MITSUBISHI ELECTRIC

*Changes for the Better*

MITSUBISHI CNC

# Specifications Manual

## M800/M80/C80 Series


IB-1501267(ENG)-G

# Introduction

This manual describes the specifications of MITSUBISHI CNC.
Supported models are as follows:

| Supported models | Abbreviations in this manual |
|---|---|
| M800W Series | M800 Series, M800, M8 |
| M800S Series | |
| M80W Series | M80 Series, M80, M8 |
| M80 Series | |
| C80 Series | C80 |

To safely use this CNC unit, thoroughly study the "Precautions for Safety" on the next page before use.
Be sure to keep this manual always at hand.

Details described in this manual

At the beginning of each item, a table indicating it's specification according to the model.
M : Machining center system
L : Lathe system
○ : Standard
△ : Optional
□ : Selection

In this manual, the following abbreviations might be used.
MTB: Machine tool builder

## ⚠ CAUTION

⚠ **The 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.**

⚠ **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.**

General precautions
(1) When the contents of this manual is updated, the version (A, B, ...) on the cover will be incremented.

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

# Manual List

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

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

Manuals for MTBs (NC)

| Manual | IB No. | Purpose and Contents |
|---|---|---|
| M800/M80/C80 Series<br>Specifications Manual | IB-1501267 | - Model selection<br>- Specifications of hardware unit<br>- Outline of various functions |
| M800W/M80W Series<br>Connection and Setup Manual | IB-1501268 | - Detailed specifications of hardware unit<br>- Installation, connection, wiring, setup (startup/adjustment) |
| M800S/M80 Series<br>Connection and Setup Manual | IB-1501269 | - Detailed specifications of hardware unit<br>- Installation, connection, wiring, setup (startup/adjustment) |
| C80 Series<br>Connection and Setup Manual | IB-1501452 | - Detailed specifications of hardware unit<br>- Installation, connection, wiring, setup (startup/adjustment) |
| M800/M80 Series<br>PLC Development Manual | IB-1501270 | - Electrical design<br>- I/O relation (assignment, setting, connection), field network<br>- Development environment (PLC on-board, peripheral development environment), etc. |
| M800/M80 Series<br>PLC Programming Manual | IB-1501271 | - Electrical design<br>- Sequence programming<br>- PLC support functions, etc. |
| M800/M80/C80 Series<br>PLC Interface Manual | IB-1501272 | - Electrical design<br>- Interface signals between NC and PLC |
| M800/M80 Series<br>Maintenance Manual | IB-1501273 | - Cleaning and replacement for each unit<br>- Other items related to maintenance |
| C80 Series<br>Maintenance Manual | IB-1501454 | - Cleaning and replacement for each unit<br>- Other items related to maintenance |

Manuals for MTBs (drive section)

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

Manuals for MTBs (Others)

■ For M800/M80 Series

| Manual | No. | Purpose and Contents |
|---|---|---|
| GX Developer Version 8 Operating Manual (Startup) | SH-080372E | - Explanation for system configuration, installation, etc. of PLC development tool GX Developer |
| GX Developer Version 8 Operating Manual | SH-080373E | - Explanation for operations using PLC development tool GX Developer |
| GX Converter Version 1 Operating Manual | IB-0800004E | - Explanation for operations using data conversion tool GX Converter |
| MELSEC-Q CC-Link System Master/ Local Module User's Manual | SH-080394E | - Explanation for system configuration, installation, wiring, etc. of master/local modules for CC-Link system |

■ For C80 Series

| Manual | No. | Purpose and Contents |
|---|---|---|
| MELSEC iQ-R Module Configuration Manual | SH-081262 | - Outline of system configuration, specifications, installation, wiring, maintenance, etc. |
| MELSEC iQ-R CPU Module User's Manual (Startup) | SH-081263 | - Outline of specifications, procedures before operation, troubleshooting, etc. for CPU module |
| MELSEC iQ-R CPU Module User's Manual (Application) | SH-081264 | - Outline of memory, functions, devices, parameters, etc. for CPU module |
| QCPU User's Manual (Hardware Design, Maintenance and Inspection) | SH-080483 | - Outline of specifications, necessary knowledge to configure the system and maintenance-related descriptions for Q series CPU module, etc. |
| GX Works3 Operating Manual | SH-081215 | - Outline of functions, programming, etc. |
| GOT2000 Series User's Manual (Hardware) | SH-081194 | - Outline of hardware such as part names, external dimensions, installation, wiring, maintenance, etc. of GOTs |
| GOT2000 Series User's Manual (Utility) | SH-081195 | - Outline of utilities such as screen display setting, operation method, etc. of GOTs |
| GOT2000 Series User's Manual (Monitor) | SH-081196 | - Outline of each monitor function of GOTs |
| GOT2000 Series Connection Manual (Mitsubishi Electric Products) | SH-081197 | - Outline of connection types and connection method between GOT and Mitsubishi Electric connection devices |
| GT Designer3 (GOT2000) Screen Design Manual | SH-081220 | - Outline of screen design method using screen creation software GT Designer3 |

Reference Manual for MTBs

| Manual | No. | Purpose and Contents |
|---|---|---|
| M800/M80 Series Smart safety observation Specification manual | BNP-C3072-022 | - Explanation for smart safety observation function |

# Precautions for Safety

Always read this manual, related manuals and attached documents before installation, operation, programming, maintenance or inspection to ensure correct use. Understand all the conditions described in this manual before using the unit. We rank the safety precautions into "DANGER", "WARNING" and "CAUTION" for the manuals issued by Mitsubishi, including this manual.

| |
|---|
| **⚠ DANGER**<br>**When there is a great risk that the user could be subject to fatalities or serious injuries if handling is mistaken.** |
| **⚠ WARNING**<br>**When the user could be subject to fatalities or serious injuries if handling is mistaken.** |
| **⚠ CAUTION**<br>**When the user could be subject to injuries or when physical damage could occur if handling is mistaken.** |

Note that even items ranked as " ⚠ CAUTION", may lead to major results depending on the situation. In any case, important information that must always be observed is described.

The following signs indicate prohibition and compulsory.

| | |
|---|---|
| ⃠ | **This sign indicates prohibited behavior (must not do).**<br>**For example, indicates "Keep fire away".** |

| | |
|---|---|
| ● | **This sign indicated a thing that is pompously (must do).**<br>**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** |

## ⚠ DANGER

Not applicable in this manual.

## ⚠ WARNING

Not applicable in this manual.

## ⚠ CAUTION

**1. Items related to product and manual**

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

**2. Items related to start up and maintenance**

- ⚠ **Follow the power specifications (input voltage range, frequency range, momentary power failure time range) described in this manual.**
- ⚠ **Follow the environment conditions (ambient temperature, humidity, vibration, atmosphere) described in this manual.**
- ❗ **Follow the remote type machine contact input/output interface described in this manual. (Connect a diode in parallel with the inductive load or connect a protective resistor in serial with the capacitive load, etc.)**
- ⚠ **If the parameter is used to set the temperature rise detection function to invalid, overheating may occur, thereby disabling control and possibly resulting in the axes running out of control, which in turn may result in machine damage and/or bodily injury or destruction of the unit. It is for this reason that the detection function is normally left "valid" for operation.The parameter for the temperature rise detection function will be validated forcibly when the NC unit is turned ON.**

# 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 recommends sorting the product and selling the members to appropriate contractors.

(2) Requirements for "Law for Treatment of Waste and Cleaning"
- (a) Mitsubishi 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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# 本製品の取扱いについて

( 日本語 /Japanese)
本製品は工業用 ( クラス A) 電磁環境適合機器です。販売者あるいは使用者はこの点に注意し、住商業環境以外での使用をお願いいたします。

# Handling of our product

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

# 본 제품의 취급에 대해서

( 한국어 /Korean)
이 기기는 업무용 (A 급 ) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며 가정외의 지역에서 사용하는 것을 목적으로 합니다 .

# WARRANTY

Please confirm the following product warranty details before using MITSUBISHI CNC.

## 1. Warranty Period and Coverage

Should any fault or defect (hereafter called "failure") for which we are liable occur in this product during the warranty period, we shall provide repair services at no cost through the distributor from which the product was purchased or through a Mitsubishi Electric service provider. Note, however that this shall not apply if the customer was informed prior to purchase of the product that the product is not covered under warranty. Also note that we are not responsible for any on-site readjustment and/or trial run that may be required after a defective unit is replaced.

**[Warranty Term]**

The term of warranty for this product shall be twenty-four (24) months from the date of delivery of product to the end user, provided the product purchased from us in Japan is installed in Japan (but in no event longer than thirty (30) months, Including the distribution time after shipment from Mitsubishi Electric or its distributor).

Note that, for the case where the product purchased from us in or outside Japan is exported and installed in any country other than where it was purchased; please refer to "2. Service in overseas countries" as will be explained.

**[Limitations]**

(1) The customer is requested to conduct an initial failure diagnosis by him/herself, as a general rule. It can also be carried out by us or our service provider upon the customer's request and the actual cost will be charged.

(2) This warranty applies only when the conditions, method, environment, etc., of use are in compliance with the terms and conditions and instructions that are set forth in the instruction manual, user's manual, and the caution label affixed to the product, etc.

(3) Even during the term of warranty, repair costs shall be charged to the customer in the following cases:

- (a) a failure caused by improper storage or handling, carelessness or negligence, etc., or a failure caused by the customer's hardware or software problem
- (b) a failure caused by any alteration, etc., to the product made by the customer without Mitsubishi Electric's approval
- (c) a failure which may be regarded as avoidable, if the customer's equipment in which this product is incorporated is equipped with a safety device required by applicable laws or has any function or structure considered to be indispensable in the light of common sense in the industry
- (d) a failure which may be regarded as avoidable if consumable parts designated in the instruction manual, etc. are duly maintained and replaced
- (e) any replacement of consumable parts (including a battery, relay and fuse)
- (f) a failure caused by external factors such as inevitable accidents, including without limitation fire and abnormal fluctuation of voltage, and acts of God, including without limitation earthquake, lightning, and natural disasters
- (g) a failure which is unforeseeable under technologies available at the time of shipment of this product from our company
- (h) any other failures which we are not responsible for or which the customer acknowledges we are not responsible for

## 2. Service in Overseas Countries

If the customer installs the product purchased from us in his/her machine or equipment, and export it to any country other than where he/she bought it, the customer may sign a paid warranty contract with our local FA center.

This falls under the case where the product purchased from us in or outside Japan is exported and installed in any country other than where it was purchased.

For details please contact the distributor from which the customer purchased the product.

## 3. Exclusion of Loss in Opportunity and Secondary Loss from Warranty Liability

Regardless of the gratis warranty term, Mitsubishi shall not be liable for compensation to:

(1) Damages caused by any cause found not to be the responsibility of Mitsubishi.

(2) Loss in opportunity, lost profits incurred to the user by Failures of Mitsubishi products.

(3) Special damages and secondary damages whether foreseeable or not, compensation for accidents, and compensation for damages to products other than Mitsubishi products.

(4) Replacement by the user, maintenance of on-site equipment, start-up test run and other tasks.

## 4. Changes in Product Specifications

Specifications shown in our catalogs, manuals or technical documents are subject to change without notice.

## 5. Product Application

(1) For the use of this product, its applications should be those that may not result in a serious damage even if any failure or malfunction occurs in the product, and a backup or fail-safe function should operate on an external system to the product when any failure or malfunction occurs.

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

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○: Standard　△: Option　□: Selection

○: Standard △: Option □: Selection

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○: Standard △: Option □: Selection

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(*3)Only the macro alarm message can be displayed.

(*4)24 points for each part system and 32 points for the whole PLC axes.

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| MDS-EM-SPVx | □ | □ | □ | □ | - |
| MDS-EMH-SPVx | □ | □ | □ | □ | - |
| Spindle | | | | | - |
| MDS-E-SPx | □ | □ | □ | □ | - |
| MDS-EH-SPx | □ | □ | □ | □ | - |
| MDS-EJ-SPx | □ | □ | □ | □ | - |
| MDS-EM-SPVx | □ | □ | □ | □ | - |
| MDS-EMH-SPVx | □ | □ | □ | □ | - |
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(*3) Only the macro alarm message can be displayed.
(*4) 24 points for each part system and 32 points for the whole PLC axes.
(*5) Restrained to 4-axis simultaneous contouring

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# M800/M80/C80 Series
# Functional Specifications

# 1

# Control Axes

## 1.1 Control Axes

The NC axis, spindle, PLC axis and auxiliary axis are generically called the control axis.
The NC axis is an axis that can be manually operated, or automatically operated with the machining program. X, Y, Z, U, V, W, A, B and C axis can be used.
The PLC axis is an axis that can be controlled from the PLC ladder.

### 1.1.1 Number of Basic Control Axes (NC Axes)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ 3 | ○ 3 | ○ 3 | ○ 3 | ○ 3 | ○ 3 | ○ 3 | ○ 3 |
| L | ○ 2 | ○ 2 | ○ 2 | ○ 2 | ○ 2 | ○ 2 | ○ 2 | ○ 2 |

### 1.1.2 Max. Number of Axes (NC Axes + Spindles + PLC Axes)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ 16<br>△ 32 | ○ 16<br>△ 32 | ○ 16<br>△ 32 | ○ 16<br>△ 32 | 11 | 11 | 9 | 16 |
| L | ○ 16<br>△ 32 | ○ 16<br>△ 32 | ○ 16<br>△ 32 | ○ 16<br>△ 32 | 12 | 12 | 9 | 16 |

A number of axes that are within the maximum number of axes, and that does not exceed the maximum number given for the NC axis, spindle and PLC axis can be used.

Connection specifications of NC axis, PLC axis and spindle:
NC axes, PLC axes and spindles (except for analog spindles) are connected to the high-speed optical servo communication (OPTH).
Refer to the Connection and Setup Manual for details.

#### 1.1.2.1 Max. Number of NC Axes (In Total for All the Part Systems)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ 16 | ○ 16 | ○ 16 | ○ 16 | 8 | 8 | 5 | 16 |
| L | ○ 16<br>△ 32 | ○ 16<br>△ 32 | ○ 16<br>△ 32 | ○ 16<br>△ 32 | 10 | 10 | 7 | 16 |

#### 1.1.2.2 Max. Number of Spindles

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | 4 | 4 | 4 | 4 | 2 | 2 | 2 | 7 |
| L | 8 | 8 | 8 | 8 | 4+G/B | 4+G/B | 3 | 4 |

(*1) G/B : Guide Bush

Includes analog spindles.

#### 1.1.2.3 Max. Number of PLC Axes

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | 8 | 8 | 8 | 8 | 6 | 6 | 6 | 8 |
| L | 8 | 8 | 8 | 8 | 6 | 6 | 6 | 8 |

### 1.1.4 Max. Number of PLC Indexing Axes

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | 8 | 8 | 8 | 8 | 4 | 4 | 4 | 8 |
| L | 8 | 8 | 8 | 8 | 4 | 4 | 4 | 8 |

PLC axis indexing function: This function is used to move the PLC axis to the positioning destination or an arbitrary coordinate position.

### 1.1.5 Number of Simultaneous Contouring Control Axes

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | 8 | 4 | 8 | 4 | 4 | 4 | 4 | 4 |
| L | 8 | 4 | 8 | 4 | 4 | 4 | 4 | 4 |

Simultaneous control of all axes is possible as a principle in the same part system.
However, for actual use, the machine tool builder specification will apply.

### 1.1.6 Max. Number of NC Axes in a Part System

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ 8<br>△ 12 | ○ 8<br>△ 12 | ○ 8<br>△ 12 | ○ 8<br>△ 12 | 8 | 8 | 5 | 8 |
| L | ○ 8<br>△ 12 | ○ 8<br>△ 12 | ○ 8<br>△ 12 | ○ 8<br>△ 12 | 8 | 8 | 5 | 8 |

Listed are the maximum number of axes which can be controlled in a part system. Follow the specifications by each machine tool builder for actual use.

### 1.1.7 Axis Name Extension

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | – |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | – |

The axis name (command axis name) to perform the absolute/incremental value command to NC control axis can be expanded to two letters. Because the command axis name while this function is invalid is set with one letter from A, B, C, U, V, W, X, Y or Z, when the increment command axis name is used (two letters of the alphabet are used per one axis), the number of axes is limited. The incremental axis name can be used to all axes by this function. The name extension axis cannot be designated to the parameter which sets the command axis name such as axes configuring plane I, J or K. Thus, apply this function to miscellaneous axis which is not used for machining (cutting).

## 1.2 Control Part System

### 1.2.1 Standard Number of Part Systems

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| L | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

### 1.2.2 Max. Number of Part Systems (Main + Sub)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ 2 | ○ 2 | ○ 2 | ○ 2 | ○ 2 | ○ 2 | ○ 1 | △ 7 |
| L | ○ 4<br>△ 8 | ○ 4<br>△ 8 | ○ 4<br>△ 8 | ○ 4<br>△ 8 | ○ 4 | ○ 4 | ○ 2 | △ 3 |

For actual use, the machine tool builder specification will apply.

#### 1.2.2.1 Max. Number of Main Part Systems

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ 2 | ○ 2 | ○ 2 | ○ 2 | ○ 2 | ○ 2 | ○ 1 | △ 7 |
| L | ○ 4<br>△ 8 | ○ 4<br>△ 8 | ○ 4<br>△ 8 | ○ 4<br>△ 8 | ○ 2 | ○ 2 | ○ 2 | △ 3 |

#### 1.2.2.2 Max. Number of Sub Part Systems

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ 2 | ○ 2 | ○ 2 | ○ 2 | — | — | — | — |
| L | ○ 4<br>△ 8 | ○ 4<br>△ 8 | ○ 4<br>△ 8 | ○ 4<br>△ 8 | ○ 2 | ○ 2 | ○ 1 | △ 2 |

## 1.3 Control Axes and Operation Modes

### 1.3.1 Tape (RS-232C Input) Mode

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | － |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | － |

In this mode, operation is performed using the machining program data from the RS-232C interface built in the CNC unit. A paper tape reader must be provided if machining programs on paper tape are to be run.

### 1.3.2 Memory Mode

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The machining programs stored in the memory of the CNC unit are run.

### 1.3.3 MDI Mode

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The MDI data stored in the memory of the CNC unit is executed. Once executed, the MDI data is set to the "setting incomplete" status, and the data will not be executed unless the "setting completed" status is established by screen operations.

### 1.3.4 High-Speed Program Server Mode

#### 1.3.4.1 Control Unit-side High-speed Program Server Mode

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | — | — | ○ | — | — | — |
| L | △ | △ | — | — | ○ | — | — | — |

The machining program stored in SD card can be operated by installing a SD card in the control unit SD card interface.
From this, mass capacity and multi-process machining can be done.
Machining programs can be copied to SD card with the front SD card or Ethernet on the input/output screen.

When a machining program stored in SD card is searched while "DS" (Data server) is selected for device during operation search, the machining program in SD card can be operated as a main program. (The operation mode is "memory mode".)
Also, when "M198 Pp;" is commanded in the main program, the machining program in SD card can be called and operated as a sub program.

Macros such as WHILE, IF and GOTO can be used. Also, calling the sub program and macro program stored in memory or SD card is possible.

#### 1.3.4.2 Display Unit-side High-speed Program Server Mode

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ /— | △ /— | △ | △ | ○ /— | ○ | ○ | — |
| L | △ /— | △ /— | △ | △ | ○ /— | ○ | ○ | — |

* Specifications of separated-type display are classified with "Windows-based" and "Windows-less"

The machining program stored in the built-in disk of the display unit can be operated.
The built-in disk of the display unit is mounted in the personal computer for M800W/M80W.
For M800S/M80, the SD card inserted into SD card I/F on the back of the display unit is equivalent to the built-in disk of the display unit.

When a machining program stored in the built-in disk of the display unit is searched while "HD" (M800W/M80W) or "DS" (M800S/M80) is selected for device during operation search, the machining program in the built-in disk of the display unit can be operated as a main program. (The operation mode is "memory mode".)
Also, when "M98 Pp ,Dd;" ("d" for designating a unit) is commanded in the main program, the machining program in the built-in disk of the display unit can be called and operated as a sub program.

Macros such as WHILE, IF and GOTO can be used. Also, calling the sub program and macro program stored in memory or the built-in disk of the display unit is possible.

### 1.3.5 Front-side SD card mode

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | － |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | － |

The machining program stored in a SD card can be operated. This SD card is installed to the front-side SD card I/F.

When a machining program stored in SD card is searched while "Memory Card" is selected for device during operation search, the machining program in SD card can be operated as a main program. (The operation mode is "memory mode".)
Also, when "M98 Pp, Dd;" ("d" for designating a unit) is commanded in the main program, the machining program in SD card can be called and operated as a sub program.

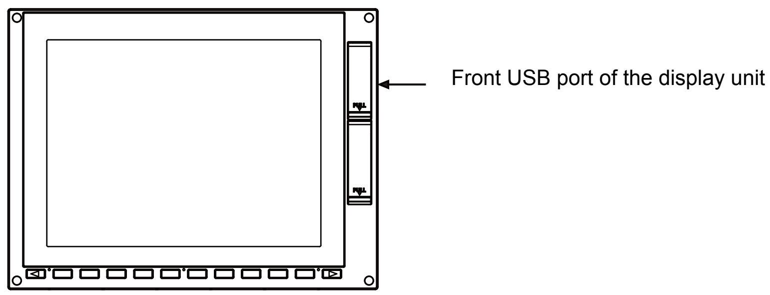
Macros such as WHILE, IF and GOTO can be used. Also, calling the sub program and macro program stored in memory or SD card is possible.

### 1.3.6 Front-side USB Memory Mode

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | － |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | － |

The control is able to run a machining program stored in a USB memory when it is inserted into the front USB port of the display unit.
USB memory may be pulled off due to the machine vibration depending on the environment. Use this function at your own risk.
USB memory mode enables you to handle the same programs as for memory mode. In addition you can handle the greater number of large-capacity programs.
When a machining program stored in the USB memory is searched while USB is selected for device during operation search, the machining program in the USB memory can be operated as a main program. (The operation mode is "memory mode".)
Also, when "M98 Pp ,Dd;" ("d" for designating a unit) is commanded in the main program, the machining program in the USB memory can be called and operated as a sub program.

Display unit



# 2

# Input Command

## 2.1 Data Increment

### 2.1.1 Least Command Increment

[M system]

| Least command increment (input setting increment) | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| 1µm (1µm) | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| 0.1µm (0.1µm) | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| 0.01µm (10nm) | △ | △ | △ | △ | — | — | — | — |
| 0.001µm (1nm) | △ | △ | △ | △ | — | — | — | — |

[L system]

| Least command increment (input setting increment) | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| 1µm (1µm) | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| 0.1µm (0.1µm) | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| 0.01µm (10nm) | △ | △ | △ | △ | — | — | — | — |
| 0.001µm (1nm) | △ | △ | △ | △ | — | — | — | — |

The data increment handled in the controller includes the input setting increment, PLC increment and machine error compensation increment. Each type is set with parameters.

(1) Input setting increment

The input setting increment applies to the data entered from or displayed in the Monitor or other screens, the travel distance per pulse of manual pulse generator, machining programs, and maintenance data. (Excluding PLC increment and machine error compensation increment mentioned below.) This increment is applied per part system (1st to the maximum part system within the specification, PLC axis).

| Input setting increment (parameter) | Metric unit system | | Inch unit system | |
|---|---|---|---|---|
| | Linear axis (Unit = mm) | Rotary axis (Unit = °) | Linear axis (Unit = inch) | Rotary axis (Unit = °) |
| 1µm (B) | 0.001 | 0.001 | 0.0001 | 0.001 |
| 0.1µm (C) | 0.0001 | 0.0001 | 0.00001 | 0.0001 |
| 10nm (D) | 0.00001 | 0.00001 | 0.000001 | 0.00001 |
| 1nm (E) | 0.000001 | 0.000001 | 0.0000001 | 0.000001 |

(Note) The inch and metric systems cannot be used together.

(2) PLC increment

PLC increment is used for setting and display of PLC interface. Input-output to ladder is handled with this increment. (excluding machine error compensation increment) This increment is applied per part system.

(Example)

When writing to 90 degree for A axis and 180 degree for C axis on the A-C axis configuration with using a rotary axis angle designation (*).

- When PLC increment is 1 μm(B).

| | Angle | | 1/1000° | | System unit | |
|---|---|---|---|---|---|---|
| <A axis> | 90 | × | 1000 | = | 90000 | ┤├─[ DMOV K90000 R2628]─ |
| <C axis> | 180 | × | 1000 | = | 180000 | ┤├─[ DMOV K180000 R2630]─ |

- When PLC increment is 1nm(E).

| | Angle | | 1/1000000° | | System unit | |
|---|---|---|---|---|---|---|
| <A axis> | 90 | × | 1000000 | = | 90000000 | ┤├─[ DMOV K90000000 R2628]─ |
| <C axis> | 180 | × | 1000000 | = | 180000000 | ┤├─[ DMOV K180000000 R2630]─ |

(*) Rotary axis angle designation

R2628-2629: part system1, 1st rotary axis of the mechanical axis angle 0 to ±720000(1°/1000) (When PLC increment is 1 μm(B))

R2630-2631: part system1, 2nd rotary axis of the mechanical axis angle 0 to ±720000(1°/1000) (When PLC increment is 1 μm(B))

(3) Machine error compensation increment

Machine error compensation increment is used for setting and display of machine error compensation amount. This increment is applied per part system.

This increment is applied for following parameters and PLC interface.

(a) Backlash compensation (parameter)

This function compensates for the error (backlash) produced when the direction is reversed.

(b) Pitch error compensation (parameter)

This function compensates for the errors in pitch intervals of ball screws.

(c) Machine rotation center error compensation (parameter)

This function compensates for the errors difference between the center of the actual rotary axis and the center of programmed rotary axis.

(d) External machine coordinate system compensation (PLC interface)

This function shifts the coordinate system by PLC.

(e) Ball screw thermal displacement compensation (PLC interface)

This function compensates for axis feed error caused by the ball screw thermal expansion, etc.

## 2.1.2 Least Control Increment

[M system]

| Least control increment | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| 0.01μm (10nm) | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| 0.001μm (1nm) | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

[L system]

| Least control increment | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| 0.01μm (10nm) | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| 0.001μm (1nm) | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The least control increment determines the CNC's internal operation accuracy.

## 2.1.3 Indexing Increment

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

This function limits the command value for the rotary axis.
This can be used for indexing the rotary table, etc. It is possible to cause a program error with a program command other than an indexing increment (parameter setting value).

(Example)When the indexing increment setting value is 2 degrees, only command with the 2-degree increment are possible.

G90 G01 C102.000 ; …Moves to the 102 degree angle.
G90 G01 C101.000 ; … Program error
G90 G01 C102 ; … Moves to the 102 degree angle. (Decimal point type II)

## 2.2 Unit System

### 2.2.1 Inch/Metric Changeover

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The unit systems of the data handled in the controller include the metric unit system and inch unit system. The unit (inch/mm) for the setting and display, as well as for the handle/incremental feed can be switched with either the parameters or machining program (G20/G21 command).
An additional specification is required when the unit is switched with the machining program command.

| Unit system | Length data | Meaning |
|---|---|---|
| Metric unit system | 1.0 | 1.0mm |
| Inch unit system | 1.0 | 1.0inch |

(Note) For the angle data, 1.0 means 1 degree (°) regardless of the unit system.

<table>
<tr><th rowspan="2" colspan="2">Parameter</th><th colspan="4">Data</th></tr>
<tr><th colspan="2">Machining program</th><th>Screen data (Compensation amount, user parameter, counter, etc.) / Feedrate of handle, etc.</th><th>Machine parameter / PLC interface machine position, etc.</th></tr>
<tr><td rowspan="4">A</td><td rowspan="2">0</td><td>G20</td><td>Inch unit system</td><td rowspan="2">Metric unit system</td><td rowspan="4">Not affected</td></tr>
<tr><td>G21</td><td>Metric unit system</td></tr>
<tr><td rowspan="2">1</td><td>G20</td><td>Inch unit system</td><td rowspan="2">Inch unit system</td></tr>
<tr><td>G21</td><td>Metric unit system</td></tr>
<tr><td rowspan="2">B</td><td>0</td><td colspan="2" rowspan="2">Not affected</td><td rowspan="2">Not affected</td><td>Metric unit system</td></tr>
<tr><td>1</td><td>Inch unit system</td></tr>
</table>

(Note 1) The parameter changeover is valid after the power is turned ON again.
(Note 2) The unit system for the PLC axis can be switched with a parameter different from the one used with the NC axis.
The PLC axis unit system cannot be switched with the machining program (G20/G21 command).
(Note 3) When the power is turned ON or resetting is performed, the command increment depends on the parameter setting.

### 2.2.2 Input Command Increment Tenfold

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | — | — | — | — | — | — | — | ○ |

The program's command increment can be multiplied by an arbitrary scale with the parameter designation.
This function is valid when a decimal point is not used for the command increment.

For example, this function allows a CNC unit, for which the command increment is set to 1 $\mu$ m, to run a machining program, which has been created with a 10 $\mu$ m input command increment, as same as before.
The scale is set with the parameters.

(Note 1) This function cannot be used for the dwell function G04_X_(P_);.
(Note 2) This function cannot be used for the compensation amount of the tool offset input.
(Note 3) This function can be used when decimal point type I is valid, but cannot be used when decimal point type II is valid.
(Note 4) This function cannot be used for a tool shape setting command (in G10L100 format).

## 2.3 Program Format

### 2.3.1 Program Format

This is G code (program) format.
The G-code of lathe system is selected by parameter.
This manual explains the G function with G-code list 3 as standard.

#### 2.3.1.1 Format 1 for Lathe (G Code List 2, 3)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ― | ― | ― | ― | ― | ― | ― | ― |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

#### 2.3.1.2 Format 2 for Lathe (G Code List 4, 5)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ― | ― | ― | ― | ― | ― | ― | ― |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

#### 2.3.1.3 Special Format for Lathe (G Code List 6, 7)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ― | ― | ― | ― | ― | ― | ― | ― |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

#### 2.3.1.4 Format 1 for Machining Center

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ― | ― | ― | ― | ― | ― | ― | ― |

#### 2.3.1.5 Format 2 for Machining Center (M2 Format)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ― | ― | ― | ― | ― | ― | ― | ― |

#### 2.3.1.6 MITSUBISHI CNC Special Format

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ― | ― | ― | ― | ― | ― | ― | ― |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The formats of the turning fixed cycles (G77 to G79), compound type fixed cycle for turning machining (G71 to G76) and drilling fixed cycles (G80 to G89) can be switched to the MITSUBISHI CNC special formats.

(Note) There is a specification (zigzag thread cutting ) for specific machine tool builder.

### 2.3.2 Program Format Switch

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | － | － | － | － | － | － | － | － |
| L | △ | △ | △ | △ | － | － | － | － |

Program format switch is a function designed to switch the program format (G code system) using G codes or PLC signal. While the switch is active, the control runs a program based on the switched G code system. When you run a lathe-based multi-tasking machine, and if you change to the G code system of Machining center system, you can use a free-curved surface machining program made with CAM without modifying the program.

[Switchover using G codes (G code method)]

Command format

Program format switch ON
When G188 is given, the control switches the L-system program format to M-system (G code system 1 (Command type II)). The control runs the next and subsequent program blocks based on the M-system G code system.

**G188 ; Change to M-system G code system (G code system 1 (Command type II))**

Program format switch OFF
When G189 is given, the control switches the M-system program format back to L-system (a system selected by command type parameter). The control runs the next and subsequent program blocks based on the L-system G code system.

**G189 ; Change back to L-system G code system (G code system determined by command type parameter)**

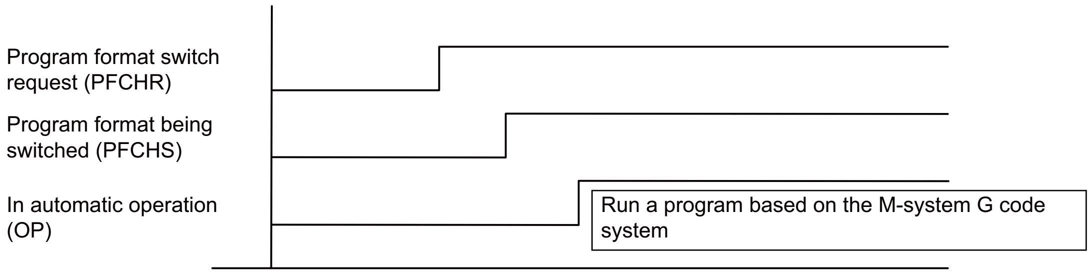
Program example
[For G code system 2]

| | |
|---|---|
| O1<br>: | L-system<br>(G code system 2 (Command type III) |
| G188; | Enable "Program format switch" |
| G90 G00 X20. Z200.;<br>G91 G01 X30. Z180. F100;<br>: | M-system<br>(G code system 1 (Command type II)) |
| G189; | Disable "Program format switch" |
| : | L-system<br>(G code system 2 (Command type III) |

[Switchover using PLC signal (PLC I/F method)]

| |
|---|
| **PFCHR ON;  Change to M-system G code system (G code system 1 (Command type II))**<br>**PFCHR OFF;  Change back to L-system G code system (G code system determined by command type parameter)** |

(Note) A switchover using the PLC I/F method is unavailable during automatic operation.




G code method and PLC I/F method are distinguished in the following points:

| | |
|---|---|
| G code method | This switches by G188/G189 commands in cycle operation.<br>(e.g. to switch the format dynamically for some machining processes) |
| PLC I/F method | This switches by PLC signal not in cycle operation.<br>(e.g. to enable the switched state at the time of power up) |

## 2.4 Command Value

### 2.4.1 Decimal Point Input I, II

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

There are two types of the decimal point input commands and they can be selected by parameter.

**(1) Decimal point input type I**

When axis coordinates and other data are issued in machining program commands, the assignment of the program data can be simplified by using a decimal point. The minimum digit of a command not using a decimal point is the same as the least command increment.

The decimal point can be applied not only to axis coordinate position but also to speed commands and dwell commands.

The decimal point position serves as the millimeter unit in the metric mode, as the inch unit in the inch mode and as the second unit in a time designation of dwell command.

**(2) Decimal point input type II**

As opposed to type I, the minimum digit of a command without a decimal point serves as the millimeter unit in the metric mode, as the inch unit in the inch mode and as the second unit in the time designation.

The "." (point) must be added when commands below the decimal point are required.

| | Unit interpretation (for metric system) | |
|---|---|---|
| | Type I | Type II |
| G00 X100. Y-200.5 | X100mm, Y-200.5mm | <- |
| G1  X100  F20. | X100µm, F20mm/min | X100mm, F20mm/min |
| G1  Y200  F100 (*1) | Y200µm, F100mm/min | Y200mm, F100mm/min |
| G4  X1.5 | Dwell 1.5s | <- |
| G4  X2 | Dwell 2ms | Dwell 2s |

(*1) The F unit is mm/min for either type (inch system : inch/min).

### 2.4.2 Absolute/Incremental Command

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

**(1) M system**

When axis coordinate data is issued in a machining program command, either the incremental command method (G91) that commands a relative distance from the current position or the absolute command method (G90) that moves to a designated position in a predetermined coordinate system can be selected.
The absolute and incremental commands can be both used in one block, and are switched with G90 or G91.
However, the arc radius designation (R) and arc center designation (I, J, K) always use incremental designations.
The absolute and incremental commands are switched with G190 and G191 depending on G code list.
G90, G190 ... Absolute command (absolute command)
G91, G191 ... Incremental command (incremental command)
These G codes can be commanded multiple times in one block.

**(2) L system**

When axis coordinate data is issued in a machining program command, either the incremental command method that commands a relative distance from the current position or the absolute command method that moves to a designated position in a predetermined coordinate system can be selected.
When issuing an incremental command, register the axis address to be commanded as the incremental axis name in the parameter. However, the arc radius designation (R) and arc center designation (I, J, K) always use incremental designations.
Absolute command (absolute command) ... X, Z
Incremental command (incremental command) ... U, W

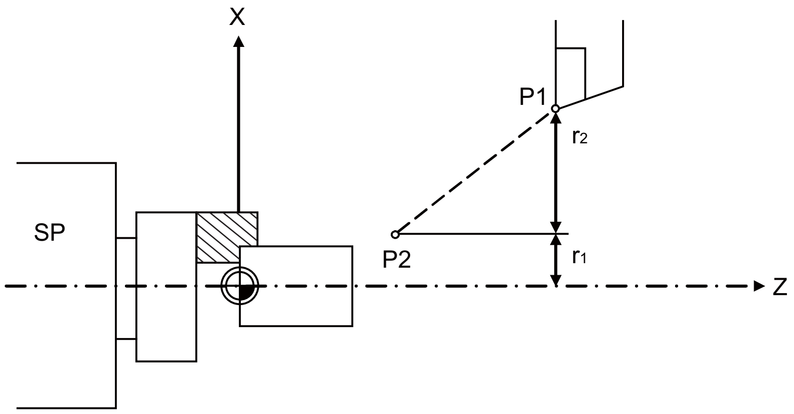
(Note) Absolute command and incremental command can be switched by the parameter. In addition to the command method using the axis addresses as indicated above, a command method using G code (G90/G91 or G190/G191) may be selected.

### 2.4.3 Diameter/Radius Designation

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | － | － | － | － | － | － | － | － |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

For axis command value, the radius designation or diameter designation can be changed over with parameters.
When the diameter designation is selected, the scale of the length of the selected axis is doubled.
(Only the half (1/2) of the commanded amount moves.)
This function is used when programming the workpiece dimensions on a lathe as diameters.
Changing over from the diameter designation to the radius designation or vice versa can be set separately for each axis.

When the tool is to be moved from point P1 to point P2




SP Spindle

**Radius and diameter commands**

| X command | | U command | | Remarks |
|---|---|---|---|---|
| Radius | Diameter | Radius | Diameter | Even when a diameter command has been selected, only the U command can be made a radius command by parameter. |
| $X = r_1$ | $X = 2r_1$ | $U = r_2$ | $U = 2r_2$ | |

# 3

# Positioning/Interpolation

## 3.1 Positioning

### 3.1.1 Positioning

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

This function carries out high-speed positioning following the movement command given in a program.

| **G00 Xx1 Yy1 Zz1 ;(Also possible for additional axes A, B, C, U, V, W simultaneously)** | |
|---|---|
| Xx1, Yy1, Zz1 | :Position data |

The above command positions the tool with rapid traverse rate. The tool path takes the shortest distance to the end point in the form of a straight line.
For details on the rapid traverse feed rate of the NC, refer to the section entitled "Rapid Traverse Rate".
Since the actual rapid traverse feed rate depends on the machine, refer to the specifications of the machine concerned.

(1) The rapid traverse feed rate can be set for each axis with parameters.
(2) The number of axes which can be commanded simultaneously depends on the specifications (number of simultaneously controlled axes). The axes can be used in any combination within this range.
(3) The feed rate is controlled within the range that it does not exceed the rapid traverse rate of each axis and so that the shortest time is taken. (Linear type)
Parameter setting enables movement at the rapid traverse rates of the respective axes independently for each axis. In this case, the tool path does not take the form of a straight line to the end point. (Non-Linear type)
(4) The tool is always accelerated at the start of the program command block and decelerated at the end of the block.

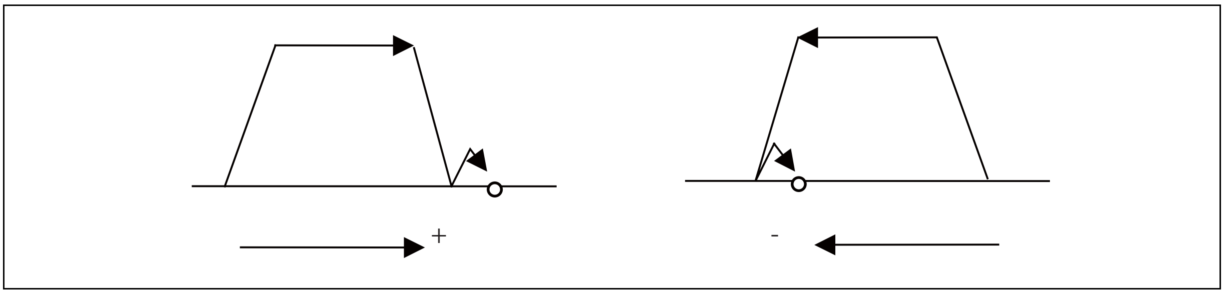
### 3.1.2 Unidirectional Positioning

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | — | — | — | — | — | — | — | — |

The G60 command always moves the tool to the final position in a direction determined with parameters.
The tool can be positioned without backlash.
The parameter setting enables G60 to switch between G code group 0 (unmodal) and G code group 01 (modal).

| | |
|---|---|
| **G60 X__ Y__ Z__ ;(Also possible for additional axes A/B/C/U/V/W simultaneously)** | |
| X/Y/Z | :Position data |

With the above command, the tool is first moved to a position distanced from the end point by an amount equivalent to the creep distance (parameter setting) with rapid traverse and then moved to its final position.
For details on the rapid traverse feed rate of the NC, refer to the section entitled "Rapid Traverse Rate".
Since the actual rapid traverse feed rate depends on the machine, refer to the specifications of the machine concerned.
Positioning to the final point is shown below (when this positioning is in the "+" direction.)




(Note 1) The processing of the above pattern will be followed even for the machine lock and Z-axis command cancel.
(Note 2) On the creep distance, the tool is moved with rapid traverse.
(Note 3) G60 is valid even for positioning in drilling in the fixed cycle.
(Note 4) When the mirror image function is on, the tool will be moved in the reverse direction by mirror image as far as the interim position, but operation over the creep distance with the final advance will not be affected by the mirror image.

## 3.2 Linear/Circular Interpolation

### 3.2.1 Linear Interpolation

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Linear interpolation is a function that moves a tool linearly by the movement command value supplied in the program at the cutting feed rate designated by the F code.

| **G01 Xx1 Yy1 Zz1 Ff1 ; (Also possible for additional axes A, B, C, U, V, W simultaneously)** | |
|---|---|
| Xx1,Yy1,z1 | :Position data |
| Ff1 | :Feed rate data |

Linear interpolation is executed by the above command at the f1 feed rate. The tool path takes the shortest distance to the end point in the form of a straight line.
For details on the f1 command values for NC, refer to the section entitled "Cutting Feedrate".
Since the actual cutting feed rate depends on the machine, refer to the specifications of the machine concerned.

(1) The number of axes which can be commanded simultaneously depends on the specifications (number of simultaneously controlled axes). The axes can be used in any combination within this range.
(2) The feed rate is controlled so that it does not exceed the cutting feed rate clamp of each axis.
(3) When a rotary axis has been commanded in the same block, it is treated as a linear axis in degree(°) units (1° = 1mm), and linear interpolation is performed.

### 3.2.2 Circular Interpolation (Center/Radius Designation)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

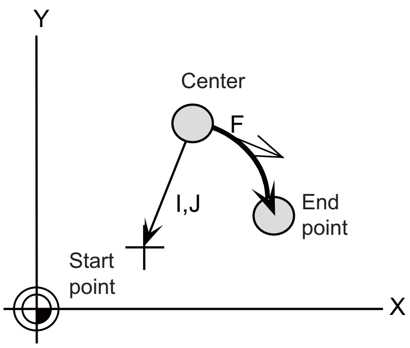
**(1) Circular interpolation with I, J, K commands**

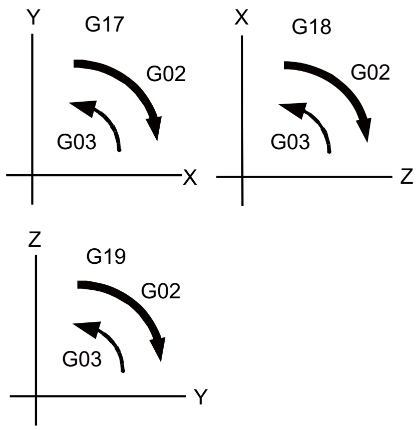
This function moves a tool along a circular arc on the plane selected by the plane selection G code with movement command supplied in the program.

| **G02(G03) Xx1 Yy1 Ii1 Jj1 Ff1 ; (Also possible for additional axes A, B, C, U, V, W)** | |
|---|---|
| G02,G03 | : Arc rotation direction |
| Xx1,Yy1 | : End point coordinate |
| Ii1,Jj1 | : Arc center |
| Ff1 | : Feed rate |

The above commands move the tool along the circular arc at the f1 feed rate. The tool moves along a circular path, whose center is the position from the start point designated by distance "i1" in the X-axis direction and distance "j1" in the Y-axis direction, toward the end point.

The direction of the arc rotation is specified by G02 or G03.
G02: Clockwise (CW)
G03: Counterclockwise (CCW)
The plane is selected by G17, G18 or G19.
G17: XY plane
G18: ZX plane
G19: YZ plane
(Example) See below for examples of circular commands.




(a) The axes that can be commanded simultaneously are the two axes for the selected plane.
(b) The feed rate is controlled so that the tool always moves at a speed along the circumference of the circle.
(c) Circular interpolation can be commanded within a range extending from 0° to 360° .
(d) The max. value of the radius can be set up to six digits above the decimal point.

(Note 1) The arc plane is always based on the G17, G18 or G19 command. If a command is issued with two addresses which do not match the plane, an alarm will occur.

(Note 2) The axes configuring a plane can be designated by parameters. Refer to the section entitled "Plane Selection".

**(2) R-specified circular interpolation**

Besides the designation of the arc center coordinates using the above-mentioned I, J and K commands, arc commands can also be issued by designating the arc radius directly.

| **G02(G03) Xx1 Yy1 Rr1 Ff1 ; (Also possible for additional axes A, B, C, U, V, W )** | |
|---|---|
| G02,G03 | : Arc rotation direction |
| Xx1,Yy1 | : End point coordinate |
| Rr1 | : Arc radius |
| Ff1 | : Feed rate |

G02 or G03 is used to designate the direction of the arc rotation.
The arc plane is designated by G17, G18 or G19.

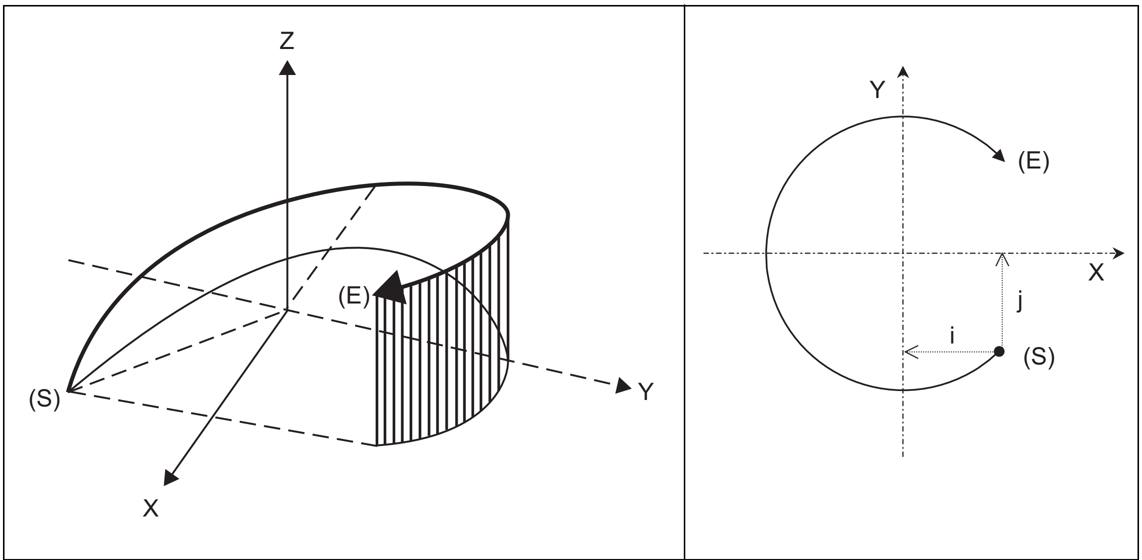
The arc center is on the bisector which orthogonally intersects the segment connecting the start and end points, and the point of intersection with the circle, whose radius has been designated with the start point serving as the center, is the center coordinate of the arc command.
When the sign of the value of R in the command program is positive, the command will be for an arc of 180 or less; when it is negative, it will be for an arc exceeding 180 .

(Note 1) The arc plane is always based on the G17, G18 or G19 command. If a command is issued with two addresses which do not match the plane, an alarm will occur.

### 3.2.3 Helical Interpolation

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

With this function, any two of three axes intersecting orthogonally are made to perform circular interpolation while the third axis performs linear interpolation in synchronization with the arc rotation. This simultaneous 3-axis control can move helically to machine and be exercised to machine large-diameter screws or 3-dimensional cams.




| 3 dimension path | ZX plane path (projection path) |
|---|---|

(S) start point (E) end point

The commanded program path

XY plane projection path of the commanded program

Command format

[M system]

| | |
|---|---|
| **G17 G02/G03 X__ Y__ Z__ I__ J__ P__ F__ ;** | **Helical interpolation command (Specify arc center)** |
| **G17 G02/G03 X__ Y__ Z__ R__ F__ ;** | **Helical interpolation command (Specify arc radius "R")** |
| G17/G18/G19 | : Arc plane (G17: XY plane, G18: ZX plane, G19: YZ plane) |
| G02/G03 | : Arc rotation direction (G02: clockwise, G3: anti-clockwise) |
| X,Y | : End point coordinate values for arc |
| Z | : End point coordinate values of linear axis |
| I,J | : Arc center coordinate values |
| R | : Arc radius |
| P | : Number of pitches |
| F | : Feed rate |

The arc center coordinate values and arc radius are commanded by the input increment. Pay attention to the case of the helical interpolation command of the axis which has a different input command increment.
To prevent confusion, command with a decimal point.
Absolute or incremental values can be assigned for the arc end point coordinates and the end point coordinates of the linear axis, but incremental values must be assigned for the arc center coordinates.
When executing the pitch command with ",P" address, "P33 format error" occurs.

[L system]

| | |
|---|---|
| **G17 G02/G03 X/U__ Y/V__ Z/W__ I__ J__ P/,P__ F__ ;** | |
| **G17 G02/G03 X/U__ Y/V__ Z/W__ R__ F__ ;** | |
| G17/G18/G19 | : Arc plane (G17: XY plane, G18: ZX plane, G19: YZ plane) |
| G02/G03 | : Arc rotation direction (G02: clockwise, G3: anti-clockwise) |
| X/U, Y/V | : End point coordinate values for arc |
| Z/W | : End point coordinate values of linear axis |
| I,J | : Arc center coordinate values |
| R | : Arc radius |
| P/,P | : Number of pitches |
| F | : Feed rate |

(Note 1) Indicates as I axis: X, J axis: Y, and K axis: Z.
(Note 2) When commanding "P" and ",P" for the number of pitches together, the command value ",P" is prioritized.

(1) The arc plane is designated by G17, G18 or G19.
(2) G02 or G03 is used to designate the direction of the arc rotation.
(3) Absolute or incremental values can be assigned for the arc end point coordinates and the end point coordinates of the linear axis, but incremental values must be assigned for the arc center coordinates.
(4) The linear interpolation axis is the other axis which is not included in the plane selection.
(5) Command the speed in the component direction that represents all the axes combined for the feed rate.
Pitch L is obtained by the formula below.

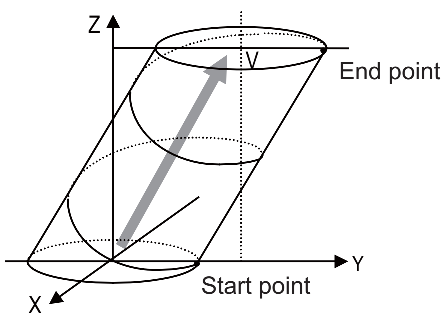
$$\mathbf{L} = \frac{Z}{(2\pi \cdot P + \theta)/2\pi}$$

$$\theta = \theta e - \theta s = \tan^{-1}\frac{ye}{xe} - \tan^{-1}\frac{ys}{xs} \quad (0 \leq \theta < 2\pi)$$

Where xs, ys are the start point coordinates $(0 \leqq \theta < 2\pi)$
xe, ye are the end point coordinates
The combination of the axes which can be commanded simultaneously depends on the specifications. The axes can be used in any combination under the specifications.
The feed rate is controlled so that the tool always moves at a speed along the circumference of the circle.

(Note 1) Helical shapes are machined by assigning linear commands for one axis which is not a circular interpolation axis using an orthogonal coordinate system. It is also possible to assign these commands to two or more axes which are not circular interpolation axes.

When a simultaneous 4-axis command is used with the V axis as the axis parallel to the Y axis, helical interpolation will be carried out for a cylinder which is inclined as illustrated below. In other words, linear interpolation of the Z and V axes is carried out in synchronization with the circular interpolation on the XY plane.



### 3.2.4 Spiral/Conical Interpolation

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | − | △ |
| L | − | − | − | − | − | − | − | − |

This function interpolates arcs where the start point and end point are not on the circumference of the same circle into spiral shapes.
There are two types of command formats which can be changed with the parameters.

**(1) For command format type 1**

**(a) Spiral interpolation**

**G17 G02.1(G03.1) Xx1 Yy1 Ii1 Jj1 Pp1 Ff1 ;**

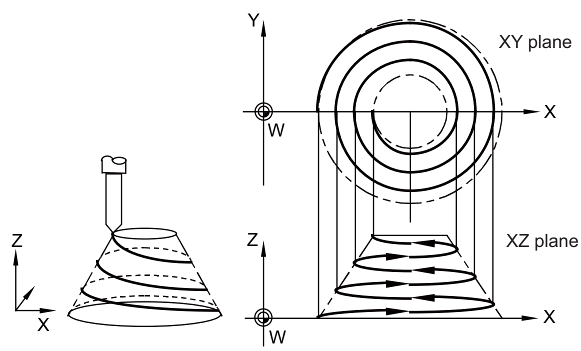
| | |
|---|---|
| G17 | : Arc plane |
| G02.1,G03.1 | : Arc rotation direction |
| Xx1,Yy1 | : End point coordinate |
| Ii1,Jj1 | : Arc center |
| Pp1 | : Number of pitches |
| Ff1 | : Feed rate |

The circular interpolation operation is performed at the feed rate f1 by the commands listed above. The tool draws a spiral arc path whose center is at the position from the start point which is designated by distance i1 for the X-axis direction and distance j1 for the Y-axis direction as the tool moves toward the end point.
The arc plane is designated by G17, G18 or G19.
G17……………XY plane
G18……………ZX plane
G19……………YZ plane
The direction of the arc rotation is designated by G02.1 or G03.1.
G02.1……………Clockwise (CW)
G03.1……………Counterclockwise (CCW)
The number of pitches (number of rotations) is designated by p1.
By assigning zero to p1, the pitch designation can be omitted in this case, the interpolation is obtained as a spiral rotation of less than one full turn. Assigning 1 to p1 yields a spiral rotation of more than one full turn but less than two full turns.

(Note 1) This function cannot be used in combination with a tool radius compensation command (G41, G42).
(Note 2) The arc plane is always based on the G17, G18 or G19 command. Arc control is performed on a plane by the G17, G18 or G19 command even when two addresses which are not on the selected plane are designated.

**(b) Conical interpolation**

When an axis other than the ones for the spiral interpolation plane has been designated at the same time, the other axis will also be interpolated in synchronization with the spiral interpolation.
G17 G91 G02.1 X100. Z150. I150. P3 F500;
In the example given above, truncated cone interpolation is performed.



(2) **For command format type 2**

(a) **Spiral interpolation**

| **G17 G02(G03) Xx1 Yy1 Ii1 Jj1 Qq1/Ll1 Ff1 ;** | |
|---|---|
| G17 | : Arc plane |
| G02,G03 | : Arc rotation direction |
| Xx1,Yy1 | : End point coordinate |
| Ii1,Jj1 | : Arc center |
| Qq1 | : Incremental/decremental amount of radius per spiral rotation |
| Ll1 | : Number of pitches |
| Ff1 | : Feed rate |

- Relation between Q and L

  L = │ (arc end point radius - arc start point radius) │ / │ Q │
- Q takes precedence if both Q and L have been designated at the same time.

(b) **Conical interpolation**

| **G17 G02(G03) Xx1 Yy1 Zz1 Ii1 Jj1 Kk1 /Qq /Ll1 Ff1 ;** | |
|---|---|
| G17 | : Arc plane |
| G02,G03 | : Arc rotation direction |
| Zz1 | : End point coordinate in height direction |
| Ii1,Jj1 | : Arc center |
| Kk1 | : Amount by which height is incremented or decremented per spiral rotation |
| Qq1 | : Amount by which radius is incremented or decremented per spiral rotation |
| Ll1 | : Number of pitches |
| Ff1 | : Feed rate |

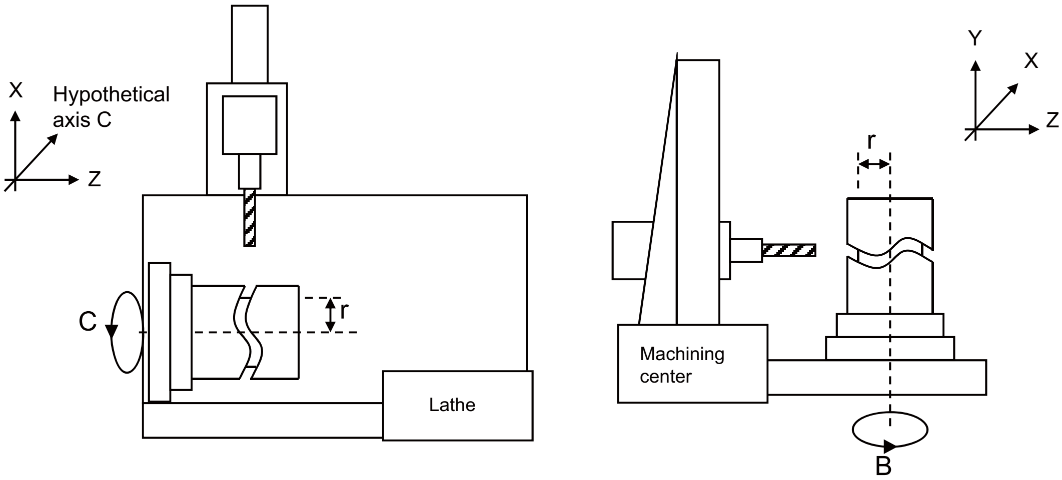
- Relation between L and (I, J) K

  L = │ Height │ / │ Amount by which height is incremented or decremented (I,J,K) │
- Q takes precedence over K which in turn takes precedence over L if Q, K and L have been designated at the same time.
- The tolerable error range (absolute position) for when the commanded end point position is deviated from the end point position obtained from the number of pitches and increment/decrement amount is set with the parameters.

### 3.2.5 Cylindrical Interpolation

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

This function transfers the shape that is on the cylinder's side surface (shape yielded by the cylindrical coordinate system) onto a plane, and when the transferred shape is designated in the program in the form of plane coordinates, the shape is converted into a movement along the linear and rotary axes of the original cylinder coordinates, and the contours are controlled by means of the CNC unit during machining.
Since the programming can be performed for the shapes produced by transferring the side surfaces of the cylinders, this function is useful when it comes to machining cylindrical cams and other such parts.
The command is programmed with the rotary axis and its orthogonal axis, which are different between the lathe and the machining center systems, to machine grooves and other shapes on the side of the cylinder.




Command format

Cylindrical interpolation mode start

| | |
|---|---|
| **G07.1 Name of rotary axis Cylinder radius;** | |
| **or G107 Name of rotary axis Cylinder radius;** | |
| Name of rotary axis | : Axis name set to the rotary axis |
| Cylinder radius | : Radius value ≠ 0: Cylindrical interpolation mode start<br>Command a value other than "0". |

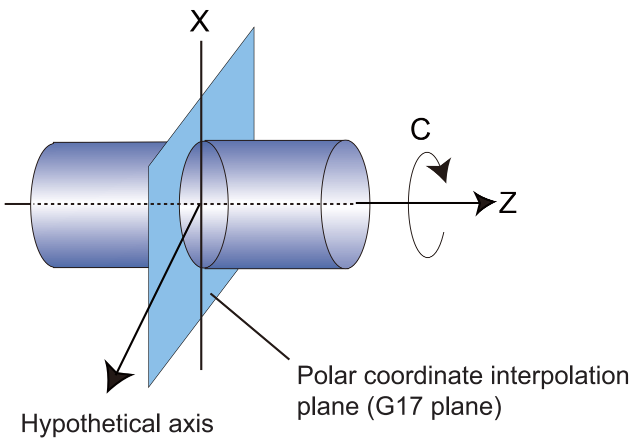
Cylindrical interpolation mode cancel

| |
|---|
| **G07.1 Name of rotary axis 0 ;** |
| **or G107 Name of rotary axis 0;** |

### 3.2.6 Polar Coordinate Interpolation

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | – | – | – | △ |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

This function converts the commands programmed by the orthogonal coordinate axes into linear axis movements (tool movements) and rotary axis movements (workpiece rotation) to control the contours. It is useful for cutting linear cutouts on the outside diameter of the workpiece, grinding cam shafts, etc.
This function can be used only with the G code list 6 or 7.




**(1) Polar coordinate interpolation mode**

(G12.1)
The polar coordinate interpolation mode is established by designating the G12.1 command.
Polar coordinate interpolation plane consists of a linear axis and a hypothetical axis, which are at right angles to each other.
Polar coordinate interpolation is performed on this plane.

(a) Linear interpolation and circular interpolation can be designated in the polar coordinate interpolation mode.
(b) Either absolute command or incremental command can be issued.
(c) Tool radius compensation can be applied to the program commands. Polar coordinate interpolation is performed for the path after tool radius compensation.
(d) For the feed rate, designate a tangential rate on the polar coordinate interpolation plane (orthogonal coordinate system) using the F command.
The F rate is in either mm/min or inch/mm units.

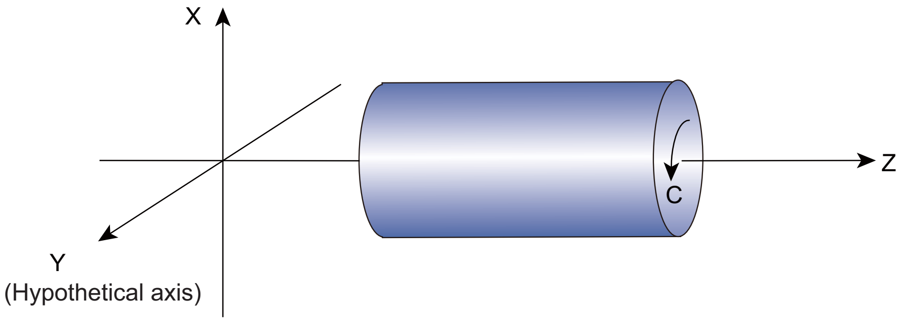
**(2) Polar coordinate interpolation cancel mode**

(G13.1)
The polar coordinate interpolation cancel mode is established by designating the G13.1 command.

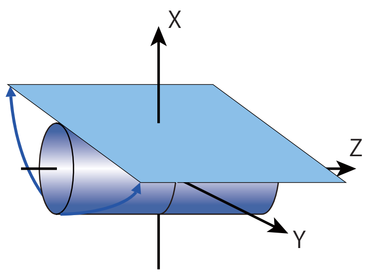
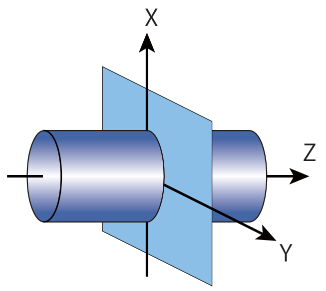
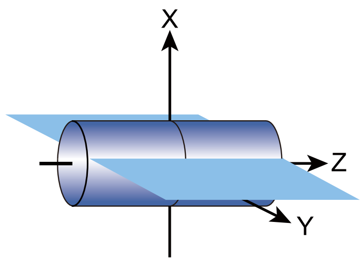
### 3.2.7 Milling Interpolation

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | – | – | – | – | – | – | – | – |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

When a lathe with linear axes (X, Z axes) and rotary axis (C axis) serving as the control axes is to perform milling at a workpiece end face or in the longitudinal direction of the workpiece, this function uses the hypothetical axis Y which is at right angles to both the X and Z axes to enables the milling shape to be programmed as the X, Y and Z orthogonal coordinate system commands.
With this function, the workpiece can be treated as a cylinder with radius X, and commands can be designated on the plane formed by transferring the cylinder side surface instead.
With milling interpolation, the commands programmed by the orthogonal coordinate system are converted into linear axis and rotary axis movements (workpiece rotation) to control the contours.




| | |
|---|---|
| **G12.1 ;** | **Milling mode ON** |
| **G13.1 ;** | **Milling mode OFF (Turning mode)** |

| G16(Y-Z cylindrical plane) | G17(X-Y plane) | G19(Y-Z plane) |
|---|---|---|
|  |  |  |
| Plane on which radius X cylinder is developed. Select this to machine the cylindrical plane of a workpiece. | X-Y plane in XYZ orthogonal coordinate system. Select this to machine the workpiece end face. | Y-Z plane in XYZ orthogonal coordinate system. Select this to machine a plane of a cylinder cut in the longitudinal direction. |

### 3.2.8 Hypothetical Axis Interpolation

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | — | — | — | — |
| L | — | — | — | — | — | — | — | — |

Take one of the axes of the helical interpolation or spiral interpolation, including a linear axis, as a hypothetical axis (axis with no actual movement) and perform pulse distribution. With this procedure, an interpolation equivalent to the helical interpolation or spiral interpolation looked from the side (hypothetical axis), or SIN or COS interpolation, will be possible. The setting of this hypothetical axis is commanded with G07.

**G07 Y0 ; (X axis command cancel ON)**
**G07 Y1 ; (X axis command cancel OFF)**

| | |
|---|---|
| | :Hypothetical axis interpolation command |
| G07 | :Designate the axis for which hypothetical axis interpolation is performed |
| Y | Designation of the axis for which axis command cancellation is performed applies for all the NC axes.<br>(0: Cancel (normal), 1: Handle as hypothetical axis) |

(1) Interpolation functions that are used for hypothetical interpolation are helical interpolation and spiral interpolation.

(2) During G07 $\alpha$ 0; to G07 $\alpha$ 1;, $\alpha$ axis will be the hypothetical axis. Thus, when $\alpha$ axis is commanded independently during this time, dwell mode will be held until finishing the pulse distribution to the hypothetical axis.

(Note) In order to perform hypothetical axis interpolation, helical interpolation must be added.

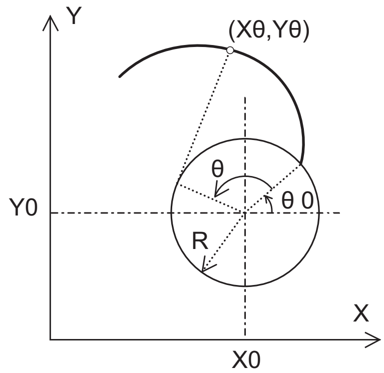
## 3.3 Curve Interpolation

### 3.3.1 Involute Interpolation

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | － | － |
| L | － | － | － | － | － | － | － | － |

Tools can be moved along the involute curve. This can be used for scroll machining of involute gears or compressors, and smooth accurate machining can be performed without stepping of path from the command by fine segment or without acceleration/deceleration by segment length.
More accurate machining can be performed by using the automatic control function for the speed such as "involute interpolation override" and "acceleration clamping during involute interpolation".

Involute curve is obtained with the following expression:
X（θ）= R{cos(θ+θ0) + θ*sin(θ+θ0)} + X0
Y（θ）= R {sin(θ+θ0) - θ*cos(θ+θ0)} + Y0
Circle in the right figure is the base circle.




Command format
Involute curve rotation direction (G02.2: clockwise; G03.2: counterclockwise)

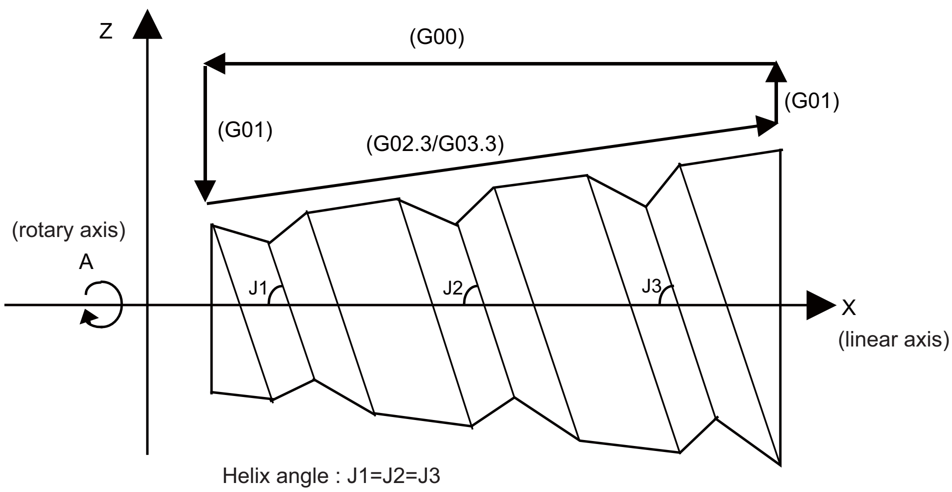
| | |
|---|---|
| **G02.2 (G03.2) Xx Yy Ii Jj Rr Ff ;   G17 Plane** | |
| **G02.2 (G03.2) Zz Xx Kk Ii Rr Ff ;  G18 Plane** | |
| **G02.2 (G03.2) Yy Zz Jj Kk Rr Ff ; G19 Plane** | |
| X | : End point of involute interpolation (X axis) |
| Y | : End point of Y involute interpolation (Y axis) |
| Z | : End point of Z involute interpolation (Z axis) |
| I | : Distance between start point and center of base circle (X axis) |
| J | : Distance between start point and center of base circle (Y axis) |
| K | : Distance between start point and center of base circle (Z axis) |
| R | : Base circle radius |
| F | : Feedrate (in involute curve tangent direction) |

The range of command value follows the input range of coordinate position data.

### 3.3.2 Exponential Interpolation

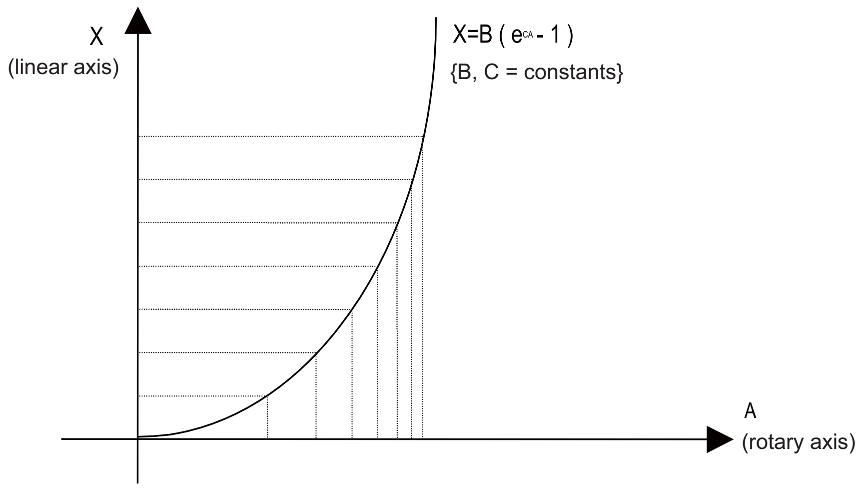
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ― | ― | ― | ― |
| L | △ | △ | △ | △ | ― | ― | ― | ― |

With this function, the rotary axis movement is changed into exponential functions vis-a-vis the linear axis movements. When exponential function interpolation is performed, linear interpolation is performed between the other axes and the linear axis. This makes it possible to machine tapered grooves (regular helix machining of tapered shapes) whose helix angle is always constant.
The function can be used for slotting and grinding end mills and other tools.
[Regular helix machining of tapered shapes]




Helix angle : J1=J2=J3

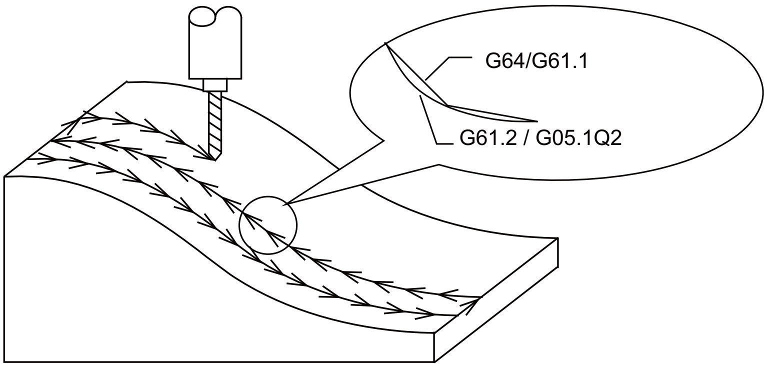
[Relationship between linear and rotary axes]



### 3.3.3 Spline Interpolation (G05.1Q2/G61.2)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | — | △ |
| L | — | — | — | — | — | — | — | — |

This function automatically generates spline curves that smoothly pass through rows of dots designated by a fine-segment machining program, and performs interpolation for the paths along the curves. This enables high-speed and high-accuracy machining to be achieved.
There are two types of the spline interpolation command format: G61.2 and G05.1Q2.
The high-speed high-accuracy control II/III is required for G05.1Q2 command. Command G05.1Q2 for the high-speed and smooth machining in the high-speed high-accuracy control II/III mode.




(Note) While the spline interpolation is valid, the high-speed high-accuracy control III operates as high-speed high-accuracy control II.

Command format

G61.2 command

| | |
|---|---|
| **G61.2 X__ Y__ Z__ F__ ;**<br>**or**<br>**G61.2 ;** | **Spline interpolation mode ON** |

| | |
|---|---|
| **G64 ;** | **Spline interpolation mode OFF** |

G05.1Q2 command

| | |
|---|---|
| **G05.1 Q2 X0 Y0 Z0 ;** | **Spline interpolation mode ON** |

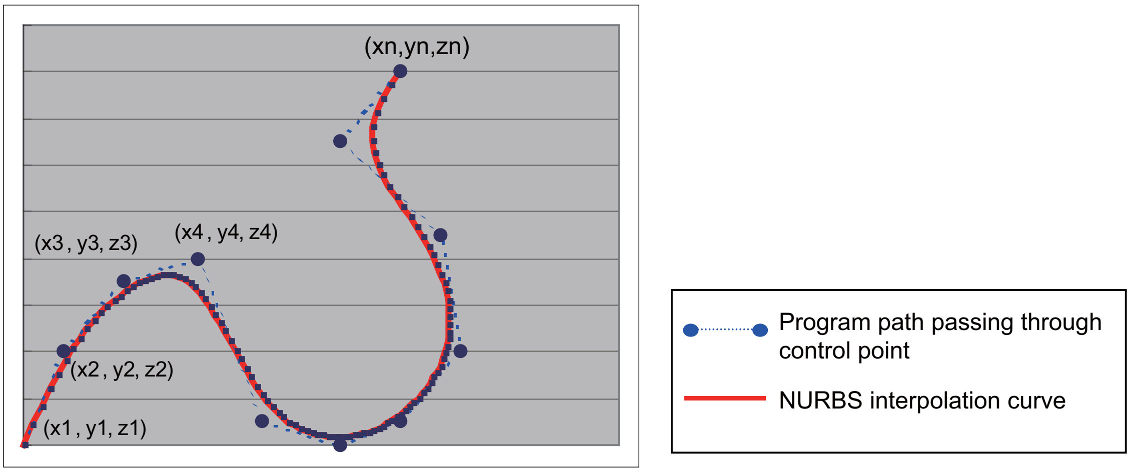
| | |
|---|---|
| **G05.1 Q0 ;** | **Spline interpolation mode OFF** |

### 3.3.4 NURBS Interpolation

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | － | － | － | － |
| L | － | － | － | － | － | － | － | － |

This function realizes NURBS curve machining by commanding NURBS curve parameters (number of stages, weight, knot, control point). The path does not need to be replaced with fine segments.
This function operates only in the high-speed high-accuracy control II/III mode, so the high-speed high-accuracy control II/III function is required.
During NURBS interpolation, interpolation takes place at the commanded speed. However, if the curvature is large, the speed is clamped so that the machine's tolerable acceleration rate is not exceeded.

NURBS interpolation cannot be used during graphic check (continuous/step check).
Linear interpolation that connects the control points is used during graphic check.
The multi-part system simultaneous high-accuracy function is required when the NURBS interpolation is commanded to 2nd part system or higher.

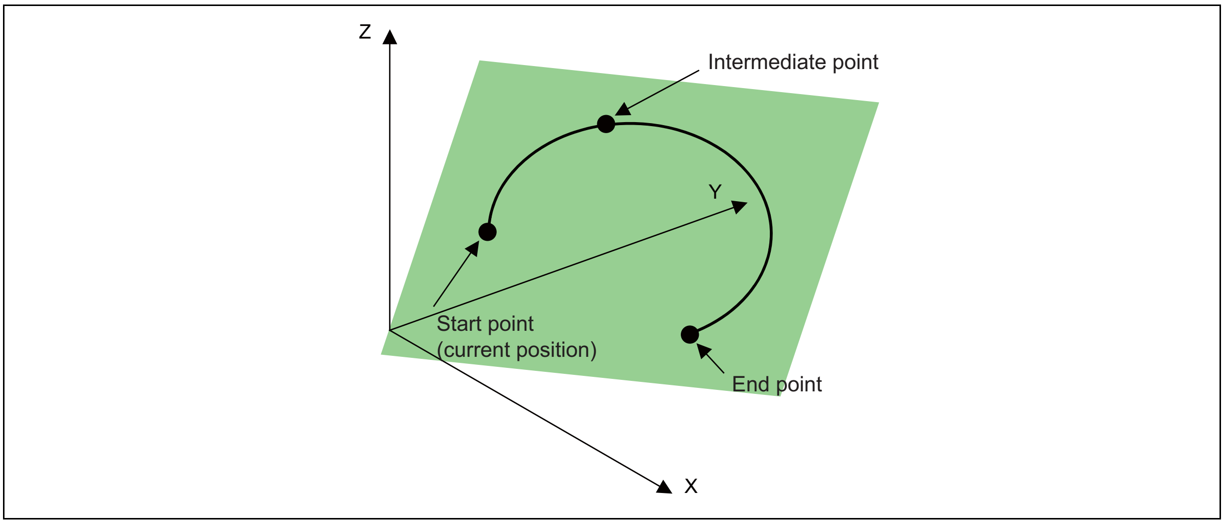



(Note) While the NURBS interpolation is valid, the high-speed high-accuracy control III operates as high-speed high-accuracy control II.

### 3.3.5 3-Dimensional Circular Interpolation

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | － | － | － | － |
| L | － | － | － | － | － | － | － | － |

To issue a circular command over a three-dimensional space, an arbitrary point (intermediate point) must be designated on the arc in addition to the start point (current position) and end point. Using the 3-dimensional circular interpolation command, an arc shape determined by the three points (start point, intermediate point, end point) designated on the three-dimensional space can be machined.




The command format is shown below.

| | |
|---|---|
| **G02.4(G03.4) Xx1 Yy1 Zz1 αα1 ... ;** | **Intermediate point designation (1st block)** |
| Xx2 Yy2 Zz2 αα2 ... ; | End point designation (2nd block) |
| G02.4(G03.4) | : 3-dimensional circular interpolation command |
| Xx1, Yy1, Zz1 | : Intermediate point coordinates |
| Xx2, Yy2, Zz2 | : End point coordinates |
| αα1 | : Arbitrary axis other than axis used as the reference in 3-dimensional circular interpolation (May be omitted) |

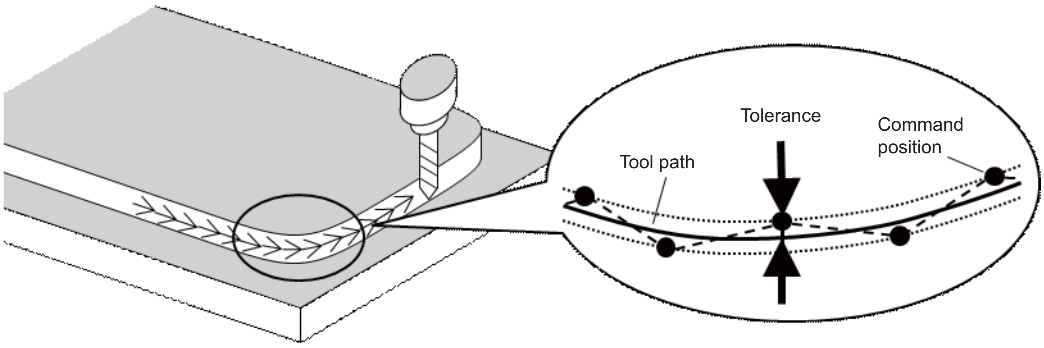
- The operation is the same for G02.4 and G03.4. (The rotation direction cannot be designated.)
- The axes used as the reference in 3-dimensional circular interpolation are the three basic axes set with the parameters.
- The X, Y, Z address in the block may be omitted. The intermediate point coordinates omitted in the 1st block become the start point coordinates, and the end point coordinates omitted in the 2nd block become the intermediate point coordinates.
- When using the 3-dimensional circular interpolation command, an arbitrary axis can be commanded in addition to the orthogonal coordinate system (X, Y, Z) used as the reference. The arbitrary axis designated in the intermediate point designating block (1st block) will interpolate to the command point when moving from the start point to intermediate point movement. The arbitrary axis designated in the end point command block (2nd block) will interpolate to the command point when moving from the intermediate point to the end point. The number of arbitrary axes that can be commanded differs according to the number of simultaneous contour control axes. The total of the basic three axes used as the reference of the 3-dimensional circular interpolation and the arbitrary axes commanded simultaneously must be less than the number of simultaneous contour control axes.

### 3.3.6 Spline Interpolation2 (G61.4)

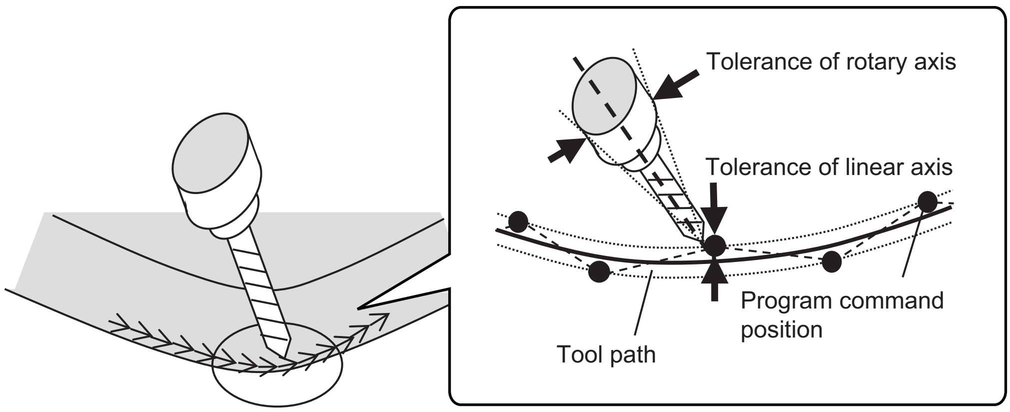
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ― | △ |
| L | ― | ― | ― | ― | ― | ― | ― | ― |

This function automatically generates a curve that smoothly passes through within the tolerable error range. The tool is able to move along the curve, providing smooth machining.
This function allows the machine to operate with the optimum tool path and speed, simply by specifying the tolerance size, so an operator can easily attain high quality machining.
This function is enabled under the tolerance control, so the specification of the tolerance control is required, too.

The tolerance size is the allowable error value between the path commanded by machining program and the path output with NC.




When spline interpolation 2 is used in combination with tool center point (TCP) control, spline interpolation 2 is performed with 5 axes. It generates a curve that passes through the TCP points smoothly within the tolerance, with the rotary axis angle also within the tolerance. The tool moves along the curve.



Command format

| | |
|---|---|
| **G61.4 (,K__ ) (,R__) ;** | **Spline interpolation 2 mode ON** |
| ,K | : Tolerance size (mm) linear axis |
| ,R | : Tolerance size (deg) rotary axis |

Spline interpolation 2 mode with command G61.4 will be cancelled by designating any one of G code group 13.

- G61 (Exact stop check mode)
- G61.1 (High-accuracy control mode)
- G61.2 (Spline interpolation command)
- G62 (Automatic corner override)
- G63 (Tapping mode)
- G64 (Cutting mode)
- G08P1 (High-accuracy control mode start)
- G08P0 (High-accuracy control mode end)

# 4

# Feed

# 4.1 Feedrate

## 4.1.1 Rapid Traverse Rate (m/min)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 |
| L | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 |

[M system]

The rapid traverse rate can be set independently for each axis by the parameter.
The rapid traverse rate is effective for G00, G27, G28, G29, G30 and G60 commands.
Override can be applied to the rapid traverse rate using the external signal supplied.
If the high-accuracy control mode's rapid traverse rate is set, the axis will move at that feedrate during high-accuracy control, high-speed high-accuracy control, high-accuracy spline control or SSS control.

- If the value set for the high-accuracy control mode rapid traverse rate is 0, the axis will move at the rapid traverse rate.
- The high-accuracy control mode rapid traverse rate can be set independently for each axis.
- The high-accuracy control mode rapid traverse rate is effective for the G00, G27, G28, G29, G30 and G60 commands.
- Override can be applied on the high-accuracy control mode rapid traverse rate using the external signal supplied.

**Rapid traverse rate and high-accuracy control mode rapid traverse rate setting**

| Least command increment | B | C | D | E |
|---|---|---|---|---|
| Metric input (mm/min, °/min) | 1 to 1000000 | 1 to 1000000 | 1 to 1000000 | 1 to 1000000 |
| Inch input (inch/min) | 1 to 100000 | 1 to 100000 | 1 to 100000 | 1 to 100000 |

Least command increment B : 0.001mm (0.0001inch)
Least command increment C : 0.0001mm (0.00001inch)
Least command increment D : 0.00001mm (0.000001inch)
Least command increment E : 0.000001mm (0.0000001inch)

[L system]

The rapid traverse rate can be set independently for each axis by the parameter.
The rapid traverse rate is effective for G00, G27, G28, G29, G30 and G53 commands.
Override can be applied to the rapid traverse rate using the external signal supplied.

**Rapid traverse rate setting range**

| Least command increment | B | C | D | E |
|---|---|---|---|---|
| Metric input (mm/min, °/min) | 1 to 1000000 | 1 to 1000000 | 1 to 1000000 | 1 to 1000000 |
| Inch input (inch/min) | 1 to 100000 | 1 to 100000 | 1 to 100000 | 1 to 100000 |

Least command increment B : 0.001mm (0.0001inch)
Least command increment C : 0.0001mm (0.00001inch)
Least command increment D : 0.00001mm (0.000001inch)
Least command increment E : 0.000001mm (0.0000001inch)

### 4.1.2 Cutting Feedrate (m/min)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 |
| L | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 |

[M system]

This function specifies the feedrate of the cutting commands, and a feed amount per spindle rotation or feed amount per minute is commanded.

Once commanded, it is stored in the memory as a modal value. The feedrate modal value is cleared to zero only when the power is turned ON.

The maximum cutting feedrate is clamped by the cutting feedrate clamp parameter (whose setting range is the same as that for the cutting feedrate).

If the high-accuracy control mode's cutting clamp speed is set, the cutting feedrate will be clamped at that speed during high-accuracy control, high-speed high-accuracy control, high-accuracy spline control or SSS control.

- If the value set for high-accuracy control mode cutting clamp speed is 0, the axis will be clamped at the cutting feed clamp speed.
- High-accuracy control mode cutting clamp speed is set with the parameters.

**Cutting feedrate setting range**

| Least command increment | B | C | D | E |
|---|---|---|---|---|
| Metric input (mm/min, °/min) | 0.001 to 1000000 | 0.0001 to 1000000 | 0.00001 to 1000000 | 0.000001 to 1000000 |
| Inch input (inch/min) | 0.0001 to 100000 | 0.00001 to 100000 | 0.000001 to 100000 | 0.0000001 to 100000 |

Least command increment B : 0.001mm (0.0001inch)
Least command increment C : 0.0001mm (0.00001inch)
Least command increment D : 0.00001mm (0.000001inch)
Least command increment E : 0.000001mm (0.0000001inch)

- G code command for which the cutting feedrate is effective
  For others such as G01,G02,G03,G02.1,G03.1,G33, etc., refer to the interpolation specifications.

[L system]

This function specifies the feedrate of the cutting commands, and a feed amount per spindle rotation or feed amount per minute is commanded.

Once commanded, it is stored in the memory as a modal value. The feedrate modal is cleared to zero only when the power is turned ON.

The maximum cutting feedrate is clamped by the cutting feedrate clamp parameter (whose setting range is the same as that for the cutting feedrate).

**Cutting feedrate setting range**

| Least command increment | B | C | D | E |
|---|---|---|---|---|
| Metric input (mm/min, °/min) | 0.001 to 1000000 | 0.0001 to 1000000 | 0.00001 to 1000000 | 0.000001 to 1000000 |
| Inch input (inch/min) | 0.0001 to 100000 | 0.00001 to 100000 | 0.000001 to 100000 | 0.0000001 to 100000 |

Least command increment B : 0.001mm (0.0001inch)
Least command increment C : 0.0001mm (0.00001inch)
Least command increment D : 0.00001mm (0.000001inch)
Least command increment E : 0.000001mm (0.0000001inch)

- G code command for which the cutting feedrate is effective
  For others such as G01,G02,G03,G02.1,G03.1,G33, etc., refer to the interpolation specifications.

### 4.1.3 Manual Feedrate (m/min)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 |
| L | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 |

The manual feedrate are designated as the feedrate in the jog mode or incremental feed mode for manual operation and the feedrate during dry run ON for automatic operation. The manual feedrate are set with external signals.
The manual feedrate signals from the PLC include two methods, the code method and value setting method.
Which method to be applied is determined with a signal common to the entire system. The signals used by these methods are common to all axes.

- Setting range under the code method
  Metric input    0.00 to 14000.00 mm/min (31 steps)
  Inch input    0.000 to 551.000 inch/min (31 steps)
- Setting range under the value setting method
  Metric input    0 to 1000000.00 mm/min in 0.01 mm/min increments
  Inch input    0 to 39370 inch/min in 0.001 inch/min increments
  Multiplication factor PCF1 and PCF2 are available with the value setting method.

### 4.1.4 Rotary Axis Command Speed Tenfold

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

This function multiplies the rotary axis' command speed by 10 during initial inching.
The commanded speeds are as follow.

<table>
<tr><td rowspan="2">Automatic operation</td><td>Cutting feedrate</td><td>For the inch system, the rotary axis command speed is multiplied by 10.<br>For example, if the B axis is the rotary axis in the inch system and the following type of machining program is executed, the rotary axis command speed will be multiplied by 10, and the rotary axis will move at 1000 deg./min.<br>N1 G1 B100. F100.;</td></tr>
<tr><td>Rapid traverse rate</td><td>The rapid traverse rate is not multiplied by 10, and is the speed set in the parameters.</td></tr>
<tr><td colspan="2">Manual operation</td><td>The command speeds related to manual operation, such as JOG feed, are not multiplied by 10. The display speed unit also remains as "deg./min".</td></tr>
</table>

## 4.2 Feedrate Input Methods

### 4.2.1 Feed per Minute (Asynchronous Feed)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

[M system]

By issuing the G94 command, the commands from that block are issued directly by the numerical value following F as the feedrate per minute (mm/min, inch/min).

Metric input

| Input Setting unit | B(0.001mm) | C(0.0001mm) | D(0.00001mm) | E(0.000001mm) |
|---|---|---|---|---|
| Command Mode | Feed per minute | Feed per minute | Feed per minute | Feed per minute |
| Command Address | F(mm/min) | F(mm/min) | F(mm/min) | F(mm/min) |
| Minimum command unit | 1(=1.00)<br>(1.=1.00) | 1(=1.000)<br>(1.=1.000) | 1(=1.0000)<br>(1.=1.0000) | 1(=1.00000)<br>(1.=1.00000) |
| Command range | 0.01 - 1000000.00 | 0.001 - 1000000.000 | 0.0001 - 1000000.0000 | 0.00001 - 1000000.00000 |

Inch input

| Input setting unit | B(0.0001inch) | C(0.00001inch) | D(0.000001inch) | E(0.0000001inch) |
|---|---|---|---|---|
| Command Mode | Feed per minute | Feed per minute | Feed per minute | Feed per minute |
| Command Address | F(inch/min) | F(inch/min) | F(inch/min) | F(inch/min) |
| Minimum command unit | 1(=1.000)<br>(1.=1.000) | 1(=1.0000)<br>(1.=1.0000) | 1(=1.00000)<br>(1.=1.00000) | 1(=1.000000)<br>(1.=1.000000) |
| Command range | 0.001 - 100000.000 | 0.0001 - 100000.0000 | 0.00001 - 100000.00000 | 0.000001 - 100000.000000 |

[L system]

By issuing the G94 command, the commands from that block are issued directly by the numerical value following F as the feedrate per minute (mm/min, inch/min).

Metric input

| Input Setting unit | B(0.001mm) | C(0.0001mm) | D(0.00001mm) | E(0.000001mm) |
|---|---|---|---|---|
| Command Mode | Feed per minute | Feed per minute | Feed per minute | Feed per minute |
| Command Address | F(mm/min) | F(mm/min) | F(mm/min) | F(mm/min) |
| Minimum command unit | 1(=1.000)<br>(1.=1.000) | 1(=1.0000)<br>(1.=1.0000) | 1(=1.00000)<br>(1.=1.00000) | 1(=1.000000)<br>(1.=1.000000) |
| Command range | 0.001 -<br>1000000.000 | 0.0001 -<br>1000000.0000 | 0.00001 -<br>1000000.00000 | 0.000001 -<br>1000000.000000 |

Inch input

| Input setting unit | B(0.0001inch) | C(0.00001inch) | D(0.000001inch) | E(0.0000001inch) |
|---|---|---|---|---|
| Command Mode | Feed per minute | Feed per minute | Feed per minute | Feed per minute |
| Command Address | F(inch/min) | F(inch/min) | F(inch/min) | F(inch/min) |
| Minimum command unit | 1(=0.0100)<br>(1.=1.0000) | 1(=0.01000)<br>(1.=1.00000) | 1(=0.010000)<br>(1.=1.000000) | 1(=0.0100000)<br>(1.=1.0000000) |
| Command range | 0.0001 -<br>100000.0000 | 0.00001 -<br>100000.00000 | 0.000001 -<br>100000.000000 | 0.0000001 -<br>100000.0000000 |

### 4.2.2 Feed per Revolution (Synchronous Feed)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

By issuing the G95 command, the commands from that block are issued directly by the numerical value following F as the feedrate per spindle revolution (mm/revolution or inch/revolution).
The least command increment and command range of the feedrate designation F are as follows.

[M system]
Metric input

| Input Setting unit | B(0.001mm) | C(0.0001mm) | D(0.00001mm) | E(0.000001mm) |
|---|---|---|---|---|
| Command Mode | Feed per revolution | Feed per revolution | Feed per revolution | Feed per revolution |
| Command Address | F(mm/rev) | F(mm/rev) | F(mm/rev) | F(mm/rev) |
| Minimum command unit | 1(=0.001)<br>(1.=1.0) | 1(=0.0001)<br>(1.=1.0) | 1(=0.00001)<br>(1.=1.0) | 1(=0.000001)<br>(1.=1.0) |
| Command range | 0.001 -<br>999.999 | 0.0001 -<br>999.9999 | 0.00001 -<br>999.99999 | 0.000001 -<br>999.999999 |

Inch input

| Input setting unit | B(0.0001inch) | C(0.00001inch) | D(0.000001inch) | E(0.0000001inch) |
|---|---|---|---|---|
| Command Mode | Feed per revolution | Feed per revolution | Feed per revolution | Feed per revolution |
| Command Address | F(inch/rev) | F(inch/rev) | F(inch/rev) | F(inch/rev) |
| Minimum command unit | 1(=0.00001)<br>(1.=1.00) | 1(=0.000001)<br>(1.=1.00) | 1(=0.0000001)<br>(1.=1.00) | 1(=0.00000001)<br>(1.=1.00) |
| Command range | 0.00001 -<br>99.99999 | 0.000001 -<br>99.999999 | 0.0000001 -<br>99.9999999 | 0.00000001 -<br>99.99999999 |

[L system]

Metric input

| Input Setting unit | B(0.001mm) | C(0.0001mm) | D(0.00001mm) | E(0.000001mm) |
|---|---|---|---|---|
| Command Mode | Feed per revolution | Feed per revolution | Feed per revolution | Feed per revolution |
| Command Address | F(mm/rev) | F(mm/rev) | F(mm/rev) | F(mm/rev) |
| Minimum command unit | 1(=0.0001)<br>(1.=1.00) | 1(=0.00001)<br>(1.=1.00) | 1(=0.000001)<br>(1.=1.00) | 1(=0.0000001)<br>(1.=1.00) |
| Command range | 0.0001 -<br>999.9999 | 0.00001 -<br>999.99999 | 0.000001 -<br>999.999999 | 0.0000001 -<br>999.9999999 |

Inch input

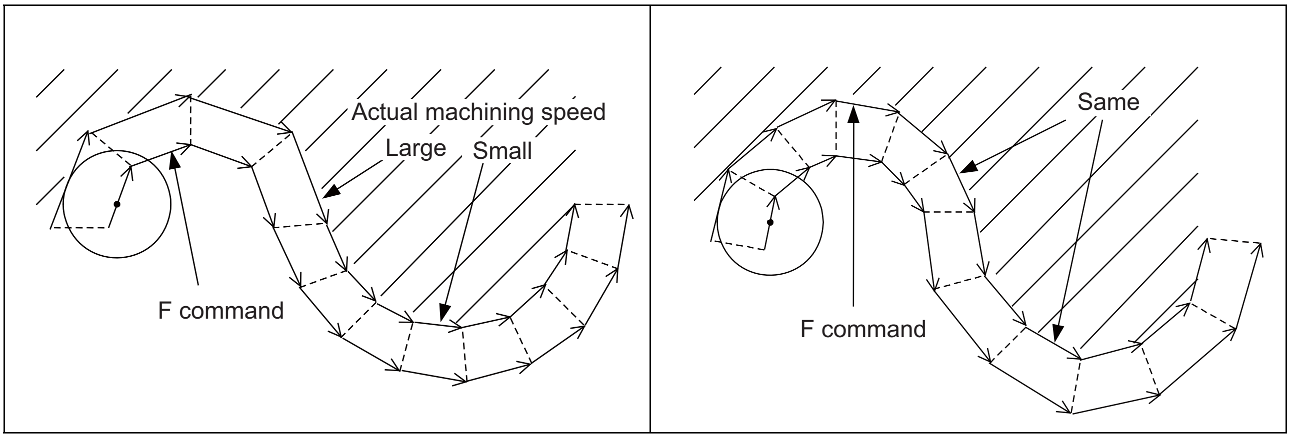
| Input setting unit | B(0.0001inch) | C(0.00001inch) | D(0.000001inch) | E(0.0000001inch) |
|---|---|---|---|---|
| Command Mode | Feed per revolution | Feed per revolution | Feed per revolution | Feed per revolution |
| Command Address | F(inch/rev) | F(inch/rev) | F(inch/rev) | F(inch/rev) |
| Minimum command unit | 1(=0.000001)<br>(1.=1.000) | 1(=0.0000001)<br>(1.=1.000) | 1(=0.00000001)<br>(1.=1.000) | 1(=0.000000001)<br>(1.=1.000) |
| Command range | 0.000001 -<br>99.999999 | 0.0000001 -<br>99.9999999 | 0.00000001 -<br>99.99999999 | 0.000000001 -<br>99.999999999 |

### 4.2.3 Inverse Time Feed

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ー | △ |
| L | ー | ー | ー | ー | ー | ー | ー | ー |

During inside cutting when machining curved shapes with tool radius compensation applied, the machining speed on the cutting surface becomes faster than the tool center feedrate. Therefore, problems such as reduced accuracy on the cutting surface may occur.
This reduced accuracy can be prevented with inverse time feed. This function can, in place of normal feed commands, issue one block of machining time (inverse) in F commands. The machining speed on the cutting surface is constantly controlled, even if radius compensation is applied to the machining program that expresses the free curve surface with fine segment lines.
Note that when the calculated machining time exceeds the cutting feed clamp speed, the F command value in the inverse time feed follows the cutting feed clamp speed.

**Regular F command** **Inverse time feed**




Command format is as shown below.

| | |
|---|---|
| **G93 ;** | **Inverse time feed** |

Inverse time feed (G93) is a modal command and is valid until feed per minute (G94) or feed per revolution (G95) is commanded.

| | |
|---|---|
| G00 Xx1 Yy1 ; | |
| G93 ; | → Inverse time feed mode ON |
| G01 Xx2 Yy2 Ff2 ; | → In inverse time feed mode |
| G02 Xx3 Yy3 Ii3 Jj3 Ff3 ; | : |
| G94(G95) ; | → Inverse time feed mode OFF |

In movement blocks, since processing time is commanded to a line segment, command the feedrate "F" each time.

### 4.2.4 F 1-digit Feed

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The feedrate registered by parameter can be assigned by designating a single digit following address F.
There are six F codes: F0 and F1 to F5. The rapid traverse rate is applied when F0 is issued which is the same as the G00 command.
When one of the codes F1 to F5 is issued, the cutting feedrate set to support the code serves as the valid rate command.
If F6 or larger value is command, the value is regarded as the cutting feedrate which has been directly commanded with numerical values.
When an F 1-digit command has been issued, the external output signal is output.

When the programmed feedrate has been issued as an F 1-digit command, the feedrate can be increased or reduced by turning the manual handle.
The feedrate cannot be changed by the 2nd and 3rd handles.

**(1) Amount by which speed is varied by manual handle**

Speed variation amount ΔF is expressed by the equation below:

$$\Delta F = \Delta P \times \frac{FM}{K}$$

ΔP : Handle pulses (±)
FM : F1 to F5 upper limit (parameter setting)
K :Speed variation constant (parameter setting)

(Example) When the feedrate is to be increased or reduced by 10 mm/min per manual handle scale increment
If FM is 3600 mm/min, then:

$$\Delta F = 10 = 1 \times \frac{3600}{K}$$ Therefore, K = 360.

**(2) Conditions under which F1-digit feed is valid**

(a) Cycle start must be underway.
(b) Cutting feed must be underway, and the F 1-digit feedrate must be designated.
(c) The F 1-digit valid parameter must be ON
(d) The F 1-digit feedrate change valid signal must be ON.
(e) The handle mode must not be selected.
(f) A dry run must not be in progress.
(g) Machine lock must not be activated.
(h) The parameter settings (the F 1-digit feedrate upper limit and F 1-digit feedrate change constant) must not be "0".

### 4.2.5 Manual Speed Command

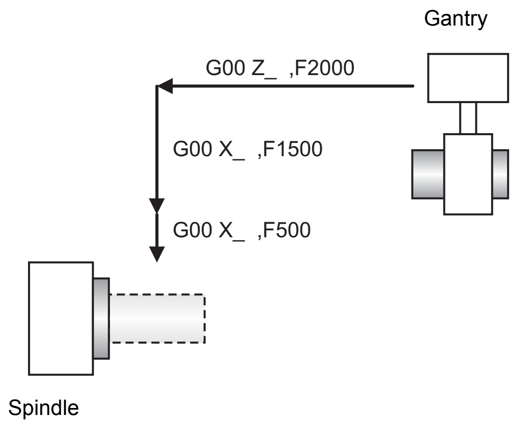
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

In the memory or MDI mode, validate the manual speed command and select either handle feed or jog (manual) feed so that the automatic operation is carried out at the feedrate.
With a command in the (-) direction, the program path can be reversed. Note that, however, program path can be reversed only within the currently executing block and not beyond the block.
Whether or not to execute reverse run with a command in the (-) direction is set with the PLC interface.
Furthermore, by setting the parameter, handle, jog and manual feed speed can be executed at the feed speed according to the ratio of program command speed of running block when issuing the manual speed command in multiple systems.

### 4.2.7 G00 Feedrate Designation (,F Command)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | — | △ |
| L | △ | △ | △ | △ | ○ | ○ | — | △ |

Feedrates can be specified for G00 (positioning command).
The speed of tool exchange, axis movement of gantry, etc. can be specified with the machining program so that the mechanical vibration can be suppressed.
Operations other than the feedrate follows the G00 specification.



Command format

The feedrates of the movement in the G00,G00 mode and the movement during the fixed cycle for drilling are commanded with ",F".

Feedrate designation in G00 block

```
G00 X__ Z__ ,F1000 ;
```

Feedrate designation for movement command in G00 mode

```
G00 ;
X__ Z__ ,F1000 ;
```

(Note) ", F" command is ignored in the G01 mode.

Feedrate designation for movement command during drilling cycle

```
G8 □ (G7 □ ) X/Z__ ..... ,F1000;
X/Z__ ...... ,F500;
 :
 :
G80
 :
```

L system G83/G87: Deep-hole drilling, G84/G88: Tapping, G85/G89: Boring
M system G81: Drilling/Spot drilling, G82: Drilling/Counter boring, G83: Deep-hole drilling, G84: Tapping, G85/G86: Boring, G87: Back boring, G88/G89: Boring, G73: Step, G74: Reverse tapping, G75: Circular cutting, G76: Fine boring

",F" command range

- The range is equal to the range of the feed per minute F command (mm/min, inch/min) in the G01 mode.
- Commands that exceed the command range cause the error "P67: F value is exceeding the limit".
- Switching inch/mm is invalid for rotary axes.

## 4.3 Override

### 4.3.1 Rapid Traverse Override

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

**(1) Type 1 (code method)**
Four levels of override (1%, 25%, 50% and 100%) can be applied to manual or automatic rapid traverse using the external input signal supplied.

**(2) Type 2 (value setting method)**
Override can be applied in 1% steps from 0% to 100% to manual or automatic rapid traverse using the external input signal supplied.

(Note 1) Type 1 and type 2 can be selected by PLC processing.
(Note 2) This function requires a built-in PLC for type 2.

### 4.3.2 Cutting Feed Override

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

**(1) Type 1 (code method)**
Override can be applied in 10% steps from 0% to 300% to the feed rate command designated in the machining program using the external input signal supplied.

**(2) Type 2 (value setting method)**
Override can be applied in 1% steps from 0% to 327% to the feed rate command designated in the machining program using the external input signal supplied.

(Note 1) This function requires a built-in PLC for type 2.

### 4.3.3 2nd Cutting Feed Override

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Override can be further applied in 0.01% steps from 0% to 327.67% as a second stage override to the feed rate after the cutting feed override has been applied.

(Note 1) This function requires a built-in PLC.

### 4.3.4 Override Cancel

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

By turning on the override cancel external signal, the override is automatically set to 100% for the cutting feed during an automatic operation mode (tape, memory and MDI).

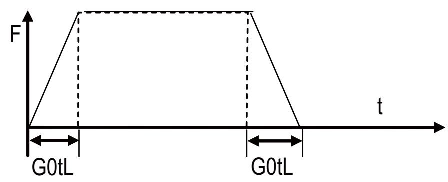
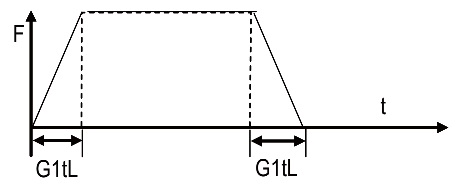
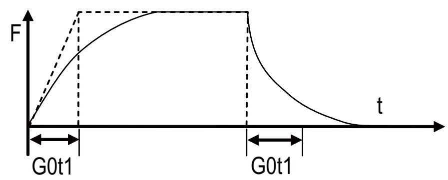
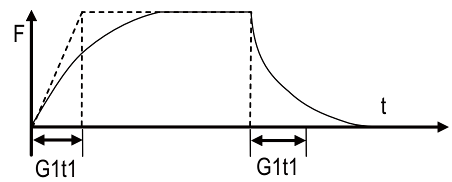
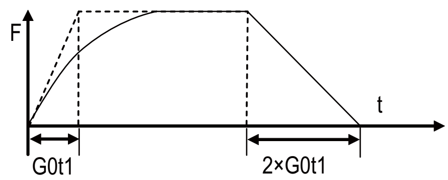
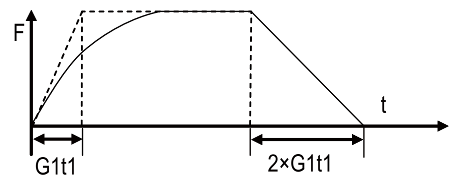
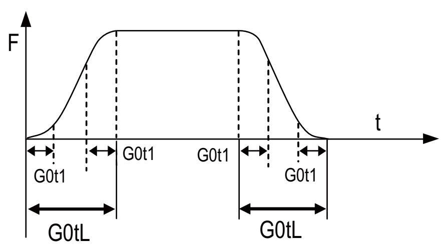
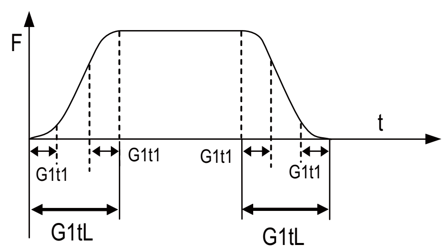
(Note 1) The override cancel signal is not valid for manual operation.
(Note 2) When the cutting feed override or second cutting feed override is 0%, the 0% override takes precedence and the override is not canceled.
(Note 3) The override cancel signal is not valid for rapid traverse.

## 4.4 Acceleration/Deceleration

### 4.4.1 Automatic Acceleration/Deceleration after Interpolation

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Acceleration/deceleration is applied to all commands automatically. The acceleration/deceleration patterns are linear acceleration/deceleration, soft acceleration/deceleration, exponent function acceleration/ deceleration, exponent function acceleration/linear deceleration and any of which can be selected by using a parameter.
For rapid traverse feed or manual feed, acceleration/deceleration is always made for each block, and the time constant can be set for each axis separately.

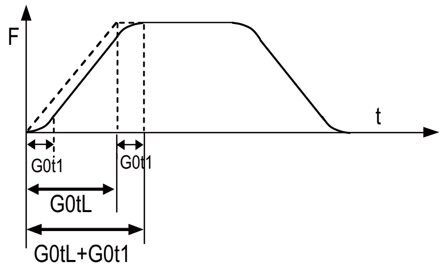
| Rapid traverse | Cutting feed |
|---|---|
| <Linear acceleration/deceleration><br> | <Linear acceleration/deceleration><br> |
| <Primary delay><br> | <Primary delay><br> |
| <Exponential acceleration-Linear deceleration><br> | <Exponential acceleration-Linear deceleration><br> |
| <Soft acceleration/deceleration><br> | <Soft acceleration/deceleration><br> |

G0tL:G0 time constant(linear)
G0t1:G0 time constant(primary delay)/The 2nd step time constant of the soft acceleration/deceleration
G1tL:G1 time constant(linear)
G1t1:G1 time constant(primary delay)/The 2nd step time constant of the soft acceleration/deceleration

(Note 1) The rapid traverse feed acceleration/deceleration patterns are effective for the following:
G00, G27, G28, G29, G30, rapid traverse feed in manual run, JOG feed, incremental feed, return to reference position.
It is invalid to G31 and handle feed.

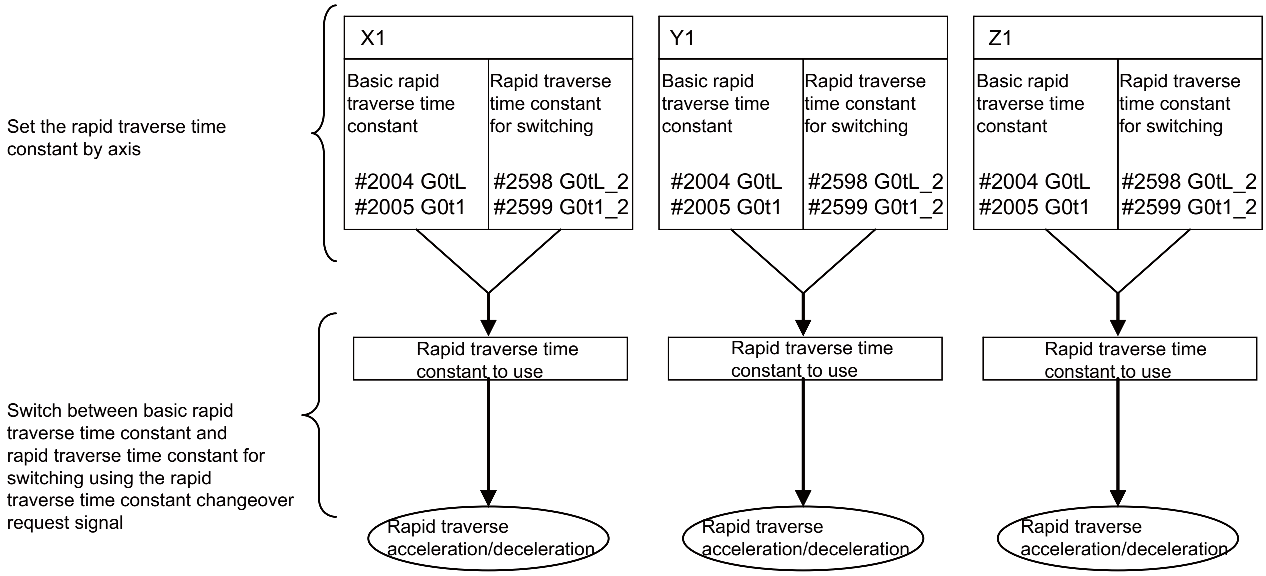
(Note 2) Acceleration/deceleration in handle feed mode is usually performed according to the acceleration/deceleration pattern for cutting feed. However, a parameter can be specified to select a pattern with no acceleration/deceleration (step).

(Note 3) Acceleration/deceleration time of soft acceleration/deceleration can be changed by parameter as follows.




Total accelerating time:G0tL+G0t1
S-pattern part time:G0t1
Linear part time:G0tL-G0t1

A rapid traverse time constant can be switched by rapid traverse time constant changeover request signal.



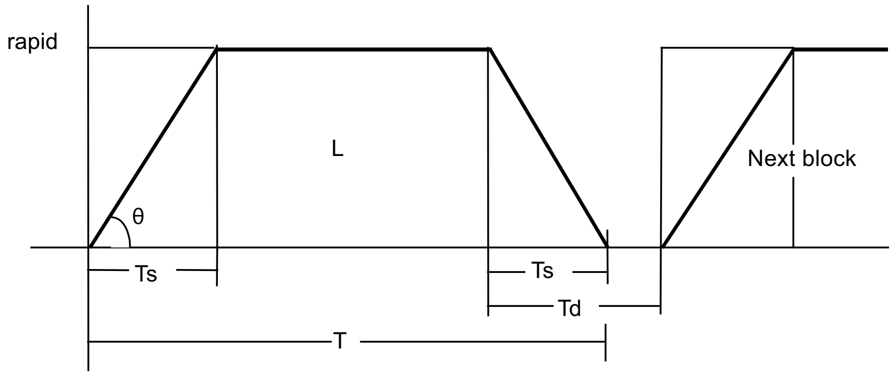
### 4.4.2 Rapid Traverse Constant Inclination Acceleration/Deceleration

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

This function performs acceleration and deceleration at a constant inclination during linear acceleration/ deceleration in the rapid traverse mode. Compared to the method of acceleration/deceleration after interpolation, the constant inclination acceleration/deceleration method makes for improved cycle time.

Rapid traverse constant inclination acceleration/deceleration are valid only for a rapid traverse command. Also, this function is effective only when the rapid traverse command acceleration/deceleration mode is linear acceleration and linear deceleration.
The acceleration/deceleration patterns in the case where rapid traverse constant inclination acceleration/ deceleration are performed are as follows.

**(1) When the interpolation distance is long enough for the rapid traverse rate to be achieved**




$$T = \frac{L}{rapid} + Ts$$

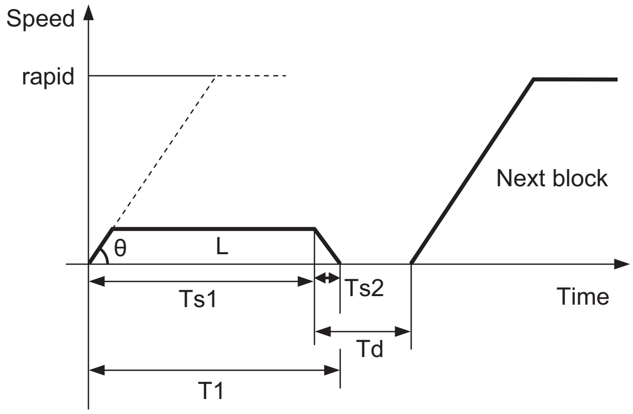
Td = Ts + (0 ～14ms)

$$\theta = \tan^{-1}\left(\frac{rapid}{Ts}\right)$$

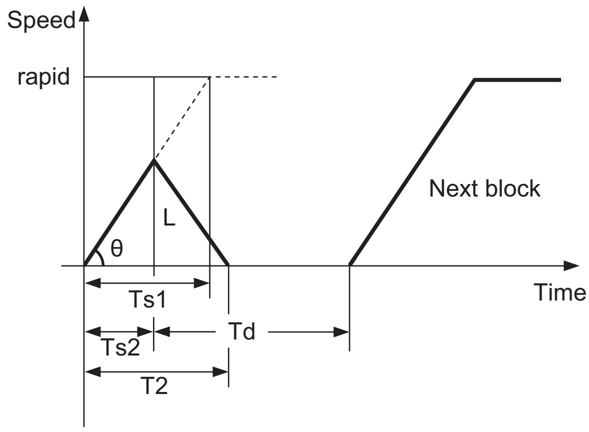
rapid : Rapid traverse rate
Ts : Acceleration/deceleration time constant
Td : Command deceleration check time
θ : Acceleration/deceleration inclination
T : Interpolation time
L : Interpolation distance

**(2) When the interpolation distance is so short that the rapid traverse rate is not achieved**

In case of time-constant acceleration/deceleration:




In case of inclination-constant acceleration/deceleration:




$$T1 = Ts1 + Ts2$$

$$T2 = 2 \times \sqrt{Ts1 \times L/rapid}$$

$$Td = T2/2 + (0 \text{ to } 14 \text{ ms})$$

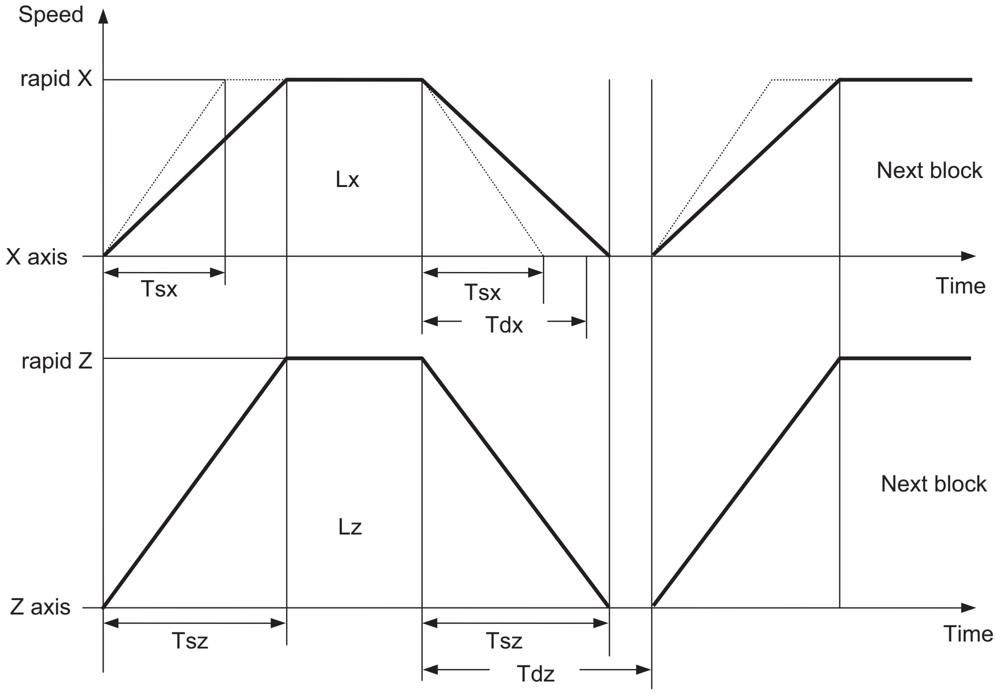
$$\theta = \frac{\tan^{-1}}{Ts1}(rapid)$$

rapid: Rapid traverse rate (Axis specification parameter #2001 rapid)
Ts1: Acceleration/deceleration time (Axis specification parameter #2004 G0tL)
Ts2: Acceleration/deceleration time to reach the maximum speed
Td: Command deceleration check time
$\theta$ : Acceleration/deceleration inclination
T1: Interpolation time (time-constant acceleration/deceleration)
T2: Interpolation time (inclination-constant acceleration/deceleration)
L: Interpolation distance

The time required to perform a command deceleration check during rapid traverse constant inclination acceleration/deceleration is the longest value among the rapid traverse deceleration check times determined for each axis by the rapid traverse rate of commands executed simultaneously, the rapid traverse acceleration/deceleration time constant, and the interpolation distance, respectively.

**(3) 2-axis simultaneous interpolation (When linear interpolation is used, Tsx < Tsz, and Lx ≠ Lz)**

When 2-axis simultaneous interpolation (linear interpolations) is performed during rapid traverse constant inclination acceleration and deceleration, the acceleration (deceleration) time is the longest value of the acceleration (deceleration) times determined for each axis by the rapid traverse rate of commands executed simultaneously, the rapid traverse acceleration and deceleration time constant, and the interpolation distance, respectively. Consequently, linear interpolation is performed even when the axes have different acceleration and deceleration time constants.



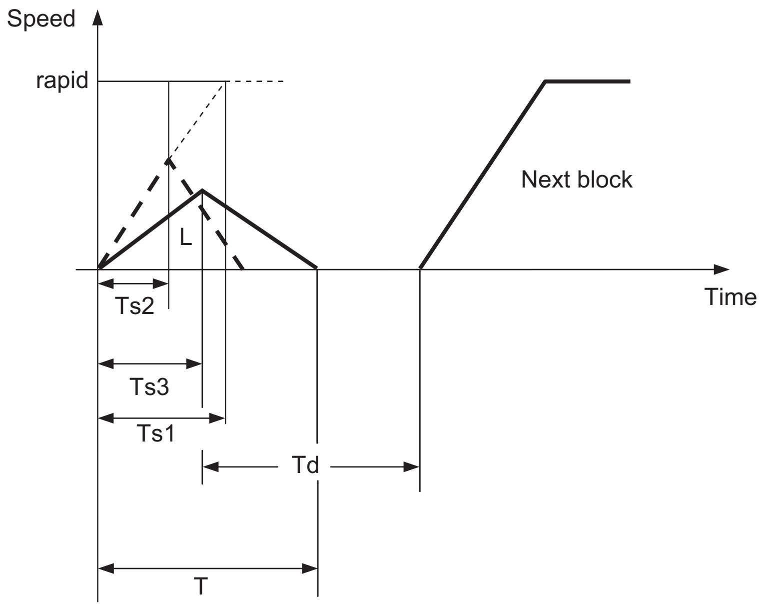

When Tsz is greater than Tsx,
Tdz is also greater than Tdx, and
Td = Tdz in this block.

Tsx: X axis acceleration/deceleration time
Tsz: Z axis acceleration/deceleration time
Tdx: X axis commanded deceleration check time
Tdz: Z axis commanded deceleration check time
Lx : X axis interpolation distance
Lz : Z axis interpolation distance

The program format of G0 (rapid traverse command) when rapid traverse constant inclination acceleration/deceleration are executed is the same as when this function is invalid (time constant acceleration/deceleration). This function is valid only for G0 (rapid traverse).

**(4) When the interpolation distance is so short that the acceleration/deceleration time is shorter than the minimum time constant for constant inclination acceleration/deceleration**

If a minimum time constant for inclination-constant acceleration/deceleration by the parameter, acceleration/deceleration speed is adjusted to prevent the acceleration/deceleration time calculated by interpolation distance from going below the minimum time constant.




$$T = 2 \times Ts2$$

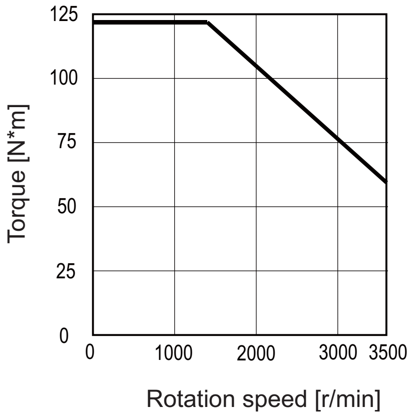
$$Td = T/2 + (0 \text{ to } 14 \text{ ms})$$

rapid: Rapid traverse speed (Axis specification parameter #2001 rapid)
Ts1: Acceleration/deceleration time (Axis specification parameter #2004 G0tL)
Ts2: Acceleration/deceleration time to reach the maximum speed
Ts3: Minimum time for inclination-constant acceleration/deceleration (Axis specification parameter #2198 G0tMin)
Td: Command deceleration check time
T: Interpolation time
L: Interpolation distance

### 4.4.3 Rapid Traverse Constant Inclination Multi-step Acceleration/Deceleration

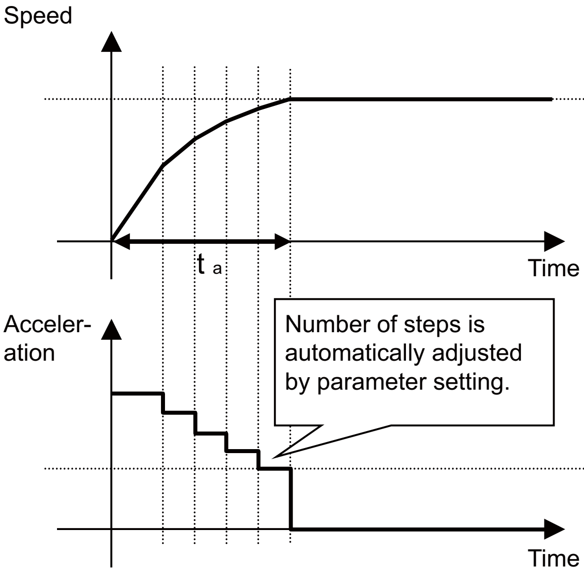
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | － | － | － | － | － | － | － | － |

This function carries out the acceleration/deceleration according to the torque characteristic of the motor in the rapid traverse mode during automatic operation. (This function is not available in manual operation.) The rapid traverse constant inclination multi-step acceleration/deceleration method makes for improved cycle time because the positioning time is shortened by using the motor ability to its maximum.
In general, the servomotor has the characteristic that the torque falls in the high-speed rotation range.

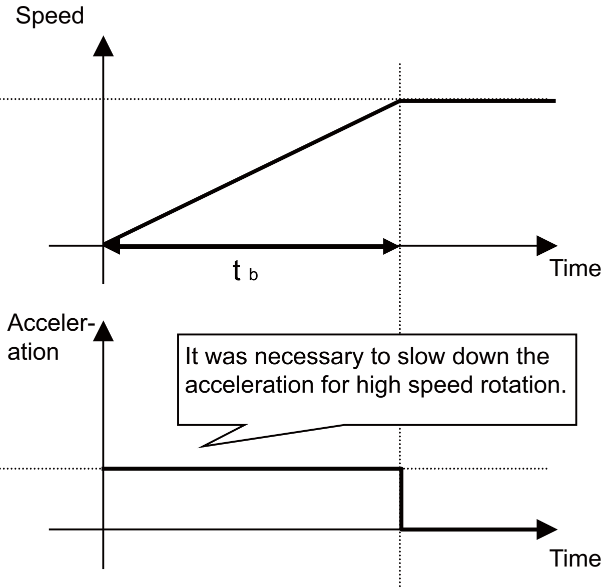



(Note) This characteristic is data at input voltage 380VAC.

In the rapid traverse constant inclination acceleration/deceleration method, the acceleration has been treated constantly because this torque characteristic is not considered. So, it is necessary to use a minimum acceleration within the used speed range. Therefore, the margin of acceleration must be had in a low-speed range. Or if the acceleration is used to its maximum, the upper limit of the rotation speed must be slowed.
Then, to use the servomotor ability to its maximum, acceleration/deceleration to which the torque characteristic is considered is carried out by the rapid traverse constant inclination multi-step acceleration/deceleration method.
The acceleration/deceleration patterns in the case where rapid traverse constant inclination multi-step acceleration/ deceleration are performed are as follows.




(a) Rapid traverse constant inclination multi-step acceleration/deceleration




(b) Rapid traverse constant inclination acceleration/deceleration

## 4.5 Thread Cutting

### 4.5.1 Thread Cutting (Lead/Thread Number Designation)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Thread cutting with designated lead can be performed. Designate the number of threads per inch with the E address to cut inch threads.

**(1) Lead designation**

The thread cutting with designated lead is performed based on the synchronization signals from the spindle encoder.

**G33 Zz1/Ww1 Xx1/Uu1 Qq1 Ff1/Ee1 ;**

| | |
|---|---|
| G33 | : Thread cutting command |
| Zz1/Ww1,Xx1/Uu1 | : Thread end point coordinates |
| Qq1 | : Shift angle at start of thread cutting (0.000 to 360.000°) |
| Ff1 | : Thread lead (normal lead threads) |
| Ee1 | : Thread lead (precise lead threads) |

The thread cutting with designated lead can be performed. Inch threads are cut by designating the number of threads per inch with the E address.

**(2) Thread number designation**

Inch threads are cut by designating the number of threads per inch with the E address.
Whether the E command is a thread number designation or lead designation is selected with the parameters.

**G33 Zz1/Ww1 Xx1/Uu1 Qq1 Ee1 ;**

| | |
|---|---|
| G33 | : Thread cutting command |
| Zz1/Ww1,Xx1/Uu1 | : Thread end point coordinates |
| Qq1 | : Shift angle at start of thread cutting (0.000 to 360.000°) |
| Ee1 | : Thread number per inch |

[M system]
Thread cutting metric input

| Input setting unit | B (0.001mm) | | | C (0.0001mm) | | |
|---|---|---|---|---|---|---|
| Command address | F (mm/rev) | E (mm/rev) | E (ridges/inch) | F (mm/rev) | E (mm/rev) | E (ridges/inch) |
| Least Command Increments | 1(=1.000) (1.=1.000) | 1(=1.0000) (1.=1.0000) | 1(=1.00) (1.=1.00) | 1(=1.0000) (1.=1.0000) | 1(=1.00000) (1.=1.00000) | 1(=1.000) (1.=1.000) |
| Command range | 0.001 - 999.999 | 0.0001 - 999.9999 | 0.03 - 999.99 | 0.0001 - 999.9999 | 0.00001 - 999.99999 | 0.026 - 222807.017 |

| Input setting unit | D (0.00001mm) | | | E (0.000001mm) | | |
|---|---|---|---|---|---|---|
| Command address | F (mm/rev) | E (mm/rev) | E (ridges/inch) | F (mm/rev) | E (mm/rev) | E (ridges/inch) |
| Least Command Increments | 1(=1.00000) (1.=1.00000) | 1(=1.000000) (1.=1.000000) | 1(=1.0000) (1.=1.0000) | 1(=1.000000) (1.=1.000000) | 1(=1.0000000) (1.=1.0000000) | 1(=1.00000) (1.=1.00000) |
| Command range | 0.00001 - 999.99999 | 0.000001 - 999.999999 | 0.0255 - 224580.0000 | 0.000001 - 999.999999 | 0.0000001 - 999.9999999 | 0.02541 - 224719.00000 |

Thread cutting inch input

| Input setting unit | B (0.0001inch) | | | C (0.00001inch) | | |
|---|---|---|---|---|---|---|
| Command address | F (inch/rev) | E (inch/rev) | E (ridges/inch) | F (inch/rev) | E (inch/rev) | E (ridges/inch) |
| Least Command Increments | 1(=1.0000) (1.=1.0000) | 1(=1.00000) (1.=1.00000) | 1(=1.000) (1.=1.000) | 1(=1.00000) (1.=1.00000) | 1(=1.000000) (1.=1.000000) | 1(=1.0000) (1.=1.0000) |
| Command range | 0.0001 - 39.3700 | 0.00001 - 39.37007 | 0.025 - 9999.999 | 0.00001 - 39.37007 | 0.000001 - 39.370078 | 0.0255 - 9999.9999 |

| Input setting unit | D (0.000001inch) | | | E (0.0000001inch) | | |
|---|---|---|---|---|---|---|
| Command address | F (inch/rev) | E (inch/rev) | E (ridges/inch) | F (inch/rev) | E (inch/rev) | E (ridges/inch) |
| Least Command Increments | 1(=1.000000) (1.=1.000000) | 1(=1.0000000) (1.=1.0000000) | 1(=1.00000) (1.=1.00000) | 1(=1.0000000) (1.=1.0000000) | 1(=1.00000000) (1.=1.00000000) | 1(=1.000000) (1.=1.000000) |
| Command range | 0.000001 - 39.370078 | 0.0000001 - 39.3700787 | 0.02541 - 9999.99999 | 0.0000001 - 39.3700787 | 0.00000001 - 39.37007873 | 0.025401 - 9999.999999 |

(Note 1) It is not possible to assign a lead that causes the feedrate converted into the feed per minute value to exceed the maximum cutting feedrate.

[L system]
Thread cutting metric input

| Input setting unit | B (0.001mm) | | | C (0.0001mm) | | |
|---|---|---|---|---|---|---|
| Command address | F (mm/rev) | E (mm/rev) | E (ridges/inch) | F (mm/rev) | E (mm/rev) | E (ridges/inch) |
| Least Command Increments | 1(=1.0000) (1.=1.0000) | 1(=1.00000) (1.=1.00000) | 1(=1.00) (1.=1.00) | 1(=1.00000) (1.=1.00000) | 1(=1.000000) (1.=1.000000) | 1(=1.000) (1.=1.000) |
| Command range | 0.0001 - 999.9999 | 0.00001 - 999.99999 | 0.03 - 999.99 | 0.00001 - 999.99999 | 0.000001 - 999.999999 | 0.026 - 222807.017 |

| Input setting unit | D (0.00001mm) | | | E (0.000001mm) | | |
|---|---|---|---|---|---|---|
| Command address | F (mm/rev) | E (mm/rev) | E (ridges/inch) | F (mm/rev) | E (mm/rev) | E (ridges/inch) |
| Least Command Increments | 1(=1.000000) (1.=1.000000) | 1(=1.0000000) (1.=1.0000000) | 1(=1.0000) (1.=1.0000) | 1(=1.0000000) (1.=1.0000000) | 1(=1.00000000) (1.=1.00000000) | 1(=1.00000) (1.=1.00000) |
| Command range | 0.000001 - 999.999999 | 0.0000001 - 999.9999999 | 0.0255 - 224580.0000 | 0.0000001 - 999.9999999 | 0.00000001 - 999.99999999 | 0.02540 - 224719.00000 |

Thread cutting inch input

| Input setting unit | B (0.0001inch) | | | C (0.00001inch) | | |
|---|---|---|---|---|---|---|
| **Command address** | F (inch/rev) | E (inch/rev) | E (ridges/inch) | F (inch/rev) | E (inch/rev) | E (ridges/inch) |
| **Least Command Increments** | 1(=1.00000) (1.=1.00000) | 1(=1.000000) (1.=1.000000) | 1(=1.000) (1.=1.000) | 1(=1.000000) (1.=1.000000) | 1(=1.0000000) (1.=1.0000000) | 1(=1.0000) (1.=1.0000) |
| **Command range** | 0.00001 - 39.37007 | 0.000001 - 39.370078 | 0.025 - 9999.999 | 0.000001 - 39.370078 | 0.0000001 - 39.3700787 | 0.0254 - 9999.9999 |

| Input setting unit | D (0.000001inch) | | | E (0.0000001inch) | | |
|---|---|---|---|---|---|---|
| **Command address** | F (inch/rev) | E (inch/rev) | E (ridges/inch) | F (inch/rev) | E (inch/rev) | E (ridges/inch) |
| **Least Command Increments** | 1(=1.0000000) (1.=1.0000000) | 1(=1.00000000) (1.=1.00000000) | 1(=1.00000) (1.=1.00000) | 1(=1.00000000) (1.=1.00000000) | 1(=1.000000000) (1.=1.000000000) | 1(=1.000000) (1.=1.000000) |
| **Command range** | 0.0000001 - 39.3700787 | 0.00000001 - 39.37007873 | 0.02540 - 9999.99999 | 0.00000001 - 39.37007873 | 0.000000001 - 39.370078736 | 0.025400 - 9999.999999 |

(Note 1) It is not possible to assign a lead that causes the feedrate converted into the feed per minute value to exceed the maximum cutting feedrate.

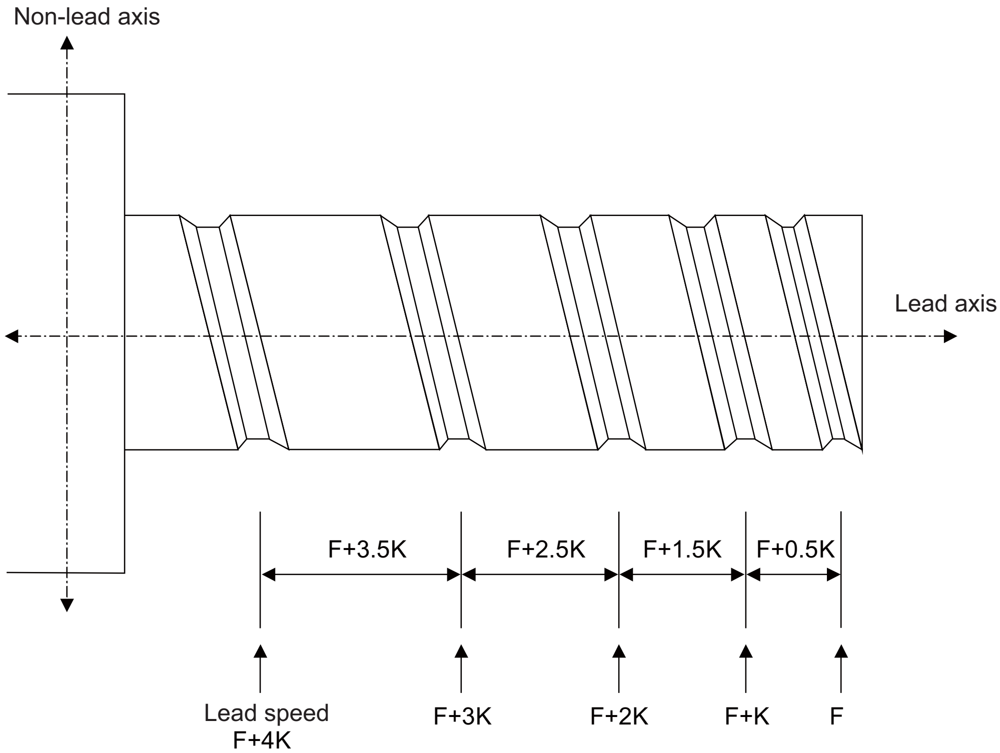
### 4.5.2 Variable Lead Thread Cutting

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | — | — | — | — | — | — | — | — |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

By commanding the lead increment/decrement amount per thread rotation, variable lead thread cutting can be done.
The machining program is commanded in the following manner.

**G34 Xx1/Uu1 Zz1/Ww1 Ff1/Ee1 Kk1 ;**

| | |
|---|---|
| G34 | : Variable lead thread cutting command |
| Xx1/Uu1 | : Thread end point X coordinate |
| Zz1/Ww1 | : Thread end point Z coordinate |
| Ff1/Ee1 | : Thread's basic lead |
| Kk1 | : Lead increment/decrement amount per thread rotation |



### 4.5.3 Synchronous Tapping

(Note) With digital I/F spindle

#### 4.5.3.1 Synchronous Tapping Cycle

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

This function performs tapping through the synchronized control of the digital spindle and servo axis. This eliminates the need for floating taps and enables tapping to be conducted at a highly precise tap depth.

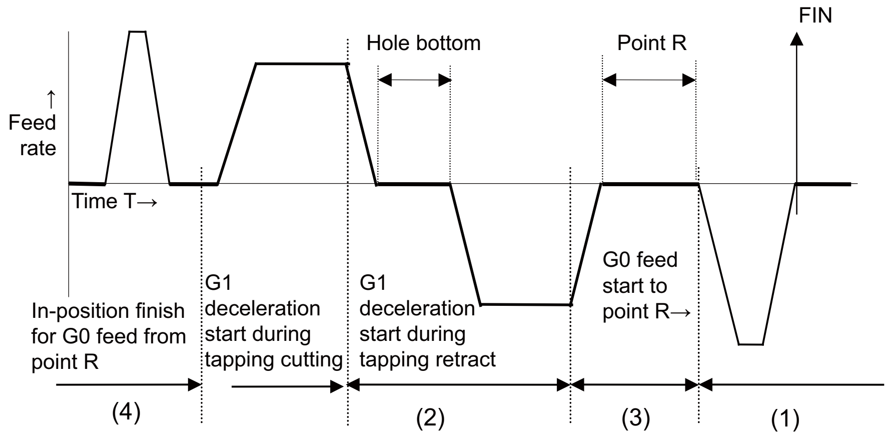
**(1) Tapping pitch assignment**

| **G84(G74) Xx1 Yy1 Zz1 Rr1 Dd1 Pp1 Ff1 Kk1 Ss1 ,Ss2 ,Rr2 ,Ii1 ,Jj1 Mm1 ;** | |
|---|---|
| G84 | : Mode, forward tapping |
| G74 | : Mode, reverse tapping |
| Xx1,Yy1 | : Hole position data, hole drilling position |
| Zz1 | : Hole machining data, hole bottom position |
| Rr1 | : Hole machining data, point R position |
| Dd1 | : Tool spindle number (d is 1 to number of spindles)<br>Depending on the parameter setting, command as "-d1" to carry out reverse tapping. |
| Pp1 | : Hole machining data, dwell time at hole bottom |
| Ff1 | : Z-axis feed amount (tapping pitch) per spindle rotation |
| Kk1 | : Number of repetitions |
| Ss1 | : Spindle speed |
| ,Ss2 | : Rotation speed of spindle during retract |
| ,Rr2 | : Synchronization method selection (r2=1 Synchronous, r2=0 Asynchronous) |
| ,Ii1/,Jj1 | : In-position width of positioning axis/hole drilling axis |
| Mm1 | : M function designation |

**(2) Tapping thread number assignment**

| **G84(G74) Xx1 Yy1 Zz1 Rr1 Dd1 Pp1 Ee1 Kk1 Ss1 ,Ss2 ,Rr2 ,Ii1 ,Jj1 Mm1 ;** | |
|---|---|
| G84 | : Mode, forward tapping |
| G74 | : Mode, reverse tapping |
| Xx1,Yy1 | : Hole position data, hole drilling position |
| Zz1 | : Hole machining data, hole bottom position |
| Rr1 | : Hole machining data, point R position |
| Dd1 | : Tool spindle number (d is 1 to number of spindles)<br>Depending on the parameter setting, command as "-d1" to carry out reverse tapping. |
| Pp1 | : Hole machining data, dwell time at hole bottom |
| Ee1 | : Tap thread number per 1-inch feed of Z axis |
| Kk1 | : Number of repetitions |
| Ss1 | : Spindle speed |
| ,Ss2 | : Rotation speed of spindle during retract |
| ,Rr2 | : Synchronization method selection (r2=1 synchronous, r2=0 asynchronous) |
| ,Ii1/,Jj1 | : In-position width of positioning axis/hole drilling axis |
| Mm1 | : M function designation |

(Note) The synchronous tapping cycle can be used for axes other than the Z axis with the plane selection. Furthermore, in-position checks can be performed at the hole bottom or point R, etc. using the parameters. The figure below shows the correlation between the in-position width and the movement of the tapping axis of the synchronous tapping in-position check.




(1) Section where in-position check is performed using servo in-position width
(2) Section where in-position check is performed using in-position width for tapping
(3) Section where in-position check is performed using in-position width for cutting feed (G1, G2, G3)
(4) Section where in-position check is performed using in-position width for rapid traverse (G0)

### 4.5.3.2 Pecking Tapping Cycle

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

The load applied to the tool can be reduced by designating the depth of cut per pass and cutting the workpiece to the hole bottom for a multiple number of passes.
The amount retracted from the hole bottom is set to the parameters.
Select either the pecking tapping cycle or the deep-hole tapping cycle by parameter.
When the pecking tapping cycle is executed in the synchronous tapping mode, the synchronous tapping cycle function and pecking tapping cycle function are required.
When "depth of cut per pass Q" is designated in the block containing the G84 or G74 command in the state where the pecking tapping cycle is selected by parameter, the pecking tapping cycle is executed.
In the following cases, the normal tapping cycle is established.

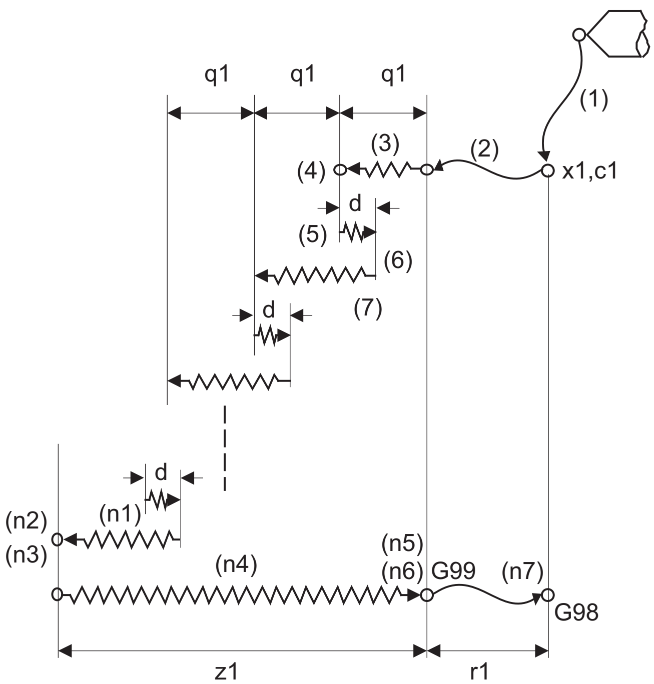
When Q is not designated
When the command value of Q is zero
When there is no Pecking tapping cycle function

(1) M system

| **G84(G74) Xx1 Yy1 Zz1 Rr1 Qq1 Ff1(Ee1) Pp1 Ss1 ,Ss2 ,Ii1 ,Jj1 ,Rr2 Ll1 ;** | |
|---|---|
| G84 | : G84 forward tapping cycle |
| G74 | : G74 reverse tapping cycle |
| Xx1,Yy1 | : Hole drilling position |
| Zz1 | : Hole bottom position |
| Rr1 | : Point R position |
| Qq1 | : Depth of cut per pass (designated as an incremental position) |
| Ff1 | : During synchronous tapping: Designation of drilling axis feed amount (tapping pitch) per spindle revolution (modal)<br>During asynchronous tapping: Designation of the feedrate for cutting feed (modal) |
| Ee1 | : Tap thread number per 1-inch feed of Z axis |
| Pp1 | : Dwell time at hole bottom position |
| Ss1 | : Rotation speed of spindle |
| ,Ss2 | : Rotation speed of spindle during retract |
| ,Ii2 | : In-position width of positioning axis |
| ,Jj2 | : In-position width of hole drilling axis |
| ,Rr2 | : Synchronization method selection (r2=1 synchronous, r2=0 asynchronous) |
| Ll1 | : Number of repetitions |

(2) L system

| **G84(G88, G84.1, G88.1) Xx1 Cc1 Zz1 Rr1 Qq1 Ff1(Ee1) Pp1 Ss1 ,Ss2 ,Ii ,Jj ,Rr2 Dd1 Ll1 Mm1 ;** | |
|---|---|
| G84 | : G84 Face forward tapping cycle |
| G88 | : G88 Side forward tapping cycle |
| G84.1 | : G84.1 Face reverse tapping cycle (It can be commanded by setting of parameter) |
| G88.1 | : G88.1 Side reverse tapping cycle (It can be commanded by setting of parameter) |
| Xx1,Cc1,Zz1 | : Hole position data and : hole bottom position |
| Rr1 | : Point R position |
| Qq1 | : Depth of cut per pass (designated as an incremental position) |
| Ff1 | : During synchronous tapping: Designation of drilling axis feed amount (tapping pitch) per spindle revolution (modal)<br>During asynchronous tapping: Designation of the feedrate for cutting feed (modal) |
| Ee1 | : Tap thread number per 1-inch feed of Z axis |
| Pp1 | : Dwell time at hole bottom position |
| Ss1 | : Rotation speed of spindle |
| ,Ss2 | : Rotation speed of spindle |
| ,Ii2 | : In-position width of positioning axis |
| ,Jj2 | : In-position width of hole drilling axis |
| ,Rr2 | : Synchronization method selection (r2=1:synchronous、r2=0:asynchronous) |
| Dd1 | : Tapping spindle number assignment<br>(By minus command, reverse tapping can be commanded by setting of parameter.<br>It can be commanded when it is multiple-spindle control Ⅰ .<br>Program error occurs when multiple-spindle control Ⅱ is commanded by D command.) |
| Ll1 | : Number of repetitions |
| Mm1 | : C axis clamp M code |




(1): G00 Xx1 Cc1 ,Ii1
(2): G00 Zr1
(3): G01 Zq1 Ff1
(4): M4 (Spindle reverse rotation)
(5): G01 Z-d Ff1
(6): M3 (Spindle forward rotation)
(7): G01 Z(q1+d) Ff1
:
(n1): G01 Z(z1-q1*n) Ff1
(n2): G04 Pp1
(n3): M4
(n4): G01 Z-z1 Ff1
(n5): G04 Pp1
(n6): M3
(n7): G98 mode G00Z-r1 ,Ij1
G99 mode No movement

d : Retract amount (parameter)

(Note) This program is for the G84 command. The spindle forward rotation (M3) and reverse rotation (M4) are reversed with the G74 command.

### 4.5.3.3 Deep-hole Tapping Cycle

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

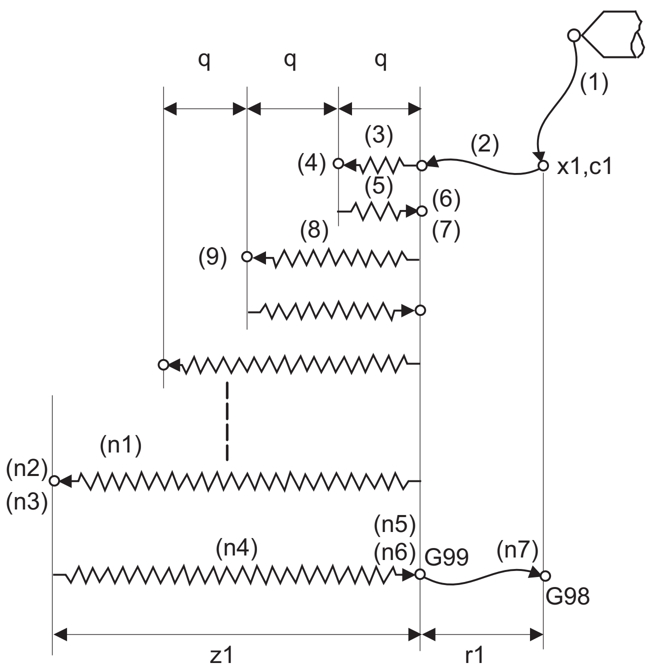
In the deep-hole tapping, the load applied to the tool can be reduced by designating the depth of cut per pass and cutting the workpiece to the hole bottom for a multiple number of passes.
Adding this function, the pecking tapping cycle function is also added.
Under the deep-hole tapping cycle, the tool is retracted to the R-point every time.
Select either the pecking tapping cycle or the deep-hole tapping cycle by parameter.
When the deep-hole tapping cycle is executed in the synchronous tapping mode, the synchronous tapping cycle function and deep-hole tapping cycle function are required.
When "depth of cut per pass Q" is designated in the block containing the G84 or G74 command in the state where the deep-hole tapping cycle is selected by parameter, the deep-hole tapping cycle is executed.
In the following cases, the normal tapping cycle is established.
When Q is not designated
When the command value of Q is zero
When there is no deep tapping cycle function

(1) M system

| **G84(G74) Xx1 Yy1 Zz1 Rr1 Qq1 Ff1(Ee1) Pp1 Ss1 ,Ss2 ,Ii ,Jj ,Rr2 Ll1 (Kk1) ;** | |
|---|---|
| G84 | : G84 forward tapping cycle |
| G74 | : G74 reverse tapping cycle |
| Xx1,Yy1 | : Hole drilling position |
| Zz1 | : Hole bottom position |
| Rr1 | : Point R position |
| Qq1 | : Depth of cut per pass (designated as an incremental position) |
| Ff1 | : During synchronous tapping: Designation of drilling axis feed amount (tapping pitch) per spindle revolution (modal)<br>During asynchronous tapping: Designation of the feedrate for cutting feed (modal) |
| Ee1 | : Tap thread number per 1-inch feed of Z axis |
| Pp1 | : Dwell time at hole bottom and point R return |
| Ss1 | : Rotation speed of spindle |
| ,Ss2 | : Rotation speed of spindle during retract |
| ,Ii2 | : In-position width of positioning axis |
| ,Jj2 | : In-position width of hole drilling axis |
| ,Rr2 | : Synchronization method selection (r2=1 synchronous, r2=0 asynchronous) |
| Ll1 | : Number of repetitions |
| Kk1 | : Number of repetitions (It commanded by parameter) |

(2) L system

| G84(G88, G84.1, G88.1) Xx1 Cc1 Zz1 Rr1 Qq1 Ff1(Ee1) Pp1 Ss1 ,Ss2 ,Ii ,Jj ,Rr2 Dd1 Ll1 Mm1 ; | |
|---|---|
| G84 | : G84 Face forward tapping cycle |
| G88 | : G88 Side forward tapping cycle |
| G84.1 | : G84.1 Face reverse tapping cycle (It can be commanded by setting of parameter) |
| G88.1 | : G88.1 Side reverse tapping cycle (It can be commanded by setting of parameter) |
| Xx1,Cc1,Zz1 | : Hole position data and : hole bottom position |
| Rr1 | : Point R position |
| Qq1 | : Depth of cut per pass (designated as an incremental position) |
| Ff1 | : During synchronous tapping: Designation of drilling axis feed amount (tapping pitch) per spindle revolution (modal)<br>During asynchronous tapping: Designation of the feedrate for cutting feed (modal) |
| Ee1 | : Tap thread number per 1-inch feed of Z axis |
| Pp1 | : Dwell time at hole bottom position |
| Ss1 | : Rotation speed of spindle |
| ,Ss2 | : Rotation speed of spindle |
| ,Ii2 | : In-position width of positioning axis |
| ,Jj2 | : In-position width of hole drilling axis |
| ,Rr2 | : Synchronization method selection (r2=1:synchronous、r2=0:asynchronous) |
| Dd1 | : Tapping spindle number assignment<br>(By minus command, reverse tapping can be commanded by setting of parameter.<br>It can be commanded when it is multiple-spindle control Ⅰ .<br>Program error occurs when multiple-spindle control Ⅱ is commanded by D command.) |
| Ll1 | : Number of repetitions |
| Mm1 | : C axis clamp M code |




(1): G00 Xx1 Cc1
(2): G00 Zr1
(3): G01 Zq1 Ff1
(4): M4 (Spindle reverse rotation)
(5): G01 Z-q1 Ff1
(6): G04 Pp1
(7): M3 (Spindle forward rotation)
(8): G01 Z(2*q1)Ff1
(9):
:
(n1): G01 Zz1 Ff1
(n2): G4 Pp1
(n3): M4
(n4): G01 Z-z1 Ff1
(n5): G04 Pp1
(n6): M3
(n7): G98 mode G00Z-r1 ,Ij1
G99 mode No movement

(Note) This program is for the G84 command. The spindle forward rotation (M3) and reverse rotation (M4) are reversed with the G74 command.

### 4.5.3.102 Multiple Spindle Synchronous Tapping

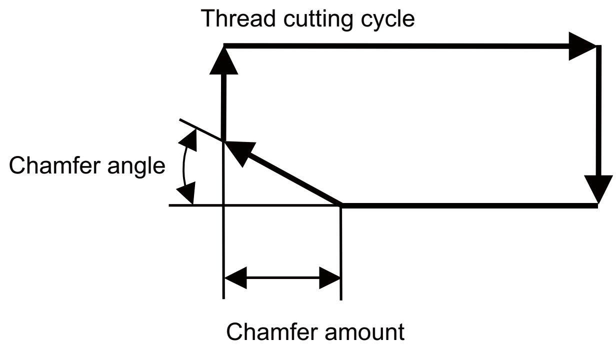
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | — | — | — | — | — | — | — | △ |
| L | — | — | — | — | — | — | — | △ |

This can perform synchronous tapping with multiple spindles simultaneously, and can improve efficiency of the tapping.
You can designate all spindles to constitute.
The command format is the same as the command for normal synchronous tapping.
The multiple spindles to execute the synchronous tapping are designated from the sequence I/F.

## 4.5.4 Chamfering

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | — | — | — | — | — | — | — | — |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Chamfering can be validated during the thread cutting cycle by using external signals.
The chamfer amount and angle are designated with parameters.



### 4.5.6 Circular Thread Cutting

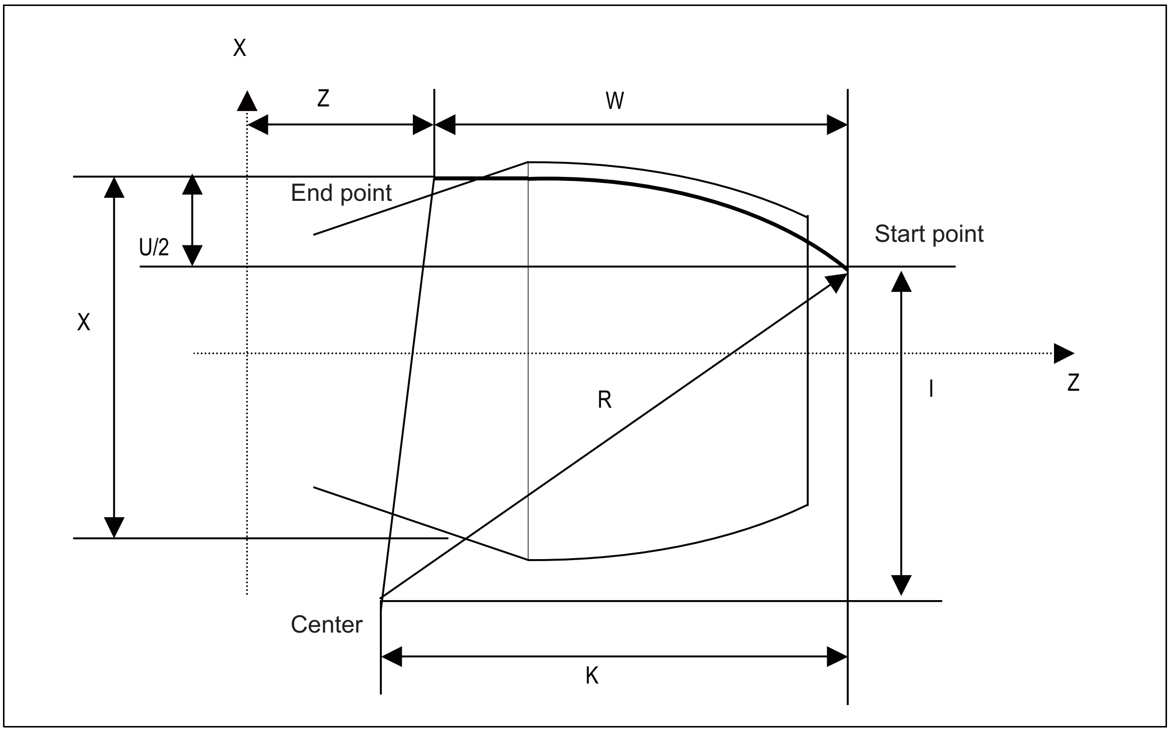
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | – | – | – | – | – | – | – | – |
| L | △ | △ | △ | △ | ○ | ○ | – | – |

Circular thread in which the lead is in longitudinal direction can be cut.
This function can be used with the G code list 6 or 7.

Command format

**G35(G36) Xx/Uu Zz/Ww { Ii Kk / Rr } Ff/Ee Qq ;**

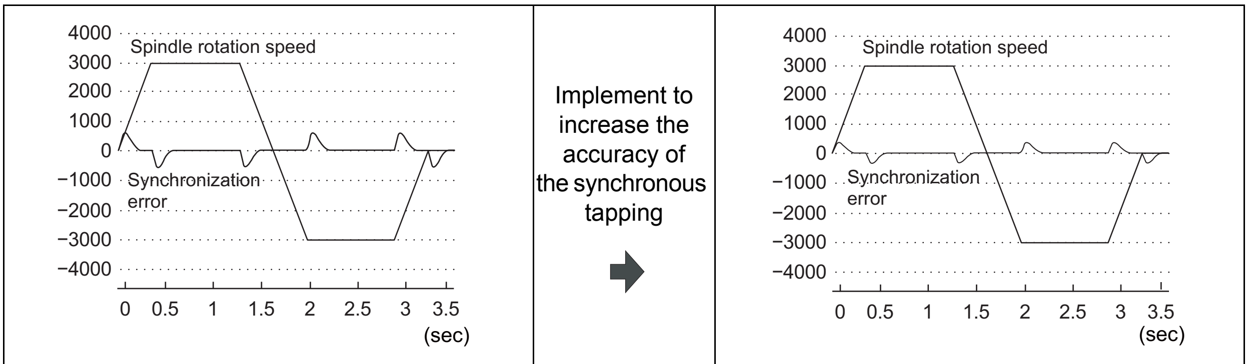
| | |
|---|---|
| G35 | : Clockwise (CW) |
| (G36) | : Counterclockwise (CCW) |
| Xx/Uu | : X-axis arc end point coordinate |
| Zz/Ww | : Z-axis arc end point coordinate |
| Ii | : X-axis arc center (incremental position of arc center as referenced from start point) |
| Kk | : Z-axis arc center (incremental position of arc center as referenced from start point) |
| Rr | : Arc radius |
| Ff/Ee | : Longitudinal axis (axis with most travel) direction lead<br>(Ff: normal lead thread cutting, Ee: precise lead threads or inch threads) |
| Qq | : Thread cutting start shift angle (0.000 to 360.000°) |



### 4.5.8 High-speed Synchronous Tapping (OMR-DD)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The servo axis directly detects and compensates of the spindle's delay in tracking by using the communication between drive unit over the high-speed optical servo network. By minimizing the synchronization error, the accuracy of the synchronous tapping is increased.




without OMR-DD control

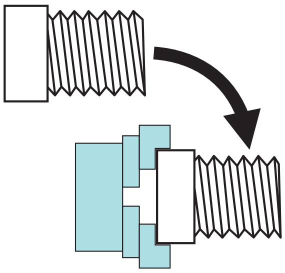
with DMR-DD control

### 4.5.10 Thread Recutting

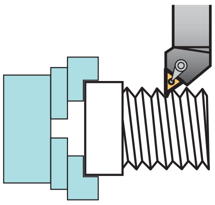
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | – | – | – | – | – | – | – | – |
| L | △ | △ | △ | △ | ○ | ○ | – | – |

The function stores a thread groove position and compensates a start position of spindle thread cutting automatically so that the tool can pass along the memorized position of the thread groove at the thread cutting execution. Thread machined workpieces which have problems such as the thread number shortage, striped groove, etc., can be re-chucked and thread recut.

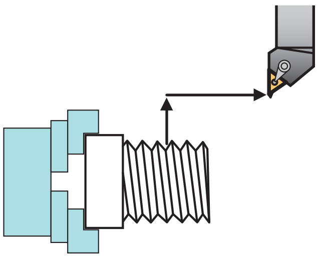
(1) Re-chucking of thread machined workpiece



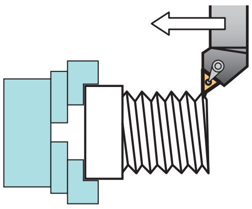
(2) Memorizing thread groove position (memorizing lead axis and spindle position)



(3) Moving to start position after tool retract



(4) Thread recutting ON and program operation start



The start position of spindle thread cutting is automatically compensated with the memorized position of the lead axis and spindle.

Thread recutting correspondence table

| Thread cutting command | Z direction feed thread | X direction feed thread |
|---|---|---|
| | Right-handed/Left-handed thread | Scroll thread |
| Thread cutting | ○ | ○ |
| Continuous thread | △ (Note 1) | △ (Note 1) |
| Variable lead thread | △ (Note 2) | △ (Note 2) |
| Fixed cycle for turning machining | ○ | ○ |
| Compound type fixed cycle for turning machining | △ (Note 3) | △ (Note 3) |

○ : Machinable △ : Machinable with conditions × : Impossible

Machinable with conditions ( △ )

(Note 1) Continuous thread: Conduct a memorizing of thread recutting position at the groove on the first block of continuous thread.

(Note 2) Variable lead thread: thread recutting is disable during an automatic operation with thread recutting enabled when the first thread cutting command is the variable lead thread cutting.

(Note 3) Compound type fixed cycle: Re-finishing can be performed to the finishing allowance.

### 4.5.11 Thread Cutting Override

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | － | － | － | － | － | － | － | － |
| L | △ | △ | △ | △ | ○ | ○ | － | △ |

The thread cutting feedrate can be changed by changing the spindle override depending on rough cutting, finish machining, etc.
The spindle speed during thread cutting is determined with the spindle override at the start of thread cutting.

### 4.5.12 Variable Feed Thread Cutting

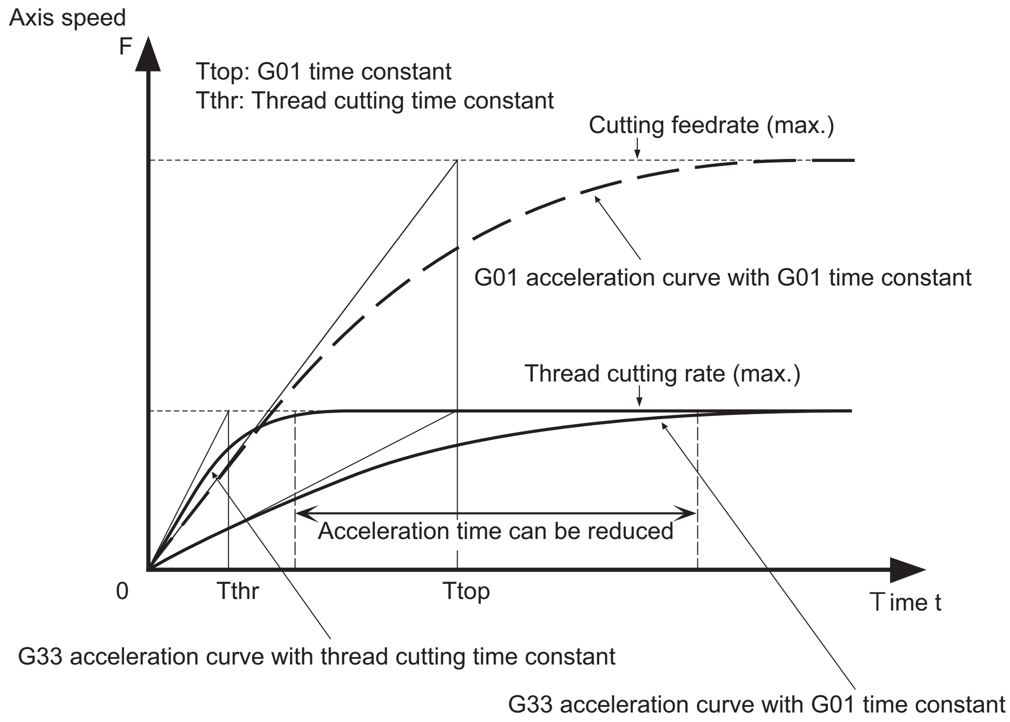
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | － | － | － | － | － | － | － | － |
| L | △ | △ | △ | △ | ○ | ○ | － | △ |

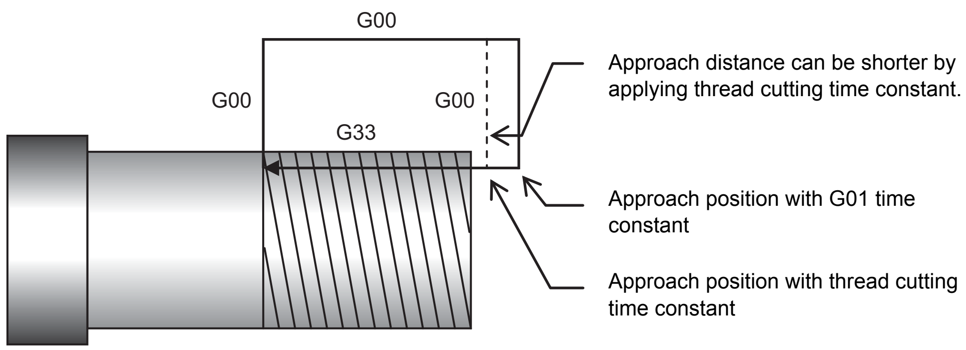
This function changes the cutting feedrate by the spindle override at the time of the thread cutting. The machining condition during thread cutting can be changed.

### 4.5.13 Thread Cutting Time Constant Switch

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | – |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | – |

"Thread cutting time constant" can be applied to the acceleration/deceleration time constant of the NC control axis during the thread cutting. Usually, incorrect lead parts occur at the start and the end of thread cutting due to the acceleration/deceleration of the NC control axis. However, the acceleration/deceleration time, which causes incorrect lead parts, can be reduced by applying the thread cutting time constant to the NC control axis during the thread cutting so that the incorrect thread parts can be reduced. Additionally, the machining time can be reduced as much as the acceleration/deceleration time reduction of thread cutting.



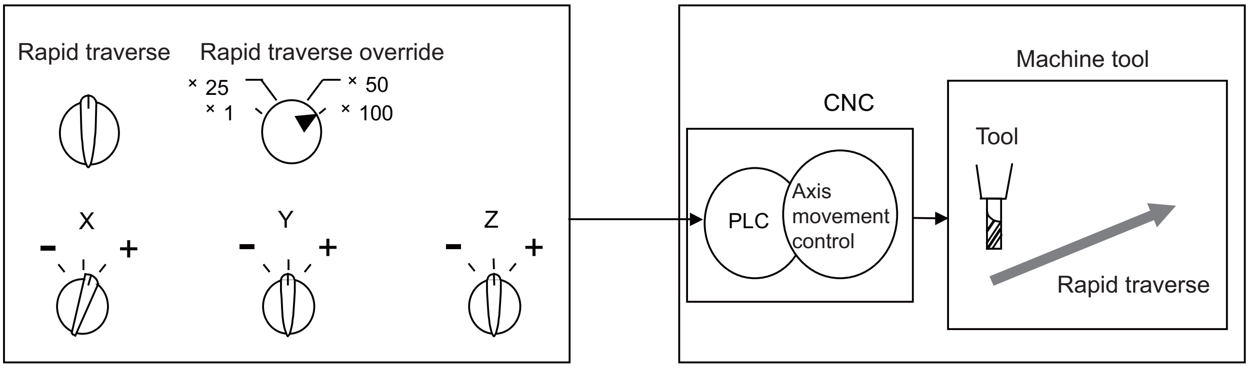



## 4.6 Manual Feed

### 4.6.1 Manual Rapid Traverse

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

When the manual rapid traverse mode is selected, the tool can be moved at the rapid traverse rate for each axis separately. Override can also be applied to the rapid traverse rate by means of the rapid traverse override function. Rapid traverse override can be set for each part system respectively.

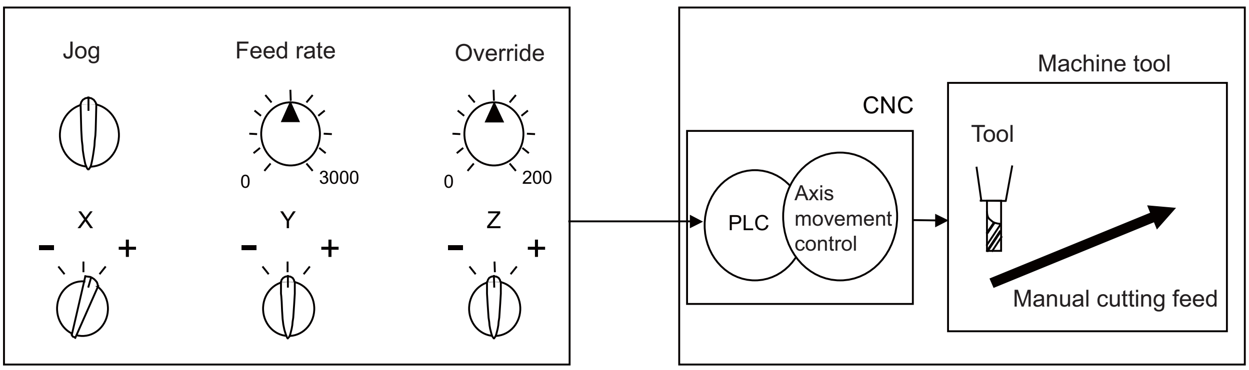



### 4.6.2 Jog Feed

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

When the jog feed mode is selected, the tool can be moved in the axis direction (+ or -) in which the machine is to be moved at the per-minute feed.
The jog feedrate can be set for each axis with the parameters.
If the jog feedrate is not set with the parameters, the jog feedrate is set with the PLC signal.

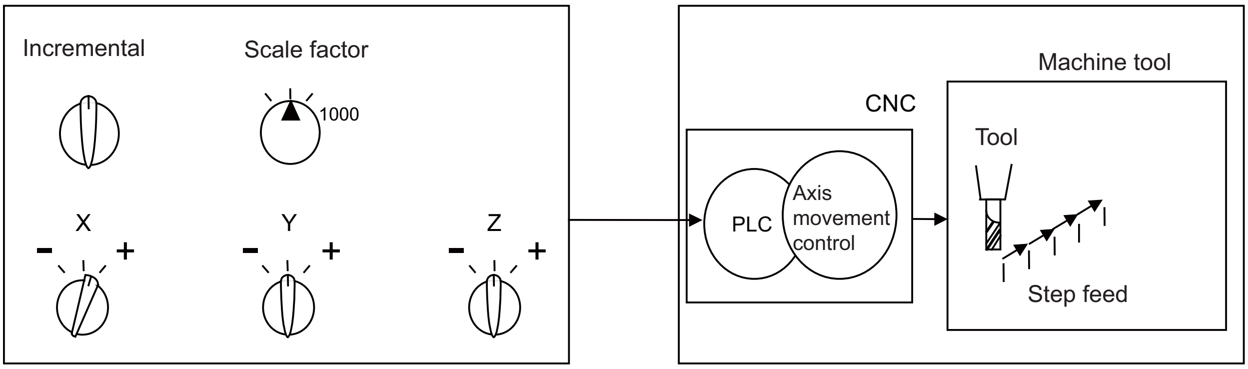
There are two methods for PLC signal which sets the jog feed rate: the code method and the value setting method. The method to be used is selected by PLC signal for each part system. The signals of code and value setting methods are set for each part system.



### 4.6.3 Incremental Feed

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

When the incremental feed mode is selected, the tool can be operated by an amount equivalent to the designated amount (incremental value) in the axis direction each time the jog switch is pressed. The incremental feed amount is the amount obtained by multiplying the least command increment that was set with the parameter by the incremental feed magnification rate.
The incremental feed amount parameter and its magnification rate can be set for each part system respectively.




### 4.6.4 Handle Feed

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

In the handle feed mode, the machine can be moved in very small amounts by rotating the manual pulse generator. The scale can be selected from X1, X10, X100, X1000 or arbitrary value.
If the least command increment is 10nm or 1nm, the scale can be selected from X5000, X10000, x50000 or X100000, as well.
Individual axes can be moved in very small amounts separately by rotating the manual pulse generators installed on each of the axes.
(Note 1) The actual movement amount and scale may not match if the manual pulse generator is rotated quickly.

Up to three handles (manual pulse generators) can be used with the MITSUBISHI CNC.
The handles can be connected to the control unit and remote I/O unit. If the operation panel I/O unit is connected, the handle can also be connected to the operation panel I/O unit.

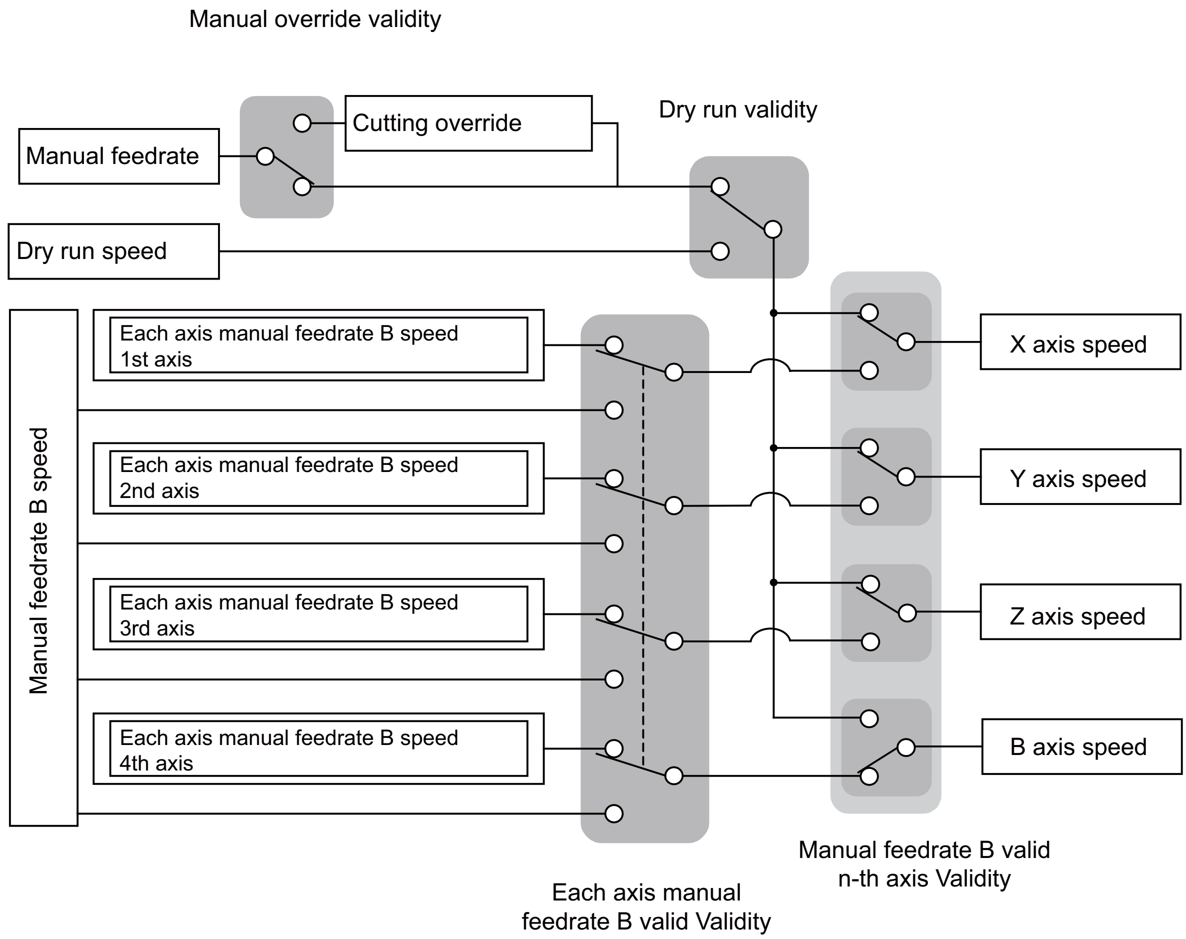
### 4.6.5 Manual Feedrate B

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

"Manual feedrate B" is a function that sets an arbitrary axis feedrate from the user PLC separately from the "manual feedrate". The "manual feedrate B" feedrate setting can be selected from the feedrate common for all axes and the feedrate independent of reach axis.
By combining the "manual feedrate B" function with the manual/automatic simultaneous function, an arbitrary axis can be moved at the "manual feedrate B" independently of the machining program operation even during automatic operation. Similarly, if the jog mode and other manual operation mode are set simultaneously, an arbitrary axis can be moved at a speed independent from the "manual feedrate" even during the manual operation mode.

The "manual feedrate B" function can move an axis at a speed different from the "manual feedrate". This is not affected by dry run, or by manual or cutting override, so an arbitrary axis can be moved independently even in operations during automatic operation or override during manual axis movement.

The relation of the "manual feedrate B" and "manual feedrate" is shown below.



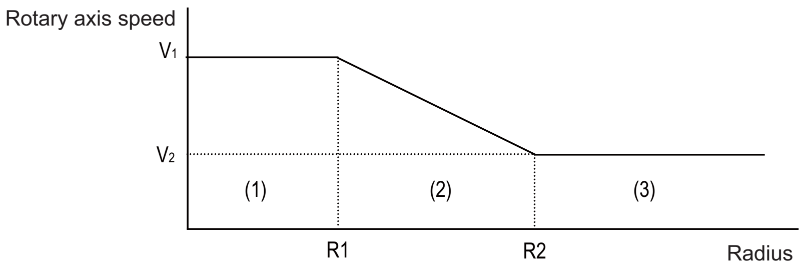

(Note) For the axis to which manual feedrate B is applied, the feedrate is not displayed on the screen.

### 4.6.6 Manual Feedrate B Surface Speed Control

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ― | ― | ― | ― |
| L | ― | ― | ― | ― | ― | ― | ― | ― |

When using the manual feedrate B function and machining by moving the orthogonal axis while rotating the rotary table, the tool nose and workpiece's relative speed will drop as the tool nears the rotation center if the table rotation speed remains under the set conditions. This function controls the table rotation speed according to the distance from the rotation center.

As shown below, the distance (radius) from the rotation center at two points and the rotary axis speed at each point is set in the parameters. When the "manual feedrate B constant surface speed control valid" signal is turned ON, the rotary axis speed will be automatically calculated according to the current radius R.




(1) If R ≦ R1, then V1 will be applied.
(2) If R1<R<R2, the speed V is calculated with the following expression.

$$V=\frac{(V_2 - V_1)}{(R_2 - R_1)} *(R - R_1)+V_1$$

(3) If R2 ≦ R, then V2 will be applied.

Override can be applied in the range of 0 to 200% in respect to the rotary axis's speed for which the manual feedrate B surface speed control is valid.

This function can be used with a rotary axis for which the manual feedrate B function is valid.
The manual feedrate B speed and each axis' manual feedrate B speed which are issued from the user PLC is ignored for an axis for which this function is valid.

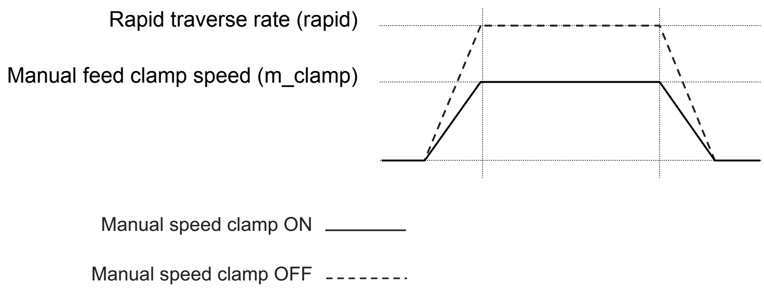
### 4.6.8 Manual Speed Clamp

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The maximum speed for manual feed can be switched to the rapid traverse rate or the manual feed clamp speed. This function is usable, for instance, when the axis speed needs to be clamped at an arbitrary rate for performing a manual feed with a cutting cover opened.

The clamp speed is switched with the parameter or PLC signal.
The manual feed clamp speed can be set to an arbitrary speed with the parameter.
The manual feedrate can be applied for operation modes as follows:

- Jog mode
- Handle mode
- Incremental mode
- Manual reference position return (high-speed) mode



## 4.7 Dwell

With this function, the program command temporarily stops the machine movement and puts the machine into standby status so that the starting time of the next block can be delayed.

### 4.7.1 Dwell (Time-based Designation)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

When G04 is commanded in the asynchronous feed mode (G94), the machine waits for the specified amount of time before executing the next block.

Command format

**G94 G04 X/U__ ; or G94 G04 P__ ;**
X/P/U : Dwell time

(1) G94 is not necessary in the asynchronous feed mode (G94).
(2) The decimal point command is enabled for the dwell time designation with X and U.
(3) The decimal point command can be switched valid/invalid by the parameter for the dwell time designation with P. When the decimal point command is set to be invalid, the command value below the decimal point with P is ignored.
(4) When the decimal point command is valid or invalid, the dwell time command range for each status is as follows.

| Command range when the decimal point command is valid | Command range when the decimal point command is invalid |
|---|---|
| 0 to 99999.999 (s) | 0 to 99999999 (ms) |

### 4.7.2 Dwell (Revolution-based Designation)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ― | ― | ― | ― | ― | ― | ― | ― |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

When G04 is commanded in the synchronous feed mode (G95), the machine waits for the spindle to rotate for the number of the revolutions designated.

Command format

| **G95 G04 X/U__ D__ ; or G95 G04 P__ D__ ;** | |
|---|---|
| X/P/U | : Number of revolutions for dwell |
| D | : Dwell target spindle (For command using the spindle number, the spindle number should be within the number of spindles for specifications. For command using the spindle name, the number from 1 to 9 is valid for the spindle name.) |

(1) G95 is not necessary when the D command is assigned in the same block as G04.
(2) G95 is not necessary in the synchronous feed mode (G95).
(3) The decimal point command is enabled for the number of revolutions designation with X and U for dwell.
(4) The decimal point command can be switched valid/invalid by the parameter for the number of revolution for dwell designation with P. When the decimal point command is set to be invalid, the command value below the decimal point with P is ignored.
(5) When the decimal point command is valid or invalid, the command range of number of revolution for dwell is as follows for each status.

| Command range when the decimal point command is valid | Command range when the decimal point command is invalid |
|---|---|
| 0 to 99999.999 (rev) | 0 to 99999999 (0.001rev) |

5

# Program Memory/Editing

## 5.1 Memory Capacity

Machining programs are stored in the NC memory, DS, and external memory device (front SD card, built-in disk of display unit, etc.).
When using devices such as the built-in disk (HD) of the display unit, DS and memory card, mass-editing, which is carried out on those devices, is possible.
The data size that can be handled in the mass-editing differs depending on the devices.

### 5.1.1 Memory Capacity (Number of Programs Stored)

[M system]

| Memory capacity (number of programs stored) | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| 500kB [1280m] (1000 programs) | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| 1000kB [2560m] (1000 programs) | △ | △ | △ | △ | — | — | — | — |
| 2000kB [5120m] (1000 programs) | △ | △ | △ | △ | — | — | — | — |

[L system]

| Memory capacity (number of programs stored) | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| 500kB [1280m] (1000 programs) | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| 1000kB [2560m] (1000 programs) | △ | △ | △ | △ | — | — | — | — |
| 2000kB [5120m] (1000 programs) | △ | △ | △ | △ | — | — | — | — |

(Note) The tape length for the multi-part system specifications is the total for all part systems.

## 5.2 Editing

### 5.2.1 Program Editing

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The following editing functions are possible.

**(1) Program erasing**

(a) Machining programs can be erased individually or totally.

**(2) Program filing**

(a) This function displays a list of the machining programs stored (registered) in the controller memory.

(b) The programs are displayed in ascending order.

(c) Comments can be added to corresponding program numbers.

**(3) Program copying**

(a) Machining programs stored in the controller memory can be copied, condensed or merged.

(b) The program No. of the machining programs in the memory can be changed.

**(4) Program editing**

(a) Overwriting, inserting and erasing can be done per character.

**(5) Mass editing (M800/M80 series)**

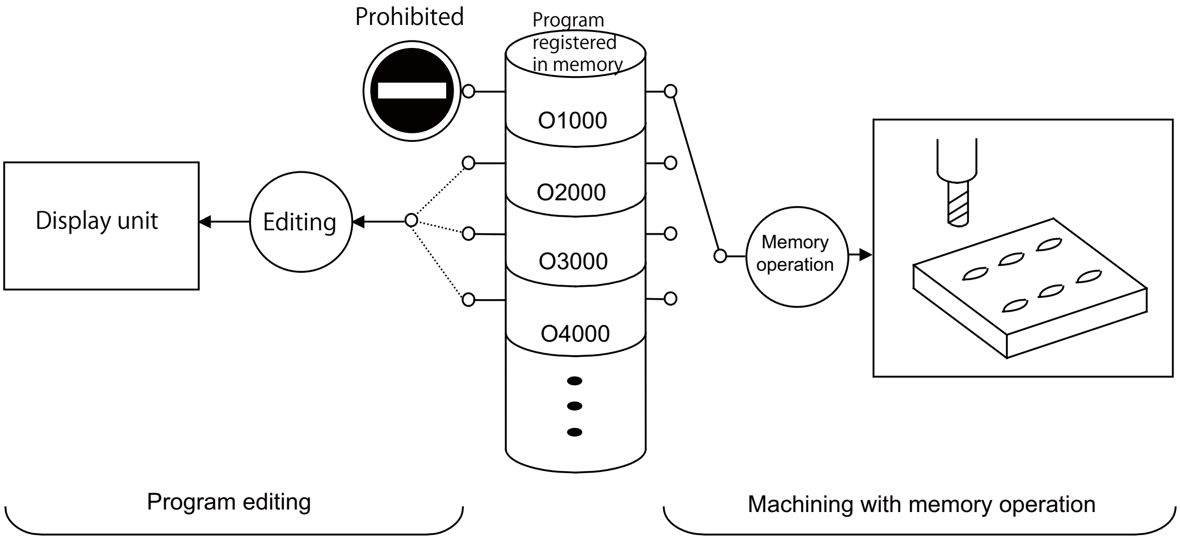
There are regular editing and mass-editing for program editing. The specification and restrictions are different between the regular editing and mass-editing.
Refer to the table below for conditions to be mass-editing and its maximum editing size.

| Series | Conditions to be mass-editing | Maximum editing size |
|---|---|---|
| M800/M80W | - The storage destination for the machining program to be opened is either the built-in disk (HD) of the display unit, USB memory, memory card or DS.<br>- A file size is 1.0MB or larger. (The size could be 2.0MB or larger, depending on the parameter settings.) | M800S: 20MB<br>M800W/M80W (Windows-based display): 1GB<br>M800W/M80W (Windows-less display): 20MB |
| M80 | - The storage destination for the machining program to be opened is either memory card, USB memory or DS.<br>- A file size is 0.5MB or larger. | 10MB |

### 5.2.2 Background Editing

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

This function enables one machining program to be created or editing while another program is being run.

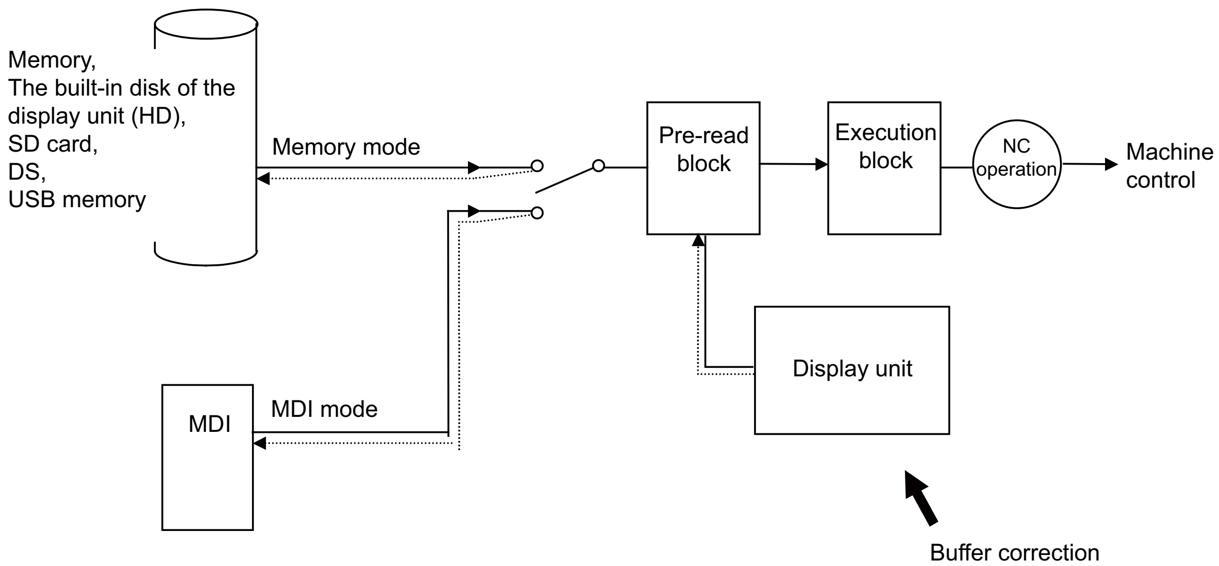



(1) The data of the machining programs being used in memory operation can be displayed and scrolled on the setting and display unit, but data cannot be added, revised or deleted.
(2) The editing functions mentioned in the preceding section can be used at any time for machining programs which are not being used for memory operation.
This makes it possible to prepare and edit the next program for machining, and so the machining preparations can be made more efficiently.
(3) The machining program will not be searched as the operation target even when searched in the edit screen.

### 5.2.3 Buffer Correction

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

During automatic operation (including memory, SD card, USB memory or DS operation) or MDI operation, this function initiates single block stop and enables the next command to be corrected or changed.
Only memory or DS operation allows the changes with buffer corrections to be updated in the machining program.
When a program error has occurred, the function enables the block in which the error occurred to be corrected and operation to be resumed without having to perform NC resetting.



### 5.2.5 Multi-part System Simultaneous Program Editing

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | － | － | － | － |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | △ |

When an operation to open a machining program in the NC memory is performed on the edit screen, machining programs are opened in the right and left areas at the same time; the specified machining program of the displayed part system in the edit area being selected and the machining program of another part system with the same name in the unselected edit area.

### 5.2.6 Special Program Editing Display for Synchronization between Part Systems

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | － | － | － | － |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

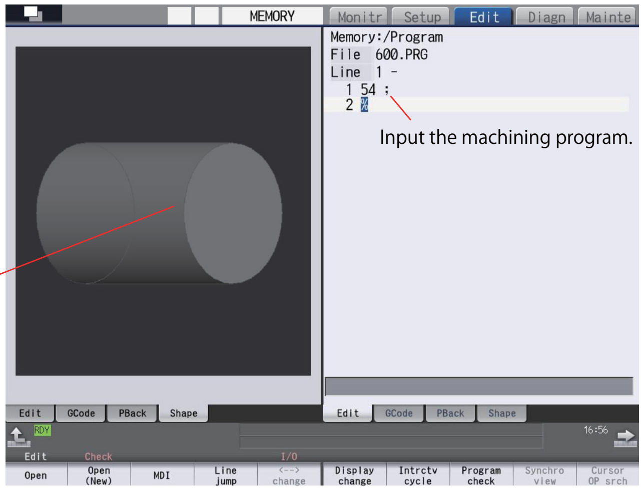
Pressing the [Synchro view] menu enables synchronized display of the left- and right-side programs aligned using the timing synchronization symbols, when all the following conditions are met:
- Multi-part system program management is ON
- Multi-program display type is selected
- The left and right edit areas are displaying the same named programs of different part systems stored on the NC memory

### 5.2.7 Finish Shape View Programming

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | － |
| L | △ | △ | △ | △ | ○ | ○ | ○ | － |

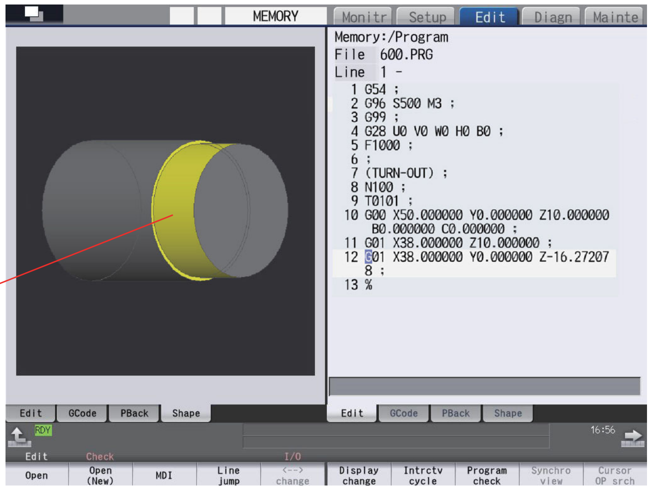
This function shows the machining shape according to the command at the time the machining program is input, and is intended to eliminate mistakes in programming.
Therefore, the machining shape can be confirmed easily without performing the automatic operation or the graphic check.

(Example) For a new program file, confirm the finish shape by inputting the machining program.




The input machining program will be reflected in the shape.
* In this example, as the cutting is not performed with G54, the shape will not be changed.

When inputting the machining program continuously ...




The input machining program will be reflected in the shape.

# 6

# Operation and Display

## 6.1 Structure of Operation/Display Panel

Setting display unit consists of the display and keyboard unit.
Refer to "General Specifications" for details.

(Note) For Separated-type color touchscreen display (19-type LCD TFT/Windows8), only software keyboard is available and there is no hardware keyboard.

### 6.1.1 Color Display (8.4-type LCD TFT)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | — | — | — | — | — | □ | □ | — |
| L | — | — | — | — | — | □ | □ | — |

### 6.1.2 Color Touchscreen Display (10.4-type LCD TFT)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | — | — | □ | □ | — | □ | □ | — |
| L | — | — | □ | □ | — | □ | □ | — |

### 6.1.3 Color Touchscreen Display (15-type LCD TFT)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | — | — | □ | □ | — | □ | □ | — |
| L | — | — | □ | □ | — | □ | □ | — |

### 6.1.4 Separated-type Color Touchscreen Display (8.4-type LCD TFT)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | — | — | — | — | □ | — | — | — |
| L | — | — | — | — | □ | — | — | — |

### 6.1.5 Separated-type Color Touchscreen Display (10.4-type LCD TFT)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | □ | □ | — | — | □ | — | — | — |
| L | □ | □ | — | — | □ | — | — | — |

### 6.1.6 Separated-type Color Touchscreen Display (15-type LCD TFT)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | □ | □ | — | — | □ | — | — | — |
| L | □ | □ | — | — | □ | — | — | — |

### 6.1.7 Separated-type Color Touchscreen Display (15-type LCD TFT/Windows8)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | □ | □ | — | — | □ | — | — | — |
| L | □ | □ | — | — | □ | — | — | — |

### 6.1.8 Separated-type Color Touchscreen Display (19-type LCD TFT/Windows8)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | □ | □ | ー | ー | □ | ー | ー | ー |
| L | □ | □ | ー | ー | □ | ー | ー | ー |

### 6.1.9 Separated-type Color Touchscreen Display (19-type Horizontal LCD TFT/Windows8)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | □ | □ | ー | ー | □ | ー | ー | ー |
| L | □ | □ | ー | ー | □ | ー | ー | ー |

### 6.1.102 GOT (GOT2000 Series GT27/GT25 12.1/10.4/8.4/5.7)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ー | ー | ー | ー | ー | ー | ー | ○ |
| L | ー | ー | ー | ー | ー | ー | ー | ○ |

## 6.2 Operation Methods and Functions

### 6.2.1 Operation Input

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

In addition to the method of directly inputting numeric data, a method to input the operation results using four rules operators and function symbols can be used for specific data settings.

Numeric values, function symbols, operators and parentheses ( ) are combined and set in the data setting area.
The operation results appear when the INPUTkey is pressed. If the INPUT key is pressed again, the data is processed and displayed on the screen. The contents in the data setting area are erased.

| Examples of operator settings and results | | | | Function symbols, setting examples and results | | | |
|---|---|---|---|---|---|---|---|
| Operation | Setting example | Operation results | | Function | Function symbol | Setting example | Operation results |
| Addition | = 100+50 | 150.000 | | Absolute value | ABS | = ABS(50-60) | 10 |
| Subtraction | = 100-50 | 50.000 | | Square root | SQRT | = SQRT(3) | 1.732 |
| Multiplication | = 12.3*4 | 49.200 | | Sine | SIN | = SIN(30) | 0.5 |
| Division | = 100/3 | 33.333 | | Cosine | COS | = COS(15) | 0.966 |
| Function | = 1.2*(2.5+SQRT(4)) | 5.4 | | Tangent | TAN | = TAN(45) | 1 |
| | | | | Arc tangent | ATAN | = ATAN(1.3) | 52.431 |

### 6.2.2 Absolute Value/Incremental Value Setting

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

When setting the data, the absolute/incremental setting can be selected from the menu.

The absolute/incremental settings can be selected on the following screens.
- Common variable screen
- Tool compensation amount screen
- Coordinate system offset screen

### 6.2.3 Multiple Display Connection

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | － | － | － | － | － | － | － | ○ (GOT) |
| L | － | － | － | － | － | － | － | ○ (GOT) |

By attaching an Ethernet hub, one CNC can be switched to display up to 8 setting display units (CNC monitor2 for GOT or NC Monitor2) at a time. (However, depending on the specification of machine operation panel, there might be the limitation of the maximum number of the connectable units.)

### 6.2.4 Common Display to Multiple NCs

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | － | － | － | － | － | － | － | ○ (GOT) |
| L | － | － | － | － | － | － | － | ○ (GOT) |

By attaching an Ethernet hub, one setting display unit can be switched to display up to 64 CNCs. (However, depending on the specification of machine operation panel, there might be the limitation of the maximum number of the connectable units.)

### 6.2.5 Displayed Part System Switch

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | － | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The part system displayed on the screen can be changed with the [$<->$] keys.
The number of displayed part systems is counted by one each time the [$<->$] keys are pressed. The screen corresponding to that part system opens.
If the number of displayed part systems exceeds the valid number of part systems, the number of displayed part systems will return to 1.

### 6.2.6 Menu List

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The menu list function displays the menu configuration of each screen as a list making it possible to directly select the menu for other screens.
When the cursor is moved to the menu, the outline of that menu's functions will also appear. The menu can be selected while checking the details of the menu.

### 6.2.7 Display Switch by Operation Mode

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The screen display changes when the screen mode selection switch is changed.
The details corresponding to the operation mode are displayed.

### 6.2.8 External Signal Display Switch

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | － | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | － | ○ |

The screen display changes with the signal from PLC.

### 6.2.9 Screen Saver

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ (GOT) |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ (GOT) |

The screen saver function protects the screen display unit by turning the backlight OFF after the time set in the parameters has elapsed. The backlight is turned OFF after a certain period of time (automatic change function) or after the key operations (manual change function).
The screen is displayed again by pressing any key, or by touching anywhere on the screen if the display unit carries a touch-sensitive screen.

### 6.2.10 Parameter Guidance

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The parameter guidance function displays the details of the parameters according to the state of the screen currently being displayed.

If the ? key is pressed on any screen, the parameter guidance window will open. If a pop-up window other than the parameter guidance window is opened, the parameter guidance window will open over the currently opened pop-up window.
For the display unit with a touch-sensitive screen, if you hold down the parameter data area (tap the target and keep your finger down for a while), the guidance of that parameter is displayed.

### 6.2.11 Alarm Guidance

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The alarm guidance displays the alarm message, details and remedy for the alarm currently issued.
By utilizing the guidance information, identify the cause from possible factors and determine the countermeasures.
When a multiple number of alarms are issued at the same time, guidance will be displayed for all the alarm issued.

### 6.2.12 Machining Program Input Mistake Check Warning

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | — | — | — | — |
| L | △ | △ | △ | △ | — | — | — | — |

If an illegal input is found in the decimal point after the current cursor position, the cursor will move to that position, and a warning message will appear.
If this function is ON when editing the program, the decimal point will be checked for the block each time an edit key (alphabet, number, symbol, Delete, etc.) is pressed. The block is not checked when the cursor keys or page feed keys are pressed.
The warning for illegal machining program can also be issued while editing an MDI program.
The comment block is also subject to the warning for illegal machining program.

A warning does not appear in the following cases.

(1) When the data in the address subject to the illegal decimal point input is "0", a warning will not be issued regardless of whether there is a decimal point or not. (Example: A warning is not issued for "X0".)
(2) When the data in the address subject to the illegal decimal point input is omitted, a warning will not be issued. (Example: A warning is not issued for "G28XYZ".)
(3) Blocks containing "[" or "]" are not subject to the warning for illegal machining program.

### 6.2.14 Screenshot Capture

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | —/ ○ | —/ ○ | ○ | ○ | —/ ○ | ○ | ○ | ○ (GOT) |
| L | —/ ○ | —/ ○ | ○ | ○ | —/ ○ | ○ | ○ | ○ (GOT) |

* Specifications of separated-type display are classified with "Windows-based" and "Windows-less"

This function allows to output a bitmap file of a screen displayed on the setting and display unit.

### 6.2.15 User Selectable Menu Configuration

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

This function allows to change the display order of operations, procedure and edit screen, and to change display/non-display selection.

### 6.2.16 PC-NC Network Automatic Connection

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○/― | ○/― | ― | ― | ○/― | ― | ― | ― |
| L | ○/― | ○/― | ― | ― | ○/― | ― | ― | ― |

* Specifications of separated-type display are classified with "Windows-based" and "Windows-less"

This function supports to restore the connection when the network connection cannot be created between the display unit and the control unit.
When the connection is not established even after the time out has expired, the connectable control unit IP address list appears. From the IP address list, the network connection can be re-established and restored when the IP address, which is to be connected with the control unit, is selected.

### 6.2.17 Device Open Parameter

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ― |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ― |

This function can set or change the user backed up area of the PLC device from the NC screen.
The following settings are available from the NC screen.
- Divide the device area accordance with the specifications of the machine maker and set and display for each divided area.
- Switch the display format or data type for each divided area.

### 6.2.18 SRAM Open Parameter

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ― |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ― |

This function can set or change the SRAM open area for the machine maker from the NC screen.
The following settings are available from the NC screen.
- Divide the SRAM area accordance with the specifications of the machine maker and set and display for each divided area.
- Switch the display format or data type for each divided area.

### 6.2.19 MTB Selectable Menu Configuration

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

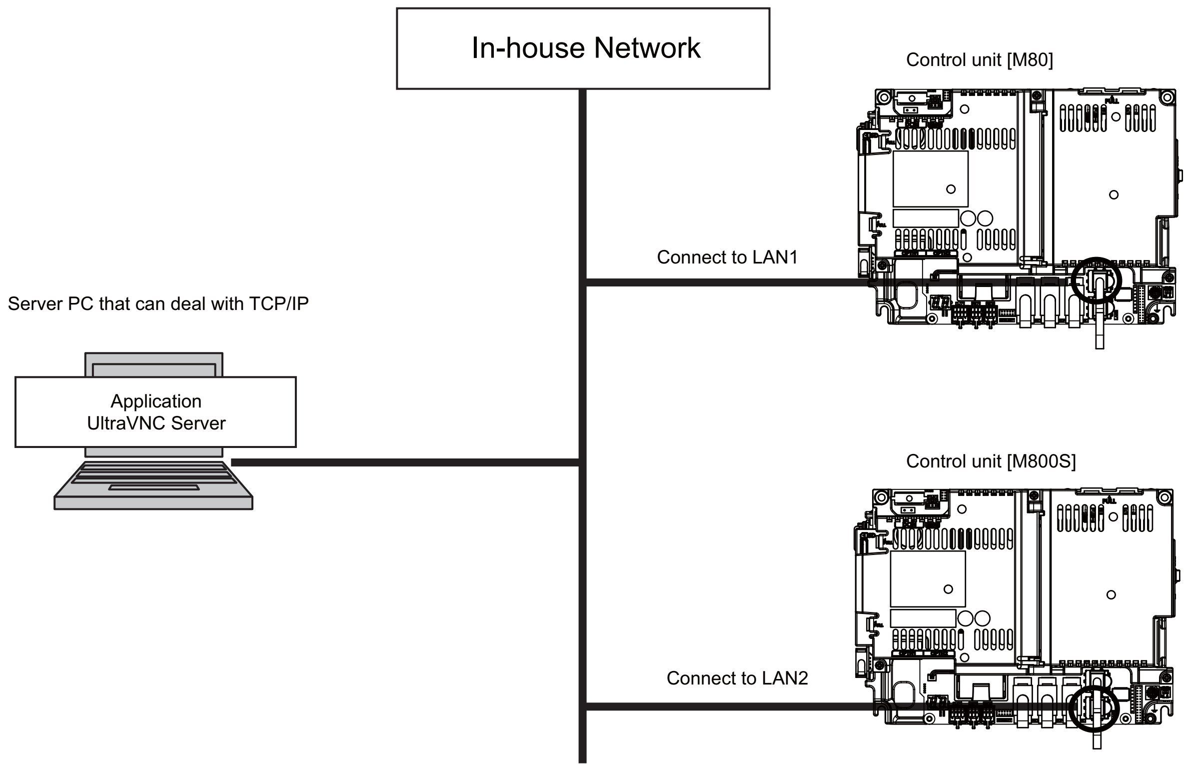
Menu items on the "Monitor", "Setup", and "Edit" screens (of MITSUBISHI standard format) can be moved within a screen or hidden as desired. The custom screen menu items added by machine tool builders, to the contrary, cannot be moved or hidden.

### 6.2.20 Remote Desktop Connection

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | –/ ○ | –/ ○ | △ | △ | –/ ○ | ○ | ○ | – |
| L | –/ ○ | –/ ○ | △ | △ | –/ ○ | ○ | ○ | – |

* Specifications of separated-type display are classified with "Windows-based" and "Windows-less"

Remote desktop connection enables you to operate an external personal computer through the NC screen when UltraVNC server is installed in the PC.



## 6.3 Display Methods and Contents

### 6.3.1 Status Display

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The status of the program now being executed is indicated.

(1) Display of G, S, T, M commands and 2nd miscellaneous command modal values

(2) Feed rate display

(3) Tool compensation No. and compensation amount display

(4) Real speed display (*)

(*) The feed rate of each axis is converted from the final speed output to the drive unit, and is displayed. However, during follow up, the speed is converted and displayed with the signals from the detector installed on the servomotor.

### 6.3.2 Clock Display

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The clock is built-in, and the date (year, month, date) and time (hour, minute, second) are displayed.
Once the time is set, it can be seen as a clock on the screen.

### 6.3.3 Monitor Screen Display

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

A variety of information related to operation, such as the axis counter, speed display and MSTB command is displayed.
The display can be switched according to the machining application (prototype or mass production).
The following operations regarding operation can be executed:

- Operation search
- Restart search
- Editing of searched machining program
- Trace (Display of machine movement path)
- Check (Display of NC program's tool movement path)
- Correction of running program's buffer
- Counter set
- Manual numeric command, etc.

(1) Simple monitor screen
The information displayed on the simple monitor screen is limited. Therefore, the size of the text is larger and it is readable from a distance.

(2) Selective display
A part of monitor screen can be customized to suit user's need (to display data which a user always needs to refer to). The following can be displayed on the selective display area by selecting with the parameter:
- Tool offset
- Common variable
- Workpiece offset, etc.

(Note) The display is not selective on the simple monitor screen.

### 6.3.4 Setup Screen Display

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Tool/workpiece related settings, user parameter settings, MDI editing, counter setting, manual numeric command issuing, etc., can be carried out.

(1) Tool compensation amount screen
Tool compensation data is set and displayed on the Tool compensation amount screen.
Tool compensation types I, II and III are available for M system, which can be selected by the parameter. For L system, tool compensation type III is always used.
The tool radius compensation can be executed with the diameter value by the parameter.
The number of tool compensation sets which can be set/displayed varies depending on the selected number of compensation sets.
(2) Tool measurement screen
Tool measurement screen is displayed.
(3) Tool management screen
The management information is set and displayed for each tool on the Tool management screen.
The data operates simultaneously with the screen which handles the tool information such as "Tool compensation amount screen", "Tool life screen" etc., so that the information can be mutually set and displayed.

### 6.3.5 Edit Screen Display

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Machining program editing (addition, deletion, change), program check, simple programming, playback and file input/output can be carried out.
The specified character string can be searched even during the mass-editing.

### 6.3.6 Diagnosis Screen Display

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The data related CNC diagnosis can be set and displayed as follows:
- Display of hardware and software configuration
- Display of CNC options
- Diagnosis of PLC interface
- Display of drive unit information
- Display of CNC internal data
- Display of alarm message / alarm history list etc.
- Display of H/W and Operation stop status
- Setting of sampling parameter and sampling of NC internal data
- Diagnosis for functional safety

### 6.3.7 Maintenance Screen Display

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Parameter setting and display, NC data input/output, NC memory format, etc., can be carried out on the Maintenance screen.
Important operations are protected with a password.

### 6.3.8 Home Application

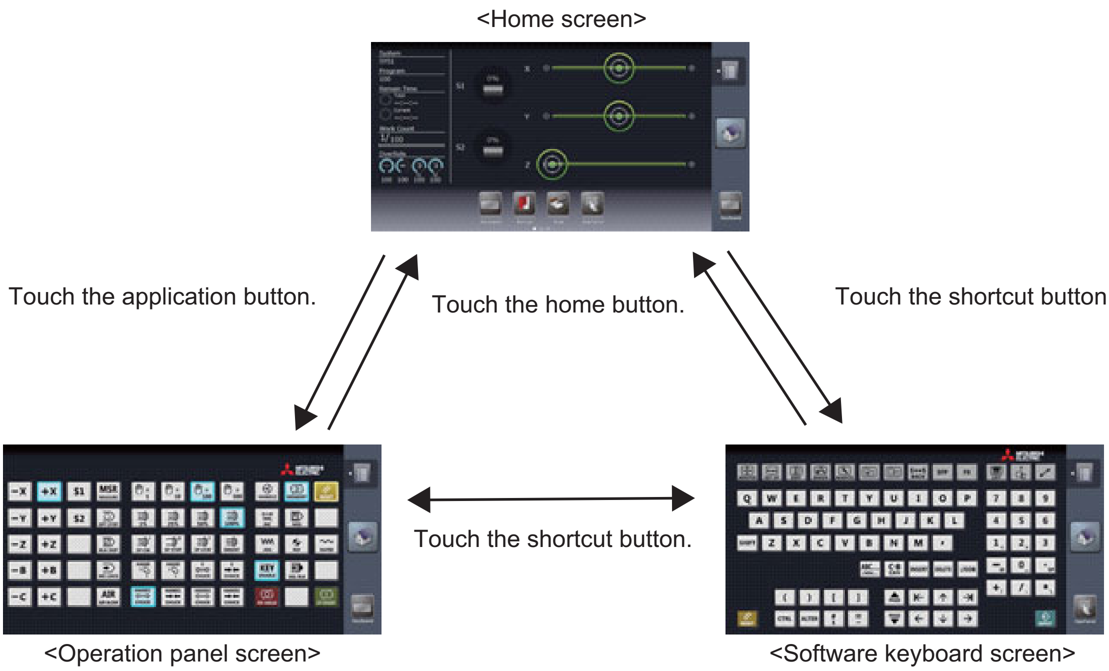
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ /― | ○ /― | ― | ― | ○ /― | ― | ― | ― |
| L | ○ /― | ○ /― | ― | ― | ○ /― | ― | ― | ― |

* Specifications of separated-type display are classified with "Windows-based" and "Windows-less"

19-type vertical display unit has the expansion applications that display the machine status, software keyboard, etc. in the lower half of the screen in no linkage with the upper half.

The following expansion applications are provided as standard MITSUBISHI CNC specifications:
- Home screen (machine state display)
- Software keyboard
- Software operation panel
- Manual
- Notepad

MTB unique applications can also be added.

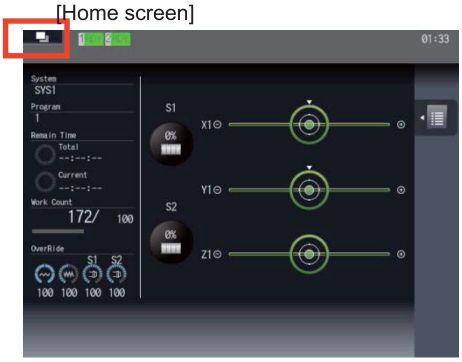


### 6.3.9 Home Screen

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | – |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | – |

Home screen is able to display the machine status (including spindle loads and positions of linear and rotary axes) which can be monitored by an operator. Also, each application can be called by pressing the application button on the home screen. Registered applications differ depending on MTB.
It can be selected by the parameter as to whether to hide, display (display at power ON) or display (not display at power ON) the home screen.

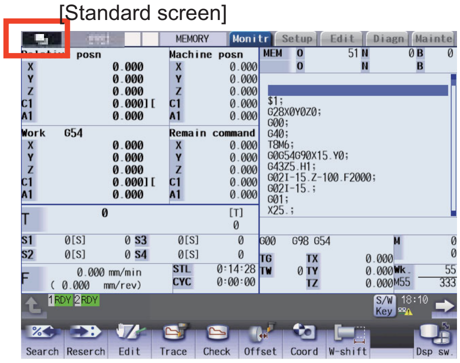
[Home screen]

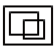



Touch the standard screen changeover button

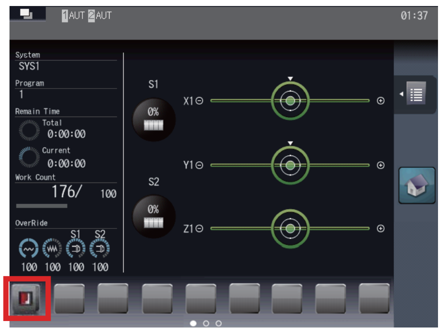
Touch the home screen changeover button

[Standard screen]



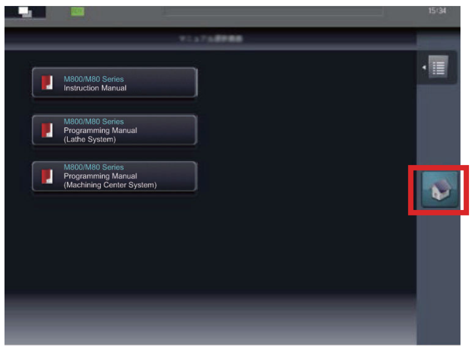

* The screen can also be changed between [Home screen] and [Standard screen] by pressing the window display key ().

(Example) When calling the manual display application with the application button




Touch the application (manual display) button.

Touch the home button.




When the manual to be displayed is touched on the manual selection screen, the selected manual is displayed. The manuals which can be displayed differ depending on MTB.

### 6.3.10 Additional Languages

A language of choice can be selected by parameter setting.

#### 6.3.10.1 Japanese

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | □ | □ | □ | □ | □ | □ | □ | □ |
| L | □ | □ | □ | □ | □ | □ | □ | □ |

#### 6.3.10.2 English

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

#### 6.3.10.3 German

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | □ | □ | □ | □ | □ | □ | □ | □ |
| L | □ | □ | □ | □ | □ | □ | □ | □ |

#### 6.3.10.4 Italian

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | □ | □ | □ | □ | □ | □ | □ | □ |
| L | □ | □ | □ | □ | □ | □ | □ | □ |

#### 6.3.10.5 French

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | □ | □ | □ | □ | □ | □ | □ | □ |
| L | □ | □ | □ | □ | □ | □ | □ | □ |

#### 6.3.10.6 Spanish

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | □ | □ | □ | □ | □ | □ | □ | □ |
| L | □ | □ | □ | □ | □ | □ | □ | □ |

#### 6.3.10.7 Chinese

##### 6.3.10.7.1 Chinese (Traditional Chinese Characters)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | □ | □ | □ | □ | □ | □ | □ | □ |
| L | □ | □ | □ | □ | □ | □ | □ | □ |

##### 6.3.10.7.2 Chinese (Simplified Chinese Characters)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | □ | □ | □ | □ | □ | □ | □ | □ |
| L | □ | □ | □ | □ | □ | □ | □ | □ |

### 6.3.10.8 Korean

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | □ | □ | □ | □ | □ | □ | □ | □ |
| L | □ | □ | □ | □ | □ | □ | □ | □ |

### 6.3.10.9 Portuguese

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | □ | □ | □ | □ | □ | □ | □ | □ |
| L | □ | □ | □ | □ | □ | □ | □ | □ |

### 6.3.10.10 Hungarian

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | □ | □ | □ | □ | □ | □ | □ | □ |
| L | □ | □ | □ | □ | □ | □ | □ | □ |

### 6.3.10.11 Dutch

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | □ | □ | □ | □ | □ | □ | □ | □ |
| L | □ | □ | □ | □ | □ | □ | □ | □ |

### 6.3.10.12 Swedish

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | □ | □ | □ | □ | □ | □ | □ | □ |
| L | □ | □ | □ | □ | □ | □ | □ | □ |

### 6.3.10.13 Turkish

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | □ | □ | □ | □ | □ | □ | □ | □ |
| L | □ | □ | □ | □ | □ | □ | □ | □ |

### 6.3.10.14 Polish

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | □ | □ | □ | □ | □ | □ | □ | □ |
| L | □ | □ | □ | □ | □ | □ | □ | □ |

### 6.3.10.15 Russian

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | □ | □ | □ | □ | □ | □ | □ | □ |
| L | □ | □ | □ | □ | □ | □ | □ | □ |

### 6.3.10.16 Czech

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | □ | □ | □ | □ | □ | □ | □ | □ |
| L | □ | □ | □ | □ | □ | □ | □ | □ |

# 7

# Input/Output Functions and Devices

## 7.1 Input/Output Data

Certain kinds of data handled by the NC system can be input and output between the NC system's memory and external devices.

### 7.1.1 Machining Program Input/Output

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

User Macros and Fixed Cycle Macros are included.

### 7.1.2 Tool Offset Data Input/Output

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

### 7.1.3 Common Variable Input/Output

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

### 7.1.4 Parameter Input/Output

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

### 7.1.5 History Data Output

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

### 7.1.7 System Configuration Data Output

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

## 7.2 Input/Output I/F

### 7.2.1 RS-232C I/F

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | − |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | − |

There are 2 ports (port 1/2) available with the RS-232C interface for both display unit and control unit.

| | Display unit | Control unit |
|---|---|---|
| Port | Port 1/2 | Port 1/2 |
| Baudrate | Up to 19.2kbps | |
| Handshake method | DC code method, RTS/CTS method possible | |

Each port can be used for the following application.
<Display unit>
Port 1: Input/output
Port 2: Input/output
<Control unit>
Port 1: Input/output, Tape operation
Port 2: Input/output, Tape operation, GX Developer communication, computer link, handy terminal

### 7.2.2 SD Card I/F

#### 7.2.2.1 Control Unit-side SD Card I/F [Up to 32GB]

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | − | − | ○ | − | − | − |
| L | ○ | ○ | − | − | ○ | − | − | − |

SD card can be attached inside the control unit and used.

#### 7.2.2.2 Front-side SD Card I/F [Up to 32GB]

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ /− | ○ /− | ○ | ○ | ○ /− | ○ | ○ | − |
| L | ○ /− | ○ /− | ○ | ○ | ○ /− | ○ | ○ | − |

* Specifications of separated-type display are classified with "Windows-based" and "Windows-less"

A SD card can be attached in front of the display unit and used.

### 7.2.3 Ethernet I/F

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ (GOT) |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ (GOT) |

The NC unit can be connected to Ethernet and used.

### 7.2.4 Display Unit-side Data Server I/F

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | － |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | － |

A built-in disk (HD) of display unit can be used.

### 7.2.5 Front-side USB Memory I/F [Up to 32GB]

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | － |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | － |

A USB memory can be mounted.

### 7.2.101 USB I/F (GOT Front-side USB I/F)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | － | － | － | － | － | － | － | ○ |
| L | － | － | － | － | － | － | － | ○ |

A USB memory can be mounted.

### 7.2.102 SD I/F (GOT Back-side SD Card I/F)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | － | － | － | － | － | － | － | ○ |
| L | － | － | － | － | － | － | － | ○ |

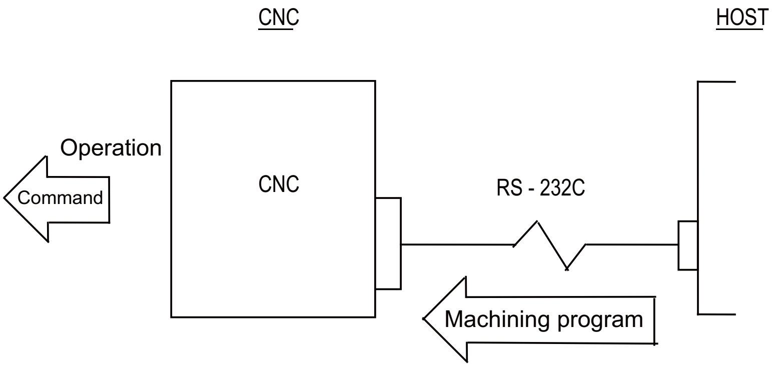
An SD card can be mounted on the back side of GOT.

## 7.3 Computer Link

### 7.3.1 Computer Link B

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | – |
| L | △ | △ | △ | △ | ○ | ○ | ○ | – |

Computer link B is a function that passes the data between host computer (hereafter abbreviated to "HOST") and CNC.
This function sends [DC1] to the HOST at the CNC cycle start, and it enables operation to be performed while the machining programs are received from the HOST.
The computer link has a reception buffer so that operation will be less susceptible to the effects of the data transfer status at the HOST end.
The high-speed machining mode function is required for high-speed fine-segment machining.
This function cannot be operated in the 2nd and following part systems.

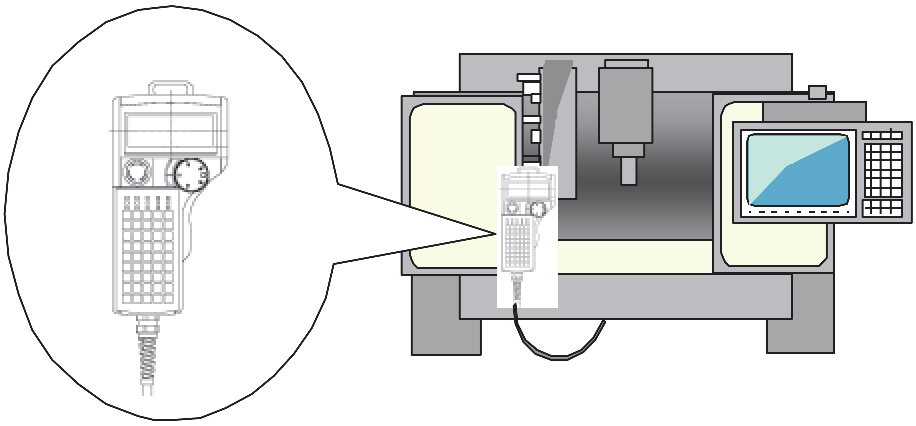


## 7.4 Others

### 7.4.1 Handy Terminal Connection

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | — |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | — |

This function controls the serial communication (RS232C) of CNC and handy terminal.
Handy terminal is a downsized machine operation panel which enables you to operate the machine including setup at hand. Consequently, machine interference can be detected at hand and the operability and safety can be improved.
CNC receives data from the handy terminal and outputs them to PLC interface. CNC also sends the transmission data which PLC set in PLC interface to the handy terminal.
Each MTB needs to create PLC program corresponding to the handy terminal.
The handy terminal needs to be customized such as the configuration of the display area, key input and communication conditions with CNC.



# 8

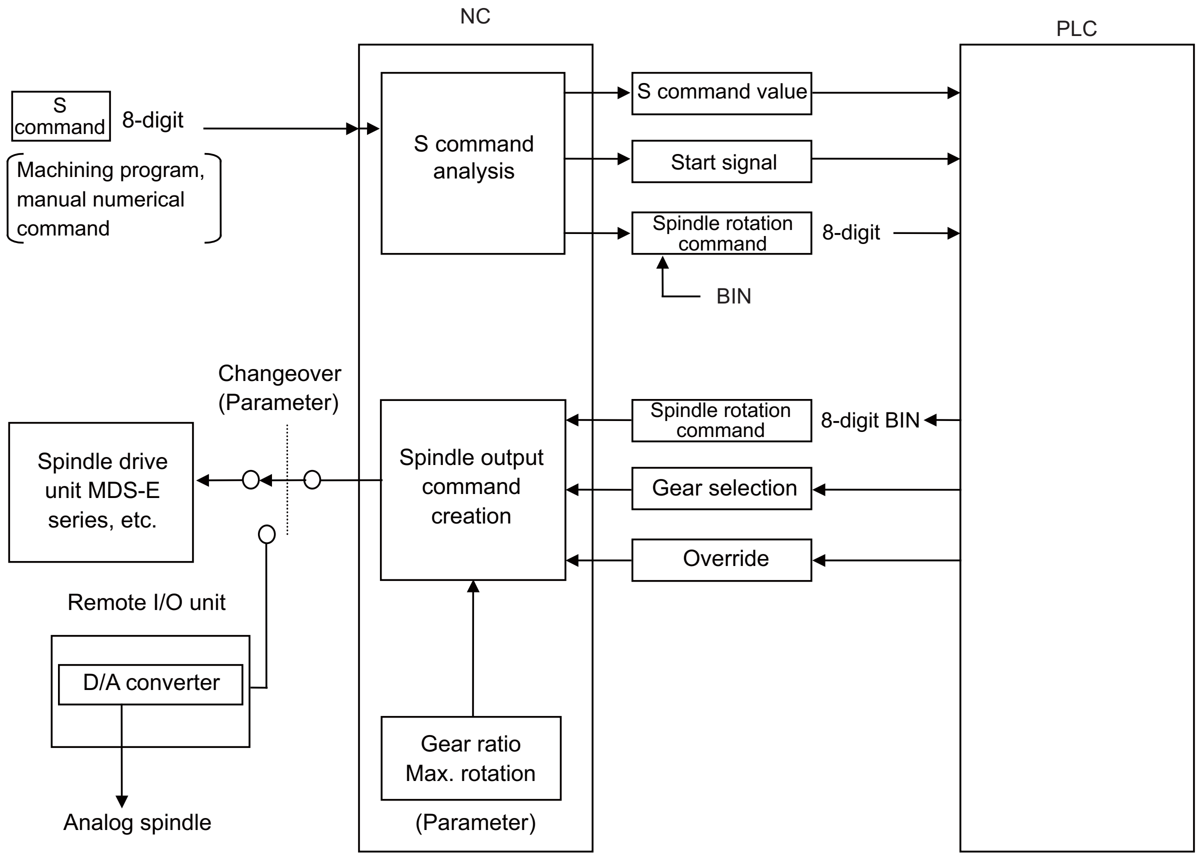
# Spindle, Tool and Miscellaneous Functions

## 8.1 Spindle Functions (S)

### 8.1.1 Spindle Control Functions

The spindle rotation speed is determined in consideration of the override and gear ratio for the S command commanded in automatic operation or with manual numerical commands, and the spindle is rotated. The following diagram shows an outline of the spindle control.

When an 8-digit number following address S (S0 to S±99999999) is commanded, a signed 32-bit binary data and start signal, or a non-signed 32-bit binary data and start signal will be output to the PLC.
Up to 1 set of S commands can be commanded in one block.
Processing and complete sequences must be incorporated on the PLC side for all S commands.




(1) The override can be designated as 50% to 120% in 10% increments or 0% to 200% in 1% increments (with built-in PLC specifications).
The override is not changed while the spindle stop input is ON, during the tapping mode, or during the thread cutting mode.
(2) The number of gear steps can be commanded up to four steps.
(3) The max. spindle rotation speed can be set for each gear.

(Note) The spindle functions can work on serially connected spindles.
Check the specifications of your machine.

### 8.1.1.1 Spindle Digital I/F

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

This interface is used to connect the digital spindle (AC spindle motor and spindle driver).

### 8.1.1.2 Spindle Analog I/F

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | △ (*1) |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | △ (*1) |

(*1) MELSEC

Spindle control can be executed using an analog spindle instead of the digital spindle.

### 8.1.1.3 Coil Switch

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Constant output characteristics can be achieved across a broad spectrum down to the low-speed range by switching the spindle motor connections.
This is a system under which commands are assigned from the PLC.

### 8.1.1.4 Automatic Coil Switch

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Constant output characteristics can be achieved across a broad spectrum down to the low-speed range by switching the spindle motor connections.
This is a system under which the NC unit switches the coils automatically in accordance with the motor speed.

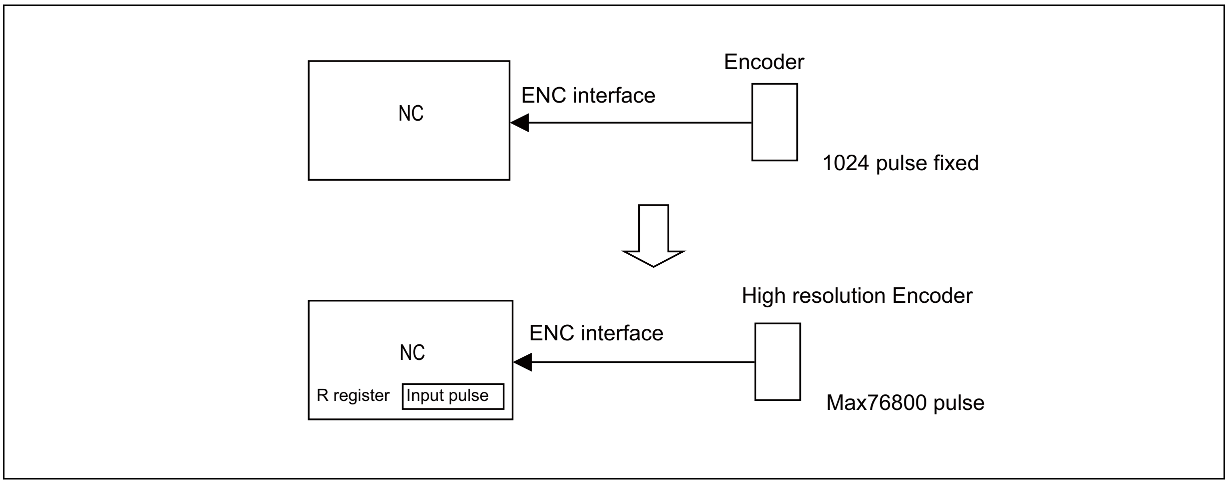
### 8.1.1.5 Encoder Input I/F

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | □ | □ | ○ | ○ | □ | ○ | ○ | － |
| L | □ | □ | ○ | ○ | □ | ○ | ○ | － |

* Encoder expansion card is required for M800W/M80W

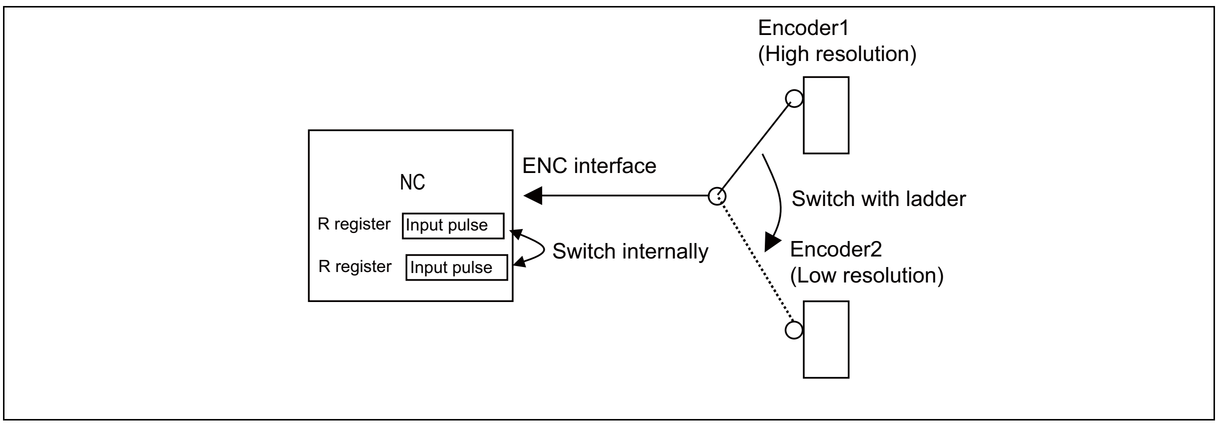
Encoder pulse input used to be fixed to 1024 pulse input on the conventional analogue interface. With this function, arbitrary pulse can be input by parameters set in R register.
The maximum number of input pulse is 76800. Synchronous feed function can be activated with the arbitrary pulse if the number of pulse to be used is set in R register and the external signal is turned ON.

Encoder arbitrary pulse input




Two kinds of encoders can be switched over and connected. Encoder switch-over is possible, using PLC device.

Encoder changeover pulse input

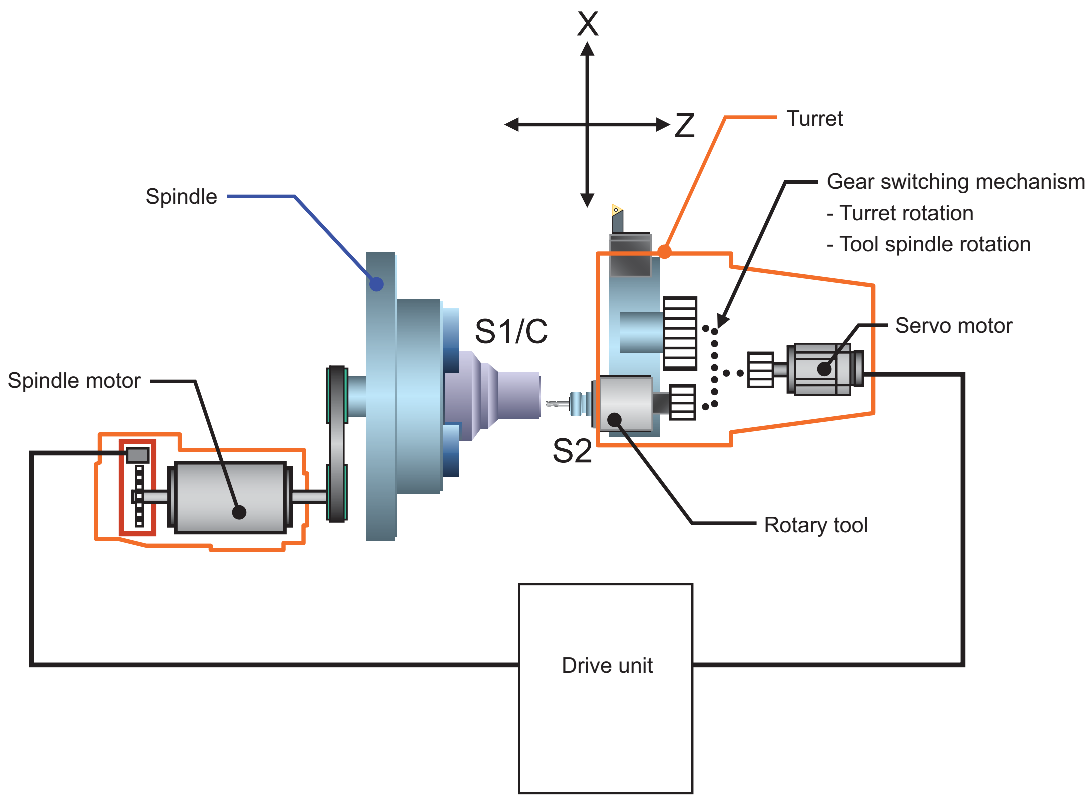


### 8.1.1.6 Spindle-mode Servo Motor Control

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

This function controls a spindle using the combination of servo motor and servo drive unit (MDS-E Series) which controls NC axis.
The maximum rotation speed of servo motor is low compared with a spindle motor. However, if the rated output is the same, the machine components can be downsized by using a servo motor to drive tool spindle, etc., because the servo motor is smaller than the spindle motor.
Note that some spindle functions can not be used under the spindle-mode servo motor control.

