FANUC

GE Fanuc Automation

Computer Numerical Control Products

Series 16i / 18i / 21i / 20i / 160i / 180i / 210i / 160is / 180is / 210is - Model A

Connection Manual (Hardware)

GFZ-63003EN/04 *July 2000*

Warnings, Cautions, and Notes as Used in this Publication

Warning

Warning notices are used in this publication to emphasize that hazardous voltages, currents, temperatures, or other conditions that could cause personal injury exist in this equipment or may be associated with its use.

In situations where inattention could cause either personal injury or damage to equipment, a Warning notice is used.

Caution

Caution notices are used where equipment might be damaged if care is not taken.

Note

Notes merely call attention to information that is especially significant to understanding and operating the equipment.

This document is based on information available at the time of its publication. While efforts have been made to be accurate, the information contained herein does not purport to cover all details or variations in hardware or software, nor to provide for every possible contingency in connection with installation, operation, or maintenance. Features may be described herein which are not present in all hardware and software systems. GE Fanuc Automation assumes no obligation of notice to holders of this document with respect to changes subsequently made.

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DEFINITION OF WARNING, CAUTION, AND NOTE

This manual includes safety precautions for protecting the user and preventing damage to the machine. Precautions are classified into Warning and Caution according to their bearing on safety. Also, supplementary information is described as a Note. Read the Warning, Caution, and Note thoroughly before attempting to use the machine.

WARNING

Applied when there is a danger of the user being injured or when there is a danger of both the user being injured and the equipment being damaged if the approved procedure is not observed.

CAUTION

Applied when there is a danger of the equipment being damaged, if the approved procedure is not observed.

NOTE

The Note is used to indicate supplementary information other than Warning and Caution.

❍ **Read this manual carefully, and store it in a safe place.**

PREFACE

This manual describes the electrical and structural specifications required for connecting the CNC control unit to a machine tool. The manual outlines the components commonly used for FANUC CNC control units, as shown in the configuration diagram in Chapter 2, and supplies additional information on using these components. Refer to individual manuals for the detailed specifications of each component.

The models covered by this manual, and their abbreviations, are :

Product Name	Abbreviations	
FANUC Series 16*i*–TA	16*i*–TA	Series 16*i*
FANUC Series 16*i*–MA	16*i*–MA	
FANUC Series 18*i*–TA	18*i*–TA	Series 18*i*
FANUC Series 18*i*–MA	18*i*–MA	
FANUC Series 21*i*–TA	21*i*–TA	Series 21*i*
FANUC Series 21*i*–MA	21*i*–MA	
FANUC Series 20*i*–TA	20*i*–TA	Series 20*i*
FANUC Series 20*i*–FA	20*i*–FA	
FANUC Series 160*i*–TA	160*i*–TA	Series 160*i*
FANUC Series 160*i*–MA	160*i*–MA	
FANUC Series 180*i*–TA	180*i*–TA	Series 180*i*
FANUC Series 180*i*–MA	180*i*–MA	
FANUC Series 210*i*–TA	210*i*–TA	Series 210*i*
FANUC Series 210*i*–MA	210*i*–MA	
FANUC Series 160*is*–TA	160*is*–TA	Series 160*is*
FANUC Series 160*is*–MA	160*is*–MA	
FANUC Series 180*is*–TA	180*is*–TA	Series 180*is*
FANUC Series 180*is*–MA	180*is*–MA	
FANUC Series 210*is*–TA	210*is*–TA	Series 210*is*
FANUC Series 210*is*–MA	210*is*–MA	

Organization of this manuals

This manual consists of chapters 1 to 15 and appendixes at the end of the book.

Chapter and title	Contents
Chapter 1 CONFIGURATION	Provides general information related to the connection of the *i* Series CNC, as well as an introduction to detailed information.
Chapter 2 TOTAL CONNECTION DAIGRAMS	Describes how to connect peripheral units to the *i* Series CNC.
Chapter 3 INSTALLATION	Describes the installation requirements for using the *i* Series CNC. 1) Required power supply capacity 2) Heat output 3) Locations of connectors on the control unit 4) Action against noise
Chapter 4 POWER SUPPLAY CONNECTION	Describes how to make connections related to the power supply of the *i* Series CNC.
Chapter 5 CONNECTION TO CNC PERIOHERALS	Describes how to connect the following peripheral devices to the *i* Series CNC: 1) MDI unit 2) I/O device (RS–232–C) 3) High–speed skip (HDI)
Chapter 6 SPINDLE CONNECTION	Describes how to connect spindle–related units to the *i* Series CNC.
Chapter 7 SERVO INTERFACE	Describes how to connect servo–related units to the *i* Series CNC.
Chapter 8 CONNECTING THE PC INTERFACE	Describes the interface unique to the *i* Series CNC that offers built–in personal computer capabilities.
Chapter 9 FANUC INTELLIGENT TERMINAL TYPE 2	Describes how to connect a FANUC Intelligent terminal type 2 to the *i* Series CNC.
Chapter 10 CONNECTION TO FANUC I/O Link	Describes how to connect machine interface I/O with the FANUC I/O Link.
Chapter 11 EMERGENCY STOP SIGNAL	Describes how to handle the emergency stop signal. Be sure to read this chapter.
Chapter 12 REMOTE BUFFER INTERFACE (INCLUDING FANUC DNC1 AND DNC2)	Describes the remote buffer, DNC1, and DNC2 interfaces that can be used with the *i* Series CNC.
Chapter 13 HIGH–SPEED SERIAL BUS (HSSB)	Describes the high–speed serial bus (HSSB) that can be used with the *i* Series CNC.
Chapter 14 CONNECTION TO OTHER NET–WORKS	Describes how to connect the *i* Series CNC to networks.
Chapter 15 CONNECTING TO THE INTERGRATED TYPE Series 160*i*s/180*i*s/210*i*s	Describes the connection unique to Series 160*i*s/180*i*s/210*i*s of the integrated type.
APPENDIX	A) EXTERNAL DIMENSIONS OF EACH UNIT B) 20–PIN INTERFACE CONNECTORS AND CABLES C) CONNECTION CABLE (SUPPLIED FROM US) D) OPTICAL FIBER CABLE E) LIQUID CRYSTAL DISPLAY (LCD) F) MEMORY CARD INTERFACE G) ABOUT the MMX–Pentium VERSION 160*i*/180*i*/210*i*

Related manuals

– Series 16*i*/18*i*/21*i*/160*i*/ 180*i*/210*i*/160*i*s/180*i*s

The table below lists manuals related to MODEL A of Series 16*i*, Series 18*i*, Series 21*i* Series 160*i* and Series 180*i*, Series 210*i* .
In the table, this manual is marked with an asterisk(*).

List of the Manuals Related to Series 16*i*/18*i*/21*i*/160*i*/180*i*/210*i*/160*i*s/180*i*s

Manual name	Specification number	
DESCRIPTIONS	B–63002EN	
CONNECTION MANUAL (Hardware)	B–63003EN	*
CONNECTION MANUAL (Function)	B–63003EN–1	
Series 16*i*/18*i*/160*i*/180*i*/160*i*s/180*i*s–TA OPERATOR'S MANUAL	B–63004EN	
Series 16*i*/18*i*/160*i*/180*i*/160*i*s/180*i*s–MA OPERATOR'S MANUAL	B–63014EN	
Series 21*i*/210*i*–TA OPERATOR'S MANUAL	B–63084EN	
Series 21*i*/210*i*–MA OPERATOR'S MANUAL	B–63094EN	
Series 16*i*/18*i*/160*i*/180*i*–MODEL A PARAMETER MANUAL	B–63010EN	
Series 21*i*/210*i*–MODEL A PARAMETER MANUAL	B–63010EN	
MACRO COMPILER/MACRO EXECUTER PROGRAMMING MANUAL	B–61803E–1	
FAPT MACRO COMPILER (For Personal Computer) PROGRAMMING MANUAL	B–66102E	
FANUC PMC–MODEL SA1/SA5 PROGRAMMING MANUAL (Ladder Language)	B–61863	
FANUC PMC–MODEL SC/NB PROGRAMMING MANUAL (C Language)	B–61863–1	
FAPT LADDER–II OPERATOR'S MANUAL	B–66184EN	
FANUC Super CAP*i* T OPERATOR'S MANUAL	B–63284EN	
FANUC Super CAP*i* M OPERATOR'S MANUAL	B–63294EN	
FANUC Symbol CAP*i* T OPERATOR'S MANUAL	B–63304EN	
FANUC Symbolic CAP T Basic Module V1 OPERATOR'S MANUAL	B–62824EN	
FANUC Symbolic CAP T C/Y–axis Module V1 OPERATOR'S MANUAL	B–62824E–1	
FANUC DATA SERVER OPERATOR'S MANUAL	B–62694EN	
FANUC I/O Link–II CONNECTION MANUAL	B–62714EN	
FANUC Ethernet Board/DATA SERVER Board OPERATOR'S MANUAL	B–63354EN	

–Series 20*i*

The table below lists manuals related to MODEL–A of Series 20*i*. In the table, this manual is marked with an asterisk(*).

Manuals Related

Manual name	Specification Number	
DESCRIPTIONS	B–63002EN	
CONNECTION MANUAL (HARDWARE)	B–63003EN	*
CONNECTION MANUAL (FUNCTION)	B–63003EN–1	
OPERATOR'S MANUAL (For LATHE)	B–63374EN	
OPERATOR'S MANUAL (For MILLING)	B–63384EN	
OPERATOR'S MANUAL Machining Guidance (For LATHE)	B–62204E–1	
OPERATOR'S MANUAL Machining Guidance (For MILLING)	B–62174E–1	
MAINTENANCE MANUAL	B–63005EN	
PARAMETER MANUAL	B–63380EN	
PROGRAMMING MANUAL (Macro Compiler /Macro Executer)	B–61803E–1	

Related manuals of SERVO MOTOR α series, β series

Related manuals of SERVO MOTOR α series, β series

Manual name	Specification number
FANUC AC SERVO MOTOR α series DESCRIPTIONS	B–65142E
FANUC AC SERVO MOTOR α series PARAMETER MANUAL	B–65150E
FANUC AC SPINDLE MOTOR α series DESCRIPTIONS	B–65152E
FANUC AC SPINDLE MOTOR α series PARAMETER MANUAL	B–65160E
FANUC SERVO AMPLIFIER α series DESCRIPTIONS	B–65162E
FANUC SERVO MOTOR α series MAINTENANCE MANUAL	B–65165E
FANUC SERVO MOTOR β series DESCRIPTIONS	B–65232EN
FANUC SERVO MOTOR β series MAINTENANCE MANUAL	B–65235EN
FANUC SERVO MOTOR β series (I/O Link Option) MAINTENANCE MANUAL	B–65245EN

Related manuals of Loader control option

Manual name	Specification number
FANUC Series 21/16/160/18/180/16*i*/18*i*/21*i*/160*i*/180*i*/210*i* LOADER CONTROL CONNECTION MANUAL	B–62443EN–2

Related manuals of I/O–Unit and other

Manual name	Specification number
FANUC I/O Unit–MODEL A CONNECTION/MAINTENANCE MANUAL	B–61813E
FANUC I/O Unit–MODEL B CONNECTION/MAINTENANCE MANUAL	B–62163E
FANUC I/O Link–II CONNECTION MANUAL	B–62714EN
FANUC DNC1 DESCRIPTIONS	B–61782E
FANUC DNC2 DESCRIPTIONS	B–61992E

Related manuals of OPEN CNC

Manual name	Specification number
FANUC MMC–IV OPERATOR'S MANUAL	B–62494E
FANUC OPEN CNC OPERATOR'S MANUAL (LADDER EDITING PACKAGE)	B–62884EN
FANUC OPEN CNC OPERATOR'S MANUAL (Basic Operation Package 1 (for Windows 95/NT))	B–62994EN
FANUC OPEN CNC OPERATOR'S MANUAL (CNC Screen Display Function)	B–63164EN

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APPENDIX

1 CONFIGURATION

1.1 CONTROL UNIT CONFIGURATION AND COMPONENT NAMES

The *i* series control units are divided into two types: the LCD–mounted type and stand–alone type.

LCD–mounted type control units have a built–in display. Stand–alone type control units have a separate display unit. In the following sections, the LCD–mounted type is also referred to as the LCD–mounted type, and the stand–alone type is also referred to as the stand–alone type.

The configuration and component names of each type are shown in the figures given below. This manual explains how to attach the connectors shown in these figures to devices. The numbers in parentheses () in the figures are keyed to the item numbers of the descriptions in this manual. The numbers in brackets [] in the figures are connector numbers.

1.1.1 Configurations of LCD–mounted Type Control Units

Series 16*i*/18*i*/21*i*/20*i* LCD–mounted type control units (A circle in the table denotes that a unit is available.)

Display	Expansion slot	Soft key	16*i*	18*i*	21*i*	20*i*	Remarks
8.4″ TFT color LCD	None	5+2	○	○	○	○	
	2	5+2	○	○	○	○	(*1)
	3	5+2	○	○			(*1)
	4	5+2	○	○			(*1)
10.4″ TFT color LCD	None	10+2	○	○	○		
	2	10+2	○	○	○		(*1)
	3	10+2	○	○			(*1)
	4	10+2	○	○			(*1)
10.4″ TFT color LCD (with touch panel)	None	None	○	○	○		
	2	None	○	○	○		(*1)
	3	None	○	○			(*1)
	4	None	○	○			(*1)
7.2″ STN monochrome LCD	None	5+2	○	○	○		
	2	5+2	○	○	○		(*1)
	3	5+2	○	○			(*1)
	4	5+2	○	○			(*1)
9.5″ STN monochrome LCD	None	10+2	○	○	○		
	2	10+2	○	○	○		(*1)
	3	10+2	○	○			(*1)
	4	19+2	○	○			(*1)

NOTE
1 The same LCD–mounted type control units as those of the Series 16*i*/18*i*/21*i* are used in the Series 160*i*/180*i*/210*i* when an HSSB interface board is inserted into an option slot to connect an intelligent terminal.

Series 160*i*/180*i*/210*i* LCD–mounted type control units (A circle denotes that a unit is available.)

Display	Expansion slot	Soft key	160*i*	180*i*	210*i*	Remarks
10.4″ TFT color LCD	None	None	○	○	○	(*2)
	2	None	○	○	○	(*2)
	3	None	○	○		(*2)
	4	None	○	○		(*2)
10.4″ TFT color LCD	None	10+2	○	○	○	(*2)
	2	10+2	○	○	○	(*2)
	3	10+2	○	○		(*2)
	4	10+2	○	○		(*2)
10.4″ TFT color LCD (with touch panel)	None	None	○	○	○	(*2)
	2	None	○	○	○	(*2)
	3	None	○	○		(*2)
	4	None	○	○		(*2)

NOTE
2 These control units are Series 160*i*/180*i*/210*i* control units incorporating PC functions.

1.1.2 Configurations of Stand–alone Type Control Units

Series 16*i*/18*i*/21*i* stand–alone type control units (A circle in the table denotes that a unit is available.)
The stand–alone type control unit is not available on the Series 20*i*.

Slot rack name	Expansion slot	Mini slot	16*i*	18*i*	21*i*	Re-marks
Single–slot rack	None	2	○	○	○	(*NOTE)
3–slot rack	2	4	○	○	○	(*NOTE)

NOTE
All the stand–alone type control units of the Series 160*i*/180*i*/210*i* are designed to connect an intelligent terminal by inserting an HSSB interface board into a mini slot. These control units are the same as those of the Series 16*i*/18*i*/21*i*.

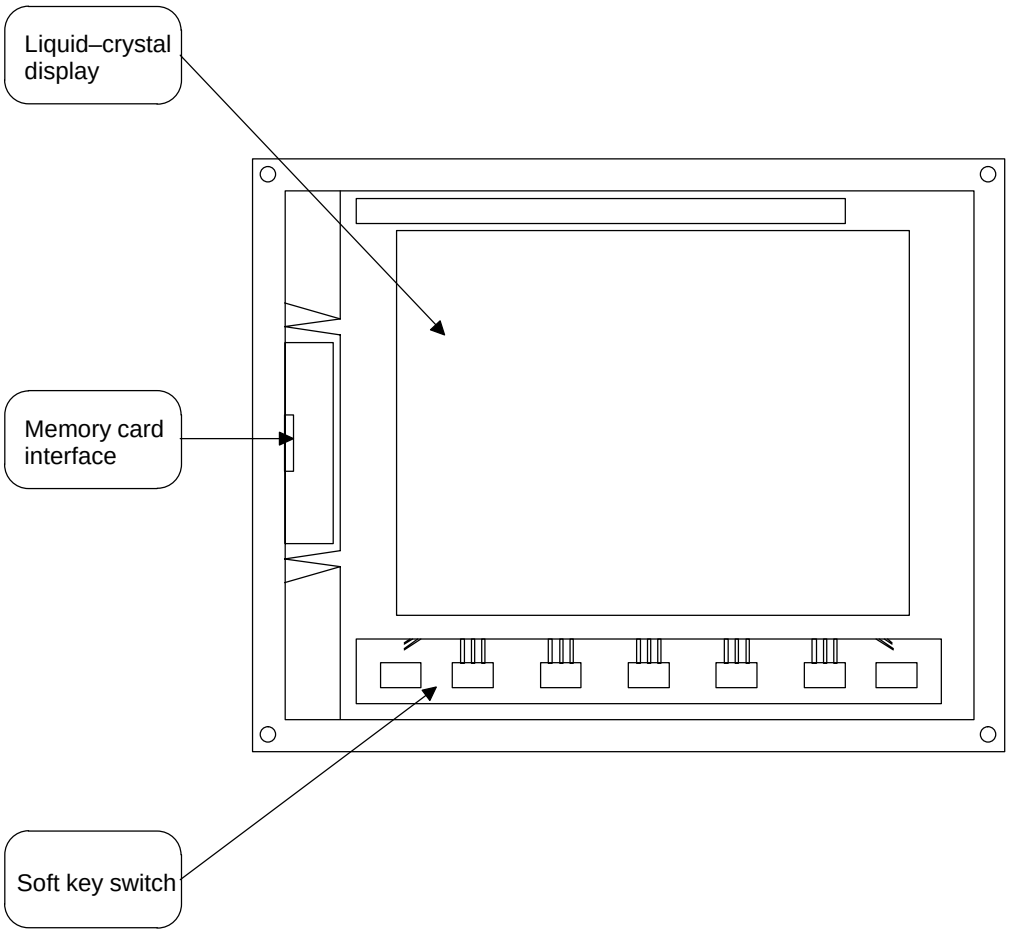
Series 16*i*/18*i*/21*i* display units (A circle in the table denotes that a unit is available.)

Display	Soft key	Graphic display	160*i*	180*i*	210*i*	Re-marks
10.4″ TFT color LCD	10+2	Provided	○	○	○	
10.4″ TFT color LCD (with touch panel)	None	Provided	○	○	○	
9.5″ STN monochrome LCD	10+2	Provided	○	○	○	
9.5″ STN monochrome LCD	10+2	None	○	○	○	

Series 160*i*/180*i*/210*i* display units (intelligent terminals) (A circle denotes that a unit is available.)

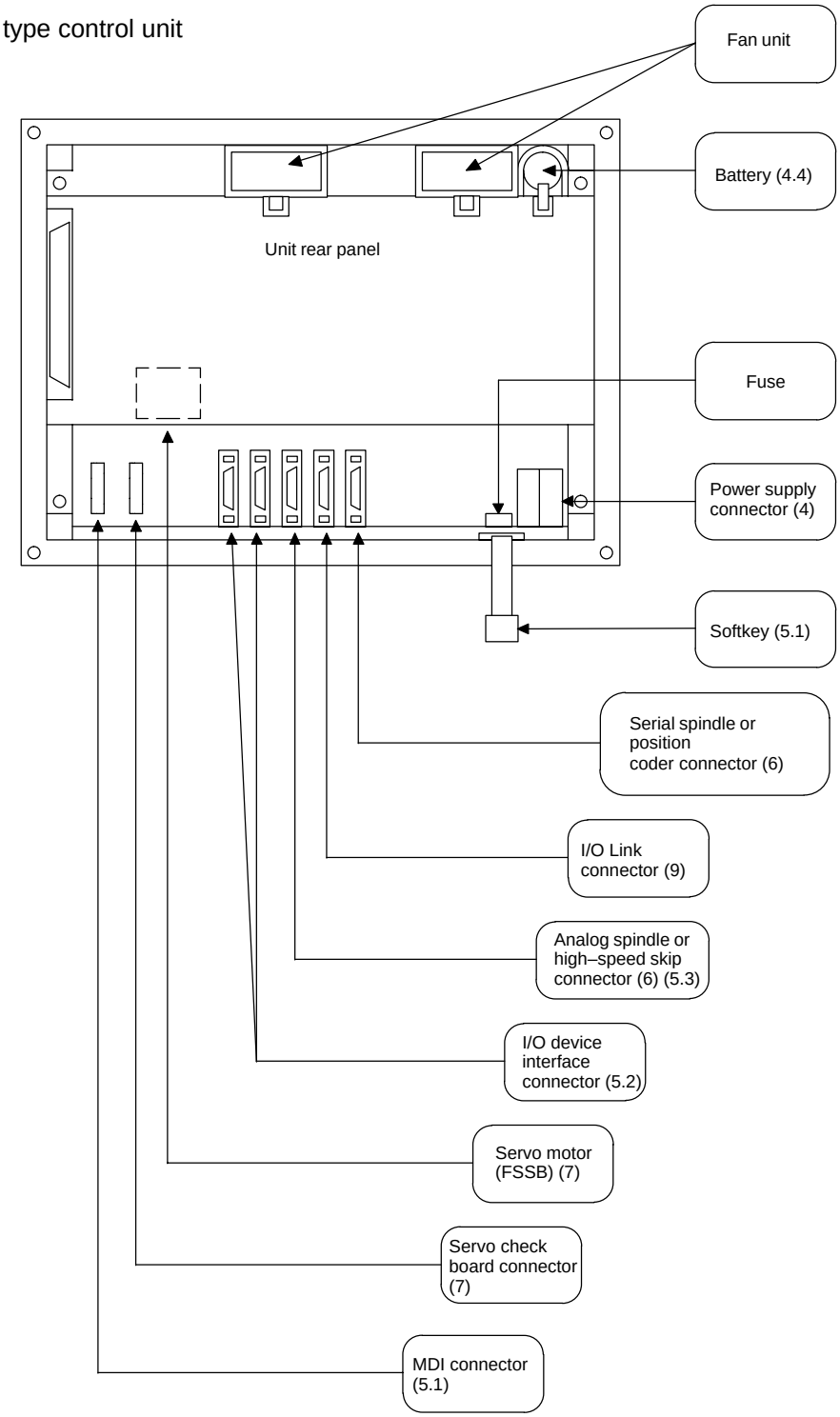
Display	Soft key	160*i*	180*i*	210*i*	Remarks
10.4″ TFT color LCD	None	○	○	○	
10.4″ TFT color LCD	10+2	○	○	○	
10.4″ TFT color LCD (with touch panel)	None	○	○	○	

LCD–mounted type control unit



NOTE
This figure is a front view of the Series 16*i*/18*i*/21*i*/20*i* LCD–mounted type control unit with an 8.4″ TFT color liquid–crystal display. The configurations of other control units are basically the same as that shown above.

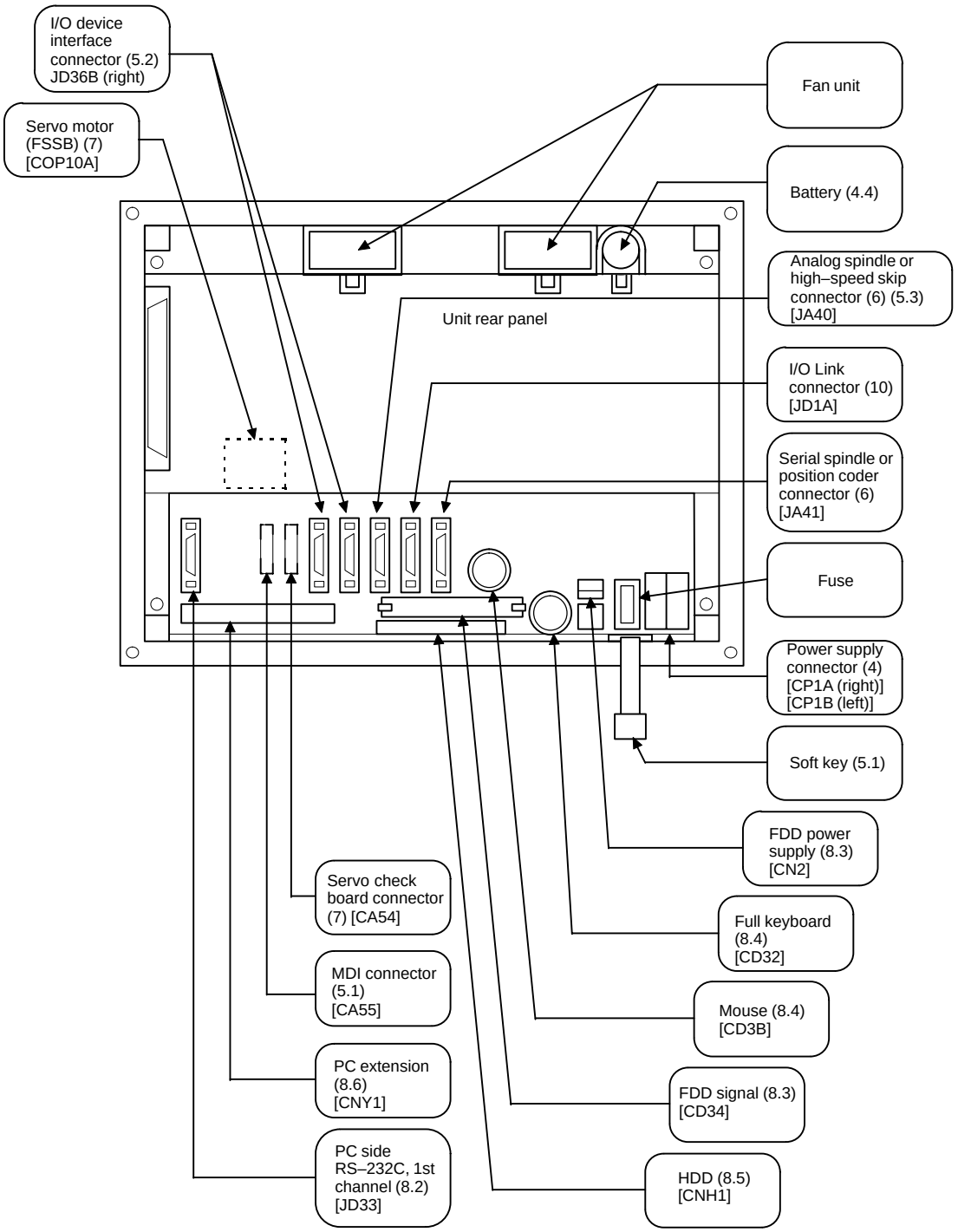
LCD–mounted type control unit



NOTE

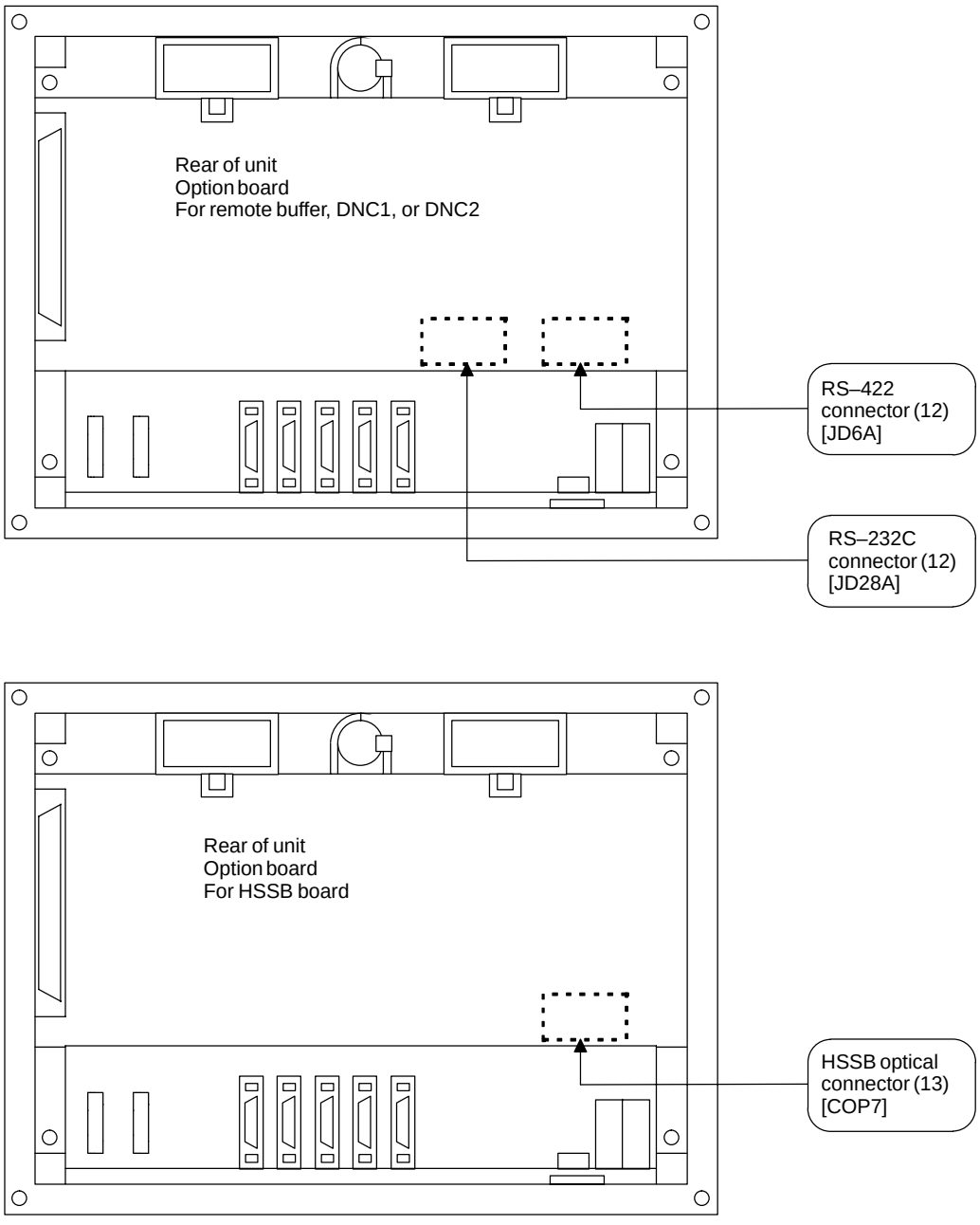
This figure is a rear view of the Series 16*i*/18*i*/21*i*/20*i* LCD–mounted type control unit without option slots. The configurations of the other control units of the Series 16*i*/18*i*/21*i*/20*i* and the Series 160*i*/180*i*/210*i* LCD–mounted type control units with HSSB are basically the same as that shown above.

LCD–mounted type control unit



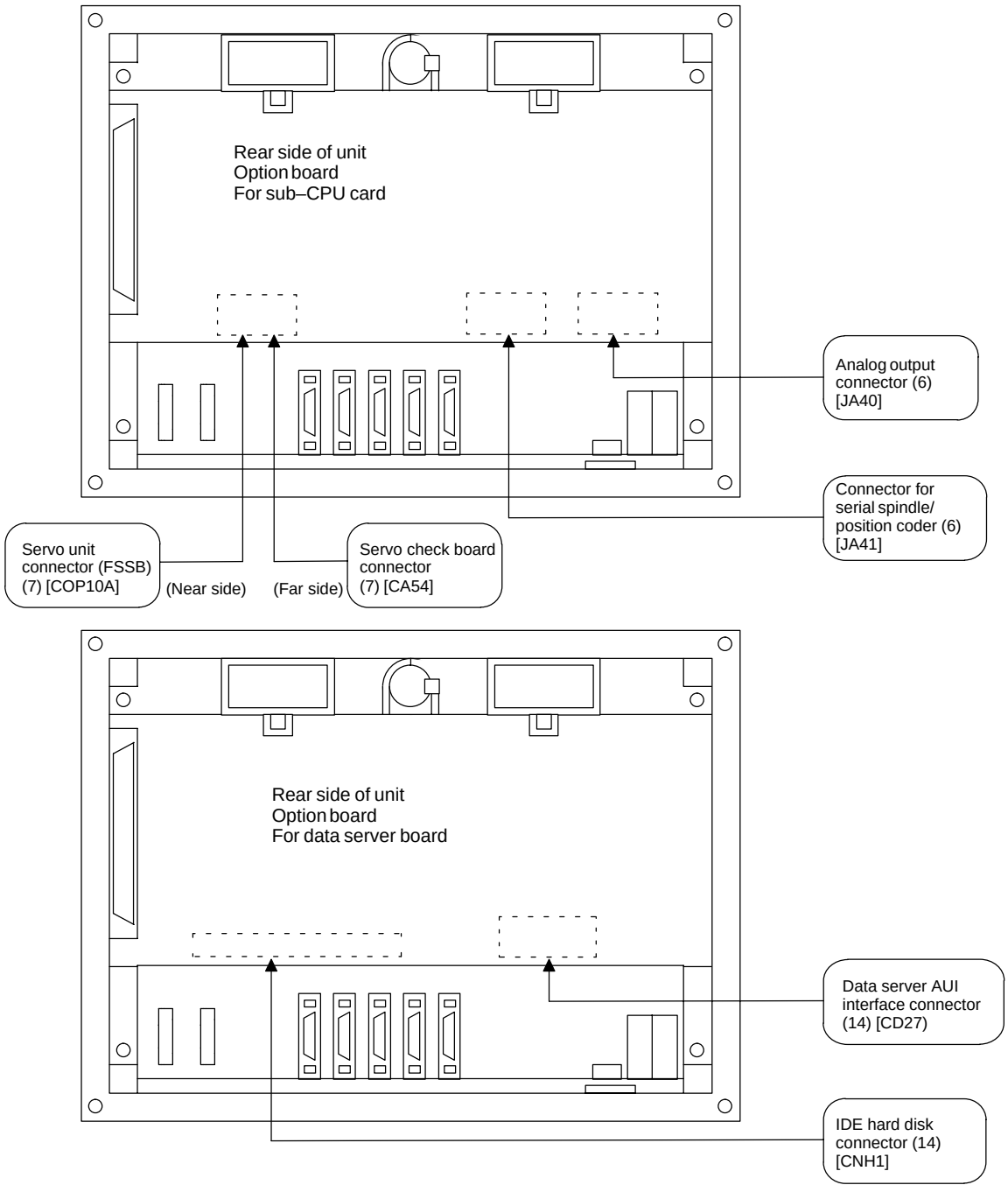
NOTE
This figure shows a rear view of the Series 160*i*/180*i*/210*i* control unit with no option slot having a 10.4″ TFT color LCD and incorporating PC functions.

LCD–mounted type control unit



NOTE
1 The above figures are rear views of a LCD–mounted type control unit with option slots. The configurations of the option slot portions of other LCD–mounted type control units are the same as in the above figures.
2 When a loader control board is used, refer to the loader control connection manual.
3 The optional functions shown below use option boards. These option boards do not have connectors for connecting external devices.
   - C
   - Symbol CAP*i* T
   - RISC

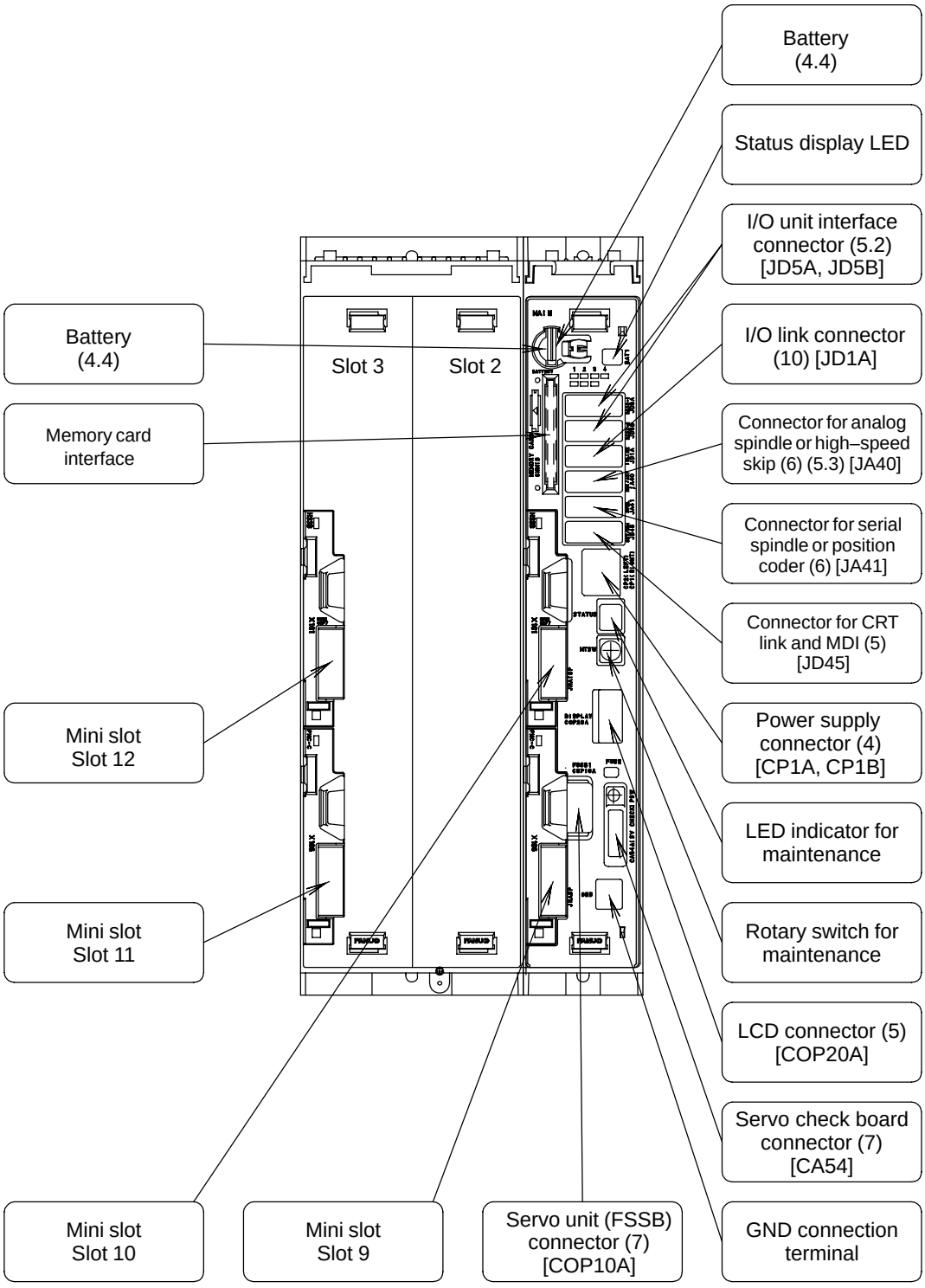
LCD–mounted type control unit



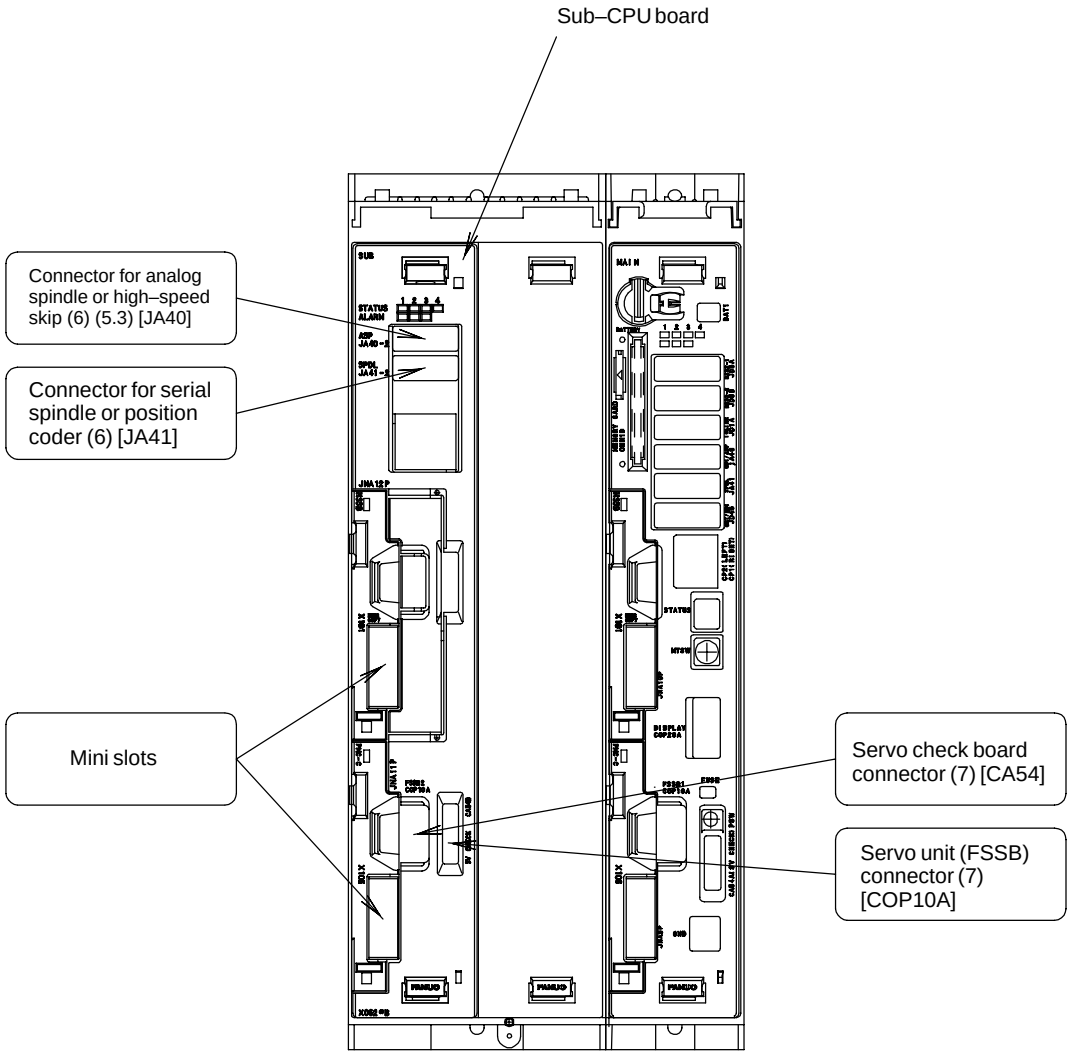
NOTE

The above figures are rear views of a LCD–mounted type control unit with option slots. The configurations of the option slot portions of other LCD–mounted type control units are the same as in the above figures.

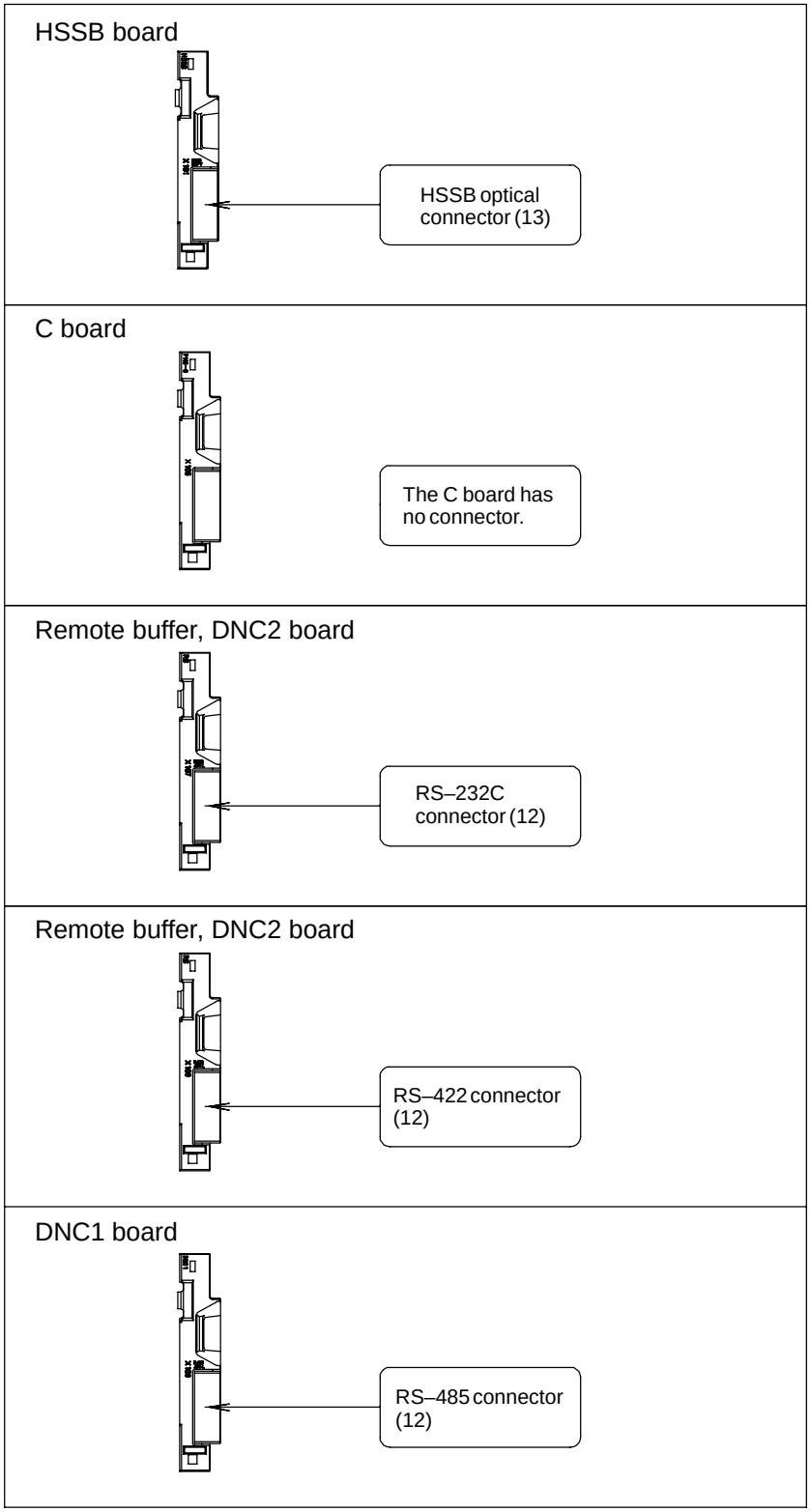
Stand–alone type control unit



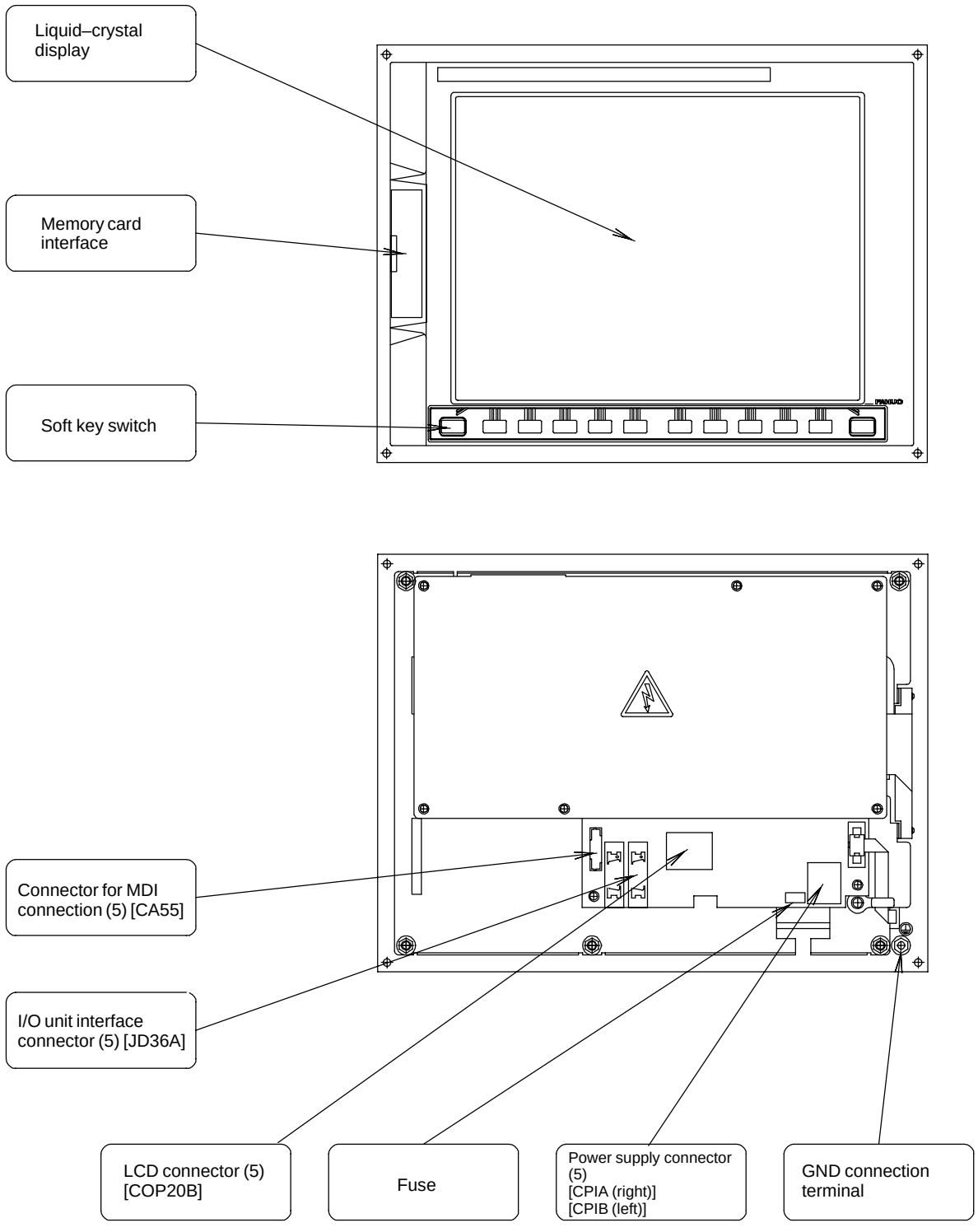
Stand–alone type control unit



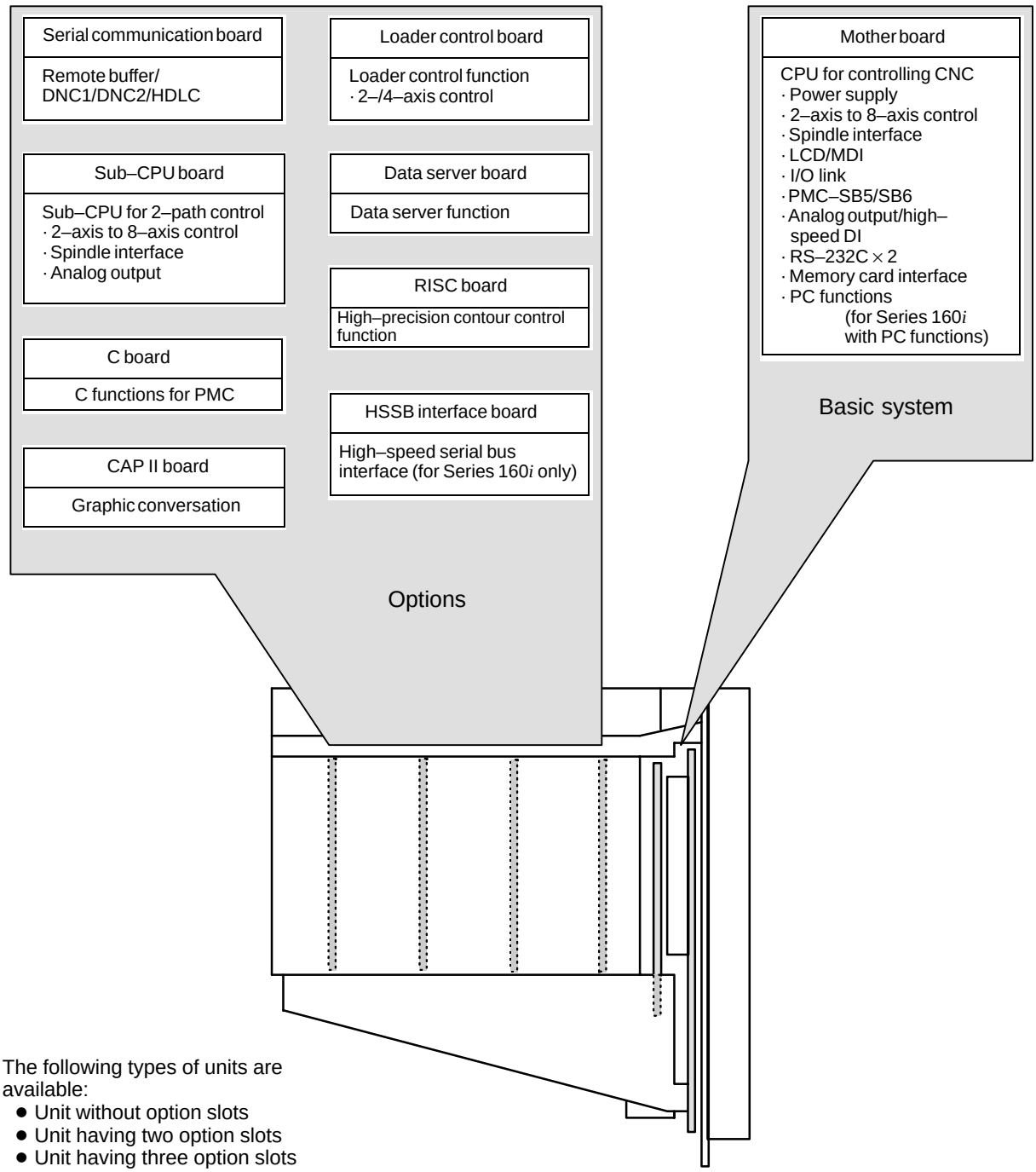
Stand–alone type control unit (mini slots)



LCD unit for stand–alone type control unit



1.2 HARDWARE OVERVIEW

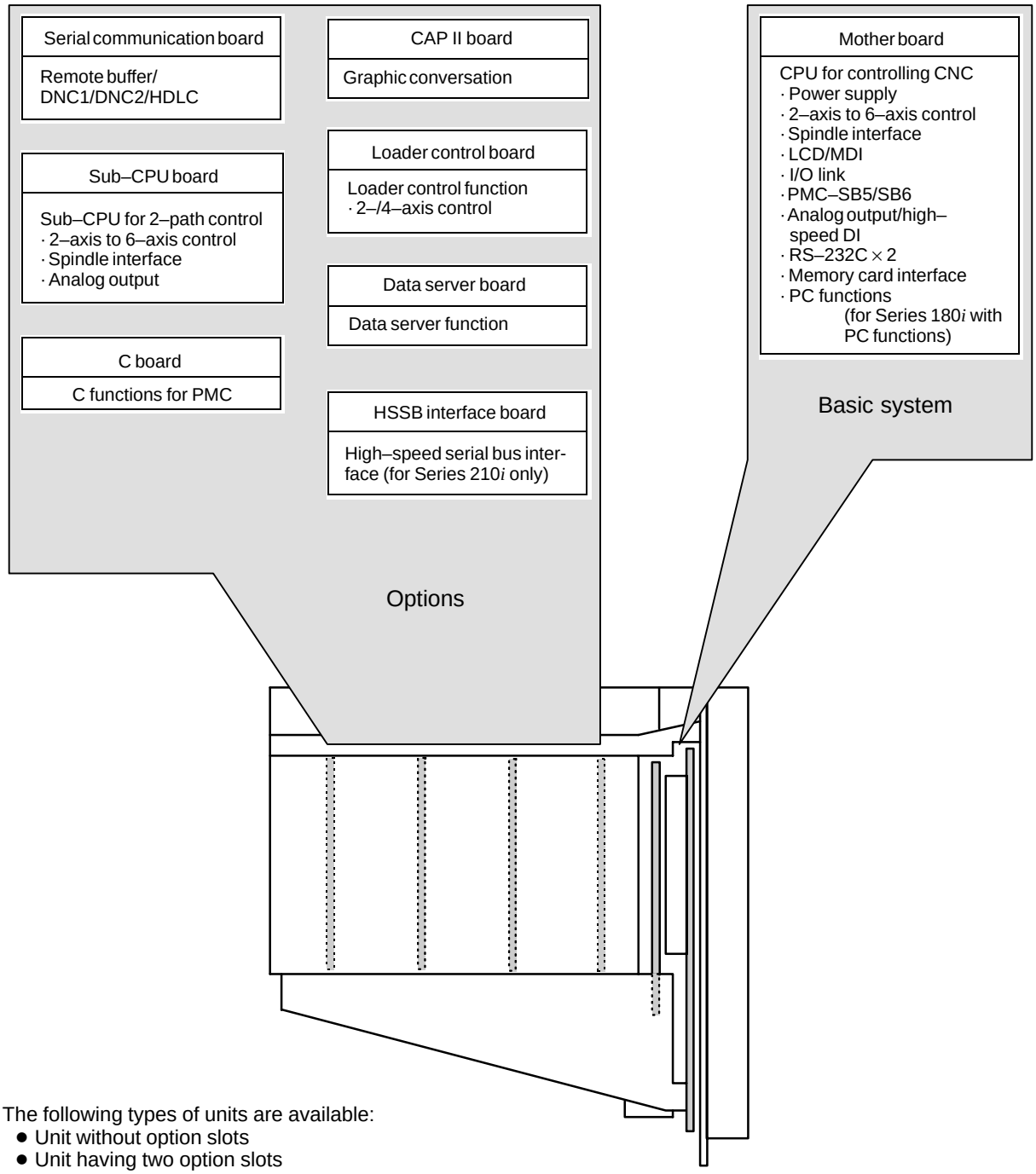


The following types of units are available:

- Unit without option slots
- Unit having two option slots
- Unit having three option slots
- Unit having four option slots

On a unit with option slots, as many option boards as the number of option slots can be mounted. (On a unit having four option slots, only a data server board or HSSB interface board can fit into the slot furthest from the LCD. On a unit having three option slots, only one of the above mentioned boards can fit into the center slot.)

Fig. 1.2 (a) Configuration of the LCD–mounted type control unit (Series 16*i*/160*i*)



The following types of units are available:

- Unit without option slots
- Unit having two option slots
- Unit having three option slots
- Unit having four option slots

On a unit with option slots, as many option boards as the number of option slots can be mounted. (On a unit having four option slots, only a data server board or HSSB interface board can fit into the slot furthest from the LCD. On a unit having three option slots, only one of the above mentioned boards can fit into the center slot.)

Fig. 1.2 (b) Configuration of the LCD–mounted type control unit (Series 18*i*/180*i*)

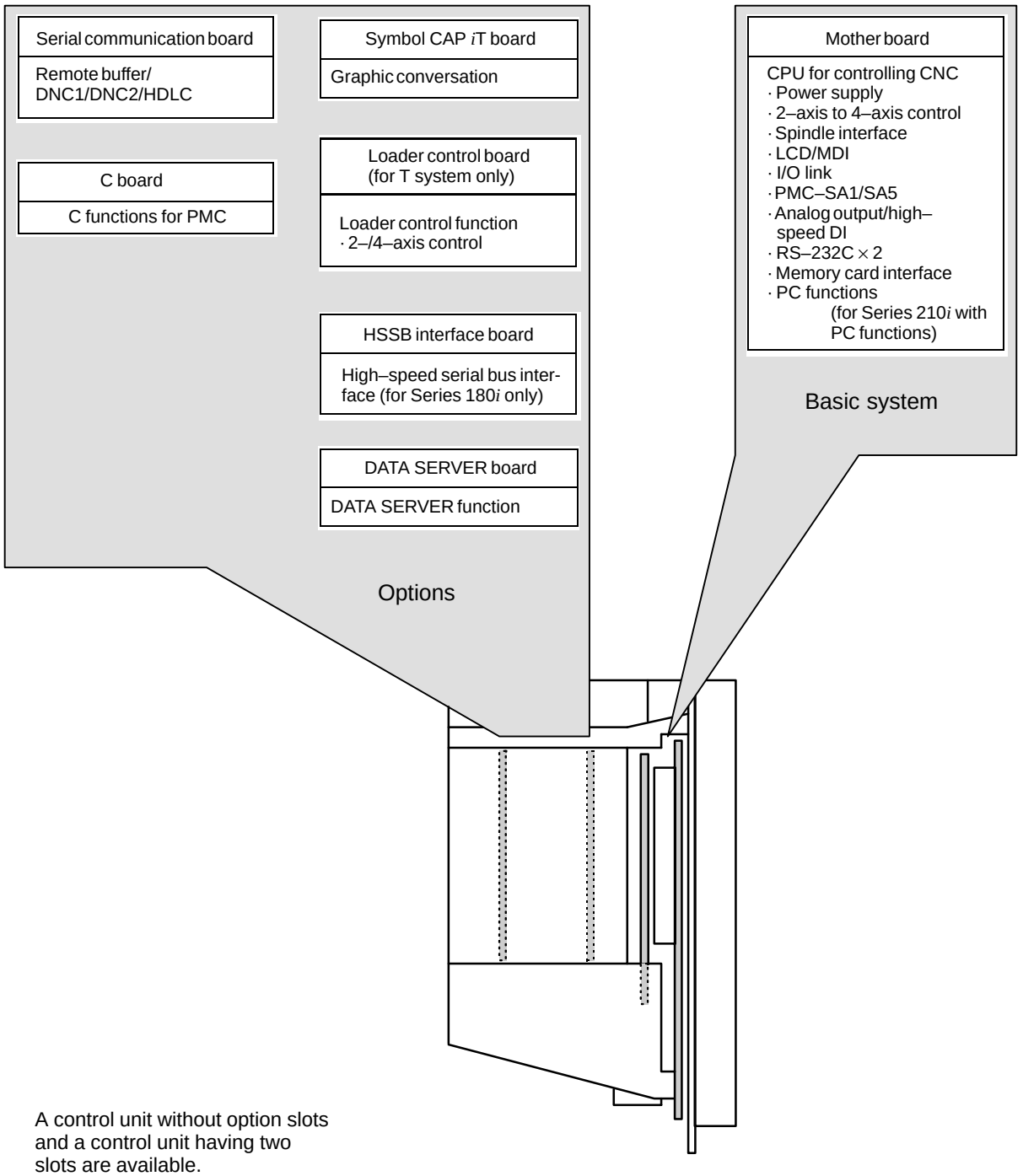
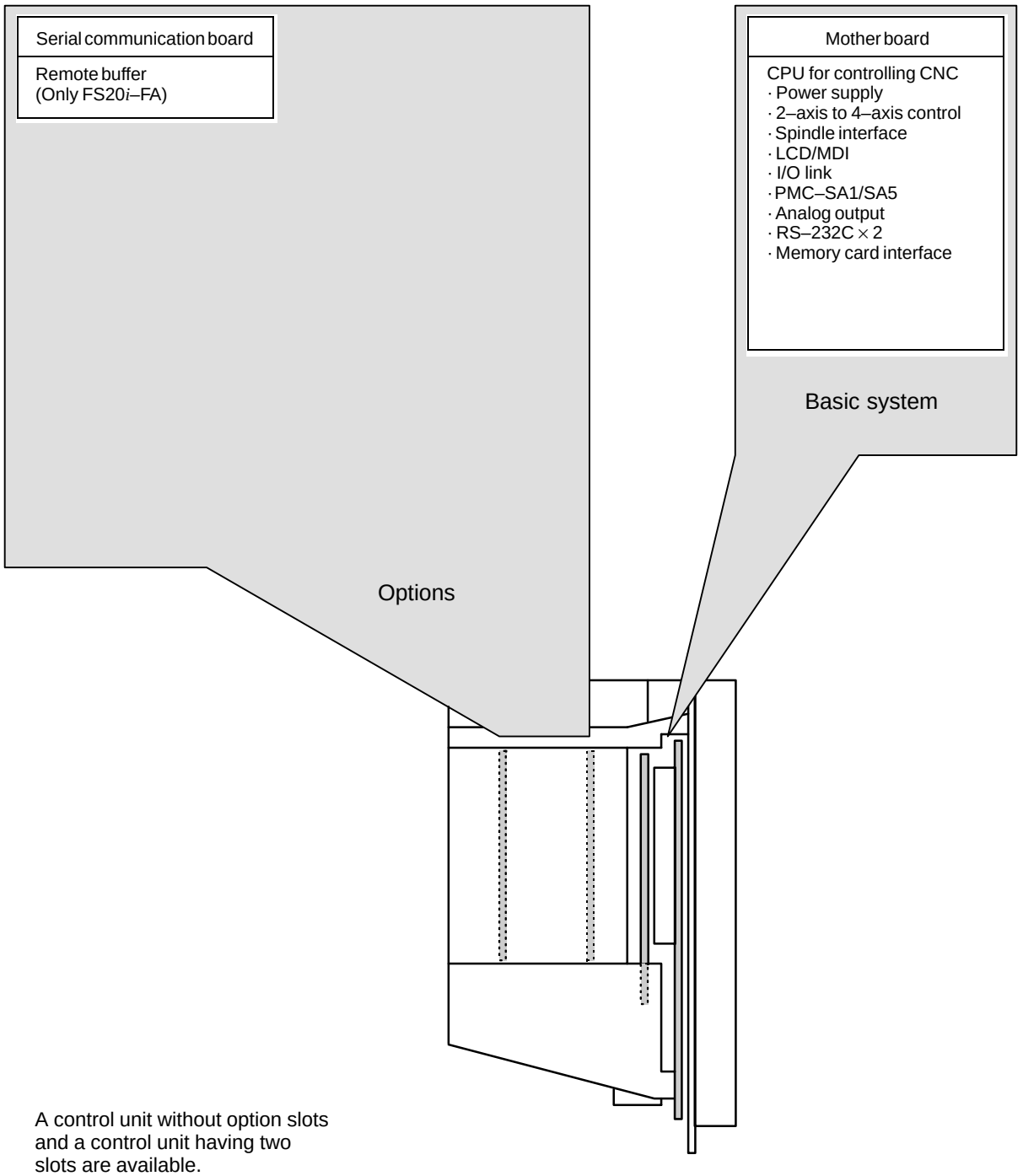


Fig. 1.2 (c) Configuration of the LCD–mounted type control unit (Series 21*i*/210*i*)



A control unit without option slots and a control unit having two slots are available.
Two slots are provided only on the FS20*i*–FA.

On a unit with option slots, as many option boards as the number of option slots can be mounted.

Fig. 1.2 (d) Configuration of the LCD–mounted type control unit (Series 20*i*)

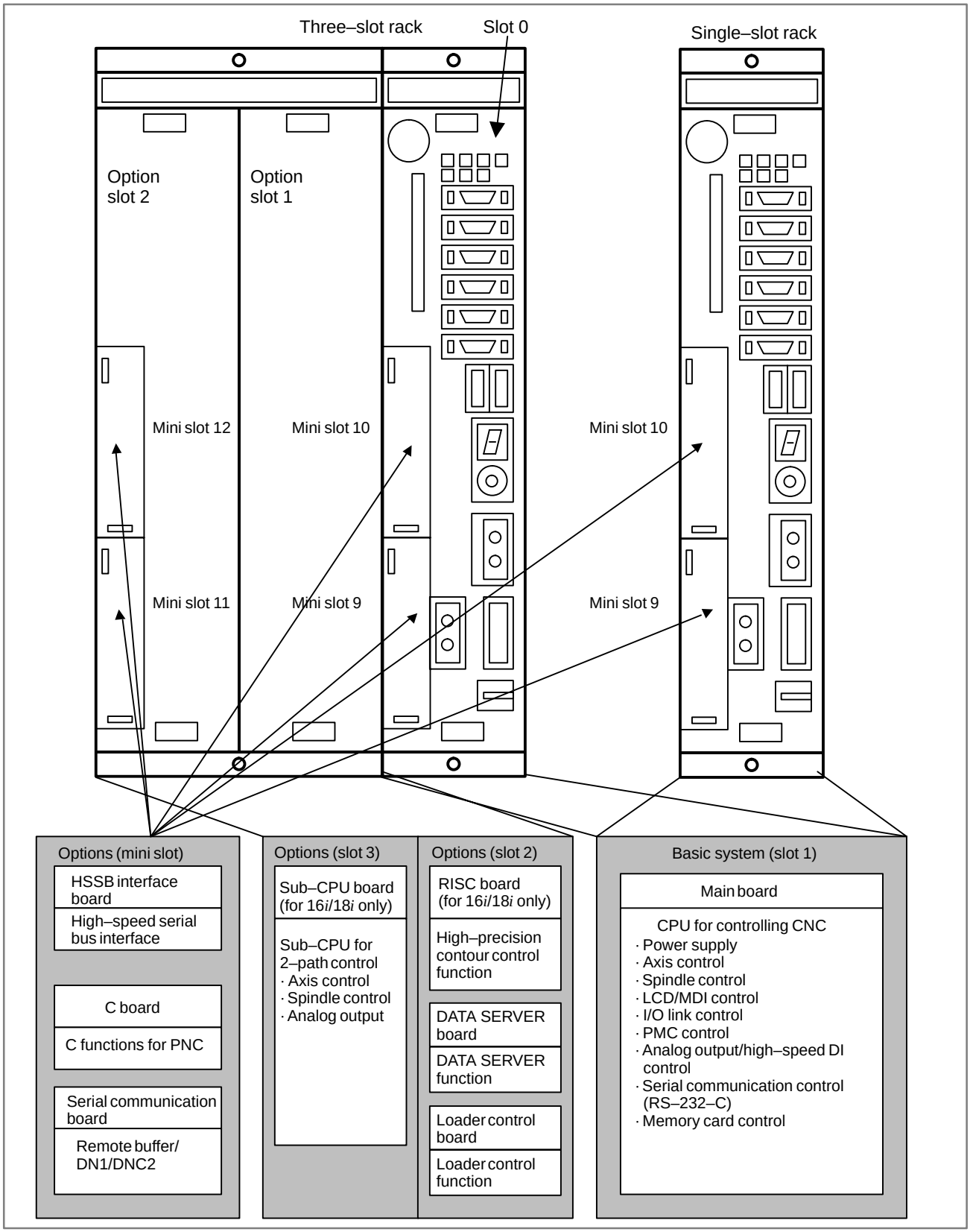
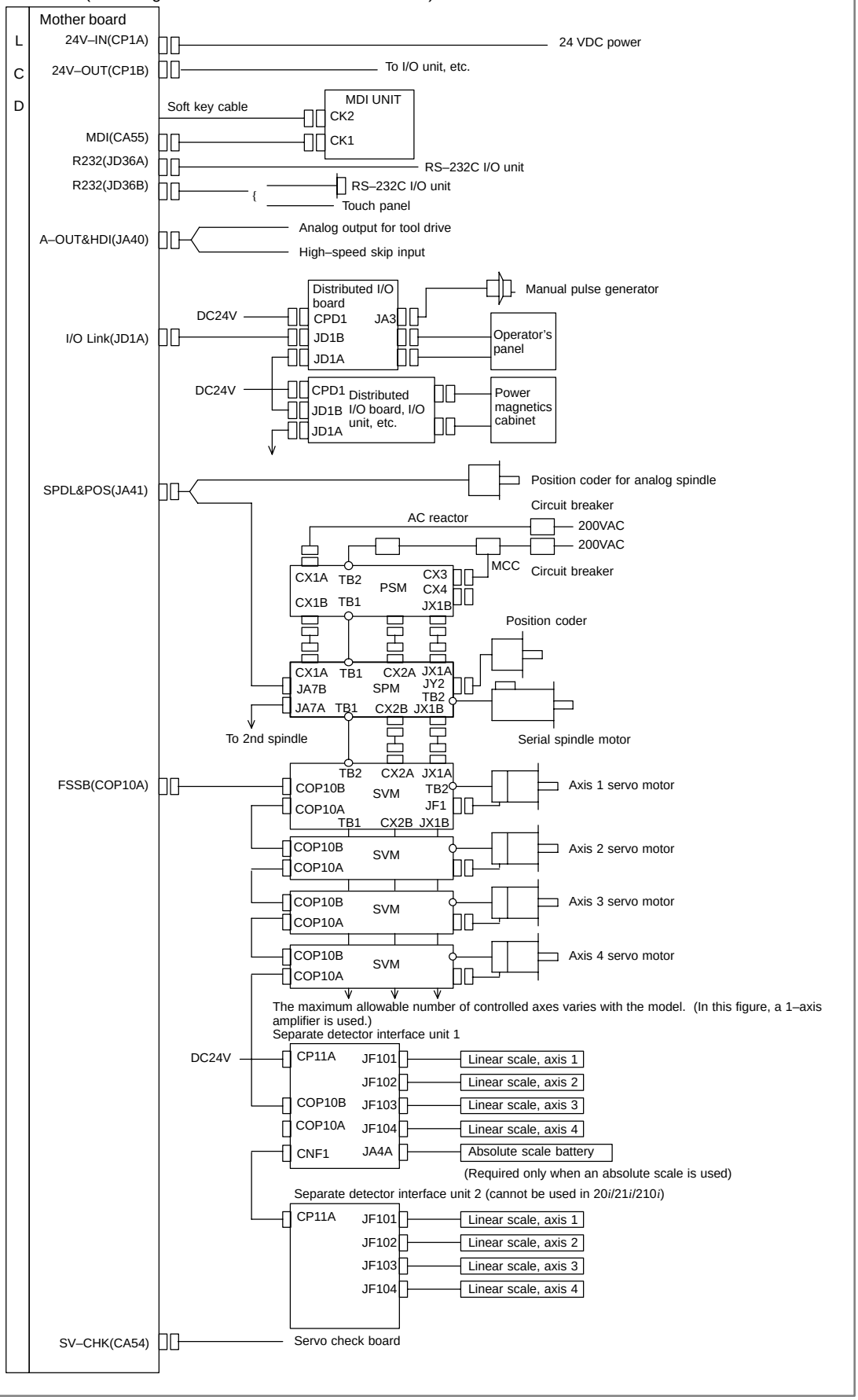


Fig. 1.2 (e) Configuration of the stand–alone type control unit

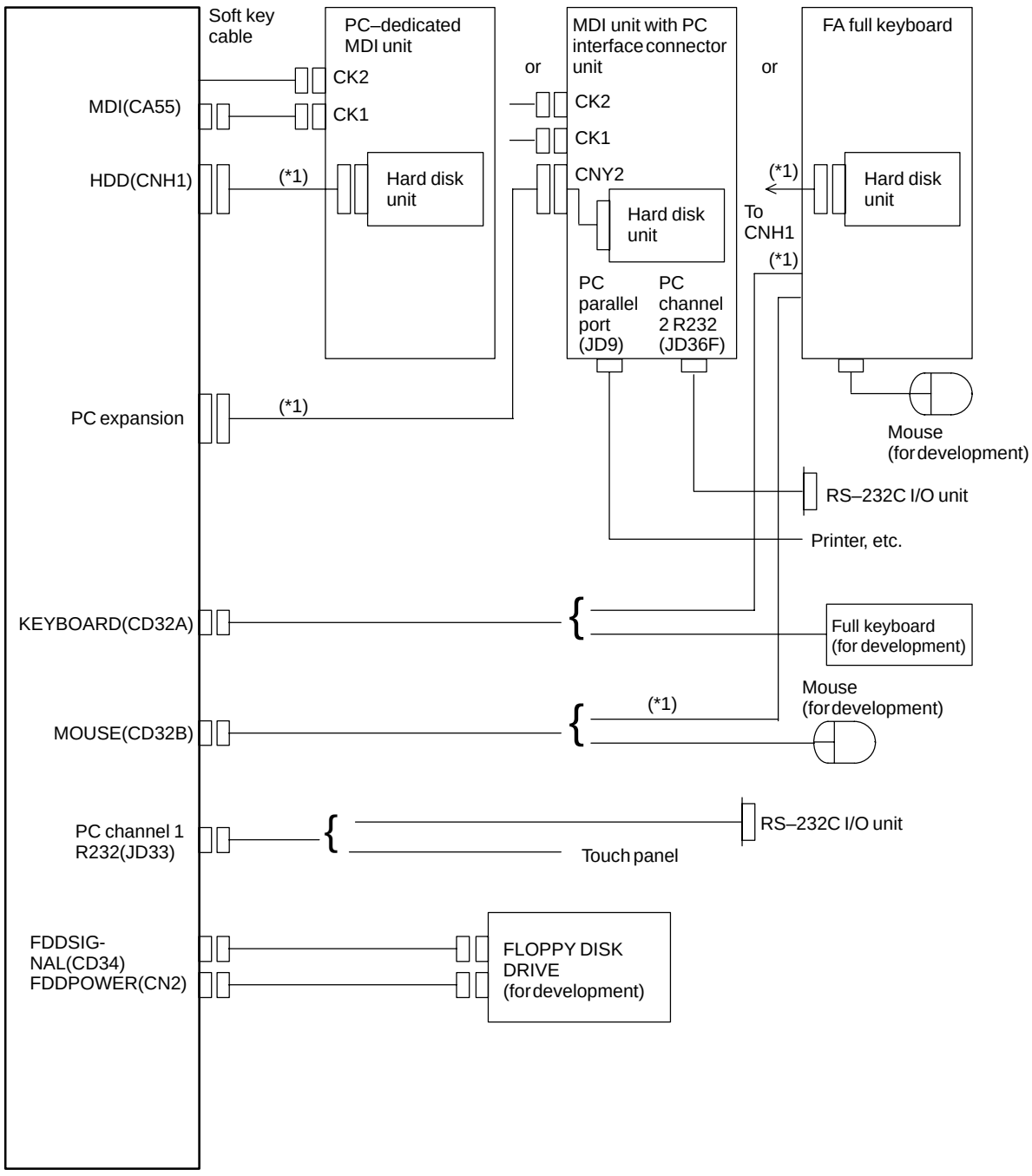
NOTE
In the above description, the 16*i*/18*i*/21*i* include the 160*i*/180*i*/210*i*, respectively.

2 TOTAL CONNECTION DIAGRAMS

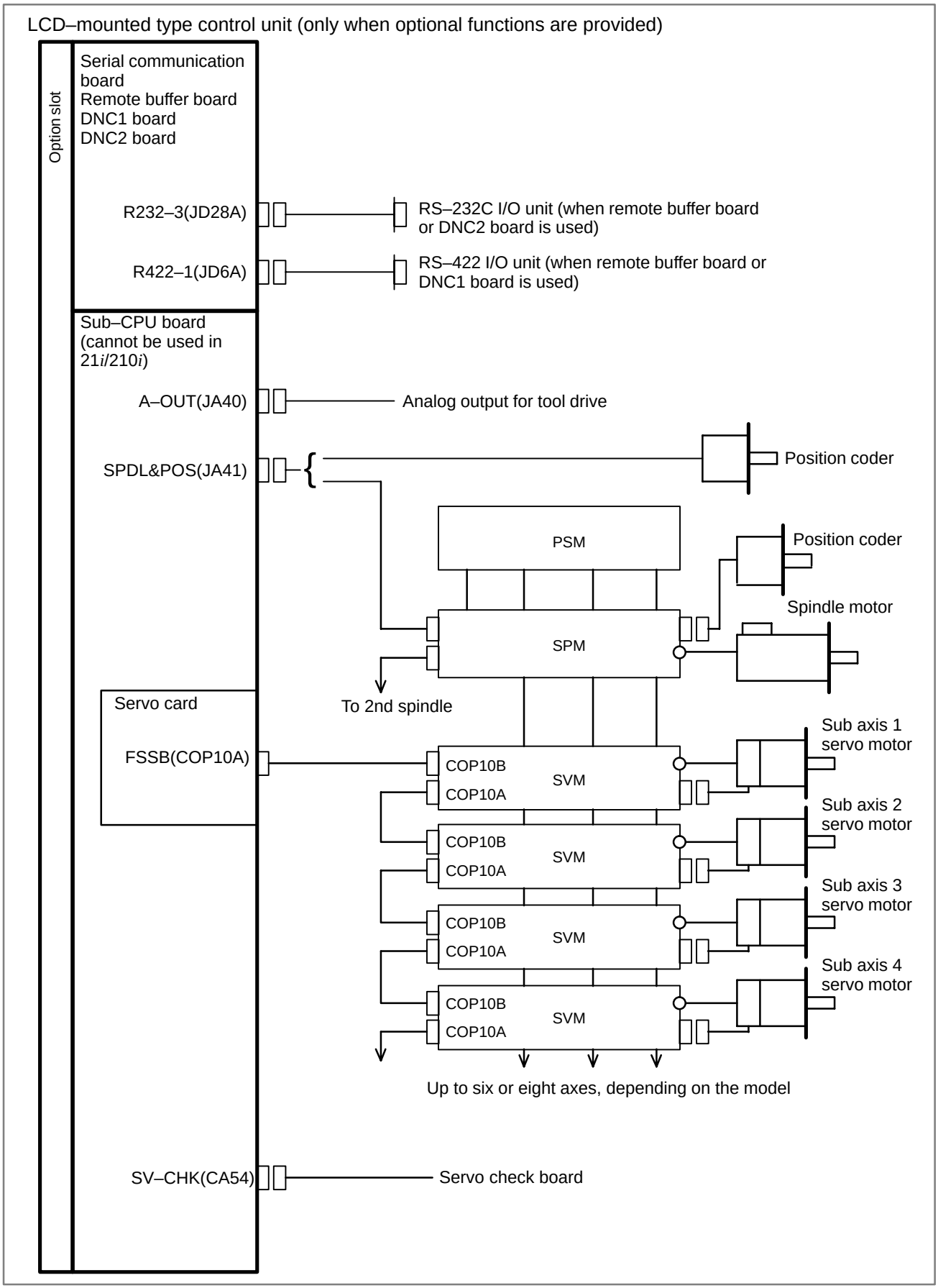
LCD–mountedtype control unit (excluding the 160*i*/180*i*/210*i* with PC functions)



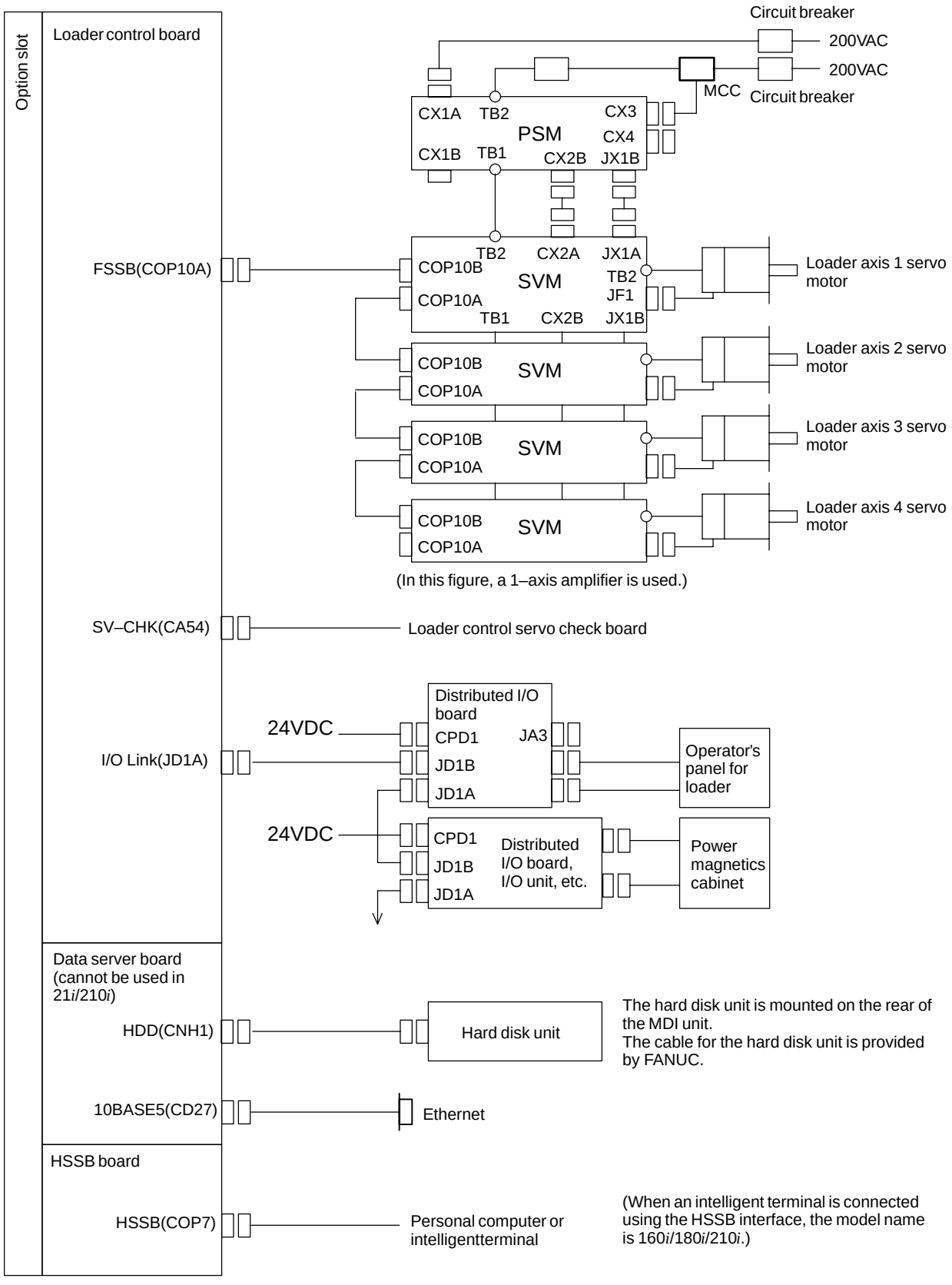
LCD–mounted type control unit (only for 160*i*/180*i*/210*i* with PC functions)



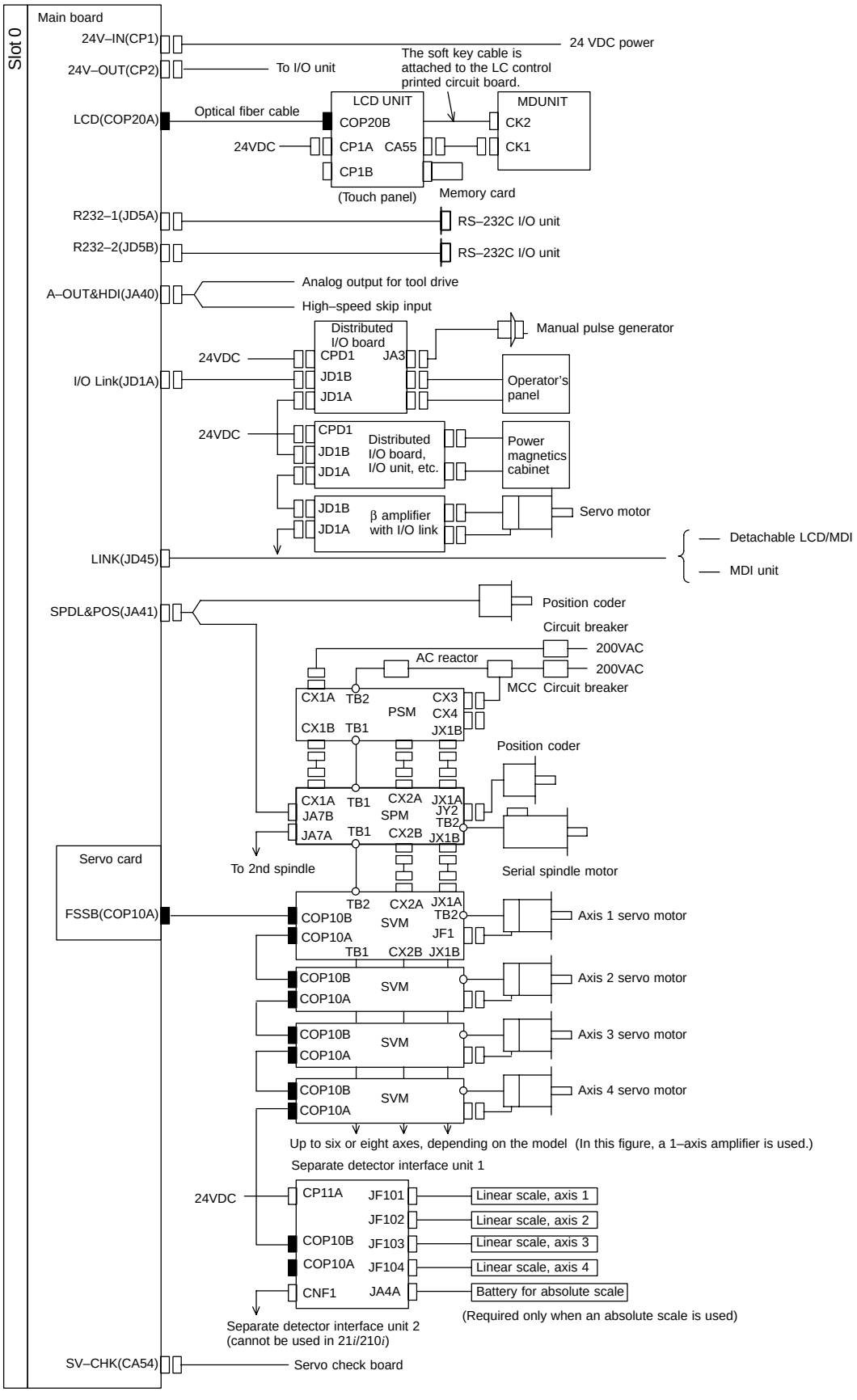
NOTE
1 The hard disk unit cables, PC interface connector unit cable, and FA full keyboard cable in the above diagram are supplied by FANUC.
2 The units to be connected to the control section or unit must not generate hazardous voltages even if an abnormality such as malfunction occurs.


LCD–mounted type control unit (only when optional functions are provided)
Option slot
Serial communication board
Remote buffer board
DNC1 board
DNC2 board
R232–3(JD28A)
RS–232C I/O unit (when remote buffer board or DNC2 board is used)
R422–1(JD6A)
RS–422 I/O unit (when remote buffer board or DNC1 board is used)
Sub–CPU board (cannot be used in 21i/210i)
A–OUT(JA40)
Analog output for tool drive
SPDL&POS(JA41)
Position coder
PSM
Position coder
Spindle motor
SPM
To 2nd spindle
Servo card
FSSB(COP10A)
COP10B
COP10A
SVM
Sub axis 1 servo motor
Sub axis 2 servo motor
Sub axis 3 servo motor
Sub axis 4 servo motor
Up to six or eight axes, depending on the model
SV–CHK(CA54)
Servo check board

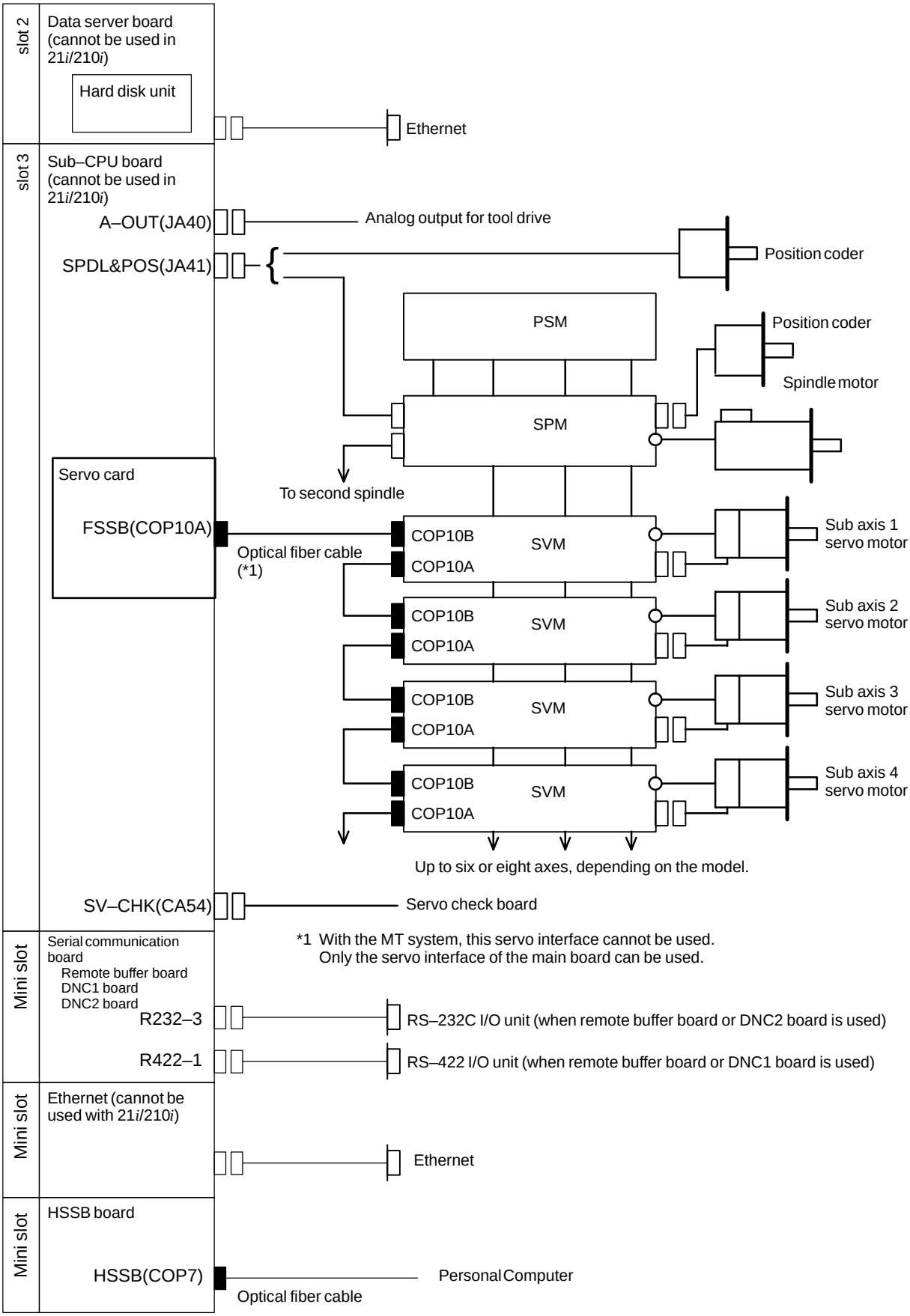
LCD–mounted type control unit (when optional functions are provided)



Stand–alone type control unit (Except Series 20*i*)



Stand–alone type control unit (Except Series 20*i*)



3 INSTALLATION

3.1 ENVIRONMENTAL REQUIREMENTS OUTSIDE THE CABINET

The peripheral units and the control unit have been designed on the assumption that they are housed in closed cabinets. In this manual "cabinet" refers to the following:

- Cabinet manufactured by the machine tool builder for housing the control unit or peripheral units;
- Operation pendant, manufactured by the machine tool builder, for housing the control unit or operator's panel.
- Equivalent to the above.

The environmental conditions when installing these cabinets shall conform to the following table. Section 3.3 describes the installation and design conditions of a cabinet satisfying these conditions.

	Condition	LCD–mounted type control unit and display unit (except unit with data server function)	Stand–alone type control unit	LCD–mounted type control unit with PC and data server functions
Ambient Temperature	Operating	0°C to 58°C	0°C to 55°C	5°C to 53°C
	Storage, Transport	–20°C to 60°C		
Humidity	Normal	75%RH or less, no condensation		10% to 75%RH, no condensation
	Short period (less than 1 month)	95%RH or less, no condensation		10% to 90%RH, no condensation
Vibration	Operating	0.5 G or less		
	Non–operating	1.0 G or less		
Meters above sea level	Operating	Up to 1000 m		Up to 1000 m
	Non–operating	Up to 12000 m		Up to 12000 m
Environment	Normal machine shop environment (The environment must be considered if the cabinets are in a location where the density of dust, coolant, and/or organic solvent is relatively high.)			

3.2 POWER SUPPLY CAPACITY

3.2.1 Power Supply Capacities of CNC–related Units

The following CNC–related units require an input power supply that satisfies the indicated current capacities with a power supply voltage of 24 VDC ±10%. Here, note that momentary voltage changes and ripples are also within ±10% of the power supply voltage.

Table 3.2.1 (a) Power supply capacity (for LCD–mounted type control units)

Unit		16*i*	18*i*	21*i*	20*i*	160*i*	180*i*	210*i*	Power supply capacity	Remarks
LCD–mounted type control unit	Without option slots	○	○	—	—	○ (*3)	○ (*3)	—	1.6A	(*1)
	With 2 option slots	○	○	—	—	○ (*3)	○ (*3)	—	1.7A	(*1)
	With 3 option slots	○	○	—	—	○ (*3)	○ (*3)	—	1.9A	(*1)
	With 4 option slots	○	○	—	—	○ (*3)	○ (*3)	—	2.0A	(*1)
	Without option slots	—	—	○	○	—	—	○ (*3)	1.5A	(*1)
	With 2 option slots	—	—	○	○	—	—	○ (*3)	1.7A	(*1)
LCD–mounted type control unit (with PC functions)	Without option slots	—	—	—	—	○	○	○	2.1A	(*2)
	With 2 option slots	—	—	—	—	○	○	○	2.3A	(*2)
	With 3 option slots	—	—	—	—	○	○	—	2.5A	(*2)
	With 4 option slots	—	—	—	—	○	○	—	2.6A	(*2)
HSSB board		○	○	○	—	○	○	○	0.2A	
Sub–CPU board		○	○	—	—	○	○	—	0.7A	
Loader control board		○	○	○	—	○	○	○	0.5A	
PMC C		○	○	○	—	○	○	○	0.3A	
Serial communication board (remote buffer, DNC1, DNC2)		○	○	○	○	○	○	○	0.3A	
CAP–II board		○	○	—	—	○	○	—	0.5A	
Symbol CAP*i* T board		—	—	○	—	—	—	○	0.5A	
RISC board		○	○	—	—	○	○	—	0.5A	
Data server board		○	○	○	—	○	○	○	0.5A	
ISA expansion board		—	—	—	—	○	○	○	1.5 A max	(*4)
PC interface connector unit		—	—	—	—	○	○	○	0A	

NOTE
1 The liquid–crystal display and MDI unit are included. Option boards are not included.
2 The liquid–crystal display, MDI unit, hard disk, and floppy disk drive are included. Option boards are not included.
3 For the *i* series with HSSB, add the power supply capacity of the HSSB board to the power supply capacity of each control unit.
4 The value varies depending on the ISA board used.
5 For other peripheral units (such as I/O units), see Table 3.2.1 (c) and also refer to the relevant manuals.

Table 3.2.1 (b) Power supply capacity (for stand–alone type control units)

Unit		16*i*	18*i*	21*i*	160*i*	180*i*	210*i*	Power supply capacity	Remarks
Stand–alone type control unit (including main CPU board)	1–slot rack	○	○	○	○	○	○	1.8A	(*1, *2)
	3–slot rack	○	○	○	○	○	○	2.3A	(*1, *2)
HSSB board		○	○	○	○	○	○	0.2A	
Sub–CPU board		○	○	—	○	○	—	0.8A	
PMC C		○	○	○	○	○	○	0.3A	
Serial communication board (remote buffer, DNC1, DNC2)		○	○	○	○	○	○	0.3A	
RISC board		○	○	—	○	○	—	0.5A	
10.4″ LCD unit		○	○	○	—	—	—	1.0A	(*3)
9.5″ LCD unit		○	○	○	—	—	—	0.8A	(*3)
Intelligent terminal type 2	(486DX4 version) with ISA expansion	—	—	—	○	○	○	3.0A	(*2)
Intelligent terminal type 2	(Pentium version) with ISA expansion	—	—	—	○	○	○	3.5A	(*2)

NOTE
1 Boards in option slots and mini slots are not included.
2 When an RS–232–C unit (with power supplied form the NC) is connected to the RS–232–C port, +1 A is further required.
3 Use memory cards that consume no more than 2 W.

Table 3.2.1 (c) Power supply rating (peripheral units common to LCD–mounted type and separation type)

Unit	16*i*	18*i*	21*i*	20*i*	160*i*	180*i*	210*i*	Power supply capacity	Remarks
MDI unit	○	○	○	○	○	○	○	0A	
Operator's panel I/O module	○	○	○	○	○	○	○	0.35A	
Connector panel I/O module (basic)	○	○	○	○	○	○	○	0.2A+7.3mA×DI	
Connector panel I/O module (additional)	○	○	○	○	○	○	○	0.1A+7.3mA×DI	
Separate detector interface unit	○	○	○	○	○	○	○	0.9A	Basic 4–axis unit only
Separate detector interface unit	○	○	—	—	○	○	—	1.5A	Basic 4 axes + additional 4 axes

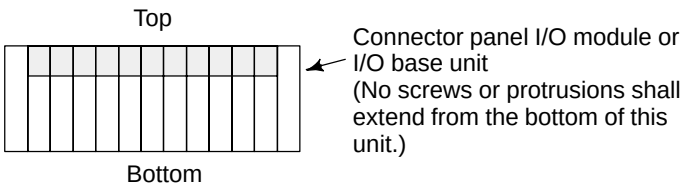
3.3 DESIGN AND INSTALLATION CONDITIONS OF THE MACHINE TOOL MAGNETIC CABINET

When a cabinet is designed, it must satisfy the environmental conditions described in Section 3.1. In addition, the magnetic interference on the screen, noise resistance, and maintenance requirements must be considered. The cabinet design must meet the following conditions :

- The cabinet must be fully closed.
  The cabinet must be designed to prevent the entry of airborne dust,coolant,and organic solvent.
- The cabinet must be designed so that the permissible temperature of each unit is not exceeded. For actual heat design, see Section 3.4.
- A closed cabinet must be equipped with a fan to circulate the air within. (This is not necessary for a unit with fan.)
  The fan must be adjusted so that the air moves at 0.5 m/sec along the surface of each installed unit.

CAUTION
If the air blows directly from the fan to the unit, dust easily adheres to the unit. This may cause the unit to fail. (This is not necessary for a unit with fan.)

- For the air to move easily, a clearance of 100 mm is required between each unit and the wall of the cabinet. (This is not necessary for a unit with fan.)
- Packing materials must be used for the cable port and the door in order to seal the cabinet.
- The display unit must not be installed in such a place that coolant would directly fall onto the unit. The control unit has a dust–proof front panel, but the unit should not be placed in a location where coolant would directly fall onto it.
- Noise must be minimized.
  As the machine and the CNC unit are reduced in size, the parts that generate noise may be placed near noise–sensitive parts in the magnetics cabinet.
  The CNC unit is built to protect it from external noise. Cabinet design to minimize noise generation and to prevent it from being transmitted to the CNC unit is necessary. See section 3.5 for details of noise elimination/management.
- When placing units in the cabinet, also consider ease of maintenance. The units should be placed so that they can be checked and replaced easily when maintenance is performed.
- The hard disk drive and floppy disk drive must not be installed near the source of a strong magnetic field.
- The installation conditions of the I/O unit and connector panel I/O module must be satisfied.
  To obtain good ventilation in the module, the I/O unit and connector panel I/O module must be installed in the direction shown in the following figure. Clearances of 100 mm or more both above and below the I/O unit are required for wiring and ventilation.
  Equipment radiating too much heat must not be put below the I/O unit and connector panel I/O module.



- Operating ambient temperature of control units with PC functions
  A temperature sensor in each control unit monitors the temperature to determine whether it is within the optimum range.
  (1) When the temperature is out of range when the power is turned on
  The control unit does not start until the temperature settles to within the optimum range.
  (2) If the temperature drifts out of range after normal start–up
  Error occurs when the hard disk is accessed.
- A control unit with PC functions must be carefully isolated against vibration.
  The CNC control unit or hard disk unit itself may resonate at certain frequencies. Perform a thorough check after mounting the CNC control unit on the machine.

CAUTION
For a control unit with PC functions data stored on the hard disk may be destroyed due to operator errors or accidents even when the environmental conditions above are satisfied. To guard against such data loss, back up the important hard disk data regularly. In particular, never turn off the power, even momentarily, while the hard disk is being accessed is running, as doing so is highly likely to destroy part of the contents of the disk. End users should be made fully aware of this, to ensure that they do not inadvertently lose important data.

- If a unit with PC functions is used, be careful when installing the MDI unit.
  (1) The MDI unit must be installed immediately below the control unit allowing no space between the two units.
  (2) The MDI unit must be installed vertically.

3.4 THERMAL DESIGN OF THE CABINET

The internal air temperature of the cabinet increases when the units and parts installed in the cabinet generate heat. Since the generated heat is radiated from the surface of the cabinet, the temperature of the air in the cabinet and the outside air balance at certain heat levels. If the amount of heat generated is constant, the larger the surface area of the cabinet, the less the internal temperature rises. The thermal design of the cabinet refers to calculating the heat generated in the cabinet, evaluating the surface area of the cabinet, and enlarging that surface area by installing heat exchangers in the cabinet, if necessary. Such a design method is described in the following subsections.

3.4.1 Temperature Rise within the Cabinet

The cooling capacity of a cabinet made of sheet metal is generally 6 W/°C per 1m^2 surface area, that is, when the 6W heat source is contained in a cabinet having a surface area of 1 m^2, the temperature of the air in the cabinet rises by 1°C. In this case the surface area of the cabinet refers to the area useful in cooling , that is, the area obtained by subtracting the area of the cabinet touching the floor from the total surface area of the cabinet. There are two preconditions : The air in the cabinet must be circuited by the fun, and the temperature of the air in the cabinet must be almost constant.The following expression must then be satisfied to limit the difference in temperature between the air in the cabinet and the outside air to 13°C or less when the temperature in the cabinet rises:

Internal heat loss P [W] ≦
6[W/m^2·°C] × surface area S[m^2]×13[°C] of rise in temperature

For example, a cabinet having a surface area of 4m^2 has a cooling capacity of 24W/°C. To limit the internal temperature increase to 13°C under these conditions, the internal heat must not exceed 312W. If the actual internal heat is 360W, however, the temperature in the cabinet rises by 15°C or more. When this happens, the cooling capacity of the cabinet must be improved using the heat exchanger.

For the power magnetic cabinet containing a stand–alone type control unit, the internal temperature rise must be suppressed to 10°C or less, instead of 13°C.

3.4.2 Heat Output of Each Unit

Table 3.4.2 (a) Heat output (for LCD–mounted type control unit)

Unit		16*i*	18*i*	21*i*	20*i*	160*i*	180*i*	210*i*	Heat output (W)	Remarks
LCD–mounted type control unit	Without option slots	○	○	○	○	○ (*3)	○ (*3)	○ (*3)	33W	(*1)
	With 2 option slots	○	○	○	○	○ (*3)	○ (*3)	○ (*3)	37W	(*1)
	With 3 option slots	○	○	—	—	○ (*3)	○ (*3)	—	39W	(*1)
	With 4 option slots	○	○	—	—	○ (*3)	○ (*3)	—	40W	(*1)
LCD–mounted type control unit (with PC functions) (CPU: 486DX4)	Without option slots	—	—	—	—	○	○	○	45W	(*2)
	With 2 option slots	—	—	—	—	○	○	○	52W	(*2)
	With 3 option slots	—	—	—	—	○	○	—	53W	(*2)
	With 4 option slots	—	—	—	—	○	○	—	54W	(*2)
LCD–mounted type control unit (with PC functions) (CPU: Pentium)	Without option slots	—	—	—	—	○	○	○	54W	(*2)
	With 2 option slots	—	—	—	—	○	○	○	61W	(*2)
	With 3 option slots	—	—	—	—	○	○	—	62W	(*2)
	With 4 option slots	—	—	—	—	○	○	—	63W	(*2)
Option board (*5)	HSSB board	○	○	○	—	○	○	○	3W	
	Sub–CPU board	○	○	—	—	○	○	—	13W	
	Loader control board	○	○	○	—	○	○	○	10W	
	PMC C	○	○	○	—	○	○	○	5W	
	Serial communication board (remote buffer, DNC1, DNC2)	○	○	○	○	○	○	○	6W	
	CAP–II board	○	○	—	—	○	○	—	10W	
	Symbol CAP*i* T board	—	—	○	—	—	—	○	10W	
	RISC board	○	○	—	—	○	○	—	9W	
	Data server board	○	○	○	—	○	○	○	9W	
ISA expansion board		—	—	—	—	○	○	○		(*4)
PC interface connector unit		—	—	—	—	○	○	○	0W	

NOTE
1 The liquid–crystal display and MDI unit are included. Option boards are not included.
2 The liquid–crystal display, MDI unit, hard disk, and floppy disk drive are included. Option boards are not included.
3 For the *i* series with HSSB, add the heat output of the HSSB board to the heat output of each control unit.
4 The value varies depending on the ISA board being used. Add the heat output of the ISA board being used.
5 When option boards are used, the total heat output of the selected option boards must not exceed the following value:

Rack type	Total heat output
2–slot rack	26W
3–slot rack	38W
4–slot rack	38W

Table 3.4.2 (b) Heat output (for stand–alone type control units)

Unit		16*i*	18*i*	21*i*	160*i*	180*i*	210*i*	Heat output	Re-marks
Stand–alone type control unit (including main CPU board)	1–slot rack	○	○	○	○	○	○	35W	(*1)
	3–slot rack	○	○	○	○	○	○	46W	(*1)
Option board	HSSB board	○	○	○	○	○	○	4W	
	Sub–CPU board	○	○	—	○	○	—	14W	
	PMC C	○	○	○	○	○	○	7W	
	Serial communication board (remote buffer, DNC1, DNC2)	○	○	○	○	○	○	7W	
	RISC board	○	○	—	○	○	—	12W	
10.4″ LCD unit		○	○	○	—	—	—	18W	
9.5″ LCD unit		○	○	○	—	—	—	14W	
Intelligent terminal type 2	(486DX4 version) with ISA expansion	—	—	—	○	○	○	25W	(*2)
Intelligent terminal type 2	(Pentium version) with ISA expansion	—	—	—	○	○	○	37W	(*2)

NOTE
1 The indicated heat output values are the maximum values, including the heat outputs of the boards in the option slots and mini slots.
2 The heat outputs of units connected to the CNC and memory cards are not included.

Table 3.4.2 (c) Heat output (peripheral units common to LCD–mounted type and separation type)

Unit	16*i*	18*i*	21*i*	20*i*	160*i*	180*i*	210*i*	Heat output (W)	Remarks
MDI unit	○	○	○	○	○	○	○	0W	
Operator's panel I/O module	○	○	○	○	○	○	○	12W	(*1)
Connector panel I/O module (basic)	○	○	○	○	○	○	○	8W	(*1)
Connector panel I/O module (additional)	○	○	○	○	○	○	○	5W	(*1)
Separate detector interface unit	○	○	○	○	○	○	○	9W	Basic 4–axis unit only(*2)
Separate detector interface unit	○	○	—	—	○	○	—	14W	Basic 4 axes + additional 4 axes(*2)

NOTE
1 The indicated values are when 50% of the module input signals are ON.
2 Heat output generated within the separate detector is not included.

3.4.3 Thermal Design of Operator's Panel

With a small cabinet like the operator's panel, the heat dissipating capacity of the cabinet is as shown below, assuming that there is sufficient mixing of the air inside the cabinet.
Coated metal surfaces: 8 W/m^2°C
Plastic surfaces: 3.7 W/m^2°C
An example of the thermal design for the cabinet shown in Fig. 3.4.4 is shown below.

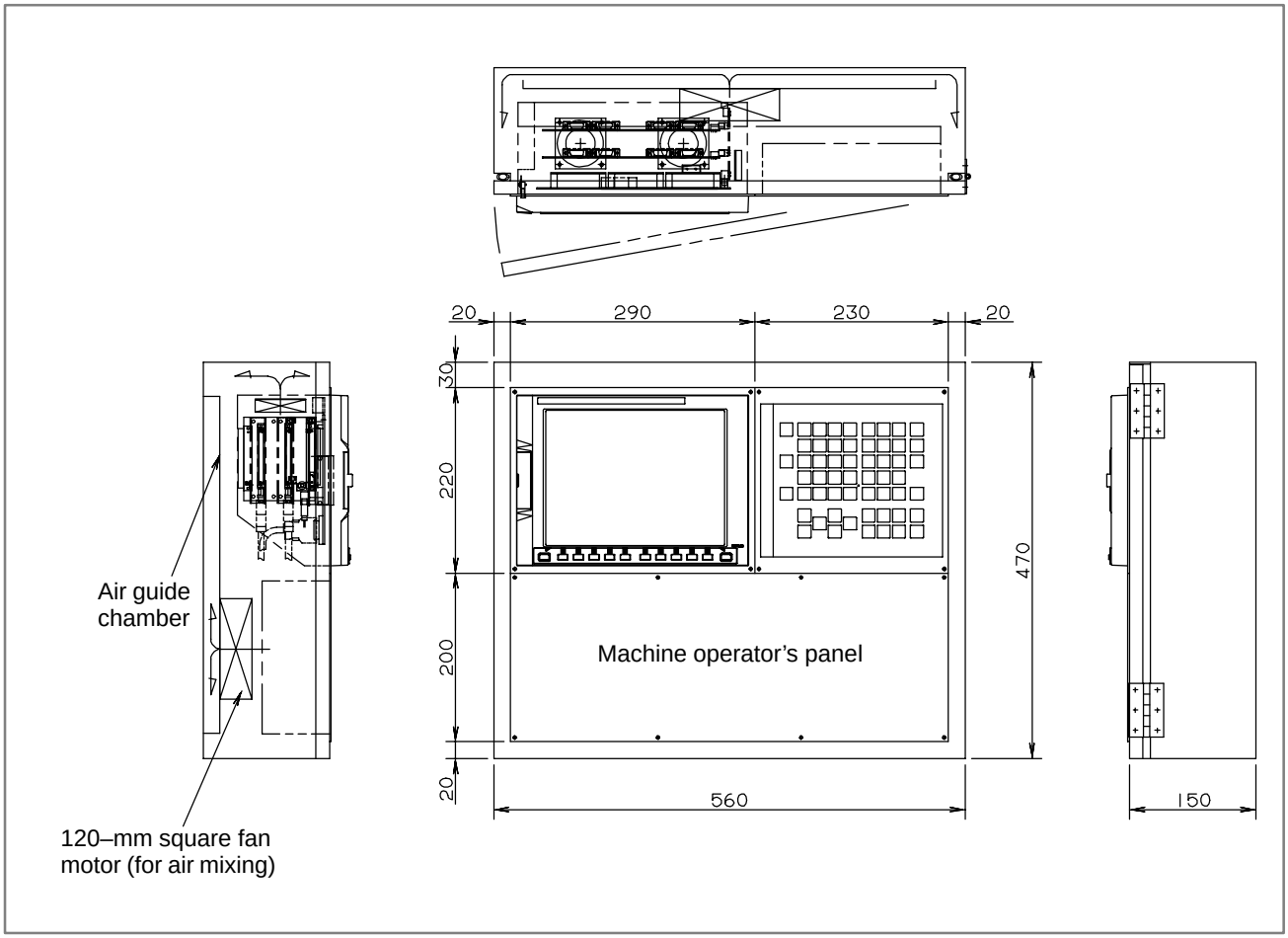


Fig. 3.4.3

Assume the following.
Thermal exchange rates : Coated metal surfaces 8 W/m^2°C
: Plastic surfaces 3.7 W/m^2°C
: Allowable temperature rise:
13°C higher than the exteriortemperature

Also, assume the following.
Dimensions of pendant type cabinet shown in Fig. 3.4.4(a):
560(W) × 470(H) × 150(D) mm
Surface area of metallic sections : 0.5722 m^2
Surface area of plastic sections : 0.2632 m^2

In this case, the allowable total heat dissipation for the cabinet is:
$8 \times 0.5722 \times 13 + 3.7 \times 0.2632 \times 13 = 72$ W.

In consequence, it can be concluded that the units shown in Table 3.4.4(a) on the next page can be installed in this cabinet.

Table 3.4.3

LCD–mounted type control unit with option 2 slots	37 W
Option board (PMC C language)	6 W
Option board (DATA SERVER Board)	9 W
Distributed operator's panel I/O module	12 W
120–mm square fan motor for air mixing	8 W
Total heat dissipation of the above	72 W

NOTE
The 12 W quoted for the I/O module of the distribution–type operator's panel represents an example heat output value when half of all the input signals are turned on. This value varies, depending on the mechanical configuration.

3.5 ACTION AGAINST NOISE

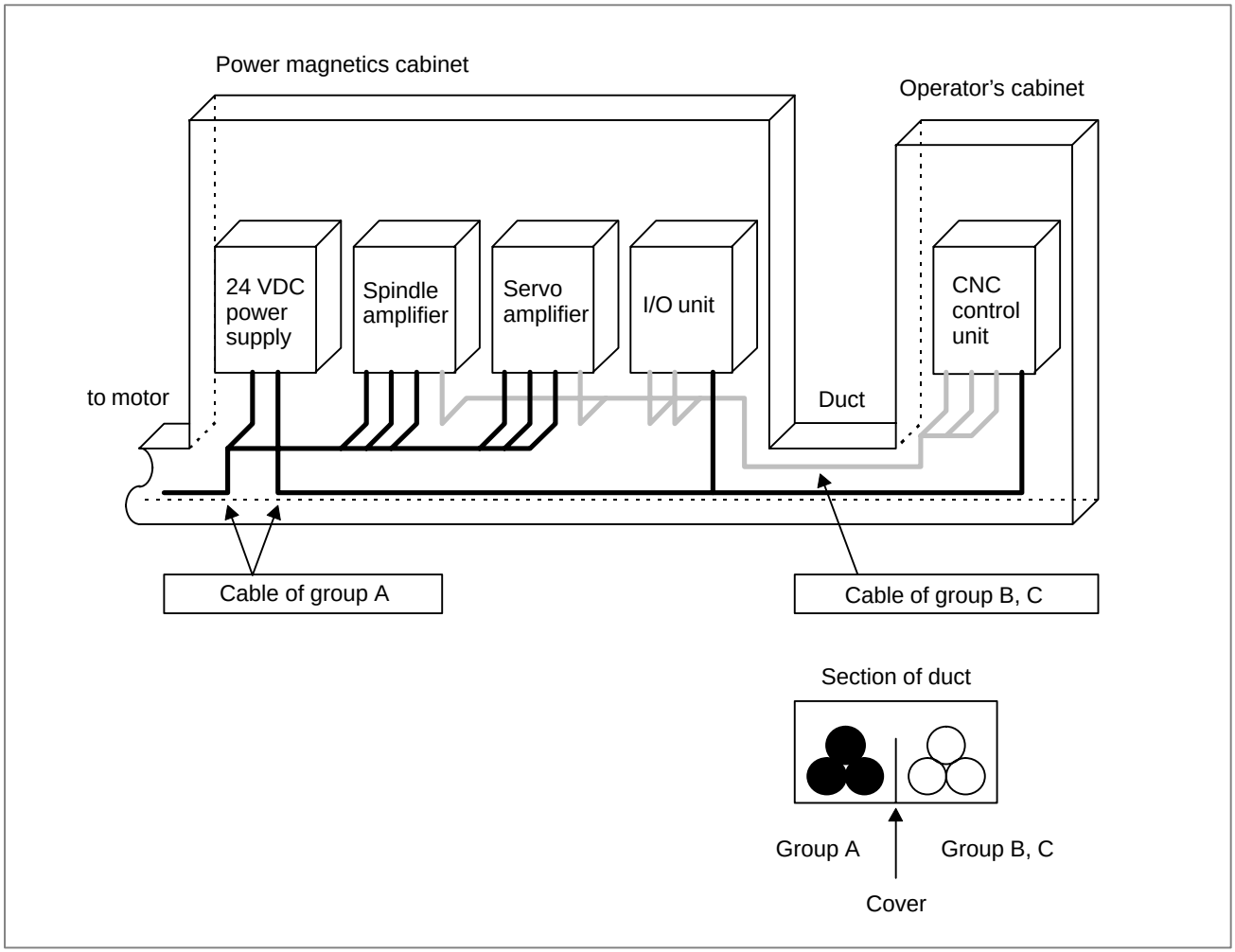
The CNC has been steadily reduced in size using surface–mount and custom LSI technologies for electronic components. The CNC also is designed to be protected from external noise. However, it is difficult to measure the level and frequency of noise quantitatively, and noise has many uncertain factors. It is important to prevent both noise from being generated and generated noise from being introduced into the CNC. This precaution improves the stability of the CNC machine tool system.
The CNC component units are often installed close to the parts generating noise in the power magnetics cabinet. Possible noise sources into the CNC are capacitive coupling, electromagnetic induction, and ground loops.
When designing the power magnetics cabinet, guard against noise in the machine as described in the following section.

