error, possible causes are as listed below.
Take measures and then perform the download procedure again.

LED	Cause	Measure
n1 ↑ Alternately ↓ 2 - 20	Process was stopped due to communication error. LED displays "n1" and "detailed cause" alternately.	When the detailed cause is 2, 4, 10 or 15, Confirm the wiring. Confirm the communication parameters. When the detailed cause is other than the above, Contact the service center. (Note) The detailed cause is the output value (absolute value) of PLC signal R299. For details on R299, refer to "PLC Interface Manual".
n2	There is no version consistency between the custom data creation tool and the handy terminal.	Confirm the version of custom data creation tool.
n3	The passwords set in the handy terminal and the NC are not consistent with each other.	Specify the password for custom data of the handy terminal correctly in "#11011 Handy TERM. PW.".
n4	There is no custom data named "handy.cod" in the SD card root.	Confirm the content of the SD card.
n5	The size of customize data exceeds 512KB.	The customize data cannot be downloaded unless the capacity is 512 KB or less.
n6	Process was stopped due to communication error (timeout error).	Set a longer timeout on the NC side.
n7	Process was stopped due to communication error (parameter error).	Confirm if Serial handy terminal communication valid (#6452 bit4) is ON. Confirm that "#6451/bit5" is OFF.

29

Setting the Deceleration Check

29.1 Function

The next block is executed after the axis is decelerated and stopped at the joint between the axis movement blocks. This is to reduce the machine shock and to prevent the corner roundness, at the time when the sudden change of the control axis feedrate occurs.

(1) Deceleration check during rapid traverse
The deceleration check is always carried out at the block end (before executing the next block) during rapid traverse.

(2) Deceleration check during cutting feed
The deceleration check is carried out at the block end (before executing the next block) during cutting feed when any one of the following conditions is valid.
(a) When the error detect switch is ON.
(b) When G09 (exact stop check) is commanded in the same block.
(c) When G61 (exact stop check mode) has been selected.

(3) Selection of deceleration check method
There are three methods for the deceleration check: command deceleration check method, smoothing check method and in-position check method.
The deceleration check method can be set independently for each execution block with the rapid traverse command (G00) or the cutting feed command (G01/G02/G03).

(a) Operation list
This table shows the operation list for each movement command set.

	Current block		
Succeeding block	**G00**	**G01**	**G00/G01 without moving**
G00	○	(○)(1)(2)	×
G01	○	(○)(1)(3)	×
Other than the above	○	(○)(1)	×

○: Deceleration check is valid
(○) : (1)The deceleration check is valid when the error detect signal is ON, or G09 or G61 is valid.
(2) When the block commands G01 -> G00 are executed, #1502 G0Ipfg is turned ON, and the opposite direction movement is reversed, the command deceleration check is performed.
(3) When the block commands G01 -> G01 are executed, #1503 G1Ipfg is turned ON, and the opposite direction movement is reversed, the command deceleration check is performed.
In the case other than the above conditions, the deceleration check is not performed.
Refer to "Deceleration Check for Opposite Direction Movement Reversal" for the details of opposite direction movement reversal.
×: Deceleration check is invalid

(b) Selecting the deceleration check method

There are three methods for the deceleration check, and the method is selected by the parameter.

1) For the execution block with the rapid traverse command (G00/G53)

Parameter #1193 inpos	Deceleration check method	Determination condition
0	Command deceleration check	Deceleration check time passed
1	In-position check method	Deceleration check time passed, all axis smoothing zero and all axis in-position
2	Smoothing check method	Deceleration check time passed and all axis smoothing zero

2) For the execution block with the cutting feed command (G01/G02/G03)

Parameter			Deceleration check method	Determination condition
#1306 InpsTyp (G0/G1 common)	#1389 G1SmthChk	#1223 aux07/BIT1		
0 (cutting block)	**0**	**0**	Command deceleration check	Deceleration check time passed
		1	In-position check method	Deceleration check time passed, all axis smoothing zero and all axis in-position
	1	**-**	Smoothing check method	Deceleration check time passed and all axis smoothing zero

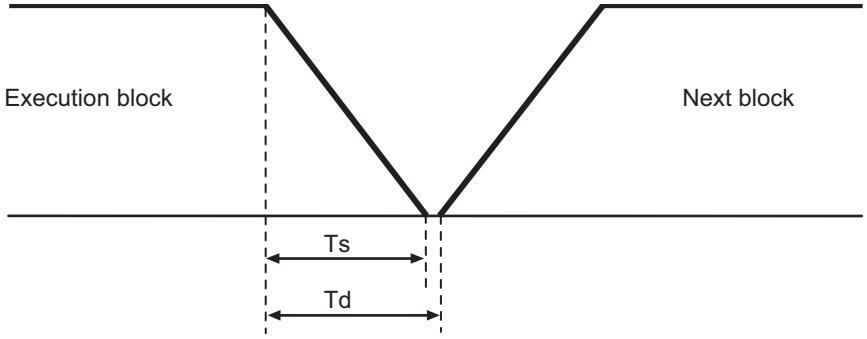
When the parameter "#1306 InpsTyp" is "1", the deceleration check method will be the same as the method of 1) rapid traverse regardless of the value of the parameter "#1389 G1SmthChk".

29.2 Deceleration Check Method

(1) Command deceleration check

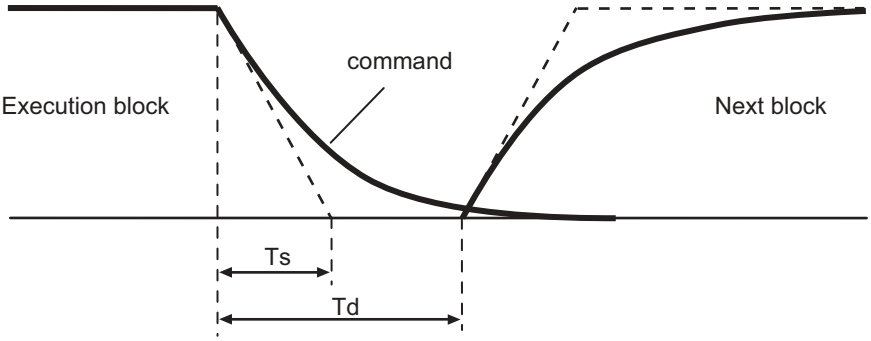
After interpolation for one block has been completed, the completion of the command system deceleration is confirmed before execution of the next block. The required time for the deceleration check is equal to the longest one of the deceleration check time for the simultaneously commanded axes, which are determined according to the acceleration/deceleration mode and time constant.

(a) For linear acceleration/deceleration



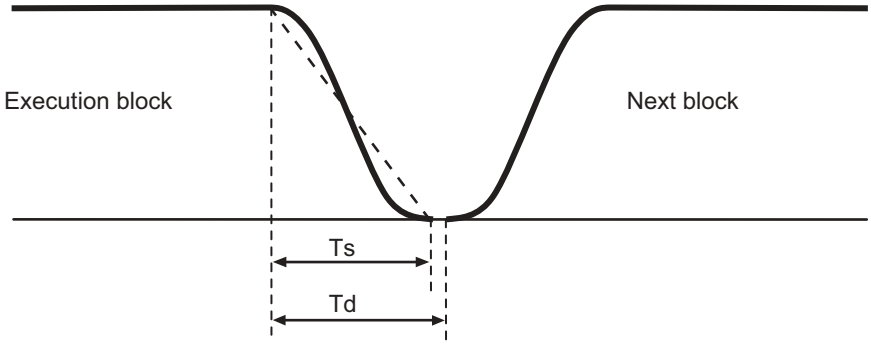
Ts : Liner acceleration/deceleration time constant
Td : Deceleration check time Td = Ts + α(0 to 10ms)

(b) For exponential acceleration/deceleration



Ts : Exponential acceleration/deceleration time constant
Td : Deceleration check time Td = Ts×2 + α(0 to 10ms)

(c) For soft acceleration/deceleration



Ts : Soft acceleration/deceleration time constant
Td : Deceleration check time Td = Ts + α(0 to 10ms)

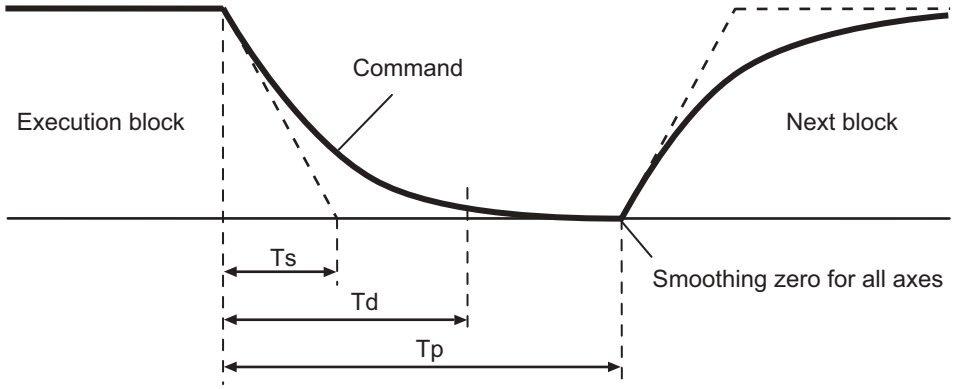
The deceleration check time required during rapid traverse is the longest rapid traverse deceleration check time of all axes. This check time is determined by the rapid traverse acceleration/deceleration mode and rapid traverse acceleration/deceleration time constant of simultaneously commanded axes.

The deceleration check time required during cutting feed is determined in the same manner. It is the longest cutting feed deceleration check time of all axes. This check time is determined by the cutting feed acceleration/deceleration mode and cutting feed acceleration/deceleration time constant of simultaneously commanded axes.

(2) Smoothing check method

After the command deceleration check has been completed, the completion of all axes smoothing zero in the part system is confirmed before execution of the next block.

(Example) For exponential acceleration/deceleration

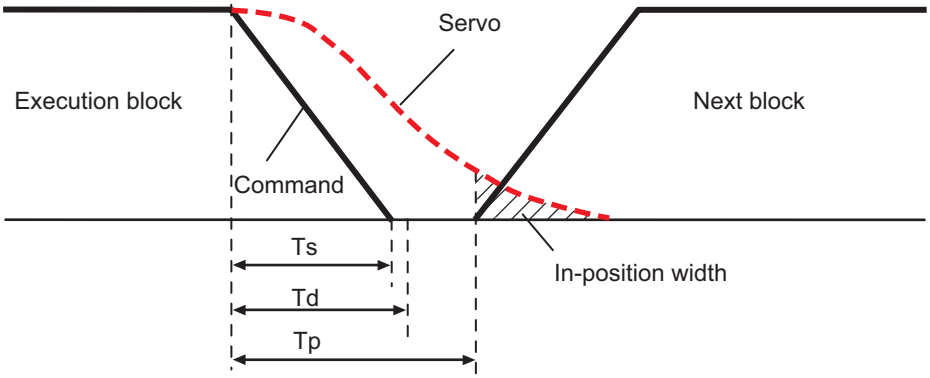


Ts : Exponential acceleration/deceleration time constant
Td : Deceleration check time
Tp : Waiting time for block completion

(3) In-position check

When the in-position check is valid, the command deceleration check is carried out. After that, it is confirmed that the servo system positional error is less than the parameter setting value, and the next block is executed.
The in-position check width can be designated with the servo parameter in-position width (SV024). Note that G0 and G1 can be designated independently with the axis specification parameter G0 in-position check width (G0inps) and G1 in-position check width (G1inps). If both the servo parameter and axis specification parameter are set, the larger value will have the priority.

(Example) For linear acceleration/deceleration



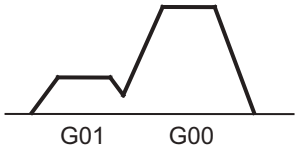
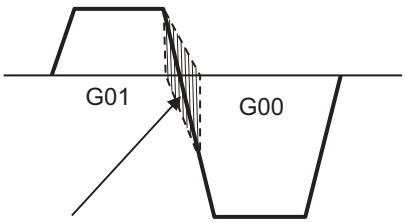
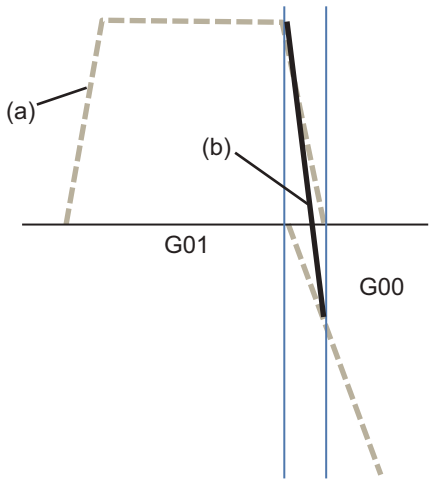
Ts : Liner acceleration/deceleration time constant
Td : Deceleration check time
Tp : Waiting time for block completion

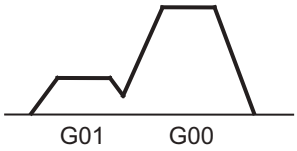
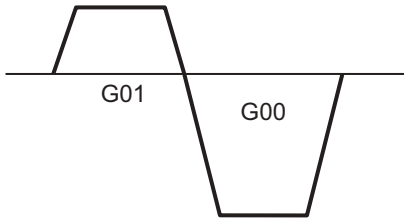
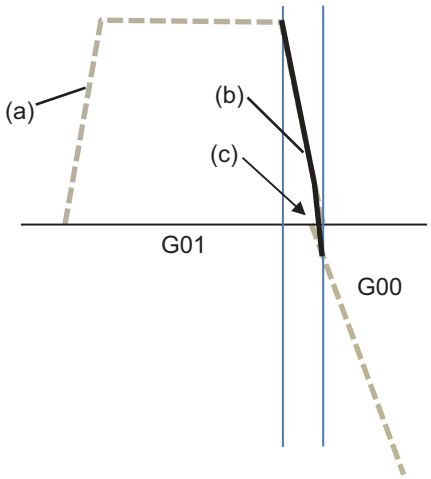
If the SV024 setting value is larger, in-position check will end when the SV024 setting value is established.

29.3 Deceleration Check for Opposite Direction Movement Reversal

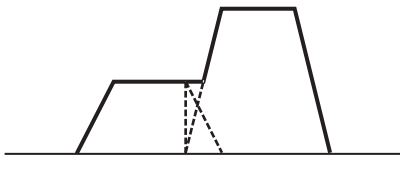
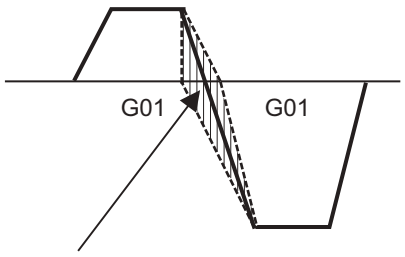
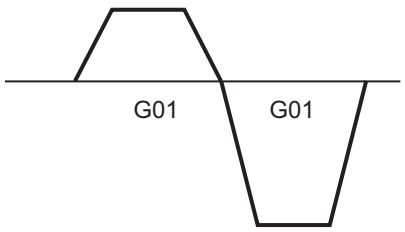
Deceleration check cannot be designated for G01 -> G00 or G01 -> G01, but it can be designated in the following manner only when the movement reverses to the opposite direction in successive blocks. Deceleration check can also be executed if even one axis is moving in the opposite direction while several axes are interpolating.

(1) Designating deceleration check for G01 -> G00 opposite direction movement reversal
If the axis movement reverses to the opposite direction in a G01 to G00 successive block, the deceleration check for the movement in the opposite direction can be changed with the base specification parameter G01 -> G00 deceleration check (#1502 G0Ipfg).

	Same direction	Opposite direction
#1502 = 0		 The acceleration rate is excessive due to the G01 and G00 composite speed. Enlarged figure  (a) Commanded speed (b) Resultant speed

	Same direction	Opposite direction
#1502 = 1		 Command deceleration Enlarged figure  (a) Commanded speed (b) Resultant speed (c) Command deceleration is completed.

(2) Designating deceleration check for G01 -> G01 opposite direction movement reversal
If the axis movement reverses to the opposite direction in a G01 to G01 successive block, the deceleration check for the movement in the opposite direction can be changed with the base specification parameter G01 -> G01 deceleration check (#1503 G1Ipfg).

	Same direction	Opposite direction
#1503 = 0		 The acceleration rate is excessive due to the G01 and G01 composite speed.
#1503 = 1		 Command deceleration

29.4 Parameter

(1) Designating deceleration check
Base specification parameter

#	Item		Details	Setting range
1193	inpos	The definitions are changed with the setting of "#1306 InpsTyp Deceleration check specification type".		
		When Deceleration check method 1 is selected	Select the deceleration check method for G0. 0: Command deceleration check 1: In-position check 2: Smoothing check	0 to 2
		When Deceleration check method 2 is selected	Select the deceleration confirmation method for the positioning or cutting command. 0: G0, G1+G9 Command deceleration check 1: G0, G1+G9 In-position check 2: G0,G1+G9 Smoothing check	
1223	aux07/bit1	Deceleration check method 2	Select the deceleration check method in G1+G9. 0: Command deceleration check in G1+G9 1: In-position check in G1+G9 The deceleration check is not performed for the commands except G1+G9. When "#1306 InpsTyp deceleration check specification type" is set to "1" (Deceleration check specification type 2), this parameter will be invalid.	0 / 1
1306	InpsTyp	Deceleration check specification type	Select the parameter specification type for the G0 or G1 deceleration check. 0: Deceleration check specification type 1 G0 is specified with "#1193 inpos", and G1+G9 with "#1223 aux07/bit1". 1: Deceleration check specification type 2 G0 or G1+G9 is specified with "#1193 inpos".	0 / 1
1389	G1SmthChk	Smoothing check method in cutting block	Select whether to apply smoothing check method to a cutting block for deceleration check, when deceleration check method is selected individually for G0 and G1 (when "#1306 InpsTyp"=0). 0: Follow the setting of "#1223 aux07/bit1" 1: Apply smoothing check method	0 / 1

(2) Deceleration check during opposite direction travel
Base specification parameter

#	Item		Details	Setting range
1502	G0Ipfg	G1 -> G0 deceleration check	Select whether to perform a deceleration check when the travel direction is changed from G1 to G0. 0: Not perform 1: Perform	0 / 1
1503	G1Ipfg	G1 -> G1 deceleration check	Select whether to perform a deceleration check when the travel direction is changed from G1 to G1. 0: Not perform 1: Perform	0 / 1

(3) Designation of in-position check width

(a) Servo parameter

#	Item		Details	Setting range
2224	SV024 INP	In-position detection width	Set the in-position detection width. Set the accuracy required for the machine. The lower the setting is, the higher the positioning accuracy gets; however, the cycle time (setting time) becomes longer. The standard setting value is "50".	0 to 32767 (μm)
13024	SP024 INP	In-position width	Set the in-position detection width. Set the positioning accuracy required to the machine. Lower setting value increases the positioning accuracy, but prolongs the cycle time (settling time). The standard setting is "875".	0 to 32767 (1deg/1000)

(b) Axis specification parameter

#	Item		Details	Setting range
2077	G0inps	G0 in-position width	Set the in-position width for G0. Between SV024 and this parameter, the parameter with a larger value will be applied. When "0" is set, this parameter will be invalid: only SV024 will be available.	0.000 to 99.999 (mm)
2078	G1inps	G1 in-position width	Set the in-position width for G1. Between SV024 and this parameter, the parameter with a larger value will be applied. When "0" is set, this parameter will be invalid: only SV024 will be available.	0.000 to 99.999 (mm)

29.5 Relation with Other Functions

(1) Tool compensation
When the tool compensation is performed, the deceleration check will be operated on the block after compensation.

(2) Control axis synchronization (G125), control axis superimposition (G126), arbitrary axis exchange (G140), arbitrary axis superimposition (G156)
When control axis synchronization (G125), control axis superimposition (G126), arbitrary axis exchange (G140) or arbitrary axis superimposition (G156) is performed in the other part system, the succeeding block start timing may be delayed in the cutting block to which the axis related to these functions belongs.

(3) Automatic error detect
The deceleration check is invalid in the block with the automatic error detect ON, the block complete condition follows the automatic error detect.

(4) High-speed machining mode
When the axis movement reverses to the opposite direction in G01 to G01 successive block during the high-speed machining mode, the commanded deceleration will not be performed even if G1Ipfg has been set to "1". When the axis movement reverses to the opposite direction in G01 to G00 successive block, it follows the setting of G0Ipfg.

(5) High-speed simple program check
The deceleration check is performed during the high-speed operation in the high-speed simple program check also. The deceleration check time is reduced according to the time reduction coefficient during the high-speed simple program check operation.

(6) Deceleration check in polar coordinate interpolation / milling interpolation / cylindrical start / cancel command
- The deceleration check in polar coordinate interpolation / milling interpolation / cylindrical start / cancel command are as follows.

Parameter: #1223 aux07 BIT1	Deceleration check method
0	Command deceleration check
1	In-position check

29.6 Precautions

(1) When in-position check is valid, set the servo in-position width of the servo parameter.
(2) This function is invalid for the axes in the automatic machine lock.
(3) When the MSTB is commanded to the next block of the cutting commanded block, the MSTB code is output before the completion of the cutting command deceleration. Confirm the DEN (motion command completion) signal with PLC before the execution of the MSTB command which needs to be executed after the completion of the axis movement.
(4) When the control axis in the synchronous/superimposition control exists in the part system for which in-position check method has been set, the deceleration completion will be determined when the smoothing for all axes reaches zero. (Same as the smoothing check method)
(5) When the thread cutting commands are issued consecutively, the deceleration check will not be performed at the block joint.
(6) If the parameter "#1205 G0bdcc" is set to "1", the value set with the parameter "#2224 SV024" (in-position detection width) will be used as the in-position width.
The setting of the parameter "#2077 G0inps" (G0 in-position width) and the programmable in-position check with ",I" address are disabled.
(7) When the operation with machine lock is performed and variable-acceleration pre-interpolation acceleration/ deceleration is enabled by the function such as high-accuracy control, "Each axis in-position" signal is always ON.
(8) "Each axis in-position" signal can not be used during the synchronous operation.
(9) Deceleration check for opposite direction movement reversal
- When deceleration check is valid (#1502 G0Ipfg = 1), deceleration check will be executed when the axis reverses its movement to the opposite direction at the G1 -> G0 successive block regardless of whether G0 non-interpolation is ON or OFF.
- When deceleration check is valid (#1502 G0Ipfg = 1), deceleration check will be executed when the axis reverses its movement to the opposite direction at the G1 -> G0 successive block even in the fixed cycle.
- In the G1 -> G28, G1 -> G29 or G1 -> G30 successive blocks, deceleration check will always be executed when the G1 movement is completed, when movement to the intermediate point is completed and when movement to the return point is completed. Note that if the simple zero point return "#1222 aux06/bit7" is valid, G1 -> G0 deceleration check (#1502) will be followed when the G1 movement is completed and when movement to the intermediate point is completed. (Deceleration check will always be executed when movement to the return point is completed even in this case.)

(10) Deceleration check in movement including spindle/C-axis
- The deceleration check for spindle/C-axis movement command is as described in the table below. That is because a vibration and so on occurs in the machine when the position loop gain (#13002 PGN) is changed during the axis movement.

Parameter	Rapid traverse command
Inpos(#1193)	**G0 → XX (G0+G9 → XX)**
0	Command deceleration check
1	In-position check
2	Smoothing check

Parameter	Parameter	Other than rapid traverse command (G1: other than G0 command)	
G1SmthChk(#1389)	**AUX07/BIT-1 (#1223/BIT-1)**	**G1 → G0 (G1+G9 → XX)**	**G1 → G1**
0	0	In-position check (Applicable only to SV024)	No deceleration check
	1		
1	0	Smoothing check	
	1		

(Note 1) When G1 command is issued, the in-position check is performed regardless of the deceleration check parameter.
(Note 2) XX expresses all commands.

30

Synchronous Control and Multiple-axis Synchronization Control

30.1 Synchronous Control

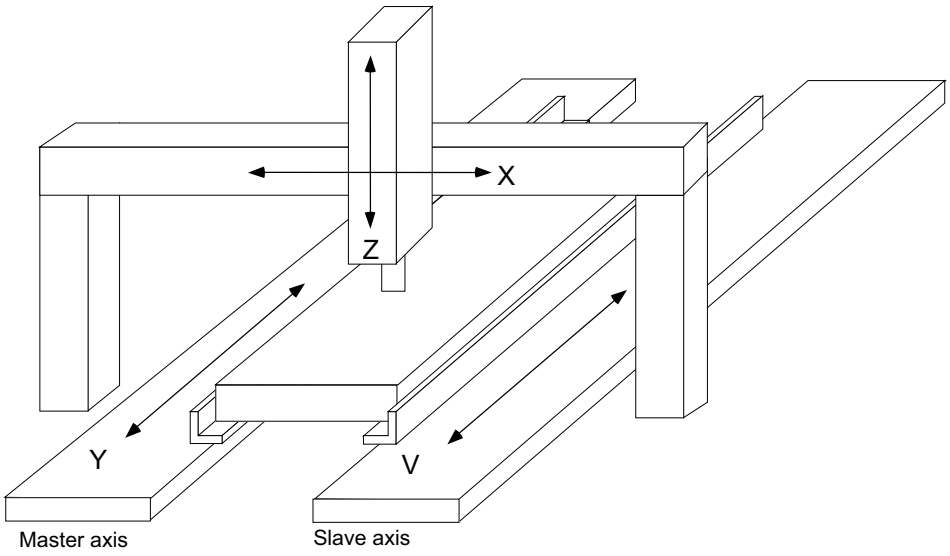
This chapter describes position alignment that is required at the setup of the machine.
Refer to "Synchronous Control Specifications Manual" (BNP-C3072-074) for details of parameter settings, operations, etc.

30.1.1 Outline

The synchronous control is a control method that both master and slave axes are controlled with the same movement command by designated the movement command for the master axis also to the slave axis. This function is assumed to be used in the large machine tool, etc. which drives one axis with two servo motors.
The axis for the base of the synchronization is called the master axis, and the axis according to the master axis is called the slave axis.

(Note 1) The axis detachment function cannot be added to the axes used in the synchronous control.
(Note 2) The control axis synchronization between part systems and the synchronous control cannot be used simultaneously.

- The slave axis is controlled with the movement command for the master axis.
- One slave axis can be set to one master axis.
- Up to the following sets of the master axes/slave axes can be set for all the part systems in total.
  8 sets for M800 Series, 3 sets for M80 Series



There are 3 types of synchronous control as follows:

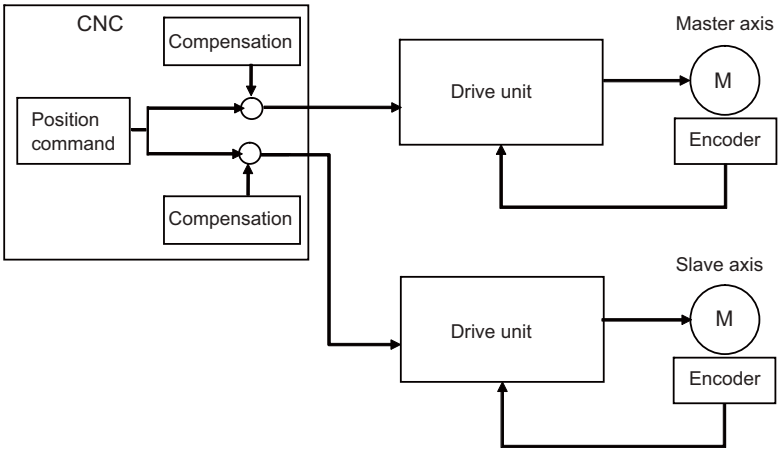
(1) Position command synchronous control

This is used when the machine's rigidity is low.

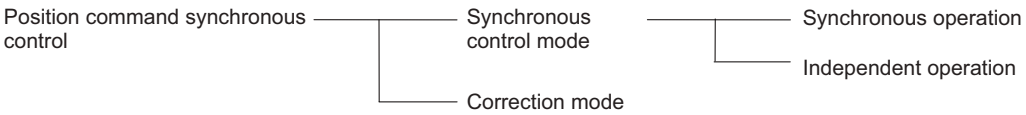
This conforms the position command of the master axis to that of the slave axis using the synchronous control function of NC and drive those axes in parallel.

This can be used only by changing the NC setting, without changing the settings in the servo drive unit.