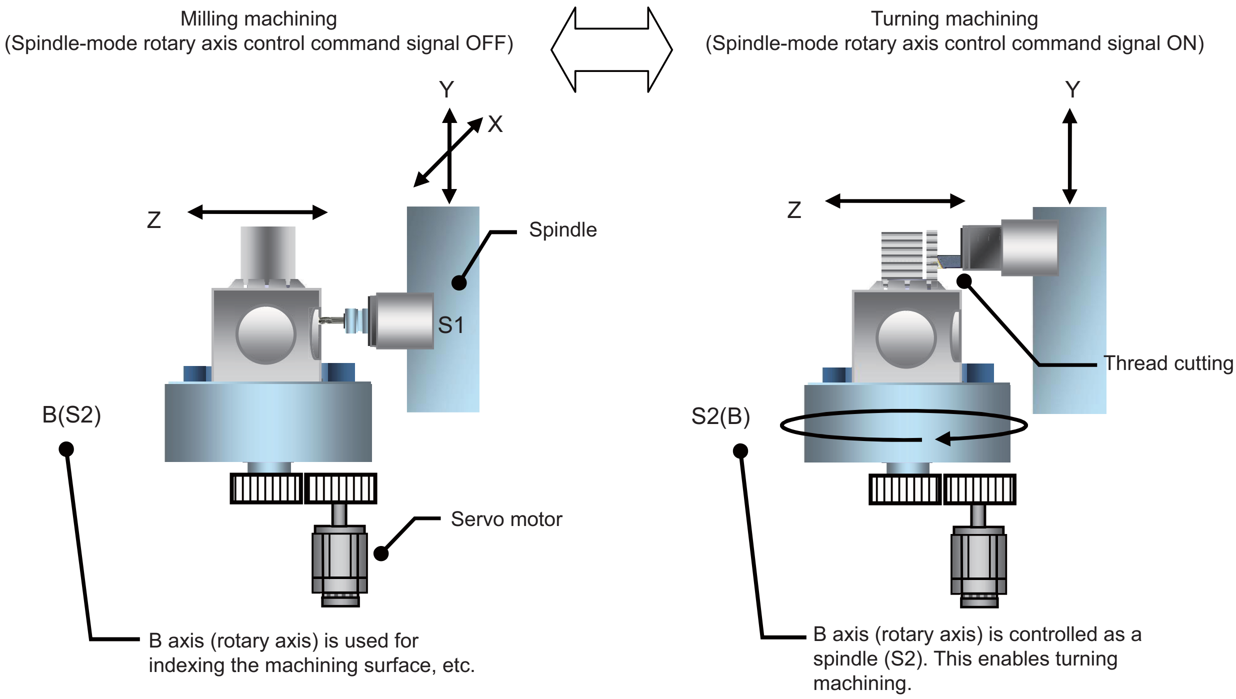
The figure below is the example of the application.
Normally, the components "spindle drive unit + spindle motor" are needed when cutting, drilling or milling is performed on a lathe with turret type tool selection mechanism, which means two pairs of "spindle drive unit + spindle motor" are needed; one for a main spindle and one for a turret.
However, downsizing of the turret, space-saving of the lathe and cost reduction can be achieved by replacing the turret side spindle drive with a servo motor and using spindle-mode servo motor control.



### 8.1.1.7 Spindle-mode Rotary Axis Control

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | － | － |
| L | － | － | － | － | － | － | － | － |

This function enables a rotary axis driven by a servo motor to be controlled as a spindle. When the spindle-mode rotary axis control command signal is turned ON, the rotary axis is controlled as a spindle. This enables lathe-turning machining, including synchronous feed and thread cutting, to be performed in synchronization with the feedback speed of the rotary axis (spindle-mode rotary axis mode). When the signal is turned OFF, positioning and interpolation commands can be given to the rotary axis (servo axis mode).
The following is the example of the application.
Add S2 as B axis spindle. B axis can be controlled as S2 spindle by setting "2" to B axis parameter "#1020 sp_ax" and setting the same value as the B axis (servo axis) drive unit I/F number to S2 axis parameter "#3031 smcp_no". B axis can be controlled as S2 spindle by turning the spindle-mode rotary axis control command signal ON after being used as B axis for indexing the machining surface. This enables turning machining, including thread cutting.



### 8.1.1.8 Turret Gear Change Control

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | — | — | — | — | — | — | — | — |
| L | △ | △ | △ | △ | ○ | ○ | ○ | — |

This function enables axes in the semi-closed system to select four types of gear ratios which are set to the spindle specification parameters according to the control input from the PLC.

There are differences from normal gear change as follows:

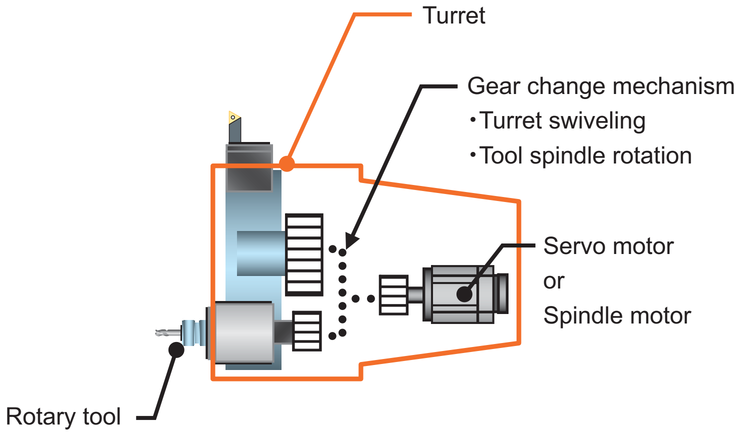
(1) Positioning can be made at the predefined motor-end position regardless of the selected gear step during spindle orientation or change to spindle position control (C axis control).

(2) Gears can be changed during the rotation.

Example of application

(1) Gear change between turret swiveling and tool spindle rotation in turret type tool post

For gear change on a turret where the turret swiveling and tool rotation are switched by physical gear using one servo or spindle motor as illustrated below, the positioning to Z-phase position of motor end (orientation) can be made regardless of the selected gear steps by using this function. Consequently, the gears for the physical gear change are engaged and the physical gears can be changed.




(2) Gear change during rotation

For example, the tool for polygon has a tool system in which the reduction gear is for starting torque (cutter + tool folder). If this tool is installed in a tool post that has mechanism which rotates multiple tools by one motor, the gear change is needed when selecting the polygon tool. However, the gear change can be performed during the tool rotation without temporary stop so that the tool change time can be reduced.

(3) Gear change during spindle-mode servo motor control

This function is used when gear change is needed in the spindle-mode servo motor control which controls a servo motor as spindle using the combination of servo drive unit and servo motor.

### 8.1.2 S Code Output

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

When an 8-digit number following address S (S0 to S±99999999) is commanded, a signed 32-bit binary data and start signal, or a non-signed 32-bit binary data and start signal will be output to the PLC.
One set of S commands can be issued in one block.
Processing and complete sequences must be incorporated on the PLC side for all S commands.

S function can be designated with any other kind of commands. In the case where a movement command is in the same block, two different command sequences are available. Depending on user PLC specifications, either one of the following two will be applied.

(1) S function is executed after the movement is completed.
(2) S function is executed at the same time as when the movement command is issued.

### 8.1.3 Constant Surface Speed Control

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

This function enables the spindle rotation speed to be adjusted (constant surface speed control) in accordance with the movement of tool nose point so that the cutting point always remains at the constant speed (constant surface speed).
Using this function for processes such as a cutting-off process is effective for a machining time and tool life, etc.
Note that when the tool nose point is moving to the workpiece zero point, the rotation may be at the maximum rotation speed of the machine specification and this is dangerous.

Command format

Constant surface speed ON

| **G96 S__ P__ ;** | |
|---|---|
| S | : Surface speed designation (-99999999 to 99999999 (m/min), (feet/min)) |
| P | : Constant surface speed control axis designation (0 to the maximum number of the controllable axes in G96 part system.) |

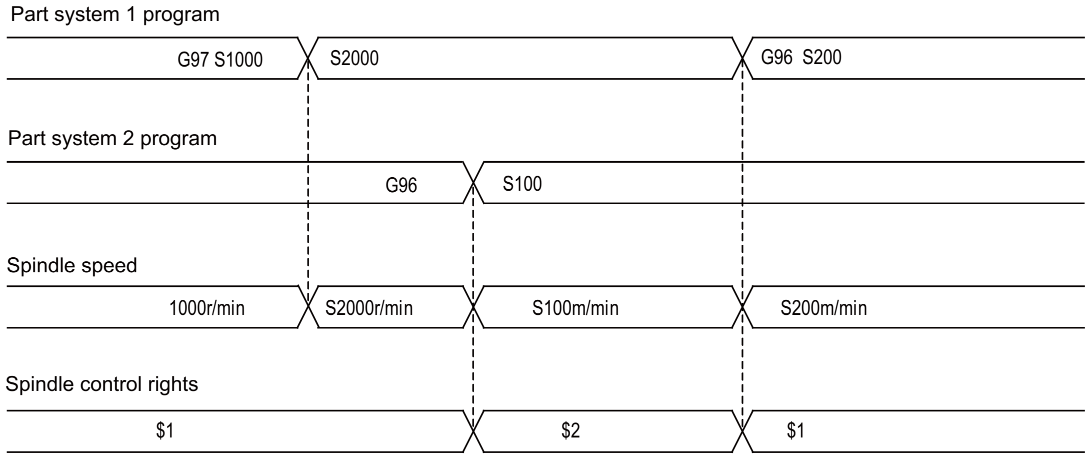
Constant surface speed cancel

| **G97 S__ ;** | |
|---|---|
| S | : Spindle rotation speed (-99999999 to 99999999 (r/min)) |

The surface speed is commanded with an S code. For the metric designation, the speed is commanded with an m/min unit, and for the inch designation, the speed is commanded with a feet/min unit.
In the constant surface speed cancel mode, the S code is a spindle rotation speed command.
The axis for which constant surface speed is controlled is generally the X axis. However, this can be changed with the parameter settings or with address P in the G96 block.
Select with the parameter whether to enable the spindle rotation command from other part systems to the spindle which is in the constant surface speed control.

(Note 1) 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 or may cause damage to the operators. Thus make sure to use this control while the "spindle speed clamp" is enabled. When the constant surface speed control is commanded, keep enough distance from the program zero point.

(Note 2) If there is only one spindle, the spindle will not operate normally if the constant surface speed control command, S command or spindle related M command is commanded randomly from each part system. These commands must be commanded from only one certain part system, or commanded simultaneously with timing synchronization function.
The controller will execute the following control for the constant surface speed control and S commands. The part system from which an S command was issued last will have the spindle control rights. That part system will judge whether the constant surface speed command mode is valid or canceled, and will execute spindle control.




$1: Part system 1
$2: Part system 2

### 8.1.4 Spindle Override

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

This function applies override to the rotation speed of a spindle or mill spindle assigned by the machining program command during automatic operation or by manual operation. There are two types of override.

**(1) Type 1 (code method)**
Using an external signal, override can be applied to the commanded rotation speed of a spindle or mill spindle in 10% increments from 50% to 120%.

**(2) Type 2 (value setting method)**
Using an external signal, override can be applied to the commanded rotation speed of a spindle or mill spindle in 1% increments from 0% to 200%.

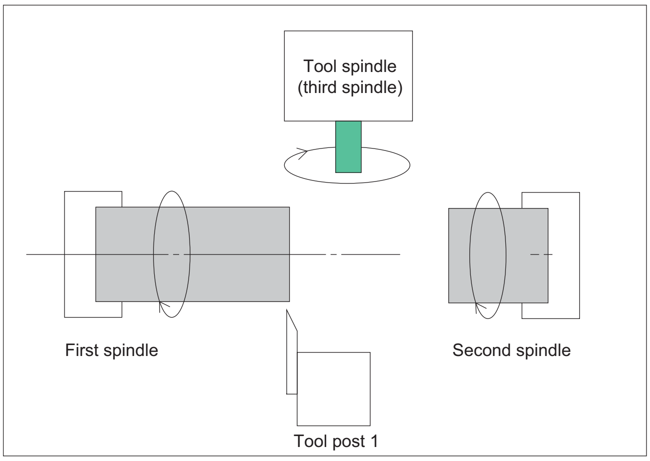
(Note 1) Selection between type 1 and type 2 can be designated by user PLC processing.

### 8.1.5 Multiple-spindle Control

Multiple-spindle control is a function that controls second and following spindles in addition to the first spindle in a machine tool equipped with multiple spindles.
Multiple-spindle control I can be switched to multiple-spindle control II or vice versa using a parameter and, by so doing, the spindle control method changes.

| | |
|---|---|
| Multiple-spindle control I<br>(L system only) | Control based on a spindle selection command (such as G43.1) and spindle control command<br>([S*****;] or [SO=*****;]), etc. |
| Multiple-spindle control II | Control based on a PLC signal (spindle command selection signal, spindle selection signal) and spindle control command ([S*****;] only), etc.<br>Spindle selection command and control command of [SO=*****;] cannot be used. |

The figure below shows an example of the configuration for a machine which is equipped with second and third spindles.



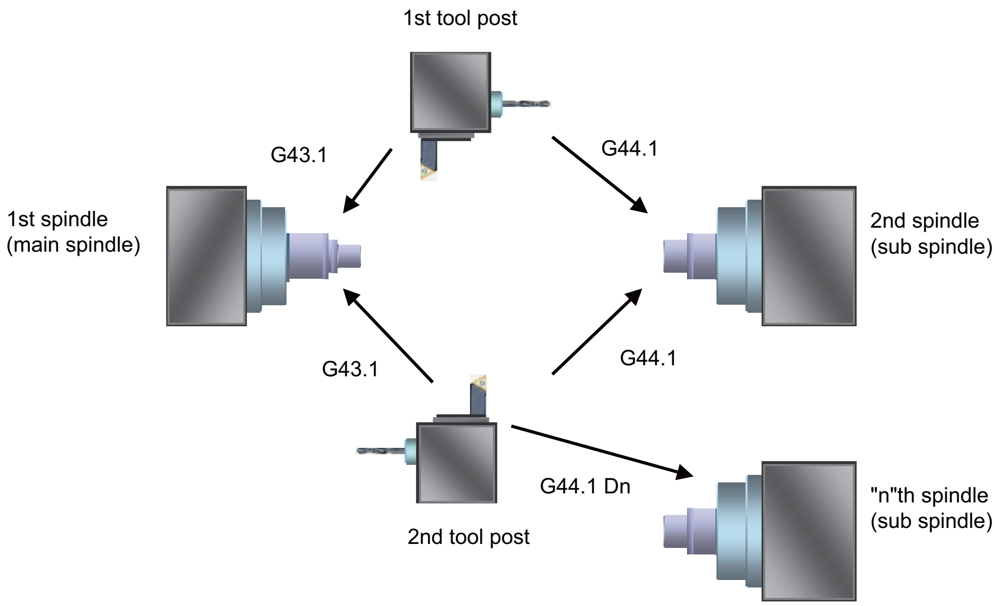
### 8.1.5.1 Multiple-spindle Control I

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | — | — | — | — | — | — | — | — |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

**(1) Spindle selection command**

In a machine with two or more spindles, this function makes it possible to select the spindle to apply the S commands or feed per revolution.
Spindle selection command (G43.1/G44.1/G44.1 D_) makes it possible to select the spindle.
Using the 1st spindle control command (G43.1) and the 2nd spindle control command (G44.1), the commands can be given to the spindle designated with the parameter.
Using the arbitrary spindle control command (G44.1 D_), an arbitrary spindle can be selected with address D.
Using all spindles simultaneous control command (G47.1), all spindles are selected.
Use this function when cutting the back of workpiece by shifting it to the second spindle from the first spindle, cutting multiple workpieces with the respective spindles or on the respective tool posts, etc.

When selecting G43.1 = 1st spindle, G44.1 = 2nd spindle




Command format

| | |
|---|---|
| **G43.1 ;** | **First spindle control mode ON (The spindle to be used is set using the parameter.)** |
| **G44.1 ;** | **Second spindle control mode ON (The spindle to be used is set using the parameter.)** |
| **G44.1 D__;** | **Arbitrary spindle control mode ON (The spindle to be used is set using address D.)** |
| **G47.1 ;** | **All spindles simultaneous control mode ON (Encoder of the 1st spindle is used)** |
| D | : Designate the spindle. (For a spindle number command, the range is from 1 to the number of available spindles, or from 1 to 9 for a spindle name command.) |

**(2) Spindle control command (Using extended word address (S =****))**

In addition to using the "S*****" S commands, it is also possible to assign commands which differentiate each spindle by using the S =*****.

Command format

| | |
|---|---|
| **S ○ =***** ;** | |
| ○ | : Number assigned as the spindle number (1: first spindle; 2:second spindle; ...; n: "n"th spindle (n = maximum number of spindles for the specification)); variables can be designated. |
| ***** | : Rotational speed or surface speed value assigned by command; variables can be designated. |

### 8.1.5.2 Multiple-spindle Control II

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

This function selects which spindle to perform spindle function (S) command or feed per revolution (synchronous feed) on a machine equipped with 2 or more spindles.
Command to spindles is issued with one spindle function (S) command, and you can select the target spindle with a PLC signal (spindle selection or spindle command selection).
A parameter is used to switch the control to multiple-spindle control I.
There are two types of spindle rotation speed control: common to part systems (which validates the S function command issued last to each spindle), and separated by each part system (which validates the S function command issued last in the part system to which the selected spindle belongs).

### 8.1.6 Spindle Orientation

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

This function stops the spindle at a specified position.
The spindle zero position is determined to be the Z-phase position at the encoder method spindle orientation (PLG and external encoder). At the proximity switch method spindle orientation, the spindle zero position is determined to be the position of the proximity switch attached at the spindle end.
On a lathe, this function can be used for the workpiece positioning to align the attaching/removing direction and the turret turn positioning for the tool exchanges.
When Z-phase has not yet been passed, pass Z-phase twice (excluding reciprocations within one rotation), and then position to the orientation position.
When Z-phase has been passed already, immediately position to the orientation position.
The rotation direction of the spindle orientation is determined by the spindle zero point return specification parameter.
The spindle does not rotate if Z-phase has been passed and the orientation position is already established when orientation command is issued.
When the spindle has been rotating in the direction opposite from that of orientation rotation when the orientation command is issued, orientation operation will be executed after decelerating to stop. By using the parameter, the orientation operation can be executed with the spindle revolution direction as it is, without having to decelerate and stop.

**(a) Orientation**

This function stops the spindle rotation at a certain position when using the digital spindle.
When the orientation command is used, the spindle will rotate several times and then stop at the orientation point.
The orientation position differs depending on the detector.

- When the orientation (PLG and external encoder) is used:
  …At the Z-phase position
- When the proximity switch method orientation is used:
  …At the proximity switch installation position

**(b) Multi-point orientation**

This function performs orientation to a position other than the Z-phase position by inputting a shift amount with the parameter or PLC. The shift amount is -35999 to 35999. (Unit: 360°/36000=0.01°)
(Note 1) Multi-point orientation cannot be executed when using the proximity switch.
(Note 2) Orientation is possible only when the gear ratio is 1:1 for the PLG orientation.
(The orientation is completed at the PLG encoder's Z-phase, so when using reduction gears, the orientation points will be generated at several points during one spindle rotation.)

**(c) Orientation in-position advance output**

This function turns the spindle in-position signal ON as soon as the spindle reaches within the second in-position width. Then, the spindle 2nd in-position signal is turned ON as soon as the spindle reaches within the in-position width.
Since orientation completion can be predicted using this function, it is possible to eliminate the sequence delay time, etc. for tool changes and other such operations, thereby achieving a faster takt time.

**(d) Proximity switch method orientation**

Proximity switch method orientation enables the spindle positioning by providing the proximity switch position installed on the spindle side as the spindle position zero point.
When the spindle motor and the spindle are connected with V-belt, the spindle position zero point calculated from the spindle motor position varies due to belt slipping, etc. Thus, the spindle position zero point must be detected from the proximity switch signal every time orientation or zero point return is carried out.
In the conventional spindle position zero point detection method, the spindle position zero point is calculated from the spindle drive unit and transmitted to NC when the position detector detects the one-time rotation signal (Z-phase) for the first time after the system has been turned ON, and the zero point will not be changed thereafter.
In the case of proximity switch signal orientation, NC updates the spindle position zero point every time orientation or zero point return is carried out.

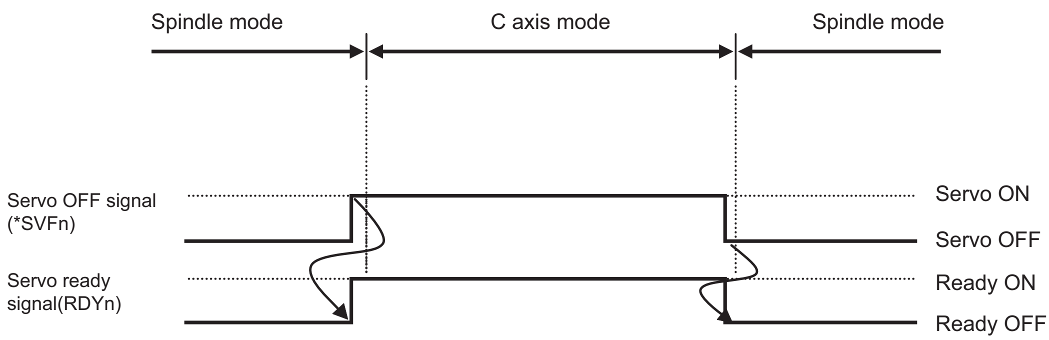
## 8.1.7 Spindle Position Control (Spindle/C Axis Control)

### 8.1.7.1 Spindle Position Control (Spindle/C Axis Control)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

A spindle can be controlled as the rotary axis. After switching the spindle to the rotary axis, the positioning and the interpolation between the spindle and other servo axes can be operated in the same way as the servo axis by executing the position command (the movement command).
The servo axis for controlling the spindle as the rotary axis or the machinery for switching the spindle and servo axis (such as a gear switching machinery) had been necessary for controlling a spindle readily as the rotary axis, but they are not necessary with this function.
There are two method for switching a spindle and a rotary axis: PLC signal method and program command method. The method can be selected with the parameter.

(1) PLC signal method
The spindle mode and the C axis mode can be switched with the servo OFF signal (*SVFn) ON/OF with PLC ladder.
The interpolation operation is enabled by executing the movement command to the C axis in the C axis mode same as NC axis.
(a) Switching spindle mode to C axis mode
Change the servo OFF signal (*SVFn) OFF to ON.
(b) Switching C axis mode to spindle mode
Change the servo OFF signal (*SVFn) ON to OFF.




(2) Program command method
In the machining program, the program switches to the C axis mode with G00 command, and to the spindle mode with S command. The C axis servo OFF signal (*SVFn) must be kept ON while the program command method is selected.
(a) Switching spindle mode to C axis mode
Command [G00 C__ ] in the NC program during the spindle mode. The axis is positioned directly to the specified position.
The non-interpolation positioning for each axes is performed by specifying [G00 X__ Z__ C__ ] regardless of the parameter setting, and C axis is switched to the C axis mode.
(b) Switching C axis mode to spindle mode
- The switching is performed with the spindle forward run signal (SRN) ON or the spindle reverse run signal (SRI) ON and the S command.
- The switching is performed with the rising edge of the spindle forward run signal (SRN) or the spindle reverse run signal (SRI).

### 8.1.7.2 C Axis Control during Spindle Synchronization

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ― | ― | ― | ― |
| L | △ | △ | △ | △ | ○ | ○ | ○ | ― |

This control enables C axis positioning while a long workpiece is controlled by Front and Back spindles that are in synchronization with each other. Under this control, the machine can perform milling at the center of workpiece.

### 8.1.8 Spindle Synchronization

In a machine with two or more spindles, this function controls the rotation speed and phase of one selected spindle (synchronized spindle) in synchronization with the rotation of the other selected spindle (reference spindle). This function can be assigned by G code or by PLC.
It is used in cases where, for instance, workpiece clamped to the reference spindle is to be clamped to the synchronized spindle instead or where the spindle rotation speed is to be changed while one workpiece remains clamped to both spindles.

#### 8.1.8.1 Spindle Synchronization I

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | － |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The synchronized spindle is designated and the start/end of the synchronization are commanded with the G command in the machining program.

The other spindle synchronization functions (Spindle synchronization control I/ Spindle synchronization control II/ Tool spindle synchronization IA/ Tool spindle synchronization IB/ Tool spindle synchronization II/ Spindle superimposition control) cannot be commanded during executing this function. Also this function cannot be commanded while the above functions are being executed. In these cases an operation error will occur.
However, if multiple spindle synchronization set control is enabled, multiple spindle synchronization functions can be commanded.

Command format

Spindle synchronization control ON (G114.1)

This command is used to designate the reference spindle and the spindle to be synchronized with the reference spindle, and it places the two designated spindles in the synchronized state.
By designating the synchronized spindle phase shift amount, the phases of the reference spindle and synchronized spindle can be aligned.

**G114.1 H__ D__ R__ A__ ;**

| | |
|---|---|
| H | : Designate the reference spindle. (The number will be 1 to available numbers of spindles for command with spindle number, and 1 to 9 for command with spindle name.) |
| D | : Designate the spindle to be synchronized with the reference spindle. (The number will be 1 to available numbers of spindle or from -1 to - available numbers of spindle for command with spindle number, and 1 to 9 or -1 to -9 for command with spindle name.) |
| R | : Designates the synchronized spindle phase shift amount. (0 to 359.999[°] or 0 to359999[°×$10^{-3}$]) |
| A | : Designates the spindle synchronization acceleration/deceleration time constant. (0.001 to 9.999[s] or 1 to 9999[ms]) |

Spindle synchronization control cancel (G113 or G113.1)

This command releases the state of synchronization between two spindles whose rotation has been synchronized by the spindle synchronization command.

**G113 ; (Lathe system)**
**G113.1 ; (Lathe system/Machining center system)**

### 8.1.8.2 Spindle Synchronization II

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | − |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The selection of the spindles to be synchronized, the start of the synchronization and other settings are all designated from the PLC.

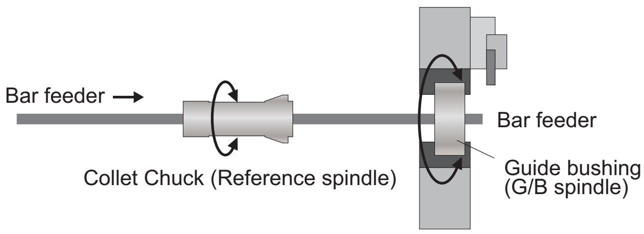
The spindle synchronization control mode is established by inputting the spindle synchronization control signal. While this mode is established, the synchronized spindle is controlled in synchronization with the rotation speed assigned for the reference spindle.

The other spindle synchronization functions (Spindle synchronization control I/ Spindle synchronization control II/ Tool spindle synchronization IA/ Tool spindle synchronization IB/ Tool spindle synchronization II/ Spindle superimposition control) cannot be commanded during executing this function. Also this function cannot be commanded while the above functions are being executed. In these cases an operation error will occur.
However, if multiple spindle synchronization set control is enabled, multiple spindle synchronization functions can be commanded.

### 8.1.8.3 Guide Bushing Spindle Synchronization

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | − | − | − | − | − | − | − | − |
| L | △ | △ | △ | △ | ○ | ○ | − | − |

This function is for a machine with a spindle motor to rotate a guide bushing: This function allows the guide bushing spindle motor (G/B spindle) to synchronize with a reference spindle motor (Reference spindle).
The position error compensation function reduces the spindle’s vibration due to the workpiece’s torsion, and the motor’s overload.



## 8.1.9 Tool Spindle Synchronization I (Polygon)

### 8.1.9.1 Tool Spindle Synchronization IA (Spindle-Spindle, Polygon)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ― | ― | ― | ― | ― | ― | ― | ― |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

With a machine equipped with two or more spindles, this function enables polygon machining between spindles (IA) by controlling the workpiece spindle rotation in synchronization with the rotary tool spindle rotation. The rotary tool spindle and workpiece spindle are designated among the spindles.

Control for the workpiece spindle and rotary tool spindle can be performed by Spindle drive unit MDS-*-SP series, etc. This function can be used with the G code list 2 to 5.

The other spindle synchronization functions (Spindle synchronization control I/ Spindle synchronization control II/ Tool spindle synchronization IA/ Tool spindle synchronization IB/ Tool spindle synchronization II/ Spindle superimposition control) cannot be commanded during executing this function. Also this function cannot be commanded while the above functions are being executed. In these cases an operation error will occur.
However, if multiple spindle synchronization set control is enabled, multiple spindle synchronization functions can be commanded.

Command format

Tool spindle synchronization IA mode command (G114.2)
This command establishes the spindle-spindle polygon machining mode (IA) in which two spindles are rotated in synchronization at two different speeds. It is required to designate the rotary tool spindle, workpiece spindle and the rotational ratios (number of rotary tool teeth and number of work angles) of the two designated spindles.

**G114.2 H__ D__ E__ L__ R__ ;**

| | |
|---|---|
| H | : Selects the rotary tool spindle. |
| D | : Selects the workpiece spindle. |
| E | : Designates the rotary tool spindle rotational ratio. |
| L | : Designates the workpiece spindle rotational ratio. |
| R | : Synchronized spindle phase shift amount |

Tool spindle synchronization IA mode cancel command (G113)
This command releases the state of synchronization between two spindles whose rotation has been synchronized by the spindle synchronization command.

**G113 ;**

(Note) An axis that involves any travel cannot be put in the same block as Tool spindle synchronization IA mode cancel command. If the axis address is included in the block, a program error occurs upon the cancel command, causing the automatic operation to stop.

### 8.1.9.2 Tool Spindle Synchronization IB (Spindle-Spindle, Polygon)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | － | － | － | － | － | － | － | － |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

With a machine equipped with two or more spindles, this function enables polygon machining between spindles (IB) by controlling the rotary tool spindle rotation in synchronization with the workpiece spindle rotation. The rotary tool spindle and workpiece spindle are designated among the spindles.
A parameter is used to switch from Tool spindle synchronization IB to Tool spindle synchronization IC or vice versa.

Control for the workpiece spindle and rotary tool spindle can be performed by Spindle drive unit MDS-*-SP series, etc.
This function can be used with the G code list 6 and 7.

The other spindle synchronization functions (Spindle synchronization control I/ Spindle synchronization control II/ Tool spindle synchronization IA/ Tool spindle synchronization IB/ Tool spindle synchronization II/ Spindle superimposition control) cannot be commanded during executing this function. Also this function cannot be commanded while the above functions are being executed. In these cases an operation error will occur.
However, if multiple spindle synchronization set control is enabled, multiple spindle synchronization functions can be commanded.

Command format

Tool spindle synchronization IB mode ON (G51.2 or G251)
This command establishes the spindle-spindle polygon machining mode in which two spindles are rotated in synchronization at two different speeds. It is required to designate the rotary tool spindle, workpiece spindle and the rotational ratios (number of work angles and number of rotary tool teeth) of the two designated spindles.

| G51.2 H__ D__ P__ Q__ R__ ; | |
|---|---|
| H | : Selects the workpiece spindle (spindle). |
| D | : Selects the rotary tool spindle (spindle). |
| P | : Designates the workpiece spindle rotational ratio. |
| Q | : Designates the rotary tool spindle rotational ratio. |
| R | : Synchronized spindle phase shift amount |

Tool spindle synchronization IB mode cancel command (G50.2 or G250)

| G50.2 ; |
|---|

(Note) An axis that involves any travel cannot be put in the same block as Tool spindle synchronization IB mode cancel command. If the axis address is included in the block, a program error occurs upon the cancel command, causing the automatic operation to stop.

### 8.1.9.3 Tool Spindle Synchronization IC (Spindle-NC Axis, Polygon)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | — | — | — | — | — | — | — | — |
| L | △ | △ | △ | △ | ○ | ○ | — | △ |

This function controls so that the workpiece (spindle) and tool (NC axis) synchronously rotate at the commanded ratio and allows polygon machining. Tool spindle synchronization IB and Tool spindle synchronization IC can be switched by the parameter.
This function can be used with the G code list 6 and 7.

Command format

Tool spindle synchronization IC mode ON (G51.2 or G251)

| | |
|---|---|
| **G51.2 P__ Q__ ;** | **Spindle synchronization start (Tool spindle synchronization IC mode start)** |
| P | : Spindle rotational ratio |
| Q | : Rotary tool axis rotational ratio<br>Rotation direction is specified with a sign.<br>+: Forward run / -: Reverse run |

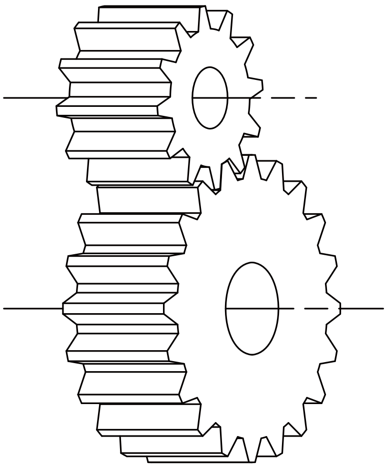
Tool spindle synchronization IC mode OFF (G50.2 or G250)

| |
|---|
| **G50.2 ;** |

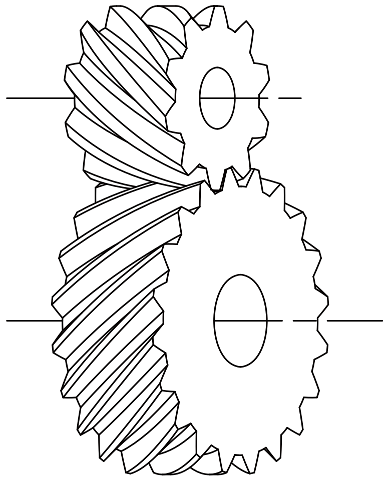
### 8.1.10 Tool Spindle Synchronization II (Hobbing)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | — | — | — | — | — | — | — | — |
| L | △ | △ | △ | △ | ○ | ○ | — | △ |

This function is to cut the gear with hob (hob cutter).
A spur gear can be machined by synchronizing and rotating the hob axis and the workpiece axis in a constant ratio.
A helical gear can be machined by compensating the workpiece axis according to the gear torsion angle for the Z axis movement.

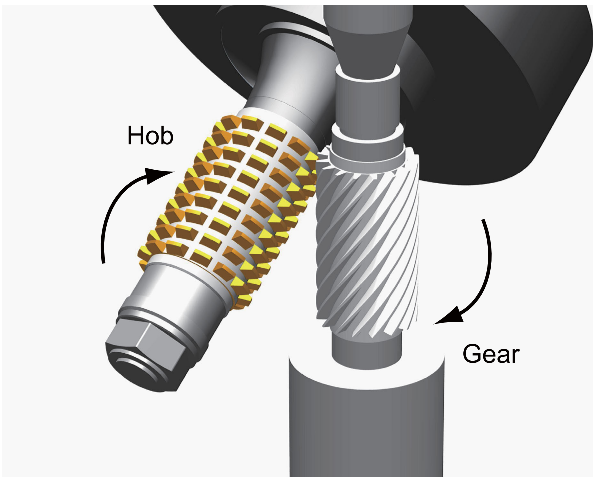


Spur gears



Helical gears

By synchronizing and rotating the hob axis and the workpiece axis in a constant rotation ratio, a gear is machined so that the cutter is engaged with gear.




Hob axis : Rotary tool axis on which a hob is mounted.
Workpiece axis : Rotary axis on which a workpiece is mounted.

The other spindle synchronization functions (Spindle synchronization control I/ Spindle synchronization control II/ Tool spindle synchronization IA/ Tool spindle synchronization IB/ Tool spindle synchronization II/ Spindle superimposition control) cannot be commanded during executing this function. Also this function cannot be commanded while the above functions are being executed. In these cases an operation error will occur.
However, if multiple spindle synchronization set control is enabled, multiple spindle synchronization functions can be commanded.

### 8.1.11 Spindle Speed Clamp

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

This function is to limit the spindle rotation speed to the ranges between the maximum rotation speed and the minimum rotation speed.
This function can be set by a parameter or a program.

| | |
|---|---|
| **G92 S__ Q__ ;** | **Spindle clamp speed setting** |
| S | : Maximum clamp rotation speed |
| Q | : Minimum clamp rotation speed |

An alarm will occur if the constant surface speed control is conducted without issuing the spindle clamp speed command (G92).

### 8.1.13 Spindle Oscillation

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | — | — | — | — |
| L | △ | △ | △ | △ | — | — | — | — |

This function reciprocates (oscillates) the spindles with designated amplitude and frequency.

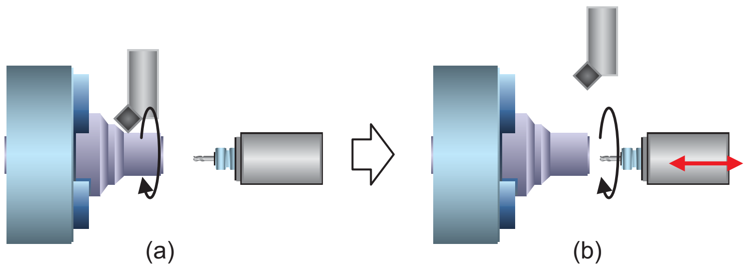
### 8.1.14 Spindle Superimposition Control

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | — | — | — | — | — | — | — | — |
| L | △ | △ | △ | △ | ○ | ○ | — | △ |

Spindles are controlled by superimposing the rotation speed of one spindle on the rotary speed of other spindle.
Use this function when the tool spindle needs to be rotated with the superimposed speed on the spindle rotation speed.
If this function is used when tapping is performed to the center of a workpiece clamped to a spindle during its rotation, for instance, the tapping to the center of the workpiece (shown in Figure (b) below) can be performed during the turning machining (shown in Figure (a) below) so that the cycle time can be reduced.

The other spindle synchronization functions (Spindle synchronization control I/ Spindle synchronization control II/ Tool spindle synchronization IA/ Tool spindle synchronization IB/ Tool spindle synchronization II/ Spindle superimposition control) cannot be commanded during executing this function. Also this function cannot be commanded while the above functions are being executed. In these cases an operation error will occur.
However, if multiple spindle synchronization set control is enabled, multiple spindle synchronization functions can be commanded.

(1) Conventional method




Synchronous tapping
Forward:
+500 (r/min)
Backward:
-500 (r/min)

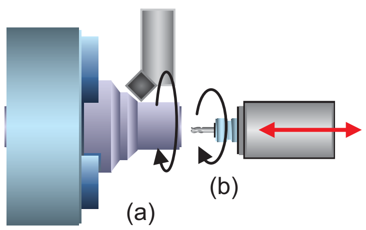
S1=1000(r/min)

S1 = 0 (r/min)

Normal turning machining

The rotation of the front workpiece is stopped, and then the tapping is started at the front center.

(2) Using the spindle superimposition control




Synchronous tapping
Forward:
+1500 (r/min)
Backward:
+500 (r/min)

S1=1000(r/min)

Turning (a) and tapping at the front center (b) are performed simultaneously.

Command format

Spindle superimposition control valid command

G164 command specifies the reference spindle and superimposed spindle and makes the two spindles to be superimposed.

| **G164 H__ D__ ;** | |
|---|---|
| H | : Select the reference spindle (For command using the spindle number, the spindle number should be within the number of spindles for specifications. For command using the spindle name, the name is valid from 1 to 9.) |
| D | : Select the superimposed spindle (For command using the spindle number, the spindle number should be within the number of spindles for specifications. For command using the spindle name, the number from 1 to 9 or from -1 to -9 is valid for the spindle name.) |

Command with the spindle name if all spindle names are set to the spindle name parameter. For others, command with the spindle number.

Spindle superimposition control cancel command

G113 command cancels the superimposition of two spindles which are rotating by the differential velocity rotation tool command.

The superimposition can be cancelled also with "Spindle synchronization cancel" signal ON.

| **G113 ;** |
|---|

(Note) An axis that involves any travel cannot be put in the same block as the spindle superimposition control cancel command. If the axis address is included in the block, a program error occurs upon the cancel command, causing the automatic operation to stop.

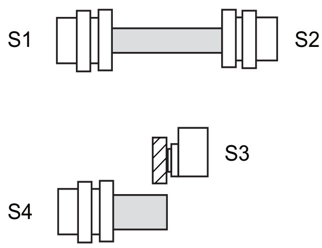
### 8.1.15 Multiple Spindle Synchronization Set Control

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | – | – | – | – | – | – | – | – |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | – |

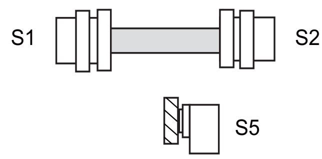
By setting the parameter, Spindle synchronization I, Tool spindle synchronization IA / IB (Spindle-Spindle, Polygon), Tool spindle synchronization II (Hobbing) and Spindle superimposition control can be executed simultaneously for multiple sets of spindles.

This function enables the following machining.

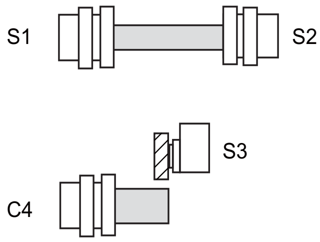
Spindle synchronization I command (S1-S2)
+ Tool spindle synchronization IA command (S3-S4)



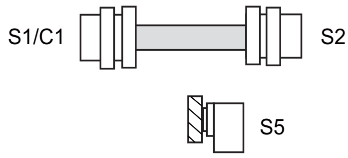

Spindle synchronization I command (S1-S2)
+ Tool spindle synchronization IA command (S1-S5)



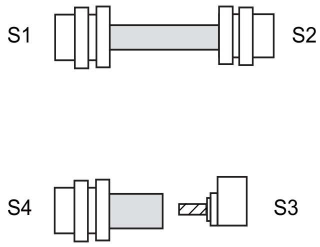

Spindle synchronization I command (S1-S2)
+ Tool spindle synchronization II command (S3-C4)



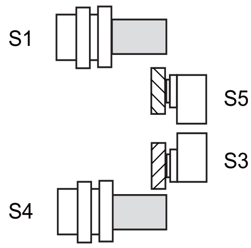

Spindle/C axis synchronization control command (S1/C1-S2)
+ Tool spindle synchronization II command (S5-C1)



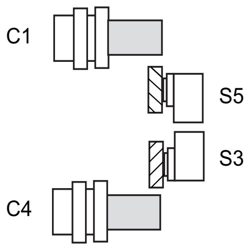

Spindle synchronization I command (S1-S2)
+ Spindle superimposition control command (S4-S3)



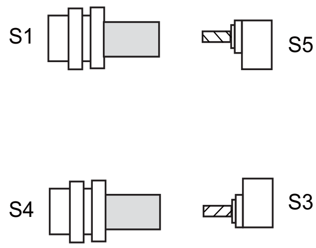

Tool spindle synchronization IA command (S5-S1)
+ Tool spindle synchronization IA command (S3-S4)




Tool spindle synchronization II command (S5-C1)
+ Tool spindle synchronization II command (S3-C4)




Spindle superimposition control command (S1-S5)
+ Spindle superimposition control command (S4-S3)




(Note 1) The guide bushing spindle synchronization is not included in the number of multiple spindle synchronization sets.

Command format

For details on the command format which starts each function, refer to the respective chapters.

Spindle synchronization control cancel

(1) Command to cancel all synchronization modes
Cancels all the synchronized sets. The format varies depending on the parameter settings.

**G113 H0 ; Cancels all the active tool spindle synchronization II (hobbing) commands.**
**G113 D0 ; Cancels all the active Spindle synchronization I, Tool spindle synchronization IA (Spindle-Spindle, Polygon), and spindle superimposition commands.**

**G113 ;**

(2) Spindle synchronization I, Tool spindle synchronization IA (Spindle-Spindle, Polygon), or Spindle superimposition control cancel command

**G113 D_ ;**
D : Synchronized or superimposed spindle to cancel (For a spindle number command, the range is from 1 to the number of available spindles, or from 1 to 9 for a spindle name command.)

(3) Tool spindle synchronization II (hobbing) cancel command (when the G code system of the program is 2, 3, 4, or 5)

**G113 H_ ;**
H : Reference spindle to cancel (For a spindle number command, the range is from 1 to the number of available spindles, or from 1 to 9 for a spindle name command.)

(4) Tool spindle synchronization II (hobbing) cancel command (when the G code system of the program is 6 or 7)
Cancel tool spindle synchronization II (hobbing) of the specified part system.

**G80.4 ;**

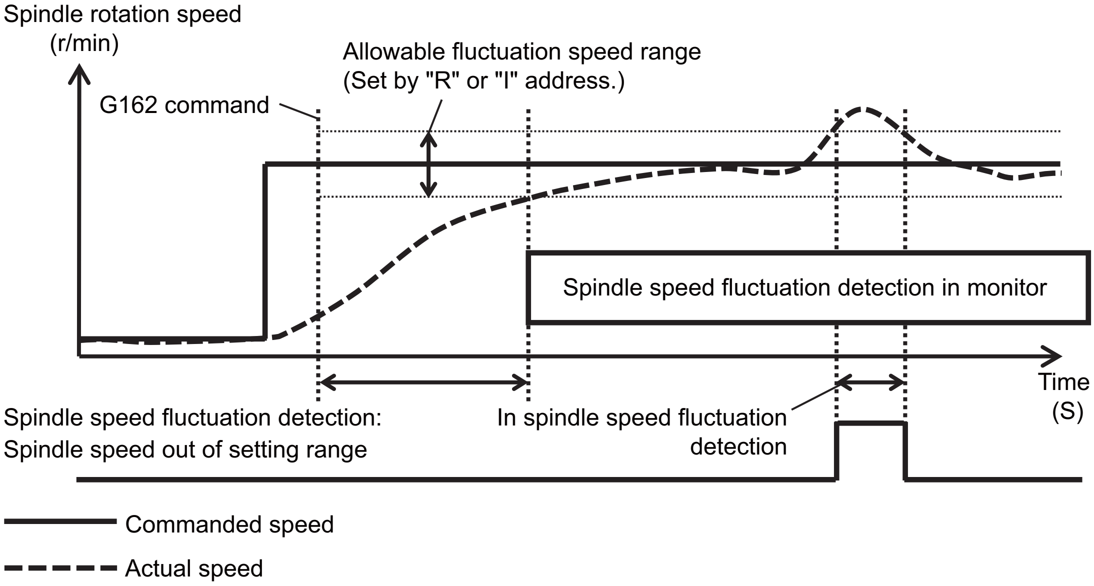
(5) Tool spindle synchronization IB (Spindle-Spindle, Polygon) cancel command
Cancel tool spindle synchronization IB (Spindle-Spindle, Polygon) of the specified part system.

**G50.2 ;**

### 8.1.16 Spindle Speed Fluctuation Detection

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ― | ― | ― | ― |
| L | △ | △ | △ | △ | ― | ― | ― | ― |

When this function is valid and the spindle actual speed fluctuates for the commanded speed by the program due to external factors such as load fluctuation, the NC outputs the signal (Spindle speed out of setting range) to PLC and the operation error occurs.
PLC can take the necessary measure for the fluctuation of the spindle speed using the output signal (Spindle speed out of setting range) from the NC.
The operation error output from the NC does not stop the automatic operation or the spindle.
A parameter is used to switch whether or not to output the operation error during spindle speed fluctuation detection (G162).




Command format

Starting the spindle speed fluctuation detection
The spindle speed fluctuation detection is started by commanding G162.

| **G162 S__ P__ Q__ R__ I__ ;** | |
|---|---|
| S | : Detection target spindle name (1 to 9) |
| P | : Delay time for starting spindle speed fluctuation detection (0 to 99.999 (s)) |
| Q | : Spindle speed attainment detection range (1 to 100 (%)) |
| R | : Spindle speed fluctuation allowance rate (1 to 100 (%)) |
| I | : Allowable fluctuation range in spindle speed (0 to 999999 (r/min)) |

Canceling the spindle speed fluctuation detection
The spindle speed fluctuation detection is canceled by commanding G163.

| **G163 S__ ;** | |
|---|---|
| S | : Detection target spindle name (1 to 9) |

## 8.2 Tool Functions (T)

### 8.2.1 Tool Functions (T Command)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The command is issued with an 8-digit number following address T (T0 - T99999999). The tool function is used to command the tool No. In the lathe specification controller, the tool compensation (tool length compensation, tool nose wear compensation) Nos. are also indicated.

**(1) M system**

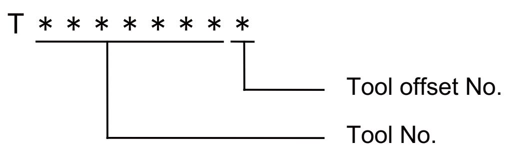
Tool function, or T function, is used to designate the tool No. and tool compensation No.
This can be designated with an 8-digit number following address T (0 to 99999999). Up to four sets of T commands can be issued in one block. Note that the number of T commands to be issued within the same block is determined by parameter.
BCD output or binary output can be selected by parameter.
Output signal is 8-digit BCD code and start signal, signed 32-bit binary data and start signal, or non-signed 32-bit binary data and start signal.
T function can be designated with any other kind of commands. In the case where a movement command is in the same block, two different command sequences are available. Depending on machine specifications, either one of the following two will be applied.

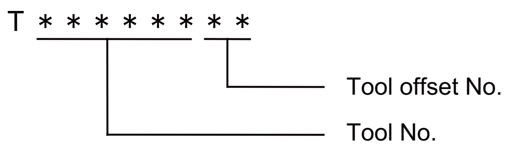
(a) T function is executed after the movement is completed.
(b) T function is executed at the same time as when the movement command is issued.

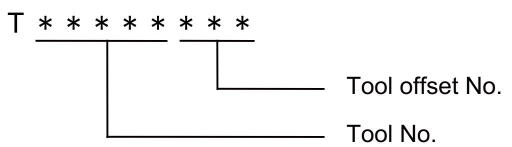
Processing and completion sequences are required for all the T commands.
(Note 1) In some setting and display units, there may be screens that cannot display all eight digits.

**(2) L system**

The command is issued with an 8-digit number following address T (T0 to T99999999). The high-order digits are designated as the tool No., and the low-order digit(s) are designated as the offset No. Each number of high/low-order digits depends on the specifications of MTB (the parameter setting).




The tool No. code data and start signal will be output to the PLC.
All the other details are the same as in M system.

## 8.3 Miscellaneous Functions (M)

### 8.3.1 Miscellaneous Functions

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Miscellaneous function, or M function, is used to command auxiliary functions for NC, such as rotating the spindle forward/backward or stopping it, as well as turning the cooling oil ON/OFF.
This can be designated with an 8-digit number following address M (0 to 99999999). Up to four sets of M commands can be issued in one block. Note that the number M commands to be issued within the same block is determined by parameter.
BCD output or binary output can be selected by parameter.
Output signal is 8-digit BCD code and start signal, signed 32-bit binary data and start signal, or non-signed 32-bit binary data and start signal.
(Example) G00 Xx1 Mm1 Mm2 Mm3 Mm4 ;

(1) When 5 or more sets are commanded in one block, only the last 4 sets are valid.
M00, M01, M02, M30, M98 and M99 are used only for some specific purposes and cannot be assigned as regular M functions.

(2) Processing and completion sequences are required for all M functions except M98 and M99.
Refer to user PLC specification for the relationship between values and functions.
As for M00, M01, M02 and M30, next block is not read into pre-reading buffer due to ban on pre-reading processing.

(3) Although M00, M01, M02, and M30 output an independent signal for each, the independent output of M00, M01, M02 and M30 will be reset upon pressing a reset key.

(4) M command can be designated with other commands within the same block. In the case where a movement command is in the same block, two different command sequences are available. Depending on user PLC specifications, either one of the following two will be applied.
(a) M function is executed after the movement is completed.
(b) M function is executed at the same time as when the movement command is issued.
Processing and completion sequences are required for all the M commands except M98 and M99.

(Note 1) In some setting and display units, there may be screens that cannot display all eight digits.

### 8.3.2 Multiple M Codes in 1 Block

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Up to four sets of M commands can be issued in a block.
Respective processing and completion sequences are required for all M commands included in a block (except M98 and M99).

(Note 1) This function requires a built-in PLC. In this case, the code data and start signals of all the M commands in the same block are transferred simultaneously from the controller to the PLC, and so high-speed machine control can be done by the PLC processing sequence.

### 8.3.3 M Code Independent Output

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

When the M00, M01, M02 or M30 command is assigned during an automatic operation (tape, memory, MDI) or by a manual numerical command, the signal of this function is output. It is turned OFF after the miscellaneous function finishes or by the reset & rewind signal.

| Machining program | M code independent output | Response to controller |
|---|---|---|
| M00 | M00 | Fin1 or Fin2 |
| M01 | M01 | Fin1 or Fin2 |
| M02 | M02 | Reset & rewind |
| M30 | M30 | Reset & rewind |

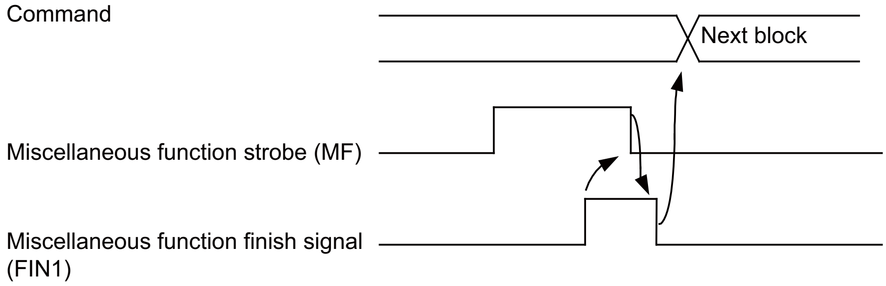
If movement or dwell command exists in the same block as these M commands, this signal is output upon completion of the movement or dwell command.

### 8.3.4 Miscellaneous Function Finish

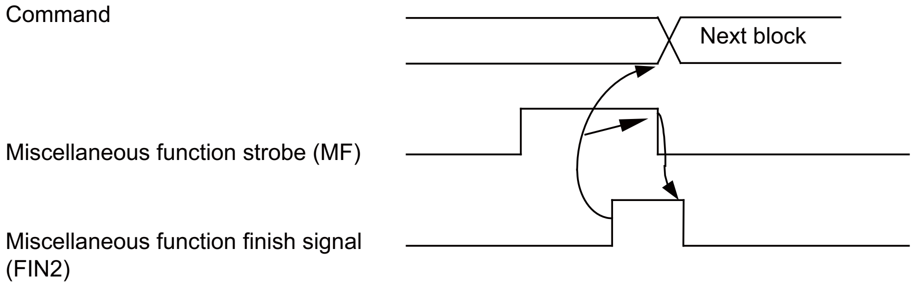
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

These signals inform the CNC system that a miscellaneous function (M), spindle function (S), tool function (T) or 2nd miscellaneous function (A, B, C) has been assigned and that the PLC which has received it has completed the required operation. They include miscellaneous function finish signal 1 (FIN1) and miscellaneous function finish signal 2 (FIN2).

Miscellaneous function finish signal 1 (FIN1)
When the controller checks that FIN1 is ON, it sets the function strobes OFF. Furthermore, when the PLC checks that the function strobes are OFF, it sets FIN1 OFF. The controller checks that FIN1 is OFF and advances to the next block.
Below is an example of a time chart applying when a miscellaneous function has been assigned.




Miscellaneous function finish signal 2 (FIN2)
When the controller checks that FIN2 is ON, it sets the function strobes OFF and simultaneously advances to the next block. The PLC checks that the strobe signals are OFF and sets FIN2 OFF.
Below is an example of a time chart applying when a miscellaneous function has been assigned.



### 8.3.5 M Code Output during Axis Traveling

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | － | － | － | － | － | － | － | － |
| L | ○ | ○ | ○ | ○ | ○ | ○ | － | ○ |

This function controls the timing at which miscellaneous functions are output, and it outputs a miscellaneous function when axis reaches at the designated position movement.

The command format is as follows.

| **G117 Xx1 Zz1 Cc1 □ □ □ □ ;** | |
|---|---|
| G117 | : Command of M code output during axis traveling |
| Xx1,Zz1,Cc1 | : Movement start points |
| □□□□ | : Miscellaneous function |

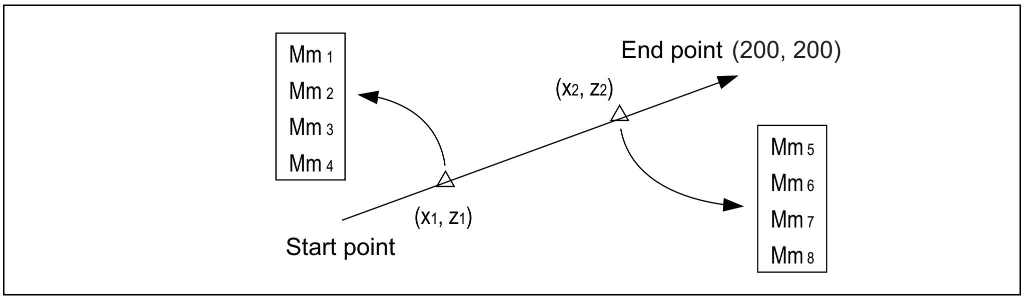
(1) This command is issued independently immediately before the block with the movement command that activates the miscellaneous function.

(2) Single block stop does not apply to this command.

(3) The maximum number of groups to which the miscellaneous functions in the G117 block can be issued is as follows:

| | |
|---|---|
| M commands | 4 sets |
| S commands | 2 sets |
| T commands | 1 set |
| 2nd miscellaneous function | 1 set |

(4) This command can be issued in up to two consecutive blocks.
When issued in three or more consecutive blocks, the last two blocks will be valid.
(Example) G117 $Xx_1$ $Zz_1$ $Mm_1$ $Mm_2$ $Mm_3$ $Mm_4$ ;
G117 $Xx_2$ $Zz_2$ $Mm_5$ $Mm_6$ $Mm_7$ $Mm_8$ ;
G01 X200 Z200 ;
:



### 8.3.6 Miscellaneous Function Command High-speed Output

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

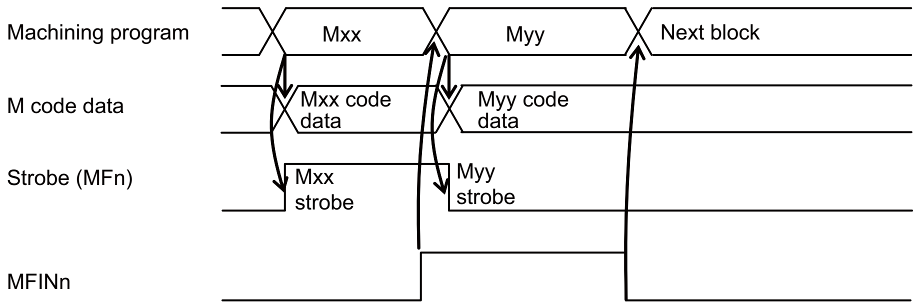
The miscellaneous command high-speed output shortens a processing time per miscellaneous function. There are two functions that can be selected individually.

(1) Change miscellaneous command completion method
Select one of the following methods by the parameter.
High-speed method:
The controller inverts a strobe signal logically at the time of outputting a miscellaneous command. The PLC performs the designated operation and logically inverts the high-speed miscellaneous function finish signal (MFIN1 to 4, SFIN1 to 6, TFIN1 to 4, BFIN1 to 4). The controller completes the miscellaneous function when the strobe signal and the high-speed miscellaneous function finish signal become the same logic level.
Normal method:
Conventional method (Refer to "8.3.4 Miscellaneous Function Finish" for details.)

(2) Selecting miscellaneous command completion method
Select whether or not to wait for a finish signal from the PLC using the parameter.
It can be selected for M, S, T or B individually.

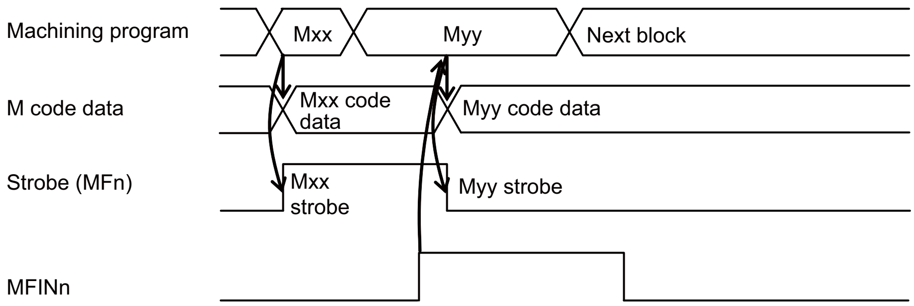
- High-speed method that waits for a finish signal from the PLC

  The miscellaneous function completes by matching the logic level of the finish signal with that of the strobe signal.



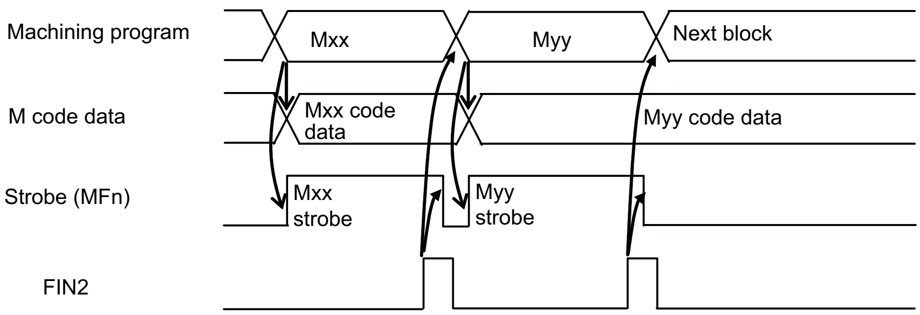

- High-speed method that does not wait for a finish signal from the PLC

  When a series of miscellaneous commands is issued, the completion of the previous miscellaneous command is waited.



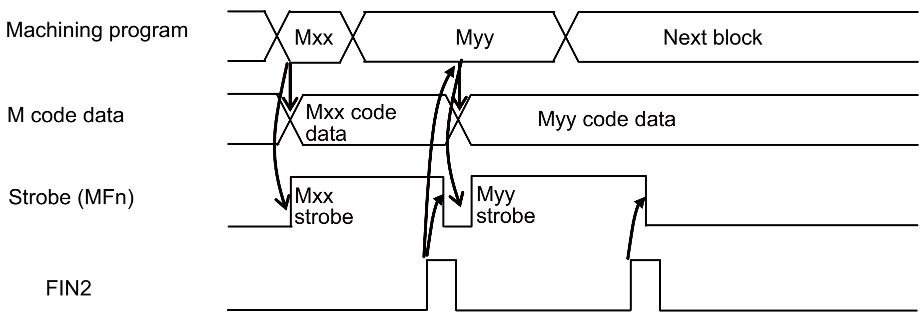

- Normal method that waits for a finish signal from the PLC

  Conventional method.




- Normal method that does not wait for a finish signal from the PLC

  When a series of miscellaneous commands is issued, the completion of the previous miscellaneous command is waited.



## 8.4 2nd Miscellaneous Functions (B)

### 8.4.1 2nd Miscellaneous Functions

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The code data and start signals are output when an 8-digit number is assigned following the address code A, B or C - whichever does not duplicate the axis name being used.
Processing and complete sequences must be incorporated on the PLC side for all 2nd miscellaneous commands.
(Note 1) This function requires a built-in PLC.
(Note 2) There are some screens in the setting and display unit that cannot display all eight digits.

### 8.4.2 2nd Miscellaneous Function Name Extension

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The 2nd miscellaneous function name same as the additional axes (A, B, C) can be used by specifying the command address of the 2nd miscellaneous function with two characters.
Whether the command address has one character or two characters can be set by the parameter.
The operation of the 2nd miscellaneous function is same as the operation with the one character address method.

# 9

# Tool Compensation

# 9.1 Tool Length/Tool Position

## 9.1.1 Tool Length Offset

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

These commands make it possible to control the axis movement by compensating the position of the end point of the movement command by a compensation amount set on the tool compensation screen.
Using this function, it is possible to compensate the difference in distance between the actual position of the machine's tool nose and the program coordinate position made by the tool length and to enhance both the programming and operational efficiency.

**(1) M system**

**G43 Zz1 Hh1 ;**
**G44 Zz1 Hh1 ;**

| | |
|---|---|
| G43 | : Tool length compensation command + direction (z1+h1) |
| G44 | : Tool length compensation command + direction (z1-h1) |
| Zz1 | : Compensation axis. Tool length compensation can be provided not only for the Z axis but for all the other axes (X, Y, etc.) which can be controlled in the system. |
| Hh1 | : Compensation No. |

Compensation can be canceled by the following G commands.

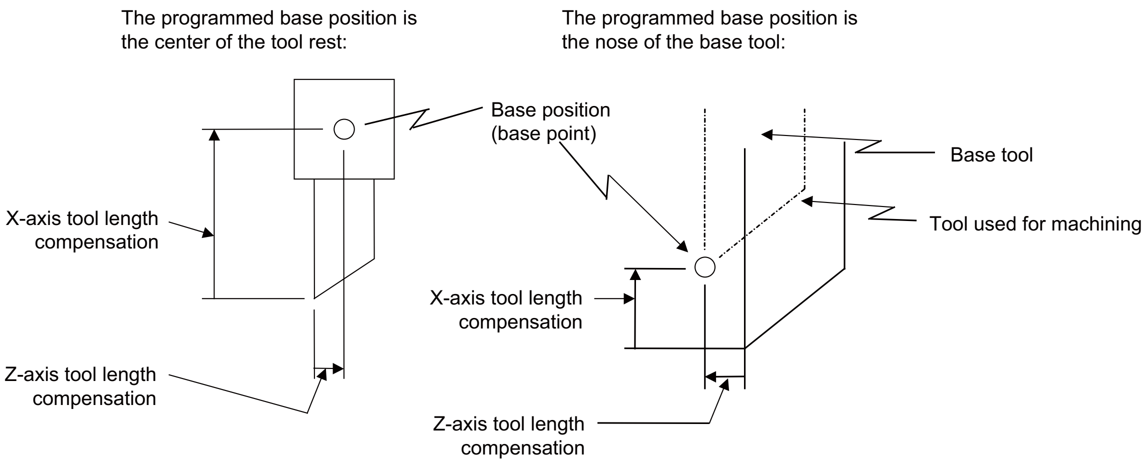
**G49 ;**
**G43 H0 ;**
**G44 H0 ;**

(Note) When the tool length compensation axis is returned to the reference position, the compensation of that axis is canceled.

**(2) L system**

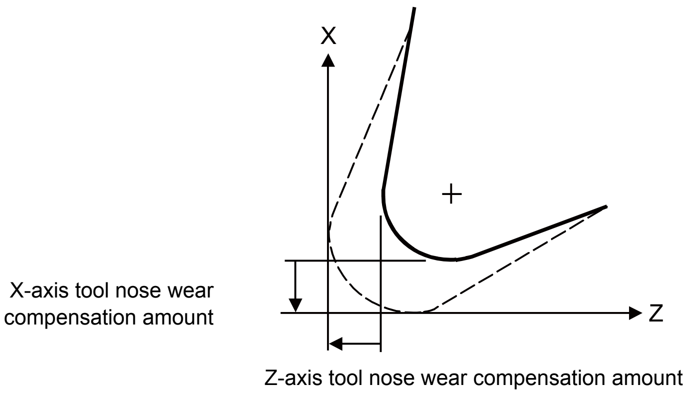
(a) Shape compensation

Tool length is compensated in reference to the programmed base position. The programmed base position is usually the center of the tool rest or the nose position of the base tool.




(b) Wear compensation

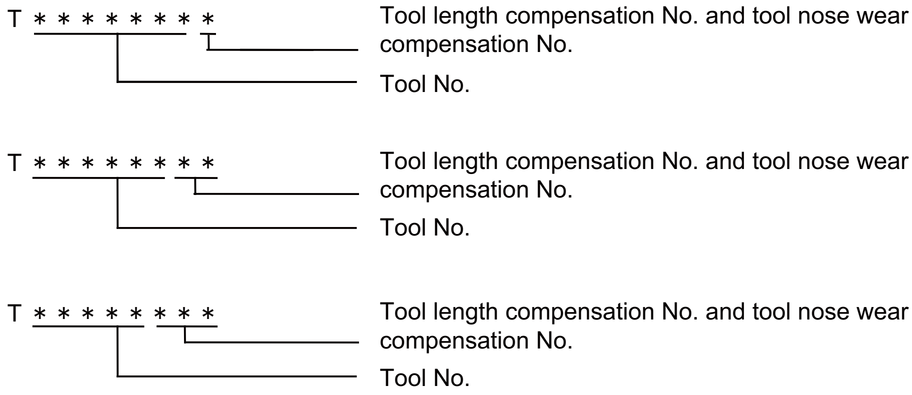
The wear of a tool nose can be compensated.



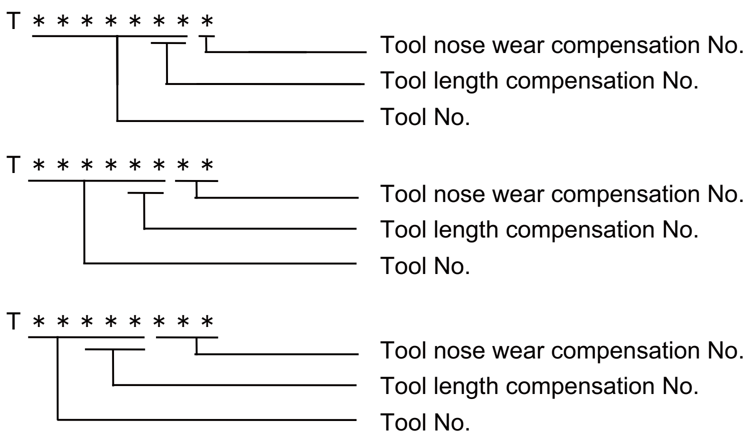
(c) Command format

Tool compensation is performed by a T command. It is specified in eight digits following address T. Tool compensation is divided into two types: tool length compensation and tool nose wear compensation. It depends on the machine specifications as to which digit of T command denotes the tool No., tool length compensation No. or tool nose wear compensation No. (specified by parameters).

(i) Specifying tool length and wear compensation Nos. together using low-order digits of the T command




(ii) Specifying tool length and wear compensation Nos. separately




The tool compensation for the lathe is valid only for the X and Z axes. If an additional axis (Y axis) and the second additional axis are added, the tool compensation will be validated for each additional axis. It supports 4 axes in total.

The additional axis is the third or fourth axis which is selected using a parameter.

### 9.1.2 Tool Position Offset

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | － | － | － | － | － | － | － | － |

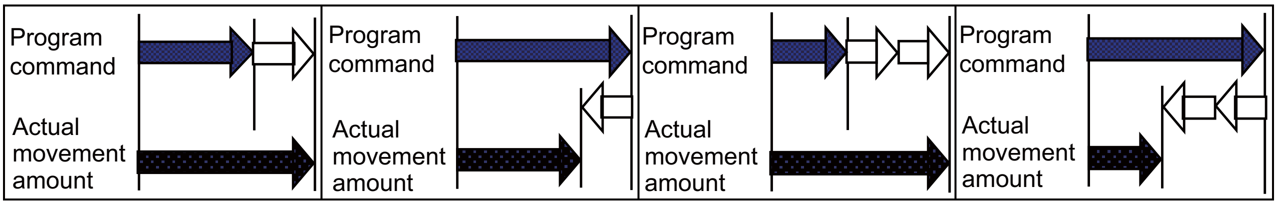
This function uses commands to control the movement by changing the positions of the end points of the movement commands to positions which have been extended or reduced by an amount equivalent to the tool compensation amount.
This function can be used to compensate for the difference in distance between the position where the tool on the machine is actually mounted and the programmed coordinate position based on the tool position and thereby improve the efficiency of both machining and operation.

**G45 G00 Xx1 Yy1 Dd1 ;**

| | |
|---|---|
| G45 | : Tool position offset command |
| Xx1,Yy1 | : Movement axes |
| Dd1 | : Offset No. |

With tool position offset, the offset operation is performed only for blocks containing a G45 to G48 command.

| G45 command | G46 command | G47 command | G48 command |
|---|---|---|---|
| Extension by amount equivalent to offset amount | Reduction by amount equivalent to offset amount | Extension by twice the offset amount | Reduction by twice the offset amount |




(1) If the start and end points are on an axis, the radius can be extended or reduced only for one-quarter, one-half and three-quarter arcs.
(2) In the case of absolute commands, the position is extended or reduced in each axial direction from the end point of the previous block along the line of the movement toward the position commanded in the block containing the G45 (or G46, G47 or G48) command.
(3) In the case of simultaneous n axes command, the same amount of offset is applied to all the axes that have the command within the range of the number of the axes which can be simultaneously controlled. Tool position offset is also valid for additional axes.

### 9.1.3 Tool Compensation for Additional Axes

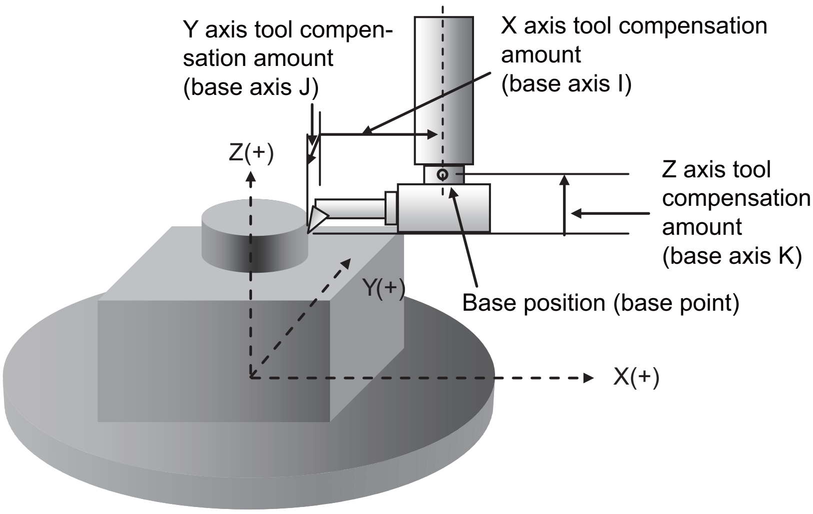
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | － | － | － | － | － | － | － | － |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The tool compensation for the lathe is valid for the first axis (normally X axis) and the second axis (normally Z axis). If additional or second additional axes are added as the third and subsequent axes, the tool compensation is also valid for each additional axes.
The additional axes to which the tool compensation is executed are determined according to the parameter setting.

### 9.1.4 Tool position compensation (G43.7)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | — | — | — | — |
| L | — | — | — | — | — | — | — | — |

The position compensation of a turning tool is executed when turning is performed in a machine of machining center system. Use of the tool position compensation enables the three base axes (X, Y and Z axes) to be compensated from the tool base position (base point).
Before setting the compensations of the three base axes, set the parameter to switch the tool compensation display type to type III.




Command format

| | |
|---|---|
| **G43.7 H__; Tool position compensation start** | |
| **G49; Tool position compensation cancel** | |
| H | : Compensation No. (H0 cancels tool position compensation.) |

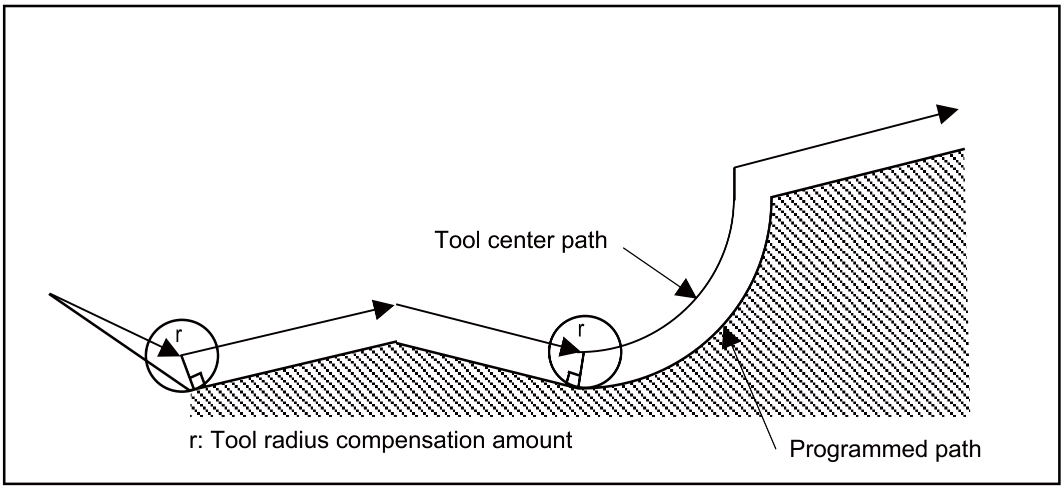
## 9.2 Tool Radius

### 9.2.1 Tool Radius Compensation

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ― | ― | ― | ― | ― | ― | ― | ― |

These commands function to provide tool radius compensation. Through a combination with the G command and D address assignment, they compensate for the actual tool center path either inside or outside the programmed path by an amount equivalent to the tool radius.
The tool path is calculated by the intersection point arithmetic system and, as a result, excessive cut amounts on the inside of corners are avoided.

| G code | Function |
|---|---|
| G38 | Vector designation during tool radius compensation |
| G39 | Corner arc during tool radius compensation |
| G40 | Tool radius compensation cancel |
| G41 | Tool radius compensation left command |
| G42 | Tool radius compensation right command |




The tool radius compensation command controls the compensation from that block in which G41 or G42 is commanded.
In the tool radius compensation mode, the program is read up to five blocks ahead including blocks with no movement, and interference check using tool radius is conducted up to three blocks ahead in any of those blocks with movement.

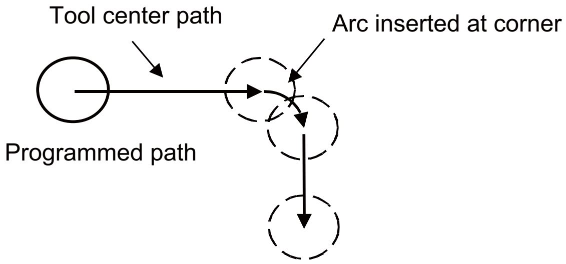
| **G17 G01 G41 Xx1 Yy1 Dd1 ;** | |
|---|---|
| G17 | : Compensation plane |
| G01 | : Cutting command |
| G41 | : Tool radius compensation left command |
| Xx1,Yy1 | : Movement axis |
| Dd1 | : Compensation No. |

The compensation plane, movement axes and next advance direction vector are based on the plane selection command designated by G17 to G19.

G17: XY plane, X, Y, I, J
G18: ZX plane, Z, X, K, I
G19: YZ plane, Y, Z, J, K

An arc is inserted at the corner by the following command during tool radius compensation.

| **G39 Xx1 Yy1 ;** | |
|---|---|
| G39 | : Corner arc during tool radius compensation |
| Xx1,Yy1 | : Movement amount |



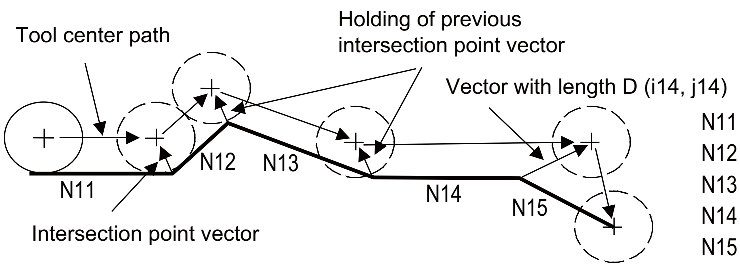

The compensation vector can be changed in following two ways.

| **G38 Xx1 Yy1 ;** | |
|---|---|
| G38 | : Vector designation for tool radius compensation |
| Xx1,Yy1 | : Movement amount |

The tool radius compensation vector amount and direction are retained.

| **G38 Xx1 Yy1 Ii1 Jj1 Dd1 ;** | |
|---|---|
| G38 | : Vector designation for tool radius compensation |
| Xx1,Yy1 | : Movement amount |
| Ii1,Jj1 | : Compensation vector direction |
| Dd1 | : Compensation vector length |

The tool radius compensation vector direction is updated by I and J.

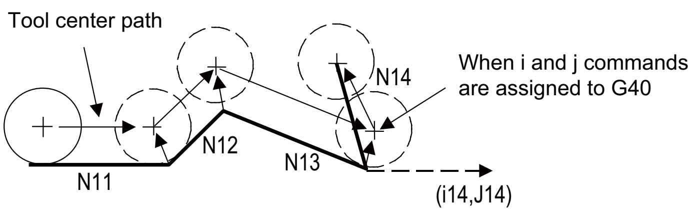



N11 G01 Xx11;
N12 G38 Xx12 Yy12;
N13 G38 Xx13 Yy13;
N14 G38 Xx14 Ii14 Ji14 Dd14;
N15 G40 Xx15 Yy15;

The tool radius compensation is canceled by the following command.

| **G40 Xx1 Yy1 Ii1 Jj1 ;** | |
|---|---|
| G40 | : Tool radius compensation cancel |
| Xx1,Yy1 | : Movement amount |
| Ii1,Jj1 | : Compensation vector direction |

The vector prior to canceling is prepared by calculating the intersection point with the I and J direction.




N11 G01 Xx11 ;
N12 Xx12 Yy12 ;
N13 Xx13 Yy13 ;
N14 G40 Xx14 Ii14 Jj14 ;

## 9.2.2 3-dimensional Tool Radius Compensation

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ― | ― | ― | ― |
| L | △ (*1) | △ (*1) | ― | ― | ― | ― | ― | ― |

(*1) This function is available during program format switch.

This command serves the function of compensating for the spherical radius of ball end mills. It compensates for the actual tool center path to be either more outside or inside the programmed path by an amount equivalent to the tool radius amount in accordance with the 3-dimensional vectors.

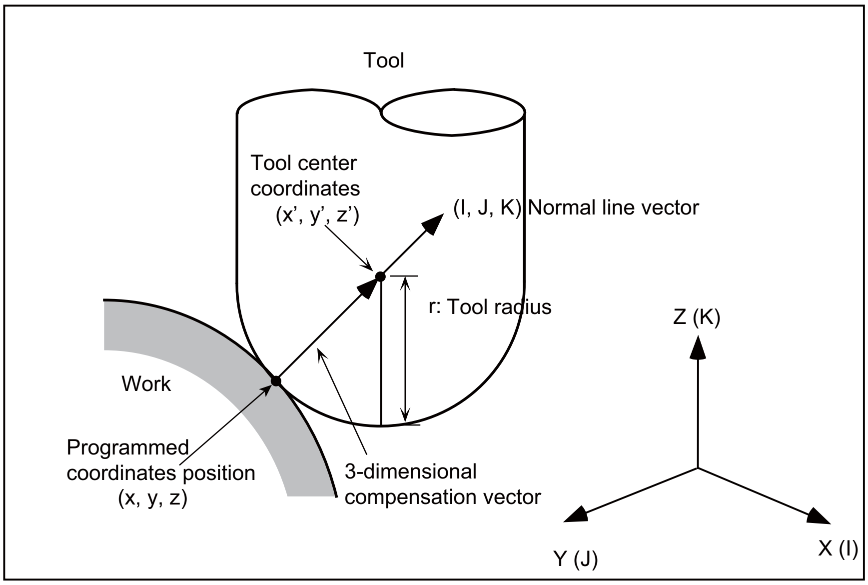
| G code | Function |
|---|---|
| G40 | Tool radius compensation cancel |
| G41 | Tool radius compensation left command (compensation in the direction toward IJK) |
| G42 | Tool radius compensation right command (compensation in the direction away from IJK) |

With 3-dimensional tool radius compensation, the compensation is controlled from the block in which the block containing the G41 or G42 command has been designated.

**G01 G41 Xx1 Yy1 Zz1 Ii1 Jj1 Kk1 Dd1 ;**

| | |
|---|---|
| G01 | : Cutting |
| G41 | : Tool radius compensation left command |
| Xx1,Yy1,Zz1 | : Movement axis |
| Ii1,Jj1,Kk1 | : Tool sphere center vectors |
| Dd1 | : Compensation No. |

The radius from the tool spherical center to the end nose serves as the compensation amount that corresponds to the tool compensation No. designated by d1. The compensation Nos. that can be used are limited by the "number of tool compensation sets." (Refer to the section "9.3.1 Number of Tool Offset Sets".)
If the compensation vectors (tool spherical center vectors) are to be changed, the G41 and I, J and K commands must be assigned.

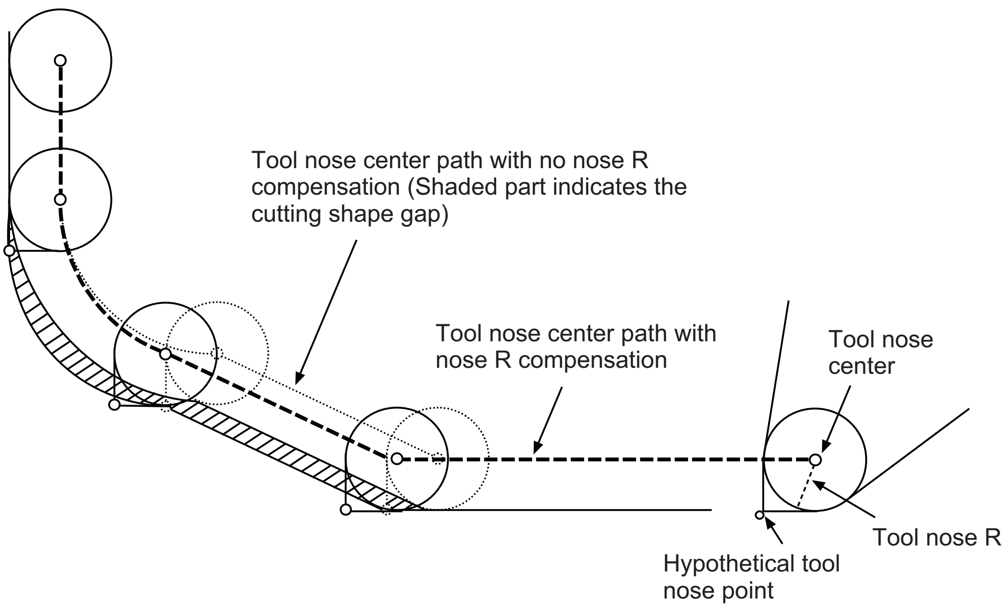


### 9.2.3 Tool Nose Radius Compensation (G40/41/42)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | － | － | － | － |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Because a tool nose is generally rounded, a hypothetical tool nose point is used for creating programming. As a result, due to this roundnessof the tool nose, there will be a gap between the programmed shape and the actual cutting shape during taper cutting or circular cutting. Nose radius compensation is a function to automatically calculate and offset this error by setting the tool nose radius value.
"Nose radius compensation" is a type of compensation that is available when turning is performed on a lathe.
"Nose radius compensation for machining center system" is a function which enables the nose radius compensation when turning is performed on a machining center. The basic operation follows the specifications of "Tool Nose Radius Compensation".

| G code | Function |
|---|---|
| G40 | Nose R compensation cancel |
| G41 | Nose R compensation left command |
| G42 | Nose R compensation right command |




Nose R interference check
In the nose radius compensation mode, the program is read up to five blocks ahead including blocks with no movement, and an interference check using the nose radius is conducted up to three blocks ahead in any of those blocks with movement.

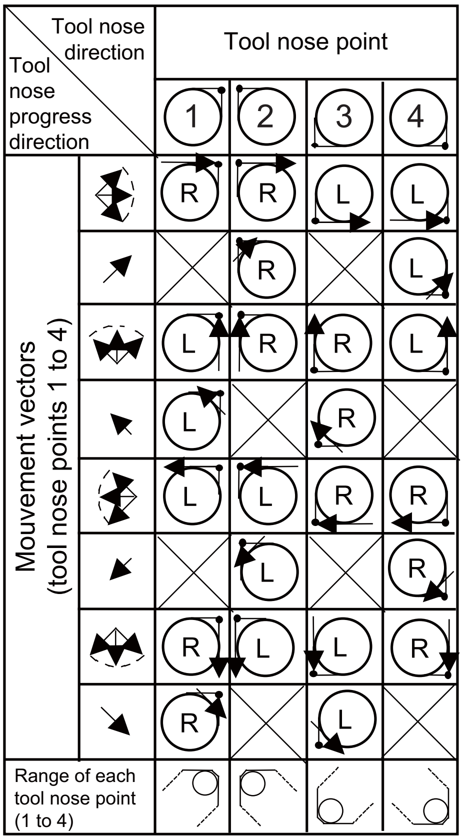
### 9.2.4 Automatic Decision of Nose Radius Compensation Direction (G46/40)

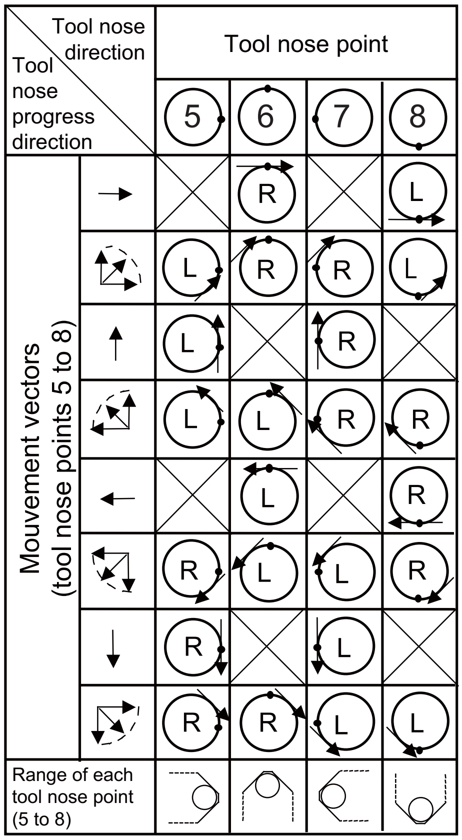
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ― | ― | ― | ― | ― | ― | ― | ― |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The nose radius compensation direction is automatically determined from the tool nose point and the specified movement vector.

| G code | Function |
|---|---|
| G40<br>G46 | Nose radius compensation cancel<br>Nose radius compensation ON (Automatic decision of compensation direction) |

The compensation directions based on the movement vectors at the tool nose points are as follows:




### 9.2.5 Tool Radius Compensation Diameter Designation

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ― | ― | ― | ― | ― | ― | ― | ― |

Tool diameter designation handles the compensation amount as diameter value and compensates the amount set in the tool compensation amount screen when tool radius compensation (G41/G42 command) is commanded.
Whether compensation amount is handled in radius value or diameter value is switched by the parameter.

## 9.3 Tool Offset Amount

### 9.3.1 Number of Tool Offset Sets

[M system]

| Number of tool compensation sets | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| Number of tool offset sets (99 sets) | — | — | — | — | — | — | — | — |
| Number of tool offset sets (128 sets) | — | — | — | — | — | — | — | — |
| Number of tool offset sets (200 sets) | ○ | ○ | ○ | ○ | — | — | — | ○ |
| Number of tool offset sets (256 sets) | — | — | — | — | — | — | — | — |
| Number of tool offset sets (400 sets) | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| Number of tool offset sets (999 sets) | △ | △ | △ | △ | — | — | — | — |

[L system]

| Number of tool compensation sets | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| Number of tool offset sets (99 sets) | — | — | — | — | — | — | ○ | — |
| Number of tool offset sets (128 sets) | ○ | ○ | ○ | ○ | — | — | — | ○ |
| Number of tool offset sets (200 sets) | — | — | — | — | — | — | — | — |
| Number of tool offset sets (256 sets) | — | — | — | — | ○ | ○ | — | △ |
| Number of tool offset sets (400 sets) | △ | △ | △ | △ | — | — | — | — |
| Number of tool offset sets (999 sets) | △ | △ | △ | △ | — | — | — | — |

The number of tool compensation sets (the number of tool offset sets) for the fixed allocation is shown in the following tables. Refer to "9.3.3 Number of Tool Offset Sets Allocation to Part Systems" for the arbitrary allocation.

<M system>

| Function name | Common for part systems or 1-part system specification | Independent for part systems and multi-part system specification |
|---|---|---|
| Number of tool offset sets (200 sets) | 200 sets | Divide the number of tool offset sets by the number to obtain the number of sets per part system. (If there is the remainder, the remainder goes to the 1st part system.) |
| Number of tool offset sets (400 sets) | 400 sets | |
| Number of tool offset sets (999 sets) | 999 sets | |

<L system>

| Function name | Common for part systems or 1-part system specification | Independent for part systems and multi-part system specification |
|---|---|---|
| Number of tool offset sets (99 sets) | 99 sets | Divide the number of tool offset sets by the number to obtain the number of sets per part system. (If there is the remainder, the remainder goes to the 1st part system.) |
| Number of tool offset sets (128 sets) | 128 sets | |
| Number of tool offset sets (256 sets) | 256 sets | |
| Number of tool offset sets (400 sets) | 400 sets | |
| Number of tool offset sets (999 sets) | 999 sets | |

(Note) Whether the tool compensation memory is provided commonly for the part systems or independently for the part systems depends on the parameter settings.

## 9.3.2 Offset Memory

### 9.3.2.1 Tool Shape/Wear Offset Amount

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

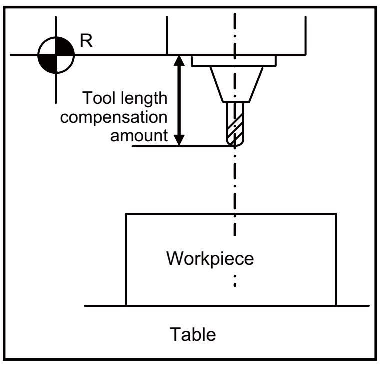
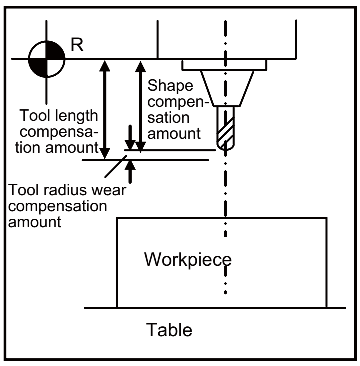
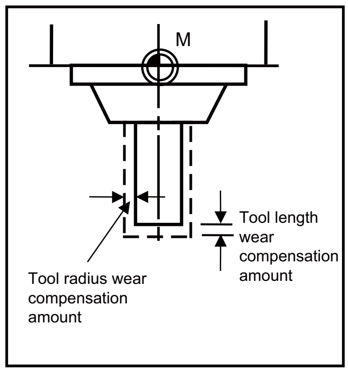
This function registers the tool shape compensation and wear compensation amounts. Compensation may encompass two or more axes.
Tool compensation types I, II and III are available for M system, which can be selected by the parameter. For L system, tool compensation type III is always used.

**(1) Shape compensation amount**
The tool length compensation amount, tool radius compensation amount, nose radius compensation amount, nose radius imaginary tool tip point or tool width can be set as the shape compensation amount.
The compensation amount that can be set and used differs depending on whether compensation amount setting type I,II or III is used.

**(2) Wear compensation amount**
When the tip of the tool used has become worn, the wear compensation amount is used to compensate this wear. Types of wear compensation amounts include the tool length wear compensation amount, tool radius wear compensation amount, and nose radius wear compensation amount.
The wear compensation amount can be used with compensation amount setting types II and III, and it is added to the shape compensation amount for compensation.

(a) Type I: 1-axis compensation amount [M system]
This is the value that is used by rotary tools.
As the tool length compensation amount, among the compensation amounts for the position of the tool moving in the direction parallel to the control axis, the compensation amount in the longitudinal direction of the rotary tool is registered. The tool length compensation amount is set as a minus value.
As the tool radius compensation amount, among the compensation amounts for the position of the tool moving in the direction parallel to the control axis, the compensation amount in the radial direction of the rotary tool is registered. The tool radius compensation amount is set as a plus value.
One compensation amount data is registered in one compensation No., and the compensation Nos. are assigned using the address D or H commands. When a No. is assigned by a D address command, compensation is provided in the form of the tool radius; when it is assigned by an H address command, it is provided in the form of the tool length.

(b) Type II: 1-axis compensation amounts/with wear compensation [M system]
As with type I, type II is for the compensation amounts used by rotary tools.
With type II, four kinds of compensation amount data are registered in one compensation No.: the tool length compensation amount, tool length wear compensation amount, tool radius compensation amount, and tool radius wear compensation amount.
When a compensation No. is assigned by address D as the compensation amount, the tool radius is compensated using the amount obtained by adding the shape compensation amount and tool radius wear compensation amount. Further, the tool length is compensation using the amount obtained by adding the shape compensation amount and tool length wear compensation amount.

<table>
<tr><th colspan="2">Tool length compensation amount</th><th rowspan="2">Wear compensation amount when using type II</th></tr>
<tr><th>Compensation types I</th><th>Compensation types I and II</th></tr>
<tr><td>
</td><td>
</td><td>
</td></tr>
</table>

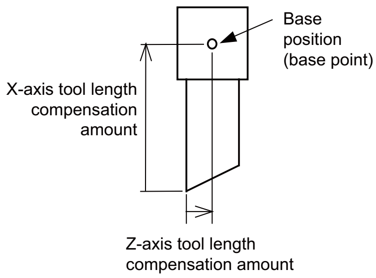
(c) Type III: 2-axis compensation amounts [M system][L system]

Type III is for the compensation amounts used by non-rotary tools.

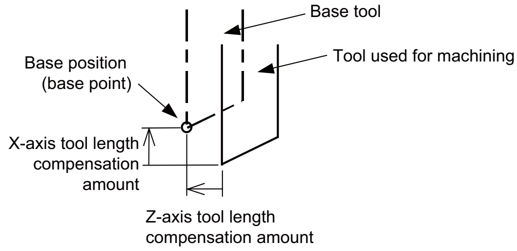
As the compensation amounts, the tool length along the X, Y and Z axes and the wear amount along each of these axes, the nose radius and nose radius wear amount, tool tip point P and tool width can be registered.

Compensation is carried out in the directions of the X, Y and Z axes from the base position in the program. Generally, the center of the tool rest or the tip of the base tool is used as the programmed base position.

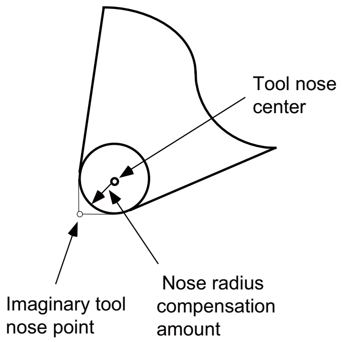
1. The programmed base position is the center of the tool rest:

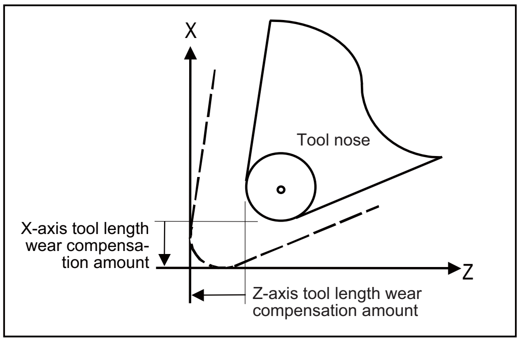



2. The programmed base position is the tip of the base tool:




The tool tip contour arc radius (nose radius) of a non-rotary tool with an arc (nose radius) at its tip is registered as the nose radius compensation amount.




The X-axis tool length compensation amount, Z-axis tool length compensation amount and nose radius compensation amount are set as plus amounts.

### 9.3.2.2 Compensation Type Selection by Parameter

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | － |
| L | － | － | － | － | － | － | － | － |

This function switches the tool compensation type with the parameter.
The type is switched to the tool compensation type III by setting the parameter, regardless of #1037 cmdtyp.
This function enables tool compensation for a turning tool by registering the tool compensation amount of the base axes IJK and tool tip point for a machining center system.

(1) Machining center system

Tool compensation type I and II are used for machining center system. However, use of this function switches the type to tool compensation type III.

[Correspondence of the registered data between the compensation types]

(a) Tool compensation type I -> Tool compensation type III

The tool compensation amount of tool compensation type I is handled as tool length Z of tool compensation type III.

(b) Tool compensation type II -> Tool compensation type III

The table below shows the relationship between the registered items.

| Tool compensation type II | Tool compensation type III |
|---|---|
| Length | Length Z |
| L wear | Wear Z |
| Radius | Nose R |
| R wear | R-wear |

(2) Lathe system

The tool compensation type is not switched by using this function.

### 9.3.3 Number of Tool Offset Sets Allocation to Part Systems

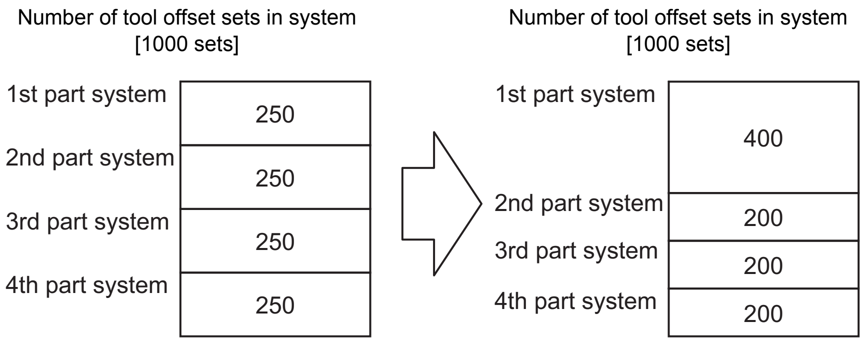
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | – | – | – | – |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | – |

* Variable number of per-part-system tool offset sets

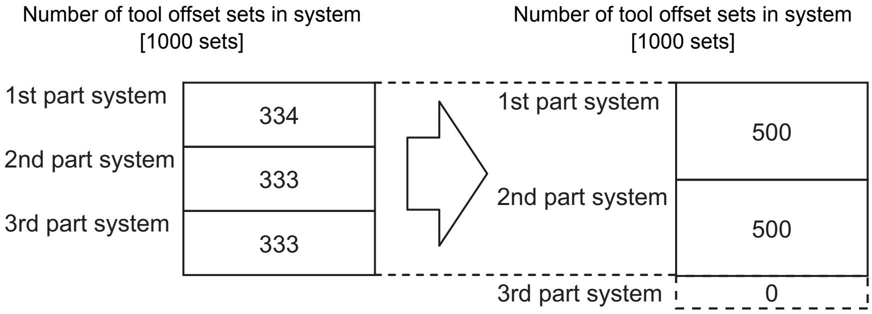
The number of tool offset sets can be set per part system.
There are two types of the allocation: "Arbitrary allocation" which allocates the number of tool offset sets to each part system arbitrarily and "Fixed allocation" which automatically allocates the number of tool offset sets to each part system equally, and the type can be selected using the parameter.
The arbitrary allocation enables the efficient allocation because when a certain part system needs only a small number of offset sets, the rest can be allocated to another part system. If an auxiliary-axis part system does not need the tool offset set at all, the number of tool offset sets can be set 0 in the auxiliary-axis part system.
"Number of tool offset sets in system" is the total number of tool offset sets of all part systems.

(1) Arbitrary allocation

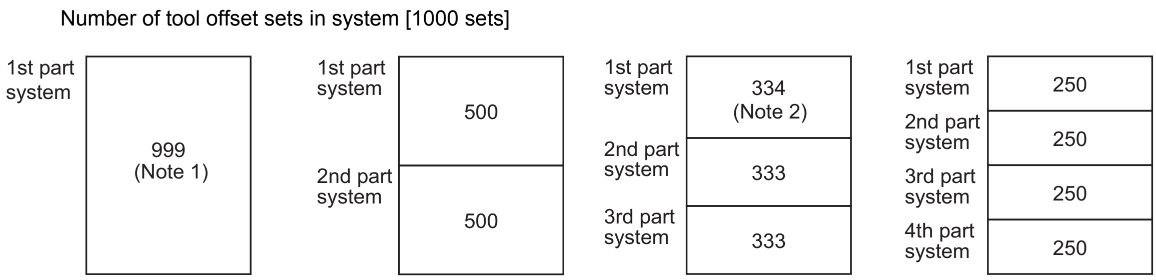
(a) When the number of tool offset sets is increased in the 1st part system of 4-part system




(b) When the number of offset sets is set "0" to the 3rd part system of 3-part system for use of the 3rd part system as auxiliary-axis part system




(2) Fixed allocation



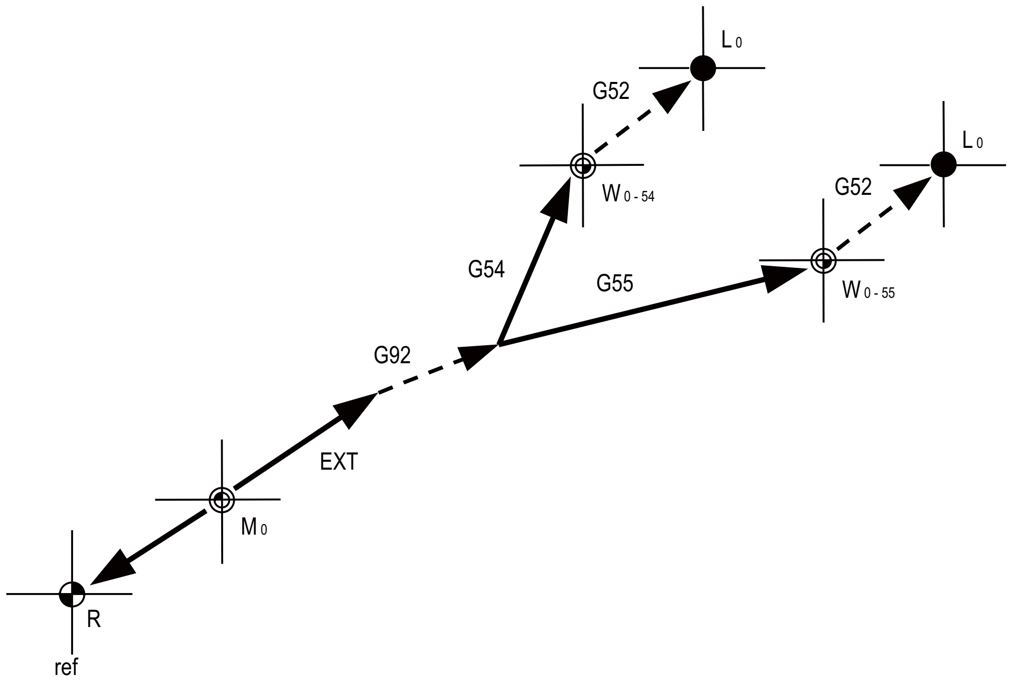

(Note 1) The maximum number of tool offset sets per part system is 999.
(Note 2) If there is any remainder, the remainder is allocated to the 1st part system.

# 10

# Coordinate System

## 10.1 Coordinate System Type and Setting

The coordinate system handled by the NC is shown below.
The points that can be commanded with the movement command are points on the local coordinate system or machine coordinate system.




| | |
|---|---|
| L0 | Local coordinate system zero point |
| G52 | Local coordinate system offset (*1) |
| W0-54 | Workpiece coordinate system zero point (G54) |
| W0-55 | Workpiece coordinate system zero point (G55) |
| G54 | Workpiece coordinate system (G54) offset (*1) |
| G55 | Workpiece coordinate system (G55) offset |
| G92 | G92 coordinate system shift |
| EXT | External workpiece coordinate offset |
| M0 | Machine coordinate system zero point |
| ref | Reference position |

Offset set with parameters

Offset set with program
(0 when power is turned ON)

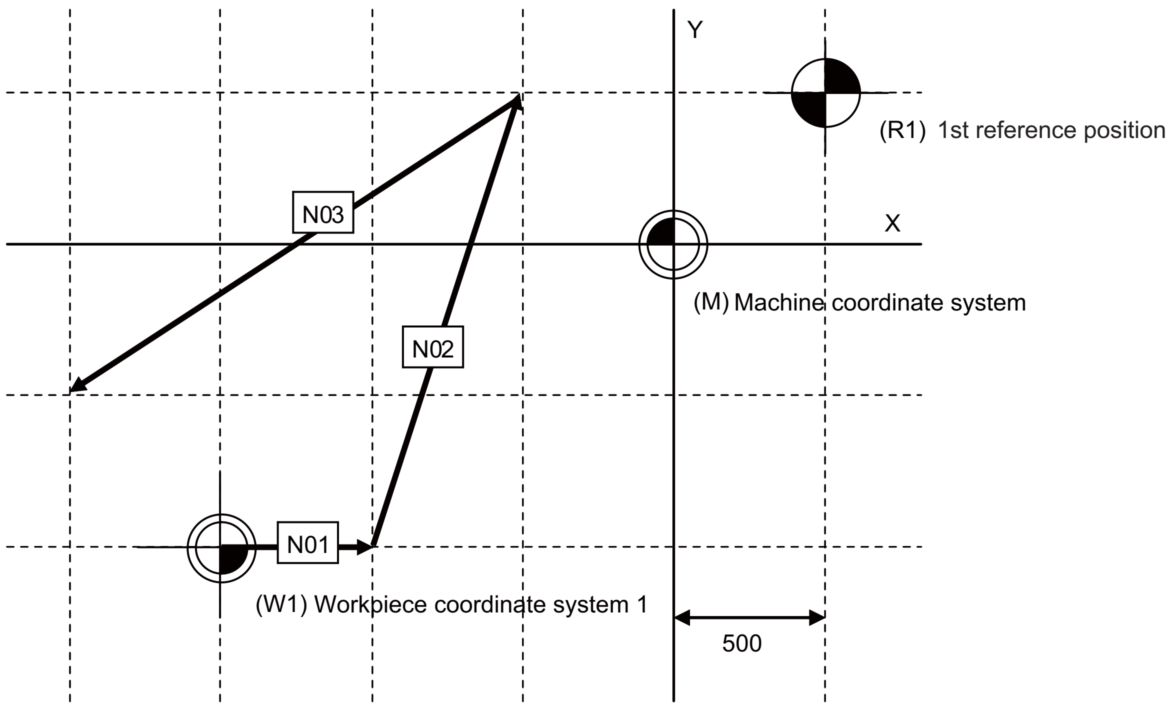
(*1) The G52 offset is available independently for G54 to G59.

### 10.1.1 Machine Coordinate System

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The machine coordinate system is used to express the prescribed positions (such as the tool exchange and stroke end positions) that are specific to each machine.
The G53 command followed by coordinates moves the tool to the command position in the machine coordinate system.

If a coordinate command is included in the same block as G53, it is treated as a command not in the workpiece coordinate system but in the machine coordinate system.




When the initial position of workpiece coordinate is (0,0) with absolute value command.
N01 G01 X500. Y0. F1000
N02 G53 X-500. Y500.
N03 X-500. Y500.

Command format

| | |
|---|---|
| **G53 X__ (U__) Y__ (V__) Z__ (W__) α__ β__ ;** | |
| X/U/Y/V/Z/W/α/β | : Axis address (range of coordinate position command (mm, inch)) |

If the incremental or absolute commands and movement mode have been omitted, operation complies with the modal command that prevails at the time.
G53 (movement on machine coordinate system) is an unmodal command which is effective only in the block where it is assigned. The workpiece coordinate system being selected is not changed by this command.

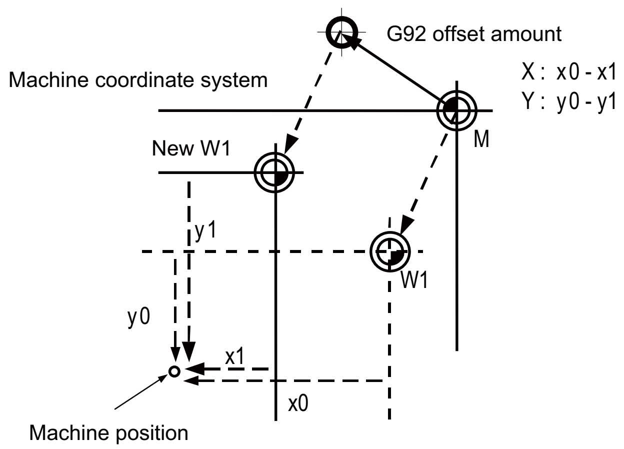
### 10.1.2 Coordinate System Setting

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Among the workpiece coordinate systems with the G92, the program coordinate system (the programmed zero point) can be changed.
When a coordinate system setting is assigned using the G92 command, the G92 offset amount is applied so that the machine position in the current workpiece coordinate system is set to the coordinate position assigned by the G92 command, as shown in the figure below, and the workpiece coordinate systems are shifted accordingly. The machine does not run, and all the workpiece coordinate systems from G54 to G59 referenced to the machine coordinate system (or the external workpiece coordinate system if the external workpiece coordinate offset has been set) are shifted.

Offset of coordinate system by G92 coordinate system setting

| |
|---|
| Example where W1 is shifted to new W1 when the machine was at the position (x0, y0) above W1 and the G92 Xx1 Yy1; command was assigned when the workpiece coordinate system W1 is modal (external workpiece coordinate system offset = 0; interrupt amount offset = 0) |

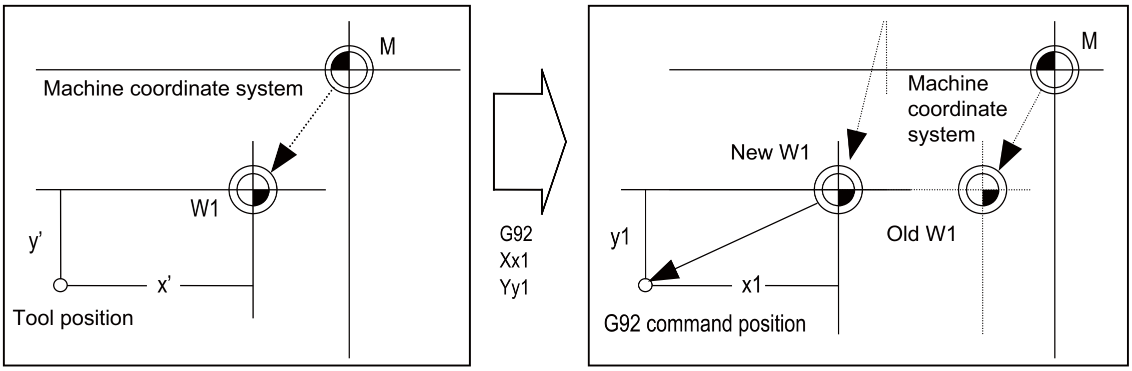



The shifted coordinate system is returned to its original position by dog-type reference position return or the program.

When the coordinate system setting is commanded by G92, all the workpiece coordinate systems from G54 through G59 referenced to the machine coordinate system undergo a shift.

Coordinate system created by automatic coordinate system setting

Coordinate system after coordinate system setting by G92




(1) All the workpiece coordinates from G54 to G59 move in parallel.
(2) There are two ways to return a shifted coordinate system to its original position.
    (a) Carry out dog-type reference position return
    (b) Move to machine coordinate system zero point and assign G92 and G53 commands in same block to set the machine coordinate system.

| | |
|---|---|
| G90 G53 G00 X0 Y0 ; | Positioning at machine coordinate system zero point. |
| G92 G53 X0 Y0 ; | Coordinate system zero setting in machine coordinate system.<br>This returns all the workpiece coordinates from G54 to G59 to their original positions. |

### 10.1.3 Automatic Coordinate System Setting

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

After the power is turned ON, the basic machine coordinate system and the workpiece coordinate system are automatically set without executing the zero point return.
The coordinate systems created are given below.

(1) Machine coordinate system corresponding to G53
(2) G54 to G59 workpiece coordinate system
(3) Local coordinate systems created under G54 to G59 workpiece coordinate systems

The distances from the zero point of G53 machine coordinate system are set to the controller coordinate related parameters.

### 10.1.4 Workpiece Coordinate System Selection

#### 10.1.4.1 Workpiece Coordinate System Selection (6 Sets)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

When a multiple number of workpieces with the same shape are to be machined, these commands enable the same shape to be machined by executing a single machining program in the coordinate system of each workpiece.
Up to 6 workpiece coordinate systems can be selected.
The G54 workpiece coordinate system is selected when the power is turned ON or the reset signal which cancels the modal information is input.

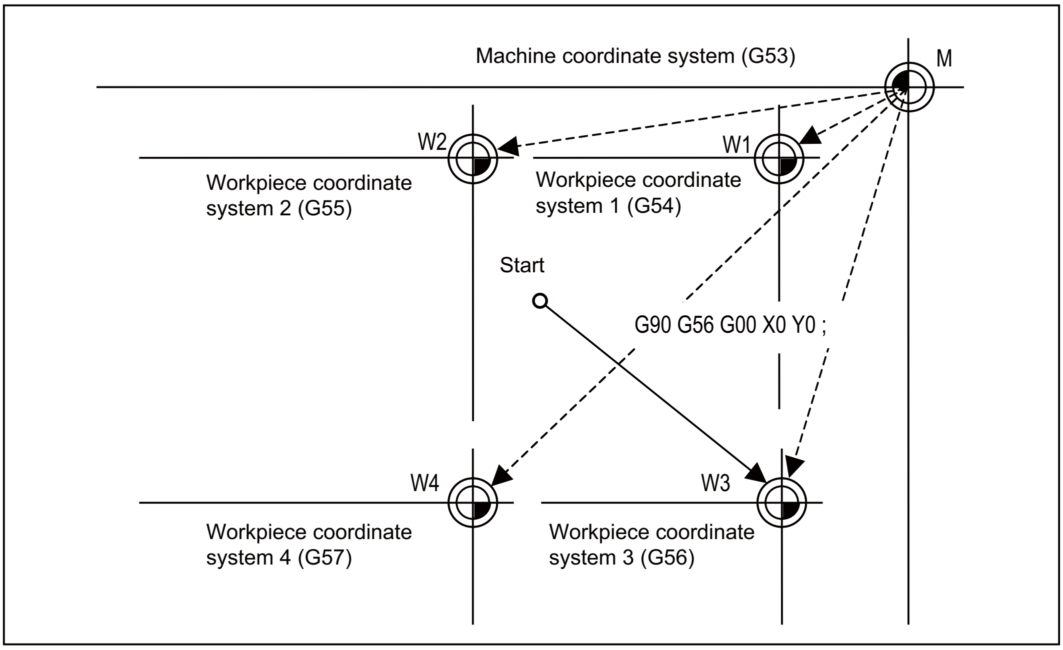
| G code | Function |
|---|---|
| G54 | Workpiece coordinate system 1 (W1) |
| G55 | Workpiece coordinate system 2 (W2) |
| G56 | Workpiece coordinate system 3 (W3) |
| G57 | Workpiece coordinate system 4 (W4) |
| G58 | Workpiece coordinate system 5 (W5) |
| G59 | Workpiece coordinate system 6 (W6) |

The command formats to select the workpiece coordinate system and to move on the workpiece coordinate system are given below.

| **(G90) G54 G00 Xx1 Yy1 Zz1 ;** | |
|---|---|
| (G90) | : (Absolute command) |
| G54 | : Coordinate system selection |
| G00 | : Movement mode |
| Xx1,Yy1,Zz1 | : Coordinate position of end point |

The workpiece coordinate zero points are provided as distances from the zero point of the machine coordinate system.
Settings can be performed in one of the following three ways:

(1) Setting using the setting and display unit
(2) Setting using commands assigned from the machining program
(3) Setting from the user PLC



### 10.1.4.2 Extended Workpiece Coordinate System Selection (48 Sets) G54.1P1 to P48

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

When a multiple number of workpieces with the same shape are to be machined, these commands enable the same shape to be machined by executing a single machining program in the coordinate system of each workpiece.
In addition to the six workpiece coordinate systems G54 to G59, 48 workpiece coordinate systems can be used by assigning G54.1Pn command.
The command format to select the workpiece coordinate system using the G54.1Pn command and to move on the workpiece coordinate system are given below.

**(G90) G54.1Pn G00 X__ Y__ Z__ ;**

| | |
|---|---|
| G90 | : (Absolute command) |
| G54.1Pn | : Coordinate system selection |
| G00 | : Movement mode |
| X,Y,Z | :Coordinate position of end point |

The numerical value n of P following G54.1 indicates each workpiece coordinate system. Specify a value between 1 and 48.
The workpiece coordinate zero points are provided as distances from the zero point of the machine coordinate system.
Settings can be performed in one of the following three ways:

(a) Setting using the setting and display unit
(b) Setting using commands assigned from the machining program
(c) Setting from the user PLC

G54Pn can be used as the extended workpiece coordinate system selection command by setting the parameter.

### 10.1.4.3 Extended Workpiece Coordinate System Selection (96 Sets) G54.1P1 to P96

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | － | － | － | － |
| L | － | － | － | － | － | － | － | － |

In addition to the six workpiece coordinate systems (G54 to G59), 96 workpiece coordinate systems can be used by assigning G54.1Pn command. Refer to "Extended workpiece coordinate system selection (48 sets) G54.1P1 to P48" for details.

### 10.1.4.4 Extended Workpiece Coordinate System Selection (300 Sets) G54.1P1 to P300

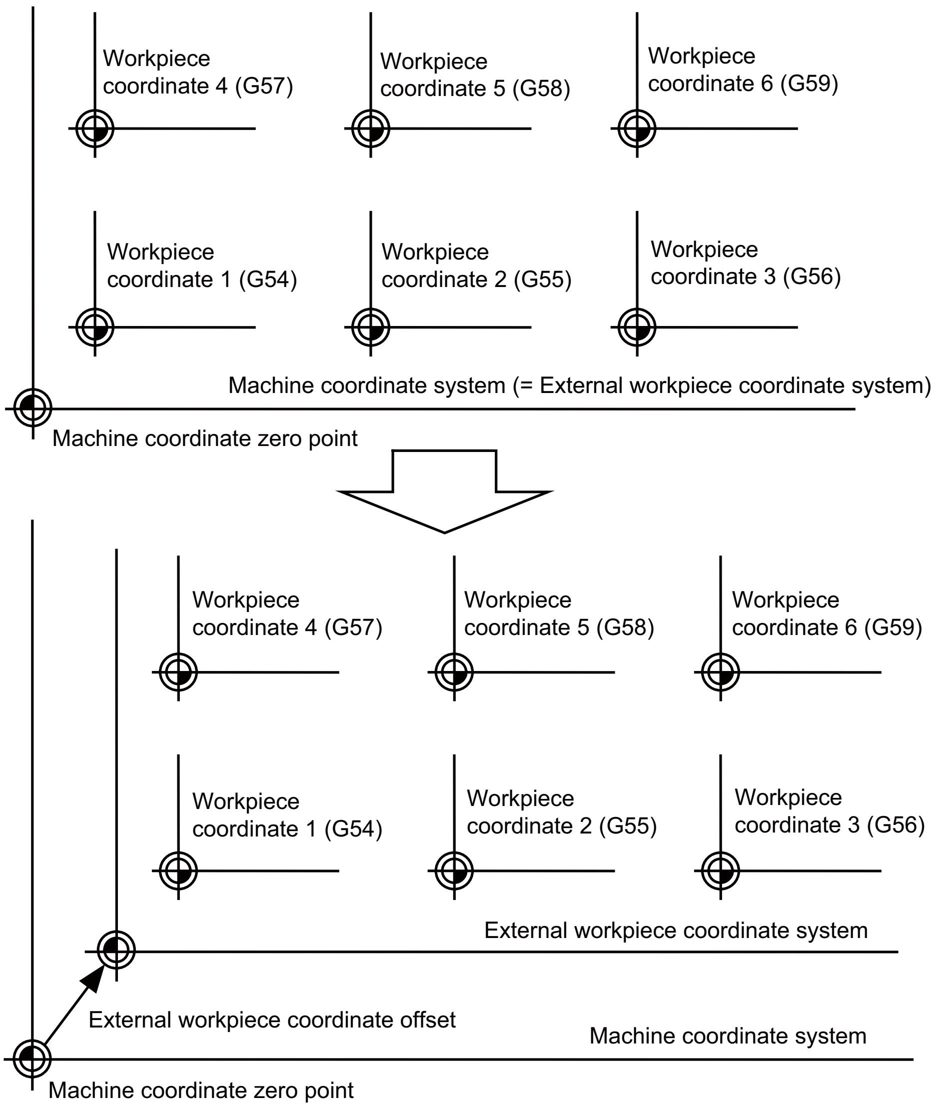
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | － | － | － | － |
| L | － | － | － | － | － | － | － | － |

In addition to the six workpiece coordinate systems (G54 to G59), 300 workpiece coordinate systems can be used by assigning G54.1Pm command. Refer to "Extended Workpiece Coordinate System Selection (48 sets) G54.1P1 to P48" for details.

### 10.1.5 External Workpiece Coordinate Offset

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

External workpiece coordinate offset that serves as the reference for all the workpiece coordinate systems is available outside the workpiece coordinates.
By setting the external workpiece coordinate offset, the external workpiece coordinate system can be shifted from the machine coordinate system, and all the workpiece coordinate systems can be simultaneously shifted by an amount equivalent to the offset.
When the external workpiece coordinate offset is zero, the external workpiece coordinate systems coincide with the machine coordinate system.
It is not possible to assign movement commands with the external workpiece coordinate selected.



### 10.1.6 Workpiece Coordinate System Preset (G92.1)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ― | ― | ― | ― |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

This function presets the workpiece coordinate system, which has been shifted by the programmed command or the manual operation, as the workpiece coordinate system which has been offset by the programmed command (G92.1) from the machine zero point by an amount equivalent to the workpiece coordinate offset amount.

The workpiece coordinate system is shifted from the machine coordinate system when the such operations or the programmed commands as below have been performed.
- When manual intervention has occurred in the manual absolute OFF status
- When a movement command was performed in the machine lock status
- When movement was initiated by handle interrupt
- When a movement command was performed in the mirror image mode
- When a local coordinate system was set using the G52 command
- When a workpiece coordinate system was shifted using the G92 command

Just as when manual reference position return has been performed, this function presets the workpiece coordinate system which has been shifted once to the workpiece coordinate system which has been offset from the machine zero point by an amount equivalent to the workpiece coordinate offset amount.
Furthermore, whether to preset relative coordinates as well is selected with a parameter.

Command format

```
G92.1 (G50.3)  X0  Y0  Z0  α0  ;    (where α is an additional axis)
```

Designate the addresses of the axes to be preset.
Axes whose addresses have not designated will not be preset.
Depending on the command type, G50.3 command is used in stead.
A program error results when a value other than 0 is commanded.

### 10.1.7 Local Coordinate System

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

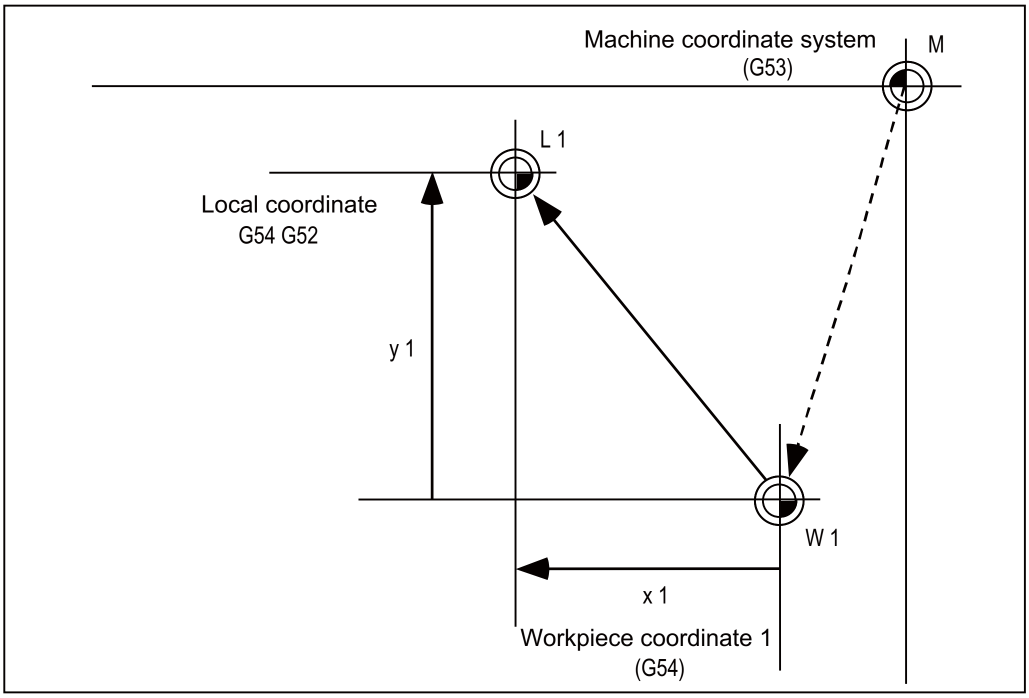
This function is for assigning a coordinate system on the workpiece coordinate system now being selected. This enables the workpiece coordinate system to be changed temporarily.
The local coordinate system can be selected independently on each workpiece coordinate system G54 to G59.

| G code | Function |
|---|---|
| G54 G52 | Local coordinate system on the workpiece coordinate system 1 |
| G55 G52 | Local coordinate system on the workpiece coordinate system 2 |
| G56 G52 | Local coordinate system on the workpiece coordinate system 3 |
| G57 G52 | Local coordinate system on the workpiece coordinate system 4 |
| G58 G52 | Local coordinate system on the workpiece coordinate system 5 |
| G59 G52 | Local coordinate system on the workpiece coordinate system 6 |

The command format of the local coordinate system is given below.

| **(G54) G52 Xx1 Yy1 Zz1 ;** | |
|---|---|
| (G54) | : Workpiece coordinate system selection |
| G52 | : Local coordinate system setting |
| Xx1,Yy1,Zz1 | : Local coordinate offset amount |

The local coordinate zero points are provided as distances from the zero point of the designated workpiece coordinate system (local coordinate offset).
In the incremental position setting mode, the position obtained by adding the local coordinate offset amount to the previously specified offset amount serves as the new local coordinate zero point.
If no workpiece coordinates are designated, the local coordinates will be created on the currently selected workpiece coordinates.
This command is unmodal but the local coordinate system created by G52 is valid until the next G52 command is issued.
The local coordinate system is canceled by the input of the reset signal or by manual or automatic dog-type reference position return.



### 10.1.8 Coordinate System for Rotary Axis

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The axis designated as the rotary axis with the parameters is controlled with the rotary axis' coordinate system.

The rotary axis includes the rotating type (short-cut valid/invalid) and linear type (workpiece coordinate position linear type, all coordinate position linear type).

The workpiece coordinate position range is 0 to 359.999° for the rotating type, and 0 to 99999.999° for the linear type.

The machine position and relative position differ according to the parameters.

The rotary axis is commanded with a degree (°) unit regardless of the inch or metric designation.

The rotary axis type can be set with the parameters for each axis.

<table>
<tr><td rowspan="3"></td><td colspan="4">Rotary axis</td><td rowspan="3">Linear axis</td></tr>
<tr><td colspan="2">Rotating type rotary axis</td><td colspan="2">Linear type rotary axis</td></tr>
<tr><td>Short-cut invalid</td><td>Short-cut valid</td><td>Workpiece coordinate position linear type</td><td>All coordinate position linear type</td></tr>
<tr><td>Workpiece coordinate position</td><td colspan="2">Displayed in the range of 0° to 359.999°.</td><td colspan="3">Displayed in the range of 0° to 99999.999°.</td></tr>
<tr><td>Machine position/ relative position</td><td colspan="3">Displayed in the range of 0° to 359.999°.</td><td colspan="2">Displayed in the range of 0° to 99999.999°.</td></tr>
<tr><td>ABS command</td><td>The incremental amount from the end point to the current position is divided by 360, and the axis moves by the remainder amount according to the sign.</td><td>Moves with a short-cut to the end point.</td><td colspan="3">In the same manner as the normal linear axis, moves according to the sign by the amount obtained by subtracting the current position from the end point (without rounding up to 360 degrees.).</td></tr>
<tr><td>INC command</td><td colspan="5">Moves in the direction of the commanded sign by the commanded incremental amount starting at the current position.</td></tr>
<tr><td rowspan="2">Reference position return</td><td colspan="5">Follows the absolute/relative command for a movement to the interim position.</td></tr>
<tr><td colspan="3">Returns to the reference position from the interim position within a 360 degree movement.</td><td colspan="2">Moves and returns in the reference position direction for the difference from the current position to the reference position.</td></tr>
</table>

### 10.1.9 Plane Selection

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

G17, G18, and G19 are for specifying the planes for the arc, tool radius compensation, coordinate rotation and other such commands.

| | |
|---|---|
| **G17;** | **Xp-Yp plane designation** |
| **G18;** | **Zp-Xp plane designation** |
| **G19;** | **Yp-Zp plane designation** |

(1) A parameter can be used to set either the X, Y or Z axis to which the additional axis is to be parallel.
(2) A parameter can be used to set the initialization status (when the power has been turned ON or when the reset status has been entered) to G17, G18 or G19.
(3) The movement commands have no connection with the plane selection.
(Example)

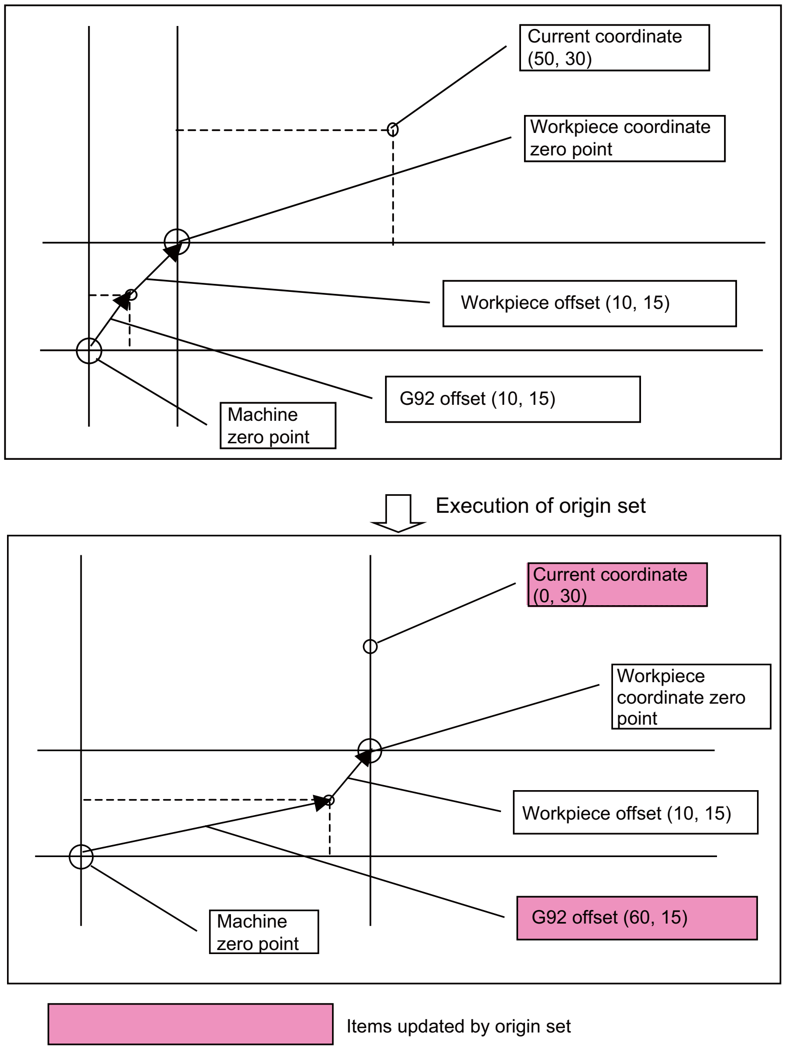
| | |
|---|---|
| G19 X100. ; | With these program commands, X100. is the axis which does not exist on the G19 (Yp, Zp) plane, Yp-Zp plane is selected by G19 and the X axis moves by 100. mm separately from the plane selection. |
| G17 X100 . R50. ; | With these program commands, the Xp-Yp plane is selected by G17 and the arc command is controlled on the X-Y plane by this command. |

### 10.1.10 Origin Set/Origin Cancel

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

**(1) Origin set**

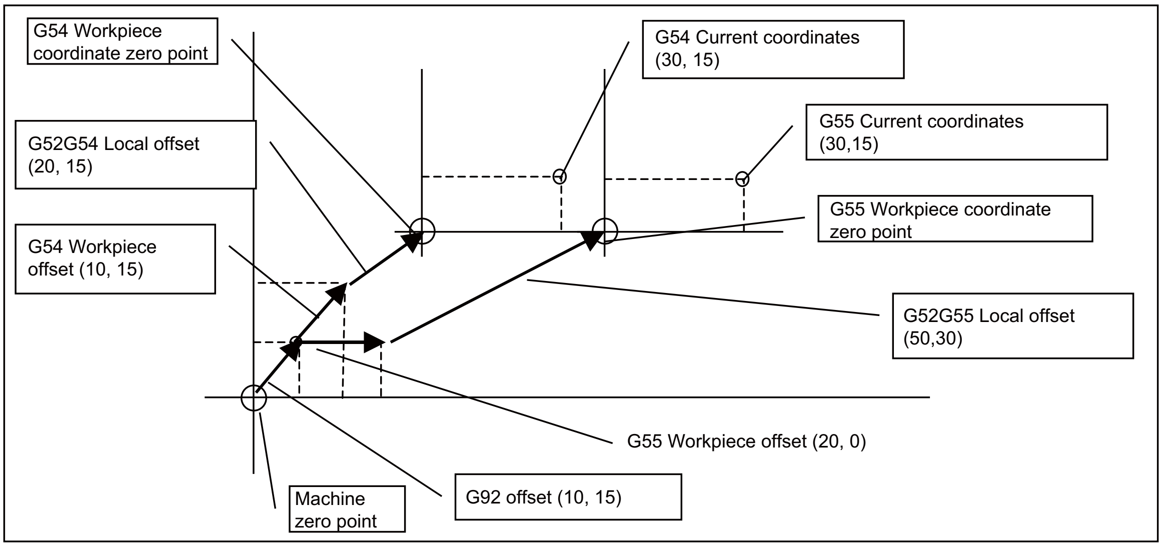
Origin set is a function that shifts the coordinate system so that the current position is the zero point on the workpiece coordinate system containing the workpiece coordinate system's offset value.
The relative position counter and workpiece coordinate counter are set to "0" with this operation. In other words, this is the same as the coordinate system setting command "G92 X0;". (For target axis: X)



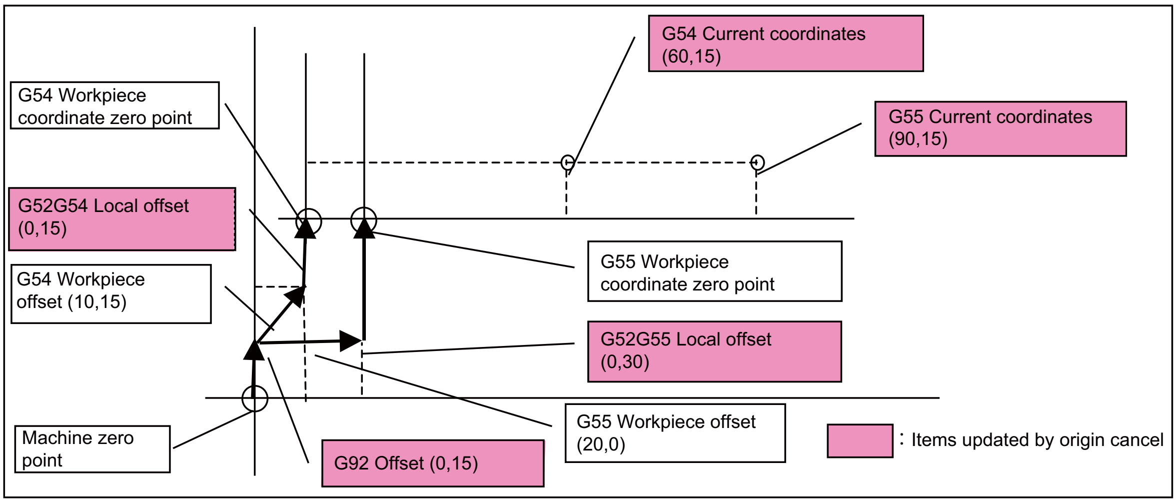
**(2) Origin cancel**

Origin cancel is a function that manually cancels all deviated amounts, and shifts to the designated zero point with the workpiece offset.

The relative position counter and machine position counter are set to "0" with this operation. In other words, this is the same "G92 G53 X0 ;". (For target axis: X)




Execution of origin cancel




## 10.1.11 Counter Set

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The relative position counter can be set to an arbitrary value by operating the setting and display unit screens.

Select the axis and then input a value. Finally, press the INPUT key.

Only the [Relative Position] display field will change to the set value. The other coordinate positions displayed will not change.

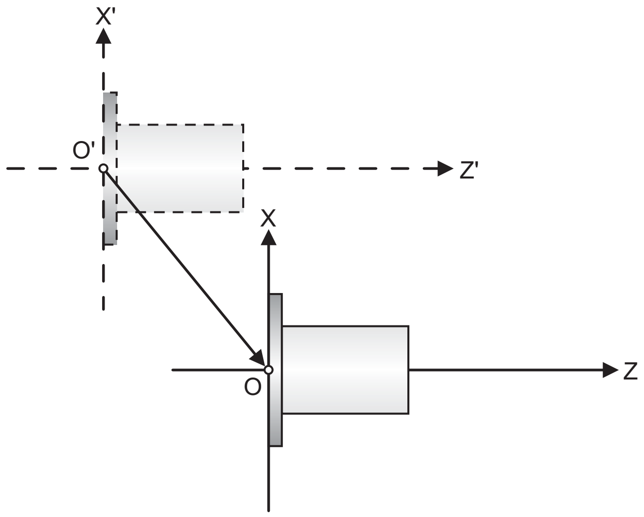
Up to 9 digits can be input in the integer section. The number of digits after the decimal point depends on the parameter setting.

### 10.1.13 Workpiece coordinate system shift

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | — | — | — | — | — | — | — | — |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

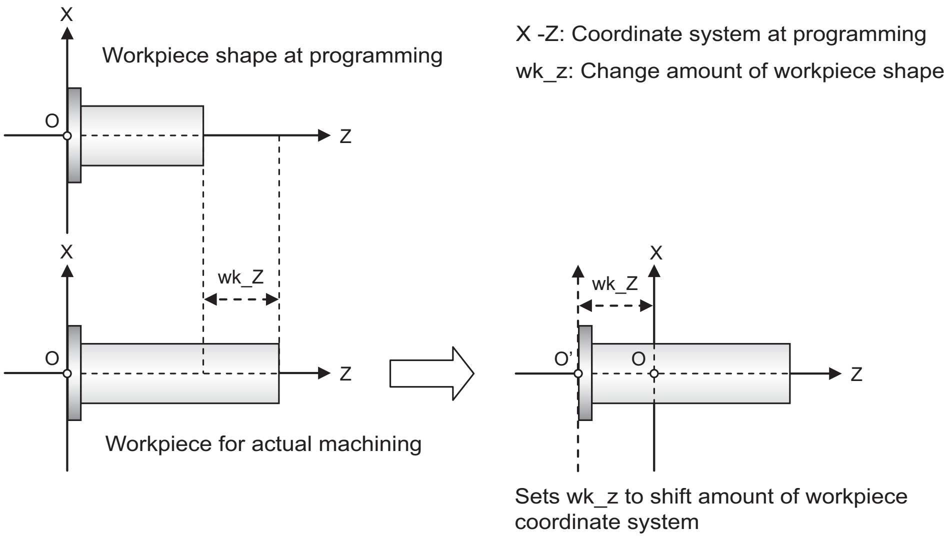
This function can shift the workpiece coordinate system.
When a workpiece coordinate system which is considered at programming is misaligned with an actual set workpiece coordinate or a workpiece coordinate set by automatic coordinate system setting, the measured workpiece coordinate system can be shifted to the workpiece coordinate system at the program creation so that the machining can be performed without modification of the machining program. This function also eliminates the need to change the machining program even when the workpiece shape is changed.

Setting the shift amount to O' -O to the shift amount of the workpiece coordinate system




X' -Z': Actual measured coordinate system
X .Z: Coordinate system at programming

Setting the change amount of the workpiece shape to the shift amount of the workpiece coordinate system




The methods for the setting are as follows:
- Setting on screen
- Setting with machining program (G code command)
- Setting by automatic measurement
- Setting and acquiring with system variables

# 10.2 Return

## 10.2.1 Manual Reference Position Return

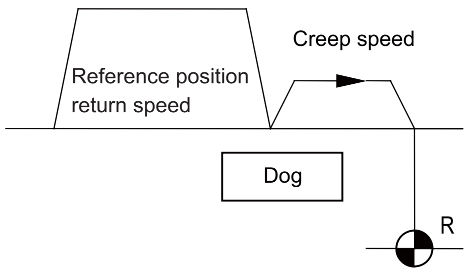
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

This function enables the tool to be returned manually to the position (reference position) which is characteristic to the machine.

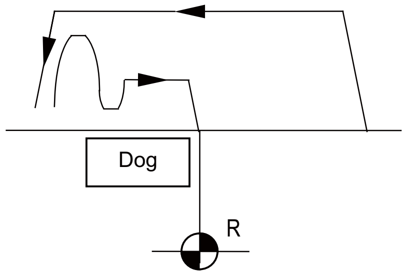
**(1) Return pattern to reference position**

[Dog type]

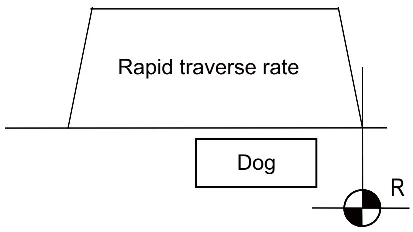
When starting in same direction as final advance direction




When starting in opposite direction as final advance direction




[High-speed type]




**(2) Differences according to detection method**

| | First return after power ON | Second return and following |
|---|---|---|
| Incremental position detection method | Dog-type | High-speed type |
| Absolute position detection method | High-speed type | High-speed type |

### 10.2.2 Automatic 1st Reference Position Return

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The machine can be returned to the first reference position by assigning the G28 command during automatic operation. If the interim point is commanded, the machine is moved up to that point by rapid traverse so that it is positioned and then returned separately for each axis to the first reference position.
Alternatively, by assigning the G29 command, the machine can be first positioned separately for each axis at the G28 or G30 interim point, and then positioned at the assigned position.

| G code | Function |
|---|---|
| G28 | Automatic 1st reference position return |
| G29 | Start position return (The tool first returns to the interim position from the 1st reference position, and then is positioned at the position assigned in the program.) |

The G28 programming format is given below.

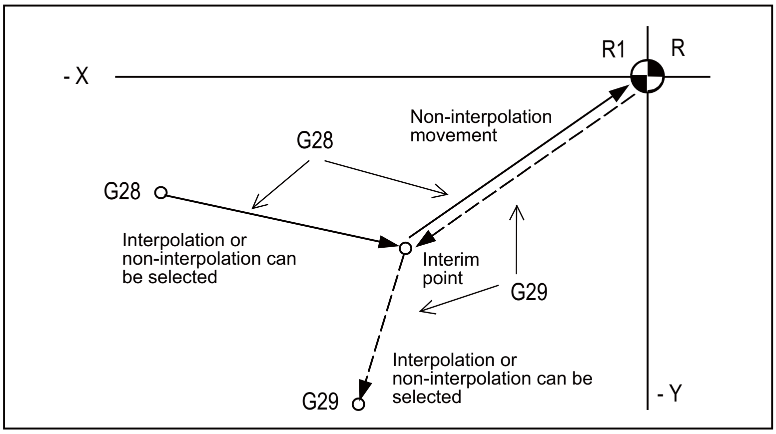
| | |
|---|---|
| **G28 Xx1 Yy1 Zz1 ;** | |
| G28 | : Return command |
| Xx1,Yy1,Zz1 | : Return control axes (coordinate of interim point) |

Tool is first positioned by rapid traverse to the assigned position (interim point) and then is returned to the 1st reference position for each axis independently.

The G29 programming format is given below.

| | |
|---|---|
| **G29 Xx1 Yy1 Zz1 ;** | |
| G29 | : Return command |
| Xx1,Yy1,Zz1 | : Return control axes (coordinate of assigned position) |

The tool is first moved by rapid traverse for each axis to the interim position which is passed through with G28 or G30, and is then positioned by rapid traverse at the position assigned by the program.




R1 1st reference position

If the position detector is for the incremental detection system, the first reference position return for the first time after the NC power has been turned ON will be the dog-type.  However, whether the second and subsequent returns are to be the dog type or the high-speed type can be selected by designating a parameter.
The high-speed type is always used when the position detector is for the absolute position detection system.

(Note 1) The automatic 1st reference position return pattern is the same as for manual reference position return.

(Note 2) The number of axes for which reference position return can be performed simultaneously depends on the number of simultaneously controlled axes.

(Note 3) If, at the time of the first reference position return, the tool radius compensation or nose radius compensation has not been canceled, it will be temporarily canceled during the movement to the interim point. The compensation is restored at the next movement after the return.

(Note 4) If, at the time of the reference position return, the tool length compensation has not been canceled, it will be canceled and the compensation amount also cleared upon completion of reference position return.  The tool length compensation can also be canceled temporarily using a parameter. In this case, however, the tool compensation is restored by the next movement command.

(Note 5) Interpolation or non-interpolation can be selected using a parameter for the movement up to the G28 interim point or for the movement from the G29 interim point to the command point. Non-interpolation applies for movement from the G28 interim point to the reference position and movement up to the G29 interim point.

(Note 6) When a single block operation is selected, it can be chosen by parameter setting whether or not to enable interim point stop.

### 10.2.3 2nd, 3rd, 4th Reference Position Return

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

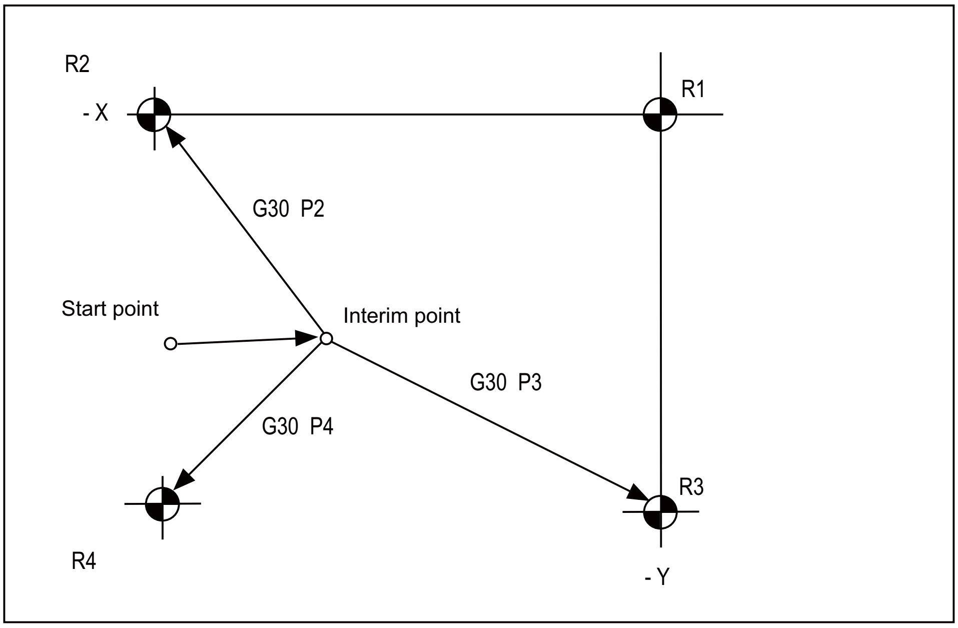
As with automatic 1st reference position return, commanding G30Pn during automatic operation enables the tool to be returned to the set points (2nd, 3rd or 4th reference positions) characteristic to the machine. The 2nd, 3rd and 4th reference positions can be set by parameters.

| G code | Function |
|---|---|
| G30 P2<br>G30 P3<br>G30 P4 | 2nd reference position return<br>3rd reference position return<br>4th reference position return |

The G30 programming format is given below.

| **G30 Xx1 Yy1 Zz1 Pp1 ;** | |
|---|---|
| G30 | : Return command |
| Xx1,Yy1,Zz1 | : Return control axes (coordinate of interim point) |
| Pp1 | : Return position No. |

The tool is first positioned by rapid traverse to the assigned interim point and then is returned to the reference position for each axis independently.




R1: 1st reference position
R2: 2nd reference position
R3: 3rd reference position
R4: 4th reference position

(Note 1) The second reference position return is performed if the P address is omitted.
(Note 2) The number of axes for which reference position return can be performed simultaneously depends on the number of simultaneously controlled axes.
(Note 3) If, at the time of the reference position return, the tool radius compensation or nose R compensation has not been canceled, it will be temporarily canceled during the movement up to the interim point. The compensation is restored at the next movement command after the return.
(Note 4) If, at the time of the reference position return, the tool length compensation has not been canceled, it will be canceled and the compensation amount also cleared upon completion of reference position return. The tool length compensation can also be canceled temporarily using a parameter. In this case, however, the tool compensation is restored by the next movement command.
(Note 5) Whether interpolation or non-interpolation is to apply to the movement up to the interim point can be selected using a parameter. Non-interpolation applies for movement from the interim point to each of the reference positions.
(Note 6) When a single block operation is selected, it can be chosen by parameter setting whether or not to enable interim point stop.

### 10.2.4 Reference Position Check

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

By commanding G27, a machining program, which has been prepared so that the tool starts off from the reference position and returns to the reference position, can be checked to see whether the tool will return properly to the reference position.

Command format

```
G27  Xx1  Yy1  Zz1  Pp1  ;
G27                : Check command
Xx1,Yy1,Zz1        : Return control axes
Pp1                : Check No.
                   P1:1st reference position check
                   P2: 2
                   P3: 3
                   P4: 4
```

The tool is first positioned by rapid traverse to the assigned position and then, if this is the reference position, the reference position arrival signal is output.
When the address P is omitted, the first reference position verification will be applied.

(Note 1) The number of axes for which reference position check can be performed simultaneously depends on the number of simultaneously controlled axes.
(Note 2) An alarm results unless the tool is positioned at the reference position upon completion of the command.
(Note 3) Whether interpolation or non-interpolation is to apply to the movement can be selected using a parameter.

### 10.2.5 Absolute Position Detection

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The absolute position detection function holds the position data of the actual machine position and the machine coordinates in the controller even after the power is turned OFF. When the power is turned ON again, a position command can be executed in automatic operation immediately without executing reference position return. (High-speed return is always used for the reference position return command.)
There are two types of absolute position detection method: dog type and dog-less type, which use different reference position establishment methods.
The type is selected with the parameter.

<table>
<tr><th colspan="3">Method</th><th>Details</th><th>Establishment of zero point</th><th>Adjustment of zero point position</th></tr>
<tr><td rowspan="3">Dog-less type</td><td colspan="2">Machine end stopper method</td><td>The zero point is established by pressing the machine against a set point on the machine.</td><td>The zero point is established when a torque limit is applied on the servo and the torque limit is reached by pressing against the machine stopper.</td><td>Input a value equivalent to the shift amount on the absolute position setting screen.</td></tr>
<tr><td rowspan="2">Basic position alignment method</td><td>Method I</td><td rowspan="2">The zero point position is set from the screen.</td><td rowspan="2">The zero point is established by inputting it through the absolute position setting screen.</td><td rowspan="2">Input a value equivalent to the shift amount on the absolute position setting screen.</td></tr>
<tr><td>Method II</td></tr>
<tr><td colspan="3">Dog-type</td><td>Same method as incremental detection dog-type.</td><td>The zero point is established with dog-type reference position return completion.</td><td>Set a value in the parameter.</td></tr>
</table>

(Note) This function is valid for the NC axis and the PLC axis. This function cannot be used for the spindle and the auxiliary axis.

### 10.2.6 Tool Exchange Position Return

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

By specifying the tool change position in a parameter and also assigning a tool change position return command in a machining program, the tool can be changed at the most appropriate position.
The axes for which returning to the tool change position is performed and the order in which the axes begin to return can be changed by commands.

| |
|---|
| **G30.n ;** |
| n = 1 to 6 : Specify the axes that return to the tool change position and the order in which they return. (For L system, n = 1 to 5) |

Command and return order
[M system]

| Command | Return order |
|---|---|
| G30. 1 | Z axis → X axis / Y axis ( → additional axis) |
| G30. 2 | Z axis → X axis → Y axis ( → additional axis) |
| G30. 3 | Z axis → Y axis → X axis ( → additional axis) |
| G30. 4 | X axis → Y axis / Z axis ( → additional axis) |
| G30. 5 | Y axis → X axis / Z axis ( → additional axis) |
| G30. 6 | X axis / Y axis / Z axis ( → additional axis) |

[L system]

| Command | Return order |
|---|---|
| G30. 1 | X axis only ( → additional axis) |
| G30. 2 | Z axis only ( → additional axis) |
| G30. 3 | X axis → Z axis ( → additional axis) |
| G30. 4 | Z axis → X axis ( → additional axis) |
| G30. 5 | X axis / Z axis ( → additional axis) |

(Note 1) An arrow ( → ) indicates the order of axes that begin to return. A period (/) indicates that the axes begin to return simultaneously.
Example : "Z axis → X axis" indicate that the Z axis returns to the tool change position, then the X axis does.
(Note 2) G30.6 is only for the M system.

The tool change position return ON/OFF for the additional axis can be set with parameter for the additional axis.
For the order to return to the tool change position, the axes return after the standard axis completes the return to the tool change position (refer to above table).
The additional axis cannot return to the tool change position alone.

# 11

# Operation Support Functions

## 11.1 Program Control

### 11.1.1 Optional Block Skip

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

It is possible to command to selectively ignore a part, from a "/" (slash) code to the end of the block, of a machining program. When the optional block skip input signal from the external source is turned ON for automatic operation, the block with the "/" code is skipped. If the optional block skip signal is turned OFF, the block with the "/" code will be executed without being skipped.

| Programming example | Optional block skip | |
|---|---|---|
| | Switch OFF | Switch ON |
| N1 ; | N1 | N1 |
| N2 ; | N2 | N2 |
| N3 ; | N3 | N3 |
| / N4 ; | N4 | |
| / N5 ; | N5 | |
| N6 ; | N6 | N6 |
| N7 ; | N7 | N7 |
| : | : | : |

Skipping from a "/" in the middle of a program to the end of the program can also be enabled by parameter setting.

### 11.1.2 Optional Block Skip Addition

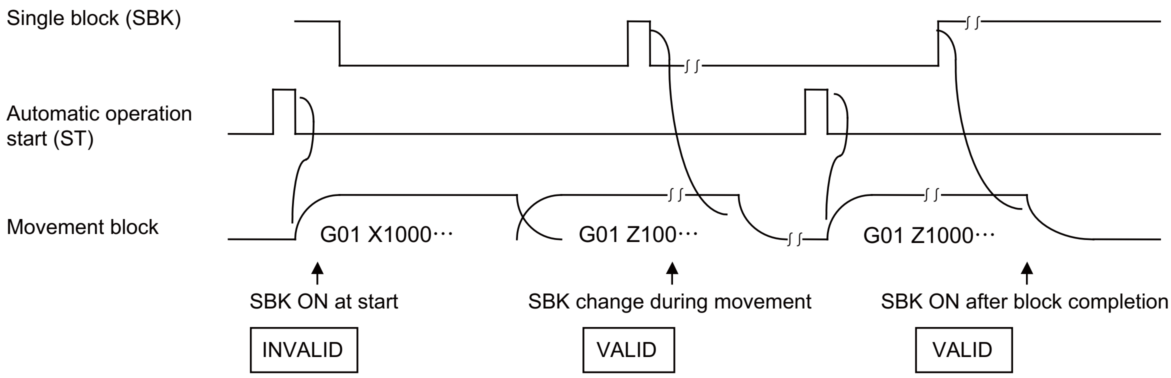
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

When "/n (n:1 to 9)" (slant code) is programmed at the head of a block, and the optional block skip n input signal from the external source is turned ON for automatic operation, the block with the "/n" code is skipped.
If the optional block skip n signal is turned OFF, the block with the "/n" code will be executed without being skipped.

### 11.1.3 Single Block

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The commands for automatic operation can be executed one block at a time (block stop) by turning ON the single block input signal. When the single block input signal is turned ON temporarily during continuous operation, the machine will stop after that block has been executed.
Even when operation is switched to another automatic operation mode (for example, memory operation mode to MDI operation mode) during continuous operation, the machine will stop after that block has been executed.




As with the multi-part system specification, the following function can be selected instead.

Multi-part system single block (L system)
This function is for executing single block operation while maintaining the synchronization between the part systems when two or more part systems are operated.  When one part system has been stopped by single block stop, the other part systems are stopped by feed hold.

## 11.2 Program Test

### 11.2.1 Dry Run

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

F code feed commands for automatic operation can be switched to the manual feed rate data of the machine operation board by turning ON the dry run input signal.

| Command | Dry run switch ON | |
|---|---|---|
| | Rapid traverse selection switch OFF | Rapid traverse selection switch ON |
| G00,G27,G28,G29,G30,G60 | Manual feed rate | Rapid traverse rate |
| G01,G02,G03 | Manual feed rate | Cutting clamp speed |

### 11.2.2 Machine Lock

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

When the machine lock input signal is set to ON, the NC operations can be executed without assigning commands to the NC axes.

The feed rate in the machine lock status is the command speed.
The M, S, T and B commands are executed as usual and operation is completed by returning the FIN signal.

(1) Reference position return (manual, G28, G29, G30) is controlled as far as the interim point in the machine lock status but the block is completed when the interim point is reached.
(2) Machine lock is effective in the signal status applying when the axis has stopped.
(3) Block stop will be applied if the machine lock signal is turned ON to OFF or OFF to ON during automatic operation.

### 11.2.3 Miscellaneous Function Lock

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The M, S, T and B (2nd miscellaneous function) output signals are not output to the machine or PLC when the miscellaneous function lock signal of external input is turned ON. This function can be used when checking only the movement commands in a program check.
The start signals of the M command are output for the M00, M01, M02 and M30 commands, and so a completion signal must be returned.

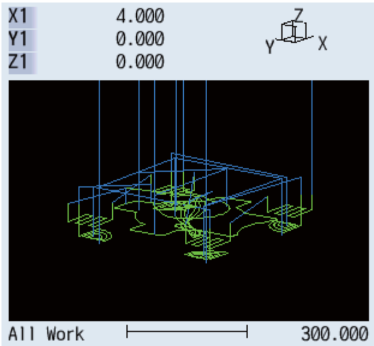
(1) Fixed cycle spindle functions containing an S code and any M, S, T or B function assigned by a manual numerical command or in automatic operation will not be executed. The code data and strobe (MF, SF, TF, BF) outputs are stopped.
(2) If this signal is set ON after the code data has already been output, the output is executed as it would normally be executed until the end (until FIN1 or FIN2 is received and the strobe is turned OFF).
(3) Even when this signal is ON, the M00, M01, M02 and M30 commands among the miscellaneous functions are executed, and the decode signal, code data and strobe signals are also output as they would be normally.
(4) Any miscellaneous functions which are executed only inside the controller and not output (M96, M97, M98, M99) are executed as they would be normally even if this signal is ON.

## 11.2.4 Graphic Check

### 11.2.4.1 Graphic Check

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | − |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | − |

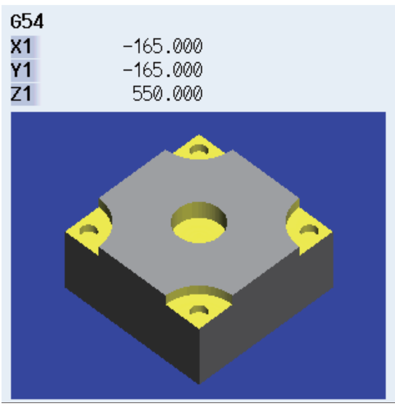
The machining program movement path can be confirmed with the graphic drawing without executing automatic operation. Therefore, the machining program can be checked while drawing the figure accurately at a high speed.
There are two description method for the graphic check function: 2D check and 3D check.
The drawing's viewpoint can be moved, enlarged and reduced while drawing. The three axes displayed are set with the parameters.
(Note) Automatic operation is disabled during graphic check for M80.




### 11.2.4.2 3D Solid Program Check

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | − |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | − |

The machining program movement path can be confirmed with the graphic drawing without executing automatic operation. Therefore, the machining program can be checked while drawing the figure accurately at a high speed.
The turning machining and milling for the front and back face of a workpeice can be drawn with the 3D check.
The workpiece shape's viewpoint can be moved, enlarged and reduced while drawing. The three axes displayed are set with the parameters.
The workpiece shape and tool shape used are set on this screen.



### 11.2.4.3 Graphic Check Rotary Axis Drawing

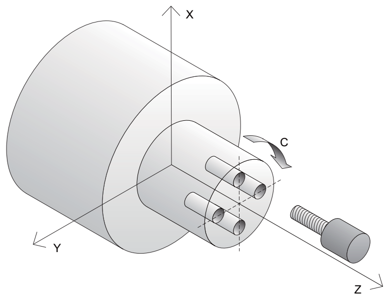
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | — | — | — | — | — | — | — | — |
| L | △ | △ | △ | △ | ○ | ○ | ○ | — |

When the rotary axis (C axis) is designated with the parameter in program check (2D), the path is drawn depending on the rotary axis. The rotary axis can be set for each part system.
Refer to "11.2.4.1 Graphic Check" for details on the graphic check.

(Note 1) When the control axis address other than C axis is designated with the parameter, the path corresponding to the rotary axis is not drawn.

(Note 2) The workpiece coordinate system must be set so that the center of the rotary axis becomes the coordinate system zero point.

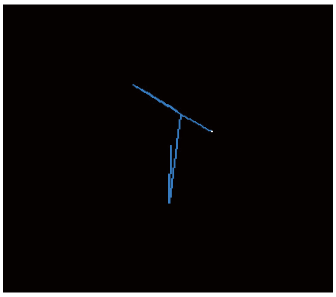
**Image of actual tool and workpiece**



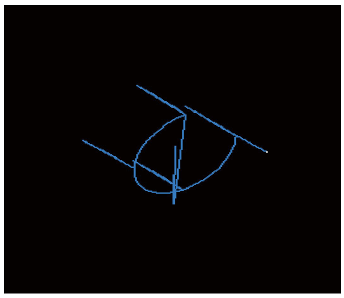

**Example of machining program**

```
G83Z-20.R-5.Q5000F300 ;
G0C90. ;
G83Z-20.R-5.Q5000F300 ;
G0C180. ;
G83Z-20.R-5.Q5000F300 ;
G0C270. ;
G83Z-20.R-5.Q5000F300 ;
G80 ;
```

**Drawing image when the rotary axis drawing is invalid**



**Drawing image when the rotary axis drawing is valid**



## 11.2.5 Graphic Trace

### 11.2.5.1 Graphic Trace

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | － |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | － |

This function draws the machine tool's machine position. The movement path following the actual automatic operation or manual operation, or the tool tip movement path can be drawn, and the machine operation during machining can be monitored.
For the display mode, 1-plane, 2-plane and 3-dimensional display are provided. In the 3-dimensional display mode, cubic shapes can be rotated and tracing of the figure seen from the desired direction can be assigned.

One of the following functions is required for the trace of tool path:
- Tool center point control
- Tool length compensation along the tool axis
- Tool handles feed & interruption, workpiece installation error compensation
- Inclined surface machining command
- Simple inclined surface machining command
- 3-dimensional tool radius compensation (tool's vertical-direction compensation)
- 3-dimentional manual feed
- R-Navi

### 11.2.5.2 Graphic Trace Rotary Axis Drawing

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | – | – | – | – | – | – | – | – |
| L | △ | △ | △ | △ | ○ | ○ | ○ | – |

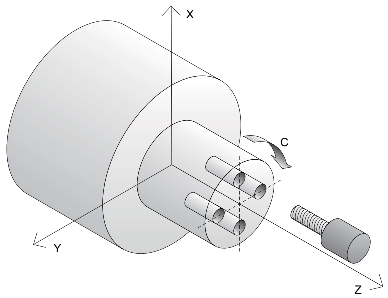
When the rotary axis (C axis) is designated with the parameter in program trace, the path is drawn depending on the rotary axis. The rotary axis can be set for each part system.

Refer to "11.2.5.1 Graphic Trace" for details on the graphic trace.

(Note 1) When the control axis address other than C axis is designated with the parameter, the path corresponding to the rotary axis is not drawn.

(Note 2) The workpiece coordinate system must be set so that the center of the rotary axis becomes the coordinate system zero point.

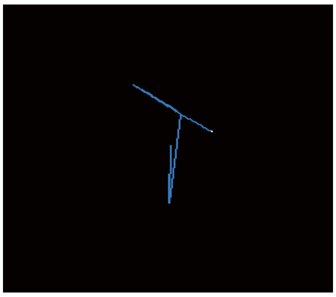
**Image of actual tool and workpiece**



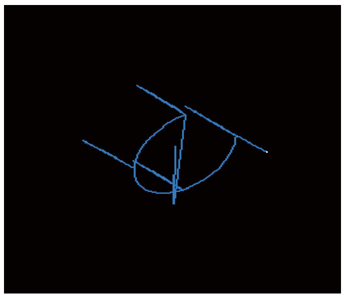

**Example of machining program**

```
G83Z-20.R-5.Q5000F300 ;
G0C90. ;
G83Z-20.R-5.Q5000F300 ;
G0C180. ;
G83Z-20.R-5.Q5000F300 ;
G0C270. ;
G83Z-20.R-5.Q5000F300 ;
G80 ;
```

**Drawing image when the rotary axis drawing is invalid**



**Drawing image when the rotary axis drawing is valid**



### 11.2.6 Machining Time Computation

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | – |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | – |

This function analyzes the machining program without moving the axis and calculates the approximate time required for machining.

Machining time is calculated by adding the following times:

- Rapid traverse time
- Cutting feed time
- Dwell time

The machining time is displayed as "hour: minute: second".

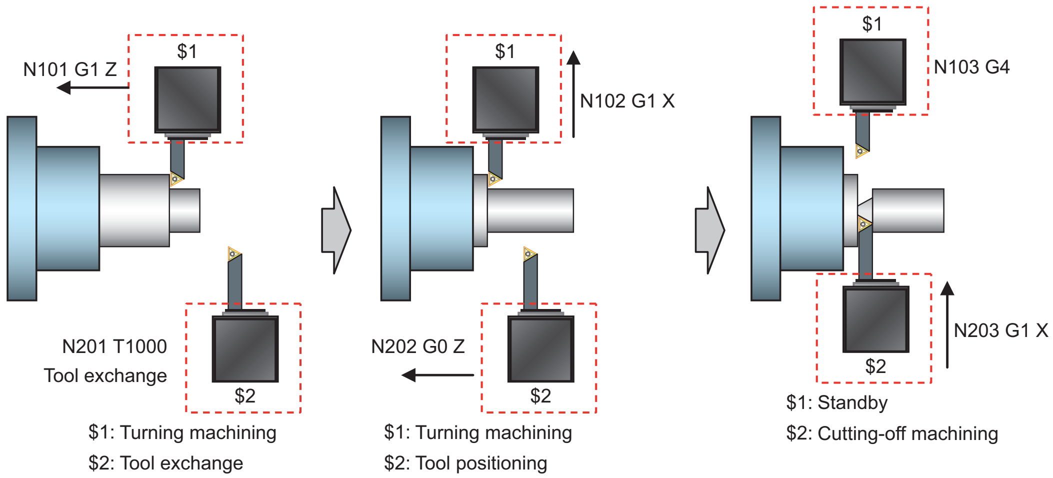
The miscellaneous function (M), spindle function (S), tool function (T) and 2nd miscellaneous function execution times differ according to the sequence and each function, and are not included in the calculated machining time.

### 11.2.7 Manual Arbitrary Reverse Run (Program Check Operation)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

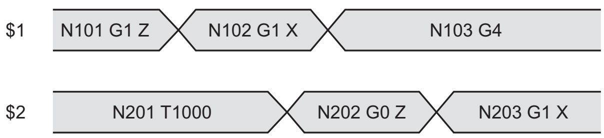
The manual arbitrary reverse run can be performed by controlling the feedrate being in the automatic operation in the memory or MDI mode in proportion to the manual feedrate by jog or the rotation speed by manual handle.
This function allows a program to run the executed blocks backward (reverse run) after the block stop in the automatic operation. The buffer correction of the program can be performed after reverse run to a desired point and the corrected program can be run.

Example of machining operation

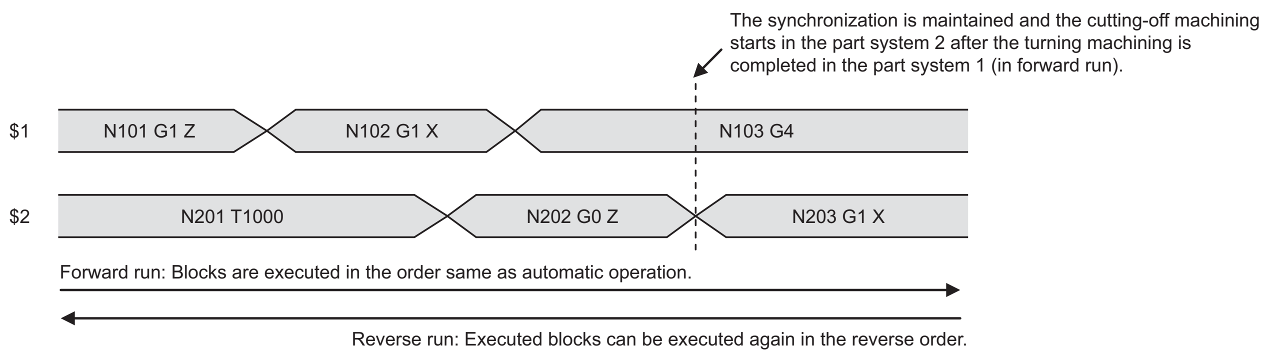



$1: Part system 1
$2: Part system 2

Timing diagram in override 100%




Timing diagram in manual arbitrary reverse run

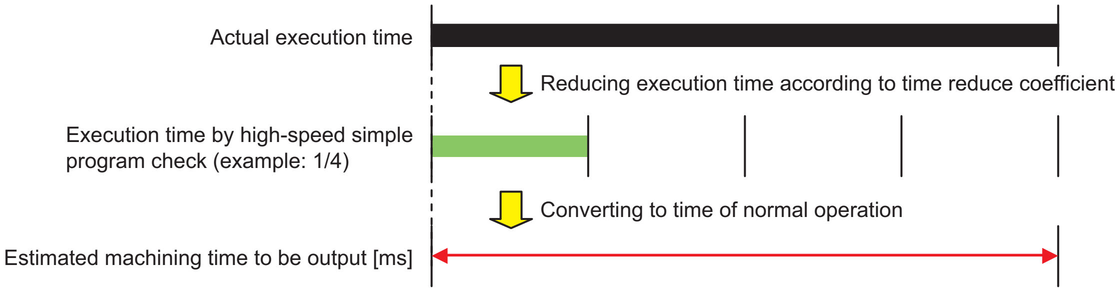



The total operation time is increased in the timing diagram for the manual arbitrary reverse run, however the synchronization between part systems can be maintained and the cutting-off machining starts after the turning machining is completed in forward run. The synchronization between part systems is maintained in both forward and reverse run.

### 11.2.8 High-speed Simple Program Check

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

This function checks whether a program error occurs by operating the machining program without the axes movements.
The estimated machining time can be checked in time shorter than the actual execution time of the machining program.
This function is valid with the "High-speed simple program check" signal ON .
The machining program is operated in the reduced time according to the coefficient which is set to the time reduce coefficient.
The estimated machining time of the machining program is output to time measurement output.
The miscellaneous command code which outputs strobes can be allocated arbitrarily with the parameter during the high-speed simple program check.



## 11.3 Program Search/Start/Stop

### 11.3.1 Program Search

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The program No. of the program to be operated automatically can be designated and called. Upon completion of search, the head of the program searched is displayed.
Machining programs are stored in the memory inside the NC system.

### 11.3.2 Sequence Number Search

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

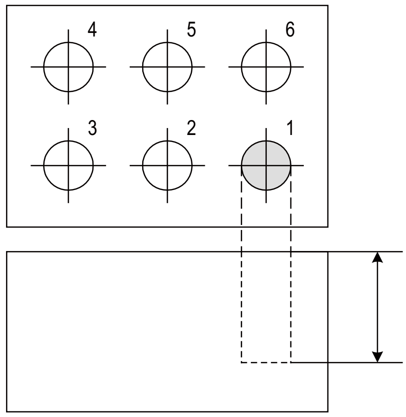
Blocks can be indexed by setting the program No., sequence No. and block No. of the program to be operated automatically.
The searched program is displayed upon completion of the search.
Machining programs are stored in the memory inside the NC system.

### 11.3.3 Verification Stop

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

This function enables the single block stop status to be established at any block without having to set the SINGLE BLOCK switch to ON.
It can be used to readily check the machining shape up to the designated block and resume machining.

```
  G91 ;
  :
  G00 Z-150. ;
  N100 G81 X-100. Z-100. R-50. F100 ;
  N101 X-100. ;
→ N102 X-100. ;
  N103 Y100. ;
  N104 X100. ;
  N105 X-100. ;
  :
```




Verification stop is executed when drilling of one hole is completed (N100 block is completed) as shown on the left.
The hole depth is measured to confirm that the dimensions are correct. If the dimensions are not correct, the tool compensation amount is changed.
If machining is started from the head of the program, accurate hole drilling can be carried out.

## 11.3.4 Program Restart

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

With this function, the program search can be executed while updating the coordinate values and the modal information in the same manner as an actual program operation.
Therefore, this function enables machining from a block in the middle of the program as if the actual machining was carried out from the beginning.
This function is used to restart machining when a machining program is to be resumed after it has been suspended midway due to tool damage or for some other reason.
The machine will not move during the search.
When the search is completed, the distance from the current position of the machine (workpiece coordinates) to the restart position (start point of the searched block) is displayed as restart remaining distance on the screen.
After the program restart, positioning to the restart position is carried out at the cycle start, and automatic operation is performed for the searched and subsequent blocks.
Positioning to the restart position can also be manually performed.
After the program restart, an arbitrary M, S, T or B command can be executed by the manual numerical value command before the cycle start.
There are two search methods by the program restart.

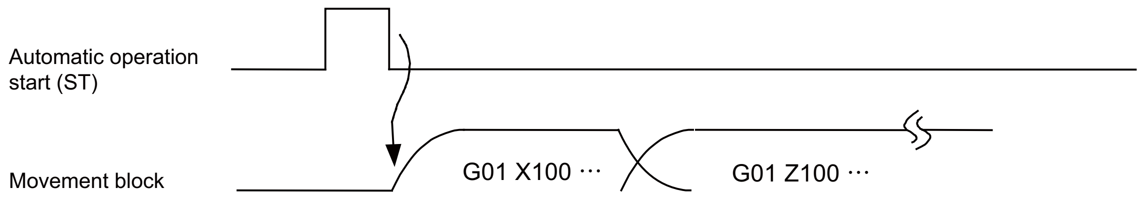
<table>
<tr><th>Restart method</th><th colspan="2">Details</th></tr>
<tr><td>Restart type 1</td><td colspan="2">After machining is reset due to a tool breakage, etc., machining is restarted from the designated sequence number and/or block number.<br>Only the program which had been executed just before can be restarted.<br>Even after the power is turned ON again, the program can be restarted if the program has been executed before the power supply is turned OFF.</td></tr>
<tr><td rowspan="3">Restart type 2</td><td colspan="2">If a machining program different from the machining program to be restarted was run before starting restart search, specify the sequence No. and block No. before restarting the machining.</td></tr>
<tr><td>Automatic top search OFF</td><td>A top search must be executed from the screen. Then, command a sequence No. and block No., and restart a program.</td></tr>
<tr><td>Automatic top search ON</td><td>A top search may not be executed from the screen. A top search is automatically executed, so it is not necessary to execute a top search from the screen. Command a sequence No. and block No., and restart a machining.<br>An arbitrary program can be restarted by designating the program No.<br>When a program No. is omitted, the program currently searched is restarted.</td></tr>
</table>

The validity of the automatic top search can be changed with control parameter.

### 11.3.5 Automatic Operation Start

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

With the input of the automatic operation start signal (change from ON to OFF), the automatic operation of the program that has been operation searched is started by the controller (or the halted program is restarted).




Automatic operation startup is performed on a part system by part system basis.

### 11.3.6 NC Reset

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

This function enables the controller to be reset.

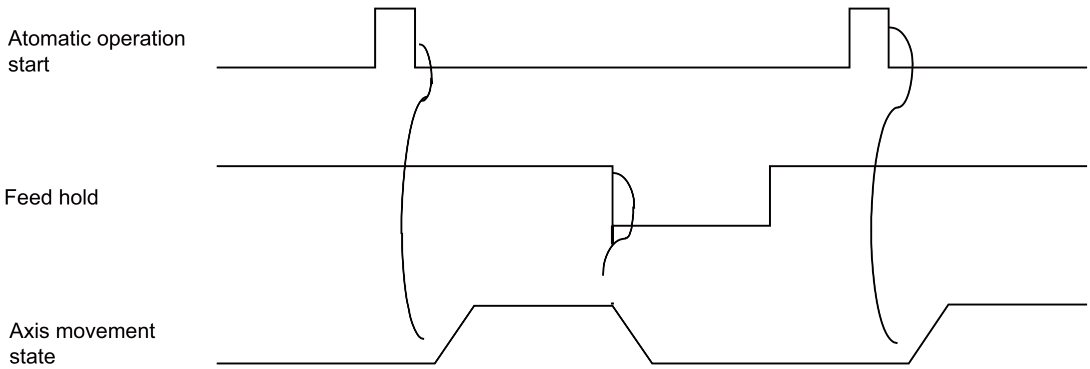
| | | Reset 1 | Reset 2 | Reset & Rewind |
|---|---|---|---|---|
| 1 | G command modals | Retained | Initialized | Initialized |
| 2 | Tool compensation data | Retained | Canceled (no operations) | Canceled |
| 3 | Memory indexing | Executed | Not executed | Executed |
| 4 | Errors/alarms | Reset | Reset | Reset |
| 5 | M, S and T code outputs | Retained | Retained | Retained |
| 6 | M code independent output | OFF | OFF | OFF |
| 7 | Control axis moving | Decelerated and stopped | Decelerated and stopped | Decelerated and stopped |
| 8 | Output signals | "In reset" signal | "In reset" signal | "In reset" signal<br>"In rewind" signal |

### 11.3.7 Feed Hold

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

When the feed hold signal is set ON during automatic operation, the machine feed is immediately decelerated and stopped. The machine is started again by the "Automatic operation start (cycle start)" signal.

(1) When the feed hold mode is entered during cycle start, the machine feed is stopped immediately, but the M, S, T and B commands in the same block are still executed as programmed.
(2) When the mode is switched during automatic operation to manual operation (such as jog feed, handle feed or incremental feed), the feed hold stop mode is entered.
(3) An interrupt operation based on manual operation (such as jog feed, handle feed or incremental feed) can be executed during feed hold.




### 11.3.8 Search & Start

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

If the search & start signal is input in a status where the memory mode is selected, the designated machining program is searched and executed from its head.
If the search & start signal has been input during automatic operation in the memory mode, search & start is executed after resetting.

### 11.3.10 Auto-restart

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

A machining program is restarted automatically at the completion of the machining program execution.

## 11.4 Interrupt Operation

### 11.4.1 Manual Interruption

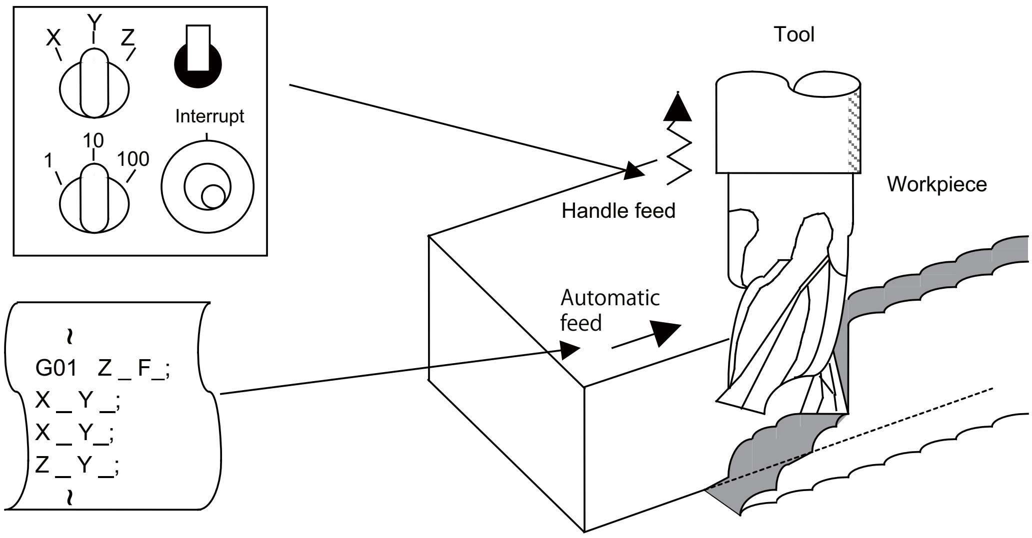
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Manual interrupt is a function that enables manual operations to be performed during automatic operation.
The methods to select the operation mode are as follows:
- Initiates the interrupt by switching from the automatic mode to manual mode
- Initiates the interrupt by selecting the manual mode at the same time as the automatic mode
(Refer to "11.4.9 Simultaneous Operation of Manual and Automatic Modes".)
Whether the manual interrupt amount is to be retained and automatic operation is to be continued is determined by setting manual absolute mode ON or OFF (refer to "11.4.3 Manual Absolute Switch").

### 11.4.2 Automatic Operation Handle Interruption

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The handle command can interrupt and be superimposed onto a command without suspending automatic operation and the machine can be moved by rotating the manual pulse generator during automatic operation.
If the spindle load is greatly exceeded when cutting a workpiece as per the machining program due to a high rough cutting amount in face machining, for instance, automatic handle interrupt makes it possible to raise the Z surface and reduce the load easily without suspending feed in the automatic operation mode.
Automatic handle interrupt is conducted by setting the "automatic handle interrupt" valid switch which is provided separately from the "manual operation mode". The axis selection, pulse scale factor and operation are conducted as for manual handle feed.
Whether, after an interrupt, to return to the path of the machining program by automatic operation or remain offset by the amount equivalent to the interrupt amount is determined using a parameter.

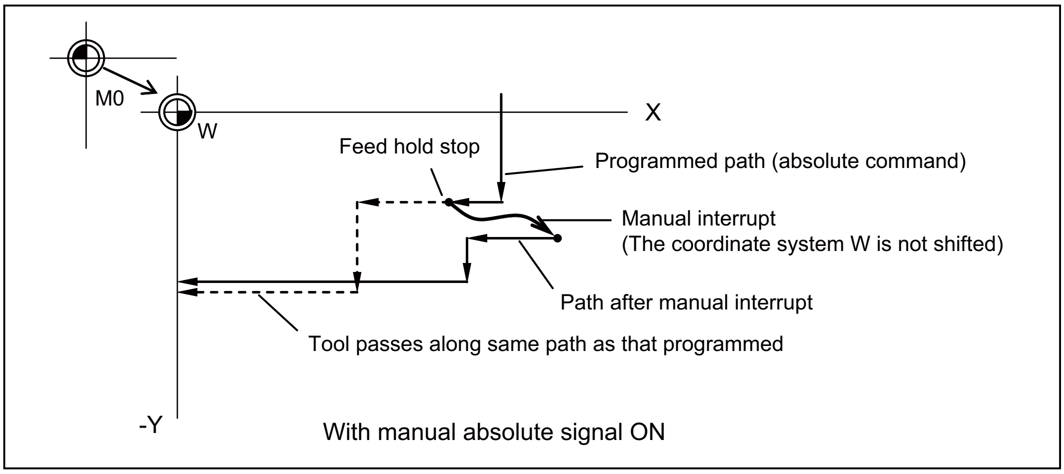


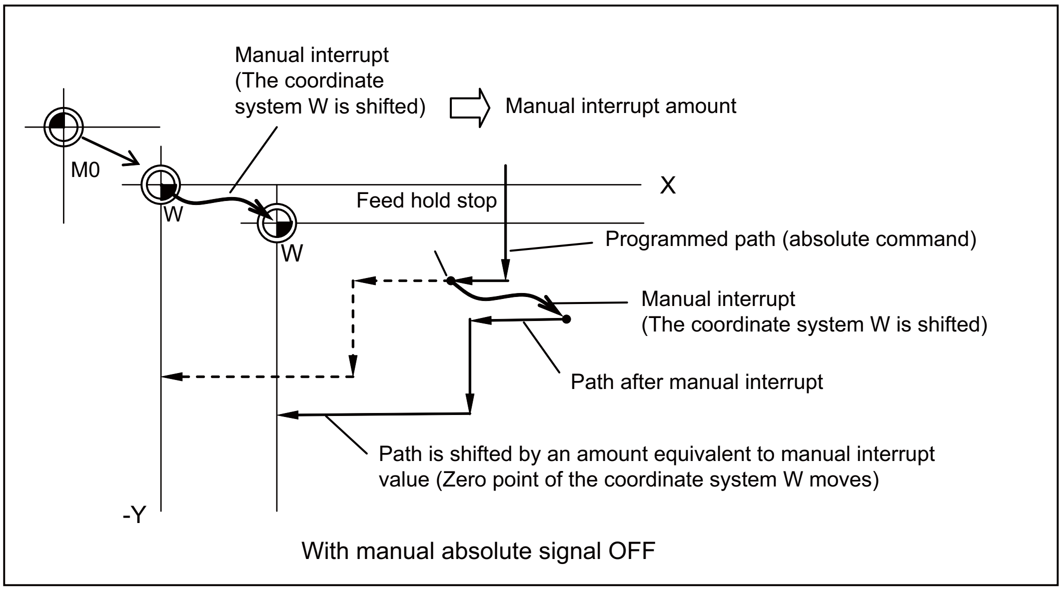

Feed path with automatic feed and handle feed superimposed

### 11.4.3 Manual Absolute Switch

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The program absolute positions are updated by an amount equivalent to the distance by which the tool is moved by hand when the manual absolute switch signal is turned ON.
In other words, the coordinate system based on the original program will not shift even if the tool (machine) is moved by hand. Thus, if automatic operation is started in this case, the tool will return to the path before manual movement.



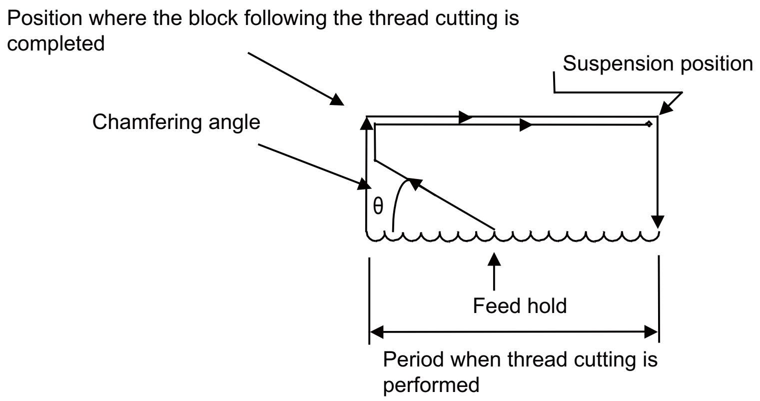




The manual absolute ON state will be entered when the power is turned ON.

### 11.4.4 Thread Cutting Cycle Retract

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | — | — | — | — | — | — | — | — |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

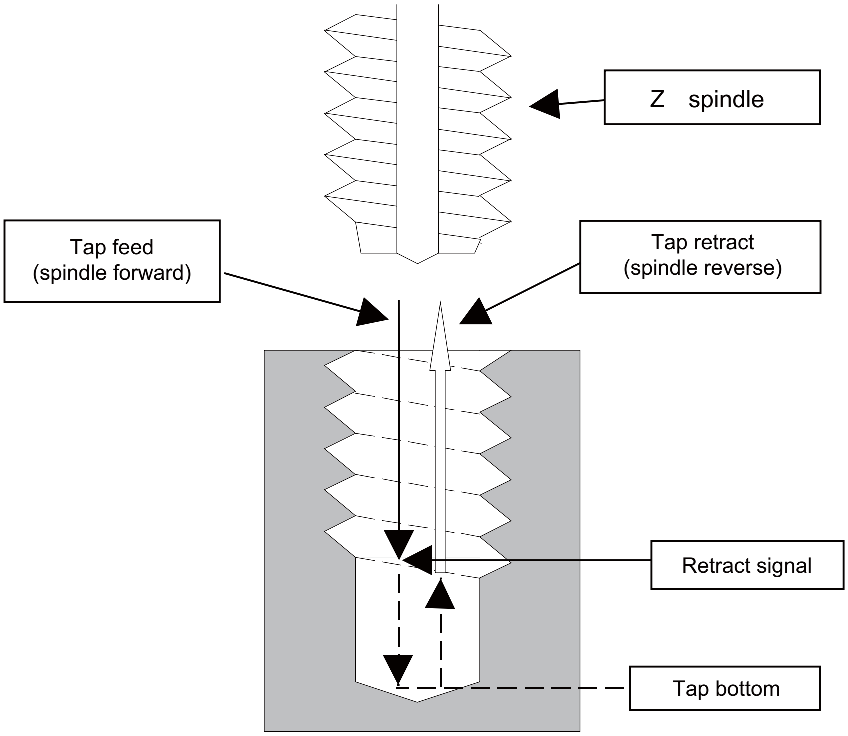
This function suspends the thread cutting cycle if a feed hold signal has been input during thread cutting in a thread cutting cycle.
If a feed hold signal is input during chamfering or thread cutting without chamfering, operation stops at the position where the block following the thread cutting is completed.



### 11.4.5 Tapping Retract

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

If tapping is interrupted by a reset or emergency stop signal that is input during tapping and the tap is left engaged inside the workpiece, the tap tool engaged inside the workpiece can be rotated in the reverse direction so that it will be disengaged by inputting the tap retract signal.




This function can be used when the machining was interrupted upon reset, emergency stop or power OFF during tapping cycle.
(Note that "power OFF" is applied only when the absolute position detection system is valid.)
A return is made to the initial point by tap retract.

### 11.4.6 Manual Numerical Value Command

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

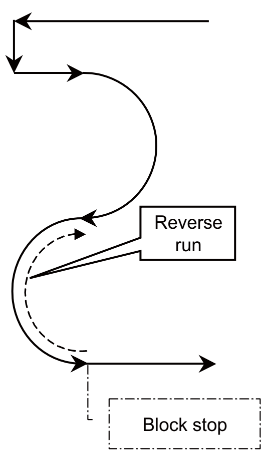
Commands of spindle function (S), miscellaneous function (M), tool function (T) and 2nd miscellaneous function (B) can be executed through the Monitor screen or Setup screen.
This enables operations such as spindle speed changing, starting, stopping, calling and selecting assigned tools and replacing of the spindle tools to be done easily without having to prepare or revise the machining program.
When M/S/T/B which was set with the macro call is commanded by the manual numeric command while the miscellaneous command macro call is valid, the corresponding user macro subprogram can be executed.

### 11.4.7 Arbitrary Reverse Run

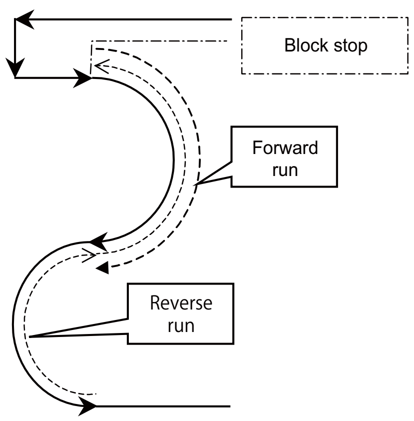
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | － | － |
| L | － | － | － | － | － | － | － | － |

This function allows a program to run the executed blocks backward (hereinafter called "reverse run") after the block stop in the automatic operation.
The following steps are available:
- Execute the reverse run to the point to go back,
- Run the reversed blocks again following the program (hereinafter called "forward run") and
- Continue the remaining blocks from the point of the interruption.
Maximum 200 blocks can be executed in the reverse run.
Only the 1st to 3rd axes of each part system can be used for this function.

(Example 1) Reverse run




(Example 2) Forward run after the reverse run



### 11.4.8 MDI Interruption

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

This function enables MDI programs to be executed during automatic operation in the single block stop status. When the modal status is changed in the MDI program, the modal status in the automatic operation mode is also changed.

### 11.4.9 Simultaneous Operation of Manual and Automatic Modes

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

This function enables manual operations to be performed during automatic operation by selecting an automatic operation mode (tape, MDI or memory) and manual mode (handle, step, jog or manual reference position return) simultaneously.
(Arbitrary feed based on the PLC is also possible.)

The feed rates for the axes subject to automatic commands and the feed rates for axes subject to manual command are set separately. The acceleration/deceleration modes (rapid traverse, cutting feed) are also set separately. Rapid traverse override, cutting feed override and second cutting feed override are valid both for axes subject to automatic commands and manual commands. Override cancel is valid for axes subject to automatic commands.
Manual interlock is applied to axes subject to manual commands; automatic interlock is applied to axes subject to automatic commands.

### 11.4.10 Simultaneous Operation of JOG and Handle Modes

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

When executing the jog feed and handle feed, both these feeds are available without changing the mode each time by inputting the jog mode signal and simultaneous operation of jog and handle modes signal to the control unit. However, while axis is moving in one of the two modes, the feed in the other mode is not valid.

### 11.4.11 Reference Position Retract

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

When the retract signal is turned ON during the automatic and manual operation, this function can retract the tool immediately to a set reference position.
The reference position to be retracted to can be selected from the 1st reference position to 4th reference position with 2-bit input signal.
Set the retracting order of axes with parameter.

(1) Other operations

(a) When the retract signal is turned ON, the control unit is reset, the operation is interrupted, and the machining program is indexed.

(b) When the rapid traverse input signal is input, the rapid traverse rate is applied. When the rapid traverse input signal is not input, the manual feed rate is applied.

(c) If the retract signal is input during execution of a tapping cycle, the operation will be the tapping retract, and the normal reference position retract will be executed from the end point of tapping retract operation.

(d) Even if the retract signal is input during the thread cutting cycle, it will be invalid. However, if the retract signal is input in a block other than the thread cutting block, the retracting operation will be executed.

(e) If the retract signal is turned OFF midway during retracting, the operation will decelerate and stop. However, since the machining program is indexed, the block can not be resumed.

(f) The retract signal is invalid if the coordinate system is not established. An operation error will occur when the retract signal is input in such case.

### 11.4.12 Tool Retract and Return

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ― | ― | ― | ― |
| L | ― | ― | ― | ― | ― | ― | ― | ― |

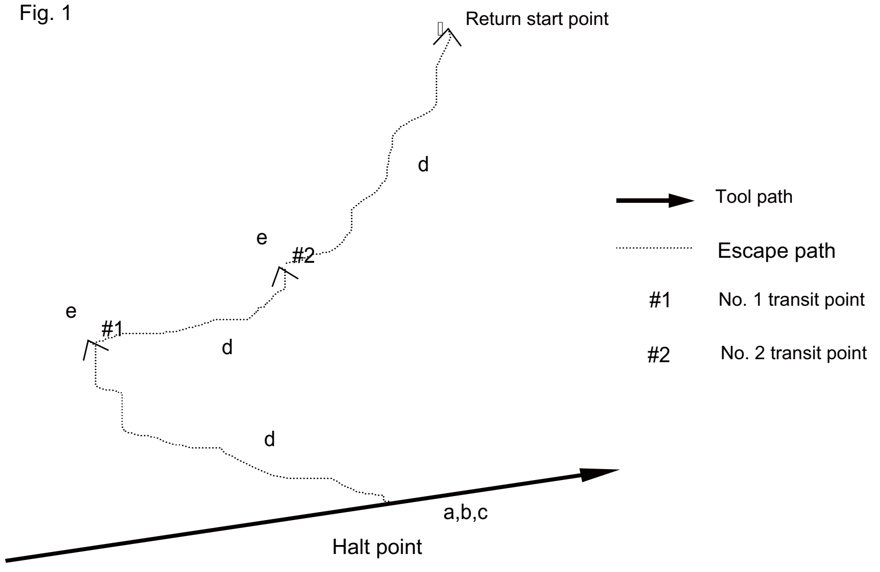
Even if the machining program's operation is halted and the tool is escaped to change the tool or check the workpiece, etc., the tool can be returned to the halted point (machining halted point) and machining resumed.

The two main functions are as follow.

- After the machining program is halted, the halt point is designated, and the tool is escaped manually.
  The transit points for returning are designated when escaping.
- The tool returns automatically.

When returning, the tool passes through the transit points designated when escaping and returns to the halt point. Then, machining restarts.

Fig. 1




a. Machining program halt
b. Halt point designation
c. Operation mode changeover
d. Tool retract
e. Transit point designation

### 11.4.13 Skip Retract

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | — | — | — | — | — | — | — | — |

This function is used to return to the opposite advance direction when the skip signal is input during G31 command.

### 11.4.14 PLC Interruption

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The interrupt program set with the R register is executed with the signals from the PLC during single block stop in program operation or during the manual mode.

# 12

# Program Support Functions

# 12.1 Machining Method Support Functions

## 12.1.1 Program

### 12.1.1.1 Subprogram Control [Layers]

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 8 |
| L | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 8 |

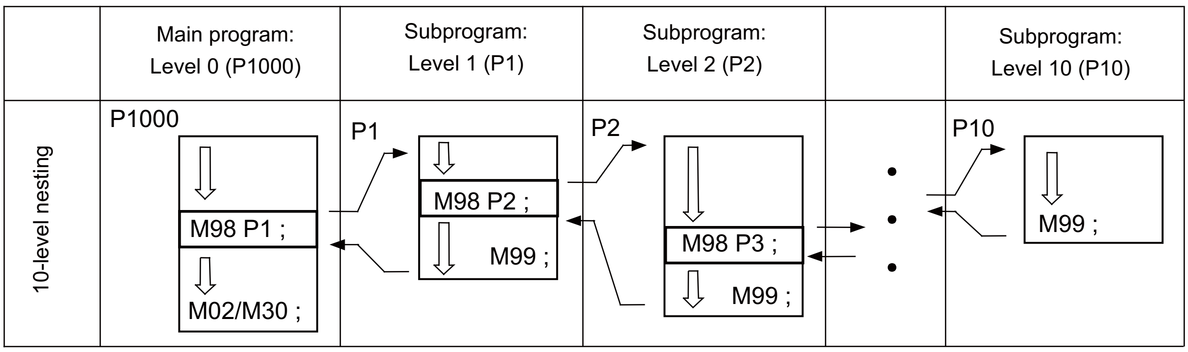
When the same pattern is repeated during machining, the machining pattern can be registered as one subprogram and the subprogram can be called from the main program as required, thereby realizing the same machining easily. Efficient use of program can be made. The subprogram is called with the program No. and sequence No. or the file name and sequence No.

**(1) Calling the subprogram with M98 command**

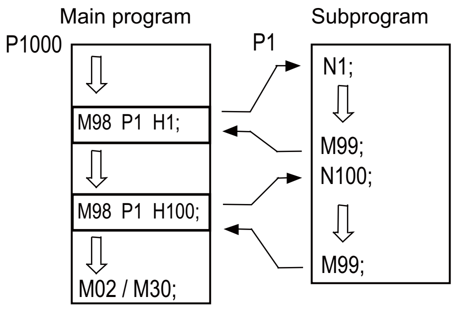
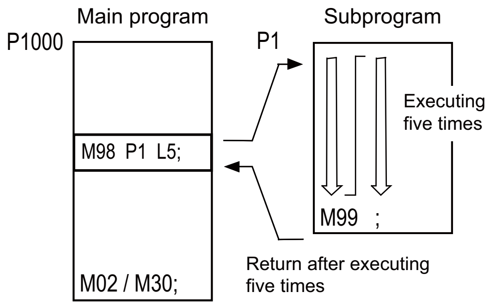
**M98 P__ H__ L__ ,D__ ;**
**or, M98 <File name> H__ L__ ,D__ ;**

| | |
|---|---|
| M98 | : Subprogram call command |
| P | : Program No. in subprogram to be called. (Own program if omitted.)<br>Note that P can be omitted only during memory operation MDI operation, high-speed program server operation, SD card operation and hard disk operation.<br>(Max. 8-digit value)<br>A four-digit or eight-digit program No. starting with O No. can be called by the parameter.<br>However, the commanded subprogram is called when the number of digits of the command value is larger than the one set in the parameter. |
| <File name> | : A file name can be designated instead of the program No. In this case, enclose the file name with brackets <>.<br>(The file name can have up to 32 characters, including the extension.)<br>(Example) M98 <PARTS-12.RAF>; |
| H | : Sequence No. in subprogram to be called (Head block if omitted) |
| L | : Number of subprogram repetitions<br>(If omitted, this is handled as L1. When L0 is set, the subprogram is not called.)<br>(1 to 9999 times) |
| ,D | : Device No. where subprogram is stored. (0 to 4)<br>If ,D is omitted, the subprogram in the memory will be used.<br>The device No. is set with the machining parameters. |

Subprograms can be nested up to 10 levels deep.



A subprogram branch destination or repetition of a subprogram can be specified.

| Specifying a subprogram branch destination | Specifying repetition of a subprogram |
|---|---|
|  |  |





**(2) Returning to main program from the subprogram with M99 command**

| **M99 P__ ;** | |
|---|---|
| P | : Sequence No. of return destination (returned to block that follows the calling block) |

**(3) Calling the subprogram with M198 command**

A program registered in the data server (SD card in control unit) or Front SD card can be called out as a subprogram.
To call a program in the SD card as the subprogram, command as shown below in the main program.

| **M198 P__ L__ ;**<br>**or, M198 <File name> L__ ;** | |
|---|---|
| M198 | : Call command |
| P | : Program No. in SD card to be called as subprogram (Max. 8 digits)<br>A four-digit or eight-digit program No. starting with O No. can be called by the parameter.<br>However, the commanded subprogram is called when the number of digits of the command value is larger than the one set by the parameter. |
| <File name> | : A file name can be designated instead of the program No. In this case, enclose the file name with brackets <>.<br>(The file name can have up to 32 characters, including the extension.) |
| L | : Number of subprogram repetitions (Max. 4 digits)<br>This can be omitted. (If omitted, this is handled as L1.)<br>When L0 is set, the subprogram is not called. |

(Note 1) Sequence No. call (M198 H****) is not possible.

(Note 2) The device that can be used for M198 subprogram call differs depending on the NC models.
The device is the front-side SD card for M800S/M80, or the SD card in the control unit for M800W/M80W.

(Note 3) Calling of the subprogram with the M198 command is limited to once in the subprogram nest.
The subprogram can be called only from the memory or MDI program.

(Note 4) The data from the head of the program to the first LF (lien feed code. 0x0A as hexadecimal) is invalid, and cannot be run or displayed. Note that if the head starts from an O number (program No.), the program is valid from the head.

(Note 5) A program registered in an SD card can be executed from only one part system. A program error will occur if an attempt is made to execute the programs in the SD card simultaneously by two or more part systems. If all the part system is reset when the error occurred, programs will be displayed as only "%" except for the first part system.

(Note 6) Refer to "(1) Calling the subprogram with M98 command" for <File name> and calling the subprogram with O No.

**(4) Returning to main program from the subprogram with M99 command**

| **M99 ;** |
|---|

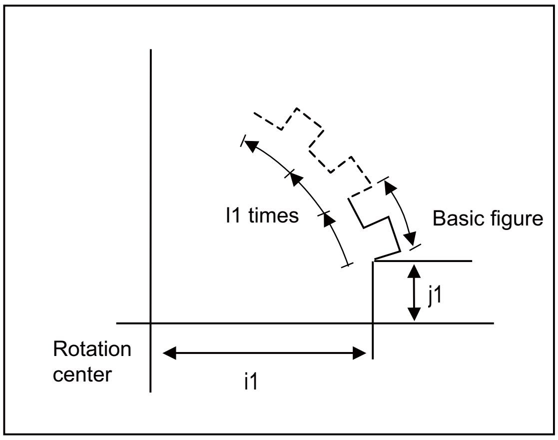
### 12.1.1.2 Figure Rotation

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ― | ― | ― | ― |
| L | ― | ― | ― | ― | ― | ― | ― | ― |

If the same pattern is used repeatedly on a concentric circle, one of the rotating machining patterns can be registered as a subprogram. When the subprogram is called from the main program, if the rotation center is designated, a path similar to the rotary phase can be easily created on the concentric circle. This simplifies creation of the program.
The program format is shown below.

**M98 Ii1 Jj1 (Kk1) Pp1 Hh1 Ll1 ,Dd1;**
**or, M98 Ii1 Jj1 (Kk1) <File name> Hh1 Ll1 ,Dd1 ;**

| | |
|---|---|
| M98 | : Subprogram call command |
| Ii1 Jj1 (Kk1) | : Rotation center coordinates |
| Pp1 | : Program No. in subprogram to be called. (Own program if omitted.)<br>Note that P can be omitted only during memory operation and MDI operation.<br>(Max. 8-digit value)<br>A four-digit or eight-digit program No. starting with O No. can be called by the parameter. |
| <File name> | : A file name can be designated instead of the program No. In this case, enclosed the file name with brackets <>.<br>(The file name can have up to 32 characters, including the extension.)<br>(Example) M98 <PARTS-12.RAF>; |
| Hh1 | : Sequence No. in subprogram to be called (Head block if omitted) |
| Ll1 | : Number of subprogram repetitions<br>(If omitted, this is handled as L1. When L0 is set, the subprogram is not called.)<br>(1 to 9999 times) |
| ,Dd1 | : Subprogram device No. (0 to 4)<br>The subprogram in the memory can be used when ,D is omitted.<br>The device No. is set with the machining parameters. |



(1) The first subprogram called out with subprogram call is executed at a 0° rotation angle. The path is created as commanded.
(2) If the number of repetitions is set to two or more, the rotation angle is obtained from the called subprogram's start point, end point and rotation center coordinate. The path of the first subprogram is used as a basic figure and is rotated and arranged for the designated number of call repetitions, using the rotation center coordinates as a reference.
(3) During figure rotation, all blocks in the subprogram are treated as to be rotated.
(4) If the subprogram start point and end point are not on the same circle having the commanded figure rotation center coordinates as the center, the axis will interpolate using the subprogram's end point as the start point, and the end point in the first movement command block in the rotated subprogram as the end point.
(5) The figure is rotated on the workpiece coordinate system, and can be shifted with the G92, G52, G54 to G59 (workpiece coordinate system shift) command.
(6) Functions (reference position return, uni-direction positioning, etc.) on the machine coordinate system for the rotary plane axis cannot be used while the figure is rotated. However, the machine coordinate system functions can be used for axes other than the rotation plane.
(7) A program error will occur if figure rotation is commanded during figure rotation.
(8) Figure rotation and program coordinate rotation cannot be commanded simultaneously.

### 12.1.1.3 Scaling

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | ― | ― | ― | ― | ― | ― | ― | ― |

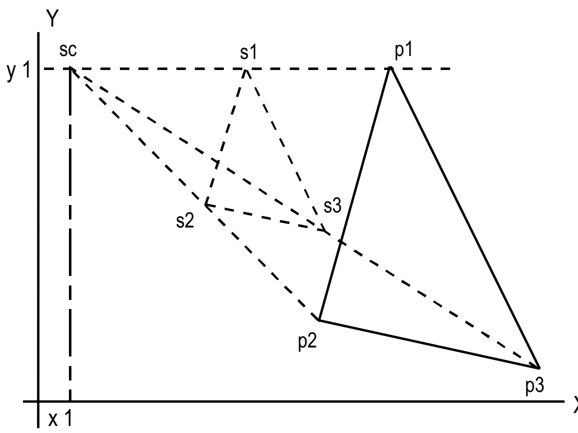
The shape commanded by the program can be extended or reduced to the desired size by applying a scale factor to the movement axis command position.

| Gcode | Function |
|---|---|
| G50<br>G51 | Scaling cancel<br>Scaling ON |

The program format is given below.

| **G51 Xx1 Yy1 Zz1 Pp1 ;** | |
|---|---|
| G51 | : Call command |
| Xx1,Yy1,Zz1 | : Scaling center coordinate position |
| Pp1 | : Scale factor |

The scale factor ranges from 0.000001 to 99.999999 times.




sc : Scaling center
p1, p2, p3 : Programmed shape
s1, s2, s3 : Shape after scaling

(Note 1) Scaling cannot be applied to compensation amount for tool radius compensation, tool position offset, or tool length compensation, etc. (The compensation and offset are calculated for the scaled shape.)

(Note 2) Scaling applies only to the axes commanded with G51 block; it does not apply to axes which have not been commanded.
When the scale factor is not assigned, the parameter setting applies instead.

### 12.1.1.4 Axis Name Switch

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | — | — | — | — | — | — | — | — |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The axis name switch function switches the name of command axis and control axis.

| **G111 Axis name1 Axis name2 ;** | |
|---|---|
| G111 | : Axis name switch command |
| Axis name 1,2 | : Axes to be performed the name switch command<br>When the axis name switch command is canceled, assign only "G111;" command. |

When switching the name of X-axis and Y-axis by axis name switch command, the machine performs as follow.

| <Before axis name switch> | | | <After axis name switch> | |
|---|---|---|---|---|
| **Command axis name** | **Control axis** | | **Command axis name** | **Control axis** |
| **X** | **Xaxis** | **->** | **X** | **Yaxis** |
| **Y** | **Yaxis** | | **Y** | **Xaxis** |

(Example)
G111 X Y ;
G01 X100. ; (Y axis moves to 100.mm)
G01 Y100. ; (X axis moves to 100.mm)

## 12.1.2 Macro Program

### 12.1.2.1 User Macro [Layers]

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ 4 | ○ 4 | ○ 4 | ○ 4 | ○ 4 | ○ 4 | ○ 4 | ○ 4 |
| L | ○ 4 | ○ 4 | ○ 4 | ○ 4 | ○ 4 | ○ 4 | ○ 4 | ○ 4 |

**(1) Macro commands 1 ; G65 to G67**

In order to carry through one integrated function, a group of control and arithmetic instructions can be used and registered as a macro program. Furthermore, subprograms with a high degree of expandability can be configured by setting these macro programs as types which are capable of conducting control and arithmetic operations using variable commands.

| G code | Function |
|---|---|
| G65 | Macro call (Sample call) |
| G66 | Macro modal call A |
| G66.1 | Macro modal call B |
| G67 | Macro modal call cancel |

The program formats are given below

| **G65 P__ L__ --Argument--;or,G65 <File name> L__ --Argument--;** | |
|---|---|
| G65 | : Call command |
| P | : Program No.<br>A four-digit or eight-digit program No. starting with O No. can be called by the parameter. |
| <File name> | : File name<br>When designating the file name, enclose the file name with brackets < >. |
| L | : Number of repetitions |
| Argument | : Variable data assignment |

The macro program is called immediately by this command

| **G66 P__ L__ --Argument--;or,G66 <File name> L__ --Argument--;** | |
|---|---|
| G66 | : Call command |
| P | : Program No.<br>A four-digit or eight-digit program No. starting with O No. can be called by the parameter. |
| <File name> | : File name<br>When designating the file name, enclose the file name with brackets < >. |
| L | : Number of repetitions |
| Argument | : Variable data assignment |

The macro program is executed from the block with the axis command following this command.

| **G66.1 P__ L__ --Argument--;or, G66.1 <File name> L__ --Argument--;** | |
|---|---|
| G66.1 | : Call command |
| P | : Program No.<br>A four-digit or eight-digit program No. starting with O No. can be called by the parameter. |
| <File name> | : File name<br>When designating the file name, enclose the file name with brackets < >. |
| L | : Number of repetitions |
| Argument | : Variable data assignment |

The macro program is executed with the word data of each block as the argument.

The following macro command functions are available.

| | | |
|---|---|---|
| Arithmetic commands | #1=<Expression> ;<br>Various arithmetic operations can be conducted between variables by the above.<br>"<Expression>" is a combination of constants, variables, functions and operators. | |
| Assignment of priority of arithmetic operations | The portion in which the operator is to be given priority can be enclosed in [ ].<br>Up to five pairs of square parentheses [ ] including the function [ ] can be used.<br>The normal priority of operation is functions and multiplication/division followed by addition/ subtraction. | |
| Control commands | (1) IF[<Conditional expression>]GOTO n ;<br>(2) WHILE[<Conditional expression>]Do m ;<br>---<br>END m ; | The flow of the program can be controlled by these commands. "n" denotes the sequence numbers of the branching destination. "m" is an identification number, and 1 to 127 can be used. Note that only 27 nestings can be used. |

(Note 1) The variable commands are provided under the optional specifications independently of the user macros. If they are to be used, specify the optional specifications separately.

**(2) Macro commands 2**

Specific G commands and the miscellaneous commands (M, S, T, B) can be used for macro call.

(a) Macro call using G codes

Simply by assigning a G code, it is possible to call user macro programs with the prescribed program number.

Format

| **G** P__ L__ Argument;** | |
|---|---|
| G** | : G code for performing macro call |
| P | : Argument (When macro argument L/P valid function is enabled. Disabled when it is invalid.) |
| L | : Argument (When macro argument L/P valid function is enabled. Disabled when it is invalid.) |
| Argument | : Variable data designation |

The correspondence between the G** code which performs macro call and the program number for the macro to be called is set by a parameter.

Up to 10 codes from G100 to G999 can be used for this command. (The G codes that are used in the system also can be made available for this use by parameter setting.)

(Note 1) G101 to G110 and G200 to G202 are user macro I codes. However, if a parameter is set for the G code call code, the G code call will have the priority, and these cannot be used as the user macro I.

(b) Macro call using miscellaneous commands (M, S, T, B code macro call)
Simply by designating an M (or S, T, B) code, it is possible to call user macro programs with the prescribed program number. (Entered M codes and all S, T and B codes can be used.)
Format

| **M** (or S**;, T**;, B**;) P__ L__ Argument;** | |
|---|---|
| M** (S**, T**, B**) | : M (or S, T, B) code for performing macro call |
| P | : Argument (When macro argument L/P valid function is enabled. Disabled when it is invalid.) |
| L | : Argument (When macro argument L/P valid function is enabled. Disabled when it is invalid.) |

The correspondence between the M** code which performs macro call and the program number for the macro to be called is set by a parameter. Up to 10 M codes from M00 to M9999, M198 can be entered. Select codes to be entered other than the codes basically required by the machine and M codes of M0, M1, M2, M30 and M96 through M99.

(Note 1) G commands in G code macro programs are not subject to macro calls but normal G commands. M commands in M code macro programs are not subject to macro calls but normal M commands. (The same applies to S, T and B codes.)
(Note 2) The registration of the program number used for calling the G code macro or M (or S, T, B) code macro can be done independently for each part system.

**(3) Macro argument L/P valid**

This function allows the addresses L (number of subprogram repetitions) and P (calling program No.) used as commands in user macro to be used as arguments. This function is enabled by a parameter.

Followings can be used by user macro.
- G65 Macro call (Sample call)
- G66 Macro modal call A
- G66.1 Macro modal call B
- Macro call using G codes
- Macro call using miscellaneous commands
- ASCII macro

**(4) Common variables protection**

This function protects the common variables used for machine tool builder macro from being changed by user operation.
The common variables in the range designated with the parameter cannot be changed by user operation, such as through a machining program, screen operation or file input.
The range of common variables to be protected can be designated individually for each part system.

### 12.1.2.2 Machine Tool Builder Macro

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

This function enables dedicated macro programs made by MTB to be registered in the CNC. By registering the macro as a program numbered in the 100010000s, the macro program display, editing and input/output can be protected with a password and the macro program confidentiality can be kept.
Machine tool builder macro programs are stored in a dedicated area which means that the user program registration area is not reduced in the process.
When registering a machine tool builder macro, secure its space by formatting.

Macro program memory capacity

| Model | When the simple programming is in use (Note 1) | | When the simple programming is not in use | |
|---|---|---|---|---|
| | Memory capacity (KB) | Max. registrable number of programs (programs) | Memory capacity (KB) | Max. registrable number of programs (programs) |
| M800W<br>M800S | 128 | 500 | 256 | 600 |
| M80<br>M80W | 80 | 100 | 208 | 200 |
| C80 | 80 | 100 | 208 | 200 |

(Note 1) "When the simple programming is in use" means that the simple programing (NAVI MILL/NAVI Lathe) is being used and the macro is stored in the machine tool builder macro area.
(Note 2) The memory capacity and the maximum registrable number of programs vary depending on the simple programing macro when the simple programming macro is registered in the machine tool builder macro area.

The macro program registered as a machine tool builder macro is called out as "G65 command" or "G code macro equivalent to G65". The macro program is described in the same manner as a conventional machining program.
Variables for the machine tool builder macros can be used within the machine tool builder macros. These variables can be used commonly within the machine tool builder macro programs.

Command format

User macro call (G65)

| **G65 P__ L__ Argument ;** | |
|---|---|
| P | : Machine tool builder macro program No.(100010000 to 199999998) |
| L | : Number of repetitions (0 to 9999) |
| Argument | : Variable data designation |

(Note) The machine tool builder macro program cannot be called with G66, G66.1 or M98. Note that a machine tool builder macro program can be called from a machine tool builder macro program using M98.

Macro call with G code (G***)

| **G*** Argument;** | |
|---|---|
| *** | : G code defined in macro definition program or G command macro parameter |
| Argument | : Variable data designation<br>Argument is used when a local variable must be delivered to the macro program. Designate a real value after the address. |

Miscellaneous command macro call (M or T code macro call)

| **M*** Argument; (or T***)** | |
|---|---|
| *** | : M (or T) code defined in macro definition program |
| Argument | : Variable data designation<br>Use this argument when a local variable needs to be passed on to the macro program. Designate a real value after the address. |

(Note) If M96, M97, M98, M99, M198 or the M code for G83 S Mode (for M system only) is commanded, machine tool builder macro will not be called and the said M code will be handled as a normal miscellaneous command.

### 12.1.2.3 Macro Interruption

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

This function inputs from the machine to interrupt the program currently being executed, and instead calls and executes another program.
The program can be operated flexibly enough to meet varying conditions.
There are two types of interrupts, type 1 and type 2, as described below, and they are selected using a parameter.

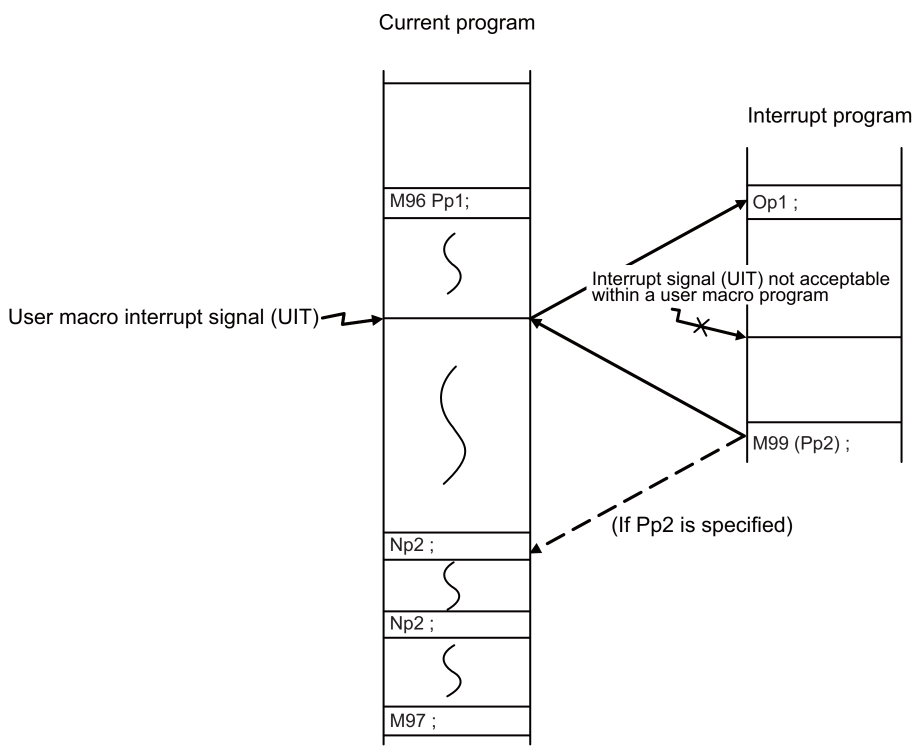
[Interrupt type 1] The block being executed is immediately interrupted, and the interrupt program is run immediately.

[Interrupt type 2] After the block being executed is complete, the interrupt program is executed.

The command format is given below.

| **M96 P__ H__ ; or, M96 <File name> H__ ;** | **User macro interrupt valid** |
|---|---|
| M96 | : Interrupt valid command |
| P | : Interrupt program number<br>A four-digit or eight-digit program No. starting with O No. can be called by the parameter. |
| <File name> | : File name<br>When designating a file name, enclose the file name in brackets <>. |
| H | : Interrupt sequence No. |

| **M97 ;** | **User macro interrupt invalid** |
|---|---|
| M97 | : User macro interrupt end command |



### 12.1.2.4 Variable Command

[M system]

| Variable sets | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| 600 sets | — | — | — | — | — | — | — | — |
| 700 sets | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| 8000 sets | △ | △ | △ | △ | ○ | ○ | — | — |
| (600 + 100 × number of part systems) sets | ○ | ○ | ○ | ○ | ○ | ○ | — | ○ |
| (7900 + 100 × number of part systems) sets | △ | △ | △ | △ | ○ | ○ | — | — |

[L system]

| Variable sets | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| 600 sets | — | — | — | — | — | — | ○ | — |
| 700 sets | ○ | ○ | ○ | ○ | ○ | ○ | — | ○ |
| 8000 sets | △ | △ | △ | △ | ○ | ○ | — | — |
| (600 + 100 × number of part systems) sets | ○ | ○ | ○ | ○ | ○ | ○ | — | ○ |
| (7900 + 100 × number of part systems) sets | △ | △ | △ | △ | ○ | ○ | — | — |

Programming can be given flexible and general-purpose capabilities by designating variables instead of directly assigning numbers for addresses in programs and by supplying the values of those variables as required when running the programs.
Arithmetic operations (adding, subtracting, multiplying and dividing) can also be conducted for the variables.

Number of variable sets specifications

<table>
<tr><th colspan="3">Type</th><th colspan="2">Number</th><th>Function</th></tr>
<tr><td colspan="3">Common variables</td><td>Common variables 1</td><td>Common variables 2</td><td rowspan="6">Can be used commonly for main, sub and each macro program.<br><br>When using the common variables across multiple part systems, Some MTB specifications allow you to designate the number of common variables that are common to part systems.</td></tr>
<tr><td rowspan="3"></td><td rowspan="3">For 1-part system specifications</td><td>600 sets</td><td>500 to 999<br>100100 to 800199(Note 6)</td><td>100 to 199</td></tr>
<tr><td>700 sets</td><td>400 to 999<br>100100 to 800199(Note 6)</td><td>100 to 199</td></tr>
<tr><td>8000 sets</td><td>400 to 999<br>100100 to 800199(Note 6)<br>900000 to 907399</td><td>100 to 199</td></tr>
<tr><td rowspan="2"></td><td rowspan="2">For multi-part system specifications</td><td>600+100 sets</td><td>400 to 999<br>100100 to 800199(Note 6)</td><td>100 to 199×number of part systems</td></tr>
<tr><td>7900+100 sets</td><td>400 to 999<br>100100 to 800199(Note 6)<br>900000 to 907399</td><td>100 to 199×number of part systems</td></tr>
<tr><td colspan="3">Local variables</td><td colspan="2">1 to 33</td><td>Can be used as local in macro program.</td></tr>
<tr><td colspan="3">ZR device access variables<br>(only for C80 series)</td><td colspan="2">50000 to 52749</td><td>Can be read and written by the PLC or GOT.</td></tr>
<tr><td colspan="3">System variables</td><td colspan="2">1000 to</td><td>Application is fixed in system.</td></tr>
<tr><td colspan="3">Fixed cycle variables</td><td colspan="2">1 to 32</td><td>Local variables in fixed cycle program.</td></tr>
</table>

(Note 1) All common variables are held even when the power is turned OFF.

(Note 2) The common variables can be emptied by resetting or turning the power OFF when the parameters are set accordingly.

(Note 3) The common variables are divided into the following two types.
Common variable 1: Variables that can be used commonly through the part systems.
Common variable 2: Variables that can be used commonly within that part system's program.

(Note 4) The variable names can be set for some common variables.

(Note 5) The common variables used for machine tool builder macro can be protected from being changed by user operation.

(Note 6) The part system common variable which can be used is shown in the table below.

<table>
<tr><th colspan="2">Variable sets</th><th>Common variables 1</th></tr>
<tr><td rowspan="2">Variable sets specification</td><td>700 sets(600+100)</td><td rowspan="2">#100100 to #100199<br>#200100 to #200199<br>#300100 to #300199<br>#400100 to #400199<br>#500100 to #500199<br>#600100 to #600199<br>#700100 to #700199<br>#800100 to #800199</td></tr>
<tr><td>8000 sets(7900 ＋ 100)</td></tr>
</table>

Variable expressions
Variable : #Numerical value #100
(Numerical value: 1,2,3, .....)
: # [Expression] #100
Expression : Numerical value
: Variable
: Expression Operator Expression #100 + #101
: - (minus) Expression -#120
: [Expression] [#110]
: Function [Expression] SIN [#110]

Variable definition
Variable = expression

(Note 1) Variables cannot be used with addresses "O" and "N".

### 12.1.3 Fixed Cycle

List of fixed cycles

| Type of fixed cycle | M system | L system | | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | Gcode list 1 | Gcode list 2 | Gcode list 3 | Gcode list 4 | Gcode list 5 | Gcode list 6 | Gcode list 7 | |
| Fixed cycle for drilling | G73 | G80 | G80 | G80 | G80 | G80 | G80 | Refer to 12.1.3.1.<br>Refer to 12.1.3.2 (Type II).<br>Refer to 4.5.3. |
| | : | : | : | : | : | : | : | |
| | G89 | G89 | G89 | G89 | G89 | G89 | G89 | |
| | | G79 | G83.2 | G79 | G83.2 | G79 | G83.2 | |
| | G98 | G98 | G98 | G98 | G98 | G98 | G98 | |
| | G99 | G99 | G99 | G99 | G99 | G99 | G99 | |
| | G187 | G187 | G187 | G187 | G187 | G187 | G187 | |
| Special fixed cycles | G34 | | | | | | | Refer to 12.1.3.3. |
| | G35 | - | - | - | - | - | - | |
| | G36 | | | | | | | |
| Fixed cycles for turning machining | | G90 | G77 | G90 | G77 | G90 | G77 | Refer to 12.1.3.4. |
| | - | G92 | G78 | G92 | G78 | G92 | G78 | |
| | | G94 | G79 | G94 | G79 | G94 | G79 | |
| Compound-type fixed cycles for turning machining | | G70 | G70 | G70 | G70 | G70 | G70 | Refer to 12.1.3.5.<br>Refer to 12.1.3.6 (Type II).<br>Refer to 12.1.8.8. |
| | | : | : | : | : | : | : | |
| | - | G76 | G76 | G76 | G76 | G76 | G76 | |
| | | G76.1 | G76.1 | G76.1 | G76.1 | G76.1 | G76.1 | |
| | | G76.2 | G76.2 | G76.2 | G76.2 | G76.2 | G76.2 | |
| Small-diameter deep-hole drilling cycle | G83 | - | - | - | - | - | - | Refer to 12.1.3.7. |

### 12.1.3.1 Fixed Cycle for Drilling

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

**(1) M system**

These functions enable drilling, tapping and other hole machining cycles to be assigned in a simple 1-block program.

| Gcode | Function |
|---|---|
| G73 | Step cycle |
| G74 | Reverse tapping cycle |
| G75 | Circular cutting cycle |
| G76 | Fine boring cycle |
| G80 | Fixed cycle cancel |
| G81 | Drilling, spot drilling cycle |
| G82 | Drilling, counterboring cycle |
| G83 | Deep hole drilling cycle |
| G84 | Tapping cycle |
| G85 | Boring cycle |
| G86 | Boring cycle |
| G87 | Backboring cycle |
| G88 | Boring cycle |
| G89 | Boring cycle |
| G187 | Thread milling cycle |

There are two levels of hole machining axis return which apply upon completion of the fixed cycle machining operation.

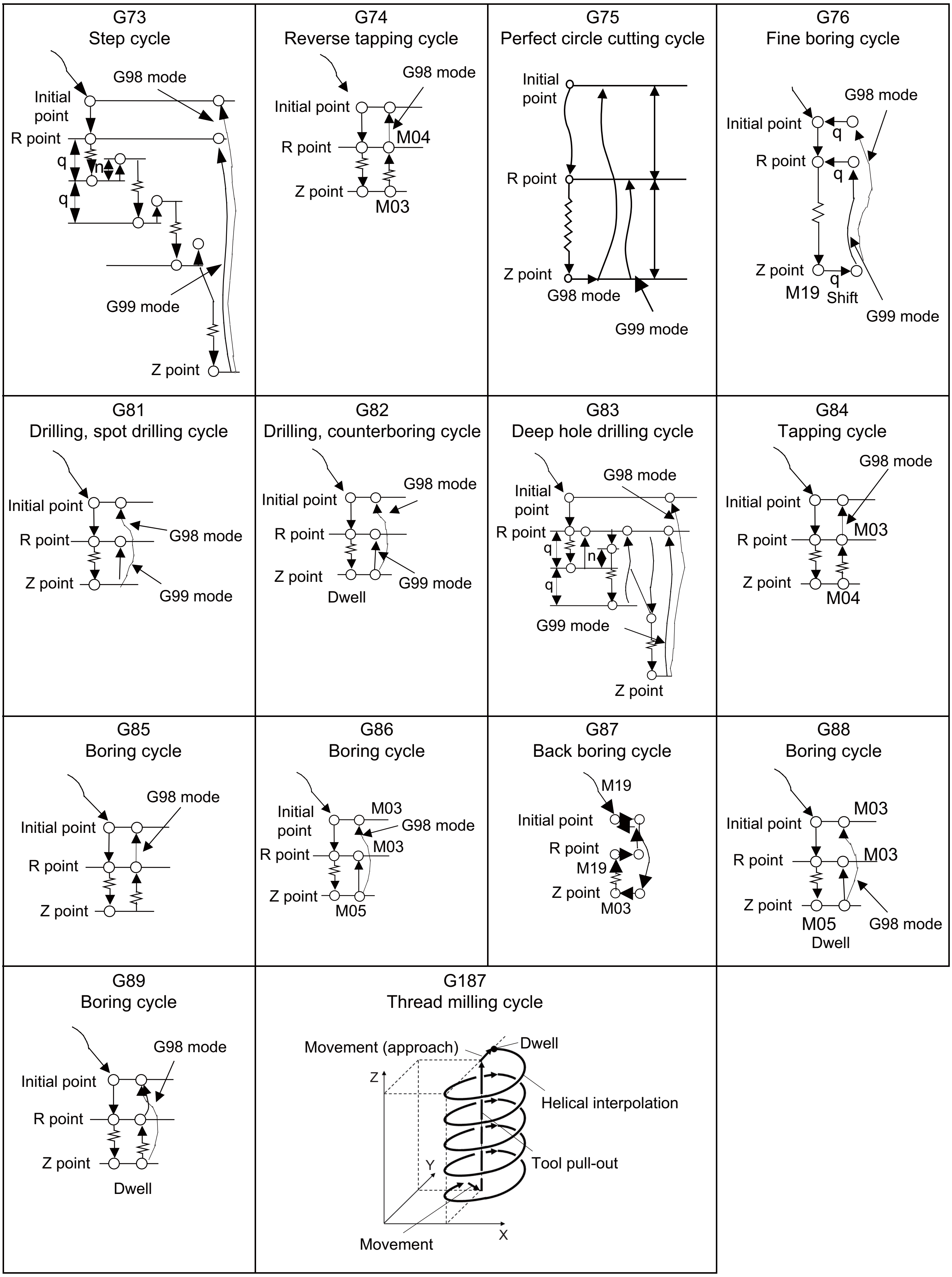
| Gcode | Function |
|---|---|
| G98 | Initial point level return |
| G99 | R point level return |

The basic program format for the fixed cycle commands is shown below.

**G8*(G7*) X__ Y__ Z__ R__ Q__ P__ F__ L__ S__ ,S__ ,I__ ,J__ ;**
**G8*(G7*) X__ Y__ Z__ R__ Q__ P__ F__ L__ S__ ,R__ ,I__ ,J__ ;**

| | |
|---|---|
| G8*(G7*) | : Hole drilling mode |
| X/Y | : Hole position data |
| Z/R/Q/P/F | : Hole machining data |
| L | : Number of repeats |
| S | : Spindle rotation speed |
| ,S | : Spindle rotation speed during return |
| ,R | : Synchronization switch |
| ,I | : Positioning axis in-position width |
| ,J | : Drilling axis in-position width |

For details on the synchronous tapping cycle (including pecking tapping cycle and deep-hole tapping cycle), refer to the section "4.5.3 Synchronous Tapping".


G73
Step cycle
G98 mode
Initial point
R point
q
n
q
G99 mode
Z point
G74
Reverse tapping cycle
G98 mode
Initial point
M04
R point
Z point
M03
G75
Perfect circle cutting cycle
Initial point
R point
Z point
G98 mode
G99 mode
G76
Fine boring cycle
G98 mode
Initial point
q
R point
q
Z point
q
M19
Shift
G99 mode
G81
Drilling, spot drilling cycle
Initial point
R point
G98 mode
Z point
G99 mode
G82
Drilling, counterboring cycle
G98 mode
Initial point
R point
Z point
G99 mode
Dwell
G83
Deep hole drilling cycle
G98 mode
Initial point
R point
q
n
q
G99 mode
Z point
G84
Tapping cycle
G98 mode
Initial point
M03
R point
Z point
M04
G85
Boring cycle
G98 mode
Initial point
R point
Z point
G86
Boring cycle
Initial point
M03
G98 mode
R point
M03
Z point
M05
G87
Back boring cycle
M19
Initial point
R point
M19
Z point
M03
G88
Boring cycle
M03
Initial point
R point
M03
Z point
M05
G98 mode
Dwell
G89
Boring cycle
G98 mode
Initial point
R point
Z point
Dwell
G187
Thread milling cycle
Movement (approach)
Dwell
Z
Helical interpolation
Tool pull-out
Y
X
Movement

**(2) L system**

These functions enable drilling, tapping and other hole machining cycles to be assigned in a simple 1-block program.

| Gcode | Drilling axis | Drilling work start | Motion at hole bottom | Retract motion | Use |
|---|---|---|---|---|---|
| G80 | | | | | Cancel |
| G83 | Z | Cutting feed<br>Intermittent feed | In-position check<br>Dwell | Rapid traverse feed | Deep-hole drilling cycle1 |
| G84<br>(G84.1) | Z | Cutting feed | In-position check<br>Dwell<br>Spindle CCW | Cutting feed | Tapping cycle<br>(Reverse tapping cycle)<br>Pecking tapping cycle<br>Deep tapping cycle |
| G85 | Z | Cutting feed | In-position check<br>Dwell | Cutting feed | Boring cycle |
| G87 | X | Cutting feed<br>Intermittent feed | In-position check<br>Dwell | Rapid traverse feed | Deep-hole drilling cycle1 |
| G88<br>(G88.1) | X | Cutting feed | In-position check<br>Dwell<br>Spindle CCW | Cutting feed | Tapping cycle<br>(Reverse tapping cycle)<br>Pecking tapping cycle<br>Deep tapping cycle |
| G89 | X | Cutting feed | In-position check<br>Dwell | Cutting feed | Boring cycle |
| G83.2 | Z/X | Cutting feed<br>Intermittent feed | In-position check<br>Dwell | Rapid traverse feed | Deep-hole drilling cycle2 |
| G187 | X/Y/Z | Cutting feed | - | Rapid traverse feed | Thread milling cycle |

The fixed cycle mode is canceled when G80 or some G command of the G01 group is issued. Data is also cleared to zero simultaneously.