3.5.1 Separating Signal Lines

The cables used for the CNC machine tool are classified as listed in the following table:
Process the cables in each group as described in the action column.

Group	Signal line	Action
A	Primary AC power line	Bind the cables in group A separately (Note 1) from groups B and C, or cover group A with an electromagnetic shield (Note 2). See Section 3.5.4 and connect spark killers or diodes with the solenoid and relay.
	Secondary AC power line	
	AC/DC power lines (containing the power lines for the servo and spindle motors)	
	AC/DC solenoid	
	AC/DC relay	
B	DC solenoid (24VDC)	Connect diodes with DC solenoid and relay. Bind the cables in group B separately from group A, or cover group B with an electromagnetic shield. Separate group B as far from Group C as possible. It is more desirable to cover group B with the shield.
	DC relay (24VDC)	
	DI/DO cable between the CNC and power magnetics cabinet	
	DI/DO cable between the CNC and machine	
	24–VDC input power cables connected to the control unit and its peripherals	
C	Cable between the CNC and I/O Unit	Bind the cables in group C separately from group A, or cover group C with an electromagnetic shield. Separate group C as far from Group B as possible. Be sure to perform shield processing in Section 3.5.5.
	Cable for position and velocity feedback	
	Cable between the CNC and spindle amplifier	
	Cable for the position coder	
	Cable for the manual pulse generator	
	Cable between the CNC and the MDI	
	RS–232C and RS–422 interface cable	
	Cable for the battery	
	Other cables to be covered with the shield	

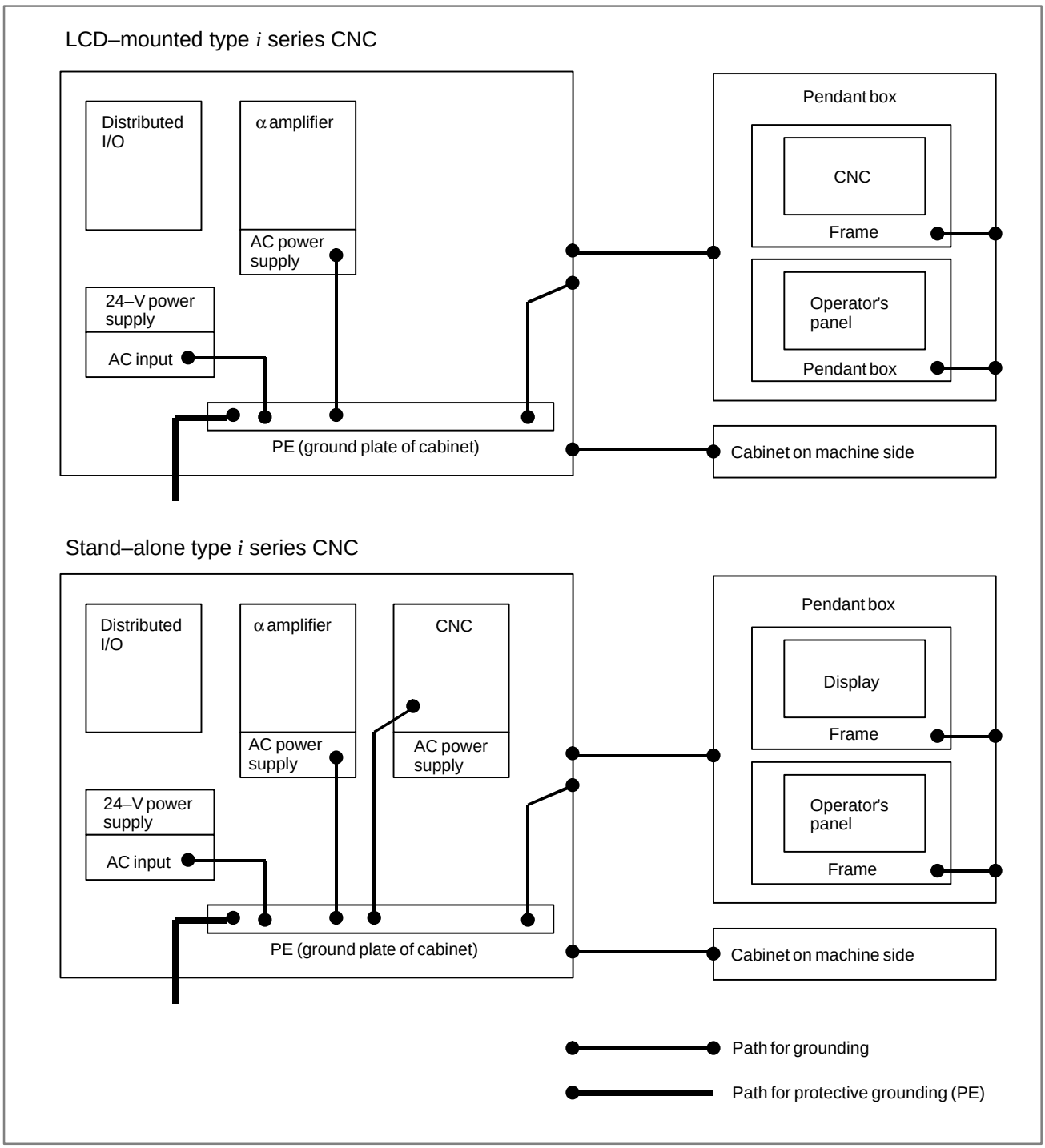
NOTE
1 The groups must be 10 cm or more apart from one another when binding the cables in each group.
2 The electromagnetic shield refers to shielding between groups with grounded steel plates.
3 The shield is not required when the cable between the CNC and MDI is shorter than 30 cm.



3.5.2 Ground

The CNC machine tool uses the following three types of grounding:

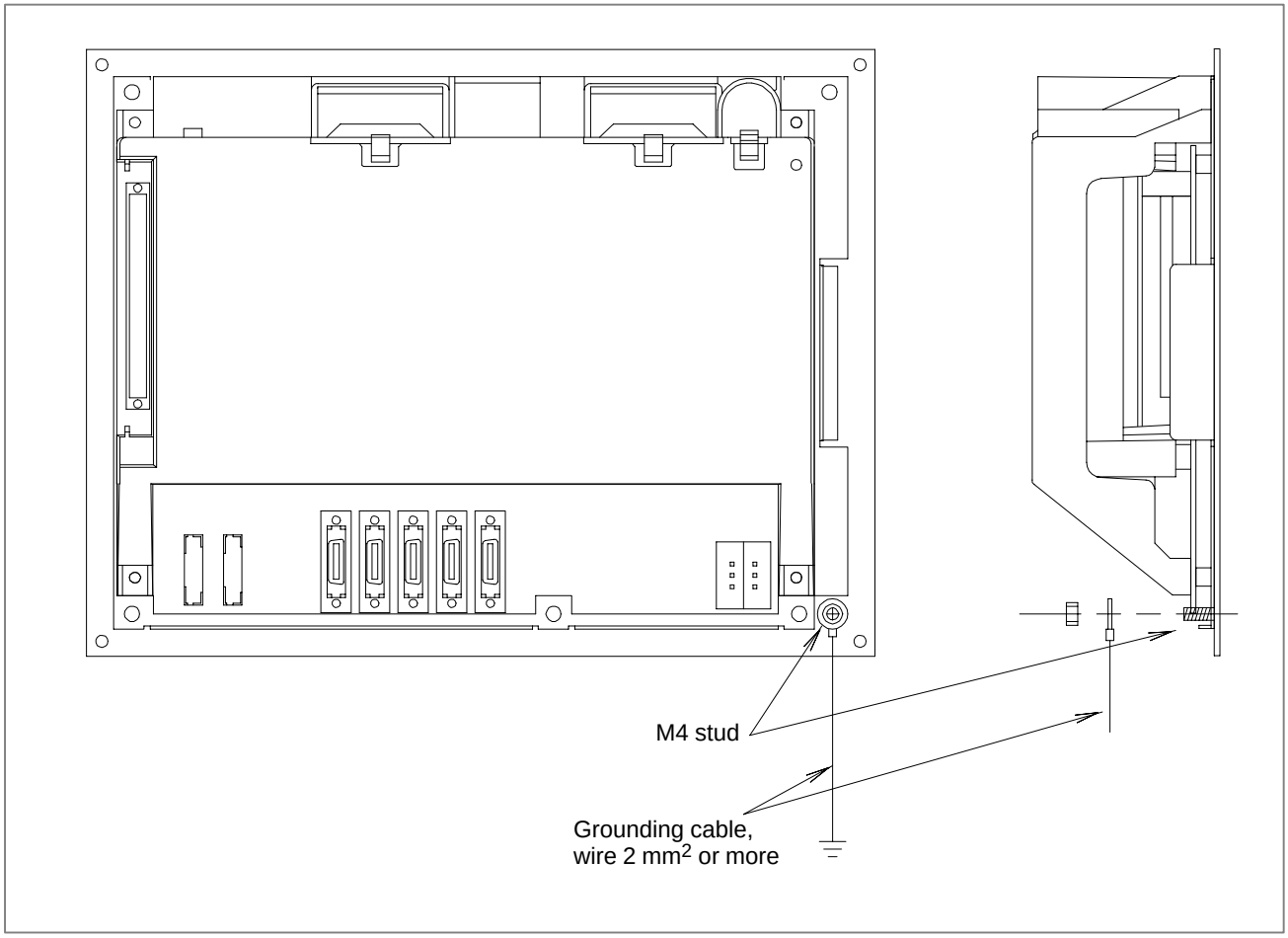
- Signal grounding
  Signal grounding supplies a reference potential (0 V) for electrical signals.
- Grounding for protection
  Grounding for protection is performed for safety reasons as well as to shield against external and internal noise. This type of grounding includes, for example, the equipment frames, cases and panels of units, and the shielding on interface cables connecting the equipment.
- Protective grounding (PE)
  Protective grounding (PE) is performed to connect protection grounds provided for equipment or between units to ground together at one point as a grounding system.



Notes on grounding

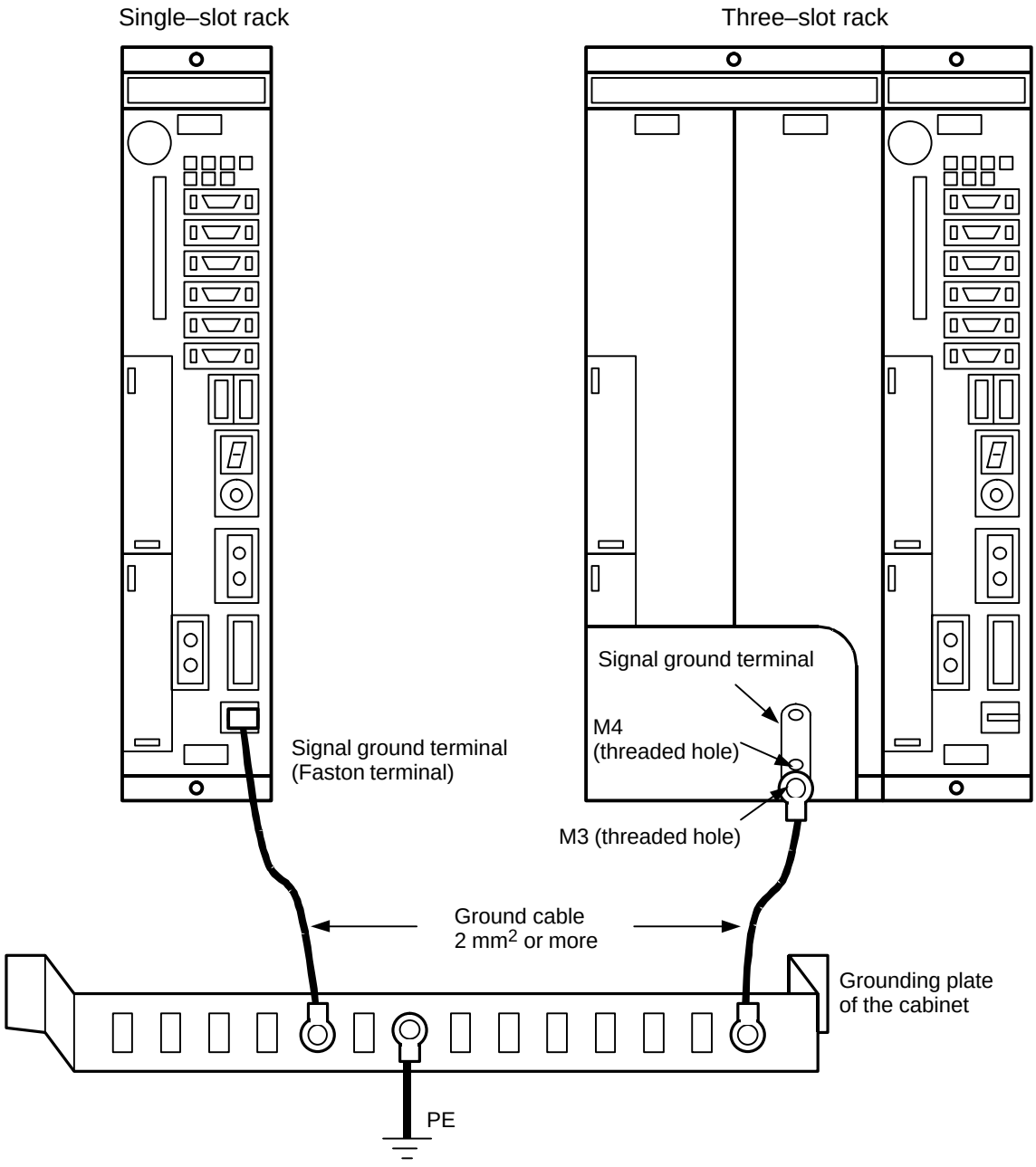
- The ground resistance in protective grounding (PE) must be 100 Ω or less (type D grounding).
- The cable used for protective grounding (PE) must be of a sufficient cross section to allow current to flow safely into protective ground (PE) if an accident such as a short–circuit occurs. (Generally, a cross section equal to or greater than that of the AC power cable is required.)
- The cable connected to protective ground (PE) must be incorporated into the AC power wire such that power cannot be supplied with the ground wire disconnected.

3.5.3 Connecting the Signal Ground (SG) of the Control Unit



Connect the 0 V line of the electronic circuit in the control unit with the ground plate of the cabinet via the signal ground (SG) terminal.
For the locations of the grounding terminals of other units, see “EXTERNAL DIMENSIONS OF EACH UNIT” in APPENDIX.

Stand–alone type control unit



Connect the 0–V lines of the electronic circuits in the control unit to the ground plate of the cabinet via the signal ground terminal.

Note that the grounding method differs depending on whether option slots are present.

Use the Faston terminal (FANUC specification: A02B–0166–K330).

3.5.4 Noise Suppressor

The AC/DC solenoid and relay are used in the power magnetics cabinet. A high pulse voltage is caused by coil inductance when these devices are turned on or off.
This pulse voltage induced through the cable causes the electronic circuits to be disturbed.

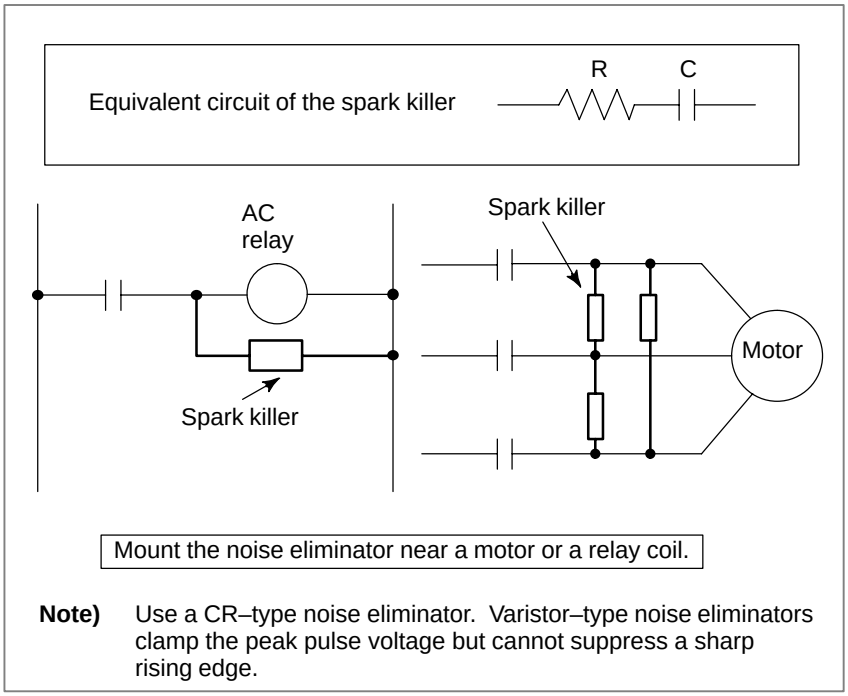
Notes on selecting the spark killer

- Use a spark killer consisting of a resistor and capacitor in series. This type of spark killer is called a CR spark killer.(Use it under AC)
  (A varistor is useful in clamping the peak voltage of the pulse voltage, but cannot suppress the sudden rise of the pulse voltage. FANUC therefore recommends a CR spark killer.)
- The reference capacitance and resistance of the spark killer shall conform to the following based on the current (I (A)) and DC resistance of the stationary coil:

  1) Resistance (R) : Equivalent DC resistance of the coil

  2) Capacitance (C) : $\frac{I^2}{10} \sim \frac{I^2}{20}$ (μF)

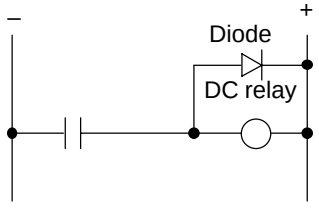
  I : Current at stationary state of the coil



Mount the noise eliminator near a motor or a relay coil.

Note) Use a CR–type noise eliminator. Varistor–type noise eliminators clamp the peak pulse voltage but cannot suppress a sharp rising edge.

Diode (used for direct–current circuits)



Use a diode which can withstand a voltage up to two times the applied voltage and a current up to two times the applied current.

3.5.5 Cable Clamp and Shield Processing

If a cable connected to the CNC, servo amplifier, spindle amplifier, or other device requires shielding, clamp the cable as shown below. The clamp both supports and shields the cable. Use this clamp to ensure stable operation of the system.
Partially peel out the sheath and expose the shield. Push and clamp by the plate metal fittings for clamp at the part. The ground plate must be made by the machine tool builder, and set as follows :

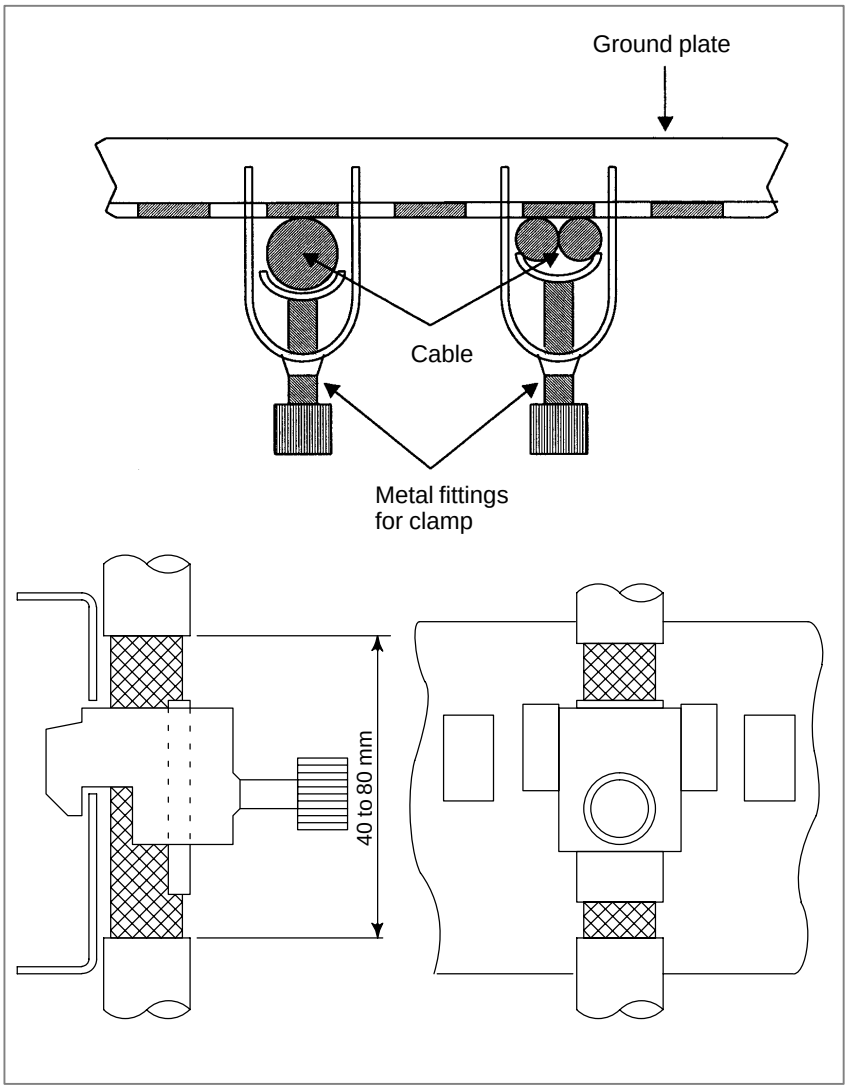


Fig. 3.5.5 (a) Cable clamp (1)

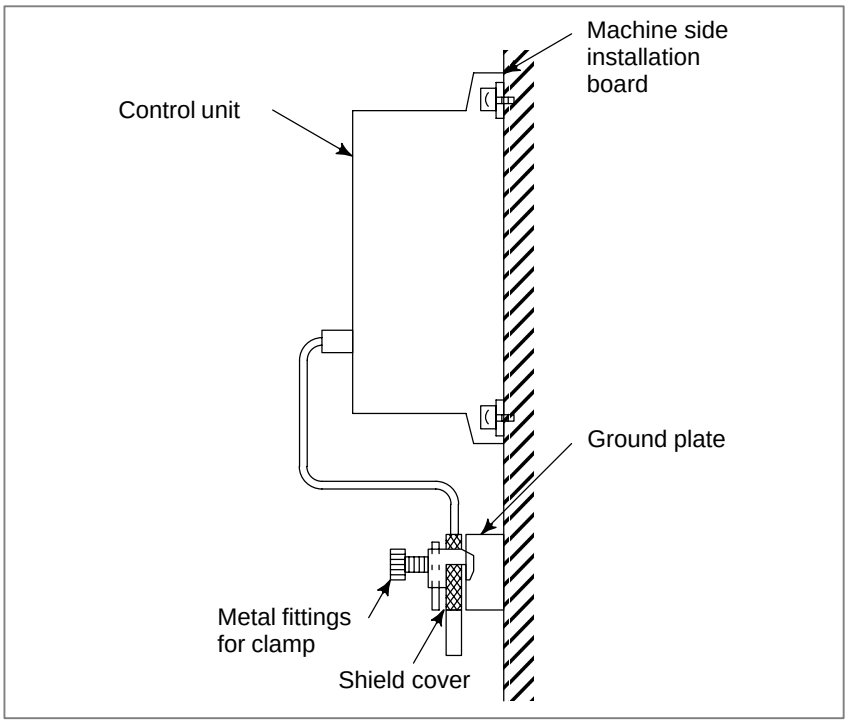


Fig. 3.5.5 (b) Cable clamp (2)

Prepare ground plate like the following figure.

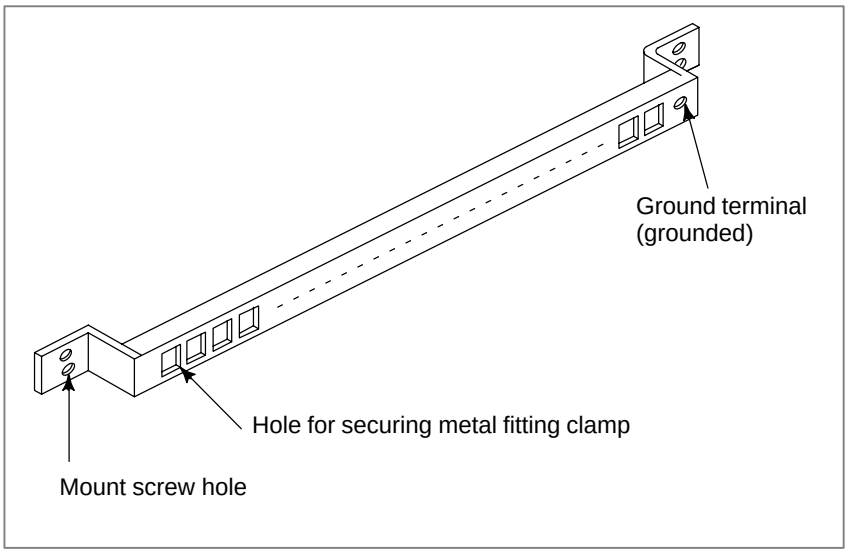


Fig. 3.5.5 (c) Ground plate

For the ground plate, use a metal plate of 2 mm or thicker, which surface is plated with nickel.

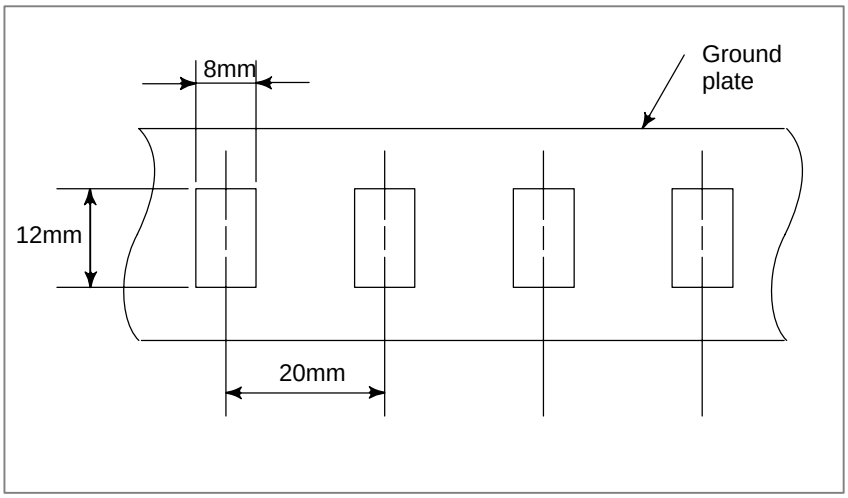


Fig. 3.5.5 (d) Ground plate holes

(Reference) Outer drawings of metal fittings for clamp.

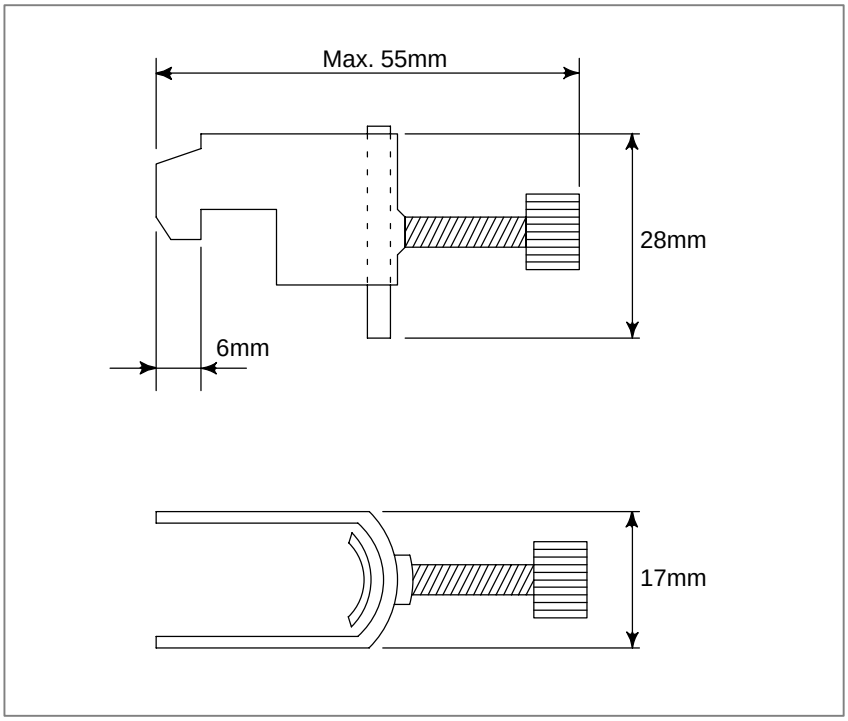


Fig. 3.5.5 (e) Outer drawings of metal fittings for clamp

Ordering specification for metal fittings for clamp
A02B–0124–K001 (8 pieces)

3.5.6 Measures Against Surges due to Lightning

To protect the devices from surge voltages due to lightening, it is recommended to install surge–absorbing elements between the lines of the input power and between one line and ground. This does not, however, assure protection from all surges due to lightening.
The recommended items are as follows. (Items made by Okaya Denki Sangyo Co.)

For the 200–V system

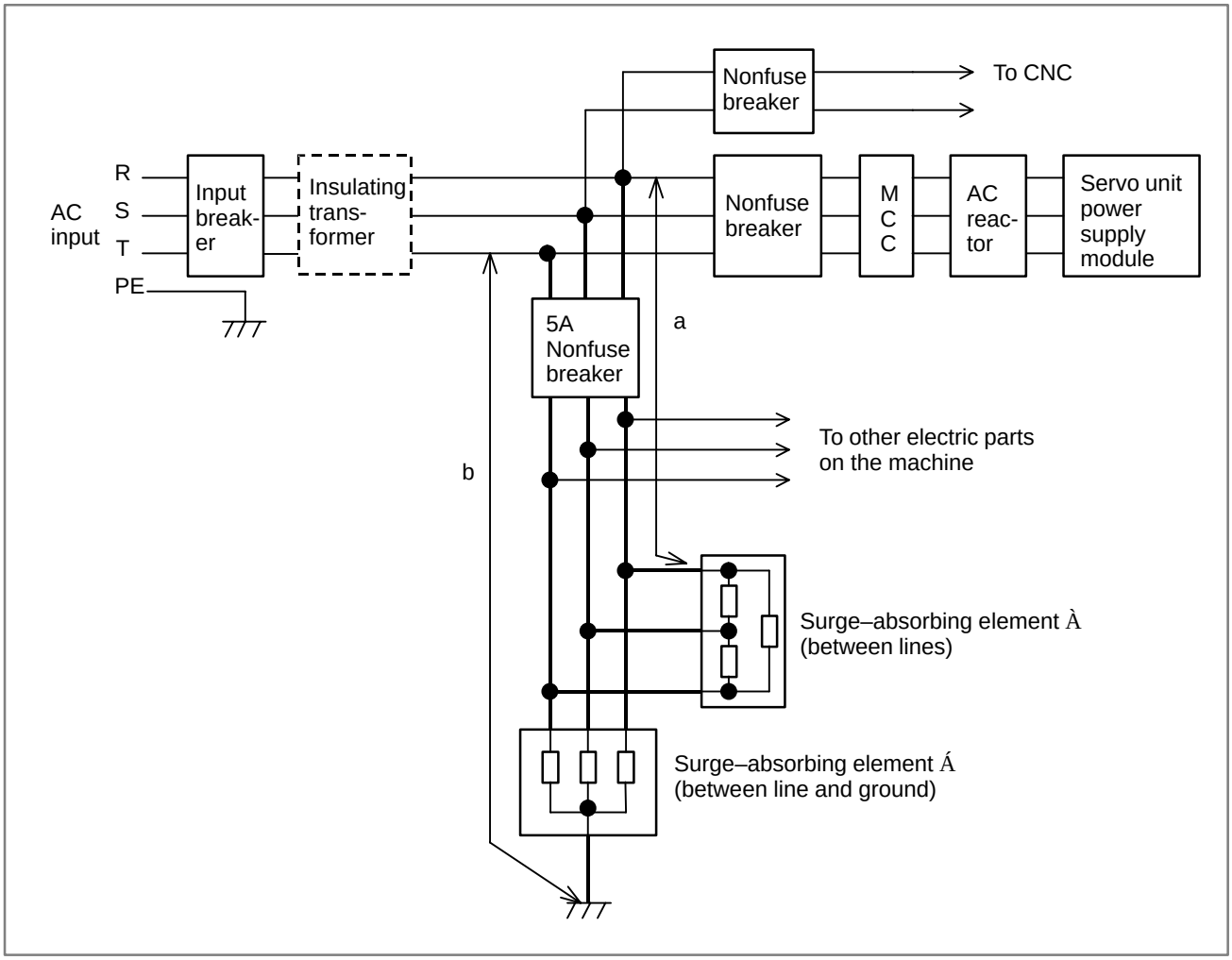
Between lines	R • A • V–781BYZ–2
Between line and ground	R • A • V–781BXZ–4

For the 400–V system

Between lines	R • A • V–152BYZ–2A
Between line and ground	R • A • V–801BXZ–4

Installation procedure

The surge–absorbing elements used for measures against surges due to lightening must be installed in the input power unit as shown in the figure below. The figure below shows an example in which an insulating transformer, shown by dotted lines, is not installed. If an insulating transformer is installed, surge–absorbing element ¿ (between line and ground) is not required.



Notes

(1) For a better surge absorbing effect, the wiring shown by heavy line must be as short as possible.

Wire Size: The wire diameter must be 2 mm^2 or greater.

Wire length: The sum of the length (a) of the wire for the connection of surge–absorbing element ¿ and that (b) of surge–absorbing element ¿ must be 2 m or less.

(2) If conducting dielectric strength tests by applying overvoltages (1000 VAC and 1500 VAC) to the power line, remove surge–absorbing element ¿. Otherwise, the overvoltages would activate the element.

(3) The nonfuse breaker (5A) is required to protect the line when a surge voltage exceeding the capacity of the surge–absorbing elements is applied and the surge–absorbing elements are short–circuited.

(4) Because no current flows through surge–absorbing elements ¿ and ¿ during normal operation, the nonfuse breaker (5A) can be shared by other electric devices on the machine. It can be used with the control power supply of the servo unit power supply module or with the power supply for the fan motor of the spindle motor.

3.6 CONTROL UNIT

3.6.1 Installation of the Control Unit

The control unit has a built–in fan motor.
Air enters the control unit through the bottom and is drawn through the fan motor which is located on the top of the control unit.

Space (A), shown in Fig. 3.6.1, must be provided to ensure unrestricted air flow. Also, space (B) should be provided whenever possible. When space (B) cannot be provided, ensure that nothing is placed in the immediate vicinity which could obstruct the air flow.

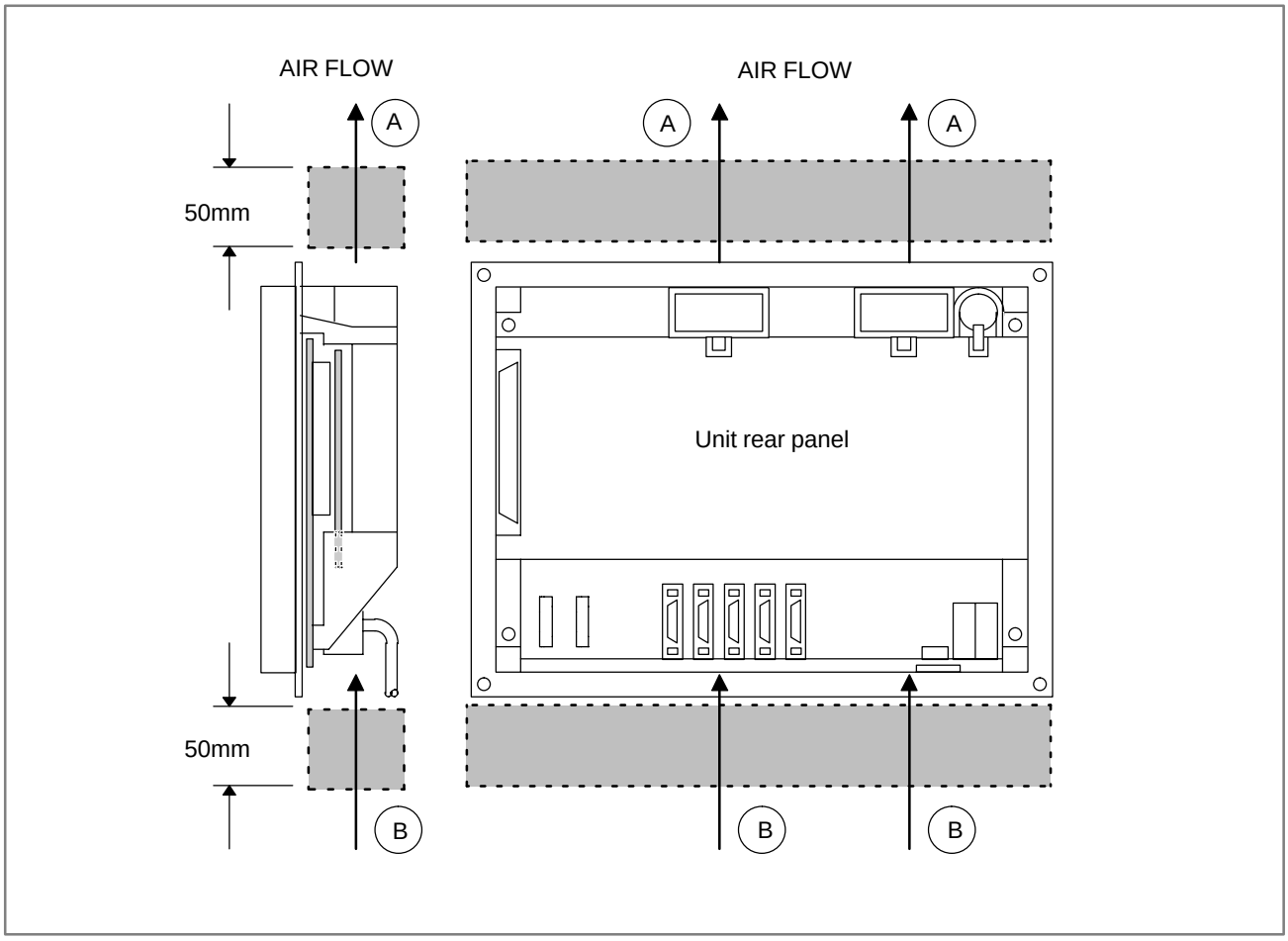


Fig. 3.6.1

3.6.2 Installing the Stand–alone Type Control Unit

The control unit is equipped with a fan motor.

Air is fed into the bottom of the unit and output from the fan motor mounted on the top of the unit.

The spaces shown in Fig. 3.6.2 (areas (A) and (B)) are always required to ensure smooth air flow.

Also, adequate service access space is required in front of and at the top of the unit so that printed circuit boards and the fan motor can be replaced easily if necessary.

There is a spare connector located at the far end (at middle height) on the right side of the control unit. This connector is used for controller testing and other purposes. Therefore, space (area (C)) for handling the connector is required.

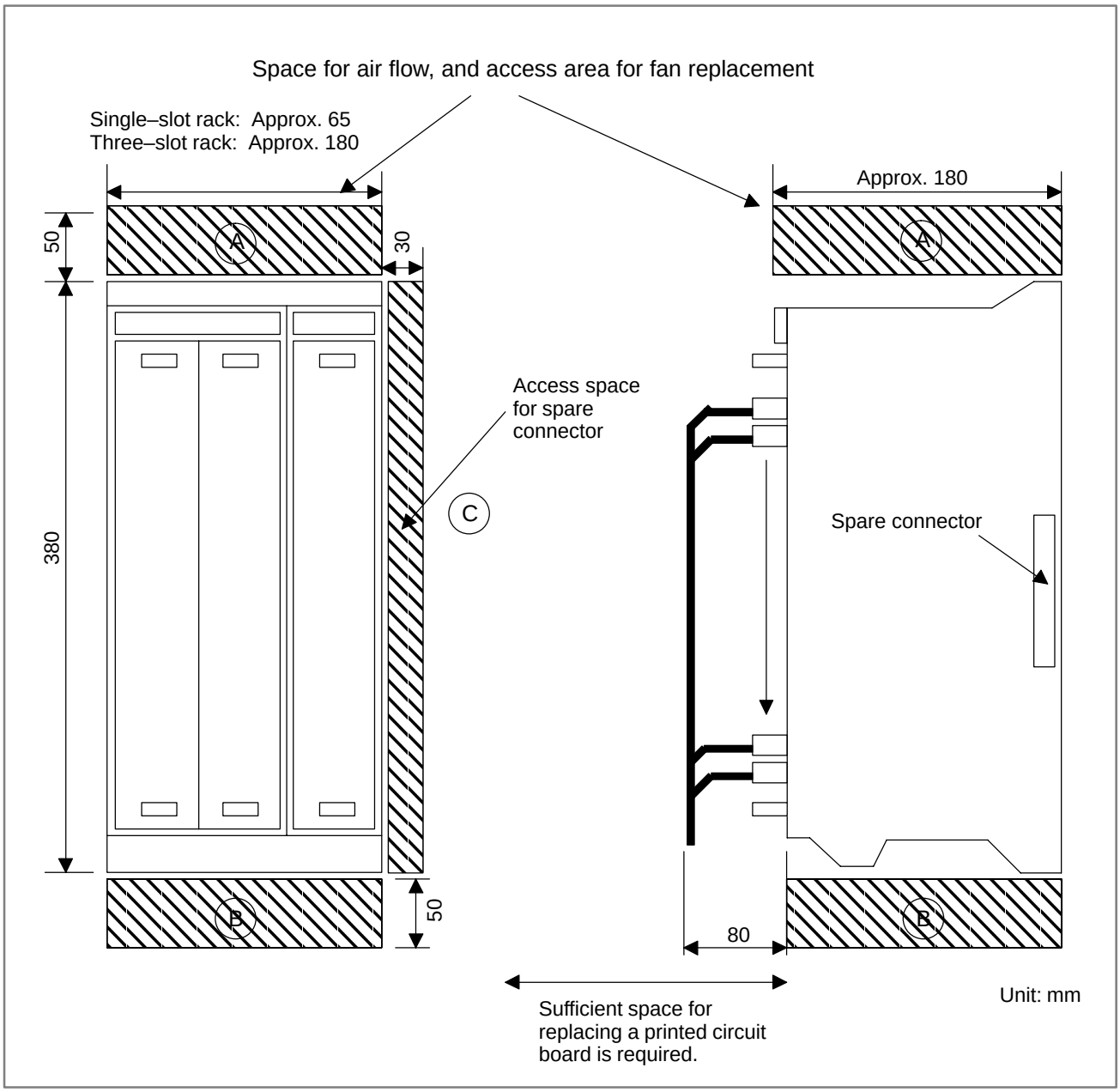


Fig. 3.6.2

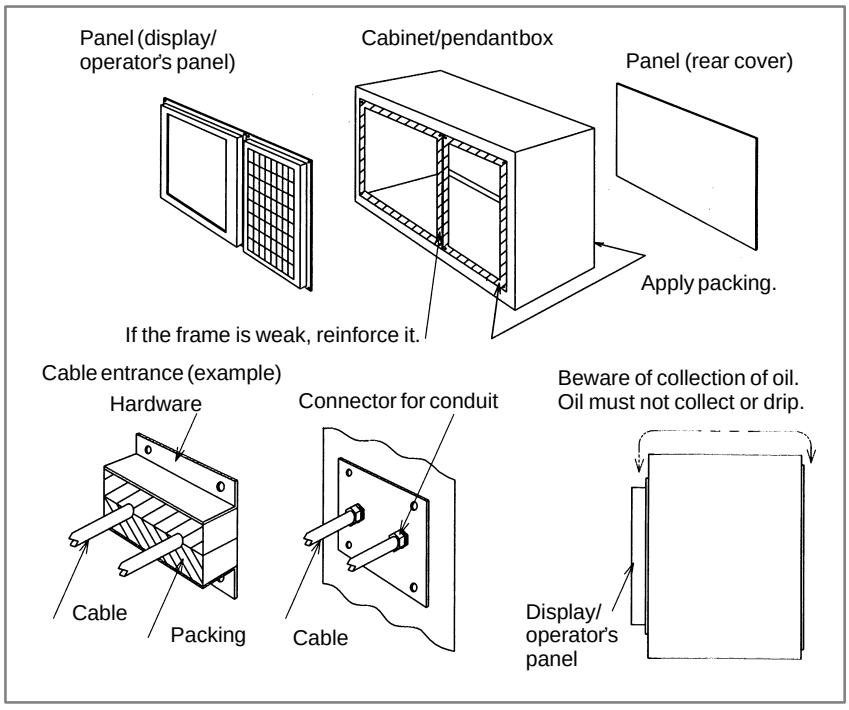
3.7 CABLING DIAGRAM

For the cabling diagram, see the control unit configuration and component names in Section 1.1.

3.8 DUSTPROOF MEASURES FOR CABINETS AND PENDANT BOXES

The cabinet and pendant box that house a display and a operator's panel that are to be designed and manufactured by the machine tool builder are susceptible to dust, cutting debris, oil mist, etc. Note the following and make sure that they are structured to prevent their entry.

1) The cabinet and pendant box must be of a hermetically sealed structure.
2) Apply packing to the panel mounting surface to which a display and operator's panel are to be mounted.
3) Make sure that the door packing of the cabinet and pendant box is sealed firmly.
4) For a cabinet or pendant box with a rear cover, apply packing to the mounting surface.
5) Make sure that the cable entrance is sealed with packing, connectors for conduits, etc.
6) Make sure that all other openings are blocked, if any.
7) Make sure that the display and operator's panel do not receive cutting debris and coolant directly.
8) Oil can easily stay on the top of the cabinet and pendant box, possibly dripping down the display and operator's panel. Make sure that the cabinet and pendant box is of such a structure that oil do not collect or that oil do not drip down the display or panel.



4 POWER SUPPLY CONNECTION

4.1 GENERAL

This section explains the connection of power supply for *i* Series control unit.

4.2 TURNING ON AND OFF THE POWER TO THE CONTROL UNIT

4.2.1 Power Supply for the Control Unit

Supply power (24VDC) to the control uint of Series 21*i*/210*i* from an external sources.

Install a power switch at (1) in Fig. 4.2.1 (a).

When the Series 210*i* control unit with PC functions is used, apply countermeasures to guard against the possible destruction of hard disk storage due to momentary power failure or power outage, by installing an uninterruptible power supply, etc.

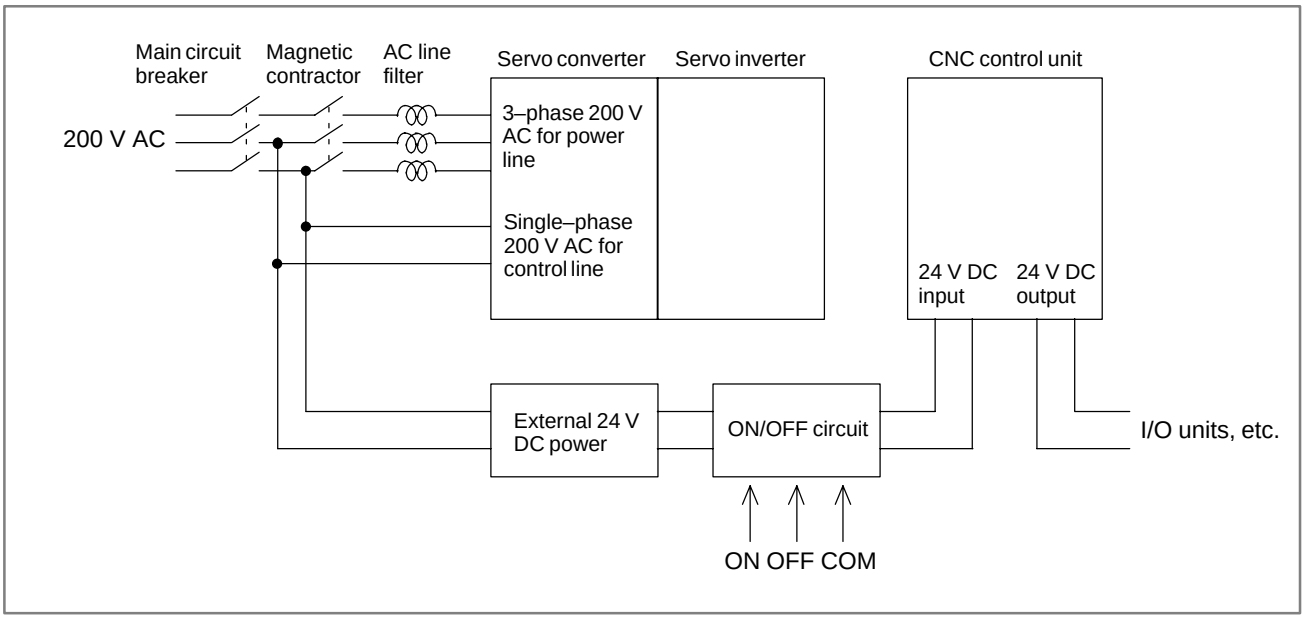


Fig. 4.2.1 (a)

ON/OFF circuit (example)

For example, “ON/OFF circuit” is as follows : (Fig.4.2.1 (b))
Select the circuit devices, in consideration of its capacity.

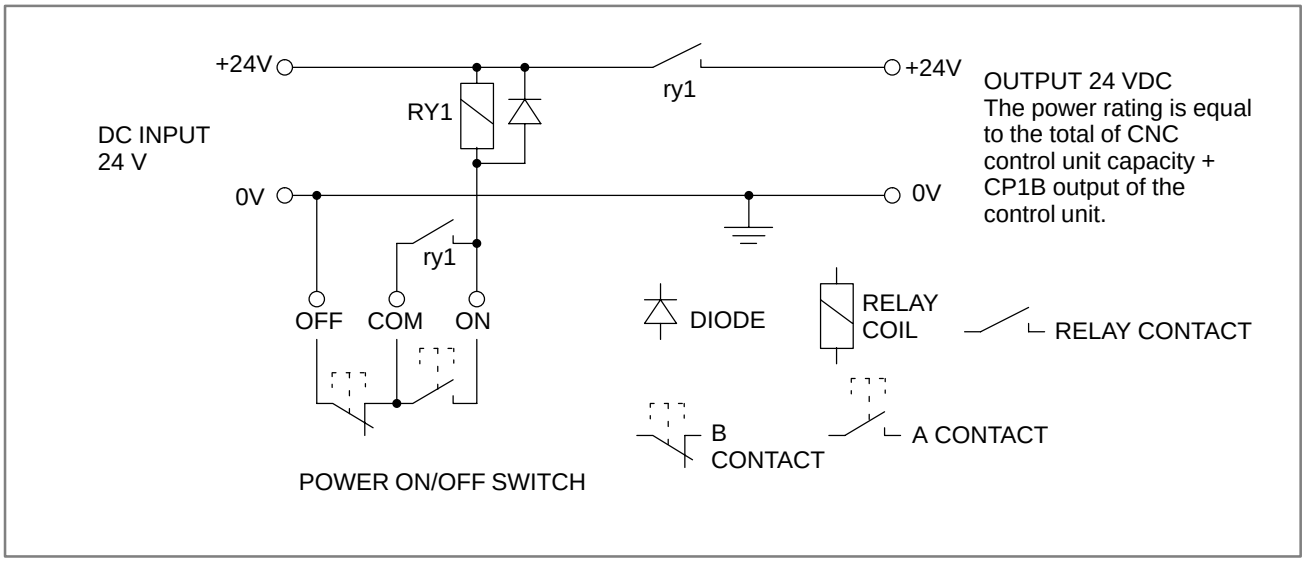
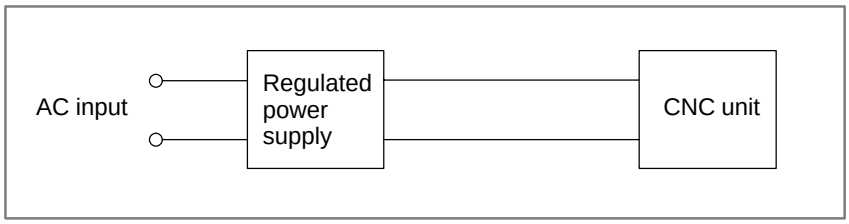


Fig. 4.2.1 (b)

4.2.2 +24V Input Power Specifications

Recommended connection and recommended power specifications

(1) Recommended connection



(2) Recommended power specifications

(The power supply must conform to the applicable safety standard.)

Output voltage: +24 V (10% (21.6 V to 26.4 V)
(including ripple voltage and noise. See the figure below.)

Output current: The continuous load current must be larger than the current consumption of the CNC.
(At the maximum temperature inside the power magnetics cabinet in which the power supply is located)

Instantaneous input interruption retention time: 10 mS (for –100%)
20 mS (for –50%)

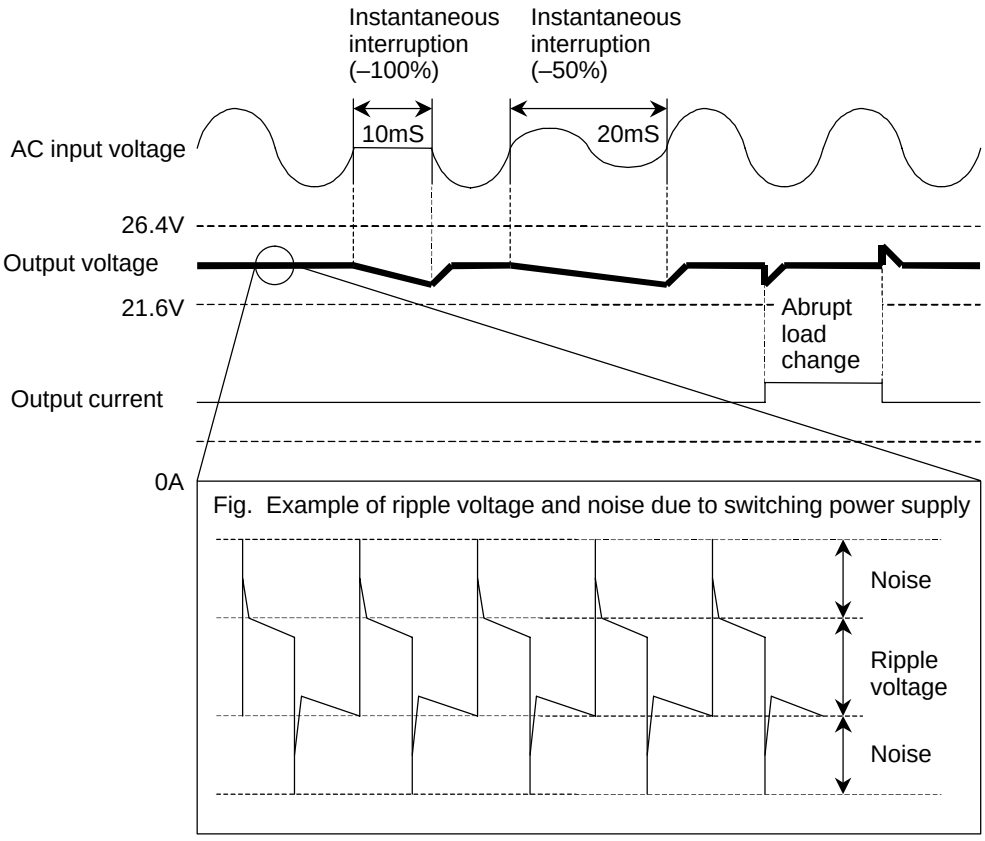


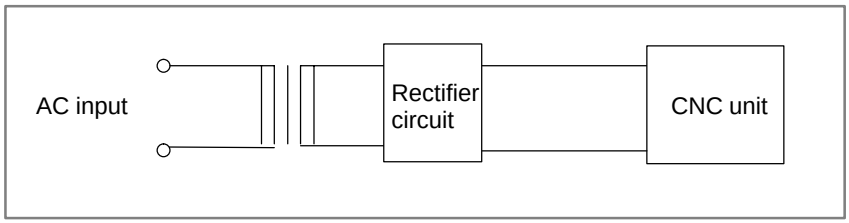
Fig 4.2.2 Timing chart

• Circuit configurations

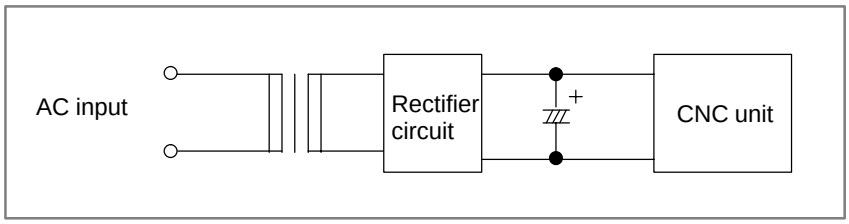
The following circuit configurations are not recommended.

- Circuit examples that cannot retain the output voltage at an instantaneous interruption (the voltage reduces to 21.6 V or below)

Example 1

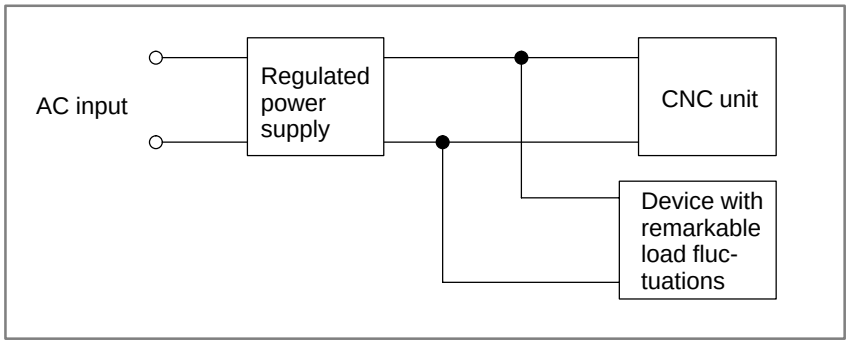


Example 2

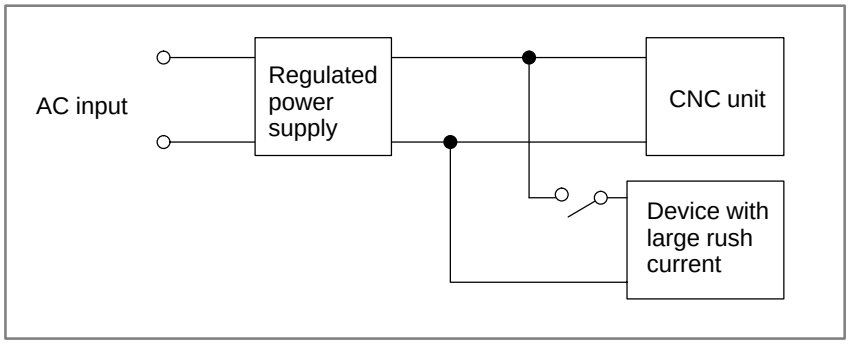


- Circuit examples that exceed the output voltage specifications (21.6 V to 26.4 V) due to an abrupt load change

Example 1



Example 2



4.2.3 Power–on Sequence

Turn on the power to all the units at the same time, or in the following sequence:

1 Power to the overall machine (200 VAC), power to the separate detector (scale)
2 Power to slave I/O units connected via the I/O link, separate detector interface unit, and stand–alone type LCD unit (24 VDC), servo amplifier control power supply (200 VAC)
3 Power to the CNC (24 VDC)

"Turning on the power to all the units at the same time" means completing the power–on operations in 1 and 2 above within 500 ms of performing power–on in 3.

When a separate detector (scale) is used, the output signal of the separate detector must become stable within 500 ms of the separate detector interface unit being turned on.

In some cases, the detector must be turned on prior to the separate detector interface unit according to the specifications of the detector.

The power–on sequence for a stand–alone type LCD unit supporting the display link and an intelligent terminal is undefined.

4.2.4 Power–off Sequence

Turn off the power to all the units at the same time, or in the following sequence:

1 Power to the CNC (24 VDC)
2 Power to the slave I/O units connected via the I/O link, separate detector interface unit, and stand–alone type LCD unit (24 VDC), servo amplifier control power supply (200 VAC), and power to any separate detector (scale)
3 Power to the overall machine (200 VAC)

"Turning off the power to all units at the same time" means completing the power–off operations in 2 and 3 above within 500 ms before the power–off operation described in 1 above. If the power to the units indicated in 2 or 3 is turned off other than within 500 ms of the power in 1 being turned off, alarm information is left in the NC.

The power–off sequence for a stand–alone type LCD unit supporting the display link and an intelligent terminal is undefined.

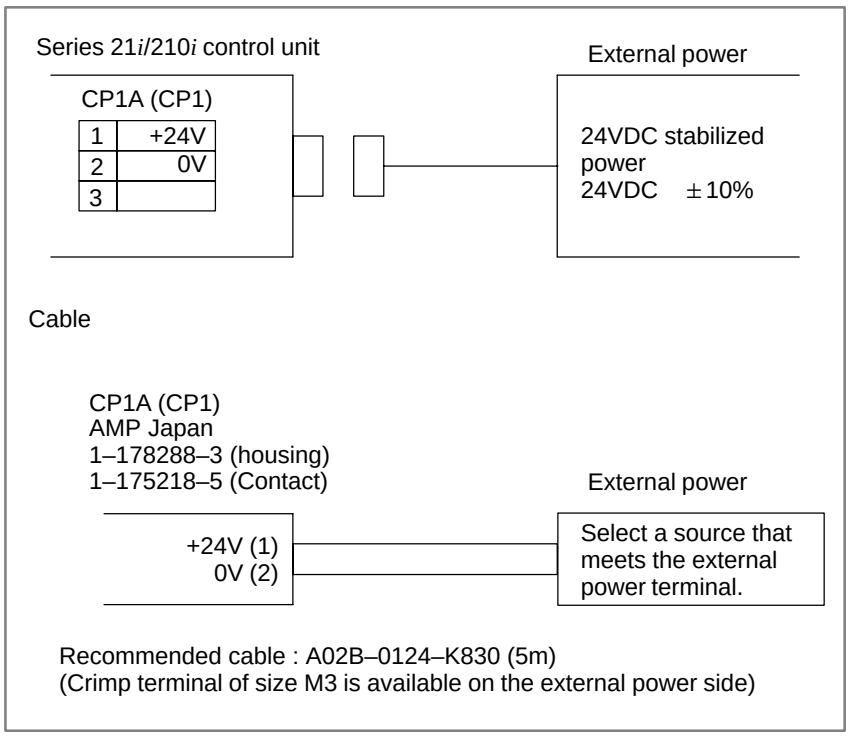
CAUTION
When the *i* Series CNC with PC functions or an intelligent terminal is used, the OS must be shut down before the power to the control unit is turned off. Be careful not to turn off the power while the hard disk is being accessed or before the OS has terminated; otherwise, the hardware contents may be destroyed.

When the power is turned off or when the power is momentarily disconnected, motor control is disabled. Problems that may be generated from the motor control disabled state should be handled from the machine, as necessary.

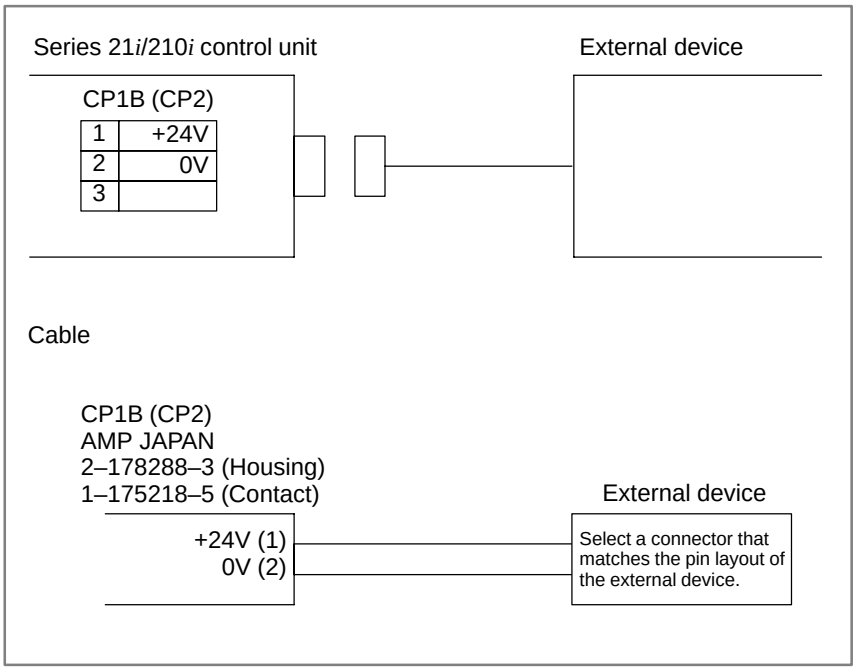
For example, when movement along a vertical axis is controlled, a brake should be applied to prevent falling. Usually, the brake clamps the motor when the servo is not activated or when the motor is not turning. The clamp is released only when the motor is turning. When servo axis control is disabled by power–off or momentary power disconnection, the brake usually clamps the servo motor. In this case, before the relay for clamping operates, the controlled axis may fall. So, also consider whether the distance the axis is likely to fall will cause a problem.

4.3 CABLE FOR POWER SUPPLY TO CONTROL UNIT

Supply power to the control unit from external resouce.
The brackets in the figures are the stand–alone type connector name.



The 24 V DC input to CP1A (CP1) can be output from CP1B (CP2) for use in branching. The connection of CP1B (CP2) is as shown below. In this case, the external 24 V DC power supply should have a rating which is equal to the sum of the current consumed by the control unit and the current used via CP1B (CP2).



4.4 BATTERIES

In a system using the *i* Series CNC, batteries are used as follows:

Use	Component connected to battery
Memory backup in the CNC	CNC
BIOS data backup in the intelligent terminal	Intelligent terminal
Preservation of the current position indicated by the separate absolute pulse coder	Separate detector interface unit
Preservation of the current position indicated by the absolute pulse coder built into the motor	Servo amplifier

Used batteries must be discarded according to appropriate local ordinances or rules. When discarding batteries, insulate them by using tape and so forth to prevent the battery terminals from short–circuiting.

4.4.1 Battery for Memory Backup (3VDC)

Part programs, offset data, and system parameters are stored in CMOS memory in the control unit. The power to the CMOS memory is backed up by a lithium battery mounted on the front panel of the control unit. The above data is not lost even when the main battery goes dead. The backup battery is mounted on the control unit at shipping. This battery can maintain the contents of memory for about a year.
When the voltage of the battery becomes low, alarm message “BAT” blinks on the display and the battery alarm signal is output to the PMC. When this alarm is displayed, replace the battery as soon as possible. In general, the battery can be replaced within two or three weeks, however, this depends on the system configuration.
If the voltage of the battery becomes any lower, memory can no longer be backed up. Turning on the power to the control unit in this state causes system alarm 910 (SRAM parity alarm) to occur because the contents of memory are lost. Clear the entire memory and reenter data after replacing the battery.
The following two kinds of batteries can be used.

- Lithium battery built into the CNC control unit.
- Two alkaline dry cells (size D) in the external battery case.

NOTE
A lithium battery is installed as standard at the factory.

Replacing the lithium battery

(1) Prepare a new lithium battery (ordering drawing number: A02B–0200–K102).

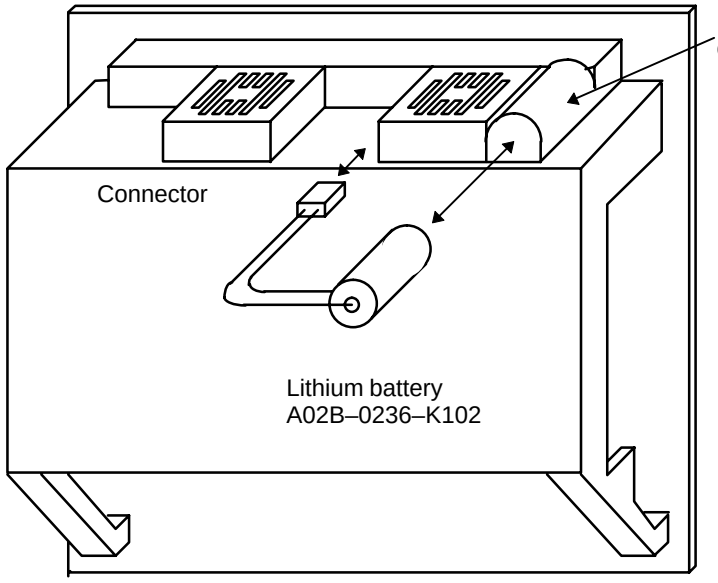
(2) Turn the *i* Series on for about 30 seconds.

(3) Turn the *i* Series off.

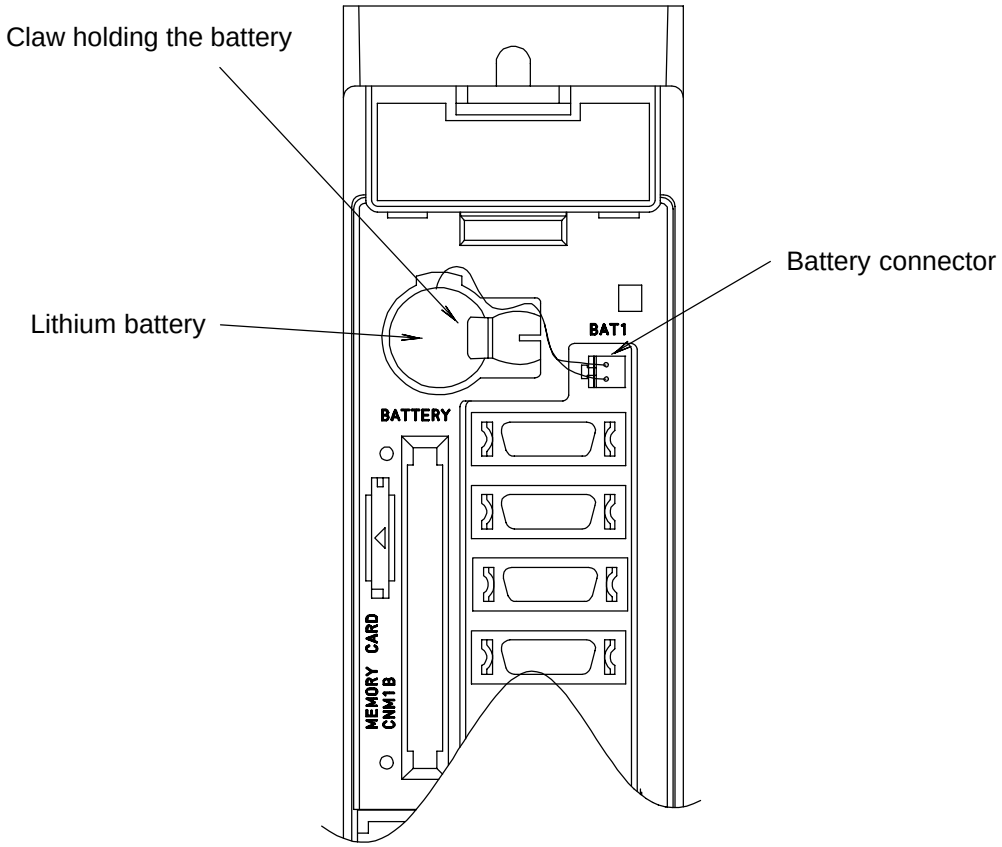
(4) (LCD–mounted type *i* Series CNC)
Remove the old battery from the top of the CNC control unit.
First unplug the battery connector then take the battery out of its case.
The battery case of a control unit without option slots is located at the top right end of the unit. That of a control unit with 2 slots is located in the central area of the top of the unit (between fans).
(Stand–alone type *i* Series CNC)
Remove the old battery from the front panel of the CNC control unit.
First unplug the battery connector then take the battery out of its case.

(5) Insert a new battery and reconnect the connector.

NOTE
Steps (3) to (5) should be completed within the period indicated below. Do not leave the control unit without a battery for any longer than the period shown, as this will result in the contents of memory being lost.
Series 16*i*/18*i*/21*i*/20*i*: Within 30 minutes
Series 160*i*/180*i*/210*i* stand–alone type: Within 30 minutes
Series 160*i*/180*i*/210*i* with PC functions LCD–mounted type: Within 5 minutes



(LCD–mounted type *i* Series CNC)



(Stand–alone type *i* Series CNC)

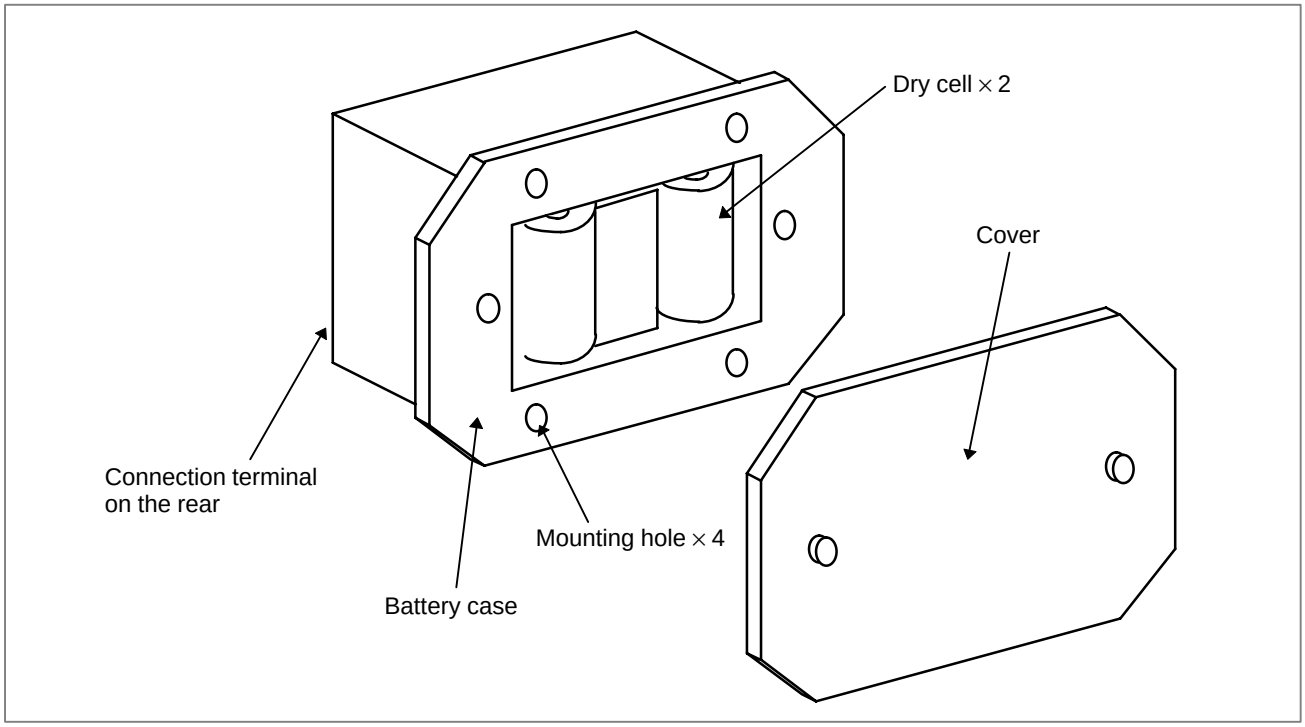
WARNING

Incorrect battery replacement may cause an explosion. Do not use a battery other than that specified (specification: A02B–0200–K102).

Replacing the alkaline dry cells (size D)

(1) Prepare two new alkaline dry cells (size D).
(2) Turn the Series 16*i*/18*i*/160*i*/180*i* on.
(3) Remove the battery case cover.
(4) Replace the batteries, paying careful attention to their orientation.
(5) Replace the battery case cover.

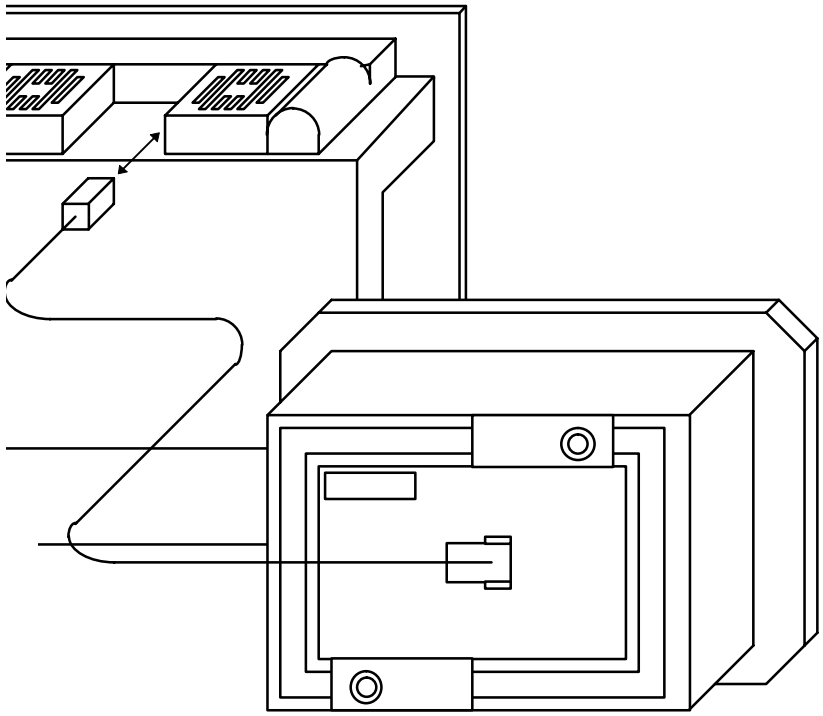
NOTE
When replacing the dry cells while the power is off, use the same procedure as that for lithium battery replacement procedure, described above.



Use of alkaline dry cells (size D)

Connection

Power from the external batteries is supplied through the connector to which the lithium battery is connected. The lithium battery, provided as standard, can be replaced with external batteries in the battery case (A02B–0236–C281) according to the battery replacement procedures described above.



NOTE

1 Install the battery case (A02B–0236–C281) in a location where the batteries can be replaced even when the control unit power is on.
2 The battery cable connector is attached to the control unit by means of a simple lock system. To prevent the connector from being disconnected due to the weight of the cable or tension within the cable, fix the cable section within 50 cm of the connector.

4.4.2 Battery in the Intelligent Terminal (3 VDC)

A lithium battery is used to back up BIOS data in the intelligent terminal. This battery is factory–set in the intelligent terminal. This battery has sufficient capacity to retain BIOS data for one year.

When the battery voltage becomes low, the LCD screen blinks. (The LCD screen also blinks if a fan alarm is issued.) If the screen blinks, replace the battery as soon as possible (within one week). FANUC recommends that the battery be replaced once per year regardless of whether a battery alarm is issued.

Replacing the battery

(1) To guard against the possible loss or destruction of BIOS parameters, write down the BIOS parameter values.

(2) Obtain a new lithium battery (A02B–0200–K102).

(3) After power has been supplied for at least five seconds, turn off the power to intelligent terminal type 2. Remove the intelligent terminal from the panel so that replacement work can be done from the rear of the intelligent terminal.

(4) Detach the connector of the lithium battery, and remove the battery from the battery holder.

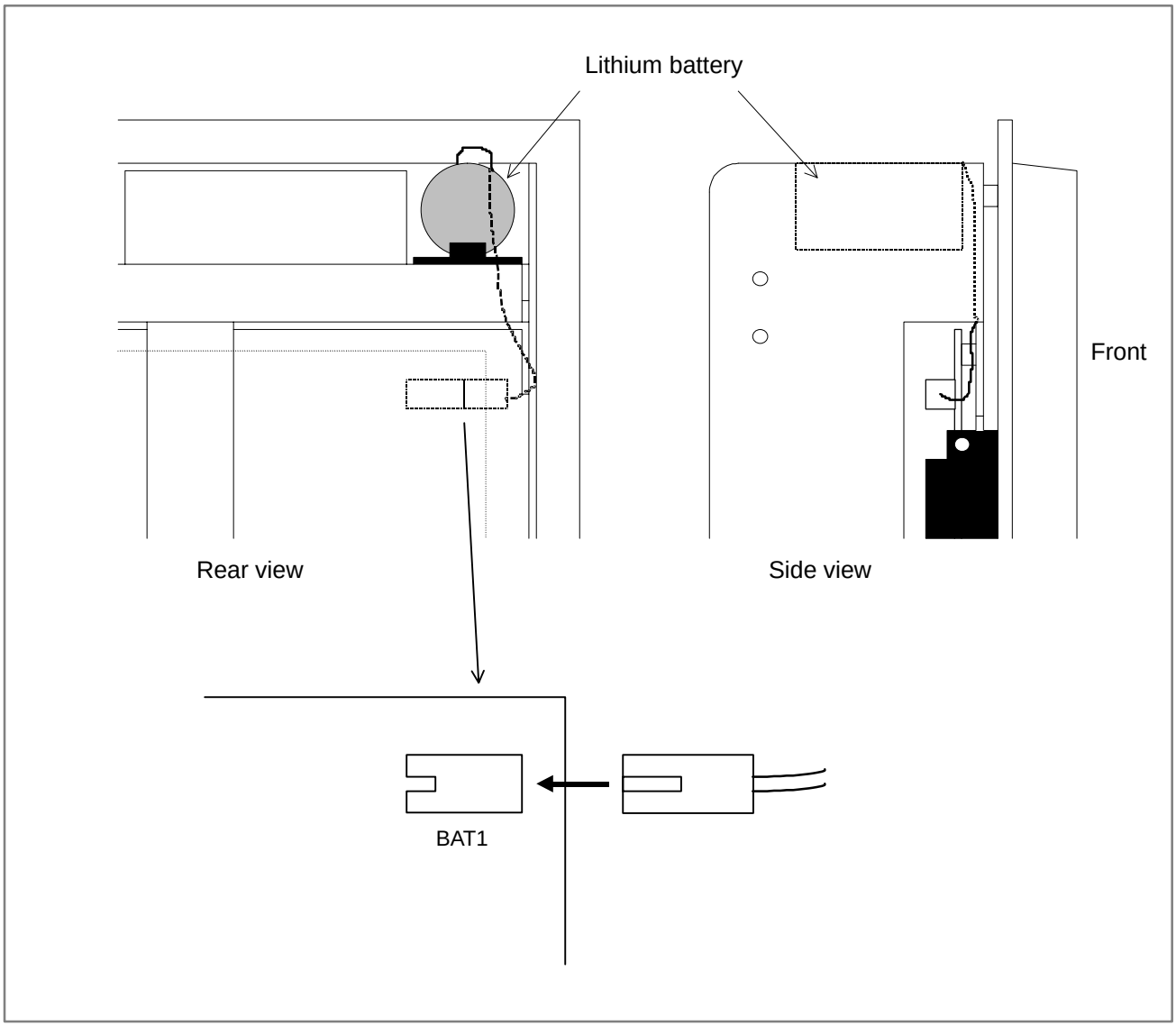
(5) Run the cable for the new lithium battery as shown in the figure.

(6) Attach the connector, and place the battery in the battery holder.

(7) Install intelligent terminal type 2 again.

(8) Turn on the power, and check that the BIOS parameters are maintained (BIOS setup is not activated forcibly).

Between removing an old battery and inserting new battery, no more than five minutes must be allowed to elapse.



Lithium battery connection

4.4.3 Battery for Separate Absolute Pulse Coders (6VDC)

One battery unit can maintain current position data for six absolute pulse coders for a year.
When the voltage of the battery becomes low, APC alarms 3n6 to 3n8 (n: axis number) are displayed on the LCD display. When APC alarm 3n7 is displayed, replace the battery as soon as possible. In general, the battery should be replaced within one or two weeks, however, this depends on the number of pulse coders used.
If the voltage of the battery becomes any lower, the current positions for the pulse coders can no longer be maintained. Turning on the power to the control unit in this state causes APC alarm 3n0 (reference position return request alarm) to occur. Return the tool to the reference position after replacing the battery.
Therefore, FANUC recommends that the battery be replaced once a year regardless of whether APC alarms are generated.
See Section 7.1.3 for details of connecting the battery to separate absolute pulse coders.

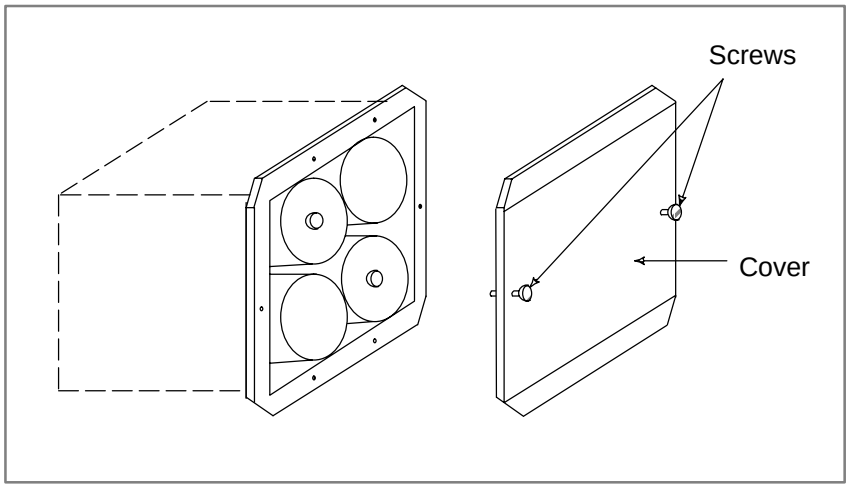
Replacing batteries

Obtain four commercially available alkaline batteries (size D).

(1) Turn on the power to the machine (*i* Series CNC).

(2) Loosen the screws of the battery case, and remove the cover.

(3) Replace the dry batteries in the case.
Note the polarity of the batteries as shown in the figure below (orient two batteries one way and the other two in the opposite direction).



(4) After installing the new batteries, replace the cover.

(5) Turn off the power to the machine (*i* Series CNC).

WARNING
If the batteries are installed incorrectly, an explosion may occur. Never use batteries other than the specified type (Size D alkaline batteries).

CAUTION
Replace batteries while the power to the *i* Series CNC is on. Note that, if batteries are replaced while no power is supplied to the CNC, the recorded absolute position is lost.

4.4.4 Battery for Absolute Pulse Coder Built into the Motor (6 VDC)

The battery for the absolute pulse coder built into the motor is installed in the servo amplifier. For how to connect and replace the battery, refer to the following manuals:

- FANUC SERVO MOTOR α Series Maintenance Manual
- FANUC SERVO MOTOR β Series Maintenance Manual
- FANUC SERVO MOTOR β Series (I/O Link Option) Maintenance Manual

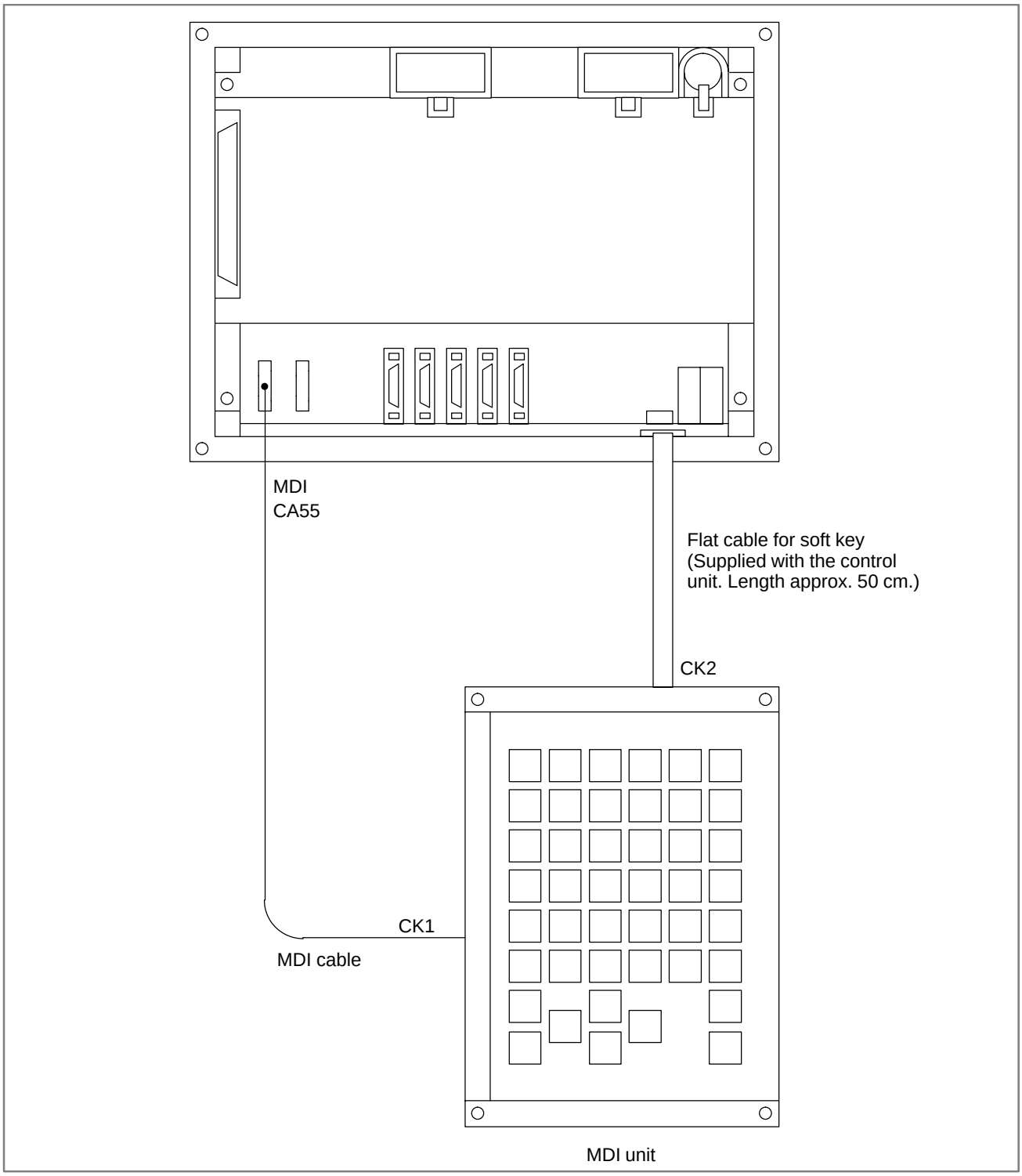
5 CONNECTION TO CNC PERIPHERALS

5.1 CONNECTION OF MDI UNIT (LCD–MOUNTED TYPE)

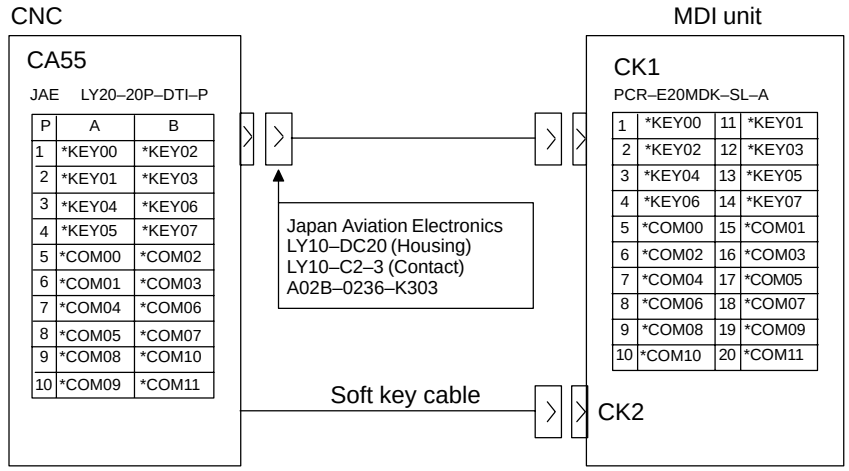
5.1.1 General

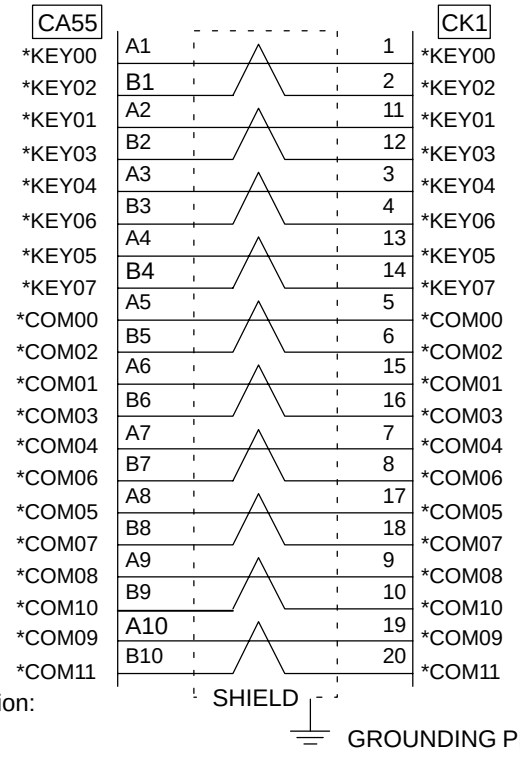
"MDI unit" is the generic name used to refer to a manual data input device. It has a keyboard and is used to input CNC data such as programs and parameters into the CNC.
A standard MDI unit is available for each of the *i* Series models with personal computer function according to the specifications.
See Section 8.4 for details of connecting the FA full keyboard. Note that this keyboard can be connected only to the Series 160*i*/180*i*/210*i*.

5.1.2 Connection to the MDI Unit (LCD–mounted Type)



5.1.3 Connection with the Standard MDI Unit





Recommended cable specification:
A02B–0236–K812 (25 cm)
A02B–0236–K813 (45 cm)
Recommended wire specification:
A66L–0001–0284#10P (#28AWG × 10 pairs)

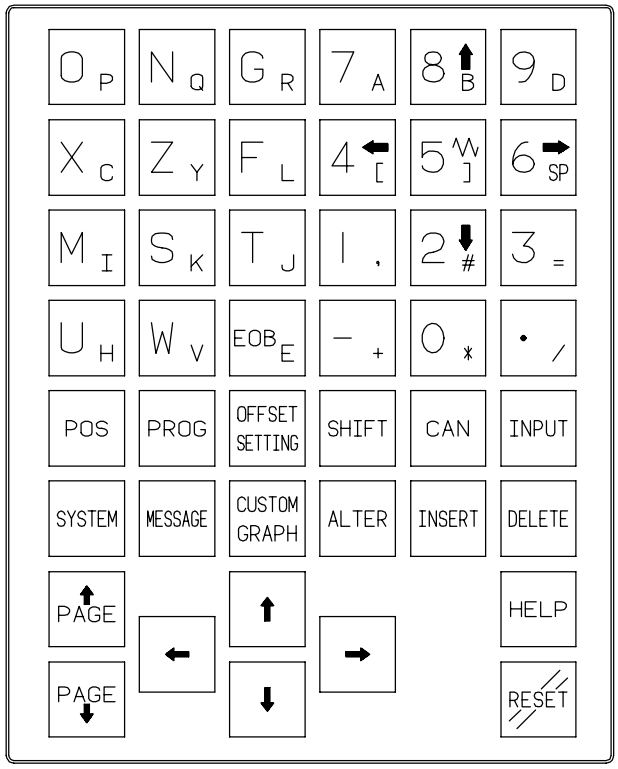
NOTE

For MDI cable connector mating on the CA55 side, a simple lock mechanism is employed. Ensure that a load greater than 1 kg is not applied to the connectors. Moreover, clamp the cable so that excessive force is not applied due to vibration. However, shielding and clamping are not required for a cable of up to 50 cm.

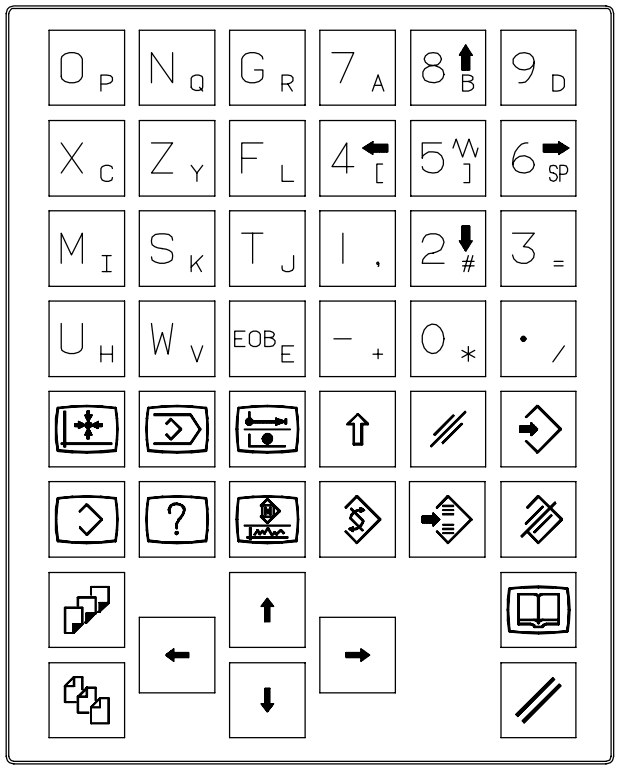
5.1.4 Key Layout of Separate–type MDI

Compact keys for lathe series (T series)

English display

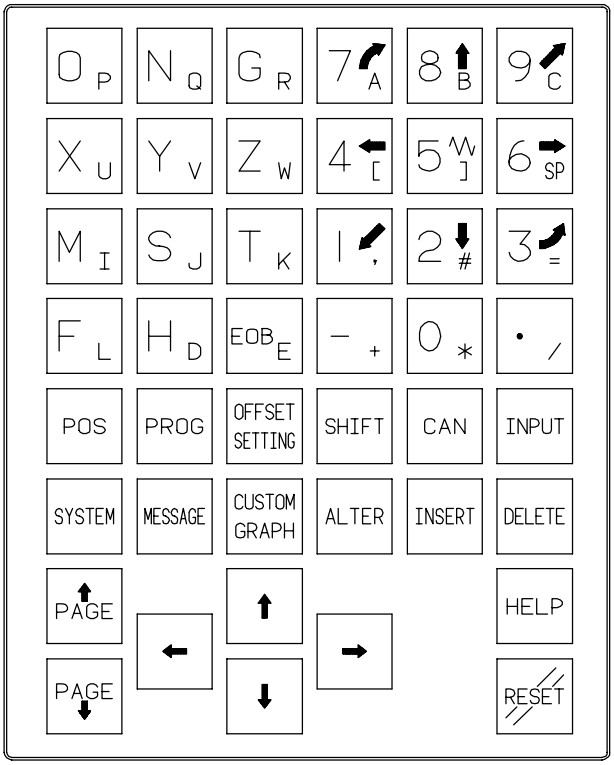


Symbol display

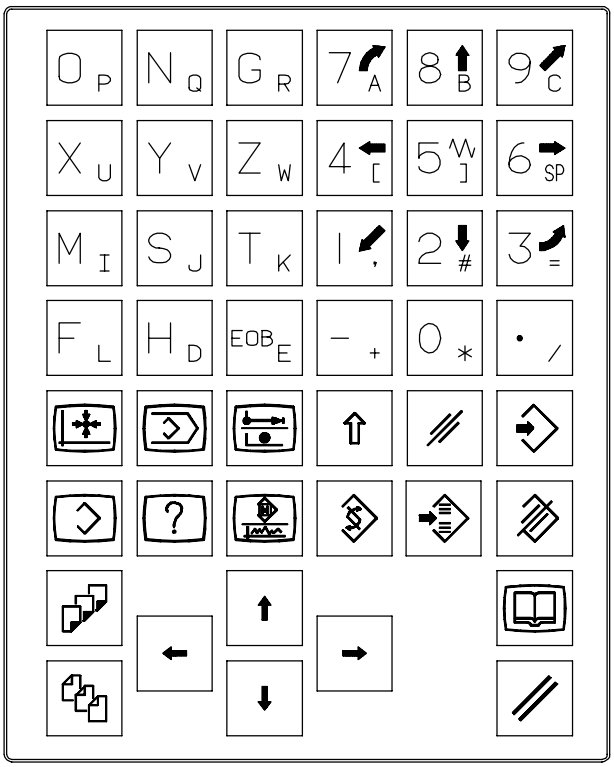


Compact keys for machine center series (M series)

English display

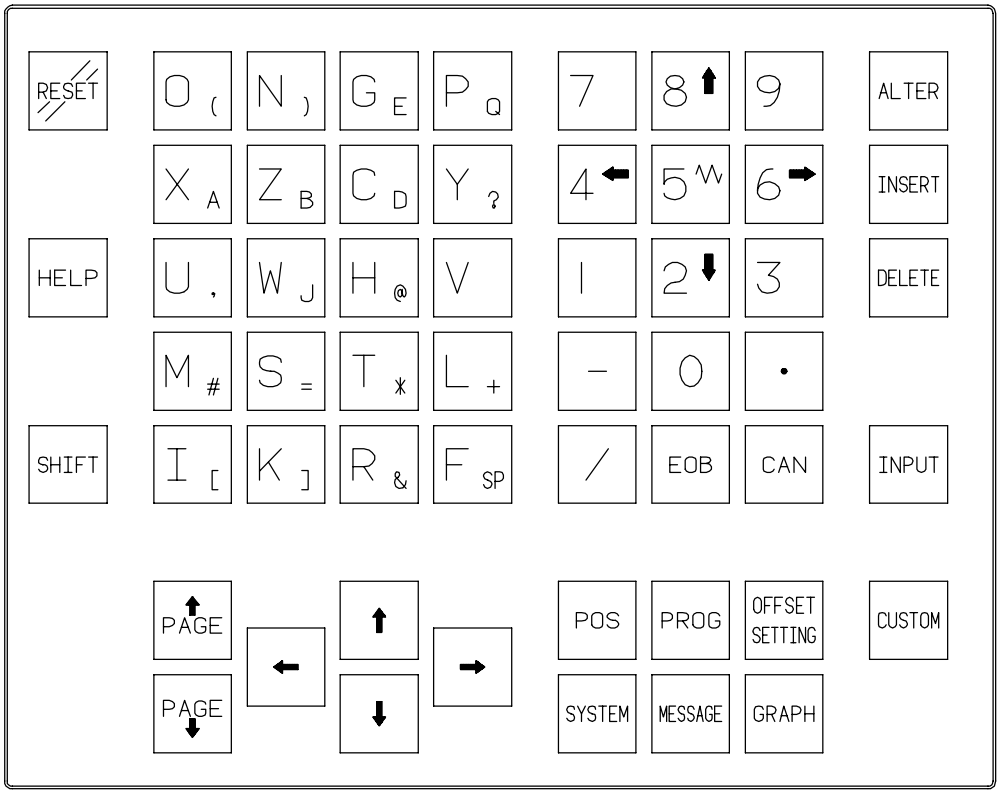


Symbol display

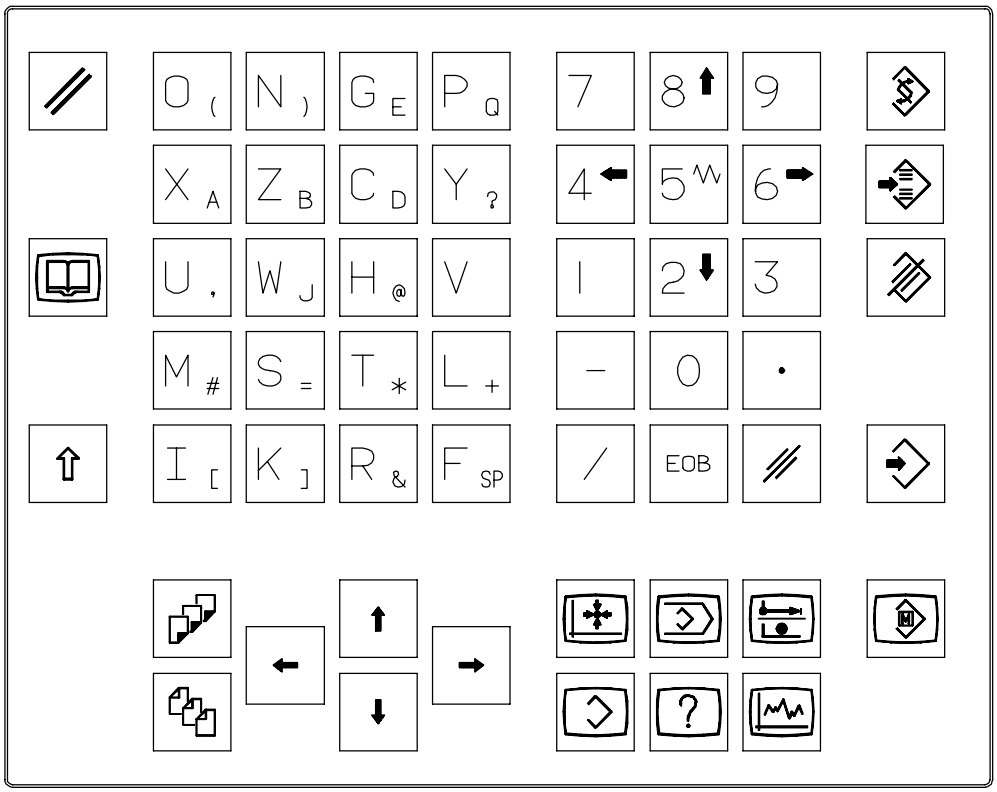


Standard keys for lathe series (T series)

English display

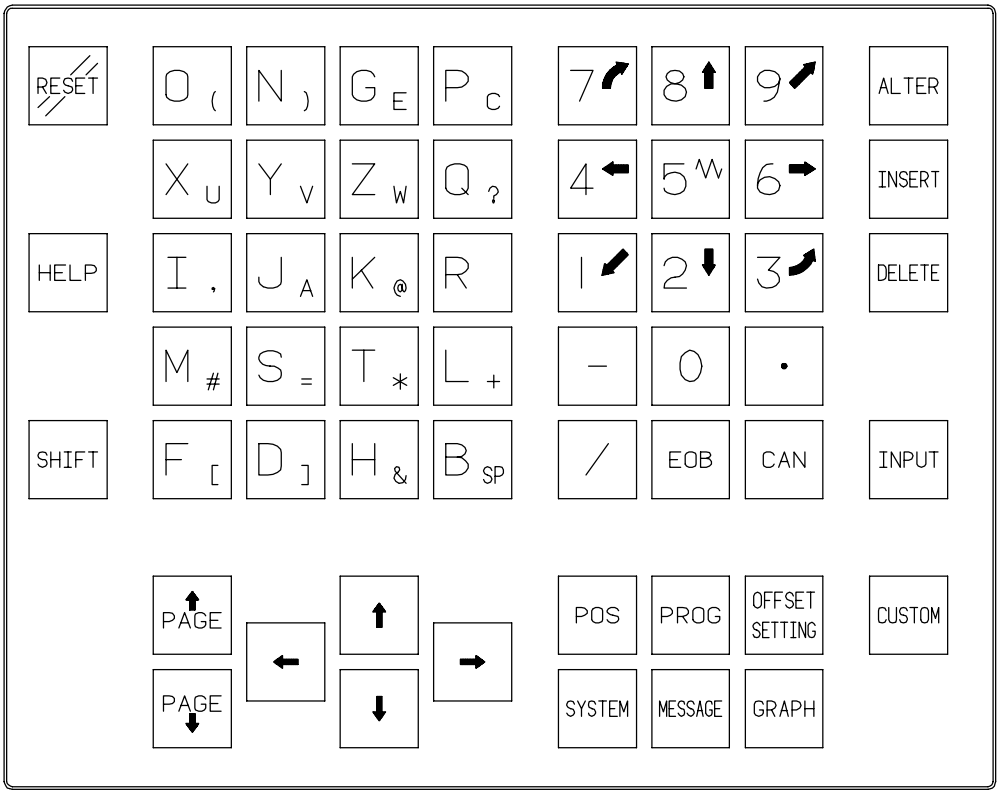


Symbol display

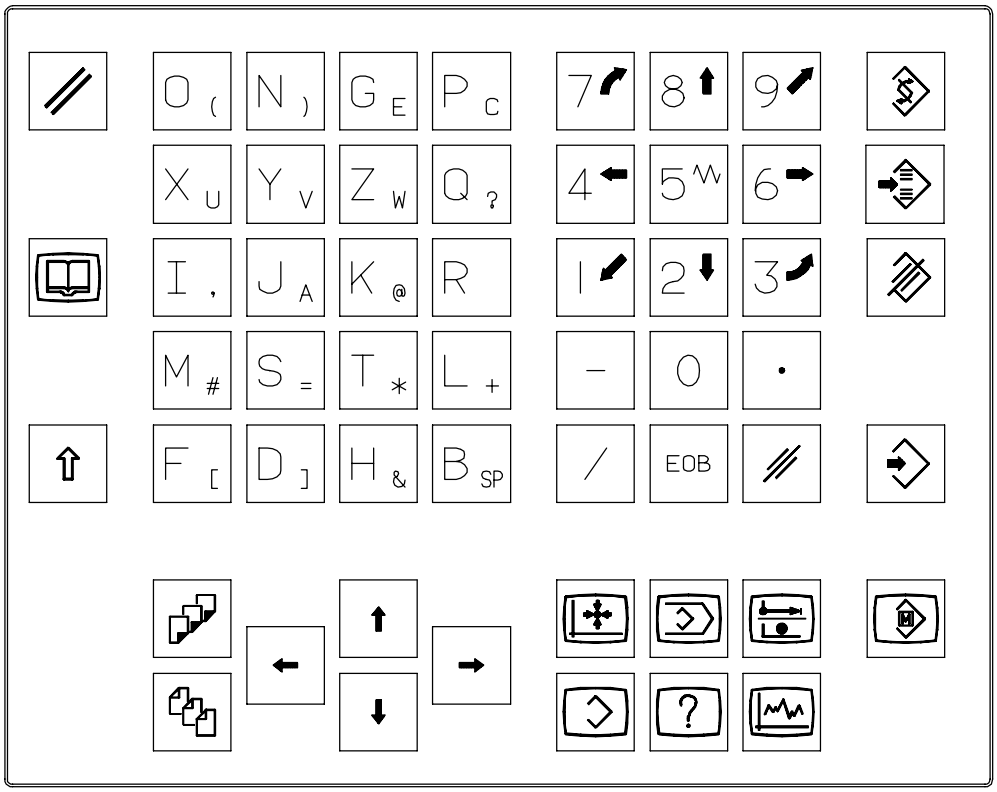


Compact keys for machining center series (M series)

English display



Symbol display



5.1.5 61–Key MDI Unit

Except for the FS20*i*, the 61–key MDI unit can be used, in addition to the conventional MDI units (small MDI unit and standard MDI unit). On this 61–key MDI unit, the alphabetic keys are each assigned to a single letter, and are arranged in alphabetical order.

(1) Connection

The 61–key MDI unit can be connected in the same way as the small and standard MDI units. See Subsection 5.1.3.

The 61–key MDI unit cannot, however, be detached. The CNC control unit automatically determines whether a 61–key MDI unit or a conventional MDI unit is attached when the control unit is turned on. If a 61–key MDI unit is connected after the control unit is turned on, therefore, the keys cannot be recognized correctly.

(2) Software series supporting the 61–key MDI unit

For each model, the following series and edition or later support the 61–key MDI unit:

FS16*i*/160*i*/160*is*–MA B0F2–05 (installation: basic)
FS16*i*/160*i*/160*is*–TA B1F2–05 (installation: basic)
FS18*i*/180*i*/180*is*–MA BDF2–05 (installation: basic)
FS18*i*/180*i*/180*is*–TA BEF2–05 (installation: basic)
FS21*i*/210*i*/210*is*–MA DDF2–05 (installation: basic)
FS21*i*/210*i*/210*is*–TA DEF2–05 (installation: basic)

The FS160*i*/180*i*/210*i* require PC software of the following editions or later:

Drivers and Libraries Disk A02B–0207–K730 Edition 01.7
Drivers Disk A02B–0207–K792 Edition 01.1

(3) Outline drawing

An outline drawing is given in Appendix A.

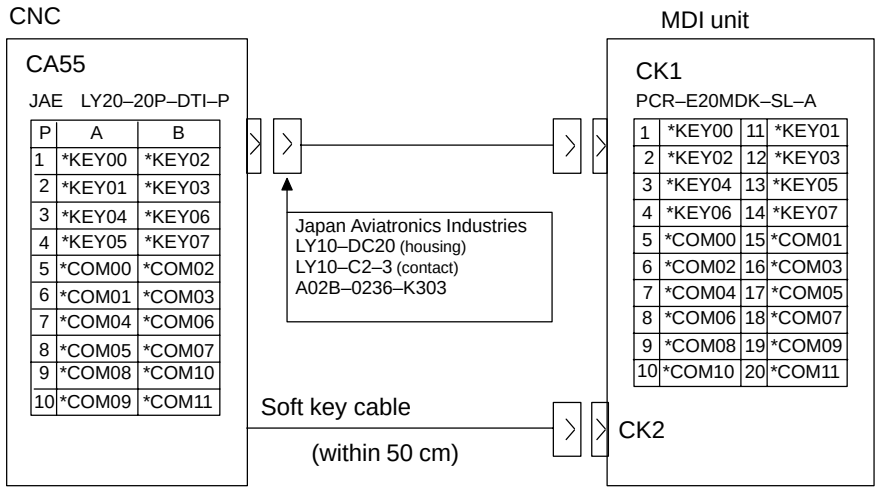
(4) Connector panel

The 61–key MDI unit for the 12.1" LCD unit of the FS160*i*/180*i*/210*i* has a connector panel on the side and at the bottom of the MDI. This connector panel is provided with an open/close cover. Opening the cover reveals an opening measuring 27 mm × 156 mm. Usually, the opening is blocked with a blank panel (metal plate). Instead of this blank panel, a connector–attached metal plate manufactured by the machine tool builder can be mounted. For mounting dimensions, see the outline drawing given in Appendix A.

5.1.6 Connecting to the MDI Unit for the FS20*i*

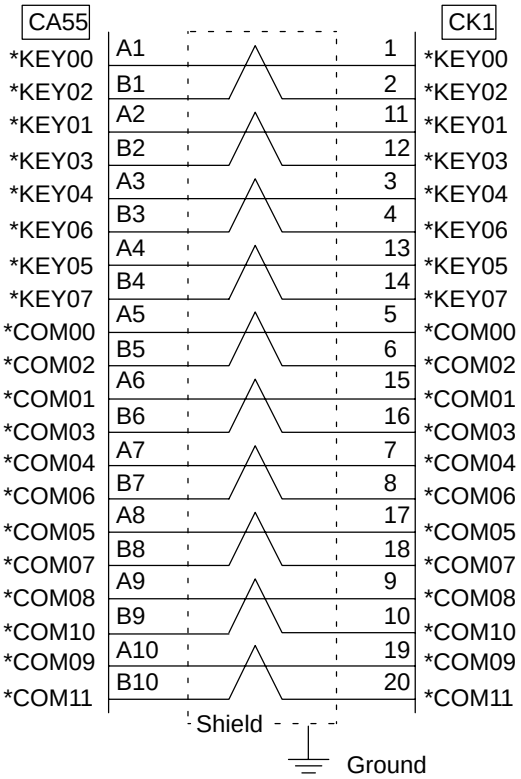
This item describes the MDI interface when the machine tool manufacturer makes his own MDI keyboard and connects it to the FS20*i* controller.

CAUTION
1 To use the guidance program function, a standard MDI unit is necessary.
For this reason, the machine tool builder cannot make his own MDI keyboard.
2 This interface cannot be used on models other than the FS20*i*.



P	A	B
1	*KEY00	*KEY02
2	*KEY01	*KEY03
3	*KEY04	*KEY06
4	*KEY05	*KEY07
5	*COM00	*COM02
6	*COM01	*COM03
7	*COM04	*COM06
8	*COM05	*COM07
9	*COM08	*COM10
10	*COM09	*COM11

1	*KEY00	11	*KEY01
2	*KEY02	12	*KEY03
3	*KEY04	13	*KEY05
4	*KEY06	14	*KEY07
5	*COM00	15	*COM01
6	*COM02	16	*COM03
7	*COM04	17	*COM05
8	*COM06	18	*COM07
9	*COM08	19	*COM09
10	*COM10	20	*COM11



CK2
(NFP–10A–0124)

01	*KEY01	02	*COM06
03	*KEY02	04	
05	*KEY03	06	
07	*KEY04	08	*KEY07
09	*KEY05	10	*KEY06

Connector specifications of MDI PCB
(NFP–10A–0124 made by Yamaichi Electric)

Recommended cable specifications: A02B–0236–K812(25cm)
A02B–0236–K813(45cm)
Recommended wire material specifications: A66L–0001–0284#10P(#28AWGX10 pair)

NOTE

As the fitting on the CA55 side connector of the MDI cable is a simple lock type, prevent a force of 1 kg or more from being applied to the connector section. Also clamp it down to prevent a large force from being applied by vibration. Note, however, that shielding or clamping are not necessary if the cable length is within 50 cm.

Minimum required key switches

The following key switches are needed for the Series 20 when making an MDI. Note, however, that programs cannot be made by using NC statements or edited by these switches alone.

(1) Number keys “0” to “9”
(2) Decimal point “.”
(3) Sign “–”
(4) Cancel key “CAN”
(5) Input key “INPUT”

Keyboard map (layout of absolutely necessary key switches)

	#7	#6	#5	#4	#3	#2	#1	#0
*COM00	7	6	5	4	3	2	1	0
*COM01	CAN				.	–	9	8
*COM02					INPUT		End input	Restart input
*COM06	SK1	SK2	SK3	SK4	SK5	SK6	SK7	

CAUTION

1 Keys (soft keys) in the hatched area are interface signals for the soft keys.
Connect these to the MDI interface together with the keyboard’s internal wiring.
2 When only the above keys are provided, programs cannot be made by using NC statements or edited by these switches alone.
3 When the FANUC machining guidance function (macro program) is not changed by the machine tool builder and is used as it is, the keys enclosed in bold are necessary.
4 Only keys with a label can be used.

