MITSUBISHI ELECTRIC

Changes for the Better

Numerical Control (CNC)

User's Manual

High Speed Processing Unit

IB-1501714(ENG)-D

Introduction

This manual describes the items required for installing, connecting and setting up the high speed processing unit that is used by connecting to a Mitsubishi Electric computerized numerical controller (CNC).
Read this manual thoroughly and understand the product's functions and performance before use.

The high speed processing unit supports the following CNC.

Supported CNC
M800VW Series/M80VW Series

To safely use this CNC unit, thoroughly study the "Precautions for Safety" before use.
Be sure to keep this manual always at hand.
Also refer to the manuals on "Manual List" as necessary.

This product is commercially available encryption device and commercially available encryption program.

■ Notes on reading this manual

(1) 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.
(2) 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".
(3) This manual is for the machine tool builders who set up the NC system.
(4) Do not connect to the pin described as "NC" on the pin assignment table of the connector.
(5) The characteristic values and numerical values without tolerances mentioned in this manual are representative values.

■ Details described in this manual

- The computerized numerical controller is configured of the control unit, display unit, personal computer 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
- Personal computer unit
- Operation board (operation panel I/O unit)
- Computerized numerical controller 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 with driver

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

Manual List

Manuals related to M800V/M80V 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
M800V/M80V Series Instruction Manual	IB-1501618	• Operation guide for NC • Explanation for screen operation, etc.
M800V/M80V Series Programming Manual (Lathe System) (1/2)	IB-1501619	• G code programming for lathe system • Basic functions, etc.
M800V/M80V Series Programming Manual (Lathe System) (2/2)	IB-1501620	• G code programming for lathe system • Functions for multi-part system, high-accuracy function, etc.
M800V/M80V Series Programming Manual (Machining Center System) (1/2)	IB-1501621	• G code programming for machining center system • Basic functions, etc.
M800V/M80V Series Programming Manual (Machining Center System) (2/2)	IB-1501622	• G code programming for machining center system • Functions for multi-part system, high-accuracy function, etc.
M800V/M80V Series Alarm/Parameter Manual	IB-1501623	• Alarms • Parameters

Manuals for MTBs (NC)

Manual	IB No.	Purpose and Contents
M800V/M80V Series Specifications Manual (Function)	IB-1501610	• Model selection • Outline of various functions
M800V/M80V Series Specifications Manual (Hardware)	IB-1501611	• Model selection • Specifications of hardware unit
M800VW/M80VW Series Connection and Setup Manual	IB-1501612	• Detailed specifications of hardware unit • Installation, connection, wiring, setup (startup/adjustment)
M800VS/M80V Series Connection and Setup Manual	IB-1501613	• Detailed specifications of hardware unit • Installation, connection, wiring, setup (startup/adjustment)
M800V/M80V Series PLC Development Manual	IB-1501614	• Electrical design • I/O relation (assignment, setting, connection), field network • Development environment (PLC on-board, peripheral development environment), etc.
M800V/M80V Series PLC Programming Manual (1/2)	IB-1501667	• Electrical design • Sequence programming • Explanation for instructions, functions, and parameters
M800V/M80V Series PLC Programming Manual (2/2)	IB-1501668	• Electrical design • Sequence programming • Usage examples of instructions
M800V/M80V Series PLC Interface Manual	IB-1501616	• Electrical design • Interface signals between NC and PLC
M800V/M80V Series Maintenance Manual	IB-1501617	• Cleaning and replacement for each unit • Other items related to maintenance
NC Complier2 Instruction Manual	IB-1501322	• Complier for custom software development

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.
MDS-EX-CVP Series Specifications and Instruction Manual	IB-1501587	• Specifications and instruction for the power supply unit with large capacity

Precautions for Safety

Always read the specifications issued by the machine tool builder, this manual, related manuals and attached documents before installation, operation, programming, maintenance or inspection to ensure correct use. Understand this numerical controller, safety items and cautions before using the unit.
This manual ranks the safety precautions into "DANGER", "WARNING" and "CAUTION".

⚠ **DANGER** **When the user may be subject to fatalities or major 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 may be subject to medium or minor injuries or when only property damage may occur, if handling is mistaken.**

Note that even items ranked as " ⚠ CAUTION" may lead to serious consequences 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**

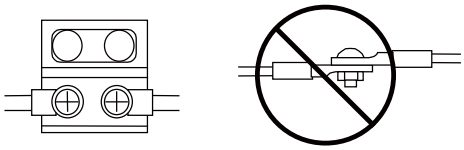
For Safe Use

Mitsubishi Electric 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.

■ 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 caution could result in electric shocks.**
- **Earth ground the controller, drive unit and motor according to the local laws. (In Japan, ground the 200 V Series input products with Class C or higher protective grounding and the 400 V 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 caution 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.**

■ 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.**

■ 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.

Do not reverse polarity (+ -). Failure to observe this could cause bursting, 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.

■ General precautions

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

[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.

For information about each machine tool, refer to manuals issued from the machine tool builder.

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.

[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. 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 matter to enter the controller, drive unit or motor. Take particular care to avoid allowing any conductive foreign matters such as screws or metal chips, or combustible foreign matters such as oil to enter. 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.**

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

⚠ CAUTION

⚠ **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).**

[Items related to wiring]

⚠ CAUTION

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

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

⚠ **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.**

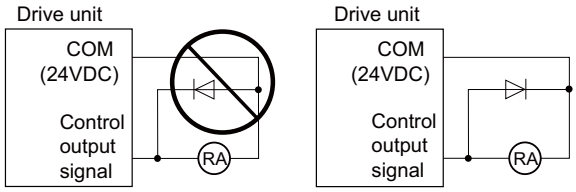
⚠ **Always install an appropriate breaker per each power supply unit. A breaker cannot be shared for multiple power supply units.**

⚠ **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.**

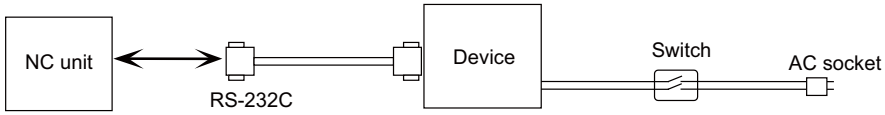
⚠ **Carry out wiring so that there is no possibility of short circuit between wires, nor of dangerous state.**

⚠ **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 24 V.**

⚠ **Output from 12 V/5 V/3.3 V connectors is for powering peripheral devices only. If used for powering other equipment, NC operation will not be guaranteed due to voltage drops or wraparound noise.**

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.**

[Setup]

⚠ 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

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.

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.

[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".

[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.**

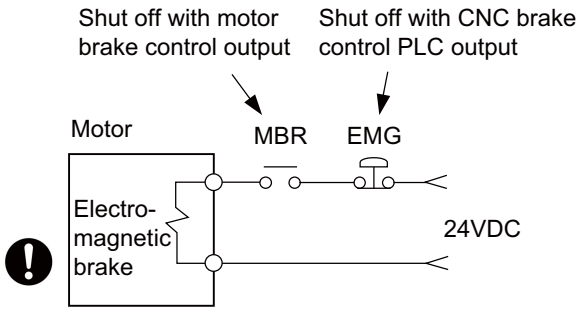
⚠ **Before touching the unit, make sure to touch a conductive material such as a grounded metal object to discharge static electricity accumulated in human body, etc. Otherwise, faults or malfunction may occur in the unit.**

[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.

[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.
Memory loss could have happened in replacing the battery. In this case, reload all the data which 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 Electric 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.**

[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.**

[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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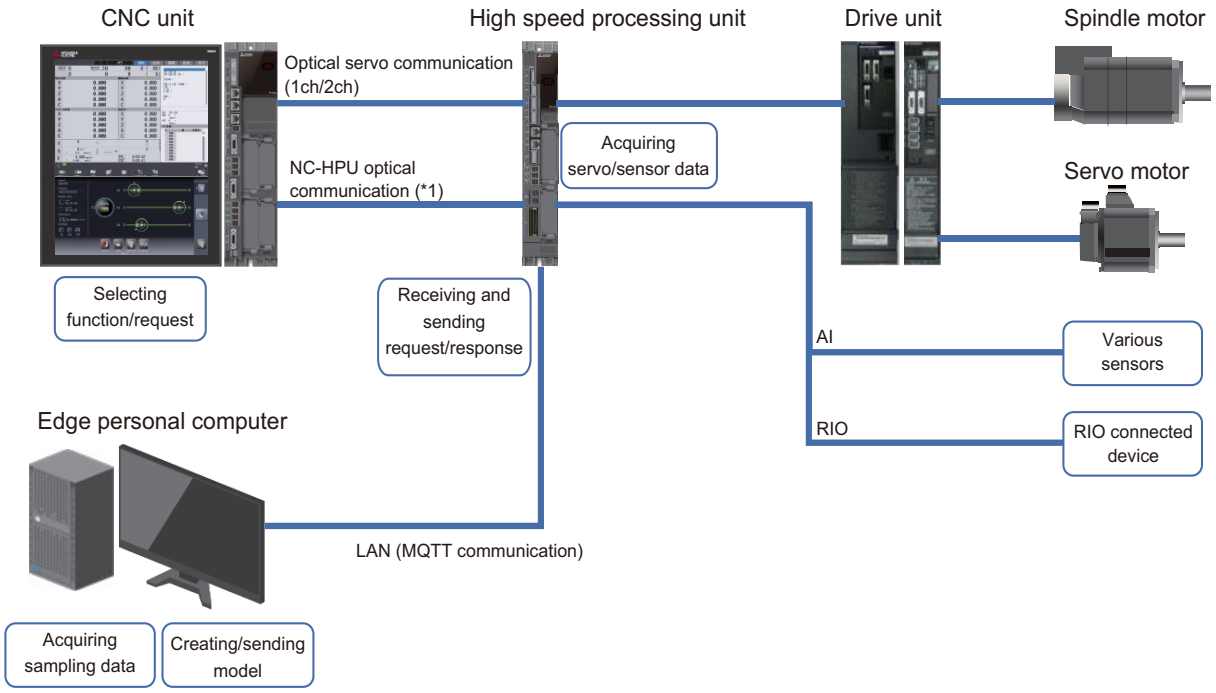
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1

Outline

1.1 Characteristics

The high speed processing unit is equipped with functions for sampling data, such as various sensors and I/O signal data in addition to the feedback position and current value of the servo axis, at a high speed.
The sampled data can also be imported into an edge personal computer, and then used to add a machine tool builder's original functions, such as the operation status monitoring, machining diagnosis, and preventative maintenance of machine tools.



(*1) NC-HPU optical communication is available only in NC system which has up to 4 part systems and up to 16 axes.

(*) To realize MTB's original functions, the MTB needs to create the following software.

- HPU custom module (Hereinafter, it is called "custom module".)
  This is a software which works in the high speed processing unit. Functions such as data sampling, compensation by model parameter, etc. can be mounted.
- Custom application
  This is a software which works in the edge personal computer. Functions such as creation of model parameter, etc. can be mounted by using data acquired by the custom module.
- Custom screen
  This is created to display an MTB-dedicated screen on a CNC display unit.
- PLC program
  This is created to request sampling and model creation from CNC to a custom module.

1.2 Interface

Interfaces mounted on the high speed processing unit are as follows:

Mounted I/F	Main purposes of use	High speed processing unit
LAN	Communication with the edge personal computer Communication with the personal computer for setting	LAN: 1 channel NCLAN: 1 channel
Optical servo communication	Acquiring servo data	2 channels
Analog input (IEPE support)	Acquiring data such as sensor data	6 channels
RIO 1.0/2.0	Master: connection with RIO unit Local: connection with CNC	Master: 1 channel Local: 1 channel
SD card	-	One slot on front An SDHC card of up to 32 GB can be used.

1.3 Data Acquisition Function

This section explains about main data which can be acquired through the interface of the high speed processing unit: optical servo communication, analog input, and RIO.

1.3.1 Optical Servo Communication Data Input

The data in the table below can be collected in the high speed processing unit by changing the wiring of the optical servo communication cables between the CNC and drive unit and placing the high speed processing unit between the CNC and drive unit. The high speed processing unit can collect the optical servo drive communication data for "2 channels × 16 axes".

[Optical servo communication data acquirable through the high speed processing unit]

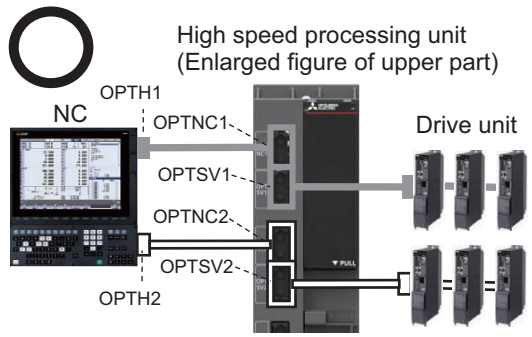
Data types	Overview of the data	Unit
Machine error compensation amount	Compensation amount for a machine error	Linear axis: 0.00005 mm Rotary axis: 0.00005°
Control status	Control input signal from a drive unit	No unit
Position FB	Position FB to NC from drive unit	Linear axis: 0.00005 mm Rotary axis: 0.00005°
Grid amount	Position in one rotation of motor	Linear axis: 0.00005 mm Rotary axis: 0.00005°
Speed FB	Speed FB to NC from drive unit	0.01 r/min
Electric current FB	Electric current FB in drive unit	1% or 0.01% (Depends on the parameter)
Driver display status	Alarm/warning No. of drive unit	No unit

Connection of optical communication cables

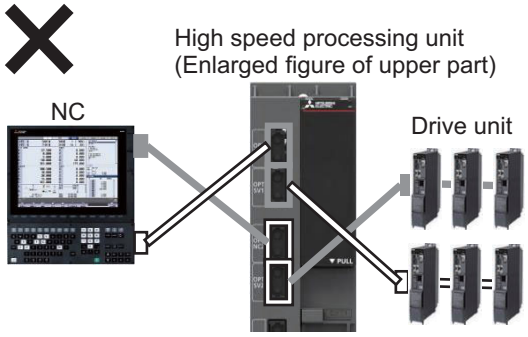
Connect the optical communication cables of the 1st channel and 2nd channel of optical servo communication to the 1st channel (OPTNC1, OPTSV1) and 2nd channel (OPTNC2, OPTSV2) of the high speed processing unit, respectively. If a mistake is made with the connections, sampling of the optical servo communication data by the high speed processing unit is not possible since communication between the NC and drive unit cannot be performed.

: Optical communication cable of 1st channel

: Optical communication cable of 2nd channel



[Correct connection example]
The 1st channel of optical servo communication is connected to the 1st channel of the high speed processing unit.
The 2nd channel of optical servo communication is connected to the 2nd channel of the high speed processing unit.

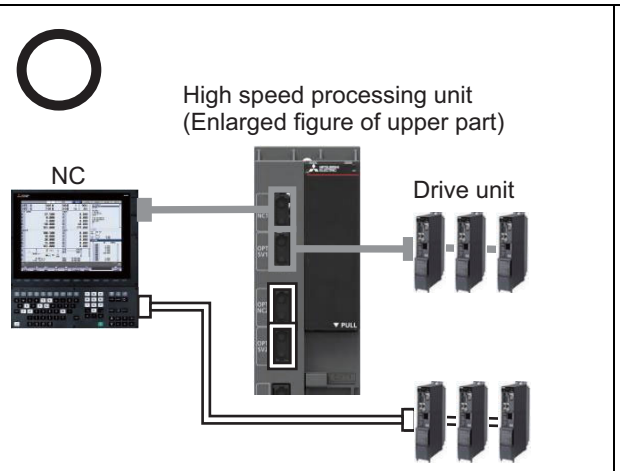
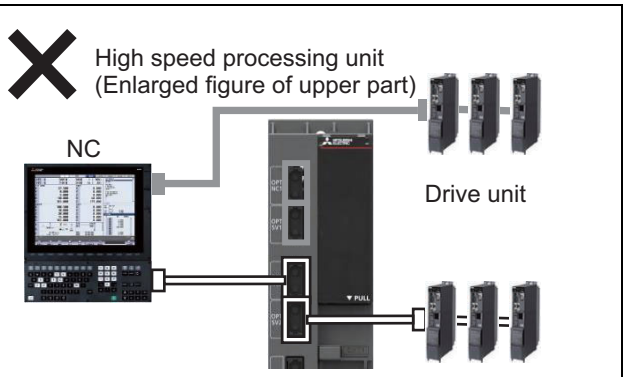


[Incorrect connection example]
The 2nd channel of optical servo communication is connected to the 1st channel of the high speed processing unit.
The 1st channel of optical servo communication is connected to the 2nd channel of the high speed processing unit.

Only the optical communication cable of 1st channel of optical servo communication can be used connected to the drive units via the high speed processing unit. If the 2nd channel is not connected to the high speed processing unit, connect the optical communication cable directly to the drive units.
When connecting the optical communication cable of the 2nd channel of optical servo communication via the high speed processing unit, be sure to also connect the 1st channel of optical servo communication via the high speed processing unit. Use with only the 2nd channel of optical servo communication connected via the high speed processing unit is not possible.

: Optical communication cable of 1st channel

: Optical communication cable of 2nd channel

	
[Correct connection example] Only the 1st channel of optical servo communication is connected via the high speed processing unit, and the 2nd channel is connected directly.	[Incorrect connection example] Only the 2nd channel of optical servo communication is connected via the high speed processing unit. The 1st channel also needs to be connected.

Parameter settings

Set whether to sample the optical servo communication data in "Opt. 1ch Invalid" of bit0 and "Opt. 2ch Invalid" of bit1 of the "#0001 Basic Setting 1" parameter.
The data of a channel with "0" (valid) set is the target for sampling. If an optical communication cable is not connected between the NC and drive unit, set "1" (invalid).

Precautions

(1) If the high speed processing unit fails to acquire the information of the servo axis or spindle when the power of the NC is turned ON, the "E012" error (servo axis/spindle information acquisition error) is displayed. Some of the optical servo communication data cannot be sampled while the "E012" is displayed. Turn ON the power of the NC again.
(2) Only one NC can be connected per high speed processing unit. Do not connect multiple NCs.

1.3.2 RIO Input/Output

By I/O connecting RIO unit to RIO master of the high speed processing unit, I/O data of RIO unit can be collected in the high speed processing unit.
By connecting RIO local station of the high speed processing unit to CNC, data can be transmitted or received between sequence program within CNC and the unit. As the unit is equipped with two RIO local connectors, it can be connected with a daisy chain in the same manner as RIO unit.
Refer to "2.6.6 Connecting with NC Control Unit / Remote I/O Unit" for details on RIO input.

Note

(1) Data cannot be collected for the signals of a remote I/O unit connected to "RIOS2".

1.3.3 Analog Input

Sensor data which can be output as the analog voltage can be collected in the high speed processing unit by the analog input function of the high speed processing unit. In addition, primary conversion (tilt or offset) of collected data is possible.
The high speed processing unit can collect the analog input data for 6 channels.
Refer to "2.3.5 Connector" ((11) AI (analog input 6 channels/IEPE input 6 channels)) for details on analog input, and "2.6.7 Connecting with Analog Input" for details on connecting the equipment.

Item	Specifications
Number of input channels	6 channels (differential input)
Sampling rate	56.25 kHz
Input voltage range	-10 to +10 VDC
Input band	0 to 18 kHz
Effective resolution	12 bits ±10 V range: 4.88 mV
Conversion accuracy	±1%/FS (0 ℃ to 58 ℃)
Insulation/non-insulation between channels	Non-insulation
Disconnection detecting function	None

1.4 Data Sending Function

From the high speed processing unit to the edge personal computer, data can be sent with MQTT protocol.

1.4.1 MQTT

MQ Telemetry Transport (MQTT) is a lightweight broker-based publish/subscribe messaging protocol. MQTT is designed to be open, simple, lightweight, and easy to implement. (Source: MQTT version 3.1 protocol specifications)
The broker needs to be prepared by the machine tool builder (MTB). If a commercially available broker or the broker of the open source software (OSS) satisfies the specifications described in the table below, it can be used as it is.
The subscriber is included with the edge personal computer application (HPU Connector). HPU connector is an application to create a model by an edge personal computer receiving the data sampled by the high speed processing unit and then running the analysis functions. The created model can be sent to the high speed processing unit and then used in analysis processing performed by the high speed processing unit.
Refer to "7 Creating Model Parameter" for details of the edge personal computer application.

[Specifications of MQTT in the high speed processing unit]

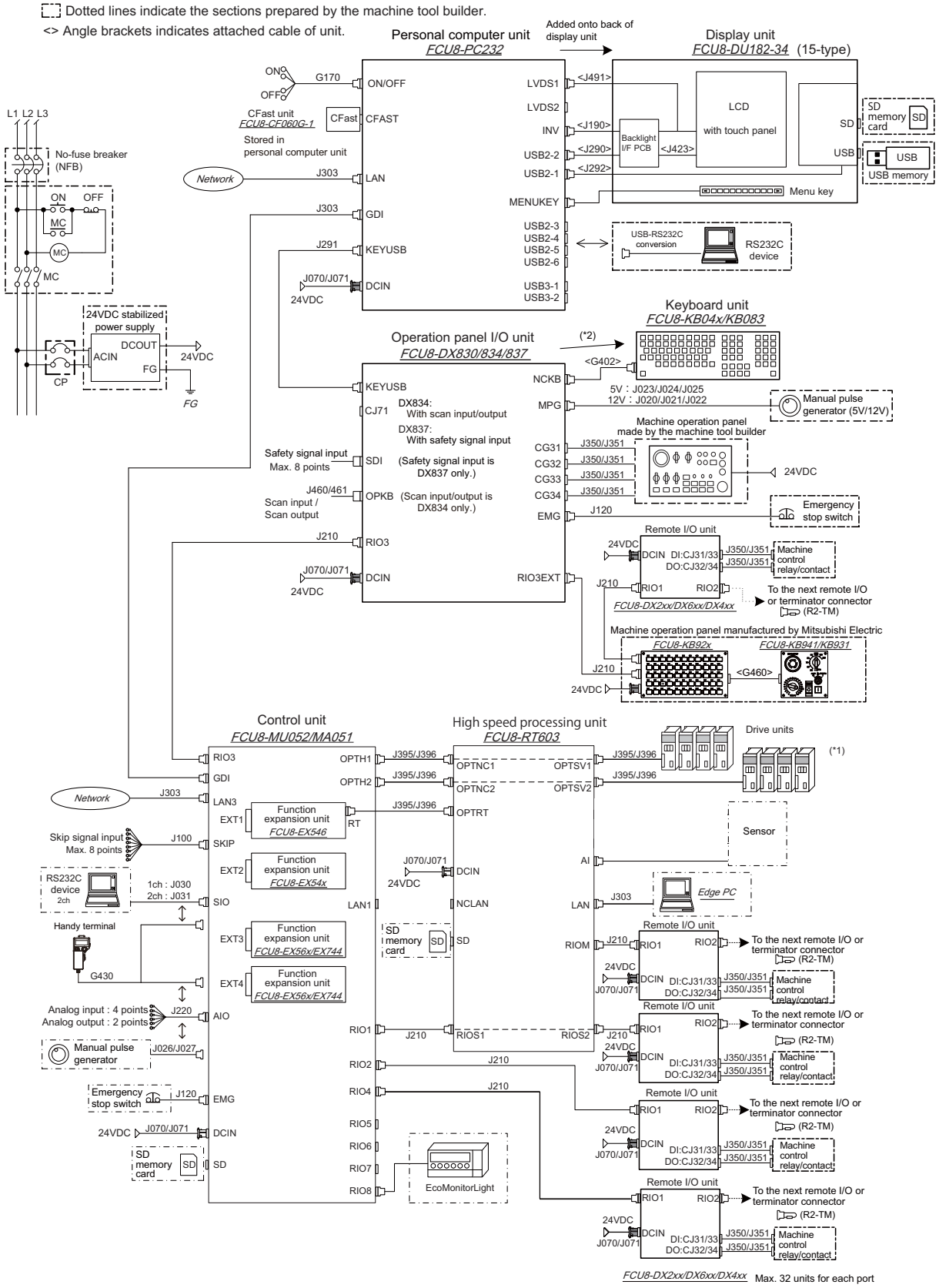
Item	Specifications
Protocol version	"5.0" and "3.1.1"
TCP/IP port	1883 ("8883" when SSL communication is enabled)
Role of the unit	Publisher
Maximum message size	Approximately 200 KB
QoS (quality of service for sending messages) to be used	0 (at most once), 2 (exactly once)
Retain function	Use
Will function	Do not use

2

Connection

2.1 General Connection Diagram

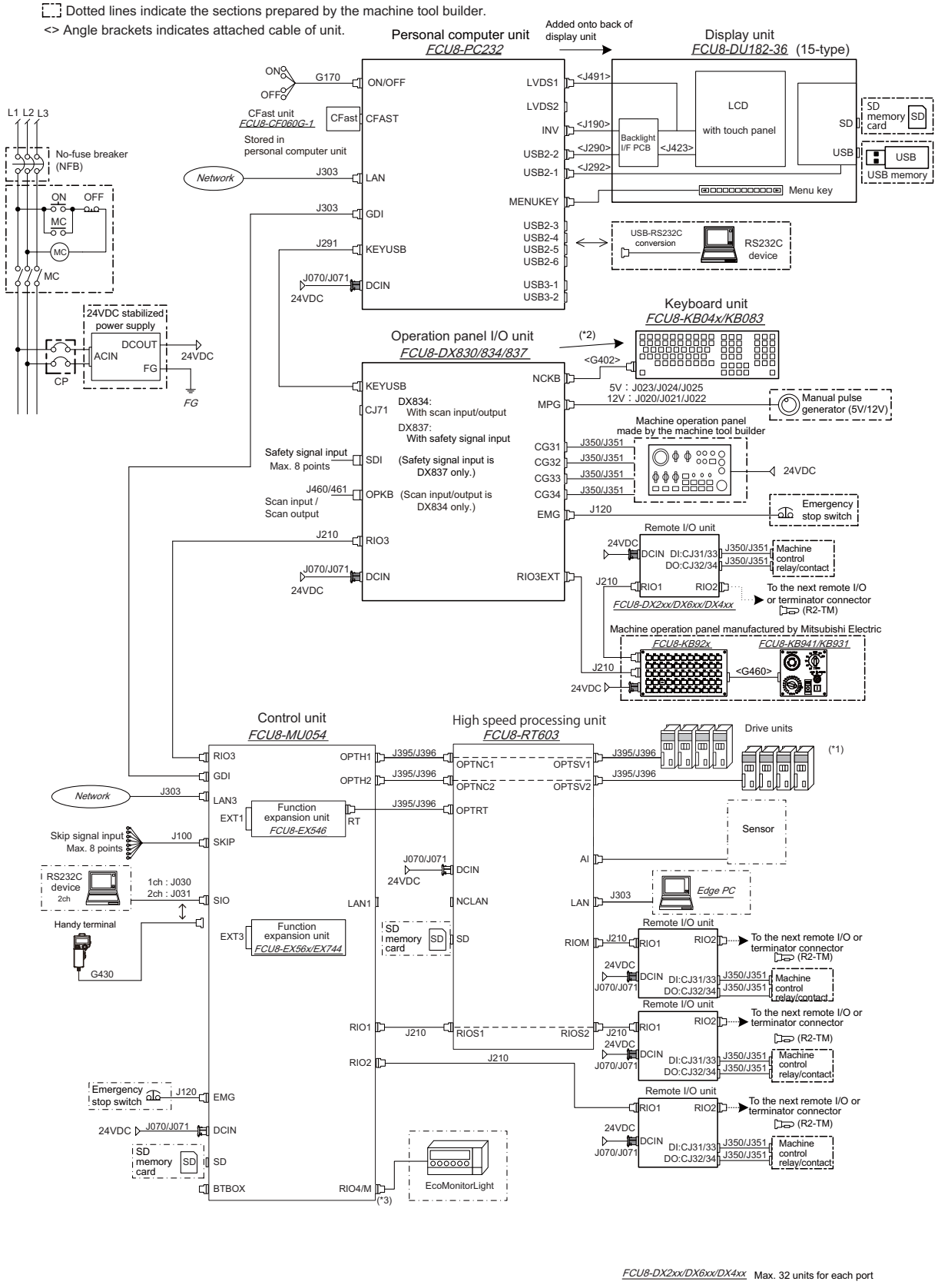
2.1.1 General Connection Diagram of High Speed Processing Unit (M800VW Connection)



(*1) For details on the connection of drive units, refer to the instruction manual of the drive units.

(*2) When using a keyboard unit, install the operation panel I/O unit on the back of the keyboard unit.

2.1.2 General Connection Diagram of High Speed Processing Unit (M80VW Connection)



(*1) For details on the connection of drive units, refer to the instruction manual of the drive units.

(*2) When using a keyboard unit, install the operation panel I/O unit on the back of the keyboard unit.

2.2 List of Configuration

2.2.1 Module Configuration List

Classification	Type	Components	Remarks
[IoT unit]			
High speed processing unit	FCU8-RT603	Main CPU card 7SEG card SDHC: 1 channel Back panel card Unit lid (resin molded article) etc.	This unit is not compliant with either the Export Trade Control Order or Foreign Exchange Order.

2.2.2 Cable List

Type	Application	Available cable length (m)	Max. cable length	Connectors
J070 LxM	24VDC power cable	1, 2, 3, 5, 7, 10, 15	15 m	DCIN
J071 LxM	24VDC power cable (for long distance)	20	20 m	
J210 LxM	Remote I/O 2.0 communication cable	0.3, 1, 2, 3, 5, 7, 10, 15, 20, 30	50 m (*)	RIOM/RIOS1/RIOS2
J303 LxM	LAN straight cable	1, 2, 3, 5, 7, 10, 15, 20, 30	50 m	NCLAN/LAN
J395 LxM	Optical communication cable For wiring between drive units (outside panel) For wiring between NC and drive unit	3, 5, 7, 10	10 m	OPT NC1/OPT SV1/OPT NC2/ OPT SV2/OPT RT
J396 LxM	Optical communication cable For wiring between drive units (inside panel)	0.2, 0.3, 0.5, 1, 2, 3, 5	5 m	
G380 LxM	Optical communication cable (PCF type, with sheath) (for wiring outside panel)	5, 10, 12, 15, 20, 25, 30	30 m	

Note

(1) "x" in the "Type" column indicates cable length (unit: m).

(2) Lengths indicated with an asterisk (*) in the "Max. cable length" column indicate the maximum cable length when connecting via another unit.

2.3 General Specifications

2.3.1 Environment Conditions (Environment Conditions Inside the Operation Panel)

Unit name			High speed processing unit
Unit type			FCU8-RT603
General specifications	Ambient temperature	During operation	0 °C to 55°C
		During storage	-20 °C to 60 °C
	Ambient humidity	Long term	10 to 75% RH (with no dew condensation)
		Short term (*1)	10 to 95% RH (with no dew condensation)
	Vibration resistance		4.9 m/s^2 or less
	Shock resistance		29.4 m/s^2 or less
	Working atmosphere		No corrosive gases, dust or oil mist
	Altitude		Operation/Storage: 1,000 meters or less above sea level Transportation: 13,000 meters or less above sea level (*2)
Power supply voltage			24 VDC
Current consumption (max)			1.6 A
Instantaneous power interruption tolerance			25 ms or more
Maximum heating value (W)			38.4 (W)
Mass			1.2 kg
Outline dimension			60 mm (W) × 180 mm (D) × 380 mm (H)

(*1) Short term means within one month.

(*2) 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.

2.3.2 24 VDC Stabilized Power Supply Selecting Conditions

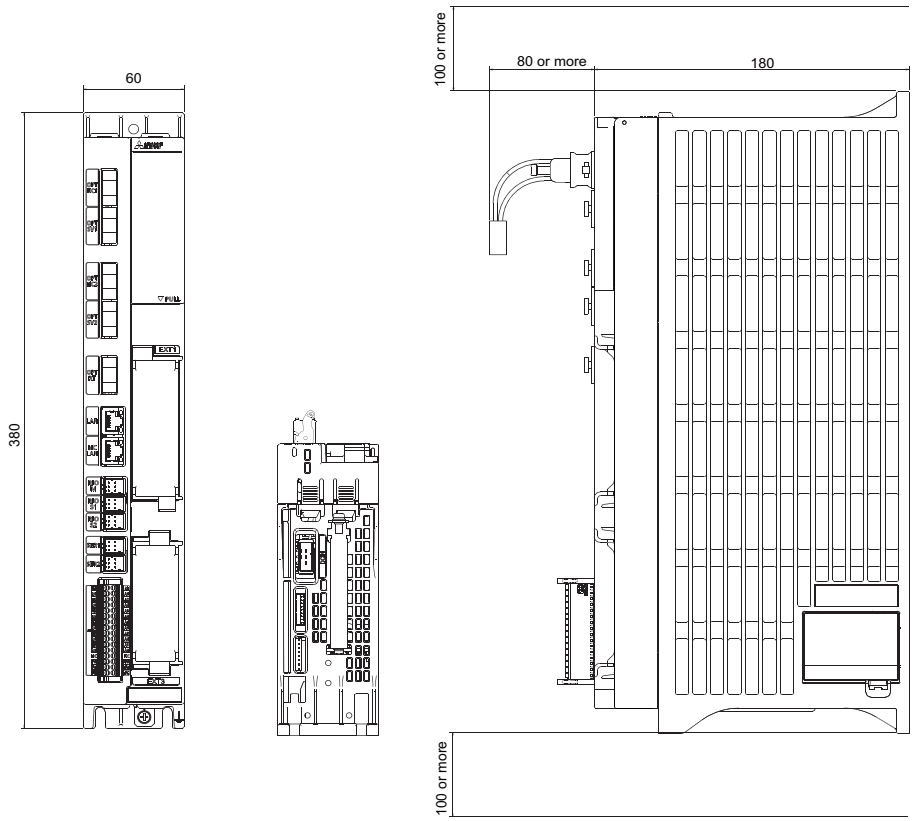
Considering the following characteristics for the stabilized power supply, select a power supply that complies with laws, regulations, and safety standards of the country where the machine will be installed.

Item		Specifications	Remarks
Output	Voltage	24 VDC	When the stabilized power supply and 24 VDC input unit are distant from each other, select a stabilized power supply for which an output voltage of 24 VDC or more can be set to allow for the influence of a voltage drop due to the cable.
	Voltage fluctuation	±5%	
	Current	-	Calculate the current value by referring to the maximum current consumption for the unit which uses the power supply.
	Ripple noise	0.2 V (P-P)	
	Output holding time	min 20 ms	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.

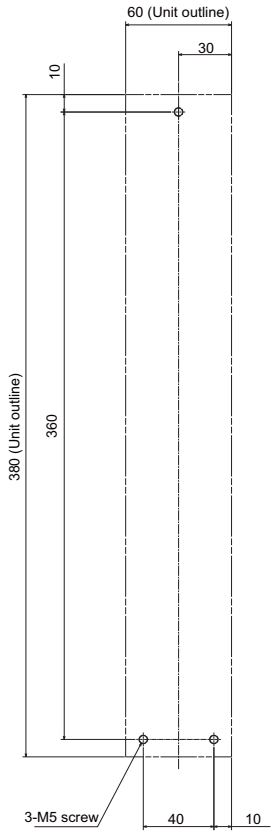
⚠ CAUTION

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

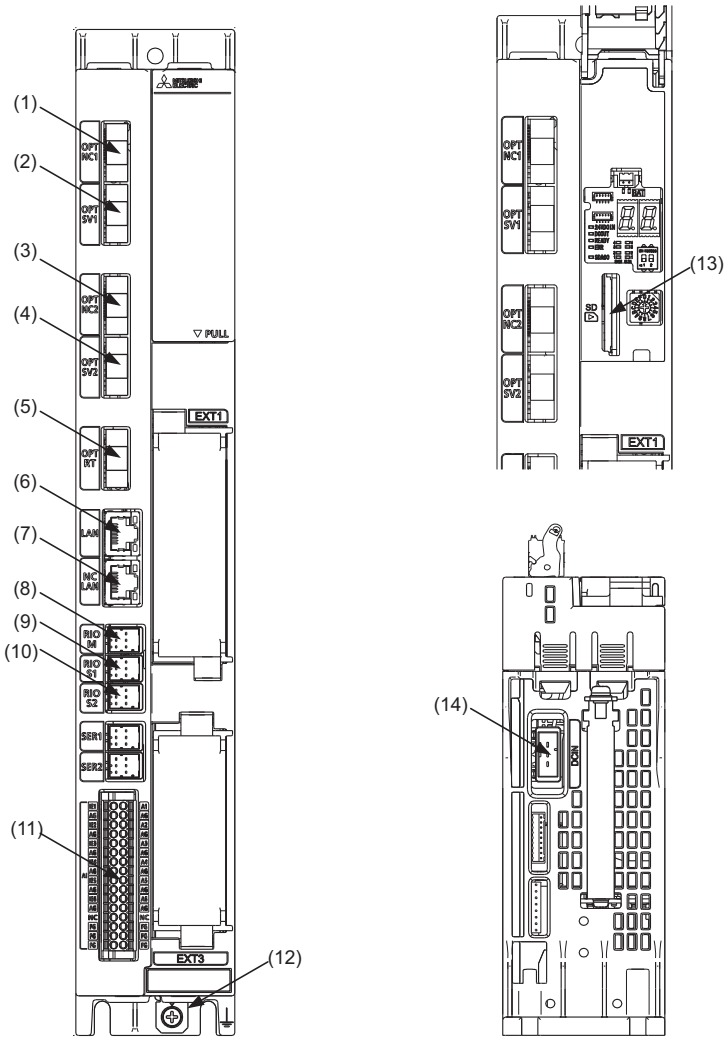
2.3.3 Outline dimensions



2.3.4 Installation dimensions



2.3.5 Connector



No.	Connector name	Function
(1)	OPT NC1	For high-speed optical servo communication connection (to NC control unit)
(2)	OPT SV1	For high-speed optical servo communication connection (to drive unit)
(3)	OPT NC2	For high-speed optical servo communication connection (to NC control unit)
(4)	OPT SV2	For high-speed optical servo communication connection (to drive unit)
(5)	OPT RT	For high-speed communication (to NC control unit)
(6)	LAN	Ethernet communication
(7)	NCLAN	Ethernet communication
(8)	RIOM	Remote I/O communication (master)
(9)	RIOS1	Remote I/O communication (local)
(10)	RIOS2	Remote I/O communication (local)
(11)	AI	Analog input 6 channels IEPE input 6 channels
(12)	FG	FG terminal
(13)	SD	SD card I/F
(14)	DCIN	24 VDC input

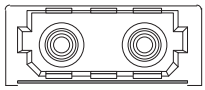
(1) OPT NC1 (for high-speed optical servo communication connection (to NC control unit))

(2) OPT SV1 (for high-speed optical servo communication connection (to drive unit))

(3) OPT NC2 (for high-speed optical servo communication connection (to NC control unit))

(4) OPT SV2 (for high-speed optical servo communication connection (to drive unit))

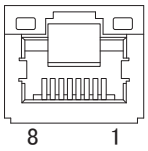
(5) OPT RT (for high-speed communication (to NC control unit))



<Cable side connector type>
Connector: LGP-Z0007K
Manufacturer: HONDA TSUSHIN KOGYO

(6) LAN (Ethernet communication)

(7) NCLAN (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-

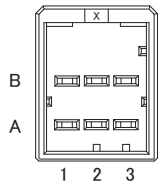
- Connect connector case with FG pattern.

<Cable side connector type>
Connector: J00026A0165
Manufacturer: Japan Telegärtner

(8) RIOM (remote I/O communication (master))

(9) RIOS1 (remote I/O communication (local))

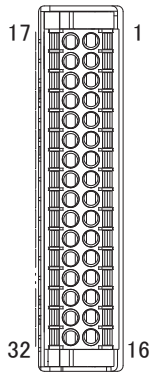
(10) RIOS2 (remote I/O communication (local))



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

<Cable side connector type>
Connector: 1-1318119-3
Contact: 1318107-1
Manufacturer: Tyco Electronics

(11) AI (analog input 6 channels/IEPE input 6 channels)



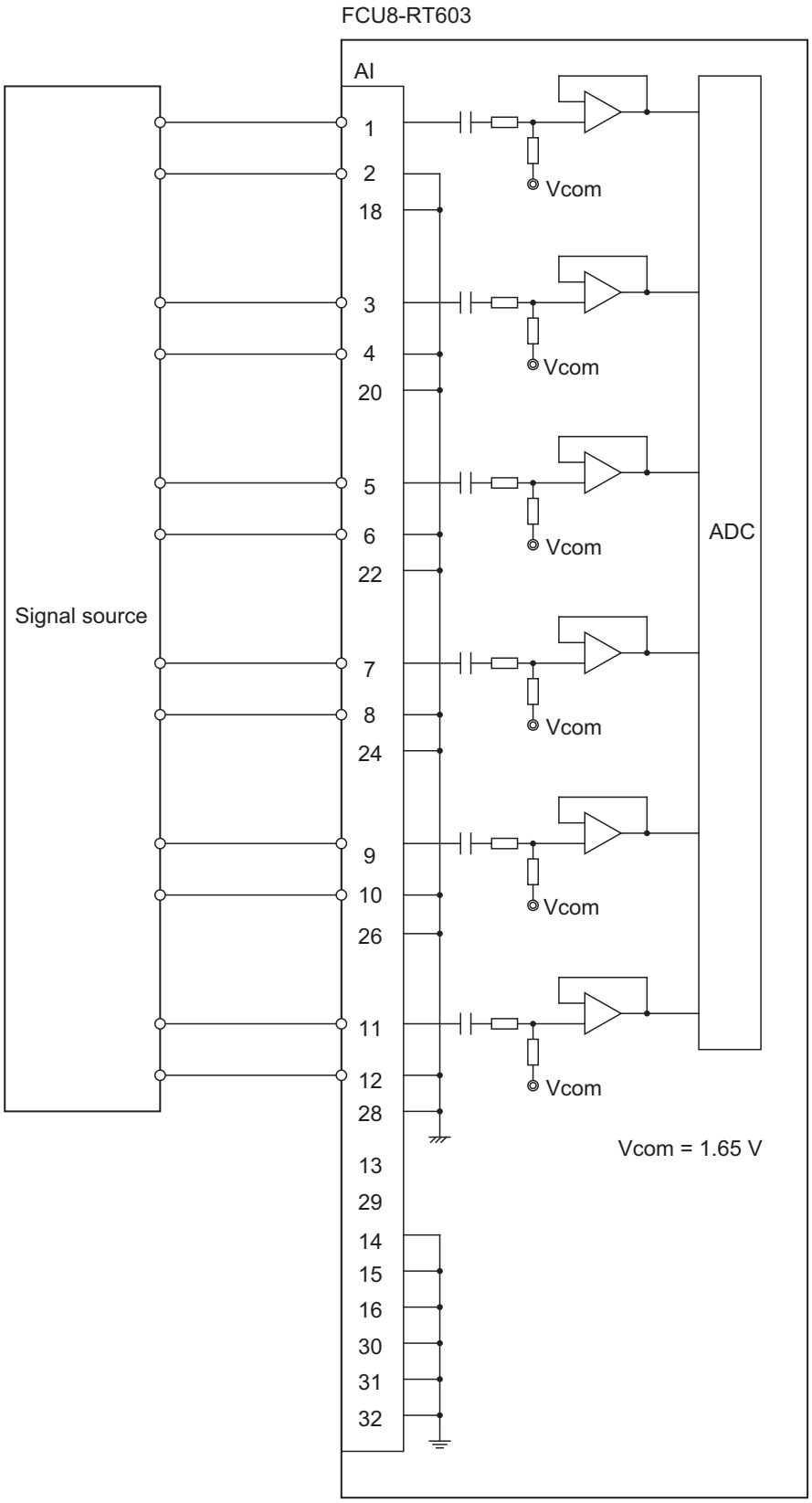
No.	Signal name	I/O	Supplement	No.	Signal name	I/O	Supplement
1	A1	I	Channel 1 general-purpose analog input	17	IE1	I	Channel 1 IEPE connection
2	AG	-	Analog ground	18	AG	-	Analog ground
3	A2	I	Channel 2 general-purpose analog input	19	IE2	I	Channel 2 IEPE connection
4	AG	-	Analog ground	20	AG	-	Analog ground
5	A3	I	Channel 3 general-purpose analog input	21	IE3	I	Channel 3 IEPE connection
6	AG	-	Analog ground	22	AG	-	Analog ground
7	A4	I	Channel 4 general-purpose analog input	23	IE4	I	Channel 4 IEPE connection
8	AG	-	Analog ground	24	AG	-	Analog ground
9	A5	I	Channel 5 general-purpose analog input	25	IE5	I	Channel 5 IEPE connection
10	AG	-	Analog ground	26	AG	-	Analog ground
11	A6	I	Channel 6 general-purpose analog input	27	IE6	I	Channel 6 IEPE connection
12	AG	-	Analog ground	28	AG	-	Analog ground
13	NC	-	Not used	29	NC	-	Not used
14	FG	-	FG (shield)	30	FG	-	FG (shield)
15	FG	-	FG (shield)	31	FG	-	FG (shield)
16	FG	-	FG (shield)	32	FG	-	FG (shield)

- Switching between the general-purpose analog input mode and IEPE sensor input mode is possible for each channel.
- The cable side connector is provided as an accessory of the unit.
- Screw-fastening type connector is recommended.
- Easy lock release type connector is distributed; however, using this type of connector could result in a connection fault if there is a lot of vibration.

<Cable side connector type>
Connector: DFMC1.5/8-STF-3.5 (Standard module)
Manufacturer: Phoenix Contact

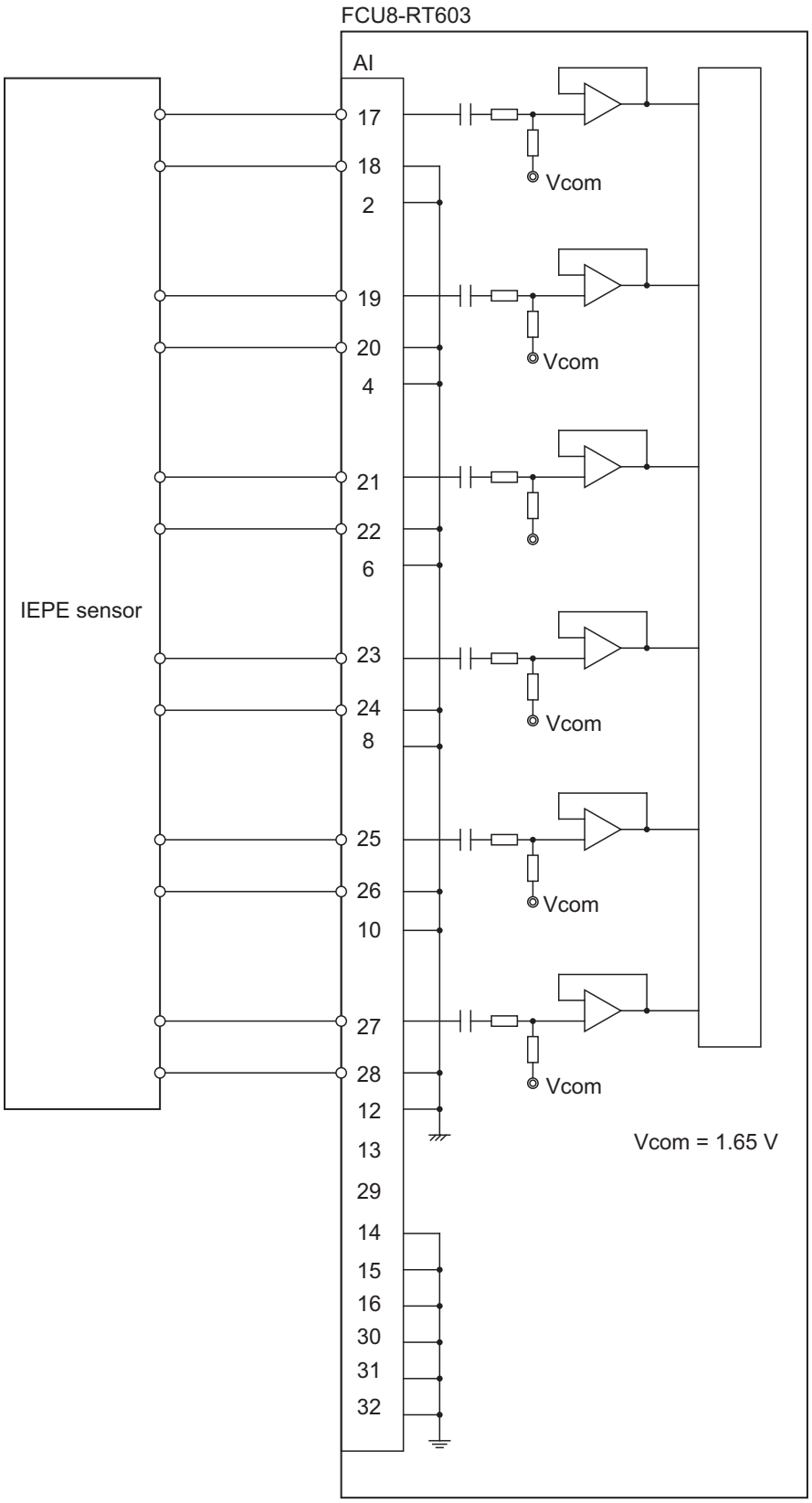
[General-purpose analog input mode]

A shielded twisted pair cable is recommended. To improve the noise resistance, connect the cable shield to the FG terminal of each of the high speed processing unit and the other device. The cable needs to be prepared by MTB.



[IEPE sensor input mode]

A shielded twisted pair cable is recommended. To improve the noise resistance, connect the cable shield to the FG terminal of each of the high speed processing unit and the other device. The cable needs to be prepared by MTB.



[General-purpose analog input interface and IEPE sensor input interface specifications]

Item	General-purpose analog input	IEPE sensor input
Number of input channels	6 channels	
Sampling rate	ADC device: 112.5 kSPS User data: 56.25 kSPS	
Input voltage range	-10 to +10 VDC	0 to 20 VDC (bias 7 to 13 VDC)
Resolution	ADC device resolution: 24 bits Resolution available to user: 16 bits	
Noise-free resolution	12 bits or more	
Conversion accuracy	±1%/FS (0 °C to 60 °C)	
LPF cutoff (-3dB)	20 kHz or more	
HPF cutoff (-3dB)	-	0.5 Hz or less
Insulation/non-insulation between channels	Non-insulation	
Excitation voltage	-	20.7 V ±1 V
Disconnection detection	-	18 V or greater
Short-circuit detection	-	2 V or less
Constant current output	-	2 to 10 mA (1 mA increments) Allowable error ±0.5 mA

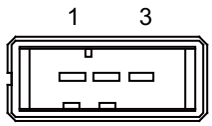
Note

- Do not connect a device other than that which supports IEPE to the IEPE sensor input terminals because the specifications are designed so that a constant current is output from the same terminals. The connected device may be damaged by the output current.
- Connect a sensor that operates with an excitation voltage of 20 V or less. A sensor that requires an excitation voltage of greater than 20 V will not operate properly even if it is connected.
- The constant current output terminal is common to the signal input terminal of an IEPE compatible sensor.
- The settings of the current values are common with channels 1 to 3 and common with channels 4 to 6.
- The initial setting value for constant current output is 4 mA. If an overcurrent flows to the sensor, the sensor will generate abnormal heat internally and may even be damaged in the worst case. Check the specifications of the sensor in advance of setting the current value.

(12) FG (FG terminal)

(13) SD (SD card I/F)

(14) DCIN (24 VDC input)



1	I	+24V
2		0 V
3		FG

<Cable side connector type>
Connector: 2-178288-3
Contact: 1-175218-5
Manufacturer: Tyco Electronics

2.3.6 Exclusive SD Cards

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

(*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) and TLC (Triple Level Cell), which are commonly applied to SD cards.

Note

(1) 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.

2.3.6.1 SD Interface

Standards	SD/SDHC (*1)
Transfer speed	Depends on the connecting SD card
Maximum capacity	32 GB
Number of free ports	1

(*1) SDXC is not supported.

■ Precautions for use of commercially available SD card

Mitsubishi Electric will not provide performance guarantee and maintenance for commercially available SD card, mini SD card or micro SD card (requires converting adapter). When any of them is to be used, careful performance check must be required by the machine tool builder.
Commercially available devices may not be compatible with Mitsubishi Electric units or suitable FA environment for temperature- or noise-wise.

■ Precautions for insertion/removal of SD card

When inserting/removing an SD card, turn the Mitsubishi Electric 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 Electric will not guarantee the broken or lost data.

■ Static electricity

Static electricity may cause malfunction of SD card. Before using the SD card, make sure to touch a conductive material such as a grounded metal object to discharge the static electricity accumulated in your body, etc.

2.4 Installation

2.4.1 Heat Radiation Countermeasures

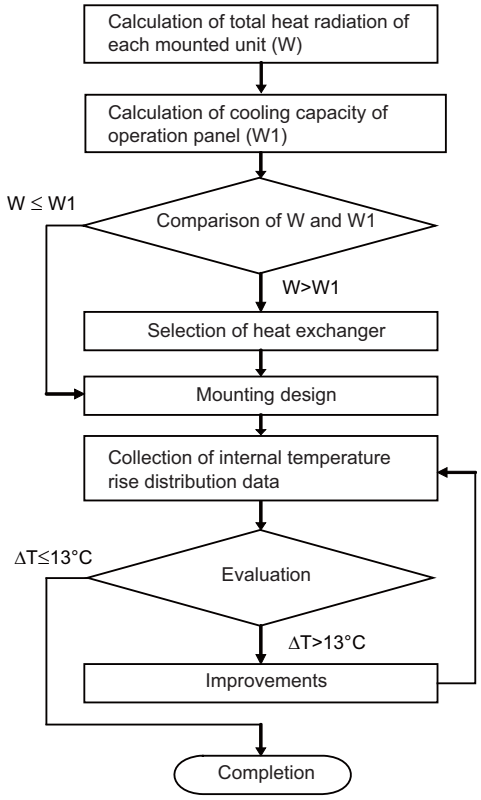
Please refer to the following method for heat radiation countermeasures.
The high speed processing unit can be installed inside the operation panel or the electric cabinet.
When the unit is to be installed inside the operation panel, follow the procedures of heat radiation countermeasures.

Example of heat radiation countermeasures

■ Hypothetical conditions

- Average internal temperature of operation panel: T ≤ 58 °C
- Peripheral temperature of operation panel: Ta ≤ 0 °C to 45 °C
- Internal temperature rise value: ΔT = T - Ta (max) = 13 °C

[Procedures for heat design and verification]



[Supporting description]

- Refer to "2.3 General Specifications" for the heat generated by each unit.
- Enclosed cabinet (thin steel plate) cooling capacity (W1) 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)

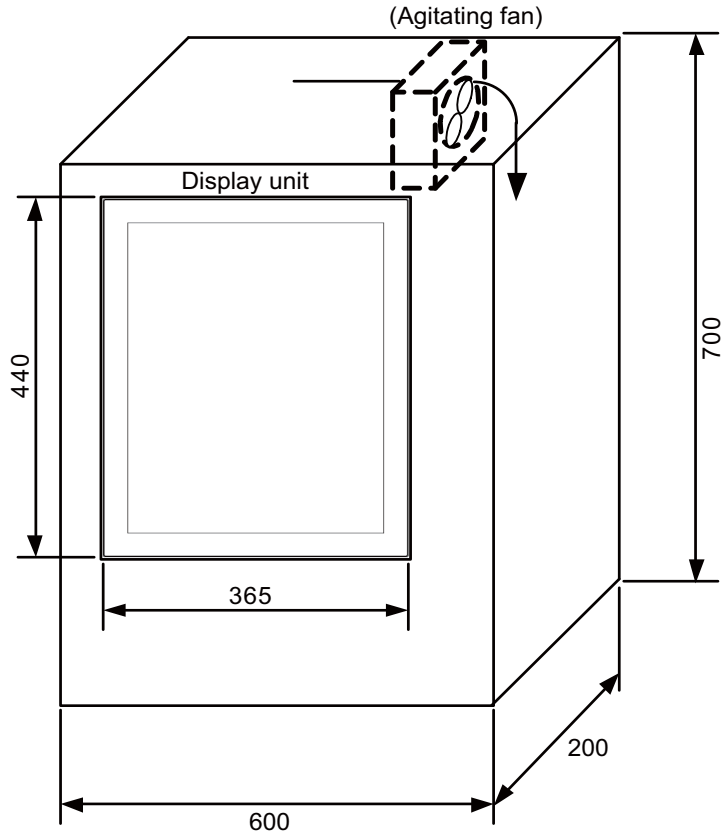
Note

(1) 8 W/m^2 °C can be applied only when the operation panel is so small that the internal temperature stays uniform.

- 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.

- Criterion for internal temperature rise distribution data
  ΔT (average) ≤ 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 19-type display unit is used. Because heat accumulates in the upper portions of the unit, install an agitating fan as required.



Calculation example of panel internal heating value

[Calculation of unit heating value (In the case of FCU8-DU193-75 + FCU8-PC232 + FCU8-DX837)]

<Heating value (W)>

Total heating value of units (W): 60 W

This is the total of the heating values of display unit, personal computer unit and operation panel I/O unit.

Total heating value (W) by machine input (DI): 9.2 W

The current consumption per point of the operation panel I/O unit DI is as follows.

24 V / 5 kΩ ≈ 4.8 mA

The total heating value when 80 points are simultaneously turned ON is as follows.

24 V x 4.8 mA x 80 ≈ 9.2 W

Total heating value (W): 69.2 W (60 W + 9.2 W)

[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

$$= 1.079\ mm^2 \quad (\approx \underset{(1)}{(0.6 \times 0.2)} + \underset{(2)}{(0.7 \times 0.6 \times 2)} + \underset{(3)}{(0.7 \times 0.2 \times 2)} - \underset{(4)}{(0.44 \times 0.365)})$$

(1) Top surface
(2) Front/rear surfaces
(3) Side surfaces
(4) Unit surfaces

<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 = 84.2W (6 × A × ΔT)

[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.

[Confirmation with actual machine]

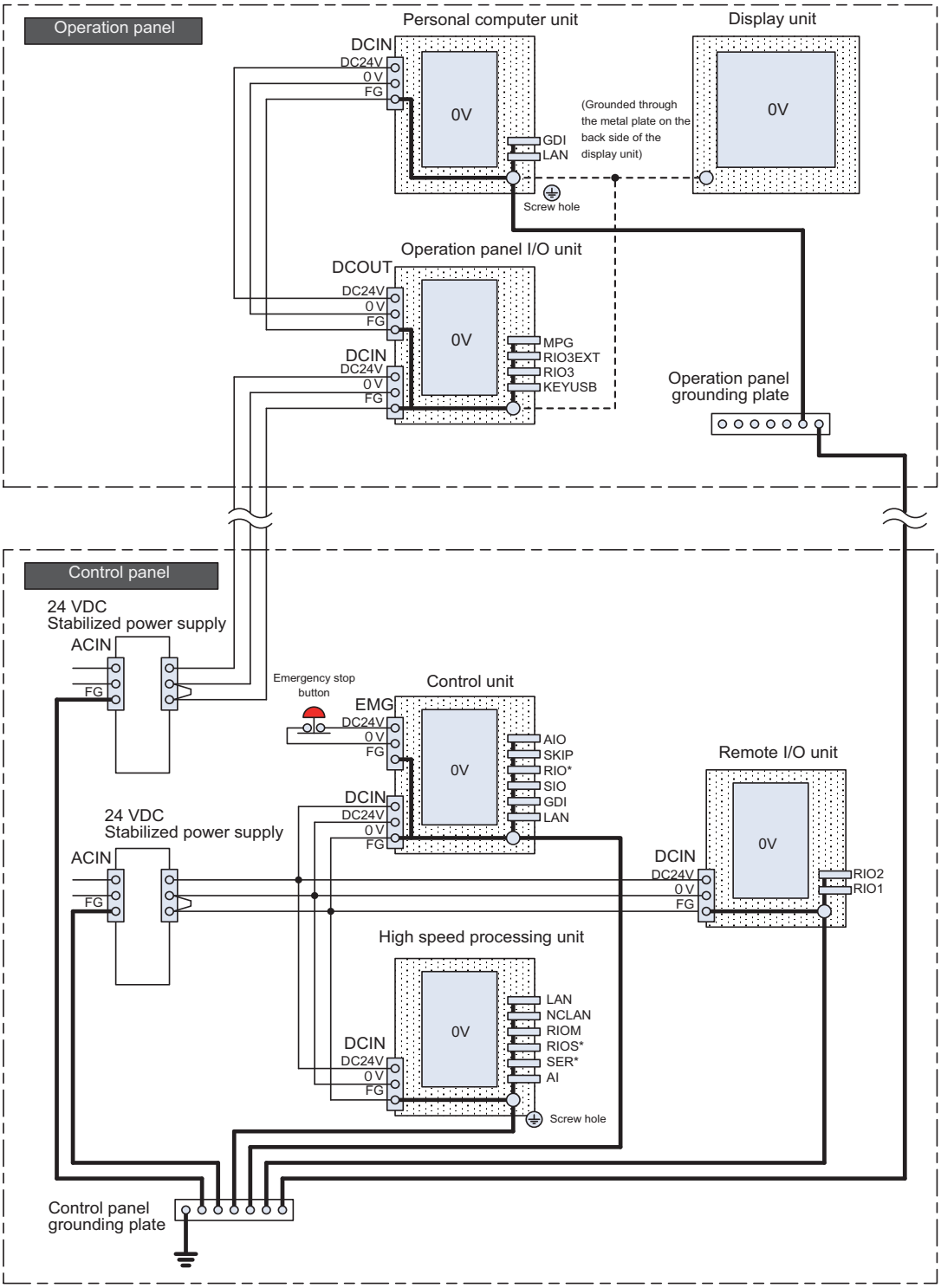
The result of the calculation above is only a rough indication. The actual temperature rise may differ according to the structure of the operation panel.

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.

2.4.2 Noise Countermeasures

2.4.2.1 Connection of Frame Ground (FG)

The frame should basically be grounded at one ground point.
Because the personal computer unit and the operation panel I/O unit are located in a place away from the electric cabinet, connect the ground terminal of the personal computer to the grounding plate of the operation section and connect the grounding plate of the operation panel to the grounding plate of the electric cabinet. (Be sure to ground the ground terminal of the personal computer. Otherwise, it affects controllability of the touchscreen.)
Connect 0 V (common) and FG on the 24 VDC power supply.

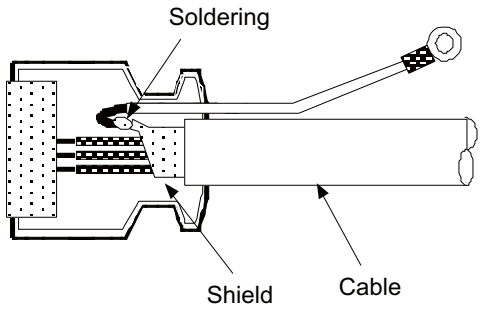


: Indicates that the metal case of connector is connected to FG ⏚ according to the pattern on PCB.

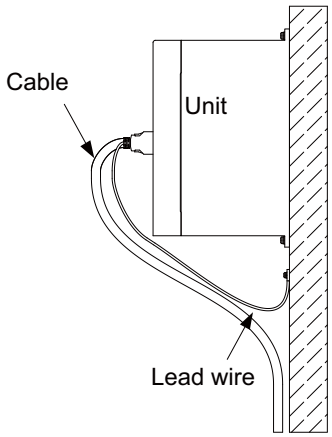
2.4.2.2 Shield Clamping of Cables

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 fix the shield cable.