Position command synchronous control diagram



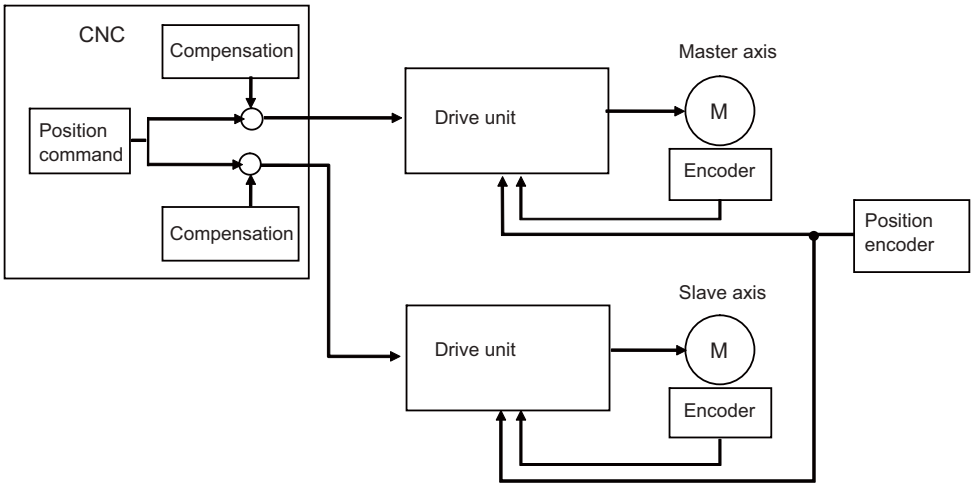
The position command synchronous control has the following configuration:



(2) Speed command synchronous control

This is used when reducing the scale of the full-closed system or when the machine's rigidity, etc. cause the mutual interference to the axes positions.
This drives the master axis and the slave axis in parallel using the common position feedback. Since the feedrate of each axis is controlled by the speed feedback of each axis, the stable control is available.
This can be used when the settings of the NC and the servo drive unit are changed.

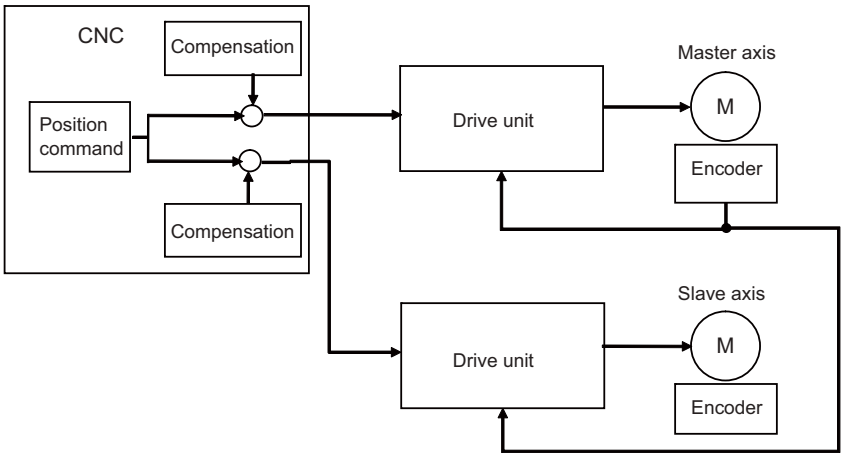
Speed command synchronous control diagram



(3) Current command synchronous control

This drives the master and slave axes in parallel by reference to the speed feedback from the encoder onto the master axis side on the slave axis. Since that speed feedback is not the slave axis's itself, the slave axis easily vibrates.
Also, as the slave axis is easily influenced by the disturbance, this is not appropriate for the machine tools which need the positioning accuracy or the interpolation accuracy.
This can be used when the setting of the NC and the servo drive unit are changed.

Current command synchronous control diagram



The "compensation" in the (1), (2) and (3) diagrams indicates the pitch error compensation, the thermal expansion compensation, the backlash compensation and the external machine coordinate compensation.
The axes which can set the compensation during the synchronous control differ according to the synchronous control type.

30.1.1.1 Synchronous control mode

The following two operation methods are available in the synchronous control mode.

(1) Synchronous operation

This is a method that both master and slave axes are moved simultaneously with the movement command for the master axis.

(2) Independent operation

This is a method that either the master or slave axis is moved with the movement command for the master axis.

30.1.1.2 Correction mode

The synchronization is temporary canceled to adjust the balance of the master and slave axes during the synchronous control mode in the machine adjustment. Each axis can be moved separately with the manual handle feed or the arbitrary feed in manual mode. If the operation mode other than the manual handle feed and arbitrary feed in manual mode is applied during the correction mode, the operation error will occur.

30.1.2 Reference Position Establishment in Synchronous Operation

Carry out the position alignment of the master and slave axes during machine's setup. The positions between the synchronous axes tend to deviate at power ON, thus this deviation needs to be adjusted. After position alignment, the position error between the synchronous axes is always checked while the synchronous operation method is selected. Perform the zero point establishment in the following steps for machines that perform synchronous operation at all times.

30.1.2.1 Zero Point Establishment in Relative Position Detection System/Dog-type Absolute Position Detection System

Position alignment at machine setup

In machine setup, carry out the position alignment between the two synchronous axes.
There are two types of position alignment methods as follows:

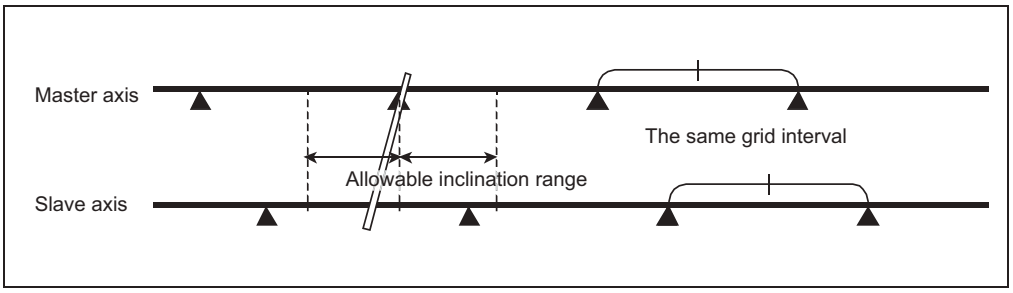
- Method using reference position adjustment value
- Method without using reference position adjustment value

(1) Position alignment using reference position adjustment value

This method is enabled when in a synchronous operation, and parameter "#1493 ref_syn" (synchronization at zero point establishment) is "1" (synchronous). This method is disabled when the parameter is set to "0" (Asynchronous).

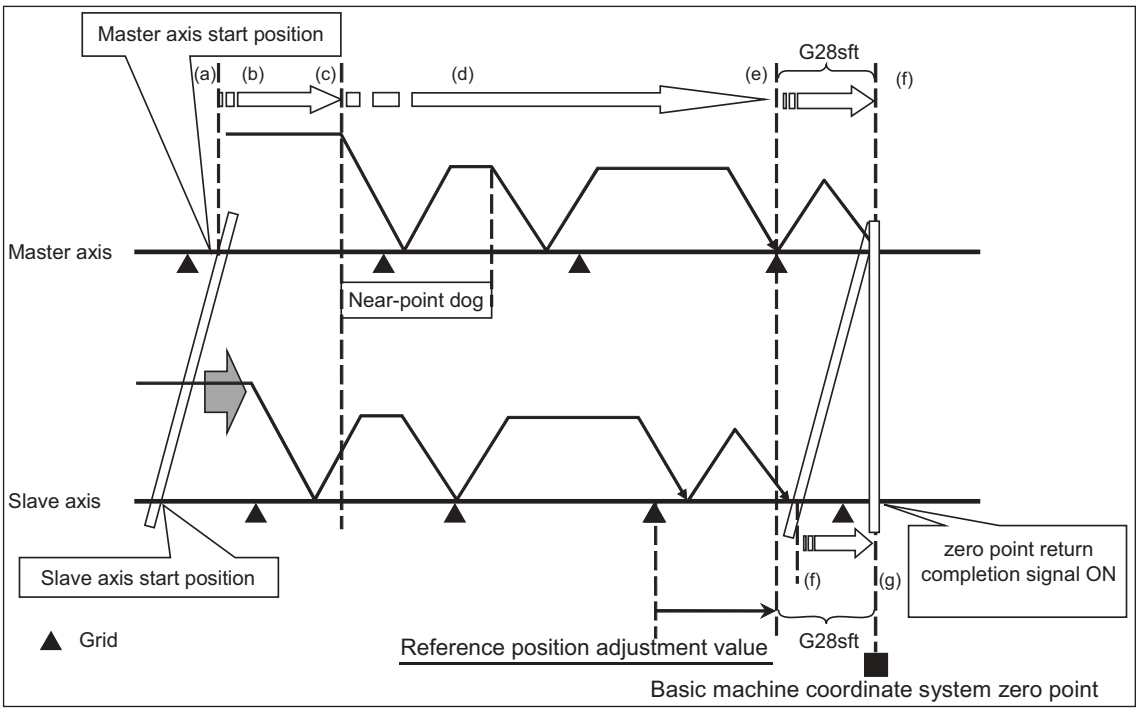
There are following limitations in using the reference position adjustment value.

- The grid intervals (#2029 grspc) of the master and slave axes must be the same.
- Zero point return should start when the angle formed by the master and slave axes is smaller than [± Grid interval / 2].
  The zero point of the master axis is deviated from that of the slave axis by one grid, when zero point return is performed while the inclination is exceeding the allowance.



When the procedure on the next page is performed while the reference position adjustment value is other than "0", the remaining distance of the slave axis is compensated by the reference position adjustment value in step (e). Therefore, set the reference position adjustment value to "0" when starting position alignment after balancing.
For speed command synchronization and current command synchronization, carry out "(2) Position alignment without using reference position adjustment value".

(a) From the PLC, turn ON the bits of the "synchronous control operation method" signal, which are corresponding to the master and slave axes, in order to select synchronous operation in "synchronous control mode".
(b) Carry out zero point return manually.
(c) When the master axis reaches a dog, both axes decelerate at the same time.
(d) After deceleration, both axes start traveling at a creep speed.
(e) The master axis travels until reaching the second grid after dog OFF, and stops on the grid.
(If the deceleration after dog OFF goes over the 1st grid, the master axis stops on the 3rd grid)
The slave axis moves in synchronization with the master axis, when the reference position adjustment value is "0".
If the amount is other than "0", the slave axis moves asynchronously with the master axis after compensation by the reference position adjustment value.
(f) The master axis travels by the reference position shift distance (#2027 G28sft), and then stops.
The slave axis travels in synchronization with the master axis.
(g) Switch to "Correction mode", and feed the slave axis by handle feed to the position to be defined as its zero point.
(h) At this point, the "zero point adjustment completion" signal is input from the PLC.
(i) When the "zero point adjustment completion" signal is input, the NC automatically sets the reference position adjustment value in the parameter "#2036 slv_adjust" (reference position adjustment value).
Reference position adjustment value is a distance between the position obtained by subtracting the reference position shift distance from the current position and a near grid. Select a grid with which this vector becomes positive as the near grid.
"#" that stands for the zero point return completion is not displayed, and the alarm "Z81" is not cleared.
(j) Enter back into synchronous control mode synchronous operation.
(k) Carry out the normal manual zero point return. If necessary, adjust the position by the reference position shift distancet (#2027 G28sft).
Set the reference position shift distance to the master axis' parameter. If set to the slave axis' parameter, the setting is ignored.



Adjustment sequence

(2) Position alignment without using reference position adjustment value

[When synchronization at zero point establishment (#1493 ref_syn) is "0" (asynchronous)]

(a) Select the correction mode, and feed the master and slave axes using the manual handle to correct the error between the two axes.
Use an instrument such as a level to detect horizontal level errors between the synchronous axes.

(b) Adjust the dog position.
Adjust the dog position so that the return position is always the same at reference position return.

(c) Change back to synchronous mode, and carry out manual dog-type reference position return.
Make sure to decelerate enough before carrying out reference position return.
When the master and slave axes individually decelerate and reach zero point after the master axis' dog ON, adjust each axis' reference position shift distance (#2027 G28sft) so that there is no error between the two axes.

[When synchronization at zero point establishment (#1493 ref_syn) is "1" (synchronous)]

(a) Set "#2036 slv_adjust" (reference position adjustment value) to "0".

(b) From the PLC, turn ON the master and slave axis bits of the "synchronous control operation method" signal to select "synchronous control mode" synchronous operation.

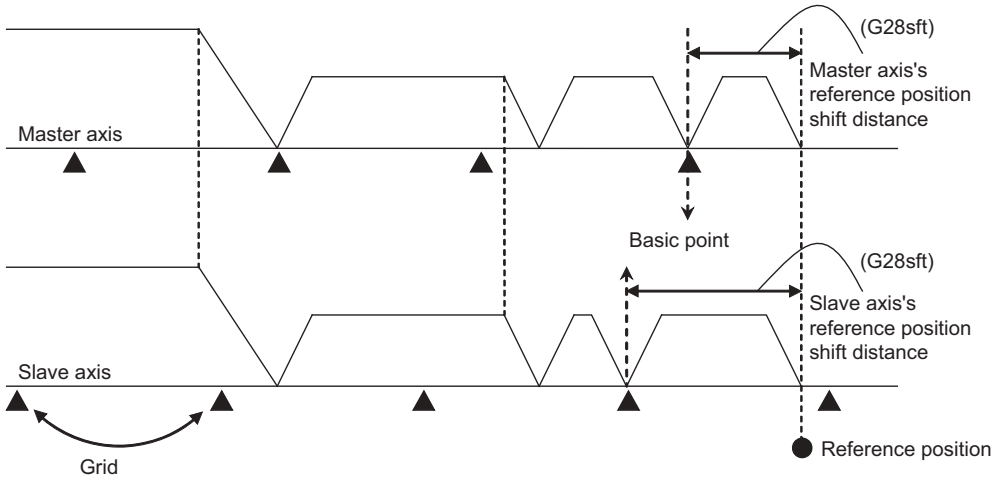
(c) Carry out zero point return manually.
The master axis travels until reaching the second grid after dog OFF, and stops on the grid.
(If the deceleration after dog OFF goes over the 1st grid, the master axis stops on the 3rd grid)
The slave axis travels in synchronization with the master axis.

(d) When necessary, adjust the zero point using the reference position shift distance (#2027 G28sft).
Set the reference position shift distance to the master axis' parameter. If set to the slave axis' parameter, the setting is ignored.

Position alignment after power ON

Normally, positions of the master and slave axes deviate at power ON, thus the position alignment for this deviation is required.
This position alignment is automatically done at the first dog-type reference position return after power ON. However, the settings of the zero point return parameters such as the reference position shift distance must be adjusted correctly.
Synchronous error check is not carried out until this position alignment is done.

Below is an example of reference position return.



30.1.2.2 Zero Point Establishment in Dogless-type Absolute Position Detection System

Zero point establishment in dogless-type absolute position detection system can be performed by combining "#1493 ref_syn" and "#1496 push_typ" in one of the three ways below.

(1) When synchronization is set to "0"

Parameter	Setting value
synchronization at zero point establishment (#1493 ref_syn)	0

Master axis and slave axis determine their zero points individually.

(2) When synchronization is set to "1" and stopper method is set to "0"

Parameter	Setting value
synchronization at zero point establishment (#1493 ref_syn)	1
stopper method in zero point establishing operation (#1496 push_typ)	0

The zero points of both master and slave axes are determined by establishing the master axis' zero point.
During stopper method in zero point initial setting, push until either master or slave axis reaches the current limit.

(3) When synchronization is set to "1" and stopper method is set to "1"

Parameter	Setting value
synchronization at zero point establishment (#1493 ref_syn)	1
stopper method in zero point establishing operation (#1496 push_typ)	1

The zero points of both master and slave axes are determined by establishing the master axis' zero point.
During stopper method in zero point initial setting, push toward the machine end stopper until both master and slave axes reach the current limit and the droop is canceled when the current limit is reached.

During position command synchronous control, select (2) or (3) because zero points of both master and slave axes need to be established with synchronization at zero point establishment of the master axis.

Position alignment at machine setup

In machine setup, carry out the position alignment of the synchronous axes in the following procedure.

(1) Select the correction mode, and feed the master and slave axes using the manual handle to correct the error between the two axes.
Use an instrument such as a level to detect horizontal level errors between the synchronous axes.

(2) Change back to synchronous mode, and carry out the zero point initial setting.
There are two types of zero point initial setting: stopper method and marked point alignment method.
Moreover, there are two types of stopper methods: manual initialization and automatic initialization, and there are two types of marked point alignment methods: Marked point alignment method I and marked point alignment method II.
When automatic initialization is selected, some part of the following operations are automated.

[When synchronization is set to "0"]

Parameter	Setting value
synchronization at zero point establishment (#1493 ref_syn)	0

Master axis and slave axis determine their zero points individually.

(a) Set "1" to "#0 Absolute posn set" of master and slave axes individually.

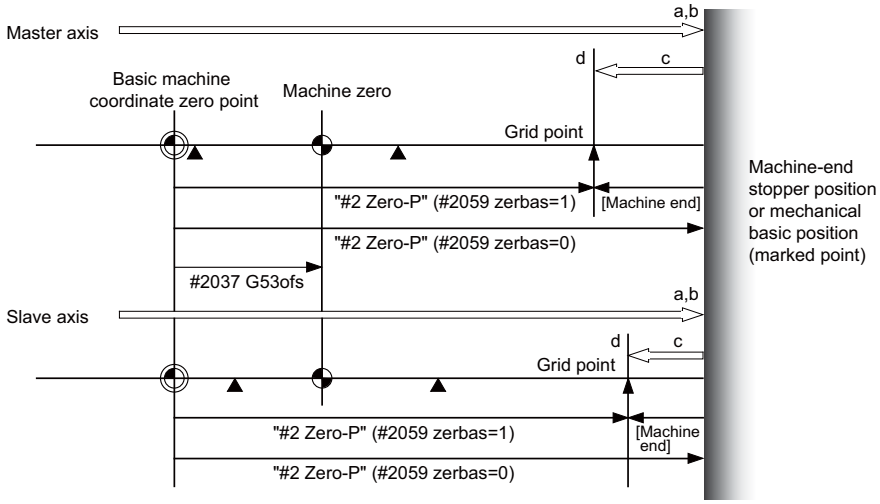
(b) For the marked point alignment method, align both axes to the machine basic position (marked point) and set "1" to "#1 Origin-P".
For the stopper method, push toward the machine end stopper until both axes reach the current limit.

(c) For the stopper method with #2059 set to "0", when each axis is pushed against machine end stopper and reaches the current limit, the absolute position is established.
For the stopper method with #2059 set to "1", when each axis is pushed against machine end stopper and reaches the current limit, the axis moves to the opposite direction and the absolute position is established.
For the marked point alignment method I, when each axis is moved toward basic Z direction with "Ret. Ref. P." displayed in the "State" item and reaches its grid point, the absolute position is established.
For the marked point alignment method II, the absolute position is established without each axis moving to its grid point.

(d) Set "#2 Zero-P" to each axis.

- Synchronous error check is not performed during absolute position initial setting.
- When initial setting is carried out for one of the two synchronous axes, do this in asynchronous mode.
- During automatic initialization, the values set to push speed (#2055 pushf) for master and slave axes are valid respectively.
- "1" can be set to "#0 Absolute posn set" with PLC signal (AZSn).

The following is the operation example when synchronization at zero point establishment (#1493 ref_syn) is set to "0" in zero point establishing operation:



(Note) In carrying out zero point initial setting, even when one axis has stopped on a grid, the other axis keeps traveling. Thus, decelerate enough before setting.

[When synchronization is set to "1" and stopper method is set to "0"]

Parameter	Setting value
synchronization at zero point establishment (#1493 ref_syn)	1
stopper method in zero point establishing operation (#1496 push_typ)	0

The zero points of both master and slave axes are determined by establishing the master axis's zero point.
Slave axis moves synchronously with master axis.
At zero point establishment of stopper method, push until either master or slave axis reaches the current limit.
Due to this, when slave axis reaches the stopper first, the stopper position may not be the basic point.

(a) Set "1" in "#0 Absolute posn set" of master axis.
When "1" is set to "#0 Absolute posn set" of slave axis, "Setting error" occurs.

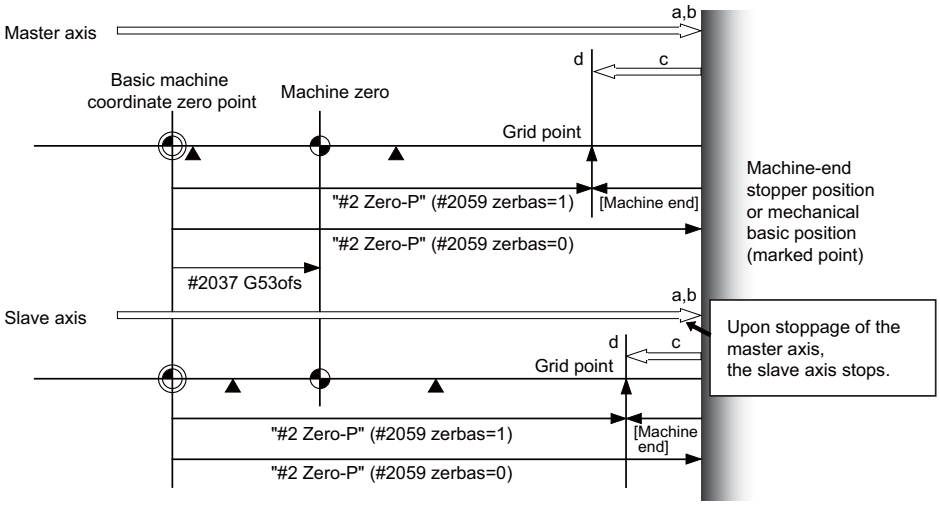
(b) For the marked point alignment method, align the master axis to the machine basic position (marked point) and set "1" to "#1 Origin-P".
For the stopper method (with "#2059 zerbas" set to "1"), push toward the machine end stopper until either master or slave axis reaches the current limit.

(c) For the stopper method with #2059 set to "0", when the master axis or the slave axis is pushed against machine end stopper and either axis reaches the current limit, the absolute position is established.
For the stopper method with #2059 set to "1", when the master axis or the slave axis is pushed against machine end stopper and either axis reaches the current limit, the axis moves in the opposite direction and the absolute position is established.
For the marked point alignment method I, when the master axis is moved toward basic Z direction with "Ret. Ref. P." displayed in the "State" item and reaches its grid points, the absolute position is established.
For the marked point alignment method II, the absolute position is established without each axis moving to its grid point.

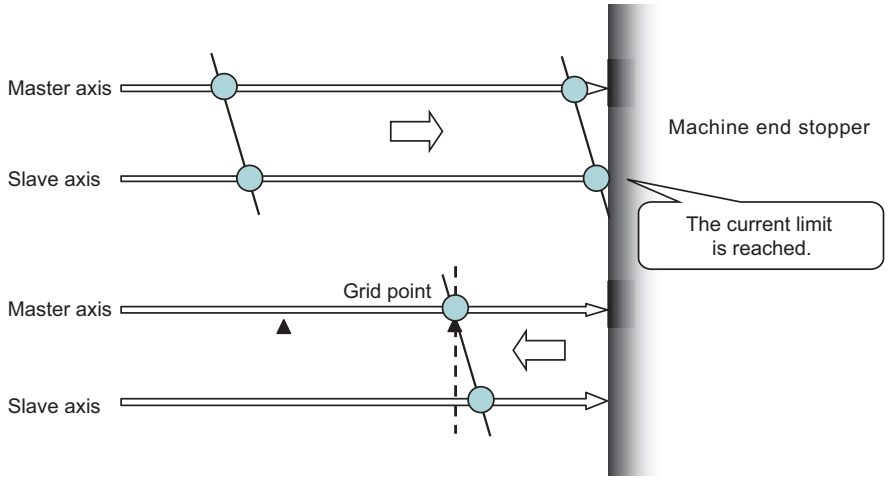
(d) Set "#2 Zero-P" to master axis. When "#2 Zero-P" is set to master axis, the same value is set to "#2 Zero-P" of slave axis.
"#2 Zero-P" of slave axis cannot be set.

- Synchronous error check is not performed during absolute position initial setting. If an operation error (M01 0051) occurs at the start of the initial setting, correct the error with correction mode before the initial setting is performed.
- During automatic initialization, the values set to push speed (#2055 pushf) and approach distance (#2056 aproch) for master axis are also valid for the slave axis.
- Set the same value to select zero point parameter and basic point(#2059 zerbas) for master and slave axes.
- When different values are set to "#2 Zero-P" of master and slave axes, the automatic initial setting cannot be started.
- "1" can be set to "#0 Absolute posn set" with PLC signal (AZSn).
- When "1" is set to "#0 Absolute posn set" in the following status, "setting error" occurs.
  (*1) Synchronous control method is not selected.
  (*2) Setting to "#0 Absolute posn set" of slave axis was attempted.
  (*3) When the initial setting method is marked point alignment method I, "#2050 absdir" of the master and slave axes is different.

The following is the operation example when synchronization at zero point establishment (#1493 ref_syn) is set to "1" in zero point establishing operation:



The following is the operation example of stopper method when the slave axis reaches the stopper first:



[When synchronization is set to "1" and stopper method is set to "1"]

Parameter	Setting value
synchronization at zero point establishment (#1493 ref_syn)	1
stopper method in zero point establishing operation (#1496 push_typ)	1

The zero points of both master and slave axes are determined by establishing the master axis's zero point.
Slave axis moves synchronously with master axis.
At zero point establishment of stopper method, push toward the machine end stopper until both master and slave axes reach the current limit.
Also, the droop is canceled when the current limit is reached, which enables correction of the deviation to establish the zero point. During automatic initialization, the above operation is performed by two pushing operations.

(a) Set "1" to "#0 Absolute posn set" of master axis.
When "1" to "#0 Absolute posn set" of slave axis is set, "setting error" occurs.

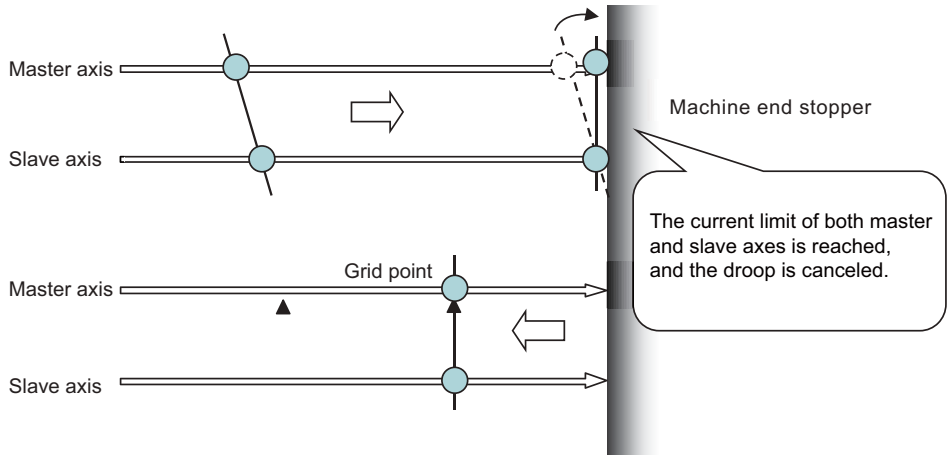
(b) For the marked point alignment method, align the master axis to the machine basic position (marked point) and set "1" to "#1 Origin-P". The droop is canceled at this time.
For the stopper method, push toward the machine end stopper until both axes reach the current limit. When the current limit is reached, the droop is canceled.

(c) For the stopper method with #2059 set to "0", when the master axis and the slave axis are pushed against machine end stopper and both axes reach the current limit, the absolute position is established.
For the stopper method with #2059 set to "1", when the master axis and the slave axis are pushed against machine end stopper and both axes reach the current limit, the axes move in the opposite direction and the absolute position is established.
For the marked point alignment method I, when the master axis is moved toward basic Z direction with "Ret. Ref. P." displayed in the "State" item and reaches its grid point, the absolute position is established.
For the marked point alignment method II, the absolute position is established without each axis moving to its grid point.

(d) Set "#2 Zero-P" to master axis. When "#2 Zero-P" is set to master axis, the same value is set to "#2 Zero-P" of slave axis.
"#2 Zero-P" of slave axis cannot be set.

- Synchronous error check is not performed during absolute position initial setting.
- During automatic initialization, the values set to push speed (#2055 pushf) and approach distance (#2056 aproch) for master axis are also valid for the slave axis.
- Set the same value to select zero point parameter and basic point(#2059 zerbas) for master and slave axes.
- When different values are set to "#2 Zero-P" of master and slave axes, the automatic initial setting cannot be started.
- "1" can be set to "#0 Absolute posn set" with PLC signal (AZSn).
- When "1" is set to "#0 Absolute posn set" in the following status, "setting error" occurs.
  (*1) Synchronous control method is not selected.
  (*2) Setting to "#0 Absolute posn set" of slave axis was attempted.
  (*3) When the initial setting method is marked point alignment method I, "#2050 absdir" of the master and slave axes is different.

The following is the operation example of stopper method when the slave axis reaches the stopper first:
Canceling the droop when the current limit is reached enables correcting the deviation of the master and slave axes with the stopper as positive.



Position alignment after power OFF-ON

Normally, positions of the master and slave axes deviate at power ON, thus the position alignment for this deviation is required. Below are the position alignment methods.

(1) When synchronous error automatic correction at servo ON is enabled (#1281 ext17/bit3 = 1)
The position of the slave axis is automatically corrected to the position of the master axis at servo ON.

(2) When synchronous error automatic correction at servo ON is disabled
Position alignment is done automatically by carrying out manual zero point return. But the zero point related parameters need to be correctly adjusted and set.