Keyboard map (when creating or editing programs using NC statements)

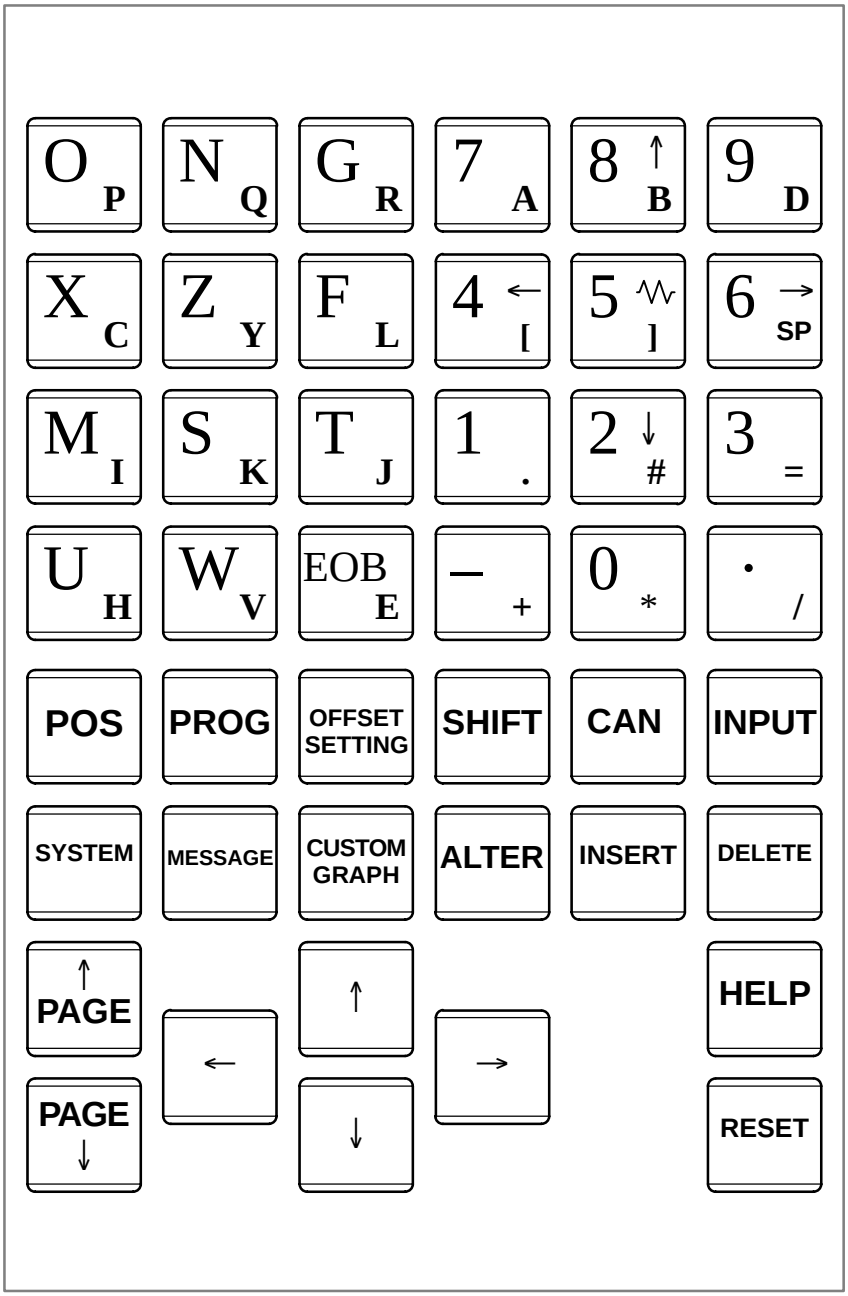
- **Layout of Series 20*i*–TA key switches**

	#7	#6	#5	#4	#3	#2	#1	#0
*COM00	7 A	6 SP	5]	4 [	3 =	2 #	1 ,	0 *
*COM01	CAN	EOB E.No.			. /	– +	9 D	8 B
*COM02	←CURSOR	CURSOR→	SHIFT	HELP	INPUT	DELETE	INSERT	ALTER
*COM03			CUSTOM GRAPHIC	MESSAGE	SYSTEM	OFFSET SETTING	PROGRAM	POSITION
*COM04					PAGE⇑	PAGE⇓	CUROSR↑	CURSOR↓
*COM05	RESET							
*COM06	SK1	SK2	SK3	SK4	SK5	SK6	SK7	
*COM07		F L	Z Y	X C		G R	N Q	O P
*COM08		T J	S K	M I			W V	U H

CAUTION

1 The characters in the hatched area are enabled when the SHIFT key is pressed. For details on the keytop of the keyboard, refer to the example layout for the FS20*i*–TA key switches on the following page.
2 Keys (soft keys) in the hatched area are soft keys. Connect the soft key interface signals to the MDI interface together with the signals to be used on the MDI keyboard.
3 Place only the required keys from the above keyboard map.
4 When the FANUC machining guidance function (macro program) is not changed by the machine tool builder and is used as it is, the keys enclosed in bold also have the following meanings.
INSERT:End input by machining guidance function.
ALTER: Resume input by machining guidance function.
5 Only keys with a label can be used.

- **Layout example of 20*i*–TA key switches**



Keyboard map (when creating or editing programs using NC statements)

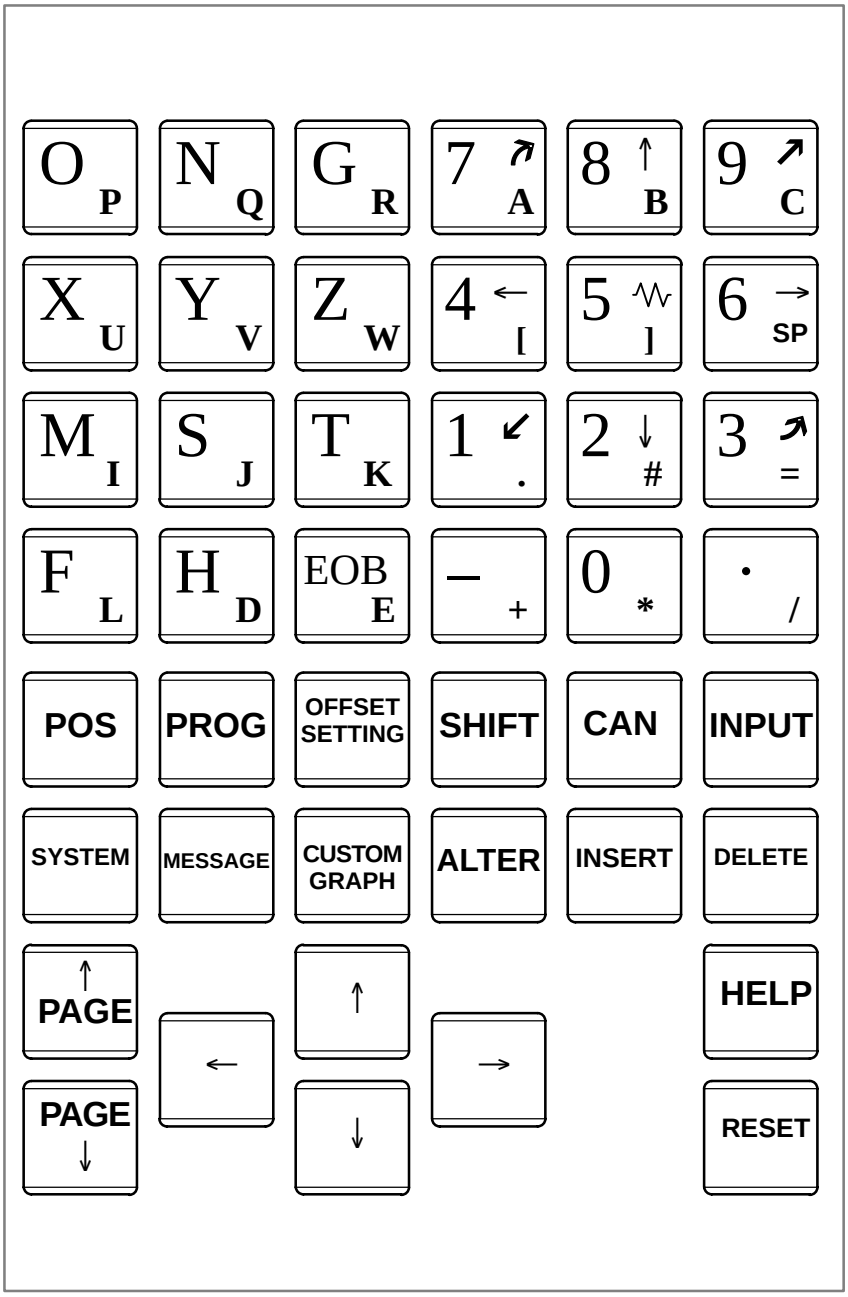
- **Layout of Series 20*i*–FA key switches**

	#7	#6	#5	#4	#3	#2	#1	#0
*COM00	7 A	6 SP	5]	4 [	3 =	2 #	1 ,	0 *
*COM01	CAN	EOB E.No.			. /	– +	9 D	8 B
*COM02	←CURSOR	CURSOR→	SHIFT	HELP	INPUT	DELETE	INSERT	ALTER
*COM03			CUSTOM GRAPHIC	MESSAGE	SYSTEM	OFFSET SETTING	PROGRAM	POSITION
*COM04					PAGE⇑	PAGE⇓	CUROSR↑	CURSOR↓
*COM05	RESET							
*COM06	SK1	SK2	SK3	SK4	SK5	SK6	SK7	
*COM07		F L	Z Y	X C		G R	N Q	O P
*COM08		T J	S K	M I			W V	U H
*COM09								
*COM10								
*COM11								
*COM12								

CAUTION

1 The characters in the hatched area are enabled when the SHIFT key is pressed. For details on the keytop of the keyboard, refer to the example layout for the FS20*i*–TA key switches on the following page.
2 Keys (soft keys) in the hatched area are soft keys. Connect the soft key interface signals to the MDI interface together with the signals to be used on the MDI keyboard.
3 Place only the required keys from the above keyboard map.
4 When the FANUC machining guidance function (macro program) is not changed by the machine tool builder and is used as it is, the keys enclosed in bold also have the following meanings.
INSERT:End input by machining guidance function.
ALTER: Resume input by machining guidance function.
5 Only keys with a label can be used.

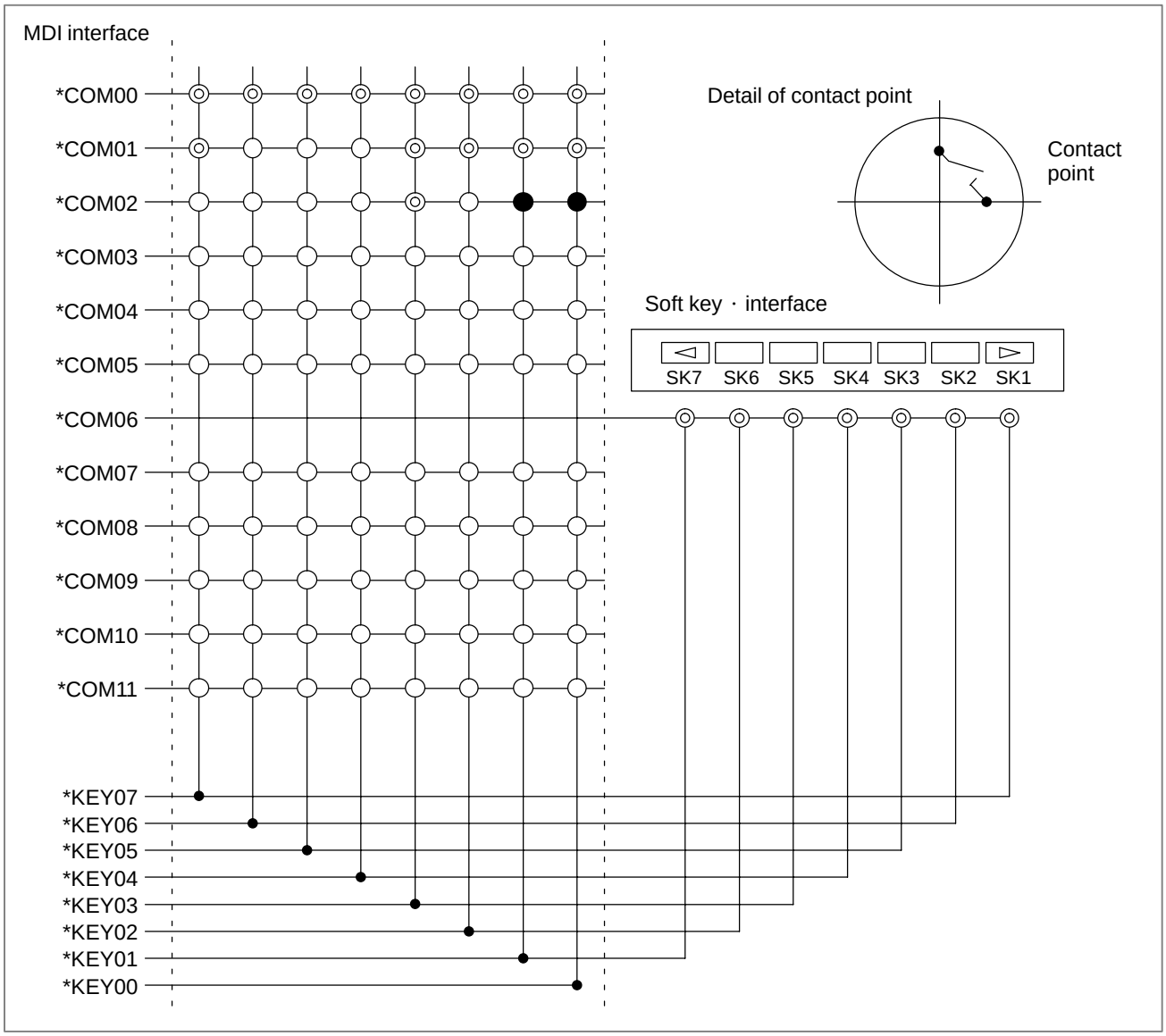
- **Layout example of 20*i*–FA key switches**



Electric specification of key switch

Maximum current	10VDC/5mA or more
Collision resistance	500 Ω or less (Condition of DC5V, 1mA)
Chattering	10msec or less

Example of MDI circuit



CAUTION

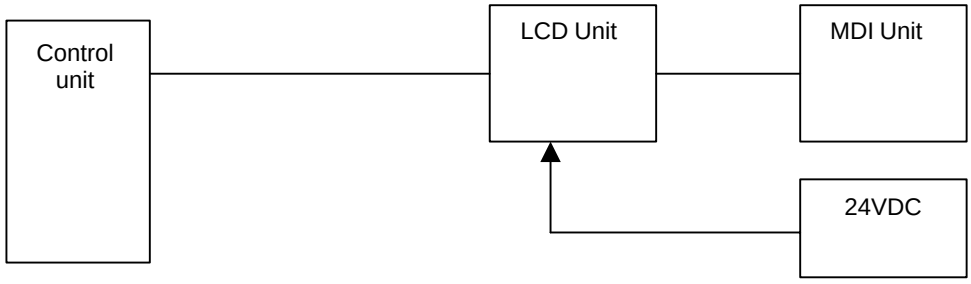
1 The contact points of the keyboard marked with ◎ ' are necessary.
2 When the FANUC machining guidance function (macro program) is not changed by the machine tool builder and is used as it is, the contact points marked with '● ' are necessary.

5.2 CONNECTION WITH THE DISPLAY/MDI UNITS (FOR THE STAND–ALONE TYPE *i* SERIES CNC)

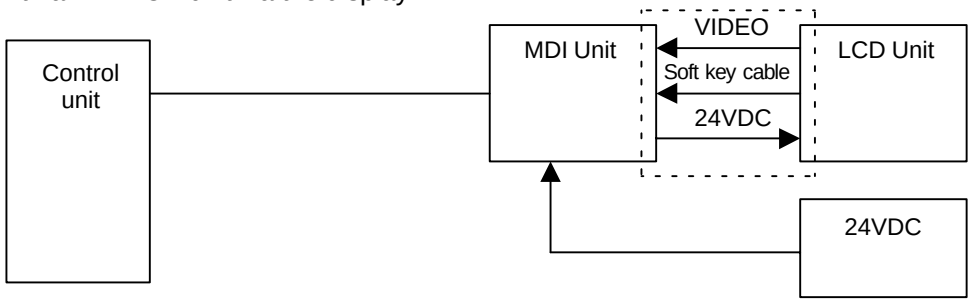
5.2.1 Overview

With the stand–alone type *i* Series CNC, the following display/MDI units can be connected:

Connection with a 10.4″ LCD unit or 9.5″ LCD unit

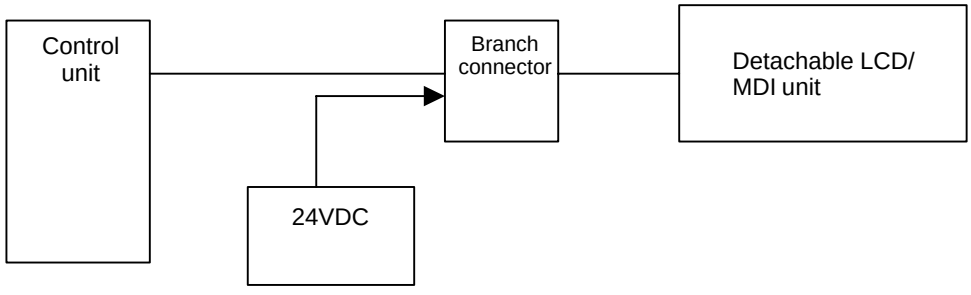


Connection with a 7.2″ LCD unit via the display link

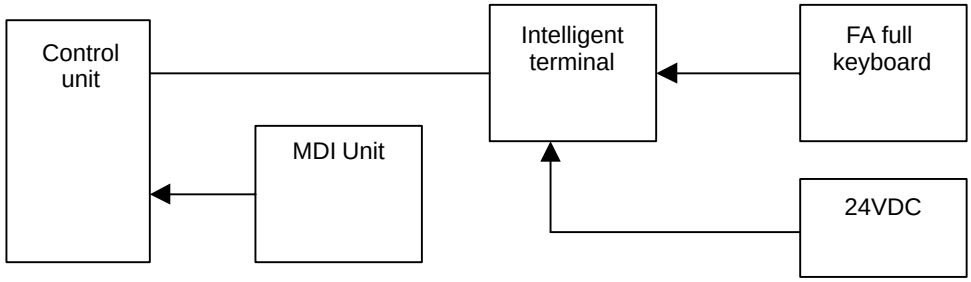


When an LCD/MDI integration unit is used, the connections within the dotted box ( ) are completed inside the unit.

Connection with a detachable 7.2″ LCD unit via the display link

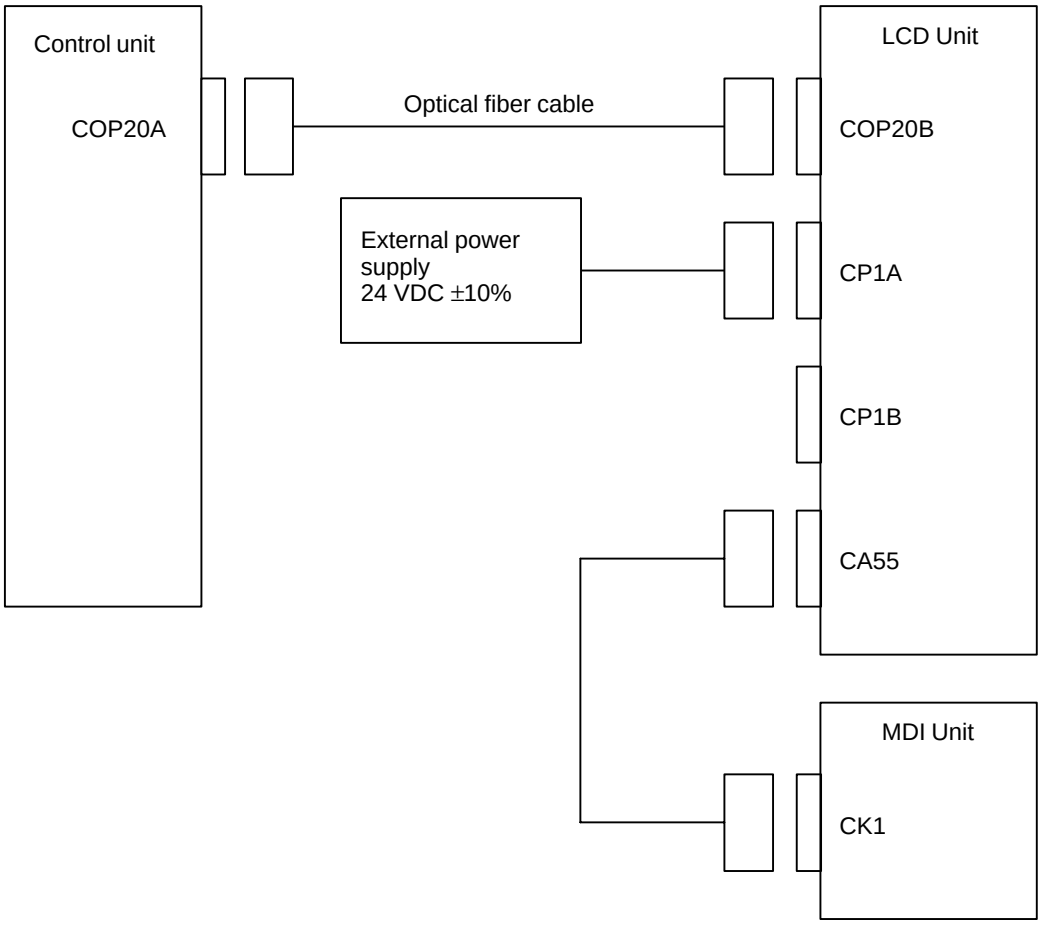


Connection with an intelligent terminal



Either an FA full keyboard or MDI unit can be connected.

5.2.2 Connection with the 10.4″/9.5″ LCD Unit

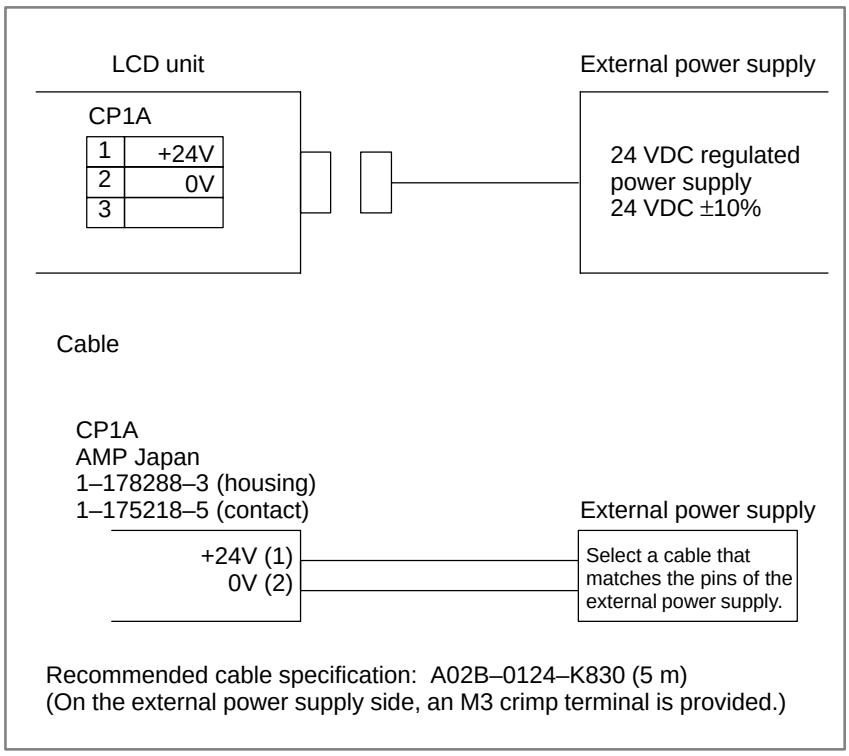


- **Connection between the CNC control unit and LCD unit**

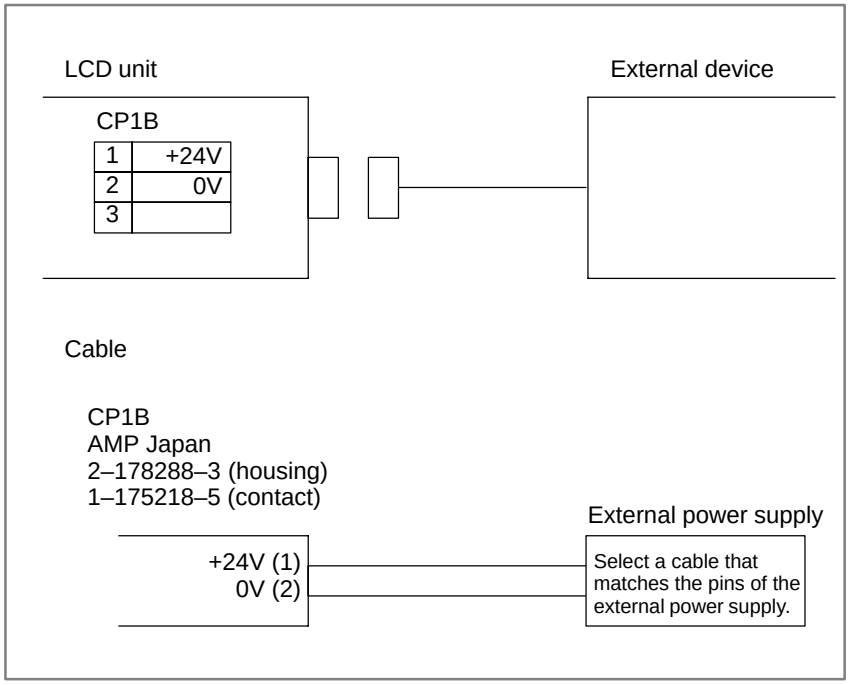
An optical fiber cable is used to make the connection between the CNC control unit and 10.4″ unit or 9.5″ LCD unit. For details of the optical fiber cable, see Appendix D.

- **Connection of a power supply to the LCD unit**

Feed power to the LCD unit from an external 24 VDC power supply.



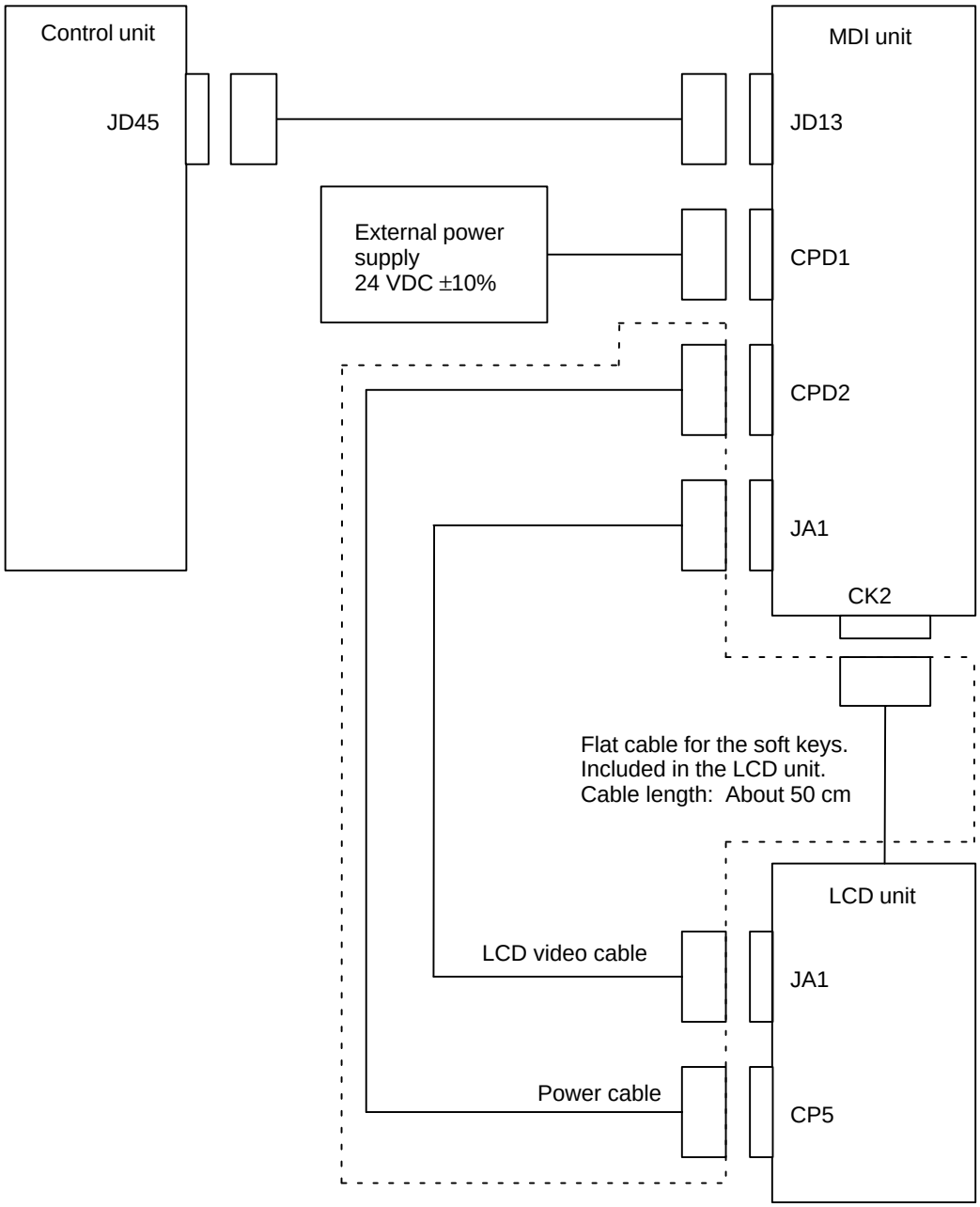
For distribution, 24 VDC applied to CP1A can be output on CP1B. CP1B is connected as shown below. In this case, the sum of the current drawn by the LCD unit and that drawn through CP1B needs to be supplied to CP1A from the external 24 VDC power supply.



- **Connection between the LCD unit and MDI unit**

For the connection between the connector (CA55) of the LCD unit and that (CK1) of the MDI unit, see Section 5.1.3. With the LCD–mounted type *i* Series CNC, the connector (CA55) is located on the CNC control unit at the back of the LCD. With the stand–alone type *i* Series CNC, the connector (CA55) is located on the back of the LCD unit. With the stand–alone type *i* Series CNC, a soft key cable connection is made inside the unit, so that the machine tool builder need not make a soft key cable connection.

5.2.3 Connection with the 7.2″ LCD Unit Via the Display Link



With an LCD/MDI integration unit, the wiring of the flat cable for the soft keys, LCD video cable, and power cable enclosed in the dotted box is made in the unit, so that the machine tool builder need not make any connections.

- **Connection between the CNC control unit and MDI unit**

i Series CNC

JD45
(PCR–EV20MDT)

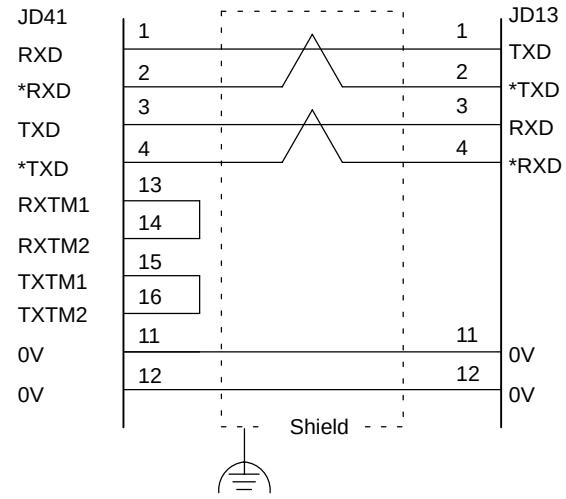
1	RXD	11	0V
2	*RXD	12	0V
3	TXD	13	RXTM1
4	*TXD	14	RXTM2
5		15	TXTM1
6		16	TXTM2
7		17	
8		18	
9		19	
10		20	

MDI unit

JD13
(PCR–EV20MDT)

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

Cable connections

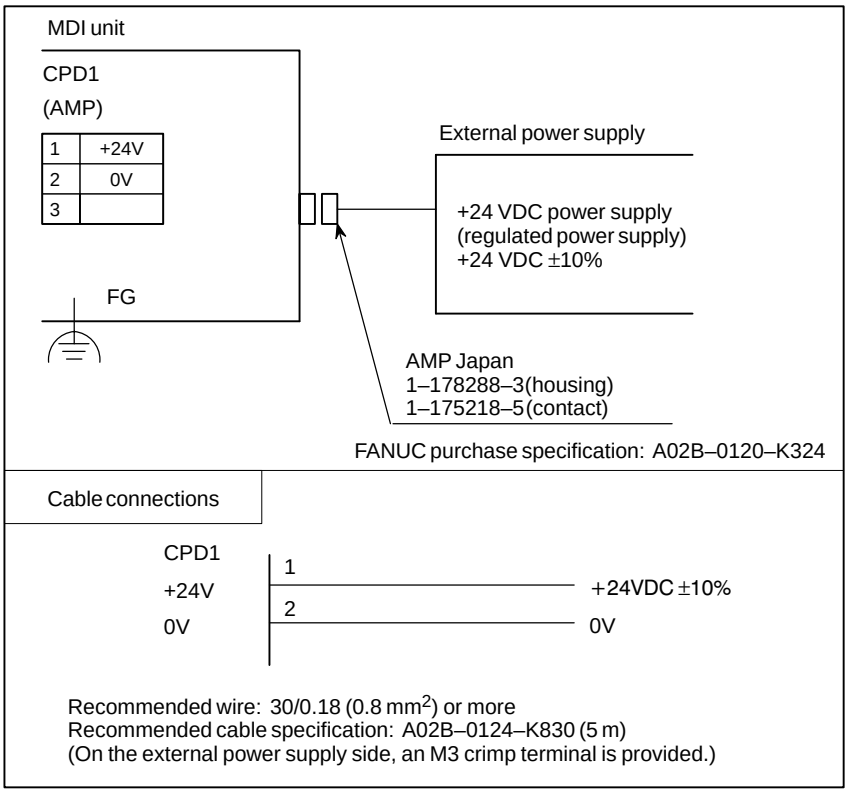


Recommended wire:
A66L–0001–0284#10P(#28AWG × 10 pairs)
Recommended connector:
PCR–E20FS or PCR–E20FA
Housing: PCR–V20LA
Recommended cable:
A02B–0259–K811 (5 m)
A02B–0259–K812 (10 m)

NOTE
1 Connect JD45 (13) with JD45 (14), and connect JD45 (15) with JD45 (16).
2 Never make connections with those pins to which no signals are assigned.
3 Never make connections with pins 13 through 16 of JD13.

- **Connection of a power supply to the MDI unit**

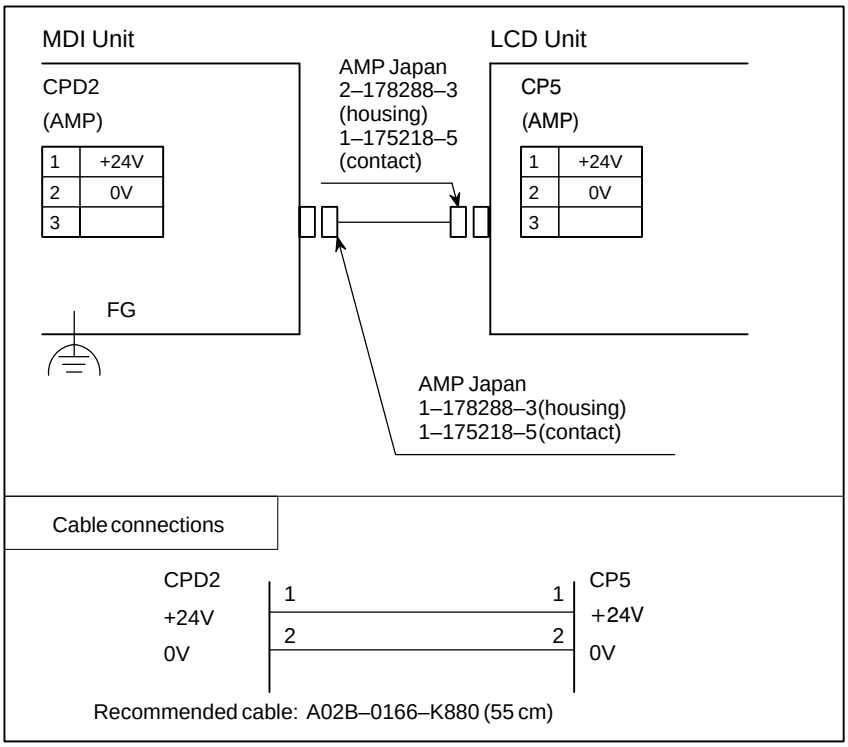
Feed power to the MDI unit from an external 24 VDC power supply.



Power is fed from an external 24 VDC power supply to the LCD unit through the MDI unit.

- **Connection of a power supply to the LCD unit**

With an LCD/MDI integration unit, the connection of a power supply to the LCD unit is completed inside the unit, so that the machine tool builder need not make any connections.



● LCD video connection

With an LCD/MDI integration unit, the video connection to the LCD unit is made inside the unit, so that the machine tool builder need not make any connections.

MDI Unit

JA1

(PCR–EV20MDT)

1	VDR	11	
2	0V	12	VSYNC
3	VDG	13	
4	0V	14	0V
5	VDB	15	
6	0V	16	0V
7		17	
8	(DTC)	18	HSYNC
9		19	(+24V)
10	(+24V)	20	

( ): Signal not used

Video cable

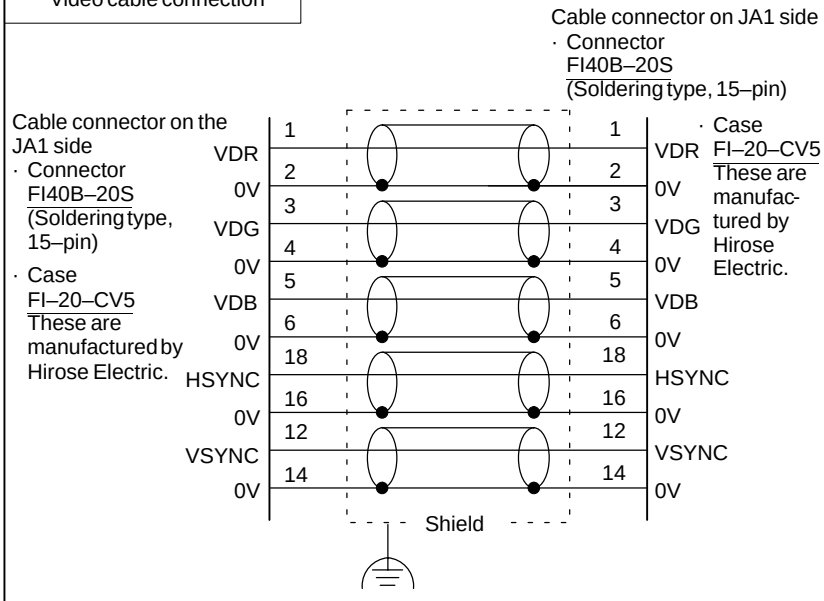
LCD Unit

JA1

(PCR–EV20MDT)

1	VDR	11	
2	0V	12	VSYNC
3	VDG	13	
4	0V	14	0V
5	VDB	15	
6	0V	16	0V
7		17	
8		18	HSYNC
9		19	
10		20	

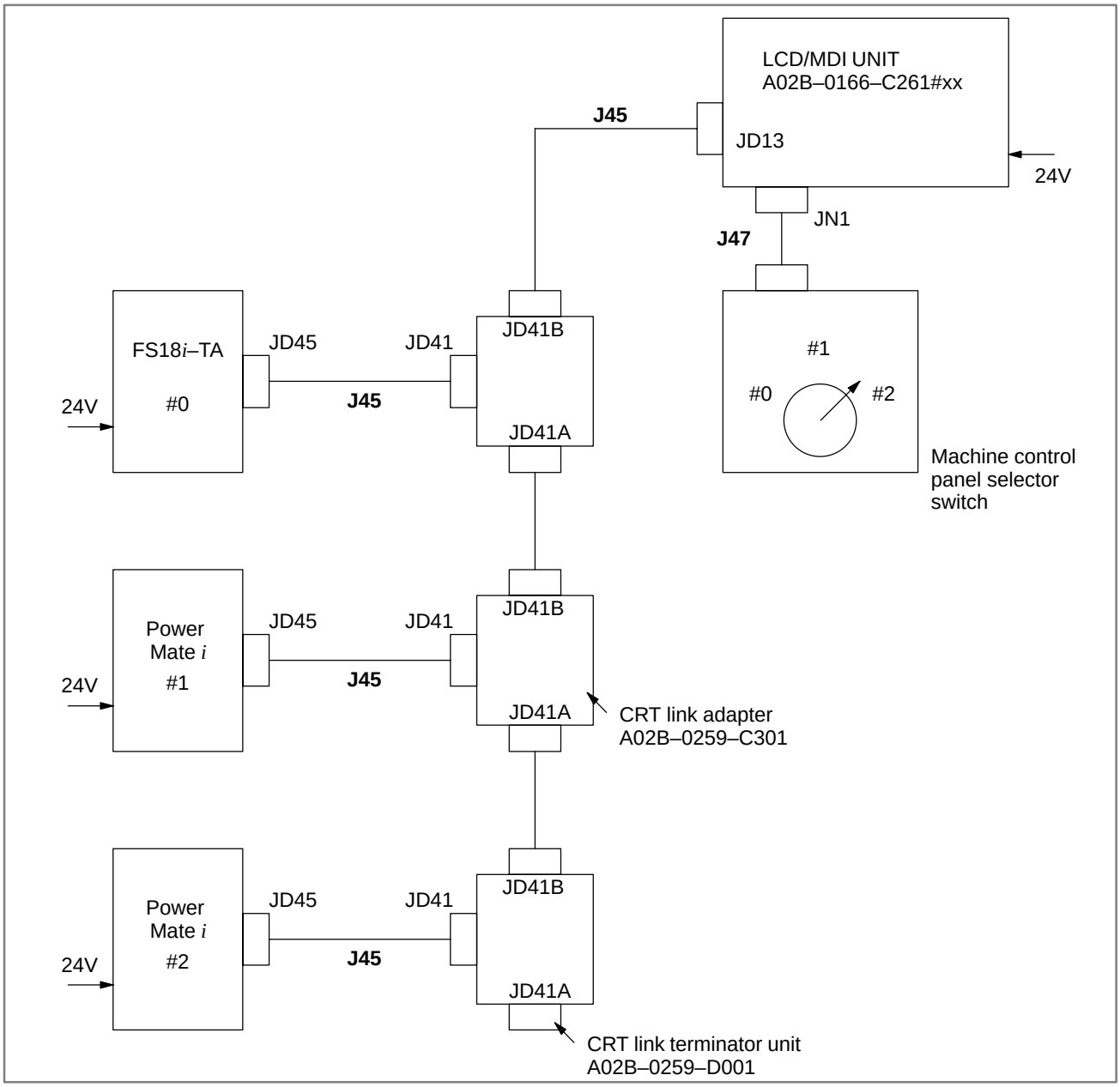
Video cable connection



Recommended wire:
A66L–0001–0371: Coaxial cable (5–conductor, common shield)
Recommended cable:
A02B–0166–K870 (55 cm)

5.2.4 Connecting to the 7.2″ LCD Unit by the Display Link (Multiple Connection)

Example where one FS18*i* and two Power Mate *i*'s are connected



1) When two Power Mates are connected to the FS18C, the CRT/MDI selector and CRT/MDI control for the Power Mate that were needed are no longer necessary.
2) The CRT link adapter and CRT link terminator unit are necessary. Also, specify an LCD/MDI unit that supports the CRT link. A separate type MDI also is available.
3) In this connection, graphic display is not possible, and the memory card interface on the side is not available.

Power Mate, *i* series CNC

JD41 [JD45]
(PCR–EV20MDT)

1	RXD	11	0V
2	*RXD	12	0V
3	TXD	13	(RXTM1)
4	*TXD	14	(RXTM2)
5	(RXALM)	15	(TXTM1)
6	(*RXALM)	16	(TXTM2)
7	(TXALM)	17	(COMMA)
8	(*TXALM)	18	(*COMMA)
9	(ATCH1)	19	
10		20	(ATCH2)

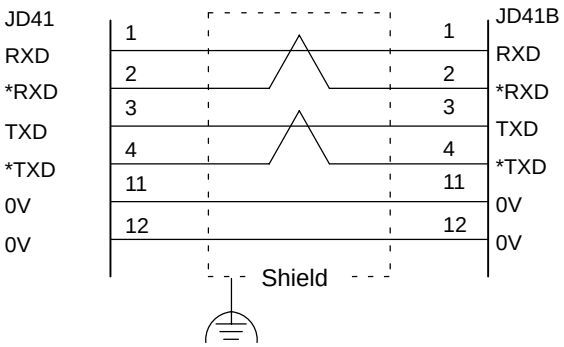
J45

CRT link adapter

JD41
(PCR–EV20MDT)

1	RXD	11	0V
2	*RXD	12	0V
3	TXD	13	(RXTM1)
4	*TXD	14	(RXTM2)
5	(RXALM)	15	(TXTM1)
6	(*RXALM)	16	(TXTM2)
7	(TXALM)	17	(COMMA)
8	(*TXALM)	18	(*COMMA)
9	(ATCH1)	19	
10		20	(ATCH2)

Cable wiring (J45)



Recommended wire material specifications:
A66L–0001–0284#10P (#28AWG10 pair)

Recommended connector:
PCR–E20FS or PCR–E20FA
Housing PCR–V20LA

NOTE
Connector names in brackets [ ] are for when an *i* series CNC is used.

NOTE
1 Place the CRT link adapter right next to (within 500 mm) the Power Mate to keep the cable between the Power Mate and the CRT link adapter as short as possible.
2 The cable between the CRT/MDI unit (JD13) and the CRT link adapter (JD41B) is the same as the above.
3 The cable between the CRT link adapter (JD41A) and the CRT link adapter (JD41B) is the same as the above.
4 Signals in parentheses () are used on a separate interface. Take care not to connect to these signals.

Unit selection with interface

Separate type MDI unit

CRT/MDI unit

JN1

(PCR–EV20MDT)

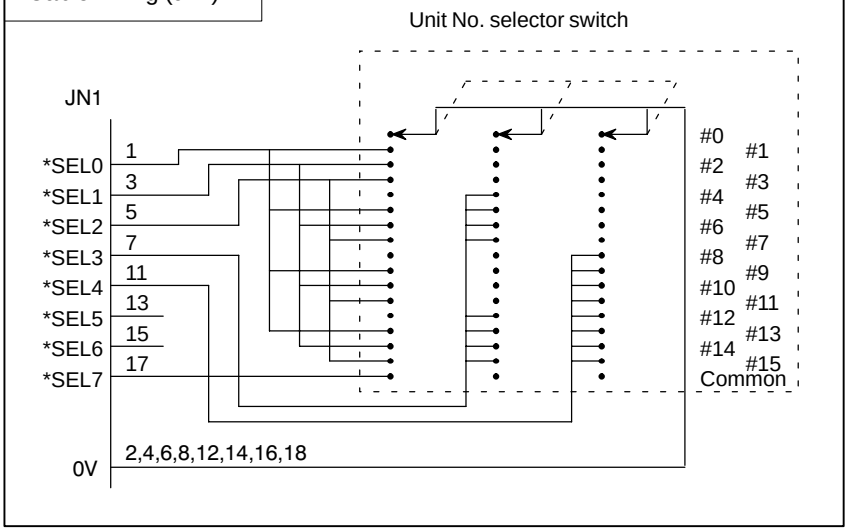
1	*SEL0	11	*SEL4
2	0V	12	0V
3	*SEL1	13	*SEL5
4	0V	14	0V
5	*SEL2	15	*SEL6
6	0V	16	0V
7	*SEL3	17	*SEL7
8	0V	18	0V
9		19	
10		20	

J47

Machine control panel

Unit No. selector switch

Cable wiring (J47)



When the total length of the CRT link cable is between 50 to 100 m, connect *SEL5 to 0V. The overall line length is the total length of the CRT interface cables in use. When the total length exceeds 50 mm, the cables cannot be used in a detachable configuration.

Relationship between selector switch

Unit No.	*SEL7	*SEL4	*SEL3	*SEL2	*SEL1	*SEL0
#0	×	×	×	×	×	×
#1	×	×	×	×	×	○
#2	×	×	×	×	○	×
#3	×	×	×	○	×	×
#4	×	×	○	×	×	×
#5	×	×	○	×	×	○
#6	×	×	○	×	○	×
#7	×	×	○	○	×	×
#8	×	○	×	×	×	×
#9	×	○	×	×	×	○
#10	×	○	×	×	○	×
#11	×	○	×	○	×	×
#12	×	○	○	×	×	×
#13	×	○	○	×	×	○
#14	×	○	○	×	○	×
#15	×	○	○	○	×	×
Common screens	○	–	–	–	–	–

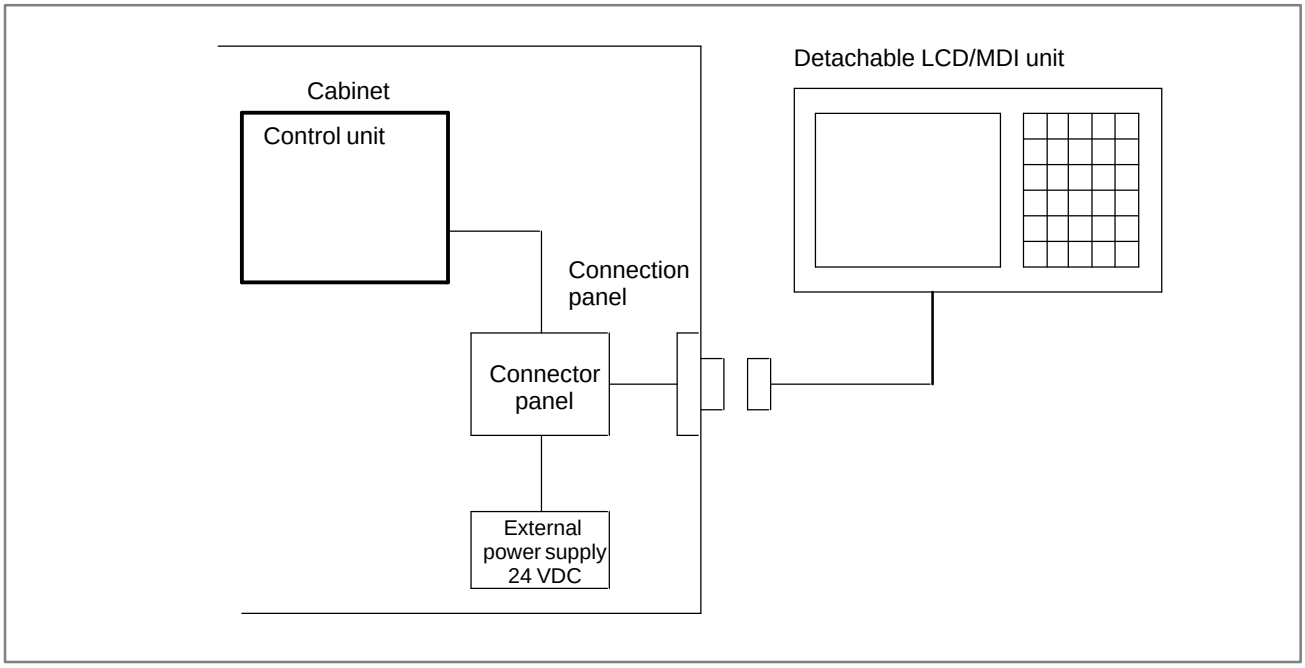
× : Switch open
○ : Switch closed
– : Either OK

Recommended wire material specifications:
A66L–0001–0284#10P (#28AWG10 pair)

Recommended connector:
PCR–E20FS or PCR–E20FA
Housing PCR–V20LA
Max. line length 10m

5.2.5 Connection of the Detachable 7.2″ LCD/MDI Unit Via the Display Link

The detachable 7.2″ LCD/MDI unit is a 7.2″ LCD/MDI unit housed in a portable dustproof case. The unit can be connected/disconnected while the power is turned on.

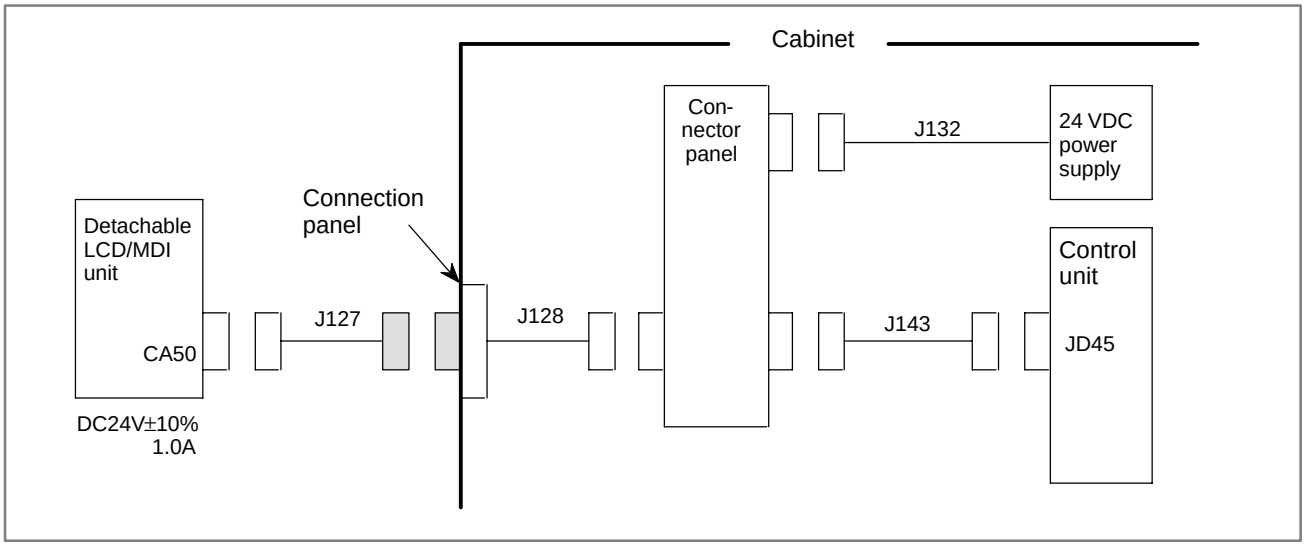


(1) The detachable LCD/MDI unit is not provided with a cable.

(2) The machine tool builder is required to prepare a connector panel, external power supply, and connection panel.

(3) The machine tool builder is required to prepare all interconnection cables.

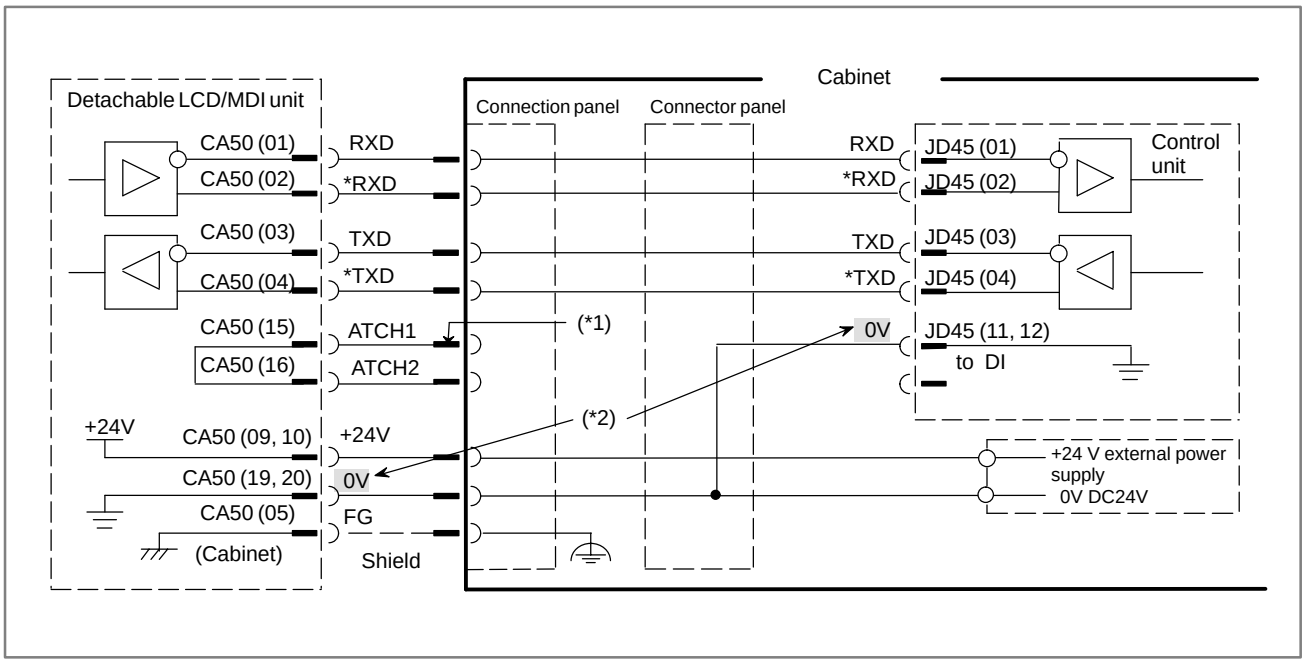
1) Interconnection diagram



(a) The total length of the cables (J127, J128, and J143) between the detachable LCD/MDI unit and control unit must not exceed 50 m.

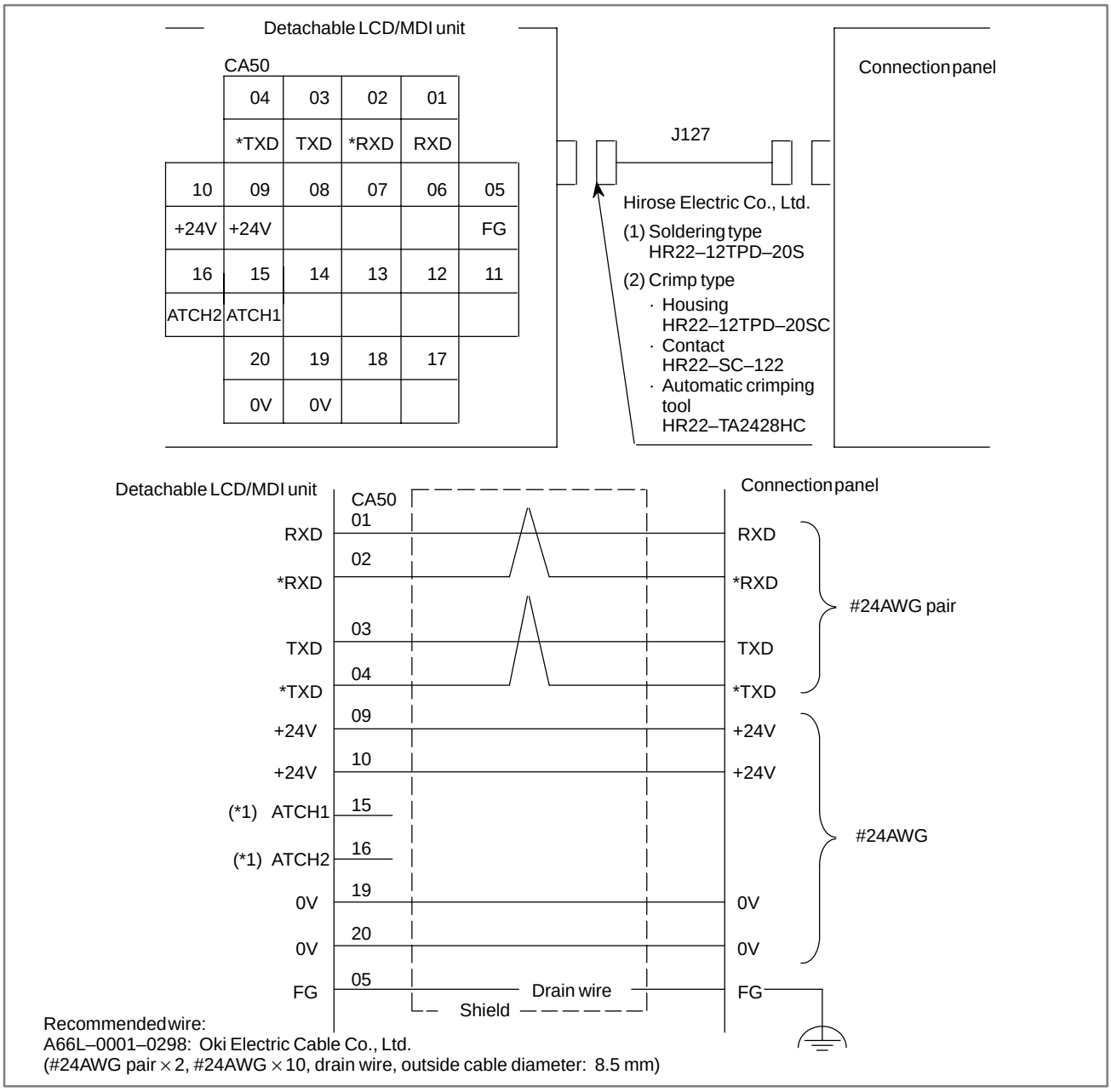
(b) The cables J127, J128, and J132 also serve as the 24 VDC power line for the detachable LCD/MDI unit. On the 24 VDC line, a voltage drop which corresponds to the resistances of the 24 V and 0 V lines of these cables occurs. Considering this voltage drop, determine the cable length so that 24 VDC ±10% is provided at the CA50 connector of the unit.

(c) While the power is turned on, only the connector (shaded in the figure above) of the connection panel can be attached or detached. The other connectors (such as CA50 and JD41) must not be attached and detached while the power is turned on.



NOTE
1 ATCH1 and ATCH2 of the detachable LCD/MDI unit are not used.
2 To allow the detachable LCD/MDI unit to be connected or disconnected while the power to the *i* Series CNC is on, ensure that the 0 V line of the *i* Series CNC is first connected to the 0 V line of the detachable LCD/MDI unit.

2) Details of the cable J127



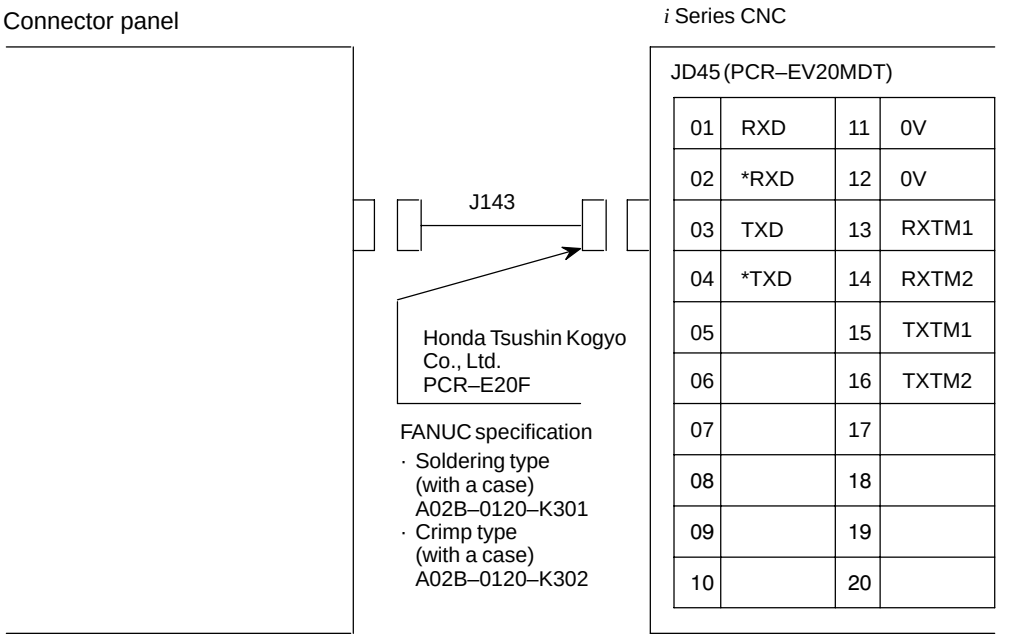
NOTE

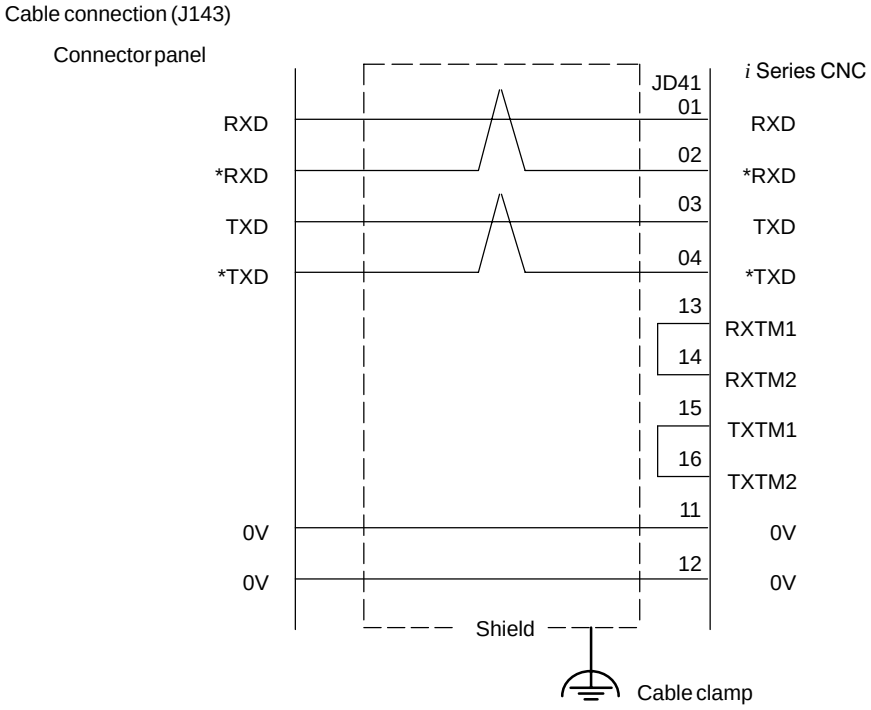
1 ATCH1 and ATCH2 are not used.

2 FG
Connect CA50 (05) to the FG pin of the connection panel using a drain wire.
Connect the FG pin of the connection panel to the frame ground.
For grounding, use a twisted wire, 100 to 300 mm long, with a cross–sectional area of 2 mm^2 or more.

3 The outside cable diameter that matches the connector CA50 is 8.5 mm. When using a cable whose outside diameter is smaller than 8.5 mm, increase the diameter of the cable at the connector joint area to 8.5 mm by using a material such as a shrinkable tube or tape to maintain a dustproof seal.

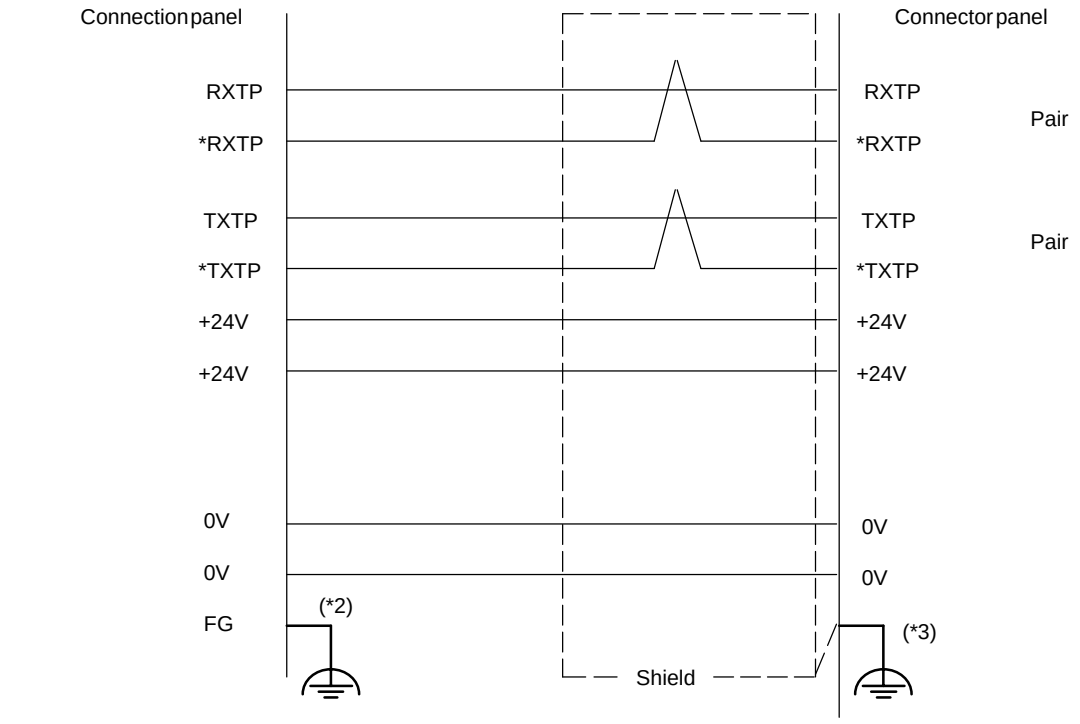
3) Details of the cable J126





Recommended wire:
A66L–0001–0284#10P(#28AWG × 10 pairs): Oki Electric Cable Co., Ltd., Hitachi Cable Ltd.

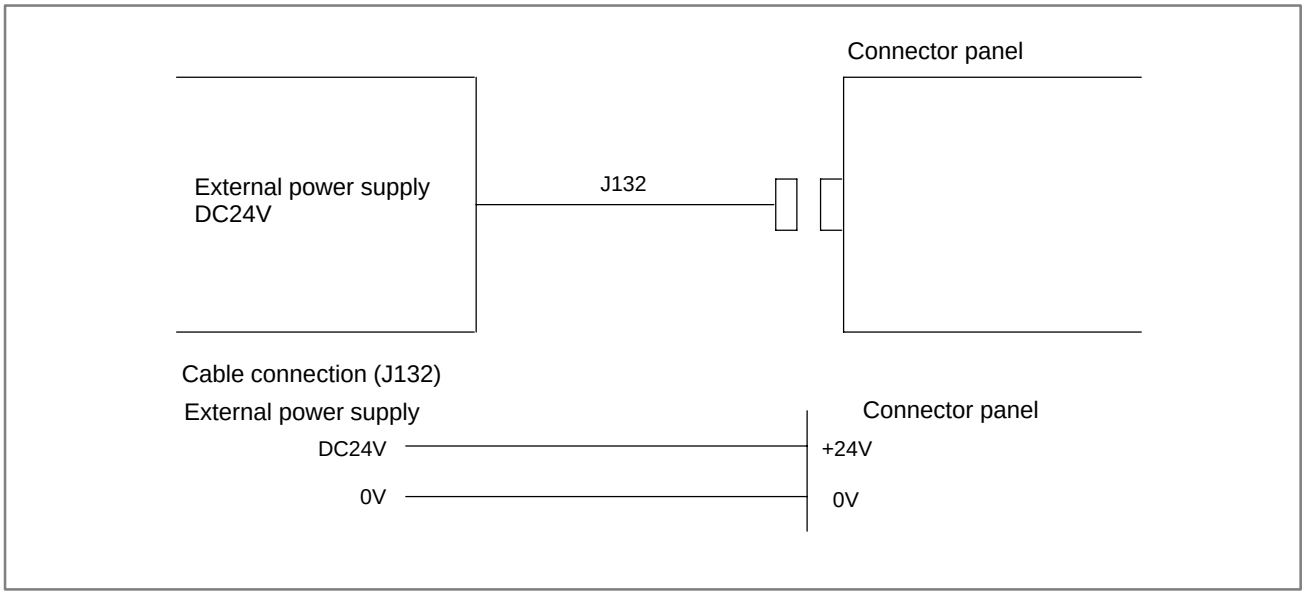
4) Details of the cable J128



NOTE

1 ATCH1 and ATCH2 are not used.
2 FG on the connection panel
Connect the FG of the connection panel to the frame ground.
For grounding, use a twisted wire, 100 to 300 mm long, with a cross–sectional area of 2 mm^2 or more.
The FG is used to ground the shield of the J127 cable.
3 FG on the connector panel
Connect the shield of the J128 cable on the connector panel to the frame ground.
For grounding, use a twisted wire, 100 to 300 mm long, with a cross–sectional area of 2 mm^2 or more.

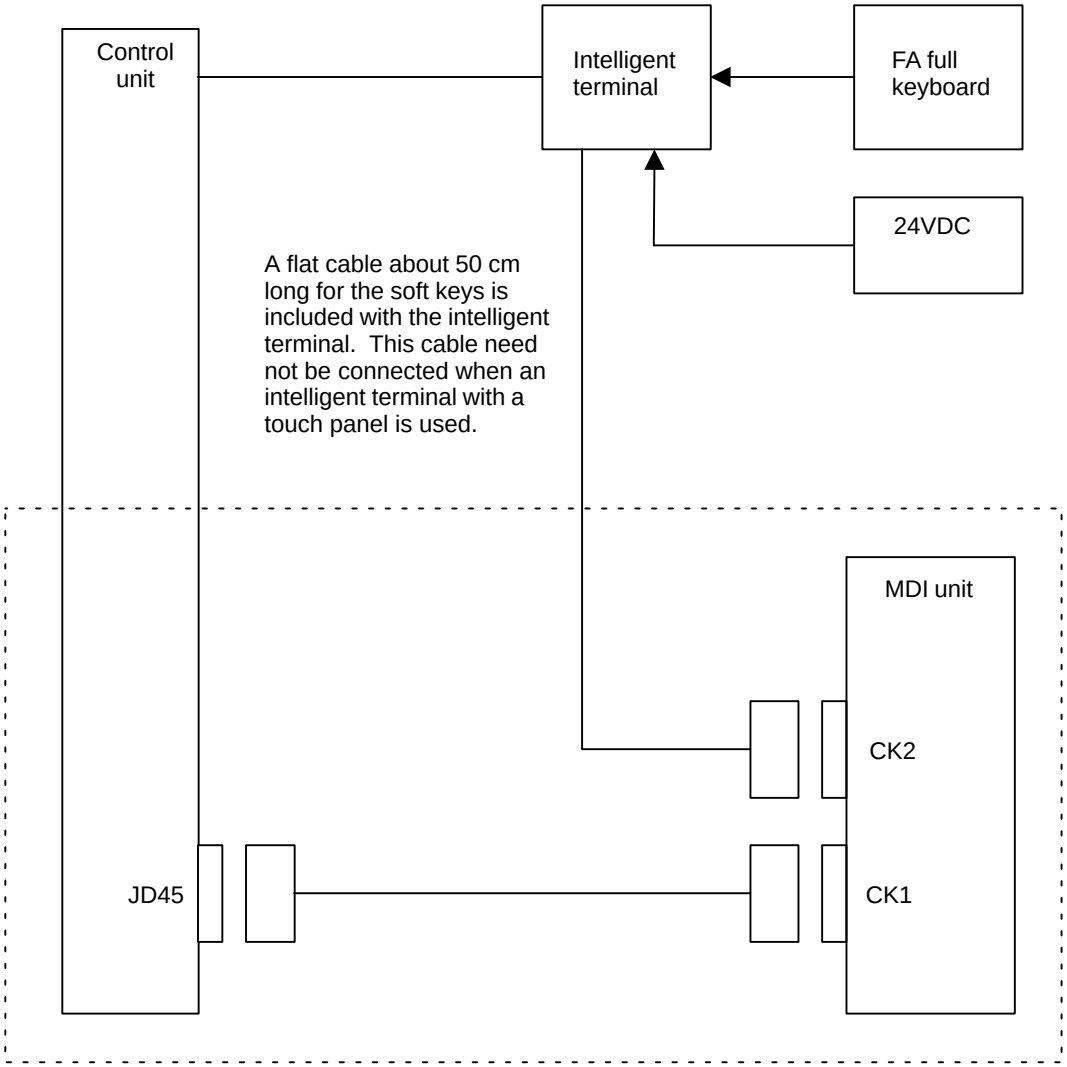
5) Details of the J132 cable



5.2.6 Connection with an Intelligent Terminal

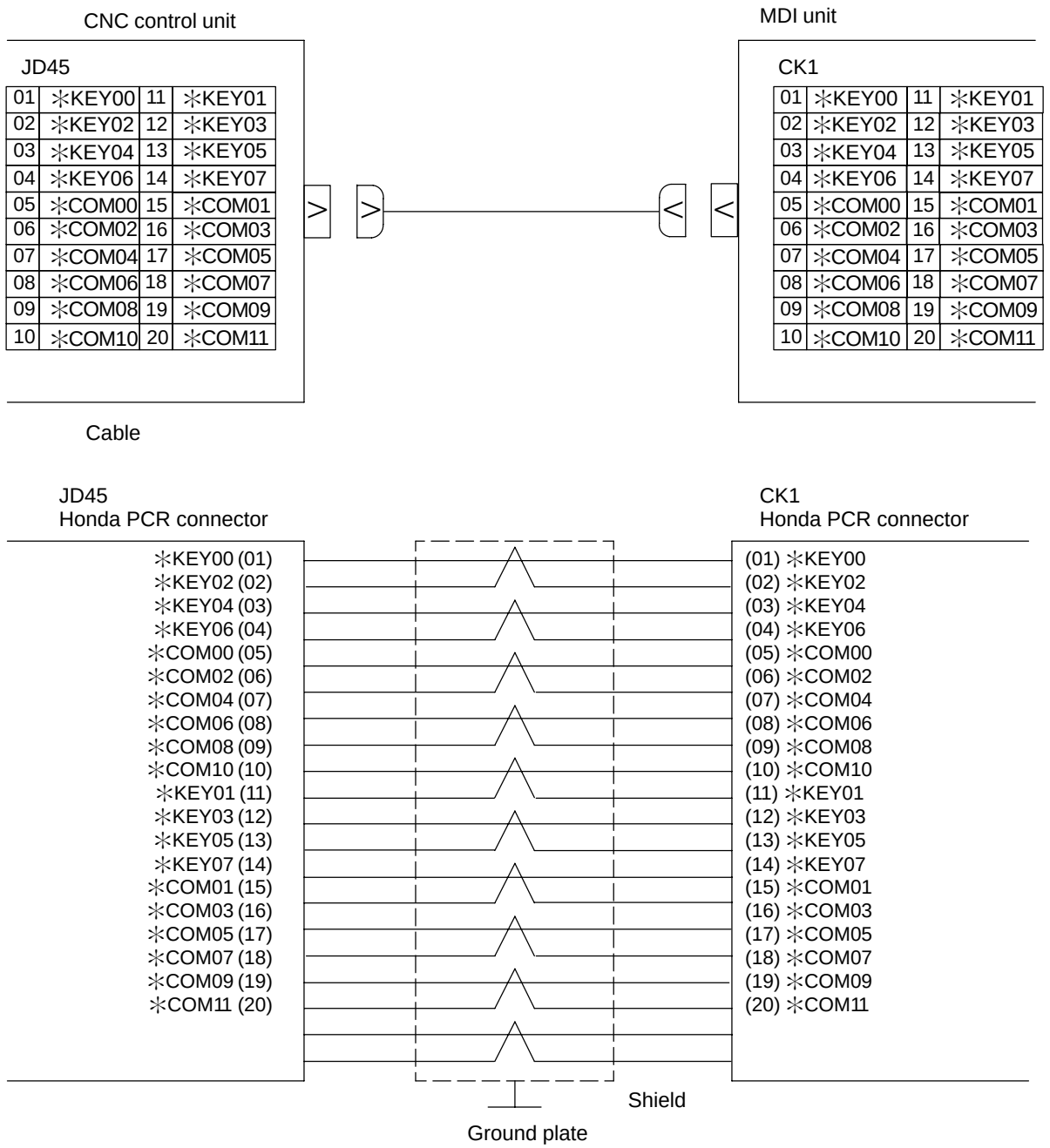
This section describes the connection of an MDI unit with an intelligent terminal. For other intelligent terminal connections, see Chapter 9.

Connection with an intelligent terminal



This section describes the inside of the dotted box.
Either an FA full keyboard or MDI unit is connected.

- **Connection with an MDI unit**



Recommended cable specification: A02B–0120–K810 (5 m)
Recommended wire specification: A66L–0001–0284#10P (#28AWG × 10 pairs)
Recommended cable connector (JD45, CK1):
PCR–E20FA (Honda Tsushin Kogyo)
FCN–247J020–G/E (Fujitsu)
52622–2011 (Molex Japan)

5.3 CONNECTION WITH INPUT/OUTPUT DEVICES

5.3.1 Overview

An input/output device is used to enter information such as CNC programs and parameters from an external device to the CNC, or to output information from the CNC to an external device.

The input/output devices usable with the *i* Series CNC include Handy File. The interface of the input/output devices electrically conforms to RS–232–C, so that a connection can be made with a device that has an RS–232–C interface.

The tables below indicate the serial ports of the *i* Series CNC. For the serial ports on the remote buffer, see Chapter 12. For the serial ports on the personal computer and intelligent terminal, see Chapters 8 and 9.

(For 16*i*/18*i*/21*i* of LCD–mounted type)

Port name	Interface location	
First channel (JD36A)	Main control unit	
Second channel (JD36B)	Main control unit	(*1)
Third channel (JD28A)	On the remote buffer option printed circuit board	

(For 160*i*/180*i*/210*i* with PC functions)

Port name	Interface location	
First channel on the CNC side (JD36A)	Main control unit	
Second channel on the CNC side (JD36B)	Main control unit	
Third channel on the CNC side (JD28A)	On the remote buffer option printed circuit board	
First channel on the PC side (JD33)	Main control unit	(*2)
On the PC interface connector unit	Second channel on the PC side (JD36F)	

(For 16*i*/18*i*/21*i* of stand–alone type)

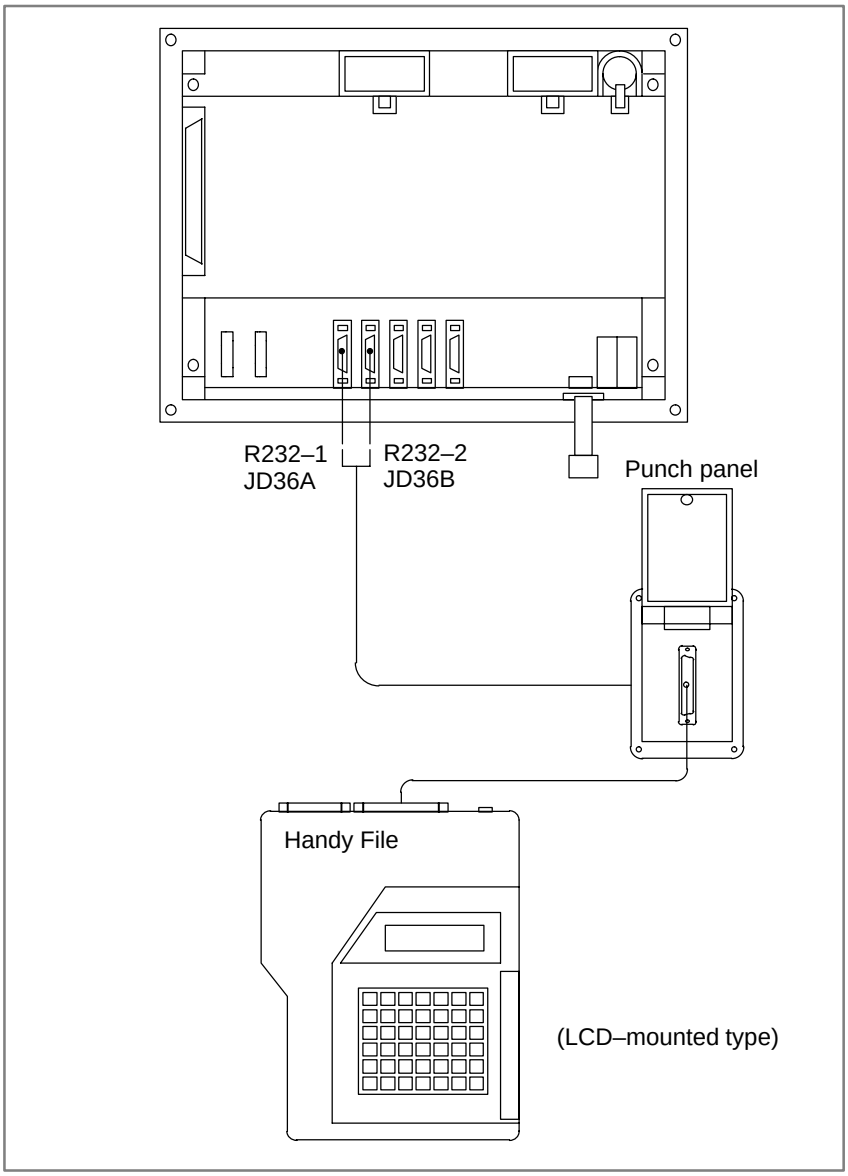
Port name	Interface location	
First channel (JD5A)	Main control unit	
Second channel (JD5B)	Main control unit	
Third channel (JD28A)	On the remote buffer option printed circuit board	
Serial port dedicated to a touch panel	On the 10.4″ LCD unit or 9.5″ LCD unit for a CNC with a touch panel	(*3)

(For 160*i*/180*i*/210*i* with an intelligent terminal)

Port name	Interface location	
First channel on the CNC side (JD36A)	Main control unit	
Second channel on the CNC side (JD36B)	Main control unit	
Third channel on the CNC side (JD28A)	On the remote buffer option printed circuit board	
First channel on the intelligent terminal side (JD33)	On the intelligent terminal	(*2)
Second channel on the intelligent terminal side (JD34)	On the intelligent terminal	
On the 10.4″ LCD unit or 9.5″ LCD unit for a CNC with a touch panel	Serial port dedicated to a touch panel	(*3)

NOTE
1 When a touch panel is used, this serial port is used for touch panel communication on the CNC side, so that this port cannot be used as a general–purpose port.
2 When a touch panel is used, this serial port is used for touch panel communication on the PC side, so that this port cannot be used as a general–purpose port.
3 This serial port is dedicated to touch panel communication. Even if no touch panel is attached, this port cannot be used as a general–purpose port.

5.3.2 Connecting I/O Devices

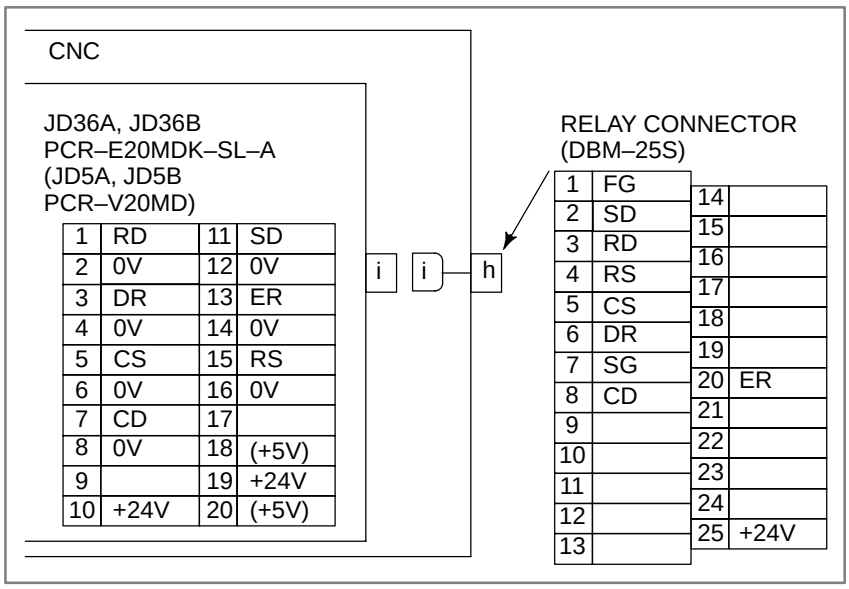


NOTE

This interface is based on the RS–232–C interface of the CNC. Therefore, for a Series 210*i* CNC control unit with PC functions, the parameters and programs should be input and output using the RS–232–C interface of the personal computer (JD33). However, the interface shown above can be used when using any of the following functions which are processed directly by the CNC. Cases in which this RS–232–C interface is used when a Series 210*i* with PC functions is used

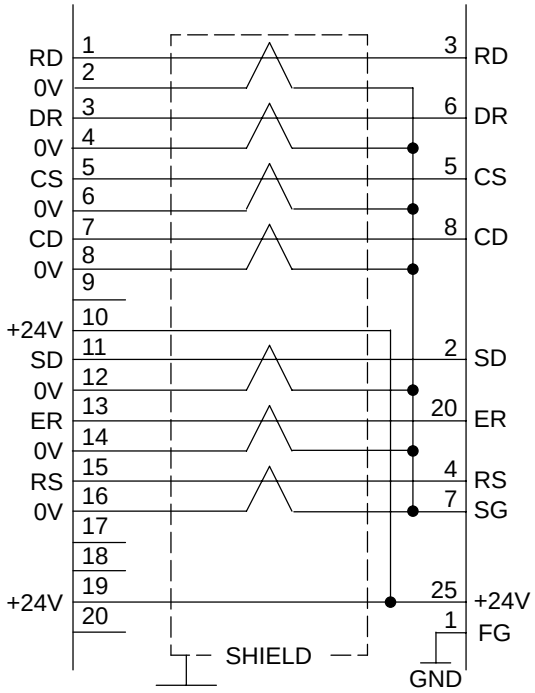
Ladder uploading or downloading via RS–232–C using FAPT–LADDER or FAPT–LADDER II
Ladder monitoring from an external PC using FAPT–LADDER II
DNC operation via RS–232–C, external I/O device control
Input/output of parameters and programs by using the CNC screen display function

5.3.3 RS–232–C Serial Port



NOTE
1 +24 V can be used as the power supply for FANUC RS–232–C equipment.
2 Do not connect anything to those pins for which signal names are not indicated.
3 Pins 18 and 20 (+5V) are provided for touch channel connection. Never use these pins for making any other connection.
4 The upper connector specification of JD36A/36B is used with the LCD–mounted type *i* series CNC.
The lower connector specification (in parentheses) is used with the stand–alone type *i* series CNC.

CABLE CONNECTION



RECOMMENDED CABLE SPECIFICATION
A66L–0001–0284#10P (#28AWG × 10 pairs)
RECOMMENDED CABLE–SIDE CONNECTORS (JD36A, JD36B)
PCR–E20FA (Honda Tsushin Kogyo Co., Ltd.)
FI30–20S (Hirose Electric Co., Ltd.)
FCN–247J020–G/E (Fujitsu, Ltd.)
52622–2011 (Molex Japan Co., Ltd.)

RECOMMENDED CABLE SPECIFICATION (PUNCH PANEL)
For JD36A and JD36B
<Narrow width type>
A02B–0236–C191 (1 m)
A02B–0236–C192 (2 m)
A02B–0236–C193 (5 m)

RECOMMENDED CABLE SPECIFICATION (PUNCH PANEL)
For JD5A and JD5B
<Narrow width type>
A02B–0120–C191 (1 m)
A02B–0120–C192 (2 m)
A02B–0120–C193 (5 m)

NOTE
1 Do not connect anything to those pins for which signal names are not indicated.
2 The recommended cable connector FI30–20S (manufactured by Hirose Electric) cannot be used for connectors JD5A and JD5B of the stand–alone type *i* Series CNC.

5.3.4 RS–232–C Interface Specification

RS–232–C Interface signals

Generally signals as follows are used in RS–232–C interface.

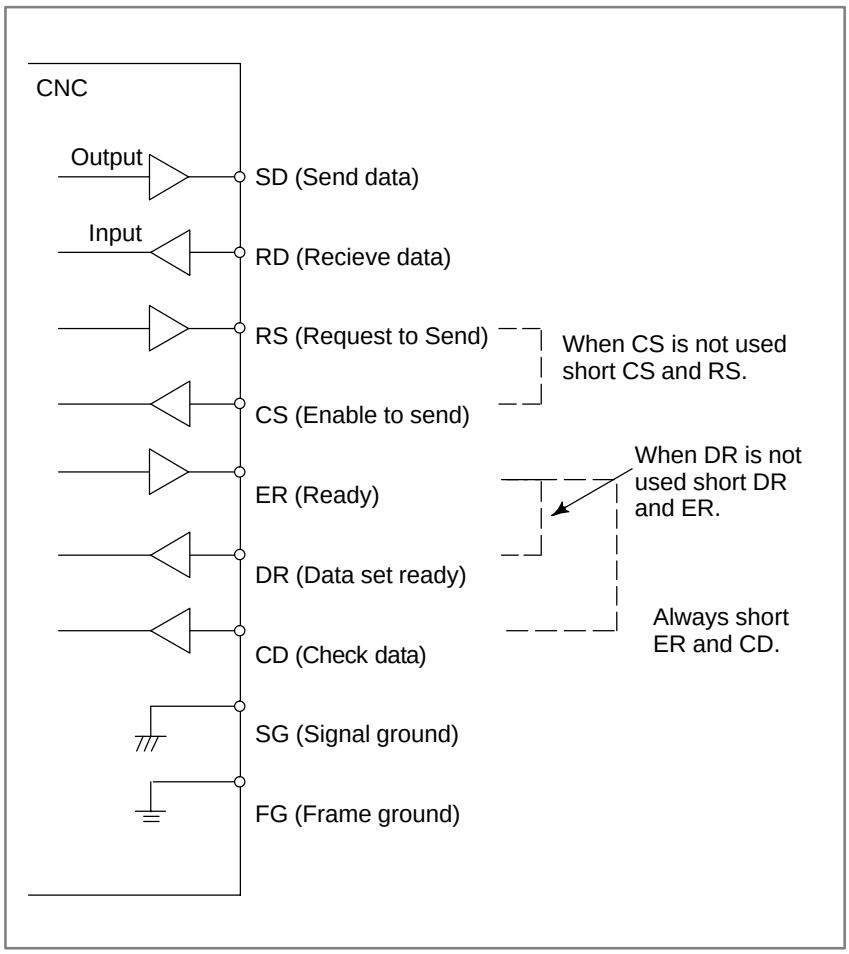
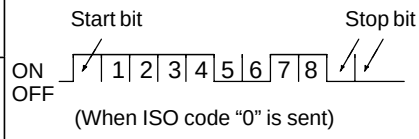


Fig. 5.3.4 (a) RS–232–C interface

Signal description of RS–232–C interface

Signal name	RS–232C circuit number	I/O	Description	
SD	103	Output	Sending data	
RD	104	Input	Receiving data	
RS	105	Input	Sending request	This signal is set to on when NC starts sending data and is turned off when transmission ends.
CS	106	Input	Sending permitted	When both this signal and the DR signal are set, the NC can send data. If external device processing is delayed by a punching operation, etc., NC data sending can be stopped by turning off this signal after sending two characters, including the data being sent currently. If this signal will not be used, make sure to strap this signal circuit to the RS signal circuit.
DR	107	Input	Data set ready	When external device is ready to operate, this signal is set. This signal should usually be connected to the signal indicating external device power supply being on. (ER signal of external device). See Note below. The NC transfers data when this signal is set. If the signals turned off during data transfer, alarm 086 is issued. If the DR signal will not be used, make sure to strap this signal circuit to the ER signal circuit.
ER	108.2	Output	NC ready to operation	This signal is set when the NC is ready to operate. External device should regard the SD signal as being significant when the ER signal is set.
CD	109	Input	Signal quality signal	Since this signal is not used in connections with external device, the signal circuit must be strapped, inside the connecting cable, to the ER signal circuit.
SG	102		Signal grounding	
FG	101		Frame grounding	

NOTE

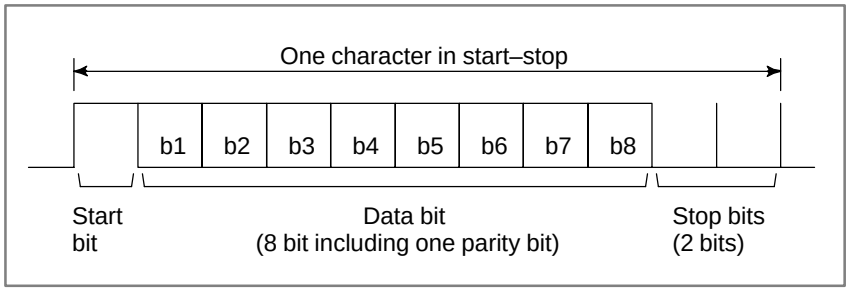
Signal on/off state is defined as follows;

	–3V or lower	+3V or higher
Function	OFF	ON
Signal Condition	Marking	Spacing

Transmission Method of RS–232–C interface

Start–stop

Generally, two transmission methods are available at the serial interface. *i* Series CNC use the start–stop method. With this method, start and stop signals are output before and after each data bit.



Codes

Transmission codes are as follows:

(i) EIA code and Control codes DC1 to DC4.

(ii) ISO code and Control codes DC1 to DC4 (Optional ISO code input is necessary.)

The connected external device must be able to recognize the following control codes, sent from NC.

Control code		8	7	6	5	4		3	2	1
DC1	Tape reader start				○		○			○
DC2	Tape punch designation				○		○		○	
DC3	Tape reader stop	○			○		○		○	
DC4	Tape punch release				○		○	○		○

NOTE
The listed control codes are used for both EIA and ISO.

In this interface, control codes DC1 to DC4 are used.

(a) NC can control external device by issuing codes DC1 to DC4.

(b) When external processing falls behind the pace of the NC signals (When NC issues data)

(i) External device can temporarily stop NC data output by using the NC's CS signal. Data output stops within two characters including a currently transmitting character when CS OFF signal is input to NC. When CS signal is turned on again, data transmission start.

(ii) If control code DC3 is input to NC, NC stops data output within ten characters. When control code DC1 is input to NC, NC starts sending data again.

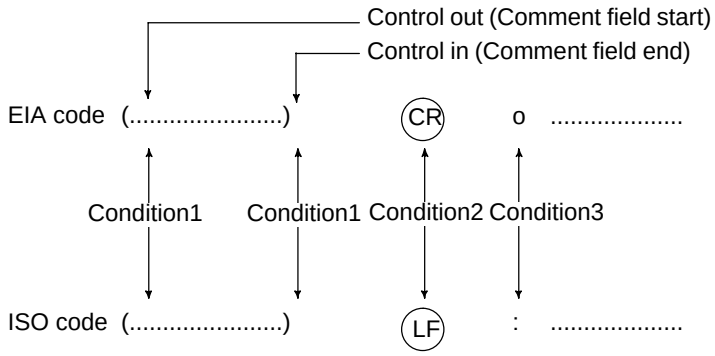
(c) When the external device is equipped with an ISO/EIA converter, the external device must satisfy the specification shown in Table 5.3.4 (a).

Table 5.3.4 (a)

ISO code										EIA code										Meaning	
Character	8	7	6	5	4		3	2	1	Character	8	7	6	5	4		3	2	1		
0			○	○		•				0			○			•					Numeral 0
1	○		○	○		•			○	1						•			○		Numeral 1
2	○		○	○		•		○		2						•		○			Numeral 2
3			○	○		•		○	○	3				○		•		○	○		Numeral 3
4	○		○	○		•	○			4						•	○				Numeral 4
5			○	○		•	○		○	5				○		•	○		○		Numeral 5
6			○	○		•	○	○		6				○		•	○	○			Numeral 6
7	○		○	○		•	○	○	○	7						•	○	○	○		Numeral 7
8	○		○	○	○	•				8					○	•					Numeral 8
9			○	○	○	•			○	9				○	○	•			○		Numeral 9
A		○				•			○	a		○	○			•			○		Address A
B		○				•		○		b		○	○			•		○			Address B
C	○	○				•		○	○	c		○	○	○		•		○	○		Address C
D		○				•	○			d		○	○			•	○				Address D
E	○	○				•	○		○	e		○	○	○		•	○		○	?	Address E
F	○	○				•	○	○		f		○	○	○		•	○	○			Address F
G		○				•	○	○	○	g			○	○		•	○	○	○		Address G
H		○			○	•				h		○	○		○	•					Address H
I	○	○			○	•			○	i		○	○	○	○	•			○		Address I
J	○	○			○	•		○		j		○		○		•			○		Address J
K		○			○	•		○	○	k		○		○		•		○			Address K
L	○	○			○	•	○			l		○				•		○	○		Address L
M		○			○	•	○		○	m		○		○		•	○				Address M
N		○			○	•	○	○		n		○				•	○		○		Address N
O	○	○			○	•	○	○	○	o		○				•	○	○			Not used at significant data zone in ISO code. Assumed as address 0 at EIA code.
P		○		○		•				p		○		○		•	○	○	○		Address P
Q	○	○		○		•			○	q		○		○	○	•					Address Q
R	○	○		○		•		○		r		○			○	•			○		Address R
S		○		○		•		○	○	s			○	○		•		○			Address S
T	○	○		○		•	○			t			○			•		○	○		Address T
U		○		○		•	○		○	u			○	○		•	○				Address U
V		○		○		•	○	○		v			○			•	○		○		Address V
W	○	○		○		•	○	○	○	w			○			•	○	○			Address W
X	○	○		○	○	•				x			○	○		•	○	○	○		Address X
Y		○		○	○	•			○	y			○	○	○	•					Address Y
Z		○		○	○	•		○		z			○		○	•			○		Address Z
DEL	○	○	○	○	○	•	○	○	○	Del		○	○	○	○	•	○	○	○	※	Delete (cancel erroneous hole)
NUL						•				Blank						•				※	No holes. Not used at significant data zone is EIA code.
BS	○				○	•				BS			○		○	•		○		※	Back space
HT					○	•			○	Tab			○	○	○	•	○	○		※	Tabulator
LF or NL					○	•		○		CR or EOB	○					•					End of block
CR	○				○	•	○		○											※	Carriage return
SP	○		○			•				SP				○		•				※	Space
%	○		○			•	○		○	ER					○	•		○	○		Absolute rewind stop
(			○		○	•				(2–4–5)				○	○	•		○			Control out (start of comment)
)	○		○		○	•			○	(2–4–7)		○			○	•		○			Control in (end of comment)
+			○		○	•		○	○	+		○	○	○		•				※	Plus sign
–			○		○	•	○		○	–		○				•				–	Minus sign
:			○	○	○	•		○													Assumed as program number in ISO code.
/	○		○		○	•	○	○	○	/			○	○		•			○		Optional block skip
.			○		○	•	○	○		.		○	○		○	•		○	○		Decimal point
#	○		○			•		○	○											※	Sharp
$			○			•	○													※	Dollar symbol
&	○		○			•	○	○		&					○	•	○	○		※	Ampersand
’			○			•	○	○	○											※	Apostrophe
※	○		○		○	•		○												※	Asterisk
,	○		○		○	•	○			,			○	○	○	•		○	○	※	Comma
;	○		○	○	○	•		○	○											※	Semicolon
<			○	○	○	•	○													※	Left angle bracket
=	○		○	○	○	•	○		○											※	Equal mark
>	○		○	○	○	•	○	○												※	Right angle bracket
?			○	○	○	•	○	○	○											※	Question mark
@	○	○				•														※	Commerical at mark
”			○			•		○												※	Quotation mark

NOTE

1 When the external device is equipped with an ISO/EIA converter, the following items must be noted in Table 5.3.4 (a).



Condition1

Left parenthesis “(”of the ISO code punches holes at bits 2, 4 and 5 when used in the EIA code.
Right parenthesis “)”of the ISO code punches holes at bits 2, 4 and 7 when used in the EIA code.

Condition2

EIA code (CR) is (LF) in ISO code.

Condition3

EIA code O is : in ISO code.

2 Control codes DC1 to DC4 are transmission codes output from the NC. So they need not to be punched on the NC tape.

(iii) Transmission rate (Baud rate)

The transmission rate (Baud rate) is the number of bits transferred per second.

The following baud rates are available depending on the system parameter.

50, 100, 110, 150, 200, 300, 600, 1200, 2400, 4800, 9600.

(Example)

Baud rate : 110

When using one start bit and two stop bits (totalling 11 bits per character):

$$\text{Transmission characters/second} = \frac{110}{11} = 10 \text{ characters/second}$$

(Max.)

(iv) Cable length

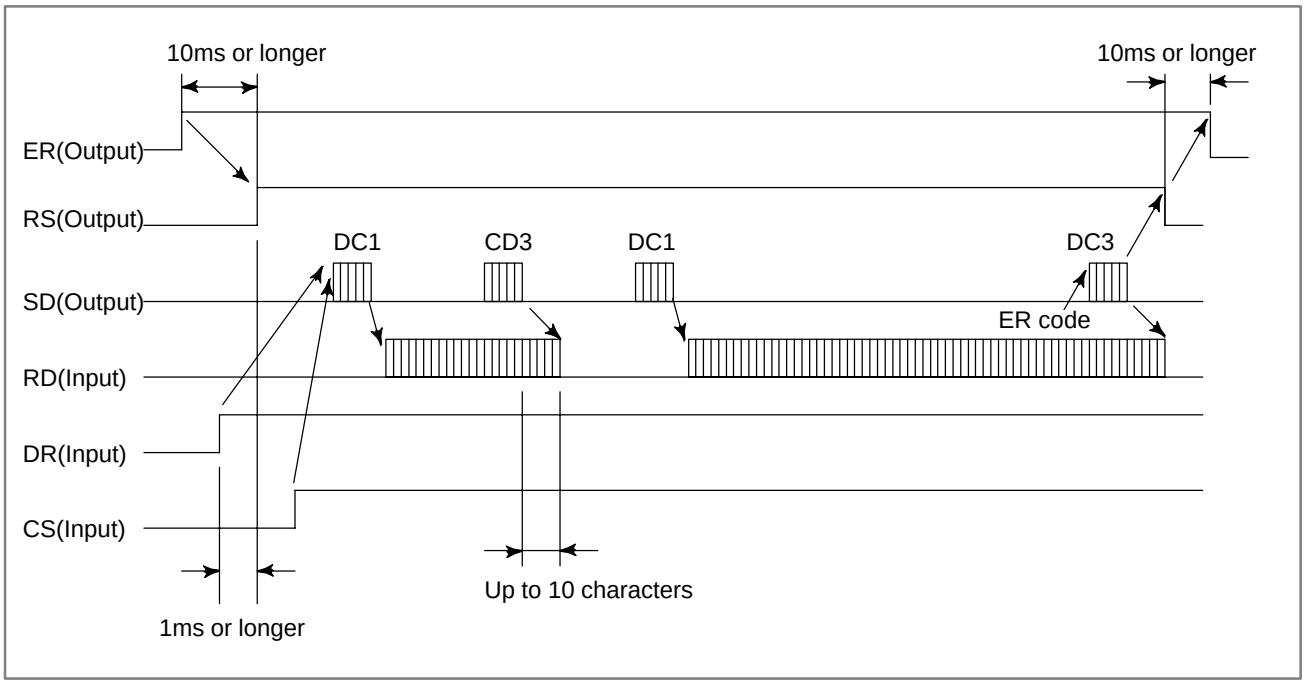
The cable length depends on the external device type. Consult with the device manufacturers for actual connecting cable lengths.

When cable A (A66L–0001–0041) is used, cable length is as follows by the specification of NC.

for RS–232C 100m or less ... 4800 bauds or less
50m or less ... 9600 bauds or less

Time chart when the NC receives data (Read into memory)

(1) NC outputs DC1.
(2) The external device starts sending data upon receiving DC1.
(3) NC sends DC3 when NC processing is delayed.
(4) The external device stops sending data to NC after receiving DC3. The device may send up to 10 characters after receiving DC3. If it sends more than 10 characters, alarm 087 will occur.
(5) NC reissues DC1 upon completing delayed processing.
(6) The external device restarts data output upon receiving the DC1 code (the data must be the next data to the preceding.)
(7) NC sends DC3 upon completing data read.
(8) The external device stops sending data.



Time chart when the NC send data (Punch out)

(1) NC output DC2.

(2) NC outputs punch data in succession.

(3) When data processing is delayed at the external device.

(a) Data output stops within two characters including a currently transmitting character when CS signal is turned off.
When CS signal is turned on again, data transmission starts. (See Fig. 5.3.4 (b))

(b) If control code DC3 is input to NC, NC stops data output within ten characters. When control code DC1 is input to NC, NC starts sending data again. (See Fig. 5.3.4 (c))

(4) The NC starts sending the next data if the CS signal is turned on after the external device completes data processing.

(5) The NC issues DC4 upon completing data output.

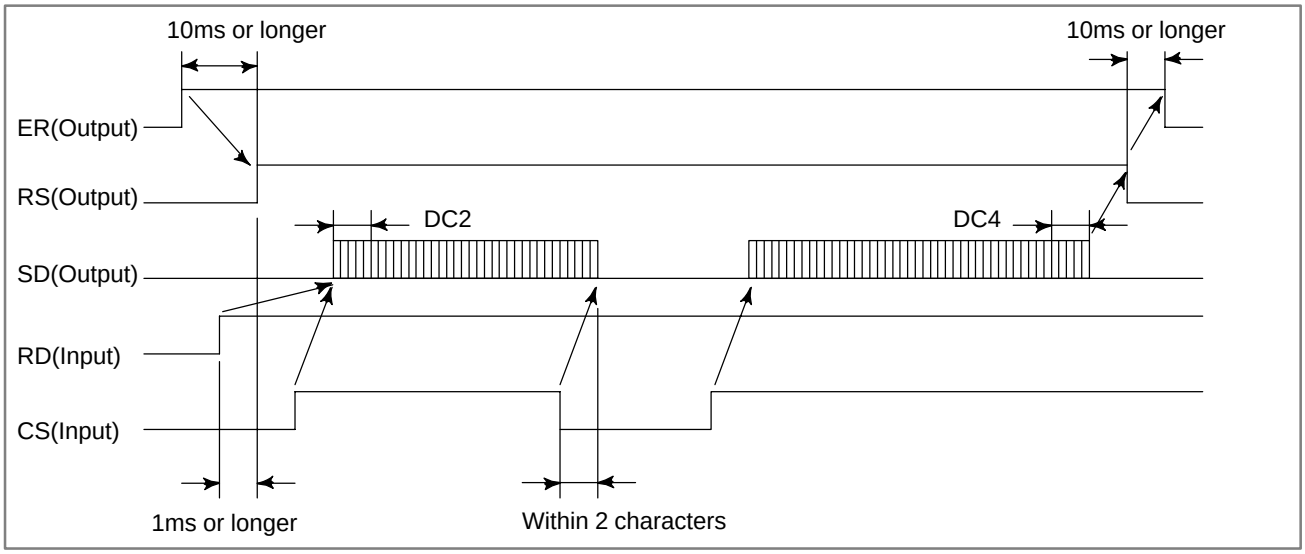


Fig. 5.3.4 (b)

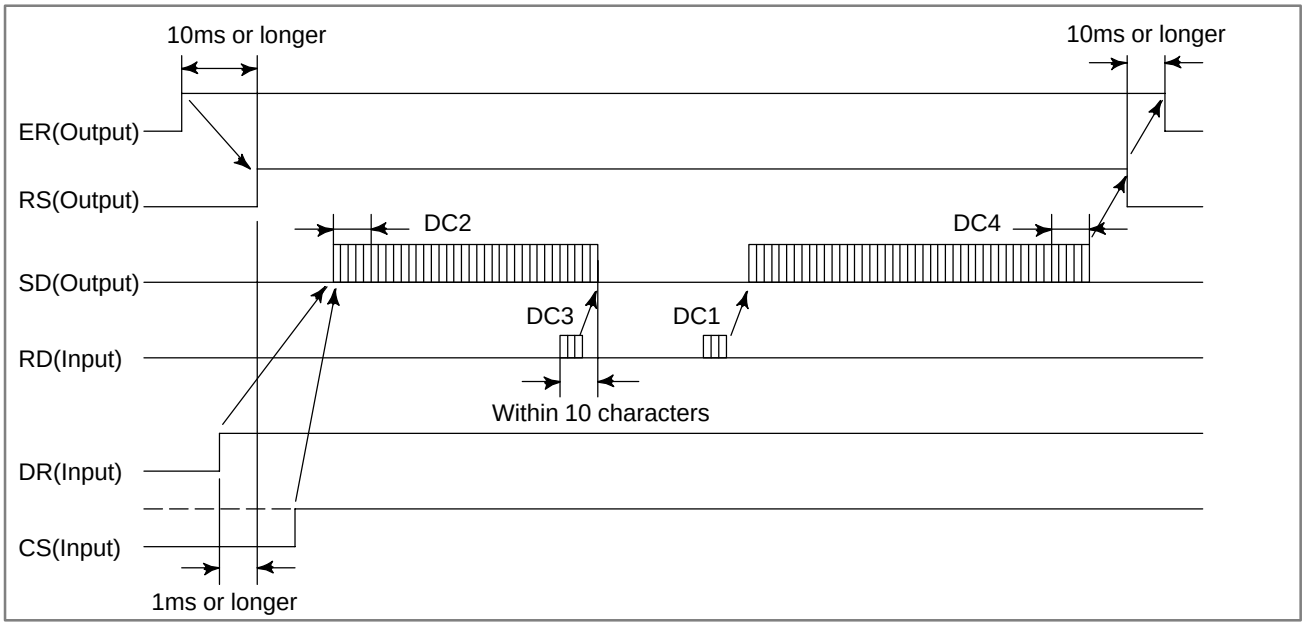
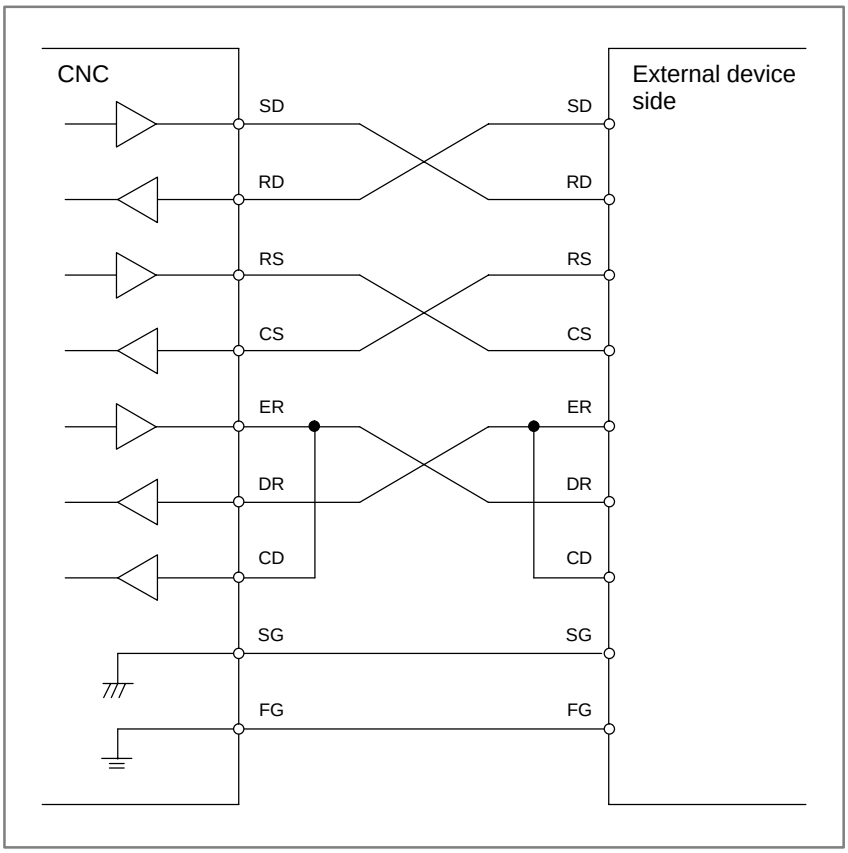
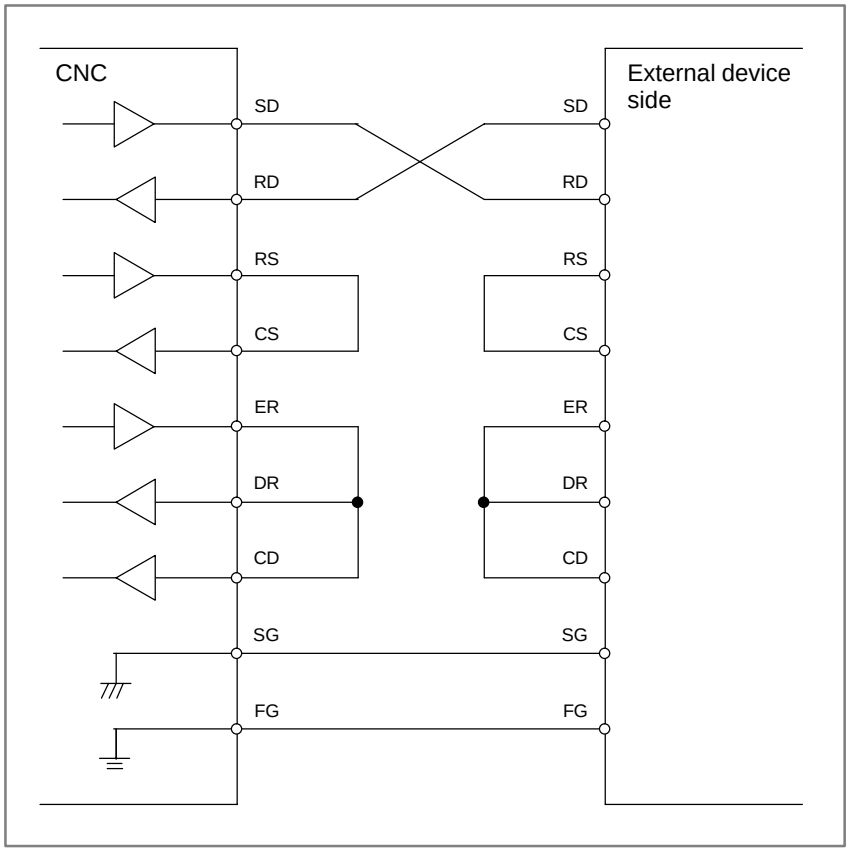


Fig. 5.3.4 (c)

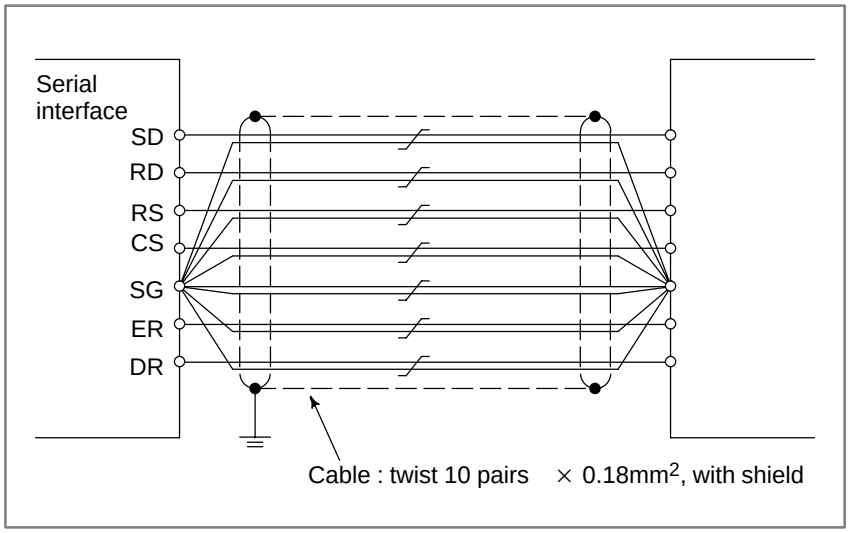
Connection between RS–232–C interface and external device



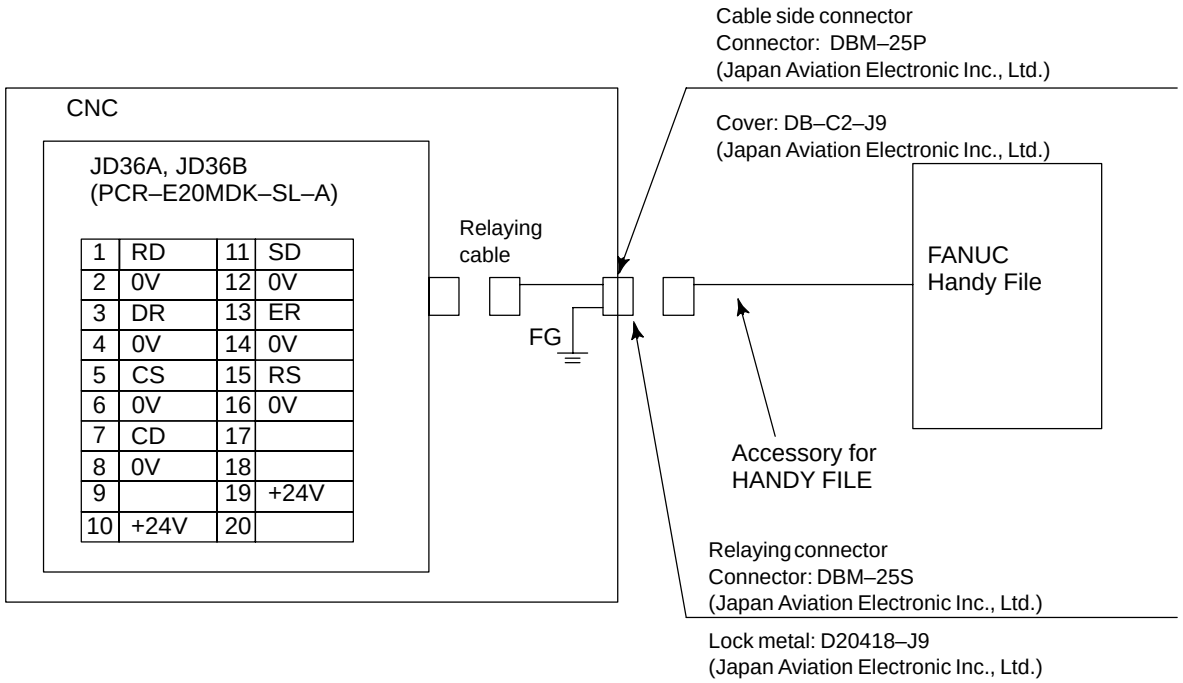
- The cable for connecting the PG–Mate to the NC should be connected as shown in the below diagram.