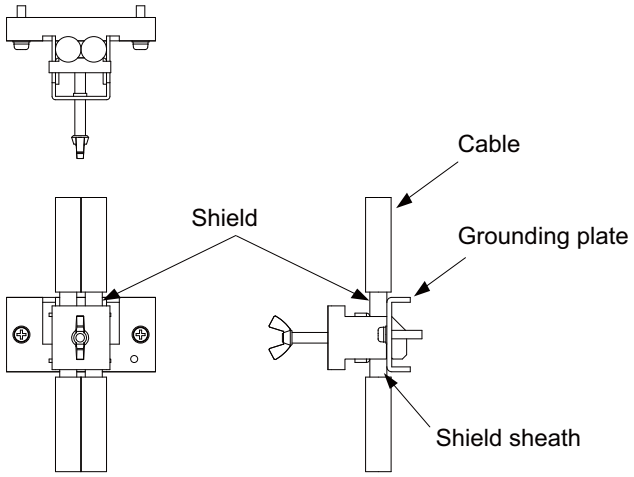
■ Example of connection with lead wire

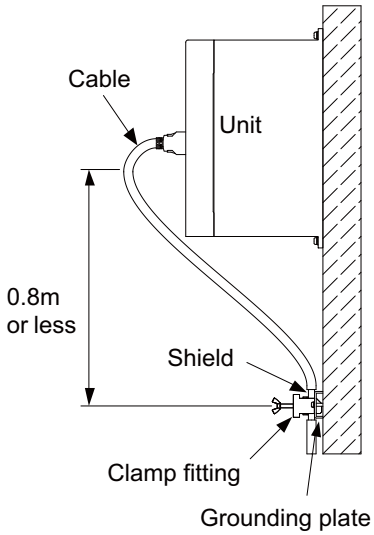


Example of lead wire treatment



■ Example of connection with clamp fitting

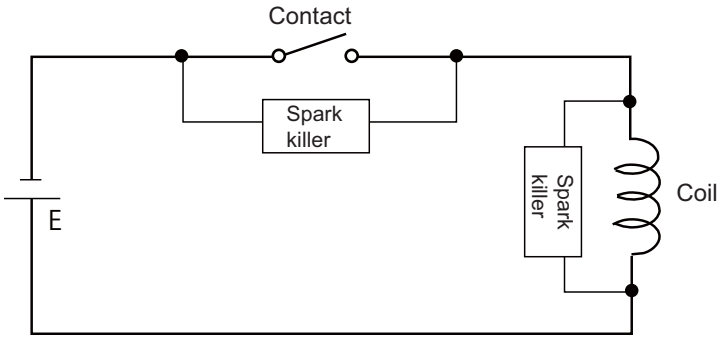




- Peel part of the cable sheath and expose the shield as shown in the drawing. Press the exposed part against the grounding plate with the cable clamp fittings.
- If the cables are thin, several can be bundled and clamped together.
- Use adequate force when tightening the cable so that the wire material is not damaged.
- Connect each grounding plate together and ground them at one point.

2.4.2.3 Connecting Spark Killers

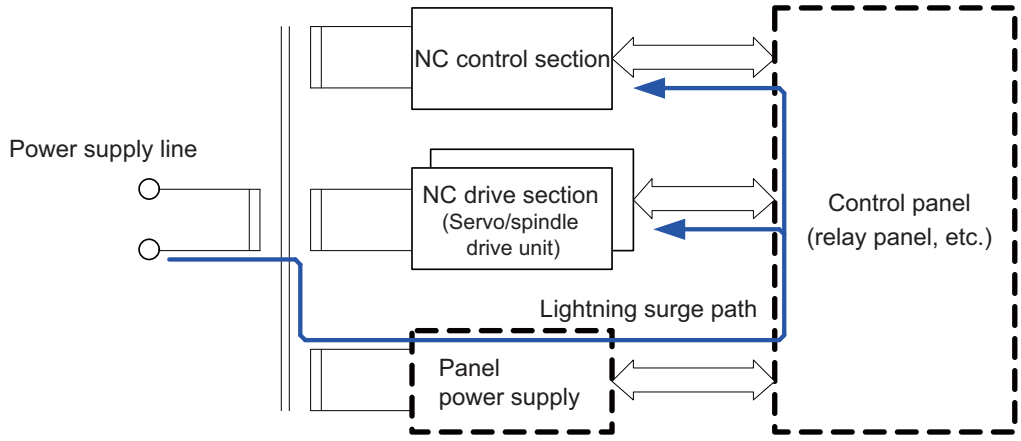
The noise which is generated during the operation of the coil or contact needs to be eliminated.
Connect the spark killers (CR composite element) in parallel with the coil and the contact for the countermeasure.
The Spark killer is effective in eliminating the noise generated by electromagnetic induction.



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

2.4.2.4 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 a lightning surge, the Mitsubishi Electric NC unit has a surge absorber for the control power supply of the NC control section and NC drive section.
However, when there is a device without the countermeasure illustrated below implemented, a lightning surge may intrude through the signal line of the device and may damage the NC device.

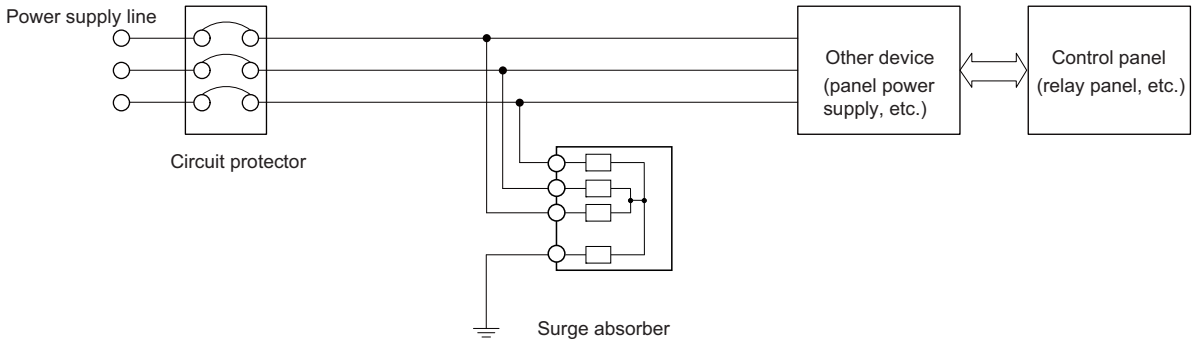


Path of damage caused by lightning surge

■ Protection 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 entire system from a surge.

- Surge absorber installation
- Circuit protector installation



Lightning surge countermeasure for three-phase power supply line

■ Product example of surge absorber

Surge absorber for OKAYA ELECTRIC INDUSTRIES

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

Note

(1) Refer to "14.6.3 Surge Absorber" for outline dimensions, etc.
Refer to the manufacturer catalog for detailed characteristics, outline and connection methods of the surge absorber.

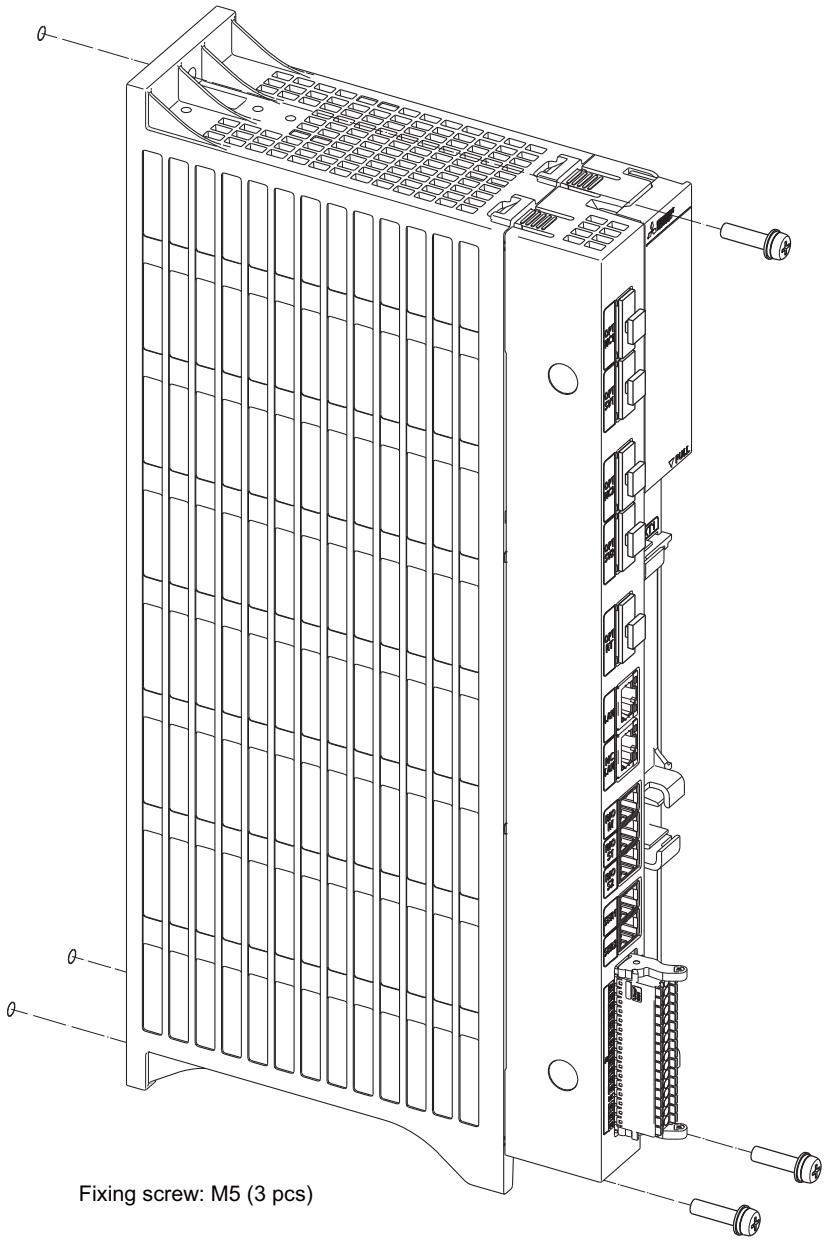
2.4.3 Unit Installation

Mount the high speed processing unit with the prescribed number of fixing screws.

Note

(1) Refer to "2.3 General Specifications" for the installation dimensions and screw hole positions.

FCU8-RT603



Fixing screw: M5 (3 pcs)

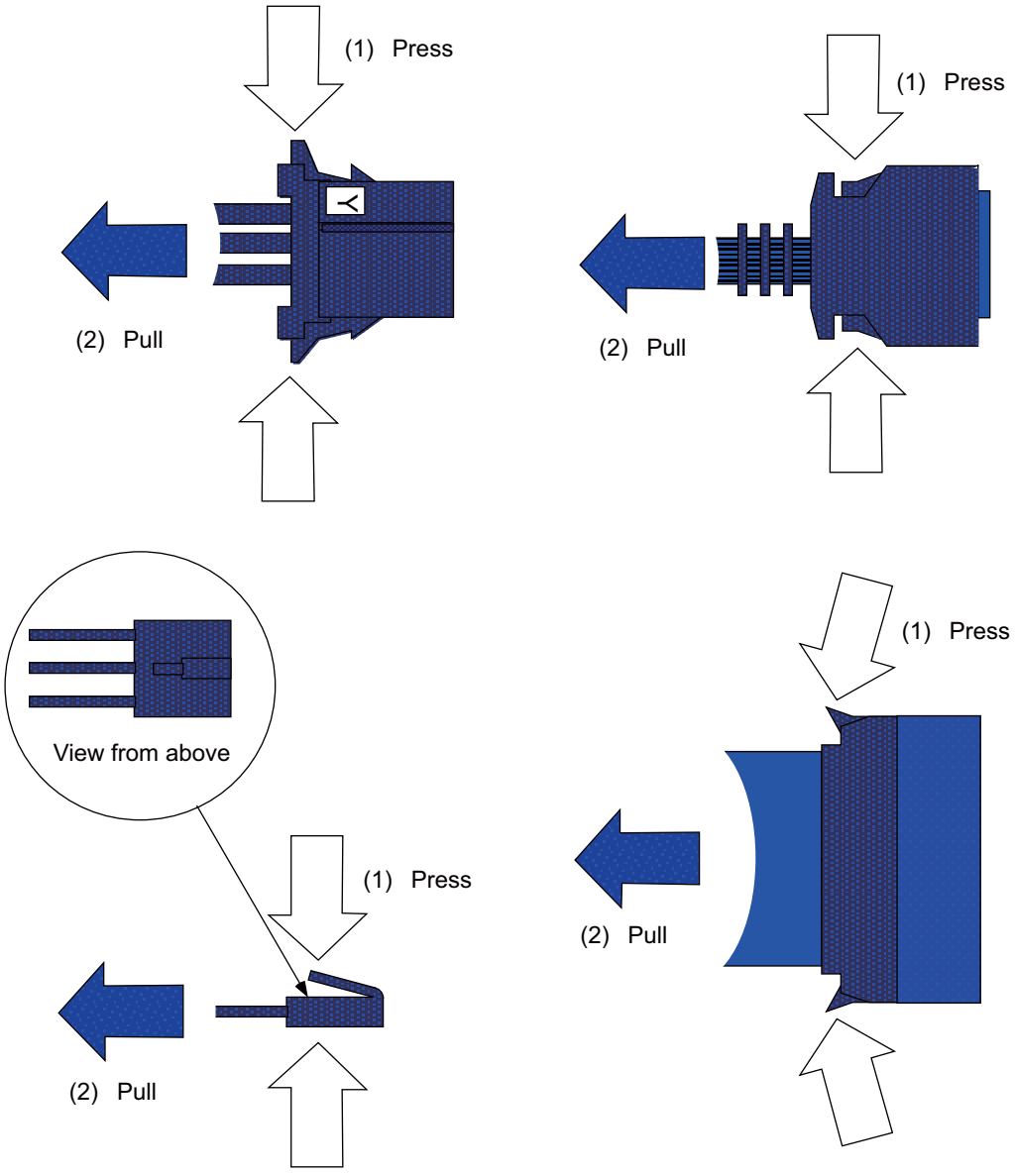
2.5 Precautions for Connecting

2.5.1 Precautions for Wiring

2.5.1.1 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 types of connector, pull the connector out while pressing the tabs with a thumb and forefinger in the directions of the arrows.

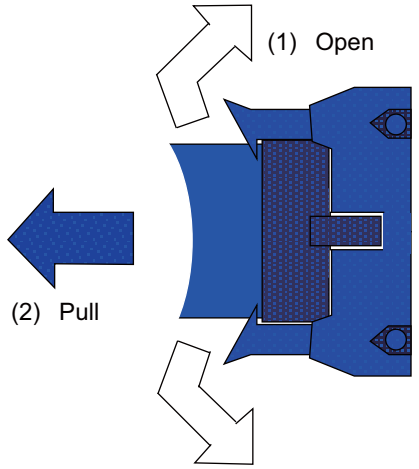


⚠ CAUTION

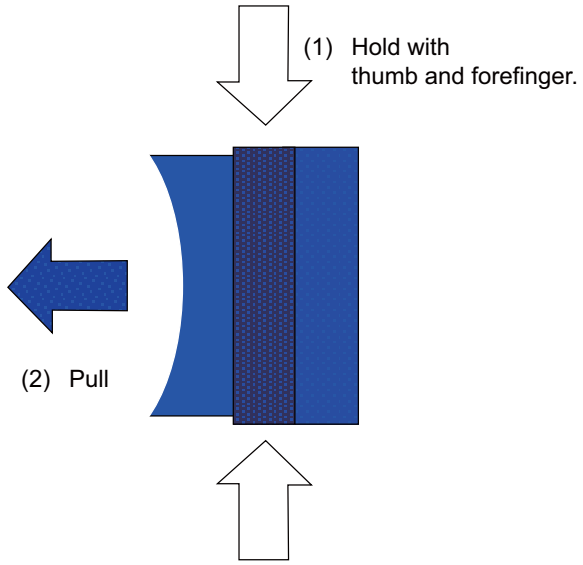
(1) Do not connect or disconnect the cables between units while the power is ON.

(2) Do not pull on the cables when connecting/disconnecting them.

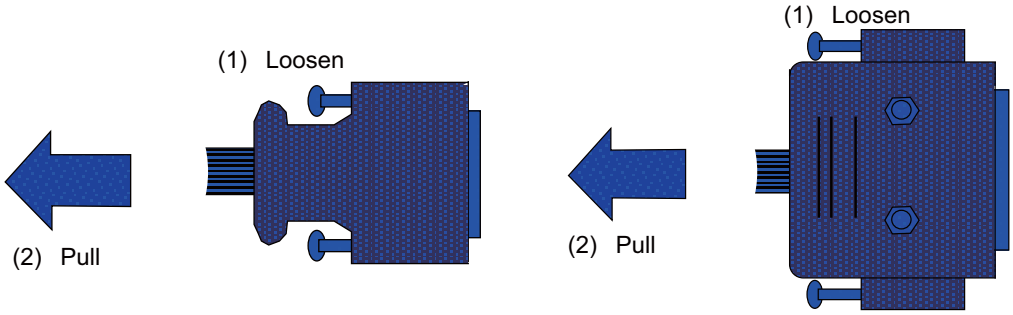
(b) For a flat cable type connector with latches, open the latches in the directions of the arrows, and pull the connector out.



(c) For a flat cable type connector without latches, hold the connector with a thumb and forefinger, and pull the connector out.



(d) For a screw fixed type connector, loosen the two fixing screws, and pull the connector out.

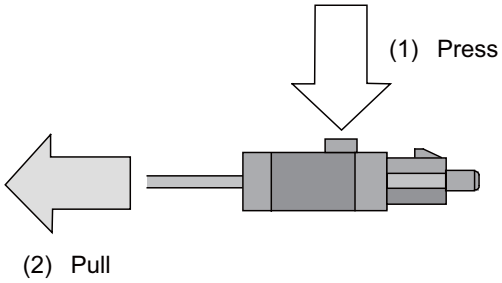


⚠ CAUTION

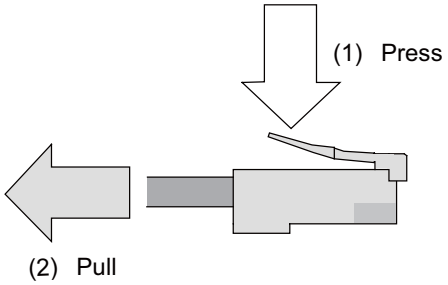
(1) Do not connect or disconnect the cables between units while the power is ON.

(2) Do not pull on the cables when connecting/disconnecting them.

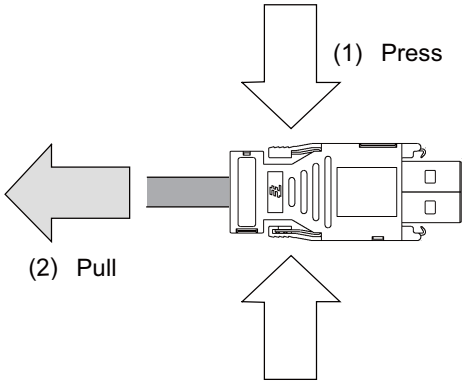
(e) For an optical cable connector, pull the connector out while pressing the lock button.



(f) For an Ethernet connector, pull the connector out while pressing the locking tab.



(g) For a USB connector, pull the connector out while pressing the locked latches.



⚠ CAUTION

(1) Do not connect or disconnect the cables between units while the power is ON.

(2) Do not pull on the cables when connecting/disconnecting them.

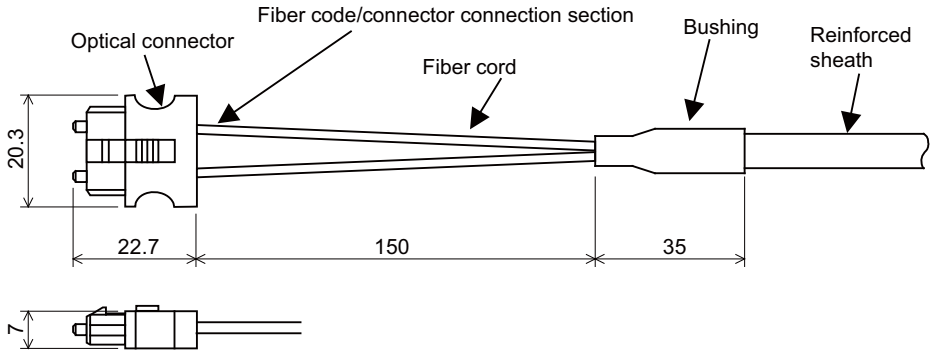
2.5.1.2 Precautions for Using Optical Communication Cable

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

(1) If the optical communication cable used is not Mitsubishi Electric's, trouble resulting from modifying the cable when disconnecting and connecting and malfunctions due to aging deterioration will not be covered under the warranty.

Optical communication cable outline and parts



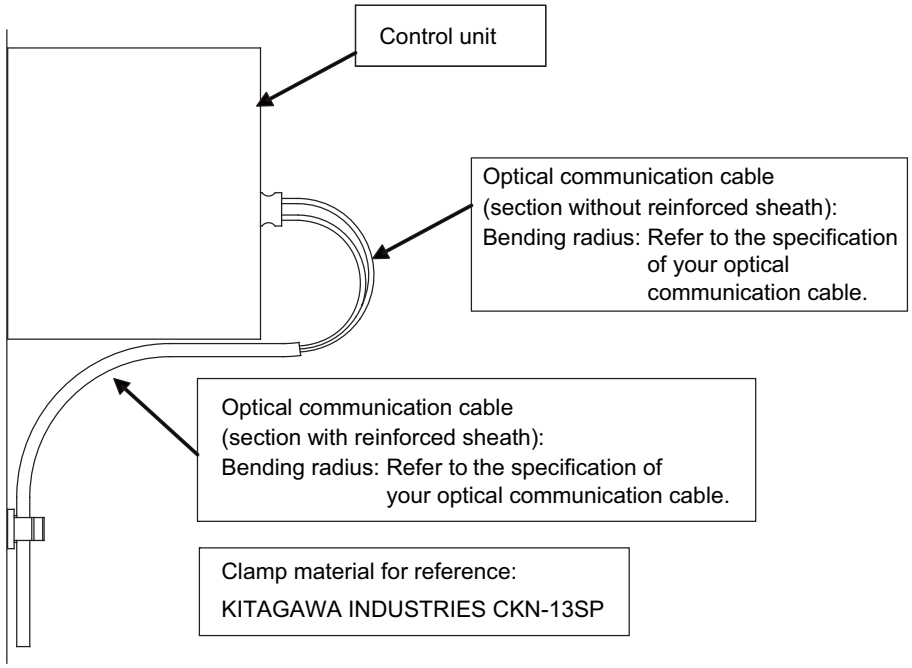
To ensure the system performance and reliability, purchase the optical communication cable from Mitsubishi Electric. A machining drawing is given in "Cable" as reference, but the purchased optical communication cable cannot be cut or connected by the machine tool builder.

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.

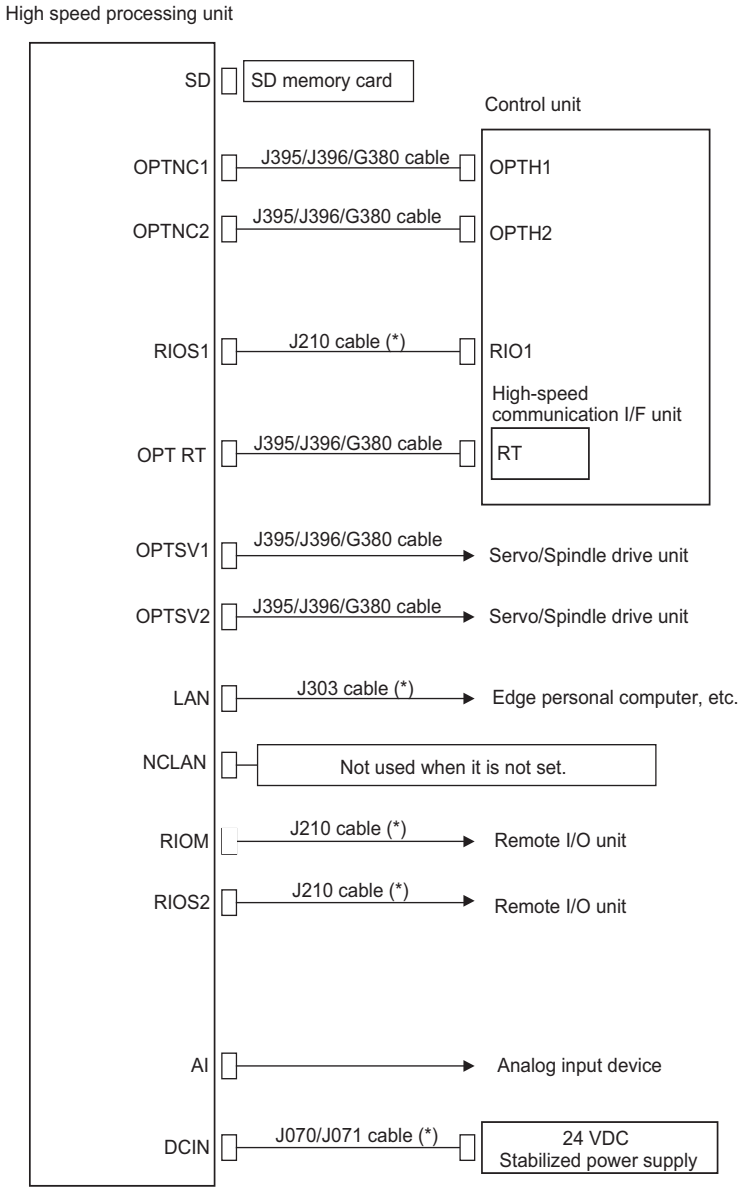


2.5.1.3 Precautions for Connecting 24 V Power Supply

(1) Note that when 24 V power is supplied to the unit, welding may occur on the contacts due to rush current under the following conditions.
- When 24 VDC power is directly controlled ON/OFF by a relay or other magnetic switch AND When heat capacity is low for the contacts of the magnetic switches used to control 24 VDC power

2.6 Connecting High Speed Processing Unit

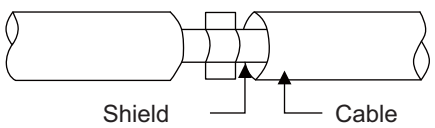
2.6.1 General Connection System Drawing



Note

(1) 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.



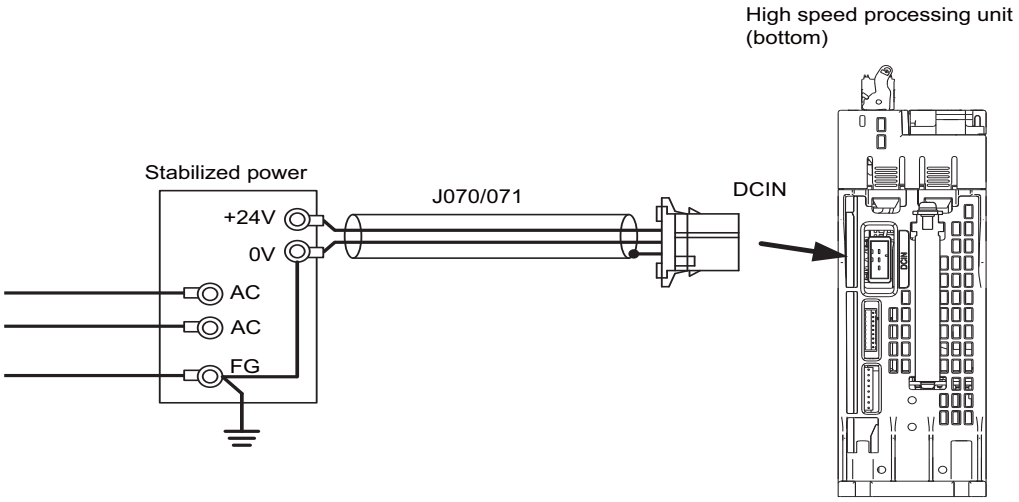
When you cannot use the shield clamp, install a ferrite core as a substitute.

<Related Items>

Shield Clamp Fittings: "14.6.1 Shield Clamp Fitting"

Ferrite Core: "14.6.2 Ferrite Core"

2.6.2 Connecting with Power Supply



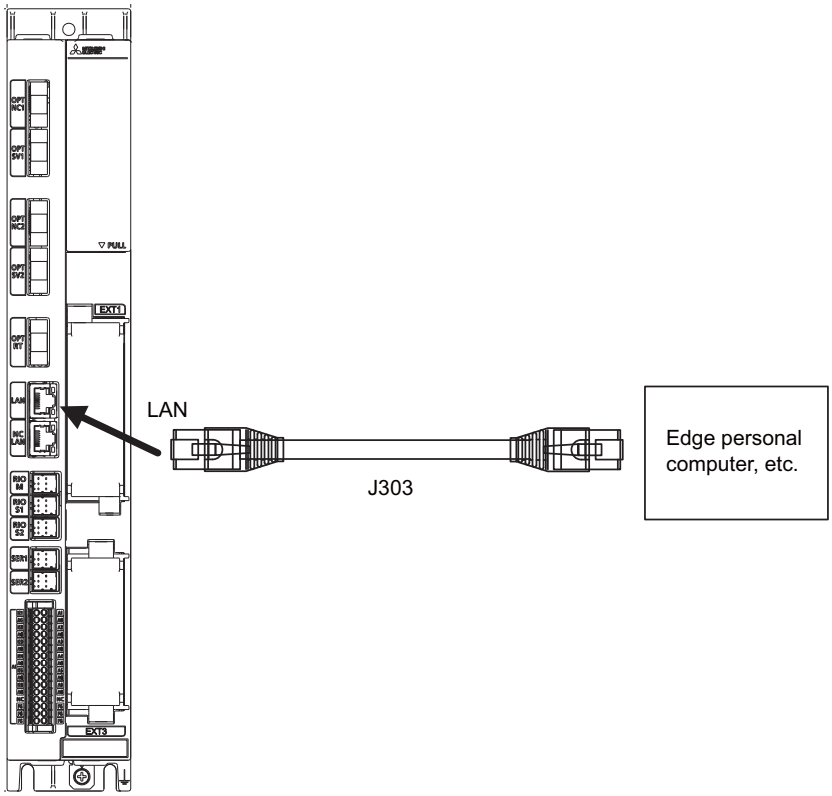
Note

(1) For noise countermeasure, short between 0 V and FG using connectors.
(2) Rush current may occur to lead welding on the contacts, when a magnetic switch such as relay directly controls 24 VDC ON/OFF during 24 V power supply to the control unit.
Use relay with large heat capacity of contacts to control 24 VDC ON/OFF.
(3) Turn ON the power of the high speed processing unit at the same timing as power is supplied to the drive units. If the high speed processing unit is powered ON after the NC control unit, optical servo communication may not be established.
(4) When custom module is written on the NC input/output screen, both the NC control unit and the high speed processing unit need to be restarted.
(5) For details on the process of turning the NC power ON/OFF, refer to "Connection and Setup Manual" of the NC you are using.

[Related items]
Cable connection drawing "2.7.1 J070/J071 Cable" (J070/J071 cable)
Connector pin assignment: "2.3.5 Connector" (DCIN connector)

2.6.3 Connecting with Host Device (Edge Computer)

High speed processing unit

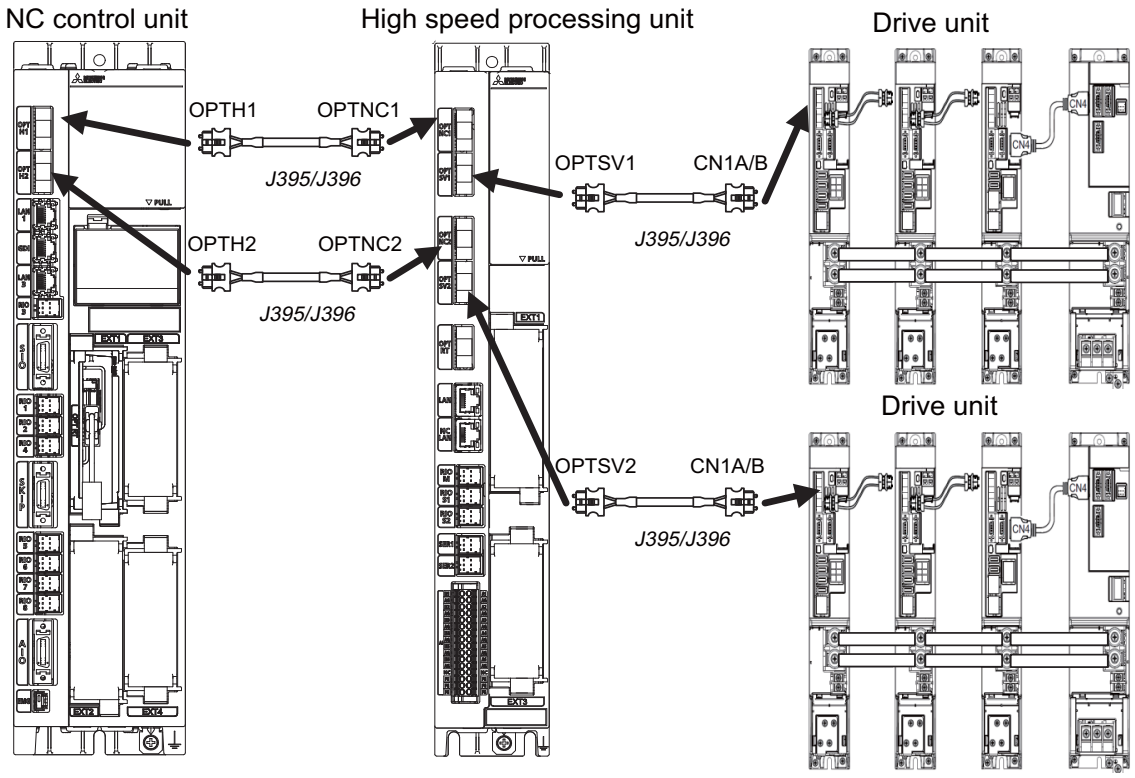


[Related items]

Cable connection drawing "2.7.3 J303 Cable" (J303 cable)

Connector pin assignment: "2.3.5 Connector" (LAN connector)

2.6.4 Connecting with NC Control Unit / Drive Unit



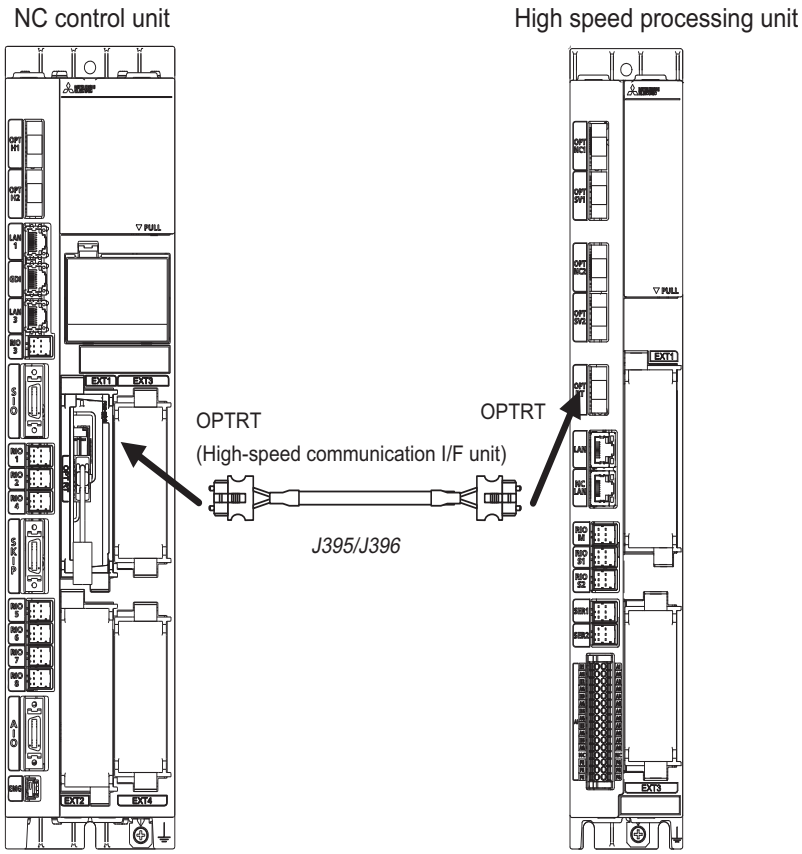
Note

(1) Wire the high speed processing unit so that it connects the NC control unit and drive unit.
(2) The optical communication cables from the NC to the final drive unit must be within 30 m.

[Related items]

Cable connection drawing "2.7.4 J395 Cable" and "2.7.5 J396 Cable" (J395/J396 cable)
Connector pin assignment: "2.3.5 Connector" (OPT NC1, OPT NC2, OPT SV1, OPT SV2)

2.6.5 High-speed Communication Connection with NC

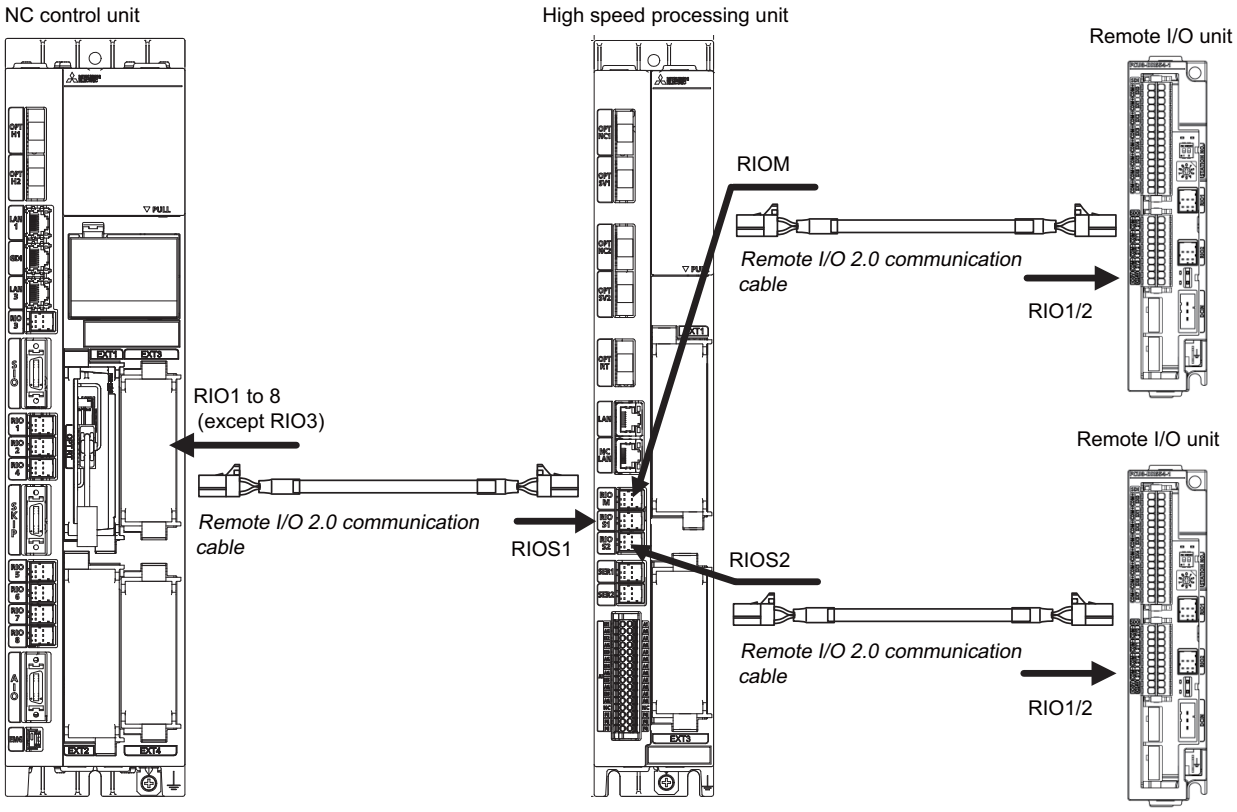


[Related items]

Cable connection drawing "2.7.4 J395 Cable" and "2.7.5 J396 Cable" (J395/J396 cable)

Connector pin assignment: "2.3.5 Connector" (OPT RT)

2.6.6 Connecting with NC Control Unit / Remote I/O Unit



The remote I/O unit can be connected to the connectors "RIOM" and "RIOS2" of the high speed processing unit.
The following is the available maximum number of stations and maximum number of input/output points.

	RIO communication protocol	
	RIO1.0	**RIO2.0**
Number of connected units	Up to 8 units	Up to 32 units
Maximum number of stations	8 stations	64 stations
Maximum input points **Maximum output points**	256 points (32 points x 8 stations)	2048 points (32 points x 64 stations)

When all the units in the part system is the RIO2.0 specification, the maximum number of stations and the maximum number of points are those for RIO2.0.
When a unit of the RIO1.0 specification is included in the part system, the maximum number of stations and the maximum number of points are those for RIO1.0.

Note

(1) RIOM is master of remote I/O.
RIOS1 and RIOS2 are local of remote I/O.
(2) Connect the cable to be connected to the NC control unit, to the connector "RIOS1" of the high speed processing unit.

[Related items]
Cable connection drawing "2.7.2 J210 Cable" (J210 cable)
Connector pin assignment: "2.3.5 Connector" (RIOM connector, RIOS connector)

Connectable Remote I/O Units

The connectable RIO1.0 compatible units and RIO2.0 compatible units are as follows.

Classification	Type	Protocol	Remarks
DI 24 V/0 V common input [32 points] DO Source output [32 points]	FCU8-DX220	RIO2.0	DI: 32-point 24 V/0 V common type DO: 32-point source type (200 mA/point) Number of occupied stations: 1
DI 24 V/0 V common input [64 points] DO Source output [48 points]	FCU8-DX230	RIO2.0	DI: 64-point 24 V/0 V common type DO: 48-point source type (200 mA/point) Number of occupied stations: 2
DI 0 V common input [16 points] DO Source output (large capacity) [8 points]	FCU8-DX213	RIO2.0	DI: 16-point 0 V common type (3 mA/point) DO: 8-point source type (2A/point) Number of occupied stations: 1
DI 0 V common input [16 points] DO Source output (large capacity) [8 points]	FCU8-DX213-1	RIO2.0	DI: 16-point 0 V common type (9 mA/point) DO: 8-point source type (2A/point) Number of occupied stations: 1
DI 24 V/0 V common input [32 points] DO sink output [32 points]	FCUA-DX100	RIO1.0	DI: 32-point 24 V/0 V common type DO: 32-point sink type Number of occupied stations: 1
DI 24 V/0 V common input [64 points] DO sink output [48 points]	FCUA-DX110	RIO1.0	DI: 64-point 24 V/0 V common type DO: 48-point sink type Number of occupied stations: 2
DI 24 V/0 V common input [32 points] DO Source output [32 points]	FCUA-DX101	RIO1.0	DI: 32-point 24 V/0 V common type DO: 32-point source type Number of occupied stations: 1
DI 24 V/0 V common input [64 points] DO Source output [48 points]	FCUA-DX111	RIO1.0	DI: 64-point 24 V/0 V common type DO: 48-point source type Number of occupied stations: 2

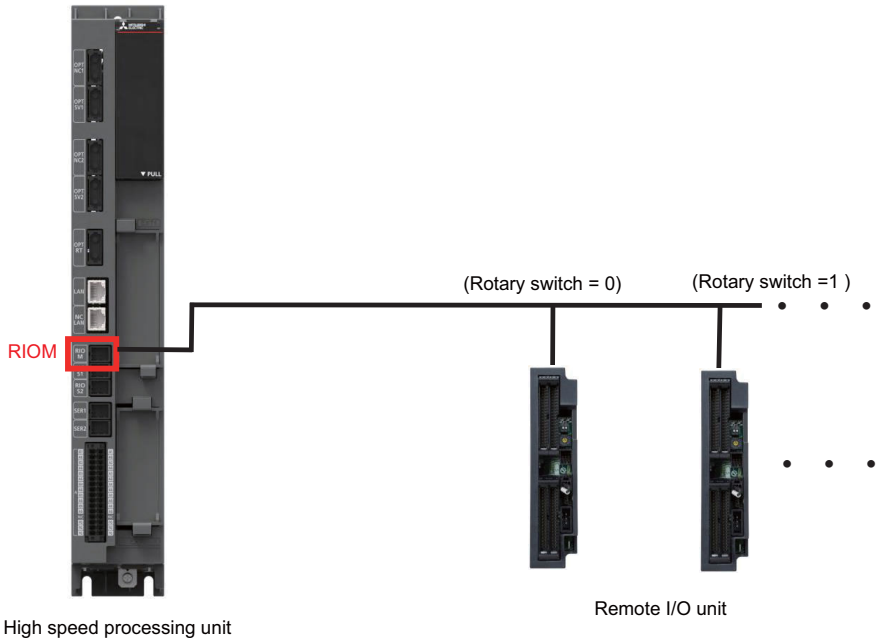
- DI: Digital input signals, DO: Digital output signals

For details on each remote I/O unit, refer to Connection and Setup Manual.

Connection examples

■ When setting the high speed processing unit as the master station of the remote I/O unit

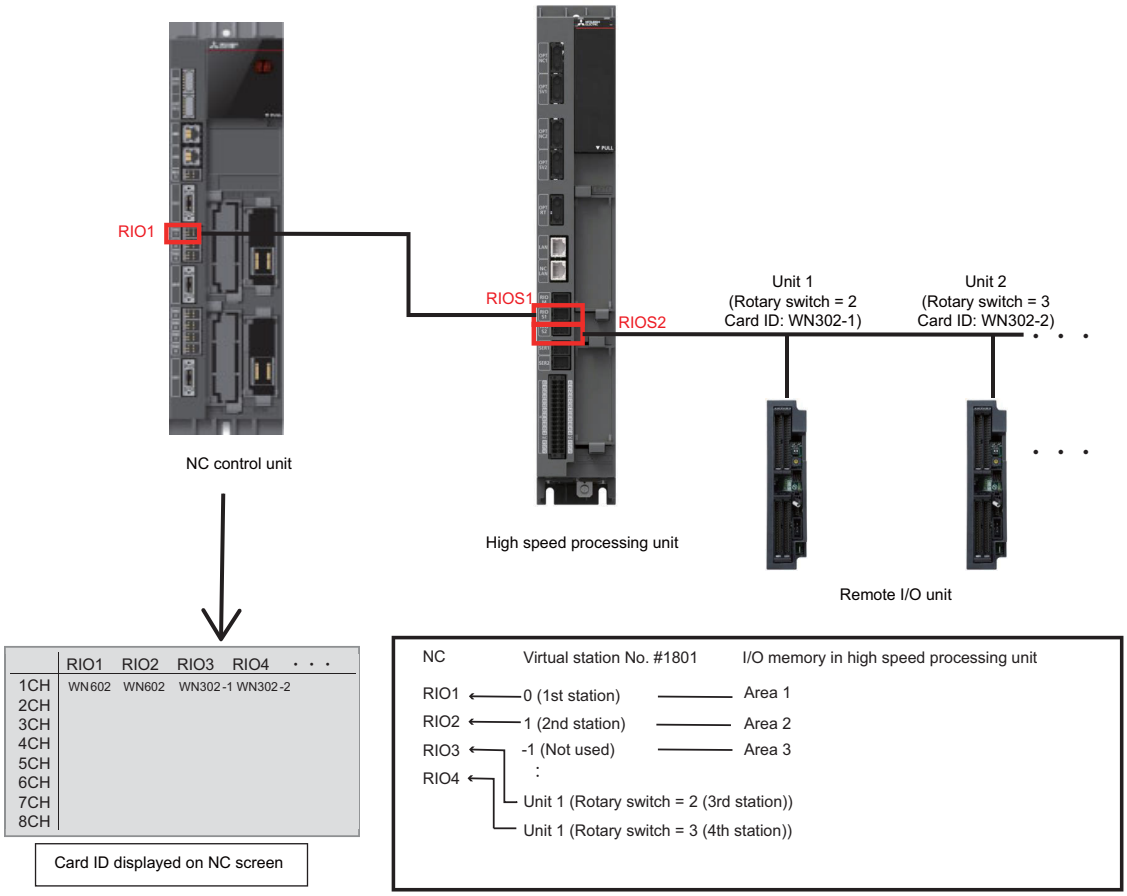
If a remote I/O unit is connected to the connector "RIOM", the high speed processing unit will function as the master station of the remote I/O unit. The signals of the connected unit can be collected by the high speed processing unit.
When using "RIOM", set "RioMCom. valid" of bit0 of the "#0007 RIO Com. Set" parameter to "1".
With remote I/O units of protocol RIO2.0, up to 64 stations can be connected.
If units of protocol RIO1.0 are included, up to 8 stations can be connected.



Parameter	Setting value	Remarks
#0007 / bit0	1	RIO communication master function is valid.

■ When setting the high speed processing unit as the local station of the remote I/O unit

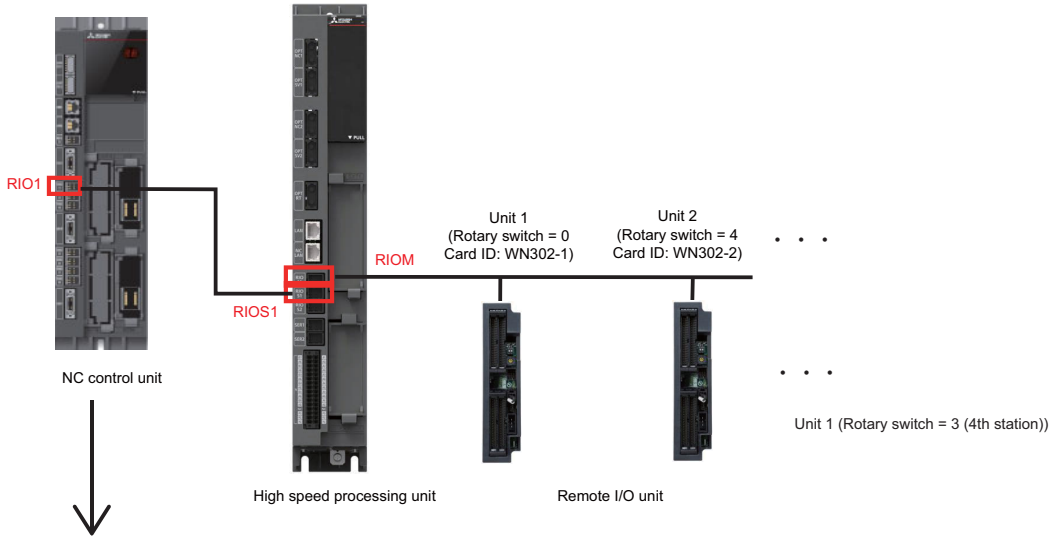
The high speed processing unit functions as a local station of remote I/O by connecting NC control unit to the connector "RIOS1".
When using "RIOS1", set "RioSCom. valid" of bit1 of the "#0007 RIO Com. Set" parameter to "1".
The signals of the remote I/O units connected to "RIOS2" are delivered to the NC control unit via "RIOS1". Furthermore, since I/O memory for 64 stations is also built into the high speed processing unit, setting the station numbers in the "#1801 RIO-S Vrtl St. num" parameter enables the signals to be delivered to the NC control unit.
With remote I/O units of protocol RIO2.0, up to 64 stations can be connected.
If units of protocol RIO1.0 are included, up to 8 stations can be connected.
Set the station numbers so that the station number of the "#1801" parameter and the station number of a unit connected to "RIOS2" will not be the same.
The high speed processing unit cannot collect the signals of the units connected to "RIOS2". To collect the signals, connect the units as shown on the next page.

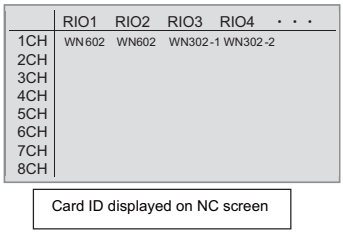


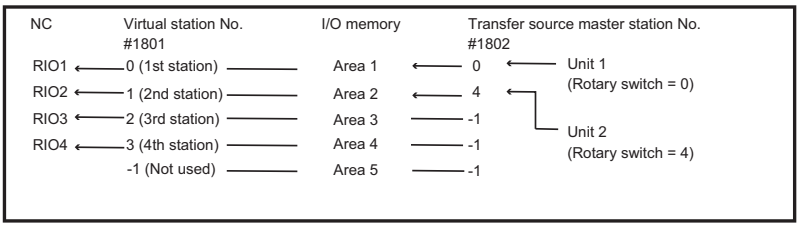
Parameter		Setting value	Remarks
#0007 / bit1		1	RIO communication local function is valid.
#0007 / bit3		1	Card ID WN602 (for RIO2.0 communication)
#1801 Virtual rotary switch number	Area 1	0	The local station I/O memory area 1 is allocated to the 1st station.
	Area 2	1	The local station I/O memory area 2 is allocated to the 2nd station.
	Area 3	-1	The local station I/O memory area 3 to 64 are not used.
	:	:	
	Area 64	-1	

■ When transferring information of a device on the master side to the local side

To deliver signals of the remote I/O units connected to the connector "RIOM" to the NC control unit, use the data transfer function.
When using this function, set "RioTCom. valid" of bit2 of the "#0007 RIO Com. Set" parameter to "1". Then, set the rotary switch number of the unit to transfer the signals in the "#1802 RIO-M Trsf St. num" parameter.
The above settings enable the signals of the units connected to "RIOM" to be transferred to the I/O memory inside the high speed processing unit.
The signals of the I/O memory can be delivered to the NC control unit by making the connections and setting the parameters of "When setting the high speed processing unit as the local station of the remote I/O unit" on the previous page. A delay of up to 3.5 ms occurs in the transmission of signals using the data transfer function.







Parameter		Setting value	Remarks
#0007 / bit0		1	RIO communication master function is valid.
#0007 / bit1		1	RIO communication local function is valid.
#0007 / bit2		1	Transfer function is valid.
#0007 / bit3		1	Card ID WN602 (for RIO2.0 communication)
#1801 Virtual rotary switch number	Area 1	0	The local station I/O memory area 1 is allocated to the 1st station.
	Area 2	1	The local station I/O memory area 2 is allocated to the 2nd station.
	Area 3	2	The local station I/O memory area 3 is allocated to the 3rd station.
	Area 4	3	The local station I/O memory area 4 is allocated to the 4th station.
	Area 5	-1	(Not used)
	:	:	:
#1802 Memory area of master station to be transferred (rotary switch number)	Area 1	0	Data of the master station "0" is transferred to the local station area 1.
	Area 2	4	Data of the master station "4" is transferred to the local station area 2.
	Area 3	-1	(Not transferred)
	:	:	:

2.6.7 Connecting with Analog Input

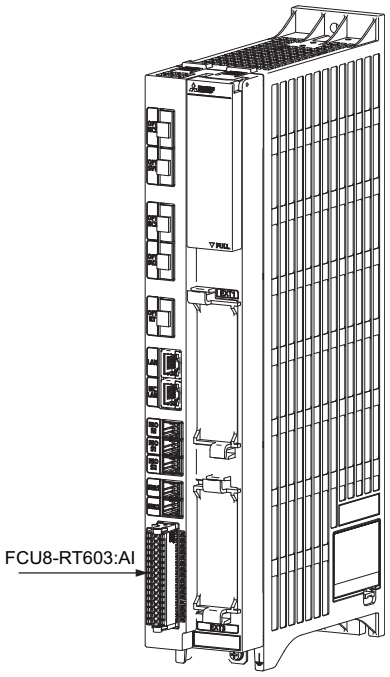
<Applicable wire>
Single wire: 0.2-1.5 mm^2
Twisted wire: 0.2-1.5 mm^2
Bar terminal with insulation collar: 0.25-0.75 mm^2
Bar terminal without insulation collar: 0.25-1.5 mm^2
Stripping line length: 10 mm

<Wire mounting tool (driver) type>
Type: SZS 0,4X2,5 VDE
Recommended manufacturer: Phoenix Contact

<Bar terminal type>
Type: AI series
Recommended manufacturer: Phoenix Contact

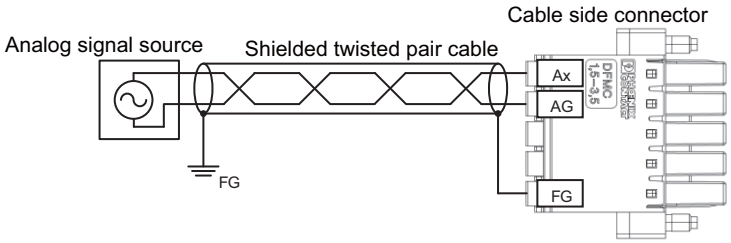
<Crimp tool type>
Type: CRIMPFOX 6
Recommended manufacturer: Phoenix Contact

<Recommended cable with shield material>
Type: HK-SB/20276XL LF
Recommended manufacturer: Taiyo Cabletec



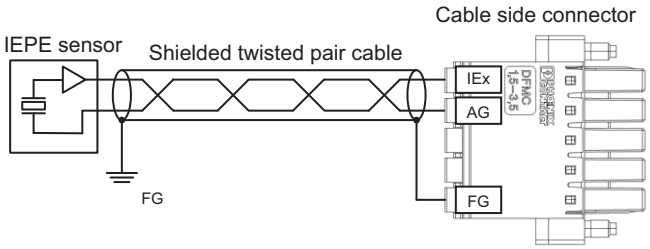
(Select the wire diameter from AI connector specification.)

When inputting general-purpose analog signals, connect an analog signal source to the general-purpose analog input terminals (A1 to A6) and AG.
To improve the noise resistance, a shielded twisted pair cable is recommended.
Maximum cable length is 30 m. Line resistance is 10 Ω or less, and line resistance difference is 0.1 Ω or less (see below).



・Line resistance of each conducting wire is 10 Ω or less.
・Line resistance difference between conducting wires is 0.1 Ω or less.

When inputting IEPE sensor signals, connect an IEPE sensor to the IEPE sensor terminals (IE1 to IE6) and AG.
To improve the noise resistance, a shielded twisted pair cable is recommended.
The maximum length for a shielded twisted pair cable differs depending on the capacity of the cable to be used, sensor specifications (maximum output voltage and sensor signal maximum frequency), and setting value for constant current output.
Refer to the information made available by the sensor manufacturer for details, then use a cable of the appropriate length.



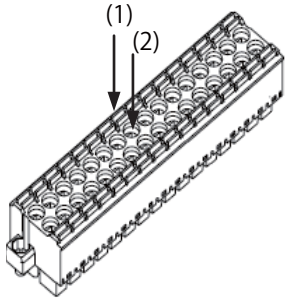
[Related items]
Connector pin assignment: "2.3.5 Connector" (AI connector)

Note

(1) The connector is provided as an accessory of the unit.
(2) When the connector is damaged, purchase either of the following types from the connector manufacturer.
<Cable side connector type>
DFMC1.5/16-STF-3.5 (standard module)
Manufacturer: Phoenix Contact
(3) Use a screw tightening type connector.
(4) Easy lock type connectors can also be used, but note that signal communication may be interrupted by machine vibration.

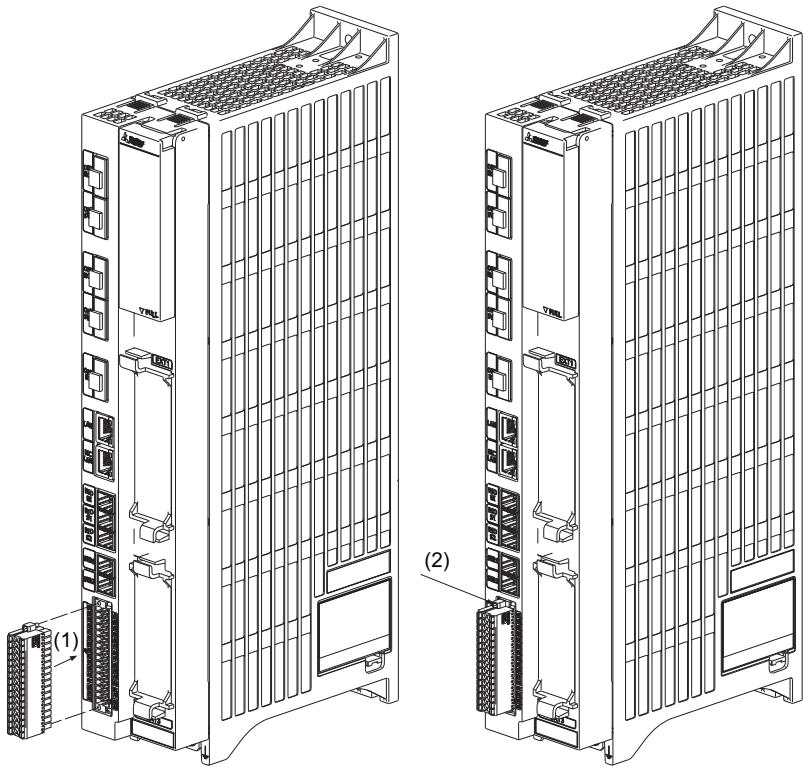
Mounting the wire

(1) Push in the wire opening lever (orange) using a slotted screwdriver (blade width: 2.5 mm).
(2) Insert the wire and then pull the screwdriver out of the wire opening lever.



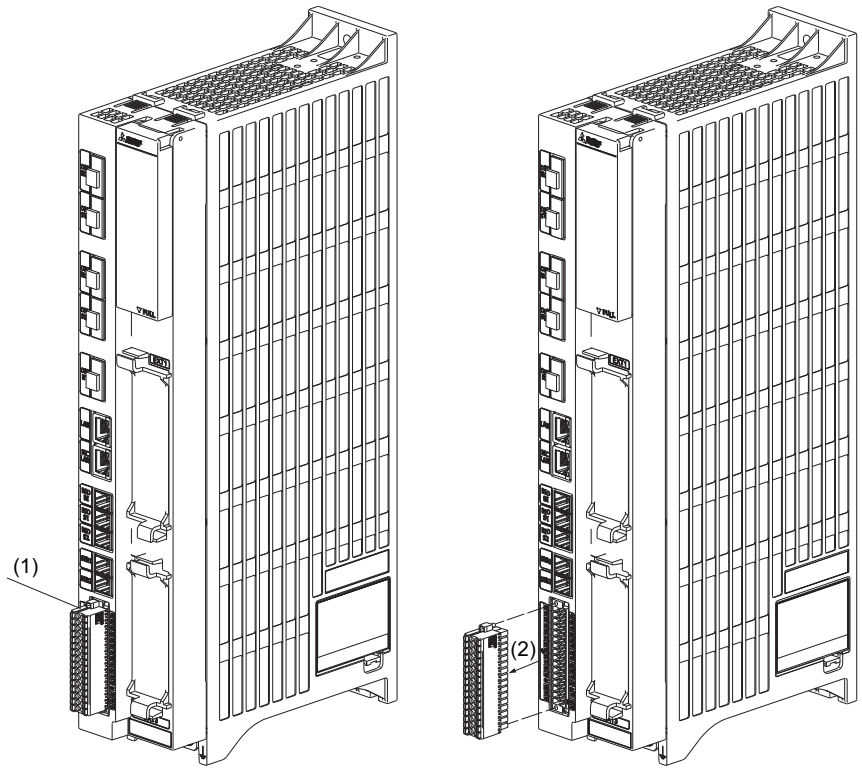
Mounting the connector

(1) Connect the connector to the AI of the unit.
(2) Tighten the screws on both ends of the connector with a slotted screwdriver. (Tightening torque: 0.1 to 0.2 N·m)

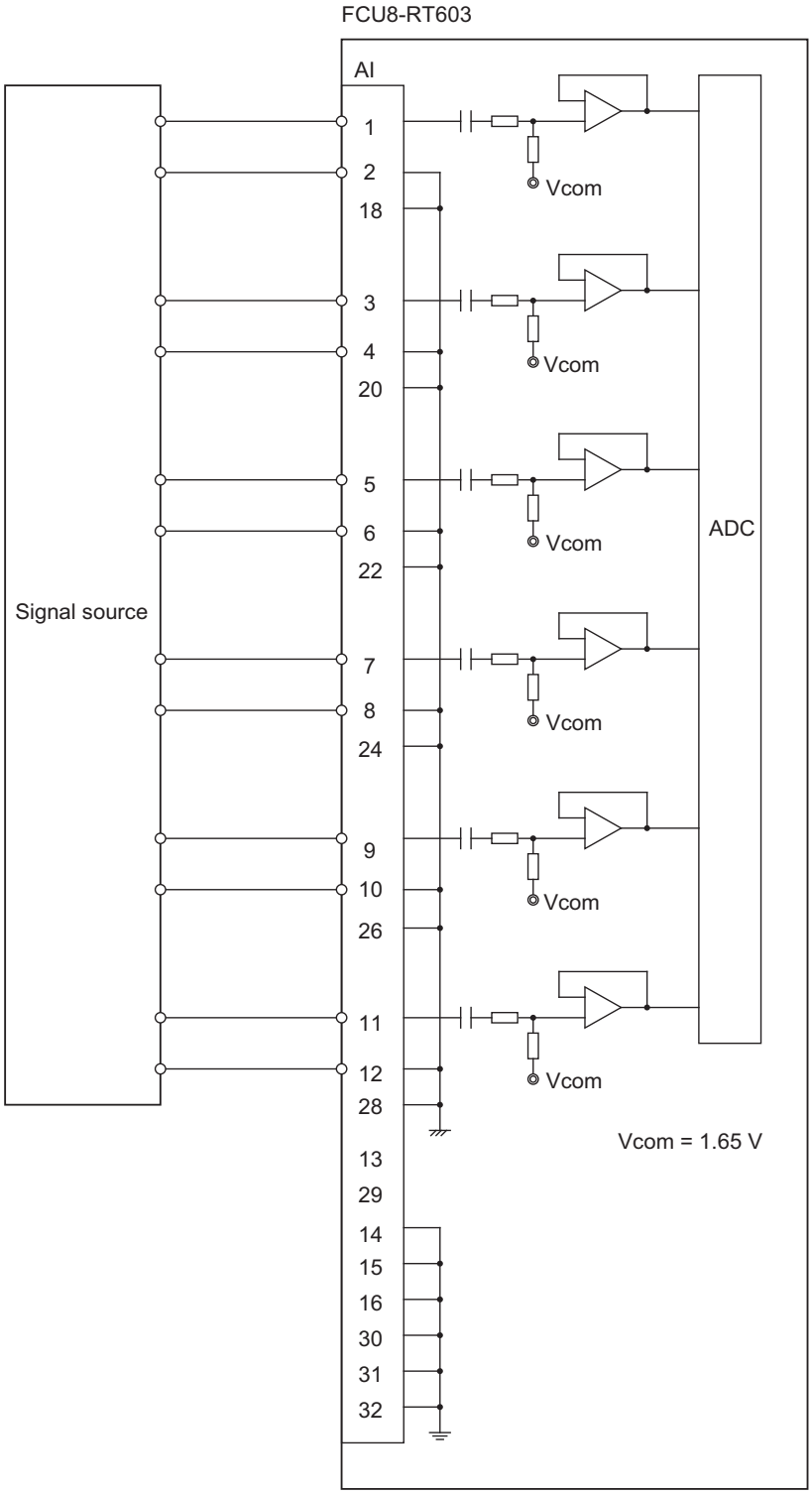


Removing the connector

(1) Loosen the screws on both ends of the connector with a slotted screwdriver.
(2) Remove the connector from the unit AI.