When zero point has been established, synchronous error check is carried out even before this position alignment.

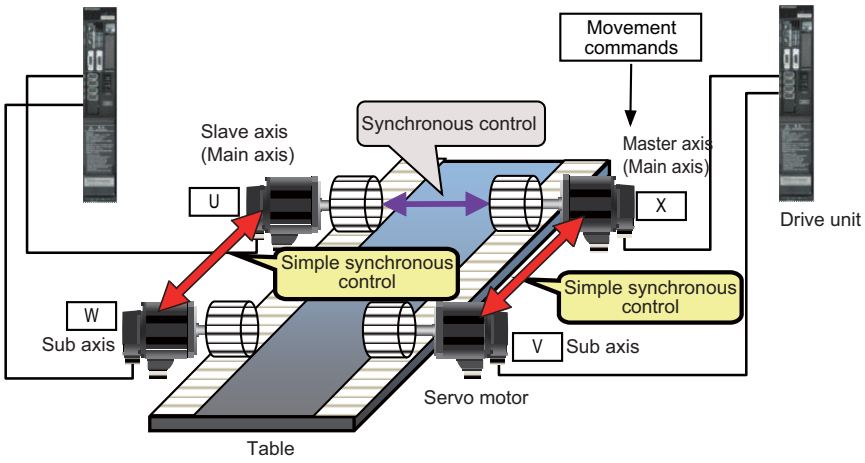
30.1.3 Simple Synchronous Control

Simple synchronous control is an extension of the synchronous control function. This function enables an axis to be synchronized with the axis previously defined as master axis for the synchronous control, and another axis to be synchronized with the slave axis. Backlash can be restrained by distributing load torque imposed on one axis to two servo motors. When the synchronous control and the simple synchronous control are combined, one axis can be driven with four servo motors. An axis to be synchronized with is referred to as a "main axis" and an axis which follows the main axis is referred to as a "sub axis".

This is a control method in which the main axis and the sub axis are controlled in the same position by executing a position command for the main axis to the sub axis as well. The main points of the method are as follows:

- The sub axes can be set only for the master axis and the slave axis for the synchronous control.
- The sub axis is controlled with the movement command for the main axis.
- Only one sub axis can be set for the main axis.
- The main axis and the sub axis are controlled at the same position. Therefore, the main axis and the sub axis can only be used together, while either of the axes can be used singly for single operation and correction mode for the synchronous control.
- For simple synchronous control, synchronization error between the main axis and the sub axis is not monitored.
- For the main axis and the sub axis, specify the speed command synchronous control or the current command synchronous control.

(Example) Example of use of the simple synchronous control



30.1.3.1 Zero Point Establishment During Simple Synchronous Control

There are following regulations and cautions regarding the zero point establishment during simple synchronous control.

- For the absolute position detection method (#2049 type), set "2: Marked point alignment method I" or "4: Marked point alignment method II".
- Apply the same absolute position detection method (#2049 type) to the main axis and the sub axis.
- When the reference point establishment is performed for the master axis and the slave axis (main axis) in accordance with the zero point initial setting, the reference point for the sub axis is established at the same position.
- The absolute position setting is not available in the sub axis. If "1" is set to "#0 Abs pos set" of the sub axis in "ABS. POSITION SET" screen, "setting error" will occur.
- If either the main axis or sub axis issued absolute position detection alarm (Z70 0003), the, same error will occur to the other axis.

30.1.4 Parameter Setting for Synchronous Control

To carry out synchronous control, it is necessary to set the synchronous axes names and the allowable synchronization error value.

There is a restriction in the settings of the slave axis's axis parameters.

For details, refer to "Synchronous Control Specifications Manual" (BNP-C3072-074).

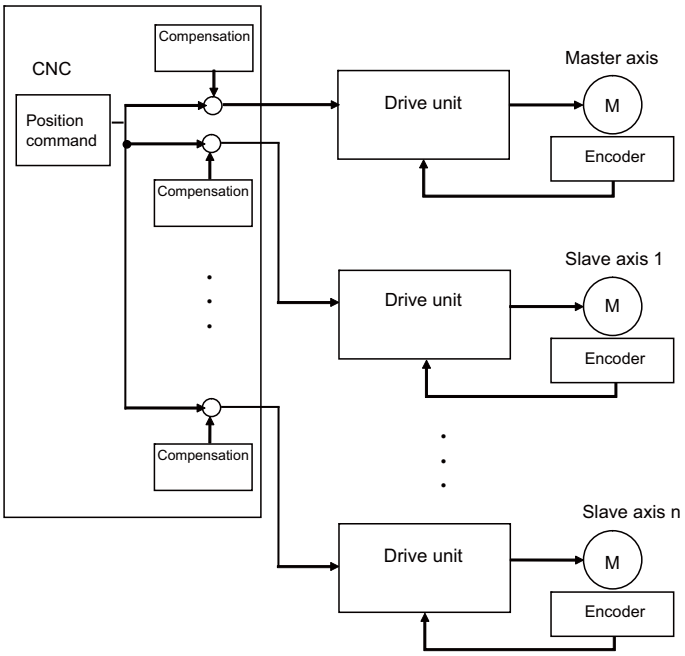
30.2 Multiple-axis Synchronization Control

Refer to "Multiple-Axis Synchronization Control Specifications Manual" (BNP-C3072-339) for details of parameter settings, operations, etc.

30.2.1 Outline

Multiple-axis synchronization control is the function that enables multiple slave axes to be synchronized with commands to the master axis. This function can be used, for example, in multi-head machine configurations.
The axis that serves as the reference of synchronization is called "master axis", whereas the axis that follows the master axis is called "slave axis".
- The synchronized axes are controlled with travel commands to the master axis.
- For one master axis, two or more slave axes can be set.
- Up to three combinations of master axis and slave axes can be set for all the part systems.

Configuration example of multiple-axis synchronization control



The "compensation" in the figure indicates the pitch error compensation, the thermal expansion compensation, the backlash compensation and the external machine coordinate compensation. Even under the multiple-axis synchronization control, the compensation is performed independently for each axis.

Perform position alignment for the master axis and each slave axis at the setup of the machine.
Also, position alignment between synchronous axes is required when power is turned ON. Perform automatic or manual reference position return, and start synchronous operation after and performing position alignment.
Refer to "22. Setting the Position Detection System" for details of position alignment.

30.2.2 Synchronous Operation and Independent Operation

Independent operation is unavailable for multiple-axis synchronization control.
Make sure to include the master axis when configuring the setting of "synchronous control operation method" signal.

Synchronous operation

This method allows both master and slave axes to move synchronously by the movement commands to the master axis.
This method is valid in both automatic and manual operations.
The synchronous operation is selected and cancelled when all axis components are in commanded positions.

Independent operation

Independent operation is unavailable for multiple-axis synchronization control.

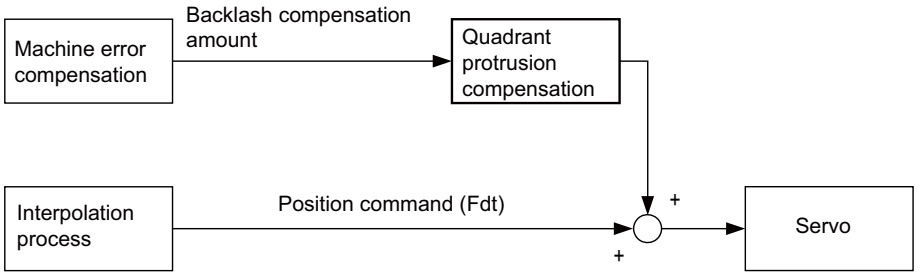
31

OMR Control

31.1 OMR II

OMR II is a function that estimates the machine or motor model (moment of inertia, clone friction, viscosity coefficient, etc.) that can cause a path error (error in actual tool path in respect to the path commanded with the program). High-accuracy machining is achieved by carrying out feed forward control based on that model. This allows error caused by quadrant protrusions during circular interpolation or quadrants on the inner side of the path to be greatly reduced. OMR-II is a function that focuses on the quadrant protrusions, and improves the path error with this. Quadrant path compensation is included in OMR-II.

The quadrant protrusion compensation function improves quadrant protrusions by issuing compensation to the backlash compensation amount to compensate the error when the machine system direction is reversed.
By adding the compensated backlash compensation amount to the position command and sending it to the servo, the gradually increasing-type lost motion which occurs at quadrant changeover can be compensated.



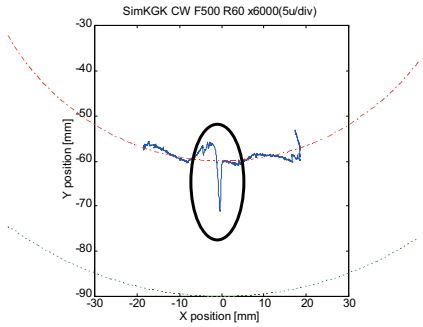
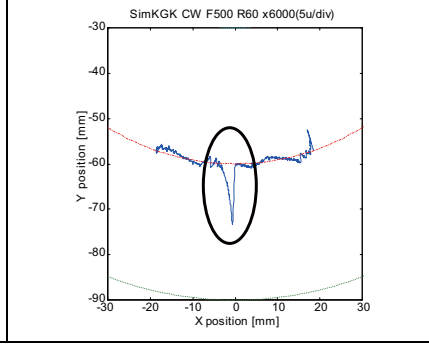
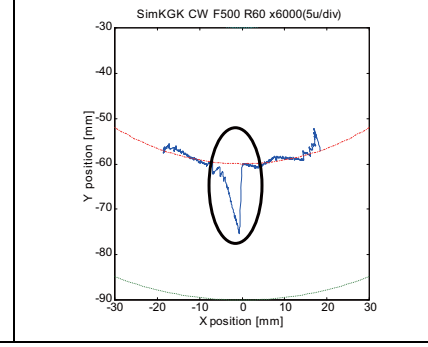
31.1.1 Adjustment Procedure

(1) Set "#2114 Blf fwdg" (Compensation FF gain) to "0".

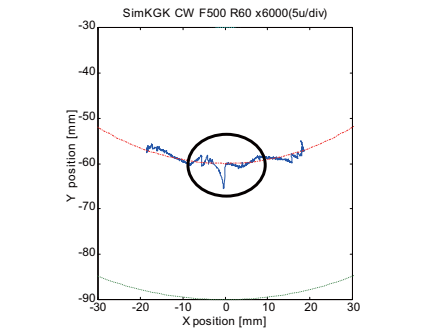
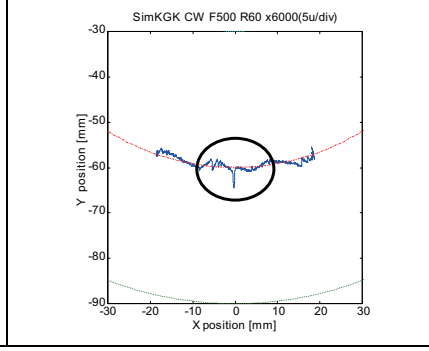
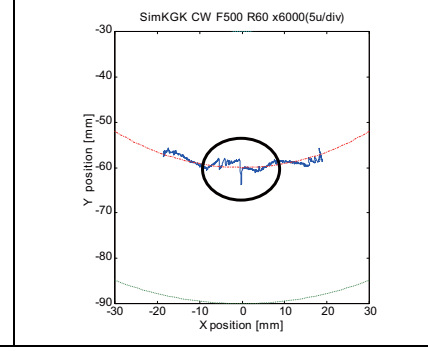
(2) Set values for "#2112 Blf motor inertia" (Motor inertia) and "#2115 Blf motor stl trq" (Motor stall torque) according to the motor specifications.
(For motor specifications, refer to the specifications manual of your drive unit.)

(3) Set "#2111 Blf valid" (Quadrant protrusion compensation valid) to "1".

(4) Adjust the setting value of "#2113 Blf visc friction" (Viscous friction) while checking the machine end.
The following figures are examples of adjusting the Y axis parameter.
Adjust the parameter while checking the part where the Y axis quadrant changeover occurs.
When the setting value of #2113 is small, a recessed part is generated inside the circle, while when the setting value of #2113 is large, a recessed part is generated outside the circle.
When a proper value is set, spike-shaped quadrant protrusions are generated with normal stepped backlash.
This quadrant protrusion is adjusted in the next section.

#2113 Blf visc friction		
0.8 × D	**D: Proper value**	**1.2 × D**
		

(5) Adjust the setting value of #2114 while checking the machine end.
The following figures are examples of adjusting the Y axis parameter.
Adjust the parameter while checking the part where the Y axis quadrant changeover occurs.
When the setting value of #2114 is small, a large quadrant protrusion is generated, while when the setting value of #2114 is large, a recessed part is generated inside the circle.

#2114 Blf fwdg		
60	**80: Proper value**	**100**
		

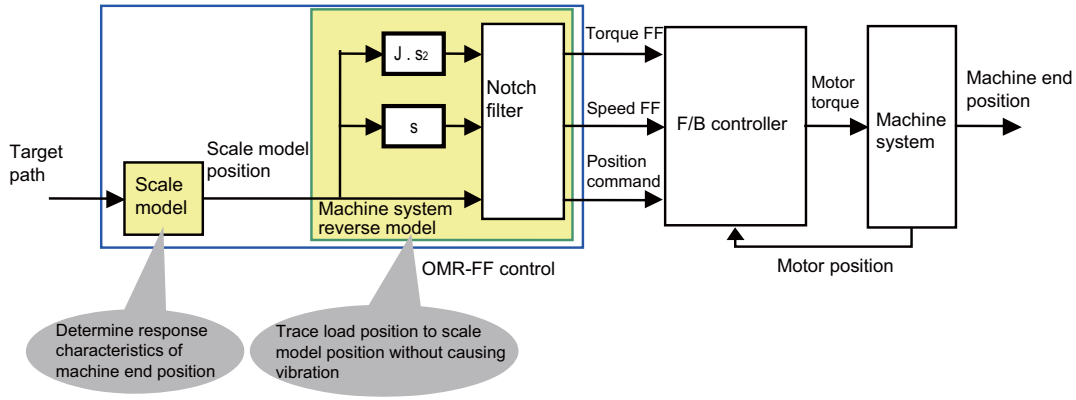
(Note) Even though #2111 is set to "1", if any of #2112, #2113, or #2115 is set to "0", the quadrant projection compensation is invalid.

31.2 OMR-FF

OMR-FF is a function that estimates the causes (moment of inertia, clone friction, viscosity coefficient, etc.) of the path error (error in actual tool path in respect to the path commanded with the program) by making a model of the control target. Feed forward control is carried out based on that model.

With the OMR-FF control method, highly accurate machining can be achieved by using the command filter function to suppress vibration in addition to the reverse model feed forward function.
The reverse model feed forward function estimates the control target's vibration characteristics using a reverse model. The feed forward command for the appropriate position, speed and current can be obtained from this estimation. This allows the machine position to be tracked to the commanded position without causing vibration when using machine tools with low rigidity.
When the command filter function is also used, the high-range vibration elements in the command can also be suppressed.

New control method to bring out the full potential of a high-speed high-acceleration machine
- High tracking ability for the command (Smaller path error)
- Suppression of the machine vibration (Suppress low-range vibration without losing tracking ability)



[Setting parameters]
- Scale model time constant
- Machine system resonance frequency ωp, anti-resonance frequency ωz, attenuation rate ζ, inertia J

For details on OMR-FF, refer to the "Instruction Manual" for the drive unit.

31.2.1 OMR-FF Enabling Procedure (Servo)

(1) Disable the OMR-FF function.
- Set "#2139 omrff_off" to "1".
- Set "#2313 SV113/bit0" to "0".

(2) Use software such as NC Analyzer2 to adjust the feedback system (position loop gain, etc.) and inertia (# 2237 SV037 JL).
(For details, refer to the "Instruction Manual" of NC Analyzer2 and the "Instruction Manual" of your drive unit.)

(3) Enable the OMR-FF function.
- Set "#2139 omrff_off" to "0".
- Set "#2313 SV113/bit0" to "1".

(4) Set the parameters related to the OMR-FF function.
- Set the same value as "#2203 SV003 PGN" to "#2306 SV106 PGM".
- Set "#2312 SV112 IFF" to "10000".

To further adjust various gains, refer to the "Instruction Manual" for your drive unit.

31.2.2 OMR-FF Enabling Procedure (Spindle)

(1) Disable the OMR-FF function.
- Set "#13229 SP229/bit0" to "0".

(2) Use software such as NC Analyzer2 to adjust the feedback system (position loop gain, etc.) and inertia (# 13037 SP037 JL).
(For details, refer to the "Instruction Manual" of NC Analyzer2 and the "Instruction Manual" of your drive unit.)

(3) Enable the OMR-FF function.
- Set "#13229 SP229/bit0" to "1".

Set the following parameters for OMR-FF according to the desired mode.
- For spindle C-axis mode, set "#13035 SP035/bitD" to "1".
- For spindle synchronization control mode, set "#13036 SP036/bit5" to "1".

(4) Set the parameters related to the OMR-FF function.
- Set the same value as "#3203 SP003 PGN" to "#13106 SP106 PGM".
- Set "#13112 SP112 IFF" to "10000".

To further adjust various gains, refer to the "Instruction Manual" for your drive unit.

31.2.3 Precautions

(1) While OMR-FF control is being performed, the conventional feed forward control parameter (#2010 fwd_g) is disabled.

(2) To perform the synchronous control, set the axis parameters and servo parameters of the axes related to OMR-FF control of the master axis and slave axis to be the same.

(3) For the spindle, OMR-FF control is valid only in C-axis mode or spindle synchronization mode.

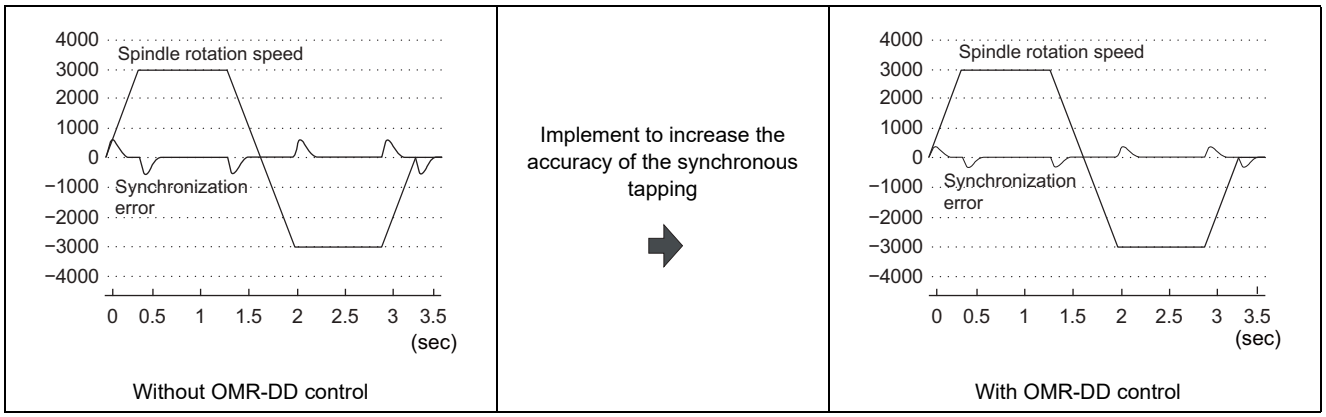
(4) To use the variable speed thread cutting function, set "#13036 SP036/bit5" to "0". However, in that case, OMR-FF control is invalid while spindle synchronization control is being performed.

(5) The OMR-FF control is disabled during the synchronous tapping, and the conventional feed forward control is performed.

(6) This function cannot be used in combination with a spindle type servo.

31.3 High-speed Synchronous Tapping (OMR-DD)

The servo axis directly detects and compensates of the spindle's delay in tracking by using the communication between drive unit over the high-speed optical servo network. By minimizing the synchronization error, the accuracy of the synchronous tapping is increased.



For details on the high-speed synchronous tapping, refer to the "Instruction Manual" of the drive unit.

31.3.1 Enabling Conditions of the Function

The following conditions are required to enable this function.

- "#1281 ext17/bit5" (High-speed synchronous tapping valid) is set to "1".
- "#3137 stap_ax_off" (High-speed synchronous tapping disabled axis) of the axis to which you want to apply the high-speed synchronous tapping is set to "0".
- "#3137 stap_ax_off" of the axis which does not use the high-speed synchronous tapping is set to "1".
- The synchronized servo and spindle are connected to the same channel.
  When they are not connected to the same channel, a normal synchronous tapping is performed.
- One spindle rotates with respect to the drilling axis of the synchronous tapping.
  When multiple spindles rotate at the same time, a normal synchronous tapping is performed.

31.3.2 Restrictions

This function has the following restrictions.

- High-speed synchronous tapping can be performed on up to four spindles on the same channel.
  The normal synchronous tapping is performed for the 5th and subsequent spindles.
- For "#1223 aux07/bit2" to "#1223 aux07/bit5" (Synchronous tap in-position check expansion function), you can select whether to enable the in-position check only for the hole bottom (bit4) and the R-point after the tapping retract (bit5).
  For I-point -> R-point (bit2), the in-position check cannot be omitted.
- When one of the following functions is commanded while the synchronization control is being performed, a normal synchronous tapping is performed.
  Program coordinate system rotation (for lathes)
  3-dimensional coordinate conversion
  Workpiece installation error compensation
  Inclined surface machining
- When the program coordinate system rotation is commanded while the inclined axis control is being performed, a normal synchronous tapping is performed.
- When the tapping axis is in the machine lock, a normal synchronous tapping is performed.
- When any of the vertical and horizontal axes of the selected plane is in the machine lock during program coordinate system rotation (for lathes), a normal synchronous tapping is performed.
- When any of the orthogonal axes of the part system being processed is in the machine lock during 3-dimensional coordinate conversion, workpiece installation error compensation, and inclined surface machining, a normal synchronous tapping is performed.
- High-speed synchronous tapping is not enabled while the tapping retract is being performed.
- When 3-dimensional coordinate conversion is performed, high-speed synchronous tapping can only be performed on the first part system.
  When it is commanded in the second part system or later, a normal synchronous tapping is performed.

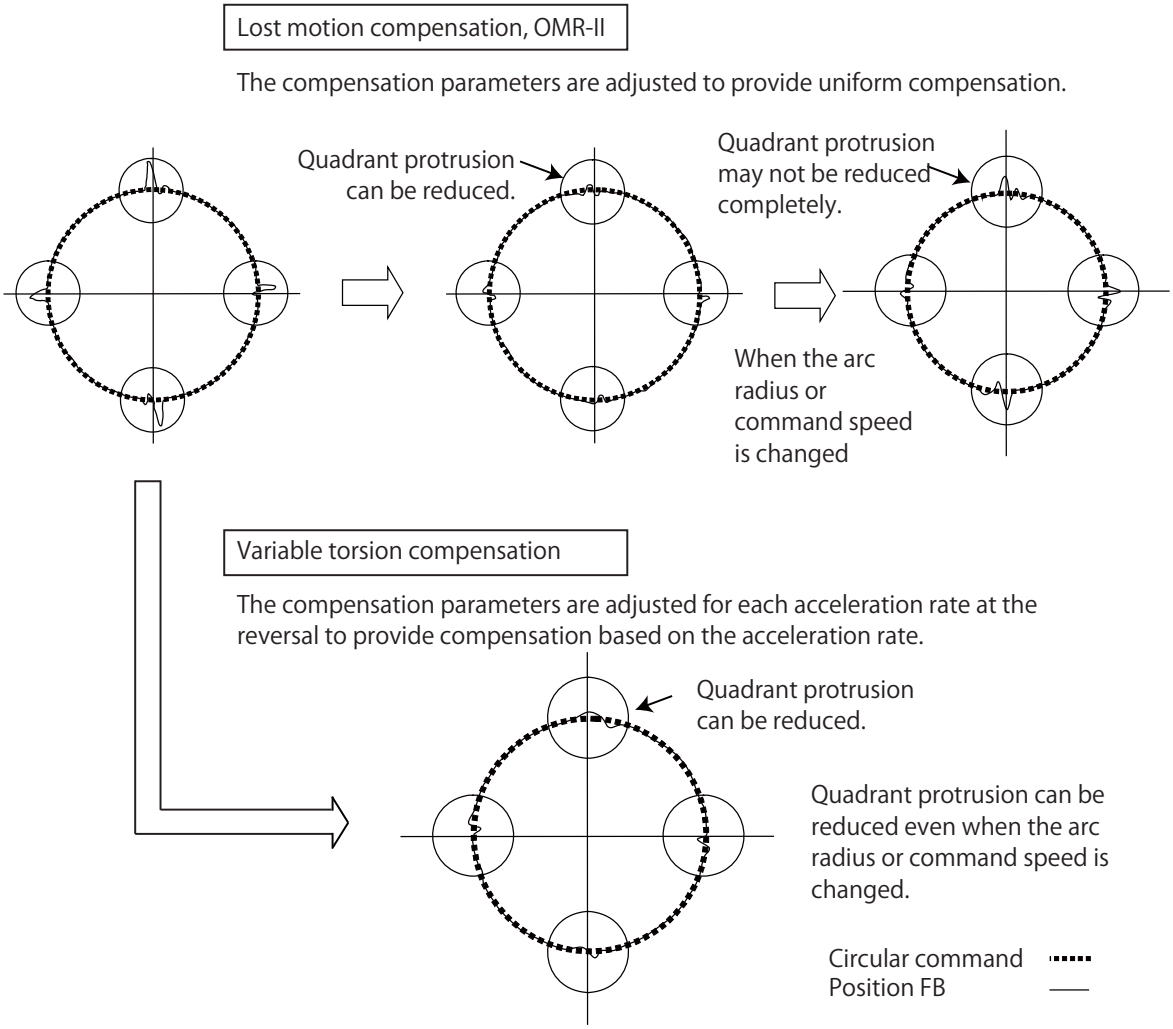
32

Variable Torsion Compensation

32.1 Outline

When the direction of the machine movement is reversed, a response delay (*1) causes protrusion on the path.
(*1) The response delay occurs due to dead band, such as friction, torsion, and backlash.

The lost motion compensation and OMR-II provide uniform compensation using the set compensation parameters regardless of the acceleration rate at the direction reversal to suppress the protrusion. However, the characteristics of the response delay at the reversal differs depending on the acceleration rate at the reversal; therefore, when the arc radius or command speed is changed, the compensation cannot be performed sufficiently.
The variable torsion compensation enables compensation based on the acceleration rate at the reversal and machining with high accuracy by setting the compensation parameters for each acceleration rate at the reversal.



This function is valid only on the first part system. Also, this function is valid on the basic axis and the additional axis. This function is invalid on the rotary axis and spindle.

32.2 Enabling Conditions

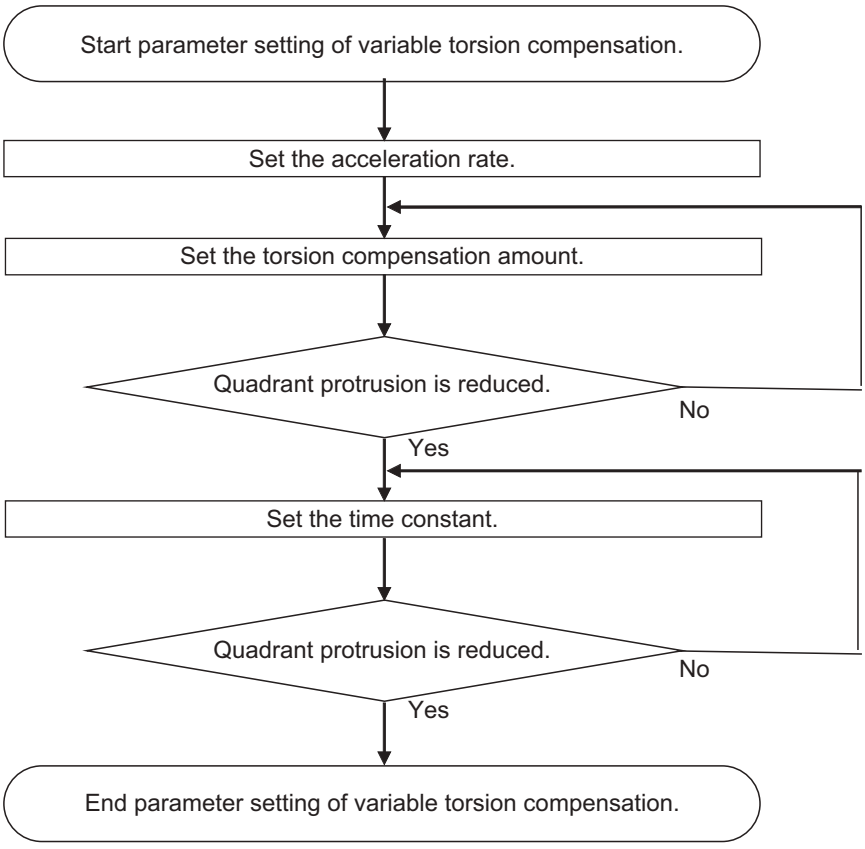
This function is enabled when all the following conditions are met.