Prepare the cable with I/O device as follows :



5.3.5 FANUC Handy File Connection



1	RD	11	SD
2	0V	12	0V
3	DR	13	ER
4	0V	14	0V
5	CS	15	RS
6	0V	16	0V
7	CD	17	
8	0V	18	
9		19	+24V
10	+24V	20	

RELAYING CONNECTOR SIGNAL LAYOUT

1	2	3	4	5	6	7	8	9	10	11	12	13
FG	SD	RD	RS	CS	DR	SG	CD					

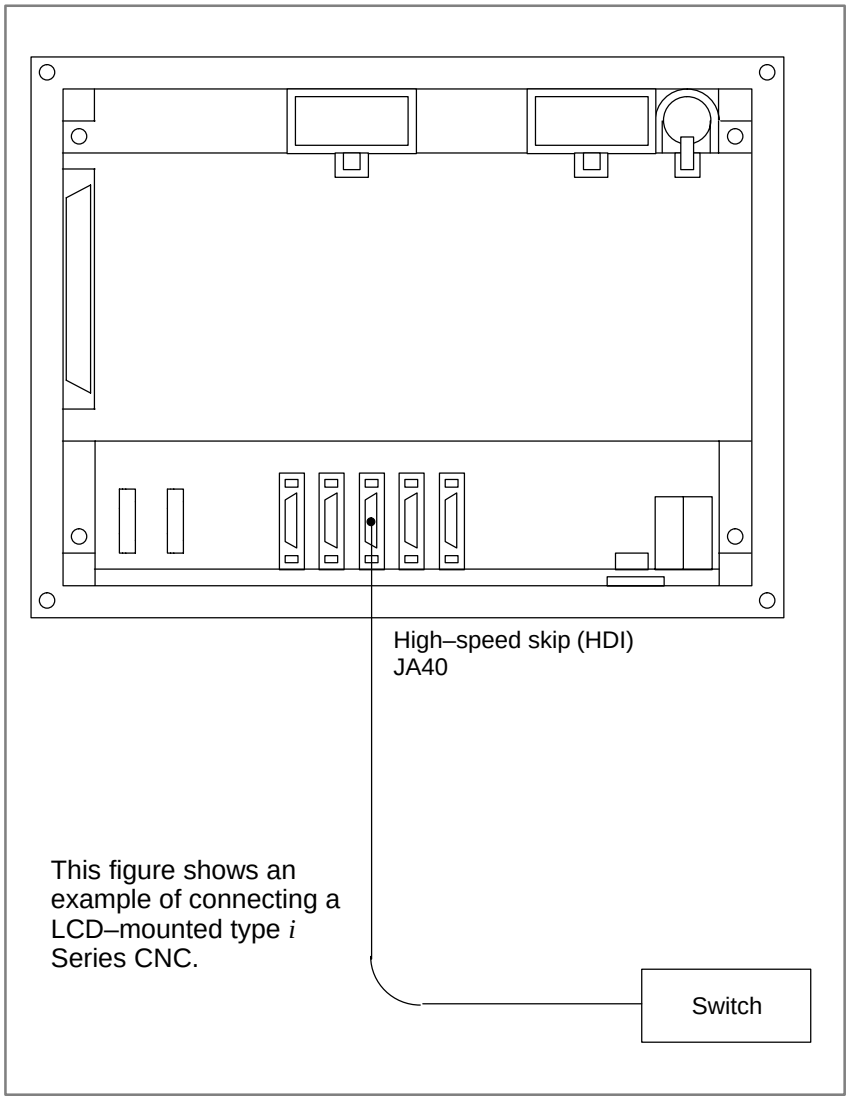
14	15	16	17	18	19	20	21	22	23	24	25
						ER					+24

NOTE

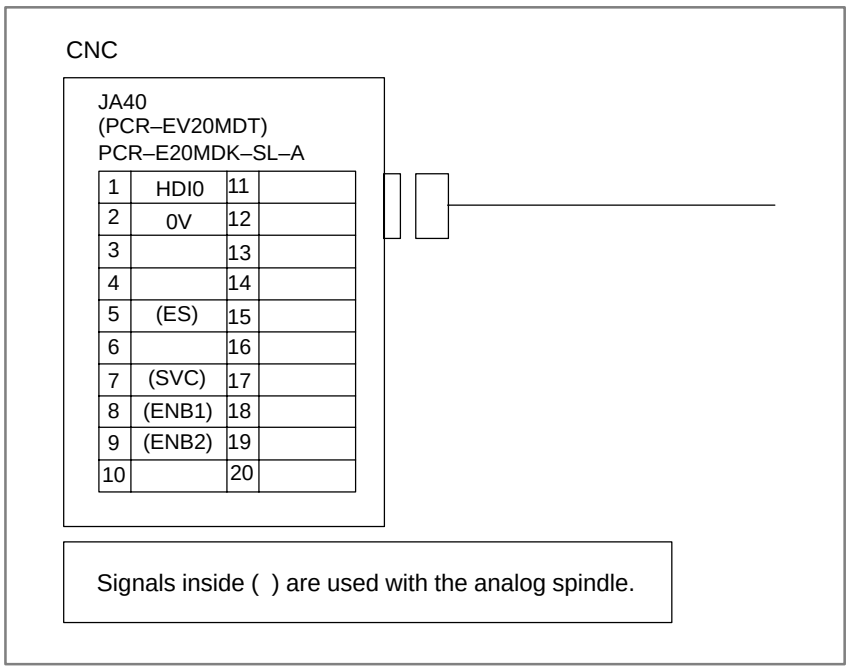
1 Machine tool builder shall furnish relay connector and relay cable.
2 Use a totally shielded cable for the signal cable.
  Recommended cable specification: A66L–0001–0284#10P
3 Open all terminals other than illustrated.
4 Set suitable parameters on reader/puncher interface for FANUC Handy File. The baud rate is 4800 baud in standard.
5 Connect the FANUC Handy File to either JD36 or JD36B. Do not use both pins; the power capacity may exceed that of +24V and blow the fuse.
6 Make no connections to pins 18 (+5V) and 20 (+5V). JD5A and JD5B have no +5V pins.
7 The upper connector name on the CNC side is for the LCD–mounted type *i* Series CNC. The lower connector name, enclosed in parentheses, is for the stand–alone type *i* Series CNC.

5.4 CONNECTING THE HIGH–SPEED SKIP (HDI)

5.4.1 General

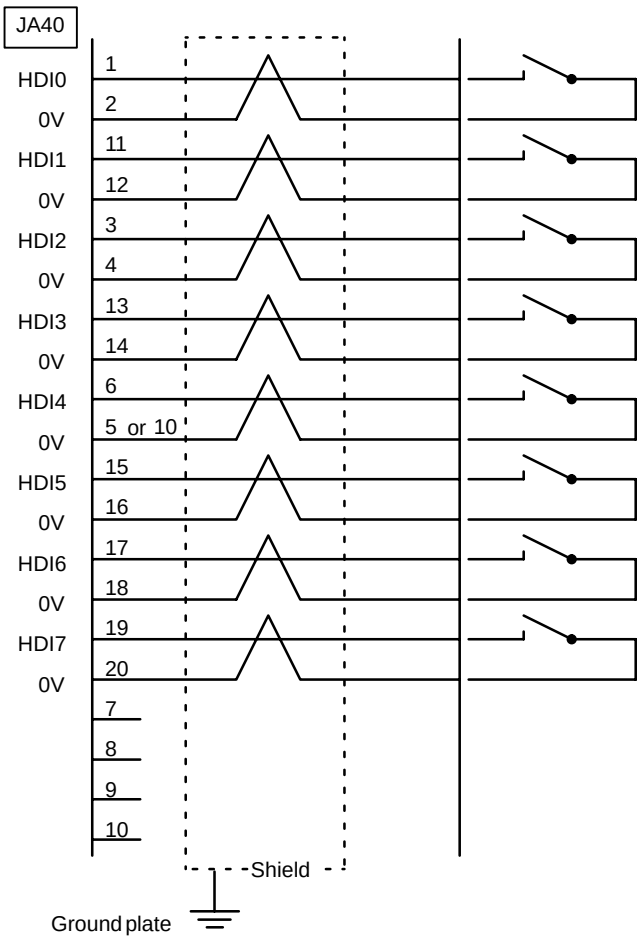


5.4.2 Connection to the High–speed Skip (HDI)



NOTE
1 The upper connector specification of JA40 is for the LCD–mounted type *i* Series CNC. The lower connector specification, enclosed in parentheses, is for the stand–alone type i Series CNC.
2 With 16*i*/18*i*/160*i*/180*i*, eight DIs (HDI0 to HDI7) can be used in total. With 21*i*/210*i*, only one DI (HDI0) can be used.
3 All DI cannot be used on the 20*i*.

Cable connections



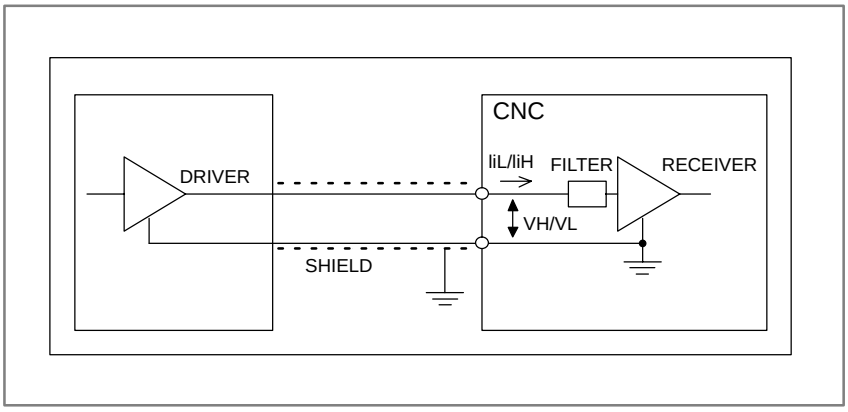
The 0V signal of pin 5 functions as a common signal when analog output is used. So, as the 0V signal paired with HDI4 when analog output is used together with a high–speed DI, use the 0V signal of pin 10.

Recommended cable connector:
PCR–E20FA (Honda Tsushin Kogyo)
FI30–20S (Hirose Electric)
FCN–247J020–G/E (Fujitsu)
52622–2011 (Molex Japan)

NOTE
The recommended cable connector FI30–20S (manufactured by Hirose Electric) cannot be used for the stand–alone type *i* Series CNC.

5.4.3 Input Signal Rules for the High–speed Skip (HDI)

Circuit configuration



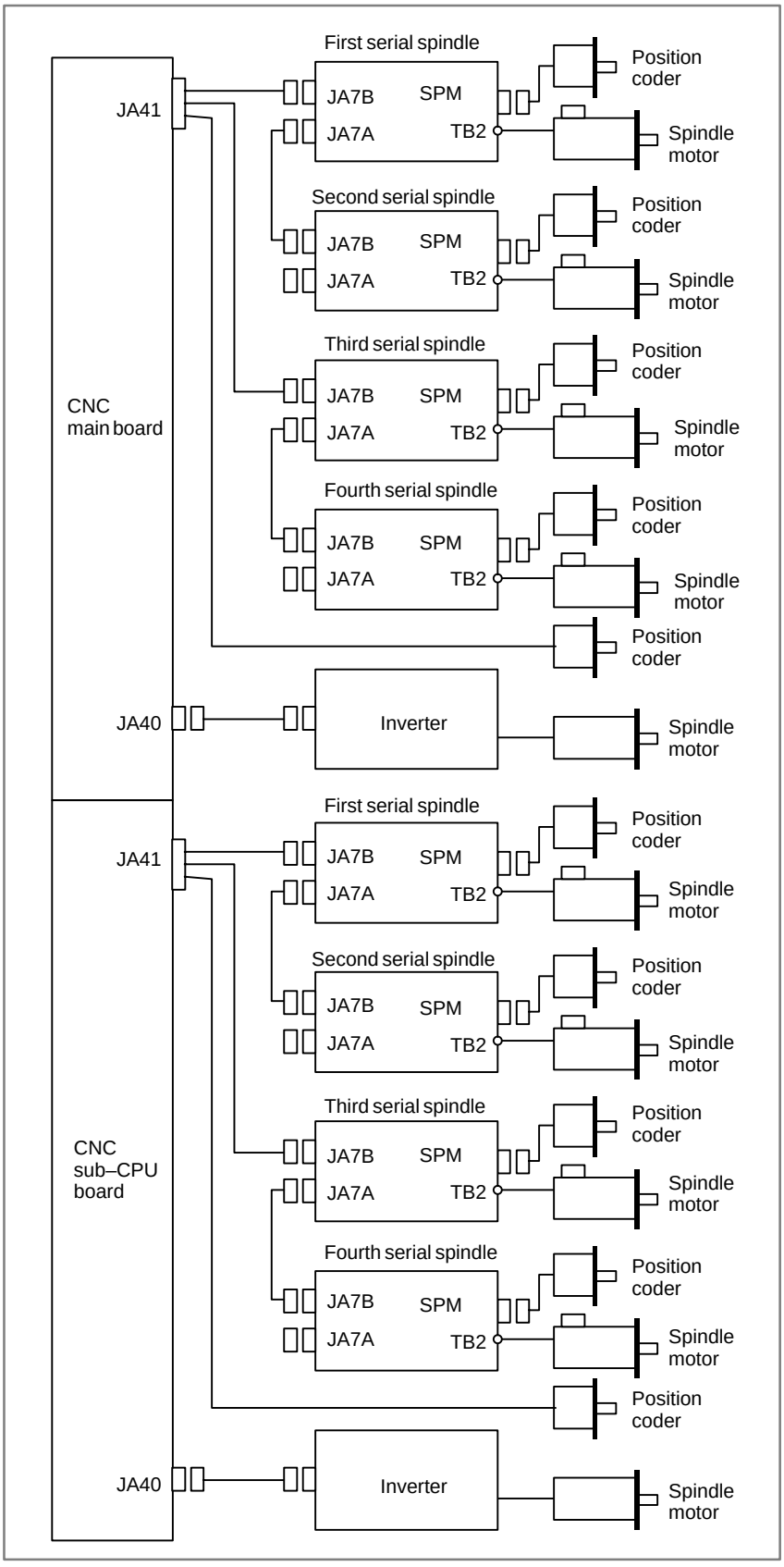
Absolute maximum rating
Input voltage range Vin: –3.6 to +13.6 V
Input characteristics

Unit	Symbol	Specification	Unit	Remark
High level input voltage	VH	3.6 to 11.6	V	
Low level input voltage	VL	0 to 1.0	V	
High level input current	IiH	2 max	mA	Vin=5 V
		11 max	mA	Vin = 10 V
Low level input current	IiL	–8.0 max	mA	Vin = 0 V
Input signal pulse duration		20 min	μ s	

NOTE
The plus (+) sign of IiH/IiL represents the direction of flow into the receiver. The minus (–) sign of IiH/IiL represents the direction of flow out of the receiver.

6 SPINDLE CONNECTION

The figure below shows the spindle–related connections. Note that the number of connectable spindles depends on the model, the number of paths, and the configuration. So, see the tables that follow the figure below.



For one–path control with Series 16*i*

First serial spindle on main board	Second serial spindle on main board	Third serial spindle on main board	Fourth serial spindle on main board	Analog output on main board	Position coder (for analog spindle)
○	○			○	
○	○	○	○		
				○	○

For two–path control using two CPUs with Series 16*i*
(Path 1)

First serial spindle on main board	Second serial spindle on main board	Third serial spindle on main board	Fourth serial spindle on main board	Analog output on main board	Position coder (for analog spindle)
○	○			○	
○	○	○	○		
				○	○

(Path 2)

First serial spindle on sub–CPU board	Second serial spindle on sub–CPU board	Third serial spindle on sub–CPU board	Fourth serial spindle on sub–CPU board	Analog output on sub–CPU board	Position coder (for analog spindle)
○	○			○	
○	○	○	○		
				○	○

For two–path control using one CPU with Series 16*i*
(The interface on the main board is shared by path 1 and path 2.)

First serial spindle on main board	Second serial spindle on main board	Third serial spindle on main board	Fourth serial spindle on main board	Analog output on main board	Position coder (for analog spindle)
○ Path 1	○ Path 1			○ Path 1	
○ Path 1	○ Path 1			○ Path 2	
○ Path 2	○ Path 2			○ Path 1	
○ Path 1	○ Path 1	○ Path 2	○ Path 2		

For three–path control using two CPUs with Series 16*i*
(The interface on the main board is used by path 1.)

First serial spindle on main board	Second serial spindle on main board	Third serial spindle on main board	Fourth serial spindle on main board	Analog output on main board	Position coder (for analog spindle)
○ Path 1	○ Path 1			○ Path 1	
○ Path 1	○ Path 1	○ Path 1	○ Path 1		
				○ Path 1	○ Path 1

(The interface on the sub–CPU board is shared by path 2 and path 3.)

First serial spindle on sub–CPU board	Second serial spindle on sub–CPU board	Third serial spindle on sub–CPU board	Fourth serial spindle on sub–CPU board	Analog output on sub–CPU board	Position coder (for analog spindle)
○ Path 2	○ Path 2			○ Path 2	
○ Path 2	○ Path 2			○ Path 3	
○ Path 3	○ Path 3			○ Path 2	
○ Path 2	○ Path 2	○ Path 3	○ Path 3		

For one–path control with Series 18*i*

First serial spindle on main board	Second serial spindle on main board	Third serial spindle on main board	Fourth serial spindle on main board	Analog output on main board	Position coder (for analog spindle)
○	○			○	
○	○	○			
				○	○

For two–path control using two CPUs with Series 18*i*
(Path 1)

First serial spindle on main board	Second serial spindle on main board	Third serial spindle on main board	Fourth serial spindle on main board	Analog output on main board	Position coder (for analog spindle)
○	○			○	
○	○	○			
				○	○

(Path 2)

First serial spindle on sub–CPU board	Second serial spindle on sub–CPU board	Third serial spindle on sub–CPU board	Fourth serial spindle on sub–CPU board	Analog output on sub–CPU board	Position coder (for analog spindle)
○	○			○	
○	○	○			
				○	○

For two–path control using one CPU with Series 18*i*
(The interface on the main board is shared by path 1 and path 2.)

First serial spindle on main board	Second serial spindle on main board	Third serial spindle on main board	Fourth serial spindle on main board	Analog output on main board	Position coder (for analog spindle)
○ Path 1	○ Path 1			○ Path 1	
○ Path 1	○ Path 1			○ Path 2	
○ Path 2	○ Path 2			○ Path 1	
○ Path 1	○ Path 1	○ Path 2			
○ Path 2	○ Path 2	○ Path 1			

For Series 21*i*

First serial spindle on main board	Second serial spindle on main board	Third serial spindle on main board	Fourth serial spindle on main board	Analog output on main board	Position coder (for analog spindle)
○	○				
○	○				
				○	○

For Series 20*i*

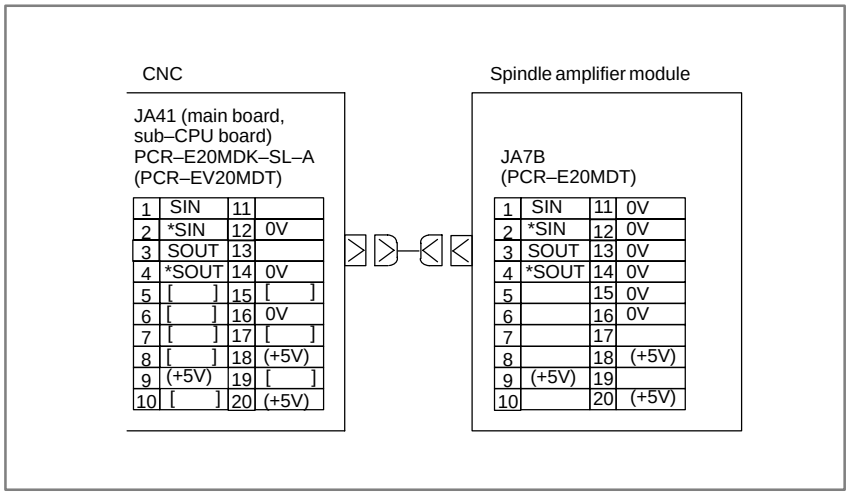
First serial spindle on main board	Second serial spindle on main board	Third serial spindle on main board	Fourth serial spindle on main board	Analog output on main board	Position coder (for analog spindle)
○					
○					
				○	○

NOTE
When the spindle function is used on the sub–CPU board, the option for analog output or serial output is always required on the main board.

NOTE
For connection between a spindle amplifier and spindle motor and connection between a spindle amplifier and position coder, refer to the relevant manual for the SPINDLE MOTOR α Series.

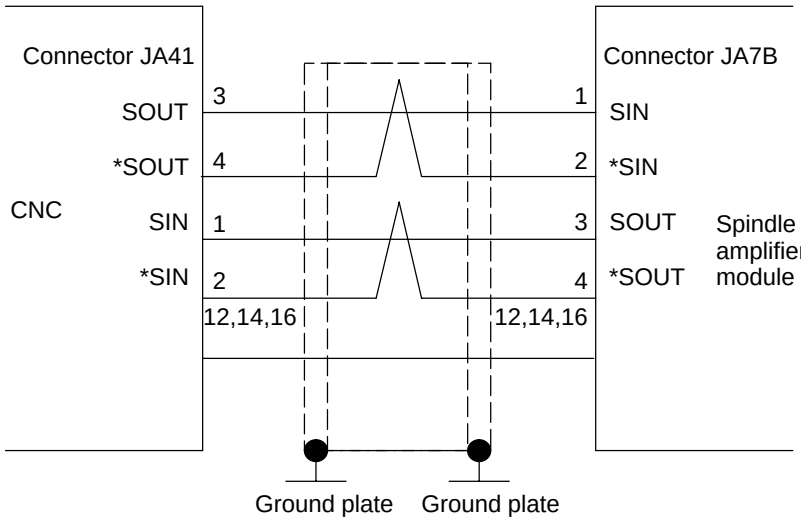
6.1 SERIAL SPINDLE

6.1.1 Connection of One to Two Serial Spindles



NOTE
1 When an optical I/O link cable is used for connection between the NC and a spindle amplifier, the +5V signals indicated in parentheses are used to feed power to the optical I/O link adapter. Do not connect these signals when an optical cable is not used. The signals in brackets ([ ]) are used when a position coder is used with an analog spindle or when three or four serial spindles are used.
2 The upper connector specification of JA41 is used with the LCD–mounted type *i* Series CNC. The lower connector specification (in parentheses) is used with the stand–alone type *i* Series CNC.
3 The second serial spindle is connected as a branch from the spindle amplifier module.

Cable connection



Recommended cable connector:
PCR–E20FA (manufactured by Honda Tsushin Kogyo)
FI30–20S (manufactured by Hirose Electric)
FCN–247J020–G/E (manufactured by Fujitsu)
52622–2011 (manufactured by Molex Japan)

Recommended wire specification:
A66L–0001–0284#10P (#28AWG × 10 pairs)

NOTE

1 In any of the following cases, make a connection via an optical fiber cable by using an optical I/O link adapter:
   - When the cable is 20 m or longer
   - When the power magnetics cabinet containing a spindle amplifier cannot be connected with the operator's panel cabinet containing a CNC control unit via a ground wire with a cross–sectional area of 5.5 mm^2 or more
   - When the cable is subject to significant noise. For example, when there is a strong electromagnetic noise source such as a welding machine near the cable, or when the cable runs in parallel with a power line or power magnetics cable that can generate noise.

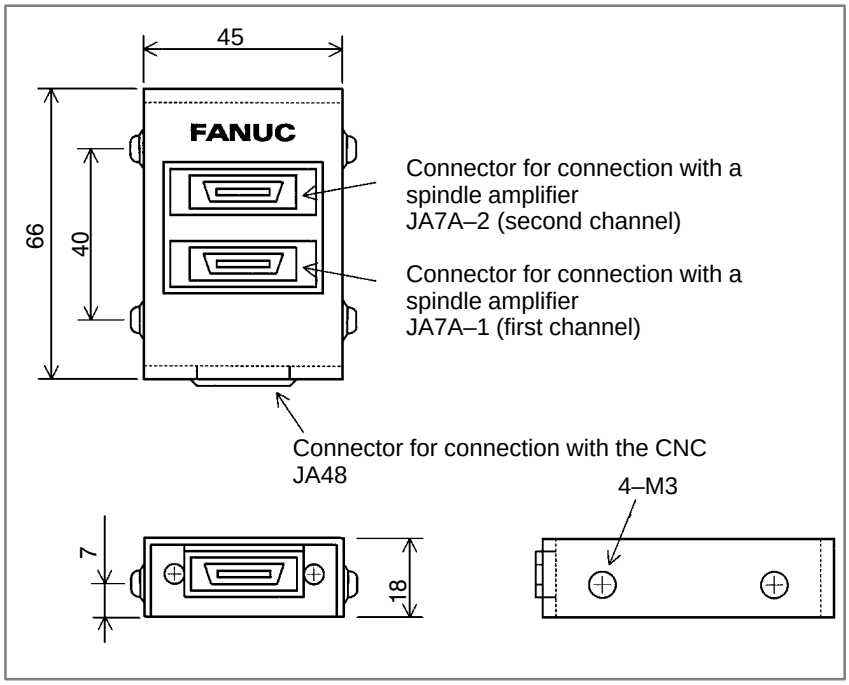
2 The recommended cable connector FI30–20S (manufactured by Hirose Electric) cannot be used for the stand–alone type *i* Series CNC and JA7B.

6.1.2 Connecting One to Four Serial Spindles

With the Series 16*i* and 18*i*, three or four serial spindles can be connected using the serial spindle connector panel described below.
Serial spindle connector panel specification: A13B–0180–B001

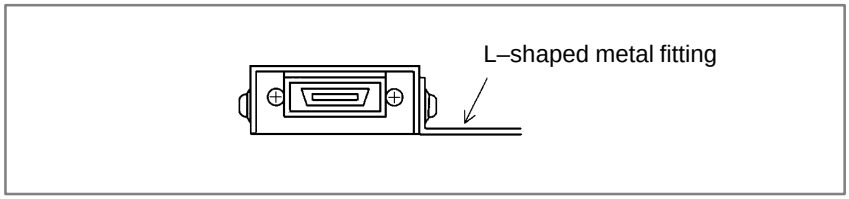
Outside dimensions of the serial spindle connector panel

The outside dimensions of the serial spindle connector panel are the same as those for the optical I/O link adapter (A13B–0154–B001).



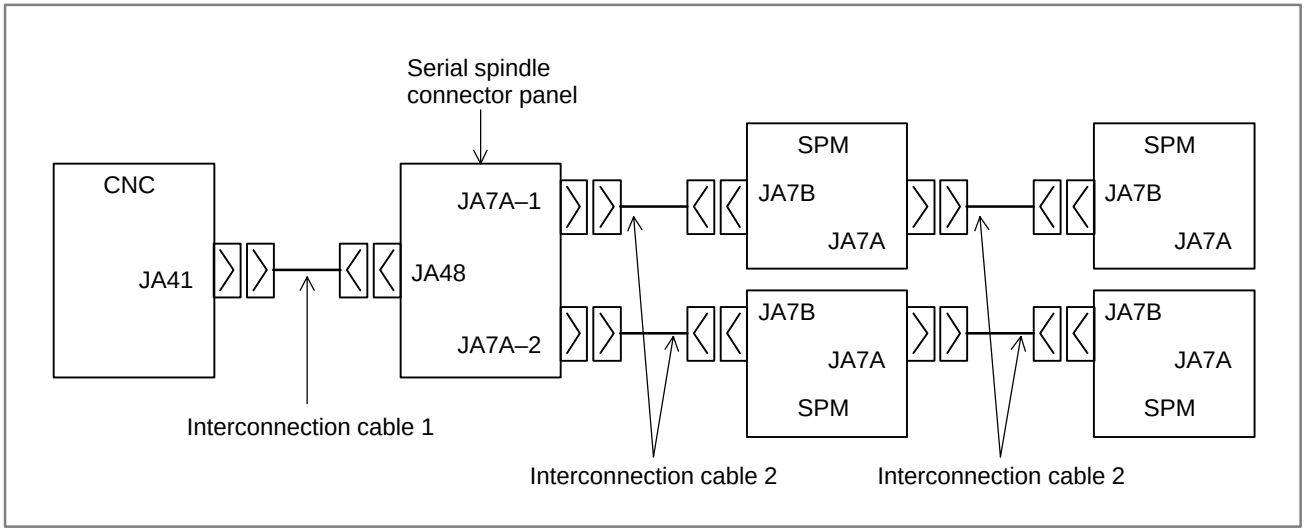
Conditions for installing the serial spindle connector panel

- The serial spindle connector panel does not have an enclosed structure. So, install the serial spindle connector panel in an enclosed cabinet as used for the CNC.
- Ground the case by using the case mounting screws of the serial spindle connector panel.
- The serial spindle connector panel is light, so that it need not be secured with screws. However, ensure that the serial spindle connector panel does not contact other electrical circuits and thus cause a short circuit. When securing the serial spindle connector panel to the cabinet, for example, attach an L–shaped metal fitting as shown below with a case mounting screw (M3) of the serial spindle connector panel.

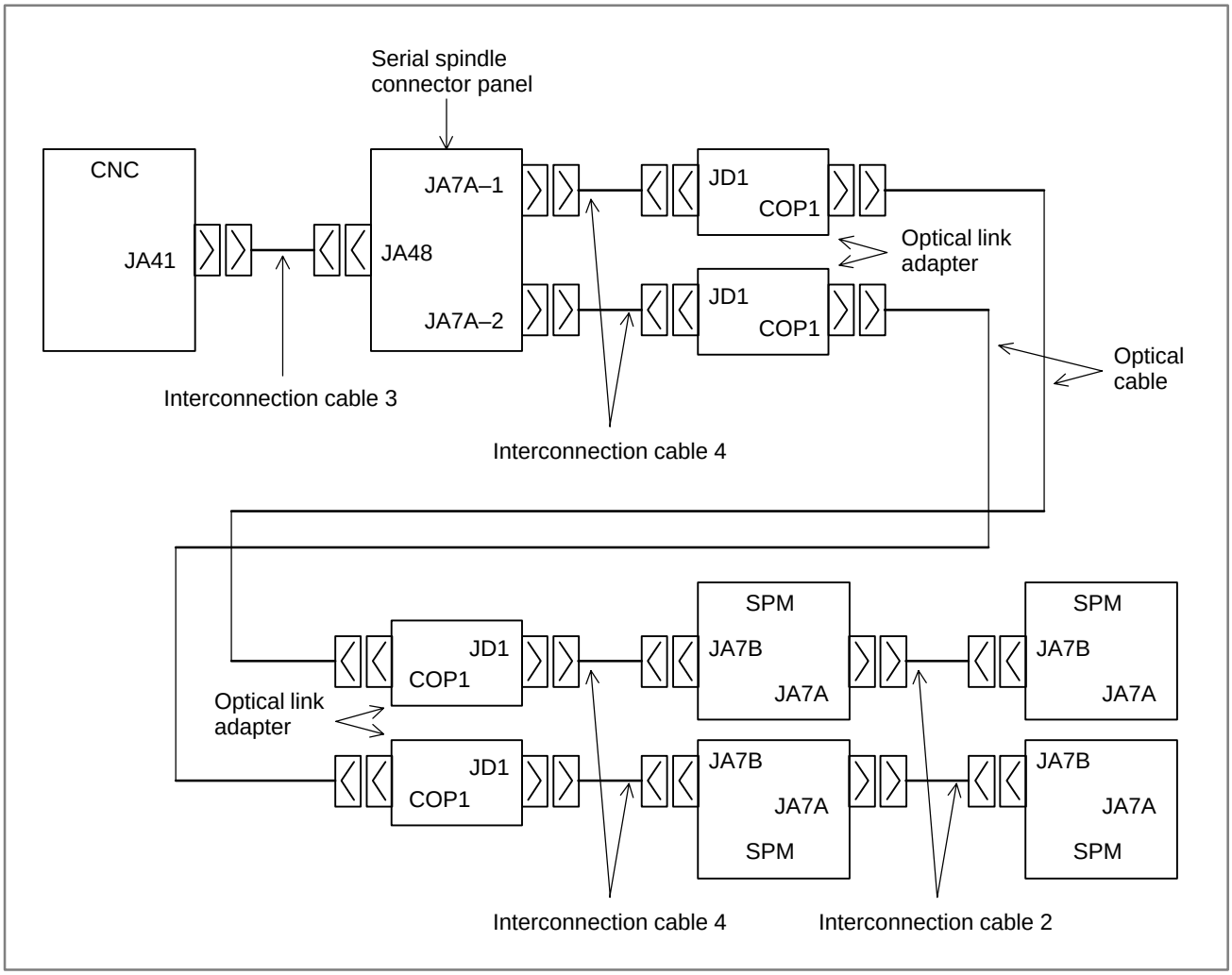


Connection diagram

(Connection diagram when only electrical cables are used)



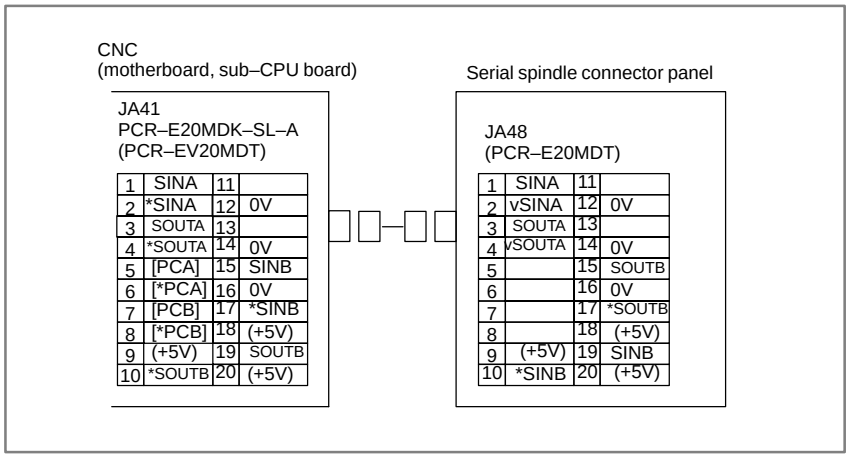
(Connection diagram when optical cables are used)



(Cable connections when only electrical cables are used)

Cable connection between the CNC and serial spindle connector panel

(Interconnection cable 1)



1	SINA	11	
2	*SINA	12	0V
3	SOUTA	13	
4	*SOUTA	14	0V
5	[PCA]	15	SINB
6	[*PCA]	16	0V
7	[PCB]	17	*SINB
8	[*PCB]	18	(+5V)
9	(+5V)	19	SOUTB
10	*SOUTB	20	(+5V)

1	SINA	11	
2	vSINA	12	0V
3	SOUTA	13	
4	vSOUTA	14	0V
5		15	SOUTB
6		16	0V
7		17	*SOUTB
8		18	(+5V)
9	(+5V)	19	SINB
10	*SINB	20	(+5V)

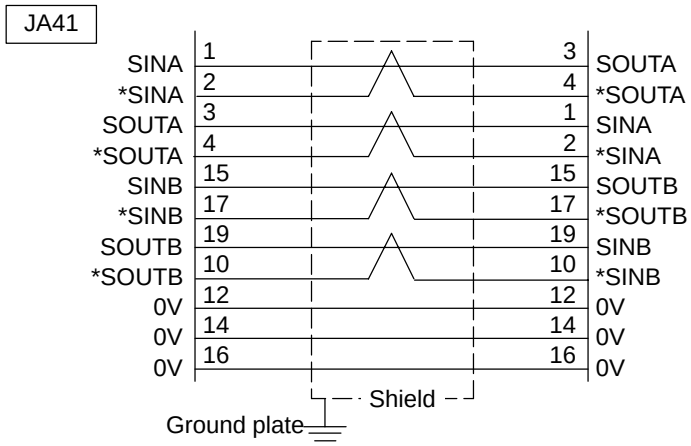
NOTE

1 When an optical cable is used for the connection between the CNC and a spindle, the +5V signals indicated in parentheses are used to feed power to the optical I/O link adapter. Do not connect these signals when an optical cable is not used. The signals in brackets ([ ]) are used when a position coder is used. These signals must not be used together with the second channel of the serial spindle interface.

2 The upper connector specification of JA41 is used with the LCD–mounted type *i* Series CNC. The lower connector specification (in parentheses) is used with the stand–alone type *i* Series CNC.

3 The second and fourth serial spindles are connected as branches from the spindle amplifier module.

Cable connection



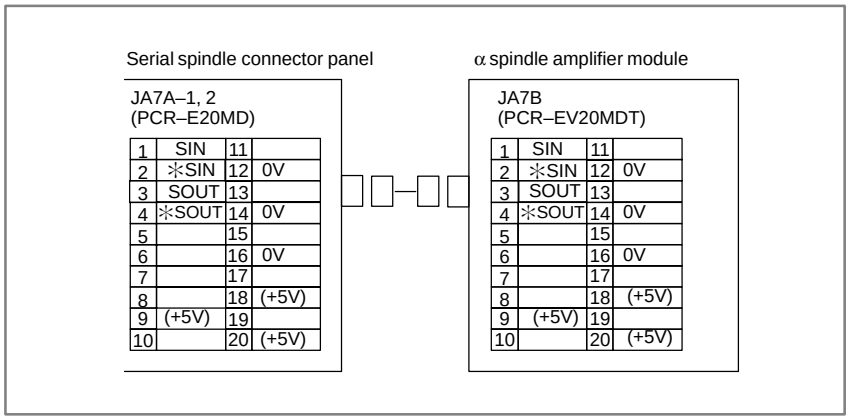
Recommended cable connector:
PCR–E20FA (manufactured by Honda Tsushin Kogyo)
FI30–20S (manufactured by Hirose Electric)
FCN–247J020–G/E (manufactured by Fujitsu)
52622–2011 (manufactured by Molex Japan)

Recommended cable specification: A02B–0236–K845
Recommended wire specification: A66L–0001–0284#10P
(#28AWG × 10 pairs)

NOTE
1 When this cable is installed close to other cables such as a power line, a shielded wire must be connected to the ground plate. When the CNC is installed close to the serial spindle connector panel, however, no connection to the ground plate is necessary.
2 The recommended cable connector FI30–20S (manufactured by Hirose Electric) cannot be used for the stand–alone type *i* Series CNC and JA48.

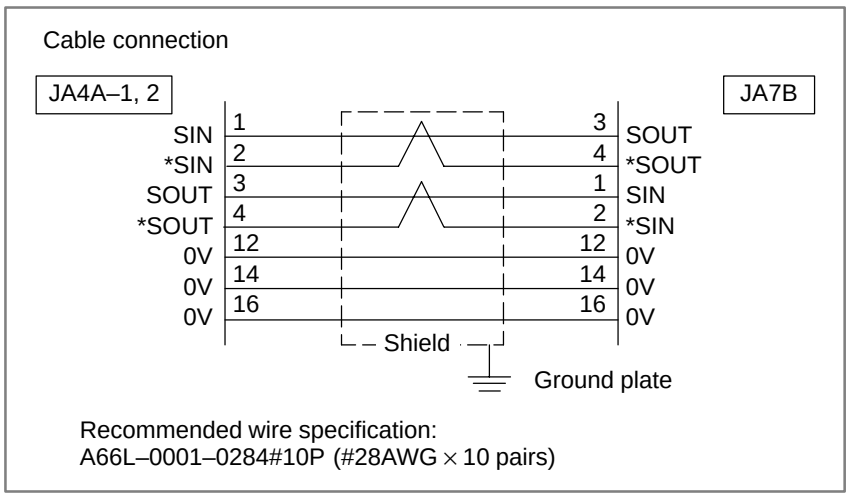
Cable connection between the serial spindle connector panel and a spindle amplifier

(Interconnection cable 2)



NOTE

When an optical cable is used for the connection between the CNC and a spindle, the +5V signals indicated in parentheses are used to feed power to the optical I/O link adapter. Do not connect these signals when an optical cable is not used.



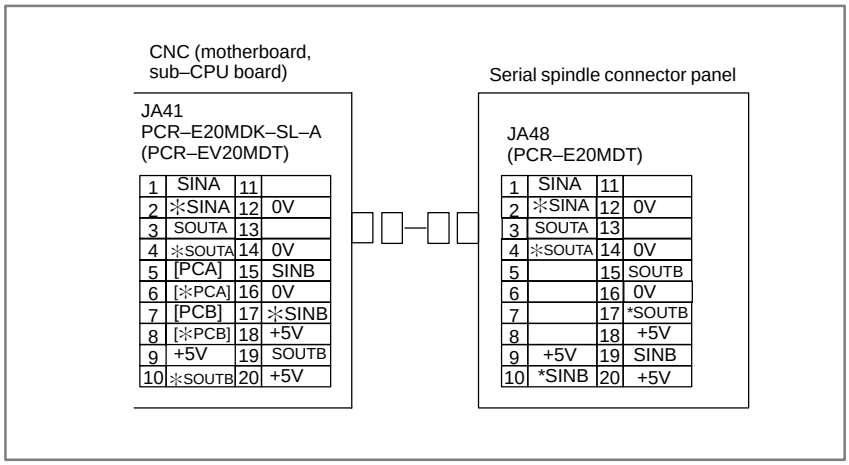
Recommended wire specification:
A66L–0001–0284#10P (#28AWG × 10 pairs)

NOTE

When this cable is installed close to other cables such as a power line, a shielded wire needs to be connected to the ground plate. When the serial spindle connector panel is installed close to the spindle amplifier module, a connection to the ground plate is unnecessary.

(Cable connections when optical cables are used)

Cable connection between the CNC and serial spindle connector panel (Interconnection cable 3)



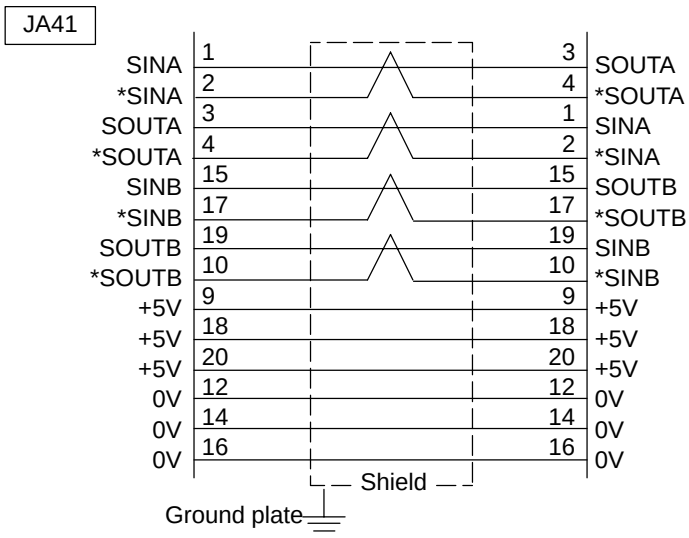
1	SINA	11	
2	⁎SINA	12	0V
3	SOUTA	13	
4	⁎SOUTA	14	0V
5	[PCA]	15	SINB
6	[⁎PCA]	16	0V
7	[PCB]	17	⁎SINB
8	[⁎PCB]	18	+5V
9	+5V	19	SOUTB
10	⁎SOUTB	20	+5V

1	SINA	11	
2	⁎SINA	12	0V
3	SOUTA	13	
4	⁎SOUTA	14	0V
5		15	SOUTB
6		16	0V
7		17	*SOUTB
8		18	+5V
9	+5V	19	SINB
10	*SINB	20	+5V

NOTE

1 The signals in brackets ([ ]) are used when a position coder is used. These signals must not be used together with the second serial spindle interface.
2 The upper connector specification of JA41 is used with the LCD–mounted type *i* Series CNC. The lower connector specification (in parentheses) is used with the stand–alone type *i* Series CNC.
3 The second and fourth serial spindles are connected as branches from the spindle amplifier module.

Cable connection



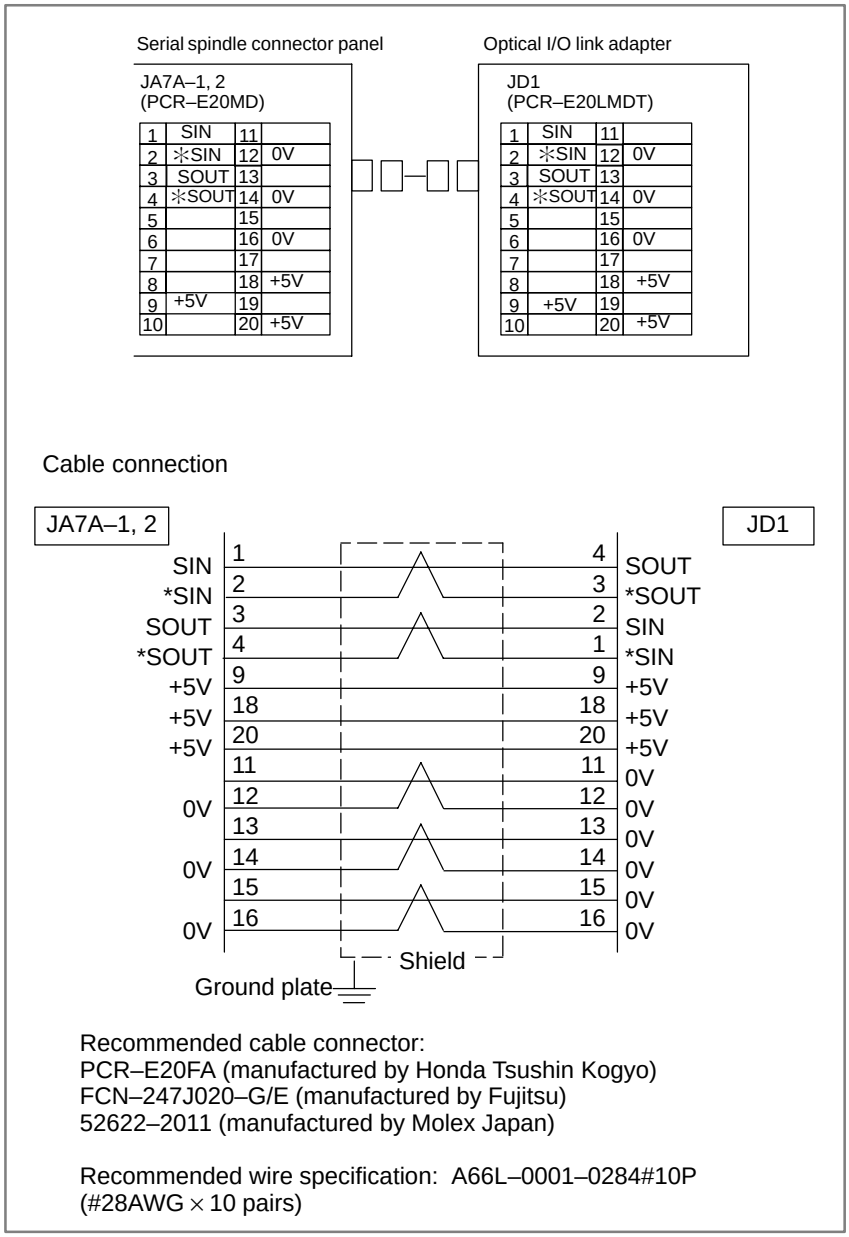
Recommended cable connector:
PCR–E20FA (manufactured by Honda Tsushin Kogyo)
FI30–20S (manufactured by Hirose Electric)
FCN–247J020–G/E (manufactured by Fujitsu)
52622–2011 (manufactured by Molex Japan)

Recommended cable specification: A02B–0236–K847
Recommended wire specification: A66L–0001–0284#10P
(#28AWG × 10 pairs)

NOTE
1 When this cable is installed close to other cables such as a power line, a shielded wire needs to be connected to the ground plate. When the CNC is installed close to the serial spindle connector panel, however, a connection to the ground plate is unnecessary.
2 The recommended cable connector FI30–20S (manufactured by Hirose Electric) cannot be used for the stand–alone type *i* Series CNC and JA48.

(Cable connection between the serial spindle connector panel and an optical I/O link adapter)

(Interconnection cable 4)



1	SIN	11	
2	⁎SIN	12	0V
3	SOUT	13	
4	⁎SOUT	14	0V
5		15	
6		16	0V
7		17	
8		18	+5V
9	+5V	19	
10		20	+5V

Recommended cable connector:
PCR–E20FA (manufactured by Honda Tsushin Kogyo)
FCN–247J020–G/E (manufactured by Fujitsu)
52622–2011 (manufactured by Molex Japan)

Recommended wire specification: A66L–0001–0284#10P
(#28AWG × 10 pairs)

6.2 ANALOG SPINDLE INTERFACE

CNC

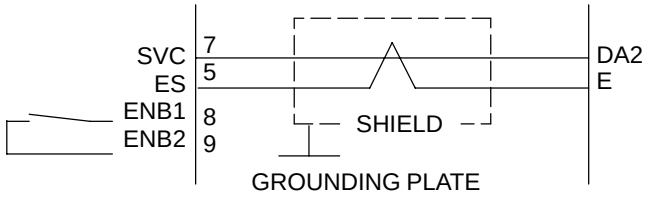
JA40(Main board)
(PCR–E20MDK–SL–A)

1	HDI0	11	
2	(0V)	12	
3		13	
4		14	
5	ES	15	
6		16	
7	SVC	17	
8	ENB1	18	
9	ENB2	19	
10		20	

Signal Name	Description
SVC, ES	Spindle command voltage and common line
ENB1, ENB2	Spindle enable signal (Note 1)

CABLE CONNECTION

ANALOG SPINDLE SERVO UNIT OR INVERTER



RECOMMENDED CABLE–SIDE CONNECTOR
PCR–E20FA (Honda Tsushin Kogyo Co., Ltd.)
FI30–20S (Hirose Electric Co., Ltd.)
FCN–247J020–G/E (Fujitsu, Ltd.)
52622–2011 (Molex Japan Co., Ltd.)
RECOMMENDED CABLE SPECIFICATION:
A66L–0001–0284#10P (#28AWG × 10 pairs)

NOTE
1 Signals ENB1 and 2 turn on when the spindle command voltage is effective. These signals are used when the FANUC Analog Spindle Servo Unit is used.
2 The analog output ratings are as follows:
  Output voltage: ±10 V
  Output current: 2 mA (maximum)
  Output impedance: 100 ohms
3 The parenthesized signals are used for the high–speed skip function (HDI).
4 The upper connector specification of JA40 is used with the LCD–mounted type *i* Series CNC. The lower connector specification (in parentheses) is used with the stand–alone type *i* Series CNC.
5 The recommended cable connector FI30–20S (manufactured by Hirose Electric) cannot be used for the stand–alone type *i* Series CNC.

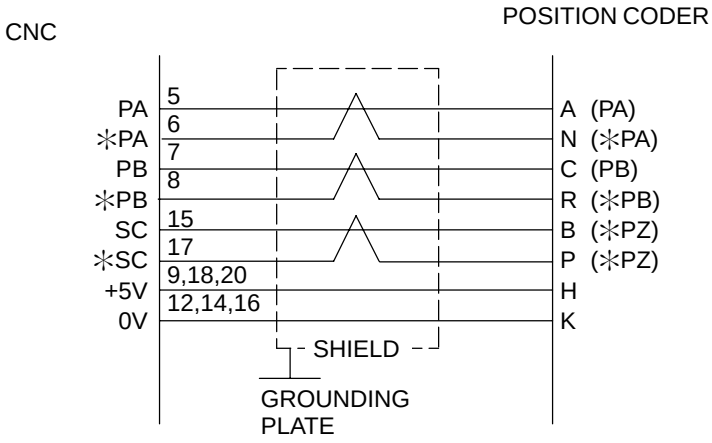
6.3 POSITION CODER INTERFACE

CNC

JA41(Main board)
(PCR–E20MD)

1	(SIN)	11	
2	(⁎SIN)	12	0V
3	(SOUT)	13	
4	(⁎SOUT)	14	0V
5	PA	15	SC
6	⁎PA	16	0V
7	PB	17	⁎SC
8	⁎PB	18	+5V
9	+5V	19	
10		20	+5V

Signal Name	Description
⁎SC	Position coder phase C signals
PA, ⁎PA	Position coder phase A signals
PB, ⁎PB	Position coder phase A signals
SOUT, ⁎SOUT SIN, ⁎SIN	Serial spindle signals (Note)

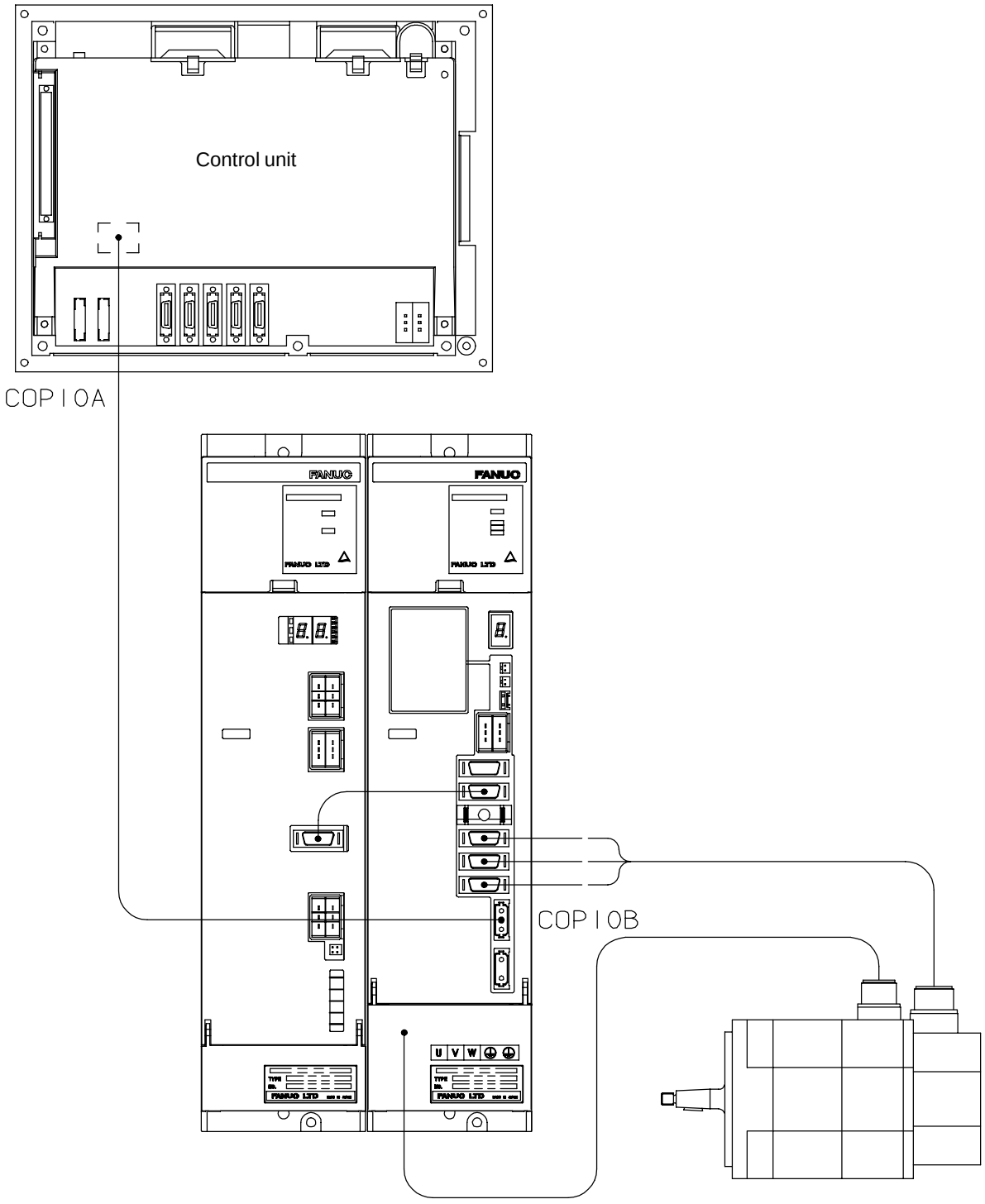


RECOMMENDED CABLE–SIDE CONNECTOR
PCR–E20FA (Honda Tsushin Kogyo Co., Ltd.)
FI30–20S (Hirose Electric Co., Ltd.)
FCN–247J020–G/E (Fujitsu, Ltd.)
52622–2011 (Molex Japan Co., Ltd.)
RECOMMENDED CABLE SPECIFICATION:
A66L–0001–0286 (#20AWG × 6 + #24AWG × 3),
MAX. LENGTH 20 m

NOTE
1 Signals SIN, ⁎SIN, SOUT and ⁎SOUT are for a serial spindle. These signals are not used for an analog spindle.
2 As the connector on the cable side, the solder–type 15–pin connector (FI40B–2015S, or conventional FI40–2015S) manufactured by Hirose Electric cannot be used.
3 The upper connector specification of JA41 is used with the LCD–mounted type *i* Series CNC. The lower connector specification (in parentheses) is used with the stand–alone type *i* Series CNC.
4 The recommended cable connector FI30–20S (manufactured by Hirose Electric) cannot be used for the stand–alone type *i* Series CNC.

7 SERVO INTERFACE

7.1 CONNECTION TO THE SERVO AMPLIFIERS



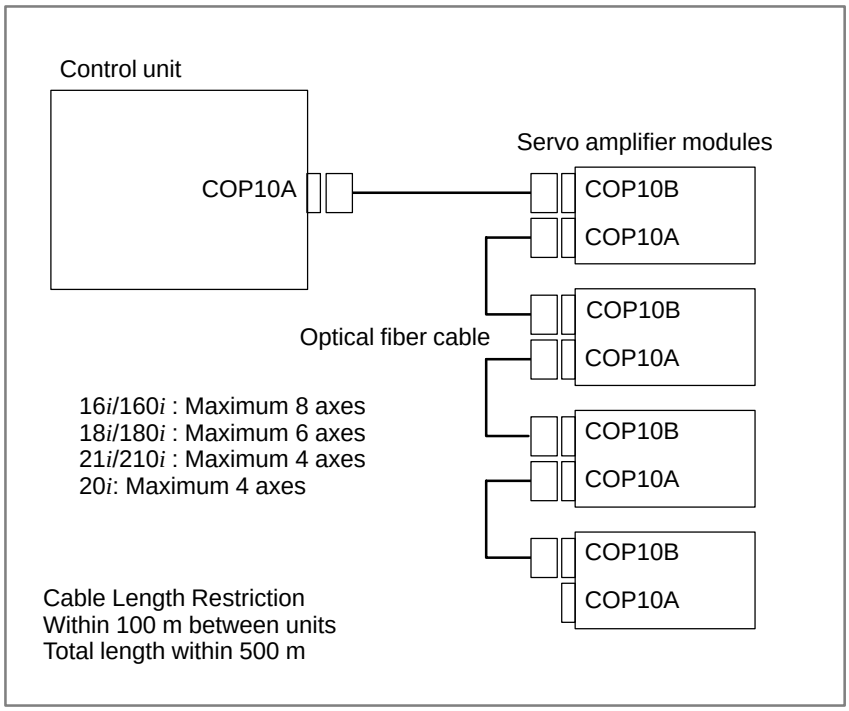
This figure is an example of connecting to an *i* Series CNC with a LCD–mounted type panel.

Connection of FSSB

7.1.1 General

This chapter describes how to connect the servo units to the Series 21*i*/210*i* control unit. For details of the connection of the Servo amplifier α Series Descriptions (B–65162E), refer to the relevant manual.

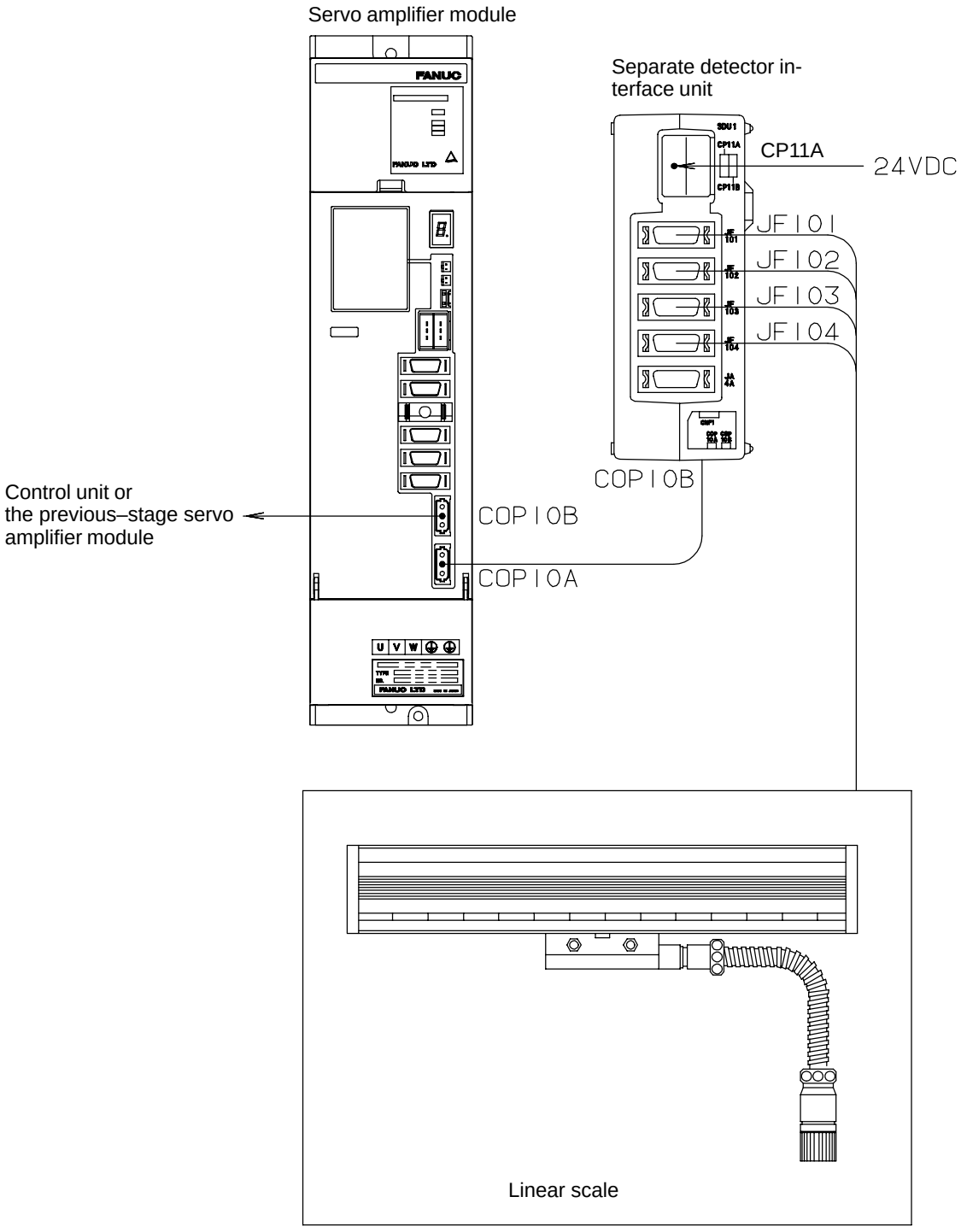
7.1.2 Interface to the Servo Amplifiers



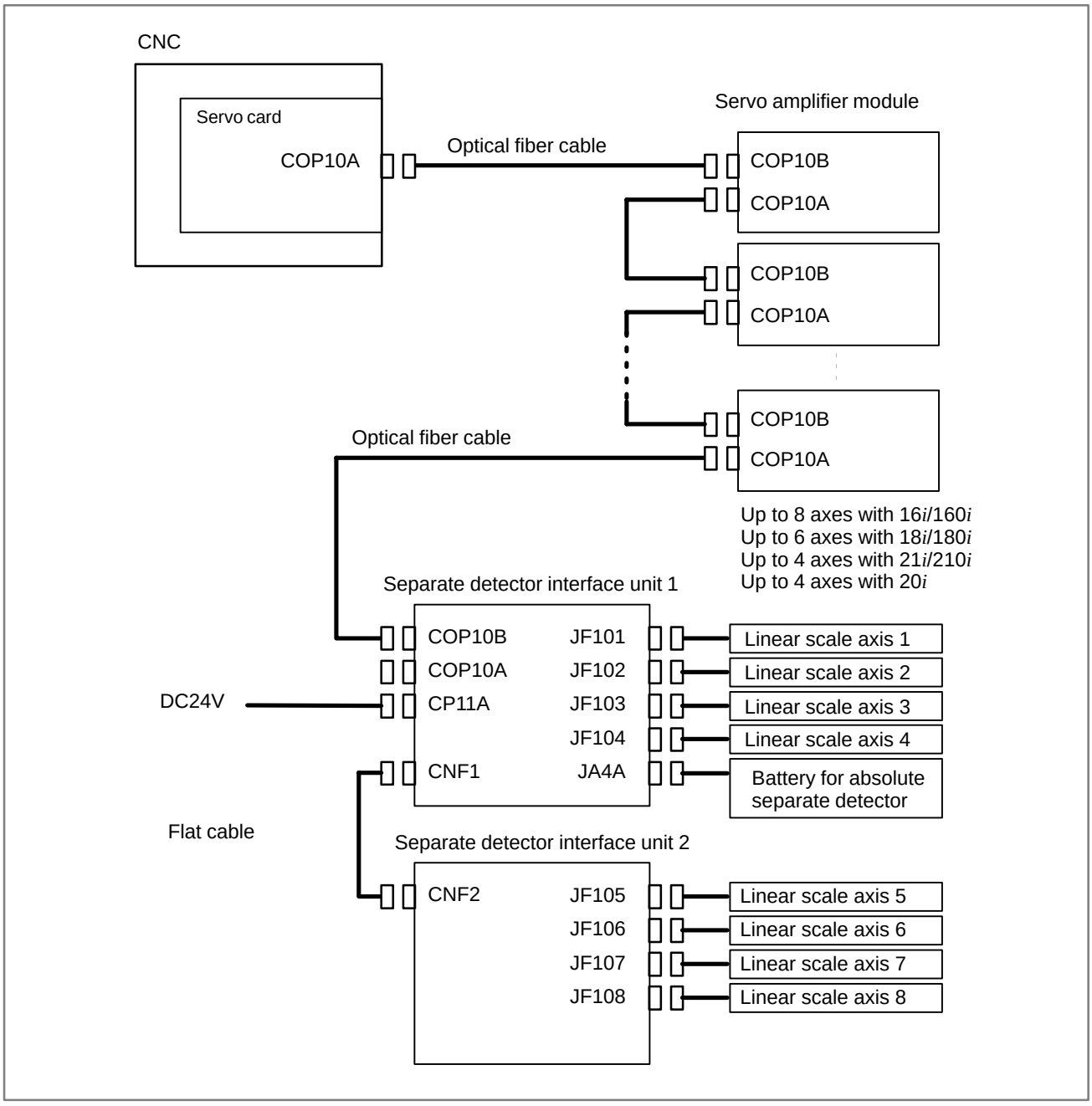
The connection between the CNC control unit and the servo amplifiers should use only one optical fiber cable, regardless of the number of controlled axes. See APPENDIX D for details on the optical fiber cable.

In the control unit, the COP10A connector is placed on the servo card installed on the main board. When a sub–CPU card is used, COP10A is placed on the servo card installed on the sub–CPU board as well.

7.1.3 Separate Detector Interface



This figure is an example of connecting the I/O Link to an *i* Series CNC with a LCD–mounted type panel.



When a separate pulse coder or linear scale is used, a separate detector interface unit, as shown above, is required. The separate detector interface unit should be connected to the CNC control unit through an optical fiber cable, as one of the units on the servo interface (FSSB). Although the above figure shows the separate detector interface connected in the final stage of the FSSB line, it can also be connected, at the nearest location, to the CNC control unit. Or, it can be installed between two servo amplifier modules.

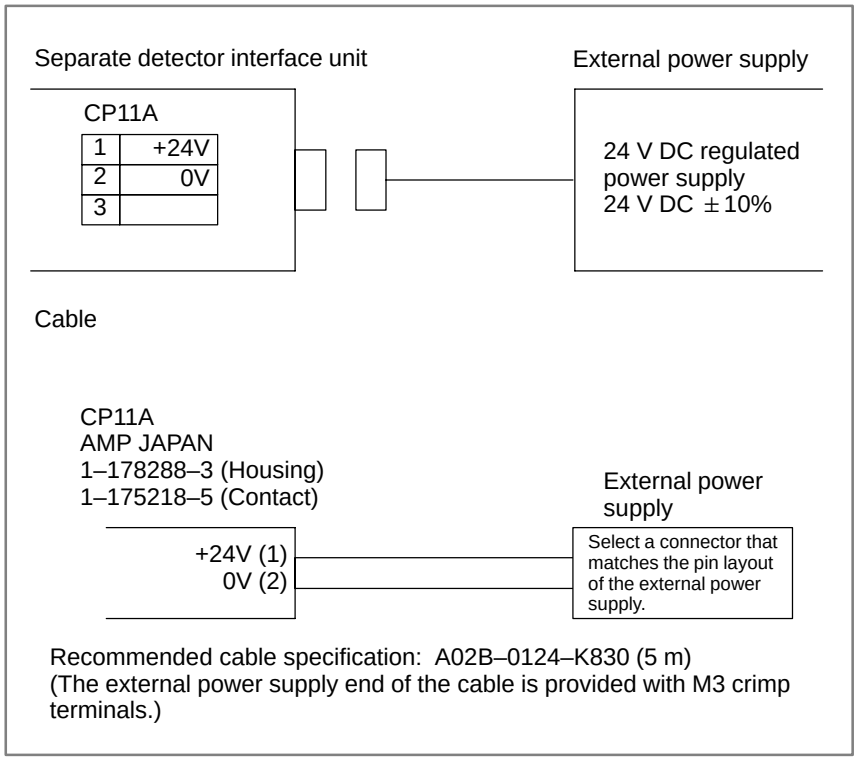
7.1.4 Separate Detector Interface Unit Specification

Usually, the separate detector corresponding to a servo motor for each of the first to eighth axes is connected to each of separate detector interfaces JF101 to JF108. If necessary, the controlled axis numbers corresponding to JF101 to JF108 can be changed. For example, when separate detectors are to be used only for the second, fourth, sixth, and eighth controlled axes in the above figure, JF101 to JF104 of the basic interface unit can be assigned to these controlled axes, thus eliminating the need to use an expansion unit. The interface unit can feed 0.35 A (5 V) to each separate detector.

Item	Specification
Power supply capacity	Voltage 24 VDC ±10% Current 0.9 A (basic unit only) 1.5 A (basic unit + expansion unit)
Ordering information	A02B–0236–C203 (basic) A02B–0236–C204 (expansion)
Method of installation	An interface unit can be installed by using screws or a DIN rail.

7.1.5 Connection of Power Supply

Power to the separate detector interface unit should be supplied from an external 24 V DC power supply.



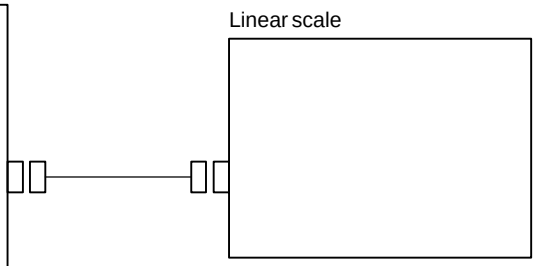
The 24 V DC input to CP11A can be output at CP11B for use in branching. The connection of CP11B is identical to that of CP11A. In this case, the power supplied to CP11A should be equal to the sum of the rating of the separate detector interface unit and that of the units after CP11B.

7.1.6 Linear Scale Interface

Separate detector interface unit

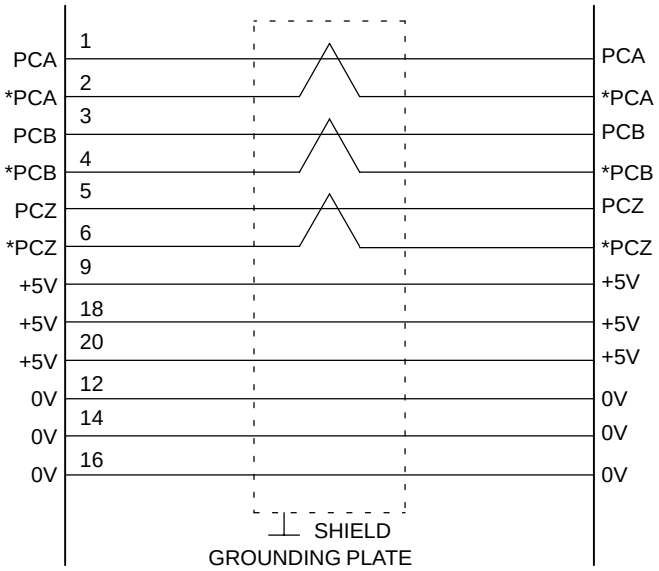
JF101 to JF104
(PCR–EV20MDT)

1	PCA	11	
2	*PCA	12	0V
3	PCB	13	
4	*PCB	14	0V
5	PCZ	15	
6	*PCZ	16	0V
7	(+6V)	17	
8	(REQ)	18	+5V
9	+5V	19	
10		20	+5V



+6V and REQ are for separate absolute pulse coders.

Cable wiring



RECOMMENDED CABLE MATERIAL

A66L–0001–0286 (#20AWG × 6 + #24AWG × 3–pair)

Recommended connectors:
PCR–E20FA (Honda Tsushin Kogyo)
FI30–20S (Hirose Electric)
FCN–247J020–G/E (Fujitsu)
52622–2011 (Molex)
FI40B–2015S (Hirose Electric)

NOTE

The +5V signals above can be used to feed power to the linear scales. The supply current per linear scale is 0.35 A maximum.

7.1.7 Stand–alone Type Pulse Coder Interface

- **For absolute detector**

Separate detector interface unit

JF101 to JF108
(PCR–EV20MDT)

1	PCA	11	
2	*PCA	12	0V
3	PCB	13	
4	*PCB	14	0V
5	PCZ	15	
6	*PCZ	16	0V
7	+6V	17	
8	REQ	18	+5V
9	+5V	19	
10		20	+5V

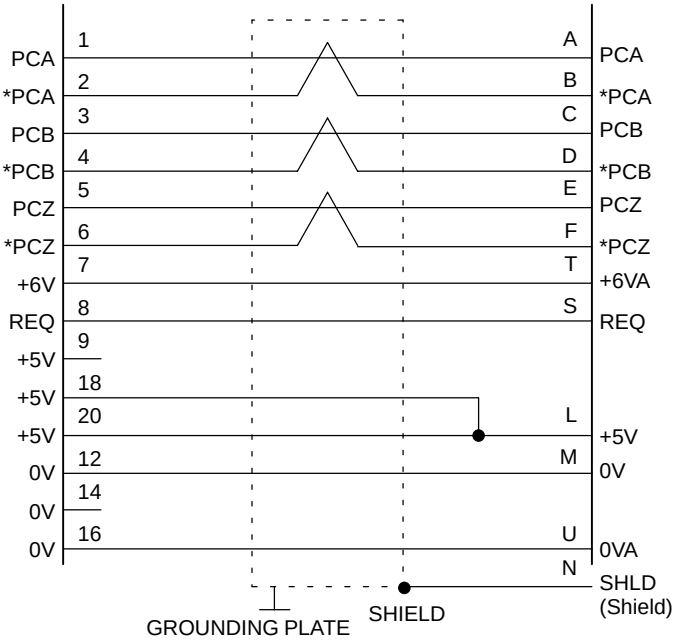
Stand–alone type detector

Pulse coder
(MS3102A–22–14P)

A	PCA	B	*PCA	C	PCB	D	*PCB
E	PCZ	F	*PCZ	G		H	
J		K		L	+5V	M	0V
N	SHLD	P		R		S	REQ
T	+6VA	U	0VA	V			

MS3106B22–14S

Cable wiring



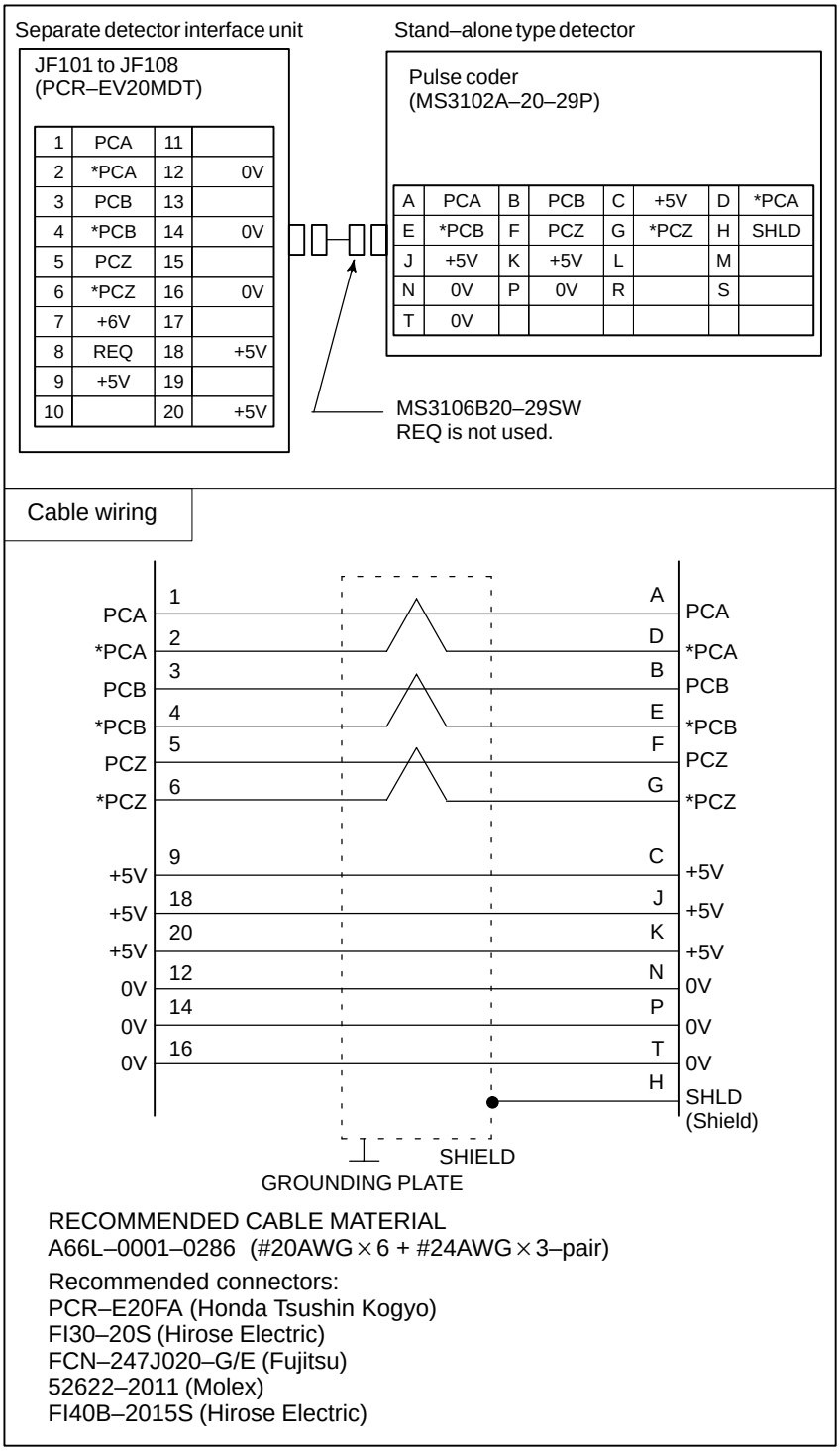
RECOMMENDED CABLE MATERIAL
A66L–0001–0286 (#20AWG × 6 + #24AWG × 3–pair)

Recommended connectors:
PCR–E20FA (Honda Tsushin Kogyo)
FI30–20S (Hirose Electric)
FCN–247J020–G/E (Fujitsu)
52622–2011 (Molex)
FI40B–2015S (Hirose Electric)

NOTE
The +5V signals above can be used to feed power to linear scales. The supply current per linear scale is 0.35 A maximum.

(Parallel interface)

- **For incremental detector**



RECOMMENDED CABLE MATERIAL
A66L–0001–0286 (#20AWG × 6 + #24AWG × 3–pair)

Recommended connectors:
PCR–E20FA (Honda Tsushin Kogyo)
FI30–20S (Hirose Electric)
FCN–247J020–G/E (Fujitsu)
52622–2011 (Molex)
FI40B–2015S (Hirose Electric)

NOTE
The +5V signals above can be used to feed power to linear scales. The supply current per linear scale is 0.35 A maximum.

(Serial interface)

Separate detector interface unit

JF101AJF108
(PCR–EV20MDT)

1	SD	11	
2	⁎SD	12	0V
3		13	
4		14	0V
5	REQ	15	
6	⁎REQ	16	0V
7	+6V	17	
8		18	+5V
9	+5V	19	
10		20	+5V

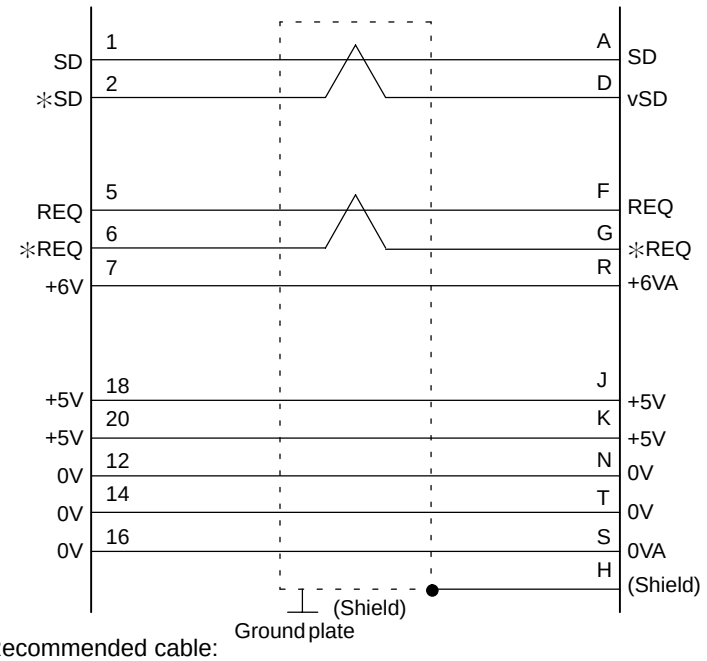
Separate detector

Pulse coder

A	SD	B		C		D	⁎SD
E		F	REQ	G	REQ	H	SHLD
J	+5V	K	+5V	L		M	
N	0V	P		R	+6VA	S	0VA
T	0V						

MS3106B20–29SW

Cable connection



Recommended cable:
A66L–0001–0266 (#20AWG × 6 + #24AWG × 3 pairs)

Recommended connector:
PCR–E20FA (Honda Tsushin Kogyo)
FI30–20S (Hirose Electric)
FCN–247J020–G/E (Fujitsu)
52622–2011 (Molex Japan)
FI40B–2015S (Hirose Electric)

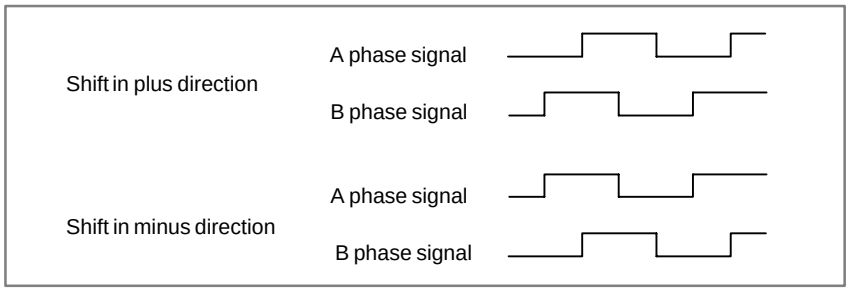
NOTE
The +5V signals above can be used to feed power to linear scales. The supply current per linear scale is 0.35 A maximum.

7.1.8 Input Signal Requirements

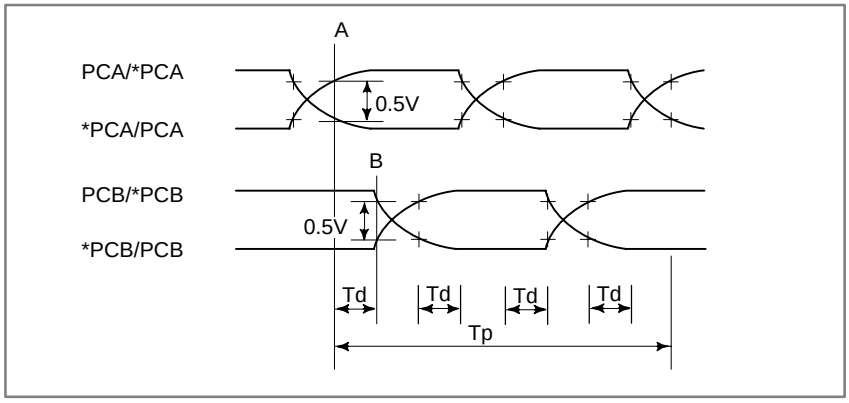
The standard of the feedback signal from the additional detector is as shown below.

(1) A and B phase signal input

This is a method to input position information by the mutual 90 degree phase slip of A and B phase signals.
Detection of the position is performed with the state in which the B phase is leading taken as a shift in the plus direction, and the state in which the A phase is leading as a shift in the minus direction.

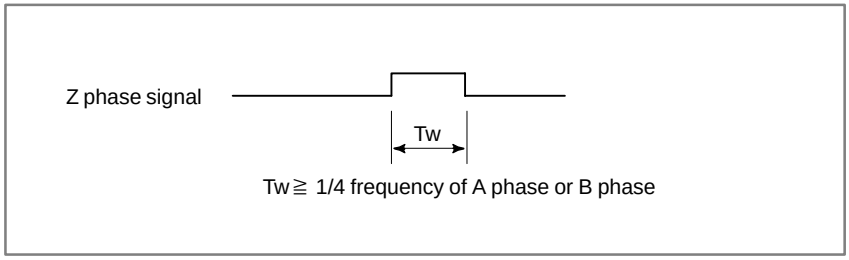


(2) Phase difference and minimum repeat frequency



(3) Z phase signal input

For the Z phase signal (1 rotation signal), a signal width of more than 1/4 frequency of the A phase or B phase signals is necessary.



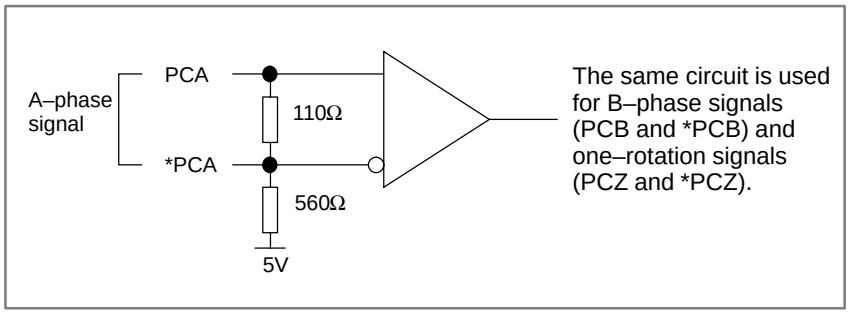
Time requirements

Requirements for the signals at the input pins of input connectors JF101 to JF104.

TD ≧ 0.15 μsec

The signals for these connectors are differential input signals with A and B phases. An important factor is time TD from point A, when the potential difference between PCA and *PCA exceeds 0.5V, to point B, when the potential difference between PCB and *PCB becomes lower than 0.5V. The minimum value of TD is 0.15 μs. The period and pulse width of the signals must be long enough to satisfy the above requirements.

Receiver circuit



Relationship between the direction of rotation of the servo motor and that of the separate pulse coder

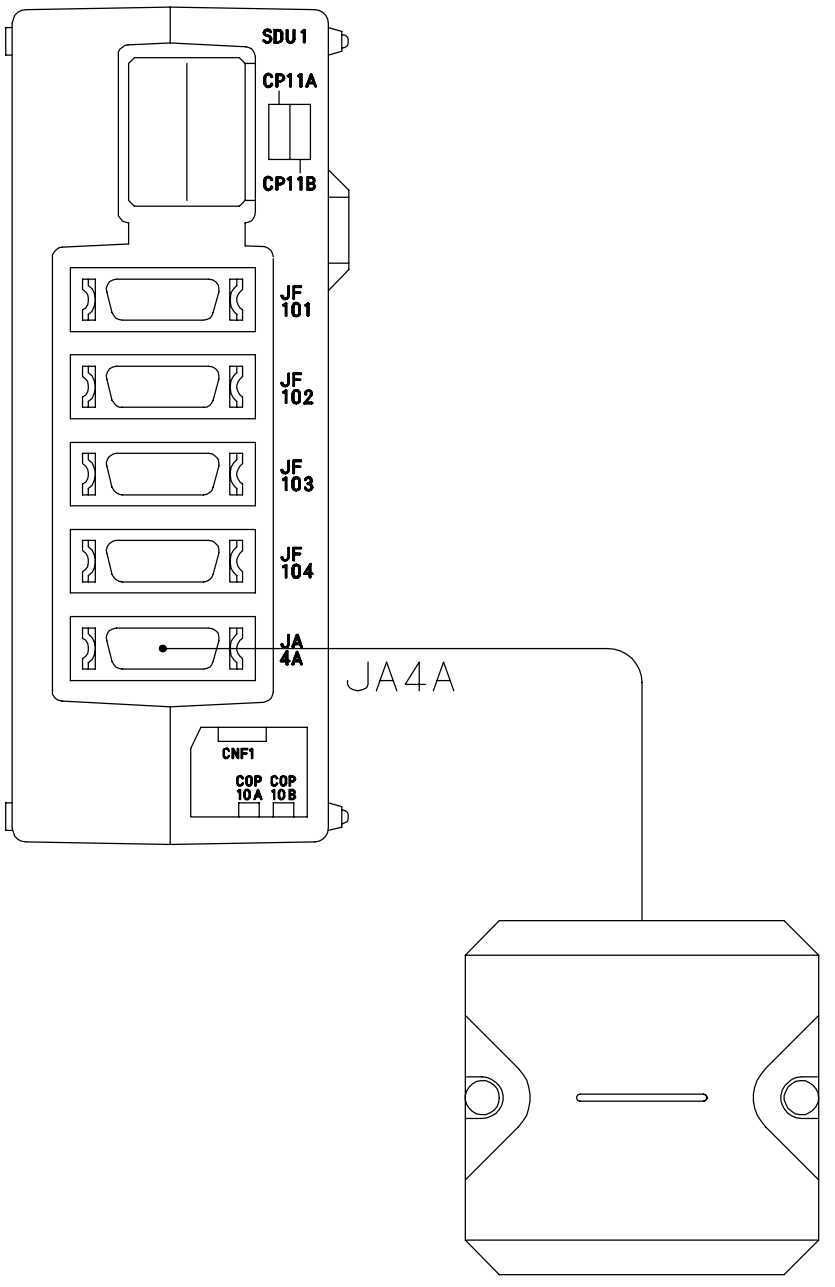
If the separate pulse coder rotates in the opposite direction to that of the servo motor, reconnect the interface cable of the separate pulse coder as described below.

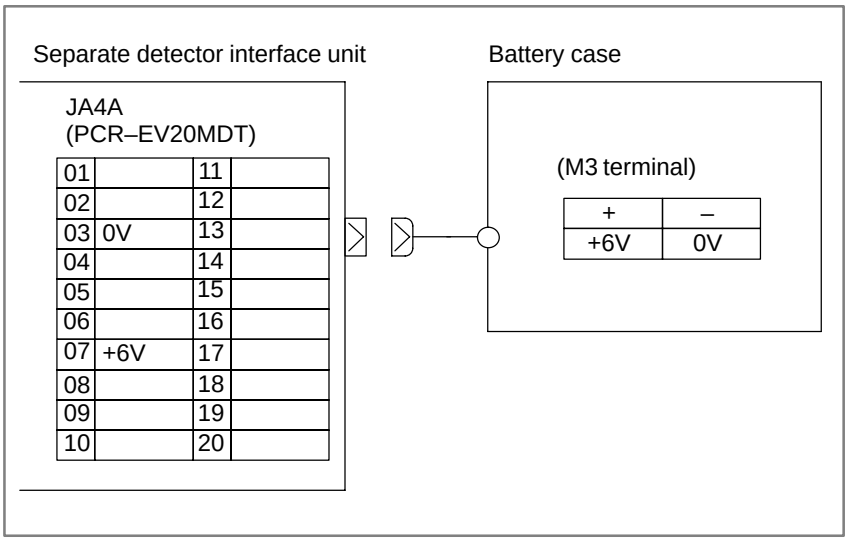
(1) Exchange signal PCA with signal PCB.

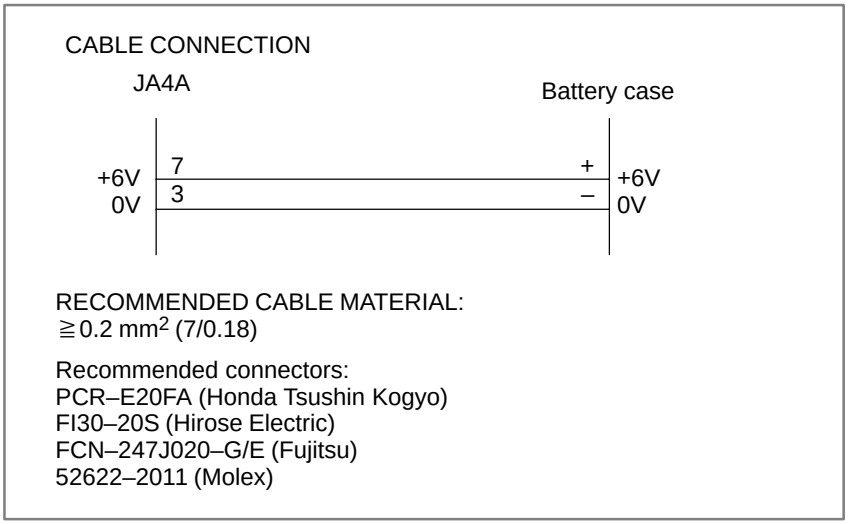
(2) Exchange signal *PCA with signal *PCB.

7.1.9 Connection of Battery for Separate Absolute Detector

Separate detector interface unit







RECOMMENDED CABLE MATERIAL:
$\geqq 0.2\ mm^2$ (7/0.18)

Recommended connectors:
PCR–E20FA (Honda Tsushin Kogyo)
FI30–20S (Hirose Electric)
FCN–247J020–G/E (Fujitsu)
52622–2011 (Molex)

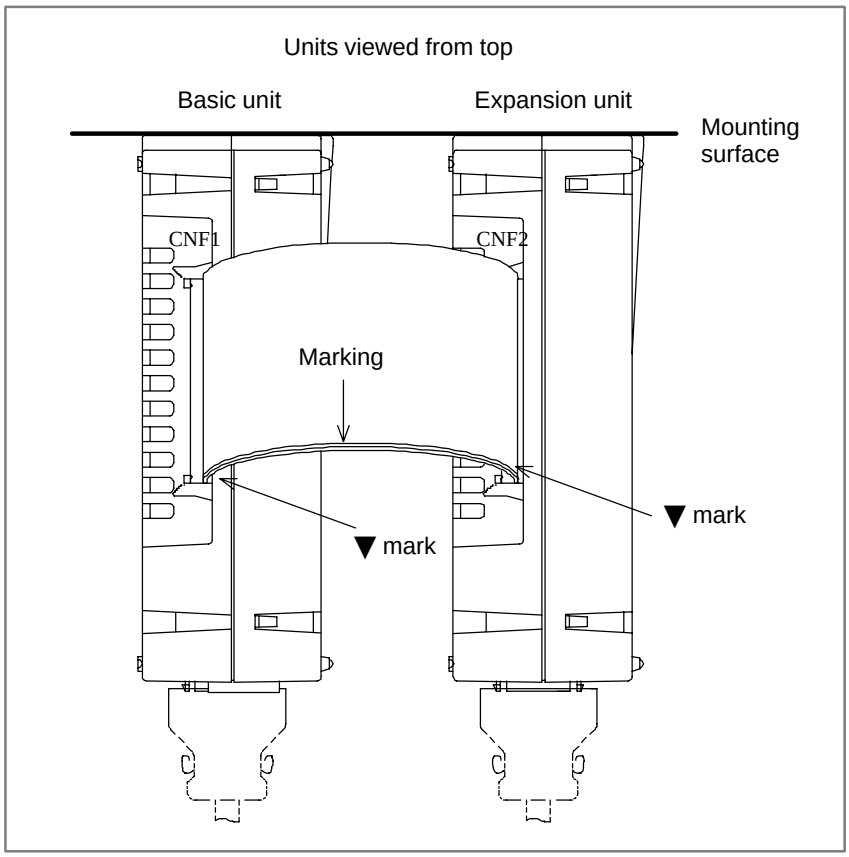
NOTE

The battery for the separate absolute detector is required only when the separate absolute detector is used. When an absolute pulse coder with built–in motor is used, it is powered by the built–in battery of the amplifier, such that the battery for the separate absolute detector is not required.

7.1.10 Connection Between the Basic Unit and Expansion Unit

A flat cable is used to make a connection between the basic unit and expansion unit as shown below.

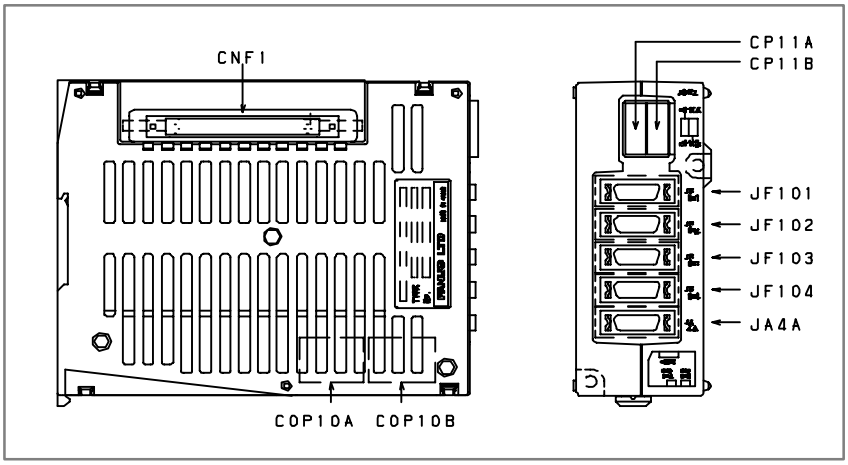
A flat cable not longer than 100 mm must be used.



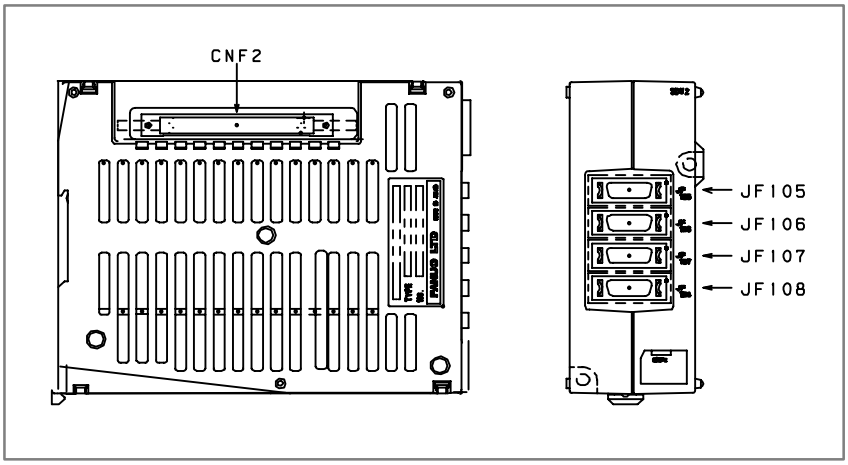
Place an order on a flat cable together with separate detector interface units.

7.1.11 Connector Locations

Connector locations on the basic unit



Connector locations on the expansion unit



For the outside dimensions, see Appendix A.

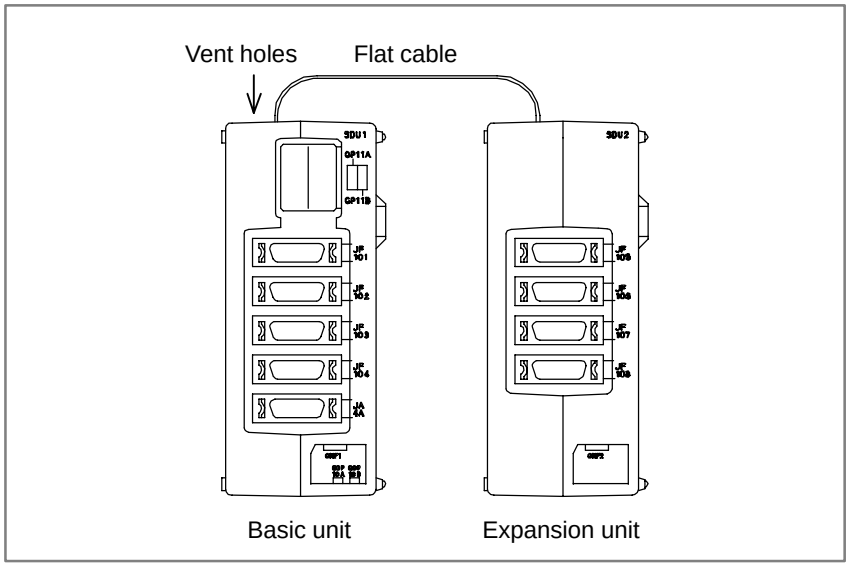
7.1.12 Installation

1) Notes on installation

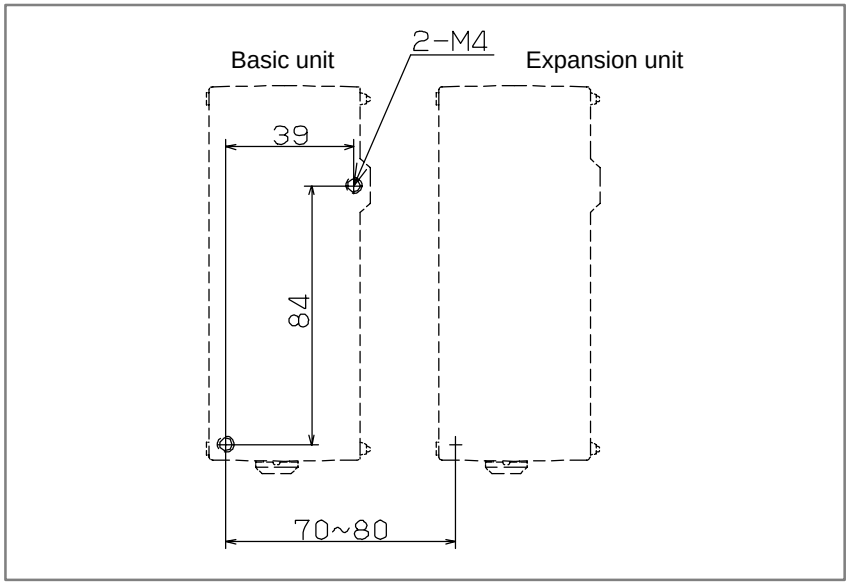
(1) Use an interface unit in a completely enclosed cabinet.

(2) Install an interface unit on a vertical surface, and provide a space of 100 mm above and below the unit. Below an interface unit, do not place equipment that generates a large amount of heat.

(3) When using a basic unit and expansion unit, place the units as shown below so that the flat cable connecting the units does not block the vent holes. A flat cable not longer than 100 mm must be used.



2) Installation using screws

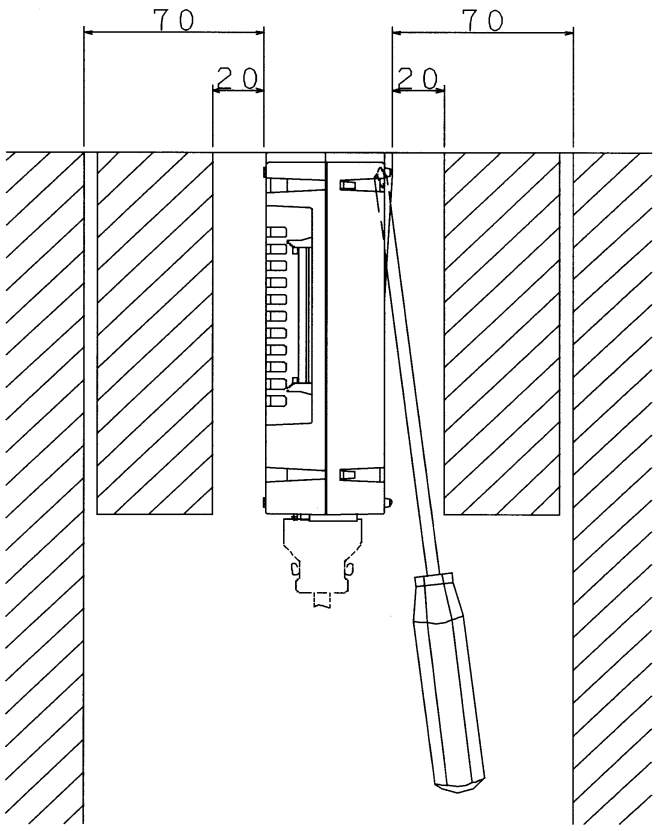


When using both a basic unit and expansion unit, install the units as shown above, with the mounting holes horizontally separated by 70 to 80 mm.

7.1.13 Notes on Installing a Separate Detector Interface Unit

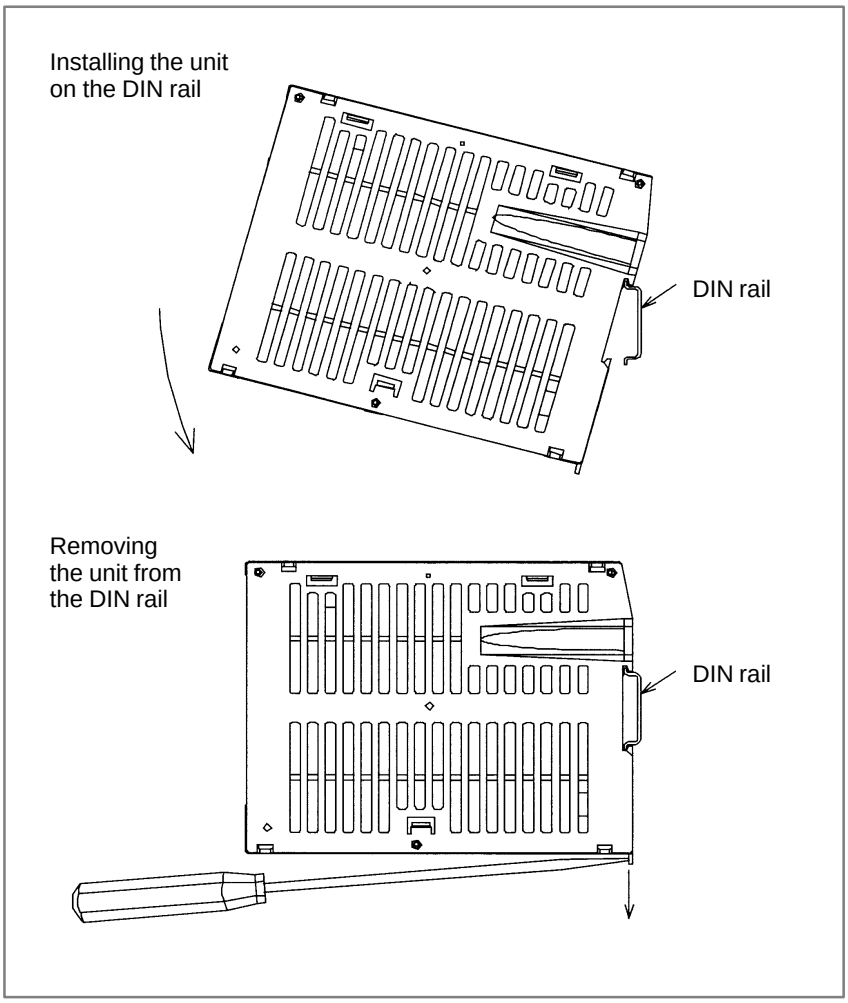
CAUTION

To install/remove the unit, a screwdriver must be inserted obliquely. So, sufficient access clearances are required on both sides of the unit. As a guideline, if the front of an adjacent unit appears flush with the unit or slightly set back, allow a clearance of about 20 mm between the unit and the adjacent unit. If the front of an adjacent unit protrudes beyond the front of the unit, allow a clearance of about 70 mm between the unit and the adjacent unit. Also, when installing the unit near a side of the cabinet, allow a clearance of about 70 mm between the unit and the side of the cabinet.



Access clearance near a separate detector interface unit

Installing the unit on the DIN rail



Installing the unit:

1. Hook the unit on the top of the DIN rail.
2. Push the unit in until it clicks.

Removing the unit:

1. Push down the lock by using a screwdriver.
2. Remove the unit by pulling the lower end of the unit towards you.

CAUTION

When removing the unit, be careful not to damage the lock by applying excessive force. When installing and removing the unit, hold the upper and lower ends of the unit so that stress is not applied to the side (that surface with the slits) of the unit.

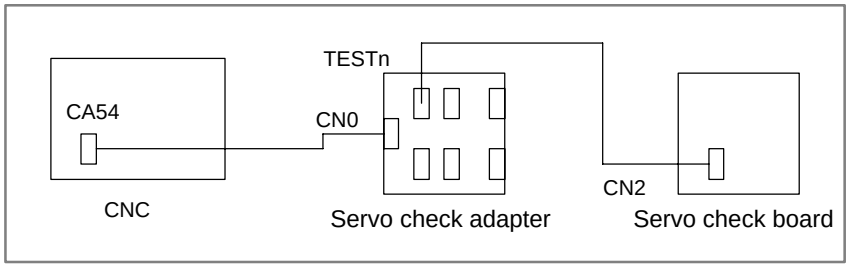
7.1.14 Connecting the Servo Check Adapter

The servo check connectors used with the *i* Series are not compatible with the conventional types. So, to connect the servo check board (board unit: A16B–1600–0320) or interface board for automatic adjustment (board unit: A16B–2300–0170, Unit: A06B–6057–H620) with the *i* Series, a new servo check adapter (board unit: A20B–1007–0240) and special cable (A660–2042–T154) are required. (The ordering information for the servo check adapter and cable is A02B–0236–K822.)

Examples of connection

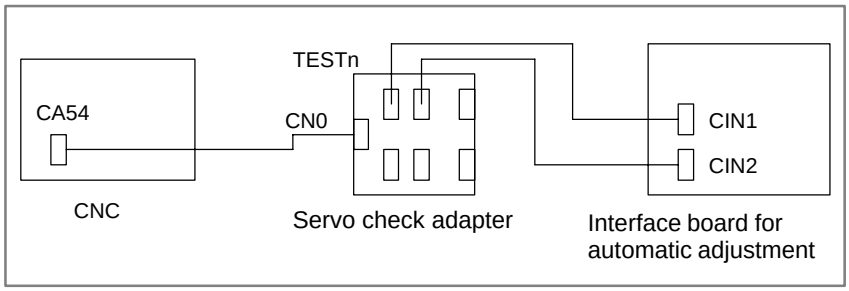
When the servo check board is used

Connect TEST0–3 with CN2 of the servo check board via the currently used flat cable.

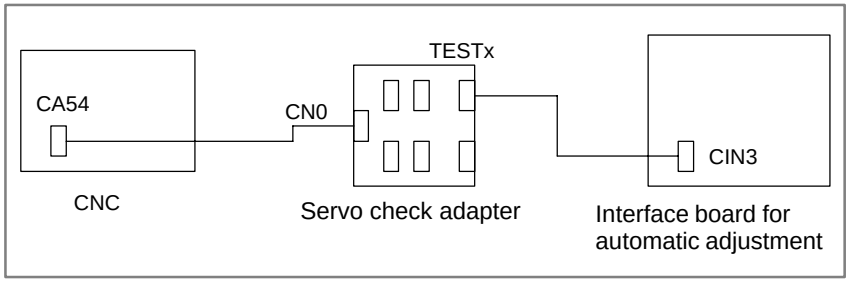


When the interface board for automatic adjustment is used

A) Connect TEST0–3 with CIN1/2 of the interface board for automatic adjustment via a currently used flat cable.



B) Connect TESTA/B with CIN3 of the interface board for automatic adjustment via a straight cable (such as A660–2042–T007#*****).



NOTE
In any case, use the special cable (A660–2042–T154) to connect CN0 with CA54 on the mother board of the CNC.

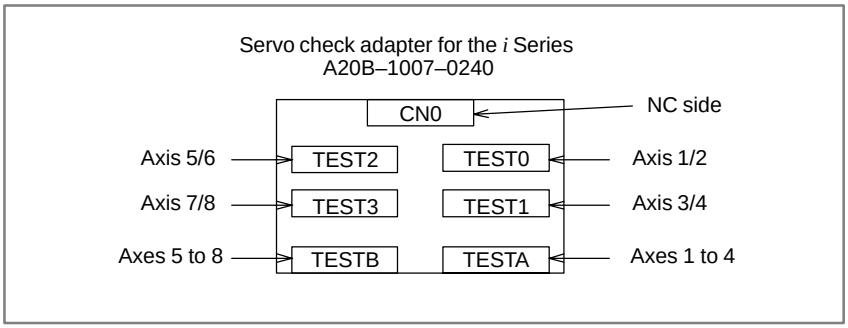
Axis signal output

Connector	Controlled axis number(*1)
TEST0	1/2
TEST1	3/4
TEST2	5/6
TEST3	7/8

Connector	Controlled axis number(*1)
TESTA	1/2/3/4
TESTB	5/6/7/8

(*1) The correspondence between the controlled axis numbers and servo axis numbers depends on the setting of parameter No. 1023.

Connector locations



Pin diagram

CN0

1	GND	11	GND
2	CLKX0	12	CLKX1
3	GND	13	GND
4	FSX0	14	FSX1
5	DX2	15	DX3
6	DX0	16	DX1
7	CLKX2	17	–15V
8	FSX2	18	+5V
9	CLKX3	19	+15V
10	FSX3	20	+5V

TEST0–3

A1	+5V	B1	GND
A2	CLKXn	B2	GND
A3	FSXn	B3	GND
A4	DXn	B4	GND
A5		B5	+5V
A6		B6	+15V
A7		B7	–15V
A8		B8	GND

TESTA/TESTB

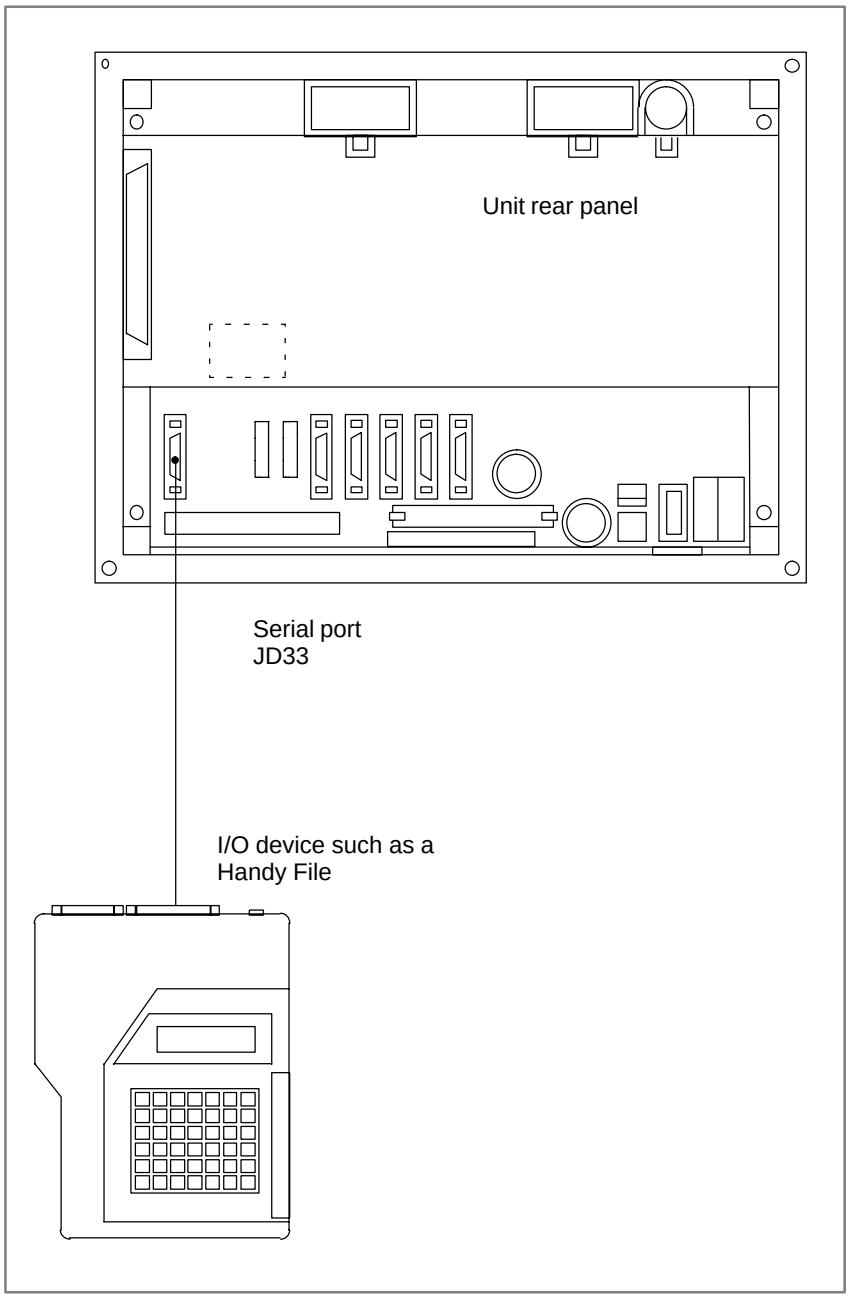
1	GND	11	GND
2	CLKX0/2	12	CLKX1/3
3	GND	13	GND
4	FSX0/2	14	FSX1/3
5	GND	15	GND
6	DX0/2	16	DX1/3
7		17	–15V
8		18	+5V
9		19	+15V
10		20	+5V

8 CONNECTING THE PC INTERFACE

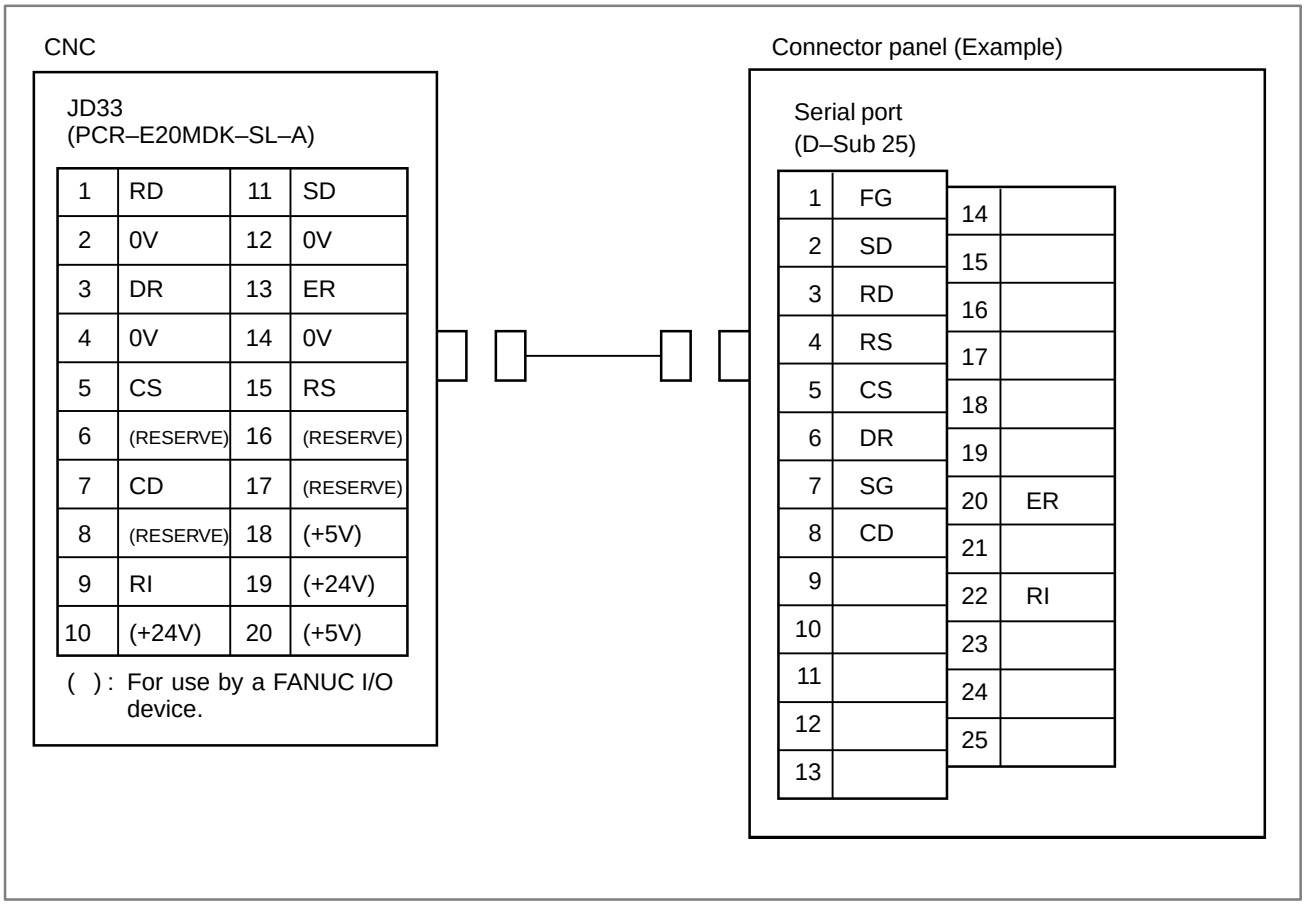
8.1 GENERAL

The control unit of LCD–mounted type Series 160*i*/180*i*/210*i* models incorporates PC functions. This chapter describes how to connect the PC function interface.