Command format

End-face drilling

| | |
|---|---|
| **G8* X/U__ C/H__ Z/W__ R__ Q__ P__ F__ K__ D__ S__ ,S__ M__ ;** | |
| G8* | : Hole machining mode (G83, G84, G85) |
| X/U/C/H | : Hole position data |
| Z/W/R/Q/P/F | : Hole machining data |
| K | : Number of repetitions |
| D | : Tool spindle number |
| S | : Spindle rotation speed |
| ,S | : Spindle rotation speed during return |
| M | : Miscellaneous command |

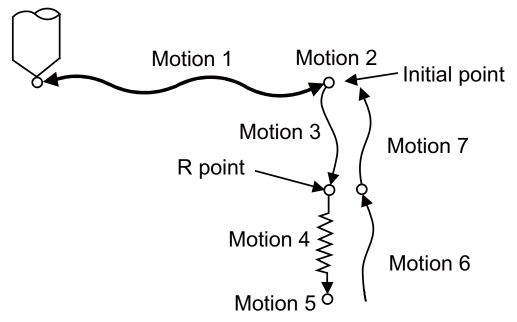
Longitudinal hole drilling

| | |
|---|---|
| **G8* Z/W__ C/H__ X/U__ R__ Q__ P__ F__ K__ D__ S__ ,S__ M__ ;** | |
| G8* | : Hole machining mode (G87, G88, G89) |
| Z/W/C/H | : Hole position data |
| X/U/R/Q/P/F | : Hole machining data |
| K | : Number of repetitions |
| D | : Tool spindle number |
| S | : Spindle rotation speed |
| ,S | : Spindle rotation speed during return |
| M | : Miscellaneous command |

Cancel

**G80 ;**

The drilling cycle motions generally are classified into the following seven.



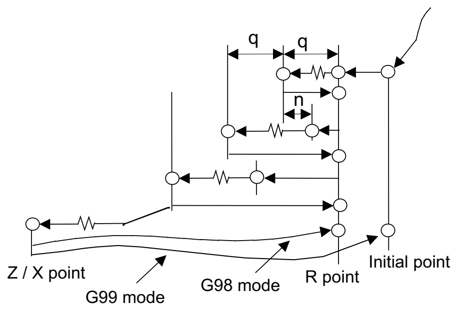

Motion 1: Rapid positioning up to the initial point of X (Z) and C axes.
If the "positioning axis in-position width" is designated, the in-position check is conducted upon completion of the block.
Motion 2: Output if the C axis clamp M code is given.
Motion 3: Rapid positioning up to the R point.
Motion 4: Hole machining at cutting feed.
If the "drilling axis in-position width" is designated, the in-position check is conducted upon completion of the block. However, in the case of deep-hole drilling cycles 1 and 2, the in-position check is not conducted with the drilling of any holes except the last one. The in-position check is conducted at the commanded hole bottom position (last hole drilling).
Motion 5: Motion at the hole bottom position. It varies depending on the fixed cycle mode.
Spindle CCW (M04), spindle CW (M03), dwell, etc., are included.
Motion 6: Return to the R point.
Motion 7: Return to the initial point at rapid traverse feed.
(Motions 6 and 7 may be conducted as a single motion depending on the fixed cycle mode.)

(Note) With a synchronous tap command, the in-position check is conducted in accordance with the parameters.

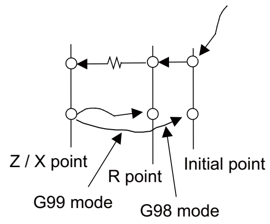
Whether the fixed cycle is complete with motion 6 or 7 can be specified by using either of the following G commands:
G98 : Initial level return
G99 : R point level return
These commands are modal. For example, once G98 is given, the G98 mode is entered until G99 is given. The G98 mode is entered in the initial state when the controller is ready.

G83/G87
Deep-hole drilling cycle (G83: Z-axis direction, G87: X-axis direction)

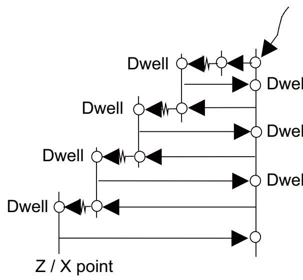
When Q command is given



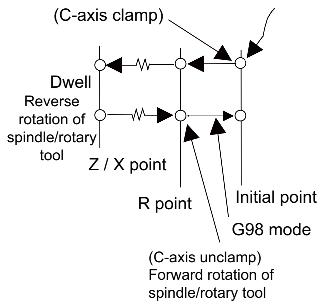

When Q command is not given




G83.2
Deep-hole drilling cycle

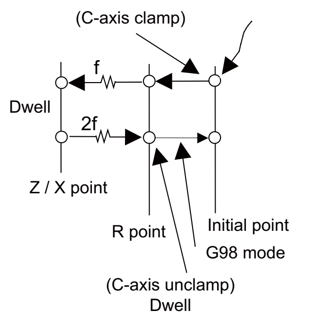



G84/88
Tapping cycle



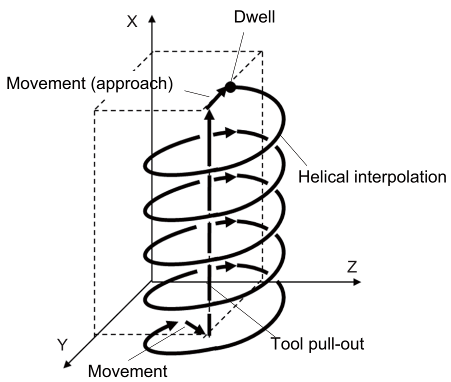

・ Output or no output can be set using a parameter for the C-axis clamp/unclamp M code
・ The rotation direction of the tapping is reversed using Reverse tapping cycle G84.1 (G88.1).

G85/89
Boring cycle




・ Output or no output can be set using a parameter for the C-axis clamp/unclamp M code

G187
Thread milling cycle




There are two levels of hole machining axis return which apply upon completion of the fixed cycle machining operation.

| Gcode | Function |
|---|---|
| G98<br>G99 | Initial point level return<br>R point level return |

### 12.1.3.2 Fixed Cycle for Drilling (Type II)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ― | ― | ― | ― | ― | ― | ― | ― |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

In the longitudinal hole drilling fixed cycle, the X axis is designated as the hole drilling axis. However, in the longitudinal hole drilling fixed cycle (type II), the Y axis can be designated as the hole drilling axis with the longitudinal hole drilling axis selection function.

The relationship between the longitudinal hole drilling axis selection signal's ON/OFF state and the hole drilling axis of the fixed cycle for drilling is shown below.

| Gcode | Details | Y axis cross tap function selection signal state | Hole drilling axis |
|---|---|---|---|
| G80 | Cancel | - | - |
| G83 | Deep hole drilling cycle 1 | ON | Z |
| | | OFF | |
| G84 (G84.1) | Tapping cycle | ON | Z |
| | | OFF | |
| G85 | Boring cycle | ON | Z |
| | | OFF | |
| G87 | Deep hole drilling cycle 1 | ON | Y |
| | | OFF | X |
| G88 (G88.1) | Tapping cycle | ON | Y |
| | | OFF | X |
| G89 | Boring cycle | ON | Y |
| | | OFF | X |
| G83.2 | Deep hole drilling cycle 2 | ON | Z/X |
| | | OFF | |

### 12.1.3.3 Special Fixed Cycle

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | － | － | － | － | － | － | － | － |

These functions enable drilling, tapping and other hole machining cycles to be assigned in a simple 1-block program. Special fixed cycles must always be used in combination with fixed cycles.

The special fixed cycles are as follows:

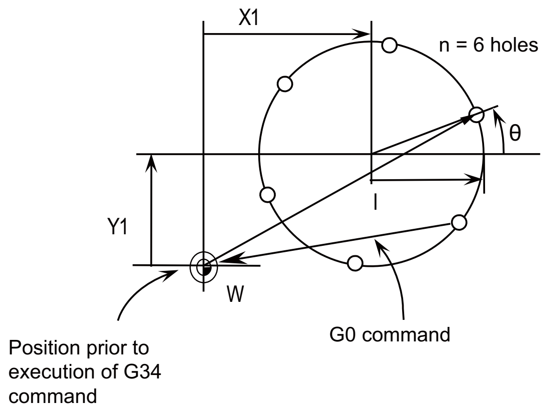
| Gcode | Function |
|---|---|
| G34 | Bolt hole circle |
| G35 | Line at angle |
| G36 | Arc |
| G37.1 | Grid |

**(1) Bolt hole circle (G34)**

The tool starts at the point forming angle θ with the X axis on the circumference of a circle with radius R whose center is the coordinates designated by X and Y, and it drills "n" number of holes at "n" equal intervals along the circumference of that circle. The drilling data for the standard fixed cycle of the G81 or other such command is retained for the drilling operation at each hole position.
All movements between the hole positions are conducted in the G00 mode. The data is not retained upon completion of the G34 command.

**G34 Xx Yy Ir Jθ Kn ;**

| | |
|---|---|
| Xx,Yy | : Center position of bolt hole circle; this is affected by the G90/G91 commands. |
| Ir | : Radius "r" of circle; it is based on the least command increment and is provided using a positive number. |
| Jθ | : Angle θ at point to be drilled initially; the counterclockwise direction is taken to be positive. |
| Kn | : Number "n" of holes to be drilled; any number of holes from 1 through 9999 can be designated; 0 cannot be assigned.<br>When 0 has been designated, the alarm will occur. A positive number provides positioning in the counterclockwise direction;<br>a negative number provides positioning in the clockwise direction. |

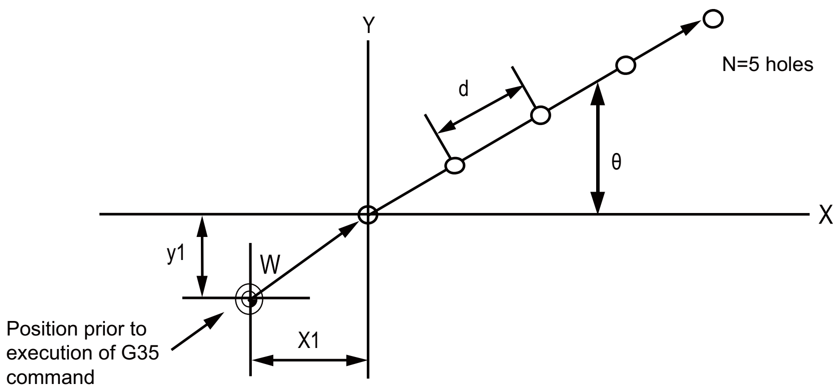



As shown in the figure, the tool is positioned above the final hole upon completion of the G34 command. This means that when it is to be moved to the next position, if the command is issued with incremental position, it will be necessary to calculate the coordinate position. Thus, it is convenient to issue the command with absolute position.

**(2) Line at angle (G35)**

With the starting point at the position designated by X and Y, the tool drills "n" number of holes each at interval "d" in the direction forming angle $\theta$ with the X axis. A standard fixed cycle applies for the drilling operation at each of the hole positions and so there is a need to retain beforehand the drilling data (drilling mode and drilling data). All movements between the hole positions are conducted in the G00 mode. The data is not retained upon completion of the G35 command.

| **G35 Xx Yy Id Jθ Kn ;** | |
|---|---|
| Xx,Yy | : The starting point coordinates; they are affected by the G90/G91 commands. |
| Id | : Interval "d"; it is based on the least command increment and when "d" is negative, drilling proceeds in the point symmetrical direction centered on the starting point. |
| Jθ | : Angle θ; the counterclockwise direction is taken to be positive. |
| Kn | : Number "n" of holes to be drilled including the starting point; any number of holes from 1 through 9999 can be assigned. |

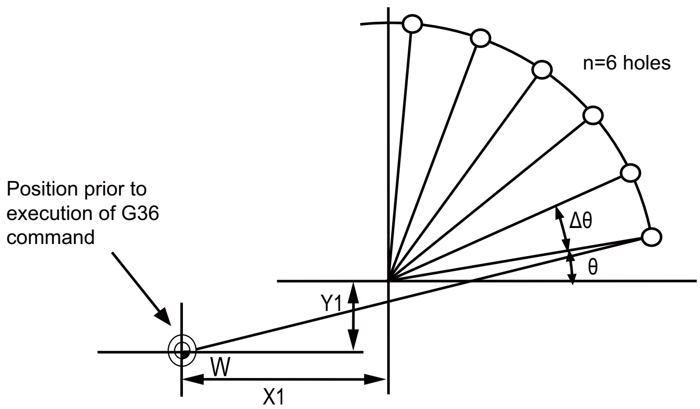



**(3) Arc (G36)**

The tool starts at the point forming angle $\theta$ with the X axis on the circumference of a circle with radius "r" whose center is the coordinates designated by X and Y, and it drills "n" number of holes aligned at angle interval $\triangle\theta$ . As with the bolt hole circle function, the drilling operation at each of the hole positions is based on a hold drilling fixed cycle and so there is a need to retain the drilling data beforehand.

All movements between the hole positions are conducted in the G00 mode. The data is not retained upon completion of the G36 command.

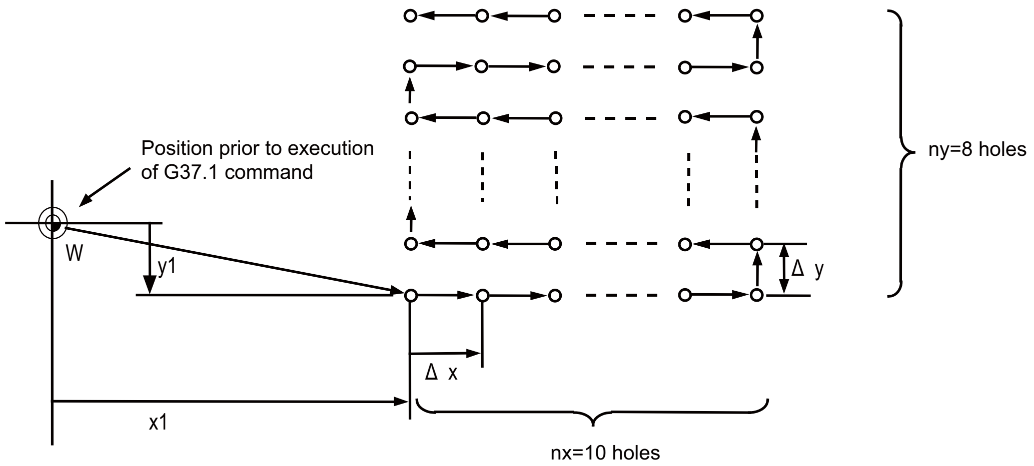
| **G36 Xx Yy Ir Jθ P△θ Kn ;** | |
|---|---|
| Xx,Yy | : Center coordinates of arc; they are affected by the G90/G91 commands. |
| Ir | : Radius "r" of arc; it is based on the least command increment and is provided with a positive number. |
| Jθ | : Angle θ at the point to be drilled initially; the counterclockwise direction is taken to be positive. |
| P△θ | : Angle interval △θ; when it is positive, the tool drills in the counterclockwise direction and when it is negative, it drills in the clockwise direction. |
| Kn | : Number "n" of holes to be drilled; any number of holes from 1 through 9999 can be assigned. |



**(4) Grid (G37.1)**

With the starting point at on the position designated by X and Y, this function enables the tool to drill the holes on the lattice with "nx" number of holes at parallel intervals of △ x to the X axis. Drilling proceeds in the X-axis direction. The drilling operation at each of the hole positions is based on a standard fixed cycle and so there is a need to command the drilling data (drilling mode and drilling data) beforehand. All movements between the hole positions are conducted in the G00 mode. The data is not retained upon completion of the G37.1 command.

| **G37.1 Xx Yy I △ x Pnx J △ y Kny ;** | |
|---|---|
| Xx,Yy | : The starting point coordinates; they are affected by the G90/G91 commands. |
| I △ x | : X-axis interval △ x; it is based on the least command increment; when △ x is positive, the intervals are provided in the positive direction as seen from the starting point and when it is negative, they are provided in the negative direction. |
| Pnx | : Number of holes "nx" in the X-axis direction; any number of holes from 1 through 9999 can be assigned. |
| J △ y | : Y-axis interval △ y; it is based on the least command increment; when △ y is positive, the intervals are provided in the positive direction as seen from the starting point and when it is negative, they are provided in the negative direction. |
| Kny | : Number of holes "ny" in the Y-axis direction; any number of holes from 1 through 9999 can be assigned. |



### 12.1.3.4 Fixed Cycle for Turning Machining

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | — | — | — | — | — | — | — | — |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

This function is to perform the machining according to the predefined work sequence with the command just in one block.

| G code | Function |
|---|---|
| G77 | Longitudinal cutting cycle |
| G78 | Thread cutting cycle |
| G79 | Face cutting cycle |

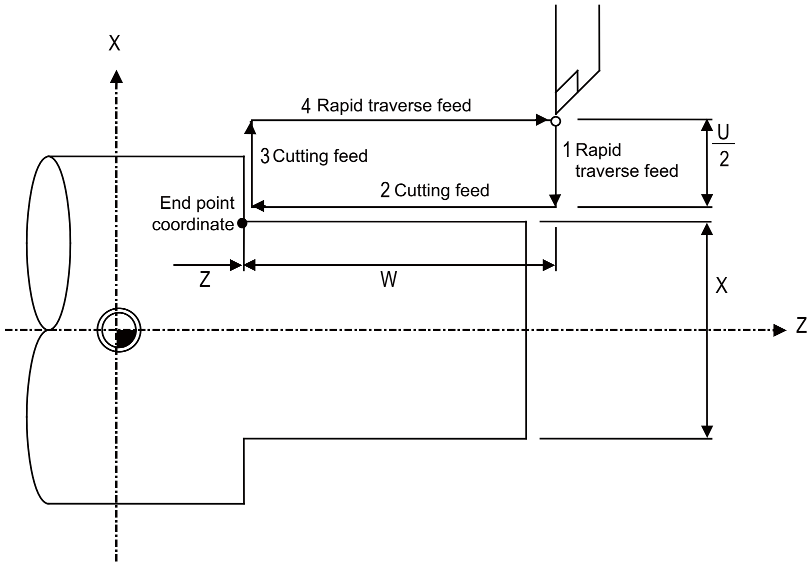
Each fixed cycle command for turning machining is a modal G code and is effective until another command of the same modal group or a cancel command is given.
The fixed cycle can be canceled by using any of the following G codes:
G00,G01,G02,G03
G09
G10,G11
G27,G28,G29,G30
G31
G33,G34
G37
G92
G52,G53
G65

**(1) Longitudinal cutting cycle (G77)**

(a) Straight cutting

Straight cutting in the longitudinal direction can be performed consecutively by the following block:

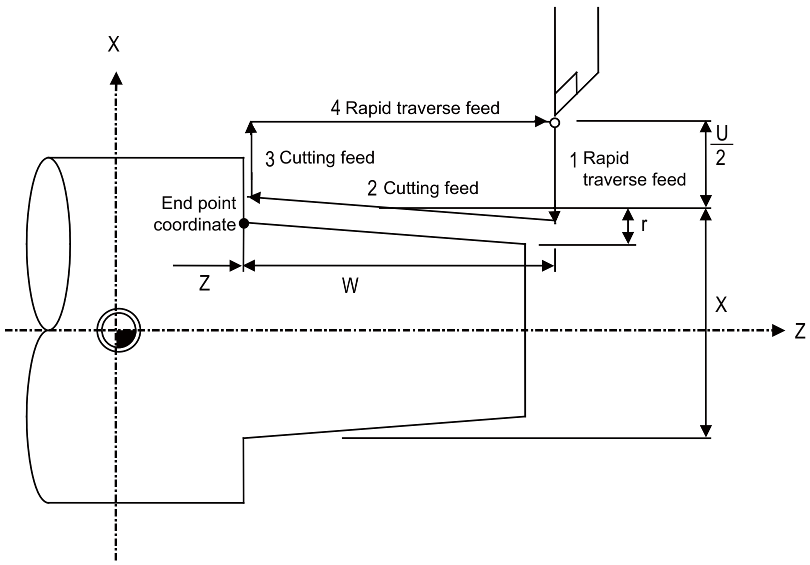
| **G77 X/U_ Z/W_ F_ ;** | |
|---|---|
| X/U | : X axis end point coordinate |
| Z/W | : Z axis end point coordinate |
| F | : Feedrate |




(b) Taper cutting

Taper cutting in the longitudinal direction can be performed consecutively by the following block:

| **G77 X/U_ Z/W_ R_ F_ ;** | |
|---|---|
| X/U | : X axis end point coordinate |
| Z/W | : Z axis end point coordinate |
| R | : Taper part depth (radius designation, incremental value, sign is required) |
| F | : Feedrate |



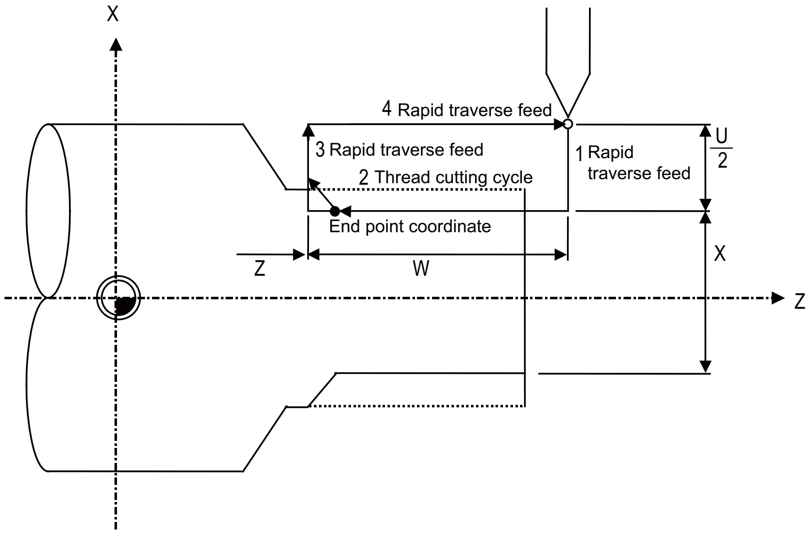

r: Taper part depth (radius designation, incremental position, sign is required)

**(2) Thread cutting cycle (G78)**

(a) Straight thread cutting

Straight thread cutting can be performed by the following block:

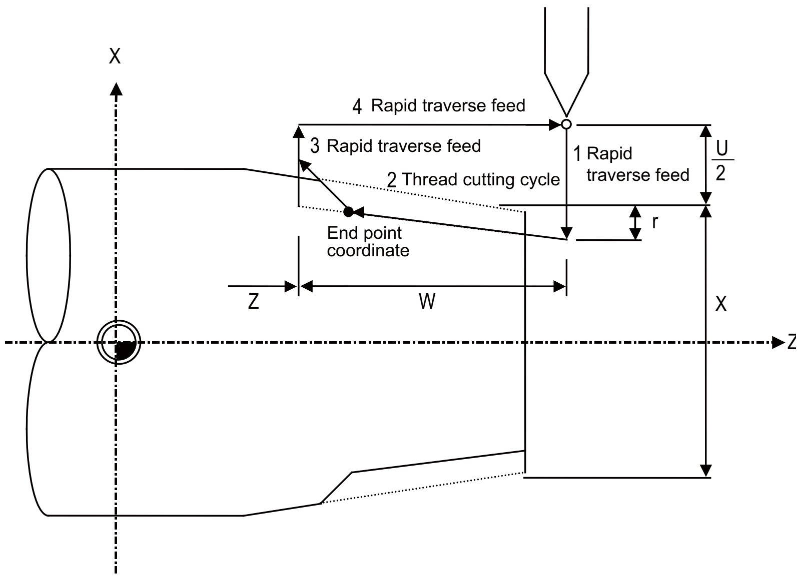
| G78 X/U_ Z/W_ F/E_ Q_ ; | |
|---|---|
| X/U | : X axis end point coordinate |
| Z/W | : Z axis end point coordinate |
| F/E | : Lead of Longitudinal axis (axis which moves most) direction |
| Q | : Thread cutting start shift angle |




(b) Taper thread cutting

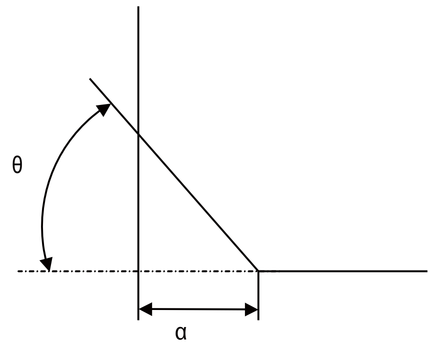
Taper thread cutting can be performed by the following block:

| G78 X/U_ Z/W_ R_ F/E_ Q_ ; | |
|---|---|
| X/U | : X axis end point coordinate |
| Z/W | : Z axis end point coordinate |
| R | : Taper part depth (radius designation, incremental value, sign is required) |
| F/E | : Lead of Longitudinal axis (axis which moves most) direction |
| Q | : Thread cutting start shift angle |




r : Taper part depth (radius designation, incremental position, sign is required)

Chamfering




$\alpha$ : Thread chamfering amount

Set the chamfer amount with the parameters.

The setting range is 0 to 12.7L with increments of 0.1L.

$\theta$ : Thread chamfering angle

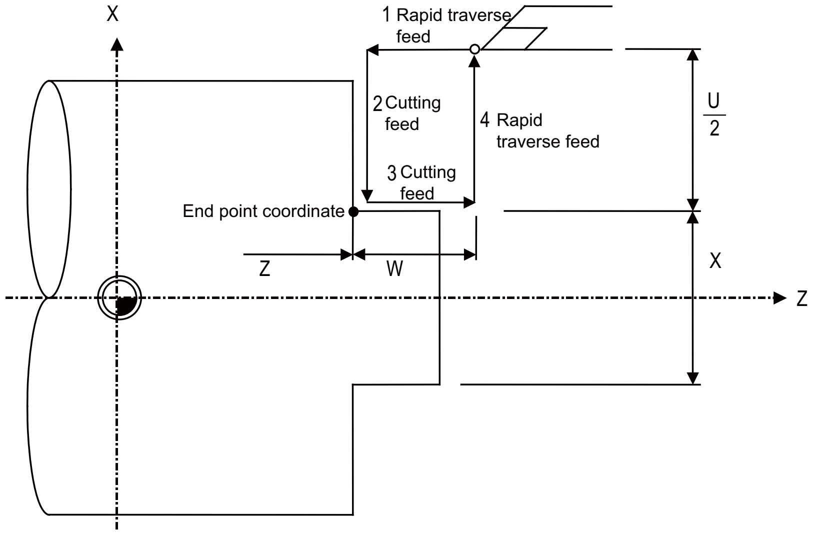
The thread chamfering angle can be set in a given parameter in 1° steps in the range of 0 to 89°

**(3) Face cutting cycle (G79)**

(a) Straight cutting

Straight cutting in the end face direction can be performed consecutively by the following block:

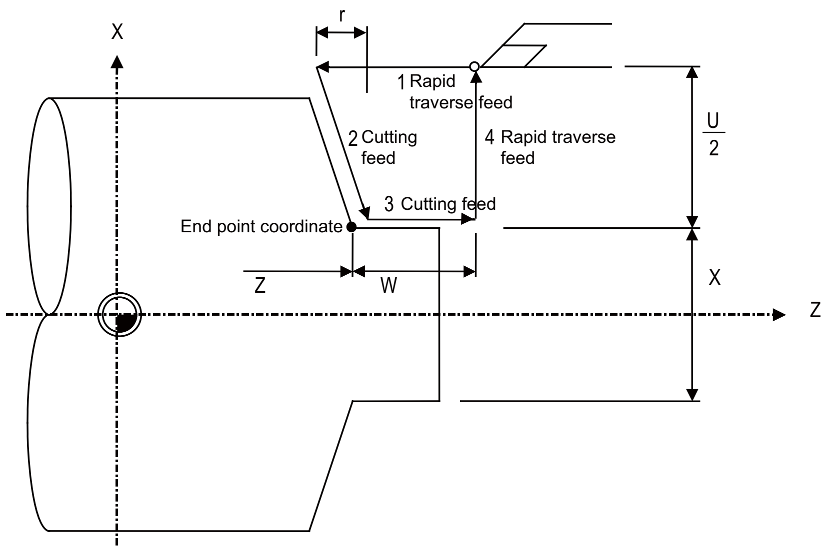
| **G79 X/U_ Z/W_ F_ ;** | |
|---|---|
| X/U | : X axis end point coordinate |
| Z/W | : Z axis end point coordinate |
| F | : Feedrate |




(b) Taper cutting

Taper cutting in the end face direction can be performed consecutively by the following block:

| **G79 X/U_ Z/W_ R_ F_ ;** | |
|---|---|
| X/U | : X axis end point coordinate |
| Z/W | : Z axis end point coordinate |
| R | : Taper part depth (radius designation, incremental value, sign is required) |
| F | : Feedrate |




r: Taper part depth (radius designation, incremental position, sign is required)

### 12.1.3.5 Compound Type Fixed Cycle for Turning Machining

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | — | — | — | — | — | — | — | — |
| L | △ | △ | △ | △ | ○ | ○ | ○ | ○ |

The shape normally programmed in several blocks for rough cutting, etc., in the turning machining can be commanded in one block. This function is useful for machining program simplification.
Compound type fixed cycle for turning machining are as follows:

| G code | Function |
|---|---|
| G71 | Longitudinal rough cutting cycle |
| G72 | Face rough cutting cycle |
| G73 | Molding material in rough cutting cycle |
| G70 | Finish cycle |
| G74 | Face cutting-off cycle |
| G75 | Longitudinal cutting-off cycle |
| G76 | Compound type thread cutting cycle |

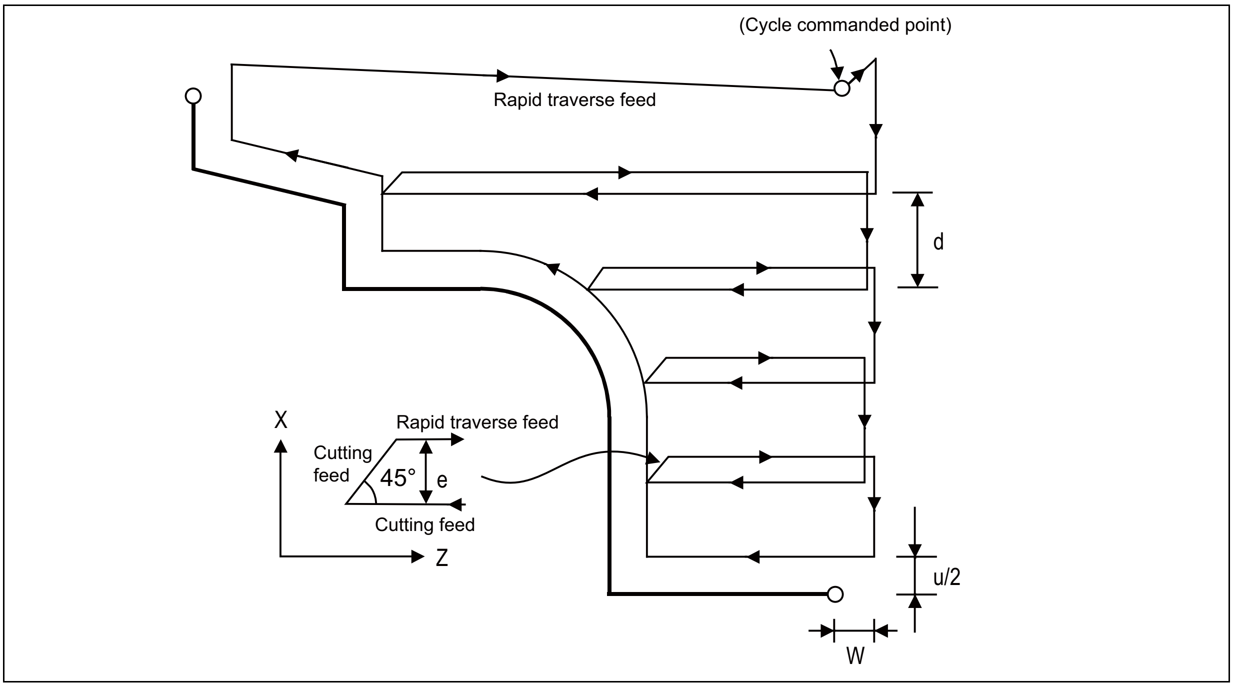
**(1) Longitudinal rough cutting cycle (G71)**

The finish shape program is called, and straight rough cutting is performed while intermediate path is being calculated automatically.

The machining program is commanded as follows.

**G71 Ud Re ;**
**G71 Aa Pp Qq Uu Ww Ff Ss Tt ;**

| | |
|---|---|
| Ud | : Cutting amount (modal) ............... Reversible parameter<br>Increment : µm or 1/10000inch ... Radius value command |
| Re | : Retract amount (modal) ............... Reversible parameter<br>Increment : µm or 1/10000inch ... Radius value command |
| Aa | : Finish shape program No. (If omitted, the program being executed is designated.)<br>A four-digit or eight-digit program No. starting with O no. can specify the finish shape program by the parameter.<br>If the setting is to call the program with O No., it becomes the A command value program starting with O No.<br>If the A command is omitted, the program being executed are applied.<br>If A is omitted, the program following the end of this cycle will be executed at the block after Qq<br>(finish shape end sequence No.).<br>A file name can be designated instead of address A by enclosing the file name in brackets <>.<br>(The file name can have up to 32 characters, including the extension.) |
| Pp | : Finish shape start sequence number (Head of program if omitted.) |
| Qq | : Finish shape end sequence number (To end of program if omitted.)<br>If M99 precedes the Q command, up to M99. |
| Uu | : Finishing allowance in X axis direction<br>(If omitted, finishing allowance in X axis direction is handled as 0.)<br>Increment : µm or 1/10000inch Diameter/radius value command follows changeover parameter. |
| Ww | : Finishing allowance in Z axis direction<br>(If omitted, finishing allowance in Z axis direction is handled as 0.)<br>Increment : µm or 1/10000inch Radius value command |
| Ff | : Cutting speed (If omitted, cutting speed (modal) before G71 is applied.) |
| Ss, Tt | : Spindle command, tool command |




d Cutting amount
u/2 Finishing allowance
W Finishing allowance

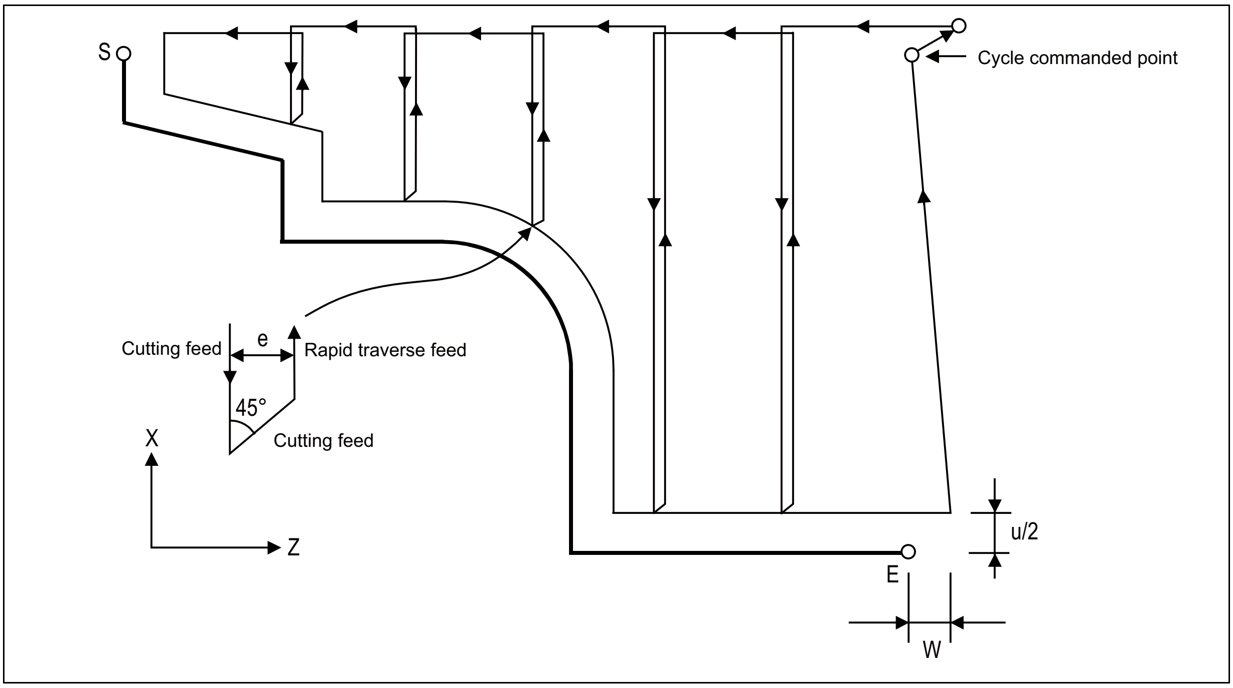
**(2) Face rough cutting cycle (G72)**

The finish shape program is called, and rough cutting is performed in the end face direction while intermediate path is being calculated automatically.

The machining program is commanded as follows

**G72 Wd Re ;**
**G72 Aa Pp Qq Uu Ww Ff Ss Tt ;**

| | |
|---|---|
| | : Cut depth d. (When P,Q command is not given). (Modal) |
| | : Retract amount e. (Modal) |
| Wd | : Finish shape program No. (If it is omitted, the program being executed is designated.) |
| Re | A four-digit or eight-digit program No. starting with O no. can specify the finish shape program by |
| Aa | the parameter. |
| | If the setting is to call the program with O No., it becomes the A command value program starting |
| | with O No. |
| | If the A command is omitted, the P, Q commands in the program being executed are applied. |
| | If the A command is omitted, the program being executed are applied. |
| | If A is omitted, the program following the end of this cycle will be executed at the block after Qq |
| | (finish shape end sequence No.). |
| Pp | A file name can be designated instead of address A by enclosing the file name in brackets <>. |
| Qq | (The file name can have up to 32 characters, including the extension.) |
| | : Finish shape start sequence number (Head of program if omitted.) |
| Uu | : Finish shape end sequence number (To end of program if omitted.) |
| | If M99 precedes the Q command, up to M99. |
| Ww | : Finishing allowance in X axis direction |
| | (If omitted, finishing allowance in X axis direction is handled as 0.) |
| Ff | : Finishing allowance in Z axis direction |
| Ss, Tt | (If omitted, finishing allowance in Z axis direction is handled as 0.) |
| | : Cutting feedrate (If omitted, cutting feedrate (modal) before G72 is applied.) |
| | : Spindle command, tool command |



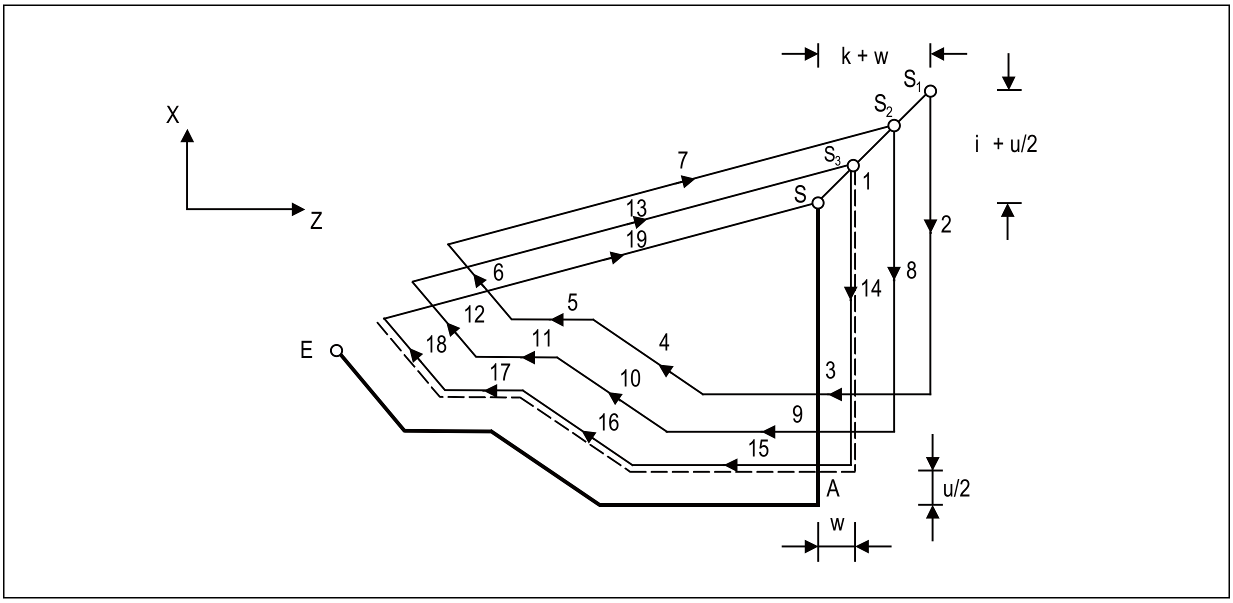

d Cut depth
u/2 Finishing allowance
W Finishing allowance

**(3) Molding material in rough cutting cycle (G73)**

The finish shape program is called. Intermediate path is automatically calculated and rough cutting is performed conforming to the finish shape.

The machining program is commanded as follows.

| | | |
|---|---|---|
| **G73 Ui Wk Rd ;**<br>**G73 Aa Pp Qq Uu Ww Ff Ss Tt ;** | | |
| Ui<br>Wk<br>Rd | :Cutting allowance in the X axis direction i<br>:Cutting allowance in the Z axis direction k<br>:Split count d | - Cutting allowance when P, Q command is not given.<br>- Modal data<br>- Sign is ignored.<br>- Cutting allowance is given with a radius designation. |
| Aa | :Finish shape program No. | (If it is omitted, the present program is assumed to be designated.)<br>A file name can be designated instead of address A by enclosing the file name in brackets <>. (The file name can have up to 32 characters, including the extension.) |
| Pp<br>Qq | :Finish shape start sequence No.<br>:Finish shape end sequence No. | (If it is omitted, the program top is assumed to be designated.)<br>(If it is omitted, the program end is assumed to be designated.)<br>However, if M99 precedes the Q command, up to M99. |
| Uu<br>Ww | :Finishing allowance in the X axis direction u<br>:Finishing allowance in the Z axis direction w | - Finishing allowance for the finish shape commanded by the address P or Q.<br>- Sign is ignored.<br>- Diameter or radius is designated according to the parameter.<br>- The shift direction is determined by the shape |
| Ff<br>Ss<br>Tt | :Cutting feed rate (F function)<br>:Spindle speed (S function)<br>:Tool selection (T function) | The F, S, and T commands in the finish shape program are ignored, and the value in the rough cutting command or the preceding value becomes effective. |



**(4) Finish cycle (G70)**

After rough cutting is performed by using G71 to G73, finish cutting can be performed by using the G70 command.

The machining program is commanded as follows.

**G70 Aa Pp Qq ;**

| | |
|---|---|
| Aa | : Finish shape program No.<br>(If it is omitted, the program being executed is assumed to be designated.)<br>A file name can be designated instead of address A by enclosing the file name in brackets <>.<br>(The file name can have up to 32 characters, including the extension.) |
| Pp | : Finish shape start sequence No.<br>(If it is omitted, the program top is assumed to be designated.) |
| Qq | : Finish shape end sequence No.<br>(If it is omitted, the program end is assumed to be designated.)<br>However, if M99 precedes the Q command, up to M99. |

(a) The F, S, and T commands in the rough cutting cycle command G71 to G73 blocks are ignored, and the F, S, and T commands in the finish shape program become effective.

(b) The memory address of the finish shape program executed by G71 to G72 is not stored. Whenever G70 is executed, a program search is made.

(c) When the G70 cycle terminates, the tool returns to the start point at the rapid traverse feed rate and the next block is read.

(Example1) Sequence No. designation

```
   ~
N100  G70  P200  Q300  ;          N200 ..... ;
N110                                 ~
                                  N300 ..... ;

N120
   ~
N200  }
   ~  }  Finish shape program
N300  }
N310
   ~
```

(Example2) Program No. designation

```
   ~
N100  G70  A100  ;
N110 ..... ;                 O100
N120 ..... ;                 G01 X100  Z50  F0.5 ;
   ~                            ~
                             M99 ;
```

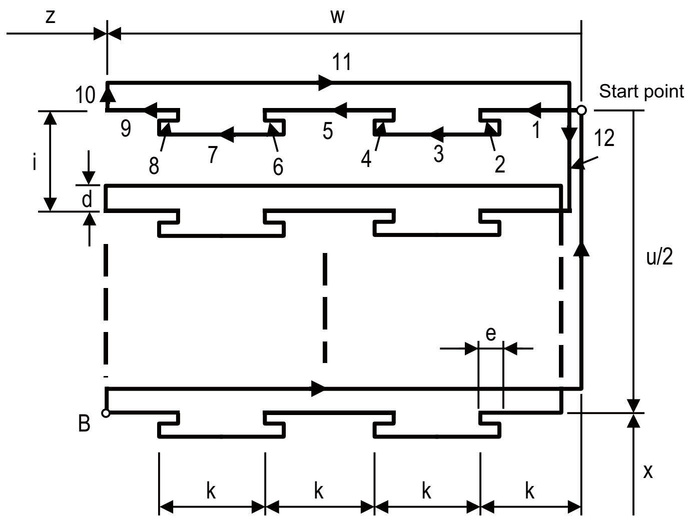
In either example 1 or 2, after the N100 cycle is executed, the N110 block is executed.

**(5) Face cutting-off cycle (G74)**

When the slotting end point coordinates, cut depth, cutting tool shift amount, and cutting tool relief amount at the cut bottom are commanded, automatic slotting is performed in the end face direction of a given bar by G74 fixed cycle. The machining program is commanded as follows.

**G74 Re ;**
**G74 Xx1/(Uu1) Zz1/(Ww1) Pi Qk Rd Ff ;**

| | | |
|---|---|---|
| Re | : Retract amount e (when X/U, Z/W command is not given) (Modal) | |
| Xx1/Uu1 | : B point coordinate (absolute/incremental position) | |
| Zz1/Ww1 | : B point coordinate (absolute/incremental position) | |
| Pi | : Tool shift amount (radius designation, incremental position, sign not required) | |
| Qk | : Cut depth k (radius designation, incremental position, sign not required) | |
| Rd | : Relief amount at cut bottom d | (If sign is not provided, relief is made at the first cut bottom. If minus sign is provided, relief is made not at the first cut bottom but made at the second cut bottom and later.) |
| Ff | : Feed rate | |

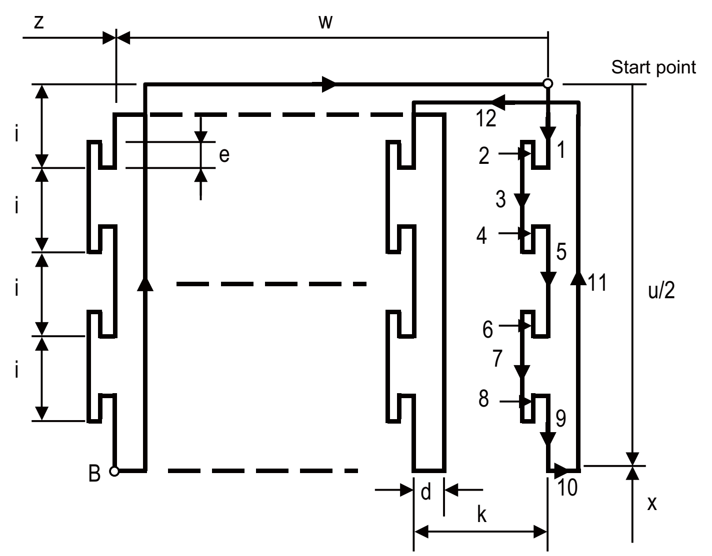



9 and 12 just before the last cycle are executed with the remaining distance. 2, 4, 6, 8, 10, 11 and 12 are executed at the rapid traverse feed rate.

**(6) Longitudinal cutting-off cycle (G75)**

When the slotting end point coordinates, cut depth, cutting tool shift amount, and cutting tool relief amount at the cut bottom are commanded, automatic slotting is performed in the longitudinal direction of a given bar by G75 fixed cycle. The machining program is commanded as follows.

| **G75 Re ;**<br>**G75 Xx1/(Uu1) Zz1/(Ww1) Pi Qk Rd Ff ;** | | |
|---|---|---|
| Re | : Retract amount e (when X/U, Z/W command is not given) (Modal) | |
| Xx1/Uu1 | : B point coordinate (absolute/incremental position) | |
| Zz1/Ww1 | : B point coordinate (absolute/incremental position) | |
| Pi | : Cut depth i (radius designation, incremental position, sign not required) | |
| Qk | : Tool shift amount k (radius designation, incremental position, sign not required) | |
| Rd | : Relief amount at cut bottom d | (If sign is not provided, relief is made at the first cut bottom. If minus sign is provided, relief is made not at the first cut bottom but made at the second cut bottom and later.) |
| Ff | : Feed rate | |




9 and 12 just before the last cycle are executed with the remaining distance.
2, 4, 6, 8, 10, 11 and 12 are executed at the rapid traverse feed rate.

**(7) Compound type thread cutting cycle (G76)**

When the thread cutting start and end points are commanded, cut at any desired angle can be made by automatic cutting so that the cut section area (cutting torque) per time becomes constant in the G76 fixed cycle.

Various longitudinal threads can be cut by considering the thread cutting end point coordinate and taper height constituent command value.

Command Format

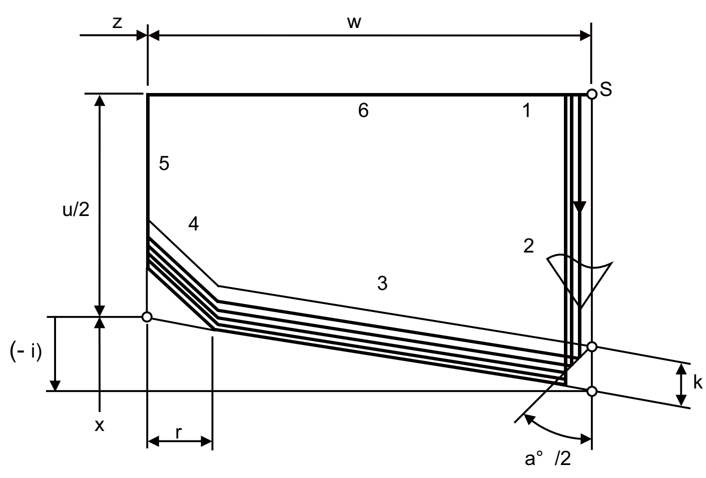
**G76 Pmra Q △ dmin Rd ;**
**G76 Xx1/Uu1 Zz1/Ww1 Ri Pk Q △ d Fl ;**

| | |
|---|---|
| m | : Cut count at finishing 01 to 99 (modal) |
| r | : Chamfering amount 00 to 99 (modal). Set in 0.1-lead increments. |
| a | : Nose angle (included angle of thread) 00 to 99 (modal) Set in 1-degree increments. |
| △ dmin | : Least cut depth<br>When the calculated cut depth becomes smaller than △ dmin, the cut depth is clamped at △ dmin. |
| d | : Finishing allowance (modal) |
| Xx1/Uu1 | : X axis end point coordinate of thread part. --- Absolute/Incremental position |
| Zz1/Ww1 | : Z axis end point coordinate of thread part. --- Absolute/Incremental position |
| Ri | : Taper height constituent in thread part (radius value). When i = 0 is set, straight screw is made. |
| Pk | : Thread height. Designate the thread height in a positive radius value. |
| Q △ d | : Cut depth. Designate the first cut depth in a positive radius value. |
| Fl | : Thread lead |

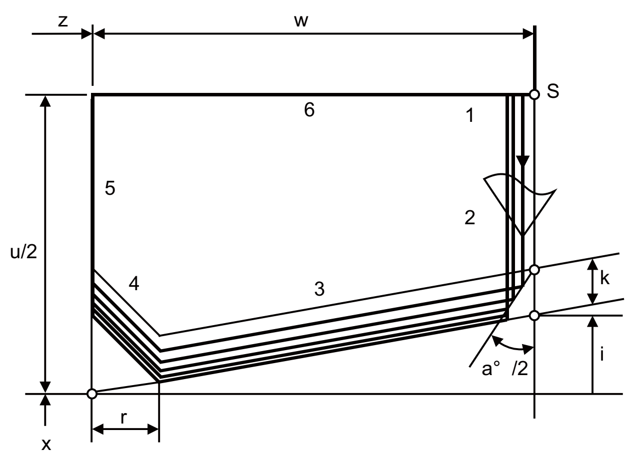
Configuration of one cycle

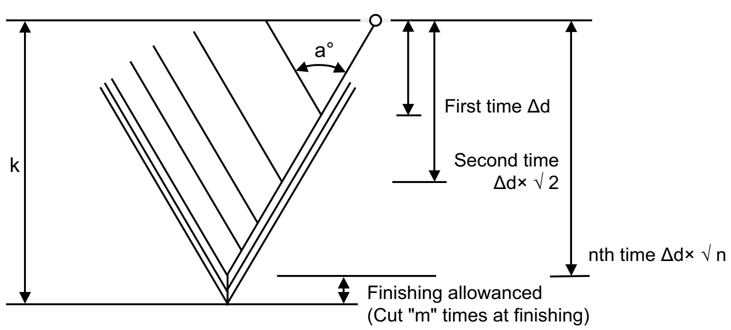
In one cycle, 1, 2, 5, and 6 move at rapid traverse feed and 3 and 4 move at cutting feed designated in F command.

When Ri is negative




When Ri is positive



### 12.1.3.6 Compound Type Fixed Cycle for Turning Machining (Type II)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | － | － | － | － | － | － | － | － |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

Pocket shapes can be machined in the longitudinal rough cutting cycle (G71) and face rough cutting cycle (G72).

The cutting method differs according to whether pocket machining is ON or OFF.

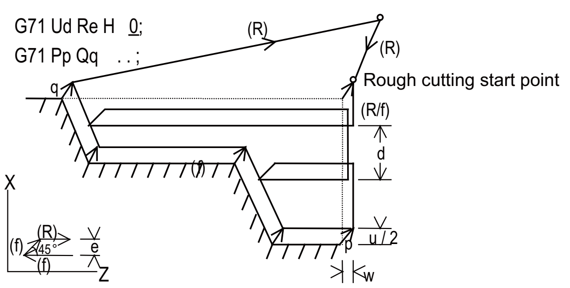
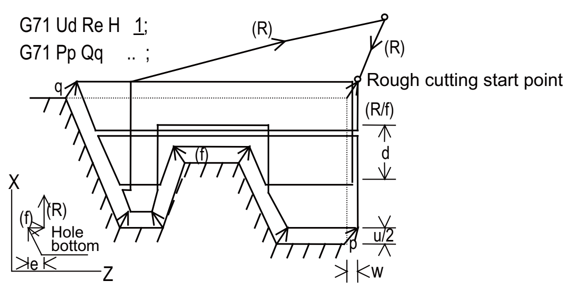
Pocket machining OFF ....... Method to pull up the tool in a 45-degree direction from the workpiece

Pocket machining ON ......... Method that traces the shape (After executing the last trace, the tool is pulled up in the X axis direction.)

Pocket machining is designated with the program (H address) or parameter.

Command format (This is a command format when the G71 is commanded. The G72 command is based on the G71 command.)

**G71 Ud Re Hh ; <- (can be omitted when values set in parameters are used)**
**G71 Aa Pp Qq Uu Ww Ff Ss Tt ;**

| <H0:Used for finished shapes without pockets> | <H1:Mainly used for finished shapes with pockets> |
|---|---|
|  |  |





Ud : Cut amount (modal) ........................ Reversible parameter
Increment : μm or 1/10000inch ..... Radius value command

Re : Retract amount (modal) .................. Reversible parameter
Increment : μm or 1/10000inch .... Radius value command

Hh : Pocket machining (modal) ............. Reversible parameter
0 : Select this only for finished shapes without hollow areas (pockets).
With the beginning of the pockets, the tool is pulled up in the 45-degree direction with each cycle until the finished shape is finally traced.
1 : This can be selected regardless of whether the finished shape has hollow (pocket) parts or not.
A method that traces the finished shape with each cycle is used for the beginning of the pockets.
Depending on the parameter setting, pocket machining ON/OFF is automatically determined by the number of axes in the finish shape start block.

Aa : Finish shape program No. (If omitted, the program being executed is designated.)
If the A command is omitted, the program being executed are applied.
If A is omitted, the program following the end of this cycle will be executed at the block after Qq (finish shape end sequence No.).
A file name can be designated instead of address A by enclosing the file name in brackets <>.
(The file name can have up to 32 characters, including the extension.)

Pp : Finish shape start sequence number (Head of program if omitted.)

Qq : Finish shape end sequence number (To end of program if omitted.)
If M99 precedes the Q command, up to M99.

Uu : Finishing allowance in X axis direction (If omitted, finishing allowance in X axis direction is handled as 0.)
Increment : μm or 1/10000inch ....... Diameter/radius value command follows changeover parameter.

Ww : Finishing allowance in Z axis direction (If omitted, finishing allowance in Z axis direction is handled as 0.)
Increment : μm or 1/10000inch ......... Radius value command

Ff : Cutting feed rate (If omitted, cutting feed rate (modal) before G73 is applied.)

Ss, Tt : Spindle command, tool command

### 12.1.3.7 Small-diameter Deep-hole Drilling Cycle

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | − |
| L | △ | △ | △ | △ | − | − | − | − |

In deep hole drilling, cutting and retract are repeated and the workpiece is machined multiple times. In addition, when PLC signals are input during cutting, the cutting for the time concerned is skipped. In this way, this cycle reduces the load applied to the tool.

Command format
The small-diameter deep-hole drilling cycle mode is established by designating the M code command which was set in the parameter.
If the G83 command is designated in this mode, the small-diameter deep-hole drilling cycle is executed.
The mode is canceled by the following conditions.
- Designation of a fixed cycle cancel command (G80, G commands in Group 1)
- Resetting
The signal is not output in respect to the M command which changes the mode to the small-diameter deep-hole drilling mode.

**G83 Xx1 Yy1 Zz1 Rr1 Qq1 Ff1 Ii1 Pp1 ;**

| | |
|---|---|
| Xx1, Yy1 | : Hole drilling position |
| Zz1 | : Hole bottom position |
| Rr1 | : R point position |
| Qq1 | : Depth of cut in each pass (designated with incremental position) |
| Ff1 | : Cutting feed rate |
| Ii1 | : Feedrate from R point to the cutting start position, the speed for returning from hole bottom |
| Pp1 | : Dwell time at hole bottom position |

## 12.1.4 Mirror Image

### 12.1.4.1 Mirror Image by Parameter Setting

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

A parameter is used to designate the axis for which the mirror image function is to be executed before the machining program is run.
When mirror image is set to ON by the parameter, an operation which is symmetrical on the left and right or at the top or bottom is performed.
Each axis has its own parameter.

### 12.1.4.2 Mirror Image by External Input

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Signals from an external device (PLC) to request the mirror image operation either while a machining program is running or before it is run.
When ON has been set for mirror image from an external device, an operation which is symmetrical on the left and right or at the top or bottom is performed.
Each axis has its own request signal.

### 12.1.4.3 Mirror Image by G Code

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | – | – | – | – | – | – | – | – |

Using a program for the left or right side of a shape, this function can machine the other side of the shape when a left/ right symmetrical shape is to be cut.
Mirror image can be applied directly by a G code when preparing a machining program.

| Gcode | Function |
|---|---|
| G50.1 | G code mirror image cancel |
| G51.1 | G code mirror image ON |

The program format for the G code mirror image is shown below.

| **G51.1 Xx1 Yy1 Zz1 ;** | |
|---|---|
| G51.1 | : Mirror image on |
| Xx1,Yy1,Zz1 | : Command axes and command positions |

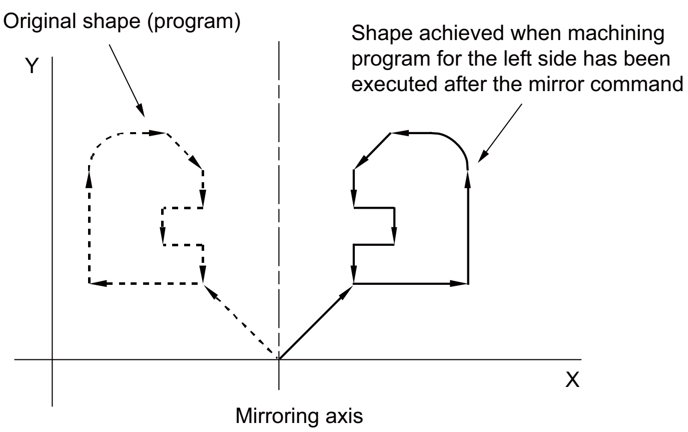
With the local coordinate system, the mirror image is applied with the mirror positioned respectively at x1, y1 and z1.

The program format for the G code mirror image cancel is shown below.

| **G50.1 Xx1 Yy1 Zz1 ;** | |
|---|---|
| G50.1 | : Mirror image cancel |
| Xx1,Yy1,Zz1 | : Command axes |

The x1, y1 and z1 indicate the axes for which the mirror image function is to be canceled and the coordinate position is ignored.

In the case of G51.1 Xx1 ;



### 12.1.4.4 Mirror Image for Facing Tool Posts

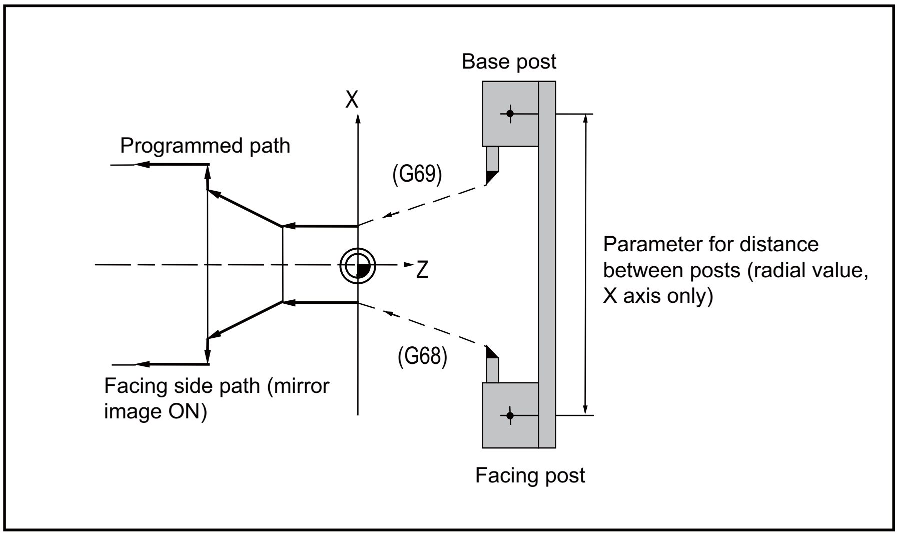
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | — | — | — | — | — | — | — | — |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

With machines in which the base tool post and facing tool post are integrated, this function enables the programs prepared for cutting at the base side to be executed by the tools on the facing side.
The distance between the two posts is set beforehand with the parameter.
The command format is given below.

| Gcode | Function |
|---|---|
| G68<br>G69 | Facing tool post mirror image ON<br>Facing tool post mirror image OFF |

When the G68 command is issued, the subsequent program coordinate systems are shifted to the facing side and the movement direction of the X axis is made the opposite of that commanded by the program.
When the G69 command is issued, the subsequent program coordinate systems are returned to the base side.

The facing tool post mirror image function can be set to ON or OFF automatically by means of T (tool) commands without assigning the G68 command.
A parameter is used to set ON or OFF for the facing tool post mirror image function corresponding to the T commands.




### 12.1.4.5 T Code Mirror Image for Facing Tool Posts

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | — | — | — | — | — | — | — | — |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

If, when tools that correspond to tool Nos. 1 to 64 are selected (T commands), these are tool Nos. for which the facing tool post mirror image function has already been designated with a parameter, the status equivalent to G68 (facing tool post mirror image ON) is established. When the commands apply to tool Nos. for which the facing tool post mirror image function is not designated, the status equivalent to G69 (facing tool post mirror image OFF) is established.

## 12.1.5 Coordinate System Operation

### 12.1.5.1 Coordinate Rotation by Program

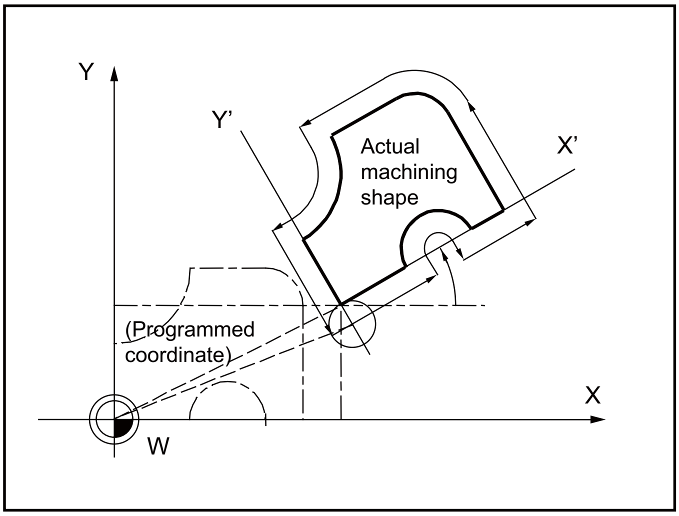
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | △ | △ | △ | △ | ○ | ○ | − | △ |

When it is necessary to machine a complicated shape at a position that has been rotated with respect to the coordinate system, you can machine a rotated shape by programming the shape prior to rotation on the local coordinate system, then specifying the parallel shift amount and rotation angle by means of this coordinate rotation command.
The program format for the coordinate rotation command is given below.

**(1) M system**

| | |
|---|---|
| **G68 Xx1 Yy1 Rr1 ;** | **Coordinate rotation ON** |
| **G69 ;** | **Coordinate rotation cancel** |
| G68 | : Call command |
| G69 | : Cancel command |
| Xx1,Yy1 | : Rotation center coordinates |
| Rr1 | : Angle of rotation |

(Example)

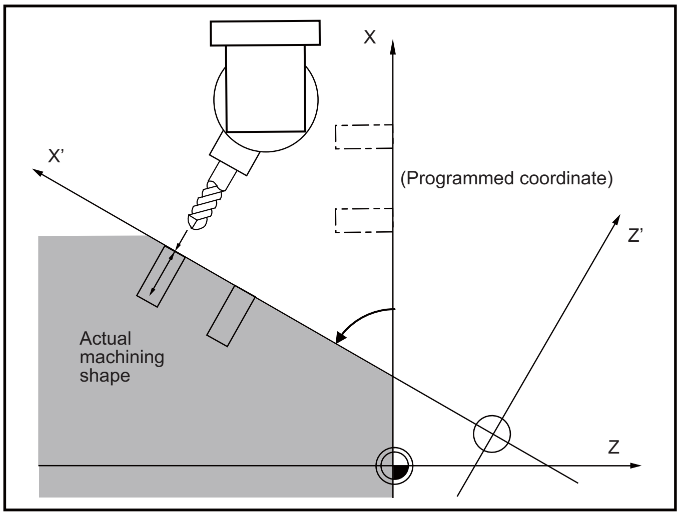


### (2) L system

| | |
|---|---|
| **G68.1 Xx1 Yy1 Rr1 ; Coordinate rotation ON** | |
| **G69.1 ; Coordinate rotation cancel** | |
| G68.1 | :Call instruction |
| Xx1,Zz1 | :Rotation center coordinates |
| Rr1 | :Angle of rotation |

(Note) This function rotates the coordinate system and realizes mainly drilling and tapping.

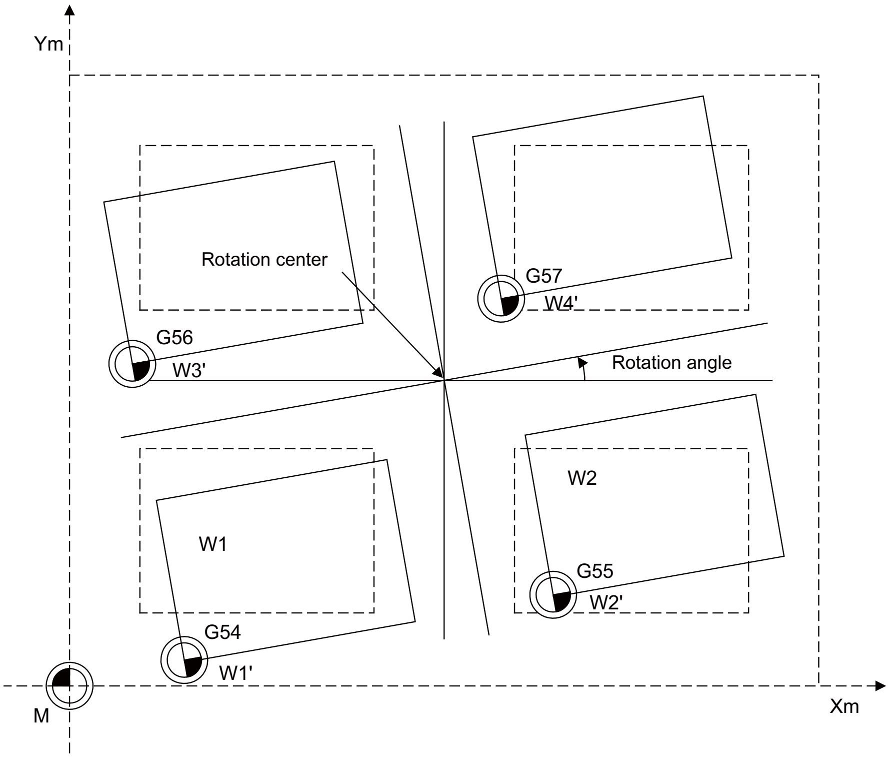
(Example)



### 12.1.5.2 Coordinate Rotation by Parameter

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ― | ― | ― | ― |
| L | ― | ― | ― | ― | ― | ― | ― | ― |

If a deviation occurs between the workpiece alignment line and machine coordinate system's coordinate axis when the workpiece is mounted, the machine can be controlled to rotate the machining program coordinates according to the workpiece alignment line deviation. The coordinate rotation amount and the rotation center are set with the parameters. The coordinate rotation amount can also be set with the G10 command.

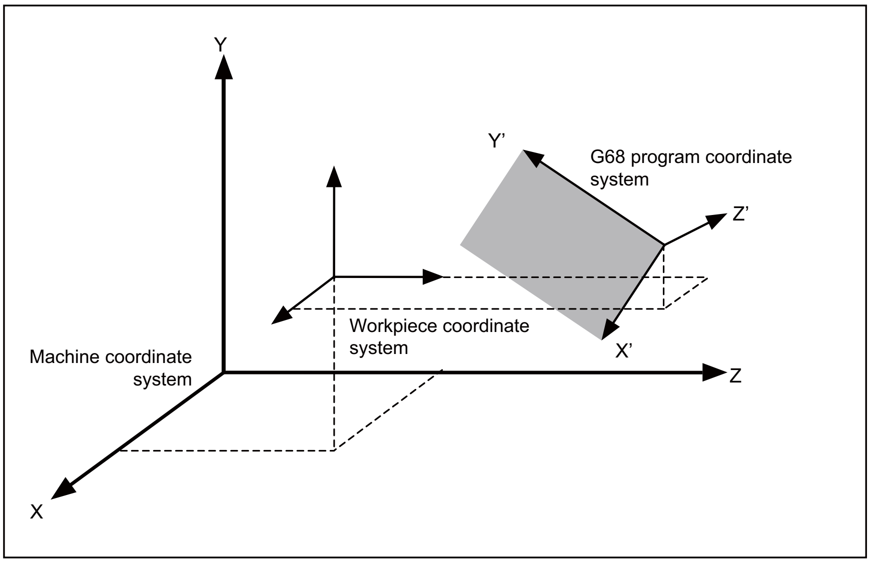



(1) As for the rotation center coordinate position, designate the position on the machine coordinate system.
(2) All workpiece coordinate systems from G54 to G59, G54.1 rotate with the rotation command.
The machine coordinate system does not rotate.
(3) If the setting is made on the parameter screen, the setting value will be valid at the timing of the followings:
Automatic operation:
After setting the parameters, the setting value will be valid from the next block.
Manual operation:
After setting the parameters, the setting value will be valid when the PLC signal (Coordinate rotation by parameter: Coordinate switch for manual feed) is ON.

### 12.1.5.3 3-dimensional Coordinate Conversion

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | － | △ |
| L | － | － | － | － | － | － | － | － |

With the 3-dimensional coordinate conversion function, a new coordinate system can be defined by rotating and moving in parallel the zero point in respect to the X, Y and Z axes of the currently set workpiece coordinate system. By using this function, an arbitrary spatial plane can be defined, and machining on that plane can be carried out with normal program commands.




When the G68 command is issued, the zero point is shifted by the command value (x, y, z) in respect to the current local coordinate system. A new G68 program coordinate system rotated by the designated rotation angle r in respect to the commanded rotation center direction (i, j, k) is created.
The local coordinate system is the same as the workpiece coordinate system when the local coordinate system offset is not ON.

The program format is as follows.

| **G68 Xx Yy Zz Ii Jj Kk Rr ;** | |
|---|---|
| G68 | : 3-dimensional coordinate conversion mode command |
| Xx,Yy,Zz | : Rotation center coordinates<br>Designate with the absolute position of the local coordinate system. |
| Ii,Jj,Kk | : Rotation center axis direction<br>1:Designated、0:Not designated<br>Note that "1" is designated for only one of the three axes. "0" is designated for the other two axes. |
| Rr | : Rotation angle<br>The counterclockwise direction looking at the rotation center from the rotation center axis direction is positive (+).<br>The setting range is -360 to 360°, and the increment follows the least command increment. |

| **G69 ;** | |
|---|---|
| G69 | : 3-dimensional coordinate conversion mode cancel command |

## 12.1.6 Dimension Input

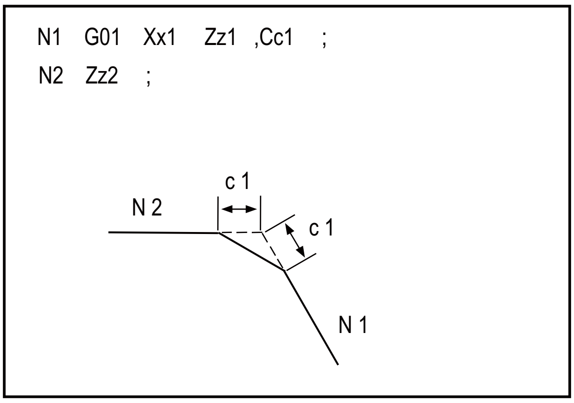
### 12.1.6.1 Corner Chamfering/Corner R

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

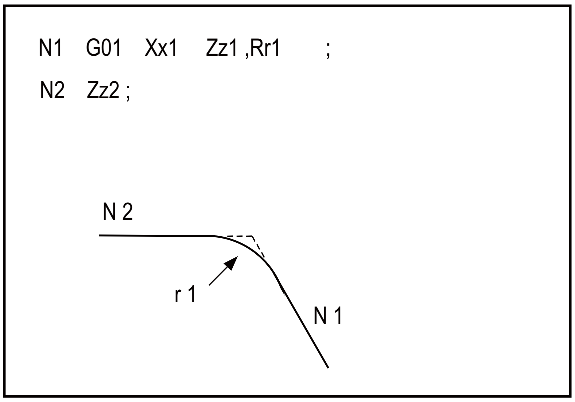
This function executes corner processing by automatically inserting a straight line or an arc by the commanded amount between two consecutive movement blocks (G01/G02/G03).
The corner command is executed by assigning the ",C" or ",R" command for the block at whose end point the corner is inserted.

**(1) Corner chamfering I/ Corner R I**
When ",C" or ",R" is commanded for linear interpolation, corner chamfering or corner R can be inserted between linear blocks.

Corner chamfering I
Example:
N1 G01 Xx1 Zz1 ,Cc1 ;
N2 Zz2 ;




Corner R I
Example:
N1 G01 Xx1 Zz1 ,Rr1 ;
N2 Zz2 ;




(Note 1) If a corner chamfering or corner R command is issued specifying a length longer than the N1 or N2 block, a program error occurs.

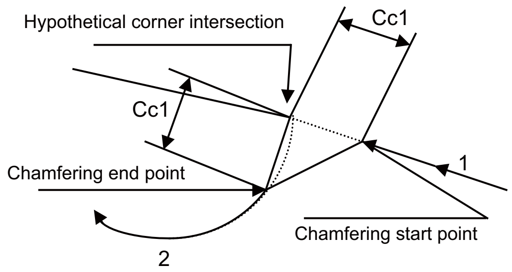
**(2) Corner chamfering II/ corner R II**

When ",C" or ",R" is commanded in a program between linear-circular, corner chamfering or corner R can be inserted between blocks.

When the parameters are set, "I_", "K_", "C_" can be used to command chamfering instead of ",C", and "R_" can be used to command rounding instead of ",R_". (L system only)

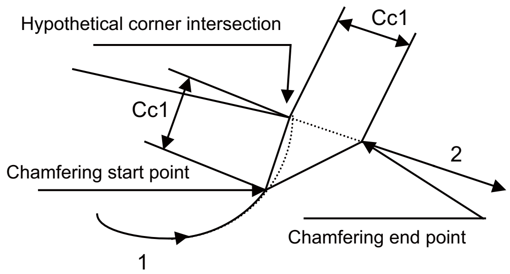
(a) Corner chamfering II (Linear - circular)

```
Example: G01 X_Z_ ,Cc1;
         G02 X_Z_ Ii1 Kk1;
```



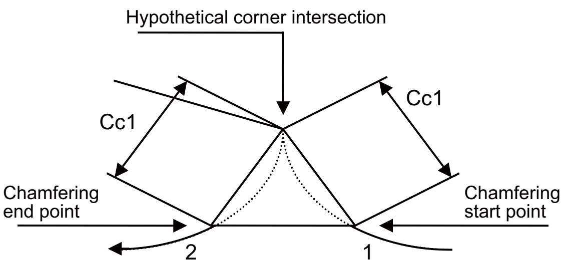

(b) Corner chamfering II (Circular - linear)

```
Example: G03 X_Z_ Ii1 Kk1 ,Cc1;
         G01 X_Z_;
```

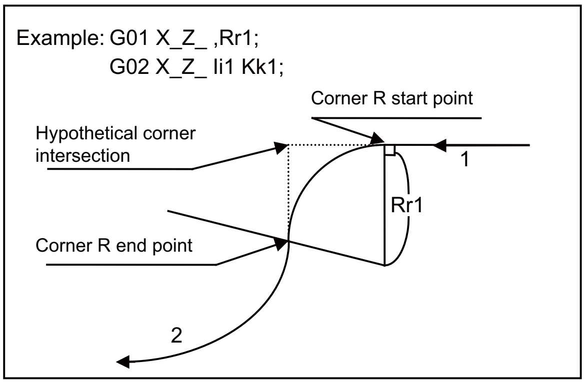



(c) Corner chamfering II (Circular - circular)

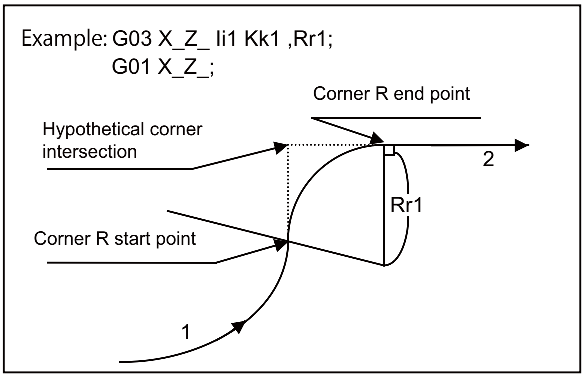
```
Example: G02 X_Z_ Ii1 Kk1 ,Cc1;
         G02 X_Z_ Ii2 Kk2;
```



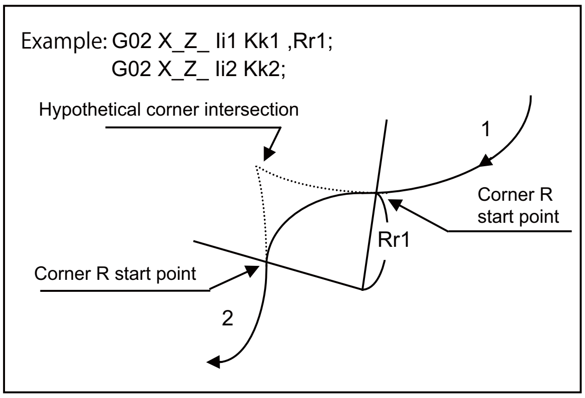
(d) Corner R II (Linear - circular)




(e) Corner R II (Circular - linear)



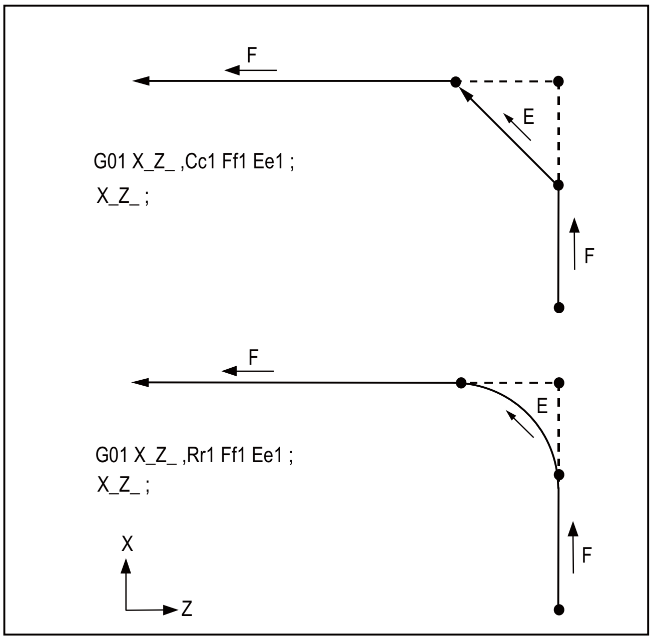

(f) Corner R II (Circular - circular)



**(3) Specification of corner chamfering Expansion/ corner R Expansion**

An E address can be used to specify the speed for corner chamfering or corner R. This enables a corner to be cut to a correct shape.

(Example)




An E address is a modal and remains effective for feeding in next corner chamfering or corner R.
An E address has two separate modals: synchronous and asynchronous feed rate modals. The effective feed rate is determined by synchronous (G95) or asynchronous (G94) mode.
If an E address is specified in 0 or no E command has been specified, the feed rate specified by an F command is assumed as the feed rate for corner chamfering or corner R.
An E address modal is not cleared even if the reset button is pressed.
It is cleared when the power is turned OFF. (In the same manner as F commands.)

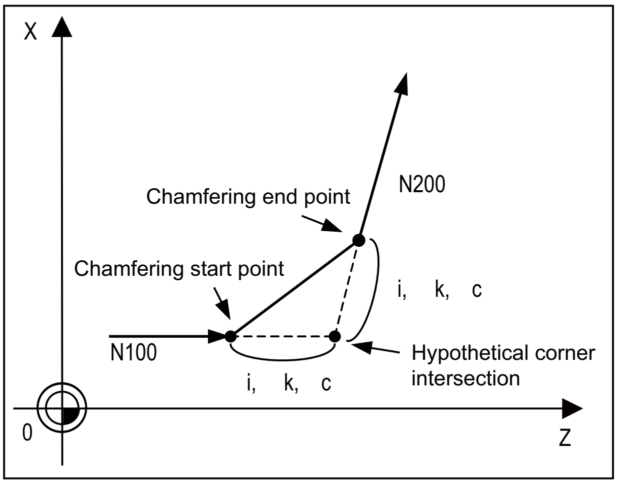
**(4) Corner chamfering / corner R (I, K designation) (L system only)**

With this command format, by means of parameter settings, corners are chamfered using the "I", "K" or "C" address without a comma, and corners are rounded using the "R" address.
The ",C" and ",R" addresses with commas can also be used.

(a) Corner chamfering (I, K designation)

Corners are chamfered using the "I_", "K_" or "C_" address with no comma.
Corners can be chamfered to any angle.
Signs, if they are provided for the corner chamfering commands, are ignored.
Command format

| | |
|---|---|
| **N100 Xx1/Uu1 Zz1/Ww1 Ii1/Kk1/Cc1 ;** | |
| **N200 Xx1/Uu1 Zz1/Ww1 ;** | |
| Xx1/Uu1 | : X-axis end point coordinate |
| Zz1/Ww1 | : Z-axis end point coordinate |
| Ii1/Kk1/Cc1 | : The length from the hypothetical corner intersection to the chamfering start point or chamfering end point is designated using the I, K or C address. |




- If multiple "I", "K" or "C" addresses or duplicated addresses have been designated in the same block, the last address will take effect.
- If both corner chamfering and corner R commands are present in the same block, the last command will take effect.
- If "C" is used as the name of an axis, corner chamfering commands cannot be designated using the "C" address.
- If "C" is used as a 2nd miscellaneous function, corner chamfering commands cannot be designated using the "C" address.
- Corner chamfering commands using the "I" or "K" address cannot be designated in an arc command block. "I" and "K" are the arc center commands.

(b) Corner R (I, K designation)

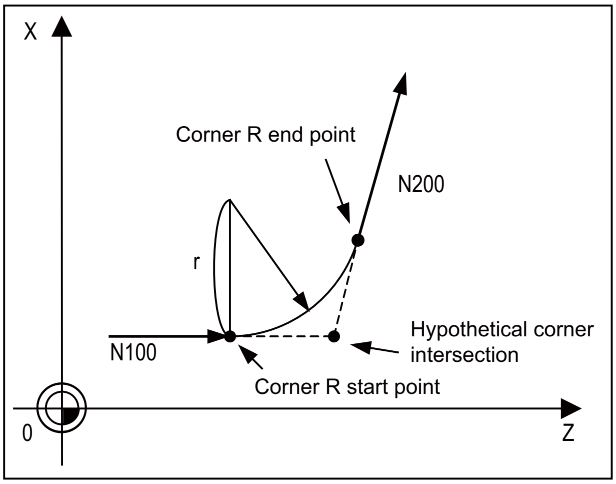
Corners are rounded using the "R_" address with no comma.

Corners can be rounded to any angle.

Signs, if they are provided for the corner R commands, are ignored.

Command format

| | |
|---|---|
| **N100 Xx1/Uu1 Zz1/Ww1 Rr1 ;** | |
| **N200 Xx1/Uu1 Zz1/Ww1 ;** | |
| Xx1/Uu1 | : X-axis end point coordinate |
| Zz1/Ww1 | : Z-axis end point coordinate |
| Rr1 | : Radius of corner R arc |



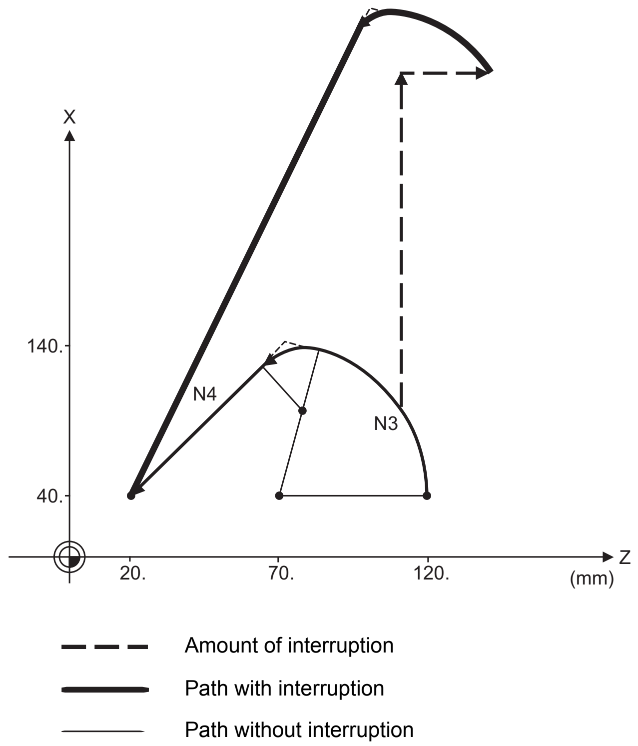

- If both corner chamfering and corner R commands are present in the same block, the last address will take effect.
- Corner R commands using the "R" address cannot be designated in an arc command block. "R" is regarded as the arc radius command in such a block.

**(5) Interrupt during corner chamfering / Interrupt during corner R**

Shown below are the operations of manual interruption during corner chamfering or corner R.

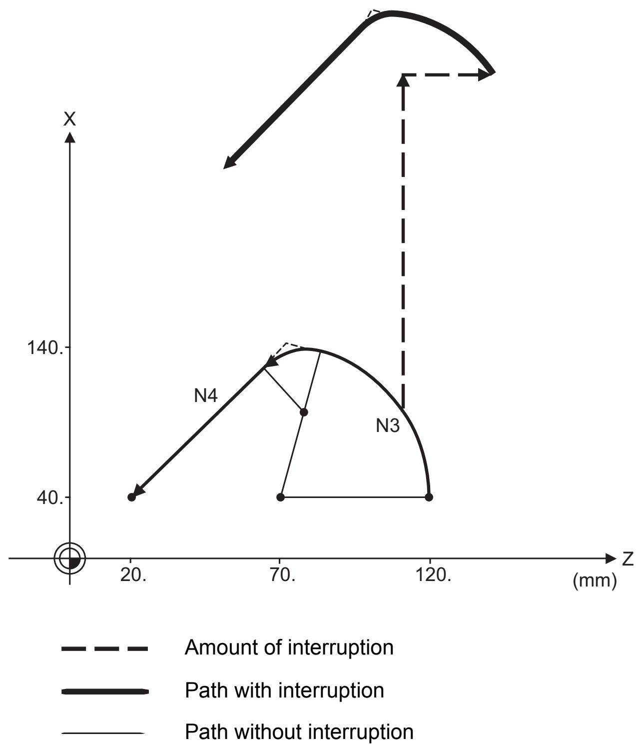
(a) With an absolute value command and manual absolute switch ON:

```
N1 G28 XZ;
N2 G00 X40. Z120.;
N3 G03 X140.Z70. K-50. ,R20. F100 ;
N4 G01 X40. Z20. ;
        :
```




(b) With an incremental value command or manual absolute switch OFF:

```
N1 G28 XZ;
N2 G00 U40. W120.;
N3 G03 U100. W-50. K-50. ,R20.
F100 ;
N4 G01 U-100.W-50. ;
        :
```



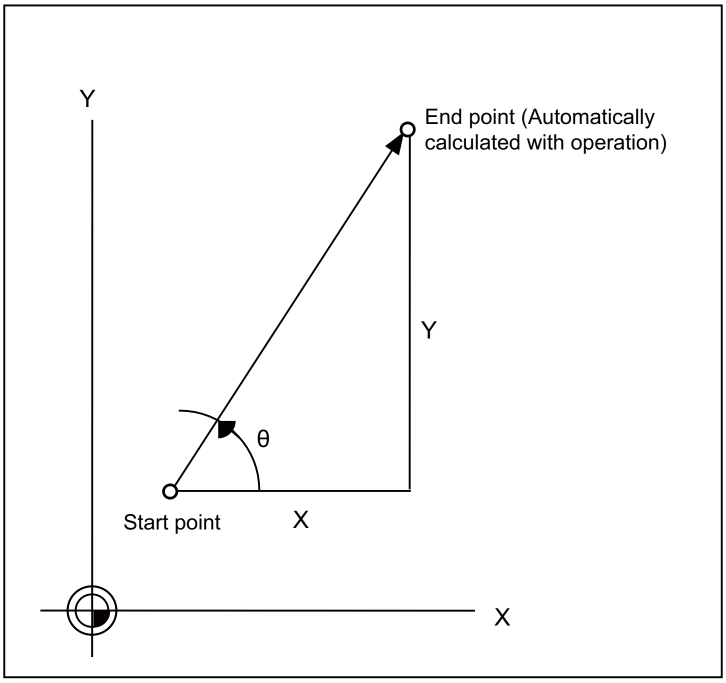
### 12.1.6.2 Linear Angle Command

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

The end point coordinates are automatically calculated by assigning one element (one component of the selected plane) of the end point coordinates and the linear angle.

| **G17 Xx1 Aa1 ; or G17 Yy1 Aa1 ;** | |
|---|---|
| G17 | : Plane selection |
| Xx1,Yy1 | : 1 element of the end point coordinate |
| Aa1 | : Angle |

Example



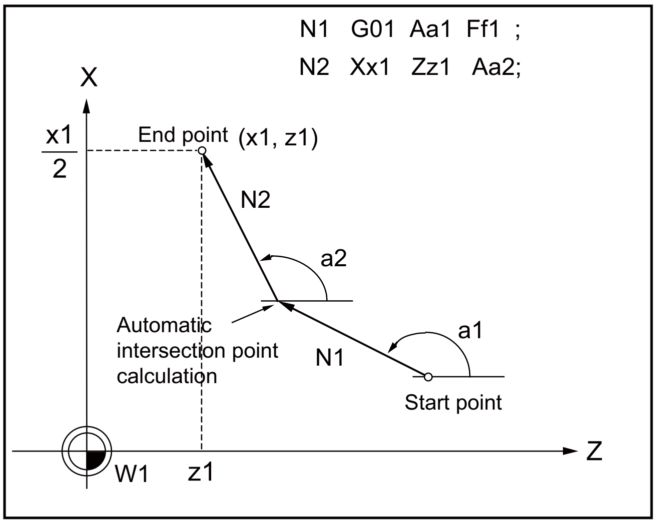

(Note 1) If the axis "A" or 2nd miscellaneous function "A" is used, address "A" is treated as the axis "A" command or the 2nd miscellaneous function, respectively.

### 12.1.6.3 Geometric Command

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | − |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

When it is difficult to find the intersection point of two straight lines with a continuous linear interpolation command, this point can be calculated automatically by programming the command for the angle of the straight lines.

Example




a: Angle (°) formed between straight line and horizontal axis on plane.
The plane is the selected plane at this time.

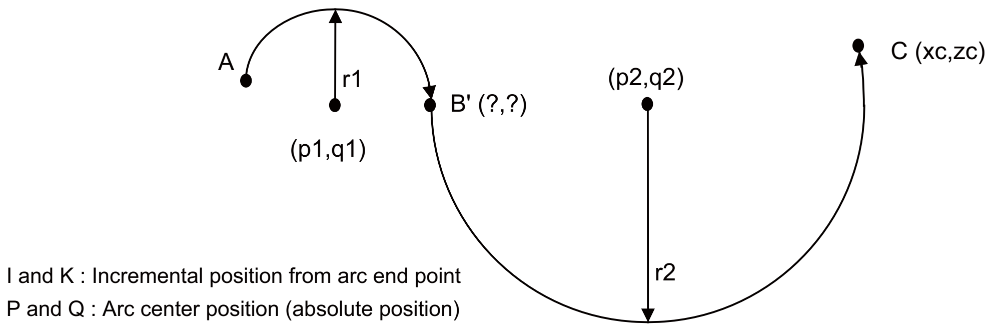
(Note 1) This function cannot be used when using the A axis or 2nd miscellaneous function A.

**(1) Automatic calculation of two-arc contact**

When two continuous circular arcs contact with each other and it is difficult to find the contact, the contact is automatically calculated by specifying the center coordinates position or radius of the first circular arc and the end point (absolute position) and center position or radius of the second circular arc.

Example

G18 G02 Ii1 Kk1 Ff1 ;
G03 Xxc Zzc Ii2 Kk2 Ff2 ;
OR
G18 G02 Ii1 Kk1 Ff1 ;
G03 Xxc Zzc Rr2 Ff2 ;
OR
G18 G02 Rr1 Ff1 ;
G03 Xxc Zzc Ii2 Kk2 Ff2 ;



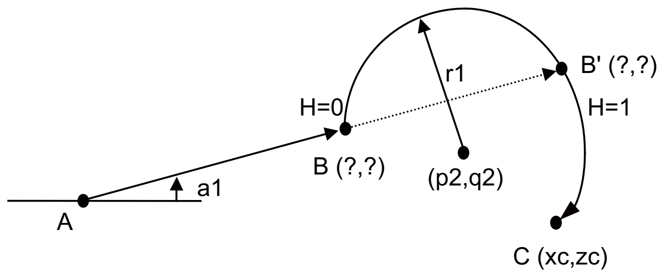

I and K are the arc center position (incremental position); distances from the start point in the first block or distances from the end point in the second block. P and Q (X, Z arc center position (absolute position)) can be commanded instead of I and K commands.

**(2) Automatic calculation of linear-arc intersection**

When it is difficult to find the intersections of a given line and circular arc, the intersections are automatically calculated by programming the following blocks.

Example

G18 G01 Aa1 Ff1 ;
G02 Xxc Zzc Ii2 Kk2 Hh2 (,Hh2) Ff2 ;




I and K : Incremental position from arc end point
P and Q : Arc center position (absolute position)
H = 0 : Intersection with shorter line (B point)
H = 1 : Intersection with longer line (B’ point)

The p2 and q2 can be commanded instead of Ii2 and Kk2.
The linear - arc contact is automatically calculated by designating R instead of I and K (P, Q).

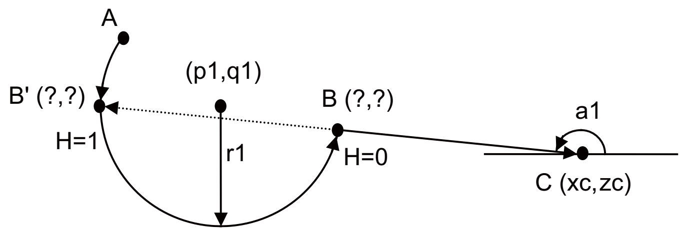
**(3) Automatic calculation of arc-linear intersection**

When it is difficult to find the intersections of a given circular arc and line, the intersections are automatically calculated by programming the following blocks.

Example

G18 G03 Ii1 Kk1 Hh1 Ff1 ;

G01 Xxc Zzc Aa1 Ff1 ;




I and K : Incremental position from arc end point

P and Q : Arc center position (absolute position)

H = 0 : Intersection with shorter line (B point)

H = 1 : Intersection with longer line (B' point)

The p1 and q1 can be commanded instead of Ii1 and Kk1.

The arc - linear contact is automatically calculated by designating R instead of I and K (P, Q).

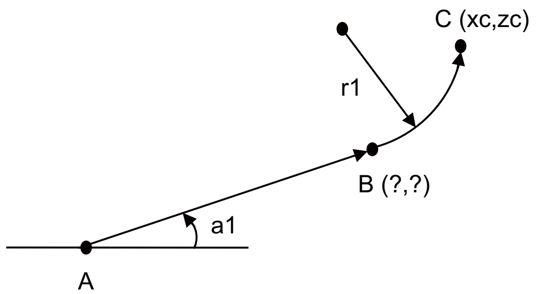
**(4) Automatic calculation of linear-arc contact**

When it is difficult to find the contact of a given line and circular arc, the contact is automatically calculated by programming the following blocks.

Example

G01 Aa1 Ff1 ;

G03 Xxc Zzc Rr1 Ff1 ;




The linear - arc intersection is automatically calculated by designating R instead of P and Q (I, K).

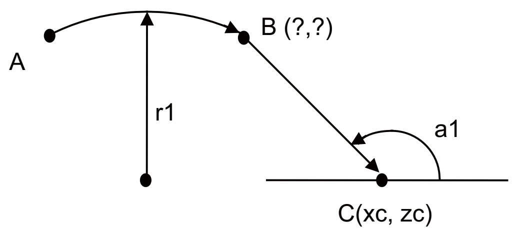
**(5) Automatic calculation of arc-linear contact**

When it is difficult to find the contact of a given circular arc and line, the contact is automatically calculated by programming the following blocks.

Example

G02 Rr1 Ff1 ;

G01 Xxc Zzc Aa1 Ff1 ;




The arc - linear intersection is automatically calculated by designating R instead of P and Q (I, K).

### 12.1.6.4 Polar Coordinate Command

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | — | — | — | — | — | — | — | — |

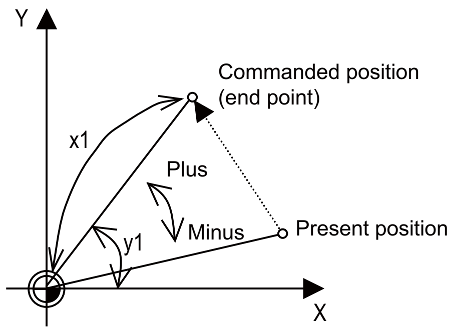
With this function, the end point position is commanded with the radius and angle.

Command format

| | |
|---|---|
| **G16 ;** | **Polar coordinate command mode ON** |

| | |
|---|---|
| **G15 ;** | **Polar coordinate command mode OFF** |

Example of program

| | |
|---|---|
| G1x ; | Plane selection for polar coordinate command (G17/G18/G19) |
| G16 ; | Polar coordinate command mode ON |
| | Polar coordinate command<br>G9x : Center selection for polar coordinate command (G90/G91))<br>G90…The workpiece coordinate system zero point is the polar coordinate center.<br>G91…The present position is the polar coordinate center.<br>x1 : 1st axis for the plane…The radius commanded<br>y1 : 2nd axis for the plane…The angle commanded |
| G9x G01 Xx1 Yy1 F2000 ;<br>: |  For G90/G17(X-Y plane) |
| G15 ; | Polar coordinate command mode OFF |

## 12.1.7 Axis Control

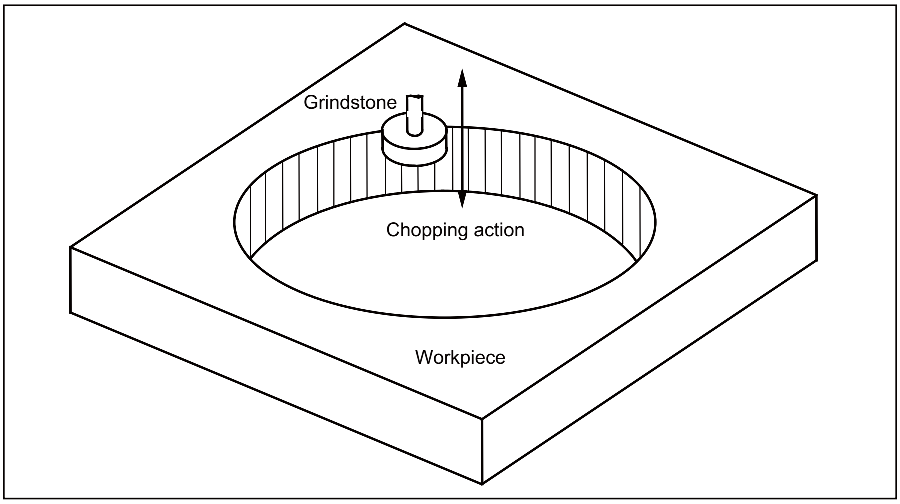
## 12.1.7.1 Chopping

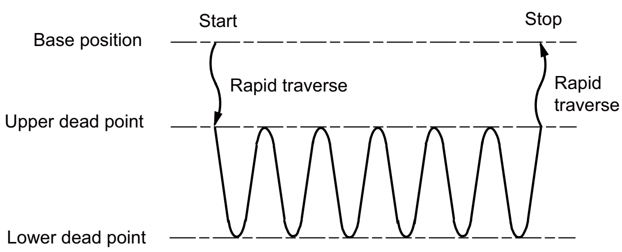
### 12.1.7.1.1 Chopping

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

This function continuously raises and lowers the chopping axis independently of the program operation when workpiece contours are to be cut. It can be used for grinding operations using machining centers, for instance.
Which of the axes is to serve as the chopping axis is set by a parameter beforehand.

(1) Chopping action




The chopping operation is initiated by setting the upper dead point position, lower dead point position and number of cycles (number of up/down movements per minute) and pressing the chopping start switch.

(Note 1) The upper dead point position, lower dead point position and number of cycles are set and the start and stop commands are designated by input signals from the user PLC.
(Note 2) The setting for the number of cycles differs according to the motor, inertia and other factors.

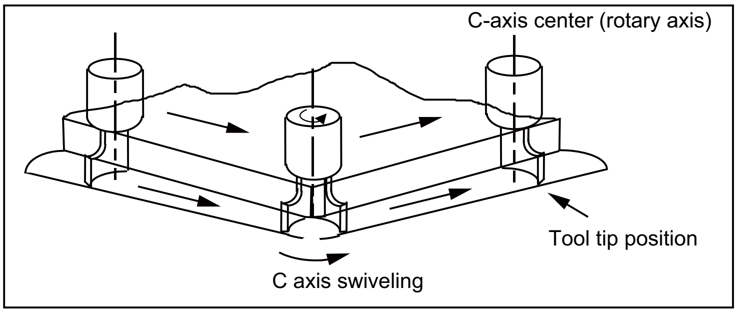
The chopping operation is performed as follows.
(a) The axis moves from the base position to the upper dead point by rapid traverse.
(b) Next, the axis moves repeatedly from the upper dead point to the lower dead point and then from the lower dead point to the upper dead point. (Sinusoidal waveforms)
The feed rate is tailored to achieve the number of cycles set for the up/down motion.

Chopping override
Override in 1% increments from 0% to 100% can be applied to the chopping operation.
(Note) Bear in mind that the override increment differs according to the machine specifications.

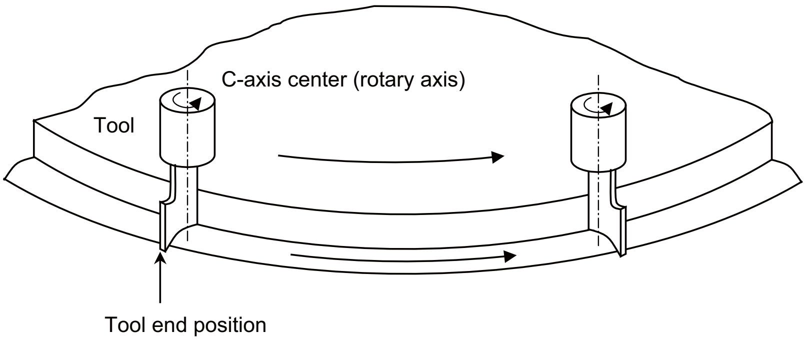
### 12.1.7.2 Normal Line Control

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | － | ○ |
| L | － | － | － | － | － | － | － | － |

This function controls the swiveling of the C axis (rotary axis) so that the tool is always pointing in the normal line direction for the X and Y axes movement commands during program operation. It can be used for machining hale, for sewing operations involving sewing machines, carpets, etc. It is valid for only one C axis (rotary axis).
At the block seams, the C axis turning is controlled so that the tool faces the normal line direction at the next block's start point.




During arc interpolation, the C axis turning is controlled in synchronization with the operation of arc interpolation.




| Gcode | Function |
|---|---|
| G40.1 | Normal line direction control cancel |
| G41.1 | Normal line direction control left ON |
| G42.1 | Normal line direction control right ON |

### 12.1.7.3 Circular Cutting

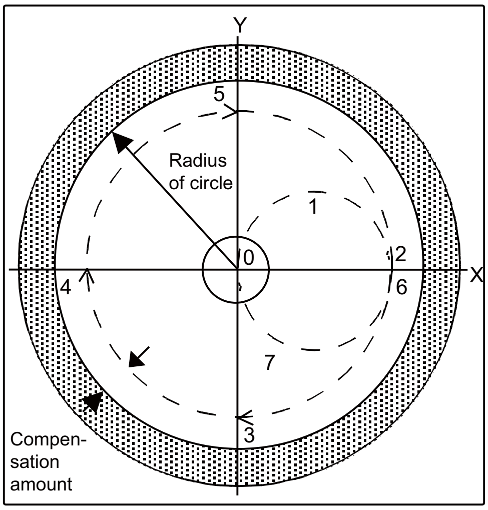
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | − | − | − | − | − | − | − | − |

In circular cutting, a system of cutting steps are performed: first, the tool departs from the center of the circle, and by cutting along the inside circumference of the circle, it draws a complete circle, then it returns to the center of the circle. The position at which G12 or G13 has been programmed serves as the center of the circle.

The program format is given below.

| **G12/(G13) Ii Dd Ff ;** | |
|---|---|
| G12 | : Circular cutting command CW (clockwise) |
| G13 | : Circular cutting command CCW (counter clockwise) |
| Ii | : Radius of complete circle |
| Dd | : Compensation No. |
| Ff | : Feed rate |

When the G12 command is used (path of tool center)
0 → 1 → 2 → 3 → 4 → 5 → 6 → 7 → 0
When the G13 command is used (path of tool center)
0 → 7 → 6 → 5 → 4 → 3 → 2 → 1 → 0




(Note 1) Circular cutting is carried out on the plane which has been currently selected (G17, G18 or G19).
(Note 2) The (+) and (-) signs for the compensation amount denote reduction and expansion respectively.

### 12.1.8 Multi-part System Control

#### 12.1.8.1 Timing Synchronization between Part Systems

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | － | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Multiple machining programs can be operated independently at same time for multi-axis and multi-part system mixed control CNC. This function enables the timing synchronization between part systems or the operation of only one part system while the machining programs are being operated independently for each part system.

Command format

Timing synchronization with ! code

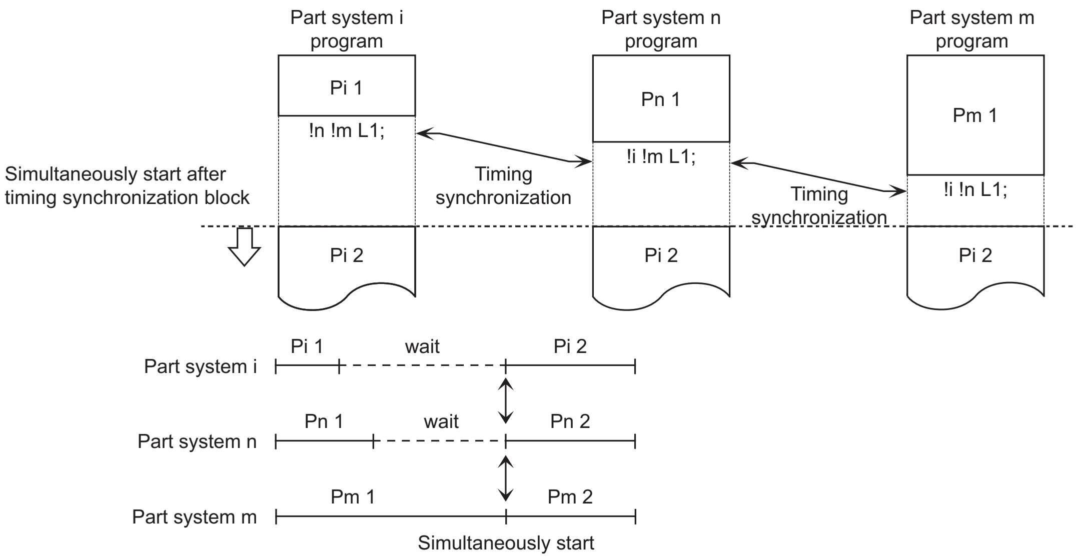
| | | |
|---|---|---|
| **!n ( !m... ) L＿ ;** | | |
| !n !m | : | Part system number for timing synchronization (Multiple command can be performed.)<br>Follows the parameter if part system number is omitted. |
| L | : | Timing synchronization number (0 to 9999) |

Timing synchronization with ! code is also valid among three part systems and more.

Timing synchronization with M code

| | | |
|---|---|---|
| **M*** ;** | | |
| *** | : | M code for timing synchronization |

The range of M code for the timing synchronization is determined with the minimum and maximum values set with the parameter beforehand.




(Note 1) The timing synchronization can be disvalued with the parameter setting and "Timing synchronization between part systems ignored" signal. When a part system to be waited for a simultaneous operation is not operating, the currently operating part system will move on to the next block without executing timing synchronization. This function is useful when conducting a program check on each part system.

(Note 2) The timing synchronization command is normally assigned as a separate command. However, if a movement command and M, S or T command have been assigned in the same block, a parameter is set to decide whether timing synchronization is executed upon executing of the movement command and M, S or T command, or the movement command and M, S or T command are executed upon completion of timing synchronization.

### 12.1.8.2 Start Point Designation Timing Synchronization

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | − | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Multiple machining programs can be operated independently at same time for multi-axis and multi-part system mixed control CNC. This function enables the timing synchronization with the position in the movement block while the machining programs are being operated independently for each part system.
When a workpiece is being delivered from part system 1 to part system 2, the movement operation in part system 2 can be started in the middle of the part system 1 tool post movement with this function so that the machining time can be reduced.

A part system for start point designation timing synchronization can be designated by adding ! code on the command block G115 and G116.

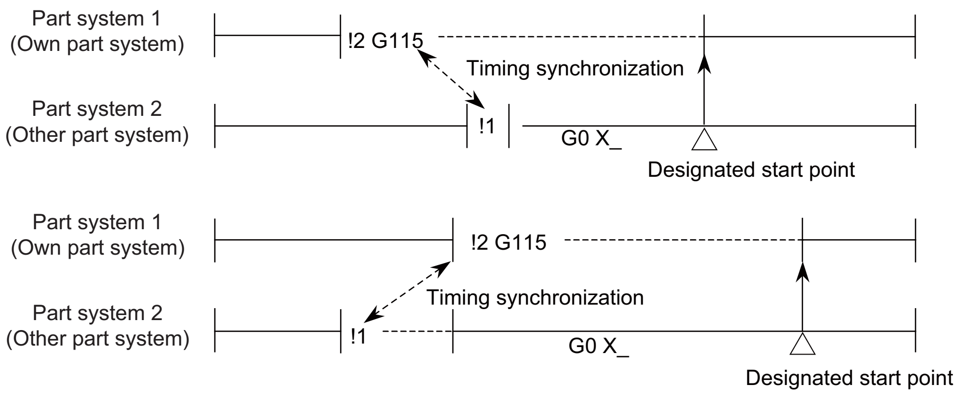
**(1) Start point designation timing synchronization Type 1 (G115)**

Command format

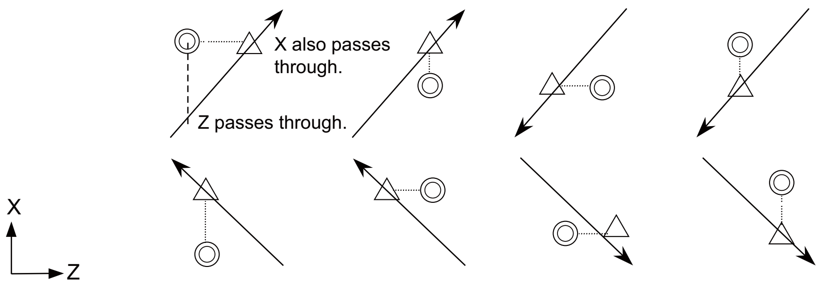
| !n L __ G115 X __ Z __ C __ ; | | |
|---|---|---|
| !n | : | Part system number for timing synchronization |
| L | : | Timing synchronization number (0 to 9999) |
| G115 | : | G command |
| X Z C | : | Start point (Designate an axis which checks the timing synchronization and workpiece coordinate value in other part system) |

(a) The other part system starts first when timing synchronization is executed.

(b) The own part system waits for the other part system to move and reach the designated start point, and then starts.




(c) When the start point designated by G115 is not on the next block movement path of the other part system, the own part system starts once the other part system has reached each start point axis coordinate position.




← : Movement

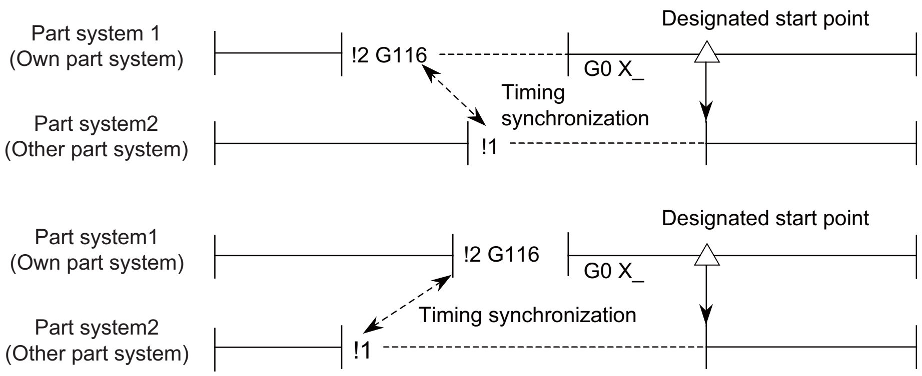
◎ : Command point

△ : Actual start point

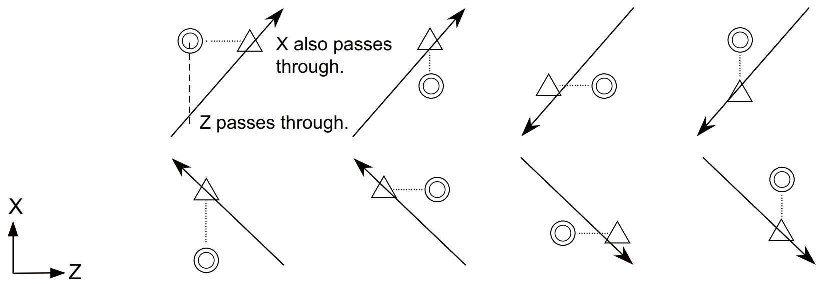
**(2) Start point designation timing synchronization Type 2 (G116)**
Command format

| !n L __ G116 X __ Z __ C __ ; | |
|---|---|
| !n | : Part system number for timing synchronization |
| L | : Timing synchronization number (0 to 9999) |
| G116 | : G command |
| X Z C | : Start point (Designate an axis which checks the timing synchronization and workpiece coordinate value in own part system) |

(a) The own part system starts first when timing synchronization is executed.
(b) The other part system waits for the own part system to move and reach the designated start point, and then starts.




(c) When the start point designated by G116 is not on the next block movement path of the own part system, the other part system starts once the own part system has reached each start point coordinate position.




← : Movement
◎ : Command point
△ : Actual start point

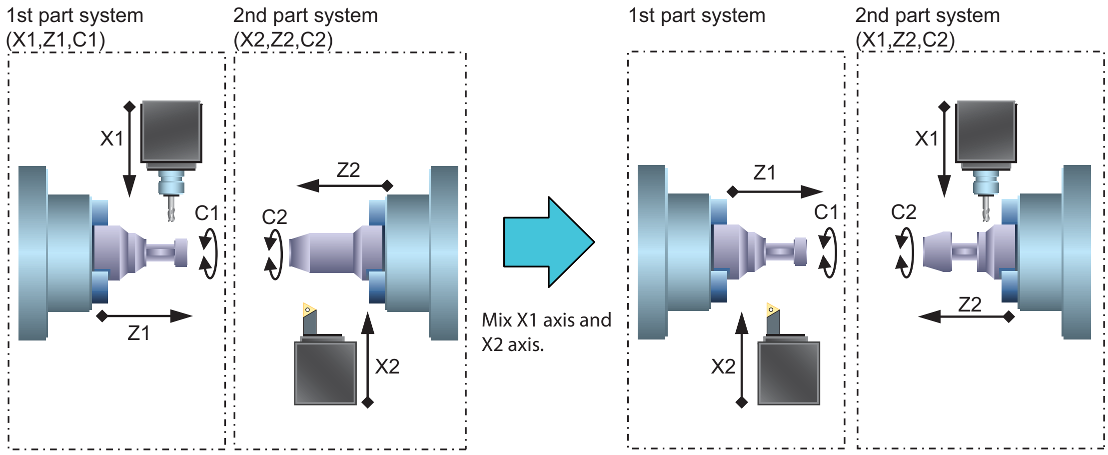
### 12.1.8.3 Mixed Control

#### 12.1.8.3.1 Mixed Control (Cross Axis Control)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | － | － | － | － | － | － | － | － |
| L | △ | △ | △ | △ | ○ | ○ | － | △ |

Performs the mixed control (cross axis control) by G command or PLC signal.

Any axis to be replaced by another axis between part systems.
This makes it possible to perform operations which are not possible with regular axis configurations: for instance, tools which are provided only on part system 1 can be used for machining on part system 2.

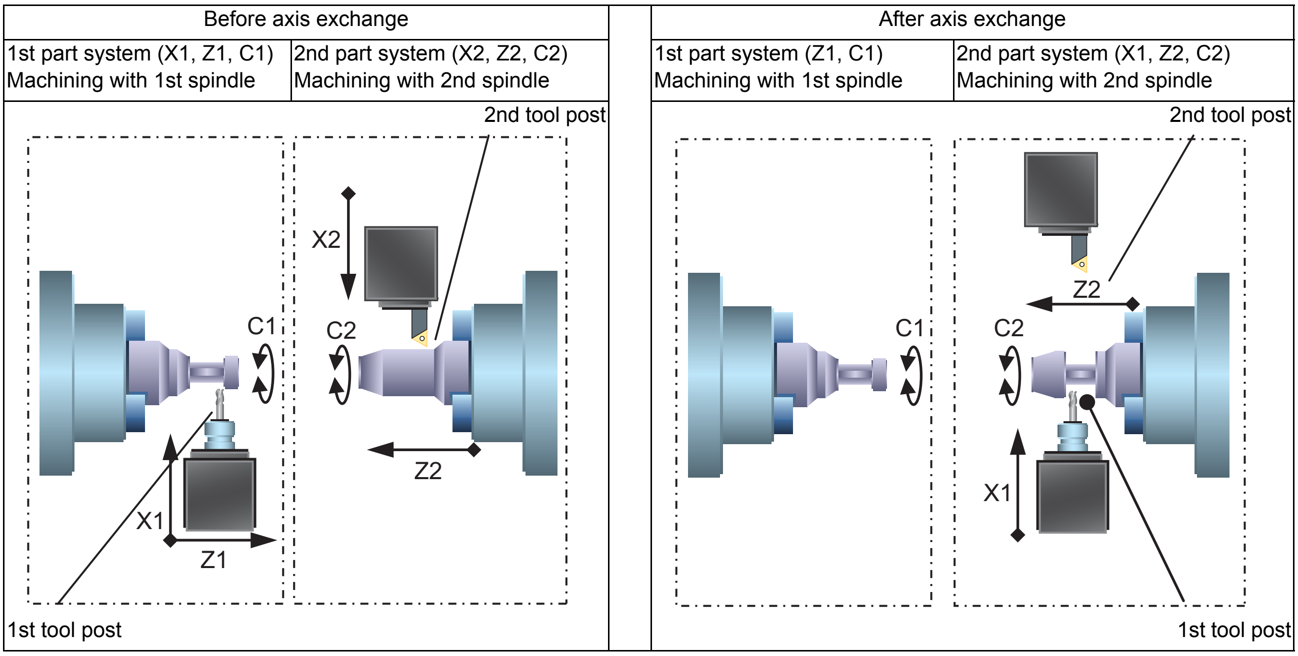


## 12.1.8.3.2 Arbitrary Axis Exchange Control

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | — | — | — | — |
| L | △ | △ | △ | △ | ○ | ○ | — | △ |

An arbitrary axis can be exchanged freely between part systems in the multiple part systems.
The machining can be freer in the multiple part systems by exchanging an axis which can be commanded for machining programs in each part system.
This makes it possible to perform operations which are not possible with regular axis configurations: for instance, tools which are provided only on the 1st part system can be used for machining on the 2nd part system.

(Example) Using X1 axis in part system 2




Command format

Arbitrary axis exchange command

Commands the arbitrary axis exchange by G140.

| **G140 command address = axis address command address = axis address...;** | |
|---|---|
| Command address | : Designate the command address used in commands such as the movement command with one alphabetical character set to the parameter after the arbitrary axis exchange command (G140). |
| Axis address | : Designate the axis name for arbitrary axis exchange with two alphanumeric characters set to the parameter. |

Arbitrary axis exchange return command

Returns the control right of the axis, exchanged by the previous arbitrary axis exchange command (G140) in the commanded part system, to the state before the axis exchange.

```
G141 ;
```

Reference axis arrange return command

Returns the control right of the axis, exchanged by the arbitrary axis exchange command (G140) in the commanded part system, to the power-on state.

```
G142 ;
```

### 12.1.8.4 Control Axis Superimposition

#### 12.1.8.4.1 Control Axis Superimposition

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | − | − | − | − | − | − | − | − |
| L | △ | △ | △ | △ | ○ | ○ | − | − |

In the multi-part system, an axis in a part system can be superimposed on an axis in another part system and can be controlled.
This is effective when machining by the 1st part system (X1, Z1) and the 2nd part system (X2, Z2) are executed simultaneously for the machine configuration where a workpiece moves by a movement command to the Z axis direction. The machining of the reference axis part system (the 1st part system) and the superimposed axis (the 2nd part system) can be operated simultaneously with no need to fix the workpiece position for machining in the superimposed part system (the 2nd part system).

| | |
|---|---|
| Reference axis: | The basic in the control axis superimposition function (moves only by its own axis command) |
| Superimposed axis: | The axis which moves including the reference axis movement in the control axis superimposition function (moves by reference axis or/and own axis command). |

The control axis superimposition can be commanded with G code or PLC signal.

Command format

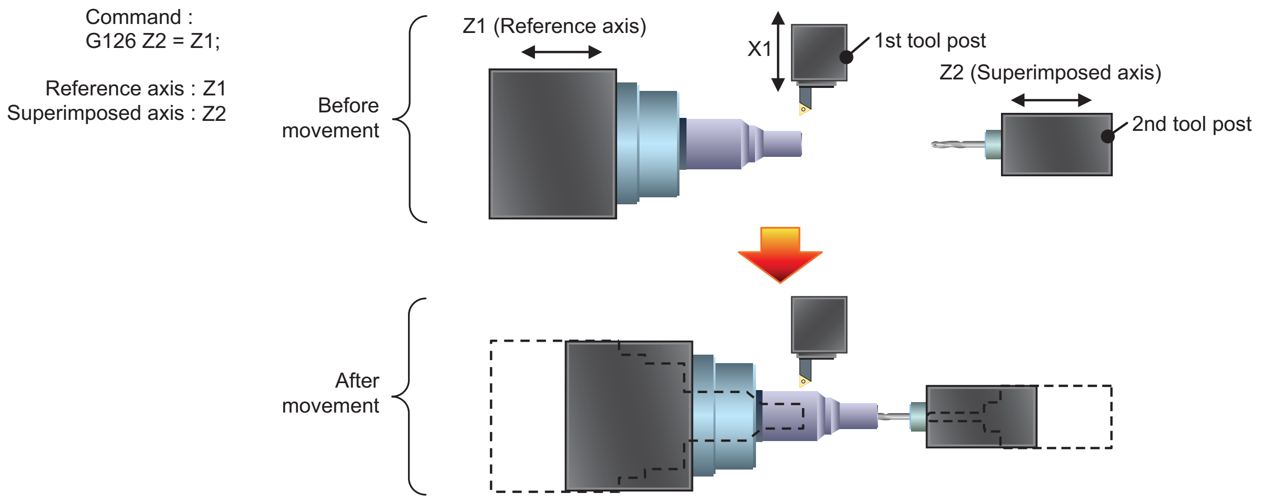
Superimposition start command

| **G126 Superimposed axis name = Reference axis name,P__ ;** | |
|---|---|
| Superimposed axis name | : Specify the superimposed axis name for the superimposition control with 2 alphanumeric characters set to the parameter. |
| Reference axis name | : Specify the reference axis name for the superimposition control with 2 alphanumeric characters set to the parameter.<br>Put the symbol "-" at the beginning of the reference axis name for synchronizing the superimposed axis with the reference axis in the reverse direction. |
| , (comma) | : Specify as delimiter when the address is needed to be assigned after "superimposed axis name = reference name". |
| P | : Superimposed axis workpiece coordinate system designation (The command range of the coordinate value is mm/inch. The decimal point command is valid.) |

Superimposition end command

| **G126 Superimposed axis name;** | |
|---|---|
| Superimposed axis name | : Specify the name of the superimposed axis which is working for the superimposition control with 2 alphanumeric characters set to the parameter. |

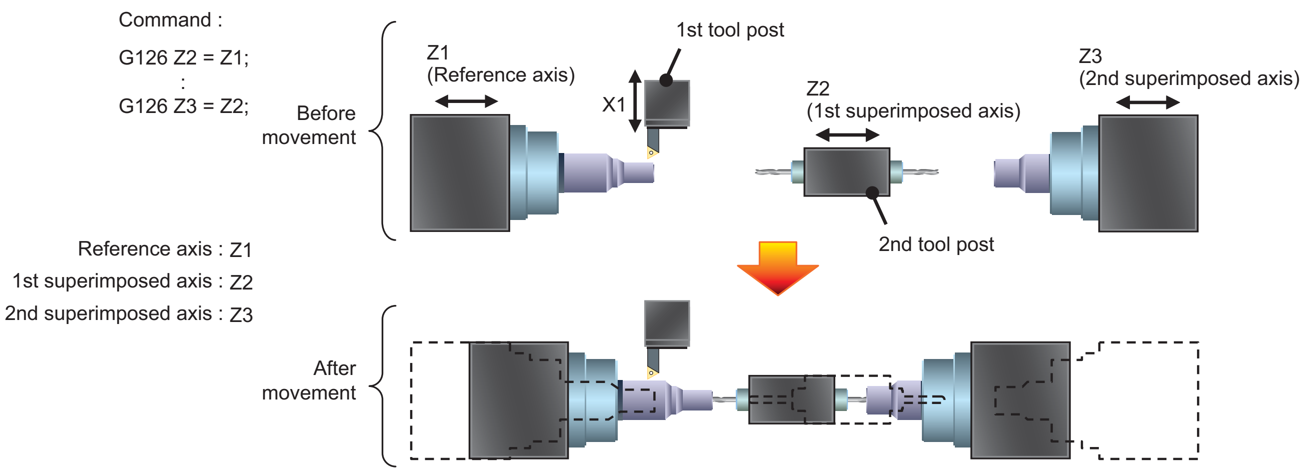
While using the control axis superimposition function, the workpiece zero point of the superimposed axis moves according to the movement amount of the reference axis. Because the superimposed axis tries to maintain the position in the workpiece coordinate system, it moves as much as the movement amount of the reference axis.




Superimposition control among 3 axes

Superimposition can be controlled among 3 axes.

3 axes tandem superimposition is the condition that an axis is the superimposed axis and becomes the reference axis for another superimposed axis at same time. The first superimposed axis is "1st superimposed axis" and the other axis is "2nd superimposed axis" for 3 axes tandem superimposition.



### 12.1.8.4.2 Arbitrary Axis Superimposition Control

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | — | — | — | — | — | — | — | — |
| L | △ | △ | △ | △ | — | — | — | — |

The arbitrary control axis in other part system can be moved by superimposing on the movement command for the arbitrary control axis in own part system.

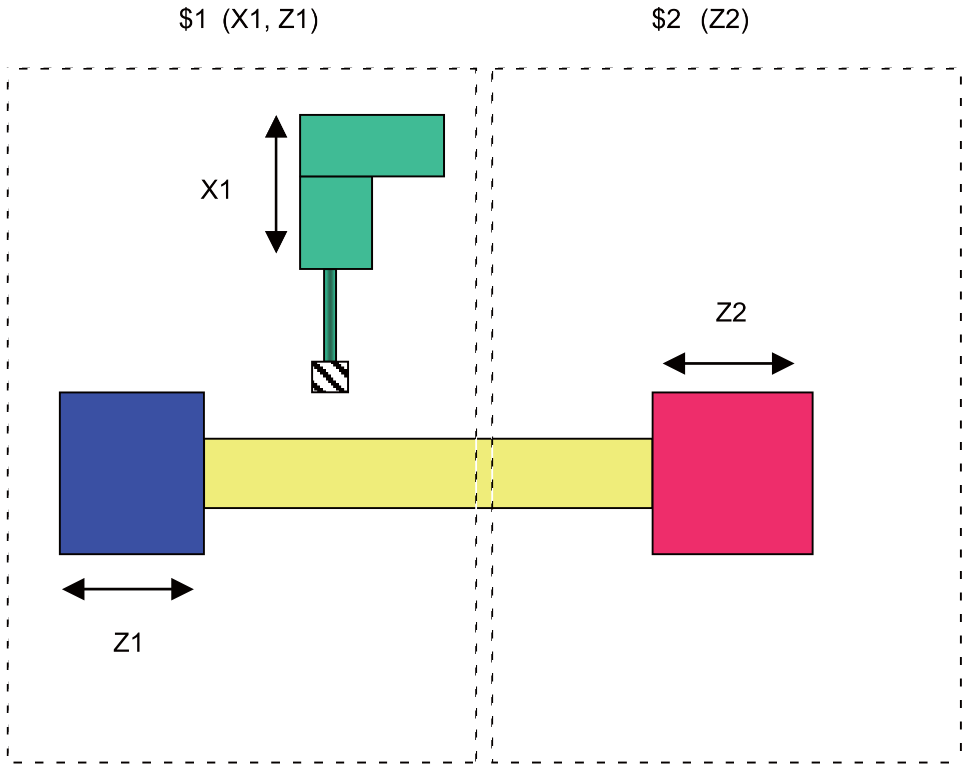
### 12.1.8.5 Control Axis Synchronization between Part Systems

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | — | — | — | — | — | — | — | — |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

Synchronization control enables an arbitrary control axis in the other part system to move in synchronization with the movement command assigned to an arbitrary control axis.
The direction in which the axis is to move synchronously can also be reversed using a parameter.

Base axis: Axis to which movement command to synchronize axes is assigned.
(Z1 in the following figure)

Synchronization axis: Axis whose movement is synchronized with base axis.
(Z2 in the following figure)

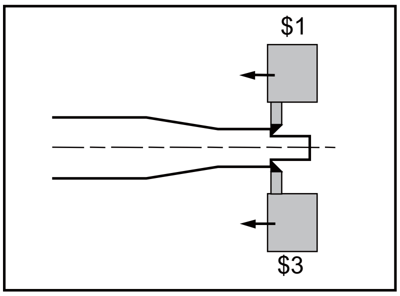



The control axis synchronization between part systems can be commanded with G code or PLC signal.

### 12.1.8.6 Balance Cut

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | – | – | – | – | – | – | – | – |
| L | ○ | ○ | ○ | ○ | ○ | ○ | – | ○ |

Multiple machining programs can be operated independently at same time for multi-axis and multi-part system mixed control CNC. This function enables the operation start timing synchronization between tool posts of two part systems. When workpiece that is relatively long and thin is machined on a lathe, deflection may result, making it impossible for the workpiece to be machined with any accuracy. In cases like this, the deflection can be minimized by holding tools simultaneously from both sides of the workpiece and using them in synchronization to machine the workpiece (balance cutting). This method has an additional advantage: since the workpiece is machined by two tools, the machining time is reduced.
This function enables the movements belonging to two different part systems to be synchronized so that this kind of machining can easily be accomplished.




Command format

Balance cut command ON (modal)

| | |
|---|---|
| **!n L__ G15 ;** | |
| !n | : Part system number for balance cut<br>Follows the parameter if the part system number is omitted. |
| L | : Timing synchronization number (0 to 9999) |

* !n LI can be omitted.

Balance cut command OFF (modal)

| |
|---|
| **G14 ;** |

(Note) The G code varies depending on the G code list.

| | G code listother than 6/7 | G code list6, 7 |
|---|---|---|
| **Balance cut command ON** | G15 | G68 |
| **Balance cut command OFF** | G14 | G69 |

G14 and G15 are modal commands. When the G15 command is assigned, the timing synchronization is being executed in all of the cutting feed command blocks until the G14 command is assigned or until the modal information is cleared by the reset signal.  The timing synchronization is possible in all blocks by the parameter.

Part system 1 program

```
T 0 1 01;
G00   X_   Z_;
!3G15;
G01   Z_   F0. 4;
      :
      :
```

Part system 3 program

```
T 0 1 0 2;
G00   X_   Z_;
!1G15
G01   Z_   F0. 4;
      :
      :
```

Whereas synchronization is possible only with the next block when using the code "!" of timing synchronization between part systems, the balance cutting function provides synchronization (at the block start timing) with multiple consecutive blocks.

### 12.1.8.7 Common Memory for Part Systems

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | － | － | － | － | － | － | － | － |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

For a machine with multiple part systems, the common variables and tool compensation memory which exist for each part system can be made common for all part systems by setting the parameters.

**(1) Common variables**

In the multi-part system, normally the common variables #100 to #199 are used for each part system, and variables #500 to #999 are common for the part systems. When this function is valid, the common variables #500 to #999 also become variables for each part system.

To use part or all of the common variables #100 to #199 and #500 to #999 commonly for all part systems, set the number of parameters to be used commonly for the part systems in variables #100 to #199 and #500 to #999.

As for the variables designated to be common to part systems, the data for part system 1 is used.

**(2) Tool compensation memory**

When this specification is valid, the tool compensation memory used for operation in the 2nd or following part system changes to be used with the part system 1 data. Thus, the 2nd part system and following data is not used when the common data is used for the part systems.

This function is only for the lathe system and supported up to 2 part systems.

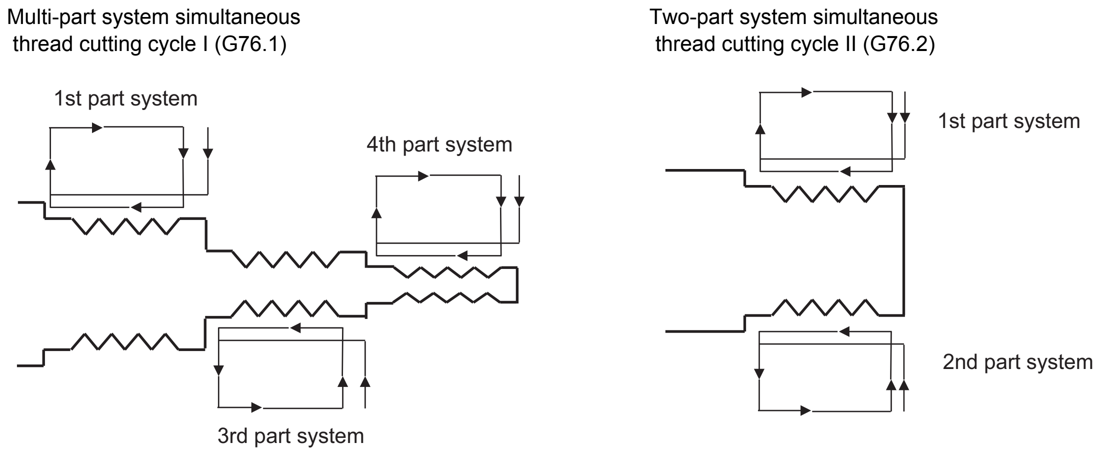
(Note) The setting (such as number of axes and axis names) for the tool compensation amount of part system 1 and part system 2 must be the same.
If the settings differ, the setting of part system 1 will be applied.

### 12.1.8.8 Multi-part System Simultaneous Thread Cutting

Multi-part system simultaneous thread cutting allows different part systems to perform thread cutting simultaneously on one spindle.

Multi-part system simultaneous thread cutting has two commands; the command (G76.1) for simultaneously cutting threads in multiple places, which is known as "multi-part system simultaneous thread cutting cycle I", and the command (G76.2) for simultaneously cutting a thread by two part systems, which is known as “two-part system simultaneous thread cutting cycle II".

Chamfering is available for multi-part system simultaneous thread cutting cycle I and two-part system simultaneous thread cutting cycle II.

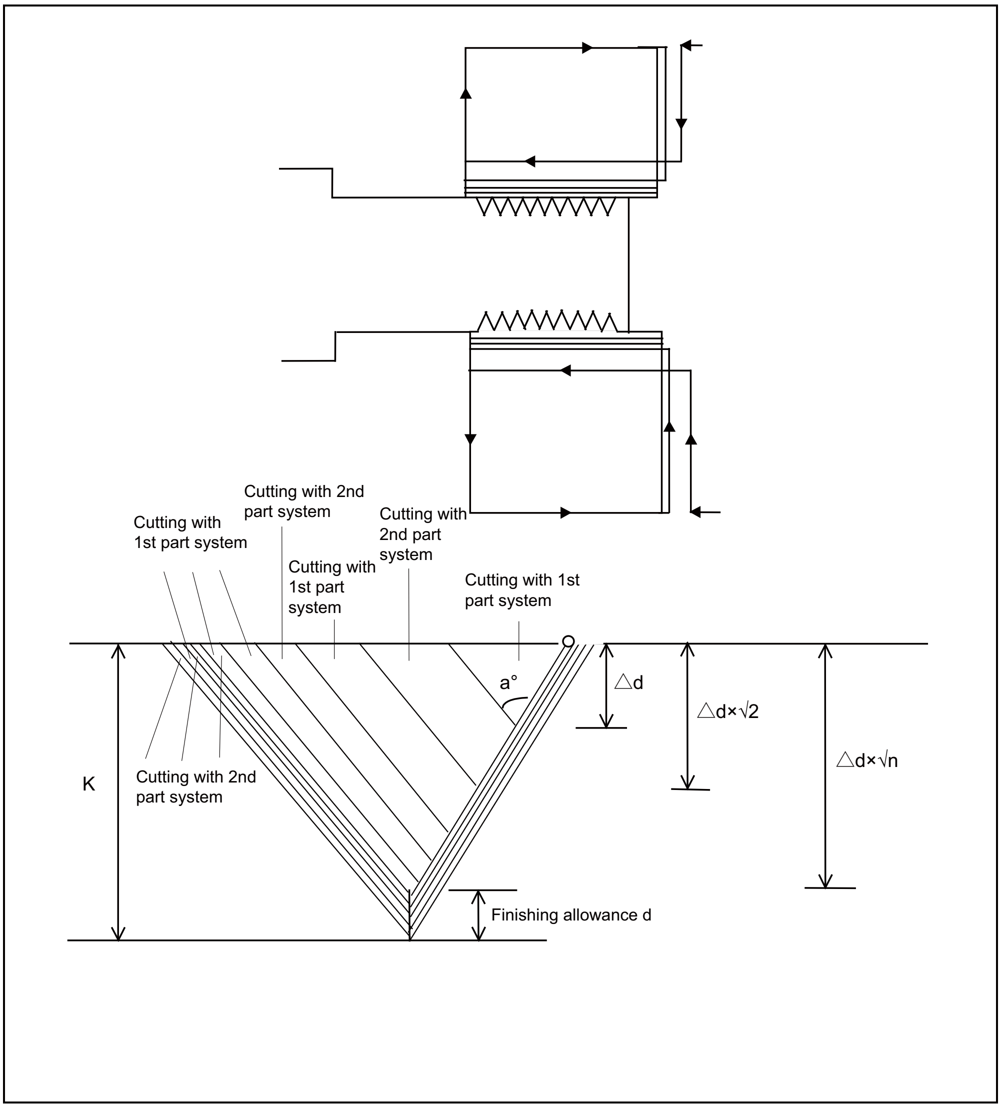


### 12.1.8.8.1 Two-part System Simultaneous Thread Cutting

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | — | — | — | — | — | — | — | — |
| L | △ | △ | △ | △ | ○ | ○ | — | ○ |

When G76.2 is issued in the 1st and 2nd part systems, waiting is done until G76.2 is issued in each part system.
The thread cutting cycle starts when the commands are aligned properly.
G76.2 assumes the same thread cutting, and deeply cuts in with the cutting amount using 1st part system and 2nd part system alternately.

| $1 | $2 |
|---|---|
| : | : |
| G00 X__ Z__ ; | : |
| G76.2 …… ; | G00 X__ Z__ ; |
| : | G76.2 …… ; |
| : | : |



Command format

| | |
|---|---|
| **G76.2 X/U__ Z/W__ R__ P__ Q__ A__ F__ ;** | |
| X/U | : X-axis end point coordinates of thread section |
| Z/W | : Z-axis end point coordinates of thread section |
| R | : Taper height component at thread section |
| P | : Thread height |
| Q | : Cut amount |
| A | : Thread cutting start shift angle |
| F | : Thread lead |

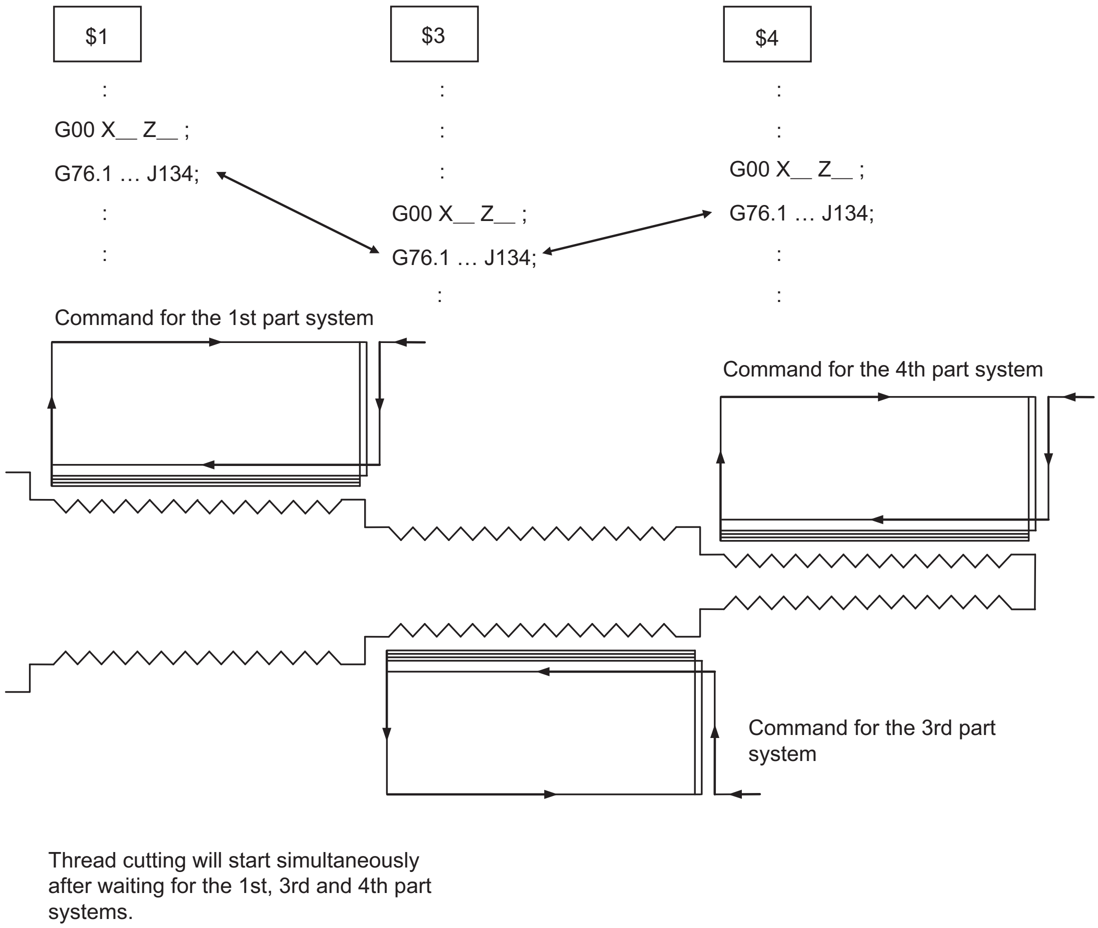
(Note) Two-part system simultaneous thread cutting cycle II (G76.2) can be commanded in part system 1 or 2 only. A program error will occur when issuing the command in the other part systems.

### 12.1.8.8.2 Multi-part System Simultaneous Thread Cutting

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | — | — | — | — | — | — | — | — |
| L | △ | △ | △ | △ | — | — | — | — |

If G76.1 is given to multiple part systems, each part system waits for G76.1 to be commanded.
The thread cutting cycle starts when the G76.1 commands are aligned properly.

When "J134" is commanded in $1, $3 and $4




Command format

| | |
|---|---|
| **G76.1 X/U__ Z/W__ R__ P__ Q__ J__ F__ ;** | |
| X/U | : X axis end point coordinate of thread part |
| Z/W | : Z axis end point coordinate of thread part |
| R | : Taper height constituent in thread part |
| P | : Thread height |
| Q | : Cut depth |
| J | : Part system for simultaneous thread cutting<br>Ones digit: Part system number for the 1st set<br>Tens digit: Part system number for the 2nd set<br>:<br>Ten-millions digit: Part system number for the 8th set |
| F | : Thread lead |

### 12.1.8.9 Multi-part System Program Management

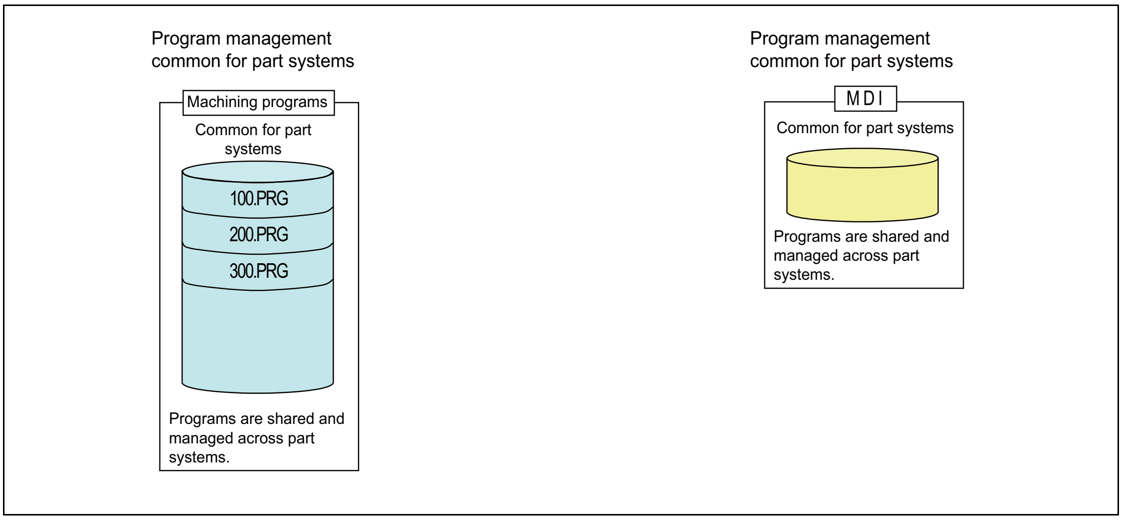
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | － | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

In a system composed of multiple part systems, this function manages the program storage method, program search method and program input/output.

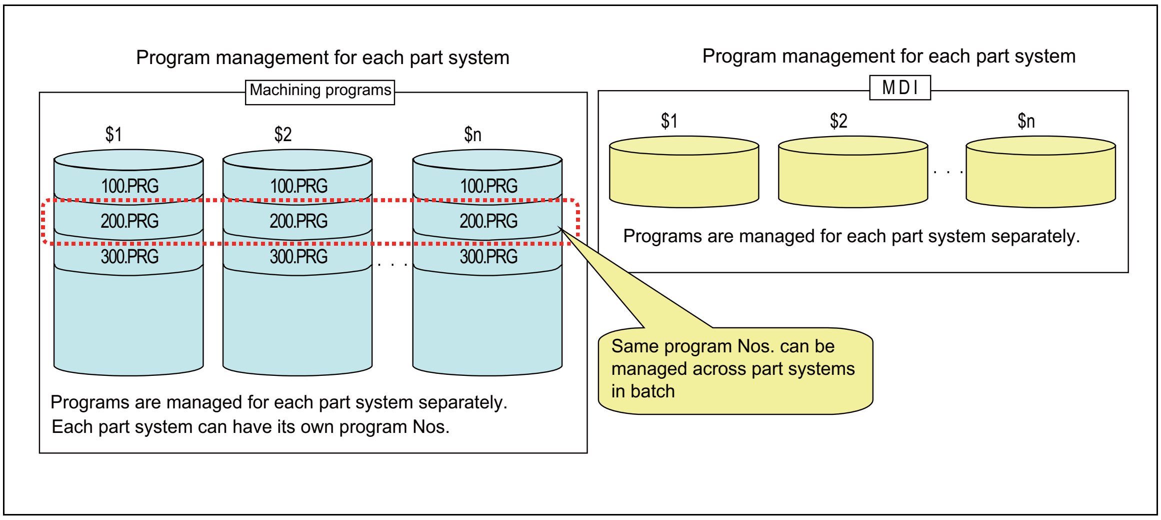
- This facilitates the management of such machining programs that run simultaneously in multiple part systems.
- This enables separate programs that run simultaneously in multiple part systems to be handled under one common name.
- The parameter enables or disables this function.
- NC memory (*1) is the only device compatible with this function.

(*1) MDI and machine tool builder's macro are included.

<Multi-part system program management INVALID>




<Multi-part system program management VALID>




$1: Part system 1
$2: Part system 2
$n: Part system n

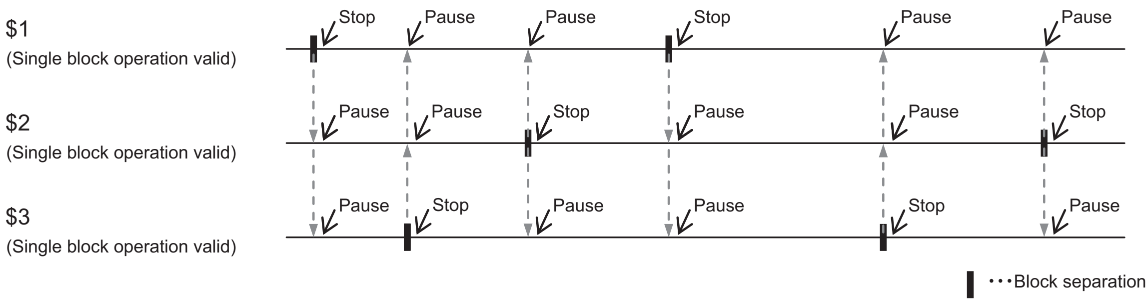
### 12.1.8.10 Synchronization between Part Systems

#### 12.1.8.10.1 Single Block between Part Systems

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | － | － | － | － | － | － | － | － |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

Single block between part systems is the function for executing single block operation while maintaining the synchronization between the part systems when two or more part systems are operated in the multi-part system. When one part system has been stopped by single block stop, the other part systems pause in the cycle operation.
In the normal single block, the synchronization between the part systems differs from the synchronization during the continuous operation because the other part systems continue the operation without stop even a part system is stopped by single block stop, and the tool interference could occur in some cases. The synchronization between part systems can be maintained the same as the continuous operation by the single block operation with part systems synchronized.
Valid/invalid can be switched with the PLC signal.

(Example) 3 part systems lathe



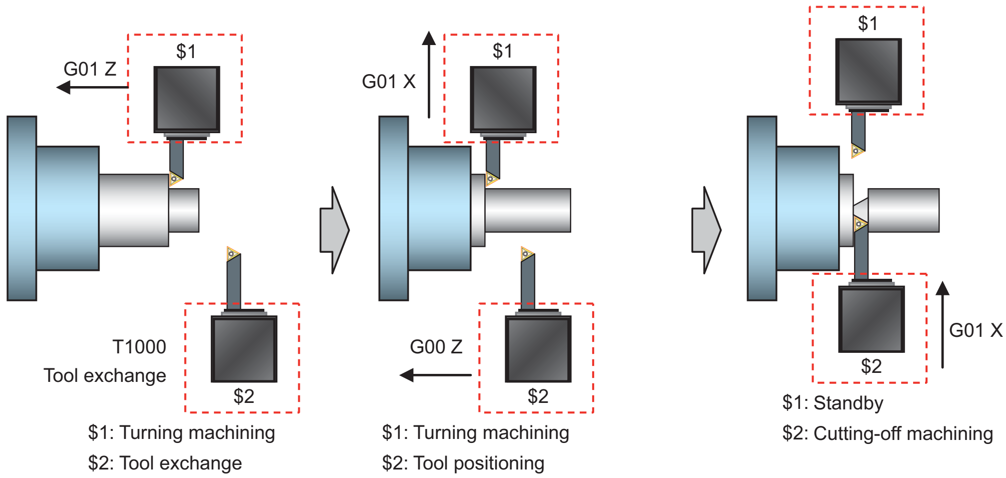

Stop: Single block stop
Pause: Cycle operation pause
$1: Part system 1
$2: Part system 2
$3: Part system 3

### 12.1.8.10.2 Dwell/Miscellaneous Function Time Override

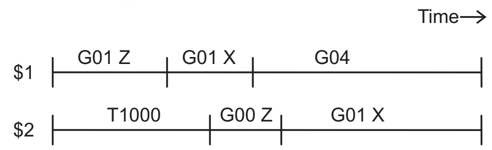
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | － | － | － | － | － | － | － | － |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

Override can be applied to dwell time and miscellaneous function finish wait time of all part systems. The synchronization between part systems can be maintained when the multiple machining programs are operated with override in the multi-axis and multi-part system mixed control CNC.
If a machining program that performs cutting-off machining in part system 2 ($2) after the completion of turning machining in part system 1 ($1) is executed with override when this function is invalid, part system 1 and part system 2 will be out of synchronization and the machining may not be operated properly.

The differences on the start timing for each command are shown in (1) to (3) when executing the machining with the part system 1 ($1) and part system 2 ($2) as shown in the figure below.

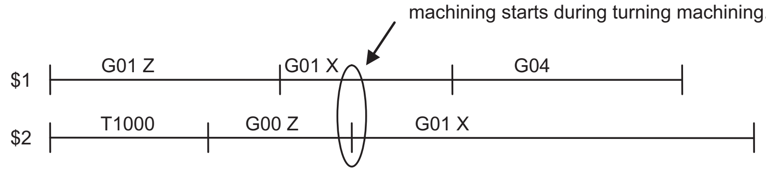



(1) Override 100%



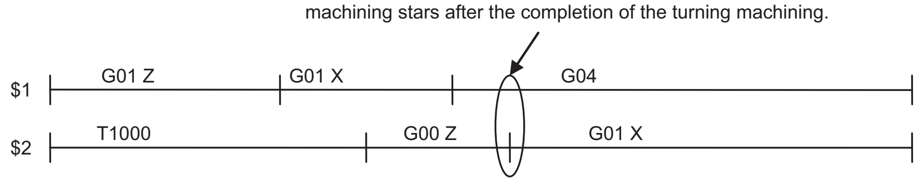

(2) When this function is invalid
Override 50%

Only feed time doubled in the operation with override 50%.
Part systems are out of synchronization and the cutting-off machining starts during turning machining.




(3) When this function is valid
Override 50%

Feed time, dwell time and miscellaneous function finish wait time double in the operation with override 50%.
The synchronization between part systems are maintained and the cutting-off machining stars after the completion of the turning machining.

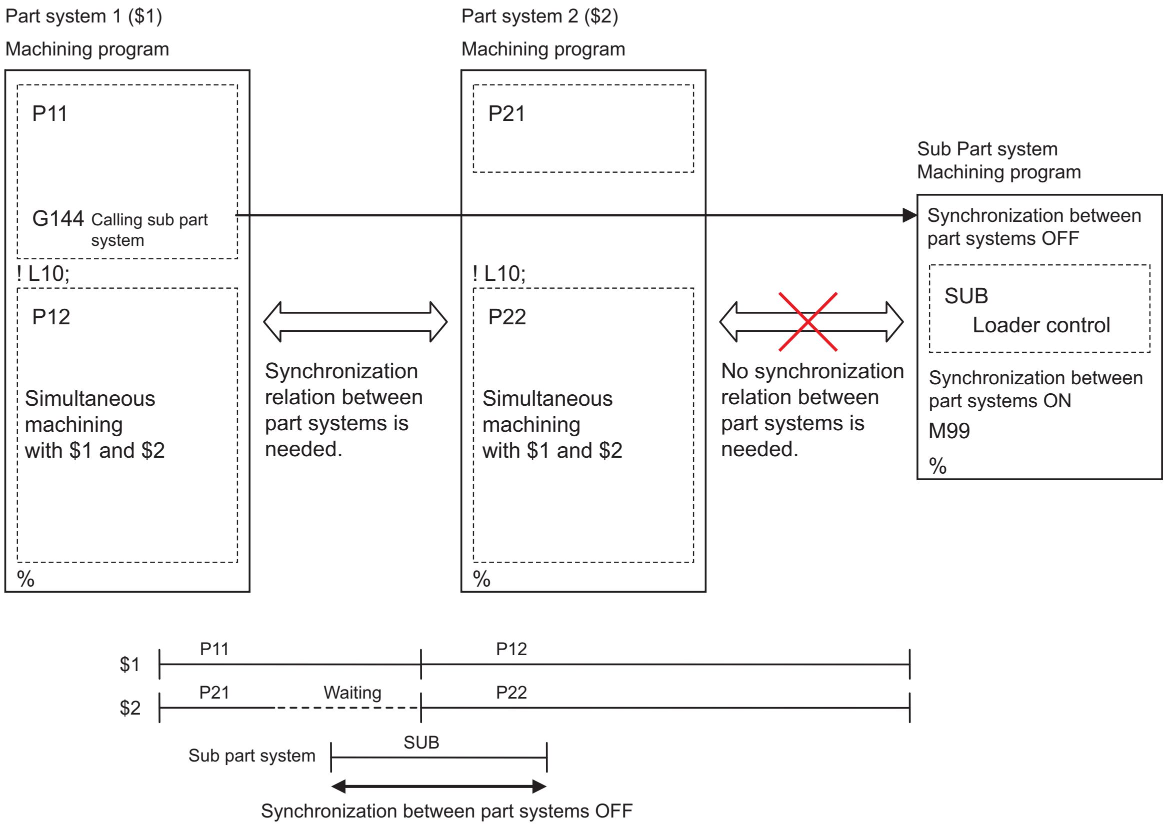


### 12.1.8.10.3 Synchronization between Part Systems OFF

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | — | — | — | — | — | — | — | — |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

Synchronization between part systems and feedrate change are turned OFF in a part of a machining program to eliminate a synchronization relation between part systems by single block operation with part systems synchronized or variation of a machining program feedrate by dry run. This function is effective mainly in blocking the cycle operation pause or feedrate variation in only some of part systems when the sub part system control II function is being used. When loader control and ATC control which are operated independently of machining are performed with a sub program or sub part system control, this function enables a operation with synchronization between part systems in machining part systems and an independent operation in sub part systems.

ON/OFF can be switched with the system variable or the PLC signal.



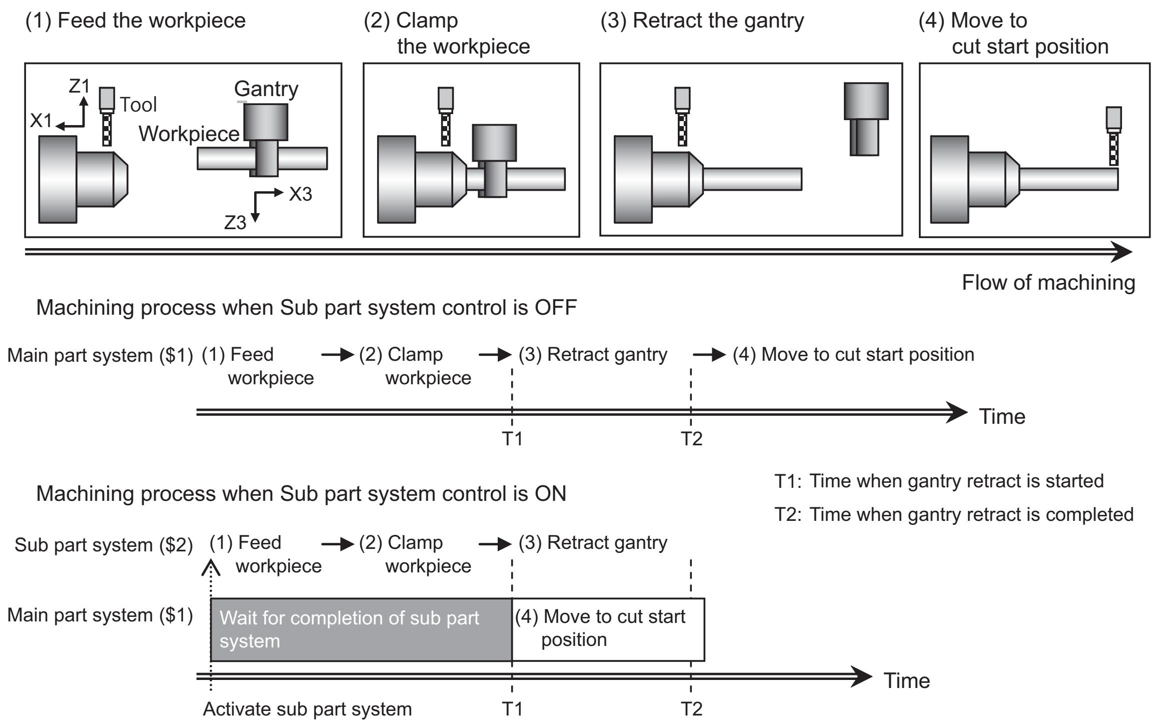

The behaviors with synchronization between part systems OFF is as follows:

| | |
|---|---|
| Single block between part systems | - The pause is not made from other part systems.<br>- The other part systems do not pause with block stop. |
| Dwell/miscellaneous function time override | - Override is invalid. |

### 12.1.8.11 Sub Part System control I

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | － | － | － | － |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

This function activates and operates any non-operating part system (sub part system) in the multi-part system.
Sub part system control I can be used in the same manner as calling subprogram in a non-operating part system. An auxiliary axis machining program can be controlled in the sub part system by commanding Sub part system control I (G122) from the main part system.
In the usage example below, the tool positioning starts to the machining start point at the same time (time T1) as the start of gantry retract by using Sub part system control I (G122) in the flow from feeding the workpiece to moving to cut start position in order to reduce the cycle time.
Select whether main part system or sub part system for each part system in Sub part system control I. When using a part system as sub part system, by setting the operation mode to "Sub part system I operation mode" with the PLC signal and commanding Sub part system control I (G122) from an operating part system, it is possible to activate the part system in the sub part system I operation mode as sub part system.



Command format

Activate sub part system

Command an activation of sub part systems by Sub part system control I with G122.

| | | |
|---|---|---|
| **G122 A__ P__ Q__ K__ D__ B__ H__ Argument;<br>Or, G122 <File name> P__ Q__ K__D__ B__ H__ Argument;** | | |
| A | : | Program No. (1 to 99999999 or 100010000 to 199999998) |
| <File name> | : | File name of program (up to 32 characters) |
| P | : | Start sequence number (Head of program if omitted.) |
| Q | : | End sequence number (To end of program (M99) if omitted.) |
| K | : | Number of repetitions (1 to 9999) |
| D | : | Synchronization control (0/1) |
| B | : | Sub part system identification number (1 to 7) |
| H | : | Sub part system reset type (0/1) |
| Argument | : | Argument of sub part system local variable (Setting rage of local variable (decimal point command is valid)) |

Complete sub part system

Command M99 in sub part system to complete an operation of sub part system.

| |
|---|
| **M99 ;** |

Cancel the standby status for completion of sub part system

When a sub part system is activated in the completion wait method (D0 command), it is possible to cancel the standby status for completion of sub part system in a calling part system by commanding G145 in the sub part system program. G145 is ignored in a sub part system activated in the parallel control method (D1 command).

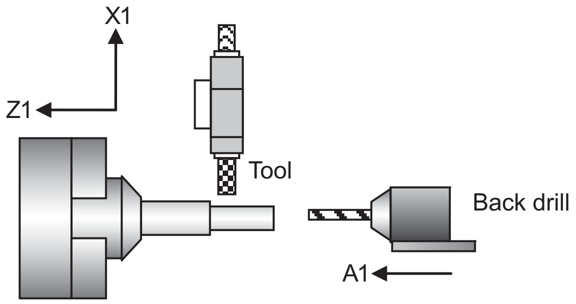
| |
|---|
| **G145 ;** |

### 12.1.8.12 Sub Part System Control II

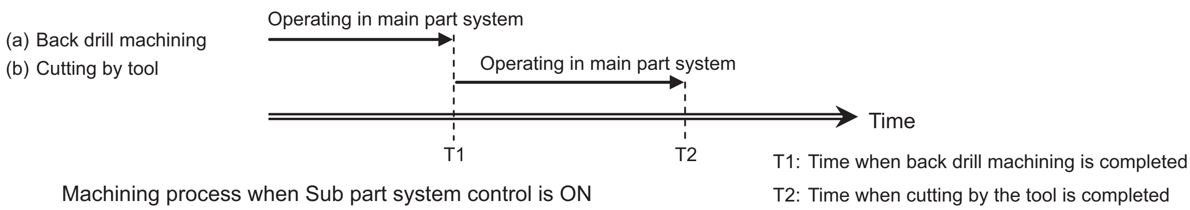
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | – | – | – | – | – | – | – | – |
| L | △ | △ | △ | △ | ○ | ○ | – | △ |

This function activates and operates any non-operating part system (sub part system) in the multi-part system. Using sub part systems enables parallel operation between an operating program in main part system and a program called with Sub part system control II (G144).
Sub part systems does not have any controllable axes soon after the activation. When an axis is needed to be controlled in sub part system, command the arbitrary axis exchange control (G140) to give sub part system authorization to control the axis.

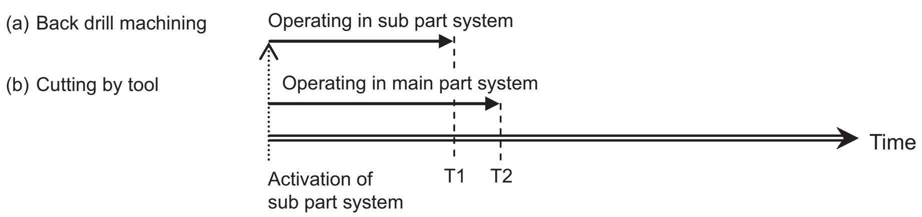
In the machine configuration below, when performing the back drill machining (machining (a)) and the cutting by tool (machining (b)), machining (a) and (b) are operated in order only with main part system, however machining (a) and (b) can be operated simultaneously by using the sub part system in addition to the main part system, resulting in a shorter cycle time. In the usage example below, T2 (time when machining (b) is completed) is shorter.




Machining process when Sub part system control is OFF




Machining process when Sub part system control is ON



Command format

Activate sub part system

Command an activation of sub part systems by Sub part system control II with G144.

| **G144 A__ P__ Q__ K__ D__ B__ H__ Argument;**<br>**Or, G144 <File name> P__ Q__ K__D__ B__ H__ Argument;** | |
|---|---|
| A | : Program No. (1 to 99999999 or 100010000 to 199999998) |
| <File name> | : File name of program (up to 32 characters) |
| P | : Start sequence number (Head of program if omitted.) |
| Q | : End sequence number (To end of program (M99) if omitted.) |
| K | : Number of repetitions (1 to 9999) |
| D | : Synchronization control (0/1) |
| B | : Sub part system identification number (1 to 9999) |
| H | : Sub part system designation (1 to 8) |
| Argument | : Argument of sub part system local variable (Setting rage of local variable (decimal point command is valid)) |

Complete sub part system

Command M99 in sub part system to complete an operation of sub part system.

```
M99 ;
```

Cancel the standby status for completion of sub part system

When a sub part system is activated in the completion wait method (D0 command), it is possible to cancel the standby status for completion of sub part system in a calling part system by commanding G145 in the sub part system program. G145 is ignored in a sub part system activated in the parallel control method (D1 command).

```
G145 ;
```

### 12.1.9 Data Input/Output by Program

#### 12.1.9.1 Parameter Input by Program

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The parameters set from the setting and display unit can be changed in the machining programs.
Command format is as follows.

**G10 L70 ; Data setting start command**
**Pparameter No. Spart system No. Aaxis No. H □ data ; ................. Bit parameter;**
**Pparameter No. Spart system No. Aaxis No. Ddata ; ..................... Numerical value parameter**
**Pparameter No. Spart system No. Aaxis No. <character string> ; ... Character string parameter**

**G11 Data setting end command**

(Note 1) The sequence of addresses in a block must be as shown above.
When an address is commanded two or more times, the last command will be valid.
(Note 2) The part system No. is set in the following manner: "1" for 1st part system, "2" for 2nd part system, and so forth.
If the address S is omitted, the part system of the executing program will be applied.
As for the parameters common to part systems, the command of part system No. will be ignored.
(Note 3) The axis No. is set in the following manner: "1" for 1st axis, "2" for 2nd axis, and so forth.
If the address A is omitted, the 1st axis will be applied.
As for the parameters common to axes, the command of axis No. will be ignored.
(Note 4) Address H is commanded with the combination of setting data (0 or 1) and the bit designation ( □ ) (0 to 7).
(Note 5) Only the decimal number can be commanded with the address D.
The value that is smaller than the input setting increment (#1003 iunit) will be round off to the nearest increment.
(Note 6) The character string must be put in angled brackets "<" and ">".
If these brackets are not provided, the program error (P33) will occur.
Up to 63 characters can be set.
(Note 7) Command G10L70, G11 in independent blocks. A program error (P33, P421) will occur if not commanded in independent blocks.
(Note 8) The following data cannot be changed with the G10 L70 command:
Tool compensation data, workpiece coordinate data, PLC switch, and PLC axis parameter.
(Note 9) The settings of the parameters with (PR) in the parameter list will be enable after the power is turned OFF and ON. Refer to the parameter list in your manual.

### 12.1.9.2 Compensation Data Input by Program

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The value of the workpiece coordinate systems selected can be set or changed by program commands.
The tool offset amounts, which have been set from the setting and display unit, can be input by program commands.

**(1) Workpiece coordinate system offset input**

[M system]

The position of the workpiece coordinate systems selected by the G54 to G59 commands can be set or changed by program commands.

During the absolute value (G90) mode, the commanded offset amount serves as the new offset, whereas during the incremental value (G91) mode, the currently set offset plus the commanded offset serves as the new offset.

| Gcode | Function |
|---|---|
| G10 L2 P0 | External workpiece coordinate system setting |
| G10 L2 P1 | Workpiece coordinate system 1 setting (G54) |
| G10 L2 P2 | Workpiece coordinate system 2 setting (G55) |
| G10 L2 P3 | Workpiece coordinate system 3 setting (G56) |
| G10 L2 P4 | Workpiece coordinate system 4 setting (G57) |
| G10 L2 P5 | Workpiece coordinate system 5 setting (G58) |
| G10 L2 P6 | Workpiece coordinate system 6 setting (G59) |
| G10 L20 Pn (n=1 to 300) | Extended workpiece coordinate system setting (G54.1 P1 to P300) |

Command format

| **G10 L2(L20) P__ X__ Y__ Z__ ;** | |
|---|---|
| G10 L2(L20) | : Workpiece coordinate system setting command |
| P | : Workpiece coordinate system No. |
| X,Y,Z | : Setting values |

(Note 1) L2 can be omitted. If the command P is omitted, the specified offset is treated as that of the currently selected workpiece coordinate system.

(Note 2) L20 is used to designate the extended workpiece coordinate system.

[L system]

When the command is given with absolute values (X, Z and R), the offset is updated with the values. On the other hand, when the command is given with incremental values (U, W and C), the currently set offset plus the commanded offset serves as the new offset.

| Gcode | Function |
|---|---|
| G10 L2 P0 | External workpiece coordinate system setting |
| G10 L2 P1 | Workpiece coordinate system 1 setting (G54) |
| G10 L2 P2 | Workpiece coordinate system 2 setting (G55) |
| G10 L2 P3 | Workpiece coordinate system 3 setting (G56) |
| G10 L2 P4 | Workpiece coordinate system 4 setting (G57) |
| G10 L2 P5 | Workpiece coordinate system 5 setting (G58) |
| G10 L2 P6 | Workpiece coordinate system 6 setting (G59) |
| G10 L20 Pn (n=1 to 48) | Extended workpiece coordinate system setting (G54.1 P1 to P48) |

Command format

| **G10 L2(L20) P__ X__ (U__) Z__ (W__) ;** | | |
|---|---|---|
| G10 L2(L20) | : | Workpiece coordinate system setting command |
| P | : | Compensation No. |
| X,Z | : | Compensation amount for each axis(absolute) |
| U,W | : | Compensation amount for each axis(incremental) |

(Note 1) L2 can be omitted. If the command P is omitted, the specified offset is treated as that of the currently selected workpiece coordinate system.

(Note 2) L20 is used to designate the extended workpiece coordinate system.

**(2) Tool compensation input**

The tool compensation amounts, which have been set from the setting and display unit, can be input by program commands.
The command format differs between the [M system] and the [L system].

[M system]

Type I

| G code | Function |
|---|---|
| G10 L10 | Tool compensation amounts |

TypeII

| Gcode | Function |
|---|---|
| G10 L10<br>G10 L11<br>G10 L12<br>G10 L13 | Tool length shape compensation amount<br>Tool length wear compensation amount<br>Tool radius shape compensation amount<br>Tool radius wear compensation amount |

Command format

| **G10 L__ P__ R__ ;** | |
|---|---|
| G10 L | : Command for setting compensation amount |
| P | : Compensation No. |
| R | : Compensation amount |

[L system]

| Gcode | Function |
|---|---|
| G10 L10<br>G10 L11 | Tool length compensation amount<br>Tool wear compensation amount |

Command format

| **G10 L10(L11) P__ X__ (U__) Z__ (W__) [Additional axis]__ [2nd additional axis]_R__ (C__) Q__ ;** | |
|---|---|
| G10 L10(L11) | : Command for setting compensation amount |
| P | : Compensation No. |
| X,Z | : Compensation amount for each axis (absolute) |
| U,W | : Compensation amount for each axis (incremental) |
| Additional axis | : Additional axis compensation amount (absolute) |
| 2nd additional axis | : 2nd additional axis compensation amount (absolute) |
| R | : Nose R compensation amount (absolute) |
| C | : Nose R compensation amount (incremental) |
| Q | : Hypothetical tool nose point |

(Note 1) L11 can be omitted.

**(3) Cancelling the compensation input**

Command format

| **G11 ;** |
|---|

### 12.1.9.3 Tool/Material shape input by program

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Tool shape data on the tool management screen (M system) and workpiece shape data (L system) of the 3D solid program check (hereinafter referred to as 3D check) can be set with the machining program. There is no need to input the tool/workpiece shape on the screen for 3D check.

**(1) L100 command format**

Tool shape data on the tool management screen can be set by the machining program with this function.

**G10 L100 ; Data setting start command**
**P__ T__ K__ D__ H__ I__ J__ C__ ; Data setting command**
**G11 ; Data setting end command**

| | |
|---|---|
| P | : Data number (The maximum number varies depending on the number of tool management data sets.) |
| T | : Tool number (0 to 99999999) |
| K | : Type |
| D | : Shape data 1 (decimal point allowed) |
| H | : Shape data 2 (decimal point allowed) |
| I | : Shape data 3 (decimal point allowed) |
| J | : Shape data 4 (decimal point allowed) |
| C | : Tool color |

(Note 1) Omitted addresses cannot be set.
(Note 2) Omitting address P or T causes the program error.
(Note 3) On graphic check of M800、M80W series, only drawing is reflected to the graphic check. Tool shape data will not be rewritten.
(Note 4) On graphic check of M80 series, tool shape data will be rewritten.

### (2) L101 command format

Workpiece shape data can be set by the machining program for 3D solid program check with this function.

**G10 L101 ; Data setting start command**
**C__ R__ D__ E__ L__ A__ K__ W__ F__ P__ H__ I__ J__ ; Data setting command**
**G11 ; Data setting end command**

| | |
|---|---|
| C | : Workpiece shape |
| R | : Number of angles (3 to 99) |
| D | : Outside diameter of workpiece (0.001 to 99999.999 mm, 0.0001 to 9999.9999 inch) |
| E | : Inside diameter of workpiece (0.001 to 99999.999 mm, 0.0001 to 9999.9999 inch) |
| L | : Workpiece length (0.001 to 99999.999 mm, 0.0001 to 9999.9999 inch) |
| A | : Installation angle (0.000 to 359.999°) |
| K | : Front face workpiece zero point position Z (-1 or 0.000 to 99999.999 mm, -1 or 0.0000 to 9999.9999 inch) |
| W | : Back face workpiece zero point position Z (-1 or 0.000 to 99999.999 mm, -1 or 0.0000 to 9999.9999 inch) |
| F | : Workpiece color |
| P | : Machining surface color |
| H | : Tapping/Thread machining surface color |
| I | : Interference surface color |
| J | : Cross-section color |

(Note 1) Omitted addresses cannot be set.
(Note 2) Omitting address C causes the program error.
(Note 3) On graphic check of M800、M80W series, only drawing is reflected to the graphic check. Workpiece shape data will not be rewritten.
(Note 4) On graphic check of M80 series, workpiece shape data will be rewritten.

### 12.1.9.5 API Section and Sub-section Nos. Input/Output by Program

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

NC internal data can be read/written by specifying the section number, sub-section number, part system number and axis number using system variables.

### 12.1.9.6 R-Navi Data Input by Program

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | − | − |
| L | − | − | − | − | − | − | − | − |

This function enables the R-Navi setup parameters to be configured from a machining program.
After the parameters have been configured from the program, you can check the values or select the machining surface from the setup screen.

Command format

| | |
|---|---|
| **G10 L110 ;** | **Workpiece data setting** |
| **G10 L111 ;** | **Machining surface data setting** |

Refer to "17.2.17 R-Navi" for details.

### 12.1.10 Machining Modal

#### 12.1.10.1 Tapping Mode

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

When tapping mode commands are issued, the NC system is set to the following internal control modes required for tapping.

1. Cutting override is fixed at 100%.
2. Deceleration commands at joints between blocks are invalid.
3. Feed hold is invalid.
4. Single block is invalid.
5. "In tapping mode" signal is output.

| G code | Function |
|---|---|
| G63 | Tapping mode ON |

The tapping mode command will be canceled with the following commands:

- Exact stop check mode (G61)
- Automatic corner override (G62)
- Cutting mode (G64)
- High-accuracy control mode command (G61.1/G08P1) [M system]

The machine is in the cutting mode status when its power is turned ON.

#### 12.1.10.2 Cutting Mode

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

When a cutting mode command is issued, the NC system is set to the cutting mode that enables smooth cutting surface to be achieved. In this mode, the next block is executed continuously without the machine having to decelerate and stop between the cutting feed blocks: this is the opposite of what happens in the exact stop check mode (G61).

| G code | Function |
|---|---|
| G64 | Cutting mode ON |

The cutting mode command will be canceled with the following commands:

- Exact stop check mode (G61)
- Automatic corner override (G62)
- Tapping mode (G63)
- High-accuracy control mode command (G61.1) [M system]

The machine is in the cutting mode status when its power is turned ON.

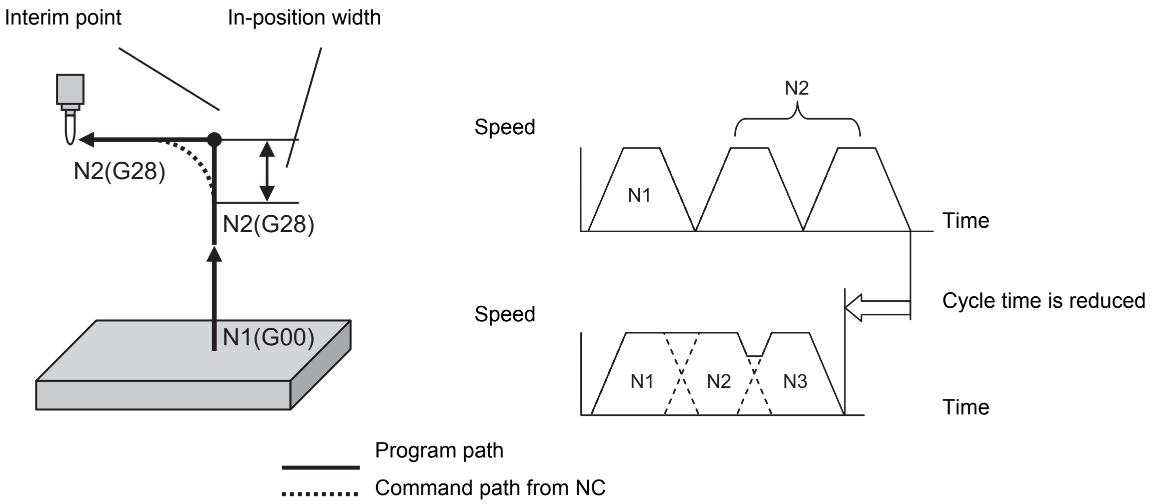
## 12.1.11 High-speed Parts Machining

### 12.1.11.1 Rapid traverse block overlap

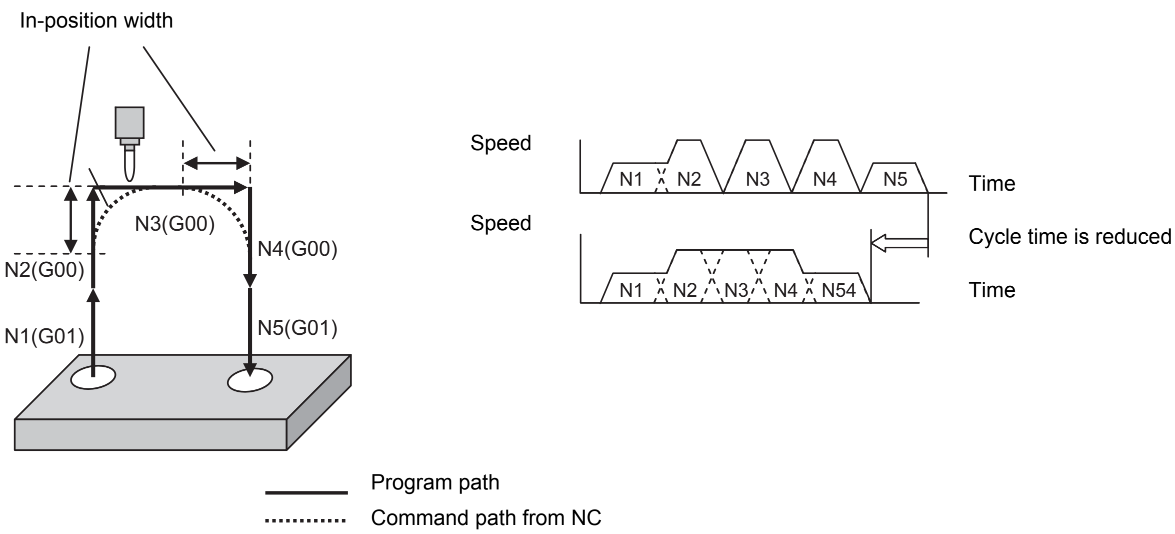
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

This function enables the next block to start (overlap) without waiting for positioning (G00) or reference position return (G28/G30). Consequently, cycle time of machining including operation of positioning (G00) or reference position return (G28/G30) can be reduced.
Adjust the overlap amount with command by machining program or with the parameter, and specify it as in-position width for rapid traverse overlap.
Also, the operation does not decelerate between blocks if the movement command continues in same direction.
The overlap is also valid when the block after G00 is G1 instead of G00 or G28/G30 and it is invalid when G00 or G28/G30 is commanded after G28 continuously.

Example of application of rapid traverse overlap in tool exchange operation




Example of application of rapid traverse overlap in continuous drilling operation



Command format

The command format to switch the rapid traverse overlap function for G00 to valid/invalid is as follows:

| G0.5 P1 J__ K__ ; Rapid traverse overlap function for G00 ON | |
|---|---|
| J | : Liner axis in-position width (0.000 to 1000.000 (mm)) |
| K | : Rotary axis in-position width (0.000 to 1000.000 (°)) |

**G0.5 P1 J__ K__ ; Rapid traverse overlap function for G00 OFF**

## 12.2 Machining Accuracy Support Functions

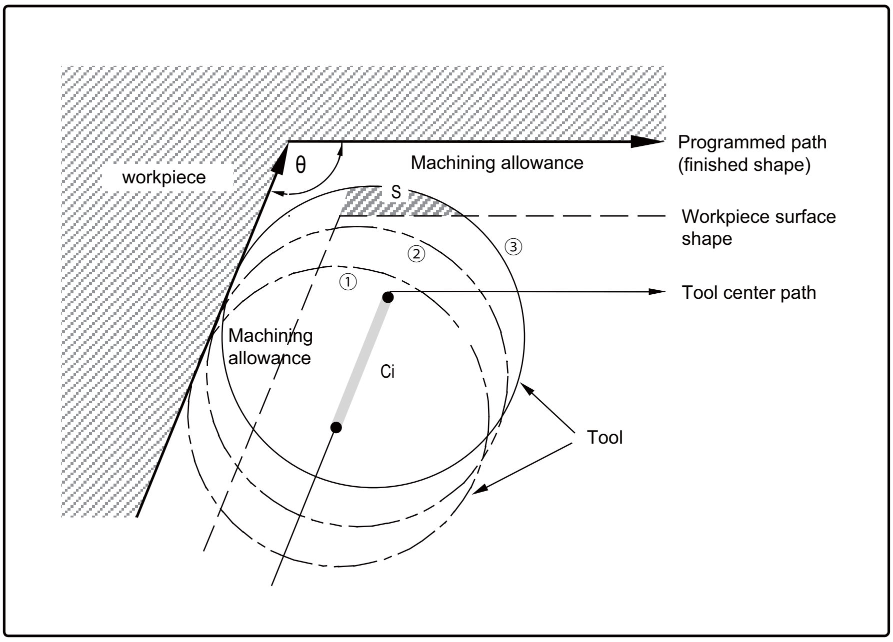
### 12.2.1 Automatic Corner Override

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

When cutting with tool radius compensation, this function applies feedrate override automatically to decrease cutting load at the inside corner cutting or the inside cutting of corner R.
There are automatic corner override (G62) and inside arc override as the automatic corner override.

Automatic corner override (G62) is valid until the tool radius compensation cancel (G40), exact stop check mode (G61), high-accuracy control mode (G61.1), tapping mode (G63), or cutting mode (G64) command is issued.
Inside arc override is valid without automatic corner override (G62) during tool radius compensation mode (G41/G42).
This can also be enabled with the parameter setting when the tool radius compensation mode (G41/G42) and the automatic corner override mode (G62) are active.

Automatic corner override (G62) inside corner




$\theta$ : Max. angle at inside corner
Ci : Deceleration range (IN)

Operation

(a) When G62 command is not given :
When the tool moves in the order of (1) -> (2) -> (3) in the figure above, the machining allowance at (3) is larger than that at (2) by an amount equivalent to the area of shaded section S and so the tool load increases.

(b) When G62 command is given :
When the inside corner angle $\theta$ in the figure above is less than the angle set in the parameter, the override set into the parameter is automatically applied in the deceleration range Ci.

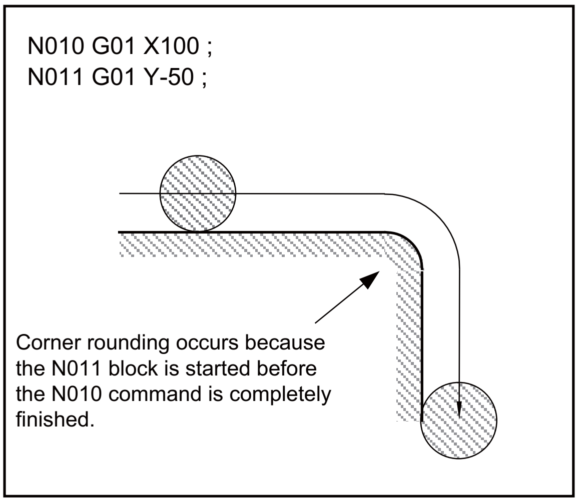
Command format

| **G62; Automatic corner override** |
|---|

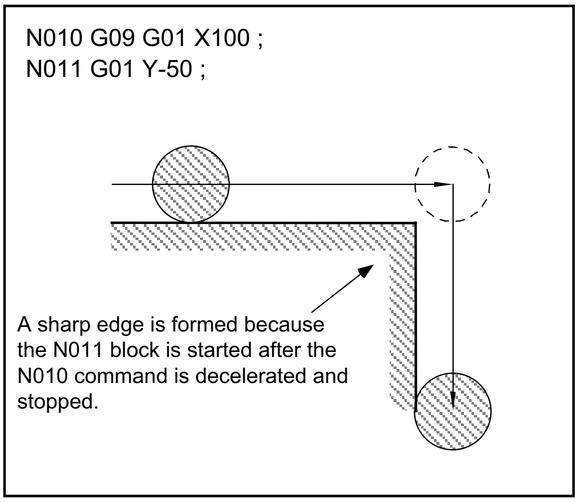
### 12.2.2 Deceleration Check

This function leads the machine to decelerate and stop at the join between axis movement blocks before executing the next block. This is effective to alleviate the machine shock and prevent the corner rounding when the feed rate of the control axis changes suddenly.
There are three methods for deceleration check: command deceleration check method, smoothing check method and in-position check method.

Without deceleration check




With deceleration check




The conditions for executing deceleration check are described below.

**(1) Deceleration check in the rapid traverse mode**

In the rapid traverse mode, the deceleration check is always performed when block movement is completed before executing the next block.

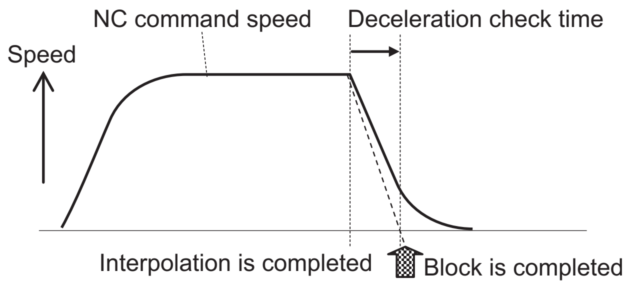
**(2) Deceleration check in the cutting feed mode**

In the cutting feed mode, the deceleration check is performed at the end of block when any of the conditions below is applicable before executing the next block.

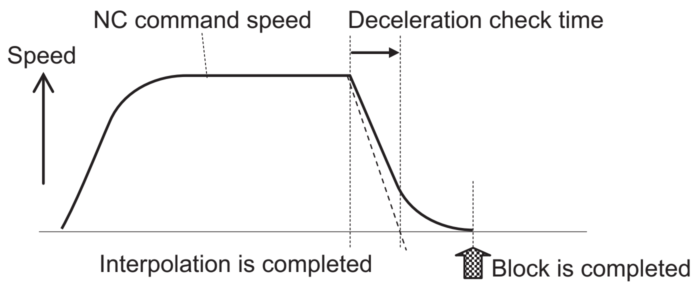
(a) When G61 (exact stop check mode) is selected.
(b) When the G09 (exact stop check) is issued in the same block.
(c) When the error detect switch (PLC signal) is ON.

The following deceleration check methods can be selected with the parameter to each feed command during rapid traverse command and cutting feed command.

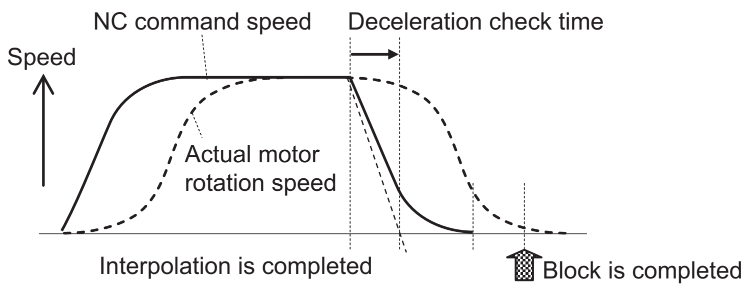
(1) Command deceleration check method
The deceleration is completed after the deceleration check time (Note) has passed after the interpolation.




(2) Smoothing check method
The deceleration is completed after the deceleration check time (Note) has passed after the interpolation and all axes smoothing has become zero.




(3) In-position check method
The deceleration is completed after the deceleration check time (Note) had passed after the interpolation, all axes smoothing has become zero and all axes have become in-position.




(Note) Deceleration check time: automatically calculated from the acceleration/deceleration mode and time constant.

### 12.2.2.1 Exact Stop Check Mode

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

A deceleration check is performed when the G61 (exact stop check mode) command has been selected.
G61 is a modal command. The modal command is released by the following commands.

G62 .................... Automatic corner override
G63 .................... Tapping mode
G64 .................... Cutting mode
G61.1/G08P1 .... High-accuracy control mode [M system]

Refer to "12.2.2 Deceleration Check" for details on the deceleration check.

### 12.2.2.2 Exact Stop Check

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

A deceleration check is performed when the G09 (exact stop check) command has been designated in the same block.
The G09 command should be issued in the same block as the cutting command. It is an unmodal command.
Refer to "12.2.2 Deceleration Check" for details on the deceleration check.

### 12.2.2.3 Error Detection

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

To prevent rounding of a corner during cutting feed, the operation can be changed by turning an external signal switch ON so that the axis decelerates and stops once at the end of the block and then the next block is executed.
The deceleration stop at the end of the cutting feed block can also be commanded with a G code.
Refer to "12.2.2 Deceleration Check" for details on the deceleration check.

### 12.2.2.4 Programmable In-position Check

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

",I" address is used to designate the in-position width for a linear interpolation command from the machining program.
The in-position width designated with a linear interpolation command is valid only in cases when the deceleration check is performed, such as:
- When the error detect switch is ON.
- When the G09 (exact stop check) command has been designated in the same block.
- When the G61 (exact stop check mode) command has been selected.

**G01 Xx1 Zz1 Ff1 ,Ii1 ;**

| | |
|---|---|
| Xx1, Zz1 | : Linear interpolation coordinate position of each axis |
| Ff1 | : Feed rate |
| ,Ii1 | : In-position width |

As with linear interpolation, ",I" address is used to designate the in-position width for a positioning command from the machining program.

**G00 Xx1 Zz1 ,Ii1 ;**

| | |
|---|---|
| Xx1, Zz1 | : Positioning coordinate position of each axis |
| ,Ii1 | : In-position width |

In-position check operation

As for G01, after it is verified that the position error of the block in which the deceleration check is performed by the linear interpolation command (G01) is less than the in-position width of this command, the execution of the next block is commenced.
As for G00, after it is verified that the position error of the positioning command (G00: rapid traverse) is less than the in-position width of this command, the execution of the next block is commenced.

### 12.2.2.5 Automatic Error Detection

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | － | － | － | － | － | － | － | － |
| L | △ | △ | △ | △ | － | － | － | － |

This function is effective to reduce the extension of cycle time for the cutting at the corner and realize the high edge accurate machining.

## 12.3 High-speed and High-accuracy Functions [kBPM: k Block per Minute]

### 12.3.1 High-speed Machining Mode

#### 12.3.1.1 High-speed Machining Mode I (G05P1) Maximum [kBPM]

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ 33.7 | △ 33.7 | △ 33.7 | △ 33.7 | ○ 33.7 | ○ 33.7 | ○ 16.8 | △ |
| L | △ 33.7 | △ 33.7 | △ 33.7 | △ 33.7 | ○ 33.7 | ○ 33.7 | − | △ |

This function runs a machining program that approximates a free curve with fine segments at a high speed.
This is effective in increasing the speed of machining dies with a free curve.
The command format is as follows.

| | |
|---|---|
| G05 P1 | : High-speed machining mode I start |
| G05 P0 | : High-speed machining mode I cancel |

In addition to the G05P0 command, the high-speed machining mode I is canceled with the following commands.
- High-speed machining mode II (G05P2)
- High-speed high-accuracy control I (G05.1Q1)
- High-speed high-accuracy control II (G05P10000)

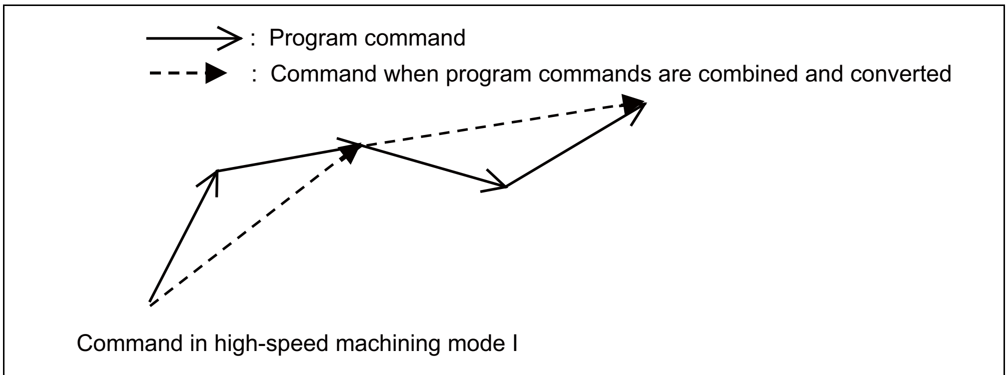
Fine segment capacity
G1 block fine segment capacity (unit: kBPM)

| Mode | Command | Maximum feed rate when G1 block is executed |
|---|---|---|
| High-speed machining mode Ⅰ | G05 P1 | 33.7 (M800W/M800S/M80W/M80 TypeA)<br>16.8 (M80 TypeB) |

The above performance applies under the following conditions.
- 6-axis system (including spindle) or less
- 1-part system
- 3 axes or less commanded simultaneously in G01
- Block containing only axis name and movement amount (Does not contain macro or variable command)
- During G61.1 high-accuracy control mode or during cutting mode (G64)

It may not be possible to attain the specified feed rate if deviated from the above conditions.

(1) During the high-speed machining mode I, the blocks are pre-read. If the length of the block is sufficiently short in respect to the command speed, and enough to be completed with one interpolation calculation, several blocks may be combined and converted into a block length that can be completed with one interpolation.




(2) Override, maximum cutting speed clamp, single block operation, dry run, manual interruption, graphic trace and high-accuracy control mode are valid even during the high-speed machining mode I.

### 12.3.1.2 High-speed Machining Mode II (G05P2) Maximum [kBPM]

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ 168 | △ 168 | △ 168 | △ 168 | ○ 67.5 | ○ 67.5 | ○ 67.5 | △ |
| L | △ 168 | △ 168 | △ 168 | △ 168 | ○ 67.5 | ○ 67.5 | — | △ |

This function runs a machining program that approximates a free curve with fine segments at a high speed.
Higher fine segment processing capacity can make the cutting speed faster, resulting in reducing the cycle time and improving the quality of the machining surface.
This function can be used simultaneously in up to two part systems.

Command format

| | |
|---|---|
| G05 P2 | : High-speed machining mode II start |
| G05 P0 | : High-speed machining mode II cancel |

In addition to the G05P0 command, the high-speed machining mode II is canceled with the following commands.
- High-speed machining mode I (G05P1)
- High-speed high-accuracy control I (G05.1Q1)
- High-speed high-accuracy control II (G05P10000)
- High-speed high-accuracy control III (G05P20000)

Fine segment capacity

The following is the fine segment capacity while high-speed machining mode II is valid.

Fine segment processing capacity (unit: kBPM)

M: Machining center system

L: Lathe system

| Number of part systemsNumber of axes | Number of setting part systems | M850/M830 | | M80W/M80 TypeA | | M80 TypeB | |
|---|---|---|---|---|---|---|---|
| | | M | L | M | L | M | L |
| 1-part system | 1-part system | 168 | 168 | 67.5 | 67.5 | 67.5 | — (*2) |
| 2-part system | 1-part system | 100 | 100 | 67.5 | 67.5 | 67.5 | — (*2) |
| | 2-part system | 67.5 | 67.5 | 33.7 | 33.7 | 33.7 | — (*2) |
| 4-part system Less than 16 axes | 1-part system | - (*1) | 33.7 | — (*1) | — (*1) | — (*1) | — (*2) |
| | 2-part system | - (*1) | 33.7 | — (*1) | — (*1) | — (*1) | — (*2) |
| 5-part system or more or 17 axes or more | 1-part system | - (*1) | 16.8 | — (*1) | — (*1) | — (*1) | — (*2) |
| | 2-part system | - (*1) | 16.8 | — (*1) | — (*1) | — (*1) | — (*2) |

(*1) The maximum number of part systems is 2

(*2) There is no specifications for high-speed machining mode II.

(Note) The above performance applies under the following conditions.
- 3 axes or less commanded simultaneously in G01
- Block containing only axis name and movement amount (Does not contain macro or variable command)
- During tool radius compensation OFF (G40)
- The numbers of process block per unit time is configured at low speed mode by parameter.

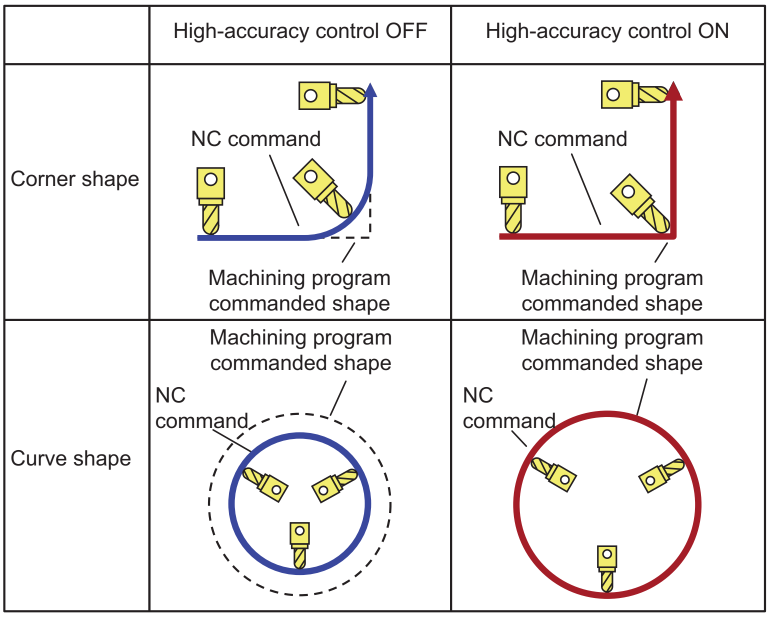
It may not be possible to attain the specified feed rate if deviated from the above conditions.

## 12.3.2 High-accuracy Control

### 12.3.2.1 High-accuracy Control (G61.1/G08)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | △ | △ | △ | △ | ○ | ○ | － | △ |

Machining errors caused by delays in control systems can be inhibited. This function is useful for machining which needs to make an edge at a corner or reduce an error from an inner route of curved shape. In high-accuracy control, acceleration/deceleration is performed not to cause machining error by pre-reading blocks and acceleration/deceleration is automatically performed according to a machining shape so that the machining error is inhibited with minimizing an extension of machining time.




High-accuracy control is valid in High-accuracy control command (G08P1/G61.1), High-speed high-accuracy control I command (G05.1Q1), High-speed high-accuracy control II command (G05P10000), High-speed high-accuracy control III command (G05P20000) and Spline interpolation command (G61.2).

One or more of the functions in the table below must be ON. Program error (P123) occurs if the high-accuracy control is commanded with all of functions OFF status.

| Function name | Details |
|---|---|
| High-accuracy control | This function enables High-accuracy control. |
| High-speed high-accuracy control I | This function enables High-speed high-accuracy control I. |
| High-speed high-accuracy control II | This function enables High-speed high-accuracy control II. |
| High-speed high-accuracy control III | This function enables High-speed high-accuracy control III. |
| Spline interpolation | This function enables Spline interpolation. |

Command format

High-accuracy control ON

```
G61.1 ;
or, G08 P1;
```

High-accuracy control OFF

```
G08 PO ;
or, G command in G code group 13 expect G61.1
```

High-accuracy control can be cancelled with either command regardless of enabled high-accuracy control.

High-accuracy control inhibits machining errors with minimizing an extension of machining time using the following functions.

(1) Acceleration/deceleration before interpolation
(2) Optimum speed control
(3) Vector accuracy interpolation
(4) Feed forward control
(5) S-pattern filter control

**(1) Acceleration/deceleration before interpolation**

Velocity waveform is smoothed by performing acceleration/deceleration control on movement commands to inhibit shocks caused by rapid acceleration at the machine movement start/stop. However, if the high-accuracy control is OFF, a corner rounding may occur at the joint between blocks or a path error may occur for the commanded shape which has been described in machining program because the acceleration/deceleration process is performed after the interpolation.

If the high-accuracy control is ON, the acceleration/deceleration process is performed before the interpolation to solve the problems mentioned above. This acceleration/deceleration before interpolation enables machining with a faithful path to the commanded shape of machining program. Furthermore, the acceleration/deceleration time can be reduced because the constant inclination acceleration/deceleration is performed for the acceleration/ deceleration before interpolation.

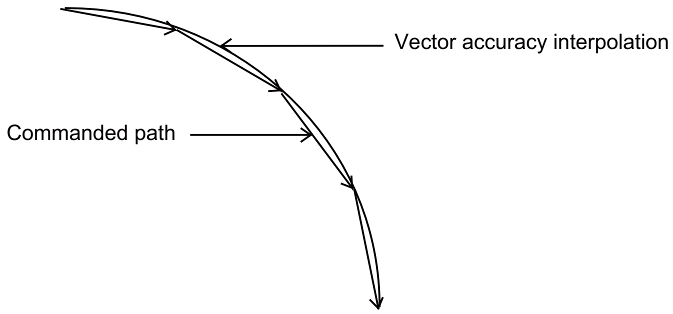
**(2) Optimum speed control**

When the moving direction is changed on the corner, arc, etc., acceleration corresponding to the amount of change and the feedrate is generated. When the acceleration is large, there is a possibility of machine vibration and it may remain stripes on the machining surface.

In the high-accuracy control mode, the deceleration control (optimum speed control) is performed to keep the generated acceleration under the allowance which has been designed with the parameter so that the problem mentioned above can be solved. The optimum speed control suppresses the machine vibration and enables highly accurate machining while minimizing the extension of cycle time.

**(3) Vector accuracy interpolation**

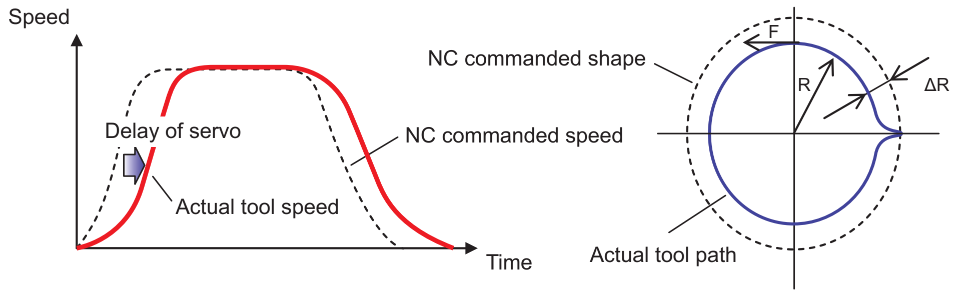
When a fine segment is commanded and the angle between the blocks is extremely small (when not using corner deceleration), interpolation can be carried out more smoothly using the vector accuracy interpolation.



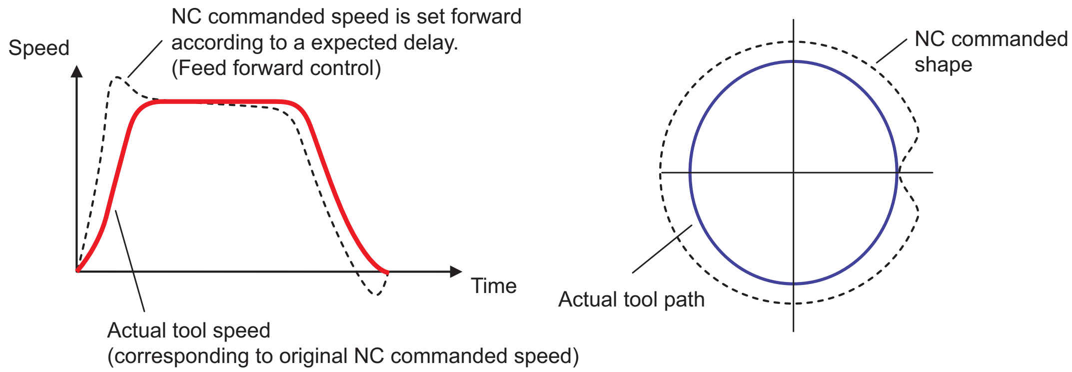

**(4) Feed forward control**

This function reduces path errors caused by delay of servo systems. Path errors caused by acceleration/ deceleration of NC can be eliminated by acceleration/deceleration before interpolation, however errors caused by delay of servo systems cannot be eliminated by acceleration/deceleration before interpolation. Therefore, when the arc shape of radius R (mm) is machined at speed F (mm/min) as the figure (a) below, for instance, the lag time occurs between the NC commanded speed and the actual tool speed in amount of the servo system time constant and the path error ΔR (mm) occurs. Feed forward control generates the command value taking the delay of servo systems as shown in figure (b) below so that the path error caused by delay of servo systems can be inhibited.

(a) NC command and actual tool movement during Feed forward control OFF



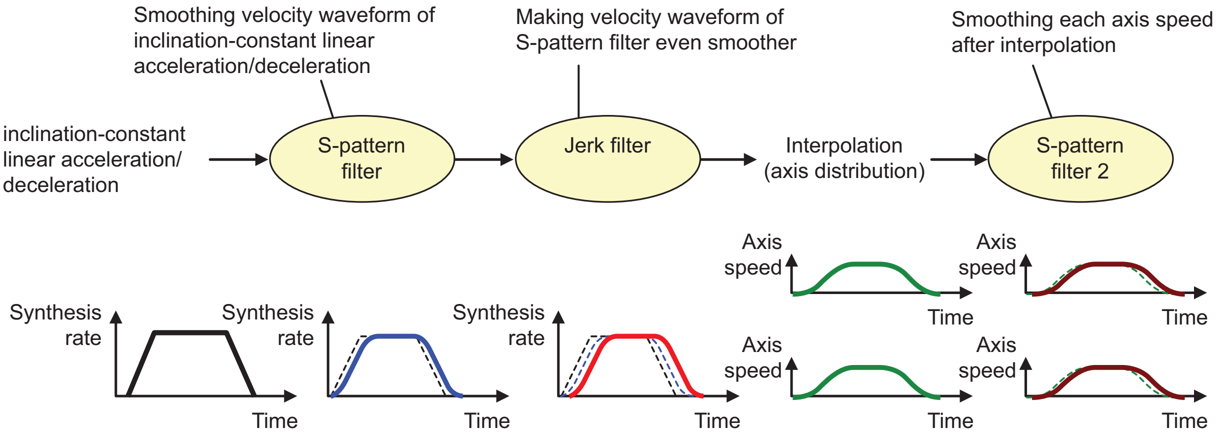

(b) NC command and actual tool movement during Feed forward control ON



**(5) S-pattern filter control**

S-pattern filter (soft acceleration/deceleration filter) is the function that inhibits the machine vibration by smoothing a velocity waveform. There are types of filters as follows:

- G1/G0 S-pattern filter
- Jerk filter
- S-pattern filter 2

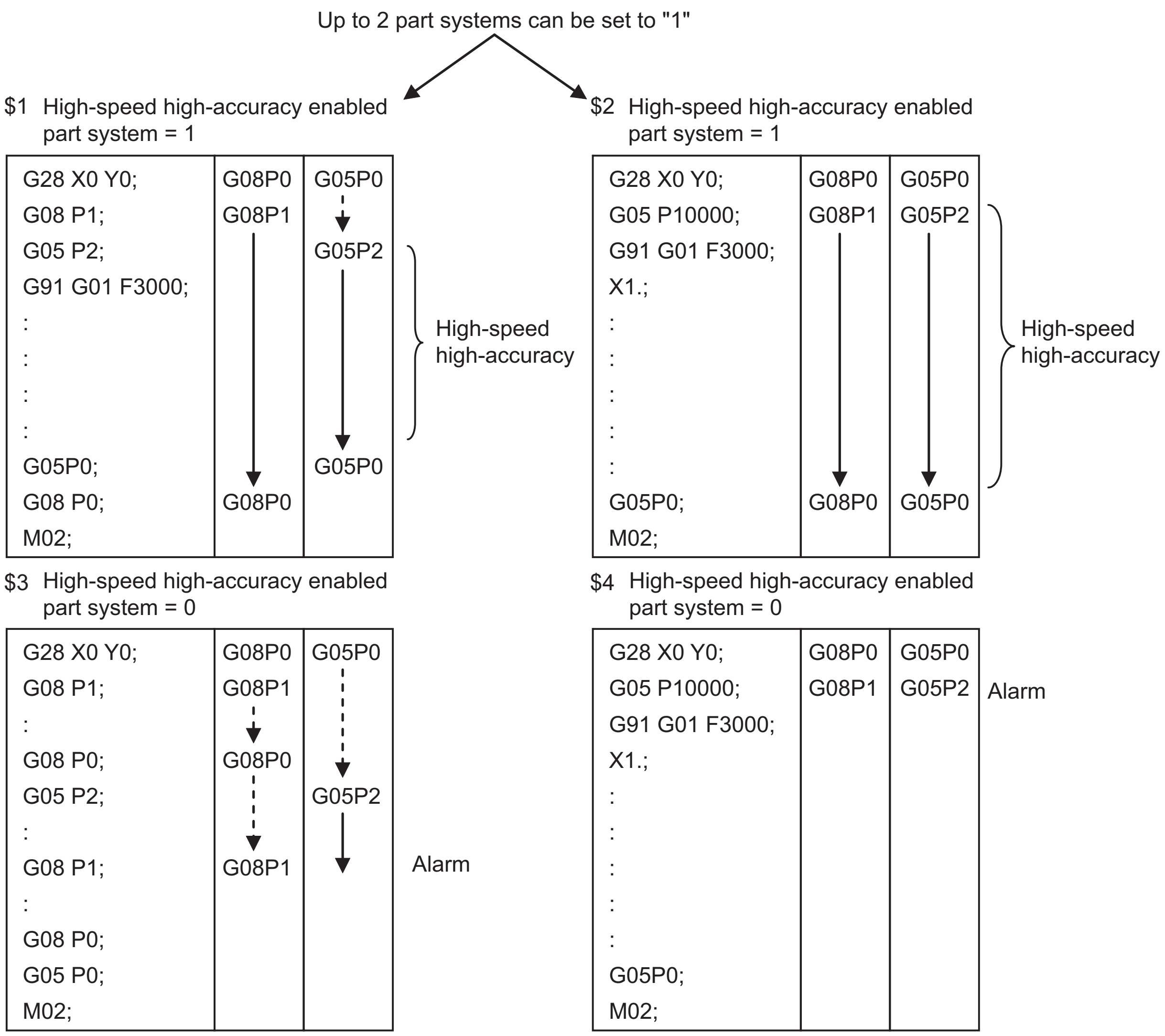


### 12.3.2.2 Multi-part System Simultaneous High-accuracy Control

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | — | △ |
| L | △ | △ | △ | △ | — | — | — | — |

* Up to two part systems.

High-accuracy control and high-speed machining mode are available respectively in all part systems, however, the simultaneous usage of high-accuracy control and high-speed machining mode (including High-speed high-accuracy control I/II/III) are available only in part systems which are limited by the parameter "High-speed high-accuracy enabled part system". The high-accuracy control and high-speed machining mode can be used simultaneously in the part system which is set to "1" for "High-speed high-accuracy enabled part system". The program error (P129) occurs when the high-accuracy control and high-speed machining mode are used simultaneously in the part system which is set to "0" for "High-speed high-accuracy enabled part system".
Note that up to 2 part systems can be set to "1" for "High-speed high-accuracy enabled part system". If 3 or more part systems are set to "1", MCP alarm (Y51) occurs. If all part systems are set to "0" for "High-speed high-accuracy enabled part system", the simultaneous usage of high-accuracy control and high-speed machining mode is available in part system 1 ($1) and part system 2 ($2).




(Note) It is limited also in G61.1 command.

### 12.3.2.3 SSS Control

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | △ | △ | △ | △ | ○ | ○ | － | － |

Machining programs that approximate a freely curved surface with fine segments are run at high speed and with high accuracy. This function enables machining with less scratches and streaks on the cutting surface compared to the conventional high-accuracy control function.
When the speed control with reference to the angle between two blocks, such as the conventional high-accuracy control "Optimum corner deceleration", is applied, the acceleration and deceleration may be frequently repeated for local steps and errors, resulting in scratches and streaks on the cutting surface.
With SSS (Super Smooth Surface) control, the large area path information is used instead of just the angle between the blocks. Thus, optimum speed control that is not adversely affected by minute steps or waviness is possible. This reduces the parts which get scratch like marks and streaks on the cutting surface.
Multiple part systems simultaneous high-accuracy function is required to conduct the SSS control in the second or following part systems.

[Features of SSS control]

(1) This is valid for machining a mold with a smooth shape using a fine segment program.
(2) This speed control is not easily affected by the error found in the path.
(3) Even if corner deceleration is not required, the speed is clamped if the predicted acceleration is high.
(The clamp speed can be adjusted with the parameter "Clamp speed coefficient".)

The length of the path direction recognized with SSS control can be adjusted with the parameter. The range is increased as the setting value increases, and the effect of the error is reduced.

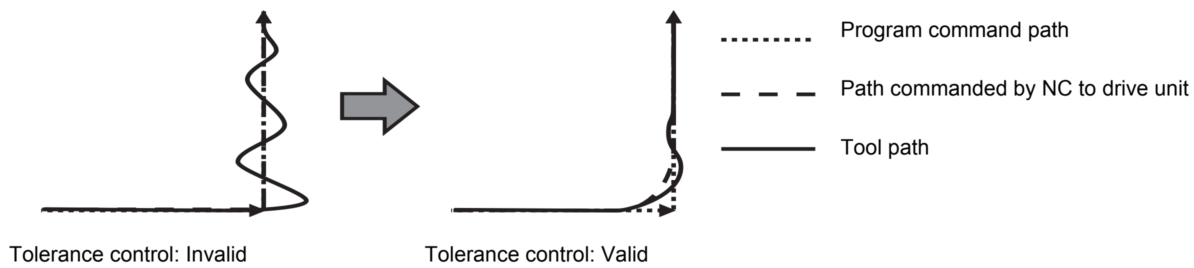
(Note 1) When using this function, one of the following SSS-controlled high-accuracy control functions is required, as well.
- High-accuracy control (G61.1)
- High-accuracy control (G08P1)
- High-speed high-accuracy control I (G05.1Q1)
- High-speed high-accuracy control II (G05P10000)
- High-speed high-accuracy control III (G05P20000)

(Note 2) The performance of fine-segment execution during SSS control differs depending on the type of high-accuracy control mode and machine model to be combined.

### 12.3.2.4 Tolerance Control

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | △ | △ | △ | △ | ○ | ○ | − | − |

This function obtains the optimum clamp speed for corners or curves based on the designated tolerance to perform operations. It also ensures smooth passing in corner sections within the tolerance range, which suppresses machine vibrations.
This function allows the machine to operate with the optimum tool path and speed, simply by specifying the tolerance, so an operator can easily carry out high quality machining.
The tolerance refers to the allowable error amount between the path commanded in the machining program and the path output by NC.
This function requires the SSS control specifications because it can only be used under SSS control.

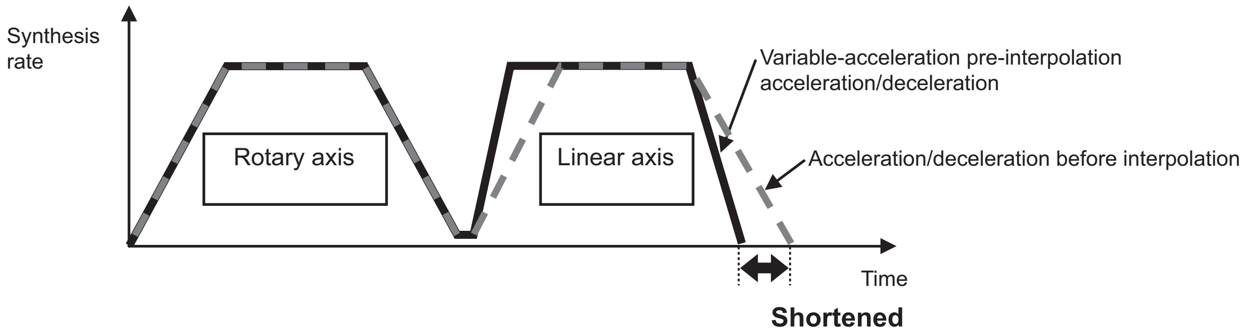


### 12.3.2.5 Variable-acceleration Pre-interpolation Acceleration/Deceleration

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | － | － | － | － |
| L | － | － | － | － | － | － | － | － |

This function is useful when each axis differs in the characteristics (responsiveness) during SSS control (4-axis/5-axis machine, etc.).
The normal acceleration/deceleration before interpolation performs the acceleration/deceleration by setting acceleration common to all axes. Therefore, if the high responsiveness and low responsiveness coexist in axes, the acceleration needs to be set to suit the axis with low responsiveness.
On the other hand, the variable-acceleration pre-interpolation acceleration/deceleration can perform the acceleration/ deceleration by setting diverse acceleration to each axis. Therefore, the acceleration for the axis with high responsiveness can be larger than before so that cycle time can be reduced especially in the indexing machining.

Shortening indexing machining time (when responsiveness of linear axis is higher than responsiveness of rotary axis)




### 12.3.2.6 High-accuracy Acceleration/Deceleration Time Constant Extension

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | － | － | － | － |
| L | － | － | － | － | － | － | － | － |

* 1st part system only.

This extends the upper limit of cutting feed time constant from 5,000[ms] to 30,000[ms] for acceleration/ deceleration before interpolation.
In the multi-part system, this function cannot be used together as an alarm will occur.

### 12.3.3 High-speed High-accuracy Control

A machining program that approximates a free curve with fine segments can be run at a high speed and with a high accuracy. This function is effective in decreasing the cycle time of machining dies with free curves. This function is also useful in machining which needs to make an edge at a corner or reduce a path error from inner route of curved shape because the high-accuracy control mode is turned ON automatically.

#### 12.3.3.1 High-speed High-accuracy Control I (G05.1Q1) Maximum [kBPM]

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ 67.5 | △ 67.5 | △ 67.5 | △ 67.5 | ○ 33.7 | ○ 33.7 | ○ 33.7 | △ |
| L | △ 67.5 | △ 67.5 | △ 67.5 | △ 67.5 | ○ 33.7 | ○ 33.7 | － | △ |

Command format

| | |
|---|---|
| **G05.1 Q1 ;** | **High-speed high-accuracy control I ON** |
| **G05.1 Q0 ;** | **High-speed high-accuracy control I OFF** |

Fine segment capacity

The following is the fine segment capacity while high-speed high-accuracy control I is valid.

Fine segment processing capacity (unit: kBPM)

M: Machining center system

L: Lathe system

| Number of part systemsNumber of axes | Number of setting part systems | M850/M830 | | M80W/M80 TypeA | | M80 TypeB | |
|---|---|---|---|---|---|---|---|
| | | M | L | M | L | M | L |
| 1-part system | 1-part system | 67.5 | 67.5 | 33.7 | 33.7 | 33.7 | — (*2) |
| 2-part system | 1-part system | 67.5 | 67.5 | 33.7 | 33.7 | 33.7 | — (*2) |
| | 2-part system | 33.7 | 33.7 | 16.8 | 16.8 | 16.8 | — (*2) |
| 4-part system<br>Less than 16 axes | 1-part system | — (*1) | 33.7 | — (*1) | — (*1) | — (*1) | — (*2) |
| | 2-part system | — (*1) | 33.7 | — (*1) | — (*1) | — (*1) | — (*2) |
| 5-part system or more<br>or<br>17 axes or more | 1-part system | — (*1) | 16.8 | — (*1) | — (*1) | — (*1) | — (*2) |
| | 2-part system | — (*1) | 16.8 | — (*1) | — (*1) | — (*1) | — (*2) |

(*1) The maximum number of part systems is 2

(*2) There is no specifications for high-speed high-accuracy control I.

(Note) The above performance applies under the following conditions.

- 3 axes or less commanded simultaneously in G01
- Block containing only axis name and movement amount (Does not contain macro or variable command)
- During tool radius compensation OFF (G40)
- The numbers of process block per unit time is configured at low speed mode by parameter.

It may not be possible to attain the specified feed rate if deviated from the above conditions.

### 12.3.3.2 High-speed High-accuracy Control II (G05P10000) Maximum [kBPM]

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ 168 | △ 168 | △ 168 | △ 168 | ○ 67.5 | ○ 67.5 | ○ 67.5 | △ |
| L | △ 168 | △ 168 | △ 168 | △ 168 | ○ 67.5 | ○ 67.5 | ー | △ |

Command format

```
G05 P10000 ;    High-speed high-accuracy control II ON
G05 P0 ;        High-speed high-accuracy control II OFF
```

Fine segment capacity

The following is the fine segment capacity while high-speed high-accuracy control II is valid.

Fine segment processing capacity (unit: kBPM)

M: Machining center system

L: Lathe system

| Number of part systemsNumber of axes | Number of setting part systems | M850/M830 | | M80W/M80 TypeA | | M80 TypeB | |
|---|---|---|---|---|---|---|---|
| | | M | L | M | L | M | L |
| 1-part system | 1-part system | 168 (*3) | 168 (*3) | 67.5 | 67.5 | 67.5 | — (*2) |
| 2-part system | 1-part system | 100 | 100 | 67.5 | 67.5 | 67.5 | — (*2) |
| | 2-part system | 67.5 | 67.5 | 33.7 | 33.7 | 33.7 | — (*2) |
| 4-part system<br>Less than 16 axes | 1-part system | — (*1) | 33.7 | — (*1) | — (*1) | — (*1) | — (*2) |
| | 2-part system | — (*1) | 33.7 | — (*1) | — (*1) | — (*1) | — (*2) |
| 5-part system or more<br>or<br>17 axes or more | 1-part system | — (*1) | 16.8 | — (*1) | — (*1) | — (*1) | — (*2) |
| | 2-part system | — (*1) | 16.8 | — (*1) | — (*1) | — (*1) | — (*2) |

(*1) The maximum number of part systems is 2

(*2) There is no specifications for high-speed high-accuracy control II.

(*3) 100kBPM for a time constant expansion system, or during tool center point control, inclined surface machining or workpiece installation error compensation.
(Time constant expansion system can be used in a system configured with a single part system when the specification is valid.)

(Note) The above performance applies under the following conditions.

- 3 axes or less commanded simultaneously in G01
- Block containing only axis name and movement amount (Does not contain macro or variable command)
- During tool radius compensation OFF (G40)
- The numbers of process block per unit time is configured at low speed mode by parameter.

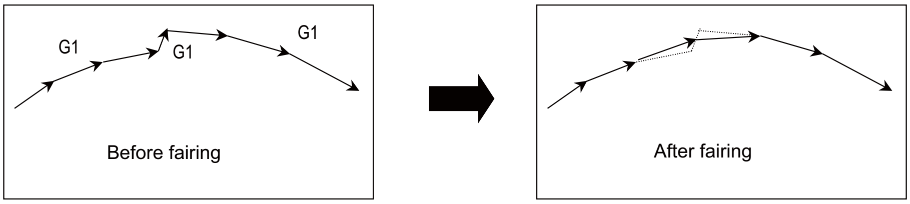
It may not be possible to attain the specified feed rate if deviated from the above conditions.

Additional functions when high-speed high-accuracy control II/III mode is ON

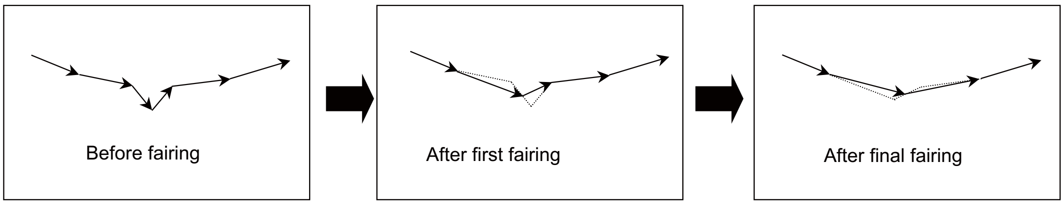
**(1) Fairing**

If the protruding path (zigzagging path) is shorter than the parameter setting values in the machining program generated with a CAM, etc., this function can be used to eliminate the protruding paths smaller than the setting value so that the front and back paths are smoothly connected.

This function is valid only for continuous linear commands (G1).

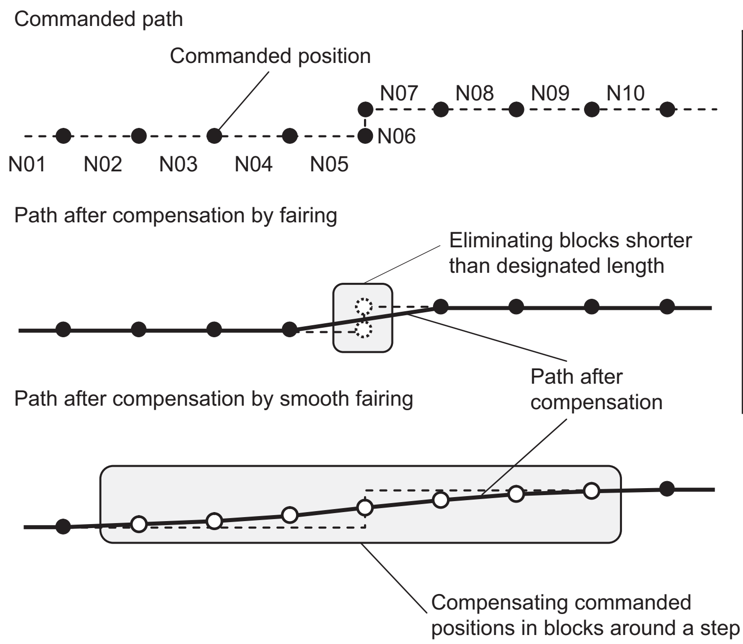



If there is any protruding path after fairing, fairing is repeated.




There is the smooth fairing function in addition to the fairing function.

When a minute step exists on a commanded path, for instance, the path after compensation differs between fairing and smooth fairing as follows:



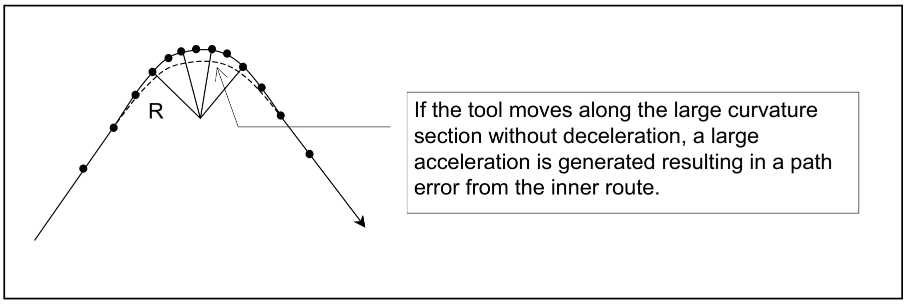

```
G90 G00 X0 Y0;
G01;
N01 X0.100 Y0.000;
N02 X0.200 Y0.000;
N03 X0.300 Y0.000;
N04 X0.400 Y0.000;
N05 X0.500 Y0.000;
N06 X0.500 Y0.010;
N07 X0.600 Y0.010;
N08 X0.700 Y0.010;
N09 X0.800 Y0.010;
N10 X0.900 Y0.010;
```

**(2) Smooth fairing**

This function interpolates the command position of machining program so that the movement path becomes smooth. This is used in cases of executing a fine-segment machining program at low speed for smooth machining and executing a long-segment rough machining program for smooth machining.
Refer to "12.3.3.4 Smooth Fairing" for details.

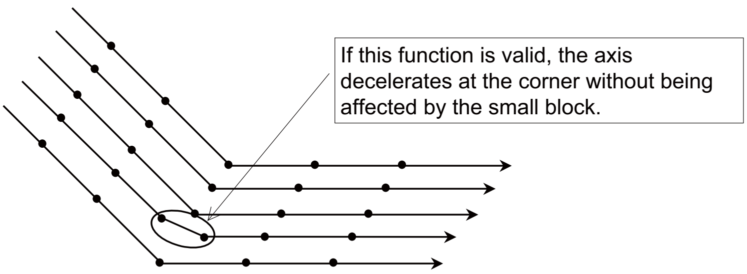
**(3) Acceleration clamp speed**

With the cutting feed clamp speed during the high-speed high-accuracy control II mode, when the parameter is set, the speed is clamped so that the acceleration generated by each block movement does not exceed the tolerable value. This function clamps the speed optimally even at a section where" angle change at each block is small but entire curvature is large" such as shown below. The tolerable acceleration value is calculated from the parameter setting values.




**(4) High-speed mode corner deceleration**

Conventionally during high-accuracy control, if the angle is large between the adjacent blocks in the machining program, this function automatically decelerates so that the acceleration generated when passing through the corner is within the tolerable value.
If a small block is inserted at the corner section with the machining program generated with the CAM, etc., the corner passing speed will not match the periphery. This can affect the machining surface.
If this type of small block is inserted when using high-speed mode corner deceleration, the corner will be largely judged by the parameter settings.
The small block is excluded when the angle is judged, but it not excluded from the actual movement command.



### 12.3.3.3 High-speed High-accuracy Control III (G05P20000) Maximum [kBPM]

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ 270 | △ 270 | △ 270 | △ 270 | ○ 135 | ○ 135 | － | △ |
| L | － | － | － | － | － | － | － | － |

Command format

(1) Setting to enable the function by G code

High-speed high-accuracy control III can be enabled by the following G code command. If the following G code is commanded, the high-speed high-accuracy control III mode will be ON even the parameter "High speed/ accu 3" is OFF.

| | |
|---|---|
| **G05 P20000 ;** | **High-speed high-accuracy control III ON** |
| **G05 P0 ;** | **High-speed high-accuracy control III OFF** |

(2) Setting to enable the function by parameter

The high-speed high-accuracy control II command can be treated as the high-speed high-accuracy control III command by enabling the parameter "High speed/accu 3".

| | |
|---|---|
| **G05 P10000 ;** | **High-speed high-accuracy control III ON** |
| **G05 P0 ;** | **High-speed high-accuracy control III OFF** |

G05P2 command in high-accuracy control mode can also be treated as the high-speed high-accuracy control III command.

Fine segment capacity

The following is the fine segment capacity while high-speed high-accuracy control III is valid.

Fine segment processing capacity (unit: kBPM)

M: Machining center system

L: Lathe system

| Number of part systemsNumber of axes | Number of setting part systems | M850/M830 | | M80W/M80 TypeA | | M80 TypeB | |
|---|---|---|---|---|---|---|---|
| | | M | L | M | L | M | L |
| 1-part system | 1-part system | 270 (*3) | — (*2) | 135 (*4) | — (*2) | — (*2) | — (*2) |
| 2-part system | 1-part system | 168 | — (*2) | 135 | — (*2) | — (*2) | — (*2) |
| | 2-part system | 100 | — (*2) | 67.5 | — (*2) | — (*2) | — (*2) |
| 4-part system<br>Less than 16 axes | 1-part system | — (*1) | — (*2) | — (*2) | — (*2) | — (*2) | — (*2) |
| | 2-part system | — (*1) | — (*2) | — (*2) | — (*2) | — (*2) | — (*2) |
| 5-part system or more<br>or<br>17 axes or more | 1-part system | — (*1) | — (*2) | — (*2) | — (*2) | — (*2) | — (*2) |
| | 2-part system | — (*1) | — (*2) | — (*2) | — (*2) | — (*2) | — (*2) |

(*1) The maximum number of part systems is 2

(*2) There is no specifications for high-speed high-accuracy control III.

(*3) 100kBPM for a time constant expansion system, or during tool center point control, inclined surface machining or workpiece installation error compensation.

(*4) 67.5kBPM for a time constant expansion system, or during tool center point control, inclined surface machining or workpiece installation error compensation.
(Time constant expansion system can be used in a system configured with a single part system when the specification is valid.)

(Note) The above performance applies under the following conditions.