- The optional specifications of variable torsion compensation are valid.
- "#14301 valVDC" (Variable full-closed torsion compensation ON) is "1".
- "#14311 VDCa1" (Variable full-closed torsion compensation acceleration 1) is not "0".
- The variable torsion compensation is available for the drive unit.

32.3 Parameter Setting Procedure

Set the parameters in the following order.

(1) Set the acceleration rate. (Refer to "Setting the Acceleration Rate".)
(2) Set the torsion compensation amount. (Refer to "Setting the Torsion Compensation Amount".)
(3) Set the time constant. (Refer to "Setting the Time Constant".)



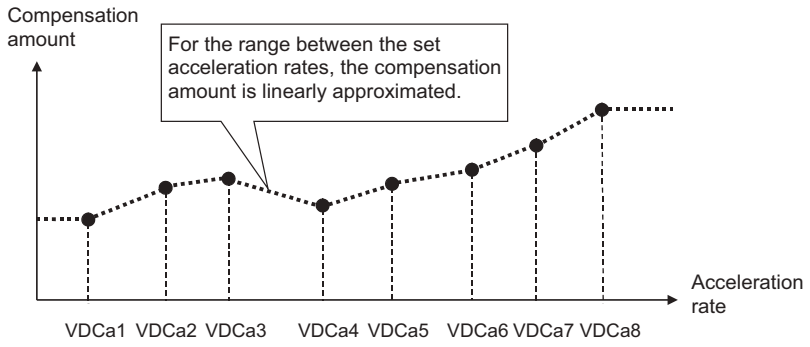
32.3.1 Setting the Acceleration Rate

Set the acceleration rate to which the variable torsion compensation is to be applied.
Set the acceleration rate at reversal of direction of the axis on which compensation is to be performed.
Set the acceleration rates by the 1st parameter to 8th parameter.
Set the acceleration rates to be greater from the 1st parameter to the 8th parameter.

1st parameter	2nd parameter	. .	8th parameter
Acceleration rate 1 (VDCa1)	Acceleration rate 2 (VDCa2)		Acceleration rate 8 (VDCa8)
Time constant 1 (VDCtex1)	Time constant 2 (VDCtex2)		Time constant 8 (VDCtex8)
:	:		:

0 < Acceleration rate 1 < Acceleration rate 2 < Acceleration rate 3 < Acceleration rate 4 < Acceleration rate 5 < Acceleration rate 6 < Acceleration rate 7 < Acceleration rate 8

For the range between the acceleration rates set in the 1st to 8th parameters, compensation is performed using the compensation amount that is linearly approximated.
For the acceleration rate smaller than that of the 1st parameter, compensation is performed using the 1st parameter. For the acceleration rate greater than that of the 8th parameter, compensation is performed using the 8th parameter.



The variable torsion compensation is invalid on the axis where "0" is set to the acceleration rate of the 1st parameter.
When the size correlation of the acceleration rates is incorrectly set from the 1st to 8th parameters, the incorrectly set parameter and the subsequent parameters are invalid.
(Example) When the acceleration rate of the 4th parameter is smaller than that of the 3rd parameter
The parameters up to the 3rd parameter are valid, and the 4th and subsequent parameters are invalid. For the acceleration rate greater than that of the 3rd parameter, compensation is performed using the 3rd parameter.

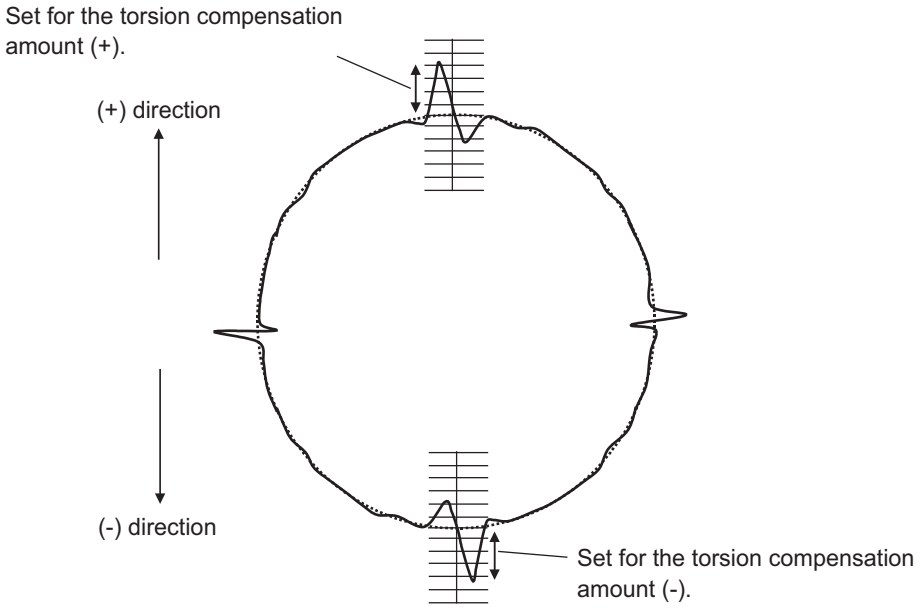
The acceleration rate parameters are as follows.

	1st	2nd	3rd	4th	5th	6th	7th	8th
Acceleration rate (VDCa1 to 8)	#14311	#14316	#14321	#14326	#14331	#14336	#14341	#14346

32.3.2 Setting the Torsion Compensation Amount

Set the variable torsion compensation amounts in the (+) and (-) directions. Perform the setting for each acceleration rate.

For the torsion compensation amount (+), set the protrusion size when the axis moves to the (+) direction and reverses to the (-) direction. For the torsion compensation amount (-), set the protrusion size when the axis moves to the (-) direction and reverses to the (+) direction.



The torsion compensation amount parameters are as follows.

	1st	2nd	3rd	4th	5th	6th	7th	8th
Torsion compensation amount (+) (VDCpex1 to 8)	#14313	#14318	#14323	#14328	#14333	#14338	#14343	#14348
Torsion compensation amount (-) (VDCnex1 to 8)	#14314	#14319	#14324	#14329	#14334	#14339	#14344	#14349

32.3.3 Setting the Time Constant

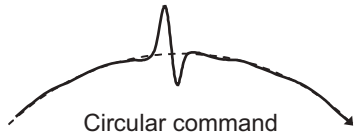
Set the time constant of the variable torsion compensation. Perform the setting for each acceleration rate.

When an appropriate value is set to the time constant, the quadrant protrusion is reduced.



When the quadrant protrusions are generated as follows, change the setting of the time constant.

■When the outward protrusion from the arc is generated before the inward protrusion

	The compensation timing is late. Set a smaller value for the time constant.

■When the outward protrusion from the arc is generated after the inward protrusion

	The compensation timing is early. Set a greater value for the time constant.

The time constant parameters are as follows.

	1st	2nd	3rd	4th	5th	6th	7th	8th
Time constant (VDCtex1 to 8)	#14312	#14317	#14322	#14327	#14332	#14337	#14342	#14347

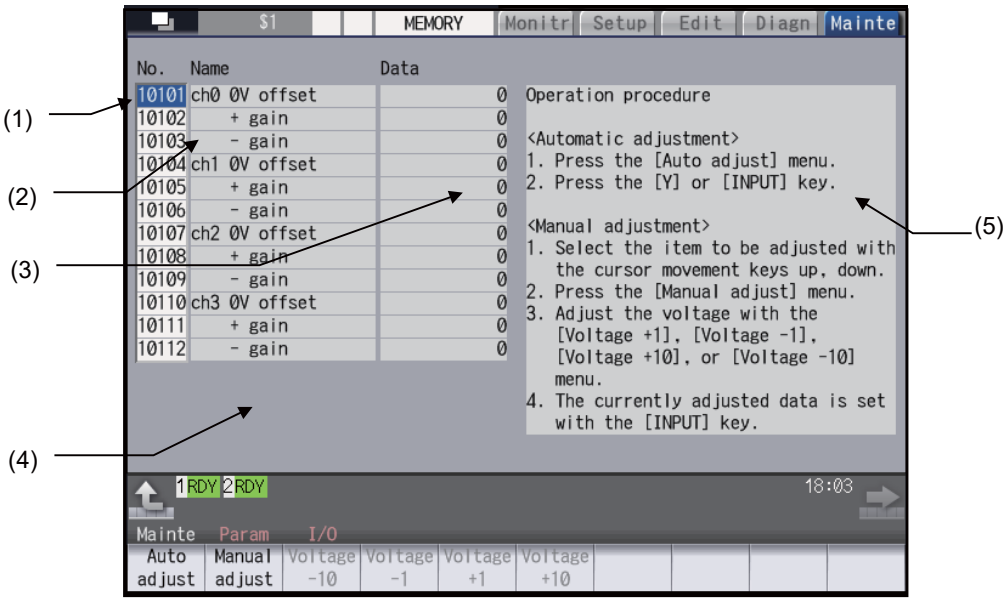
32.4 Relation with Other Functions

- Relation with lost motion
  When the variable torsion compensation is valid, the lost motion compensation is invalid.
- Relation with OMR-II
  It can be used with the variable torsion compensation.
- Relation with OMR-FF
  It can be used with the variable torsion compensation.
- Relation with drilling cycle high-speed retract
  It can be used with the variable torsion compensation. Even when the variable torsion compensation is valid, the lost motion compensation is valid during retract operation.
- Arbitrary axis exchange control
  When the arbitrary axis exchange control is performed while the variable torsion compensation is valid, the operation is as follows.
  When the axis of the part system 1 is moved in the 2nd part system, compensation is performed by the variable torsion compensation parameter set to the axis.
  When the axis of the part system 2 is moved in the 1st part system, the variable torsion compensation is not performed for the axis.
- Synchronous control
  It can be used with the variable torsion compensation.
  In the synchronous operation method, the same compensation is performed between the slave axis and the master axis. The compensation parameter set to the slave axis is ignored.
  In the independent operation method, the compensation is performed for the slave axis with the compensation parameter set to the slave axis.

33

Adjust S-analog Screen

The spindle analog output adjustment is carried out on this screen.



Display items

Display item		Details
(1)	Parameter No.	This is a number to be used when inputting/outputting the parameters. For manual adjustments, this uses the [↑][↓] keys to move the cursor to the setting item to be adjusted. The cursor does not display during automatic adjustments.
(2)	Adjustment item name	This displays the names of the spindle analog adjustment items.
(3)	Adjustment data	This displays the setting data for each adjustment item.
(4)	Current adjust data	This displays data which is being adjusted manually. (Display only during a manual adjustment.)
(5)	Operation procedure	This displays the operation procedures for automatic and manual adjustments.

Menus

Menu	Details	Reference
Auto adjust	This carries out automatic adjustment of the spindle analog output.	Performing Automatic Adjustments
Manual adjust	This carries out manual adjustment of the spindle analog output.	Performing Manual Adjustments
Voltage -10	This is used during manual adjustments to adjust downward in decrements of 10.	
Voltage -1	This is used during manual adjustments to adjust downward in decrements of 1.	
Voltage +1	This is used during manual adjustments to adjust upward in increments of 1.	
Voltage +10	This is used during manual adjustments to adjust upward in increments of 10.	

33.1 Adjustment Preparations

The PLC must be stopped when performing spindle analog output adjustments by one of the following methods below:

Operation methods (when stopping the PLC with the rotary switch)

(1) Set the rotary switch CS2 in the upper part of the unit to "1". ➡ The PLC is stopped.

Operation methods (when stopping the PLC on the maintenance screen)

(1) Press the function key [MAINTE] and then press the menu [MAINTE].

(2) Press the menu [Psswd input].

(3) Enter the machine tool builder password.

(4) Press the menu [PLC STOP] and then press [Y] key. ➡ The PLC is stopped.

33.2 Performing Automatic Adjustments

Automatic adjustment will execute "0V offset adjustment" and "+ gain adjustment" for the remote I/O analog outputs (max. 4ch) connected to the main unit. The - gain will be handled as the + gain.

Operation methods

(1) Press the menu [Auto adjust]. ➡ An operation message "Execute? (Y/N)" appears.

(2) Press the[Y] or [INPUT] key. ➡ Automatic adjustment begins, and an operation message "Auto adjust execution" appears.

The manual adjustment related menu is displayed in gray during the automatic adjustment, and manual adjustments will be disabled.
Switching to other screens is also disabled at this time.

When the automatic adjustment is completed, an operation message "Auto adjust complete" appears.
The highlighting of the menu [Auto adjust] is cleared and the cursor is returned to where it was before the auto adjustment.
The menu [Manual adjust] returns to the normal display and manual adjustment can be performed.

33.3 Performing Manual Adjustments

Adjusting the ch0 0V offset

(1) Use the [↑] [↓] keys to move the cursor to item "#10101", then press the [Manual adjust]menu button.
➡ The current setting value is displayed at "Current adjust data". A 0V analog voltage is output to ch0 at this time.

(2) Monitor the analog voltage.
➡ Adjust the 0V offset until the analog voltage is 0V ±3.5mV. The setting range -999 to 999.

(3) <For plus-voltage>

Press the menu [Voltage +1] or [Voltage +10]
➡ "Current adjust data" is adjusted downward in decrements of 1 each time the menu [Voltage +1] is pressed.
"Current adjust data" is adjusted downward in decrements of 10 each time the menu [Voltage +10] is pressed.

<For minus-voltage>

Press the menu [Voltage +1] or [Voltage +10].
➡ "Current adjust data" is adjusted upward in increments of 1 each time the menu [Voltage +1] is pressed.
"Current adjust data" is adjusted upward in increments of 10 each time the menu [Voltage +10]is pressed.

(Note) "Current adjust data" range is -999 to 999.
The adjustments cannot exceed this range.

(4) Press the [INPUT] key.
➡ "Current adjust data" is set as "ch0 0V offset", and the 0V offset result is enabled.

Adjusting the ch0 + gain

(1) Use the [↑] [↓] keys to move the cursor to item "#10102", then press the menu [Manual adjust].
➡ The current setting value is displayed at "Current adjust data". A ch0 +10V analog voltage is output at this time.

(2) Monitor the analog voltage.
➡ Adjust the + gain until the monitor voltage is 10V ±3.5mV. The setting range -999 to 999.

(3) <For 10V or higher>
Press the menu [Voltage -1] or [Voltage -10]

<For less than 10V>
Press the menu [Voltage +1] or [Voltage +10].

(4) Press the [INPUT] key.
➡ "Current adjust data" is set as "ch0 + gain", and the adjustment result is enabled.

Adjusting the ch0 - gain

(1) Use the [↑] [↓] keys to move the cursor to item "#10103", then press the menu [Manual adjust].
➡ The current setting value is displayed at "Current adjust data". A ch0 -10V analog voltage is output at this time.

(2) Monitor the analog voltage.
➡ Adjust the - gain until the monitor voltage is -10V ±3.5mV. The setting range -999 to 999.

(3) <For -10V or higher>
Press the menu [Voltage -1] or [Voltage -10].

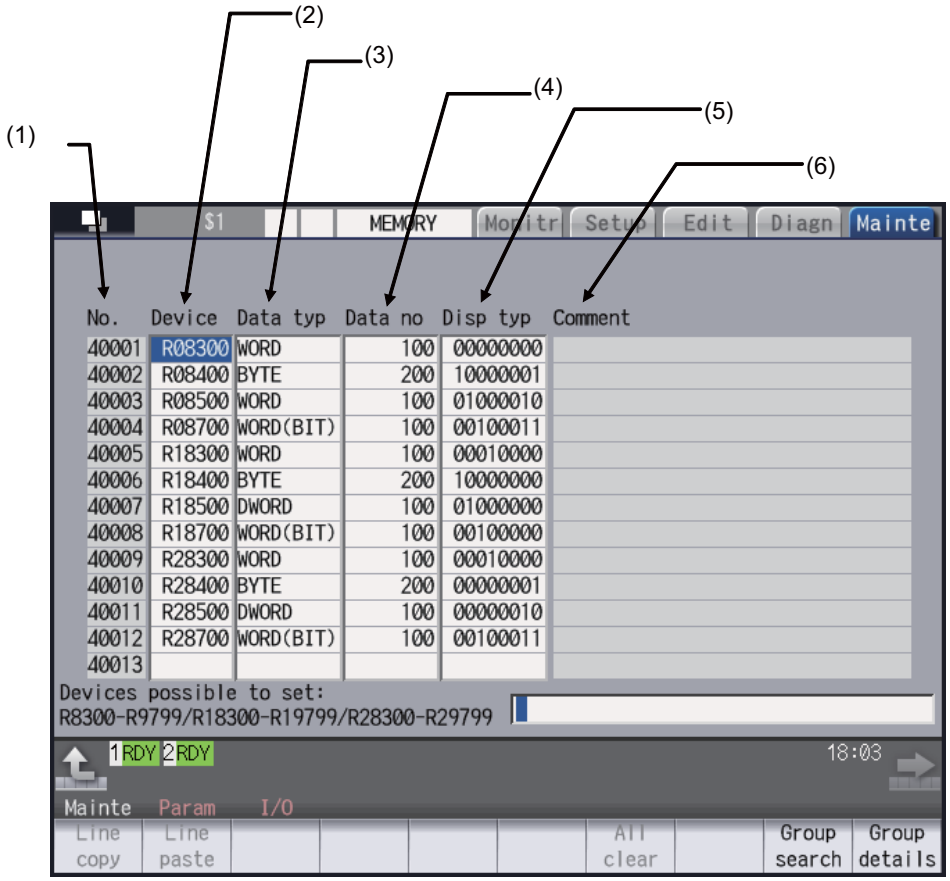
<For less than -10V>
Press the menu [Voltage +1] or [Voltage +10].

(4) Press the [INPUT] key.
➡ "Current adjust data" is set as "ch0 - gain", and the adjustment result is enabled.

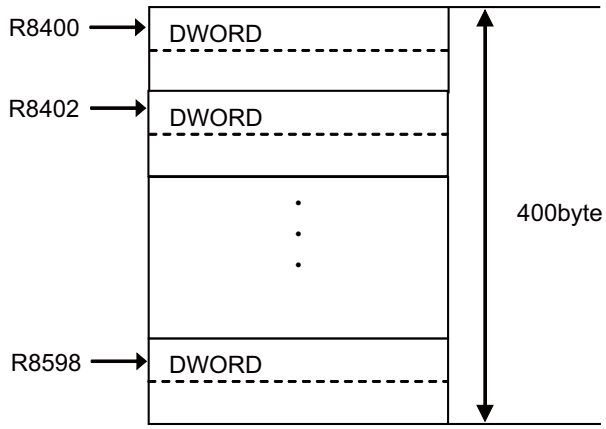
34

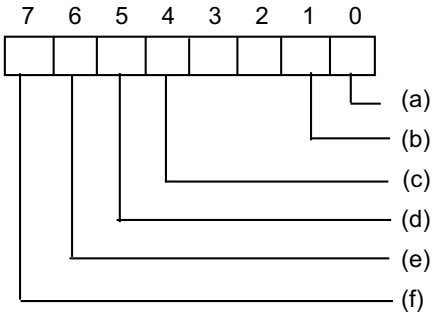
Device Open Parameter Screen

This function can set or change the user back up area of the PLC device from the NC screen.
Divide the device area in accordance with the specifications of the machine tool builder and switch the display format or data type for each divided area (hereinafter called a group information).



Display items

Display items		Details	Setting range
(1)	Parameter No.	Display the parameter No.(maximum of 100).	-
(2)	Device allocation	Set the head device which designates the divided area. - It is possible to designate the device allocation which overlaps with other groups. - When "0" is set to the device allocation, it clears the settings (data type, display format etc.) of the target group. - When an odd number address is set for the device allocation, DWORD cannot be designated for the data type.	R8300 to R9799 R18300 to R19799 R28300 to R29799 0
(3)	Data type	Set the data type (BYTE, WORD, DWORD, WORD(BIT)) of the allocation area. BYTE: The area is secured per 1-byte. WORD: The area is secured per 2-byte. DWORD: The area is secured per 4-byte. WORD(BIT): The area is secured per 2-byte. DWORD cannot be designated when the device allocation is an odd number address. BIT format is valid for the display format when WORD(BIT) is designated. The data type can also be designated by pressing the menu [BYTE], [WORD], [DWORD], or [WORD(BIT)].	0:WORD 1:DWORD 2:BYTE 3:WORD(BIT)
(4)	Number of data	Set the number of data in the allocation area. Number of data available to designate varies depending on the designated data type. (Note) When the number of data is "0", the target group will be invalid. (Example) Device allocation: R8400 Data type: DWORD Number of data: 100  	0 to 3000 It depends on the device allocation and the data type.

Display items		Details	Setting range
(5)	Display format	Designate the display format of the data, the restriction of display, and the state of input protection.  (a) Cancellation of input protection 1: Not check Input protection check for the data protection key 2 will not be executed in the group detail screen. 0: Check Input protection check for the data protection key 2 will be executed in the group detail screen. (Note) The name of the data protection key varies depending on the machine tool builder. Refer to the instruction manual issued by the machine tool builder for details. (b) Cancellation of restriction on display 1: Display The group detail screen is displayed without entering the machine tool builder's password 0: Not display The group detail screen is not displayed when the password is not entered. (c) BCD fromat 1: Valid Display the group detail screen data in BCD format. 0: Invalid (d) BIT format 1: Display the group detail screen data in BIT format. 0: Invalid (e) HEX format (Hexadecimal format) 1: Valid Display the group detail screen data in HEX format. 0: Invalid (f) Sign (Decimal format only) 1: Without sign Display the group detail screen data in decimal format without sign. 0: With sign Display the group detail screen data in decimal format with sign. (Note) When "BCD format", "HEX format" and "BIT format" are all set to "0", the display format of the data is the decimal format.	-
(6)	Group comment	Display a comment that is defined in the comment definition file for the device open or a comment of a head device of the group. a) When defining a group comment Comment of each group will be displayed. It will be displayed regardless of device allocation and the setting of number of data. b)When not define a group comment A comment of the device which is set with "(2) device allocation" will be displayed.	-

Menu for the device allocation/number of data input

Menu	Details
Line copy	Copy the data of a line where a cursor is placed.
Line paste	Writes the contents of the data copied (one line) into a line where the cursor is placed. If the data of the line is changed after the [Line copy] is pressed, the data before change will be written when pasting it. Once the line is copied, it can be pasted many times until new area is copied.
All clear	Clears all allocation of the parameter in the device open parameter screen. -Data of the group detail will not be cleared.
Group search	When parameter No. is set and [INPUT] key is pressed, the group will be displayed with the parameter No. set is a top of the group. A cursor moves to the line of the target group.
Group details	The group detail screen corresponding to the group where a cursor is placed will be displayed. When the group where the cursor is placed is not set, it will be invalid.

Menu for inputting the display format

Menu	Details
W/ DEC sign	Change the display format to the decimal format with sign. When the data type is "WORD (BIT)", it will be changed to "WORD".
W/O DEC sign	Change the display format to the decimal format without sign. When the data type is "WORD (BIT)", it will be changed to "WORD".
HEX	Change the display format to the HEX format. When the data type is "WORD (BIT)", it will be changed to "WORD".
BIT	Change the display format to the BIT format. The data type is changed to "WORD (BIT)".
BCD	Change the display format to the BCD format. When the data type is "WORD (BIT)", it will be changed to "WORD".
Enable display	Select whether to display the target group infomation on the each group detail screen to users.
Cancel protect	Select whether the input protection of the data protection key 2 is valid/invalid for setting of the target group information on the each group detail screen to users.
Line copy	Copy the data of a line where a cursor is placed.
Line paste	Writes the contents of the data copied (one line) into the line where the cursor is placed. If the data of the line is changed after [Line copy] is pressed, the data before change will be written when pasting it. Once the line is copied, it can be pasted many times until new area is copied.
All clear	Clears all allocation of the parameter in the device open parameter screen. (Note) Data of the group detail will not be cleared.
Group search	When parameter No. is set and [INPUT] key is pressed, the group will be displayed with the parameter No. set is a top of the group. A cursor moves to the line of the target group.
Group details	The group detail screen corresponding to the group where a cursor is placed will be displayed. When the group information, where a cursor is placed, is not set, it will be invalid.

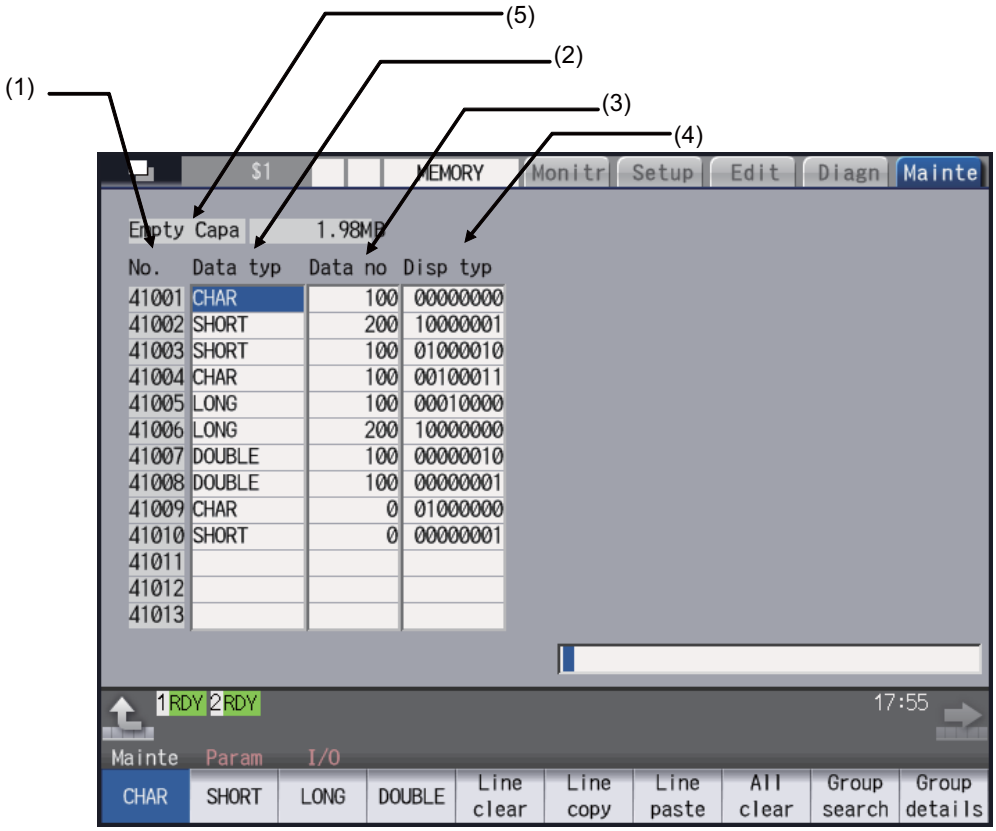
Menu for inputting the data type

Menu	Details
BYTE	Input "BYTE" to the data type. When the display format is BIT format, it will be changed to the desimal format with sign.
WORD	Input "WORD" to the data type. When the display format is BIT format, it will be changed to the desimal format with sign.
DWORD	Input "DWORD" to the data type. When the display format is BIT format, it will be changed to the desimal format with sign.
WORD (BIT)	Input "WORD(BIT)" to the data type. Display format will be changed to the BIT format.
Line copy	Copy the data of a line where a cursor is placed.
Line paste	Writes the contents of the data copied (one line) into the line where the cursor is placed. If the data of the line is changed after the [Line copy] is pressed, the data before change will be written when pasting it. Once the line is copied, it can be pasted many times until new area is copied.
All clear	Clears all allocation of the parameter in the device open parameter screen. (Note) Data of the group detail will not be cleared.
Group search	When parameter No. is set and press [INPUT] key, the group will be displayed with the parameter No. set is a top of the group. A cursor moves to the line of the target group.
Group details	The group detail screen corresponding to the group where a cursor is placed will be displayed. When the group where a cursor is placed is not set, it will be invalid.

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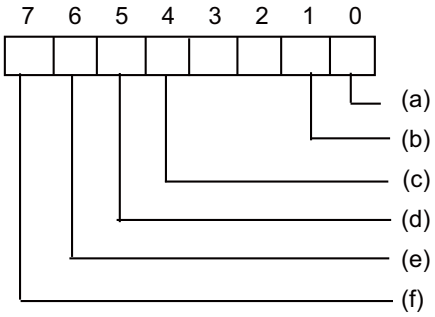
SRAM Open Parameter Screen

SRAM open area for a machine tool builder can be set or changed.
It can be divided according to the machine tool builder's usage, and the display format and the data format can be switched for each divided area (hereinafter called a group).