8.2 CONNECTION OF SERIAL PORT



The connector shown below is the RS–232–C serial port on the personal computer side. With the Series 210*i* control unit with PC functions, parameters and programs are input and output through the RS–232–C serial port of the personal computer. When the touch panel function is used, however, this interface is used by the touch panel, so parameters and programs should be input and output through the 2nd channel of the serial port on the personal computer side, which is located on the PC interface connector unit described in Section 8.7.



1	RD	11	SD
2	0V	12	0V
3	DR	13	ER
4	0V	14	0V
5	CS	15	RS
6	(RESERVE)	16	(RESERVE)
7	CD	17	(RESERVE)
8	(RESERVE)	18	(+5V)
9	RI	19	(+24V)
10	(+24V)	20	(+5V)

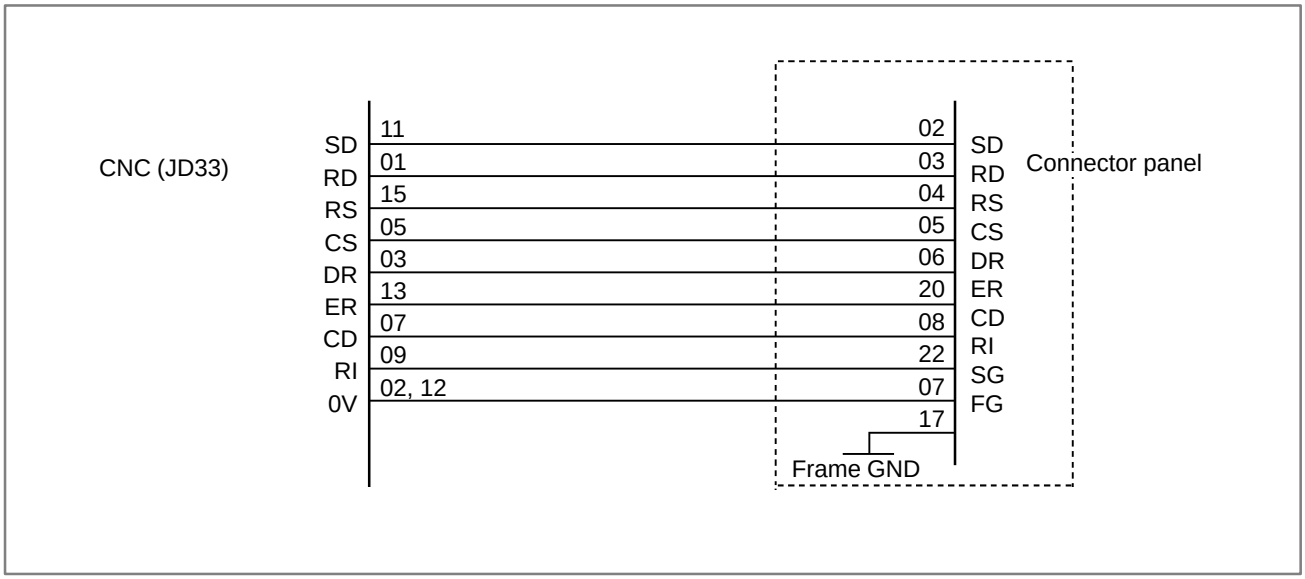
( ) : For use by a FANUC I/O device.

1	FG	14	
2	SD	15	
3	RD	16	
4	RS	17	
5	CS	18	
6	DR	19	
7	SG	20	ER
8	CD	21	
9		22	RI
10		23	
11		24	
12		25	
13			

NOTE

1 The +24 V power of the interface shown in the above figure is exclusively for use by a FANUC I/O device (FANUC Cassette, FANUC Handy File, etc.). Do not use it for any other purpose. Also, do not connect more than one FANUC I/O device to a CNC control unit, as the rating of the +24 V power supply may be exceeded if more than one I/O device is used simultaneously.
2 The +5 V power of the interface is for use by the touch panel. Do not use it for any other purpose.
3 When performing a DNC operation which is processed directly by the CNC, or remote diagnostics of the PMC, use the RS–232–C interface on the CNC side (JD36A, JD36B).
4 Do not connect any signal to those pins which are marked (RESERVE).

(1) Cable connection (Example)



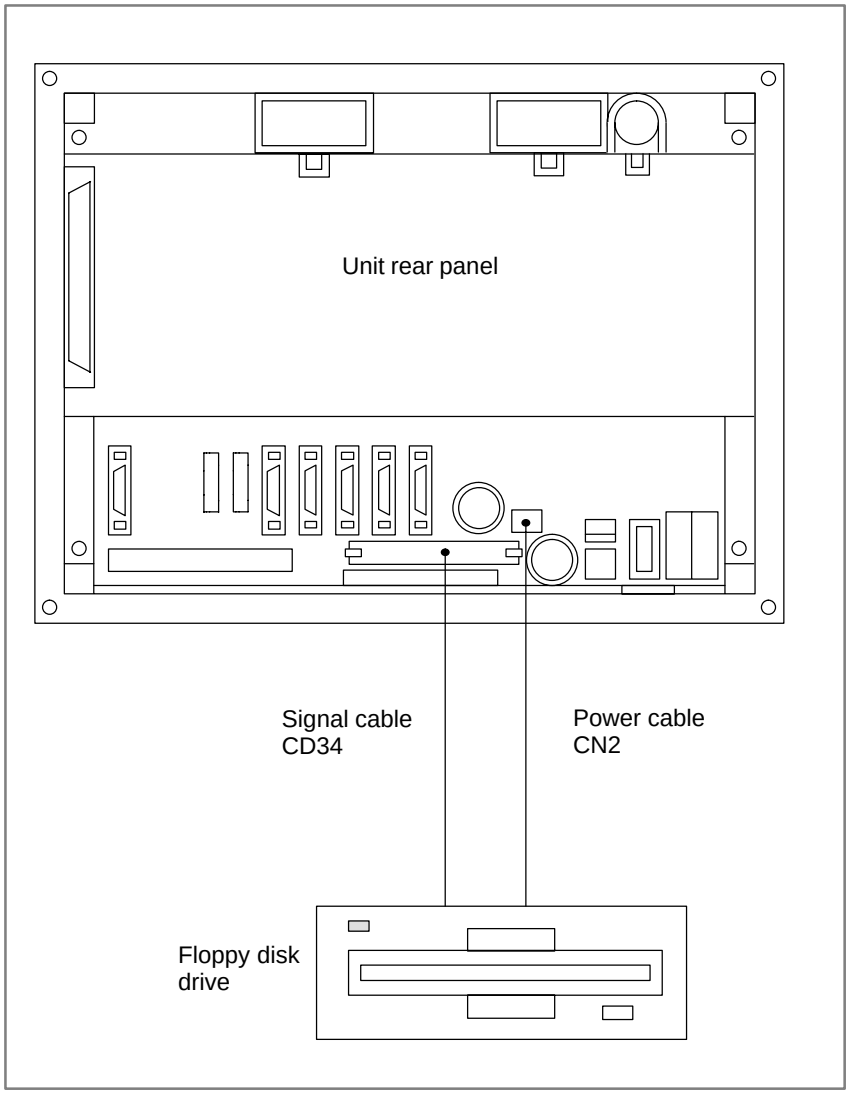
(2) Recommended cable specification

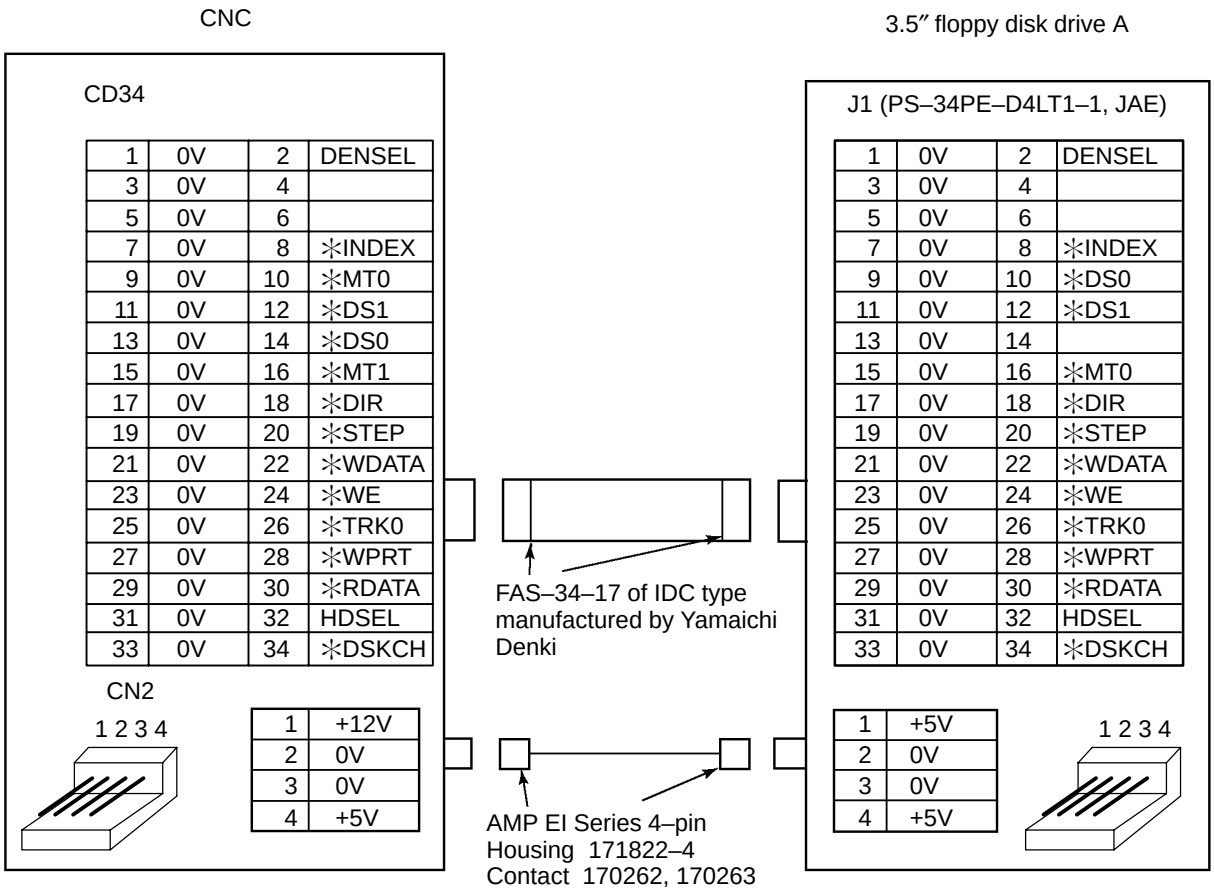
A66L–0001–0284#10P: 0.08 $mm^2 \times 10$ pairs

Recommended cable–side connector (JD33)
PCR–E20FA (Honda Tsushin Kogyo Co., Ltd.)
FI30–20S (Hirose Electric Co., Ltd.)
FCN–247J020–G/E (Fujitsu, Ltd.)
52622–2011 (Molex Japan Co., Ltd.)

NOTE
Note that the FANUC standard punch panel cannot be used with this interface.

8.3 CONNECTION OF FDDS (FLOPPY DISK DRIVES) (SIGNAL & POWER)





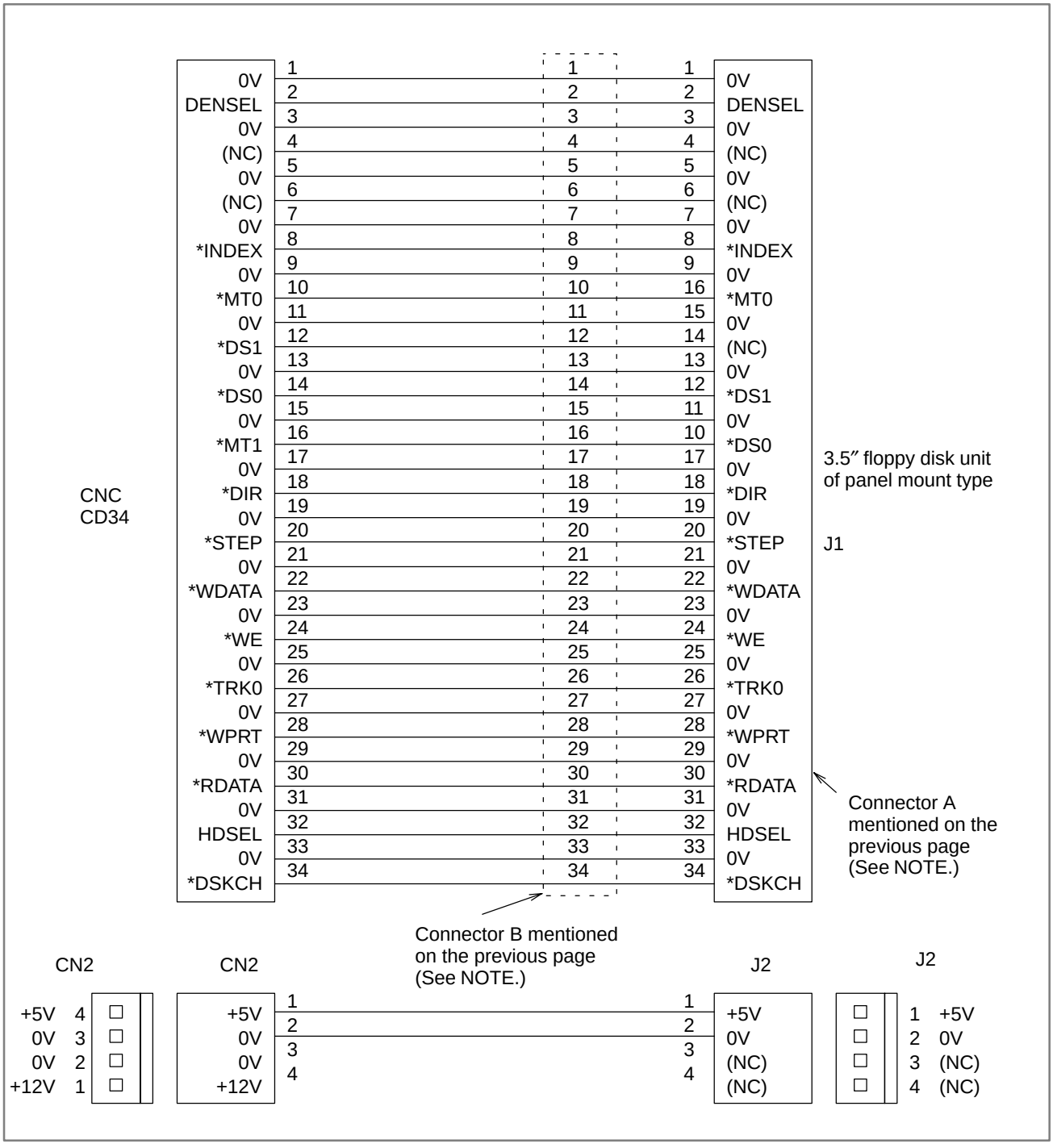
1	0V	2	DENSEL
3	0V	4	
5	0V	6	
7	0V	8	⁎INDEX
9	0V	10	⁎MT0
11	0V	12	⁎DS1
13	0V	14	⁎DS0
15	0V	16	⁎MT1
17	0V	18	⁎DIR
19	0V	20	⁎STEP
21	0V	22	⁎WDATA
23	0V	24	⁎WE
25	0V	26	⁎TRK0
27	0V	28	⁎WPRT
29	0V	30	⁎RDATA
31	0V	32	HDSEL
33	0V	34	⁎DSKCH

1	0V	2	DENSEL
3	0V	4	
5	0V	6	
7	0V	8	⁎INDEX
9	0V	10	⁎DS0
11	0V	12	⁎DS1
13	0V	14	
15	0V	16	⁎MT0
17	0V	18	⁎DIR
19	0V	20	⁎STEP
21	0V	22	⁎WDATA
23	0V	24	⁎WE
25	0V	26	⁎TRK0
27	0V	28	⁎WPRT
29	0V	30	⁎RDATA
31	0V	32	HDSEL
33	0V	34	⁎DSKCH

NOTE

1 This is an IBM PC–compatible standard interface. Particular care should be paid to the following points, however.
   (1) Only two modes (720K/1.44M bytes) can be used.
   (2) “DENSEL” is fixed to the low level.
   (3) Not all commercially available floppy disk drives require both +12 V and +5 V DC. When using a floppy disk drive which requires +12 V DC, pay careful attention to its power requirements.
2 Since many commercially available floppy disk drives perform differently with any one given personal computer, FANUC cannot guarantee all operations. Machine tool builders are requested to confirm the compatibility of each drive, and the operations that are supported. Also, be careful when using commercially available floppy disk drives because none offer dust–proof or drip–proof properties.
3 The FDD–side interface shown above is merely an example. Each cable should be designed according to the interface of the actual drive to be used.

(1) Cable connection



This is the IBM PC standard interface. Commercially available connecting cables feature wires for pins 10 to 16 that are twisted between the CNC and drive A, as shown in the above figure. When using such a cable, set the “Drive number setting pin” on drive A to “1” (second drive). Connect the floppy disk unit (A02B–0207–C006) provided by FANUC to connector A, shown above.

(2) Recommended cable specification

A02B–0207–K801: Signal cable and power cable (1.0 m long)

8.3.1 Use Environment

When this unit is to remain attached to the machine at all times, pay particular attention to the points below.

(1) Dust

The sides of the unit are all perforated, with the exception of the front door. So, place the unit in a fully sealed cabinet. Dust can enter the floppy disk unit and cabinet through the floppy disk slot. This means that floppy disk failures are more likely to occur in a dusty environment.

(2) Temperature

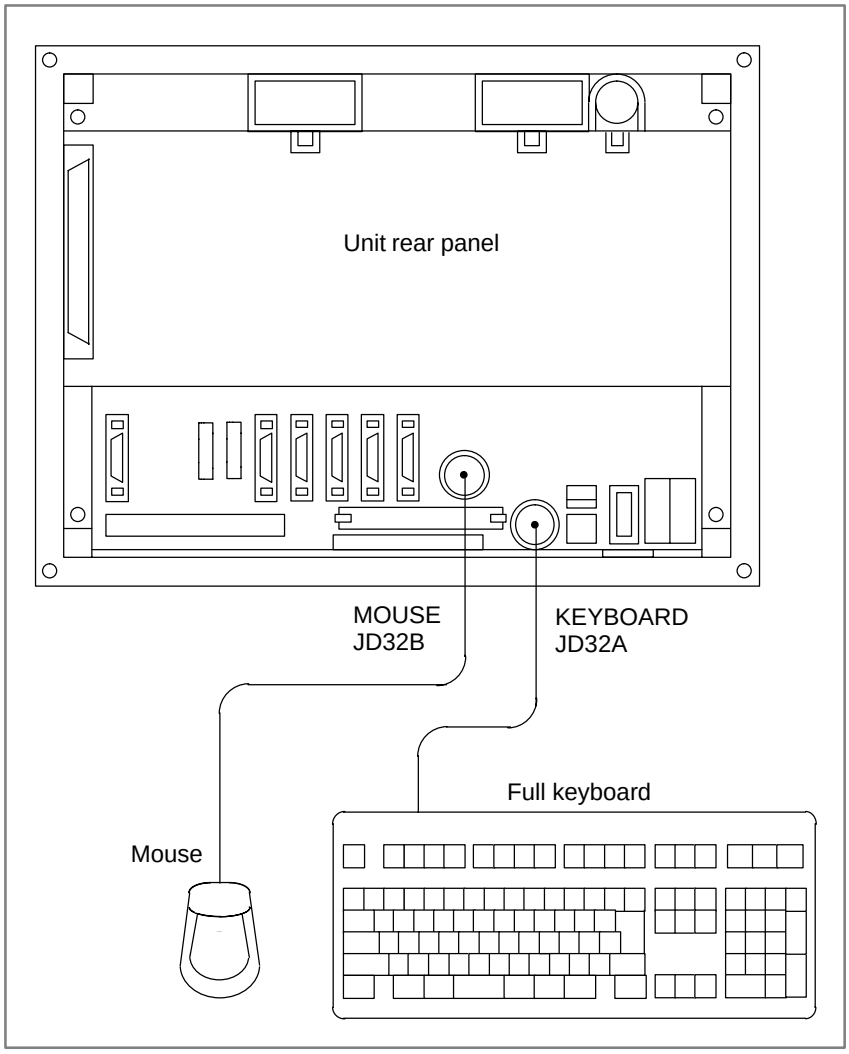
+5°C to +45°C (operating)

The ambient temperature requirements for this unit are severer because of the restrictions imposed by the floppy disk unit. So, pay special attention to the method of cooling. Providing an air flow directly from a cooling fan is not recommended because dust can build up.

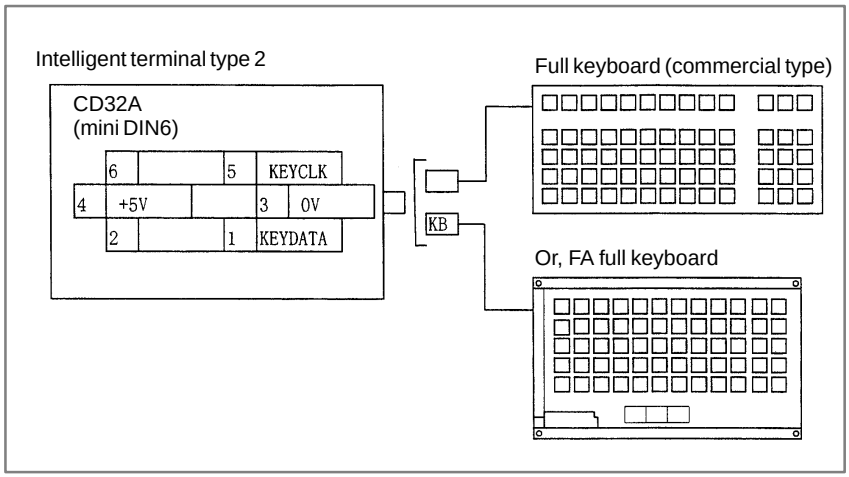
8.3.2 Caution

Never turn off the power while a floppy disk is inserted and particularly while the inserted floppy disk is being accessed (while the LED is lit). This caution should be conveyed to the end users.

8.4 CONNECTION TO THE FULL–KEYBOARD AND MOUSE



8.4.1 Full Keyboard



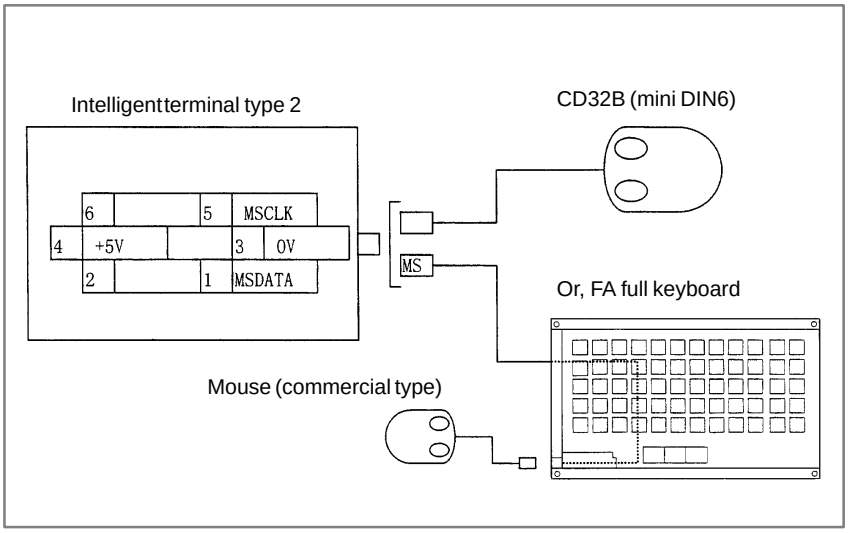
NOTE
1 Commercially available full keyboards are designed for use with a personal computer. Such commercial keyboards can not always guarantee all required operations, therefore. The machine tool builder should check this point carefully beforehand.
Usually, protection against dust and moisture is not provided by commercial full keyboards. This should also be considered by the machine tool builder.

1) Recommended full keyboard

A86L–0001–0210 . . . . . 101–type commercial type
. . . . . Dedicated to development and maintenance
A86L–0001–0211 . . . . . 101–type commercial type
. . . . . Dedicated to development and maintenance
A02L–0236–C130#JC . . FA full keyboard (Japanese)
A02B–0236–C130#EC . . FA full keyboard (English)
. . . . . LCD–mounted type full keyboard dedicated to the *i* Series CNC

NOTE
2 When using an FA full keyboard that is integrated into the system, clamp the cable at a point as close as possible to the connector so that the weight of the cable is not directly applied to the connector joint.

8.4.2 Mouse



NOTE

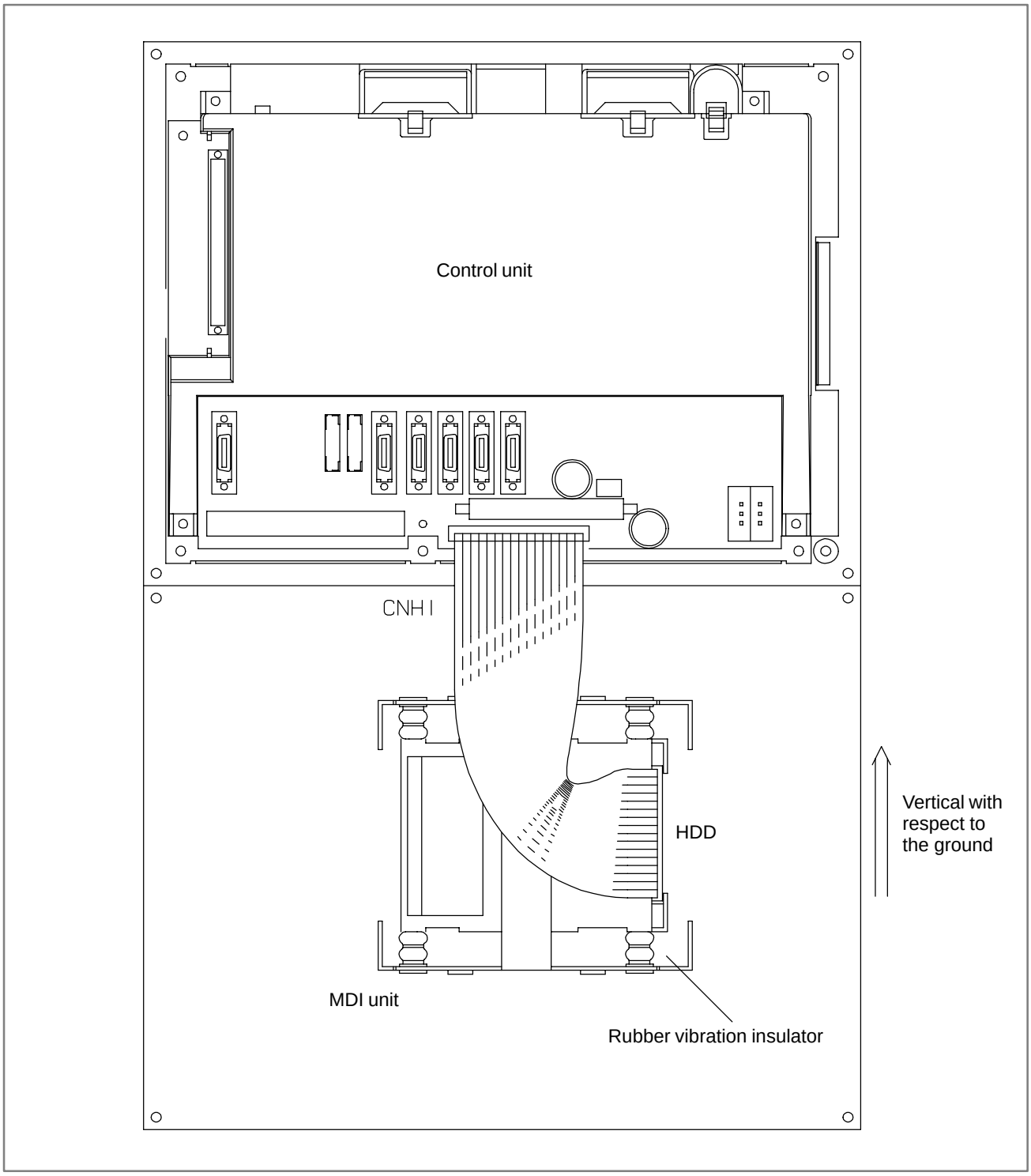
A commercially available full keyboard is designed for use with a personal computer. Such commercial keyboards can not always guarantee all required operations, therefore. The machine tool builder should check this point carefully beforehand.

Usually, protection against dust and moisture is not provided by commercial full keyboards. This should also be considered by the machine tool builder.

1) Recommended mouse

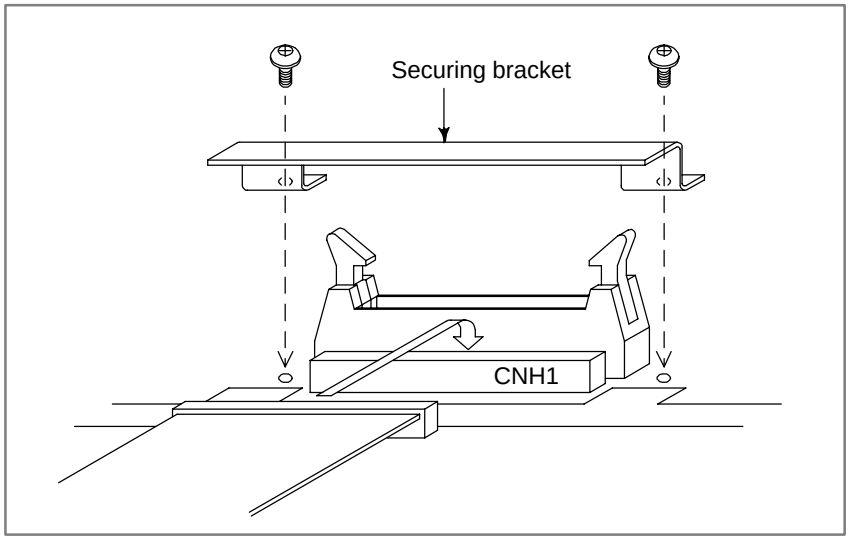
A86L–0001–0212 . . . . . Standard PS/2 mouse (commercial type)
. . . . . Dedicated to development and maintenance

8.5 CONNECTION OF HDD (HARD DISK DRIVE)



Connection

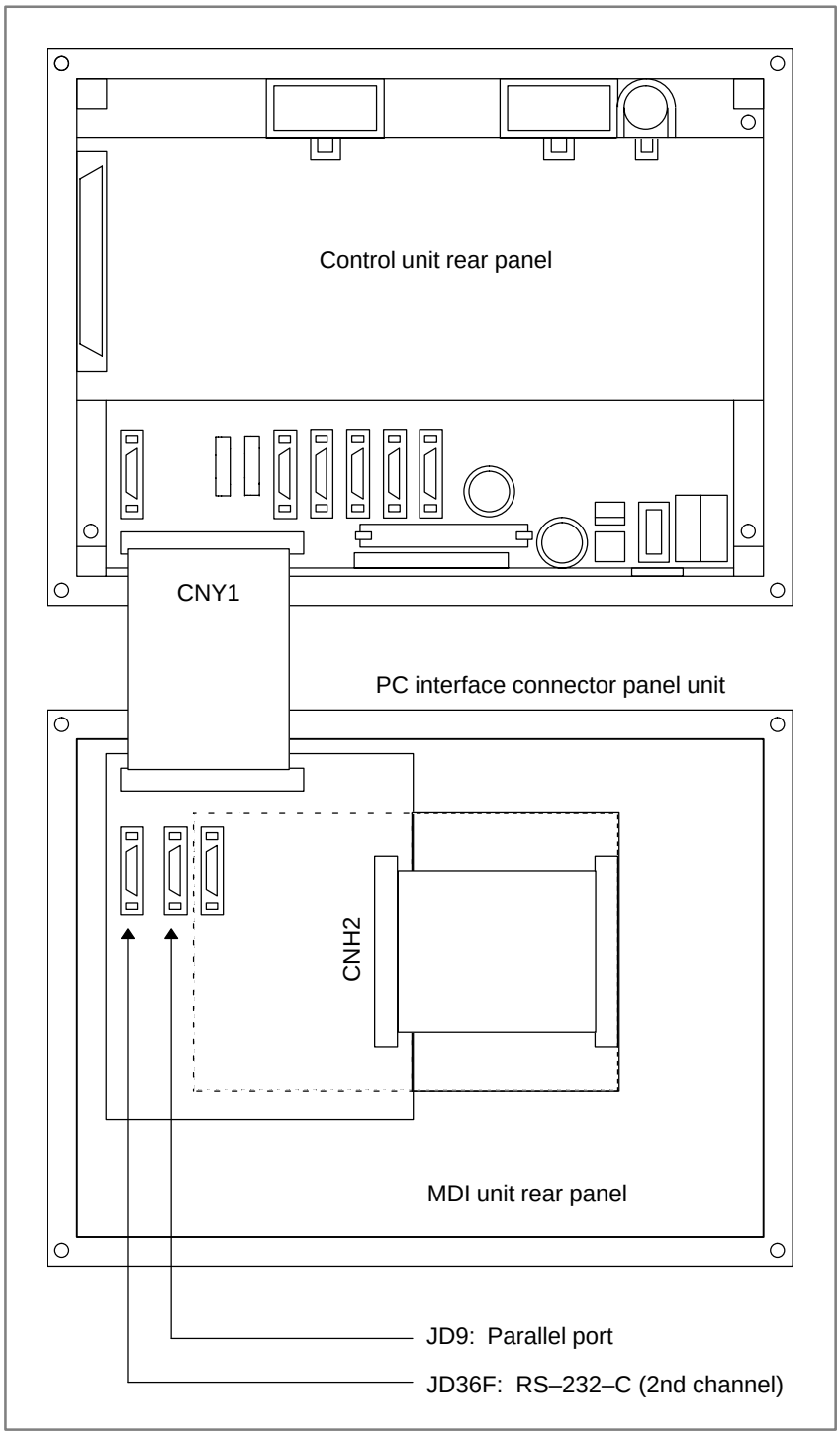
The hard disk drive itself is installed at the rear of the FANUC MDI unit. The machine tool builder is requested to connect the cable from the hard disk drive to connector “CNH1” of the CNC control unit by applying the following procedure.



1. Remove the securing bracket from connector “CNH1”. (Remove the two screws for this.)
2. Plug the cable from the hard disk drive into connector “CNH1” of the control unit.
3. Place the securing bracket on the connector and tighten the two screws.

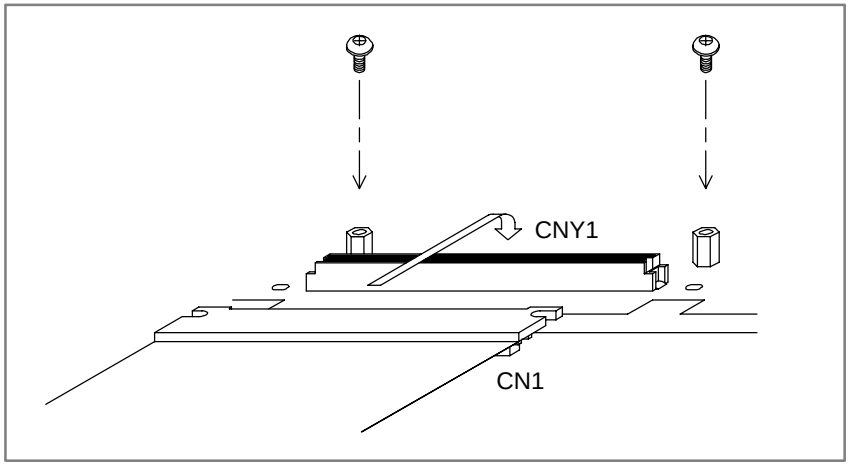
NOTE
When an MDI unit with a hard disk drive is to be installed on the machine, install the MDI unit under the main control unit so that the rubber vibration insulators are vertical with respect to the ground, as shown on the previous page.

8.6 CONNECTION OF THE PC INTERFACE CONNECTOR PANEL UNIT



Connection method

1. If the hard disk drive is connected to the control unit (CNH1), disconnect it. (When a personal computer interface connection unit is installed, the hard disk drive cable is not connected to the main control unit. Instead, it is connected to the personal computer interface connection unit.)
2. Remove the screws (× 2) from the control unit.
3. Plug the connector (CN1) of the cable from the PC interface connector panel unit into the connector (CNY1) of the control unit.
4. Tighten the screws (× 2).



NOTE

When a personal computer interface connection unit, mounted together with a hard disk drive on the MDI unit, is to be installed on the machine, install it under the control unit so that the rubber vibration insulators of the hard disk drive are vertical with respect to the ground, as shown on the previous page.

8.6.1 Centronics Parallel Port

CNC (PC interface connector panel unit)

JD9
(PCR–E20MDK–SL–A)

1	STD0	11	⁎STB
2	STD1	12	0V
3	STD2	13	⁎AFD
4	STD3	14	0V
5	STD4	15	⁎INIT
6	STD5	16	0V
7	STD6	17	⁎SLIN
8	STD7	18	⁎ACK
9	PE	19	⁎ERROR
10	SLCT	20	BUSY

Example) Printer

1	⁎STB	19	0V
2	STD	20	0V
3	STD1	21	0V
4	STD2	22	0V
5	STD3	23	0V
7	STD5	25	0V
6	STD4	24	0V
8	STD6	26	0V
9	STD7	27	0V
10	⁎ACK	28	0V
11	BUSY	29	0V
12	PE	30	0V
13	SLCT	31	⁎INIT
14	⁎AFD	32	⁎ERROR
15		33	0V
16	0V	34	
17	FG	35	
18		36	⁎SLIN

1) Recommended wire:
A66L–0001–0284#10P ... (0.08 $mm^2 \times 10$ pairs)
2) Recommended cable connector (JD9 side)
PCR–E20FA (Honda Tsushin Kogyo)
FI30–20S (Hirose Electric)
FCN–247J020–G/E (Fujitsu)
52622–2011 (Molex Japan)

NOTE
1 The printer–side interface shown above is merely an example. Each cable should be designed according to the interface of the device which is connected to the PC interface connector panel unit.
2 Since many commercially available external devices, including printers, perform differently with any one given personal computer, FANUC cannot guarantee all operations. Machine tool builders are requested to confirm the compatibility of each drive, and the operations that are supported. Also, be careful when using commercially available external devices because none offer dust–proof or drip–proof properties.

8.6.2 Serial Port 2

CNC (PC interface connector panel unit)

JD36F
(PCR–E20MDK–SL–A)

1	RD	11	SD
2	0V	12	0V
3	DR	13	ER
4	0V	14	0V
5	CS	15	RS
6	0V	16	0V
7	CD	17	
8	0V	18	
9	RI	19	(+24V)
10	(+24V)	20	

( ) : For use by a FANUC I/O device

Example) Host computer

(DBM–25S)

1	FG	14	
2	SD	15	
3	RD	16	
4	RS	17	
5	CS	18	
6	DR	19	
7	SG	20	ER
8	CD	21	
9		22	RI
10		23	
11		24	
12		25	
13			

1) Recommended wire:
A66L–0001–0284#10P (0.08 $mm^2 \times 10$ pairs)

2) Recommended cable connector (JD36F side)
PCR–E20FA (Honda Tsushin Kogyo)
FI30–20S (Hirose Electric)
FCN–247J020–G/E (Fujitsu)
52622–2011 (Molex Japan)

NOTE

1 The host computer–side interface shown above is merely an example. Each cable should be designed according to the interface of the actual device to be connected to the PC interface connector panel unit.

2 The +24 V power of the interface on the PC interface connector panel unit side in the above figure is exclusively for use by a FANUC I/O device (FANUC Cassette, FANUC Handy File, etc.). Do not use it for other purpose. Also, do not to connect more than one FANUC I/O device to a CNC control unit, as the rating of the +24 V power supply may be exceeded if more than one I/O device is used simultaneously.

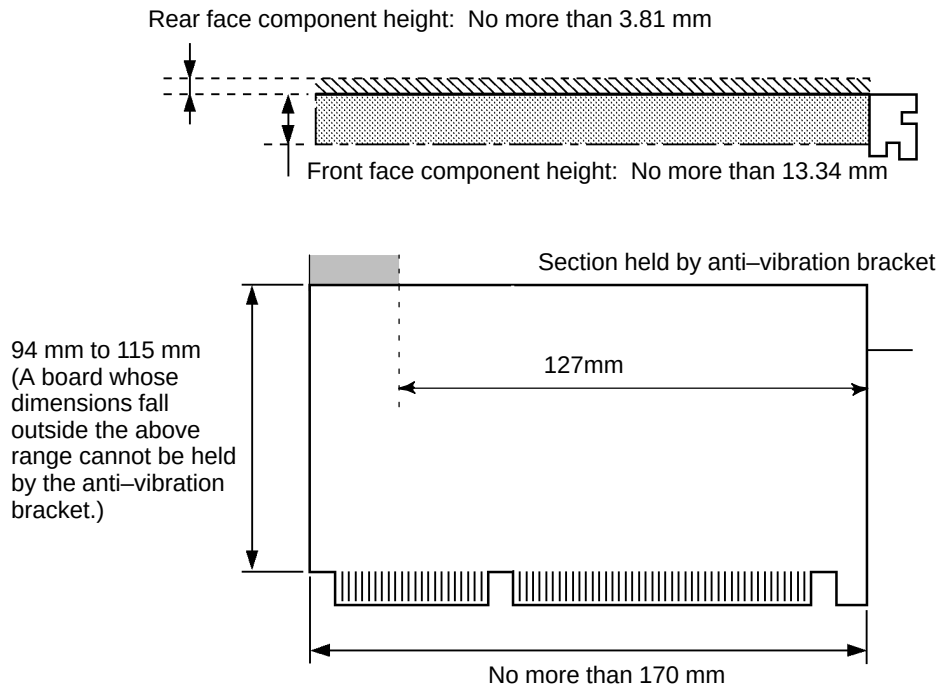
3 Do not connect anything to those pins for which a signal name is not indicated.

8.7 ISA EXPANSION UNITS

8.7.1 Installation Procedure

(1) Usable boards

Up to two ISA expansion boards, as shown below, can be used.



Unit: mm

NOTE

FANUC does not guarantee the operation of, or provide maintenance for, commercially available ISA expansion boards.

(2) ISA expansion board installation procedure
(See Fig. 8.7.1.)

(a) Remove the anti–vibration brackets.

(b) Insert each board into the connector. Push it fully home.

(c) Secure each board with the screw.

(d) Attach the anti–vibration bracket to each board by tightening screws while holding the bracket against the board.

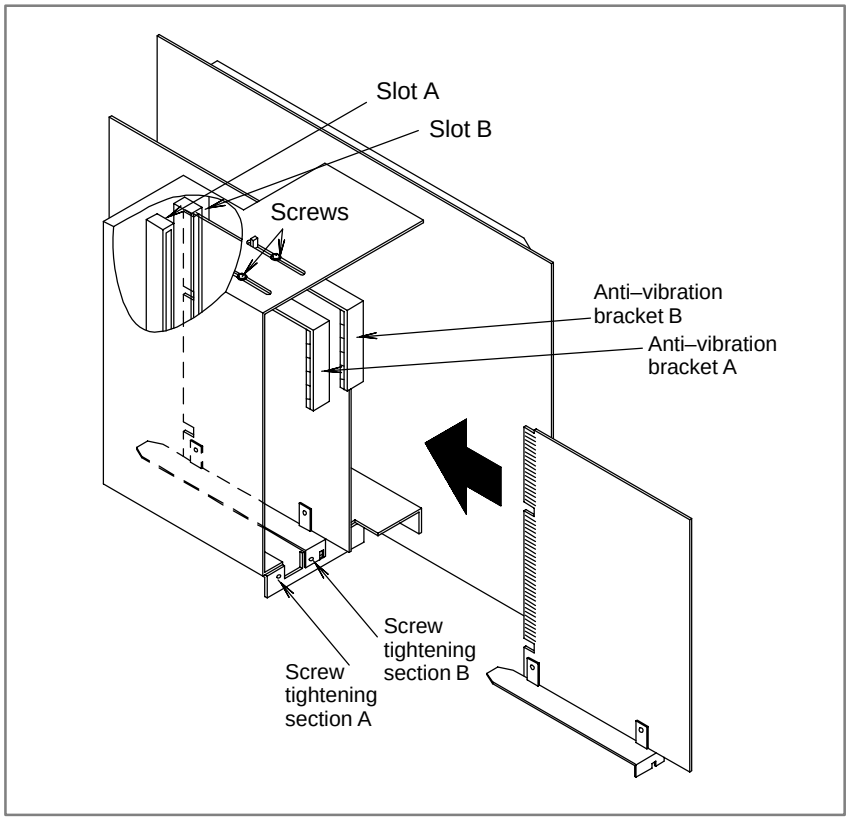
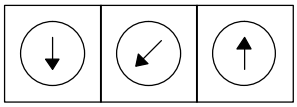


Fig. 8.7.1 Installing ISA expansion boards

8.7.2 Operating Precautions

(1) Address map

- The memory space is identical to that of IBM PC–compatible personal computers. There is no special area used by Series 210*i*.
- In the I/O space, addresses 280H to 28FH are used by the Series 210*i*, such that they are not available for the ISA expansion boards. (These addresses can be changed, however. They can be set with a rotary switch on the PC interface connector panel unit.)
  Other areas in the I/O space are identical to an IBM PC–compatible personal computer.



The I/O addresses of Series 210*i* are:
LMN0H to LMNFH.

L, M and N are set as shown below when the unit is shipped from FANUC.
L = 0 (SW3)
M = 2 (SW2)
N = 8 (SW1)

(2) Interrupt, DMA request

- Of the IRQ signals, the following are not used by the Series 210*i*.
  IRQ10, IRQ11
- Of the DRQ signals, the following is used by the Series 210*i*.
  DRQ2: Floppy disk drive.

(3) Installation and environmental conditions for ISA expansion boards
See Section 3.1. If, however, the specifications of the ISA expansion boards are inferior to those listed in Section 3.1, these conditions are restricted by those of the ISA expansion boards.

(4) Power supply to ISA expansion boards
The table below indicates the ratings of the power supply that can be fed to the ISA expansion boards mounted on the ISA expansion unit. (The total values for two slots are indicated.)

Voltage	Rating
+5V ± 10%	3.0 A maximum
+12V ± 10%	0.5 A maximum
–12V ± 10%	0.1 A maximum
–5V ± 10%	0.05 A maximum

(5) Other
In addition to the cautions given above, normal operation may be impossible under any of the following conditions.

- When pull–up or pull–down processing has been applied to the ISA bus signals.
- When the refresh cycle of the ISA bus is in use.
  In addition to the above, note that further conditions may be added in the future.

9 FANUC INTELLIGENT TERMINAL TYPE 2

9.1 OVERVIEW

The FANUC intelligent terminal type 2 (hereafter called intelligent terminal type 2) is on an IBM PC compatible panel computer. Connecting the intelligent terminal type 2 to an *i* Series CNC system via a high–speed optical fiber (high–speed serial bus) provides the system with personal computer functions.

9.2 CAUTIONS

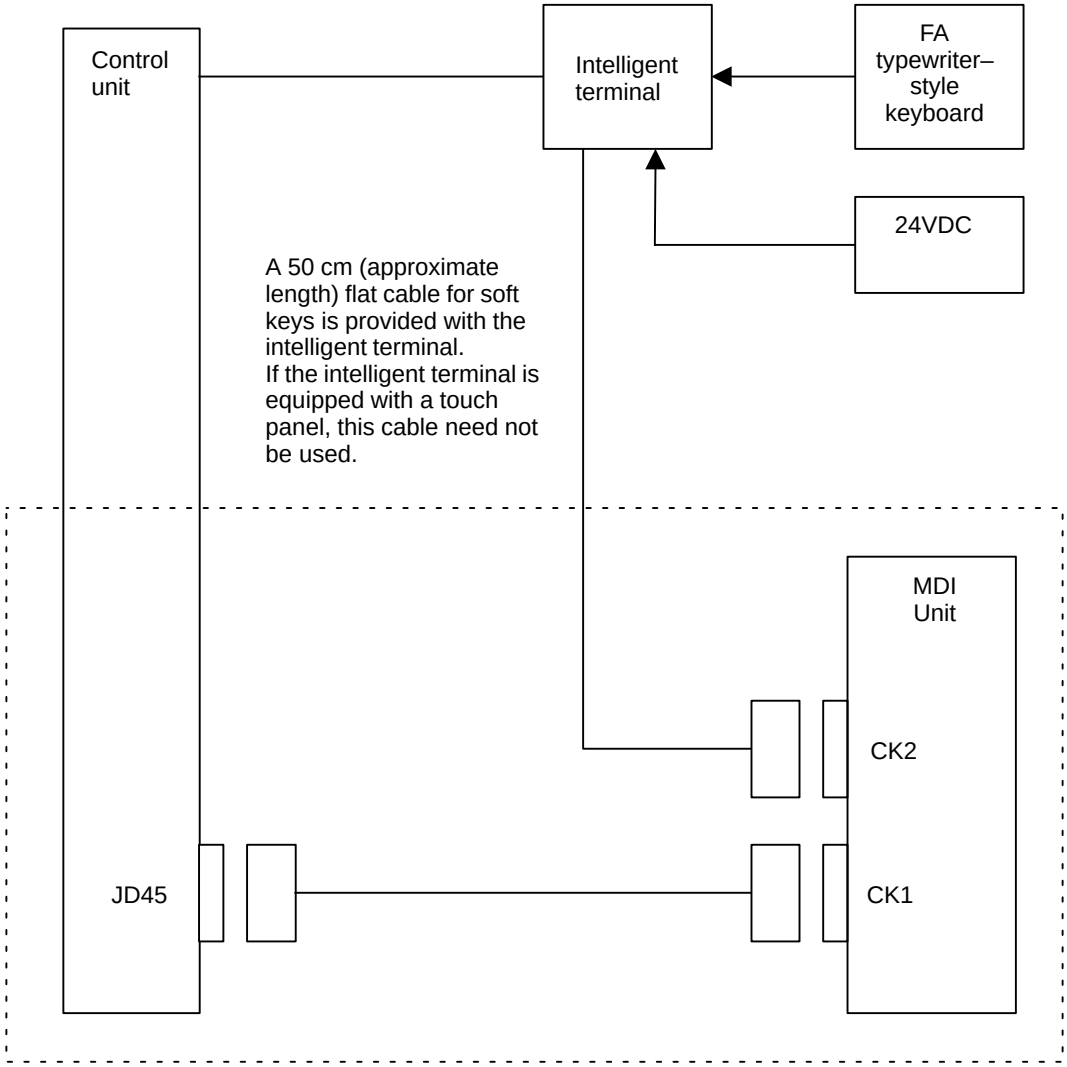
The copyrights to Windows 95, Windows NT, and other supplied software used in the intelligent terminal type 2 are owned by Microsoft Corporation of the USA, Chips and Technologies of the USA, International Business Machines Corporation of the USA, Matsushita Electric Industrial Co. of Japan, Ltd and/or Fanuc Ltd of Japan.

The software stated above and the related manuals may not be used or reproduced in part or whole without permission. They may not be sold separately from the intelligent terminal type 2.
They can be used only when the purchaser agrees all the terms and conditions stated in the license attached to the intelligent terminal type 2.
The purchaser's applying power to the intelligent terminal type 2 is deemed as their intention to agree to the terms and conditions in the license.

NOTE
1 IBM is a registered trademark of International Business Machines Corporation of the USA.
2 Windows is a registered trademark of Microsoft Corporation of the USA.
3 Other company names and product names mentioned in this manual are trademarks or registered trademarks of the respective companies.

9.3 CONNECTION

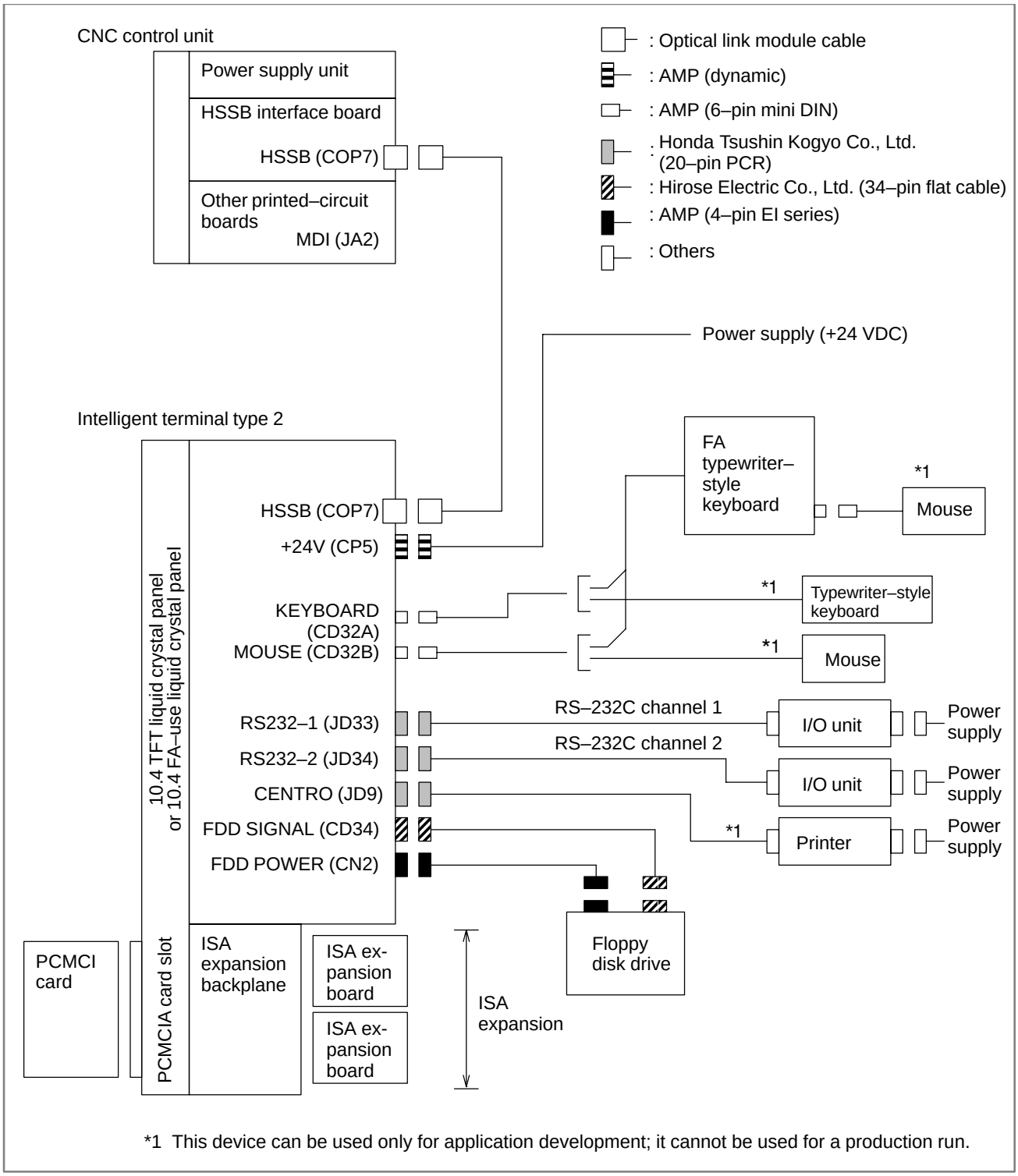
Connection with the intelligent terminal



This section describes the connection of only those components enclosed in the dotted lines above. Either an FA typewriter–style keyboard or an MDI unit can be connected.

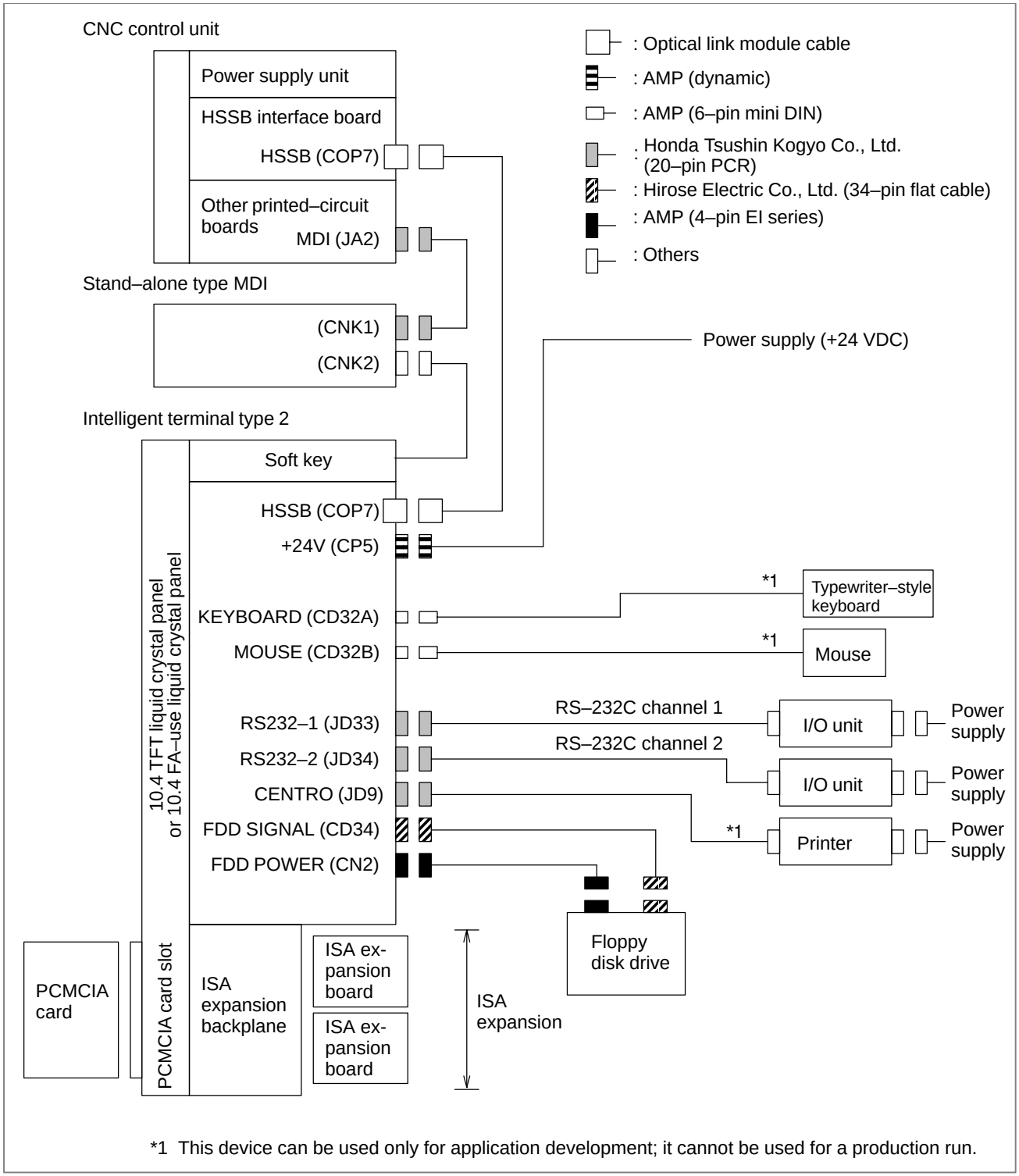
9.4 GENERAL CONNECTION DIAGRAMS

9.4.1 Intelligent Terminal Having Neither Soft Keys nor a Touch Panel



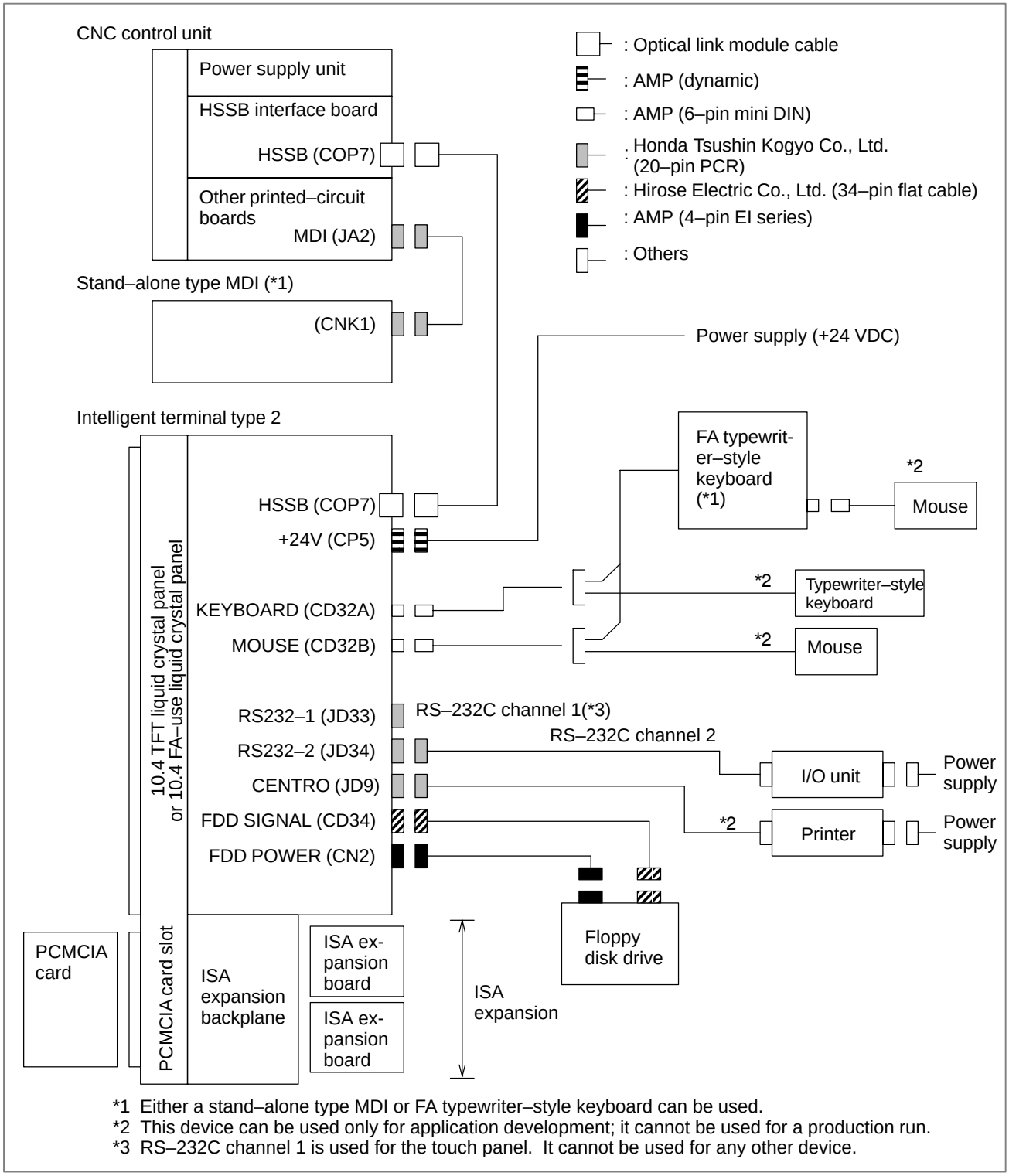
Refer to the applicable CNC connection manual for descriptions of connections not explained above.

9.4.2 Intelligent Terminal Having Soft Keys but No Touch Panel



Refer to the applicable CNC connection manual for descriptions of connections not explained above.

9.4.3 Intelligent Terminal Having a Touch Panel but No Soft Key



*1 Either a stand–alone type MDI or FA typewriter–style keyboard can be used.
*2 This device can be used only for application development; it cannot be used for a production run.
*3 RS–232C channel 1 is used for the touch panel. It cannot be used for any other device.

Refer to the applicable CNC connection manual for descriptions of connections not explained above.

9.5 SPECIFICATIONS

9.5.1 Installation Environmental Conditions

When using intelligent terminal type 2, observe the following conditions relating to the cabinet in which the terminal is installed.

Ambient temperature	Operating: 5°C to 45°C (*1) Storage: –20°C to 60°C
Temperature drift	20°C/hour (maximum)
Ambient relative humidity	Regular: 10% to 75% (without condensation) Short term (within one month): 10% to 90% (without condensation)
Vibration	Operating: 0.5 G or less(*2) Storage: 1.0 G or less
Atmosphere	Enclosure in a completely sealed cabinet
Altitude	Operating: –60 to 1000 m Storage: –60 to 1200 m

*1 Operating ambient temperature:
A temperature sensor in the intelligent terminal type 2 is used to check whether the temperature range described above is satisfied. (The detected state can be confirmed from the LEDs on the high–speed serial bus interface board of the CNC.)

1) If the specified temperature range is not satisfied when the power is switched on, the system hangs without displaying anything on the screen. This error status can be confirmed using the LEDs mentioned above. When the temperature falls within the specified range the system, including the terminal, starts automatically.
2) If the temperature moves outside the specified range after the system starts, an error is detected when an attempt is made to access the hard disk.

*2 Vibration:
The intelligent terminal type 2 and its built–in hard disk may be subject to vibration. After the terminal is mounted on the machine, carefully check for vibration. If an ISA expansion board is used, the vibration tolerance may be lower than that listed above, depending on the specification of the card.

CAUTION
Even when the environmental conditions listed above are satisfied, an operator error or an accident may destroy data on the hard disk. This is quite likely if the power is switched off while the hard disk is being accessed. Do NOT switch off the power while the hard disk is being accessed. Be sure inform end users of this caution. Always create and keep a backup copy of the data on the hard disk to prepare for the worst case.

Also note that options for development and maintenance use may not satisfy the above requirements.

9.5.2 Power Supply Specification

(1) Input power

(a) Specification

To use the intelligent terminal type 2, prepare a power supply that satisfies the requirements listed below:

Input power supply voltage	+24 VDC ±10%
Input power supply current	3.5 A (maximum)

NOTE
Use of the FANUC I/O unit also requires +1 A.

(b) Timing

The intelligent terminal type 2 should be switched on and off within ±100 ms of the CNC power supply being switched on and off.

(2) Supply power

The intelligent terminal type 2 can supply power, as listed below, to peripheral equipment. Check the amount of current drawn by each unit you want to use.

Supply voltage	Peripheral unit	Current (maximum)
+12V	ISA, FDD (CN2)	400mA
+5V	FDD (CN2), keyboard (CD32, JD33), mouse (JD33)	1000mA
	ISA	3500mA
–12V	ISA	180mA
–5V	ISA	74mA

(3) Heat dissipation

37 W (during normal operation)

NOTE
The amount of heat generated by the intelligent terminal type 2 increases if a peripheral unit or ISA expansion board is connected.

9.5.3 Shutdown

Before switching off the intelligent terminal type 2, terminate all applications and the OS according to the normal shutdown procedure. If the terminal is switched off while an application or the OS is still running, the terminal may fail to operate normally next time it is switched on. In the worst case, the initialization command for the hard disk drive may become inoperable.

9.6 INSTALLATION SPACE

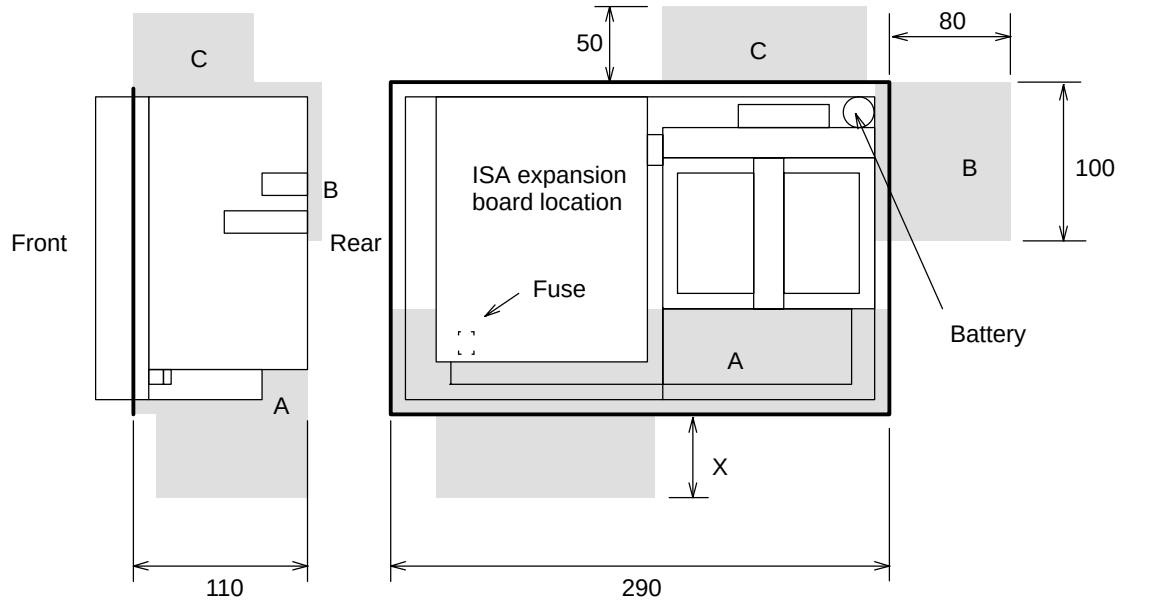
The space shown below must be available around the intelligent terminal type 2 after it is installed.

A: Space for cables. Provide an appropriate area at A so that the cables to be used can be installed. If an ISA expansion board is used, determine dimension X so that the cable to be used with the ISA expansion board can be installed.

B: This space is required for battery replacement in the intelligent terminal mounted on the panel. Battery replacement requires that the operator work at the rear of the terminal.

C: This space is required for ventilation.

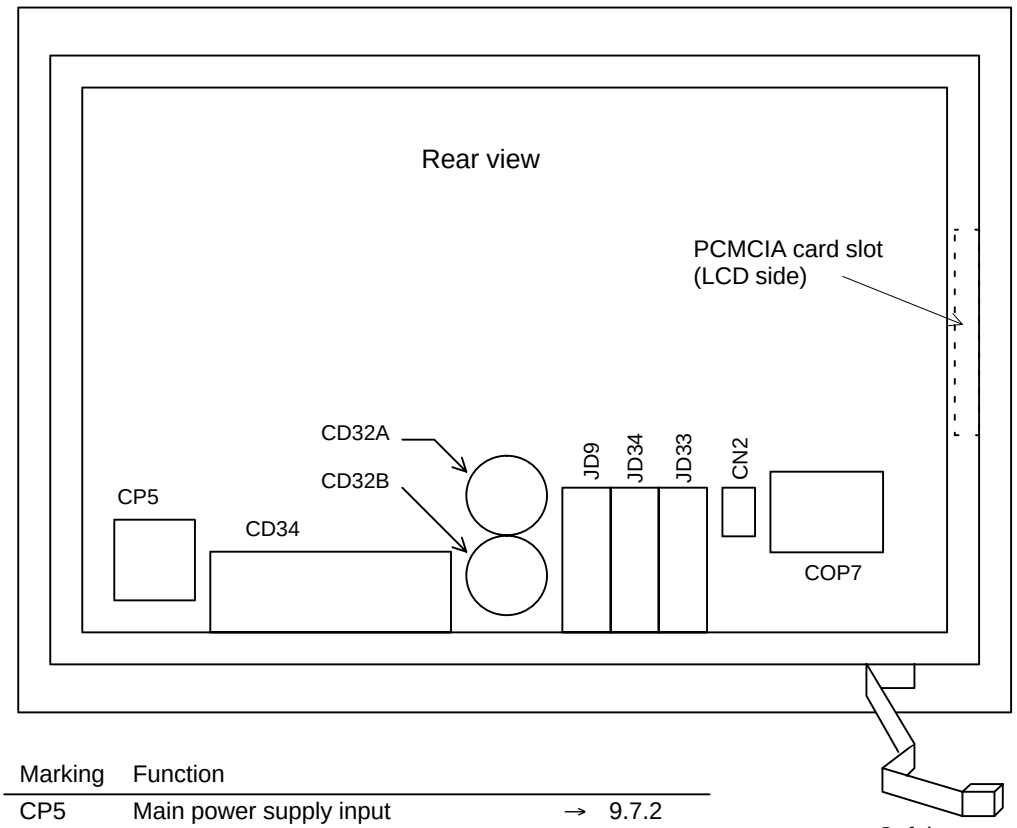
- If you want to perform fuse replacement in intelligent terminal type 2 while the terminal is mounted on the panel, there must be sufficient space available for maintenance work at the rear of the terminal.



(Unit: mm)

9.7 PERIPHERAL EQUIPMENT AND CONNECTION

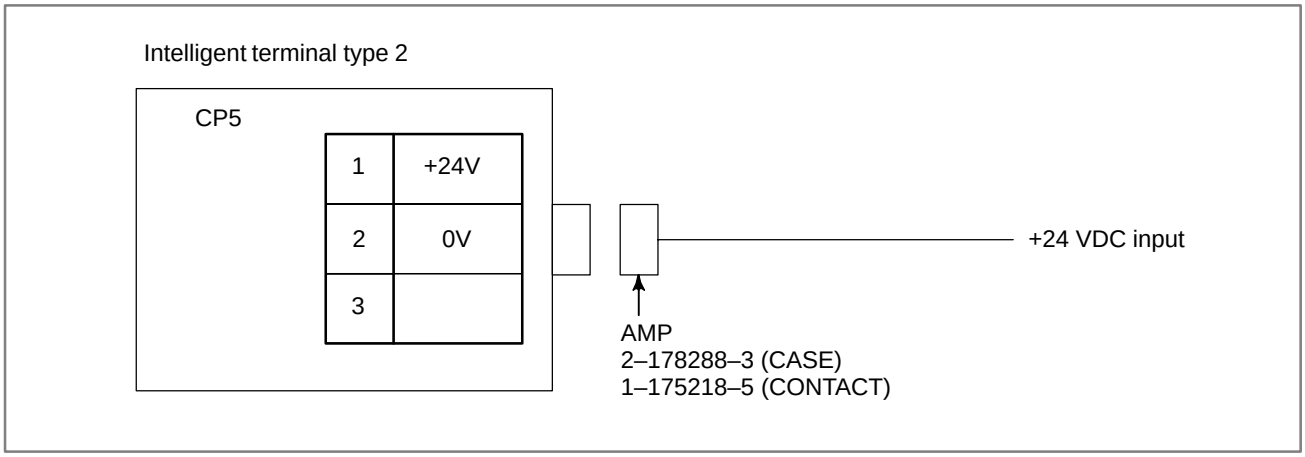
9.7.1 Connector Layout Diagram



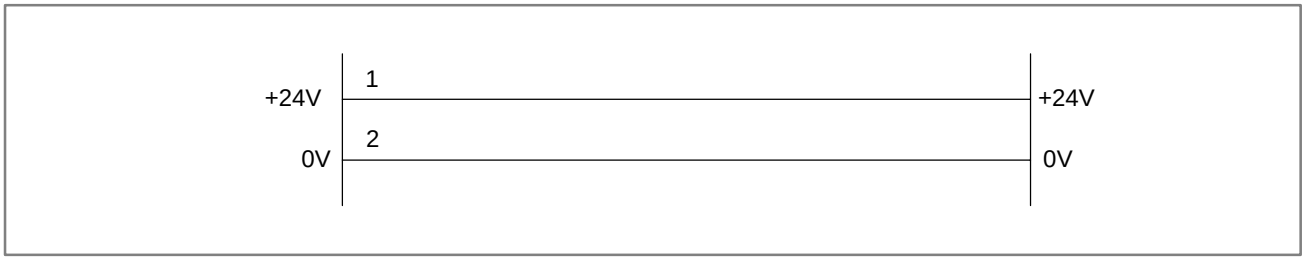
Marking	Function		
CP5	Main power supply input	→	9.7.2
CD34	Floppy disk drive signal	→	9.7.3
CD32A	Typewriter–style keyboard	→	9.7.4
CD32B	Mouse	→	9.7.5
JD9	Parallel port	→	9.7.6
JD34	Serial port 2	→	9.7.7
JD33	Serial port 1	→	9.7.8
CN2	Floppy disk drive power supply output	→	9.7.3
COP7	High–speed serial bus (HSSB)	→	9.7.9
	PCMCIA card	→	9.7.11

NOTE
1 No ISA expansion unit is used in the above example.
2 The soft key is provided only on the intelligent terminal type 2 with soft keys.

9.7.2 Main Power Supply Input



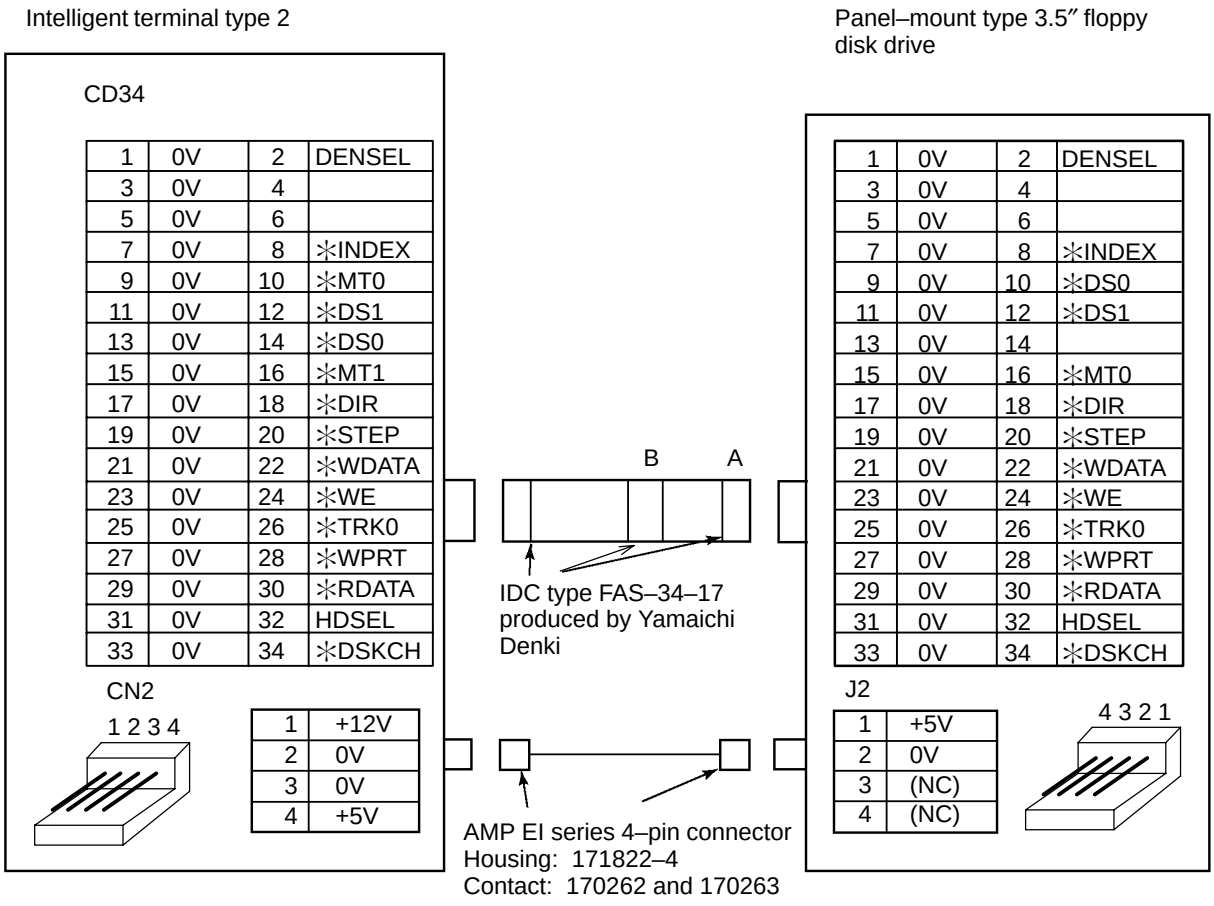
(1) Cable connection



(2) Recommended cable conductor
Use a cable whose conductor is not smaller than 30/0.18 (0.75 mm^2).

NOTE
This power supply cable should be routed away from the signal lines of the intelligent terminal.

9.7.3 Floppy Disk Drive (Signal and Power Supply)



1	0V	2	DENSEL
3	0V	4	
5	0V	6	
7	0V	8	⁎INDEX
9	0V	10	⁎MT0
11	0V	12	⁎DS1
13	0V	14	⁎DS0
15	0V	16	⁎MT1
17	0V	18	⁎DIR
19	0V	20	⁎STEP
21	0V	22	⁎WDATA
23	0V	24	⁎WE
25	0V	26	⁎TRK0
27	0V	28	⁎WPRT
29	0V	30	⁎RDATA
31	0V	32	HDSEL
33	0V	34	⁎DSKCH

1	+12V
2	0V
3	0V
4	+5V

1	0V	2	DENSEL
3	0V	4	
5	0V	6	
7	0V	8	⁎INDEX
9	0V	10	⁎DS0
11	0V	12	⁎DS1
13	0V	14	
15	0V	16	⁎MT0
17	0V	18	⁎DIR
19	0V	20	⁎STEP
21	0V	22	⁎WDATA
23	0V	24	⁎WE
25	0V	26	⁎TRK0
27	0V	28	⁎WPRT
29	0V	30	⁎RDATA
31	0V	32	HDSEL
33	0V	34	⁎DSKCH

1	+5V
2	0V
3	(NC)
4	(NC)

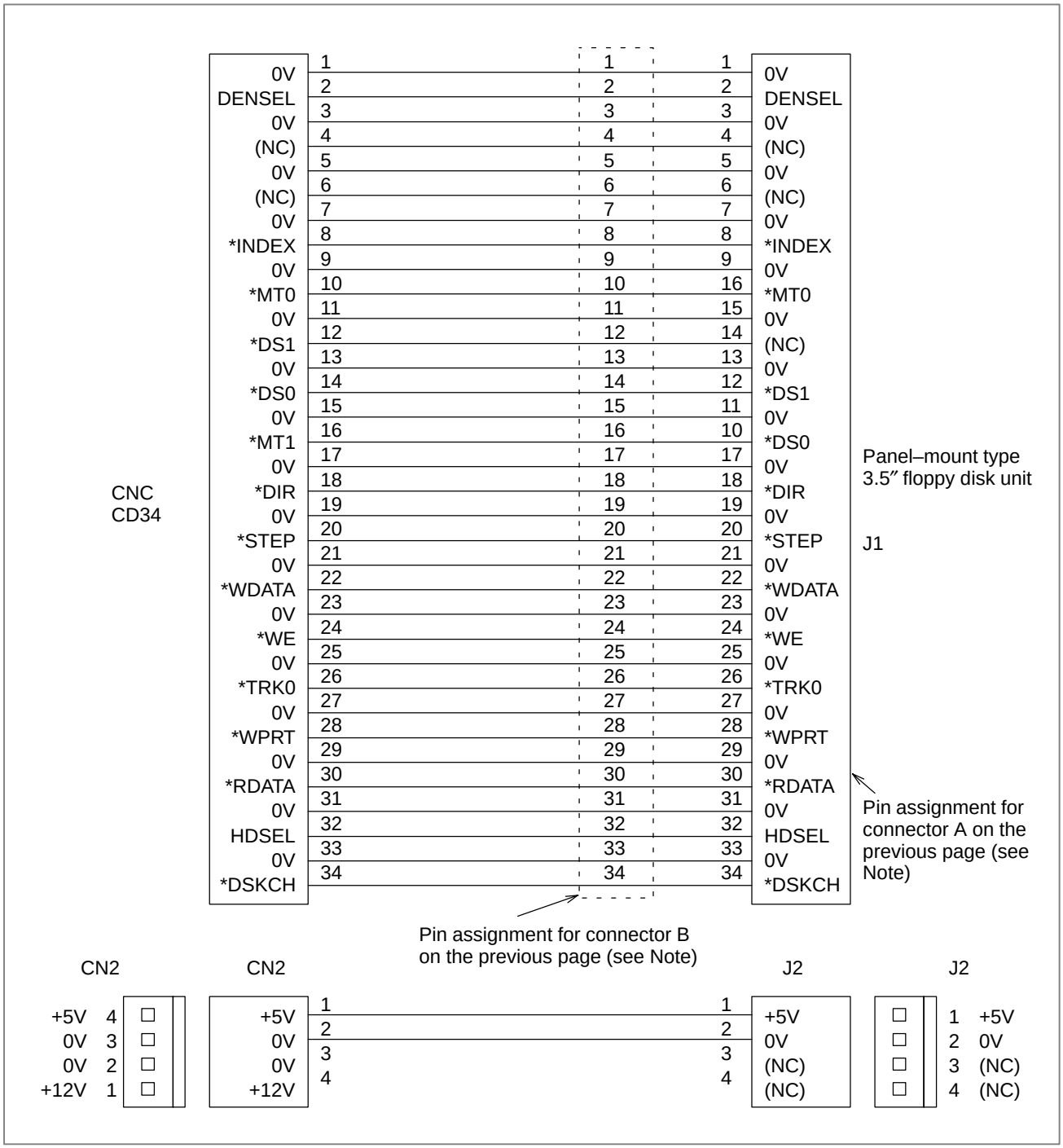
NOTE

1 This is a standard interface for the IBM PC compatible. Note the following:
- Only two floppy disk density modes (720 Kbytes and 1.44 Mbytes) are supported.
- The DENSEL signal level is fixed to low.
- Not all commercial floppy disk drives require both +12 V and +5 V power supplies. If your floppy disk drive requires +12 VDC, pay careful attention to its power requirements.

2 Commercial floppy disk drives are prone to compatibility problems with personal computers to some degree. It is not guaranteed that the intelligent terminal type 2 can operate with every commercial floppy disk drive. Machine tool builders are requested to check the operability of the floppy disk drives they select. Keep in mind that commercial floppy disk drives are neither dust–proof nor moisture–resistant.

3 The interface on the drive side shown above is only an example. Design an interface cable according to the specification of the drive with which it is used.

(1) Cable connection



This is the standard interface for the IBM PC compatible. Commercially available cables are cross–connected between pins 10 and 16 (between the CNC and drive A) as shown above. In this case, “drive No. setting pin” on drive A should be set to 1 (second drive). The floppy disk unit (A02B–0207–C006) offered by FANUC should be attached to connector A, described above.

(2) Specification of the recommended cable
A02B–0207–K801: Signal cable and power supply cable (1.0 m long)

9.7.3.1 Operating environment

When using this unit on the machine, observe the following cautions:

(1) Dust

Because the intelligent terminal type 2 is not covered with panels, except for the front door section, it must be enclosed in a sealed cabinet. While the door is open, dust can enter the floppy disk unit and cabinet via the disk insertion slot. If the terminal is installed in a dusty environment, more floppy disk failures than normal may occur.

(2) Temperature

+5°C to +45°C (operating)

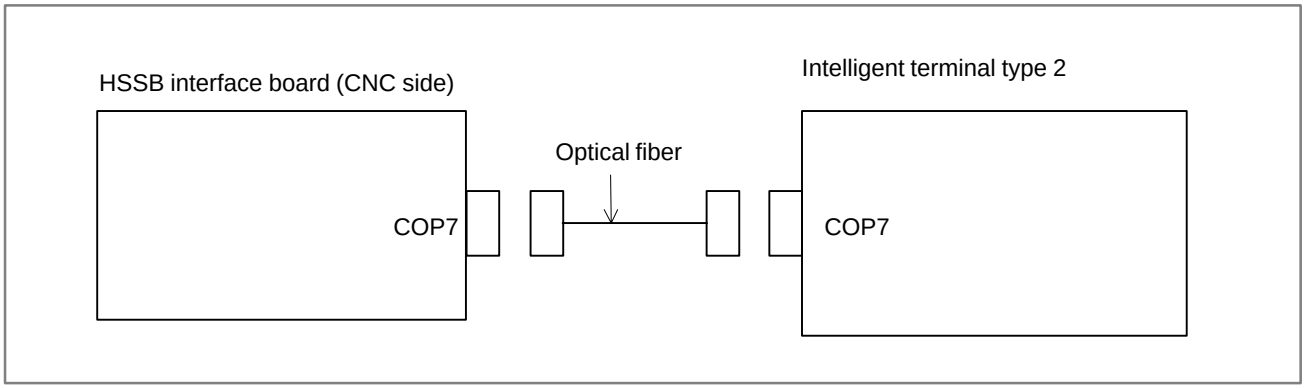
The operating temperature range for this unit is stricter than ordinary units because of the restrictions imposed by the floppy disk. So, pay special attention to the way it is cooled.

Avoid blowing air directly from a cooling fan, as dust in the air may stick to the components of the unit.

9.7.3.2 Handling precautions

Do NOT switch on the power to intelligent terminal type 2 while a floppy disk is inserted, and especially when the floppy disk is being accessed (LED is on). Machine tool builders are requested to provide this information to their end users.

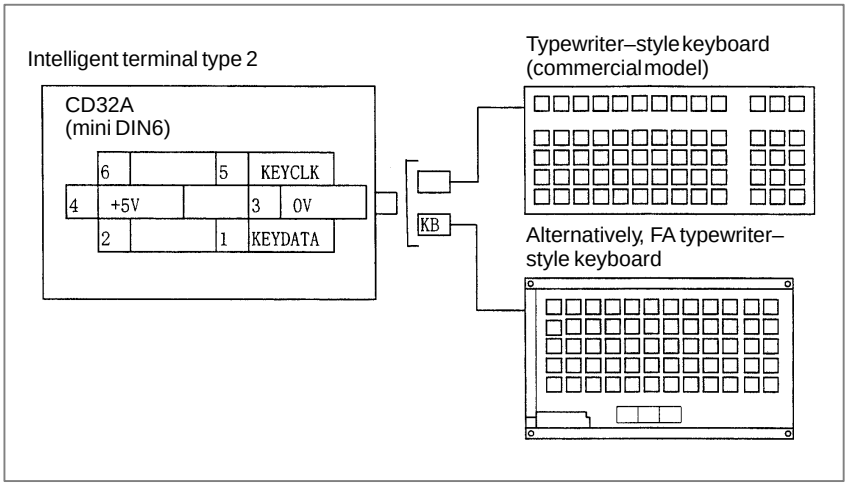
9.7.4 High–speed Serial Bus (HSSB)



1) Recommended cables (optical fiber cables)
   Only the following optical fiber cables can be used.
   A66L–6001–0026#L1R003: Cable length = 1 m
   A66L–6001–0026#L3R003: Cable length = 3 m
   A66L–6001–0026#L5R003: Cable length = 5 m
   A66L–6001–0026#L7R003: Cable length = 7 m
   A66L–6001–0026#L10R03: Cable length = 10 m
   A66L–6001–0026#L15R03: Cable length = 15 m
   A66L–6001–0026#L20R03: Cable length = 20 m
   A66L–6001–0026#L30R03: Cable length = 30 m
   A66L–6001–0026#L50R03: Cable length = 50 m
   A66L–6001–0026#L100R3: Cable length = 100 m

NOTE
1 The high–speed serial bus cannot use an optical fiber cable designed for the FANUC I/O link, FSSB extension line, or serial spindle.
2 Machine tool builders cannot cut or extend optical fiber cables. Select an appropriate type from the above list.

9.7.5 Typewriter–style Keyboard

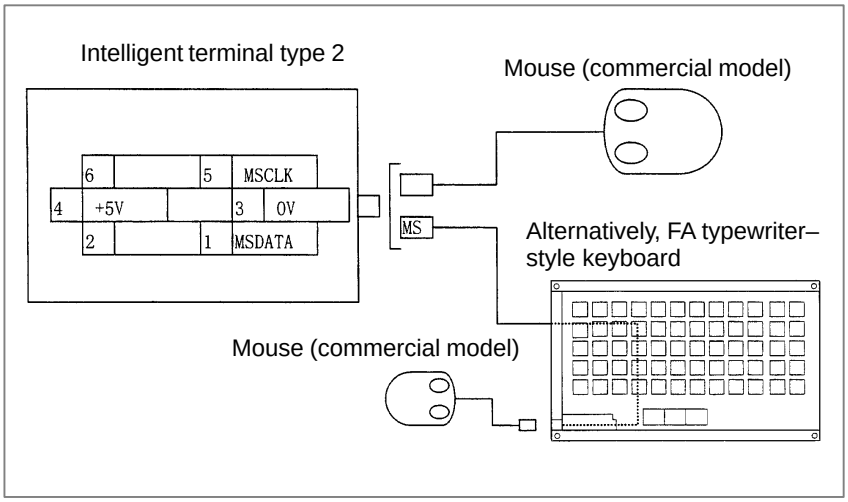


1) Recommended full keyboard

A86L–0001–0210 . . . . . 101–key keyboard (commercial model)
. . . . . for development and maintenance use only
A86L–0001–0211 . . . . . 106–key keyboard (commercial model)
. . . . . for development and maintenance use only
A02B–0234–C120#JC . . FA typewriter–style keyboard (Japanese–language version)
A02B–0234–C120#EC . . FA typewriter–style keyboard (English–language version)
. . . . . Typewriter–style keyboard designed to be incorporated into the intelligent terminal

NOTE
1 Commercial typewriter–style keyboards are prone to compatibility problems with personal computers to some degree. It is not guaranteed that the intelligent terminal type 2 can operate with every commercial typewriter–style keyboard. Machine tool builders are requested to check the operability of the typewriter–style keyboards they select. Keep in mind that general commercial typewriter–style keyboards are neither dust–proof nor moisture–resistant.
2 If an FA typewriter–style keyboard is incorporated into the system, clamp its cable at a point as close to it as possible so that the weight of the cable is not applied directly to the connector.

9.7.6 Mouse

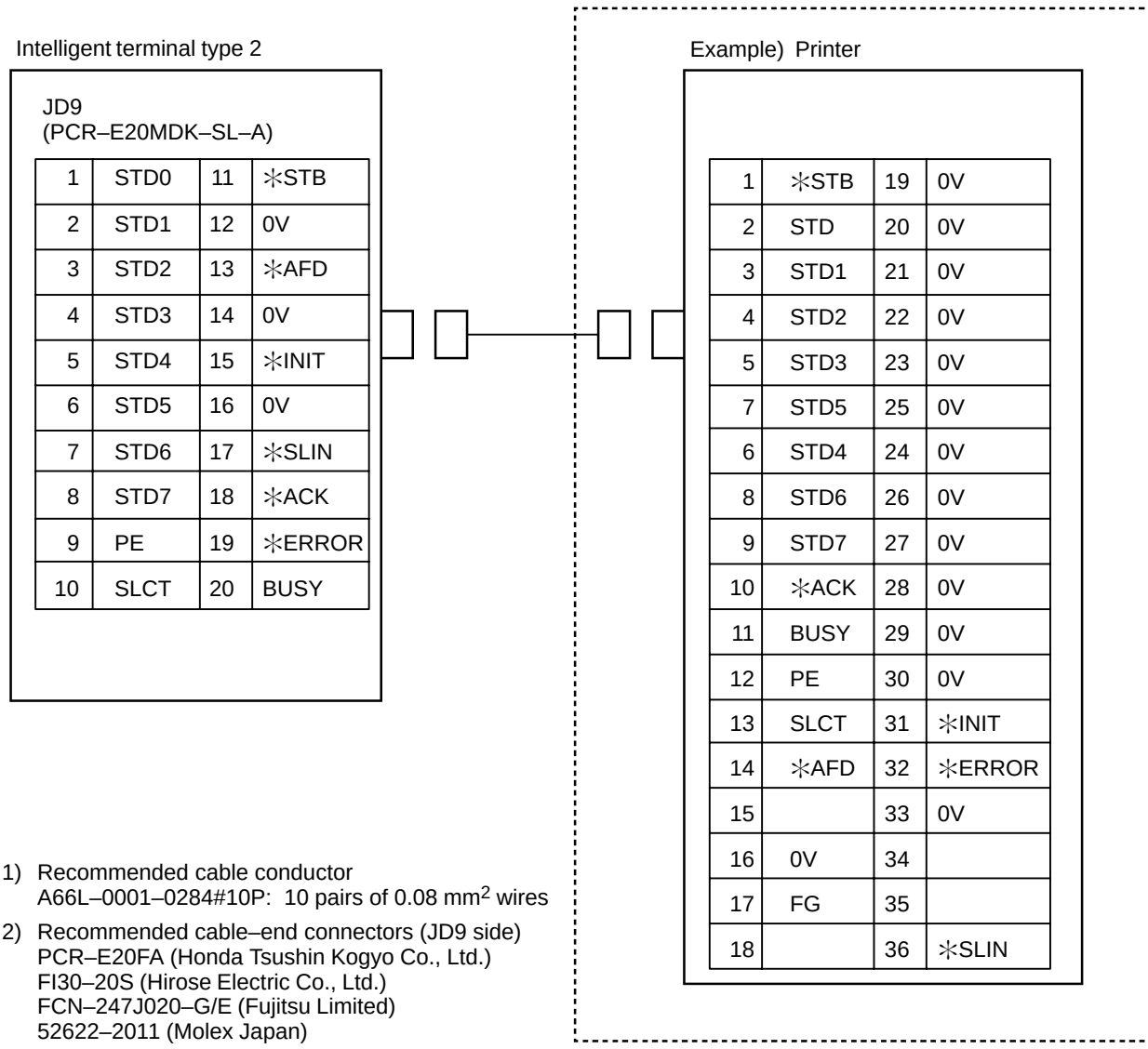


1) Recommended mouse

A86L–0001–0212 . . . . . Standard PS/2 mouse (commercial model)
. . . . . for development and maintenance use only

NOTE
1 Commercial mice are prone to compatibility problems with personal computers to some degree. It is not guaranteed that the intelligent terminal type 2 can operate with every commercial mouse. Machine tool builders are requested to check the operability of the mice they select. Keep in mind that general commercial mice are neither dust–proof nor moisture–resistant.
2 If an FA typewriter–style keyboard is incorporated into the system, clamp its cable at a point as close to it as possible so that the weight of the cable is not applied directly to the connector.

9.7.7 Centronics Parallel Port



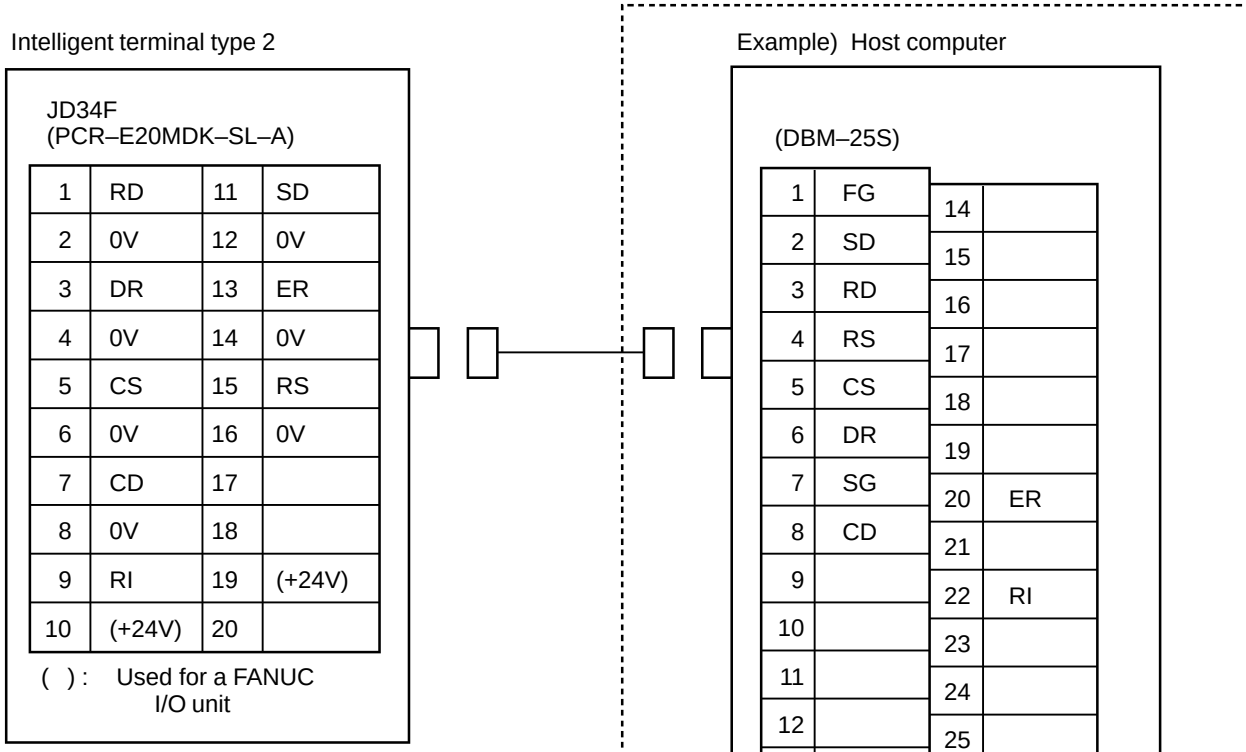
1	STD0	11	⁎STB
2	STD1	12	0V
3	STD2	13	⁎AFD
4	STD3	14	0V
5	STD4	15	⁎INIT
6	STD5	16	0V
7	STD6	17	⁎SLIN
8	STD7	18	⁎ACK
9	PE	19	⁎ERROR
10	SLCT	20	BUSY

1	⁎STB	19	0V
2	STD	20	0V
3	STD1	21	0V
4	STD2	22	0V
5	STD3	23	0V
7	STD5	25	0V
6	STD4	24	0V
8	STD6	26	0V
9	STD7	27	0V
10	⁎ACK	28	0V
11	BUSY	29	0V
12	PE	30	0V
13	SLCT	31	⁎INIT
14	⁎AFD	32	⁎ERROR
15		33	0V
16	0V	34	
17	FG	35	
18		36	⁎SLIN

1) Recommended cable conductor
   A66L–0001–0284#10P: 10 pairs of 0.08 mm^2 wires
2) Recommended cable–end connectors (JD9 side)
   PCR–E20FA (Honda Tsushin Kogyo Co., Ltd.)
   FI30–20S (Hirose Electric Co., Ltd.)
   FCN–247J020–G/E (Fujitsu Limited)
   52622–2011 (Molex Japan)

NOTE
1 The interface on the printer side shown above is only an example. Design an interface cable according to the specification of the printer with which it is used.
2 Commercial printers are prone to compatibility problems with personal computers to some degree. It is not guaranteed that intelligent terminal type 2 can operate with every commercial printer. Machine tool builders are requested to check the operability of the printers they select. Keep in mind that general commercial printers are neither dust–proof nor moisture–resistant.

9.7.8 Serial Port 2



1	RD	11	SD
2	0V	12	0V
3	DR	13	ER
4	0V	14	0V
5	CS	15	RS
6	0V	16	0V
7	CD	17	
8	0V	18	
9	RI	19	(+24V)
10	(+24V)	20	

( ) : Used for a FANUC I/O unit

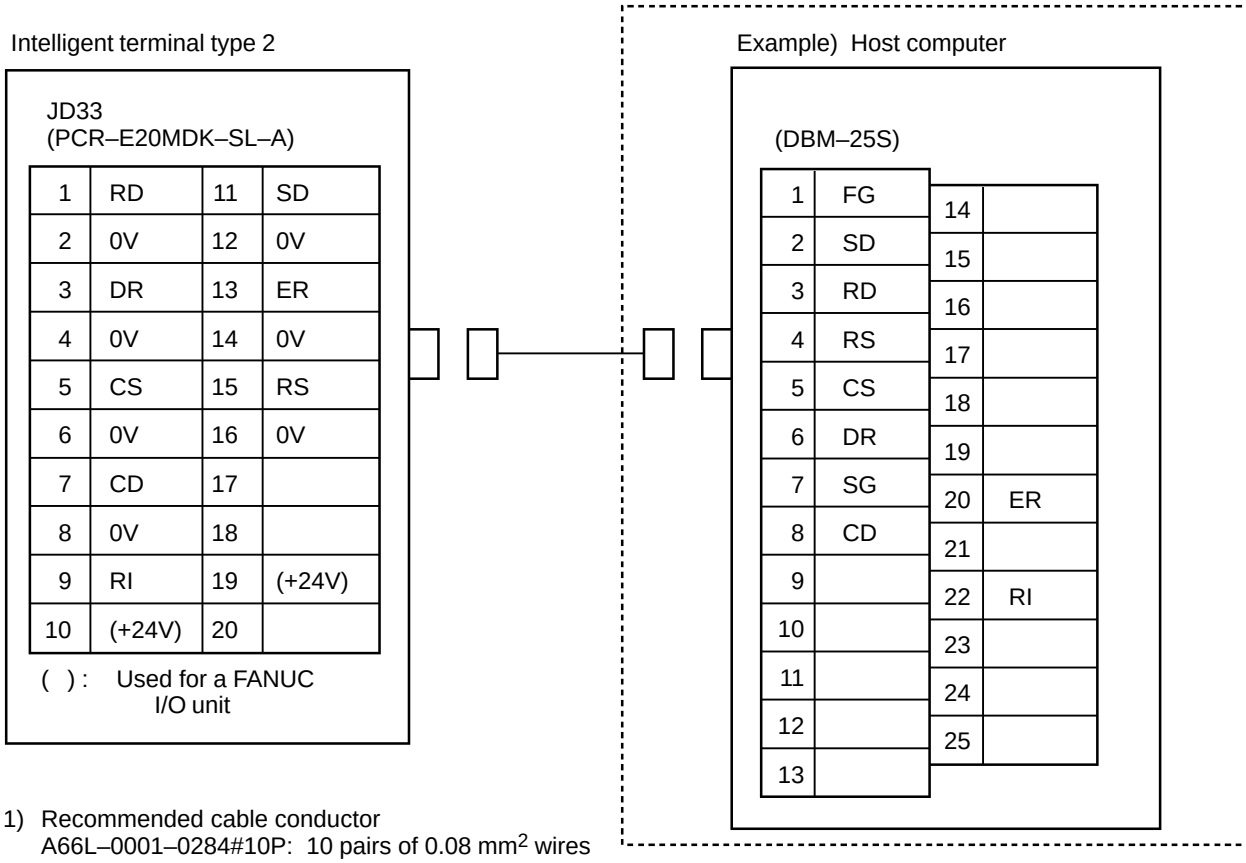
1	FG	14	
2	SD	15	
3	RD	16	
4	RS	17	
5	CS	18	
6	DR	19	
7	SG	20	ER
8	CD	21	
9		22	RI
10		23	
11		24	
12		25	
13			

1) Recommended cable conductor
A66L–0001–0284#10P: 10 pairs of 0.08 mm^2 wires
2) Recommended cable–end connectors (JD36 side)
PCR–E20FA (Honda Tsushin Kogyo Co., Ltd.)
FI30–20S (Hirose Electric Co., Ltd.)
FCN–247J020–G/E (Fujitsu Limited)
52622–2011 (Molex Japan)

NOTE
1 The interface on the host computer side shown above is only an example. Design an interface cable according to the specification of the host computer with which it is used.
2 The +24 V lines in the interface of the personal computer interface connection unit side, shown above, can be used only with FANUC I/O units (such as the FANUC cassette and FANUC Handy File). Do not use these lines for any other purpose. Also, do not connect more than one of these units to one CNC control unit. Otherwise, the +24 V power supply capacity may be exceeded.
3 Do not connect anything to pins that are not labeled.

9.7.9 Serial Port 1

For an intelligent terminal having a touch panel, the touch panel controller uses serial port 1. So this connector cannot be used for any other purpose. The touch panel controller is connected, using a dedicated connector rather than JD33.



1	RD	11	SD
2	0V	12	0V
3	DR	13	ER
4	0V	14	0V
5	CS	15	RS
6	0V	16	0V
7	CD	17	
8	0V	18	
9	RI	19	(+24V)
10	(+24V)	20	

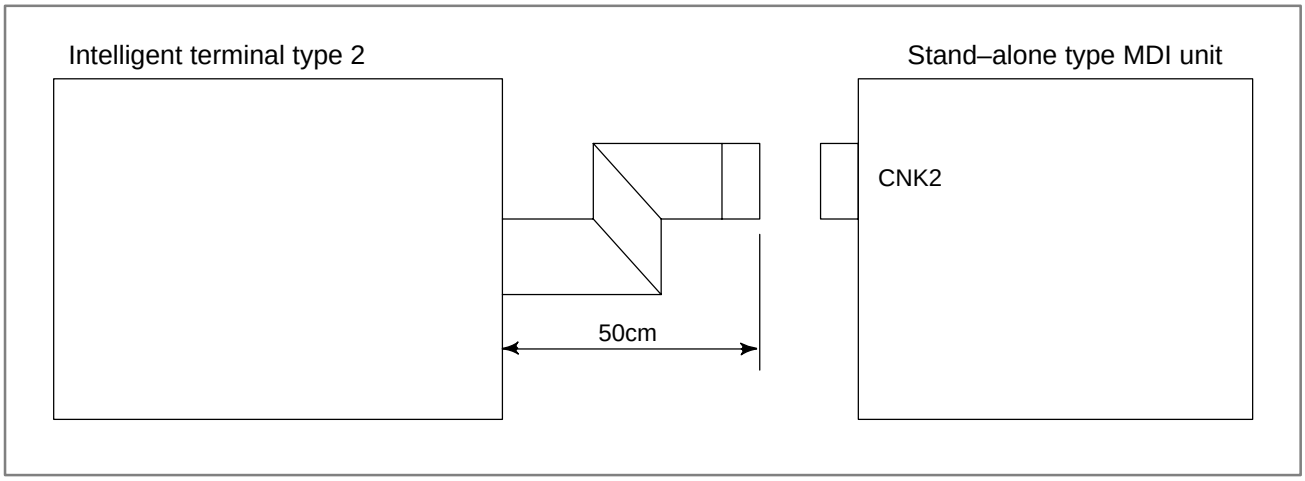
( ) : Used for a FANUC I/O unit

1	FG	14	
2	SD	15	
3	RD	16	
4	RS	17	
5	CS	18	
6	DR	19	
7	SG	20	ER
8	CD	21	
9		22	RI
10		23	
11		24	
12		25	
13			

1) Recommended cable conductor
A66L–0001–0284#10P: 10 pairs of 0.08 mm^2 wires
2) Recommended cable–end connectors (JD36 side)
PCR–E20FA (Honda Tsushin Kogyo Co., Ltd.)
FI30–20S (Hirose Electric Co., Ltd.)
FCN–247J020–G/E (Fujitsu Limited)
52622–2011 (Molex Japan)

NOTE
1 he interface on the host computer side shown above is only an example. Design an interface cable according to the specification of the host computer with which it is used.
2 The +24 V lines in the interface on the personal computer interface connection unit side shown above can be used only for FANUC I/O units (such as the FANUC cassette and FANUC Handy File). Do not use these lines for any other purpose. Also, do not connect more than one of these units to one CNC control unit. Otherwise, the +24 V power supply capacity may be exceeded.
3 Do not connect anything to those pins that are not labeled.

9.7.10 Soft Keys



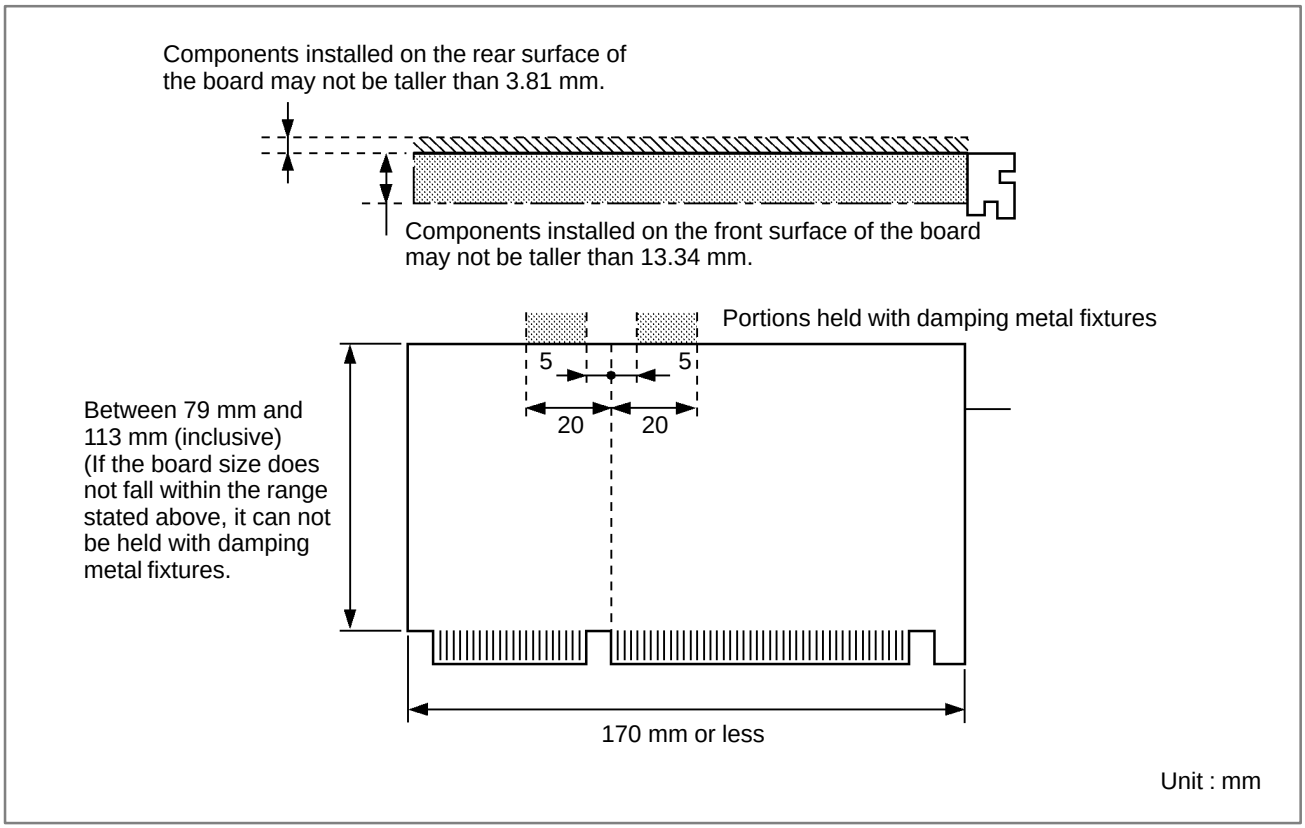
(1) Cable length: 50 cm

9.8 ISA EXPANSION BOARD

9.8.1 Installation Method

(1) Usable boards

Up to two ISA expansion boards (shown below) can be used in intelligent terminal type 2.



NOTE

FANUC does not guarantee the normal operation of any commercial ISA expansion board and is not responsible for its maintenance.

(2) ISA expansion board installation procedure

(See the following diagram.)

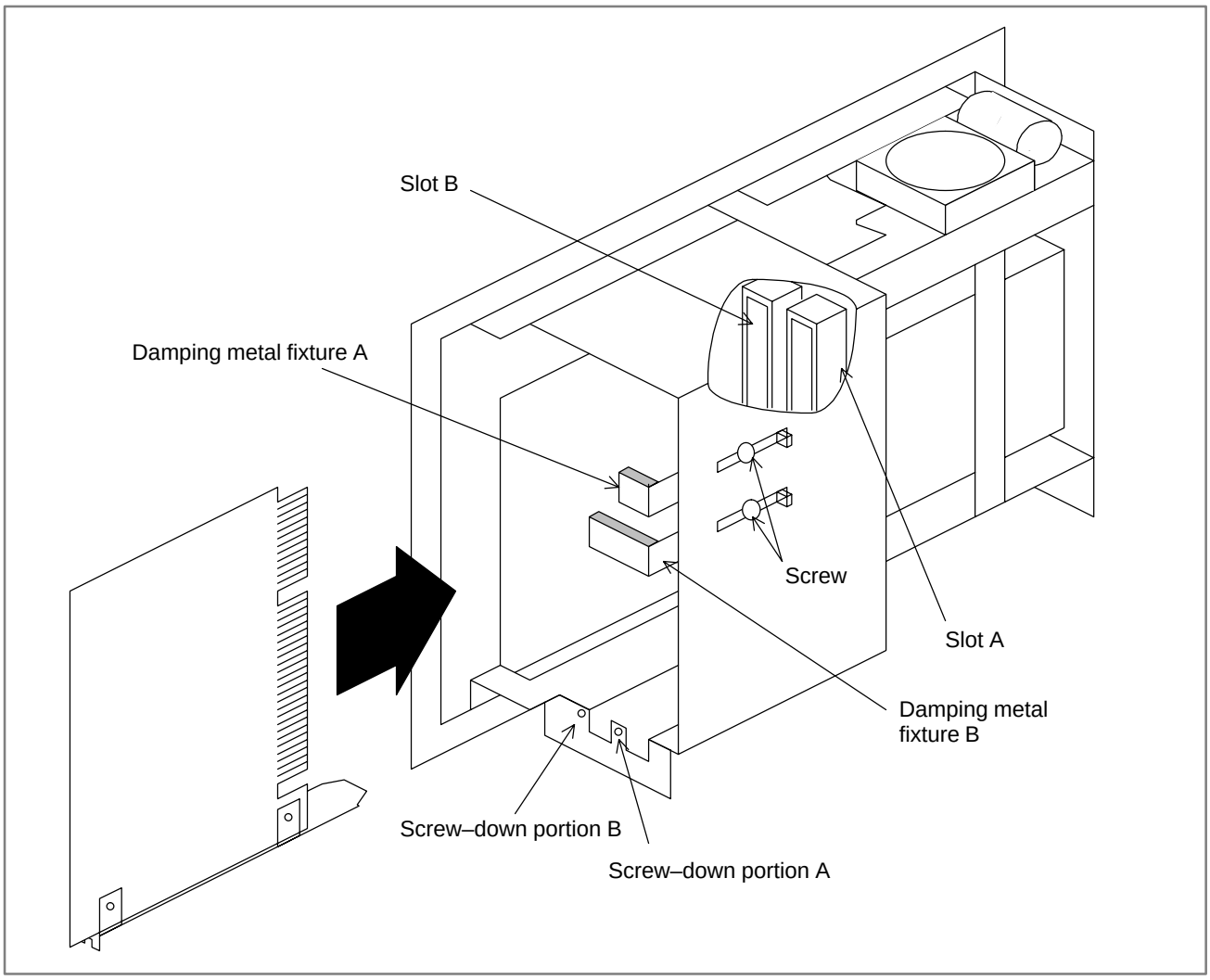
a) Remove the damping metal fixtures.

b) Fully insert the board into the connector.

c) Fasten the board with the provided screws.

d) Screw down the damping metal fixtures while holding them against the board.