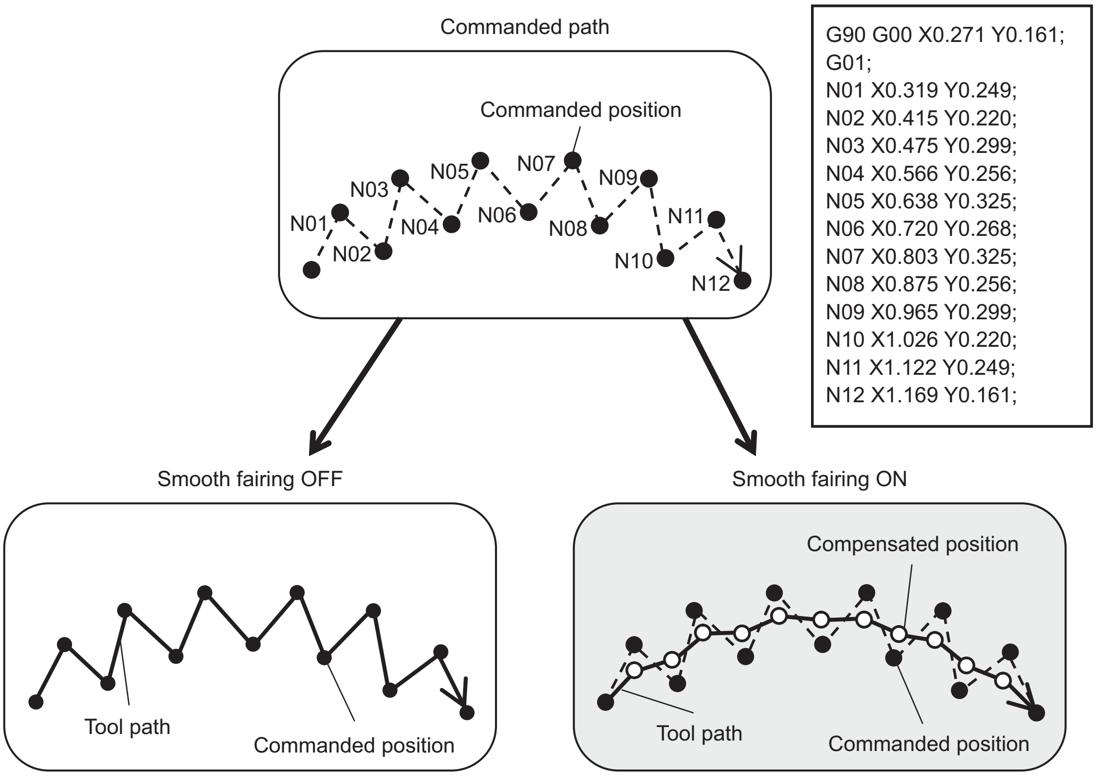
- 3 axes or less commanded simultaneously in G01
- Block containing only axis name and movement amount (Does not contain macro or variable command)
- During tool radius compensation OFF (G40)
- The numbers of process block per unit time is configured at low speed mode by parameter.

It may not be possible to attain the specified feed rate if deviated from the above conditions.

## 12.3.3.4 Smooth Fairing

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | − | △ |
| L | − | − | − | − | − | − | − | − |

A path can be smoothen by compensating commanded positions of a machining program. This function is useful when executing a fine segment program to machine smoothly at low speed or a rough machining program with long segment to machine smoothly.
This function is enabled while high-speed high-accuracy control II is ON or while high-accuracy control is ON in high-speed machining mode II/III, and performs compensation in consecutive G01 command during the time.
Refer to "12.3.3.2 High-speed High-accuracy Control II (G05P10000) Maximum [kBPM]" for the differences between fairing and smooth fairing.




(Note) While smooth fairing is valid, the high-speed high-accuracy control III operates as high-speed high-accuracy control II.

### 12.3.4 Machining Condition Selection I

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | － | ○ |

The machining condition parameter set which is consists of parameters related to the high-accuracy control can be configured in advance for each machining application (such as part machining or die machining) or machining process (such as rough or finishing), and it can be switched according to the purpose.
This can easily perform the machining which meets the conditions for the intended machining.
Multiple part systems simultaneous high-accuracy function is required to apply the machining conditions to the second or following part systems.
The machine condition commanded by G code command will reflect only to commanded part system.

### 12.3.5 Direct Command Mode

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | － | － | － | － | － | － | － | － |
| L | △ | △ | △ | △ | － | － | － | － |

This function reduces the loads of NC machining program analysis and interpolations as much as possible so that machining programs composed of fine segments are executed at high-speed with a processing speed.
Compared to normal machining modes, this function is effective for accelerating 3-dimensional machining of curved surface such as variable cam machining.

## 12.4 Programming Support Functions

### 12.4.1 Playback

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | △ | △ | △ | △ | － | － | － | － |

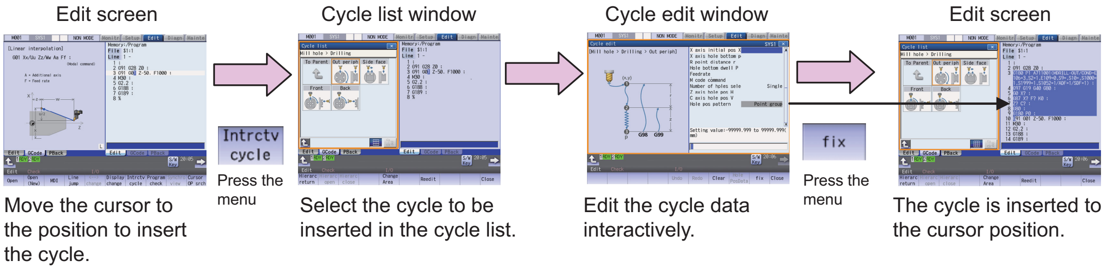
This function enables creation of a program while proceeding with sample machining by manual (handle or job) feed or mechanical handle feed. A machining program can be edited by using the playback movement amount obtained by manual operation as the program command values.
Playback edit is disabled for the machining program in the mass-editing mode.

### 12.4.3 Interactive Cycle Insertion

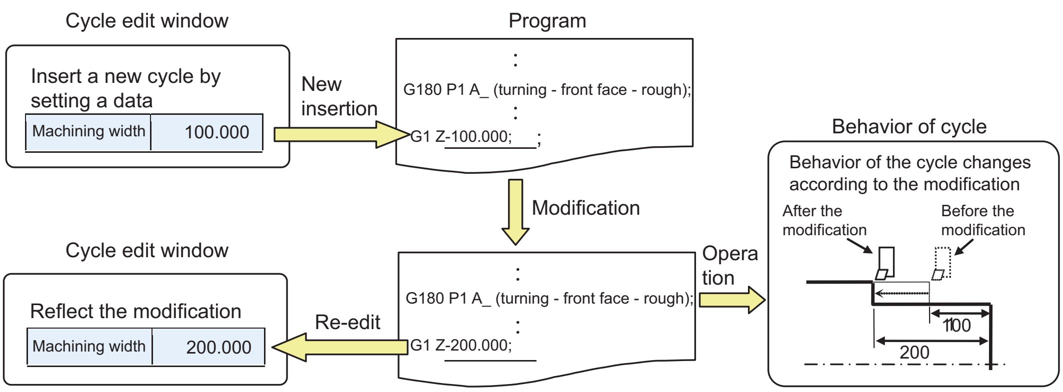
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | – | – | – | – | – | – | – | – |
| L | △ | △ | △ | △ | ○ | ○ | ○ | – |

This function enables to interactively insert a cycle to assist in the machining and setup for the program opening on the edit screen.
The programming time can be reduced by using this function.
The cycle can easily be inserted by editing data in an interactive window.

[Operation image to insert a cycle]




The program of the cycle block inserted once can directly be edited on the edit screen, and can be re-edited in the cycle edit window if the cycle format is not changed.



[Types of Cycle]
Machining cycle can be inserted. It is available for L system only.
The machining cycles listed in the table below are able to machine as drilling, turning and milling.
All Machining cycles are prepared for each machining type and machining portion.

○ : Cycle insertion available  - : No specification

| Hierarchy 1 | Hierarchy 2 | Hierarchy 3 | L system | |
|---|---|---|---|---|
| Cycle type | Machining cycle | Machining portion | Standard type | Expansion type |
| Turning hole | Drilling | Front<br>Back | ○ | ○ |
| | Deep-hole drilling | | ○ | ○ |
| | Tapping | | ○ | ○ |
| | Deep-hole tapping | | ○ | ○ |
| | Reaming | | - | ○ |
| | Boring | | ○ | ○ |
| Turning | Turning | Outer diameter<br>Inner diameter<br>Front<br>Back | ○ | ○ |
| | Turning (compound) | | ○ | ○ |
| | Copying | | ○ | ○ |
| | Grooving | | ○ | ○ |
| | Cutting-off | | ○ | ○ |
| | Thread cutting | Outer diameter<br>Inner diameter | ○ | ○ |
| | Thread cutting (compound) | | ○ | ○ |
| | Thread recutting | | ○ | ○ |
| | Thread recutting (compound) | | ○ | ○ |
| Milling hole | Drilling | Periphery<br>Side<br>Front<br>Back | ○ | ○ |
| | Deep-hole drilling | | ○ | ○ |
| | Step drilling | | ○ | ○ |
| | Tapping | | ○ | ○ |
| | Deep-hole tapping | | ○ | ○ |
| | Reaming | | - | ○ |
| | Boring | | ○ | ○ |
| Milling | Pocketing | Side<br>Front<br>Back | - | ○ |
| | Grooving | | - | ○ |

### 12.4.4 Simple Programming (NAVI MILL/LATHE)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | − |
| L | △ | △ | △ | △ | ○ | ○ | ○ | − |

Create a part program by using NAVI MILL (for machining center system) or NAVI LATHE (for lathe system).

(1) The following machining processes can be edited.

| M system | L system |
|---|---|
| - Hole drilling (Drilling, deep hole drilling, step, boring, tapping)<br>- Surface cutting (Circle, square)<br>- Contour cutting (Circle, square, arbitrary shape)<br>- Pocket machining (Circle, square, L pattern, U pattern)<br>- EIA | <Turning machining><br>- Turning (Outside dia., inside dia., front face)<br>- Copying (Outside dia., inside dia., front face)<br>- Threading (Outside dia., inside dia., front face)<br>- Grooving (Outside dia., inside dia., front face)<br>- Trapezoid grooving (Outside dia., inside dia., front face)<br>- Hole drilling (Drilling, deep hole drilling, step, tapping)<br>- EIA<br>- Cutting-off<br><br><Milling machining><br>- Milling hole machining (Drilling, deep hole drilling, boring, tapping)<br>[Hole pattern]<br>- Random (Front face, outer periphery, side face)<br>- Line (Front face, outer periphery, side face)<br>- Arc (Front face, side face)<br>- Circle (Front face, side face)<br>- Square (Front face, side face)<br>- Lattice (Front face, side face)<br>- Key groove (Front face, outer periphery, side face)<br>- Contour machining (Front face, outer periphery, side face)<br><br><Auxiliary operation><br>- Delivery<br><br><Balance cut><br>- Turning balance cut<br>- Copying balance cut<br>- Two-part system simultaneous thread cutting |

(2) Cutting conditions are automatically determined from tool management data and cutting condition file.
(3) The operation screen consists of the list view area and the operation view area. In the list view area, the entire part program can be seen at all time. In the operation view area, there are guide drawings related to each input item, which allows an easy data input.
(4) Program Checker enables the tool paths of a part program to be graphically traced. With this function, an input error can be detected at an earlier stage.
(5) Guidance function provides an operator with error recovery information.
(6) Part program is a macro-program-based NC program. Process commands can be added in the edit screen.
(7) The macro program above can be customized by the machine tool builder.

### 12.4.5 G code Guidance

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

G code guidance is a function to display illustration of the contents or movements of the commanded format for the G code currently under editing. This is used when creating or editing a machining program.
With this function, the G code contents under the editing process can be checked on the spot.

# 13

# Machine Accuracy Compensation

## 13.1 Static Accuracy Compensation

### 13.1.1 Backlash Compensation

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

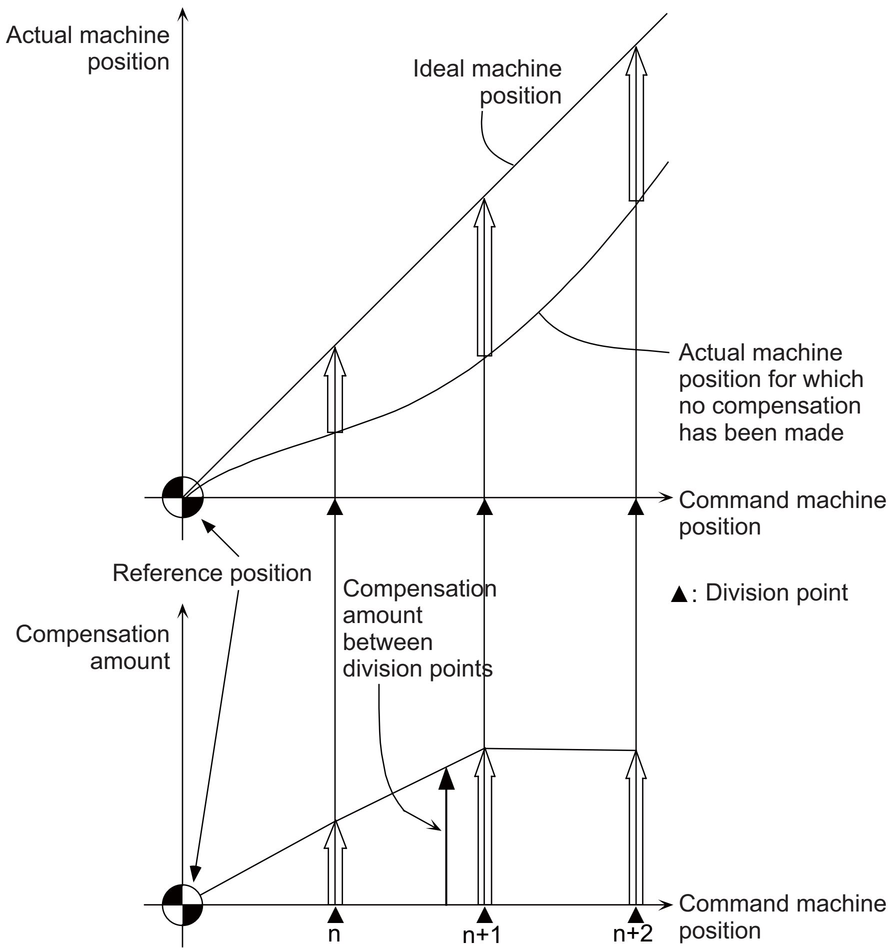
This function compensates for the error (backlash) produced when the direction of the machine system is reversed.
The backlash compensation can be set in the cutting feed mode or rapid traverse mode.
The amount of backlash compensation can be set separately for each axis. It is set using a number of pulses in increments of one-half of the least command increments. The output follows the output unit system. The "output unit system" is the unit system of the machine system (ball screw unit system).
The amount of compensation for each axis ranges from 0 to ±9999 (pulses).

### 13.1.2 Memory-type Pitch Error Compensation [sets]

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ 32 | ○ 32 | ○ 32 | ○ 32 | ○ 16 | ○ 16 | ○ 16 | ○ 10 |
| L | ○ 32 | ○ 32 | ○ 32 | ○ 32 | ○ 16 | ○ 16 | ○ 16 | ○ 10 |

With the reference position defined as the base, set the compensation amount in the division points obtained by equally dividing the machine coordinates.
According to the specified parameters, this method compensates an axis feed error caused by a ball screw pitch error, etc.
The compensation amount can be set by either the absolute or incremental system. Select the desired method with the parameter.
Machine position between division points n and n+1 is smoothly compensated by the linear approximation of the compensation amount.
Up to 32 sets of axes can be set for the compensation for M800 Series, or up to 16 sets of axes for M80 Series.
Up to 1899 points can be set for the compensation for M800 and M80 Series.

[Relationship between the compensation amount and machine position]



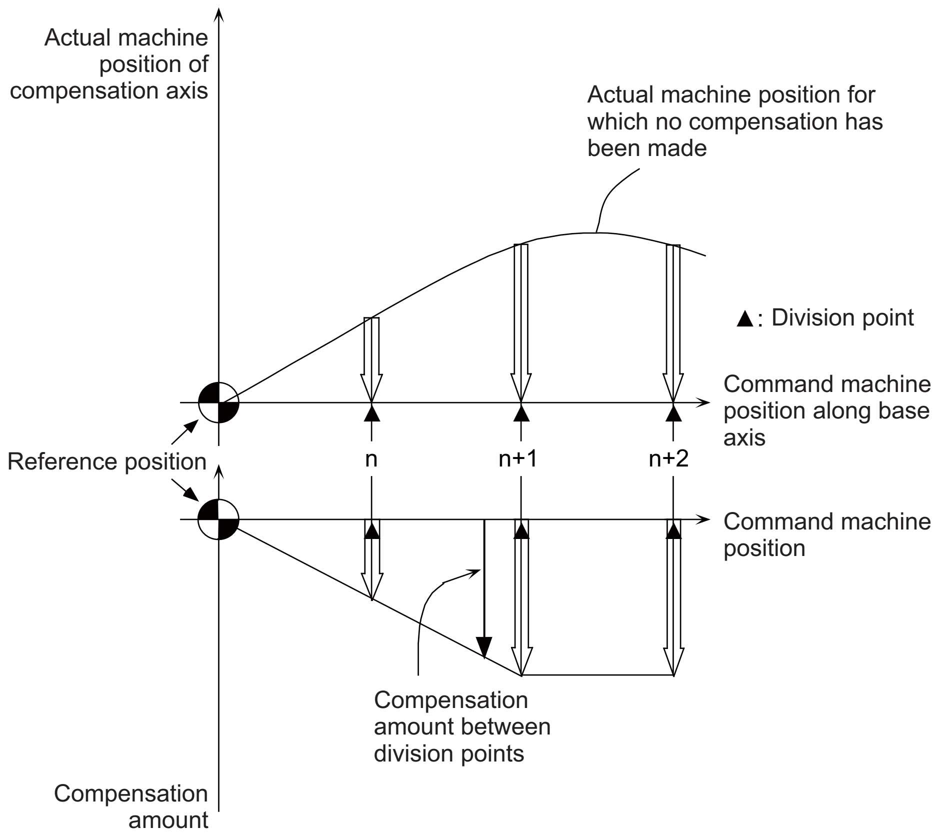

(Note 1) Compensation points 1899 is a total including the points for memory-type relative position error compensation.
(Note 2) A scale of 0 to 99-fold is applied on the compensation amount.

### 13.1.3 Memory-type Relative Position Error Compensation

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

This method, according to the parameters specified in advance, compensates the relative position error between two orthogonal axes caused by deflection of the moving stand.
Specify the compensation amount in the compensation axis direction in the division points obtained by equally dividing the machine coordinates of the base axis.
The base axis is one of the two orthogonal axes to which relative position compensation applies. This axis is used as the criterion for relative-error measurement. The compensation axis is the coordinate axis that is orthogonal to the base axis. The compensation is actually made for this coordinate axis.
Machine position between division points n and n+1 is smoothly compensated by the linear approximation of the compensation amount.
Up to 32 sets of axes can be set for the compensation for M800 Series, or up to 16 sets of axes for M80 Series.
Up to 1899 points can be set for the compensation for M800 and M80 Series.

[Relationship between the compensation amount and machine position]

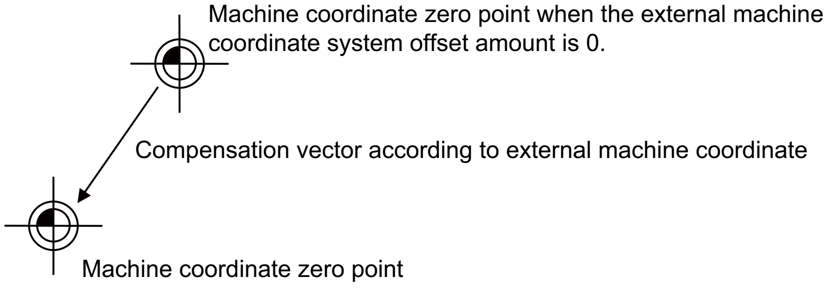



(Note 1) Compensation points 1899 is a total including the points for memory-type pitch error compensation.
(Note 2) A scale of 0 to 99-fold is applied on the compensation amount.

### 13.1.4 External Machine Coordinate System Compensation

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

The coordinate system can be shifted by inputting a compensation amount from the PLC. This compensation amount will not appear on the counter (all counters including machine position). If the machine's displacement value caused by heat is input for example, this can be used for thermal displacement compensation.




### 13.1.5 Circular Error Radius Compensation

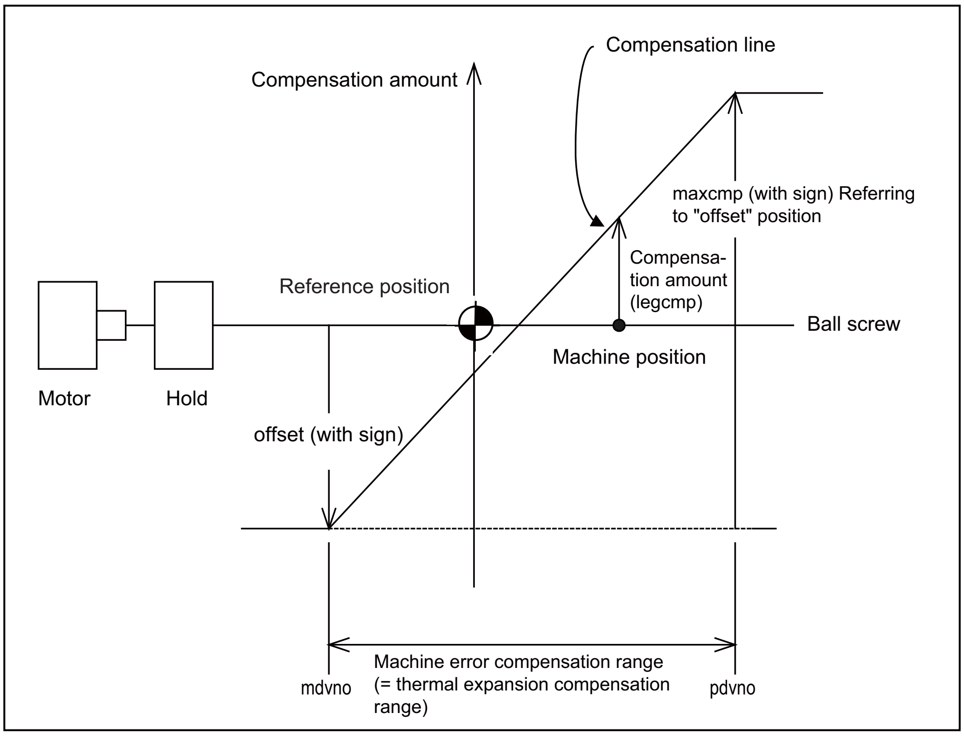
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

With commands designated during arc cutting, this function compensates for movement toward the inside of the arcs caused by a factor such as servo delay.

### 13.1.6 Ball Screw Thermal Expansion Compensation

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

This compensates the axis feed error caused by the ball screw thermal expansion, etc. using the values set in the R register's thermal displacement compensation parameter.
The compensation amount at the end of the machine error compensation range (mdvno to pdvno) is set. The compensation line is obtained from the set compensation amount, and is linearly distributed in the machine error compensation range to attain smooth compensation. A compensation amount that changes during operation can also be compensated.




**(1) Conditions under which thermal displacement compensation is valid**

- When function is valid.
- When axis No. and parameter (offset, maxcmp) is set in R register.
- When pitch error compensation parameter is set correctly.

**(2) Compensation operation**

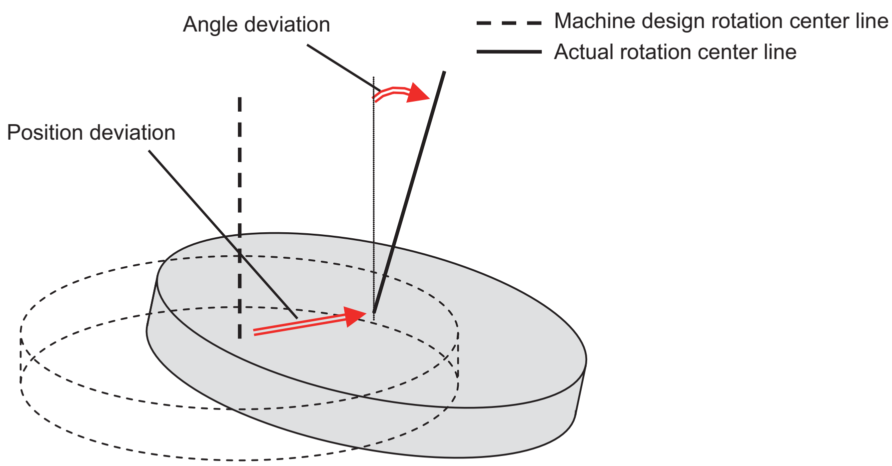
- The machine error compensation range is compensated with the thermal displacement compensation amount (absolute position compensation amount) obtained with the compensation line.
- The compensation amount is immediately calculated when thermal displacement compensation is validated.
- When the compensation amount is changed, the new compensation line is immediately obtained, and the range is compensated again with that compensation amount.
- Thermal displacement compensation can be used with machine error compensation. In this case, the sum of the machine error compensation amount and the thermal displacement compensation amount is added to the machine position and issued as the NC command.

### 13.1.7 Rotation Center Error Compensation

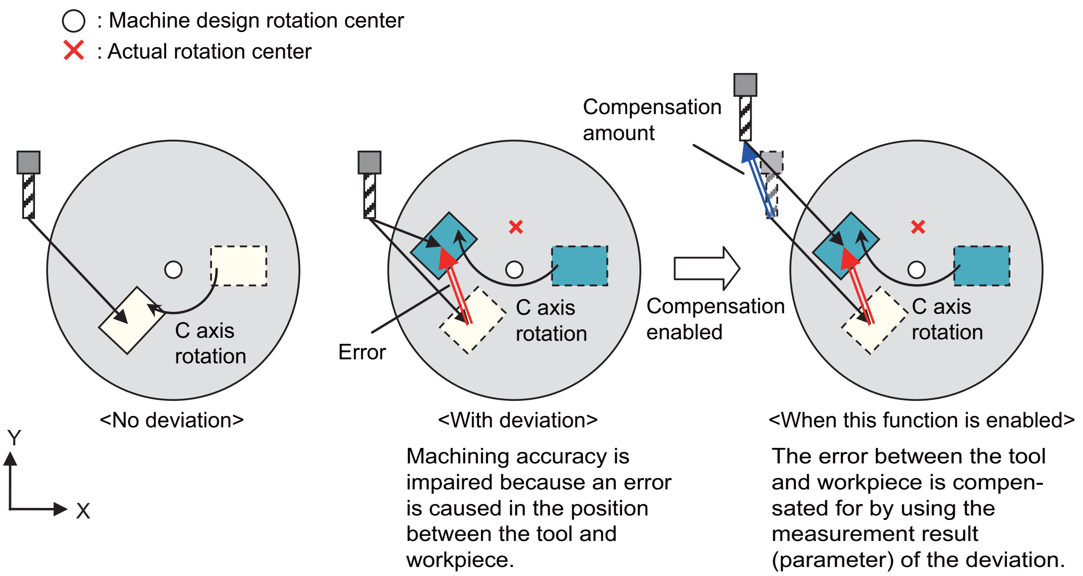
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | — | — |
| L | — | — | — | — | — | — | — | — |

In the machine having a rotary axis, the rotation center deviates due to the assembly error of the rotary axis. Thus, if a machining is carried out with the rotary axis, the machining accuracy is impaired because an error is caused in the relative position between the tool and workpiece.
There are two types of rotation center deviation. One is "position deviation", in which the rotation center is shifted in the planar direction, and the other is "angle deviation", in which the rotation center inclines.
Higher-accuracy machining is realized by compensating for these two types of deviation.

[Position deviation and angle deviation]




[Compensation for the deviation of the rotation center]

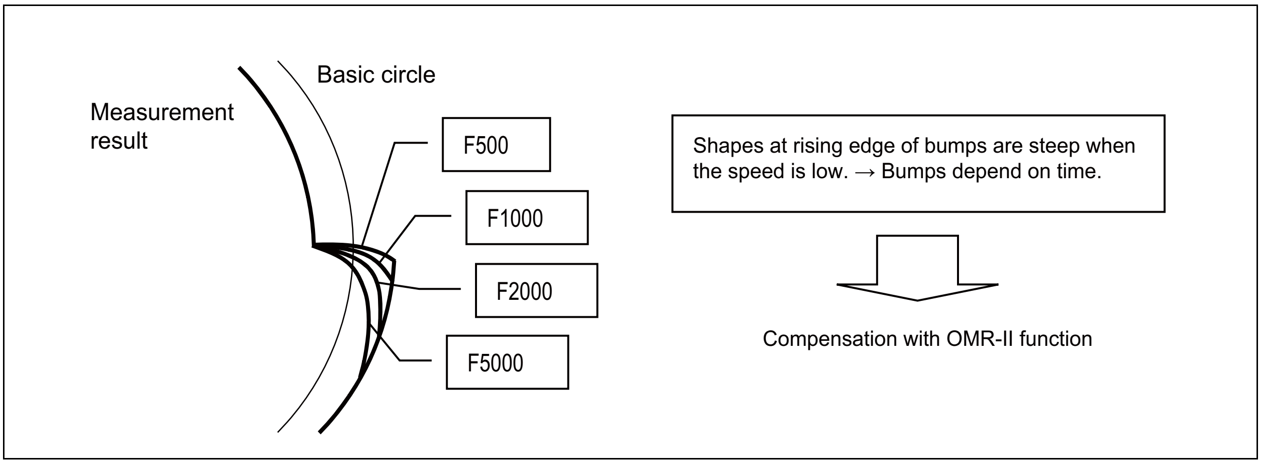


### 13.1.8 Position-dependent Gradually Increasing-type Backlash Compensation

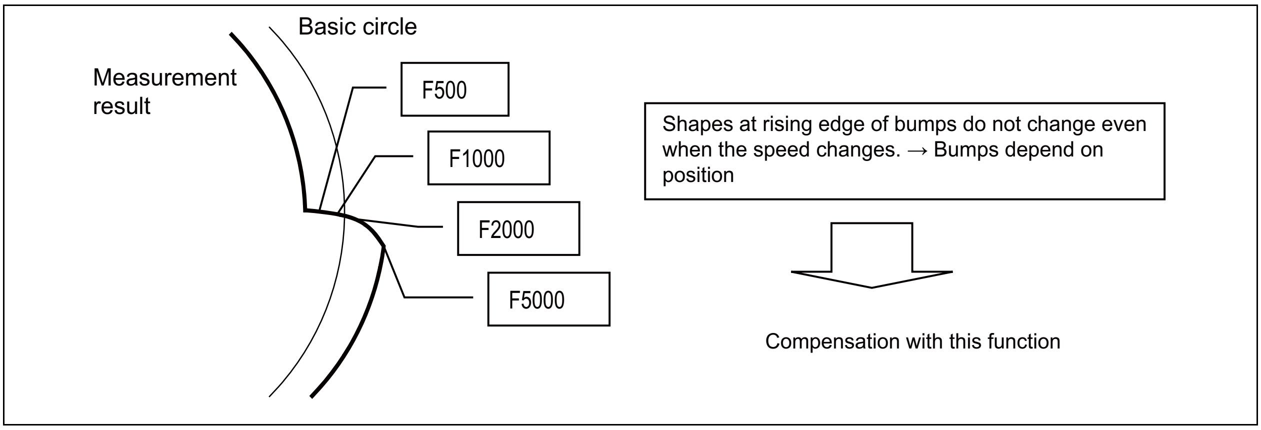
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

Usually, minute bumps are generated when the machine movement direction is reversed. (Lost motion) However, due to various mechanical system factors, there may be cases where the bumps do not change in steps but gradually change after the direction reversal. (Gradually increasing-type lost motion)
Depending on the mechanical structure, the gradually increasing-type lost motion includes the type where the bump amount depends on "duration of time" from when the machine movement direction is reversed and the type where the bump amount depends on "distance". When the bump amount depends on "duration of time", compensation is possible with the OMR-II function. (13.2.4 OMR II(Backlash with Filter)).
With this function, the gradually increasing-type lost motion which depends on the distance from the point where the machine movement direction is reversed can be compensated by controlling the variation of backlash compensation amount according to the distance from the direction reversal point.

<When the bump amount changes according to speed>




<When the bump amount does not change according to speed>



### 13.1.9 Two-way Pitch Error Compensation

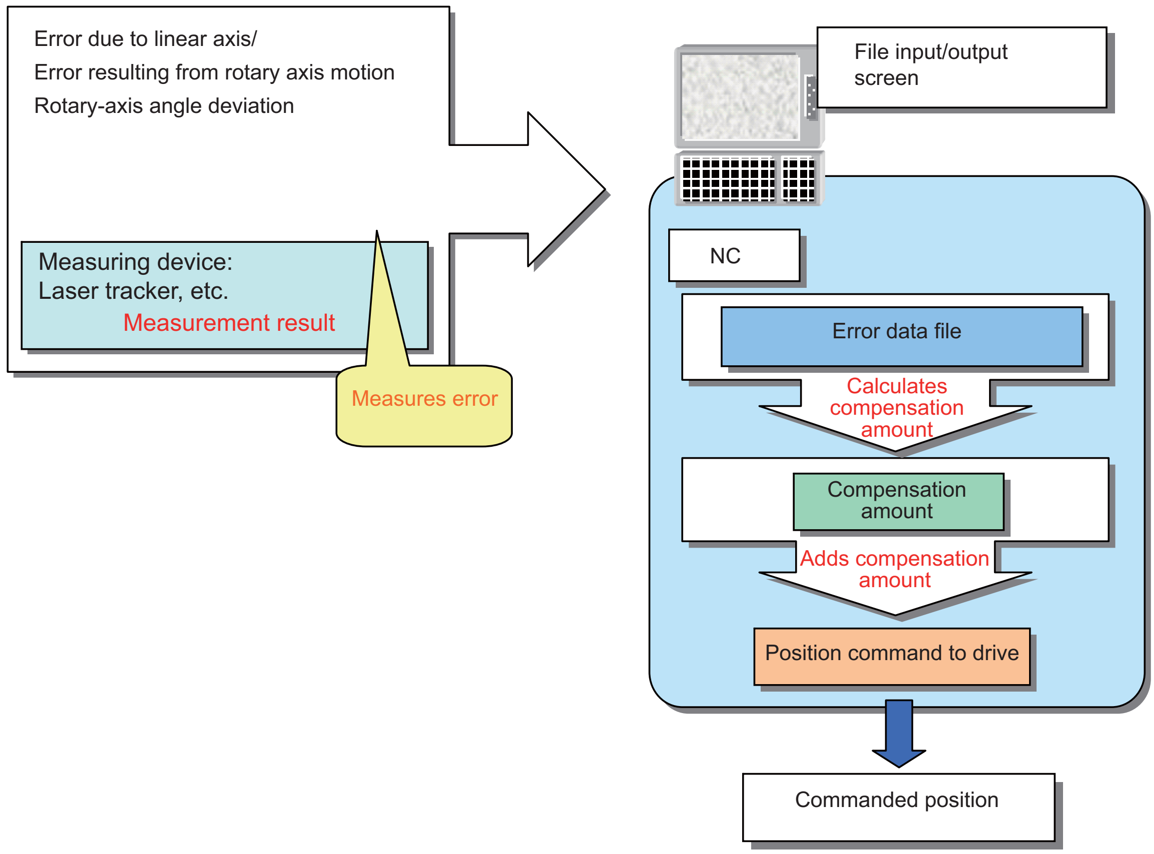
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

Two-way pitch error compensation function is used to compensate the pitch error in each direction by setting the pitch error compensation amount when moving in the positive and negative direction.
This function reduces the difference of tool path between the positive and negative direction.

### 13.1.11 Spatial Error Compensation

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | － | － | － | － |
| L | － | － | － | － | － | － | － | － |

This function can compensate for three-dimensional errors of a machine tool due to its linear and rotary axes. This measures the spatial errors caused by the linear and rotary axes with a measuring device, and inputs the measurement results to the NC to make an error data file. The function calculates the compensation amount based on the error data file and adds the calculated compensation amount of the linear and rotary axes to the drive command position to perform the compensation. The function can reduce deterioration of machining accuracy due to mechanical errors, which will lead to high-accuracy machining.
This function is enabled for a machine where three linear axes form a right-handed orthogonal coordinate system.



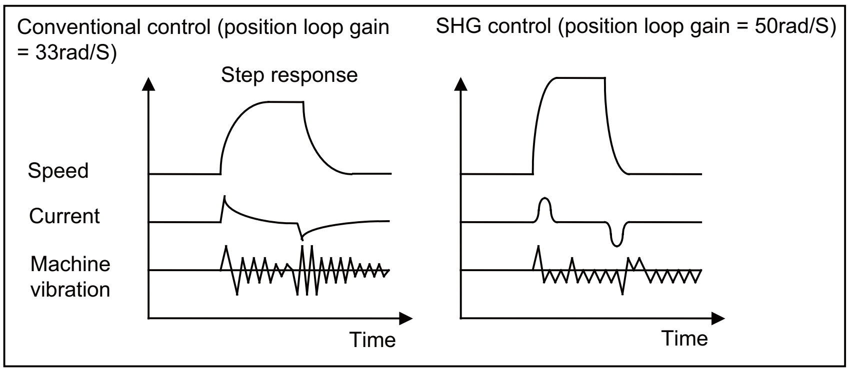
## 13.2 Dynamic Accuracy Compensation

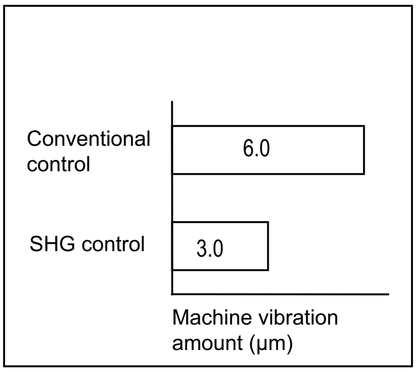
### 13.2.1 Smooth High-gain (SHG) Control

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

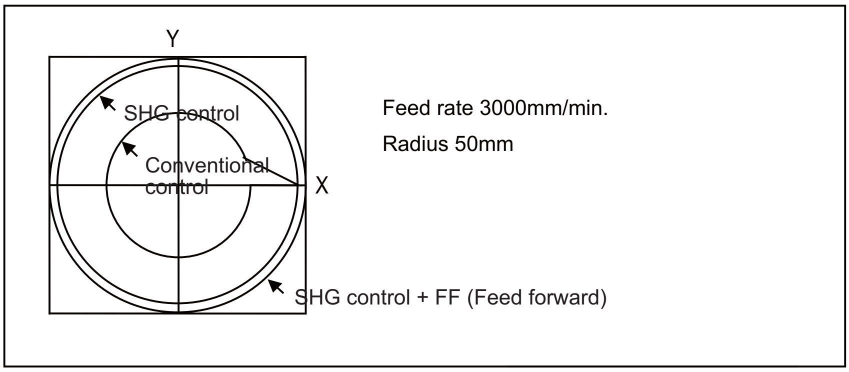
This is a high-response and stable position control method using the servo system. This SHG control achieves an approximately three-fold position loop gain equally compared to the conventional control method.
The features of the SHG control are as follows.

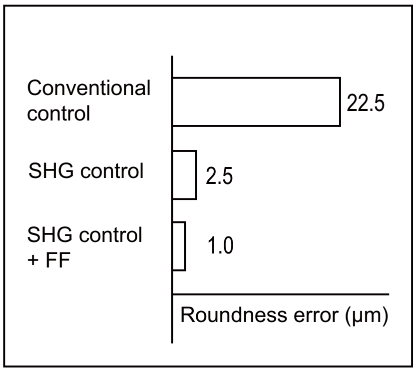
(1) The acceleration/deceleration becomes smoother, and the mechanical vibration can be suppressed (approx. 1/2) during acceleration/deceleration. (In other words, the acceleration/deceleration time constant can be shortened.)



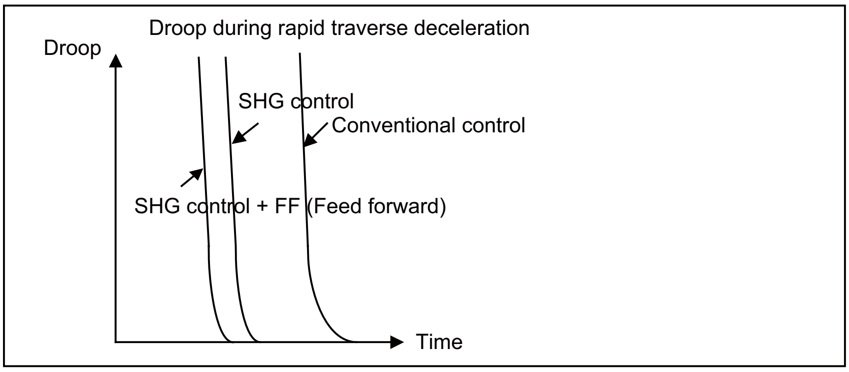



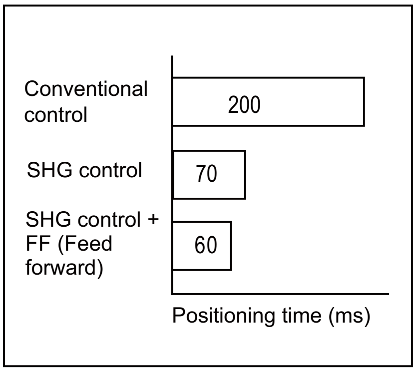

(2) The shape error is approx. 1/9 of the conventional control.




(3) The positioning time is approx. 1/3 of the conventional control.

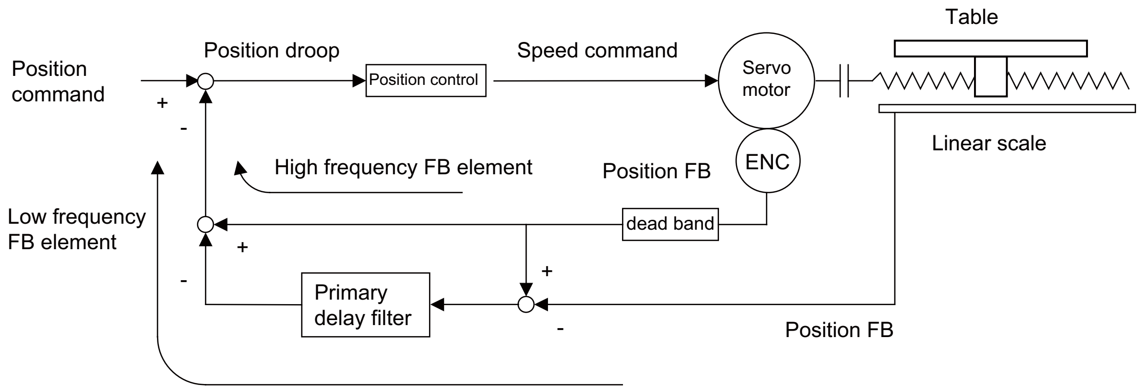


### 13.2.2 Dual Feedback

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

If the motor and machine coupling or machine system's rigidity is low (ex. large machine, etc.) when using a closed loop system, the response during acceleration/deceleration will vibrate and cause overshooting. This can cause the position loop gain from increasing. The dual feedback function is effective in this case.
To validate the dual feedback function, use position feedback with a motor side detector in ranges with high acceleration to enable stable control. In ranges with low acceleration, use position feedback with the machine side detector (scale). This will make it possible to increase the position loop gain.
The machine side detector (scale) is required separately.




Dual feedback control

The state will approach the semi-closed loop system as the primary delay filter's time constant increases, so the position loop gain limit will increase. Note that the limit of the position loop gain increased with the dual feedback function is the same as the position loop gain limit for a semi-closed system that does not use a machine side detector (scale, etc.). In addition, the positioning time will increase as the primary delay filter time constant increases.

### 13.2.3 Lost Motion Compensation

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

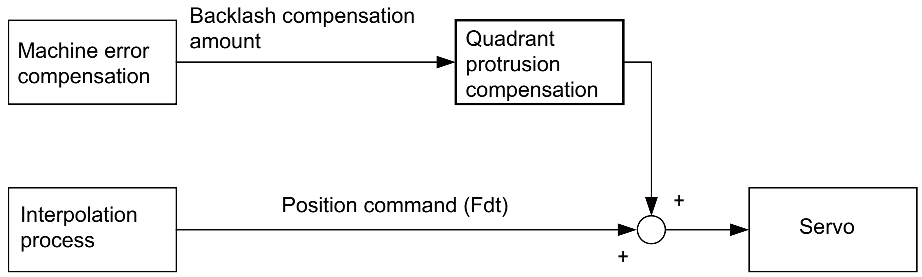
This function compensates the error in the protrusion shape caused by lost motion at the arc quadrant changeover section during circular cutting.

### 13.2.4 OMR II (Backlash with Filter)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

The OMR (Optimal Machine Response) control function estimates the machine or motor model (moment of inertia, clone friction, viscosity coefficient, etc.) that can cause a path error (error in actual tool path in respect to the path commanded with the program). High-accuracy machining is achieved by carrying out feed forward control based on that model. This allows error cased by quadrant protrusions during circular interpolation or quadrants on the inner side of the path to be greatly reduced.
OMR-II is a function that focuses on the quadrant protrusions, and improves the path error with this. Quadrant path compensation is included in OMR-II.

The quadrant protrusion compensation function improves quadrant protrusions by issuing compensation to the backlash compensation amount to compensate the error when the machine system direction is reversed.
By adding the compensated backlash compensation amount to the position command and sending it to the servo, the gradually increasing-type lost motion which occurs at quadrant changeover can be compensated.



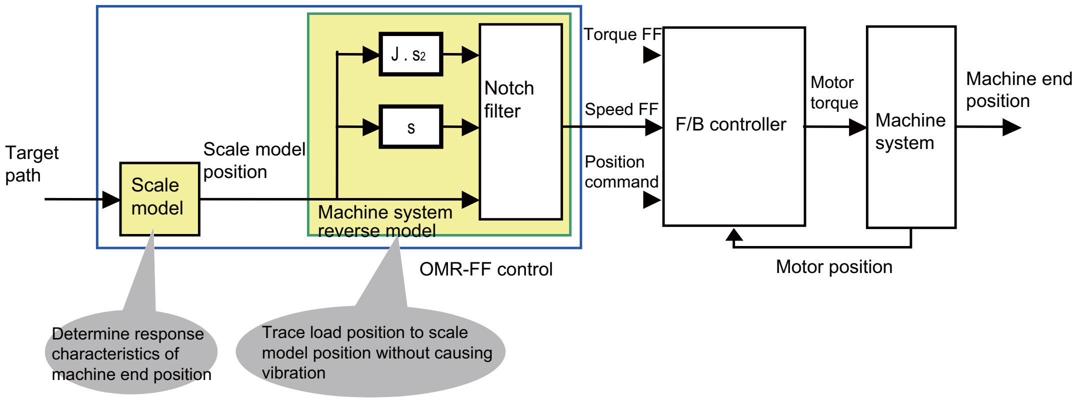
### 13.2.6 OMR-FF

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | △ | △ | △ | △ | ○ | ○ | ― | △ |

The OMR (Optimal Machine Response) control estimates the causes (moment of inertia, clone friction, viscosity coefficient, etc.) of the path error (error in actual tool path in respect to the path commanded with the program) by making a model of the control target. Feed forward control is carried out based on that model.

With the OMR-FF control method, highly accurate machining can be achieved by using the command filter function to suppress vibration in addition to the reverse model feed forward function.
The reverse model feed forward function estimates the control target's vibration characteristics using a reverse model. The feed forward command for the appropriate position, speed and current can be obtained from this estimation. This allows the machine position to be tracked to the commanded position without causing vibration when using machine tools with low rigidity.
When the command filter function is also used, the high-range vibration elements in the command can also be suppressed.

New control method to bring out the full potential of a high-speed high-acceleration machine
◆ High tracking ability for the command (Smaller path error)
◆ Suppression of the machine vibration (Suppress low-range vibration without losing tracking ability)



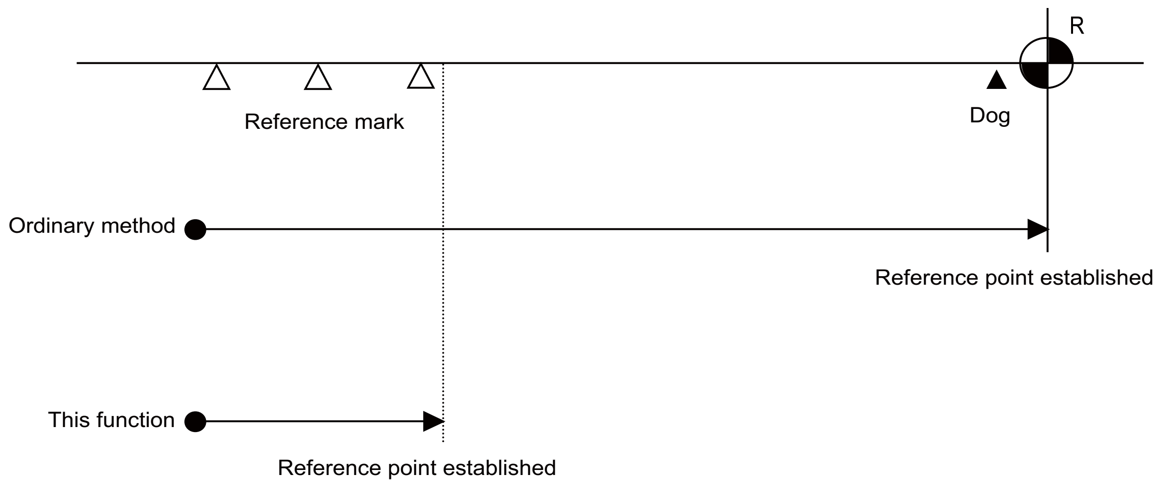

Set parameters:
(1) Scale model time constant
(2) Machine system resonance frequency ωp, anti-resonance frequency ωz, attenuation rate ζ, inertia J

### 13.2.7 Distance-coded Reference Position Detection

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | － |
| L | △ | △ | △ | △ | ○ | ○ | ○ | － |

This is the function where the scale with absolute address reference mark is used to establish the reference point in the relative position detection system.
When the reference point has not been established, it is necessary to move the axis to the reference point. On the other hand, with this function, the reference point is established by moving the axis only for several reference marks, resulting in a significant reduction of the axis movement amount.
No dog is used as the position is calculated using reference marks.

<Reference point establishment process>



# 14

# Automation Support Functions

# 14.1 Measurement

## 14.1.1 Skip

### 14.1.1.1 Skip

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

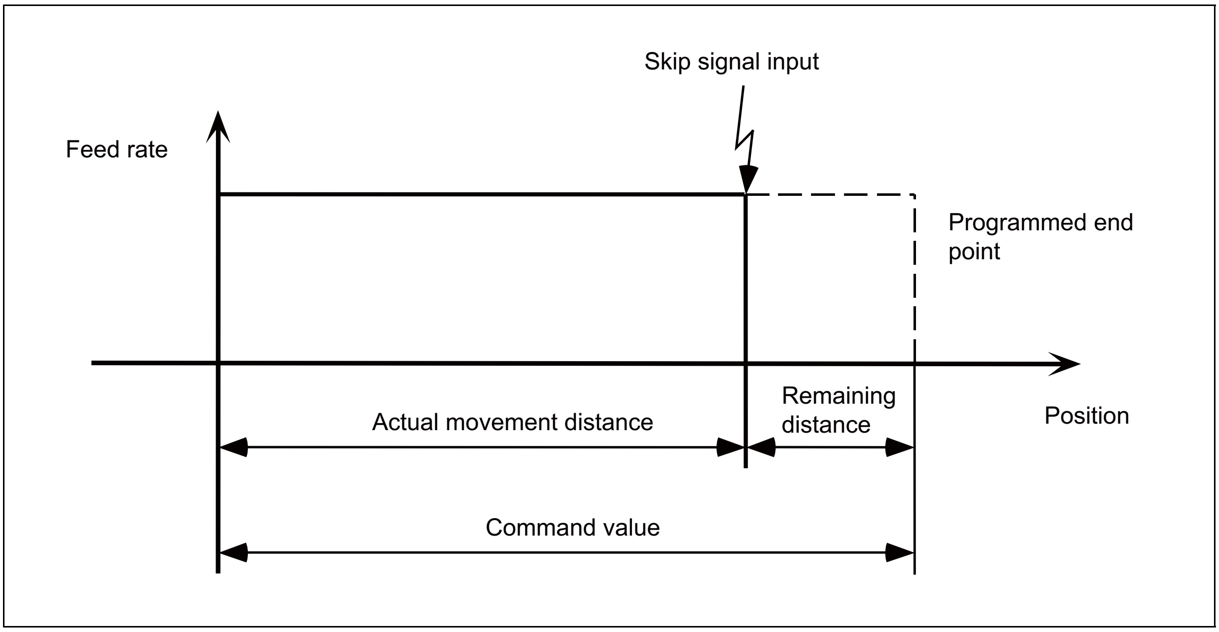
When the external skip signal is input during linear interpolation with the G31 command, the machine feed is stopped immediately, the remaining distance is discarded and the commands in the next block are executed.

[M system]

| **G31 X__ Y__ Z__ α__ R__ F__ ; (α is the additional axis.)** | |
|---|---|
| X,Y,Z,α, | : Coordinate values of each axis. Command with absolute or increment values. |
| R | : Acceleration/deceleration command |
| F | : Feed rate (mm/min) |

[L system]

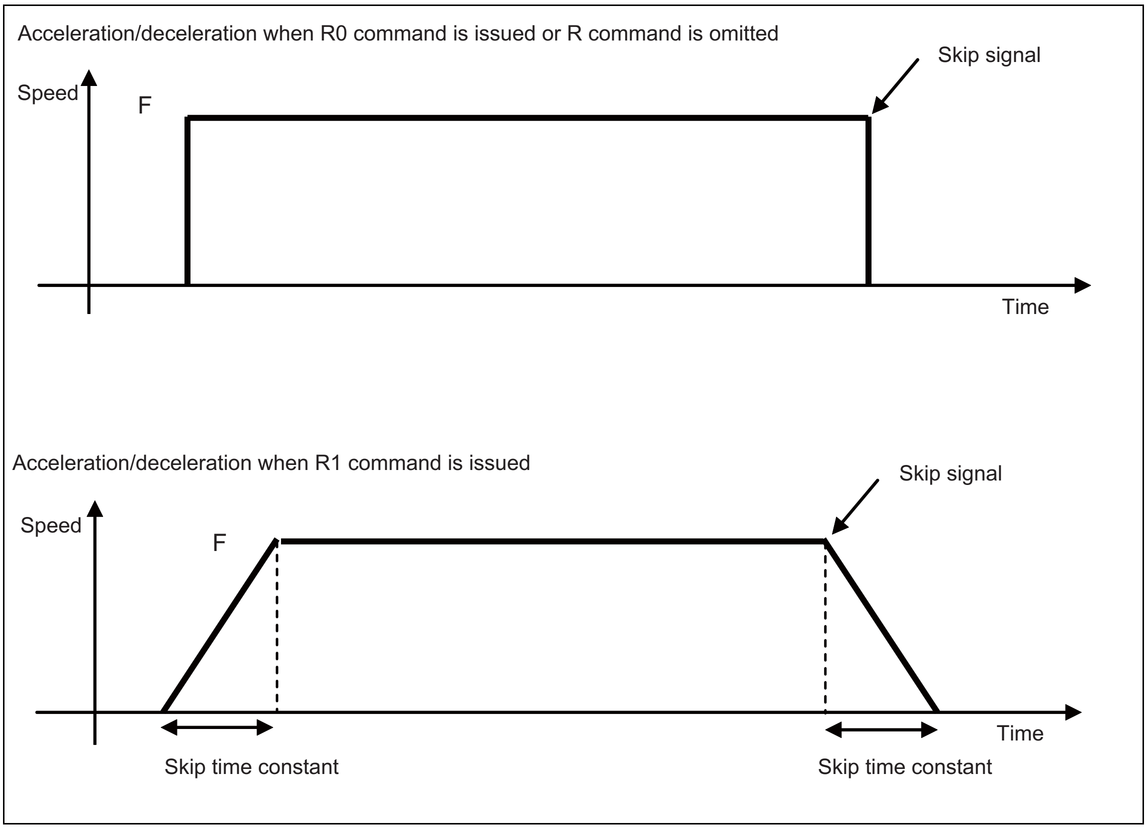
| **G31 X/U__ Z/W__ R__ F__ ;** | |
|---|---|
| X,Z,U,W | : Command values |
| R | : Acceleration/deceleration command |
| F | : Feed rate (mm/min) |




(1) The cutting feed override and dry run are enabled or disabled by the respective parameters.

(2) The feedrate switches as follows according to the parameter setting.
- The value of address F given in the G31 block, or if F is not commanded, the value set by the parameter.
- The F modal value commanded in the program.

(3) Command by G31 command basis for acceleration/deceleration command (R0/R1).
When R0 command is issued or R command is omitted, automatic acceleration/deceleration is not performed but step acceleration/deceleration is performed after interpolation in G31 block.
If R1 command is issued, automatic acceleration/deceleration is performed after interpolation even when skip signal is input.
A command is not issued or a command other than R0/R1 is issued, it will be the operation of acceleration/deceleration time constant=0(R0) and automatic acceleration/deceleration is not performed after interpolation.




Changeover of acceleration/deceleration type with R command

(4) The approximate coasting distance up to feed stop based on the detection delay in the skip signal input is calculated as below.

$$\delta 0 = \frac{F}{60} \times Tp + \frac{F}{60} \times (t1 \pm t2)$$

$$= \underbrace{\frac{F}{60} \times (Tp+t1)}_{\delta 1} \pm \underbrace{\frac{F}{60} \times t2}_{\delta 2}$$

$\delta$ : Coasting distance (mm)
F : G31 rate (mm/min)
Tp : Position loop time constant (s) = (position loop gain)$^{-1}$
t1 : Response delay time (s) = (A period of time from when the skip signal is detected until it reaches the control device.)
t2 : Response error time 0.001 (s)

(Note 1) Skipping during machine lock is not valid.

### 14.1.1.2 Multiple-step Skip

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

This function realizes skipping by designating a combination of skip signals for each skip command.

**(1) G31.n method**

This function carries out skipping by designating a combination of skip signals for each skip command (G31.1, G31.2, G31.3).

The combination of the skip signals are designated with parameters for each G code (G31.1, 31.2, 31.3), and the skip operation is executed when all signals in the combination are input.

| **G31.n Xx1 Yy1 Zz1 Ff1 ;** | |
|---|---|
| G31.n | : Skip command (n=1, 2, 3) |
| Xx1,Yy1,Zz1 | : Axis address and target position |
| Ff1 | : Feedrate (mm/min) |

**(2) G31Pn method**

As with the G31.n method, the valid skip signal is designated and skip is executed. However, the method of designating the valid skip signal differs.

The skip signals that can be used are 1 to 8. Which is to be used is designated with P in the program. Refer to Table 1 for the relation of the P values and valid signals.

Skip can be executed on dwell, allowing the remaining dwell time to be canceled during the dwell command (G04) and the next block executed under the skip conditions (to distinguish external skip signals 1 to 8) set with the parameters.

| **G31 Xx1 Yy1 Zz1 Pp Ff1 ;** | |
|---|---|
| G31 | : Skip command |
| Xx1,Yy1,Zz1 | : Axis address and target position |
| Pp | : Skip signal command |
| Ff1 | : Feedrate (mm/min) |

(a) Specify the skip rate in command feedrate F. However, F modal is not updated.

(b) Specify skip signal command in skip signal command P. Specify the P value in the range of 1 to 255. If it exceeds the specified range, a program error occurs.

(c) When the skip signals are commanded in combination, the skip operation takes place with OR result of those signals.

Table 1 Valid skip signals

| Skip signal command P | Valid skip signal | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 1 | | | | | | | | ○ |
| 2 | | | | | | | ○ | |
| 3 | | | | | | | ○ | ○ |
| 4 | | | | | | ○ | | |
| 5 | | | | | | ○ | | ○ |
| : | : | : | : | : | : | : | : | : |
| 253 | ○ | ○ | ○ | ○ | ○ | ○ | | ○ |
| 254 | ○ | ○ | ○ | ○ | ○ | ○ | ○ | |
| 255 | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

### 14.1.1.4 PLC Skip

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

This function enables skip operations to be performed by signals which are input from the user PLC.

### 14.1.1.5 Speed Change Skip

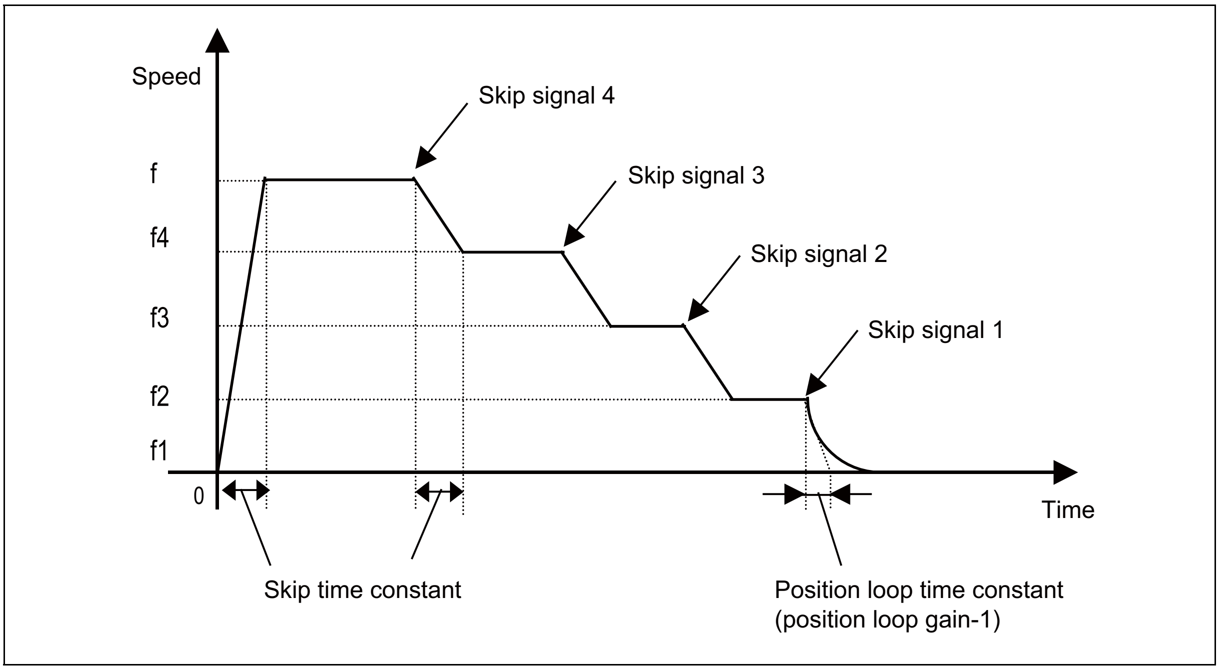
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | — | — | — | — |
| L | △ | △ | △ | △ | — | — | — | — |

This function is used to change the feed rate or to stop the movement by inputting the skip signal during the linear interpolation.
After stopping the movement with skipping, the remaining movement command is canceled and the next block is executed.
In addition to the speed change skip function, the high-speed skip option and multiple-step skip function are required to use this function.

**G31 Xx Yy Zz Ff F1 = f1 ... Fn = fn ; (n is the skip signal 1 to 8.)**

| | |
|---|---|
| G31 | : Skip command |
| Xx, Yy, Zz | : Command position |
| Ff | : Feed rate when starting the cutting feed (mm/min) |
| fn | : Feed rate after detecting the skip signal (mm/min) |
| | fn = 0 : Movement stop |
| | fn ≠ 0 : Changing the feed rate to fn |
| | F1 = Feed rate after inputting the skip signal 1 |
| | : |
| | F8 = Feed rate after inputting the skip signal 8 |

Operation example
G31 X100. Ff F1 = 0 F2 = f2 F3 = f3 F4 = f4 ;

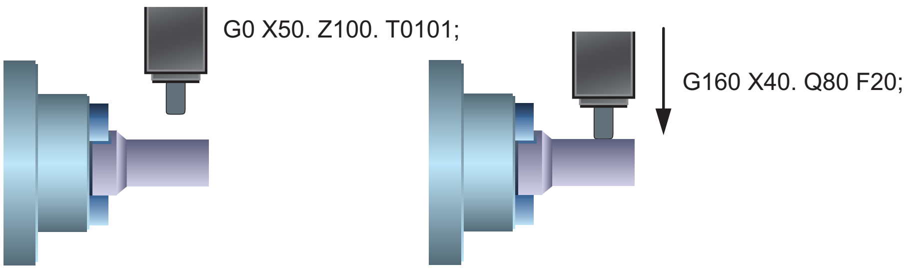


### 14.1.1.6 Torque Limitation Skip

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | – | – | – | – |
| L | △ | △ | △ | △ | ○ | ○ | – | △ |

Axis movement is performed in the torque limited status, and the axis movement command is suspended to proceed to the next block when the current command value reaches the designated torque skip value and the torque skip turns ON.
In addition to the torque, the droop value can be add to the condition of the skip ON. (Droop skip)
This function enables measurement without a sensor.

Workpiece radius measurement tool




| | |
|---|---|
| : | |
| G0 X50. Z100. T0101; | Tool selection for measurement |
| G160 X40. Q80 F20; | Torque skip command |
| #100=#5061; : | Coordinate position (workpiece value) read |
| : | |

Command format

| **G160 X/U/Z/W/α Q D F ;** | |
|---|---|
| X/U/Z/W/α | : Axis address (range of coordinate position command (mm, inch), decimal point command is possible) |
| Q | : Torque skip value (0 to 500 (%)) |
| D | : Droop skip value (0 to 99999.999 (mm, inch)) |
| F | : Skip speed (range of feedrate (mm/min, inch/min, mm/rev, inch/rev)) |

## 14.1.2 Automatic Tool Length Measurement

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

This function moves the tool in the direction of the tool measurement position by assigning a distance between the measurement start position to the measurement position. The machine stops when the tool reaches the sensor and automatically calculates the difference between the coordinate position where the tool stopped and measurement position. It registers this difference as the tool length compensation amount for that tool.

**(1) Automatic Tool Length Measurement (M system)**

This function moves the tool in the direction of the tool measurement position by commanding a distance between the measurement start position to the measurement position, it stops the tool as soon as it contacts the sensor and calculates the difference between the coordinate position when the tool has stopped and commanded coordinate position. It registers this difference as the tool length compensation amount for that tool.

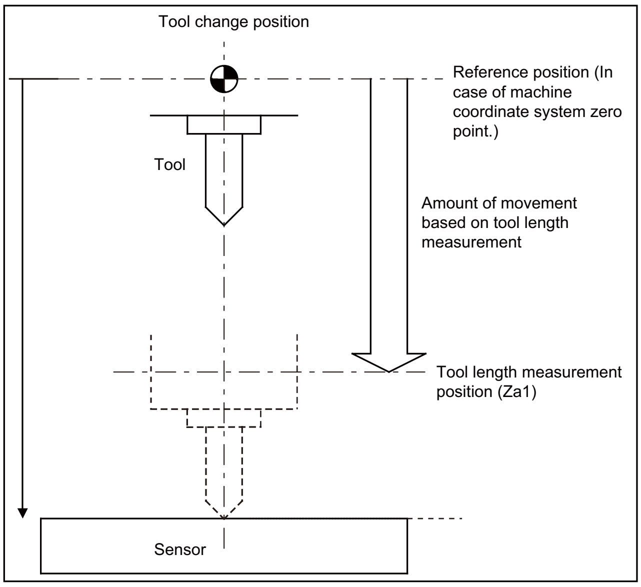
If compensation has already been applied to the tool, it is moved in the direction of the measurement position with the compensation still applied, and when the measurement and calculation results are such that a further compensation amount is to be provided, the current compensation amount is further corrected.

If the compensation amount at this time is one type, the compensation amount is automatically corrected; if there is a distinction between the tool length compensation amount and wear compensation amount, the wear amount is automatically corrected.

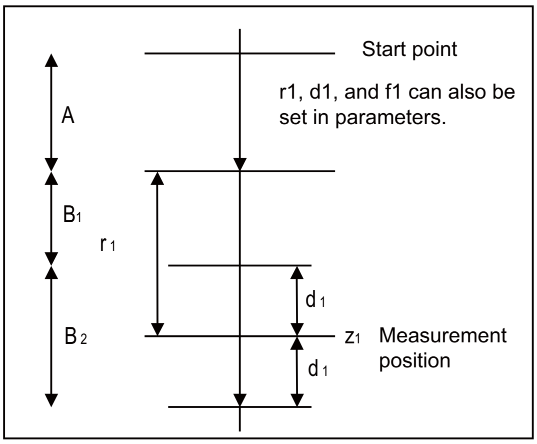
**G37 Zz1 Rr1 Dd1 Ff1 ;**

| | |
|---|---|
| G37 ; | : Measurement command |
| Zz1 | : Measurement axis address and measurement position X, Y, Z, α (α = optional axis) |
| Rr1 | : The distance between the point at which tool movement is to start at the measurement speed and the measurement position |
| Dd1 | : The range in which the tool is to stop |
| Ff1 | : The measurement rate |

When Rr1_, Dd1_ and Ff1_ have been omitted, the values set in the parameters are used.




At this time, the tool length compensation amount has a minus ("-") value.
Example of program
G28 Z0 ;
T01 ;
M06 T02 ;
G43 G00 Z0 H01 ;
G37 Z-300. R10. D2. F10 ;
:
In this case, the distance (H01 = Za1 - z0) from the tool T01 tip to the top of the measurement sensor is calculated as the tool length compensation amount which is then registered in the tool compensation table.




Area A : Moves with rapid traverse feed rate.
Areas $B_1$, $B_2$ : Moves with the measurement speed (f1 or parameter setting)

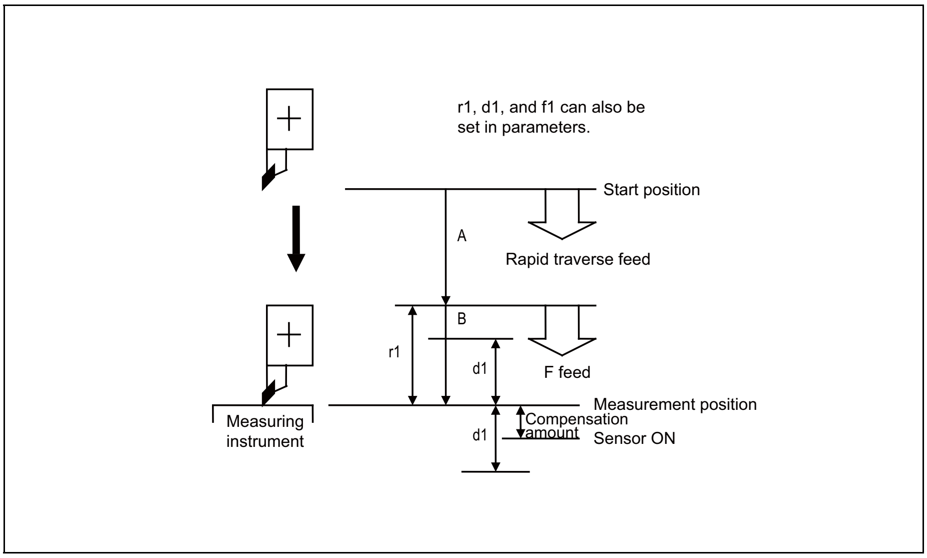
If a sensor signal is input in area $B_1$, an error will occur.
If a sensor signal is not input in the area $B_2$, an error will occur.

**(2) Automatic tool length measurement (L series)**

This function moves the tool in the direction of the tool measurement position by commanding a distance between the measurement start position to the measurement position, it stops the tool as soon as it contacts the sensor and calculates the difference between the coordinate position when the tool has stopped and commanded coordinate position. It registers this difference as the tool length compensation amount for that tool.

If compensation has already been applied to the tool, it is moved in the direction of the measurement position with the compensation still applied, and when the measurement and calculation results are such that a further compensation amount is to be provided, the current wear compensation amount is further corrected.

| **G37 αα1 Rr1 Dd1 Ff1 ;** | |
|---|---|
| G37 | : Measurement command |
| αα1 | : Measurement axis address and measurement position coordinate ... X,Z |
| Rr1 | : The distance between the point at which tool movement is to start at the measurement speed and the measurement position (Radial value fixed / incremental position) |
| Dd1 | : The range in which the tool is to stop (Radial value fixed: incremental position) |
| Ff1 | : The measurement rate |
| When Rr1_, Dd1_ and Ff1_ have been omitted, the values set in the parameters are used. | |




When the tool moves from the measurement start position to the measurement position specified in G37 x1 (z1), it passes through the A area at rapid traverse. Then, it moves at the measurement rate set in F command or parameter from the position specified in r1. If the measurement position arrival signal (sensor signal) turns ON during the tool is moving in the B area, an error occurs. If the measurement position arrival signal (sensor signal) does not turn ON although the tool passes through the measurement position x1 (z1) and moves by d1, an error occurs.

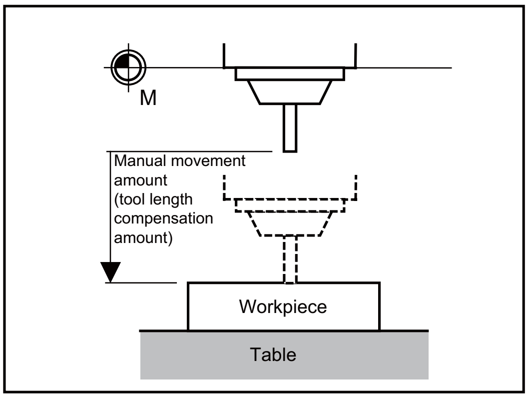
### 14.1.3 Manual Tool Length Measurement 1

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Simple measurement of the tool length is done without a sensor.

**(1) Manual tool length measurement I [M system]**

When the tool is at the reference position, this function enables the distance from the tool tip to the measurement position (top of workpiece) to be measured and registered as the tool length compensation amount.



**(2) Manual tool length measurement I [L system]**

This is the function to calculate the tool length compensation amount automatically by moving the tool to the measurement point with manual feed. There are two types of measurement methods in manual tool length measurement I: the basic point method and the measurement value input method. The method is selected by setting parameter. For key operation there are normal operation mode/simple operation mode.

(a) Basic point method

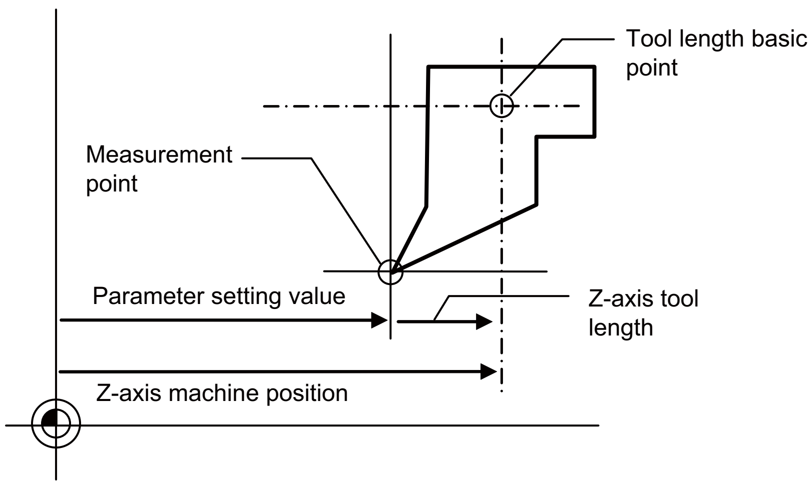
Obtain the tool length with the tool nose placed on the measurement point.
To carry out the basic point method, a point to place the tool nose on (measurement point) is required.
When measurement position is set to parameter or workpiece coordinate offset (modal).

Parameter designation method

The tool length is automatically calculated using the following formula.

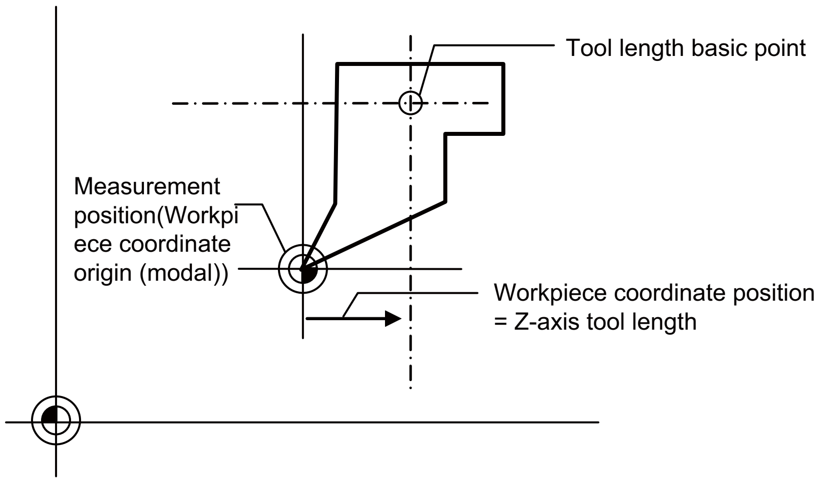
Tool length = Machine coordinates - Measurement point (#2015 tlml-)

(Note) Always set the measurement point with a radius value, regardless of the diameter/radius command.




Workpiece coordinate offset designation method

Tool length is the coordinate value on the workpiece coordinate system.



(b) Measurement value input method

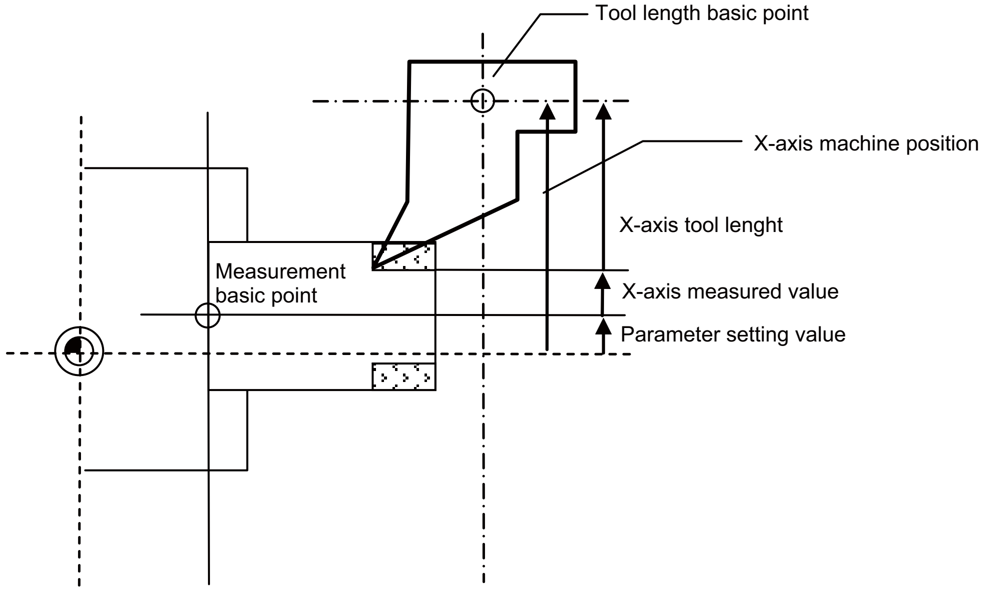
Actually cut the workpiece. Measure its dimensions, and obtain the tool length from the measured values. The measurement basic point is characteristic for each machine (the center of the chuck face, etc. designated by parameter),or workpiece coordinate offset (modal).

Parameter designation method

The tool length is automatically calculated by the equation below.

Tool length = Machine coordinate values - Measurement basic point (#2015 tlml-) - Measured value

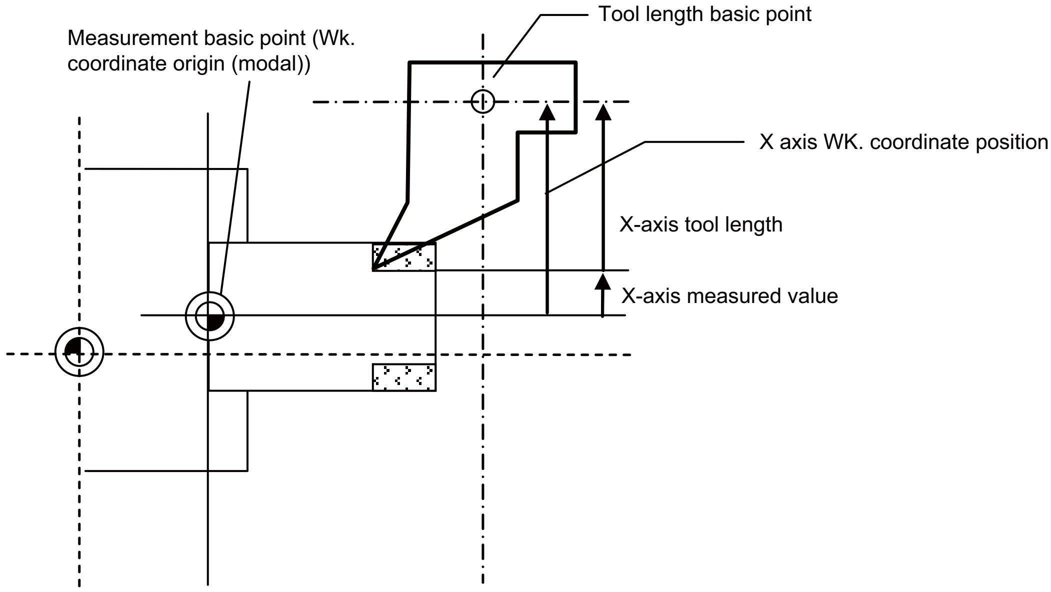
(Note) Always set the measurement point with a radius value, regardless of the diameter/radius command.




<Workpiece coordinate offset designation method>

The tool length is automatically calculated by the equation below.

Tool length = Workpiece coordinate position . Measured value

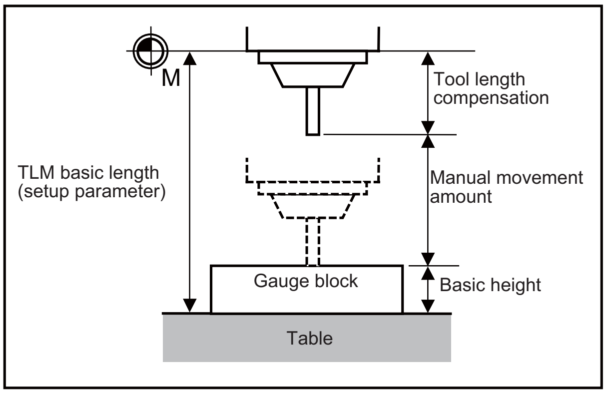


### 14.1.4 Manual Tool Length Measurement 2

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

**(1) Manual tool length measurement II [M system]**

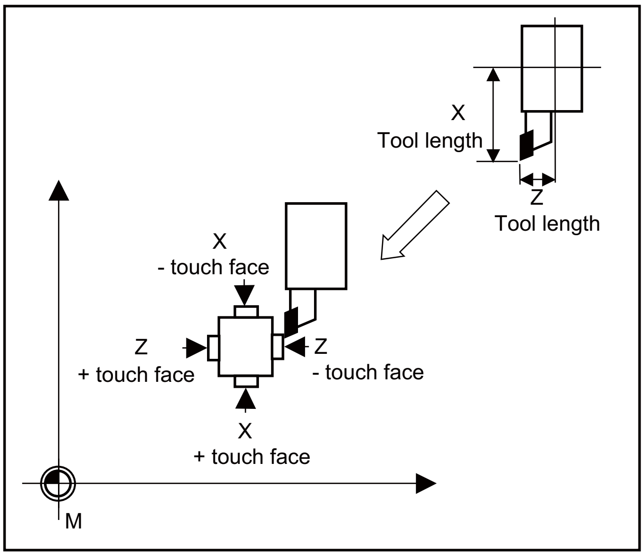
When the tool is positioned at the reference position, this function enables the distance from the reference position to the tool tip to be measured and registered as the tool length compensation amount. In this case, the position of the gauge block used as a reference must be set as the basic height.




If the height axis designation parameter is ON, the axis designated for plane selection basic axis K is the axis targeted for measurement as the height axis.
Furthermore, if the tool length measurement check parameter is ON, an input OK/cancel confirmation message appears after input key has been pressed.

**(2) Manual tool length measurement II [L system]**

A device in which a touch sensor is built is used. Simply by causing the tool nose to touch the touch sensor in manual feed, the tool compensation amount can be calculated and stored in tool compensation amount memory. If you set the tool compensation values of each tool, cut the workpiece end face manually, and then input the workpiece measurement signal, you can set the external workpiece coordinate offset data of Z axis.
Preset the machine coordinate position of the touch sensor touch face in parameter as the measurement basic position.

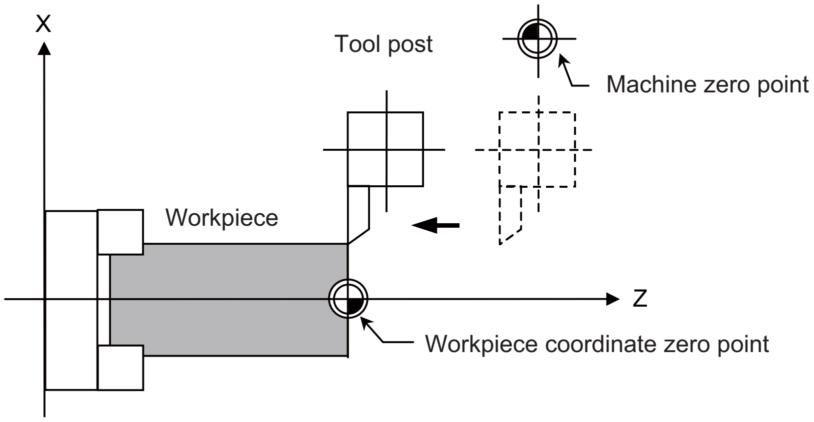


### 14.1.5 Workpiece Coordinate Offset Measurement

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | — | — | — | — | — | — | — | — |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The external workpiece coordinate offset data for the Z axis can be set by cutting the workpiece face by means of manual operations and inputting the workpiece measurement signal.
By pressing the menu key, data can be set in the Z axis of an arbitrary coordinate offset.
Coordinate offset setting for the Z axis (2nd axis) of the part system 1 to 4 is possible.
Note that the workpiece coordinate offsets for multiple part systems cannot be measured at the same time.
(Note) Measurement is disabled for the part system with one-axis structure.

Example of measurement of external workpiece coordinate offset data for Z axis




(1) Measurement method with workpiece measurement signal
  (a) Select the tool, and cut the workpiece face.
  (b) When the workpiece measurement signal is input, the external workpiece coordinate offset data for the Z axis is calculated from the machine coordinate position, length of the tool used and tool nose wear compensation amount, and stored in the memory.

(2) Measurement method with "MeasVal take in" menu
  (a) Select a tool, and cut the workpiece face.
  (b) When the "MeasVal take in" menu is pressed, workpiece coordinate offset data is calculated from the machine coordinate position, tool length and tool nose wear compensation amount of a used tool, and external workpiece coordinate offset. The workpiece coordinate offset data is stored in the Z-axis of the selected coordinate system offset.

## 14.1.6 Workpiece Position Measurement

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | － | － | － | － | － | － | － | － |

The workpiece position measurement function is used to measure each axis' coordinate point by installing a sensor on the spindle and the sensor contacting the workpiece with the manual feed or handle feed.
The surface, hole center and width center coordinates are calculated from the measured coordinates, and those calculated results are set in the workpiece coordinate offset.
The axis to be measured is designated with parameter.
The workpiece position measurement is available for all the part systems.

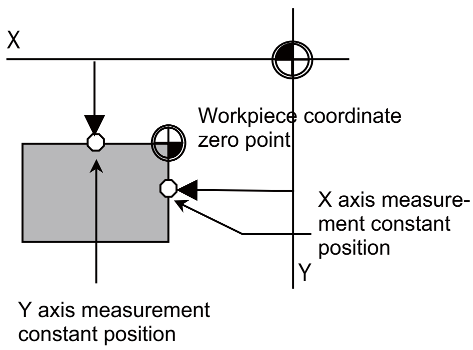
Here the measurement axes are explained as "X", "Y" and "Z".

**(1) Surface workpiece offset measurement**

The workpiece position measurement coordinates are calculated from the skip machine position of the X, Y and Z axes.
Measurement position coordinate X = X axis' skip machine position + sensor diameter/2 ± center compensation amount (horizontal) ± skip flow amount (horizontal)
Measurement position coordinate Y = Y axis' skip machine position + sensor diameter/2 ± center compensation amount (vertical) ± skip flow amount (vertical)
Measurement position coordinate Z = Z axis' skip machine position - sensor length

The sensor diameter/2 and skip flow amount change between +/- with the tool movement direction during the measurement.
The X and Y axes use the sensor diameter, center compensation amount (horizontal/vertical) and skip flow amount (horizontal/vertical).
The Z axis uses the sensor length.

The measurement position coordinate of the X axis, Y axis or Z axis is set in the specified workpiece coordinate offset.

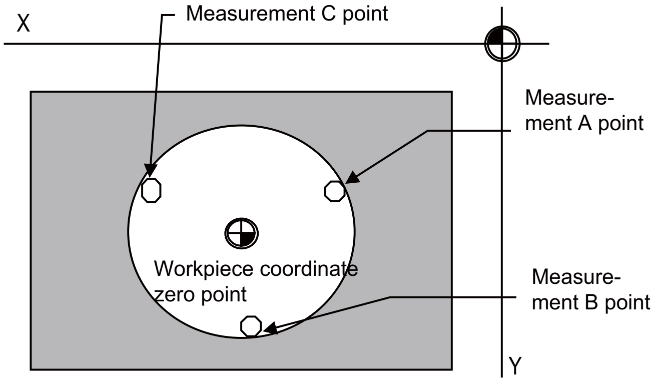



To set the workpiece coordinate offset, the X axis is measured and the X axis' offset coordinate is set. Then, the Y axis' offset is measured and set. Finally, the Z axis' offset is measured and set.

**(2) Hole center workpiece offset measurement**

The measurement position coordinates of two axes (X, Y) are measured at three points, and the hole center is calculated. The calculated result is set in the specified workpiece coordinate offset.
The workpiece position measurement coordinates are calculated from the skip machine position of the X and Y axes.
Measurement position coordinate X = X axis' skip machine position + center compensation amount (horizontal) ± skip flow amount (horizontal
Measurement position coordinate Y = Y axis' skip machine position + center compensation amount (vertical) ± skip flow amount (vertical)

The +/- of the skip flow amount changes according to the tool movement amount during measurement.

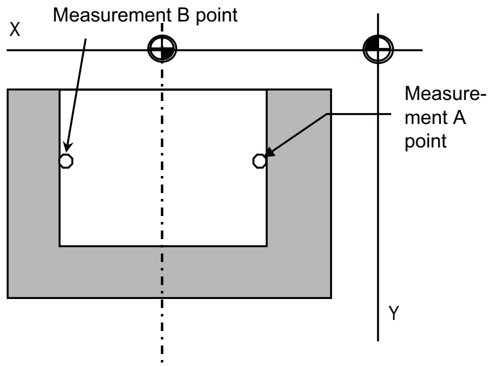



To set the workpiece coordinate offset, the position X and Y of the measurement A point are measured, and the measured values are set in the measurement A point. In the same manner as the measurement A point, the measurement B point and then C point are measured and set. The hole center coordinate is calculated by setting the workpiece coordinate system after setting three points, and the calculated result is set in the workpiece coordinate offset.

**(3) Width center workpiece offset measurement**

The two points among the measurement position coordinate of the X axis, Y axis or Z axis are measured, and each axis' groove center is calculated. The calculated result is set in the specified workpiece coordinate offset.
The workpiece position measurement coordinates are calculated from the skip machine position of the X, Y and Z axes.
Measurement position coordinate X = X axis' skip machine position + center compensation amount (horizontal) ± skip flow amount (horizontal)
Measurement position coordinate Y = Y axis' skip machine position + center compensation amount (vertical) ± skip flow amount (vertical)
Measurement position coordinate Z = Z axis' skip machine position - Sensor length

The +/- of the skip flow amount changes according to the tool movement amount during measurement




To set the workpiece coordinate offset, the position X (position Y, position Z) of the measurement A point is measured, and the measured value is set in the measurement A point. In the same manner as the measurement A point, the measurement B point is measured and set.
The groove width center coordinate of the X axis (Y axis, Z axis) is calculated by setting the workpiece coordinate system after setting two points, and the calculated result is set in the workpiece coordinate offset

### 14.1.7 Rotation Measurement

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | — | — | — | — | — | — | — | — |

The offset (rotation center and rotation angle) of the rotary coordinate system is measured, and the results are set to the workpiece coordinate system offset (rotation center) and the parameters.

<Measurement using touch sensor>
Measurement counter X = X axis skip position (Machine position)
Measurement counter Y = Y axis skip position (Machine position)

<Simple measurement (measurement without using touch sensor)>
Measurement counter X = X axis machine position + center compensation (H) + skip past amount (Horizontal axis) (Note)
Measurement counter Y = Y axis machine position + center compensation (V) + skip past amount (Vertical axis) (Note)

(Note) The skip past amount is added for only the axis that moved last.
The sign ( + or - ) of the skip past amount depends on the movement direction of the axis.

## 14.2 Tool Life Management

### 14.2.1 Tool Life Management

In this type, how long and how many times the program commanded tool is used are accumulated to monitor the usage state.

#### 14.2.1.1 Tool Life Management I

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The following two method can be selected.

- Management by the time of use
  The cutting time after specification of a tool selection (T) command (G01, G02, and G33) is added to the tool use time for the specified tool.
- Management by the frequency of use
  The tool use counter corresponding to the specified tool No. is incremented each time a tool selection (T) command is specified for the tool.

**(1) M system**
When the number of uses has reached the limit, the "Tool life over" signal will turn ON.

**(2) L system**
When a T command is issued after it has reached the limit, the "Tool life over" signal will turn ON.

#### 14.2.1.2 Tool Life Management II

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

**(1) M system**
A spare tool change function is added to tool life management I. This function selects a usable tool out of the spare tools of the group determined by the value specified by the user PLC, then outputs data of such usable spare tool. The spare tool can be selected in two ways: the tools are selected in order they were registered in the group or the tool whose remaining life is the longest of all in the group is selected.

**(2) L system**
The life of each tool (time and frequency) is controlled, and when the life is reached, a spare tool that is the same type is selected from the group where the tool belongs and used.

#### 14.2.1.3 Tool Life Management III

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | − | − | − | − | − | − | − | − |

For the user PLC designated tool, that tool's usage time (0 to 4000 minutes) or frequency of use (0 to 65000 times) is accumulated, and the tool usage state is monitored. The life for up to 1000 tools can be managed.
This function is not controlled by the group No.

### 14.2.2 Number of Tool Life Management Sets

[M system]

| Number of tool life management tools | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| Number of tool life management tools (99 tools) | — | — | — | — | — | — | — | — |
| Number of tool life management tools (128 tools) | — | — | — | — | — | — | — | — |
| Number of tool life management tools (200 tools) | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Number of tool life management tools (256 tools) | — | — | — | — | — | — | — | — |
| Number of tool life management tools (400 tools) | △ | △ | △ | △ | — | — | — | △ |
| Number of tool life management tools (999 tools) | △ | △ | △ | △ | — | — | — | — |

[L system]

| Number of tool life management tools | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| Number of tool life management tools (99 tools) | — | — | — | — | — | — | ○ | — |
| Number of tool life management tools (128 tools) | ○ | ○ | ○ | ○ | — | — | — | ○ |
| Number of tool life management tools (200 tools) | — | — | — | — | — | — | — | — |
| Number of tool life management tools (256 tools) | — | — | — | — | ○ | ○ | — | △ |
| Number of tool life management tools (400 tools) | △ | △ | △ | △ | — | — | — | — |
| Number of tool life management tools (999 tools) | △ | △ | △ | △ | — | — | — | — |

The number of tools that can be managed for their lives in the case of fixed allocation are shown below. Refer to "14.2.3 Tool Life Management Set Allocation to Part Systems" for details on the arbitrary allocation.

[M system]

<table>
<tr><th>Function name</th><th>Common for part systems or 1-part system</th><th>Independent for systems and multi-part system</th></tr>
<tr><td>Number of tool life management tools (200 tools)</td><td>200 tools</td><td rowspan="3">Divide the number of tools in the system by the number of part systems to calculate the number of tools in each part system(If there is the remainder, the remainder is allocated to the first part system.)</td></tr>
<tr><td>Number of tool life management tools (400 tools)</td><td>400 tools</td></tr>
<tr><td>Number of tool life management tools (999 tools)</td><td>999 tools</td></tr>
</table>

[L system]

<table>
<tr><th>Function name</th><th>Common for part systems or 1-part system</th><th>Independent for systems and multi-part system</th></tr>
<tr><td>Number of tool life management tools (99 tools)</td><td>99 tools</td><td rowspan="5">Divide the number of tools in the system by the number of part systems to calculate the number of tools in each part system(If there is the remainder, the remainder is allocated to the first part system.)</td></tr>
<tr><td>Number of tool life management tools (128 tools)</td><td>128 tools</td></tr>
<tr><td>Number of tool life management tools (256 tools)</td><td>256 tools</td></tr>
<tr><td>Number of tool life management tools (400 tools)</td><td>400 tools</td></tr>
<tr><td>Number of tool life management tools (999 tools)</td><td>999 tools</td></tr>
</table>

### 14.2.3 Tool Life Management Set Allocation to Part Systems

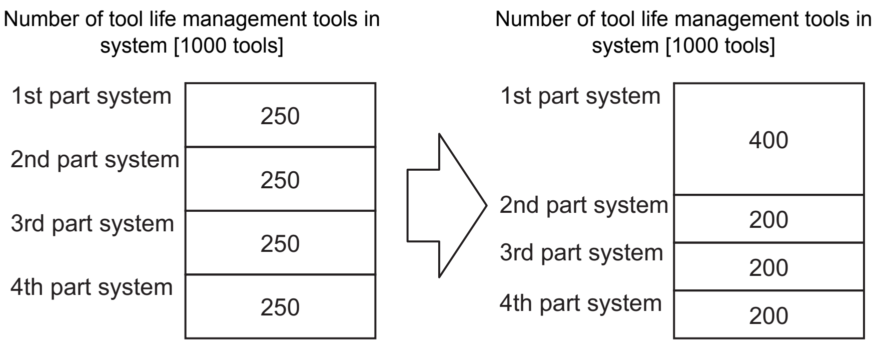
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | － | － | － | － |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

* Variable number of  management tools

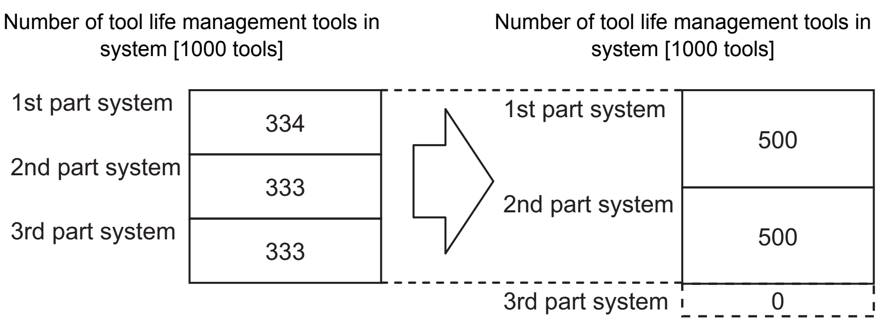
The number of tool life management tools can be set per part system.
There are two types of the allocation: "Arbitrary allocation" which allocates the number of tool life management tools to each part system arbitrarily and "Fixed allocation" which automatically allocates the number of tool life management tools to each part system equally, and the type can be selected using the parameter.
The arbitrary allocation enables the efficient allocation because when a certain part system needs only a small number of tool life management tools, the rest can be allocated to another part system. If an auxiliary-axis part system does not need the tool life management at all, the number of tool life management tools can be set 0 in the auxiliary-axis part system.
"Number of tool life management tools in system" is the total number of tool life management tools of all part systems.

(1) Arbitrary allocation

(a) When the number of tool life management tools is increased in the 1st part system of 4-part system

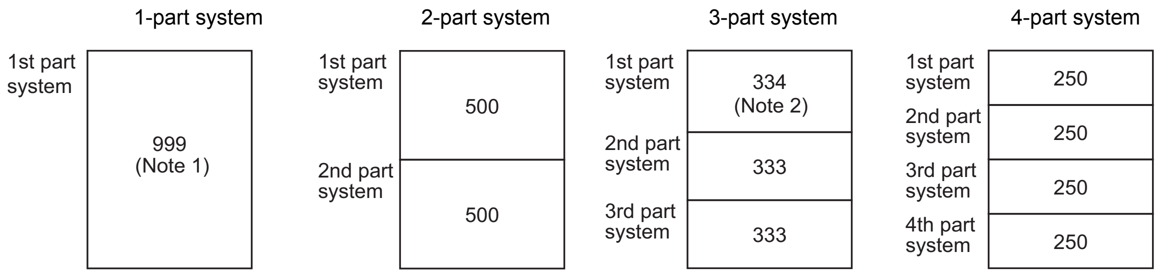



(b) When the number of tool life management tools is set "0" to the 3rd part system of 3-part system for use of the 3rd part system as auxiliary-axis part system



(2) Fixed allocation

Number of tool life management tools in system [1000 tools]




(Note 1) The maximum number of tool life management tools per part system is 999.

(Note 2) If there is any remainder, the remainder is allocated to the 1st part system.

## 14.3 Others

### 14.3.1 Programmable Current Limitation

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

This function allows the current limit value of the NC axis to be changed to a desired value in the program, and is used for the workpiece stopper, etc.
The commanded current limit value is designated with a ratio of the limit current to the rated current. The current limit value can also be set from the setting and display unit.
The validity of the current limit can be selected with the external signal input.
However, the current limit value of the PLC axis cannot be rewritten.

**G10 L14 X dn ;**

| | |
|---|---|
| G10 | : Current limit input command |
| L14 | : Current limit value setting (+ side/- side) |
| X | : Axis address |
| dn | : Current limit value 1% to 999% |

(1) If the current limit is reached when the current limit is valid, the current limit reached signal is output.
(2) The following two modes can be used with external signals as the operation after the current limit is reached.
- Normal mode
  The movement command is executed in the current state.
  During automatic operation, the movement command is executed to the end, and then the next block is moved to with the droops still accumulated.
- Interlock mode
  The movement command is blocked (internal interlock).
  During automatic operation, the operation stops at the corresponding block, and the next block is not moved to.
  During manual operation, the following same direction commands are ignored.

(3) During the current limit, the droop generated by the current limit can be canceled with external signals. (Note that the axis must not be moving.)
(4) The setting range of the current limit value is 1% to 999%. Commands that exceed this range will cause a program error.
(5) If a decimal point is designated with the G10 command, only the integer will be valid.
(Example) G10 L14 X10.123 ; The current limit value will be set to 10%.
(6) For the axis name "C", the current limit value cannot be set from the program (G10 command). To set from the program, set the axis address with an incremental axis name, or set the axis name to one other than "C".

### 14.3.2 Auto Power OFF

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | – |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | – |

This can notify that the control unit's power can be turned OFF after shutting the display unit down (Do not turn the power OFF.) by entering "automatic power OFF request" signal from user PLC to NC.

(Note) The Mitsubishi Electric-supplied display unit is required.

### 14.3.4 Load Monitoring I

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | － | － | － | － |
| L | △ | △ | △ | △ | － | － | － | － |

This function aims at detecting tool wear or degradation by detecting and monitoring the actual load (current value) on spindle and NC axes on a real time basis.
The cutting torques on spindle and NC axes are estimated, and the estimated values are output to the predetermined R registers in real time. This function can also implement sampling of the estimated cutting torque values.

### 14.3.5 Power ON/OFF Sequence

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○/－ | ○/－ | － | － | ○/－ | － | － | － |
| L | ○/－ | ○/－ | － | － | ○/－ | － | － | － |

* Specifications of separated-type display are classified with "Windows-based" and "Windows-less"

This function turns the power supply ON/OFF, synchronizing the NC control unit and the HMI screen. This enables the following:
- The relay which synchronizes the control unit and the personal computer unit when the power supply is turned ON becomes unnecessary.
- The control unit and the personal computer unit are configured with the same power supply and can be started up at optimum timing even when they are turned ON at the same time.
- By using the power ON/OFF button of the operation panel side, both the control unit and the personal computer unit can be started up and their power supply can be turned ON again.
- When the automatic power OFF is performed, NC starts the end processing right after the end processing of the personal computer unit is completed to reduce the wasteful standby time.

### 14.3.101 PLC Axis Current Limit

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | － | － | － | － | － | － | － | ○ |
| L | － | － | － | － | － | － | － | ○ |

This function can set a current limit to the PLC axis as with NC axis. This can be used for the stopper control, etc.

# 15

# Safety and Maintenance

## 15.1 Safety Switches

### 15.1.1 Emergency Stop

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

All operations are stopped by the emergency stop signal input and, at the same time, the drive section is stopped and the movement of the machine is stopped.
At this time, the READY lamp on the setting and display unit goes OFF and the servo ready signal is turned OFF.
When the emergency stop is cancelled, the reset will be performed. The reset type can be selected in the parameter.

### 15.1.2 Data Protection Key

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The editing functions such as setting and deleting of data can be prohibited by the data protection key. There are 5 types of data protection keys, and each data protection key and the data to be protected are as follows:

| Data protection key type | Description |
|---|---|
| Data protection key 1 | For protecting the overall tool data and the coordinate system presettings as based on origin setting. |
| Data protection key 2 | For protecting the user parameters and common variables. |
| Data protection key 3 | For protecting the machining programs of NC memory. |
| Data protection key (memory card) | For protecting the data on the front-side SD (memory card). |
| Data protection key (DS) | For protecting the data on the back-side SD (DS). |

The data protection keys prohibit the editing functions such as setting and deleting when the keys are OFF (0).

## 15.2 Display for Ensuring Safety

### 15.2.1 NC Warning

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The warnings which are output by the NC system are listed below. When one of these warnings has occurred, a warning number is output to the PLC and a description of the warning appears on the screen. Operation can be continued without taking further action.

| Type of warning | Description |
|---|---|
| Servo warning | The servo warning is displayed. |
| Spindle warning | The spindle warning is displayed. |
| System warning | The system warning is displayed. (State such as temperature rise, battery voltage low, etc.) |
| Absolute position warning | A warning in the absolute position detection system is displayed. |
| Auxiliary axis warning | The auxiliary axis warning is displayed. |

### 15.2.2 NC Alarm

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The alarms which are output by the NC system are listed below. When one of these alarms has occurred, an alarm number is output to the PLC, and a description of the alarm appears on the screen. Operation cannot be continued without taking remedial action.

| Type of alarm | Description |
|---|---|
| Operation alarm | This alarm occurring due to incorrect operation by the operator during NC operation and that by machine trouble are displayed. |
| Servo alarm | This alarm describes errors in the servo system such as the servo drive unit motor and encoder. |
| Spindle alarm | This alarm describes errors in the spindle system such as the spindle drive unit motor and encoder. |
| MCP alarm | An error has occurred in the drive unit and other interfaces. |
| System alarm | This alarm is displayed on the screen with the register at the time when the error occurred if the system stops due to a system error. |
| Absolute position detection system alarm | An alarm in the absolute position detection system is displayed. |
| Auxiliary axis alarm | The auxiliary axis alarm is displayed. |
| Computer link error | The computer link alarm is displayed. |
| User PLC alarm | The user PLC alarm is displayed. |
| Program error | This alarm occur during automatic operation, and the cause of this alarm is mainly program errors which occur, for instance, when mistakes have been made in the preparation of the machining programs or when programs which conform to the specification have not been prepared. |
| Network service error | The network service alarm is displayed. |

### 15.2.3 Operation Stop Cause

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The stop cause of automatic operation is displayed on the setting and display unit.

### 15.2.4 Emergency Stop Cause

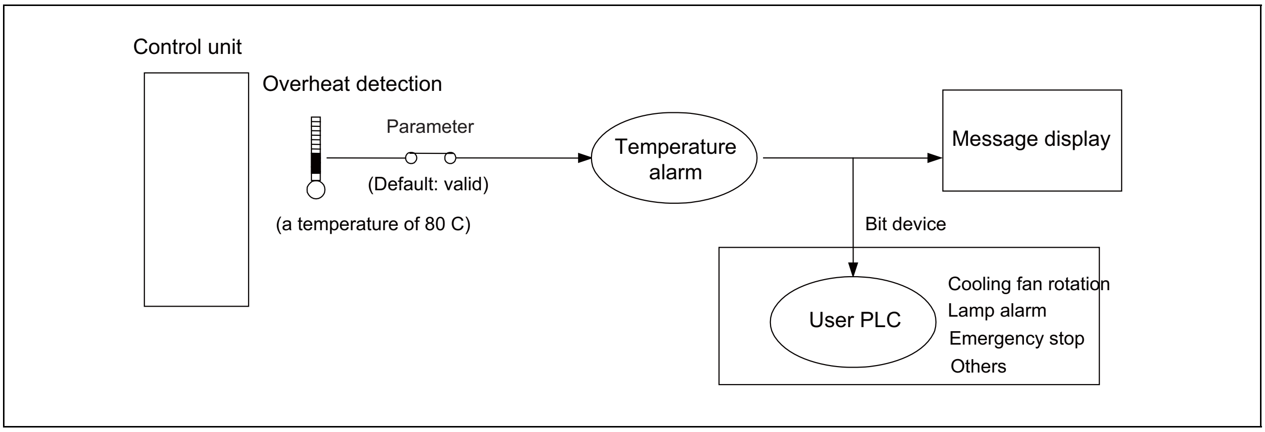
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

When "EMG" (emergency stop) message is displayed in the operation status display area of the setting and display unit, the emergency stop cause can be confirmed.

### 15.2.5 Thermal Detection

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

When overheating is detected in the control unit, an overheat signal is output at the same time as the alarm is displayed. If the system is in automatic run at the time, run is continued, but it cannot be started after reset or completion by M02/ M30. (It can be started after block stop or feed hold.)
When the temperature falls below the specified temperature, the alarm is released and the overheat signal is turned OFF.
The overheat alarm occurs at 80 C or more in the control unit.




(Note 1) If the parameter is used to set the temperature rise detection function to invalid, overheating may occur, thereby disabling control and possibly resulting in the axes running out of control, which in turn may result in machine damage and/or bodily injury or destruction of the unit. It is for this reason that the detection function is normally left "valid" for operation.

### 15.2.6 Battery Alarm/Warning

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

When it is time for changing batteries, alarm or warning is displayed.
When a warning is displayed, immediately backup all the necessary data and change batteries.
When an alarm is displayed, there is a possibility that memory has been lost.

## 15.3 Protection

### 15.3.1 Stroke End (Over Travel)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

When limit switches and dogs have been attached to the machine and a limit switch has kicked a dog, the movement of the machine is stopped by the signal input from the limit switch.
At the same time, the alarm output is sent to the machine.
The stroke end state is maintained and the alarm state is released by feeding the machine in the reverse direction in the manual mode to disengage the dog.

### 15.3.2 Stored Stroke Limit

The areas where tool entry is prohibited can be set.
The stored stroke limits I, II, IIB, IB and IC are handled as follows.

<table>
<tr><th>Type</th><th>Prohibited range</th><th>Explanation</th></tr>
<tr><td>I</td><td>Outside</td><td>- Set by the machine tool builder.<br>- When used with II, the narrow range designated by the two types becomes the movement valid range.</td></tr>
<tr><td>II</td><td>Outside</td><td rowspan="2">- Set by the user.<br>- By using the program command, the parameter can be changed and the function can be switched to ON/OFF.<br>- Select II or IIB with the parameters.</td></tr>
<tr><td>IIB</td><td>Inside</td></tr>
<tr><td>IB</td><td>Inside</td><td>- Set by the machine tool builder.</td></tr>
<tr><td>IC</td><td>Outside</td><td>- Set by the machine tool builder.</td></tr>
</table>

### 15.3.2.1 Stored Stroke Limit I/II

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

**(1) Stored Stroke Limit I**

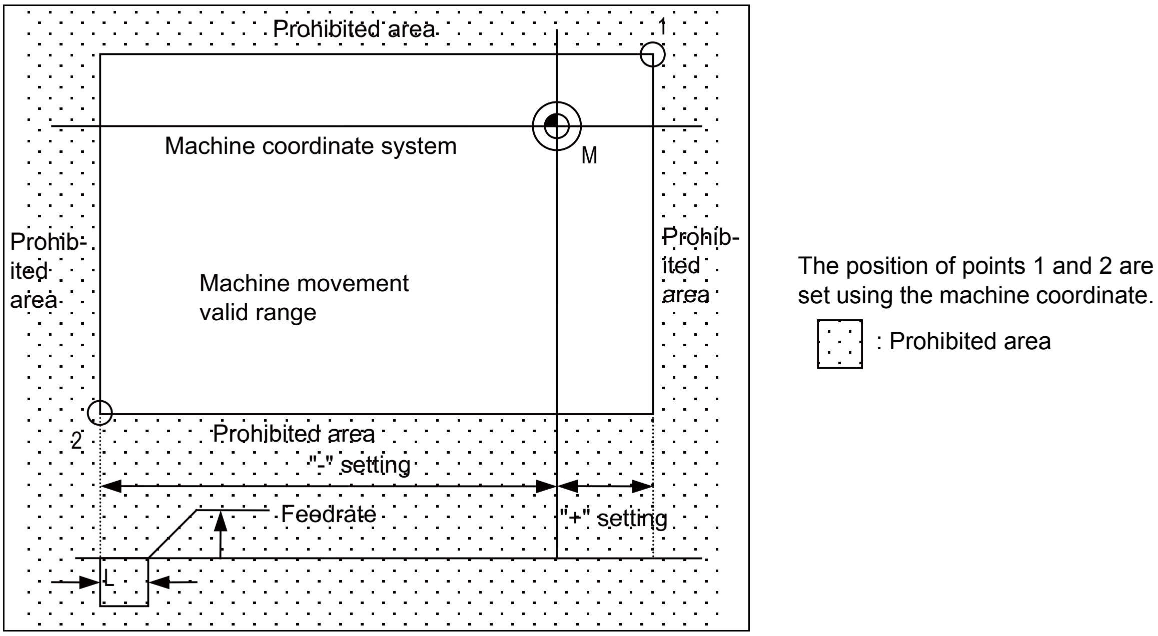
This is the stroke limit function used by the machine tool builder, and the area outside the set limits is the entrance prohibited area.

The maximum and minimum values for each axis can be set by parameters. The function itself is used together with the stored stroke limit II function described in the following section, and the tolerable area of both functions is the movement valid range.

The setting range is -99999.999 to +99999.999mm.

The stored stroke limit I function is made valid not immediately after the controller power is turned ON but after reference position return.

The stored stroke limit I function will be invalidated if the maximum and minimum values are set to the same data.




1: Point 1
2: Point 2

All axes will decelerate and stop if an alarm occurs even for a single axis during automatic operation. Only the axis for which the alarm occurs will decelerate and stop during manual operation. The stop position must be before the prohibited area.

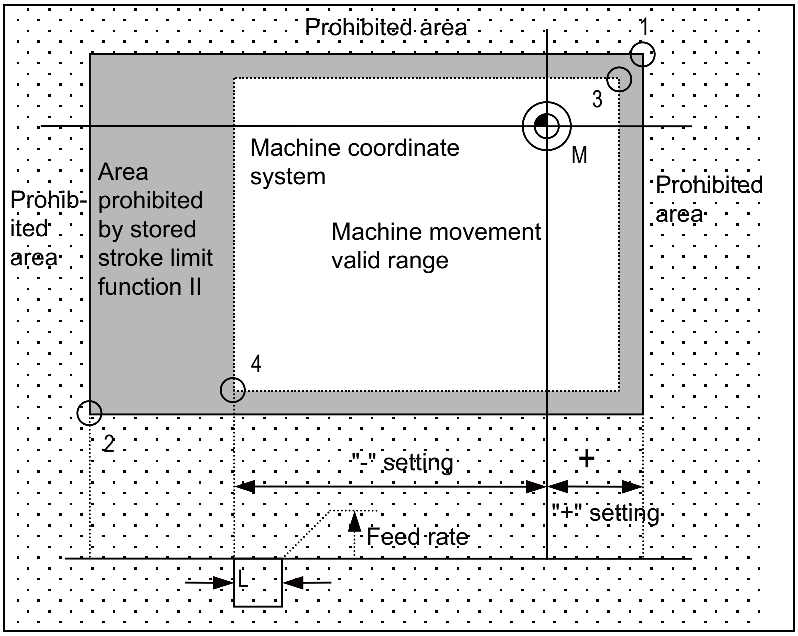
The value of distance "L" between the stop position and prohibited area differs according to the feed rate and other factors.

The range of the stored stroke limit Ⅰ can be changed to the value set to R register for each axis. When "Stored stroke limit I change request" signal is turned ON, the range of stored stroke limit changes. Changing the area for the stored stroke limit Ⅰ is also possible during automatic operation. Also, the current settings for the stored stroke limit Ⅰ can be checked by with the R register values.

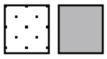
This feature allows an operator to switch the range of the stored stroke limit I during axis movement for the purpose of tool exchange, for example.

**(2) Stored Stroke Limit II**

This is the stroke limit function which can be set by the user, and the area outside the set limits is the prohibited area.
The maximum and minimum values for each axis can be set by parameters. The function itself is used together with the stored stroke limit I function described in the foregoing section, and the tolerable area of both functions is the movement valid range.
The setting range is -99999.999 to +99999.999mm.
The stored stroke limit II function will be invalidated if the maximum and minimum parameter values are set to the same data.




The position of points 3 and 4 are set with the machine coordinate.
The area determined by points 1 and 2 is the prohibited area set with stored stroke limit I.



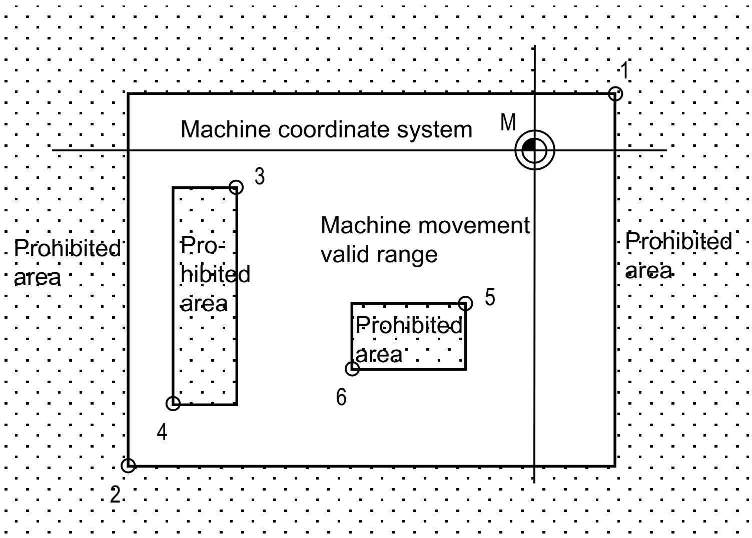

1: Point 1
2: Point 2
3: Point 3
4: Point 4

All axes will decelerate and stop if an alarm occurs even for a single axis during automatic operation. Only the axis for which the alarm occurs will decelerate and stop during manual operation. The stop position must be before the prohibited area.
The value of distance "L" between the stop position and prohibited area differs according to the feed rate and other factors.
The stored stroke limit II function can also be invalidated with the parameter settings.

### 15.3.2.2 Stored Stroke Limit IB

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

Three areas where tool entry is prohibited can be set using the stored stroke limit I, stored stroke limit II, IIB and stored stroke limit IB functions.




The area determined by points 1 and 2 is the prohibited area set with stored stroke limit I.
The area determined by points 3 and 4 is the prohibited area set with stored stroke limit IIB.
The area determined by points 5 and 6 is the prohibited area set with stored stroke limit IB.

1: Point 1
2: Point 2
3: Point 3
4: Point 4
5: Point 5
6: Point 6

When an attempt is made to move the tool beyond the set range, an alarm is displayed, and the tool decelerates and stops.
If the tool has entered into the prohibited area and an alarm has occurred, it is possible to move the tool only in the opposite direction to the direction in which the tool has just moved.

(Note 1) Bear in mind that the following will occur if the same data is set for the maximum and minimum value of the tool entry prohibited area:
(1) When zero has been set for the maximum and minimum values, tool entry will be prohibited in the whole area.
(2) If a value other than zero has been set for both the maximum and minimum values, it will be possible for the tool to move in the whole area.

### 15.3.2.3 Stored Stroke Limit IIB

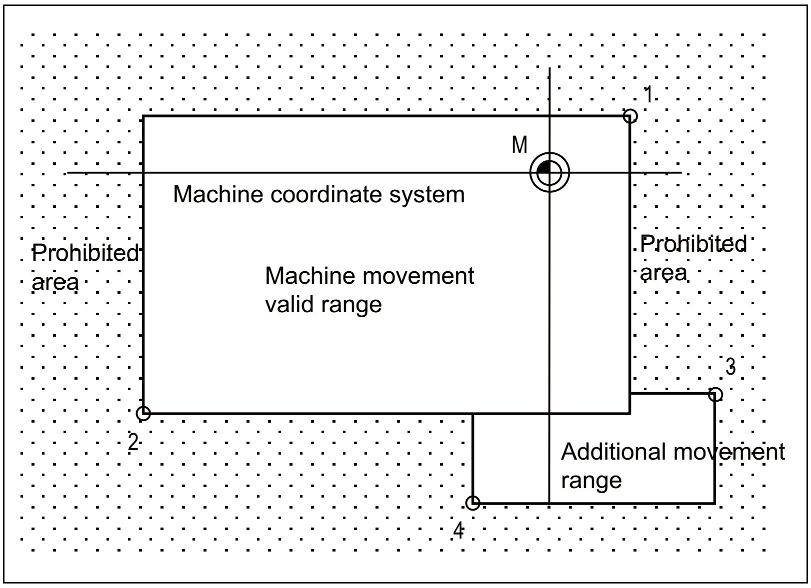
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

A parameter is used to switch between this function and stored stroke limit II. With stored stroke limit IIB, the range inside the boundaries which have been set serves as the tool entry prohibited area.

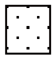
### 15.3.2.4 Stored Stroke Limit IC

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

The boundary is set for each axis with the parameters. The inside of the set boundary is the additional movement range.
This cannot be used with stored stroke limit IB.




The position of points 3 and 4 are set with the machine coordinate.
The area determined by points 1 and 2 is the prohibited area set with stored stroke limit I.



: Prohibited area

1: Point 1
2: Point 2
3: Point 3
4: Point 4

### 15.3.3 Stroke Check before Travel

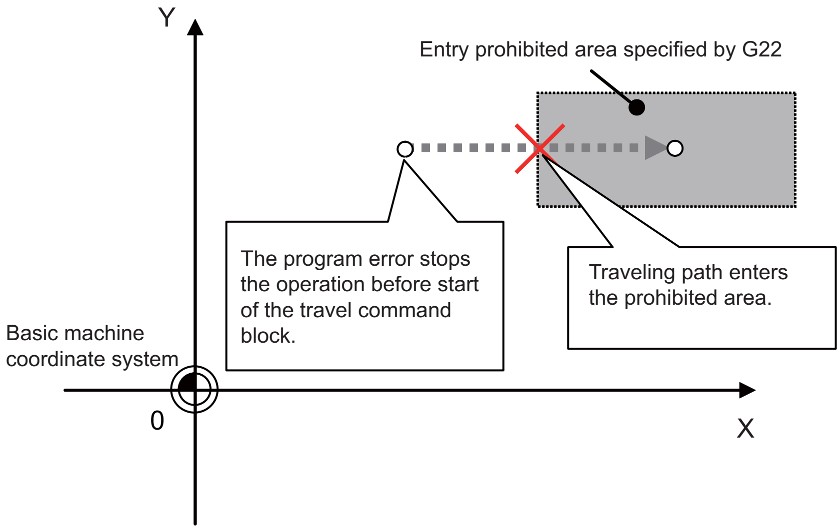
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | △ | △ | △ | △ | ○ | ○ | ○ | – |

This function detects an error of the program command which causes the machine to enter the prohibited area where machine entry is prohibited.
Whereas normal stored stroke limit stops the machine just before the set prohibited area, this function causes the program error to occur in a block where the said command is given, and stops the machine before movement. This facilitates review of program paths as well as continuous operation.

There are two methods for stroke check before travel, which can be selected with a parameter.

(1) Stroke check before travel (G22/G23)

G22 allows you to set the entry prohibited area (X, Y and Z) and enable the stroke check before travel.
The program error occurs in a command block whose start or end point of travel, or linear or circular path enters the prohibited area.
G23 turns OFF the check function.
This method can be used for machining center specification only.




Command format

Stroke check before travel ON

| | |
|---|---|
| **G22 X__ Y__ Z__ I__ J__ K__ ;** | |
| X,Y,Z (*1) | : Coordinates of upper point (basic axis name and its coordinate position) |
| I,J,K | : Coordinates of lower point (I,J,K address and its coordinate position) |

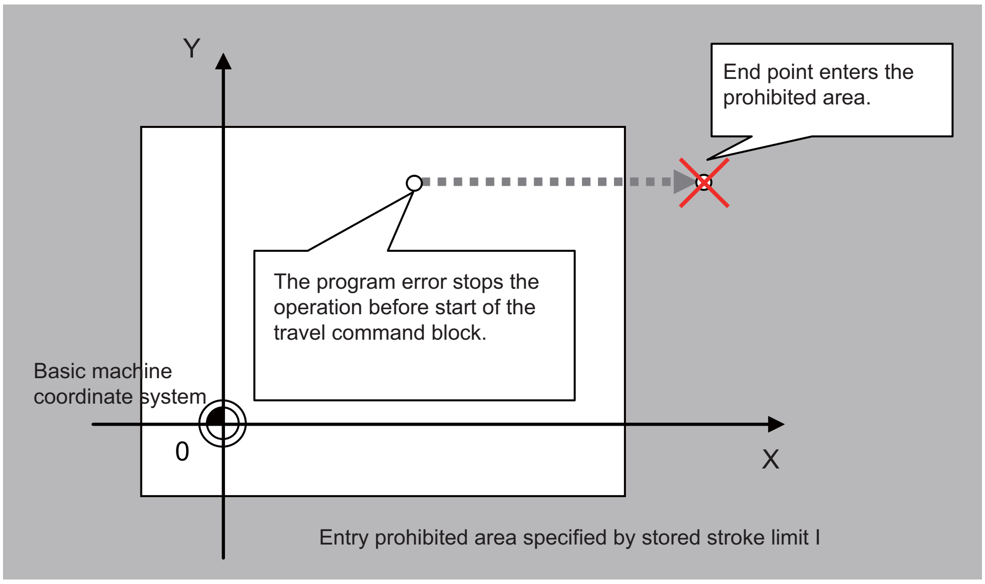
(*1) In the command format, the basic axes are X, Y and Z. Command the basic axis set in the parameter.

Stroke check before travel cancel

```
G23 ;
```

(2) Stroke check before travel in the stored stroke limit area

The block in which the end point of the movement command enters the entrance prohibited area set with the stored stroke limit I, IB, IC II or IIB function becomes a program error.



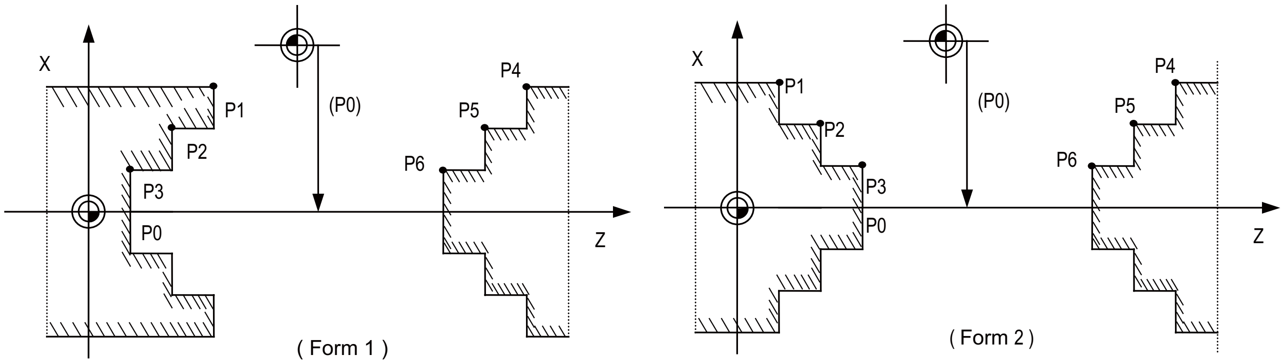
### 15.3.4 Chuck/Tailstock Barrier Check

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | – | – | – | – | – | – | – | – |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

By limiting the tool nose point move range, this function prevents the tool from colliding with the chuck or tailstock because of a programming error. When a move command exceeding the area set in a given parameter is programmed, the tool is stopped at the barrier boundaries.
Program format

```
G22 ; ..... Barrier ON
G23 ; ..... Barrier OFF (cancel)
```

(1) When the machine is about to exceed the area, the machine is stopped and an alarm is displayed. To cancel the alarm, execute reset.
(2) The function is also effective when the machine is locked.
(3) This function is valid when all axes for which a barrier has been set have completed reference position return.
(4) The chuck barrier/tailstock barrier can be set per each part system.
(5) Chuck barrier/tailstock barrier setting.




The chuck barrier and tailstock barrier are both set with the machine coordinate by inputting one set of three-point data in the parameter. Points P1, P2 and P3 are the chuck barrier, and points P4, P5 and P6 are the tailstock barrier. The X axis is set with the coordinate position (radius value) from the workpiece center, and the Z axis is set with the basic machine coordinate system coordinate.
Point P0 is the chuck barrier and tailstock barrier's basic X coordinates, and the workpiece center coordinate in the basic machine coordinate system is set.
The barrier area is assumed to be symmetrical for the Z axis, and if the X axis coordinate of barrier point P_ is minus, the sign is inverted to plus and the coordinate is converted for a check.
Set the absolute values of the X axis coordinates of the barrier points as shown below:
P1 >= P2 >= P3, P4 >= P5 >= P6
(However, this need not apply to the Z axis coordinates.)

### 15.3.5 Interlock

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The machine movement will decelerate and stop as soon as the interlock signal, serving as the external input, is turned ON.
When the interlock signal is turned OFF, the machine starts moving again.

(1) In the manual mode, only that axis for which the interlock signal is input will stop.
(2) In the automatic mode, all axes will stop when the interlock signal is input to even one axis which coincides with the moving axis.
(3) Block start interlock
While the block start interlock signal (*BSL) is OFF (valid), the execution of the next block during automatic operation will not be started. The block whose execution has already commenced is executed until its end. Automatic operation is not suspended. The commands in the next block are placed on standby, and their execution is started as soon as the signal is turned ON.

(Note 1) This signal is valid for all blocks including internal operation blocks such as fixed cycles.
(Note 2) This signal (*BSL) is set ON (invalid) when the power is turned ON. If it is not used, there is no need to make a program with the PLC.

(4) Cutting start interlock
While the cutting start interlock signal (*CSL) is OFF (valid), the execution of all movement command blocks except positioning during automatic operation will not be started. The block whose execution has already commenced is executed until its end. Automatic operation is not suspended. The commands in the next block are placed on standby, and their execution is started as soon as the signal is turned ON.

(Note 1) The signal is valid for all blocks including internal operation block such as fixed cycles.
(Note 2) This signal (*CSL) is set ON (invalid) when the power is turned ON. If it is not used, there is no need to make a program with the PLC.

### 15.3.6 External Deceleration

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

This function reduces the feed rate to the deceleration speed set by the parameter when the external deceleration input signal, which is the external input from the user PLC, has been set to ON. External deceleration input signals are provided for each axis and for each movement direction ("+" and "-"), and a signal is valid when the signal in the direction coinciding with the direction of the current movement has been input. When an axis is to be returned in the opposite direction, its speed is returned immediately to the regular speed assigned by the command.
When non-interpolation positioning is performed during manual operation or automatic operation, only the axis for which the signal that coincides with the direction of the current movement has been input will decelerate.
However, with interpolation during automatic operation, the feed rate of the axis will be reduced to the deceleration rate if there is even one axis for which the signal that coincides with the direction of current movement has been input.

The external deceleration input signal can be canceled using a parameter for the cutting feed only.

### 15.3.7 Interference Check III

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | － | － | － | － |
| L | △ | △ | △ | △ | － | － | － | － |

By checking the relative relation between interference objects, the interference can be prevented from occurring.
One interference object is defined by one to sixteen tridimensional objects.
The maximum definable number is 128 for the interference objects and is 256 for the tridimensional objects.

| Solids/interference objects | Number |
|---|---|
| Solid interference objects | 256 |
| Number of defined interference objects | 128 |
| Number of solids which can be used for one interference object | 16 |

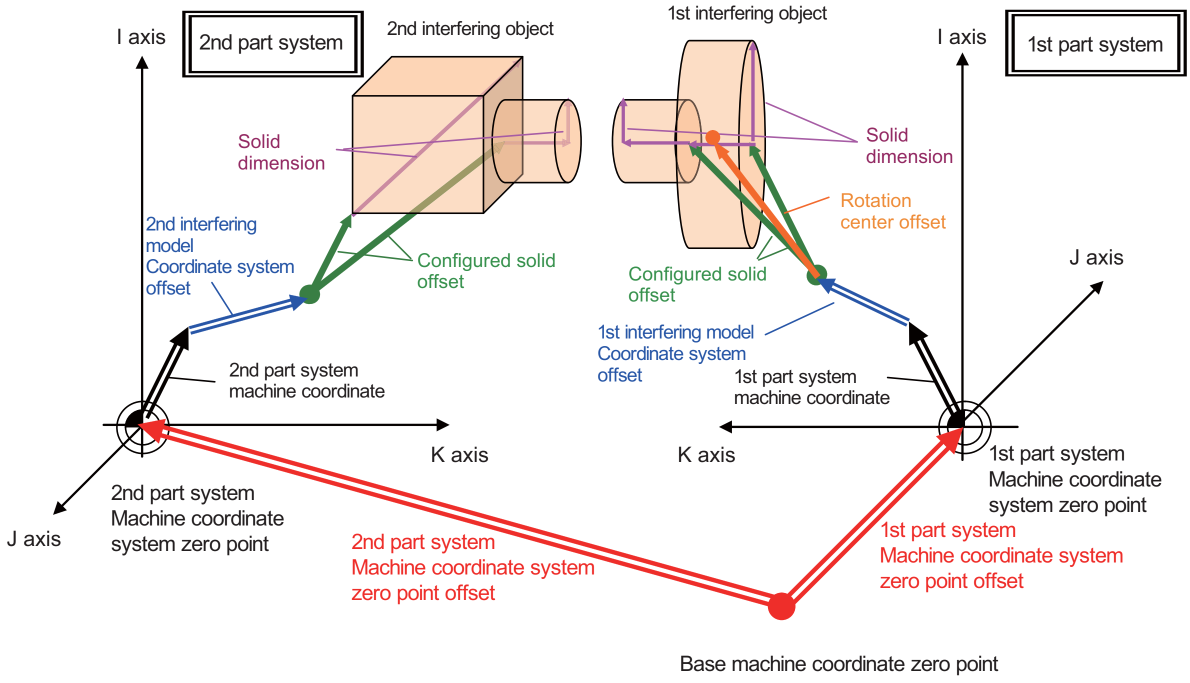
Up to 16 interference objects out of 128 can be selected for the interference check. The number of solids which can be used in the selected interference object is 42 in total.

| Solids/interference objects to be checked | Number |
|---|---|
| Number of interference objects which can be checked | 16 |
| The total of solids which can be used in the interference object to be checked | 42 |

Select 16 interference objects to be checked by the R register or the system variable.

For the solids, two kinds of shapes, cuboids and cylinders, can be defined.
It is also possible to define the rotated solid for one of the I J K axes of the solid.
For the interfering object, up to 2 axes can be defined as rotary axes.
You are able to define more than one interfering object with one-rotary axis, and one interfering object with two-rotary axis within 16 interfering objects to perform the interference check.
You are not able to define the interfering object with one-rotary axis and interfering object with two-rotary axis at the same time.
2 kinds of areas can be defined for an interference area defined as the interfering object: an area where interference must be avoided surely (interference alarm area) and an area where interference should be mitigated (interference warning area)

The schematic view of interfering object definition

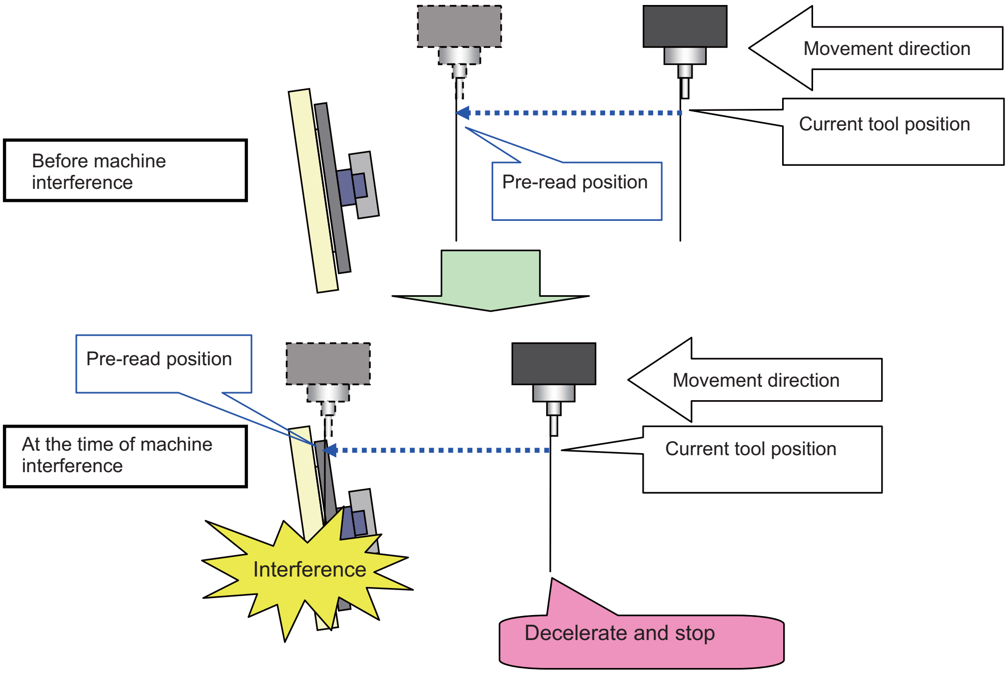


### 15.3.8 3D Machine Interference Check

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | — | — | — | — | — | — |
| L | — | — | — | — | — | — | — | — |

The machine pre-reads the position to be moved during the operation to check the interference by the 3D model (machine, tool and jig) registered in advance. When an interference is predicted, the an alarm will be shown immediately and all the axes will be decelerated to stop.

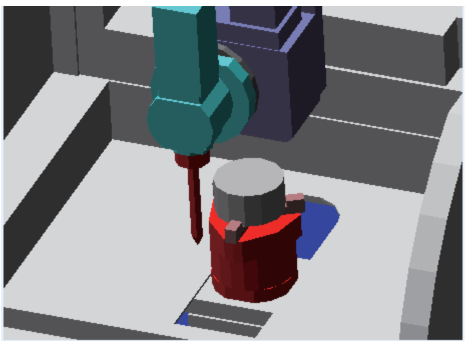
The actual positional relation between the tool position and the interference check position




Also, since the 3D model is shown on the 3D monitor screen in real time, the actual positional relation of the machine can be figured out. When the interference occurs, the interference part in the 3D model will be shown in yellow or red. The interference check is performed between the following:

- machine and machine
- machine and tool
- machine and jig
- tool and jig

The interference check is not performed between the machine and the workpiece. This function is dedicated to the machining center in single part system.



(Note) The software sold separately is required to create the 3D model.

## 15.3.9 Door Interlock

### 15.3.9.1 Door Interlock I

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

(Outline of function)
Under the CE marking scheme of the European safety standards (machine directive), the opening of any protection doors while a machine is actually moving is prohibited.
When the door open signal is input from the PLC, this function first decelerates and stops all the control axes, establishes the ready OFF status, and then shuts off the drive power inside the servo drive unit so that the motors are no longer driven.
When the door open signal has been input during automatic operation, the suspended machining can be resumed by first closing the door concerned and then initiating cycle start again.

(Description of operation)
When a door is open
The NC system operates as follows when the door open signal is input:

(1) It stops operations.
  (a) When automatic operation was underway
  The machine is set to the feed hold mode, and all the axes decelerate and stop.
  The spindle also stops.
  (b) When manual operation was underway
  All the axes decelerate and stop immediately.
  The spindle also stops.

(2) The complete standby status is established.

(3) After all the NC axes and the spindle have stopped, the ready OFF status is established.

(4) The door open enable signal is output.
Release the door lock using this signals at the PLC.

When a door is closed
After the PLC has confirmed that the door has been closed and locked, the NC system operates as follows when the door open signal is set to OFF.

(5) All the axes are set to ready ON.

(6) The door open enable signal is set to OFF.

Resuming operation

(7) When automatic operation was underway
Press the cycle start button.
Operation now resumes from the block in which machining was suspended when the door open signal was input.

(8) When manual operation was underway
Axis movement is commenced when the axis movement signals are input again.

(9) Spindle rotation
Restore the spindle rotation by inputting the forward rotation or reverse rotation signal again: this can be done either by operations performed by the operator or by using the user PLC.

(10) Chopping operation
Input the chopping signal again after returning the chopping axis to the basic point.
If the axis is not returned to the basic point, chopping operation will be resumed from the position where the chopping signal is input again.

(11) When the spindle/C axis exists
If the switching method of the spindle/C axis is PLC signal method and the "Door open signal" is input in the C axis mode, the mode shifts to the spindle mode. Operations when the "Door open signal" is set to OFF differ depending on the parameter setting value.

### 15.3.9.2 Door Interlock II

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

(Outline of function)
Under the CE marking scheme of the European safety standards (machine directive), the opening of any protection doors while a machine is actually moving is prohibited.
When the door open signal is input from the PLC, this function first decelerates and stops all the control axes, establishes the ready OFF status, and then shuts off the drive power inside the servo amplifiers so that the motors are no longer driven.
With the door interlock function established by the door open II signal, cycle start can be enabled even when the door open signal has been input. However, the axes will be set to the interlock status.

(Description of operation)
When a door is open
The NC system operates as follows when the door open II signal is input:

(1) It stops operations.
All the axes decelerate and stop.
The spindle also stops.
(2) The complete standby status is established.
(3) After all the NC axes and the spindle have stopped, the ready OFF status is established.
However, the servo ready finish signal (SA) is not set to OFF.

When a door is closed
After the PLC has confirmed that the door has been closed and locked, the NC system operates as follows when the door open signal is set to OFF.

(4) All the axes are set to ready ON.
(5) The door open enable signal is set to OFF.

Resuming operation

(6) When automatic operation was underway
The door open signal is set to OFF, and after the ready ON status has been established for all the axes, operation is resumed.
(7) When manual operation was underway
Axis movement is commenced when the axis movement signals are input again.
(8) Spindle rotation
Restore the spindle rotation by inputting the forward rotation or reverse rotation signal again: this can be done either by operations performed by the operator or by using the user PLC.

(Note) Concerning the handling of an analog spindle
The signals described in this section are valid in a system with bus connections for the NC control unit and drive units. When an analog spindle is connected, the NC system cannot verify that the spindle has come to a complete stop. This means that the door should be opened after the PLC has verified that the spindle has come to a complete stop. Since the spindle may resume its rotation immediately after the door has been closed, set the forward and reverse rotation signals to OFF when opening the door so as to ensure safety.

(9) Chopping operation
The door open signal is turned OFF, and after the ready ON status has been established, operation is resumed.
The basic point when resuming the operation is the same as where the chopping signal is turned ON.
(10) When the spindle/C axis exists
If the switching method of the Spindle/C axis is PLC signal method and the "Door open II signal" is input in the C axis mode, the mode shifts to the spindle mode. Operations when the "Door open II signal" is set to OFF differ depending on the parameter setting value.

(Note) When emergency stop occurs with the spindle forward run start signal or spindle reverse run start signal ON, the spindle rotation does not restart even if the emergency stop is cancelled.
Note, however, that if you turn ON the door open II signal during emergency stop (or if emergency stop occurs with the door open II signal ON), and then you cancel the emergency stop before turning OFF the said signal, the spindle rotation restarts. (When the door open II signal is turned OFF first, the rotation does not restart.)

Differences from door interlock I

(1) The method used to stop the machine during automatic operation is the same as with the axis interlock function.
(2) The servo ready finish signal (SE) is not set to OFF.
(3) Cycle start is valid during door interlock. However, the interlock takes effect for the axis movements.
(4) When the door interlock function (door open signal ON) is initiated during axis movement, the axes decelerate and stop.
(5) When the door interlock function (door open signal) is set to OFF, the axis movement resumes.
(6) When the door interlock function (door open signal) is set to ON and OFF in the chopping operation, the chopping operation resumes.

### 15.3.10 Parameter Lock

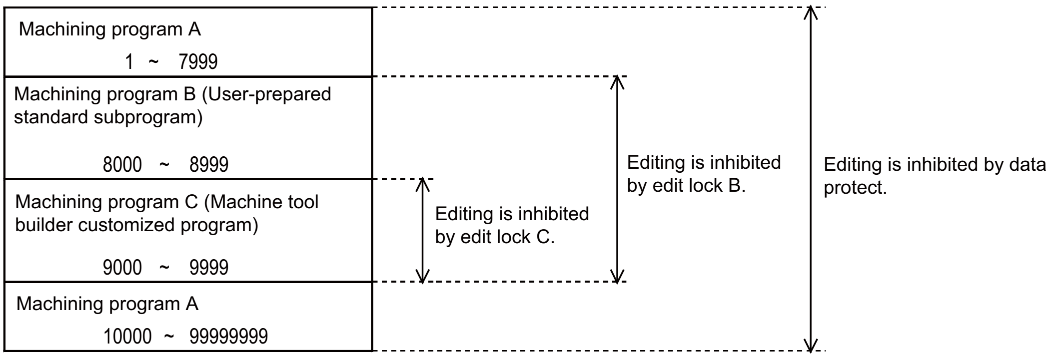
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

This function is used to prohibit changing the machine parameter.

### 15.3.11 Program Protection (Edit Lock B, C)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The edit lock function B or C inhibits machining program B or C (group with machining program numbers) from being edited or erased when these programs require to be protected.




### 15.3.12 Program Display Lock

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

This function allows the display of only a target program (label address 9000) to be invalidated for the program display in the monitor screen, etc.
The operation search of a target program can also be invalidated.
The validity of the display is selected with the parameters. The setting will be handled as follows according to the value.

0: Display and search are possible.
1: Display of the program details is prohibited.
2: Display and operation search of the program details are prohibited.

### 15.3.13 Data Protection by User's Level

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

Up to 8 levels of access permission helps to prevent you from dispatching defective works.
On the protection setting screen, the current operation level can be displayed and changed, and the password for the operation level and the protection level for each data can be changed.

## 15.3.15 Vertical Axis Pull-up

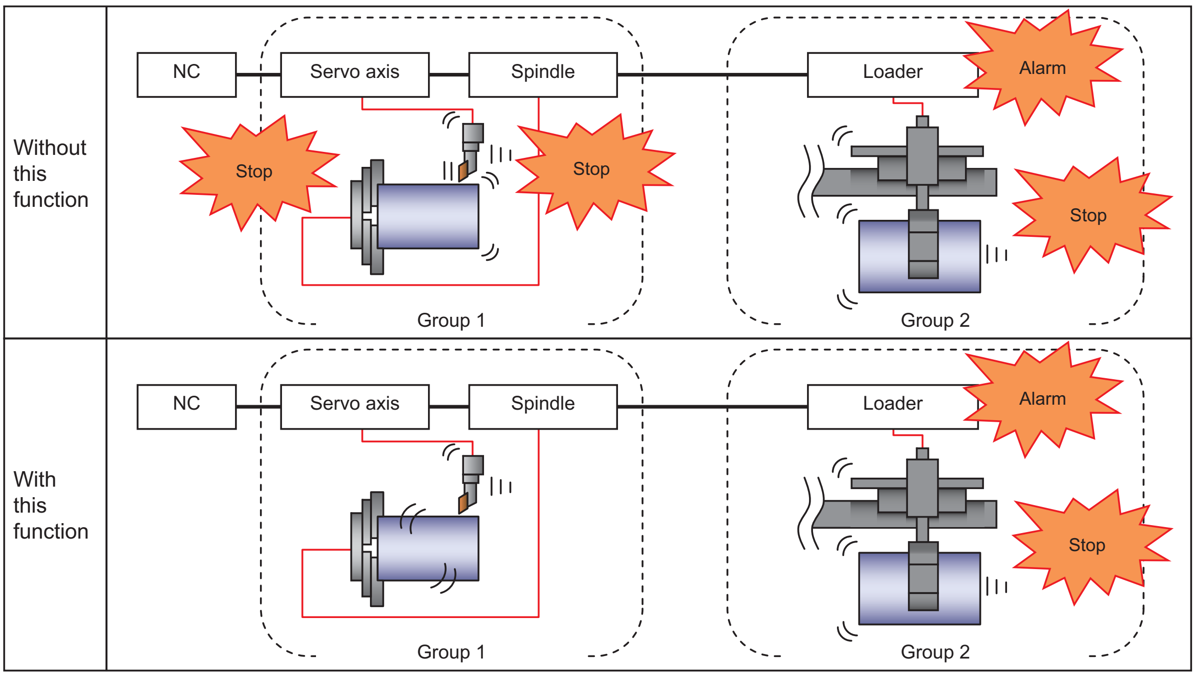
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

When emergency stop or power interruption occurs, motor brake and vertical axis drop prevention function is supposed to work to prevent vertical axis (such as Z axis of vertical machining center) from dropping. However, there might be a case that the vertical axis drops by several μm because of decrepitude of motor brake.
Therefore, emergency stop or the power interruption during finish machining at low speed might cause damage to the cutting tool in operation.
Vertical axis pull-up function prevents the tool from breakage, through pulling up the cutting tool during emergency stop or instantaneous power interruption at low cutting speed.

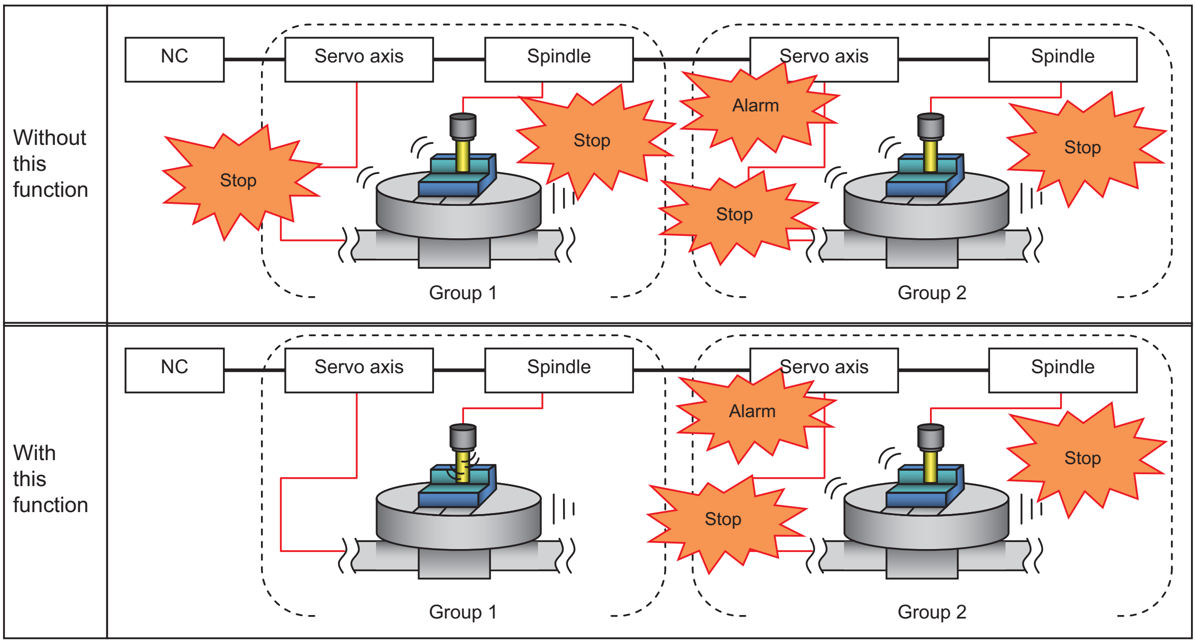
## 15.3.16 Machine Group-based Alarm Stop

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

When an alarm occurs for an axis, this function performs an alarm stop only for the axes in a machine group to which the axis belongs. When this function is used in a lathe system, even though an alarm occurs for the loader axis, the operation can be continued if the servo axis and the spindle have been set in a different machine group from the loader axis as illustrated below. Without this function, the alarm stop is performed for all the axes when an alarm occurs.



Likewise, when this function is used in a machining center system, the axes belonging to a different machine group from the axis for which an alarm has occurred can continue the operation as illustrated below. Without this function, the alarm stop is performed for all the axes when an alarm occurs.



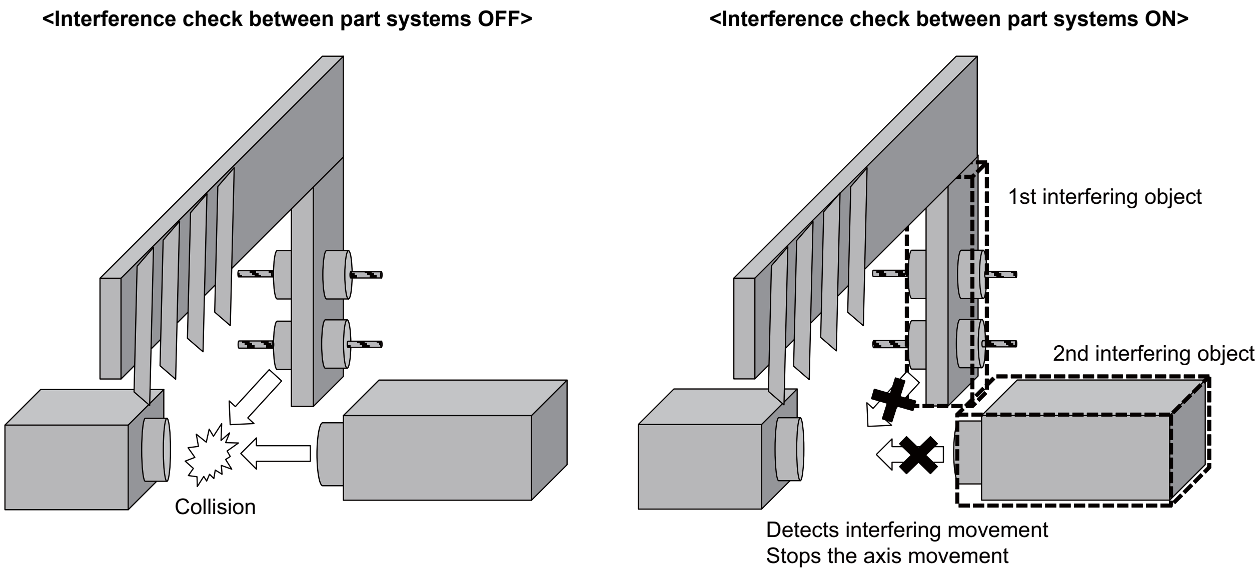

(Note) The machining group number can be set for each servo axis and spindle in this function, and incorrect setting may lead to accidents. Set the machine group number with enough care.

### 15.3.17 Interference Check Between Part Systems

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | － | － | － | － | － | － | － | － |
| L | ○ | ○ | ○ | ○ | ○ | ○ | － | － |

* Maximum 4 systems

This function checks the relative position of up to six cuboids (referred to as interfering objects) all the time, and if a command which causes the interfering objects to collide with each other is issued, the function stops the axis movement to prevent the interference in advance.
Such interference can be prevented by covering the tool post, etc. with cuboids. Because the check is performed for axis movement of all part systems, interference between tool posts which are positioned in difference part systems can be prevented.
This is valid for the L-system configured with two or more part systems.




### 15.3.18 Spindle Protection

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | － |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | － |

This function consists of a function of calculating the equivalent load ratio of spindle motor and a function of outputting the equivalent load ratio and temperature of spindle motor to the log file.

The equivalent load ratio of spindle motor is determined by calculating the average output of spindle motor from the start of cycle operation to the next cycle operation and showing the average output as a percentage of the continuous rated output. The ratio is output to the ZR register and the drive monitor (item name: Duty value).

The log file can be used to analyze the operating environment of spindle motor and to detect a decrease in cooling capacity caused by dirt or clogging of spindle motor cooling fan.

While the same machining program is operated continuously, if the equivalent load ratio of last operation exceeds the threshold at the start of cycle operation, a warning is displayed.

## 15.4 Maintenance and Troubleshooting

### 15.4.1 Operation History

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

This is a maintenance function which is useful for tracing down the history and NC operation information and analyzing trouble, etc. This information is saved in the history data file, and can be displayed on the screen and output to a file. The machine tool builder password is required to use this function.

The following of history data files are used.
The following contents can be viewed on the edit screen.
- All history:
  The key history, touchscreen history, alarm/warning history, PLC signal history, tool offset change history, workpiece offset change history and AC input power OFF history is recorded in date/time order.
- Key history:
  Only the key history is recorded in date/time order.
- Touchscreen history:
  Only the touchscreen history is recorded in date/time order.

The data sorting order of the all history data files can be changed by the parameter.
- In chronologically ascending order for each log type
- In chronologically ascending order for all the log types

(Note) If the date and time are the same, the history will be displayed in the following order.Key history
Key history
Touchscreen history
Alarm history
PLC signal history
Tool offset change history
Workpiece offset change history
AC input power OFF history

### 15.4.2 Data Sampling

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The NC internal data (speed output from NC to drive unit, feedback data from the drive unit, etc.) can be sampled and the data can be output as text data.
The type of sampling NC internal data and sampling conditions are input on the screen as the sampling parameter. The sampling parameter can be input/output with the sampling data as the header information of the sampling data.The parameter can be used to set whether the sampling starts when the power is turned ON.

| Item | Specifications |
|---|---|
| Sampling cycle | 1.776 ms × setting value |
| Number of sampled axes | NC axis: The maximum number of axes usable for specifications<br>Spindle: The maximum number of spindles usable for specifications |
| Number of sampled channels | 1 to 16 points |
| Sampling data size | Maximum 2,620,416 points<br>(Note 1) This is the entire data size. The data size per channel will decrease when the number of sampled channels increases. |

### 15.4.3 NC Data Backup

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The NC data back up function backs up the NC parameters, etc., on a built-in disk of display (HD) unit or SD card.
The data can also be restored.

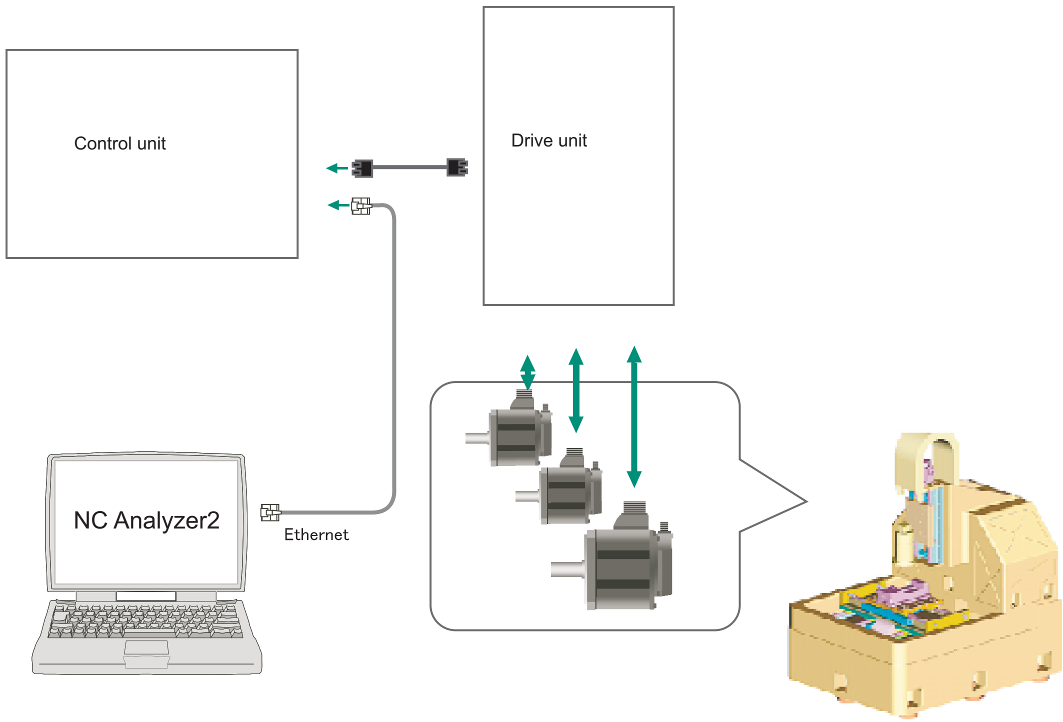
## 15.4.4 Servo Tuning Support

### 15.4.4.1 NC Analyzer2

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

(Note) Please contact us to purchase this tool.

Servo parameters can be automatically adjusted by measuring/analyzing the machine characteristics. The measurement/analysis is conducted by activating the motor using machining programs for adjustment or vibration signals. Various data can be sampled.



**<Functions>**

| Adjustment wizard | Description |
|---|---|
| Velocity loop gain adjustment | Automatically adjusts velocity loop gain and resonance filters. |
| Lost motion adjustment | Adjusts the lost motion automatically for the delay in responsecaused when the direction of the machine rotates is reversed. |

| Measurement and adjustment | Description |
|---|---|
| Frequency response measurement | Measures the frequency response of speed loop for the designated axis. The result will be output as frequency response waveform. |
| Reciprocation acceleration/ deceleration measurement | Measures the reciprocation acceleration/deceleration for the designated axis. The result will be output as time-series waveform. (*1) |
| Roundness measurement | Measures the roundness for the designated axis. The result will be output as roundness waveform. (*1) |
| Synch tap error measurement | Measures the synchronous tap error for the designated axis. The result will be output as time-series waveform.(*1) |
| Spindle acceleration/deceleration measurement | Measures the spindle acceleration/deceleration for the designated axis. The result will be output as time-series waveform. (*1) |
| Spindle orientation measurement | Measures the spindle orientation for the designated axis. The result will be output as time-series waveform.(*1) |
| Spindle C-axis measurement | Executes an arbitrary machining program with specified axis, and measures spindle C-axis by using that data. The result will be output as time-series waveform. |
| Spindle synchronization measurement | Executes an arbitrary machining program with specified axis, and measures spindle synchronization by using that data. The result will be output as time-series waveform. |
| PLC axis acceleration/deceleration measurement | Executes an arbitrary machining program with specified axis, and measures PLC axis acceleration/deceleration by using that data. The result will be output as time-series waveform. |
| Arbitrary path measurement | Executes an arbitrary machining program with specified axis, and measures arbitrary program by using that data. The result will be output as arbitrary program waveform. |

(*1) For the measurement, create a program by the program creation function or use an arbitrary machining program.

### 15.4.5 Automatic Backup

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ (GOT) |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ (GOT) |

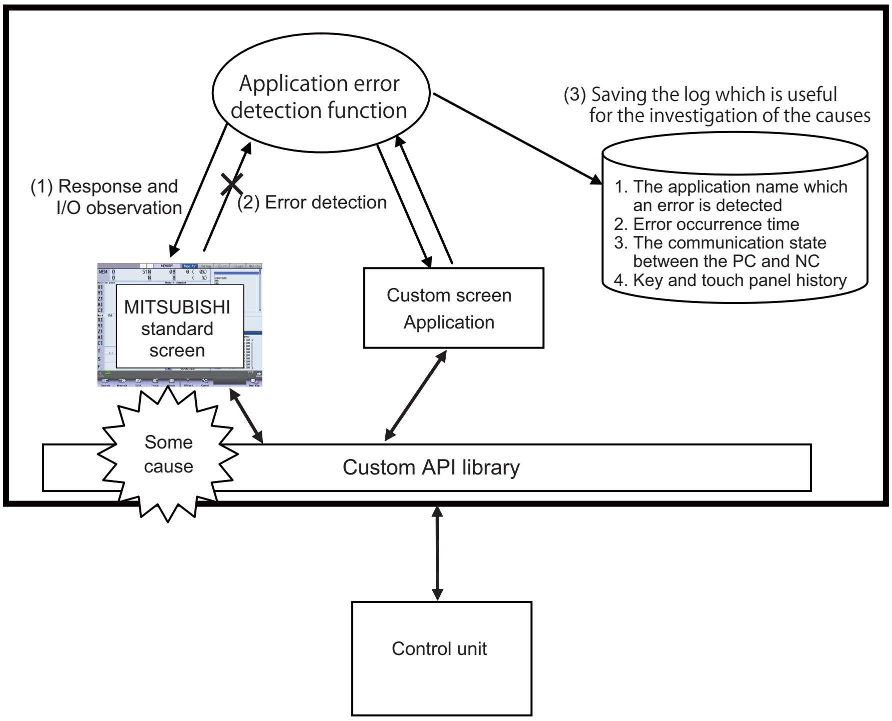
With this function, system data, ladder program and custom software can be automatically backed up in case of system failure. Up to the three most recent backup data can be stored.
The backup execution timing can be set with parameters.

### 15.4.8 Application Error Detection

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ /— | ○ /— | — | — | ○ /— | — | — | — |
| L | ○ /— | ○ /— | — | — | ○ /— | — | — | — |

* Specifications of separated-type display are classified with "Windows-based" and "Windows-less"

Application error detection function observes applications such as MITSUBISHI standard screen or custom screen. When an error such as screen lock is detected, this function saves information and data in the log to investigate the causes easily.

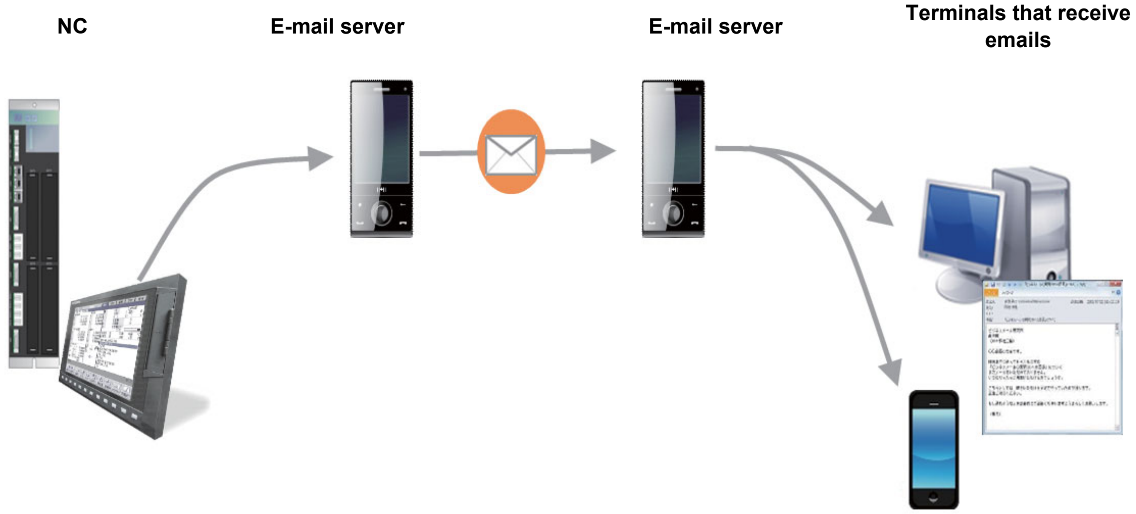



(1) Response from the application and a change of I/O is observed on a periodical basis.
(2) When an application with no response and no change of I/O for a certain period is detected, it is determined that there is an error.
(3) When an error is detected, the log which is useful for the investigation of the causes will be saved.

### 15.4.9 Email Notification to Operator

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | – |
| L | △ | △ | △ | △ | ○ | ○ | ○ | – |

This function enables NC to transmit emails to network-connected email servers (SMTP servers). The transmitted emails can be received by means of email software in PC or mobile phone via email servers. With this function, the NC can send emails to PCs and mobile terminals away from machines. You are able to know machining conditions (such as machining completion, stop and failure) even if you are in remote places.



### 15.4.10 NC Configurator2

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

NC Configurator2 achieves the following functions for the multiple NCs connected to the network, or a file in the SD card or the local disk. Data from up to 8 machines can be handled at a time.
(1) NC Data: Transmit, display, edit and control the data related to the NC machine and parameters for NC control module side, and transmit, display the machining programs, tools and work.
(2) Function parameter: Support Parameter settings for individual NC function for the users.
(3) RS232C communication function: Offer various functions using the tape mode and serial communication.

Please contact us to purchase a full function version. A limited function version is also available free of charge.

### 15.4.11 Diagnosis Data Output

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | – |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | – |

With this function, the information indicating the replacement cycle of the service parts used in NC, drive or motor can be output to the ZR registers. This information can be used for the preventive maintenance including life prediction.

### 15.4.102 Backup

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | – | – | – | – | – | – | – | ○ |
| L | – | – | – | – | – | – | – | ○ |

This function stores the setting information (sequence programs, parameters and the setting values, etc.) of a connected device to the installed data storage in GOT, and restores those data to the device as needed.

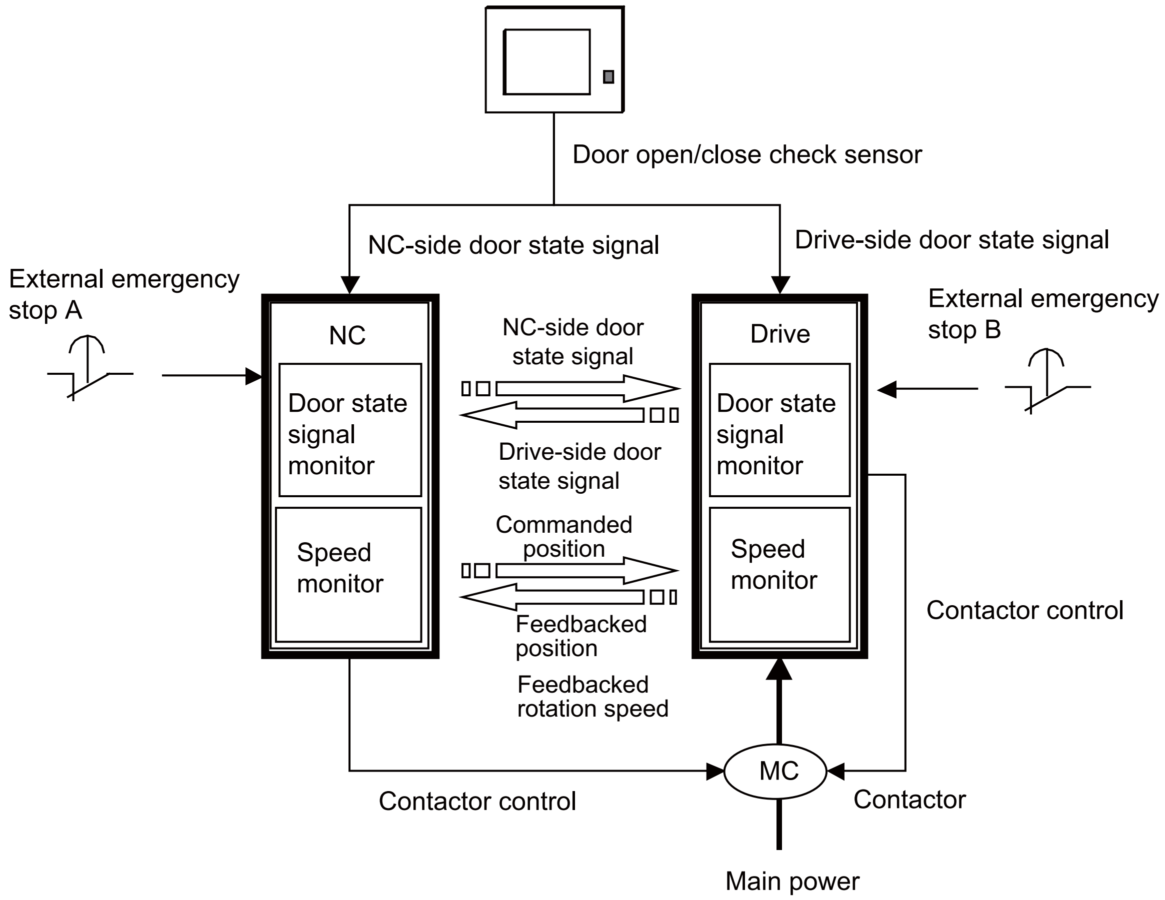
## 15.5 Functional Safety

### 15.5.1 Safety Observation

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | － |
| L | △ | △ | △ | △ | ○ | ○ | ○ | － |

With the safety observation function, access to the working part of the machine without turning the motor drive power OFF is possible even when the machine door is open. Operation speed will be the pre-set safety speed or lower while the door is open.

| Function | Description |
|---|---|
| Dual emergency stop | The control unit and the drive unit separately observe the input of emergency stop. In case of an emergency stop, both the control unit and the drive unit (power supply unit) will independently control the contactors to shut the drive power OFF. |
| Speed monitor | The control unit and the drive unit (servo/spindle drive unit) separately observe the following. When an error is detected during observation, the main power for the drive will be shut OFF.<br>(1) That the command speed should not exceed the speed set by the parameter (the "safety speed").<br>(2) That the motor rotation speed should not exceed the rotation speed set by the parameter (the "safety rotation speed"). |
| Door state signal monitor | The control unit and the drive unit separately observe the door state signal (open or closed). |



### 15.5.2 Smart Safety Observation

The smart safety observation function achieves smart and high safety with the following features.

(1) The redundant observation is enabled not only for the door signal but for various signals that require the safety.

(2) Eight new functions including the position observation are added.

(3) Signal wiring is simplified by having redundant PLC signal. (With the conventional safety observation, the signal wiring is needed for NC and drive units.)

(4) Redundant safety ladder eliminates the need for MTB to prepare the safety unit.

(5) It is possible to make only one ladder of the redundant safety ladder when they serve as the equivalent role. (It is also possible to make two ladders to have different roles.)

(6) The I/O board equipped with safety signal input terminal is available, which is mounted on the back of the operation panel. This eliminates the need to mount the safety I/O unit additionally in the operation panel. (M800/M80 Series)

(Note 1) Safety I/O devices (safety RIO unit, operation panel with safety I/O) are required for inputting/outputting safety signals. Of the I/O device connection channels on NC unit, the channels which input/output safety signals need to be composed only of safety I/O devices and RIO2.0 units. (RIO1.0 units cannot be connected to I/O channels which input/output safety signals.) (M800/M80 Series)

(Note 2) In order to input/output the safety signals, the safety signal unit needs to be used. The NC unit and the safety signal unit need to be connected with the RIO cable. (C80 Series)

(Note 3) For user safety sequence, machine tool builders need to create safety signal process logic and write it to NC unit.

(Note 4) Of connection channels for each drive unit in NC unit, channels with axes which use "Safety function S" need to be composed only of drive units of MSD-E Series.

#### 15.5.2.1 Safety-related I/O Observation

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | □ | □ | △ |
| L | △ | △ | △ | △ | ○ | □ | □ | △ |

* Safety card is required for M80

Using the dual circuits for processing signals input/output to/from the machine (safety signal compare sequence) and dual execution of safety signal process logic made by users (safety PLC), if one circuit has broken down, the other circuit can detect errors, which improves the safety of signal process.

#### 15.5.2.2 Emergency Stop Observation

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | □ | □ | △ |
| L | △ | △ | △ | △ | ○ | □ | □ | △ |

* Safety card is required for M80

Emergency stop signal is doubled and observed to see whether there is any error. When one emergency stop signal is in open state, the whole system can be set in emergency stop condition.

### 15.5.2.3 Drive Safety Function

#### 15.5.2.3.1 SLS (Safely-Limited Speed)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | □ | □ | △ |
| L | △ | △ | △ | △ | ○ | □ | □ | △ |

* Safety card is required for M80

Axis speed (command speed, FB speed) is observed doubly to see whether the speed exceeds the safe speed. Four steps of safe speed and 16 steps of override can be selected. (64 ways of safe speed can be created in total.)

#### 15.5.2.3.2 SLP (Safely-Limited Position)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | □ | □ | △ |
| L | △ | △ | △ | △ | ○ | □ | □ | △ |

* Safety card is required for M80

Axis absolute position (command position, FB position) is observed doubly to see whether the position exceeds the safe position range. Safe position range can be selected from 4 levels.

#### 15.5.2.3.3 SOS (Safe Operating Stop)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | □ | □ | △ |
| L | △ | △ | △ | △ | ○ | □ | □ | △ |

* Safety card is required for M80

SOS is made by performing the following operations simultaneously.

(1) Axis stop speed (command speed, FB speed) is observed doubly whether the speed exceeds the safe stop speed.
(2) Axis stop position (command position, FB position) is observed doubly whether the position exceeds the safe stop position range.
(3) Axis stop position deviation (difference between command position and FB position) is observed doubly to make sure that the deviation does not exceed the safe stop position deviation.

#### 15.5.2.3.4 SSM (Safe Speed Monitor)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | □ | □ | △ |
| L | △ | △ | △ | △ | ○ | □ | □ | △ |

* Safety card is required for M80

This function uses the safety signals to inform that the axis speed (command speed, FB speed) is equal to or below the safe speed. Up to 4 safe speeds can be set.

### 15.5.2.3.5 SBC/SBT (Safe Brake Control/Safe Brake Test)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | □ | □ | △ |
| L | △ | △ | △ | △ | ○ | □ | □ | △ |

* Safety card is required for M80

The brakes connected to motors are activated by this function. Because there are two circuits for activating the brakes, one circuit can activate the brakes even when the other circuit is broken down. Furthermore, Safe Brake Test (SBT) can diagnose the circuits for activating the breaks and the effectiveness of the brakes (deterioration due to abrasion, etc.).

### 15.5.2.3.6 SCA (Safe Cam)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | □ | □ | △ |
| L | △ | △ | △ | △ | ○ | □ | □ | △ |

* Safety card is required for M80

This function uses the safety signals to inform that the axis absolute position (command position, FB position) is within the range of safe position. Up to 16 sets (16 each for pulse side and minus side) can be set for the safe position range.

### 15.5.2.3.7 SS1/SS2 (Safe Stop)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | □ | □ | △ |
| L | △ | △ | △ | △ | ○ | □ | □ | △ |

* Safety card is required for M80

(1) Safe stop 1 (SS1)
STO function is activated after an axis is decelerated and the speed (command speed, FB speed) becomes equal to or below the safe stop speed. STO function is also activated when the speed does not reach the safe stop speed within a specified time from the start of deceleration.

(2) Safe stop 2 (SS2)
SOS function is activated after an axis is decelerated and the speed (command speed, FB speed) becomes equal to or below the safe stop speed. SOS function is also activated when the speed does not reach the safe stop speed within a specified time from the start of deceleration.

### 15.5.2.3.8 STO (Safe Torque Off)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | □ | □ | △ |
| L | △ | △ | △ | △ | ○ | □ | □ | △ |

* Safety card is required for M80

This function shuts OFF power supply to axes. Because there are two power shutoff circuits, one circuit can shut OFF the power supply even when the other circuit is broken down. STO also performs fault diagnosis of the shutoff circuits.

# 16

# Drive System

## 16.1 Servo/Spindle

Refer to "MITSUBISHI CNC M800W/M800S Series Specifications List" "MITSUBISHI CNC M80W/M80/C80 Series Specifications List".
Refer to the following manuals for details on the servo and spindle system.

DRIVE SYSTEM DATA BOOK (IB-1501252(ENG))
MDS-E/EH Series Specifications Manual (IB-1501226(ENG))
MDS-EJ/EJH Series Specifications Manual (IB-1501232(ENG))
MDS-EM/EMH Series Specifications Manual (IB-1501238(ENG))

# 17

# Machine Support Functions

## 17.1 PLC

### 17.1.1 Built-in PLC Processing Mode

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | － |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | － |

An exclusive sequence program that controls the various signals between the controller and machine to realize operation applicable to each machine can be created and built in.
The sequence execution modes include high-speed processing and main processing.

**(1) High-speed processing**
This mode provides repeated execution at constant cycles. It is used to process signals requiring high speeds. The max. number of program steps for high-speed processing (1 period) is 1000 steps when using basic instructions.

**(2) Main processing**
This mode provides normal sequence processing. The processing cycle depends on the number of sequence steps.

### 17.1.2 PLC Functions

#### 17.1.2.1 Built-in PLC Basic Function

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | △ (*1) |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | △ (*1) |

(*1) MELSEC

**[M800/M80 series]**

**(1) Ladder instructions**
Basic instructions (bit processing instructions)
43 instructions including LD, LDI, OR, ORI, AND, ANI, OUT, PLS, etc.
Function instructions
188 instructions including data transfer, 4 basic arithmetic operations, logic arithmetic operations, large/small identification, binary/BCD conversion, branching, conditional branching, decoding, encoding, etc.

**(2) Devices**

The device range in the following table is the default number of device points set in the project 1 when the multi-project setting or the setting of the number of device points is not performed.

| Device | Device No. | Unit | Details |
|---|---|---|---|
| X* | X0 ~ X1FFF (8192 points) | 1 bit | Input signal to PLC: Machine input, etc. |
| Y* | Y0 ~ Y1FFF (8192 points) | 1 bit | Output signal from PLC: Machine output, etc. |
| M | M0 ~ M61439 (61440 points) | 1 bit | Temporary memory |
| F | F0 ~ F2047 (2048 points) | 1 bit | Temporary memory.<br>Alarm message interface |
| L | L0 ~ L1023 (1024 points) | 1 bit | Latch relay (back up memory) |
| SM | SM0 ~ SM2047 (2048 points) | 1 bit | Special relay |
| V | V0 ~ V511 (512 points) | 1 bit | Edge relay |
| SB | SB0 ~ SB3FF (1024 points) | 1 bit | Special relay |
| B | B0 ~ BDFFF (57344 points) | 1 bit | Link relay |
| SW | SW0 ~ SW3FF (1024 points) | 1 bit | Special register |
| SD | SD0 ~ SD204 (2048 points) | 16 bit | Special register |
| T | T0 ~ T2047 (2048 points) | 1 bit/<br>16 bit | Timer<br>(The variable/fixed boundary is set with a parameter.)<br>(Note 2) |
| ST | ST0 ~ ST127 (128 points) | 1 bit/<br>16 bit | Integrated timer (100ms unit) |
| C | C0 ~ C511 (512 points) | 1 bit/<br>16 bit | Counter (The variable/fixed boundary is set with a parameter.) |
| D | D0 ~ D4095 (4096 points) | 16 bit/<br>32 bit | Data register. Register for calculation |
| R* | R0 ~ R32767 (32768 points) | 16 bit/<br>32 bit | File register. CNC word interface |
| ZR | ZR0 ~ ZR13311 (13312 points) | 16 bit/<br>32 bit | File register. User release |
| W | W0 ~ W2FFF (12288 points) | 16 bit/<br>32 bit | Link register |
| Z | Z0 ~ Z13 (14 points) | 16 bit | Address index |
| N | N0 ~ N14 (15 points) | | Master controller nesting level |
| P* | P0 ~ P4095 (4096 points) | | Label for conditional jump, subroutine call command |
| K | K-32768 ~ K32767 | | Decimal constant for 16-bit command |
| | K-2147483648<br>~ K2147483647 | | Decimal constant for 32-bit command |
| H | H0 ~ HFFFF | | Hexadecimal constant for 16-bit command |
| | H0 ~ HFFFFFFFF | | Hexadecimal constant for 32-bit command |

(Note 1) Devices marked with * in the device column have designated applications. Do not use devices other than those corresponding to the input/output signals with the machine side (input/output signals of the remote I/O unit), even if it is an undefined vacant device.

(Note 2) Distinction of 10ms timer and 100ms timer is performed by command. (10ms timer is performed by OUTH command, 100ms timer is performed by OUT command.)

**(3) Timer / counter setting display**

(a) PLC timer

The setting value of the timer used by the built-in PLC can be set from the screen on the setting and display unit.

The timer types include the 10ms, 100ms and 100ms integral types.

Whether to validate the timer in the PLC program or to validate the setting value from the screen can be selected with the parameters.

Whether to hold the integral timer when the power is turned OFF can also be selected.

(b) PLC counter

The setting value of the counter used by the built-in PLC can be set from this screen.

Whether to validate the constants in the PLC program or to validate the setting value from the screen can be selected with the parameters.

Whether to hold the counter value when the power is turned OFF can also be selected.

**(4) External key input**

By inputting the key data from the built-in PLC, the same operation as when the operator operates the operation board can be done.

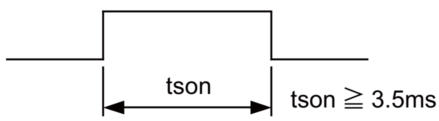
**(5) Real spindle speed output**

The real spindle speed is converted by the signals of the encoder installed on the spindle and is output to the PLC. The output increment is 0.001r/min.

**(6) High speed input/output signal**

There are signals that can be input and output at a 3.5ms cycle for high-speed processing.

(a) Input signal ON time




(b) After the signal output is set in the interface, it can be output to the machine side with a max. 3.5ms delay. The input also appears on the interface with a 3.5ms delay.

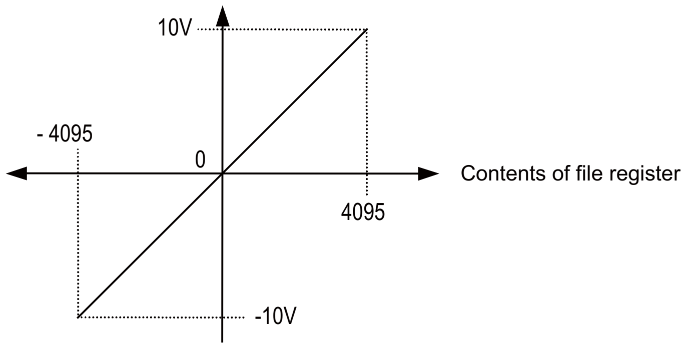
(c) The signals used for high-speed processing are assigned with the parameters. Assignment is possible in a continuous 16-point unit.

**(7) PLC analog voltage control**

(a) Analog output

When the specified data is put in the file register, the corresponding analog voltage is output from the analog output external connector.

<Relationship between file register contents and analog output voltage>




| | |
|---|---|
| **Output voltage** | 0 to ±10V(±5%) |
| **Resolution** | Full scale (10V)/4095 |
| **Load condition** | 10kΩ resistance load (standard) |
| **Output impedance** | 220Ω |

(Note) The remote I/O unit DX231 is required for analog output.

Refer to the PLC Programming Manual for details.

**[C80 series]**

For the details of C80 series, refer to the manual of MITSUBISHI iQ Platform-compatible PAC "MELSEC iQ-R series".

## 17.1.2.1.1 Index Modification

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | △ (*1) |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | △ (*1) |

(*1) MELSEC

## 17.1.2.1.2 Multi-program [Number of Programs]

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ 120 | ○ 120 | ○ 120 | ○ 120 | ○ 60 | ○ 60 | ○ 60 | △ (*1) |
| L | ○ 120 | ○ 120 | ○ 120 | ○ 120 | ○ 60 | ○ 60 | ○ 60 | △ (*1) |

(*1) MELSEC

### 17.1.2.1.3 Multi-project [Number of Projects Stored]

[M system]

| PLC project | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| Number of PLC projects: 1 | ○ | ○ | ○ | ○ | — | — | ○ | — |
| Number of PLC projects: 3 | △ | △ | △ | △ | ○ | ○ | — | — |
| Number of PLC projects: 6 | △ | △ | △ | △ | — | — | — | — |

[L system]

| PLC project | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| Number of PLC projects: 1 | ○ | ○ | ○ | ○ | — | — | ○ | — |
| Number of PLC projects: 3 | △ | △ | △ | △ | ○ | ○ | — | — |
| Number of PLC projects: 6 | △ | △ | △ | △ | — | — | — | — |

### 17.1.2.1.4 Function Block (FB)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | △ (*1) |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | △ (*1) |

(*1) MELSEC

### 17.1.2.1.5 Label Programming

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | △ (*1) |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | △ (*1) |

(*1) MELSEC

### 17.1.2.2 PLC Exclusive Instruction

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | △ (*1) |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | △ (*1) |

(*1) MELSEC

PLC exclusive instruction is provided for certain limited applications, enabling a complex machining process, which is difficult to carry out only by the basic instructions and function instructions.

**[M800/M80 series]**

PLC exclusive instructions include:

(1) ATC exclusive instruction (ATC)

This is an instruction to function ATC, or magazine index control, tool exchange with arm, etc.

ATC exclusive instructions are as follows.

- Tool No. search
- Tool change
- Tool table forward/reverse run
- Pointer (which indicates magazine index position) forward/reverse run
- Tool data read/write

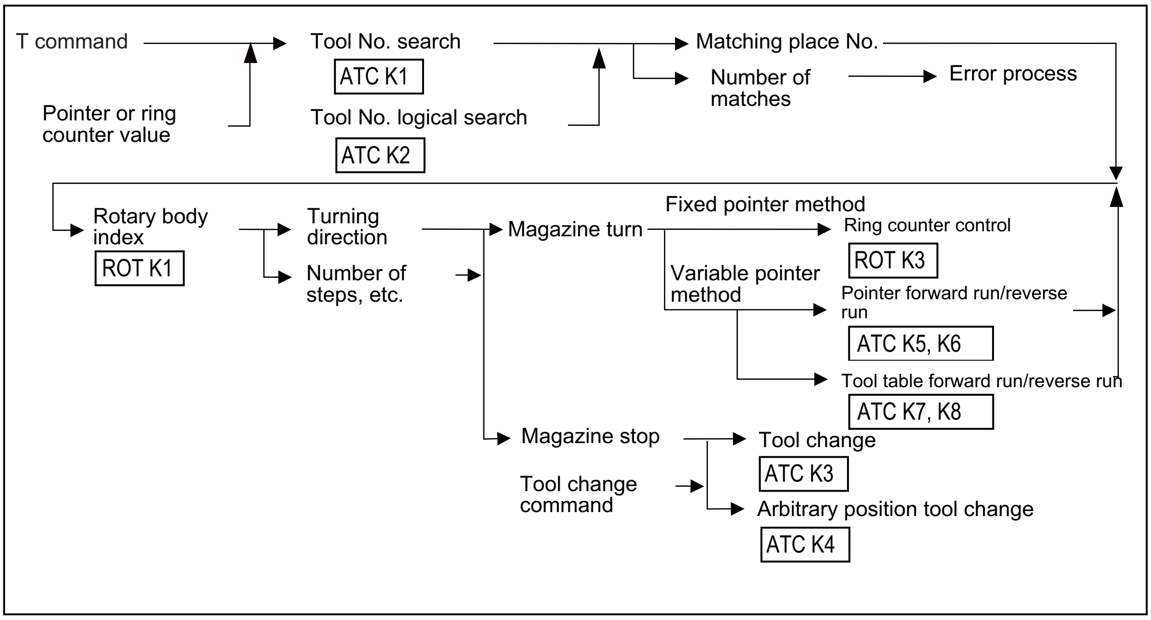
(2) Rotary body control instruction (ROT)

This is an instruction to determine the rotary body's target position or rotation direction, or to function as a ring counter.

This is used when calculating the rotation direction or number of index steps of the magazine or turret based on the output data figured from ATC exclusive instruction tool No. search processing, or when controlling the rotary body position.

**Using the ATC and ROT instructions**

The order for using the ATC and ROT instructions when T is commanded or tool exchange is commanded is shown below.



**[C80 series]**

PLC exclusive instructions include:

(1) Other device write instruction (DDWR)

This is an instruction to write the data to the device in other machine from the PLC CPU.

(2) Other device read instruction (DDRD)

This is an instruction to read the device data in other machine to the PLC CPU.

PLC exclusive instructions enable to access the device data of NC CPU from the PLC CPU.

PLC exclusive instructions are transferred via the exclusive instruction transmission between CPUs area provided in the system area on the CPU multi-buffer memory (fixed period communication area).

Also, "D (P)." or "M (P)." can be added before each instruction.

| | |
|---|---|
| Periodic instruction, D (P). | The setting needs to be changed to use the periodic connection function on GX Works3, but since the periodic instruction is compatible with the old models, it can use the program of the old models. |
| Non-periodic instruction, M (P). | This can be used regardless of the setting of the periodic connection function, but since non-periodic instruction is not compatible, the correction needs to be done in order to use the program of the old model. |

The non-periodic instruction "M (P)." is recommended as it can be used regardless of the setting.

For the details of C80 series, refer to the manual of MITSUBISHI iQ Platform-compatible PAC "MELSEC iQ-R series".

## 17.1.3 PLC Support Functions

### 17.1.3.1 Alarm Message Display

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | – |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | – |

The contents of the alarms which have occurred during sequence (user PLC) processing can be displayed on the setting and display unit.

Up to four alarm message displays can be displayed simultaneously on the alarm diagnosis screen. The maximum length of one message is 46 characters.

### 17.1.3.2 Operator Message Display

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ (*1) |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ (*1) |

(*1) Only macro alarm messages are displayed.

When a condition has arisen in which a message is to be relayed to the operator, an operator message can be displayed separately from the alarm message.

The maximum length of an operator message on PLC message screen is 60 characters. The maximum number of characters per line is 55, and the message more than 56 characters is displayed on two lines. The number of messages displayed at the same time are up to four.

### 17.1.3.3 Memory Switch (PLC Switch)

The function equivalent to the machine operation switches can be implemented by using the setting display unit of controller. Switches can be turned ON/OFF from PLC switch screen and user PLC. Each switch can be named arbitrarily.

The PLC switch has 32 points as a standard. The switch can be expanded to 64 or 96 points by the additional specification.
By the PLC switch for reverse, the valid switches by the additional specifications will be reversed.
Even when turning on the PLC switch for reverse, the invalid switches without the additional specification will not be reversed.
The PLC switch names can be created up to 96 points regardless of the additional specification state.

#### 17.1.3.3.1 Memory Switch (PLC Switch) 32 Points

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | － |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | － |

32 points of PLC switches can be set on the setting and display unit screen, and the ON/OFF control executed.

#### 17.1.3.3.2 Memory Switch (PLC Switch) 64 Points

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | － | － | － | － |
| L | △ | △ | △ | △ | － | － | － | － |

64 points of PLC switches can be set on the setting and display unit screen, and the ON/OFF control executed.

#### 17.1.3.3.3 Memory Switch (PLC Switch) 96 points

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | － | － | － | － |
| L | △ | △ | △ | △ | － | － | － | － |

96 points of PLC switches can be set on the setting and display unit screen, and the ON/OFF control executed.

### 17.1.3.4 Load Meter Display

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

A load meter can be displayed on the setting and display unit.
Up to two axes designated with the built-in PLC such as the spindle load and Z axis load can be displayed as bar graphs on the screen.

### 17.1.3.5 User PLC Version Display

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The user PLC version can be displayed in the software list on the Software Configuration screen.

### 17.1.3.6 Ladder Program Writing during RUN

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | △ (*1) |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | △ (*1) |

(*1) MELSEC

Ladder program can be edited while PLC is running. This function is available, either by GX Developer or PLC onboard edit. (Only M8)

### 17.1.3.7 PLC Program Protection

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ (*1) | ○ (*1) | ○ (*1) | ○ (*1) | ○ (*1) | ○ (*1) | ○ (*1) | △ (*2) |
| L | ○ (*1) | ○ (*1) | ○ (*1) | ○ (*1) | ○ (*1) | ○ (*1) | ○ (*1) | △ (*2) |

(*1) Each file
(*2) MELSEC

**[M800/M80 series]**
For PLC data protection, the file password can be set to each file of PLC data.
The file password of the PLC data stored in NC can be released temporarily with PLC on-board.
(Note 1) The file password registration/change or cancellation can not be made with PLC on-board. Use GX Developer for these operation.

The file password has the writing attribute (write protection/permission) and the reading attribute (read protection/ permission), and the following operation is prohibited for these attributes.
Write protection: PLC data overwrite and deletion, conversion after editing the ladder
Read/write protection: PLC data overwrite, deletion, read and verification, conversion after editing the ladder

For details, refer to the PLC Development Manual.

**[C80 series]**
For the details of C80 series, refer to the manual of MITSUBISHI iQ Platform-compatible PAC "MELSEC iQ-R series".

## 17.1.4 Built-in PLC Capacity

### 17.1.4.1 Standard PLC Capacity [Number of Steps]

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ 128000 | ○ 128000 | ○ 128000 | ○ 128000 | ○ 64000 | ○ 64000 | ○ 32000 | △ (*1) |
| L | ○ 128000 | ○ 128000 | ○ 128000 | ○ 128000 | ○ 64000 | ○ 64000 | ○ 32000 | △ (*1) |

(*1) MELSEC

For the details of C80 series, refer to the manual of MITSUBISHI iQ Platform-compatible PAC "MELSEC iQ-R series".

### 17.1.4.2 Large PLC Capacity: 256000 Steps

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | － | － | － | － |
| L | △ | △ | △ | △ | － | － | － | － |

### 17.1.4.3 Large PLC Capacity: 512000 Steps

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | － | － | － | － |
| L | △ | △ | △ | △ | － | － | － | － |

## 17.1.5 Machine Contact Input/Output I/F

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | △ (*1) |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | △ (*1) |

(*1) MELSEC

**[M800/M80 series]**

**⚠ CAUTION**

**Follow the remote type machine contact input/output interface described in this manual. (Connect a diode in parallel with the inductive load or connect a protective resistor in serial with the capacitive load, etc.)**

Refer to the "General Specifications" for details.

**[C80 series]**
Selecting from within the input/output unit of Mitsubishi PLC "MELSEC iQ-R series". Refer to the manual of input/output unit for details.

### 17.1.6 Ladder Monitor

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ (GOT) |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ (GOT) |

**[M800/M80 series]**

This function enables the operating status of the sequence circuit to be checked on the controller's setting and display unit.

The ladder monitor functions include the following.

(1) Circuit monitoring
(2) Screen stop by monitor stop trigger point
(3) Entry monitoring
(4) Decimal-hexadecimal conversion present value monitoring

**[C80 series]**

The operation state of sequence circuit can be confirmed on the screen of Mitsubishi Graphic Operation Terminal (GOT).

The ladder monitor functions include the following.

(1) Sequence program monitoring (circuit)
(2) Sequence program monitoring (R circuit)
(3) Sequence program monitoring (SFC)

Refer to the manual of Mitsubishi Graphic Operation Terminal (GOT) for details.

### 17.1.7 PLC Development

#### 17.1.7.1 On-board Development

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | － |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | － |

**[M800/M80 series]**
On-board refers generically to the PLC related operations carried out with the CNC unit.
This is the easy-to-use on-board with the enhanced ladder monitoring functions and improved ladder edit operability by enhancing the linkage with the MELSEC series sequencer development tool (GX Developer).

**[C80 series]**
The sequence program can be monitored and edited by the sequence program monitoring of Mitsubishi Graphic Operation Terminal (GOT).
Refer to the manual of Graphic Operation Terminal (GOT) for details.

#### 17.1.7.2 MELSEC Development Tool (GX Developer)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | － |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | － |

This function enables the data of the PLC contained inside the NC system to be developed and debugged using the GX Developer installed in a personal computer (OS:Windows).
Many and varied functions of the GX Developer make it possible to reduce the PLC data development and debugging time.

#### 17.1.7.3 MELSEC Development Tool (GX Works3)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | － | － | － | － | － | － | － | ○ |
| L | － | － | － | － | － | － | － | ○ |

Using GX Works3, the sequence programs of the MELSEC CPU can be developed and debugged.
(Note) The software sold separately is necessary.

### 17.1.8 PLC Parameter

The PLC constants set with the data type and the bit selection parameters set with bit types can be set from the screen as parameters used by the built-in PLC.

#### 17.1.8.1 PLC Constant (150 Points)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

#### 17.1.8.2 PLC Constant Extension (Up to 755 Points)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | － | － | － | － |
| L | ○ | ○ | ○ | ○ | － | － | － | － |

There are PLC constants that can be set with data types as parameters used by the built-in PLC. The set data is set in the R register of the PLC and backed up. If data is set in the R register corresponding to the PLC constant with sequence program MOV commands, etc., the data will be backed up in the PLC constant parameter. However, the display will not change, so enter another screen, and then select this screen again.
The number of PLC constants is 150 points in the basic area and 755 points at the maximum in the extended area.

### 17.1.9 GOT Connection

Regarding to the connection of Mitsubishi Graphic Operation Terminal (GTO), refer to the document of GTO.
To display the dedicated screen for CNC (CNC monitor2 function), connect the DISPLAY interface of NC CPU.
In addition, the size of GTO supports SVGA and VGA.

#### 17.1.9.1 CPU Direct Connection (RS-422/RS-232C)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | － | － | － | － | － | － | － | △ (*1) |
| L | － | － | － | － | － | － | － | △ (*1) |

(*1) MELSEC

#### 17.1.9.2 CC-Link Connection (Remote Device)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | － | － | － | － | － | － | － | △ (*1) |
| L | － | － | － | － | － | － | － | △ (*1) |

(*1) MELSEC

#### 17.1.9.3 CC-Link Connection (Intelligent Terminal)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | － | － | － | － | － | － | － | △ (*1) |
| L | － | － | － | － | － | － | － | △ (*1) |

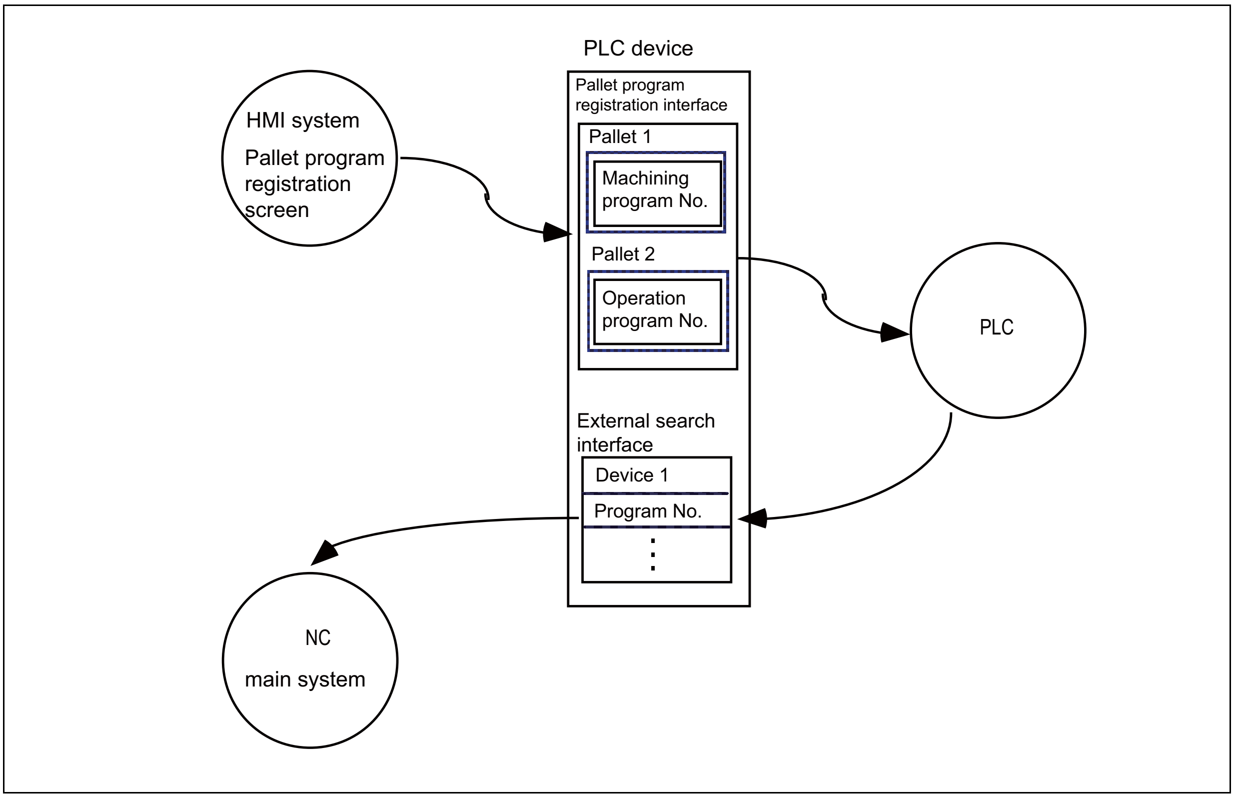
(*1) MELSEC

### 17.1.10 Pallet Program Registration

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | － | － | － | － |
| L | － | － | － | － | － | － | － | － |

Pallet program function allows machining program to be registered for each pallet of the auto pallet changer (hereinafter referred to as APC) and assists in the machining setups.
Operation search for the registered program will be executed by PLC using the external search function.

Machining program for each pallet is registered at "Pallet program registration" screen in the setup screen group.
Registered program is output to PLC device.
If necessary, execute an external search on PLC ladder by referring to the program No. registered for each pallet.




### 17.1.101 Built-in PLC Processing Mode

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | － | － | － | － | － | － | － | ○ |
| L | － | － | － | － | － | － | － | ○ |

This function is used for the safety observation of important signals with a safety signal unit.
Refer to the instruction manual on the smart safety observation function for details.

## 17.2 Machine Construction

### 17.2.1 Servo OFF

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

When the servo OFF signal (per axis) is input, the corresponding axis is set in the servo OFF state.
When the moving axis is mechanically clamped, this function is designed to prevent the servomotor from being overloaded by the clamping force.
Even if the motor shaft should move because of some reason in the servo OFF state, the movement amount will be compensated in the next servo ON state by one of the following two methods. (You can select the compensation method using a parameter.)

(1) The counter is corrected according to the movement amount (follow up function).
(2) The motor is moved according to the counter and compensated.

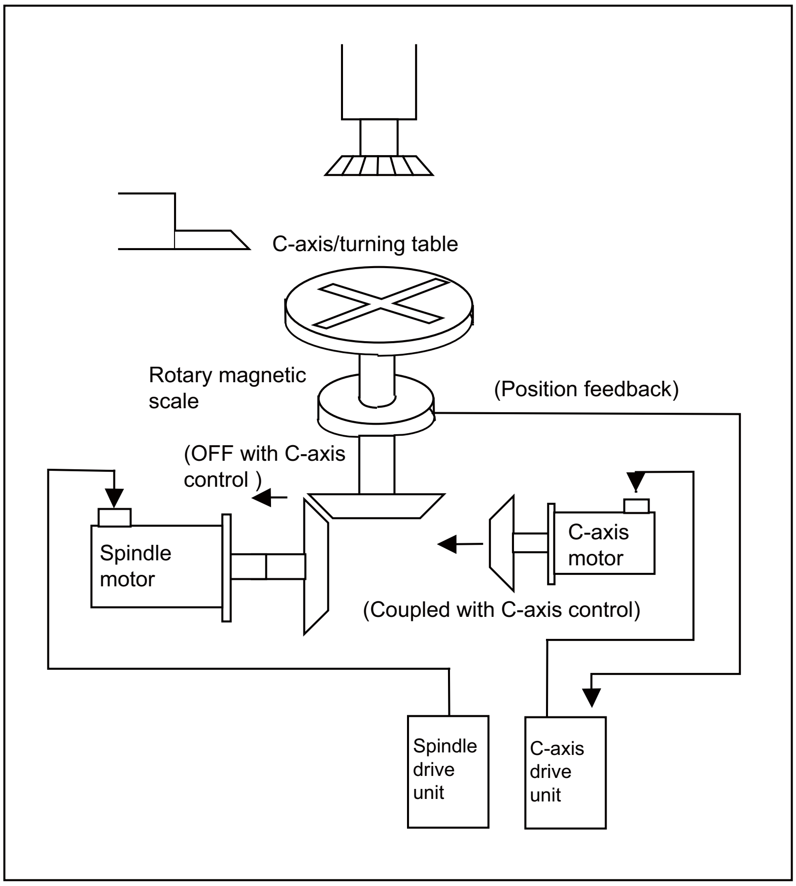
When follow up function is designated, the movement amount will be compensated even in the emergency stop state.
The axis is simultaneously set to servo OFF state and the interlock state.

Mechanical handle
Even if the servo OFF axis is moved with the mechanical handle with the application of the servo OFF function and follow up function, the position data can be constantly read in and the machine position updated. Thus, even if the axis is moved with the mechanical handle, the coordinate position display will not deviate.

### 17.2.2 Axis Detachment

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

This function enables the control axis to be freed from control. Conversely, an axis which has been freed from control can be returned to the control status.
This function enables the rotary table or attachments to be removed and replaced. Automatic operation is disabled until the axis for which the axis detach command has been released completes its dog-type reference position return.




This shows the configuration of a machine for which switching between the C axis and turning table is performed. When the spindle motor is connected, the C axis is placed in the detached status.
As a result, the position feedback of the detector is ignored.

| | |
|---|---|
| POSITION<br>X 123.456<br>Z 0.000#1<br>C 345.678>< | The detached status > < is indicated on the right of the POSITION display on the POSITION screen and at the same time the servo ready for the controller output signal is set to OFF. The POSITION counter retains the value applying when detach was assigned. |

(Note) Axis detach can be executed even for the absolute position detection specifications axis, but when the axis is reinstalled, the zero point must be set.

### 17.2.3 Synchronous Control

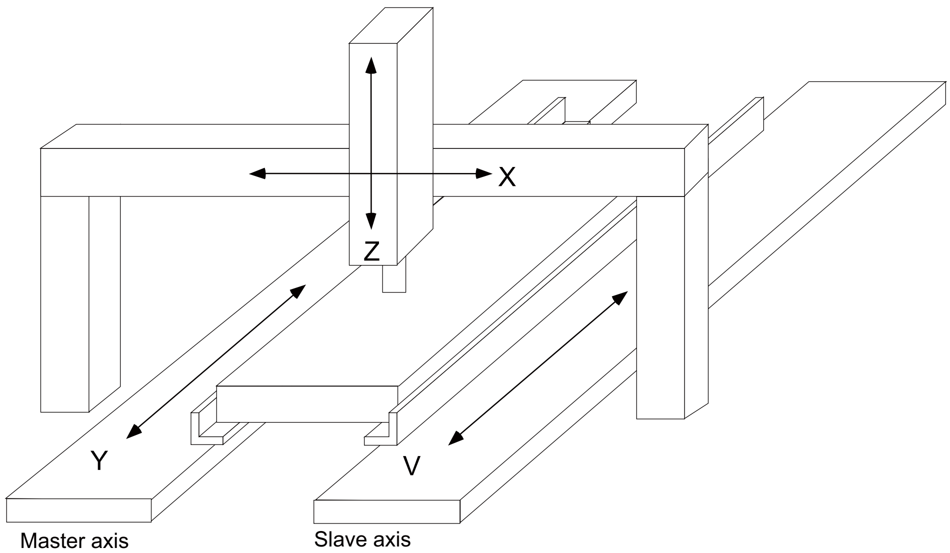
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

The synchronous control is a control method that both master and slave axes are controlled with the same movement command by designated the movement command for the master axis also to the slave axis. This function is assumed to be used in the large machine tool, etc. which drives one axis with two servo motors.
The axis for the base of the synchronization is called the master axis, and the axis according to the master axis is called the slave axis.

(Note 1) The axis detach function cannot be added to the axes used in the synchronous control.

(Note 2) The control axis synchronization between part systems and the synchronous control cannot be used simultaneously. (L system)

- The slave axis is controlled with the movement command for the master axis.
- One slave axis can be set to one master axis.
- Up to 3 sets of master axis /slave axis can be set in total for all the part systems.

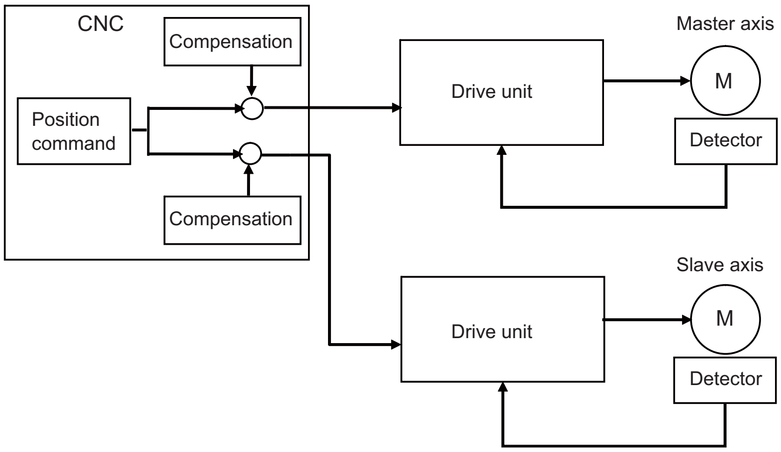


There are 3 types of synchronous control as follows:

**(1) Position command synchronous control**

This is used when the machine's rigidity is low.
This conforms the position command of the master axis to that of the slave axis using the synchronous control function of NC and drive those axes in parallel.
This can be used only by changing the NC setting, without changing the settings in the servo drive unit.

Position command synchronous control diagram



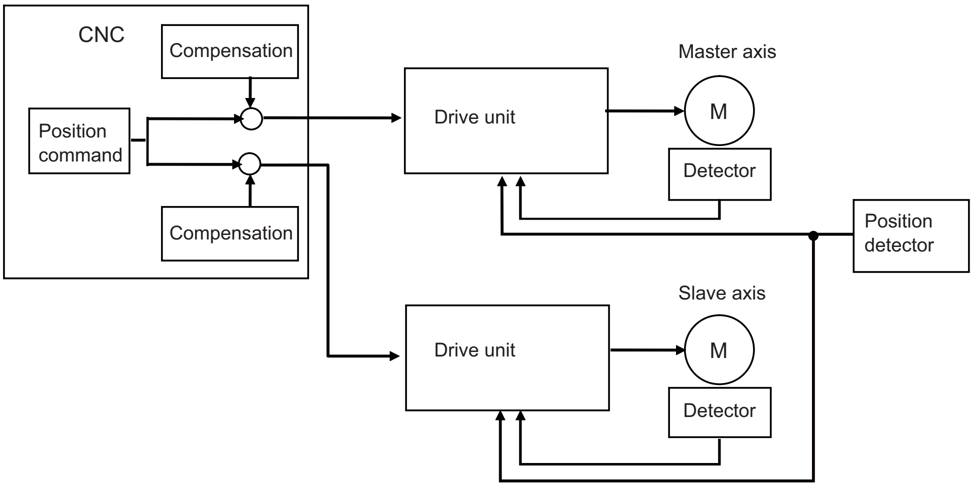

The position command synchronous control has the following configuration:

- Position command synchronous control
  - Synchronous control mode
    - Synchronous operation
    - Independent operation
  - Correction mode

**(2) Speed command synchronous control**

This is used when reducing the scale of the full-closed system or when the machine's rigidity, etc. cause the mutual interference to the axes positions.
This drives the master axis and the slave axis in parallel using the common position feedback. Since the feedrate of each axis is controlled by the speed feedback of each axis, the stable control is available.
This can be used when the settings of the NC and the servo drive unit are changed.

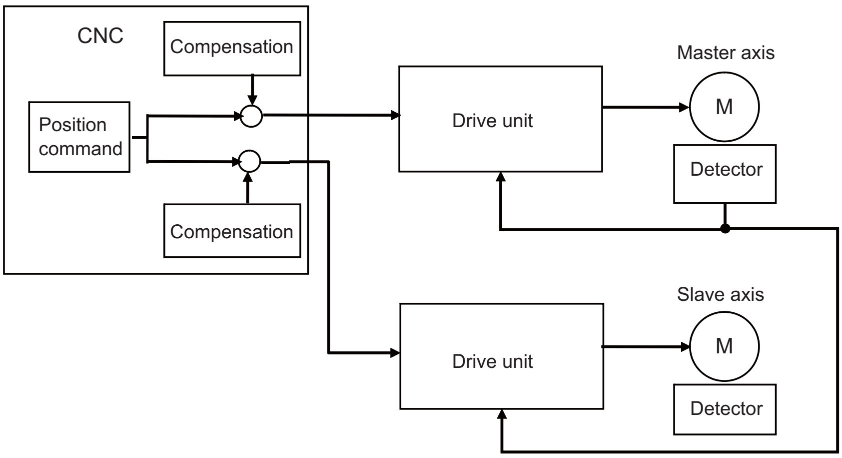
Speed command synchronous control diagram




**(3) Current command synchronous control**

This drives the master and slave axes in parallel by reference to the speed feedback from the encoder onto the master axis side on the slave axis. Since that speed feedback is not the slave axis's itself, the slave axis easily vibrates.
Also, as the slave axis is easily influenced by the disturbance, this is not appropriate for the machine tools which need the positioning accuracy or the interpolation accuracy.
This can be used when the setting of the NC and the servo drive unit are changed.

Current command synchronous control diagram




The "compensation" in the (1), (2) and (3) diagrams indicates the pitch error compensation, the thermal expansion compensation, the backlash compensation and the external machine coordinate compensation.
The axes which can set the compensation during the synchronous control differ according to the synchronous control type.

There are 2 types of modes as follows:

**(1) Synchronous control mode**

The following two operation methods are available in the synchronous control mode.

(a) Synchronous operation

This is a method that both master and slave axes are moved simultaneously with the movement command for the master axis.

(b) Independent operation

This is a method that either the master or slave axis is moved with the movement command for the master axis.

**(2) Correction mode**

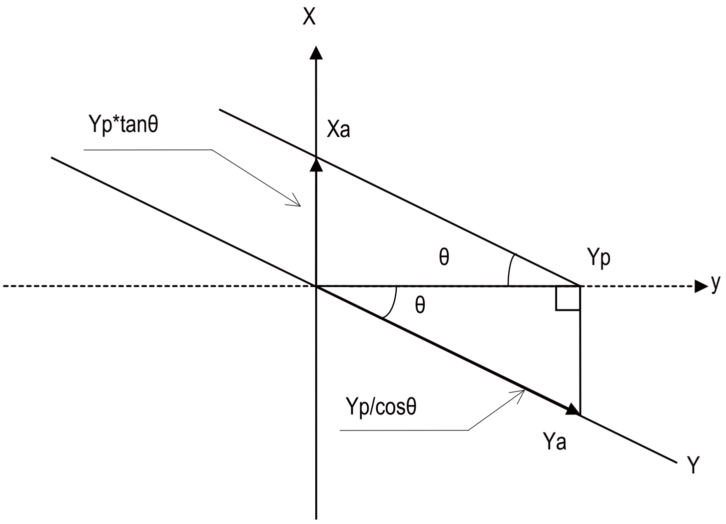
The synchronization is temporary canceled to adjust the balance of the master and slave axes during the synchronous control mode in the machine adjustment. Each axis can be moved separately with the manual handle feed or the arbitrary feed in manual mode. If the operation mode other than the manual handle feed and arbitrary feed in manual mode is applied during the correction mode, the operation error will occur.

### 17.2.4 Inclined Axis Control

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | — | — | — | — | — | — | — | — |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

Even when the control axes configuring that machine are mounted at an angle other than 90 degrees, this function enables it to be controlled by the same program as that for an orthogonal axis.
The inclination angle is set using a parameter, and axes are controlled using the movement amounts of the axes which are obtained through conversion and compensation using this angle.

<Example of use> When the X axis serves as the basic axis and the Y axis serves as the inclined axis




X: Actual X axis
Y: Actual Y axis
y: Programmed Y axis
$\theta$ : Inclination angle

Yp, the Y-axis position on the programmed coordinates (on the orthogonal coordinates), is the position of Xa and Ya which are produced by synthesis of X axis and Y axis.
Therefore, the Y-axis (inclined axis) movement amount is expressed by the following formula:
Ya=Yp/cos $\theta$ …… (1)
The X-axis (basic axis) movement amount is compensated by the inclined movement of the Y axis, and it is expressed as follows:
Xa=Xp-Yp*tan $\theta$ … (2)
The Y-axis (inclined axis) speed is as follows:
Fa=Fp/cos $\theta$

| |
|---|
| Xa, Ya and Fa are the actual movement amounts and speed.<br>Xp, Yp and Fp are the movement amounts and speed on the program coordinates. |

### 17.2.5 Position Switch

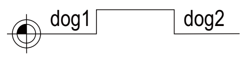
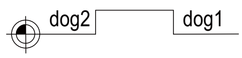
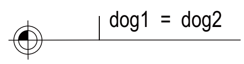
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ 24 | ○ 24 | ○ 24 | ○ 24 | ○ 24 | ○ 24 | ○ 24 | ○ (*1) |
| L | ○ 24 | ○ 24 | ○ 24 | ○ 24 | ○ 24 | ○ 24 | ○ 24 | ○ (*1) |

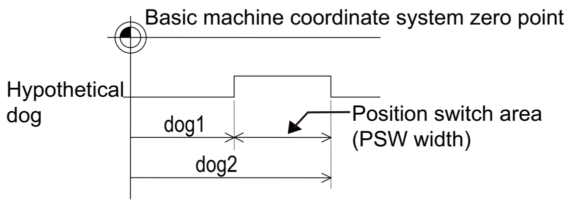
(*1) 24 points for each part system and 32 points for the whole PLC axes.

The position switch (PSW) function provides hypothetical dog switches in place of the dog switches provided on the machine axes by setting the axis names and coordinate positions indicating the hypothetical dog positions (dog1, dog2) as parameters beforehand so that signals are output to the PLC interface when the machine has reached these hypothetical dog range. The hypothetical dog switches are known as position switches (PSW).
24 points of the position switches can be set to the NC axis for each part system.

Position switch area checking can be performed at high-speed by parameter setting.
In high-speed checking, the parameter determines which is used between the command type machine position or detector feedback position for area checking by each position switch.

Example of dog1, dog2 settings and execution

| dog1, dog2 settings | dog1, dog2 positions | Description |
|---|---|---|
| dog1 < dog2 |   | Signal is output between dog1 and dog2 |
| dog1 > dog2 |   | Signal is output between dog2 and dog1 |
| dog1 = dog2 |   | Signal is output at the dog1 (dog2) position |




[Only for C80 series]

32 points of the position switches (PSW) in total can be set to the PLC axis.
Also, the position switch interlock function is in the axis interlock state outside of the position switch (PSW) by PLC signal, and prohibits the movement of the PSW target axis.
This function can be set only to the NC axis, cannot be set to the PLC axis.

The PLC axis position switch cannot be set to the axis which is used for either NC axis or PLC axis indexing.

### 17.2.7 Index Table Indexing

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

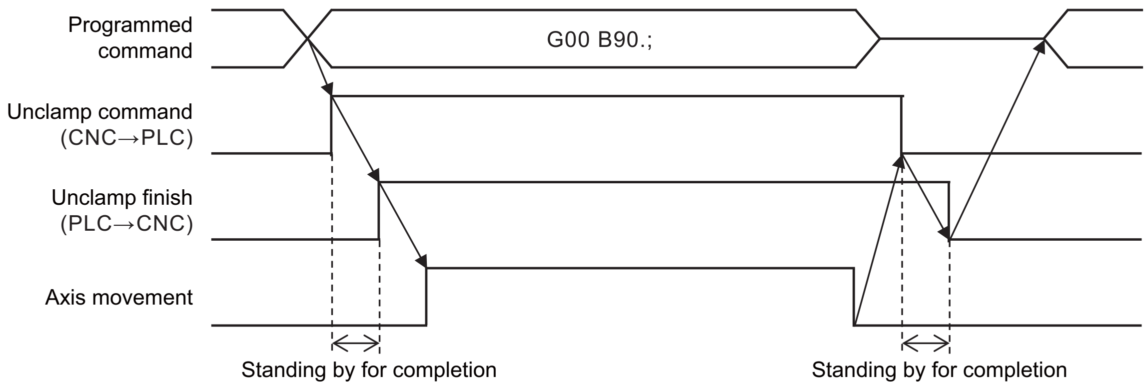
The indexing of the index table can be performed by setting the index axes.
Programming is facilitated because, in terms of the index commands, only the indexing angle need to be designated using the address of the programmed axis serving as the index setting axis, and there is no need to designate special M codes for clamping and unclamping the table.

Clamp operation is performed by setting the unclamp command signal to OFF (type A) or is performed with the clamp signal (type B).

**(1) Type A**

(a) Designate the movement commands (absolute or incremental) for the selected axis using a program.
(b) The unclamp command signal is now output prior to the axis movement.
(c) When the axes are unclamped, set the unclamp finish signal to ON with the PLC. (Set the signal to ON after performing required process such as servo ON or the unclamp process.)
(d) After checking the unclamp finish signal, the designated axis starts moving.
(e) Upon completion of the movement, the unclamp command signal is set to OFF.
(f) Clamp the axes and set the unclamp finish signal to OFF with the PLC. (Set the signal to OFF after performing required process such as in-position check, servo OFF or the clamp process.)
(g) After checking that the unclamp finish signal is OFF, processing of the next block is initiated.

[Operation timing chart for type A]



**(2) Type B**

(a) Designate the movement commands (absolute or incremental) for the selected axis using a program.

(b) The unclamp command signal is now output prior to the axis movement.

(c) When the axes are unclamped, set the unclamp finish signal to ON with the PLC.
(Set the signal to ON after performing required process such as servo ON or the unclamp process.)

(d) After checking the unclamp finish signal, set the unclamp command signal to OFF and the designated axis starts moving.

(e) Set the unclamp finish signal to OFF with the PLC.

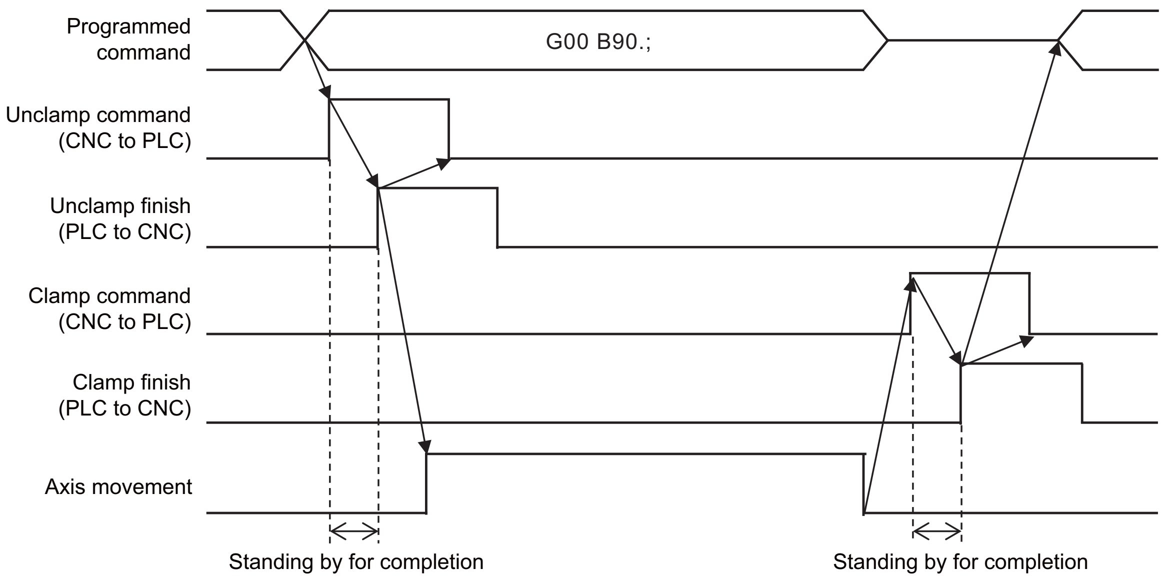
(f) Upon completion of the movement, the clamp command signal is set to ON.

(g) Clamp the axes and set the clamp finish signal to ON with the PLC.
(Set the signal to ON after performing required process such as in-position check, servo OFF or the clamp process.)

(h) After checking that the clamp finish signal is ON, set the clamp command signal to OFF and processing of the next block is initiated.

(i) Set the clamp finish signal to OFF with the PLC.

[Operation timing chart for type B]



### 17.2.8 Tool Length Compensation along the Tool Axis

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | － | － | － | － |
| L | △ (*1) | △ (*1) | △ (*1) | △ (*1) | － | － | － | － |

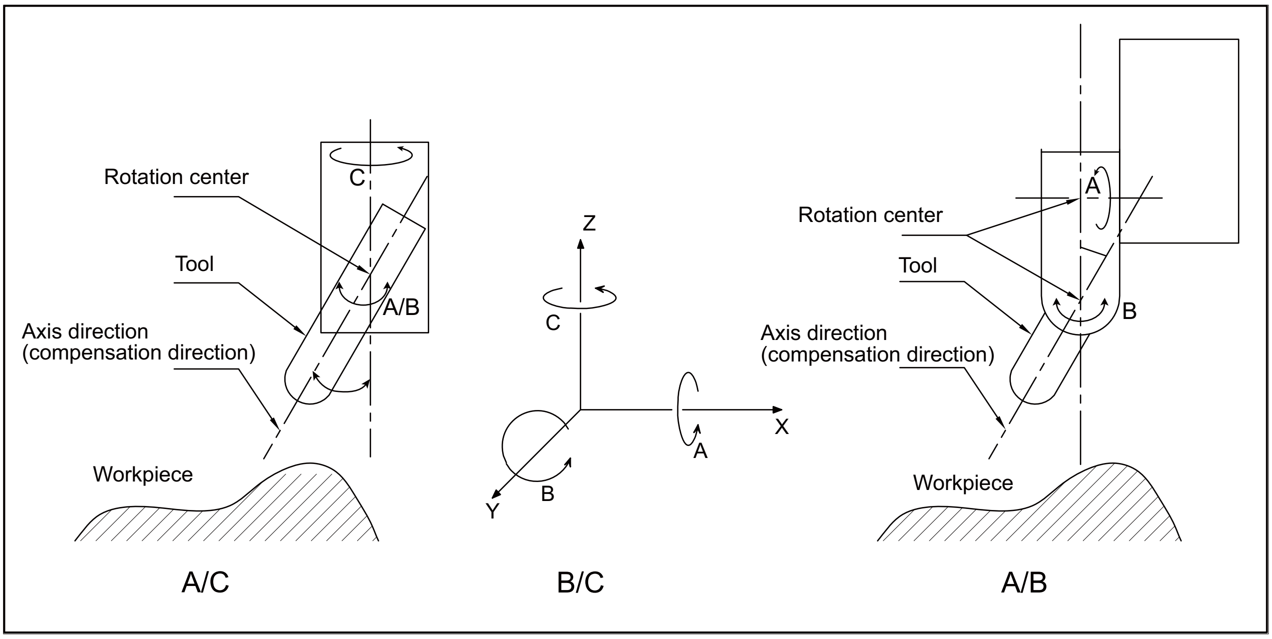
(*1) This function is available during program format switch.

**(1) Changing the tool length compensation in tool axis direction and compensation amount**

Even if the tool axis direction is not the Z axis direction because the rotary axis is rotated, the tool can be compensated in the tool axis direction. By setting the deviation of the tool length value set when the program was created and the actual tool length as a compensation amount, the program can be made more flexible.
This is especially effective for programs with many rotary axis movement commands.
The tool length compensation amount in the tool axis direction can be changed by rotating the manual pulse generator when the tool length compensation along tool axis mode and tool length compensation amount along the tool axis change mode are valid.

**(2) Machine configuration**

The tool length compensation in tool axis direction is carried out in respect to the direction of the tool nose axis (rotary axis).
The axis which determines the compensation direction is designated with the parameters as a combination of the Z-axis rotation C axis (spindle) and X-axis rotation A axis or Y-axis rotation B axis.

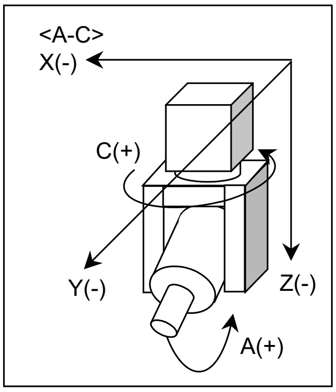


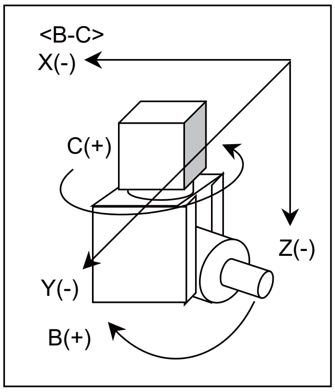
### 17.2.9 Tool Handle Feed & Interruption

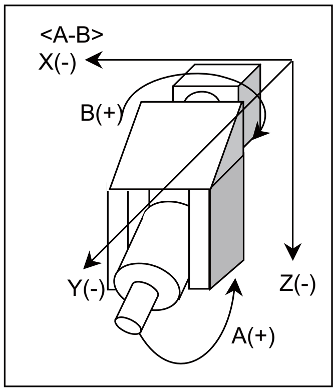
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | — | — | — | — |
| L | — | — | — | — | — | — | — | — |

The tool handle feed & interrupt function makes it possible to move the axis with the manual pulse generator in the tool axis direction, tool diameter direction X and tool diameter direction Y within the hypothetical coordinate system over the tool axis.

Normal handle feed and interrupt is applied when this function is not provided.




This is also effective for a machine configuration having the tool tilt 1 axis and table tilt 1 axis.

### 17.2.10 Tool Center Coordinate Display

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | — | — | — | — |
| L | — | — | — | — | — | — | — | — |

The tool center coordinates, handle interrupt amount (tool axis movement) , table/workpiece installation, machine position coordinates in the inclined surface coordinate system, mechanical axis angle and tool center point speed are displayed during the tool center point control function, tool length compensation along tool axis function, and tool handle feed & interrupt function (tool axis direction handle feed, tool handle interrupt, tool diameter direction handle feed, nose center rotation handle feed).
The path using the tool center coordinate position is drawn on the Graphic Trace screen.
One of the functions below is required to validate this function.

- Tool length compensation along tool axis
- Tool handle feed & interrupt
- Tool center point control
- Workpiece installation error compensation
- Inclined surface machining command
- Simple inclined surface machining command
- 3-dimensional tool radius compensation (tool's vertical-direction compensation)
- 3-dimentional manual feed
- R-Navi

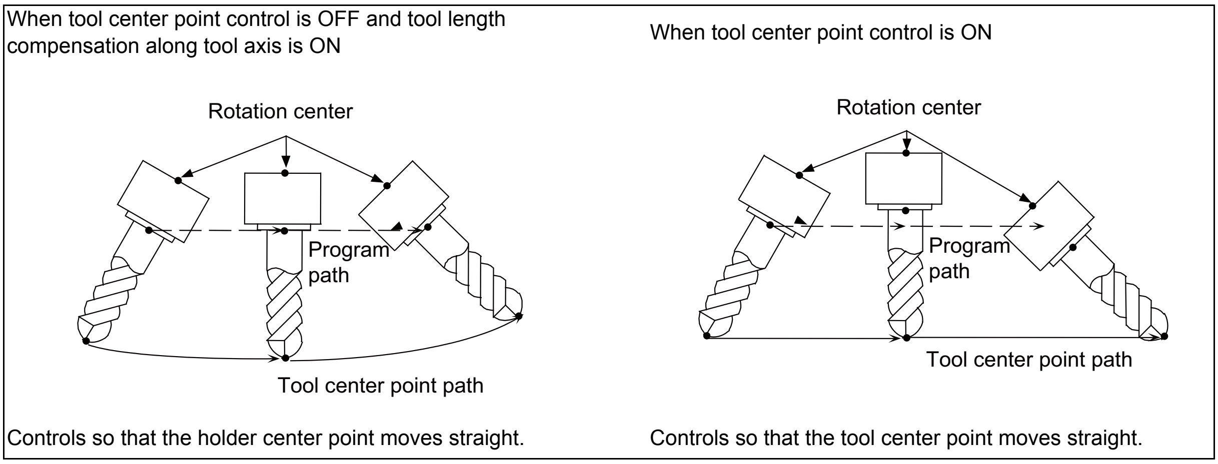
### 17.2.11 Tool Center Point Control

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ (*1) | △ | △ (*1) | ○ (*1) | ○ (*1) | ― | ― |
| L | ― | ― | ― | ― | ― | ― | ― | ― |

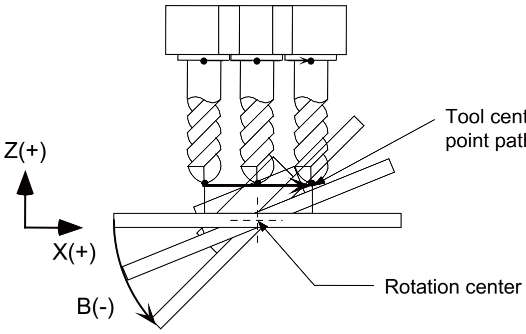
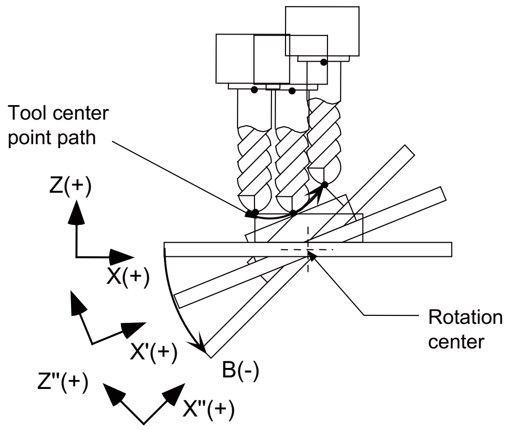
(*1) Restrained to 4-axis simultaneous contouring

The tool center point control function controls so that the position command in the machining program is at the tool center point on the coordinate system (table coordinate system) which rotates together with the workpiece. This function can be applied with the machine including the tool tilt type with two rotary axes on the head (1), the table title type with two rotary axes on the table (2), and the compound type with rotary axes on the tool and table (3).