Display items

Display item		Details	Setting range
(1)	No.	Display the parameter No.(maximum of 100).	-
(2)	Data type	Set the data type (CHAR, SHORT, LONG, DOUBLE) of the allocation area. CHAR: 1-byte integer type. The area is saved per 1-byte. SHORT: 2-byte integer type. The area is secured per 2-byte. LONG: 4-byte integer type. The area is secured per 4-byte. DOUBLE: 8-byte real type. The area is secured per 8-byte. Target group setting (No. of data, display format) will be cleared if "0" is designated. The data type can also be designated by pressing the menu [CHAR], [SHORT], [LONG] or [DOUBLE]. The data set will be valid after formatting and then turning the power ON again. If the power is turned ON without formatting after the setting, an error "Z40 Format mismatch" will be displayed. The error will be kept displayed even the power is turned ON again until the reformatting is completed.	0 1:CHAR 2:SHORT 3:LONG 4:DOUBLE
(3)	Number of data	Set the number of data in the allocated area. Number of data available to designate varies depending on the unit and the free space designated by the data type. - Target group will be invalid if the number of data is "0". - The data set will be valid after formatting and then turning the power ON again. - If the power is turned ON without formatting after the setting, a error "Z40 Format mismatch" will be displayed. The error will be kept displayed even the power is turned ON again until the reformatting is completed.	0 to 9999999 Depends on the data type and the amount of free space.

Display item	Details	Setting range
(4) Display format	Designate the display format of the data, display limitation and the state of the input protection.  (a) Cancellation of input protection 1: Not check Input protection check for the data protection key 2 will not be executed in the group detail screen. 0: Check Input protection check for the data protection key 2 will be executed in the group detail screen. The name of the data protection key varies depending on the machine tool builder. Refer to the instruction manual issued by the machine tool builder for details. (b) Cancellation of restriction on display 1: Display The group detail screen is displayed without entering the machine tool builder's password. 0: Not display The group detail screen is not displayed when the password is not entered. (c) BCD fromat 1: Valid Display the group detail screen data in BCD format. 0: Invalid (d) BIT format 1: Display the group detail screen data in BIT format. 0: Invalid (e) HEX format (Hexadecimal format) 1: Valid Display the group detail screen data in HEX format. 0: Invalid (f) Sign (Decimal format only) 1: Without sign Display the group detail screen data in decimal format without sign. 0: With sign Display the group detail screen data in decimal format with sign. - This will be valid after the power is turned ON again. - When "BCD format", "HEX format" and "BIT format" are all set to "0" or more than one format is set to "1", the data display format will be decimal format with sign. - If the data type is "DOUBLE", it will be decimal format with sign.	-
(5) Amount of free space	Display the amount of free space of the SRAM open area. It will be updated each time the data type or the number of data is set. If the data input exceeds the amount of free space, it will be displayed in negative value. The area will not be allocated even it is formatted. Adjust the data type and the number of data to make it positive value. The format is ####.##XB (X: prefix ... K, M). When it is less than 1024 byte, it is ####B.	-

Menu when inputting the data type

Menu	Details
CHAR	Input CHAR into the data type.
SHORT	Input SHORT into the data type.
LONG	Input LONG into the data type.
DOUBLE	Input DOUBLE into the data type.
Line clear	Delete a group in a line where a cursor is placed.
Line copy	Copy the data of a line where a cursor is placed.
Line paste	Writes the contents of the data copied (one line) into the line where the cursor is placed. If the data of the line is changed after the [Line copy] is pressed, the data before change will be written when pasting it. Once the line is copied, it can be pasted many times until new area is copied.
All clear	Clears all allocation of the parameter in the SRAM open parameter screen. -Data of the group detail will not be cleared.
Group search	When parameter No. is set and [INPUT] key is pressed, the group will be displayed with the set parameter No. at top of the group. A cursor moves to the line of the target group.
Group details	The group detail screen corresponding to the group where a cursor is placed will be displayed. When the group information, where a cursor is placed, is not set, it will be invalid.

Menu when inputting the number of data

Menu	Details
Line clear	Delete a group in a line where a cursor is placed.
Line copy	Copy the data of one line where a cursor is placed.
Line paste	Writes the contents of the data copied (one line) into the line where the cursor is placed. If the data of the line is changed after the [Line copy] is pressed, the data before change will be written when pasting it. Once the line is copied, it can be pasted many times until new area is copied.
All clear	Clears all allocation of the parameter in the SRAM open parameter screen. -Data of the group detail will not be cleared.
Group search	When parameter No. is set and [INPUT] key is pressed, the group will be displayed with the set parameter No. at the top of the group. A cursor moves to the line of the target group.
Group details	The group detail screen corresponding to the group where a cursor is placed will be displayed. When the group information, where a cursor is placed, is not set, it will be invalid.

Menu when inputting the display format

Menu	Details
W/ DEC sign	Change the display format to the decimal format with sign.
W/O DEC sign	Change the display format to the decimal format without sign.
HEX	Change the display format to the hexadecimal format.
BIT	Change the display format to the BIT format.
BCD	Change the display format to the BCD format.
Enable display	Change whether to show the group detail screen to the users.
Cancel protect	Change whether the input protection check is valid or not.
Line clear	Delete a group of the line where a cursor is placed.
Line copy	Copy the data of a line where a cursor is placed.
Line paste	Writes the contents of the data copied (one line) into the line where the cursor is placed. If the data of the line is changed after [Line copy] is pressed, the data before change will be written when pasting it. Once the line is copied, it can be pasted many times until new area is copied.
All clear	Clears all allocation of the parameter in the SRAM open parameter screen. (Note) Data of the group detail will not be cleared.
Group search	When parameter No. is set and [INPUT] key is pressed, the group will be displayed with the set parameter No. set at the top of the group. A cursor moves to the line of the target group.
Group details	The group detail screen corresponding to the group where a cursor is placed will be displayed. When the group information, where a cursor is placed, is not set, it will be invalid.

36

Data Backup and Restoration

The following two functions are available for the data backup and restoration: all backup function for files in batch and input/output function for separate files.
The following devices are available in all backup and restoration.

Memory card (Front-side SD card)
DS (Back-side SD card of display unit)
USB memory

The master data backup and restoration are used for backing up and restoring the initial state data set by MTB. The built-in memory is used for the master data backup and restoration regardless of the selected device.

Files to be backed up/ restored are as follows.

Screen display	File name	Data type
System data	SRAM.BIN	SRAM data (binary files) Programs, parameters, R registers and so on
	ALL.PRM (*1)	Parameters
	ASSEMBLY.INF (*1)	System configuration
Ladder	USERPLC.LAD	User PLC program
	EIPCONFDATA.BIN	EtherNet/IP configuration file
	PLCMSG_XXX.TXT (*2)	PLC message file for MTB
	PLCUMSG_XXX.TXT (*2)	PLC message file for users
	MCRMSG_XXX.TXT (*2)	Macro alarm message file
Safety parameter	SAFEPARA.BIN	Safety parameter (binary file)
Safety ladder1	SAFEPLC1.LAD	Safety PLC program1
Safety ladder2	SAFEPLC2.LAD	Safety PLC program2
APLC data	APLC.BIN	C language module created by user
Custom data	-	Custom screen data (Custom screen modules, setting files (Config.ini/ customdef.ini/customload.txt) and PLC alarm messages)

(*1) These data can be backed up only, cannot be restored.
(*2) "XXX" indicates the abbreviation for each language.

For the input/output function for separate files, refer to the "Instruction Manual".

36.1 All Backup

The following explains the procedure to backup the various NC data to the memory card in a batch.

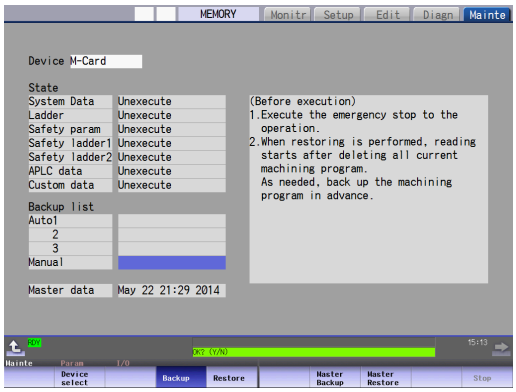
[Note]

(1) APLC data can be backed up only when the APLC release specification is valid.

Operation method

(1) Press the menu [Backup].

The all backup screen is displayed.

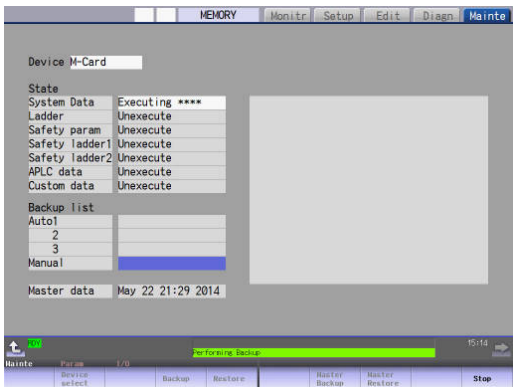


<Note>

- Press the key to cancel this process.

(2) Press [Y], [y] or [INPUT].

The backup starts. "Executing" and "*" are displayed for the state of file under processing.

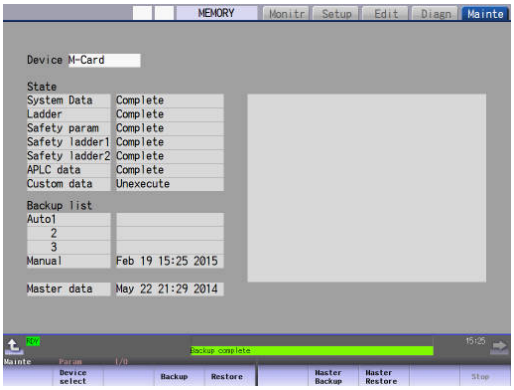


<Note>

- If any NC data file exists in the backup folder, the confirmation message "Overwrite this file? (Y/N)" appears. Press [Y], [y] or [INPUT] to start the backup.
- If the tool data is being sorted, the operation message "File access error" is displayed and the backup cannot be executed.
- For the custom data, the backup cannot be canceled during its execution.

(3) The backup is completed without error.

➡ The states of backup-complete files turn to "Complete", the date displayed in "Backup list" will be updated.



<Note>
- If the APLC release specification is invalid, the APLC data cannot be backed up and "Unexecute" is displayed.

[Note]

(1) If an error occurs during the backup execution, the display will be as follows:
- Operation message : "File access error"
- Execution state : "Error" for the file on which an error has occurred
- Selected area : Clear

(2) Even when the data protection key (for memory card or SD) is valid, the data can be backed up in the memory card or DS.

36.2 All Restoration

The following explains the procedure to restore the various NC data backed up to memory card in a batch.
The files which has been automatically backed up can be restored only when the device set by the parameter "#8919 Auto backup device" is selected.

[Note]

(1) The presence/absence of each file (system data, ladder, APLC data and custom data (for M80 Series only)) for the transfer destination is not checked when the restoration is executed.
(2) Each file for the system data, ladder, APLC data and custom data are rewritten when the restoration is executed.
(3) In the following cases, an error message appears and the restoration is not executed.
- During the automatic operation
- One of the data protection key 1, 2 and 3 is valid.
- The NC serial number does not match the manufacturing number of the backup data.
- The "System data" file does not exist in the transfer source.
- The ladder larger than 256 KB is stored and all backup is executed when the large-capacity PLC specification is valid, and then the specification is switched to invalid.

(4) APLC data can be restored only when the APLC release specification is valid.
(5) When smart safety observation is valid, entering the safety password is required. If the safety password is not entered, the safety parameters and the safety ladders are cannot be restored. Operate from the procedure (3) when the smart safety observation is invalid.

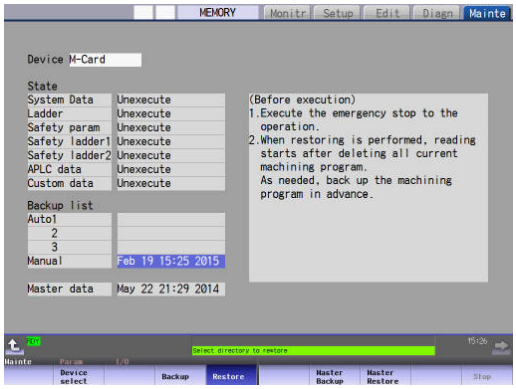
Operation method

(1) Press the menu [Psswd input] on the Mainte screen.

(2) Enter the safety password.

(3) Set the device to memory card on the all backup screen.
➡ Memory card is selected as the restoration source device.

(4) Press the menu [Restore].
➡ The all restoration screen is displayed.



<Note>
- Press the key to cancel this process.
- If the target device set for auto backup does not match the currently selected device, "Manual" is highlighted as the initial display position of the cursor.

(5) Move the cursor to select the file. Press the [INPUT] key.

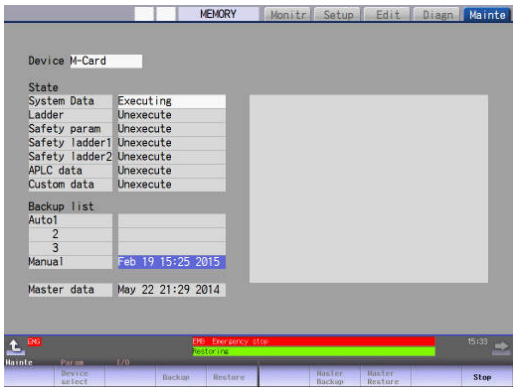
The cursor moves as follows:
[↓] key:
Auto1 -> Auto2 -> Auto3 -> Manual -> Auto1 ...
[↑] key:
Auto1 -> Manual -> Auto3 -> Auto2 -> Auto1-> ...

➡ The operation message "OK? (Y/N)" appears.

<Note>
- If there are no files at the position where the cursor moved to, the operation message "Select directory to restore" appears. Select the file again and then press the [INPUT] key.

(6) Press [Y], [y] or [Input].

➡ The restoration starts.
"Executing" and "*" are displayed for the state of file under processing.



<Note>
- If PLC is in operation, the "PLC running. Does it stop? (Y/N)" message is displayed. Press [Y], [y] or [INPUT] to continue the restoration.
- If the tool data is being sorted, the operation message "File access error" is displayed and the restoration cannot be executed.
- For the custom data, the restoration cannot be canceled during its execution.

(7) The restoration is completed without error.

➡ The states of restoration-complete files turn to "Complete", the operation message "Restore complete" appears.
"Unexecute" is displayed for the file which could not be restored, for instance, due to the nonexistence of the file.

[Note]
(1) When the restoration fails, perform the restoration again otherwise it may cause an abnormal operation.
(2) Restored data writes over the previous absolute position data. Carry out the absolute position detection again after restoration.

37

Appx.1: Setting the System Lock

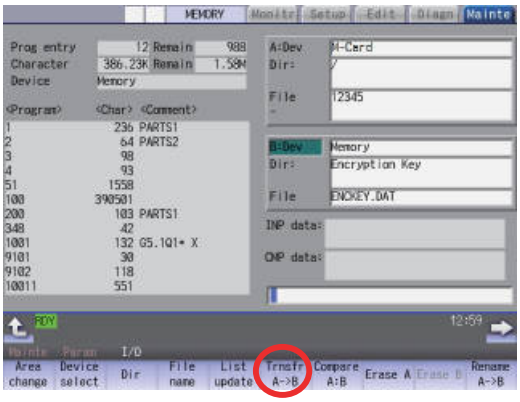
System lock is a function for a machine tool builder to set a valid term to use the machine that machine user is using.
If a decryption code is not input by a specified limit, the servo ready finish signal will be forcibly turned OFF and the use of the machine will be disabled.
Encryption key and decryption code need to be set in order to enable the system lock.

> **⚠ CAUTION**
>
> **The setting of encryption key and decryption code are required only when the system lock is used.**

37.1 Setting the Encryption Key

The system lock function is enabled by inputting an encryption key file while the system lock is disabled.
While the system lock is enabled, the date and time of the CNC cannot be set to a past date and time. Make sure to set the date and time correctly before inputting the encryption key.

(1) Set "#1249 set21/bit2" to "1".
(2) Save the encryption key file on a SD card (or USB memory).
(3) Insert the SD card (or USB memory) card into the control unit.
(4) Select [Input/Output] on the Mainte screen.
(5) Enter an encryption key in the Input/output screen.
  (a) Set the device name, directory and file name in the "A:Dev" area.
  (b) Set "Memory" for the device section and "/CRE" for the directory section of the "B:Dev" area.
  Contents in the directory and file name sections will be written over.
    Directory section: "Encryption Key"
    File name section: "ENCKEY.DAT"
  (c) Press the menu key [Trnsfr A->B].



  (d) When a confirmation message appears, press either [Y] or [INPUT].
  If the encryption key has been set, "Setting complete normally" appears.
  If the encryption key has not been set, the message "Can't write file for dev B" appears.
  Check the encryption key file and set it correctly.
    [Possible causes of this failure]
    - Length of the encryption key is wrong; not eight letters
    - You have entered the encryption key on two or more lines
    - Unavailable letter is included (non-ASCII character or lower-case alphabet)
  If an encryption key not intended to be input has been input, it can be reset by setting the correct encryption key with the same process. Note that, however, an encryption key cannot be reset after an expiration date is set by inputting the decryption code.
  If the specification is not provided, an error occurs when an encryption key is input.
(6) If the encryption key has been set correctly, an alarm message "Z41 Decryption code is missing" appears.
  To enable the system lock, go on to the "Setting of Expiration Date" (next page).
  If you do not want to enable the system lock due to the miss entry of the encryption key, etc., the system lock will be invalid by turning the power OFF and ON again to clear the encryption key.

37.2 Setting of Expiration Date

Inputting a decryption code while the system lock is disabled, the system lock function becomes enabled and the expiration date is being set.

While the system lock is enabled, the date and time of the CNC cannot be set to a past date and time. Make sure to set the date and time correctly before inputting the decryption code.

(1) Save the decryption code file in a SD card (or USB memory).

(2) Insert the SD card (or USB memory) into the control unit.

(3) Enter a decryption code in the Input/output screen.

(a) Set the device name, directory and file name in the "A:Dev" area.

(b) Select "Memory" from "B:Dev" device section and press [Dir] to display [Decrypt code] on menu key of the screen.

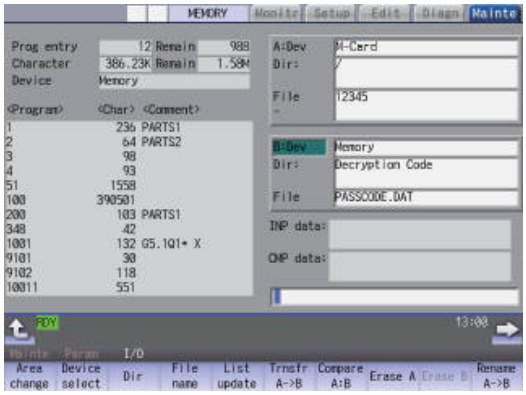
Contents in the directory section and file name section will be written over by pressing [Decryption code].

Directory section: "Decryption Code"

File name section: "PASSCODE.DAT"

Setting "Memory" in the device section and "/RLS" in the directory section of the "B:Dev" area will be the same.

(c) Press the menu key [Trnsfr A->B].



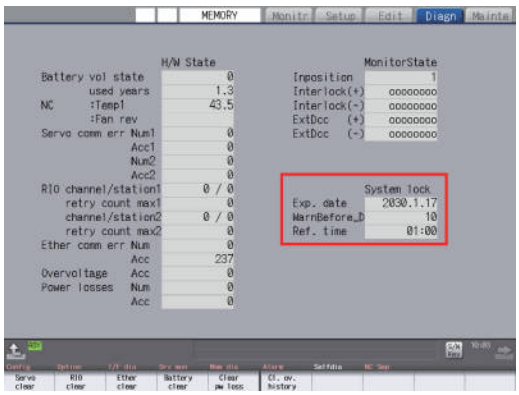
(d) When a confirmation message appears, press either [Y] or [INPUT].

If the decryption code has successfully been set, "Setting complete normally" appears.

- If the warning message is on the screen, this message will be removed.
- If an alarm is activated, the alarm message will be deleted but SA will not turn ON. Turn ON the NC power again.
- If the decryption code is wrong, the message "Can't write file for dev B" will appear.
- The "Executing automatic operation" error occurs during program operation, and setting the code is disabled.

(4) Turn the power OFF and ON after the setting is completed.

(5) Select [Selfdia] on the Diagn screen and confirm that the system lock expiration date is indicated.



If the encryption key is already input and the time limit is not set, the time limit will not display.

37.3 Display of Time Limit Warning and Alarm Notification

(1) When the indication period of warning is reached, the warning "Z64 Valid term soon to be expired" appears at the bottom right of the screen.
This warning appears at every cycle start after power ON until the expiry date comes. Cycle start operation can be performed before the warning and alarm indication reference time of the expiration date.

(2) If the warning and alarm indication reference time of the expiration date have passed, the alarm message "Z65 Valid term has been expired" appears, which disables cycle start operation. This alarm cannot be canceled with reset. Instead, enter the decryption code issued by a machine tool builder, and then turn OFF and ON the CNC power.
If the expiry date is over during a cycle start operation, the operation continues until automatic operation pause, block stop or reset is input.
If the expiry date is over during a cycle start operation and automatic operation or block stop occurred, cycle start operation cannot be performed.

37.4 Caution

(1) The system lock function is enabled by setting an encryption key and an expiration date while the system lock is disabled. Be careful that the date and time of the CNC cannot be set both to a past and to a future from the expiration date while the system lock is enabled.
When you advance date and time to the expiration date, set "#1724 cfg24/bit2" (System lock date and time setting permission) to "1". This parameter is set to "0" when the power is turned ON or at the cycle start.

(2) MTBs need to manage the encryption dedicated tool and the encryption key not to be leaked to the users. The encryption key file must be created on a PC.

(3) If you turn OFF and ON the power after the time limit has expired, "EMG Emergency stop LINE" may appear at the same time.

(4) When the clock data is incorrect without a battery backup, the automatic start cannot be performed. Exchange the battery and set the current date and time.

(5) If you upgrade the M8 Series software version from C3 or older to C4, perform the upgrading work after canceling system lock.

(6) When you upgrade the M8 Series software version from C3 or older to C5 or later with system lock enabled, the password for the system lock is automatically expanded to 8 digits. To issue a decryption code, add "0000" to the head of the conventional encryption key. Moreover, use the "System Lock Pass Code Maker" (BND-2201W000-A0 or later) to issue the decryption code.

(7) When you downgrade the M8 Series software version from C4 or later to C3 or older, you cannot perform the downgrade work with system lock enabled. To downgrade from version C4 or later to version C3 or older, cancel system lock and then perform the downgrade work.

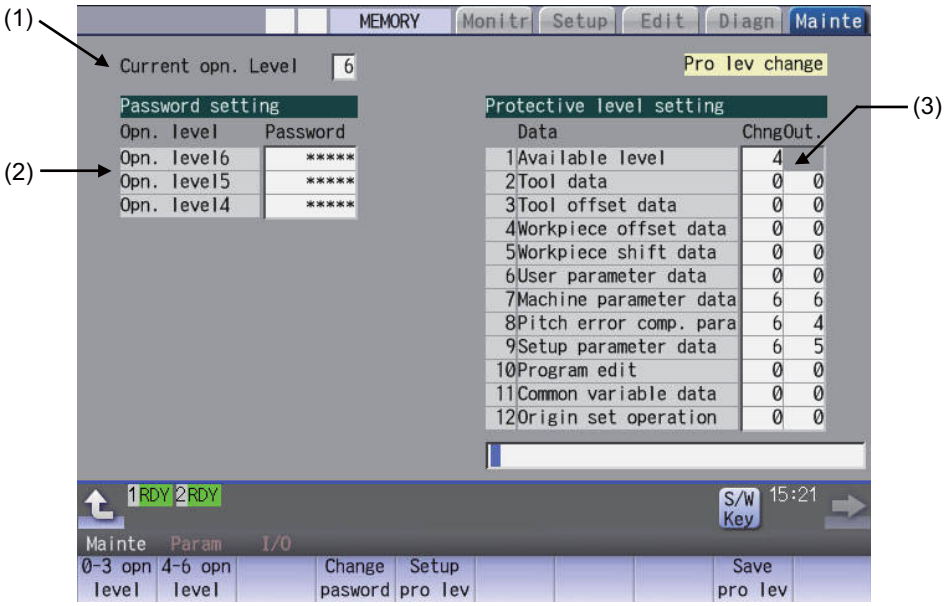
(8) When you temporarily disable the system lock function in version D6 or earlier of M8 CNC, set a past date and time on the integrated time screen, and then reset the expiration date, the expiration date may be set to "1970.1.1".
The expiration date will be set correctly following the procedure below.
    (a) Disable the System lock function.
    (b) Update the CNC to S/W version D7 or later.
    (c) Set the expiration date.
    (d) Turn the CNC power ON.

38

Appx.2: Protection Setting

Operating the maintenance screen reduces a phenomenon in which defective workpieces run out due to an operation mistake, by implementing a restriction with seven operation levels. The operation level varies depending on the MTB specifications. Refer to the instruction manual issued by the MTB for details.

38.1 Protect Setting Screen



Display items

Display items		Details
(1)	Current opn. level	Displays the current operation level.
(2)	Passwords at operation levels 4 to 6	Displays the passwords at operation levels 4 to 6 with "*****".
(3)	Protection level of each data item	Displays the protection level of each data item. The data set below the current operation level can be changed as needed. Changing the protection level displays the message "Pro lev change" at the upper right. Change: Specify the protection level to change data (including a case to input a file). Output: Specify the protection level to output a file.

Menus

Menus	Details
0-3 opn level	Changes the present authenticated password to the non-authenticated state and switches the operation level to 0 to 3. Which of the operation level between 0 and 3 being switched is followed by the PLC signal of the protection level.
4-6 opn level	Changes the operation levels.
Change pasword	Changes the password of the operation levels 4 to 6.
Setup pro lev	Changes the protection level of each data item.
Save pro lev	Saves the protection level setting of each data item.

Data to be protected

Display items	Objects to be protected			Initial value		Setting range	
		Change	Output	Change	Output	Change	Output
Available level	Table for protection level setting on this screen Table for protection level setting cannot be changed by the operation level which is lower than the set protection level.	○	-	4	-	4-6	-
Tool data	Tool management data Tool registration Tool life management data	○	-	0	0	0-6	0-6
	All tool data files (TOOLALL.DAT) Tool life management data files (TLIFE.TLF) Tool management data files (TOOLMNG.DAT)	○	○				
Tool offset data	Tool compensation amount data Tool measurement data	○	-	0	0	0-6	0-6
	Tool offset data files (TOOL.OFS)	○	○				
Workpiece offset data	Coordinate system offset data Workpiece installation error compensation data Workpiece position offset for rotary axis Workpiece measurement data	○	-	0	0	0-6	0-6
	Workpiece offset data files (WORK.OFS)	○	○				
Workpiece shift data	Workpiece shift data	○	-	0	0	0-6	0-6
	All tool data files (TOOLALL.DAT)	○	○				
User parameter data	User parameter data Barrier data	○	-	0	0	0-6	0-6
	Parameter files (ALL.PRM)	○	○				
Machine parameter data	Machine parameter data Device open parameter data SRAM open parameter data Spatial error compensation data file (POSTURE.DAT)	○	-	6	0	0-6	0-6
	Parameter files (ALL.PRM, AUXAXIS.PRM, SYSTEM.PRM, DEVOPEN.DAT, SRAMOPEN.DAT, DEVICENT.PRM) Interfering data (OBSTACL.DAT) R register data (RREG.REG) Spatial error compensation data file (POSTURE.BIN)	○	○				
Pitch error compensation parameter	Error compensation parameter data Error data	○	-	6	0	0-6	0-6
	Parameter files (ALL.PRM)	○	○				

Display items	Objects to be protected			Initial value		Setting range	
		Change	Output	Change	Output	Change	Output
Setup parameter data	Automatic backup (Output) Batch backups (menu [Backup]) Batch backups (menu [Master Backup])	-	○	6	0	0-6	0-6
	Batch backups (menu [Restore]) Batch backups (menu [Master Restore]) HMI environment setting Memory format All erasure of machining programs All erasure of machine macros All erasure of life data All erasure of tool data fixpro formatting HMI version-up System version-up Console execution Ladder monitoring (Note 1) Machine tool builder macro variables WE measurement macro writing Machine tool builder macro ROM write Security function	○	-				
	SRAM data files (SRAM.BIN) User PLC program files (USERPLC.LAD) User PLC program files per project (PROJECTxx.: 01 to available project No.) APLC data file (APLC.BIN) Custom folder (MSYS\CUSTOM) EtherNet/IP configuration file (EIPCONFDATA.BIN) Machine tool builder macro variables data file (MMACRO.VAR)	○	○				
Program editing	Program editing (only for memory) Buffer correction (only for memory)	○	○ (Note 2)	0	0	0-6	0-6
	Machining program files (PRG/USER) Fixed cycle program (PRG/FIX)	○	○				
Common variable data	Common variable data (Note 3)	○	-	0	0	0-6	0-6
	Common variable data files (COMMON.VAR)	○	○				
Origin set operation	G92 set	○	-	0	0	0-6	0-6
Operator mail notification data	Operator mail notification setting Email communication address file Email communication setting file	○	-	0	0	0-6	0-6
	Email communication log file on input/output screen Email communication address file Email communication setting file	-	○				

(Note 1) When the protection level set for "Chng" of "Setup parameter data" is any of 0 to 3, if all the following conditions are met, PLC on-board can be started but it cannot be edited.
- Operation level is "3" or lower
- Operation level is at the protection level or higher

(Note 2) When the set protection level for "Out." of "Program edit" is higher than the current operation level, any program cannot be opened on the Edit screen. The message "Data protect" appears.