If more than one ISA expansion board is installed, the board installed in slot A must be shorter than that installed in slot B; otherwise, it will be impossible to hold both with damping metal fixtures.

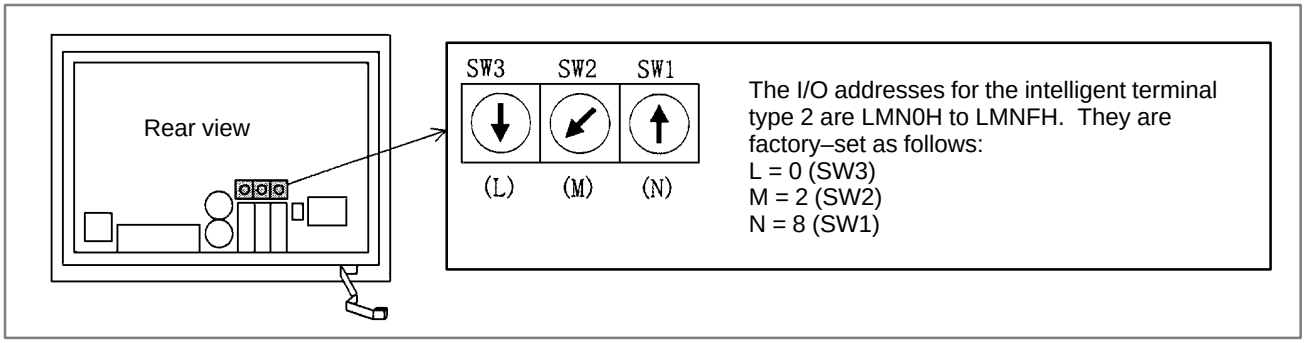


ISA expansion board installation

9.8.2 Handling Precautions

(1) Address map

- Intelligent terminal type 2 uses the same memory space configuration as the IBM PC and compatibles. It cannot use E0000H to EFFFFH, however.
- The ISA expansion board cannot use the I/O space between 0280H and 028FH, because the intelligent terminal type 2 uses this I/O space. However, these addresses can be changed using the rotary switch on the main printed–circuit board.



The other areas for intelligent terminal type 2 are the same as for the IBM PC and compatibles.

- COM1, COM2, and parallel ports are specified at setup.

(2) Interrupt and DMA requests

- The IRQ signals not used by the intelligent terminal type 2 are as follows: IRQ10 and IRQ11
- The DRQ signal used by the intelligent terminal type 2 is as follows: DRQ2 (floppy disk drive)

(3) Allowable power supply current
For the allowable power supply current for the ISA expansion board, see Section 9.5.2, “Power supply specification.”

(4) Cabling
For cabling, see Section 9.6, “Installation Space.”

(5) Environmental conditions for ISA expansion board installation
For the environmental conditions that must be satisfied when installing an ISA expansion board, see the respective ISA expansion board specifications. If your ISA expansion board does not satisfy the conditions stated in Section 9.5.1, “Installation environmental conditions,” the environmental conditions for your intelligent terminal type 2 will default to those for your ISA expansion board.

(6) Miscellaneous
In addition to the handling precautions stated above, the ISA expansion board may not operate normally if:

- Its ISA signal is pulled up or down.
- It uses the ISA bus refresh cycle.
- It functions as the bus master to perform 8–bit write access to the host.
  Note that the AHA–154 SCSI interface board manufactured by Adaptec cannot be used in intelligent terminal type 2.

It is likely that conditions will be added in the future.

FANUC does not guarantee the normal operation of any ISA expansion board. In addition, FANUC is not able to provide troubleshooting or maintenance related to ISA expansion boards.

10 CONNECTION TO FANUC I/O Link

10.1 GENERAL

The FANUC I/O Link is a serial interface which connects the CNC, cell controller, I/O Unit–A, or Power Mate and transfers I/O signals (bit data) at high speeds between each device. The FANUC I/O Link regards one device as the master and other devices as slaves when more than one device is connected. Input signals from the slaves are sent to the master at specified intervals. Output signals from the master are also sent to the slaves at specified intervals.

10.2 CONNECTION

On *i* Series, the interface connector JD1A for I/O Link is provided on the main board.
In the I/O there are the master station and its slave stations. The master is the control unit of the CNC, and the slave is the I/O unit–A. The slaves are divided into groups, and up to 16 groups can be connected to one I/O Link. A maximum of two base I/O units can be connected as a group.
The I/O Link is connected in different ways depending on the types of units actually used and the I/O points. To connect the I/O Link, the assignment and addresses of the I/O signals have been made programmable with the PMC program. The maximum number of I/O points is 1024.
The two connectors of the I/O Link are named JD1A and JD1B, and are common to all units (that have I/O Link function). A cable is always connected from JD1A of a unit to JD1B of the next unit. Although JD1A of the last unit is not used and left open, it need not be connected with a terminator.
The pin assignments of connectors JD1A and JD1B are common to all units on the I/O Link, and are illustrated on Subsec. 10.2.1. Use the figures when connecting the I/O Link irrespective of the type of unit.

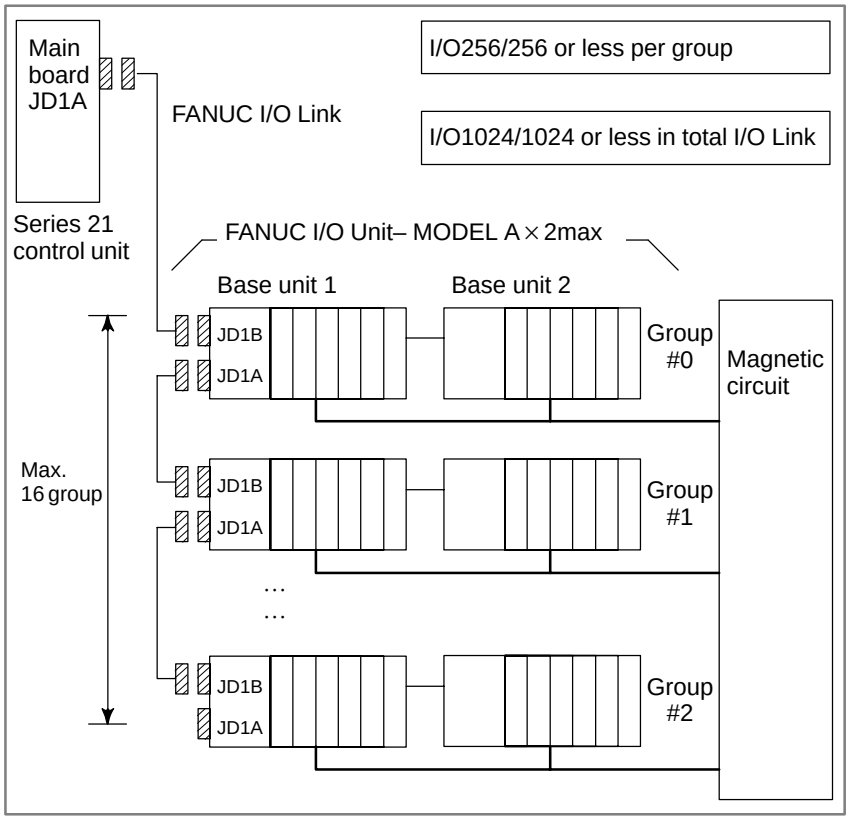
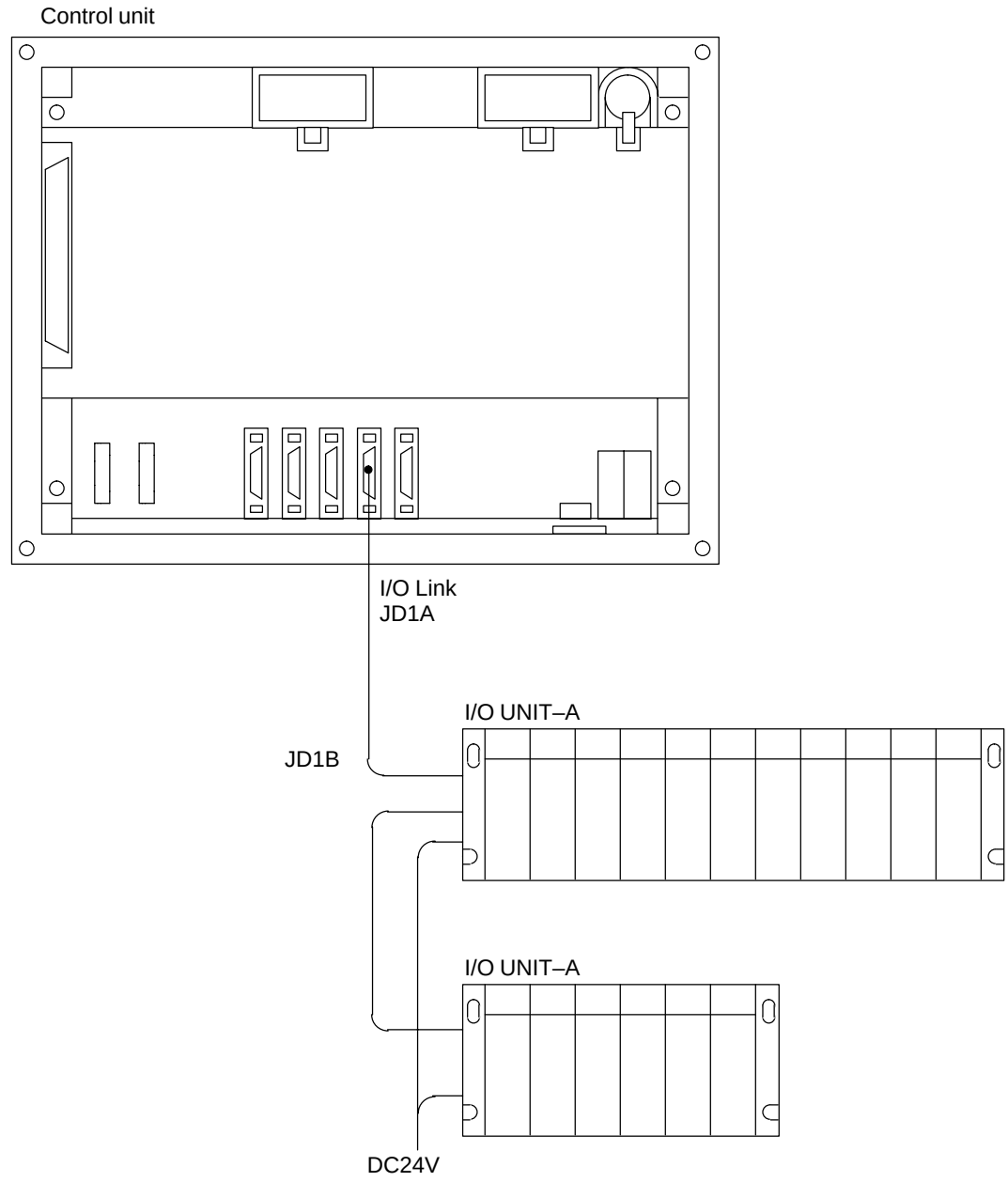
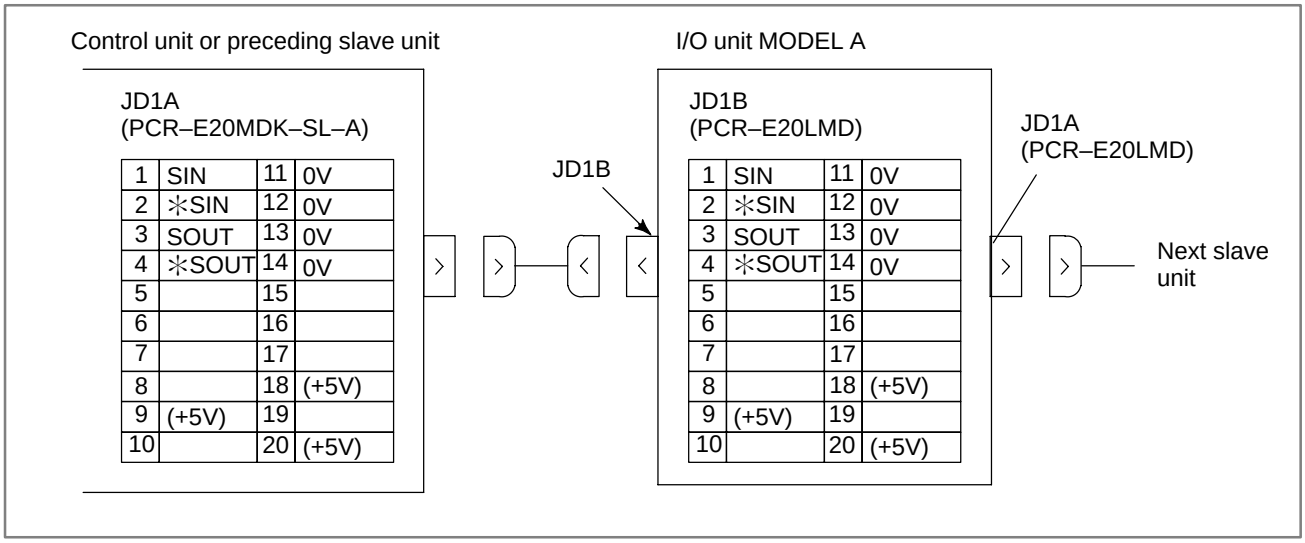


Fig. 10.2 I/O Link connection diagram



This figure is an example of connecting the I/O Link to an *i* Series CNC with a LCD–mounted type panel.

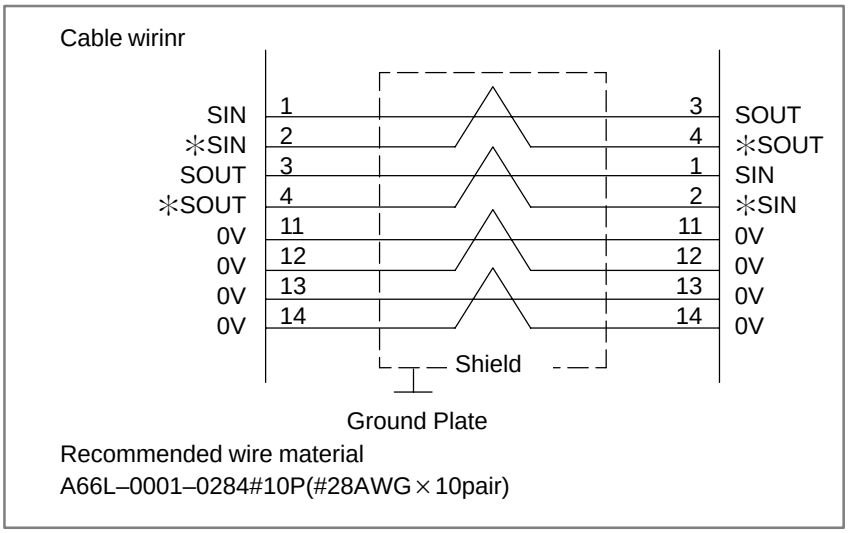
10.2.1 Connection of FANUC I/O Link by Electric Cable



1	SIN	11	0V
2	⁎SIN	12	0V
3	SOUT	13	0V
4	⁎SOUT	14	0V
5		15	
6		16	
7		17	
8		18	(+5V)
9	(+5V)	19	
10		20	(+5V)

1	SIN	11	0V
2	⁎SIN	12	0V
3	SOUT	13	0V
4	⁎SOUT	14	0V
5		15	
6		16	
7		17	
8		18	(+5V)
9	(+5V)	19	
10		20	(+5V)

+5 V terminals are for an optical I/O Link adapter. They are not necessary when connecting with a metal cable.
A line for the +5V terminal is not required when the Optical I/O Link Adapter is not used.



Recommended cable connectors
PCR–E20FA (Honda Tsushin Kogyo Co., Ltd.)
FI30–20S (Hirose Electric Co., Ltd.)
FCN–247J020–G/E (Fujitsu Ltd.)
52622–2011 (Molex Japan Co., Ltd.)

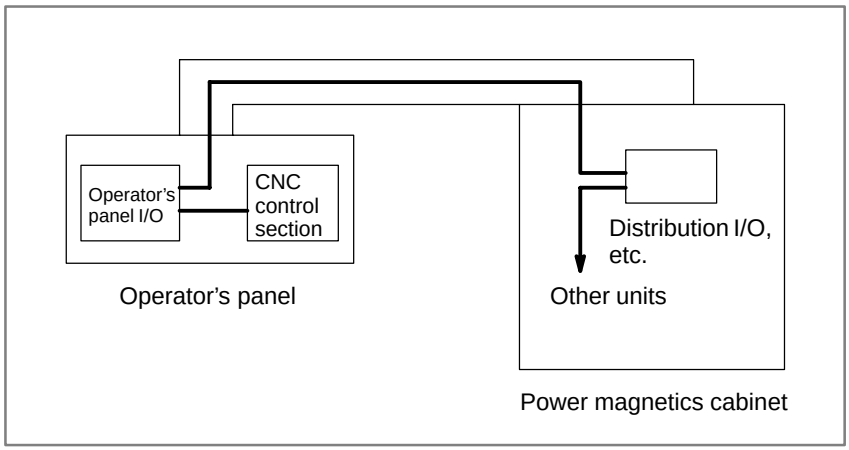
The recommended cable–end connector F130–20S (Hirose Electric Co., Ltd.) can be used only as connector JD1A for the *i* Series CNC with a LCD–mounted type panel.

10.2.2 Connection of FANUC I/O Link Optical Fiber Cable

The FANUC I/O Link can be extended to the maximum length of 200 m with optical fiber cables using an optical I/O Link adapter. The length of the electrical cable connected to the optical conversion adapter must not exceed 2 m.

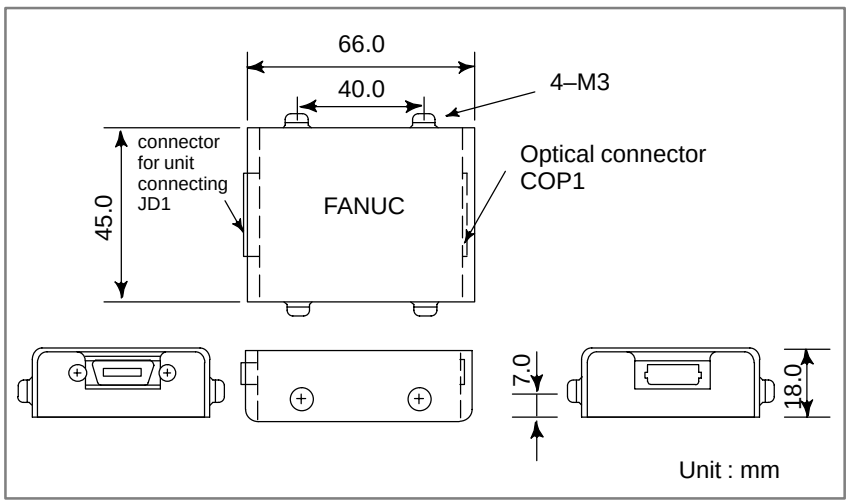
In the following cases, use an optical fiber cable.

- When the cable is more than 15 meters long.
- When the cable is run between different cabinets, and the cabinets cannot be connected with each other via a ground wire of 5.5 mm^2 or more.
  If the power magnetics cabinet includes an I/O Link slave unit, and cables are connected through a duct to the operator's panel (as shown below), the control section I/O Link slave unit can be assumed to be incorporated in the same cabinet.



- When there is concern that the cable is influenced by strong noise; for example :
  When there is a strong electromagnetic noise source beside the cable such as a welding machine.
  When a noise generating cable such as a power cable runs for a long distance in parallel with the cable.

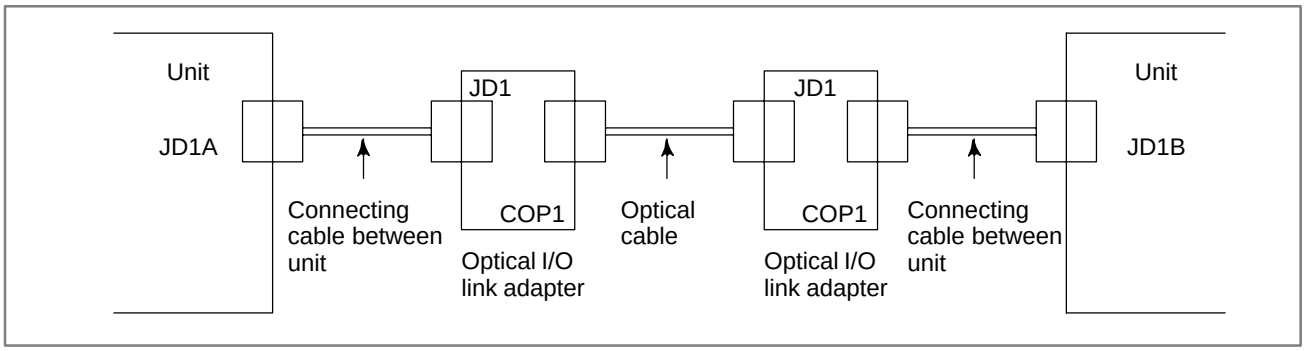
External dimension of optical link adapter



Weight of optical link adapter Main body: Approx. 100 g.

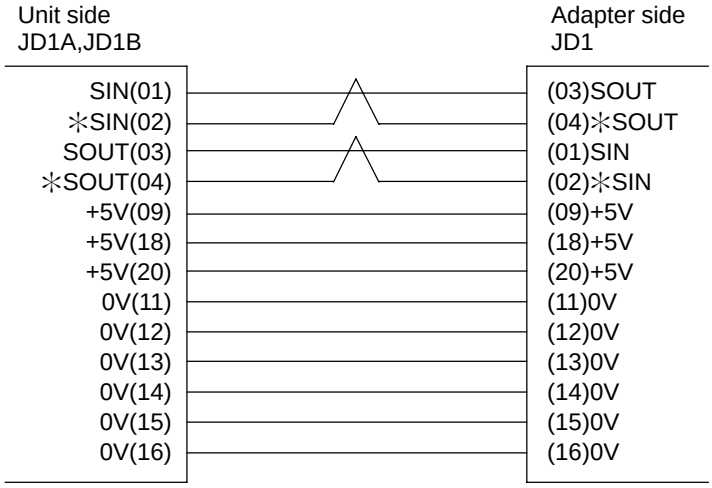
Connection

- **Connection diagram**



- **Interunit connecting cables**

01	SIN	11	0V
02	⁎SIN	12	0V
03	SOUT	13	0V
04	⁎SOUT	14	0V
05		15	0V
06		16	0V
07		17	
08		18	+5V
09	+5V	19	
10		20	+5V



1 Recommended cable connectors
PCR–E20FA (Honda Tsushin Kogyo Co., Ltd.)
FI30–20S (Hirose Electric Co., Ltd.)
FCN–247J020–G/E (Fujitsu Ltd.)
52622–2011 (Molex Japan Co., Ltd.)

NOTE
The recommended cable–end connector FI30–20S (Hirose Electric Co., Ltd.) can be used only as connector JD1A for the *i* Series CNC with a LCD–mounted type panel.

2 Recommended cable (wire material) : A66L–0001–0284#10P

3 Cable length : Max. 2 m (when the recommended cable is used)

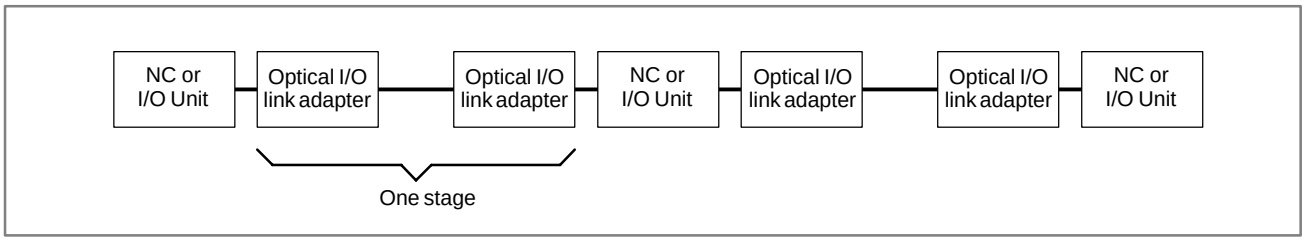
- **Optical cable**

1 Specification:
A66L–6001–0009# L5R003 5 m long
A66L–6001–0009# L10R03 10 m long
A66L–6001–0009# L15R03 15 m long

2 Cable length
Maximum length: 200 m (standard type)
Maximum length: 100 m (high–speed type)

NOTE
Be careful not bend optical cables to a radius of 25 mm or less. Be extremely careful not to twist them.

- Maximum number of connectable stages
Up to 16 high–speed type I/O link adapter stages can be connected in one I/O link, while only up to five conventional I/O link adapters (standard type) can be connected.
  1) Standard type (A13B–0154–B001) ... up to 5 adapter stages can be connected in series
  2) Standard type (A13B–0154–B002) ... up to 16 adapter stages can be connected in series



NOTE
It is impossible to use both high–speed and standard type adapters on the same line.

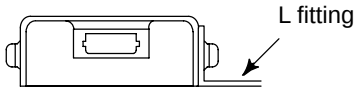
- Power supply
The same power supply type can be used for both the standard type (A13B–0154–B001) and high–speed type (A13B–0154–B002).
  (a) Power supply voltage: 4.75 to 5.25 V (at receiving end)
  (b) Required current: 200 mA

Installation conditions

(a) The optical link adapter enclosure is not fully sealed ; install it with the CNC control unit in the fully enclosed cabinet.

(b) Ground the case using the case fixing screw of the optical link adapter.

(c) The optical link adapter is light, and it may not be necessary to mount it with screws. However, keep it from coming in contact with other circuits to prevent possible short–circuits. When mounting the optical link adapter in a cabinet, attach it with an L–type fitting using the case fixing screws (M3) of the optical link adapter.



Required parts

For making up an I/O Link using the optical link adapter, the following parts are necessary:

1 Optical I/O Link adapter 2
2 Interunit connecting cable 2
3 Optical cable 1

- Relay with an optical fiber connection adapter
  For the outline drawing of the optical fiber connection adapter, see Appendix D.

NOTE
Optical fiber cables can be relayed only at are location.
When a high–speed optical link adapter is used, no optical fiber connection adapter can be used.

- Maximum transmission distance with an optical fiber cable(s)
  The table below shows the maximum transmission distance with an optical fiber cable(s), which varies depending on whether a connection adapter is used for a relay.

	Relay	Maximum transmission distance
Standard type	No	200m
	Yes	100m (total)
High–speed type	No	100m
	Yes	N/A

10.2.3 Connection when Two Channels of FANUC I/O Links are Used

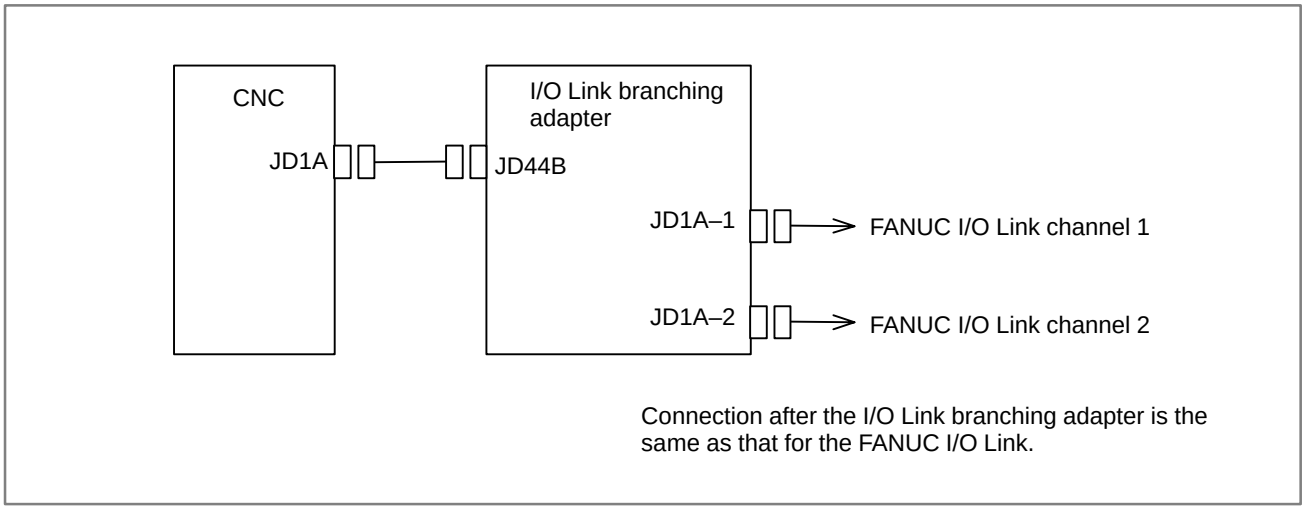
Except for the FS20*i*, two channels of FANUC I/O Link interfaces are provided. Since this feature is additional, however, some previous control units may not be capable of using two channels. Use of two channels allows the number of usable I/Os to be increased to 2048 for both inputs and outputs (previously, only 1024 inputs and 1024 outputs were usable).

Technical report called FANUC PMC Ladder Language Programming Supplement (document number: B–61863/12–5) is available separately to let you know how to use this feature, the overall version of the corresponding PC board, PMCs that can take advantage of this feature, and the series and version of their management software as well as the series and version of the CNC management software.

NOTE
When this feature is to be used by the *i* Series CNCs described above, PMC–SB6 needs to be specified.
The PMC on the loader control board cannot use this feature.

Signals for two channels are assigned to the FANUC I/O Link connector on the CNC. When using two channels, use the I/O Link branching adapter to branch off the FANUC I/O Link.

Connection



Part number of the I/O Link branching adapter: A20B–1007–0680 (60 g)

Restrictions

When two channels are used, a total of up to eight FANUC B I/O unit groups can be connected to them.

Connection between the CNC and I/O Link branching adapter

CNC
JD1A
(such as PCR–E20MDK–SL–A)

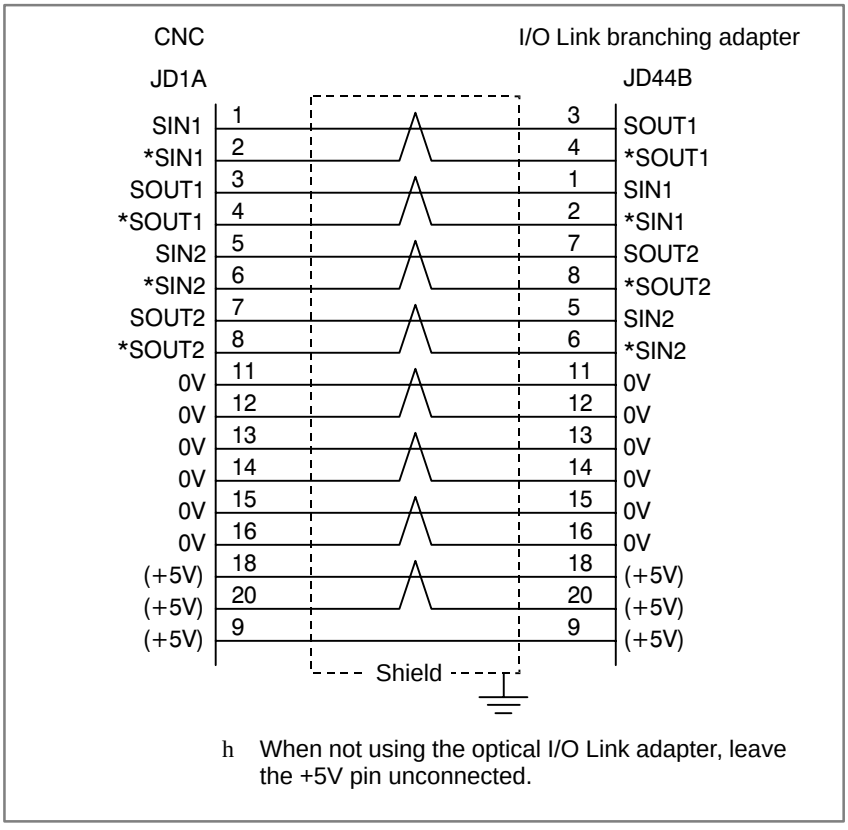
1	SIN1	11	0V
2	*SIN1	12	0V
3	SOUT1	13	0V
4	*SOUT1	14	0V
5	SIN2	15	0V
6	*SIN2	16	0V
7	SOUT2	17	
8	*SOUT2	18	(+5V)
9	(+5V)	19	(+24V)
10	(+24V)	20	(+5V)

I/O Link branching adapter
JD44B
(PCR–E20MDT)

1	SIN1	11	0V
2	*SIN1	12	0V
3	SOUT1	13	0V
4	*SOUT1	14	0V
5	SIN2	15	0V
6	*SIN2	16	0V
7	SOUT2	17	
8	*SOUT2	18	(+5V)
9	(+5V)	19	
10		20	(+5V)

The +5V pin is provided to use the optical I/O Link adapter for optical fiber transmission. When not using the optical I/O Link adapter, leave the +5V pin unconnected.
Do not connect anything to the +24V pin.

Cabling



h When not using the optical I/O Link adapter, leave the +5V pin unconnected.

Recommended cable connectors: PCR–E20FA (Honda Tsushin Kogyo Co., Ltd.)
FI30–20S (Hirose Electric Co., Ltd.)
FCN–247J020–G/E (Fujitsu)
52622–2011 (Molex Japan Co., Ltd.)

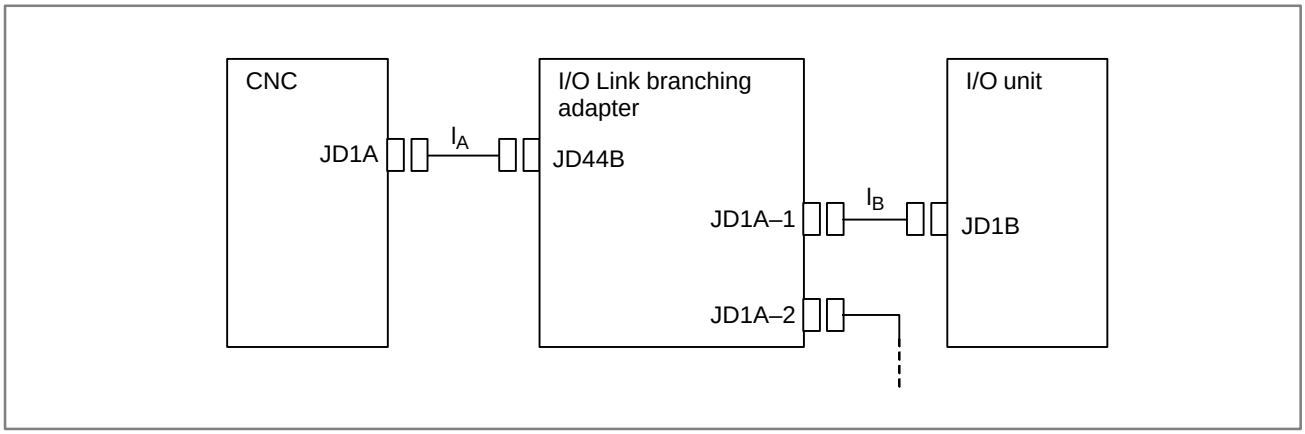
The FI30–20S connector (from Hirose Electric) cannot be used as connector JD1A on the main CPU board in the separate–type *i* Series.

Recommended cable: A66L–0001–0284#10P

Connection between the I/O Link branching adapter and FANUC I/O Link I/O units

The I/O Link branching adapter can be connected to I/O units in the same way as for the conventional FANUC I/O Link. See 10.2.1.

Cable length

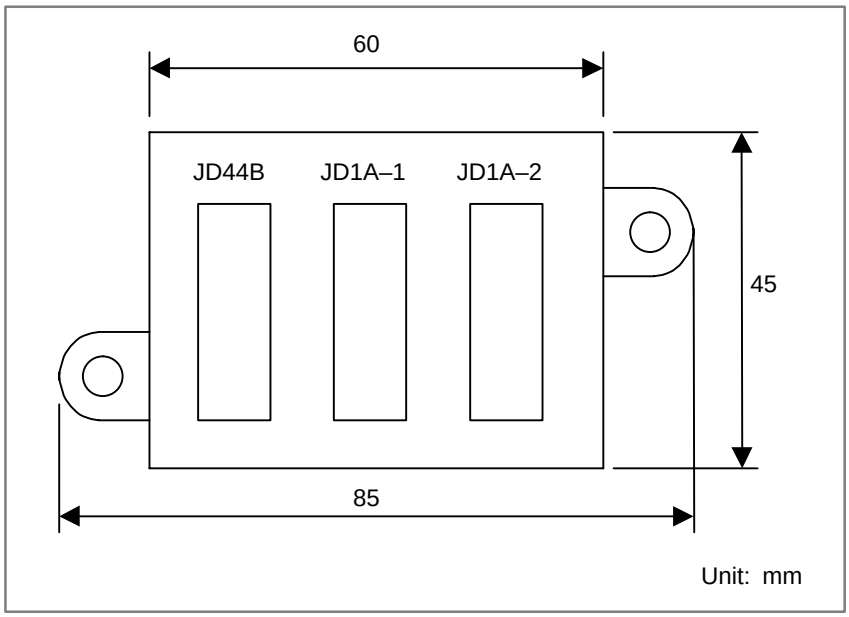


The total of lA and lB must not exceed 10 m; where lA is the length of the cable between connector JD1A on the CNC and connector JD44B on the I/O Link branching adapter, and lB is the length of the cable between connector JD1A–1 or JD1A–2 on the I/O Link branching adapter and connector JD1B on the I/O unit. When all cables are accommodated in the same cabinet, however, a total cable length of up to 15 m is allowed.

Installation of the I/O Link branching adapter

Install the I/O Link branching adapter in a hermetically sealed cabinet like the CNC.

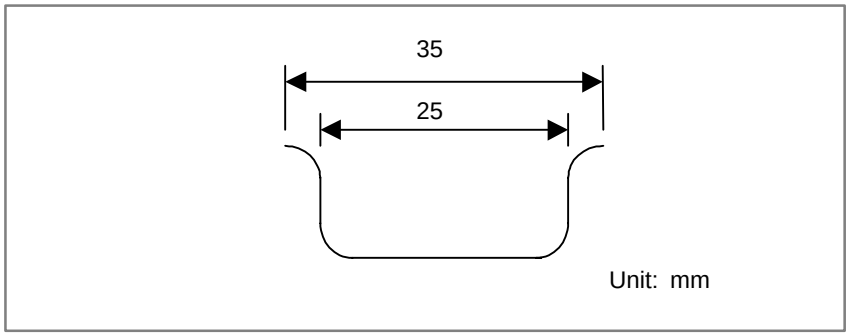
External dimensions of the I/O Link branching adapter



Allow a clearance of about 10 cm above the adapter for connection and routing of cables.

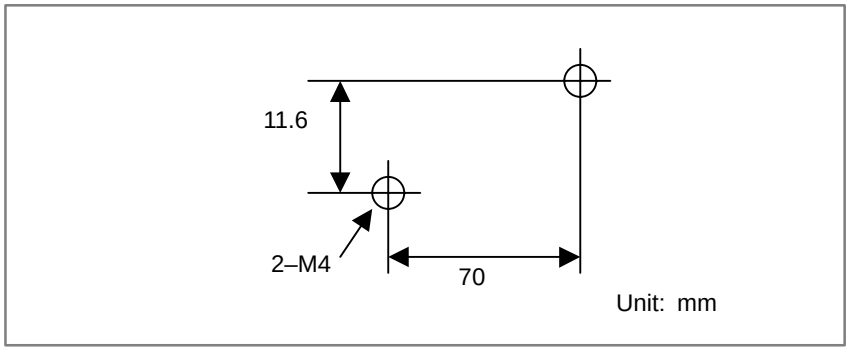
Installation of the I/O Link branching adapter

1) Installation on the DIN rail



Recommended DIN rail

2) Screwing



Drilling on the plate

10.3 UNITS THAT CAN BE CONNECTED USING FANUC I/O Link

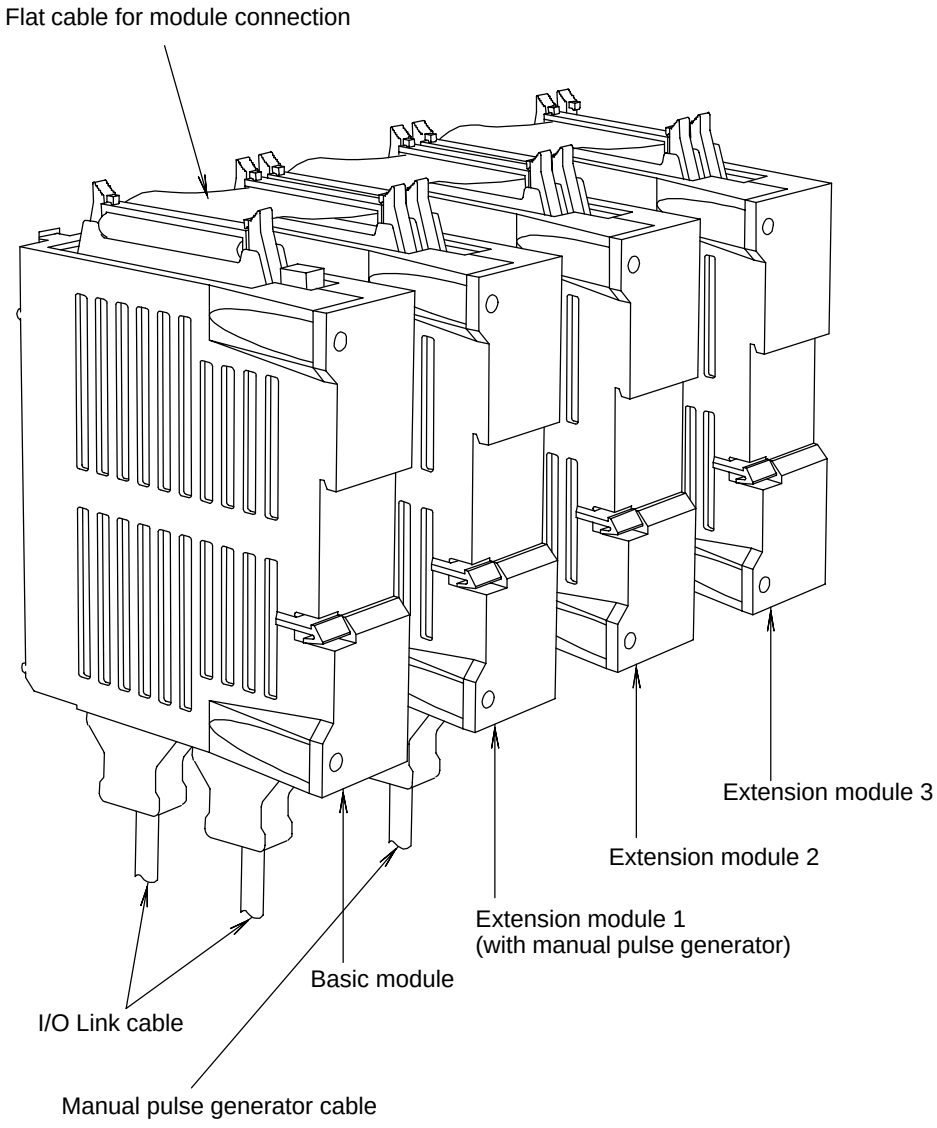
Basically, the *i* Series can be connected to any unit that has a FANUC I/O Link slave interface. The following table lists general units that can be connected to the *i* Series. Detailed descriptions of each unit are given later in this section. For details of other units, refer to the documentation provided with the unit.

General units that can be connected to the *i* Series

Unit	Description	Reference
FANUC I/O Unit–MODEL A	Modular I/O unit that supports a combination of the input/output signals required by a power magnetics circuit.	Connection and maintenance manual B–61813E
FANUC I/O Unit–MODEL B	Distribution type I/O unit that supports a combination of input/output signals required by a power magnetics circuit.	Connection and maintenance manual B–62163E
Connector panel I/O module	Distribution type I/O unit that handles the input/output signals required by the power magnetics circuit; it has an interface with a manual pulse generator.	Sec. 10.4
Operator's panel I/O module (for matrix input)	Unit having an interface with a machine operator's panel; it has an interface with a manual pulse generator.	Sec. 10.5
Operator's panel I/O module	Unit having an interface with a machine operator's panel that handles the input/output signals required by the power magnetics circuit; it has an interface with a manual pulse generator.	Sec. 10.6
Power magnetics panel I/O module	Unit having an interface with a power magnetics panel that handles the input/output signals required by the power magnetics circuit.	Sec. 10.6
Machine operator's panel interface unit	Unit having an interface with a matrix of key switches and LEDs on the machine operator's panel as well as an interface with a manual pulse generator.	Sec. 10.7
Operator's panel connection unit	Unit having an interface with a machine operator's panel	Sec. 10.8
Source type output operator's panel connection unit	Unit having an interface with a machine operator's panel; a source type output circuit is used in the DO signal output driver.	Sec. 10.9
FANUC I/O Link connection unit	Unit connecting FANUC I/O Link masters to enable the transfer of DI/DO signals	Sec. 10.10
FANUC servo unit β series (with I/O Link)	Unit connected with the CNC via the FANUC I/O Link to control a servo motor	Sec. 10.11

10.4 CONNECTION OF CONNECTOR PANEL I/O MODULE

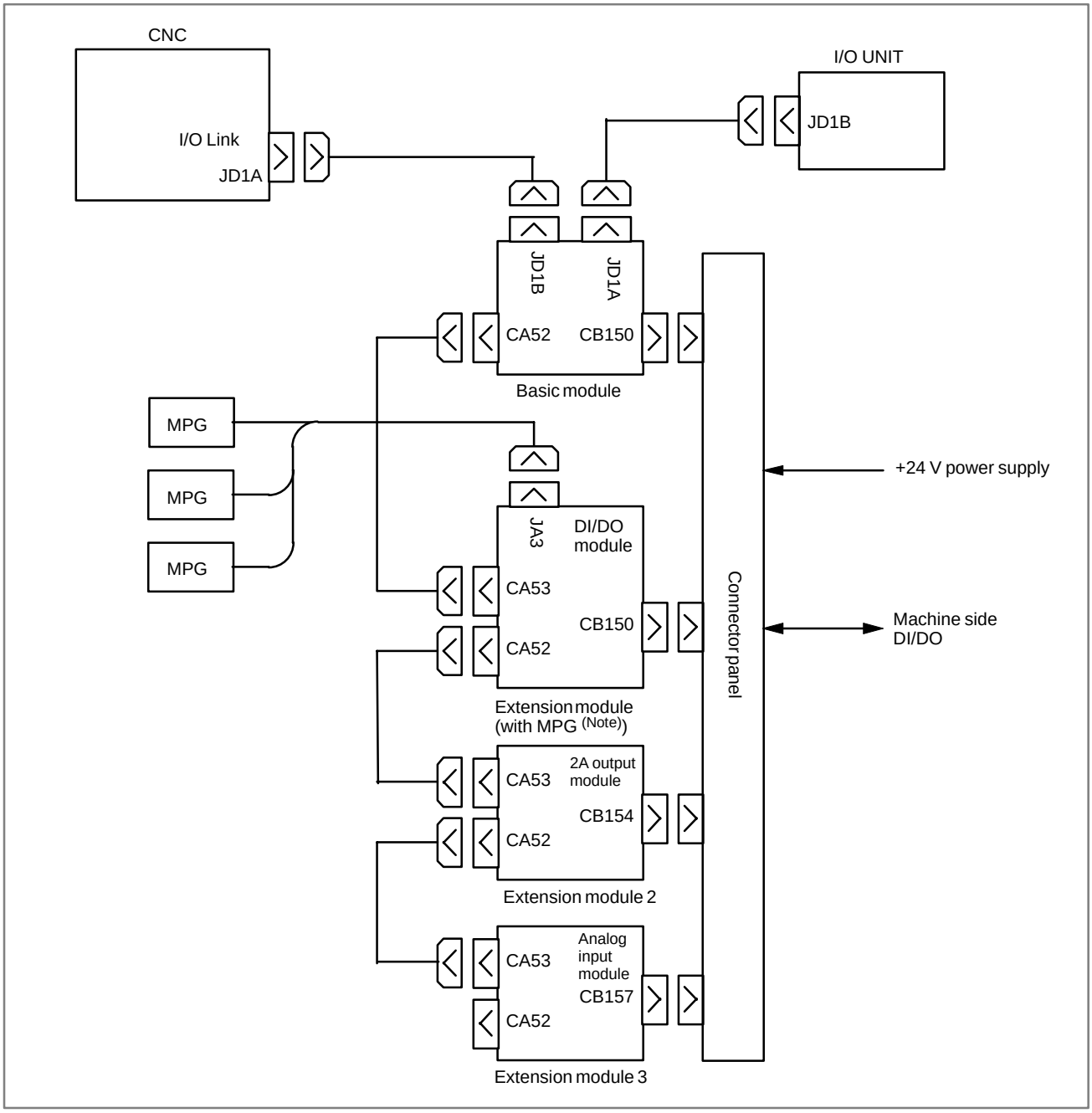
10.4.1 Configuration



NOTE

For direction connection to the connection printed circuit board, expansion modules are installed to the right of the basic module on the installation plane. For installation using DIN rails or screws, expansion modules are installed to the left of the basic module on the installation plane.

10.4.2
Connection Diagram



NOTE
1 Ensure that the extension module with the MPG interface is located nearest to the basic module, as shown in the figure. The MPG can be connected to the connector panel I/O module only when the *i* series CNC is used. When the connector panel I/O module is used together with a unit (such as an operator's panel I/O module) connected to the I/O Link supporting another MPG interface, only the MPG interface of the unit (module) closest to the CNC connected to the I/O Link is effective.
2 The connection diagram above shows an example of using a DI/DO module, 2A output module, and analog input module as expansion modules. These expansion modules can be used in any combination.

10.4.3 Module Specifications

Types of modules

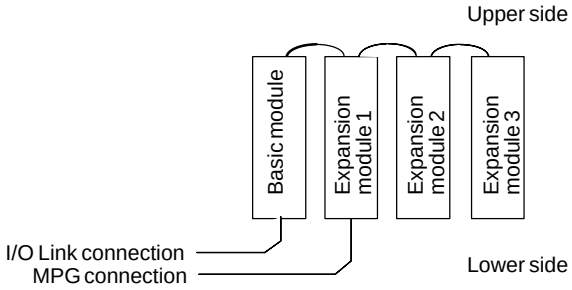
Name	Drawing No.	Specifications	Reference item
I/O module for connection (basic module)	A03B–0818–C001	DI/DO : 24/16	
I/O module for connection (expansion module A)	A03B–0818–C002	DI/DO : 24/16 With MPG interface	
I/O module for connection (expansion module B)	A03B–0818–C003	DI/DO : 24/16 Without MPG interface	
I/O module for connection (expansion module C)	A03B–0818–C004	DO : 16 2A output module	
I/O module for connection (expansion module D)	A03B–0818–C005	Analog input module	
Fuse (accessory)	A03B–0815–K002	1A (For basic module)	
Inter–module flat cable	A03B–0815–K100	20 mm long Suitable for a module interval of 32 mm	

Module specifications (common items)

Item	Specifications	Remarks
Interface with CNC	FANUC I/O Link connection	Expandable up to 16 units or 1024/1024 points as CNC slaves
Interface between basic module and expansion modules	Bus connection using a flat cable	Up to three expansion modules connectable per basic module

For the specifications (such as signal input requirements) specific to each module, see the relevant pages of each item.

Installation conditions

Ambient temperature for the unit	Operation: 0°C to 55°C Storage and transportation: –20°C to 60°C
Temperature change	1.1°C/minute maximum
Humidity	Normal condition: 75% (relative humidity) Short term (within one month): 95% (relative humidity)
Vibration	Operation: 0.5 G or less
Atmosphere	Normal machining factory environment (For use in an environment with relatively high levels of dust, coolant, organic solutions, and so forth, additional measures are required.)
Other conditions	(1) Use each I/O module in a completely sealed cabinet. (2) For ventilation within each I/O module, each module must be installed in the orientation shown below. Moreover, for ventilation and wiring, allow a clearance of 100 mm or more above and below each module. Never place a device that generates a large amount of heat below an I/O module. (3) While referring to Section 9.4.18, ensure that the vent hole of the basic module is not obstructed by the flat cable. 

Power supply rating

Module	Power supply voltage	Power supply rating	Remarks
Basic module	24 VDC ±10% is fed through the I/O connector (CB150) of the basic module; ±10% includes momentary variations and ripples.	0.2A+7.3mA × DI	Number of DI points with DI=ON
Expansion modules A and B		0.1A+7.3mA × DI	Number of DI points with DI=ON
Expansion module C (2A module)		0.1A	
Expansion module D (analog input module)		0.1A	

As a guideline for the heat dissipation, assume [power supply capacity × 24 (W)].

10.4.4 DI/DO Connector Pin Assignment

This section describes the DI/DO connector pin allocation of the basic module and expansion modules A and B.

CB150 (HONDA MR–50RMA)

33	DOCOM			01	DOCOM
34	Yn+0.0			02	Yn+1.0
35	Yn+0.1	19	0V	03	Yn+1.1
36	Yn+0.2	20	0V	04	Yn+1.2
37	Yn+0.3	21	0V	05	Yn+1.3
38	Yn+0.4	22	0V	06	Yn+1.4
39	Yn+0.5	23	0V	07	Yn+1.5
40	Yn+0.6	24	DICOM0	08	Yn+1.6
41	Yn+0.7	25	Xm+1.0	09	Yn+1.7
42	Xm+0.0	26	Xm+1.1	10	Xm+2.0
43	Xm+0.1	27	Xm+1.2	11	Xm+2.1
44	Xm+0.2	28	Xm+1.3	12	Xm+2.2
45	Xm+0.3	29	Xm+1.4	13	Xm+2.3
46	Xm+0.4	30	Xm+1.5	14	Xm+2.4
47	Xm+0.5	31	Xm+1.6	15	Xm+2.5
48	Xm+0.6	32	Xm+1.7	16	Xm+2.6
49	Xm+0.7			17	Xm+2.7
50	+24V			18	+24V

50 male pins with fittings for fixing the connector covers

NOTE

1 The DI and DO addresses for the basic and extension modules run contiguously. These basic and extension module DI and DO addresses are allocated to the I/O Link as a group. For example, when the DI and DO top addresses are X0004 and Y0000 (m = 4 and n = 0), respectively, then the addresses are allocated as shown in the following table.

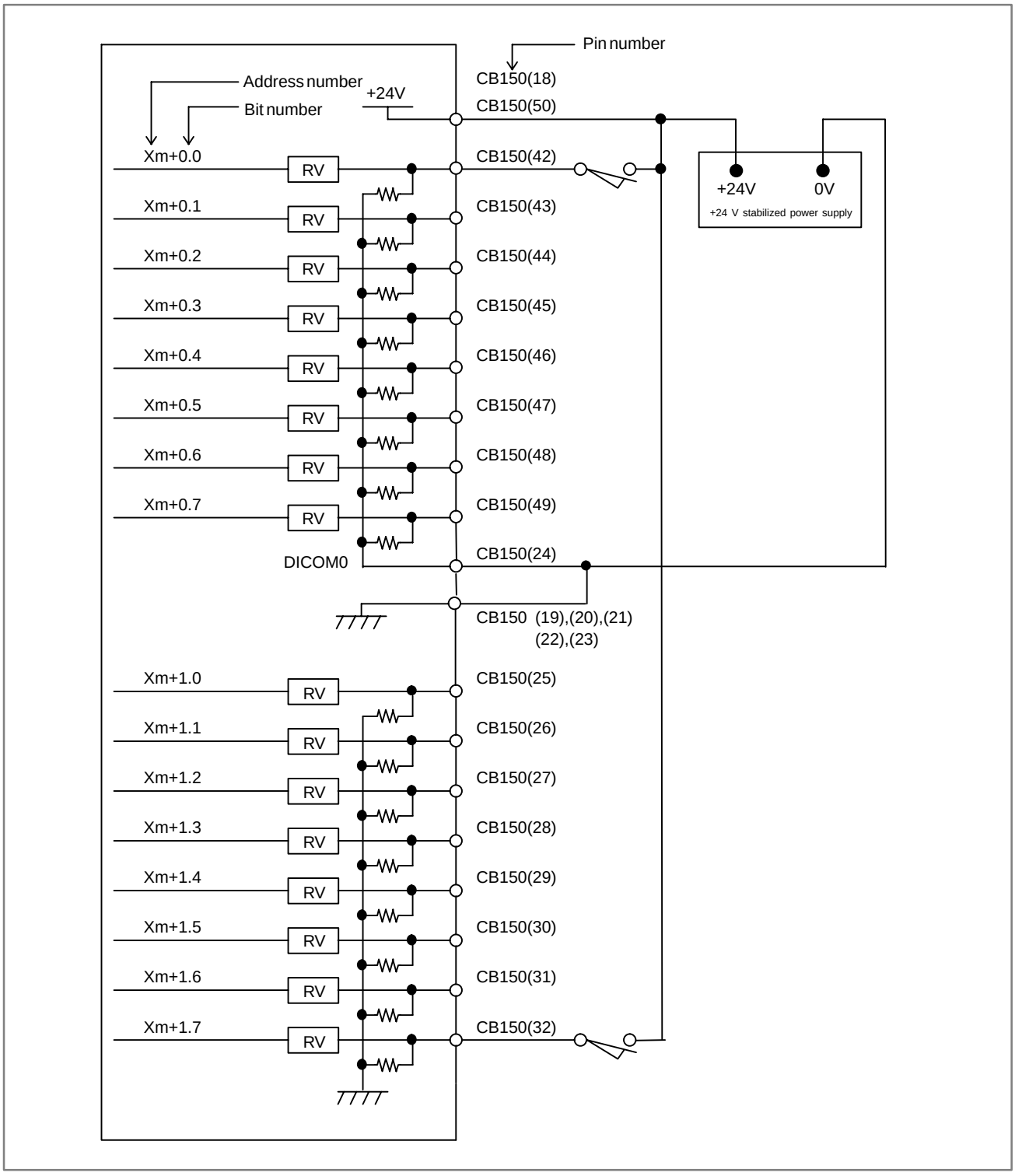
2 Pins 18 and 50 (+24V) of connector CB150 are used to apply 24 V externally to a module. Be sure to connect these pins because the +24 V applied to the module is used internally.

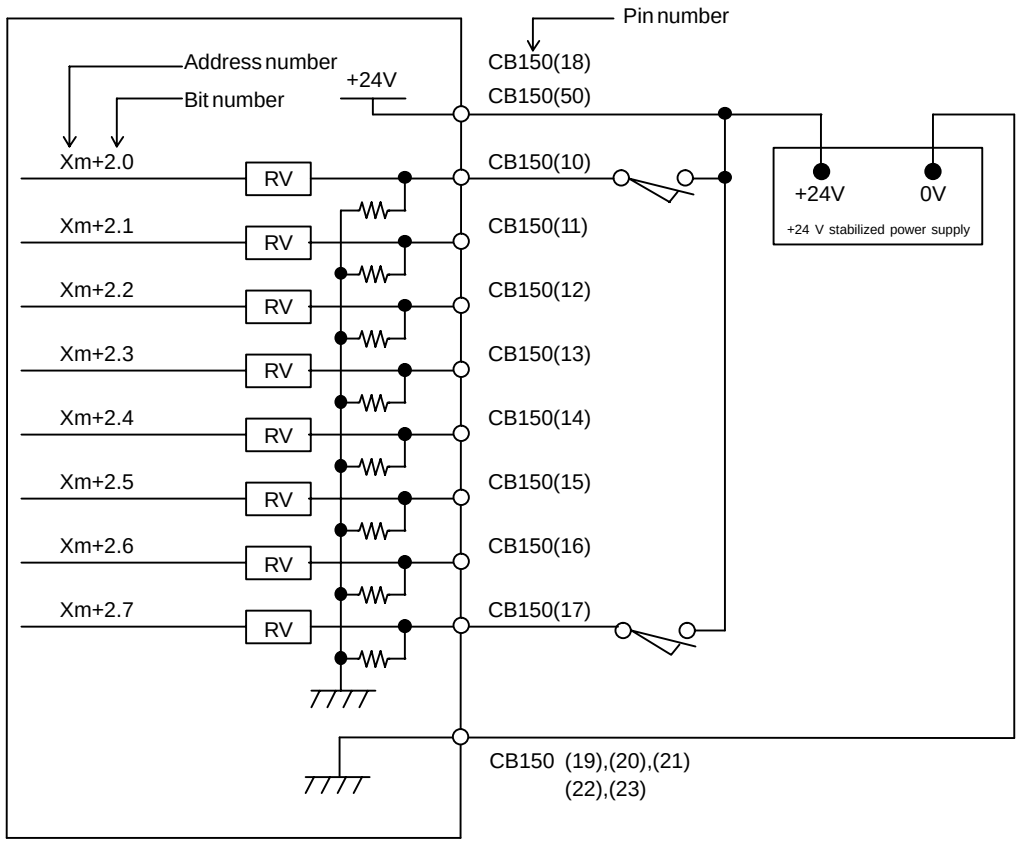
	DI	DO
Basic module	X4–X6	Y0–Y1
Extension module 1	X7–X9	Y2–Y3
Extension module 2	X10–X12	Y4–Y5
Extension module 3	X13–X15	Y6–Y7

10.4.5 DI (Input Signal) Connection

This section describes the DI (input signal) connections of the basic module and expansion modules A and B.

○ A maximum of 96 points are provided
(24 points per module; 1 basic module + 3 extension modules).





NOTE

Xm+0.0 through Xm+0.7 are DI pins for which a common voltage can be selected. That is, by connecting the DICOM0 CB150(24) pin to the +24 V power supply, a DI signal can be input with its logical state reversed. If, however, a cable is connected to ground, it has the same effect as inputting an ON state DI signal. To prevent such accidents, the connection of the DICOM0 CB150(24) pin to the 0 V power supply is recommended whereever possible.

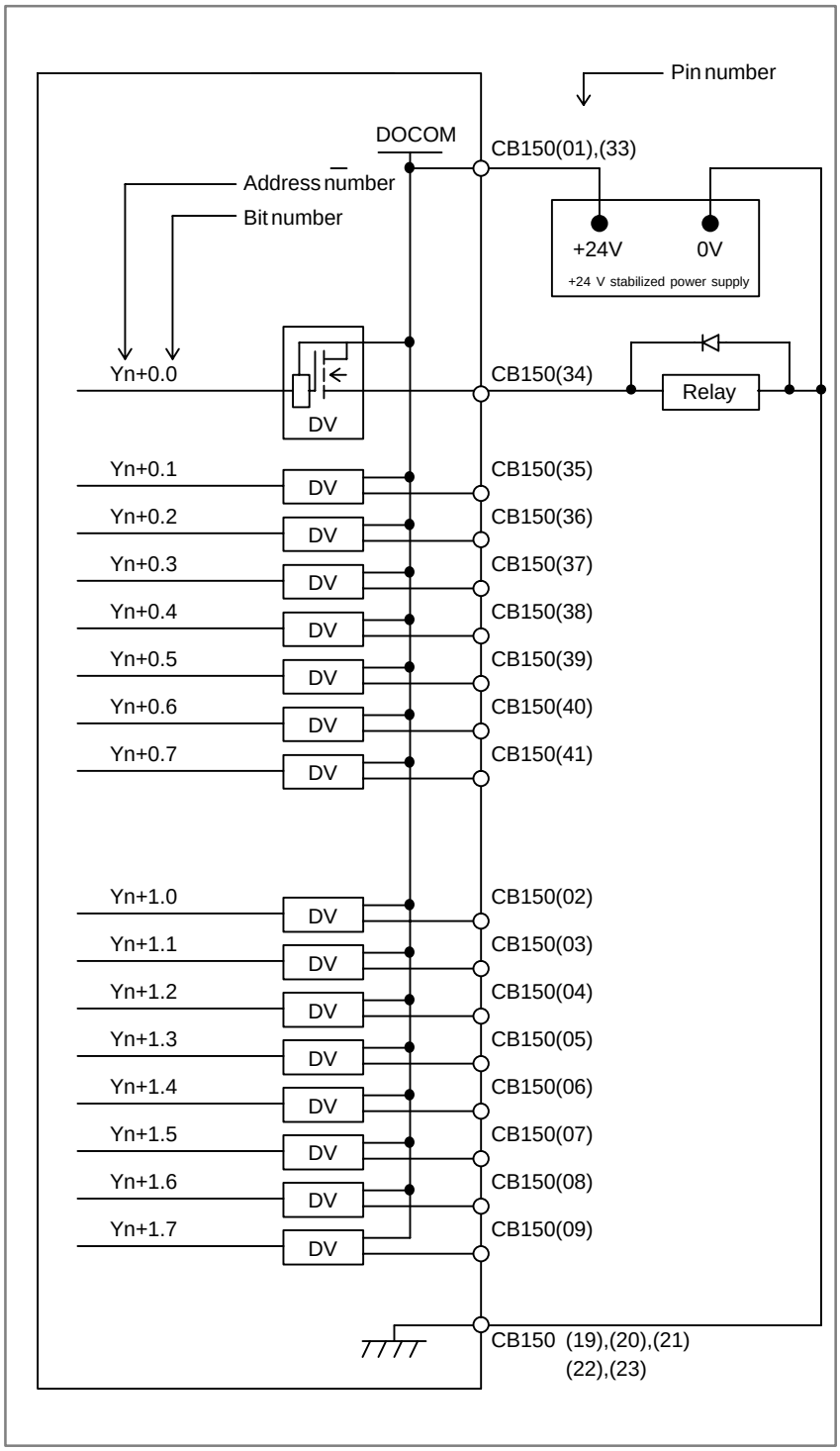
For safety reasons, the emergency stop signal needs to be allocated to an appropriate bit of the addresses for which the common voltage is fixed, ranging from Xm+1.0 to Xm+1.7 or from Xm+2.0 to Xm+2.7. See 9.4.20 for information about how to allocate the emergency stop signal.

For unused DI pins allocated to the addresses for which the common voltage is fixed (from Xm+1.0 to Xm+1.7 and from Xm+2.0 to Xm+2.7), the logic is fixed to “0”. For unused pins allocated to Xm+0.0 to Xm+0.7 for which the common voltage can be selected, the logic is fixed to “0” when the DICOM0 CB150(24) pin is connected to the 0 V power supply. When the DICOM0 CB150(24) pin is connected to the +24 V power supply, the logic is fixed to “1”. The logic of the unused pins allocated to Xm+0.0 to Xm+0.7 is variable when the contact of the DICOM0 CB150(24) pin is open.

10.4.6 DO (Output Signal) Connection

This section describes the DO (output signal) connections of the basic module and expansion modules A and B.

○ A maximum of 64 points are provided (16 points per module; 1 basic module + 3 extension modules).



10.4.7 DI/DO Signal Specifications

This section describes the specifications of the DI/DO signals used with the basic module and expansion modules A and B.

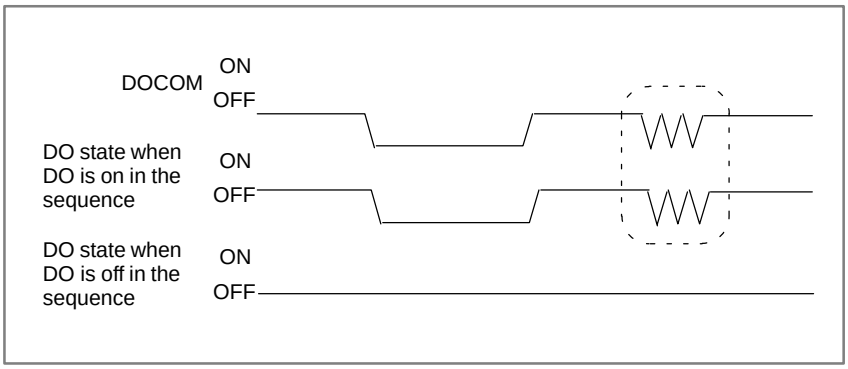
DI (input signal specifications)

Number of points	24 points (per module)
Contact rating	30 VDC, 16 mA or more
Leakage current between contacts when opened	1 mA or less (26.4 V)
Voltage decrease between contacts when closed	2 V or less (including a cable voltage decrease)
Delay time	The receiver delay time is 2 ms (maximum). In addition, [I/O Link transfer time between CNC and I/O module (2 ms maximum)] + [ladder scan period (depending on CNC)] must be considered.

DO (output signal specifications)

Number of points	16 points (per module)
Maximum load current when ON	200 mA or less including momentary variations
Saturation voltage when ON	1 V (maximum) when the load current is 200 mA
Withstand voltage	24 V +20% or less including momentary variations
Leakage current when OFF	20 μA or less
Delay time	The driver delay time is 50 μs (maximum). In addition, [I/O Link transfer time between CNC and I/O module (2 ms maximum)] + [ladder scan period (depending on CNC)] needs to be considered.

ON/OFF of the power supply (DO common) for DO signals (output signals)
By turning off (opening) the power supply pin (DOCOM) for the DO signals (output signals), all the DO signals of each module can be turned off at the same time. At this time, the DO state is as shown below.

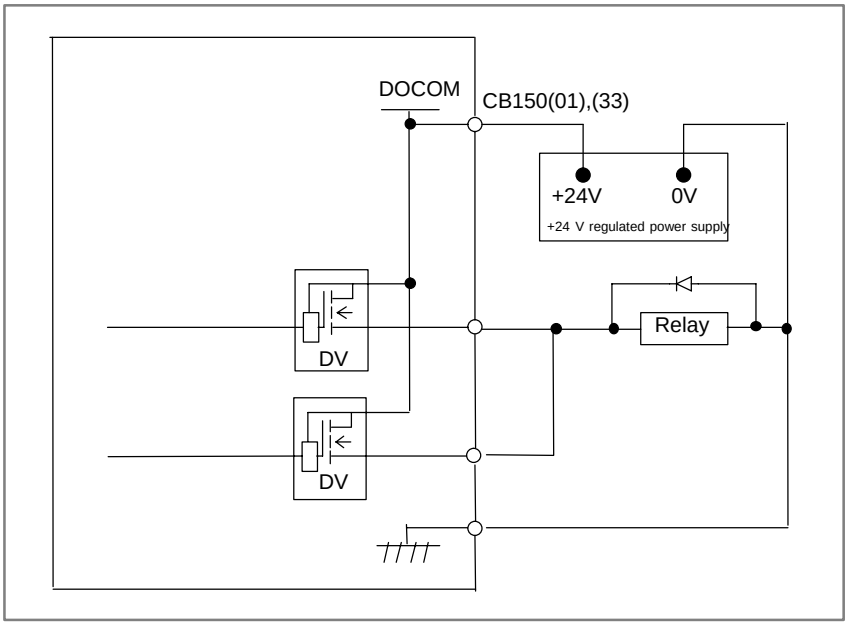


NOTE

When DO is on in the sequence, the ON/OFF state of DOCOM is directly reflected in the DO state as indicated above by the dashed box. The +24 V signal to be supplied to the I/O module must not be turned off during operation. Otherwise, a CNC communication alarm is issued. Ensure that +24 V is supplied either when or before the power to the CNC is turned on, and that +24 V is removed either when or after the power to the CNC is turned off.

Parallel DO (output signal) connection

A DO load current of twice the level can be obtained by connecting DO points in parallel and exercising ON/OFF control at the same time in the sequence. Namely, the maximum load current per DO point is 200 mA. By connecting two DO points in parallel and turning on the two DO points at the same time, 400 mA can be obtained. In this case, however, the leakage current is doubled up to 40 μA when the DO points are turned off.



10.4.8 2A Output Connector Pin Allocation

This section describes the 2A output connector pin allocation of expansion module C.

CB154 (HONDA MR–50RMA)

33	DOCOMA			01	DOCOMA
34	Yn+0.0			02	Yn+1.0
35	Yn+0.1	19	GNDA	03	Yn+1.1
36	Yn+0.2	20	GNDA	04	Yn+1.2
37	Yn+0.3	21	GNDA	05	Yn+1.3
38	Yn+0.4	22	GNDA	06	Yn+1.4
39	Yn+0.5	23	GNDA	07	Yn+1.5
40	Yn+0.6	24		08	Yn+1.6
41	Yn+0.7	25		09	Yn+1.7
42		26		10	
43		27		11	
44		28		12	
45		29		13	
46		30		14	
47		31		15	
48		32		16	
49	DOCOMA			17	DOCOMA
50	DOCOMA			18	DOCOMA

50 pins, male,
with a metal fitting for securing the connector cover

NOTE

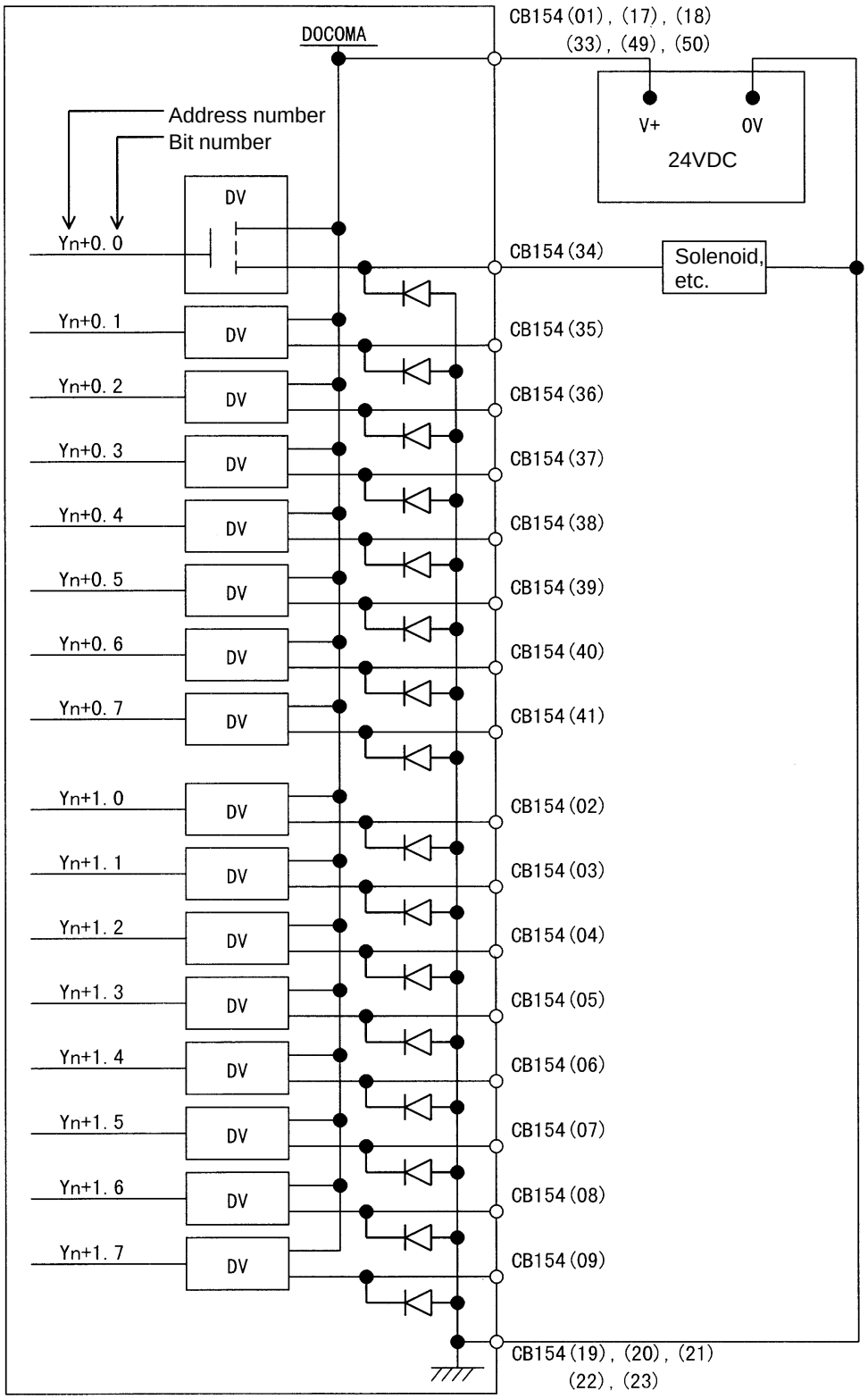
1 The DI/DO addresses of an expansion module and the DI/DO addresses of the basic module are contiguous. Addresses allocated to I/O Link are handled as a group covering the basic and expansion modules. That is, when the first addresses allocated are X0004 and Y0000 (m = 4, n = 0), the DI/DO addresses are as listed below.

2 When the 2A output module is used, the DI addresses of the module cannot be used. (When the 2A output module is used as expansion module 3, X13 through X15 cannot be used.)

	DI	DO
Basic module	X4 to X6	Y0 to Y1
Expansion module 1	X7 to X9	Y2 to Y3
Expansion module 2	X10 to X12	Y4 to Y5
Expansion module 3	X13 to X15	Y6 to Y7

10.4.9 2A DO (Output Signal) Connection

This section describes the 2A output connector connections of expansion module C.



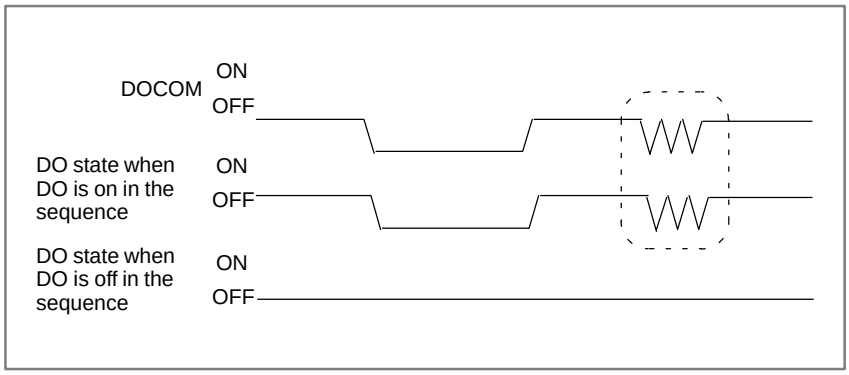
10.4.10 2A Output DO Signal Specifications

This section describes the specifications of the 2A output DO signals used with expansion module C.

DO (output signal specifications)

Number of points	32 points (per module)
Maximum load current when ON	2 A or less per point. 12 A maximum for the entire module (DO: 16 points) (including momentary variations).
Withstand voltage	24 V +20% or less (including momentary variations)
Leakage current when OFF	100 μA or less
Delay time	[I/O Link transfer time (2 ms maximum)] + [ladder scan period (depending on CNC)] must be considered.

ON/OFF of the power supply (DO common) for DO signals (output signals)
By turning off (opening) the power supply pin (DOCOM) for the DO signals (output signals), all the DO signals of each module can be turned off at one time. At this time, the DO state is as shown below.



NOTE
When DO is on in the sequence, the ON/OFF state of DOCOM is directly reflected in the DO state as indicated above by the dashed box. The +24 V signal to be supplied to the I/O module must not be turned off during operation. Otherwise, a CNC communication alarm is issued. Ensure that +24 V is supplied either when or before the power to the CNC is turned on, and that +24 V is removed either when or after the power to the CNC is turned off.

Parallel DO (output signal) connection
The 2A output module does not allow parallel DO connections including parallel connections with the DO signals of other modules.

10.4.11 Analog Input Connector Pin Allocation

This section describes the analog input connector pin allocation of expansion module D.

CB157 (HONDA MR–50RMA)

33	INM3			01	INM1
34	COM3			02	COM1
35	FGND3	19	FGND	03	FDND1
36	INP3	20	FGND	04	INP1
37	JMP3	21	FGND	05	JMP1
38	INM4	22	FGND	06	INM2
39	COM4	23	FGND	07	COM2
40	FGND4	24		08	FGND2
41	INP4	25		09	INP2
42	JMP4	26		10	JMP2
43		27		11	
44		28		12	
45		29		13	
46		30		14	
47		31		15	
48		32		16	
49				17	
50				18	

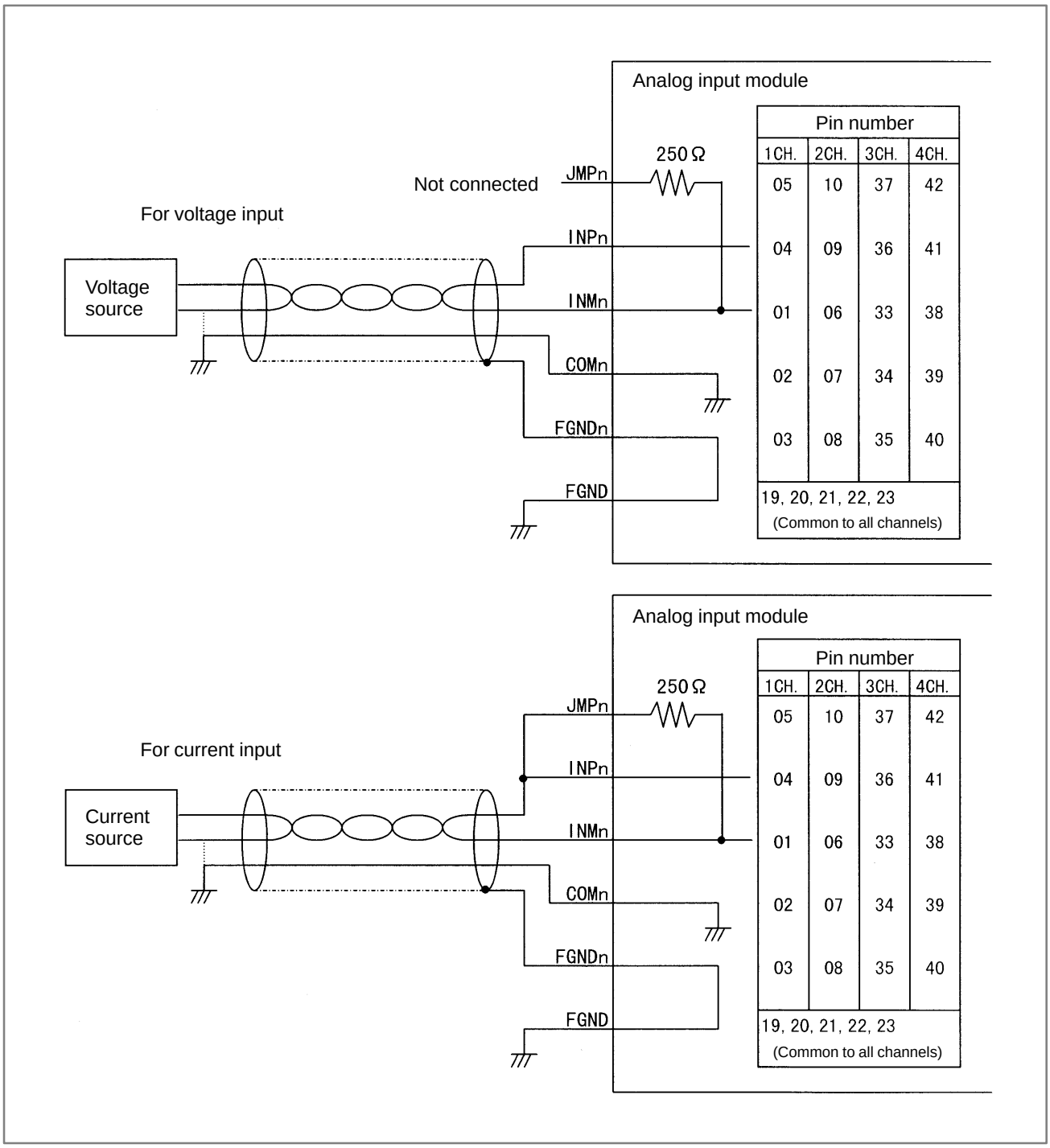
50 pins, male,
with a metal fitting for securing the connector cover

NOTE
1 The DI/DO addresses of an expansion module and the DI/DO addresses of the basic module are contiguous. Addresses allocated to I/O Link are handled as a group covering the basic and expansion modules. That is, when the first addresses allocated are X0004 and Y0000 (m = 4, n = 0), the DI/DO addresses are as listed below.
2 With the analog input module, the DO space is also used as an input channel selection area.

	DI	DO
Basic module	X4 to X6	Y0 to Y1
Expansion module 1	X7 to X9	Y2 to Y3
Expansion module 2	X10 to X12	Y4 to Y5
Expansion module 3	X13 to X15	Y6 to Y7

10.4.12 Analog Input Signal Connections

This section provides a diagram of the analog input connector connections of expansion module D.



NOTE

1 In the diagram above, n represents each channel (n = 1, 2, 3, 4).
2 Current input or voltage input can be selected on a channel–by–channel basis. For current input, connect JMPn to INPn.
3 For the connection, use a shielded twisted pair.
4 In the diagram above, the shield of each channel is connected to FGNDn, and FGND is used for shield processing of all channels. However, the shield of a channel may be directly connected to frame ground with a cable clamp, instead of using FGNDn.
5 If the voltage (current) source has a GND pin, as shown in the figure above, connect COMn to this pin. Otherwise, connect INMn and COMn together in the analog input module.

10.4.13 Analog Input Signal Specifications

This section describes the specifications of the analog input signals used with expansion module D.

Item	Specifications	Remarks
Number of input channels (Note)	Four channels	
Analog input	DC –10 to +10 V (Input resistance: 4.7 ohms) DC –20 to +20 mA (Input resistance: 250 ohms)	Voltage input or current input can be selected on channel–by–channel basis.
Digital output (Note)	12 bits (binary)	Represented as two's complement
Input/output correspondence	Analog input / Digital output +10V / +2000 +5V or +20mA / +1000 0V or 0mA / 0 –5V or –20mA / –1000 –10V / –2000	
Resolution	5 mV or 20 μA	
Overall precision	Voltage input: ±0.5% Current input: ±1%	With respect to full scale
Maximum input voltage/current	±15V/±30mA	
Minimum conversion time (Note)	Ladder scan period of CNC connected	
Number of occupied input/output points (Note)	DI = 3 bytes, DO = 2 bytes	

NOTE

This analog input module has four input channels. The digital output section consists of a group of 12 bits within the three–byte occupied input points. This means that the channel to be used can be dynamically selected by the ladder. The channel switching DO point for channel selection is included in the two–byte occupied output points.

10.4.14 Analog Input Specifications

(Digital output)

This digital input module has four input channels. The digital output section consists of a group of 12 bits within the three–byte occupied input points. The output format is indicated below.

Address in the module	7	6	5	4	3	2	1	0
Xm (even–numbered address)	D07	D06	D05	D04	D03	D02	D01	D00
Xm+1 (odd–numbered address)	0	0	CHB	CHA	D11	D10	D09	D08

D00 to D11 represent 12–bit digital output data. D00 and D11 correspond to weightings of 2^0 and 2^{11}, respectively.
D11 is a sign bit expressed as a two's complement. CHA and CHB represent analog input channels.
This means that when the two bytes above are read with a PMC program, the A–D converted data of the CHA and CHB input channels can be read from D11 to D00. For CHA and CHB, see the description of channel selection, below.
Section 6.3 provides notes on reading data with a PMC program.

(Channel selection)

With this analog input module, which of the four channels is to be output to the digital output section must be determined with a PMC program. The DO points used for this selection are CHA and CHB (two–byte occupied output points). These are mapped as indicated below.

Address in the module	7	6	5	4	3	2	1	0
Yn	X	X	X	X	X	X	X	X
Yn+1	X	X	X	X	X	X	CHB	CHA

By writing the values indicated below to CHA and CHB, the corresponding channel is selected, and the A–D converted data of the channel and the data of the selected channel can be read as DI data. The character X indicated above represents an unused bit, so that either 1 or 0 may be written in place of X.

CHB	CHA	Channel selected
0	0	Channel 1
0	1	Channel 2
1	0	Channel 3
1	1	Channel 4

(Address)

The start address of X (DI) of the basic modules including the analog input module must always be allocated at an even–numbered address. With this allocation, the digital output addresses of the analog input module are as described below, depending on where the analog input module is allocated

- When the analog input module is allocated in the space for expansion module 1 (m represents the allocation start address.)

Address in the module	7	6	5	4	3	2	1	0
Xm+3 (odd–numbered address)	Undefined							
Xm+4 (even–numbered address)	D07	D06	D05	D04	D03	D02	D01	D00
Xm+5 (odd–numbered address)	0	0	CHB	CHA	D11	D10	D09	D08

- When the analog input module is allocated in the space for expansion module 2 (m represents the allocation start address.)

Address in the module	7	6	5	4	3	2	1	0
Xm+6 (even–numbered address)	D07	D06	D05	D04	D03	D02	D01	D00
Xm+7 (odd–numbered address)	0	0	CHB	CHA	D11	D10	D09	D08
Xm+8 (even–numbered address)	Undefined							

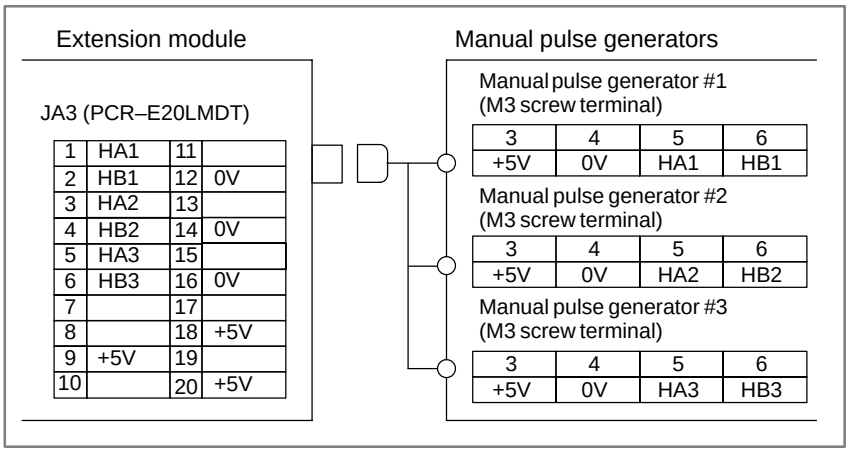
- When the analog input module is allocated in the space for expansion module 3 (m represents the allocation start address.)

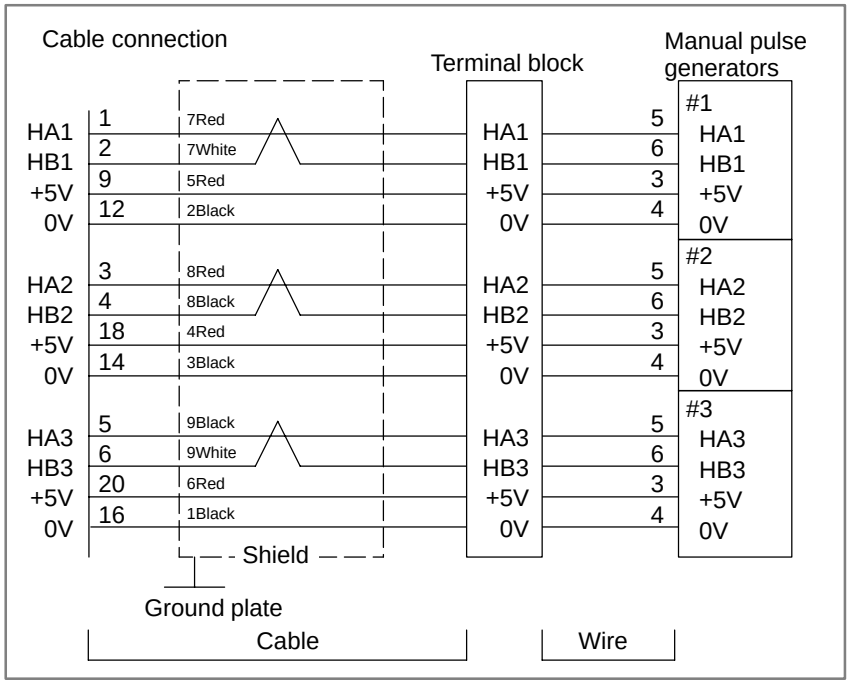
Address in the module	7	6	5	4	3	2	1	0
Xm+9 (odd–numbered address)	Undefined							
Xm+10 (even–numbered address)	D07	D06	D05	D04	D03	D02	D01	D00
Xm+11 (odd–numbered address)	0	0	CHB	CHA	D11	D10	D09	D08

NOTE
When two–byte digital output addresses are to be referenced with a PMC program, a read must always be performed word–by–word (16 bits).

10.4.15 Manual Pulse Generator Connection

An example in which three manual pulse generators are connected to extension module A is shown below. The manual pulse generator can be connected only for the *i* series CNC.





Recommended wire material:

A66L–0001–0286 (#20 AWG × 6 + #24 AWG × 3 pairs)

Recommended connector:

A02B–0120–K303 (including the following connector and case)
(Connector: FI40–2015S (Hirose Electric Co., Ltd.))
(Case: FI40–20–CV5 (Hirose Electric Co., Ltd.))

Recommended cables:

A02B–0120–K841 (7 m)
(for connecting three manual pulse generators)
A02B–0120–K848 (7 m)
(for connecting two manual pulse generators)
A02B–0120–K847 (7 m)
(for connecting one manual pulse generator)

(These cables do not include the wire shown in the above figure.)

NOTE
The number of connectable manual pulse generators depends on the type and option configuration.

10.4.16 Cable Length for Manual Pulse Generator

Like a pulse coder, the manual pulse generator operates on 5 VDC. The supply voltage drop due to the cable resistance must be held below 0.2 V (when those of the 0–volt and 5–volt wires are combined), as expressed in the following expression:

$$0.2 \geqq \frac{0.1 \times R \times 2L}{m}$$

Where
0.1 = manual pulse generator supply current (0.1 A)
R = resistance per unit cable length (Ω/m)
m = number of 0–volt and 5–volt wires
L = cable length (m).

Therefore, the cable length can be determined using the following expression.

$$L \leqq \frac{m}{R}$$

In the case of the A66L–0001–0286 cable, for example, when three pairs of signal wires and six power supply wires (20/0.18, 0.0394 Ω/m) are used (three power supply wires connected to 5 V and the other three to 0 V), the cable length is:

$$L \leqq \frac{3}{0.0394} = 76.75[m]$$

However, the maximum pulse transmission distance for the manual pulse generator is 50 m. Taking this into consideration, the cable length may be extended to:
38.37 m (when two generators are used), or
25.58 m (when three generators are used).

10.4.17 Connecting to the Manual Pulse Generator on the FS20*i*

In the case of the FS20*i*, four manual pulse generators are sometimes connected. However, only up to three manual pulse generators can be connected to the separate wiring I/O module or to the control panel I/O module. For this reason, in the case of the FS20i, two separate wiring I/O modules or control panel I/O modules having a manual pulse generator interface are used. Even in a combination of two of these modules having the same specifications, the connection is possible even in a combination of one of each of these modules.
Connect these two modules by I/O–Link, and connect the three manual pulse generators to the module close to the controller, and the remaining manual pulse generator to the module next closest to the controller.

NOTE
This method of use is applied only in the case of the FS20*i*, and cannot be used on other machine types.

Example)
The following describes an example of input signal assignments when a control panel I/O module (A20B–2002–0470) and a separate wiring module (A20B–2002–0520) are used.

- Assign 16 bytes from x0008 as the start of the input signal on A20B–2002–0470 and 16 bytes from x0024 as the start of the input signal on A20B–2002–0520.

X0008	General–purpose input signal on A20B–2002–0470	Control panel I/O module
X0009		
X0010	Reserve area on A20B–2002–0470	
X0011		
X0012	Matrix input signal on A20B–2002–0470	
:		
X0018		
X0019	Reserve area on A20B–2002–0470	
X0020	Manual pulse generator on A20B–2002–0470 (used as 1st generator)	
X0021	Manual pulse generator on A20B–2002–0470 (used as 2nd generator)	
X0022	Manual pulse generator on A20B–2002–0470 (used as 3rd generator)	
X0023	DO alarm detection on A20B–2002–0470	
X0024	General–purpose input signal on A20B–2002–0520	Separate type I/O module
:		
X0029		
X0030	Reserve area on A20B–2002–0520	
:		
X0035		
X0036	Manual pulse generator on A20B–2002–0520 (used as 4th generator)	
X0037	Manual pulse generator on A20B–2002–0520 (not available)	
X0038	Manual pulse generator on A20B–2002–0520 (not available)	
X0039	DO alarm detection on A20B–2002–0520	

Manual Pulse Generator Interface

When using other manufacturers' manual pulse generators, ensure that the following specifications are satisfied.

Pulse width

The relationship between the HAn and HBn signals and the CNC pulses shall be as shown in Fig. 10.4.17 (a).
Pulse cycle T_1 shall be 200 μsec or more. Pulse cycle T_1/4–direction pulse shall be 50 μsec or more.

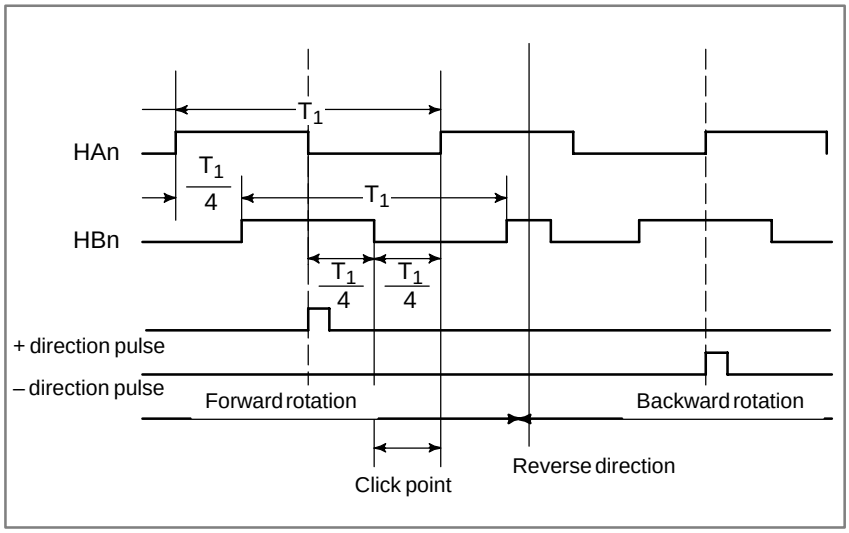


Fig. 10.4.17 (a)

Receiver

The circuit that receives signals input from the manual pulse generator shall be configured as shown in Fig. 10.4.17 (b).

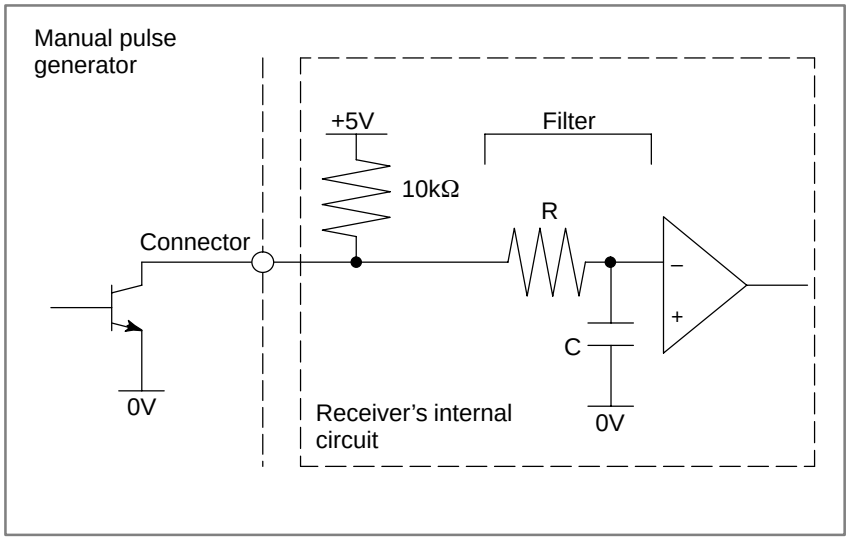
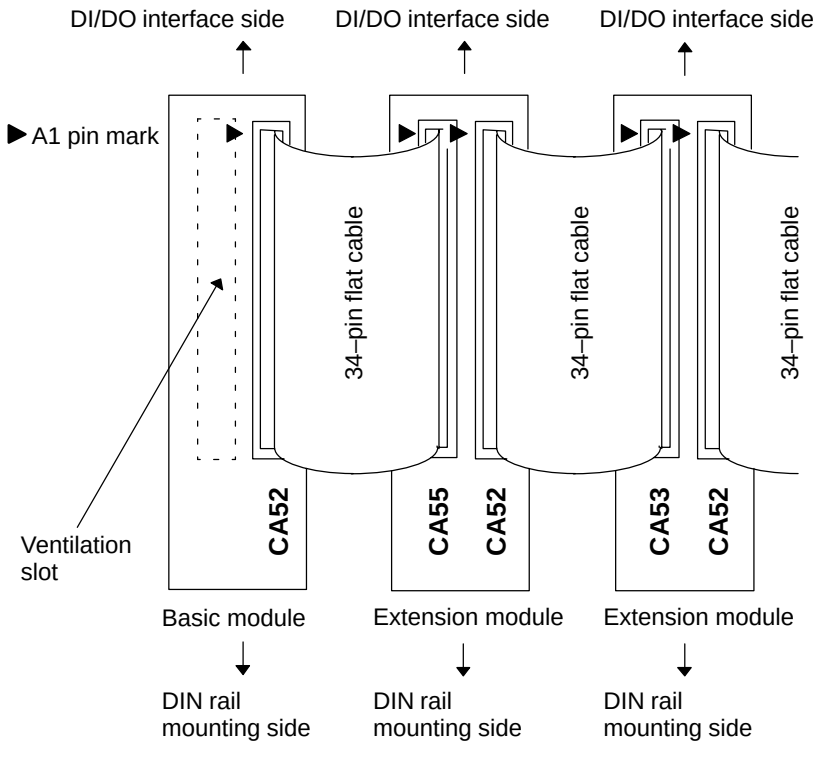


Fig. 10.4.17 (b)

Input signal level change point (threshold)
When the voltage is 3.7 V or higher, the input signal level changes from low to high.
When the voltage is 1.5 V or lower, the input signal level changes from high to low.

10.4.18 Connection of Basic and Extension Modules

Modules can be connected in the same way, regardless of whether you are connecting the basic module to an extension module or connecting two extension modules. Connect the modules by using 34–pin flat cable connectors as shown in the figure below. Ensure that all 34 pins at one end of the cable are connected to the corresponding pins at the other end; e.g., connect the A1 pin to the pin having the same designation (A1) at the other end.



Flat cable–side connector specification:
HIF3BA–34DA–2.54R (Hirose Electric Co., Ltd.)
Module connector–side specification:
HIF3BA–34PA–2.54DS (Hirose Electric Co., Ltd.) or
FAP–3403–1202–0BS (Yamaichi Denki Co., Ltd.)

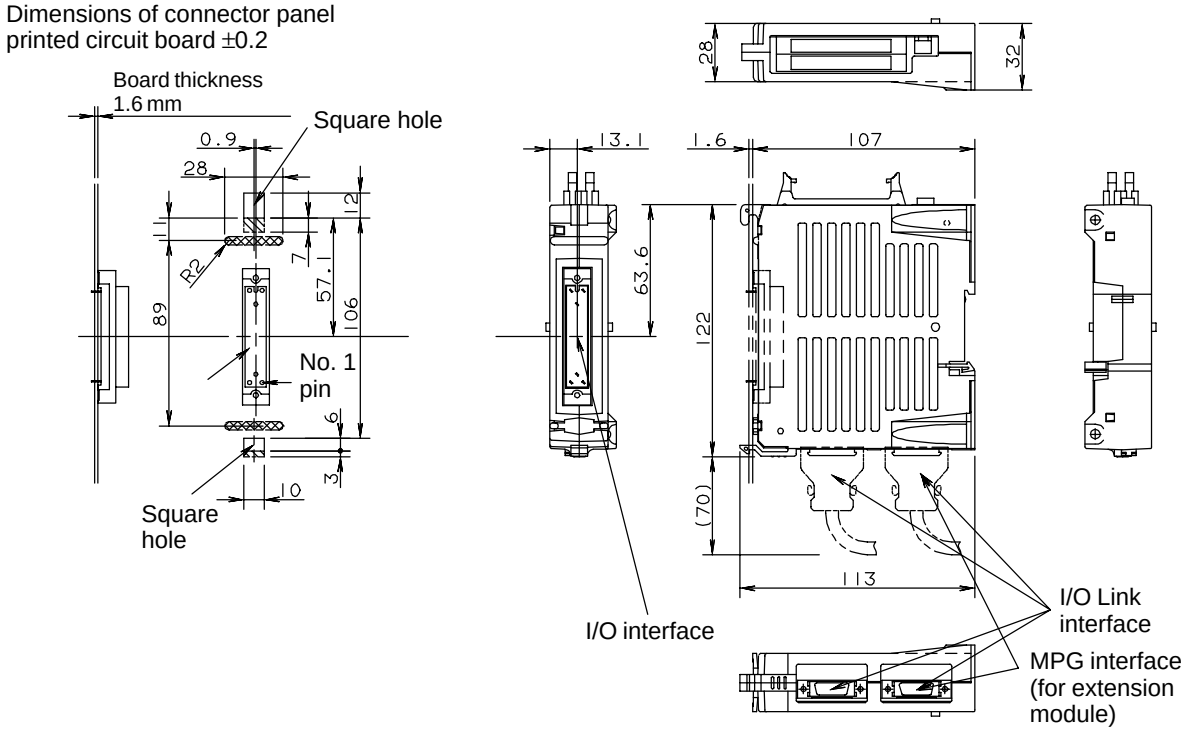
NOTE

Modules need to be spaced at least 32 mm apart, in which case a flat cable of about 20 mm in length is required. To install modules further away from each other, the cable length will be 20 mm plus the extra distance. Note that the maximum length of a flat cable is 100 mm. To ensure adequate ventilation, install the modules in such a way that the flat cables lie on top of them. The basic module has a vent at the top (as indicated by the dotted lines in the above figure). When connecting modules, install extension modules so that the flat cables do not cover the vent, as shown in the above figure.

Therefore, for direct connection to the connection printed circuit board, expansion modules are installed to the right of the basic module on the installation plane. For installation using DIN rails or screws, expansion modules are installed to the left of the basic module on the installation plane.

10.4.19 Module Installation

When connecting a connector panel printed circuit board directly (external module view and mounting diagram)



Connector panel printed circuit board connector specification:
HONDA MRH–50FD (50–pin female straight connector without fitting)

NOTE

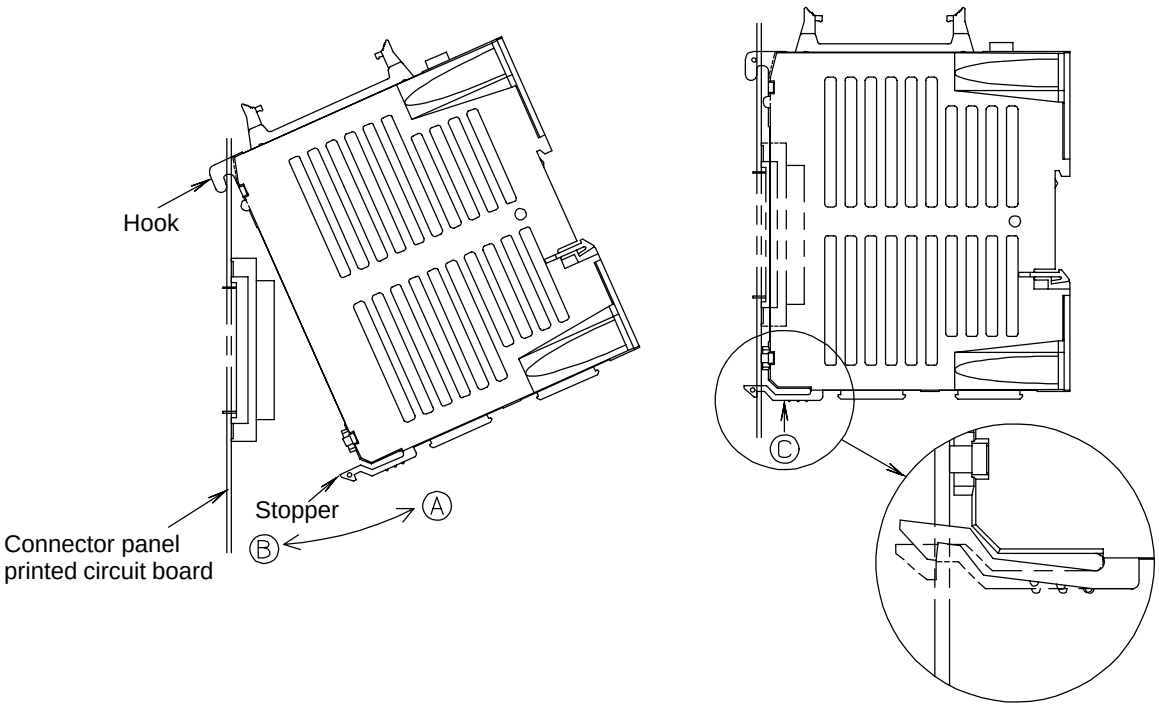
1 A connector with a fitting (HONDA MRH–50RMA) is used for the module–side I/O interface. Always use a connector having no fitting for the connector panel printed circuit board.

2 Area where pattern printing is prohibited

: Prohibited area on soldered side

: Prohibited area on component side

When connecting a connector panel printed circuit board directly (mounting and dismounting a module)



Mounting the module

1. Insert the hook of the module into the square hole located at the upper part of the connector panel printed circuit board.
2. Using the hook as a fulcrum, push the module in the direction of Ⓑ, and attach the module's connector to the connector on the printed circuit board.
3. Push the stopper into the lower hole of the printed circuit board until it clicks into place.

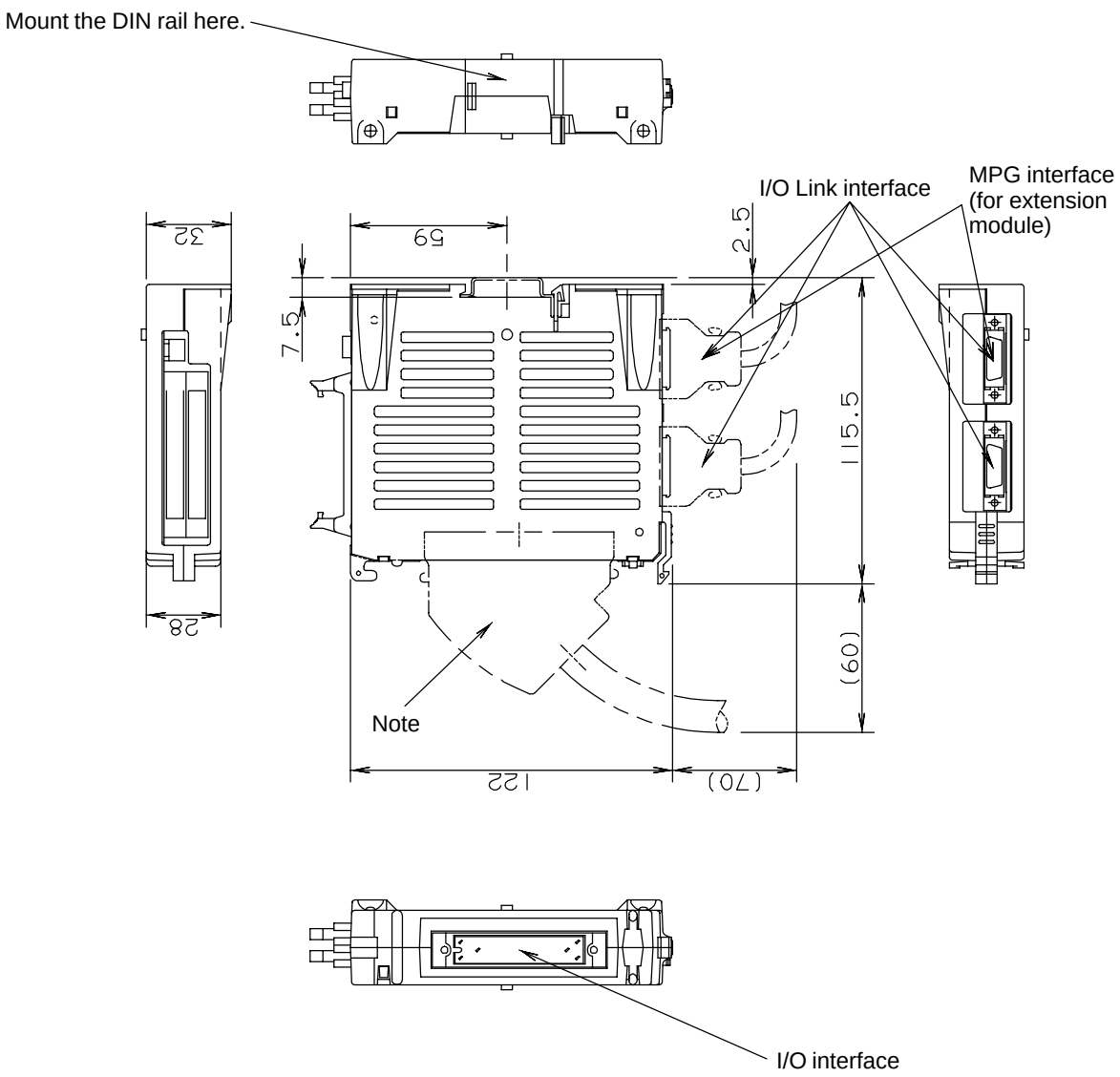
Dismounting the module

1. Press the stopper Ⓒ upward.
2. Using the hook as a fulcrum, pull the lower part of the module in the direction of Ⓐ.

NOTE

When mounting and dismounting a module, hold the module by its top and bottom surfaces. Avoid applying force to the sides where there are slits.

When mounting a DIN rail (external module view and mounting diagram)

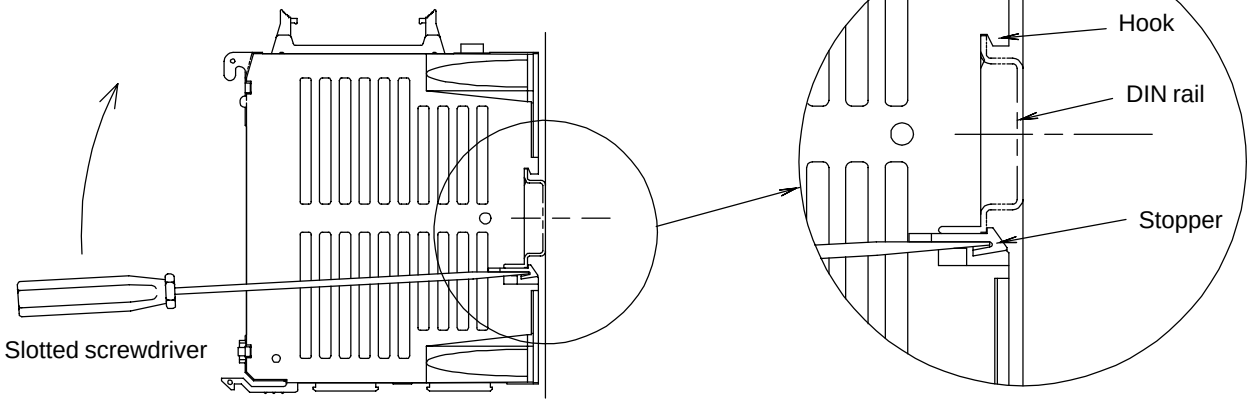


NOTE

Recommended connector: A02B–0098–K891 (including the following connector and case)
(Connector: HONDA MR–50FH solder type)
(Case: HONDA MR–50NSB angled type)

Recommended wire material: A66L–0001–0042 (7/0.18, 50 pins)

When mounting a DIN rail (mounting and dismounting a module)



Mounting the module
1. Hook the module at the upper end of the DIN rail.
2. Push the stopper into the slit located at the lower end of the rail until it clicks into place.

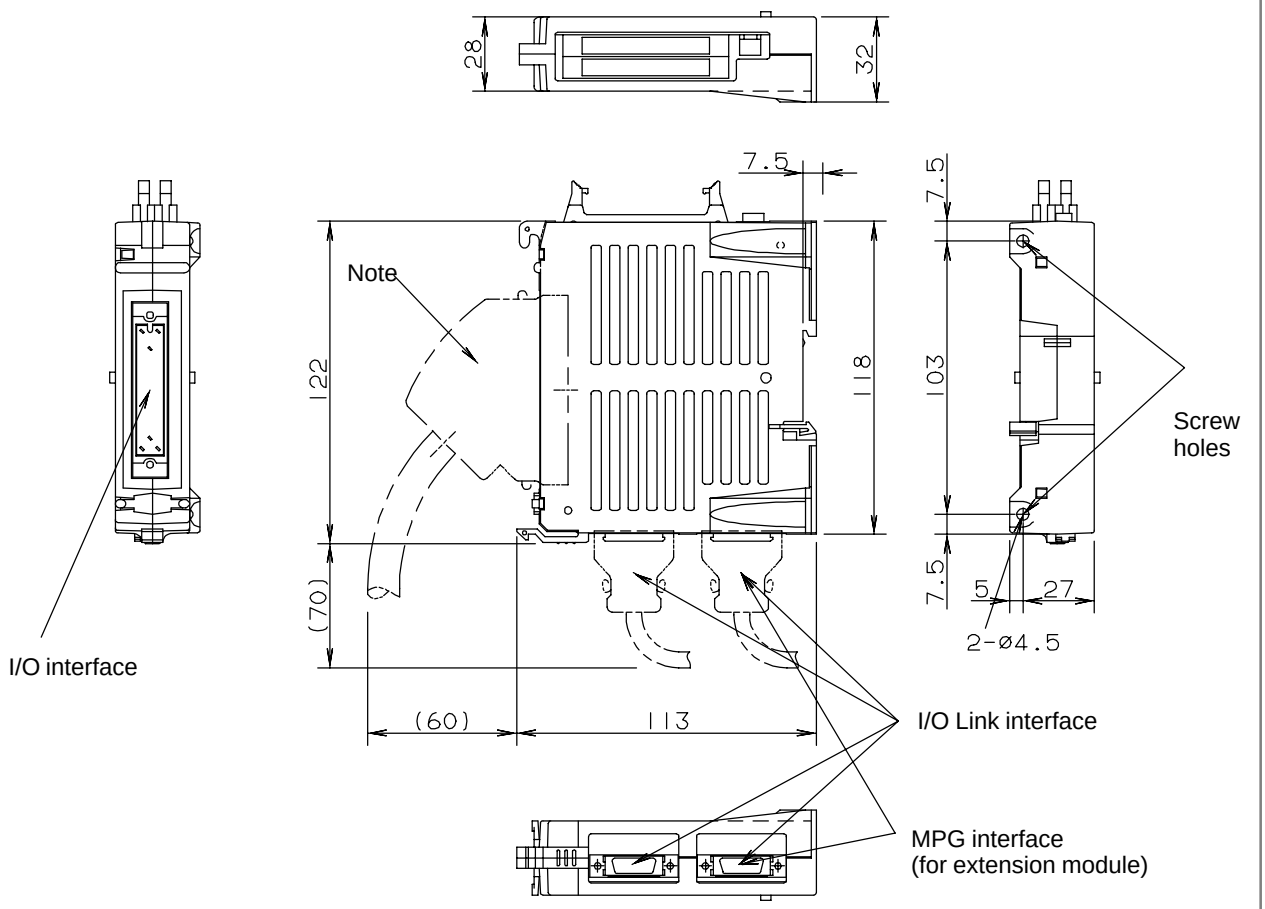
Dismounting the module
1. Insert the tip of the slotted screwdriver and push out the stopper in the direction indicated by the arrow.