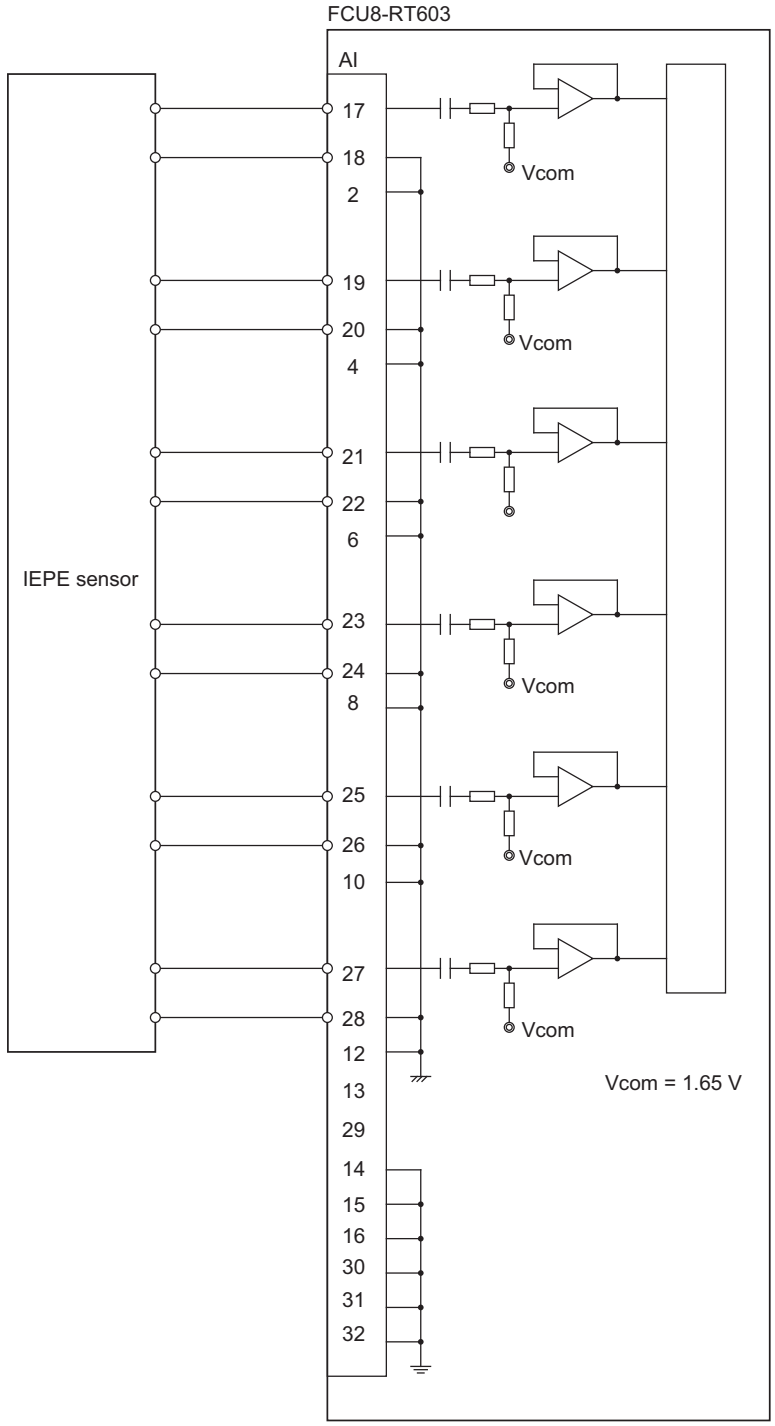
Connecting with the voltage input signal



Note

(1) Use the twisted cable with shield to reduce the influence of noise.
(2) Connect the shield to the FG pin of the AI connector. Ground the machine side as well.
(3) The FG pin is connected inside the unit.
(4) The AG pin is connected inside the unit.
(5) Do not connect or disconnect connection cables between units while power is being supplied.

Connecting with IEPE Sensor



Note

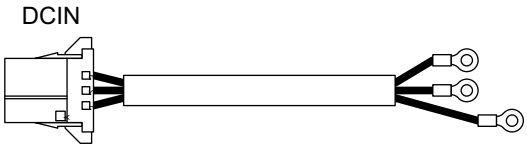
(1) Use a shielded twisted cable to reduce the influence of noise.
(2) Connect the shield to FG pin of AI connector. Ground the machine side, too.
(3) The FG pin is connected inside the unit.
(4) The AG pin is connected inside the unit.
(5) Do not connect or disconnect connection cables between units while power is being supplied.
(6) Do not connect a device other than that which supports IEPE to the IEPE sensor input terminals because the specifications are designed so that a constant current is output from the same terminals. The connected device may be damaged by the output current.

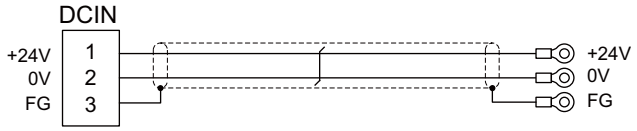
2.7 Cables

2.7.1 J070/J071 Cable

Max. cable length: 15 m (J070)/20 m (J071)

Application: 24 VDC 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 Electric Wire

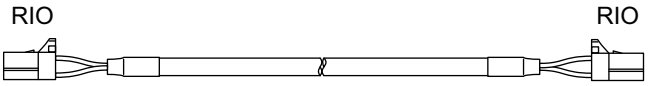
Crimp terminal: R1.25-4 × 3
Manufacturer: JST

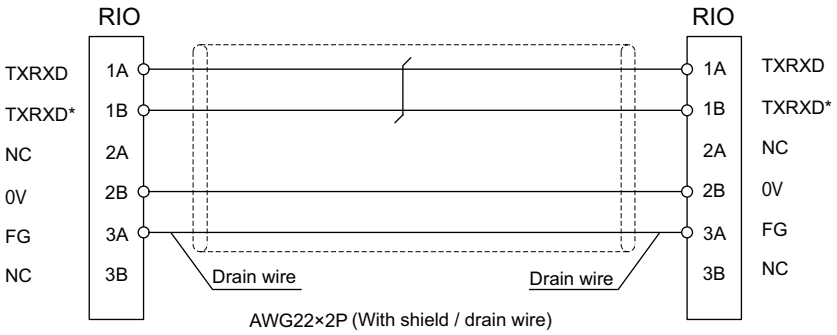
[J071 cable]
Wire material: UL2464-SB TEW 2 × 14AWG(41/0.26) LF Black × White
Manufacturer: Hitachi Metals

2.7.2 J210 Cable

Max. cable length: 50 m

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

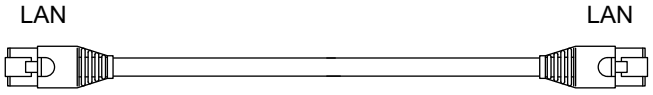
Note

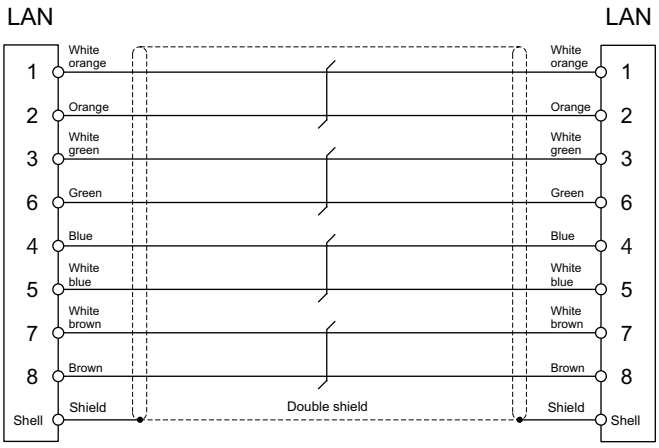
(1) Use the wire material with the characteristic impedance of 110 Ω.

2.7.3 J303 Cable

Max. cable length: 50 m

Application: LAN straight cable





[LAN]
Connector: J00026A0165
Boot: B00080F0090
Manufacturer: Japan Telegärtner

Wire material: FANC-IEF-SB 24AWG × 4P
Manufacturer: Kuramo Electric

2.7.4 J395 Cable

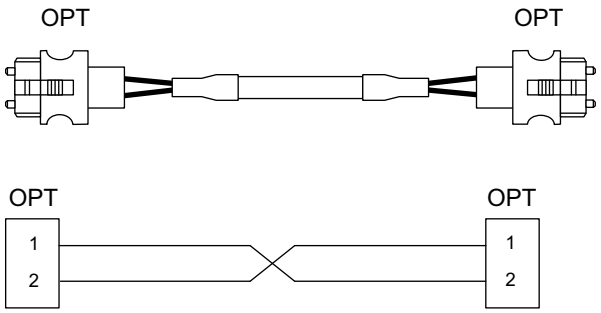
Max. cable length: 10 m

Application: Optical communication cable

For wiring between drive units (outside panel)

For wiring between NC and drive unit

Use when wiring outside of the panel with a cable of 10 m or less.



[OPT]
Connector: LGP-Z0007PK
Manufacturer: HONDA TSUSHIN KOGYO

Wire material: PFDU-CL1002-22E60VT
Manufacturer: TORAY

Cables	Minimum bending radius: R
2-core cable (section with reinforced sheath)	50 mm
2-core cable (section without reinforced sheath)	30 mm

Note

(1) Binding the cables too tightly 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)

(2) Never bundle the cables with vinyl tape. The plasticizing material in the vinyl tape could cause the POF cable to break.

(3) Loop the excessive cable with twice or more than the minimum bending radius.

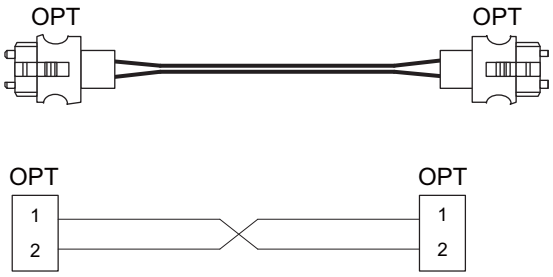
2.7.5 J396 Cable

Max. cable length: 10 m

Application: Optical communication cable

For wiring between drive units (inside panel)

Use when wiring inside of the panel with a cable of 10 m or less.



[OPT]
Connector: LGP-Z0007PK
Manufacturer: HONDA TSUSHIN KOGYO

Wire material: PFDU-CD1002-18E22T
Manufacturer: TORAY

Cables	Minimum bending radius: R
2-core parallel cord	30 mm

Note

(1) Binding the cables too tightly 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)

(2) Never bundle the cables with vinyl tape. The plasticizing material in the vinyl tape could cause the POF cable to break.

(3) Loop the excessive cable with twice or more than the minimum bending radius.

2.7.6 G380 Cable

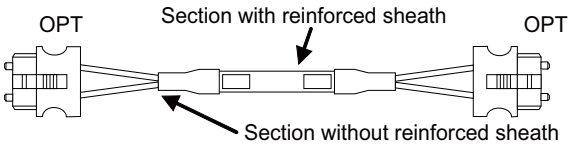
Max. cable length: 30 m

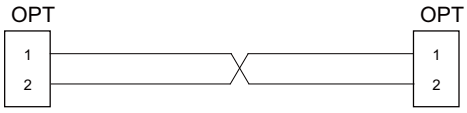
Application: Optical communication cable

For wiring between drive units (outside panel)

For optical communication repeater unit

Use when the cable length is 10 m or more to 30 m or less.





[OPT]
Connector: 1123445-1
Manufacturer: TE Connectivity

Wire material: Hard clad type PCF optic cable
Manufacturer: Oki Electric Cable

Cables	Minimum bending radius: R
2-core cable (section with reinforced sheath)	50 mm
2-core cable (section without reinforced sheath)	25 mm

Note

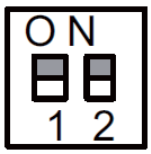
(1) Binding the cables too tightly with tie-wraps could result in an increased loss or a disconnection. Use a cushioning material such as a sponge or rubber when bundling the cables and fix so that the cables do not move. (Clamp material for reference: KITAGAWA INDUSTRIES CKN-13SP)

(2) Never bundle the cables with vinyl tape. The plasticizing material in the vinyl tape could cause the PCF cable reinforced sheath to damage.

(3) Loop the excessive cable with twice or more than the minimum bending radius.

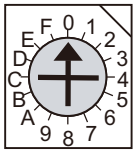
2.8 Initial Setup

2.8.1 DIP Switch



As a standard setting, turn the all DIP switches OFF.

2.8.2 Rotary Switch



As a standard setting, set the rotary switch to "0" position.

3

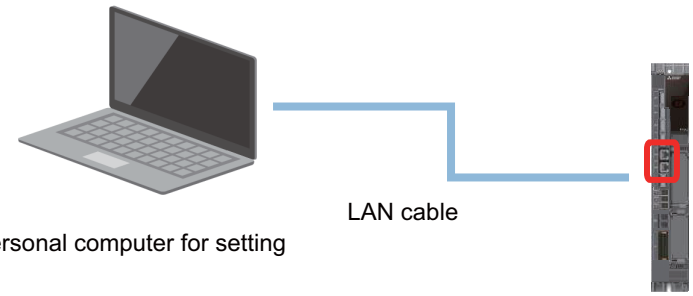
High Speed Processing Unit Parameters

3.1 Setting Parameters

To set parameters of the unit, connect "NCLAN" of the unit and a personal computer for setting with an Ethernet cable, then access to the unit with a Web browser of the personal computer.

3.1.1 Displaying the Setting Screen

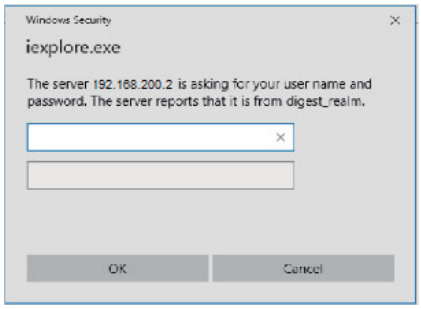
(1) Preparation
Connect to the network of the personal computer for setting and high speed processing unit as shown in the figure below.



(2) After starting the high speed processing unit, start the browser on the personal computer for setting and then input "http:///(IP address of high speed processing unit)" in the address bar.

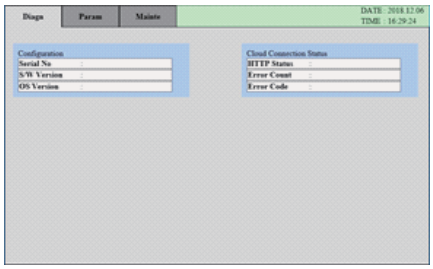
<Note>
The IP address of the high speed processing unit is "192.168.200.2" at the time of shipment.
The IP address of the high speed processing unit can be changed in the "#1010 Local IP Address" parameter.
Refer to "3.1.6 Initializing the IP Address Setting of the Unit" for the initialization procedure.

➡ The authentication dialog appears.



(3) Input "user" and "password", then press the [OK] button.

➡ The setting screen appears.



Note

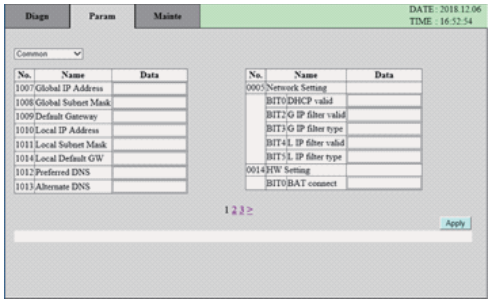
(1) When "user" or "password" input in the authentication dialog is incorrect, the authentication dialog appears again after the [OK] button is pressed.
(2) When the [Cancel] button is pressed in the authentication dialog, a page with the message "401 Unauthorized" appears. When you access to the page by an operation such as pressing the refresh button on a browser, the authentication dialog appears again.

3.1.2 Switching Screens

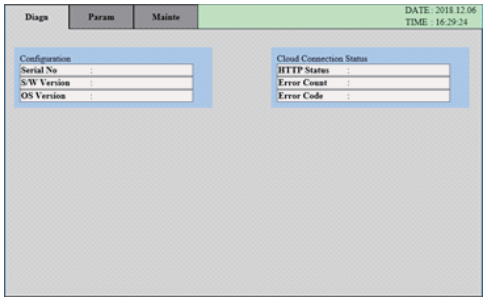
The setting screen has the following tabs.
Diagn: Diagnosis screen
Param: Parameter screen
Mainte: Maintenance screen

(Example) Switching between the diagnosis screen and parameter screen

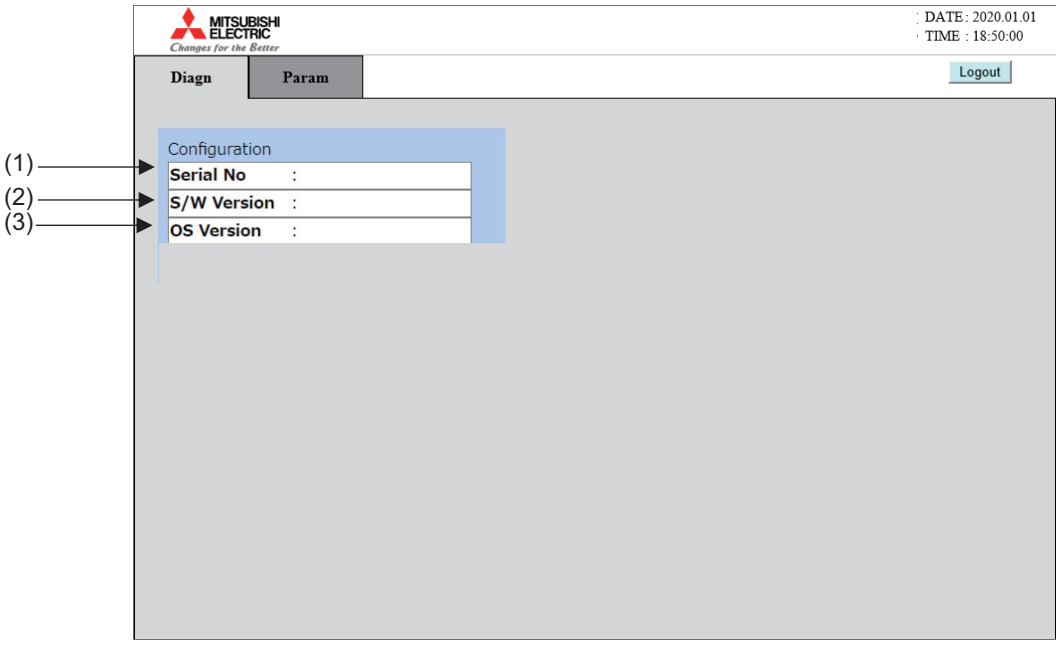
(1) Click the [Param] tab on the setting screen. ➡ The parameter screen appears.



(2) Click the [Diagn] tab on the setting screen. ➡ The diagnosis screen appears.

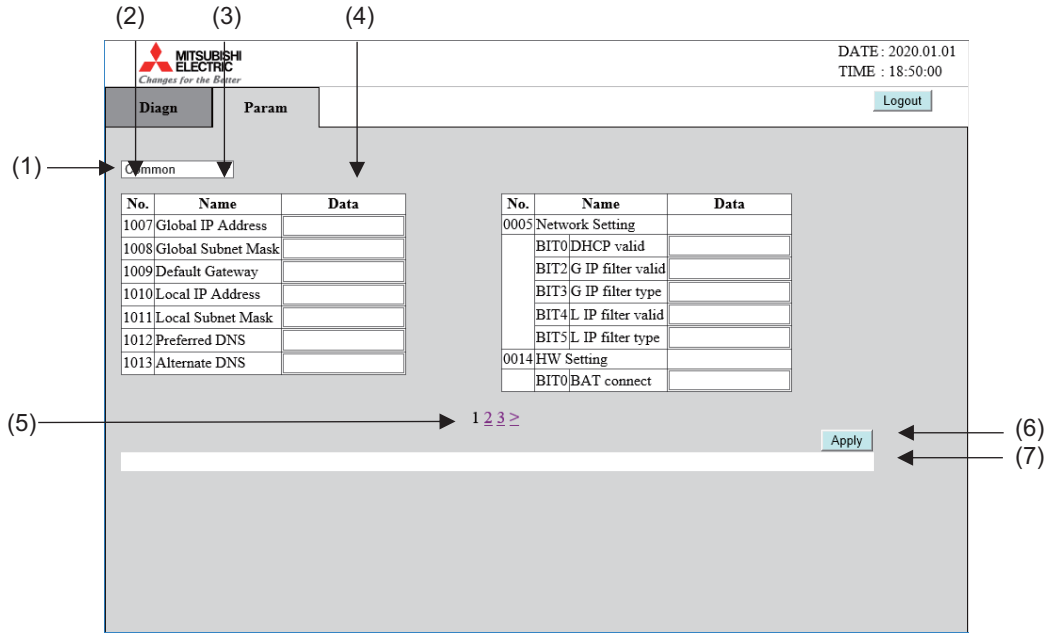


Diagnosis screen display items



Display item		Details
Configuration	(1) Serial No.	Displays the serial number of the high speed processing unit.
	(2) S/W Version	Displays the system version of the high speed processing unit.
	(3) OS Version	Displays the OS version of the high speed processing unit.

Parameter screen display items



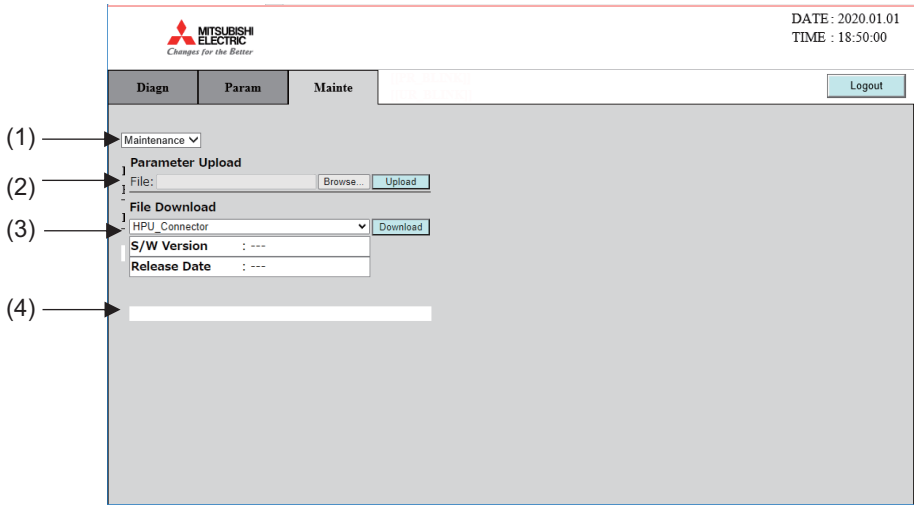
Display item		Details
(1)	Function group list	Switches the function group of the maintenance functions to display and set.
(2)	Parameter No.	Displays the parameter numbers.
(3)	Parameter name	Displays the parameter names.
(4)	Parameter value	Displays and sets the parameter values.
(5)	Page numbers	Used to display the parameters on the second and subsequent pages when the parameters are shown on more than one page.
(6)	Apply button	Sets the parameters on the displayed page in the high speed processing unit.
(7)	Setting result	Displays the parameter setting result after the [Apply] button is clicked.

Refer to "3.2 Parameter List" for details on parameters.

Maintenance screen display items

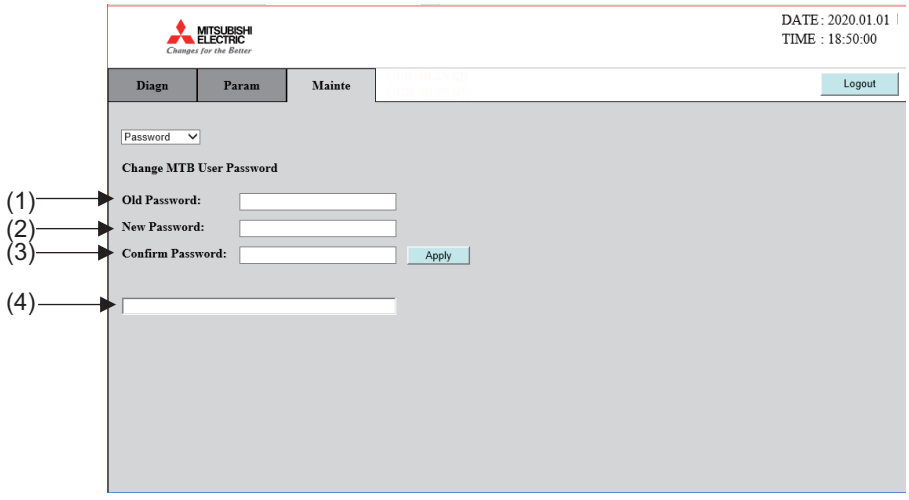
The maintenance screen is used by machine tool builders.

[Maintenance screen]



	Display item	Details
(1)	Function group list	Switches the function group of the maintenance functions to display and set.
(2)	Parameter Upload	Uploads a parameter file to the high speed processing unit.
(3)	File Download	Downloads a parameter file from the high speed processing unit.
(4)	Setting result	Displays the result after a parameter file is uploaded to the high speed processing unit.

[Password screen]

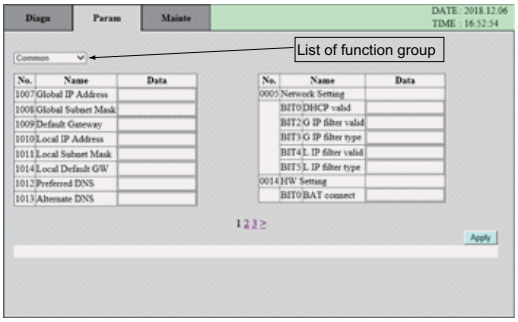


	Display item	Details
(1)	Old Password	Enter the currently set machine tool builder password.
(2)	New Password	Enter the password to set as the new password.
(3)	Confirm Password	Enter the password to set as the new password again for confirmation.
(4)	Setting result	Displays the result after the password is changed.

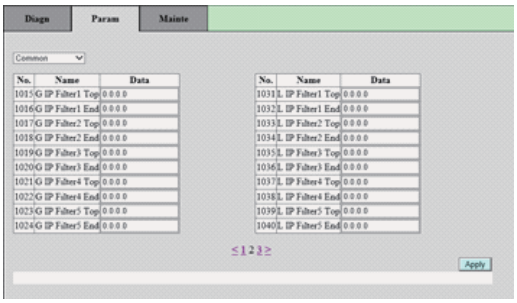
3.1.3 Switching the Parameter Display

(Example) Display the second page of the common parameter

(1) Select "Common" from the function group list. → Common parameters appear.



(2) Click the page number "2" or ">". → The second page appears.

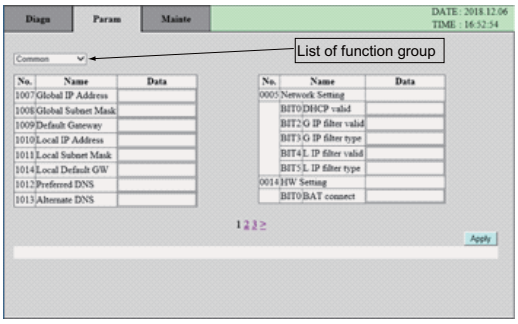


3.1.4 Setting Parameters

This section describes method for setting parameters.

(Example 1) Setting "192.168.100.2" in "1007 Global IP Address"

(1) Select "Common" from the function group list. ➡ Common parameters appear.



(2) Move the cursor to the "Data" field of "1007 Global IP Address" and input "192.168.100.2". ➡ "192.168.100.2" appears in the "Data" field.

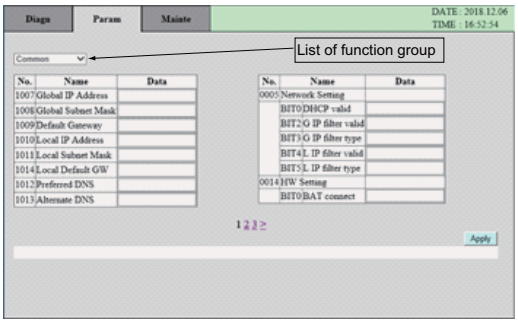
No.	Name	Data
1007	Global IP Address	192.168.100.2

(3) Press the [Apply] button. ➡ "Setting completed" appears as a setting result under the [Apply] button.

Setting completed

(Example 2) Setting "1" in "BIT0 DHCP valid" of "0005 Network Setting"

(1) Select "Common" from the function group list. ➡ Common parameters appear.



(2) "1" appears in the "Data" field of "BIT0 DHCP valid". ➡ "1" appears in the "Data" field of "BIT0 DHCP valid".

No.	Name	Data
0005	Network Setting	
	BIT0 DHCP valid	1

(3) Press the [Apply] button. ➡ "Setting completed" appears as a setting result under the [Apply] button.

Setting completed

Note

(1) For some parameters, changes take effect after the unit is turned ON again, and some other parameters requires you to turn ON the NC unit again to make them enable. When these parameters are changed, "UR" (restart the unit) and "PR" (restart the NC) appear on the right side of the tab.
(2) If parameter setting failed, "No.XXX Setting error" ("XXX" indicates the parameter number) appears as the setting result. Correct the displayed input contents of the parameter value. When there are setting errors in multiple parameters, the number of the first parameter with an error appears.
(3) Parameters must be set for each page by pressing the [Apply] button.
(4) The message which appears after pressing the [Apply] button is cleared by switching the function group or switching the displayed page.

3.1.5 Setting the Time of the High Speed Processing Unit

This section describes method for setting the time of the high speed processing unit.

To add the date and time information to the data to be sent to the edge personal computer, you need to set the correct date and time on the high speed processing unit.
Set the date and time using one of the following methods.

Method to acquire the date and time from the NC

(1) Connect the high speed processing unit to the NC with an optical cable.
Refer to "2.6.5 High-speed Communication Connection with NC" for the connection method.
(2) Set "#1607 SNTP Server" to "0".

Method to acquire the date and time from the SNTP server

(1) Specify "http://(IP address of high speed processing unit)" in the Web browser of the personal computer connected to the high speed processing unit to display the setting screen.
Refer to "3.1.1 Displaying the Setting Screen" for more details.
(2) Set the SNTP server.
[When specifying the SNTP server by IP address]
- Set "#1607 SNTP Server" to the IP address.

[When specifying the SNTP server by server name]
- Set "#1607 SNTP Server" to the server name.
- To use the DHCP (Dynamic Host Configuration Protocol) function, set the following parameters.
Set "DHCP valid" of bit0 of "#0005 Network Setting" to "1".
- To use a DNS server, set the following parameters.
Set "DHCP valid" of bit0 of "#0005 Network Setting" to "0".
Set "#1012 Preferred DNS" to the IP address of the preferred DNS server.
Set "#1013 Alternate DNS" to the IP address of the alternate DNS server.

(3) Set the other related parameters.
- "#0402 SNTP time lag (h)" (difference between time acquired from the SNTP server and the current location time (-23 to 23 (h)))
- "#0403 SNTP time lag (m)" (difference between time acquired from the SNTP server and the current location time (0 to 59 (m)))
- "#0407 SNTP Timeout" (timeout period for acquiring the time from the SNTP server (0 to 30 (s); When "0" is set, it is regarded as 5 seconds.))

3.1.6 Initializing the IP Address Setting of the Unit

If you cannot recall a setting value after changing "#1010 Local IP Address" from the initial state, the setting screen cannot be opened. In this case, initialize the IP address with the following method, and open the setting screen with the initial IP address and set a correct IP address.

■ Method to clear only network related parameters

(1) Change the rotary switch on the front of the unit to "B" and turn the power ON. When "0" and "y" are displayed on the 7-segment LED display, the parameters are cleared.
(2) Turn the power OFF, return the rotary switch to "0", and turn the power ON.
(3) Input the initial IP address in the browser to open the setting screen, then set the correct IP address.

■ Method to clear all of the parameters

(1) Change the rotary switch on the front of the unit to "7" and turn the power ON. When "-" is displayed on the 7-segment LED display, turn the power OFF.
(2) Change the rotary switch to "C" and turn the power ON. When "0" and "y" are displayed on the 7-segment LED display, the parameters are cleared.
(3) Turn the power OFF, return the rotary switch to "0", and turn the power ON.
(4) Input the initial IP address in the browser to open the setting screen, then set the correct IP address.

3.2 Parameter List

The list of parameters is as follows.

(*1) Type for clearing error

PR: Restart the NC

UR: Restart the high speed processing unit

No.	BIT	Function group	Type for clearing error (*1)		Name	Details	Setting range
			PR	UR			
#0001		NC-DRV	○	○	Basic Setting 1		
	BIT0		-		Opt. 1ch Invalid	Select high-speed optical servo communication (channel 1) sampling valid/invalid. If no optical communication cable is connected to a unit, set this bit to "1".	0: valid 1: invalid
	BIT1				Opt. 2ch Invalid	Select high-speed optical servo communication (channel 2) sampling valid/invalid. If no optical communication cable is connected to a unit, set this bit to "1". If there is no high-speed optical servo communication (channel 2) sampling specification, this parameter is ignored.	0: valid 1: invalid
#0002		DI/AI	-	○	Analog Input Set		
	BIT0				AnalogIn1 Invalid	Select analog input channel 1 valid/invalid.	0: valid 1: invalid
	BIT1				AnalogIn2 Invalid	Select analog input channel 2 valid/invalid.	
	BIT2				AnalogIn3 Invalid	Select analog input channel 3 valid/invalid.	
	BIT3				AnalogIn4 Invalid	Select analog input channel 4 valid/invalid.	
	BIT4				AnalogIn5 Invalid	Select analog input channel 5 valid/invalid.	
	BIT5				AnalogIn6 Invalid	Select analog input channel 6 valid/invalid.	
#0005		Common	-	○	Network Setting		
	BIT0				DHCP valid	Enable DHCP function.	0: invalid 1: valid
	BIT2				G IP filter valid	Enable IP address filter for global network.	0: invalid 1: valid
	BIT3				G IP filter type	Select IP address filter type for global network. 0: Transmission - Permit access from the specified address. 1: Block - Deny access from the specified address.	0: transmission 1: block
	BIT4				L IP filter valid	Enable IP address filter for local network.	0: invalid 1: valid
	BIT5				L IP filter type	Select IP address filter type for local network. 0: Transmission - Permit access from the specified address. 1: Block - Deny access from the specified address.	0: transmission 1: block
#0006		DI/AI	-	○	AI Scaling Set		
	BIT0				Scaling 1 Set	Enable analog input (CH1) scaling for analog input function.	0: invalid 1: valid
	BIT1				Scaling 2 Set	Enable analog input (CH2) scaling for analog input function.	
	BIT2				Scaling 3 Set	Enable analog input (CH3) scaling for analog input function.	
	BIT3				Scaling 4 Set	Enable analog input (CH4) scaling for analog input function.	

No.	BIT	Function group	Type for clearing error (*1)		Name	Details	Setting range
			PR	UR			
	BIT4				Scaling 5 Set	Enable analog input (CH5) scaling for analog input function.	0: invalid 1: valid
	BIT5				Scaling 6 Set	Enable analog input (CH6) scaling for analog input function.	
#0007		RIO	-	○	RIO Com. Set		
	BIT0				RioMCom. valid	Enable RIO master communication.	0: invalid 1: valid
	BIT1				RioSCom. valid	Enable RIO local communication.	0: invalid 1: valid
	BIT2				RioTCom. valid	Enable RIO transfer function.	0: invalid 1: valid
	BIT3				RioCard ID	Select RIO card ID.	0: Set card ID to WN301 (for RIO2.0) or RX311 (for RIO1.0). 1: Set card ID to WN602 (for RIO2.0) or RX311 (for RIO1.0).
#0008		MQTT	-	-	MQTT SendAxisSet1		
	BIT0				MQTTch1 ax1 valid	Enable transmission of DRV data CH1 1st axis in MQTT communication.	0: invalid 1: valid
	BIT1				MQTTch1 ax2 valid	Enable transmission of DRV data CH1 2nd axis in MQTT communication.	
	BIT2				MQTTch1 ax3 valid	Enable transmission of DRV data CH1 3rd axis in MQTT communication.	
	BIT3				MQTTch1 ax4 valid	Enable transmission of DRV data CH1 4th axis in MQTT communication.	
	BIT4				MQTTch1 ax5 valid	Enable transmission of DRV data CH1 5th axis in MQTT communication.	
	BIT5				MQTTch1 ax6 valid	Enable transmission of DRV data CH1 6th axis in MQTT communication.	
	BIT6				MQTTch1 ax7 valid	Enable transmission of DRV data CH1 7th axis in MQTT communication.	
	BIT7				MQTTch1 ax8 valid	Enable transmission of DRV data CH1 8th axis in MQTT communication.	
#0009		MQTT	-	-	MQTT SendAxisSet2		
	BIT0				MQTTch1 ax9 valid	Enable transmission of DRV data CH1 9th axis in MQTT communication.	0: invalid 1: valid
	BIT1				MQTTch1 ax10 valid	Enable transmission of DRV data CH1 10th axis in MQTT communication.	
	BIT2				MQTTch1 ax11 valid	Enable transmission of DRV data CH1 11th axis in MQTT communication.	
	BIT3				MQTTch1 ax12 valid	Enable transmission of DRV data CH1 12th axis in MQTT communication.	
	BIT4				MQTTch1 ax13 valid	Enable transmission of DRV data CH1 13th axis in MQTT communication.	
	BIT5				MQTTch1 ax14 valid	Enable transmission of DRV data CH1 14th axis in MQTT communication.	
	BIT6				MQTTch1 ax15 valid	Enable transmission of DRV data CH1 15th axis in MQTT communication.	
	BIT7				MQTTch1 ax16 valid	Enable transmission of DRV data CH1 16th axis in MQTT communication.	
#0010		MQTT	-	-	MQTT SendAxisSet3		
	BIT0				MQTTch2 ax1 valid	Enable transmission of DRV data CH2 1st axis in MQTT communication.	0: invalid 1: valid

No.	BIT	Function group	Type for clearing error (*1)		Name	Details	Setting range
			PR	UR			
	BIT1				MQTTch2 ax2 valid	Enable transmission of DRV data CH2 2nd axis in MQTT communication.	0: invalid 1: valid
	BIT2				MQTTch2 ax3 valid	Enable transmission of DRV data CH2 3rd axis in MQTT communication.	
	BIT3				MQTTch2 ax4 valid	Enable transmission of DRV data CH2 4th axis in MQTT communication.	
	BIT4				MQTTch2 ax5 valid	Enable transmission of DRV data CH2 5th axis in MQTT communication.	
	BIT5				MQTTch2 ax6 valid	Enable transmission of DRV data CH2 6th axis in MQTT communication.	
	BIT6				MQTTch2 ax7 valid	Enable transmission of DRV data CH2 7th axis in MQTT communication.	
	BIT7				MQTTch2 ax8 valid	Enable transmission of DRV data CH2 8th axis in MQTT communication.	
#0011		MQTT	-	-	MQTT SendAxisSet4		
	BIT0				MQTTch2 ax9 valid	Enable transmission of DRV data CH2 9th axis in MQTT communication.	0: invalid 1: valid
	BIT1				MQTTch2 ax10 valid	Enable transmission of DRV data CH2 10th axis in MQTT communication.	
	BIT2				MQTTch2 ax11 valid	Enable transmission of DRV data CH2 11th axis in MQTT communication.	
	BIT3				MQTTch2 ax12 valid	Enable transmission of DRV data CH2 12th axis in MQTT communication.	
	BIT4				MQTTch2 ax13 valid	Enable transmission of DRV data CH2 13th axis in MQTT communication.	
	BIT5				MQTTch2 ax14 valid	Enable transmission of DRV data CH2 14th axis in MQTT communication.	
	BIT6				MQTTch2 ax15 valid	Enable transmission of DRV data CH2 15th axis in MQTT communication.	
	BIT7				MQTTch2 ax16 valid	Enable transmission of DRV data CH2 16th axis in MQTT communication.	
#0012		MQTT	-	-	MQTT SendValidSet1		
	BIT0				MQTT DI valid	(Not used)	
	BIT1				MQTT RIO(M) valid	Enable transmission of RIO Master data in MQTT communication.	0: invalid 1: valid
	BIT2				MQTT RIO(S) valid	Enable transmission of RIO Local data in MQTT communication.	0: invalid 1: valid
	BIT3				MQTT AI valid	Enable transmission of analog input data in MQTT communication.	0: invalid 1: valid
#0015		Common	-	-	Debug param		
	BIT0				Data func display	Select the method to display the output results of the data output function in the debug screen.	0: Display from the newest output result 1: Display from the oldest output result
#0016		MTBCustom	-	○	MTBCustom valid		
	BIT0				MTBModule1 valid	Enable custom module 1 of machine tool builder custom processing.	0: invalid 1: valid
	BIT1				MTBModule2 valid	Enable custom module 2 of machine tool builder custom processing.	
	BIT2				MTBModule3 valid	Enable custom module 3 of machine tool builder custom processing.	
	BIT3				MTBModule4 valid	Enable custom module 4 of machine tool builder custom processing.	
	BIT4				MTBModule5 valid	Enable custom module 5 of machine tool builder custom processing.	

No.	BIT	Function group	Type for clearing error (*1)		Name	Details	Setting range
			PR	UR			
#0017		MTBCustom	-	○	Exe 3.5ms valid		
	BIT0				MTBModule1 valid	Enable execution of custom module 1 for the 3.5 ms period.	0: invalid 1: valid
	BIT1				MTBModule2 valid	Enable execution of custom module 2 for the 3.5 ms period.	
	BIT2				MTBModule3 valid	Enable execution of custom module 3 for the 3.5 ms period.	
	BIT3				MTBModule4 valid	Enable execution of custom module 4 for the 3.5 ms period.	
	BIT4				MTBModule5 valid	Enable execution of custom module 5 for the 3.5 ms period.	
#0018		MTBCustom	-	○	Exe 56.8ms valid		
	BIT0				MTBModule1 valid	Enable execution of custom module 1 for the 56.8 ms period.	0: invalid 1: valid
	BIT1				MTBModule2 valid	Enable execution of custom module 2 for the 56.8 ms period.	
	BIT2				MTBModule3 valid	Enable execution of custom module 3 for the 56.8 ms period.	
	BIT3				MTBModule4 valid	Enable execution of custom module 4 for the 56.8 ms period.	
	BIT4				MTBModule5 valid	Enable execution of custom module 5 for the 56.8 ms period.	
#0019		MTBCustom	-	○	Exe 1820ms valid		
	BIT0				Object1 valid	Enable execution of custom module 1 for the 1820 ms period.	0: invalid 1: valid
	BIT1				Object2 valid	Enable execution of custom module 2 for the 1820 ms period.	
	BIT2				Object3 valid	Enable execution of custom module 3 for the 1820 ms period.	
	BIT3				Object4 valid	Enable execution of custom module 4 for the 1820 ms period.	
	BIT4				Object5 valid	Enable execution of custom module 5 for the 1820 ms period.	
#0020		DI/AI	-	○	Analog Input Mode		
	BIT0				AIch1 IEPE valid	Enable IEPE input mode for analog input channel 1.	0: Invalid (general-purpose analog input mode) 1: Valid (IEPE input mode)
	BIT1				AIch2 IEPE valid	Enable IEPE input mode for analog input channel 2.	
	BIT2				AIch3 IEPE valid	Enable IEPE input mode for analog input channel 3.	
	BIT3				AIch4 IEPE valid	Enable IEPE input mode for analog input channel 4.	
	BIT4				AIch5 IEPE valid	Enable IEPE input mode for analog input channel 5.	
	BIT5				AIch6 IEPE valid	Enable IEPE input mode for analog input channel 6.	
#0021		NC-HPU	○	○	NC-HPU config.		
	BIT0				NC-HPU invalid	Disable optical communication between the NC and HPU.	0: valid 1: invalid
#0022		Common	-	○	MTB Sampling valid		
	BIT0				MTB Sampling valid	Enable the MTB data sampling function.	0: invalid 1: valid
#0023		NC-DRV	-	-	Torque output 1	(Not used)	
#0024		NC-DRV	-	-	Torque output 2	(Not used)	
#0025		NC-DRV	-	-	Torque output 3	(Not used)	
#0026		NC-DRV	-	-	Torque output 4	(Not used)	

No.	BIT	Function group	Type for clearing error (*1)		Name	Details	Setting range
			PR	UR			
#0027		MQTT	-	○	MQTT SSL setting		
	BIT0				SSL valid	Enable SSL communication.	0: invalid 1: valid
#0051		MTBCustom	-	○	MTB bit para1		
	BIT0				MTB bit para1-0	A bit parameter that can be used freely by machine tool builders	0: invalid 1: valid
	BIT1				MTB bit para1-1		
	BIT2				MTB bit para1-2		
	BIT3				MTB bit para1-3		
	BIT4				MTB bit para1-4		
	BIT5				MTB bit para1-5		
	BIT6				MTB bit para1-6		
	BIT7				MTB bit para1-7		
#0052		MTBCustom	-	○	MTB bit para2		
	BIT0				MTB bit para2-0	A bit parameter that can be used freely by machine tool builders	0: invalid 1: valid
	BIT1				MTB bit para2-1		
	BIT2				MTB bit para2-2		
	BIT3				MTB bit para2-3		
	BIT4				MTB bit para2-4		
	BIT5				MTB bit para2-5		
	BIT6				MTB bit para2-6		
	BIT7				MTB bit para2-7		
#0053		MTBCustom	-	○	MTB bit para3		
	BIT0				MTB bit para3-0	A bit parameter that can be used freely by machine tool builders	0: invalid 1: valid
	BIT1				MTB bit para3-1		
	BIT2				MTB bit para3-2		
	BIT3				MTB bit para3-3		
	BIT4				MTB bit para3-4		
	BIT5				MTB bit para3-5		
	BIT6				MTB bit para3-6		
	BIT7				MTB bit para3-7		
#0054		MTBCustom	-	○	MTB bit para4		
	BIT0				MTB bit para4-0	A bit parameter that can be used freely by machine tool builders	0: invalid 1: valid
	BIT1				MTB bit para4-1		
	BIT2				MTB bit para4-2		
	BIT3				MTB bit para4-3		
	BIT4				MTB bit para4-4		
	BIT5				MTB bit para4-5		
	BIT6				MTB bit para4-6		
	BIT7				MTB bit para4-7		
#0055		MTBCustom	-	○	MTB bit para5		
	BIT0				MTB bit para5-0	A bit parameter that can be used freely by machine tool builders	0: invalid 1: valid
	BIT1				MTB bit para5-1		
	BIT2				MTB bit para5-2		
	BIT3				MTB bit para5-3		
	BIT4				MTB bit para5-4		
	BIT5				MTB bit para5-5		
	BIT6				MTB bit para5-6		
	BIT7				MTB bit para5-7		

No.	BIT	Function group	Type for clearing error (*1)		Name	Details	Setting range
			PR	UR			
#0056		MTBCustom	-	○	MTB bit para6		
	BIT0				MTB bit para6-0	A bit parameter that can be used freely by machine tool builders	0: invalid 1: valid
	BIT1				MTB bit para6-1		
	BIT2				MTB bit para6-2		
	BIT3				MTB bit para6-3		
	BIT4				MTB bit para6-4		
	BIT5				MTB bit para6-5		
	BIT6				MTB bit para6-6		
	BIT7				MTB bit para6-7		
#0057		MTBCustom	-	○	MTB bit para7		
	BIT0				MTB bit para7-0	A bit parameter that can be used freely by machine tool builders	0: invalid 1: valid
	BIT1				MTB bit para7-1		
	BIT2				MTB bit para7-2		
	BIT3				MTB bit para7-3		
	BIT4				MTB bit para7-4		
	BIT5				MTB bit para7-5		
	BIT6				MTB bit para7-6		
	BIT7				MTB bit para7-7		
#0058		MTBCustom	-	○	MTB bit para8		
	BIT0				MTB bit para8-0	A bit parameter that can be used freely by machine tool builders	0: invalid 1: valid
	BIT1				MTB bit para8-1		
	BIT2				MTB bit para8-2		
	BIT3				MTB bit para8-3		
	BIT4				MTB bit para8-4		
	BIT5				MTB bit para8-5		
	BIT6				MTB bit para8-6		
	BIT7				MTB bit para8-7		
#0059		MTBCustom	-	○	MTB bit para9		
	BIT0				MTB bit para9-0	A bit parameter that can be used freely by machine tool builders	0: invalid 1: valid
	BIT1				MTB bit para9-1		
	BIT2				MTB bit para9-2		
	BIT3				MTB bit para9-3		
	BIT4				MTB bit para9-4		
	BIT5				MTB bit para9-5		
	BIT6				MTB bit para9-6		
	BIT7				MTB bit para9-7		
#0060		MTBCustom	-	○	MTB bit para10		
	BIT0				MTB bit para10-0	A bit parameter that can be used freely by machine tool builders	0: invalid 1: valid
	BIT1				MTB bit para10-1		
	BIT2				MTB bit para10-2		
	BIT3				MTB bit para10-3		
	BIT4				MTB bit para10-4		
	BIT5				MTB bit para10-5		
	BIT6				MTB bit para10-6		
	BIT7				MTB bit para10-7		
#0209		MQTT	-	-	DRV narrowing down	Select how to narrow down DRV data in MQTT communication. 0: Feedback position, Position droop, Grid amount, Speed feedback, Current feedback, and Display status 1: Data for the set value "0" and control status "1" to "6"	0/1

No.	BIT	Function group	Type for clearing error (*1)		Name	Details	Setting range
			PR	UR			
#0211		DI/AI	-	○	IEPE Output1	Set the current output value of the constant current source in IEPE input mode on channels 1 to 3.	0: 4 mA 1: 4 mA 2: 2 mA 3: 3 mA 4: 4 mA 5: 5 mA 6: 6 mA 7: 7 mA 8: 8 mA 9: 9 mA 10: 10 mA
#0212		DI/AI	-	○	IEPE Output2	Set the current output value of the constant current source in IEPE input mode on channels 4 to 6.	
#0213		MQTT	-	○	MQTT send trigger	Select the trigger for sending the sampling data by MQTT communication. 0: Start trigger 1: Always send	0: Start trigger 1: Always send
#0251		MTBCustom	-	○	MTB char para1	A char type (1-byte) parameter that can be used freely by machine tool builders	-128 to 127
#0252		MTBCustom	-	○	MTB char para2		
#0253		MTBCustom	-	○	MTB char para3		
#0254		MTBCustom	-	○	MTB char para4		
#0255		MTBCustom	-	○	MTB char para5		
#0256		MTBCustom	-	○	MTB char para6		
#0257		MTBCustom	-	○	MTB char para7		
#0258		MTBCustom	-	○	MTB char para8		
#0259		MTBCustom	-	○	MTB char para9		
#0260		MTBCustom	-	○	MTB char para10		
#0402		Common	-	○	SNTP time lag (h)	Time difference from UTC to current location (hour) If a minus time difference is set, set a minus value for this parameter. (Example) #0402=0 #0403=30 -> +0 hour 30 minutes #0402=-1 #0403=30 -> -1 hour 30 minutes	-23 to 23
#0403		Common	-	○	SNTP time lag (m)	Time difference from UTC to current location (minute)	0 to 59
#0407		Common	-	○	SNTP Timeout	Set the timeout period (in seconds) for acquiring the time information from the SNTP server.	0 to 30 (sec) 0: 5 (sec) (Default value)
#0551		MTBCustom	-	○	MTB short para1	A short type (2-byte) parameter that can be used freely by machine tool builders	-32768 to 32767
#0552		MTBCustom	-	○	MTB short para2		
#0553		MTBCustom	-	○	MTB short para3		
#0554		MTBCustom	-	○	MTB short para4		
#0555		MTBCustom	-	○	MTB short para5		
#0556		MTBCustom	-	○	MTB short para6		
#0557		MTBCustom	-	○	MTB short para7		
#0558		MTBCustom	-	○	MTB short para8		
#0559		MTBCustom	-	○	MTB short para9		
#0560		MTBCustom	-	○	MTB short para10		
#0561		MTBCustom	-	○	MTB short para11		
#0562		MTBCustom	-	○	MTB short para12		
#0563		MTBCustom	-	○	MTB short para13		
#0564		MTBCustom	-	○	MTB short para14		
#0565		MTBCustom	-	○	MTB short para15		
#0566		MTBCustom	-	○	MTB short para16		
#0567		MTBCustom	-	○	MTB short para17		
#0568		MTBCustom	-	○	MTB short para18		
#0569		MTBCustom	-	○	MTB short para19		

No.	BIT	Function group	Type for clearing error (*1)		Name	Details	Setting range
			PR	UR			
#0570		MTBCustom	-	○	MTB short para20	A short type (2-byte) parameter that can be used freely by machine tool builders	-32768 to 32767
#0571		MTBCustom	-	○	MTB short para21		
#0572		MTBCustom	-	○	MTB short para22		
#0573		MTBCustom	-	○	MTB short para23		
#0574		MTBCustom	-	○	MTB short para24		
#0575		MTBCustom	-	○	MTB short para25		
#0576		MTBCustom	-	○	MTB short para26		
#0577		MTBCustom	-	○	MTB short para27		
#0578		MTBCustom	-	○	MTB short para28		
#0579		MTBCustom	-	○	MTB short para29		
#0580		MTBCustom	-	○	MTB short para30		
#0581		MTBCustom	-	○	MTB short para31		
#0582		MTBCustom	-	○	MTB short para32		
#0583		MTBCustom	-	○	MTB short para33		
#0584		MTBCustom	-	○	MTB short para34		
#0585		MTBCustom	-	○	MTB short para35		
#0586		MTBCustom	-	○	MTB short para36		
#0587		MTBCustom	-	○	MTB short para37		
#0588		MTBCustom	-	○	MTB short para38		
#0589		MTBCustom	-	○	MTB short para39		
#0590		MTBCustom	-	○	MTB short para40		
#0591		MTBCustom	-	○	MTB short para41		
#0592		MTBCustom	-	○	MTB short para42		
#0593		MTBCustom	-	○	MTB short para43		
#0594		MTBCustom	-	○	MTB short para44		
#0595		MTBCustom	-	○	MTB short para45		
#0596		MTBCustom	-	○	MTB short para46		
#0597		MTBCustom	-	○	MTB short para47		
#0598		MTBCustom	-	○	MTB short para48		
#0599		MTBCustom	-	○	MTB short para49		
#0600		MTBCustom	-	○	MTB short para50		
#0601		MTBCustom	-	○	MTB short para51		
#0602		MTBCustom	-	○	MTB short para52		
#0603		MTBCustom	-	○	MTB short para53		
#0604		MTBCustom	-	○	MTB short para54		
#0605		MTBCustom	-	○	MTB short para55		
#0606		MTBCustom	-	○	MTB short para56		
#0607		MTBCustom	-	○	MTB short para57		
#0608		MTBCustom	-	○	MTB short para58		
#0609		MTBCustom	-	○	MTB short para59		
#0610		MTBCustom	-	○	MTB short para60		
#0611		MTBCustom	-	○	MTB short para61		
#0612		MTBCustom	-	○	MTB short para62		
#0613		MTBCustom	-	○	MTB short para63		
#0614		MTBCustom	-	○	MTB short para64		
#0615		MTBCustom	-	○	MTB short para65		
#0616		MTBCustom	-	○	MTB short para66		
#0617		MTBCustom	-	○	MTB short para67		
#0618		MTBCustom	-	○	MTB short para68		

No.	BIT	Function group	Type for clearing error (*1)		Name	Details	Setting range
			PR	UR			
#0619		MTBCustom	-	○	MTB short para69	A short type (2-byte) parameter that can be used freely by machine tool builders	-32768 to 32767
#0620		MTBCustom	-	○	MTB short para70		
#0621		MTBCustom	-	○	MTB short para71		
#0622		MTBCustom	-	○	MTB short para72		
#0623		MTBCustom	-	○	MTB short para73		
#0624		MTBCustom	-	○	MTB short para74		
#0625		MTBCustom	-	○	MTB short para75		
#0626		MTBCustom	-	○	MTB short para76		
#0627		MTBCustom	-	○	MTB short para77		
#0628		MTBCustom	-	○	MTB short para78		
#0629		MTBCustom	-	○	MTB short para79		
#0630		MTBCustom	-	○	MTB short para80		
#0631		MTBCustom	-	○	MTB short para81		
#0632		MTBCustom	-	○	MTB short para82		
#0633		MTBCustom	-	○	MTB short para83		
#0634		MTBCustom	-	○	MTB short para84		
#0635		MTBCustom	-	○	MTB short para85		
#0636		MTBCustom	-	○	MTB short para86		
#0637		MTBCustom	-	○	MTB short para87		
#0638		MTBCustom	-	○	MTB short para88		
#0639		MTBCustom	-	○	MTB short para89		
#0640		MTBCustom	-	○	MTB short para90		
#0641		MTBCustom	-	○	MTB short para91		
#0642		MTBCustom	-	○	MTB short para92		
#0643		MTBCustom	-	○	MTB short para93		
#0644		MTBCustom	-	○	MTB short para94		
#0645		MTBCustom	-	○	MTB short para95		
#0646		MTBCustom	-	○	MTB short para96		
#0647		MTBCustom	-	○	MTB short para97		
#0648		MTBCustom	-	○	MTB short para98		
#0649		MTBCustom	-	○	MTB short para99		
#0650		MTBCustom	-	○	MTB short para100		
#1007		Common	-	○	Global IP Address	Set the IP address for global network.	0.0.0.0 to 255.255.255.255
#1008		Common	-	○	Global Subnet Mask	Set the sub-net mask for global network.	0.0.0.0 to 255.255.255.255
#1009		Common	-	○	Default Gateway	Set the default gateway.	0.0.0.0 to 255.255.255.255
#1010		Common	-	○	Local IP Address	Set the IP address for local network.	0.0.0.0 to 255.255.255.255
#1011		Common	-	○	Local Subnet Mask	Set the sub-net mask for local network.	0.0.0.0 to 255.255.255.255
#1012		Common	-	○	Preferred DNS	Set the IP address of preferred DNS. <Note> This parameter is disabled when the DHCP function is enabled.	0.0.0.0 to 255.255.255.255 0.0.0.0: DNS invalid (Default value) 255.255.255.255 : DNS invalid

No.	BIT	Function group	Type for clearing error (*1)		Name	Details	Setting range
			PR	UR			
#1013		Common	-	○	Alternate DNS	Set the IP address of alternate DNS. <Note> This parameter is disabled when the DHCP function is enabled.	0.0.0.0 to 255.255.255.255 0.0.0.0: Alternate DNS invalid (Default value) 255.255.255.255: Alternate DNS invalid
#1014		Common	-	○	Local Default GW	Set the default gateway for local network.	0.0.0.0 to 255.255.255.255
#1015		Common	-	○	G IP Filter1 Top	Set the top IP address of IP address filter range 1 for global network.	0.0.0.0 to 255.255.255.255
#1016		Common	-	○	G IP Filter1 End	Set the end IP address of IP address filter range 1 for global network.	
#1017		Common	-	○	G IP Filter2 Top	Set the top IP address of IP address filter range 2 for global network.	
#1018		Common	-	○	G IP Filter2 End	Set the end IP address of IP address filter range 2 for global network.	
#1019		Common	-	○	G IP Filter3 Top	Set the top IP address of IP address filter range 3 for global network.	
#1020		Common	-	○	G IP Filter3 End	Set the end IP address of IP address filter range 3 for global network.	
#1021		Common	-	○	G IP Filter4 Top	Set the top IP address of IP address filter range 4 for global network.	
#1022		Common	-	○	G IP Filter4 End	Set the end IP address of IP address filter range 4 for global network.	
#1023		Common	-	○	G IP Filter5 Top	Set the top IP address of IP address filter range 5 for global network.	
#1024		Common	-	○	G IP Filter5 End	Set the end IP address of IP address filter range 5 for global network.	
#1025		Common	-	○	G IP Filter6 Top	Set the top IP address of IP address filter range 6 for global network.	
#1026		Common	-	○	G IP Filter6 End	Set the end IP address of IP address filter range 6 for global network.	
#1027		Common	-	○	G IP Filter7 Top	Set the top IP address of IP address filter range 7 for global network.	
#1028		Common	-	○	G IP Filter7 End	Set the end IP address of IP address filter range 7 for global network.	
#1029		Common	-	○	G IP Filter8 Top	Set the top IP address of IP address filter range 8 for global network.	
#1030		Common	-	○	G IP Filter8 End	Set the end IP address of IP address filter range 8 for global network.	
#1031		Common	-	○	L IP Filter1 Top	Set the top IP address of IP address filter range 1 for local network.	0.0.0.0 to 255.255.255.255
#1032		Common	-	○	L IP Filter1 End	Set the end IP address of IP address filter range 1 for local network.	
#1033		Common	-	○	L IP Filter2 Top	Set the top IP address of IP address filter range 2 for local network.	
#1034		Common	-	○	L IP Filter2 End	Set the end IP address of IP address filter range 2 for local network.	
#1035		Common	-	○	L IP Filter3 Top	Set the top IP address of IP address filter range 3 for local network.	
#1036		Common	-	○	L IP Filter3 End	Set the end IP address of IP address filter range 3 for local network.	
#1037		Common	-	○	L IP Filter4 Top	Set the top IP address of IP address filter range 4 for local network.	