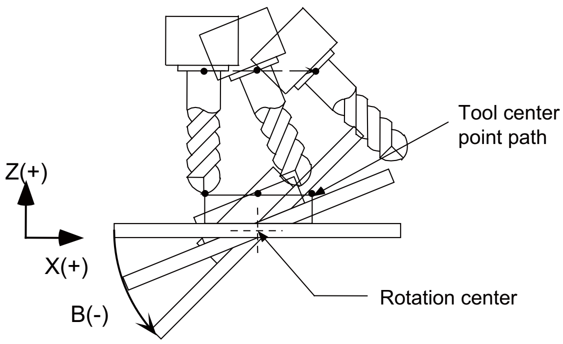
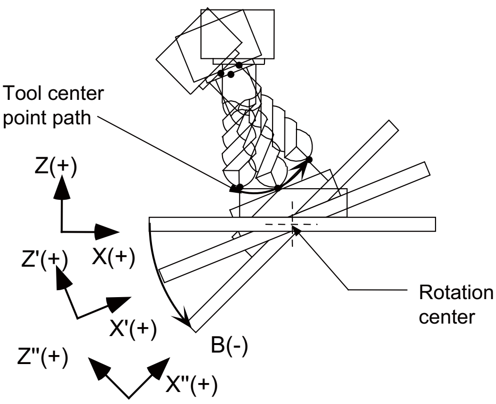
(1) Tool tilt type



(2) Table tilt type

| When tool center point control is OFF and tool length compensation along tool axis is ON | When tool center point control is ON |
|---|---|
|  |  |
| Controls so that the holder center point is at the workpiece coordinate system's position | Controls so that the tool center point is at the table coordinate system's position. |

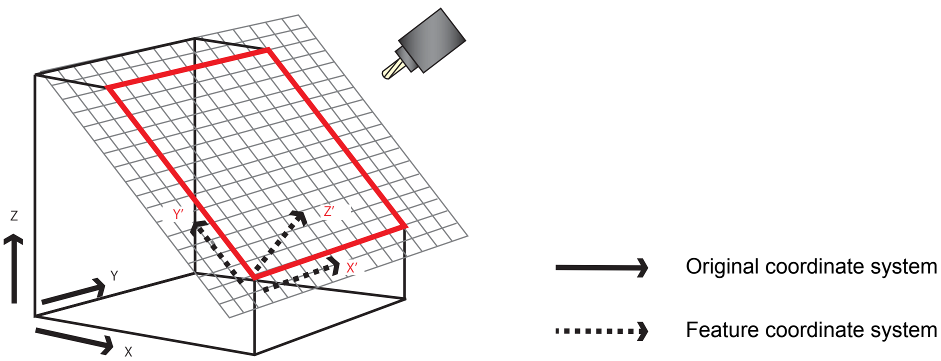
(3) Compound type

| When tool center point control is OFF and tool length compensation along tool axis is ON | When tool center point control is ON |
|---|---|
|  |  |
| Controls so that the holder center point is at the workpiece coordinate system's position. | Controls so that the tool center point is at the table coordinate system's position. |

### 17.2.12 Inclined Surface Machining Command

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | － | △ |
| L | － | － | － | － | － | － | － | － |

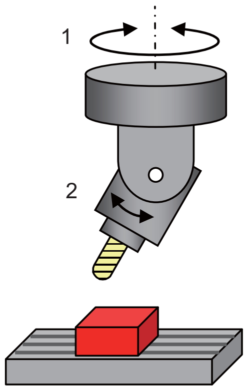
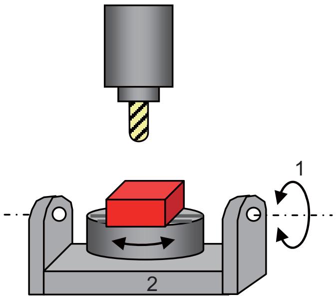
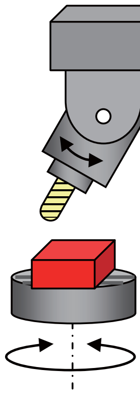
This function is to define the new coordinate system (called the "feature coordinate system") which was created by rotation and reference position translation of the X, Y, Z axes of the original one (before the inclined surface machining command was applied). By using this function, an arbitrary spatial plane can be defined, and machining on that plane can be carried out with normal program commands.
Also, the tool axis can automatically be controlled to the + Z direction of the newly defined feature coordinate system. Since the feature coordinate system will be re-created in accordance with the tool axis direction, machining programs can be developed without the need to consider the direction of the feature coordinate system and rotation of the tool axis.




The feature coordinate system is defined in the following method.

- Designation with Euler angle.
- Designation with the roll angle, pitch and yaw angle.
- Designation  with the three points on the plane.
- Designation with two vectors.
- Designation with a projection angle.
- Designation with the registered machining surface selection
- Designation with the tool axis direction.

This function is compatible with the following types of machine.

| Type | Tool tilt type | Table tilt type | Compound type |
|---|---|---|---|
| **Description** | Two rotary axes on the tool side | Two rotary axes on the table side | One rotary axis on each of the tool side and table side |
| **Example of machine** |   |   |  |
| **Primary rotary axis** | The 2nd rotary axis on the tool side | The 1st rotary axis on the table side | Rotary axis on the tool side |

### 17.2.13 Simple Inclined Surface Machining Command

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | — | — | — | — | — | — | — | — |
| L | △ | △ | △ | △ | ○ | ○ | — | — |

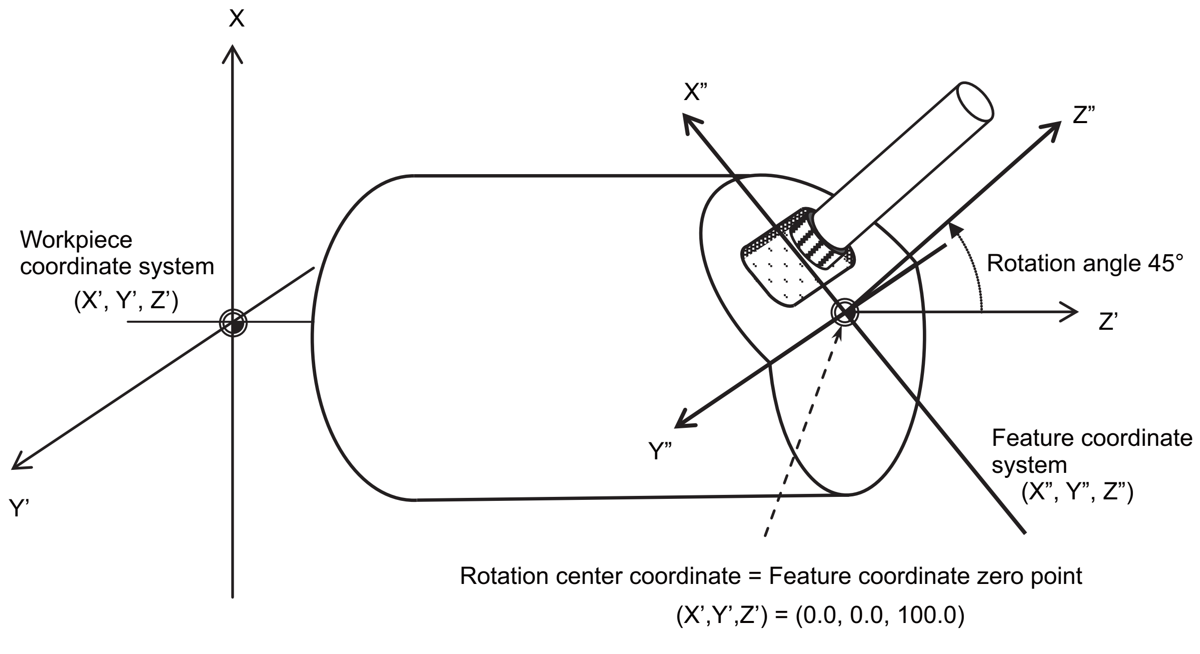
In a lathe with three orthogonal axes and one rotary axis on the tool side, this function enables simultaneous 4-axis control milling on an inclined surface along workpiece end face.
To facilitate machining on an inclined surface, this function uses three commands: simple inclined surface control (G176), simple tool center point control (G174), and tool axis direction control (G53.1) as follows. The tool axis direction can be turned at right angles to the inclined surface by issuing the tool axis direction control command (G53.1) after the simple inclined surface control command (G176). When G174 is given after G176, the direction of tool length is compensated in accordance with the tool angle.
For a machine configured with a turret, this function allows you to use any tool on the turret to carry out simple inclined surface machining.

(1) Simple inclined surface control (G176)
G176 enables a new coordinate system (called "feature coordinate system") to be defined. Feature coordinate system is obtained by rotating and parallel translating a plane using the X, Y and Z axes configuring the workpiece coordinate system as a rotary axis. Consequently, there is no need to calculate the coordinate position in accordance with the inclined surface angle. This simplifies creation of a machining program.

(2) Simple tool center point control (G174)
G174 allows a tool length offset in the tool axis direction even when the tool axis direction is not parallel to the orthogonal coordinate system after rotation of the rotary axis. Consequently, the nose of the tool mounted on the rotary axis can be kept in the programmed position at all times. This simplifies creation of a complicated-shape machining program.

(3) Tool axis direction control (G53.1)
G53.1 aligns the tool with the + Z direction of the feature coordinate system. This eliminates the need for you to mind the feature coordinate system's direction or tool axis' rotation direction, resulting in greater ease of programming.

Feature coordinate system



Command format

Simple inclined surface control start

| | |
|---|---|
| **G176 X__Z__D__ ;** | **When rotating K-I plane about the axis parallel to the J axis** |
| **G176 X__Y__D__ ;** | **When rotating I-J plane about the axis parallel to the K axis** |
| **G176 Y__Z__D__ ;** | **When rotating J-K plane about the axis parallel to the I axis** |
| X,Y,Z | : Feature coordinate system zero point (Rotation center position) ( -99999.999 to 99999.999) |
| D | : Rotation angle ( -359.999 to 359.999) |

Simple inclined surface control cancel

```
G69.1;
```

Simple tool center point control start

| | |
|---|---|
| **G174 R__ ;** | |
| R | : Tool axis rotation angle compensation amount (-359.999 to 359.999° ) |

| |
|---|
| **G174 (X__Y__Z__B__) ; The axis movement command in ( ) can be omitted.** |

Simple tool center point control cancel command

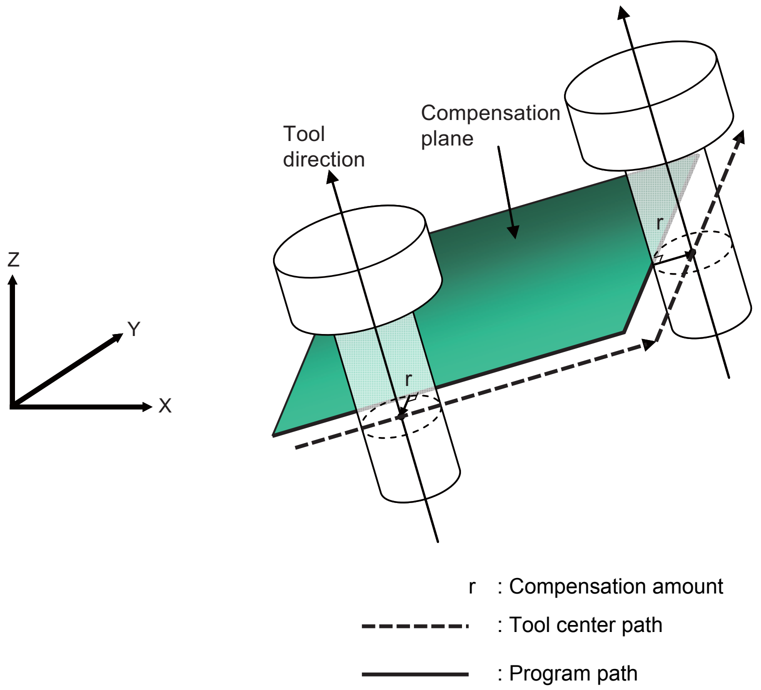
```
G175;
```

### 17.2.14 3-dimensional Tool Radius Compensation (Tool's Vertical-direction Compensation)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | — | — | — | — |
| L | △ (*1) | △ (*1) | △ (*1) | △ (*1) | — | — | — | — |

(*1) This function is available during program format switch.

This function is to compensate the tool radius of the machine with two rotary axes, in accordance with the change of the workpiece direction and inclination of the tool due to the movement of the rotary axis. The 3-dimensional tool radius compensation was realized by searching the tool path on the workpiece by the program command and calculating the compensation vector on the plane (compensation plane) which is vertical to the path in the tool direction.



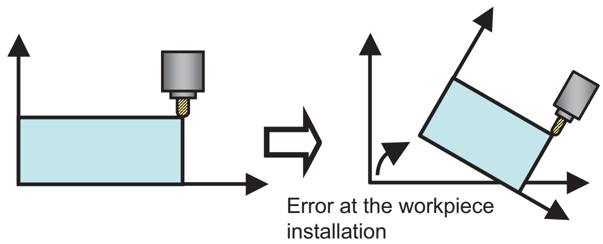

When the 3-dimensional tool radius compensation (tool's vertical-direction compensation) is commanded while the specification is not added, an alarm will occur.

### 17.2.15 Workpiece Installation Error Compensation

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | ー | △ | ー | ー | ー | ー | ー |
| L | △ (*1) | ー | △ (*1) | ー | ー | ー | ー | ー |

(*1) This function is available during program format switch.

This function is for the 5-axis machine. This compensates the error when a workpiece is placed off the workpiece coordinate system to enable machining according to the program. In this function, a new coordinate system with the workpiece as its reference position will be defined (called "workpiece installation coordinate system) and the program will be executed in this new coordinate system.




This function is compatible with the same types of machine as listed in the inclined surface machining command.

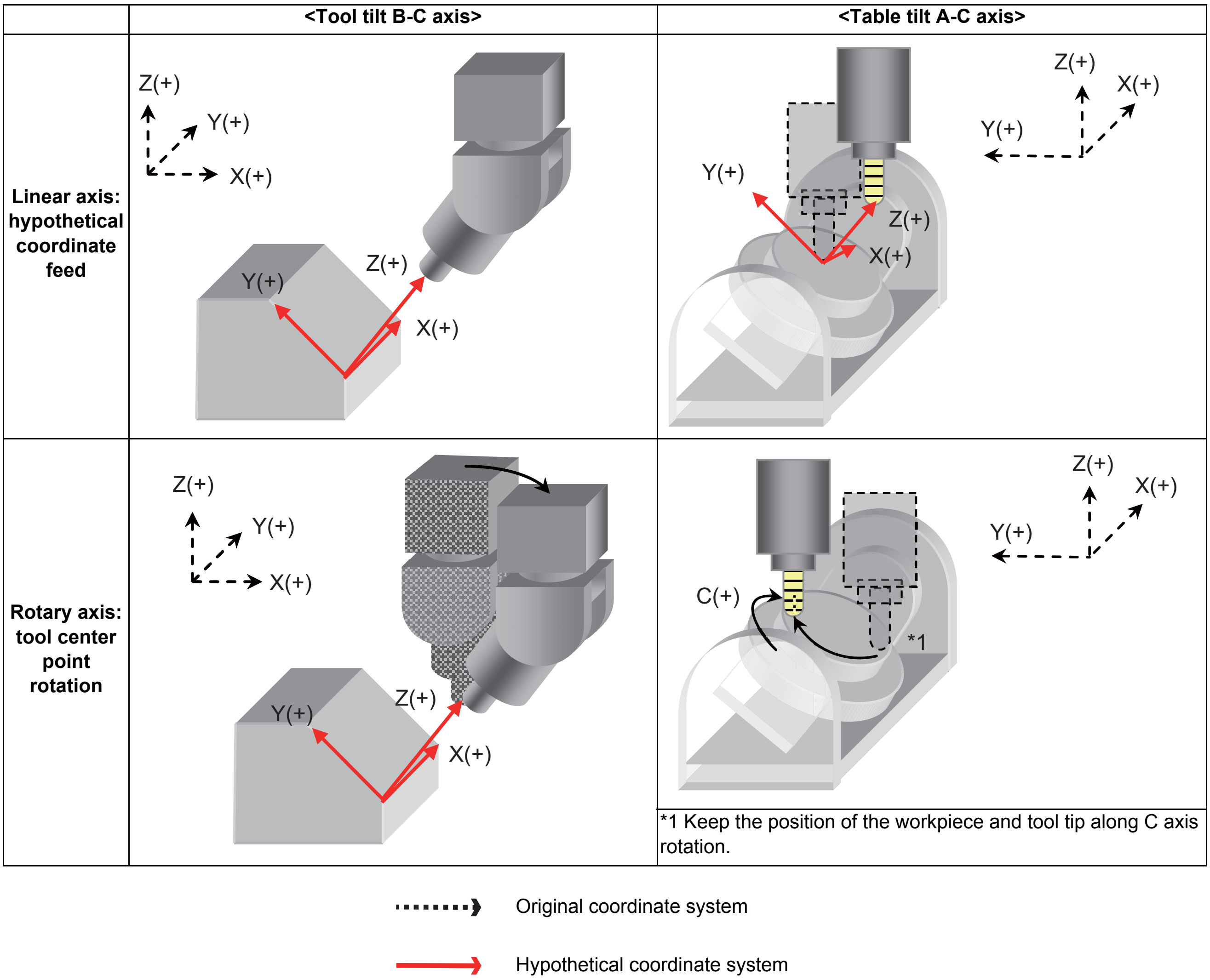
### 17.2.16 3-dimensional Manual Feed

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | — | △ |
| L | △ | △ | △ | △ | ○ | ○ | — | — |

By selecting the hypothetical coordinate system to be machined, axis can be moved with manual feed (JOG, HANDLE or INCREMENTAL) in the coordinate system with this function.
If a movement command on the hypothetical coordinate is issued, it can be easy to setup because multiple axes is moved by NC according to the tool angle or the inclination of the table.

This function consists of the hypothetical coordinate feed and tool center point rotation.
Movement command for the linear axis operates as the hypothetical coordinate feed and manual feed will be carried out on the hypothetical coordinate.
Movement command for the rotary axis operates as the tool center point rotation and manual feed will be carried out with the rotary axis and 3 linear axes which are issued a movement command to keep position relations of the workpiece and tool tip.

Standard manual feed is applied when this function is not provided.



### 17.2.17 R-Navi

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | – | – |
| L | – | – | – | – | – | – | – | – |

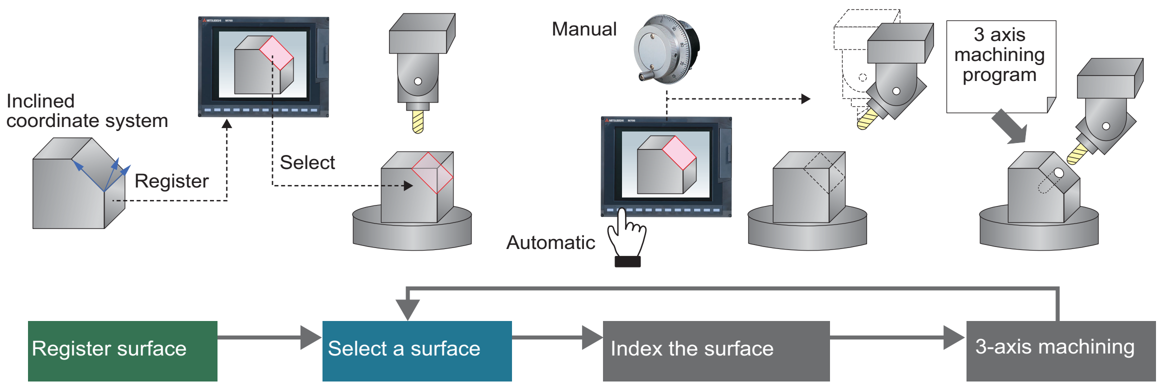
This function allows you to perform index machining (including inclined surface and multiple-surface machining) simply and smoothly using a rotary axis.
To enable index machining, register a feature coordinate system (coordinate origin and coordinate axial direction) along the machining surface in advance, and select the registered surface from the operation screen. Then the tool is able to move along the coordinate system to perform index machining.
As shown below, the machining surface selected from the screen is not affected by whether the surface indexing is complete or not.
The function is effective for the machine configuration with the right-hand orthogonal coordinate system defined in ISO standard.
The R-Navi function enables you to use "Inclined machining surface" and "3-dimensional manual feed".

Features of this function are as follows;
(1) Various and simple machining surface registration (Feature coordinate system registration)
- Possible to register multiple surfaces (Up to 16 surfaces per workpiece, and up to 10 workpieces)
- Guide drawing which helps to set the coordinate system along the machining surface
- Feature coordinate system setting without dependence on the workpiece installation position.
- 3D workpiece graphics which enables a visual check of the registered surface.

(2) Easy-to-understand machining surface selection
- An operator is able to select a surface while observing the 3D workpiece graphics.

(3) Automatic indexing and manual indexing of the selected machining surface
- R-Navi automatically executes surface indexing to set the tool to be perpendicular to the selected surface.
- Manual indexing is also available.
- The coordinate system is linked with rotation of the rotary axis (no need to calculate the coordinate origin after the rotation).

(4) A program for 3-axis machining can be used without modification (G68.2 command-less inclined surface machining).
- Able to work on the coordinate system defined along the selected surface (by automatic or manual operation)
- The coordinate system is held even when NC reset is input (no need to re-define the coordinate system).



Command format

The R-Navi setup parameters can be configured from a machining program.

(1) Workpiece registration and setting

| | |
|---|---|
| **G68.2 P10 Q0 D0** | **Cancel the selected machining surface** |
| **G10 L110 ;** | **Start setting workpiece data** |
| **Q__ <__> F__ C__ R__ X__ Y__ Z__ I__ J__ K__ ;** | **Data setting** |
| **G11 ;** | **End data setting** |

| | |
|---|---|
| Q | : Workpiece registration No. (1 to 10) |
| < > | : Workpiece name (max. 20 characters) |
| F | : Workpiece shape |
| C | : Basic coordinate system |
| R | : Basic No. (0 to 8) |
| X/Y/Z | : Workpiece size (0.000 to 99999.999) |
| I/J/K | : Workpiece shift (-99999.999 to 99999.999) |

(2) Machining surface registration and setting

| | |
|---|---|
| **G68.2 P10 Q0 D0** | **Cancel the selected machining surface** |
| **G10 L111 ;** | **Start setting machining surface data** |
| **P0 Q__ D__ <__> X__ Y__ Z__ A__ ;** | **Machining surface setting** |
| **P1 M__ B__ C__ E__ F__ H__ I__ ;** | **Designate coordinate axial direction for 1st axis** |
| **P2 M__ B__ C__ E__ F__ H__ I__ ;** | **Designate coordinate axial direction for 2nd axis** |
| **G11 ;** | **End data setting** |
| **G68.2 P10 Q__ D__;** | **Select the registered machining surface** |

Command address of machining surface registration

| | |
|---|---|
| P | : Machining surface registration |
| Q | : Workpiece registration No. (1 to 10) |
| D | : Machining surface registration No. (2 to 17) |
| < > | : Machining surface name (max. 15 characters) |
| X/Y/Z | : Feature coordinate origin (-99999.999 to 99999.999) |
| A | : Coordinate axis selection |

Command address of coordinate axial direction designation

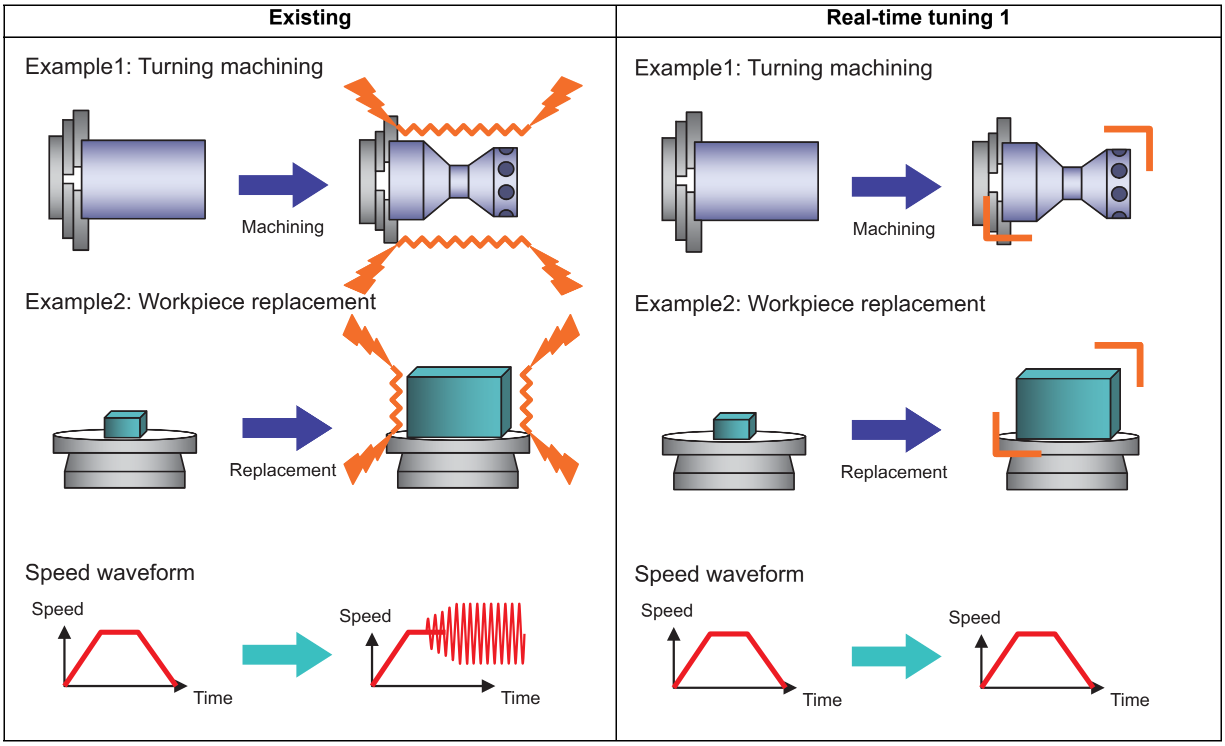
| | |
|---|---|
| P | : Coordinate axial direction axis designation |
| M | : Coordinate axial direction designation method |
| B/C/E/F/H/I | : Coordinate axial direction setting (-99999.999 to 99999.999) |

## 17.2.20 Real-time Tuning

### 17.2.20.1 Real-time Tuning 1 (Speed Gain)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | － | － |
| L | △ | △ | △ | △ | ○ | ○ | － | － |

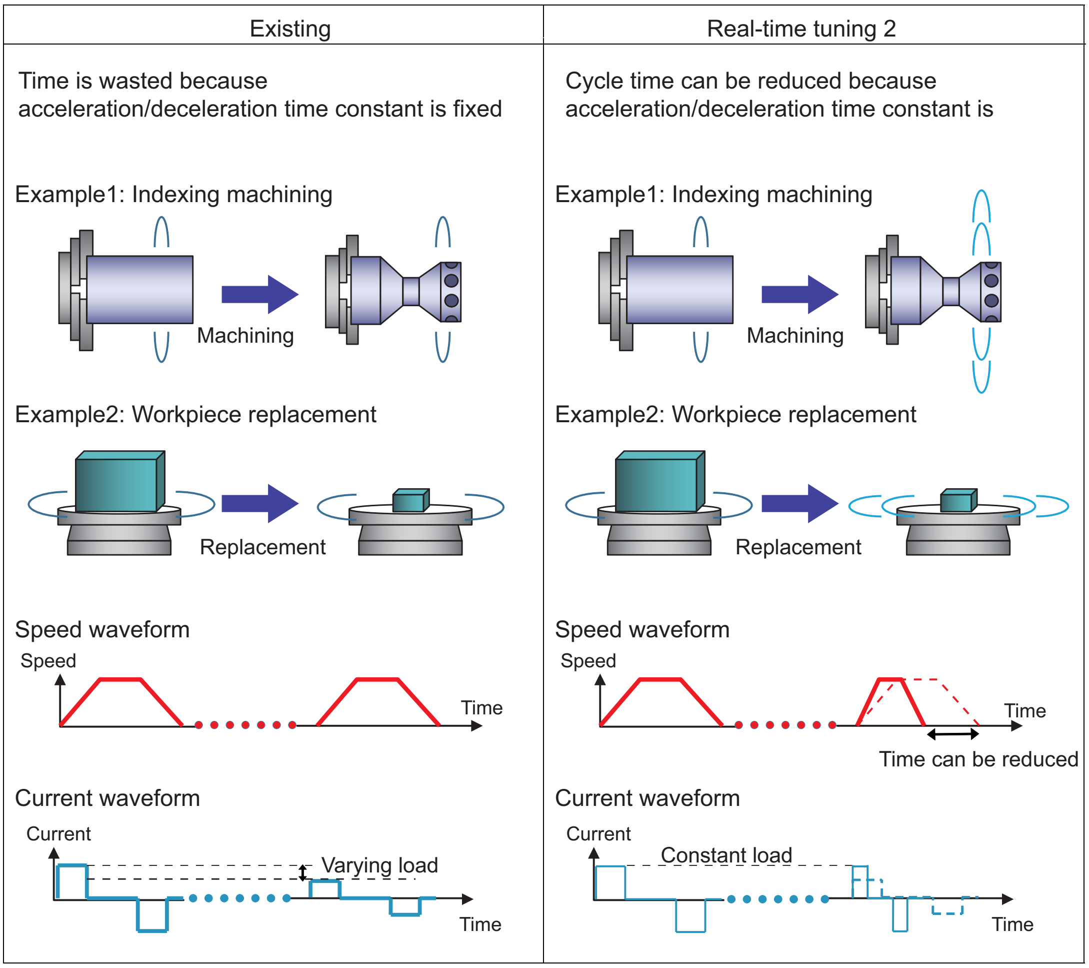
This function estimates the inertia (or workpiece weight) of mechanical system and changes the speed control gain automatically according to the estimation results to suppress mechanical vibration.
For example, this suppresses vibration caused when a large workpiece becomes smaller in turning machining as illustrated in Example 1 below. This function also suppresses vibration caused when a workpiece that is relatively small for the table is replaced by a larger one as illustrated in Example 2 below.
Using this function, users can expect suppression of vibration caused by inertia fluctuation, as well as reduction of machining time through adaptation of appropriate speed control gain.
This function also commands a stop of speed control gain change and displays the estimated inertia ratio and magnification of speed control gain (ratio of the changed speed control gain to the initially set gain).



### 17.2.20.2 Real-time Tuning 2 (Rapid Traverse Time Constant)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | － | － |
| L | △ | △ | △ | △ | ○ | ○ | － | － |

This function estimates the inertia of workpiece and optimizes the operation acceleration/deceleration time constant automatically according to the estimation results.
This allows the cycle time to be reduced when the inertia of workpiece fluctuates considerably.
This function is useful when the inertia of workpiece fluctuates considerably during machining as illustrated in Example 1: Indexing machining and Example 2: Workpiece replacement on the rotary table below.
In Example 1, the inertia of workpiece is reduced gradually as machining progresses. In Example 2, the inertia of workpiece on the rotary table is reduced by workpiece replacement. When the inertia of workpiece is large in Example 1 or Example 2, the machine tool is required to be operated at a low acceleration to suppress the vibration for the workpiece and overload for the motor. On the other hand, when the inertia of workpiece is smaller, the operation at a higher acceleration is available. In other words, acceleration/deceleration time constant can be reduced when the inertia of workpiece is smaller.
In the existing specifications, the operation acceleration/deceleration time constant is fixed regardless of the inertia of workpiece, which wastes time because a large time constant is applied even if the inertia of workpiece is small.
On the other hand, this function enables the operation with optimum acceleration/deceleration time constant according to the inertia of the workpiece. Therefore, machining is performed while reducing the acceleration/deceleration time constant in Example 1 or Example 2, which leads to a shorter tact time.
Furthermore, the large inertia workpiece is not machined with small acceleration/deceleration time constant since the optimum time constant is adjusted automatically. This enables suppression of vibration and overload.



### 17.2.21 Constant Torque Control

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | − | − | − | − | − | − | − | − |
| L | △ | △ | △ | △ | ○ | ○ | − | − |

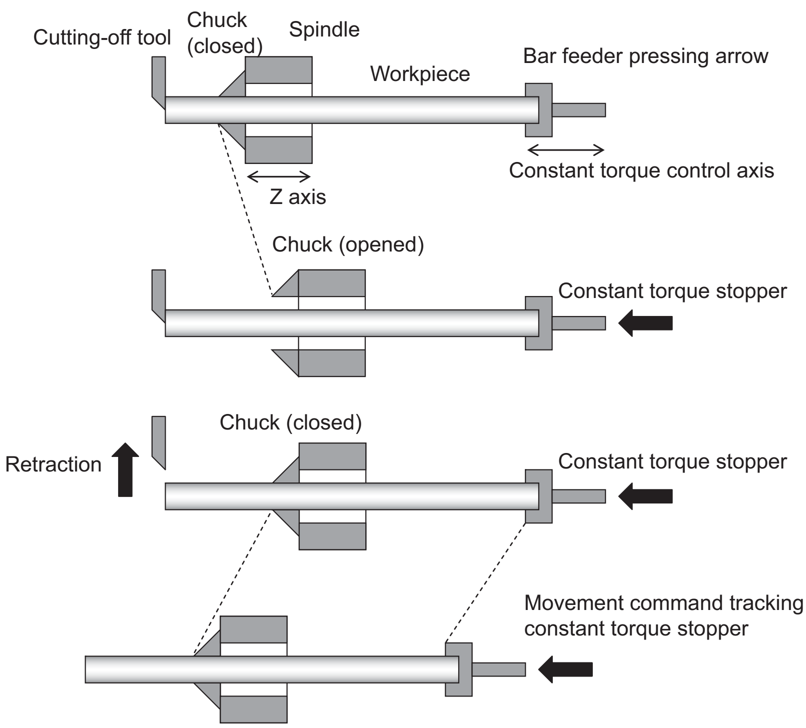
(1) Constant torque control

By setting "Constant torque control request axis" signal to ON from PLC, the servo motor of the designated axis outputs torque set by the parameter in a constant direction. By using this function for a servo motor which drives a bar feeder, the bar feeder can press the workpiece with constant torque regardless of whether it is during movement, stop, or acceleration/deceleration.

By setting "Proportional torque stopper control request axis" signal to ON from PLC, proportional torque stopper control enables a servo motor of the designated axis to generate torque set by the parameter in the stopper direction. When position droop is generated, the motor generates torque in proportion to the position droop in the stopper direction to keep the stopper position.

(Note) Do not cancel the constant torque control or the proportional torque stopper control for an axis moving under manual or automatic operation. Otherwise the fixed workpiece, fixed turret, etc., may get loose, and it is dangerous.

Example of constant torque control




(2) Droop cancel under constant torque control

Droop cancel under constant torque control cancels the position droop generated during constant torque control without moving an axis.
Note that the droop cancel under constant torque control must be commanded while the axis is pressed against the workpiece, etc.

(3) Proportional constant torque control

Proportional torque stopper control generates constant torque in the stopper direction according to the value designated to the parameter. When position droop is generated, the motor generates torque in proportion to the position droop in the stopper direction and to keep the stopper position.

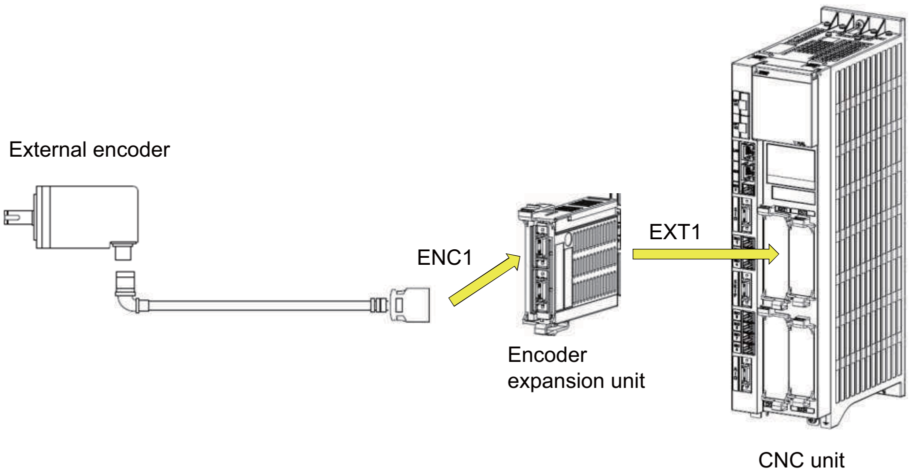
### 17.2.22 External Encoder Position Output I/F

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | – |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | – |

* Encoder expansion card is required for M800W/M80W

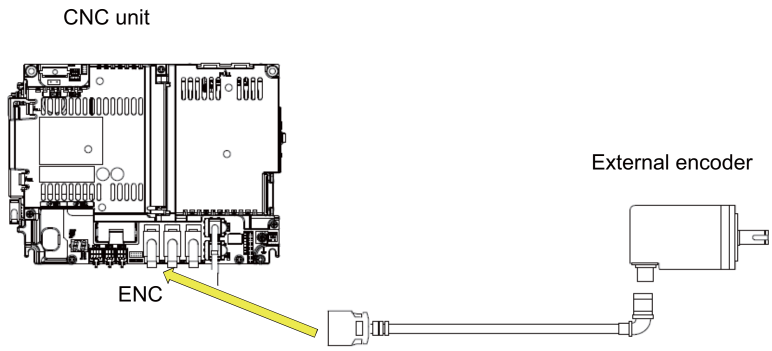
This function outputs the position (angle) of external encoder to PLC device based on the input pulses from the encoder.
This function can be used to monitor the position of angular head which the external encoder is connected to.
The position to output to PLC device can be cleared to 0 with PLC signal.

M800W/M80W connection diagram




(Note) Encoder expansion unit can be used for ENC1 only.

M800S/M80 connection diagram



## 17.3 PLC Operation

### 17.3.1 Arbitrary Feed in Manual Mode

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

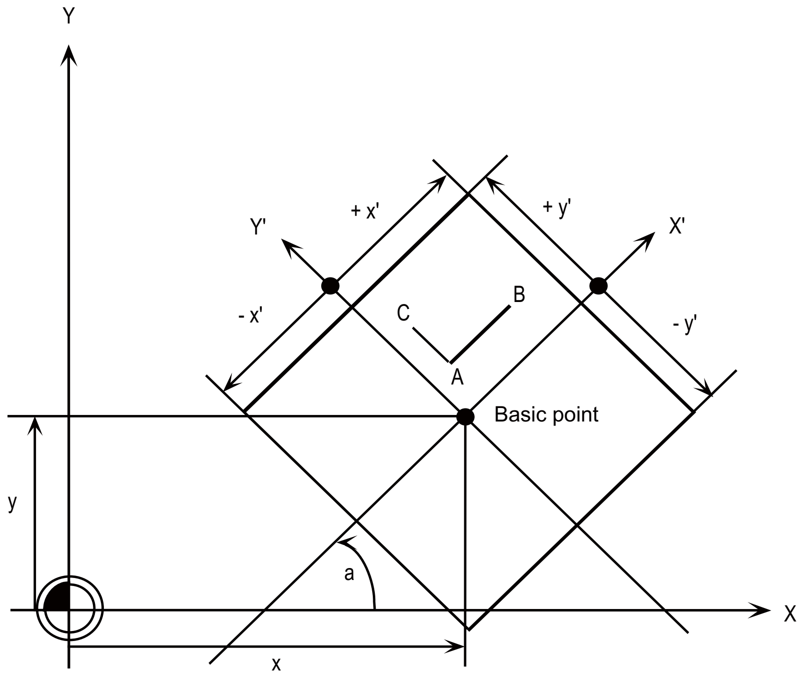
This function enables the feed directions and feed rates of the control axes to be controlled using commands from the user PLC.
The arbitrary feed function controls the movement of the axes at the specified rates while the start signal is output from the PLC to the NC system.
PLC operations can be performed even during manual operation or automatic operation, but they cannot be performed when an axis for which arbitrary feed has been assigned is executing a command from the NC system (that is, while the axis is moving).

## 17.3.2 Circular Feed in Manual Mode

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | — | — | — | — |
| L | △ | △ | △ | △ | — | — | — | — |

By specifying a hypothetical coordinate on the machine coordinate from the user PLC, oblique linear interpolation or circular interpolation is executed with jog/handle feed, manual rapid traverse or incremental feed of either X-axis or Y-axis.
This function is valid only in the jog mode, handle mode, manual rapid traverse mode or incremental mode. This function cannot be used in the other manual modes and automatic operation modes.
This function works for the X axis and Y axis. This function cannot be used for the other NC axes and PLC axis. When this function is valid, all the axes other than X axis and Y axis move as usual.

(1) Oblique linear interpolation

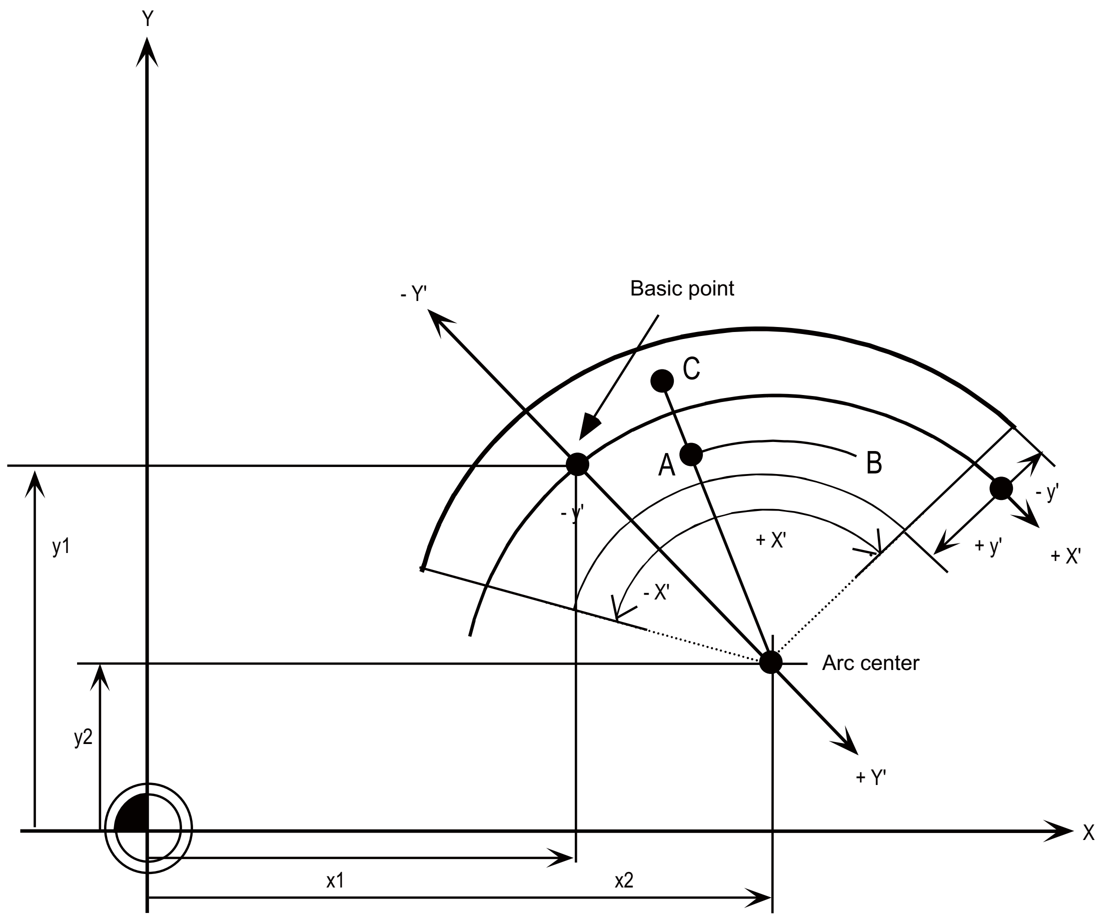



When the circular feed in manual mode (oblique linear interpolation) is valid:
- Jog/handle feed of X-axis moves in parallel with X'-axis (see above).
- Jog/handle feed of Y-axis moves in parallel with Y'-axis (see above).

These are set in the R registers.
a : Gradient angle
x,y : Basic point coordinate
±x' : X' travel range
±y' : Y' travel range

(2) Circular interpolation

By specifying a hypothetical coordinate on the machine coordinate as shown in the figure below, jog/handle feed can be executed on the hypothetical coordinate.




When the circular feed in manual mode (circular interpolation) is valid:
- Jog/handle feed of X-axis moves on the arc having the distance from the arc center to the current position as its radius.
- Jog/handle feed of Y-axis moves on the line connecting the current position and the arc center.

These are set in the R registers.

x1, y1 : Basic point coordinate

x2, y2 : Arc center coordinate

±x' : X' travel range

±y' : Y' travel range

### 17.3.3 PLC Axis Control

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Over and above the NC control axes, this function enables axes to be controlled independently by commands based on the PLC.

**Specifications**

| Item | Description |
|---|---|
| Number of control axes | The maximum number of axes: 8 axes (M800/C80 series), 6 axes (M80 series) |
| Simultaneously controlled axes | PLC control axis is controlled independently from NC control axes.<br>A multiple number of PLC axes can be started simultaneously. |
| Command increment | Least command increment<br>0.001 mm (0.0001 inch)<br>0.0001 mm (0.00001 inch)<br>0.00001 mm (0.000001 inch)<br>0.000001 mm (0.0000001 inch)<br>(The command increment depends on the parameter setting.) |
| Feed rate | 0 to 1000000mm/min (0 to 100000 inch/min)<br>(Speed is fixed regardless of the unit system.) |
| Movement commands | Incremental commands from current position<br>Absolute commands for machine coordinate system<br>0 to ±99999999<br>(The command increment depends on the parameter setting.) |
| Operation modes | Rapid traverse, cutting feed, jog feed (+) (-), reference position return feed (+) (-), handle feed,<br>Automatic initial setting (C80 series) |
| Backlash compensation | Available |
| Stroke end | Device arbitrary allocation is available |
| Soft limit | Available |
| Rotary axis command | Available<br>For absolute commands……amount within 1 rotation<br>(rotation by amount remaining after division into the division number of rotary axis)<br>For incremental commands……rotation by assigned amount |
| Inch/mm changeover | None<br>Set to the command that corresponds to the feedback unit. |
| Position detector | Encoder (Absolute position can also be detected.) |

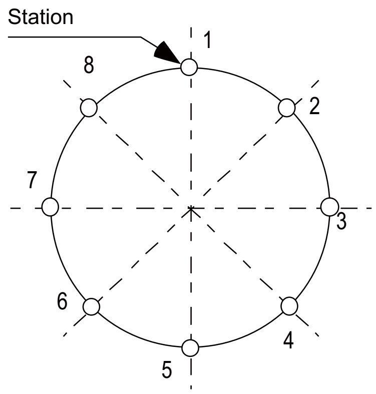
### 17.3.5 PLC Axis Indexing

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

PLC axis indexing allows a PLC axis to function as an auxiliary axis with no need for changing the user ladder used conventionally for an auxiliary axis. (The position of R register will be changed.)

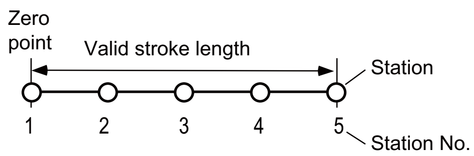
(1) Command methods

Station method (for rotary axis) : One rotation (360°) of the rotary axis is equally divided to determine the stations (positioning destinations). The maximum number of divisions is 360.




Setting 8 stations (8 divisions)

Station method (for linear axis) : A valid stroke is equally divided to determine the stations (positioning destinations). The maximum number of stations is 360.




Setting 5 stations

The zero point is station 1, and the final end of the valid stroke is station 5.
When using a linear axis, the No. of equal divisions is "number of stations - 1".

Unequal station method : When the positioning stations are not at equal intervals, this method allows you to set up to 20 coordinate points arbitrarily to determine the station coordinates. This method is available for a rotary or linear axis.

Arbitrary coordinate designation method : This method allows you to transfer arbitrary coordinates (the absolute coordinates based on the zero point) from PLC to perform positioning.

(2) Feed functions

Feed rate selection : Four different feeds per minute are set in the unit of " °/min" (rotary axis) or "mm/min" (linear axis). Which of the four is used is switched by the PLC I/F.

Acceleration/deceleration method : The constant inclination acceleration/deceleration is automatically controlled. The linear or soft acceleration/deceleration is selectable.

Acceleration/deceleration pattern designation method : Four different acceleration/deceleration patterns are set to be selected by switching with PLC I/F.

Short-cut control : A least movement distance is automatically judged when a rotary axis is rotated. Also the rotation direction can be designated by the command.

(3) Operation functions

The following operation modes are available. Send a command from PLC to change the operation mode.

| | | |
|---|---|---|
| Automatic mode | : | The axis is positioned at the station No. designated by the start signal. When the start signal has turned OFF before the positioning is completed, the axis is positioned at the nearest station position.<br>The arbitrary position command operation is also available: the positioning can be carried out to any position other than a station by directly commanding the positioning coordinates from the PLC. |
| Manual mode | : | While the start signal is ON, the axis is rotated at a constant speed in the designated direction. When the start signal has turned OFF, the axis is positioned at the nearest station position. |
| JOG mode | : | While the start signal is ON, the axis is rotated at a constant speed in the designated direction. |
| Incremental feed mode | : | This mode is to feed the axis by the designated distance at each activation. |
| Manual handle mode | : | The axis is moved by using a pulse generator. |
| Reference position return mode | : | This mode is to position at the reference position. The reference position return by the dog switch is not available. |

(4) Operation support function

| | | |
|---|---|---|
| Position switch | : | A signal is output to the PLC interface when the machine has reached within the specified range. |

### 17.3.101 NC Axis/PLC Axis Switchover

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | — | — | — | — | — | — | — | △ |
| L | — | — | — | — | — | — | — | △ |

This function is to use one drive unit by switching the control from the NC or the PLC dynamically.
The function of the NC axis can be used during the NC axis control and the function of the PLC axis can be used during the PLC axis control respectively.
A part of function or signal of the NC axis can also be used during the PLC axis control.

## 17.4 PLC Interface

### 17.4.1 CNC Control Signal

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Control commands to the CNC system are assigned from the PLC. Input signals with an A/D conversion function and skip inputs that respond at high speed can also be used.

**(1) Control signals**

- Control signals for operations in automatic operation mode
- Control signals for operations in manual operation mode
- Control signals for program execution
- Control signals for interrupt operations
- Control signals for servo
- Control signals for spindle
- Control signals for mode selection
- Control signals for axis selection
- Control signals for feed rates

**(2) Analog voltage control [M system]**

When an analog voltage is input to an external connector used to connect CNC analog inputs, the data corresponding to the input voltage can be read out in the prescribed file register. This data can be used for load meter displays, thermal deformation compensation, etc. (Maximum 4 points)

**(3) Skip signals**

When signals are input to the skip input interface, they are processed by interrupt processing. This enables functions requiring a high response speed to be implemented. (Maximum 8 points)

For further details, refer to the PLC Interface Manual.

### 17.4.2 CNC Status Signal

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

The status signals are output from the CNC system. They can be utilized by referencing them from the PLC.
These signals can also be output as analog data by setting the data from the PLC in the R register.

Status output functions

**(1) Controller operation ready**
When the controller power is turned ON and the controller enters the operation ready status, the "Ready" signal is output to the machine.
Refer to the PLC Interface Manual for details of the sequences from when the controller power is supplied to when the controller ready status is entered.

**(2) Servo operation ready**
When the controller power is turned ON and the servo system enters the operation ready status, the "Servo ready" signal is output to the machine.
Refer to the PLC Interface Manual for details of the sequences from when the power is supplied to when the "Servo ready" signal is turned ON.

**(3) In automatic operation**
Generally, if the "cycle start" switch is turned ON in the automatic operation mode (memory, MDI), this signal is output until the reset state or emergency stop state is entered by the M02, M30 execution or the reset & rewind input to the controller using the reset button.

**(4) In cycle start**
The signal that denotes that the controller is operating in the automatic mode is output from the time when the cycle start button is pressed in the memory or MDI mode and the cycle start status has been entered until the time when the automatic operation is terminated in the automatic operation pause status entered by the "feed hold" function, block completion stop entered by the block stop function or resetting.

**(5) In automatic pause**
An automatic operation pause occurs and this signal is output during automatic operation from when the automatic pause switch is pressed ON until the cycle start switch is pressed ON, or during automatic operation when the mode select switch is changed from the automatic mode to the manual mode.

**(6) In rapid traverse**
The "In rapid traverse" signal is output when the command now being executed is moving an axis by rapid traverse during automatic operation.

**(7) In cutting feed**
The "In cutting feed" signal is output when the command now being executed is moving an axis by cutting feed during automatic operation.

**(8) In tapping**
The "In tapping" signal is output when the command now being executed is in a tapping modal which means that one of the statuses below is entered during automatic operation.
(a) G84, G88 (fixed cycle: tapping cycle)
(b) G84.1, G88.1 (fixed cycle: reverse tapping cycle)
(c) G63 (tapping mode)

**(9) In thread cutting**

The "In thread cutting" signal is output when the command now being executed is moving an axis by thread cutting feed during automatic operation.

**(10) In rewinding**

The "In rewinding" signal is output when the reset & rewind signal is input by M02/M30, etc., during memory operation and the program currently being executed is being indexed.

The rewinding time is short, so there may be cases when it cannot be confirmed with the sequence program (ladder).

**(11) Axis selection output**

The "Axis selection output" signal for each axis is output to the machine during machine axis movement.

(a) Automatic mode

The signal is output in the movement command of each axis. It is output until the machine stops during stop based on feed hold or block stop.

(b) Manual mode (including incremental feed)

The signal is output while the axis is moving from the time when the jog feed signal is turned ON until the time when it is turned OFF and the machine feed stops.

(c) Handle feed mode

The signal is output at all times when the axis selection input is on.

**(12) Axis movement direction**

This output signal denotes the direction of the axis now moving, and for each axis a "+" (plus) signal and a "-" (minus) signal are output respectively.

**(13) Alarm**

This signal indicates the various alarm statuses that arise during controller operation. It is divided into the following types and output.

(a) System errors

(b) Servo alarms

(c) Program errors

(d) Operation errors

**(14) In resetting**

The "Reset" signal is output during the reset process when the reset & rewind command is input to the controller with the "reset" button on the setting and display unit is pressed or when the "Reset" signal is input from the machine operation panel, etc.

This signal will also be output when the controller READY status is OFF, when the Emergency stop signal is input or when a servo alarm is occurring, etc.

**(15) Movement command finish**

In the memory or MDI automatic operation, the "Movement command finish" signal is output when the command block in the machining program features a movement command and when that block command has been completed.

When the movement command and M, S, T or B command have been assigned in the same block, then the movement command signal can be used as a sync signal for either executing the processing of the M, S, T or B command at the same time as the command or executing it upon completion of the movement command.

### 17.4.3 PLC Window

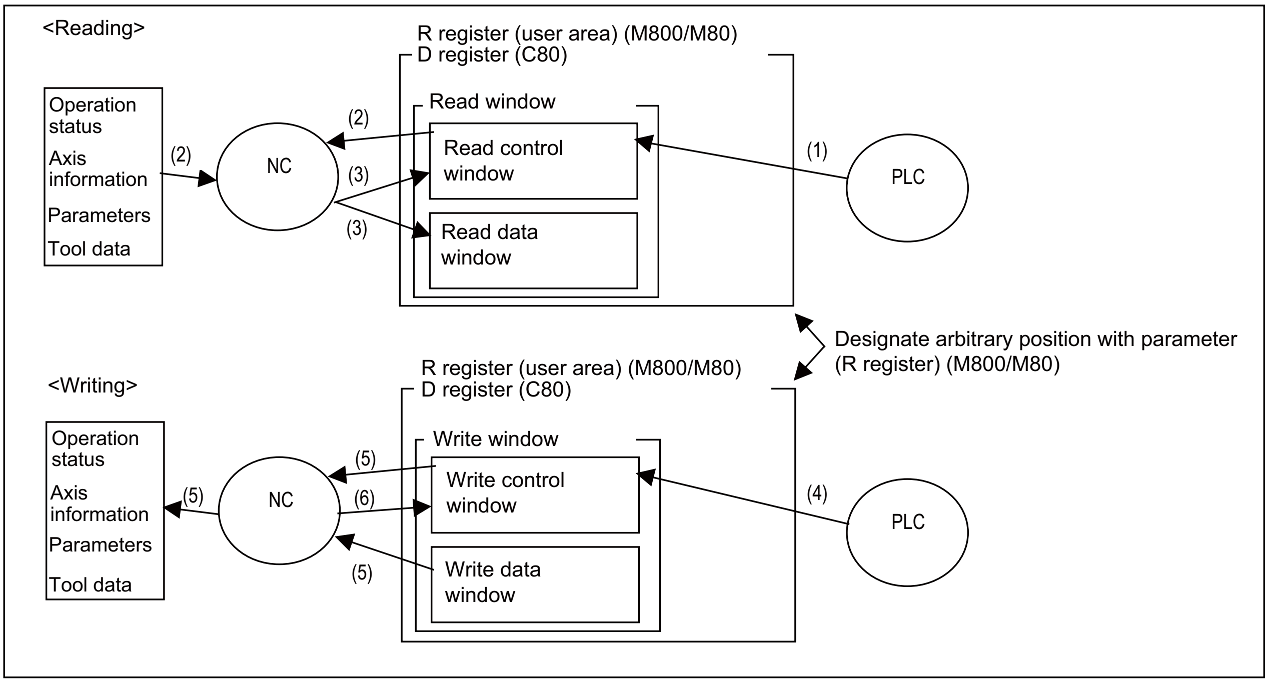
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

**[M800/M80 series]**

Using the "read window" or "write window" that are arbitrarily allocated to the R register's user area, it is possible to read and write the CNC operation status, axis information, parameters and tool data etc.
The area used for the "read window" and "write window" has 1500 points for the backup area and 100 points for the non-backup area.
Up to three window areas can be specified simultaneously for both "read window" area and "write window" area. 16 R registers are used for one read window or write window.
The read window is further divided into the "read control window" and "read data window". The write window is also divided into the "write control window" and "write data window".
Up to four data items can be successively read or written from the data designated in one read window or write window.

**[C80 series]**

The operation status of NC CPU, the axis information, the parameters, and the tool data, etc. can be read and written by using "Read control window" or the "write control window".
The "read control window" and "write control window" are available by 50 sets each.




(1) PLC turns control signal ON.
(2) NC receives control signal, and reads designated data in control window.
(3) Results of NC read are set in read control window and read data window.
(4) PLC turns control signal ON.
(5) NC receives control signal, and writes contents of write data window corresponding to designated data in control window.
(6) Results of NC write are set in write control window.

### 17.4.4 External Search

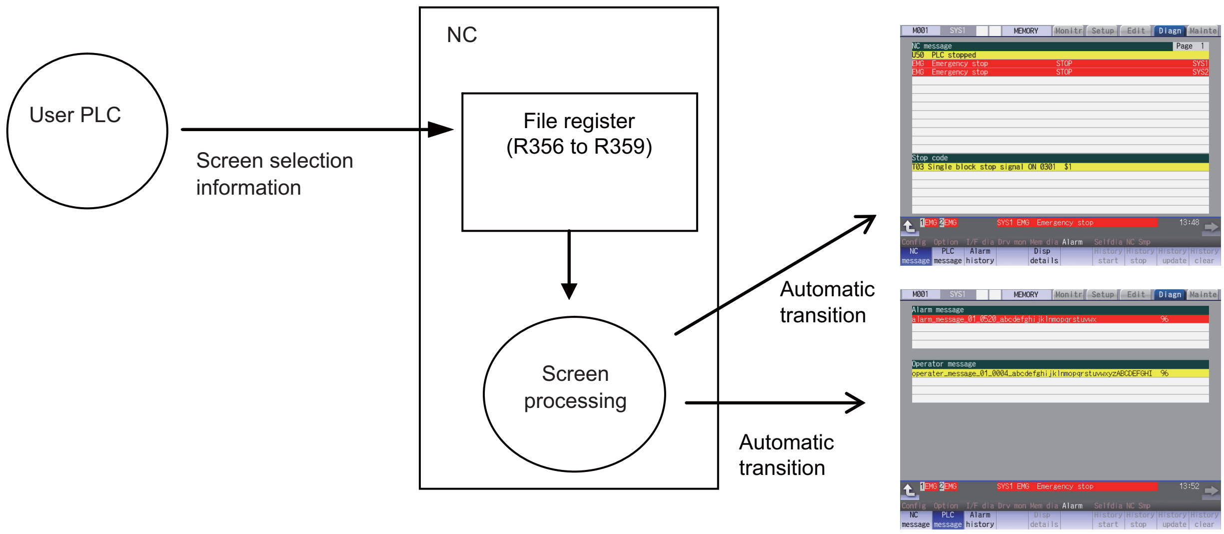
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Machining program can be searched from user PLC by specifying the storage device of machining program, program No., sequence No. or block No.

### 17.4.5 Direct Screen Selection

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

This function enables automatic transition to an arbitrary screen by setting the screen selection information to the file registers from user PLC.
The screens that can be selected as the transition destination are Monitr, Setup, Edit, Diagn, Mainte and custom release screens.
This function is used to move to the custom screen being set by the MTB.

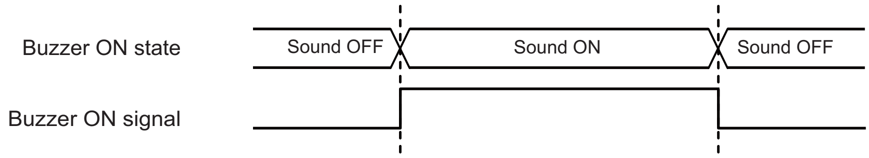


### 17.4.6 Buzzer Sound Control

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | － |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | － |

This function gives a buzzer mounted on the NC keyboard by operating the PLC device.
The buzzer will be activated when the PLC device is turned ON, and be deactivated when the PLC device is turned OFF.
This is effective in applications of sounding a buzzer such as during the alarm occurrence, or for the program operation end notification.
This function also gives a buzzer when the operation sound disable has set.
This can be used when the NC keyboard is mounted.

The buzzer sound image by the buzzer ON operation:



## 17.5 Machine Contact I/O

### 17.5.1 Operation Panel I/O

#### 17.5.1.1 DI:64/DO:64

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | □ /— | □ /— | — | — | □ /— | — | — | — |
| L | □ /— | □ /— | — | — | □ /— | — | — | — |

* Specifications of separated-type display are classified with "Windows-based" and "Windows-less"

#### 17.5.1.2 DI:64/DO:64 + SDI:8

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | □ /— | □ /— | — | — | □ /— | — | — | — |
| L | □ /— | □ /— | — | — | □ /— | — | — | — |

* Specifications of separated-type display are classified with "Windows-based" and "Windows-less"

#### 17.5.1.3 DI:96/DO:64

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | —/ □ | —/ □ | □ | □ | —/ □ | □ | □ | — |
| L | —/ □ | —/ □ | □ | □ | —/ □ | □ | □ | — |

* Specifications of separated-type display are classified with "Windows-based" and "Windows-less"

## 17.5.2 Remote I/O

### 17.5.2.1 DI:32/DO:32

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | □ | □ | □ | □ | □ | □ | □ | − |
| L | □ | □ | □ | □ | □ | □ | □ | − |

### 17.5.2.2 DI:64/DO:48

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | □ | □ | □ | □ | □ | □ | □ | − |
| L | □ | □ | □ | □ | □ | □ | □ | − |

### 17.5.2.3 DI:64/DO:48 ＋ AO:1

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | □ | □ | □ | □ | □ | □ | □ | − |
| L | □ | □ | □ | □ | □ | □ | □ | − |

### 17.5.2.5 DI:16/DO:8

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | □ | □ | □ | □ | □ | □ | □ | − |
| L | □ | □ | □ | □ | □ | □ | □ | − |

### 17.5.2.6 DI:32/DO:32 + SDI:8/SDO:4

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | □ | □ | □ | □ | □ | □ | □ | − |
| L | □ | □ | □ | □ | □ | □ | □ | − |

* Safety card is required for M80

### 17.5.2.7 SDI:8/SDO:4

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | □ | □ | □ | □ | □ | □ | □ | − |
| L | □ | □ | □ | □ | □ | □ | □ | − |

* Safety card is required for M80

## 17.6 External PLC Link

### 17.6.1 CC-Link (Master/Local)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | □ | □ | □ | □ | □ | □ | □ | △ (*1) |
| L | □ | □ | □ | □ | □ | □ | □ | △ (*1) |

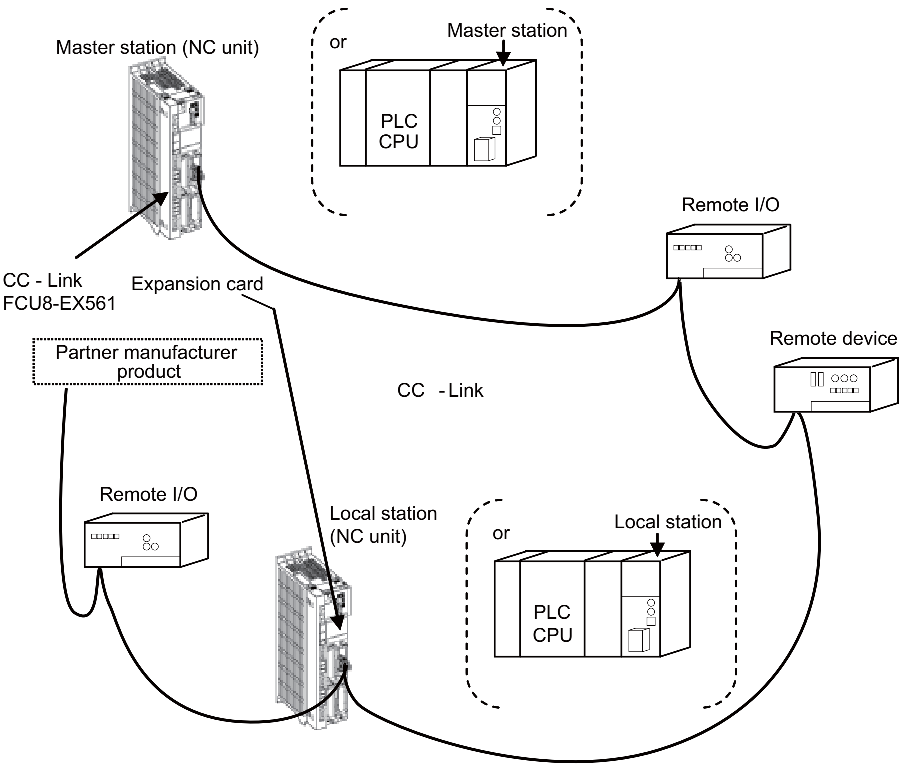
(*1) MELSEC

**[M800/M80 series]**

NC unit can be directly connected to the network to serve as the master/local station of the MELSEC CC-Link.
CC-Link unit is required for this connection.
With this function, the GOT connection and the transient instruction with MELSEC A series cannot be used.

(1) Outline of CC-Link
- Distributing and installing each unit to the equipments such as conveyor line and mechanical device can simplify the wiring of the whole system.
- The ON/OFF data and numerical data such as input/output treated by each unit can be communicated easily and at high speed.
- The simple distribution system can be established by connecting several PLC CPUs or NCs.
- Connecting the device equipments made by the partner manufacturer can flexibly support various systems.

(2) Outline drawing (M800W Series)




| | |
|---|---|
| Master station | This station controls the remote station and local station.<br>One master station is required for one system. |
| Local station | This station contains the CPU and can communicate with the master and the other local stations. |
| Remote I/O station | Remote station that handles only bit information. |
| Remote device station | Remote station that handles bit information and word information. |
| Intelligent device station | This station allows the transient transmission. (Including local station) |

(3) Performance specifications

MITSUBISHI CNC M8 Series is compliant with CC-Link Ver.2.00.

<CC-Link Ver.2.00 specification>

| Item | | | CC-Link master/local unit | | | |
|---|---|---|---|---|---|---|
| Max. number of link points per one system (Note 1) | | Remote input/output (RX,RY) | 8192 points each | | | |
| | | Remote register (RWw)<br>(Master St. → Remote/Local St.) | 2048 points | | | |
| | | Remote register (RWr)<br>(Remote/Local St. → Master St.) | 2048 points | | | |
| Extended cyclic setting | | | 1 time setting | 2 times setting | 4 times setting | 8 times setting |
| Number of link points per one remote/local station | 1 station occupied | Remote input/output (RX,RY) | 32 points each | 32 points each | 64 points each | 128 points each |
| | | Remote register (RWw)<br>(Master St. → Remote/Local St.) | 4 words | 8 words | 16 words | 32 words |
| | | Remote register (RWr)<br>(Remote/Local St. → Master St.) | 4 words | 8 words | 16 words | 32 words |
| | 2 stations occupied | Remote input/output (RX,RY) | 64 points each | 96 points each | 192 points each | 384 points each |
| | | Remote register (RWw)<br>(Master St. → Remote/Local St.) | 8 words | 16 words | 32 words | 64 words |
| | | Remote register (RWr)<br>(Remote/Local St. → Master St.) | 8 words | 16 words | 32 words | 64 words |
| | 3 stations occupied | Remote input/output (RX,RY) | 96 points each | 160 points each | 320 points each | 640 points each |
| | | Remote register (RWw)<br>(Master St. → Remote/Local St.) | 12 words | 24 words | 48 words | 96 words |
| | | Remote register (RWr)<br>(Remote/Local St. → Master St.) | 12 words | 24 words | 48 words | 96 words |
| | 4 stations occupied | Remote input/output (RX,RY) | 128 points each | 224 points each | 448 points each | 896 points each |
| | | Remote register (RWw)<br>(Master St. → Remote/Local St.) | 16 words | 32 words | 64 words | 128 words |
| | | Remote register (RWr)<br>(Remote/Local St. → Master St.) | 16 words | 32 words | 64 words | 128 words |
| Number of occupied stations<br>(Number of local stations) | | Station 1 to station 4 (The station No. can be switched with parameters.) | | | | |
| Baud rates | | 156kbps / 625kbps / 2.5Mbps / 5Mbps / 10Mbps can be selected.<br>(Baud rate can be selected with parameters.) | | | | |
| Communication method | | Polling method | | | | |
| Synchronization method | | Flame synchronization method | | | | |
| Encode method | | NRZI method | | | | |
| Transmission path method | | Bus (EIA RS485 compliant) | | | | |
| Transmission format | | HDLC compliant | | | | |
| Illegal control method | | CRC($X^{16} + X^{12} + X^5 + 1$) | | | | |

| Item | CC-Link master/local unit |
|---|---|
| Max. number of connection units | 64 units<br>Note that the following two conditions must be satisfied.<br>Condition 1:<br>- (a+a2+a4+a8)+(b+b2+b4+b8)×2+(c+c2+c4+c8)×3+(d+d2+d4+d8)×4 ≦ 64<br>-<br>(a×32+a2×32+a4×64+a8×128)+(b×64+b2×96+b4×192+b8×384)+(c×96+c2×160+c4×320+c8×640)+(d×128+d2×224+d4×448+d8×896) ≦ 8192<br>-<br>(a×4+a2×8+a4×16+a8×32)+(b×8+b2×16+b4×32+b8×64)+(c×12+c2×24+c4×48+c8×96)+(d×16+d2×32+d4×64+d8×128) ≦ 2048<br>a : Number of units when 1 station is occupied in 1 time extended cyclic setting<br>b : Number of units when 2 stations are occupied in 1 time extended cyclic setting<br>c : Number of units when 3 stations are occupied in 1 time extended cyclic setting<br>d : Number of units when 4 stations are occupied in 1 time extended cyclic setting<br>a2: Number of units when 1 station is occupied in 2 times extended cyclic setting<br>b2: Number of units when 2 stations are occupied in 2 times extended cyclic setting<br>c2: Number of units when 3 stations are occupied in 2 times extended cyclic setting<br>d2: Number of units when 4 stations are occupied in 2 times extended cyclic setting<br>a4: Number of units when 1 station is occupied in 4 times extended cyclic setting<br>b4: Number of units when 2 stations are occupied in 4 times extended cyclic setting<br>c4: Number of units when 3 stations are occupied in 4 times extended cyclic setting<br>d4: Number of units when 4 stations are occupied in 4 times extended cyclic setting<br>a8: Number of units when 1 station is occupied in 8 times extended cyclic setting<br>b8: Number of units when 2 stations are occupied in 8 times extended cyclic setting<br>c8: Number of units when 3 stations are occupied in 8 times extended cyclic setting<br>d8: Number of units when 4 stations are occupied in 8 times extended cyclic setting<br>Condition 2:<br>- {(16×A)+(54×B)+(88×C)} ≦ 2304<br>- A:Number of remote I/O stations ≦ 64 units<br>- B:Number of remote device stations ≦ 42 units<br>- C:Number of local stations, standby master stations and intelligent device stations ≦ 26 units |
| Remote station No. | 1 to 64 |
| Max. total cable length and each cable length between stations | CC-Link Ver.1.10 compliant cable (When a 110Ω of terminating resistance is used.) (Note 2)<br>Baud rates / Cable length between stations / Max. total cable length<br>156kbps / 20cm or more / 1200m<br>625kbps / 20cm or more / 900m<br>2.5Mbps / 20cm or more / 400m<br>5Mbps / 20cm or more / 160m<br>10Mbps / 20cm or more / 100m |
| Connection cable | CC-Link Ver.1.10 compliant cable (3-core twisted pair cable with shield) (Note 3) |
| RAS function (Note 4) | - Automatic link refresh function<br>- Sub-station isolation function<br>- Link special relay/error detection by register |

(Note 1) If the points which can be reserved as the device for the CC-Link in the NC side does not reach 8192 points, the number of points which can be reserved in the NC side is the max. number of link points per one system. This applies for the remote register (RWw, RWr), as well.

(Note 2) When CC-Link Ver.1.00 compliant cables are mixed, the cable length between stations and the maximum total length of the cable should follow the specifications for CC-Link Ver.1.00.

(Note 3) This can be used with the cables made by different manufacturers as long as they are Ver.1.10 compliant cables.

(Note 4) "RAS" is short for "Reliability", "Availability" and "Serviceability".

(4) Usable functions

Of all the CC-Link functions, the following functions can be used with the NC.

( ○ : Available ×: Not available － : Not relevant)

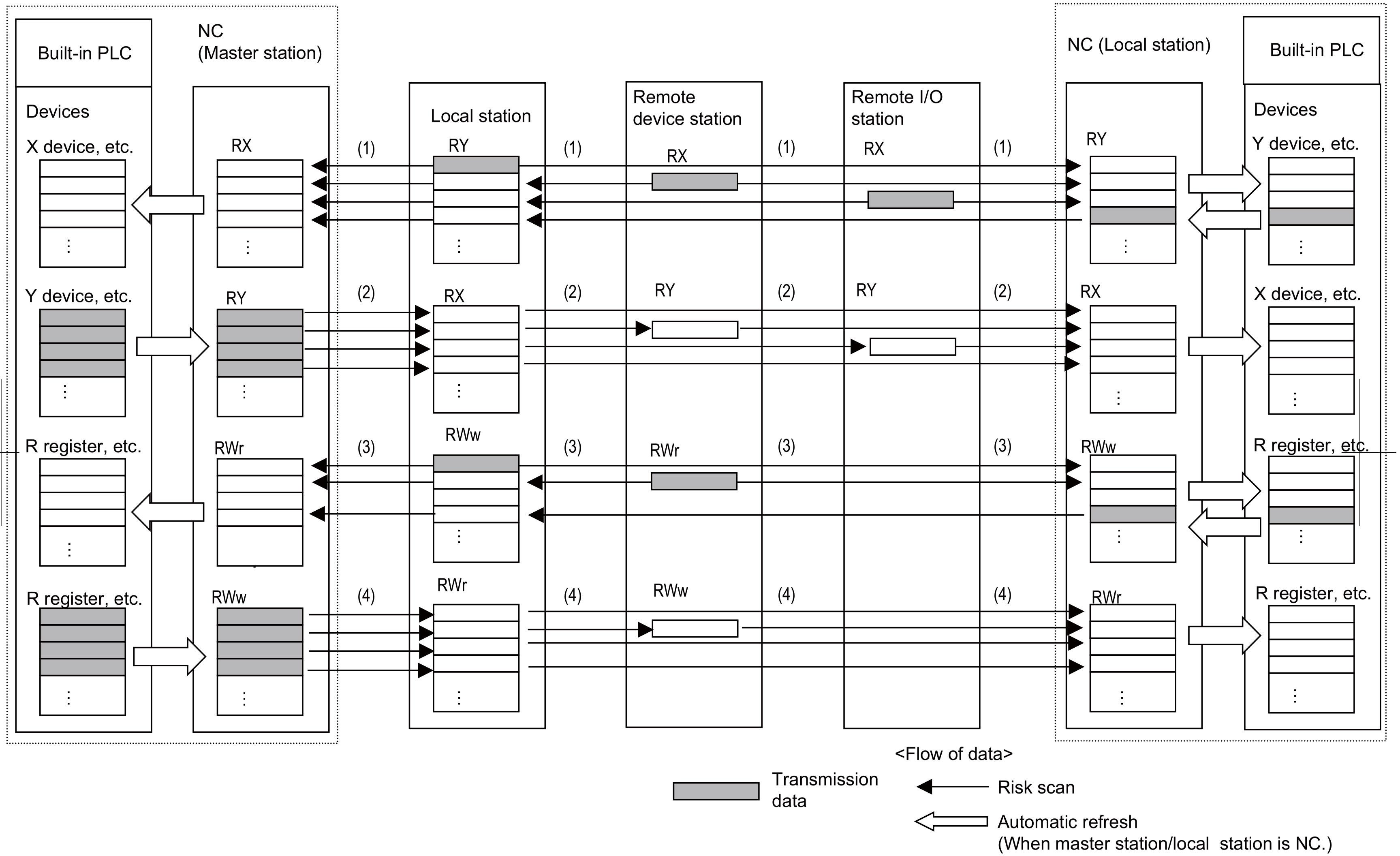
| | Function item | | MELSEC | | NC unit | |
|---|---|---|---|---|---|---|
| | | | Master station | Local station | Master station | Local station |
| Method | Ver.1.00 | | ○ | ○ | ○ | ○ |
| | Ver.2.00 | | ○ | ○ | ○ | ○ |
| Master function | Communication between master station and remote I/O station | | ○ | – | ○ | – |
| | Communication between master station and remote device station | | ○ | – | ○ | – |
| | Communication between master station and local station | | ○ | ○ | ○ | ○ |
| | Mixed system communication | | ○ | ○ | ○ | ○ |
| | Reserved station function | | ○ | – | ○ | – |
| | Error cancel station function | | ○ | – | ○ | – |
| | Setting of data link status when trouble occurs in CPU of master station | | ○ | ○ | ○ | ○ |
| | Registration of parameters in $E^2$PROM | | ○ | – | ○ (Note 2) | – |
| | Setting of input data status from data link trouble station | | ○ | ○ | ○ | ○ |
| | Unit resetting by sequence program | | ○ | ○ | ○ | ○ |
| | Data link stop/restart | | ○ | ○ | ○ | ○ |
| | Parameter registration function | | ○ | ○ | ○ (Note 2) | ○ (Note 2) |
| | Automatic refresh function | | ○ | ○ | ○ | ○ |
| | Scan synchronization function | Synchronous mode | ○ | – | ○ | – |
| | | Asynchronous mode | ○ | ○ | ○ | ○ |
| Setting & display function | LED diagnosis status | | 16-point display (A1SJ61QBT11) | | 16-point display | |
| | Station number setting | | Unit front panel switches | | Parameters (Note 2) | |
| | Baud rate setting | | | | | |
| | Mode setting switch | | | | | |
| | Condition setting | | | | H/W switches | |
| RAS function | Automatic link refresh function | | ○ | ○ | ○ | ○ |
| | Sub-station isolation function | | ○ | – | ○ | – |
| | Data link status check (SB/SW) | | ○ | ○ | ○ | ○ |
| | Off-line test | | ○ | ○ | ○ | ○ |
| | On-line test | | ○ | ○ | ○ | ○ |
| | Monitor diagnosis | | ○ | ○ | × | × |
| | Standby master function (Note 3) | | ○ | – | ○ | – |
| | Temporary error cancel station designation function | | ○ | – | ○ | – |
| exclusive instruction | READ instruction / SREAD instruction (Note 1) | | ○ | ○ | ○ | ○ |
| | WRITE instruction / SWRITE instruction (Note 1) | | ○ | ○ | ○ | ○ |
| | RIRD instruction / RIWT instruction (Note 1) | | ○ | ○ | × | × |

(Note 1) The transient instruction cannot be used.

(Note 2) The parameter for the CC-Link is set with the GX Developer.

(Note 3) With this function, when an error occurs in the master station, switch to the standby master station so that data link can be continued. (The NC unit cannot be used as the standby master station.)

(5) Communication data flow
The flow of data communicated by the CC-Link's link scan is as follows.
(The master station and local station of MELSEC CPU can be also mixed.)



(1) By executing a link scan, data in the remote I/O station and remote device station's remote input (RX) and in the local station's remote output (RY) is transmitted to the master station's remote input (RX) and the local station's remote output (RY).
(2) By executing a link scan, data in the master station's remote output (RY) is transmitted to the remote I/O station and remote device station's remote output (RY) and the local station's remote input (RX).
(3) By executing a link scan, data in the remote device station's remote register (RWr) and the local station's remote register (RWw) is transmitted to the master station's remote register (RWr) and the local station's remote register (RWw).
(4) By executing a link scan, data in the master station's remote register (RWw) is transmitted to the remote device station's remote register (RWw) and the local station's remote register (RWr).

**[C80 series]**

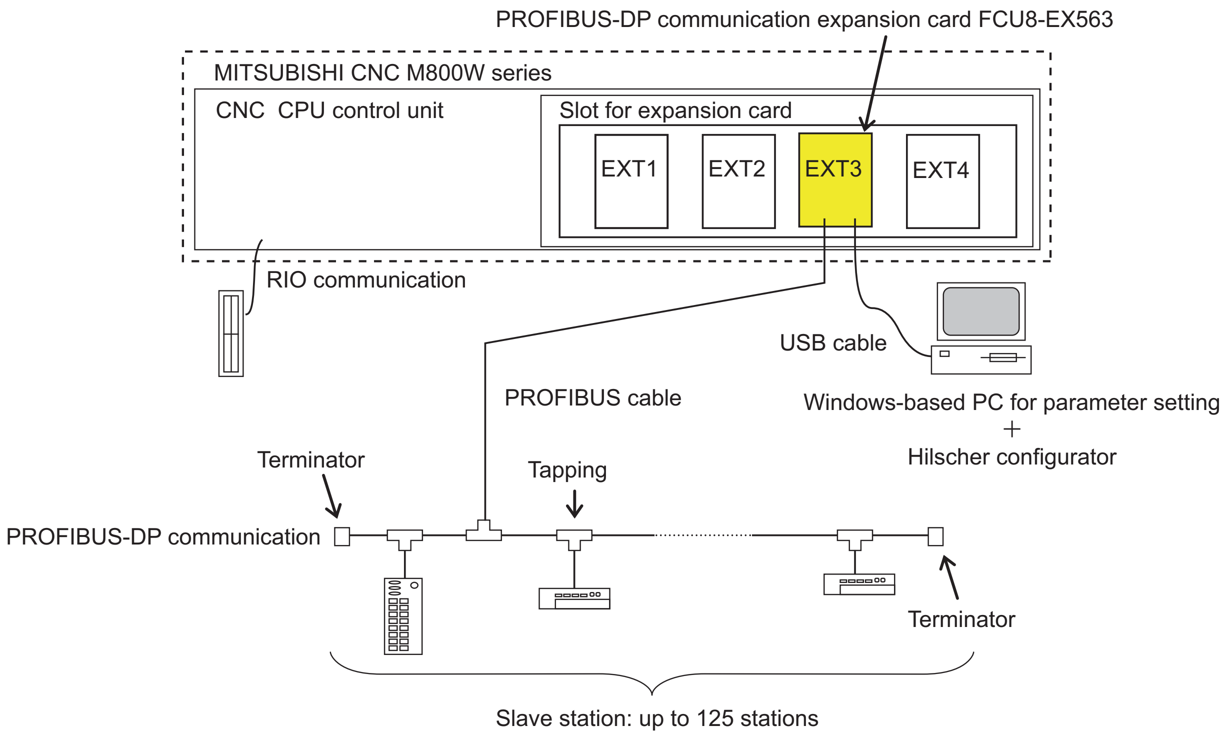
For the details of C80 series, refer to the manual of each unit of MITSUBISHI PLC "MELSEC iQ-R series".

### 17.6.2 PROFIBUS-DP (Master)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | □ | □ | □ | □ | □ | □ | □ | − |
| L | □ | □ | □ | □ | □ | □ | □ | − |

NC can input/output devices to/from slave stations as a master station of PROFIBUS-DP communication by connecting to PROFIBUS-DP-capable slave stations.

For M800W Series, the PROFIBUS-DP communication expansion card FCU8-EX563 is mounted on an expansion slot (EXT3 or EXT4), and for M80W Series, it is mounted on an expansion slot (EXT3). Note that only one FCU8-EX563 card is allowed to be installed at a time for operation. If two FCU8-EX563 cards are installed at a time, both cards stop their operation and output an error.
FCU8-EX563 uses Hilscher Fieldbus communication control circuit (COMX module). Use the Hilscher configurator "SYCON.net" to configure parameters. Up to 125 slave stations can be connected.
NC handles all the devices input/output to/from PLC as bit device data. Up to 512 points can be input/output.
Maximum number of inputs/outputs for NC remote I/O unit is 768, irrespective of the presence of FCU8-EX563.




### 17.6.3 CC-Link IE Field (Master/Slave)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | − | − | − | − | − | − | − | △ (*1) |
| L | − | − | − | − | − | − | − | △ (*1) |

(*1) MELSEC

For the details of C80 series, refer to the manual of each unit of MITSUBISHI iQ Platform-compatible PAC "MELSEC iQ-R series".

## 17.7 Installing S/W for Machine Tools

### 17.7.1 Customization (NC Designer2)

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | － |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | － |

Custom release allows the user-original window to display as an HMI screen or another application.
(Note) Please contact us to purchase this tool.

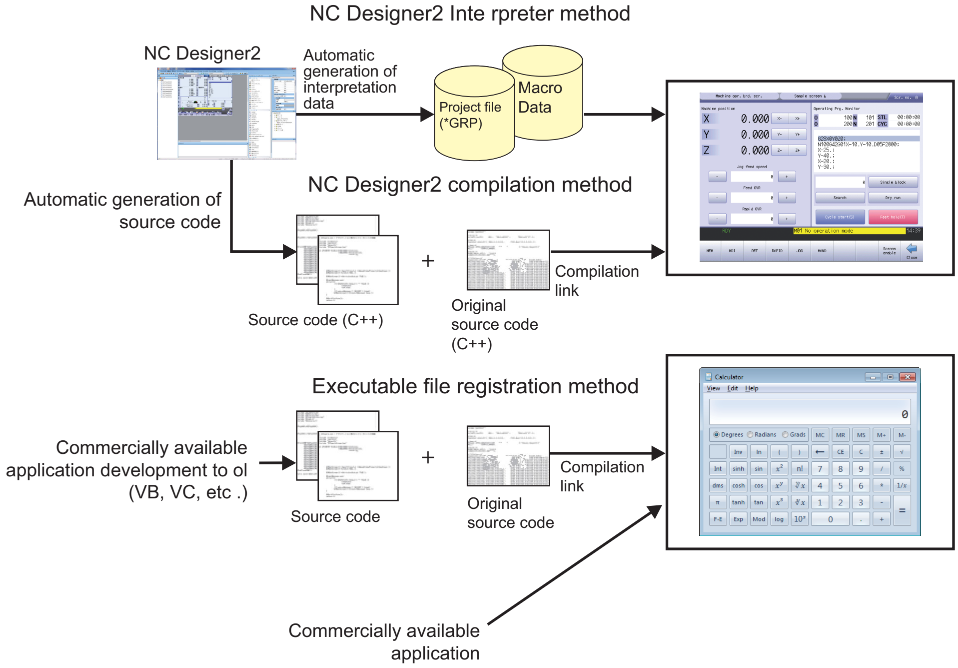
Custom release includes, mainly, two types of F0 release and menu release. Each custom release can be created and registered by "NC Designer2 interpreter method", "NC Designer2 compilation method", and "Executable file registration method".

F0 release :
Custom release screen (Note 1) can be assigned to function keys (F0, SEP, window display, window selection).
When a function key is pressed, the assigned custom release screen will be displayed.

Menu release :
Custom release window (Note 2) can be registered in the main menu of the monitor screen, setup screen and edit screen.
Main menu contents of the monitor, setup and edit screen can be rearranged.
When the main menu in which custom release window is registered is pressed, the custom release window will be displayed.
Depending on the conditions, display/non-display of the custom menu can be changed.

Screen part release :
Custom release window created by "NC Designer2 interpreter method" or "NC Designer2 compilation method" can be displayed as the part of standard screen.

(Note 1) An HMI screen originally created with NC Designer2 by the user or an executable file prepared by the user. (Note that an executable file prepared by the user cannot be used with M800S/M80.)
(Note 2) An HMI window originally created with NC Designer2 by the user or an executable file prepared by the user. (Note that an executable file prepared by the user cannot be used with M800S/M80.)
(Note 3) "Executable file registration method" cannot be used with M800S/M80.


NC Designer2 Inte rpreter method
NC Designer2
Automatic generation of interpretation data
Project file (*GRP)
Macro Data
NC Designer2 compilation method
Automatic generation of source code
Source code (C++)
Original source code (C++)
Compilation link
Executable file registration method
Commercially available application development to ol (VB, VC, etc .)
Source code
Original source code
Compilation link
Commercially available application

### 17.7.1.1 Customization Data Storage Capacity [MB]

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | □ (*1) | □ (*1) | 6 | 6 | □ (*1) | 6 | 6 | — |
| L | □ (*1) | □ (*1) | 6 | 6 | □ (*1) | 6 | 6 | — |

(*1)Depending on display unit-side memory space.

### 17.7.1.2 Customization Working Memory Size [MB]

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | 6 | 6 | 6 | 6 | 3 | 3 | 3 | — |
| L | 6 | 6 | 6 | 6 | 3 | 3 | 3 | — |

## 17.7.2 User-defined Key

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | — |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | — |

This function allows an arbitrary character string to be assigned to one key and makes it easy to input the fixed phrases.
Register correspondences between SHIFT keys and character strings in a configuration file (keydef.txt).
The maximum number of registerable key types is 8 for ABC layout and 10 for QWERTY layout.
The maximum number of characters used per definition is 256. The definition is disregarded when it is set exceeding the number.

In the configuration file (Keydef.txt), a character string should be defined as follows:
n [character string] ;
n(Registration No.): 0 to 7 (SHIFT+A to SHIFT+H (ABC layout))
: 0 to 9 (SHIFT+Q to SHIFT+G (QWERTY layout))
Example:
0[G28X0Y0]; ← When SHIFT+A and a key is input, a character string "G28X0Y0" is input.
1[G28Z0]; ← When SHIFT+B and a key is input, a character string "G28Z0" is input.

## 17.7.3 EZSocket I/F

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | △ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | △ |

(Note) Please contact us to purchase this tool.
This middleware makes it easy to develop applications having a Windows interface.
The various functions of the NC unit can be used from a Windows application using VC++ language, VB language and VBA macro language.

## 17.7.4 APLC Release

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | △ |
| L | △ | △ | △ | △ | ○ | ○ | ○ | △ |

(Note) Please contact us to purchase this tool.

APLC (Advanced Programmable Logic Controller) release is a function that allows the user-generated C language module to be called from NC.

Control operations that are difficult to express in ladder language can be created with C language.

PLC ladder can easily be customized by converting a part of PLC ladder that has grown complex and bulky into C language module.

There are three methods where APLC is executed. It is possible to use the three in combination.

- Type 1 : By registering the start address of the module to be processed asynchronously with PLC, C language module will be executed in a constant frequency.

- Type 2 : By registering the start address of the module to be processed synchronously with PLC, C language module will be started synchronizing with PLC. Note that C language will not be called if PLC is incorrect, even if the process has been registered.
- Type 3 (M800/M80 series) : By registering the start address of the module to be called from the sequence program and processed, C language module will be started from the sequence program upon S.CALL instruction.

(Note) C language module needs to be generated by NC compiler2.

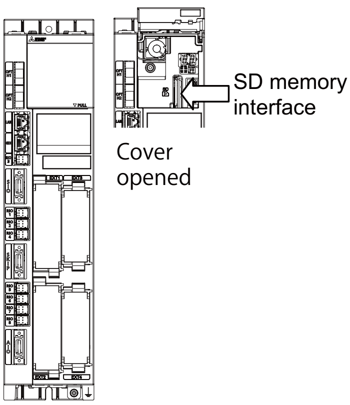
[Hardware configuration]

This function will be activated by installing C language module into a SD memory card or control unit built-in memory.

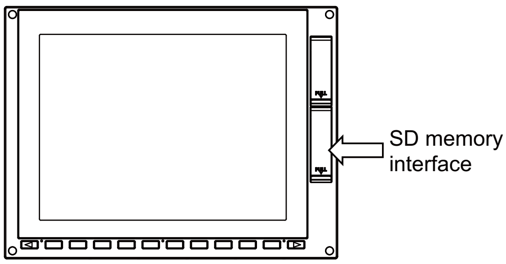
If C language module is stored in SD memory card (only for M800/M80 series), this function will be activated by installing the module into SD memory interface of the control unit for M800W/M80W series, or front SD memory interface of the display unit for M800S/M80 series.

Up to 120KB data can be stored in built-in memory.

When C language module is installed in SD memory card, C language inside the SD memory card is executed. (The module inside the built-in memory is not executed.)




M800W




M800S/M80

[Software configuration]

The names of directory, file and initialize function, where C language modules are stored, are fixed.

(Note) Incorrect hardware or software configuration disables operations.

### 17.7.5 Custom API Library

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | － |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | － |

(Note) Please contact us to purchase this tool.
Reading/writing of each information within NC unit is possible by using custom API library.

### 17.7.6 MES Interface Library

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | － |
| L | △ | △ | △ | △ | ○ | ○ | ○ | － |

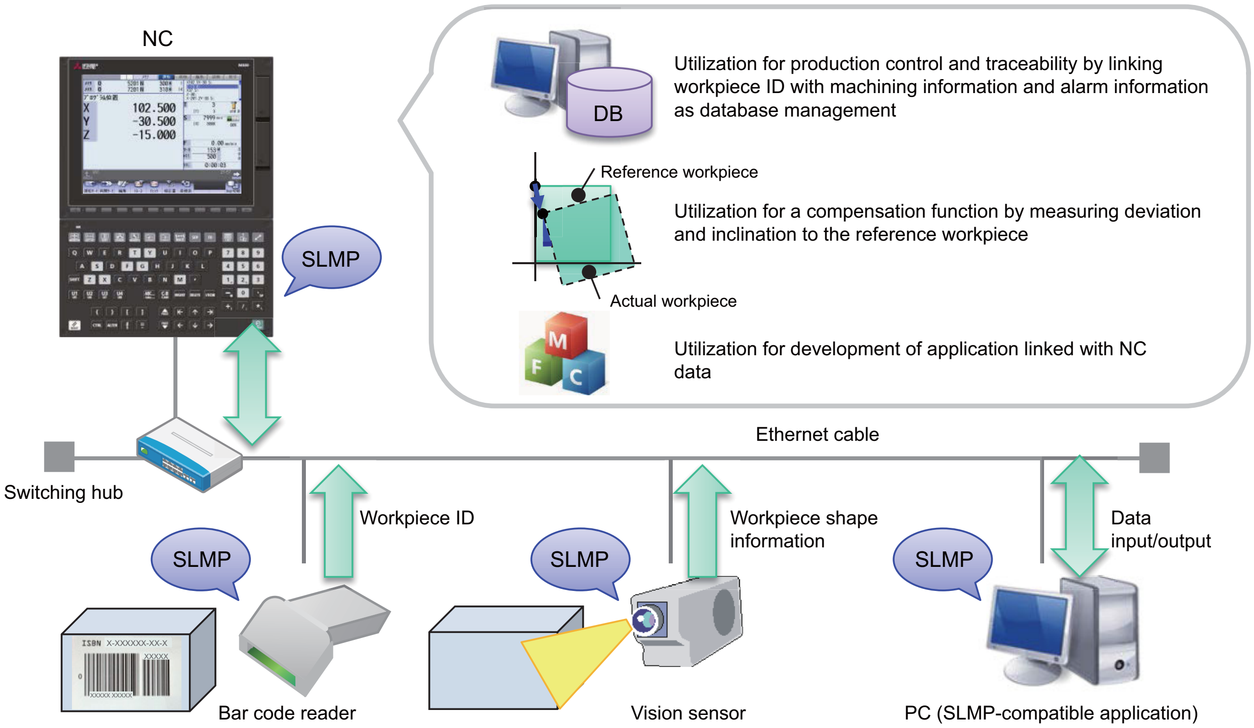
**[M800/M80 series]**
This function enables to link the CNC internal data and the database of information system (manufacturing execution system). Production control and traceability can be ensured with the registered information by registering at machining completion, alarm occurrence, or user's arbitrary timing as needed. The data registered in the database can also be operated with CNC.
Conventionally, data was obtained by constantly monitoring CNC from an external computer (information system). However, by using MES interface library function, it is possible to connect without a communication gateway and it allows the communication between CNC and the database at a necessary timing.
This function is supported on CNC and the function range is from obtaining the information at the time of machining completion, alarm occurrence, and user's arbitrary timing to transmitting to the database. Screen application of database and external computer must be prepared by user side.

**[C80 series]**
For the details of C80 series, refer to the manual of MITSUBISHI iQ Platform-compatible PAC "MELSEC iQ-R series".

### 17.7.7 SLMP Server

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | － |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | － |

SLMP server is a function that transfers data using the SLMP between an NC and an external device.
SLMP (Seamless Message Protocol) is a general-purpose protocol to transfer information between the NC and an SLMP-compatible external device through the Ethernet cable and the SLMP is applied to many external devices because it can be easily utilized only by applying S/W.
This function enables easy connection with external devices and read/write NC data through the Ethernet cable, improving productivity by utilizing external devices and meeting broad automation needs.



### 17.7.8 MITSUBISHI Communication Software for CNC FCSB1224W000

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | － |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | － |

(Note) The software sold separately is required.

The Mitsubishi CNC communication software FCSB1224W000 is designed to help development of an application with Windows interface for Mitsubishi computerized numerical controller.
The product can accelerate development by eliminating necessity to know about internal processing of the computerized numerical controller and enabling use of the common OLE interface on the Mitsubishi computerized numerical controller.

### 17.7.102 GOT2000 Screen Design Tool GT Works3

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | － | － | － | － | － | － | － | ○ |
| L | － | － | － | － | － | － | － | ○ |

This software provides comprehensive support for the screen design of a display unit.

(Note) The software sold separately is necessary.

## 17.8 Others

### 17.8.1 System Lock

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | △ | △ | △ | △ | ○ | ○ | ○ | － |
| L | △ | △ | △ | △ | ○ | ○ | ○ | － |

System lock is a function that allows machine tool builders to set the expiration date for use of their machines.
If the cancel code is not entered by the specified deadline, the system forcibly turns OFF the Servo ready completion signal to place the machine in an inoperable status.
(Note) We do not compensate for any detriment that may be caused when the lock is cancelled illegally.

### 17.8.2 CNC Remote Operation Tool

#### 17.8.2.1 NC Monitor2

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

(Note) Please contact us to purchase this tool.
NC Monitor2 is the software tool that monitors the condition of NC remotely with a personal computer using a intranet of a plant. Multiple NCs can be connected and their conditions can be monitored simultaneously.

#### 17.8.2.2 NC Explorer

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

(Note) This tool is free of charge. Please contact us.
NC Explorer is a software tool to operate the machining data files of each NC unit connected with a host personal computer by Ethernet connection from the Explorer on the host personal computer.

### 17.8.3 Automatic Operation Lock

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Automatic operation lock function prevents the falsification of APLC(C language module: herein after called APLC) by a third party.
Automatic operation will be prohibited when illegal APLC is installed by authenticating APLC with the password for APLC authentication which is registered to NC unit beforehand using this function.
Refer to "17.7.4 APLC Release" for details on the APLC.

### 17.8.4 Power Consumption Computation

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Present power consumption and accumulated power consumption can be acquired with this function.
The power consumption is the total amount of power which is consumed by the rotation and movement of the spindles and servo axes in the drive section and power which is consumed by the electrical equipment of the machine tool other than the drive section.
The present power consumption notifies the instantaneous power consumption and the accumulated power consumption notifies the integrated value of the present power consumption.

### 17.8.5 EcoMonitorLight Connection

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | ○ | ○ | ○ | ○ | ○ | ○ | ○ | − |
| L | ○ | ○ | ○ | ○ | ○ | ○ | ○ | − |

(Note) EcoMonitorLight sold separately is required.

NC system can collect and manage the electric power of the machine tool which is measured by the energy measuring unit "EcoMonitorLight".
The electric power (mainly consumed and regenerated power) of entire machine tool and peripheral devices can be measured by connecting EcoMonitorLight to the main breaker of the machine tool or the breaker of the peripheral devices (motor, coolant, etc.) which configure the machine tool.
By establishing serial communication (Modbus) between the NC unit and EcoMonitorLight using a serial cable, the NC system can collect the power values of the entire machine tool and peripheral devices measured by EcoMonitorLight.
Consequently, the electric power in the machine tool can be finely managed, which enables energy-saving operation.

### 17.8.102 GOT Window

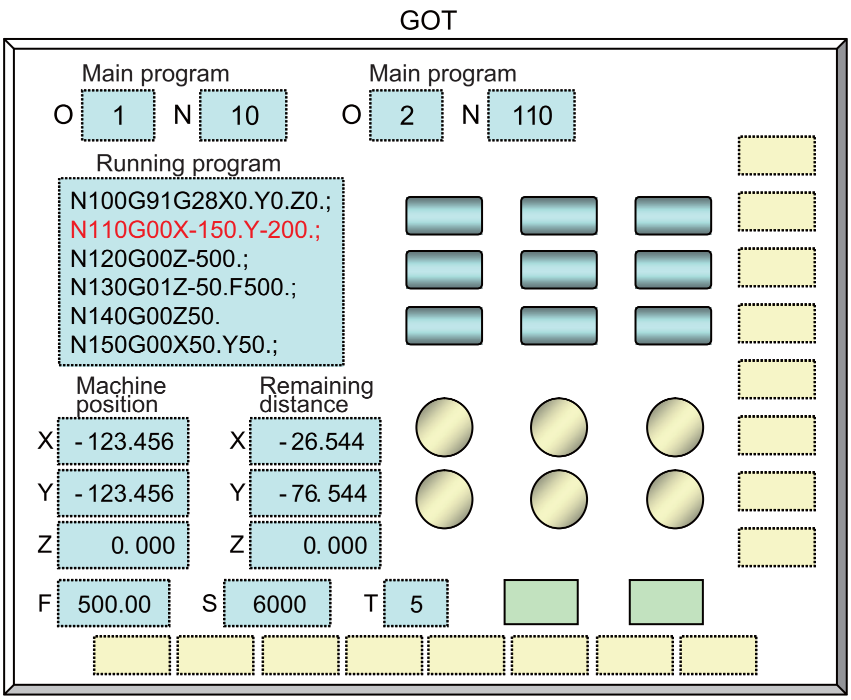
| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | – | – | – | – | – | – | – | ○ |
| L | – | – | – | – | – | – | – | ○ |

This is the interface to display the variety of NC data on GOT connected to the CNC CPU.
This reads out the running machining program No., the running machining program and the coordinate values, etc. by the device read command.

Setting the command from the GOT or sequence program for the CNC CPU, then the CNC CPU generates the data corresponding to the command.
Because there are up to ten command areas, you can designate up to 10 kinds of commands at the same time.

Additionally, there is also an interface which can refer the often used commands without the sequence programs by automatically setting them up at the time of power ON.

Examples of a screen display and used commands



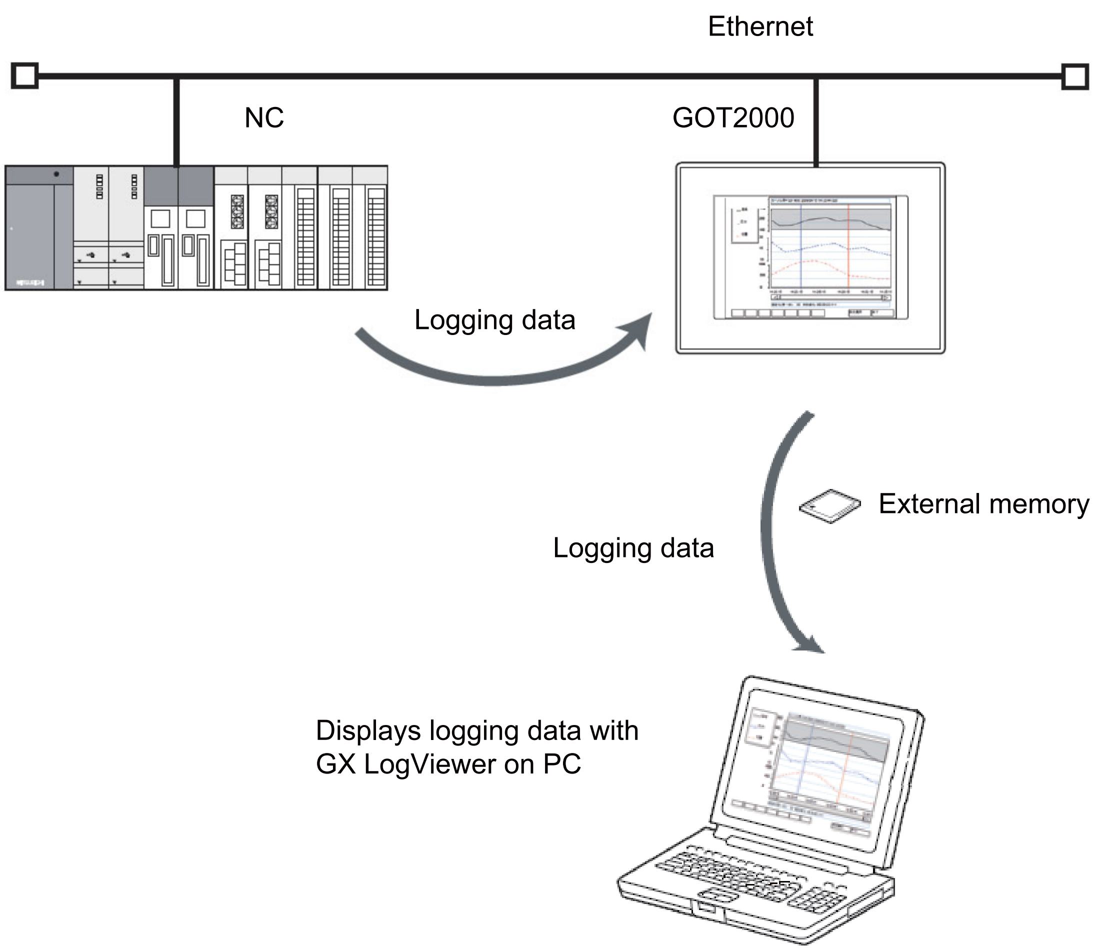
### 17.8.103 Log Viewer

| | M850W | M830W | M850S | M830S | M80W | M80 TypeA | M80 TypeB | C80 |
|---|---|---|---|---|---|---|---|---|
| M | — | — | — | — | — | — | — | ○ |
| L | — | — | — | — | — | — | — | ○ |

This function enables the recorded data by the data sampling function of the NC to display with a graph on the GOT, and to store the data as a file.
The data acquired by the GOT can be stored in an external memory, and also can be read to display with the peripheral tool "GX LogViewer".

This function uses the "Data Sampling function" of NC, and the "Log viewer function" of GOT for displaying and controlling the logging data.
The connectable log viewer to one NC is one GOT only . The second or subsequent units cannot connect the log viewer.

The NC and the GOT are connected through the Ethernet, and the logging data sampled with the NC is displayed on the GOT.

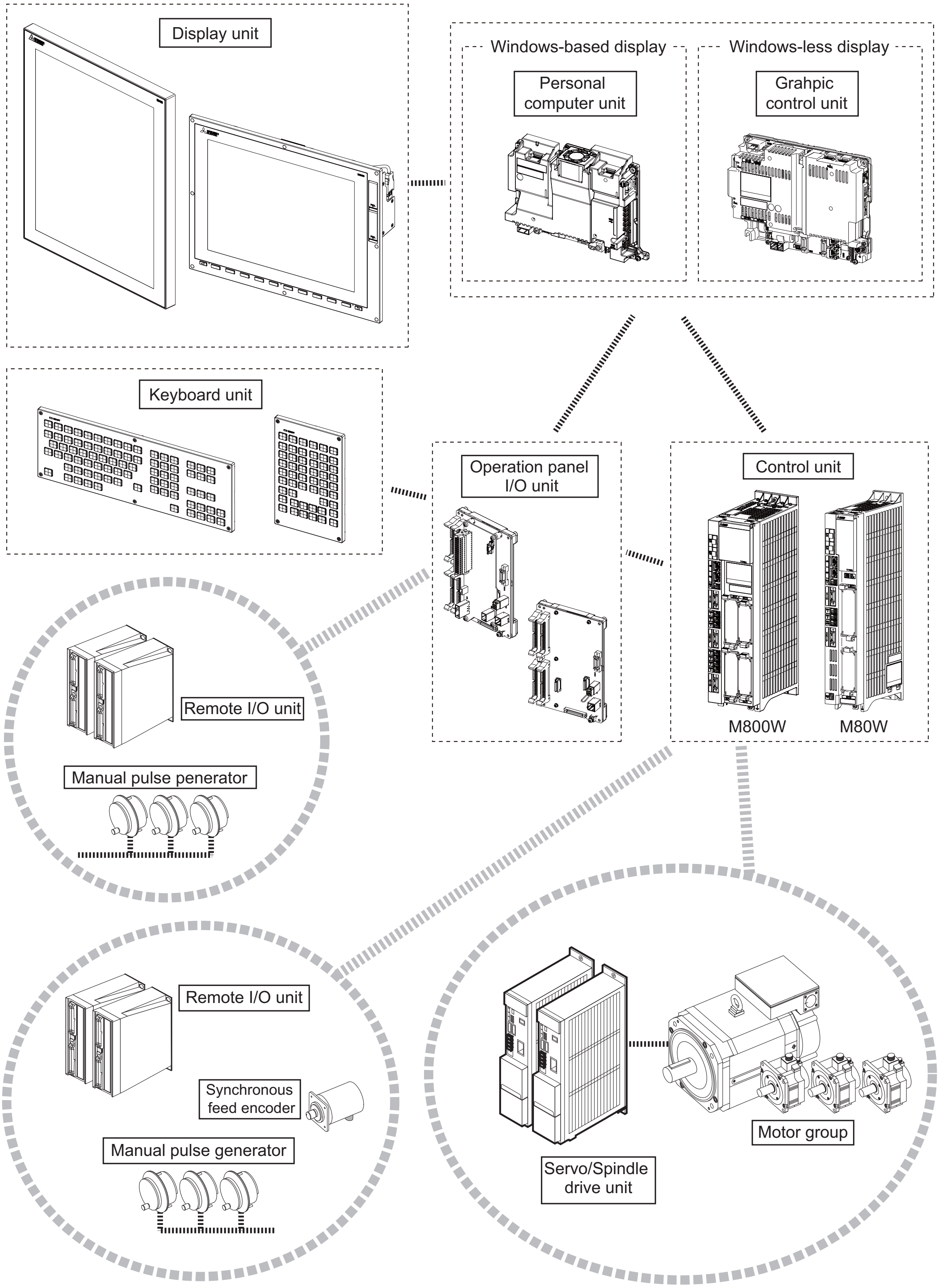


# M800W Series
# General Specifications

# 1

# System Basic Configuration (M800W Series)

## 1.1 System Basic Configuration Drawing



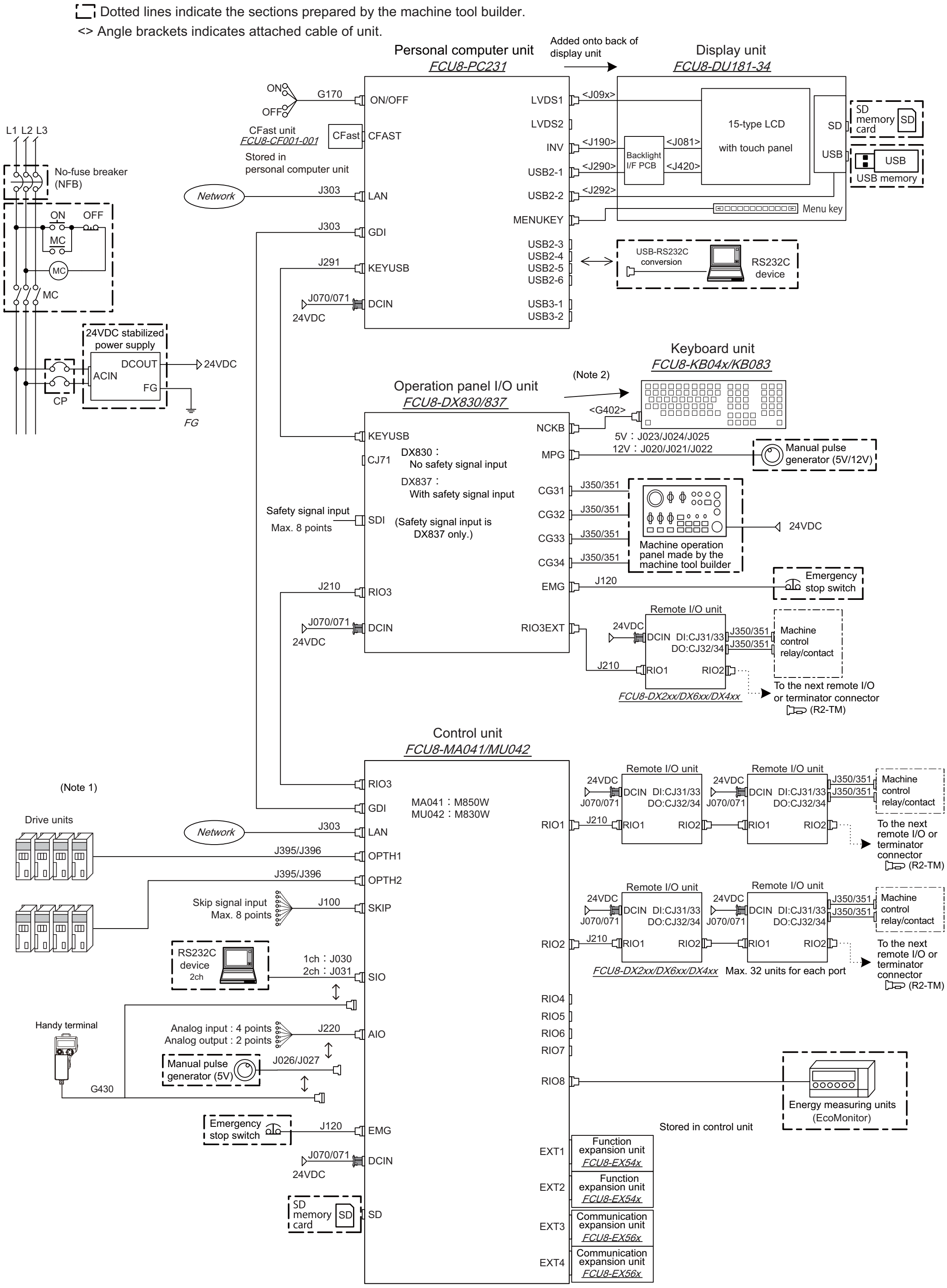

(Note) For the drive unit configuration, refer to the Instruction Manual of the drive unit you use.

# 2

# General Connection Diagram (M800W Series)

# 2.1 General Connection Diagram [M800W]

## 2.1.1 M800W, Windows-based Display (15-type)

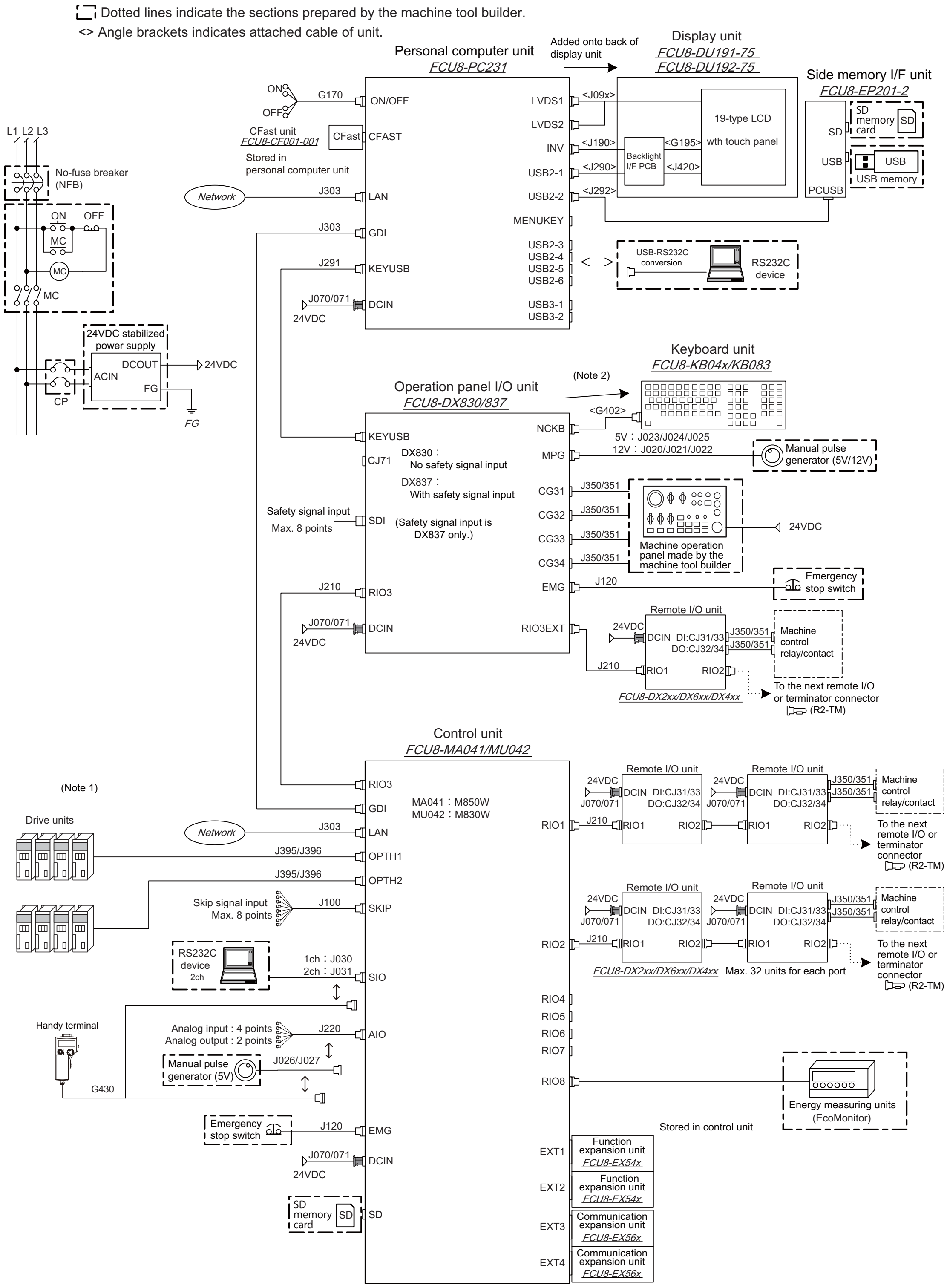



(Note 1) For information on how to connect the drive unit, refer to the drive unit's manual.

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

(Note 3) For the connection of MITSUBISHI CNC machine operation panel, refer to the chapter "Connection of MITSUBISHI CNC Machine Operation Panel".

## 2.1.2 M800W, Windows-based Display (19-type)

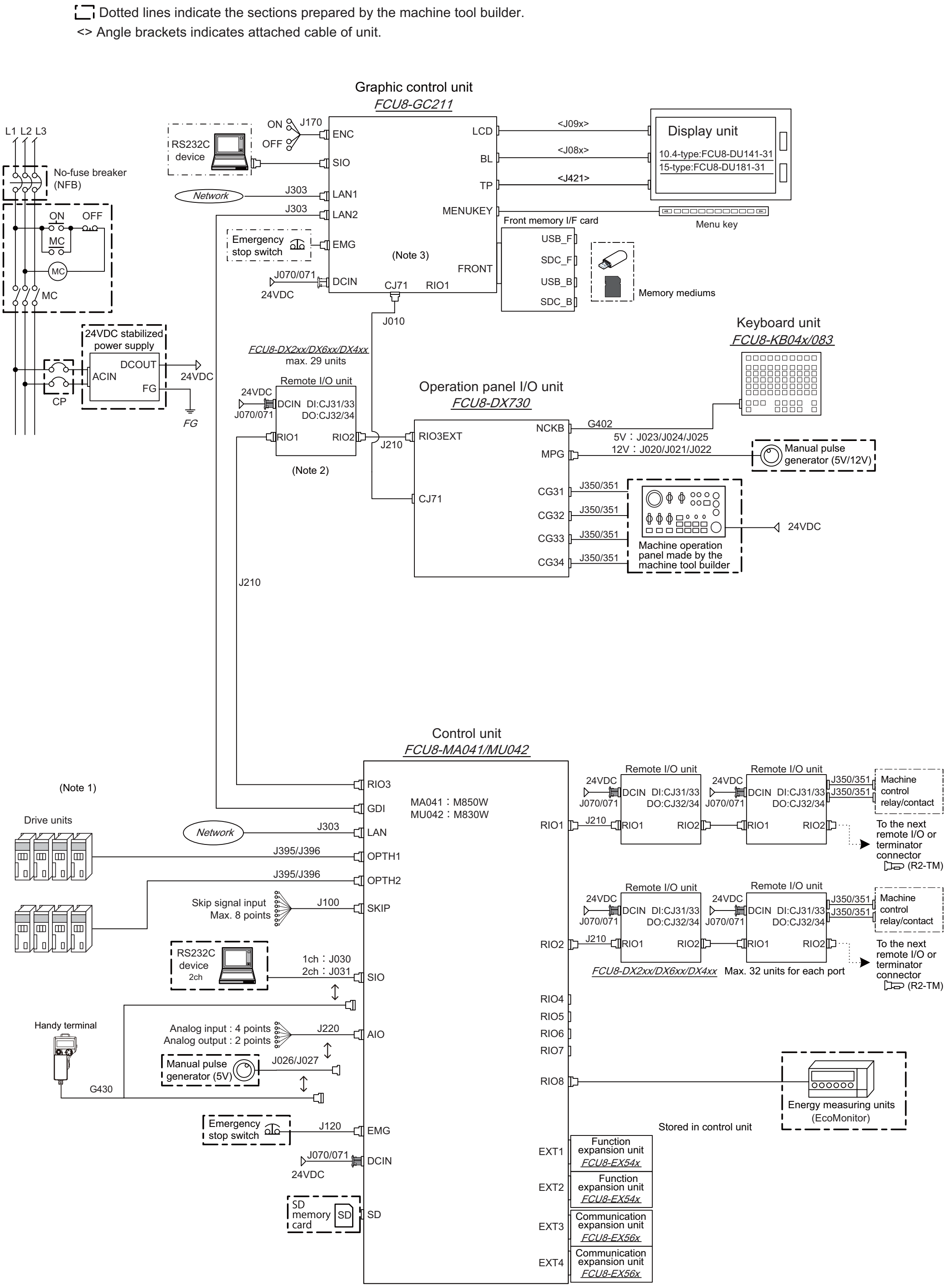



(Note 1) For information on how to connect the drive unit, refer to the drive unit's manual.

(Note 2) When using a keyboard unit, install the operation panel I/O unit on the back of the keyboard unit. When not using a keyboard unit, install the operation panel I/O unit on the back of the display unit.

(Note 3) For the connection of MITSUBISHI CNC machine operation panel, refer to the chapter "Connection of MITSUBISHI CNC Machine Operation Panel".

### 2.1.3 M800W, Windows-less Display (10.4-type / 15-type)




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

(Note 2) When connecting a remote I/O unit to the 3rd RIO channel, insert it between the control unit and operation panel I/O unit.

(Note 3) There is no need to connect a terminator R2-TM to the graphic control unit.

(Note 4) For the connection of MITSUBISHI CNC machine operation panel, refer to the chapter "Connection of MITSUBISHI CNC Machine Operation Panel".

# 3

# List of Configuration (M800W Series)

## 3.1 Control Unit [M800W]

| Classification | Type | Components | Remarks |
|---|---|---|---|
| NC functions<br>For M830W | FCU8-MU042 | Main CPU card (for non-applicable)<br>7SEG card<br>SDHC: 1ch<br>Back panel card<br>Unit lid (Resin molded article) etc. | Export Trade Control Order noncompliant unit and Foreign Exchange Order noncompliant unit<br>G123 cable for EMG is attached. |
| NC functions<br>For M850W | FCU8-MA041 | Main CPU card(for applicable)<br>7SEG card<br>SDHC: 1ch<br>Back panel card<br>Unit lid (Resin molded article) etc. | Export Trade Control Order noncompliant unit and Foreign Exchange Order compliant unit<br>G123 cable for EMG is attached. |

## 3.2 Display Unit [M800W]

| Classification | Type | Components | Remarks |
|---|---|---|---|
| 10.4-type color TFT touch panel<br>(VGA:640*480) | FCU8-DU141-31 | LCD panel<br>Menu keys<br>Escutcheon<br>Base metal plate<br>Cable<br>Screw cap set | Front side memory I/F is normally equipped with the control unit<br>(Windows-less display) |
| 15-type color TFT touch panel<br>(XGA:1024*768) | FCU8-DU181-31 | LCD panel<br>Menu keys<br>Escutcheon<br>Base metal plate<br>Cable<br>Screw cap set | Front side memory I/F is normally equipped with the control unit<br>(Windows-less display) |
| 15-type color TFT touch panel<br>(XGA:1024*768) | FCU8-DU181-34 | LCD panel<br>Backlight I/F PCB<br>Menu keys<br>Escutcheon<br>Base metal plate<br>Cable<br>Screw cap set | Personal computer unit is prepared at the same time.<br>Built-in disk of the display unit is prepared at the same time.<br>Front side memory I/F is normally equipped with the display unit<br>(Windows-based display) |
| 19-type color TFT touch panel<br>(SXGA:1024*1280) | FCU8-DU191-75 | LCD panel<br>Backlight I/F PCB<br>Escutcheon<br>Base metal plate<br>Cable | Personal computer unit is prepared at the same time.<br>Built-in disk of the display unit is prepared at the same time.<br>Side memory I/F unit is separately prepared.<br>(Windows-based display) |
| 19-type color TFT touch panel<br>(SXGA:1280*1024) | FCU8-DU192-75 | LCD panel<br>Backlight I/F PCB<br>Escutcheon<br>Base metal plate<br>Cable | Personal computer unit is prepared at the same time.<br>Built-in disk of the display unit is prepared at the same time.<br>Side memory I/F unit is separately prepared.<br>(Windows-based display) |

## 3.3 Personal Computer Unit

| Classification | Type | Components | Remarks |
|---|---|---|---|
| Personal Computer Unit | FCU8-PC231 | PC board<br>PC cooling FAN<br>Unit lid (Resin molded article) etc. | |
| Built-in Disk of the Display Unit | FCU8-CF001-001 | Windows OS / data storage | Windows8 |

## 3.4 Graphic Control Unit [M800W]

| Classification | Type | Components | Remarks |
|---|---|---|---|
| Graphic control unit | FCU8-GC211 | Base control card<br>Front-side memory I/F card | (Note) This unit occupies the 13th and 14th RIO stations. |

# 3.5 Keyboard Unit [M800W]

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

# 3.6 Operation Panel I/O Unit

| Classification | Type | Components | Remarks |
|---|---|---|---|
| DI 24V/0V common input [64 points]<br>DO Source output [64 points] | FCU8-DX830 | Base card<br>Add-on card<br>RIO 2.0 terminator connector (R2-TM) | DI: 64-points 24V/0V common type<br>DO: 64-points source type (200mA/point)<br>Manual pulse generator input: 3ch<br>Display unit I/F<br>Keyboard unit I/F<br>Emergency stop input<br>Remote I/O 2.0 I/F<br>RIO occupied stations (fixed):<br>1 to 4, 7 to 14<br>RIO extensible stations:<br>5, 6, 15 to 64<br>(Note) J291 cable is required for connection with the personal computer unit.<br>(for windows-based display) |
| DI 24V/0V common input [64 points]<br>DO Source output [64 points]<br>Safety DI 24V/0V common input [8 points] | FCU8-DX837 | Base card<br>Add-on card<br>RIO 2.0 terminator connector (R2-TM) | DI: 64-points 24V/0V common type<br>DO: 64-points source type (200mA/point)<br>Safety DI: 8-points 0V common type<br>Manual pulse generator input: 3ch<br>Display unit I/F<br>Keyboard unit I/F<br>Emergency stop input<br>Remote I/O 2.0 I/F<br>RIO occupied stations (fixed):<br>1 to 4, 7 to 14<br>RIO extensible stations:<br>5, 6, 15 to 64<br>(Note) J291 cable is required for connection with the personal computer unit.<br>(for windows-based display) |
| DI 24V/0V common input [64 points]<br>DO Source output [64 points] | FCU8-DX730 | Base card<br>RIO 2.0 terminator connector (R2-TM) | DI: 64-points 24V/0V common type<br>DO: 64-points source type (200mA/point)<br>Manual pulse generator input: 3ch<br>Graphic control unit I/F<br>Keyboard unit I/F<br>Remote I/O 2.0 I/F<br>RIO occupied stations (fixed):<br>1, 2, 7 to 12<br>RIO extensible stations:<br>3 to 6, 15 to 64<br>(13 and 14 are occupied by the graphic control unit.)<br>(Note) J010 cable is required for connection with the graphic control unit.<br>(for windows-less display) |

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

## 3.7 Remote I/O Unit

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

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

## 3.8 Function Expansion Unit

| Classification | Type | Components | Remarks |
|---|---|---|---|
| Encoder (manual pulse generator) I/F expansion unit | FCU8-EX544 | Encoder I/F PCB | Encoder input 1ch<br>5V manual pulse generator input 2ch |

## 3.9 Communication Expansion Unit

| Classification | Type | Components | Remarks |
|---|---|---|---|
| CC-Link expansion unit | FCU8-EX561 | CC-Link I/F PCB | CC-Link 1ch |
| PROFIBUS-DP master unit | FCU8-EX563 | PROFIBUS-DP I/F PCB | PROFIBUS-DP 1ch |
| EtherNet/IP<br>Scanner/adapter unit | FCU8-EX565 | Base card<br>Add-on card | EtherNet/IP 1ch<br>(Only LAN1, LAN2 cannot be used) |

## 3.10 Side Memory I/F Unit

| Classification | Type | Components | Remarks |
|---|---|---|---|
| Side Memory I/F Unit | FCU8-EP201-2 | Side memory I/F PCB<br>J292 cable<br>Structural member | SDHC 1ch<br>USB2.0 1ch<br>USB communication<br>(between side memory I/F PCB and personal computer)<br>Unit lid (resin molded article), metal plate, etc.<br>Exclusive for 19-type display unit |

# 3.11 Manual Pulse Generator

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

# 3.12 Synchronous Feed Encoder

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

# 3.13 MITSUBISHI CNC Machine Operation Panel

| Classification | Type | Components | Remarks |
|---|---|---|---|
| Main panel A<br>(For 8.4-type/15-type display unit) | FCU8-KB921 | Escutcheon, key switch<br>control card<br>G054 cable, Screw cap set | Mitsubishi standard 55 key |
| Main panel B<br>(For 10.4-type display unit) | FCU8-KB923 | Escutcheon, key switch<br>control card<br>G054 cable, Screw cap set | Mitsubishi standard 55 key |
| Sub panel A<br>(Common for all display units) | FCU8-KB931 | Escutcheon<br>Emergency stop switch, Override switch<br>ON/OFF switch, Screw cap set | |

# 3.14 Handy Terminal

| Classification | Type | Components | Remarks |
|---|---|---|---|
| Handy Terminal | HG1T-SB12UH-<br>MK1346-L5 | | |

# 3.15 Cable Connector Sets

| Classification | Type | Components | Remarks |
|---|---|---|---|
| General I/O units<br>(For SKIP,SIO,MPG,AIO) | FCUA-CS000 | Connector (10120-3000PE,2pcs),<br>Shell kit (10320-52F0-008,2pcs) | |
| Emergency stop connector<br>(For EMG) | 50-57-9403<br>0016020103 x 3 pcs. | Connector (50-57-9403),<br>Contact (0016020103,3pcs.) | |
| Connector kit for RIO 2.0 unit | RIO2 CON | Connector (1-1318119-3,2pcs.),<br>Contact (1318107-1,8pcs.),<br>Connector (2-178288-3),<br>Contact (1-175218-5,3pcs) | |
| 24VDC power supply connector<br>(For DCIN) | FCUA-CN220 | Connector (2-178288-3),<br>Contact (1-175218-5,3pcs) | |
| DI/DO connector<br>(For operation panel I/O unit)<br>(For remote I/O unit) | 7940-6500SC x 4pcs.<br>3448-7940 x 4pcs. | Connector (7940-6500SC,4pcs.),<br>Strain relief (3448-7940,4pcs.) | |
| ON/OFF switch connector | 50-57-9404<br>0016020103 x 4pcs. | Connector (50-57-9404),<br>Contact (0016020103,4pcs.) | |
| THERMISTOR connector | 37104-2165-000FL 10P | Connector (37104-2165-000FL,10pcs.) | |

## 3.16 Thermistor Sets

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

## 3.17 Genuine Memory Card

| Classification | Type | Components | Remarks |
|---|---|---|---|
| Exclusive SD cards for MITSUBISHI CNC 1GB | FCU8-SD001G | FCU8-SD001G | 1GB capacity |
| Exclusive SD cards for MITSUBISHI CNC 4GB | FCU8-SD004G | FCU8-SD004G | 4GB capacity |

## 3.18 Durable Parts

| Durable parts | Part type |
|---|---|
| Battery for control unit | Q6BAT BKO-C10811H03 |
| Cooling fan for personal computer unit | 109P0424H3103 |

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

## 3.19 Replacements

| Replacements | Part type | Manufacturer |
|---|---|---|
| Protection fuse for control unit | LM40 | Daito Communication Apparatus Co., Ltd. |
| Protection fuse for operation panel I/O | LM50 | Daito Communication Apparatus Co., Ltd. |
| Protection fuse for FCU8-DX220/230/231 | LM50 | Daito Communication Apparatus Co., Ltd. |
| Protection fuse for FCU8-DX213/654/213-1/654-1 | MP63 | Daito Communication Apparatus Co., Ltd. |

# 3.20 List of Cables

**[Cable relating to NC]**

| Type | Application | Available cable length (m) | Max. cable length |
|---|---|---|---|
| FCUA-R050-xM | Synchronous encoder - control unit (straight, with connector)<br>(for FCU8-EX544) | 5 | 30m |
| FCUA-R054-xM | Synchronous encoder - control unit (right angle, with connector)<br>(for FCU8-EX544) | 3, 5, 10, 15, 20 | 30m |
| G071 LxM | 24VDC relay cable for MITSUBISHI CNC machine operation panel | 0.12, 0.5, 1 | 1m |
| G123 | Cable for emergency stop release | - | - |
| G170 LxM | ON/OFF switch cable<br>(ON/OFF switch - Personal computer unit)<br>(for windows-based display) | 1, 2, 3, 5, 10, 15 | 15m |
| G430 LxM | Cable for connection to handy terminal | 3, 5, 10 | 10m |
| G460 LxM | Cable for MITSUBISHI CNC machine operation panel<br>(Cable between main panel and sub panel) | 0.5 | 0.5m |
| J010 LxM | Operation panel I/O interface cable<br>(for windows-less display) | 0.5, 1 | 1m |
| J020 LxM | Manual pulse generator cable (12V): 1ch | 1, 2, 3, 5, 7, 10, 15, 20, 30 | 50m |
| J021 LxM | Manual pulse generator cable (12V): 2ch | 1, 2, 3, 5, 7, 10, 15, 20, 30 | 50m |
| J022 LxM | Manual pulse generator cable (12V): 3ch | 1, 2, 3, 5, 7, 10, 15, 20, 30 | 50m |
| J023 LxM | Manual pulse generator cable (5V): 1ch | 1, 2, 3, 5, 7, 10, 15, 20 | 20m |
| J024 LxM | Manual pulse generator cable (5V): 2ch | 1, 2, 3, 5, 7, 10, 15, 20 | 20m |
| J025 LxM | Manual pulse generator cable (5V): 3ch | 1, 2, 3, 5, 7, 10, 15, 20 | 20m |
| J026 LxM | Manual pulse generator cable (5V): 1ch<br>(for connection to control unit) | 1, 2, 3, 5, 7, 10, 15, 20 | 20m (*) |
| J027 LxM | Manual pulse generator cable (5V): 2ch<br>(for connection to control unit) | 1, 2, 3, 5, 7, 10, 15, 20 | 20m (*) |
| J030 LxM | RS-232C I/F cable: 1ch | 1, 2, 3, 5, 7, 10 | 15m (*) |
| J031 LxM | RS-232C I/F cable: 2ch | 1, 2, 3, 5, 7, 10 | 15m (*) |
| J070 LxM | 24VDC power cable | 1, 2, 3, 5, 7, 10, 15 | 15m |
| J071 LxM | 24VDC power cable (for long distance) | 20 | 20m |
| J100 LxM | SKIP input cable | 1, 2, 3, 5, 7, 10, 15, 20 | 20m |
| J120 LxM | Emergency stop cable | 1, 2, 3, 5, 7, 10, 15, 20, 30 | 30m |
| J121 LxM | Emergency stop cable for MITSUBISHI CNC machine operation panel | 1, 2, 3, 5, 7, 10, 15, 20, 30 | 30m |
| J170 LxM | ON/OFF switch cable<br>(ON/OFF switch - Graphic control unit)<br>(for windows-less display) | 1, 2, 3, 5, 10, 15 | 15m |
| J210 LxM | Remote I/O 2.0 communication cable | 0.3, 1, 2, 3, 5, 7, 10, 15, 20, 30 | 50m (*) |
| J220 LxM | Analog output cable<br>(for M800W) | 2, 3, 7 | 30m |
| J221 LxM | Analog input/output cable (for remote I/O unit) | 2, 3, 7 | 30m |
| J291 LxM | Connection cable between personal computer unit and operation panel I/O unit | 0.15, 0.5, 1 | 1m |
| J303 LxM | LAN straight cable | 1, 2, 3, 5, 7, 10, 15, 20, 30 | 50m |
| J350 LxM | DI/DO cable (connectors at both ends) | 1, 2, 3, 5 | 50m |
| J351 LxM | DI/DO cable (connector at one end) | 3 | 50m |
| R2-TM | Terminator for remote I/O interface | - | - |

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

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

**[Cable Relating to Drive Unit]**

| Type | Application | Available cable length (m) | Max. cable length |
|---|---|---|---|
| CNP2E-1-xM | Motor side PLG cable<br>Spindle side accuracy detector<br>TS5690 cable | 2, 3, 4, 5, 7, 10, 15, 20, 25, 30 | 30m |
| CNP3EZ-2P-xM | Spindle side detector cable<br>OSE-1024 cable | 2, 3, 4, 5, 7, 10, 15, 20, 25, 30 | 30m |
| CNP3EZ-3P-xM | Spindle side detector cable<br>OSE-1024 cable | 2, 3, 4, 5, 7, 10, 15, 20, 25, 30 | 30m |
| CNV2E-8P-xM | For HG/HG-H,HQ/HQ-H Motor side detector cable (for D48/D51/D74) | 2, 3, 4, 5, 7, 10, 15, 20, 25, 30 | 30m |
| CNV2E-9P-xM | For HG/HG-H,HQ/HQ-H Motor side detector cable (for D48/D51/D74) | 2, 3, 4, 5, 7, 10, 15, 20, 25, 30 | 30m |
| CNV2E-D-xM | MDS-B-SD unit cable | 2, 3, 4, 5, 7, 10, 15, 20, 25, 30 | 30m |
| CNV2E-HP-xM | MDS-B-HR unit cable | 2, 3, 4, 5, 7, 10, 15, 20, 25, 30 | 30m |
| CNV2E-MB-xM | MBE405W/MBA405W cable | 2, 3, 4, 5, 7, 10, 15, 20 | 20m |
| DG30-xM | Battery cable<br>(For drive unit - Battery box,<br>For drive unit - drive unit) | 0.3, 0.5, 1, 2, 3, 5, 7, 10 | 10m |
| G380 LxM | Optical communication cable<br>For wiring between drive units (outside panel) | 5, 10, 12, 15, 20, 25, 30 | 30m |
| J395 LxM | Optical communication cable<br>For wiring between drive units (outside panel)<br>For wiring between NC-drive units | 3, 5, 7, 10 | 10m |
| J396 LxM | Optical communication cable<br>For wiring between drive units (inside panel) | 0.2, 0.3, 0.5, 1, 2, 3, 5 | 10m |
| MR-BKS1CBLxMA1-H | <200V Series><br>Brake cable for HG96<br>Lead out in direction of motor shaft | 2, 3, 5, 7, 10 | 10m |
| MR-BKS1CBLxMA2-H | <200V Series><br>Brake cable for HG96<br>Lead out in opposite direction of motor shaft | 2, 3, 5, 7, 10 | 10m |
| MR-BT6V2CBL LxM | Battery cable (MDS-EJ/EJH)<br>(For drive unit - drive unit) | 0.3, 1 | 1m |
| MR-D05UDL3M-B | STO cable | 3 | 3m |
| MR-PWS1CBLxMA1-H | <200V Series><br>Power cable for HG96<br>Lead out in direction of motor shaft | 2, 3, 5, 7, 10 | 10m |
| MR-PWS1CBLxMA2-H | <200V Series><br>Power cable for HG96<br>Lead out in opposite direction of motor shaft | 2, 3, 5, 7, 10 | 10m |
| SH21 LxM | Power supply communication cable<br>Power backup unit communication cable | 0.35, 0.5, 1, 2, 3 | 30m |

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

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

# 4

# General Specifications (M800W Series)

# 4.1 Environment Conditions [M800W]

## 4.1.1 Environment Conditions inside the Operation Panel

| Item | Unit name | | Display unit | Personal computer unit | Graphic control unit |
|---|---|---|---|---|---|
| | Type | | FCU8-DU141-31 : (10.4-type)<br>FCU8-DU181-31 : (15-type)<br>FCU8-DU181-34 : (15-type)<br>FCU8-DU191-75 : (19-type)<br>FCU8-DU192-75 : (19-type) | FCU8-PC231 | FCU8-GC211 |
| General Specifications | Ambient temperature | During operation | 0 to 58°C | | |
| | | During storage | -20 to 60°C | | |
| | Ambient humidity | Long term | 10 to 75% RH (with no dew condensation) | | |
| | | Short term | 10 to 95% RH (with no dew condensation) (Note 1) | | |
| | Vibration resistance | | $4.9m/s^2$ [0.5G] or less | | |
| | Shock resistance | | $29.4m/s^2$ [3G] or less | | |
| | Working atmosphere | | No corrosive gases, dust or oil mist | | |
| | Altitude | | Operation/Storage: 1000 meters or less above sea level,<br>Transportation: 13000 meters or less above sea level | | |
| | Power supply voltage | | FCU8-DU141-31 : 12VDC/5VDC/3.3VDC<br>FCU8-DU181-31 : 12VDC/5VDC/3.3VDC<br>FCU8-DU181-34 : 12VDC/5VDC/3.3VDC<br>FCU8-DU191-75 : 12VDC/5VDC<br>FCU8-DU192-75 : 12VDC/5VDC<br>(Supply from personal computer unit or graphic control unit) | 24VDC | 24VDC |
| | Current consumption | | 24V 2.2A | | 24V 2.5A |
| | Heating value | (max) | FCU8-DU141-31 : 10W<br>FCU8-DU181-31 : 14W<br>FCU8-DU181-34 : 18W<br>FCU8-DU191-75 : 21W<br>FCU8-DU192-75 : 21W | 32W | 12W |
| | Mass | (kg) | FCU8-DU141-31 : 1.7<br>FCU8-DU181-31 : 4<br>FCU8-DU181-34 : 4<br>FCU8-DU191-75 : 5.7<br>FCU8-DU192-75 : 5.7 | 1.2 | 1.1 |
| | Outline dimension W×H or W×H×D | (mm) | FCU8-DU141-31 : 290×220<br>FCU8-DU181-31 : 400×320<br>FCU8-DU181-34 : 290×220<br>FCU8-DU191-75 : 365×440<br>FCU8-DU192-75 : 440×365 | 220×182×53.5 | 239.1×173.4×75 |

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

(Note 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.

(Note 3) When the display unit is mounted on an incline, the inclination angle to place the unit should follow below.
10.4 or 15-type display unit: the inclination should be 30 degrees or less from the vertical direction.
19-type display unit: the inclination should be 60 degrees or less from the vertical direction.

| Item | Unit name | | Keyboard unit | Operation panel I/O unit | | Machine operation panel |
|---|---|---|---|---|---|---|
| | Type | | FCU8-KB041/KB046 : (10.4-type)<br>FCU8-KB047 : (10.4-type/vertical arrangement)<br>FCU8-KB048 : (10.4-type)<br>FCU8-KB083 : (15-type/ vertical arrangement) | FCU8-DX830/ DX837 | FCU8-DX730 | FCU8-KB921<br>FCU8-KB923<br>FCU8-KB931 |
| General Specifications | Ambient temperature | During operation | 0 to 58°C | | | |
| | | During storage | -20 to 60°C | | | |
| | Ambient humidity | Long term | 10 to 75% RH (with no dew condensation) | | | |
| | | Short term | 10 to 95% RH (with no dew condensation) (Note 1) | | | |
| | Vibration resistance | | $4.9m/s^2$ [0.5G] or less | | | |
| | Shock resistance | | $29.4m/s^2$ [3G] or less | | | |
| | Working atmosphere | | No corrosive gases, dust or oil mist | | | |
| | Altitude | | Operation/Storage: 1000 meters or less above sea level,<br>Transportation: 13000 meters or less above sea level | | | |
| | Power supply voltage | | 5VDC<br>(Supply from Operation Panel I/O Unit ) | 24VDC | 5VDC, 3.3VDC<br>(Supply from Graphic Control Unit ) | 24VDC (Note 7) |
| | Current consumption | | - (Note 2) | 24V 0.3A (Note 3) | - (Note 3,4) | 0.3A (Note 7) |
| | Heating value | (max) | 1W | 8W (Note 5) | 4W (Note 5) | 7.2W |
| | Mass | (kg) | FCU8-KB041/KB046 : 0.8<br>FCU8-KB047 : 1.3<br>FCU8-KB048 : 1.4<br>FCU8-KB083 : 1.5 | 0.4 | 0.3 | FCU8-KB921 : 1.1<br>FCU8-KB923 : 1.2<br>FCU8-KB931 : 0.5 |
| | Outline dimension W×H | (mm) | FCU8-KB041/KB046 : 140×220<br>FCU8-KB047 : 290×160<br>FCU8-KB048 : 230×220<br>FCU8-KB083 : 400×140 | 116×179 | | FCU8-KB921 : 260×140<br>FCU8-KB923 : 290×140<br>FCU8-KB931 : 140×140 |

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

(Note 2) The current consumption of the keyboard unit is included in that of the operation panel I/O unit or the graphic control unit.

(Note 3) Current consumption for the I/O circuit needs to be separately calculated based on the number of points used and its load.

(Note 4) The current consumption of FCU8-DX730 is included in that of the graphic control unit.

(Note 5) For the heating value of the I/O circuit, calculate with the number of points used.

(Note 6) For the whole NC system, consider the characteristics of the drive units when the altitude is more than 1000 meters above sea level. Refer to the manual of drive unit for details.

(Note 7) 24V power input is not required for FCU8-KB931.

## 4.1.2 Environment Conditions inside the Control Panel

| Item | Unit name | | Control unit |
|---|---|---|---|
| | Type | | FCU8-MU042<br>FCU8-MA041 |
| General Specifications | Ambient temperature | During operation | 0 to 55°C |
| | | During storage | -20 to 60°C |
| | Ambient humidity | Long term | 10 to 75% RH (with no dew condensation) |
| | | Short term | 10 to 95% RH (with no dew condensation) (Note 1) |
| | Vibration resistance | | 4.9m/s$^2$ [0.5G] or less |
| | Shock resistance | | 29.4m/s$^2$ [3G] or less |
| | Working atmosphere | | No corrosive gases, dust or oil mist |
| | Altitude | | Operation/Storage: 1000 meters or less above sea level,<br>Transportation: 13000 meters or less above sea level |
| | Power supply voltage | | 24VDC |
| | Current consumption | | 1.5A |
| | Heating value | (max) | 16W |
| | Mass | (kg) | 2.0 |
| | Outline dimension W×H×D | (mm) | 90×380×180 |

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

(Note 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.

| Item | Unit name | | Remote I/O unit | | | | |
|---|---|---|---|---|---|---|---|
| | Type | | FCU8-DX220/ DX230/ DX231 | FCU8-DX202 | FCU8-DX213/ DX213-1/ DX654/ DX654-1 | FCU8-DX408 | FCU8-DX651 |
| General Specifications | Ambient temperature | During operation | 0 to 58°C | | | | |
| | | During storage | -20 to 60°C | | | | |
| | Ambient humidity | Long term | 10 to 75% RH (with no dew condensation) | | | | |
| | | Short term | 10 to 95% RH (with no dew condensation) (Note 1) | | | | 10 to 85% RH (with no dew condensation) (Note 1) |
| | Vibration resistance | | $4.9m/s^2$ or less | | | | |
| | Shock resistance | | $29.4m/s^2$ or less | | | | |
| | Working atmosphere | | No corrosive gases, dust or oil mist | | | | |
| | Altitude | | Operation/Storage: 1000 meters or less above sea level, Transportation: 13000 meters or less above sea level | | | | |
| | Power supply voltage | | 24VDC | | | | |
| | Current consumption | | 3.5A (Note 2) | 0.3A | 0.3A (Note 3) | 0.1A | 3.7A (Note 2) |
| | Heating value | (max) | 8W (Note 4) | | | | |
| | Mass | (kg) | 0.4 | | | 0.2 | 0.8 |
| | Outline dimension W×H×D | (mm) | 40×175×133 | 40×175×119 | 40×175×130 | 40×175×109 | 172×100×115 |

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

### 4.1.3 24VDC Stabilized Power Supply Selecting Conditions

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

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

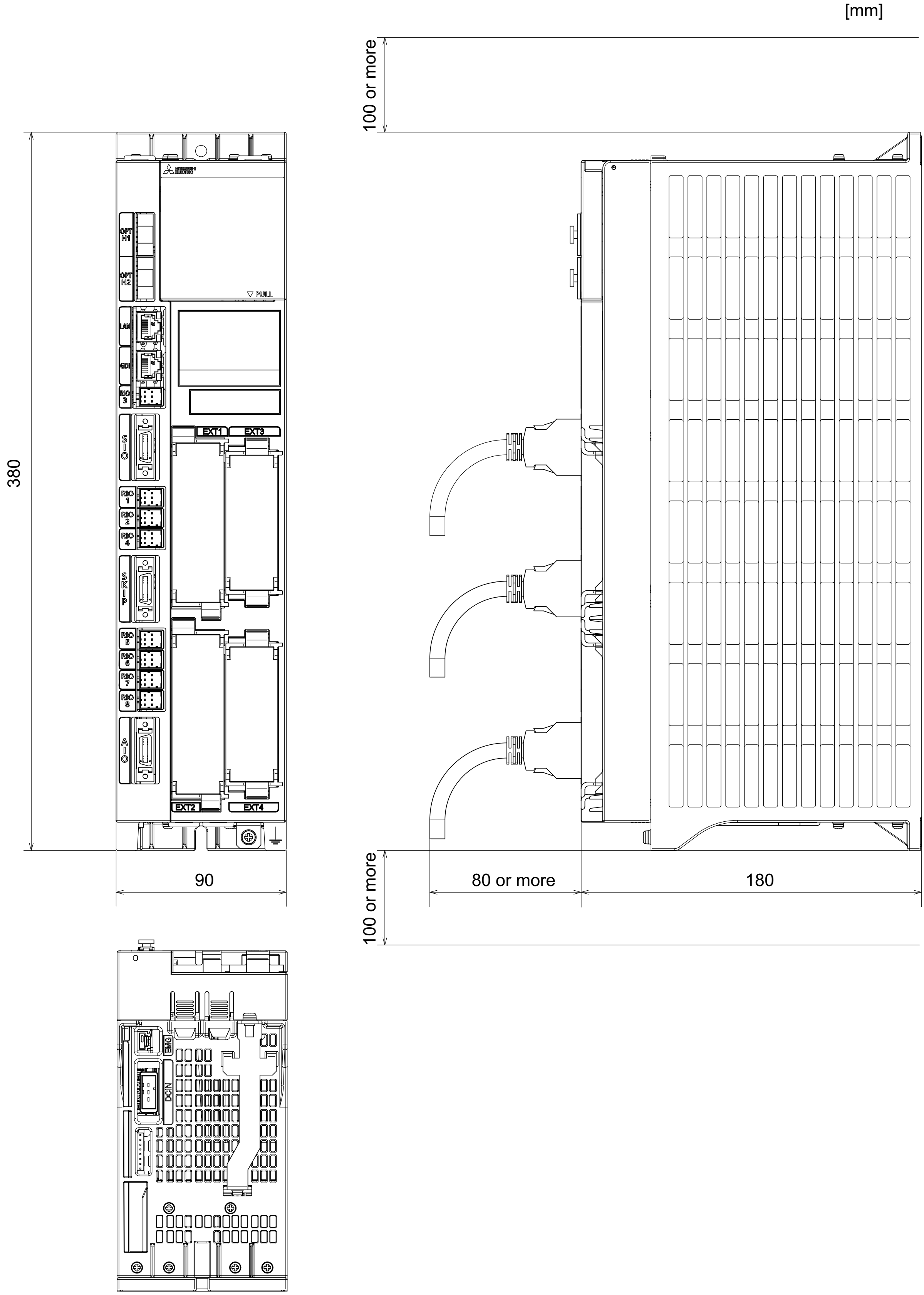
**⚠ CAUTION**

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

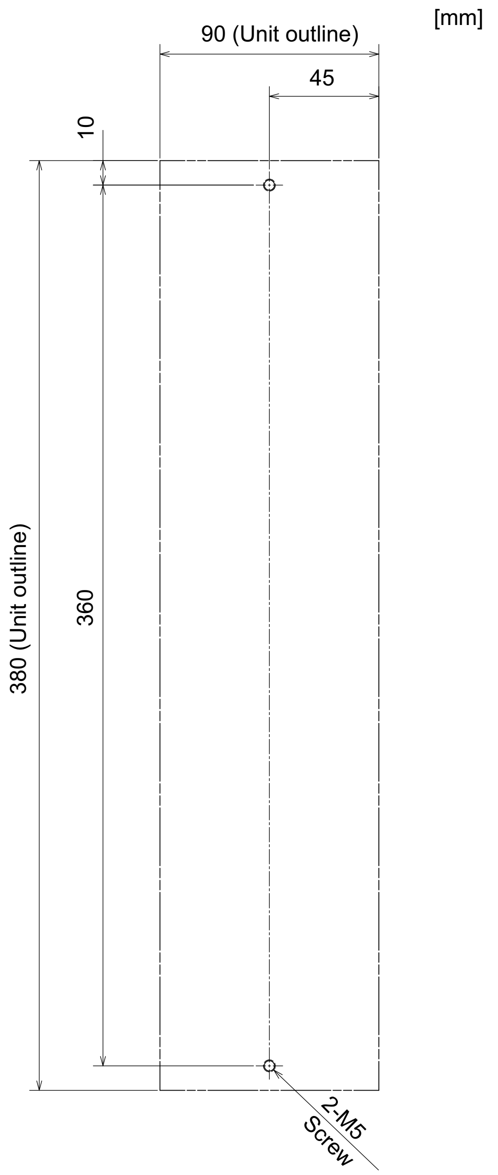
# 4.2 Control Unit [M800W]

## 4.2.1 M830W(FCU8-MU042) / M850W(FCU8-MA041)

**[Outline dimension]**



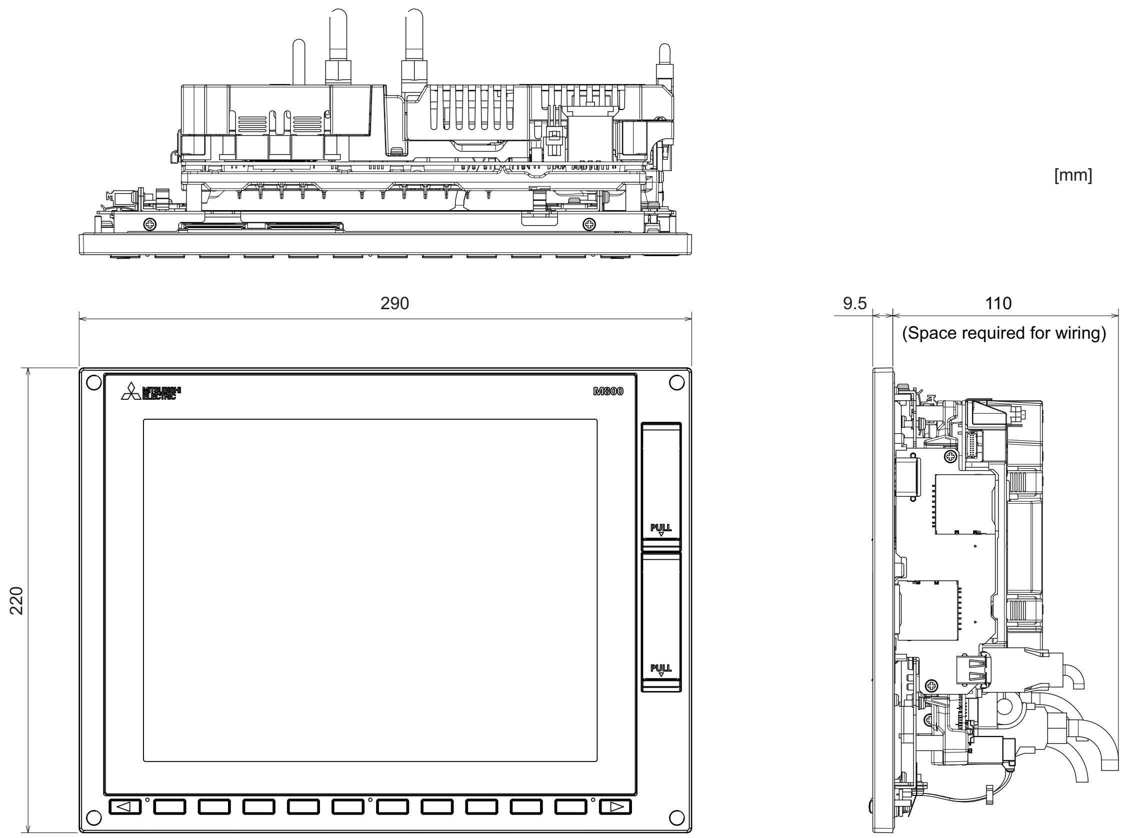
**[Installation dimension]**



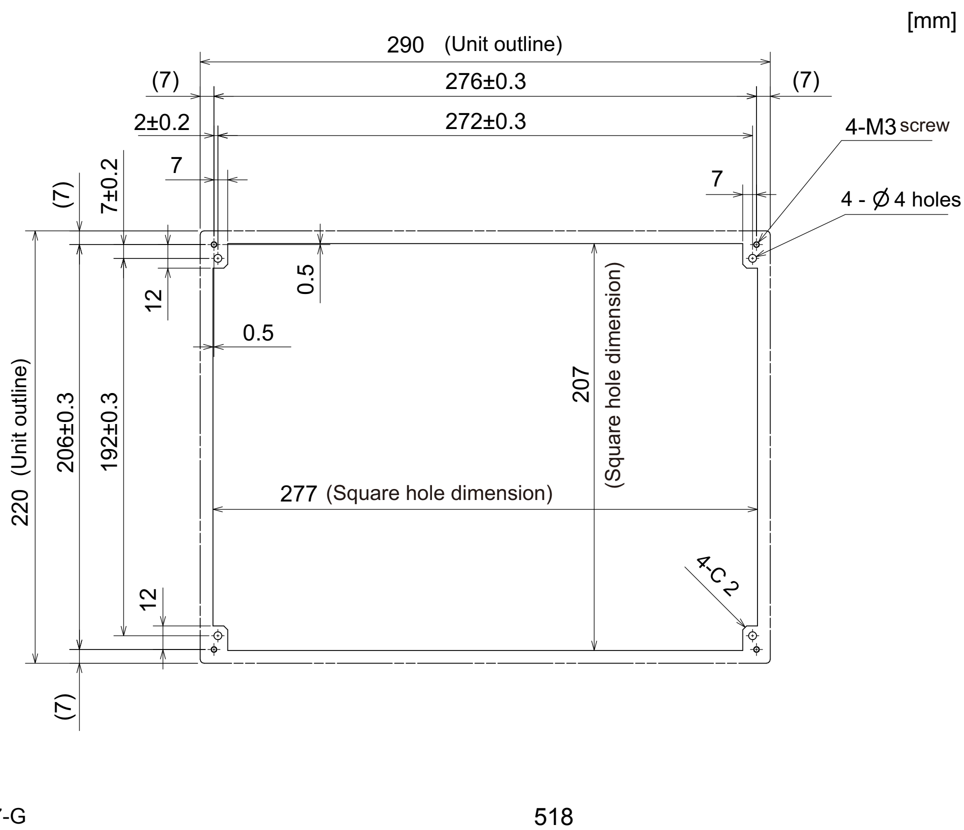
# 4.3 Display Unit [M800W]

## 4.3.1 10.4-type (FCU8-DU141-31)

**[Outline dimension]**

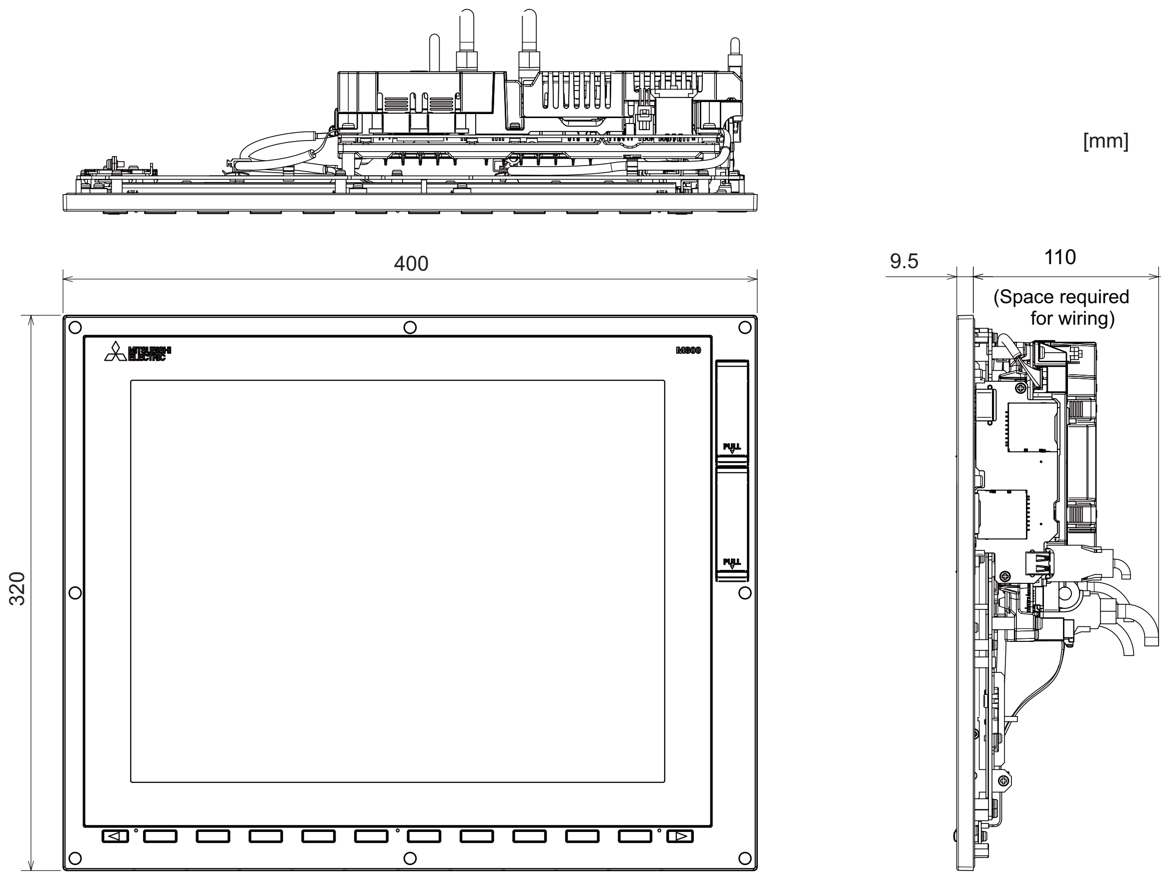



**[Panel cut dimension]**



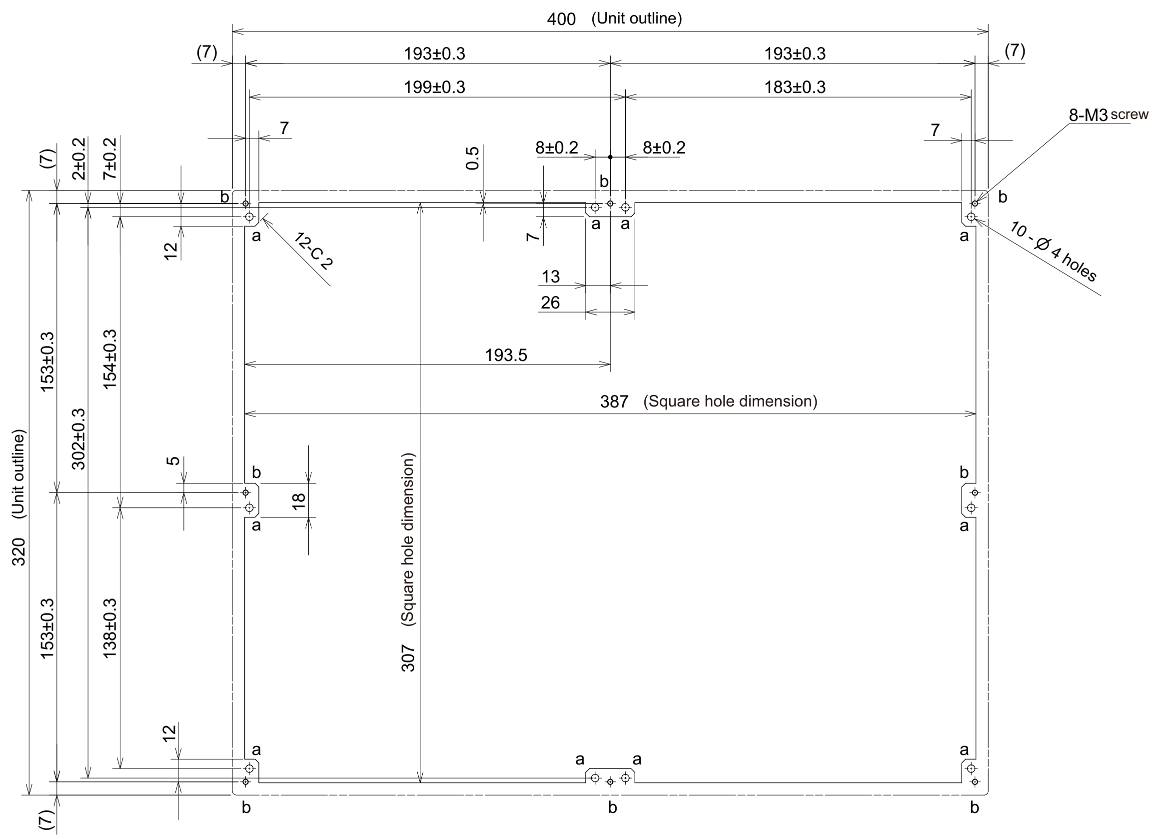
### 4.3.2 15-type (FCU8-DU181-31)

**[Outline dimension]**



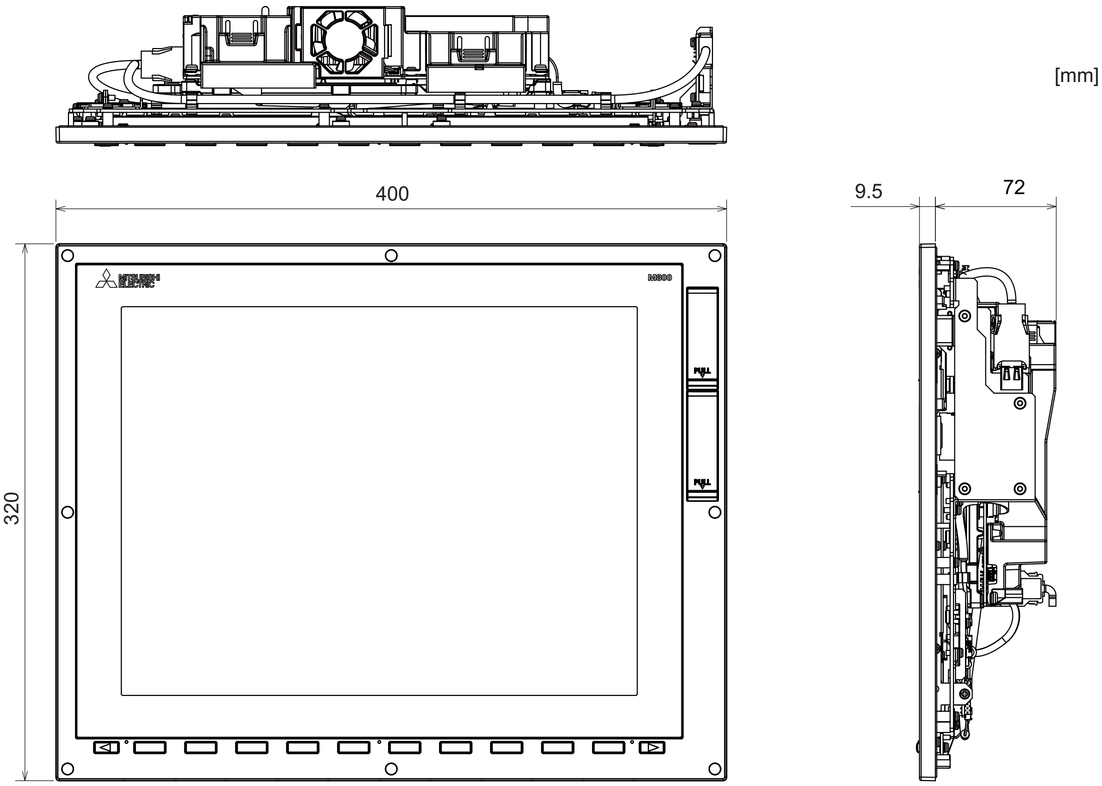
### [Panel cut dimension]

[mm]

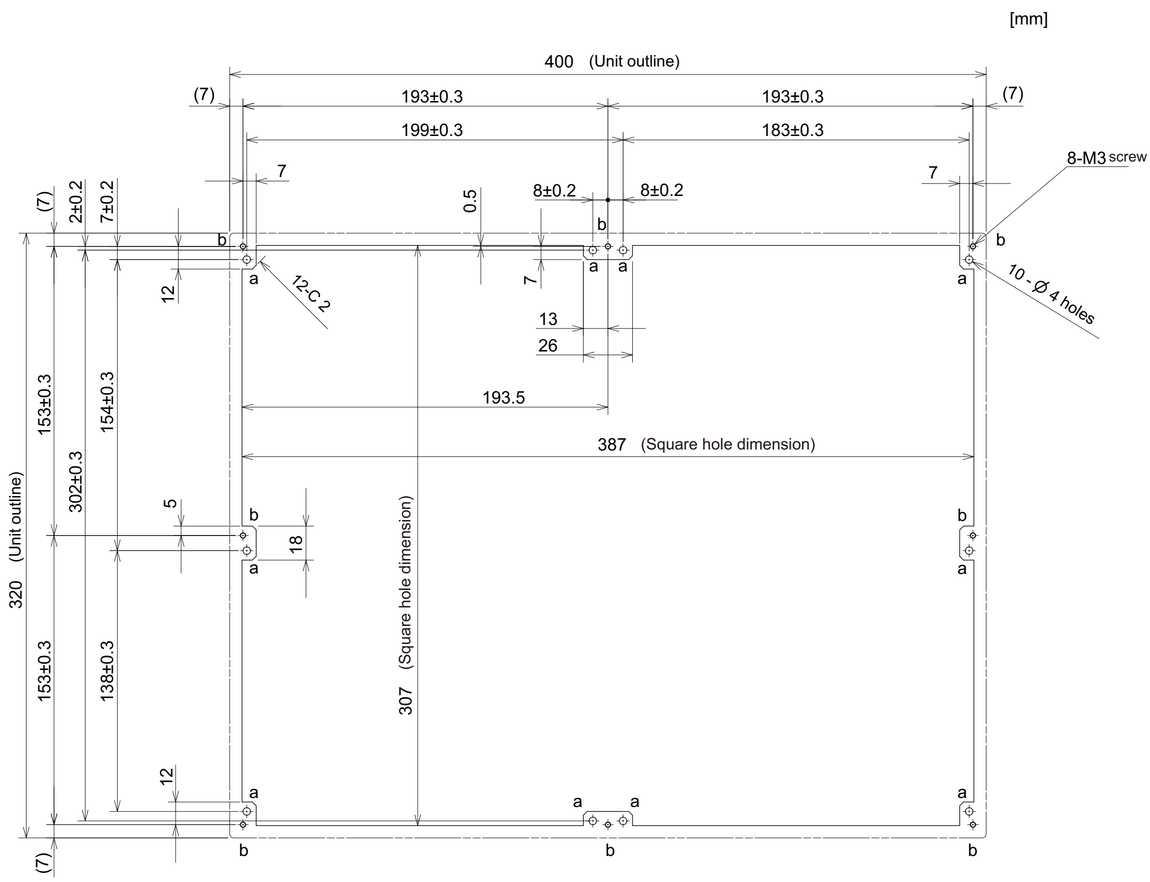


### 4.3.3 15-type (FCU8-DU181-34)

**[Outline dimension]**

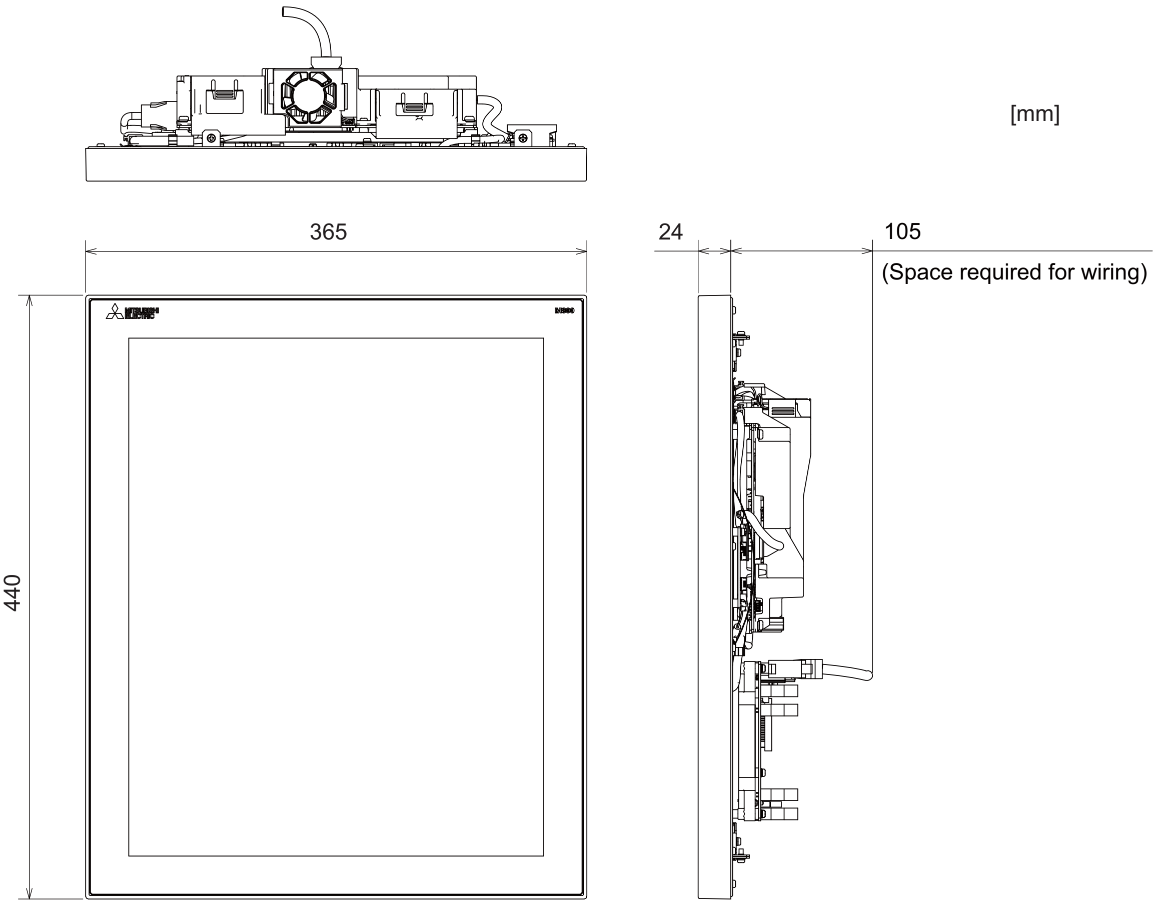


**[Panel cut dimension]**

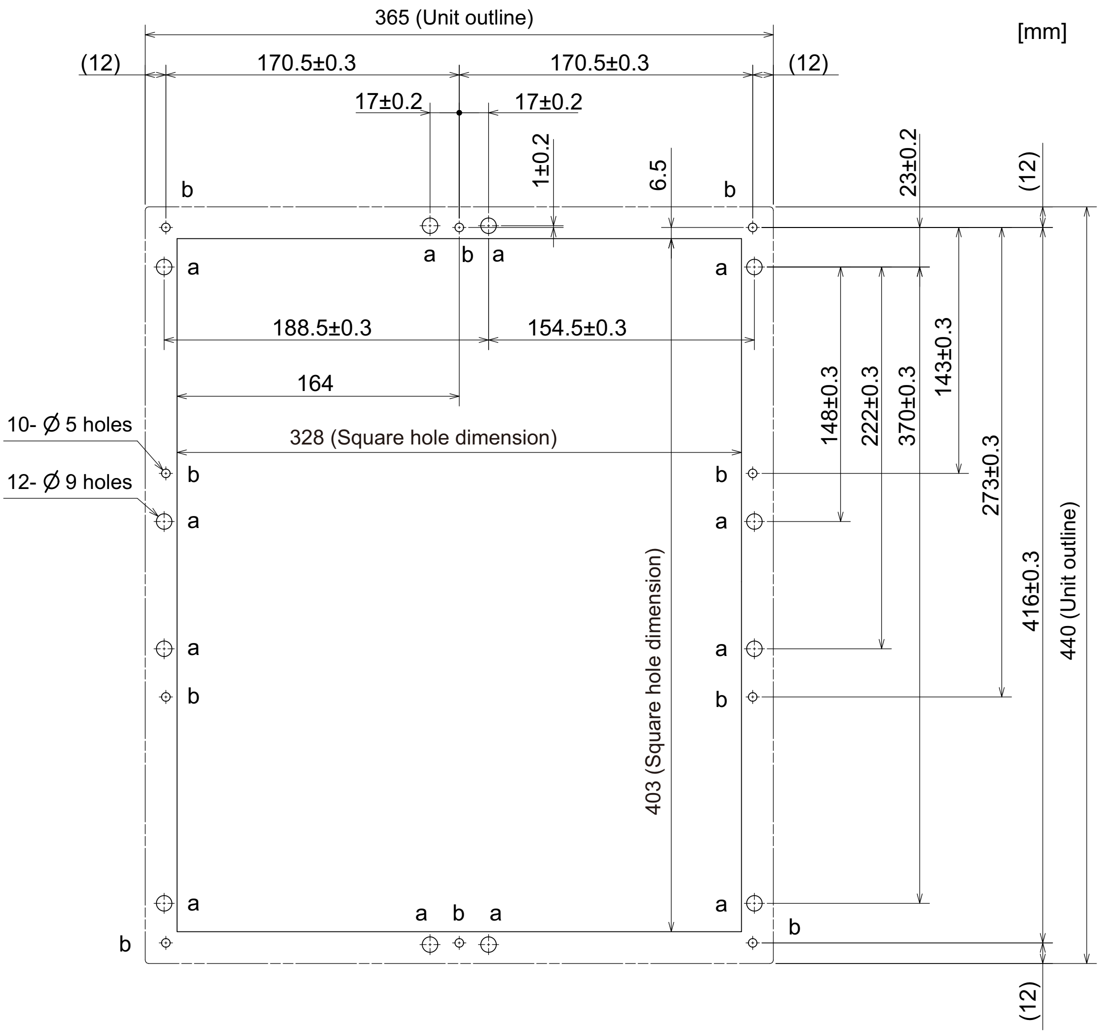


### 4.3.4 19-type (FCU8-DU191-75)

**[Outline dimension]**

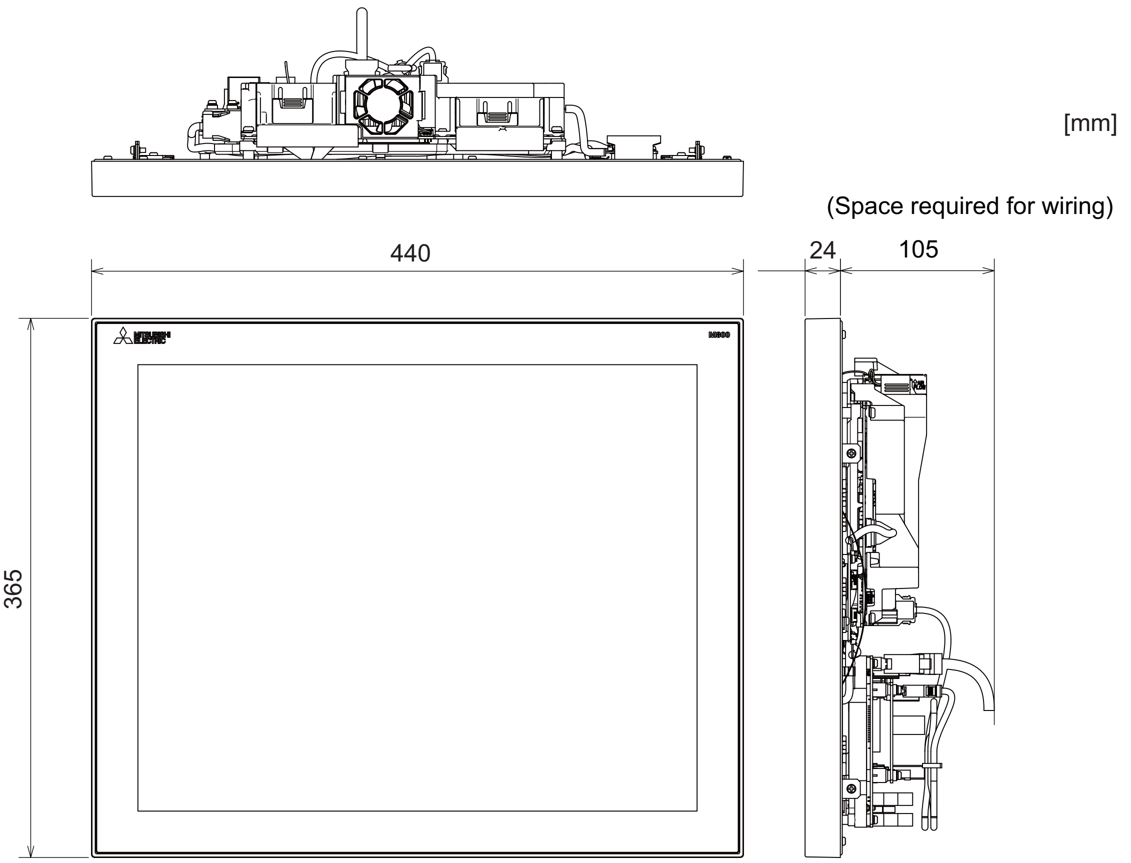


**[Panel cut dimension]**



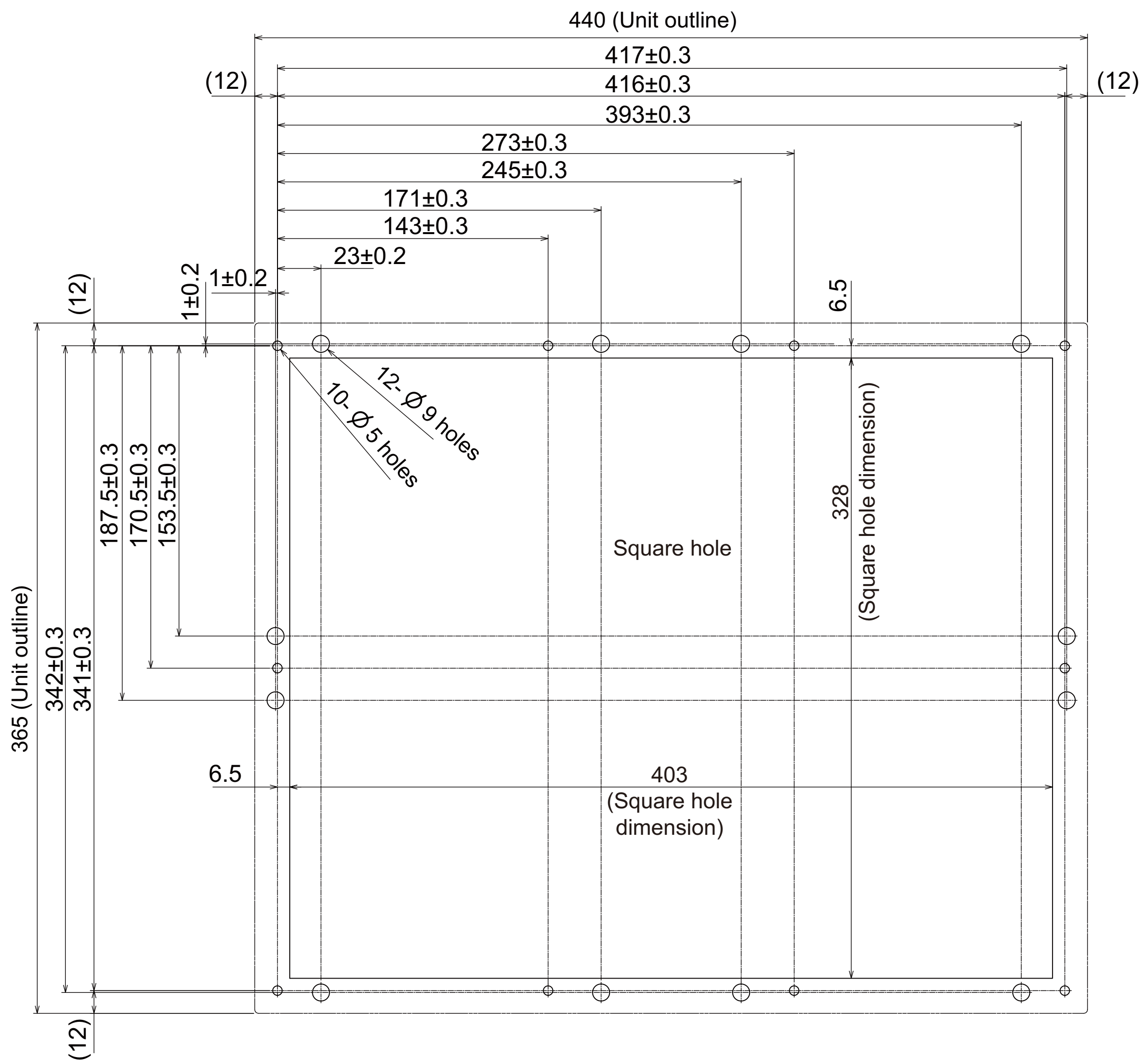
### 4.3.5 19-type (FCU8-DU192-75)

**[Outline dimension]**



**[Panel cut dimension]**

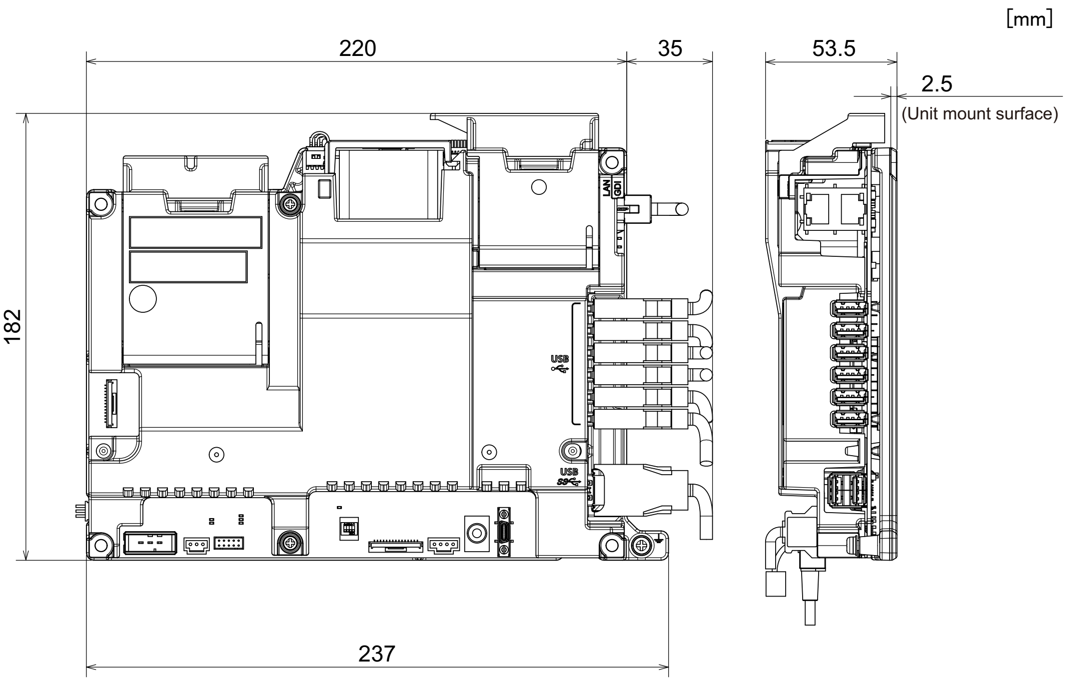
[mm]



# 4.4 Personal Computer Unit

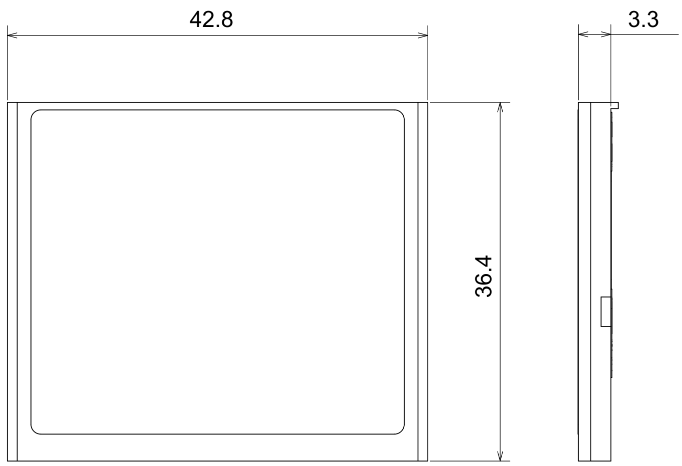
## 4.4.1 Personal Computer Unit (FCU8-PC231)

**[Outline dimension]**




## 4.4.2 Built-in Disk of the Display Unit (FCU8-CF001-001)

**[Outline dimension]**

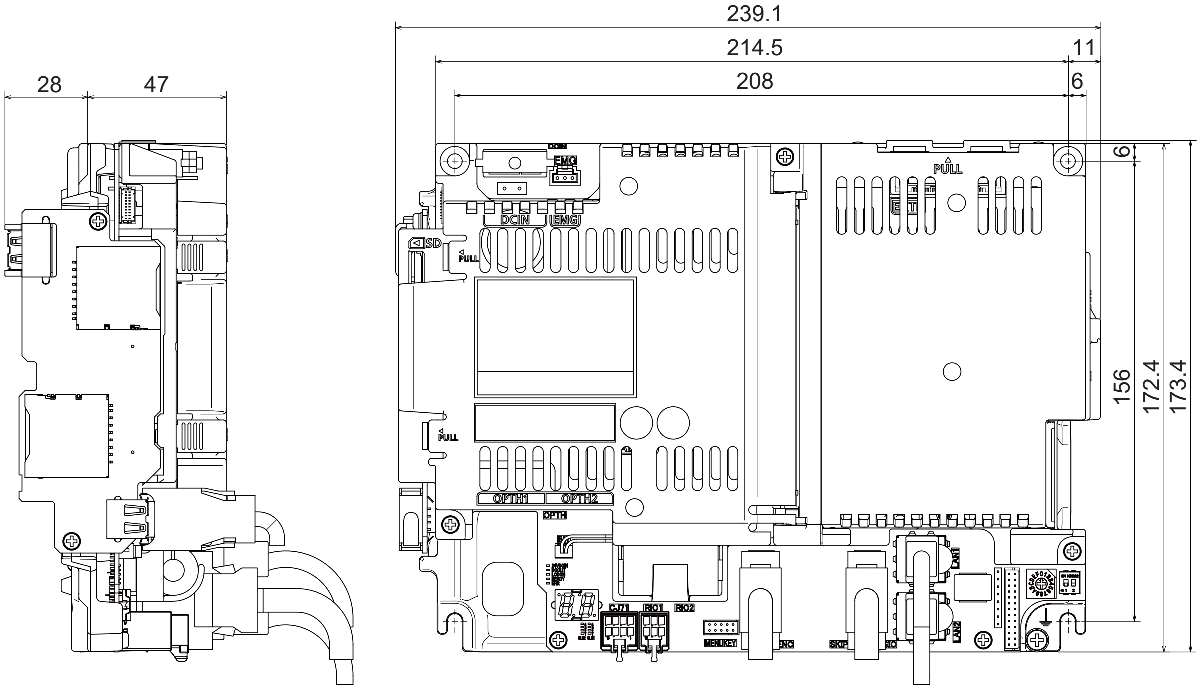


# 4.5 Graphic Control Unit

## 4.5.1 FCU8-GC211

### [Outline dimension]

[mm]



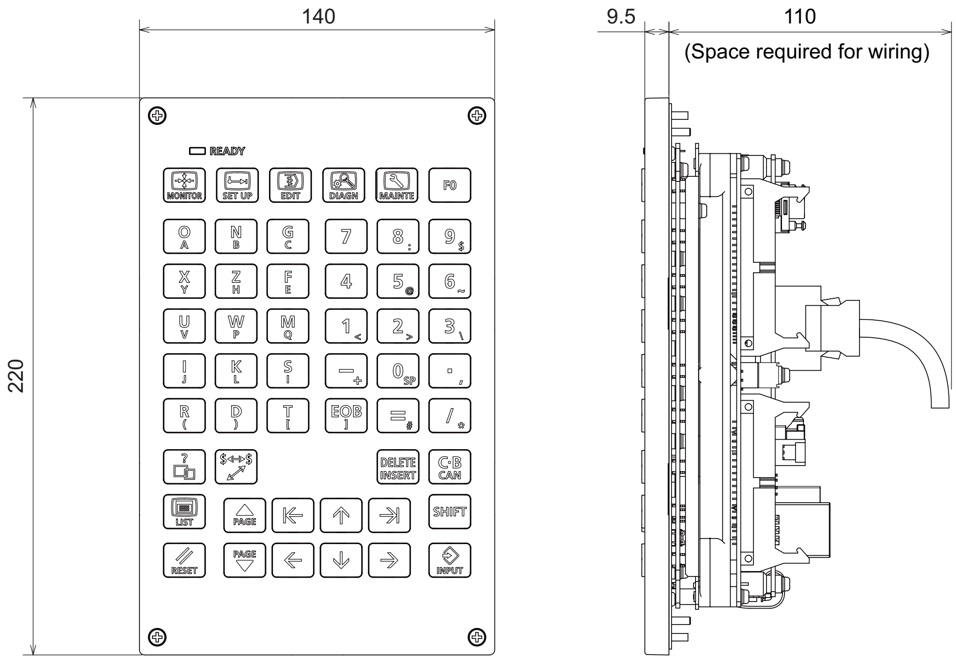

(Note) Refer to the following chapter for the space required for wiring.
「4.5 Display Unit [M800W]」
「4.6 Display Unit [M80W]」

# 4.6 Keyboard Unit

## 4.6.1 Keyboard for 10.4-type Display Unit (FCU8-KB041)

**[Outline dimension]**

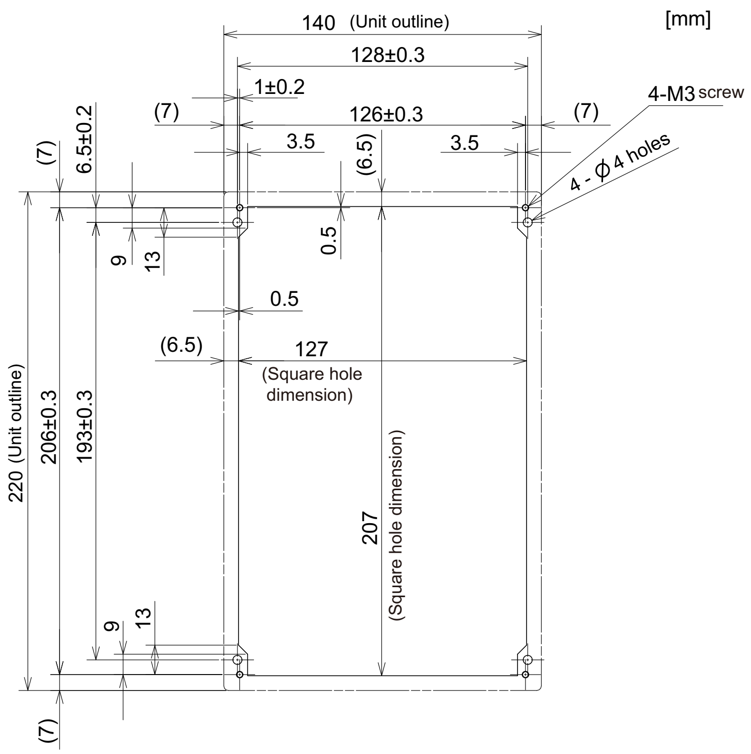
[mm]




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

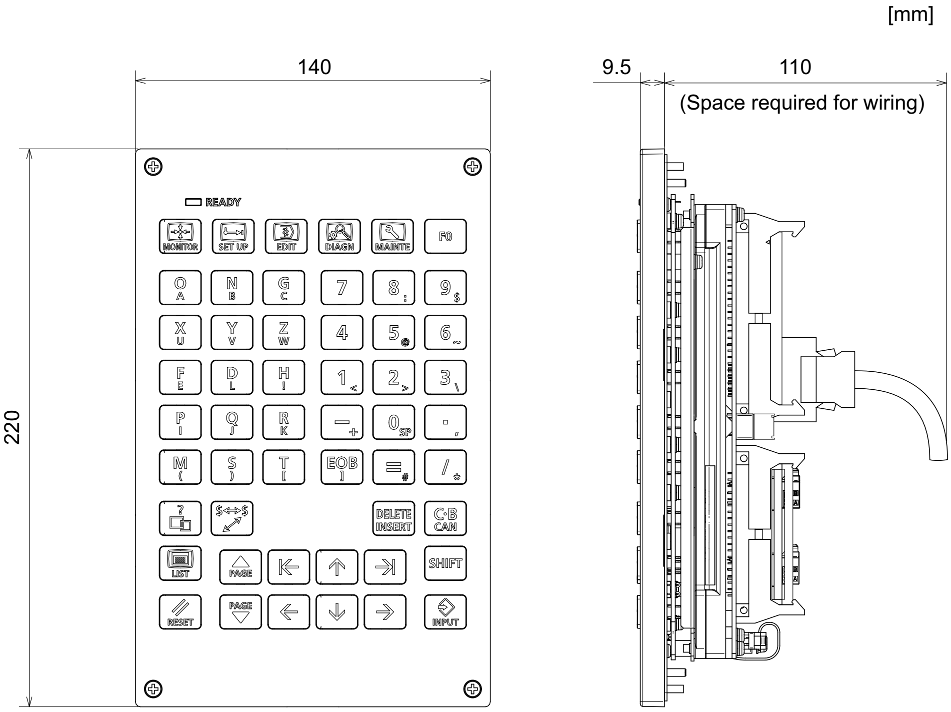
**[Panel cut dimension]**

[mm]



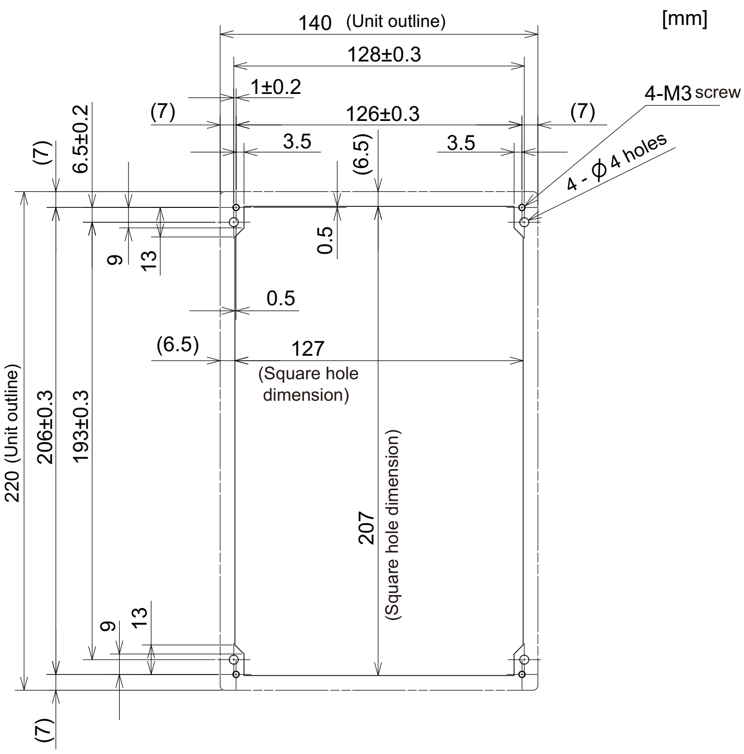
## 4.6.2 Keyboard for 10.4-type Display Unit (FCU8-KB046)

**[Outline dimension]**




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

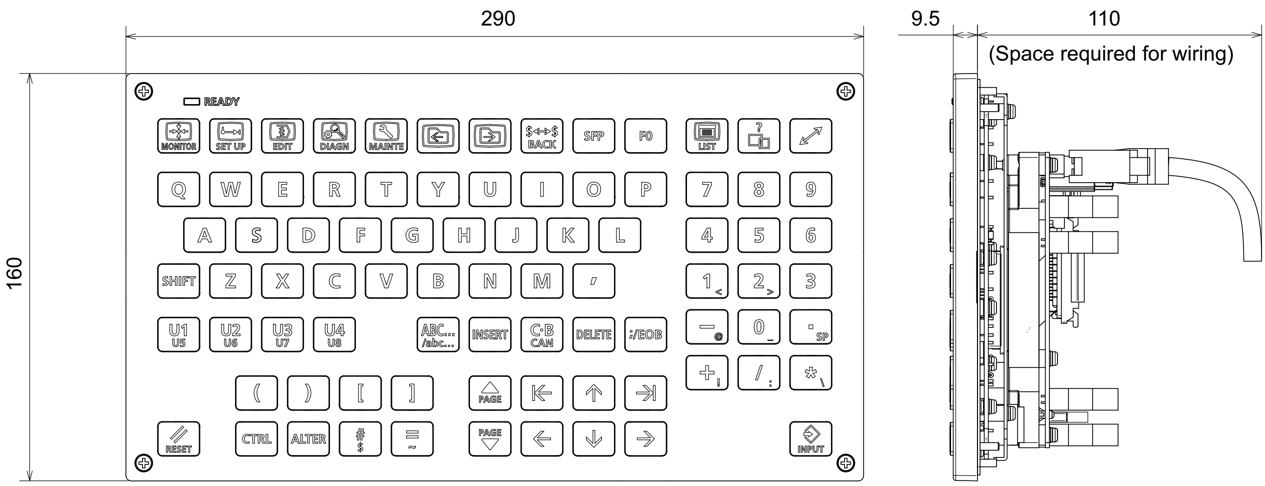
**[Panel cut dimension]**



### 4.6.3 Keyboard for 10.4-type Display Unit (FCU8-KB047)

**[Outline dimension]**

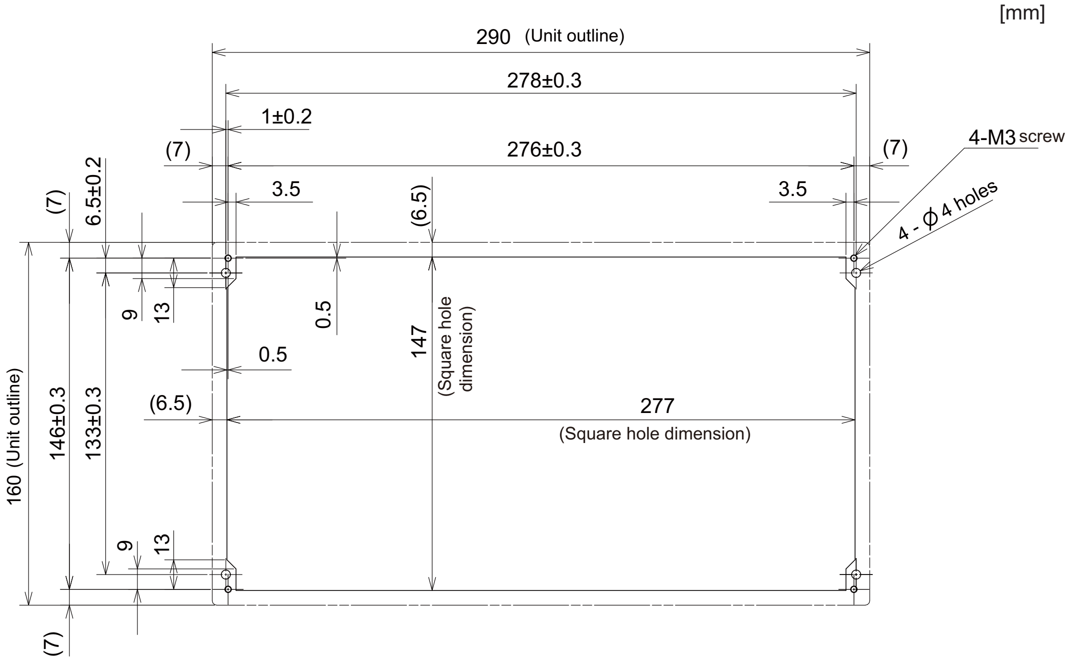
[mm]




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

**[Panel cut dimension]**

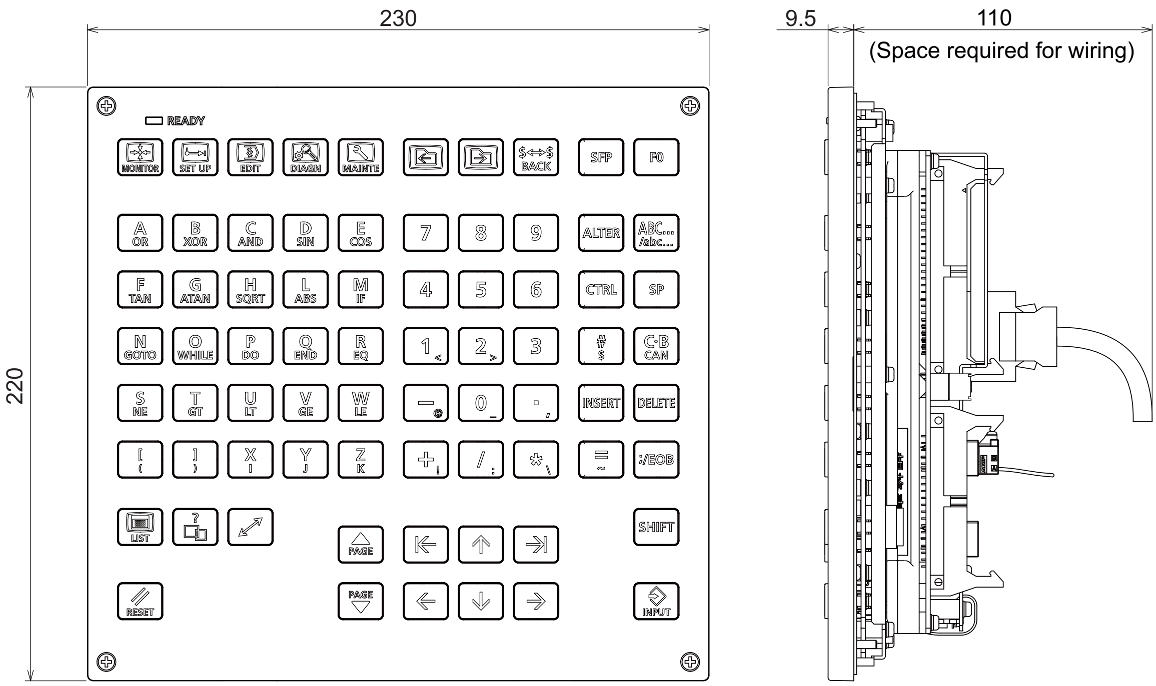
[mm]



## 4.6.4 Keyboard for 10.4-type Display Unit (FCU8-KB048)

**[Outline dimension]**

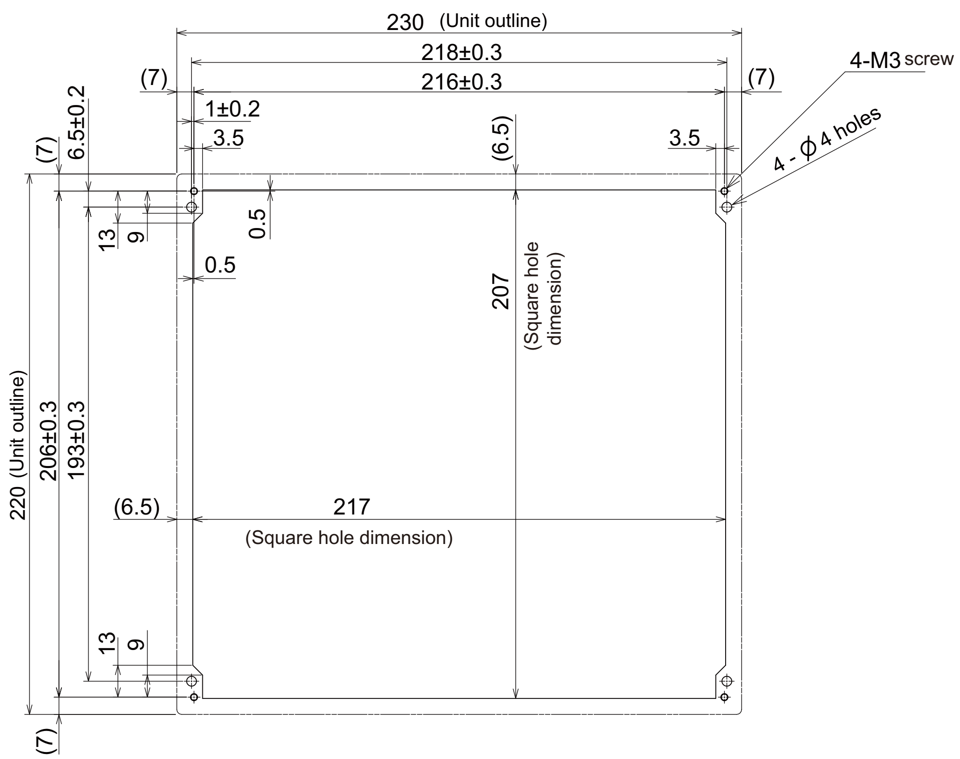
[mm]




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

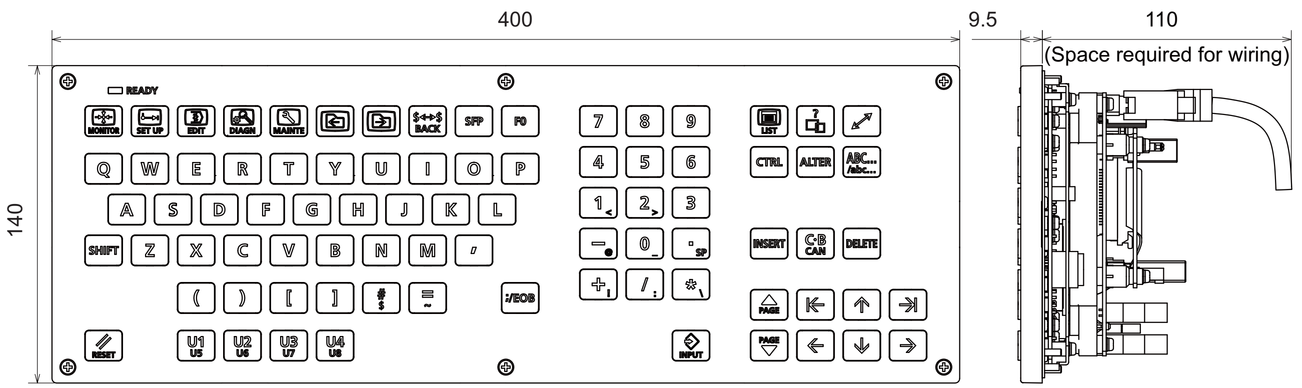
**[Panel cut dimension]**

[mm]



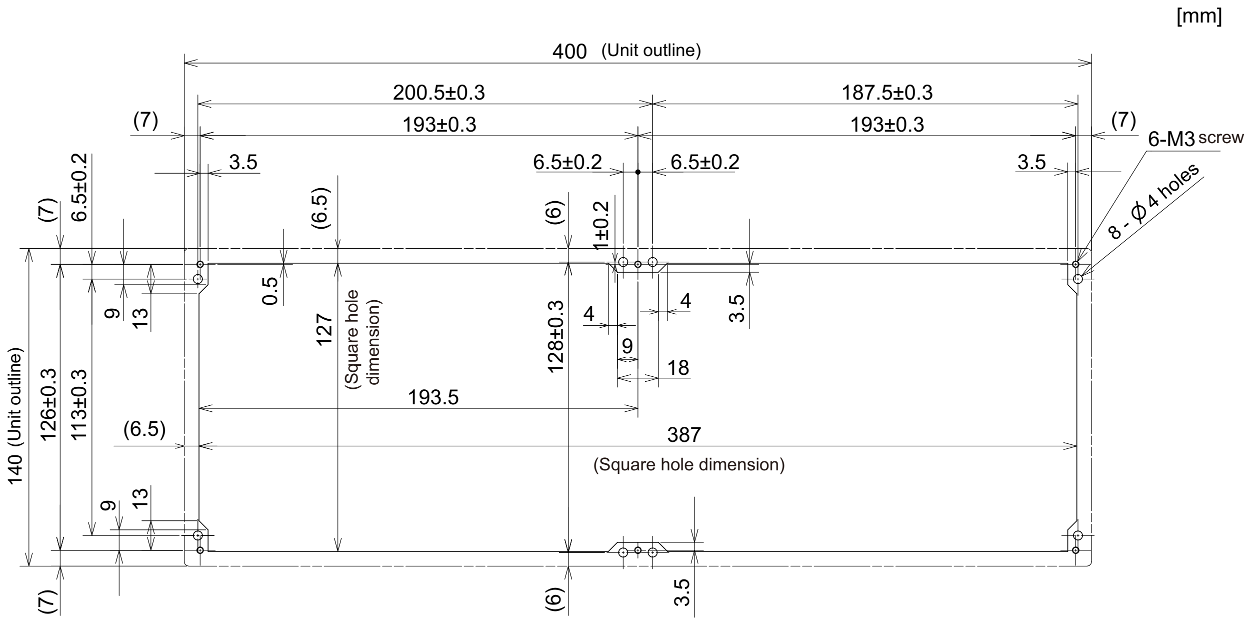
## 4.6.5 Keyboard for 15-type Display Unit (FCU8-KB083)

### [Outline dimension]




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

### [Panel cut dimension]



# 4.7 Operation Panel I/O Unit

Characteristics of operation panel I/O unit are as follows.

(1) Operation panel (display unit section) and electric cabinet (control unit section) are wired with J210 cable.
The communication of all signals including the emergency stop signal to be set to the operation panel are performed with J210 cable and this is effective to simplify the wiring.
(2) Number of DI/DO points that are mounted on the operation panel is 64/64.
Input can be switched between sink and source. Output is source output.
(3) Remote I/O 2.0 is adopted and up to 64 stations can be connected in the whole of other channels.
Number of addable units varies according to the type of the operation panel I/O unit as follows.
FCU8-DX830/DX837: 12 stations are occupied and 52 stations remain, 32 points/32 points × 54 stations, as result, up to 1664 points/1664 points can be expanded in total.
FCU8-DX730: 10 stations are occupied in sets with graphic control unit. 54 stations remain, 32 points/32 points × 54 stations, as result, up to 1728 points/1728 points can be expanded in total.
(4) Safety input conforming to safety standards is available by adopting remote I/O 2.0.
FCU8-DX837: Number of input points is 8.
(5) 3ch of manual pulse generators can be connected.
5V and 12V manual pulse generators can be connected.
(6) DO output can output 200mA/point.
(Total output current of whole unit is 3.8A at the maximum.)

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

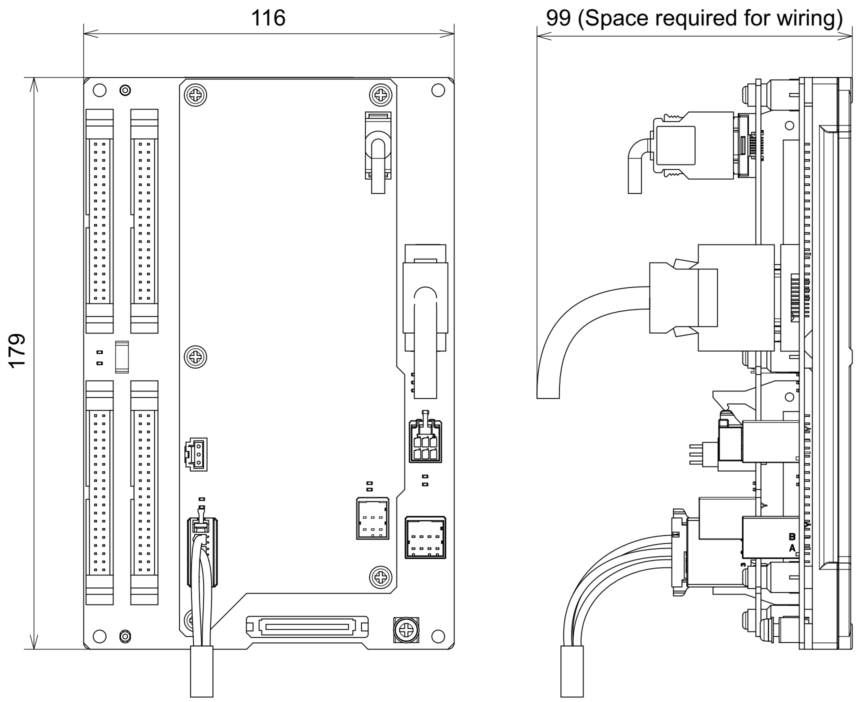
## 4.7.1 List of Units

| Classification | Type | Components | Remarks |
|---|---|---|---|
| DI 24V/0V common input [64 points]<br>DO Source output [64 points] | FCU8-DX830 | Base card<br>Add-on card<br>RIO 2.0 terminator connector (R2-TM) | DI: 64-points 24V/0V common type<br>DO: 64-points source type (200mA/point)<br>Manual pulse generator input: 3ch<br>Display unit I/F<br>Keyboard unit I/F<br>Emergency stop input<br>Remote I/O 2.0 I/F<br>RIO occupied stations (fixed):<br>1 to 4, 7 to 14<br>RIO extensible stations:<br>5, 6, 15 to 64<br>(Note) J291 cable is required for connection with the personal computer unit.<br>(for windows-based display) |
| DI 24V/0V common input [64 points]<br>DO Source output [64 points]<br>Safety DI 24V/0V common input [8 points] | FCU8-DX837 | Base card<br>Add-on card<br>RIO 2.0 terminator connector (R2-TM) | DI: 64-points 24V/0V common type<br>DO: 64-points source type (200mA/point)<br>Safety DI: 8-points 0V common type<br>Manual pulse generator input: 3ch<br>Display unit I/F<br>Keyboard unit I/F<br>Emergency stop input<br>Remote I/O 2.0 I/F<br>RIO occupied stations (fixed):<br>1 to 4, 7 to 14<br>RIO extensible stations:<br>5, 6, 15 to 64<br>(Note) J291 cable is required for connection with the personal computer unit.<br>(for windows-based display) |
| DI 24V/0V common input [64 points]<br>DO Source output [64 points] | FCU8-DX730 | Base card<br>RIO 2.0 terminator connector (R2-TM) | DI: 64-points 24V/0V common type<br>DO: 64-points source type (200mA/point)<br>Manual pulse generator input: 3ch<br>Graphic control unit I/F<br>Keyboard unit I/F<br>Remote I/O 2.0 I/F<br>RIO occupied stations (fixed):<br>1, 2, 7 to 12<br>RIO extensible stations:<br>3 to 6, 15 to 64<br>(13 and 14 are occupied by the graphic control unit.)<br>(Note) J010 cable is required for connection with the graphic control unit.<br>(for windows-less display) |

### 4.7.2 FCU8-DX830 / FCU8-DX837 / FCU8-DX730

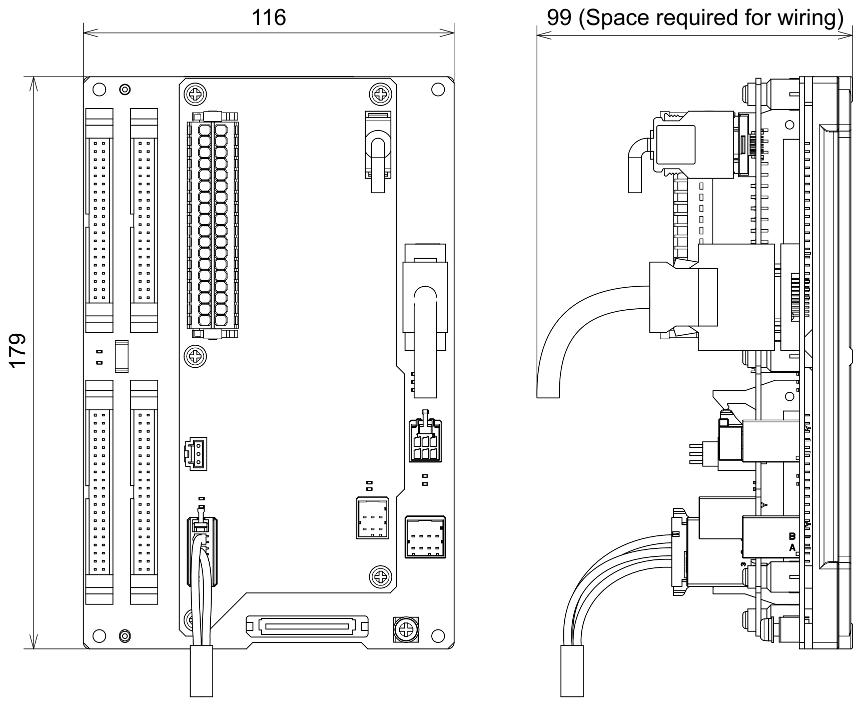
**[Outline dimension : FCU8-DX830]**

[mm]

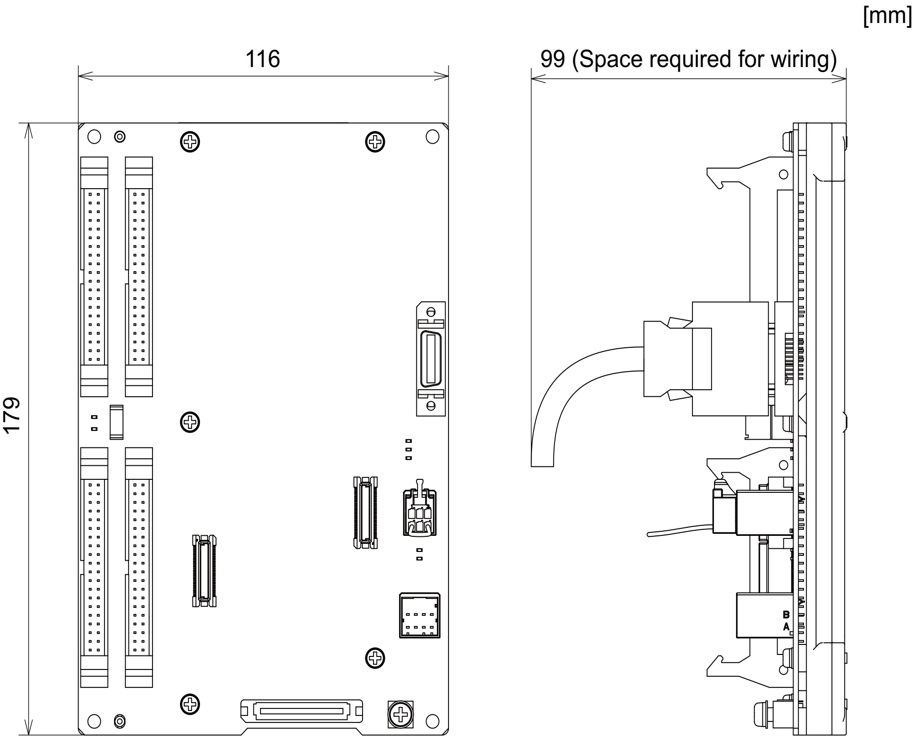



**[Outline dimension : FCU8-DX837]**

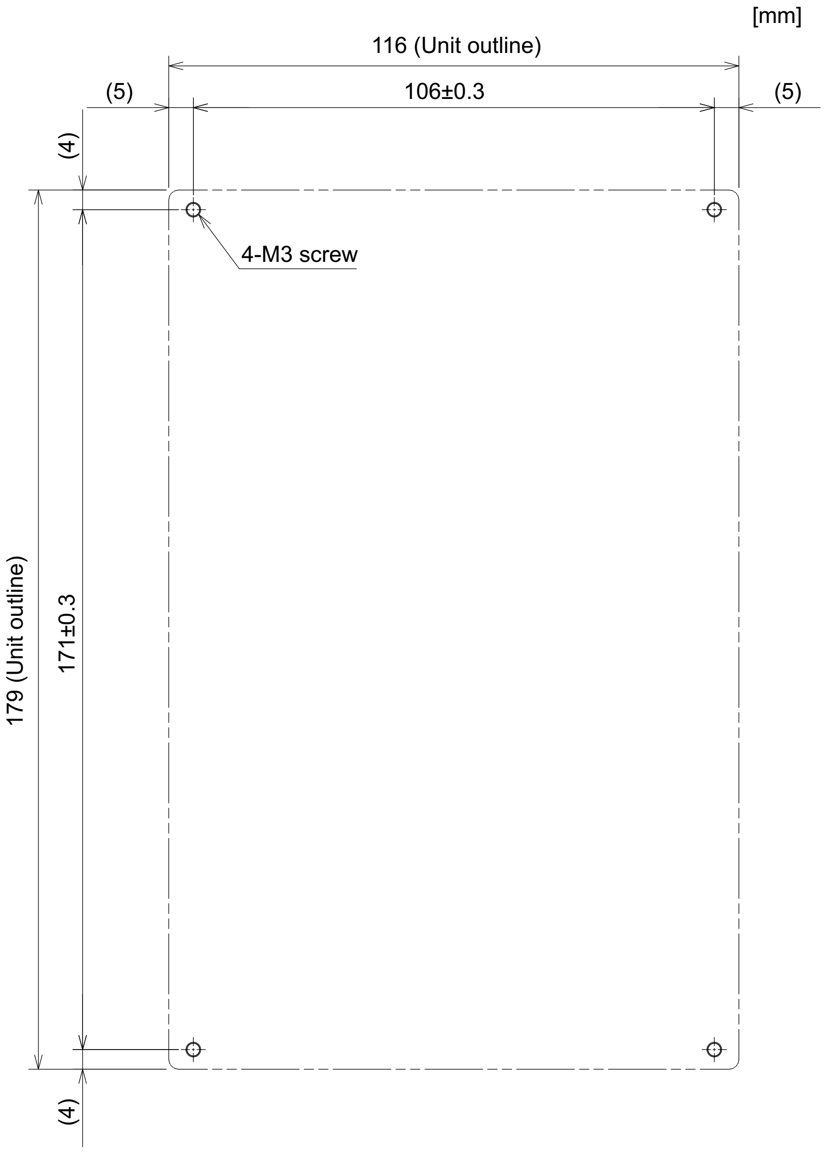
[mm]



**[Outline dimension : FCU8-DX730]**



**[Installation dimension : FCU8-DX830 / FCU8-DX837 / FCU8-DX730]**




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

# 4.8 Remote I/O Unit

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

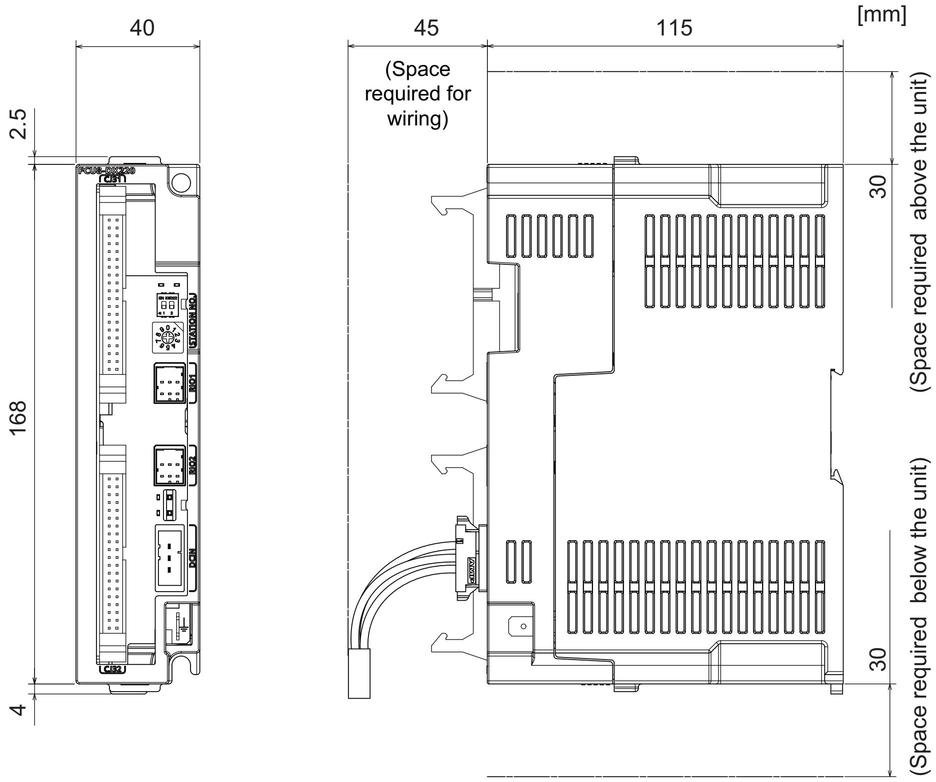
(Note) The maximum connectable number of remote I/O units is 32.