NOTE

When dismounting the module, take care not to damage the stopper by applying excessive force with the screwdriver.

When mounting and dismounting a module, hold the module by its top and bottom surfaces. Avoid applying force to the sides where there are slits.

When mounting a module using screws (external module view and mounting diagram)



NOTE

Recommended connector: A02B–0098–K891 (including the following connector and case)
(Connector: HONDA MR–50FH solder type)
(Case: HONDA MR–50NSB angled type)
Recommended wire material: A66L–0001–0042 (7/0.18, 50 pins)

10.4.20 Other Notes

DO signal reaction to a system alarm

If a system alarm occurs in a CNC using the connector panel I/O module, or if I/O Link communication between the CNC and connector panel I/O module fails, all the DO signals of the I/O module are turned off. Therefore, due care must be taken when setting up the machine sequence. Also, the same phenomenon occurs if the power to the CNC or the I/O module is turned off.

Address allocation

For the connector panel I/O module, I/O addresses are mapped as follows.

DI space map

Xm	Basic module
Xm+1	
Xm+2	
Xm+3	Extension module 1
Xm+4	
Xm+5	
Xm+6	Extension module 2
Xm+7	
Xm+8	
Xm+9	Extension module 3
Xm+10	
Xm+11	
Xm+12 (for 1st MPG)	Extension module 1
Xm+13 (for 2nd MPG)	
Xm+14 (for 3rd MPG)	
Xm+15 (DO alarm detection)	Basic module

DO space map

Yn	Basic module
Yn+1	
Yn+2	Extension module 1
Yn+3	
Yn+4	Extension module 2
Yn+5	
Yn+6	Extension module 3
Yn+7	

The basic connector panel I/O module is allocated a group of DI addresses (16 bytes) and a group of DO addresses (8 bytes). Up to three hardware extension modules can be added or removed as required. The reason for this address allocation is explained below.

The MPG interface (MPG counter) occupies a DI space from Xm+12 through Xm+14. These addresses are fixed regardless of whether extension module 2 or 3 is used, and Xm+12 through Xm+14 must be allocated as a DI work area to enable the use of the MPG. Therefore, when using an MPG for the *i* series CNC, allocate DI addresses in units of 16 bytes. Do not use the DI space from Xm+12 through Xm+14 for Ladder; the CNC processes the MPG counter value directly.

DI address Xm+15 is used for detecting overcurrent and overheating alarms that occur in the IC used in the DO driver. [For details, see the section describing the detection of DO (output signal) alarms.] This address is fixed regardless of whether extension module 2 or 3 is used, and it must be allocated as a work area before it can be used. When using this area, therefore, allocate DI addresses in units of 16 bytes.

Basically, I/O addresses can be allocated to the connector panel I/O modules freely. When allocating DI addresses, however, consider also the addresses that are directly supervised by the CNC, and keep the following in mind.

Fixed addresses directly supervised by the CNC (for FS21*i*/210*i*)

	7	6	5	4	3	2	1	0
X0004	SKIP	ESKIP SKIP6	–MIT2 SKIP5	+MIT2 SKIP4	–MIT1 SKIP3	+MIT1 SKIP2	ZAE SKIP8	XAE SKIP7
	SKIP	ESKIP SKIP6	SKIP5	SKIP4	SKIP3	ZAE SKIP2	YAE SKIP8	XAE SKIP7
X0005								
X0006								
X0007								
X0008				*ESP				
X0009					*DEC4	*DEC3	*DEC2	*DEC1

The upper row indicates those signals used for the T series. Those in the lower row are for the M series.

When DI addresses are allocated in units of 16 bytes, starting at X0004

X0004	Basic module
X0005	
X0006	
X0007	Extension module 1
X0008	
X0009	
X0010	Extension module 2
X0011	
X0012	
X0013	Extension module 3
X0014	
X0015	
X0016 (for 1st MPG)	Extension module 1
X0017 (for 2nd MPG)	
X0018 (for 3rd MPG)	
X0019 (DO alarm detection)	Basic module

← SKIPn and other fixed signals

←*ESP fixed signal

←*DECn fixed signal

The minimum configuration consists of the basic module and extension module 1. Extension modules 2 and 3 may be added as required. This allows fixed signals, such as SKIPn and *DECn, to always be used and the *ESP fixed signal to be allocated to an address for which the common voltage is fixed to 24 V. Also, with the I series CNC, the MPG interface provided by extension module 1 can always be used.

When DI addresses are allocated in units of 16 bytes, starting at X0007

X0007	Basic module
X0008	
X0009	
X0010	Extension module 1
X0011	
X0012	
X0013	Extension module 2
X0014	
X0015	
X0016	Extension module 3
X0017	
X0018	
X0019 (for 1st MPG)	Extension module 1
X0020 (for 2nd MPG)	
X0021 (for 3rd MPG)	
X0022 (DO alarm detection)	Basic module

←*ESP fixed signal

←*DECn fixed signal

The minimum configuration consists of the basic module only. Extension modules 1, 2, and 3 may be added as required. In the minimum configuration, SKIP and other fixed signals and the MGP interface of extension module 1 cannot be used. In this case, however, the *DECn fixed signal can always be used and the *ESP fixed signal can be allocated to an address for which the common voltage is fixed to 24 V in the minimum configuration.

DO (output signal) alarm detection

The DO driver of the Basic and Extension module A/B is capable of detecting an overcurrent and measuring its own temperature. If an accident, such as the connecting of the cable to ground, causes an abnormal increase in the load current or in the driver temperature, a protection circuit, which is provided for each DO driver (1 byte), is activated and keeps the DO signal for the relevant 1 byte in the OFF state until the cause of the problem is eliminated. Even if this occurs, the CNC and I/O module continue operating. The DI address (Xm+15) identifies the DO driver which has detected the alarm. The following table shows the correspondence between the DI address (Xm+15) bits and the DO addresses. Bit value "1" indicates that the corresponding DO driver has detected an alarm. The contents of the Xm+15 area can be checked by using the DGN screen of the CNC or by performing alarm processing for the area in advance by using Ladder. This helps alarm detection and recovery.

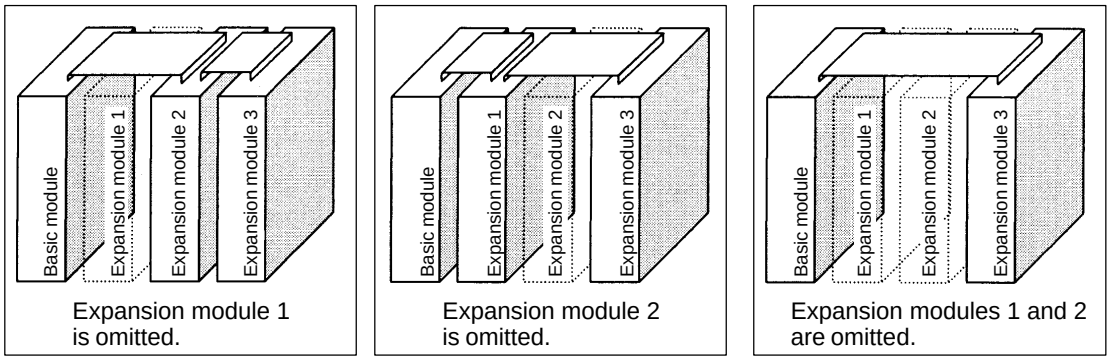
Alarm detection address and bit	DO address	Location
Xm+15.0	Yn+0	Basic module
Xm+15.1	Yn+1	Basic module
Xm+15.2	Yn+2	Extension module 1
Xm+15.3	Yn+3	Extension module 1
Xm+15.4	Yn+4	Extension module 2
Xm+15.5	Yn+5	Extension module 2
Xm+15.6	Yn+6	Extension module 3
Xm+15.7	Yn+7	Extension module 3

NOTE
This function is not supported by the 2A output module or analog input module.

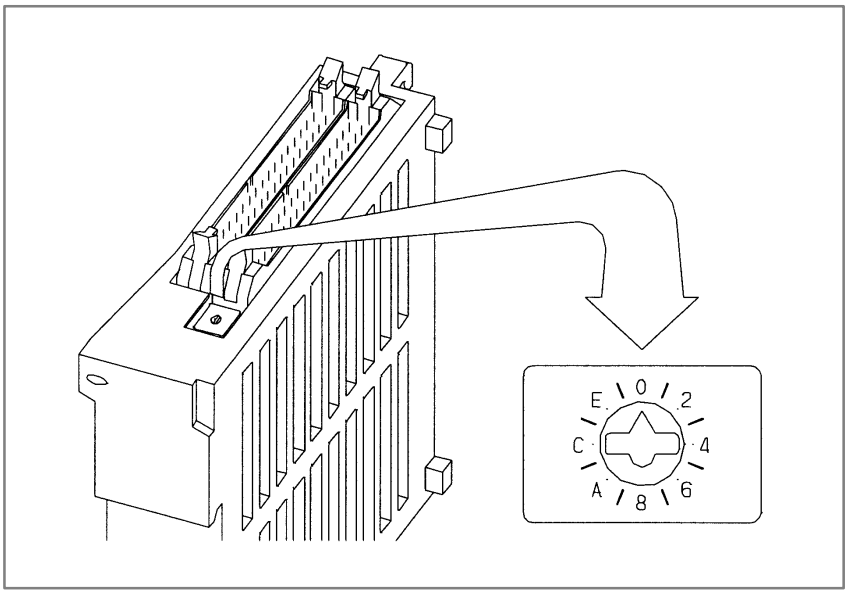
Allocation of the 2A output module and analog input module
The 2A output module and analog input module can be allocated to any of the spaces for expansion modules 1, 2, and 3. In addition, up to three 2A output modules or analog input modules can be allocated to all the spaces for expansion modules 1, 2, and 3. When an MPG interface is required, the module occupies the space for expansion module 1; no 2A output module or analog input module can be allocated in the space for expansion module 1.
The 2A output module does not involve DI points, so that the DI area of the space in which a 2A output module is allocated is unusable. When a 2A output module is allocated to the space for expansion module 2, for example, the areas from Xm+6 to Xm+8 cannot be used. (The spaces for the other modules are not shifted. In this case, the DI space of expansion module 3 remains at Xm+9 through Xm+11.)

10.4.21 Distribution I/O Setting

By changing the setting (rotary switch) for the expansion modules, connections can be made by omitting some expansion modules as shown below.



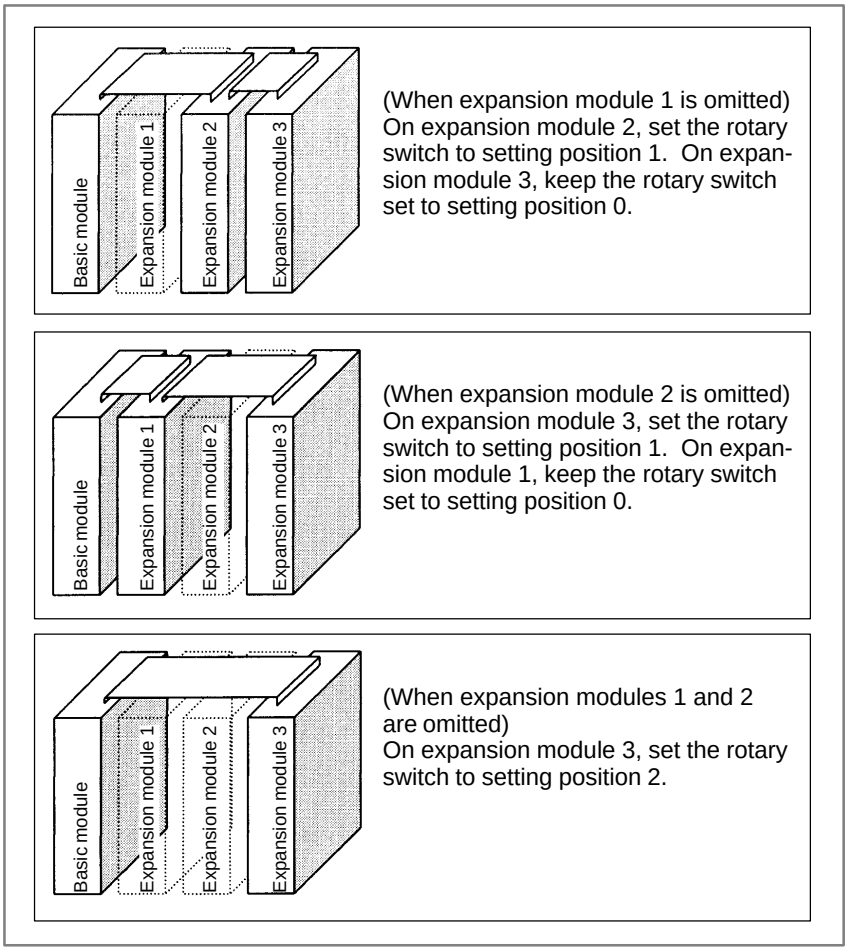
Method of setting (control and method of setting the control)
As shown below, the control (rotary switch) is located on an expansion module. To change the setting, turn the switch with a flat–bladed screwdriver with a tip width of about 2.5 mm.



The function of the rotary switch is as follows:

Setting position	Actual indication	Meaning of setting
0	0	This is the standard setting. The rotary switch is factory–set to this position. This setting is used when no expansion module is omitted.
1	–	Set the rotary switch on an expansion module to this position when the preceding expansion module is omitted.
2	2	Set the rotary switch on an expansion module to this position when the preceding two expansion modules are omitted.
3	–	This setting is prohibited.
4 to F	4, –, 6, –, 8, –, A, –, C, –, E, –,	4, 8, or C has the same effect as 0. 5, 9, or D has the same effect as 1. 6, A, or E has the same effect as 2. 7, B, or F has the same effect as 3. (This setting, however, is prohibited.)

Examples of setting



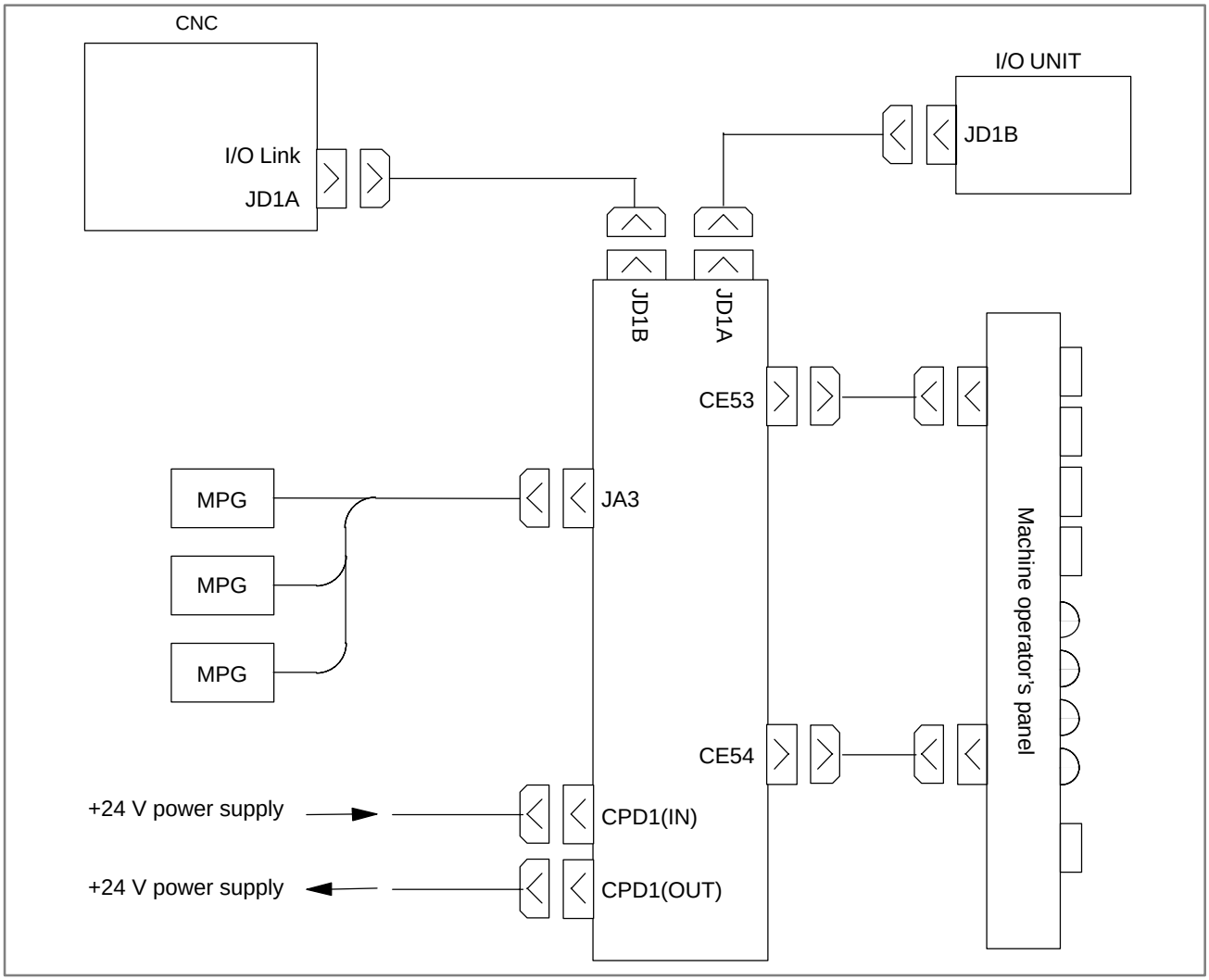
NOTE

1 Expansion module A (DI/DO = 24/16, with manual pulse interface) (A03B–0815–C002) is fitted with an additional rotary switch as other types of modules are modified. However, expansion module A is always mounted at the location of expansion module 1, so that its factory setting need not be changed.

2 This feature was added in the middle. The expansion modules shipped before August 1998 are not provided with this feature.

10.5 CONNECTION OF OPERATOR'S PANEL I/O MODULE (FOR MATRIX INPUT)

10.5.1 Overall Connection Diagram



NOTE

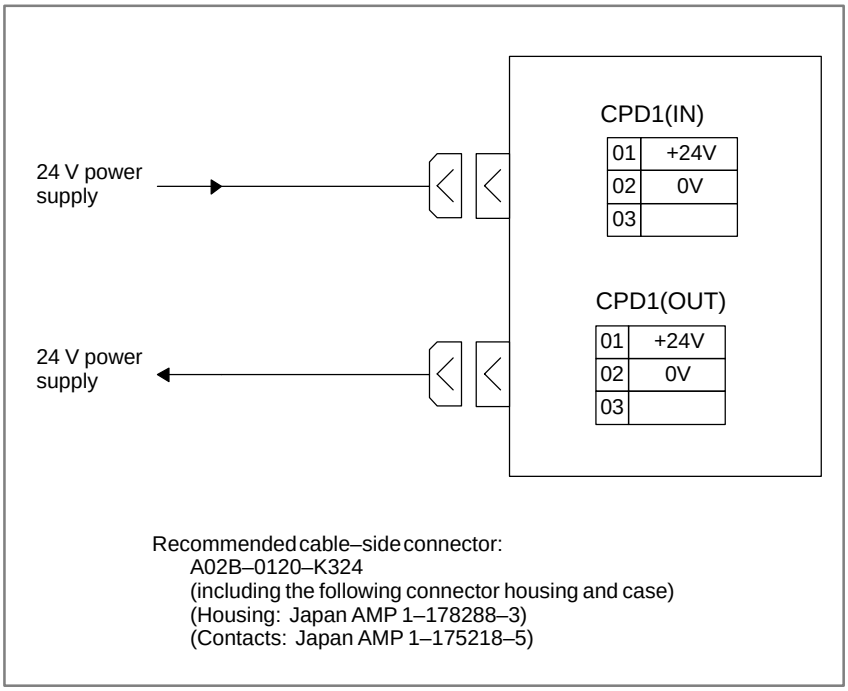
The MPG can be connected to this operator's panel I/O module only when the *i* series CNC is used. When the operator's panel I/O module is used together with a unit (connector panel I/O module) connected to the I/O Link supporting another MPG interface, only the MPG interface of the unit (module) closest to the CNC connected to the I/O Link is enabled. The following screw type connectors, newly incorporated into the *i* series main board, cannot be used to connect the I/O Link or MPG.

Connectors that cannot be used on the cable side

	Specification	Manufacturer
Connector	FI–20–CV7	Hirose Electric Co., Ltd.
Connector case and connector	FI30–20S–CV7	Hirose Electric Co., Ltd.

10.5.2 Power Connection

Provide the CPD1 (IN) connector, shown below, with the power necessary for printed circuit board operation and that for DI operation. To facilitate power division, the power is output to CPD1 (OUT) exactly as it is input from CPD1 (IN). When power division is required, use CPD1 (OUT).



Recommended cable–side connector:
A02B–0120–K324
(including the following connector housing and case)
(Housing: Japan AMP 1–178288–3)
(Contacts: Japan AMP 1–175218–5)

NOTE

The specification of the power supply connector CPD1 (IN) is the same as that for CPD1 (OUT). There are no indications on the printed circuit board to distinguish between the IN and OUT connectors. Do not turn off the +24 V supply to the connector during operation. Turning off the +24 V supply will cause a CNC communication alarm. When turning on the power, the +24 V supply to the I/O module must be turned on before or at the same time as the power supply to the CNC. When turning off the power, the +24 V supply to the I/O module must be turned off after or at the same time as the power supply to the CNC.

10.5.3 DI/DO Connector Pin Arrangement

CE53

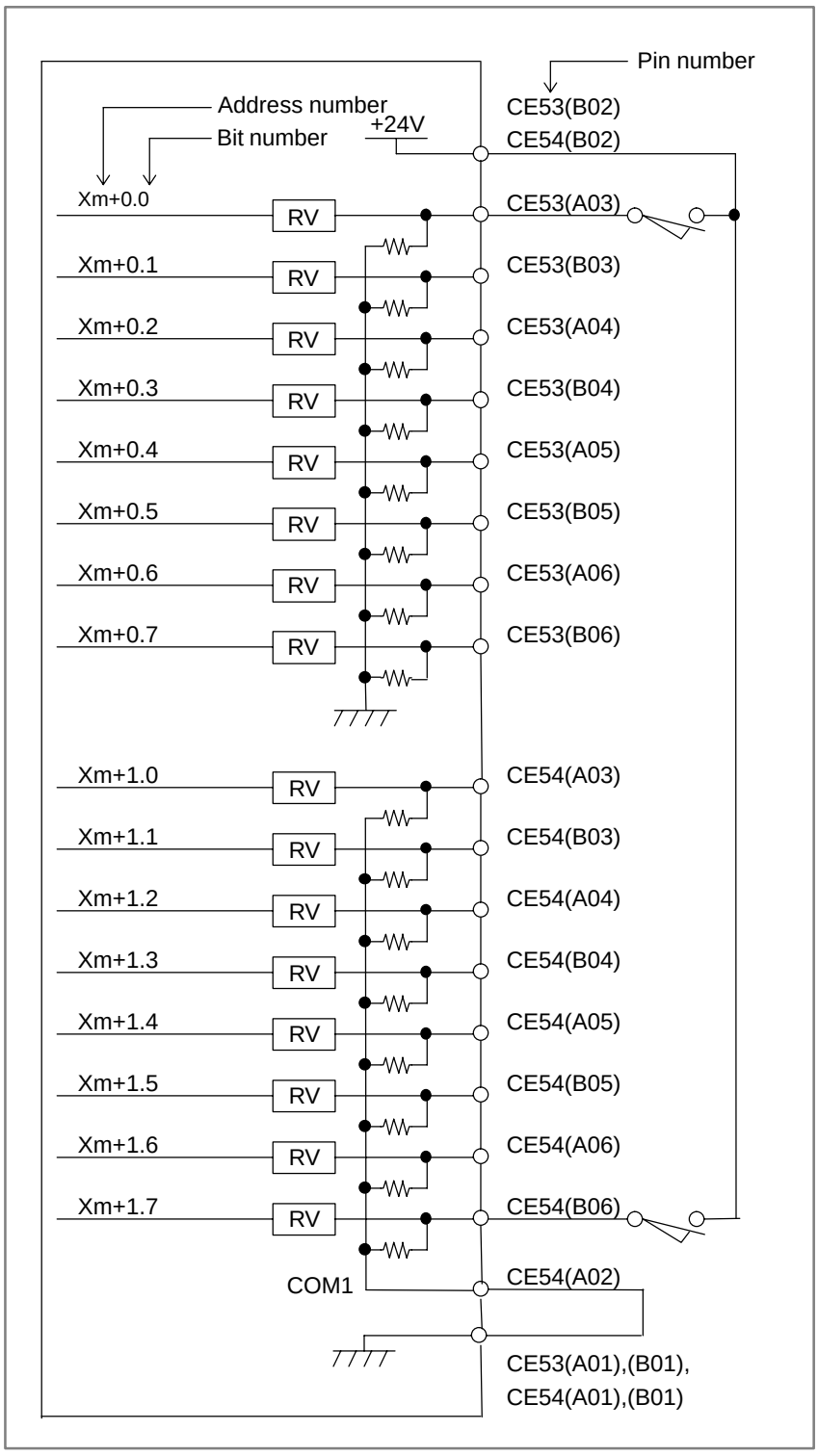
	A	B
01	0V	0V
02	N.C.	+24V
03	Xm+0.0	Xm+0.1
04	Xm+0.2	Xm+0.3
05	Xm+0.4	Xm+0.5
06	Xm+0.6	Xm+0.7
07	Yn+0.0	Yn+0.1
08	Yn+0.2	Yn+0.3
09	Yn+0.4	Yn+0.5
10	Yn+0.6	Yn+0.7
11	Yn+1.0	Yn+1.1
12	Yn+1.2	Yn+1.3
13	Yn+1.4	Yn+1.5
14	Yn+1.6	Yn+1.7
15	Yn+2.0	Yn+2.1
16	Yn+2.2	Yn+2.3
17	Yn+2.4	Yn+2.5
18	Yn+2.6	Yn+2.7
19	KYD0	KYD1
20	KYD2	KYD3
21	KYD4	KYD5
22	KYD6	KYD7
23	KCM1	KCM2
24	KCM3	KCM4
25	DOCOM	DOCOM

CE54

	A	B
01	0V	0V
02	COM1	+24V
03	Xm+1.0	Xm+1.1
04	Xm+1.2	Xm+1.3
05	Xm+1.4	Xm+1.5
06	Xm+1.6	Xm+1.7
07	Yn+3.0	Yn+3.1
08	Yn+3.2	Yn+3.3
09	Yn+3.4	Yn+3.5
10	Yn+3.6	Yn+3.7
11	Yn+4.0	Yn+4.1
12	Yn+4.2	Yn+4.3
13	Yn+4.4	Yn+4.5
14	Yn+4.6	Yn+4.7
15	Yn+5.0	Yn+5.1
16	Yn+5.2	Yn+5.3
17	Yn+5.4	Yn+5.5
18	Yn+5.6	Yn+5.7
19	Yn+6.0	Yn+6.1
20	Yn+6.2	Yn+6.3
21	Yn+6.4	Yn+6.5
22	Yn+6.6	Yn+6.7
23	KCM5	KCM6
24	KCM7	DOCOM
25	DOCOM	DOCOM

Flat cable–side connector specification:
A02B–0120–K342
(HIFBB–50D–2.54R (Hirose Electric Co., Ltd.))
50 contacts
Cable material specification:
A02B–0120–K886
(61–meter, 50–pin cable
(Hitachi Cable, Ltd. or Oki Electric Cable Co., Ltd.))

10.5.4 DI (General–purpose Input Signal) Connection



NOTE

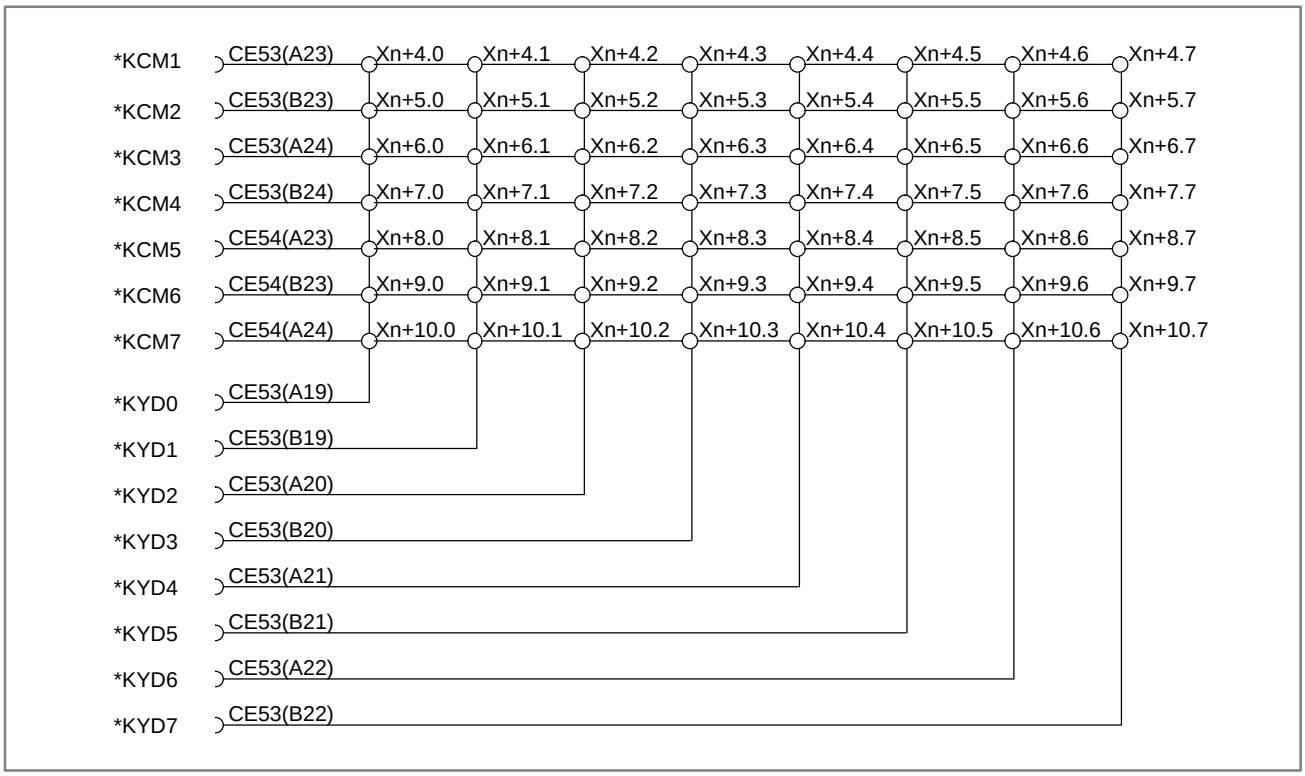
Xm+1.0 through Xm+1.7 are DI pins for which a common voltage can be selected. That is, by connecting the COM1 CE54(A02) pin to the +24 V power supply, a DI signal can be input with its logical state reversed. If, however, a cable is connected to ground, it has the same effect as inputting an ON state DI signal. To prevent this from occurring, the connection of the COM1 CE54(A02) pin to the 0 V power supply is recommended whereever possible.

For safety reasons, the emergency stop signal needs to be allocated to an appropriate bit of the addresses for which the common voltage is fixed, ranging from Xm+0.0 to Xm+0.7. See “Address allocation” in Section 9.5.10 for details of how to allocate the emergency stop signal.

For unused DI pins allocated to the addresses for which the common voltage is fixed (from Xm+1.0 to Xm+1.7), the logic is fixed to “0”. For unused pins allocated to Xm+1.0 to Xm+1.7 for which the common voltage can be selected, the logic is fixed to “0” when the COM1 CE54(A02) pin is connected to the 0 V power supply. When the COM1 CE54(A02) pin is connected to the +24 V power supply, the logic is fixed to “1”. The logic of the unused pins allocated to Xm+1.0 to Xm+1.7 is variable when the contact of the COM1 CE54(A02) pin is open.

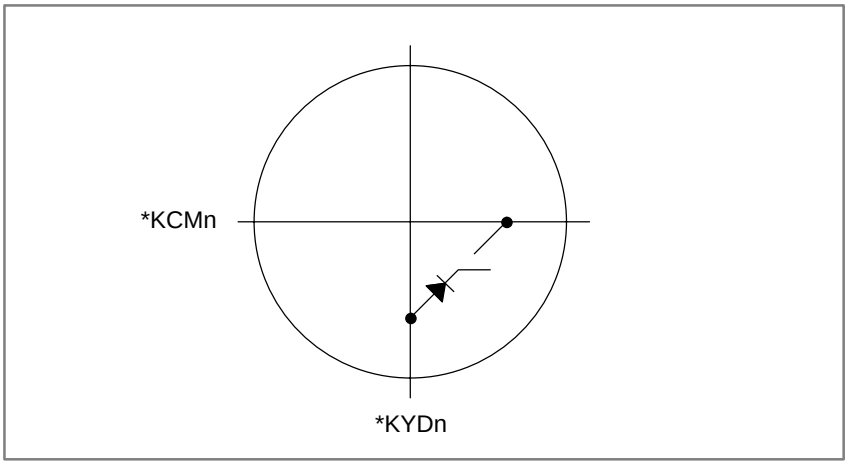
10.5.5 DI (Matrix Input Signal) Connection

○ A maximum of 56 points are provided.



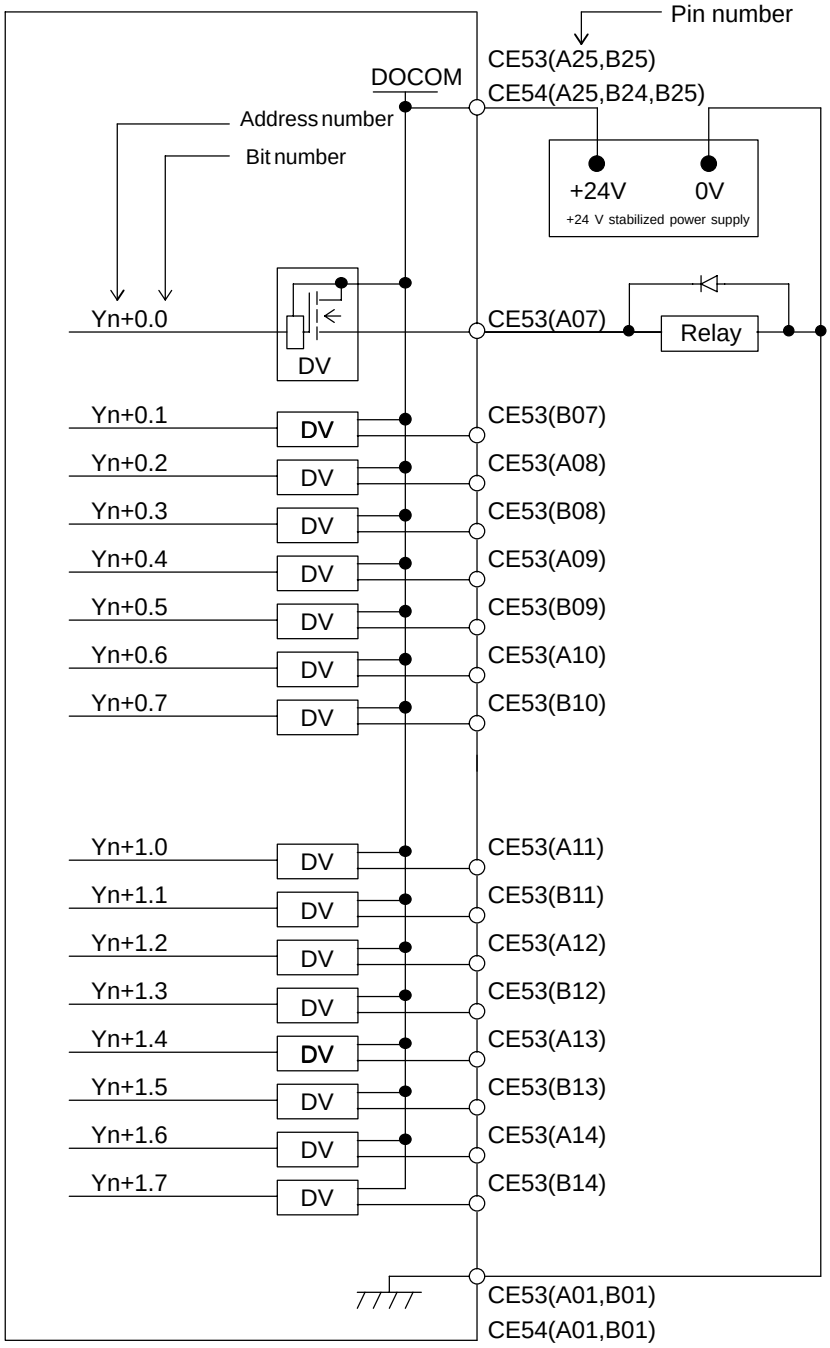
NOTE

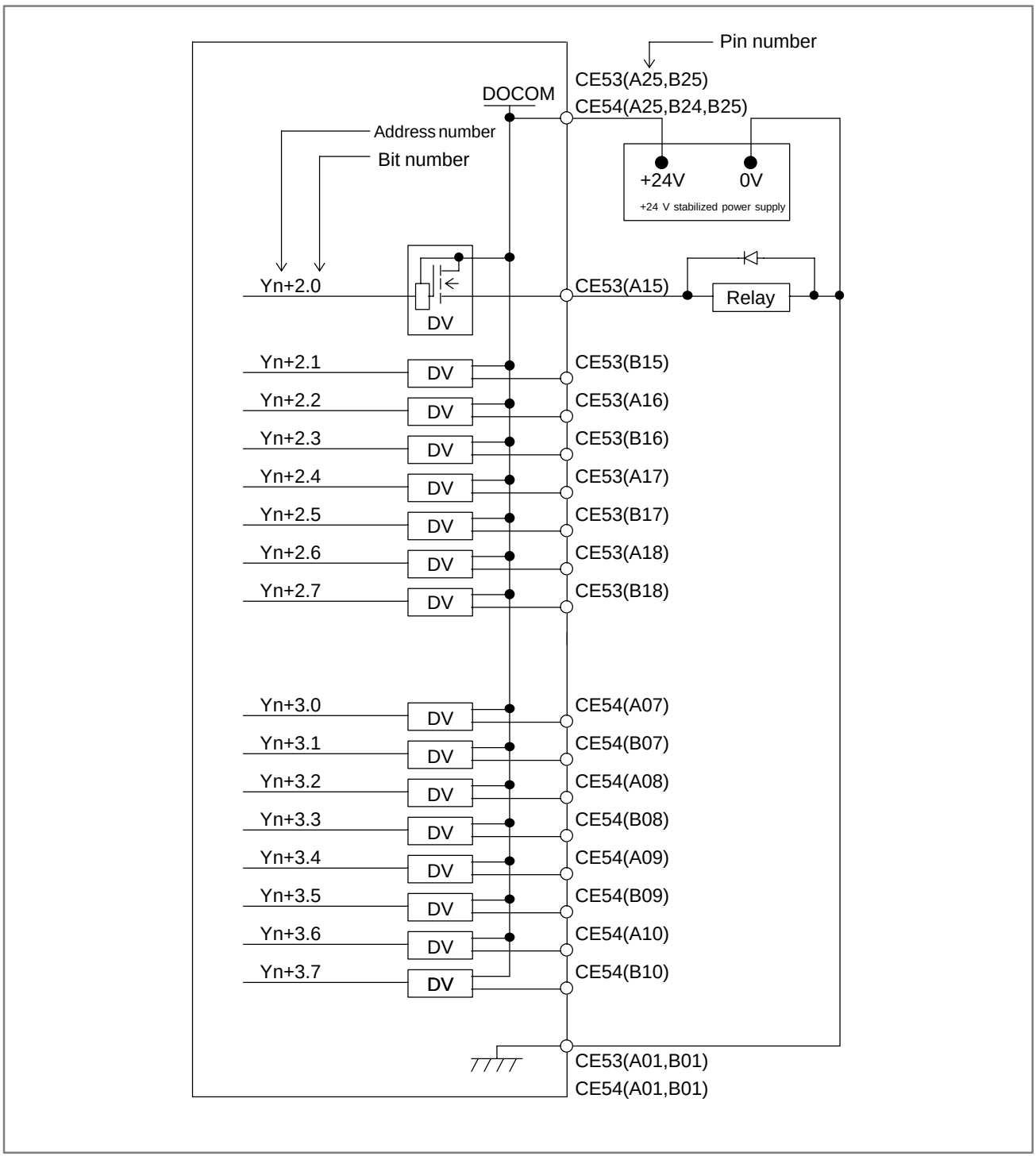
Detour prevention diodes must be incorporated for matrix signal input, as shown in the following figure. Otherwise, only two signals can be input at the same time. Inputting three or more signals simultaneously without using detour prevention diodes may result in data input errors.

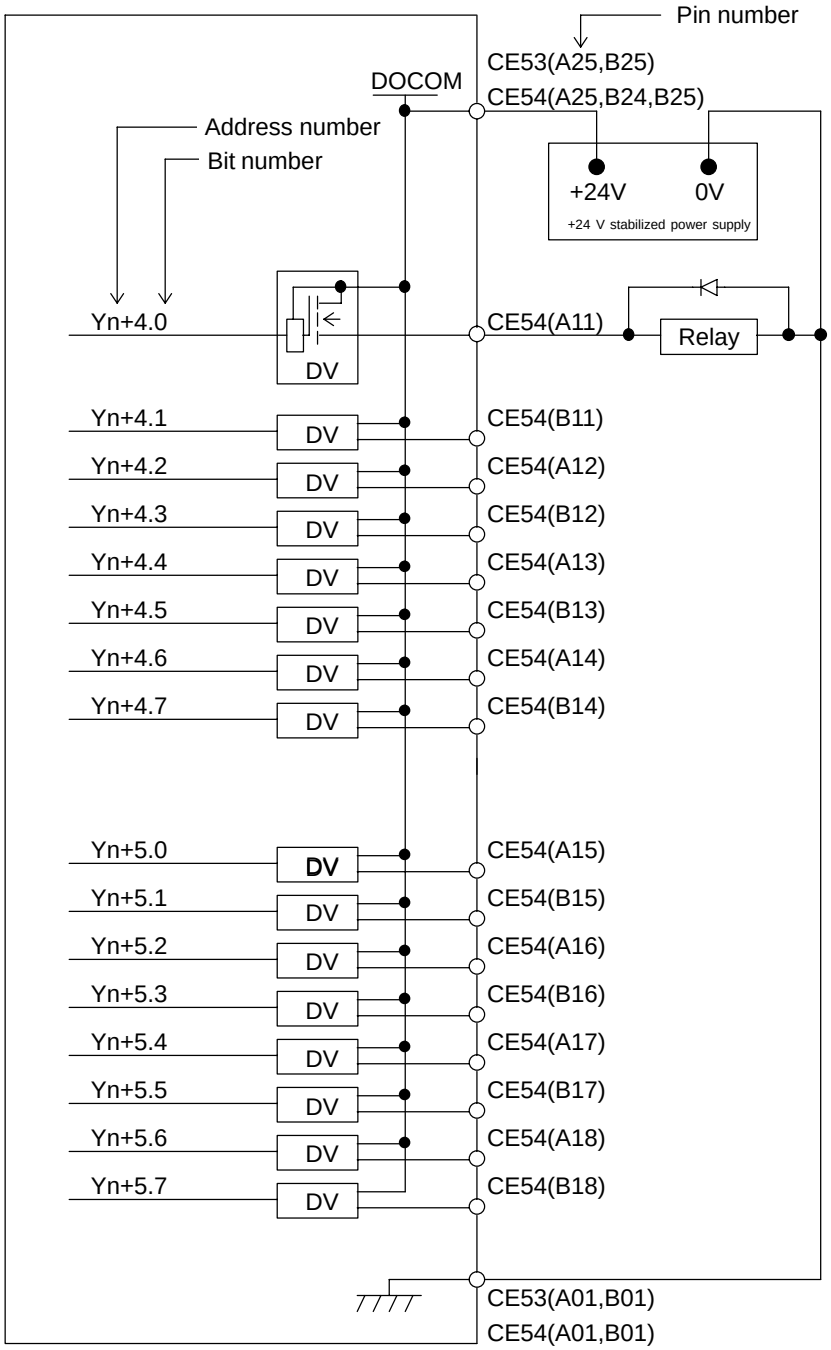


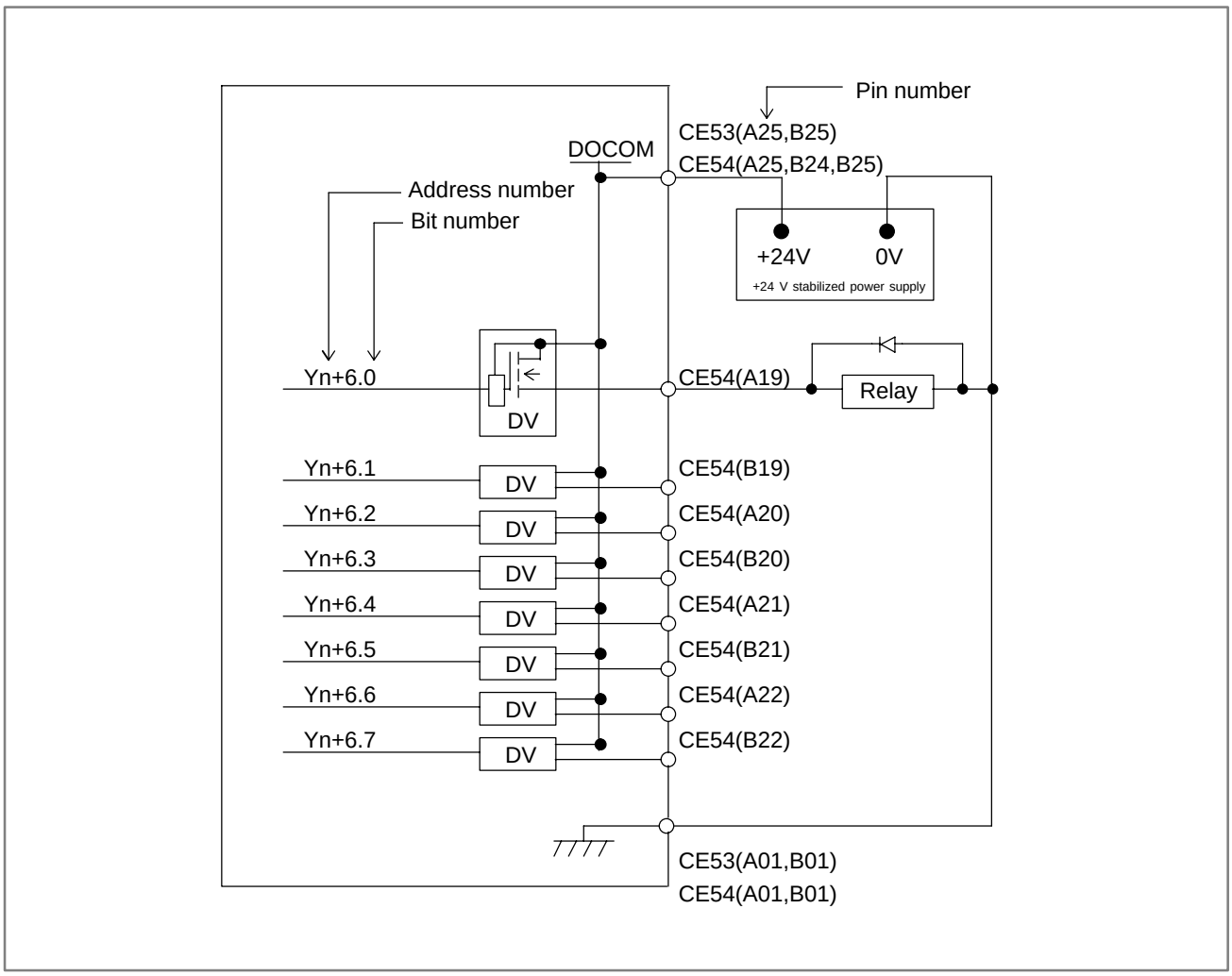
10.5.6 DO (Output Signal) Connection

○ A maximum of 56 points are provided.




Pin number
CE53(A25,B25)
DOCOM
CE54(A25,B24,B25)
Address number
Bit number
+24V
0V
+24 V stabilized power supply
Yn+2.0
CE53(A15)
Relay
DV
Yn+2.1
CE53(B15)
Yn+2.2
CE53(A16)
Yn+2.3
CE53(B16)
Yn+2.4
CE53(A17)
Yn+2.5
CE53(B17)
Yn+2.6
CE53(A18)
Yn+2.7
CE53(B18)
Yn+3.0
CE54(A07)
Yn+3.1
CE54(B07)
Yn+3.2
CE54(A08)
Yn+3.3
CE54(B08)
Yn+3.4
CE54(A09)
Yn+3.5
CE54(B09)
Yn+3.6
CE54(A10)
Yn+3.7
CE54(B10)
CE53(A01,B01)
CE54(A01,B01)

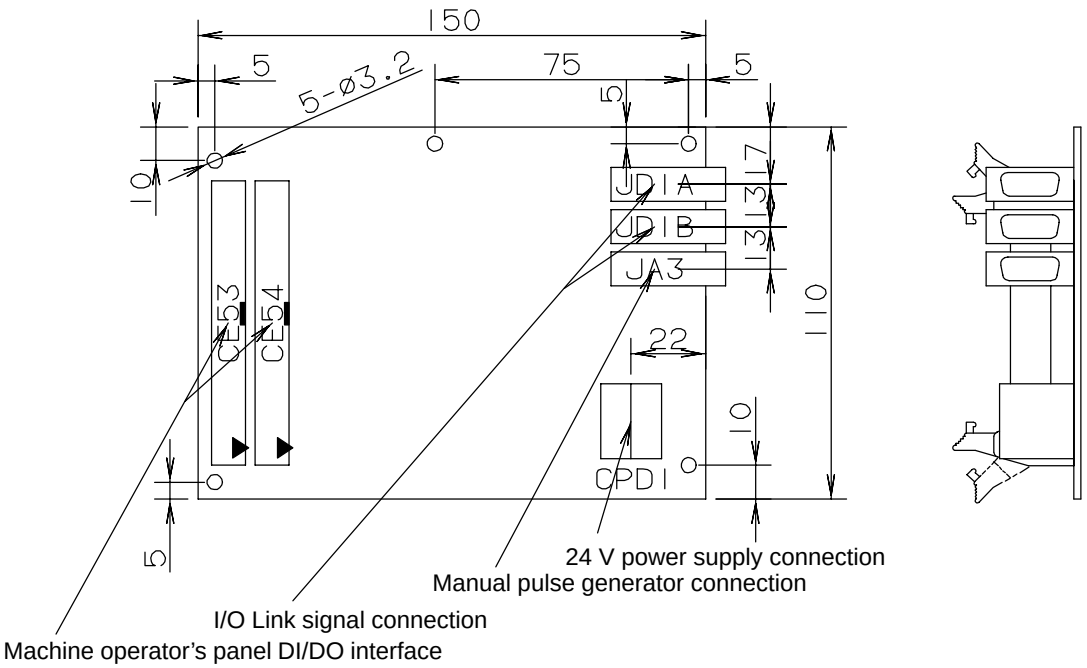

Pin number
CE53(A25,B25)
DOCOM
CE54(A25,B24,B25)
Address number
Bit number
+24V
0V
+24 V stabilized power supply
Yn+4.0
CE54(A11)
Relay
DV
Yn+4.1
CE54(B11)
Yn+4.2
CE54(A12)
Yn+4.3
CE54(B12)
Yn+4.4
CE54(A13)
Yn+4.5
CE54(B13)
Yn+4.6
CE54(A14)
Yn+4.7
CE54(B14)
Yn+5.0
CE54(A15)
Yn+5.1
CE54(B15)
Yn+5.2
CE54(A16)
Yn+5.3
CE54(B16)
Yn+5.4
CE54(A17)
Yn+5.5
CE54(B17)
Yn+5.6
CE54(A18)
Yn+5.7
CE54(B18)
CE53(A01,B01)
CE54(A01,B01)

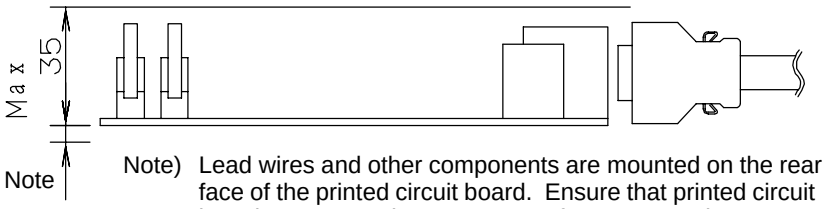


10.5.7 Manual Pulse Generator Connection

For details of the connection of the manual pulse generator, see Section 10.4.15.

10.5.8
External View

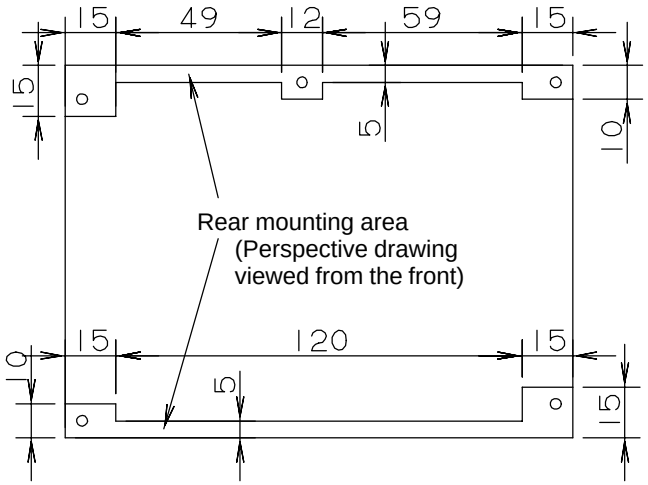




Note

Note) Lead wires and other components are mounted on the rear face of the printed circuit board. Ensure that printed circuit boards are spaced 5 mm or more from one another to prevent interference.

▌: Polarity guide
▶: A1 pin mark



10.5.9 Specifications

Installation specifications

Ambient temperature	During operation 0°C to 58°C During storage and transportation –20°C to 60°C
Temperature change	Max. 1.1°C/min.
Relative humidity	Normal : 75% or less Short term (1 month or less) : 95% or less
Vibration	During operation : 0.5 G or less
Environment	Ordinary machining factory environment (Special consideration is required when installing the module in a dusty location or where highly concentrated cutting lubricant or organic solvent is used.)
Other requirements	(1) Install the I/O module in a fully enclosed cabinet.

Ordering specifications

Item	Specification	Remarks
Operator's panel I/O module	A20B–2002–0470	General–purpose DI: 16 points Matrix DI: 56 points DO: 56 points MPG interface is supported.
Fuse (replacement part)	A03B–0815–K001	1 A

Module specifications

Item	Specification	Remarks
General–purpose DI	16 points	24–V input
Matrix DI	56 points (8 × 7)	5–V input
DO points	56 points	24 V source type output
CNC interface	FANUC I/O Link connection	Up to 16 modules can be connected as CNC slaves. Or, a maximum of 1024 points can be supported on both the input and output sides.
MPG interface	Max. 3 units	MPG interface can be used only for the *i* series CNC.

Power supply rating

Module	Supply voltage	Current rating	Remarks
Operator's panel I/O module	24 VDC ±10% supplied from the power supply connector CPD1. The allowance of ±10% should include instantaneous voltage and ripple voltage.	0.35A	The total power consumption of DI points is included. The power consumption of DO points is not included.

DI (input signal) specifications
(General–purpose input signal)

Contact rating	30 VDC, 16 mA or more
Open circuit intercontact leakage current	1 mA or less (at 26.4 V)
Closed circuit intercontact voltage drop	2 V or less (including cable voltage drop)
Delay	Receiver delay: Max. 2 ms The time required for I/O Link transmission between the CNC and I/O module (max. 2 ms + CNC ladder scan cycle) must also be taken into account.

(Matrix input signal)

Contact rating	6 VDC, 2 mA or more
Open circuit intercontact leakage current	0.2 mA or less (at 26 V)
Closed circuit intercontact voltage drop	0.9 V or less (with a current of 1 mA)
Delay	The maximum matrix period of 16 ms, the maximum time of I/O Link transfer between CNC and I/O module of 2 ms, and the ladder scanning period (by CNC) must be considered.

NOTE
When detour prevention diodes are used, the voltage drop across closed contacts indicated above must be maintained, including the diode voltage drop.

DO (output signal) specifications

Maximum load current in ON state	200 mA or less (including momentary current)
Saturation voltage in ON state	Max. 1 V (when load current is 200 mA)
Withstand voltage	24 V +20% or less (including momentary values)
Leakage current in OFF state	20 μA or less
Delay	Driver delay: Max. 50 μs The time required for I/O Link transmission between the CNC and I/O module (max. 2 ms + CNC ladder scan cycle) must also be taken into account.

NOTE
Ensure that the maximum current per DOCOM pin (DO power supply pin) does not exceed 0.7 A.

10.5.10 Other Notes

DO signal reaction to a system alarm

If a system alarm occurs in the CNC using the operator's panel I/O module, or if I/O Link communication between the CNC and operator's panel I/O module fails, all the DO signals of the I/O module are turned off. Therefore, sufficient care is necessary when setting up the machine sequence. Also, the same phenomenon occurs if the power to the CNC or the I/O module is turned off.

Address allocation

For the operator's panel I/O module, I/O addresses are mapped as follows.

DI space map

Xm	General–purpose input signal
Xm+1	
Xm+2	Reserved
Xm+3	
Xm+4	Matrix input signal
Xm+5	
Xm+6	
Xm+7	
Xm+8	
Xm+9	
Xm+10	
Xm+11	Reserved
Xm+12 (for 1st MPG)	MPG
Xm+13 (for 2nd MPG)	
Xm+14 (for 3rd MPG)	
Xm+15 (DO alarm detection)	DO alarm detection

DO space map

Yn	Output signal
Yn+1	
Yn+2	
Yn+3	
Yn+4	
Yn+5	
Yn+6	
Yn+7	Reserved

The operator's panel I/O module is allocated a group of DI addresses (16 bytes) and a group of DO addresses (8 bytes). This address allocation is explained below.

The MPG interface (MPG counter) occupies DI space from Xm+12 through Xm+14. These addresses are fixed, and Xm+12 through Xm+14 must be allocated as a DI work area to enable the use of the MPG. Therefore, when using an MPG for the I series CNC, allocate DI addresses in units of 16 bytes. Do not use the DI space from Xm+12 through Xm+14 for Ladder; the CNC processes the MPG counter value directly.

DI address Xm+15 is used for detecting overcurrent and overheating alarms that may occur in the IC used in the DO driver. [For details, see the section describing the detection of DO (output signal) alarms.] This address is fixed, and must be allocated as a work area before it can be used. Therefore, when using this area, allocate DI addresses in units of 16 bytes.

Basically, I/O addresses can be allocated to the operator's panel I/O module freely. When allocating DI addresses, however, consider also the fixed addresses that are directly supervised by the CNC, and keep the following in mind.

Fixed addresses directly supervised by the CNC (for FS21*i*/210*i*)

	7	6	5	4	3	2	1	0
X0004	SKIP	ESKIP SKIP6	–MIT2 SKIP5	+MIT2 SKIP4	–MIT1 SKIP3	+MIT1 SKIP2	ZAE SKIP8	XAE SKIP7
	SKIP	ESKIP SKIP6	SKIP5	SKIP4	SKIP3	ZAE SKIP2	YAE SKIP8	XAE SKIP7
X0005								
X0006								
X0007								
X0008				*ESP				
X0009					*DEC4	*DEC3	*DEC2	*DEC1

The upper row indicates those signals used for the T series. Those in the lower row are for the M series.

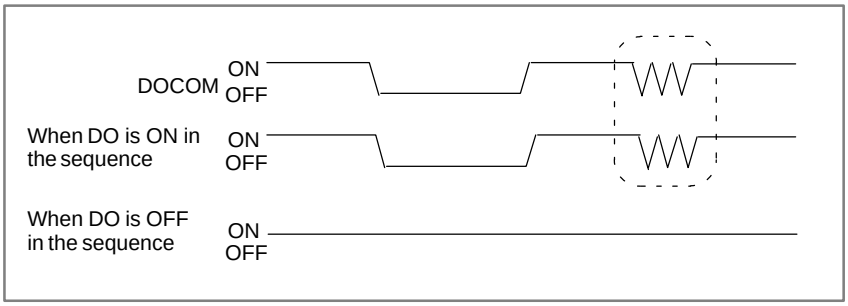
When DI addresses are allocated in units of 16 bytes, starting at X0008

X0008	General–purpose input signal ← *ESP fixed signal
X0009	← *DECn fixed signal
X0010	Reserved
X0011	
X0012	Matrix input signal
X0013	
X0014	
X0015	
X0016	
X0017	
X0018	
X0019	Reserved
X0020(for 1st MPG)	MPG
X0021(for 2nd MPG)	
X0022(for 3rd MPG)	
X0023(DO alarm detection)	DO alarm detection

Although fixed signals such as SKIP cannot be used, allocating DI addresses starting from X0008 allows the *DECn signal to be used and the *ESP fixed signal to be allocated to an address for which the common voltage is fixed to 24 V. (Fixed signals cannot be allocated to the for the matrix input signals.)

Turning the DO (output signal) power on and off (DOCOM)

All the DO signals can be turned off simultaneously by turning off (opening) the DO (output signal) power supply pin “DOCOM”. Doing so causes the DO signal status to change as shown below.

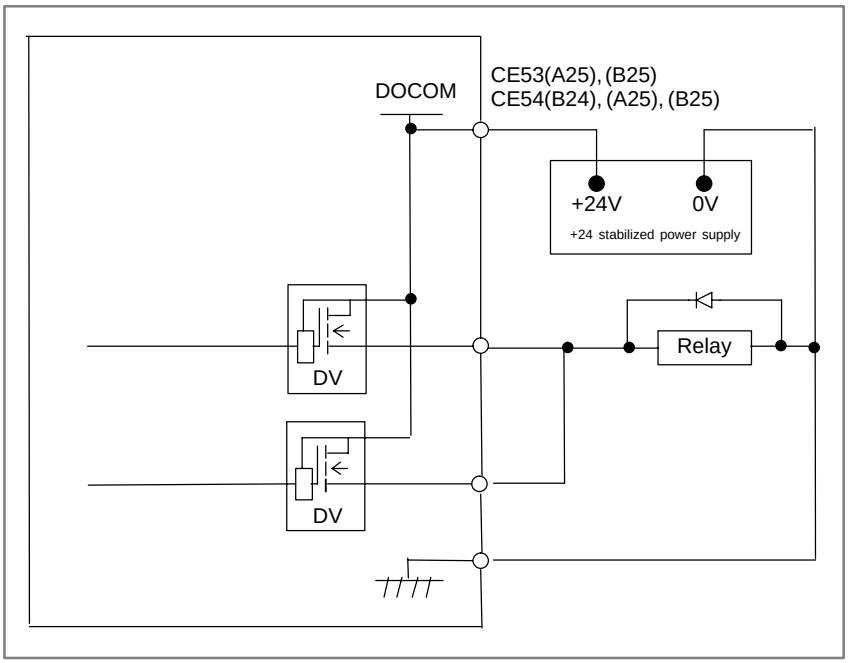


NOTE

When the DO signal is in the ON state in the sequence, the ON or OFF state of the DOCOM pin determines the state of the signal, as indicated by the dotted lines in the above figure. Do not turn off the +24 V supply, provided by the CPD1 to the I/O module, during the operation. Turning off the +24 V supply would cause a CNC communication alarm. When turning on the power, the +24 V supply to the I/O module must be turned on before or at the same time as the power supply to the CNC. When turning off the power, the +24 V supply to the I/O module must be turned off after or at the same time as the power supply to the CNC.

Parallel DO (output signal) connection

The DO load current can be doubled by connecting two DO points in parallel and turning them on and off simultaneously in sequence, as shown in the figure below. The maximum load current per DI point is 200 mA. Connecting two DO points in parallel and turning them on at the same time produces a current of 400 mA. Note that, however, when two DO points are connected in parallel, the leakage current also doubles while they are off (max. 40 μA).



DO (output signal) alarm detection

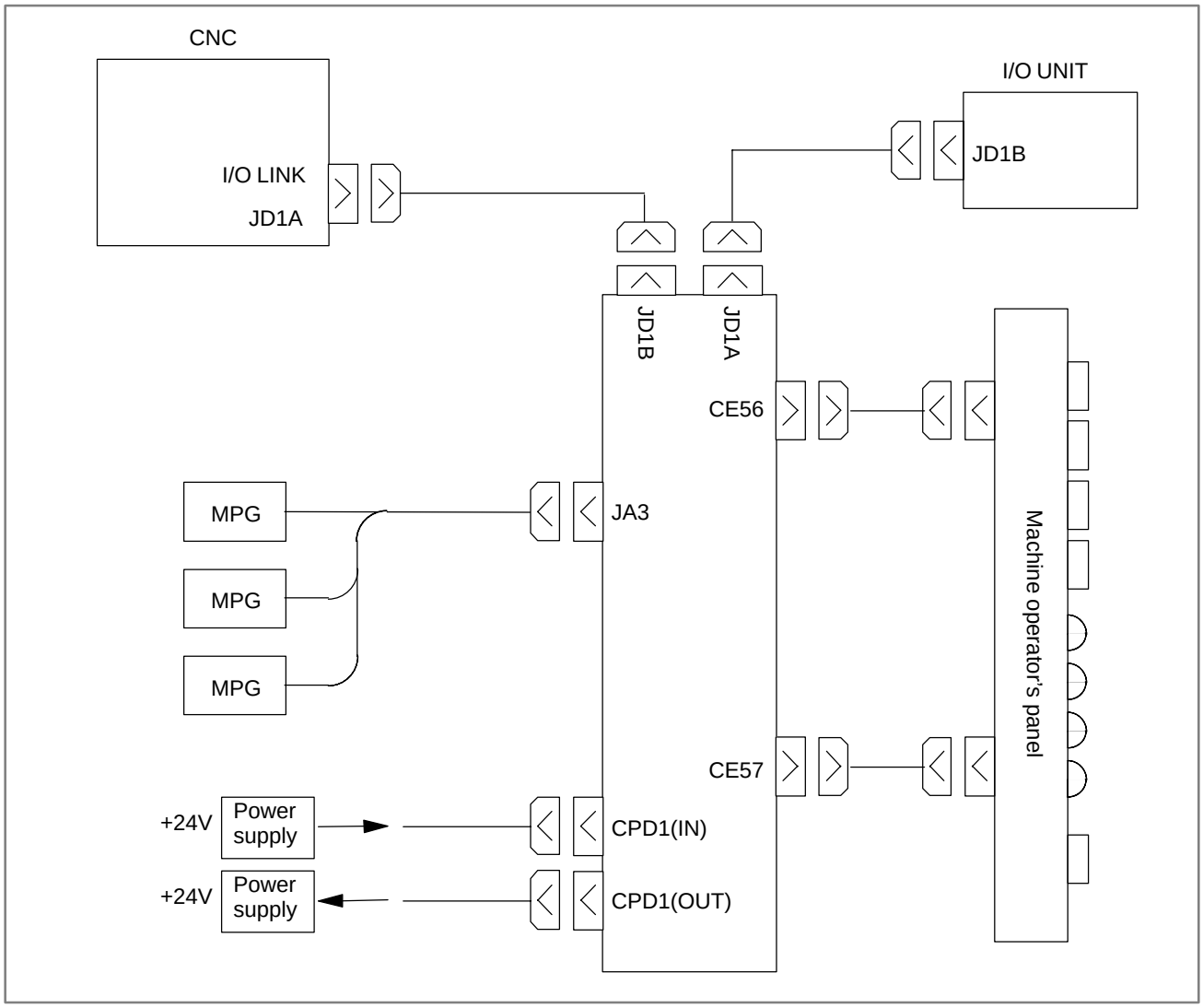
The DO driver of the I/O module is capable of detecting an overcurrent and measuring its own temperature. If an accident, such as connecting the cable to ground, causes an abnormal increase in the load current or in the driver temperature, a protection circuit, which is provided for each DO driver (1 byte), is activated which keeps the DO signal for the relevant 1 byte in the OFF state until the cause of the problem is eliminated. Even if this occurs, the CNC and the I/O module continue operating. The DI address (Xm+15) identifies which DO driver has detected an alarm. The following table shows the correspondence between the DI address (Xm+15) bits and the DO addresses. Bit value "1" indicates that the corresponding DO driver has detected an alarm. The contents of the Xm+15 area can be checked by using the DGN screen of the CNC or by performing the alarm processing for the area in advance by using Ladder. This helps alarm detection and recovery.

Alarm detection address and bit	DO address	Remarks
Xm+15.0	Yn+0	
Xm+15.1	Yn+1	
Xm+15.2	Yn+2	
Xm+15.3	Yn+3	
Xm+15.4	Yn+4	
Xm+15.5	Yn+5	
Xm+15.6	Yn+6	
Xm+15.7	Yn+7	Reserved

10.6 CONNECTION OF OPERATOR'S PANEL I/O MODULE AND POWER MAGNETICS CABINET I/O MODULE

The difference between the operator's panel I/O module and the power magnetics cabinet I/O module lies in whether an interface to a manual pulse generator is provided. The power magnetics cabinet does not provide an interface to a manual pulse generator.

10.6.1 Overall Connection Diagram



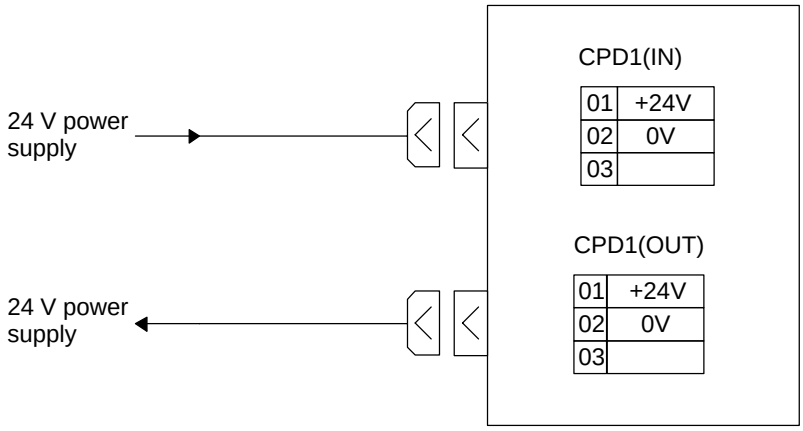
NOTE
The MPG can be connected to this operator's panel I/O module only when the *i* series CNC is used. When the operator's panel I/O module is used together with a unit (connector panel I/O module) connected to the I/O Link supporting another MPG interface, only the MPG interface of the unit (module) closest to the CNC connected to the I/O Link is enabled. The following screw type connectors, newly incorporated into the *i* series main board, cannot be used to connect the I/O Link or MPG.

Connectors that cannot be used on the cable side

	Specification	Manufacturer
Connector	FI–20–CV7	Hirose Electric Co., Ltd.
Connector case and connector	FI30–20S–CV7	Hirose Electric Co., Ltd.

10.6.2 Power Connection

Provide the CPD1 (IN) connector, shown below, with the power necessary for the printed circuit board operation and that for DI operation. To facilitate power division, the power is output to CPD1 (OUT) exactly as it is input from CPD1 (IN). When power division is required, use CPD1 (OUT).



Recommended cable–side connector: A02B–0120–K324
(including the following connector housing and case)
(Housing: Japan AMP 1–178288–3)
(Contacts: Japan AMP 1–175218–5)

NOTE

The specification of the power supply connector CPD1 (IN) is the same as that for CPD1 (OUT). There are no indications on the printed circuit board to distinguish between the IN and OUT connectors. Do not turn off the +24 V supply to the connector during operation. Turning off the +24 V supply will cause a CNC communication alarm. When turning on the power, the +24 V supply to the I/O module must be turned on before or at the same time as the power supply to the CNC. When turning off the power, the +24 V supply to the I/O module must be turned off after or at the same time as the power supply to the CNC.

10.6.3 DI/DO Connector Pin Arrangement

CE56

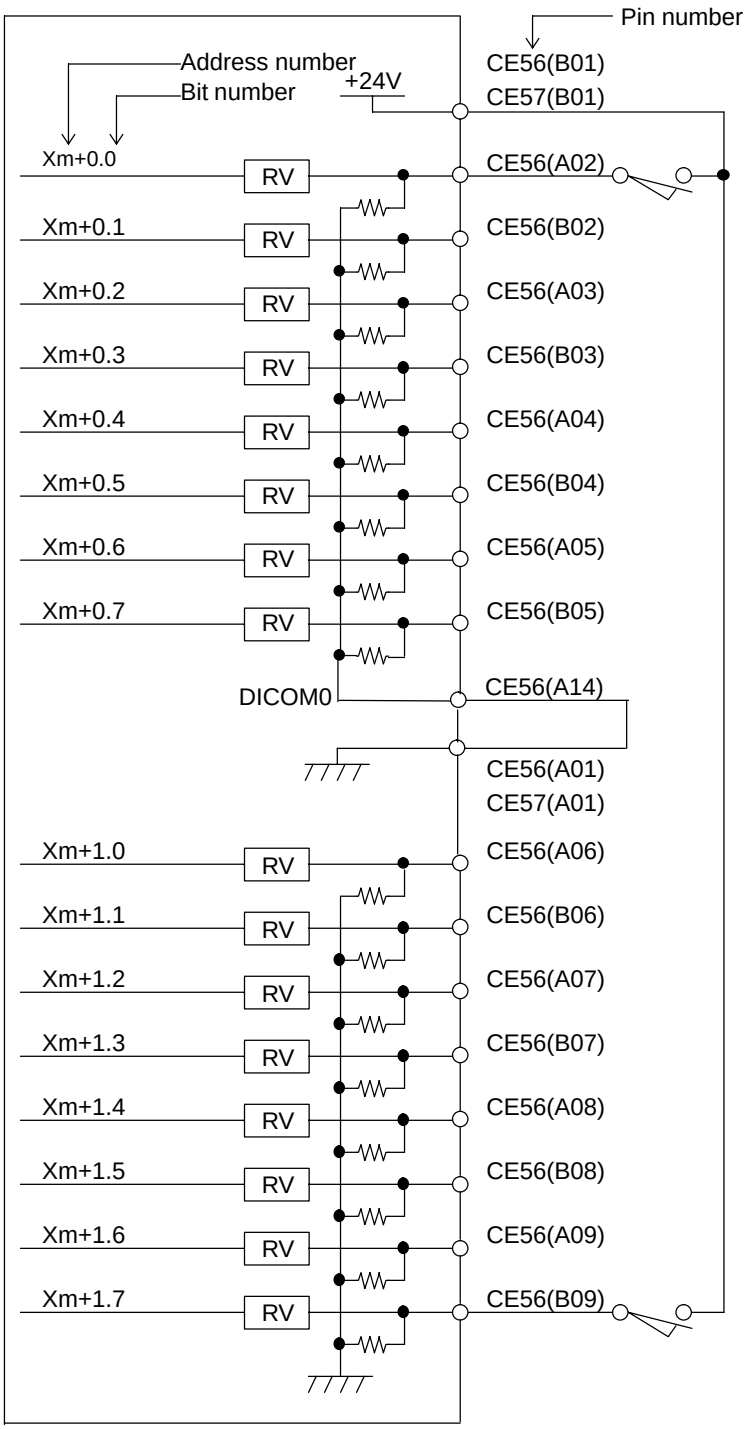
	A	B
01	0V	+24V
02	Xm+0.0	Xm+0.1
03	Xm+0.2	Xm+0.3
04	Xm+0.4	Xm+0.5
05	Xm+0.6	Xm+0.7
06	Xm+1.0	Xm+1.1
07	Xm+1.2	Xm+1.3
08	Xm+1.4	Xm+1.5
09	Xm+1.6	Xm+1.7
10	Xm+2.0	Xm+2.1
11	Xm+2.2	Xm+2.3
12	Xm+2.4	Xm+2.5
13	Xm+2.6	Xm+2.7
14	DICOM0	
15		
16	Yn+0.0	Yn+0.1
17	Yn+0.2	Yn+0.3
18	Yn+0.4	Yn+0.5
19	Yn+0.6	Yn+0.7
20	Yn+1.0	Yn+1.1
21	Yn+1.2	Yn+1.3
22	Yn+1.4	Yn+1.5
23	Yn+1.6	Yn+1.7
24	DOCOM	DOCOM
25	DOCOM	DOCOM

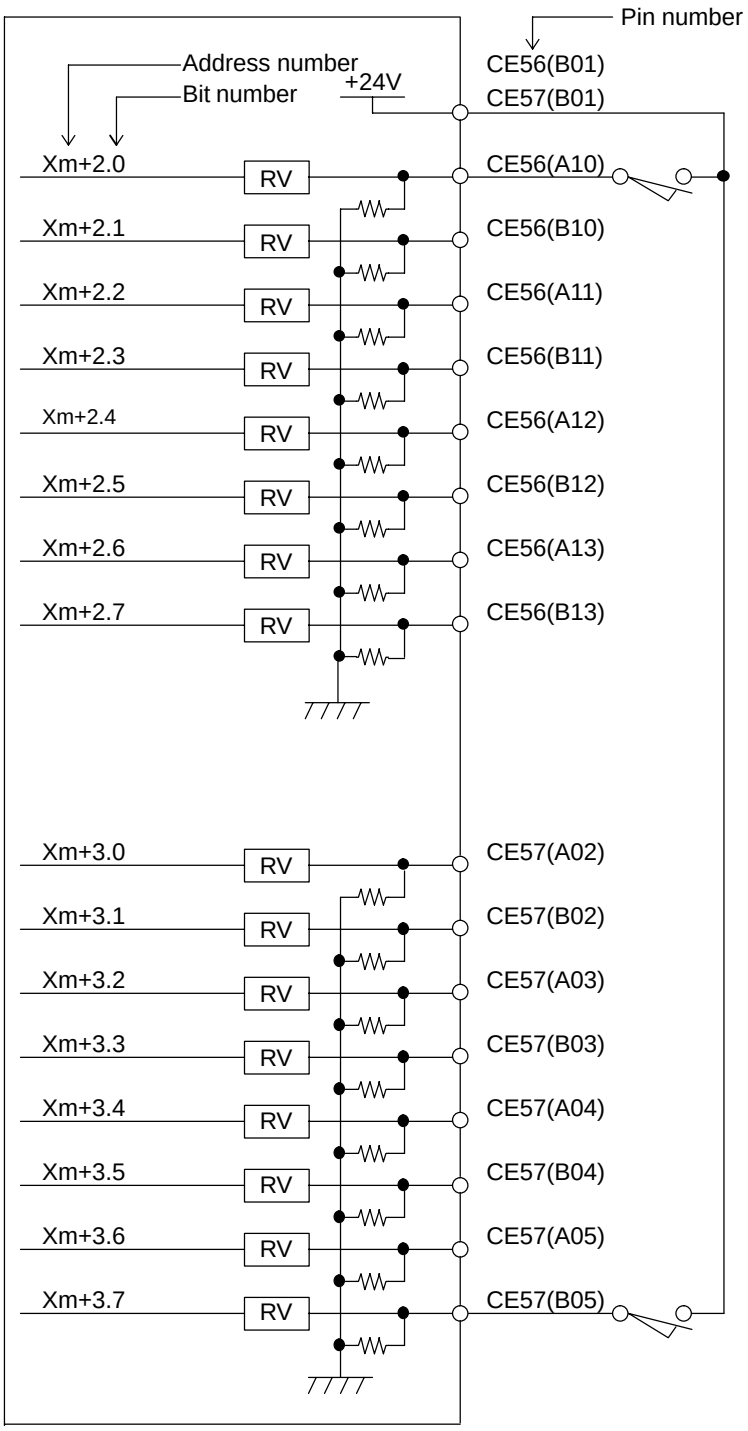
CE57

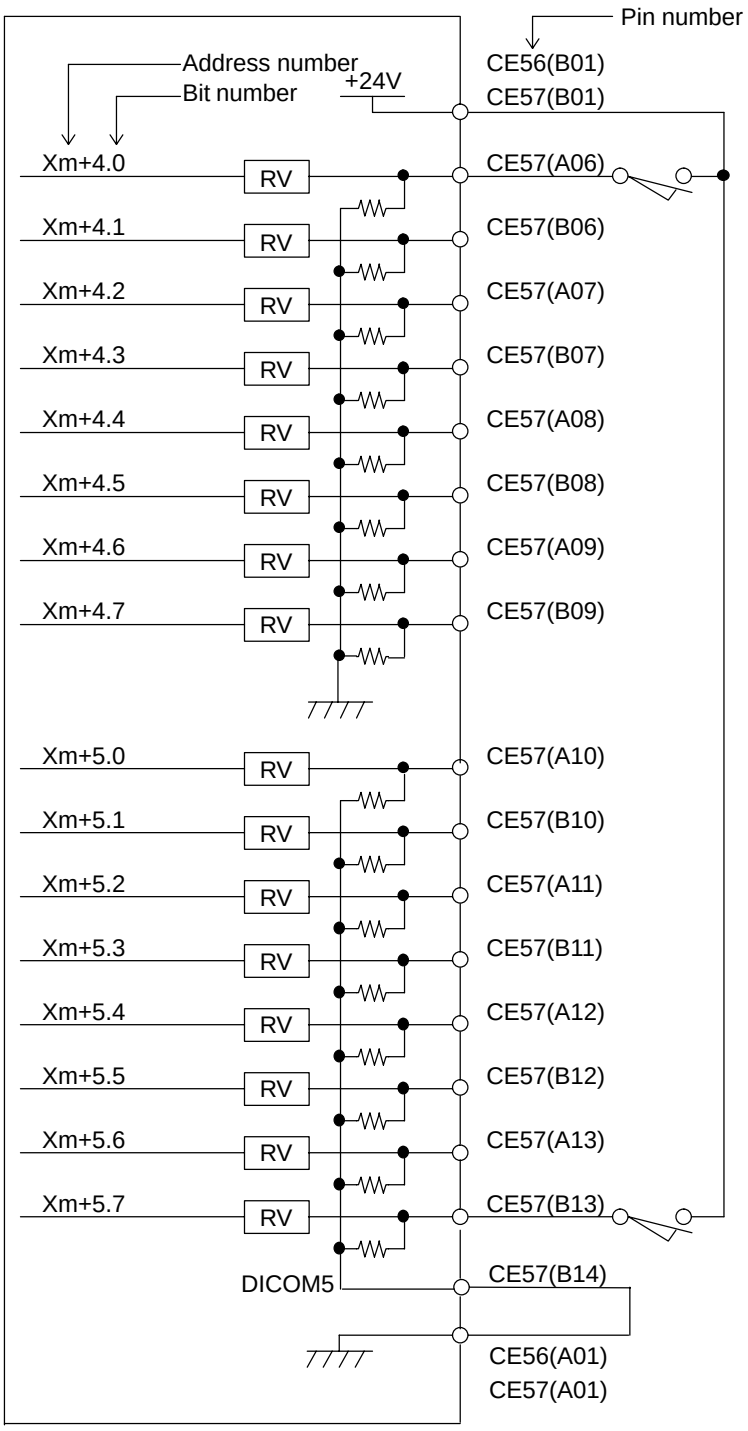
	A	B
01	0V	+24V
02	Xm+3.0	Xm+3.1
03	Xm+3.2	Xm+3.3
04	Xm+3.4	Xm+3.5
05	Xm+3.6	Xm+3.7
06	Xm+4.0	Xm+4.1
07	Xm+4.2	Xm+4.3
08	Xm+4.4	Xm+4.5
09	Xm+4.6	Xm+4.7
10	Xm+5.0	Xm+5.1
11	Xm+5.2	Xm+5.3
12	Xm+5.4	Xm+5.5
13	Xm+5.6	Xm+5.7
14		DICOM5
15		
16	Yn+2.0	Yn+2.1
17	Yn+2.2	Yn+2.3
18	Yn+2.4	Yn+2.5
19	Yn+2.6	Yn+2.7
20	Yn+3.0	Yn+3.1
21	Yn+3.2	Yn+3.3
22	Yn+3.4	Yn+3.5
23	Yn+3.6	Yn+3.7
24	DOCOM	DOCOM
25	DOCOM	DOCOM

Flat cable–side connector specification:
A02B–0120–K342
(HIF3BB–50D–2.54R (Hirose Electric Co., Ltd.))
50 contacts
Cable material specification:
A02B–0120–K886
(61–meter, 50–pin cable
(Hitachi Cable, Ltd. or Oki Electric Cable Co., Ltd.))

10.6.4 DI (General–purpose Input Signal) Connection




Pin number
Address number
Bit number
+24V
CE56(B01)
CE57(B01)
Xm+2.0
RV
CE56(A10)
Xm+2.1
RV
CE56(B10)
Xm+2.2
RV
CE56(A11)
Xm+2.3
RV
CE56(B11)
Xm+2.4
RV
CE56(A12)
Xm+2.5
RV
CE56(B12)
Xm+2.6
RV
CE56(A13)
Xm+2.7
RV
CE56(B13)
Xm+3.0
RV
CE57(A02)
Xm+3.1
RV
CE57(B02)
Xm+3.2
RV
CE57(A03)
Xm+3.3
RV
CE57(B03)
Xm+3.4
RV
CE57(A04)
Xm+3.5
RV
CE57(B04)
Xm+3.6
RV
CE57(A05)
Xm+3.7
RV
CE57(B05)


Pin number
Address number
Bit number
+24V
CE56(B01)
CE57(B01)
Xm+4.0
RV
CE57(A06)
Xm+4.1
RV
CE57(B06)
Xm+4.2
RV
CE57(A07)
Xm+4.3
RV
CE57(B07)
Xm+4.4
RV
CE57(A08)
Xm+4.5
RV
CE57(B08)
Xm+4.6
RV
CE57(A09)
Xm+4.7
RV
CE57(B09)
Xm+5.0
RV
CE57(A10)
Xm+5.1
RV
CE57(B10)
Xm+5.2
RV
CE57(A11)
Xm+5.3
RV
CE57(B11)
Xm+5.4
RV
CE57(A12)
Xm+5.5
RV
CE57(B12)
Xm+5.6
RV
CE57(A13)
Xm+5.7
RV
CE57(B13)
DICOM5
CE57(B14)
CE56(A01)
CE57(A01)

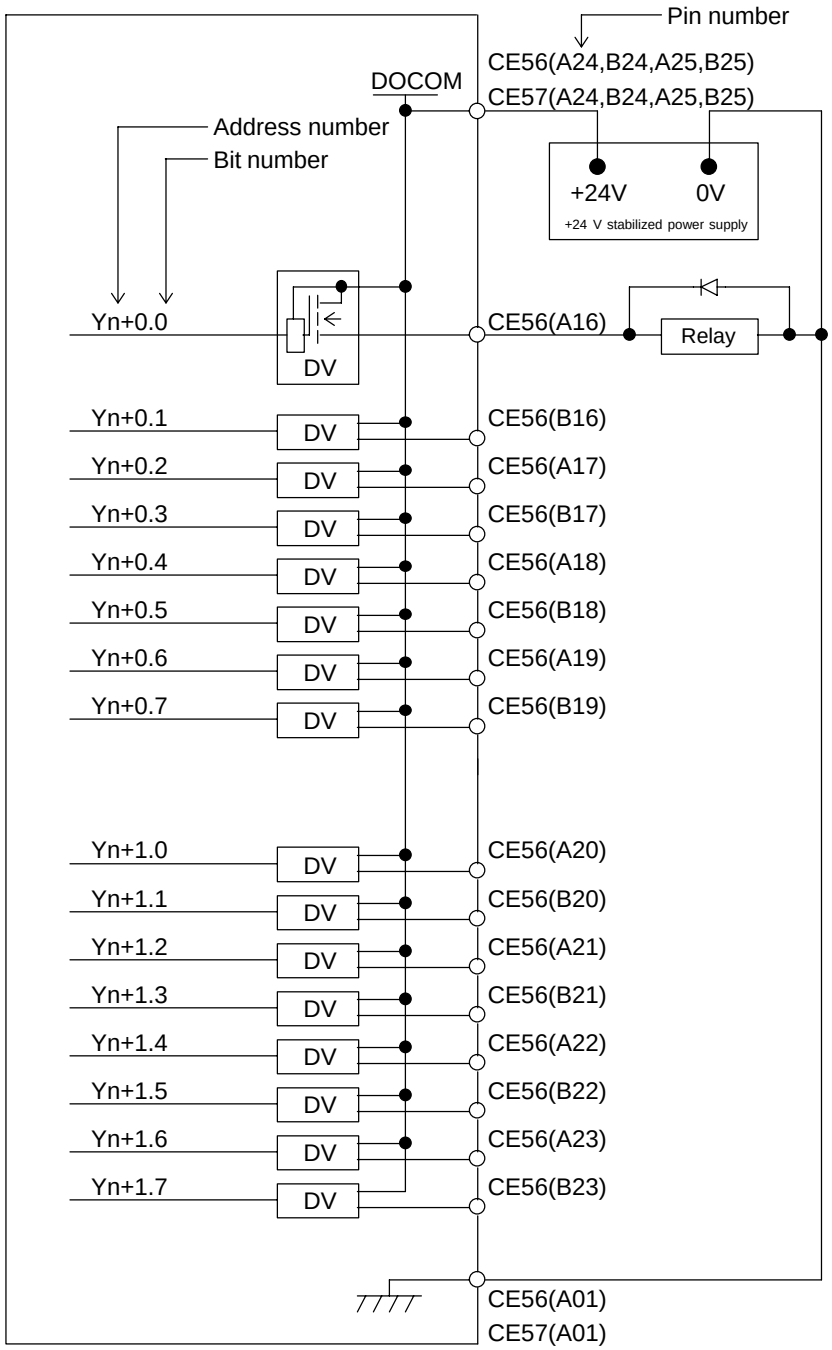
NOTE

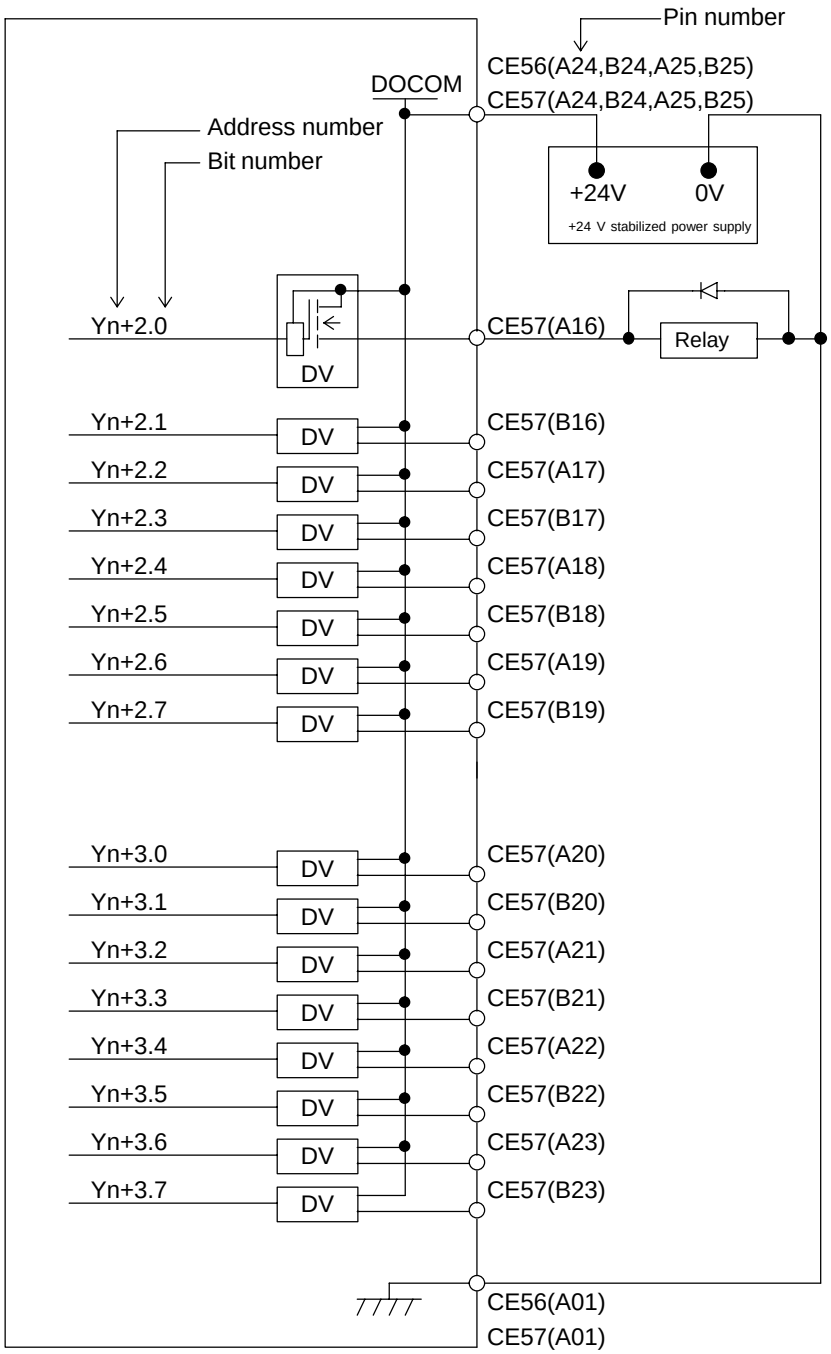
Xm+0.0 through Xm+0.7 and Xm+5.0 through Xm+5.7 are DI pins for which a common voltage can be selected. That is, by connecting the DICOM0 CE56(A14) or DICOM5 CE57(B14) pin to the +24 V power supply, a DI signal can be input with its logical state reversed. If, however, a cable is connected to ground, it has the same effect as inputting an ON state DI signal. To prevent this from occurring, the connection of the DICOM0 CE56(A14) and DICOM5 CE57(B14) pins to the 0 V power supply is recommended whereever possible.

For safety reasons, the emergency stop signal needs to be allocated to an appropriate bit of the addresses for which the common voltage is fixed. See “Address allocation” in Section 9.6.9 for details of how to allocate the emergency stop signal.

For unused DI pins allocated to the addresses for which the common voltage is fixed, the logic is fixed to “0”. For unused pins allocated to the addresses for which the common voltage can be selected, the logic is fixed to “0” when the DICOM0 CE56(A14) or DICOM5 CE57(B14) pin is connected to the 0 V power supply. When the DICOM0 CE56(A14) or DICOM5 CE57(B14) pin is connected to the +24 V power supply, the logic is fixed to “1”. The logic of the unused pins is variable when the contacts of the DICOM0 CE56(A14) and DICOM5 CE57(B14) pins are open.

10.6.5 DO (Output Signal) Connection

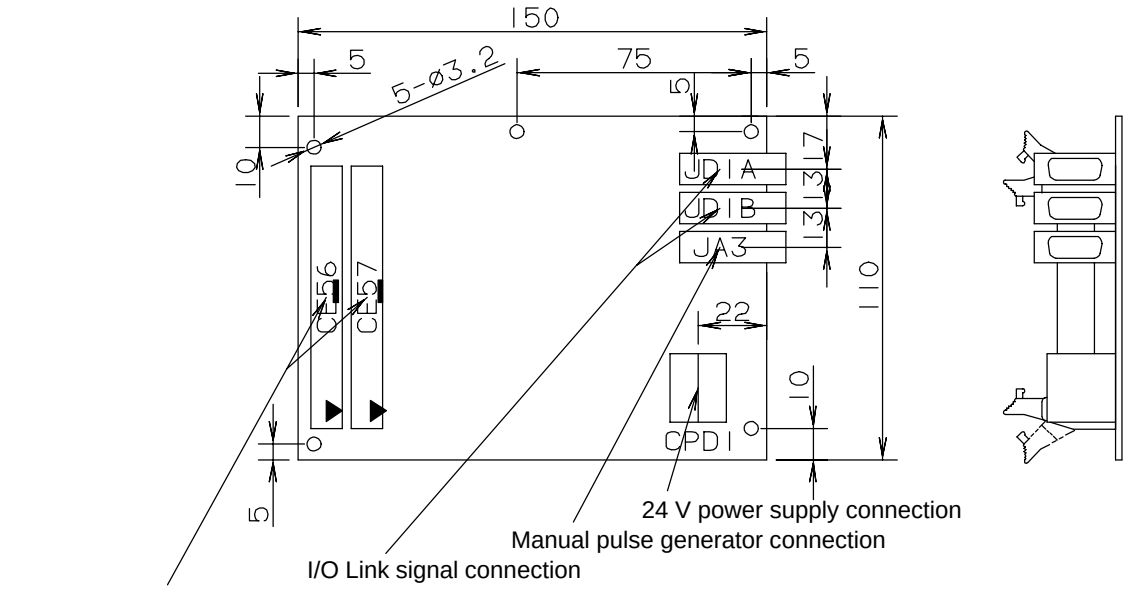


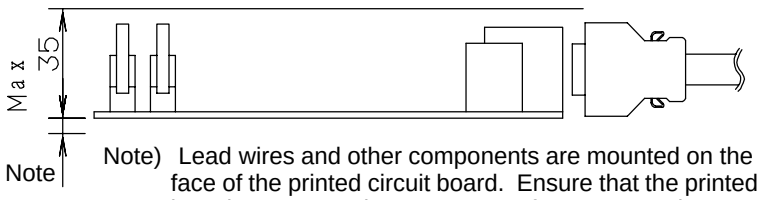

Pin number
CE56(A24,B24,A25,B25)
DOCOM
CE57(A24,B24,A25,B25)
Address number
Bit number
+24V
0V
+24 V stabilized power supply
Yn+2.0
CE57(A16)
Relay
DV
Yn+2.1
CE57(B16)
Yn+2.2
CE57(A17)
Yn+2.3
CE57(B17)
Yn+2.4
CE57(A18)
Yn+2.5
CE57(B18)
Yn+2.6
CE57(A19)
Yn+2.7
CE57(B19)
Yn+3.0
CE57(A20)
Yn+3.1
CE57(B20)
Yn+3.2
CE57(A21)
Yn+3.3
CE57(B21)
Yn+3.4
CE57(A22)
Yn+3.5
CE57(B22)
Yn+3.6
CE57(A23)
Yn+3.7
CE57(B23)
CE56(A01)
CE57(A01)

10.6.6 Manual Pulse Generator Connection

For details of the connection of the manual pulse generator, see Section 10.4.15.

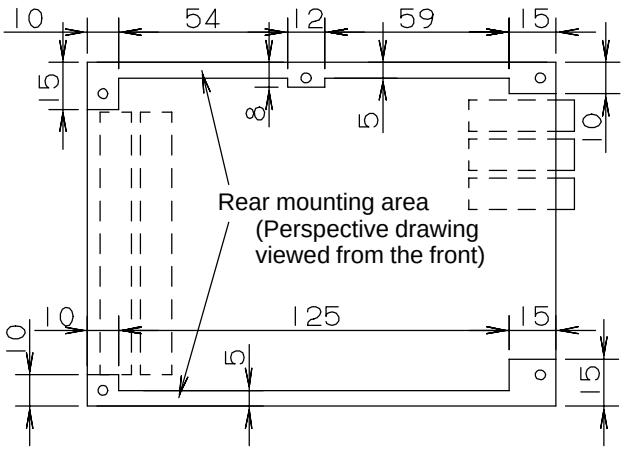
10.6.7 External View





Note) Lead wires and other components are mounted on the rear face of the printed circuit board. Ensure that the printed circuit boards are spaced 5 mm or more from one another to prevent interference.

▌: Polarity guide
▶: A1 pin mark



10.6.8 Specifications

Installation specifications

Ambient temperature	During operation 0° to 58°C During storage and transportation –20°C to 60°C
Temperature change	Max. 1.1°C/min.
Relative humidity	Normal: 75% or less Short term (1 month or less): 95% or less
Vibration	During operation: 0.5 G or less
Environment	Ordinary machining factory environment (Special consideration is required when installing the module in a dusty place or where highly concentrated cutting lubricant or organic solvent is used.)
Other requirements	(1) Install the I/O module in a fully enclosed cabinet.

Ordering specifications

Item	Specification	Remarks
Operator's panel I/O module (with MPG interface)	A20B–2002–0520	DI: 48 points DO: 32 points MPG interface is supported.
Power magnetics panel I/O module (without MPG interface)	A20B–2002–0521	DI: 48 points DO: 32 points MPG interface is not supported.
Fuse (replacement part)	A03B–0815–K001	1 A

Module specifications

Item	Specification	Remarks
DI points	48 points	24 V input
DO points	32 points	24 V source type output
CNC interface	FANUC I/O Link connection	Up to 16 modules can be connected as CNC slaves. Or, a maximum of 1024 points can be supported on both the input and output sides.
MPG interface	Max. 3 units	MPG interface can be used only for the *i* series CNC.

Power supply rating

Module	Supply voltage	Power supply rating	Remarks
Operator's panel I/O module	24 VDC ±10% is supplied from power supply connector CPD1. The tolerance of ±10% includes momentary and ripple currents.	0.3 A+7.3 mA×DI	DI = number of DI points in the ON state

DI (input signal) specifications
(general–purpose input signal)

Contact rating	30 VDC, 16 mA or more
Open circuit intercontact leakage current	1 mA or less (at 26.4 V)
Closed circuit intercontact voltage drop	2 V or less (including cable voltage drop)
Delay	Receiver delay: Max. 2 ms The time required for I/O Link transmission between the CNC and I/O module (max. 2 ms + CNC ladder scan cycle) must also be taken into account.

DO (output signal) specifications

Maximum load current in ON state	200 mA or less (including momentary current)
Saturation voltage in ON state	Max. 1 V (when load current is 200 mA)
Withstand voltage	24 V +20% or less (including momentary values)
Leakage current in OFF state	20 μA or less
Delay	Driver delay: Max. 50 μs The time for I/O Link transmission between the CNC and I/O module (max. 2 ms + CNC ladder scan cycle) must also be taken into account.

NOTE
Ensure that the maximum current per DOCOM pin (DO power supply pin) does not exceed 0.7 A.

10.6.9 Other Notes

DO signal reaction to a system alarm

If a system alarm occurs in a CNC using this 48/32–point I/O module, or if I/O Link communication between the CNC and operator's panel I/O module fails, all the DO signals of the I/O module are turned off. Therefore, due care must be taken when setting up the machine sequence. Also, the same phenomenon occurs if the power of the CNC or the I/O module is turned off.

Address allocation

For the operator's panel I/O module, I/O addresses are mapped as follows.

DI space map

Xm	Input signal
Xm+1	
Xm+2	
Xm+3	
Xm+4	
Xm+5	
Xm+6	Not used
Xm+7	
Xm+8	
Xm+9	
Xm+10	
Xm+11	
Xm+12 (for 1st MPG)	MPG
Xm+13 (for 2nd MPG)	
Xm+14 (for 3rd MPG)	
Xm+15 (DO alarm detection)	DO alarm detection

DO space map

Yn	Output signal
Yn+1	
Yn+2	
Yn+3	

Basically, this 48/32–point I/O module is allocated a group of DI addresses (16 bytes) and a group of DO addresses (4 bytes). This address allocation is explained below.

The MPG interface (MPG counter) occupies DI space from Xm+12 through Xm+14. These addresses are fixed, and Xm+12 through Xm+14 must be allocated as a DI work area to enable the use of the MPG. Therefore, when using an MPG for the *i* series CNC, allocate DI addresses in units of 16 bytes. Do not use the DI space from Xm+12 through Xm+14 for Ladder; the CNC processes the MPG counter value directly.

DI address Xm+15 is used for detecting overcurrent and overheating alarms that occur in the IC used in the DO driver. [For details, see the section describing the detection of DO (output signal) alarms.] This address is fixed, and must be allocated as a work area before it can be used. When using this area, therefore, allocate DI addresses in units of 16 bytes.

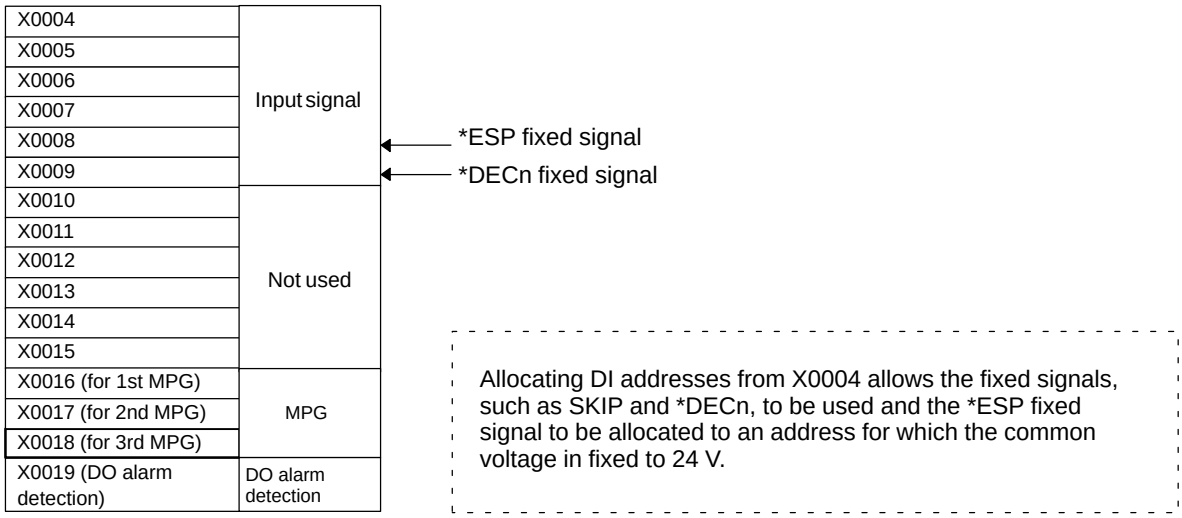
Basically, I/O addresses can be allocated to the 48/32–point I/O module freely. When allocating DI addresses, however, consider also the fixed addresses that are directly supervised by the CNC, and keep the following in mind.

Fixed addresses directly supervised by the CNC (for FS21*i*)

	7	6	5	4	3	2	1	0
X0004	SKIP	ESKIP SKIP6	–MIT2 SKIP5	+MIT2 SKIP4	–MIT1 SKIP3	+MIT1 SKIP2	ZAE SKIP8	XAE SKIP7
	SKIP	ESKIP SKIP6	SKIP5	SKIP4	SKIP3	ZAE SKIP2	YAE SKIP8	XAE SKIP7
X0005								
X0006								
X0007								
X0008				*ESP				
X0009					*DEC4	*DEC3	*DEC2	*DEC1

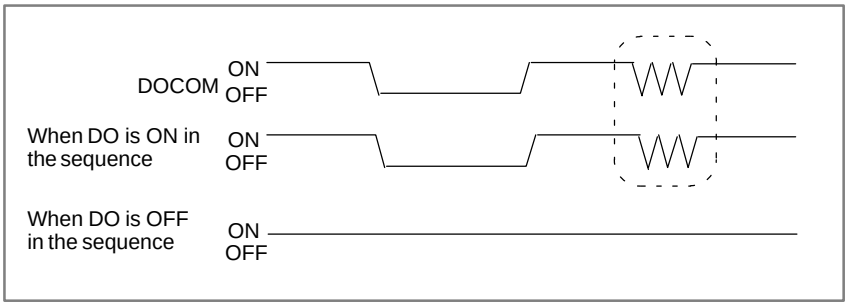
The upper row indicates those signals used for the T series. Those in the lower row are for the M series.

When DI addresses are allocated in units of 16 bytes, starting at X0004



Turning the DO (output signal) power on and off (DOCOM)

All the DO signals can be turned off simultaneously by turning off (opening) the DO (output signal) power supply pin “DOCOM”. Doing so causes the DO signal status to change as shown below.

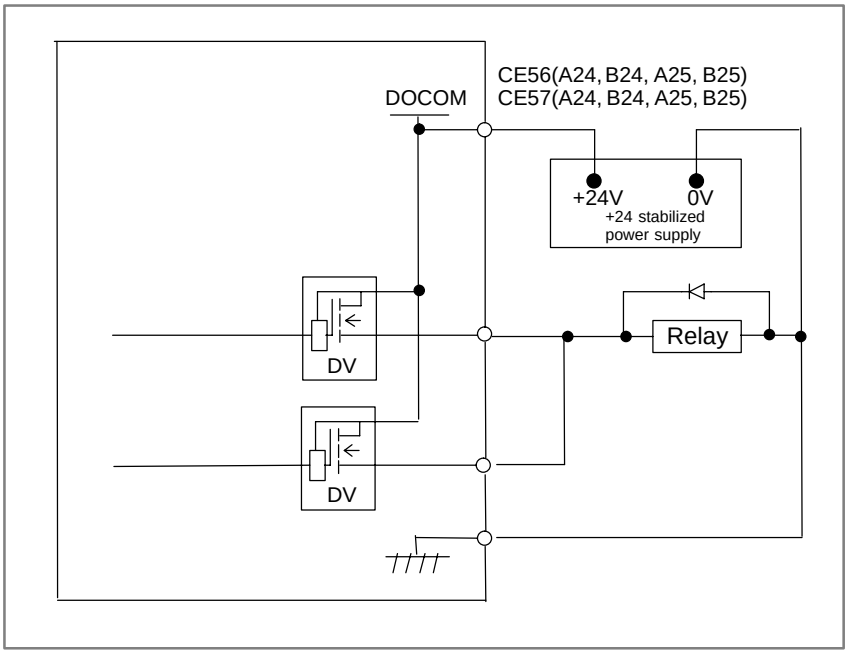


NOTE

When the DO signal is in the ON state in the sequence, the ON or OFF state of the DOCOM pin determines the state of the signal, as shown within dotted lines in the above figure. Do not turn off the +24 V supply provided by the CPD1 to the I/O module during the operation. Turning off the +24 V supply causes a CNC communication alarm. When turning on the power, the +24 V supply to the I/O module must be turned on before or at the same time as the power supply to the CNC. When turning off the power, the +24 V supply to the I/O module must be turned off after or at the same time as the power supply to the CNC.

Parallel DO (output signal) connection

The DO load current can be doubled by connecting two DO points in parallel and turning them on and off simultaneously in sequence, as shown in the figure below. The maximum load current per DI point is 200 mA. Connecting two DO points in parallel and turning them on at the same time produces a current of 400 mA. Note that, however, when two DO points are connected in parallel, the leakage current also doubles when they are off (max. 40 μA).



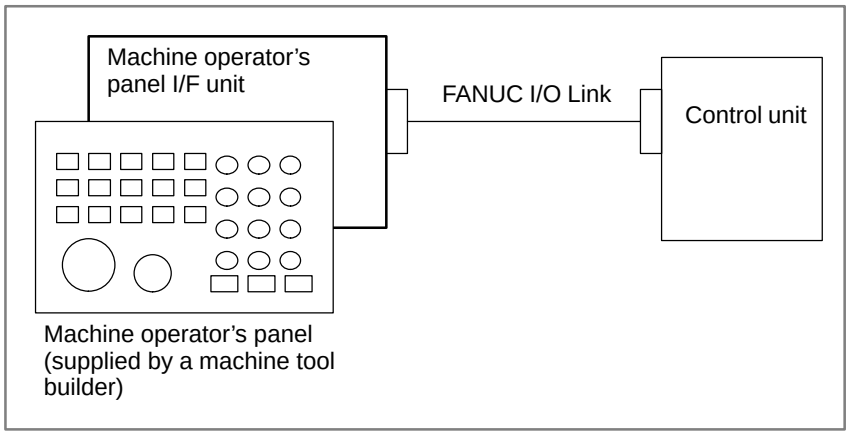
DO (output signal) alarm detection

The DO driver of the I/O module is capable of detecting an overcurrent and measuring its own temperature. If an accident, such as the connecting of the cable to ground, causes an abnormal increase in the load current or in the driver temperature, a protection circuit, which is provided for each DO driver (1 byte), is activated and keeps the DO signal for the relevant 1 byte in the OFF state until the cause of the problem is eliminated. Even if this occurs, the CNC and I/O module continue operating. The DI address (Xm+15) identifies the DO driver which has detected the alarm. The following table shows the correspondence between the DI address (Xm+15) bits and the DO addresses. Bit value “1” indicates that the corresponding DO driver has detected an alarm. The contents of the Xm+15 area can be checked by using the DGN screen of the CNC or by performing alarm processing for the area in advance by using Ladder. This helps alarm detection and recovery.

Alarm detection address and bit	DO address	Remarks
Xm+15.0	Yn+0	
Xm+15.1	Yn+1	
Xm+15.2	Yn+2	
Xm+15.3	Yn+3	
Xm+15.4	Yn+4	Reserved
Xm+15.5	Yn+5	Reserved
Xm+15.6	Yn+6	Reserved
Xm+15.7	Yn+7	Reserved

10.7 CONNECTION OF MACHINE OPERATOR'S PANEL INTERFACE UNIT

The machine operator's panel interface unit (A16B–2201–0110) is connected to the control unit through the I/O Link and is used for interfacing with the machine operator's panel.
It features interfaces with matrix key switches, LEDs and manual pulse generators.



10.7.1 Function Overview

Number of DI/DO points

Operator's panel control PCB allocation to the I/O Link DI/DO (module name) / DI or DO	DI/DO = 128/128		DI/DO = 256/256	
	DI (OC02I)	DO (OC02O)	DI (OC03I)	DO (OC03O)
Number of matrix key switch inputs	64		96	
Number of matrix LED data outputs		64		64
Number of general–purpose switch inputs	32		32	
Number of general–purpose LED data outputs		32		32
Number of total DI/DO points	96	96	128	96

- Matrix key switch inputs (matrix DI)
  Ninety–six DI points are provided by a matrix of twelve common signals times eight data signals. Note that I/O Link allocation may limit the number of usable key switch inputs.
- Matrix LED data outputs (matrix DO)
  Sixty–four DO points are provided by a matrix of eight common signals times eight data signals.
- General–purpose switch inputs (general–purpose DI)
  Each general–purpose DI point has an individual interface.
- General–purpose LED data outputs (general–purpose DO)
  Each general–purpose DO point has an individual interface.

Analog signal inputs

- Two inputs (input voltage: 0 to +10 V)
- Input voltages are converted from analog to digital. The resulting five bits of data are sent to the CNC through the FANUC I/O Link.
- The analog signal input function can be used regardless of whether I/O Link allocation is 128/128 or 256/256.

Terminal for signal forwarding

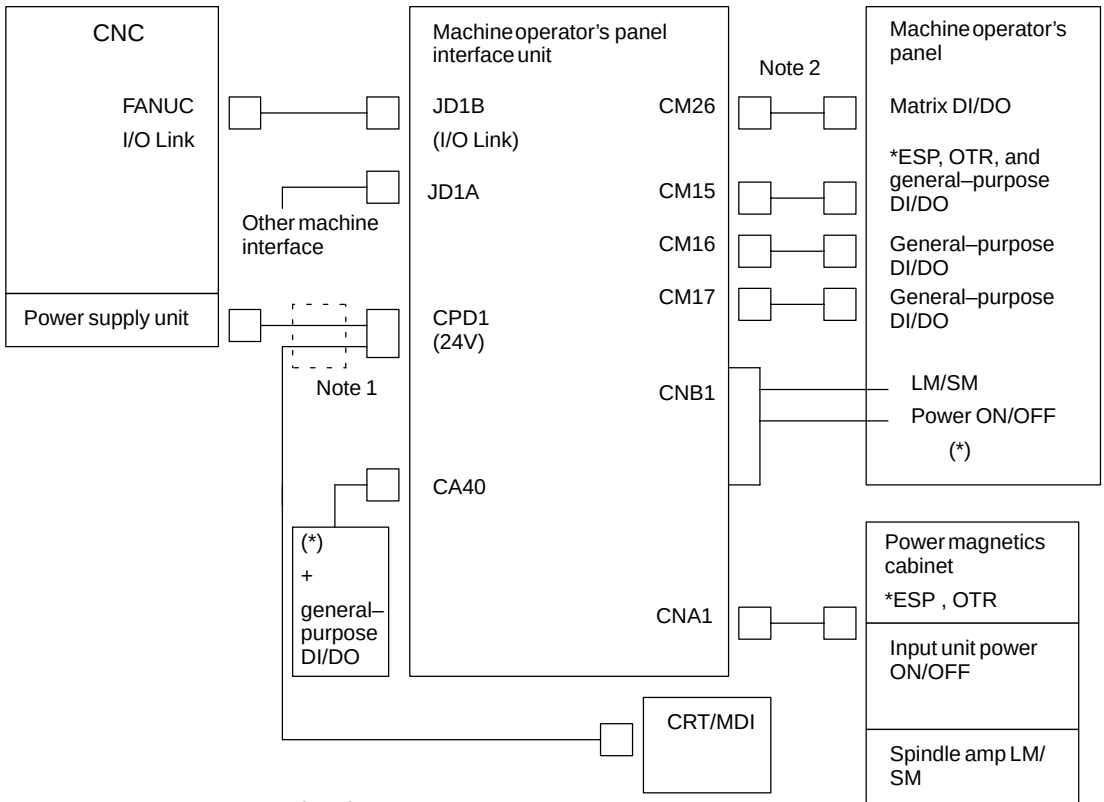
- Emergency stop and OT release signals are forwarded without change to the power magnetics cabinet.
- Power ON/OFF control signals are forwarded without change to an input unit.
- Analog signal inputs described in item “Analog signal inputs” can be sent out without being changed.

First manual pulse generator

Pulse information from the manual pulse generator is transferred via an I/O Link.

When this unit is used together with a unit (connector panel I/O module) connected to the I/O Link supporting another MPG interface, only the MPG interface of the unit (module) closest to the CNC connected to the I/O Link is valid.

10.7.2 System Configuration



*ESP : Emergency stop signal
OTR : OT release signal
ON/OFF : Power ON/OFF control signal
LM/SM: Load meter or speed meter signal
* : Manual pulse generator

NOTE
1 Power requirements
When 60% of the DI/DO points are on, this interface unit requires “1.0 A”
2 The cable connected to CM26 must not be longer than 30 cm.

10.7.3 Signal Assignment

Connector pin signal assignment

CM15 (General DI/DO)

	A	B
01	+5E	DI06
02	0V	DO06
03	+5E	DI07
04	0V	DO07
05	+5E	DI16
06	0V	DO16
07	+5E	DI17
08	0V	DO17
09	*ESP	ECM1
10	OTR	ECM2
11	DI00	D102
12	DI04	+5E
13	DI03	DI01
14	DI05	DI10
15	DI12	DI14
16	+5E	DI13
17	DI11	DI15

CM16 (General DI/DO)

	A	B
01	DI20	DI22
02	DI24	+5E
03	DI23	DI21
04	DI25	DI26
05	DI27	+5E
06	DO00	0V
07	DI05	+5E
08	DO01	0V
09	DI15	+5E
10	DO02	0V
11	DO03	DO04
12	DO05	0V
13	0V	0V
14	DO10	DO11
15	DO12	DO13
16	DO14	DO15
17	+5E	+5E

CM17 (General DI/DO)

	A	B
01	0V	0V
02	DO20	DO21
03	DO22	DO23
04	DO24	DO25
05	DO26	DO27
06	0V	0V
07	DO30	DO31
08	DO32	DO33
09	DO34	DO35
10	DO36	DO37
11	0V	0V
12	+5E	+5E
13	DI30	DI31
14	DI32	DI33
15	DI34	DI35
16	DI36	DI37
17	+5E	+5E

CA40 (Connector on the manual pulse generator)

14	DI37	08	DI31	01	+5V
15	0V	09	DI32	02	+5V
16	DO37	10	DI33	03	HA1
17	0V	11	DI34	04	HB1
18		12	DI35	05	
19	+5E	13	DI36	06	
20	+5E			07	DI30

CNA1 (Connector on the machine side)

9	0M	10	ECM2	19	OTR	20	
7	DO36	8	ECM1	17	*ESP	18	
5	SM	6	SM	15	COM	16	
3	0M	4	0M	13	EOF	14	
1	LM	2	LM	11	EON	12	

CNB1 (Connector on the operator's panel side)

01	LM	05	EON	09	HA1
02	SM	06	EOF	10	HB1
03	0M	07	COM	11	+5V
04	0M	08	0V	12	0V

CPD1 (Power supply)

3	2	1
	0V	+24V
6	5	4
	0V	+24V

Pins shaded by ▭ are those for forwarding signals. Pins with the same name are connected directly to one another.