No.	BIT	Function group	Type for clearing error (*1)		Name	Details	Setting range
			PR	UR			
#1038		Common	-	○	L IP Filter4 End	Set the end IP address of IP address filter range 4 for local network.	0.0.0.0 to 255.255.255.255
#1039		Common	-	○	L IP Filter5 Top	Set the top IP address of IP address filter range 5 for local network.	
#1040		Common	-	○	L IP Filter5 End	Set the end IP address of IP address filter range 5 for local network.	
#1041		Common	-	○	L IP Filter6 Top	Set the top IP address of IP address filter range 6 for local network.	
#1042		Common	-	○	L IP Filter6 End	Set the end IP address of IP address filter range 6 for local network.	
#1043		Common	-	○	L IP Filter7 Top	Set the top IP address of IP address filter range 7 for local network.	
#1044		Common	-	○	L IP Filter7 End	Set the end IP address of IP address filter range 7 for local network.	
#1045		Common	-	○	L IP Filter8 Top	Set the top IP address of IP address filter range 8 for local network.	
#1046		Common	-	○	L IP Filter8 End	Set the end IP address of IP address filter range 8 for local network.	
#1051		MQTT	-	-	broker IP Address	Set the IP address of the MQTT broker to be connected.	0.0.0.0 to 255.255.255.255
#1151		MTBCustom	-	○	MTB long para1	A long type (4-byte) parameter that can be used freely by machine tool builders	-2147483648 to 2147483647
#1152		MTBCustom	-	○	MTB long para2		
#1153		MTBCustom	-	○	MTB long para3		
#1154		MTBCustom	-	○	MTB long para4		
#1155		MTBCustom	-	○	MTB long para5		
#1156		MTBCustom	-	○	MTB long para6		
#1157		MTBCustom	-	○	MTB long para7		
#1158		MTBCustom	-	○	MTB long para8		
#1159		MTBCustom	-	○	MTB long para9		
#1160		MTBCustom	-	○	MTB long para10		
#1161		MTBCustom	-	○	MTB long para11		
#1162		MTBCustom	-	○	MTB long para12		
#1163		MTBCustom	-	○	MTB long para13		
#1164		MTBCustom	-	○	MTB long para14		
#1165		MTBCustom	-	○	MTB long para15		
#1166		MTBCustom	-	○	MTB long para16		
#1167		MTBCustom	-	○	MTB long para17		
#1168		MTBCustom	-	○	MTB long para18		
#1169		MTBCustom	-	○	MTB long para19		
#1170		MTBCustom	-	○	MTB long para20		
#1171		MTBCustom	-	○	MTB long para21		
#1172		MTBCustom	-	○	MTB long para22		
#1173		MTBCustom	-	○	MTB long para23		
#1174		MTBCustom	-	○	MTB long para24		
#1175		MTBCustom	-	○	MTB long para25		
#1176		MTBCustom	-	○	MTB long para26		
#1177		MTBCustom	-	○	MTB long para27		
#1178		MTBCustom	-	○	MTB long para28		
#1179		MTBCustom	-	○	MTB long para29		
#1180		MTBCustom	-	○	MTB long para30		
#1181		MTBCustom	-	○	MTB long para31		
#1182		MTBCustom	-	○	MTB long para32		

No.	BIT	Function group	Type for clearing error (*1)		Name	Details	Setting range
			PR	UR			
#1183		MTBCustom	-	○	MTB long para33	A long type (4-byte) parameter that can be used freely by machine tool builders	-2147483648 to 2147483647
#1184		MTBCustom	-	○	MTB long para34		
#1185		MTBCustom	-	○	MTB long para35		
#1186		MTBCustom	-	○	MTB long para36		
#1187		MTBCustom	-	○	MTB long para37		
#1188		MTBCustom	-	○	MTB long para38		
#1189		MTBCustom	-	○	MTB long para39		
#1190		MTBCustom	-	○	MTB long para40		
#1191		MTBCustom	-	○	MTB long para41		
#1192		MTBCustom	-	○	MTB long para42		
#1193		MTBCustom	-	○	MTB long para43		
#1194		MTBCustom	-	○	MTB long para44		
#1195		MTBCustom	-	○	MTB long para45		
#1196		MTBCustom	-	○	MTB long para46		
#1197		MTBCustom	-	○	MTB long para47		
#1198		MTBCustom	-	○	MTB long para48		
#1199		MTBCustom	-	○	MTB long para49		
#1200		MTBCustom	-	○	MTB long para50		
#1201		MTBCustom	-	○	MTB long para51		
#1202		MTBCustom	-	○	MTB long para52		
#1203		MTBCustom	-	○	MTB long para53		
#1204		MTBCustom	-	○	MTB long para54		
#1205		MTBCustom	-	○	MTB long para55		
#1206		MTBCustom	-	○	MTB long para56		
#1207		MTBCustom	-	○	MTB long para57		
#1208		MTBCustom	-	○	MTB long para58		
#1209		MTBCustom	-	○	MTB long para59		
#1210		MTBCustom	-	○	MTB long para60		
#1211		MTBCustom	-	○	MTB long para61		
#1212		MTBCustom	-	○	MTB long para62		
#1213		MTBCustom	-	○	MTB long para63		
#1214		MTBCustom	-	○	MTB long para64		
#1215		MTBCustom	-	○	MTB long para65		
#1216		MTBCustom	-	○	MTB long para66		
#1217		MTBCustom	-	○	MTB long para67		
#1218		MTBCustom	-	○	MTB long para68		
#1219		MTBCustom	-	○	MTB long para69		
#1220		MTBCustom	-	○	MTB long para70		
#1221		MTBCustom	-	○	MTB long para71		
#1222		MTBCustom	-	○	MTB long para72		
#1223		MTBCustom	-	○	MTB long para73		
#1224		MTBCustom	-	○	MTB long para74		
#1225		MTBCustom	-	○	MTB long para75		
#1226		MTBCustom	-	○	MTB long para76		
#1227		MTBCustom	-	○	MTB long para77		
#1228		MTBCustom	-	○	MTB long para78		
#1229		MTBCustom	-	○	MTB long para79		
#1230		MTBCustom	-	○	MTB long para80		

No.	BIT	Function group	Type for clearing error (*1)		Name	Details	Setting range
			PR	UR			
#1231		MTBCustom	-	○	MTB long para81	A long type (4-byte) parameter that can be used freely by machine tool builders	-2147483648 to 2147483647
#1232		MTBCustom	-	○	MTB long para82		
#1233		MTBCustom	-	○	MTB long para83		
#1234		MTBCustom	-	○	MTB long para84		
#1235		MTBCustom	-	○	MTB long para85		
#1236		MTBCustom	-	○	MTB long para86		
#1237		MTBCustom	-	○	MTB long para87		
#1238		MTBCustom	-	○	MTB long para88		
#1239		MTBCustom	-	○	MTB long para89		
#1240		MTBCustom	-	○	MTB long para90		
#1241		MTBCustom	-	○	MTB long para91		
#1242		MTBCustom	-	○	MTB long para92		
#1243		MTBCustom	-	○	MTB long para93		
#1244		MTBCustom	-	○	MTB long para94		
#1245		MTBCustom	-	○	MTB long para95		
#1246		MTBCustom	-	○	MTB long para96		
#1247		MTBCustom	-	○	MTB long para97		
#1248		MTBCustom	-	○	MTB long para98		
#1249		MTBCustom	-	○	MTB long para99		
#1250		MTBCustom	-	○	MTB long para100		
#1607		Common	-	○	SNTP Server	Set the name of SNTP (time synchronization) server or the IP address of the SNTP server. If the server name exceeds 63 characters, set the IP address. When specifying the server name, enable the DHCP function or set a DNS server.	String (maximum 63 characters)
#1608		MQTT	-	-	MQTT Unit Name	Set the unit name required when broker is connected.	String
#1609		MQTT	-	-	MQTT User Name	When authenticating users, set the user name required when broker is connected.	String
#1610		MQTT	-	-	MQTT Password	When password authentication is performed, set the password required when broker is connected.	String
#1801		RIO	○	○	RIO-S Vrtl St. num	Set the virtual rotary switch number as RIO local station to connect NC. Set it from "0" to "63". It is invalid if "-1" is set.	-1 to 63
#1802		RIO	○	○	RIO-M Trsf St. num	If transfer will be performed between the local station connected to the RIO master of the unit and the local station inside the unit, set the rotary switch number of the local station connected to the unit. With this setting, information can be exchanged between NC and the local station connected to the unit. Set it from "0" to "63". It is invalid if "-1" is set.	-1 to 63
#1803		DI/AI	-	-	AI Input Data Rng	Set the input voltage range (upper limit) to be used for scale conversion with the analog input CH1 to CH6.	0 to 10
#1804		DI/AI	-	-	AI Scaling Max	Set the scaling range (upper limit) for scale conversion with analog input CH1 to CH6.	-32768 to 32767
#1805		DI/AI	-	-	AI Scaling Min	Set the scaling range (lower limit) for scale conversion with analog input CH1 to CH6.	-32768 to 32767
#1806		DI/AI	-	-	AI Offset num	Set the scaling offset value for scale conversion with analog input CH1 to CH6.	-32768 to 32767

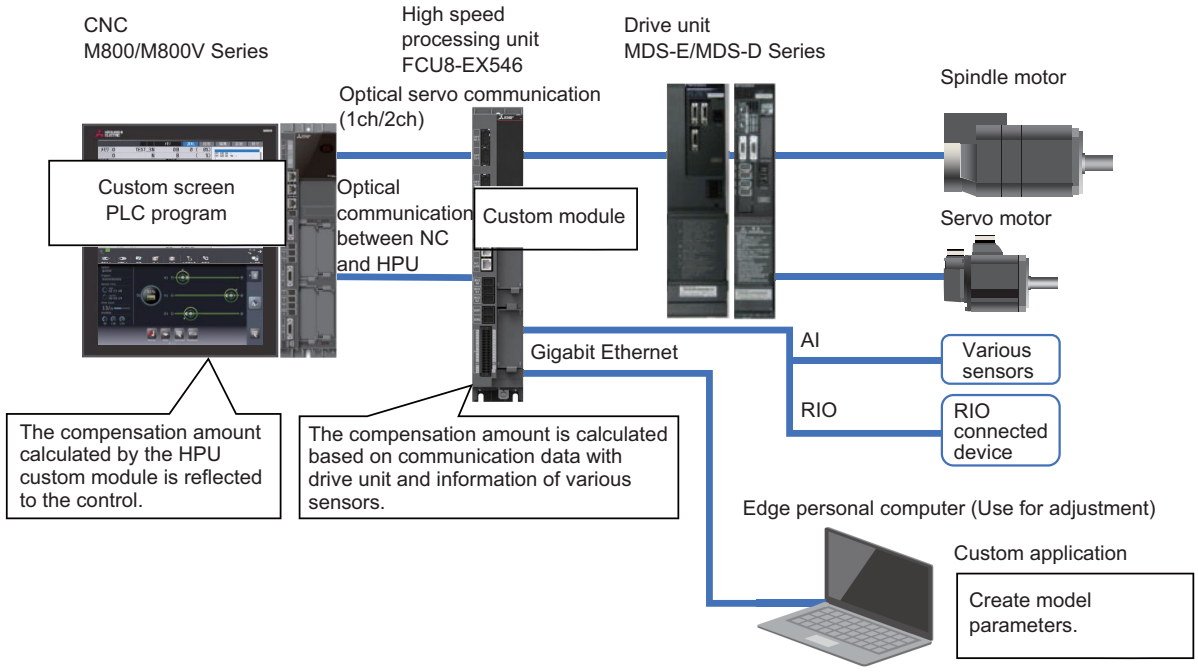
No.	BIT	Function group	Type for clearing error (*1)		Name	Details	Setting range
			PR	UR			
#1807		NC-DRV	-	-	TorqueConst.TH ch1	(Not used)	
#1808		NC-DRV	-	-	TorqueConst.TH ch2	(Not used)	
#1809		NC-DRV	-	-	TorqueConst.TL ch1	(Not used)	
#1810		NC-DRV	-	-	TorqueConst.TL ch2	(Not used)	
#1811		NC-DRV	-	-	TorqueConst.NH ch1	(Not used)	
#1812		NC-DRV	-	-	TorqueConst.NH ch2	(Not used)	
#1813		NC-DRV	-	-	TorqueConst.NL ch1	(Not used)	
#1814		NC-DRV	-	-	TorqueConst.NL ch2	(Not used)	

4

Building Custom Functions

4.1 Outline

The following software needs to be developed to realize original functions such as visualization of the processing situation and control to improve machining quality in the high speed processing unit.



[Custom module]

This is a software to be integrated in the high speed processing unit.

The following processes can be performed with the custom module.

- Acquisition of signals of remote I/O connected to the high speed processing unit, information of sensor connected to the analog input, and various information of servo and NC in real time
- Compensation of the override amount of rapid traverse rate and cutting feedrate
- Compensation of the machine error
- Advanced compensation based on model parameter

The custom module is developed in C language. NC Compiler2 is used to generate the module.

[Analysis function module]

This is a software to be integrated in the edge personal computer.

Model parameter to be used for compensation function is created by linking with the custom module of the high speed processing unit.

The analysis function module is implemented in the form of DLL (Dynamic Link Library) and integrated in the application (HPU Connector) supplied by Mitsubishi Electric.

[Custom screen/PLC program]

Model parameter can be created on the edge personal computer, by M code command and button operation on the custom screen.

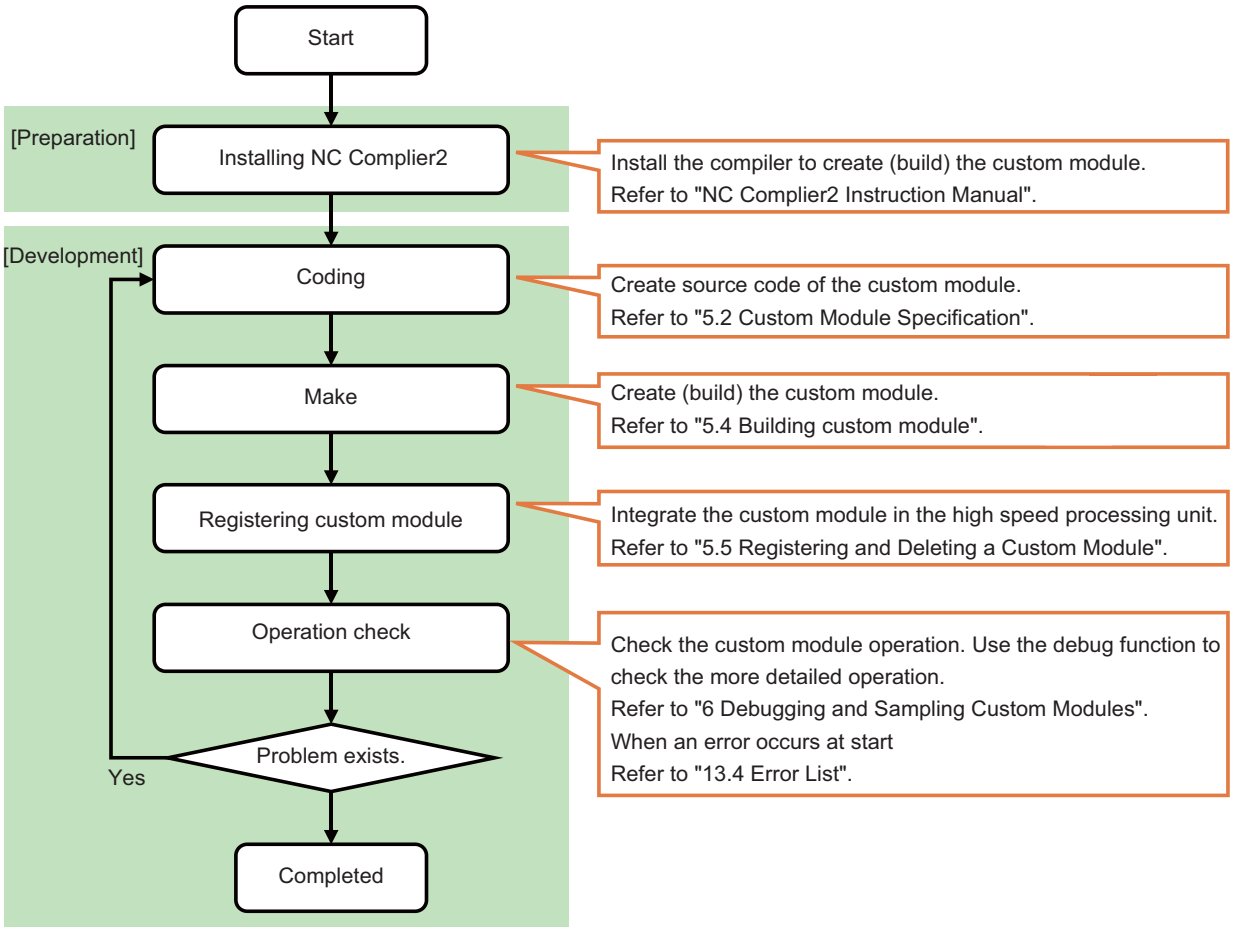
Dedicated PLC signals are controlled by PLC program.

5

Development of Custom Module

5.1 Custom Module Development Flow

Develop the custom module by following the flow below.
For information on installing NC Compiler2 and configuring environment settings, refer to the NC Compiler2 Instruction Manual. The environment settings using a batch file must be performed every time you start the command prompt.



5.2 Custom Module Specification

Create the custom module according to the specification below, such as size, name, etc.

[Custom module specification list]

Item	Details
Maximum number of registrations	5
Total size of all modules	Within 5 MB
Execution cycle	Select from 3.5 ms, 56.8 ms, and 1820 ms. (Parameter)
External variable size limit	Up to 10 MB per module
Generation tool	NC Compiler2

[Custom module and main function names]

Item	Name
Custom module	mtbobj(N).o
Initialization function	void mtb(N)_ini(void)
Main function (Execution cycle: 3.5ms)	void mtb(N)_main3_5(void)
Main function (Execution cycle: 56.8ms)	void mtb(N)_main56_8(void)
Main function (Execution cycle: 1820ms)	void mtb(N)_main1820(void)

Replace the (N) part of the name with the number of the custom module.
For example, assume that the custom module number (N) is "1" and the main function with an execution cycle of 56.8 ms is "mtb1_main56_8()". Also, assume that the custom module to be generated is "mtbobj1.o".

Follow the rules below to name the structures, external variables, and functions used in custom modules.
Structure: Add "MTB(N)_" (uppercase) as a prefix.
External variable: Add "mtb(N)_" as a prefix.
Function: Add "mtb(N)_" as a prefix.

Set the following parameters to execute a custom module.
BIT0 to BIT4 of each parameter correspond to custom module number "N" ("N" is 1 to 5).
For example, if you want to execute the custom module with number 1 at the 56.8 ms frequency, set "#0016/bit0" and "#0018/bit0" to "1".

(1) Specify a valid module.
#0016/BIT0 to BIT4: The module with the ON bit is enabled.

(2) Specify the operating cycle of the module.
#0017/BIT0 to BIT4: The main function "mtb(N)_main3_5()" of the module with the ON bit operates at a 3.5 ms cycle.
#0018/BIT0 to BIT4: The main function "mtb(N)_main56_8()" of the module with the ON bit operates at a 56.8 ms cycle.
#0019/BIT0 to BIT4: The main function "mtb(N)_main1820()" of the module with the ON bit operates at a 1820 ms cycle.

Note

(1) Set the parameter #0016 to match the module name "mtbobj(N).o".
(2) Set the parameters #0017 to #0019 to match the registered module number, main function name and execution cycle.
(3) If the parameter is inconsistent with the module number, main function name or execution cycle, an error occurs when the high speed processing unit starts. For the error, refer to "13 LED Display".

5.2.1 Program Example

Below is a description example of source codes of initialization function and main function when the custom module number (N) is "1".

The initialization function "mtb1_ini()" is called once when the high speed processing unit starts.
The main function "mtb1_main3_5()" is called at a 3.5 ms cycle after the initialization function is called.
The main functions "mtb1_main56_8()" and "mtb1_main1820()" are different in the call cycle from "mtb1_main3_5()" but the same in the other operations.

Set the character code to UTF-8 (no BOM), and the line feed code to LF.
File name: mtb1main.c

```
/* module 1 version */
char mtb1_ver[20] = "MODULE1-0001";
/* initialization function */
void mtb1_ini(void)
{
  return;
}
/* 3.5 ms cycle main function */
void mtb1_main3_5(void)
{
  return;
}
/* 56.8 ms cycle main function */
void mtb1_main56_8(void)
{
  return;
}
/* 1820 ms cycle main function */
void mtb1_main1820(void)
{
  return;
}
```

Version definition for custom module

The custom module can have the version defined (optional).
For the variable name of the version definition for the custom module, set "char mtb(N)_ver[20]".
Follow the example below to set the version using an initializer.
If the number of characters in the version exceeds 20 characters, 19 characters and the null-terminated character are handled as the version.

(Example) When setting the version of custom module 1

```
char mtb1_ver[20] = "MODULE1-0001";
```

5.2.2 Customization Parameters

Customization parameters are parameters that can be freely defined by MTB.
They can be checked and set on the same screen as the high speed processing unit parameters. (Refer to "3 High Speed Processing Unit Parameters".)

The customization parameter numbers are as follows. (*1)

#0051 to #0060: They are in bit format (bit0 to bit7). Each bit can be turned ON/OFF.
#0251 to #0260: They are in char type (1 byte). A value of "-128" to "127" can be set.
#0551 to #0650: They are in short type (2 bytes). A value of "-32768" to "32767" can be set.
#1151 to #1250: They are in long type (4 bytes). A value of "-2147483648" to "2147483647" can be set.

To refer to the parameter from the custom module, specify "DATA_READ_PARAM" as the section ID and parameter No. as the sub-section ID in the data acquisition function "dataRead()". (*2)

(*1) The MTB should manage what is assigned to the customization parameters.
(*2) The parameters cannot be set from the custom module.

5.3 Internal Data Access Function

Original compensation functions can be built by obtaining information of device and NC connected to the high speed processing unit at fixed intervals and feeding back the calculated compensation values to the NC.

The internal data access function is used to obtain and output data at fixed cycles.
The following data can be obtained with this function.

- Remote I/O (master/local) signal
- Analog input
- Servo axis/spindle information

Also, the following data can be output at fixed cycles.

- Remote I/O (master/local) output side signal
- Compensation value of each override amount of cutting feedrate, rapid traverse rate and spindle speed
- Compensation value of machine error compensation amount

Refer to "9 Library Functions" for details.

Operation of the developed custom module can be checked with the debug function.
Refer to "6 Debugging and Sampling the Custom Module".

The compensation function based on the model parameter can be built by linking with the edge personal computer.
Refer to "7 Creating Model Parameter" for link function with edge personal computer.

5.3.1 Obtaining NC Information

The table below shows NC information that can be obtained from the custom module.
To obtain these data, optical communication interface between NC and HPU is used. Set the NC parameter "#1762 cfgPR12/bit0" to "1" (Enable).
IDs of the data to be received in the optical communication interface need to be added in advance.
For the data ID, refer to "10 NC-HPU Optical Communication, Send/Receive Data ID". To add the ID, refer to the operation example in "9.1.5 NC-HPU Optical Communication, Send Data ID Operation Enabled/Disabled Check: nchpuTxCtrlCheck".

Classification	Data
Information by part system	Operation status
	Operation mode
	Tool type
	The number of tool edges
	Modal information
	Feedrate
	1st cutting feed override
	2nd cutting feed override
	Rapid traverse override
Information by spindle	Spindle override
Compensation state	Compensation state of cutting feed override
	Compensation state of rapid traverse override
	Compensation state of spindle override
	Compensation state of machine error compensation amount

5.3.2 Outputting Compensation Data / Arbitrary Data to NC

Data below can be output from the custom module to NC.
To output these data, optical communication interface between NC and HPU is used. Enable the following NC parameters.

- Set "#1762 cfgPR12/bit0" to "1" (Enable).
- Set "#1766 cfgPR16/bit0" to "0" (Enable).

IDs of the data to be sent in the optical communication interface need to be added in advance.
For the data ID, refer to "10 NC-HPU Optical Communication, Send/Receive Data ID". To add the ID, refer to the operation example in "9.1.5 NC-HPU Optical Communication, Send Data ID Operation Enabled/Disabled Check: nchpuTxCtrlCheck".

To perform compensation control by using the model parameter, obtain the model parameter saved in the high speed processing unit in "9.3.5 Model parameter acquisition: hpuModelParamRead" and output the compensation amount, etc. to NC after calculation.

(*) For methods of creating the model parameter and storing it in the high speed processing unit, refer to "7 Creating Model Parameter".

Classification	Data
Compensation amount	Cutting feed override
	Rapid traverse override
	Spindle override
	Machine error compensation amount
Others	Custom module arbitrary data

(1) Cutting feed override

The cutting override specified on the machine operation panel is applied to the cutting feedrate in automatic operation, then the compensation value override is applied to the resultant feedrate.
When the scale-applied cutting feed override exceeds the upper limit value, it is clamped at the upper limit value.
While the scale is applied, the custom module cutting feed override compensation status (ZR4960) is turned ON.
When the application conditions are not met, the compensation value is the default value.

Application conditions of compensation value	When all the following conditions are met, the compensation value is applied. • During cycle start • During optical communication between NC and HPU • The custom module informs about the compensation value of cutting feed override.
Default value of compensation value	100%
Lower limit value of compensation value	0% (When the value is less than the lower limit value, it is clamped at 0%.)
Upper limit value of compensation value	300% (When the value exceeds the upper limit value, it is clamped at 300%.)

(2) Rapid traverse override

The rapid traverse override specified on the machine operation panel is applied to the rapid traverse rate in automatic operation, then the compensation value override is applied to the resultant rate.(*1)
When the scale-applied rapid traverse override exceeds the upper limit value, it is clamped at the upper limit value.
While the scale is applied, the custom module rapid traverse override compensation status (ZR4961) is turned ON.
When the application conditions are not met, the compensation value is the default value.

(*1) In the following cases, the override by custom module is not applied.
- G00 command when the NC parameter "#1086 G0Intp" (G00 non-interpolation) is "1"
- Command for non-interpolation operation

Application conditions of compensation value	When all the following conditions are met, the compensation value is applied. • During cycle start • During optical communication between NC and HPU • The custom module informs about the compensation value of rapid traverse override. • The movement by rapid traverse is the interpolation type.
Default value of compensation value	100%
Lower limit value of compensation value	0% (When the value is less than the lower limit value, it is clamped at 0%.)
Upper limit value of compensation value	100% (When the value exceeds the upper limit value, it is clamped at 100%.)

(3) Spindle override

The spindle override specified on the machine operation panel is applied to the spindle rotation speed in automatic operation, then the compensation value override is applied to the resultant rotation speed.
When the scale-applied spindle override exceeds the upper limit value, it is clamped at the upper limit value.
While the scale is applied, the custom module spindle override compensation status (ZR4978) is turned ON.
When the application conditions are not met, the compensation value is the default value.

Application conditions of compensation value	When all the following conditions are met, the compensation value is applied. • During cycle start • During optical communication between NC and HPU • The custom module informs about the compensation value of spindle override.
Default value of compensation value	100%
Lower limit value of compensation value	0% (If the specified value is less than the lower limit value, the default value is set.)
Upper limit value of compensation value	200% (When the value exceeds the upper limit value, it is clamped at 200%.)

(4) Machine error compensation amount

The compensation amount calculated by the custom module is added to the machine error compensation amount. The range of the compensation amount that can be compensated by the custom module is from -1 mm to +1 mm. When the compensation amount is out of the range, it is clamped at the lower limit value and the upper limit value.
The unit of the machine error compensation amount by the custom module is always mm (1/20000 mm (0.05 μm)) regardless of inch or mm. The compensation value is enabled even during NC reset or emergency stop, and is added to the machine error compensation amount. While the compensation is performed, the custom module machine error compensation amount compensation status (ZR4976, ZR4977) is turned ON.
When the application conditions are not met, the compensation value is the default value.

Application conditions of compensation value	When all the following conditions are met, the compensation value is applied. • During optical communication between NC and HPU • The custom module informs about the compensation value of machine error compensation amount.
Default value of compensation value	0mm
Lower limit value of compensation value	-1 mm (When the value is less than the lower limit value, it is clamped at -1 mm.)
Upper limit value of compensation value	+1 mm (When the value exceeds the upper limit value, it is clamped at +1 mm.)

(5) Custom module arbitrary data

Arbitrary data can be sent to ZR registers of the NC. Arbitrary data can be freely defined by the custom module. Set the arbitrary data in 8-byte unit by using optical communication between NC and HPU, divide the set data into 2 bytes, and output them to four ZR registers.

Update conditions of ZR register	When all the following conditions are met, the ZR register is updated. • During optical communication between NC and HPU • The custom module informs about the custom module information.
Behavior when the update conditions are not met	The ZR register is not updated, and the previous data remains. However, the ZR register where arbitrary data is output at start of NC is cleared to zero.

Example of output to ZR register (Data ID: 0x2300)

NC-HPU optical communication data ID: x2300

byte	Data contents
1	User definition
2	User definition
3	User definition
4	User definition
5	User definition
6	User definition
7	User definition
8	User definition

Output by dividing into 2 bytes

ZR register

Register No.	Data contents
ZR4880	User definition (1st byte)
	User definition (2nd byte)
ZR4881	User definition (3rd byte)
	User definition (4th byte)
ZR4882	User definition (5th byte)
	User definition (6th byte)
ZR4883	User definition (7th byte)
	User definition (8th byte)

* No. depends on the used data ID.

The ZR register number differs depending on the data ID defined by the optical communication between NC and HPU. Refer to the table below for correspondence between data ID and ZR register. Up to 20 data IDs are available for custom module information, and up to 160 bytes of data can be output. However, when two or more custom modules are used, do not overlap the data IDs between the custom modules. If the data IDs are overlapped, the data may be overwritten by one custom module before the data updated by the other custom module is informed to NC.

Data ID	ZR register		Data ID	ZR register
0x2300	ZR4880 to ZR4883		0x230A	ZR4920 to ZR4923
0x2301	ZR4884 to ZR4887		0x230B	ZR4924 to ZR4927
0x2302	ZR4888 to ZR4891		0x230C	ZR4928 to ZR4931
0x2303	ZR4892 to ZR4895		0x230D	ZR4932 to ZR4935
0x2304	ZR4896 to ZR4899		0x230E	ZR4936 to ZR4939
0x2305	ZR4900 to ZR4903		0x230F	ZR4940 to ZR4943
0x2306	ZR4904 to ZR4907		0x2400	ZR4944 to ZR4947
0x2307	ZR4908 to ZR4911		0x2401	ZR4948 to ZR4951
0x2308	ZR4912 to ZR4915		0x2402	ZR4952 to ZR4955
0x2309	ZR4916 to ZR4919		0x2403	ZR4956 to ZR4959

5.3.3 Behavior when NC function and compensation data are used together

This describes behaviors when compensation by the custom module and another function are used together.

- Override cancel
  When the override cancel (OVC) is ON, cutting feed override compensation by the custom module is disabled.

- Spindle synchronization, Tool spindle synchronization IA/IB/IC/II, Spindle superimposition
  Spindle override compensation by the custom module is enabled for the reference axis. In this case, the compensation for the reference axis is also applied to the synchronized axis.

- Spindle oscillation
  During spindle oscillation, spindle override compensation by the custom module is disabled.

- Spindle-mode rotary axis control
  When the rotary axis is operated as the spindle by spindle-mode rotary axis control, spindle override compensation by the custom module is disabled.

- Spindle position control (Spindle/C axis control)
  When the spindle is operated as the C axis by spindle position control (spindle/C axis control), cutting feed override compensation and rapid traverse override compensation by the custom module are disabled.

- Synchronous control, Multiple-axis synchronization control, Control axis superimposition, Control axis synchronization between part systems
  Cutting feed override compensation and rapid traverse override compensation by the custom module are enabled for the reference axis. In this case, the compensation for the reference axis is also applied to the synchronized axis.
  The table below shows behavior of machine error compensation amount by the custom module.

Synchronous control	Simple synchronous control	Multiple-axis synchronization control	Control axis synchronization between part systems	Control axis superimposition
Compensate each axis. (*1)	Compensate synchronously with the reference axis.	Compensate each axis.	Compensate each axis.	Compensate each axis.

  (*1) For machine error compensation of the custom module during synchronous control, the machine error compensation amount set for each axis is used regardless of "#1281 ext17/bit6" (Compensation method for external machine coordinate system/ball screw thermal expansion during synchronization).

- Spindle orientation
  During spindle orientation, spindle override compensation by the custom module is disabled.

- Manual reference position return
  During manual reference position return, rapid traverse override compensation by the custom module is disabled.
  During the return, the machine error compensation amount by the custom module is not applied even when it is updated, and the operation is performed with the compensation amount before the update. However, at the time of dog-type reference position return, the machine error compensation amount by the custom module is not applied.

- Automatic 1st reference position return, 2nd, 3rd, 4th reference position return
  During automatic reference position return, rapid traverse override compensation by the custom module is enabled for movement from start point to interim point, and rapid traverse override compensation by the custom module is disabled for movement from interim point to reference position. When the NC parameter "#1086 G0Intp" is "1" (non-interpolation) or when the NC parameter "#1091 Mpoint" is "1" (Ignore the middle point designated in the program and move straight to the reference point.), rapid traverse override compensation by the custom module is disabled even for movement from start point to interim point.
  During the return, the machine error compensation amount by the custom module is not applied even when it is updated, and the operation is performed with the compensation amount before the update. However, at the time of dog-type reference position return, the machine error compensation amount by the custom module is not applied.

- Dry run
  During dry run, cutting feed override compensation and rapid traverse override compensation by the custom module are disabled.

- Manual arbitrary reverse run
  During manual arbitrary reverse run, cutting feed override compensation and rapid traverse override compensation by the custom module are disabled.

- Program restart
  After the restart search, while the axis is returning to the restart position, rapid traverse override compensation by the custom module is disabled. It is enabled after the axis returns.

- Manual interruption, Simultaneous operation of manual and automatic modes, Automatic operation handle interruption
  For feedrate commanded by automatic operation (tape, MDI or memory), cutting override compensation and rapid traverse override compensation by the custom module are enabled.
  For feedrate by manual operation (handle, step, jog or manual reference position return), they are disabled.

- Constant torque control
  During constant torque control, cutting feed override compensation and rapid traverse override compensation by the custom module are disabled.

- Programmable current limitation
  During current limitation, cutting feed override compensation and rapid traverse override compensation by the custom module are disabled.

- Cutting load control
  During cutting load control, cutting feed override compensation by the custom module is enabled. However, the cutting feed override may vary depending on the cutting load.

- External deceleration
  Cutting feed override compensation by the custom module is enabled; however, if the resultant feedrate exceeds the external deceleration speed, it is clamped at the external deceleration speed.

- F 1-digit feed
  During F 1-digit feed command, cutting feed override compensation by the custom module is enabled. When "F0" is commanded, rapid traverse override compensation by the custom module is enabled. However, the speed cannot be changed by manual handle.

- Manual speed command
  During manual speed command, cutting feed override compensation and rapid traverse override compensation by the custom module are disabled.

- Thread cutting
  During thread cutting, cutting feed override compensation and spindle override compensation by the custom module are disabled. During retract, rapid traverse override compensation by the custom module is disabled. When thread cutting override and variable feed thread cutting are enabled, spindle override is enabled; however, spindle override compensation by the custom module is disabled.

- Tapping, Tapping retract
  During tapping and tapping retract, cutting feed override compensation and spindle override compensation by the custom module are disabled.

- Dwell
  Spindle override compensation by the custom module is enabled.
  For dwell (revolution-based designation), when the spindle rotation speed changes by spindle override, the spindle rotation wait time also changes.
  For dwell (time-based designation), when dwell/miscellaneous function time override is enabled, cutting feed override is applied to the wait time; however, cutting feed override compensation by the custom module is disabled.

- Backlash compensation
  Machine error compensation amount by the custom module is added to backlash compensation amount.

- Memory-type pitch error compensation
  Machine error compensation amount by the custom module is added to memory-type pitch error compensation amount.

- Memory-type relative position error compensation
  Machine error compensation amount by the custom module is added to memory-type relative position error compensation amount.

- External machine coordinate system compensation
  Machine error compensation amount by the custom module is added to external machine coordinate system compensation amount.

- Circular radius error compensation
  Machine error compensation amount by the custom module is added to circular radius error compensation amount.

- Ball screw thermal expansion compensation
  Machine error compensation amount by the custom module is added to ball screw thermal expansion compensation amount.

- Rotation center error compensation
  Machine error compensation amount by the custom module is added to rotation center error compensation amount.

- Position-dependent gradually increasing-type backlash compensation
  Machine error compensation amount by the custom module is added to position-dependent gradually increasing-type backlash compensation amount.

- Bidirectional pitch error compensation
  Machine error compensation amount by the custom module is added to bidirectional pitch error compensation amount.

- Spatial error compensation
  Machine error compensation amount by the custom module is added to spatial error compensation amount.

- Backlash compensation II
  Machine error compensation amount by the custom module is added to backlash compensation amount.

- NC axis/PLC axis switchover
  For PLC axis control of the NC axis/PLC axis switchover function, cutting feed override compensation and rapid traverse override compensation by the custom module are disabled. Regardless of NC axis or PLC axis control mode, the machine error compensation amount by the custom module is not applied.

- Unidirectional positioning
  The unidirectional positioning command (G60) works as follows during rapid traverse override compensation by the custom module.
  Movement to a position distanced from the final point by an amount equivalent to the creep distance: Rapid traverse override compensation is disabled.
  Movement to the final point: Rapid traverse override compensation is enabled.
  However, when the NC parameter "#1086 G0Intp" is "1" (non-interpolation), compensation is always disabled.

5.3.4 Precautions

- It takes at least 7.1 ms to feed back the compensation amount calculated by the custom module, in NC.
- When two or more custom modules are executed, do not overlap the data IDs of optical communication between NC and HPU. When they are overlapped, the data written by one custom module is overwritten by the data written by the other custom module.
- When cutting feed override compensation and rapid traverse override compensation by the custom module are "0", the behavior is the same as that of when cutting feed override and rapid traverse override in NC are "0".
  When "#12116 CutOvrZeroMovRap" is "0" or rapid traverse override is performed with the code method, the axis for rapid traverse will stop if cutting feed override compensation by the custom module is 0%.
  When "#12116 CutOvrZeroMovRap" is "1" and rapid traverse override is performed with the value setting method, the axis for rapid traverse will not stop even if cutting feed override compensation by the custom module is 0%. (Rapid traverse override control is performed by rapid traverse override only.)
- When spindle override compensation is performed by the custom module on a machine where thread cutting is commanded, set the NC parameter "#1227 aux11/bit0" (Select PLC signal or spindle feedrate attained) to "1" (Cutting start interlock by spindle feedrate attained) before shipment.
- When a machine error compensation amount of less than 1 μm is set by the custom module on a machine where the NC parameter "#1004 ctrl_unit" is "B" (1 μm), the machine error compensation amount to be added to the NC is 0 mm.

5.4 Building custom module

Create (build) a custom module with the following procedure.

(1) Prepare a folder where a custom module is created.
This chapter explains how to use the sample source included in NC Compiler2.
The sample source included in NC Compiler2 is in the "aplc_sample" folder under the NC Compiler2 installation folder.
Store the created custom module program in the "src" folder.

[Folder structure of the sample included in NC Compiler2]

aplc_sample (Root folder of the sample)
- src (Folder where the MTB custom module program is stored)
- Makefile

(2) Copy the sample Makefile included in NC Complier2.

(3) Change the macro definition of the copied Makefile as follows.

Macro	Before change	After change
OUTMODL	aplc.o	mtbobj(N).o
LOCAL_DEFINE	-D_UNICODE -DUNICODE -DNC_TYPE_NX -DNO_WINDOWS -D_NCDVxWorks -DRW_MULTI_THREAD -D_REENTRANT -D_INTERPRETER_ -DGCC960 -DUNDER_VXW -DNDEBUG	-D_UNICODE -DUNICODE -D_REENTRANT -DNDEBUG
LD_PARTIAL_FLAGS	-X -r	-X –r -dc
EXTRA_DEFINE	-DNCDSSample	(None)
TNGSCL	$(TGT_CPP)/aplcmain.c	$(TGT_CPP)/mtb(N)main.c

Replace the (N) part of the name with the number of the custom module.
Add the "-dc" option when the object is linked to build the custom module. Otherwise values of external variables may not be able to be checked with the debug function.

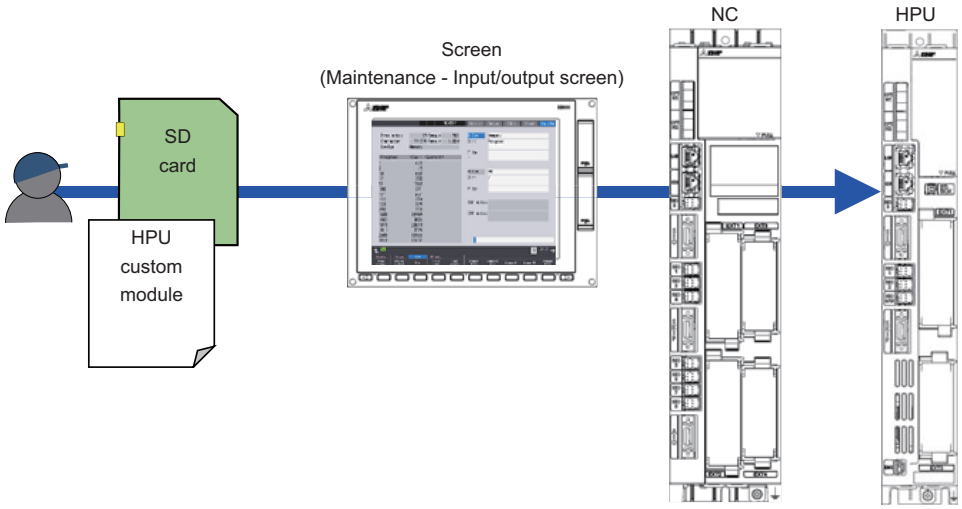
(4) Use the created Makefile to run "make" at the command prompt where you have configured the environment settings.
For the environment settings, refer to the NC Compiler2 Instruction Manual.

5.5 Registering and Deleting a Custom Module

The custom module registration/deletion operation is made available by entering the password of NC operation level 6 in advance.
To prevent any unintentional custom module registrations, it is recommended to change the password if it is set to the default. For details on how to enter and change the password, refer to the maintenance screen specifications manual.
"Output", "Merge", "Compare", and "Rename" are not available for the custom modules using the input/output screen.
Custom modules up to a total size of 5 MB can be saved. If you run out of space, reduce the size of the custom module or delete unnecessary modules.

Registration procedure

Follow the steps below to register the custom module.



(1) Store the custom module in a medium such as an SD card, and mount it in NC.

(2) Open the maintenance screen of NC, press the [Mainte] - [Psswd input] menu, enter the password of operation level 6, and press [INPUT].

➡ The entry field is cleared, and the password becomes available.
(After this, it operates as operation level 6.)

(3) Press the [Input/Output] menu on the maintenance screen.

➡ The input/output screen is displayed.



(4) In the file setting field "A", set "mtbobj(N).o" you prepared in step (1).
Example: Setting of when "mtbobj1.o" is stored in the "test" folder of SD
Device: Memory card
Directory: test
File name: mtbobj1.o (*1)

(5) Set the following in the file setting field "B".
Device: Memory
Directory: HPU custom module
File name: (*2)

(6) Press the [Trnsfr A->B] menu, and press [Y] or [INPUT] in response to the confirmation message.

(7) With the file setting field "B" enabled, press the [Update List] menu. ➡ Confirm that "mtbobj(N).crypt" is saved. (*3)

(8) Set the high speed processing unit parameters #0016 to #0019 and the NC parameters #1762/bit0 and #1766/bit0 correctly, and then restart the high speed processing unit and NC. (*4) ➡ While the registered module is updated by the high speed processing unit, "HPU in preparation" is displayed on the NC display unit.
While "HPU in preparation" is displayed, it is not possible to operate a machining machine or enter and restore a custom module.
When the "HPU in preparation" message disappears, the registration of the custom module is complete.

(*1) The name of the transferable custom module is "mtbobj(N).o" or "mtbobj(N).crypt".
(N) indicates a number from 1 to 5, for which parentheses are not required.
Even if they do not match, you can change the name and transfer the target one by entering the name in the file setting field "B".

(*2) If you want to rename and transfer the custom module, enter it here.
The available names are the same as those that can be used for the transfer source custom module.
In addition, you cannot name files with a different extension in each file setting field.
(Example) If the file setting field "A" is ".o" and the file setting field "B" is ".crypt", transfer is not possible.

(*3) "mtbobj(N).crypt" is a file with "mtbobj(N).o" encrypted, which prevents third parties from illegally obtaining, tampering with, or copying the custom module.
The file update time displays the date and time when the custom module was encrypted (the entry date and time).

(*4) The transferred custom module cannot be used until the power is turned on again.

Deletion procedure

Follow the steps below to delete the registered custom module.

(1) Press the [Mainte] - [Psswd input] menu on the maintenance screen, enter the password of operation level 6, and press [INPUT]. ➡ The entry field is cleared, and the password becomes available. (After this, it operates as operation level 6.)

(2) Access [Mainte] - [Input/Output] from the NC display unit. ➡ The input/output screen is displayed.



(3) Set the following items in the file setting field "A".
Device: Memory card
Directory: HPU custom module
File name: (File to be deleted)

(4) Press [Erase A] menu, and press [Y] or [INPUT] in response to the confirmation message. ➡ File deletion starts.

(5) With the file setting field "A" enabled, press the [List Update] menu. ➡ Confirm that "mtbobj(N).crypt" is deleted.

(6) Set the high speed processing unit parameters #0016 to #0019 to match the module registration state, and then restart the high speed processing unit and NC. (*1) ➡ While the registered/deleted module is updated by the high speed processing unit, "HPU in preparation" is displayed on the NC display unit.
While "HPU in preparation" is displayed, it is not possible to operate a machining machine or enter and restore a custom module.
When the "HPU in preparation" message disappears, the deletion of the custom module is complete.

(*1) The deleted custom module can be used until the power is turned ON again.

Messages displayed when registering/deleting a custom module

The following messages with their contents are displayed when a custom module is registered/deleted.

Message	Contents
Data protect	Data is protected by operation level. Change to operation level 6 or higher before operating.
Setting error	The name of the custom module to be transferred is not "mtbobj(N).o" or "mtbobj(N).crypt". <Note> • (N) indicates a number from 1 to 5, for which parentheses are not required.
Memory over	The maximum storage capacity (total 5 MB) has been exceeded. Delete unnecessary files or reduce the size of the custom module.

5.6 Custom Module Backup/Restore

Backup

Follow the steps below to back up the custom module registered in the high speed processing unit.

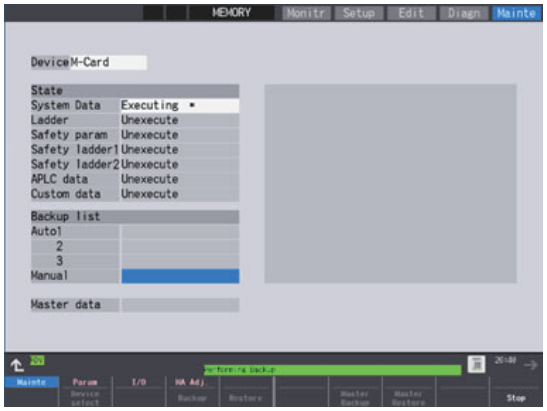
(1) Press the [Mainte] - [Psswd input] menu on the maintenance screen, enter the password of operation level 6, and press [INPUT]. → The entry field is cleared, and the password becomes available. (After this, it operates as operation level 6.)

(2) Access [Mainte] - [All backup] from the NC display unit. → The All backup screen is displayed.



(3) From the [Device Select] menu, select the device to back up.
For example, if you want to back up to an SD, select [Device Select] - [Memory card].

(4) Select the [Backup] menu, and press [Y] or [INPUT] in response to the confirmation message. → The all backup processing starts.
The custom module is backed up at the same time as "custom data" is backed up.
At this time, "mtbobj(N).crypt" is output to the "HPUOBJ" folder of the backup destination device. (*1)



(*1) "mtbobj(N).crypt" is a file with "mtbobj(N).o" encrypted, which prevents third parties from illegally obtaining, tampering with, or copying the custom module.

Restore

Follow the steps below to restore the backed-up custom module in the high speed processing unit.

(1) Mount the medium such as the SD card where the backup data is stored, in NC.

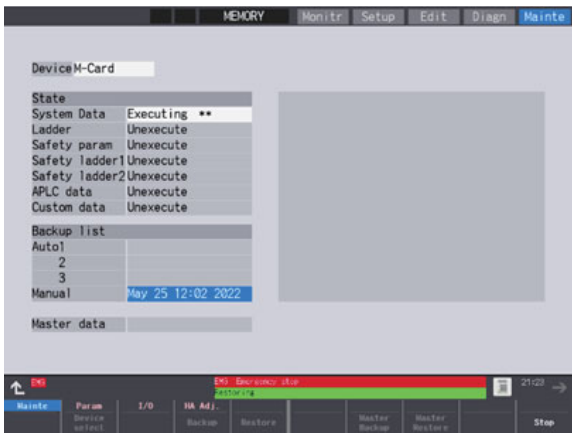
(2) Press the [Mainte] - [Psswd input] menu on the maintenance screen, enter the password of operation level 6, and press [INPUT]. ➡ The entry field is cleared, and the password becomes available.

(3) Access [Mainte] - [All backup] from the NC display unit. ➡ The All backup screen is displayed.



(4) From the [Device Select] menu, select the device on which the backup data has been saved.
For example, if you want to restore from the SD, select [Device Select] - [Memory card].

(5) Select the [Restore] menu, and press [Y] or [INPUT] in response to the confirmation message. ➡ Restore starts.



(6) Turn ON the power to the high speed processing unit and NC again. (*1) ➡ "HPU in preparation" is displayed on the NC display unit. While "HPU in preparation" is displayed, it is not possible to operate a machining machine or enter and restore a custom module.
When the "HPU in preparation" message disappears, the restoration of the HPU custom module is complete.

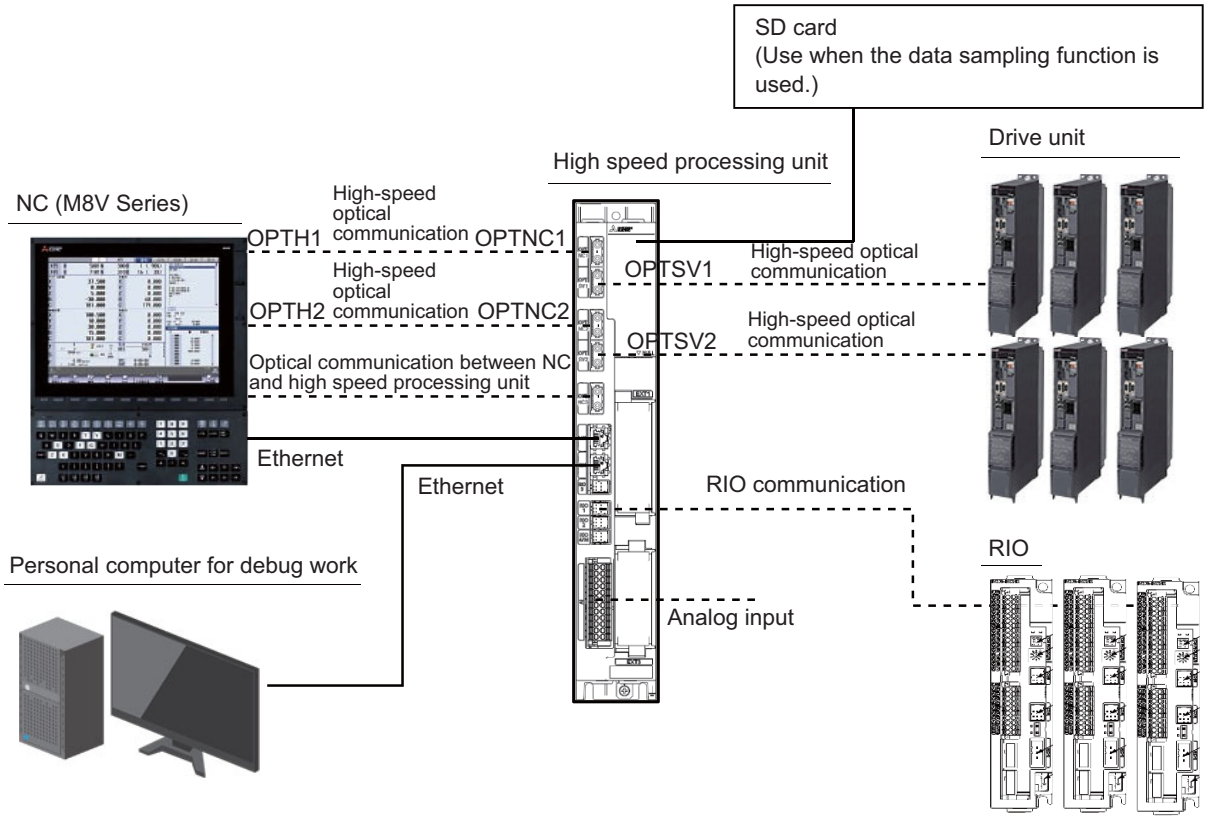
(*1) The transferred custom module cannot be used until the power is turned on again.

6

Debugging and Sampling the Custom Module

This chapter describes the debug function of the custom module to be built into the high-speed processing unit.
The diagram below shows an example to connect the high-speed processing unit and the PC for debugging when performing the debug work.

[Connection diagram between high-speed processing unit and PC for debugging]



The "debug function" and "data sampling function" are provided to check the operation of the custom module.

Use the debug function from the "Debug" screen, and use the data sampling function from the "Sampling" screen.
On the "Debug" screen, you can specify the symbol name or address of a variable to display the contents of the variable.
The "Sampling" screen can display waveforms of the axis status, I/O signals, and others.

If you want to use the data sampling function, you need to install an SD card in the high-speed processing unit.
Start from step (1).
If you do not use the data sampling function, start from step (2).

(1) Turn off the high-speed processing unit and insert the SD card or SDHC card.
<Note>
- Insert a card containing sufficient free space (50 MB or more recommended).
  If there is not enough free space, incomplete sampling data may be output.
- If no card is inserted, sampling cannot be carried out.

(2) Turn on the high-speed processing unit.

(3) Start the browser on your work computer and enter the following address in the address bar:
http://(IP address of high-speed processing unit)

(4) Click the [Login] button on the displayed screen.
When the authentication dialog opens, enter the user name "mtbuser" and the password set by the MTB.

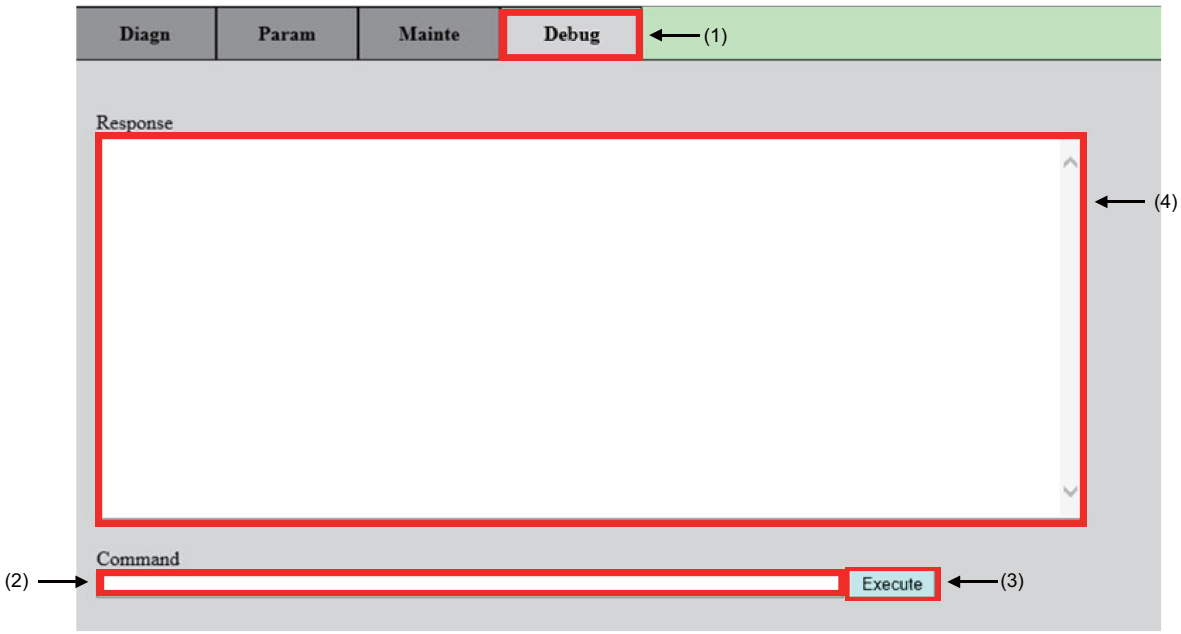
(5) To use the debug function, open the "Debug" tab.
To use the data sampling function, open the "Sampling" tab.
(If the "Sampling" tab is not displayed, open the "Param" tab and set the parameter "#0022/bit0" to "1".)
The "Sampling" tab is displayed, and the data sampling function is enabled.

6.1 Debug Screen

Debug the custom module on the Debug screen of the setting screen.
When you enter the MTB password, the "Debug" tab is displayed, enabling you to select the Debug screen.

The following functions are available on the Debug screen.

- Memory Dump function
- Debug function using data output functions
- Log output function at system-down



Display item	Meaning	Contents
(1) Debug	Debug screen tab	Displays the Debug screen.
(2) Command	Entry field	Enter the Debug command.
(3) Execute	Execute button	Executes the Debug command. When you press the [Execute] button, the contents displayed on the execution result screen until now are cleared.
(4) Response	Execution result screen	Displays the execution result of the Debug command. The execution result can be copied and pasted.

- If the Debug command is incorrect, "Incorrect Command" is displayed on the execution result screen.
- You can enter up to 128 characters in the entry field. If you enter more than 129 characters in the entry field and execute the command, "Incorrect Command" is displayed on the execution result screen.
- You can enter up to 63 characters for each argument of the Debug command. If you execute a Debug command with an argument of 64 characters or more, "Incorrect Command" is displayed on the execution result screen.
- If "Retry" is displayed on the execution result screen, execute the same command again.

6.1.1 Memory Dump function

You can view the data in the memory area with the custom module to be embedded (hereinafter referred to as the "memory area for function expansion") on the Debug screen.

Command specification format

Command	Specification format	Function
d	d [Top address], [Data no], [Data size]	Displays data in the memory area for function expansion.

Entry item	Meaning
Top address	Set the top address. • Only the addresses within the memory area for function expansion are available. • Set the symbol name or a hexadecimal number with "0x" prefixed. You can also perform address calculations using "+". Setting example 1: &sample + 0x00d0 Setting example 2: 0x8ccbf220
Data no	Set the number of data items to be displayed. • Set a decimal number or a hexadecimal number with "0x" prefixed. • The setting range changes depending on the data size as shown below. 1 byte: 1 to 720 2 bytes: 1 to 360 4 bytes: 1 to 180 8 bytes: 1 to 90
Data size	Set the data size for each data to be displayed. • Set a decimal number. • The setting range is 1, 2, 4, or 8. (Unit is [byte].)

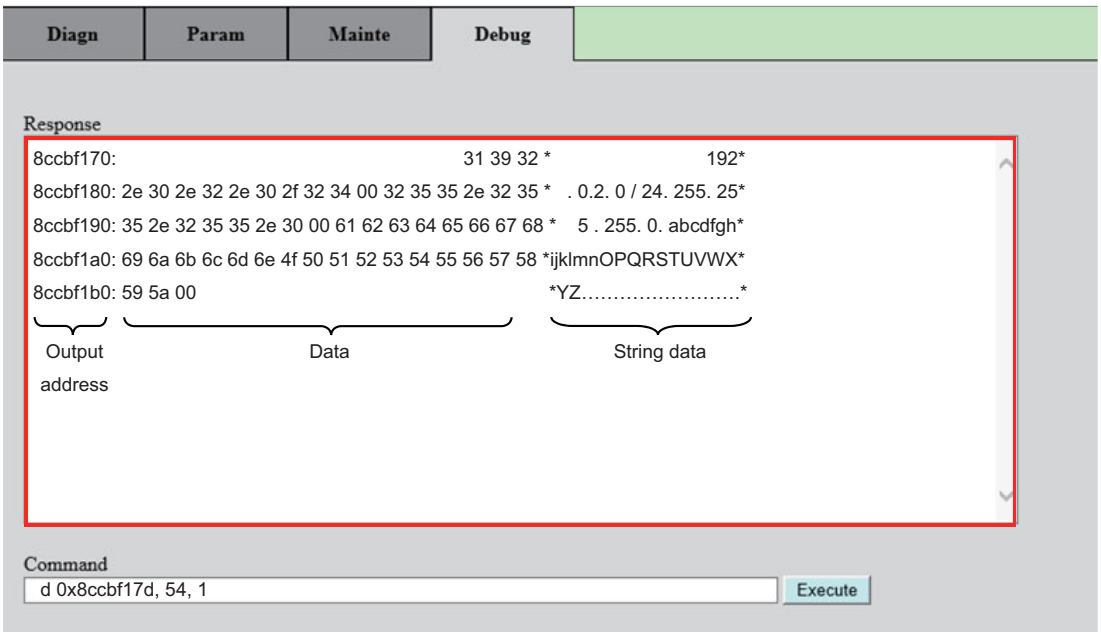
- If the top address is not on the boundary of the number of bytes set in the data size, it is displayed from the boundary value immediately before the set top address. (If the top address is "0x8ccbf223" and the data size is "4 bytes", it is displayed from "0x8ccbf220".)

Command operation example

The below example shows how to view 54 bytes of data starting from address 0x8ccbf17d in 1 byte units.

(1) Enter "d 0x8ccbf17d, 54, 1" in the "Command" field and press the [Execute] button.

(2) The "Execution result screen" displays the address to be output, data, and results of converting data into strings.



6.1.2 Debug Console Output Function

By embedding the debug console output function into a custom module, you can output the specified string and variable values to the screen at any location, and check them.

Debug console output function

[Function]

The debug console output function can output a combination of arbitrary string and numerical value such as a variable. Following the string specified with the first argument, the number specified with the second argument is displayed. There are three types of functions depending on the type of numerical value to be output:

[Format]

```
long printLong
(
    char *str,          /* String (e.g. "String AAA") */
    long num            /* Integer */
)
long printLongLong
(
    char *str,          /* String (e.g. "String BBB") */
    long long num       /* Integer */
)
long printDouble
(
    char *str,          /* String (e.g. "String CCC") */
    double num,         /* Real number */
    short digitNum      /* Number of decimal places (Range: 0 to 15)*/
                        /* (0: Displays up to six digits after the decimal point) */
)
```

[Detail]

- Each function is displayed on one line, and a line break is inserted at the end of the sentence. Line breaks cannot be used within the string of the first argument.
- The string in the first argument is displayed up to the null-terminated character. Use up to 64 characters (maximum 63 characters + null-terminated character). If it exceeds 63 characters, the first 63 characters are displayed.
- If you want to display only the second argument, specify two double quotation marks ("") for the first argument.
- Only characters or symbols with ASCII character codes, excluding control characters, can be displayed on the Debug screen. Characters or numbers other than ASCII character codes or control characters may be garbled.
- In the printDouble function, set the number of decimal places to be displayed with the third argument. It displays the value rounded off to the next digit after the set number of digits. If "0" or a value outside the range is set, up to six digits after the decimal point are displayed.
- The printDouble function displays 15 significant digits for a real number.
- If the number of characters displayed with the printDouble function (including line breaks) exceeds 128, the value set in the second argument is displayed in the exponential format.
  (Example: 1.234568e+200)
- If the number of characters to be displayed (including line breaks) exceeds 4096, refer to the "Selecting the output result display method" section.