## 4.8.1 List of Units

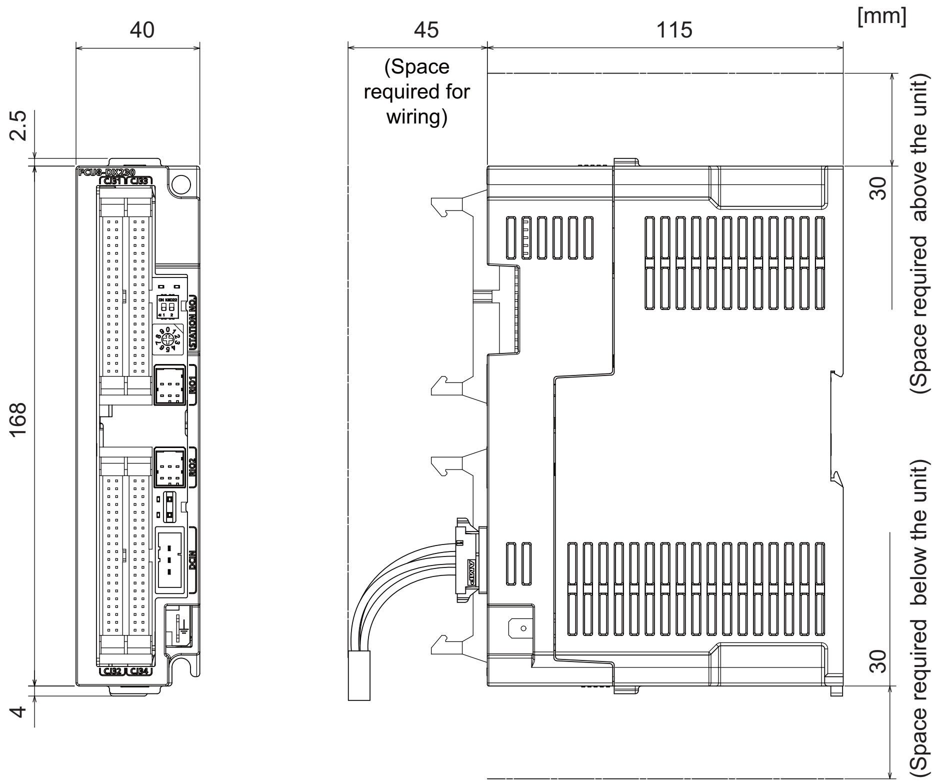
| Classification | Type | Components | Remarks |
|---|---|---|---|
| DI 24V/0V common input [32 points]<br>DO Source output [32 points] | FCU8-DX220 | Base card<br>RIO 2.0 connector set | DI: 32-points 24V/0V common type<br>Do: 32-points source type (200mA/point)<br>Number of occupied stations: 1 |
|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

### 4.8.2 FCU8-DX220 / FCU8-DX230 / FCU8-DX231 / FCU8-DX202 / FCU8-DX213 / FCU8-DX213-1 / FCU8-DX654 / FCU8-DX654-1 / FCU8-DX651/ FCU8-DX408

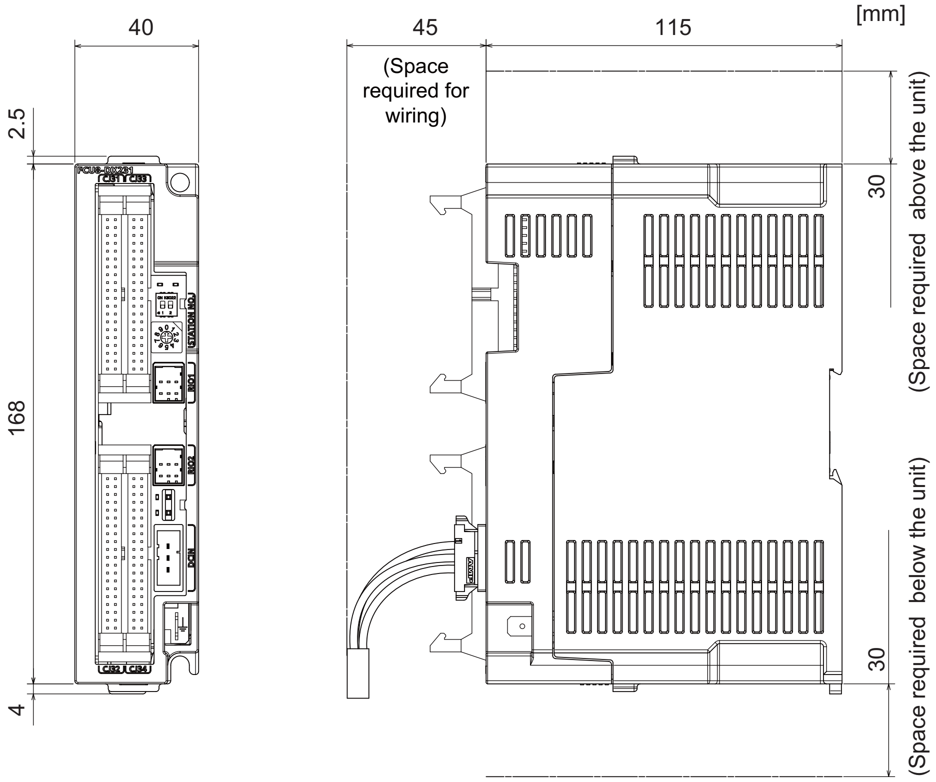
**[Outline dimension : FCU8-DX220]**



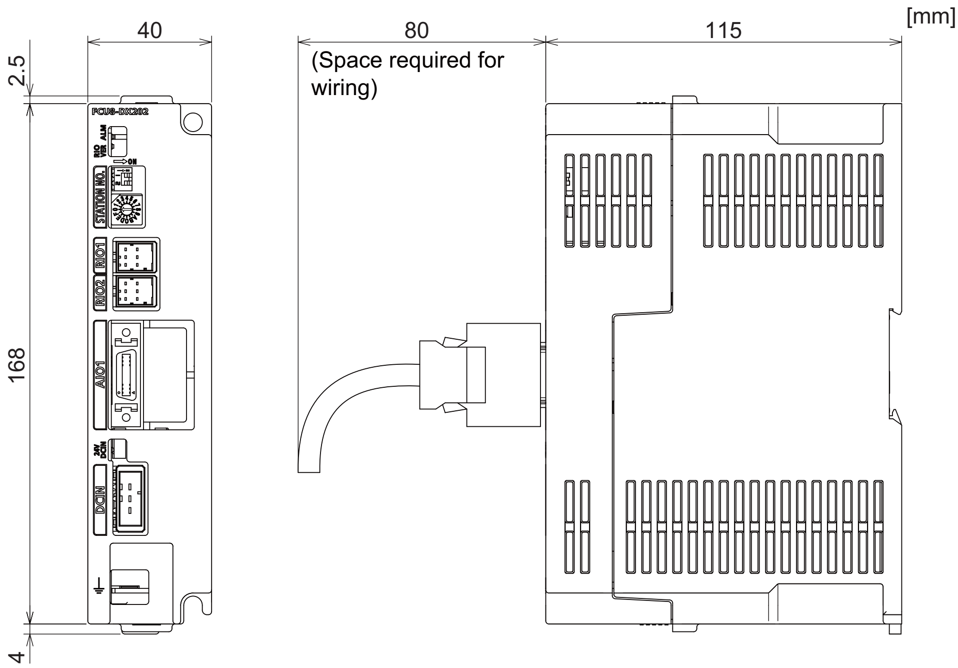

**[Outline dimension : FCU8-DX230]**



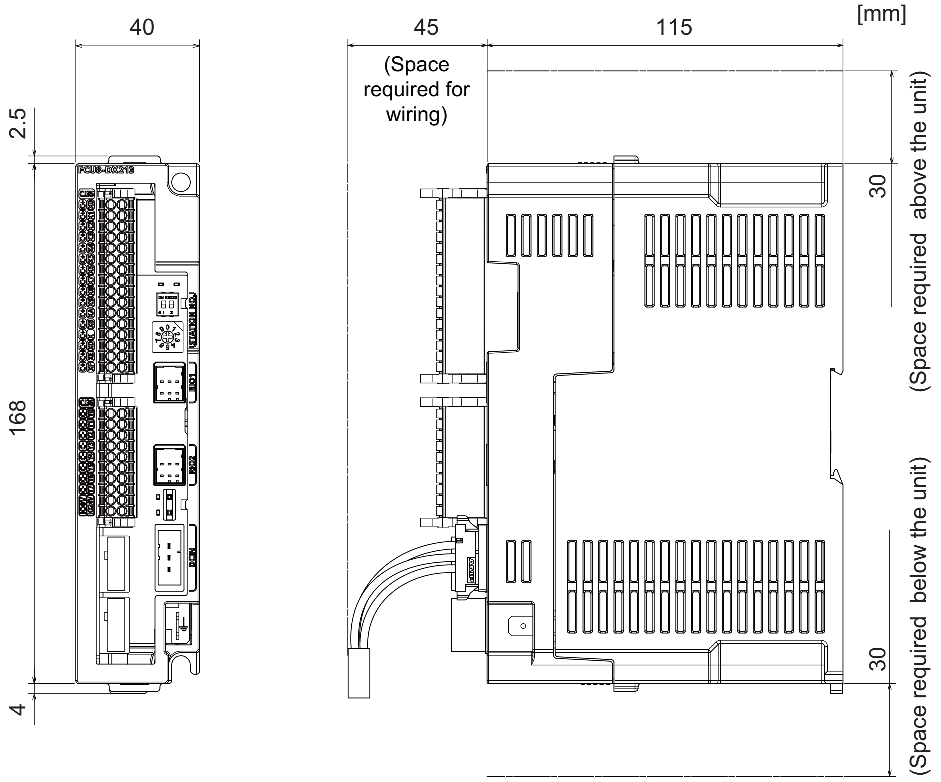
[Outline dimension : FCU8-DX231]



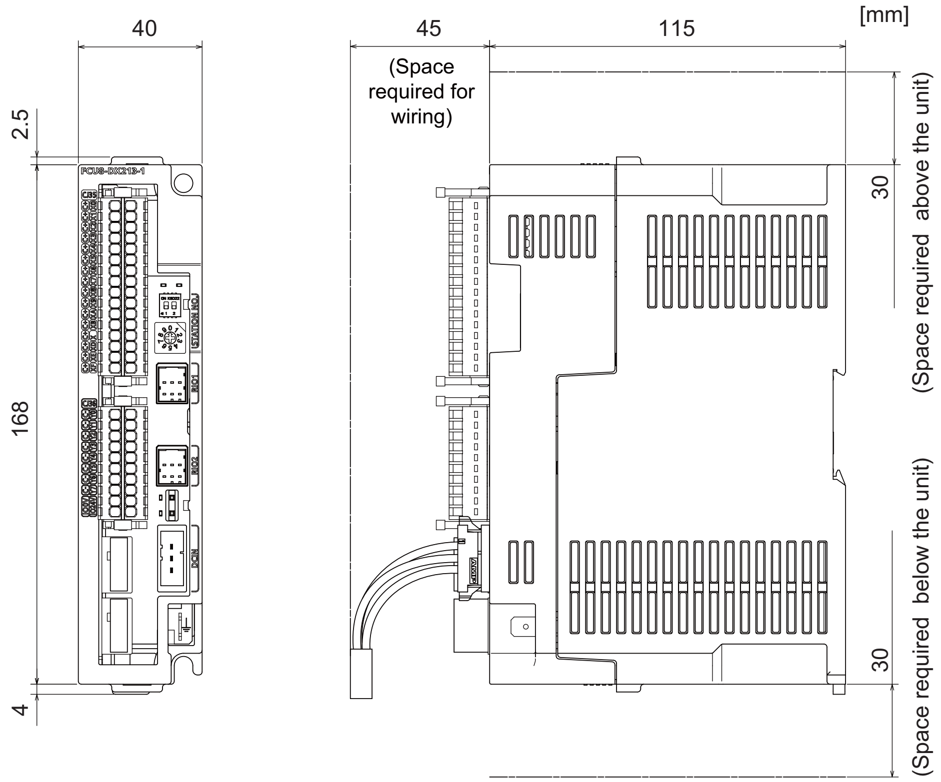

[Outline dimension : FCU8-DX202]



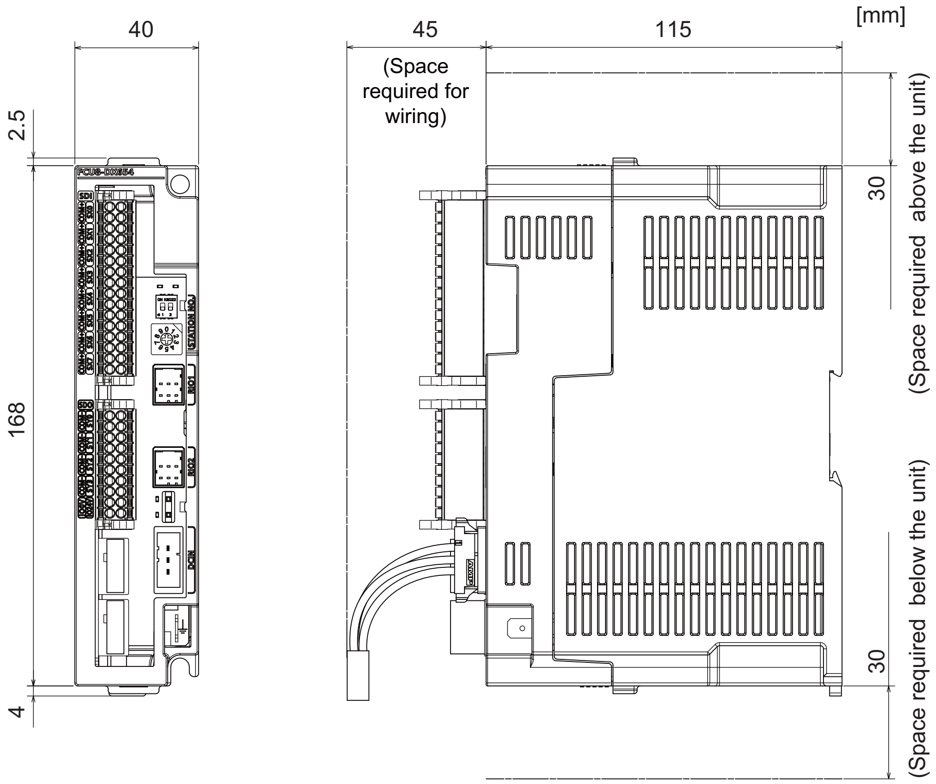
**[Outline dimension : FCU8-DX213]**



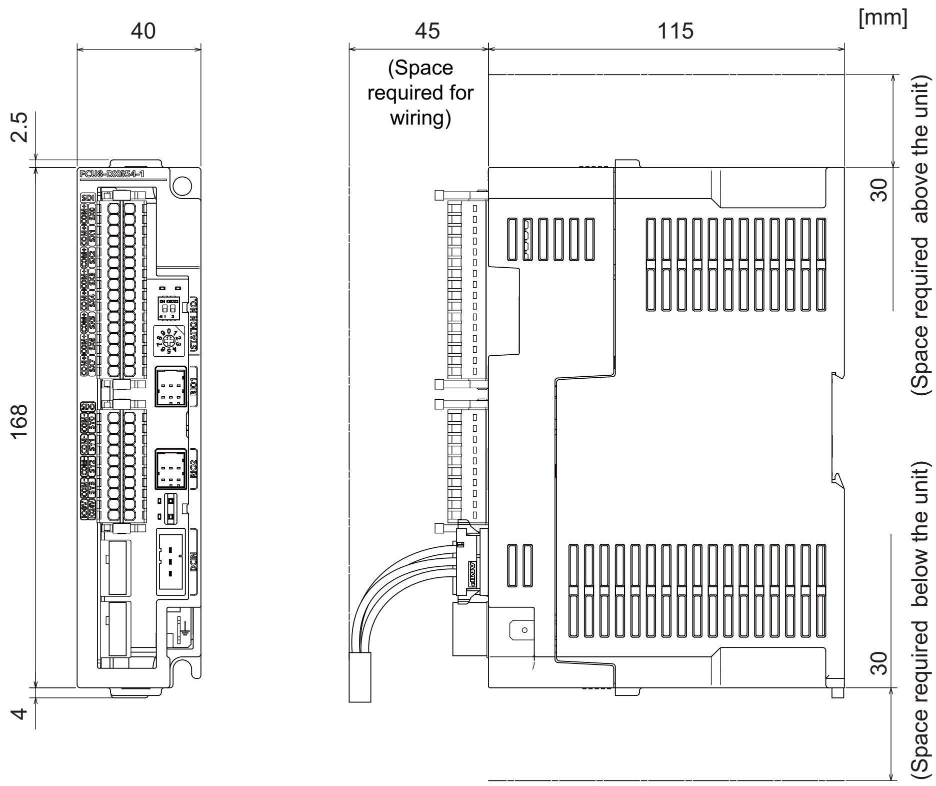

**[Outline dimension : FCU8-DX213-1]**



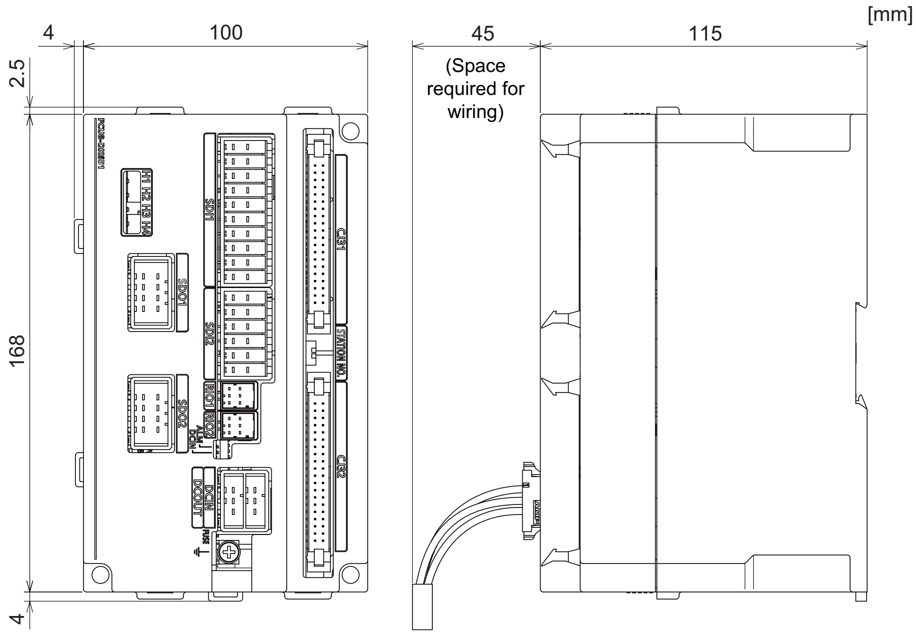
**[Outline dimension : FCU8-DX654]**



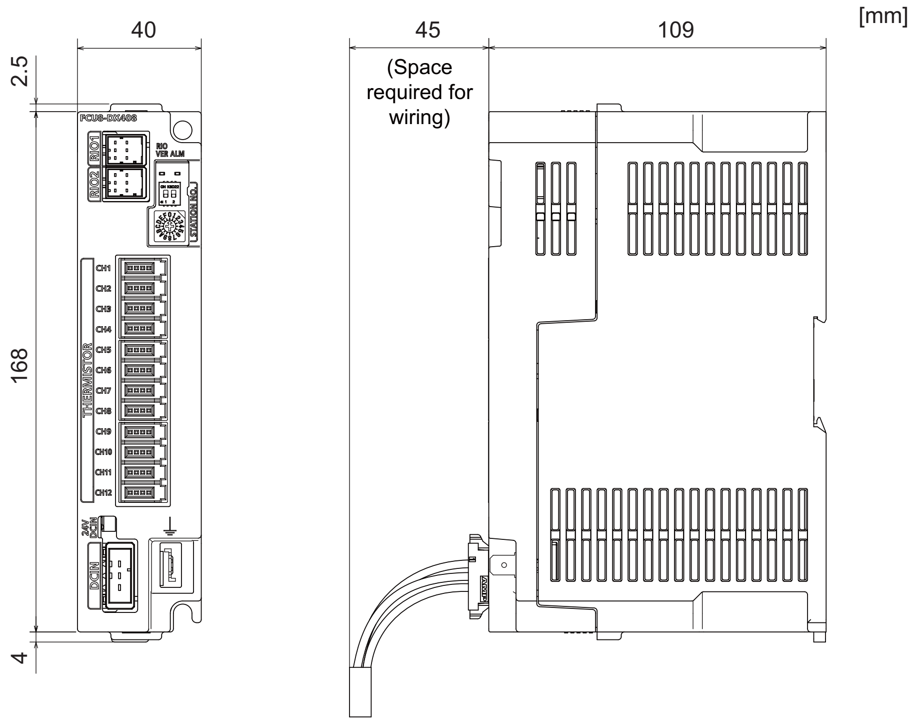

**[Outline dimension : FCU8-DX654-1]**



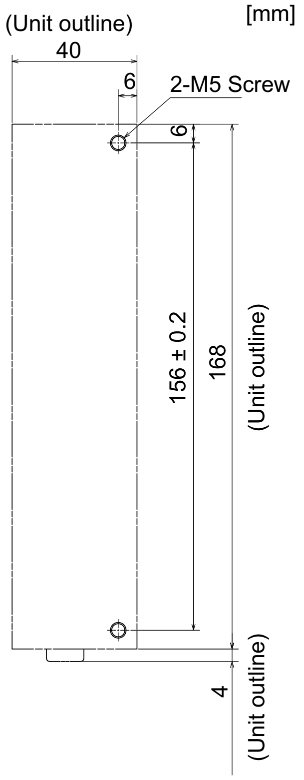
**[Outline dimension : FCU8-DX651]**



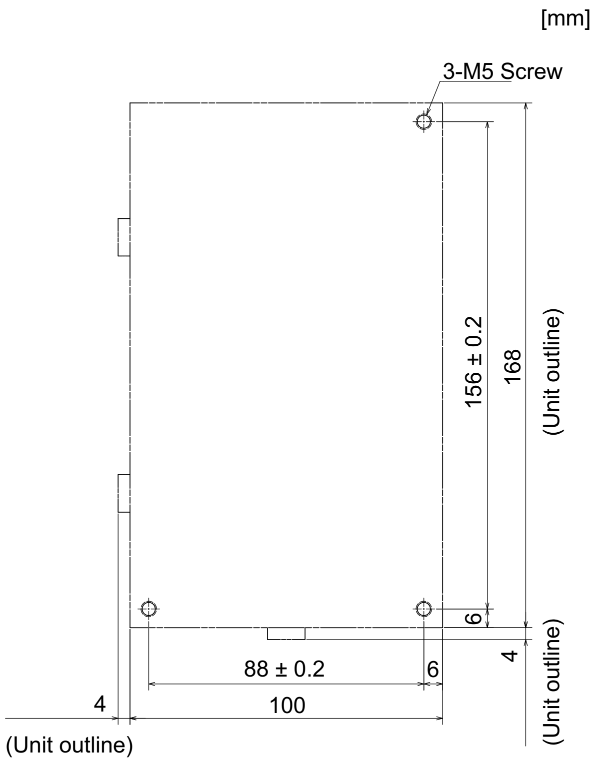

**[Outline dimension : FCU8-DX408]**



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



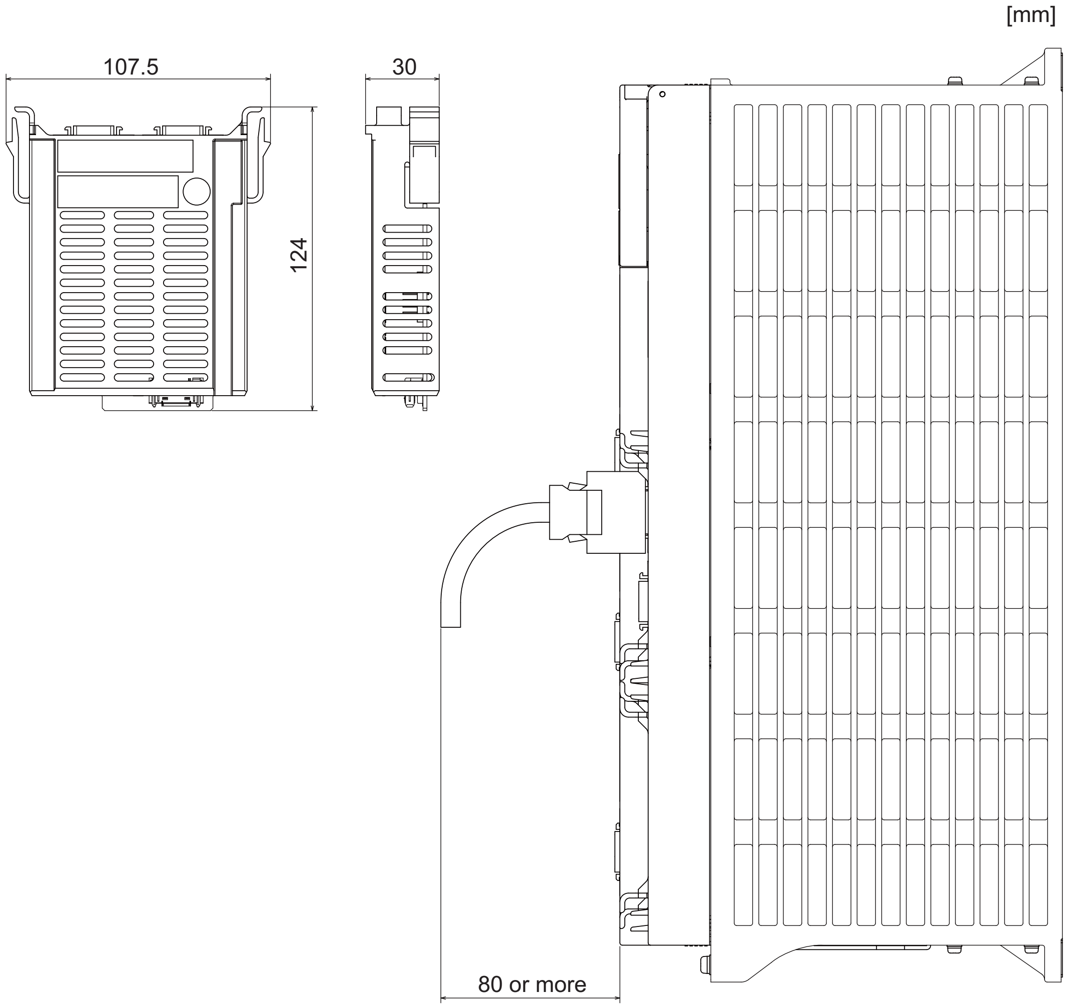

**[Installation dimension : FCU8-DX651]**



# 4.9 Function Expansion Unit

## 4.9.1 Encoder (Manual Pulse Generator) I/F Expansion (FCU8-EX544)

**[Outline dimension]**

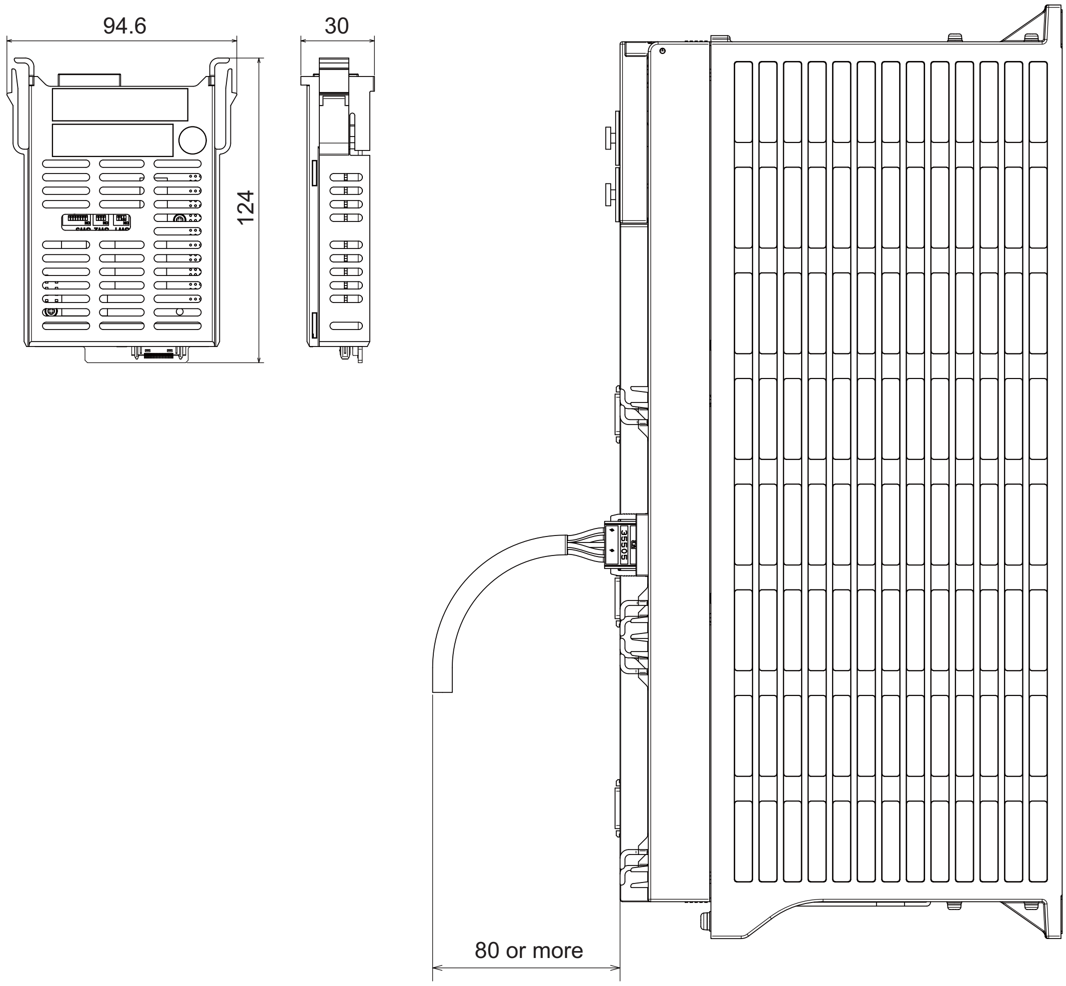


# 4.10 Communication Expansion Unit

## 4.10.1 CC-Link (FCU8-EX561)

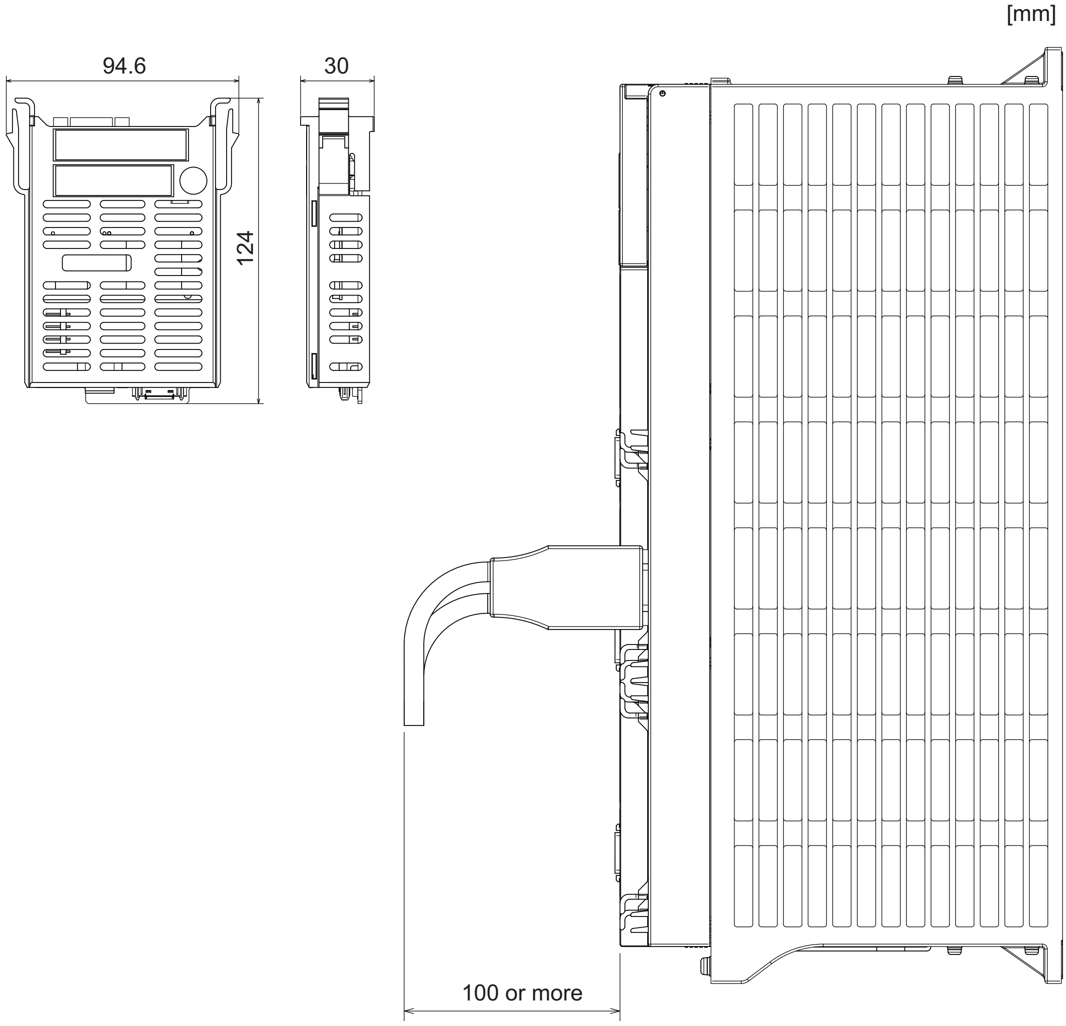
**[Outline dimension]**

[mm]



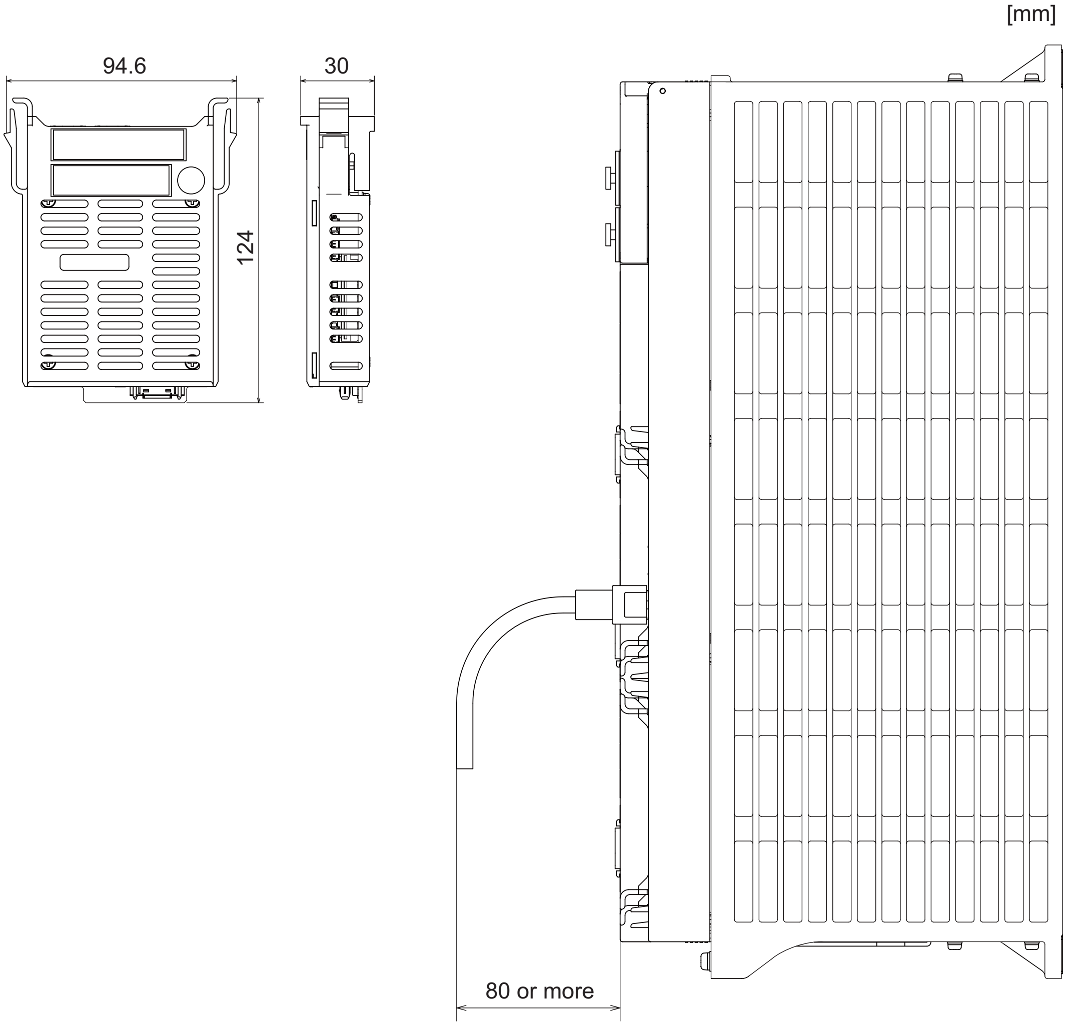
### 4.10.2 PROFIBUS-DP (FCU8-EX563)

**[Outline dimension]**



### 4.10.3 EtherNet/IP (FCU8-EX565)

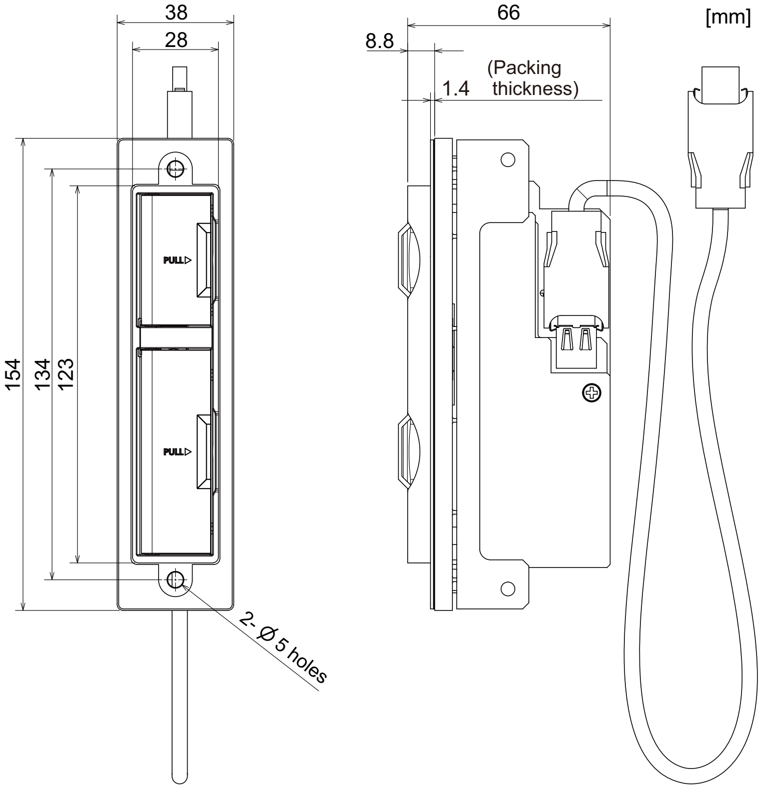
**[Outline dimension]**



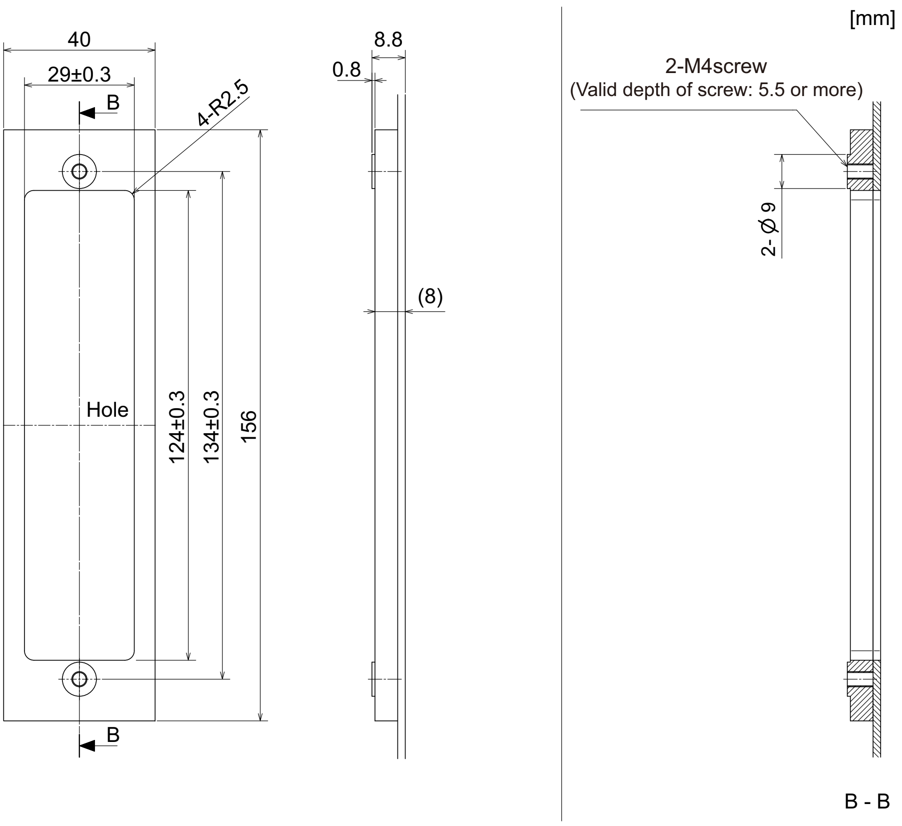
# 4.11 Side Memory I/F Unit

(Note) Side memory I/F unit is only for 19-type display unit.

**[Outline dimension]**




**[Installation dimension]**

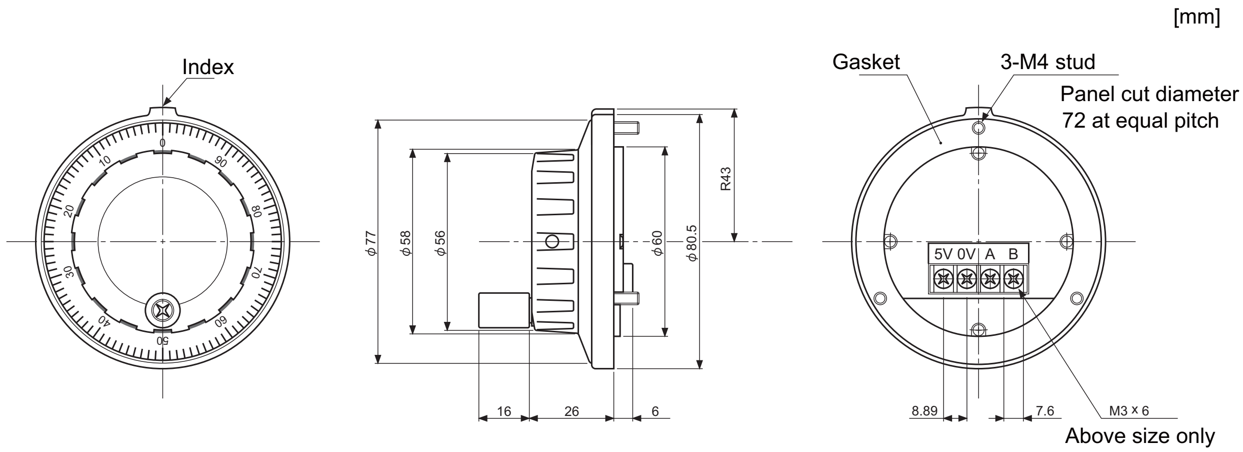


# 4.12 Manual Pulse Generator

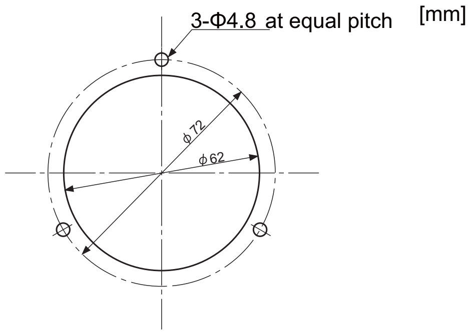
## 4.12.1 5V Manual Pulse Generator (UFO-01-2Z9)

100 pulse/rev

**[Outline dimension]**




**[Panel cut dimension]**



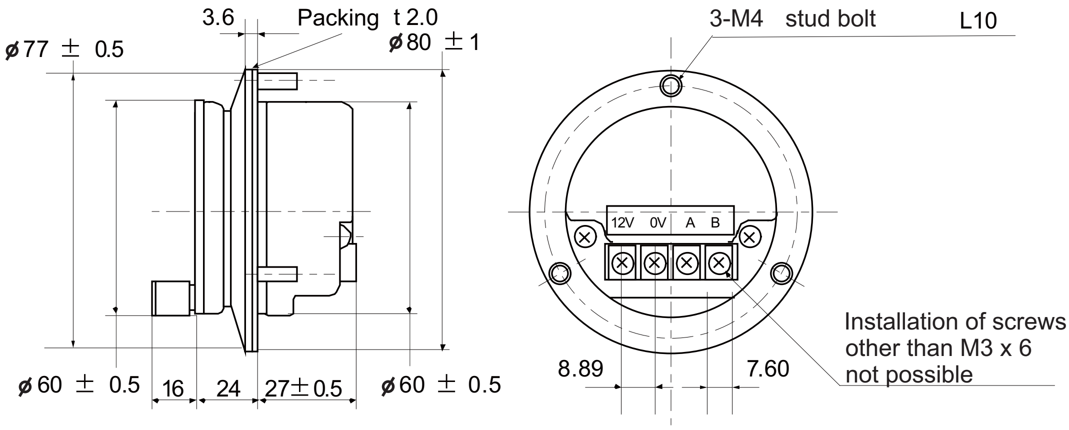

Produced by NIDEC NEMICON CORPORATION

## 4.12.2 Manual Pulse Generator (HD60C)

25 pulse/rev

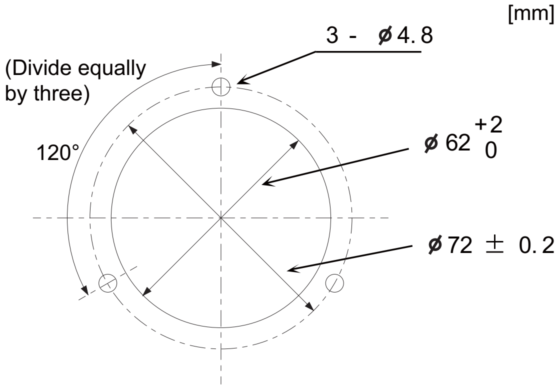
**[Outline dimension]**

[mm]




**[Panel cut dimension]**

[mm]

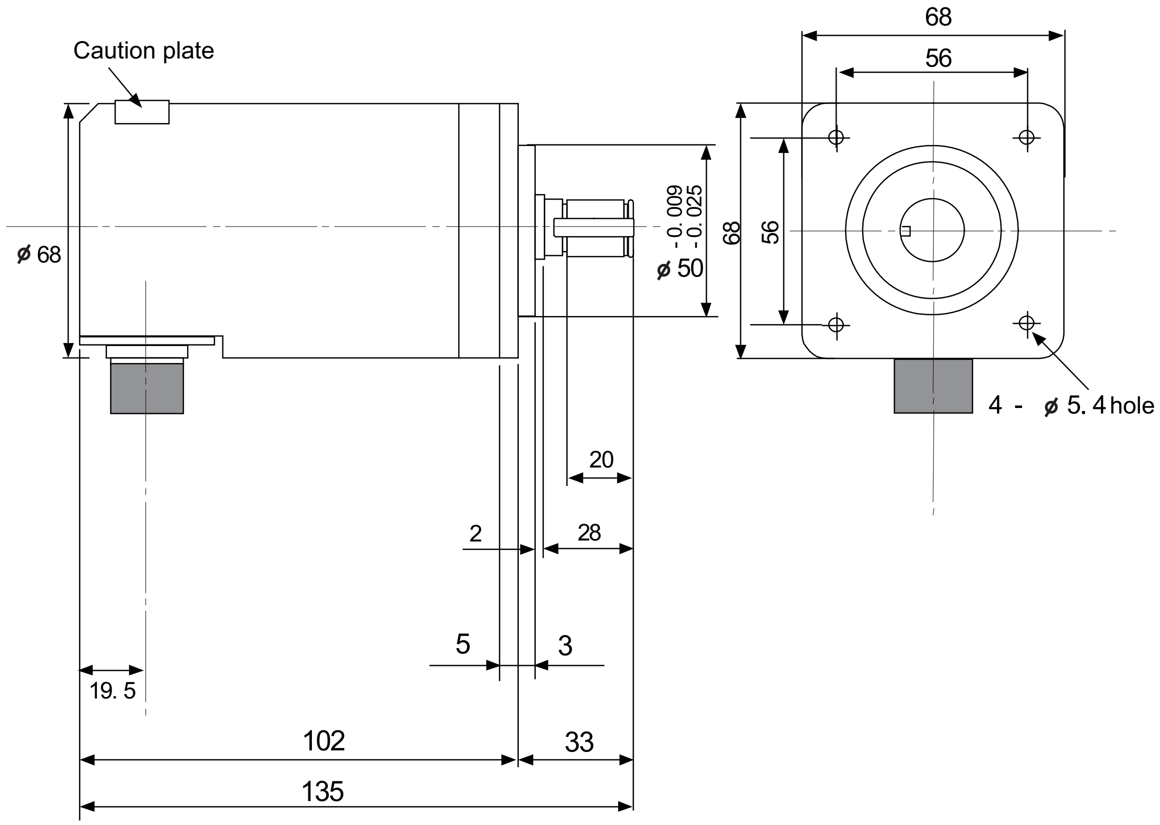


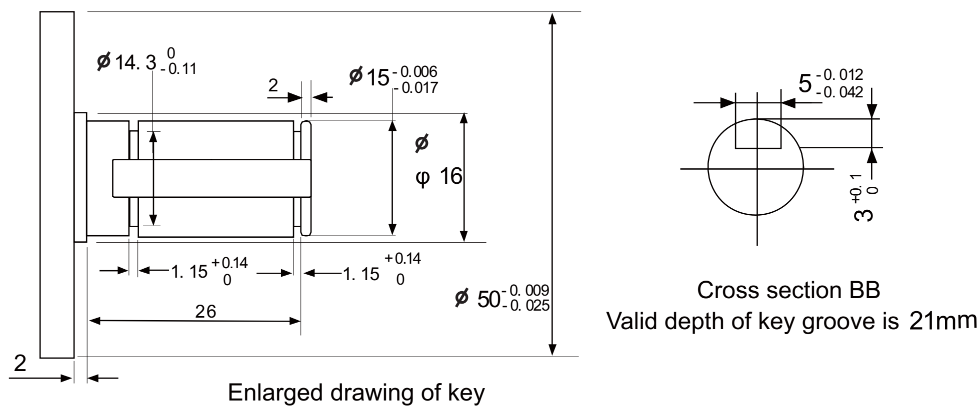
# 4.13 Synchronous Feed Encoder

## 4.13.1 Synchronous Feed Encoder (OSE-1024-3-15-68)

**[Outline dimension]**

[mm]

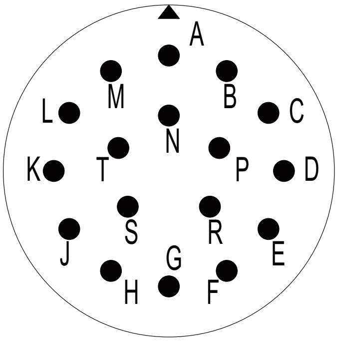



Enlarged drawing of key

Cross section BB
Valid depth of key groove is 21mm

**[Connector]**




**Connector pin assignment**

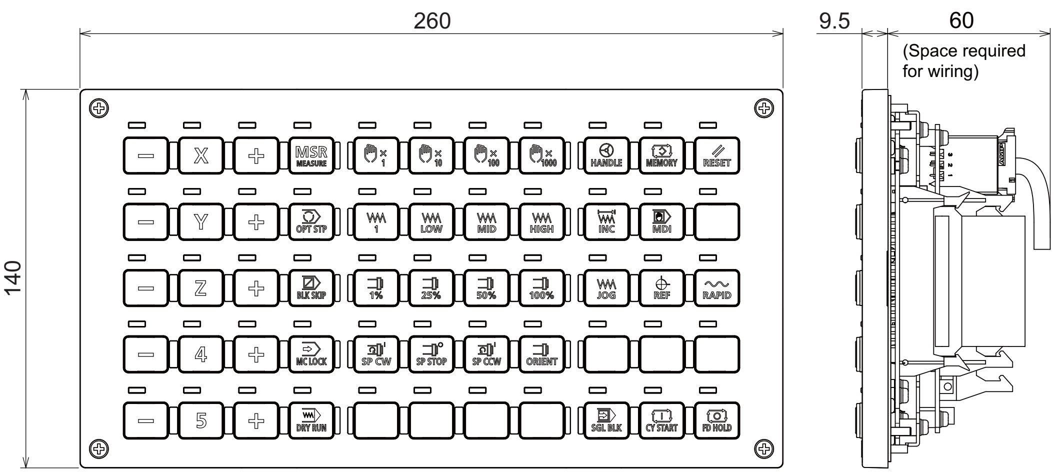
| Pin | Function | Pin | Function |
|---|---|---|---|
| **A** | A phase | **K** | 0V |
| **B** | Z phase | **L** | - |
| **C** | B phase | **M** | - |
| **D** | - | **N** | A phase reverse |
| **E** | Case grounding | **P** | Z phase reverse |
| **F** | - | **R** | B phase reverse |
| **G** | - | **S**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

# 4.14 MITSUBISHI CNC Machine Operation Panel

## 4.14.1 Main Panel A/B (FCU8-KB921 / FCU8-KB923)

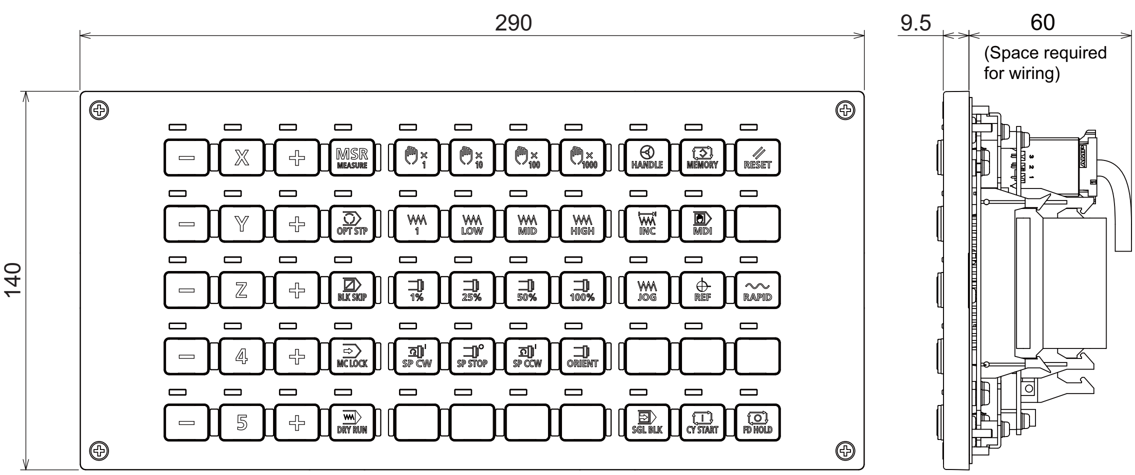
**[Outline dimension : FCU8-KB921]**

[mm]



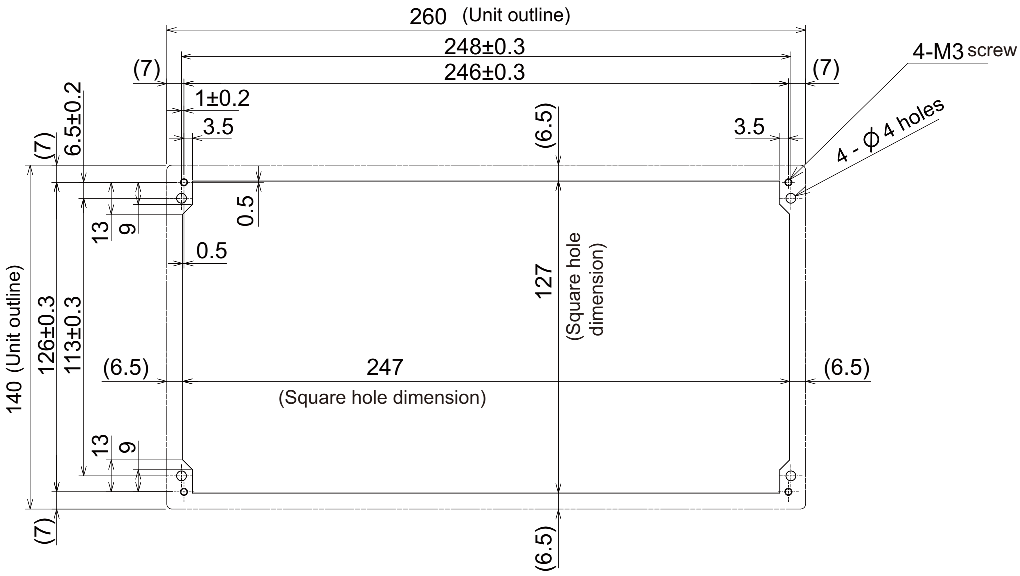

**[Outline dimension : FCU8-KB923]**

[mm]



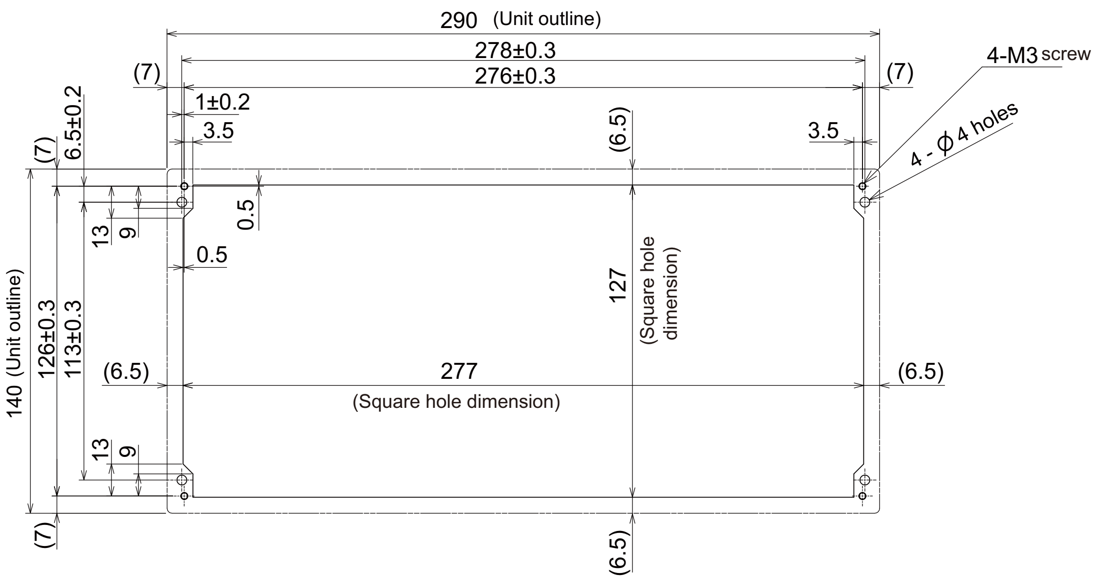
**[Panel cut dimension : FCU8-KB921]**

[mm]




**[Panel cut dimension : FCU8-KB923]**

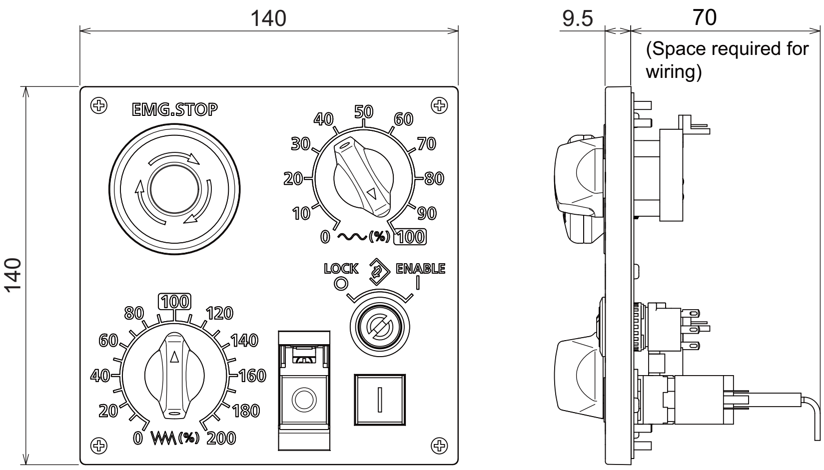
[mm]



## 4.14.2 Sub Panel A (FCU8-KB931)

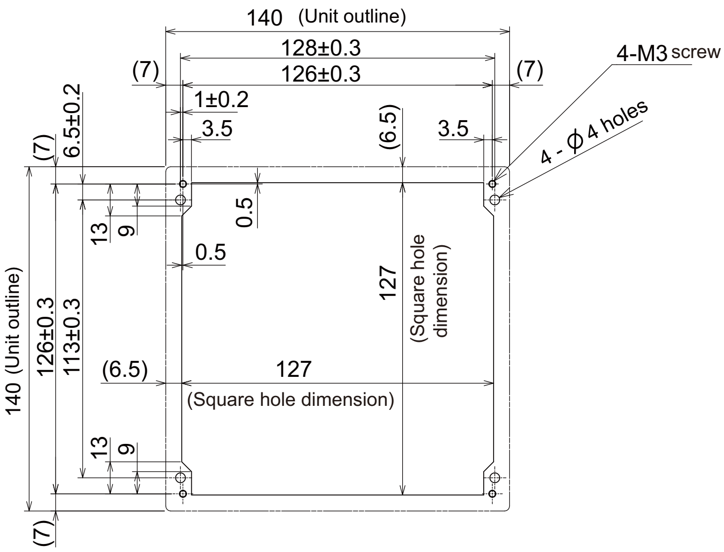
**[Outline dimension]**

[mm]




**[Panel cut dimension]**

[mm]

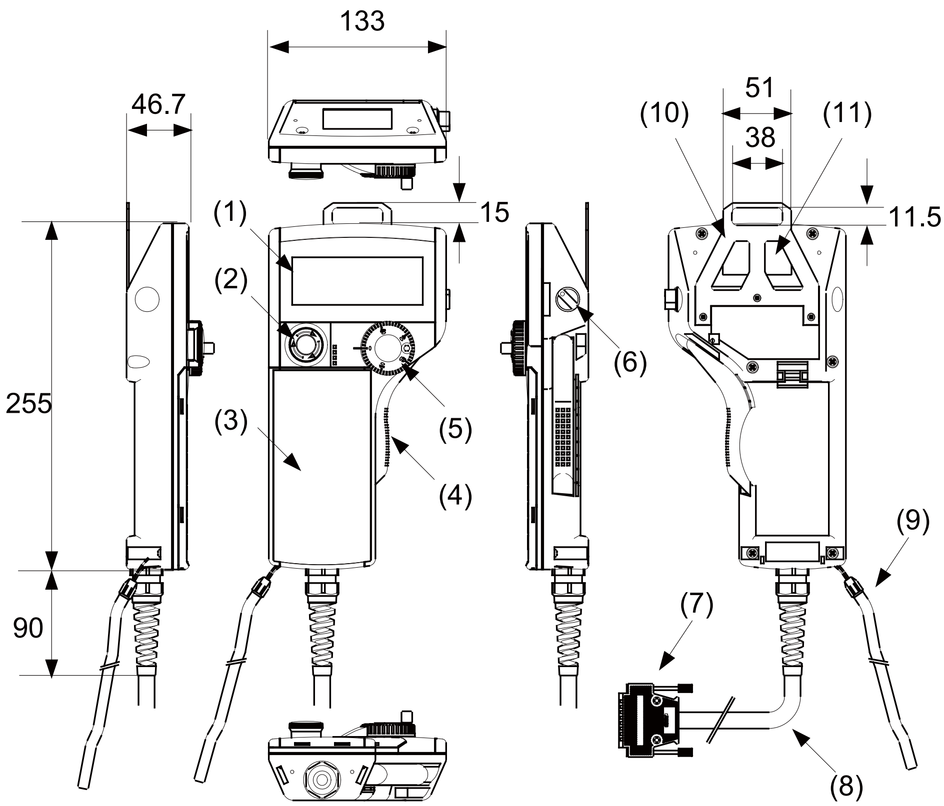


# 4.15 Handy Terminal

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

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

**Dimension and names of parts**




| No. | Name | Function/ Specification |
|---|---|---|
| (1) | LCD | Monochrome display with backlight<br>192(W) × 64(H) dots |
| (2) | SW1 | Emergency stop switch<br>Contact rating/ Contact: 24VDC, 1A<br>Contact configuration: 2b contacts<br>(IDEC Corporation: HA1E-V2S2VR) |
| (3) | - | Membrane switch (Note) |
| (4) | SW2 | Enable switch<br>Contact rating/ Contact: 24VDC, 50mA<br>Contact configuration: 3 position contact × 2<br>(OFF-ON-OFF)<br>(IDEC Corporation: HE3B-M2) |
| (5) | SW4 | Manual pulse generator<br>Output: Open collector<br>4.7kΩ pull-up resistor is connected. (TOKYO SOKUTEIKIZAI CO., LTD: RE19PH50C16RR) |
| (6) | SW6 | Selector switch |

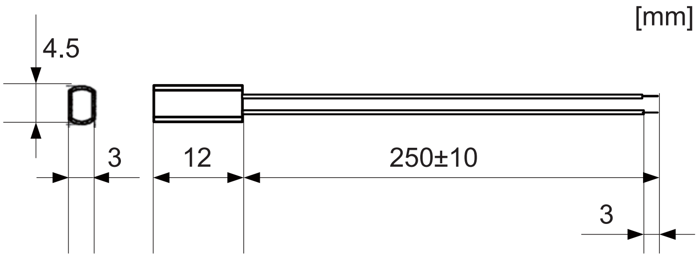
| No. | Name | Function/ Specification |
|---|---|---|
| (7) | HOST | Host interface connector<br>(DDK: 17JE-23250-02(D8A6)) |
| (8) | - | Host interface cable<br>(5m) |
| (9) | - | Simplified hand strap<br>(IDEC Corporation: HG9Z-PS1) |
| (10) | - | Panel hanging fitting<br>(IDEC Corporation: HG9Z-TK1) |
| (11) | - | Serial number plate |

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

# 4.16 Thermistor

## 4.16.1 Thermistor(PT3C-51F-M2)

**[Outline dimension]**




Made by SHIBAURA ELECTRONICS Co., Ltd.

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

# 4.17 Exclusive SD Cards for MITSUBISHI CNC

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

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

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

# 4.18 Specifications and Precautions of USB/SD/LAN Interface

## 4.18.1 USB Interface (Personal Computer Unit, Side Memory I/F Unit)

| Standards | USB3.0 | USB2.0 |
|---|---|---|
| Data transfer speed (Note) | Super Speed (5Gbps)<br>High Speed (480Mbps)<br>Full Speed (12Mbps)<br>Low Speed (1.5Mbps) | High Speed (480Mbps)<br>Full Speed (12Mbps)<br>Low Speed (1.5Mbps) |
| Power supply to USB device | Supply voltage: 5V ± 5%<br>Supply current: Max. 900mA/port | Supply voltage: 5V ± 5%<br>Supply current: Max. 500mA/port<br>(However, max. 200mA/port for side memory I/F unit) |
| Number of free ports | Personal computer unit × 2 | Personal computer unit × 4, Side memory I/F unit × 1 |
| Max. cable length | 3m<br>(During Super Speed. 5m for up to High Speed) | 5m |

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

(Note 2) Side memory I/F unit is only for 19-type display unit.

(Note 3) Do not connect devices other than the USB memory to the front memory I/F of the graphic control unit.

**(1) Precautions for use of commercially available USB keyboards and mice(Only for the display unit with the computer.)**

MITUBISHI will not provide performance guarantee and maintenance for commercially available USB keyboards and mice. In case of using one of them, careful performance check must be required by the machine tool builder. Commercially available devices may not be compatible with MITSUBISHI units or suitable FA environment for temperature- or noise-wise.

Commercially available USB keyboards/mice are susceptible to noise, etc., and may cause a malfunction in the unit that may lead to an accident. Do not use them while the machine is operated.

**(2) Precautions for use of other commercially available USB devices(Only for the display unit with the computer.)**

When connecting a commercially available USB device that requires power exceeding the maximum current, select the one of which power can be supplied from an outside source.

MITSUBISHI will not provide performance guarantee and maintenance for commercially available USB printer, USB floppy disk, USB memory, USB hub, USB-CD drive, USB-DVD drive, and other USB devices. Commercially available devices may not be compatible with MITSUBISHI units or suitable FA environment for temperature- or noise-wise.

In the case of using one of them, careful performance check must be required by the machine tool builder, and necessary noise countermeasures, such as executing EMI countermeasures or adding the ferrite cores, must be taken.

**(3) Precautions for insertion/removal of USB memory**

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

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

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

**(4) Precaution for operation with front-side USB memory**

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

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

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

### 4.18.2 SD Interface (Control Unit, Side Memory I/F Unit)

| Standards | SD/SDHC (Note) |
|---|---|
| Transfer speed | According to the connecting SD card |
| Capacity | 32GB |
| Number of free ports | Control unit × 1, Side memory I/F unit × 1 |

(Note 1) SDXC is not supported.

(Note 2) Side memory I/F unit is only for 19-type display unit.

**(1) Precautions for use of commercially available SD card**

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

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

**(2) Precautions for insertion/removal of SD card**

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

### 4.18.3 LAN Interface (Control Unit, Personal Computer Unit)

| Standards | 1000BASE-T / 100BASE-TX / 10BASE-T |
|---|---|
| Data transfer speed (Note) | 1000Mbps / 100Mbps / 10Mbps |
| Number of free ports | Control unit × 1, Personal computer unit × 1 |
| Max. cable length | 100m |

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

(Note 2) When using half-duplex communication, the response time may become long depending on the opposite device.
Use full-duplex communication to connect with the opposite device via a switching HUB.

**(1) Precautions for selection of LAN cable**

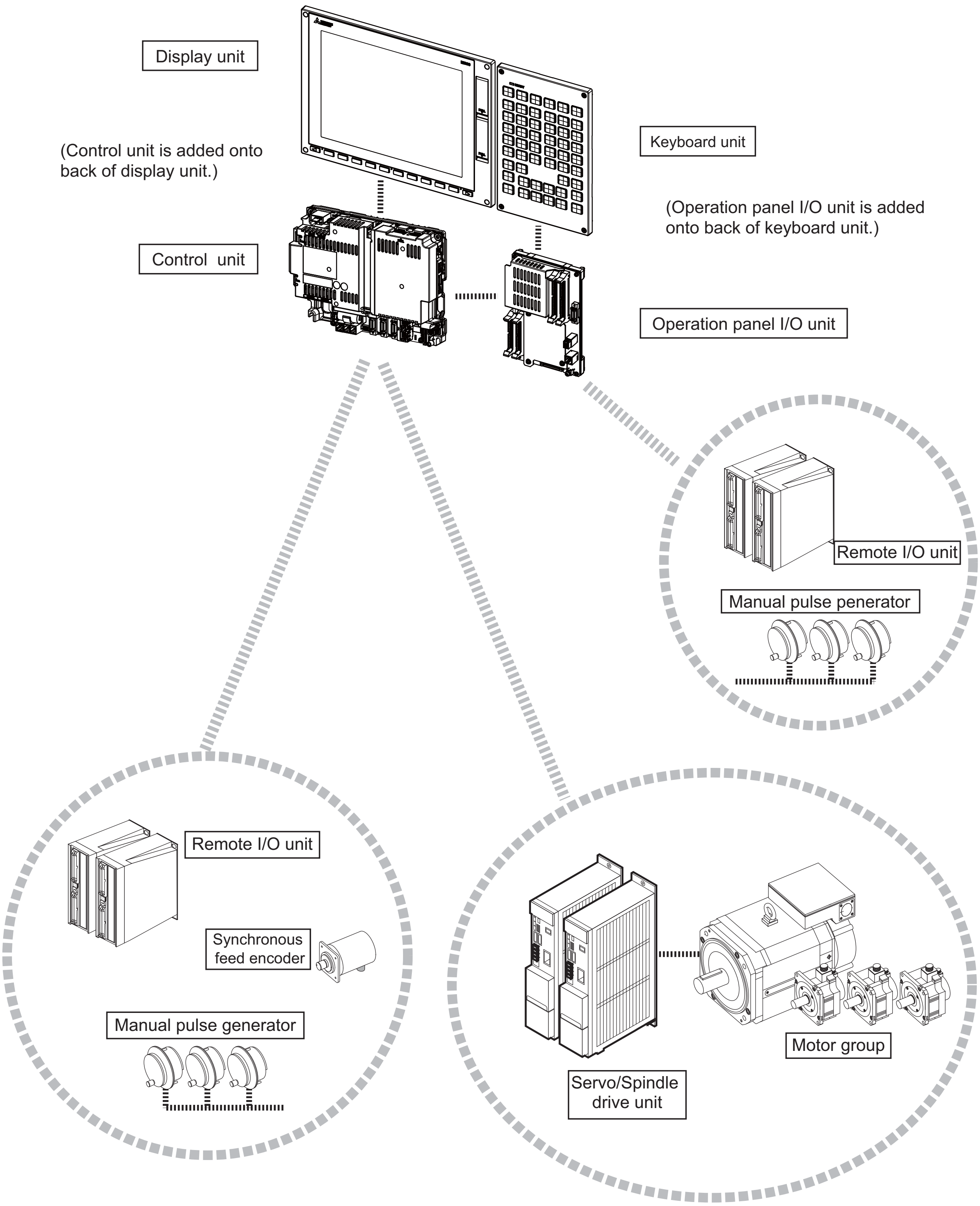
Make sure to select the LAN cables which are "category 5e or above" and "shielded". Cable wire material with double shielded, which is appropriate for FA environment., is recommended.

# M800S Series
# General Specifications

1

# System Basic Configuration (M800S Series)

## 1.1 System Basic Configuration Drawing

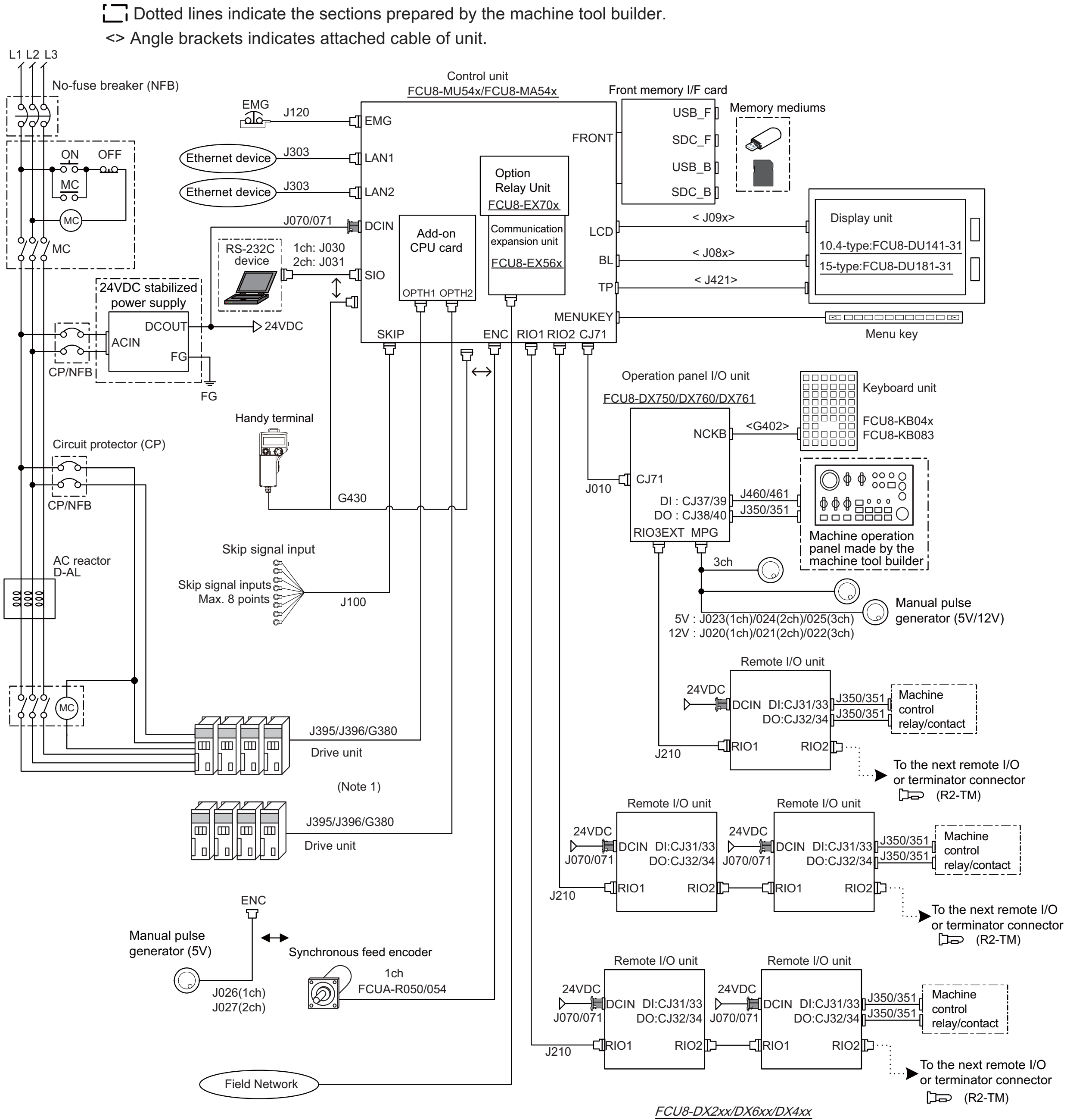



(Note) For the drive unit configuration, refer to the Instruction Manual of the drive unit you use.

# 2

# General Connection Diagram (M800S Series)

# 2.1 General Connection Diagram [M800S]




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

(Note 2) For the connection of MITSUBISHI CNC machine operation panel, refer to the chapter "Connection of MITSUBISHI CNC Machine Operation Panel".

3

# List of Configuration (M800S Series)

# 3.1 Control Unit [M800S]

| Classification | Type | Components | Remarks |
|---|---|---|---|
| NC functions<br>and display controller<br>For M830S | FCU8-MU542 | Base control card<br>Add-on CPU card<br>Front-side memory I/F card | Export Trade Control Order noncompliant unit and Foreign Exchange Order noncompliant unit |
| NC functions<br>and display controller<br>For M850S | FCU8-MA542 | Base control card<br>Add-on CPU card<br>Front-side memory I/F card | Export Trade Control Order noncompliant unit and Foreign Exchange Order compliant unit |
| NC functions<br>and display controller<br>For M830S | FCU8-MU541 | Base control card<br>Add-on CPU card<br>Front-side memory I/F card | Export Trade Control Order noncompliant unit and Foreign Exchange Order noncompliant unit |
| NC functions<br>and display controller<br>For M850S | FCU8-MA541 | Base control card<br>Add-on CPU card<br>Front-side memory I/F card | Export Trade Control Order noncompliant unit and Foreign Exchange Order compliant unit |

# 3.2 Display Unit [M800S]

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

# 3.3 Keyboard Unit [M800S]

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

# 3.4 Operation Panel I/O Unit

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

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

# 3.5 Remote I/O Unit

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

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

# 3.6 Communication Expansion Unit

| Classification | Type | Components | Remarks |
|---|---|---|---|
| CC-Link expansion unit | FCU8-EX561 | CC-Link I/F PCB | CC-Link 1ch |
| PROFIBUS-DP master unit | FCU8-EX563 | PROFIBUS-DP I/F PCB | PROFIBUS-DP 1ch |
| EtherNet/IP<br>Scanner/adapter unit | FCU8-EX565 | Base card<br>Add-on card | EtherNet/IP 1ch<br>(Only LAN1, LAN2 cannot be used) |

| Classification | Type | Components | Remarks |
|---|---|---|---|
| Option Relay Unit | FCU8-EX702 | Relay PCB | Communication expansion unit for 1ch |
| Option Relay Unit | FCU8-EX703 | Relay PCB | Communication expansion unit for 2ch |

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

## 3.7 Manual Pulse Generator

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

## 3.8 Synchronous Feed Encoder

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

## 3.9 MITSUBISHI CNC Machine Operation Panel

| Classification | Type | Components | Remarks |
|---|---|---|---|
| Main panel A<br>(For 8.4-type/15-type display unit) | FCU8-KB921 | Escutcheon, key switch<br>control card<br>G054 cable, Screw cap set | Mitsubishi standard 55 key |
| Main panel B<br>(For 10.4-type display unit) | FCU8-KB923 | Escutcheon, key switch<br>control card<br>G054 cable, Screw cap set | Mitsubishi standard 55 key |
| Sub panel A<br>(Common for all display units) | FCU8-KB931 | Escutcheon<br>Emergency stop switch, Override switch<br>ON/OFF switch, Screw cap set | |

## 3.10 Handy Terminal

| Classification | Type | Components | Remarks |
|---|---|---|---|
| Handy Terminal | HG1T-SB12UH-<br>MK1346-L5 | | |

## 3.11 Cable Connector Sets

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

## 3.12 Thermistor Sets

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

## 3.13 Genuine Memory Card

| Classification | Type | Components | Remarks |
|---|---|---|---|
| Exclusive SD cards for MITSUBISHI CNC 1GB | FCU8-SD001G | FCU8-SD001G | 1GB capacity |
| Exclusive SD cards for MITSUBISHI CNC 4GB | FCU8-SD004G | FCU8-SD004G | 4GB capacity |

## 3.14 Durable Parts

| Durable parts | Part type |
|---|---|
| Battery for control unit | Q6BAT |

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

## 3.15 Replacements

| Replacements | Part type | Manufacturer |
|---|---|---|
| Protection fuse for control unit | LM40 | Daito Communication Apparatus Co., Ltd. |
| Protection fuse for operation panel I/O | LM50 | Daito Communication Apparatus Co., Ltd. |
| Protection fuse for FCU8-DX220/230/231/651 | LM50 | Daito Communication Apparatus Co., Ltd. |
| Protection fuse for FCU8-DX213/654/213-1/654-1 | MP63 | Daito Communication Apparatus Co., Ltd. |

# 3.16 List of Cables

**[Cable relating to NC]**

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

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

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

**[Cable Relating to Drive Unit]**

| Type | Application | Available cable length (m) | Max. cable length |
|---|---|---|---|
| CNP2E-1-xM | Motor side PLG cable<br>Spindle side accuracy detector<br>TS5690 cable | 2, 3, 4, 5, 7, 10, 15, 20, 25, 30 | 30m |
| CNP3EZ-2P-xM | Spindle side detector cable<br>OSE-1024 cable | 2, 3, 4, 5, 7, 10, 15, 20, 25, 30 | 30m |
| CNP3EZ-3P-xM | Spindle side detector cable<br>OSE-1024 cable | 2, 3, 4, 5, 7, 10, 15, 20, 25, 30 | 30m |
| CNV2E-8P-xM | For HG/HG-H,HQ/HQ-H Motor side detector cable (for D48/D51/D74) | 2, 3, 4, 5, 7, 10, 15, 20, 25, 30 | 30m |
| CNV2E-9P-xM | For HG/HG-H,HQ/HQ-H Motor side detector cable (for D48/D51/D74) | 2, 3, 4, 5, 7, 10, 15, 20, 25, 30 | 30m |
| CNV2E-D-xM | MDS-B-SD unit cable | 2, 3, 4, 5, 7, 10, 15, 20, 25, 30 | 30m |
| CNV2E-HP-xM | MDS-B-HR unit cable | 2, 3, 4, 5, 7, 10, 15, 20, 25, 30 | 30m |
| CNV2E-MB-xM | MBE405W/MBA405W cable | 2, 3, 4, 5, 7, 10, 15, 20 | 20m |
| DG30-xM | Battery cable<br>(For drive unit - Battery box,<br>For drive unit - drive unit) | 0.3, 0.5, 1, 2, 3, 5, 7, 10 | 10m |
| G380 LxM | Optical communication cable<br>For wiring between drive units (outside panel) | 5, 10, 12, 15, 20, 25, 30 | 30m |
| J395 LxM | Optical communication cable<br>For wiring between drive units (outside panel)<br>For wiring between NC-drive units | 3, 5, 7, 10 | 10m |
| J396 LxM | Optical communication cable<br>For wiring between drive units (inside panel) | 0.2, 0.3, 0.5, 1, 2, 3, 5 | 10m |
| MR-BKS1CBLxMA1-H | <200V Series><br>Brake cable for HG96<br>Lead out in direction of motor shaft | 2, 3, 5, 7, 10 | 10m |
| MR-BKS1CBLxMA2-H | <200V Series><br>Brake cable for HG96<br>Lead out in opposite direction of motor shaft | 2, 3, 5, 7, 10 | 10m |
| MR-BT6V2CBL LxM | Battery cable (MDS-EJ/EJH)<br>(For drive unit - drive unit) | 0.3, 1 | 1m |
| MR-D05UDL3M-B | STO cable | 3 | 3m |
| MR-PWS1CBLxMA1-H | <200V Series><br>Power cable for HG96<br>Lead out in direction of motor shaft | 2, 3, 5, 7, 10 | 10m |
| MR-PWS1CBLxMA2-H | <200V Series><br>Power cable for HG96<br>Lead out in opposite direction of motor shaft | 2, 3, 5, 7, 10 | 10m |
| SH21 LxM | Power supply communication cable<br>Power backup unit communication cable | 0.35, 0.5, 1, 2, 3 | 30m |

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

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

# 4

# General Specifications (M800S Series)

# 4.1 Environment Conditions [M800S]

## 4.1.1 Installation Environment Conditions

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

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

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

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

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

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

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

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

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

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

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

| Item | Unit name | | Remote I/O unit | | | | |
|---|---|---|---|---|---|---|---|
| | Type | | FCU8-DX220/ DX230/ DX231 | FCU8-DX202 | FCU8-DX213/ DX213-1/ DX654/ DX654-1 | FCU8-DX408 | FCU8-DX651 |
| General Specifications | Ambient temperature | During operation | 0 to 58°C | | | | |
| | | During storage | -20 to 60°C | | | | |
| | Ambient humidity | Long term | 10 to 75% RH (with no dew condensation) | | | | |
| | | Short term | 10 to 95% RH (with no dew condensation) (Note 1) | | | | 10 to 85% RH (with no dew condensation) (Note 1) |
| | Vibration resistance | | $4.9m/s^2$ or less | | | | |
| | Shock resistance | | $29.4m/s^2$ or less | | | | |
| | Working atmosphere | | No corrosive gases, dust or oil mist | | | | |
| | Altitude | | Operation/Storage: 1000 meters or less above sea level, Transportation: 13000 meters or less above sea level | | | | |
| | Power supply voltage | | 24VDC | | | | |
| | Current consumption | | 3.5A (Note 2) | 0.3A | 0.3A (Note 3) | 0.1A | 3.7A (Note 2) |
| | Heating value | (max) | 8W (Note 4) | | | | |
| | Mass | (kg) | 0.4 | | | 0.2 | 0.8 |
| | Outline dimension W×H×D | (mm) | 40×175×133 | 40×175×119 | 40×175×130 | 40×175×109 | 172×100×115 |

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

### 4.1.2 24VDC Stabilized Power Supply Selecting Conditions

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

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

**⚠ CAUTION**

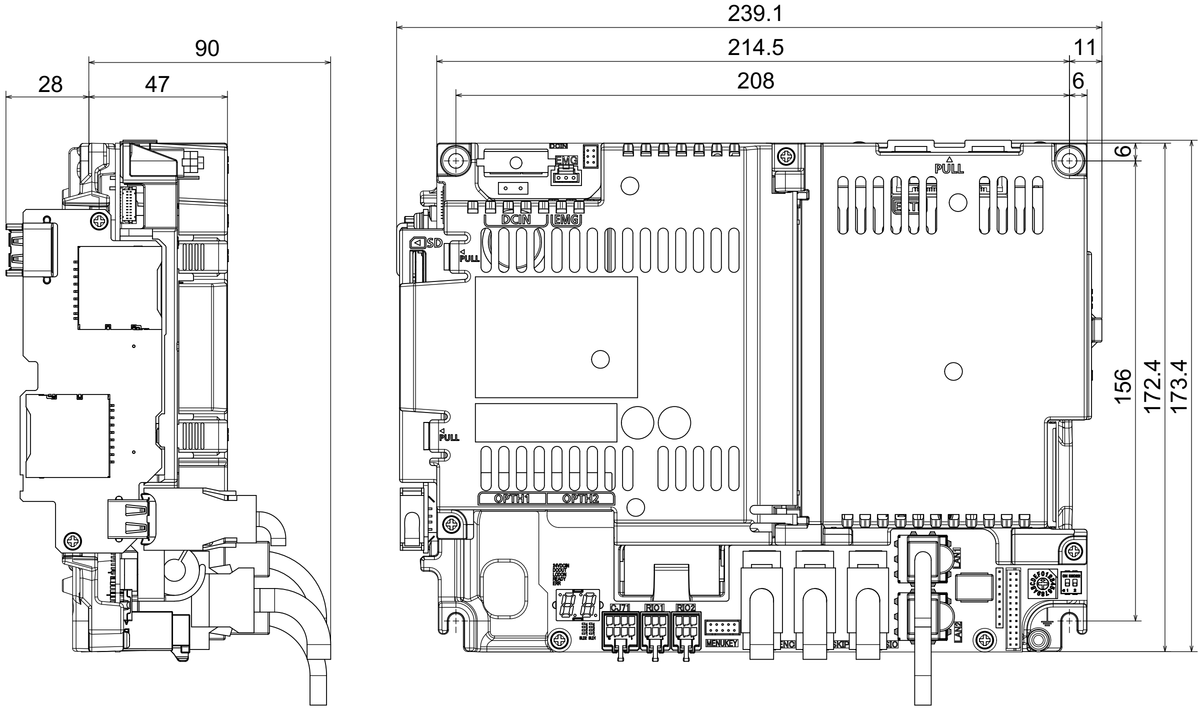
**1. Using a stabilized power supply without overcurrent protection may cause the unit's failure due to miswiring of 24V.**

# 4.2 Control Unit [M800S]

## 4.2.1 FCU8-MU542 / FCU8-MA542 / FCU8-MU541 / FCU8-MA541

**[Outline dimension]**

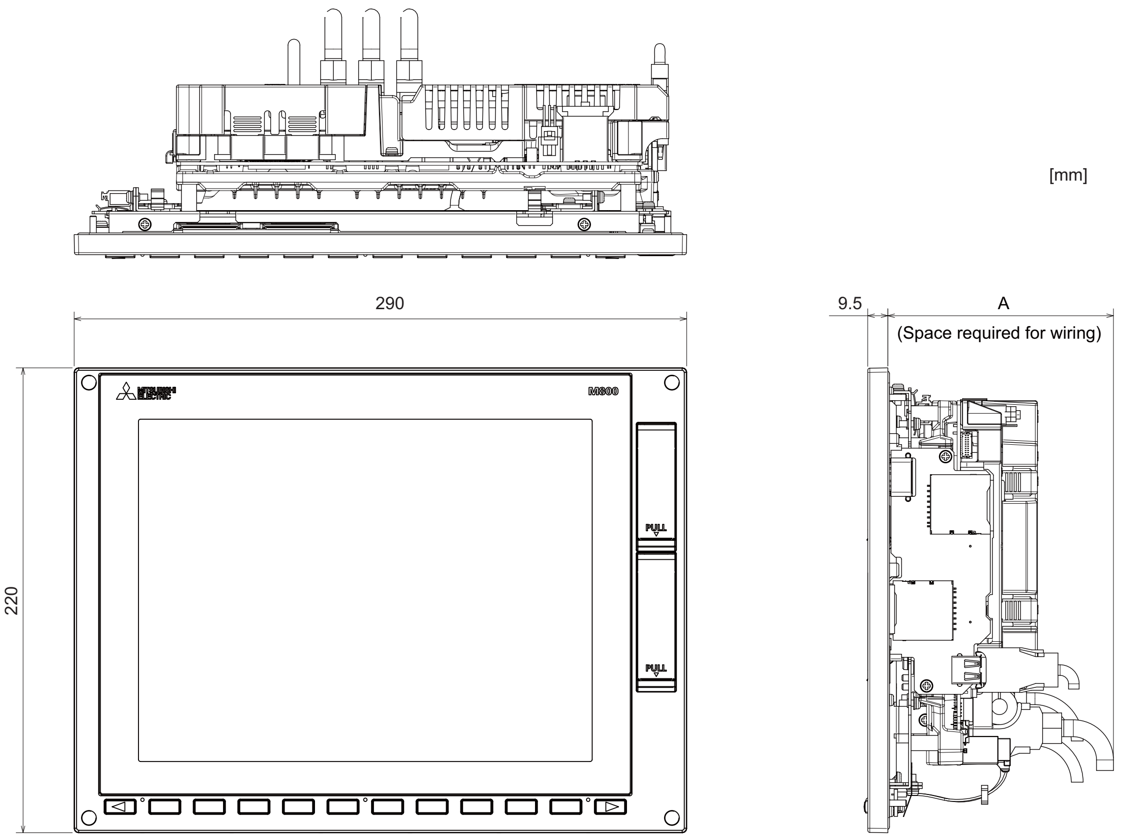
[mm]



# 4.3 Display Unit [M800S]

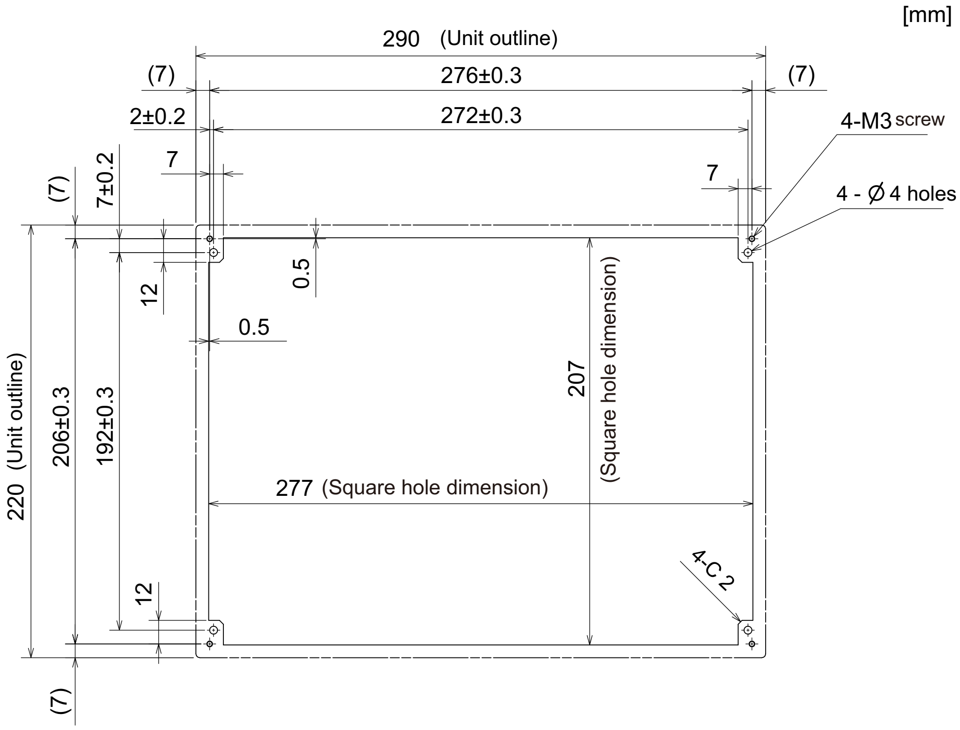
## 4.3.1 10.4-type (FCU8-DU141-31)

**[Outline dimension]**



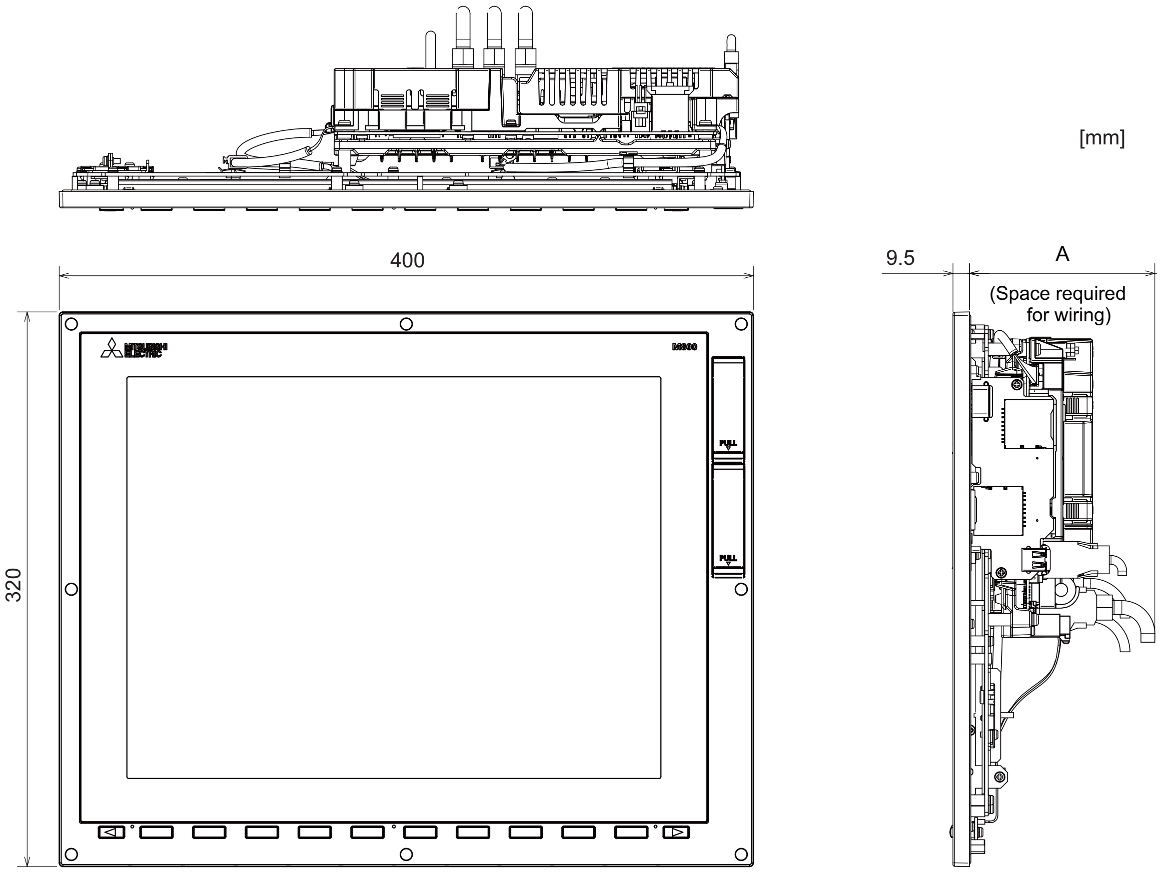

| | Option relay unit not mounted | Option relay unit, FCU8-EX702 mounted | Option relay unit, FCU8-EX703 mounted |
|---|---|---|---|
| **A (Space required for wiring)** | 110 | | 114 |

**[Panel cut dimension]**



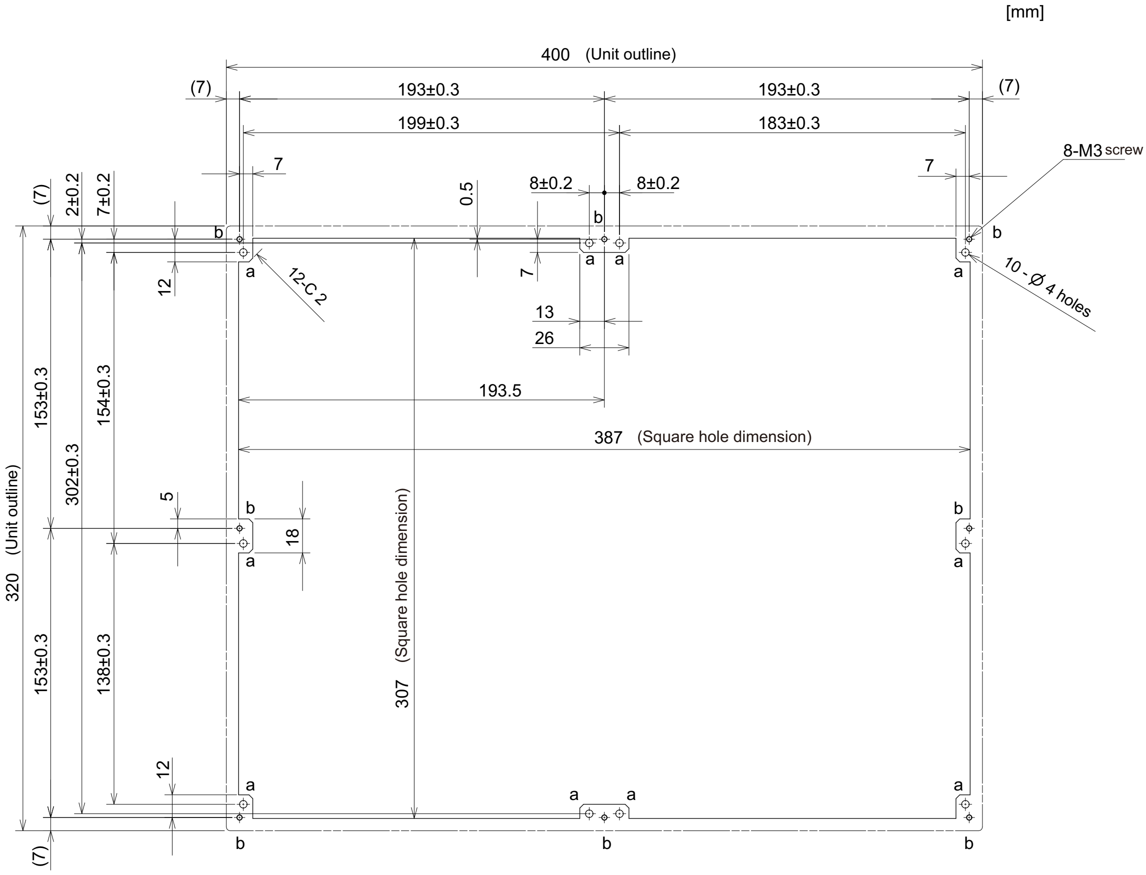
## 4.3.2 15-type (FCU8-DU181-31)

**[Outline dimension]**




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

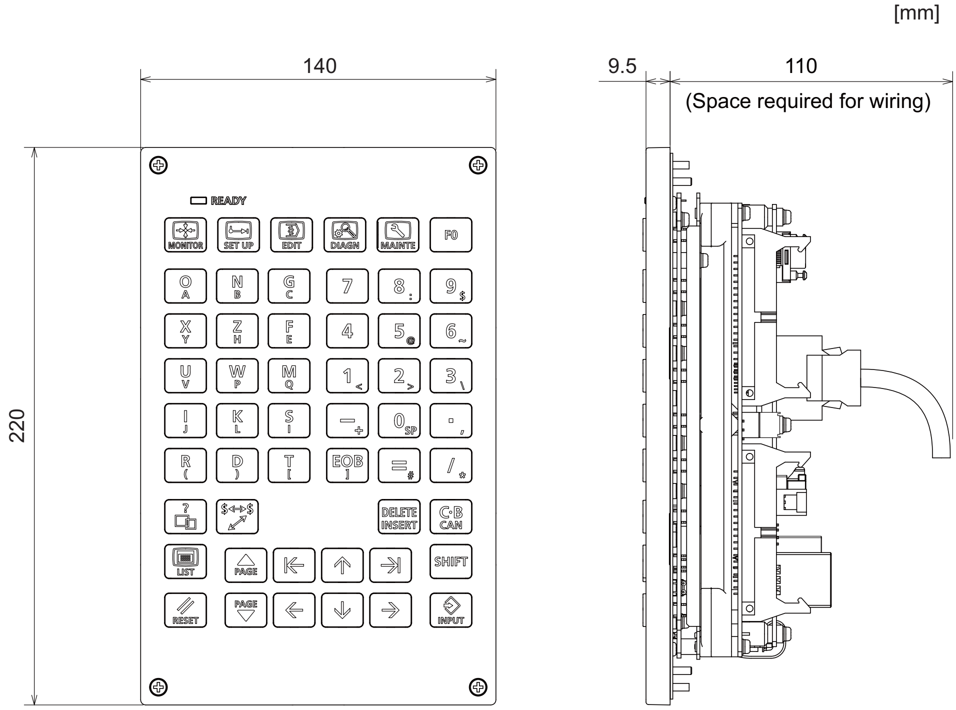
## [Panel cut dimension]



# 4.4 Keyboard Unit

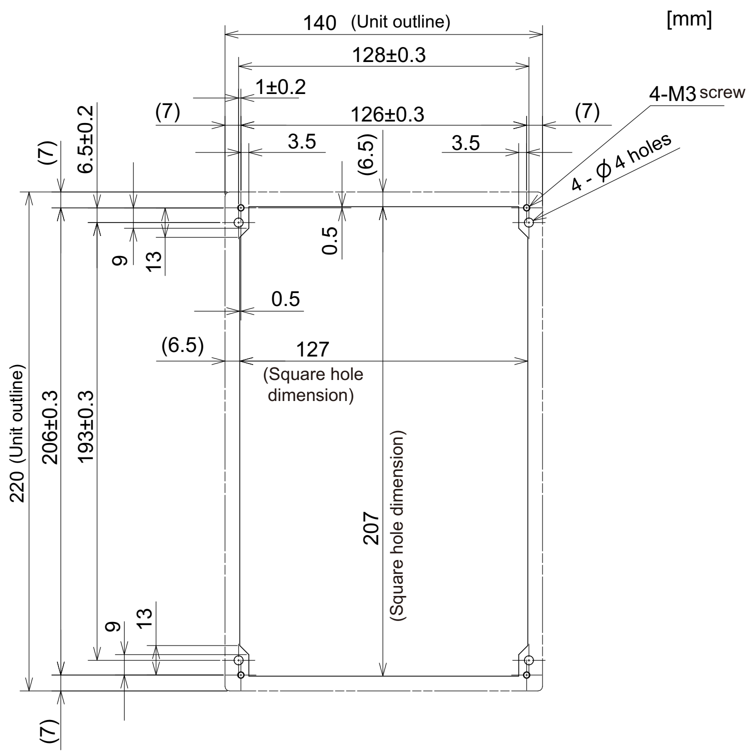
## 4.4.1 Keyboard for 10.4-type Display Unit (FCU8-KB041)

**[Outline dimension]**



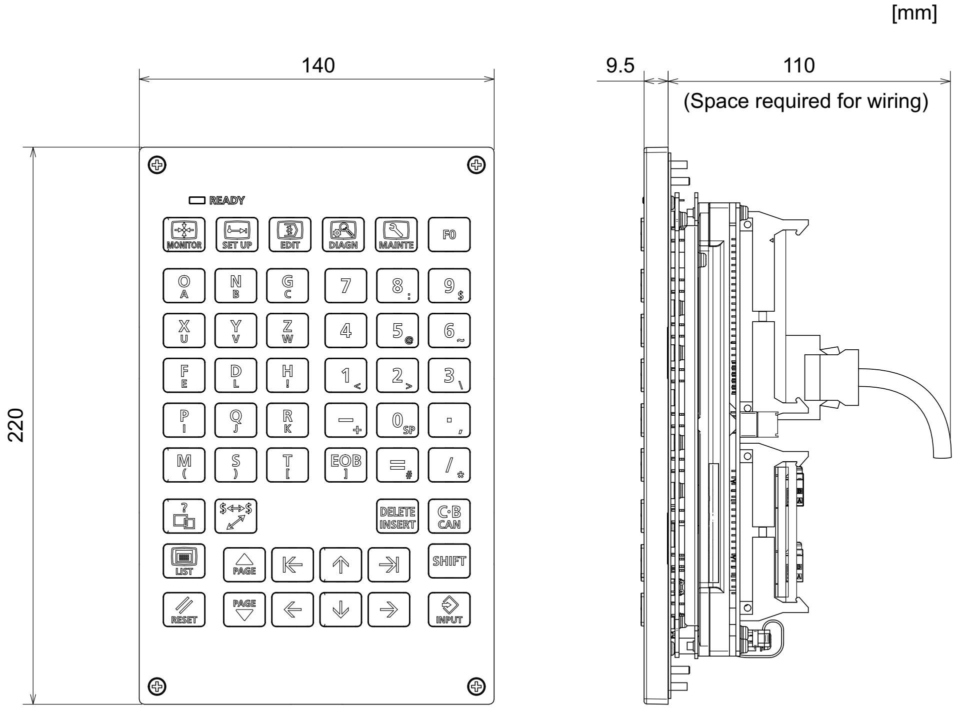

(Note) The above side view shows the state with the operation panel I/O unit mounted.

**[Panel cut dimension]**



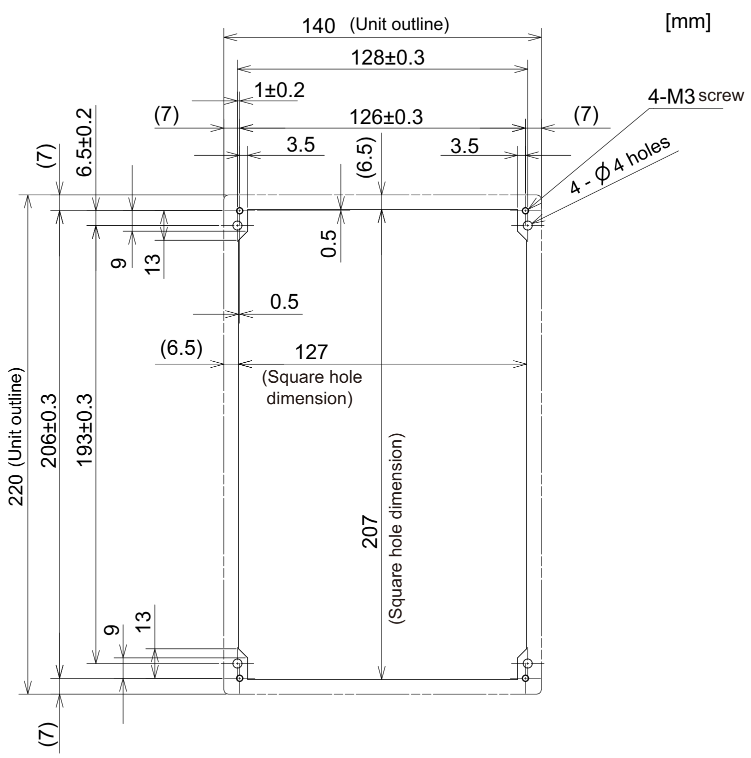
## 4.4.2 Keyboard for 10.4-type Display Unit (FCU8-KB046)

**[Outline dimension]**




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

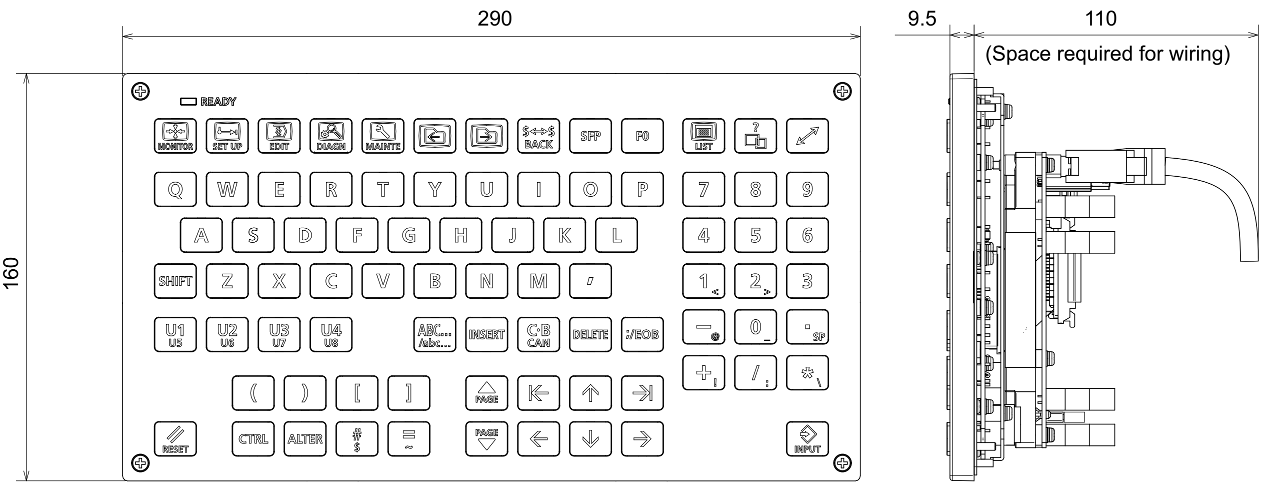
**[Panel cut dimension]**



## 4.4.3 Keyboard for 10.4-type Display Unit (FCU8-KB047)

**[Outline dimension]**

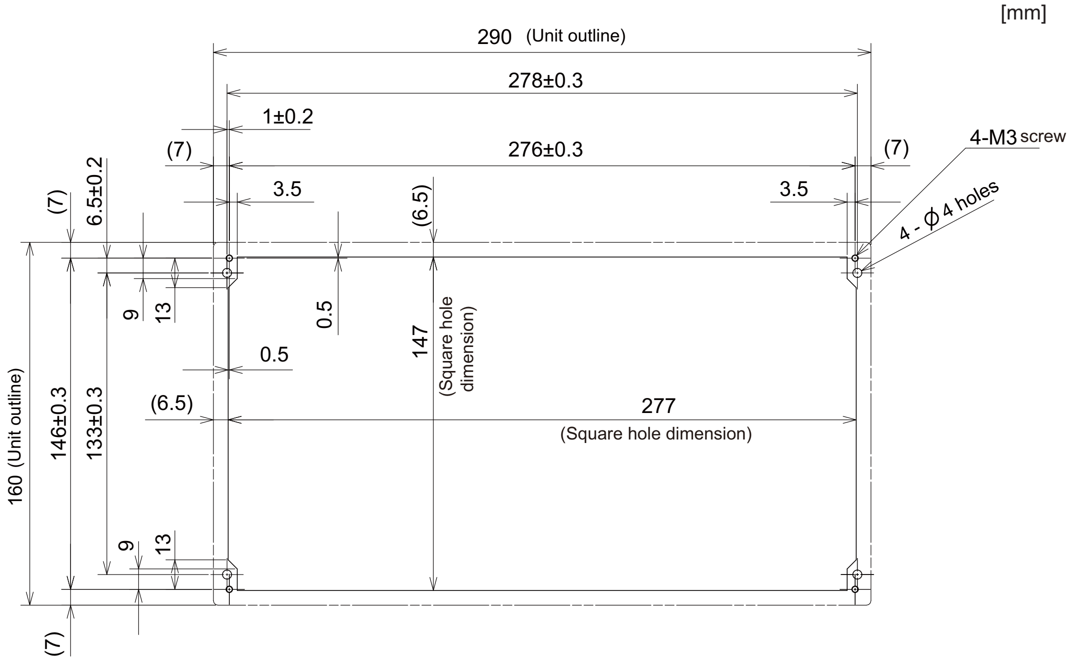
[mm]




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

**[Panel cut dimension]**

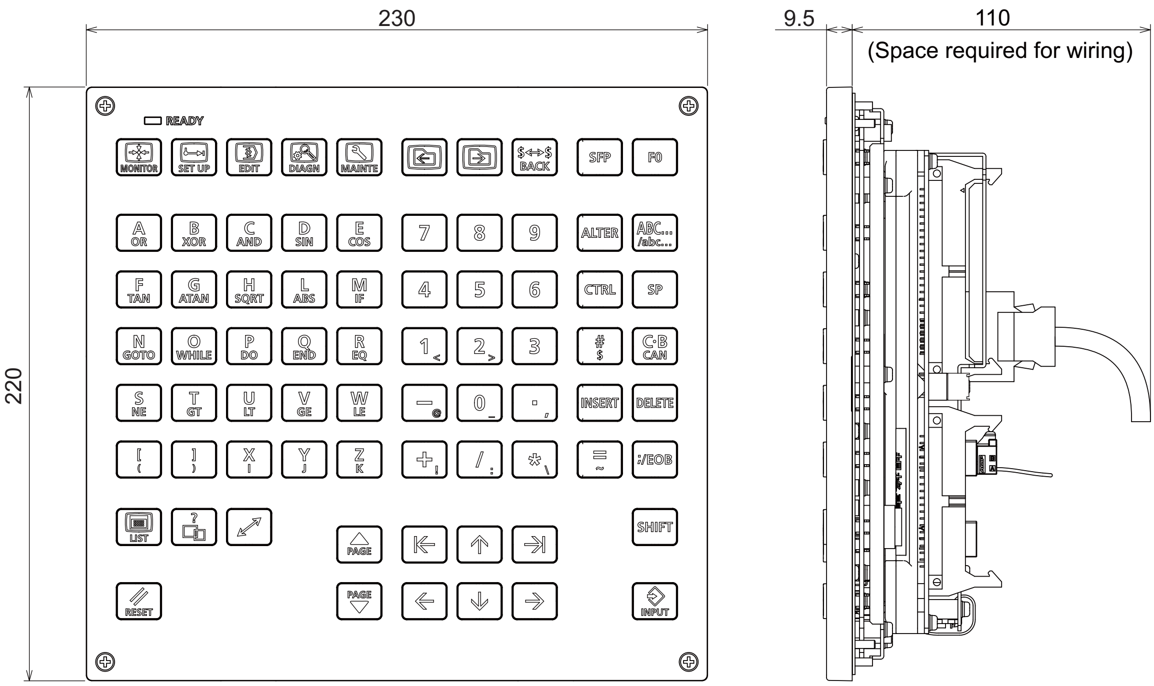
[mm]



## 4.4.4 Keyboard for 10.4-type Display Unit (FCU8-KB048)

**[Outline dimension]**

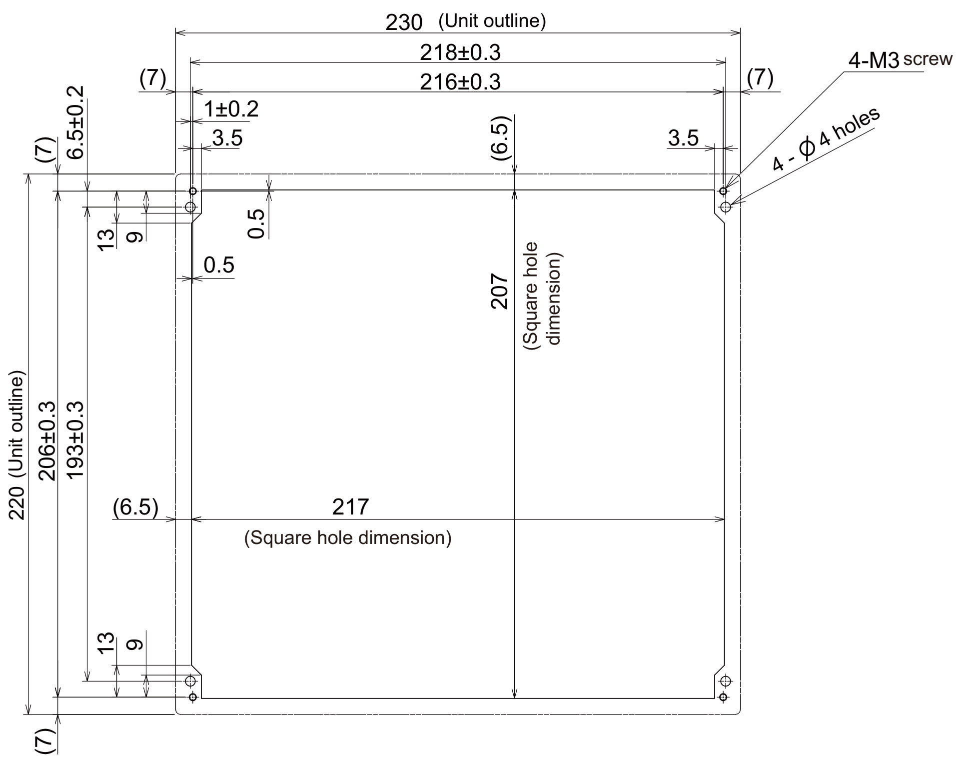
[mm]




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

**[Panel cut dimension]**

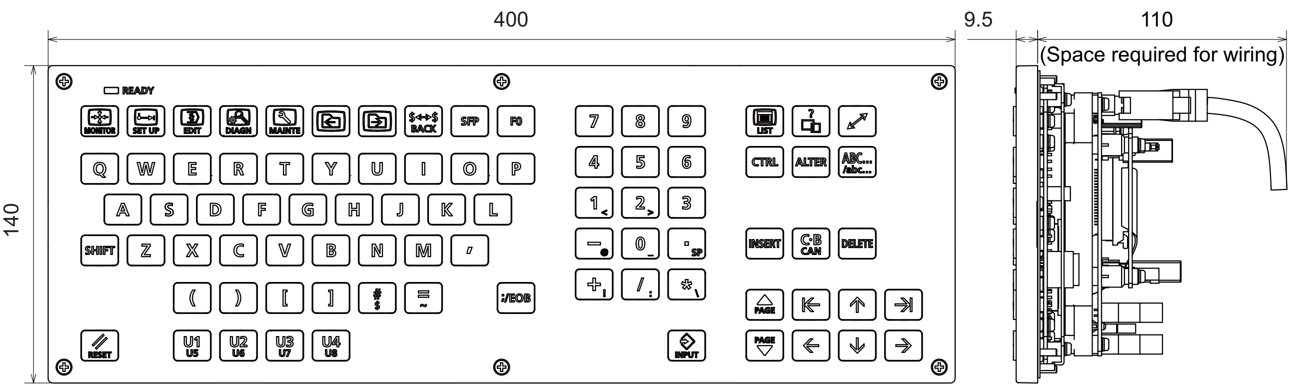
[mm]



### 4.4.5 Keyboard for 15-type Display Unit (FCU8-KB083)

**[Outline dimension]**

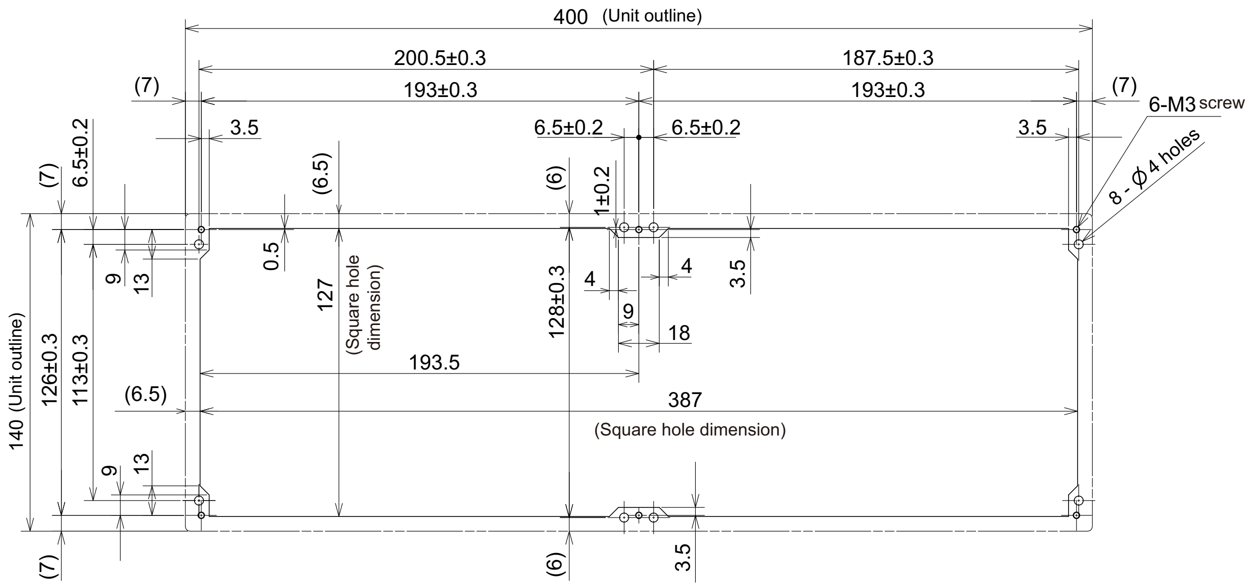
[mm]




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

**[Panel cut dimension]**

[mm]



# 4.5 Operation Panel I/O Unit

Characteristics of operation panel I/O unit are as follows.

(1) The followings can be connected to the operation panel I/O unit.
  (a) Remote I/O interface ... 1ch
    Input/output signals can be extended with Remote I/O units.
  (b) Manual pulse generator ... 3ch
    5V and 12V manual pulse generators can be connected.
(2) The operation panel I/O unit can be mounted on the back side of the keyboard unit.
  This contributes to space saving inside the operation panel.
(3) DO output can output 200mA/point.
  For FCU8-DX750/DX761, total output current of whole unit is 3.8A at the maximum.
  For FCU8-DX760, total output current of whole unit is 5.7A at the maximum.

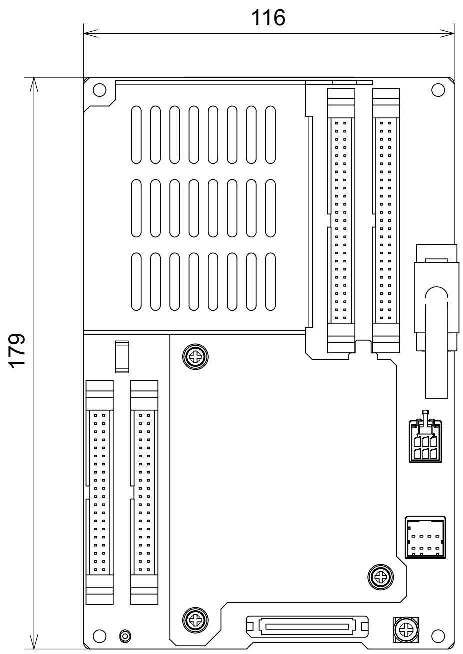
(Note 1) The maximum connectable number of remote I/O units is 32.
(Note 2) Set the number of DI points that are simultaneously turned ON to be less than half of the total points.
If many points are set to be simultaneously turned ON, operation panel I/O unit may be deteriorated due to the heat.

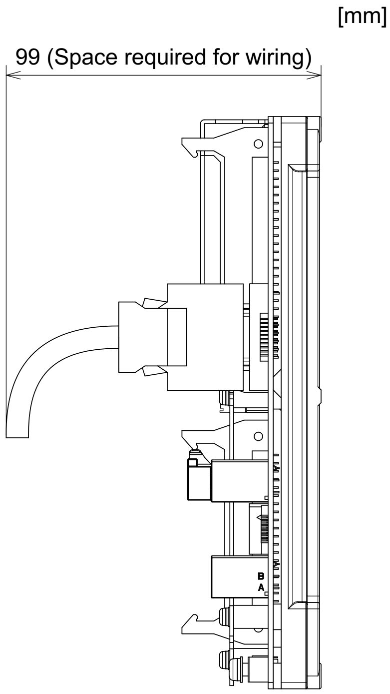
## 4.5.1 List of Units

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

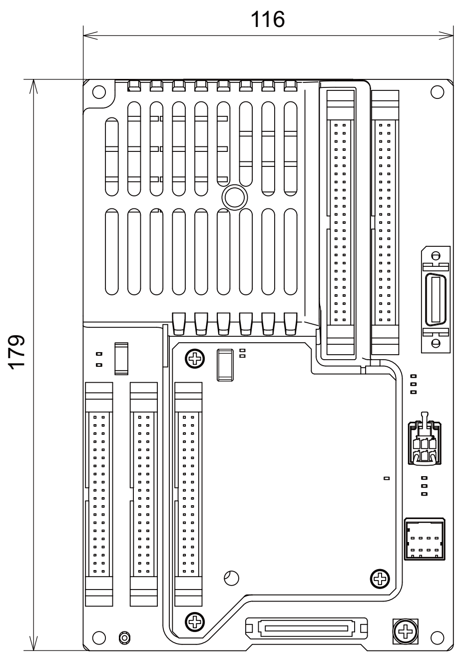
## 4.5.2 FCU8-DX750/ FCU8-DX760 / FCU8-DX761

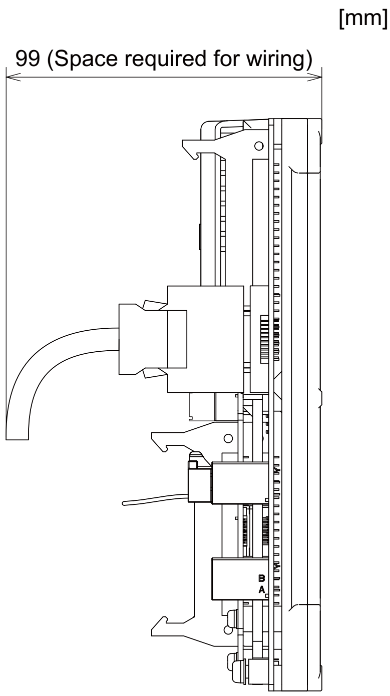
### [Outline dimension : FCU8-DX750]



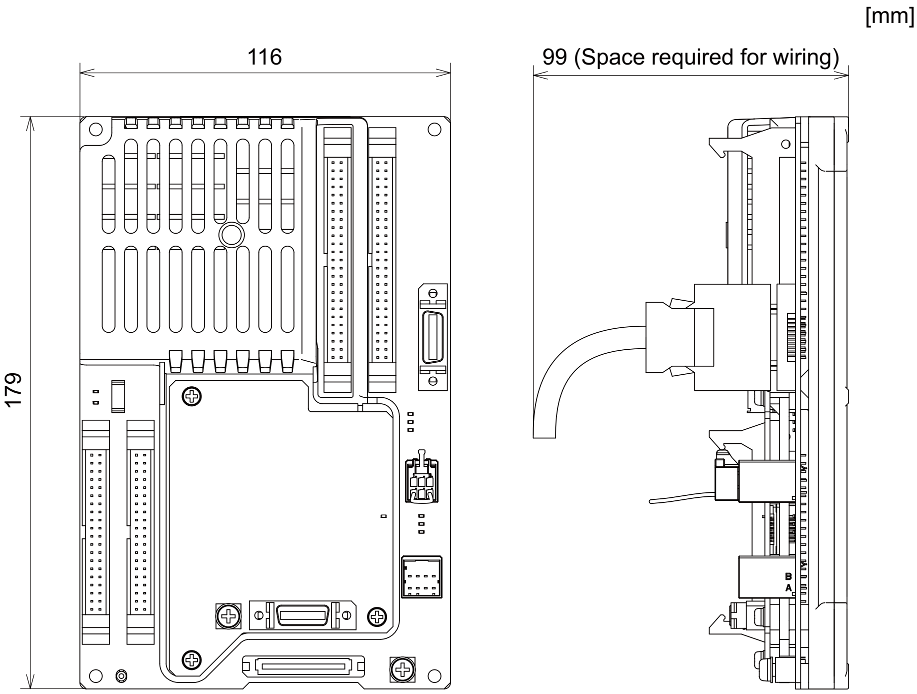




### [Outline dimension : FCU8-DX760]

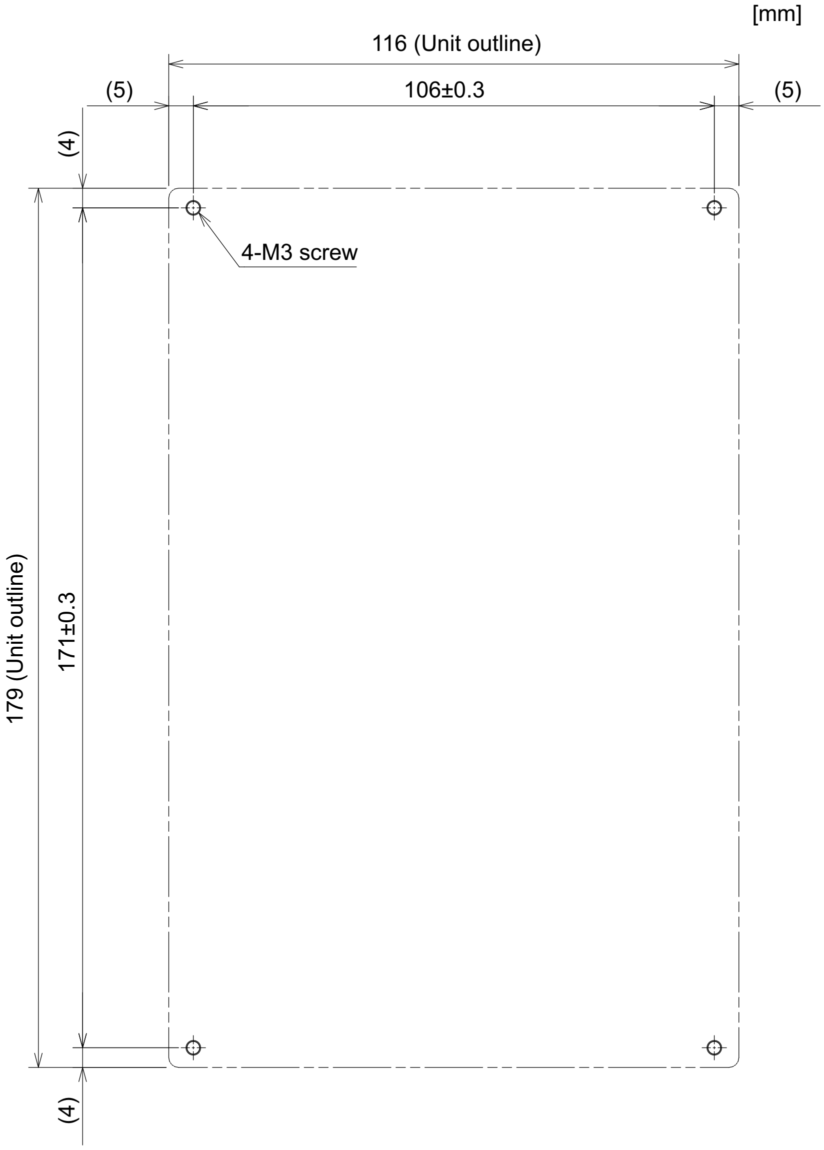


**[Outline dimension : FCU8-DX761]**



**[Installation dimension: FCU8-DX750 / FCU8-DX760 / FCU8-DX761]**




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

# 4.6 Remote I/O Unit

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

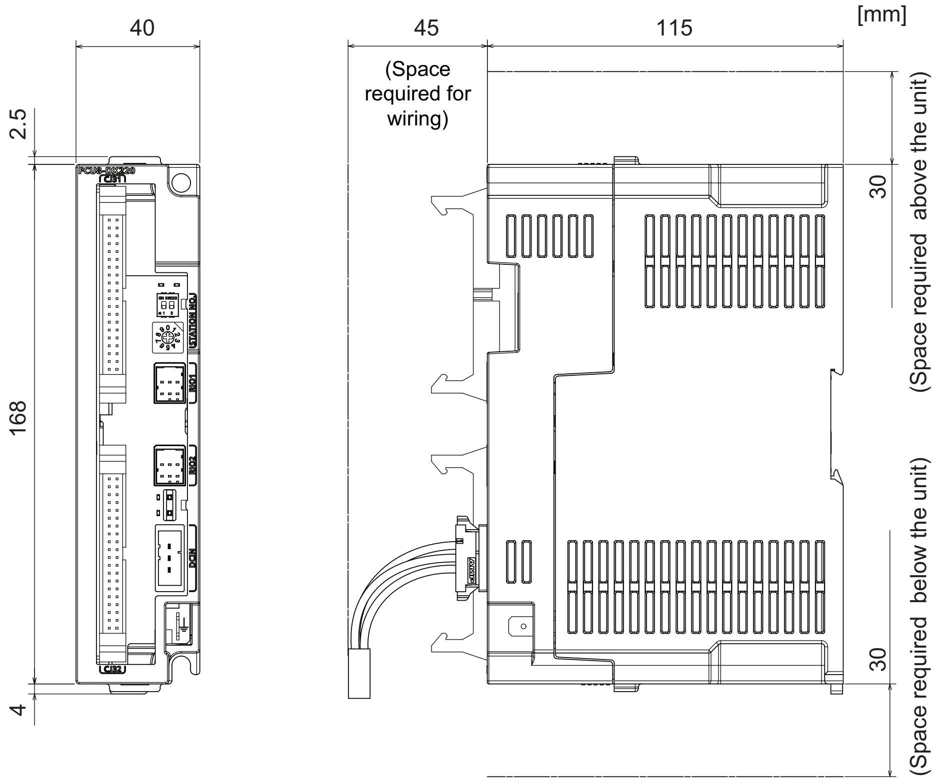
(Note) The maximum connectable number of remote I/O units is 32.

## 4.6.1 List of Units

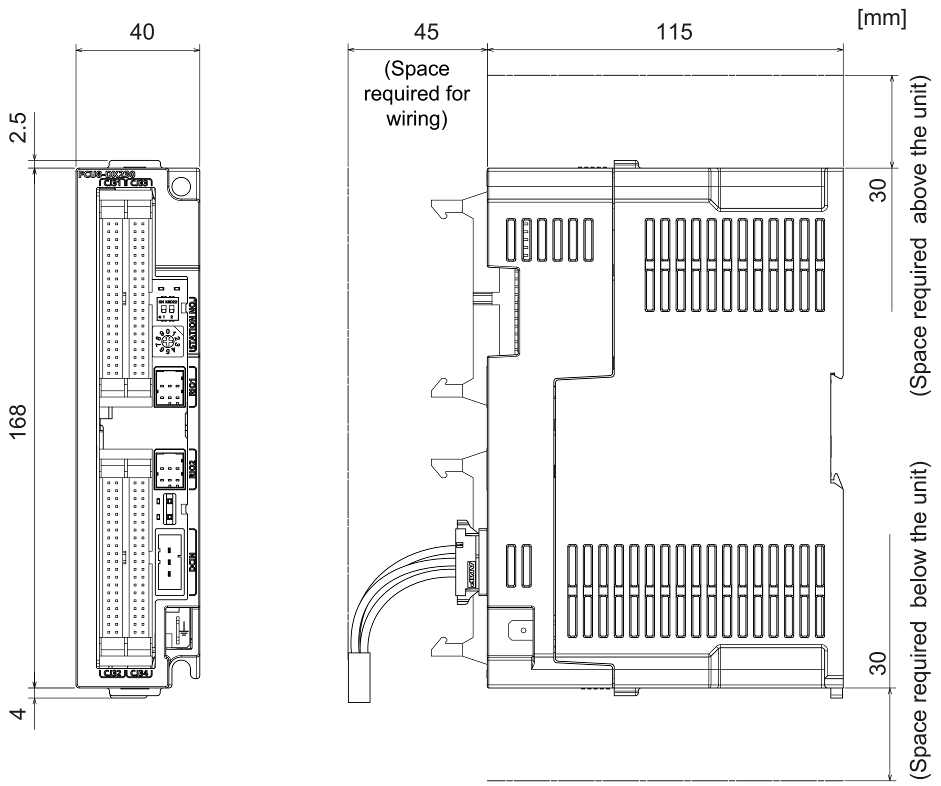
| Classification | Type | Components | Remarks |
|---|---|---|---|
| DI 24V/0V common input [32 points]<br>DO Source output [32 points] | FCU8-DX220 | Base card<br>RIO 2.0 connector set | DI: 32-points 24V/0V common type<br>Do: 32-points source type (200mA/point)<br>Number of occupied stations: 1 |
|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

### 4.6.2 FCU8-DX220 / FCU8-DX230 / FCU8-DX231 / FCU8-DX202 / FCU8-DX213 / FCU8-DX213-1 / FCU8-DX654 / FCU8-DX654-1 / FCU8-DX651/ FCU8-DX408

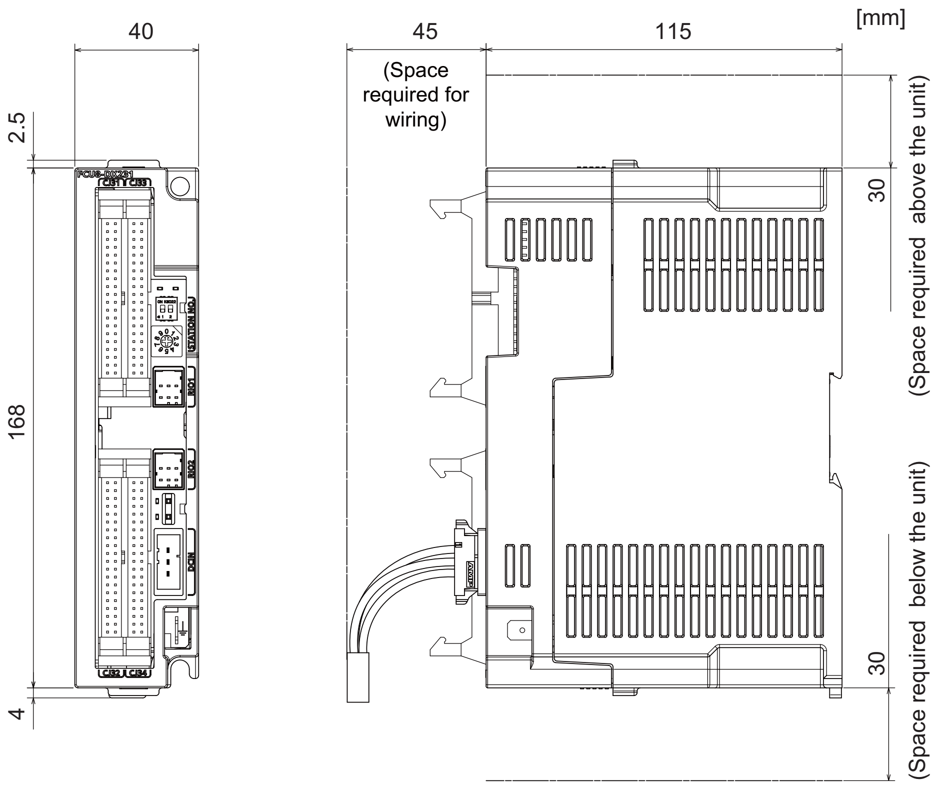
**[Outline dimension : FCU8-DX220]**



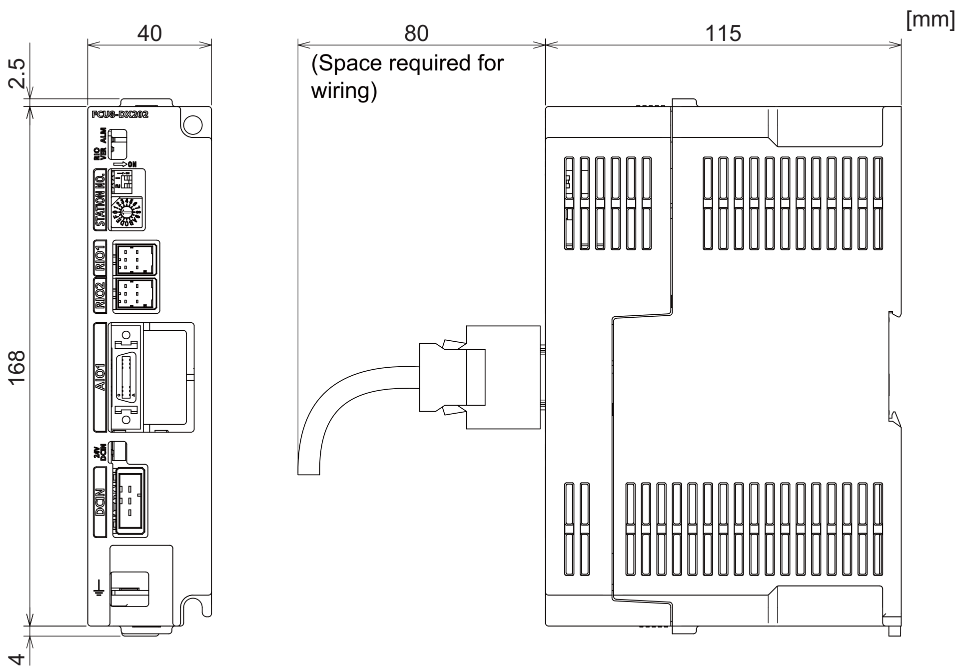

**[Outline dimension : FCU8-DX230]**



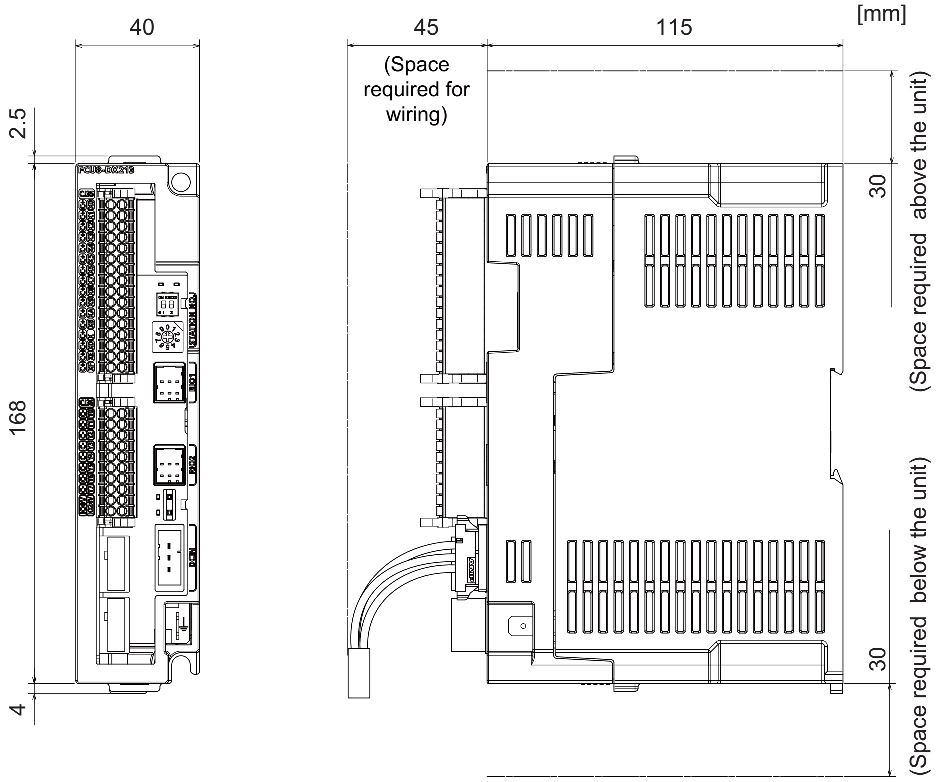
[Outline dimension : FCU8-DX231]



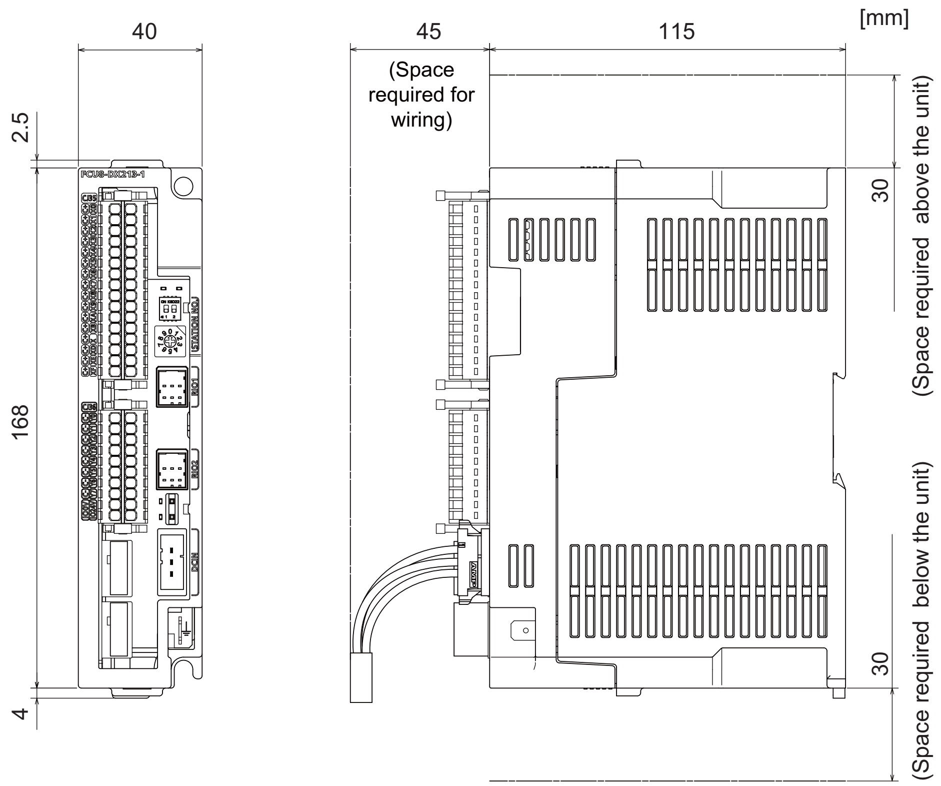

[Outline dimension : FCU8-DX202]



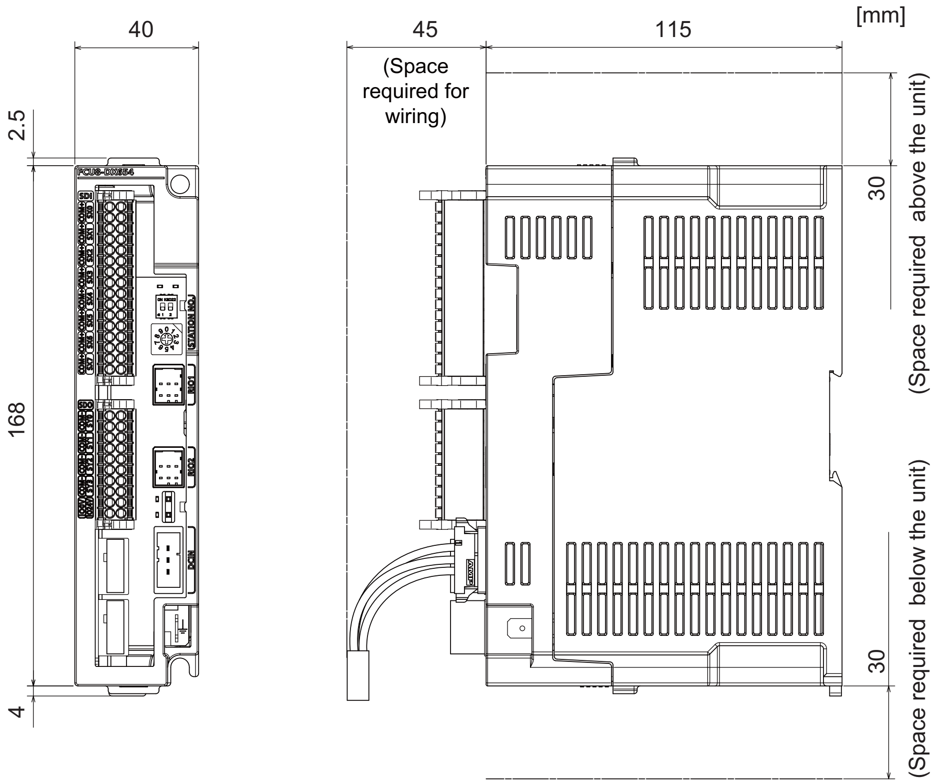
**[Outline dimension : FCU8-DX213]**



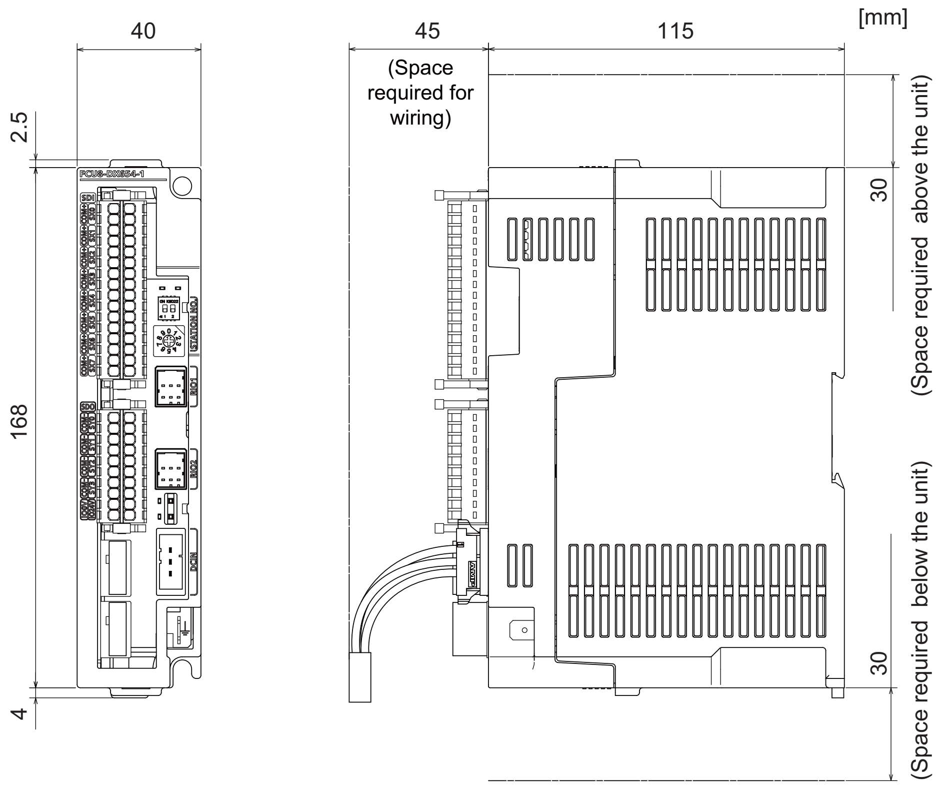

**[Outline dimension : FCU8-DX213-1]**



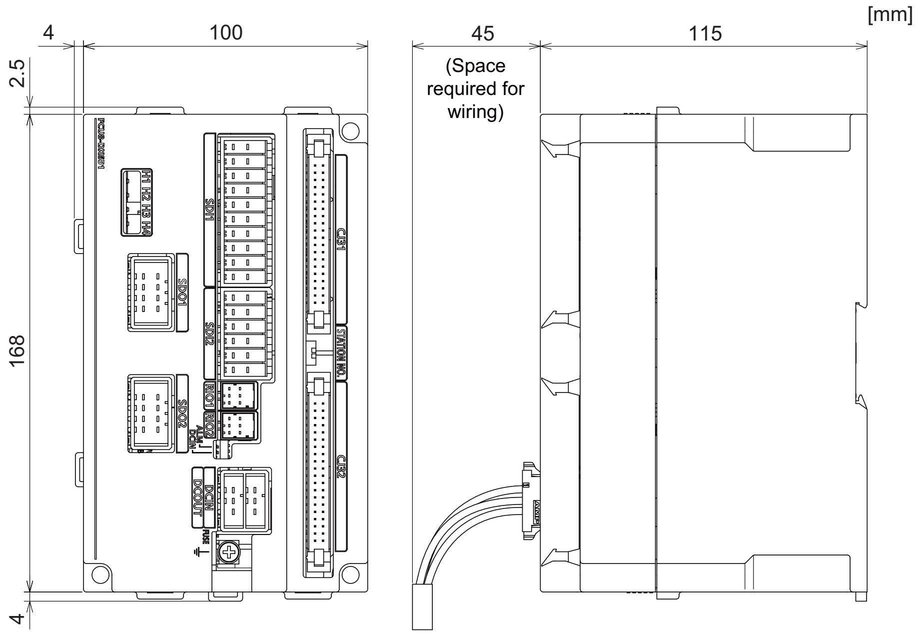
**[Outline dimension : FCU8-DX654]**



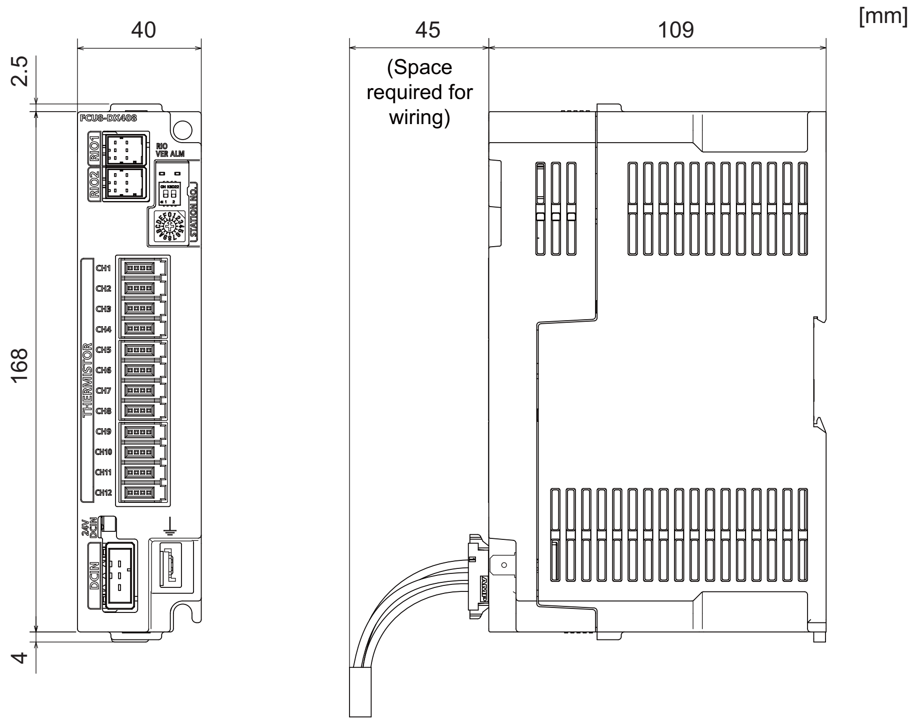

**[Outline dimension : FCU8-DX654-1]**



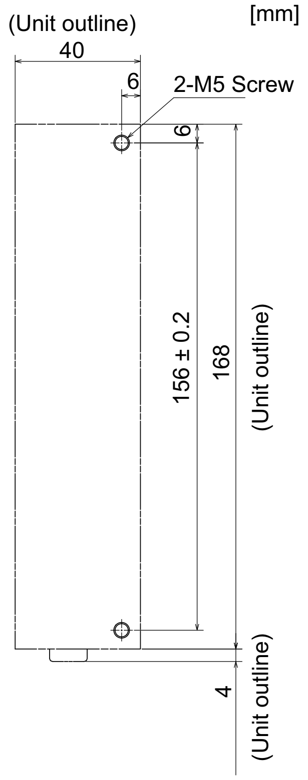
[Outline dimension : FCU8-DX651]



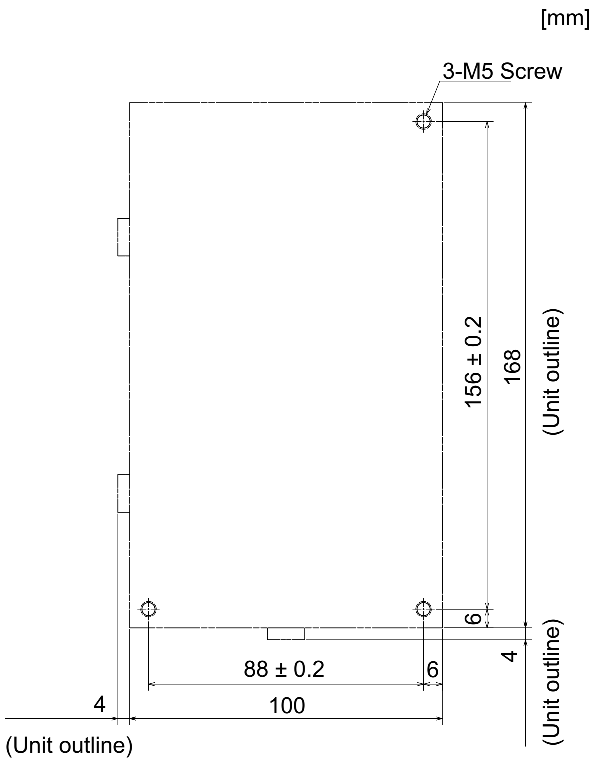

[Outline dimension : FCU8-DX408]



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




**[Installation dimension : FCU8-DX651]**

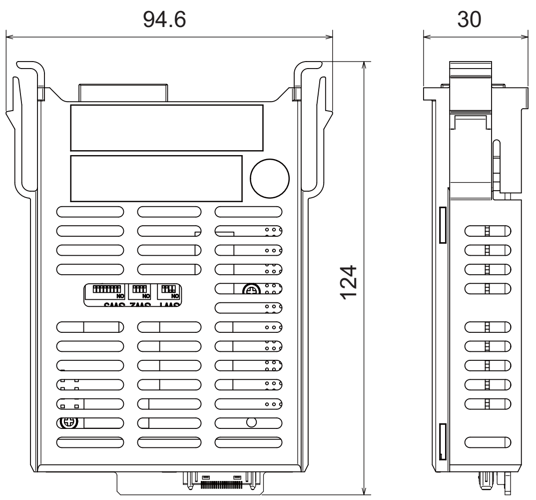


# 4.7 Communication Expansion Unit

## 4.7.1 CC-Link (FCU8-EX561)

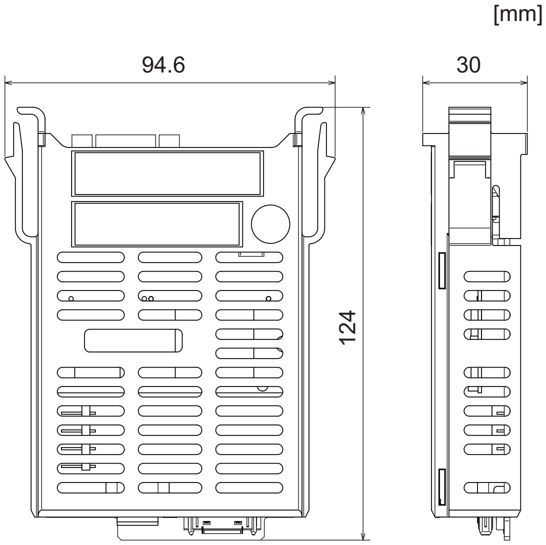
**[Outline dimension]**

[mm]



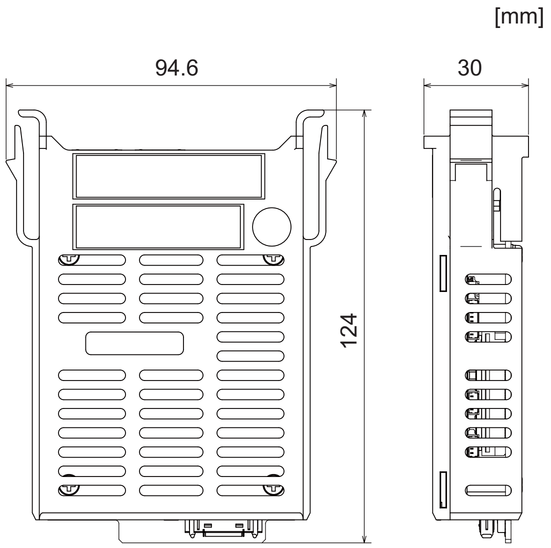
## 4.7.2 PROFIBUS-DP (FCU8-EX563)

**[Outline dimension]**



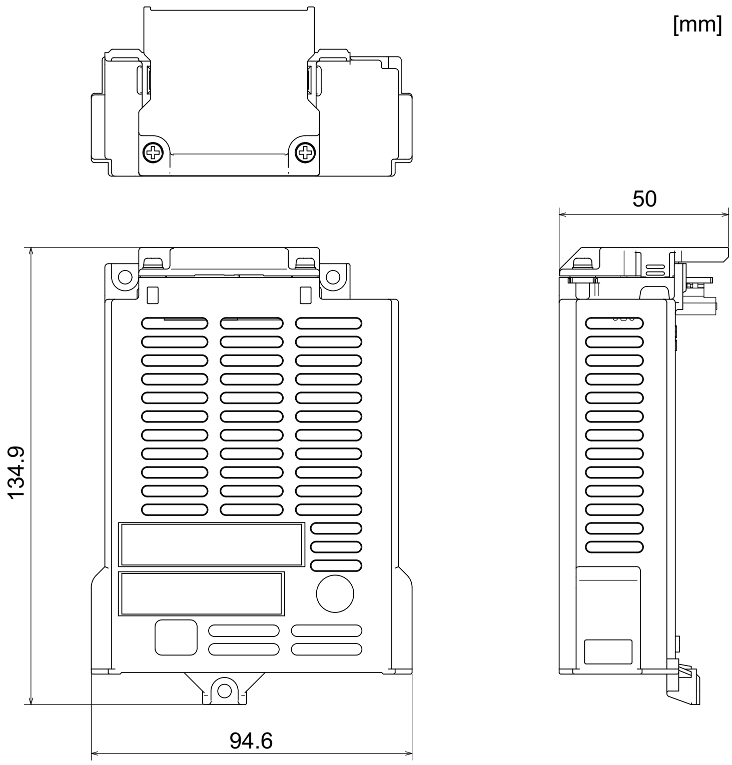
### 4.7.3 EtherNet/IP (FCU8-EX565)

**[Outline dimension]**



### 4.7.4 Option Relay Unit (FCU8-EX702)

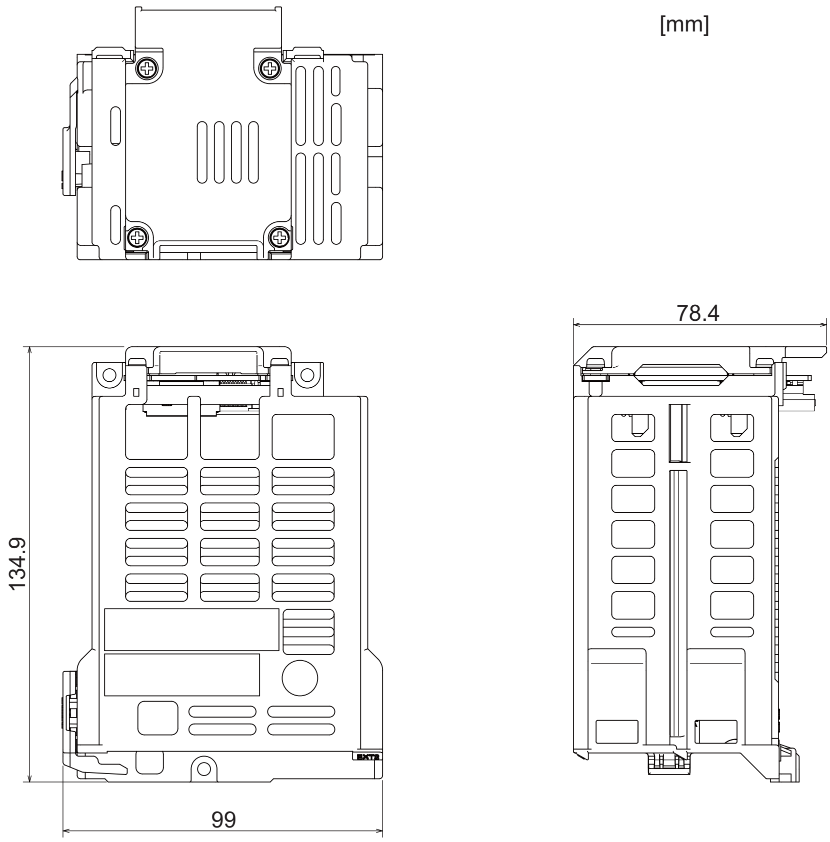
**[Outline dimension]**



### 4.7.5 Option Relay Unit (FCU8-EX703)

**[Outline dimension]**

[mm]

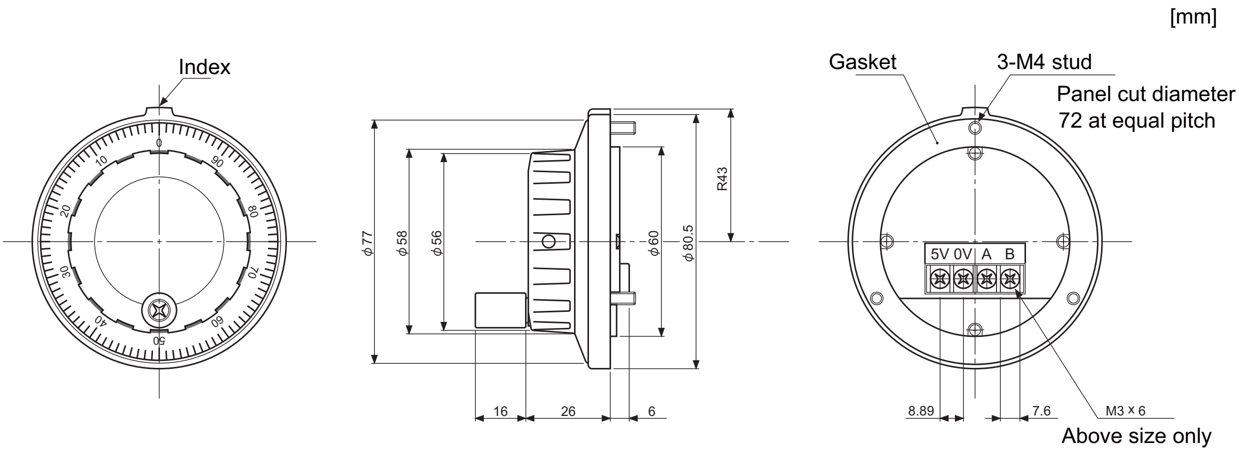


# 4.8 Manual Pulse Generator

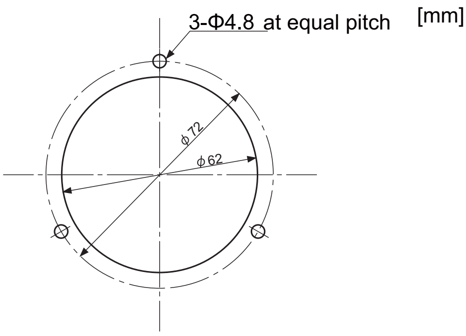
## 4.8.1 5V Manual Pulse Generator (UFO-01-2Z9)

100 pulse/rev

**[Outline dimension]**




**[Panel cut dimension]**

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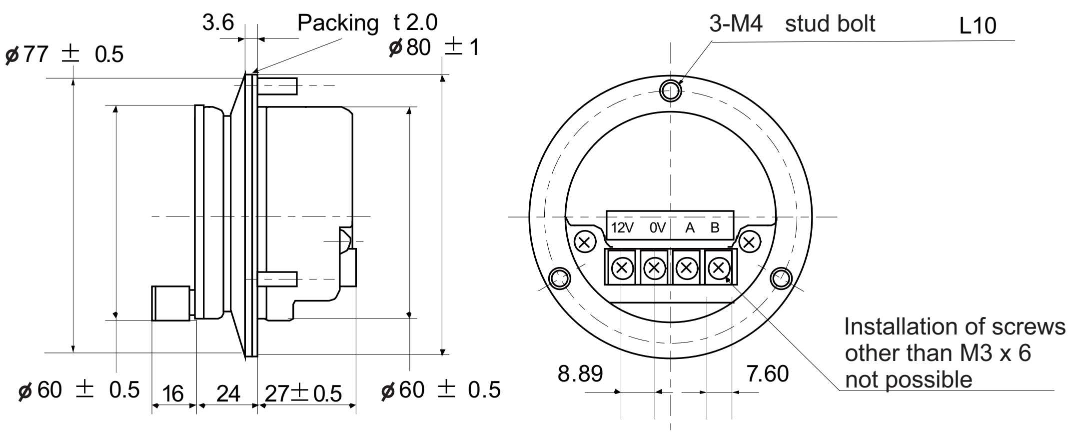
### 4.8.2 Manual Pulse Generator (HD60C)

25 pulse/rev

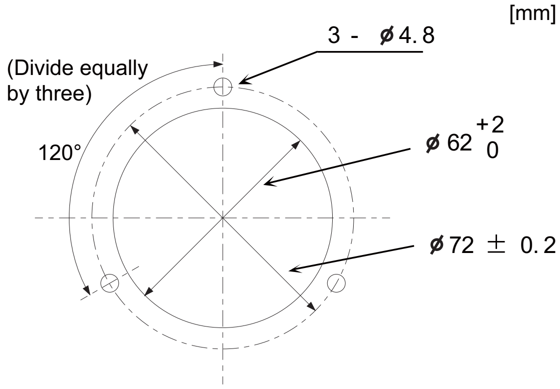
**[Outline dimension]**

[mm]




**[Panel cut dimension]**

[mm]

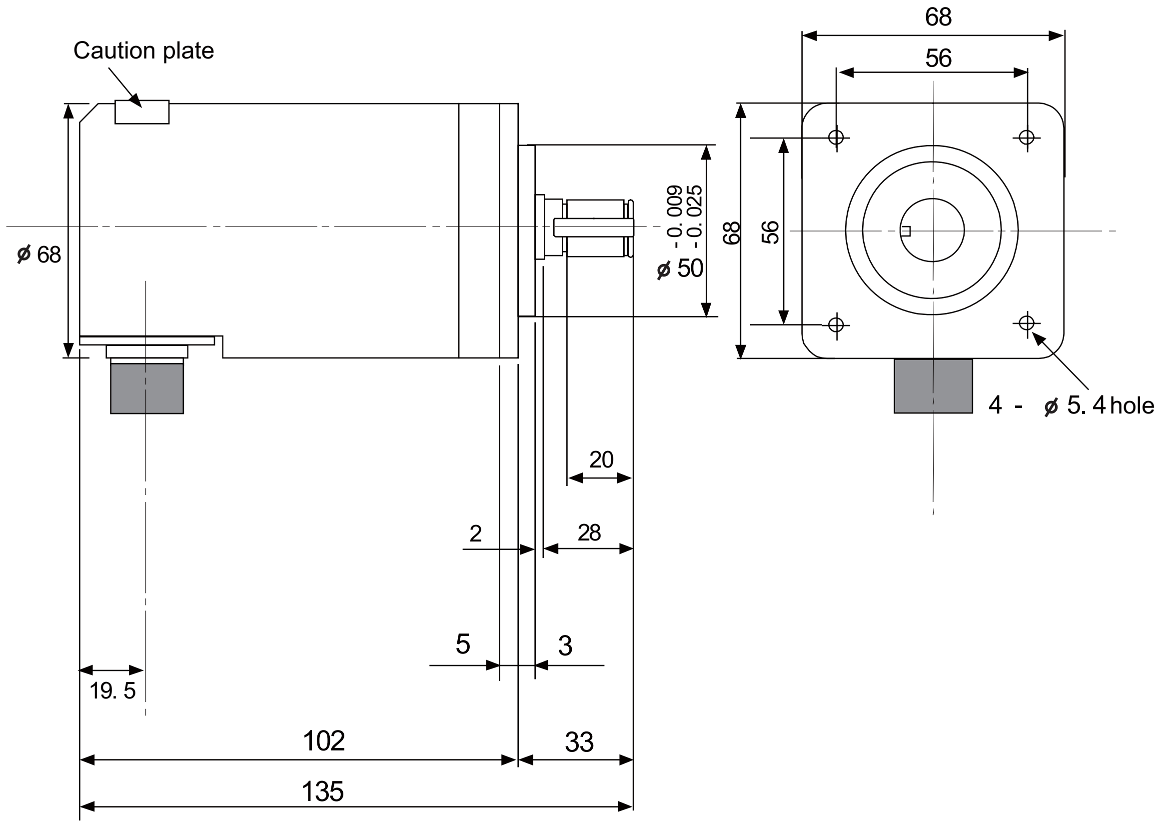


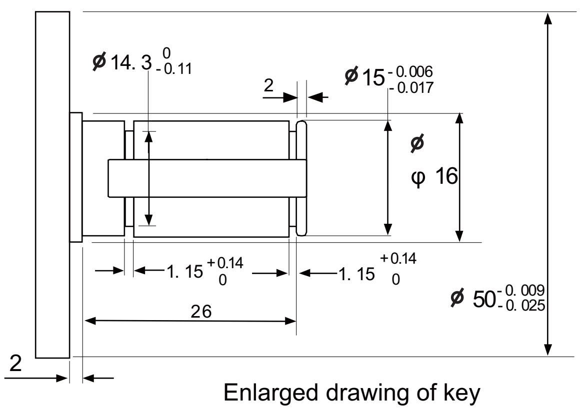
# 4.9 Synchronous Feed Encoder

## 4.9.1 Synchronous Feed Encoder (OSE-1024-3-15-68)

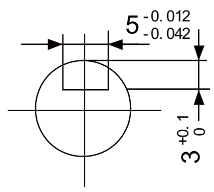
**[Outline dimension]**

[mm]



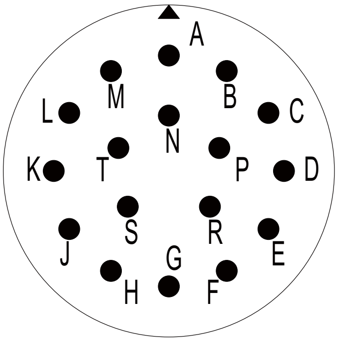




Enlarged drawing of key




Cross section BB
Valid depth of key groove is 21mm

[Connector]




**Connector pin assignment**

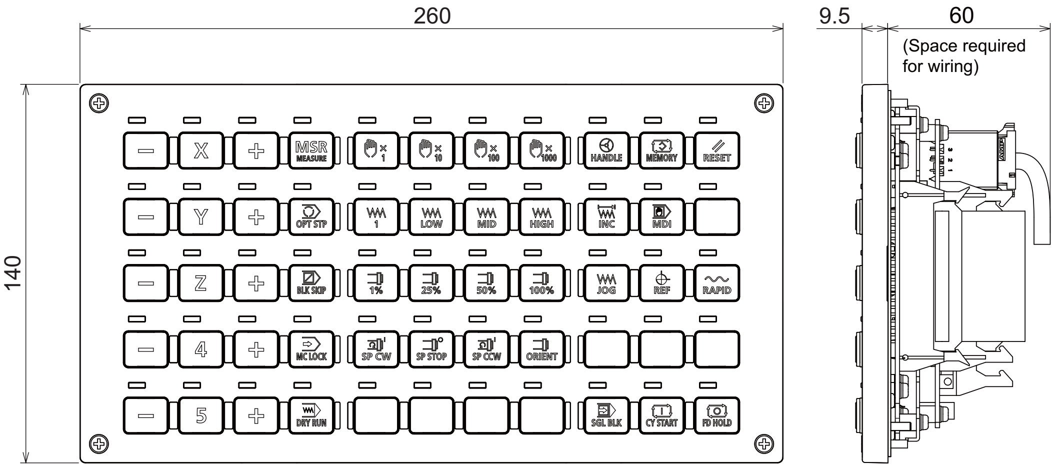
| Pin | Function | Pin | Function |
|---|---|---|---|
| **A** | A phase | **K** | 0V |
| **B** | Z phase | **L** | - |
| **C** | B phase | **M** | - |
| **D** | - | **N** | A phase reverse |
| **E** | Case grounding | **P** | Z phase reverse |
| **F** | - | **R** | B phase reverse |
| **G** | - | **S**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

# 4.10 MITSUBISHI CNC Machine Operation Panel

## 4.10.1 Main Panel A/B (FCU8-KB921 / FCU8-KB923)

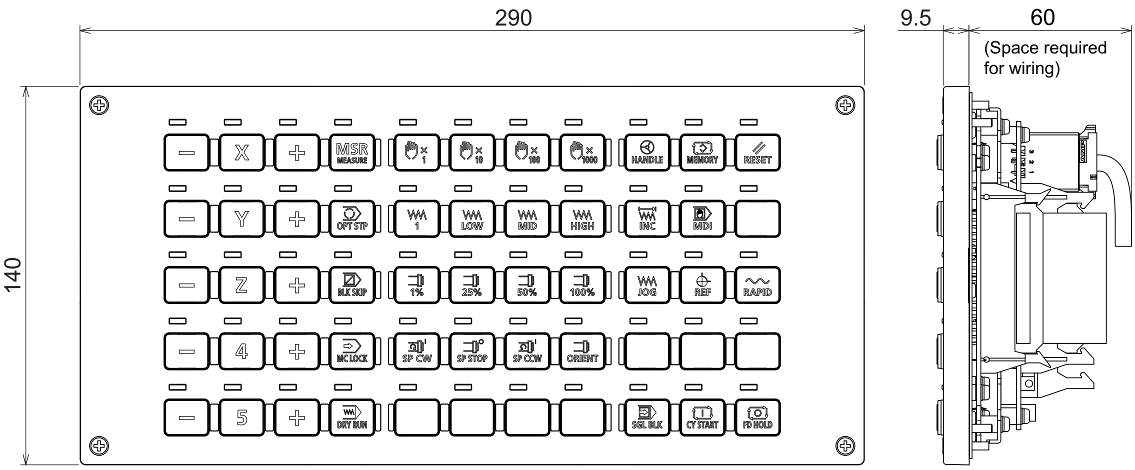
**[Outline dimension : FCU8-KB921]**

[mm]



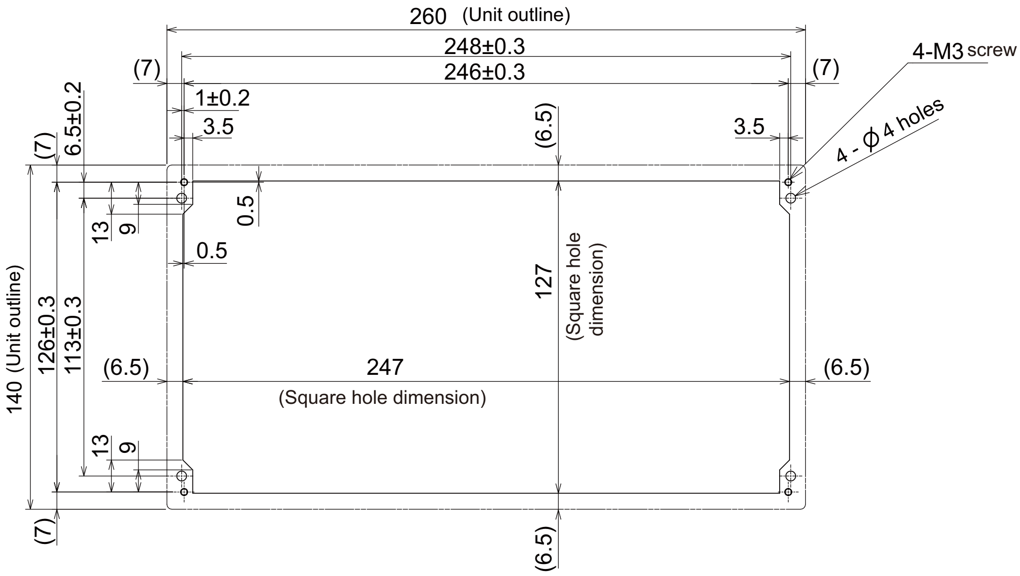

**[Outline dimension : FCU8-KB923]**

[mm]



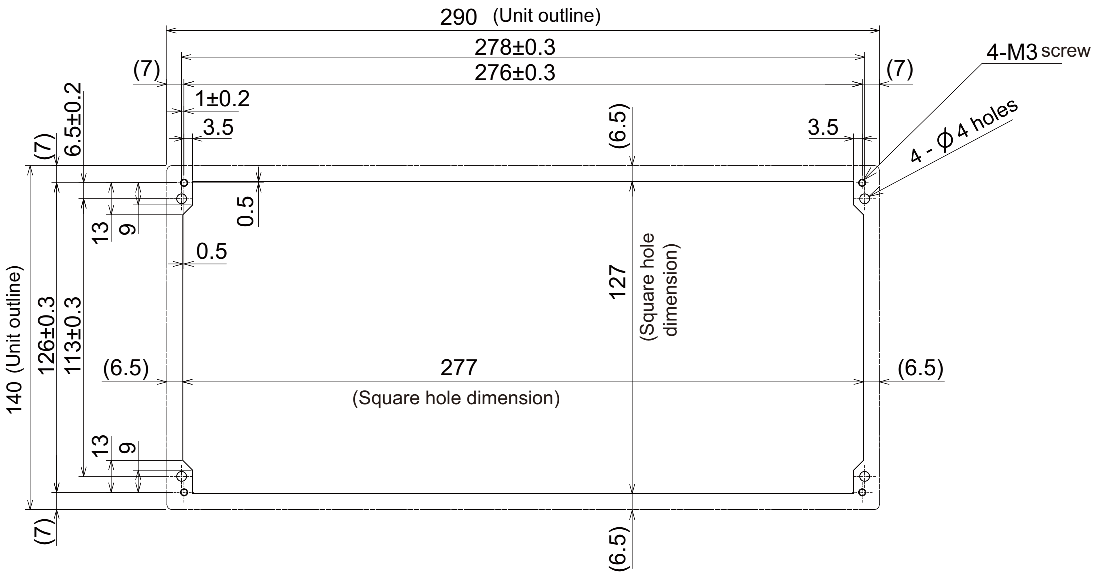
**[Panel cut dimension : FCU8-KB921]**

[mm]




**[Panel cut dimension : FCU8-KB923]**

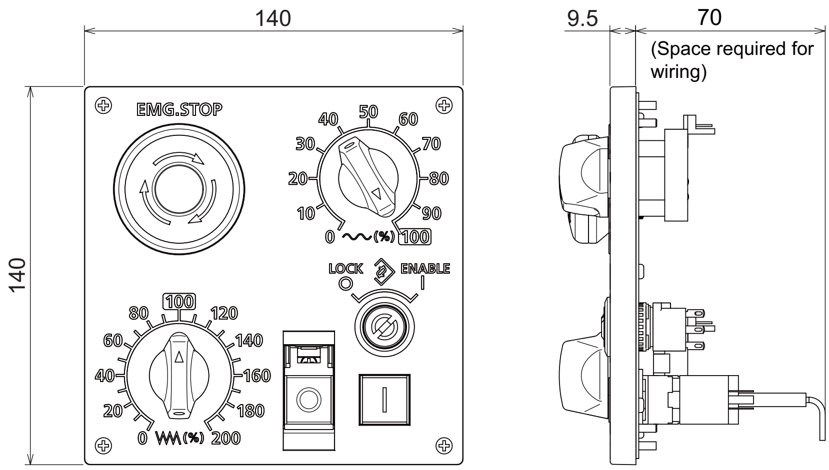
[mm]



## 4.10.2 Sub Panel A (FCU8-KB931)

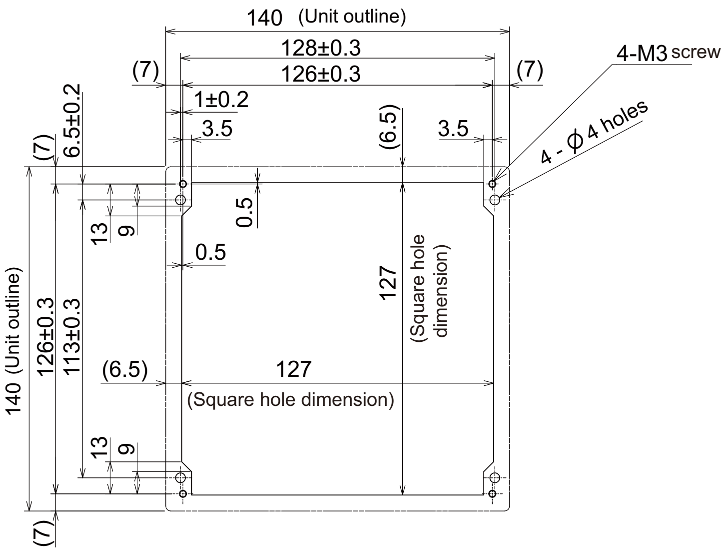
### [Outline dimension]

[mm]




### [Panel cut dimension]

[mm]

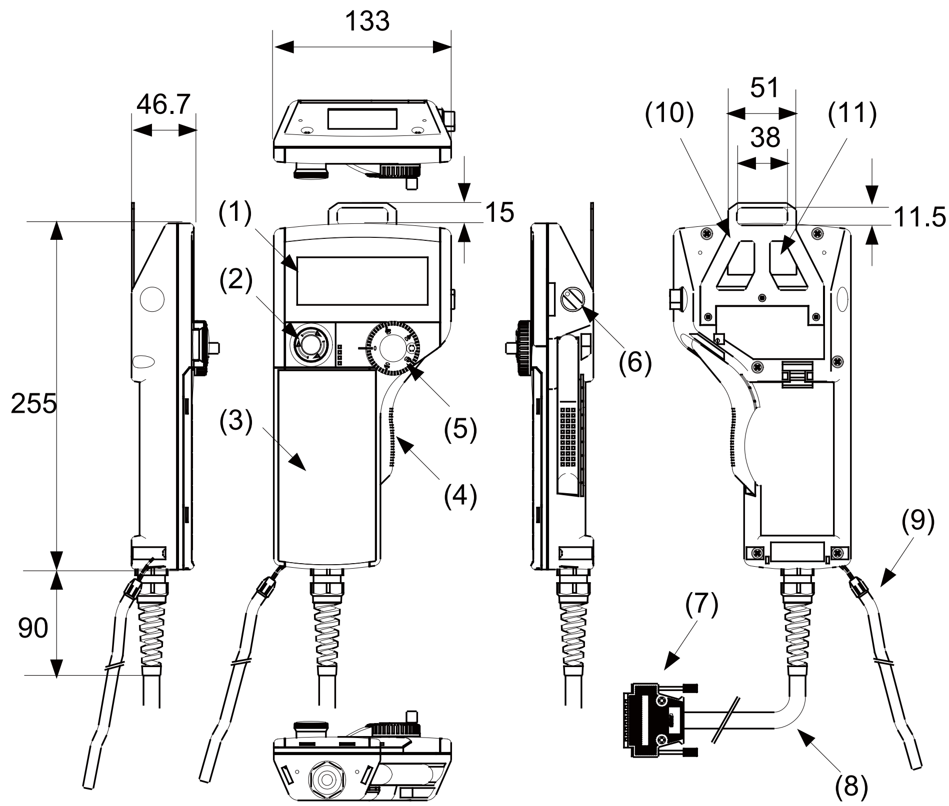


## 4.11 Handy Terminal

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

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

**Dimension and names of parts**



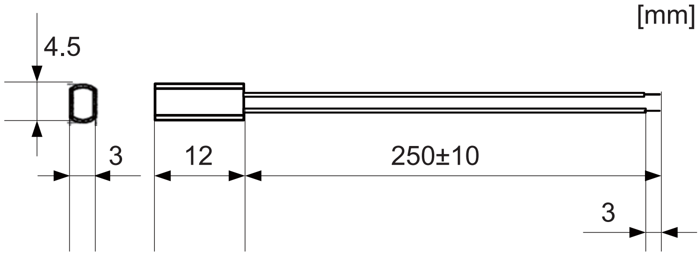

| No. | Name | Function/ Specification | No. | Name | Function/ Specification |
|---|---|---|---|---|---|
| (1) | LCD | Monochrome display with backlight<br>192(W) × 64(H) dots | (7) | HOST | Host interface connector<br>(DDK: 17JE-23250-02(D8A6)) |
| (2) | SW1 | Emergency stop switch<br>Contact rating/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

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

# 4.12 Thermistor

## 4.12.1 Thermistor(PT3C-51F-M2)

**[Outline dimension]**




Made by SHIBAURA ELECTRONICS Co., Ltd.

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

# 4.13 Exclusive SD Cards for MITSUBISHI CNC

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

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

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

# 4.14 Specifications and Precautions of USB/SD/LAN Interface

## 4.14.1 USB Interface (Memory I/F card)

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

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

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

**(1) Precautions for insertion/removal of USB memory**

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

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

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

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

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

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

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

### 4.14.2 SD Interface (Memory I/F card)

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

(Note) SDXC is not supported.

**(1) Precautions for use of commercially available SD card**

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

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

**(2) Precautions for insertion/removal of SD card**

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

### 4.14.3 LAN Interface (Control Unit)

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

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

(Note 2) When using half-duplex communication, the response time may become long depending on the connected device.
Use full-duplex communication to connect with the opposite device via a switching HUB.

**(1) Precautions for selection of LAN cable**

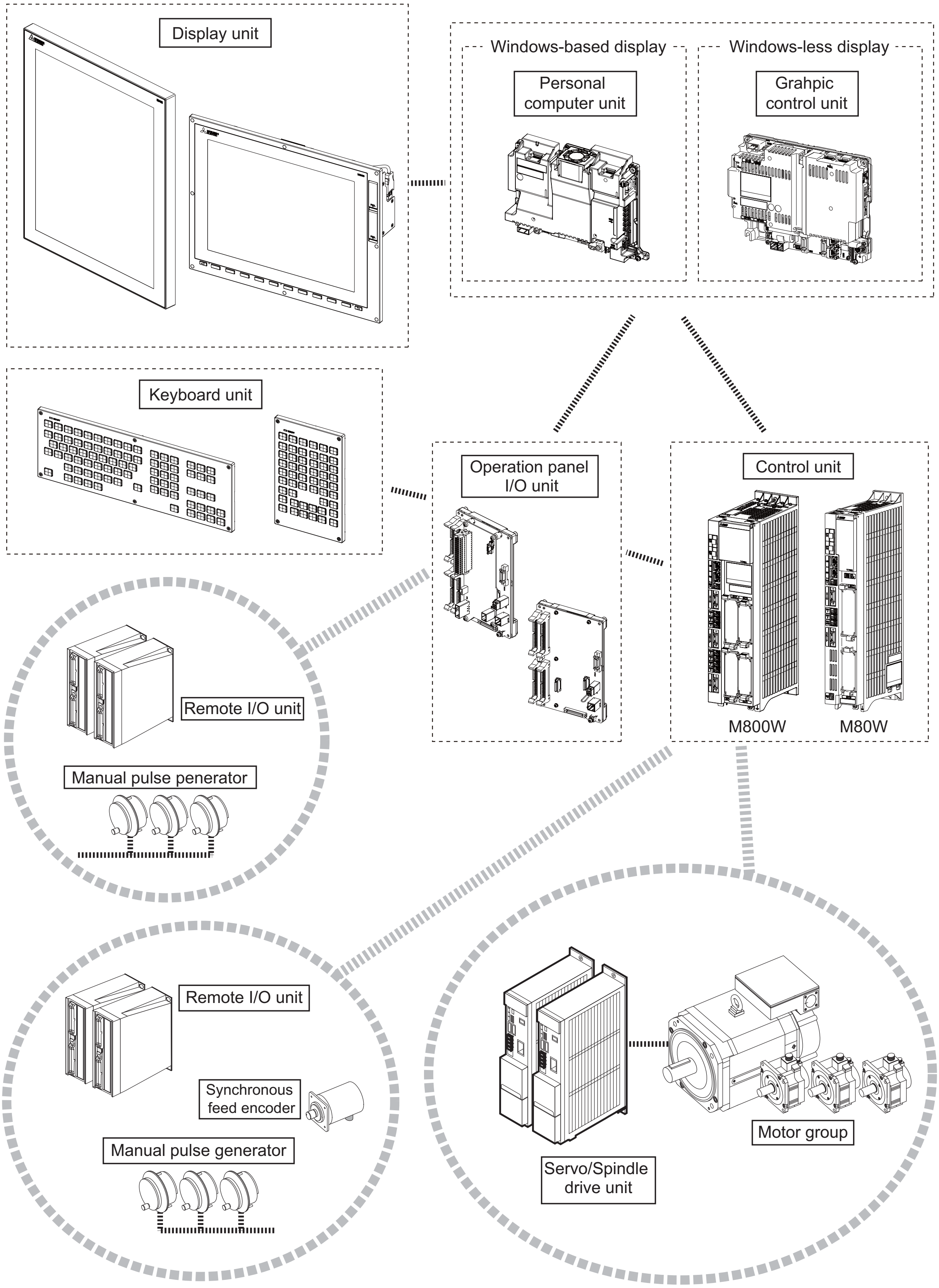
Make sure to select the LAN cables which are "category 5e or above" and "shielded". Cable wire material with double shielded, which is appropriate for FA environment., is recommended.

# M80W Series
# General Specifications

1

# System Basic Configuration (M80W Series)

## 1.1 System Basic Configuration Drawing



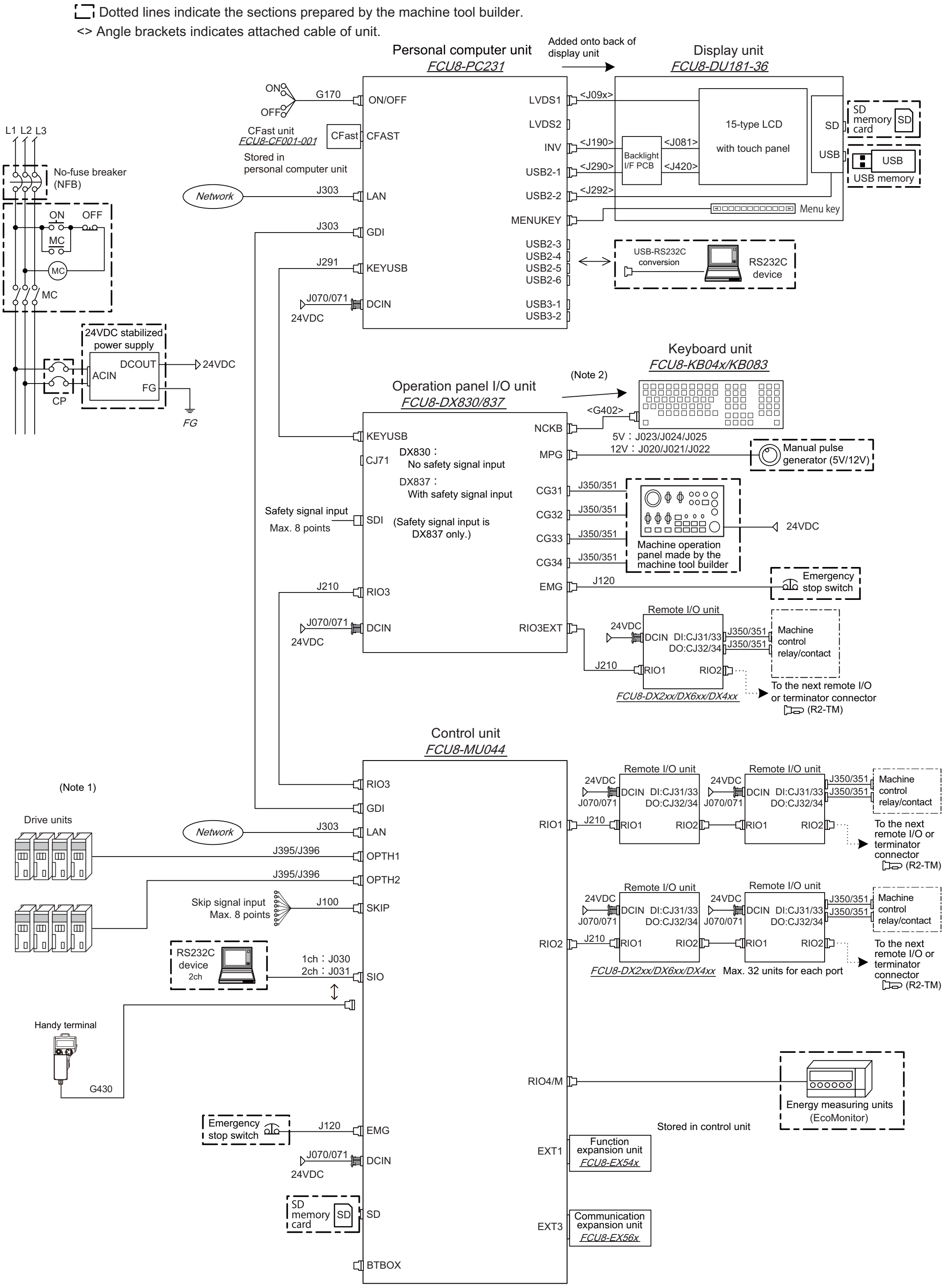

(Note) For the drive unit configuration, refer to the Instruction Manual of the drive unit you use.

# 2

# General Connection Diagram (M80W Series)

# 2.1 General Connection Diagram [M80W]

## 2.1.1 M80W, Windows-based Display (15-type)



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

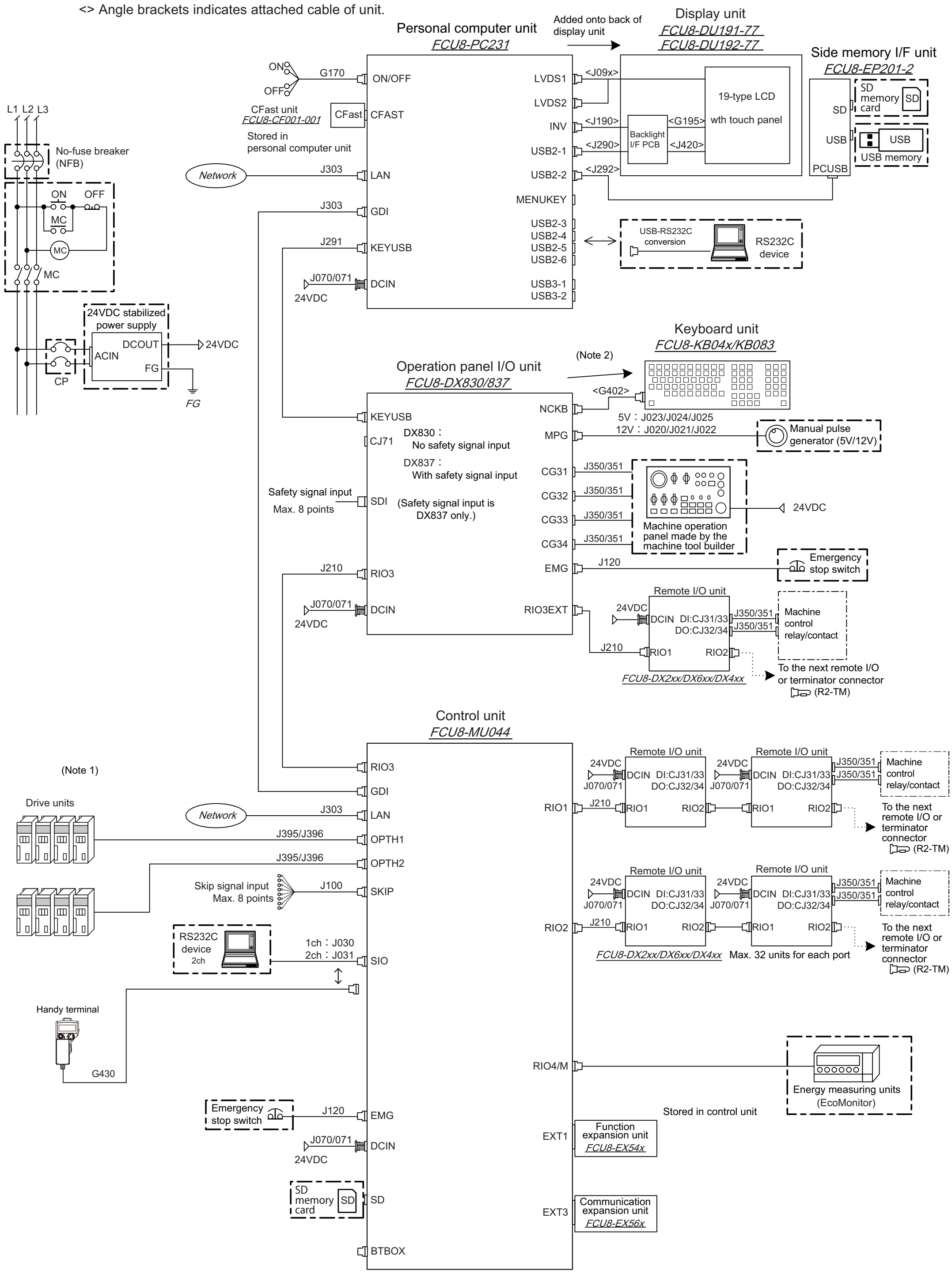
(Note 2) When using a keyboard unit, install the operation panel I/O unit on the back of the keyboard unit.

(Note 3) For the connection of MITSUBISHI CNC machine operation panel, refer to the chapter "Connection of MITSUBISHI CNC Machine Operation Panel".

(Note 4) When the handle of handy terminal is used, connect ENC connector of G430 cable to MPG connector of the operation panel I/O unit.
Because the pin assignment of ENC connector of G430 is different from that of MPG connector of the operation panel I/O unit, conversion is required.
The conversion cable needs to be prepared by the MTB.

## 2.1.2 M80W, Windows-based Display (19-type)

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



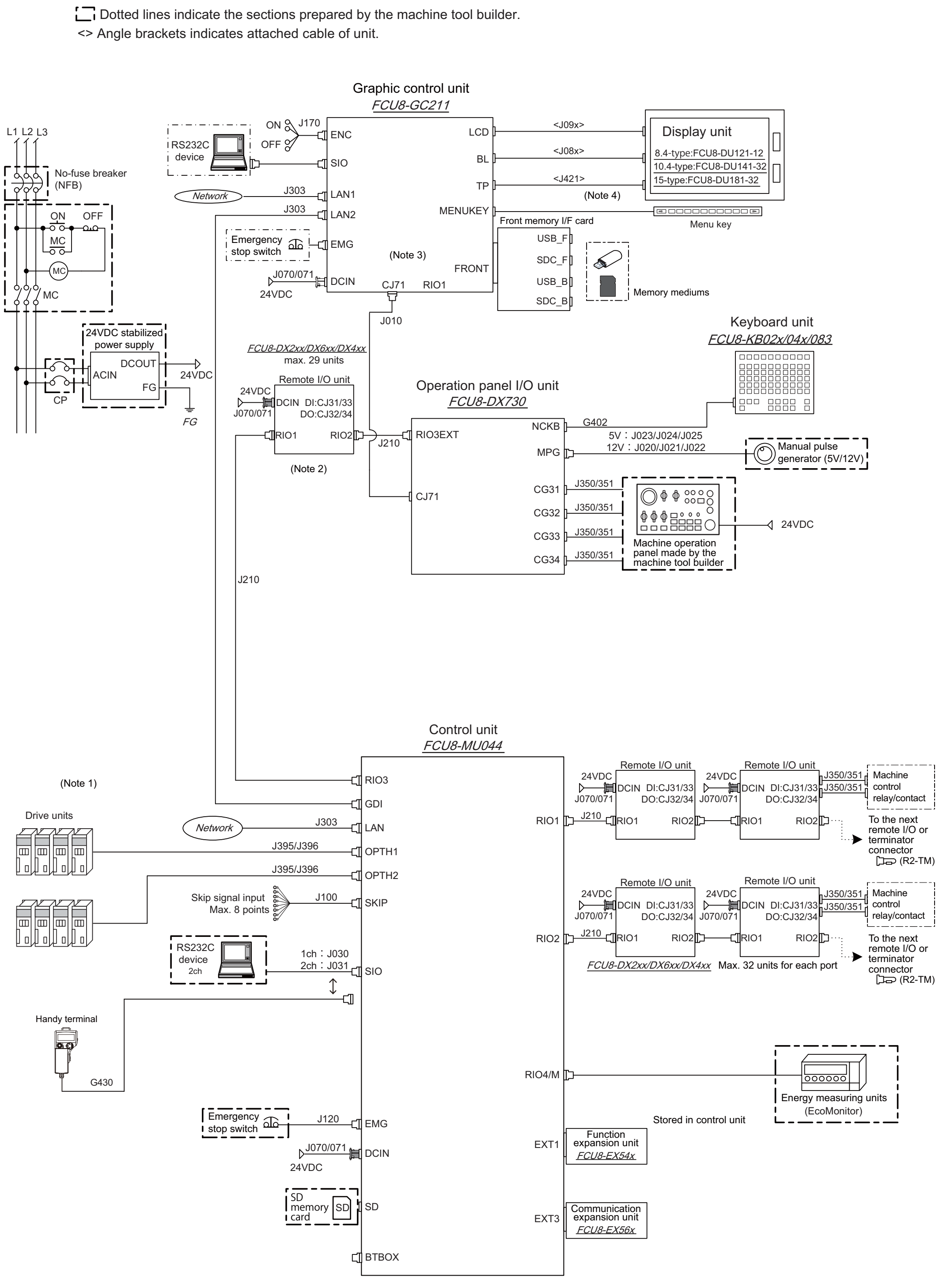

(Note 1) For information on how to connect the drive unit, refer to the drive unit's manual.

(Note 2) When using a keyboard unit, install the operation panel I/O unit on the back of the keyboard unit.
When not using a keyboard unit, install the operation panel I/O unit on the back of the display unit.

(Note 3) For the connection of MITSUBISHI CNC machine operation panel, refer to the chapter "Connection of MITSUBISHI CNC Machine Operation Panel".

(Note 4) When the handle of handy terminal is used, connect ENC connector of G430 cable to MPG connector of the operation panel I/O unit.
Because the pin assignment of ENC connector of G430 is different from that of MPG connector of the operation panel I/O unit, conversion is required.
The conversion cable needs to be prepared by the MTB.

### 2.1.3 M80W, Windows-less Display (8.4-type /10.4-type /15-type)




(Note 1) For information on how to connect the drive unit, refer to the drive unit's manual.
(Note 2) When connecting a remote I/O unit to the 3rd RIO channel, insert it between the control unit and operation panel I/O unit.
(Note 3) There is no need to connect a terminator R2-TM to the graphic control unit.
(Note 4) For the 8.4-type display unit, TP connector is not used.
(Note 5) For the connection of MITSUBISHI CNC machine operation panel, refer to the chapter "Connection of MITSUBISHI CNC Machine Operation Panel".
(Note 6) When the handle of handy terminal is used, connect ENC connector of G430 cable to MPG connector of the operation panel I/O unit.
Because the pin assignment of ENC connector of G430 is different from that of MPG connector of the operation panel I/O unit, conversion is required.
The conversion cable needs to be prepared by the MTB.

# 3

# List of Configuration (M80W Series)

# 3.1 Control Unit [M80W]

| Classification | Type | Components | Remarks |
|---|---|---|---|
| NC functions<br>For M80W | FCU8-MU044 | Main CPU card (for non-applicable)<br>7SEG card<br>SDHC: 1ch<br>Back panel card<br>Unit lid (Resin molded article) etc. | Export Trade Control Order noncompliant unit and Foreign Exchange Order noncompliant unit<br>G123 cable for EMG is attached. |

# 3.2 Display Unit [M80W]

| Classification | Type | Components | Remarks |
|---|---|---|---|
| 8.4-type color TFT<br>(VGA:640*480) | FCU8-DU121-12 | LCD panel<br>Menu keys<br>Escutcheon<br>Base metal plate<br>Cable<br>Screw cap set | Front side memory I/F is normally equipped with the control unit<br>(Windows-less display) |
| 10.4-type color TFT touch panel<br>(VGA:640*480) | FCU8-DU141-32 | LCD panel<br>Menu keys<br>Escutcheon<br>Base metal plate<br>Cable<br>Screw cap set | Front side memory I/F is normally equipped with the control unit<br>(Windows-less display) |
| 15-type color TFT touch panel<br>(XGA:1024*768) | FCU8-DU181-32 | LCD panel<br>Menu keys<br>Escutcheon<br>Base metal plate<br>Cable<br>Screw cap set | Front side memory I/F is normally equipped with the control unit<br>(Windows-less display) |
| 15-type color TFT touch panel<br>(XGA:1024*768) | FCU8-DU181-36 | LCD panel<br>Backlight I/F PCB<br>Menu keys<br>Escutcheon<br>Base metal plate<br>Cable<br>Screw cap set | Personal computer unit is prepared at the same time.<br>Built-in disk of the display unit is prepared at the same time.<br>Front side memory I/F is normally equipped with the display unit<br>(Windows-based display) |
| 19-type color TFT touch panel<br>(SXGA:1024*1280) | FCU8-DU191-77 | LCD panel<br>Backlight I/F PCB<br>Escutcheon<br>Base metal plate<br>Cable | Personal computer unit is prepared at the same time.<br>Built-in disk of the display unit is prepared at the same time.<br>Side memory I/F unit is separately prepared.<br>(Windows-based display) |
| 19-type color TFT touch panel<br>(SXGA:1280*1024) | FCU8-DU192-77 | LCD panel<br>Backlight I/F PCB<br>Escutcheon<br>Base metal plate<br>Cable | Personal computer unit is prepared at the same time.<br>Built-in disk of the display unit is prepared at the same time.<br>Side memory I/F unit is separately prepared.<br>(Windows-based display) |

## 3.3 Personal Computer Unit

| Classification | Type | Components | Remarks |
|---|---|---|---|
| Personal Computer Unit | FCU8-PC231 | PC board<br>PC cooling FAN<br>Unit lid (Resin molded article) etc. | |
| Built-in Disk of the Display Unit | FCU8-CF001-001 | Windows OS / data storage | Windows8 |

## 3.4 Graphic Control Unit [M800W]

| Classification | Type | Components | Remarks |
|---|---|---|---|
| Graphic control unit | FCU8-GC211 | Base control card<br>Front-side memory I/F card | (Note) This unit occupies the 13th and 14th RIO stations. |

## 3.5 Keyboard Unit [M80W]

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

## 3.6 Operation Panel I/O Unit

| Classification | Type | Components | Remarks |
|---|---|---|---|
| DI 24V/0V common input [64 points]<br>DO Source output [64 points] | FCU8-DX830 | Base card<br>Add-on card<br>RIO 2.0 terminator connector (R2-TM) | DI: 64-points 24V/0V common type<br>DO: 64-points source type (200mA/point)<br>Manual pulse generator input: 3ch<br>Display unit I/F<br>Keyboard unit I/F<br>Emergency stop input<br>Remote I/O 2.0 I/F<br>RIO occupied stations (fixed):<br>1 to 4, 7 to 14<br>RIO extensible stations:<br>5, 6, 15 to 64<br>(Note) J291 cable is required for connection with the personal computer unit.<br>(for windows-based display) |
| DI 24V/0V common input [64 points]<br>DO Source output [64 points]<br>Safety DI 24V/0V common input [8 points] | FCU8-DX837 | Base card<br>Add-on card<br>RIO 2.0 terminator connector (R2-TM) | DI: 64-points 24V/0V common type<br>DO: 64-points source type (200mA/point)<br>Safety DI: 8-points 0V common type<br>Manual pulse generator input: 3ch<br>Display unit I/F<br>Keyboard unit I/F<br>Emergency stop input<br>Remote I/O 2.0 I/F<br>RIO occupied stations (fixed):<br>1 to 4, 7 to 14<br>RIO extensible stations:<br>5, 6, 15 to 64<br>(Note) J291 cable is required for connection with the personal computer unit.<br>(for windows-based display) |
| DI 24V/0V common input [64 points]<br>DO Source output [64 points] | FCU8-DX730 | Base card<br>RIO 2.0 terminator connector (R2-TM) | DI: 64-points 24V/0V common type<br>DO: 64-points source type (200mA/point)<br>Manual pulse generator input: 3ch<br>Graphic control unit I/F<br>Keyboard unit I/F<br>Remote I/O 2.0 I/F<br>RIO occupied stations (fixed):<br>1, 2, 7 to 12<br>RIO extensible stations:<br>3 to 6, 15 to 64<br>(13 and 14 are occupied by the graphic control unit.)<br>(Note) J010 cable is required for connection with the graphic control unit.<br>(for windows-less display) |

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

# 3.7 Remote I/O Unit

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

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

# 3.8 Function Expansion Unit

| Classification | Type | Components | Remarks |
|---|---|---|---|
| Encoder (manual pulse generator) I/F expansion unit | FCU8-EX544 | Encoder I/F PCB | Encoder input 1ch<br>5V manual pulse generator input 2ch |

# 3.9 Communication Expansion Unit

| Classification | Type | Components | Remarks |
|---|---|---|---|
| CC-Link expansion unit | FCU8-EX561 | CC-Link I/F PCB | CC-Link 1ch |
| PROFIBUS-DP master unit | FCU8-EX563 | PROFIBUS-DP I/F PCB | PROFIBUS-DP 1ch |
| EtherNet/IP<br>Scanner/adapter unit | FCU8-EX565 | Base card<br>Add-on card | EtherNet/IP 1ch<br>(Only LAN1, LAN2 cannot be used) |

# 3.10 Side Memory I/F Unit

| Classification | Type | Components | Remarks |
|---|---|---|---|
| Side Memory I/F Unit | FCU8-EP201-2 | Side memory I/F PCB<br>J292 cable<br>Structural member | SDHC 1ch<br>USB2.0 1ch<br>USB communication<br>(between side memory I/F PCB and personal computer)<br>Unit lid (resin molded article), metal plate, etc.<br>Exclusive for 19-type display unit |

## 3.11 Manual Pulse Generator

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

## 3.12 Synchronous Feed Encoder

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

## 3.13 MITSUBISHI CNC Machine Operation Panel

| Classification | Type | Components | Remarks |
|---|---|---|---|
| Main panel A<br>(For 8.4-type/15-type display unit) | FCU8-KB921 | Escutcheon, key switch<br>control card<br>G054 cable, Screw cap set | Mitsubishi standard 55 key |
| Main panel B<br>(For 10.4-type display unit) | FCU8-KB923 | Escutcheon, key switch<br>control card<br>G054 cable, Screw cap set | Mitsubishi standard 55 key |
| Sub panel A<br>(Common for all display units) | FCU8-KB931 | Escutcheon<br>Emergency stop switch, Override switch<br>ON/OFF switch, Screw cap set | |

## 3.14 Handy Terminal

| Classification | Type | Components | Remarks |
|---|---|---|---|
| Handy Terminal | HG1T-SB12UH-<br>MK1346-L5 | | |

## 3.15 Cable Connector Sets

| Classification | Type | Components | Remarks |
|---|---|---|---|
| General I/O units<br>(For SKIP,SIO,MPG,AIO) | FCUA-CS000 | Connector (10120-3000PE,2pcs),<br>Shell kit (10320-52F0-008,2pcs) | |
| Emergency stop connector<br>(For EMG) | 50-57-9403<br>0016020103 x 3 pcs. | Connector (50-57-9403),<br>Contact (0016020103,3pcs.) | |
| Connector kit for RIO 2.0 unit | RIO2 CON | Connector (1-1318119-3,2pcs.),<br>Contact (1318107-1,8pcs.),<br>Connector (2-178288-3),<br>Contact (1-175218-5,3pcs) | |
| 24VDC power supply connector<br>(For DCIN) | FCUA-CN220 | Connector (2-178288-3),<br>Contact (1-175218-5,3pcs) | |
| DI/DO connector<br>(For operation panel I/O unit)<br>(For remote I/O unit) | 7940-6500SC x 4pcs.<br>3448-7940 x 4pcs. | Connector (7940-6500SC,4pcs.),<br>Strain relief (3448-7940,4pcs.) | |
| ON/OFF switch connector | 50-57-9404<br>0016020103 x 4pcs. | Connector (50-57-9404),<br>Contact (0016020103,4pcs.) | |
| THERMISTOR connector | 37104-2165-000FL 10P | Connector (37104-2165-000FL,10pcs.) | |

# 3.16 Thermistor Sets

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

# 3.17 Genuine Memory Card

| Classification | Type | Components | Remarks |
|---|---|---|---|
| Exclusive SD cards for MITSUBISHI CNC 1GB | FCU8-SD001G | FCU8-SD001G | 1GB capacity |
| Exclusive SD cards for MITSUBISHI CNC 4GB | FCU8-SD004G | FCU8-SD004G | 4GB capacity |

# 3.18 Durable Parts

| Durable parts | Part type |
|---|---|
| Battery for control unit | Q6BAT BKO-C10811H03 |
| Cooling fan for personal computer unit | 109P0424H3103 |

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

# 3.19 Replacements

| Replacements | Part type | Manufacturer |
|---|---|---|
| Protection fuse for control unit | LM40 | Daito Communication Apparatus Co., Ltd. |
| Protection fuse for operation panel I/O | LM50 | Daito Communication Apparatus Co., Ltd. |
| Protection fuse for FCU8-DX220/230/231 | LM50 | Daito Communication Apparatus Co., Ltd. |
| Protection fuse for FCU8-DX213/654/213-1/654-1 | MP63 | Daito Communication Apparatus Co., Ltd. |

## 3.20 List of Cables

**[Cable relating to NC]**

| Type | Application | Available cable length (m) | Max. cable length |
|---|---|---|---|
| FCUA-R050-xM | Synchronous encoder - control unit (straight, with connector)<br>(for FCU8-EX544) | 5 | 30m |
| FCUA-R054-xM | Synchronous encoder - control unit (right angle, with connector)<br>(for FCU8-EX544) | 3, 5, 10, 15, 20 | 30m |
| G071 LxM | 24VDC relay cable for MITSUBISHI CNC machine operation panel | 0.12, 0.5, 1 | 1m |
| G123 | Cable for emergency stop release | - | - |
| G170 LxM | ON/OFF switch cable<br>(ON/OFF switch - Personal computer unit)<br>(for windows-based display) | 1, 2, 3, 5, 10, 15 | 15m |
| G430 LxM | Cable for connection to handy terminal | 3, 5, 10 | 10m |
| G460 LxM | Cable for MITSUBISHI CNC machine operation panel<br>(Cable between main panel and sub panel) | 0.5 | 0.5m |
| J010 LxM | Operation panel I/O interface cable<br>(for windows-less display) | 0.5, 1 | 1m |
| J020 LxM | Manual pulse generator cable (12V): 1ch | 1, 2, 3, 5, 7, 10, 15, 20, 30 | 50m |
| J021 LxM | Manual pulse generator cable (12V): 2ch | 1, 2, 3, 5, 7, 10, 15, 20, 30 | 50m |
| J022 LxM | Manual pulse generator cable (12V): 3ch | 1, 2, 3, 5, 7, 10, 15, 20, 30 | 50m |
| J023 LxM | Manual pulse generator cable (5V): 1ch | 1, 2, 3, 5, 7, 10, 15, 20 | 20m |
| J024 LxM | Manual pulse generator cable (5V): 2ch | 1, 2, 3, 5, 7, 10, 15, 20 | 20m |
| J025 LxM | Manual pulse generator cable (5V): 3ch | 1, 2, 3, 5, 7, 10, 15, 20 | 20m |
| J026 LxM | Manual pulse generator cable (5V): 1ch<br>(for connection to control unit) | 1, 2, 3, 5, 7, 10, 15, 20 | 20m (*) |
| J027 LxM | Manual pulse generator cable (5V): 2ch<br>(for connection to control unit) | 1, 2, 3, 5, 7, 10, 15, 20 | 20m (*) |
| J030 LxM | RS-232C I/F cable: 1ch | 1, 2, 3, 5, 7, 10 | 15m (*) |
| J031 LxM | RS-232C I/F cable: 2ch | 1, 2, 3, 5, 7, 10 | 15m (*) |
| J070 LxM | 24VDC power cable | 1, 2, 3, 5, 7, 10, 15 | 15m |
| J071 LxM | 24VDC power cable (for long distance) | 20 | 20m |
| J100 LxM | SKIP input cable | 1, 2, 3, 5, 7, 10, 15, 20 | 20m |
| J120 LxM | Emergency stop cable | 1, 2, 3, 5, 7, 10, 15, 20, 30 | 30m |
| J121 LxM | Emergency stop cable for MITSUBISHI CNC machine operation panel | 1, 2, 3, 5, 7, 10, 15, 20, 30 | 30m |
| J170 LxM | ON/OFF switch cable<br>(ON/OFF switch - Graphic control unit)<br>(for windows-less display) | 1, 2, 3, 5, 10, 15 | 15m |
| J210 LxM | Remote I/O 2.0 communication cable | 0.3, 1, 2, 3, 5, 7, 10, 15, 20, 30 | 50m (*) |
| J220 LxM | Analog output cable<br>(for M800W) | 2, 3, 7 | 30m |
| J221 LxM | Analog input/output cable (for remote I/O unit) | 2, 3, 7 | 30m |
| J291 LxM | Connection cable between personal computer unit and operation panel I/O unit | 0.15, 0.5, 1 | 1m |
| J303 LxM | LAN straight cable | 1, 2, 3, 5, 7, 10, 15, 20, 30 | 50m |
| J350 LxM | DI/DO cable (connectors at both ends) | 1, 2, 3, 5 | 50m |
| J351 LxM | DI/DO cable (connector at one end) | 3 | 50m |
| R2-TM | Terminator for remote I/O interface | - | - |

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

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

**[Cable Relating to Drive Unit]**

| Type | Application | Available cable length (m) | Max. cable length |
|---|---|---|---|
| CNP2E-1-xM | Motor side PLG cable<br>Spindle side accuracy detector<br>TS5690 cable | 2, 3, 4, 5, 7, 10, 15, 20, 25, 30 | 30m |
| CNP3EZ-2P-xM | Spindle side detector cable<br>OSE-1024 cable | 2, 3, 4, 5, 7, 10, 15, 20, 25, 30 | 30m |
| CNP3EZ-3P-xM | Spindle side detector cable<br>OSE-1024 cable | 2, 3, 4, 5, 7, 10, 15, 20, 25, 30 | 30m |
| CNV2E-8P-xM | For HG/HG-H,HQ/HQ-H Motor side detector cable (for D48/D51/D74) | 2, 3, 4, 5, 7, 10, 15, 20, 25, 30 | 30m |
| CNV2E-9P-xM | For HG/HG-H,HQ/HQ-H Motor side detector cable (for D48/D51/D74) | 2, 3, 4, 5, 7, 10, 15, 20, 25, 30 | 30m |
| CNV2E-D-xM | MDS-B-SD unit cable | 2, 3, 4, 5, 7, 10, 15, 20, 25, 30 | 30m |
| CNV2E-HP-xM | MDS-B-HR unit cable | 2, 3, 4, 5, 7, 10, 15, 20, 25, 30 | 30m |
| CNV2E-MB-xM | MBE405W/MBA405W cable | 2, 3, 4, 5, 7, 10, 15, 20 | 20m |
| DG30-xM | Battery cable<br>(For drive unit - Battery box,<br>For drive unit - drive unit) | 0.3, 0.5, 1, 2, 3, 5, 7, 10 | 10m |
| G380 LxM | Optical communication cable<br>For wiring between drive units (outside panel) | 5, 10, 12, 15, 20, 25, 30 | 30m |
| J395 LxM | Optical communication cable<br>For wiring between drive units (outside panel)<br>For wiring between NC-drive units | 3, 5, 7, 10 | 10m |
| J396 LxM | Optical communication cable<br>For wiring between drive units (inside panel) | 0.2, 0.3, 0.5, 1, 2, 3, 5 | 10m |
| MR-BKS1CBLxMA1-H | <200V Series><br>Brake cable for HG96<br>Lead out in direction of motor shaft | 2, 3, 5, 7, 10 | 10m |
| MR-BKS1CBLxMA2-H | <200V Series><br>Brake cable for HG96<br>Lead out in opposite direction of motor shaft | 2, 3, 5, 7, 10 | 10m |
| MR-BT6V2CBL LxM | Battery cable (MDS-EJ/EJH)<br>(For drive unit - drive unit) | 0.3, 1 | 1m |
| MR-D05UDL3M-B | STO cable | 3 | 3m |
| MR-PWS1CBLxMA1-H | <200V Series><br>Power cable for HG96<br>Lead out in direction of motor shaft | 2, 3, 5, 7, 10 | 10m |
| MR-PWS1CBLxMA2-H | <200V Series><br>Power cable for HG96<br>Lead out in opposite direction of motor shaft | 2, 3, 5, 7, 10 | 10m |
| SH21 LxM | Power supply communication cable<br>Power backup unit communication cable | 0.35, 0.5, 1, 2, 3 | 30m |

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

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

# 4

# General Specifications (M80W Series)

# 4.1 Environment Conditions [M80W]

## 4.1.1 Environment Conditions inside the Operation Panel

| Item | Unit name | | Display unit | Personal computer unit | Graphic control unit |
|---|---|---|---|---|---|
| | Type | | FCU8-DU121-12 : (8.4-type)<br>FCU8-DU141-32 : (10.4-type)<br>FCU8-DU181-32 : (15-type)<br>FCU8-DU181-36 : (15-type)<br>FCU8-DU191-77 : (19-type)<br>FCU8-DU192-77 : (19-type) | FCU8-PC231 | FCU8-GC211 |
| General Specifications | Ambient temperature | During operation | 0 to 58°C | | |
| | | During storage | -20 to 60°C | | |
| | Ambient humidity | Long term | 10 to 75% RH (with no dew condensation) | | |
| | | Short term | 10 to 95% RH (with no dew condensation) (Note 1) | | |
| | Vibration resistance | | 4.9m/s$^2$ [0.5G] or less | | |
| | Shock resistance | | 29.4m/s$^2$ [3G] or less | | |
| | Working atmosphere | | No corrosive gases, dust or oil mist | | |
| | Altitude | | Operation/Storage: 1000 meters or less above sea level,<br>Transportation: 13000 meters or less above sea level | | |
| | Power supply voltage | | FCU8-DU121-12 : 12VDC/3.3VDC<br>FCU8-DU141-32 : 12VDC/5VDC/3.3VDC<br>FCU8-DU181-32 : 12VDC/5VDC/3.3VDC<br>FCU8-DU181-36 : 12VDC/5VDC/3.3VDC<br>FCU8-DU191-77 : 12VDC/5VDC<br>FCU8-DU192-77 : 12VDC/5VDC<br>(Supply from personal computer unit or graphic control unit) | 24VDC | 24VDC |
| | Current consumption | | 24V 2.2A | | 24V 2.5A |
| | Heating value | (max) | FCU8-DU121-12 : 6W<br>FCU8-DU141-32 : 10W<br>FCU8-DU181-32 : 14W<br>FCU8-DU181-36 : 18W<br>FCU8-DU191-77 : 21W<br>FCU8-DU192-77 : 21W | 32W | 12W |
| | Mass | (kg) | FCU8-DU121-12 : 1.2<br>FCU8-DU141-32 : 1.7<br>FCU8-DU181-32 : 4<br>FCU8-DU181-36 : 4<br>FCU8-DU191-77 : 5.7<br>FCU8-DU192-77 : 5.7 | 1.2 | 1.1 |
| | Outline dimension W×H or W×H×D | (mm) | FCU8-DU121-12 : 260×200<br>FCU8-DU141-32 : 290×220<br>FCU8-DU181-32 : 400×320<br>FCU8-DU181-36 : 400×320<br>FCU8-DU191-77 : 365×440<br>FCU8-DU192-77 : 440×365 | 220×182×53.5 | 239.1×173.4×75 |

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

(Note 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.

(Note 3) When the display unit is mounted on an incline, the inclination angle to place the unit should follow below.
8.4, 10.4, or 15-type display unit: the inclination should be 30 degrees or less from the vertical direction.
19-type display unit: the inclination should be 60 degrees or less from the vertical direction.

<table>
<tr><th rowspan="2">Item</th><th colspan="2">Unit name</th><th>Keyboard unit</th><th colspan="2">Operation panel I/O unit</th><th>Machine operation panel</th></tr>
<tr><td colspan="2">Type</td><td>FCU8-KB026/KB028 : (8.4-type)<br>FCU8-KB029 : (8.4-type/ vertical arrangement)<br>FCU8-KB041/KB046 : (10.4-type)<br>FCU8-KB047 : (10.4-type/vertical arrangement)<br>FCU8-KB048 : (10.4-type)<br>FCU8-KB083 : (15-type/ vertical arrangement)</td><td>FCU8-DX830/ DX837</td><td>FCU8-DX730</td><td>FCU8-KB921<br>FCU8-KB923<br>FCU8-KB931</td></tr>
<tr><td rowspan="12">General Specifications</td><td rowspan="2">Ambient temperature</td><td>During operation</td><td colspan="4">0 to 58°C</td></tr>
<tr><td>During storage</td><td colspan="4">-20 to 60°C</td></tr>
<tr><td rowspan="2">Ambient humidity</td><td>Long term</td><td colspan="4">10 to 75% RH (with no dew condensation)</td></tr>
<tr><td>Short term</td><td colspan="4">10 to 95% RH (with no dew condensation) (Note 1)</td></tr>
<tr><td colspan="2">Vibration resistance</td><td colspan="4">4.9m/s$^2$ [0.5G] or less</td></tr>
<tr><td colspan="2">Shock resistance</td><td colspan="4">29.4m/s$^2$ [3G] or less</td></tr>
<tr><td colspan="2">Working atmosphere</td><td colspan="4">No corrosive gases, dust or oil mist</td></tr>
<tr><td colspan="2">Altitude</td><td colspan="4">Operation/Storage: 1000 meters or less above sea level,<br>Transportation: 13000 meters or less above sea level</td></tr>
<tr><td colspan="2">Power supply voltage</td><td>5VDC<br>(Supply from Operation Panel I/O Unit )</td><td>24VDC</td><td>5VDC, 3.3VDC<br>(Supply from Graphic Control Unit )</td><td>24VDC (Note 7)</td></tr>
<tr><td colspan="2">Current consumption</td><td>- (Note 2)</td><td>24V 0.3A (Note 3)</td><td>- (Note 3,4)</td><td>0.3A (Note 7)</td></tr>
<tr><td>Heating value</td><td>(max)</td><td>1W</td><td>8W (Note 5)</td><td>4W (Note 5)</td><td>7.2W</td></tr>
<tr><td>Mass</td><td>(kg)</td><td>FCU8-KB026/KB028 : 0.75<br>FCU8-KB029 :1.0<br>FCU8-KB041/KB046 : 0.8<br>FCU8-KB047 : 1.3<br>FCU8-KB048 : 1.4<br>FCU8-KB083 : 1.5</td><td>0.4</td><td>0.3</td><td>FCU8-KB921 : 1.1<br>FCU8-KB923 : 1.2<br>FCU8-KB931 : 0.5</td></tr>
<tr><td></td><td>Outline dimension W×H</td><td>(mm)</td><td>FCU8-KB026/KB028 : 140×200<br>FCU8-KB029 : 260×140<br>FCU8-KB041/KB046 : 140×220<br>FCU8-KB047 : 290×160<br>FCU8-KB048 : 230×220<br>FCU8-KB083 : 400×140</td><td colspan="2">116×179</td><td>FCU8-KB921 : 260×140<br>FCU8-KB923 : 290×140<br>FCU8-KB931 : 140×140</td></tr>
</table>

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

(Note 2) The current consumption of the keyboard unit is included in that of the operation panel I/O unit or the graphic control unit.

(Note 3) Current consumption for the I/O circuit needs to be separately calculated based on the number of points used and its load.

(Note 4) The current consumption of FCU8-DX730 is included in that of the graphic control unit.

(Note 5) For the heating value of the I/O circuit, calculate with the number of points used.

(Note 6) For the whole NC system, consider the characteristics of the drive units when the altitude is more than 1000 meters above sea level. Refer to the manual of drive unit for details.

(Note 7) 24V power input is not required for FCU8-KB931.

### 4.1.2 Environment Conditions inside the Control Panel

| Item | Unit name | | Control unit |
|---|---|---|---|
| | Type | | FCU8-MU044 |
| General Specifications | Ambient temperature | During operation | 0 to 55°C |
| | | During storage | -20 to 60°C |
| | Ambient humidity | Long term | 10 to 75% RH (with no dew condensation) |
| | | Short term | 10 to 95% RH (with no dew condensation) (Note 1) |
| | Vibration resistance | | 4.9m/s$^2$ [0.5G] or less |
| | Shock resistance | | 29.4m/s$^2$ [3G] or less |
| | Working atmosphere | | No corrosive gases, dust or oil mist |
| | Altitude | | Operation/Storage: 1000 meters or less above sea level, Transportation: 13000 meters or less above sea level |
| | Power supply voltage | | 24VDC |
| | Current consumption | | 1.25A |
| | Heating value | (max) | 16W |
| | Mass | (kg) | 2.0 |
| | Outline dimension W×H×D | (mm) | 60×380×180 |

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

(Note 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.

| Item | Unit name | | Remote I/O unit | | | | |
|---|---|---|---|---|---|---|---|
| | Type | | FCU8-DX220/ DX230/ DX231 | FCU8-DX202 | FCU8-DX213/ DX213-1/ DX654/ DX654-1 | FCU8-DX408 | FCU8-DX651 |
| General Specifications | Ambient temperature | During operation | 0 to 58°C | | | | |
| | | During storage | -20 to 60°C | | | | |
| | Ambient humidity | Long term | 10 to 75% RH (with no dew condensation) | | | | |
| | | Short term | 10 to 95% RH (with no dew condensation) (Note 1) | | | | 10 to 85% RH (with no dew condensation) (Note 1) |
| | Vibration resistance | | 4.9m/s$^2$ or less | | | | |
| | Shock resistance | | 29.4m/s$^2$ or less | | | | |
| | Working atmosphere | | No corrosive gases, dust or oil mist | | | | |
| | Altitude | | Operation/Storage: 1000 meters or less above sea level, Transportation: 13000 meters or less above sea level | | | | |
| | Power supply voltage | | 24VDC | | | | |
| | Current consumption | | 3.5A (Note 2) | 0.3A | 0.3A (Note 3) | 0.1A | 3.7A (Note 2) |
| | Heating value | (max) | 8W (Note 4) | | | | |
| | Mass | (kg) | 0.4 | | | 0.2 | 0.8 |
| | Outline dimension W×H×D | (mm) | 40×175×133 | 40×175×119 | 40×175×130 | 40×175×109 | 172×100×115 |

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

## 4.1.3 24VDC Stabilized Power Supply Selecting Conditions

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

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

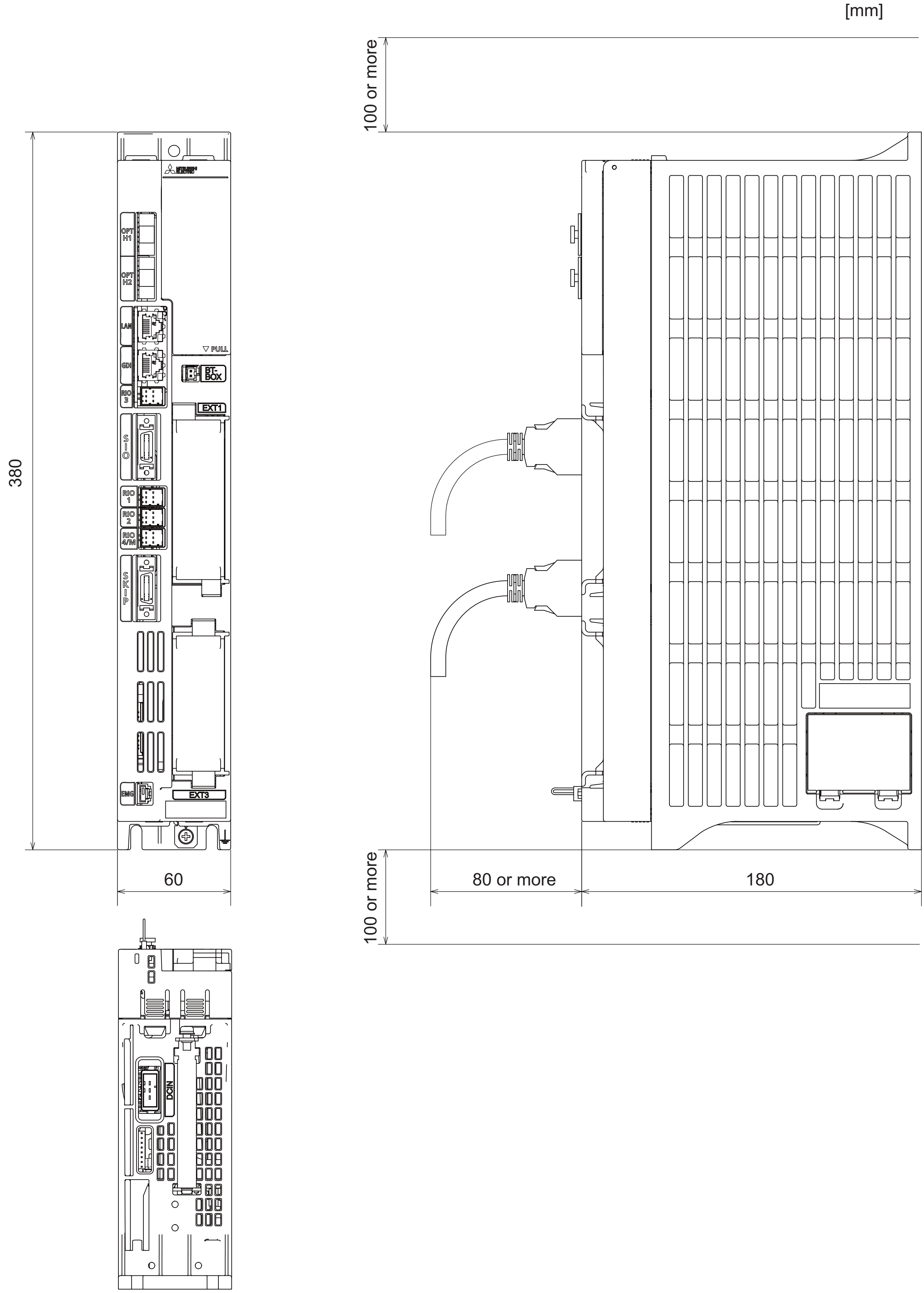
⚠ **CAUTION**

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

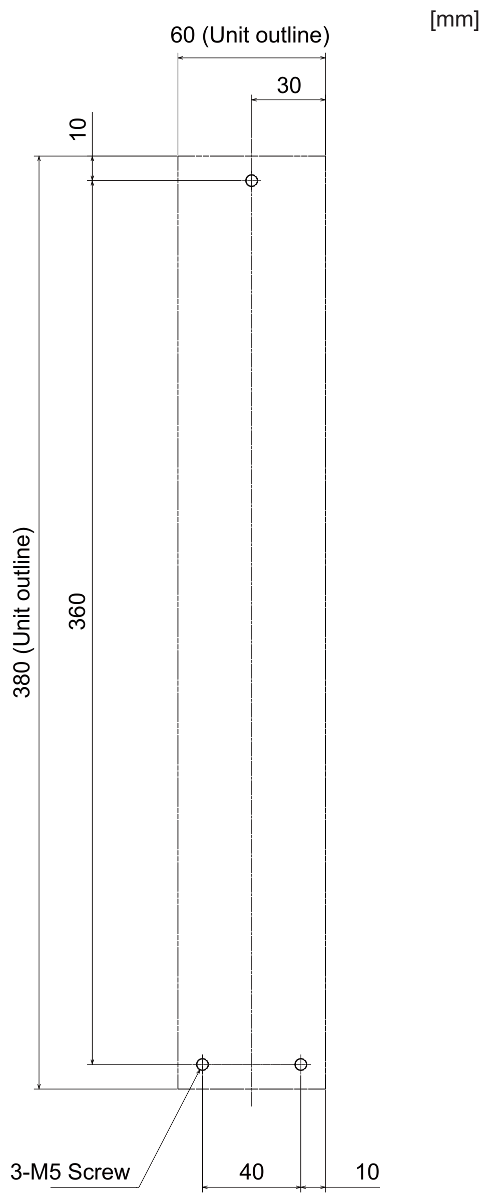
## 4.2 Control Unit [M80W]

### 4.2.1 FCU8-MU044

**[Outline dimension]**



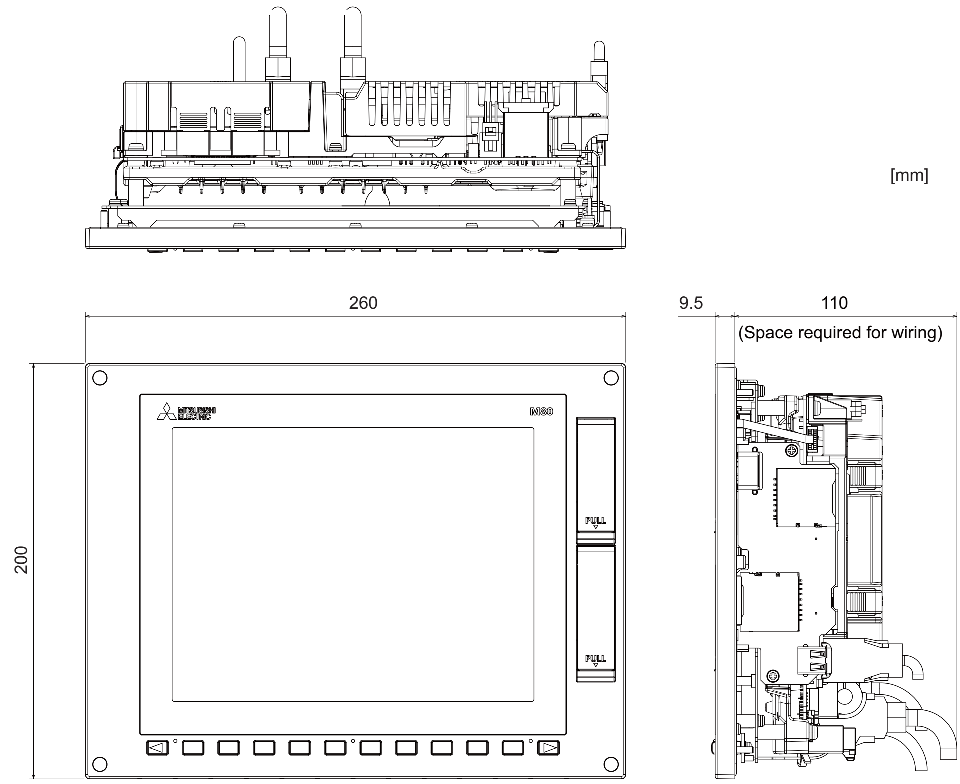
**[Installation dimension]**



# 4.3 Display Unit [M80W]

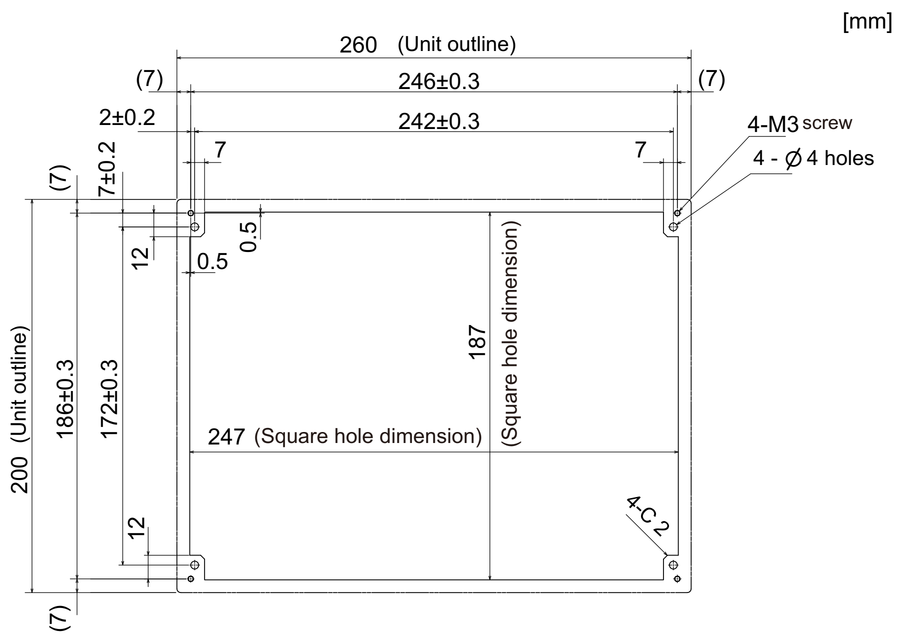
## 4.3.1 8.4-type (FCU8-DU121-12)

**[Outline dimension]**



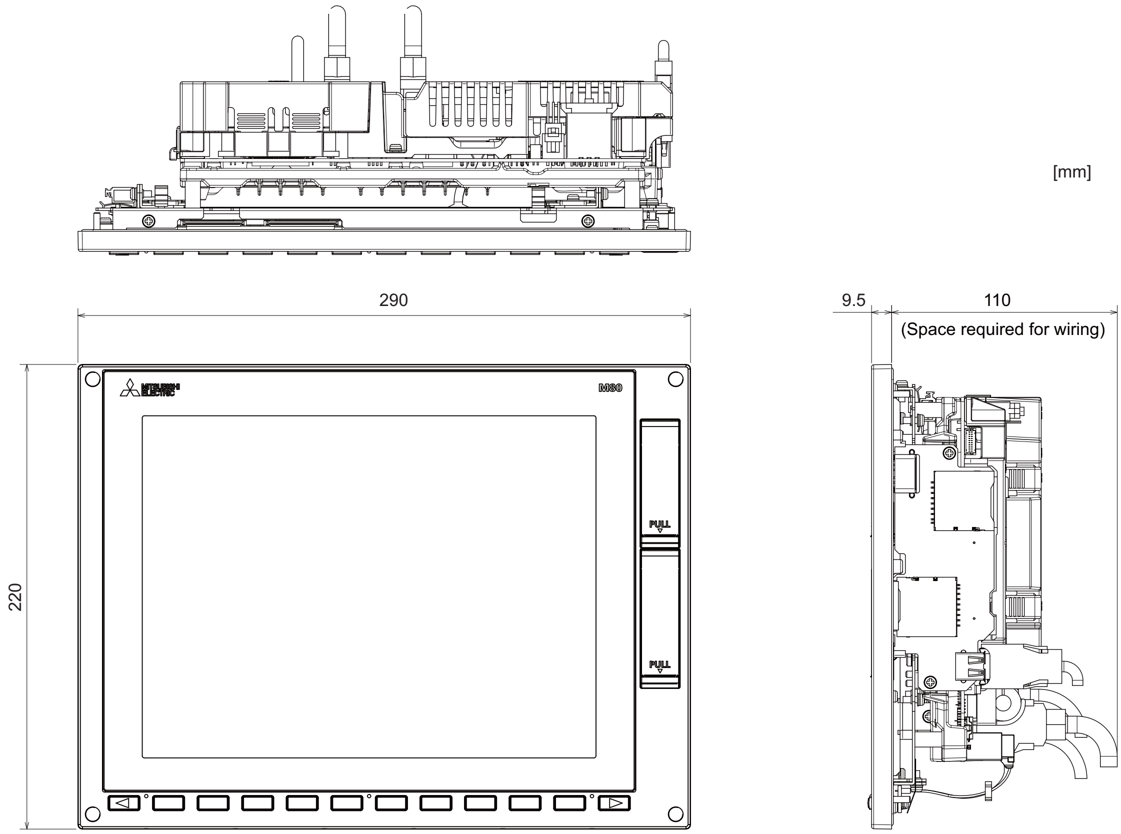

(Note) The 8.4-type display unit is incompatible with the touchscreen.