(Note 3) The common variables protected in #12111 to #12114 cannot be configured or changed regardless of the operation level or the protection level.

(Note 4) For specifications on inputting and outputting files which are objects to be protected, refer to "Instruction Manual".

(Note 5) Following operations are available to operate at the protection level 6 and over.
- Modal output, one-shot output and modal clear
- PLC-STOP
- S analog adjustment
- Absolute position setting
- Servo diagnosis
- Collection setting
- HMI ending
- Screen size change
- PLC indexing test operation

38.2 Returning the Password to the Non-input State (Operation level 0 to 3)

Operation Methods

(1)	Press the menu [0-3 opn level].	➡	The menu [0-3 opn level] is highlighted. The operation message "Change opn. level back to 0 to 3? (Y/N)" is displayed. When the protection level setting is not saved, the operation message "Save the protective level setting? (Y/N)" is displayed, and the above message appears after Y/N is entered.
(2)	Press the [Y] or [INPUT] key.	➡	The operation message "Operation level has returned to 0 to 3." is displayed, and the highlighted menu [0-3 opn level] returns to normal. The operation level returns to one of operation levels 0 to 3 in accordance with the current signal status. All menus are displayed in gray.

38.3 Changing the Operation Level to One of 4 to 6

Operation Methods

(Example) Change the operation level to "6"

(1)	Press the menu [4-6 opn level].	➡	The menu [4-6 opn level] is highlighted. The cursor appears on the current operation level. The operation message "Select the opn. level to be changed to." is displayed.
(2)	Enter the operation level to be changed to with a number. (Example) 6 [INPUT]	➡	The operation message "Type in your password." is displayed.
(3)	Enter the password of the level to be changed.	➡	<When the password is correct> The operation message "Operation level has changed." is displayed, and the operation level after the change is displayed in the current operation level field. <When the password is incorrect> The operation message "Your password is incorrect." is displayed, and the operation level returns to the previous one. In both cases, the highlighted menu returns to normal, and the cursor disappears, too.

38.4 Changing the Password

Operation Methods

(Example) Change the password of operation level 4 from "OLDPASS" to "NEWPASS"

(1)	Press the menu [Change pasword].	➡	The menu [Change pasword] is highlighted. The operation message "Enter the current password." is displayed. The cursor appears on the current operation level.
(2)	Use [↑] or [↓] key to move the cursor to the operation level where you want to change the password. (Operation level 4 in this case)	➡	The operation message "Enter the current password." is displayed.
(3)	Enter the current password for the operation level of the cursor position. (Example) OLDPASS [INPUT]	➡	<When the password is correct> The operation message "Enter a new password." is displayed. <When the password is incorrect> The operation message "Your password is incorrect." is displayed, and then the operation returns to the process (2).
(4)	Enter a new password. (Example) NEWPASS [INPUT]	➡	<When the acceptable password is entered> The operation message "Type in the new password again." is displayed. <When the unacceptable password is entered> The operation message "Set a password that meets the condition." is displayed, and then the operation returns to the process (4).
(5)	Enter the new password again. (Example) NEWPASS [INPUT]	➡	<When the re-entered password is equal to the first one> The operation message "Password has changed" is displayed, and the highlighted menu [Change pasword] returns to normal. <When the re-entered password is not equal to the first one> The operation message "Your password is incorrect." is displayed, and then the operation returns to the process (4).

(Note 1) Set a password with one-byte alphanumeric characters between 3 and 8 letters (only capital letters are acceptable for alphabet). In addition, "UPARA" is unavailable to set as the password.

(Note 2) Changing the password is available only for the lower operation level than the current one.

38.5 Clearing the Password

Operation Methods

(Example) Clear the password of operation level 4

(1)	Press the menu [Change pasword].	➡	The menu [Change pasword] is highlighted. The operation message "Enter the current password." is displayed. The cursor appears on the current operation level.
(2)	Use [↑] or [↓] key to move the cursor to the operation level where you want to change the password. (Operation level 4 in this case)	➡	The operation message "Enter the current password." is displayed.
(3)	Enter the current password for the operation level of the cursor position. (Example) OLDPASS [INPUT]	➡	<When the password is correct> The operation message "Enter a new password." is displayed. <When the password is incorrect> The operation message "Your password is incorrect." is displayed, and then the operation returns to the process (2).
(4)	Enter "0". (Example) 0 [INPUT]	➡	The operation message "Clear the password? (Y/N)" is displayed.
(5)	Press the [Y] or [INPUT] key.	➡	<When pressing [Y] or [INPUT] key> The operation message "Password has been cleared" is displayed, and then the password returns to the initial one. The highlighted menu [Change pasword] returns to normal. <When pressing other than [Y] or [INPUT] key> The operation message disappears and the password stays the same. The highlighted menu [Change pasword] returns to normal.

(Note 1) Clearing the password is available only for the lower operation level than the current one.

38.6 Changing the Protection Level

Changing the protection level is available only for the data being set in the lower level than a current operation level.

Operation Methods

(Example) Change the "Available level" from "4" to "5"

(1)	Press the menu [Setup pro lev].	➡	The menu [Setup pro lev] is highlighted. The cursor appears on the "Chng" of "Available level".
(2)	Move the cursor to the protection level to be changed, then enter the new protection level. (Example) 5 [INPUT]	➡	"5" is set in the "Chng" field of "Available level". The cursor moves to the right when "Chng" is set. (The cursor moves downward when "Available level" is changed.) The cursor moves to the left below when [Out.] is set. "Pro lev change" is displayed on the upper right of the screen.
(3)	Press the menu [Setup pro lev].	➡	The highlighted menu [Setup pro lev] turns to normal. The cursor disappears.

(Note 1) When the value of "Available level" in the setup protection level is higher than the current operation level, the protection level is unable to change. (The menu [Setup pro lev] is grayed out.)

(Note 2) The higher protection level than the current operation level is unable to set.

(When the current operation level is "5", the protection level is unable to be set to "6".)

(Note 3) When changing the protection level during input-output, an error may occur in the middle of the input-output.

38.7 Saving the Protection Level Setting

Operation Methods

(1)	Press the menu [Save pro lev].	➡	The operation message "Save the protective level setting? (Y/N)" is displayed.
(2)	Press the [Y] or [INPUT] key.	➡	The operation message "Protective level setting has been saved." is displayed. The displayed message "Pro lev change" on the upper right of the screen is disappeared.

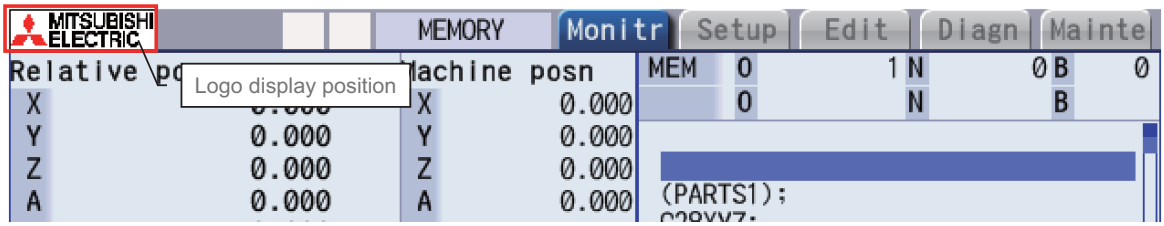
(Note 1) After changing the protection level, if the screen is switched without saving the change, the operation message "Save the protective level setting? (Y/N)" is displayed. If you switch the screen without saving the change, the changed setting is canceled.

(Note 2) After changing the protection level, if you turn the power OFF without saving the change, the changed protection level is canceled.

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Appx.3: Displaying Original Logo On Standard Screen

A logo that machine tool builders create can be displayed on the upper left of the standard screen. In order to display the logo, create a logo file (JPG) and install it. When a logo file is prepared by machine tool builders, the unit name (Base common parameter #1135 unt_nm) is not displayed.



[Logo file specification]

File name	logo.jpg	
Storage location (Note 1)	\Custom\	
Size (Note 2)	VGA	22×80 pixels
	XGA	32×135 pixels
Number of colors (Note 3)	16 bits	

(Note 1) Add the logo file to the installer as well as the customized screen module. (Refer to "18. Setting Up with M80/M800S SETUP INSTALLER" for details.)

(Note 2) When the size of the logo file is different from the specified size, the display image may differ from the actual logo as a result of scaling to fit in the display range.

(Note 3) When the logo file is other than 16-bit color, the display image may differ from the actual color because it is converted to 16-bit color.

40

Appx.4: EMC Installation Guidelines

For details of the drive section (servo/spindle drive unit), refer to the "EMC Installation Guidelines" of instruction manuals for each drive unit.

40.1 Introduction

EMC Directives became mandatory in EU (European Union) as of January 1, 1996. The subject products must have a CE mark attached indicating that the product complies with the Directives.
In United Kingdom, the subject products require the EMC Directives and will need to have a UKCA marking as of January 1, 2023.
As the NC unit is a component designed to control machine tools, it is believed that it is not a direct EMC Directives subject. However, we would like to introduce the following measure plans to back up EMC Directives compliance of the machine tool as the NC unit is a major component of the machine tools.

(1) Methods of installation in control/operation panel
(2) Methods of wiring cables to outside of panel
(3) Introduction of members for measures

Mitsubishi Electric is carrying out tests to confirm the compliance to the EMC Directives under the environment described in this manual. However, the level of the noise will differ according to the equipment type and layout, control panel structure and wiring lead-in, etc.
Thus, we ask that the final noise level be confirmed by the machine manufacturer.

40.2 EMC Directives

The EMC Directives largely regulate the following two items.
- Emission: Capacity to prevent output of interference noise that adversely affects external devices
- Immunity: Capacity to not malfunction due to interference noise from external source

The details of each level are classified in the table below.
It is assumed that the standards and test details required for a machine tool are the same as these.

Class	Name	Details	CE marking/UKCA marking	
Emission				
	Radiated noise	Restriction of electromagnetic noise radiated through the air	EN61000-6-4 (General industrial machine) EN61800-3 (Motor control unit)	EN55011 (CLASS: A)
	Conductive noise	Restriction of electromagnetic noise discharged from power supply line		
Immunity				
	Static electricity electrical discharge	(Example) Regulation of withstand level of static electricity electrical discharge accumulated in human body	EN61000-6-2 (General industrial machine) EN61800-3 (Motor control unit)	EN61000-4-2
	Radiated noise immunity	(Example) Simulation of immunity from digital wireless telephones		EN61000-4-3
	Burst immunity	(Example) Regulation of withstand level of noise from relay or plug and play		EN61000-4-4
	Conductive immunity	(Example) Regulation of withstand level of noise flowed from power supply wires, etc.		EN61000-4-6
	Power supply frequency magnetic field	(Example) Regulation of electromagnetic noise of 50/60Hz power supply frequency		EN61000-4-8
	Power supply dip (fluctuation)	(Example) Regulation of power voltage drop withstand level		EN61000-4-11
	Surge	(Example) Regulation of withstand level of noise caused by lightning		EN61000-4-5

40.3 EMC Measures

The following items mainly need to be taken into account as a countermeasure for EMC.

(1) Store the device in a sealed metal panel.
(2) Ground all conductors that are floating electrically. Decrease the impedance.
(3) Increase the distance between the drive line and signal wire.
(4) Use shielded cables for wiring outside of the panel.
(5) Install a noise filter.

Pay attention to the following items to suppress the noise radiated outside of the panel.

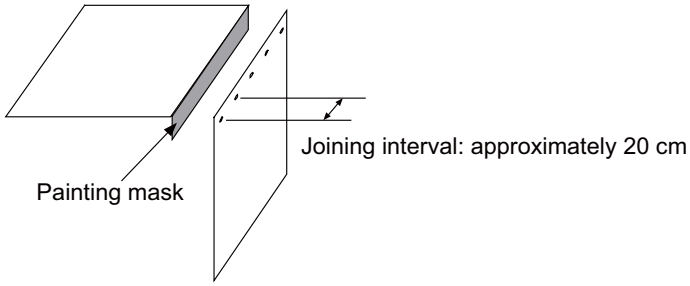
(1) Accurately ground the devices.
(2) Use shielded cables.
(3) Increase the electrical seal of the panel. Reduce the gaps and holes.

40.4 Panel Structure

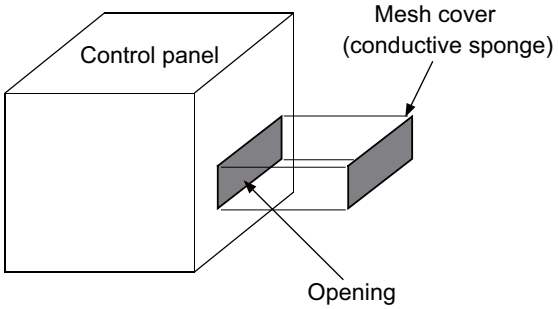
The design of the panel is a very important factor for the EMC measures. Take the following measures sufficiently into consideration when creating a panel.

40.4.1 Measures for Control Panel Body

(1) Use metal for all members configuring the panel.
(2) When joining the metal plate, treat the welded or contacting sections so that the impedance is reduced, and then fix with screws.



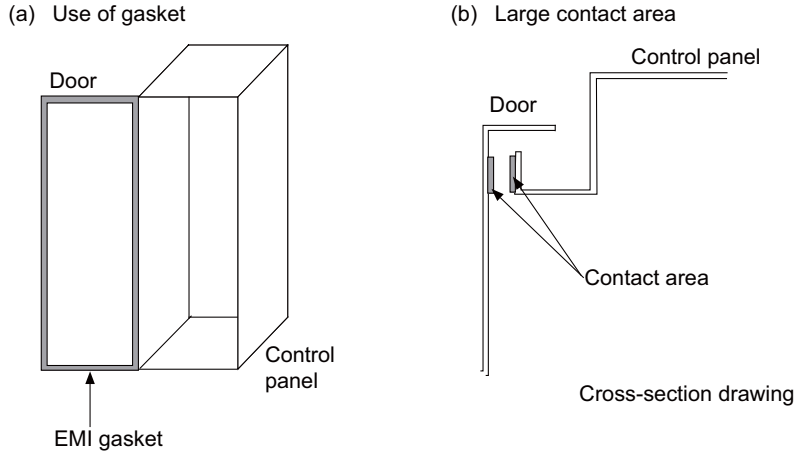
(3) Be careful not to bend the plate by such as screwing work. If there is a gap, noise leaks out from that part.
(4) Plate (nickel tin) the metal plate surface at the grounding plate, and connect the connection parts with the low impedance.
(5) If there is a large opening, such as ventilation holes, make sure to close the hole.



(Note 1) Using screws to fix the plates that have been painted is the same as an insulated state. Remove the paint and fix the screws.

40.4.2 Measures for Door

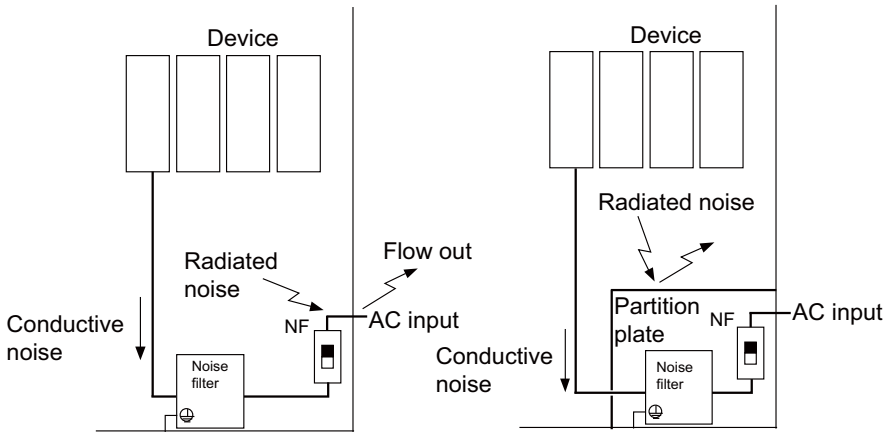
(1) Use metal for all members configuring the panel.
(2) When joining the door, use a gasket to lower the impedance of the contacting sections, or use a structure with a large contact area as shown below.
(3) The EMI gasket or conductive packing must contact the metal surface uniformly and at the correct position.



(Note 1) When not using a gasket, ground the control panel grounding with a grounding wire to lower the door's impedance.
(Note 2) Using screws to fix the plates that have been painted (attachment of packing) is the same as an insulated state. Remove the paint and fix the screws.

40.4.3 Measures for Power Supply

(1) Shield the power supply section and insert a filter to prevent the noise from flowing in or out. Selection of the noise filter capacity varies depending on the drive unit and devices to be used.



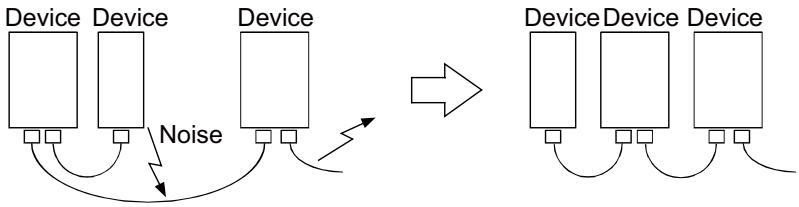
(Note 1) The conductive noise can be suppressed by inserting a noise filter, but the radiated noise will flow out.
(Note 2) The conductive and radiated noise can both be suppressed by adding a partition plate to the noise filter.

40.5 Measures for Wiring in Panel

Cables act as antennas to propagate unnecessary noise, and thus must be appropriately shielded and treated. The following measures must be sufficiently considered for the cables (J210/J303) that carry out high-speed communication.

40.5.1 Precautions for Wiring in Panel

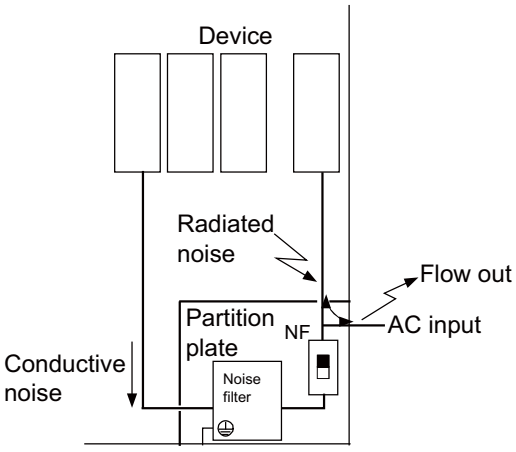
(1) If the cables are led unnecessary in the panel, they will pick up noise. Pay attention to the device layout and wire length so that the wiring length is as short as possible.



(2) Always connect the grounding wire to the FG terminal indicated on the device.

(3) Keep the distance between the drive line and encoder cable to the drive section motor as far apart as possible when wiring.

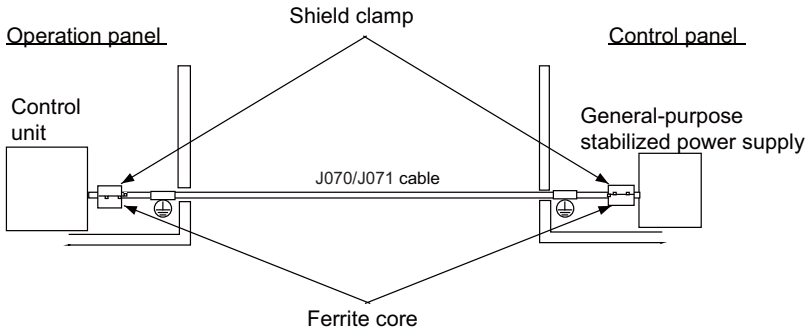
(4) Do not lead the power supply wire around the panel without using a filter.



40.5.2 Shield Treatment of Cables

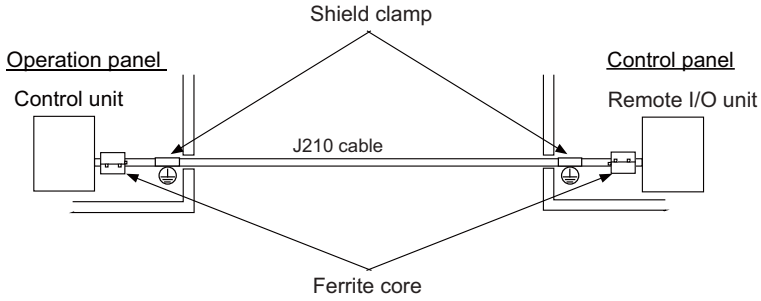
Use shielded cables for wiring outside the panel.
Use a shield clamp within 10cm of the lead-out port from the panel. (Refer to "EMC Countermeasure Parts: Shield Clamp Fitting".)

(1) DC power supply cable [J070/J071 cable]



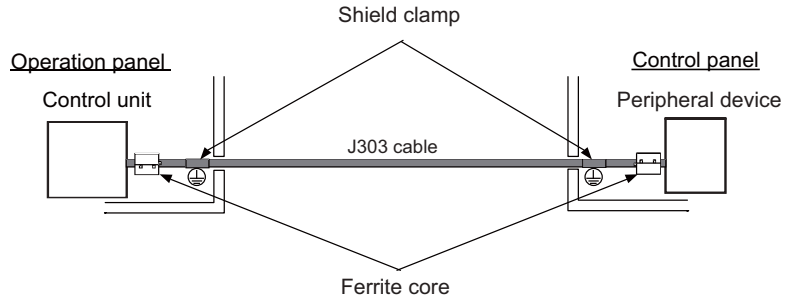
- Use a shield clamp within 10cm from the panel's inlet/outlet.
- When using a ferrite core, install it on both ends of the connected units.
- Always install a ferrite core (Refer to "EMC Countermeasure Parts: Ferrite Core".) on the general-purpose stabilized power supply. The ferrite core may not be required depending on the selected power supply.

(2) Remote I/O cable [J210 cable]



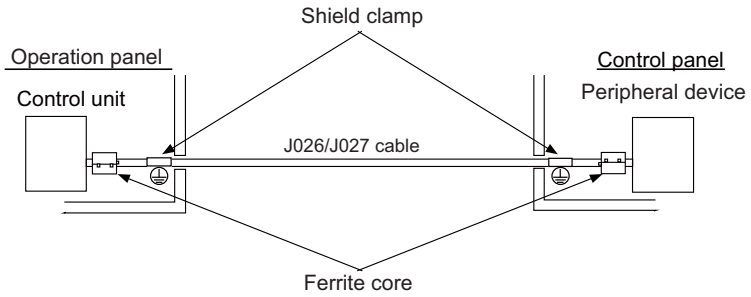
- Use a shield clamp within 10cm from the panel's inlet/outlet.
- When using a ferrite core, install it on both ends of the connected units.

(3) LAN cable [J303 cable]



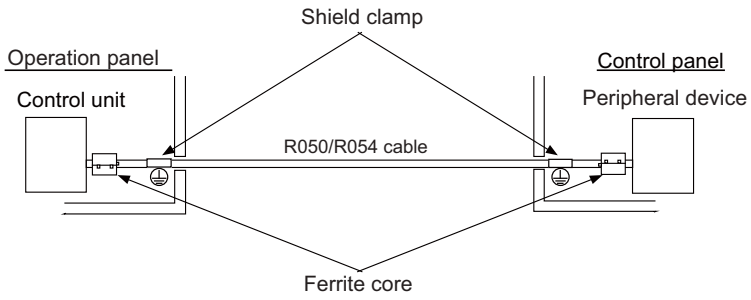
- Use a shielded cable. Use a shield clamp within 10cm from the panel's inlet/outlet.
- When using a ferrite core, install it on both ends of the connected units.

(4) Manual pulse generator cable (5V) [J026/J027 cable]



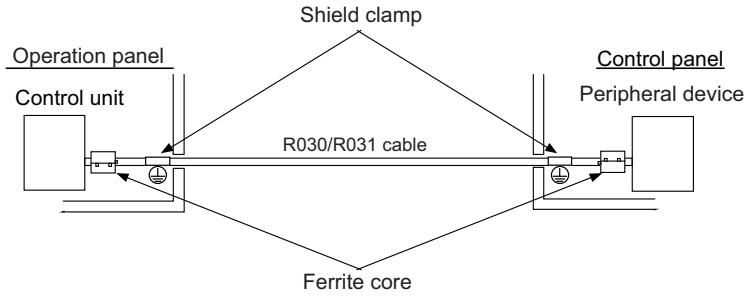
- Use a shield clamp within 10 cm from the panel's inlet/outlet.
- When using a ferrite core, install it on both ends of the connected units.

(5) Cable between synchronous feed encoder and control unit [R050/R054 cable]



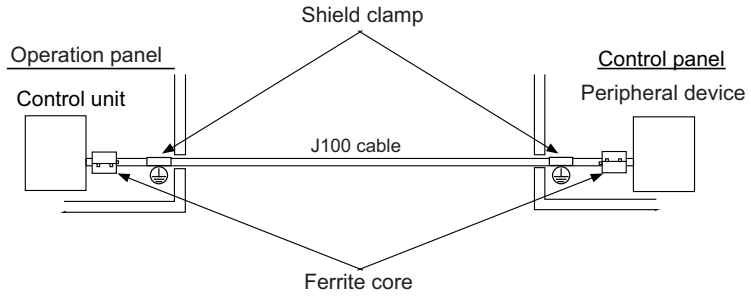
- Use a shield clamp within 10 cm from the panel's inlet/outlet.
- When using a ferrite core, install it on both ends of the connected units.

(6) RS-232C I/F cable [J030/J031 cable]



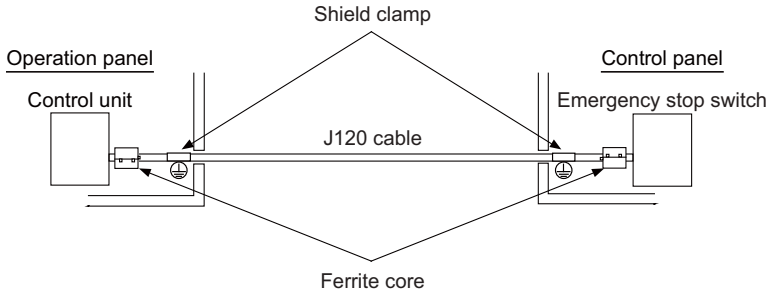
- Use a shield clamp within 10 cm from the panel's inlet/outlet.
- When using a ferrite core, install it on both ends of the connected units.

(7) SKIP input cable [J100 cable]



- Use a shield clamp within 10 cm from the panel's inlet/outlet.
- When using a ferrite core, install it on both ends of the connected units.

(8) Emergency stop cable [J120 cable]



- Use a shield clamp within 10 cm from the panel's inlet/outlet.
- When using a ferrite core, install it on both ends of the connected units.

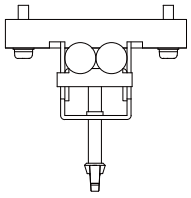
40.6 EMC Countermeasure Parts

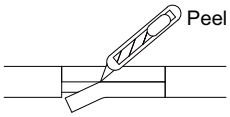
40.6.1 Shield Clamp Fitting

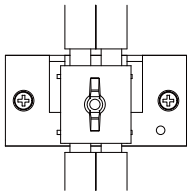
The effect can be improved by directly connecting the cable's shield sheath to the grounding plate as shown below.
Install the grounding plate near the outlet (within 10 cm) of each panel, and press against the grounding plate with the clamp fitting.
If the cables are thin, several can be bundled and clamped together.
To provide sufficient frame ground, install the grounding plate directly on the cabinet or connect with a grounding wire.