[Return value]

When succeeded: Total number of characters to display
When failed: 0

Command specification format

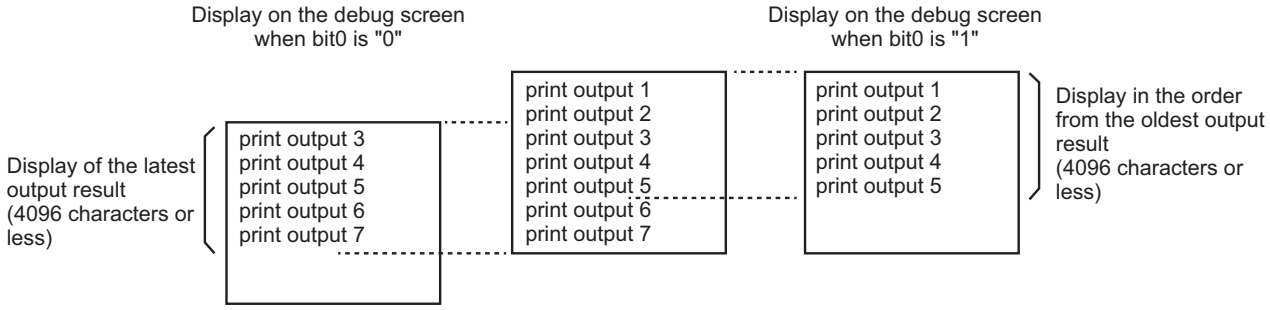
Command	Specification format	Function
print	print	Displays the output result of the data output function embedded into the custom module.
printclr	printclr	Clears the output results of the data output function. The output results before this command is executed are not displayed on the Execution result screen.

Selecting the output result display method

Up to 4096 characters can be displayed on the screen as the output result of the data output function. If this is exceeded, the display method can be selected using the parameter "#0015 debug_param/bit0" (Data func display).
If you change "#0015 debug_param/bit0", the results output up to that point are erased.

[When "#0015 debug_param/bit0" is "0" (displays up to the latest results in chronological order)]
Displays the latest output results in chronological order. This is useful when you want to check the latest output results.

[When "#0015 debug_param/bit0" is "1" (displays results in chronological order starting from the oldest result)]
Displays results in chronological order starting with the oldest output. This is useful when you want to check the output results at the start of processing.



Command operation example

This section describes the steps to include the data output function into a custom module and display the output results on the "Execution results screen".

(1) Include the data output function in the custom module.
This section describes an example to include the data output function underlined below into the functions "square()" and "circle()" in the custom module.

```
short square (short L)
{
    /*****************************************************/
    /* Function to calculate the area of a square   */
    /* Argument: L (length of one side)             */
    /*****************************************************/
    short S1;                                  /* Area of square                                    */

    S1 = L * L;                                /* Calculates the area of a square with side L       */
    printLong(″result square : ″, (long)S1);   /* Displays the area of the square with the data output function */
                                               /* Converts short type S1 to long type to use        */
    return S1;
}

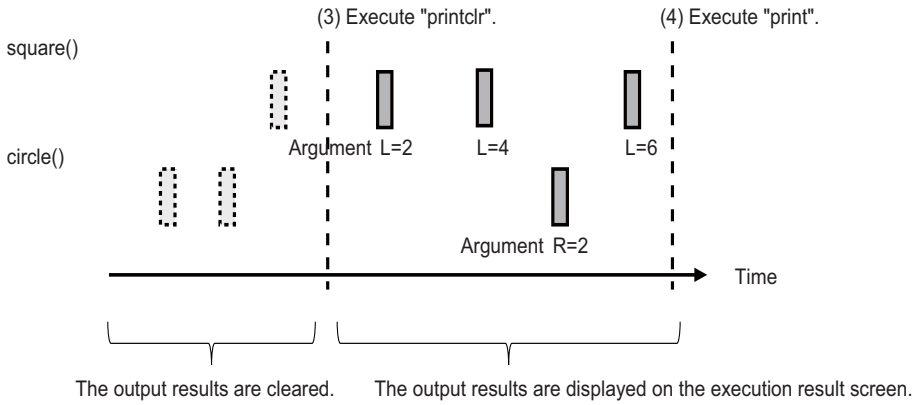
double circle (double R)
{
    /*************************************************/
    /* Function to calculate the area of a circle   */
    /* Argument: R (radius of circle)               */
    /*************************************************/
    double S2;                                 /* Area of circle                                    */
    char text[] = ″result circle : ″;          /* Defines the string to be displayed in the data output function */

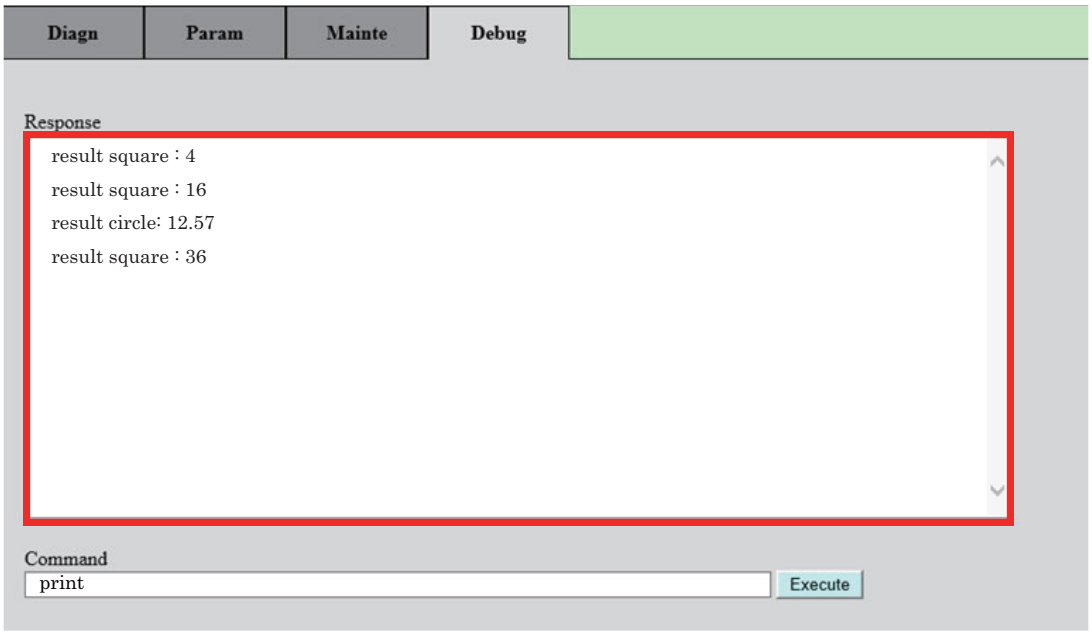
    S2 = R * R * 3.1415;                       /* Calculates the area of a circle with radius R     */
    printDouble(text, S2, 2);                  /* Displays the area of the circle up to two decimal places */

    return S2;
}
```

(2) Displays the Debug screen. (Refer to "6.1 Debug Screen".)
(3) Enter "printclr" in the entry field, and press the [Execute] button. (This clears the results of previous data output functions.)
(4) "Done" is displayed on the Execution result screen.
(5) Enter "print" in the entry field, and press the [Execute] button.

(6) If the functions "square()" and "circle()" operate with the timing and arguments shown below, the output results are displayed as follows.





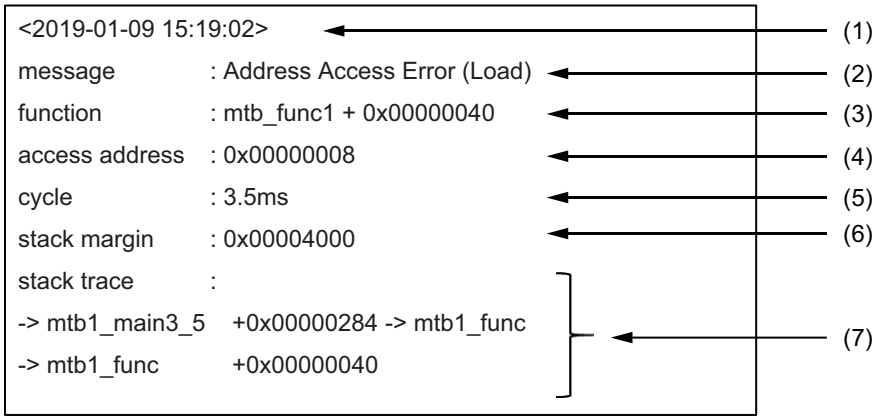
Precautions

If you execute the "printclr" command while the data output function is in execution, or if you change "#0015 debug_param/bit0", the strings output by that data output function may not be displayed partially.

6.1.3 System Down Log Output Function

If a system down occurs due to a custom module, the cause and location of the occurrence are displayed on the Debug screen.

[Example of executing the system down log output function]



Display item	Meaning	Contents
(1) <YYYY-MM-DD hh:mm:ss>	System down occurrence date and time	Displays the date and time when the system down occurred in the order of "Year-Month-Day Hour:Minute:Second".
(2) message	System down occurrence factor	Displays the system down occurrence factor. For details on the message and action, refer to "List of system down cause messages".
(3) function	Function name + offset when system down occurs	Displays the name of the function where the system down occurred as well as the offset from the beginning of the function to the point where the system down occurred. (*1) (*2) (*3)
(4) access address	Access address when reading or writing to an invalid address	Displays the access address when reading or writing to an invalid address. (*4)
(5) cycle	Custom module execution cycle	Displays the custom module execution cycle. (*5)
(6) stack margin	Custom module stack margin	Displays the stack margin of the function where the system went down in hexadecimal.
(7) stack trace	Function call path immediately before system down	Displays up to eight layers of the function call path immediately before the system down occurs. (*1) (*3)

(*1) "(3) function" and "(7) stack trace" display the name of the function that follows the custom module naming convention, along with the offset. The function name can be displayed up to 64 characters long. If the function name exceeds 64 characters, "*" is displayed at the 64th character, and characters after the 65th are not displayed. Functions that do not follow the naming convention are displayed as "***".

(*2) The offset displayed in "(3) function" may deviate from the point where the system down occurred. When investigating the location where the system down occurred, check the processing that corresponds to the message near the location indicated by the offset.

(*3) If the custom module is changed or deleted or the high-speed processing unit version is changed after the system down occurred, the function name and offset content of "(3) function" and "(7) stack trace" differ from the actual location where the system down occurred.

(*4) "(4) access address" is displayed when "(2) message" is "Address Access Error (Load)" or "Address Access Error (Store)". Otherwise, "***" is displayed.

(*5) If a system down occurs within the initialization function of the custom module, "(initial)" is displayed in "(5) cycle".

List of system down cause messages

Message	Contents	Countermeasure
Address Access Error (Load)	An invalid address was accessed (read).	• Correct the part that accesses the invalid address.
Address Access Error (Store)	An invalid address was accessed (written).	• Correct the part that accesses the invalid address.
Address Access Error (Load)	An invalid address was accessed (read).	• Correct the part that accesses at an invalid address boundary.
Address Boundary Error (Store)	An invalid address boundary was accessed (written).	• Correct the part that accesses at an invalid address boundary.
Divide by Zero	The value was divided by zero.	• Correct the part where the divisor is "0".
Unknown Error	An error other than the above has occurred	• Check the "stack trace" and correct the source code. • Check whether an invalid address is accessed.

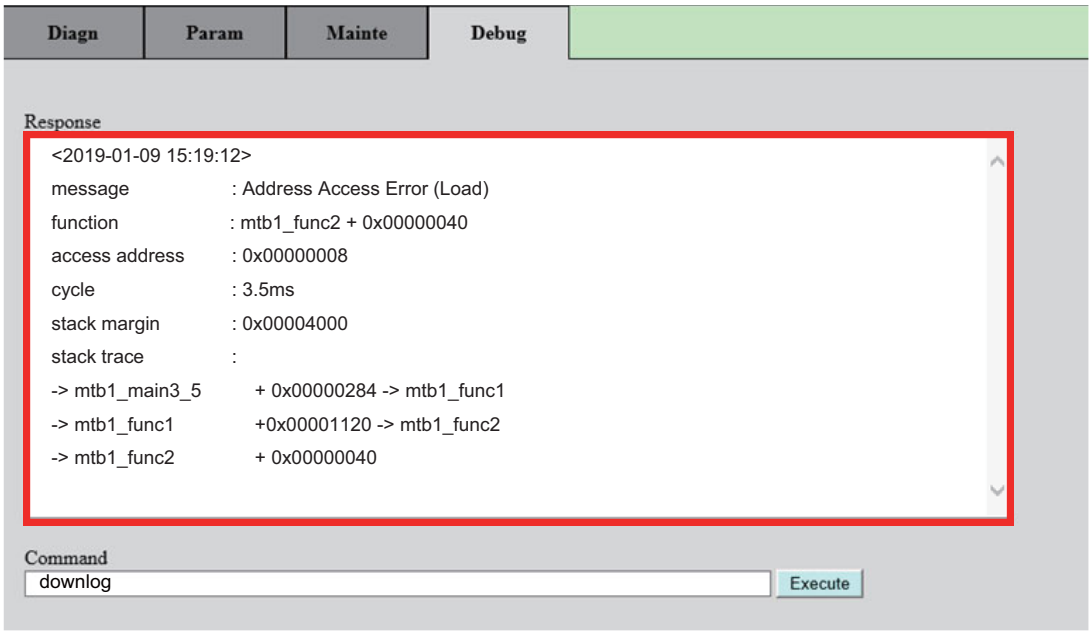
Command specification format

Command	Specification format	Function
downlog	downlog	Displays the system down occurrence factor and occurrence location on the Debug screen.

Command operation example

This section describes the steps to check the system down occurrence factor and location on the Execution results screen when system down occurs.
It is assumed that the custom module is registered in the high-speed processing unit where the system went down.

(1) Restart the high-speed processing unit that caused the system down, and confirm that the high-speed processing unit starts normally.
If it does not start normally, disable the custom module and restart the high-speed processing unit.
(2) After the high-speed processing unit started, the Debug screen is displayed. (Refer to "6.1 Debug Screen".)
(3) Enter "downlog" in the entry field, and press the [Execute] button.
(4) The system down occurrence factor and location are displayed on the Execution result screen.



Precautions

- If a system down has not occurred, "System down data has not occurred." is displayed on the Execution result screen.
- If a system down occurs outside the custom module, the system down occurrence date and time and "System down occurred outside the custom module." are displayed on the Execution result screen.
- The system down information displayed on the Execution result screen displays only the information with the most recent occurrence date and time.
- If the high-speed processing unit does not start normally due to the custom module, disable the custom module and restart the high-speed processing unit.
  The custom module is disabled by setting the following bits of parameter "#0016" to "0".
  Parameter "#0016"
  bit0: Custom module 1
  bit1: Custom module 2
  bit2: Custom module 3
  bit3: Custom module 4
  bit4: Custom module 5

6.1.4 List of Debug commands

Command	Specification format	Function
d	d [Top address], [Data no], [Data size]	Displays data in the memory area for function expansion.
print	print	Displays the output result of the data output function embedded into the custom module.
printclr	printclr	Clears the output results of the data output function. The output results before this command is executed are not displayed on the Execution result screen.
downlog	downlog	Displays the system down occurrence factor and occurrence location on the Debug screen.

6.1.5 Message list

Common error messages

Message	Contents	Countermeasure
Incorrect Command	An incorrect Debug command has been specified. Or, the Debug command is invalid.	• Review the Debug command you specified. • Check that the MTB custom processing is enabled.

Memory dump function error messages

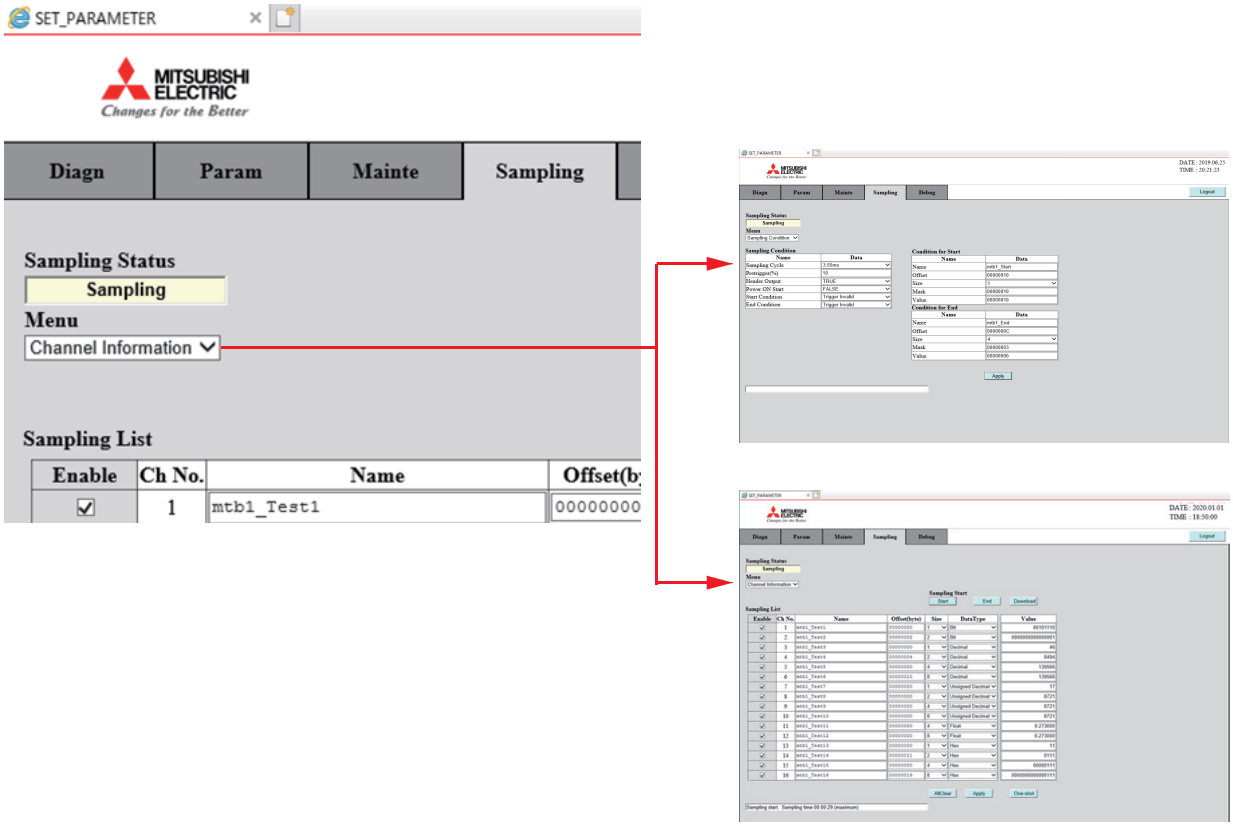
Message	Contents	Countermeasure
Address Range Error	The range of the acquired address includes outside the memory area for function expansion.	• Review the top address, number of data, and data size.
Start Address Error	The top address is set to an address outside the memory area for function expansion or set to a value without "0x".	• Review the top address.
Data Number Error	A value outside the range is set for the number of data items.	• Review the number of data items.
Data Size Error	A value other than 1, 2, 4, or 8 is set for the data size.	• Review the data size.

System down log output function messages

Message	Contents	Countermeasure
System down has not occurred.	System down has not occurred.	-
<YYYY-MM-DD hh:mm:ss> System down occurred outside the custom module.	The system is down outside of the custom module.	• There may be a problem with the custom module. If the system goes down again even after the custom module was disabled, contact your Mitsubishi Electric representative.

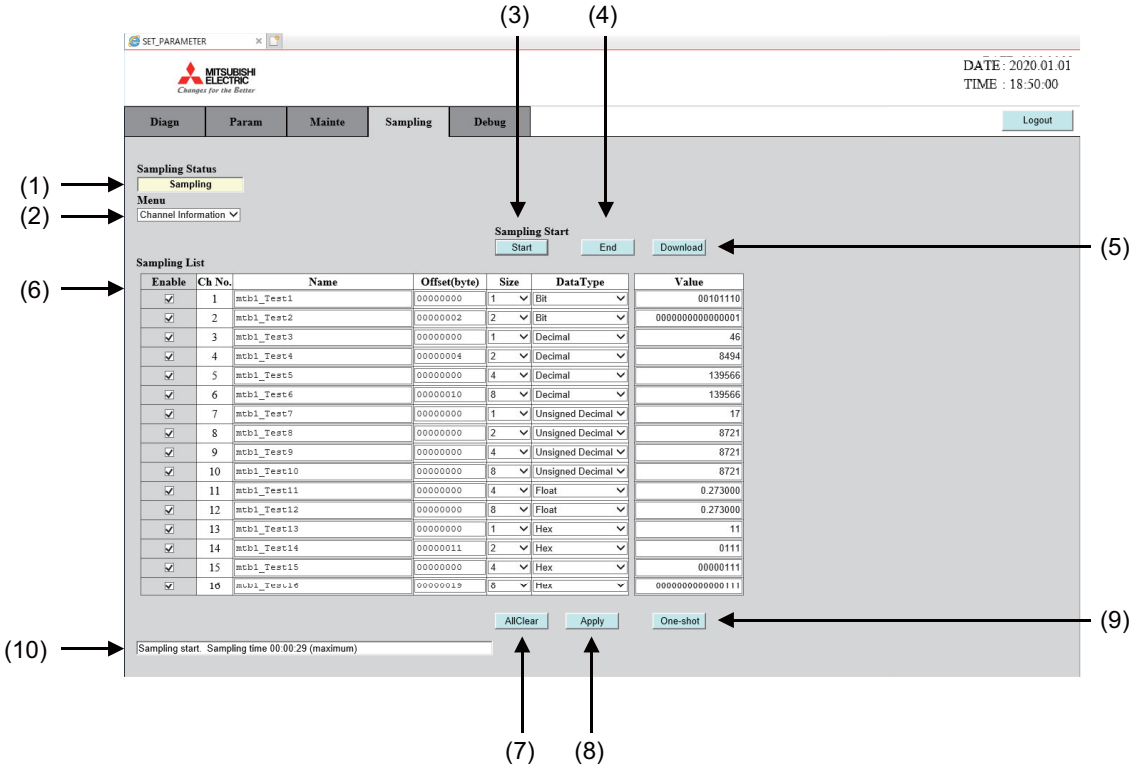
6.2 Sampling Screen

The Sampling screen is displayed by selecting the "Sampling" tab.
The Sampling screen has the "Channel Information screen" for registering sampling data, and the "Sampling Condition screen" for setting the sampling period and the sampling start/stop trigger conditions.
Select "Channel Information" and "Sampling Condition" from "Menu" at the top left of the screen to switch between the two screens.



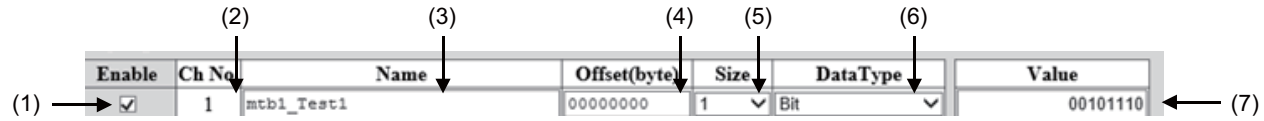
6.2.1 Channel Information Screen

Select "Channel Information" from the menu list on the Sampling screen to display the Channel Information screen. The Channel Information screen allows you to display and set sampling information for each channel.



Display item		Details
(1)	Sampling Status	The sampling state is displayed. Sampling: Sampling in progress Stop: Stop sampling Trigger Wait: Waiting for trigger Saving Data: Data transfer in progress
(2)	Menu	Switches the screen you want to display. Channel Information: Channel information Sampling Condition: Sampling condition
(3)	Start	Reflects the channel information to the high-speed processing unit and starts sampling.
(4)	End	Ends sampling.
(5)	Download	Downloads the sampling results in the SD card to your work PC.
(6)	Sampling List	Displays and sets sampling information for each channel. The detailed explanation is provided on the next page.
(7)	All Clear	Clears all channel information. Channel information is not reflected on the high-speed processing unit until you press the [Apply] button.
(8)	Apply	Reflects the channel information to the high-speed processing unit.
(9)	One-shot	Reflects the channel information to the high-speed processing unit, and displays the instantaneous value of each channel.
(10)	(Message area)	Displays error messages, and others.

[Sampling list setting item field]



Display item		Details
(1)	Enable	The checked channels are targeted for sampling.
(2)	Ch. No	Displays the channel number.
(3)	Name (*1)	Enter the symbol name to you want to sample. You can enter up to 31 characters.
(4)	Offset	Enter the offset from the symbol name. Enter a 8-digit hexadecimal number. The data at the symbol name + offset address is targeted for sampling. <Setting range> 00000000 to 000A0000
(5)	Size	Select the size (byte) of the data you want to sample. <Setting value> (Blank), 1, 2, 4, 8
(6)	DataType	Select whether there is a decimal point, base number, and others. <Setting value> (Blank): No setting value Bit: Binary number Decimal: Decimal integer Unsigned Decimal: Unsigned decimal integer Float: Decimal with decimal point Hex: Hexadecimal number
(7)	Value	Press the [One-shot] button to display the acquired instantaneous value. The display format follows the Data Type setting. <Display range> (*2) Binary: 0000000000000000 to 1111111111111111 Hexadecimal: 0000000000000000 to FFFFFFFFFFFFFFFF Integer: -9223372036854775808 to 18446744073709551615 Decimal: -99999999999999.999999 to 99999999999999.999999 (*3) (*4) (*5)

(*1) Custom module shared variables cannot be specified.

(*2) The numbers when the maximum size is set for "Size" are described in the display range. The display range varies depending on the "Size" setting.

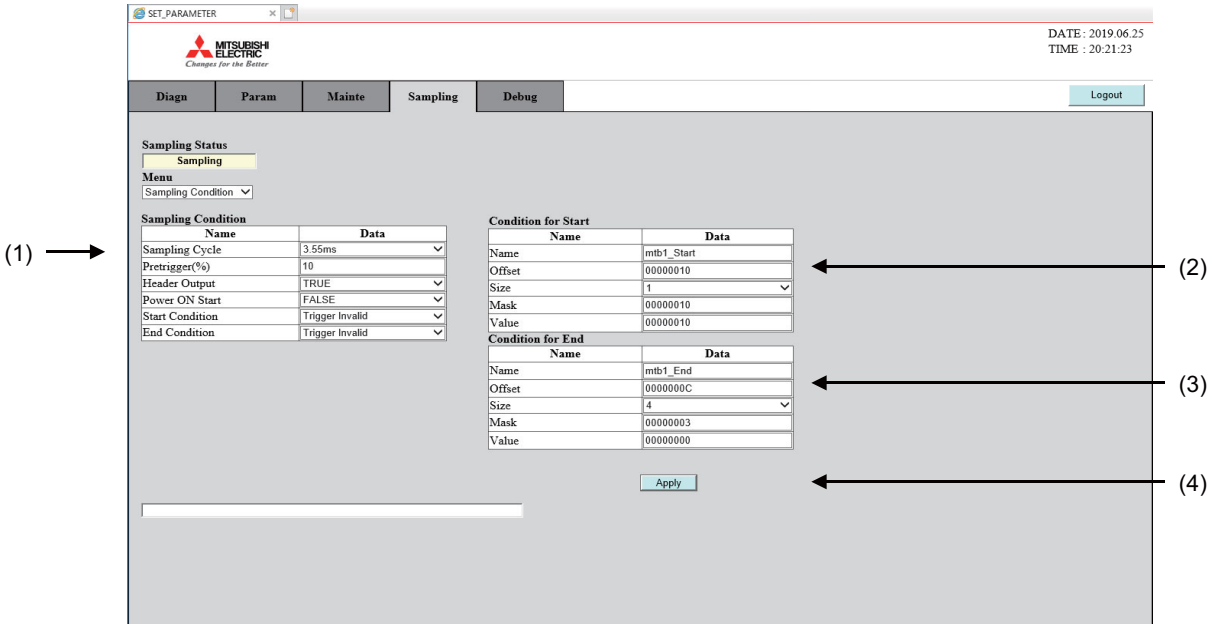
(*3) If "DataType" is "Float", the display after the decimal point is fixed at six digits.

(*4) The effective digits when setting "Float" are seven digits if the "Size" setting value is 4 (byte), and 15 digits if it is 8 (byte). Therefore, the value accuracy cannot be guaranteed if the value exceeds the number of significant digits.
Example: 123456789012345.123456 → 123456789012345.125000

(*5) If the number of output characters (including minus and decimal point) is 24 or more, the exponential conversion is performed for the number.
Example: 1234567890123456 → 1234567890123456.000000 (23 characters in total)
Example: -1234567890123456 → -1234567890123456.000000 (24 characters in total) → -1.234568e+15

6.2.2 Sampling Condition screen

Select "Sampling Condition" from the menu list on the Sampling screen to display the Sampling Condition screen. On the Sampling screen, you can display and set information that is common between channels, such as the sampling period. For details on the same items as the Channel Information screen, refer to "6.2.1 Channel Information Screen".



Display item			Details	Setting range
(1)	Sampling Condition		Allows you to make sampling settings.	
		Sampling Cycle	Select the sampling period.	3.55ms, 56.8ms, 1.82s
		Pretrigger (%)	Set the pre-trigger buffer size with the percentage (%) of the entire buffer. This setting value is applied when the start trigger is enabled.	0 to 99
		Header Output	Set whether to include header information when outputting.	TRUE: Header information included FALSE: Header information not included
		Power ON Start	Select whether to start sampling when the high-speed processing unit is powered on.	TRUE: Starts sampling when the power is turned on. FALSE: Does not start sampling when the power is turned on.
		Start Condition	Select the start trigger type. If you select "Data Value(TRUE)" or "Data Value(FALSE)", set the trigger condition in "(2) Condition for Start".	Trigger Invalid: Trigger invalid Data Value(TRUE): Condition match Data Value(FALSE): Condition mismatch
		End Condition	Select the end trigger type. If you select "Data Value(TRUE)" or "Data Value(FALSE)", set the trigger condition in "(3) Condition for End".	
(2)	Condition for Start		Set the trigger to start and end the sampling function.	
(3)	Condition for End			
		Name (*1) (*6)	Enter the symbol name of the variable used as the trigger condition. You can enter only characters or symbols with ASCII character codes, excluding control characters. You cannot directly enter the data address that is prefixed by "0x" or "&". (0x8ccbf17d, &mtb1_SampData, etc. cannot be specified.)	Max. 31 characters
		Offset (*5)	Enter the offset from the symbol name. The data at the symbol name + offset address is targeted for trigger. Enter a 8-digit hexadecimal number.	00000000 to 000A0000
		Size	Select the data size (byte) used as the trigger condition.	(Blank), 1, 2, 4, 8
		Mask (*2) (*5)	Set the mask value applied to the trigger condition. Enter a 8-digit hexadecimal number. If you set "0" or "FFFFFFFF", no mask is applied.	00000000 to FFFFFFFF
		Value (*3) (*4) (*5)	Set the value for the trigger condition. Enter a 8-digit hexadecimal number.	00000000 to FFFFFFFF
(4)	Apply		Press this button to transfer the settings of "Sampling Condition" to the high-speed processing unit.	

(*1) If you specify an address outside the memory area for function expansion, "Ch No. (N) Setting error" is displayed when the [Apply] button is pressed.
(*2) If masks exceed the number of bytes specified with Size, they are ignored. (Example: If Size is set to "1 byte" and Mask is set to "0x3FF", the mask value is set to 0xFF.)
(*3) Sampling does not start until the value obtained by multiplying the variable used as the trigger condition by "Mask" matches "Value", and the state is set to "Trigger Wait". Press the [End] button to stop sampling.
(*4) If you want to use a negative value as a trigger condition, enter the two's complement of the positive number.
Example: To use "-1" as a trigger, enter "FFFFFFFF", which is the two's complement of "00000001".
(*5) When entering a hexadecimal number, use uppercase characters for A to F.
(*6) Custom module shared variables cannot be specified.

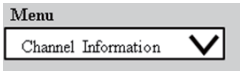
6.2.3 Operation Procedure

Setting the channel information

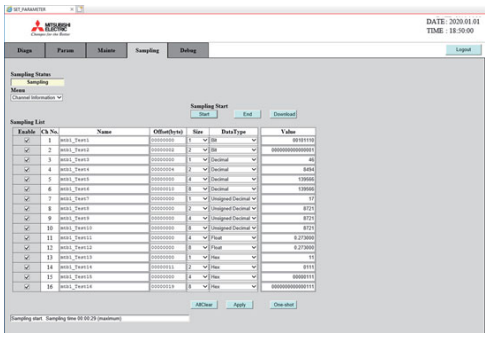
The sampling function allows you to acquire variable values at regular intervals and examine time-series changes in variable values.
Set the data to be sampled on the "Channel Information screen".

Follow the steps below.

(1) Select "Channel Information" from the menu list (Menu).

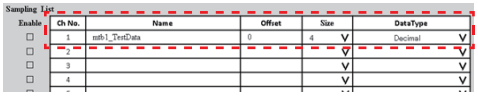


➡ The Channel Information screen is displayed.



(2) Set "Name", "Offset", "Size", and "DataType" of the data to be sampled in "Sampling List". For example, if you want to sample the long type array variable "mtbl_TestData[2]", set as follows.
Name: mtb1_TestData
Offset: 00000008
Size: 4
DataType: Decimal

➡ For the setting value of each entry item, refer to "6.2.2 Sampling Condition screen".

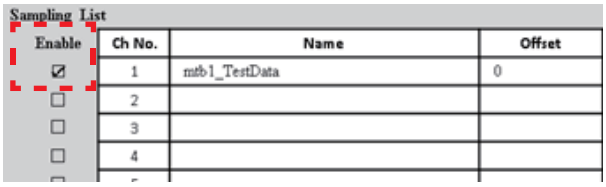


In the "Name" field, set the symbol of the variable to be sampled. Also, in the "Offset" field, specify the number of bytes to sample from the symbol in the "Name" field.
For example, if you want to specify the long type (4 bytes) array variable "mtb1_TestData[]", the Offset corresponding to each element is as follows.

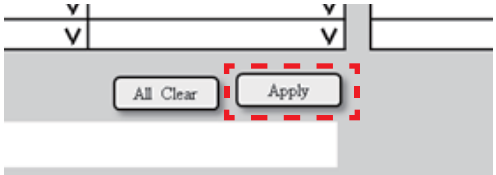
long type array variable	Offset
mtb1_TestData[0]	00000000
mtb1_TestData[1]	00000004
mtb1_TestData[2]	00000008
mtb1_TestData[3]	0000000C
:	:

(3) Check the "Enable" column on the row of the data to be sampled in "Sampling List".

➡ The checked row is targeted for sampling.



(4) Press the [Apply] button.



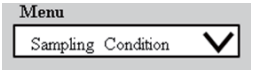
➡ If set correctly, "Setting completed" is displayed in the setting result.
"Sampling time ..." indicates the maximum sampling time that is possible with the current settings.



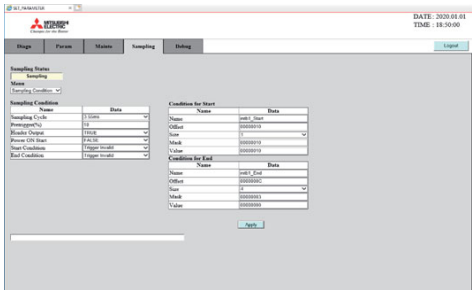
Setting the sampling conditions

Next, set the sampling cycle (interval to acquire data).

(1) Select "Sampling Condition" from the menu list (Menu).

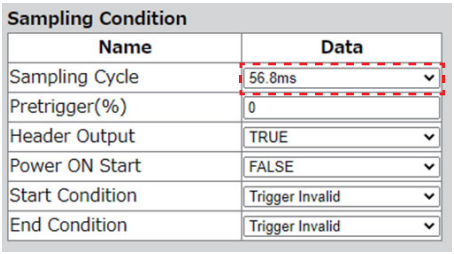


➡ The Sampling Condition screen is displayed.



(2) Select the sampling cycle from the pull-down menu in the "Sampling Cycle" field.

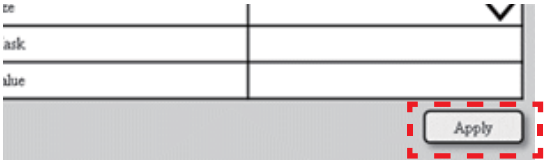
➡ The figure below shows an example where 56.8ms is selected as the sampling cycle.



Sampling Condition

Name	Data
Sampling Cycle	56.8ms
Pretrigger(%)	0
Header Output	TRUE
Power ON Start	FALSE
Start Condition	Trigger Invalid
End Condition	Trigger Invalid

(3) Press the [Apply] button.



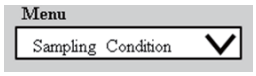
➡ If set correctly, "Setting completed" is displayed in the setting result.
"Sampling time ..." indicates the maximum sampling time that is possible with the current settings.



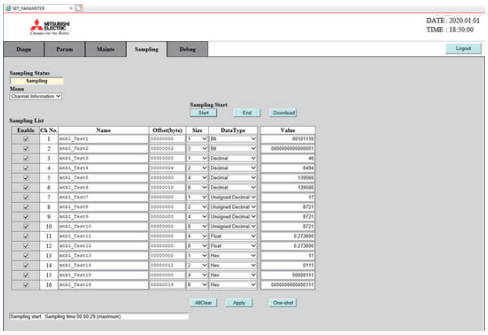
Trigger settings

You can control the timing of the start and end of sampling by setting a condition for each start and end of sampling.

(1) Select "Sampling Condition" from the menu list (Menu).



→ The Sampling Condition screen is displayed.



(2) "Start Condition" sets the sampling start condition, and "End Condition" sets the sampling end condition. Specify one of the following options.

- Trigger Invalid: Trigger invalid
- Data Value(TRUE): Condition match
- Data Value(FALSE): Condition mismatch

Whether the condition matches or not is determined by performing a logical product (AND for each bit) of the variable value specified next and the value of "Mask", and judging whether the result matches or mismatches with the "Value" value.

The following shows a setting example to start sampling with "condition match".

→ The following shows an example where the condition match "Data Value (TRUE)" is selected.

Sampling Condition

Name	Data
Sampling Cycle	56.8ms
Pretrigger(%)	0
Header Output	TRUE
Power ON Start	FALSE
Start Condition	Data Value (TRUE)
End Condition	Trigger Invalid

(3) If you select "Data Value (TRUE): Condition match" or "Data Value (FALSE): Condition mismatch" for "Start Condition", set variables and judgment values for condition judgment in the "Condition for Start" field.
For "End Condition", set those values in the "Condition for End" field.
For details on the setting values, refer to "6.2.2 Sampling Condition screen".

The following shows a setting example to start sampling when the 5th bit (bit4) of the Char type variable "mtb1_StartTrigger" becomes "0".
If you want to start when bit4 becomes "1", set "Value" to "00000010".

→ The entry items are displayed.

Condition for Start

Name	Data
Name	mtb1_StartTrigger
Offset	00000000
Size	1
Mask	00000010
Value	00000000

(4) Press the [Apply] button.



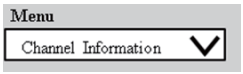
→ If set correctly, "Setting completed" is displayed in the setting result.

Setting completed. Sampling time 00:01:39 (maximum)

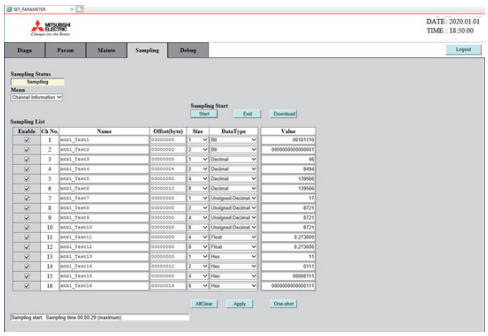
Starting sampling

After setting the data to be sampled and the start and stop conditions, start sampling.

(1) Select "Channel Information" from the menu list (Menu).



➡ The Channel Information screen is displayed.



(2) Press the [Start] button.

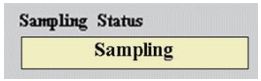


➡ If you set sampling start conditions on the "Sampling Condition screen", the execution status (Sampling Status) changes to "Trigger Wait", and the system waits for the start of sampling until the conditions are met.



(3) When the start trigger conditions are met.
Or when the start condition is invalid (Trigger Invalid).

➡ The execution status (Sampling Status) changes to "Sampling", and sampling starts.



Note

(1) If the SD card is not installed correctly, "SD error." is displayed in the message area when you press the [Start] button.
(2) If you press the [Start] button when the execution display status (Sampling Status) is not set to "Stop", sampling does not start.
(3) If "Power ON Start" is "TRUE" on the Sampling Condition screen, sampling starts when the high-speed processing unit is powered on.

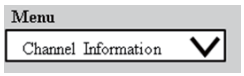
Ending sampling

Sampling automatically ends in one of the following cases: The sampling results are stored on the SD card in the high-speed processing unit.

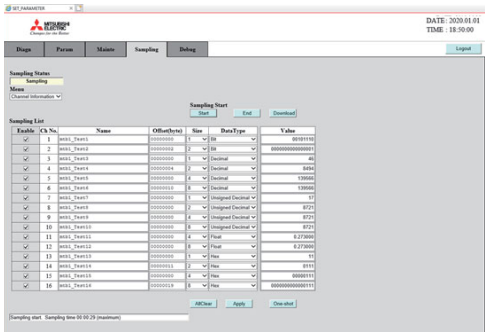
- The set end condition has been met.
- The sampling buffer is full.

Sampling can also be ended manually. Follow the steps below.

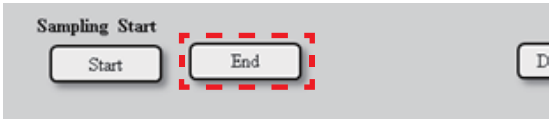
(1) Select "Channel Information" from the menu list (Menu).



➡ The Channel Information screen is displayed.



(2) Press the [End] button.



➡ The execution status (Sampling Status) changes to "Saving Data", which starts saving and transferring the sampling results.



(3) When the sampling results have been output to the SD card:

➡ The execution status (Sampling Status) changes to "Stop".

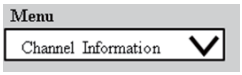


Acquiring the sampling results

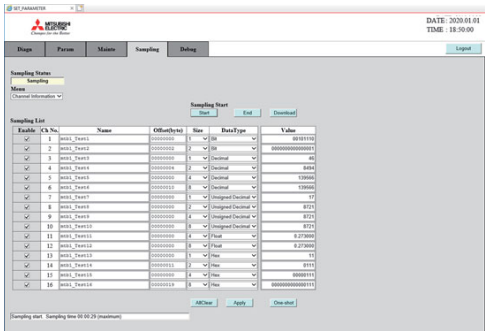
The sampling results are saved on the SD card in the high-speed processing unit as a CSV format file, which can be downloaded to your computer.

Follow the steps below.

(1) Select "Channel Information" from the menu list (Menu).



➡ The Channel Information screen is displayed.



(2) Press the [Download] button.



➡ The sampling results (SAMPDATA.CSV) are downloaded.
(*) The downloaded file is stored in the folder set in the browser you are using.

Note

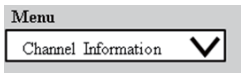
(1) Perform the download operation when the sampling execution status is set to "Stop". If you download in a status other than "Stop", incorrect data may be acquired.

Acquiring the instantaneous value

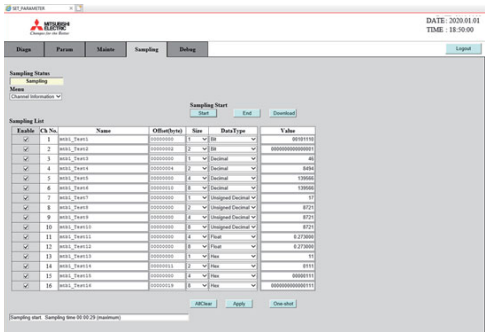
You can view the current value (instantaneous value) of the variable.

Follow the steps below.

(1) Select "Channel Information" from the menu list (Menu).

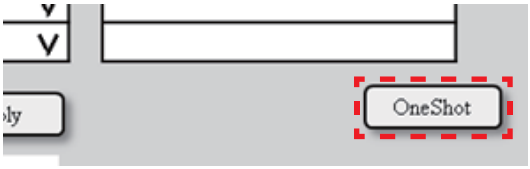


➡ The Channel Information screen is displayed.

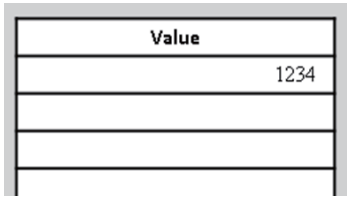


(2) Follow the steps shown in "Setting the channel information" to set the variables you want to reference.

(3) Press the [OneShot] button.



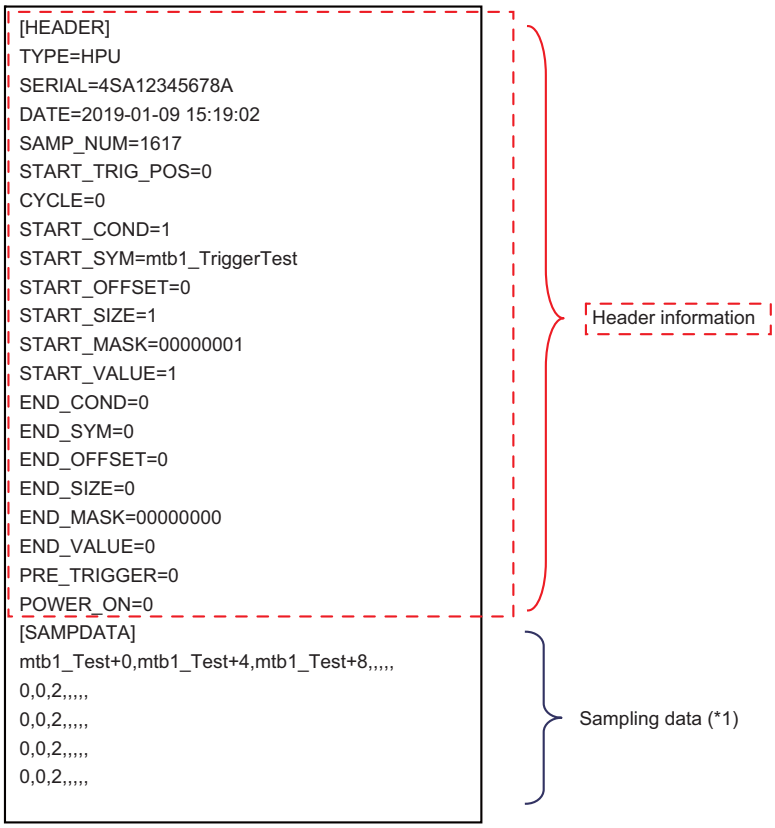
➡ The current value (instantaneous value) of the variable is displayed in the "Value" column.



6.2.4 Specifications of Sampling Result File "SAMPDATA.CSV"

The sampling results are saved in the MTB_Sampling/SAMPDATA.CSV on the SD card.

Output example



(*1) Invalid channel columns are output as null strings.
The "symbol name + offset" of the sampling data is added to the first row of the [SAMPDATA] section.

"SAMPDATA.CSV" has a header ([HEADER] section) in the following format added before the sampling data ([SAMPDATA] section) only when the item (Header Output) on the "Sampling Condition screen" is "TRUE".

Header output format

Section	Key	Meaning
[HEADER]	TYPE	Model name
	SERIAL	Serial No.
	DATE	Sampling start date and time<YYYY-MM-DD hh:mm:ss>
	CYCLE	Sampling cycle 0: 3.55ms 1: 56.8ms 2: 1.82s
	SAMP_NUM	Total number of rows
	START_TRIG_POS	Number of start trigger rows
	START_COND	Start condition 0: Trigger Invalid 1: Data Value(TRUE) 2: Data Value(FALSE)
	START_SYMBOL	Start trigger symbol name
	START_OFFSET	Offset from start trigger symbol name
	START_SIZE	Start trigger size
	START_MASK	Start trigger mask
	START_VALUE	Start trigger condition value
	END_COND	End condition 0: Trigger Invalid 1: Data Value(TRUE) 2: Data Value(FALSE)
	END_SYMBOL	End trigger symbol name
	END_OFFSET	Offset from end trigger symbol name
	END_SIZE	End trigger size
	END_MASK	End trigger mask
	END_VALUE	End trigger condition value
	PRE_TRIGGER	Pre-trigger
	POWER_ON	Sampling start at power-on 0: invalid 1: valid

6.2.5 Message list

Message	Contents	Countermeasure
Sampling start. Sampling time hh:mm:ss (maximum)	Indicates that sampling has started. "Sampling time ..." indicates the maximum sampling time that is possible with the current settings. (hours, minutes, and seconds)	-
Setting completed. Sampling time hh:mm:ss (maximum)	Indicates that the configuration was completed successfully. "Sampling time ..." indicates the maximum sampling time that is possible with the current settings. (hours, minutes, and seconds)	-
SD error.	No SD card is installed. Or it is not recognized.	• Check that the SD card is installed in the high-speed processing unit. Reinstall the SD card and turn the power back on.
Ch No.(N) Setting error	There is an error in the channel number (N) data. (If there are errors in multiple channel numbers, the lowest number is displayed.)	• Check the channel number (N) setting displayed in the message, and correct any errors.
Setting completed. (No available channel)	Indicates that the configuration was completed successfully, but there are no valid channels. If there are no valid channels, sampling cannot start.	• Turn on Enable for either channel.
Cannot start sampling. (No available channel)	Indicates that there are no valid channels and sampling cannot start.	• Check Enable for either channel.
Setting Error. (Sampling Condition)	There is an error in the sampling settings you entered.	• Review the sampling settings you entered.
Setting Error. (Condition for Start)	There is an error in the start trigger setting you entered.	• Review the start trigger setting you entered.
Setting Error. (Condition for End)	There is an error in the end trigger setting you entered.	• Review the end trigger setting you entered.

6.2.6 Troubleshooting and FAQ

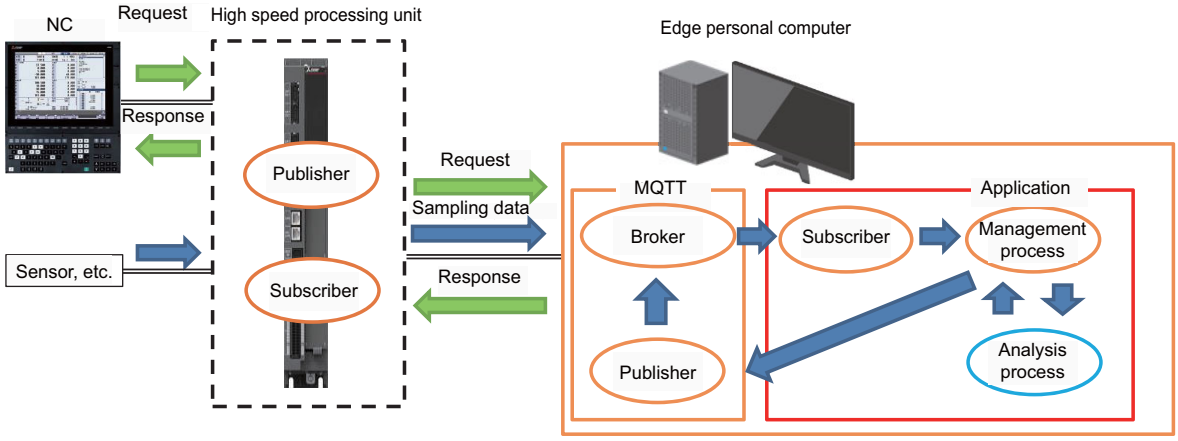
#	Item	Details
1	Trouble	The sampling result file is not updated, or the results are incorrect.
	Action	• Check that the SD card is installed in the high-speed processing unit. • Reinstall the SD card. • Check the free space on the SD
2	Trouble	The sampling results are not as expected.
	Action	• Review the values of "Size" and "Offset" (byte). <Supplement> If the address on the high-speed processing unit to be sampled is not within the byte number boundary set in "Size", it is adjusted to the boundary value just preceding the specified address before sampling. (Example 1) If "mtb1_CharData" is located at "0x00000103" and "Size" is set to "4 bytes", sampling starts from "0x00000100". (Example 2) If "Offset" (byte) is set to "1" and "Size" is set to "4 bytes" for "mtb1_LongData" located at "0x00000100", sampling starts from "0x00000100" instead of "0x00000101".

7

Creating Model Parameter

"HPU Connector" is an application that runs on the edge personal computer.
You can calculate model parameters for the compensation function executed using the custom module of the high-speed processing unit by including the analysis function module into "HPU Connector".

[System configuration]



When using the edge PC application, set the following high-speed processing unit parameters.

- #1608 Unit name (*1)
- #1051 Broker's IP address (*2)
- Sending effective parameters for sampling data to be sent
  - #0009 to #0011 MQTT SendAxisSet1 to 4
  - #0012/bit1 MQTT RIO(M) valid
  - #0012/bit2 MQTT RIO(S) valid
  - #0012/bit3 MQTT AI valid
- In "MQTT settings-Mosquitto Path", set the destination where to install mosquitto.

(*1) When connecting multiple high-speed processing units, set the parameter "#1608 unit name" to a name that does not overlap with other units. When a unit with the same name already exists, the functions of sampling, analysis, model management, etc. cannot be used in this application.

(*2) When installing the broker (mosquitto) on the edge PC, set #1051 to the IP address of the edge PC. (Recommended) (If you install the broker on a PC other than the edge PC, set the IP address of that PC.)

7.1 Installing the edge PC application

To create model parameter, install the following software on the edge PC.

HPU Connector	Software that performs various operations to create model parameter.
mosquitto	Software required to communicate with the high-speed processing unit.
Analysis function module	Software that creates model parameter. Please prepare at the MTB.

The operating environment of the software is as follows.

Item	Details
OS	Windows10 (32bit/64bit)
CPU	1.6 GHz or more
Memory	8 GB or more
Hard disk space	10 GB or more is recommended.
Display	Resolution of XGA (1024 * 768) or higher
Interface	100 M/1G Ethernet
mosquitto (32-bit version) (*1)	Version: 1.6.4 (*2)

(*1) This application does not include a "broker" to be used for MQTT communication.

(*2) The above version of mosquitto is mandatory to operate this application.

Installing HPU Connector

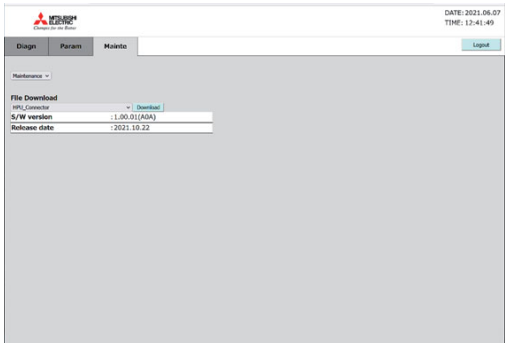
First, download the installer of "HPC Connector" and install it.

(1) Connect to the network of the edge personal computer and high speed processing unit.
Edge personal computer <- (LAN cable) -> High speed processing unit

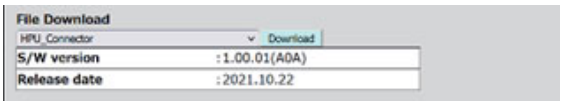
(2) Start the high speed processing unit, start the Web browser on the edge personal computer, and then input "http://(IP address of high speed processing unit)" in the address bar.

(3) Input your user name and password to sign in.
(*) The sign-in user must log in as a user with operation authority of MTB functions.

(4) Click the [Mainte] tab on the setting screen.

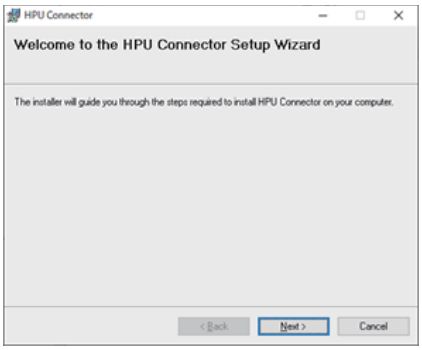


(5) Select [HPU Connector] from the pull-down menu of "File Download".



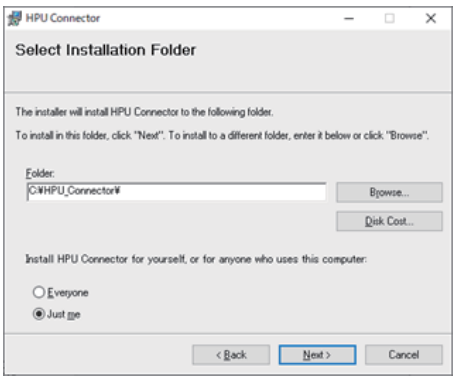
(6) Click the [Download] button on the right side of the pull-down menu.
The installer "HPU_Connector.zip" is downloaded into the edge personal computer.

(7) Extract the zip file and execute "HPU_Connector.exe". → The installer starts.

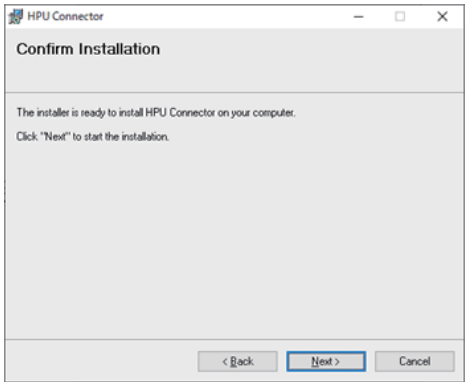


(8) Click [Next>]. → The installation destination setting screen appears.

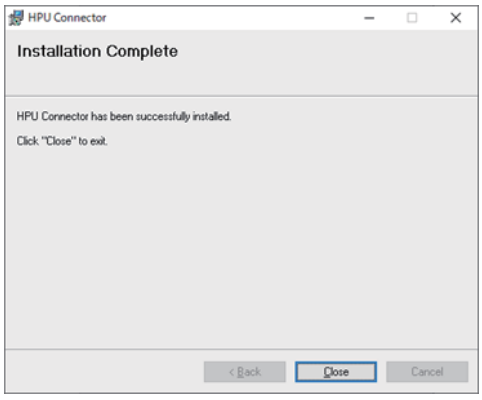
(9) Set the installation destination.
(*) Execute "HPU_Connector.exe" as administrator to install it into a folder ("C:\Program Files\", etc.) where administrator authority is required for writing. The HPU_Connector setting file (config.ini) cannot be saved if you executed it as standard authority.
→ The default installation destination is "C:\HPU_Connector".



(10) Confirm the installation destination and click [Next>]. → The installation destination confirmation screen appears.

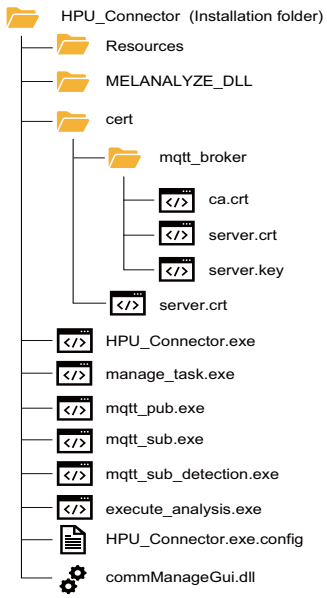


(11) When the installation is completed, the right screen appears.
Click [Close].
"HPU_Connector" is registered in the start menu.



HPU Connector folder structure

The folders and files shown in the figure are stored under the folder you specified when installing.
Do no delete these files. The application does not work normally.

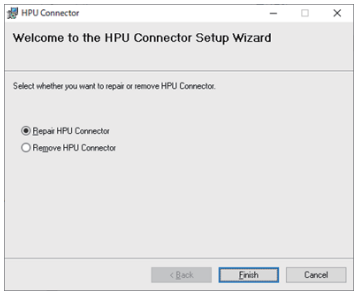


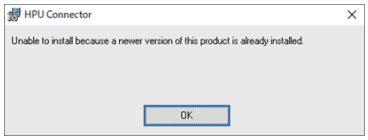
Updating "HPU Connector"

To update "HPU Connector", follow the same procedure as installation to obtain the latest installer, and reinstall it.

Note

(1) When any of the following screens is displayed, update is not required.





Uninstalling "HPU Connector"

Follow the steps below to uninstall "HPU Connector".

(1) Select [Program and Features] in Control Panel of Windows. → The "Uninstall or change a program" screen appears.

(2) Select "HPU_Connector" in the list, and uninstall it. → When the uninstallation is completed, "HPU_Connector" is deleted from the list.

The files included in "HPU Connector folder structure" are targeted for uninstallation.
The files, such as "config.ini", sampling data, model, etc., created after installation are not uninstalled. If these files exist, the HPU_Connector folder is not deleted by the uninstallation.

Installing mosquitto

Next, install "mosquitto", the software required for communication with high speed processing unit.

(1) Access "https://mosquitto.org/". → The top page of "Eclipse Mosquitto" appears.

(2) Click [Download]. → The page to obtain mosquitto appears.

(3) Click the link of "Older installers can be found at..." in the page. → The page to obtain an old version of mosquitto appears.

(4) Click [win32/].

(5) Click "mosquitto-1.6.4-install-windows-x86.exe". → The installer is downloaded.

(6) Run the installer and follow the guidance to install it. → The installation is completed.
(*) Take notes of the mosquitto installation destination because it needs to be set in the edge personal computer.

Installing the analysis function module

Next, install the analysis function module (DLL).
The analysis function module is software to create model parameter. Please prepare at the MTB.

The installation steps are as follows:

(1) Store the analysis function module (DLL file) in the "MELANALYZE_DLL" folder under the installation folder of "HPU Connector".
(2) Set the DLL file name, storage folder path, analysis function execution function name, and others.
For details, refer to "7.3 Settings".

Follow the specifications below to create the analysis function module.

Item	Details
Maximum number of registrations	5
Module format	DLL
Analysis function module name	31 characters or less
Execution function name	31 characters or less
Entry data	Sampling data storage path Output file storage path (including the file name) Analysis information
Output file	Binary file ♦ Be sure to set the file size within 1 MB.

Follow the specifications below to create the execution function of the analysis function module.

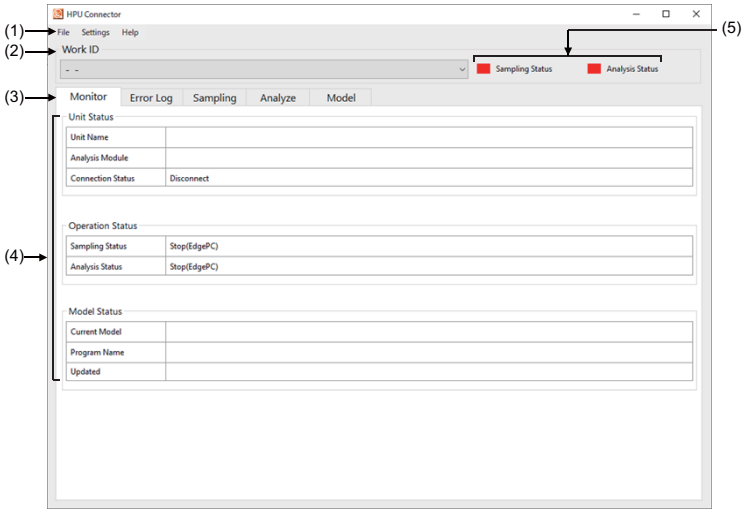
Format	(Function name) (char *input, char *output, void *additional_data) Any function name is available.	
Argument	char *input	Path of the storage folder of the sampling data to be used for analysis (*1)
	char *output (*4)	Path of the file to be output (including the file name)
	void *additional_data	Information for analysis function (*2)
Return value	0 to 9999 (*3)	

(*1) The path to [Analysis function] is input to the "input" argument among "SAMP\[Unit name]\[Analysis function]\[Sampling start time]". Then, use the sampling data in the [Sampling start time] folder.
(*2) This data is to be created when the analysis start operation is performed from NC and to be sent to this application, and can include information required for the analysis. The data size is 16 bytes. The data format can be defined freely, and must be the same between the analysis function and NC.
(*3) The meaning of the return value can be defined freely regardless of whether the function execution result is normal or abnormal, and a value that 10000 is added to the return value is displayed in the error history. The displayed value must be read as the meaning defined for each analysis function. When the return value is out of the range, it is regarded as "0".
(*4) Be sure to set the file size of the output model parameter within 1 MB. Files larger than 1 MB cannot be transferred to the high-speed processing unit.