**[Panel cut dimension]**

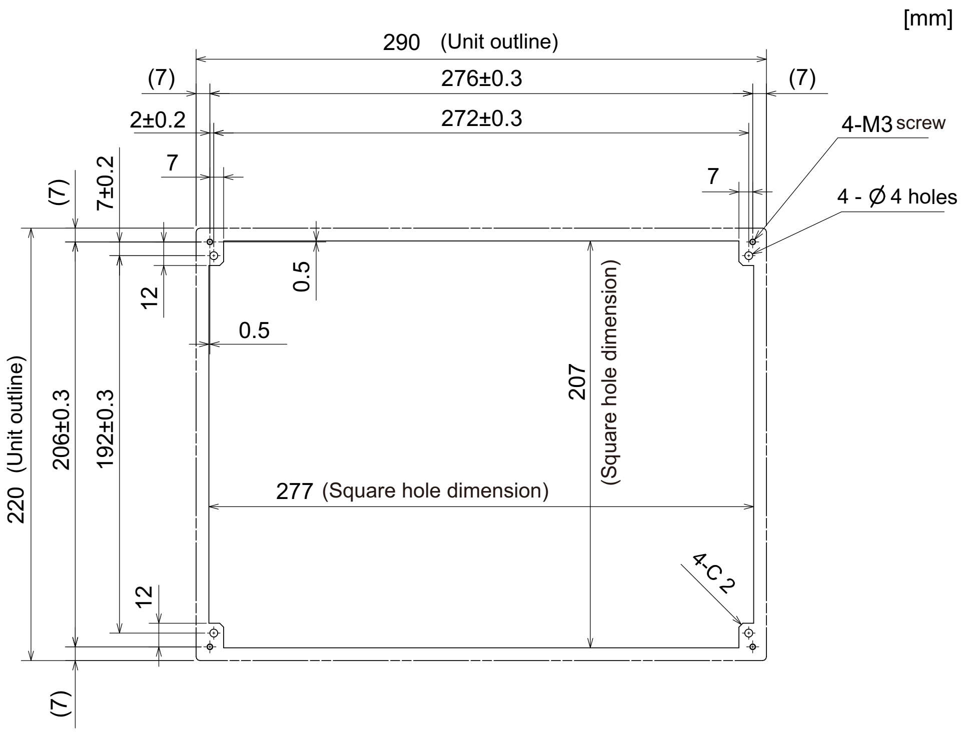


## 4.3.2 10.4-type (FCU8-DU141-32)

**[Outline dimension]**

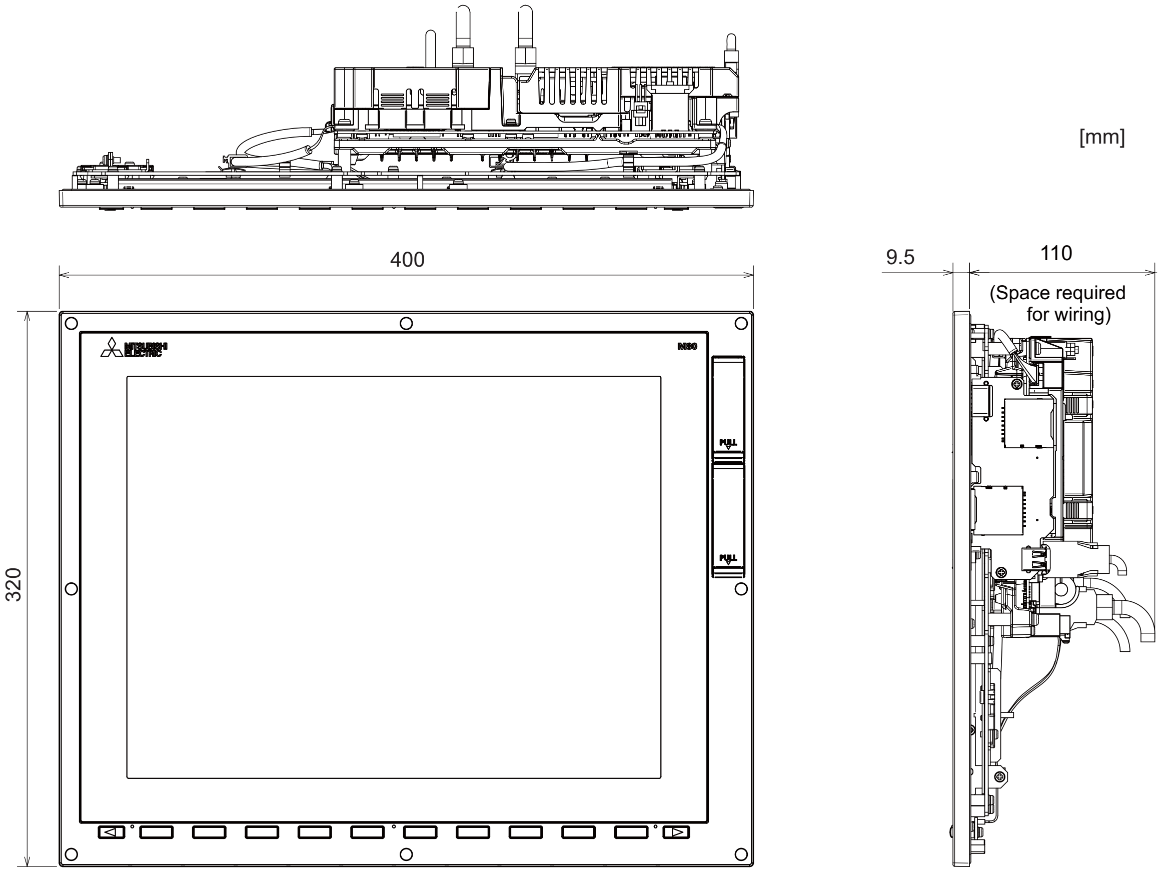



**[Panel cut dimension]**

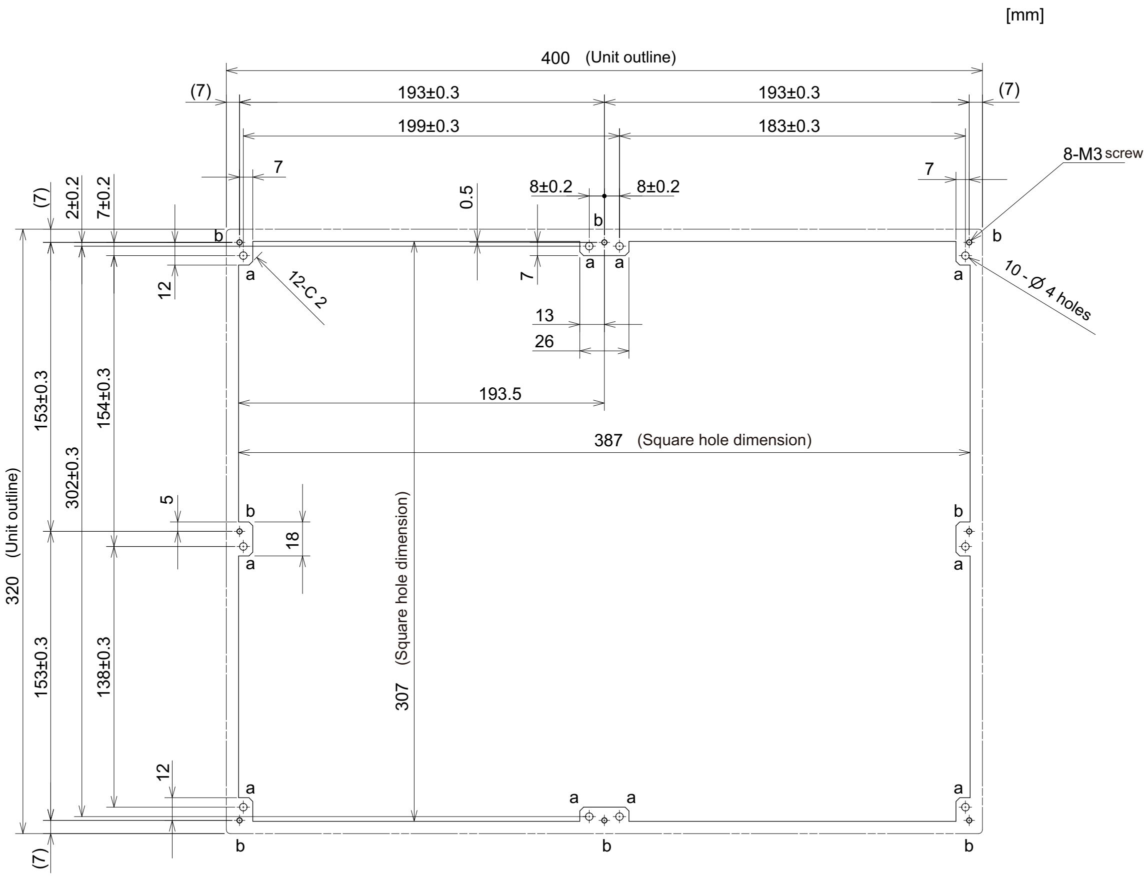


### 4.3.3 15-type (FCU8-DU181-32)

**[Outline dimension]**

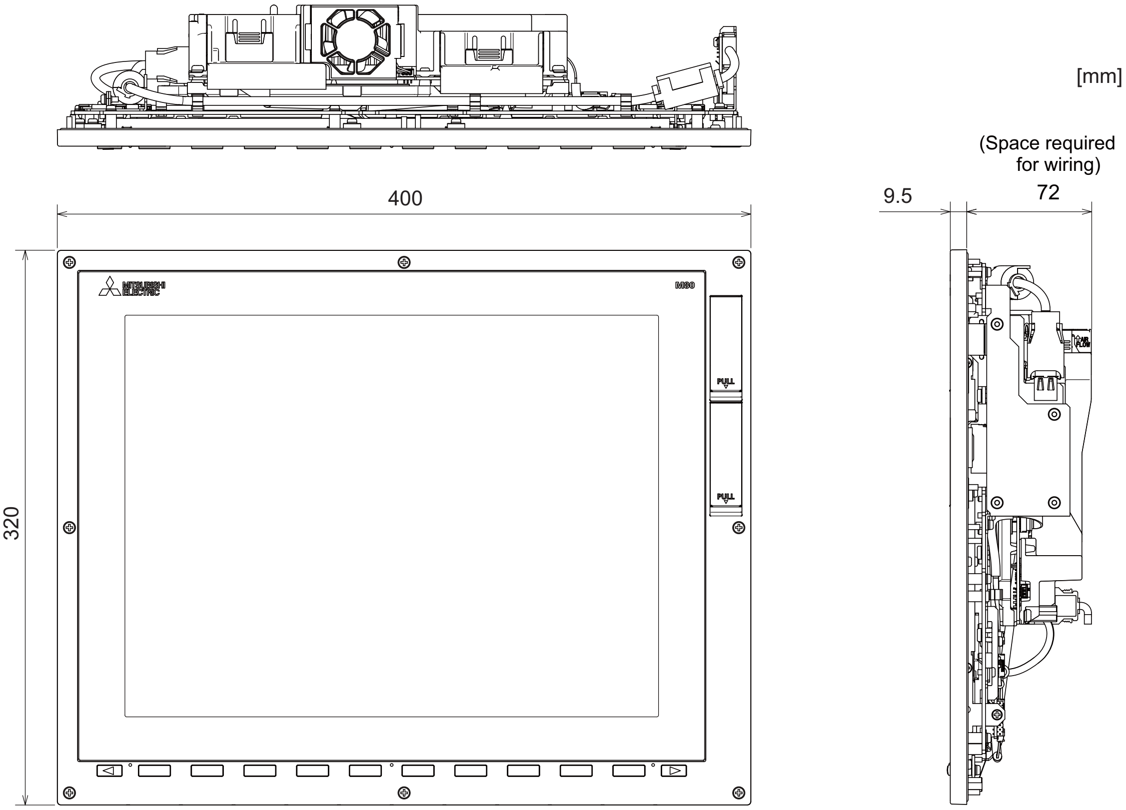


### [Panel cut dimension]



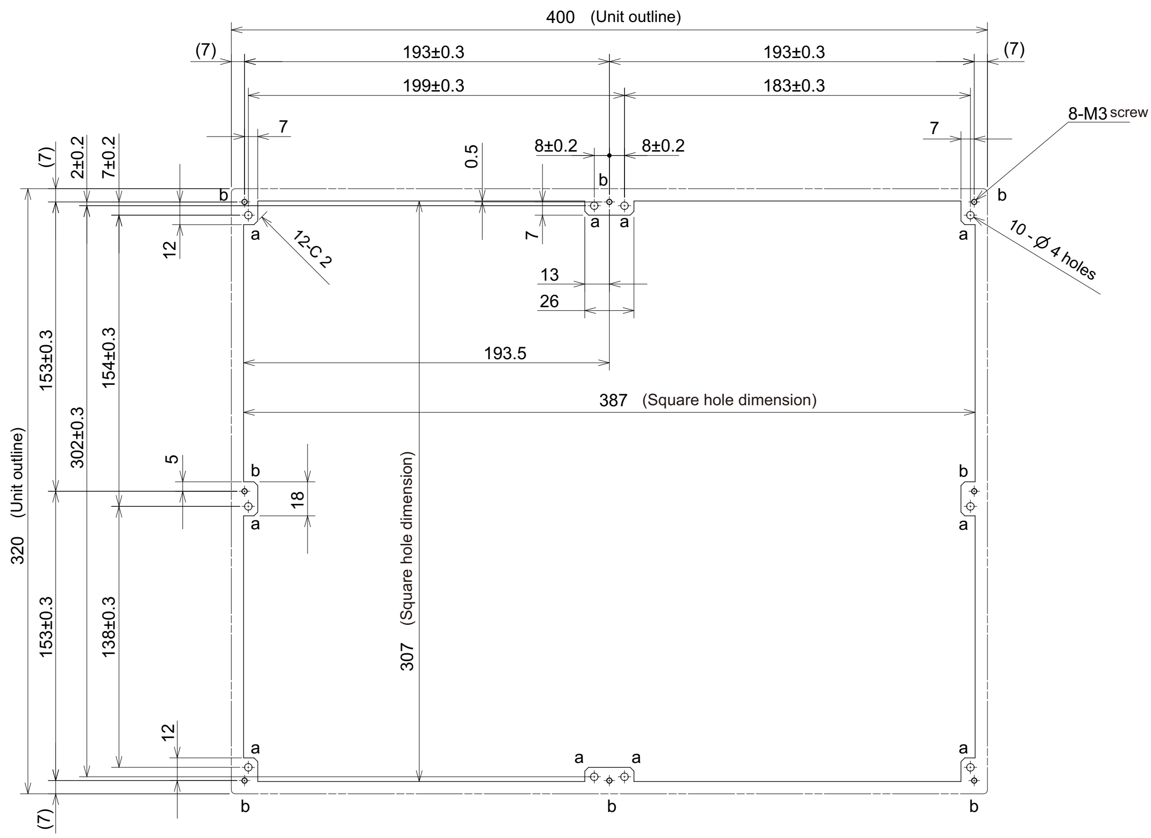
### 4.3.4 15-type (FCU8-DU181-36)

**[Outline dimension]**



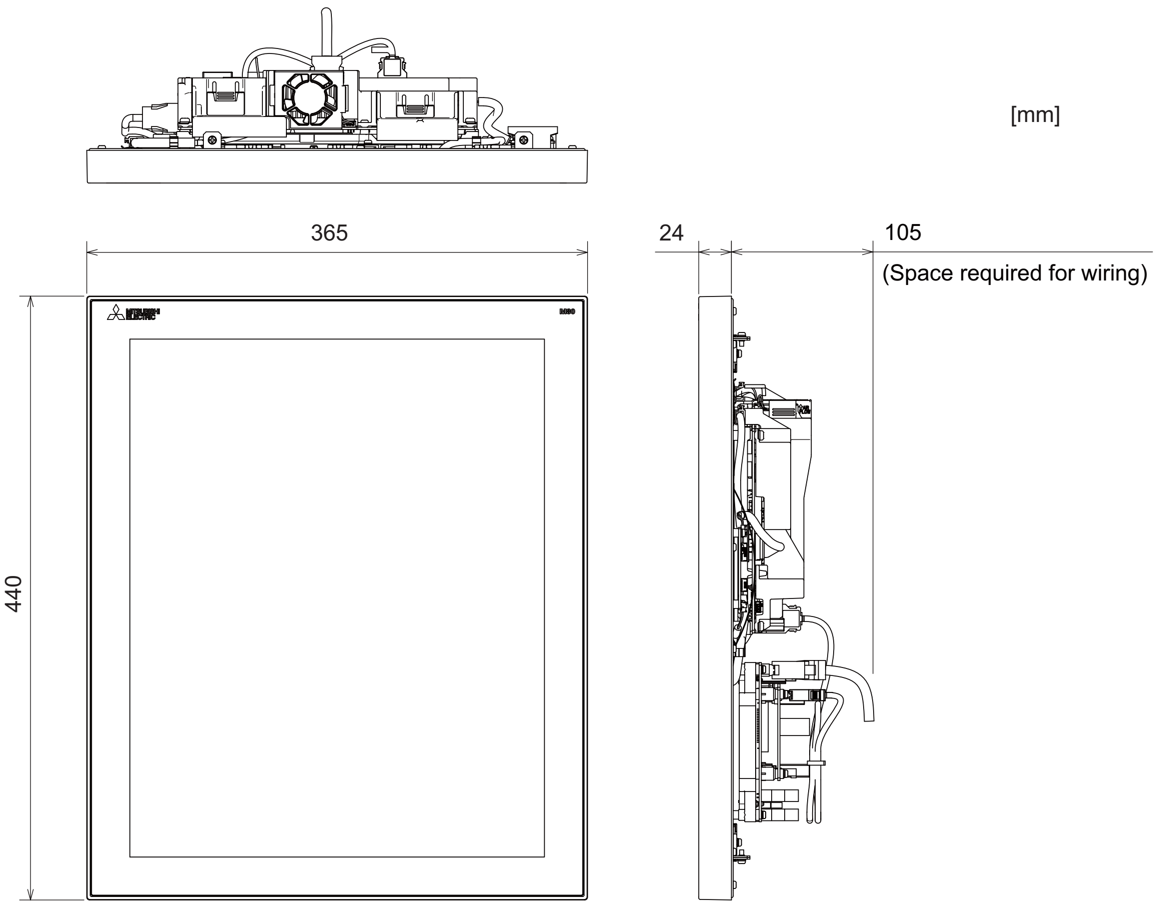
**[Panel cut dimension]**

[mm]

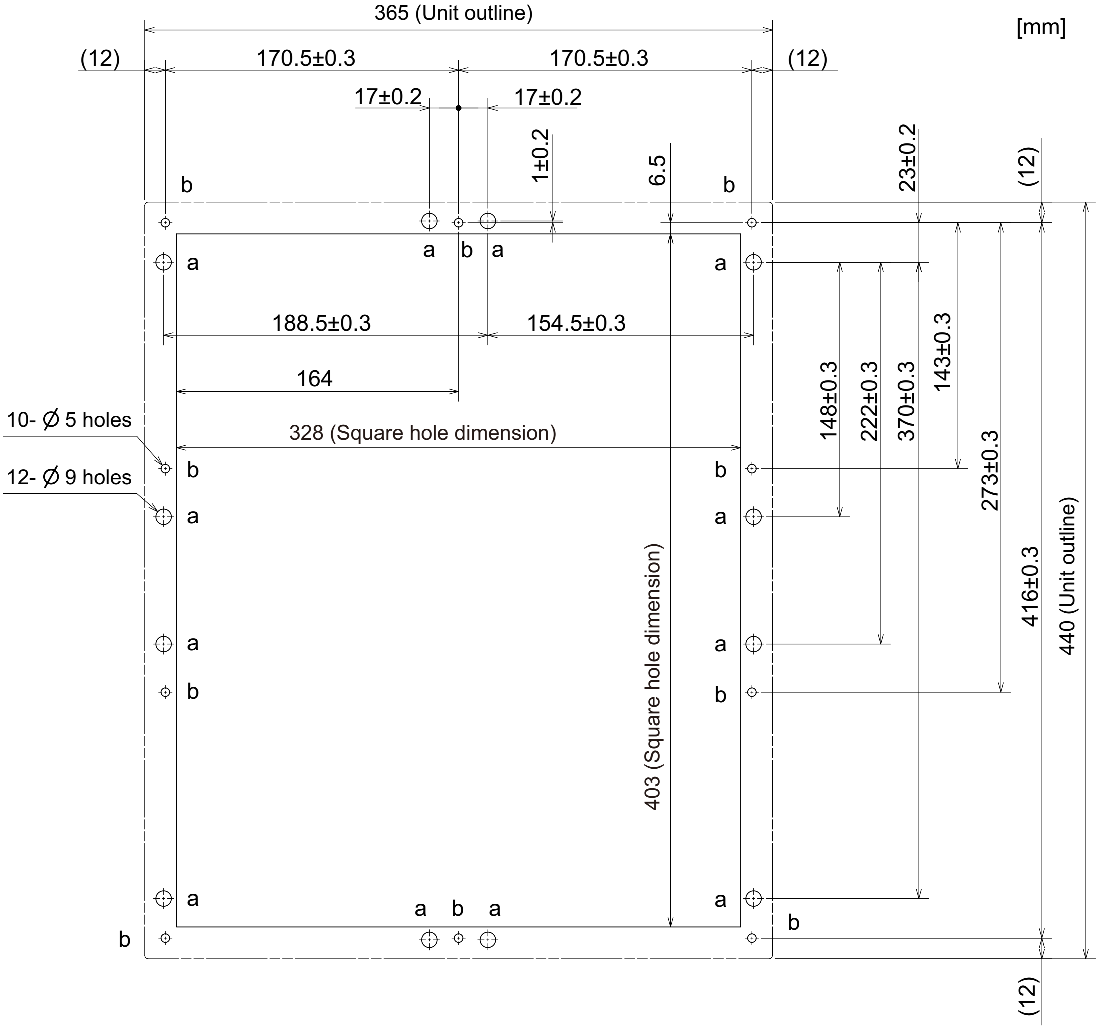


## 4.3.5 19-type (FCU8-DU191-77)

**[Outline dimension]**

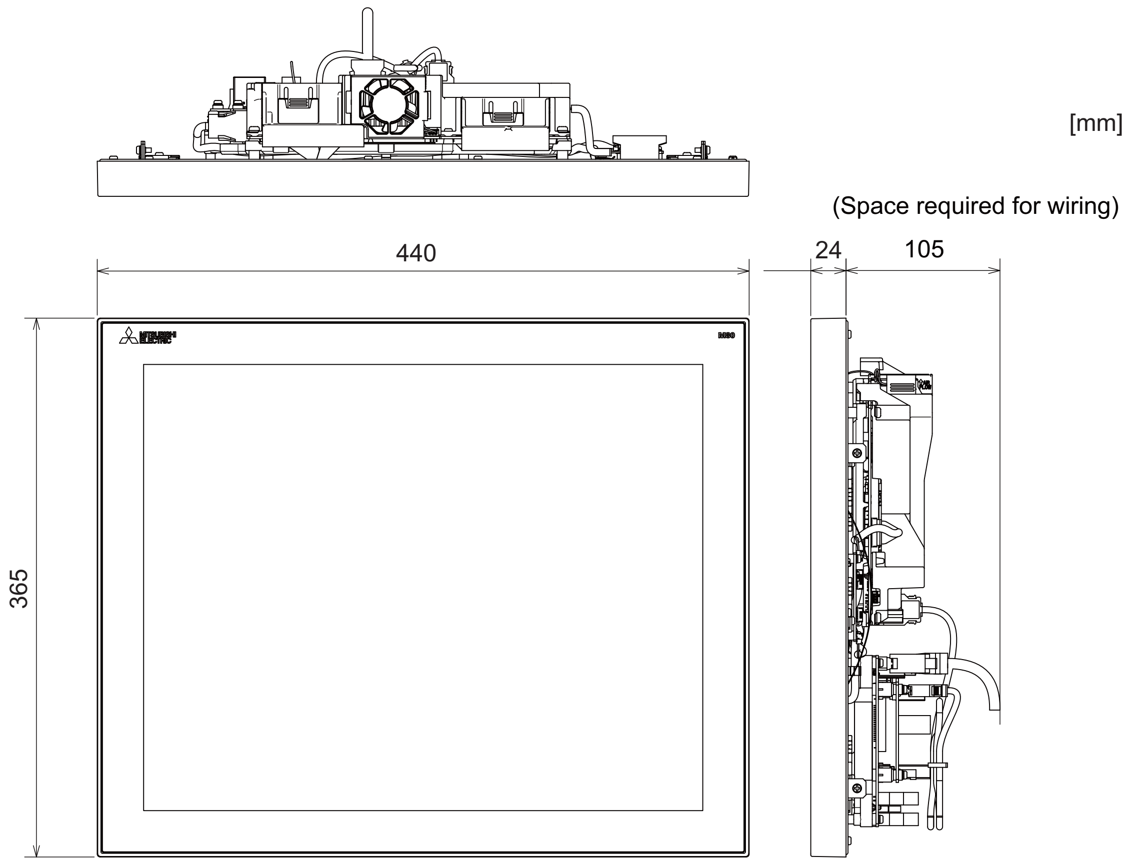


**[Panel cut dimension]**



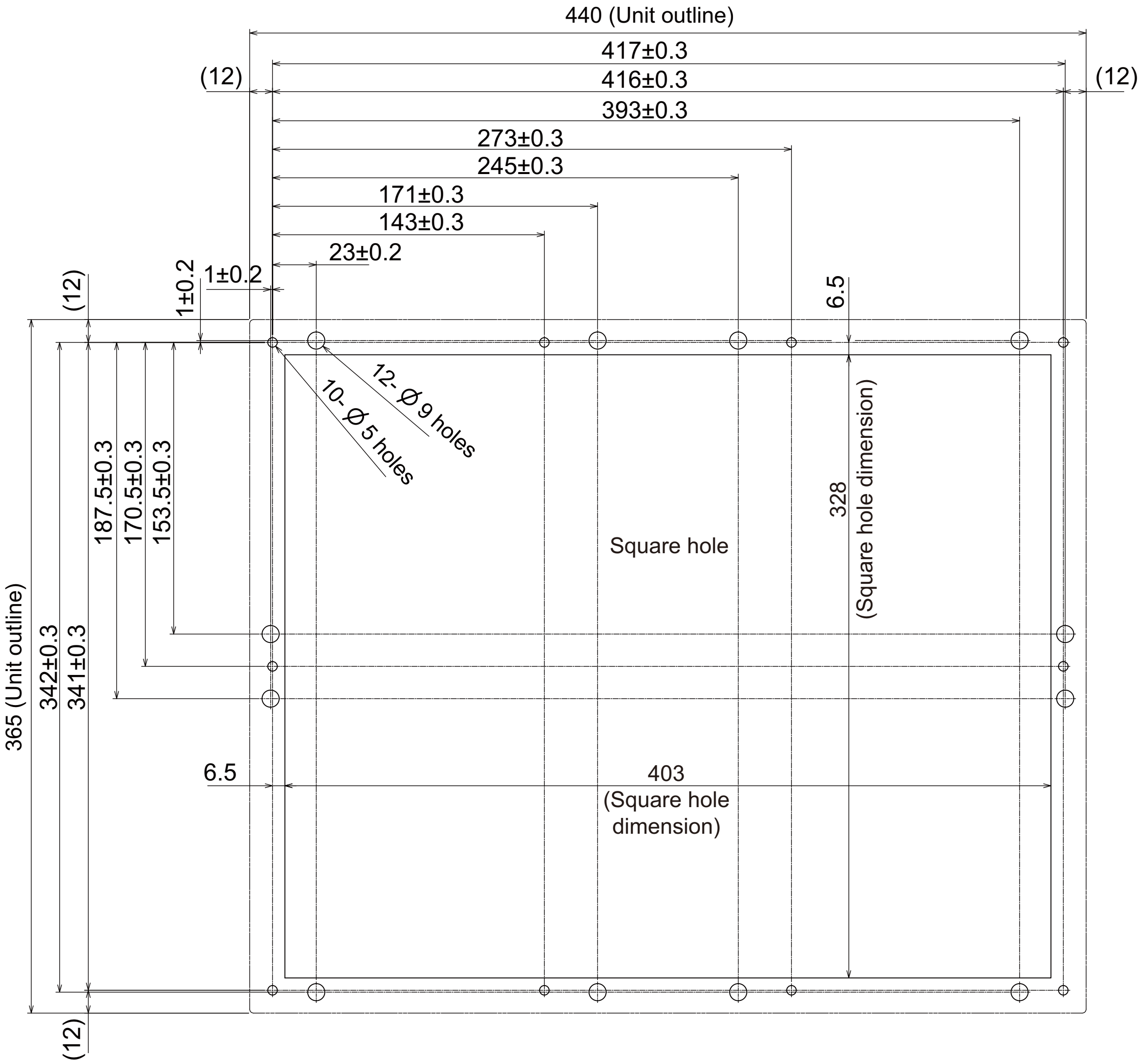
### 4.3.6 19-type (FCU8-DU192-77)

**[Outline dimension]**



**[Panel cut dimension]**

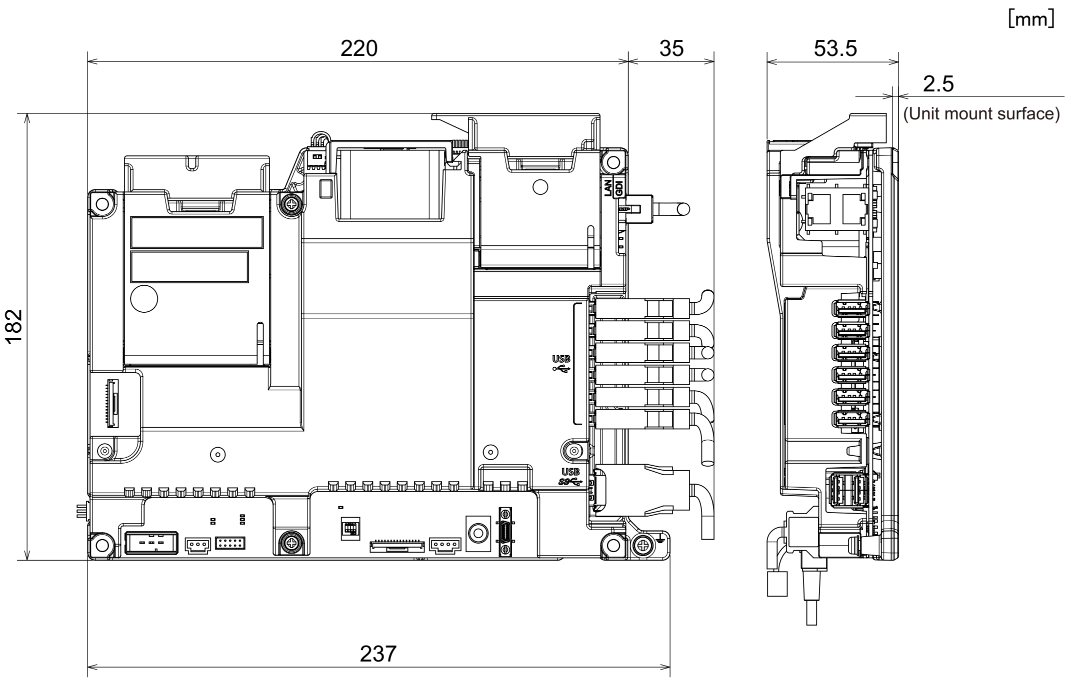
[mm]



# 4.4 Personal Computer Unit

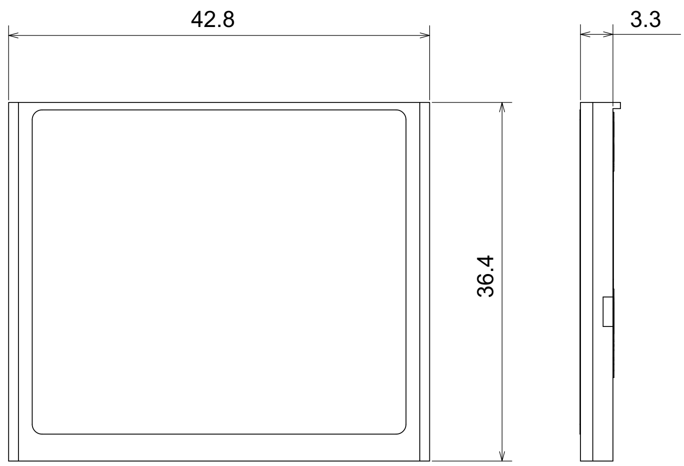
## 4.4.1 Personal Computer Unit (FCU8-PC231)

**[Outline dimension]**




## 4.4.2 Built-in Disk of the Display Unit (FCU8-CF001-001)

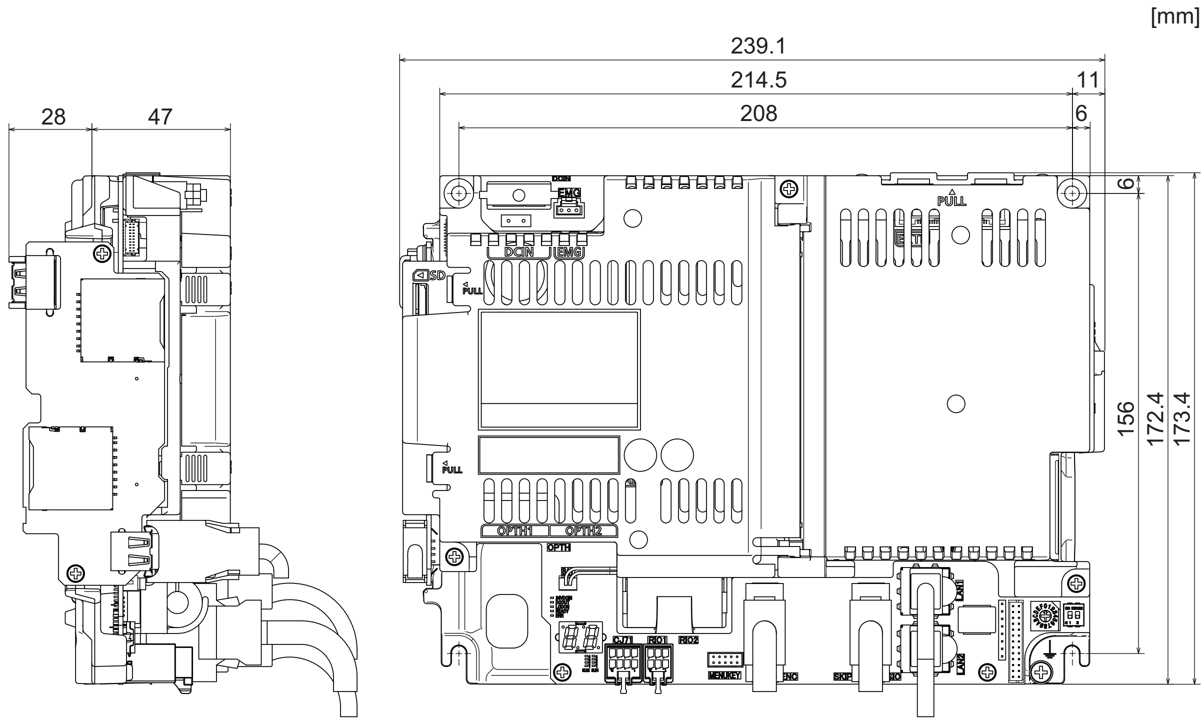
**[Outline dimension]**



# 4.5 Graphic Control Unit

## 4.5.1 FCU8-GC211

**[Outline dimension]**

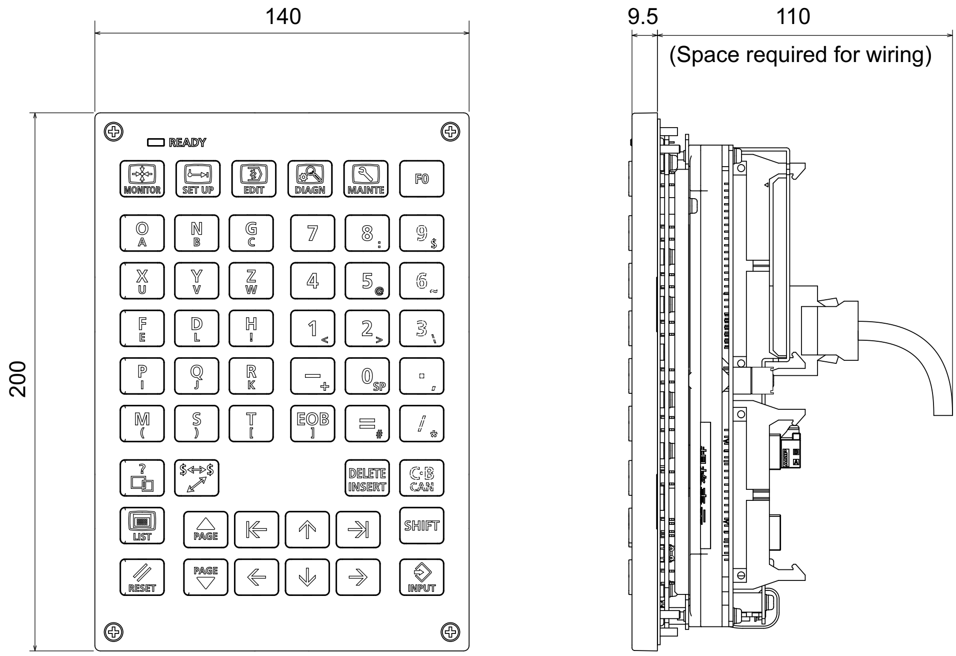



(Note) Refer to the following chapter for the space required for wiring.
「4.5 Display Unit [M800W]」
「4.6 Display Unit [M80W]」

# 4.6 Keyboard Unit

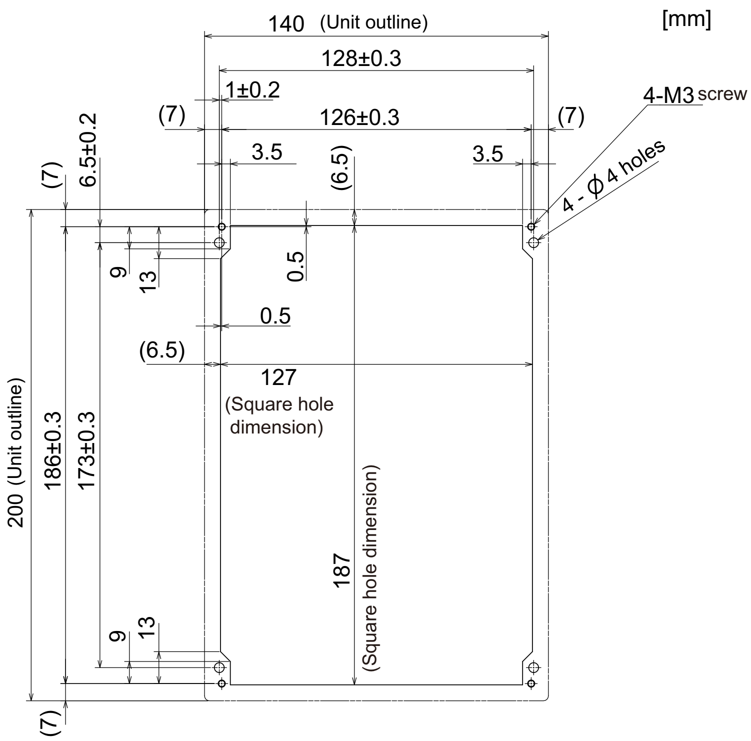
## 4.6.1 Keyboard for 8.4-type Display Unit (FCU8-KB026)

**[Outline dimension]**



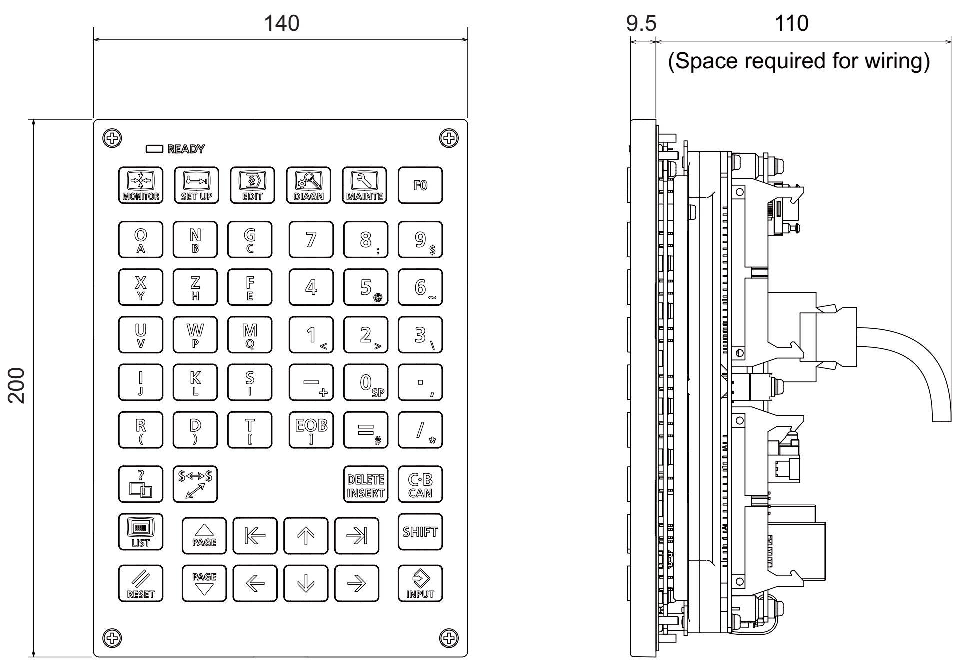

(Note) The above side view shows the state with the operation panel I/O unit mounted.

**[Panel cut dimension]**



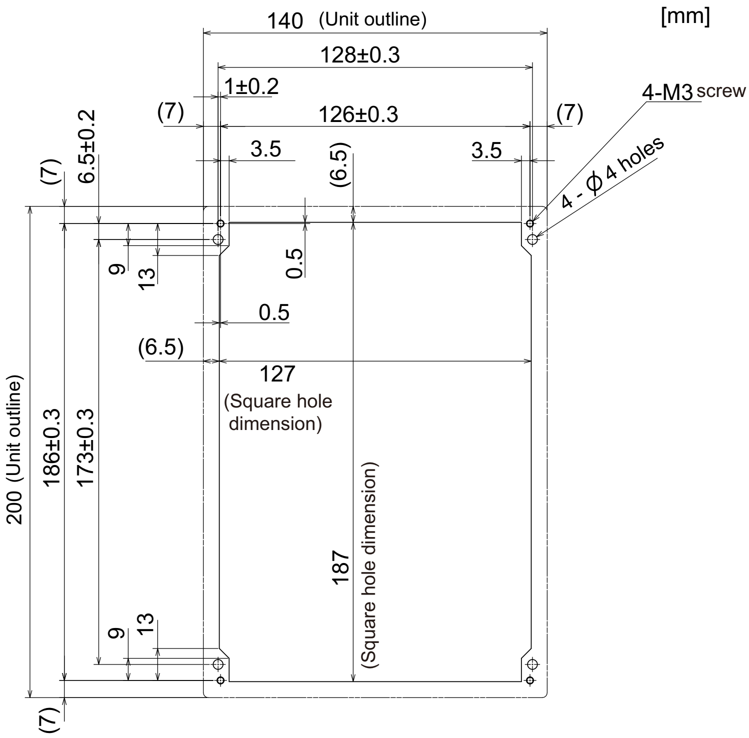
## 4.6.2 Keyboard for 8.4-type Display Unit (FCU8-KB028)

**[Outline dimension]**




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

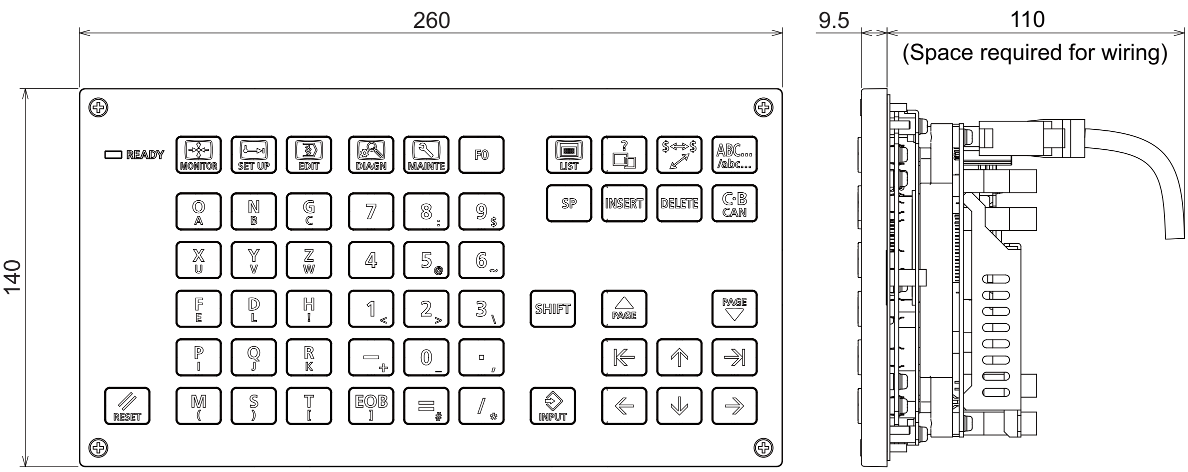
**[Panel cut dimension]**



### 4.6.3 Keyboard for 8.4-type Display Unit (FCU8-KB029)

**[Outline dimension]**

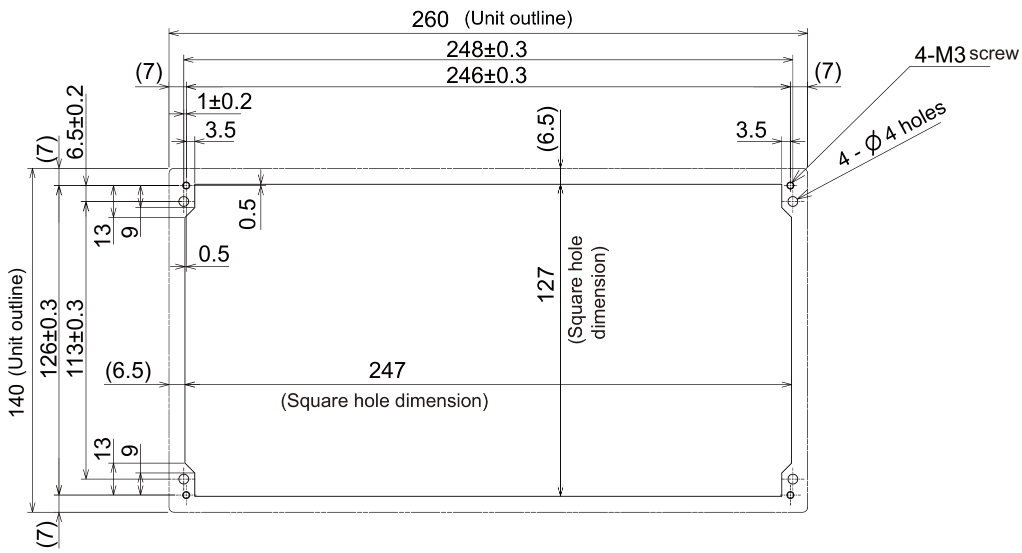
[mm]




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

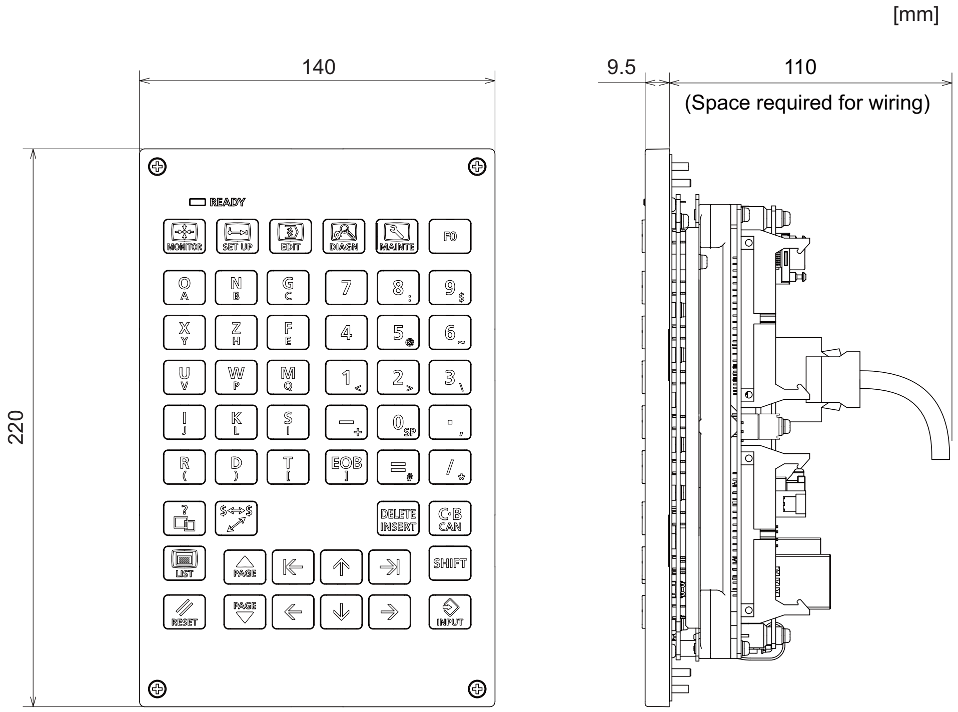
**[Panel cut dimension]**

[mm]



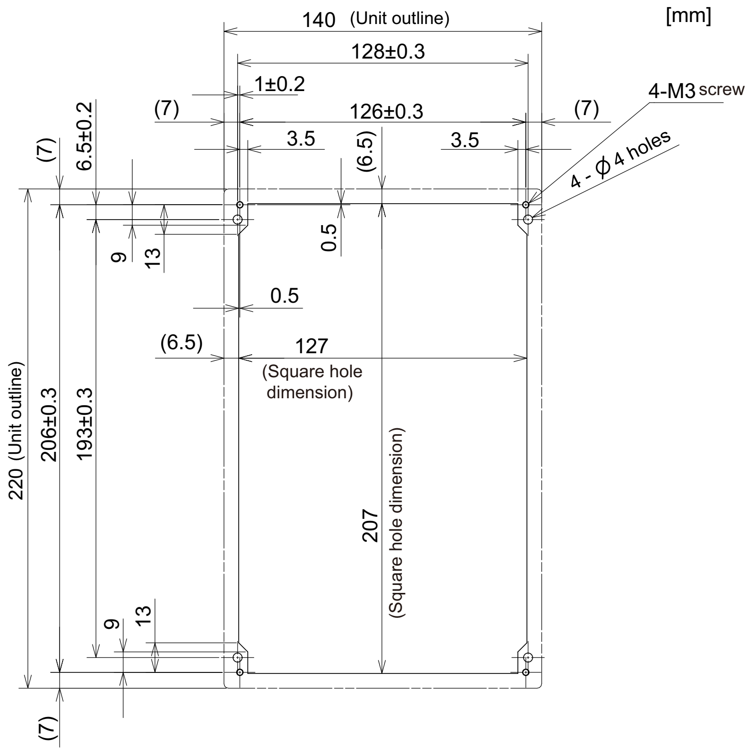
## 4.6.4 Keyboard for 10.4-type Display Unit (FCU8-KB041)

**[Outline dimension]**




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

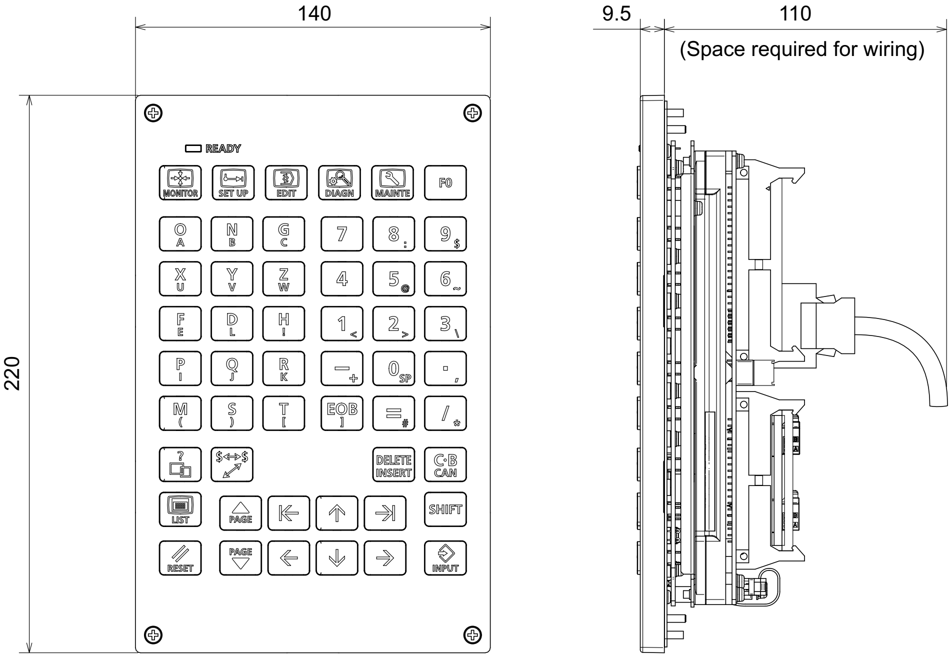
**[Panel cut dimension]**



## 4.6.5 Keyboard for 10.4-type Display Unit (FCU8-KB046)

### [Outline dimension]

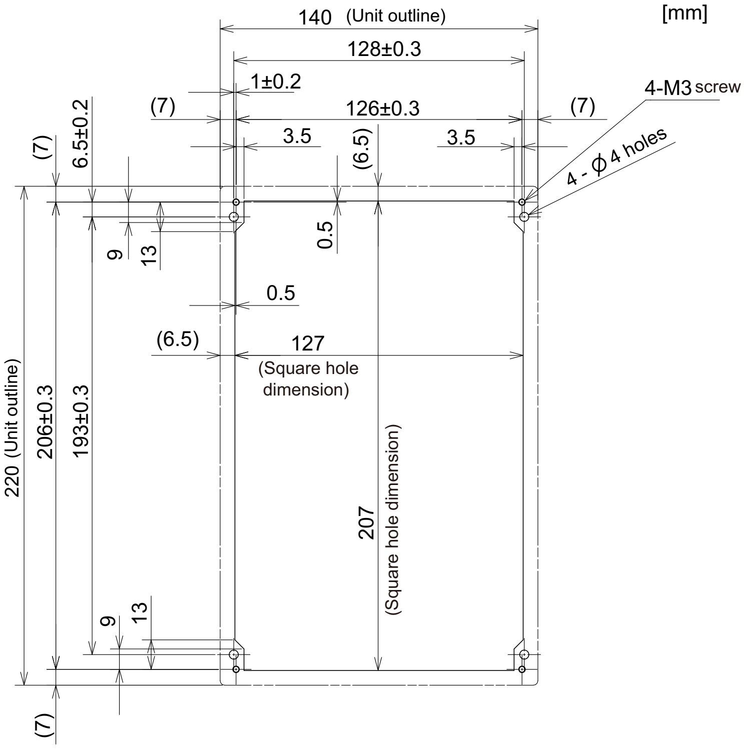
[mm]




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

### [Panel cut dimension]

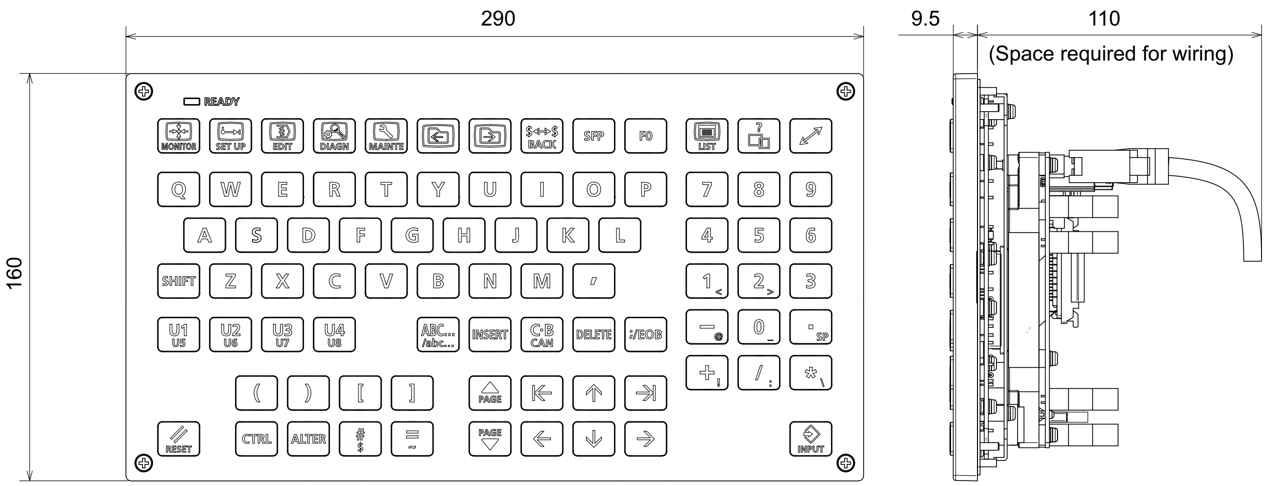
[mm]



### 4.6.6 Keyboard for 10.4-type Display Unit (FCU8-KB047)

**[Outline dimension]**

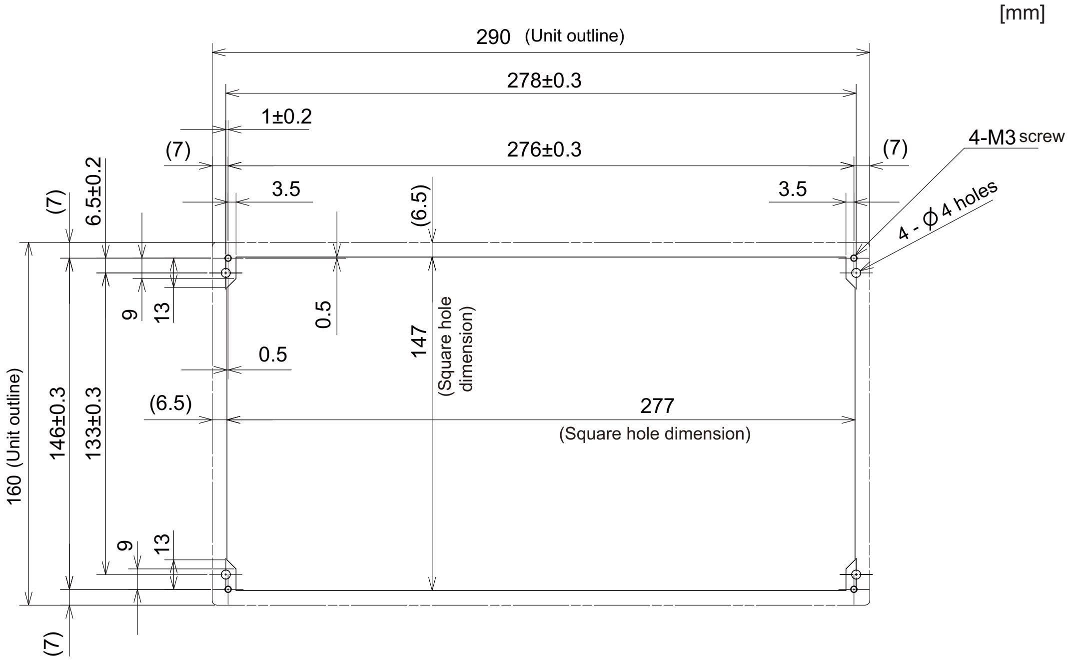
[mm]




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

**[Panel cut dimension]**

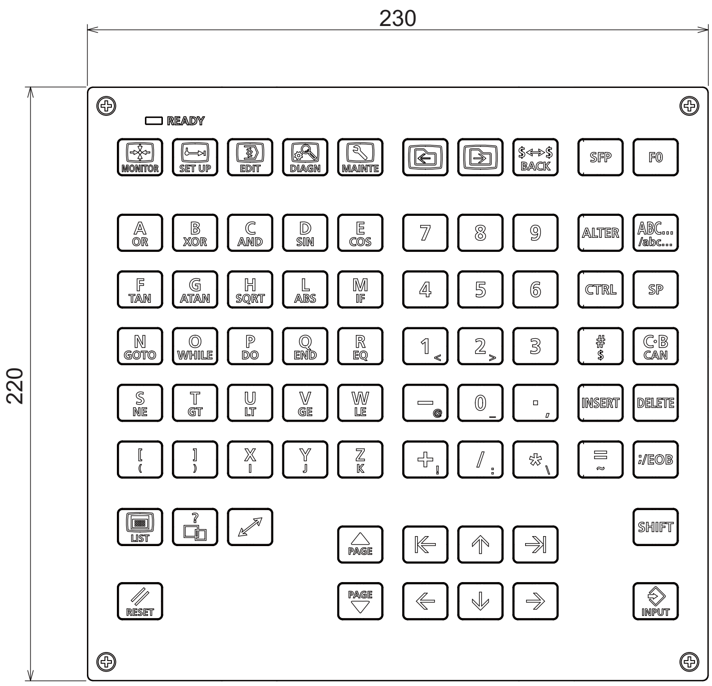
[mm]

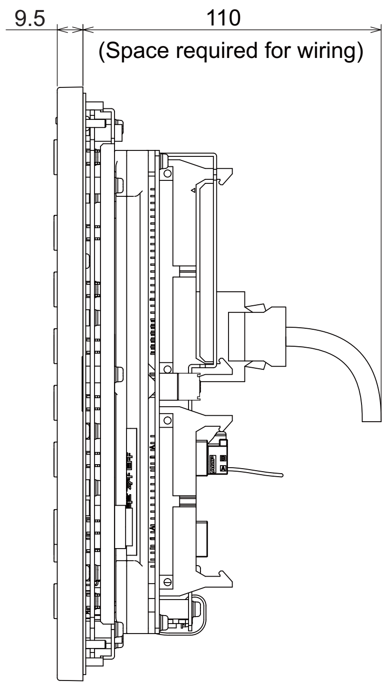


## 4.6.7 Keyboard for 10.4-type Display Unit (FCU8-KB048)

**[Outline dimension]**

[mm]

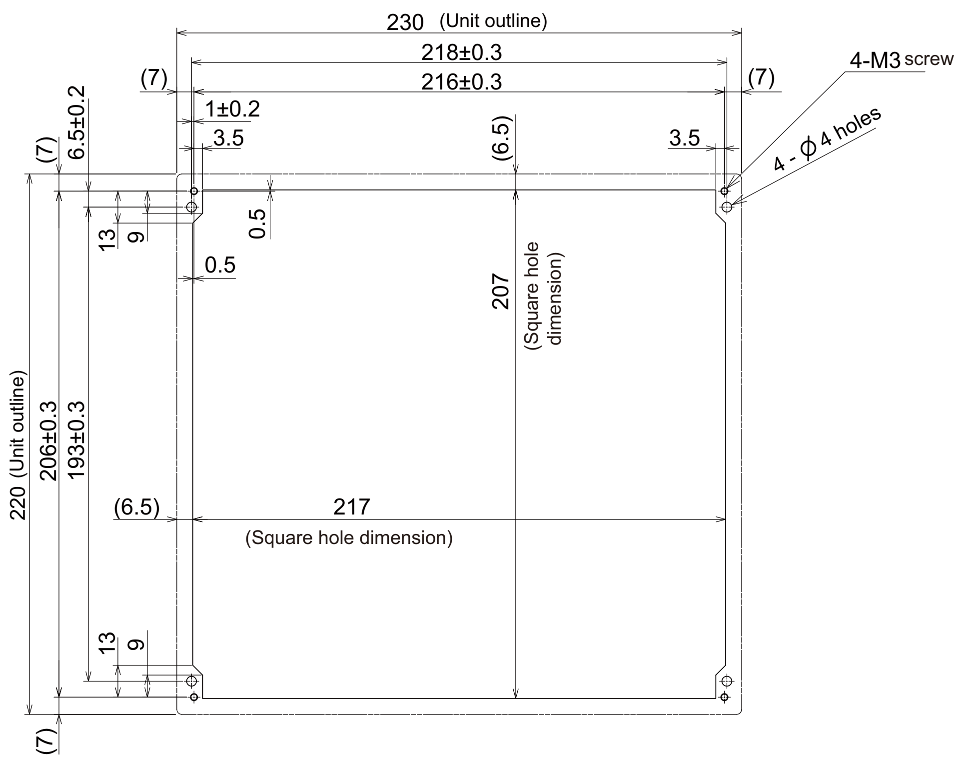



(Note) The above side view shows the state with the operation panel I/O unit mounted.

**[Panel cut dimension]**

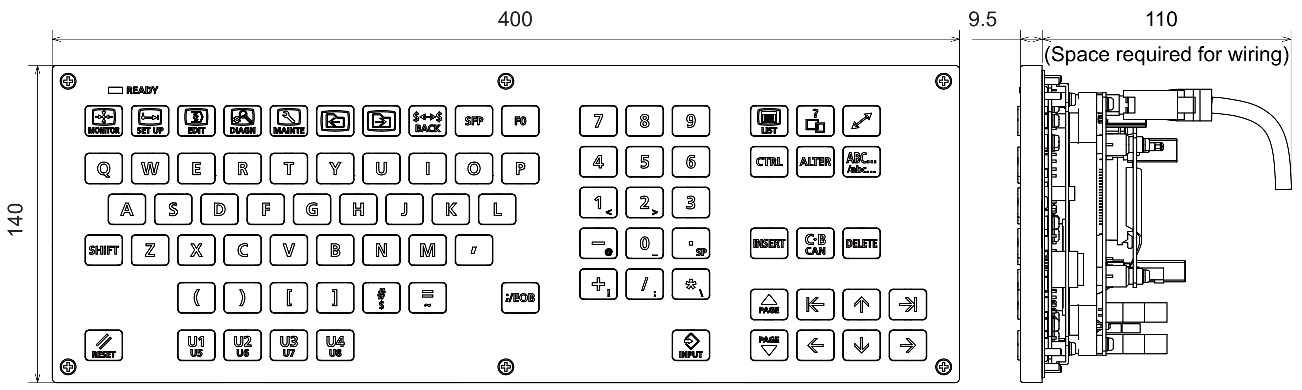
[mm]



### 4.6.8 Keyboard for 15-type Display Unit (FCU8-KB083)

**[Outline dimension]**

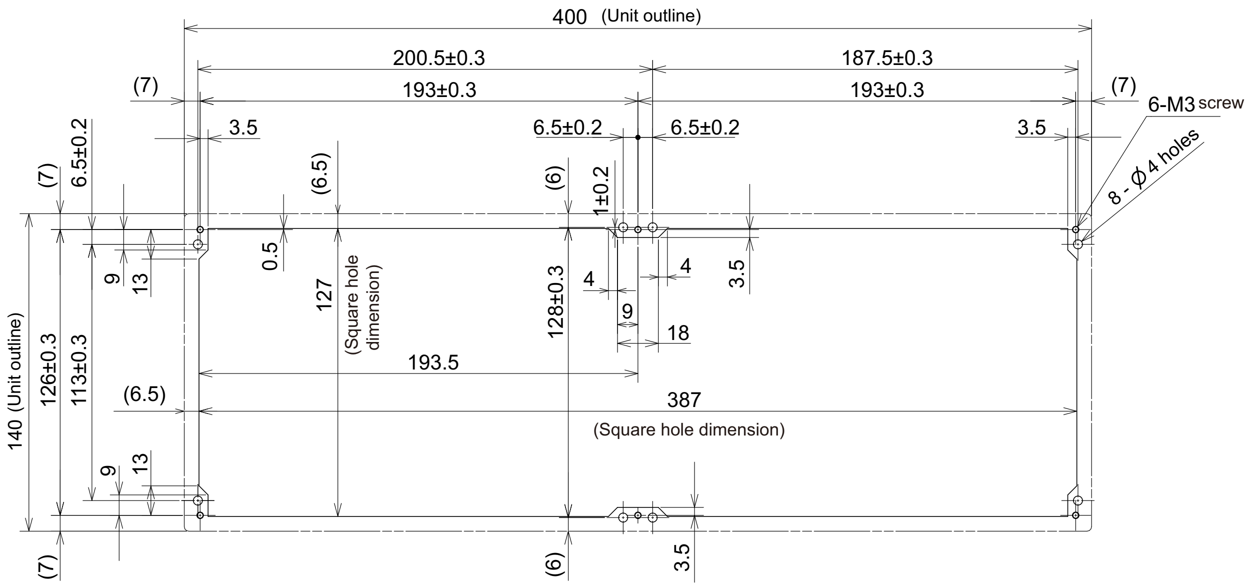
[mm]




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

**[Panel cut dimension]**

[mm]



# 4.7 Operation Panel I/O Unit

Characteristics of operation panel I/O unit are as follows.

(1) Operation panel (display unit section) and electric cabinet (control unit section) are wired with J210 cable.
The communication of all signals including the emergency stop signal to be set to the operation panel are performed with J210 cable and this is effective to simplify the wiring.
(2) Number of DI/DO points that are mounted on the operation panel is 64/64.
Input can be switched between sink and source. Output is source output.
(3) Remote I/O 2.0 is adopted and up to 64 stations can be connected in the whole of other channels.
Number of addable units varies according to the type of the operation panel I/O unit as follows.
FCU8-DX830/DX837: 12 stations are occupied and 52 stations remain, 32 points/32 points × 54 stations, as result, up to 1664 points/1664 points can be expanded in total.
FCU8-DX730: 10 stations are occupied in sets with graphic control unit. 54 stations remain, 32 points/32 points × 54 stations, as result, up to 1728 points/1728 points can be expanded in total.
(4) Safety input conforming to safety standards is available by adopting remote I/O 2.0.
FCU8-DX837: Number of input points is 8.
(5) 3ch of manual pulse generators can be connected.
5V and 12V manual pulse generators can be connected.
(6) DO output can output 200mA/point.
(Total output current of whole unit is 3.8A at the maximum.)

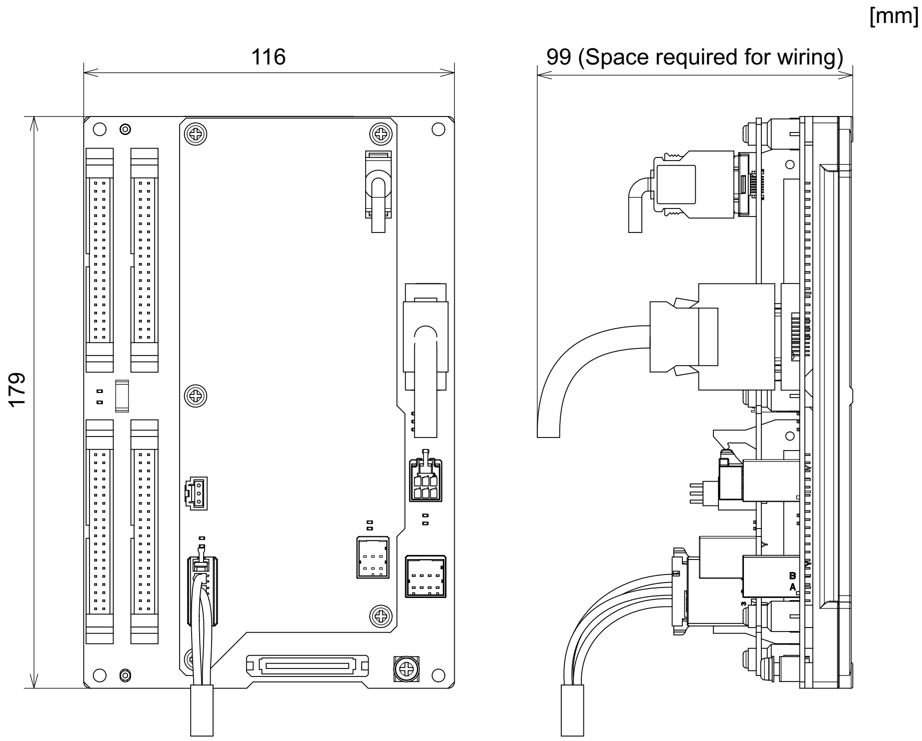
(Note) The maximum connectable number of remote I/O units is 32.

## 4.7.1 List of Units

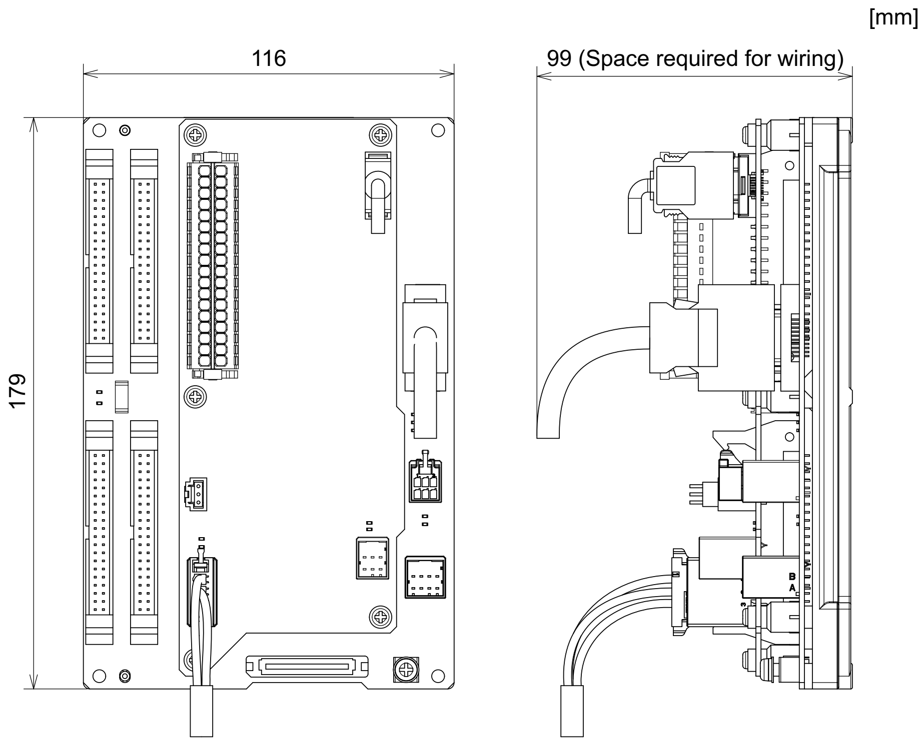
| Classification | Type | Components | Remarks |
|---|---|---|---|
| DI 24V/0V common input [64 points]<br>DO Source output [64 points] | FCU8-DX830 | Base card<br>Add-on card<br>RIO 2.0 terminator connector (R2-TM) | DI: 64-points 24V/0V common type<br>DO: 64-points source type (200mA/point)<br>Manual pulse generator input: 3ch<br>Display unit I/F<br>Keyboard unit I/F<br>Emergency stop input<br>Remote I/O 2.0 I/F<br>RIO occupied stations (fixed):<br>1 to 4, 7 to 14<br>RIO extensible stations:<br>5, 6, 15 to 64<br>(Note) J291 cable is required for connection with the personal computer unit.<br>(for windows-based display) |
| DI 24V/0V common input [64 points]<br>DO Source output [64 points]<br>Safety DI 24V/0V common input [8 points] | FCU8-DX837 | Base card<br>Add-on card<br>RIO 2.0 terminator connector (R2-TM) | DI: 64-points 24V/0V common type<br>DO: 64-points source type (200mA/point)<br>Safety DI: 8-points 0V common type<br>Manual pulse generator input: 3ch<br>Display unit I/F<br>Keyboard unit I/F<br>Emergency stop input<br>Remote I/O 2.0 I/F<br>RIO occupied stations (fixed):<br>1 to 4, 7 to 14<br>RIO extensible stations:<br>5, 6, 15 to 64<br>(Note) J291 cable is required for connection with the personal computer unit.<br>(for windows-based display) |
| DI 24V/0V common input [64 points]<br>DO Source output [64 points] | FCU8-DX730 | Base card<br>RIO 2.0 terminator connector (R2-TM) | DI: 64-points 24V/0V common type<br>DO: 64-points source type (200mA/point)<br>Manual pulse generator input: 3ch<br>Graphic control unit I/F<br>Keyboard unit I/F<br>Remote I/O 2.0 I/F<br>RIO occupied stations (fixed):<br>1, 2, 7 to 12<br>RIO extensible stations:<br>3 to 6, 15 to 64<br>(13 and 14 are occupied by the graphic control unit.)<br>(Note) J010 cable is required for connection with the graphic control unit.<br>(for windows-less display) |

## 4.7.2 FCU8-DX830 / FCU8-DX837 / FCU8-DX730

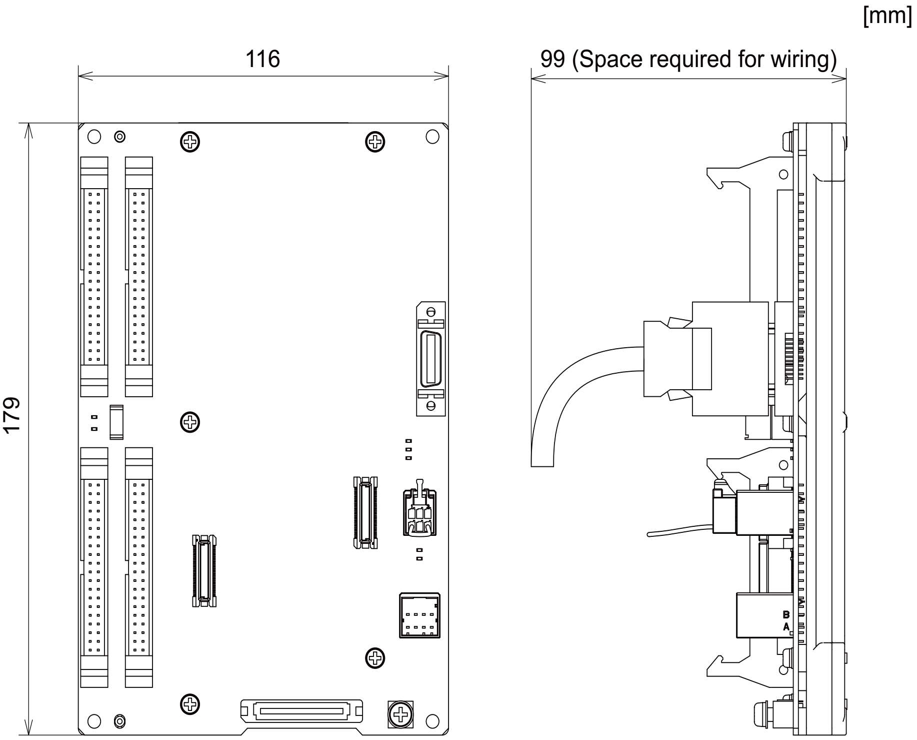
### [Outline dimension : FCU8-DX830]



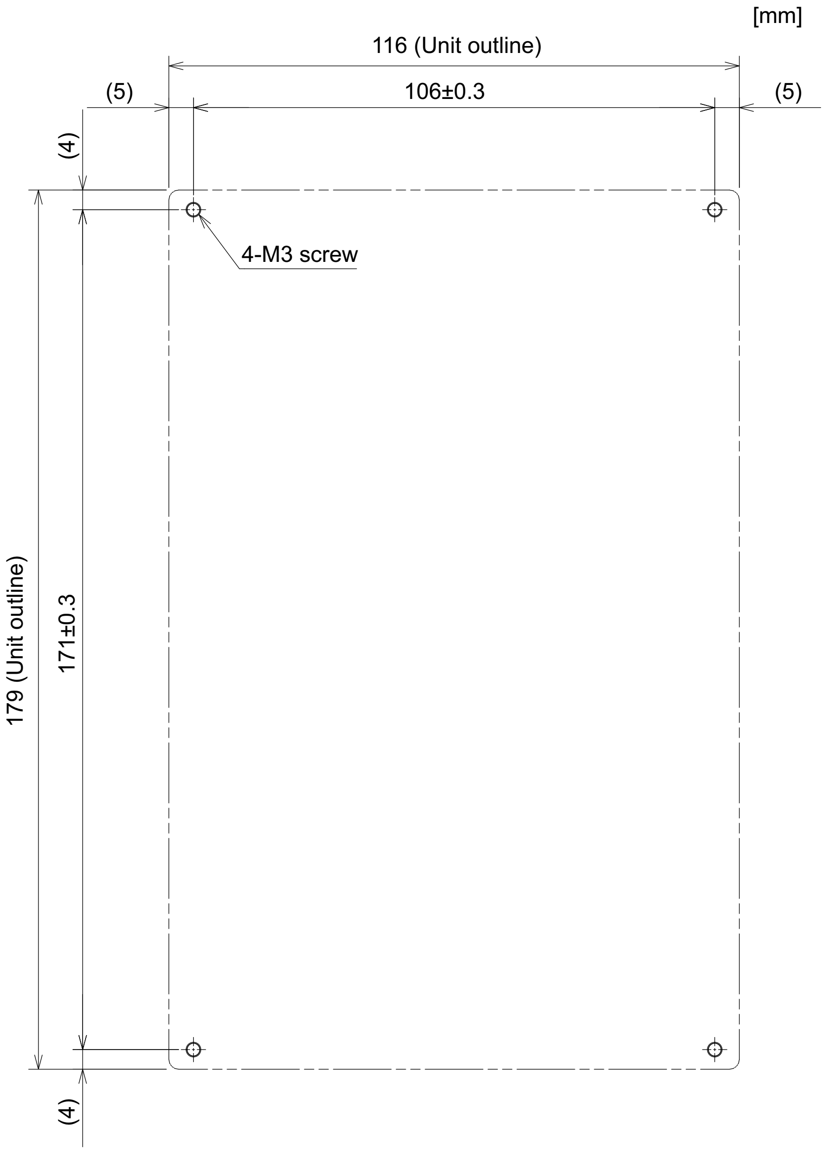

### [Outline dimension : FCU8-DX837]



**[Outline dimension : FCU8-DX730]**



**[Installation dimension : FCU8-DX830 / FCU8-DX837 / FCU8-DX730]**




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

# 4.8 Remote I/O Unit

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

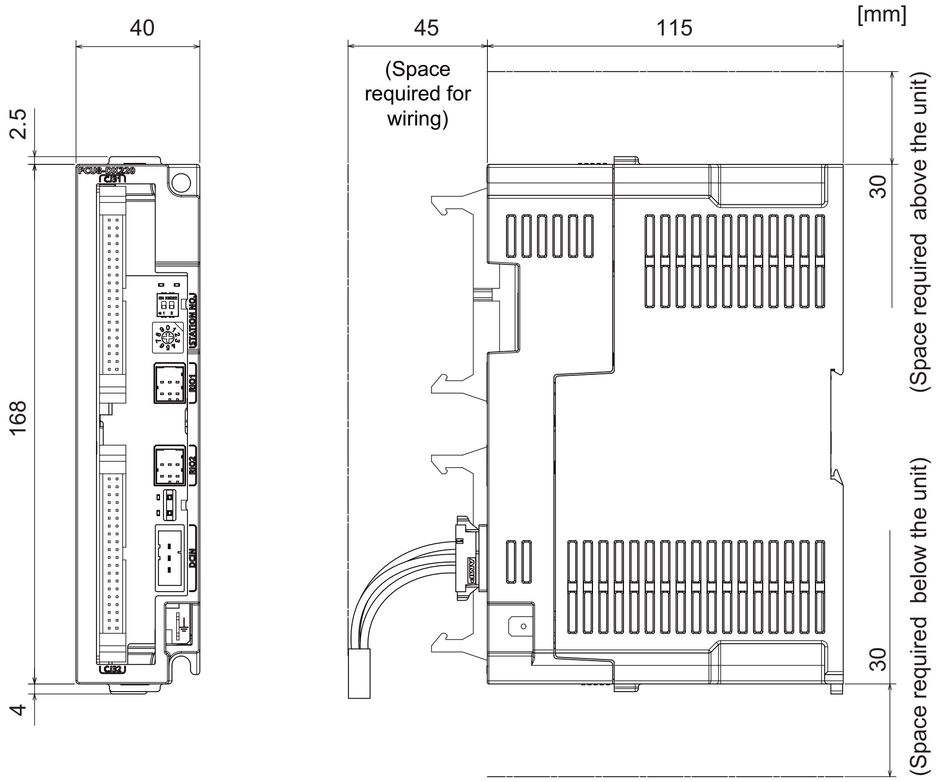
(Note) The maximum connectable number of remote I/O units is 32.

## 4.8.1 List of Units

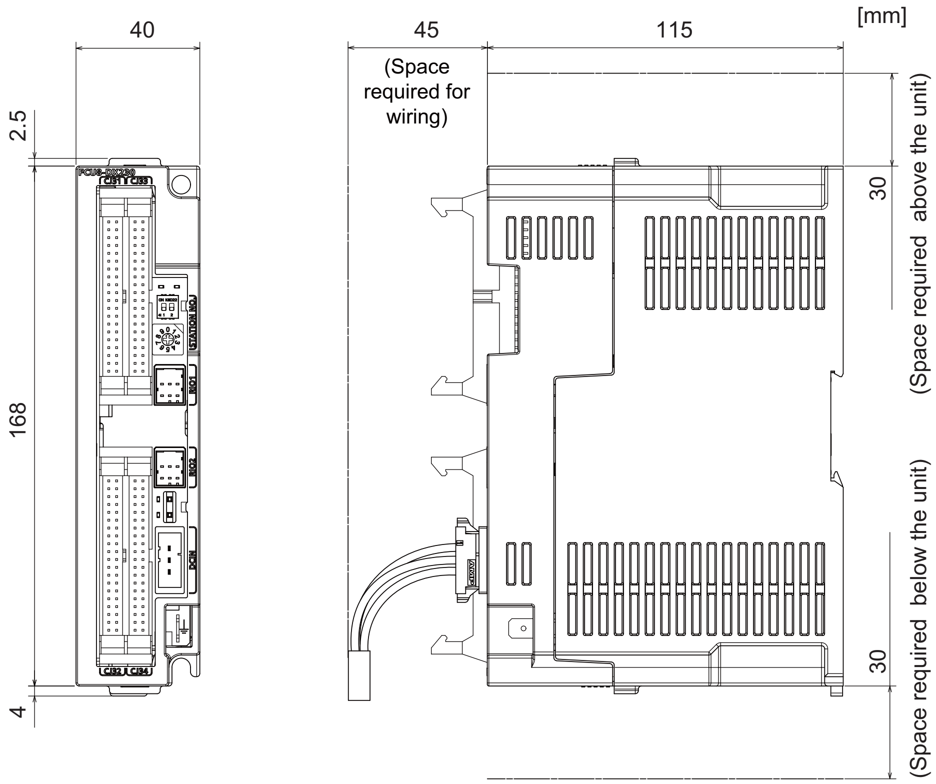
| Classification | Type | Components | Remarks |
|---|---|---|---|
| DI 24V/0V common input [32 points]<br>DO Source output [32 points] | FCU8-DX220 | Base card<br>RIO 2.0 connector set | DI: 32-points 24V/0V common type<br>Do: 32-points source type (200mA/point)<br>Number of occupied stations: 1 |
|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

### 4.8.2 FCU8-DX220 / FCU8-DX230 / FCU8-DX231 / FCU8-DX202 / FCU8-DX213 / FCU8-DX213-1 / FCU8-DX654 / FCU8-DX654-1 / FCU8-DX651/ FCU8-DX408

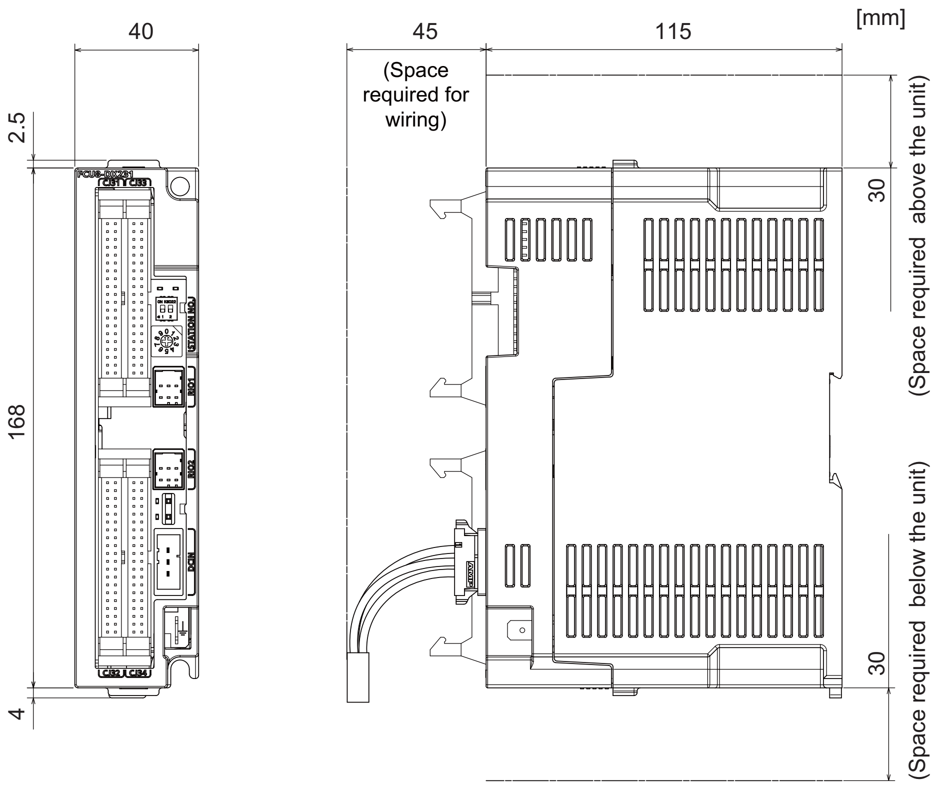
**[Outline dimension : FCU8-DX220]**



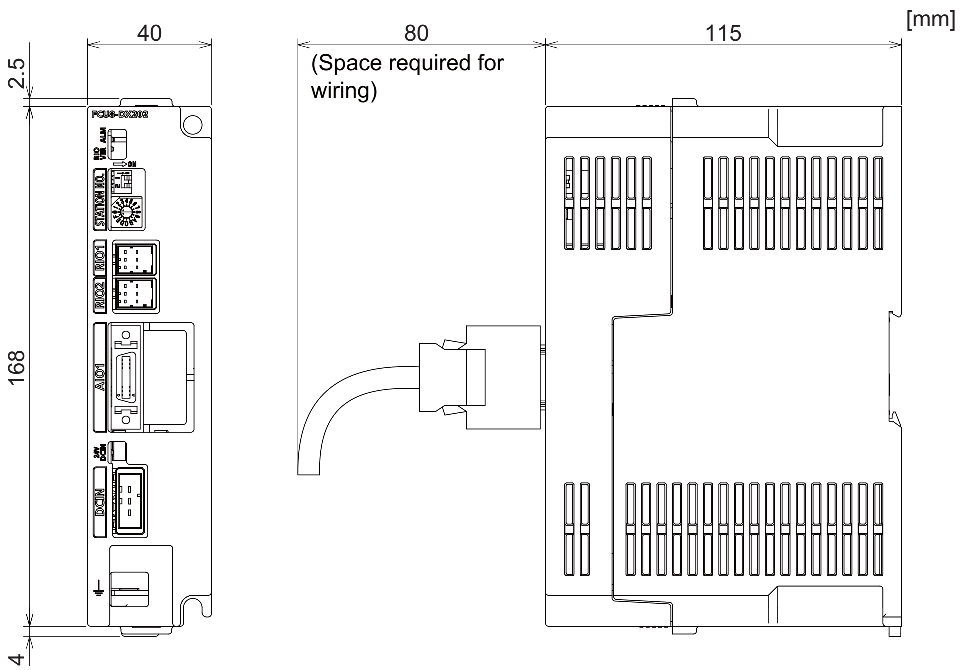

**[Outline dimension : FCU8-DX230]**



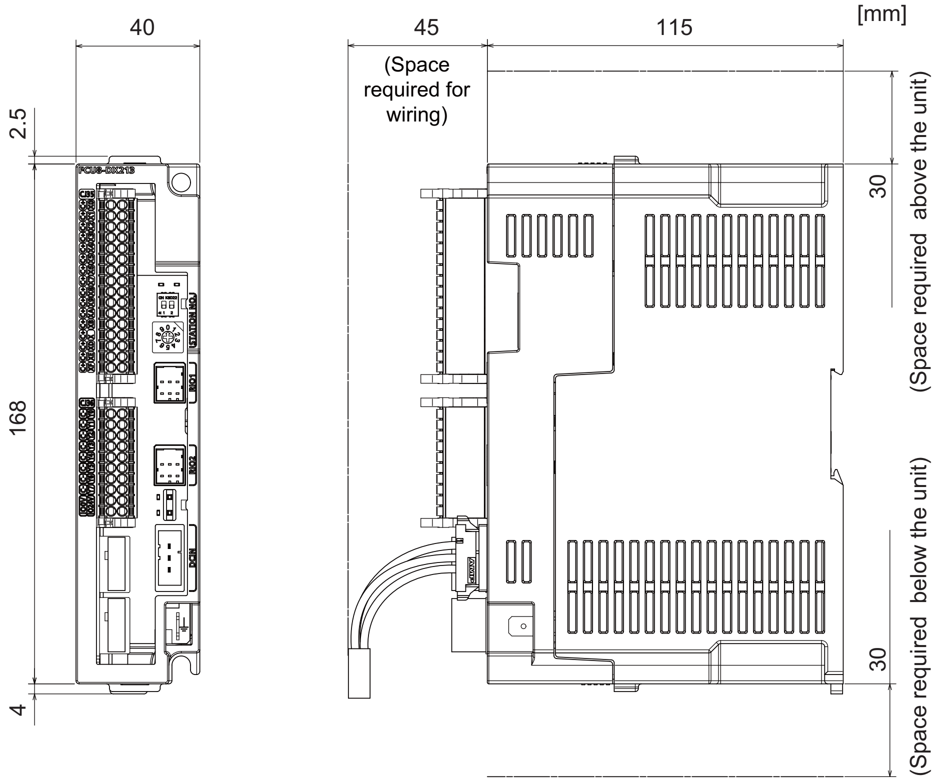
**[Outline dimension : FCU8-DX231]**



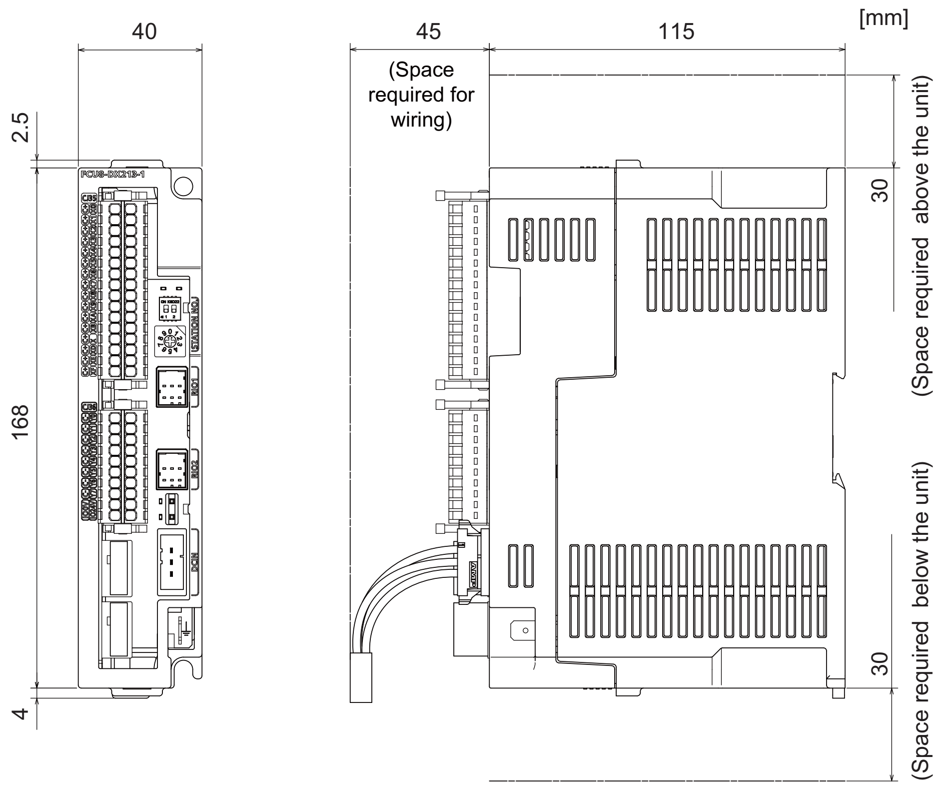

**[Outline dimension : FCU8-DX202]**



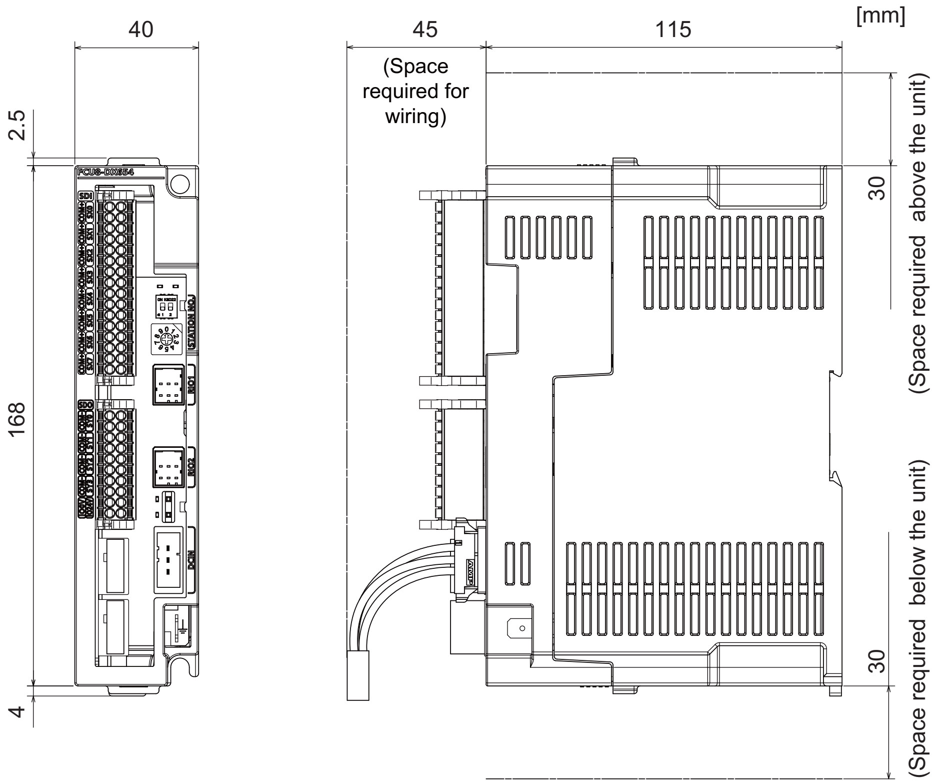
**[Outline dimension : FCU8-DX213]**



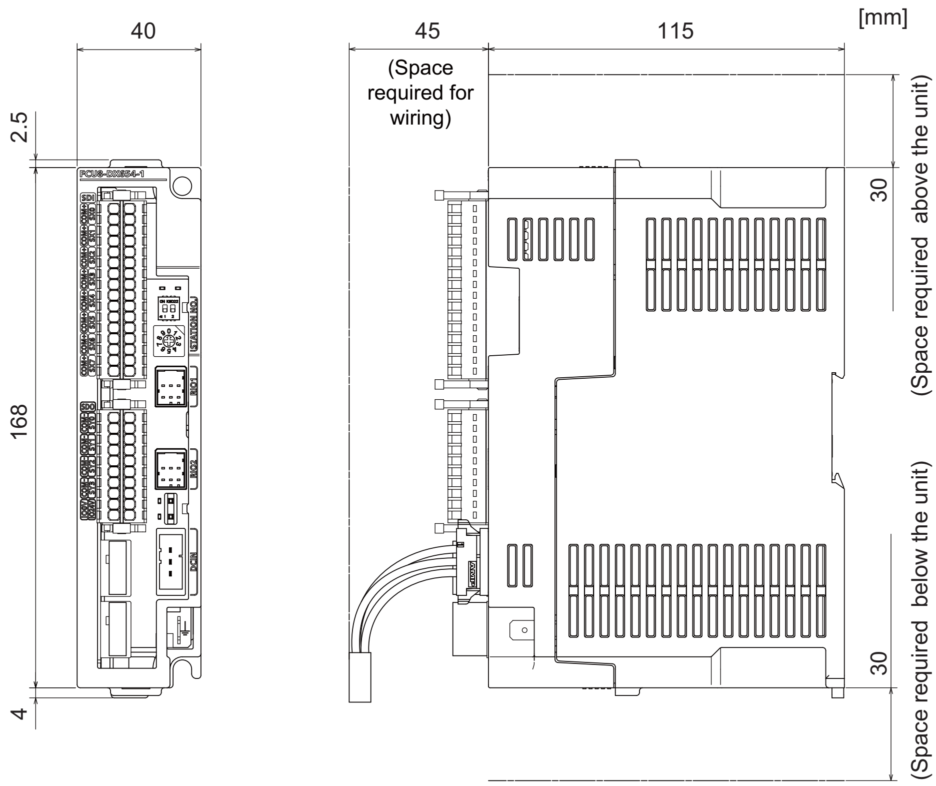

**[Outline dimension : FCU8-DX213-1]**



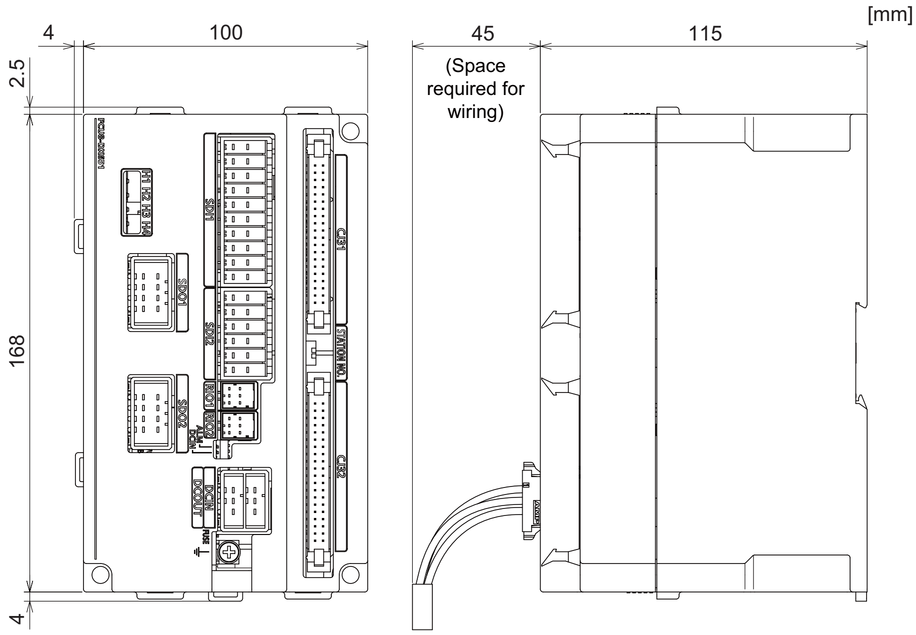
[Outline dimension : FCU8-DX654]



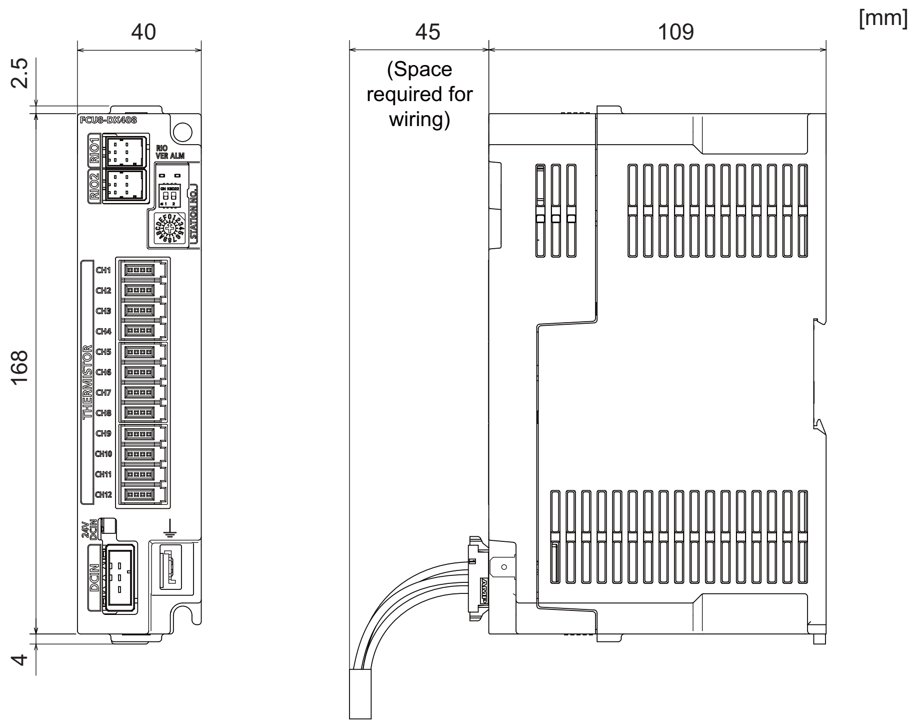

[Outline dimension : FCU8-DX654-1]



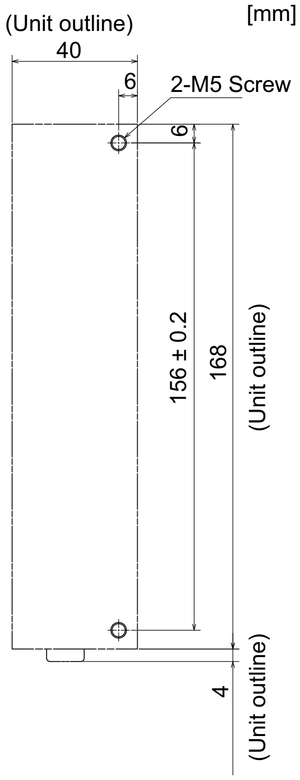
[Outline dimension : FCU8-DX651]



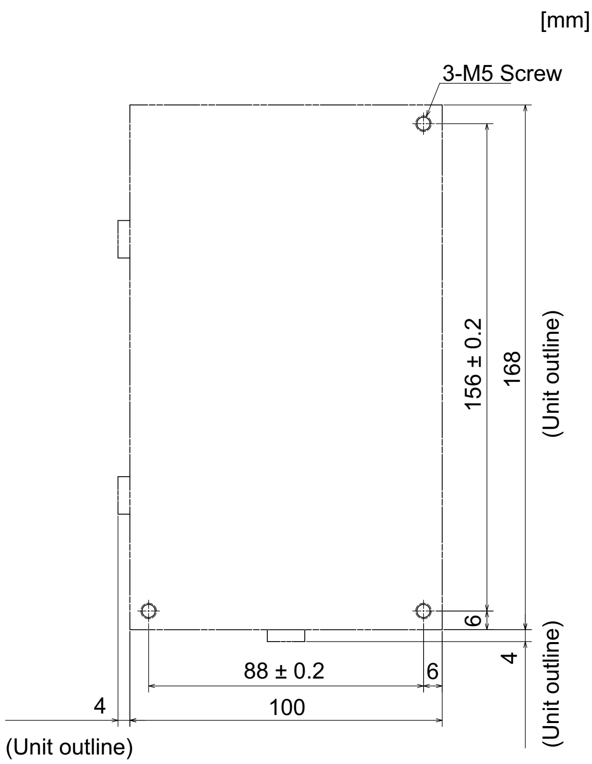

[Outline dimension : FCU8-DX408]



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



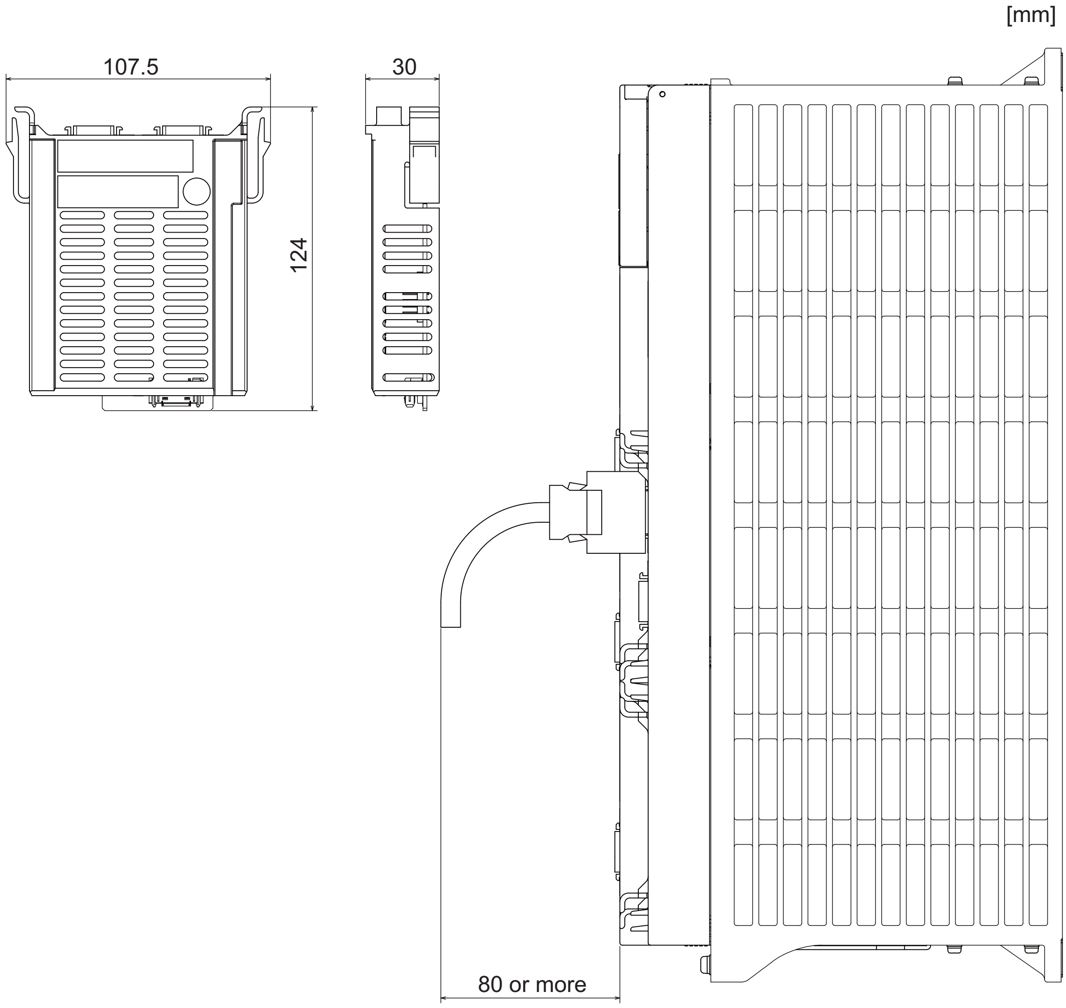

**[Installation dimension : FCU8-DX651]**



# 4.9 Function Expansion Unit

## 4.9.1 Encoder (Manual Pulse Generator) I/F Expansion (FCU8-EX544)

**[Outline dimension]**

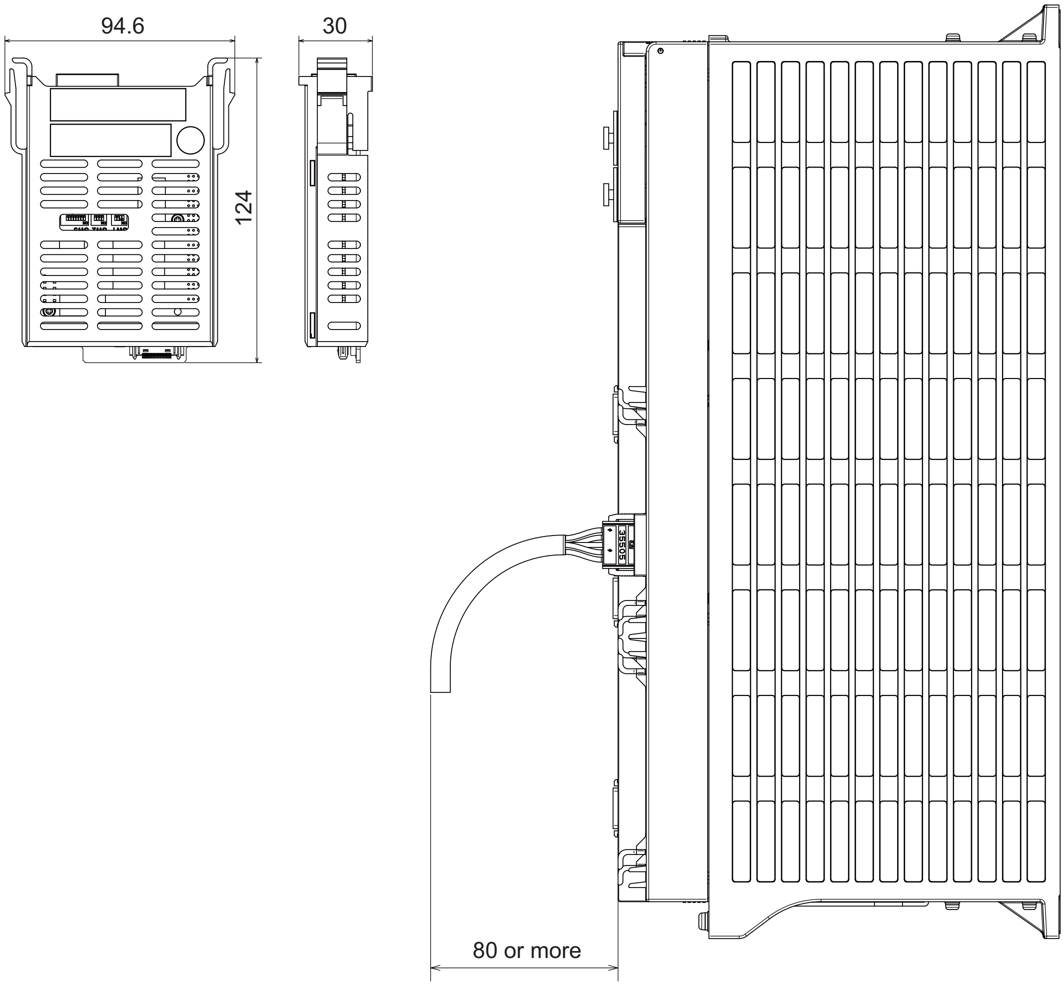


# 4.10 Communication Expansion Unit

## 4.10.1 CC-Link (FCU8-EX561)

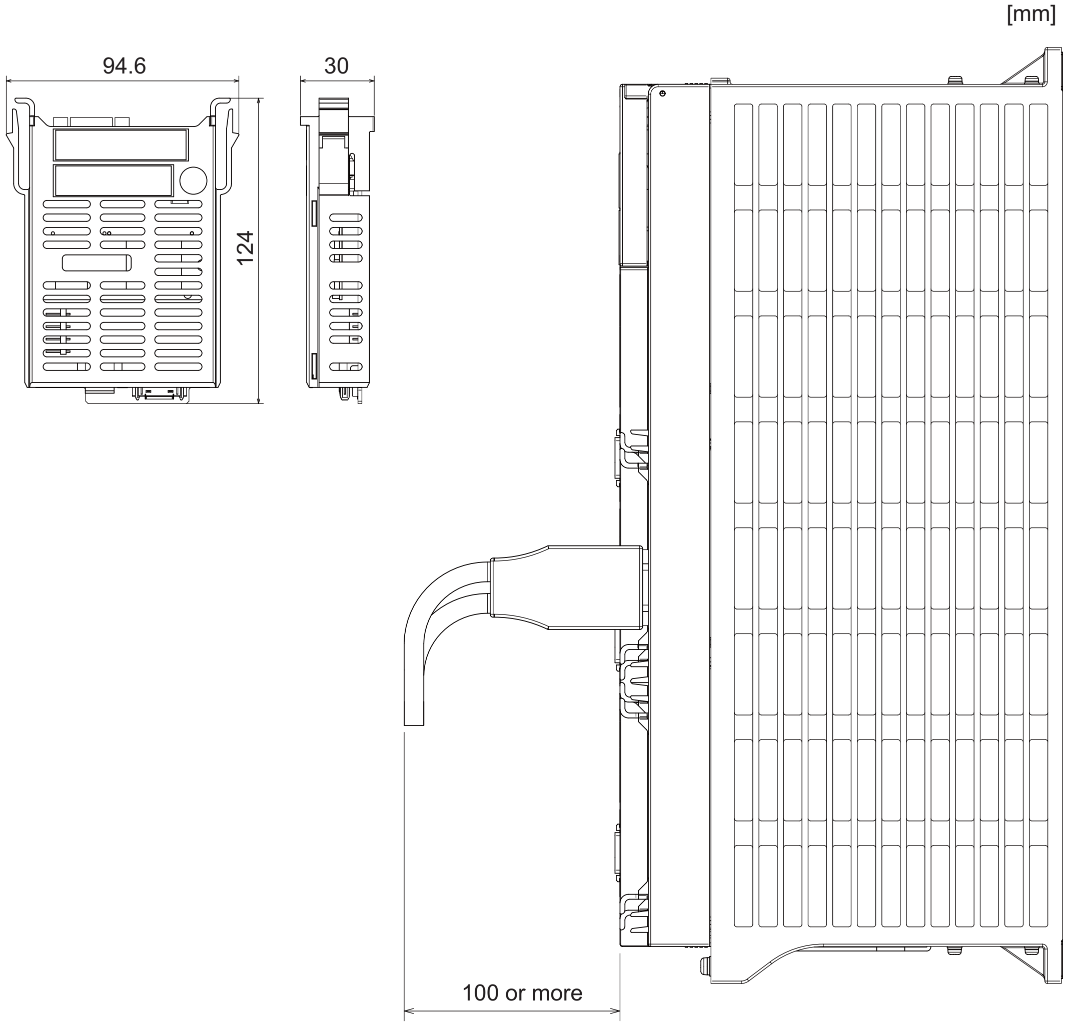
**[Outline dimension]**

[mm]



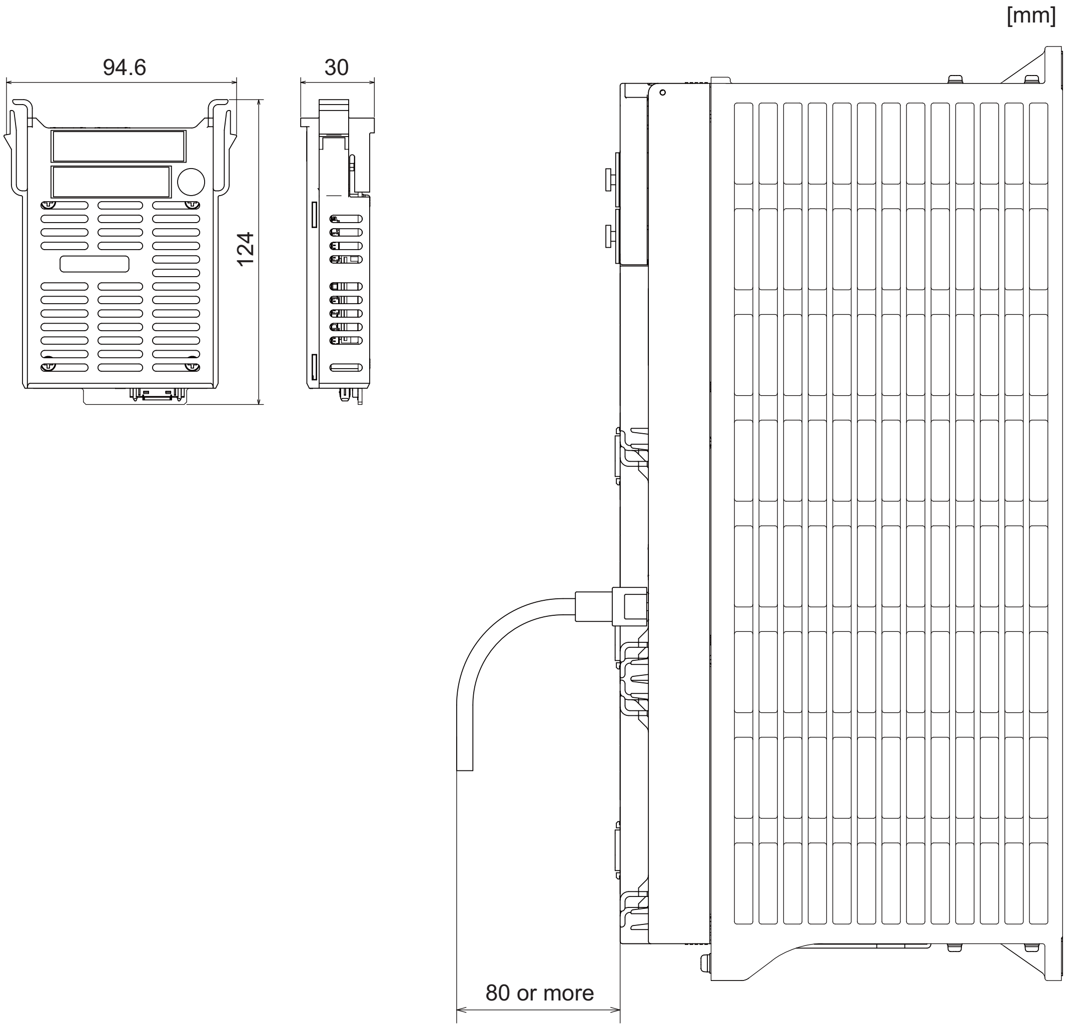
## 4.10.2 PROFIBUS-DP (FCU8-EX563)

**[Outline dimension]**



### 4.10.3 EtherNet/IP (FCU8-EX565)

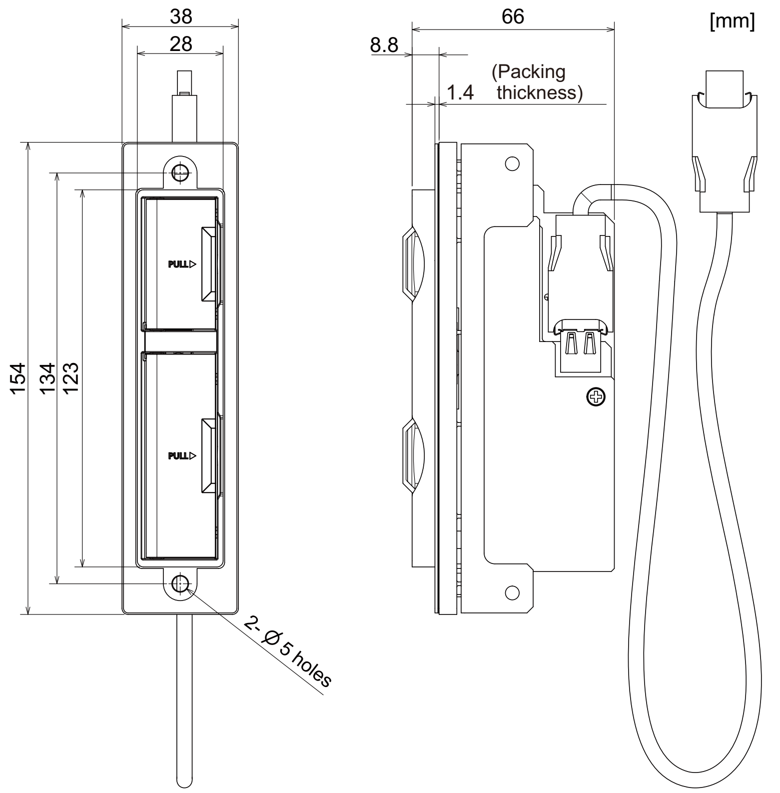
**[Outline dimension]**



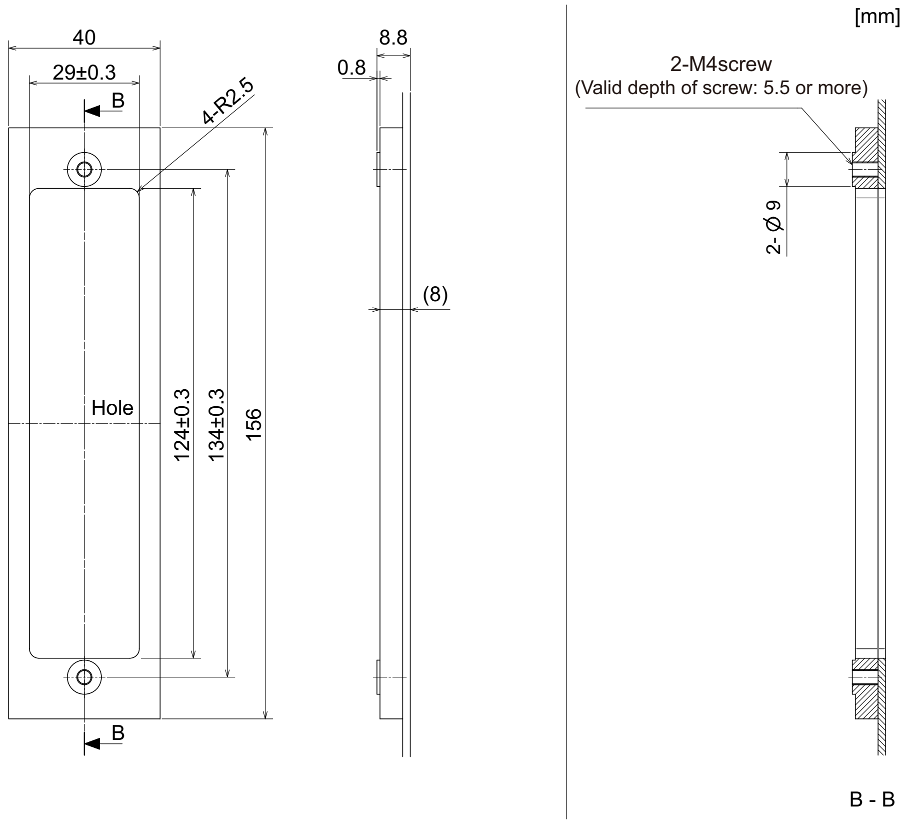
# 4.11 Side Memory I/F Unit

(Note) Side memory I/F unit is only for 19-type display unit.

**[Outline dimension]**




**[Installation dimension]**



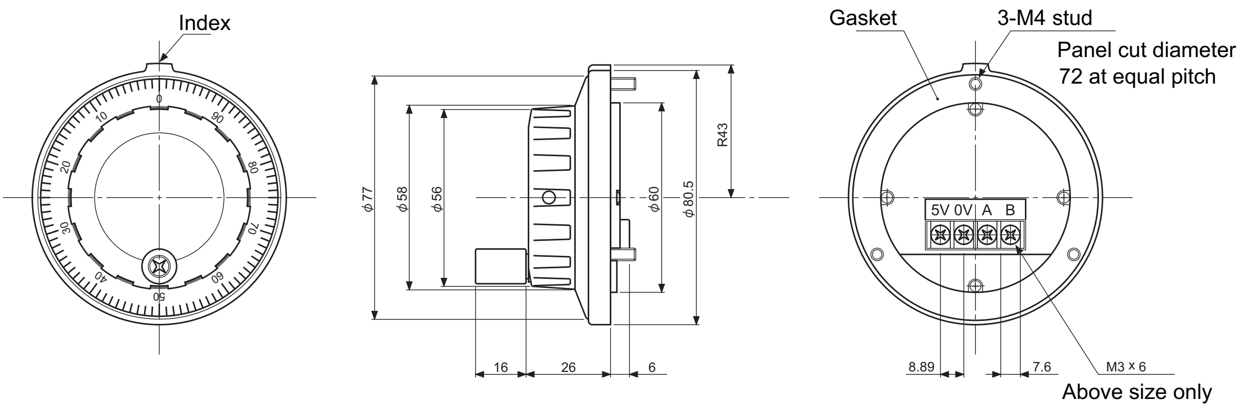
# 4.12 Manual Pulse Generator

## 4.12.1 5V Manual Pulse Generator (UFO-01-2Z9)

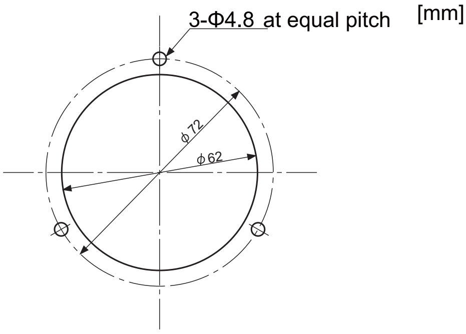
100 pulse/rev

**[Outline dimension]**

[mm]




**[Panel cut dimension]**



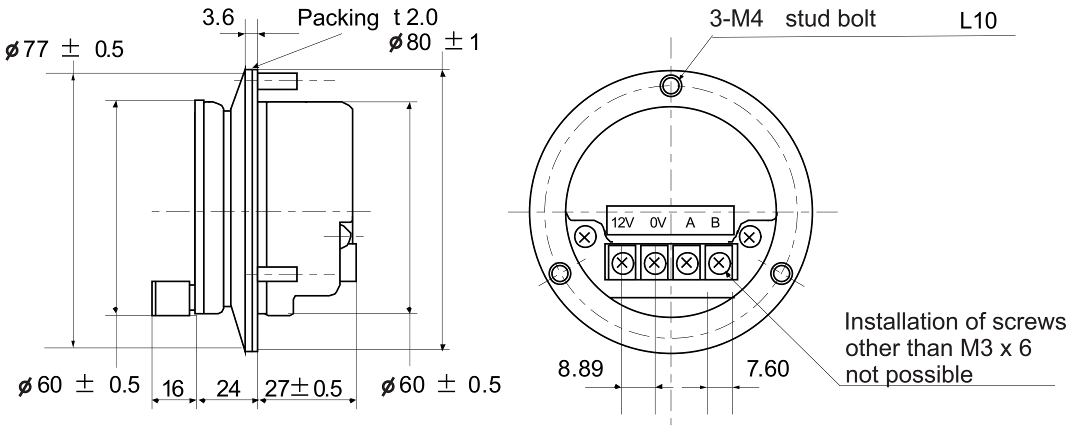

Produced by NIDEC NEMICON CORPORATION

## 4.12.2 Manual Pulse Generator (HD60C)

25 pulse/rev

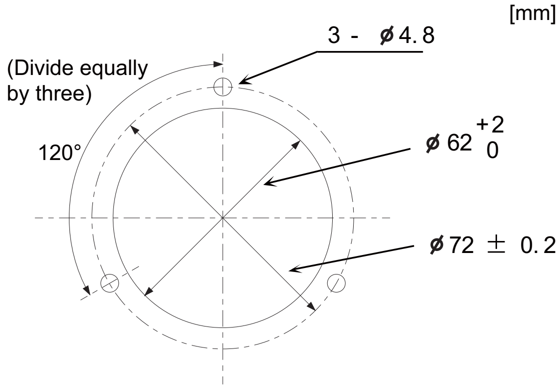
**[Outline dimension]**

[mm]




**[Panel cut dimension]**

[mm]

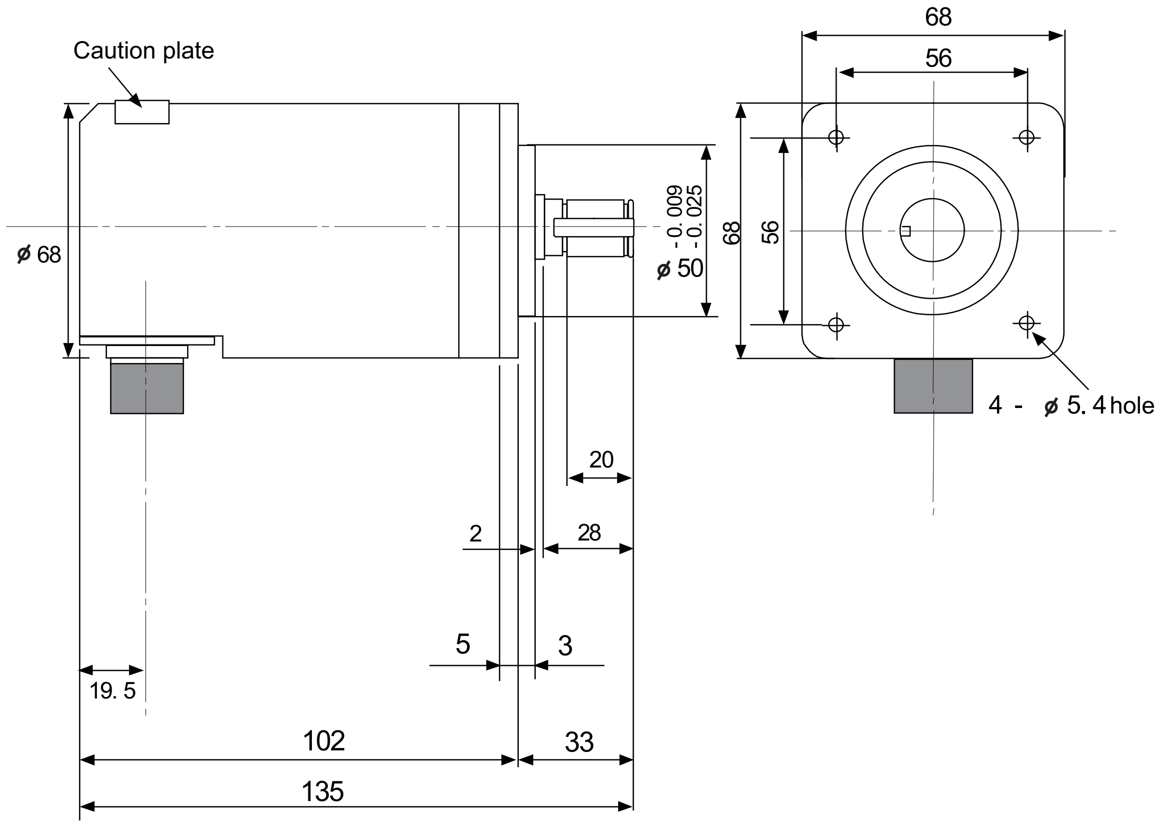


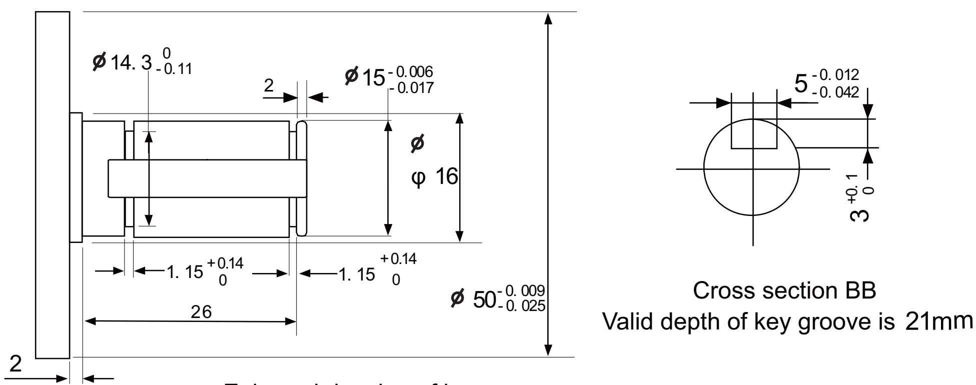
# 4.13 Synchronous Feed Encoder

## 4.13.1 Synchronous Feed Encoder (OSE-1024-3-15-68)

**[Outline dimension]**

[mm]

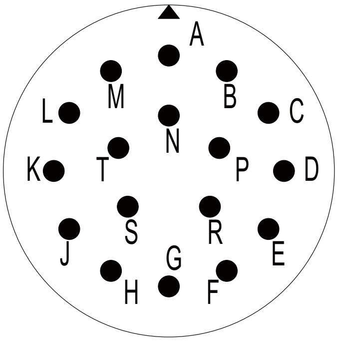



Enlarged drawing of key

Cross section BB
Valid depth of key groove is 21mm

**[Connector]**



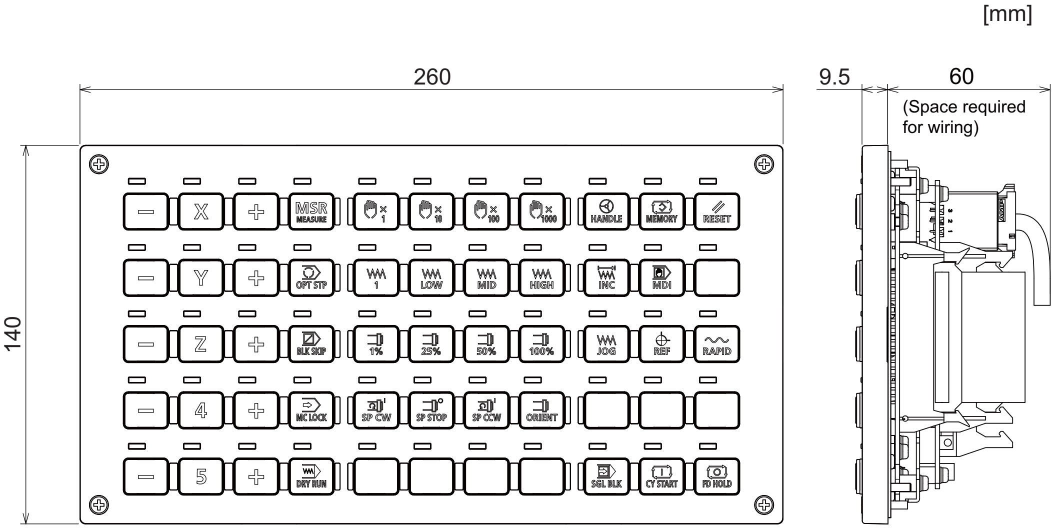

**Connector pin assignment**

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

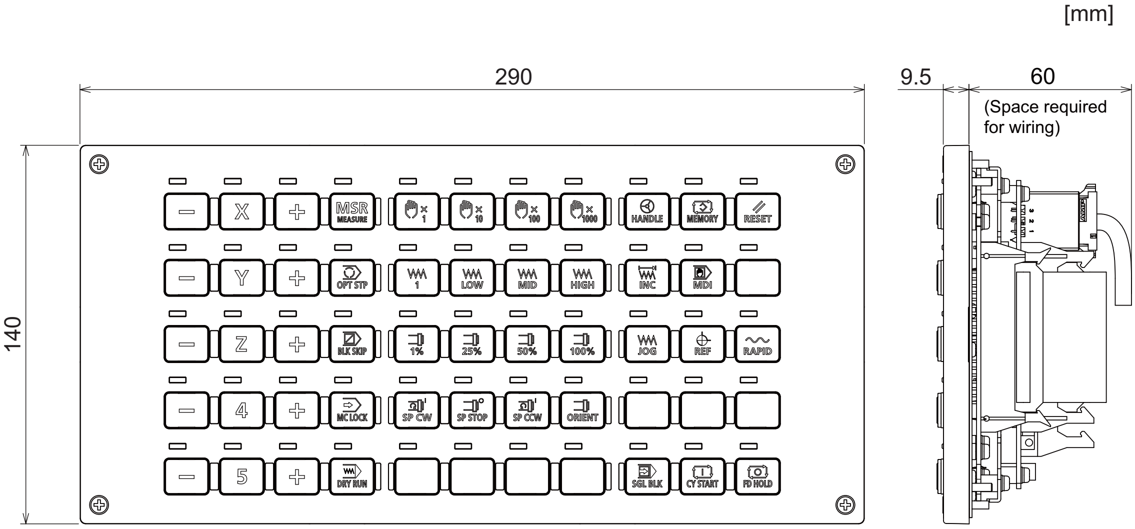
# 4.14 MITSUBISHI CNC Machine Operation Panel

## 4.14.1 Main Panel A/B (FCU8-KB921 / FCU8-KB923)

**[Outline dimension : FCU8-KB921]**

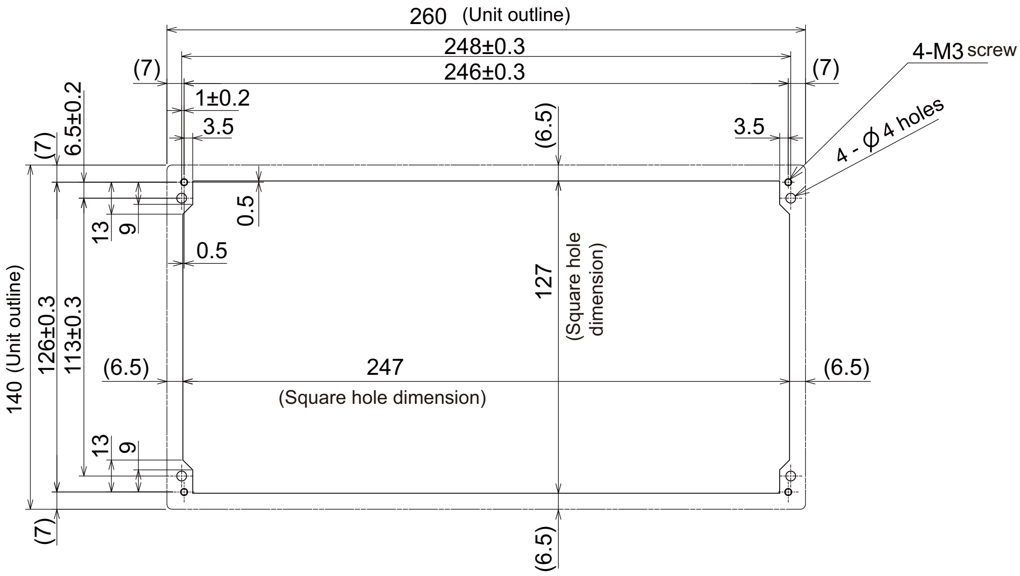



**[Outline dimension : FCU8-KB923]**



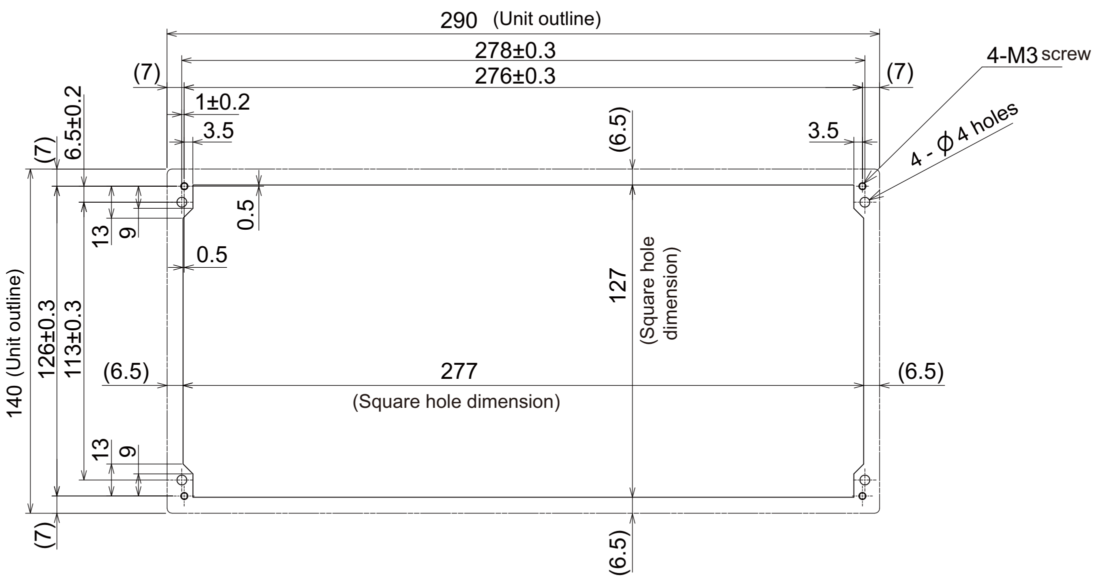
**[Panel cut dimension : FCU8-KB921]**

[mm]




**[Panel cut dimension : FCU8-KB923]**

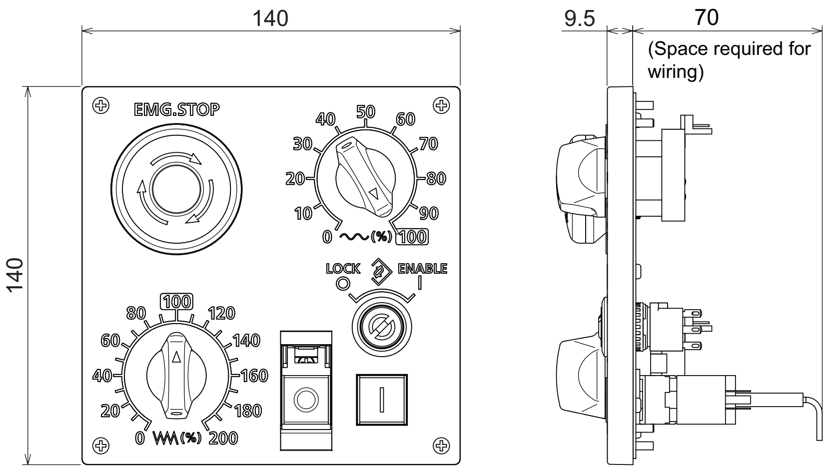
[mm]



## 4.14.2 Sub Panel A (FCU8-KB931)

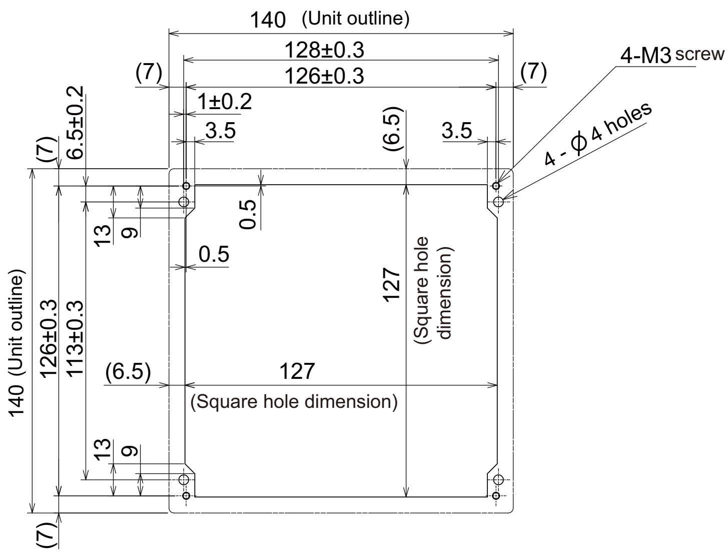
### [Outline dimension]

[mm]




### [Panel cut dimension]

[mm]

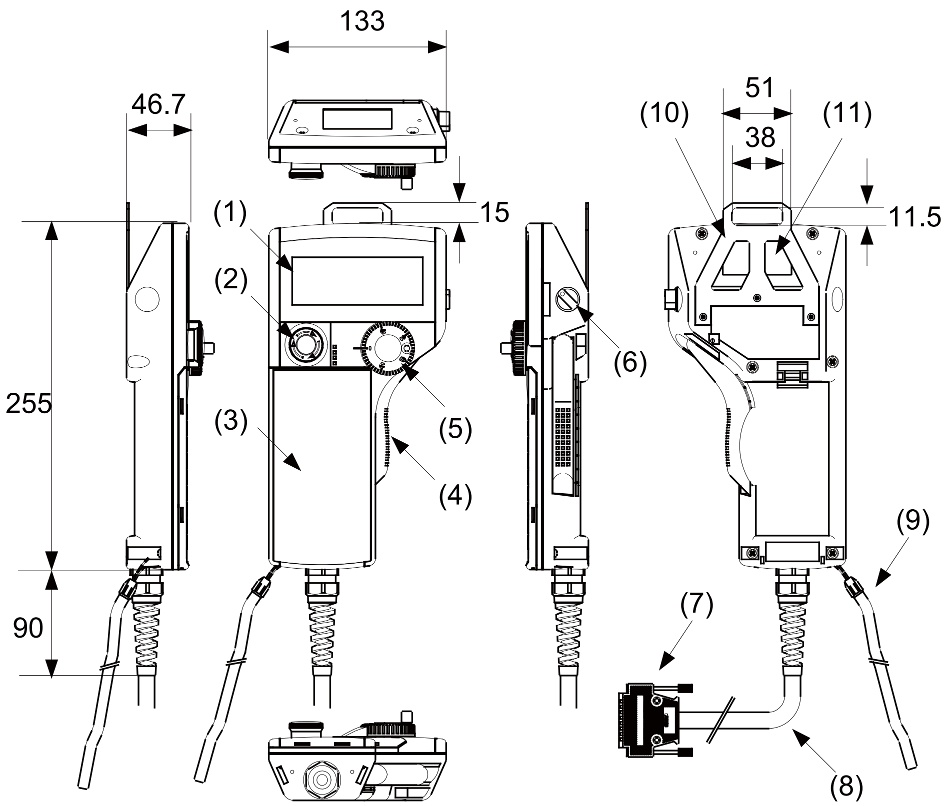


## 4.15 Handy Terminal

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

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

**Dimension and names of parts**



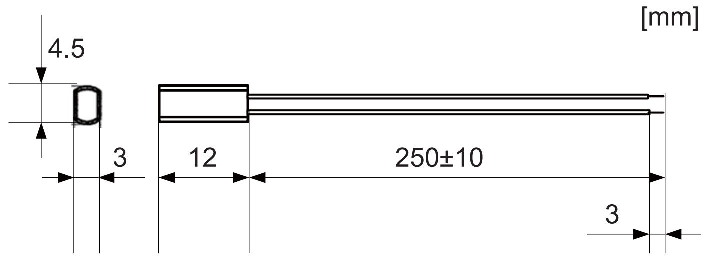

| No. | Name | Function/ Specification | No. | Name | Function/ Specification |
|---|---|---|---|---|---|
| (1) | LCD | Monochrome display with backlight<br>192(W) × 64(H) dots | (7) | HOST | Host interface connector<br>(DDK: 17JE-23250-02(D8A6)) |
| (2) | SW1 | Emergency stop switch<br>Contact rating/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

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

# 4.16 Thermistor

## 4.16.1 Thermistor(PT3C-51F-M2)

**[Outline dimension]**




Made by SHIBAURA ELECTRONICS Co., Ltd.

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

# 4.17 Exclusive SD Cards for MITSUBISHI CNC

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

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

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

# 4.18 Specifications and Precautions of USB/SD/LAN Interface

## 4.18.1 USB Interface (Personal Computer Unit, Side Memory I/F Unit)

| **Standards** | **USB3.0** | **USB2.0** |
|---|---|---|
| **Data transfer speed (Note)** | Super Speed (5Gbps)<br>High Speed (480Mbps)<br>Full Speed (12Mbps)<br>Low Speed (1.5Mbps) | High Speed (480Mbps)<br>Full Speed (12Mbps)<br>Low Speed (1.5Mbps) |
| **Power supply to USB device** | Supply voltage: 5V ± 5%<br>Supply current: Max. 900mA/port | Supply voltage: 5V ± 5%<br>Supply current: Max. 500mA/port<br>(However, max. 200mA/port for side memory I/F unit) |
| **Number of free ports** | Personal computer unit × 2 | Personal computer unit × 4, Side memory I/F unit × 1 |
| **Max. cable length** | 3m<br>(During Super Speed. 5m for up to High Speed) | 5m |

(Note 1) Data transfer speed is the theoretical value on the standard, and the actual speed will be inferior to the value listed above. The transfer speed may be restrained depending on the specification of the connected device.
(Note 2) Side memory I/F unit is only for 19-type display unit.
(Note 3) Do not connect devices other than the USB memory to the front memory I/F of the graphic control unit.

**(1) Precautions for use of commercially available USB keyboards and mice(Only for the display unit with the computer.)**

MITUBISHI will not provide performance guarantee and maintenance for commercially available USB keyboards and mice. In case of using one of them, careful performance check must be required by the machine tool builder. Commercially available devices may not be compatible with MITSUBISHI units or suitable FA environment for temperature- or noise-wise.
Commercially available USB keyboards/mice are susceptible to noise, etc., and may cause a malfunction in the unit that may lead to an accident. Do not use them while the machine is operated.

**(2) Precautions for use of other commercially available USB devices(Only for the display unit with the computer.)**

When connecting a commercially available USB device that requires power exceeding the maximum current, select the one of which power can be supplied from an outside source.
MITSUBISHI will not provide performance guarantee and maintenance for commercially available USB printer, USB floppy disk, USB memory, USB hub, USB-CD drive, USB-DVD drive, and other USB devices. Commercially available devices may not be compatible with MITSUBISHI units or suitable FA environment for temperature- or noise-wise.
In the case of using one of them, careful performance check must be required by the machine tool builder, and necessary noise countermeasures, such as executing EMI countermeasures or adding the ferrite cores, must be taken.

**(3) Precautions for insertion/removal of USB memory**

When inserting/removing an USB memory, turn the MITUBISHI device's power OFF. Do not pull out the USB memory or turn OFF the power during access to the USB memory. Failure to observe this could cause the memory contents to be erased.
When Inserting/removing a USB memory, be sure to have enough interval to perform that (about 10 seconds or more).
In case of emergency, always perform backups by having your important data duplicate, etc. as MITUBISHI will not guarantee the broken or lost data.

**(4) Precaution for operation with front-side USB memory**

A USB memory to be used has to be supported USB2.0 Hi-Speed (480Mbps).
When connecting the USB memory, connect it directly without using the extension cable or USB hub.
Machine vibration may cause the USB memory to fall out depending on environment. Therefore, the operation with the front-side USB memory is required to be performed on your own responsibility.

### 4.18.2 SD Interface (Control Unit, Side Memory I/F Unit)

| **Standards** | **SD/SDHC (Note)** |
|---|---|
| **Transfer speed** | According to the connecting SD card |
| **Capacity** | 32GB |
| **Number of free ports** | Control unit × 1, Side memory I/F unit × 1 |

(Note 1) SDXC is not supported.
(Note 2) Side memory I/F unit is only for 19-type display unit.

**(1) Precautions for use of commercially available SD card**

MITUBISHI will not provide performance guarantee and maintenance for commercially available SD card, mini SD card or micro SD card (requires converting adapter). In case of using one of them, careful performance check must be required by the machine tool builder.
Commercially available devices may not be compatible with MITSUBISHI units or suitable FA environment for temperature- or noise-wise.

**(2) Precautions for insertion/removal of SD card**

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

### 4.18.3 LAN Interface (Control Unit, Personal Computer Unit)

| **Standards** | **1000BASE-T / 100BASE-TX / 10BASE-T** |
|---|---|
| **Data transfer speed (Note)** | 1000Mbps / 100Mbps / 10Mbps |
| **Number of free ports** | Control unit × 1, Personal computer unit × 1 |
| **Max. cable length** | 100m |

(Note 1) Data transfer speed is the theoretical value on the standard, and the actual speed will be inferior to the value listed above. The transfer speed may be restrained depending on the specification of the connected device.
(Note 2) When using half-duplex communication, the response time may become long depending on the opposite device.
Use full-duplex communication to connect with the opposite device via a switching HUB.

**(1) Precautions for selection of LAN cable**

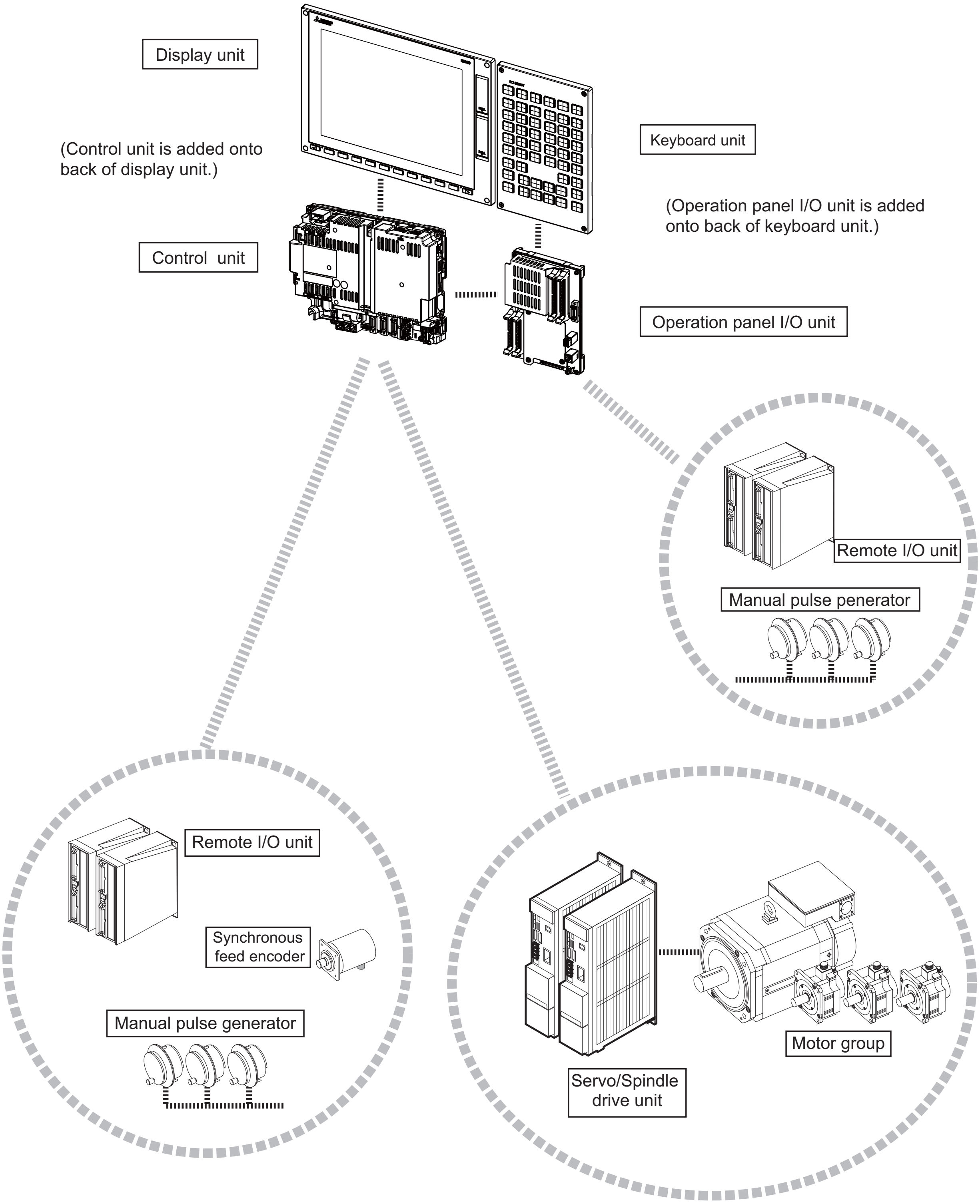
Make sure to select the LAN cables which are "category 5e or above" and "shielded". Cable wire material with double shielded, which is appropriate for FA environment., is recommended.

# M80 Series
# General Specifications

1

# System Basic Configuration (M80 Series)

# 1.1 System Basic Configuration Drawing



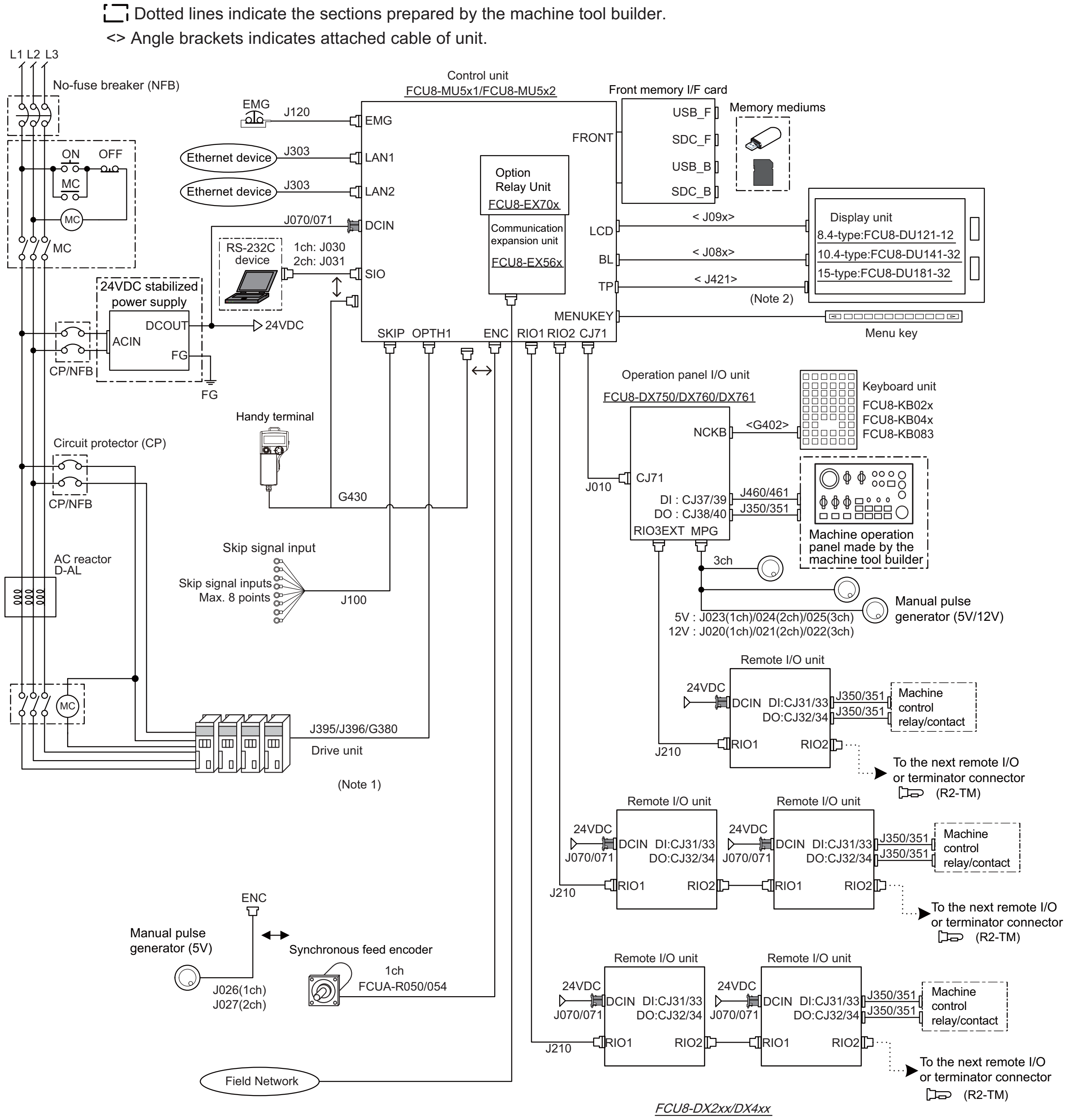

(Note) For the drive unit configuration, refer to the Instruction Manual of the drive unit you use.

# 2

# General Connection Diagram (M80 Series)

# 2.1 General Connection Diagram [M80]

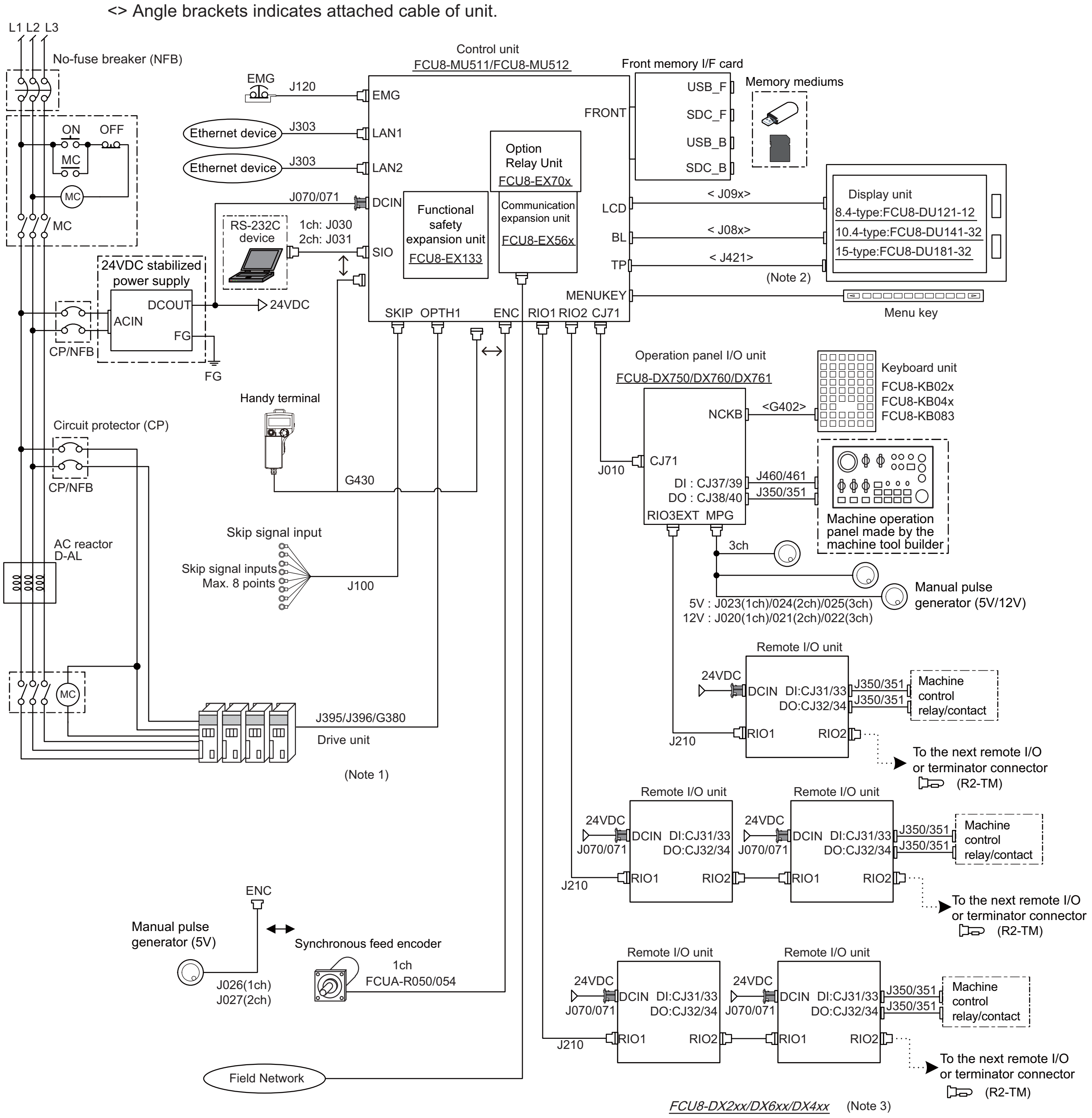
## (1) Without smart safety observation




(Note 1) For information on how to connect the drive unit, refer to the drive unit's manual.
(Note 2) For the 8.4-type display unit, TP connector is not used.
(Note 3) For the connection of MITSUBISHI CNC machine operation panel, refer to the chapter "Connection of MITSUBISHI CNC Machine Operation Panel".

### (2) With smart safety observation

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




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

(Note 2) For the 8.4-type display unit, TP connector is not used.

(Note 3) The safety remote I/O unit is available only when the functional safety expansion unit is mounted.

(Note 4) For the connection of MITSUBISHI CNC machine operation panel, refer to the chapter "Connection of MITSUBISHI CNC Machine Operation Panel".

# 3

# List of Configuration (M80 Series)

# 3.1 Control Unit [M80]

| Classification | Type | Components | Remarks |
|---|---|---|---|
| NC functions<br>and display controller<br>For M80 Type B | FCU8-MU511 | Base control card<br>Front-side memory I/F card | Export Trade Control Order noncompliant unit and Foreign Exchange Order noncompliant unit |
| NC functions<br>and display controller<br>For M80 Type A | FCU8-MU512 | Base control card<br>Front-side memory I/F card | Export Trade Control Order noncompliant unit and Foreign Exchange Order noncompliant unit |
| NC functions<br>and display controller<br>For M80 Type B | FCU8-MU501 | Base control card<br>Front-side memory I/F card | Export Trade Control Order noncompliant unit and Foreign Exchange Order noncompliant unit |
| NC functions<br>and display controller<br>For M80 Type A | FCU8-MU502 | Base control card<br>Front-side memory I/F card | Export Trade Control Order noncompliant unit and Foreign Exchange Order noncompliant unit |

# 3.2 Display Unit [M80]

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

# 3.3 Keyboard Unit [M80]

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

# 3.4 Operation Panel I/O Unit

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

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

## 3.5 Remote I/O Unit

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

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

## 3.6 Function Expansion Unit [M80]

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

## 3.7 Communication Expansion Unit

| Classification | Type | Components | Remarks |
|---|---|---|---|
| CC-Link expansion unit | FCU8-EX561 | CC-Link I/F PCB | CC-Link 1ch |
| PROFIBUS-DP master unit | FCU8-EX563 | PROFIBUS-DP I/F PCB | PROFIBUS-DP 1ch |
| EtherNet/IP<br>Scanner/adapter unit | FCU8-EX565 | Base card<br>Add-on card | EtherNet/IP 1ch<br>(Only LAN1, LAN2 cannot be used) |

| Classification | Type | Components | Remarks |
|---|---|---|---|
| Option Relay Unit | FCU8-EX702 | Relay PCB | Communication expansion unit for 1ch |
| Option Relay Unit | FCU8-EX703 | Relay PCB | Communication expansion unit for 2ch |

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

## 3.8 Manual Pulse Generator

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

## 3.9 Synchronous Feed Encoder

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

## 3.10 MITSUBISHI CNC Machine Operation Panel

| Classification | Type | Components | Remarks |
|---|---|---|---|
| Main panel A<br>(For 8.4-type/15-type display unit) | FCU8-KB921 | Escutcheon, key switch<br>control card<br>G054 cable, Screw cap set | Mitsubishi standard 55 key |
| Main panel B<br>(For 10.4-type display unit) | FCU8-KB923 | Escutcheon, key switch<br>control card<br>G054 cable, Screw cap set | Mitsubishi standard 55 key |
| Sub panel A<br>(Common for all display units) | FCU8-KB931 | Escutcheon<br>Emergency stop switch, Override switch<br>ON/OFF switch, Screw cap set | |

## 3.11 Handy Terminal

| Classification | Type | Components | Remarks |
|---|---|---|---|
| Handy Terminal | HG1T-SB12UH-<br>MK1346-L5 | | |

## 3.12 Cable Connector Sets

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

## 3.13 Thermistor Sets

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

## 3.14 Genuine Memory Card

| Classification | Type | Components | Remarks |
|---|---|---|---|
| Exclusive SD cards for MITSUBISHI CNC 1GB | FCU8-SD001G | FCU8-SD001G | 1GB capacity |
| Exclusive SD cards for MITSUBISHI CNC 4GB | FCU8-SD004G | FCU8-SD004G | 4GB capacity |

## 3.15 Durable Parts

| Durable parts | Part type |
|---|---|
| Battery for control unit | Q6BAT |

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

## 3.16 Replacements

| Replacements | Part type | Manufacturer |
|---|---|---|
| Protection fuse for control unit | LM40 | Daito Communication Apparatus Co., Ltd. |
| Protection fuse for operation panel I/O | LM50 | Daito Communication Apparatus Co., Ltd. |
| Protection fuse for FCU8-DX220/230/231/651 | LM50 | Daito Communication Apparatus Co., Ltd. |
| Protection fuse for FCU8-DX213/654/213-1/654-1 | MP63 | Daito Communication Apparatus Co., Ltd. |

# 3.17 List of Cables

**[Cable relating to NC]**

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

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

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

### [Cable Relating to Drive Unit]

| Type | Application | Available cable length (m) | Max. cable length |
|---|---|---|---|
| CNP2E-1-xM | Motor side PLG cable<br>Spindle side accuracy detector<br>TS5690 cable | 2, 3, 4, 5, 7, 10, 15, 20, 25, 30 | 30m |
| CNP3EZ-2P-xM | Spindle side detector cable<br>OSE-1024 cable | 2, 3, 4, 5, 7, 10, 15, 20, 25, 30 | 30m |
| CNP3EZ-3P-xM | Spindle side detector cable<br>OSE-1024 cable | 2, 3, 4, 5, 7, 10, 15, 20, 25, 30 | 30m |
| CNV2E-8P-xM | For HG/HG-H,HQ/HQ-H Motor side detector cable (for D48/D51/D74) | 2, 3, 4, 5, 7, 10, 15, 20, 25, 30 | 30m |
| CNV2E-9P-xM | For HG/HG-H,HQ/HQ-H Motor side detector cable (for D48/D51/D74) | 2, 3, 4, 5, 7, 10, 15, 20, 25, 30 | 30m |
| CNV2E-D-xM | MDS-B-SD unit cable | 2, 3, 4, 5, 7, 10, 15, 20, 25, 30 | 30m |
| CNV2E-HP-xM | MDS-B-HR unit cable | 2, 3, 4, 5, 7, 10, 15, 20, 25, 30 | 30m |
| CNV2E-MB-xM | MBE405W/MBA405W cable | 2, 3, 4, 5, 7, 10, 15, 20 | 20m |
| DG30-xM | Battery cable<br>(For drive unit - Battery box,<br>For drive unit - drive unit) | 0.3, 0.5, 1, 2, 3, 5, 7, 10 | 10m |
| G380 LxM | Optical communication cable<br>For wiring between drive units (outside panel) | 5, 10, 12, 15, 20, 25, 30 | 30m |
| J395 LxM | Optical communication cable<br>For wiring between drive units (outside panel)<br>For wiring between NC-drive units | 3, 5, 7, 10 | 10m |
| J396 LxM | Optical communication cable<br>For wiring between drive units (inside panel) | 0.2, 0.3, 0.5, 1, 2, 3, 5 | 10m |
| MR-BKS1CBLxMA1-H | <200V Series><br>Brake cable for HG96<br>Lead out in direction of motor shaft | 2, 3, 5, 7, 10 | 10m |
| MR-BKS1CBLxMA2-H | <200V Series><br>Brake cable for HG96<br>Lead out in opposite direction of motor shaft | 2, 3, 5, 7, 10 | 10m |
| MR-BT6V2CBL LxM | Battery cable (MDS-EJ/EJH)<br>(For drive unit - drive unit) | 0.3, 1 | 1m |
| MR-D05UDL3M-B | STO cable | 3 | 3m |
| MR-PWS1CBLxMA1-H | <200V Series><br>Power cable for HG96<br>Lead out in direction of motor shaft | 2, 3, 5, 7, 10 | 10m |
| MR-PWS1CBLxMA2-H | <200V Series><br>Power cable for HG96<br>Lead out in opposite direction of motor shaft | 2, 3, 5, 7, 10 | 10m |
| SH21 LxM | Power supply communication cable<br>Power backup unit communication cable | 0.35, 0.5, 1, 2, 3 | 30m |

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

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

# 4

# General Specifications (M80 Series)

# 4.1 Environment Conditions [M80]

## 4.1.1 Installation Environment Conditions

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

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

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

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

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

<table>
<tr><td rowspan="2">Item</td><td colspan="2">Unit name</td><td>Keyboard unit</td><td>Operation panel I/O unit</td><td>Machine operation panel</td></tr>
<tr><td colspan="2">Type</td><td>FCU8-KB026/KB028 : (8.4-type)<br>FCU8-KB029 : (8.4-type/vertical arrangement)<br>FCU8-KB041/KB046 : (10.4-type)<br>FCU8-KB047 : (10.4-type/vertical arrangement)<br>FCU8-KB048 : (10.4-type)<br>FCU8-KB083 : (15-type/vertical arrangement)</td><td>FCU8-DX750<br>FCU8-DX760<br>FCU8-DX761</td><td>FCU8-KB921<br>FCU8-KB923<br>FCU8-KB931</td></tr>
<tr><td rowspan="14">General Specifications</td><td rowspan="2">Ambient temperature</td><td>During operation</td><td colspan="3">0 to 58°C</td></tr>
<tr><td>During storage</td><td colspan="3">-20 to 60°C</td></tr>
<tr><td rowspan="2">Ambient humidity</td><td>Long term</td><td colspan="3">10 to 75% RH (with no dew condensation)</td></tr>
<tr><td>Short term</td><td colspan="3">10 to 95% RH (with no dew condensation) (Note 1)</td></tr>
<tr><td colspan="2">Vibration resistance</td><td colspan="3">4.9m/s$^2$ or less</td></tr>
<tr><td colspan="2">Shock resistance</td><td colspan="3">29.4m/s$^2$ or less</td></tr>
<tr><td colspan="2">Working atmosphere</td><td colspan="3">No corrosive gases, dust or oil mist</td></tr>
<tr><td colspan="2">Altitude</td><td colspan="3">Operation/Storage: 1000 meters or less above sea level,<br>Transportation: 13000 meters or less above sea level</td></tr>
<tr><td colspan="2" rowspan="2">Power supply voltage</td><td>5VDC</td><td>5VDC/3.3VDC</td><td rowspan="2">24VDC (Note 5)</td></tr>
<tr><td colspan="2">(Supply from Control Unit)</td></tr>
<tr><td colspan="2">Current consumption</td><td colspan="2">- (Note 2)</td><td>0.3A (Note 5)</td></tr>
<tr><td>Heating value</td><td>(max)</td><td>1W</td><td>4W (Note 3)</td><td>7.2W</td></tr>
<tr><td>Mass</td><td>(kg)</td><td>FCU8-KB026/KB028 : 0.75<br>FCU8-KB029 :1.0<br>FCU8-KB041/KB046 : 0.8<br>FCU8-KB047 : 1.3<br>FCU8-KB048 : 1.4<br>FCU8-KB083 : 1.5</td><td>FCU8-DX750 : 0.4<br>FCU8-DX760 : 0.5<br>FCU8-DX761 : 0.5</td><td>FCU8-KB921 : 1.1<br>FCU8-KB923 : 1.2<br>FCU8-KB931 : 0.5</td></tr>
<tr><td>Outline dimension W×H</td><td>(mm)</td><td>FCU8-KB026/KB028 : 140×200<br>FCU8-KB029 : 260×140<br>FCU8-KB041/KB046 : 140×220<br>FCU8-KB047 : 290×160<br>FCU8-KB048 : 230×220<br>FCU8-KB083 : 400×140</td><td>116×179</td><td>FCU8-KB921 : 260×140<br>FCU8-KB923 : 290×140<br>FCU8-KB931 : 140×140</td></tr>
</table>

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

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

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

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

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

| Item | Unit name | | Remote I/O unit | | | | |
|---|---|---|---|---|---|---|---|
| | Type | | FCU8-DX220/ DX230/ DX231 | FCU8-DX202 | FCU8-DX213/ DX213-1/ DX654/ DX654-1 | FCU8-DX408 | FCU8-DX651 |
| General Specifications | Ambient temperature | During operation | 0 to 58°C | | | | |
| | | During storage | -20 to 60°C | | | | |
| | Ambient humidity | Long term | 10 to 75% RH (with no dew condensation) | | | | |
| | | Short term | 10 to 95% RH (with no dew condensation) (Note 1) | | | | 10 to 85% RH (with no dew condensation) (Note 1) |
| | Vibration resistance | | $4.9m/s^2$ or less | | | | |
| | Shock resistance | | $29.4m/s^2$ or less | | | | |
| | Working atmosphere | | No corrosive gases, dust or oil mist | | | | |
| | Altitude | | Operation/Storage: 1000 meters or less above sea level, Transportation: 13000 meters or less above sea level | | | | |
| | Power supply voltage | | 24VDC | | | | |
| | Current consumption | | 3.5A (Note 2) | 0.3A | 0.3A (Note 3) | 0.1A | 3.7A (Note 2) |
| | Heating value | (max) | 8W (Note 4) | | | | |
| | Mass | (kg) | 0.4 | | | 0.2 | 0.8 |
| | Outline dimension W×H×D | (mm) | 40×175×133 | 40×175×119 | 40×175×130 | 40×175×109 | 172×100×115 |

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

### 4.1.2 24VDC Stabilized Power Supply Selecting Conditions

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

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

**⚠ CAUTION**

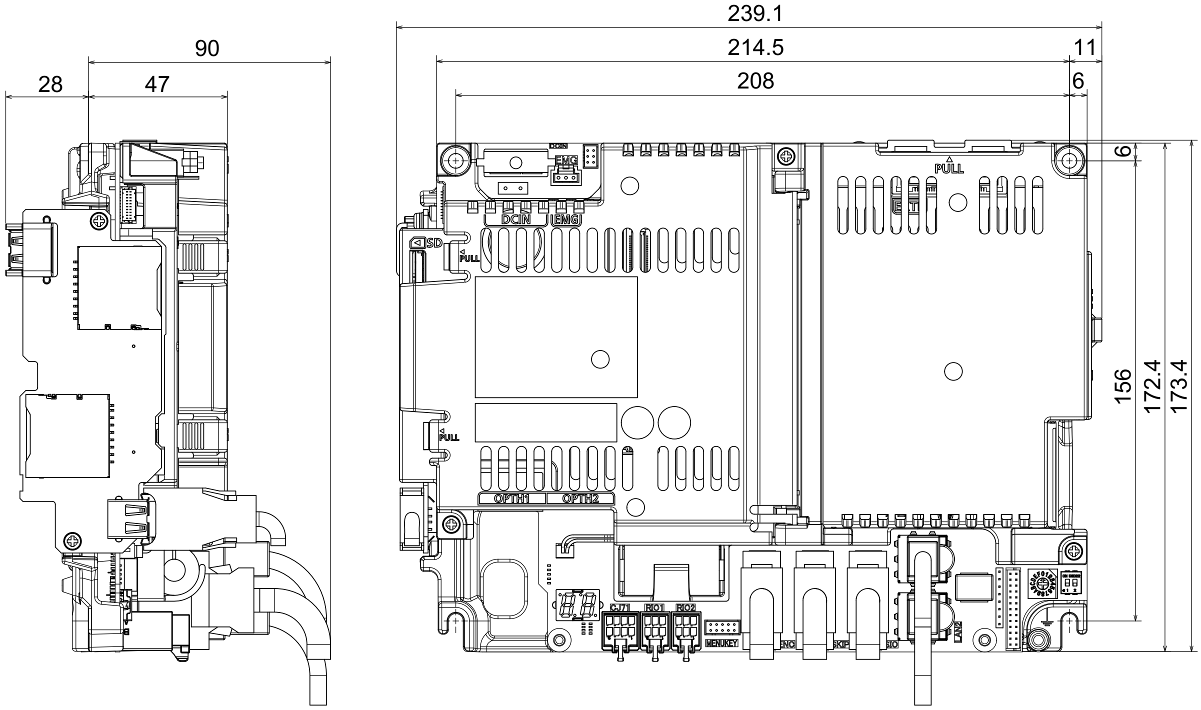
**1. Using a stabilized power supply without overcurrent protection may cause the unit's failure due to miswiring of 24V.**

# 4.2 Control Unit [M80]

## 4.2.1 FCU8-MU511 / FCU8-MU512 / FCU8-MU501 / FCU8-MU502

**[Outline dimension]**

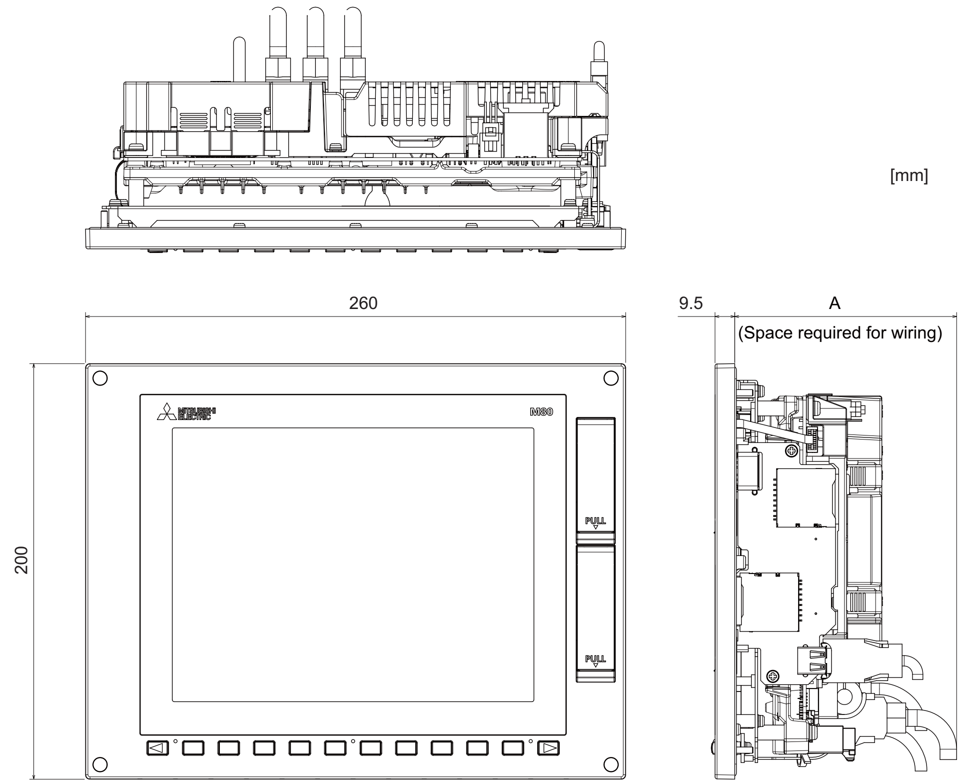
[mm]



# 4.3 Display Unit [M80]

## 4.3.1 8.4-type (FCU8-DU121-12)

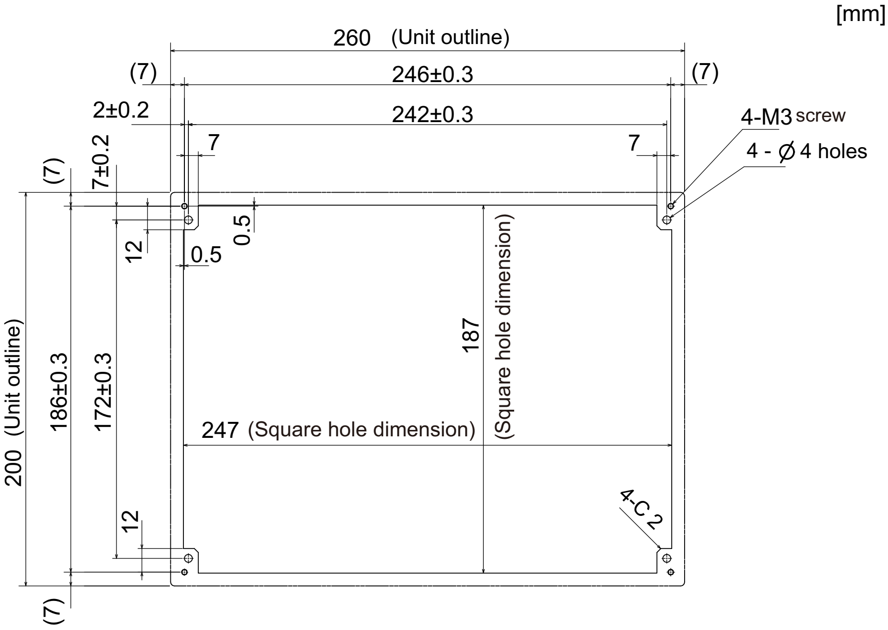
**[Outline dimension]**




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

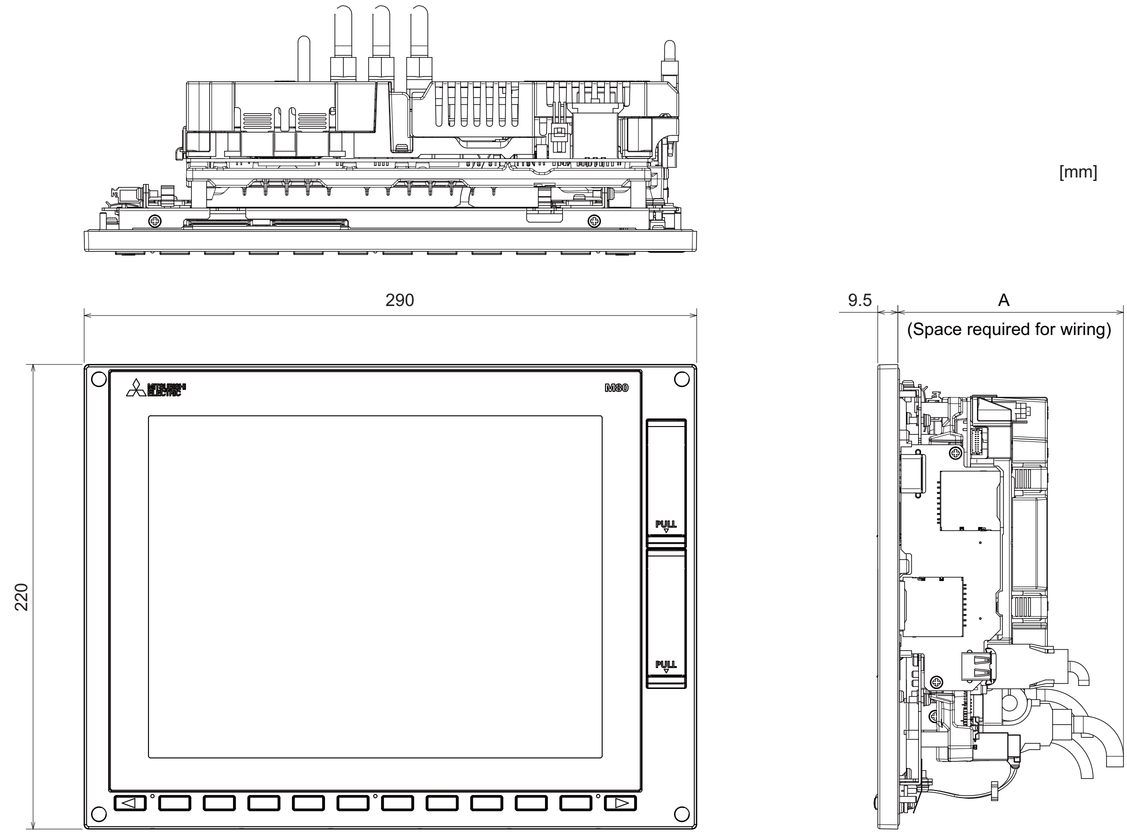
(Note) The 8.4-type display unit is incompatible with the touchscreen.

**[Panel cut dimension]**



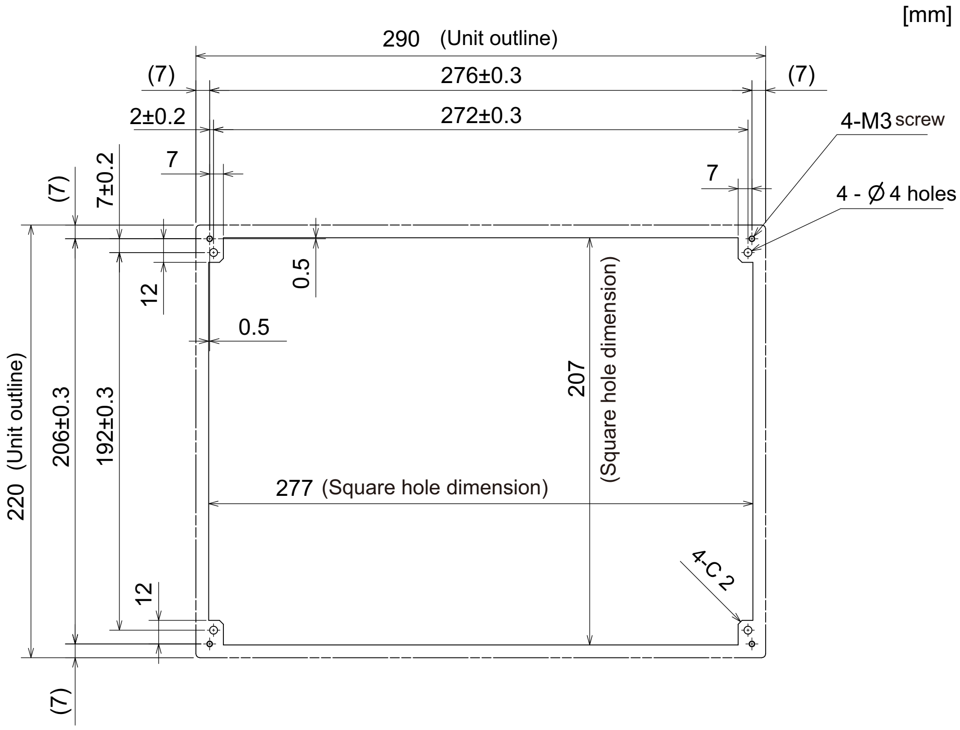
## 4.3.2 10.4-type (FCU8-DU141-32)

### [Outline dimension]



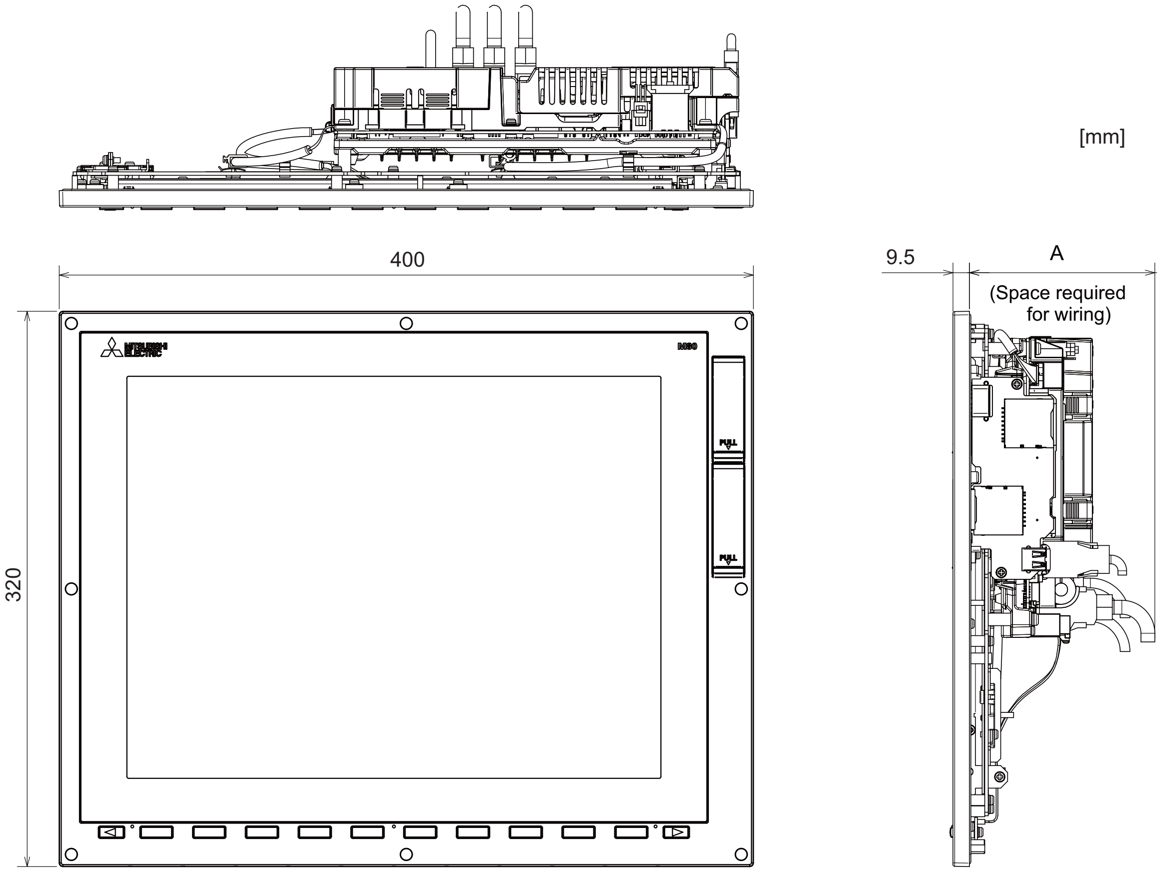

| | Option relay unit not mounted | Option relay unit, FCU8-EX702 mounted | Option relay unit, FCU8-EX703 mounted |
|---|---|---|---|
| **A (Space required for wiring)** | 110 | | 114 |

**[Panel cut dimension]**



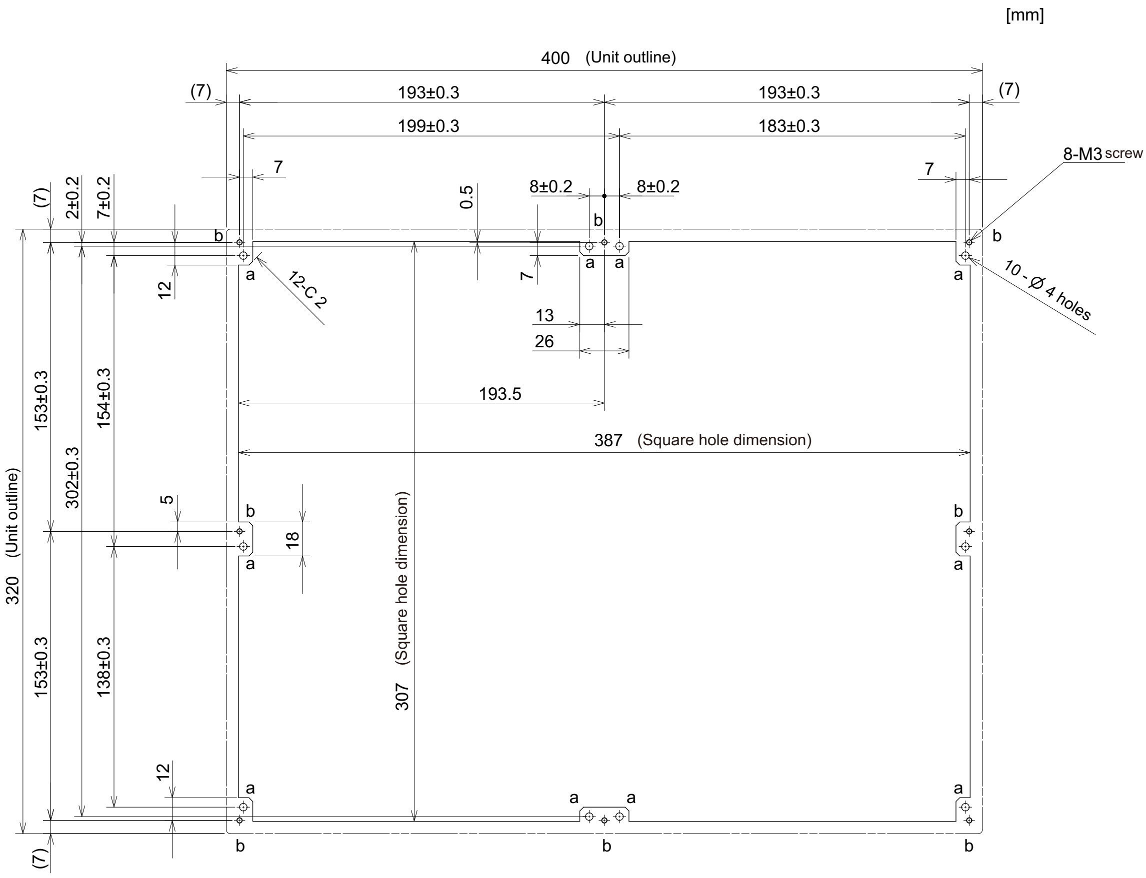
## 4.3.3 15-type (FCU8-DU181-32)

**[Outline dimension]**




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

[Panel cut dimension]

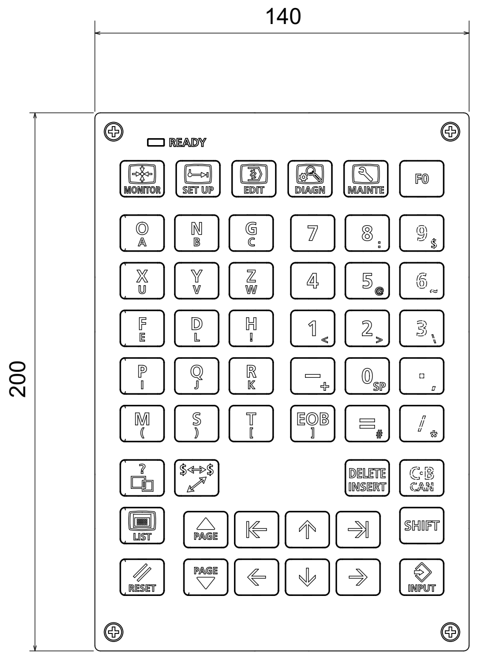


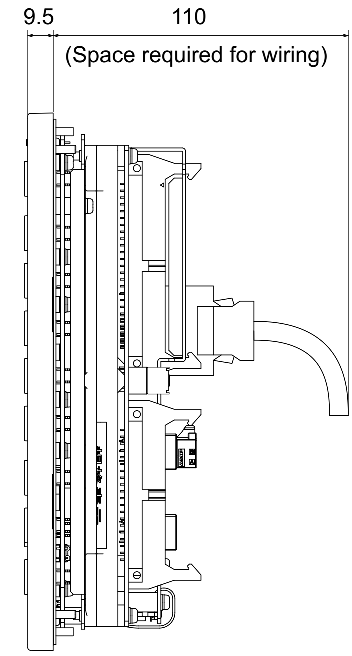
# 4.4 Keyboard Unit

## 4.4.1 Keyboard for 8.4-type Display Unit (FCU8-KB026)

**[Outline dimension]**

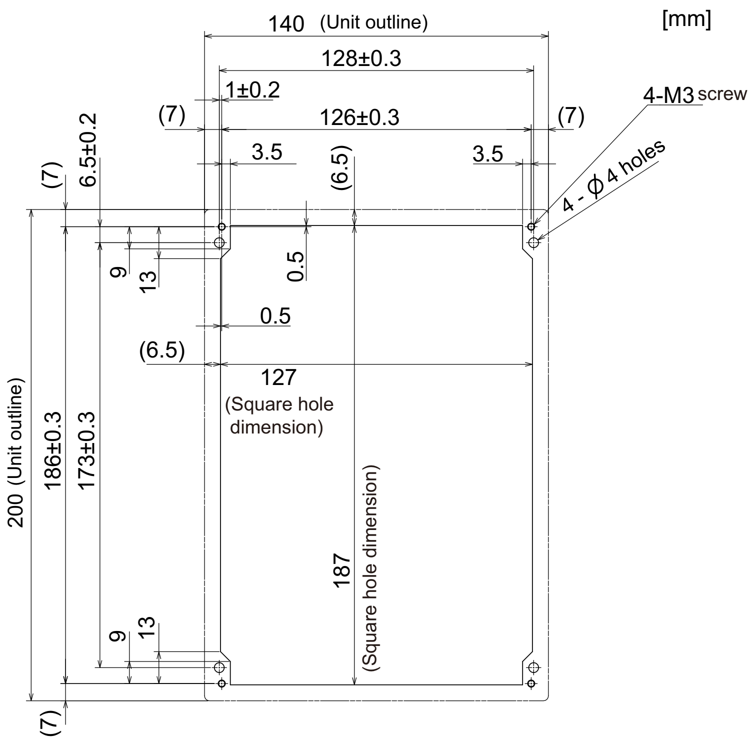
[mm]




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

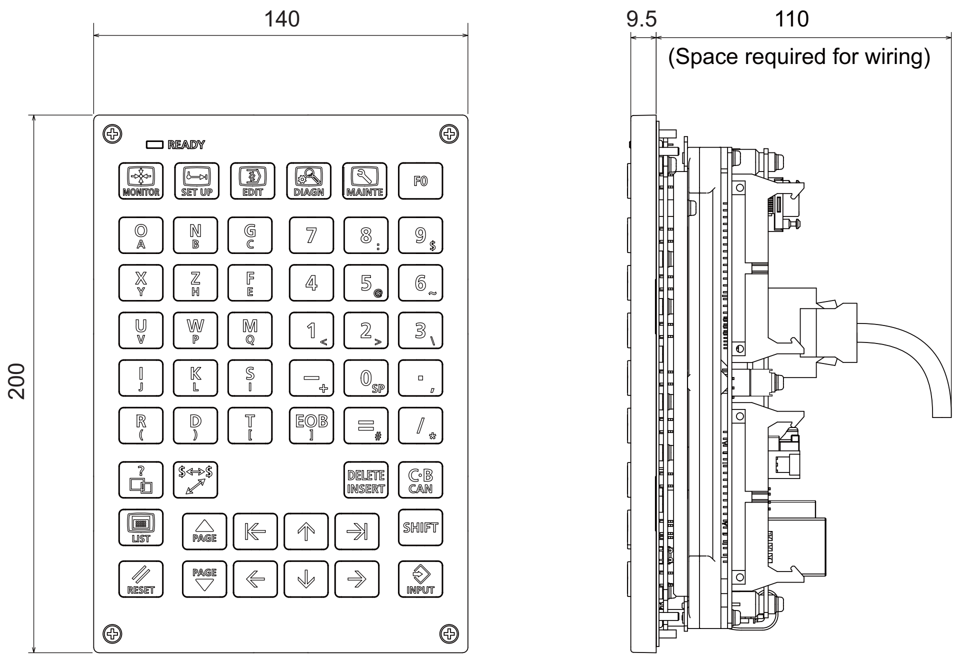
**[Panel cut dimension]**



## 4.4.2 Keyboard for 8.4-type Display Unit (FCU8-KB028)

**[Outline dimension]**

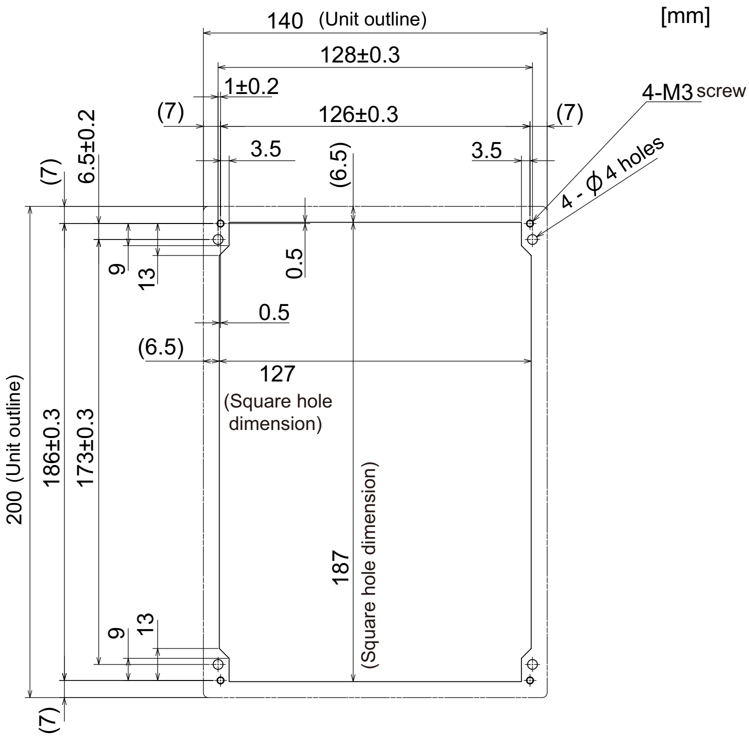
[mm]




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

**[Panel cut dimension]**

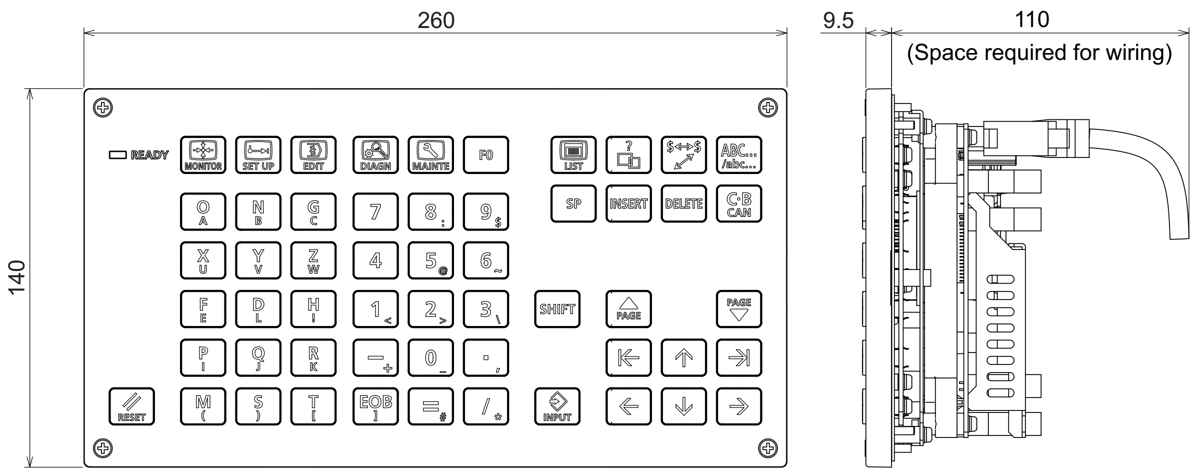
[mm]



## 4.4.3 Keyboard for 8.4-type Display Unit (FCU8-KB029)

**[Outline dimension]**

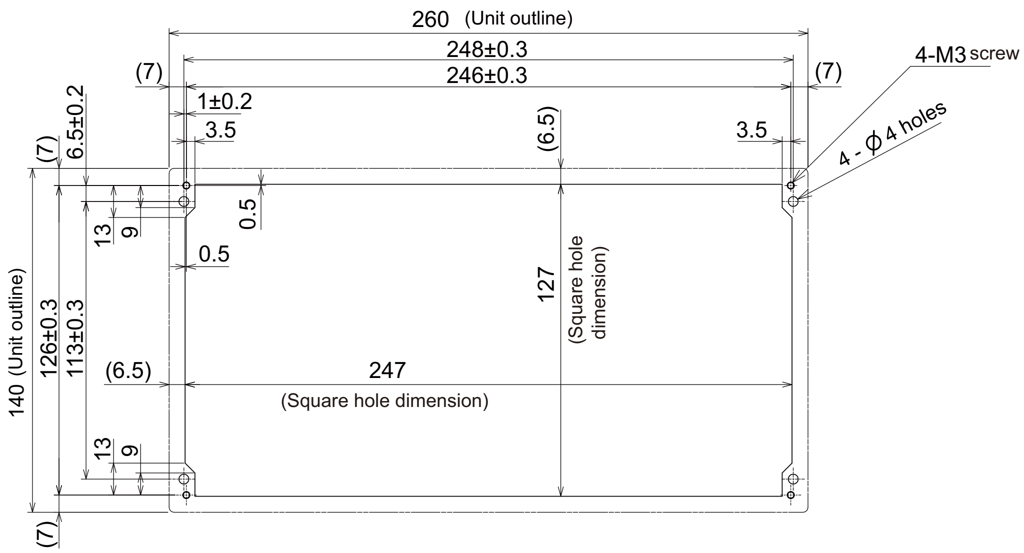
[mm]




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

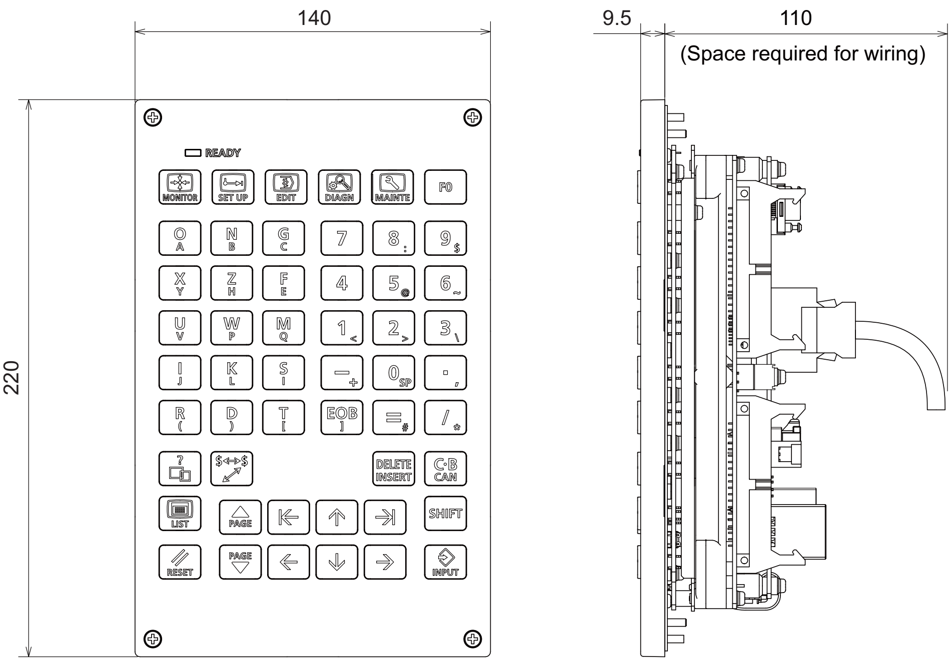
**[Panel cut dimension]**

[mm]



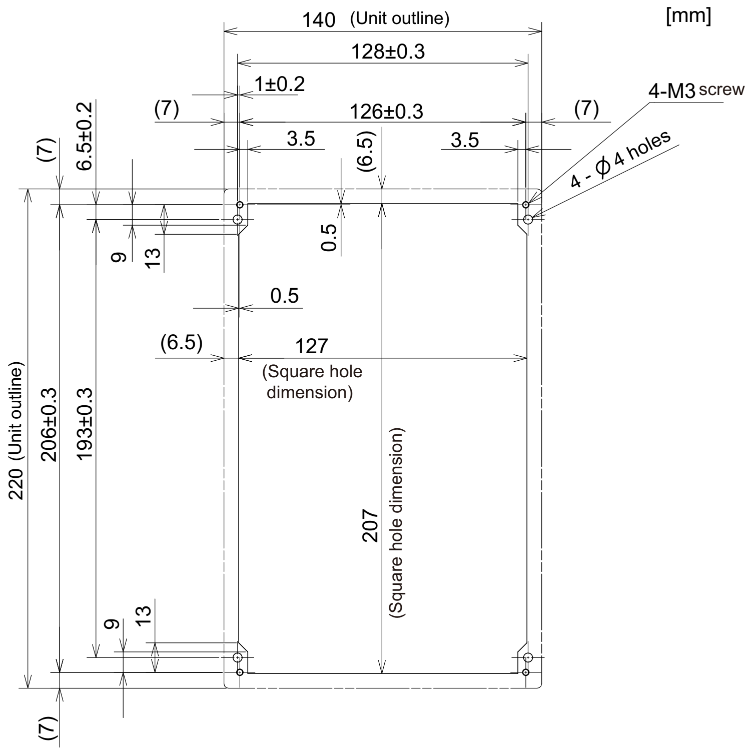
## 4.4.4 Keyboard for 10.4-type Display Unit (FCU8-KB041)

**[Outline dimension]**




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

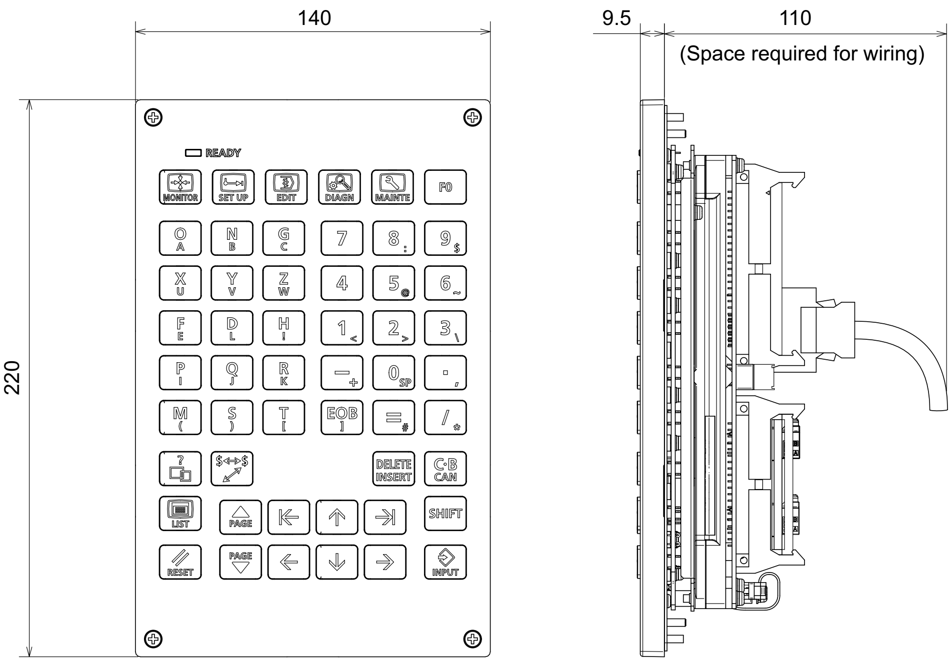
**[Panel cut dimension]**



## 4.4.5 Keyboard for 10.4-type Display Unit (FCU8-KB046)

### [Outline dimension]

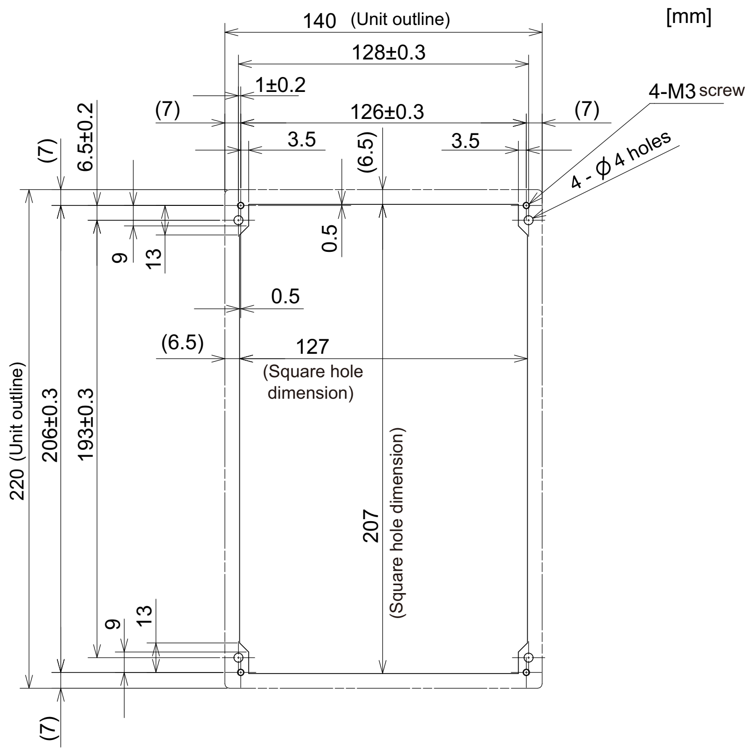
[mm]




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

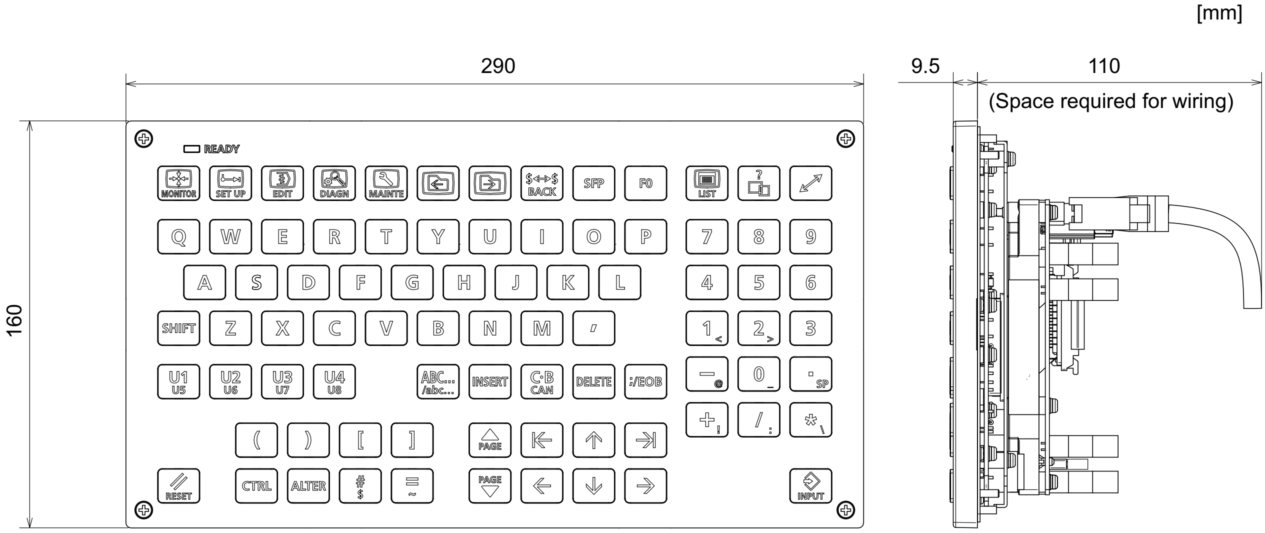
### [Panel cut dimension]

[mm]



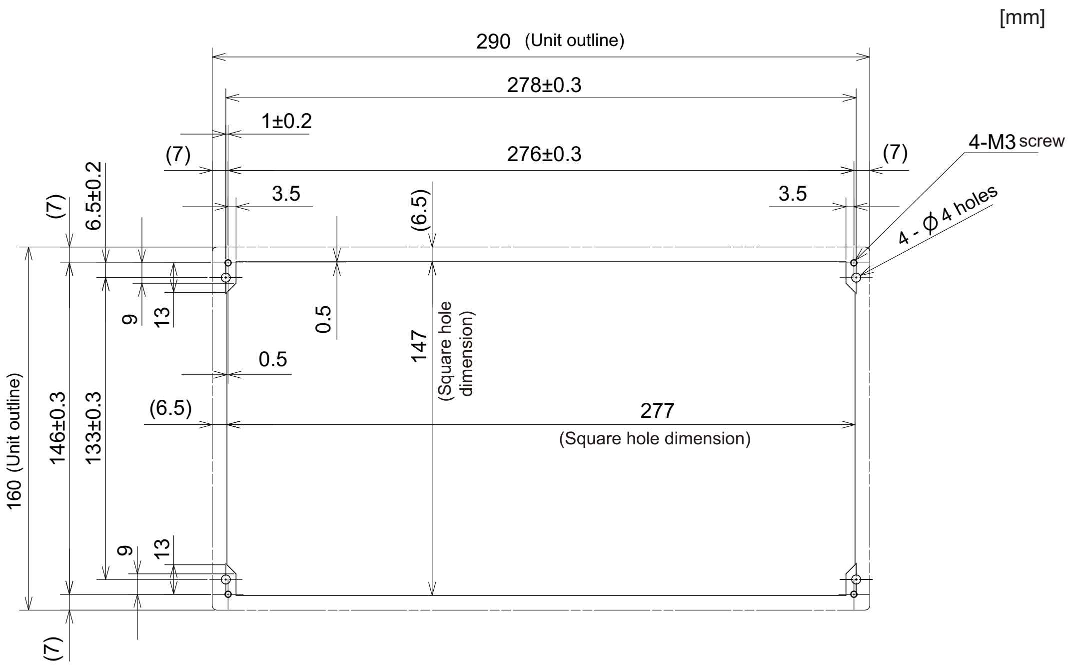
### 4.4.6 Keyboard for 10.4-type Display Unit (FCU8-KB047)

**[Outline dimension]**




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

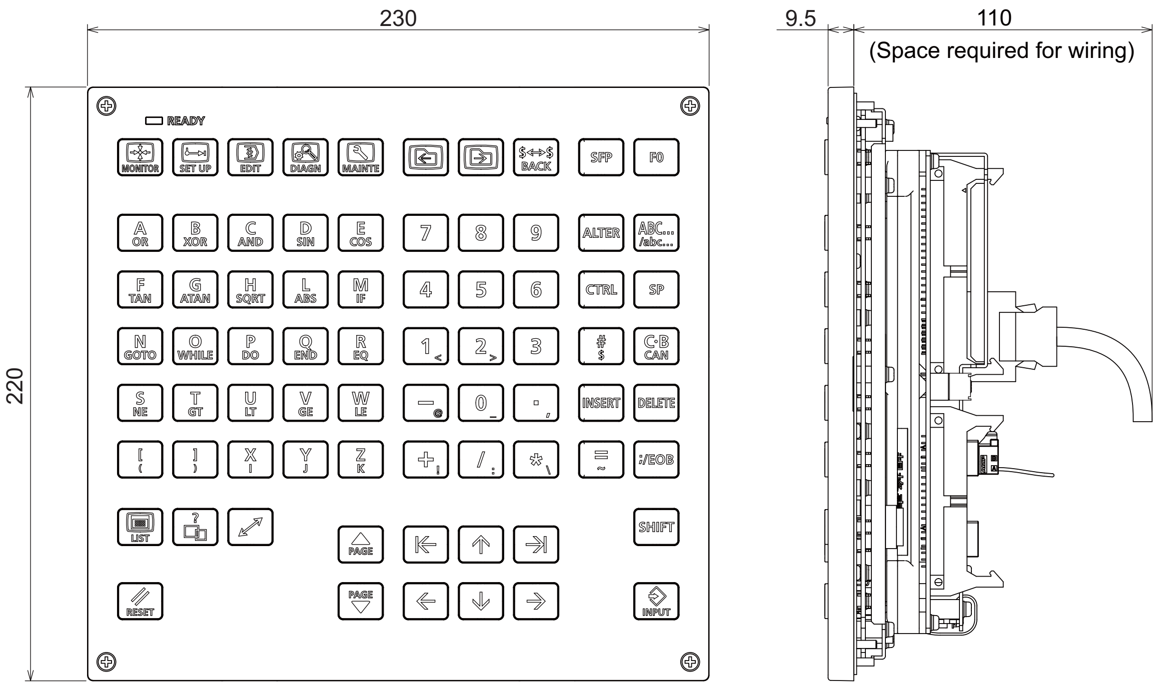
**[Panel cut dimension]**



### 4.4.7 Keyboard for 10.4-type Display Unit (FCU8-KB048)

**[Outline dimension]**

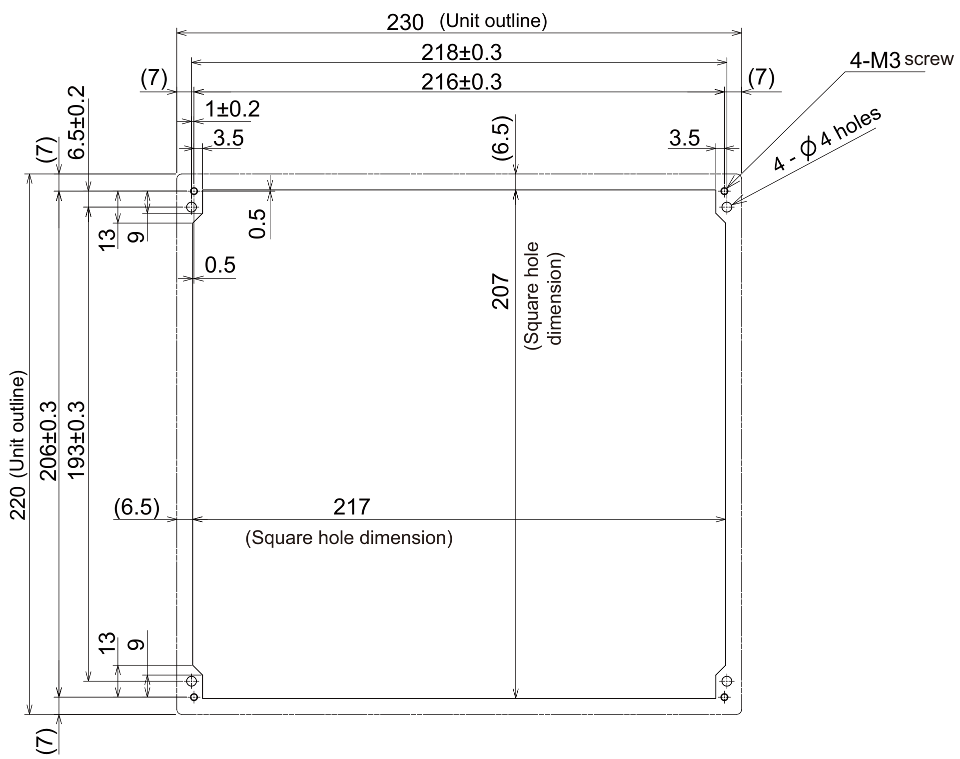
[mm]




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

**[Panel cut dimension]**

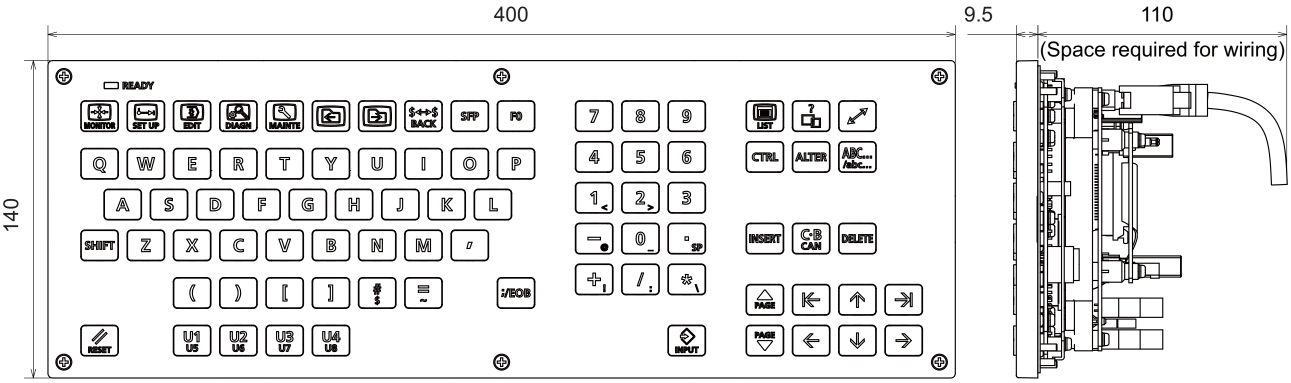
[mm]



## 4.4.8 Keyboard for 15-type Display Unit (FCU8-KB083)

### [Outline dimension]

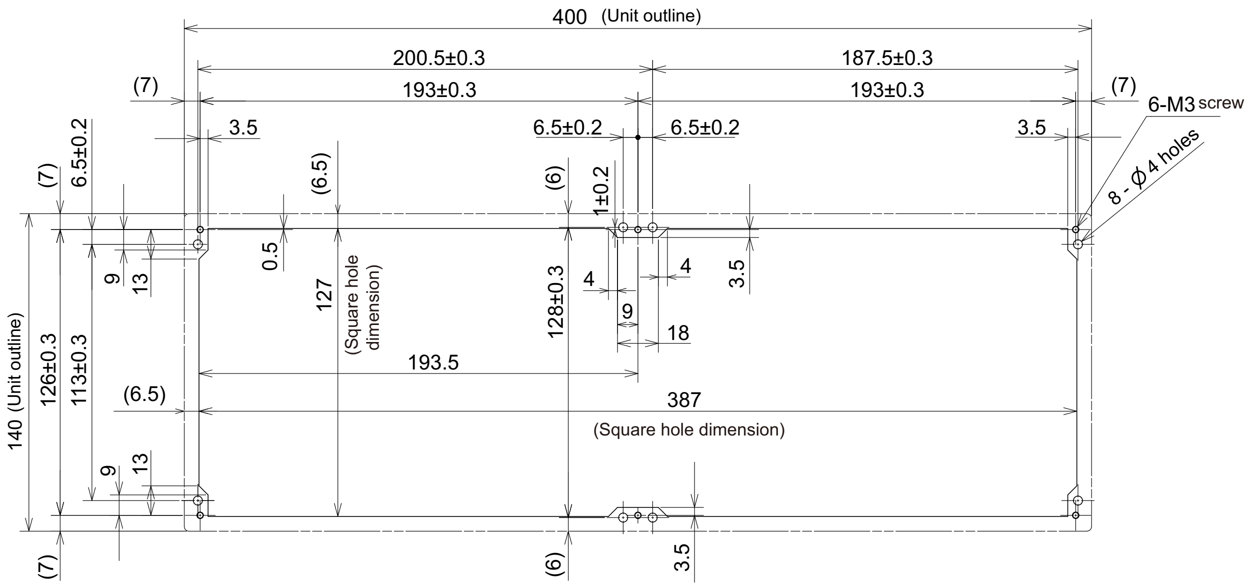
[mm]




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

### [Panel cut dimension]

[mm]



# 4.5 Operation Panel I/O Unit

Characteristics of operation panel I/O unit are as follows.

(1) The followings can be connected to the operation panel I/O unit.
  (a) Remote I/O interface ... 1ch
    Input/output signals can be extended with Remote I/O units.
  (b) Manual pulse generator ... 3ch
    5V and 12V manual pulse generators can be connected.
(2) The operation panel I/O unit can be mounted on the back side of the keyboard unit.
  This contributes to space saving inside the operation panel.
(3) DO output can output 200mA/point.
  For FCU8-DX750/DX761, total output current of whole unit is 3.8A at the maximum.
  For FCU8-DX760, total output current of whole unit is 5.7A at the maximum.

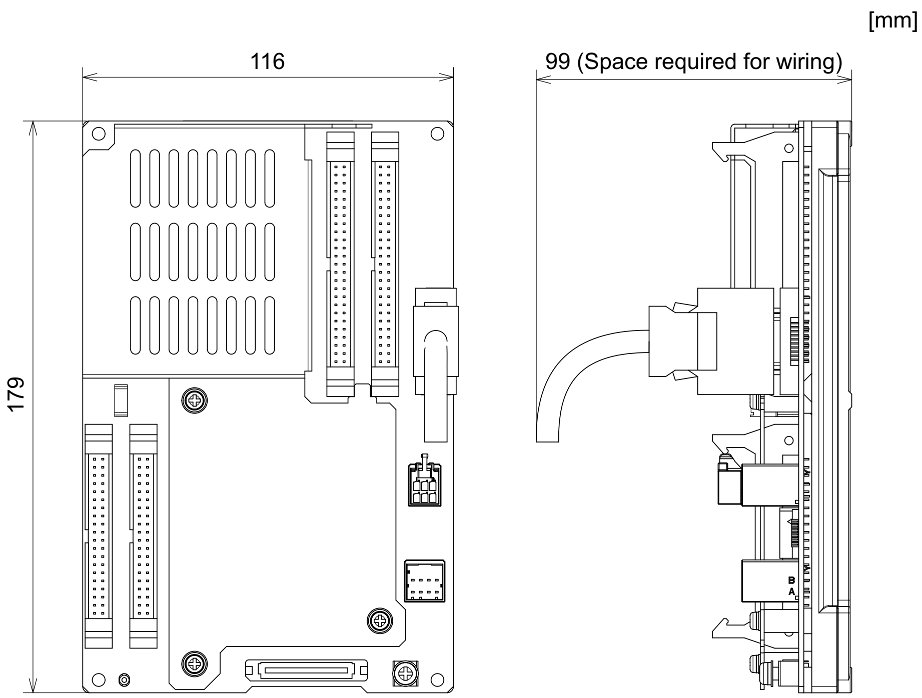
(Note 1) The maximum connectable number of remote I/O units is 32.
(Note 2) Set the number of DI points that are simultaneously turned ON to be less than half of the total points.
If many points are set to be simultaneously turned ON, operation panel I/O unit may be deteriorated due to the heat.