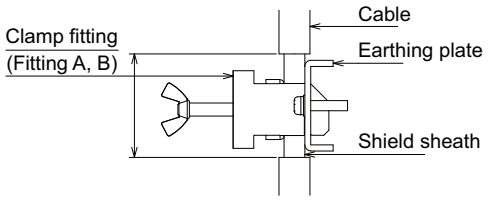
	A	B	C	Enclosed fittings
Ground Plate #D	100	86	30	Clamp fitting F×2
Ground Plate #E	70	56	-	Clamp fitting G×1

	L1 (maximum dimension when it is open)	L2 (reference dimension)
Clamp fitting F	25	(77)
Clamp fitting G	12	(54)





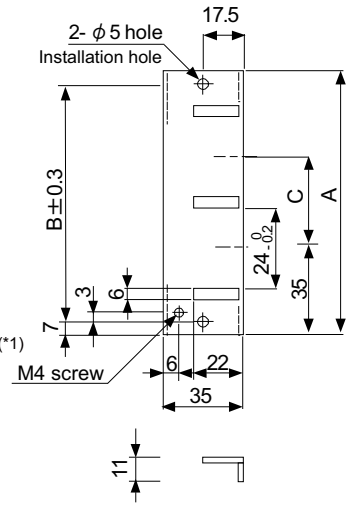




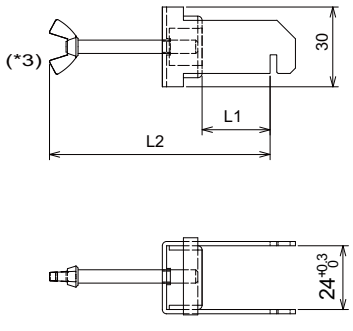
View of clamp section

・Outline drawing

Earthing plate



Clamp fitting

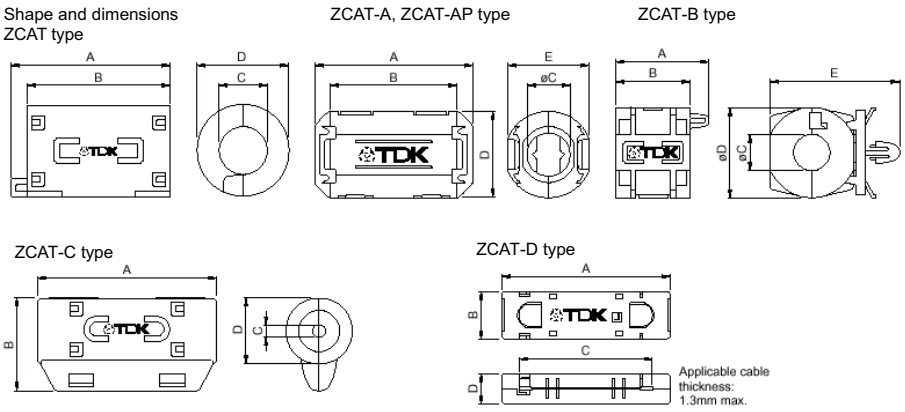


[Unit: mm]

(*1) Screw hole for wiring to earthing plate in cabinet.
(*2) The earthing plate thickness is 2.2mm.
(*3) The screw is a manual tightening part.
Tighten it with hands without using a tool.

40.6.2 Ferrite Core

The ferrite core is mounted integrally with the plastic case.
This can be installed with one touch without cutting the interface cable or power supply cable.
This ferrite core is effective for common mode noise, and countermeasures for noise can be taken without affecting the quality of the signal.



Recommended ferrite core: TDK ZCAT Series

Unit: mm

Part Name	A	B	φC	φD	E	Applicable cable outer diameter	Mass (g)
ZCAT1518-0730-M(-BK) (*1)	22±1	18±1	7±1	15±1	-	7 maximum	6
ZCAT1518-0730(BK) (*2)	22±1	18±1	7±1	15±1	-	7 maximum	6
ZCAT2017-0930-M(-BK)	21±1	17±1	9±1	20±1	-	9 maximum	11
ZCAT2032-0930-M(-BK) (*1)	36±1	32±1	9±1	19.5±1	-	9 maximum	22
ZCAT2032-0930(-BK) (*2)	36±1	32±1	9±1	19.5±1	-	9 maximum	22
ZCAT2132-1130-M(-BK) (*1)	36±1	32±1	11±1	20.5±1	-	11 maximum	22
ZCAT2132-1130(-BK) (*2)	36±1	32±1	11±1	20.5±1	-	11 maximum	22
ZCAT3035-1330-M(-BK) (*1)	39±1	34±1	13±1	30±1	-	13 maximum	63
ZCAT3035-1330(-BK) (*2)	39±1	34±1	13±1	30±1	-	13 maximum	63
ZCAT1525-0430AP-M(-BK)	25±1	20±1	4±1	15±1	11.5±1	2.5 to 4 (USB)	7
ZCAT1325-0530A-M(-BK) (*1)	25±1	20±1	5±1	12.8±1	11.2±1	3 to 5 (USB)	7
ZCAT1325-0530A(-BK)	25±1	20±1	5±1	12.8±1	11.2±1	3 to 5 (USB)	7
ZCAT1730-0730A-M(-BK)	30±1	23±1	7±1	16.5±1	15±1	4 to 7 (USB)	12
ZCAT2035-0930A-M(-BK) (*1)	35±1	28±1	9±1	19.5±1	17.4±1	6 to 9	22
ZCAT2035-0930A(-BK)	35±1	28±1	9±1	19.5±1	17.4±1	6 to 9	22
ZCAT2235-1030A-M(-BK)	35±1	28±1	10±1	21.5±1	20±1	8 to 10	27
ZCAT2436-1330A-M(-BK)	36±1	29±1	13±1	23.5±1	22±1	10 to 13	29
ZCAT2017-0930B-M(-BK)	21±1	17±1	9±1	20±1	28.5±1	9 maximum	12
ZCAT2749-0430C-M(-BK)	49±1	27±1	4.5±1	19.5±1	-	4.5 maximum	26
ZCAT4625-3430D(-BK)	45.5±1	24.5±1	34±1	12±1	-	26 For core flat cable	32
ZCAT4625-3430DT(-BK) (*3)	45.5±1	24.5±1	34±1	13±1	-	26 For core flat cable	32
ZCAT6819-5230D(-BK)	67.5±1	18.5±1	52±1	16±1	-	40 For core flat cable	58
ZCAT6819-5230DT(-BK) (*3)	67.5±1	18.5±1	52±1	17±1	-	40 For core flat cable	58

(*1) The M stamp is attached.
(*2) A fixing band is attached at shipment.
(*3) The core is fixed with double-sided tape. (The tape is enclosed with the part.)
●ZCAT-B type: Cabinet fixing type installation hole φ4.8 to 4.9 mm, plate thickness 0.5 to 2 mm
●ZCAT-AP, ZCAT-C type: Structure that prevents easy opening after case is closed.

40.6.3 Surge Absorber

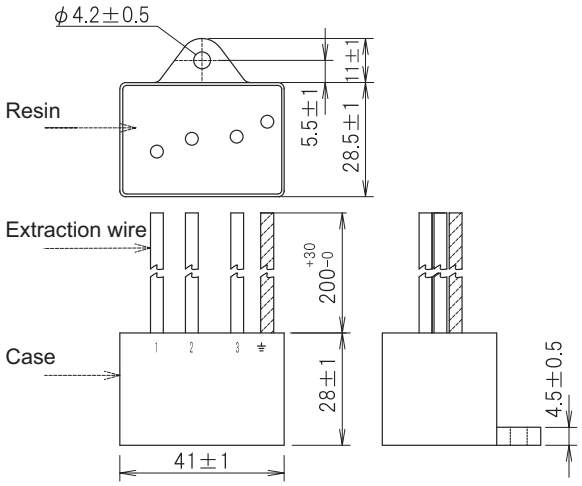
Make sure that the surge does not directly enter the AC line of the general-purpose stabilized power supply (user-prepared) supplying power to the control unit and DIO. Select a product equivalent to or higher than the following products for the surge absorber. Refer to the manufacturer catalog for detailed characteristics, outline and connection methods of the surge absorber.

(1) Part name: RSPD-250-U4

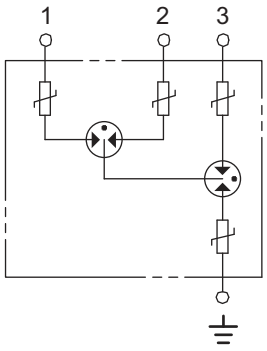
Manufacturer: OKAYA ELECTRIC INDUSTRIES

Rated Voltage (50/60Hz)	DC Breakdown voltage	Voltage protection level	Normal discharge current	Maximum discharge current	Surge current life
250VAC (Three phase)	700V±25%	1.3kV	8/20μs 2.5kA	8/20μs 5kA	Approximately 300 times 8/20μs-1kA

Outline drawing

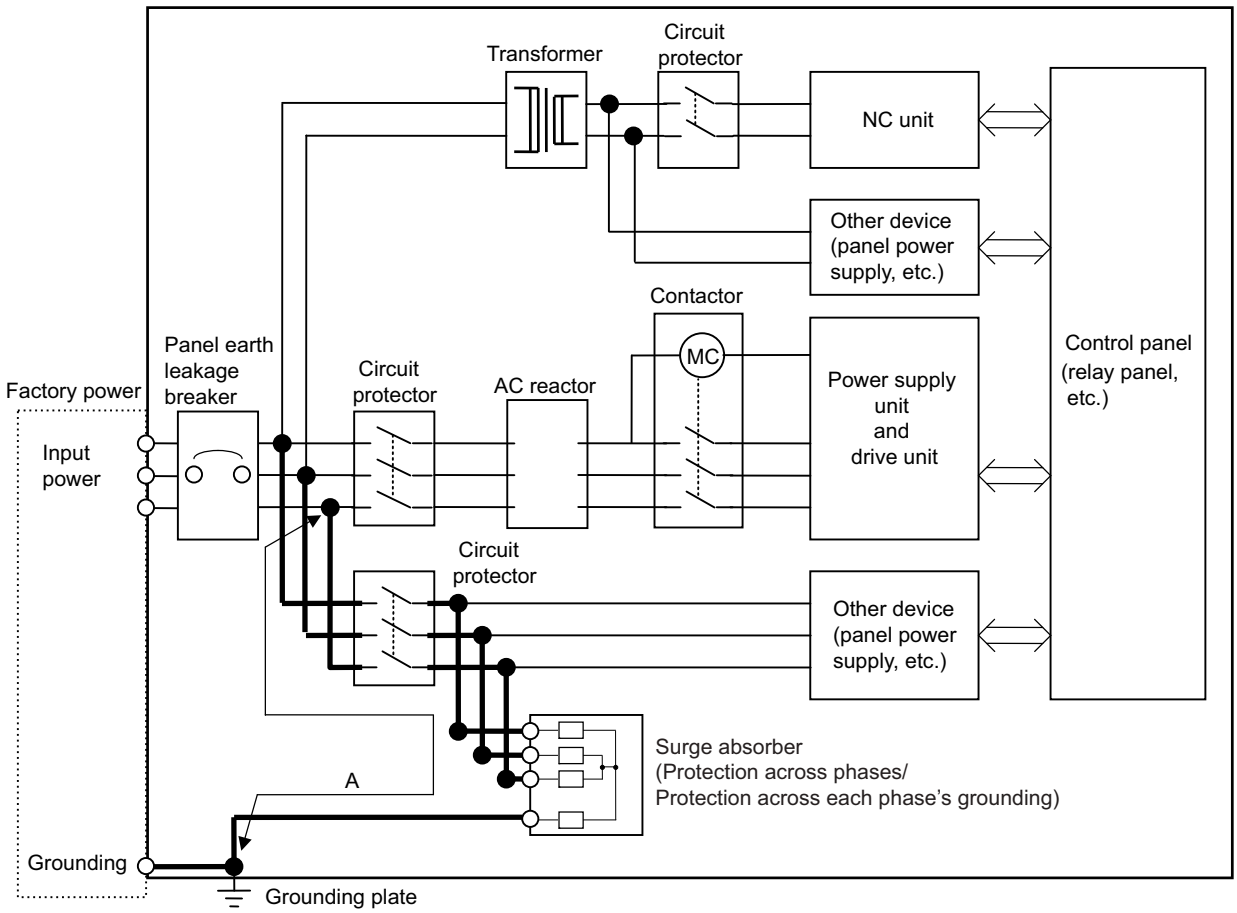


Circuit drawing



(2) Example of surge absorber installation

An example of installing the surge absorber in the machine control panel is shown below.
A short-circuit fault will occur in the surge absorber if a surge exceeding the tolerance is applied. Thus, install a circuit protection breaker in the stage before the surge abs orber. Note that almost no current flows to the surge absorber during normal use. Therefore, a breaker installed as the circuit protection for another device can be used with the surge absorber.



Surge absorber installation

⚠ CAUTION

1. The wires from the surge absorber should be connected without extensions.

2. If the surge absorber cannot be installed just with the enclosed wires, keep the wiring length of A to 2m or less. If the wires are long, the surge absorber's performance may drop and inhibit protection of the devices in the panel.

3. Surge absorber to be selected varies depending on input power voltage.

4. Do not insert the surge absorber in the place with a lot of harmonic components.

40.6.4 Selection of Stabilized Power Supply

Consider the following characteristics when selecting the stabilized power supply (prepared by machine manufacturer). Use a power supply that complies with CE Marking or that follows the safety standards given below.

Stabilized power supply selection items

Item		Standard setting	Remarks
Output	Voltage fluctuation	±5%	±5% or less of 24VDC output
	Ripple noise	120 mV (maximum)	
	Spike noise	500 mV (maximum)	
Output current		——	Refer to the maximum current consumption of the unit in use and calculate.
Output holding time		20 ms (min)	Instantaneous power failure time (AC side)

Standards

Safety Standards	UL1950, CSA C22.2 No. 234 approved, IEC950 compliant
Noise Terminal Voltage	FCC Class A, VCCI Class A
High Harmonics Current Restrictions	IEC61000-3-2

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Appx.5: Restrictions for Lithium Batteries

41.1 Restriction for Packing

When transporting lithium batteries with means such as by air transport, measures corresponding to the United Nations Dangerous Goods Regulations (hereafter called "UN Regulations") must be taken.
The UN Regulations classify the batteries as dangerous goods (Class 9) or not dangerous goods according to the lithium metal content. To ensure safety during transportation, lithium batteries (battery unit) directly exported from Mitsubishi are packaged in a dedicated container (UN package) for which safety has been confirmed.
When the customer is transporting these products with means subject to the UN Regulations, such as air transport, the shipper must follow the details explained in the section "Transportation Restrictions for Lithium Batteries: Handling by User".
The followings are restrictions for transportation. Each restriction is specified based on the recommendation of the United Nations.

Area	Transportation method	Restriction	Special clause
World	Air	ICAO, IATA	-
World	Marine	IMO	188
United States	All (air, marine, land)	DOT	49 CFR 173.185
Europe	land	RID, ADR	-

41.1.1 Target Products

The following Mitsubishi NC products use lithium batteries. If the lithium metal content exceeds 1g for battery cell and 2g for battery, the battery is classified as dangerous good (Class9).
In order to avoid an accidental actuation during the transportation, all lithium battery products incorporated in a machinery or device must be fixed securely and must be shipped with wrapped over the outer package as to prevent damage or short-circuits.

(1) Materials falling under Class 9

Mitsubishi type (Type for arrangement)	Battery type	Lithium metal content	Number of incorporated batteries	Application (Data backup)	Battery class	Outline dimension drawing
CR23500SE-CJ5	CR23500SE-CJ5	1.52g	-	For NC SRAM (M500)	Battery cell	Refer to "Battery Option" in the specification manual for drive unit you are using for the outline dimension drawing for servo.

(2) Materials not falling under Class 9

Mitsubishi type (Type for arrangement)	Battery type	Lithium metal content	Number of incorporated batteries	Application (Data backup)	Battery class	Outline dimension drawing
CR2032 (for built-in battery)	CR2032	0.067g	-	For NC SRAM/	Battery cell	Refer to "Battery Option" in the specification manual for drive unit you are using for the outline dimension drawing for servo.
CR2450 (for built-in battery)	CR2450	0.173g	-	For NC SRAM		
ER6, ER6V series (for built-in battery)	ER6, ER6V	0.65g	-	For NC SRAM/ servo encoder		
MR-BAT	ER17330V	0.48g	-	For servo encoder		
Q6BAT	Q6BAT	0.57g	-	For NC SRAM		
MDS-BAT6V1SET **MR-BAT6V1SET**	2CR17335A	1.2g	2	For servo encoder	Battery	

(Note) If the number of batteries exceeds 24 batteries for the battery cell or 12 batteries for the battery, the dedicated packing (for materials falling under Class 9) is required.

41.1.2 Handling by User

The shipper must confirm the latest IATA Dangerous Goods Regulations, IMDG Codes and laws and orders of the corresponding export country.
These should be checked by the company commissioned for the actual transportation.

IATA: International Air Transport Association
http://www.iata.org/
IMDG Code: A uniform international code for the transport of dangerous goods by seas determined by IMO (International Maritime Organization).
http://www.imo.org/

41.1.3 Reference

Refer to the following materials for details on the regulations and responses.
Guidelines regarding transportation of lithium batteries and lithium ion batteries

Battery Association of Japan
http://www.baj.or.jp/e/

41.2 Products Information Data Sheet (ER Battery)

MSDS system does not cover the product used in enclosed state. The ER battery described in this section applies to that product.
This description is applied to the normal use, and is provided as reference but not as guarantee.
This description is based on the lithium battery's (ER battery) hazardous goods data sheet (Products Information Data Sheet) which MITSUBISHI has researched, and will be applied only to the ER batteries described in "Transportation Restrictions for Lithium Batteries: Restriction for Packing".

(1) Outline of hazard

Principal hazard and effect	Not found.
Specific hazard	As the chemical substance is stored in a sealed metal container, the battery itself is not hazardous. But when the internal lithium metal attaches to human skin, it causes a chemical skin burn. As a reaction of lithium with water, it may ignite or forms flammable hydrogen gas.
Environmental effect	Not found.
Possible state of emergency	Damages or short-circuits may occur due to external mechanical or electrical pressures.

(2) First-aid measure

Inhalation	If a person inhales the vapor of the substance due to the battery damage, move the person immediately to fresh air. If the person feels sick, consult a doctor immediately.
Skin contact	If the content of the battery attaches to human skin, wash off immediately with water and soap. If skin irritation persists, consult a doctor.
Eye contact	In case of contact with eyes due to the battery damage, rinse immediately with a plenty of water for at least 15 minutes and then consult a doctor.
Ingestion	If swallowed, consult a doctor immediately.

(3) Fire-fighting measure

Appropriate fire-extinguisher	Dry sand, dry chemical, graphite powder or carbon dioxide gas
Special fire-fighting measure	Keep the battery away from the fireplace to prevent fire spreading.
Protectors against fire	Fire-protection gloves, eye/face protector (face mask), body/skin protective cloth

(4) Measure for leakage

Environmental precaution	Dispose of them immediately because strong odors are produced when left for a long time.
How to remove	Get them absorbed into dry sand and then collect the sand in an empty container.

(5) Handling and storage

Handling	**Cautions for safety handling**	Do not peel the external tube or damage it. Do not dispose of the battery in fire or expose it to heat. Do not immerse the battery in water or get it wet. Do not throw the battery. Do not disassemble, modify or transform the battery. Do not short-circuit the battery.
Storage	**Appropriate storage condition**	Avoid direct sunlight, high temperature and high humidity. (Recommended temp. range: +5 to +35°C, humidity: 70%RH or less)
	Material to avoid	Flammable or conductive material (Metal: may cause a short-circuit)

(6) Physical/chemical properties

Appearance	**Physical form**	Solid
	Shape	Cylinder type
	Smell	Odorless
	pH	Not applicable (insoluble)
	Boiling point/Boiling range, Melting point, Decomposition temperature, Flash point	No information

(7) Stability and reactivity

Stability	Stable under normal handling condition.
Condition to avoid	Do not mix multiple batteries with their terminals uninsulated. This may cause a short-circuit, resulting in heating, bursting or ignition.
Hazardous decomposition products	Irritative or toxic gas is emitted in the case of fire.

(8) Toxicological information

As the chemical substance is stored in a sealed metal container, the battery has no harmfulness. Just for reference, the table below describes the main substance of the battery.

< Lithium metal >

Acute toxicity	No information
Local effect	Corrosive action in case of skin contact

< Thionyl chloride >

Acute toxicity	Lc_{50}: 500ppm (inhaled administration to rat)
Local effect	The lungs can be damaged by chronic cough, dyspnea and asthma.

< Aluminum chloride >

Acute toxicity	L_{D50}: 3700ppm (oral administration to rat)
Local effect	Not found.

< Lithium chloride >

Acute toxicity	L_{D50}: 526ppm (oral administration to rat)
Local effect	The central nerves and kidney can be influenced.

< Carbon black >

Acute toxicity	L_{D50}: 2,000mg/kg > (rat)
Carcinogenicity	LARC group 2 (suspected of being carcinogenic)

(9) Ecological information

Mobility, Persistence/ Decomposability, Bio-accumulation potential, Ecological toxicity	Not found.

(10) Caution for disposal

Dispose of the battery following local laws or regulations.

Pack the battery properly to prevent a short-circuit and avoid contact with water.

41.3 Forbiddance of Transporting Lithium Battery by Passenger Aircraft Provided in the Code of Federal Regulation

This regulation became effective from Dec.29, 2004. This law is a domestic law of the United States, however it also applies to the domestic flight and international flight departing from or arriving in the United States. Therefore, when transporting lithium batteries to the United State, or within the United State, the shipper must take measures required to transport lithium batteries. Refer to the Federal Register and the code of Federal Regulation for details.
When transporting primary lithium battery by cargo aircraft, indicate that transportation by passenger aircraft is forbidden on the exterior box.
"Lithium Metal batteries forbidden for transport aboard Passenger aircraft"

41.4 California Code of Regulation "Best Management Practices for Perchlorate Materials"

When any products that contain primary lithium batteries with perchlorate are shipped to or transported through the State of California, they are subject to the above regulation.The following information must be indicated on the package, etc. of the products that contain primary lithium batteries (with a perchlorate content of 6 ppb or higher).
"Perchlorate Meterial-special handling may apply. See http://www.dtsc.ca.gov/hazardouswaste/perchlorate"

41.5 Restriction Related to EU Battery Directive

EU Battery Directive (2006/66/EC) has been enforced since September 26th in 2008. Hereby, battery and machinery incorporating battery marketed in European Union countries must be in compliance with the EU Battery Directive. Lithium battery provided by MITSUBISHI are subjected to this restriction.

41.5.1 Important Notes

Follow the instruction bellow as shipping products incorporating MITSUBISHI device.

(1) When shipping products incorporating MITSUBISHI device any time later than September 26th, 2008, the symbol mark shown as Figure 1 in section "Information for End-user" is required to be attached on the machinery or on the package. Also, the explanation of the symbol must be added.

(2) Machinery with battery and maintenance battery produced before the EU Battery Directive are also subjected to the restriction. When shipping those products to EU countries later than September 26th, 2008, follow the instruction explained in (1).

41.5.2 Information for End-user



Figure 1

Note: This symbol mark is for EU countries only.

This symbol mark is according to the directive 2006/66/EC Article 20 Information for end-users and Annex II.

Your MITSUBISHI ELECTRIC product is designed and manufactured with high quality materials and components which can be recycled and/or reused. This symbol means that batteries and accumulators, at their end-of-life, should be disposed of separately from your household waste.

If a chemical symbol is printed beneath the symbol shown above, this chemical symbol means that the battery or accumulator contains a heavy metal at a certain concentration. This will be indicated as follows:Hg: mercury (0.0005%), Cd: cadmium (0.002%), Pb: lead (0.004%)

In the European Union there are separate collection systems for used batteries and accumulators. Please, dispose of batteries and accumulators correctly at your local community waste collection/recycling centre.

Please, help us to conserve the environment we live in!

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Appx.6: Precautions for Compliance to UL/c-UL Standards

(1) Selection of external 24 VDC power supply unit (The unit shall be prepared by the machine tool builder.)

This NC system complies with the UL Standards on the condition that the stabilized power supply unit supplying 24 VDC to each unit meets the requirements for SELV/limited power LPS or Class 2 power supplies and that supply voltage fluctuations do not exceed ±5% of nominal voltage.

The stabilized power supply unit supplying 24 VDC to each unit must comply with the requirements of international standards and national laws/standards required for stabilized power supplies.

(2) Unit's ambient environment

This NC system complies with the UL Standards on the condition that the unit is used under the environmental conditions described in "Environment Conditions", including the maximum relative humidity of 95% (non-condensing) and the maximum altitude of 1000 m.

To comply with UL Standards, each unit must be designed to be within the environmental conditions described in the "Environment Conditions" section.

The product must be used under environmental conditions of Overvoltage category II or lower and Pollution degree 2 or lower.

Revision History

Date of revision	Manual No.	Revision details
Apr. 2015	IB(NA)1501269-A	First edition created.
Aug. 2015	IB(NA)1501269-B	- The following units were added. FCU8-DU121-12 (8.4-type Display Unit) FCU8-KB026 (Keyboard for 8.4-type Display Unit) FCU8-KB083 (Keyboard for 15-type Display Unit) - The following chapters and sections were added. 3.5 Keyboard Unit [M800S] 3.6 Keyboard Unit [M80] 3.12 Cable Connector Sets 4.7.1 Keyboard for 8.4-type Display Unit (FCU8-KB026) 7.4.11 MR-BT6V2CBL Cable 7.4.12 MR-D05UDL3M-B Cable 7.5 List of Cable Connector Sets 9.4 Connecting and Setting Drive Unit MDS-EM Series Appendix2 Restrictions for Lithium Batteries - Chapter number change Section 4.7.1to 4.7.3 were changed into 4.7.2 to 4.7.4 Chapter 8 was changed into Appendix 1. Chapter 9 was changed into Appendix 3. Chapter 10 to 21 were changed into chapter 8 to 19. - Mistakes were corrected.
Apr. 2016	IB(NA)1501269-C	- The following units were added. FCU8-MU542 (Control Unit) FCU8-MA542 (Control Unit) FCU8-MU511 (Control Unit) FCU8-MU512 (Control Unit) FCU8-KB028 (Keyboard for 8.4-type Display Unit) FCU8-KB029 (Keyboard for 8.4-type Display Unit) FCU8-KB041 (Keyboard for 10.4-type Display Unit) FCU8-KB048 (Keyboard for 10.4-type Display Unit) FCU8-DX202 (Remote I/O Unit) FCU8-EX133 (Functional Safety Expansion Unit) FCU8-EX563 (PROFIBUS-DP Expansion Unit) - The following chapters and sections were added. 3.9 Function Expansion Unit [M80] 3.14 Genuine Memory Card 4.7.2 Keyboard for 8.4-type Display Unit (FCU8-KB028) 4.7.3 Keyboard for 8.4-type Display Unit (FCU8-KB029) 4.7.4 Keyboard for 10.4-type Display Unit (FCU8-KB041) 4.7.7 Keyboard for 10.4-type Display Unit (FCU8-KB048) 4.10 Function Expansion Unit 4.11.2 PROFIBUS-DP (FCU8-EX563) 4.14 Exclusive SD cards for MITSUBISHI CNC 5.3.5 Function Expansion Unit 7.11.2 Connecting I/O Device via PROFIBUS-DP 10.9 Connecting with Analog I/O Signal (FCU8-DX202) 13.2.12 J221 Cable 26 Appx.2: Protection Setting (Continue to the next page)

Date of revision	Manual No.	Revision details
Apr.2016	IB(NA)1501269-C	(Continued from the previous page) - Chapter composition change Title of chapter 6 was changed into "Precautions for Connecting" Former 6.3 to 6.9 were changed into independent chapters (Chapter 7 to 12) Explanations for connection of drive unit in former 9.3 to 9.5 were moved to a new chapter 7 Former chapter numbers 7 to 19 were changed into 13 to 24 due to the change of chapter 6 - Chapter number change Section 4.10.2 was changed into 4.11.3 Chapter 17 was changed into Chapter 25 Appendix 1 to 3 were changed into Chapter 27 to 29 - Mistakes were corrected.
Oct.2016	IB(NA)1501269-D	The contents were corrected to correspond with the system software C1 version. - The following units were added. FCU8-DX760 (Operation Panel I/O Unit) FCU8-DX761 (Operation Panel I/O Unit) - The following chapters and sections were added. 9.2 Connecting with Frame Ground 9.7.4 Example of Wiring CJ42 (FCU8-DX760) 9.8 Connecting with Analog I/O Signal (FCU8-DX761) 13.2.13 J224 Cable 13.3.12 MR-BKS1CBL-A1-H/MR-BKS1CBL-A2-H Cable 13.3.15 MR-PWS1CBL-A1-H/MR-PWS1CBL-A2-H Cable 24 Adjust S-analog Screen 25 Device Open Parameter Screen 26 SRAM Open Parameter Screen - Chapter number change Due to addition of the chapters as above, the existing chapters were renumbered. - Chapter title change 4.8.2 FCU8-DX750/FCU8-DX760/FCU8-DX761 - Correspond with MDS-EMH. - Mistakes were corrected.

Date of revision	Manual No.	Revision details
Mar. 2017	IB(NA)1501269-E	The contents were corrected to correspond with the system software C3 version. - The following units were added. FCU8-DX213-1 (Remote I/O unit) FCU8-DX654-1 (Remote I/O unit) FCU8-DX408 (Remote I/O unit) FCU8-EX565 (Communication expansion unit) FCU8-EX703 (Option relay unit) FCU8-KB921 (MITSUBISHI CNC Machine operation panel) FCU8-KB923 (MITSUBISHI CNC Machine operation panel) FCU8-KB931 (MITSUBISHI CNC Machine operation panel) Handy terminal - The following chapters and sections were added. 3.13 MITSUBISHI CNC Machine Operation Panel 3.14 Handy Terminal 3.16 Thermistor Sets 4.11.3 EtherNet/IP (FCU8-EX565) 4.11.5 Option Relay Unit (FCU8-EX703) 4.14 MITSUBISHI CNC Machine Operation Panel 4.15 Handy Terminal 4.16 Thermistor 5.3.7 MITSUBISHI CNC Machine Operation Panel 7.11.3 Connecting I/O Device via EtherNet/IP 10.10 Connecting with Thermistor (FCU8-DX408) Chapter 13 Connection of MITSUBISHI CNC Machine Operation Panel Chapter 14 Connection of Handy Terminal 15.2.2 G071 Cable 15.2.4 G430 Cable 15.2.5 G460 Cable 15.2.14 J121 Cable 22.1.6 Setting the Grid Interval and the Reference Encoder for Grid Interval Chapter 25 Setting Handy Terminal - Chapter number change Due to addition of the chapters as above, the existing chapters were renumbered. - Chapter title change Some of chapter titles were changed due to addition of the Remote I/O unit. - Mistakes were corrected.