7.2 "HPU Connector" screen

Start "HPU Connector". To start "HPU Connector", execute "HPU Connector" in the installation folder. The items below are displayed on the screen. (This application cannot be started multiple times.)

Items displayed on the "HPU Connector" screen



Display item			Details
(1)	Menu bar		The menus are displayed.
		[File] - [Quit]	HPU Connector is ended.
		[Settings] - [Settings]	The setting window is displayed.
		[Help] - [About]	The window to show the HPU Connector version is displayed.
(2)	Work ID selection menu		Select the work ID of the operation target. After the selection, the information on the main screen is changed. The unit name and analysis function module (DLL) name assigned to the work ID are displayed. (Example) When the unit name is "Unit1", the module type is "MTB1", and the analysis function name is "Module1", "Unit1 - MTB1 Module1" is displayed.
(3)	Tab		Select the operation screen from the tab.
		Monitor	The screen to check the unit connection condition, analysis state, etc. is displayed.
		Error log	The screen to check the error history is displayed.
		Sampling	The screen to perform sampling and display the waveform, is displayed. (*1)
		Analyze	The screen to analyze the obtained sampling data is displayed. (*1)
		Model	The screen to send the created model to the high speed processing unit is displayed. (*1)
(4)	Main screen		The contents of the selected tab for the work ID are displayed.
(5)	Status		The sampling status and analysis status are displayed like LED lamps. Green: Execute Red: Stop

(*1) When "Trigger" is set to "NC", this function is disabled.

7.3 Settings

(1) Select [Settings] in the menu bar. (*)
(*) If the setting is changed during sampling or during analysis, the process in execution is suspended. The suspended process needs to be performed again from the beginning.

(2) Click "Work ID Assignment" on the left side of the screen, and set each item for "Work ID 1" on the right side of the screen. (*)
- For "Unit Assignments", select the high-speed processing unit to be analyzed.
- For "Unit Module Assignments", select a name that represents the analysis type.
- For "Analyze Module Assignments", select the analysis function module (DLL).

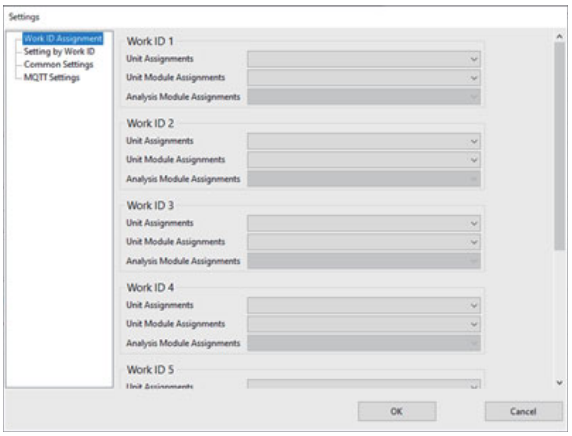
(*) When registering multiple analysis functions, set them to "Work ID 2" to "Work ID 5".

(3) Click "Settings by Work ID" on the left side of the screen and set each item on the right side of the screen.
- For "Start Function", set the function name of the analysis function module to be called at the start of analysis.
- For "Execution at reboot", specify whether or not to perform the analysis on the interrupted data when sampling is interrupted by rebooting the edge PC.
- For "Trigger", select "Edge PC". (Perform operations such as starting and stopping sampling from the edge PC. When operating on the NC side, select "NC".)
- For "Sampling size", set the sampling data storage capacity.
  Sampling data is saved to a file each time sampling is executed.
  When the total file size reaches the "Sampling size" capacity, the oldest files are deleted.
- For "Sampling target", select the data to be sampled.
- Set the following data depending on the data to be sampled.
  - When "Drive Data" is selected: "Axis No.(Channel *)" (channel and axis number)
  - When "Remote IO (master) data" is selected: "RIO (master)" (RIO station number)
  - When "Remote IO (local) data" is selected: "RIO (slave)" (RIO station number)
  - When "Analog input data" is selected: "Analog Input" (analog input channel number)

(4) Click "Common settings" on the left side of the screen and set each item on the right side of the screen.
- For "Sampling Data Path", set the folder path to save the sampling results.
- For "Model Path", set the folder path to save model parameter.
- For "Analyze Module Path", set the folder path that contains the analysis module.
  (Refer to "Installing the analysis function module" in "7.1 Installing the edge PC application".)

(5) Click "MQTT settings" on the left side of the screen and configure each item on the right side of the screen.

(6) After completing the settings, press the [OK] button. "config.ini" is created in the folder in which the HPU Connector execution file is, and the setting values are determined. If you press the [Cancel] button or [x], the window closes without applying the settings.



Item		Details
Work ID Assignment	Unit Assignments	Select the unit to be analyzed from among the high-speed processing units displayed in the list. (*1) (*2) (*3) (*)The list shows high-speed processing units connected to MQTT.
	Unit Module Assignments	Select the type of analysis function. There are up to five types of analysis functions: "MTB Module 1: MTB analysis processing 1" "MTB Module 2: MTB analysis processing 2" : "MTB Module 5: MTB analysis processing 5"
	Analyze Module Assignments	Select the module you want to execute from the list of analysis function modules. (*) The name of the module (DLL) stored in the folder set in "Analyze Module Path" of "Common settings" is displayed in the list.
Settings by Work ID	Start Function	Set a function name to be called from the assigned module when the analysis starts. (Maximum number of characters: 31)
	Execution at reboot	Set whether or not to perform analysis when any sampling data is missing due to reboot of the edge personal computer.
	Trigger	Select the edge personal computer or NC to start and stop sampling, start analysis and send models. (*3) If not set, "Edge PC" is applied.
	Sampling size	Set the maximum capacity for sampling data to be saved on the edge personal computer by gigabytes. When the sampling data exceeds the set capacity, the data is deleted from the old one. (Minimum value: 1 GB) (*4)
	Sampling target	Select a sampling target. (Drive data/Remote IO (master) data/Remote IO (local) data/Analog input data)
	Axis No. (Channel 1) Axis No. (Channel 2)	Among the drive data, specify the axis number to be obtained. (CH1: 1 to 16, CH2: 1 to 16)
	RIO(master)	Among the remote IO (master) data, specify the station number to be obtained. (1 to 64 CH)
	RIO(slave)	Among the remote IO (local) data, specify the station number to be obtained. (1 to 64 CH)
	Analog Input	Among the analog input data, specify the channel number to be obtained. (1 to 6 CH)
Common settings	Sampling Data Path	Set the folder path to save the sampling result. (*5) (*6)
	Model Path	Set the folder path to save the model parameter. (*5) (*6)
	Analyze Module Path	Set the path of the folder to store the analysis function module. (*5) (*6)
MQTT settings	Mosquitto Path	Select the folder path where mosquitto is installed. (*6) (*9)
	MQTT Protocol Version	Select the MQTT communication protocol version. (ver3.1.1/ver5)
	SSL Enable	Select whether to enable or disable SSL communication. When neither is selected, it is regarded as that Disable is selected.
	Broker IP Address	Set the IP address of the PC where the MQTT broker is installed. (*7)
	User Name	Enter the user name to connect to the broker.
	Password	Enter the password to connect to the broker. (*8)

(*1) Up to 255 high speed processing units can be displayed in the list.

(*2) Up to seven high speed processing units can be connected at the same time.

(*3) The target operations are to start/stop sampling, start analysis and send models. Regardless of the setting, operation status check in the "Monitor" tab, waveform display in the "Sampling" tab, etc. are available.

(*4) When a value less than the minimum value is entered, it is regarded as the minimum value.

(*5) If not entered, the system refers to the same folder as the HPU Connector executable file.

(*6) The setting values are restricted as follows.
- The maximum number of characters is 185.
- Only 1-byte alphanumeric characters and symbols are available (2-byte characters are not available).
- Enter "\" as a folder delimiter.

(*7) When not entered, the IP address of the PC where HPU Connector works is applied.

(*8) When no characters are entered in the password setting field, the password is not updated.
If you want to initialize (delete) your password, select the "Reset" check box next to the password setting field.

(*9) If there is an error in the configured folder or if mosquitto version is not 1.6.4, you will not be able to communicate with the high-speed processing unit.

7.4 Creating model parameter by "HPU Connector" operation

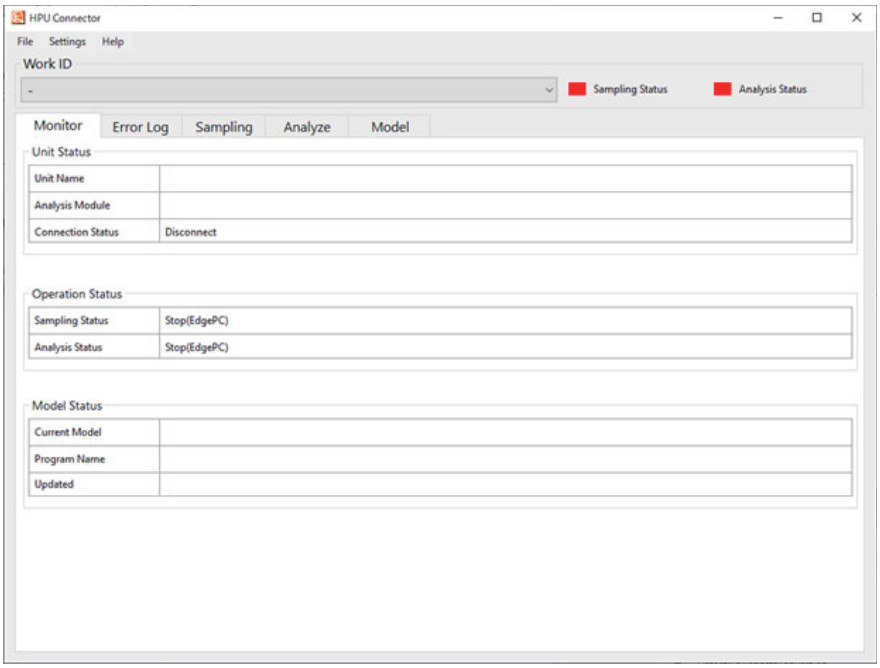
There are two ways to create model parameter: by operating the HPU Connector, and by operating the NC side. This chapter describes the steps to operate HPU Connector and create model parameter.

(*) When operating on the NC side, refer to "7.5 Creating Model Parameter by CNC Operation".

7.4.1 Selecting the work ID

(1) Select the "Monitor" tab.

(2) Select "Work ID" to check the configured high-speed processing unit name, analysis function, and others.
For details on the items displayed on this screen, refer to the table below.



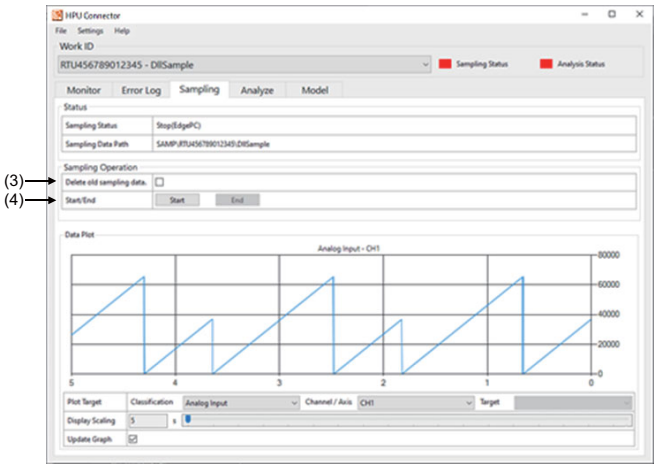
Item	Details
Unit Name	The high speed processing unit name is displayed. ♦ Displays the setting value of the parameter (#1608) of the high-speed processing unit.
Analysis Module	Displays the name of the currently applied analysis function module.
Connection Status	The connection status between the high speed processing unit and the edge PC is displayed. (Connect: Connecting / Disconnect: Disconnecting)
Sampling Status	The sampling state is displayed. Whether the sampling is performed from NC or the edge personal computer is displayed. When executed from the NC: [Stop (NC): Stopped / Execute(NC): Sampling) When executed from the edge PC: [Stop (EdgePC) / Execute (EdgePC)]
Analysis Status	The analysis state is displayed. (Stop: Stopped / Execute: Analyzing)
Current Model	The name of the model applied to the high speed processing unit is displayed.
Program Name	Displays the name of the analysis function module for which you created the model.
Updated	The date and time when the model was created is displayed.

7.4.2 Performing sampling

The parameters "#0009 to #0012" of the high-speed processing unit are ON (enabled), and the sampling data of the items set in the "Settings" screen - "Settings by Work ID" - "Sampling target" in "7.3 Settings" are saved by executing sampling.

(1) Select the "Sampling" tab.

(2) In "Work ID", select the work ID for sampling.



(3) If you want to delete the previous sampling data when sampling starts, turn on the "Delete Old Sampling Data" switch.

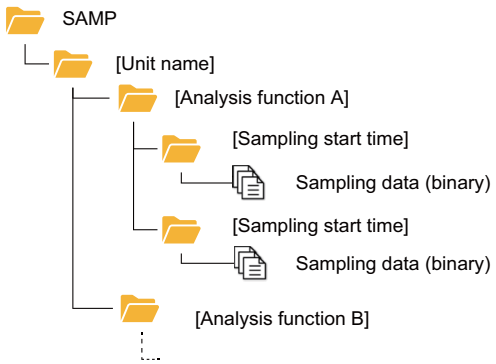
(4) Sampling begins when you press the [Start] button, and ends when you press the [End] button. (*1)
The sampling execution status is displayed in "Sampling status" ("Execute(EdgePC)" indicates that sampling is in execution", and "Stop(EdgePC)" indicates that sampling is currently stopped.)
To start the sampling again after the sampling is ended, an interval of 4.0 or more seconds is required.
If the interval is short, the previous sampling data may not be saved correctly. (*2)

(*1) When "Trigger" is set to "NC", "Stop (NC)" or "Execute (NC)" is displayed in "Sampling Status". The buttons are grayed out, and sampling cannot be performed on the edge personal computer. Change the setting or perform the sampling on NC.

(*2) If you perform a new sampling start operation before sampling ends, the later start operation is recorded in the error history. Data in the "Sampling Start Time" folder with the closest time before the error history may not be saved correctly.

Sampling data is saved in folders by unit name or analysis function as shown below.

[Sampling data folder structure]



- The [SAMP] folder is located at the path set in the "Setting" screen - "Common settings" - "Sampling Data Path" in "7.3 Settings".
- [Unit name] shows the name of the high-speed processing unit that acquired the sampling data.
- The name of the high-speed processing unit is determined by the parameter "#1608 unit name".
- The folder name of the analysis function is set to the name selected on the "Setting" screen - "Work ID Assignment" - "Analyze Module Assignments" in "7.3 Settings".
- [Sampling start time] is set to the name that represents the sampling start time in the "YYYYMMDDHHMMSS" format.

The format of the sampling data can be determined from the "data structure information" file ([unit name]-[time] - FRAMEINFO.bin) located in the same folder.

[Sampling data file name]

Data type	File name
Data structure information	[Unit name] - [Time] - FRAMEINFO.bin
AI data	[Unit name] - [Time] - DRV-CH[CH number] - AX[Axis number].bin
RIO (master) data	[Unit name] - [Time] - RIOM - ST[Station number].bin
RIO (local) data	[Unit name] - [Time] - RIOS - ST[Station number].bin
AI data	[Unit name] - [Time] - AI-CH[CH number].bin

Note

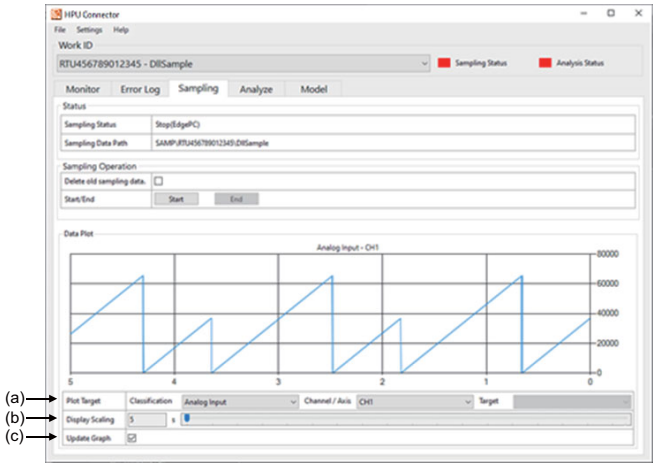
- If the total size of sampling data reaches the maximum capacity set in the "Settings" screen - "Settings by Work ID" - "Sampling size" in "7.3 Settings" while sampling, files in the same folder are deleted starting with those with the oldest saving date and time, then, new files are saved.
  However, the data structure information file is not deleted.

7.4.3 Displaying waveform of sampling data

(1) Select the "Sampling" tab.

(2) In "Work ID", select the work ID for which you want to display waveforms.
(*) Specify the work ID for which sampling has been completed. (Refer to "7.4.2 Performing sampling".)

(3) Select a type of sampled data to display the waveform in time series. This is available during the sampling or after the sampling is completed. (*1)



	Item		Details
(a)	Plot Target		Select data for which you want to display waveforms. (*2)
		Classification	Select one of the following sampling targets. • Drive Data • Remote I/O – Master • Remote I/O – Slave • Analog Input
		Channel / Axis	When Classification = DriveData: • Specify one optical servo communication channel and axis number. When Classification = Remote I/O - Master or Slave: • ST1 to ST64 When Classification = Analog Input: • CH1 to CH6
		Target	Select one of the following data types. When Classification = DriveData: • Machine Error Compensation • Feedback Position • Grid Amount • Speed Feedback • Current Feedback • Driver Status When Classification = Remote I/O - Master or Slave: • Input, Output When Classification = Analog Input: • (No selection required.)
(b)	Display Scaling		Change the horizontal axis scale. You can change the scale between the last 5 and 180 seconds.
(c)	Update Graph		Turn ON this switch to display the waveform of the latest sampling data for the scale. The 0 position indicates the latest data position. To display the waveform at the same time as sampling, the waveform is automatically updated every approximately two seconds. Turn OFF the "Update Graph" switch to stop the automatic update of the waveform. When the target data or the scale is changed, the waveform at the time when the switch is turned OFF is updated as the latest data.

(*1) The waveform display function is available even when the sampling is started on NC.

(*2) "(Not used)" in the "Target" column cannot be used. If selected, the sampled data's waveform is displayed.

(*3) The vertical axis is automatically scaled. The units vary depending on the target to display the waveform.

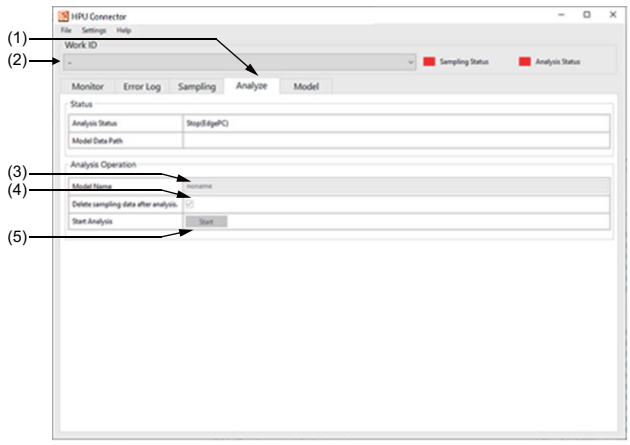
Note

(1) The waveform of deleted sampling data cannot be displayed. (When the "Delete sampling data after analysis." switch is turned ON and the analysis function is used, etc.)

7.4.4 Analysis and model parameter creation

(1) Select the "Analyze" tab.

(2) In" Work ID", select the work ID for which you want to analyze.
(*) Specify the work ID for which sampling has been completed. (Refer to "7.4.2 Performing sampling".)



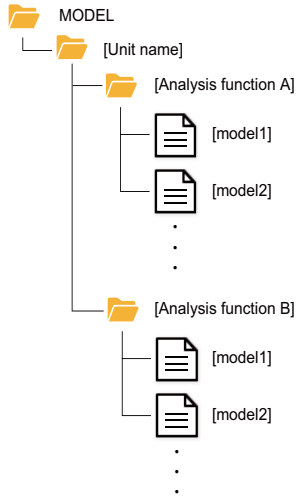
(3) For "Model Name", set the model name. The model name can be specified using single-byte alphanumeric characters and single-byte symbol "_". Specify within 31 characters. This creates a file with the specified name and the extension ".model". If no name is set, the file name of the created model is set to "noname.model".

(4) Specify whether or not to delete sampling data after analysis is complete. Turn on the switch to delete the sampled data at the end of analysis. (*2)
If you want to perform the analysis again, turn off the switch. (Sampling data is not deleted even after analysis is completed.)

(5) Click the [Start] button to start the analysis. While analyzing, "Execute" is displayed in "Analysis Status", and when analysis is completed, "Stop" is displayed. (*1)

The model parameter created by analyzing the sampling data is saved in folders by unit name or analysis function as shown below.
The "MODEL" folder is located at the path set in the "Setting" screen - "Common settings" - "Model Path" in "7.3 Settings".
"Unit name" is the name of the high-speed processing unit that acquired the sampling data.
The name of the high-speed processing unit is determined by the parameter "#1608 unit name".
The folder name for the analysis function is set to the name selected on the "Setting" screen - "Work ID Assignment" - "Analyze Module Assignments" in "7.3 Settings".

[Model parameter folder structure]

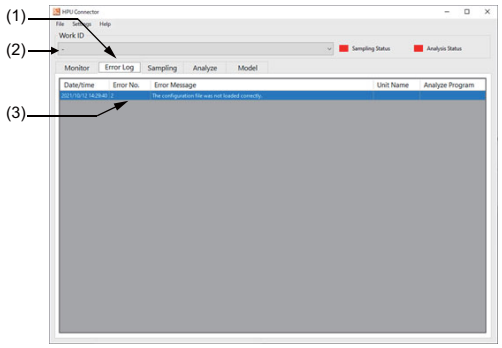


(*1) Up to five analysis functions can be executed simultaneously. If the number of analysis functions executable simultaneously is exceeded, execute the excess after the analysis function in progress has finished.
When "Trigger" is set to "NC", "Stop (NC)" or "Execute (NC)" is displayed in "Analysis Status". The buttons are grayed out, and sampling cannot be performed on the edge personal computer. Change the setting or perform the sampling on NC.

(*2) When the analysis is suspended, such as when the edge personal computer is restarted, the data is not deleted.

7.4.5 Checking the error history

(1) Select the "Error log" tab.
(2) In "Work ID", select the work ID for which you want to check the error history.
(3) Check that there are no errors in the sampling or analysis process. (*1)



Item	Details
Date/time	The error occurrence time is displayed in the "YYYY/MM/DD hh:mm:ss" format.
Error No.	The error No. is displayed.
Error Message	The error message is displayed.
Unit Name	The string set in the parameter (#1608) of the error unit is displayed. (*2)
Analyze Program	Displays the name of the analysis function module where the error occurred. (*2)

(*1) When the setting is changed or the application is restarted, the history is deleted.
(*2) An error common to all the work IDs is not displayed.

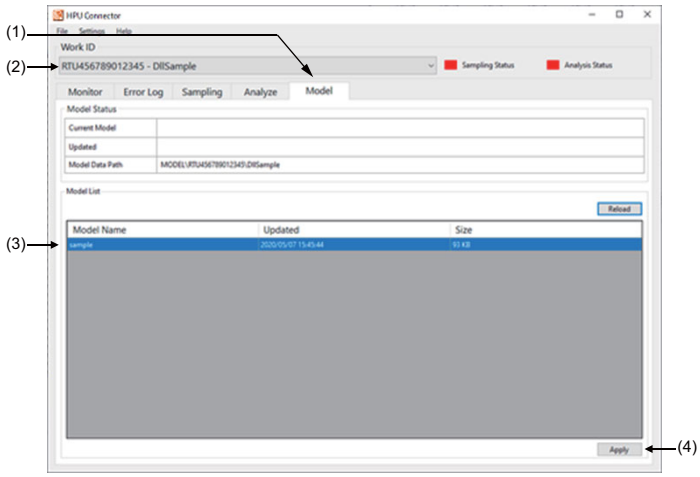
<Obtaining the error history>
You can copy the error history to the clipboard.
Select the area you want to copy with the mouse and highlight the display.
Right-click the mouse and select "Copy" from the menu. With the above operations, you can copy the highlighted data to the clipboard.
The copied data can be pasted to an external text file or CSV file. (*)

(*) The delimiters are newline characters (CRLF) and TAB characters.

7.4.6 Sending model parameter

(1) Select the "Model" tab.

(2) In "Work ID", select the work ID for which you want to send the model.



(3) Select the model parameter to be sent to the high-speed processing unit from the list displayed in the "Modellist" field.
(*) The model name, creation date and time, and file size are displayed in the list. Model parameter with the file size exceeding 1 MB cannot be sent.

(4) Press the [Apply] button to send the model to the high-speed processing unit.

7.5 Creating Model Parameter by CNC Operation

(1) Prepare the M code and sequence program to control the processing required to create model parameter.
This manual uses examples of assigning the following M codes to make explanations.
M101: Sampling start command
M102: Sampling end command
M103: Analysis start command
M104: Analysis interrupt command
M105: Model parameter transfer command

(2) Follow the steps below to create model parameter.
- Sample the data to be analyzed… M101, M102
- Analyze sampling data (create model parameter)... M103, M104
- Transfer model parameter to the high-speed processing unit...M105

Create a sequence program for the "timing chart" of "8.2 PLC Output Signals".
For details on the PLC interface signal, refer to " PLC Interface".

(3) Before executing the model parameter creation processing, create the edge PC configuration file "config.ini".
For the format of "config.ini", refer to "7.5.1 config.ini file settings".
(*) "config.ini" can be created using the "HPU Connector" app. Refer to "7.3 Settings".

Precautions

If a request is selected from the NC, the edge PC performs the operation according to the request and returns a response when completed. Do not send another request between the time you select a request and the time you receive a response. If you send requests consecutively, the edge PC may not work as expected.
If you want to perform sampling multiple times, select the sampling end request to end the sampling before starting the next sampling. If you select the sampling start request and then select the sampling start request again without selecting the sampling end request, the saving of the sampling data that has already started is finished and saving of the new sampling data starts. For details, refer to "7.4.2 Performing sampling".
If the analysis start request is selected, the analysis of the same function cannot be performed until the analysis is completed. If you select an analysis start request for the same function before the analysis is completed, the analysis that is already in progress continues without starting a new analysis. If you want to execute an analysis with the same function, complete the analysis that is already executed before starting the target analysis.

7.5.1 config.ini file settings

Set the analysis functions to be executed, sampling data, model storage destination, and others in the configuration file "config.ini".

Store "config.ini" in the same folder as the "HPU Connector" executable file.

The setting items of "config.ini" are as follows.

Section name	Key name	Contents
[WorkId1] to [WorkId7] (Unit information)	unit_name	Set the unit name of the high-speed processing unit to be connected. (Maximum number of characters: 15)
	module_name	Set the name ("MTB1" to "MTB5") that represents the type of analysis function.(*1)
	program_name	Set the name of the analysis function module. (Maximum number of characters: 31)
	start_func	Set the function to call. (Maximum number of characters: 31)
	exe_enable	Set whether or not to perform analysis when any sampling data is missing due to reboot of the edge personal computer. (1: Execute / 0: Do not execute)
	operate_trigger	Set the edge personal computer or NC to start and stop sampling, start analysis and send models. (1. NC, 2: Edge PC)
	samp_size_max	Set the maximum capacity for sampling data to be saved in gigabytes. (Minimum value 4000000 (Hex) [1GB])
	save_bit	Set the type of sampling data to be saved in hexadecimal.(*2) BIT0: Drive (servo axis) data BIT1: Unused BIT2: RIO (master) data BIT3: RIO (local) data BIT4: Analog input data
	drv_bit	Set the axis number of the servo axis to be saved in hexadecimal. BIT0: 1st axis (1ch) : BIT15: 16th axis (1ch) BIT16: 1st axis (2ch) : BIT31: 16th axis (2ch)
	di_bit	(Not used)
	riom_bit	Set the node number of the remote I/O unit (master) to be saved in hexadecimal. BIT0:1st node : BIT63: 64th node
	rios_bit	Set the node number of the remote I/O unit (local) to be saved in hexadecimal. BIT0:1st node : BIT63: 64th node
	ai_bit	Set the channel number of the analog input unit to be saved in hexadecimal. BIT0: 1ch : BIT5: 6ch
[Common] (*3) (Common setting)	program_path	Set the path of the folder to store the analysis function module (DLL). If not set, the system refers to the same folder as the HPU Connector executable file.
	sampling_path	Set the path of the folder to save sampling data. If not set, the sampling data is saved in the same folder as the HPU Connector executable file.
	model_path	Set the path to save model parameter. If not set, create a model in the same folder as the HPU Connector executable file.
Mqtt (MQTT setting information)	protocol_ver	Set the MQTT protocol version. You need to use the broker that corresponds to the version you configured. (4: ver3.1.1 / 5: ver5) For versions other than ver3.1.1 and ver5, set "4".

(*1) The following strings are settable.

Setting value of analysis type "module_name"	Contents
MTB1	MTB analysis processing 1
MTB2	MTB analysis processing 2
MTB3	MTB analysis processing 3
MTB4	MTB analysis processing 4
MTB5	MTB analysis processing 5

(*2) The data storage information set here defines the sampling data to be saved on the edge PC, which is different from the data structure information set with the parameters. Also, even if enabled in the configuration file, sampling data cannot be saved if the sampling data parameters are disabled.

(*3) The setting values are restricted as follows.

- The maximum number of characters is 185.
- Only 1-byte alphanumeric characters and symbols are available (2-byte characters are not available).
- Enter "\" as the folder delimiter.

Create "config.ini" with the character code "UTF-8".
Use "CR LF" as the line feed code.
Lines starting with a semicolon ";" are handled as comment lines.

Setting examples are shown below.

```
[WorkId1]
unit_name = "HPUtest"
module_name = "MTB1"
program_name = "mtb_dll.dll"
start_func = "Dll_Main"
exe_enable = 0
operate_trigger = 1
samp_size_max = 6400000
send_bit = 1F
drv_bit = FFFF0000
di_bit = F
riom_bit = 0
rios_bit = 0
ai_bit = 1

[Common]
sampling_path = " □□□□ "
model_path = " □□□□ "
program_path = " □□□□ "

[Mqtt]
protocol_ver = 5
```

(*) Be sure to enclose the values set for the following keys in double quotation marks " ".

- unit_name
- module_name
- program_name
- start_func

8

PLC Interface

8.1 PLC input signal

B contact	Signal name	Abbrev.	Common ($)
-	High-speed processing unit I/F response signal (MTB custom processing 1)	-	ZR4820
-	High-speed processing unit I/F response signal (MTB custom processing 2)	-	ZR4821
-	High-speed processing unit I/F response signal (MTB custom processing 3)	-	ZR4822
-	High-speed processing unit I/F response signal (MTB custom processing 4)	-	ZR4823
-	High-speed processing unit I/F response signal (MTB custom processing 5)	-	ZR4824

[Function]
These signals receive the responses to the requests sent to the high speed processing unit or edge personal computer in ZR4800 to ZR4804.

[Operation]
BIT0 to BIT6 are the response signals to respond to the requests of the same bits of ZR4800.
ZR4820 to ZR4824 respond to the requests of ZR4800 to ZR4804.
BIT0: Sampling start notification (corresponds to BIT0 of the "high speed processing unit I/F request" signal.)
BIT1: Sampling end notification (corresponds to BIT1 of the "high speed processing unit I/F request" signal.)
BIT2: Analysis start notification (corresponds to BIT2 of the "high speed processing unit I/F request" signal.)
BIT3: Analysis completion notification (corresponds to BIT2 or BIT3 of the "high speed processing unit I/F request" signal.)
BIT6: Model application notification (corresponds to BIT6 of the "high speed processing unit I/F request" signal.)
BIT7 to BITF: Unused.

[Related signals]
- High speed processing unit I/F request signal
- High speed processing unit I/F status signal
- High speed processing unit I/F error status signal

B contact	Signal name	Abbrev.	Common ($)
-	High speed processing unit I/F status signal (MTB custom processing 1)	-	ZR4840
-	High speed processing unit I/F status signal (MTB custom processing 2)	-	ZR4841
-	High speed processing unit I/F status signal (MTB custom processing 3)	-	ZR4842
-	High speed processing unit I/F status signal (MTB custom processing 4)	-	ZR4843
-	High speed processing unit I/F status signal (MTB custom processing 5)	-	ZR4844

[Function]
These signals receive the operation statuses of the high speed processing unit or edge personal computer in response to the request of ZR4800 to ZR4804.

[Operation]
BIT0 to BIT3 of ZR4840 are the status signals in response to BIT0, 2, 4 and 5 of ZR4800.
ZR4840 to ZR4844 respond to the requests of ZR4800 to ZR4804.
BIT0: Sampling status (ON: In sampling / OFF: Sampling stop)
BIT1: Analysis status (ON: In analysis / OFF: Analysis stop)
BIT2: Model list request status (ON: In request / OFF: Sending stop)
BIT3: Model request status (ON: In request / OFF: Sending stop)
[Related signals]
- High speed processing unit I/F request signal
- High speed processing unit I/F response signal
- High speed processing unit I/F error status signal

B contact	Signal name	Abbrev.	Common ($)
-	High speed processing unit I/F error status signal (MTB custom processing 1)	-	ZR4860
-	High speed processing unit I/F error status signal (MTB custom processing 2)	-	ZR4861
-	High speed processing unit I/F error status signal (MTB custom processing 3)	-	ZR4862
-	High speed processing unit I/F error status signal (MTB custom processing 4)	-	ZR4863
-	High speed processing unit I/F error status signal (MTB custom processing 5)	-	ZR4864

[Function]
These signals receive errors in response to the request of ZR4800 to ZR4804.

[Operation]
The ON BIT shows the error that occurred.
ZR4860 to ZR4864 respond to the requests of ZR4800 to ZR4804.
BIT0: Multi-request error (Multiple types of requests have been output at once. / Another request was output before the previous request was completed.)
BIT1: Timeout error (A response to a request timed out.)
BIT2: NC-HPU optical communication error (The NC-HPU optical communication is not connected.)
BIT3: Request execution error (An error was detected on the edge personal computer.)
BIT4: High speed processing unit I/F not supported (A system incompatible with the high speed processing unit I/F is used.)

[Related signals]
- High speed processing unit I/F request signal
- High speed processing unit I/F response signal
- High speed processing unit I/F status signal

Error cause and countermeasure

The following are the error cause and countermeasure.

Error type	Error condition/cause	Update contents of PLC input signal			Alarm	Countermeasure
		Response signal	Status	Error status		
Multiple requests	Multiple requests are selected by one request signal at the same time.	OFF	OFF	ON	Not displayed	Clear the request signal and select a request again.
	An additional request is selected while a request is selected by the same request signal.	OFF	OFF	ON	Not displayed	
Time out	A certain time (60 seconds) has passed during the wait for response from the high speed processing unit.	OFF	OFF	ON	Not displayed	Check the communication status with the high speed processing unit, and connect again.
NC-HPU optical communication error	The request signal is updated while the optical communication between NC and HPU is disconnected.	OFF	OFF	ON	Not displayed	Check the communication status with the high speed processing unit, and connect again.
	The optical communication between NC and HPU is disconnected during waiting time of response from the high speed processing unit.	OFF	OFF	ON	Not displayed	
	The optical communication between NC and HPU is disconnected while the status signal is ON.	Not updated	OFF	Not updated	Not displayed	

B contact	Signal name	Abbrev.	Common ($)
-	HPU custom module: Arbitrary data	HPUCMDAT	ZR4880 to ZR4959

[Function]
This signal receives arbitrary data sent from the custom module.

[Operation]
Data sent from the custom module to NC is stored in ZR4880 to ZR4959.
The data ID and data storage device are as follow when the data is sent.

n	Data ID	Data storage device
1	0x2300	ZR4880 to ZR4883
2	0x2301	ZR4884 to ZR4887
3	0x2302	ZR4888 to ZR4891
	:	:
n	0x2300+(n-1)	ZR(4880+4(n-1)) to ZR(4880+4(n-1)+3)
	:	:
20	0x2313	ZR4956 to ZR4959

The data is not updated when the optical communication between NC and HPU is not active or when the data ID for the custom module information is disabled.
This signal is cleared to zero at start of NC.

[Related signals]
None

B contact	Signal name	Abbrev.	$1	$2	$3	$4	$5	$6	$7	$8
-	HPU custom module Cutting feed override compensating	HPUFO-VSTSm	ZR4960	ZR4962	ZR4964	ZR4966	ZR4968	ZR4970	ZR4972	ZR4974

[Function]
This function indicates the cutting feed override compensation status by the custom module.

[Operation]
While the custom module is compensating the cutting feed override, the value of this signal is set to "1" (being compensated).
While the HPU custom module is not compensating the cutting feed override, the value of this signal is set to "0" (uncompensated).

B contact	Signal name	Abbrev.	$1	$2	$3	$4	$5	$6	$7	$8
-	HPU custom module Rapid traverse override compensating	HPUROVSTSm	ZR4961	ZR4963	ZR4965	ZR4967	ZR4969	ZR4971	ZR4973	ZR4975

[Function]
This function indicates the rapid traverse override compensation status by the custom module.

[Operation]
While the custom module is compensating the rapid traverse override, the value of this signal is set to "1" (being compensated).
While the custom module is not compensating the rapid traverse override, the value of this signal is set to "0" (uncompensated).

B contact	Signal name	Abbrev.	1st axis	2nd axis	3rd axis	4th axis	5th axis	6th axis	7th axis	8th axis
-	HPU custom module: Machine error adjustment amount compensation status	HPU-MECSTSm	ZR4976 bit0	ZR4976 bit1	ZR4976 bit2	ZR4976 bit3	ZR4976 bit4	ZR4976 bit5	ZR4976 bit6	ZR4976 bit7
			9th axis	**10th axis**	**11th axis**	**12th axis**	**13th axis**	**14th axis**	**15th axis**	**16th axis**
			ZR4976 bit8	ZR4976 bit9	ZR4976 bit10	ZR4976 bit11	ZR4976 bit12	ZR4976 bit13	ZR4976 bit14	ZR4976 bit15
			17th axis	**18th axis**	**19th axis**	**20th axis**	**21th axis**	**22th axis**	**23th axis**	**24th axis**
			ZR4977 bit0	ZR4977 bit1	ZR4977 bit2	ZR4977 bit3	ZR4977 bit4	ZR4977 bit5	ZR4977 bit6	ZR4977 bit7
			25th axis	**26th axis**	**27th axis**	**28th axis**	**29th axis**	**30th axis**	**31th axis**	**32th axis**
			ZR4977 bit8	ZR4977 bit9	ZR4977 bit10	ZR4977 bit11	ZR4977 bit12	ZR4977 bit13	ZR4977 bit14	ZR4977 bit15

[Function]
This function indicates the compensation status of machine error compensation amount by the custom module.

[Operation]
While the custom module is compensating the machine error compensation amount, the value of this signal is set to "1" (being compensated).
While the custom module is not compensating the machine error compensation amount, the value of this signal is set to "0" (uncompensated).

B contact	Signal name	Abbrev.	1stSP	2ndSP	3rdSP	4thSP	5thSP	6thSP	7thSP	8thSP
-	HPU custom module Spindle override compensation status	HPUSOVSTSm	ZR4978	ZR4979	ZR4980	ZR4981	ZR4982	ZR4983	ZR4984	ZR4985

[Function]
This function indicates the spindle override compensation status by the custom module.

[Operation]
While the custom module is compensating the spindle override, the value of this signal is set to "1" (being compensated).
While the custom module is not compensating the spindle override, the value of this signal is set to "0" (uncompensated).

8.2 PLC Output Signals

B contact	Signal name	Abbrev.	Common ($)
-	High speed processing unit I/F request signal (MTB custom processing 1)	-	ZR4800
-	High speed processing unit I/F request signal (MTB custom processing 2)	-	ZR4801
-	High speed processing unit I/F request signal (MTB custom processing 3)	-	ZR4802
-	High speed processing unit I/F request signal (MTB custom processing 4)	-	ZR4803
-	High speed processing unit I/F request signal (MTB custom processing 5)	-	ZR4804

[Function]
This signal is used to select a request to be sent to the high speed processing unit or the edge personal computer.

[Operation]
This signal sends a request corresponding to the BIT turned ON to the high speed processing unit or the edge personal computer.
BIT0: Sampling start request
BIT1: Sampling end request
BIT2: Analysis start request
BIT3: Analysis end request
BIT6: Model application request
BIT7 to BITF: Unused.

[Related signals]
- High speed processing unit I/F response signal
- High speed processing unit I/F status
- High speed processing unit I/F error status

Timing chart

The following is the flow to send a request to the high speed processing unit or edge personal computer by using the high speed processing unit I/F.

(1) Update the request signal.
Turn ON the request signal corresponding to the analysis function to be sent to the high speed processing unit or edge personal computer. Then, wait until the response signal is turned ON. For example, to perform sampling, make a sequence to keep (wait for) ZR4800/BIT0 until ZR4820/BIT0 (sampling start response) is turned ON after ZR4800/BIT0 (start request) is turned ON, as shown in the timing chart [Sampling] below.
At this time, if the error status signal is turned ON instead of the response signal, an error occurs. Clear the request signal.
For the error conditions, refer to "Error cause and countermeasure".

(2) Check the response signal.
When the requested process is completed, the response signal corresponding to the received request signal is turned ON.
At this time, if an error occurs, the error status signal is turned ON instead of the response signal.
For the error conditions, refer to "Error cause and countermeasure".

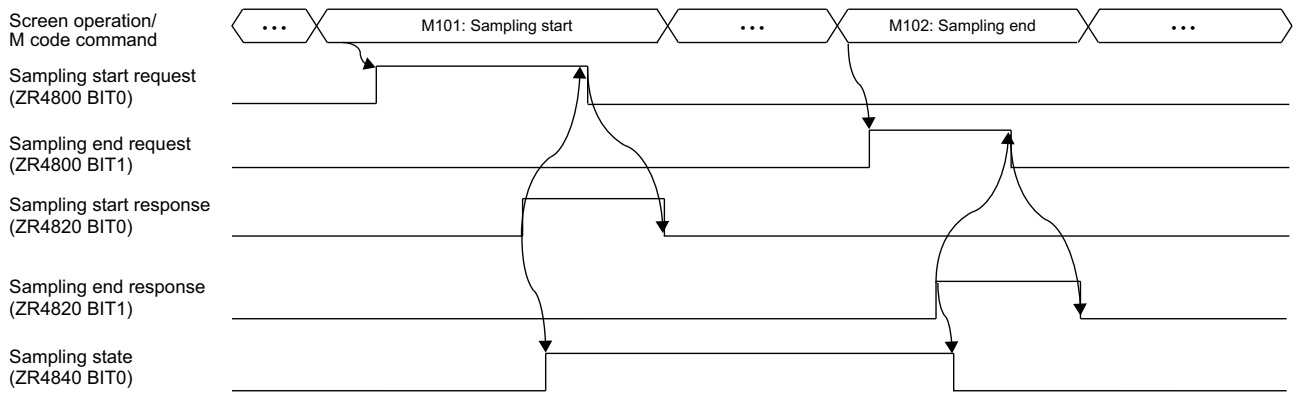
(3) Clear the request signal.
When it is confirmed that the response signal or error status signal is turned ON, turn OFF the request signal that was turned ON in (1). Then, when the response signal or error status signal is turned OFF, the next request can be sent to the high speed processing unit or edge personal computer.

The following time chart shows the sequence process of start and end of sampling, start and interruption of analysis, and model parameter transmission.

(*) The time chart shows an example of custom processing 1 signal.
For custom processing 2 to 5, replace the signals as follows.

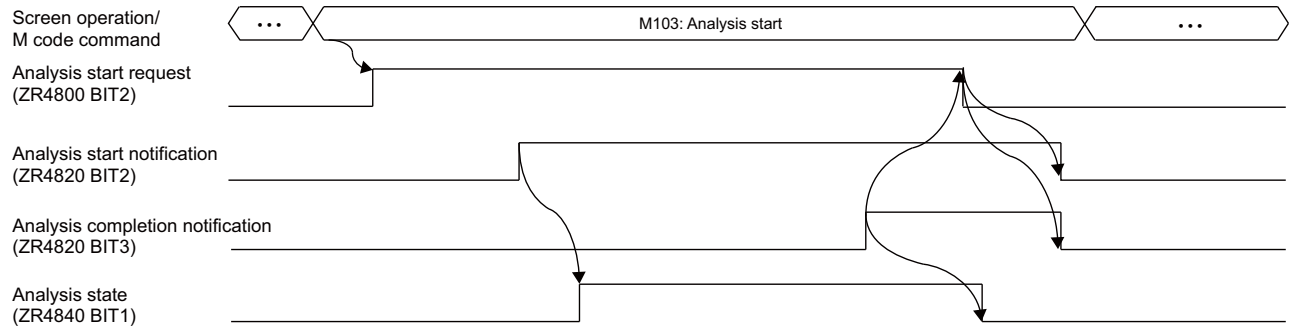
	Request	Response	Status	Err,Sts
Custom processing 1:	ZR4800	ZR4820	ZR4840	ZR4860
Custom processing 2:	ZR4801	ZR4821	ZR4841	ZR4861
Custom processing 3:	ZR4802	ZR4822	ZR4842	ZR4862
Custom processing 4:	ZR4803	ZR4823	ZR4843	ZR4863
Custom processing 5:	ZR4804	ZR4824	ZR4844	ZR4864

[Sampling]

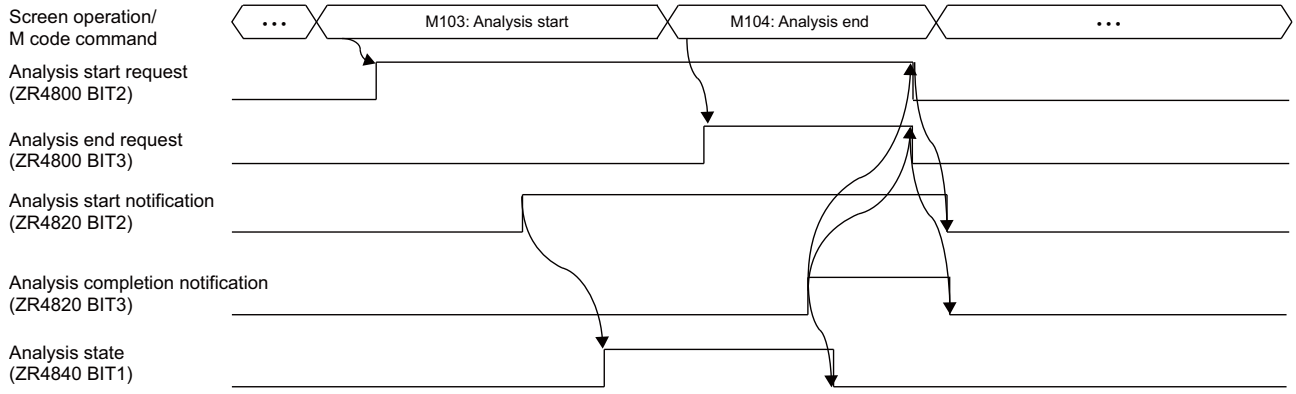


(*) Take an interval of four or more seconds between "Sampling end request" and "Sampling start request".
If "Sampling start request" is performed immediately after the sampling end, the sampling data may not be saved correctly.

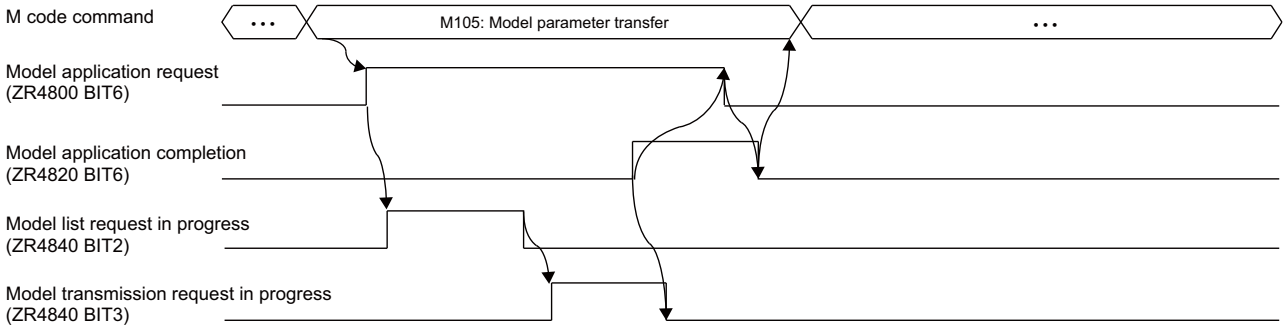
[Analysis (model creation)]



[Analysis interruption]



[Model parameter transmission (from edge personal computer to HPU)]



9

Library Functions

9.1 Library Functions for High-speed Processing Unit (Custom Module)

By calling the following functions from the custom module of the high-speed processing unit (HPU), you can acquire data from servo/spindle drive (DRV), remote I/O (RIO), analog input (AI), and perform data acquisition from RIO, and output various compensation data via the RIO and optical communication I/F.

Function	Variable name	Chapter
Data Acquisition	dataRead	9.1.1
Data Write Request	dataWriteReq	9.1.2
NC Connection Axis Information Acquisition	nchpuStsGet	9.1.3
For NC-HPU Optical Communication		
I/F Size Acquisition	nchpuIFSizeGet	9.1.4
Send Data ID Operation Enabled/Disabled Check	nchpuTxCtrlCheck	9.1.5
Send Data ID Addition	nchpuTxIdAdd	9.1.6
Send Data ID Removal	nchpuTxIdRemove	9.1.7
Send Data ID Check	nchpuTxIdCheck	9.1.8
Receive Data ID Operation Permission Request	nchpuRxCtrlRequest	9.1.9
Receive Data ID Operation Permission Request Execution Check Result	nchpuRxCtrlCheck	9.1.10
Receive Data ID Addition Request	nchpuRxIdAddRequest	9.1.11
Receive Data ID Removal Request	nchpuRxIdRemoveRequest	9.1.12
Receive Data ID check	nchpuRxIdCheck	9.1.13

9.1.1 Data Acquisition: dataRead

[Format]

```
long dataRead
(
unsigned short majorDataId,        /* Section data ID                    */
unsigned short subsectionDataId,   /* Sub-section data ID                */
unsigned short dataType1,          /* Acquired data type 1               */
unsigned short dataType2,          /* Acquired data type 2               */
void* dataAddress,                 /* Address to write acquired data     */
unsigned long writeDataSize,       /* Secured buffer size                */
unsigned short *dataSize           /* Write data size                    */
)
```

[Function]

This function acquires the DRV, RIO (master), RIO (slave), analog input, and NC-HPU optical communication data.

[Detail]

- This function collectively acquires all the data sampled during the 3.5ms immediately before it is called.
  The number of data items to be sampled during 3.5ms depends on the type of data.
  AI data is sampled 200 times during 3.5ms, so sampling data of 200 times are acquired at once.
  Optical communication data is acquired twice, and RIO data and parameter data are acquired once.
- Specify the data to be acquired using the section data ID (majorDataId), sub-section data ID (subsectionDataId), acquisition data type 1 (dataType1), and acquisition data type 2 (dataType2). For on the setting values, refer to "9.2.1 Data Acquisition Function Argument Definition" and "Data acquisition function usage examples".
- For the argument (*dataAddress), specify the address of the buffer to acquire and store the data.
- For the argument (writeDataSize), specify the size of the buffer specified by the argument (dataAddress). For the buffer size required to store data, refer to "Data size to be acquired (bytes)" in "9.2.1 Data Acquisition Function Argument Definition".
- The size of the data stored in the argument (dataAddress) is set to the argument (dataSize).

[Supplement]

- If the parameter (DATA_READ_PARAM) is specified for the section data ID and the parameter number is specified for the sub-section data ID, all values are acquired if multiple parameter values can be set for one parameter number.
  Example: If you acquire "#1801" virtual rotary number, acquire the rotary number data for 64 nodes.
- For the argument (dataAddress) area, be careful of the address boundary.
  To acquire 4 bytes of data, specify an address that is divisible by 4 (4-byte boundary), and to obtain 2 bytes of data, specify an address that is divisible by 2 (2-byte boundary).
  Specify an address area that is also divisible by 2 for the argument (dataSize).
- When acquiring DRV sampling data/NC-HPU optical communication data, acquire the target axis type using the NC connection axis information acquisition function, check whether it is servo axis data or spindle data, and check the sub-section ID.
  The relationship between the types of axes acquired with the NC connection axis information acquisition function and the axes that can be acquired with the dataRead() function is as follows.
  For servo axes: Acquire the data of the target servo axis.
  For the spindle (including the spindle type servo axes): Acquire the data of the target spindle.
  For spindle/C axis: Acquire the data of the spindle that is paired with the target spindle/C axis (servo axis).
  For rotary axis spindle: Acquire the data of the servo axis that is paired with the target rotation axis spindle (main axis).

[Return value]

Normal end	0:	Data acquisition OK
Warning	1:	The size of the acquired data is smaller than the buffer size. (*) The acquired size of data will be stored in the argument (dataAddress). The rest remains as it was when you reserved the space. The acquired data size is stored in the argument (dataSize).
Error status	-1:	Argument specification error (You specified a value that is not in the table "9.2.1 Data Acquisition Function Argument Definition".)
	-2:	Writing failure (NULL or an area outside DRAM was specified for the arguments (dataAddress, dataSize)) (An area where the 2-byte boundary and 4-byte boundary are incorrect was specified.)
	-3:	Buffer size over (The acquired data size is larger than the buffer size)
	-4:	Data acquisition error at NC connection/disconnection (DRV sampling data and NC-HPU optical communication data were acquired using this function while the NC was powered off/rebooted.)
	-5:	No specified data (Data that does not exist on the NC-HPU optical communication was specified.)

Data acquisition function usage examples

- When you want to read RIO data]

Function usage example	Meaning of argument
dataRead (DATA_READ_RIOM,DATA_READ_RIOM_IN,10,0,&dataAddress,4,&dataSize)	RIO master (10) node, input data
dataRead (DATA_READ_RIOS,DATA_READ_RIOS_IN,5,0,&dataAddress,4,&dataSize)	RIO local (5) node, input data

- When you want to read analog data

Function usage example	Meaning of argument
dataRead (DATA_READ_AI,DATA_READ_AI6CH,3,0,&dataAddress,8,&dataSize)	Analog data 3CH

- When you want to read parameter data

Function usage example	Meaning of argument
dataRead (DATA_READ_PARAM,1803,0,0,&dataAddress,6,&dataSize)	Parameter (#1803 analog input data range)
dataRead (DATA_READ_PARAM,1608,0,0,&dataAddress,16,&dataSize)	Parameter (#1608 MQTT Unit Name)

- When you want to load NC-HPU optical communication data

Function usage example	Meaning of argument
dataRead (DATA_READ_NCHPU, 0x0001,0,0,&dataAddress,16,&dataSize)	NC-HPU Optical Communication Data Data with data ID 0x0001

- When you want to read DRV sampling data

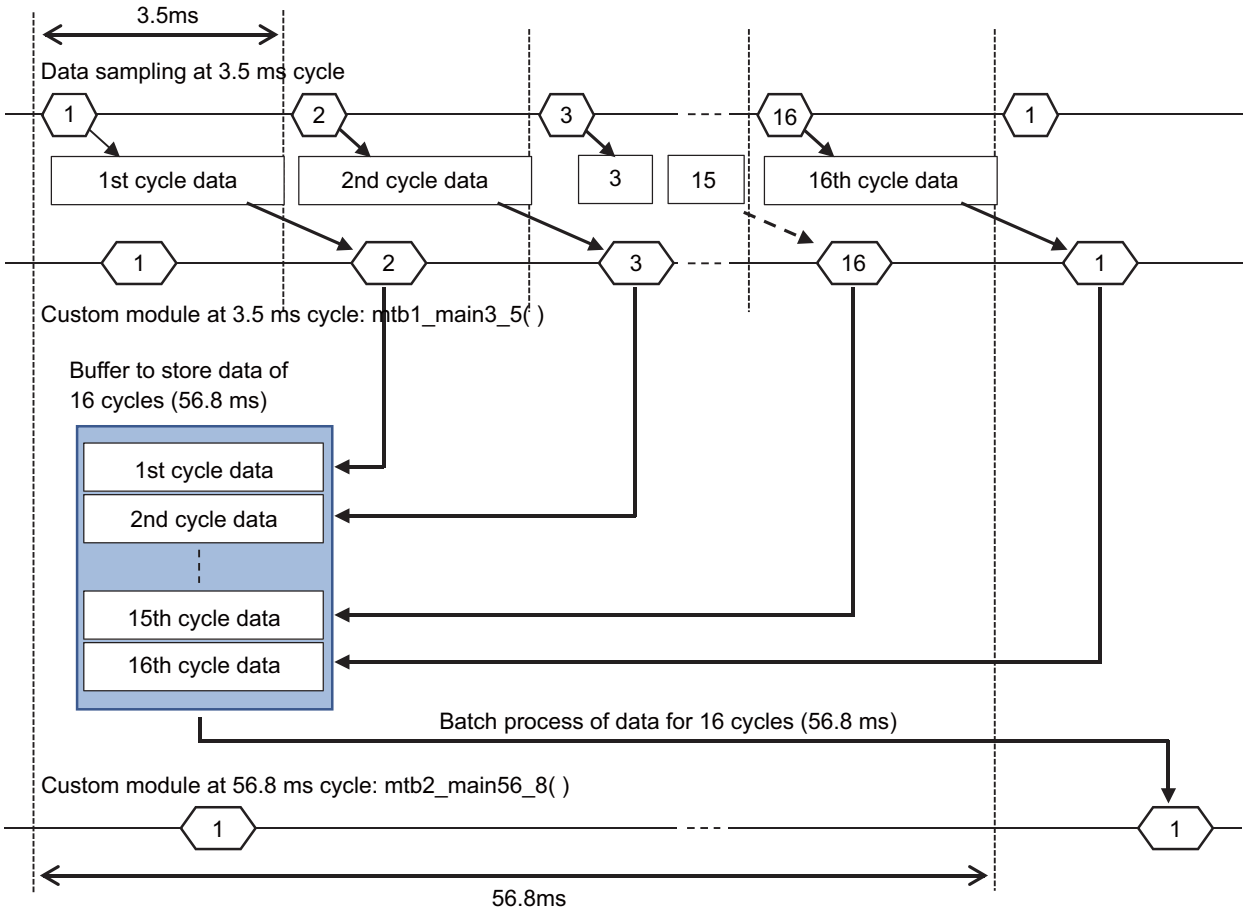
Function usage example (CH number/rotary switch number specification method)	Meaning of argument
dataRead (DATA_READ_DRV,DATA_NR_FPSN,DRV_CH1,2,&dataAddress,16,&dataSize)	DRV data 1CH rotary switch 2 feedback position

Function usage example (Part system number / (Intra-part system left-justified axis number specification method)	Meaning of argument
dataRead (DATA_READ_DRV,DATA_NR_FPSN,SYS1,1,&dataAddress,16,&dataSize)	DRV data 1 part system 2nd servo axis's feedback position

Function usage example (System common axis number specification method)	Meaning of argument
dataRead (DATA_READ_DRV,DATA_NR_FPSN,SYSCOM,1,&dataAddress,16,&dataSize)	DRV data 2nd servo axis's feedback position common to part systems

About the sampling timing of the data acquired by an analysis task

The sampling data collected by the high-speed processing unit is imported into the custom module using the data acquisition function. For the custom module, acquire data at the same 3.5ms interval as the high-speed processing unit. The acquired data is 3.5ms worth of sampling data from one cycle before.
When processing sampling data at a cycle longer than 3.5ms (for example, a 56.8ms cycle), store the data acquired at a 3.5ms cycle in a buffer as shown in the figure, and process the data for the processing cycle at once.



9.1.2 Data write request: dataWriteReq

[Format]

```
long dataWriteReq
(
unsigned short majorDataId,          /* Section data ID                          */
unsigned short subsectionDataId,     /* Sub-section data ID                      */
unsigned short dataType1,            /* Write data type 1                        */
unsigned short dataType2,            /* Write data type 2                        */
void* dataAddress                    /* Address to specify write data            */
)
```

[Function]

This function outputs data to the RIO (master/local) or the NC-HPU optical communication.

[Detail]

- Specify the data to be written using the setting values of section data ID, sub-section data ID, write data type 1 and write data type 2. For the setting values, refer to "9.2.2 Data Write Request Function Argument Definition" and "Data Write Request Function Usage Examples".
- Store the data to be written in the argument (dataAddress) in advance.
- If multiple modules write to the same data ID for the output data of NC-HPU optical communication, the last set data is output to the NC.

[Supplement]

- If an invalid address (NULL address or area outside DRAM) is stored in the argument (dataAddress), no data is output.
- For the argument (dataAddress), set the address on a 4-byte boundary if it is 4-byte data, or a 2-byte boundary address if it is 2-byte data.
- If the NC-HPU optical communication data is not written at a 3.5ms cycle, the content of the NC-HPU optical communication data for the cycles that are not written is set as the previous value.

[Return value]

Normal end	0:	Writing completed
Error status	-1:	Argument specification error (You specified a value that is not in the table "9.2.2 Data Write Request Function Argument Definition".)
	-2:	Loading failed (dataAddress is a NULL address, or an area outside of DRAM was specified, or an area that is not on a 2-byte or 4-byte boundary was specified.)
	-3:	Data write error at NC connection/disconnection (An attempt was made to write to the NC-HPU optical communication data using this function while the NC was powered off/rebooted.)
	-4:	No specified data (Data that does not exist on the NC-HPU optical communication was specified.)

Data Write Request Function Usage Examples

- When you want to read RIO data

Function usage example	Meaning of argument
dataWriteReq (DATA_WRITE_RIOM,DATA_WRITE_RIOM_OUT,10,0,&dataAddress)	RIO master (10) node, Output data
dataWriteReq (DATA_WRITE_RIOS,DATA_WRITE_RIOS_OUT,5,0,&dataAddress)	RIO local (5) node, output data

- When you want to write NC-HPU optical communication data

Function usage example	Meaning of argument
dataWriteReq (DATA_WRITE_NCHPU,0x2001,0,0,&dataAddress)	NC-HPU Optical Communication Data Data with data ID 0x2001

9.1.3 NC Connection Axis Information Acquisition: nchpuStsGet

[Format]

```
long nchpuStsGet
(
unsigned short dataType1,     /* Data type 1                    */
unsigned short dataType2      /* Data type 2                    */
)
```

[Function]

This function specifies the axis with the argument and acquires the type of axis (servo axis/spindle (including spindle type servo axes)/spindle C axis/rotary axis spindle).
Used to determine whether the target axis is the spindle or servo axis when acquiring DRV sampling data.

[Detail]

Specify the target axis for axis information acquisition using the arguments (dataType1, dataType2).
There are three ways to specify:

Method 1: Specify the axis by CH number or the rotary switch number.
Method 2: Specify the axis using the system number or the left-justified axis number within the system.
Method 3: Specify the axis with the axis number common to part systems.

Method	dataType1	dataType2
Method 1	CH number: DRV_CH1(1), DRV_CH2(2)	Rotary switch number: 0 to 15
Method 2	Part system number: SYS1(10) to SYS8(17) Spindle specification : SPDAT(20)	Axis number in part system: 0 to 15 Spindle number: 0 to 7
Method 3	Common to part systems: SYSCOM(30)	Part system sequence axis number: 0 to 31

[Supplement]

- There is data with the same name for the spindle and servo axis, such as "Control Status 1", but the meaning is different between the spindle and the servo axis.
  When acquiring/writing data, check the axis type using this function and specify the spindle and servo axis correctly.
- Points to note when the axis to acquire/write data is a spindle/C axis, rotary axis/spindle, or spindle-type servo axis
  For the spindle C-axis, the data on the spindle side will be acquired/written regardless of whether you set the spindle side or servo axis side in the argument of the data acquisition/write request function.
  For the rotary axis/spindle, acquire/write data on the servo axis side.
  For the spindle-type servo axis, data on the spindle side can be acquired and written in the same way as normal spindles.