## 4.5.1 List of Units

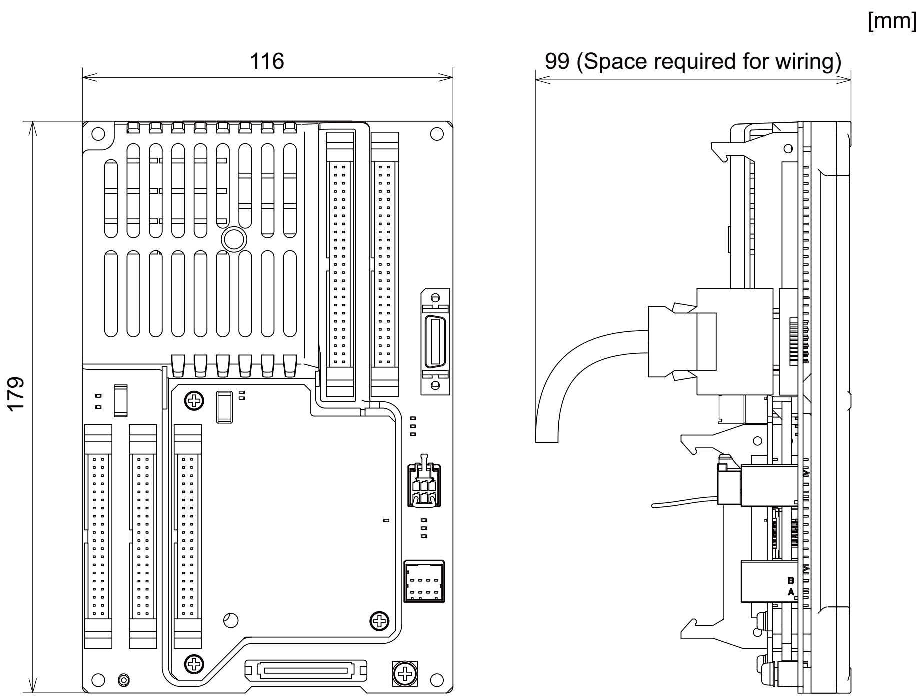
| Classification | Type | Components | Remarks |
|---|---|---|---|
| DI 24V/0V common input [96 points]<br>DO Source output [64 points] | FCU8-DX750 | Base card<br>RIO 2.0 terminator connector (R2-TM) | DI: 96-points 24V/0V common type<br>DO: 64-points source type (200mA/point)<br>Manual pulse generator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

## 4.5.2 FCU8-DX750/ FCU8-DX760 / FCU8-DX761

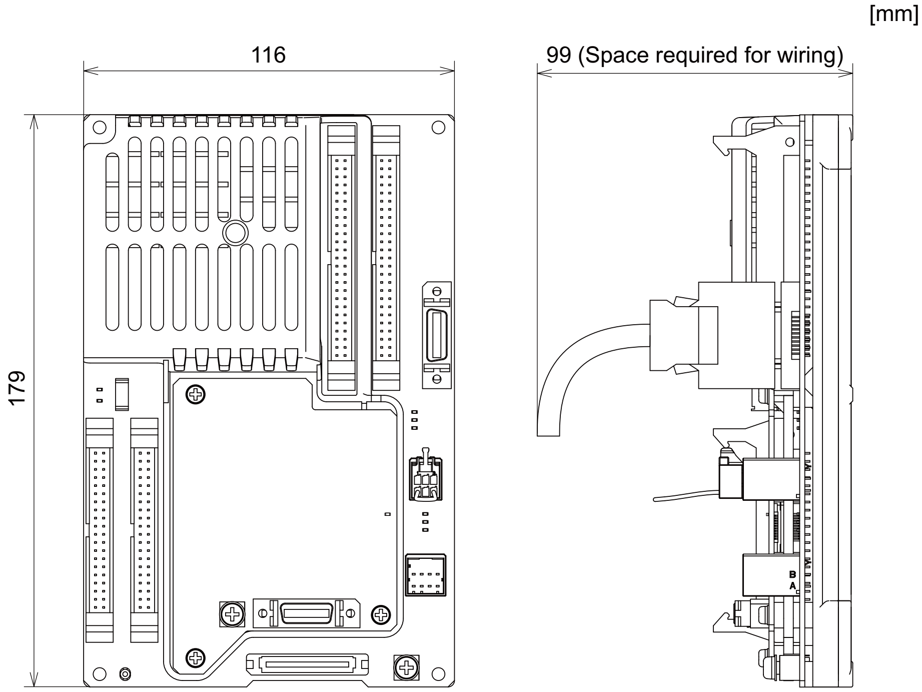
### [Outline dimension : FCU8-DX750]



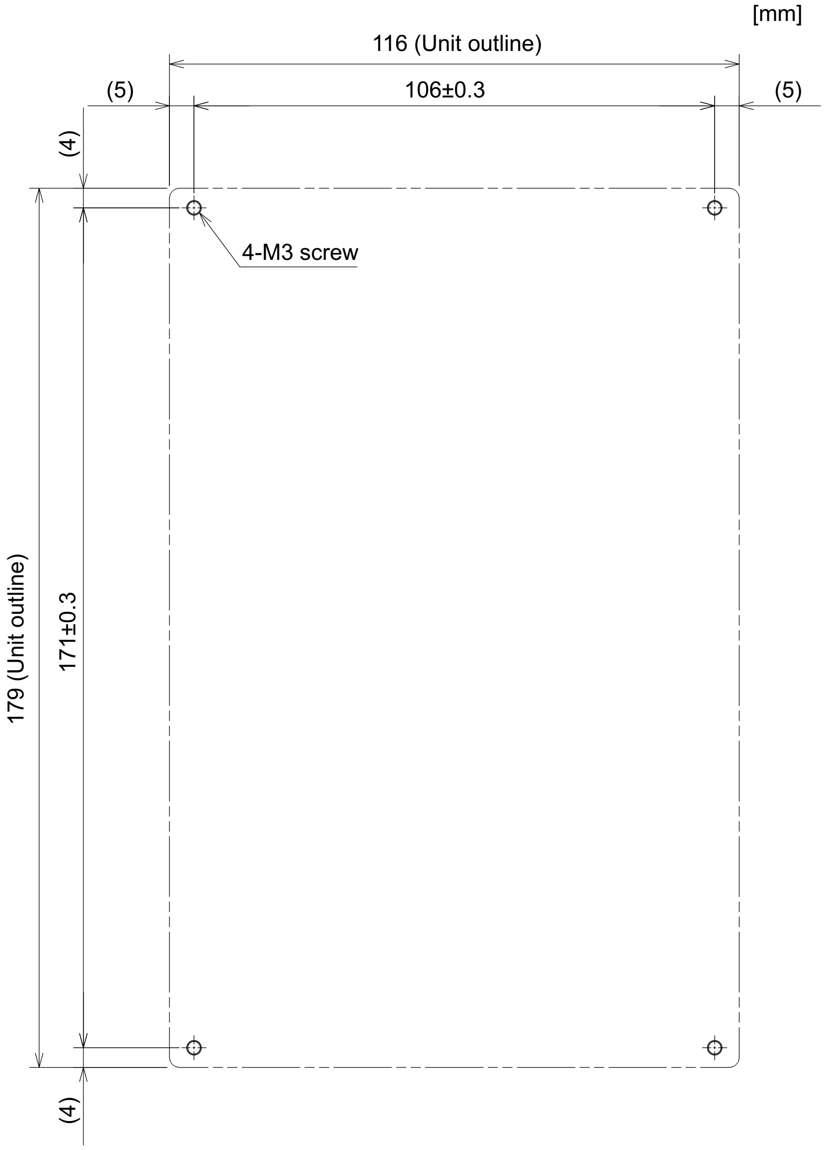

### [Outline dimension : FCU8-DX760]



**[Outline dimension : FCU8-DX761]**



**[Installation dimension: FCU8-DX750 / FCU8-DX760 / FCU8-DX761]**




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

# 4.6 Remote I/O Unit

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

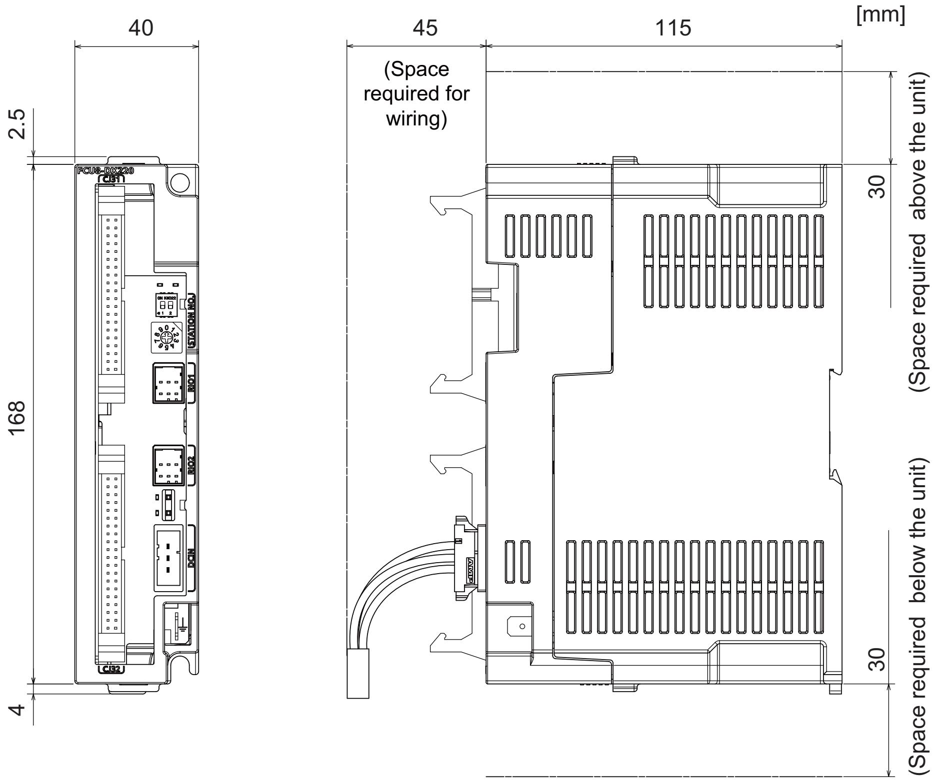
(Note) The maximum connectable number of remote I/O units is 32.

## 4.6.1 List of Units

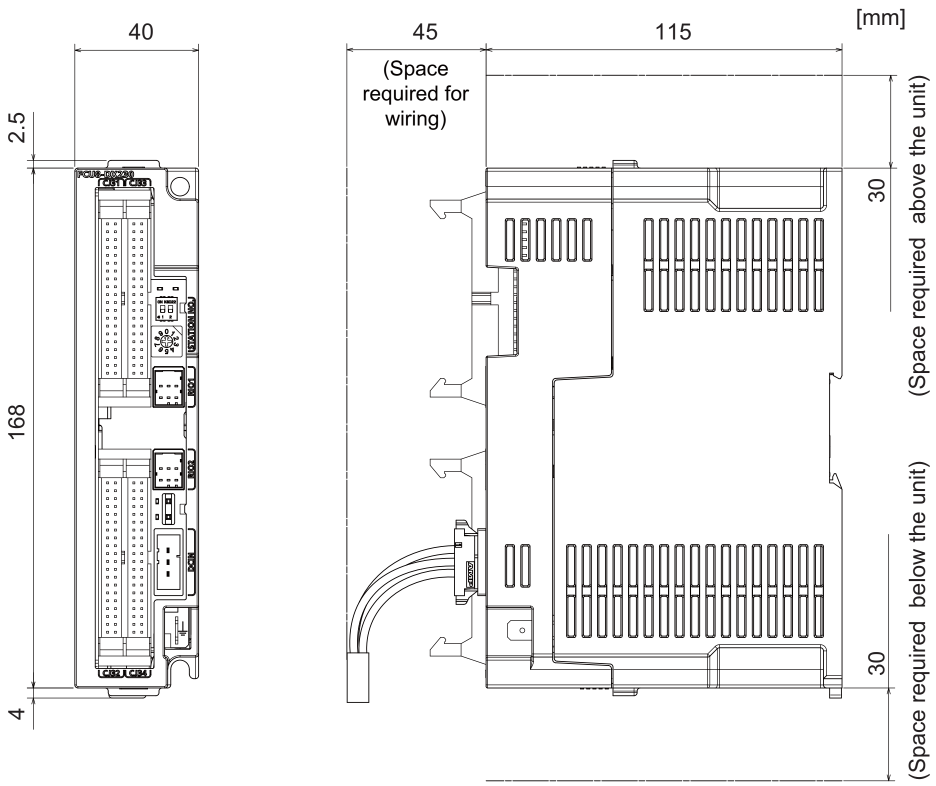
| Classification | Type | Components | Remarks |
|---|---|---|---|
| DI 24V/0V common input [32 points]<br>DO Source output [32 points] | FCU8-DX220 | Base card<br>RIO 2.0 connector set | DI: 32-points 24V/0V common type<br>Do: 32-points source type (200mA/point)<br>Number of occupied stations: 1 |
|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

### 4.6.2 FCU8-DX220 / FCU8-DX230 / FCU8-DX231 / FCU8-DX202 / FCU8-DX213 / FCU8-DX213-1 / FCU8-DX654 / FCU8-DX654-1 / FCU8-DX651/ FCU8-DX408

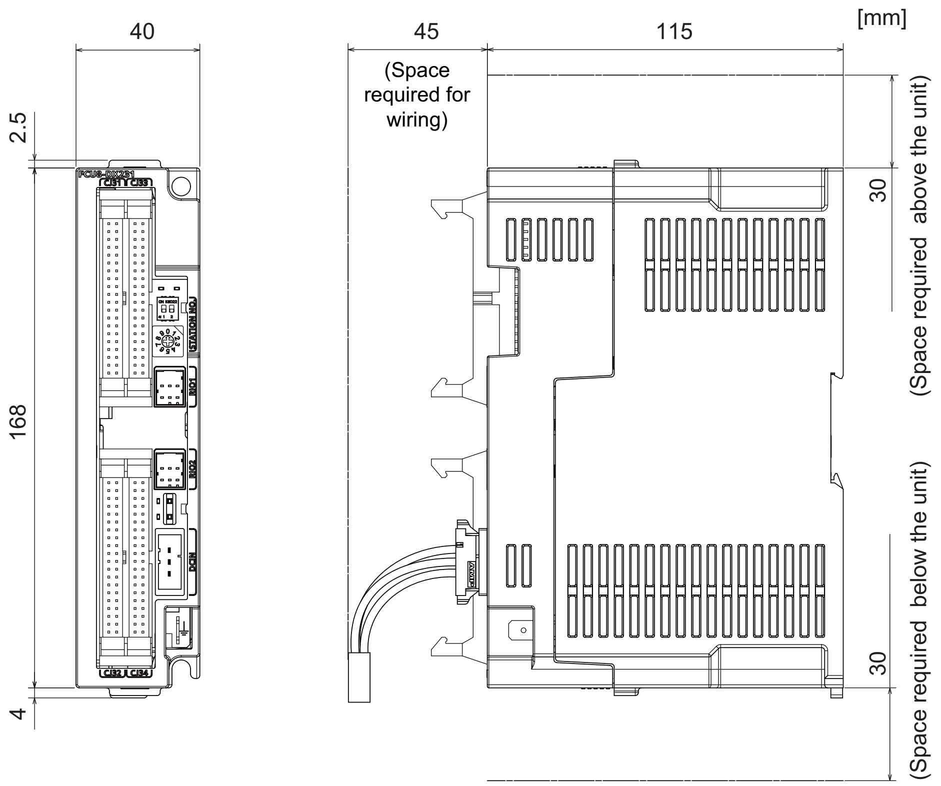
**[Outline dimension : FCU8-DX220]**



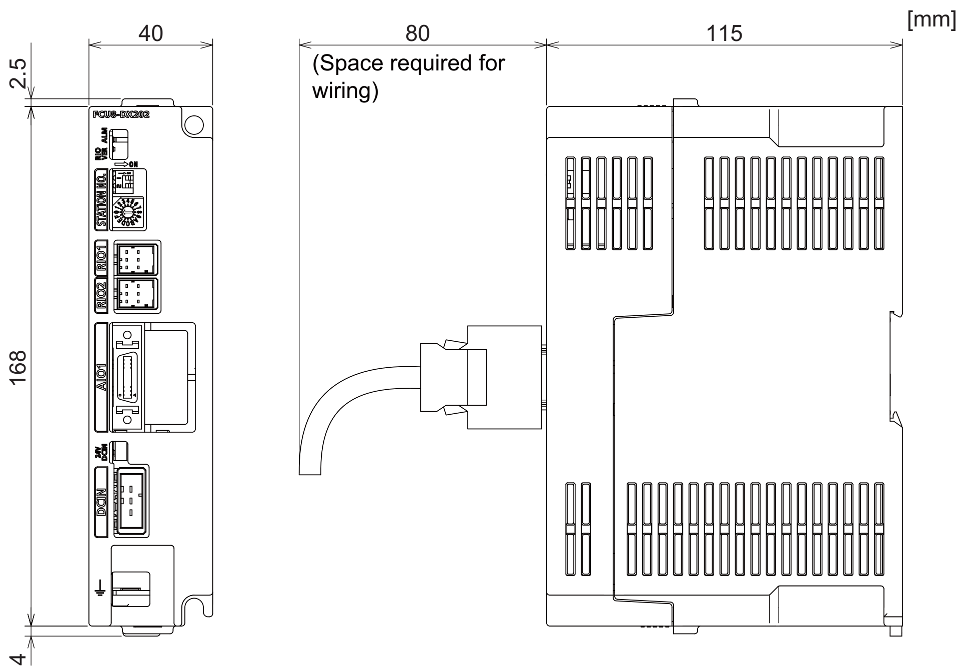

**[Outline dimension : FCU8-DX230]**



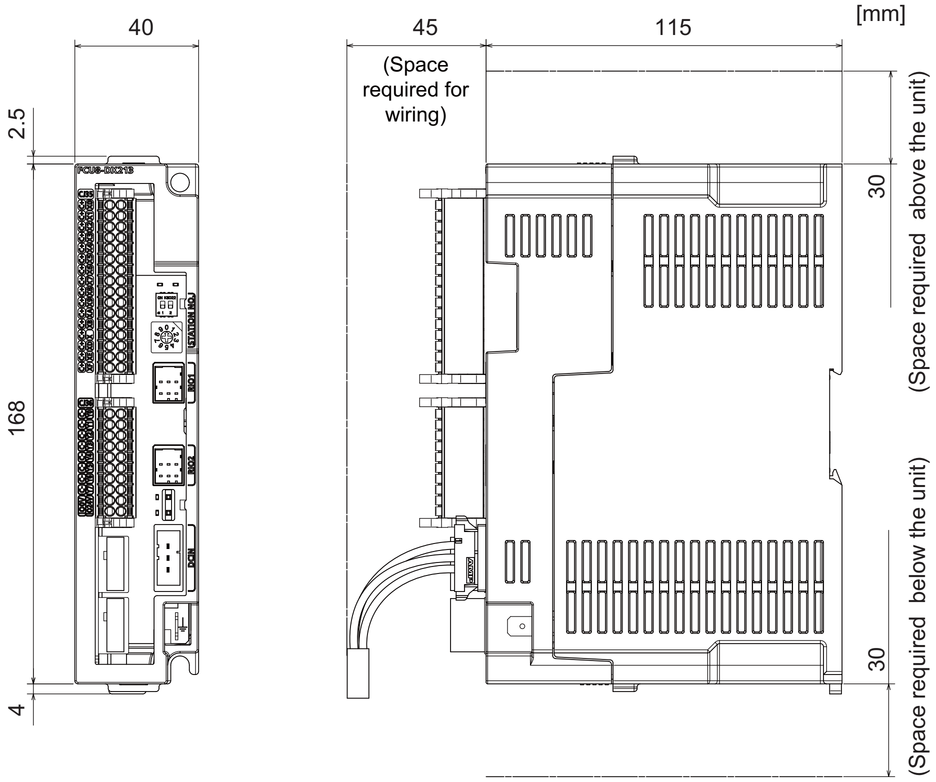
**[Outline dimension : FCU8-DX231]**



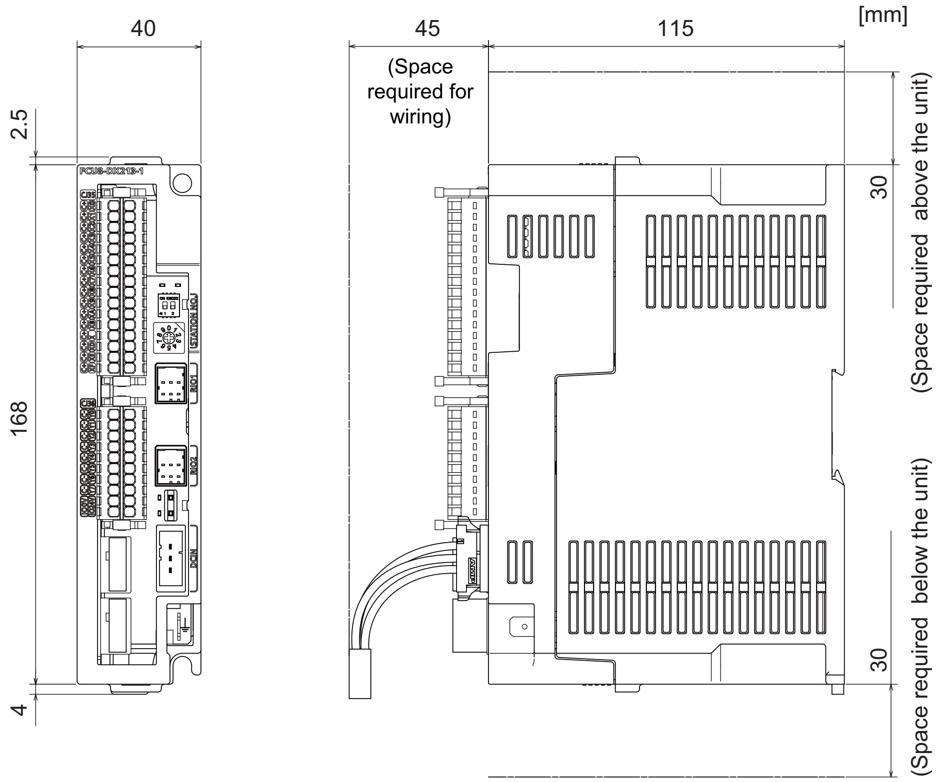

**[Outline dimension : FCU8-DX202]**



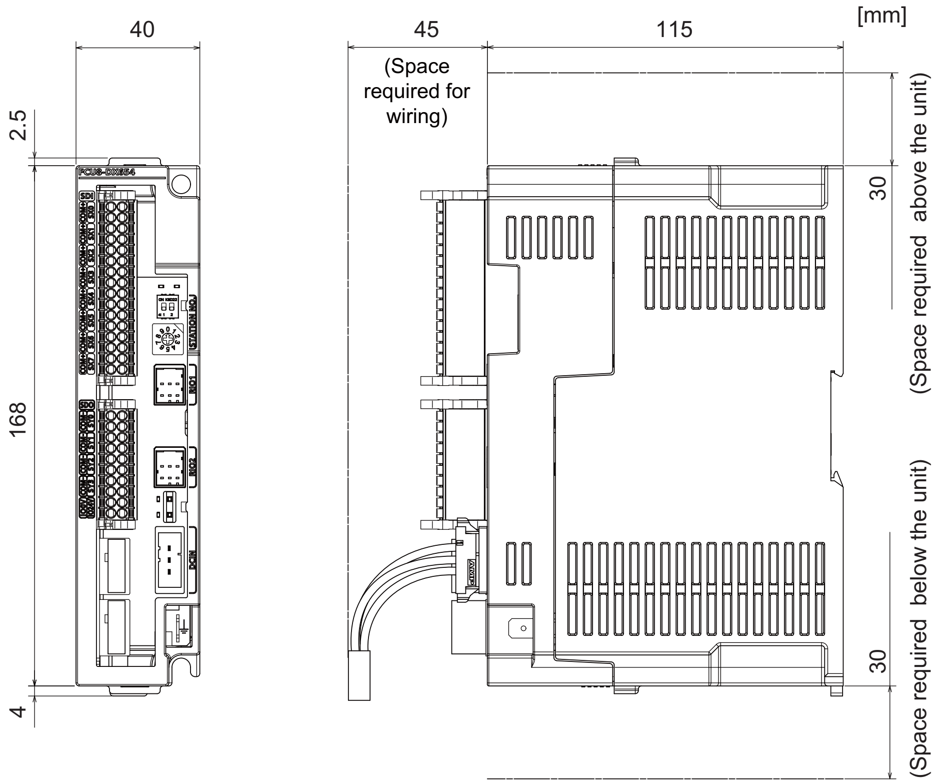
**[Outline dimension : FCU8-DX213]**



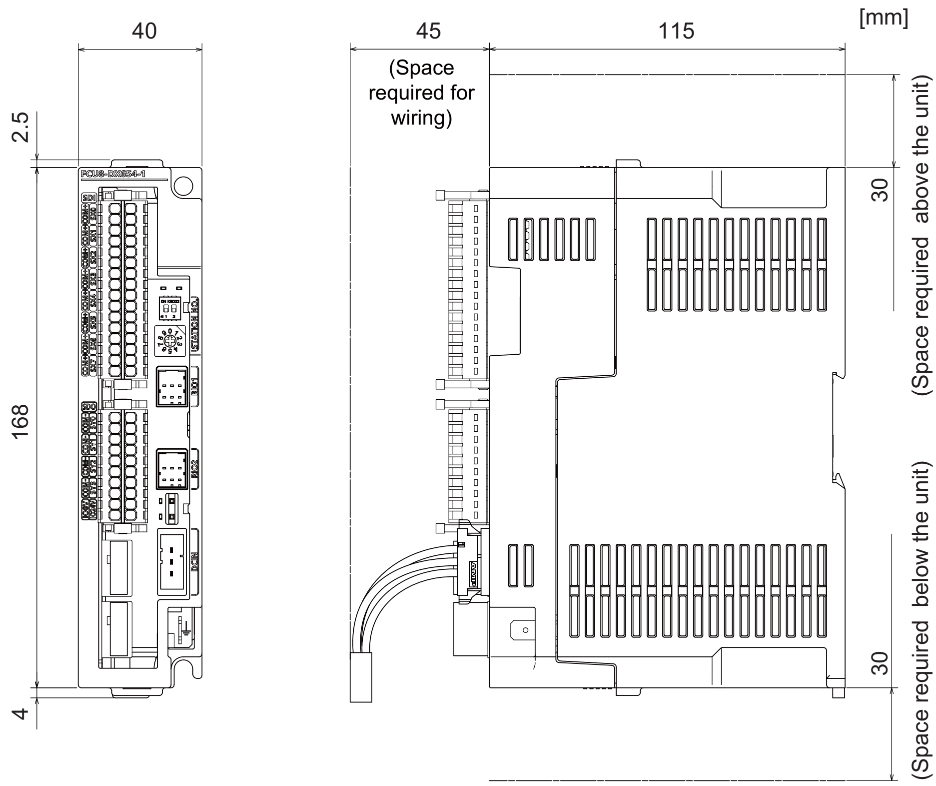

**[Outline dimension : FCU8-DX213-1]**



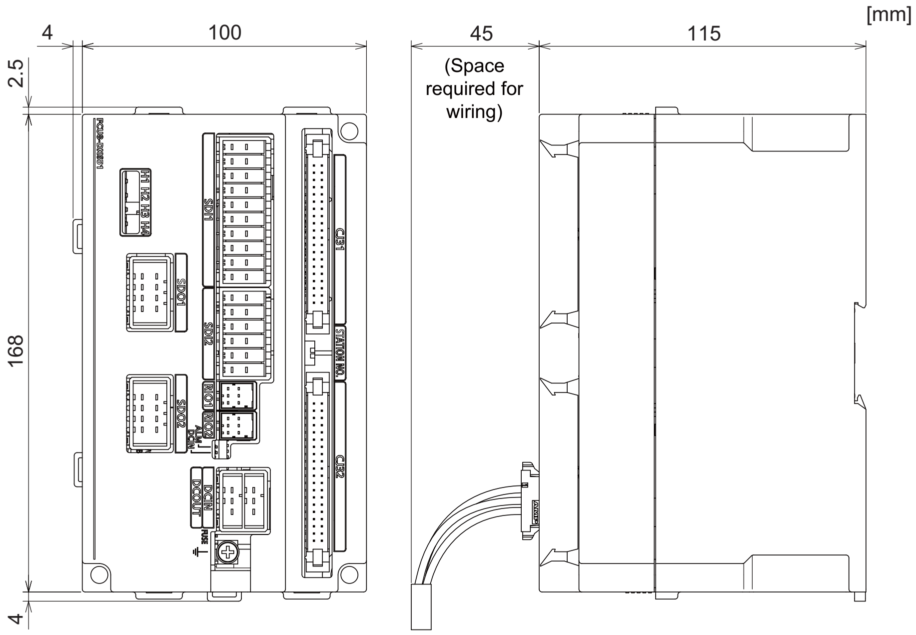
**[Outline dimension : FCU8-DX654]**



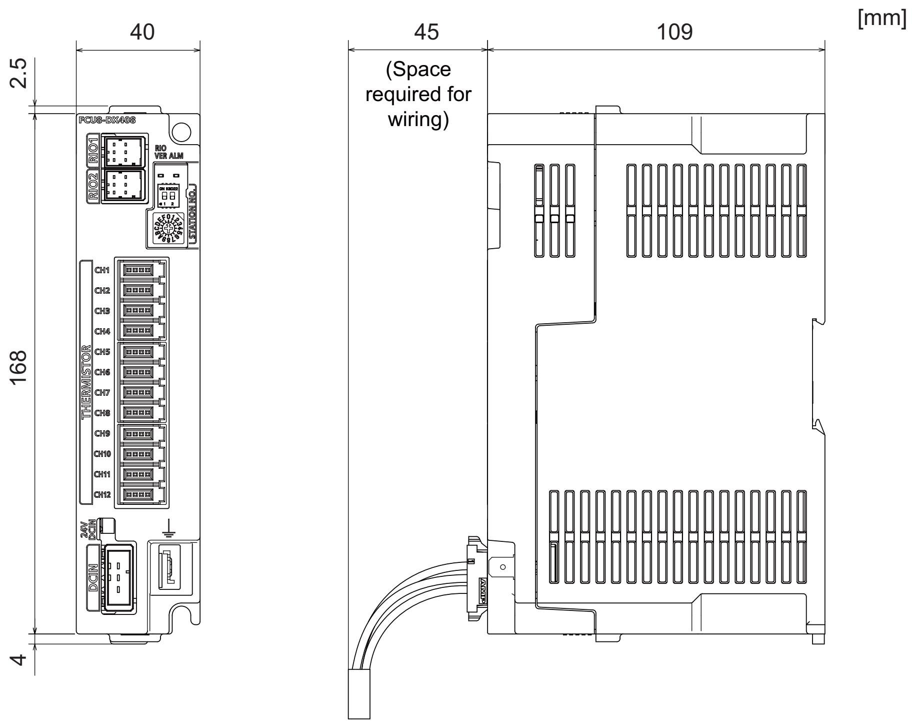

**[Outline dimension : FCU8-DX654-1]**



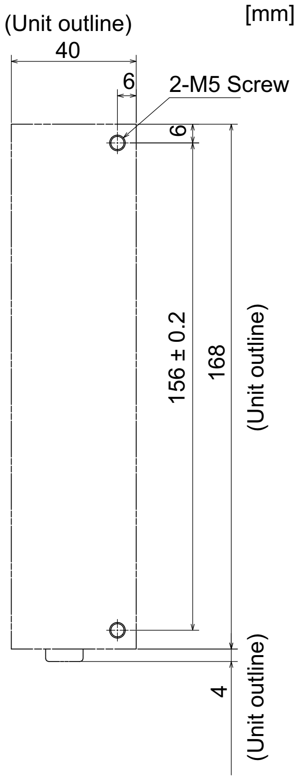
**[Outline dimension : FCU8-DX651]**



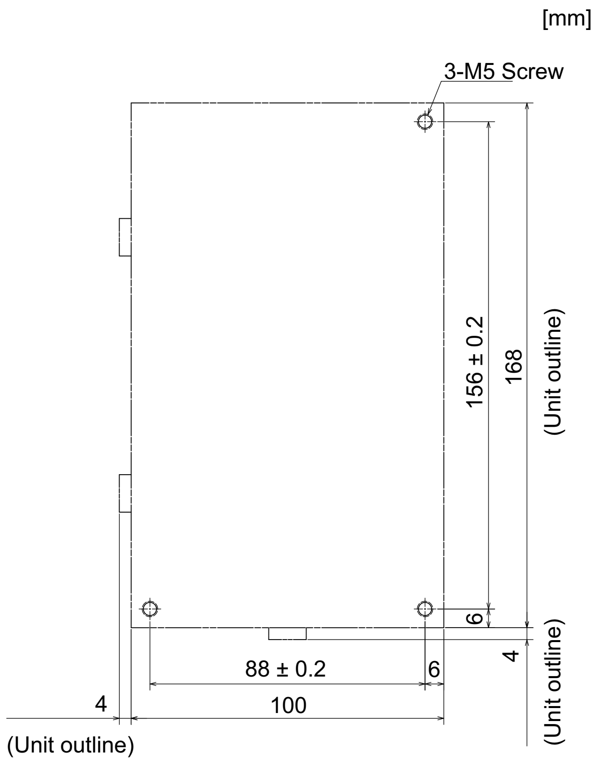

**[Outline dimension : FCU8-DX408]**



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




**[Installation dimension : FCU8-DX651]**

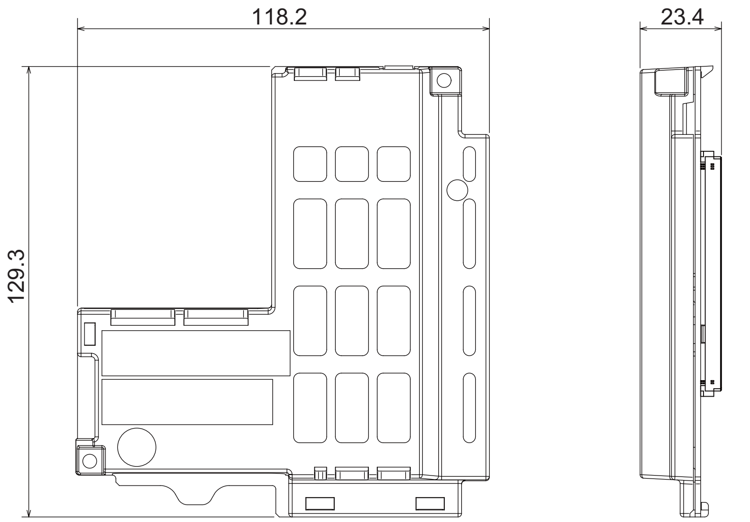


# 4.7 Function Expansion Unit

## 4.7.1 Functional Safety Expansion Unit (FCU8-EX133)

**[Outline dimension]**

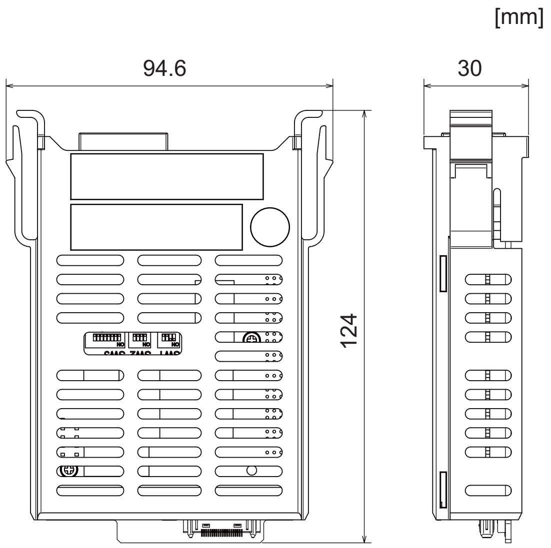
[mm]



# 4.8 Communication Expansion Unit

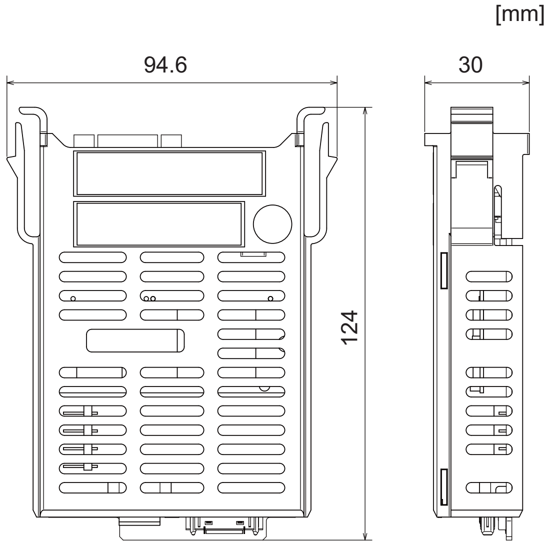
## 4.8.1 CC-Link (FCU8-EX561)

**[Outline dimension]**



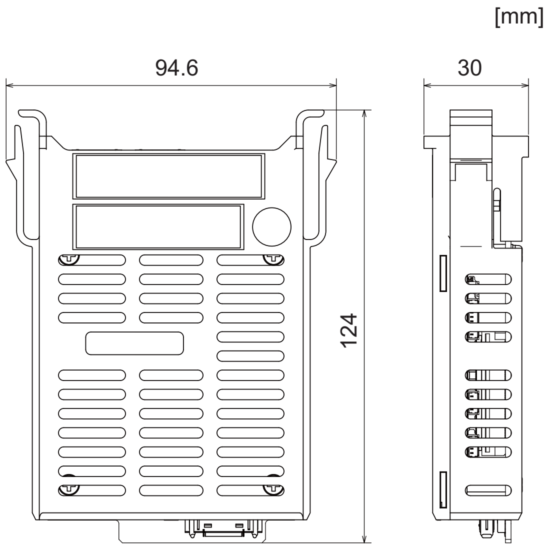
## 4.8.2 PROFIBUS-DP (FCU8-EX563)

**[Outline dimension]**



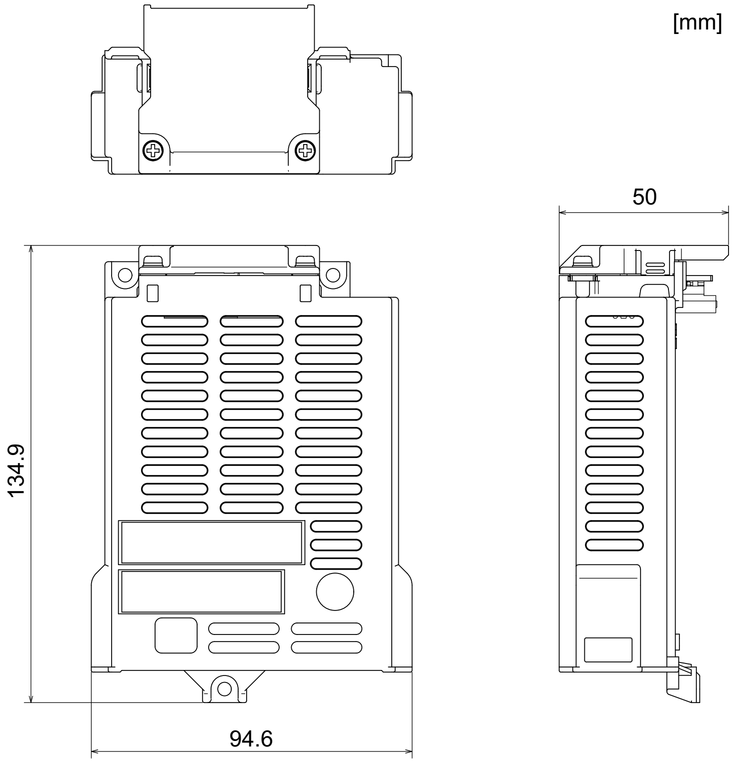
### 4.8.3 EtherNet/IP (FCU8-EX565)

**[Outline dimension]**



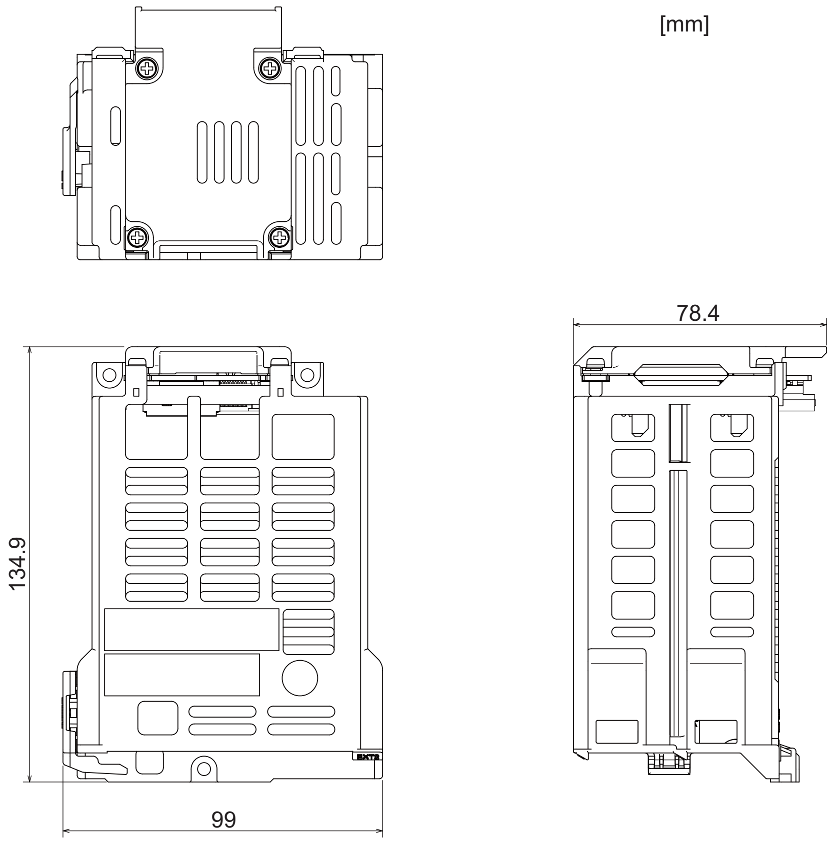
### 4.8.4 Option Relay Unit (FCU8-EX702)

**[Outline dimension]**



## 4.8.5 Option Relay Unit (FCU8-EX703)

**[Outline dimension]**

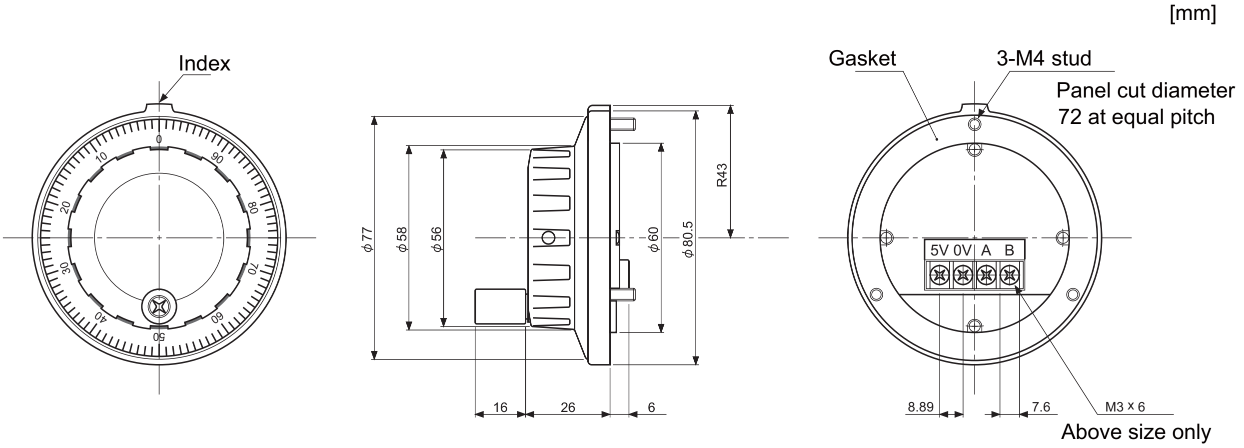


# 4.9 Manual Pulse Generator

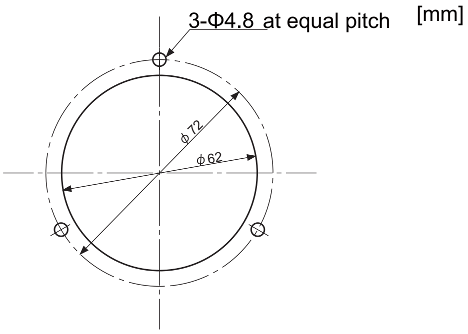
## 4.9.1 5V Manual Pulse Generator (UFO-01-2Z9)

100 pulse/rev

**[Outline dimension]**




**[Panel cut dimension]**



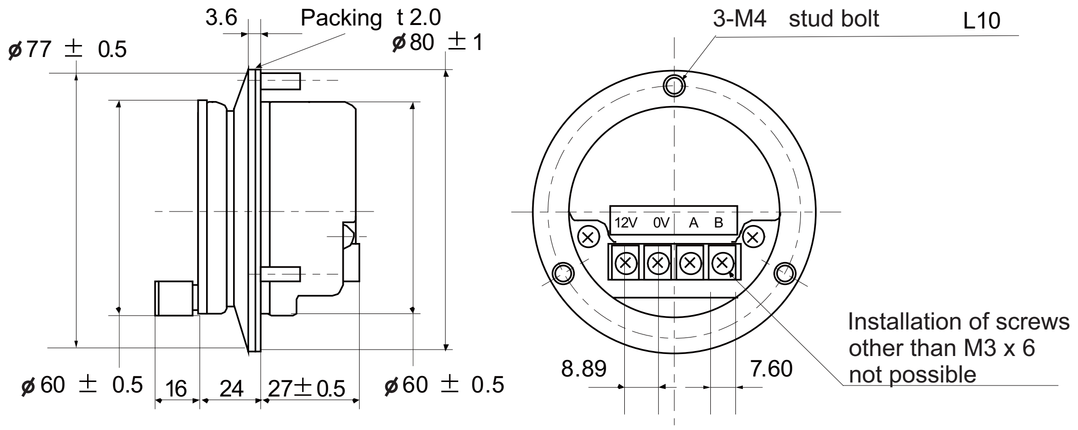

Produced by NIDEC NEMICON CORPORATION

### 4.9.2 Manual Pulse Generator (HD60C)

25 pulse/rev

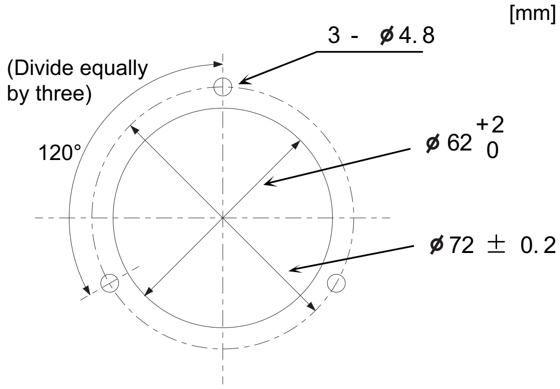
**[Outline dimension]**

[mm]




**[Panel cut dimension]**

[mm]

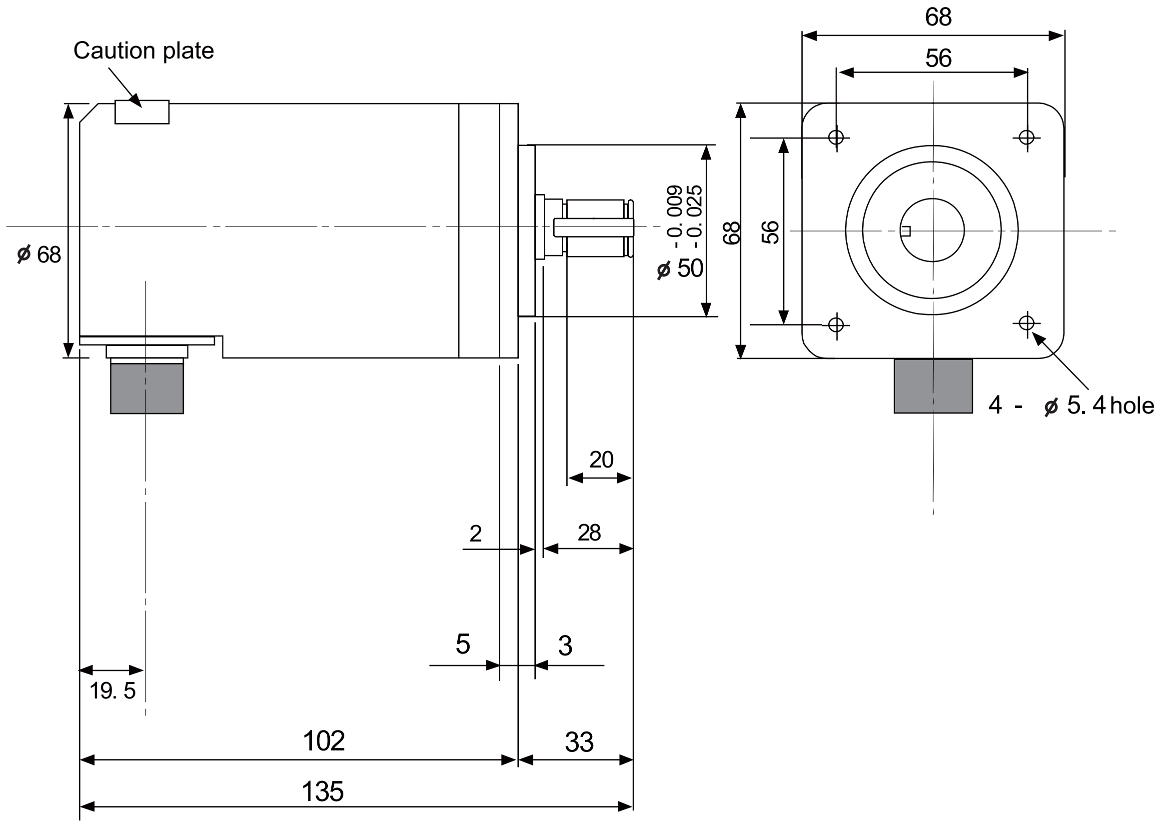


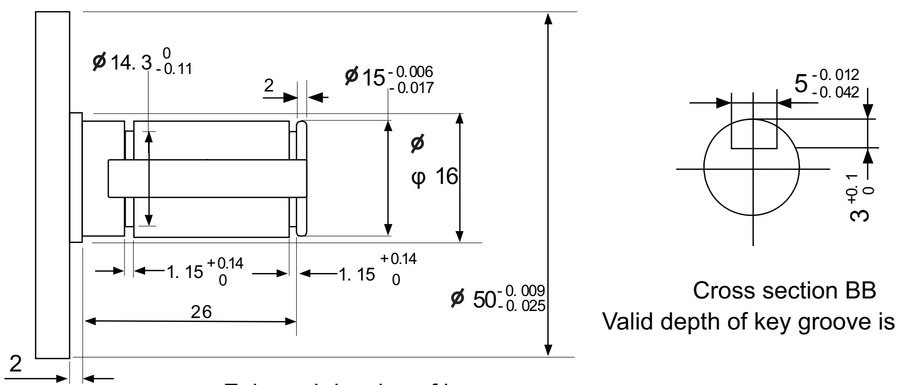
# 4.10 Synchronous Feed Encoder

## 4.10.1 Synchronous Feed Encoder (OSE-1024-3-15-68)

**[Outline dimension]**

[mm]

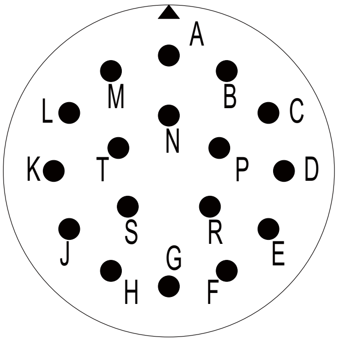



Enlarged drawing of key

Cross section BB
Valid depth of key groove is 21mm

[Connector]



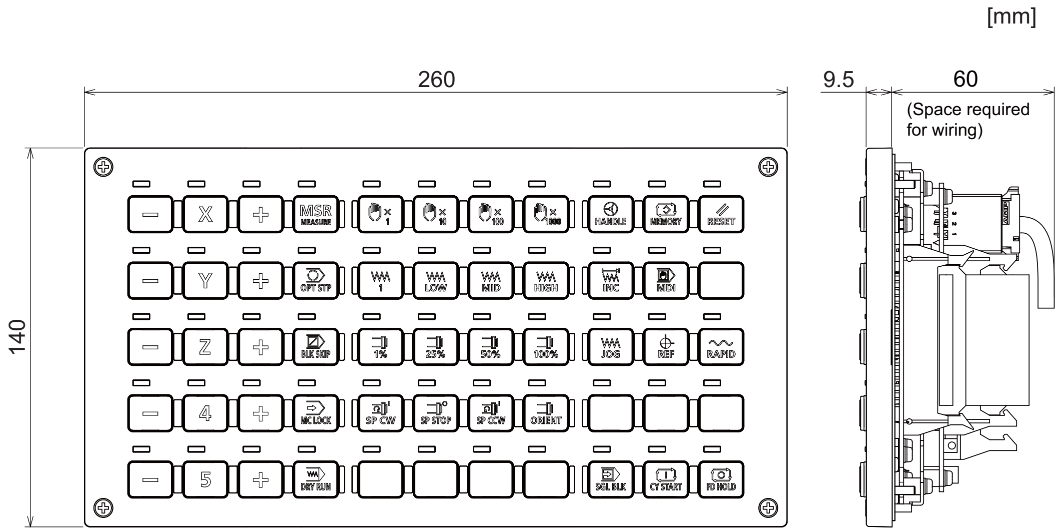

**Connector pin assignment**

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

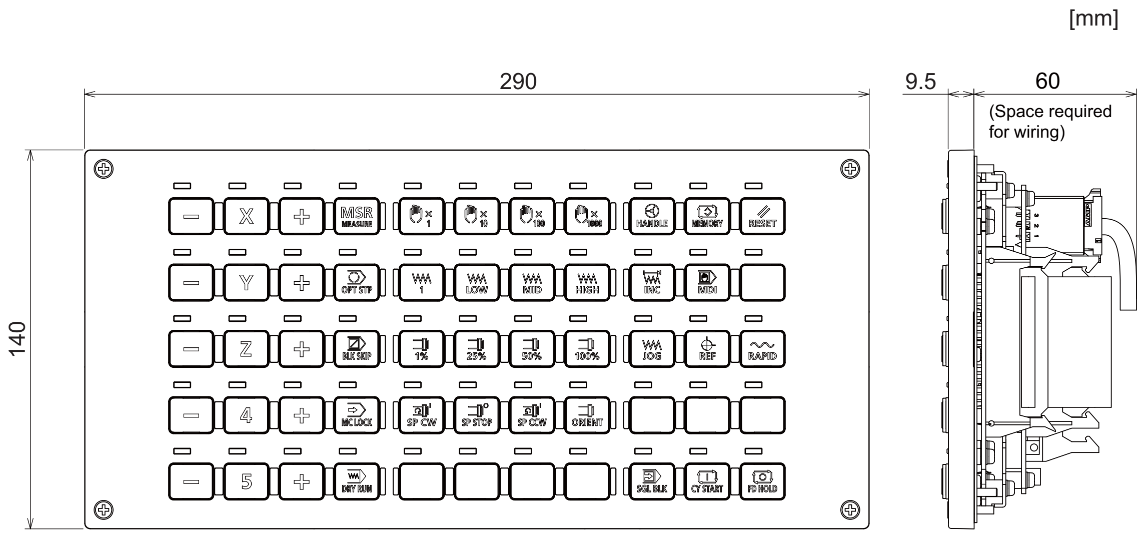
# 4.11 MITSUBISHI CNC Machine Operation Panel

## 4.11.1 Main Panel A/B (FCU8-KB921 / FCU8-KB923)

**[Outline dimension : FCU8-KB921]**

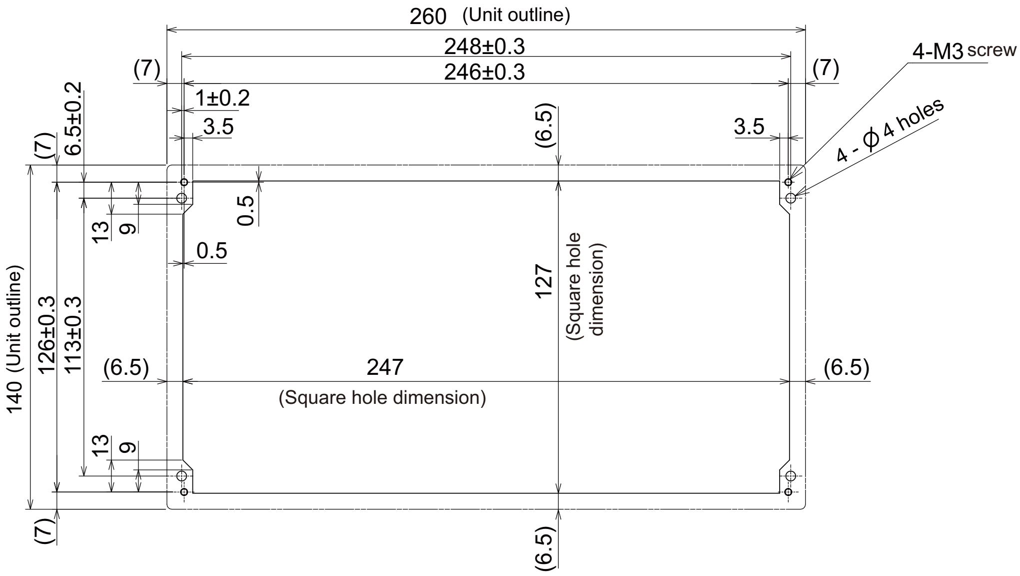



**[Outline dimension : FCU8-KB923]**



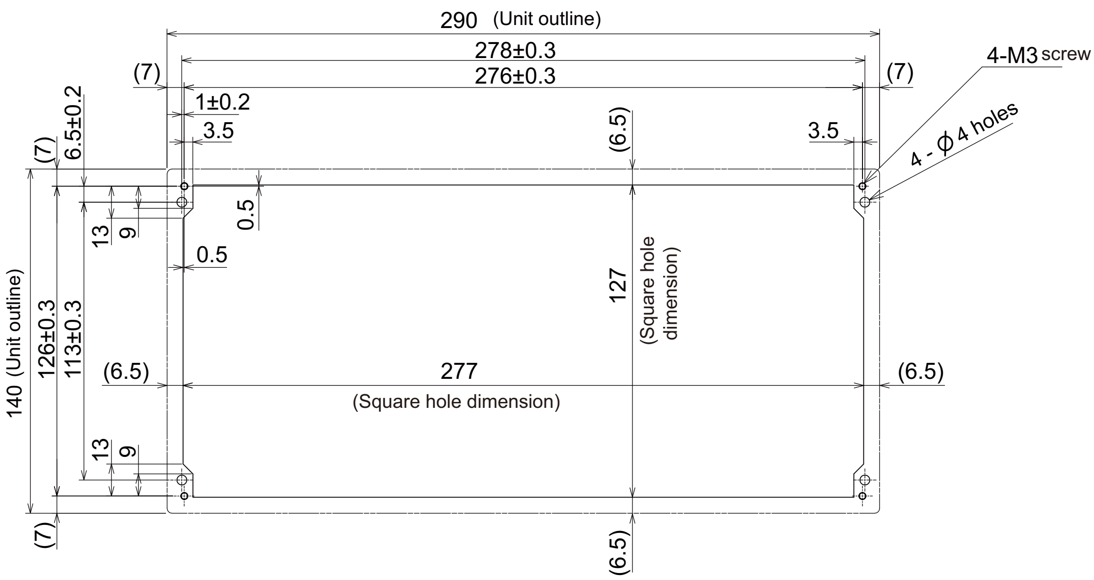
**[Panel cut dimension : FCU8-KB921]**

[mm]




**[Panel cut dimension : FCU8-KB923]**

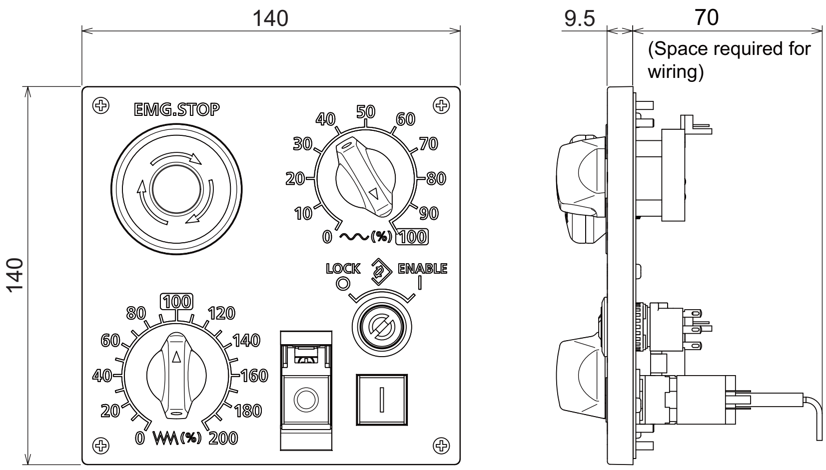
[mm]



## 4.11.2 Sub Panel A (FCU8-KB931)

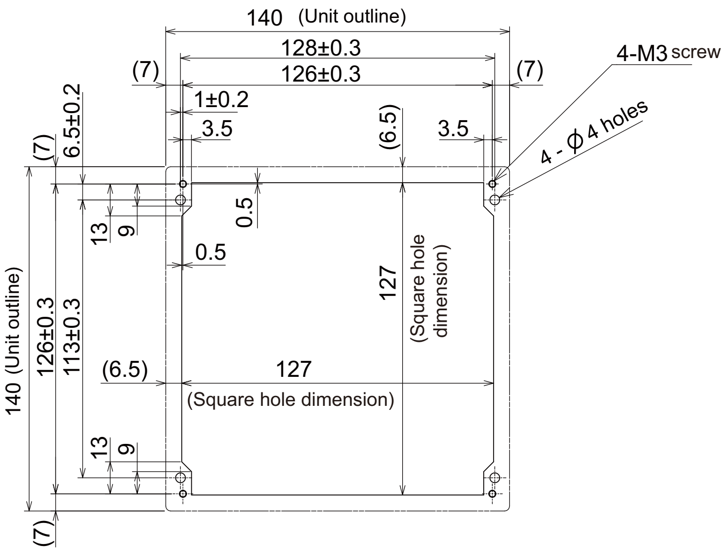
**[Outline dimension]**

[mm]




**[Panel cut dimension]**

[mm]

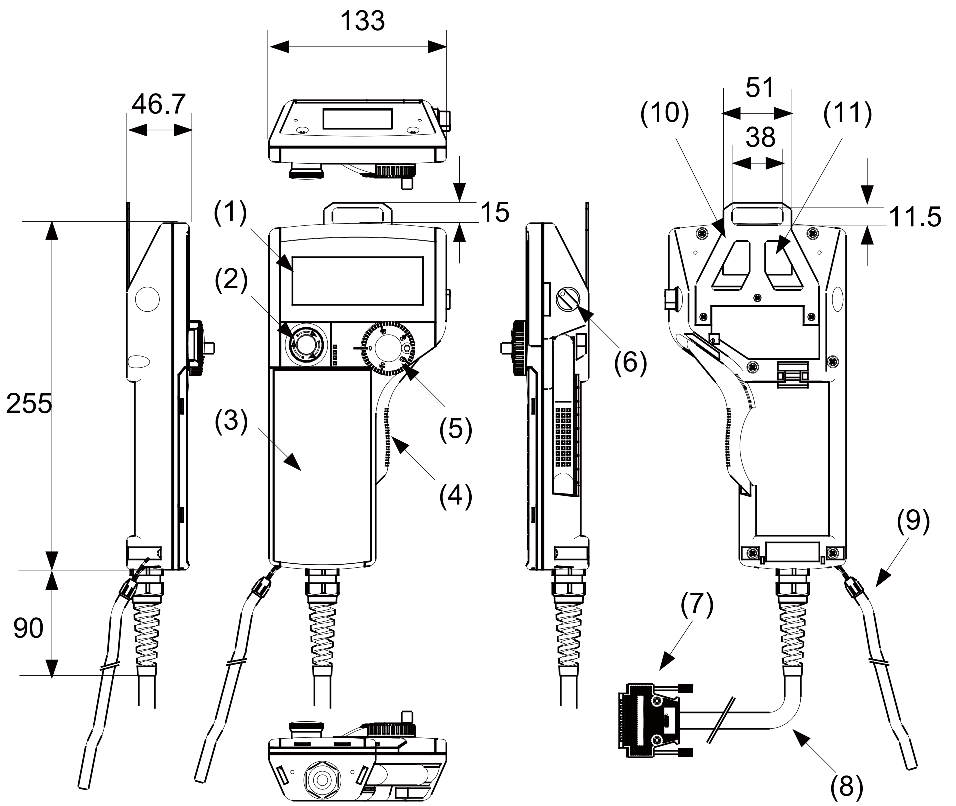


# 4.12 Handy Terminal

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

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

**Dimension and names of parts**



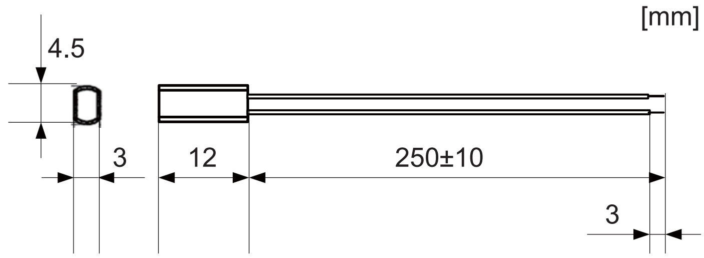

| No. | Name | Function/ Specification | | No. | Name | Function/ Specification |
|---|---|---|---|---|---|---|
| (1) | LCD | Monochrome display with backlight<br>192(W) × 64(H) dots | | (7) | HOST | Host interface connector<br>(DDK: 17JE-23250-02(D8A6)) |
| (2) | SW1 | Emergency stop switch<br>Contact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

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

# 4.13 Thermistor

## 4.13.1 Thermistor(PT3C-51F-M2)

**[Outline dimension]**




Made by SHIBAURA ELECTRONICS Co., Ltd.

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

# 4.14 Exclusive SD Cards for MITSUBISHI CNC

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

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

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

# 4.15 Specifications and Precautions of USB/SD/LAN Interface

## 4.15.1 USB Interface (Memory I/F card)

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

(Note 1) Data transfer speed is the theoretical value on the standard, and the actual speed will be inferior to the value listed above. The transfer speed may be restrained depending on the specification of the connected device.
(Note 2) Do not connect the devices other than the USB memory.

**(1) Precautions for insertion/removal of USB memory**

When inserting/removing an USB memory, turn the MITUBISHI device's power OFF. Do not pull out the USB memory or turn OFF the power during access to the USB memory. Failure to observe this could cause the memory contents to be erased.
When Inserting/removing a USB memory, be sure to have enough interval to perform that (about 10 seconds or more).
In case of emergency, always perform backups by having your important data duplicate, etc. as MITUBISHI will not guarantee the broken or lost data.

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

A USB memory to be used has to be supported USB2.0 Hi-Speed (480Mbps).
When connecting the USB memory, connect it directly without using the extension cable or USB hub.
Machine vibration may cause the USB memory to fall out depending on environment. Therefore, the operation with the front-side USB memory is required to be performed on your own responsibility.

## 4.15.2 SD Interface (Memory I/F card)

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

(Note) SDXC is not supported.

**(1) Precautions for use of commercially available SD card**

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

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

**(2) Precautions for insertion/removal of SD card**

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

## 4.15.3 LAN Interface (Control Unit)

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

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

(Note 2) When using half-duplex communication, the response time may become long depending on the connected device.
Use full-duplex communication to connect with the opposite device via a switching HUB.

**(1) Precautions for selection of LAN cable**

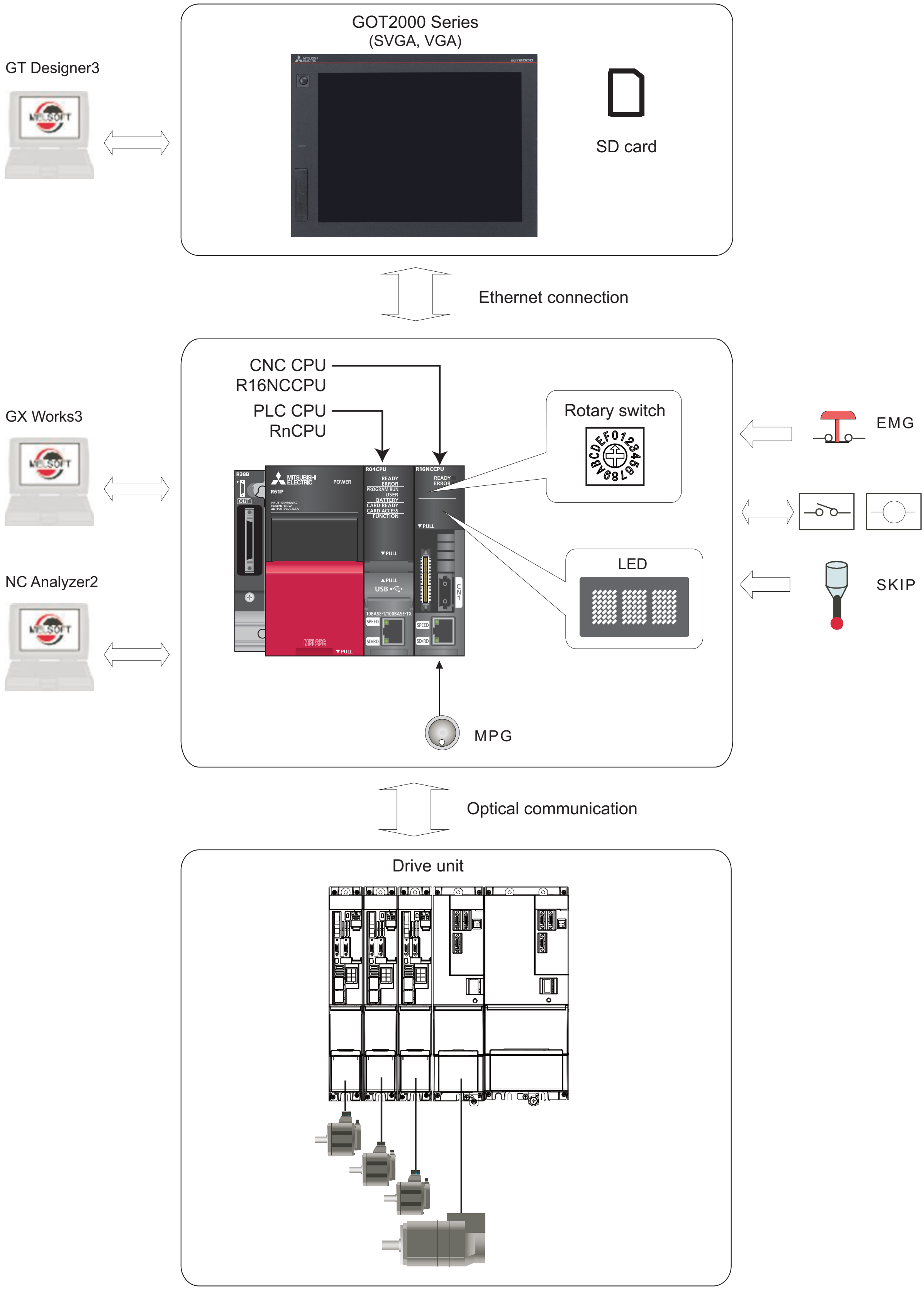
Make sure to select the LAN cables which are "category 5e or above" and "shielded". Cable wire material with double shielded, which is appropriate for FA environment., is recommended.

# C80 Series
# General Specifications

# 1

# System Basic Configuration (C80 Series)

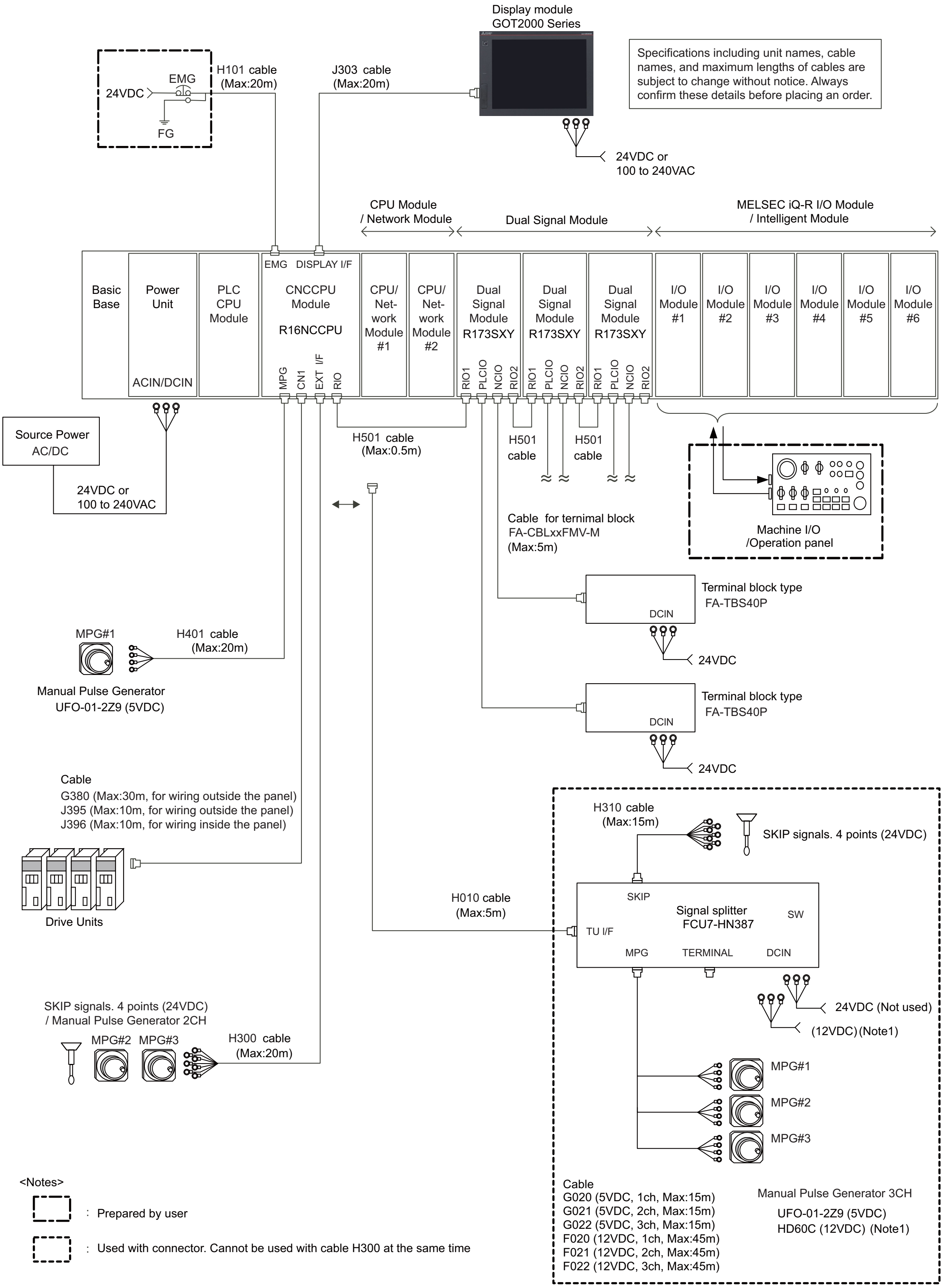
# 1.1 System Basic Configuration Drawing




(Note) The supported versions of the GT Designer3 are as follows:
SVGA: Version 1.155M or later
VGA: Version 1.165X or later
GX Works3 Version 1.025B or later is required.

# 2

# General Connection Diagram (C80 Series)




(Note 1) HD60C (12VDC) requires another power source12VDC.

(Note 2) A CPU module can be mounted on the CPU slot of the base unit or the slot No. 0 to 6. A slot between CPU modules can be left empty for reservation. Note that you cannot mount an I/O module or intelligent function module on a slot between CPU modules.

# 3

# List of Configuration (C80 Series)

# 3.1 CNC Control Unit

### (1) Basic base

| Model name | Remarks | Reference |
|---|---|---|
| R35B | 5 slots: for mounting MELSEC iQ-R series module | MELSEC iQ-R Module Configuration Manual (SH(NA)-081262) |
| R38B | 8 slots: for mounting MELSEC iQ-R series module | |
| R312B | 12 slots: for mounting MELSEC iQ-R series module | |

### (2) Power supply

| Model name | Remarks | Reference |
|---|---|---|
| R61P | AC power supply module input: AC100 to 240V, output: DC5V/6.5A | MELSEC iQ-R Module Configuration Manual (SH(NA)-081262) |
| R62P | AC power supply module input: AC100 to 240V, output: DC5V/3.5A, DC24V/0.6A | |
| R63P | DC power supply module input: DC24V, output: DC5V/6.5A | |
| R64P | AC power supply module input: AC100 to 240V, output: DC5V/9A | |

### (3) PLC CPU

| Model name | Remarks | Reference |
|---|---|---|
| R04CPU | Program capacity: 40k steps, Elementary operation processing speed (LD command): 0.98ns | MELSEC iQ-R CPU Module User's Manual (Startup) (SH(NA)-081263)<br>MELSEC iQ-R CPU Module User's Manual (Application) (SH(NA)-081264) |
| R08CPU | Program capacity: 80k steps, Elementary operation processing speed (LD command): 0.98ns | |
| R16CPU | Program capacity: 160k steps, Elementary operation processing speed (LD command): 0.98ns | |
| R32CPU | Program capacity: 320k steps, Elementary operation processing speed (LD command): 0.98ns | |
| R120CPU | Program capacity: 1200k steps, Elementary operation processing speed (LD command): 0.98ns | |

### (4) CNC CPU module

| Model name | Remarks |
|---|---|
| R16NCCPU | CNC CPU module |

### (5) Input module

#### (a) AC

| Model name | Remarks | Reference |
|---|---|---|
| RX10 | AC input: 16 points, AC100 to 120V (50/60Hz) | MELSEC iQ-R I/O Module User's Manual (SH(NA)-081247) |

#### (b) DC (positive/negative common type)

| Model name | Remarks | Reference |
|---|---|---|
| RX40C7 | DC input: 16 points, DC24V, 7.0mA | MELSEC iQ-R I/O Module User's Manual (SH(NA)-081247) |
| RX41C4 | DC input: 32 points, DC24V, 4.0mA | |
| RX42C4 | DC input: 64 points, DC24V, 4.0mA | |

### (6) Analog input module

#### (a) Voltage input module

| Model name | Remarks | Reference |
|---|---|---|
| R60ADV8 | Voltage input module: 8CH<br>DC-10 to 10V/-32000 to 32000 80µs/CH | MELSEC iQ-R Analog-Digital Converter Module User's Manual (Startup) (SH(NA)-081232)<br>MELSEC iQ-R Analog-Digital Converter Module User's Manual (Application) (SH(NA)-081233) |

#### (b) Current input module

| Model name | Remarks | Reference |
|---|---|---|
| R60ADI8 | Current input module: 8CH<br>DC0 to 20mA/0 to 32000 80µs/CH | MELSEC iQ-R Analog-Digital Converter Module User's Manual (Startup) (SH(NA)-081232)<br>MELSEC iQ-R Analog-Digital Converter Module User's Manual (Application) (SH(NA)-081233) |

#### (c) Voltage/current input module

| Model name | Remarks | Reference |
|---|---|---|
| R60AD4 | Voltage/current input module: 4CH<br>DC-10 to 10V/-32000 to 32000、DC0 to 20mA/0 to 32000 80µs/CH | MELSEC iQ-R Analog-Digital Converter Module User's Manual (Startup) (SH(NA)-081232)<br>MELSEC iQ-R Analog-Digital Converter Module User's Manual (Application) (SH(NA)-081233) |

### (7) Output module

#### (a) Relay

| Model name | Remarks | Reference |
|---|---|---|
| RY10R2 | Relay output: 16 points, DC24V/2A, AC240V/2A | MELSEC iQ-R I/O Module User's Manual (SH(NA)-081247) |

#### (b) Transistor (sink type)

| Model name | Remarks | Reference |
|---|---|---|
| RY40NT5P | Transistor (sink type) output: 16 points, DC12 to 24V, 0.5A | MELSEC iQ-R I/O Module User's Manual (SH(NA)-081247) |
| RY41NT2P | Transistor (sink type) output: 32 points, DC12 to 24V, 0.2A | |
| RY42NT2P | Transistor (sink type) output: 64 points, DC12 to 24V, 0.2A | |
| RY40NT5P | Transistor (sink type) output: 16 points, DC12 to 24V, 0.5A | |

#### (c) Transistor (independent)

| Model name | Remarks | Reference |
|---|---|---|
| RY40PT5P | Transistor (source type) output: 16 points, DC12 to 24V, 0.5A | MELSEC iQ-R I/O Module User's Manual (SH(NA)-081247) |
| RY41PT1P | Transistor (source type) output: 32 points, DC12 to 24V, 0.1A | |
| RY42PT1P | Transistor (source type) output: 64 points, DC12 to 24V, 0.1A | |

### (8) Analog output module

#### Voltage output module

| Model name | Remarks | Reference |
|---|---|---|
| R60DAV8 | Voltage output module: 8CH<br>-32000 to 32000/DC-10 to 10V 80μs/CH | MELSEC iQ-R Digital-Analog Converter Module User's Manual (Startup) (SH(NA)-081235)<br>MELSEC iQ-R Digital-Analog Converter Module User's Manual (Application) (SH(NA)-081237) |

#### (b) Current output module

| Model name | Remarks | Reference |
|---|---|---|
| R60DAI8 | Current input module: 8CH<br>0 to 32000/DC0 to 20mA 80μs/CH | MELSEC iQ-R Digital-Analog Converter Module User's Manual (Startup) (SH(NA)-081235)<br>MELSEC iQ-R Digital-Analog Converter Module User's Manual (Application) (SH(NA)-081237) |

#### (c) Voltage/current output module

| Model name | Remarks | Reference |
|---|---|---|
| R60DA4 | Voltage/current input module: 4CH<br>DC-10 to 10V/-32000 to 32000、DC0 to 20mA/0 to 32000 80μs/CH | MELSEC iQ-R Digital-Analog Converter Module User's Manual (Startup) (SH(NA)-081235)<br>MELSEC iQ-R Digital-Analog Converter Module User's Manual (Application) (SH(NA)-081237) |

## (9) Temperature adjustment

### (a) Thermocouple

| Model name | Remarks | Reference |
|---|---|---|
| R60TCTRT2TT2<br>(R60TCTT4) | 4 channels<br>Thermocouple (K,J,T,B,S,E,R,N,U,L,PL Ⅱ,W5Re/W26Re)<br>Platinum RTD (Pt100,JPt100)<br>Without heater disconnection detection<br>Sampling period: 250ms/4channels, 500ms/4channels<br>18-point terminal block<br>Channels are isolated<br>Heating and cooling control | Temperature Control Module User's Manual (Startup) (SH(NA)-081535)<br>Temperature Control Module User's Manual (Application) (SH(NA)-081536) |
| R60TCTRT2TT2BW<br>(R60TCTT4BW) | 4 channels<br>Thermocouple (K,J,T,B,S,E,R,N,U,L,PL Ⅱ,W5Re/W26Re)<br>Platinum RTD (Pt100,JPt100)<br>With heater disconnection detection<br>Sampling period: 250ms/4channels, 500ms/4channels<br>2 units of 18-point terminal block<br>Channels are isolated<br>Heating and cooling control | |

### (b) Platinum RTD

| Model name | Remarks | Reference |
|---|---|---|
| R60TCRT4 | 4 channels<br>Platinum RTD (Pt100,JPt100)<br>Without heater disconnection detection<br>Sampling period: 250ms/4channels, 500ms/4channels<br>18-point terminal block<br>Channels are isolated<br>Heating and cooling control | Temperature Control Module User's Manual (Startup) (SH(NA)-081535)<br>Temperature Control Module User's Manual (Application) (SH(NA)-081536) |
| R60TCRT4BW | 4 channels<br>Platinum RTD (Pt100,JPt100)<br>With heater disconnection detection<br>Sampling period: 250ms/4channels, 500ms/4channels<br>2 units of 18-point terminal block<br>Channels are isolated<br>Heating and cooling control | |

### (10) High-speed counter module

| Model name | Remarks | Reference |
|---|---|---|
| RD62P2 | DC5/12/24V, input: 2CH<br>Maximum counting speed: 200kpulse/s<br>External output: transistor (sink type) | MELSEC iQ-R High-Speed Counter Module User's Manual (Startup) (SH(NA)-081239)<br>MELSEC iQ-R High-Speed Counter Module User's Manual (Application) (SH(NA)-081241) |
| RD62D2 | Differential-input: 2CH<br>Maximum counting speed: 8Mpulse/s<br>External output: transistor (sink type) | |
| RD62P2E | DC5/12/24V, input: 2CH<br>Maximum counting speed: 200kpulse/s<br>External output: transistor (source type) | |

### (11) Ethernet

| Model name | Remarks | Reference |
|---|---|---|
| RJ71EN71 | 1Gbps/100Mbps/10Mbps: 2 ports<br>Multi-network supported<br>(Ethernet/CC-Link IE Field Network, CC-Link IE Controller Network (twisted pair cable)) | MELSEC iQ-R Ethernet/CC-Link IE User's Manual (Startup) (SH(NA)-081256)<br>MELSEC iQ-R Ethernet User's Manual (Application) (SH(NA)-081257)<br>MELSEC iQ-R CC-Link IE Controller Network User's Manual (Application) (SH(NA)-081258)<br>MELSEC iQ-R CC-Link IE Field Network User's Manual (Application) (SH(NA)-081259) |

### (12) Serial communication

| Model name | Remarks | Reference |
|---|---|---|
| RJ71C24 | Max. 230.4kbps RS-232:1CH、RS-422/485:1CH | MELSEC iQ-R Serial Communication Module User's Manual (Startup) (SH(NA)-081250)<br>MELSEC iQ-R Serial Communication Module User's Manual (Application) (SH(NA)-081251) |
| RJ71C24-R2 | Max. 230.4kbps RS-232:2CH | |
| RJ71C24-R4 | Max. 230.4kbps RS-422/485:2CH | |

### (13) MES interface module

| Model name | Remarks | Reference |
|---|---|---|
| RD81MES96 | 1000BASE-T/100BASE-TX/10BASE-T<br>Database dynamic link (MX ME Interface-R is separately required.) | MELSEC iQ-R MES Interface Module User's Manual (Startup) (SH(NA)-081422)<br>MELSEC iQ-R MES Interface Module User's Manual (Application) (SH(NA)-081423) |

### (14) CC-Link

| Model name | Remarks | Reference |
|---|---|---|
| RJ61BT11 | Max. 10Mbps master/local station CC-Link Ver.2 supported | MELSEC iQ-R CC-Link System Master/Local Module User's Manual (Startup) (SH(NA)-081269)<br>MELSEC iQ-R CC-Link System Master/Local Module User's Manual (Application) (SH(NA)-081270) |

### (15) CC-Link IE controller network

| Model name | Remarks | Reference |
|---|---|---|
| RJ71GP21-SX | 1Gbps optical fiber cable control/normal station | MELSEC iQ-R Ethernet/CC-Link IE User's Manual (Startup) (SH(NA)-081256)<br>MELSEC iQ-R CC-Link IE Controller Network User's Manual (Application) (SH(NA)-081258) |

### (16) CC-Link IE Field Network

| Model name | Remarks | Reference |
|---|---|---|
| RJ71GF11-T2 | 1Gbps master/local station | MELSEC iQ-R Ethernet/CC-Link IE User's Manual (Startup) (SH(NA)-081256)<br>MELSEC iQ-R CC-Link IE Field Network User's Manual (Application) (SH(NA)-081259) |

### (17) Extension base

| Model name | Remarks | Reference |
|---|---|---|
| R65B | 5 slots: for mounting MELSEC iQ-R series module | MELSEC iQ-R Module Configuration Manual (SH(NA)-081262) |
| R68B | 8 slots: for mounting MELSEC iQ-R series module | |
| R612B | 12 slots: for mounting MELSEC iQ-R series module | |

### (18) RQ extension base

| Model name | Remarks | Reference |
|---|---|---|
| RQ65B | 5 slots: for mounting MELSEC Q series module | MELSEC iQ-R Module Configuration Manual (SH(NA)-081262) |
| RQ68B | 8 slots: for mounting MELSEC Q series module | |
| RQ612B | 12 slots: for mounting MELSEC Q series module | |

### (19) Spring clamp terminal block

| Model name | Remarks | Reference |
|---|---|---|
| Q6TE-18SN | For 16 points I/O modules, 0.3 to 1.5mm$^2$ (AWG22 to 16) | I/O Module Type Building Block User's Manual (SH(NA)-080042) |

### (20) Connector/terminal block converter module

| Model name | Remarks | Reference |
|---|---|---|
| A6TBX70 | For positive common type input modules (3-wire type) | I/O Module Type Building Block User's Manual (SH(NA)-080042) |
| A6TBXY36 | For positive common type input modules and sink type output modules (standard type) | |
| A6TBXY54 | For positive common type input modules and sink type output modules (2-wire type) | |

### (21) Cable

#### (a) Cables for CNC CPU

| Cable type | Application | Max. length | Standard cable length (m) | Remarks |
|---|---|---|---|---|
| F020 | Manual pulse generator: 1ch | 45m | 0.5, 1, 2, 3, 5, 7, 10, 15, 20 | 12V power supply type can be used.<br>For Signal splitter |
| F021 | Manual pulse generator: 2ch | 45m | 0.5, 1, 2, 3, 5, 7, 10, 15, 20 | |
| F022 | Manual pulse generator: 3ch | 45m | 0.5, 1, 2, 3, 5, 7, 10, 15, 20 | |
| G020 | Manual pulse generator: 1ch | 15m | 0.5, 1, 2, 3, 5, 7, 10, 15 | 5V power supply type can be used.<br>For Signal splitter |
| G021 | Manual pulse generator: 2ch | 15m | 0.5, 1, 2, 3, 5, 7, 10, 15 | |
| G022 | Manual pulse generator: 3ch | 15m | 0.5, 1, 2, 3, 5, 7, 10, 15 | |
| H010 | Signal splitter connection | 5m | 0.5, 1, 2, 3, 5 | |
| H101 | Emergency stop | 20m | 0.5, 1, 2, 3, 5, 7, 10, 15, 20 | |
| H300 | SKIP/manual pulse generator input | 20m | 0.5, 1, 2, 3, 5, 7, 10, 15, 20 | |
| H310 | SKIP connection | 15m | 0.5, 1, 2, 3, 5, 7, 10, 15 | For Signal splitter |
| H401 | Manual pulse generator: 1ch for 5V | 20m | 0.5, 1, 2, 3, 5, 7, 10, 15, 20 | |
| H501 | Dual-signal module communication | 0.5m | 0.1, 0.2, 0.3, 0.5 | |
| J303 | Display module communication (Straight) | 20m | 1, 2, 3, 5, 7, 10, 15, 20 | |

(Note) The Standard cable length column shows the lengths of the cable available from MITSUBISHI.

#### (b) Cable for connector and terminal block changeover unit

| Model name | Remarks | Reference |
|---|---|---|
| AC05TB | For A6TBXY36/A6TBXY54/A6TBX70 (positive common/sink type modules) 0.5m | I/O Module Type Building Block User's Manual (SH(NA)-080042) |
| AC10TB | For A6TBXY36/A6TBXY54/A6TBX70 (positive common/sink type modules) 1m | |
| AC20TB | For A6TBXY36/A6TBXY54/A6TBX70 (positive common/sink type modules) 2m | |
| AC30TB | For A6TBXY36/A6TBXY54/A6TBX70 (positive common/sink type modules) 3m | |
| AC50TB | For A6TBXY36/A6TBXY54/A6TBX70 (positive common/sink type modules) 5m | |
| AC80TB | For A6TBXY36/A6TBXY54/A6TBX70 (positive common/sink type modules) 8m (Common current not exceeding 0.5A) | |
| AC100TB | For A6TBXY36/A6TBXY54/A6TBX70 (positive common/sink type modules) 10m (Common current not exceeding 0.5A) | |

### (c) Cable for drive unit

| Cable type | Application | Max. length | Standard cable length (m) |
|---|---|---|---|
| CNP2E-1-xM | Motor side PLG cable<br>Spindle side accuracy detector<br>TS5690 cable | 30m | 2, 3, 4, 5, 7, 10, 15, 20, 25, 30 |
| CNP3EZ-2P-xM | Spindle side detector cable<br>OSE-1024 cable | 30m | 2, 3, 4, 5, 7, 10, 15, 20, 25, 30 |
| CNP3EZ-3P-xM | Spindle side detector cable<br>OSE-1024 cable | 30m | 2, 3, 4, 5, 7, 10, 15, 20, 25, 30 |
| CNV2E-8P-xM | Motor side detector cable for HG/HG-H, HQ/HQ-H (For D48/D51/D74) | 30m | 2, 3, 4, 5, 7, 10, 15, 20, 25, 30 |
| CNV2E-9P-xM | Motor side detector cable for HG/HG-H, HQ/HQ-H (For D48/D51/D74) | 30m | 2, 3, 4, 5, 7, 10, 15, 20, 25, 30 |
| CNV2E-D-xM | MDS-B-SD unit cable | 30m | 2, 3, 4, 5, 7, 10, 15, 20, 25, 30 |
| CNV2E-HP-xM | MDS-B-HR unit cable | 30m | 2, 3, 4, 5, 7, 10, 15, 20, 25, 30 |
| CNV2E-MB-xM | Cable for MBE405W/MBA405W | 20m | 2, 3, 4, 5, 7, 10, 15, 20 |
| DG30-xM | Battery cable<br>(drive unit - battery box, drive unit - drive unit) | 10m | 0.3, 0.5, 1, 2, 3, 5, 7, 10 |
| G380 LxM | Optical communication cable<br>for wiring between drive units (outside panel) | 30m | 5, 10, 12, 15, 20, 25, 30 |
| J395 LxM | Optical communication cable<br>for wiring between drive units (outside panel)<br>for wiring between NC-drive units | 10m | 3, 5, 7, 10 |
| J396 LxM | Optical communication cable<br>for wiring between drive units (inside panel) | 10m | 0.2, 0.3, 0.5, 1, 2, 3, 5 |
| MR-BKS1CBLxMA1-H | <200V Series><br>Brake cable for HG96<br>Lead out in direction of motor shaft | 10m | 2, 3, 5, 7, 10 |
| MR-BKS1CBLxMA2-H | <200V Series><br>Brake cable for HG96<br>Lead out in opposite direction of motor shaft | 10m | 2, 3, 5, 7, 10 |
| MR-BT6V2CBL LxM | Battery cable (MDS-EJ/EJH)<br>(drive unit - drive unit) | 1m | 0.3, 1 |
| MR-D05UDL3M-B | STO cable | 3m | 3 |
| MR-PWS1CBLxMA1-H | <200V Series><br>Power cable for HG96<br>Lead out in direction of motor shaft | 10m | 2, 3, 5, 7, 10 |
| MR-PWS1CBLxMA2-H | <200V Series><br>Power cable for HG96<br>(Note) It can not be used with HF-KP13.<br>Lead out in opposite direction of motor shaft | 10m | 2, 3, 5, 7, 10 |
| SH21 LxM | Power supply communication cable<br>Power backup unit communication cable | 30m | 0.35, 0.5, 1, 2, 3 |

(Note 1) The Standard cable length column shows the lengths of the cable available from MITSUBISHI.

(Note 2) "x" in type columns indicate cable length (unit: m).

### (22) Relay terminal unit

#### (a) Unit

| Model name | Remarks | Reference |
|---|---|---|
| A6TE2-16SRN | 40 pin connector For 24VDC Transistor output unit (sink type module) | Relay Terminal Module User's Manual (Hardware) A6TE2-16SRN (IB(NA)-66833) |

#### (b) Cable

| Model name | Remarks | Reference |
|---|---|---|
| AC06TE | For A6TE2-16SRN 0.6m<br>For 32 points (1 connector), one of this cable and two units of the relay terminal unit are used | Relay Terminal Module User's Manual (Hardware) A6TE2-16SRN (IB(NA)-66833) |
| AC10TE | For A6TE2-16SRN 1m<br>For 32 points (1 connector), one of this cable and two units of the relay terminal unit are used | |
| AC30TE | For A6TE2-16SRN 3m<br>For 32 points (1 connector), one of this cable and two units of the relay terminal unit are used | |
| AC50TE | For A6TE2-16SRN 5m<br>For 32 points (1 connector), one of this cable and two units of the relay terminal unit are used | |
| AC100TE | For A6TE2-16SRN 10m<br>For 32 points (1 connector), one of this cable and two units of the relay terminal unit are used | |

### (23) Extension cable

| Model name | Remarks | Reference |
|---|---|---|
| RC06B | 0.6m cable for connecting the extension base/the RQ extension base with the basic base | MELSEC iQ-R Module Configuration Manual (SH(NA)-081262) |
| RC12B | 1.2m cable for connecting the extension base/the RQ extension base with the basic base | |
| RC30B | 3m cable for connecting the extension base/the RQ extension base with the basic base | |
| RC50B | 5m cable for connecting the extension base/the RQ extension base with the basic base | |

### (24) Connector

| Model name | Remarks | Reference |
|---|---|---|
| A6CON1 | Soldering type 32 point-connector (40-pin connector) | I/O Module Type Building Block User's Manual (SH(NA)-080042) |
| A6CON2 | Crimp-contact type 32 point-connector (40-pin connector) | |
| A6CON3 | Flat cable pressure displacement type 32-point connector (40-pin connector) | |
| A6CON4 | Soldering type 32 point-connector<br>(40-pin connector; two-way cable can be mounted) | |

### (25) CC-Link Remote I/O unit

#### (a) Thread terminal block type

| Model name | Remarks | Reference |
|---|---|---|
| AJ65SBTB1-32D | Input 32 points: 24VDC (positive/negative common shared type), 1- wire, terminal block type, response time: 1.5 ms | CC-Link System Compact Type Remote I/O Module User's Manual (SH(NA)-4007) |
| AJ65SBTB1-32TE1 | Output 32 points: 12/24VDC (0.5A), transistor output (source type), 1-wire, terminal block type | |

#### (b) Waterproof connector type

| Model name | Remarks | Reference |
|---|---|---|
| AJ65FBTA4-16DE | Input 16 points: 24VDC (negative common), 4-wire, super-slim waterproof type, response time: 1.5 ms | CC-Link System Compact Type Remote I/O Module User's Manual (SH(NA)-4007) |
| AJ65FBTA2-16TE | Output 16 points: 12/24VDC (1.0A), transistor output (source type), 2-wire, super-slim waterproof type | |

### (26) I/O mixed unit

#### (a) DC input/transistor output

| Model name | Remarks | Reference |
|---|---|---|
| RH42C4NT2P | DC input: 32 points, DC24V, 4.0mA<br>Transistor (sink type) output: 32 points, DC12 to 24V, 0.2A | MELSEC iQ-R I/O Module User's Manual (SH(NA)-081247) |

### (27) SD memory card

| Model name | Remarks | Reference |
|---|---|---|
| NZ1MEM-2GBSD | 2G byte | MELSEC iQ-R Module Configuration Manual (SH(NA)-081262) |

### (28) Extended SRAM cassette

| Model name | Remarks | Reference |
|---|---|---|
| NZ2MC-1MBS | 1M byte | MELSEC iQ-R Module Configuration Manual (SH(NA)-081262) |

# 3.2 GOT

## 3.2.1 GT27

### (1) GOT

#### (a) GT2712

| Model name | Remarks | Reference |
|---|---|---|
| GT2712-STBA | 12.1-type SVGA [800×600 dots] TFT color liquid crystal display, 65536 colors<br><Multimedia and video/RGB and multi-touch supported><br>100-240VAC, user memory, storage memory (ROM):57MB, operation memory (RAM): 128MB<br>・Requiring GT Designer3 Version1 (GOT2000) 1.155M or later. | GT27 General Description<br>(IB(NA)-0800502) |
| GT2712-STBD | 12.1-type SVGA [800×600 dots] TFT color liquid crystal display, 65536 colors<br><Multimedia and video/RGB and multi-touch supported><br>24VDC, user memory, storage memory (ROM): 57MB, operation memory (RAM): 128MB<br>・Requiring GT Designer3 Version1 (GOT2000) 1.155M or later. | |

#### (b) GT2710

| Model name | Remarks | Reference |
|---|---|---|
| GT2710-STBA | 10.4-type SVGA [800×600 dots] TFT color liquid crystal display, 65536 colors<br><Multimedia and video/RGB and multi-touch supported><br>100-240VAC, user memory, storage memory (ROM):57MB, operation memory (RAM): 128MB<br>・Requiring GT Designer3 Version1 (GOT2000) 1.155M or later. | GT27 General Description<br>(IB(NA)-0800502) |
| GT2710-STBD | 10.4-type SVGA [800×600 dots] TFT color liquid crystal display, 65536 colors<br><Multimedia and video/RGB and multi-touch supported><br>24VDC, user memory, storage memory (ROM): 57MB, operation memory (RAM): 128MB<br>・Requiring GT Designer3 Version1 (GOT2000) 1.155M or later. | |
| GT2710-VTBA | 10.4-type VGA ［640×480 dots] TFT color liquid crystal display, 65536 colors<br><Multimedia and video/RGB and multi-touch supported><br>100-240VAC, user memory, storage memory (ROM):57MB, operation memory (RAM): 128MB<br>・Requiring GT Designer3 Version1 (GOT2000) 1.165X or later. | GT27 General Description<br>(IB(NA)-0800502) |
| GT2710-VTBD | 10.4-type VGA ［640×480 dots] TFT color liquid crystal display, 65536 colors<br><Multimedia and video/RGB and multi-touch supported><br>24VDC, user memory, storage memory (ROM): 57MB, operation memory (RAM): 128MB<br>・Requiring GT Designer3 Version1 (GOT2000) 1.165X or later. | |

### (c) GT2708

| Model name | Remarks | Reference |
|---|---|---|
| GT2708-STBA | 8.4-type SVGA [800×600 dots] TFT color liquid crystal display, 65536 colors<br><Multimedia and video/RGB and multi-touch supported><br>100-240VAC, user memory, storage memory (ROM): 57MB, operation memory (RAM): 128MB<br>・Requiring GT Designer3 Version1 (GOT2000) 1.155M or later. | GT27 General Description (IB(NA)-0800502) |
| GT2708-STBD | 8.4-type SVGA [800×600 dots] TFT color liquid crystal display, 65536 colors<br><Multimedia and video/RGB and multi-touch supported><br>24VDC, user memory, storage memory (ROM): 57MB, operation memory (RAM): 128MB<br>・Requiring GT Designer3 Version1 (GOT2000) 1.155M or later. | |
| GT2708-VTBA | 8.4-type VGA ［640×480 dots] TFT color liquid crystal display, 65536 colors<br><Multimedia and video/RGB and multi-touch supported><br>100-240VAC, user memory, storage memory (ROM): 57MB, operation memory (RAM): 128MB<br>・Requiring GT Designer3 Version1 (GOT2000) 1.165X or later. | GT27 General Description (IB(NA)-0800502) |
| GT2708-VTBD | 8.4-type VGA ［640×480 dots] TFT color liquid crystal display, 65536 colors<br><Multimedia and video/RGB and multi-touch supported><br>24VDC, user memory, storage memory (ROM): 57MB, operation memory (RAM): 128MB<br>・Requiring GT Designer3 Version1 (GOT2000) 1.165X or later. | |

### (d) GT2705

| Model name | Remarks | Reference |
|---|---|---|
| GT2705-VTBD | 5.7-type VGA ［640×480 dots] TFT color liquid crystal display, 65536 colors<br><Multi-touch supported><br>24VDC, user memory, storage memory (ROM): 32MB, operation memory (RAM): 80MB<br>・Requiring GT Designer3 Version1 (GOT2000) 1.165X or later. | GT27 General Description (IB(NA)-0800502) |

## (2) SD card

| Model name | Remarks | Reference |
|---|---|---|
| NZ1MEM-2GBSD | 2GB SD memory card for GOT | MELSEC iQ-R Module Configuration Manual (SH(NA)-081262) |

## (3) Protection sheet

| Model name | Remarks | Reference |
|---|---|---|
| GT25-12PSCC | Protection sheet for 12.1-type (Clear, 5 sheets)<br>Surface treatment: clear, sheet color: clear, USB environment resistant cover part: with opening, the number of sheets in a set: 5 sheets | GOT2000 Series Protective Sheet for GT27/GT25/GT23 User's Manual (IB(NA)-0800499) |
| GT25-10PSCC | Protection sheet for 10.4-type (Clear, 5 sheets)<br>Surface treatment: clear, sheet color: clear, USB environment resistant cover part: with opening, the number of sheets in a set: 5 sheets | |
| GT25-08PSCC | Protection sheet for 8.4-type (Clear, 5 sheets)<br>Surface treatment: clear, sheet color: clear, USB environment resistant cover part: with opening, the number of sheets in a set: 5 sheets | |
| GT25-05PSCC | Protection sheet for 5.7-type (Clear, 5 sheets)<br>Surface treatment: clear, sheet color: clear, USB environment resistant cover part: with opening, the number of sheets in a set: 5 sheets | |

## 3.2.2 GT25

### (1) GOT

#### (a) GT2512

| Model name | Remarks | Reference |
|---|---|---|
| GT2512-STBA | 12.1-type SVGA [800×600 dots] TFT color liquid crystal display, 65536 colors 100-240VAC, user memory, storage memory (ROM):32MB, operation memory (RAM): 80MB<br>・Requiring GT Designer3 Version1 (GOT2000) 1.155X or later. | GT25 General Description (IB(NA)-0800537) |
| GT2512-STBD | 12.1-type SVGA [800×600 dots] TFT color liquid crystal display, 65536 colors 24VDC, user memory, storage memory (ROM): 32MB, operation memory (RAM): 80MB<br>・Requiring GT Designer3 Version1 (GOT2000) 1.155X or later. | |

#### (b) GT2510

| Model name | Remarks | Reference |
|---|---|---|
| GT2510-VTBA | 10.4-type VGA［640×480 dots] TFT color liquid crystal display, 65536 colors 100-240VAC, user memory, storage memory (ROM):32MB, operation memory (RAM): 80MB<br>・Requiring GT Designer3 Version1 (GOT2000) 1.165X or later. | GT25 General Description (IB(NA)-0800537) |
| GT2510-VTBD | 10.4-type VGA［640×480 dots] TFT color liquid crystal display, 65536 colors 24VDC, user memory, storage memory (ROM): 32MB, operation memory (RAM): 80MB<br>・Requiring GT Designer3 Version1 (GOT2000) 1.165X or later. | |

#### (c) GT2508

| Model name | Remarks | Reference |
|---|---|---|
| GT2508-VTBA | 8.4-type VGA［640×480 dots] TFT color liquid crystal display, 65536 colors 100-240VAC, user memory, storage memory (ROM): 32MB, operation memory (RAM): 80MB<br>・Requiring GT Designer3 Version1 (GOT2000) 1.165X or later. | GT25 General Description (IB(NA)-0800537) |
| GT2508-VTBD | 8.4-type VGA［640×480 dots] TFT color liquid crystal display, 65536 colors 24VDC, user memory, storage memory (ROM): 32MB, operation memory (RAM): 80MB<br>・Requiring GT Designer3 Version1 (GOT2000) 1.165X or later. | |

### (2) SD card

| Model name | Remarks | Reference |
|---|---|---|
| NZ1MEM-2GBSD | 2GB SD memory card for GOT | MELSEC iQ-R Module Configuration Manual (SH(NA)-081262) |

### (3) Protection sheet

| Model name | Remarks | Reference |
|---|---|---|
| GT25-12PSCC | Protection sheet for 12.1-type (Clear, 5 sheets)<br>Surface treatment: clear, sheet color: clear, USB environment resistant cover part: with opening, the number of sheets in a set: 5 sheets | GOT2000 Series Protective Sheet for GT27/GT25/GT23 User's Manual (IB(NA)-0800499) |
| GT25-10PSCC | Protection sheet for 10.4-type (Clear, 5 sheets)<br>Surface treatment: clear, sheet color: clear, USB environment resistant cover part: with opening, the number of sheets in a set: 5 sheets | |
| GT25-08PSCC | Protection sheet for 8.4-type (Clear, 5 sheets)<br>Surface treatment: clear, sheet color: clear, USB environment resistant cover part: with opening, the number of sheets in a set: 5 sheets | |

# 3.3 Peripheral Device

### (1) Signal splitter

| Model name | Remarks |
|---|---|
| FCU7-HN387 | Option (Manual pulse generator is required for 2 or 3 axes specifications) |

### (2) Manual pulse generator

| Model name | Remarks |
|---|---|
| UFO-01-2Z9 | 5V specifications |
| HD60C | 12V specifications, for connection to operation panel I/O module<br>12V power supply is separately required. |

# 3.4 Dual Signal Module

### (1) Dual signal module

| Model name | Remarks |
|---|---|
| R173SXY | I/O duplication monitoring module (Maximum 3 modules) |

### (2) Terminal block

| Model name | Remarks |
|---|---|
| FA-TBS40P | Terminal block converter module (Arrangement : MITSUBISHI ELECTRIC ENGINEERING COMPANY LIMITED)<br>UL supported. |
| FA-LTB40P | Terminal block converter module (Arrangement : MITSUBISHI ELECTRIC ENGINEERING COMPANY LIMITED) |

### (3) Cable

| Model name | Remarks |
|---|---|
| FA-CBL □□ FMV-M | Cable for terminal block converter module (Cable length □□ = 05:0.5m, 10:1m, 20:2m, 30:3m, 50:5m)<br>(Arrangement: MITSUBISHI ELECTRIC ENGINEERING COMPANY LIMITED) |

# 3.5 List of Q Series Units (for RQ extension base unit)

### (1) Extension base

| Model name | Remarks | Reference |
|---|---|---|
| Q63B | 3 slots; for mounting Q series modules including power supply module | QCPU User's Manual (Hardware Design, Maintenance and Inspection) (SH(NA)-080483ENG) |
| Q65B | 5 slots; for mounting Q series modules including power supply module | |
| Q68B | 8 slots; for mounting Q series modules including power supply module | |
| Q612B | 12 slots; for mounting Q series modules including power supply module | |
| Q52B | 2 slots; for mounting Q series modules including power supply module | |
| Q55B | 5 slots; for mounting Q series modules including power supply module | |

### (2) Extension cable

| Model name | Remarks | Reference |
|---|---|---|
| QC05B | 0.45m Cable | QCPU User's Manual (Hardware Design, Maintenance and Inspection) (SH(NA)-080483ENG) |
| QC06B | 0.6m Cable | |
| QC12B | 1.2m Cable | |
| QC30B | 3m Cable | |
| QC50B | 5m Cable | |
| QC100B | 10m Cable | |

### (3) Power supply

| Model name | Remarks | Reference |
|---|---|---|
| Q61P | Input power supply: 100 to 240VAC, output power supply: 5VDC, output current: 6A | QCPU User's Manual (Hardware Design, Maintenance and Inspection) (SH(NA)-080483ENG) |
| Q63P | Input voltage: 24VDC, output voltage: 5VDC, output current: 6A | |
| Q64PN | Input voltage: 100 to 240VAC, output voltage: 5VDC, output current: 8.5A | |

### (4) Output module

#### (a) Transistor (independent)

| Model name | Remarks | Reference |
|---|---|---|
| QY68A | 8 points, 5 to 24VDC<br>OFF-time leakage current: 0.1mA<br>Response time: 10ms, Sink/source type<br>18-point terminal block, Surge killer provided<br>All points isolated | I/O Module Type Building Block User's Manual (SH(NA)-080042) |

### (5) Analog output module

#### (a) Voltage/current output module

| Model name | Remarks | Reference |
|---|---|---|
| Q62DA-FG | 2 channels<br>Input (resolution): 0 to 12000; -12000 to 12000; -16000 to 16000<br>Output: -12 to 12VDC, 0 to 22mADC<br>Conversion speed: 10ms/2channels<br>18-point terminal block, Channels are isolated | Channel Isolated Digital-Analog Converter Module User's Manual (SH(NA)-080281) |

### (6) MELSECNET/H

#### (a) SI/QSI optical interface

| Model name | Remarks | Reference |
|---|---|---|
| QJ71LP21-25 | SI/QSI/H-PCF/Broad-band H-PCF optical cable, Double loop<br>PLC to PLC network (control/normal station)/Remote I/O net (remote master station) | Q Corresponding MELSECNET/H Network System Reference Manual (PLC to PLC network) (SH(NA)-080049)<br>Q Corresponding MELSECNET/H Network System Reference Manual (Remote I/O network) (SH(NA)-080124)<br>For QnA/Q4AR MELSECNET/10 Network System Reference Manual (IB(NA)-66690) |

#### (b) Coaxial interface

| Model name | Remarks | Reference |
|---|---|---|
| QJ71BR11 | 3C-2V/5C-2V coaxial cable, Single bus<br>PLC to PLC network (control/normal station)/<br>Remote I/O net (remote master station) | Q Corresponding MELSECNET/H Network System Reference Manual (PLC to PLC network) (SH(NA)-080049)<br>Q Corresponding MELSECNET/H Network System Reference Manual (Remote I/O network) (SH(NA)-080124)<br>For QnA/Q4AR MELSECNET/10 Network System Reference Manual (IB(NA)-66690) |

### (7) FL-net (OPCN-2)

#### (a) Ver.2.00

| Model name | Remarks | Reference |
|---|---|---|
| QJ71FL71-T-F01 | 10BASE-T/100BASE-TX | FL-net(OPCN-2) Interface Module User’s Manual (SH(NA)-080350E) |

### (8) AS-i

| Model name | Remarks | Reference |
|---|---|---|
| QJ71AS92 | Master station, AS-Interface Specification Version 2.11 supported | AS-i Master Module User's Manual (Hardware) (IB(NA)-0800122E) |

### (9) DeviceNet

| Model name | Remarks | Reference |
|---|---|---|
| QJ71DN91 | | |

# 4

# General Specifications (C80 Series)

For the specifications of GOT, I/O unit, etc. refer to the manuals listed in "List of Configuration".
For the drive unit specifications, refer to the specification manual for the drive unit you are using

# 4.1 Installation Environment Conditions

C80, which is an open equipment, must be installed within a sealed metal control panel (IP54 or higher).
C80 must also be used and stored under the conditions listed in the table of specifications below.

<table>
<tr><th>Item</th><th colspan="6">Specification</th></tr>
<tr><td>Operating ambient temperature</td><td colspan="6">0 to 55 ℃ (-13 to 167°F)</td></tr>
<tr><td>Storage ambient temperature</td><td colspan="6">-25 to 75 ℃ (-13 to 167°F)</td></tr>
<tr><td>Operating ambient humidity</td><td colspan="6">5 to 95%RH non-condensing</td></tr>
<tr><td>Storage ambient humidity</td><td colspan="6">5 to 95%RH non-condensing</td></tr>
<tr><td rowspan="5">Vibration resistance</td><td rowspan="5">Compliant with JIS B 3502 and IEC 61131-2</td><td></td><td>Frequency</td><td>Constant acceleration</td><td>Half amplitude</td><td>Sweep count</td></tr>
<tr><td rowspan="2">Under intermittent vibration</td><td>5 to 8.4Hz</td><td>-</td><td>3.5mm</td><td rowspan="2">10 times each in X, Y, Z directions (For 80 min.)</td></tr>
<tr><td>8.4 to 150Hz</td><td>$9.8m/s^2$</td><td>-</td></tr>
<tr><td rowspan="2">Under continuous vibration</td><td>5 to 8.4Hz</td><td>-</td><td>1.75mm</td><td rowspan="2">-</td></tr>
<tr><td>8.4 to 150Hz</td><td>$4.9m/s^2$</td><td>-</td></tr>
<tr><td>Shock resistance</td><td colspan="6">$147m/s^2$, 3 times in each of 3 directions X, Y, Z</td></tr>
<tr><td>Operating ambience</td><td colspan="6">No corrosive gases nor inflammable gases</td></tr>
<tr><td>Operating altitude</td><td colspan="6">2000m (6561.68ft.) or less (Note 3)</td></tr>
<tr><td>Installation location</td><td colspan="6">Inside control panel</td></tr>
<tr><td>Overvoltage category (Note 1)</td><td colspan="6">II or less</td></tr>
<tr><td>Pollution level (Note 2)</td><td colspan="6">2 or less</td></tr>
</table>

(Note 1) This indicates the section of the power supply to which the equipment is assumed to be connected between the public electrical power distribution network and the machinery within premises.
Category II applies to equipment for which electrical power is supplied from fixed facilities.
The surge withstand voltage for the equipment up to the rated 300V is 2500V.

(Note 2) This index indicates the degree to which conductive material is generated in terms of the environment in which the equipment is used.
Pollution level 2 is when only non-conductive pollution occurs. A temporary conductivity caused by condensing must be expected occasionally.

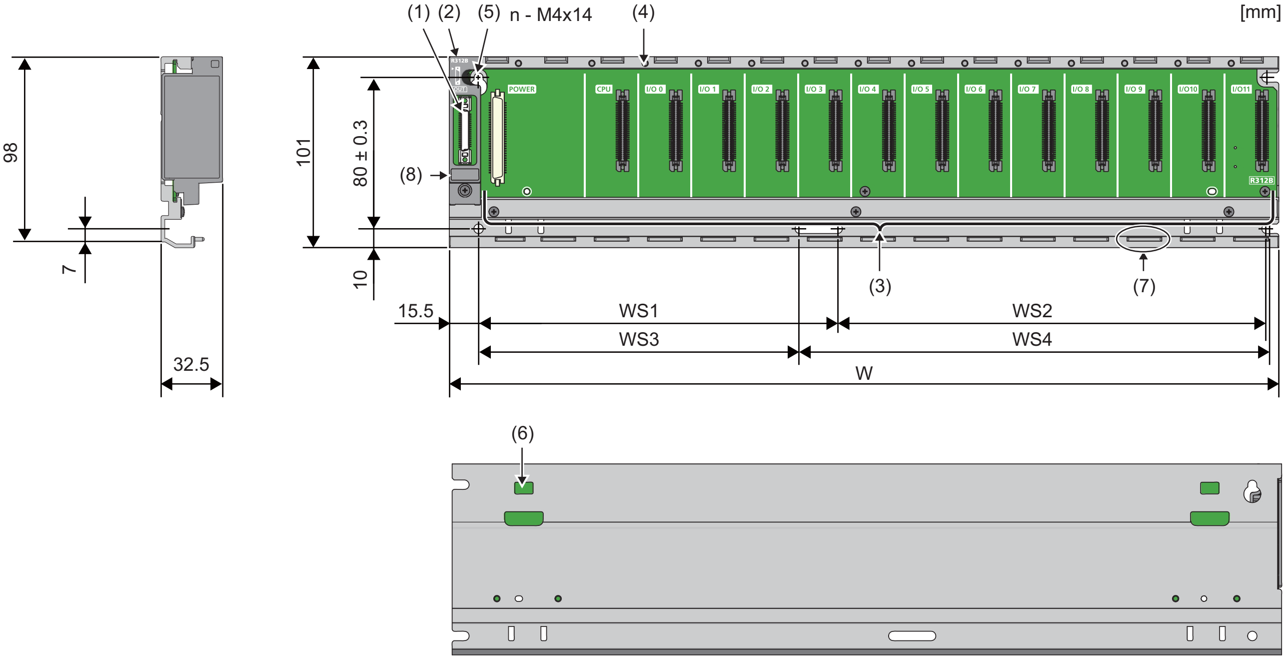
(Note 3) Do not use or store C80 under pressure higher than the atmospheric pressure of altitude 0m. Doing so can cause an operation failure.

(Note 4) The following environment conditions are also required for the layout design.

- No large amount of conductible dust, iron filings, oil mist, salt, or organic solvents
- No direct sunlight
- No strong electrical or magnetic fields
- No direct vibrations nor shocks on C80

# 4.2 Base Unit

## 4.2.1 Basic Base Unit



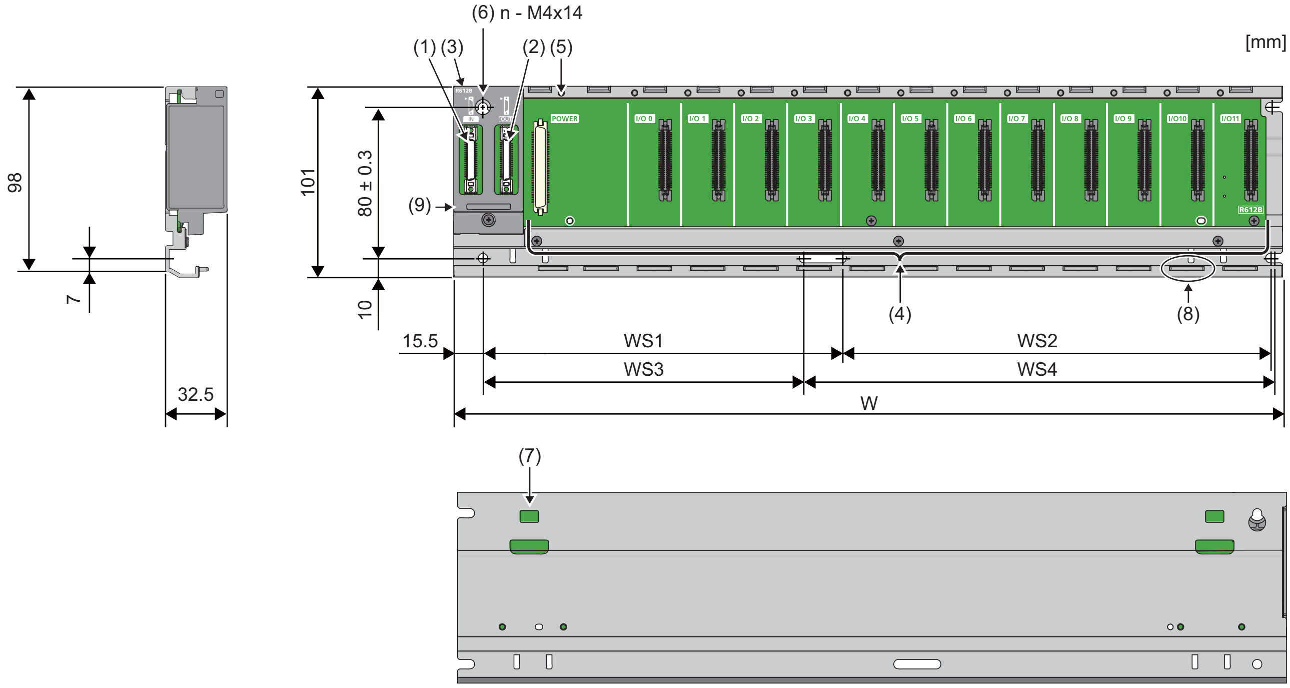

| | R35B | R38B | R312B |
|---|---|---|---|
| **n** | 4 | 5 | 5 |
| **W** | 245 | 328 | 439 |
| **WS1** | - | 190±0.3 | 190±0.3 |
| **WS2** | - | 116±0.3 | 227±0.3 |
| **WS3** | - | (170) | (170) |
| **WS4** | - | (138) | (249) |
| **WS1+WS2** | 222.5±0.3 | - | - |
| **WS3+WS4** | (224.5) | - | - |

[mm]

| Number | Name | Description |
|---|---|---|
| **(1)** | Extension cable connector (OUT) | A connector for connecting to an extension base unit. A MELSEC iQ-R series extension cable is connected here.<br>When no cable is connected, attach the supplied extension connector cover to prevent entry of foreign matter such as dust. |
| **(2)** | Extension connector cover | A protective cover for the extension cable connector. |
| **(3)** | Module connector | A connector for mounting MELSEC iQ-R series modules.<br>Attach the supplied connector cover or the blank cover module (RG60) to the connector(s) where no module is mounted to prevent entry of foreign matter such as dust. |
| **(4)** | Module fixing hole | A screw hole to fix a module to the base unit (M3×12 screw) |
| **(5)** | Base unit installation hole | A hole to install a base unit to a control panel. (M4 screw) |
| **(6)** | DIN rail adapter mounting hole | A hole to mount a DIN rail adapter. |
| **(7)** | Guide | A guide to mount a module to the base unit. |
| **(8)** | Production information marking | Shows the production information (16 digits) of the module. |

### 4.2.2 Extension Base Unit

(1) R65B/R68B/RQ612B

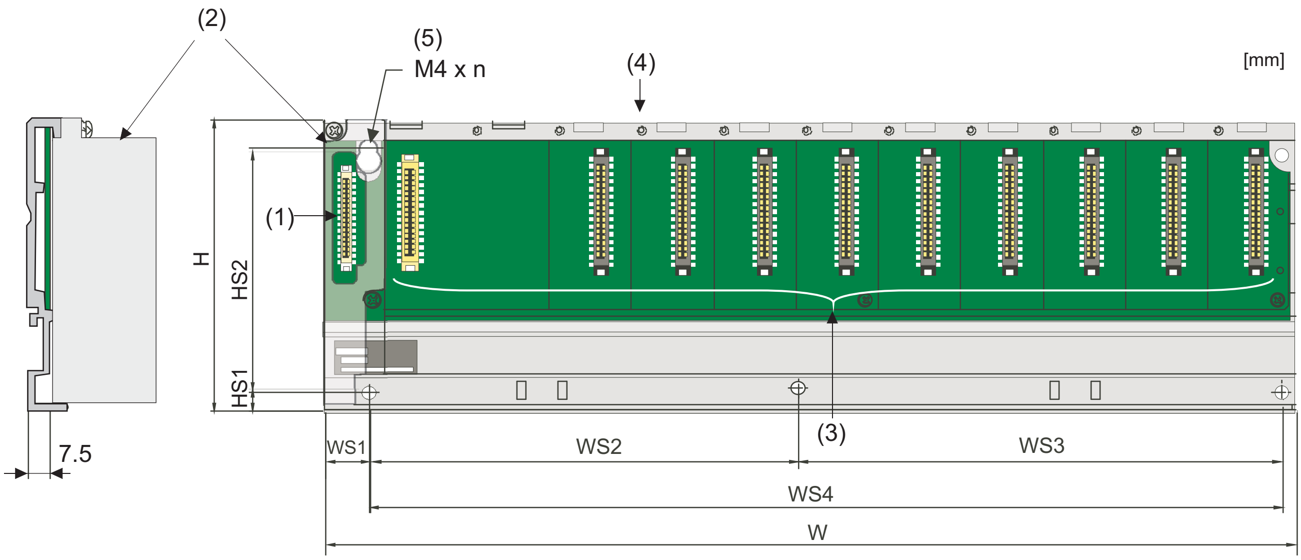



| | R65B | R68B | R612B |
|---|---|---|---|
| n | 4 | 5 | 5 |
| W | 245 | 328 | 439 |
| WS1 | - | 190±0.3 | 190±0.3 |
| WS2 | - | 116±0.3 | 227±0.3 |
| WS3 | - | (170) | (170) |
| WS4 | - | (138) | (249) |
| WS1+WS2 | 222.5±0.3 | - | - |
| WS3+WS4 | (224.5) | - | - |

[mm]

| No. | Name | Description |
|---|---|---|
| (1) | Extension cable connector (IN) | A connector for connecting to a base unit (upper level). A MELSEC iQ-R series extension cable is connected here. |
| (2) | Extension cable connector (OUT) | A connector for connecting to a base unit (lower level). A MELSEC iQ-R series extension cable is connected here.<br>When no cable is connected, attach the supplied extension connector cover to prevent entry of foreign matter such as dust. |
| (3) | Extension connector cover | A protective cover for the extension cable connector. |
| (4) | Module connector | A connector for mounting MELSEC iQ-R series modules. The CPU module and remote head module cannot be mounted on an extension base unit. Attach the supplied connector cover or the blank cover module (RG60) to the connector(s) where no module is mounted to prevent entry of foreign matter such as dust. |
| (5) | Module fixing hole | A screw hole to fix a module to the base unit. (M3×12 screw) |
| (6) | Base unit installation hole | A hole to install a base unit to a control panel. (M4 screw) |
| (7) | DIN rail adapter mounting hole | A hole to mount a DIN rail adapter. |
| (8) | Guide | A guide to mount a module to the base unit. |
| (9) | Production information marking | Shows the production information (16 digits) of the module. |

(2) Q63B/Q65B/Q68B/Q612B/Q52B/Q55B

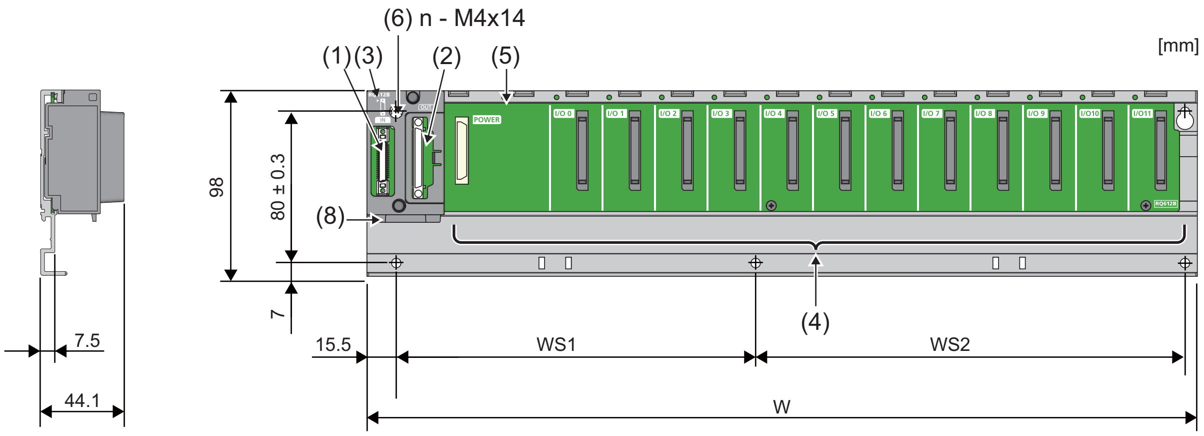


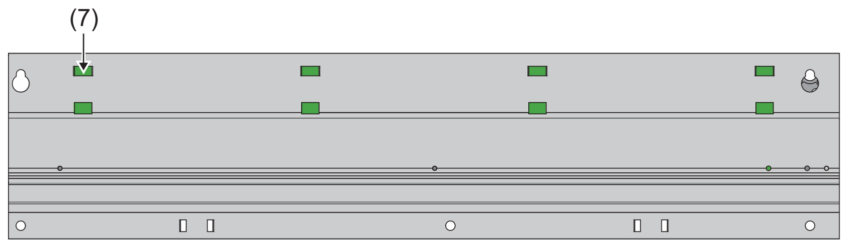

| | Q63B | Q65B | Q68B | Q612B | Q52B | Q55B |
|---|---|---|---|---|---|---|
| **n** | 4 | 4 | 5 | 5 | 4 | 4 |
| **W** | 189 | 245 | 328 | 439 | 106 | 189 |
| **WS1** | 15.5 | | | | | |
| **WS2** | - | - | 190±0.3 | 190±0.3 | - | - |
| **WS3** | - | - | 116±0.3 | 227±0.3 | - | - |
| **WS4** | 167±0.3 | 222.5±0.3 | - | - | 83.5±0.3 | 167±0.3 |
| **H** | 98 | | | | | |
| **HS1** | 7 | | | | | |
| **HS2** | 80±0.3 | | | | | |

[mm]

| No. | Name | Application |
|---|---|---|
| (1) | Extension cable connector | Connector to which the extension cables are connected for sending and receiving signals from the extension base unit. |
| (2) | Base cover | Protective cover of extension cable connector. Before an extension cable is connected, the area of the base cover surrounded by the groove under the word "OUT" on the base cover must be removed with a tool such as nippers. |
| (3) | Module connector | Connector for installing the Q series power supply module, CPU module, I/O modules, and intelligent function module.<br>Attach the supplied connector cover or the blank cover module (QG60) to the connector(s) where no module is mounted to prevent entry of foreign matter such as dust. |
| (4) | Module fixing screw hole | Screw hole for fixing the module to the base unit. Screw size: M3x12 |
| (5) | Base fixing hole | Hole for fixing this base unit onto the panel of the control panel.<br>(for M4 screw) |

### 4.2.3 RQ Extension Base Unit




| | RQ65B | RQ68B | RQ612B |
|---|---|---|---|
| **n** | 4 | 5 | 5 |
| **W** | 245 | 328 | 439 |
| **WS1** | - | 190±0.3 | 190±0.3 |
| **WS2** | - | 116±0.3 | 227±0.3 |
| **WS1+WS2** | 222.5±0.3 | - | - |

[mm]

| No. | Name | Description |
|---|---|---|
| **(1)** | Extension cable connector (IN) | A connector for connecting to a MELSEC iQ-R series base unit (upper level). A MELSEC iQ-R series extension cable is connected here. |
| **(2)** | Extension cable connector (OUT) | A connector for connecting to a MELSEC-Q series base unit (lower level). A MELSEC-Q series extension cable is connected here.<br>When no cable is connected, attach the supplied extension connector cover to prevent entry of foreign matter such as dust. |
| **(3)** | Extension connector cover | A protective cover for the extension cable connector. |
| **(4)** | Module connector | A connector for mounting the MELSEC-Q series unit. The CPU module cannot be mounted on the extension base unit.<br>Attach the supplied connector cover or the blank cover module (QG60) to the connector(s) where no module is mounted to prevent entry of foreign matter such as dust. |
| **(5)** | Module fixing hole | A screw hole to fix a module to the base unit. (M3×12 screw) |
| **(6)** | Base unit installation hole | A hole to install a base unit to a control panel. (M4 screw) |
| **(7)** | DIN rail adapter mounting hole | A hole to mount a DIN rail adapter. |
| **(8)** | Production information marking | Shows the production information (16 digits) of the module. |

# 4.3 Power Supply

## 4.3.1 R61P/R62P/R63P/R64P

**Specifications**

| Item | | AC input power supply module | | | DC input power supply module |
|---|---|---|---|---|---|
| | | R61P | R62P | R64P | R63P |
| Input power supply voltage *1 | | 100 to 240VAC<br>(85 to 264VAC) | | | 24VDC<br>(15.6 to 31.2VDC) |
| Input frequency | | 50/60Hz±5% | | | - |
| Input voltage distortion factor | | Within 5% | | | - |
| Maximum input apparent power | | 130VA | 120VA | 160VA | - |
| Maximum input power | | - | | | 50W |
| Inrush current *2 | | 20A, 8ms or less | | | 100A, 1ms or less |
| Rated output current | 5VDC | 6.5A | 3.5A | 9A | 6.5A |
| | 24VDC | - | 0.6A | - | - |
| Overcurrent protection *3 | 5VDC | 7.1A or higher | 3.8A or higher | 10.0A or higher | 7.1A or higher |
| | 24VDC | - | 0.66A or higher | - | - |
| Overvoltage protection *4 | 5VDC | 5.5 to 6.5V | | | |
| Efficiency | | 76% or more | | | 70% or more |
| Allowable momentary power failure time *5 | | Within 20ms | | | Within 10ms |
| Withstand voltage | | 2300VACrms per minute (altitude 0 to 2000m),<br>Between the combined "line input/LG terminals" and the "FG terminal and output" | | | 510VAC per minute (altitude 0 to 2000m), between primary terminal and 5VDC terminal |
| Insulation resistance | | 10MΩ or higher by 500VDC insulation resistance tester (between the combined "line input/LG terminals" and the "FG terminal and output", the line input and LG terminals, the output and FG terminals) | | | |
| Noise withstand level | | • Noise voltage 1500Vp-p, noise width 1μs, noise frequency 25 to 60Hz (noise simulator condition)<br>• Noise immunity test IEC 61000-4-4: 2kV | | | |
| Fuse | | Built-in (user-unchangeable) | | | |
| Contact output section | Application | ERR contact | | | |
| | Rated switching voltage/current | 24VDC, 0.5A | | | |
| | Minimum switching load | 5VDC, 1mA | | | |
| | Response time | Off → on: 10ms or less<br>On → off: 12ms or less | | | |
| | Life time | Mechanical: 20 million times or more<br>Electrical: Rated switching voltage/current, 100 thousand times or more | | | |
| | Surge suppressor | None | | | |
| | Fuse | None | | | |
| Terminal screw size | | M4 (M3.5 for +24V and 24G terminals of the R62P) | | | |
| Applicable wire size | | 0.75 to 2mm2 | | | |
| Applicable solderless terminal | | RAV1.25-4, RAV2-4, thickness of 0.8mm or less, up to two solderless terminal connections per terminal<br>(for the +24V and 24G terminals of the R62P: RAV1.25-3.5, RAV2-3.5, thickness of 0.8mm or less, up to two solderless terminal connections per terminal) | | | |
| Applicable tightening torque | | M4 screw: 1.02 to 1.38N·m<br>M3.5 screw: 0.66 to 0.89N·m | | | |
| External dimensions | Height | 106mm (Base unit mounting side: 98mm) | | | |
| | Width | 54.6mm | | | |
| | Depth | 110mm | | | |
| Mass | | 0.41kg | 0.45kg | 0.46kg | 0.41kg |

*1 Input power supply voltage

Input power supply voltage is a voltage required for the power supply module to operate normally. If the voltage is out of the specified range, an error is detected and the system may stop.

*2 Inrush current

Inrush current is the maximum, instantaneous input current drawn into the circuits immediately after power-on. If power is supplied to the system immediately after shut-off, an inrush current of more than the specified value may flow.

Wait for five seconds or more after shut-off, and supply power to the system again.

When selecting a fuse or a breaker for the external circuit, consider blowouts, sensing property, and specified value of inrush current.

*3 Overcurrent protection

The function of this protection is to shut off the circuit to stop the system if a current exceeding the specification value flows into a circuit of 5VDC or 24VDC.

With overcurrent protection activated, the LED of the power supply module goes off or lights dim green due to a voltage drop.

To restart the system, shut off the power and eliminate the cause of the problem, such as insufficient current or short-circuit. After the cause is eliminated, wait for a few minutes, and supply power to the system again. When the output current is back to normal, the system starts initially.

*4 Overvoltage protection

The function of this protection is to shut off the circuit to stop the system if an overvoltage exceeding the specified value is applied to a 5VDC circuit.

With overvoltage protection activated, the POWER LED of the power supply module turns off.

To restart the system, shut off the power, wait for a few minutes, and supply power to the system again. Then, the system starts initially.

If the system does not restart and the POWER LED remains off, replace the power supply module.

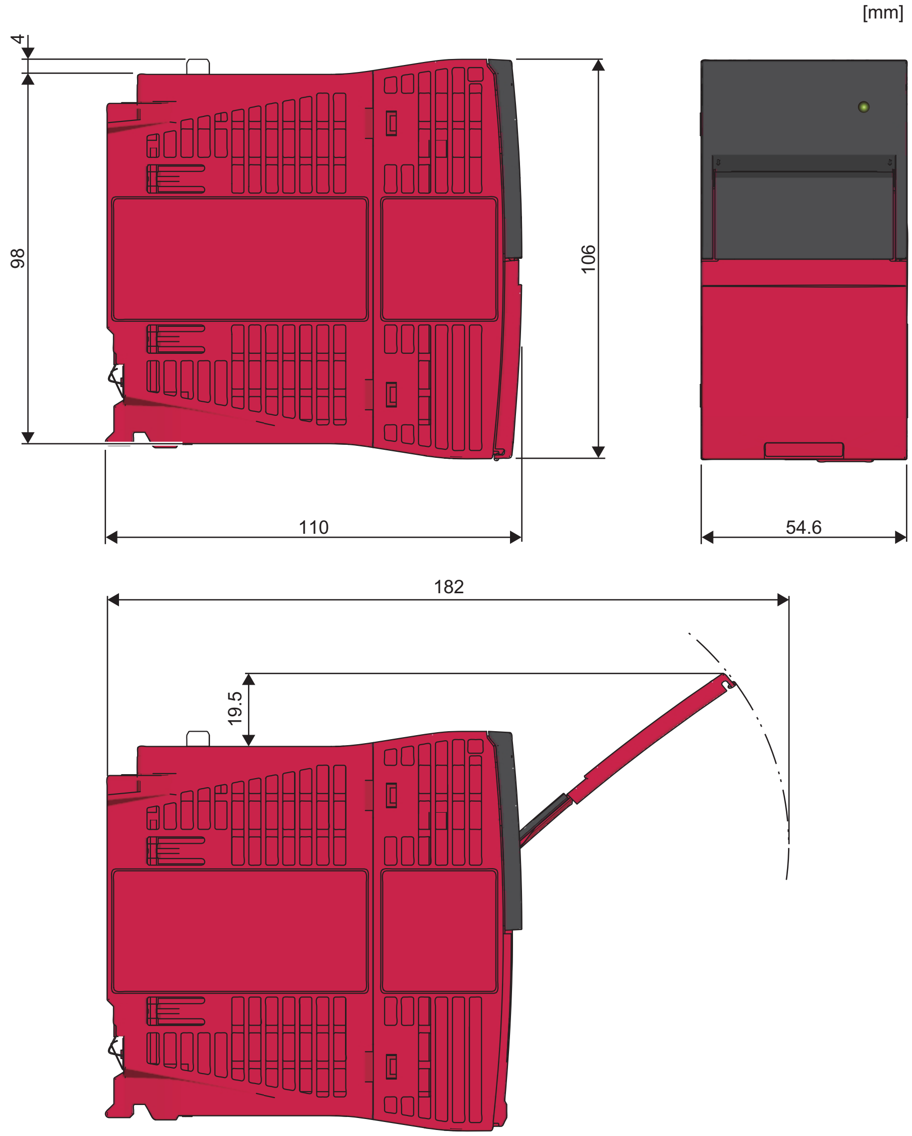
*5 Allowable momentary power failure time

The system detects an input voltage down and stops its operation when a momentary power failure occurs.

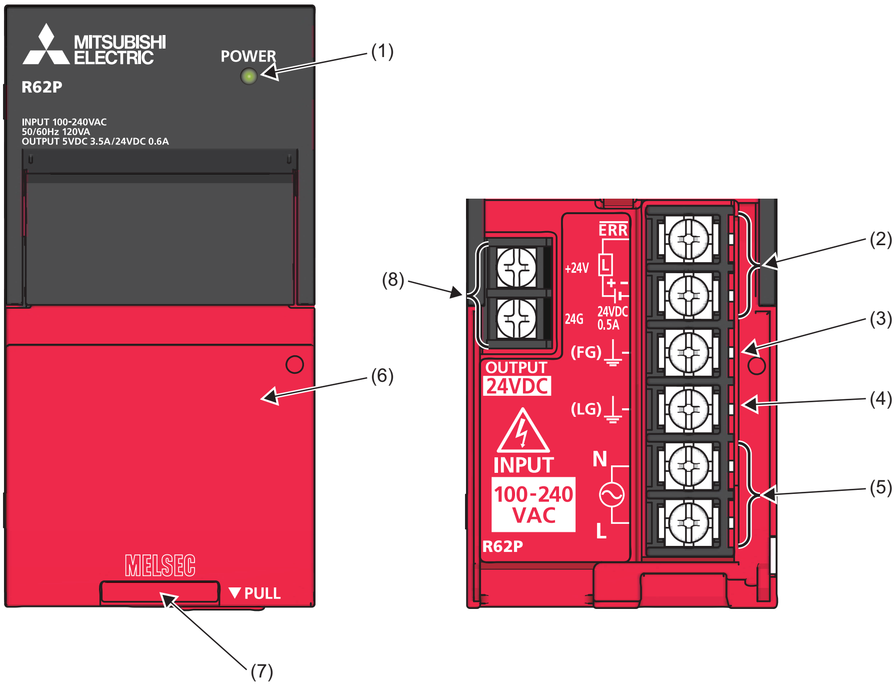
Allowable momentary power failure time is a period of time that the system can continue its operation even after the power failure.

If power fails exceeding this period of time, the system can either continue its operation or start initially, depending on the load of the power supply module. When the system continues its operation, the operation will be the same as that of the system returned within the allowable momentary power failure time.

### Outline dimension



### Names of parts




| No. | Name | Description |
|---|---|---|
| (1) | POWER LED | Indicates the operating status of the power supply module.<br>On: Normal operation<br>Off: Power-off, power failure, or hardware failure |
| (2) | $\overline{\text{ERR}}$ contact | [When mounting the module on the main base unit]<br>The contact turns on when the entire system operates normally. (M4 screw)<br>This contact turns off (opens) in the following cases:<br>• When the power supply module fails<br>• When the power is not supplied<br>• When a stop error (including reset) occurs in the CPU module<br>• When the fuse is blown<br>In a multiple CPU system, the contact turns off when a stop error occurs in any of the CPU modules.<br>When the remote head module is mounted, this contact turns off when moderate or major error (including reset) occurs.<br>[When mounting the module on the extension base unit]<br>The contact is off at all times.<br>When the module is mounted on a redundant power supply extension base unit, the following operation is performed:<br>• The contact turns on when the power supply module operates normally. (M4 screw)<br>• This contact turns off (opens) when the power supply module fails, the power is not supplied, or the fuse is blown. |
| (3) | FG terminal *1 | A ground terminal connected to the shield pattern of the printed circuit board. This terminal is a functional ground terminal. (M4 screw) |
| (4) | LG terminal *1 | A ground terminal for the power supply input filter. This terminal is a functional ground terminal. For AC input, the terminal has one-half the potential of the input voltage. (M4 screw) |
| (5) | Power input terminal | A power input terminal for the power supply module. The power supply to be connected differs depending on a power supply module. (M4 screw) (Refer to the specifications list.) |
| (6) | Terminal cover | A protective cover for the terminal block. |
| (7) | Production information marking | Shows the production information (16 digits) of the module. |
| (8)*2 | +24V terminal and 24G terminal | Used for a device that requires a supply of 24VDC. (M3.5 screw)<br>The power is supplied to a device through the external wiring. |

*1 Individually ground the FG and LG terminals with a ground resistance of 100 ohms or less.

*2 Only the R62P has these terminals.

### 4.3.2 Q61P/Q63P/Q64PN

#### Specifications

| Item | | | Q61P |
|---|---|---|---|
| Base loading position | | | Q series power supply module loading slot |
| Applicable base unit | | | Q63B, Q65B, Q68B, Q612B |
| Input power supply | | | 100 to 240VAC+10%-15%<br>(85 to 264VAC) |
| Input frequency | | | 50/60Hz±5% |
| Input voltage distortion factor | | | Within 5% |
| Maximum input apparent power | | | 130VA |
| Inrush current | | | Within 20A 8ms *4 |
| Rated output current | | 5VDC | 6A |
| | | 24VDC | - |
| Overcurrent protection *1 | | 5VDC | 6.6A or higher |
| | | 24VDC | - |
| Overvoltage protection *2 | | 5VDC | 5.5 to 6.5V |
| Efficiency | | | 70% or more |
| Permissible instantaneous power off time *3 | | | Within 20ms |
| Withstand voltage | | | Across inputs/LG and outputs/FG<br>2830VAC rms/3 cycles<br>(Altitude: 2000m) |
| Insulation resistance | | | Across inputs and outputs<br>(LG and FG separated),<br>across inputs for LG/FG,<br>across outputs for LG/FG<br>10MΩ or more by insulation<br>resistance tester (500VDC) |
| Noise withstand level | | | By noise simulator of 1500Vp-p noise voltage,<br>1μs noise width and 25 to 60Hz noise frequency<br>Noise voltage IEC61000-4-4, 2kV |
| Operation display | | | LED display (Normal: ON (Green), Error: OFF) |
| Fuse | | | Built-in (Unchangeable by user) |
| Contact output section | Application | | ERR contact |
| | Rated switching voltage/current | | 24VDC, 0.5A |
| | Minimum switching load | | 5VDC, 1mA |
| | Response time | | OFF to ON:10ms or less, ON to OFF:12ms or less |
| | Life time | | Mechanical: 20 million times or more<br>Electrical: 100 thousand times or more at rated switching voltage/current |
| | Surge suppressor | | None |
| | Fuse | | None |
| Terminal screw size | | | M3.5 screw |
| Applicable size of wire | | | 0.75 to $2mm^2$ |
| Applicable solderless terminal | | | RAV1.25-3.5, RAV2-3.5 |
| Applicable tightening torque | | | 0.66 to 0.89N·m |
| Mass [kg] | | | 0.4 |

| Item | | Q63P | Q64PN |
|---|---|---|---|
| Base loading position | | Q series power supply module loading slot | |
| Applicable base unit | | Q63B, Q65B, Q68B, Q612B | |
| Input power supply | | 24VDC+30%-35%<br>(15.6 to 31.2VDC) | 100 to 240VAC+10%-15%<br>(85 to 264VAC) |
| Input frequency | | - | 50/60Hz±5% |
| Input voltage distortion factor | | - | Within 5% |
| Maximum input apparent power | | 45W | 160VA |
| Input current | | at 24VDC input: 1.82A or less<br>at 15.6VDC input: 2.8A or less | at 100VAC input: 1.3A or less<br>at 200VAC input: 0.75A or less |
| Repetitive peak current | | - | 4A or less |
| Inrush current | | 100A 1ms or less (at 24VDC input) | Within 20A 8ms *4 |
| Rated output current | 5VDC | 6A | 8.5A |
| | 24VDC | - | - |
| Overcurrent protection *1 | 5VDC | 6.6A or higher | 9.9A or higher |
| | 24VDC | - | - |
| Overvoltage protection *2 | 5VDC | 5.5 to 6.5V | |
| Efficiency | | 70% or more | |
| Permissible instantaneous power off time *3 | | Within 10ms (at 24VDC input) | Within 20ms |
| Withstand voltage | | 500VAC across primary and 5VDC | Across inputs/LG and outputs/FG<br>2,830VAC rms/3 cycles<br>(Altitude: 2,000m (6,561.68ft.)) |
| Insulation resistance | | 10MΩ or more (measured with an insulation resistance tester) | Input and LG batched, output and FG batched, batch input-LG, batch output-FG<br>10MΩ or m ore by insulation resistance tester (500VDC) |
| Noise withstand level | | By noise simulator of 500Vp-p noise voltage, 1μs noise width and 25 to 60Hz noise frequency | By noise simulator of 1,500Vp-p noise voltage, 1μs noise width and 25 to 60Hz noise frequency<br>Noise voltage IEC61000-4-4, 2kV |
| Operation display | | LED display<br>(Normal: ON (Green), Error: OFF) | LED display<br>(Normal: ON (Green), Error: OFF) |
| Fuse | | Built-in (Unchangeable by user) | |
| Contact output section | Application | ERR contact | |
| | Rated switching voltage/current | 24VDC, 0.5A | |
| | Minimum switching load | 5VDC, 1mA | |
| | Response time | OFF to ON: 10ms or less, ON to OFF: 12ms or less | |
| | Life time | Mechanical: 20 million times or m ore<br>Electrical: 100 thousand times or more at rated switching voltage/current | |
| | Surge suppressor | None | |
| | Fuse | None | |
| Terminal screw size | | M3.5 screw | |
| Applicable size of wire | | 0.75 to 2mm $^2$ | |
| Applicable solderless terminal | | RAV1.25-3.5, RAV2-3.5 | |
| Applicable tightening torque | | 0.66 to 0.89N·m | |
| Mass [kg] | | 0.33 | 0.47 |

*1: Overcurrent protection

The overcurrent protection device shuts off the 5V, 24VDC circuit and stops the system if the current flowing in the circuit exceeds the specified value.
The LED of the power supply module is turned off or lights up in dim green when voltage is lowered.
If this device is activated, switch the input power supply off and eliminate the cause such as insufficient current capacity or short. Then, a few minutes later, switch it on to restart the system.
The initial start for the system takes place when the current value becomes normal.

*2: Overvoltage protection

The overvoltage protection device shuts off the 5VDC circuit and stops the system if a voltage of 5.5VDC or more is applied to the circuit.
When this device is activated, the power supply module LED is switched OFF.
To restart the system, switch the input power OFF, then a few minutes later ON.
The initial start for the system will take place.
The power supply module must be changed if the system is not booted and the LED remains OFF.

*3: Permissible instantaneous power off time

(1) For AC input power supply

An instantaneous power failure lasting less than 20ms will cause AC down to be detected, but operation will continue.
An instantaneous power failure lasting in excess of 20ms may cause the operation to continue or initial start to take place depending on the power supply load.
Further, when the AC supply of the AC input module is the same as that of the power supply module, it prevents the sensor connected to the AC input module, which is ON at power-off, from turning OFF by switching off the power supply.
However, if only the AC input module is connected to the AC line, which is connected to the power supply, detection of the AC down for the power supply module may be delayed by the capacitor in the AC input module. Thus, connect a load of approx. 30mA per AC input module to the AC line.

(2) For DC input power supply

An instantaneous power failure lasting less than 10ms* will cause 24VDC down to be detected, but operation will continue.
An instantaneous power failure lasting in excess of 10ms* may cause the operation to continue or initial start to take place depending on the power supply load. * : This is for a 24VDC input. This is 10ms or less for less than 24VDC.

*4: Inrush current

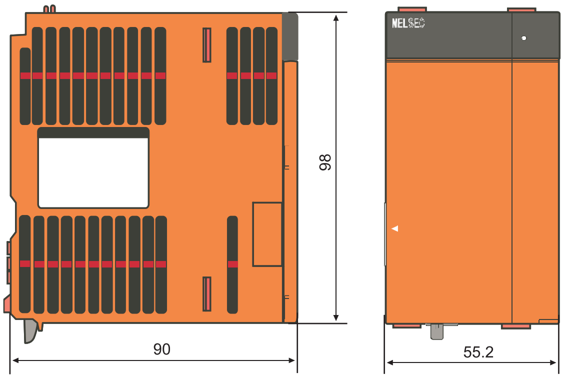
When power is switched on again immediately (within 5 seconds) after power-off, an inrush current of more than the specified value (2ms or less) may flow. Reapply power 5 seconds after power-off.
When selecting a fuse and breaker in the external circuit, take account of the blow out, detection characteristics and above matters.

*5: Operation indication

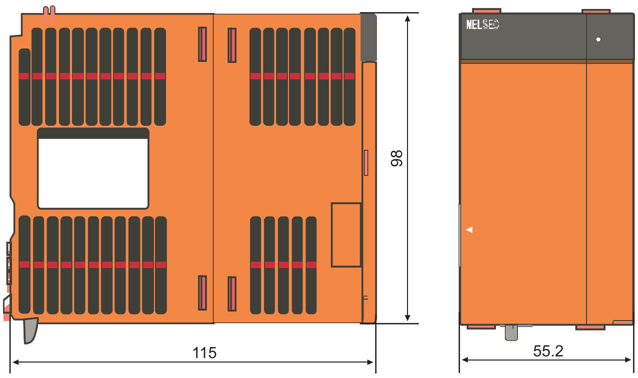
During the operation, do not allow the input voltage to change from 200VAC level (170 to 264VAC) to 100VAC level (85 to 132VAC).
(If changed, the POWER LED of the module turns off and the system operation stops.)

### Outline dimension

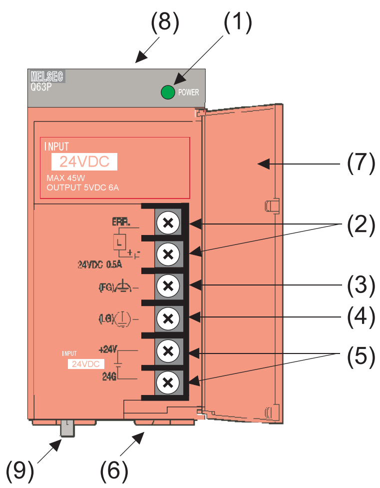
Q61P/Q63P [mm]



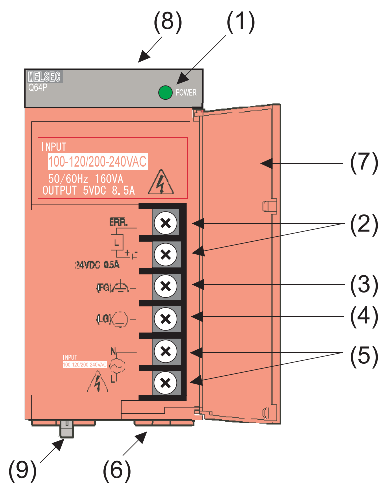

Q64PN [mm]




### Names of parts




Q63P




Q61P/Q64PN

**(1) POWER LED**

Q61P/Q64PN

ON (green):

Normal (5VDC output, instantaneous power failure within 20ms)

OFF:

- The power supply module is out of order while AC power supply is ON. (5VDC error, internal circuit failure, blown fuse)
- Over current protection or over voltage protection operated.
- AC power supply is not ON (including power failure and an instantaneous power failure of more than 20ms)

Q63P

ON (green):

Normal (5VDC output, instantaneous power failure within 10ms)

OFF:

- The power supply module is out of order while DC power supply is ON. (5VDC error, internal circuit failure, blown fuse)
- Over current protection or over voltage protection operated.
- DC power supply is not ON (including power failure and an instantaneous power failure of more than 10ms)

**(2) ERR terminal**

Q61P/Q64PN

- Turned ON when the whole system operates normally.
- This terminal turns OFF (opens) when the AC power is not input, a stop error (including a reset) occurs in the CPU module, or the fuse is blown.
- In a Multiple CPU system configuration, turned OFF when a stop error occurs in any of the CPU modules.
- Normally OFF when loaded in an extension base unit.

Q63P

- Turned ON when the whole system operates normally.
- This terminal turns OFF (opens) when the DC power is not input, a stop error (including a reset) occurs in the CPU module, or the fuse is blown.
- In a Multiple CPU system configuration, turned OFF when a stop error occurs in any of the CPU modules.
- Normally OFF when loaded in an extension base unit.

**(3) FG terminal**

Ground terminal connected to the shield pattern of the printed circuit board.

**(4) LG terminal**

- Grounding for the power supply filter.
- This terminal has potential of 1/2 of the input voltage for AC input (Q61P, Q64PN and Q64P).
- This is also a protective earth terminal (PE).

**(5) Power input terminals**

- Power input terminals connected to a power supply of 100VAC or 200VAC. (Q64PN)
- Power input terminals connected to a power supply of 24VDC. (Q63P)
- Power input terminals connected to a power supply of 100-200VAC. (Q61P)

**(6) Terminal screw**

M3.5 x 7 screw

**(7) Terminal cover**

Protective cover of the terminal block

**(8) Module fixing screw hole**

Used to fix the module to the base unit.
M3 x 12 screw (user-prepared) (Tightening torque: 0.36 to 0.48 N·m)

**(9) Module loading lever**

Used to load the module into the base unit.

(Note 1) Q63P is dedicated for inputting a voltage of 24VDC. Q63P may break down unless connected to 24VDC for inputting or with reversed polarity.

(Note 2) Ensure that the earth terminals LG and FG are grounded. (Ground resistance: 100 or less) Since the LG terminals have potential of 1/2 input voltage, the operator may receive an electric shock when touching metal parts.

(Note 3) When Q61P, Q63P, Q64PN or Q64P is loaded on the extension base unit, a system error cannot be detected by the ERR terminal. (ERR terminal is always OFF.)

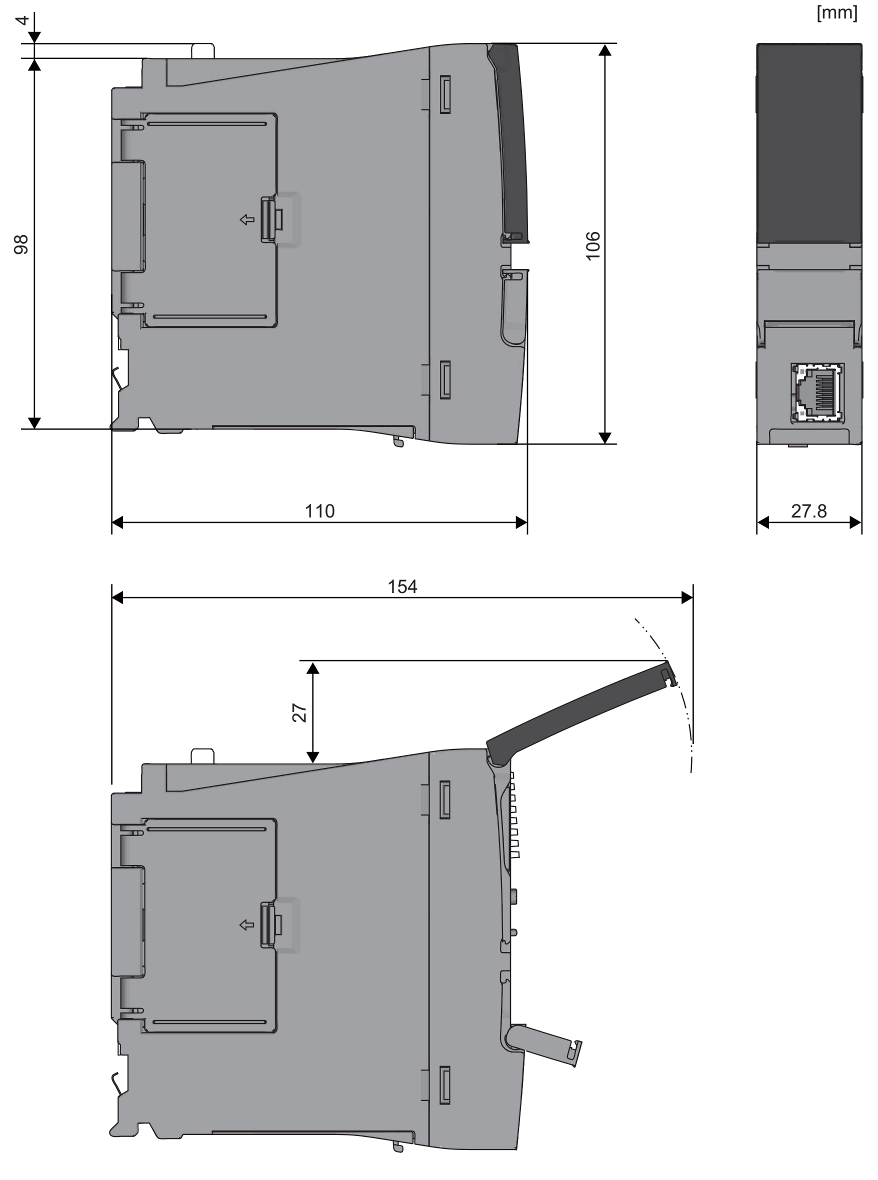
# 4.4 PLC CPU

For the further details than the following descriptions, refer to the following manuals:

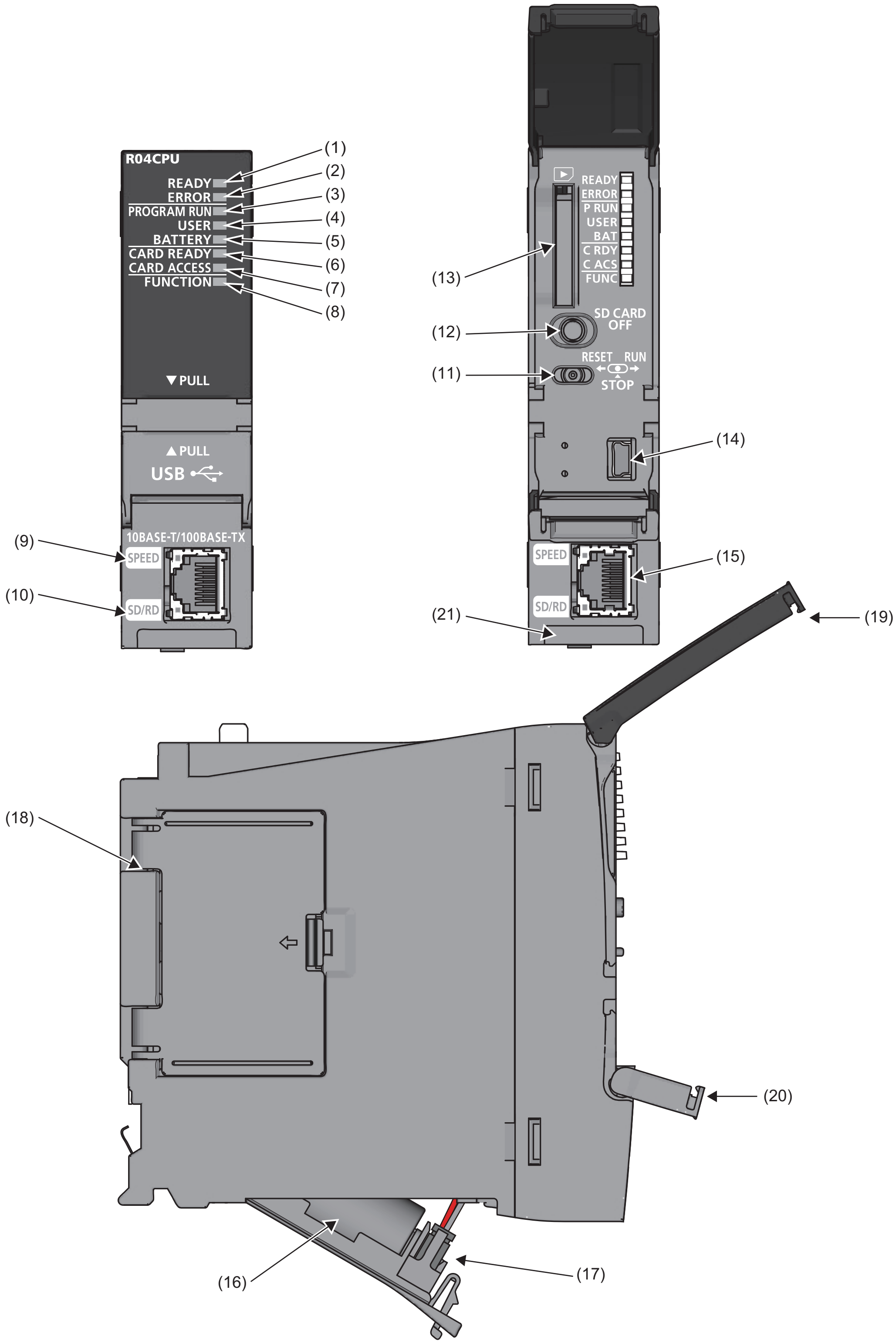
MELSEC iQ-R CPU Module User's Manual (Startup) (SH(NA)-081263)

MELSEC iQ-R CPU Module User's Manual (Application) (SH(NA)-081264)

**Outline dimension**



### Names of parts



| Number | Name | Details |
|---|---|---|
| **(1)** | READY LED | Indicates the operating status of the CPU module and the error level.<br>[READY LED-ERROR LED status]<br>On-off: Normal operation<br>On-on: Minor error<br>On-flashing: Moderate error<br>Flashing-on: Minor error (Changing module online)<br>Flashing (every 2s)-off: Initial processing<br>Flashing (every 400ms)-off: Changing module online<br>Off-on/flashing: Major error |
| **(2)** | ERROR LED | |
| **(3)** | PROGRAM RUN LED | Indicates the operating status of the program.<br>On: Being executed (RUN state)<br>Flashing: Being suspended (PAUSE state)<br>Off: Stopped (STOP state) or stop error |
| | PROGRAM RUN LED<br>(When the Process CPU is used in redundant mode) | Indicates the operating status of the program.<br>(a) Control system (CTRL LED of the redundant function module: On)<br>On: Being executed (RUN state)<br>Flashing: Being suspended (PAUSE state)<br>Off: Stopped (STOP state) or stop error<br>(b) Standby system (SBY LED of the redundant function module: On)<br>[Backup mode]<br>On: Being executed (programs being executed in both systems)<br>Flashing: Being suspended (PAUSE state) (programs being executed in both systems)<br>Off: Stopped (STOP state/RUN state/PAUSE state) (no program being executed in both systems) or stop error<br>[Separate mode]<br>On: Being executed (RUN state)<br>Flashing: Being suspended (PAUSE state) or waiting for state transition to RUN (same as STOP state)<br>Off: Stopped (STOP state) or stop error<br>(c) Systems not determined<br>Flashing: Waiting for state transition to RUN by switch operation (same as STOP state)<br>Off: Under normal operation |
| **(4)** | USER LED | Indicates the status of the annunciator (F).<br>On: Annunciator (F) ON<br>Off: Normal operation |
| **(5)** | BATTERY LED | Indicates the battery status.<br>Flashing: Battery low<br>Off: Normal operation |
| **(6)** | CARD READY LED | Indicates the availability of the SD memory card.<br>On: Available<br>Flashing: Ready<br>Off: Not available or not inserted |
| **(7)** | CARD ACCESS LED | Indicates the access status of the SD memory card.<br>On: Being accessed<br>Off: Not accessed |
| **(8)** | FUNCTION LED | Indicates the status of the function being executed. |
| **(9)** | SPEED LED | Refer to the following.<br>MELSEC iQ-R Ethernet/CC-Link IE User's Manual (Startup) |
| **(10)** | SD/RD LED | |
| **(11)** | RUN/STOP/RESET switch | A switch for controlling the operating status of the CPU module.<br>RUN: Executes the program.<br>STOP: Stops the program.<br>RESET: Resets the CPU module. (Keep the switch in the RESET position for approximately one second.)<br>Operate the RUN/STOP/RESET switch with your fingers. To prevent the switch from being damaged, do not use any tool such as a screwdriver. |
| **(12)** | SD memory card access control switch | A switch for disabling access to the SD memory card to remove it from the CPU module. |
| **(13)** | SD memory card slot | A slot where an SD memory card is inserted. |
| **(14)** | USB port *1 | A connector for a USB-compatible peripheral. (connector type: miniB) |
| **(15)** | Ethernet port | Refer to the following.<br>MELSEC iQ-R Ethernet/CC-Link IE User's Manual (Startup) |
| **(16)** | Battery | A backup battery to hold clock data and to use the backup power function for the device/label memory. |
| **(17)** | Battery connector pin | A pin for connecting a lead wire of the battery.<br>To save the battery, the lead wire is disconnected from the connector before shipment. |

| Number | Name | Details |
|---|---|---|
| **(18)** | Cassette cover | A cover for the connector where an extended SRAM cassette is inserted. To use an extended SRAM cassette, open the cover, and insert the cassette. |
| **(19)** | LED cover | A cover for the LED indicators, SD memory card slot, and switches. Open this cover and insert or remove an SD memory card or set the RUN/STOP/RESET switch.<br>Otherwise, keep the cover closed to prevent entry of foreign matter such as dust. |
| **(20)** | USB cover | A cover for the USB port. Open this cover and connect a USB-compatible peripheral.<br>Otherwise, keep the cover closed to prevent entry of foreign matter such as dust. |
| **(21)** | Production information marking | Shows the production information (16 digits) of the module. |

*1 When a cable is connected to the USB connector at all times, clamp the cable. It prevents a poor connection, moving, and disconnection by unintentional pulling.

**Battery life**

There are two types of values for describing a battery life: actual service value and guaranteed value.

• Actual service value: The battery life estimated based on the value actually measured by Mitsubishi under a storage ambient temperature of 40 ℃ . This value varies depending on the characteristics and variation of the components, and should be referred to as a reference value.

• Guaranteed value: Refers to the battery life at 70℃ guaranteed by Mitsubishi in a storage ambient temperature of 70 ℃ based on the characteristics of the memory device provided by the component manufacturer.

**[Actual service value (reference value)]**

<table>
<tr><th rowspan="2">Extended SRAM cassette</th><th rowspan="2">Power-on time ratio *1</th><th colspan="2">Actual service value when used with the R04CPU</th><th colspan="2">Actual service value when used with the R08CPU, R16CPU, R32CPU, or R120CPU</th></tr>
<tr><th>Q6BAT</th><th>Q7BAT</th><th>Q6BAT</th><th>Q7BAT</th></tr>
<tr><td>Not used,<br>used (1MB type),<br>used (2MB type),<br>used (4MB type),<br>used (8MB type)</td><td>0 to 100%</td><td>43800 hours (5.00 years)</td><td rowspan="4">43800 hours (5.00 years)</td><td>43800 hours (5.00 years)</td><td rowspan="4">43800 hours (5.00 years)</td></tr>
<tr><td rowspan="3">Used (16MB type) *2</td><td>0%</td><td>30100 hours (3.43 years)</td><td>25500 hours (2.91 years)</td></tr>
<tr><td>30%</td><td>43000 hours (4.90 years)</td><td>36400 hours (4.15 years)</td></tr>
<tr><td>50 to 100%</td><td>43800 hours (5.00 years)</td><td>43800 hours (5.00 years)</td></tr>
</table>

**[Guaranteed value]**

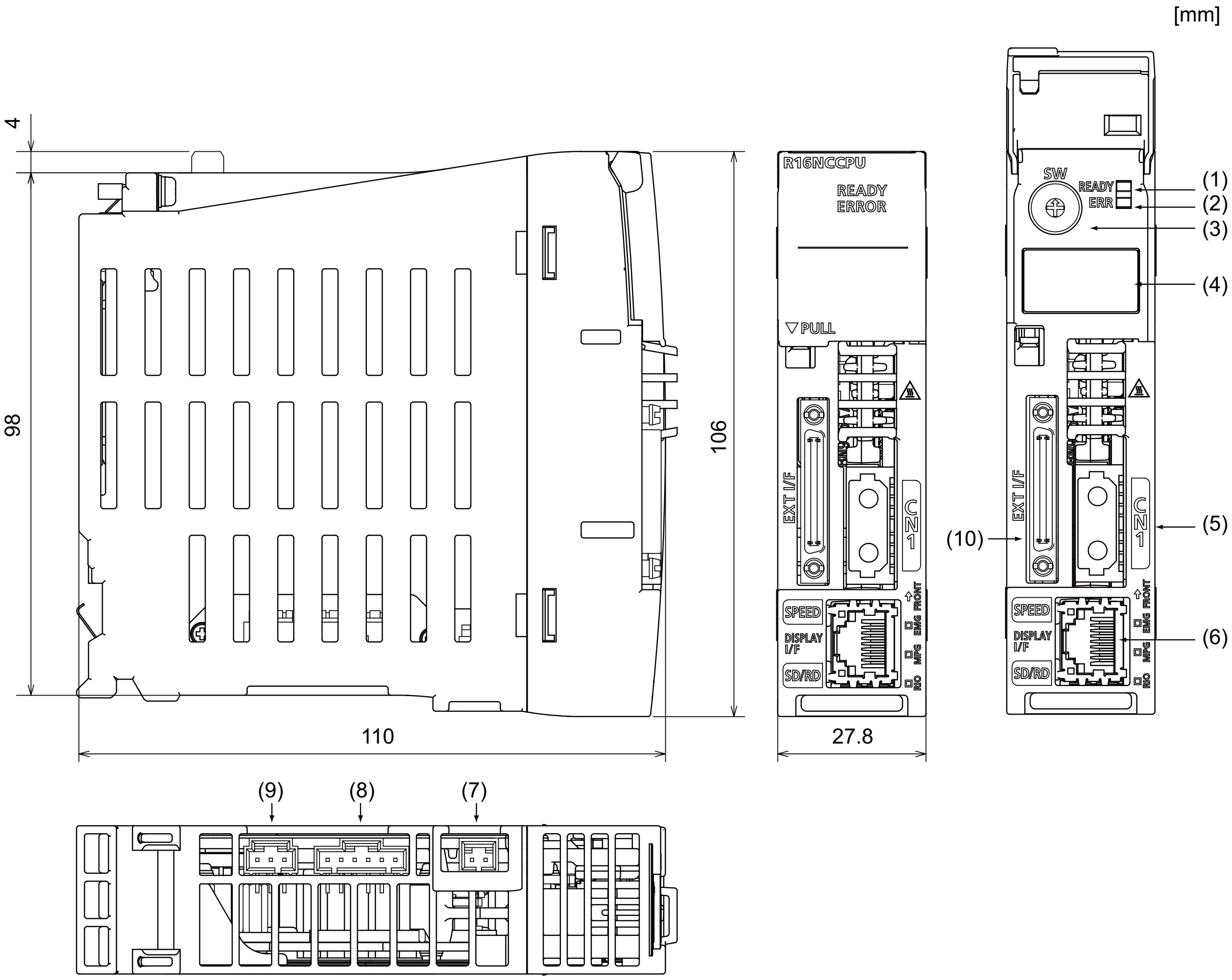
<table>
<tr><th rowspan="2">Extended SRAM cassette</th><th rowspan="2">Power-on time ratio *1</th><th colspan="2">Guaranteed value when used with the R04CPU</th><th colspan="2">Guaranteed value when used with the R08CPU, R16CPU, R32CPU, or R120CPU</th></tr>
<tr><th>Q6BAT</th><th>Q7BAT</th><th>Q6BAT</th><th>Q7BAT</th></tr>
<tr><td rowspan="3">Not used</td><td>0%</td><td>31700 hours (3.61 years)</td><td rowspan="11">43800 hours (5.00 years)</td><td>30600 hours (3.49 years)</td><td rowspan="7">43800 hours (5.00 years)</td></tr>
<tr><td>30%</td><td rowspan="2">43800 hours (5.00 years)</td><td>43700 hours (4.98 years)</td></tr>
<tr><td>50 to 100%</td><td>43800 hours (5.00 years)</td></tr>
<tr><td rowspan="4">Used (1MB type)</td><td>0%</td><td>22000 hours (2.51 years)</td><td>21500 hours (2.45 years)</td></tr>
<tr><td>30%</td><td>31400 hours (3.58 years)</td><td>30700 hours (3.50 years)</td></tr>
<tr><td>50%</td><td rowspan="2">43800 hours (5.00 years)</td><td>43000 hours (4.90 years)</td></tr>
<tr><td>70 to 100%</td><td>43800 hours (5.00 years)</td></tr>
<tr><td rowspan="4">Used (2MB type)</td><td>0%</td><td>19600 hours (2.23 years)</td><td>19100 hours (2.18 years)</td><td>43100 hours (4.92 years)</td></tr>
<tr><td>30%</td><td>28000 hours (3.19 years)</td><td>27200 hours (3.10 years)</td><td rowspan="3">43800 hours (5.00 years)</td></tr>
<tr><td>50%</td><td>39200 hours (4.47 years)</td><td>38200 hours (4.36 years)</td></tr>
<tr><td>70 to 100%</td><td>43800 hours (5.00 years)</td><td>43800 hours (5.00 years)</td></tr>
<tr><td rowspan="4">Used (4MB type)</td><td>0%</td><td>15300 hours (1.74 years)</td><td>39600 hours (4.52 years)</td><td>15000 hours (1.71 years)</td><td>36200 hours (4.13 years)</td></tr>
<tr><td>30%</td><td>21800 hours (2.48 years)</td><td rowspan="3">43800 hours (5.00 years)</td><td>21400 hours (2.44 years)</td><td rowspan="3">43800 hours (5.00 years)</td></tr>
<tr><td>50%</td><td>30600 hours (3.49 years)</td><td>30000 hours (3.42 years)</td></tr>
<tr><td>70 to 100%</td><td>43800 hours (5.00 years)</td><td>43800 hours (5.00 years)</td></tr>
<tr><td rowspan="5">Used (8MB type)</td><td>0%</td><td>10100 hours (1.15 years)</td><td>26900 hours (3.07 years)</td><td>10000 hours (1.14 years)</td><td>24800 hours (2.83 years)</td></tr>
<tr><td>30%</td><td>14400 hours (1.64 years)</td><td>38400 hours (4.38 years)</td><td>14200 hours (1.62 years)</td><td>35400 hours (4.04 years)</td></tr>
<tr><td>50%</td><td>20200 hours (2.30 years)</td><td rowspan="3">43800 hours (5.00 years)</td><td>20000 hours (2.28 years)</td><td rowspan="3">43800 hours (5.00 years)</td></tr>
<tr><td>70%</td><td>33600 hours (3.83 years)</td><td>33300 hours (3.80 years)</td></tr>
<tr><td>100%</td><td>43800 hours (5.00 years)</td><td>43800 hours (5.00 years)</td></tr>
<tr><td rowspan="5">Used (16MB type) *2</td><td>0%</td><td>6400 hours (0.73 years)</td><td>16100 hours (1.83 years)</td><td>6400 hours (0.73 years)</td><td>16000 hours (1.82 years)</td></tr>
<tr><td>30%</td><td>9100 hours (1.03 years)</td><td>23000 hours (2.62 years)</td><td>9100 hours (1.03 years)</td><td>22800 hours (2.62 years)</td></tr>
<tr><td>50%</td><td>12800 hours (1.46 years)</td><td>32200 hours (3.67 years)</td><td>12800 hours (1.46 years)</td><td>32000 hours (3.65 years)</td></tr>
<tr><td>70%</td><td>21300 hours (2.43 years)</td><td rowspan="2">43800 hours (5.00 years)</td><td>21300 hours (2.43 years)</td><td rowspan="2">43800 hours (5.00 years)</td></tr>
<tr><td>100%</td><td>43800 hours (5.00 years)</td><td>43800 hours (5.00 years)</td></tr>
</table>

*1 The power-on time ratio indicates the ratio of the programmable controller power-on time to 24 hours. (If the total power-on time is 12 hours, the ratio will be 50%. If the total power-on time is 6 hours, the ratio will be 25%.)

*2 To use the extended SRAM cassette (16MB type) with the RnCPU, check the version of the CPU module and engineering tool.

# 4.5 CNC CPU Module

**Dimension and Names of parts**




**(1) READY LED**

**(2) ERROR LED**

The operating state and the error state of CNC CPU will be displayed.

| READY LED | ERROR LED | Operating state |
|---|---|---|
| Not lit | Not lit | Power OFF or hardware failure |
| Flashing | Not lit | Initializing |
| Lit | Not lit | Under normal operation |
| Lit | Flashing | Occurrence of a moderate error |
| Not lit | Lit or flashing | Occurrence of a severe error |

**(3) SW**

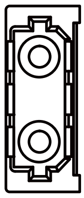
Rotary switch for maintenance (usually set to “0”)

**(4) Dot matrix LED**

The operating state and the error information will be displayed. (3 digits)

**(5) CN1**

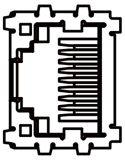
Connector for servo/spindle drive unit




| | | |
|---|---|---|
| 1 | IN | RD |
| 2 | OUT | TD |

**(6) DISPLAY I/F**

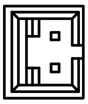
Connector for display (GOT)




| | | |
|---|---|---|
| 1 | OUT | TD+ |
| 2 | OUT | TD- |
| 3 | IN | RD+ |
| 4 | | CMTR |
| 5 | | CMTR |
| 6 | IN | RD- |
| 7 | | CMIT |
| 8 | | CMIT |

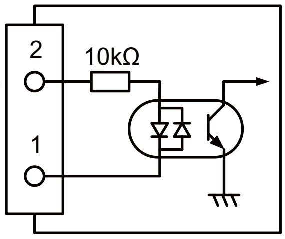
**(7) EMG**

Connector for the emergency stop signal input




70553-0001
(MOLEX)

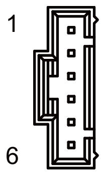
| | | |
|---|---|---|
| 1 | IN | EMG.COM |
| 2 | IN | EMG |




Input type: Current sinking/sourcing
Insulation method: Photocoupler insulation
Input voltage: 24VDC (+10%, -15%, ripple ratio within 5%)
OFF voltage/current : 17.5VDC or more / 3.0mA or less
ON voltage/current : 1.8VDC or less / 0.18mA or less
Input resistance: Approximate 10kΩ
Response time (OFF -> ON or ON -> OFF): 1ms
Applicable size of wire : 0.3mm$^2$

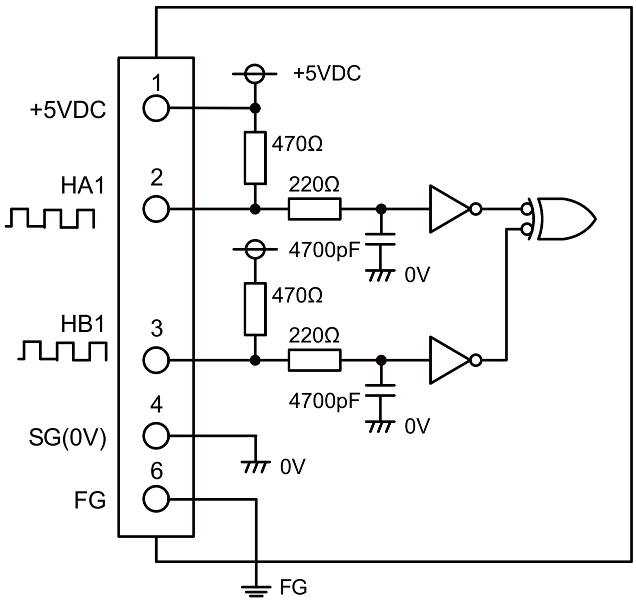
## (8) MPG

Connector for 5V manual pulse generator



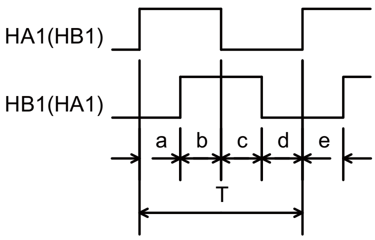

70553-0005
(MOLEX)

| | | |
|---|---|---|
| 1 | OUT | 5VDC |
| 2 | IN | HA1 |
| 3 | IN | HB1 |
| 4 | OUT | SG(0V) |
| 5 | | - |
| 6 | | FG |




Input pulse signal type: 90°phase difference between HA1 and HB1
Max. input pulse frequency: 5kHz
Number of pulses per rotation: 100pulse/rev Input signal voltage: H level 3.5V to 5.25V, L level 0V to 0.5V
For pulse generators

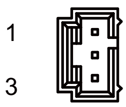
Power voltage for pulse generators : 5VDC±10%
Max. output current: 100mA




a.b.c.d.e: HA1 or HB1 rising edge (falling edge) phase difference = T/4 ± T/10
T: Ha1 or HB1 phase cycle (Min. 10 $\mu$ s)

## (9) RIO

Connector for Dual signal module

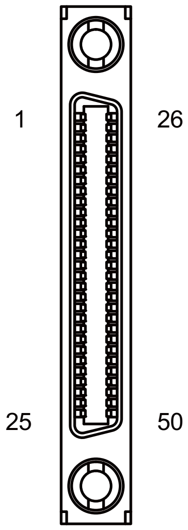



70553-0002
(MOLEX)

| | | |
|---|---|---|
| 1 | IN/OUT | RXTXH |
| 2 | IN/OUT | RXTXL |
| 3 | | SG(V) |

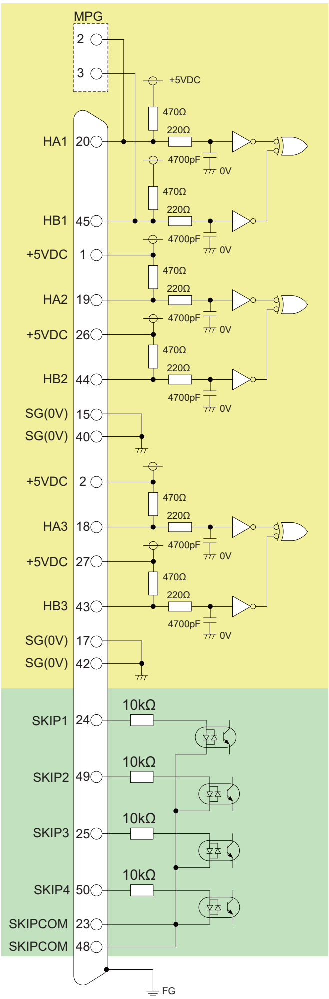
### (10) EXT I/F

Connector for the expansion connection of skip signal/ 5V manual pulse generator



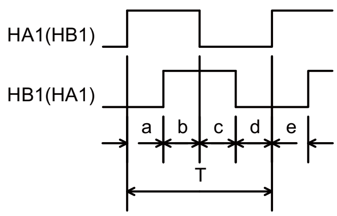

HDR-EC50LFDT1-SDL+
(HONDA)

| | | | | | |
|---|---|---|---|---|---|
| 1 | OUT | 5VDC | 26 | OUT | 5VDC |
| 2 | OUT | 5VDC | 27 | OUT | 5VDC |
| 3 | OUT | SG(0V) | 28 | OUT | SG(0V) |
| 4<br>11 | (Reserve) | | 29 | OUT | SG(0V) |
| | | | 30<br>36 | (Reserve) | |
| 12 | OUT | SG(0V) | 37 | OUT | SG(0V) |
| 13 | | (Reserve) | 38 | | (Reserve) |
| 14 | | (Reserve) | 39 | | (Reserve) |
| 15 | OUT | SG(0V) | 40 | OUT | SG(0V) |
| 16 | | (Reserve) | 41 | | (Reserve) |
| 17 | OUT | SG(0V) | 42 | OUT | SG(0V) |
| 18 | IN | HA3 | 43 | IN | HB3 |
| 19 | IN | HA2 | 44 | IN | HB2 |
| 20 | IN | HA1 | 45 | IN | HB1 |
| 21 | | (Reserve) | 46 | | (Reserve) |
| 22 | | (Reserve) | 47 | | (Reserve) |
| 23 | IN | SKIPCOM | 48 | IN | SKIPCOM |
| 24 | IN | SKIP1 | 49 | IN | SKIP2 |
| 25 | IN | SKIP3 | 50 | IN | SKIP4 |



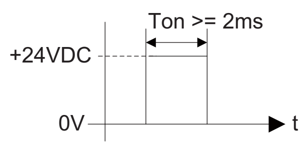

---Manual pulse generator I/F specification----
Input pulse signal type: 90°phase difference between HA1 and HB1.
Max. input pulse frequency : 5kHz
Number of pulses per rotation: 100pulse/rev
Input signal voltage : H level 3.5V to 5.25V, L level 0V to 0.5V
Output power voltage : +5VDC -10% -10%
Max. output current : 100mA

(Note) The connector MPG and EXT I/F have input pins for HA1 and HB1. Use either of the connectors. Use either of the connectors.




a.b.c.d.e: HA1 or HB1 rising edge (falling edge) phase difference = T/4 ± T/10
T: Ha1 or HB1 phase cycle (Min. 10μs)

---SKIP I/F specification---
Input ON voltage : 18V or more to 25.2V or less
Input ON current : 2mA or more
Input OFF voltage : 4V or less
Input OFF current : 0.4mA or less
Input signal holding time (Ton) : 2ms or more
Internal response time : 0.08ms or less



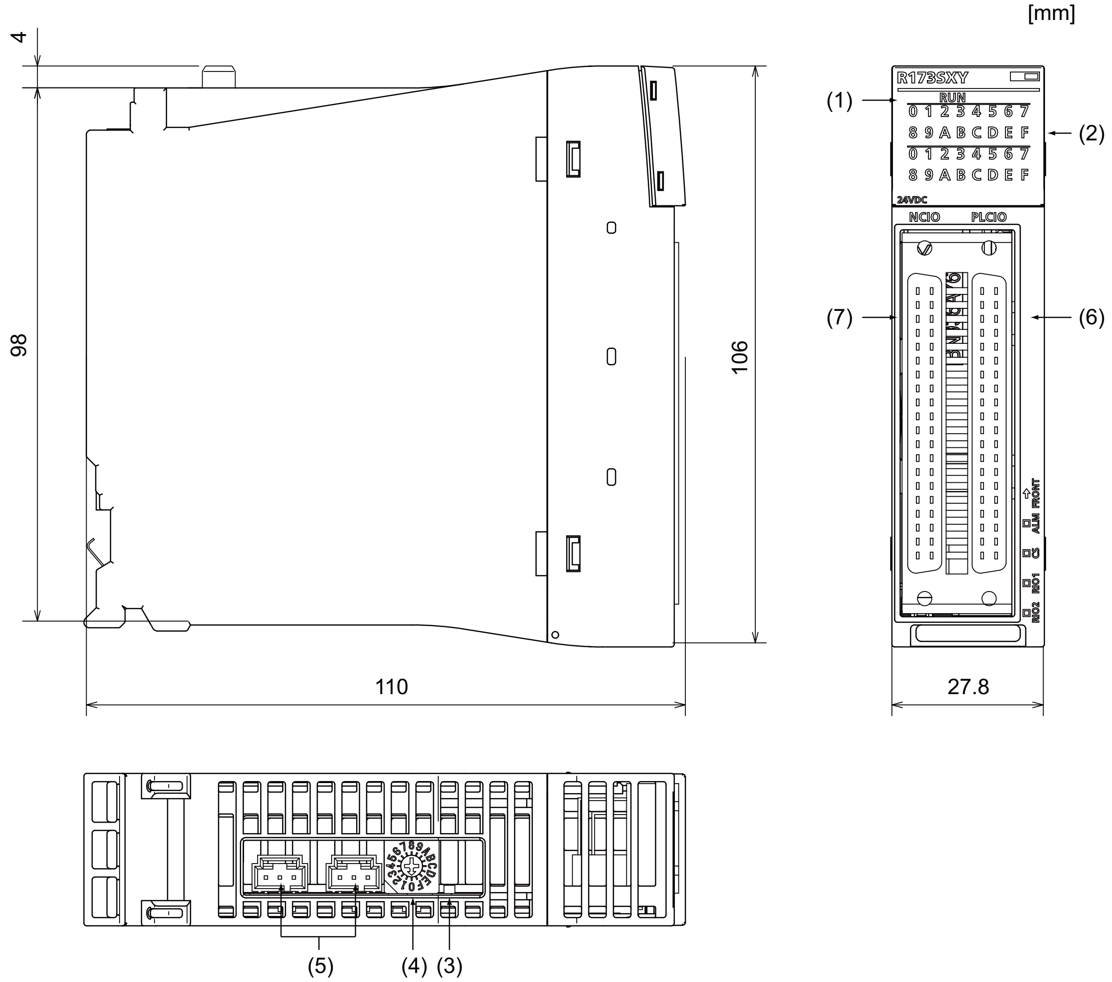

(Note) NC recognizes input signals of 2ms or more as the valid skip signals. If machine contacts (relay, etc.) are used, malfunctions will occur due to chattering. Use semiconductor contacts (transistor, etc.).

## 4.6 Dual Signal Module

Use the dual signal module within the following specifications.

| Items | Specifications |
|---|---|
| | R173SXY |
| Number of input points | 32 points x 2 systems (32 points for PLC CPU control + 32 points for CNC CPU control, 20 points x 2 systems for safety input, 12 points x 2 systems for feedback input for output) |
| Input insulation method | Photocoupler insulation |
| Rated input voltage | 24VDC (+20/-15%, ripple ratio within 5%) |
| Rated input current | Approximate 4mA |
| Input derating | Refer to the derating figure |
| ON voltage/ON current | 19V or more/3mA or more |
| OFF voltage/OFF current | 4V or less / 1.7mA or less |
| Input resistance | Approximate 5.6kΩ |
| Input response time | 1ms |
| Input common method | 32 points/common<br>(Common terminal 1A01, 1A02, 2A01, 2A02)<br>(Each part-system has a different common.) |
| Input type | Type 1, Current sinking |
| Number of output points | 12 points x 2 systems |
| Output insulation method | Photocoupler insulation |
| Rated load voltage | 24VDC (+20/-15%) |
| Maximum load current | (0.1A x 8 points, 0.2A x 4 points) x 2 systems<br>Common current: 1.6A or less for each connector |
| Utilization category | DC12/DC13 |
| Maximum rush current | 0.7A,10ms or less (1.4A, 10ms or less for 0.2A output pin) |
| OFF-time leakage current | 0.1mA or less |
| ON-time maximum voltage drop | 0.1VDC(TYP.)0.1A, 0.2VDC(MAX.)0.1A |
| Output response time | 1ms or less (at rated load and resistance load) |
| Output common method | 12 points/common<br>(Common terminal 1B01, 1B02, 2B01, 2B02)<br>(Each part-system has a different common.) |
| Output | Current sourcing |
| Surge suppressor | Zener diode |
| Fuse | Not provided |
| External power supply | 24VDC (+20/-15%, ripple ratio within 5%) |
| Protection | Provided (thermal protection and short circuit protection)<br>Thermal protection works for each 2 points.<br>Short circuit protection works for each 1 point. (1 to 3A/point) |
| Withstand voltage | 560VAC rms/3cycles (at 2000m elevation) |
| Insulation resistance | 10MΩ or more (measured with an insulation resistance tester) |
| Noise withstand level | Simulator noise 500Vp-p, Noise width 1μs<br>measured with a noise simulator with noise frequency 25 to 60Hz |
| | First transient noise IEC61000-4-4: 1kV |
| Protection degree | IP2X |
| Number of I/O occupational points | 32 points (with I/O assignments as 32 points I/O mixed unit) |
| Operation display | ON display (LED) and 32 input points display for PLC CPU control |
| External connection method | 40-pin connector |
| Applicable size of wire | 0.3mm$^2$ (for A6CON1 and A6CON4) |
| Connector for external wiring | A6CON1, A6CON2, A6CON3, A6CON4 (sold separately) |
| Terminal block changeover unit | FA-LTB40P (Cable FA-CBL □□ FMV-M) |
| 5VDC internal power dissipation | 200mA (TYP. when all points are ON) |
| Mass | 0.14kg |

### Names of parts



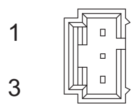

**(1) RUN LED**
Shows the operating state of the dual signal module.

**(2) LED**
Shows the input signal state of PLCIO (part-system 2).

**(3) ALM LED**
Shows the communication state with the CNC CPU module.

**(4) RSW**
Rotary switch for station No. setting Set within the range of 0 to 2.

**(5) RIO1/RIO2**
Connector for connecting the CNC CPU module and the 2nd or subsequent dual signal module.

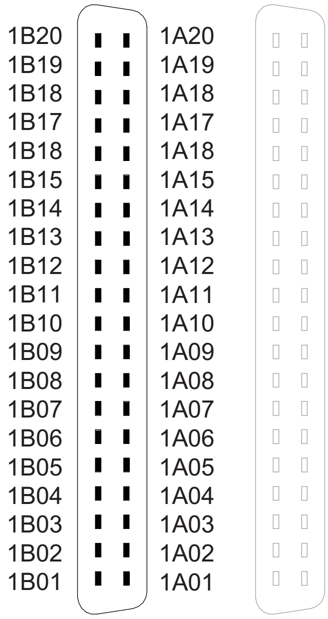



70553-0005
(MOLEX)

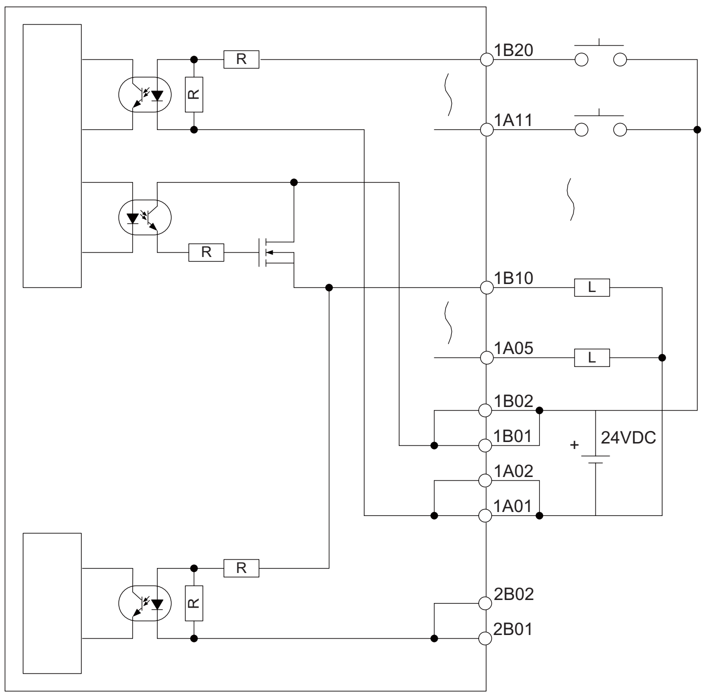
| | | |
|---|---|---|
| 1 | IN/OUT | RXTXH |
| 2 | IN/OUT | RXTXL |
| 3 | | SG(V) |

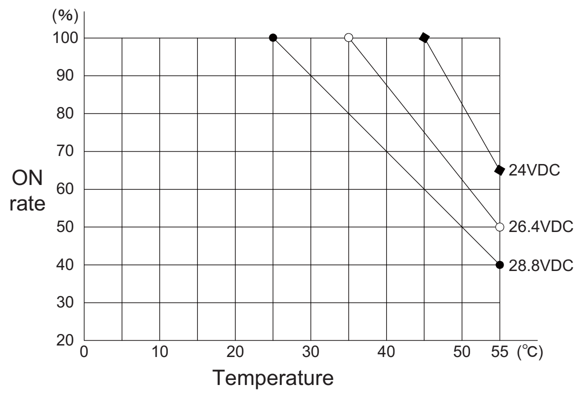
### (6) NCIO

Part-system 1 I/O signal connector




| | | | | | | |
|---|---|---|---|---|---|---|
| **1B20** | IN | NC-X00 | | **1A20** | IN | NC-X10 |
| **1B19** | IN | NC-X01 | | **1A19** | IN | NC-X11 |
| **1B18** | IN | NC-X02 | | **1A18** | IN | NC-X12 |
| **1B17** | IN | NC-X03 | | **1A17** | IN | NC-X13 |
| **1B16** | IN | NC-X04 | | **1A16** | IN | NC-X14 |
| **1B15** | IN | NC-X05 | | **1A15** | IN | NC-X15 |
| **1B14** | IN | NC-X06 | | **1A14** | IN | NC-X16 |
| **1B13** | IN | NC-X07 | | **1A13** | IN | NC-X17 |
| **1B12** | IN | NC-X08 | | **1A12** | IN | NC-X18 |
| **1B11** | IN | NC-X09 | | **1A11** | IN | NC-X19 |
| **1B10(*)** | IN/OUT | NC-Y0A/PC-X0A | | **1A10(*)** | IN/OUT | NC-Y1A/PC-X1A |
| **1B09(*)** | IN/OUT | NC-Y0B/PC-X0B | | **1A09(*)** | IN/OUT | NC-Y1B/PC-X1B |
| **1B08** | IN/OUT | NC-Y0C/PC-X0C | | **1A08** | IN/OUT | NC-Y1C/PC-X1C |
| **1B07** | IN/OUT | NC-Y0D/PC-X0D | | **1A07** | IN/OUT | NC-Y1D/PC-X1D |
| **1B06** | IN/OUT | NC-Y0E/PC-X0E | | **1A06** | IN/OUT | NC-Y1E/PC-X1E |
| **1B05** | IN/OUT | NC-Y0F/PC-X0F | | **1A05** | IN/OUT | NC-Y1F/PC-X1F |
| **1B04** | | --- | | **1A04** | | --- |
| **1B03** | | --- | | **1A03** | | --- |
| **1B02** | | 24VDC(COM1) | | **1A02** | | 0V(COM2) |
| **1B01** | | 24VDC(COM1) | | **1A01** | | 0V(COM2) |



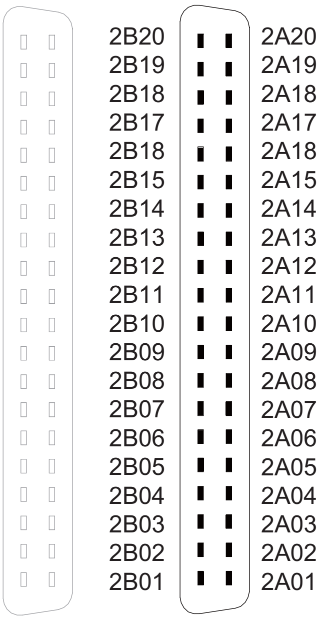

(Note 1) Output pins with (*) allow 0.2A output. Other pins have 0.1A output.

(Note 2) Pins with signal names "NC-Y0A" and "NC-X0A" are the output signals controlled by CNC CPU. When any of the signals is output to Y0A, the signal is input to X0A as a feedback signal.

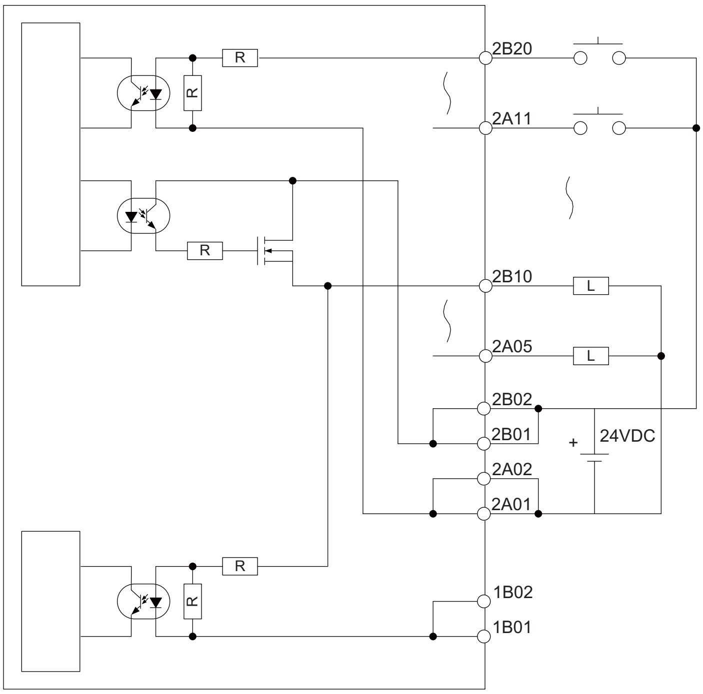
(Note 3) The device Nos. written above are for the assignment on hardware. These Nos. are different from the device Nos. to be actually used.

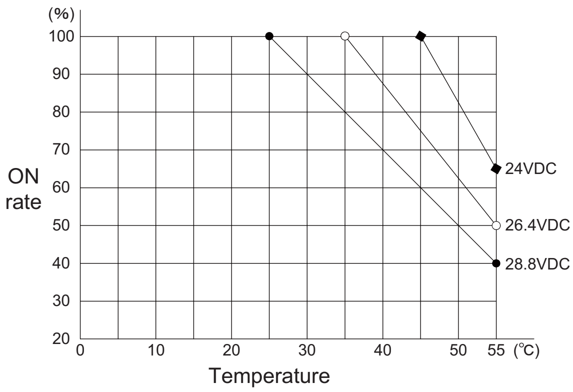
## (7) PLCIO

Part-system 2 I/O signal connector




| | | | | | | |
|---|---|---|---|---|---|---|
| **2B20** | IN | PC-X00 | | **2A20** | IN | PC-X10 |
| **2B19** | IN | PC-X01 | | **2A19** | IN | PC-X11 |
| **2B18** | IN | PC-X02 | | **2A18** | IN | PC-X12 |
| **2B17** | IN | PC-X03 | | **2A17** | IN | PC-X13 |
| **2B16** | IN | PC-X04 | | **2A16** | IN | PC-X14 |
| **2B15** | IN | PC-X05 | | **2A15** | IN | PC-X15 |
| **2B14** | IN | PC-X06 | | **2A14** | IN | PC-X16 |
| **2B13** | IN | PC-X07 | | **2A13** | IN | PC-X17 |
| **2B12** | IN | PC-X08 | | **2A12** | IN | PC-X18 |
| **2B11** | IN | PC-X09 | | **2A11** | IN | PC-X19 |
| **2B10(*)** | IN/OUT | PC-Y0A/NC-X0A | | **2A10(*)** | IN/OUT | PC-Y1A/NC-X1A |
| **2B09(*)** | IN/OUT | PC-Y0B/NC-X0B | | **2A09(*)** | IN/OUT | PC-Y1B/NC-X1B |
| **2B08** | IN/OUT | PC-Y0C/NC-X0C | | **2A08** | IN/OUT | PC-Y1C/NC-X1C |
| **2B07** | IN/OUT | PC-Y0D/NC-X0D | | **2A07** | IN/OUT | PC-Y1D/NC-X1D |
| **2B06** | IN/OUT | PC-Y0E/NC-X0E | | **2A06** | IN/OUT | PC-Y1E/NC-X1E |
| **2B05** | IN/OUT | PC-Y0F/NC-X0F | | **2A05** | IN/OUT | PC-Y1F/NC-X1F |
| **2B04** | | --- | | **2A04** | | --- |
| **2B03** | | --- | | **2A03** | | --- |
| **2B02** | | 24VDC(COM1) | | **2A02** | | 0V(COM2) |
| **2B01** | | 24VDC(COM1) | | **2A01** | | 0V(COM2) |




(Note 1) Output pins with (*) allow 0.2A output. Other pins have 0.1A output.

(Note 2) The device Nos. written above are for the assignment on hardware. These Nos. are different from the device Nos. to be actually used.

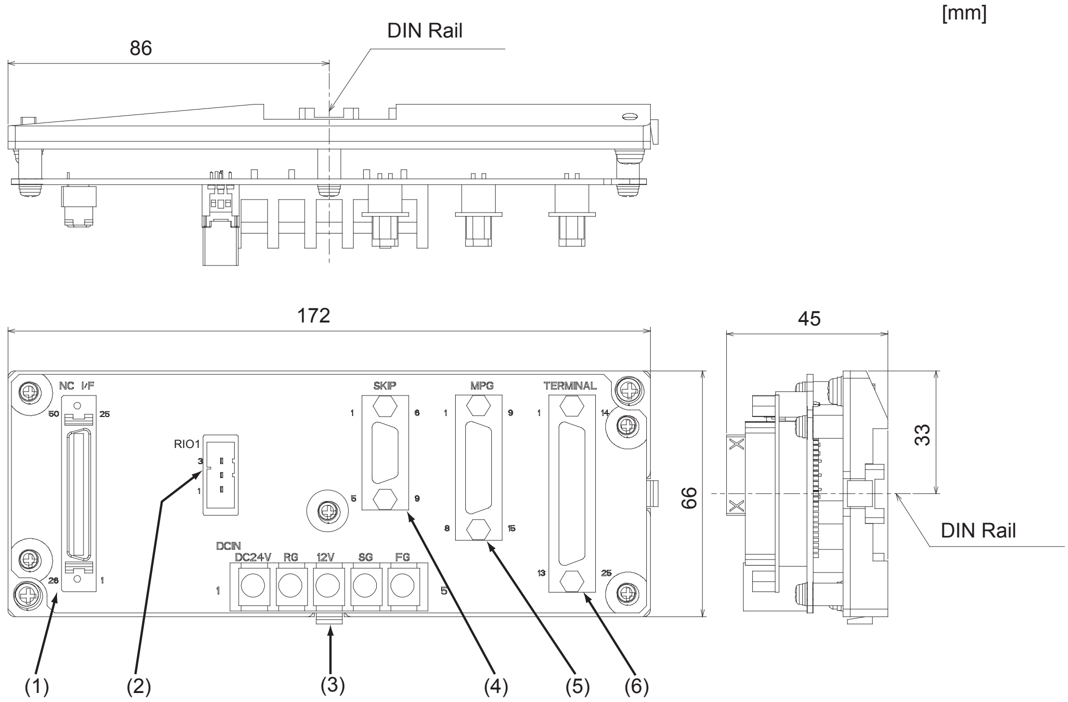
<Cable side connector type>

<table>
<tr><th>Connector type</th><th>Pressure displacement type</th><th>Crimp-contact type</th><th>Soldering type</th></tr>
<tr><td>Connector</td><td>FCN-367J040-AU/F</td><td>FCN-363J040</td><td>FCN-361J040-AU</td></tr>
<tr><td>Contact</td><td>-</td><td>AWG#24 to #28: FCN-363J-AU<br>AWG#22 to #26: FCN-363J-AU/S</td><td>-</td></tr>
<tr><td rowspan="2">Case</td><td rowspan="2">-</td><td colspan="2">FCN-360C040-B<br>FCN-360C040-D (Wide-mouthed type)<br>FCN-360C040-E (Long screw type)</td></tr>
<tr><td>-</td><td>FCN-360C040-H/E (Side-mouthed type)<br>FCN-360C040-J1 (Sloped-mouth cover)<br>FCN-360C040-J2 (Thin sloped-mouth cover)</td></tr>
<tr><td>Manufacturer</td><td colspan="3">FUJITSU Component</td></tr>
</table>

# 4.7 Signal Splitter

(Note) Signal splitter allows DIN rail installation only.

### Dimension and Names of parts




**(1) NC I/F**

Connector for CNC CPU

**(2) RIO1**

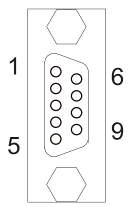
(Not used)

**(3) DCIN**

Terminal block for power supply (Used for the 12V power supply type manual pulse generator)

**(4) SKIP**

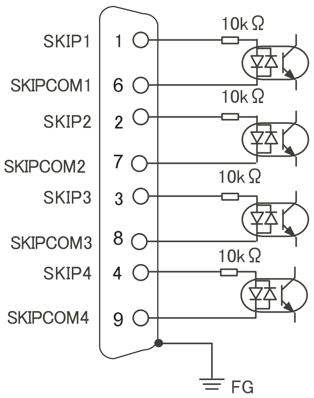
Connector for skip signal




D-SUB 9pin

| | | |
|---|---|---|
| 1 | IN | SKIP1 |
| 2 | IN | SKIP2 |
| 3 | IN | SKIP3 |
| 4 | IN | SKIP4 |
| 5 | | --- |

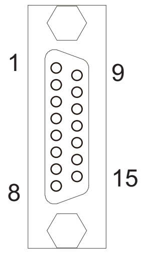
| | | |
|---|---|---|
| 6 | IN | COM1 |
| 7 | IN | COM2 |
| 8 | IN | COM3 |
| 9 | IN | COM4 |




---SKIP I/F specification---
Input ON voltage: 18V or more to 25.2V or less
Input ON current: 6mA or more
Input OFF voltage: 4V or less
Input OFF current: 2mA or less
Input signal holding time (Ton): 2ms or more
Internal response time: 0.08ms or less
(Note) NC recognizes input signals of 2ms or more as the valid skip signals. If machine contacts (relay, etc.) are used, malfunctions will occur due to chattering. Use semiconductor contacts (transistor, etc.).

**(5) MPG**

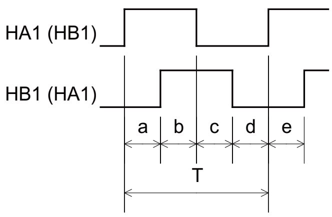
5V/12V Connector for manual pulse generator




D-SUB 15pin

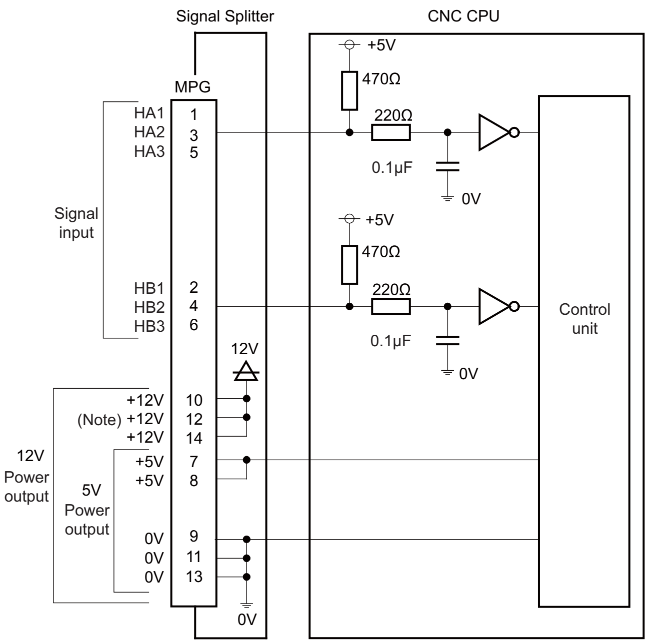
| | | | | | |
|---|---|---|---|---|---|
| 1 | IN | HA1 | 9 | OUT | SG(0V) |
| 2 | IN | HB1 | 10 | OUT | +12VDC |
| 3 | IN | HA2 | 11 | OUT | SG(0V) |
| 4 | IN | HB2 | 12 | OUT | +12VDC |
| 5 | IN | HA3 | 13 | OUT | SG(0V) |
| 6 | IN | HB3 | 14 | OUT | +12VDC |
| 7 | OUT | +5VDC | 15 | | --- |
| 8 | OUT | +5VDC | | | |

| | 5V manual pulse generator (UFO-01-2Z9) input conditions | 12V manual pulse generator (HD60C) input conditions |
|---|---|---|
| **Input pulse signal type** | HA1 and HB1 phases (with phase difference 90°) (Refer to the waveform below.) | |
| **Input signal voltage** | H level 3.5V to 5.25V<br>L level 0V to 0.5V | |
| **Max. input pulse frequency** | 5kHz | |
| **Pulse generators power supply voltage** | 5VDC±10% | 12VDC±10% |
| **Current consumption** | 100mA or less | |
| **Number of pulses per rotation** | 100 pulse/rev | 25 pulse/rev |




a.b.c.d.e: HA1 or HB1 rising edge (falling edge) phase difference = T/4 ± T/10

T: HA1 or HB1 cycle (Min. 10 $\mu$ s)




(Note) 12V power is separately required to connect 12V manual pulse generator.
(Refer to "6.9 Connecting the Manual Pulse Generator".)

**(6) TERMINAL**

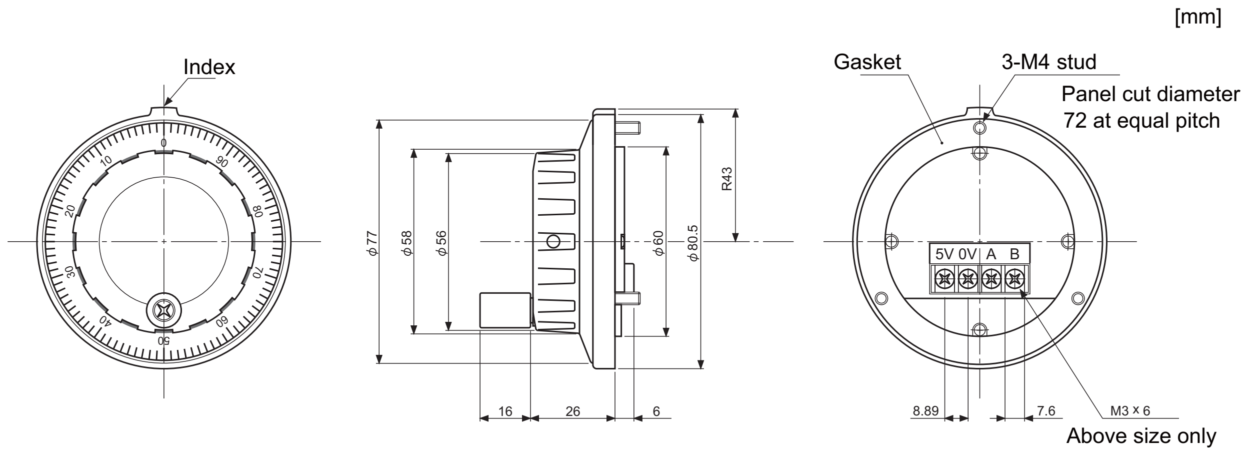
(Not used)

# 4.8 Manual Pulse Generator

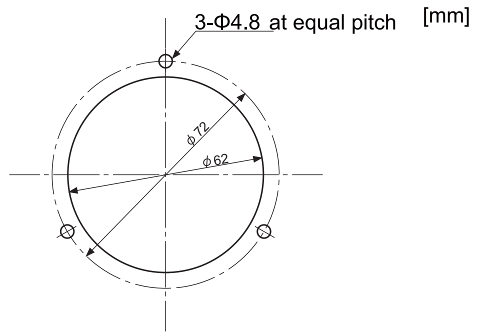
## 4.8.1 5V Manual Pulse Generator (UFO-01-2Z9)

100 pulse/rev

**[Outline dimension]**




**[Panel cut dimension]**



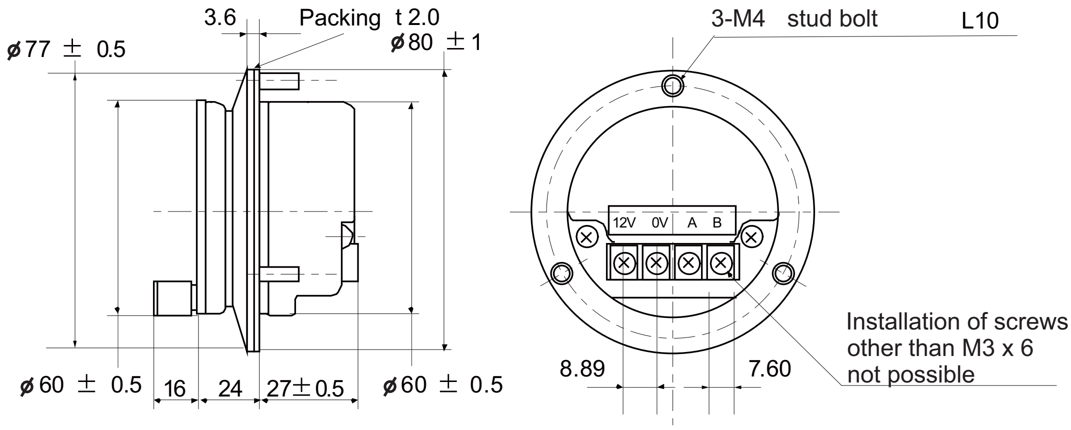

Produced by NIDEC NEMICON CORPORATION

### 4.8.2 Manual Pulse Generator (HD60C)

25 pulse/rev

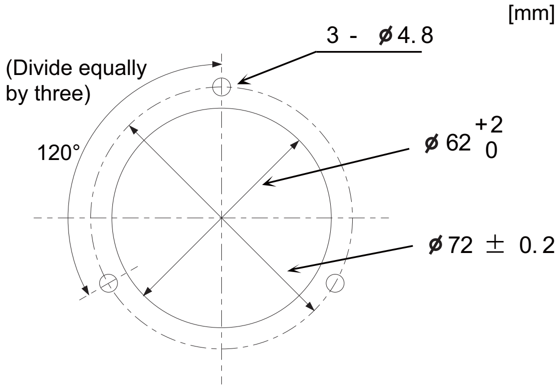
**[Outline dimension]**

[mm]




**[Panel cut dimension]**

[mm]




# 4.9 Recommended Terminal Block for Dual Signal Module

Terminal block converter module FA-TBS40P or FA-LTB40P, produced by MITSUBISHI ELECTRIC ENGINEERING, is recommended to connect the dual signals to the dual signal module. Use the connection cable FA-CBL □□ FMV-M produced by MITSUBISHI ELECTRIC ENGINEERING.
[MITSUBISHI ELECTRIC ENGINEERING: http://www.mee.co.jp]

# Revision History

| Date of revision | Manual No. | Revision details |
|---|---|---|
| Feb. 2015 | IB(NA)1501267-A | First edition created. |
| Mar. 2015 | IB(NA)1501267-B | The descriptions of M800S Series/M80 Series and the following chapters were added to "MITSUBISHI CNC M800/M80 Series Specifications List" and the general specifications.<br>- 5.2.5 Multi-part System Simultaneous Program Editing<br>- 5.2.6 Special Program Editing Display for Synchronization between Part Systems<br>- 6.3.8 Home Application<br>- 12.3.2.4 Tolerance Control<br>- 12.4.3 Interactive Cycle Insertion<br>- 14.3.5 Power ON/OFF Sequence<br>- 15.3.13 Data Protection by User's Level<br>- 17.2.13 Simple Inclined Surface Machining Command<br>- 17.2.20.2 Real-time Tuning 2 (Rapid Traverse Time Constant)<br>- 17.6.5 EtherNet/IP<br>- 17.7.6 MES Interface Library<br>- 17.8.4 Power Consumption Computation<br>- 17.8.5 EcoMonitorLight Connection<br>"M800W Series General Specifications", "M800S Series General Specifications" and "M80 Series General Specifications" were added.<br>Other contents were added/revised/deleted according to specification. |
| Sep. 2015 | IB(NA)1501267-C | The descriptions of M800 Series/M80 Series were revised in response to S/W version A4.<br><br>"MITSUBISHI CNC M800/M80 Series Specifications List" , "M800/M80 Series Function Specifications".<br>The following chapters were added.<br>- 3.3.6 Spline Interpolation2 (G61.4)<br>- 6.1.1 Color Display(8.4-type LCD TFT)<br>- 6.1.6 Color touchscreen display(15-type LCD TFT/Windows8)<br>- 12.1.9.6 R-Navi Data Input by Program<br>- 16.1 MDS-EJH-SPx<br>- 16.1 MDS-EJ-SPx<br>- 17.1.3.6 Ladder Program Writing during RUN<br>- 17.4.5 Direct screen selection<br><br>"M800W Series General Specifications"<br>The following units were added.<br>- FCU8-DU181-34 (15-type Display Unit)<br>- FCU8-KB083 (Keyboard for 15-type Display Unit)<br>- FCU8-DX213 (Remote I/O Unit)<br>The following chapters were added.<br>- 2.1 General Connection Diagram [15-type]<br>- 3.4 Keyboard Unit<br>- 3.10 Cable Connector Sets"<br><br>M800S Series General Specifications"<br>The following units were added.<br>- FCU8-KB083 (Keyboard for 15-type Display Unit)<br>The following chapters were added.<br>- 3.3 Keyboard Unit [M800S]<br>- 3.9 Cable Connector Sets<br><br>(Continue to the next page) |

| Date of revision | Manual No. | Revision details |
| --- | --- | --- |
| | | (Continued from the previous page)<br><br>"M80 Series General Specifications"<br>The following units were added.<br>- FCU8-DU121-12 (8.4-type Display Unit)<br>- FCU8-KB026 (Keyboard for 8.4-type Display Unit)<br>- FCU8-KB083 (Keyboard for 15-type Display Unit)<br>The following chapters were added.<br>- 3.3 Keyboard Unit [M80]<br>- 3.9 Cable Connector Sets<br>- 4.4.1 Keyboard for 8.4-type Display Unit (FCU8-KB026)<br><br>Other contents were added/revised/deleted according to specification. |
| Mar. 2016 | IB(NA)1501267-D | The descriptions of M800 Series/M80 Series were revised in response to S/W version B2.<br><br>"MITSUBISHI CNC M800/M80 Series Specifications List" was divided into “L system” and “M system”.<br>"MITSUBISHI CNC M800/M80 Series Specifications List", "M800/M80 Series Function Specifications".<br>The following chapters were added.<br><br>-1.3.6 Front-side USB Memory Mode<br>-6.2.20 Remote Desktop Connection<br>-6.3.9 Home Screen<br>-8.1.1.7 Spindle-mode Rotary Axis Control<br>-8.1.15 Multiple Spindle Synchronization Set Control<br>-9.1.4 Tool position compensation (G43.7)<br>-9.3.2.2 Compensation Type Selection by Parameter<br>-12.1.8.8.2 Multi-part System Simultaneous Thread Cutting<br>-12.4.3 Interactive Cycle Insertion<br>-15.4.11 Diagnosis Data Output<br>-17.2.13 Simple Inclined Surface Machining Command<br>-17.2.20.2 Real-time Tuning 2 (Rapid Traverse Time Constant)<br><br>Other contents were added/revised/deleted according to specification. |
| May 2016 | IB(NA)1501267-E | The descriptions of M800 Series/M80 Series were revised in response to S/W version C0.<br><br>"MITSUBISHI CNC M800/M80 Series Specifications List", "M800/M80 Series Function Specifications".<br>The descriptions of M80W Series and the following chapters were added.<br>-5.2.7 Finish Shape View Programming<br>-15.3.7 Interference Check III<br>-15.3.8 3D Machine Interference Check<br>-17.4.6 Buzzer Sound Control<br><br>"M80W Series General Specifications" was added.<br><br>(Continue to the next page) |

| Date of revision | Manual No. | Revision details |
| --- | --- | --- |
| | | (Continued from the previous page)<br><br>“M800W Series General Specifications"<br>The following units were added.<br>- FCU8-DU141-31 (10.4-type Display Unit)<br>- FCU8-DU181-31 (15-type Display Unit)<br>- FCU8-DU192-75 (19-type Display Unit)<br>- FCU8-GC211 (Graphic Control Unit)<br>- FCU8-KB041 (Keyboard for 10.4-type Display Unit)<br>- FCU8-KB046 (Keyboard for 10.4-type Display Unit)<br>- FCU8-KB047 (Keyboard for 10.4-type Display Unit)<br>- FCU8-KB048 (Keyboard for 10.4-type Display Unit)<br>- FCU8-DX730 (Operation Panel I/O Unit)<br>- FCU8-DX202 (Remote I/O Unit)<br>- FCU8-EX544 (Encoder (Manual Pulse Generator) I/F Expansion Unit)<br>- FCU8-EX563 (PROFIBUS-DP Expansion Unit)<br>The following chapters and sections were added.<br>- 2.1.3 M800W, Windows-less display (10.4-type/15-type)<br>- 3.4 Graphic Control Unit<br>- 3.8 Function Expansion Unit<br>- 3.12 Synchronous Feed Encoder<br>- 3.14 Genuine Memory Card<br>- 4.5 Graphic Control Unit<br>- 4.6.1 Keyboard for 10.4-type Display Unit (FCU8-KB041)<br>- 4.6.2 Keyboard for 10.4-type Display Unit (FCU8-KB046)<br>- 4.6.3 Keyboard for 10.4-type Display Unit (FCU8-KB047)<br>- 4.6.4 Keyboard for 10.4-type Display Unit (FCU8-KB048)<br>- 4.9 Function Expansion Unit<br>- 4.10.2 PROFIBUS-DP (FCU8-EX563)<br>- 4.13 Synchronous Feed Encoder<br>- 4.14 Exclusive SD cards for MITSUBISHI CNC<br><br>Chapter title Change<br>Some of chapter titles were changed to correspond with M80W and Windows-less Display<br><br>“M800S Series General Specifications"<br>The following units were added.<br>- FCU8-MU542 (Control Unit)<br>- FCU8-MA542 (Control Unit)<br>- FCU8-KB041 (Keyboard for 10.4-type Display Unit)<br>- FCU8-KB048 (Keyboard for 10.4-type Display Unit)<br>- FCU8-DX202 (Remote I/O Unit)<br>- FCU8-EX563 (PROFIBUS-DP Expansion Unit)<br>The following chapters and sections were added.<br>- 3.11Genuine Memory Card<br>- 4.4.1 Keyboard for 10.4-type Display Unit (FCU8-KB041)<br>- 4.4.4 Keyboard for 10.4-type Display Unit (FCU8-KB048)<br>- 4.7.2 PROFIBUS-DP (FCU8-EX563)<br>- 4.11 Exclusive SD cards for MITSUBISHI CNC<br><br>Chapter number change<br>Section 4.7.2 was changed into 4.7.3<br><br>(Continue to the next page) |

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| | | (Continued from the previous page)<br><br>“M80 Series General Specifications"<br>The following units were added.<br>- FCU8-MU511 (Control Unit)<br>- FCU8-MU512 (Control Unit)<br>- FCU8-KB028 (Keyboard for 8.4-type Display Unit)<br>- FCU8-KB029 (Keyboard for 8.4-type Display Unit)<br>- FCU8-KB041 (Keyboard for 10.4-type Display Unit)<br>- FCU8-KB048 (Keyboard for 10.4-type Display Unit)<br>- FCU8-DX202 (Remote I/O Unit)<br>- FCU8-EX133 (Functional Safety Expansion Unit)<br>- FCU8-EX563 (PROFIBUS-DP Expansion Unit)<br><br>The following chapters and sections were added.<br>- 3.9 Function Expansion Unit [M80]<br>- 3.10 Genuine Memory Card<br>- 4.4.2 Keyboard for 8.4-type Display Unit (FCU8-KB028)<br>- 4.4.3 Keyboard for 8.4-type Display Unit (FCU8-KB029)<br>- 4.4.4 Keyboard for 10.4-type Display Unit (FCU8-KB041)<br>- 4.4.7 Keyboard for 10.4-type Display Unit (FCU8-KB048)<br>- 4.7 Function Expansion Unit<br>- 4.8.2 PROFIBUS-DP (FCU8-EX563)<br>- 4.11 Exclusive SD cards for MITSUBISHI CNC<br><br>Chapter number change<br>Section 4.7.2 was changed into 4.7.3<br><br>Other contents were added/revised/deleted according to specification. |
| Nov. 2016 | IB(NA)1501267-F | The contents of C80 Series S/W version A1 and the following chapters were added to "MITSUBISHI CNC M800/M80/C80 Series Specifications List" and Functional Specifications page.<br>- 4.5.3.102 Multiple Spindle Synchronous Tapping<br>- 6.1.102 GOT (GOT2000 Series H/M Model 15/12.1/10.4/8.4)<br>- 6.2.3 Multiple Display Connection<br>- 6.2.4 Common Display to Multiple NCs<br>- 7.2.101 USB I/F (GOT Front Side USB I/F)<br>- 7.2.102 SD I/F (GOT Back Side SD Card I/F)<br>- 14.3.101 PLC Axis Current Limit<br>- 15.4.102 Backup<br>- 17.1.9 GOT Connection<br>- 17.1.9.1 CPU Direct Connection (RS-422/RS-232C)<br>- 17.1.9.2 CC-Link Connection (Remote Device)<br>- 17.1.9.3 CC-Link Connection (Intelligent Terminal)<br>- 17.1.101 Built-in PLC Processing Mode<br>- 17.3.101 NC axis/PLC axis Switchover<br>- 17.6.3 CC-Link IE Field (Master/Slave)<br>- 17.7.102 GOT2000 Screen Design Tool GT Works3<br>- 17.8.102 GOT Window<br>- 17.8.103 Log Viewer<br><br>"C80 series General Specifications" were added.<br><br>Other contents were added/revised/deleted according to MITSUBISHI CNC M800/M80 Series S/W version C1.<br><br>(Continue to the next page) |

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| | | (Continued from the previous page)<br><br>"M800S Series General Specifications"<br>The following units were added.<br>- FCU8-DX760(Operation Panel I/O Unit)<br>- FCU8-DX761(Operation Panel I/O Unit)<br><br>Chapter titles change<br>4.5.2 FCU8-DX750/FCU8-DX760/FCU8-DX761<br><br>"M80 Series General Specifications"<br>The following units were added.<br>- FCU8-DX760(Operation Panel I/O Unit)<br>- FCU8-DX761(Operation Panel I/O Unit)<br><br>Chapter titles change<br>4.5.2 FCU8-DX750/FCU8-DX760/FCU8-DX761<br><br>Other contents were added/revised/deleted according to specification. |
| Apr. 2017 | IB(NA)1501267-G | The descriptions of M800 Series/M80 Series were revised in response to S/W version C3.<br><br>"MITSUBISHI CNC M800/M80/C80 Series Specifications List (L system)" was divided as follows:<br>"MITSUBISHI CNC M800W/M800S Series Specifications List (L system)"<br>"MITSUBISHI CNC M80W/M80/C80 Series Specifications List (L system)"<br><br>"MITSUBISHI CNC M800/M80/C80 Series Specifications List (M system)" was divided as follows:<br>"MITSUBISHI CNC M800W/M800S Series Specifications List (M system)"<br>"MITSUBISHI CNC M80W/M80/C80 Series Specifications List (M system)"<br><br>"MITSUBISHI CNC M800W/M800S Series Specifications List (L system)"<br>"MITSUBISHI CNC M800W/M800S Series Specifications List (M system)"<br>"MITSUBISHI CNC M80W/M80/C80 Series Specifications List (L system)"<br>"MITSUBISHI CNC M80W/M80/C80 Series Specifications List (M system)"<br>"M800/M80/C80 Functional Specifications"<br>The following chapters were added.<br>- 1.1.7 Axis Name Extension<br>- 2.3.2 Program Format Switch<br>- 3.3.1 Involute Interpolation<br>- 6.1.4 Separated-type Color Touchscreen Display (8.4-type LCD TFT)<br>- 6.1.5 Separated-type Color Touchscreen Display (10.4-type LCD TFT)<br>- 6.1.6 Separated-type Color Touchscreen Display (15-type LCD TFT)<br>- 7.4 Others<br>- 7.4.1 Handy Terminal Connection<br>- 8.1.16 Spindle Speed Fluctuation Detection<br>- 13.1.11 Spatial Error Compensation<br>- 15.3.17 Interference Check Between Part Systems<br>- 15.3.18 Spindle Protection<br>- 15.4.9 Email Notification to Operator<br>- 17.1.3.3.3 Memory Switch (PLC Switch) 96 points<br>- 17.2.22 External Encoder Position Output I/F<br>- 17.7.7 SLMP Server<br>- 17.7.8 MITSUBISHI Communication Software for CNC FCSB1224W000<br><br>Other contents were added/revised/deleted according to specifications.<br><br><br>(Continue to the next page) |

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| | | (Continued from the previous page)<br><br>"M800W Series General Specifications"<br>The following units were added.<br>- FCU8-DX213-1 (Remote I/O unit)<br>- FCU8-DX654-1 (Remote I/O unit)<br>- FCU8-DX408 (Remote I/O unit)<br>- FCU8-EX565 (Communication expansion unit)<br>- FCU8-KB921 (MITSUBISHI CNC Machine operation panel)<br>- FCU8-KB923 (MITSUBISHI CNC Machine operation panel)<br>- FCU8-KB931 (MITSUBISHI CNC Machine operation panel)<br>- Handy terminal<br>The following chapters and sections were added.<br>- 3.13 MITSUBISHI CNC Machine Operation Panel<br>- 3.14 Handy Terminal<br>- 3.16 Thermistor Sets<br>- 4.10.3 EtherNet/IP (FCU8-EX565)<br>- 4.14 MITSUBISHI CNC Machine Operation Panel<br>- 4.15 Handy Terminal<br>- 4.16 Thermistor<br><br>Due to addition of the chapters as above, the existing chapters were renumbered.<br><br>Some of chapter titles were changed due to addition of the Remote I/O unit.<br><br><br>“M800S Series General Specifications"<br>The following units were added.<br>- FCU8-DX213-1 (Remote I/O unit)<br>- FCU8-DX654-1 (Remote I/O unit)<br>- FCU8-DX408 (Remote I/O unit)<br>- FCU8-EX565 (Communication expansion unit)<br>- FCU8-EX703 (Option relay unit)<br>- FCU8-KB921 (MITSUBISHI CNC Machine operation panel)<br>- FCU8-KB923 (MITSUBISHI CNC Machine operation panel)<br>- FCU8-KB931 (MITSUBISHI CNC Machine operation panel)<br>- Handy terminal<br>The following chapters and sections were added.<br>- 3.9 MITSUBISHI CNC Machine Operation Panel<br>- 3.10 Handy Terminal<br>- 3.12 Thermistor Sets<br>- 4.7.3 EtherNet/IP (FCU8-EX565)<br>- 4.7.5 Option Relay Unit (FCU8-EX703)<br>- 4.10 MITSUBISHI CNC Machine Operation Panel<br>- 4.11 Handy Terminal<br>- 4.12 Thermistor<br><br>Due to addition of the chapters as above, the existing chapters were renumbered.<br><br>Some of chapter titles were changed due to addition of the Remote I/O unit.<br><br><br>(Continue to the next page) |

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|---|---|---|
| | | (Continued from the previous page)<br><br>“M80W Series General Specifications"<br>The following units were added.<br>- FCU8-DX213-1 (Remote I/O unit)<br>- FCU8-DX654-1 (Remote I/O unit)<br>- FCU8-DX408 (Remote I/O unit)<br>- FCU8-EX565 (Communication expansion unit)<br>- FCU8-KB921 (MITSUBISHI CNC Machine operation panel)<br>- FCU8-KB923 (MITSUBISHI CNC Machine operation panel)<br>- FCU8-KB931 (MITSUBISHI CNC Machine operation panel)<br>- Handy terminal<br>The following chapters and sections were added.<br>- 3.13 MITSUBISHI CNC Machine Operation Panel<br>- 3.14 Handy Terminal<br>- 3.16 Thermistor Sets<br>- 4.10.3 EtherNet/IP (FCU8-EX565)<br>- 4.14 MITSUBISHI CNC Machine Operation Panel<br>- 4.15 Handy Terminal<br>- 4.16 Thermistor<br><br>Due to addition of the chapters as above, the existing chapters were renumbered.<br><br>Some of chapter titles were changed due to addition of the Remote I/O unit.<br><br>“M80 Series General Specifications"<br>The following units were added.<br>- FCU8-DX213-1 (Remote I/O unit)<br>- FCU8-DX654-1 (Remote I/O unit)<br>- FCU8-DX408 (Remote I/O unit)<br>- FCU8-EX565 (Communication expansion unit)<br>- FCU8-EX703 (Option relay unit)<br>- FCU8-KB921 (MITSUBISHI CNC Machine operation panel)<br>- FCU8-KB923 (MITSUBISHI CNC Machine operation panel)<br>- FCU8-KB931 (MITSUBISHI CNC Machine operation panel)<br>- Handy terminal<br>The following chapters and sections were added.<br>- 3.10 MITSUBISHI CNC Machine Operation Panel<br>- 3.11 Handy Terminal<br>- 3.13 Thermistor Sets<br>- 4.8.3 EtherNet/IP (FCU8-EX565)<br>- 4.8.5 Option Relay Unit (FCU8-EX703)<br>- 4.11 MITSUBISHI CNC Machine Operation Panel<br>- 4.12 Handy Terminal<br>- 4.13 Thermistor<br><br>Due to addition of the chapters as above, the existing chapters were renumbered.<br><br>Some of chapter titles were changed due to addition of the Remote I/O unit.<br><br>Other contents were added/revised/deleted according to specification. |

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**Notice**

Every effort has been made to keep up with software and hardware revisions in the contents described in this manual. However, please understand that in some unavoidable cases simultaneous revision is not possible.
Please contact your Mitsubishi Electric dealer with any questions or comments regarding the use of this product.

MITSUBISHI CNC

**MITSUBISHI ELECTRIC CORPORATION**

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|---|---|
| MODEL | M800/M80/C80 Series |
| MODEL CODE | 100-432 |
| Manual No. | IB-1501267 |

IB(NA)1501267(ENG)-G(1704)MEE
Made in JAPAN

Specifications are subject to change without notice.