Date of revision	Manual No.	Revision details
Nov. 2017	IB(NA)1501269-F	The descriptions of M800 Series/M80 Series were revised in response to S/W version C7. - The following units were added. FCU8-KB922 (MITSUBISHI CNC Machine operation panel) FCU8-KB924 (MITSUBISHI CNC Machine operation panel) - The following cable was deleted. CNV2E-MB (Cable for MBE405W/MBA405W) - The following chapter was deleted. 15.3.7 CNV2E-MB Cable - The following chapters were added. 17.6.5 Thermistor Input Interface 18.5 Install User Cycle 33 Appx.3: Displaying Original Logo On Standard Screen - The following contents were changed. 3.13 MITSUBISHI CNC Machine Operation Panel 3.20 List of Cables 4.1.1 Installation Environment Conditions 4.2.1 Installation Environment Conditions 4.8.2 FCU8-DX750 / FCU8-DX760 / FCU8-DX761 4.12.2 12V Manual Pulse Generator (HD60C) 4.14.1 Main Panel A , B (FCU8-KB921 / FCU8-KB922 , FCU8-KB923 / FCU8-KB924) 5.3.7 MITSUBISHI CNC Machine Operation Panel 10.2 Connecting with Power Supply 13.1 Machine Operation Panel Connection System Drawing 13.2 Connecting with Power Supply 13.3 Connecting with Frame Ground 13.4 Connecting with Operation Panel I/O Unit 16.2 Flow of Initial Setup 17.3.1 Setting the Rotary Switch 17.3.2 Setting the DIP Switch 17.7 Initializing the NC Internal Data (SRAM) 18.1 Activate M80/M800S SETUP INSTALLER 18.2 Install Custom Screen 18.3 Install Start-up Screen 18.4 Install APLC C Language Module 19.3 Setting the Parameters for the Machine Specifications 20.5.2 Setting the Number of Device Points 31.1 Setting the Encryption Key 31.3 Display of Time Limit Warning and Alarm Notification 31.4 Caution 32.1 Protect Setting Screen 34.4.3 Measures for Power Supply 35.1 Restriction for Packing 36 Appx.6: Precautions for Compliance to UL/c-UL Standards - The following chapter numbers were corrected. Due to addition of the chapters as above, the existing chapter numbers/chapter titles were corrected. 34 Appx.4: EMC Installation Guidelines 35 Appx.5: Restrictions for Lithium Batteries 36 Appx.6: Precautions for Compliance to UL/c-UL Standards - Mistakes were corrected.

Date of revision	Manual No.	Revision details
Mar. 2018	IB(NA)1501269-G	The descriptions were revised in response to Mitsubishi Electric CNC E80 Series. - The following units were added. FCU8-MU513 (Control unit) FCU8-MU514 (Control unit) FCU8-DU121-13 (Display unit) FCU8-KB024 (Keyboard unit) FCU8-KB025 (Keyboard unit) FCU8-DX731 (Operation panel I/O unit) FCU8-DX409 (Remote I/O unit) FCU8-EX564 (Communication expansion unit) FCU8-KB925 (MITSUBISHI CNC Machine operation panel) FCU8-KB926 (MITSUBISHI CNC Machine operation panel) FCU8-KB941 (MITSUBISHI CNC Machine operation panel) - The following cable was added. J225 (Analog output cable) - The following chapters were added. 2.3 General Connection Diagram [E80] 3.3 Control Unit [E80] 3.6 Display Unit [E80] 3.9 Keyboard Unit [E80] 3.12 Remote I/O Unit [E80] 3.18 MITSUBISHI CNC Machine Operation Panel [E80] 4.3 Environment Conditions [E80] 4.6 Control Unit [E80] 4.9 Display Unit [E80] 4.10.9 Keyboard for 8.4-type Display Unit (FCU8-KB024) 4.10.10 Keyboard for 8.4-type Display Unit (FCU8-KB025) 4.14.3 CC-Link IE Field (FCU8-EX564) 7.11.3 Connecting I/O Device via CC-Link IE Field 9.8 Connecting with Analog Output Signal (FCU8-DX731) 10.11 Connecting with Multi-analog Input Signal (FCU8-DX409) 15.2.18 J225 Cable - The following contents were changed. 2 General Connection Diagram 3.10 Operation Panel I/O Unit 3.11 Remote I/O Unit [M800S/M80] 3.14 Communication Expansion Unit 3.17 MITSUBISHI CNC Machine Operation Panel [M800S/M80] 3.20 Cable Connector Sets 3.25 List of Cables 4.1.1 Installation Environment Conditions 4.2.1 Installation Environment Conditions 4.10 Keyboard Unit 4.11 Operation Panel I/O Unit 4.12 Remote I/O Unit 4.14.1 CC-Link (FCU8-EX561) 4.14.2 PROFIBUS-DP (FCU8-EX563) 4.14.4 EtherNet/IP (FCU8-EX565) 4.17.1 Main Panel A , B (FCU8-KB921 / FCU8-KB922 / FCU8-KB925 , FCU8-KB923 / FCU8-KB924 / FCU8-KB926) 4.17.2 Sub Panel A (FCU8-KB931 / FCU8-KB941) (Continue to the next page)

Date of revision	Manual No.	Revision details
Mar. 2018	IB(NA)1501269-G	(Continued from the previous page) 5.3.2 Keyboard Unit 5.3.3 Operation Panel I/O Unit 5.3.4 Remote I/O Unit 5.3.6 Communication Expansion Unit 5.3.7 MITSUBISHI CNC Machine Operation Panel 7.1 Machine Operation Panel Connection System Drawing 7.6.2 Connecting with Drive Unit MDS-EM/EMH Series 7.9.1 Handle Numbers 7.11 Connecting I/O Device via Communication Expansion Unit 7.11.4 Connecting I/O Device via EtherNet/IP 9.1 Operation Panel I/O Unit Connection System Drawing 9.2 Connecting with Frame Ground 9.5 Connecting with Remote I/O Unit 9.6.1 Handle Numbers 9.7 Connecting with Machine Operation Panel 9.8 Connecting with Analog I/O Signal (FCU8-DX761) 10.1 Remote I/O Unit Connection System Drawing 10.2 Connecting with Power Supply 10.3 Connecting with Frame Ground 10.5 Connecting with Operation Panel I/O Unit 13.2 Connecting with Power Supply 13.3 Connecting with Frame Ground 13.4 Connecting with Operation Panel I/O Unit 13.6 Connecting with Sub Panel 15.2.20 J350 Cable 15.2.21 J351 Cable 16.1 Hardware Configuration 17.2.1 Setting the Rotary Switch 17.5 Connecting the Batteries 17.6.1 Outline of the Remote I/O Unit 17.6.2 Connection and Station No. Setting on Remote I/O Unit 17.6.3 Station No. Setting when Using Multiple Remote I/O Units 30 Data Backup and Restoration 32.1 Protect Setting Screen - The chapter numbers were corrected. Due to addition of the chapters as above, the existing chapter numbers/chapter titles were corrected. - Mistakes were corrected.

Date of revision	Manual No.	Revision details
Mar. 2019	IB(NA)1501269-H	The descriptions of M800 Series/M80 Series/E80 Series were revised in response to S/W version E0. - The following chapters and sections were added. 7.6.1.2 Drive Unit Arrangement - The following chapter titles were added. 7.6.1.1 Connection of Optical Communication Cables Due to addition of section 7.6.1.2, only the chapter title was added. - The following contents were changed. 2.1 General Connection Diagram [M800S] 2.2 General Connection Diagram [M80] 2.3 General Connection Diagram [E80] 3.10 Operation Panel I/O Unit 3.14 Communication Expansion Unit 3.20 Cable Connector Sets 3.24 Replacements 4.11.1 List of Units 4.11.2 FCU8-DX731 / FCU8-DX750 / FCU8-DX760 / FCU8-DX761 7.6.1.1 Connection of Optical Communication Cables 7.6.2 Connecting with Drive Unit MDS-EM/EMH Series 7.6.3 Connecting with Drive Unit MDS-EJ/EJH Series 7.11 Connecting I/O Device via Communication Expansion Unit 9.5 Connecting with Remote I/O Unit 9.7.1 Wiring for 24V Common Input 9.7.2 Wiring for 0V Common Input 9.8 Connecting with Analog Output Signal (FCU8-DX731) 10.5 Connecting with Operation Panel I/O Unit 13.1 Machine Operation Panel Connection System Drawing 13.4 Connecting with Operation Panel I/O Unit 13.5 Connecting Emergency Stop Switch 15.4 List of Cable Connector Sets 16.2 Flow of Initial Setup 17.1.1 Setting the Rotary Switch 17.5.2 Servo Drive Unit Battery 17.6.2 Connection and Station No. Setting on Remote I/O Unit 17.6.3 Station No. Setting when Using Multiple Remote I/O Units 19.3 Setting the Parameters for the Machine Specifications 20 PLC Program Writing 20.2.2 Setting the IP Address for PC Side 20.4 Setting the Communication with GX Developer 20.5.4 Setting the Program Execution Order 22.2.2 Dog-type Reference Position Return Adjustment Procedures 31.4 Caution 34.6.3 Surge Absorber 35.1.1 Target Products - Mistakes were corrected.

Date of revision	Manual No.	Revision details
Sep. 2019	IB(NA)1501269-J	The descriptions of M800 Series/M80 Series/E80 Series were revised in response to S/W version E1. - The following units were added. FCU8-DX834 (Operation panel I/O unit) FCU8-EX568 (FL-net expansion unit) - The following cable was added. J012 (Operation panel I/O interface cable) - The following chapters were added. 2.3.1 Connecting a Spindle Drive Unit 2.3.2 Connecting a Pulse-controlled Inverter 3.26 System Type 4.14.5 FL-net (FCU8-EX568) 7.7 Connecting with Pulse-controlled Inverter [E80] 7.12.5 Connecting I/O Device via FL-net 9.2 Connecting with Power Supply 9.8.5 Connection with the scan input signal (FCU8-DX834) 9.8.6 Connection with the scan output signal (FCU8-DX834) 15.2.7 J012 cable 20.8 Setting the Communication with GX Works2 20.9 Setting the Parameters on GX Works2 20.10 Writing a Sequence Program with GX Works2 20.11 Writing a Sequence Program to ROM with GX Works2 24 Setting the Machine Error Compensation 25 Setting the Position Switches 26 Setting the Backlash Compensation - The following contents were changed. 2.1 General Connection Diagram [M800S] 2.2 General Connection Diagram [M80] 2.3 General Connection Diagram [E80] 3.1 Control Unit [M800S] 3.10 Operation Panel I/O Unit 3.14 Communication Expansion Unit 3.25 List of Cables 4.1.1 Installation Environment Conditions 4.2.1 Installation Environment Conditions 4.3.1 Installation Environment Conditions 4.4.1 FCU8-MU542 / FCU8-MA542 / FCU8-MU541 / FCU8-MA541 4.6.1 FCU8-MU513 / FCU8-MU514 4.7.1 10.4-type (FCU8-DU141-31) 4.7.2 15-type (FCU8-DU181-31) 4.8.1 8.4-type (FCU8-DU121-12) 4.8.2 10.4-type (FCU8-DU141-32) 4.8.3 15-type (FCU8-DU181-32) 4.9.1 8.4-type (FCU8-DU121-13) 4.11 Operation Panel I/O Unit 4.11.1 List of Units 4.11.2 FCU8-DX731 / FCU8-DX750/ FCU8-DX760 / FCU8-DX761 / FCU8-DX834 4.12.2 FCU8-DX220 / FCU8-DX230 / FCU8-DX231 / FCU8-DX202 / FCU8-DX213 / FCU8-DX213-1 / FCU8-DX654 / FCU8-DX654-1 / FCU8-DX651 / FCU8-DX408 / FCU8-DX409 (Continue to the next page)

Date of revision	Manual No.	Revision details
Sep. 2019	IB(NA)1501269-J	(Continued from the previous page) 5.3.3 Operation Panel I/O Unit 5.3.6 Communication Expansion Unit 7.1 Control Unit Connection System Drawing 7.3 Connecting with Emergency Stop Signal 7.4 Connecting with Operation Panel I/O Unit 7.5 Connecting with Remote I/O Unit 7.12 Connecting I/O Device via Communication Expansion Unit 9.1 Operation Panel I/O Unit Connection System Drawing 9.6 Connecting with Remote I/O Unit 9.8 Connecting with Machine Operation Panel 9.8.3 Wiring for Source Type Output 10.5 Connecting with Operation Panel I/O Unit 10.11 Connecting with Multi-analog Input Signal (FCU8-DX409) 16.2 Flow of Initial Setup 17.6.2 Connection and Station No. Setting on Remote I/O Unit 17.6.3 Station No. Setting when Using Multiple Remote I/O Units 20 Sequence Program Writing 20.1 Writing Sequence Program using the SD Card 20.2.2 Setting the IP Address for PC Side 20.3 Connecting the Control Unit and a Personal Computer 20.4 Setting the Communication with GX Developer 20.6 Writing a Sequence Program with GX Developer 20.7 Writing a Sequence Program to ROM with GX Developer 33 Data Backup and Restoration 34.3 Display of Time Limit Warning and Alarm Notification 34.4 Caution 35.1 Protect Setting Screen - The chapter numbers were corrected. Due to addition of the chapters as above, the existing chapter numbers were corrected. - The chapter titles were corrected. The expression "PLC Program" included in the titles in the chapter 20 was changed to "Sequence Program". - Mistakes were corrected.

Date of revision	Manual No.	Revision details
Jun. 2020	IB(NA)1501269-K	The descriptions of M800 Series/M80 Series/E80 Series were revised in response to S/W version F1. - The following chapters were added. 2.2.1 Connecting a Spindle Drive Unit 2.2.2 Connecting a Pulse-controlled Inverter 23.2.9 Behavior in Prohibited Area 24.3 Cyclic Error Compensation 30 Synchronous Control and Multiple-axis Synchronization Control - The following contents were changed. 2.1 2.1 General Connection Diagram [M800S] 2.2.1 Connecting a Spindle Drive Unit 2.3.1 Connecting a Spindle Drive Unit 2.3.2 Connecting a Pulse-controlled Inverter 3.1 Control Unit [M800S] 3.2 Control Unit [M80] 3.3 Control Unit [E80] 3.22 Genuine Memory Card 3.25 List of Cables 4.1.1 Installation Environment Conditions 4.2.1 Installation Environment Conditions 4.3.1 Installation Environment Conditions 4.4.1 FCU8-MU542 / FCU8-MA542 / FCU8-MU541 / FCU8-MA541 4.6.1 FCU8-MU513 / FCU8-MU514 4.12.2 FCU8-DX220 / FCU8-DX230 / FCU8-DX231 / FCU8-DX202 / FCU8-DX213 / FCU8-DX213-1 / FCU8-DX654 / FCU8-DX654-1 / FCU8-DX651 / FCU8-DX408 / FCU8-DX409 5.3.7 Machine Operation Panel 6.1.2 Precautions for Using Optical Communication Cable 7.1 Control Unit Connection System Drawing 7.6.1.2 Drive Unit Arrangement 7.7 Connecting with Pulse-controlled Inverter [M80/E80] 9.1 Operation Panel I/O Unit Connection System Drawing 9.6 Connecting with Remote I/O Unit 10.1 Remote I/O Unit Connection System Drawing 10.5 Connecting with Operation Panel I/O Unit 13 Connection of Machine Operation Panel 13.2 Connecting with Power Supply 13.4 Connecting with Operation Panel I/O Unit 13.5 Connecting Emergency Stop Switch 13.6 Connecting with Sub Panel 15.2.2 G071 Cable 15.2.5 G460 Cable 15.2.9 J023/J024/J025 Cable 15.2.10 J026/J027 Cable 15.2.14 J120 Cable 15.2.15 J121 Cable 15.2.18 J224 Cable 15.3.1 Cable Wire and Assembly 15.3.3 CNP3EZ-2P/CNP3EZ-3P Cable 17.4 Setting Up without Connecting to the Motor/Drive Units at the Setup of Drive Unit 17.6.2 Connection and Station No. Setting on Remote I/O Unit 17.6.4.2 Arbitrary Device Assignment 20.4 Setting the Communication with GX Developer 20.8 Setting the Communication with GX Works2 20.11 Writing a Sequence Program to ROM with GX Works2 (Continue to the next page)

Date of revision	Manual No.	Revision details
Jun. 2020	IB(NA)1501269-K	(Continued from the previous page) 22.1 Adjusting the Absolute Position Detection System 22.1.1 Basic Position Alignment Method I 22.1.2 Basic Position Alignment Method II 22.1.3 Machine End Stopper Method: Automatic Initialization 22.1.4 Machine End Stopper Method: Manual Initialization 22.1.5 Dog-type 22.1.6 Setting the Grid Interval and the Reference Encoder for Grid Interval 23 Setting the Tool Entry Prohibited Range 23.2.10 Precautions 26.2.2.1 Setting the backlash compensation II acceleration rate 26.2.2.2 Setting compensation amount of backlash compensation II 29.2 Deceleration Check Method 29.3 Deceleration Check for Opposite Direction Movement Reversal 29.6 Precautions 35.2 Setting of Expiration Date 35.3 Display of Time Limit Warning and Alarm Notification 36.1 Protect Setting Screen - The chapter titles were corrected. 3.17 Machine Operation Panel [M800S/M80] 3.18 Machine Operation Panel [E80] 4.17 Machine Operation Panel 4.20 Exclusive SD Cards 5.3.7 Machine Operation Panel 7.7 Connecting with Pulse-controlled Inverter [M80/E80] 13 Connection of Machine Operation Panel 17.4 Setting Up without Connecting to the Motor/Drive Units at the Setup of Drive Unit 23.1 Stroke End 23.2 Stored Stroke Limit - Mistakes were corrected.

Date of revision	Manual No.	Revision details
Mar. 2021	IB(NA)1501269-L	The descriptions of M800 Series/M80 Series/E80 Series were revised in response to S/W version F4. - The following units were added. FCU8-EX744 (Vibration cutting expansion Unit) - The following chapters were added. 2.4 Connecting a Pulse-controlled Inverter [M80/E80] 3.15 Function Expansion Unit [E80] 4.14.6 Vibration Cutting Expansion Unit (FCU8-EX744) - The following chapter was deleted. 2.2.2 Connecting a Pulse-controlled Inverter 2.3.2 Connecting a Pulse-controlled Inverter - The following contents were changed. 2.1 General Connection Diagram [M800S] 2.2 General Connection Diagram [M80] 2.3 General Connection Diagram [E80] 3.14 Function Expansion Unit [M800S/M80] 4.4.1 FCU8-MU542 / FCU8-MA542 / FCU8-MU541 / FCU8-MA541 4.5.1 FCU8-MU511 / FCU8-MU512 / FCU8-MU501 / FCU8-MU502 4.6.1 FCU8-MU513 / FCU8-MU514 4.7.1 10.4-type (FCU8-DU141-31) 4.7.2 15-type (FCU8-DU181-31) 4.8.1 8.4-type (FCU8-DU121-12) 4.8.2 10.4-type (FCU8-DU141-32) 4.8.3 15-type (FCU8-DU181-32) 4.9.1 8.4-type (FCU8-DU121-13) 4.10.1 Keyboard for 8.4-type Display Unit (FCU8-KB026) 4.10.2 Keyboard for 8.4-type Display Unit (FCU8-KB028) 4.10.3 Keyboard for 8.4-type Display Unit (FCU8-KB029) 4.10.4 Keyboard for 10.4-type Display Unit (FCU8-KB041) 4.10.5 Keyboard for 10.4-type Display Unit (FCU8-KB046) 4.10.6 Keyboard for 10.4-type Display Unit (FCU8-KB047) 4.10.7 Keyboard for 10.4-type Display Unit (FCU8-KB048) 4.10.8 Keyboard for 15-type Display Unit (FCU8-KB083) 4.10.9 Keyboard for 8.4-type Display Unit (FCU8-KB024) 4.10.10 Keyboard for 8.4-type Display Unit (FCU8-KB025) 4.11.2 FCU8-DX731 / FCU8-DX750 / FCU8-DX760 / FCU8-DX761 / FCU8-DX834 4.12.2 FCU8-DX220 / FCU8-DX230 / FCU8-DX231 / FCU8-DX202 / FCU8-DX213 / FCU8-DX213-1 / FCU8-DX654 / FCU8-DX654-1 / FCU8-DX651 / FCU8-DX408 / FCU8-DX409 4.15.1 5V Manual Pulse Generator (UFO-01-2Z9) 4.15.2 12V Manual Pulse Generator (HD60C) 4.17.1 Main Panel A , B (FCU8-KB921 / FCU8-KB922 / FCU8-KB925 , FCU8-KB923 / FCU8-KB924 / FCU8-KB926) 4.17.2 Sub Panel A (FCU8-KB931 / FCU8-KB941) 5.3.6 Function Expansion Unit 7.12 Connecting I/O Device via Function Expansion Unit 7.12.1 Connecting I/O Device via CC-Link 7.12.2 Connecting I/O Device via PROFIBUS-DP 7.12.3 Connecting I/O Device via CC-Link IE Field 7.12.4 Connecting I/O Device via EtherNet/IP 7.12.5 Connecting I/O Device via FL-net (Continue to the next page)

Date of revision	Manual No.	Revision details
Mar. 2021	IB(NA)1501269-L	(Continued from the previous page) 13 Connection of Machine Operation Panel 13.3 Connecting with Frame Ground 20.4 Setting the Communication with GX Developer 20.8 Setting the Communication with GX Works2 22.1.3 Machine End Stopper Method: Automatic Initialization 22.1.4 Machine End Stopper Method: Manual Initialization 29.6 Precautions 30.1.2.2 Zero Point Establishment in Dogless-type Absolute Position Detection System - The chapter titles were corrected. 3.13 Function Safety Expansion Unit [M80] 3.14 Function Expansion Unit [M800S/M80] 4.13 Functional Safety Expansion Unit 4.14 Function Expansion Unit 4.14.7 Option Relay Unit (FCU8-EX702) 4.14.8 Option Relay Unit (FCU8-EX703) 5.3.6 Function Expansion Unit 7.12 Connecting I/O Device via Function Expansion Unit - Chapter title deleted. 2.2.1 Connecting a Spindle Drive Unit 2.3.1 Connecting a Spindle Drive Unit - Mistakes were corrected.
Sep. 2021	IB(NA)1501269-M	- The following contents were changed. 7.1 Control Unit Connection System Drawing 38.1 Introduction 38.2 EMC Directives - The chapter titles were corrected. 38.2 EMC Directives

Date of revision	Manual No.	Revision details
Jul. 2022	IB(NA)1501269-N	The descriptions of M800 Series/M80 Series/E80 Series were revised in response to S/W version F8. - The following display units were added. FCU8-DU142-31 / FCU8-DU182-31 / FCU8-DU142-32 / FCU8-DU182-32 - The following chapters were added. 2.4 Difference in Connection Depending on the Display Unit 2.5 Connecting an Operation Panel I/O Unit (FCU8-DX834) 2.7 Connecting a BiSS Encoder 7.8 Connecting with a BiSS Encoder 31 OMR Control 32 Variable Torsion Compensation - The following contents were changed. 2.1 General Connection Diagram [M800S] 2.2 General Connection Diagram [M80] 2.3 General Connection Diagram [E80] 3.4 Display Unit [M800S] 3.5 Display Unit [M80] 3.27 System Type 4.1.1 Installation Environment Conditions 4.2.1 Installation Environment Conditions 4.3.1 Installation Environment Conditions 4.4.1 FCU8-MU542 / FCU8-MA542 / FCU8-MU541 / FCU8-MA541 4.7.2 15-type (FCU8-DU182-31/FCU8-DU181-31) 4.7.3 Precautions 4.8.3 15-type (FCU8-DU182-32/FCU8-DU181-32) 4.8.4 Precautions 4.17.1 Main Panel A,B (FCU8-KB921 / FCU8-KB922 / FCU8-KB925, FCU8-KB923 / FCU8-KB924 / FCU8-KB926) 5.1 Heat Radiation Countermeasures 5.3.1 Display Unit 7.1 Control Unit Connection System Drawing 7.13.2 Connecting I/O Device via PROFIBUS-DP 9.1 Operation Panel I/O Unit Connection System Drawing 10.1 Remote I/O Unit Connection System Drawing 11.1 Manual Pulse Generator Connection System Drawing 12.1 Synchronous Feed Encoder Connection System Drawing 14.1 Handy Terminal Connection System Drawing 16.2 Flow of Initial Setup 18.1 Activate M80/800S SETUP INSTALLER 19.1 Selecting the NC System Type and Displayed Language 19.2 Setting the Parameters for the System Specifications 19.3 Setting the Parameters for the Machine Specifications 38.5.2 Shield Treatment of Cables 40 Appx.6: Precautions for Compliance to UL/c-UL Standards - The chapter titles were changed. 4.7.1 10.4-type (FCU8-DU142-31/FCU8-DU141-31) 4.7.2 15-type (FCU8-DU182-31/FCU8-DU181-31) 4.8.2 10.4-type (FCU8-DU142-32/FCU8-DU141-32) 4.8.3 15-type (FCU8-DU182-32/FCU8-DU181-32) 18 Setting Up with M80/800S SETUP INSTALLER 18.1 Activate M80/800S SETUP INSTALLER - Mistakes were corrected.

Date of revision	Manual No.	Revision details
Dec. 2022	IB(NA)1501269-P	- The following contents were corrected. 2.1 General Connection Diagram [M800S] 2.2 General Connection Diagram [M80] 2.3 General Connection Diagram [E80] 29.4 Parameter - The following contents were changed. 40 Appx.4: EMC Installation Guidelines
Jan. 2024	IB(NA)1501269-Q	The descriptions of M800 Series/M80 Series/E80 Series were revised in response to S/W version FC. - The following chapters were added. 2.8 Connecting an EcoMonitorLight 7.9 Connecting with EcoMonitorLight 15.3.14 MR-ENE4CBL-H-MTH Cable - The following contents were changed. 3.26 List of Cables 4.4.1 FCU8-MU542 / FCU8-MA542 / FCU8-MU541 / FCU8-MA541 4.11.2 FCU8-DX731 / FCU8-DX750 / FCU8-DX760 / FCU8-DX761 / FCU8-DX834 4.12.2 FCU8-DX220 / FCU8-DX230 / FCU8-DX231 / FCU8-DX202 / FCU8-DX213 / FCU8-DX213-1 / FCU8-DX654 / FCU8-DX654-1 / FCU8-DX651 / FCU8-DX408 / FCU8-DX409 5.2.1 Connection of Frame Ground (FG) 5.2.2 Shield Clamping of Cables 7.1 Control Unit Connection System Drawing 7.14.2 Connecting I/O Device via PROFIBUS-DP 7.14.3 Connecting I/O Device via CC-Link IE Field 7.14.4 Connecting I/O Device via EtherNet/IP 15.2.1 FCUA-R050/R054 Cable 15.2.4 G430 Cable 15.2.8 J020/J021/J022 Cable 15.2.9 J023/J024/J025 Cable 15.2.10 J026/J027 Cable 15.2.13 J100 Cable 15.2.17 J221 Cable 15.2.18 J224 Cable 15.2.19 J225 Cable 15.3.4 CNV2E-8P/CNV2E-9P Cable 15.3.6 CNV2E-HP Cable 40.6.1 Shield Clamp Fitting - Mistakes were corrected.
Jun. 2024	IB(NA)1501269-R	The descriptions of M800 Series/M80 Series/E80 Series were revised in response to S/W version FD. - The following contents were changed. 4.4.1 FCU8-MU542 / FCU8-MA542 / FCU8-MU541 / FCU8-MA541 30.1 Synchronous Control

Date of revision	Manual No.	Revision details
Jan. 2025	IB(NA)1501269-S	The descriptions of M800 Series/M80 Series/E80 Series were revised in response to S/W version FG. - The following contents were changed. 2.1 General Connection Diagram [M800S] 2.2 General Connection Diagram [M80] 2.3 General Connection Diagram [E80] 4.4.1 FCU8-MU542 / FCU8-MA542 / FCU8-MU541 / FCU8-MA541 4.5.1 FCU8-MU511 / FCU8-MU512 / FCU8-MU501 / FCU8-MU502 4.6.1 FCU8-MU513 / FCU8-MU514 18.1 Activate M80/800S SETUP INSTALLER 18.2 Install Custom Screen 18.4 Install APLC C Language Module 18.5 Install User Cycle - Mistakes were corrected.

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Notice

Every effort has been made to keep up with software and hardware revisions in the contents described in this manual. However, please understand that in some unavoidable cases simultaneous revision is not possible. Please contact your Mitsubishi Electric dealer with any questions or comments regarding the use of this product.

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