[Return value]

Normal end	0:	The axis specified by the argument is a servo axis.
	1:	The axis specified by the argument is a spindle (including a spindle-type servo axis).
	2:	The axis specified by the argument is Spindle/C axis.
	3:	Rotary axis/spindle specified with the argument
Error status	-1:	Axis Information acquisition failure
	-2:	Specified axis unconnected error (The axis that was not connected to the NC was specified with the argument value.)

9.1.4 Acquiring the NC-HPU Optical Communication I/F Size: nchpuIFSizeGet

[Format]

```
long nchpuIFSizeGet
(
void
)
```

[Function]

This function acquires the size of the NC-HPU optical communication I/F that is in use.

[Detail]

The number of data IDs that can be added to transmission and reception varies depending on the size of the optical communication I/F. For details, refer to "9.1.6 NC-HPU Optical Communication, Send Data ID Addition; nchpuTxIdAdd" and "9.1.11 NC-HPU Optical Communication, Receive Data ID Additional Request: nchpuRxCtrlCheck".

[Return value]

Normal end	0:	512Byte
	1:	1024byte
	2:	2048byte
Error status	-1:	NC-HPU optical communication I/F size acquisition error when NC connection is disconnected (An attempt was made to acquire the NC-HPU optical communication I/F size by this function while the NC is powered off or is rebooted.)

9.1.5 NC-HPU Optical Communication, Send Data ID Operation Enabled/Disabled Check: nchpuTxCtrlCheck

[Format]

```
long nchpuTxCtrlCheck
(
void
)
```

[Function]

This function checks whether to enable or disable the send data ID operation for NC-HPU optical communication.

[Return value]

Normal end	0:	Send data ID operation enabled
	1:	Send data ID operation disabled (The send data ID is being operated by another custom module.)
	2:	Send data ID operation disabled (A data ID operation request is being executed from the NC to the high speed processing unit.)
Error status	-2 to -3:	The NC-HPU optical communication is not executed.

NC-HPU Optical Communication, Send Data ID Operation Examples

[When adding/removing data ID 0x2001 to the send data]

(1) Use nchpuTxCtrlCheck to check whether to enable or disable the send data ID operation. Depending on the result, processing branches as follows.
- When enabled (return value is "0"): Move to (2).
- When disabled (return value is not "0"): End the processing of the current cycle, and re-execute (1) in the next cycle.

(2) Use nchpuTxIdAdd to add the send data ID. Depending on the result, processing branches as follows.
- Success (When the return value is "0" or "1"): The send data ID was added.
- Failure (When the return value is other than "0" or "1"): End the processing of the current cycle, and re-execute (1) to (2) again in the next cycle.

[Operation example]

```
/* Data ID status definition */
#define TX_ID_STAT_INACTIVE (0) /* Not added to send data. */
#define TX_ID_STAT_ACTIVE (1)   /* Added to send data. */
/* Target data ID status (not added to sent data/already added) */
int g_tx_id_status = TX_ID_STAT_INACTIVE;
/* Additional processing sample for send data (executed periodically) */
void sampleAddCyclicFunc(void)
{
        long tx_id_ctrl_check; /* Send data ID operation enabled/disabled check result */
        long tx_id_add_result; /* Send data ID addition result */
        /* Processed when the target data ID is not added to the sent data */
        if(g_tx_id_status == TX_ID_STAT_INACTIVE)
        {
                /* Check whether to enable or disable the send data ID and process if enabled. */
                tx_id_ctrl_check = nchpuTxCtrlCheck();
                if(tx_id_ctrl_check == 0)
                {
                        /* Send data ID addition */
                        tx_id_add_result = nchpuTxIdAdd(0x2001);
                        /* If the send data ID addition succeeds, processing is completed. */
                        if((tx_id_add_result == 0) || (tx_id_add_result == 1))
                        {
                                g_tx_id_status = TX_ID_STAT_ACTIVE;
                        }
                }
        }
        re-
        turn;
}
```

```
/* Send data removal processing sample (executed periodically) */
void sampleRemoveCyclicFunc(void)
{
	long tx_id_ctrl_check; /* Send data ID operation enabled/disabled check result */
	long tx_id_remove_result; /* Send data ID removal result */
	/* Processed when the target data ID is added to the sent data */
	if(g_tx_id_status == TX_ID_STAT_ACTIVE)
	{
		/* Check whether to enable or disable the send data ID and process if enabled. */
		tx_id_ctrl_check = nchpuTxCtrlCheck();
		if(tx_id_ctrl_check == 0)
		{
			/* Send data ID removal */
			tx_id_remove_result = nchpuTxIdRemove(0x2001);
			/* If the send data ID removal succeeds, processing is completed. */
			if((tx_id_remove_result == 0) || (tx_id_remove_result == 1))
			{
				g_tx_id_status = TX_ID_STAT_INACTIVE;
			}
		}
	}
	re-
	turn;
}
```

9.1.6 NC-HPU Optical Communication, Send Data ID Addition; nchpuTxIdAdd

[Format]

```
long nchpuTxIdAdd
(
unsigned short data_id
)
```

[Function]

This function adds the argument-specified ID to the send data for NC-HPU optical communication.

[Detail]

- Specify the data to be added to the optical communication using the argument (data_id). For on the setting values, refer to "10.2 HPU→NC Data ID List".
- The number of IDs that can be added to send data is as follows.
  The number that can be added varies depending on the size of the communication I/F.
  Check the size of the communication I/F using the communication I/F size acquisition function (nchpuIFSizeGet).

Communication I/F size	Maximum number of IDs that can be added
512 bytes:	20
1024 bytes:	44
2048 bytes:	96

[Supplement]

- Data ID operations cannot be performed in the following status (error (-2), (-3)). In this case, retry after resolving the cause.
  - (The send data ID is being operated by another custom module.)
  - A data ID operation request is being executed from the NC to the high speed processing unit.
- After executing this function, there is a time lag before the ID becomes valid. Use the nchpuTxIdCheck function to check whether the ID has been added.

[Return value]

Normal end	0:	Success
	1:	Success (Warning: The argument-specified data ID is already added to the send data.)
Error status	-1:	The argument-specified data ID is outside the valid range.
	-2 to -3:	The NC-HPU optical communication is not executed.
	-100:	The number of data IDs added to the send data has reached the upper limit.
	-200:	(The send data ID is being operated by another custom module.)
	-201:	A data ID operation request is being executed from the NC to the high speed processing unit.

9.1.7 NC-HPU Optical Communication, Send Data ID Removal: nchpuTxIdRemove

[Format]

```
long nchpuTxIdRemove
(
unsigned short data_id
)
```

[Function]

This function removes the argument-specified ID from the send data for NC-HPU optical communication.

[Detail]

- Specify the data to be removed from optical communication using the argument (data_id). For on the setting values, refer to "10.2 HPU→NC Data ID List".

[Supplement]

- Data ID operations cannot be performed in the following status (error (-2), (-3)). In this case, retry after resolving the cause.
  - (The send data ID is being operated by another custom module.)
  - A data ID operation request is being executed from the NC to the high speed processing unit.
- After executing this function, there is a time lag before the ID is removed. Use the nchpuTxIdCheck function to check whether the ID has been removed.

[Return value]

Normal end	0:	Success
	1:	Success (Warning: The argument-specified data ID is not added to the send data.)
Error status	-1:	The argument-specified data ID is outside the valid range.
	-2 to -3:	The NC-HPU optical communication is not executed.
	-200:	(The send data ID is being operated by another custom module.)
	-201:	A data ID operation request is being executed from the NC to the high speed processing unit.

9.1.8 NC-HPU Optical Communication, Send data ID Check: nchpuTxIdCheck

[Format]

```
nchpuTxCtrlCheck
(
unsigned short data_id
)
```

[Function]

This function checks whether the argument-specified ID exists in the send data for NC-HPU optical communication.

[Detail]

This function is used to check that the ID could be added or removed using the function (nchpuTxIdAdd or nchpuTxIdRemove).

[Return value]

Normal end	0:	The argument-specified ID does not exist in the send data.
	1:	The argument-specified ID exists in the send data.
Error status	-1:	The argument-specified data ID is outside the valid range.
	-2 to -3:	The NC-HPU optical communication is not executed.

9.1.9 NC-HPU Optical Communication, Receive Data ID Operation Permission Request: nchpuRxCtrlRequest

[Format]

```
long nchpuTxCtrlCheck
(
void
)
```

[Function]

This function requests the NC to allow the receive data ID operation for NC-HPU optical communication.

[Supplement]

If an action to allow the receive data ID operation is already executed when this function is called, an error occurs.

[Return value]

Normal end	0:	Success
Error status	-2 to -3:	The NC-HPU optical communication is not executed.
	-100:	The sequence to allow the received data ID operation is already started.

NC-HPU Optical Communication, Receive Data ID Operation Examples

[When requesting to add the data ID 0x2001 to the receive data]

(1) Use nchpuRxCtrlRequest to request the receive data ID operation permission. Depending on the result, processing branches as follows.
- When enabled (return value is "0"): Move to (2).
- When disabled (return value is not "0"): End the processing of the current cycle, and re-execute (1) in the next cycle.

(2) Use nchpuRxCtrlCheck to check the result of the receive data ID operation permission request. Depending on the result, processing branches as follows.
- When the data ID operation is permitted (return value is "0"): Move to (3).
- When the data ID operation is not permitted (return value is not "0"): End the processing of the current cycle, and re-execute (2) in the next cycle.

(3) Use nchpuRxIdAddRequest to request the addition of a receive data ID. Depending on the result, processing branches as follows.
- Success (Return value is "0" or "1"): Move to (4).
- Failure (Return value is not "0" or "1"): Move to (5).

(4) Use nchpuRxIdCheck to check whether the receive data ID is added. Depending on the result, processing branches as follows.
- When the specified ID exists in the receive data (return value is "1"): The receive data ID was added.
- When the specified ID does not exist in the receive data (return value is not "0"): End the processing of the current cycle, and re-execute (4) in the next cycle.

(5) Use nchpuRxCtrlCheck to check the result of the receive data ID operation permission request. Depending on the result, processing branches as follows.
- When the data ID operation is permitted (return value is "0"): End the processing of the current cycle, and re-execute (5) in the next cycle.
- When the data ID operation is not permitted (return value is not "0"): Move to (1) and retry processing.

[Operation example]

```
#define STAT_INIT (0)              /* Initial status */
#define STAT_PERMIT_WAIT (1)  /* Data ID operation permission waiting */
#define STAT_ID_WAIT (2)          /* Data ID operation reflection waiting */
#define STAT_FIN_OK (3)           /* Finish (Success) */
#define STAT_FIN_NOK (4)          /* Finish (Failure) */

int g_rx_id_status = STAT_INIT;
/* Receive Data ID addition sample */
void sampleRxIdAdd(void)
{
        long rx_id_ctrl_req;          /* Return value of receive data ID operation permission request */
        long rx_id_ctrl_check;        /* Receive data ID operation permission request execution check result */
        long rx_id_add_result;        /* Receive data ID addition processing result */
        long rx_id_add_check;         /* Receive data ID check result*/
        /* Status transition */
        switch(g_rx_id_status)
        {
                case STAT_INIT :
                        /* Data ID operation permission request
                          If the request succeeds, the system transitions to the data ID operation permission waiting status. */
                        rx_id_ctrl_req = nchpuRxCtrlRequest();
                        if(rx_id_ctrl_req == 0)
                        {
                                g_rx_id_status = STAT_PERMIT_WAIT;
                        }
                        break;

                case STAT_PERMIT_WAIT :
                        /* Data ID operation permission status check
                          If permitted, the system additionally requests a data ID and transitions to the additional data ID wait-
                        ing status.
                        rx_id_ctrl_check = nchpuRxCtrlCheck();
                        if(rx_id_ctrl_check == 0)
                        {
                                /* Receive data ID addition Request */
                                rx_id_add_result = nchpuRxIdAddRequest(0x2001);
                                if((rx_id_add_result == 0) || (rx_id_add_result == 1))
                                {
                                        g_rx_id_status = STAT_ID_WAIT;
                                }
                                else
                                {
                                        g_rx_id_status = STAT_FIN_NOK;
                                }
                        }
                        break;
```

```
            case STAT_ID_WAIT :
                /* Check whether the data ID operation is reflected.
                   If reflected, the system transitions to the finish (success) status. */
                rx_id_add_check = nchpuRxIdCheck(0x2001);
                if(rx_id_add_check == 0)
                {
                        g_rx_id_status = STAT_FIN_OK;
                }
                break;

            case STAT_FIN_NOK :
                /* Check whether the data ID operation permission status is reset.
                   If reset, the operation starts over. */
                rx_id_ctrl_check = nchpuRxCtrlCheck();
                if(rx_id_ctrl_check == 3)
                {
                        g_rx_id_status = STAT_INIT;
                }
                break;

            default :
                break;
        }
        return;
}
```

9.1.10 NC-HPU Optical Communication, Receive Data ID Operation Permission Request Execution Result Check: nchpuRxCtrlCheck

[Format]

```
long nchpuRxCtrlCheck
(
void
)
```

[Function]

This function checks the result of requesting the NC to permit the receive data ID for NC-HPU optical communication.

[Return value]

Normal end	0:	The receive data ID operation is permitted.
	1:	The receive data ID operation is not permitted (in request).
	2:	The receive data ID operation is not permitted (in completion sequence).
	3:	The receive data ID operation is not permitted (not requested).
Error status	-2 to -3:	The NC-HPU optical communication is not executed.

9.1.11 NC-HPU Optical Communication, Receive Data ID Additional Request: nchpuRxCtrlCheck

[Format]

```
long nchpuRxIdAddRequest
(
unsigned short data_id
)
```

[Function]

This function requests the NC for NC-HPU optical communication to add the ID specified by the argument to the receive data.

[Detail]

Specify the data to be added to the optical communication using the argument (data_id). For the setting values, refer to "10.1 NC→HPU Data ID List".

The number of IDs that can be added to receive data is as follows.
The number that can be added varies depending on the size of the communication I/F.
Check the size of the communication I/F using the communication I/F size acquisition function (nchpuIFSizeGet).

Communication I/F size	Maximum number of IDs that can be added
512 bytes:	40
1024 bytes:	88
2048 bytes:	192

[Supplement]

- Data ID operations cannot be performed in the following status (error (-200)). In this case, retry after resolving the cause.
  - The received data ID is being operated by another custom module.
- Before executing this processing, acquire the receive data ID operation permission using the function (nchpuRxCtrlRequest, nchpuRxCtrlCheck). If this function is executed without obtaining the data ID operation permission, error (-4) occurs.
- After executing this function, there is a time lag before the ID becomes valid. Use the nchpuRxIdCheck function to check whether the ID has been added.

[Return value]

Normal end	0:	Success
	1:	Success (Warning: The argument-specified data ID is already added to the receive data.)
Error status	-1:	The argument-specified data ID is outside the valid range.
	-2 to -3:	The NC-HPU optical communication is not executed.
	-4:	The receive data ID operation is not permitted.
	-100:	The number of data IDs added to the receive data has reached the upper limit.
	-200:	The received data ID is being operated by another custom module.

9.1.12 NC-HPU Optical Communication, Receive Data ID Removal Request: nchpuRxIdRemoveRequest

[Format]

```
long nchpuRxIdRemoveRequest
(
unsigned short data_id
)
```

[Function]
This function requests the NC for NC-HPU optical communication to remove the argument-specified ID from the receive data.

[Detail]
Specify the data to be removed from optical communication using the argument (data_id). For the setting values, refer to "10.1 NC→HPU Data ID List".

[Supplement]
- Data ID operations cannot be performed in the following status (error (-200)). In this case, retry after resolving the cause.
  - The received data ID is being operated by another custom module.
- Before executing this processing, get the receive data ID operation permission using the function (nchpuRxCtrlRequest, nchpuRxCtrlCheck). If this function is executed without obtaining the data ID operation permission, error (-4) occurs.
- After executing this function, there is a time lag before the ID is removed. Use the nchpuRxIdCheck function to check whether the ID has been removed.

[Return value]

Normal end	0:	Success
	1:	Success (Warning: The argument-specified data ID is not added to the receive data.)
Error status	-1:	The argument-specified data ID is outside the valid range.
	-2 to -3:	The NC-HPU optical communication is not executed.
	-4:	The receive data ID operation is not permitted.
	-200:	The received data ID is being operated by another custom module.

9.1.13 NC-HPU Optical Communication, Receive data ID Check: nchpuRxIdCheck

[Format]

```
long nchpuRxIdCheck
(
unsigned short data_id
)
```

[Function]
This function checks whether the argument-specified ID exists in the receive data for NC-HPU optical communication.

[Detail]
For the setting value of the argument (data_id), refer to "10.1 NC→HPU Data ID List".

[Return value]

Normal end	0:	The argument-specified ID does not exist in the receive data.
	1:	The argument-specified ID exists in the receive data.
Error status	-1:	The argument-specified data ID is outside the valid range.
	-2 to -3:	The NC-HPU optical communication is not executed.

9.2 Argument Definition

9.2.1 Data Acquisition Function Argument Definition

The argument definitions for acquiring RIO master data, RIO local data, analog input data, parameter data, and NC-HPU optical communication data are as shown in the table below.

Section ID		Sub-section ID		dataType1	dataType2	Acquired data size (byte) (*1)	Data type
RIO master data	DATA_READ_RIOM (3)	Output side	DATA_READ_RIOM_OUT (1)	1 to 64 (*2)	-	4	unsigned long
		Input side	DATA_READ_RIOM_IN (2)	1 to 64 (*2)	-	4	unsigned long
RIO local data	DATA_READ_RIOS (4)	Output side	DATA_READ_RIOS_OUT (1)	1 to 64 (*2)	-	4	unsigned long
		Input side	DATA_READ_RIOS_IN (2)	1 to 64 (*2)	-	4	unsigned long
AI data	DATA_READ_AI (5)	-	DATA_READ_AI6CH (1)	1 to 6 (*3)	-	400 (2 bytes × 200)	short
Parameter data	DATA_READ_PARAM (8)	-	Parameter No. (*4)	-	-	Depends on parameter.	Depends on parameter.
NC-HPU Optical Communication Data	DATA_READ_NCHPU (10)	-	Data ID (*5)	-	-	16 (8 bytes × 2)	unsigned char [8]

Ignore the argument value in the "-" part.

(*1) Data size: Data size that can be acquired in 3.5 ms.

(*2) Specify the node number of the RIO unit.

(*3) Specify the CH number for analog input.

(*4) For the sub-section ID, specify the parameter number of the high speed processing unit.

(*5) For the data ID, refer to "10.1 NC→HPU Data ID List".

The argument definitions for acquiring DRV sampling data are as shown in the table below.
There are three methods for specifying the axis: For the arguments (dataType1, dataType2) for each method, refer to the separate table.
Method 1: Specify the axis using the CH number/rotary switch number.
Method 2: Specify the axis using the part system number or the left-justified axis number within the part system.
Method 3: Specify the axis using the axis number common to the part systems.

Section ID		Sub-section ID		dataType1	dataType2	Acquired data size (byte) (*1)	Data type
DRV sampling data	DATA_READ_DRV (1)	Axis type(*2)	DATA_READ_FRAMEID (1)	Refer to the table below.		4	char
		Axis No.	DATA_READ_AXNUM (2)			4	char
		Machine error compensation amount	DATA_READ_MCERR (12)			16	long
		Control status 1	DATA_READ_STS1 (17)			8	short
		Control status 2	DATA_READ_STS2 (18)			8	short
		Control status 3	DATA_READ_STS3 (19)			8	short
		Control status 4	DATA_READ_STS4 (20)			8	short
		Control status 5	DATA_READ_STS5 (21)			8	short
		Control status 6	DATA_READ_STS6 (22)			8	short
		Feedback position	DATA_READ_FPSN (23)			16	long
		Grid amount	DATA_READ_GRD (25)			16	long
		Speed FB	DATA_READ_VFBK (26)			16	long
		Electric current FB	DATA_READ_IFBK (27)			8	short
		Driver display status (Operation alarm/ warning No.)	DATA_READ_ALMNO (28)			8	short

Method	Classification	Specification Enabled/Disabled	dataType1	dataType2
Method 1	Information by part system	Disabled	-	-
	Information by axis	Enabled	DRV_CH1(1), DRV_CH2(2) (*3)	0 to 15 (*4)
	Information by spindle	Enabled	DRV_CH1(1), DRV_CH2(2) (*3)	0 to 15 (*4)
	Others	Enabled	Inaction	Inaction
Method 2	Information by part system	Enabled	SYS1(10) to SYS8(17) (*5)	Inaction
	Information by axis	Enabled	SYS1(10) to SYS8(17) (*5)	0 to 15 (servo axis) (*6)
	Information by spindle	Enabled	SPDAT(20) (*7)	0 to 7 (Spindle) (*8)
	Others	Enabled	Inaction	Inaction
Method 3	Information by part system	Disabled	-	-
	Information by axis	Enabled	SYSCOM(30) (*9)	0 to 31 (*10)
	Information by spindle	Disabled	-	-
	Others	Enabled	Inaction	Inaction

(*1) Data size: Data size that can be acquired in 3.5 ms.
(*2) The axis type data is used to distinguish between the spindle and the servo axis.
(If the acquired value is 1, the servo axis data is processed, and if it is 2, the spindle data is processed.)
(*3) Set the CH number of the axis to acquire data.
(*4) Set the rotary switch number of the amplifier of the axis to acquire data.
(*5) Set the part system specification symbol name (part system 1: SYS1, part system 2: SYS2, ... part system 8: SYS8).
(*6) Set the servo axis number in the part system. (0, 1, 2, etc. in order from the 1st axis)
(*7) Set the spindle specification symbol name (SPDAT).
(*8) Set the spindle number. (0, 1, 2, etc. in order from the 1st spindle)
(*9) Set the symbol name (SYSCOM).
(*10) Set the axis number common to part systems. (0, 1, 2, etc. in order from the 1st axis)

9.2.2 Data Write Request Function Argument Definition

When specifying "RIO master data," "RIO local data," and "NC-HPU optical communication data" in the sections, follow the table below for the arguments of the data write request function.

Section ID		Sub-section ID		dataType1	dataType2	Data type
RIO master data	DATA_WRITE_RIOM (3)	Output side	DATA_WRITE_RIOM_OUT (1)	1 to 64 (*2)	-	unsigned long
RIO local data	DATA_WRITE_RIOS (4)	Output side	DATA_WRITE_RIOS_OUT (1)	1 to 64 (*2)	-	unsigned long
NC-HPU optical communication	DATA_WRITE_NCHPU (10)	-	Data ID (*1)	-	-	unsigned char [8]

(*1) For the data ID, refer to "10.2 HPU→NC Data ID List".

(*2) Specify the node number of the RIO unit.
For output to the RIO (master), set the node that is specified with the rotary switch number of the RIO unit connected to the RIO (master side) of the high speed processing unit.
For output to the RIO (slave), set the specified node in the virtual rotary number (parameter #1801) of the RIO (local node side) of the high-speed processing unit.
It is not output to unconnected RIOs (master node, local node).

9.3 I/F functions for custom modules

This section describes I/F functions that can be used in the custom module.

9.3.1 Data setting for analysis: mtbcSetAnalyzeInfo

[Format]

```
long mtbcSetAnalyzeInfo
(
unsigned    long dataSize,
            void *analyzeInfo
)
```

[Function]

Set the storage area for data that is to be transferred from the high-speed processing unit to the execution function of the edge PC.

[Detail]

- For the argument (analyzeInfo), set the top address of the area that contains the data to be sent to the edge PC.
- For the argument (dataSize), set the size of the data to be stored. The data size ranges from 1 to 16 bytes.
- For the second argument, specify the address of the area defined as an external variable. If the address is other than an external variable or the address is invalid (NULL pointer), this function returns the return value (-1).

[Supplement]

- Use this function in the custom processing initialization function (mtb(N)_ini()).
  If it is used outside of the initialization function, the return value (-2) is returned.
- The data format of the analysis data specified in the second argument must be unified with the analysis function that is running on the edge PC side.

[Return value]

Normal end	0:	Setting completed
Error	-1:	Argument error
	-2:	Called function invalid

9.3.2 MQTT Communication Connection Status Acquisition: mtbcGetMqttStatus

[Format]

```
long mtbcGetMqttStatus
(
void
)
```

[Function]

This function acquires the MQTT communication connection status. (0: Not connected, 1: Connected)
When the return value is "0" (not connected), sampling and analysis functions cannot be executed on the edge PC.

[Supplement]

Use this function within the main function of custom processing.
If this function is called with the initialization function, the return value (-2) is returned.

[Return value]

Normal end	0:	Unconnected
	1:	Connected
Error	-2:	Called function invalid

9.3.3 Time measurement: calc_us

[Format]

```
unsigned long calc_us
(
unsigned long start,
unsigned long end
)
```

[Function]

This function returns the difference between the CPU count register values in μs.

[Detail]

For the arguments "start" and "end", set the CPU count register values at the start and end of measurement.
Acquire the counter register value using sysCountGet().

[Usage example]

Example of obtaining the time between "start" and "end" and storing the result in "result":

```
    unsigned long start,end,result;
    start = sysCountGet();

Processing to be measured
    end = sysCountGet();
    result = calc_us(start, end);
```

[Return value]

Measurement time (μs)

9.3.4 CPU counter acquisition: sysCountGet

[Format]

```
unsigned long sysCountGet
(
void
)
```

[Function]
This function acquires the CPU count register value.

[Return value]
CPU count register value

9.3.5 Model parameter acquisition: hpuModelParamRead

[Format]

```
long hpuModelParamRead
(
void* dataAddress,          /* Top address of model parameter storage area   */
unsigned long dataSize      /* Model parameter size (byte)                   */
)
```

[Function]
This function acquires the model parameters stored in the high-speed processing unit.

[Function]
- This function can only be executed from the main function (1820ms cycle) of the custom module.
- When the loading of the model parameters is completed, the return value "1" (loading completed) is returned, and the model parameters of the size specified by the argument (dataSize) are loaded into the area specified by the argument (dataAddress). The return value "0" (reading) is returned while the model parameters are being loaded.
  Execute this function repeatedly until a value other than "0" is returned.
- For the argument (dataAddress), specify the address of a global variable declared in the same source code as the custom module that executes this function.
- Ensure that the area specified by the argument (dataAddress) is equal to or larger than the size specified by the argument (dataSize).
- The size of model parameters that can be specified in the argument (dataSize) is in the range of 1 byte to 1048576 bytes.
- For the address and size specified in the arguments (dataAddress and dataSize), the values specified at the first execution of this function (excluding when an error occurs) are used. The argument values from the second and subsequent executions are not reflected.

[Supplement]
- If another custom module is loading model parameters, an error (-4) is returned.
- The file size of model parameters varies depending on the DLL created by the MTB.
  For the argument (dataSize), specify a size that matches the model parameters.
  If the specified size is smaller than the model parameter, only dataSize is loaded.
  If you specify a size larger than the model parameter, "0" is stored in the area that exceeds the model parameter size.

[Return value]

Normal end	0:	Loading
	1:	Loading completed
Error	-1:	Argument error (An address outside the function expansion memory area was specified for the argument (dataAddress).)
	-2:	Argument error (A size outside the range (1 to 1048576) was specified for the argument (dataSize).)
	-3:	Loading failed. (Model parameters are not saved in the high-speed processing unit.)
	-4:	Loading disabled. (Model parameters are being loaded in the high-speed processing unit)
	-5:	Execution function error (This function was executed outside of the main function (1820ms cycle).)

Model Parameter Acquisition Function Operation Examples

This section shows examples to perform analysis processing with reference to model parameters.

(1) Acquire the model parameters using the main function (mtb(N)_main1820) with a period of 1820ms. (*)
Repeat the process until the model parameter acquisition function (hpuModelParamRead) returns "1" (acquisition complete).
When the model parameters are acquired, the value of the global variable (mtb1_read_status) is updated from "MODELPARAM_READ_NOTFIN" (acquisition not completed) to "MODELPARAM_READ_FIN" (acquisition completed).

(2) The main function (mtb(N)_main3_5) with a 3.5ms cycle implements analysis processing that refers to model parameters.
The analysis processing is performed after confirming that the value of the global variable (mtb1_read_status) is "MODELPARAM_READ_FIN" (acquisition complete).

(*) If you execute the retrieval function at the same time as saving model parameters, the retrieval time may increase.

[Operation example]

```
/* Model parameter acquisition processing sample */
#define MODELPARAM_SIZE (1024U)                                  /* Model parameter size (for 1024 bytes) */
#define MODELPARAM_READ_NOTFIN (0U)                              /* Model parameter acquisition not completed */
#define MODELPARAM_READ_FIN (1U)                                 /* Model parameter acquisition completed */
char mtb1_modelparam_buff[MODELPARAM_SIZE];                      /* Area to acquire model parameters */
unsigned char mtb1_read_status = MODELPARAM_READ_NOTFIN;         /* Model parameter acquisition status */
/* initialization function */
void mtb1_ini(void)
{
        /* Variable initialization processing */
        /* (Execute as necessary) */
        return;
}
```

```
/* 3.5 ms cycle main function */
void mtb1_main3_5(void)
{
	/* Perform analysis processing when the model parameter acquisition is complete */
	if(mtb1_read_status == MODELPARAM_READ_FIN)
	{
		/* Acquire the information obtained through internal data access (sensor information, DRV data, etc.) and perform analysis processing. */
		/* For how to use internal data access, refer to "5.2 Internal Data Access Function". */
	}
	return;
}
/* 1820 ms cycle main function */
void mtb1_main1820(void)
{
	long read_result;	/* Store the return value of the model parameter acquisition function. */
	/* Execute the model parameter retrieval function until model parameters can be acquired. */
	if(mtb1_read_status == MODELPARAM_READ_NOTFIN)
	{
		/* Execute the model parameter acquisition function. */
		read_result = hpuModelParamRead((void *)mtb1_modelparam_buff, sizeof(mtb1_modelparam_buff));
		if(read_result == 1)					/* Model parameter acquisition completed */
		{
			/* Update the model parameter acquisition status to "acquisition completed" */
			mtb1_read_status = MODELPARAM_READ_FIN;
		}
	}
	return;
}
```

9.4 Custom Module Shared Variables

This section describes the shared variables that can be used to exchange information between custom modules.
The shared variables are initialized to 0 when the high-speed processing unit is powered on.
For the variable names, refer to the table below.

Variable name	Type	Default value	Initialization timing	Setting range
mtbcShareChar[16]	unsigned char	All 0	At HPU startup	0 to 255
mtbcShareShort[16]	unsigned short	All 0	At HPU startup	0 to 65535
mtbcShareLong[16]	unsigned long	All 0	At HPU startup	0 to 4294967295

When using the above variables, make the extern declaration before using them.
(Example) When using mtbcShareChar[16]

```
extern unsigned char mtbcShareChar[16];
```

When loading data with a custom module with a long cycle, data may be rewritten with a custom module with a short cycle.

9.4.1 Related Parameters

This section describes the parameters related to custom processing.

■ Custom processing parameters

#	Item		Details	Setting range
0016/BIT0-4 (Non-PR, UR)	mtbcustom_valid	Custom processing valid parameter	Set "1" to the BIT corresponding to the custom module to be enabled in custom processing. BIT0: Custom module 1 to BIT4: Custom module 5	0, 1
0017/BIT0-4 (Non-PR, UR)	mtbc_exe3_5cycle	Custom module 3.5ms cycle execution valid	Set "1" to the BIT corresponding to the custom module to be executed in the 3.5 ms cycle. BIT0: Custom module 1 to BIT4: Custom module 5	0, 1
0018/BIT0-4 (Non-PR, UR)	mtbc_exe56_8cycle	Custom module 56.8ms cycle execution valid	Set "1" to the BIT corresponding to the custom module to be executed in the 56.8 ms cycle. BIT0: Custom module 1 to BIT4: Custom module 5	0, 1
0019/BIT0-4 (Non-PR, UR)	mtbc_exe1820cycle	Custom module 1820ms cycle execution valid	Set "1" to the BIT corresponding to the custom module to be executed in the 1820 ms cycle. BIT0: Custom module 1 to BIT4: Custom module 5	0, 1

■ MTB customization parameters

#	Item		Details	Setting range
0051-0060/BIT0-7 (Non-PR, UR)	mtb_bitpara1 to mtb_bitpara10	Custom processing, MTB customization BIT parameters 1 to 10	MTB customization BIT parameter. Use this parameter to switch the custom processing.	0, 1
0251 to 0260 (Non-PR, UR)	mtb_charpara1 to mtb_charpara10	Custom processing, MTB customization CHAR parameters 1 to 10	MTB customization BIT parameter.	-128 to 127
0551 to 0650 (Non-PR, UR)	mtb_shortpara1 to mtb_shortpara100	Custom processing, MTB customization SHORT parameters 1 to 100	MTB customization BIT parameter.	-32768 to 32767

#	Item		Details	Setting range
1151 to 1250 (Non-PR, UR)	mtb_longpara1 to mtb_longpara100	Custom processing, MTB customization LONG parameters 1 to 100	MTB customization BIT parameter.	-2147483648 to 2147483647

10

NC-HPU Optical Communication, Send/Receive Data ID

10.1 NC→HPU Data ID List

Information by part system (1): Modal information

Data ID	Contents	Compatible SW version
0000	High speed processing unit I/F data (Part system 1)	-
0001	High speed processing unit I/F data (Part system 2)	-
0002	High speed processing unit I/F data (Part system 3)	-
0003	High speed processing unit I/F data (Part system 4)	-
0004	High speed processing unit I/F data (Part system 5)	-
0005	High speed processing unit I/F data (Part system 6)	-
0006	High speed processing unit I/F data (Part system 7)	-
0007	High speed processing unit I/F data (Part system 8)	-

Information by part system(2): Feedrate

Data ID	Contents	Compatible SW version
0008	High speed processing unit I/F data (Part system 1)	-
0009	High speed processing unit I/F data (Part system 2)	-
000A	High speed processing unit I/F data (Part system 3)	-
000B	High speed processing unit I/F data (Part system 4)	-
000C	High speed processing unit I/F data (Part system 5)	-
000D	High speed processing unit I/F data (Part system 6)	-
000E	High speed processing unit I/F data (Part system 7)	-
000F	High speed processing unit I/F data (Part system 8)	-

Information by part system (3): Operation status, Operation mode, Feed override

Data ID	Contents	Compatible SW version
0100	High speed processing unit I/F data (Part system 1)	-
0101	High speed processing unit I/F data (Part system 2)	-
0102	High speed processing unit I/F data (Part system 3)	-
0103	High speed processing unit I/F data (Part system 4)	-
0104	High speed processing unit I/F data (Part system 5)	-
0105	High speed processing unit I/F data (Part system 6)	-
0106	High speed processing unit I/F data (Part system 7)	-
0107	High speed processing unit I/F data (Part system 8)	-

Information by part system (4): Tool type

Data ID	Contents	Compatible SW version
0108	High speed processing unit I/F data (Part system 1)	-
0109	High speed processing unit I/F data (Part system 2)	-
010A	High speed processing unit I/F data (Part system 3)	-
010B	High speed processing unit I/F data (Part system 4)	-
010C	High speed processing unit I/F data (Part system 5)	-
010D	High speed processing unit I/F data (Part system 6)	-
010E	High speed processing unit I/F data (Part system 7)	-
010F	High speed processing unit I/F data (Part system 8)	-

Information by spindle

Data ID	Contents	Compatible SW version
0200	High speed processing unit I/F data (1st spindle)	-
0201	High speed processing unit I/F data (2nd spindle)	-
0202	High speed processing unit I/F data (3rd spindle)	-
0203	High speed processing unit I/F data (4th spindle)	-
0204	High speed processing unit I/F data (5th spindle)	-
0205	High speed processing unit I/F data (6th spindle)	-
0206	High speed processing unit I/F data (7th spindle)	-
0207	High speed processing unit I/F data (8th spindle)	-

Custom module compensation status

Data ID	Contents	Compatible SW version
0300	Custom module compensation information (by part system 1 - part system 1)	-

Information by part system (1): Modal information

Byte	Contents	Sign	Type	Outline	Unit	Setting range (Upper limit, Lower limit)
1	Modal	signed	long	Current modal information 0: G00 (Positioning) 1: G01 (Linear interpolation) 2: G02 (Circular interpolation CW) 4: G02.1 (Spiral interpolation CW) 3: G03 (Circular interpolation CCW) 5: G03.1 (Spiral interpolation CCW) 6: G33 (Threading cutting) 7: G32 (Threading cutting) 8: G34 (Variable lead thread cutting) 9: Unused 10: Unused 11: Unused 12: G01 (Dry run movement) 13: G60 (Unidirectional positioning) 14: G02.3 (Exponential interpolation CW) 15: G03.3 (Exponential interpolation CCW) 16: G35 (Thread cutting(CW)) 17: G36 (Thread cutting(CCW)) 18: G02.4 (3D circular interpolation CW) 19: G03.4 (3D circular interpolation CCW) 20: G06.2 (NURBS interpolation) 21: G33.1 (C axis interpolation-type thread cutting CW) 22: G33.2 (C axis interpolation-type thread cutting CCW) 23: G33.3 (C-axis synchronous thread cutting) 24: G02.2 (Involute interpolation (CW)) 25: G03.2 (Involute interpolation (CCW))	-	-
2						
3						
4						
5	Unused	-	-			
6	Unused	-	-			
7	Unused	-	-			
8	Unused	-	-			

Information by part system(2): Feedrate

Byte	Contents	Sign	Type	Outline	Unit	Setting range (Upper limit, Lower limit)
1	Feed	signed	double	Feedrate	mm/min	-
2						
3						
4						
5						
6						
7						
8						

Information by part system (3): Operation status, Operation mode, Feed override

Byte	Contents	Sign	Type	Outline	Unit	Setting range (Upper limit, Lower limit)
1	1st cutting override	signed	short	Cutting speed override value	%	-
2						
3	2nd cutting override	signed	short	Cutting speed override value	%	-
4						
5	Operation status	unsigned	char	NC automatic operation status 0: Reset status 1: Automatic operation stop status 2: Automatic operation pause status 3: Automatic operation start status	-	-
6	Operation mode	unsigned	char	NC operation mode 0: In jog mode (Manual operation) 1: In handle mode (Manual operation) 2: In incremental mode (Manual operation) 3: In fixed point mode (Manual operation) 4: In reference position return mode (Manual operation) 5: In memory mode (Automatic operation) 6: In tape mode (Automatic operation) 7: In MDI mode (Automatic operation)	-	-
7	Rapid traverse override	signed	short	Feedrate override value	%	-
8						

Information by part system (4): Tool type

Byte	Contents	Sign	Type	Outline	Unit	Setting range (Upper limit, Lower limit)
1	Tool type	signed	char	Tool No. in use 0: No meaning 1: Ball end mill 2: Flat end mill 3: Drill 4: Radius end mill 5: Chamfer 6: Tap 7: Face mill 8: Boring 9: Back boring 10: Tap UN No. 11: Tap UN Frac 12: Tap - Pipe Rc 13: Tap - Pipe G 14: Tap - Pipe Rp 51: Turning 52: Groove 53: Thread cutting 54: Turning drill 55: Turning tap 56: Turn - UN No. 57: Turn - UN Frac 58: Turn - Pipe Rc 59: Turn - Pipe G 60: Turn - Pipe Rp	-	-
2	The number of tool edges	unsigned	char	The number of tool edges	-	-
3	Unused	-	-		-	-
4	Unused	-	-		-	-
5	Unused	-	-		-	-
6	Unused	-	-		-	-
7	Unused	-	-		-	-
8	Unused	-	-		-	-

Information by spindle

Byte	Contents	Sign	Type	Outline	Unit	Setting range (Upper limit, Lower limit)
1	Spindle override	signed	short	Spindle rotation speed override value	%	-
2						
3	Unused	-	-			
4	Unused	-	-			
5	Unused	-	-			
6	Unused	-	-			
7	Unused	-	-			
8	Unused	-	-			

Custom module compensation status

Byte	Contents	Sign	Type	Outline	Unit	Setting range (Upper limit, Lower limit)
1 2 3 4	Machine error adjustment amount compensation status	unsigned	long	This function indicates the compensation status of machine error compensation amount by the custom module. (0: Uncompensated, , 1: Being compensated) bit0: 1st axis bit1: 2nd axis bit2: 3rd axis bit3: 4th axis bit4: 5th axis bit5: 6th axis bit6: 7th axis bit7: 8th axis bit8: 9th axis bit9: 10th axis bit10: 11th axis bit11: 12th axis bit12: 13th axis bit13: 14th axis bit14: 15th axis bit15: 16th axis bit16: 17th axis bit17: 18th axis bit18: 19th axis bit19: 20th axis bit20: 21st axis bit21: 22nd axis bit22: 23th axis bit23: 24th axis bit24: 25th axis bit25: 26th axis bit26: 27th axis bit27: 28th axis bit28: 29th axis bit29: 30th axis bit30: 31st axis bit31: 32nd axis	-	-
5	Cutting feed override compensation status	unsigned	char	This function indicates the cutting feed override compensation status by the custom module. (0: Uncompensated, , 1: Being compensated) bit0: 1st part system bit1: 2nd part system bit2: 3rd part system bit3: 4th part system bit4: 5th part system bit5: 6th part system bit6: 7th part system bit7: 8th part system	-	-
6	Rapid traverse override compensation status	unsigned	char	This function indicates the rapid traverse override compensation status by the custom module. (0: Uncompensated, , 1: Being compensated) bit0: 1st part system bit1: 2nd part system bit2: 3rd part system bit3: 4th part system bit4: 5th part system bit5: 6th part system bit6: 7th part system bit7: 8th part system	-	-

Byte	Contents	Sign	Type	Outline	Unit	Setting range (Upper limit, Lower limit)
7	Spindle override compensation status	unsigned	char	This function indicates the spindle override compensation status by the custom module. (0: Uncompensated, , 1: Being compensated) bit0: 1st spindle bit1: 2nd spindle bit2: 3rd spindle bit3: 4th spindle bit4: 5th spindle bit5: 6th spindle bit6: 7th spindle bit7: 8th spindle	-	-
8	Unused	-	-		-	-

10.2 HPU→NC Data ID List

Information by axis: Machine error compensation amount

Data ID	Contents	Compatible SW version
2000	Custom module compensation amount (Axis 1)	-
2001	Custom module compensation amount (Axis 2)	-
2002	Custom module compensation amount (Axis 3)	-
2003	Custom module compensation amount (Axis 4)	-
2004	Custom module compensation amount (Axis 5)	-
2005	Custom module compensation amount (Axis 6)	-
2006	Custom module compensation amount (Axis 7)	-
2007	Custom module compensation amount (Axis 8)	-
2008	Custom module compensation amount (Axis 9)	-
2009	Custom module compensation amount (Axis 10)	-
200A	Custom module compensation amount (Axis 11)	-
200B	Custom module compensation amount (Axis 12)	-
200C	Custom module compensation amount (Axis 13)	-
200D	Custom module compensation amount (Axis 14)	-
200E	Custom module compensation amount (Axis 15)	-
200F	Custom module compensation amount (Axis 16)	-
2100	Custom module compensation amount (Axis 17)	-
2101	Custom module compensation amount (Axis 18)	-
2102	Custom module compensation amount (Axis 19)	-
2103	Custom module compensation amount (Axis 20)	-
2104	Custom module compensation amount (Axis 21)	-
2105	Custom module compensation amount (Axis 22)	-
2106	Custom module compensation amount (Axis 23)	-
2107	Custom module compensation amount (Axis 24)	-
2108	Custom module compensation amount (Axis 25)	-
2109	Custom module compensation amount (Axis 26)	-
210A	Custom module compensation amount (Axis 27)	-
210B	Custom module compensation amount (Axis 28)	-
210C	Custom module compensation amount (Axis 29)	-
210D	Custom module compensation amount (Axis 30)	-
210E	Custom module compensation amount (Axis 31)	-
210F	Custom module compensation amount (Axis 32)	-

Information by part system: Feed override

Data ID	Contents	Compatible SW version
2200	Custom module compensation amount (Part system 1)	-
2201	Custom module compensation amount (Part system 2)	-
2202	Custom module compensation amount (Part system 3)	-
2203	Custom module compensation amount (Part system 4)	-
2204	Custom module compensation amount (Part system 5)	-
2205	Custom module compensation amount (Part system 6)	-
2206	Custom module compensation amount (Part system 7)	-
2207	Custom module compensation amount (Part system 8)	-

Information by spindle: Spindle override

Data ID	Contents	Compatible SW version
2208	Custom module compensation amount (Spindle 1)	-
2209	Custom module compensation amount (Spindle 2)	-
220A	Custom module compensation amount (Spindle 3)	-
220B	Custom module compensation amount (Spindle 4)	-
220C	Custom module compensation amount (Spindle 5)	-
220D	Custom module compensation amount (Spindle 6)	-
220E	Custom module compensation amount (Spindle 7)	-
220F	Custom module compensation amount (Spindle 8)	-

Custom module: Arbitrary data

Data ID	Contents	Compatible SW version
2300	Custom module information 1	-
2301	Custom module information 2	-
2302	Custom module information 3	-
2303	Custom module information 4	-
2304	Custom module information 5	-
2305	Custom module information 6	-
2306	Custom module information 7	-
2307	Custom module information 8	-
2308	Custom module information 9	-
2309	Custom module information 10	-
230A	Custom module information 11	-
230B	Custom module information 12	-
230C	Custom module information 13	-
230D	Custom module information 14	-
230E	Custom module information 15	-
230F	Custom module information 16	-
2400	Custom module information 17	-
2401	Custom module information 18	-
2402	Custom module information 19	-
2403	Custom module information 20	-

Information by axis: Machine error compensation amount

Byte	Contents	Sign	Type	Outline	Unit	Setting range (Upper limit, Lower limit)
1	Validity flag	unsigned	char	Flag that indicates whether the custom module compensation amount is valid or invalid. Bit0: Custom module machine error compensation amount	BIT	-
2	Unused	-	-			
3	Unused	-	-			
4	Unused	-	-			
5 6 7 8	Custom module machine error compensation amount	signed	long	Correction value of machine error compensation amount calculated in custom module	1/20000 mm	Upper limit: 20000 (+1 mm) Lower limit: -20000 (-1 mm)

Information by part system: Feed override

Byte	Contents	Sign	Type	Outline	Unit	Setting range (Upper limit, Lower limit)
1	Validity flag	unsigned	char	Flag that indicates whether the custom module compensation amount is valid or invalid. Bit0: Custom module cutting override Bit1: Custom module rapid traverse override	BIT	-
2	Unused	-	-			
3 4	Custom module cutting override	signed	short	Correction value of cutting override calculated in custom module	0.10%	Upper limit: 100% Lower limit: 0%
5 6	Custom module rapid traverse override	signed	short	Correction value of rapid traverse override calculated in custom module	0.10%	Upper limit: 100% Lower limit: 0%
7	Unused	-	-			
8	Unused	-	-			

Information by spindle: Spindle override

Byte	Contents	Sign	Type	Outline	Unit	Setting range (Upper limit, Lower limit)
1	Validity flag	unsigned	char	Flag that indicates whether the custom module compensation amount is valid or invalid. Bit0: Custom module spindle override	BIT	-
2	Unused	-	-			
3 4	Custom module spindle override	signed	short	Correction value of spindle override calculated in custom module	0.10%	Upper limit: 200% Lower limit: 0%
5	Unused	-	-			
6	Unused	-	-			
7	Unused	-	-			
8	Unused	-	-			

Custom module: Arbitrary data

[Custom module information 1]

Byte	Contents	Sign	Type	Outline	Unit	Setting range (Upper limit, Lower limit)
1	Custom module information	-	-	Arbitrary data (output to ZR4880)	-	-
2						
3				Arbitrary data (output to ZR4881)	-	-
4						
5				Arbitrary data (output to ZR4882)	-	-
6						
7				Arbitrary data (output to ZR4883)	-	-
8						

[Custom module information 2]

Byte	Contents	Sign	Type	Outline	Unit	Setting range (Upper limit, Lower limit)
1	Custom module information	-	-	Arbitrary data (output to ZR4884)	-	-
2						
3				Arbitrary data (output to ZR4885)	-	-
4						
5				Arbitrary data (output to ZR4886)	-	-
6						
7				Arbitrary data (output to ZR4887)	-	-
8						

[Custom module information 3]

Byte	Contents	Sign	Type	Outline	Unit	Setting range (Upper limit, Lower limit)
1	Custom module information	-	-	Arbitrary data (output to ZR4888)	-	-
2						
3				Arbitrary data (output to ZR4889)	-	-
4						
5				Arbitrary data (output to ZR4890)	-	-
6						
7				Arbitrary data (output to ZR4891)	-	-
8						

[Custom module information 4]

Byte	Contents	Sign	Type	Outline	Unit	Setting range (Upper limit, Lower limit)
1	Custom module information	-	-	Arbitrary data (output to ZR4892)	-	-
2						
3				Arbitrary data (output to ZR4893)	-	-
4						
5				Arbitrary data (output to ZR4894)	-	-
6						
7				Arbitrary data (output to ZR4895)	-	-
8						

[Custom module information 5]

Byte	Contents	Sign	Type	Outline	Unit	Setting range (Upper limit, Lower limit)
1	Custom module information	-	-	Arbitrary data (output to ZR4896)	-	-
2						
3				Arbitrary data (output to ZR4897)	-	-
4						
5				Arbitrary data (output to ZR4898)	-	-
6						
7				Arbitrary data (output to ZR4899)	-	-
8						

[Custom module information 6]

Byte	Contents	Sign	Type	Outline	Unit	Setting range (Upper limit, Lower limit)
1	Custom module information	-	-	Arbitrary data (output to ZR4900)	-	-
2						
3				Arbitrary data (output to ZR4901)	-	-
4						
5				Arbitrary data (output to ZR4902)	-	-
6						
7				Arbitrary data (output to ZR4903)	-	-
8						

[Custom module information 7]

Byte	Contents	Sign	Type	Outline	Unit	Setting range (Upper limit, Lower limit)
1	Custom module information	-	-	Arbitrary data (output to ZR4904)	-	-
2						
3				Arbitrary data (output to ZR4905)	-	-
4						
5				Arbitrary data (output to ZR4906)	-	-
6						
7				Arbitrary data (output to ZR4907)	-	-
8						

[Custom module information 8]

Byte	Contents	Sign	Type	Outline	Unit	Setting range (Upper limit, Lower limit)
1	Custom module information	-	-	Arbitrary data (output to ZR4908)	-	-
2						
3				Arbitrary data (output to ZR4909)	-	-
4						
5				Arbitrary data (output to ZR4910)	-	-
6						
7				Arbitrary data (output to ZR4911)	-	-
8						

[Custom module information 9]

Byte	Contents	Sign	Type	Outline	Unit	Setting range (Upper limit, Lower limit)
1	Custom module information	-	-	Arbitrary data (output to ZR4912)	-	-
2						
3				Arbitrary data (output to ZR4913)	-	-
4						
5				Arbitrary data (output to ZR4914)	-	-
6						
7				Arbitrary data (output to ZR4915)	-	-
8						

[Custom module information 10]

Byte	Contents	Sign	Type	Outline	Unit	Setting range (Upper limit, Lower limit)
1	Custom module information	-	-	Arbitrary data (output to ZR4916)	-	-
2						
3				Arbitrary data (output to ZR4917)	-	-
4						
5				Arbitrary data (output to ZR4918)	-	-
6						
7				Arbitrary data (output to ZR4919)	-	-
8						

[Custom module information 11]

Byte	Contents	Sign	Type	Outline	Unit	Setting range (Upper limit, Lower limit)
1	Custom module information	-	-	Arbitrary data (output to ZR4920)	-	-
2						
3				Arbitrary data (output to ZR4921)	-	-
4						
5				Arbitrary data (output to ZR4922)	-	-
6						
7				Arbitrary data (output to ZR4923)	-	-
8						

[Custom module information 12]

Byte	Contents	Sign	Type	Outline	Unit	Setting range (Upper limit, Lower limit)
1	Custom module information	-	-	Arbitrary data (output to ZR4924)	-	-
2						
3				Arbitrary data (output to ZR4925)	-	-
4						
5				Arbitrary data (output to ZR4926)	-	-
6						
7				Arbitrary data (output to ZR4927)	-	-
8						

[Custom module information 13]

Byte	Contents	Sign	Type	Outline	Unit	Setting range (Upper limit, Lower limit)
1	Custom module information	-	-	Arbitrary data (output to ZR4928)	-	-
2						
3				Arbitrary data (output to ZR4929)	-	-
4						
5				Arbitrary data (output to ZR4930)	-	-
6						
7				Arbitrary data (output to ZR4931)	-	-
8						

[Custom module information 14]

Byte	Contents	Sign	Type	Outline	Unit	Setting range (Upper limit, Lower limit)
1	Custom module information	-	-	Arbitrary data (output to ZR4932)	-	-
2						
3				Arbitrary data (output to ZR4933)	-	-
4						
5				Arbitrary data (output to ZR4934)	-	-
6						
7				Arbitrary data (output to ZR4935)	-	-
8						

[Custom module information 15]

Byte	Contents	Sign	Type	Outline	Unit	Setting range (Upper limit, Lower limit)
1	Custom module information	-	-	Arbitrary data (output to ZR4936)	-	-
2						
3				Arbitrary data (output to ZR4937)	-	-
4						
5				Arbitrary data (output to ZR4938)	-	-
6						
7				Arbitrary data (output to ZR4939)	-	-
8						

[Custom module information 16]

Byte	Contents	Sign	Type	Outline	Unit	Setting range (Upper limit, Lower limit)
1	Custom module information	-	-	Arbitrary data (output to ZR4940)	-	-
2						
3				Arbitrary data (output to ZR4941)	-	-
4						
5				Arbitrary data (output to ZR4942)	-	-
6						
7				Arbitrary data (output to ZR4943)	-	-
8						

[Custom module information 17]

Byte	Contents	Sign	Type	Outline	Unit	Setting range (Upper limit, Lower limit)
1	Custom module information	-	-	Arbitrary data (output to ZR4944)	-	-
2						
3				Arbitrary data (output to ZR4945)	-	-
4						
5				Arbitrary data (output to ZR4946)	-	-
6						
7				Arbitrary data (output to ZR4947)	-	-
8						

[Custom module information 18]

Byte	Contents	Sign	Type	Outline	Unit	Setting range (Upper limit, Lower limit)
1	Custom module information	-	-	Arbitrary data (output to ZR4948)	-	-
2						
3				Arbitrary data (output to ZR4949)	-	-
4						
5				Arbitrary data (output to ZR4950)	-	-
6						
7				Arbitrary data (output to ZR4951)	-	-
8						

[Custom module information 19]

Byte	Contents	Sign	Type	Outline	Unit	Setting range (Upper limit, Lower limit)
1	Custom module information	-	-	Arbitrary data (output to ZR4952)	-	-
2						
3				Arbitrary data (output to ZR4953)	-	-
4						
5				Arbitrary data (output to ZR4954)	-	-
6						
7				Arbitrary data (output to ZR4955)	-	-
8						

[Custom module information 20]

Byte	Contents	Sign	Type	Outline	Unit	Setting range (Upper limit, Lower limit)
1	Custom module information	-	-	Arbitrary data (output to ZR4956)	-	-
2						
3				Arbitrary data (output to ZR4957)	-	-
4						
5				Arbitrary data (output to ZR4958)	-	-
6						
7				Arbitrary data (output to ZR4959)	-	-
8						

11

NC Parameters

For the high-speed processing unit parameters, refer to "3 High Speed Processing Unit Parameters".

■ Base Common Parameters

#	Item	Details	Setting range
1762 (PR)	cfgPR12/bit0 (NC-HPU Optical Communication: Communication Function Enabled)	Specify whether to disable/enable communication function in the NC-HPU optical communication. 0: Disables the communication function (not communicates). 1: Enables the communication function (communicates)	0/1
1762 (PR)	cfgPR12/bit1 (NC-HPU optical communication: error type)	Specify the error type of NC-HPU optical communication. 0: Z107 0001 "NC-HPU optical communication warning" 1: Z107 0002 "NC-HPU optical communication alarm"	0/1
1762 (PR)	cfgPR12/bit2 (NC-HPU optical communication: received data initialization at error)	Specify whether to initialize the received data or not at the NC-HPU optical communication error. 0: Not initialize 1: Initialize	0/1
1762 (PR)	cfgPR12/bit3 cfgPR12/bit4 (NC-HPU optical communication: send/receive data size selection)	Specify the send/receive data size in the NC-HPU optical communication. 00: 512 Bytes 01: 1024 Bytes 10: 2048 Bytes 11: 512 Bytes	00/01/10/11
1766 (PR)	cfgPR16/bit0 (HPU custom module: notification data disabled)	Select whether to reflect the data notified from HPU custom module in NC. When Disable is selected, all the data notified from HPU custom module will be invalid, and will not be reflected in NC. 0: Enable (default) 1: Disable	0/1

■ Base System Parameters

#	Item	Details	Setting range
12116	CutOvrZeroMovRap (Rapid traverse operation when the cutting feed override is 0%)	Select whether to switch the rapid traverse operation when the cutting feed override is 0%. 0: Stop rapid traverse 1: Does not stop rapid traverse. <Note> • This parameter is invalid when the rapid traverse override is set to the code method.	0/1

12

Alarms and Operation Messages of NC

This chapter explains NC alarms and operation messages.
For the alarms of the high-speed processing unit, refer to "13 LED Display".

12.1 Operation error

Error No.	Error message	Details	Countermeasure
M01 1620	HPU in preparation	HPU custom module is being registered and deleted. When this error is being displayed, HPU custom module cannot be input, restored or executed cycle start. This alarm is exported to NC alarm 5.	• When the registration and deletion of the HPU custom module is completed, an error will be canceled automatically.

12.2 System alarms

Error No.	Error message	Details	Countermeasure
Z107 0001	NC-HPU optical communication warning	A communication error occurred in the NC-HPU optical communication while parameter "#1762 cfgPR12/bit1" is set to "0". bit0: Communication start error bit1: Initial communication error bit2: Communication error	• Check that the cable is properly connected. • Check that the HPU power is turned ON.
Z107 0002	NC-HPU optical communication alarm	A communication error occurred in the NC-HPU optical communication while parameter "#1762 cfgPR12/bit1" is set to "1". bit0: Communication start error bit1: Initial communication error bit2: Communication error	• Check that the cable is properly connected. • Check that the HPU power is turned ON. • Turn OFF/ON the NC power.
Z108	HPU error	An error has arisen in the HPU. bit0: E0 System/HW/SD/optical communication error bit1: E1 RIO/AI/DI/SIO error bit2: E2 Network error bit3: E3 Analyzing process error bit4: E4 (spare) bit5: E5 (spare) bit6: E6 User customization bit7: E7 User customization	• Check the HPU status.
Z109	HPU preparation error	Failed to register or delete the custom module.	• Take the following procedures depending on the details of the error.
		0x0001: The total size of the custom module exceeded 5 MB.	0x0001: Correct the custom module.
		0x0002: Failed to load the custom module.	0x0002: Re-register the HPU custom module.
		0x0003: Failed to load the custom module in the HPU.	0x0003: Correct the custom module.
		0x0004: The custom module was transferred and deleted while the custom module is already loaded.	0x0004: Restart the NC and HPU.
		0x0005: The HPU custom module to be deleted did not exist in the HPU.	0x0005: Initialize the MTB password of the HPU. Re-register the HPU custom module.
		0x0006: An error has occurred with the SD card in the HPU.	0x0006: Contact the customer center.
		0x0020 to 0x00FF: An internal error has occurred.	0x0020 to 0x00FF: Restart the NC and HPU. If the problem persists, contact the customer center.

Error No.	Error message	Details	Countermeasure
Z115	High speed processing unit I/F not supported	The NC, the high speed processing unit or the edge PC does not support the high speed processing unit I/F. n1: Displays the function for which the request failed. (DEC) 2: HPU custom module 1 3: HPU custom module 2 4: HPU custom module 3 5: HPU custom module 4 6: HPU custom module 5 n2: Displays the system that does not support the high speed processing unit I/F. (DEC) 0: NC 1: High speed processing unit 2: Edge PC	• Upgrade the system.
Z116	High speed processing unit I/F request error	An error occurred in the edge PC for the request by the high speed processing unit I/F. n1: Displays the function for which the request failed. (DEC) 2: HPU custom module 1 3: HPU custom module 2 4: HPU custom module 3 5: HPU custom module 4 6: HPU custom module 5 n2: Displays the error number detected in the RT Processing unit or the edge PC. (DEC) If the error number is between 1 and 9999, look it up in the relevant errors in Edge PC App Specificaton Manual. If the error number is between 10001 and 19999, look it up in the specification manual of each HPU custom module.	• Check the state of the RT Processing unit or the edge PC.

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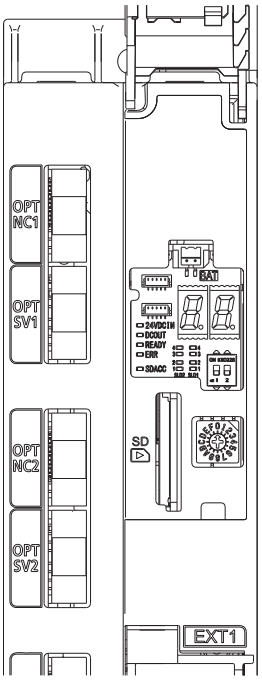
LED Display

LED has the following three types.

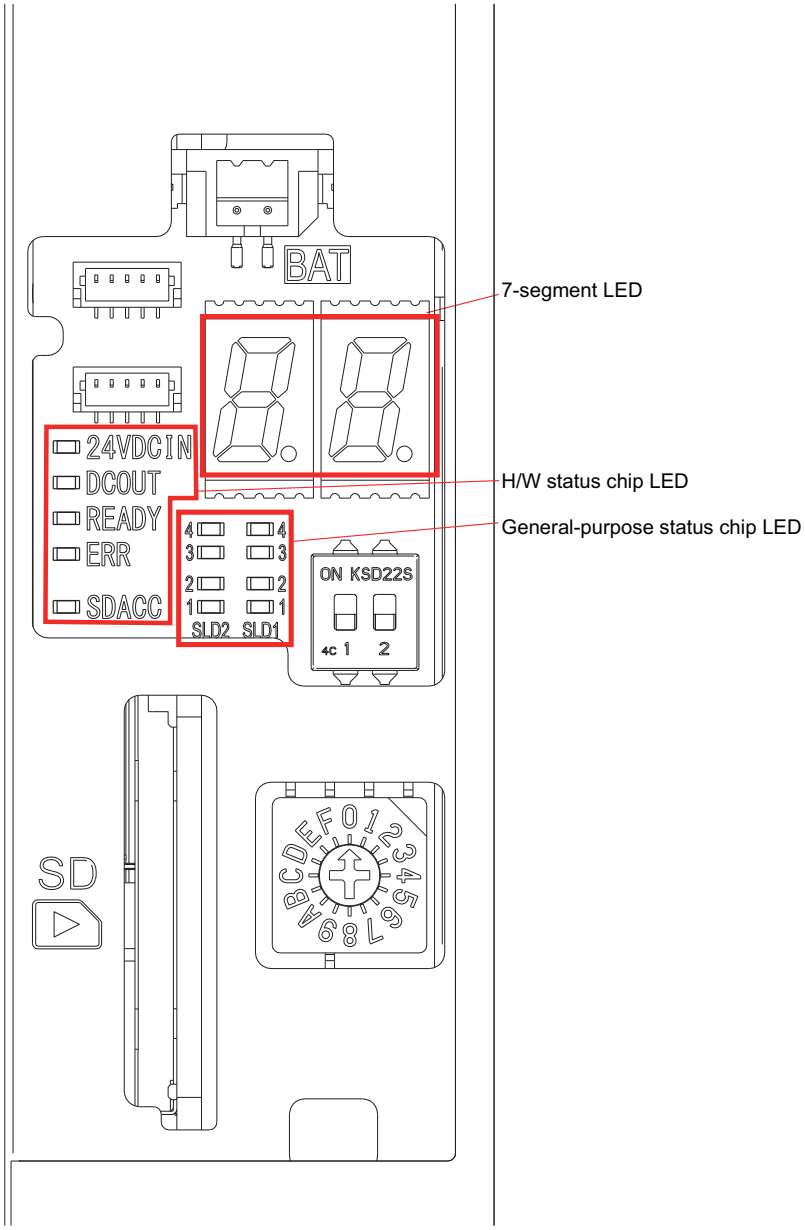
- Segment LED
- H/W status chip LED
- General-purpose status chip LED (unused)

Display content and meaning of each LED are described in the following sections.

Upper part of the front of the high speed processing unit

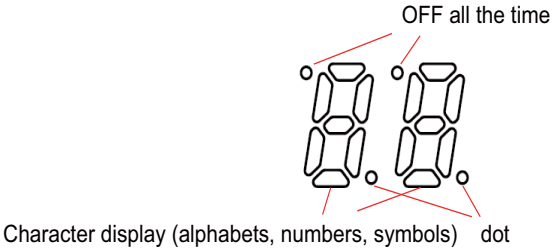


Expanded image of LED

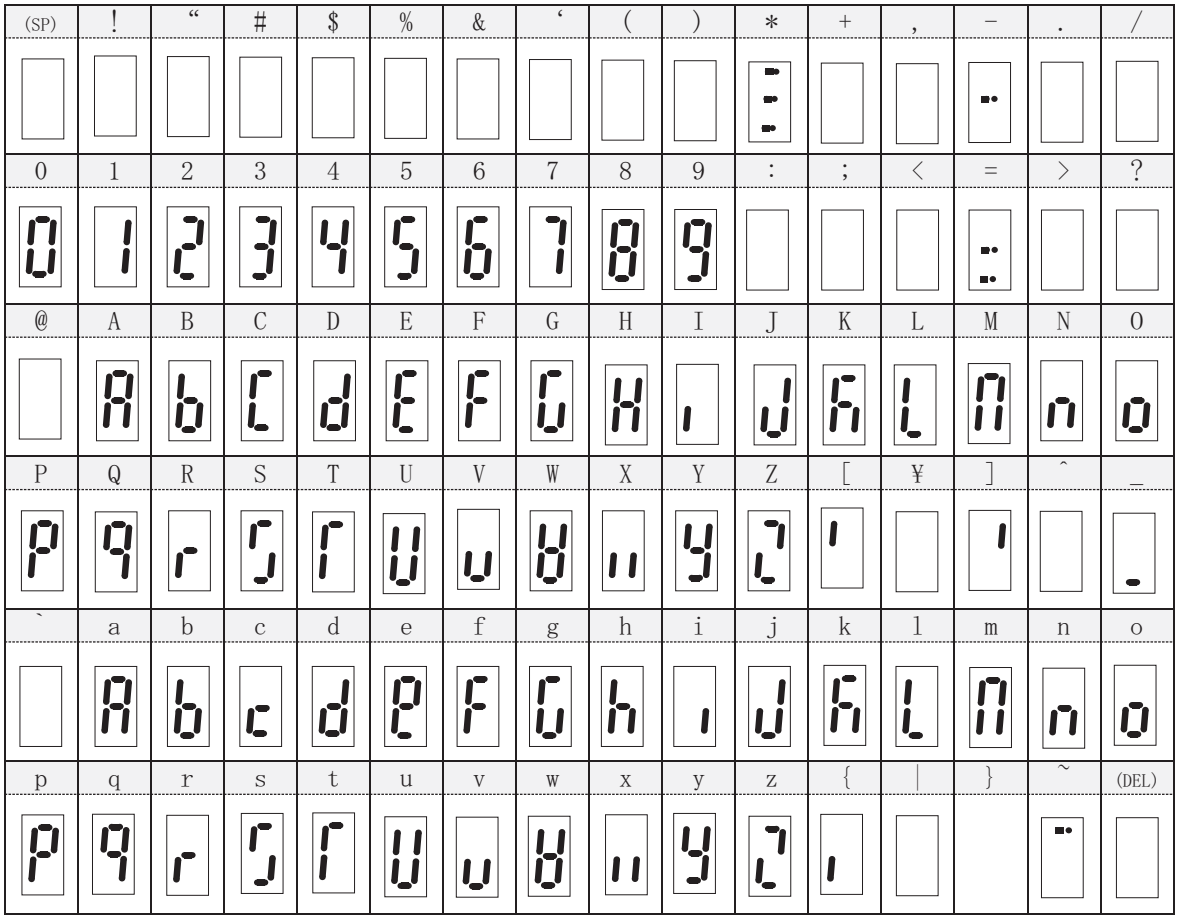


13.1 Segment LED

7-segment LED display area indicates the state of the unit with 2-digit alphabets, numbers, symbols and dots in the lower right.



The correspondence between characters displayed on 7-segment LED display and characters to be displayed (alphabets, numbers, and symbols) is as follows.



The content to be displayed on the 7-segment LED display can be classified into the following two categories:

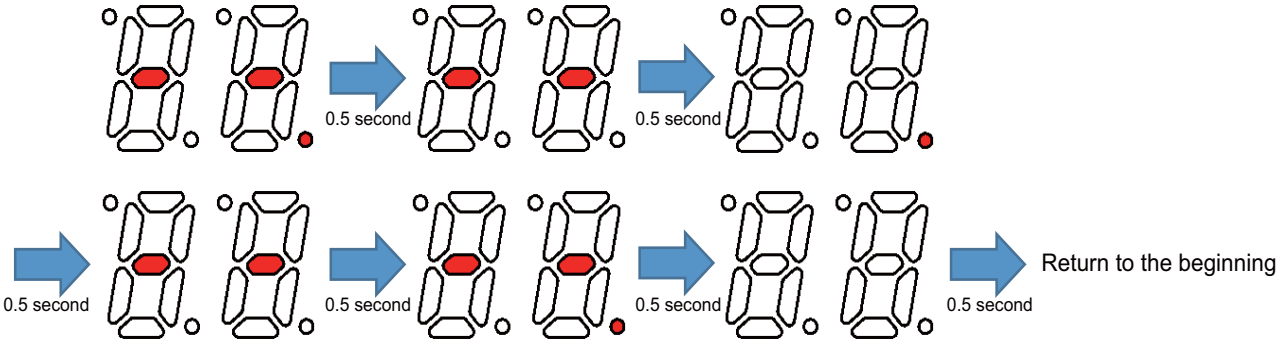
- Content displayed on H/W, boot, and OS when the unit is turned ON
- Content displayed on system S/W after the unit is turned ON (refer to "13.1.1 7-segment LED Display After Turning ON the Unit")

13.1.1 7-segment LED Display After Turning ON the Unit

After the high speed processing unit is turned ON, 7-segment LED displays an error occurs in the unit. In normal operation (when no error has occurred), hyphen "-" is displayed with blinking. The dot in the lower right of the second digit blinks every 0.5 second to indicate that the system has not turned down. The dot in the lower right of the first digit is off.

13.1.1.1 7-segment LED Display in Normal Operation

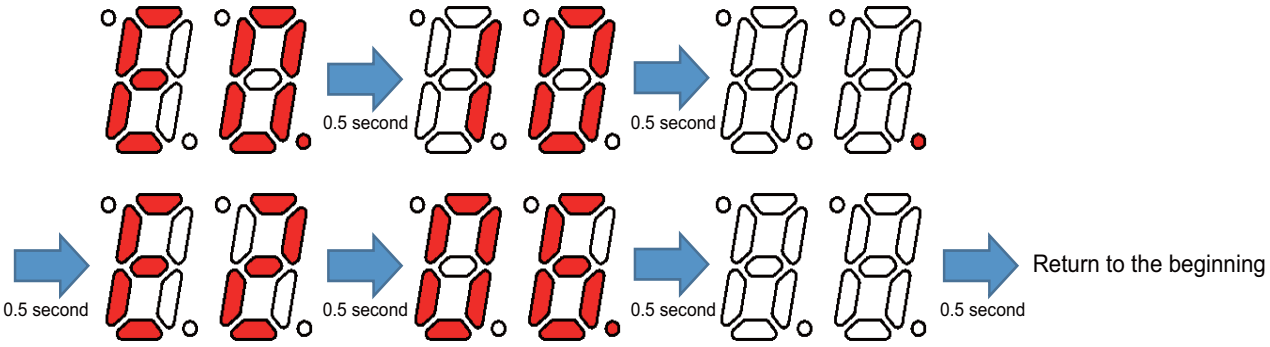
In normal operation (when no error has occurred), hyphen "-" is displayed with blinking. The hyphen "-" is turned on for 1 second and turned off for 0.5 second repeatedly. The dot turns on and off repeatedly every 0.5 second.



13.1.1.2 7-segment LED Display When an Error Occurred

When an error has occurred, error group code and error code of the error is repeatedly displayed on 7-segment LED. Error group code is displayed for 0.5 second, then error code for 0.5 second, and lastly the light turns off for 0.5 second. This operation is repeated.
When multiple errors have occurred, the error group codes and error codes are displayed in ascending order. This operation is repeated. When 21 or more errors have occurred simultaneously, the error group codes and error codes are displayed in ascending order. However, the 21st and later errors are not displayed, and "Num of simul errors 20 over (E0-01)" appears for the 21st error.
When the factor of the error is removed and the machine status changes to normal (no error), 7-segment LED also returns to normal. The dot turns on and off repeatedly every 0.5 second.

7-segment LED display when an error has occurred (Example of E0-10 and E2-06 occurred simultaneously)



Refer to "13.4 Error List" for the errors that occur in the unit.

13.2 H/W status chip LED

Display contents of H/W status chip LED are as follows.

Name	Lamp state	Details
24VDCIN	Lit (Yellow green)	24 V power is being supplied from the external power source.
	Not lit	One of the following factors may have caused an error: • No power is supplied from the external power source. • Disconnection of fuse near the DCIN connector • Failure of LED
DCOUT	Lit (Yellow green)	Each internal power supply generated from 24V is normally being output.
	Not lit	One of the following factors may have caused an error: • 24 V power is not supplied from the external power source. • Failure in any of the power output circuits. • Failure of LED or IC which helps turn the LED on
READY	Lit (Yellow green)	Unit has been turned ON and the system started its periodic processing.
	Not lit	Periodic processing has not been started yet.
ERR	Lit (Red)	H/W is not operating properly. One of the following factors may have caused an error: • Occurrence of watchdog error • Failure of main CPU card
	Not lit	H/W is operating properly.
SDACC	Lit (Green)	Accessing front panel SD card
	Not lit	Not accessing front panel SD card

13.3 General-purpose Status Chip LED

In display area of general-purpose status chip LED, the status of the unit is indicated with eight chip LEDs.



13.3.1 General-purpose Status Chip LED Display After Turning ON the Unit

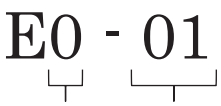
LED display is as follows after the high speed processing unit is turned ON normally.



13.4 Error List

An error code consists of "E" and 3-digit code. The first digit next to "E" is called "Error group code". Errors are classified into groups. An error is figured out by a combination of the "Error group code" and "Detailed error code" which is represented by the second digit and the third digit.

[Error example]



The classification of error groups and the list of errors are as follows.

[Classification of error groups]

Error group No.	Classification
E0	Error related system, HW, SD or optical communication
E1	Error related RIO, AI, DI, SIO
E2	Network error
E3	Analyzing process error

[Error list]

(*1) Type for clearing error

PR: Restart the NC

UR: Restart the high speed processing unit

Error code		Type for clearing error (*1)		Name	Details	Remedy
Group code	Detailed code	PR	UR			
E0	01	—	—	Num of simul errors 20 over	The number of simultaneous errors exceeded 20. The 21st error and subsequent errors are not displayed. However, the 21st and subsequent errors are recorded in the error history. This error is not recorded in the error history.	Cancel the displayed 20 errors.
E0	02	—	○	S/W error	An error occurred in the S/W process inside the unit.	Contact our service center.
E0	03	—	○	System SD error	An error occurred in the system SD.	Contact our service center.
E0	04	—	○	SD error	An error occurred in the SD.	Replace the SD card inserted in the unit.
E0	08	—	○	Overvoltage	Power supply voltage is abnormal. (Overvoltage)	Correct the power supply environment.
E0	09	—	○	Undervoltage	Power supply voltage is abnormal. (Undervoltage)	Correct the power supply environment.
E0	10	—	—	Overheat	The unit temperature has risen above the designated value.	Cooling measures are required. Turn OFF the unit power, or lower the temperature with a cooler, etc.
E0	11	—	—	Heat notice	The unit temperature has risen above the designated value.	Cooling measures are required. Turn OFF the unit power, or lower the temperature with a cooler, etc.
E0	12	○	—	Servo axis/spindle information acquisition error	The information for the servo axis or spindle could not be acquired.	Turn ON the NC power again.
E0	14	—	○	Internal voltage fault 1	Internal voltage fault 1	Contact our service center.
E0	15	—	○	Internal voltage fault 2	Internal voltage fault 2	Contact our service center.
E0	16	—	○	Internal voltage fault 3	Internal voltage fault 3	Contact our service center.

Error code		Type for clearing error (*1)		Name	Details	Remedy
Group code	Detailed code	PR	UR			
E0	17	—	○	Internal voltage fault 4	Internal voltage fault 4	Contact our service center.
E0	18	—	○	Internal voltage fault 5	Internal voltage fault 5	Contact our service center.
E0	19	—	○	Internal voltage fault 6	Internal voltage fault 6	Contact our service center.
E0	20	—	○	Internal voltage fault 7	Internal voltage fault 7	Contact our service center.
E0	21	—	○	Internal voltage fault 8	Internal voltage fault 8	Contact our service center.
E0	22	—	○	Internal voltage fault 9	Internal voltage fault 9	Contact our service center.
E0	23	—	○	Internal voltage fault 10	Internal voltage fault 10	Contact our service center.
E0	24	—	○	Internal voltage fault 11	Internal voltage fault 11	Contact our service center.
E0	25	—	○	Internal voltage fault 12	Internal voltage fault 12	Contact our service center.
E0	26	—	○	Internal voltage fault 13	Internal voltage fault 13	Contact our service center.
E0	27	—	○	Internal voltage fault 14	Internal voltage fault 14	Contact our service center.
E0	28	—	○	Internal voltage fault 15	Internal voltage fault 15	Contact our service center.
E0	29	—	○	Internal voltage fault 16	Internal voltage fault 16	Contact our service center.
E0	30	—	○	H/W error 1	H/W error 1	Contact our service center.
E0	31	—	○	2nd CPU initialization waiting timeout	Initialization of the 2nd CPU did not complete. Connection timed out.	Contact our service center.
E0	32	○	—	NC-RTU optical communication error	An error occurred in optical communication between the NC and RTU.	Turn ON the NC power again.
E0	33	—	○	Analysis data transmission time over	The time for analysis data transmission processing was exceeded.	Correct the processing time for analysis processing.
E0	36	—	—	NC → edge PC data transfer error	The transfer of data from the NC to the edge PC failed.	Check whether communication is enabled, and correct the settings if necessary.
E0	36	—	—	Edge PC → NC data transfer error	The transfer of data from the edge PC to the NC failed.	Check whether communication is enabled, and correct the settings if necessary.
E0	36	—	—	Transient transfer (RTU → NC) error	The exchange of data by optical communication transient transfer (RTU to NC) between the NC and RTU failed.	Check whether the cable is connected correctly.
E0	37	—	—	Transient transfer (NC → RTU) error	The exchange of data by optical communication transient transfer (NC to RTU) between the NC and RTU failed.	Check whether the cable is connected correctly.
E1	01	—	○	RIO parameter error	RIO communication function parameter is not set correctly.	Set the RIO parameter of the DAU/RTU correctly.
E1	02	—	○	Remote I/O master error	A communication error occurred in RIO1.0 master communication.	Check the connection of the RIO unit on the master side, or replace the RIO unit and turn ON the power again.
E1	03	—	○	Remote I/O 2.0 master error	A communication error occurred in RIO2.0 master communication.	Check the connection of the RIO unit on the master side, or replace the RIO unit and turn ON the power again.
E1	04	—	○	RIO initialize error	Error occurred in RIO initial communication.	Contact our service center. Set the station number of the RIO unit to a value from 1 to 8. Turn ON the DAU/RTU power again.
E1	11	—	—	Disconnection error in IEPE mode (channel 1)	A disconnection occurred in IEPE input mode for analog input channel 1.	Connect the cable to the analog input channel 1 terminal.
E1	12	—	—	Disconnection error in IEPE mode (channel 2)	A disconnection occurred in IEPE input mode for analog input channel 2.	Connect the cable to the analog input channel 2 terminal.
E1	13	—	—	Disconnection error in IEPE mode (channel 3)	A disconnection occurred in IEPE input mode for analog input channel 3.	Connect the cable to the analog input channel 3 terminal.
E1	14	—	—	Disconnection error in IEPE mode (channel 4)	A disconnection occurred in IEPE input mode for analog input channel 4.	Connect the cable to the analog input channel 4 terminal.
E1	15	—	—	Disconnection error in IEPE mode (channel 5)	A disconnection occurred in IEPE input mode for analog input channel 5.	Connect the cable to the analog input channel 5 terminal.
E1	16	—	—	Disconnection error in IEPE mode (channel 6)	A disconnection occurred in IEPE input mode for analog input channel 6.	Connect the cable to the analog input channel 6 terminal.

Error code		Type for clearing error (*1)		Name	Details	Remedy
Group code	Detailed code	PR	UR			
E1	17	—	—	Short-circuit error in IEPE mode (channel 1)	A short-circuit occurred in IEPE input mode for analog input channel 1.	Remove the cause of the short-circuit of the cable connected to the analog input channel 1 terminal.
E1	18	—	—	Short-circuit error in IEPE mode (channel 2)	A short-circuit occurred in IEPE input mode for analog input channel 2.	Remove the cause of the short-circuit of the cable connected to the analog input channel 2 terminal.
E1	19	—	—	Short-circuit error in IEPE mode (channel 3)	A short-circuit occurred in IEPE input mode for analog input channel 3.	Remove the cause of the short-circuit of the cable connected to the analog input channel 3 terminal.
E1	20	—	—	Short-circuit error in IEPE mode (channel 4)	A short-circuit occurred in IEPE input mode for analog input channel 4.	Remove the cause of the short-circuit of the cable connected to the analog input channel 3 terminal.
E1	21	—	—	Short-circuit error in IEPE mode (channel 5)	A short-circuit occurred in IEPE input mode for analog input channel 5.	Remove the cause of the short-circuit of the cable connected to the analog input channel 4 terminal.
E1	22	—	—	Short-circuit error in IEPE mode (channel 6)	A short-circuit occurred in IEPE input mode for analog input channel 6.	Remove the cause of the short-circuit of the cable connected to the analog input channel 6 terminal.
E1	23	—	—	Analog input hardware error	An error occurred with the hardware (AD converter) of the analog input function.	Contact our service center.
E1	24	—	—	Remote I/O slave error	A communication error occurred in RIO1.0 slave communication.	Establish a connection with the master unit.
E1	25	—	—	Remote I/O 2.0 slave error	A communication error occurred in RIO2.0 slave communication.	Establish a connection with the master unit.
E2	01	—	○	IP address acquisition failure	Failed to acquire IP address from DHCP.	Check communication to the DHCP server. Restart the unit.
E2	02	—	○	Time synchronization failure	Time synchronization with the SNTP server failed.	Check communication to the SNTP server. Correct "#1607 SNTP server address". Correct "#0407 SNTP server timeout period". Restart the unit.
E2	03	—	○	IP addr. filter disabled	The IP address filter is disabled because the IP address filter range settings are all "0".	Set "#1015-#1046 IP address filter range".
E2	04	—	—	IP addr. filter range abnormal	The IP address filter range settings are all "0".	Set "#1015-#1046 IP address filter range".
E2	05	—	—	Illegal unit name setting	The unit name is not set or characters that can not be used are set.	Correct "#1608 unit name". For "#1608 unit name", specify characters from "0" to "9", "a" to "z", and "A" to "Z".
E2	06	—	—	Illegal broker's IP addr	The broker's IP address has not been set or an incorrect IP address is set.	Correct "#1051 broker IP Address".
E2	07	—	—	Transmission data size over	The total size of the selected transmission data exceeds the size that can be transmitted.	Correct the setting of the following parameters. • "#0008-#0011 MQTT SendAxisSet1 to 4" • "#0012/BIT1 MQTT RIO(M) valid" • "#0012/BIT2 MQTT RIO(S) valid" • "#0012/BIT3 MQTT AI valid" • "#0209 MQTT communication. Select DRV data narrowing down"
E2	08	—	—	Transmission time over	Transmission processing could not be completed within 1.8 seconds due to insufficient network communication speed.	Check the communication speed of the network. Reduce the sampling data to be transmitted.
E2	09	—	—	Protocol ver not acceptable	Connection return code 1 was received with the CONNACK message.	Prepare the broker corresponding to protocol version 3.1.1.

Error code		Type for clearing error (*1)		Name	Details	Remedy
Group code	Detailed code	PR	UR			
E2	10	—	—	Client identifier rejection	Connection return code 2 was received with the CONNACK message.	Correct "#1608 unit name". Allow "#1608 unit name" as a client identifier in the broker.
E2	11	—	—	Server unavailable	Connection return code 3 was received with the CONNACK message.	Make sure that the server is available.
E2	12	—	—	Invalid user name or password	Connection return code 4 was received with the CONNACK message.	Correct "#1609 user name for broker connection" and "#1610 password for broker connection". Allow username/password at broker.
E2	13	—	—	No authority	Connection return code 5 was received with the CONNACK message.	Check whether the client is allowed to connect.
E4	01	—	○	Custom module 1 unregistered	Custom module 1 is not registered.	Register custom module. Check the parameter #0016 (specification of valid module).
E4	02	—	○	Custom module 2 unregistered	Custom module 2 is not registered.	
E4	03	—	○	Custom module 3 unregistered	Custom module 3 is not registered.	
E4	04	—	○	Custom module 4 unregistered	Custom module 4 is not registered.	
E4	05	—	○	Custom module 5 unregistered	Custom module 5 is not registered.	
E4	11	—	○	Initialization function 1 unregistered	Initialization function 1 is not registered.	Register initialization function "mtb(N)_ini()". Check the parameter #0016 (specification of valid module).
E4	12	—	○	Initialization function 2 unregistered	Initialization function 2 is not registered.	
E4	13	—	○	Initialization function 3 unregistered	Initialization function 3 is not registered.	
E4	14	—	○	Initialization function 4 unregistered	Initialization function 4 is not registered.	
E4	15	—	○	Initialization function 5 unregistered	Initialization function 5 is not registered.	
E4	21	—	○	3.5 ms main function 1 unregistered	3.5 ms main function 1 is not registered.	Register 3.5 ms main function "mtb(N)_main3_5()". Check the parameters #0016 and #0017 (specification of valid module).
E4	22	—	○	3.5 ms main function 2 unregistered	3.5 ms main function 2 is not registered.	
E4	23	—	○	3.5 ms main function 3 unregistered	3.5 ms main function 3 is not registered.	
E4	24	—	○	3.5 ms main function 4 unregistered	3.5 ms main function 4 is not registered.	
E4	25	—	○	3.5 ms main function 5 unregistered	3.5 ms main function 5 is not registered.	
E4	31	—	○	56.8 ms main function 1 unregistered	56.8 ms main function 1 is not registered.	Register 56.8 ms main function "mtb(N)_main56_8()". Check the parameters #0016 and #0018 (specification of valid module).
E4	32	—	○	56.8 ms main function 2 unregistered	56.8 ms main function 2 is not registered.	
E4	33	—	○	56.8 ms main function 3 unregistered	56.8 ms main function 3 is not registered.	
E4	34	—	○	56.8 ms main function 4 unregistered	56.8 ms main function 4 is not registered.	
E4	35	—	○	56.8 ms main function 5 unregistered	56.8 ms main function 5 is not registered.	

Error code		Type for clearing error (*1)		Name	Details	Remedy
Group code	Detailed code	PR	UR			
E4	41	—	○	1820 ms main function 1 unregistered	1820 ms main function 1 is not registered.	Register 1820 ms main function "mtb(N)_main1820()". Check the parameters #0016 and #0019 (specification of valid module).
E4	42	—	○	1820 ms main function 2 unregistered	1820 ms main function 2 is not registered.	
E4	43	—	○	1820 ms main function 3 unregistered	1820 ms main function 3 is not registered.	
E4	44	—	○	1820 ms main function 4 unregistered	1820 ms main function 4 is not registered.	
E4	45	—	○	1820 ms main function 5 unregistered	1820 ms main function 5 is not registered.	

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Appendix 1: 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.

14.1 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.

- Methods of installation in control/operation panel
- Methods of wiring cables to outside of panel
- 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.

14.2 EMC Directives

The EMC Directives largely regulate the following two items.
- Emissions: 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.

<table>
<tr><th>Class</th><th>Name</th><th>Details</th><th colspan="2">CE marking/UKCA marking</th></tr>
<tr><td colspan="5">Emission</td></tr>
<tr><td rowspan="2"></td><td>Radiated noise</td><td>Restriction of electromagnetic noise radiated through the air</td><td rowspan="2">EN61000-6-4
(General industrial machine)
EN61800-3
(Motor control unit)</td><td rowspan="2">EN55011
(Class:A)</td></tr>
<tr><td>Conductive noise</td><td>Restriction of electromagnetic noise discharged from power supply line</td></tr>
<tr><td colspan="5">Immunity</td></tr>
<tr><td rowspan="8"></td><td>Static electricity electrical discharge</td><td>(Example) Regulation of withstand level of static electricity electrical discharge accumulated in human body</td><td rowspan="8">EN61000-6-2
(General industrial machine)
EN61800-3
(Motor control unit)</td><td>EN61000-4-2</td></tr>
<tr><td>Radiated noise Immunity</td><td>(Example) Simulation of immunity from digital wireless telephones</td><td>EN61000-4-3</td></tr>
<tr><td>Burst Immunity</td><td>(Example) Regulation of withstand level of noise from relay or plug and play</td><td>EN61000-4-4</td></tr>
<tr><td>Conductive Immunity</td><td>(Example) Regulation of withstand level of noise flowed from power supply wires, etc.</td><td>EN61000-4-6</td></tr>
<tr><td>Power supply frequency magnetic field</td><td>(Example) Regulation of electromagnetic noise of 50/60 Hz power supply frequency</td><td>EN61000-4-8</td></tr>
<tr><td>Power supply dip (fluctuation)</td><td>(Example) Regulation of power voltage drop withstand level</td><td>EN61000-4-11</td></tr>
<tr><td>Surge</td><td>(Example) Regulation of withstand level of noise caused by lightning</td><td>EN61000-4-5</td></tr>
</table>

14.3 EMC Measures

The main items relating to EMC measures include the following.

- Store the device in a sealed metal panel.
- Ground all conductors that are floating electrically. Decrease the impedance.
- Increase the distance between the drive line and signal wire.
- Use shielded cables for wiring outside of the panel.
- Install a noise filter.

Take care to the following items to suppress the noise radiated outside of the panel.

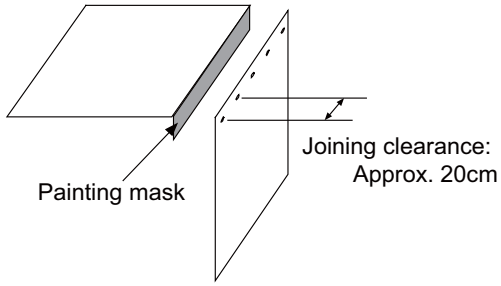
- Accurately ground the devices.
- Use shielded cables.
- Increase the electrical seal of the panel. Reduce the gaps and holes.

14.4 Panel Structure

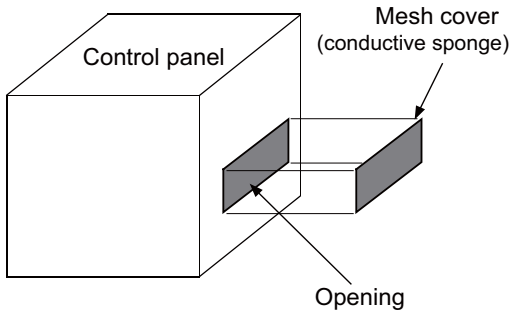
Panel design is a very important factor for the EMC measures. Take the following measures into consideration when creating panels.

14.4.1 Measures for Control Panel Body

- Use metal for all members configuring the panel.
- When joining the metal plate, treat the welded or contacting sections so that the impedance is reduced, and then fix with screws.



- Note that if the plate warps due to the screw fixing, etc. By creating a clearance, noise could leak from that place.
- Plate (nickel tin) the metal plate surface at the grounding plate, and connect the connections with a low impedance.
- If there is a large opening, such as ventilation holes, make sure to close the hole.



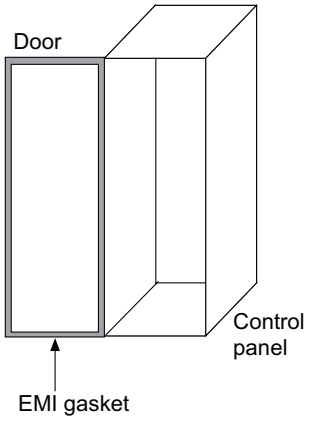
Note

(1) Using screws to fix the plates that have been painted is the same as an insulated state. Peel the paint and fix the screws.

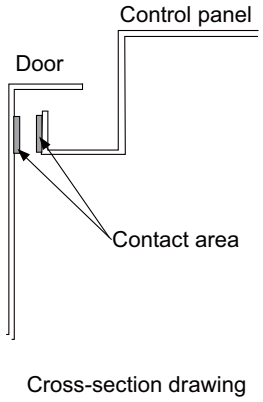
14.4.2 Measures for Door

- Use metal for all members configuring the panel.
- 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.
- The EMI gasket or conductive packing must contact the metal surface uniformly and at the correct position.

(a) Use of gasket



(b) Large contact area



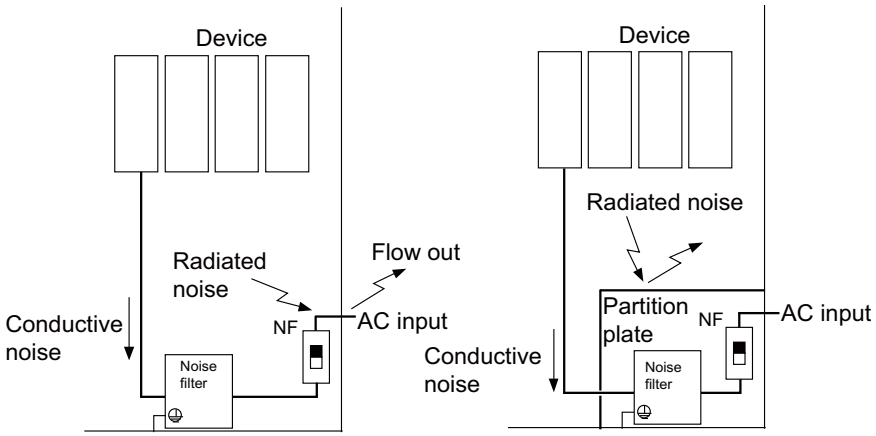
Cross-section drawing

Note

(1) When not using a gasket, ground the control panel grounding with a grounding wire to lower the door's impedance.
(2) Using screws to fix the plates that have been painted (attachment of packing) is the same as an insulated state. Peel the paint and fix the screws.

14.4.3 Measures for Power Supply

- Shield the power supply section and insert a filter to prevent the noise from flowing in or out.
  Selection of the noise filter capacity will differ according to the drive unit and devices being used.



Note

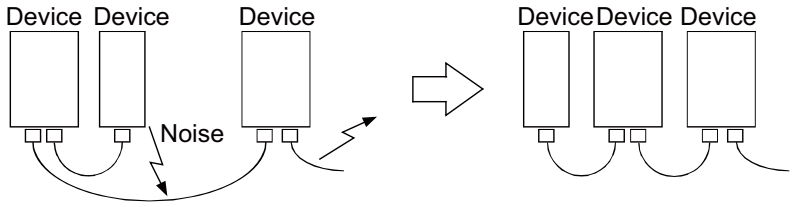
(1) The conductive noise can be suppressed by inserting a noise filter, but the radiated noise will flow out.
(2) The conductive and radiated noise can both be suppressed by adding a partition plate to the noise filter.

14.5 Measures for Wiring in Panel

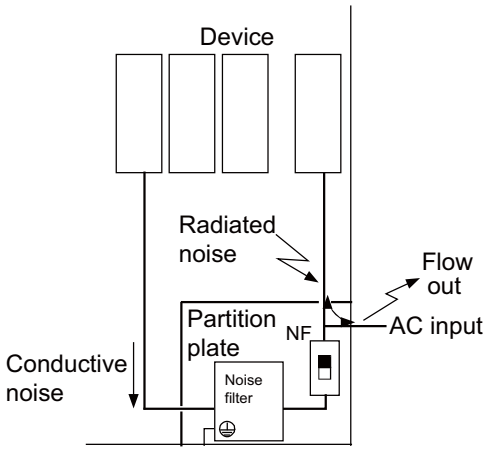
Cables act as antennas to propagate unnecessary noise, and thus must be appropriately shielded and treated.
The following measures must be sufficiently considered for the cables (J210/J303) that carry out high-speed communication.

14.5.1 Precautions for Wiring in Panel

- If the cables are led unnecessarily 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.



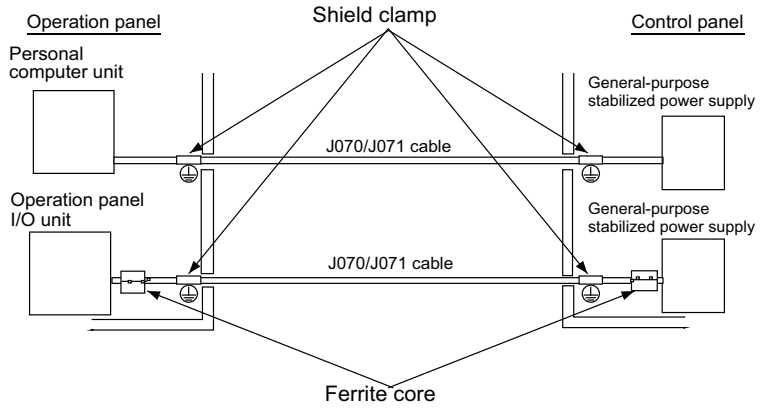
- Always connect the grounding wire to the FG terminal indicated on the device.
- Keep the distance between the drive line and encoder cable to the drive section motor as far apart as possible when wiring.
- Do not lead the power supply wire around the panel without using a filter.



14.5.2 Shield Treatment of Cables

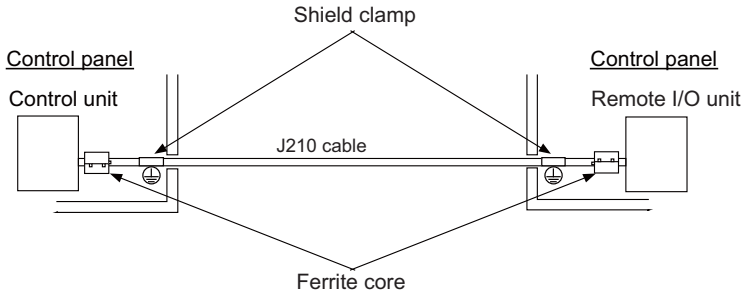
Use shielded cables for wiring outside the panel.
Use shield clamps within 10 cm of the lead-out port from the panel. (Refer to "14.6.1 Shield Clamp Fitting".)

■ DC power supply cable [J070/J071 cable]



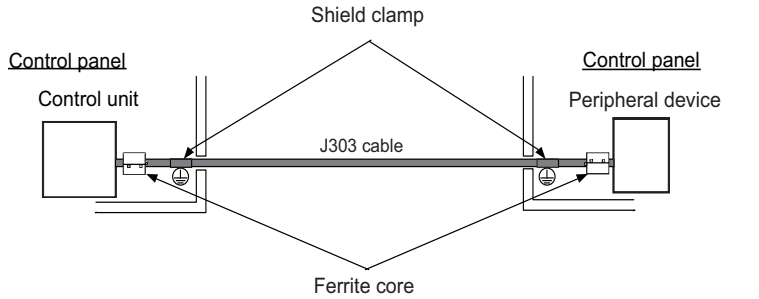
- Use a shield clamp within 10 cm from the panel's inlet/outlet.
- When using a ferrite core, install it on both ends of the connected units.
- Always install a ferrite core (Refer to "14.6.2 Ferrite Core") on the general-purpose stabilized power supply.
  The ferrite core may not be required depending on the selected power supply.

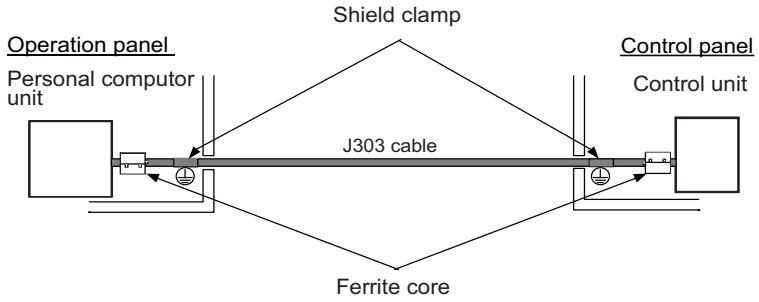
■ Remote I/O cable [J210 cable]



- 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.

■ LAN cable [J303 cable]





- Use a shielded 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.

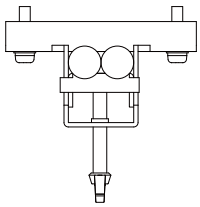
14.6 EMC Countermeasure Parts

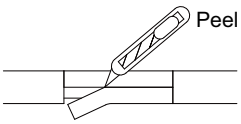
14.6.1 Shield Clamp Fitting

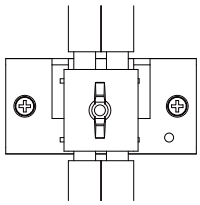
The effect can be improved by directly connecting the cable's shield sheath to the grounding plate as shown below.
Install the grounding plate near the outlet (within 10cm) of each panel, and press against the grounding plate with the clamp fitting.
If the cables are thin, several can be bundled and clamped together.
To provide sufficient frame ground, install the grounding plate directly on the cabinet or connect with a grounding wire.

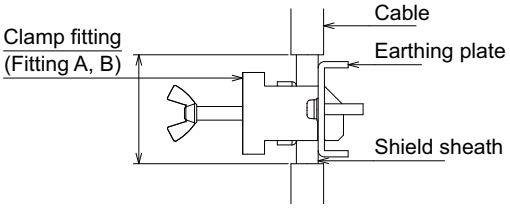
	A	B	C	Enclosed fittings
Ground Plate #D	100	86	30	Clamp fitting F × 2
Ground Plate #E	70	56	-	Clamp fitting G × 1

	L1 (maximum dimension when it is open)	L2 (reference dimension)
Clamp fitting F	25	(77)
Clamp fitting G	12	(54)





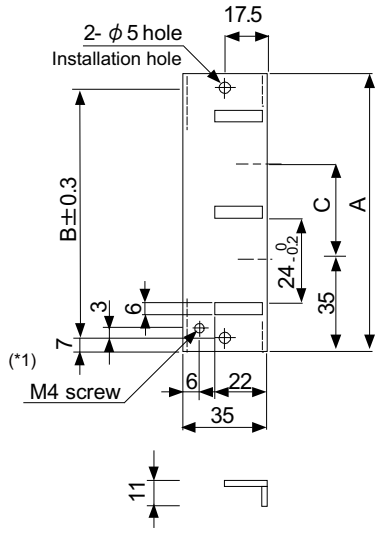




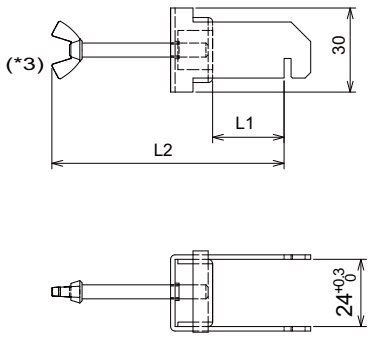
View of clamp section

・Outline drawing

Earthing plate



Clamp fitting

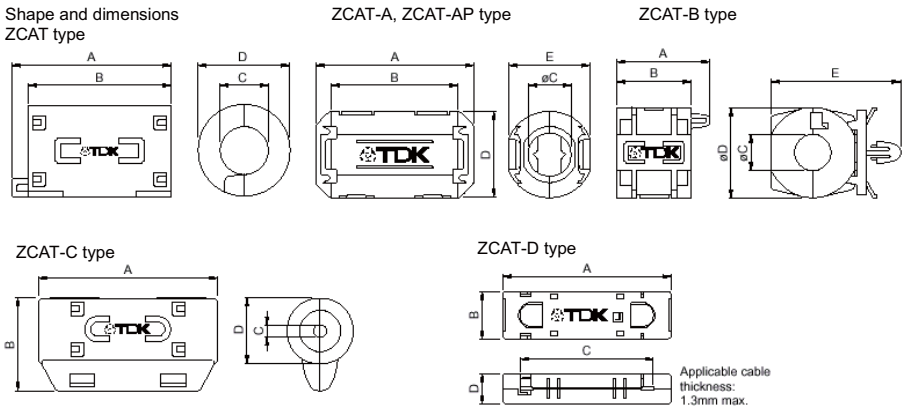


[Unit: mm]

(*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.

14.6.2 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 against common mode noise, allowing measures against noise 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	-	Maximum 7	6
ZCAT1518-0730(BK)(*2)	22±1	18±1	7±1	15±1	-	Maximum 7	6
ZCAT2017-0930-M(-BK)	21±1	17±1	9±1	20±1	-	Maximum 9	11
ZCAT2032-0930-M(-BK)(*1)	36±1	32±1	9±1	19.5±1	-	Maximum 9	22
ZCAT2032-0930(-BK)(*2)	36±1	32±1	9±1	19.5±1	-	Maximum 9	22
ZCAT2132-1130-M(-BK)(*1)	36±1	32±1	11±1	20.5±1	-	Maximum 11	22
ZCAT2132-1130(-BK)(*2)	36±1	32±1	11±1	20.5±1	-	Maximum 11	22
ZCAT3035-1330-M(-BK)(*1)	39±1	34±1	13±1	30±1	-	Maximum 13	63
ZCAT3035-1330(-BK)(*2)	39±1	34±1	13±1	30±1	-	Maximum 13	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	Maximum 9	12
ZCAT2749-0430C-M(-BK)	49±1	27±1	4.5±1	19.5±1	-	Maximum 4.5	26
ZCAT4625-3430D(-BK)	45.5±1	24.5±1	34±1	12±1	-	For 26 core flat cable	32
ZCAT4625-3430DT(-BK)(*3)	45.5±1	24.5±1	34±1	13±1	-	For 26 core flat cable	32
ZCAT6819-5230D(-BK)	67.5±1	18.5±1	52±1	16±1	-	For 40 core flat cable	58
ZCAT6819-5230DT(-BK)(*3)	67.5±1	18.5±1	52±1	17±1	-	For 40 core flat cable	58

(*1) Stamped with an "M".
(*2) A fixing band is attached at shipment.
(*3) The core is taped with double-sided tape. (The part arrives taped)

- 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.

14.6.3 Surge Absorber

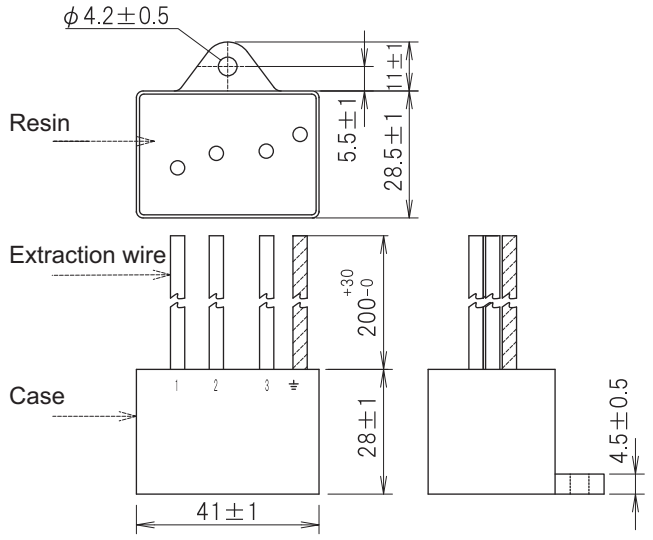
Make sure that the surge does not directly enter the AC line of the general-purpose stabilized power supply (user-prepared) supplying power to the control unit and DIO. Select the following product or equivalent for the surge absorber.
Refer to the manufacturer catalog for detailed characteristics, outline and connection methods of the surge absorber.

■ Part name: RSPD-250-U4

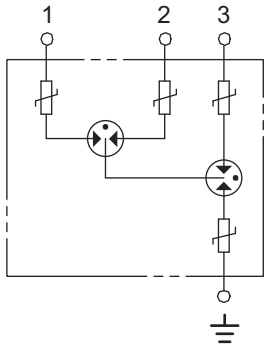
Manufacturer: OKAYA ELECTRIC INDUSTRIES

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

[Outline drawing]



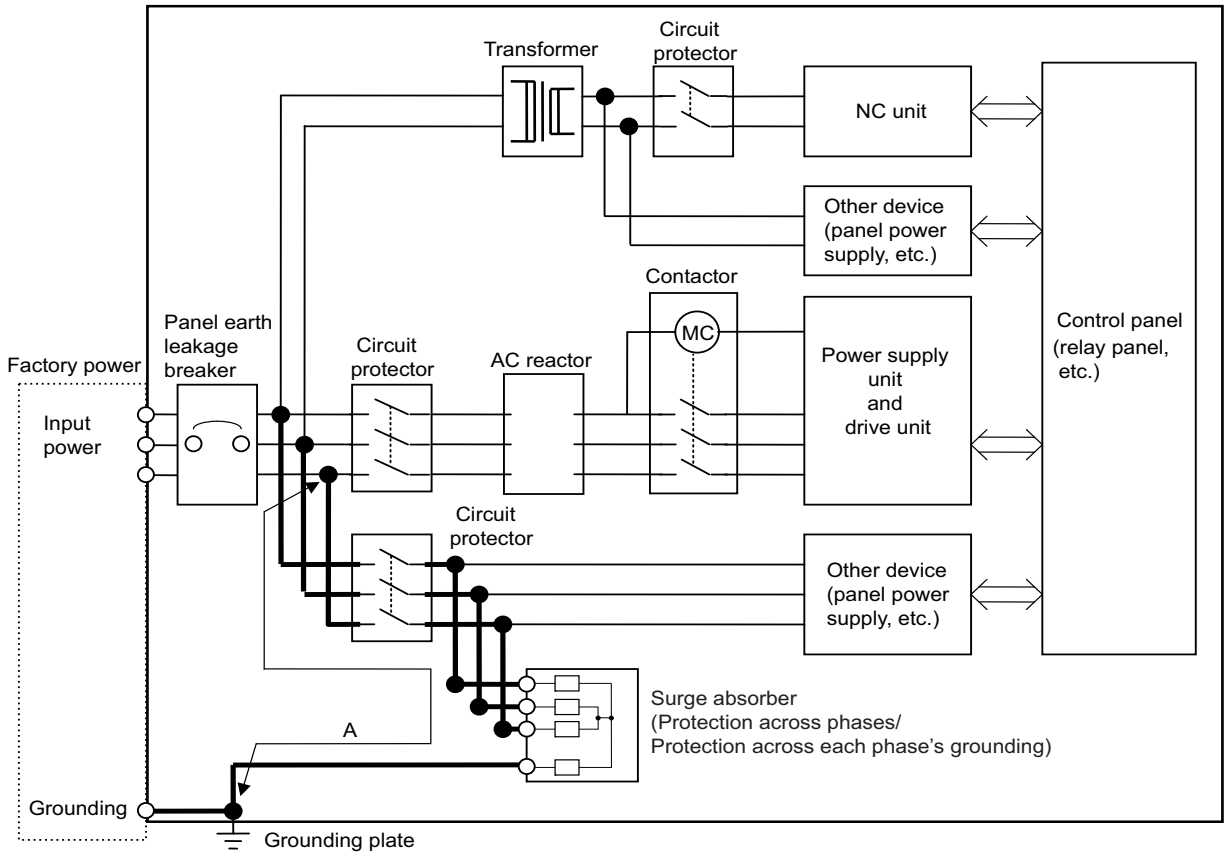
[Circuit drawing]



■ 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 absorber. Note that almost no current flows to the surge absorber during normal use, so a breaker installed as the circuit protection for another device can be used for 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 2 m 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.

14.6.4 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 24 VDC output
	Ripple noise	120 mV (max.)	
	Spike noise	500 mV (max.)	
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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Appendix 2: 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
Sep. 2022	IB(NA)1501714-A	The first edition was created.
Dec. 2022	IB(NA)1501714-B	The following contents were corrected. • 2.1.1 General Connection Diagram of High Speed Processing Unit (M800VW Connection) • 2.1.2 General Connection Diagram of High Speed Processing Unit (M80VW Connection) • 2.6.1 General Connection System Drawing Other mistakes were corrected.
Feb. 2023	IB(NA)1501714-C	The following contents were corrected. • 1.3.2 RIO Input/Output • 2.6.6 Connecting with NC Control Unit / Remote I/O Unit Other changes were made.
Feb. 2024	IB(NA)1501714-D	The following chapters were added. • 4. Building Custom Functions • 5. Development of Custom Module • 6. Debugging and Sampling the Custom Module • 7. Creating Model Parameter • 8. PLC Interface • 9. Library Functions • 10. NC-HPU Optical Communication, Send/Receive Data ID • 11. NC Parameters • 12. Alarms and Operation Messages of NC The following chapters were revised. • 1.1 Characteristics • 1.4.1 MQTT • 2.6.2 Connecting with Power Supply • 3.2 Parameter List • 13.4 Error List Other mistakes were corrected.

Global Service Network

AMERICA

MITSUBISHI ELECTRIC AUTOMATION INC. (AMERICA FA CENTER)
HQ and Central Region Service Center (Chicago)
500 CORPORATE WOODS PARKWAY, VERNON HILLS, ILLINOIS 60061, U.S.A.
TEL: +1-847-478-2500 / FAX: +1-847-478-2650
Minneapolis, MN Service Satellite
Detroit, MI Service Satellite
Grand Rapids, MI Service Satellite
Cleveland, OH Service Satellite
St. Louis, MO Service Satellite
Indianapolis, IN Service Saltellite

South/East Region Service Center (Georgia)
1845 SATELLITE BOULEVARD STE. 450, DULUTH, GEORGIA 30097, U.S.A.
TEL +1-678-258-4529 / FAX +1-678-258-4519
Charleston, SC Service Satellite
Charlotte, NC Service Satellite
Raleigh, NC Service Satellite
Dallas, TX Service Satellite
Houston, TX Service Satellite
Hartford, CT Service Satellite
Knoxville, TN Service Satellite
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Huntsville, AL Satellite
Pittsburg, PA Service Satellite
Tampa, FL Service Satellite
Miami, FL Satelite
Lafayette, LA Service Satellite
Allentown, PA Satelite

Western Region Service Center (California)
5900-B KATELLA AVE. - 5900-A KATELLA AVE. CYPRESS, CALIFORNIA 90630, U.S.A.
TEL: +1-714-699-2625 / FAX: +1-847-478-2650
San Francisco, CA Satelite
Seattle, WA Service Satellite
Denver, CO Service Satellite

Canada Region Service Center (Toronto)
4299 14TH AVENUE MARKHAM, ONTARIO L3R OJ2, CANADA
TEL: +1-905-475-7728 / FAX: +1-905-475-7935
Edmonton, AB Service Satellite
Montreal, QC Service Satellite

Mexico Region Service Center (Queretaro)
Parque Tecnológico Innovación Querétaro, Lateral Carretera Estatal 431, Km 2+200, Lote 91 Modulos 1 y 2
Hacienda la Machorra, CP 76246, El Marqués, Querétaro, México
TEL: +52-442-153-6050
Monterrey, NL Service Satellite
Mexico City, DF Service Satellite

BRAZIL

MITSUBISHI ELECTRIC DO BRASIL COMÉRCIO E SERVIÇOS LTDA.
Votorantim Office
AV. GISELE CONSTANTINO,1578, PARQUE BELA VISTA, VOTORANTIM-SP, BRAZIL CEP:18.110-650
TEL: +55-15-3023-9000
Blumenau, Santa Catarina Office

EUROPE

MITSUBISHI ELECTRIC EUROPE B.V.
European Service Headquarters (Dusseldorf, GERMANY)
Mitsubishi-Electric-Platz 1 40882 RATINGEN, GERMANY
TEL: +49-2102-486-5000 / FAX: +49-2102-486-5910

South Germany Service Center (Stuttgart)
SCHELMENWASENSTRASSE 16-20, 70567 STUTTGART, GERMANY
TEL: + 49-711-770598-123 / FAX: +49-711-770598-141

France Service Center (Paris)
2 RUE DE L'UNION, 92565 RUEIL-MALMAISON CEDEX, FRANCE
TEL: +33-1-41-02-83-13 / FAX: +33-1-49-01-07-25

France Service Satellite (Lyon)
240, ALLEE JACQUES MONOD 69800 SAINT PRIEST FRANCE
TEL: +33-1-41-02-83-13 / FAX: +33-1-49-01-07-25

Italy Service Center (Milan)
VIA ENERGY PARK 14, VIMERCATE 20871 (MB) ITALY
TEL: +39-039-6053-342 / FAX: +39-039-6053-206

Italy Service Satellite (Padova)
VIA G. SAVELLI, 24 - 35129 PADOVA, ITALY
TEL: +39-039-6053-342 / FAX: +39-039-6053-206

U.K. Service Center
TRAVELLERS LANE, HATFIELD, HERTFORDSHIRE, AL10 8XB, U.K.
TEL: +44-1707-288-780 / FAX: +44-1707-278-695

Spain Service Center
CTRA. RUBI, 76-80 8174 SAINT CUGAT DEL VALLES, BARCELONA, SPAIN
TEL: +34-935-65-2236 / FAX: +34-935-89-1579

Poland Service Center
UL.KRAKOWSKA 50, 32-083 BALICE, POLAND
TEL: +48-12-347-6500 / FAX: +48-12-630-4701

Hungary Service Center
MITSUBISHI ELECTRIC EUROPE B.V. HUNGARIAN BRANCH
BUDAÖRS OFFICE PARK, SZABADSÁG ÚT 117., 2040 BUDAÖRS, HUNGARY
TEL: +36-70-433-2263

Turkey Service Center
MITSUBISHI ELECTRIC TURKEY ELEKTRİK ÜRÜNLERİ A.Ş
SERIFALI MAHALLESI KALE SOKAK. NO.41 34775
UMRANIYE, ISTANBUL, TURKEY
TEL: +90-216-969-2500 / FAX: +90-216-661-44-47

Czech Republic Service Center
MITSUBISHI ELECTRIC EUROPE B.V. PRAGUE OFFICE
Pekařská 621/7, 155 00 PRAHA 5, CZECH REPUBLIC
TEL: +420-734-402-587

Sweden Service Center
HAMMARBACKEN 14, P.O.BOX 750 SE-19127, SOLLENTUNA, SWEDEN
TEL: +46-8-6251200 / FAX: +46-8-6251014

Bulgaria Service Center
AKHNATON Ltd. (Service Partner)
4 ANDREJ LJAPCHEV BLVD. POB 21, BG-1756 SOFIA, BULGARIA
TEL: +359-2-8176009 / FAX: +359-2-9744061

Ukraine Service Center (Kiev)
CSC Automation Ltd. (Service Partner)
4 B, YEVHENA SVERSTYUKA STR., 02002 KIEV, UKRAINE
TEL: +380-44-494-3344 / FAX: +380-44-494-3366

South Africa Service Center
Adroit Technologies (Service Partner)
20 WATERFORD OFFICE PARK, WATERFORD DRIVE, CNR OF WITKOPPEN ROAD,
FOURWAYS JOHANNESBURG SOUTH AFRICA
TEL: +27-11-658-8100 / FAX: +27-11-658-8101

ASEAN

MITSUBISHI ELECTRIC ASIA PTE. LTD. (ASEAN FA CENTER)
Singapore Service Center
307 ALEXANDRA ROAD MITSUBISHI ELECTRIC BUILDING SINGAPORE 159943
TEL: +65-6473-2308 / FAX: +65-6476-7439

PHILIPPINES

MELCO FACTORY AUTOMATION PHILIPPINES INC.
Head Office
128 LOPEZ RIZAL STREET, BRGY., HIGHWAY HILLS, MANDALUYONG CITY , MM PHILIPPINES 1550
TEL: +63-2-8256-8042 / FAX: +632-8637-2294

Philippines Service Center
KM.23 WEST SERVICE ROAD SSH, CUPANG ,MUNTINLUPA CITY, PHILIPPINES
TEL: +63-2-8807-0420 / FAX: +63-2-8842-5202

VIETNAM

MITSUBISHI ELECTRIC VIETNAM CO., LTD.
Vietnam Ho Chi Minh Service Center
11TH & 12TH FLOOR, VIETTEL TOWER B, 285 CACH MANG THANG 8 STREET, WARD 12, DISTRICT 10,
HO CHI MINH CITY, VIETNAM
TEL: +84-28-3910-5945 / FAX: +84-28-3910-5947

Vietnam Hanoi Service Center
14TH FLOOR, CAPITAL TOWER, 109 TRAN HUNG DAO STREET, CUA NAM WARD,
HOAN KIEM DISTRICT, HA NOI CITY, VIETNAM
TEL: +84-24-3937-8075 / FAX: +84-24-3937-8076

INDONESIA

PT. MITSUBISHI ELECTRIC INDONESIA
Indonesia Service Center (Cikarang)
JL. KENARI RAYA BLOK G2-07A, DELTA SILICON 5, LIPPO CIKARANG - BEKASI 17550, INDONESIA
TEL: +62-21-2961-7797 / FAX: +62-21-2961-7794

MALAYSIA

MITSUBISHI ELECTRIC SALES MALAYSIA SDN. BHD.
Malaysia Service Center (Kuala Lumpur Service Center)
LOT 11, JALAN 219, P.O BOX 1036, 46860 PETALING JAYA, SELANGOR DARUL EHSAN, MALAYSIA
TEL: +60-3-7626-5032

Johor Bahru Service Center
9, Jalan Perjiranan 4/6, Bandar Dato Onn, 81100 Johor.
TEL: 07-3642250 / 2256

Pulau Pinang Service Center
25-G, Pusat Perniagaan Perdana Jaya, Jalan Permatang Rawa, 14000 Bukit Mertajam, Pulau Pinang
TEL: +60-4-510-1838 / Fax: +60-4-510-1835

THAILAND

MITSUBISHI ELECTRIC FACTORY AUTOMATION (THAILAND) CO., LTD.
Thailand Service Center (Bangkok)
101, TRUE DIGITAL PARK OFFICE, 5TH FLOOR, SUKHUMVIT ROAD, BANGCHAK, PHRA KHANONG,
BANGKOK, 10260 THAILAND
TEL: +66-2-092-8600 / FAX: +66-2-043-1231-33

INDIA

MITSUBISHI ELECTRIC INDIA PVT., LTD.
Service Head office and South India Service Center (Bangalore)
CNC eXPerience Park, PLOT NO. 57/A, PEENYA PHASE 3,
PEENYA INDUSTRIAL AREA, BANGALORE 560058, KARNATAKA, INDIA
TEL : +91-80-4655-2121
Chennai Service Satellite
Coimbatore Service Satellite
Hyderabad Service Satellite

North India Service Center (Gurgaon)
PLOT 517, GROUND FLOOR, UDYOG VIHAR PHASE-III, GURUGRAM 122008, HARYANA, INDIA
TEL : +91-124-463-0300
Ludhiana Service Satellite
Panthnagar Service Satellite
Delhi Service Satellite
Jamshedpur Service Satellite
Manesar Service Satellite

West India Service Center (Pune)
ICC-Devi GAURAV TECHNOLOGY PARK, UNIT NO.402, FOURTH FLOOR, NORTH WING,
SURVEY NUMBER 191-192 (P), NEXT to INDIAN CARD CLOTHING COMPANY Ltd,
OPP. VALLABH NAGAR, PIMPRI, PUNE- 411 018, MAHARASHTRA, INDIA
TEL : +91-20-6819-2274
Kolhapur Service Satellite
Aurangabad Service Satellite
Mumbai Service Satellite

West India Service Center (Ahmedabad)
204-209, 2ND FLOOR, 31FIVE, CORPORATE ROAD PRAHLADNAGAR,
AHMEDABAD -380015, GUJARAT, INDIA
TEL : + 91-79-6777-7888
Rajkot Service Satellite

CHINA

MITSUBISHI ELECTRIC AUTOMATION (CHINA) LTD. (CHINA FA CENTER)
CNC Call Center
TEL: +86-400-921-5130

Shanghai Service Center
NO.1386 HONG QIAO ROAD, CHANG NING QU, SHANGHAI 200336, CHINA
TEL: +86-21-2322-3030 / FAX: +86-21-2322-3000*8422
Qingdao Service Center
Suzhou Service Center
Wuhan Service Center
Ningbo Service Center
Hefei Service Center
Beijing Service Center
Tianjin Service Center
Xian Service Center
Dalian Service Center
Chengdu Service Center

Shenzhen Service Center
LEVEL8, GALAXY WORLD TOWER B, 1 YABAO ROAD, LONGGANG DISTRICT,
SHENZHEN 518129, CHINA
TEL: +86-755-2399-8272 / FAX: +86-755-8229-3686
Dongguan Service Center
Xiamen Service Center

KOREA

MITSUBISHI ELECTRIC AUTOMATION KOREA CO., LTD. (KOREA FA CENTER)
Korea Seoul Service Center
8F GANGSEO HANGANG XI-TOWER A, 401 YANGCHEON-RO, GANGSEO-GU,
SEOUL 07528 KOREA
TEL: +82-2-3660-9631 / FAX: +82-2-3664-8668

Korea Daegu Service Center
2F KT BLDG. 8, HOGUK-RO, BUK-GU, DAEGU 41518, KOREA
TEL: +82-53-382-7401 / FAX: +82-53-382-7412

Korea Changwon Technical Center
#205, 888, CHANGWON-DAERO, SEONGSAN-GU, CHANGWON-SI,
GYEONGSANGNAM-DO, 51532, KOREA
TEL: +82-55-261-5559 / FAX: +82-55-261-5558

TAIWAN

MITSUBISHI ELECTRIC TAIWAN CO., LTD. (TAIWAN FA CENTER)
Taiwan Taichung Service Center
NO. 8-1, GONGYEQU 16TH RD., XITUN DIST., TAICHUNG CITY 40768 , TAIWAN
TEL: +886-4-2359-0688 / FAX: +886-4-2359-0689

Taiwan Taipei Service Center
11F, NO.88, SEC.6, ZHONGSHAN N. RD., SHILIN DIST., TAIPEI CITY 11155, TAIWAN
TEL: +886-2-2833-5430 / FAX: +886-2-2833-5433

Taiwan Tainan Service Center
11F-1, NO.30, ZHONGZHENG S. RD., YONGKANG DIST., TAINAN CITY 71067, TAIWAN
TEL: +886-6-252-5030 / FAX: +886-6-252-5031

OCEANIA

MITSUBISHI ELECTRIC AUSTRALIA PTY. LTD.
Oceania Service Center
348 VICTORIA ROAD, RYDALMERE, N.S.W. 2116 AUSTRALIA
TEL: +61-2-9684-7269/ FAX: +61-2-9684-7245

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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MITSUBISHI ELECTRIC CORPORATION
HEAD OFFICE : TOKYO BLDG.,2-7-3 MARUNOUCHI,CHIYODA-KU,TOKYO 100-8310,JAPAN

MODEL	High Speed Processing Unit
MODEL CODE	100-844
Manual No.	IB-1501714

IB(NA)1501714(ENG)-D(2402)MEE
Made in JAPAN

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