NOTE
1 LM and SM also function as input terminals to the A/D converter.
2 OM is connected to 0 V on the PCB.
Input/output pins shaded by ▨ are in pairs. Only one in each pair is usable.
3 Do not connect a cable longer than 30 cm to CM15, CM16, or CM17.

JD1A (FANUC I/O Link : NEXT SLAVE)

9	+5V	10		19		20	+5V
7		8		17		18	+5V
5		6		15	0V	16	0V
3	TXB	4	*TXB	13	0V	14	0V
1	RXB	2	*RXB	11	0V	12	0V

JD1B (FANUC I/O Link : BEFORE SLAVE)

9	+5V	10		19		20	+5V
7		8		17		18	+5V
5		6		15	0V	16	0V
3	TXA	4	*TXA	13	0V	14	0V
1	RXA	2	*RXA	11	0V	12	0V

CM26 (Matrix DI/DO)

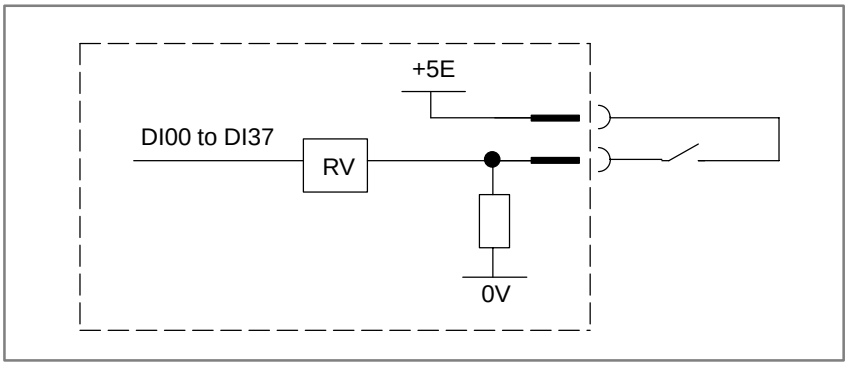
	A	B
01	0V	*MND1
02	*KYD0	*KYD1
03	*KYD2	*KYD3
04	*KYD4	*KYD5
05	*KYD6	*KYD7
06	*KYC0	*KYC1
07	*KYC2	*KYC3
08	*KYC4	*KYC5
09	*KYC6	*KYC7
10	*KYC8	*KYC9
11	*KYCA	*KYCB
12	*BZMD	0V
13	*LD0	*LD8
14	*LD1	*LD9
15	*LD2	*LD10
16	*LD3	*LD11
17	*LD4	*LD12
18	*LD5	*LD13
19	*LD6	*LD14
20	*LD7	*LD15
21	LC1L	LC1H
22	LC2L	LC2H
23	LC3L	LC3H
24	LC4L	LC4H
25	0V	0V

DInx	General–purpose DI	LM	Load meter voltage
DOnx	General–purpose DO	SM	Speed meter voltage
*ESP	Emergency stop	0M	LM/SM reference voltage (0V)
ECM1	*ESP common signal	*KYDx	Matrix DI data signal
OTR	OT release	*KYCx	Matrix DI common signal
ECM2	OTR common signal	*LDx	Matrix DO data signal
EON/OF	Power ON/OFF control signal	LCnL/H	Matrix DO common signal
COM	EON/EOF common signal	*MNDI	Three DI points acceptable
HAI	Input from manual pulse generator	*BZMD	Buzzer off
HBI	Input from manual pulse generator		

See Subsec. 10.7.4 for details of connection and signal meanings.

10.7.4 Interface

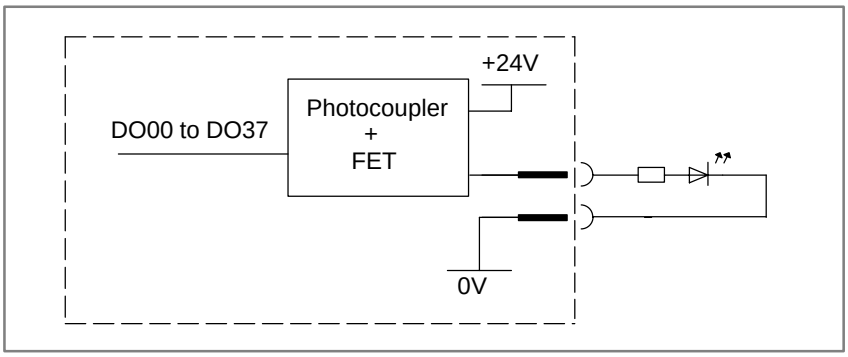
General–purpose DI



Input signal specifications

Contact rating	5VDC, 3.2mA or higher
Leakage current between open contacts	0.2mA or lower (5 VDC)
Voltage drop across closed contacts	0.75V or lower

General–purpose DO



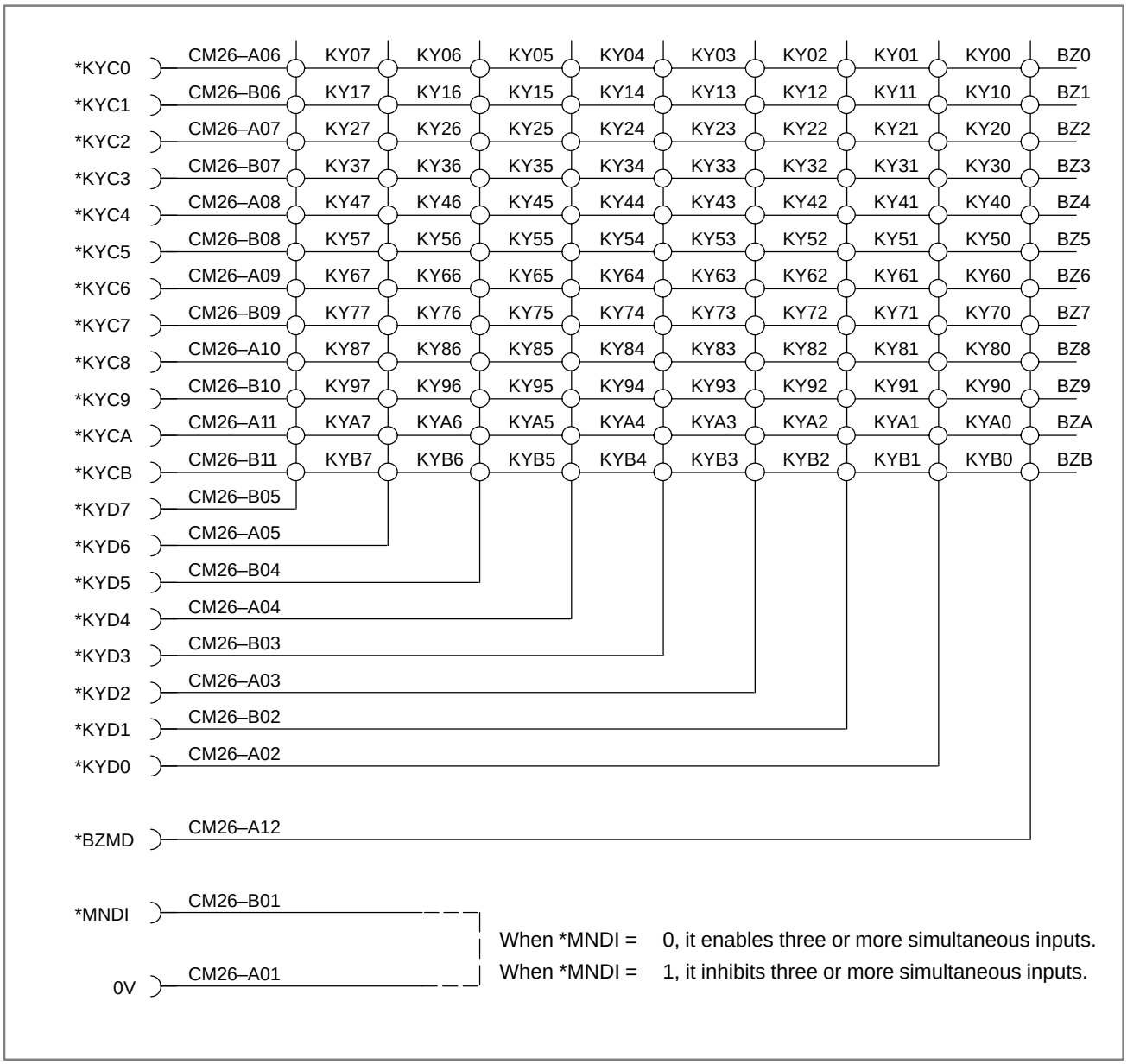
Output signal specifications

Maximum load current	0.03A
Maximum open–circuit leakage current	0.1mA
Maximum closed–circuit voltage drop	0.1V

NOTE
When using an LED at the DO point, connect an external resistor that meets the requirements of the LED.

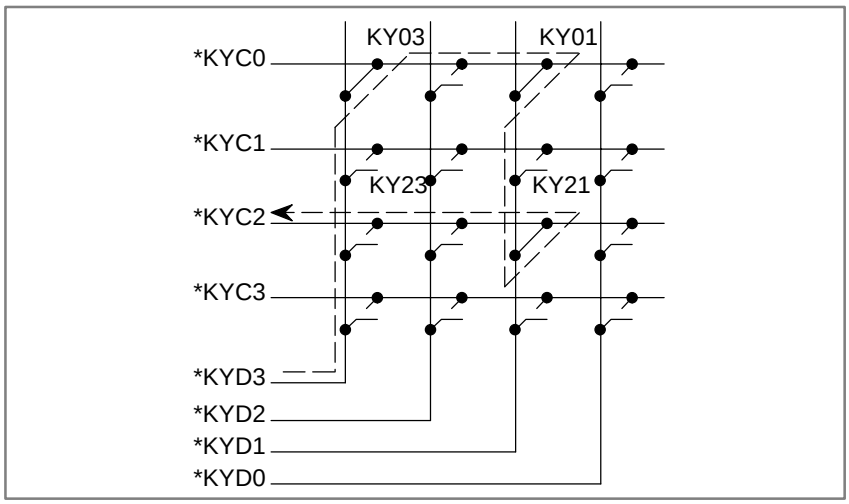
Matrix DI

- **Key switch addresses** See Subsec. 10.7.5 for the corresponding PMC addresses.



- **Mode selection**

❑ Preventing malfunctions that may be caused by detouring current
When there are three or more matrix DI points, detouring current can cause a nonexistent DI input to be falsely detected as existing.
As shown below, if KY01, KY03, and KY21 are closed simultaneously, current detours through the path indicated with arrows, thus causing a false input of *KY23 to be detected because of a current path formed by a combination of common signal *KYC2 and data signal *KYD3.



Two modes are available to prevent this malfunction. One should be selected according to the user applications.

[Method 1]

- Ignoring all occurrences of three or more simultaneous inputs

  Action : Make the *MNDI signal open (see item "● Key switch addresses")

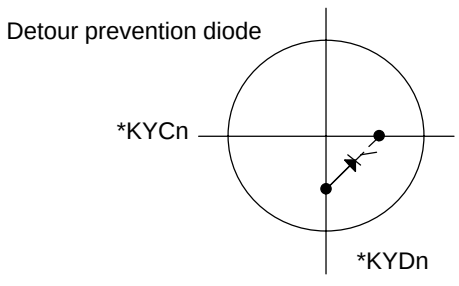
NOTE
If there are two inputs and a third is added, all three are ignored. When one of the three inputs is removed, two are accepted.

[Method 2]

- Attaching detour prevention diodes to enable three simultaneous inputs

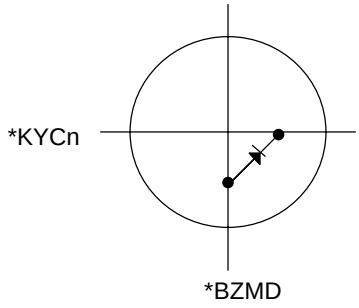
  Action : Connect the *MNDI signal (see item "● Key switch addresses") to 0V.

A diode must be connected in series with a switch, as shown below.

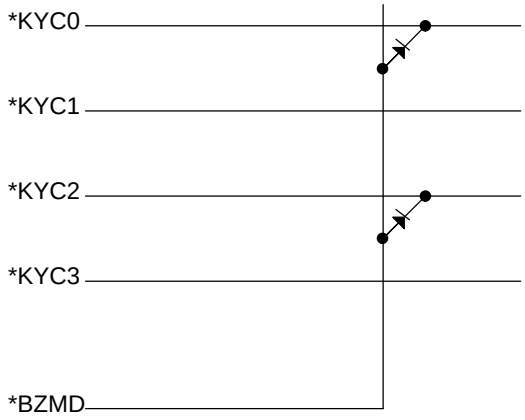


❑ This PCB can raise a confirmation sound when a key is pressed. The condition to raise an audible alarm is set in 8–bit units, or in *KYCn units. If *BZMD and common *KYCn are disconnected, a KYnx input causes a sound to generate. If they are connected, a KYnx input does not generate the sound.
To generate a confirmation sound for key input, the DO (PMC address DO + 00.7) “MD07” must have been turned to “1” (see Subsec. 10.7.5).

1 A diode is necessary to connect *BZMD and *KYCn, as shown below.
2 This setting cannot be changed when power is supplied.
3 The sound is generated when the circuit closes between common signal *KYCn and data signal *KYDx. It does not sound when the circuit is disconnected. If key switches are used, the sound is heard at the moment a key is pressed. It does not sound when a key is released or when a key is held pressed.



(Example)
If *BZMD is connected to *KYC0 and *KYC2, but disconnected from *KYC1 and *KYC3, as shown below, closing a switch at key addresses KY10 to KY17 and KY30 to KY37 causes a confirmation sound for key input to be heard, but closing a switch at key addresses KY00 to KY07 and KY20 to KY27 does not.
See item “● Key switch addresses”.



- **Signal specification**

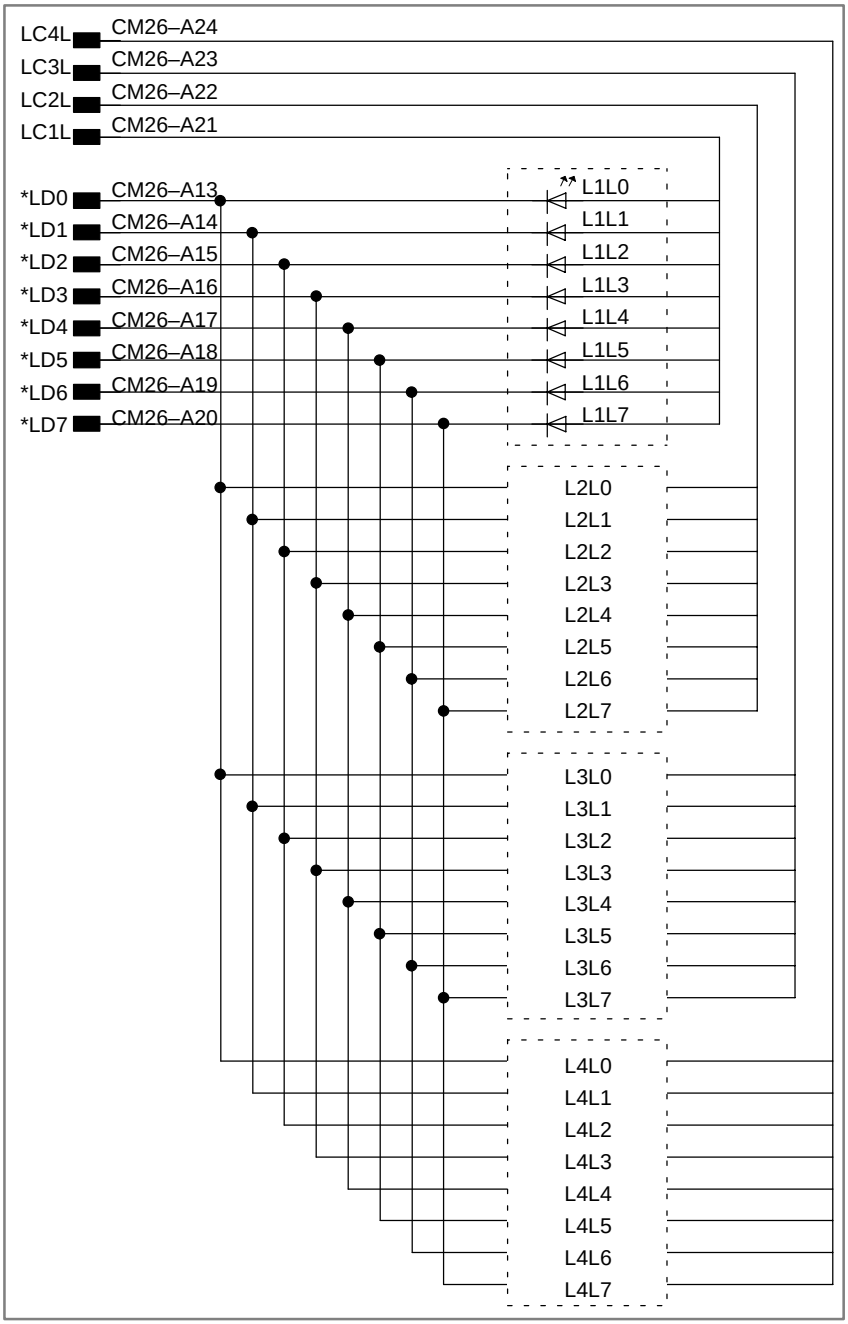
Contact rating	6VDC, 2mA or higher
Leakage current between open contacts	0.2mA or lower (6VDC)
Voltage drop across closed contacts	0.9V or lower (1 mA) Note)

NOTE
This voltage must be maintained even when detour prevention diodes are used.

Matrix DO

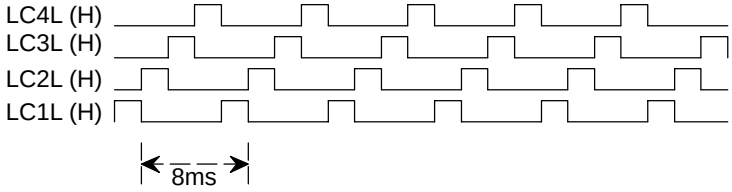
- **LED addresses**

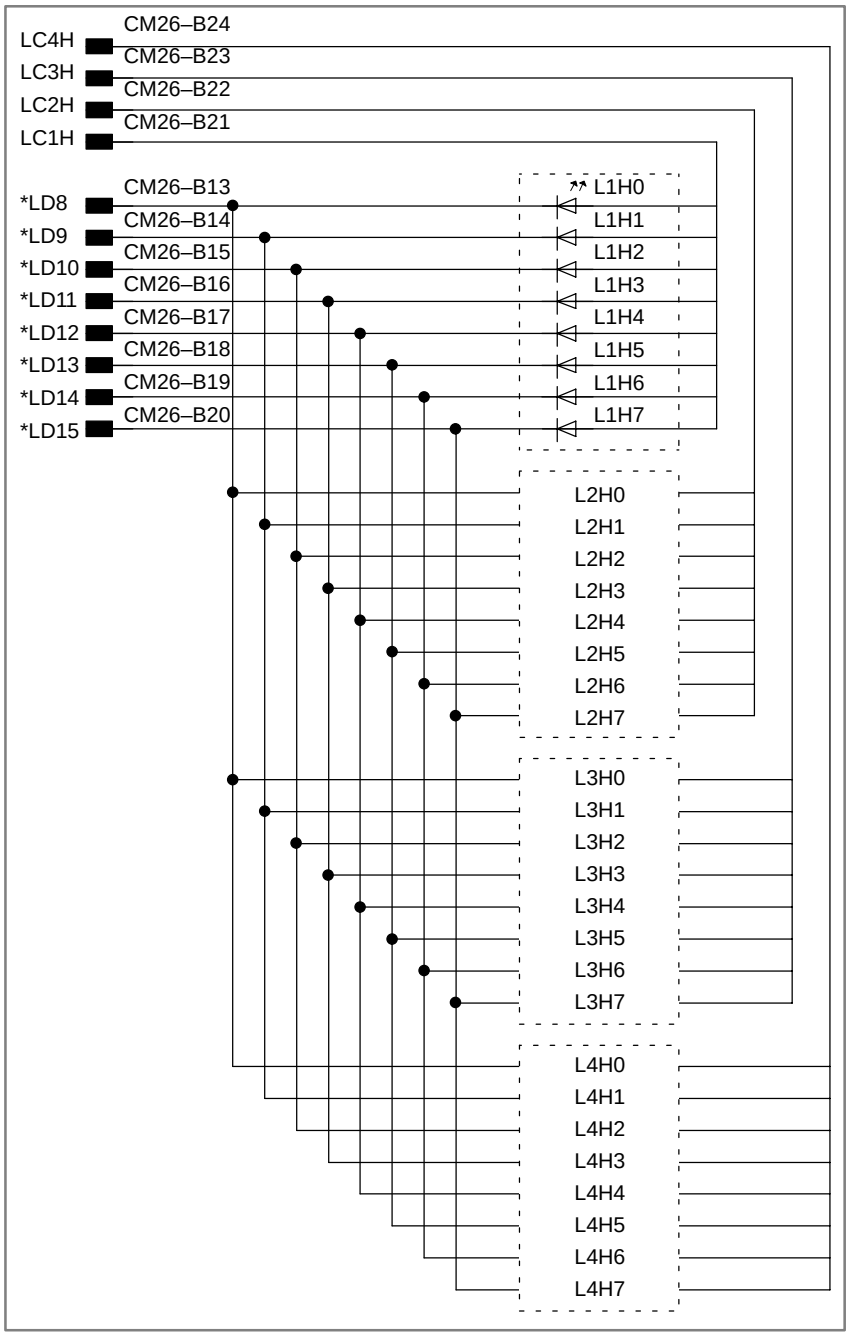
See Subsec. 10.7.5 for the corresponding PMC addresses.



NOTE

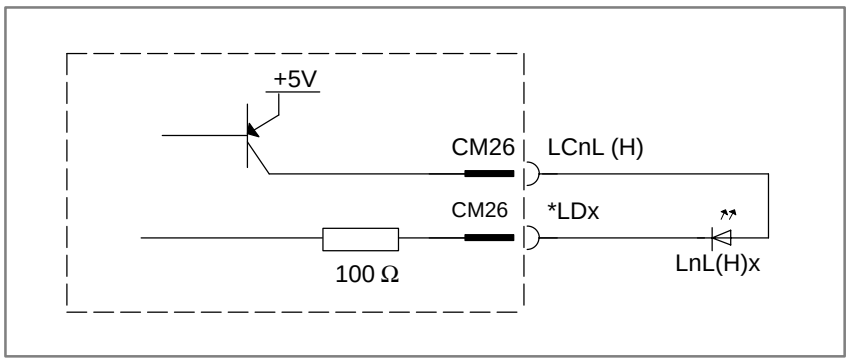
The timing for the common signals are shown below. Their duty cycle is 2 ms for LEDs being on and 6 ms for LEDs being off.





- **Internal circuit**

The circuit contains a 100–ohm resistor, as shown below.
Connecting an LED does not require an external resistor.



- **Signal specifications**

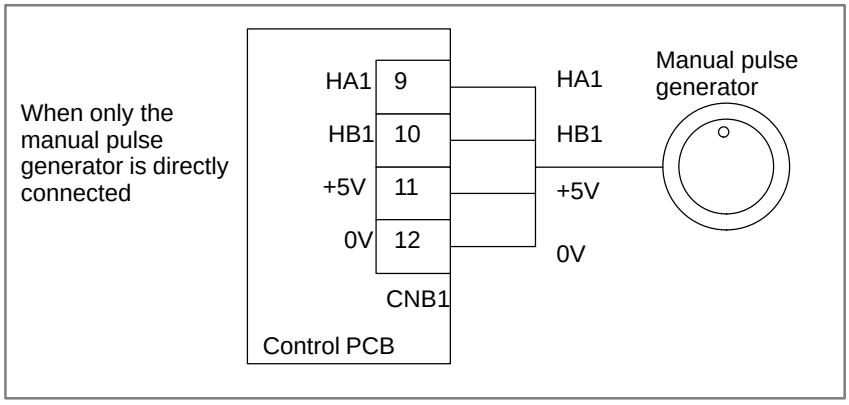
The LEDs must have the following rating

Forward voltage	2.4V max (I_f=5mA)(Typical value)
Forward current	30mA max
Reverse voltage	3V max

Interface for manual pulse generator

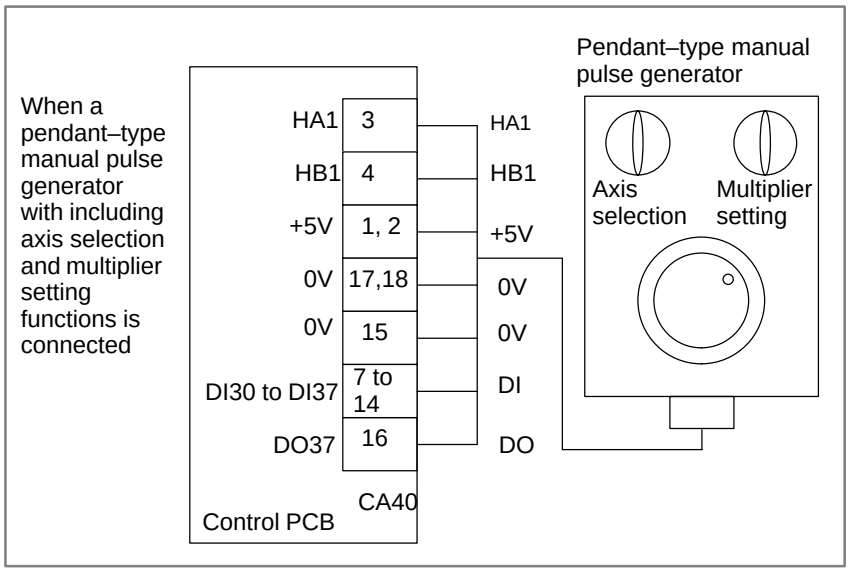
- **Connection of connector CNB1**

One interface is provided on connector CNB1.



- **Connection of connector CA40**

Pendant–type manual pulse generator with axis selection and multiplier setting functions can be connected to connector CA40.



NOTE

1 When DI30 to DI37 of connector CA40 are allocated as the DIs used for the axis selection and multiplier setting, DI30 to DI37 of connector CM17 cannot be used.

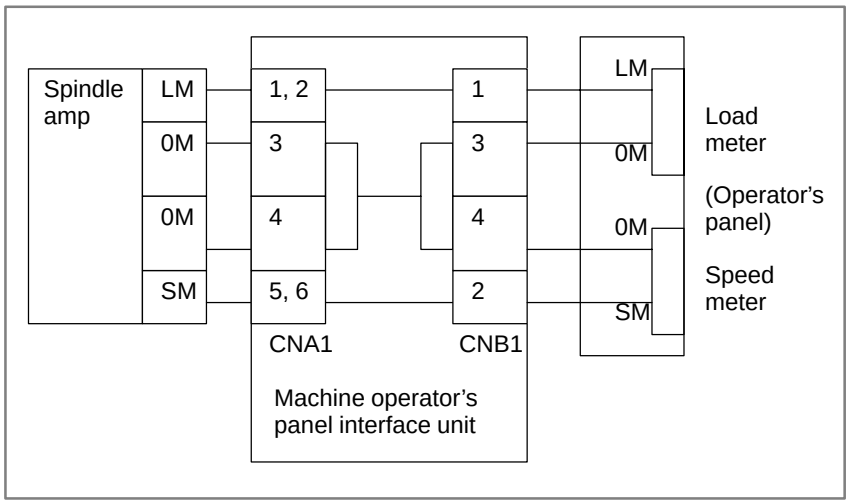
2 One DO is available for the manual pulse generator side at the user's discretion. When this is used, DO37 of CM17 cannot be used, as in the case for DIs above.

Analog signal inputs

Analog inputs received from the outside are forwarded without change to output terminals.

- **Connection diagram (example)**

Analog inputs from the spindle amp being output for load meter and speed meter indications.



- **Sent to the CNC**

Analog inputs received on the Machine operator's panel interface unit are converted to five–bit digital values, which are sent to the CNC though the I/O Link.
See Subsec. 9.7.5 for PMC addresses.
LM conversion data : "LM03 to LM07"
SM conversion data : "SM03 to SM07"

- **Analog signal specifications**

Acceptable input voltage	0V to +15V	
Voltage that can be converted to digital	0V to +10V	Note)

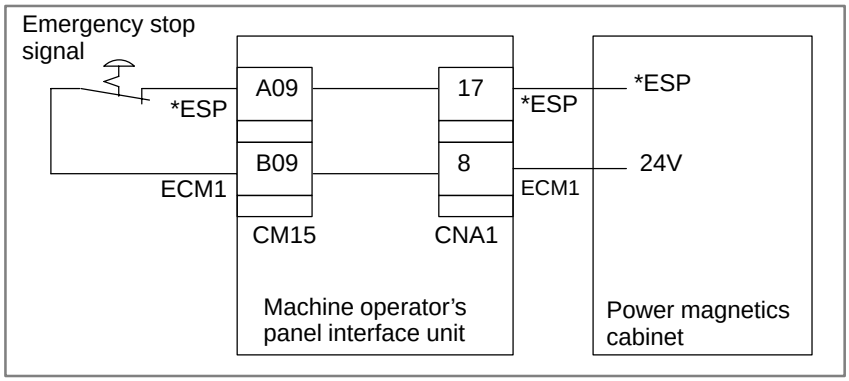
NOTE
Any voltage higher than +10V is converted to the same digital value as +10V is.

- **A/D conversion specifications**

Conversion error	5%	(max)
Resolution	5 bit	(min)

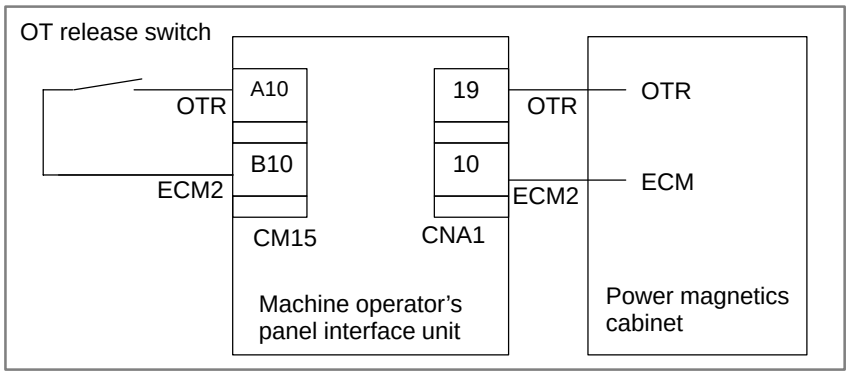
- **Emergency stop**

A signal generated by the emergency stop switch on the machine operator's panel can be sent to the power magnetics cabinet. (This signal cannot be sent to the CNC through the FANUC I/O Link.)



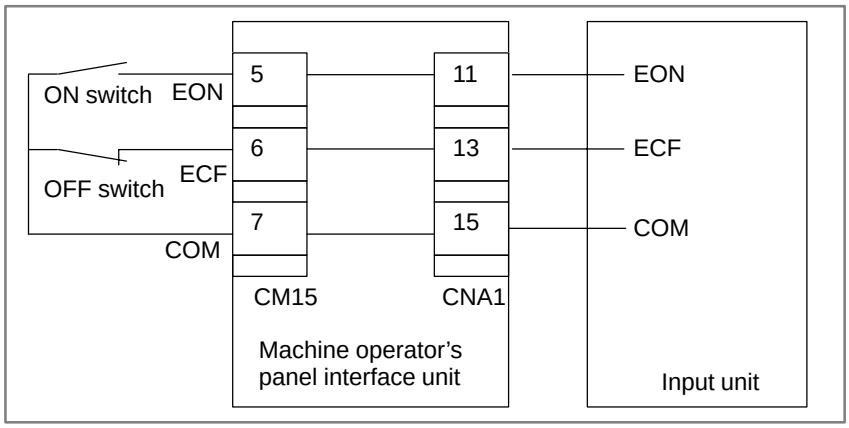
- **OT release**

A signal generated by the OT release switch on the machine operator's panel can be sent to the power magnetics cabinet.
(This signal cannot be sent to the CNC through the FANUC I/O Link.)



- **Power ON/OFF control signal**

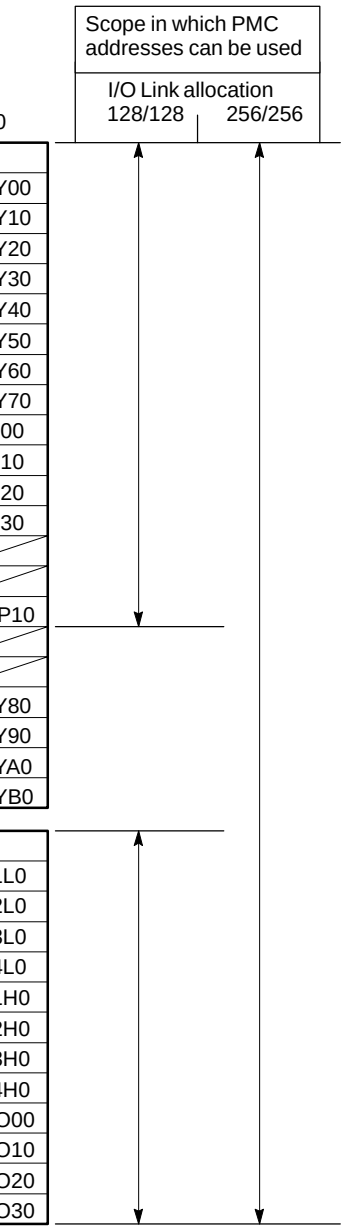
Signals generated by the power ON/OFF control switches on the machine operator's panel can be sent to an input unit. (These signals cannot be sent to the CNC through the FANUC I/O Link.)



NOTE
The LM, OM, SM, D036, ECM, EON, EOF, COM, ESP, and OTR signals are all assigned to the pins of one connector (CNA1).
They can be connected to the machine using only one cable.

10.7.5
PMC Addresses

PMC ADDRESS	BIT NUMBER 7	6	5	4	3	2	1	0
DI+00			FUSE					
DI+01	KY07	KY06	KY05	KY04	KY03	KY02	KY01	KY00
DI+02	KY17	KY16	KY15	KY14	KY13	KY12	KY11	KY10
DI+03	KY27	KY26	KY25	KY24	KY23	KY22	KY21	KY20
DI+04	KY37	KY36	KY35	KY34	KY33	KY32	KY31	KY30
DI+05	KY47	KY46	KY45	KY44	KY43	KY42	KY41	KY40
DI+06	KY57	KY56	KY55	KY54	KY53	KY52	KY51	KY50
DI+07	KY67	KY66	KY65	KY64	KY63	KY62	KY61	KY60
DI+08	KY77	KY76	KY75	KY74	KY73	KY72	KY71	KY70
DI+09	DI07	DI06	DI05	DI04	DI03	DI02	DI01	DI00
DI+10	DI17	DI16	DI15	DI14	DI13	DI12	DI11	DI10
DI+11	DI27	DI26	DI25	DI24	DI23	DI22	DI21	DI20
DI+12	DI37	DI36	DI35	DI34	DI33	DI32	DI31	DI30
DI+13	LM07	LM06	LM05	LM04	LM03			
DI+14	SM07	SM06	SM05	SM04	SM03			
DI+15	MP17	MP16	MP15	MP14	MP13	MP12	MP11	MP10
DI+16			Reserved for use by FANUC					
DI+17								
DI+18	KY87	KY86	KY85	KY84	KY83	KY82	KY81	KY80
DI+19	KY97	KY96	KY95	KY94	KY93	KY92	KY91	KY90
DI+20	KYA7	KYA6	KYA5	KYA4	KYA3	KYA2	KYA1	KYA0
DI+21	KYB7	KYB6	KYB5	KYB4	KYB3	KYB2	KYB1	KYB0
DO+00	MD07	MD06	FUSE					
DO+01	L1L7	L1L6	L1L5	L1L4	L1L3	L1L2	L1L1	L1L0
DO+02	L2L7	L2L6	L2L5	L2L4	L2L3	L2L2	L2L1	L2L0
DO+03	L3L7	L3L6	L3L5	L3L4	L3L3	L3L2	L3L1	L3L0
DO+04	L4L7	L4L6	L4L5	L4L4	L4L3	L4L2	L4L1	L4L0
DO+05	L1H7	L1H6	L1H5	L1H4	L1H3	L1H2	L1H1	L1H0
DO+06	L2H7	L2H6	L2H5	L2H4	L2H3	L2H2	L2H1	L2H0
DO+07	L3H7	L3H6	L3H5	L3H4	L3H3	L3H2	L3H1	L3H0
DO+08	L4H7	L4H6	L4H5	L4H4	L4H3	L4H2	L4H1	L4H0
DO+09	DO07	DO06	DO05	DO04	DO03	DO02	DO01	DO00
DO+10	DO17	DO16	DO15	DO14	DO13	DO12	DO11	DO10
DO+11	DO27	DO26	DO25	DO24	DO23	DO22	DO21	DO20
DO+12	DO37	DO36	DO35	DO34	DO33	DO32	DO31	DO30



FUSE : When 1, it indicates the +5E fuse has blown.
Shorting of the general–purpose DI input is considered as a possible cause. Turn off the power at once, check the general–purpose DI input and its vicinity, replace the fuse and turn the power on.
DInx : General–purpose DI
LM0x : Load meter indication
SM0x : Speed meter indication
KYnx : Ky signal (matrix)
LnL (H) x : LED signal (matrix)
DOnx : General–purpose DO
MD07 : Buzzer mode selection (It is possible to sound the key entry confirmation tone at the matrix DI input by turning this to “1”.)
MD06 : Buzzer ON/OFF setting (The buzzer sounds as this is turned to “1” and stops as it is turned to “0”. This operation is performed irrespective of MD07.)
MP1X : First manual pulse generator

10.7.6 Major Connection Precautions

- Use flat cables for connectors CM15, CM16, CM17, and CM26. When splitting and connecting flat cables to the machine operator's panel or other equipment, be careful not to break or short the conductors.
- All signals with the same name described in Subsec. 10.7.3 are connected to one another.
- One of the holes for mounting the PCB is also used for grounding. Before mounting the PCB, check the location of that hole with the diagram in Subsec. 10.7.10.

10.7.7 State of the LEDs on the Machine Operator's Panel Interface Unit

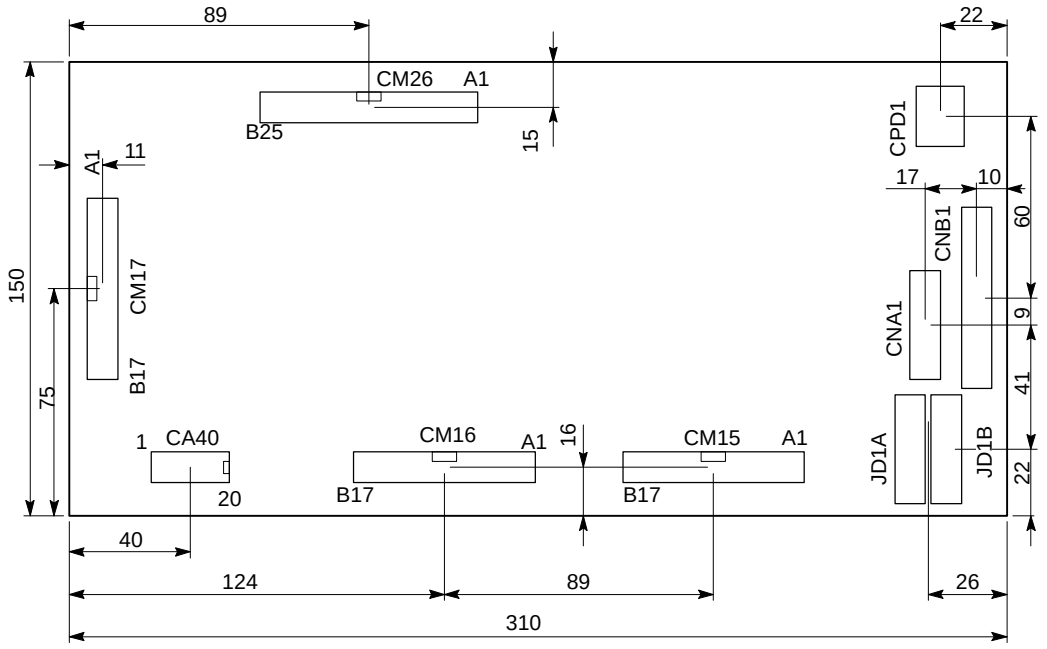
L1 (green) :
Monitors +5E. When on, it indicates that the fuse is intact (+5E: 5V for connector output).
When off, it indicates that the fuse has blown.
L2 (green) :
Monitors key scanning. When blinking, it indicates that the keys are being scanned normally. When on or off, it indicates key scanning is at halt.
L3 (red) :
When on, it indicates that an alarm condition has occurred. When off, it indicates that there is no alarm condition.

10.7.8 Connector (on the Cable Side) Specifications

Connector	Major use	Specification
CM15, CM16, CM17	General–purpose DI/DO	HIF3BA–34D–2.54R : Manufactured by HIROSE ELECTRIC CO., LTD.
CNA1	Relay terminal (to the machine)	PCR–E20FS : Manufactured by HONDA TSUSHIN KOGYO CO., LTD.
CNB1	Relay terminal (to the machine operator's panel)	MVSTBR2.5/12–ST–5.08 : Manufactured by PHOENIX CONTACT GmbH & Co.
JD1A, JD1B	FANUC I/O Link	PCR–E20FS : Manufactured by HONDA TSUSHIN KOGYO CO., LTD.
CPD1	Power supply	Dynamic D3100 (three pins) : Manufactured by AMP JAPAN, LTD. 1–178288–3 : Connector 1–175218–5 : Contact
CM26	Matrix DI/DO	HIF3BB–50D–2.54R : Manufactured by HIROSE ELECTRIC CO., LTD.
CA40	Manual pulse generator	MR–20LFH (solder type) : Manufactured by HONDA TSUSHIN KOGYO CO., LTD.

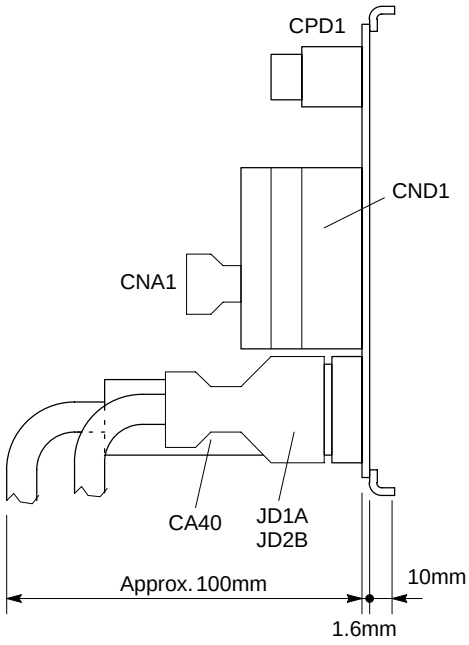
NOTE
1 Several types of connectors are available for use at the other end of the cable leading to connector CNB1. Refer to brochures of PHOENIX CONTACT GmbH & Co..
The connector used on the machine operator's panel interface unit side is MSTBVA2.5/12–G–5.08.
2 Crimped type cable connector is available for CA40. For purchase from FANUC, please specify as below.
A02B–0029–K890 : Solder type
A02B–0029–K892 : Crimped type

10.7.9 Machine Operator's Panel Interface Unit Dimension Diagram (Including Connector Locations)



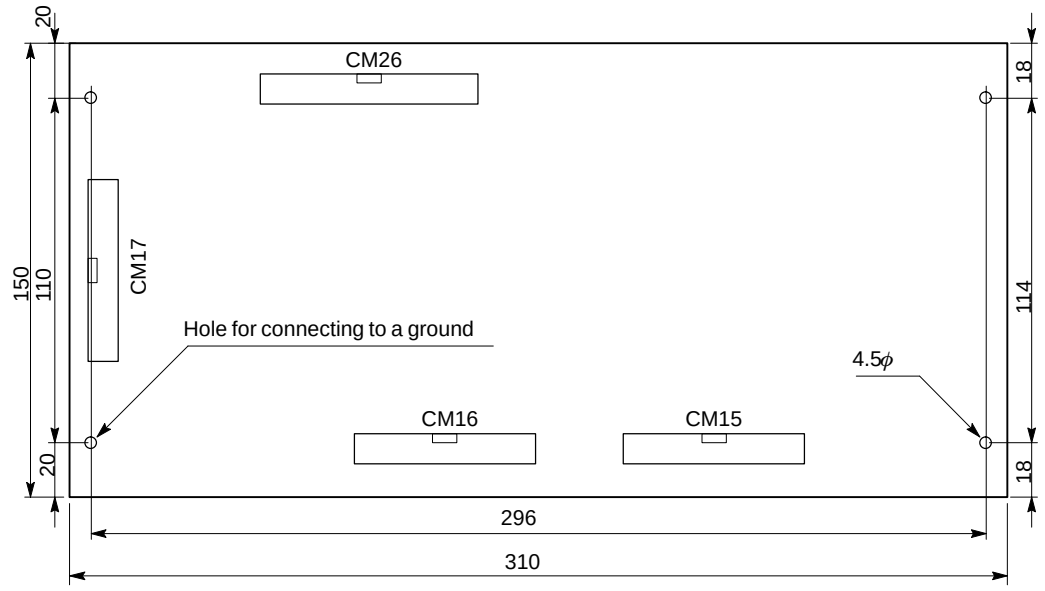
Unit : mm

Tolerance : ±5 (mm)



10.7.10 Machine Operator's Panel Interface Unit Mounting Dimension Diagram

Mounting hole position

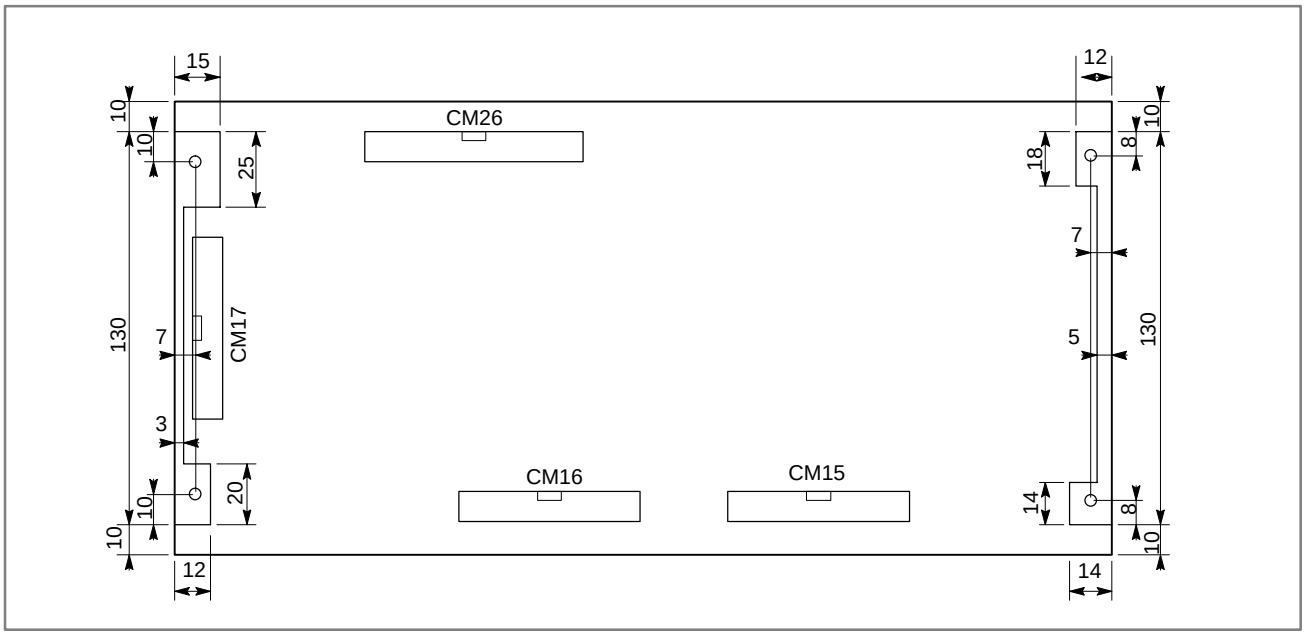


Fasten the PCB with four M4 screws.

Unit : mm

Sheet fixing area (mounting face side)

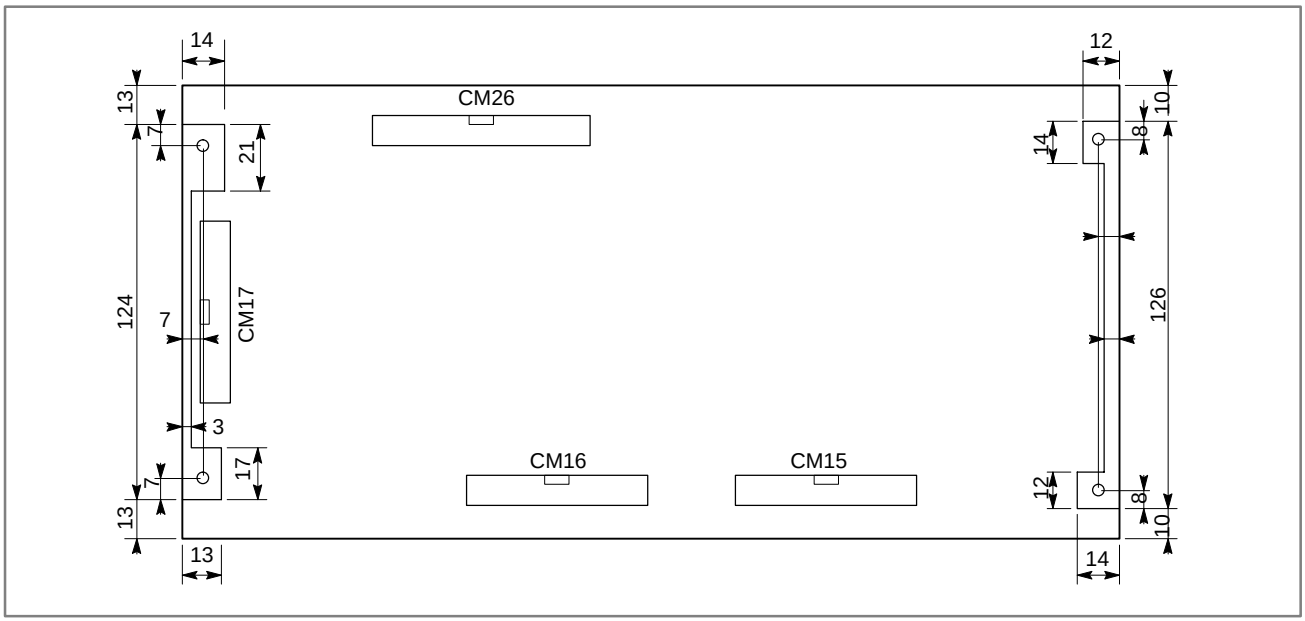
It is possible to fix the sheet, spacer, etc. only in the area shown in the diagram below.



NOTE
Applied to the PCB version number “03A” and beyond.

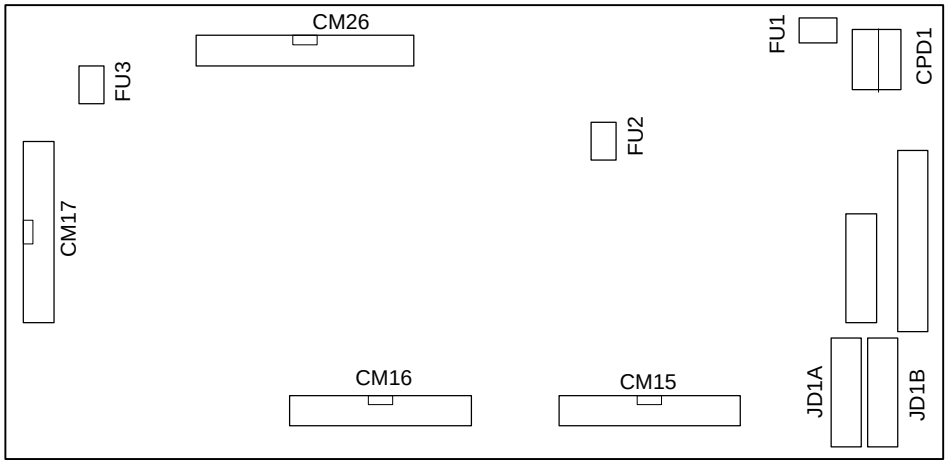
Sheet fixing area (Soldering face side)

It is possible to fix the sheet, spacer, etc. only in the area shown in the diagram below.



NOTE
Applied to the PCB version number “03A” and beyond.

10.7.11 Fuse Mounting Position



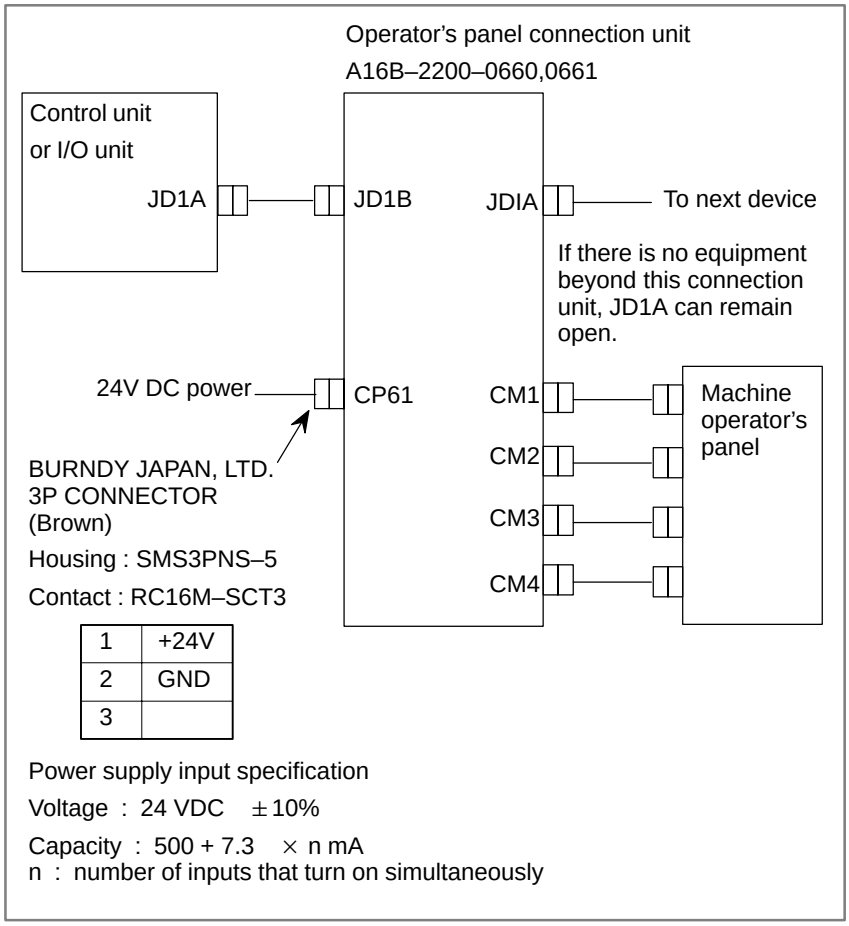
FU1 : +24V fuse (general–purpose DO, this supplies printed board power protection)
FU2 : +5V fuse (IC power, manual pulse generator protection)
FU3 : +5E fuse (general–purpose DI protection)

NOTE
FU2 is not mounted on Revision 05A or later.

10.8 CONNECTION OF OPERATOR'S PANEL CONNECTION UNIT

The operator's panel connection unit (A16B–2200–0660, 0661) is connected to the control unit through the FANUC I/O Link and is used for interfacing with the machine operator's panel.
The electric interface and pin layout of the connectors CM1 to CM4 are fully compatible with those for Series 15. There are two units available depending on the number of I/O points.

Specification	Input	Output
A16B–2200–0660	96 points	64 points
A16B–2200–0661	64 points	32 points



CAUTION
For a power cable, use a cable of 30/0.18 (0.75 mm^2) or thicker.

10.8.1 Input Signal Regulations for Operator's Panel Connection Unit

The input signal of the operator's panel connection unit is 0V common non–insulation type interface as shown below.

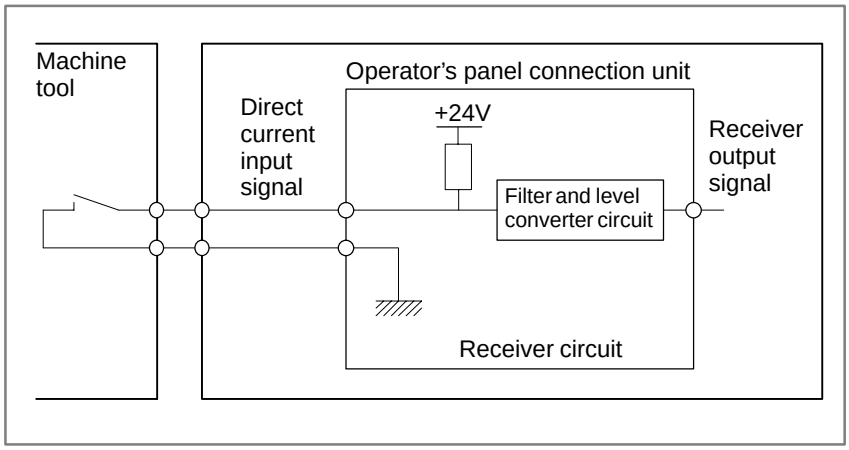


Fig. 10.8.1 (a) Receiver circuit

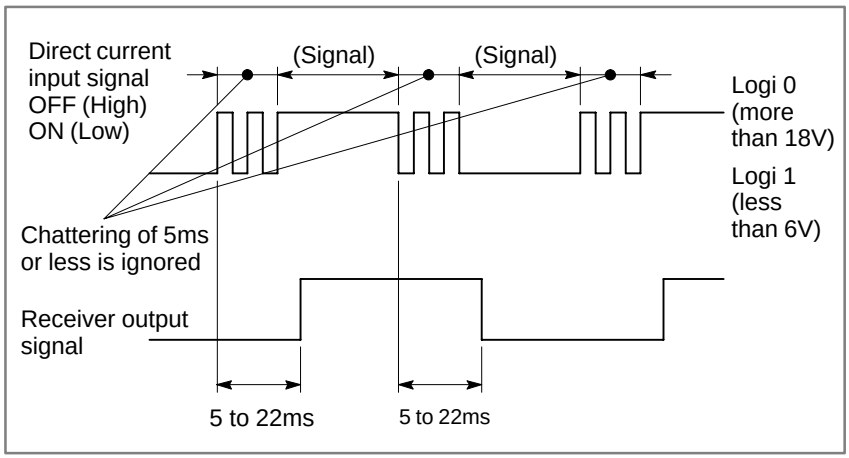


Fig. 10.8.1 (b) Width of input signals and delay time

In the above figure, it is logic 0 when the contact is open and logic 1 when closed.

Connect the common line of the input signal of the operator's panel connection unit as shown below.

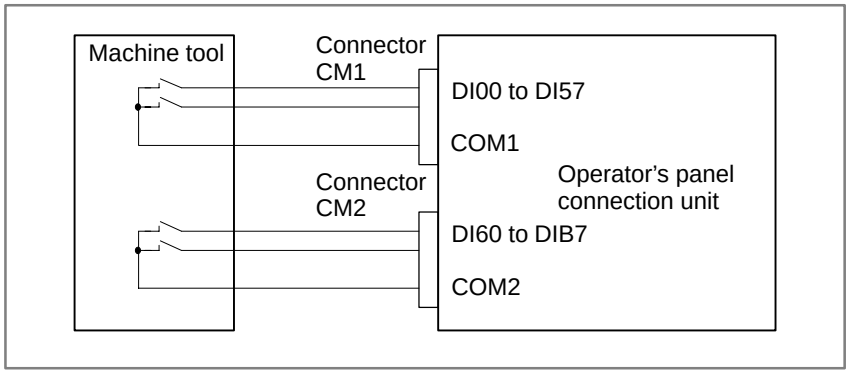


Fig. 10.8.1 (c) Connection of common lines

WARNING

All signals input to this operator's panel connection unit are of source type.

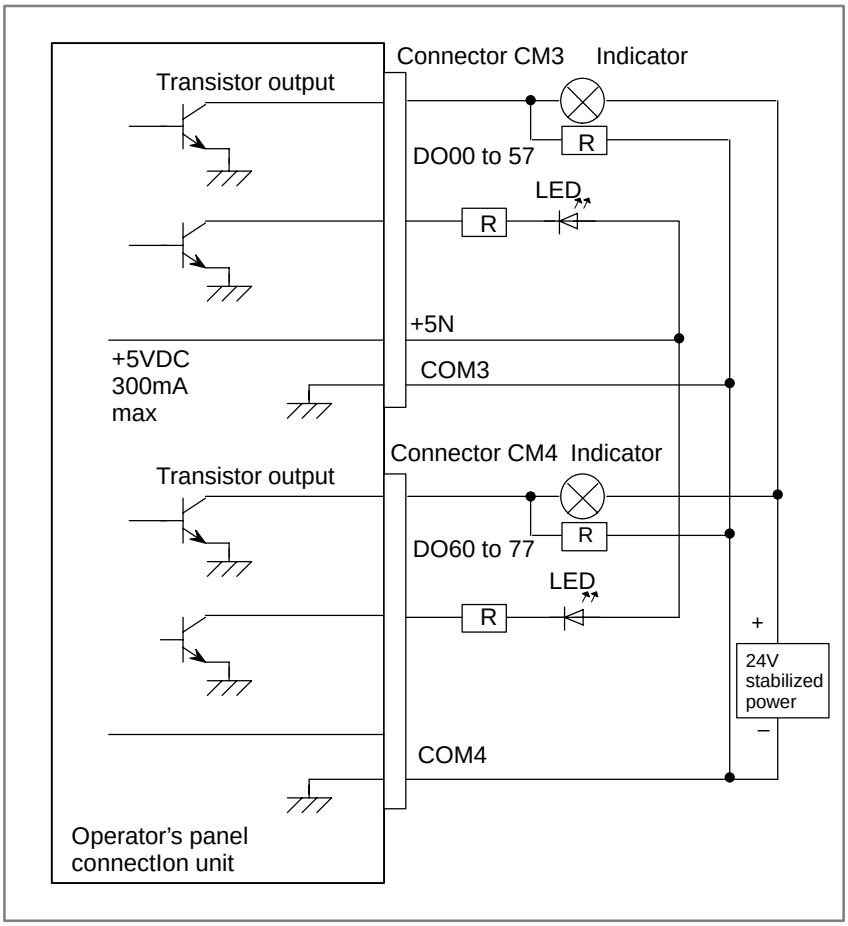
When a source interface is used, a ground fault in an input signal has the same effect as closing the contacts. From the viewpoint of safety, therefore, FANUC does not recommend the use of such an interface for input signals. In particular, input signals X008.0 to X008.7 must be connected in a sink layout, because these signals include the emergency stop signal.

Do not use this operator's panel connection unit for safety–critical input signals (such as an emergency stop signal).

10.8.2 Output Signal Regulations for Operator's Panel Connection Unit

Output signals DO00 to DO77 of the operator's panel connection unit drive indicators and LEDs on the machine operator's panel and use NPN transistor for drivers.
Prepare 24VDC for power supply of indicators and LEDs and connect 0V to COM3 and COM4. For LEDs, however, 5VDC 300mA output from the terminal +5N of the connector CM3 can be used. There is no +5N in the connector CM4; use +5N in connector CM3 as shown below:

Output regulation Load voltage : 24V +20% or less
Load current : 40mA



WARNING

When a sink output interface is used, a ground fault in an output signal causes the output signal to remain on. From the viewpoint of safety, therefore, FANUC does not recommend the use of such an interface for output signals.

10.8.3 Connector Layout for Operator's Panel Connection Unit

CM1

1	DI00			33	
2	DI03			34	DI02
3	DI06	19	DI01	35	DI05
4	DI11	20	DI04	36	DI10
5	DI14	21	DI07	37	DI13
6	DI17	22	DI12	38	DI16
7	DI22	23	DI15	39	DI21
8	DI25	24	DI20	40	DI24
9	DI27	25	DI23	41	DI26
10	DI32	26	DI30	42	DI31
11	DI35	27	DI33	43	DI34
12	DI40	28	DI36	44	DI37
13	DI43	29	DI41	45	DI42
14	DI46	30	DI44	46	DI45
15	DI51	31	DI47	47	DI50
16	DI54	32	DI52	48	DI53
17	DI56			9	DI55
18	COM1			50	DI57

Address	7	6	5	4	3	2	1	0
Xn	DI07	DI06	DI05	DI04	DI03	DI02	DI01	DI00
Xn+1	DI17	DI16	DI15	DI14	DI13	DI12	DI11	DI10
Xn+2	DI27	DI26	DI25	DI24	DI23	DI22	DI21	DI20
Xn+3	DI37	DI36	DI35	DI34	DI33	DI32	DI31	DI30
Xn+4	DI47	DI46	DI45	DI44	DI43	DI42	DI41	DI40
Xn+5	DI57	DI56	DI55	DI54	DI53	DI52	DI51	DI50

CM2

1	DI60			33	
2	DI63			34	DI62
3	DI66	19	DI61	35	DI65
4	DI71	20	DI64	36	DI70
5	DI74	21	DI67	37	DI73
6	DI77	22	DI72	38	DI76
7	DI82	23	DI75	39	DI81
8	DI85	24	DI80	40	DI84
9	DI87	25	DI83	41	DI86
10	DI92	26	DI90	42	DI91
11	DI95	27	DI93	43	DI94
12	DIA0	28	DI96	44	DI97
13	DIA3	29	DIA1	45	DIA2
14	DIA6	30	DIA4	46	DIA5
15	DIB1	31	DIA7	47	DIB0
16	DIB4	32	DIB2	48	DIB3
17	DIB6			9	DIB5
18	COM2			50	DIB7

Address	7	6	5	4	3	2	1	0
Xn+6	DI67	DI66	DI65	DI64	DI63	DI62	DI61	DI60
Xn+7	DI77	DI76	DI75	DI74	DI73	DI72	DI71	DI70
Xn+8	DI87	DI86	DI85	DI84	DI83	DI82	DI81	DI80
Xn+9	DI97	DI96	DI95	DI94	DI93	DI92	DI91	DI90
Xn+10	DIA7	DIA6	DIA5	DIA4	DIA3	DIA2	DIA1	DIA0
Xn+11	DIB7	DIB6	DIB5	DIB4	DIB3	DIB2	DIB1	DIB0

NOTE
n in addresses can be 0 to 127.
64 points (DI00 to DI77) can be used for the A16B–2200–0661.

CM3

1	DO00			33	+5N
2	DO03	19	DO01	34	DO02
3	DO06	20	DO04	35	DO05
4	DO11	21	DO07	36	DO10
5	DO14	22	DO12	37	DO13
6	DO17	23	DO15	38	DO16
7	DO22	24	DO20	39	DO21
8	DO25	25	DO23	40	DO24
9	DO27	26	DO30	41	DO26
10	DO32	27	DO33	42	DO31
11	DO35	28	DO36	43	DO34
12	DO40	29	DO41	44	DO37
13	DO43	30	DO44	45	DO42
14	DO46	31	DO47	46	DO45
15	DO51	32	DO52	47	DO50
16	DO54			48	DO53
17	DO56			9	DO55
18	COM3			50	DO57

Address	7	6	5	4	3	2	1	0
Yn	DO07	DO06	DO05	DO04	DO03	DO02	DO01	DO00
Yn+1	DO17	DO16	DO15	DO14	DO13	DO12	DO11	DO10
Yn+2	DO27	DO26	DO25	DO24	DO23	DO22	DO21	DO20
Yn+3	DO37	DO36	DO35	DO34	DO33	DO32	DO31	DO30
Yn+4	DO47	DO46	DO45	DO44	DO43	DO42	DO41	DO40
Yn+5	DO57	DO56	DO55	DO54	DO53	DO52	DO51	DO50

CM4

1	DO60			14	DO60
2	DO64	8	DO62	15	DO63
3	DO67	9	DO65	16	DO66
4	DO72	10	DO70	17	DO71
5	DO75	11	DO73	18	DO74
6		12	DO76	19	DO77
7	COM4	13		20	

Address	7	6	5	4	3	2	1	0
Yn+6	DO67	DO66	DO65	DO64	DO63	DO62	DO61	DO60
Yn+7	DO77	DO76	DO75	DO74	DO73	DO72	DO71	DO70

NOTE

n in addresses can be 0 to 127.

32 points (DO00 to DO37) can be used for the A16B–2200–0661.

10.8.4 External View of Operator's Panel Connection Unit

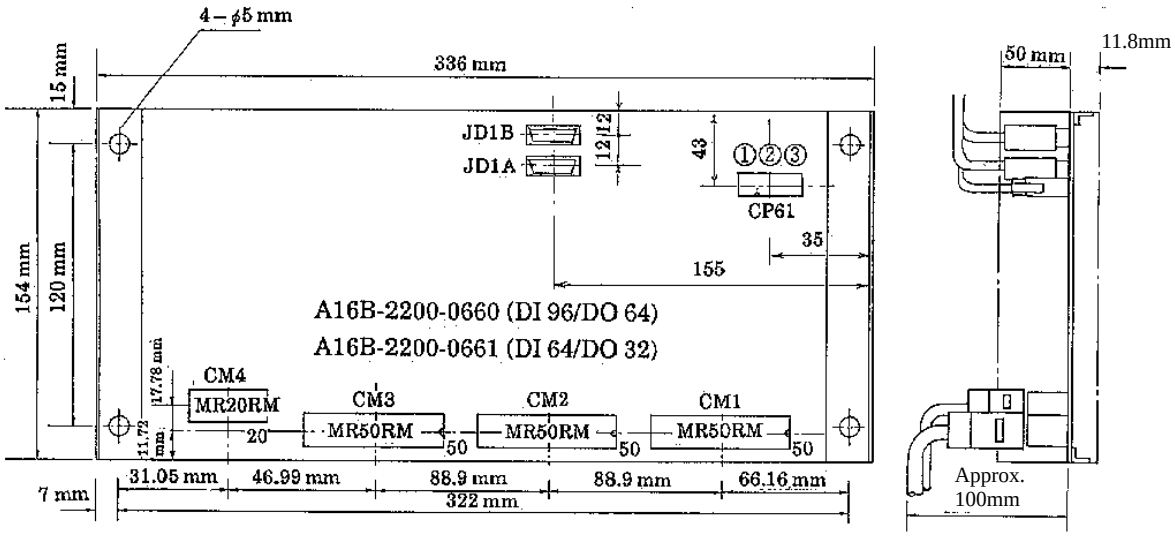
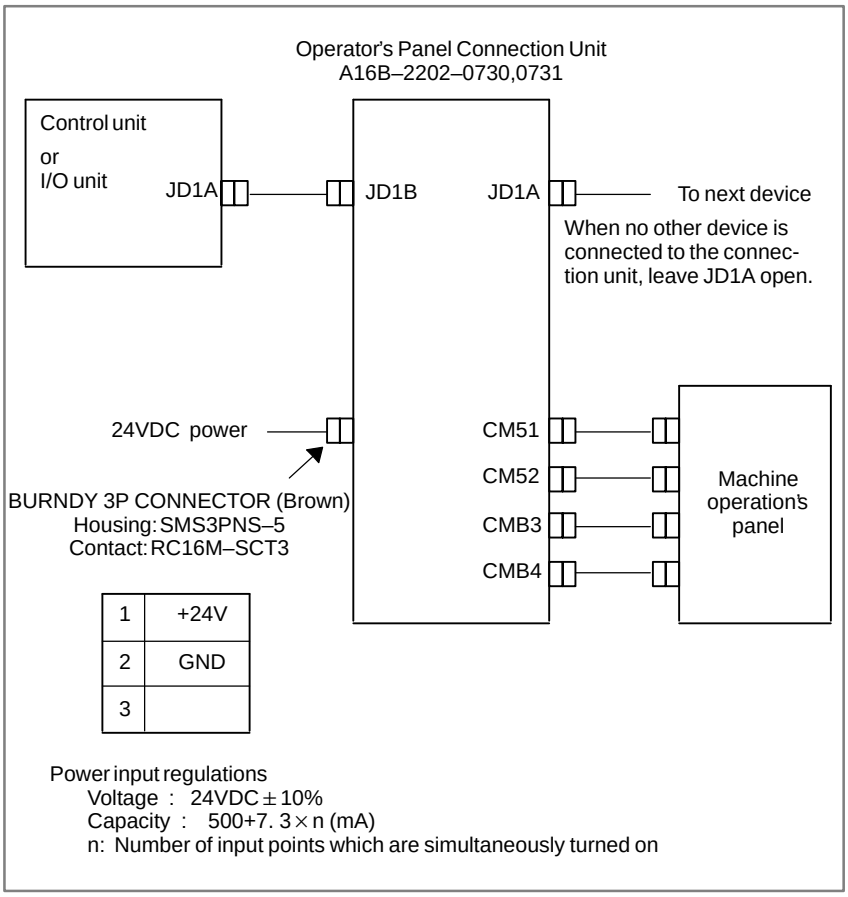


Fig. 10.8.4 External view of operator's panel connection unit

10.9 CONNECTION OF SOURCE OUTPUT TYPE CONNECTION UNIT

The operator's panel connection unit (A16B–2202–0730, 0731), which connects to the control unit via the FANUC I/O Link, acts as an interface with the machine operator's panel.
Connectors CM51, CM52, CMB3, and CMB4, used to interface with the operator's panel, feature an electrical interface and pin assignment which are fully compatible with those of the source type output operator's panel connection unit for the Series 15. The following two units are available with different numbers of I/O points:

Specifications	No. of input points	No. of output points
A16B–2202–0730	96	64
A16B–2202–0731	64	32



CAUTION
Use 30/0.18 (0.75 mm^2) or heavier wire as the power cable.

10.9.1 Input Signal Specifications for Source Output Type Connection Unit

Most input signals for the source output type connection unit support a sink type non–isolated interface. For some input signals, however, either sink or source type can be selected. (European safety standards demand the use of sink types.)

The machine's contacts shall conform to the following specifications:

Capacity: 30 VDC, 16 mA or higher
Intercontact leakage current in closed circuit:
1 mA or less (at 26.4 V)
Intercontact voltage drop in closed circuit:
2 V or less (including the voltage drop in the cables)

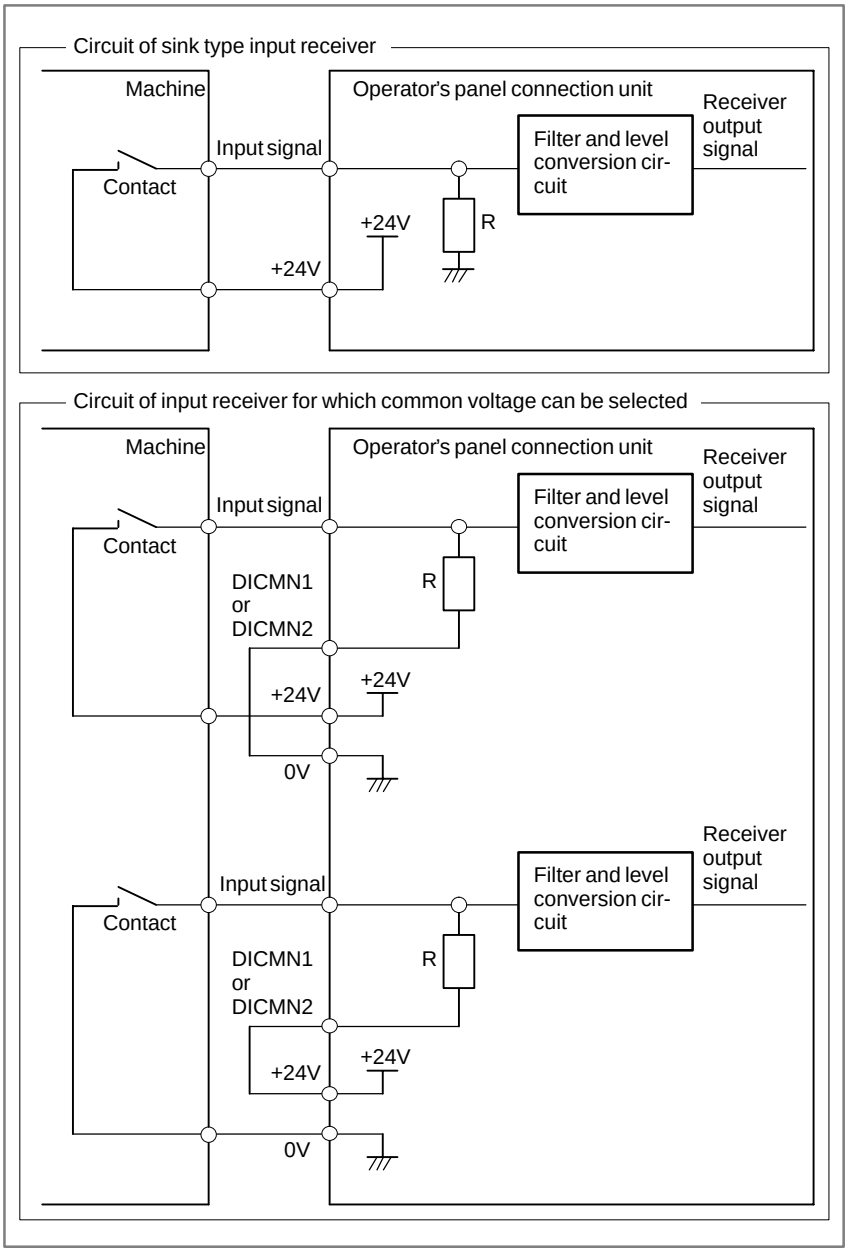


Fig. 10.9.1 (a) Receiver circuit

Always connect both DICMN1 and DICMN2 to 24 V or 0 V. Do not leave them open.

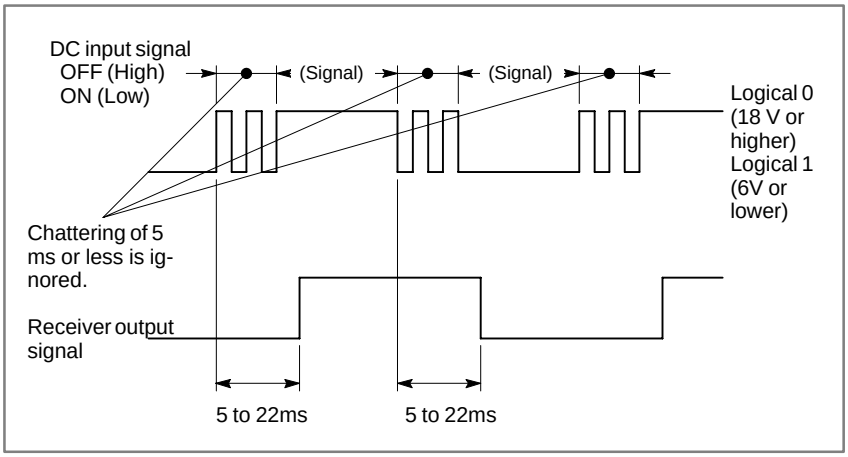


Fig. 10.9.1 (b) Signal width and delay of input signal

In the above figure, logical 0 corresponds to open contacts, while logical 1 corresponds to closed contacts.

WARNING
When a source interface is used, a ground fault in an input signal has the same effect as closing the contacts. From the viewpoint of safety, therefore, FANUC does not recommend the use of such an interface for input signals.

10.9.2 Output Signal Specifications for Source Output Type Connection Unit

The output signals shall satisfy the following:

Maximum load current when driver is on:
200 mA (including momentary values)
Saturation voltage when driver is on:
1.0 V max.
Withstand voltage: 24 V +20% (including momentary values)
Leakage current when driver is off:
100 μA

Prepare the following external power supply for the output signals:

Supply voltage: +24 V ±10%
Supply current (per board):
At least total maximum load current (including momentary values) + 100 mA
Power–on timing: At the same time as or before turning on the power to the control unit
Power–off timing: At the same time as or after turning on the power to the control unit

CAUTION
A power supply which satisfies the above specifications shall be connected to the DOCOM and 0V power supply terminals for the output signals. The maximum current that can be carried by the DOCOM pin is 2.0 A. The total load current must not exceed this value, therefore.

Output signal driver

The output signal driver used with the operator's panel connection unit can output up to eight signals.

The driver element monitors the current of each output signal. If an overcurrent is detected, the output of that signal is turned off. Once a signal has been turned off, the overcurrent will no longer exist, such that the driver turns the signal on again. Therefore, in the case of a ground fault or overload, the output of a signal will be repeatedly turned on and off. This also occurs when a load which causes a high surge current is connected.

The driver element contains an overheat detector, which turns off all eight output signals if the temperature in the device exceeds the set value as a result of an overcurrent caused by a ground fault or some other failure. This off state is held. To restore signal output, logically turn the output off then back on again, for each signal, after the temperature falls below the set value. Signal output can also be restored by turning the system power off then back on again.

On the PCB, a red LED beside the driver element lights once the overheat detection circuit operates.

NOTE
The overheat detection circuit also causes a system alarm to be issued to the CNC. (When setting pins CP1 on the PCB are closed (jumpered), this alarm is not issued to the CNC.)

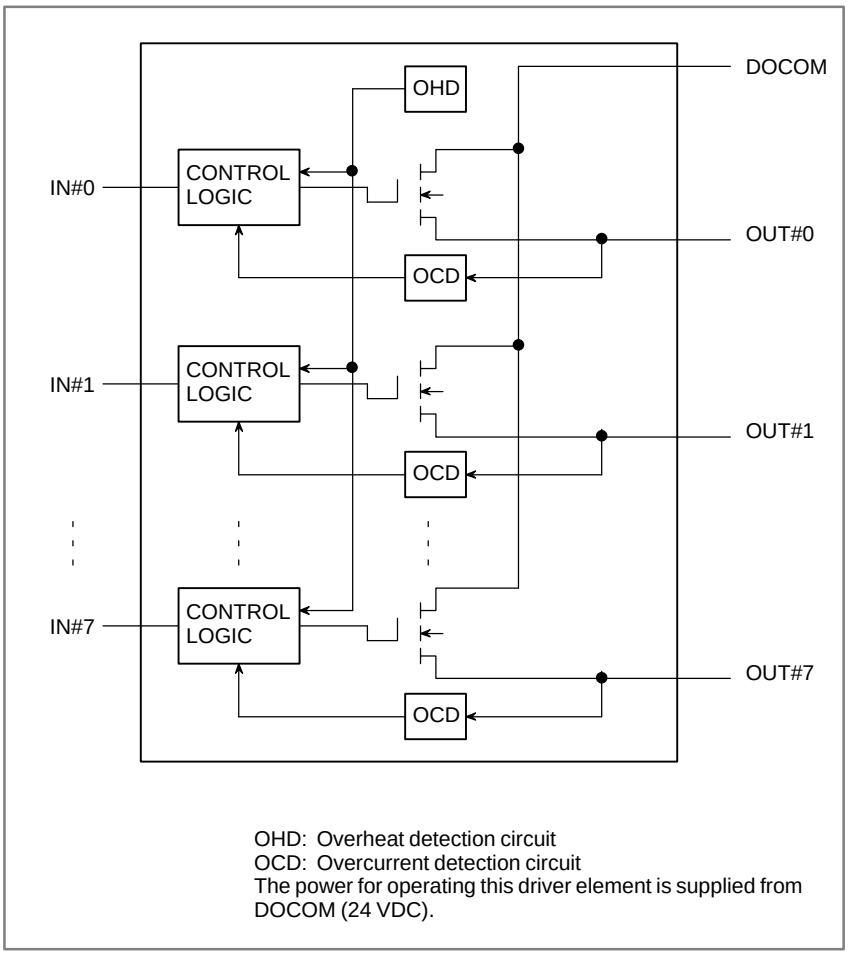
Correspondence between red LEDs and DO signals

Red LED name	DO signals	Remarks
DAL1	Y q + 0.0 to Y q + 0.7	
DAL2	Y q + 1.0 to Y q + 1.7	
DAL3	Y q + 2.0 to Y q + 2.7	
DAL4	Y q + 3.0 to Y q + 3.7	
DAL5	Y q + 4.0 to Y q + 4.7	
DAL6	Y q + 5.0 to Y q + 5.7	
DAL7	Y q + 6.0 to Y q + 6.7	
DAL8	Y q + 7.0 to Y q + 7.7	

NOTE
The above red LED and alarm transfer to the CNC are supported by PCBs of version 03B and later.

If the output of a signal cannot be turned on even though the CNC diagnostic indicates that the signal is on, that signal or another signal being handled by the same element may be overloaded, thus causing the eight output signals to be turned off. In such a case, turn the system power off and eliminate the cause of the overload.

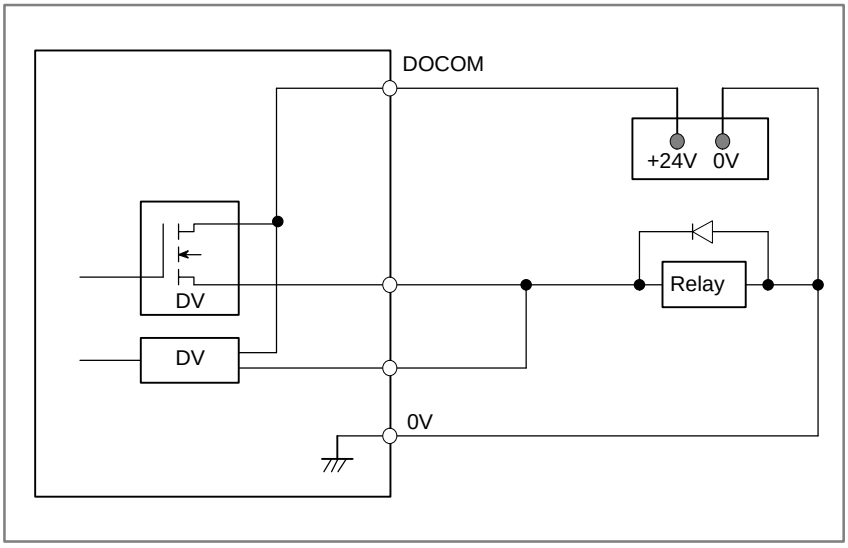
- **Driver element block diagram**



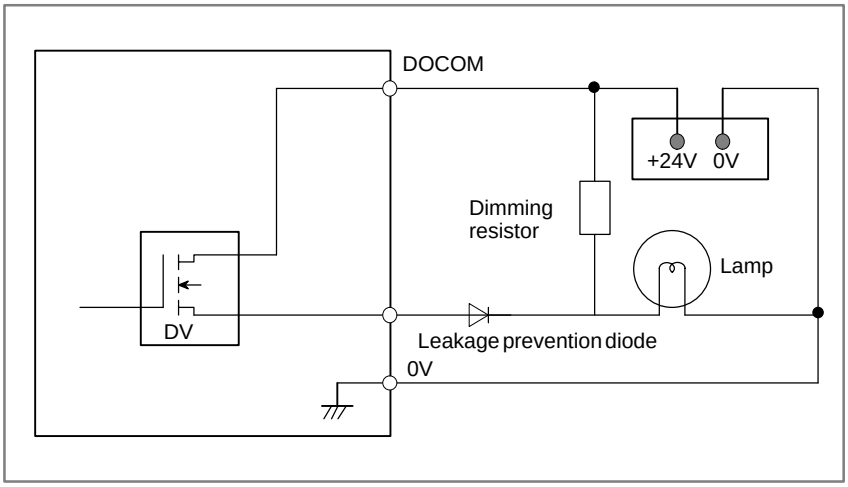
OHD: Overheat detection circuit
OCD: Overcurrent detection circuit
The power for operating this driver element is supplied from DOCOM (24 VDC).

Notes on output signals

CAUTION
Observe the following precautions when connecting output signals:
Output pins shall not be connected in parallel, as shown below.



CAUTION
When using a dimming resistor, connect a diode to prevent leakage.



10.9.3 Connector Pin Layout for Source Output Type Connection Unit

CM51

1	DI00			33	DICMN1
2	DI03	19	DI01	34	DI02
3	DI06	20	DI04	35	DI05
4	DI11	21	DI07	36	DI10
5	DI14	22	DI12	37	DI13
6	DI17	23	DI15	38	DI16
7	DI22	24	DI20	39	DI21
8	DI25	25	DI23	40	DI24
9	DI27	26	DI30	41	DI26
10	DI32	27	DI33	42	DI31
11	DI35	28	DI36	43	DI34
12	DI40	29	DI41	44	DI37
13	DI43	30	DI44	45	DI42
14	DI46	31	DI47	46	DI45
15	DI51	32	DI52	47	DI50
16	DI54			48	DI53
17	DI56			49	DI55
18	+24V			50	DI57

CM52

1	DI60			33	0V
2	DI63	19	DI61	34	DI62
3	DI66	20	DI64	35	DI65
4	DI71	21	DI67	36	DI70
5	DI74	22	DI72	37	DI73
6	DI77	23	DI75	38	DI76
7	DI82	24	DI80	39	DI81
8	DI85	25	DI83	40	DI84
9	DI87	26	DI90	41	DI86
10	DI92	27	DI93	42	DI91
11	DI95	28	DI96	43	DI94
12	DIA0	29	DIA1	44	DI97
13	DIA3	30	DIA4	45	DIA2
14	DIA6	31	DIA7	46	DIA5
15	DIB1	32	DIB2	47	DIB0
16	DIB4			48	DIB3
17	DIB6			49	DIB5
18	+24V			50	DIB7

CMB3

1	DO00			33	0V
2	DO03	19	DO01	34	DO02
3	DO06	20	DO04	35	DO05
4	DO11	21	DO07	36	DO10
5	DO14	22	DO12	37	DO13
6	DO17	23	DO15	38	DO16
7	DO22	24	DO20	39	DO21
8	DO25	25	DO23	40	DO24
9	DO27	26	DO30	41	DO26
10	DO32	27	DO33	42	DO31
11	DO35	28	DO36	43	DO34
12	DO40	29	DO41	44	DO37
13	DO43	30	DO44	45	DO42
14	DO46	31	DO47	46	DO45
15	DO51	32	DO52	47	DO50
16	DO54			48	DO53
17	DOCOM			49	DO55
18	DICMN2			50	DOCOM

CMB4

1	DO61			14	DO60
2	DO64	8	DO62	15	DO63
3	DO67	9	DO65	16	DO66
4	DO72	10	DO70	17	DO71
5	DO75	11	DO73	18	DO74
6	DO56	12	DO76	19	DO77
7	0V	13	DO57	20	DOCOM

NOTE
When the operator's panel connection unit having 64 DIs and 32 DOs is selected, connector CMB4 is not mounted on the PCB.

DICMN1, DICMN2: Pins used to switch the DI common. Usually, jumper these pins with 0V. (input)
+24V: +24 VDC output pin. This pin shall be used only for DI signals input to the operator's panel connection unit. (output)
DOCOM: Power supply for the DO driver. All DOCOM pins are connected in the unit. (input)

I/O addresses

The following PMC addresses are assigned to the operator's panel connection unit, depending on the number of I/O points (DI/DO = 96/64 or 64/32):

[DI address]

DI: 96 points
DI: 64 points

	7	6	5	4	3	2	1	0
X p	DI07	DI06	DI05	DI04	DI03	DI02	DI01	DI00
X p+1	DI17	DI16	DI15	DI14	DI13	DI12	DI11	DI10
X p+2	DI27	DI26	DI25	DI24	DI23	DI22	DI21	DI20
X p+3	DI37	DI36	DI35	DI34	DI33	DI32	DI331	DI30
X p+4	DI47	DI46	DI45	DI44	DI43	DI42	DI41	DI40
X p+5	DI57	DI56	DI55	DI54	DI53	DI52	DI51	DI50
X p+6	DI67	DI66	DI65	DI64	DI63	DI62	DI61	DI60
X p+7	DI77	DI76	DI75	DI74	DI73	DI72	DI71	DI70
X p+8	DI87	DI86	DI85	DI84	DI83	DI82	DI81	DI80
X p+9	DI97	DI96	DI95	DI94	DI93	DI92	DI91	DI90
X p+10	DIA7	DIA6	DIA5	DIA4	DIA3	DIA2	DIA1	DIA0
X p+11	DIB7	DIB6	DIB5	DIB4	DIB3	DIB2	DIB1	DIB0

- Address p is determined by the machine tool builder.
- The common voltage can be selected for the DIs assigned to the following 20 addresses:

Address	Common signal to correspond
Xp+0.0, Xp+0.1, Xp+0.2, Xp+0.7 Xp+1.0, Xp+1.1, Xp+1.2, Xp+1.7	DICMN1
Xp+4.0 to Xp+4.7	DICMN2
Xp+11.4, Xp+11.5, Xp+11.6, Xp+11.7	DICMN1

[DO address]

DO: 64 points

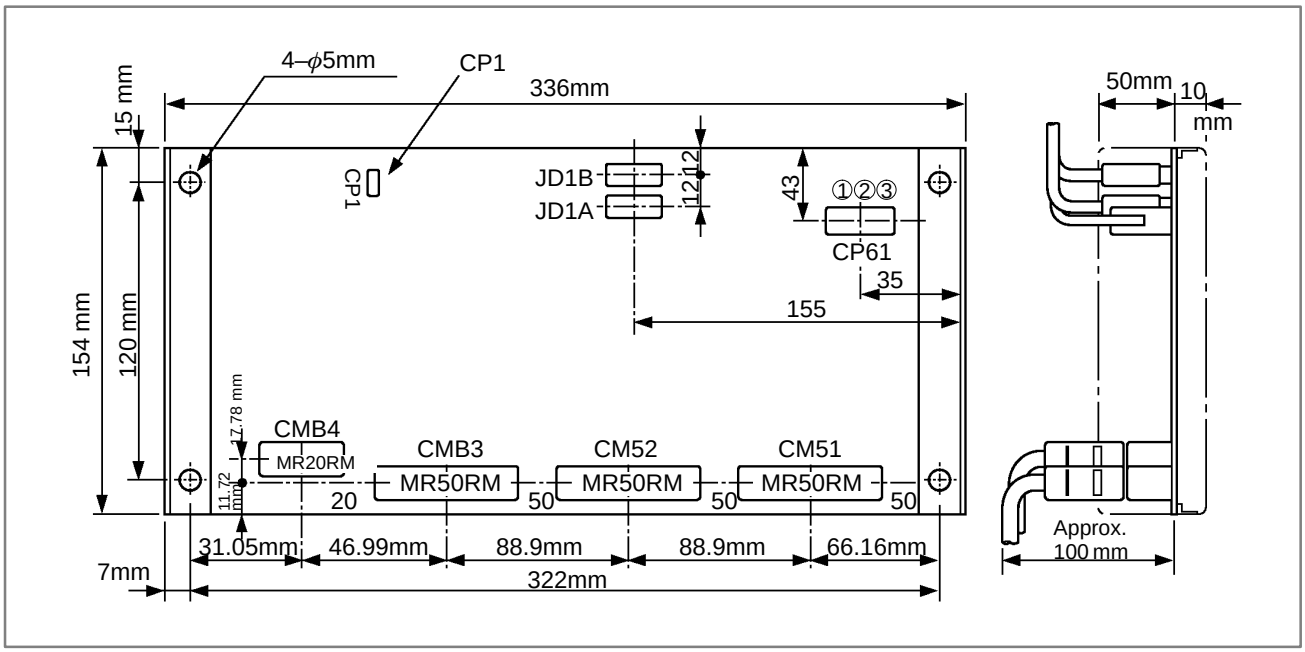
DO: 32 points

	7	6	5	4	3	2	1	0
Y q	DO07	DO06	DO05	DO04	DO03	DO02	DO01	DO00
Y q+1	DO17	DO16	DO15	DO14	DO13	DO12	DO11	DO10
Y q+2	DO27	DO26	DO25	DO24	DO23	DO22	DO21	DO20
Y q+3	DO37	DO36	DO35	DO34	DO33	DO32	DO31	DO30
Y q+4	DO47	DO46	DO45	DO44	DO43	DO42	DO41	DO40
Y q+5	DO57	DO56	DO55	DO54	DO53	DO52	DO51	DO50
Y q+6	DO67	DO66	DO65	DO64	DO63	DO62	DO61	DO60
Y q+7	DO77	DO76	DO75	DO74	DO73	DO72	DO71	DO70

Address q is determined by the machine tool builder.

For details of address assignment, refer to the FANUC PMC Programming Manual (Ladder Language) (B–61863E).

10.9.4 Dimensions of Source Output Type Connection Unit



The following LEDs, fuses, variable resistors, and setting pins are mounted on the PCB:

[LEDs]

DB1 (green, pilot) : Lights while the power to the PCB is on.
DB2 (red, alarm) : Lights if an error occurs in the PCB or CNC.
DAL1 to DAL8 : See Subsec. 10.9.2

[Variable resistors]

VR1 and VR2 : Factory–set by FANUC. The machine tool builder need not adjust these resistors.

[Setting pin]

CP1 : Used to specify whether the CNC will be notified of a DO signal error as a system alarm (see Subsec. 10.9.2).

10.10 FANUC I/O LINK CONNECTION UNIT

10.10.1 Overview

This unit connects FANUC I/O Link master devices' such as the CNC and F–D Mate, via an I/O Link to enable the transfer of DI/DO signals.

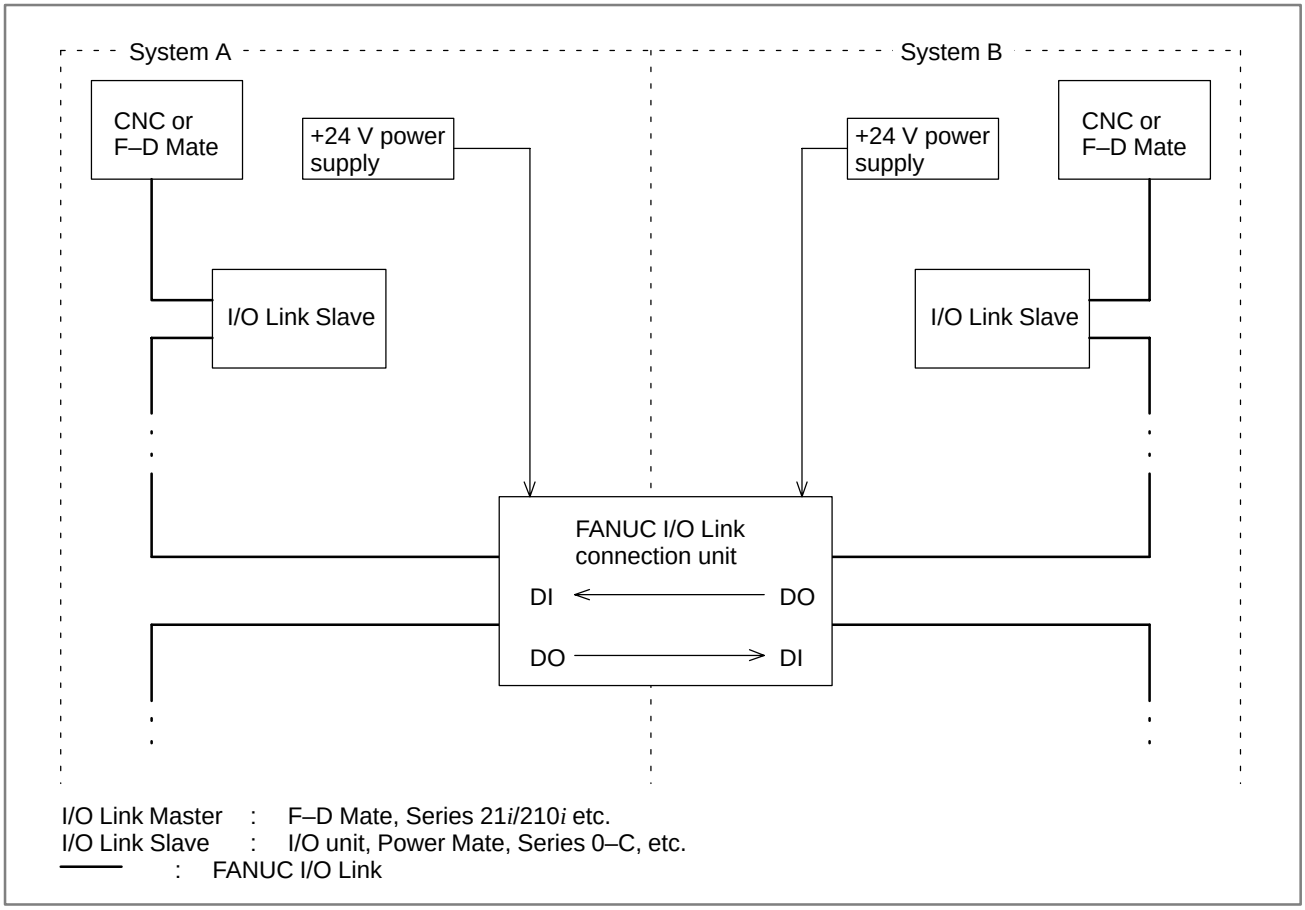


Fig. 10.10.1 System which uses FANUC I/O Link connection units

NOTE

This system enables I/O data transfer between two independent FANUC I/O Link master devices. When the system is adjusted and maintained, the FANUC I/O Link can be operated with the system power for one of the FANUC I/O Link lines switched off, that is, the link operation is stopped. In this case, DI data sent from a system at rest consists entirely of zeros. If one of the links is stopped, either abnormally or normally, it takes up to several hundred milliseconds for this function to take effect. During this period, that data which exists immediately before the link stops is sent out. Take this into account when designing your system.

10.10.2 Specification

Item	Specification
I/O Link function	Provided with two slave mode I/O Link interface channels, between which DI/DO data can be transferred. [Interface types] One of the following combinations is selected: Electrical – optical Electrical – electrical Optical – optical
Number of DI/DO data items	DI: Up to 256, DO: Up to 256 (The number of data items actually used varies depending on the amount of data assigned in the host.)
Power supply	Each I/O Link interface must be independently supplied with +24 VDC. Voltage: +24 VDC +10%, –15% Current: 0.2 A (excluding surge) If a master unit does not have sufficient capacity to supply power to each unit (0.2 A per slot), use an external power supply unit. The power supply must be switched on, either simultaneously with or before, the I/O Link master. The two systems can be switched on and off independently of each other. Data from a system to which no power is supplied appears as zeros when viewed from the other system. The data becomes 0 within 200 ms of the power being switched off.
External dimensions	180 mm (wide) × 150 mm (high) × about 50 mm (deep) Fig. 10.10.2 (b) is an outline drawing of the unit.
Installation	The unit, which is a stand–alone type, is installed in the power magnetics cabinet. Fig. 10.10.2 (c) shows how to mount the unit.
Operating environment	Temperature : 0 to 60°C Humidity : 5 to 75% RH (non–condensing) Vibration : 0.5 G or less

Ordering information

Interface type	Specification
Electrical–optical interface	A20B–2000–0410
Electrical–electrical interface	A20B–2000–0411
Optical–optical interface	A20B–2000–0412

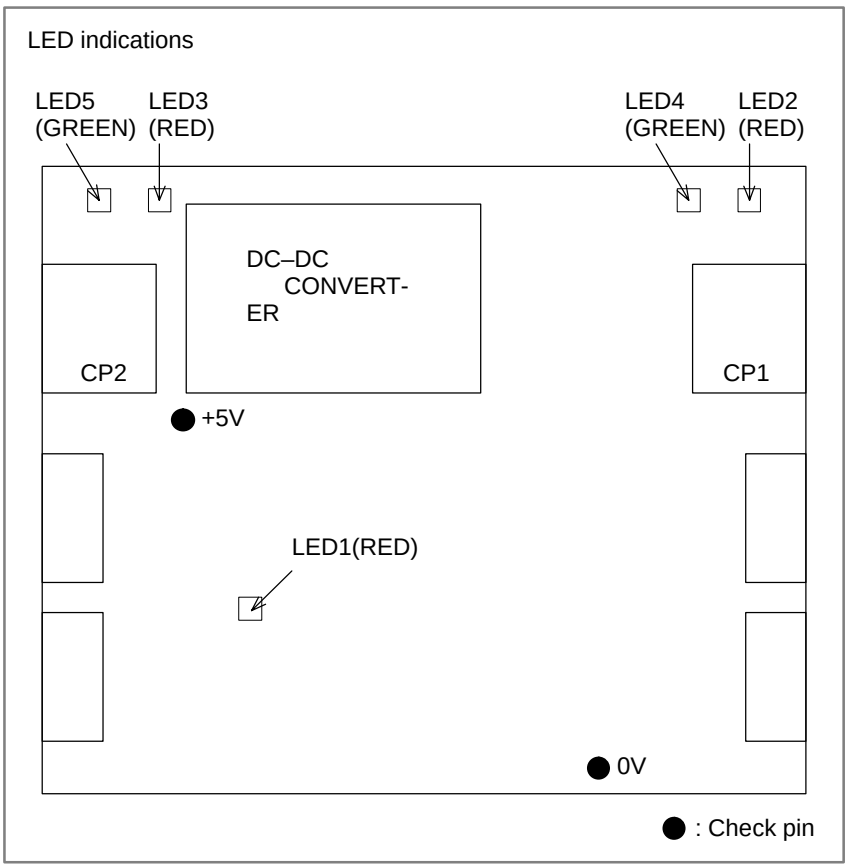


Fig. 10.10.2 (a) LED locations

	LED status	Description
1	LED1 □	Normal
	LED1 ■	A RAM parity error occurred because of a hardware failure.
2	LED4 ■ LED2 □	CP1 is supplied with the specified voltage. (Pilot lamp)
	LED4 □ LED2 ■	CP1 is supplied with a voltage that is lower than specified or zero.
	LED4 ■ LED2 ■	A communication error occurred in a channel of CP1.
3	LED5 ■ LED3 □	CP2 is supplied with the specified voltage. (Pilot lamp)
	LED5 □ LED3 ■	CP2 is supplied with a voltage that is lower than specified or zero.
	LED5 ■ LED3 ■	A communication error occurred in a channel of CP2.

■ : On □ : Off

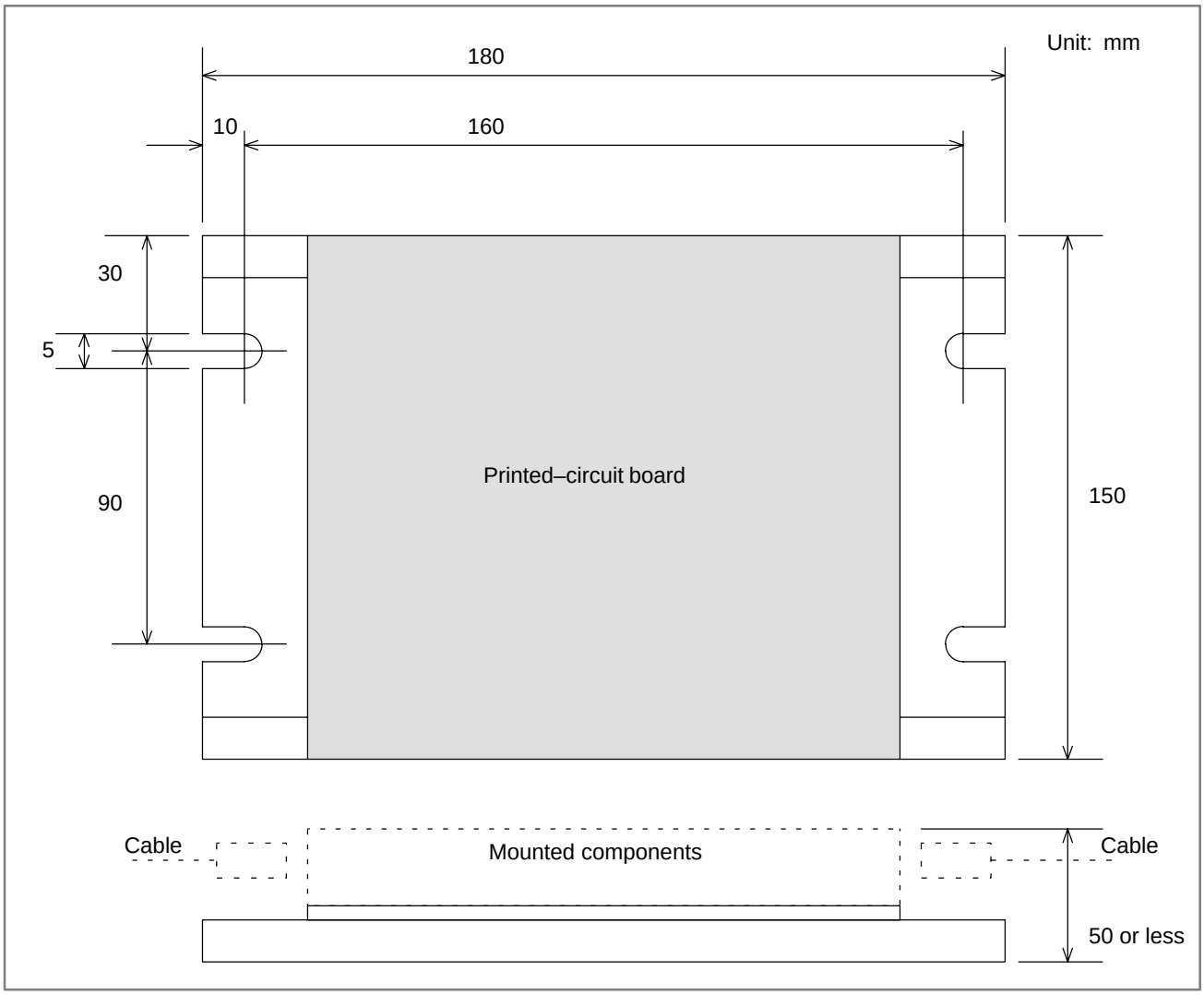


Fig. 10.10.2 (b) Outline drawing

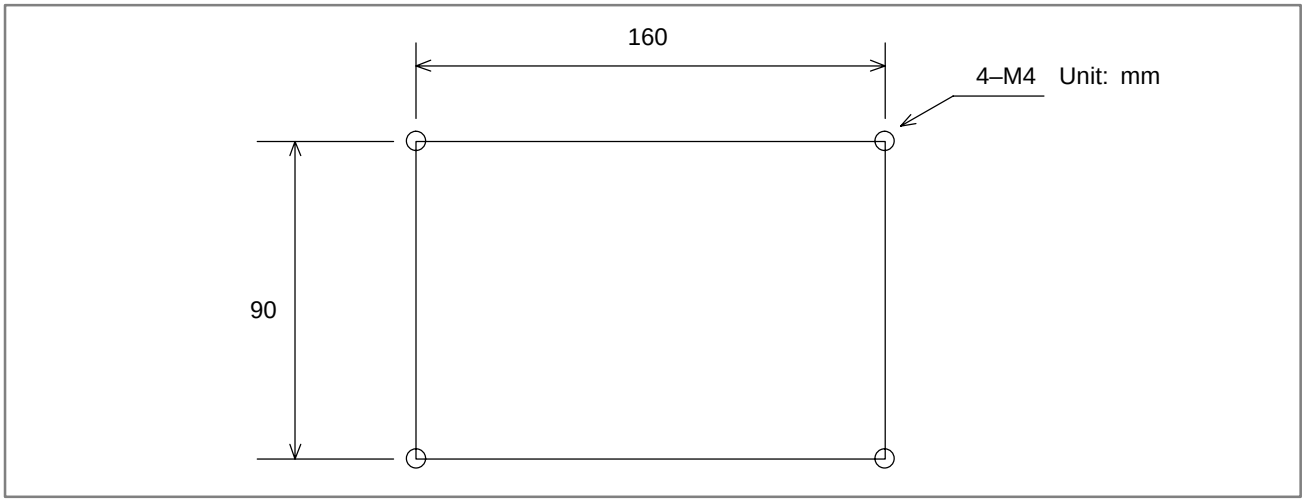
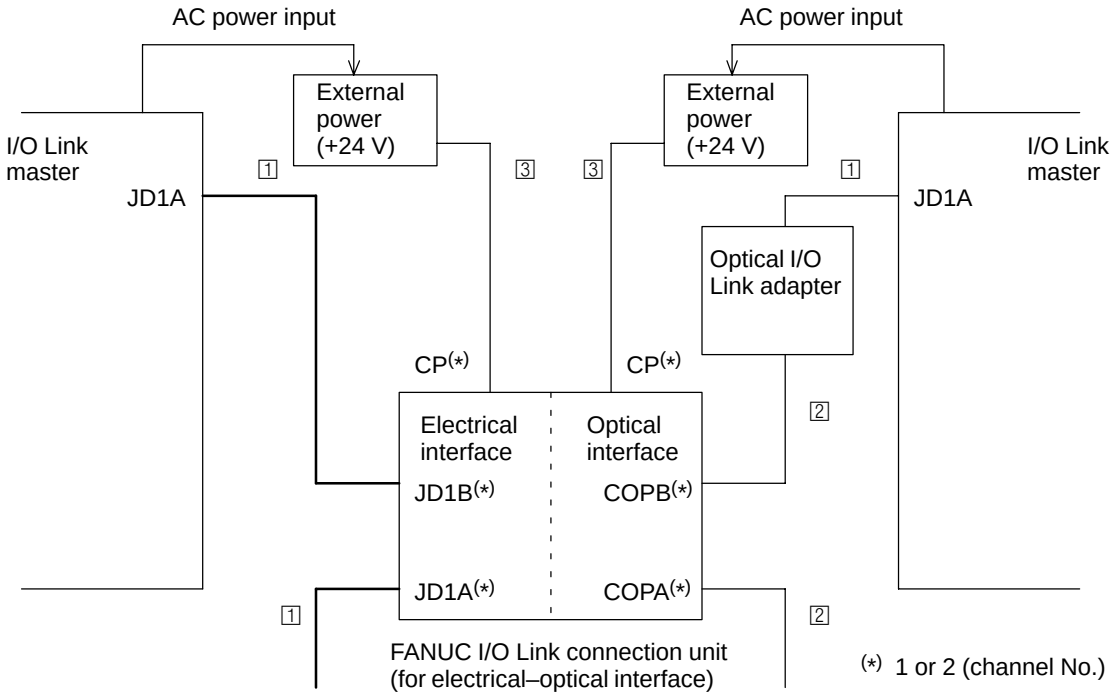


Fig. 10.10.2 (c) Mounting location

10.10.3 Connection

10.10.3.1 I/O Link interface

(1) Connection diagram (example)



[1] : Signal cable (electrical)
[2] : Signal cable (optical)
[3] : Power supply cable

Additionally, the FANUC I/O Link connection unit frame must be grounded.

[Name of I/O Link connection unit connectors]

Electrical–optical

Connector name I/O Link interface	
Channel 1	Channel 2
JD1A1	COPA2
JD1B1	COPB2
CP1	CP2

Electrical–electrical

Connector name I/O Link interface	
Channel 1	Channel 2
JD1A1	JD1A2
JD1B1	JD1B2
CP1	CP2

Optical–optical

Connector name I/O Link interface	
Channel 1	Channel 2
COPA1	COPA2
COPB1	COPB2
CP1	CP2

(2) Signal cable (electrical)

JD1A1/JD1A2

11	0V	1	RXB
12	0V	2	⁎RXB
13	0V	3	TXB
14	0V	4	⁎TXB
15	0V	5	
16	0V	6	
17		7	
18	–	8	
19		9	–
20	–	10	

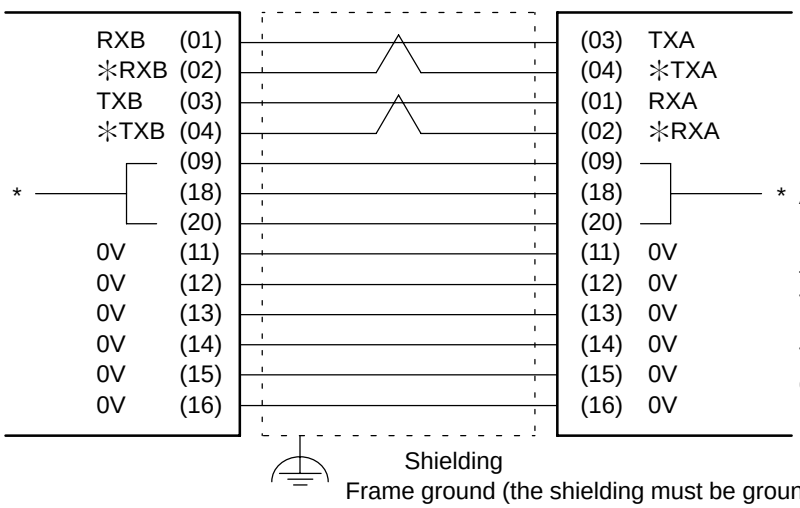
JD1B1/JD1B2

11	0V	1	RXA
12	0V	2	⁎RXA
13	0V	3	TXA
14	0V	4	⁎TXA
15	0V	5	
16	0V	6	
17		7	
18	–	8	
19		9	–
20	–	10	

This unit (JD1A1/JD1A2) ⟷ Another device (JD1B)

or

Another device (JD1A) ⟷ This unit (JD1B1/JD1B2)



Indicates a twisted pair.

* An optical I/O Link adapter cannot be connected to this unit, because the electrical interface for this unit cannot supply +5 V. To use an optical interface, prepare a appropriate unit. These wires can, therefore, be omitted.

- Cable–side connector specification : PCR–E20FA (manufactured by Honda Tsushin)
- Cable specification : A66L–0001–0284#10P or equivalent
- Cable length : 10 m (maximum)

(3) Signal cable (optical)

- Optical cable specification : A66L–6001–0009#XXXX
  (where XXXX is a cable length specification)
  Cable specification examples
  10 m – L10R03
  100 m – L100R3
- Cable length : 200 m (maximum)

(4) Power supply cable

CP1/CP2 connector

	1	2	3	
Y	+24V	0V		(Input)
X	+24V	0V		(Output)

- 24 VDC is supplied via a Y–connector. Provided the power supply has sufficient capacity, power can be supplied to another device with the X–side as output.
- Power must be supplied to both CP1 and CP2.
- Cable–side connector specification

  Y–connector: A63L–0001–0460#3LKY
  (AMP Japan, 2–178288–3)
  X–connector: A63L–0001–0460#3LKX
  (AMP Japan, 1–178288–3)
  Contact : A63L–0001–0456#BS (AMP Japan, 175218–5)
  Ordering information : Y + 3 contacts : A02B–0120–K323
  X + 3 contacts : A02B–0120–K324
- Cable material : Vinyl–insulated electrical wire AWG20–16
- Cable length : Determine the length of the cable such that the supplied voltage at the receiving end satisfies the requirements, because the voltage may fluctuate and drop as a result of the resistance of the cable conductor.

(5) Frame grounding

Ground the frame of the unit using a wire having a cross section of at least 5.5 m^2 (class 3 or higher). An M4 frame ground terminal is provided.

10.11 CONNECTING THE FANUC SERVO UNIT β SERIES WITH I/O LINK

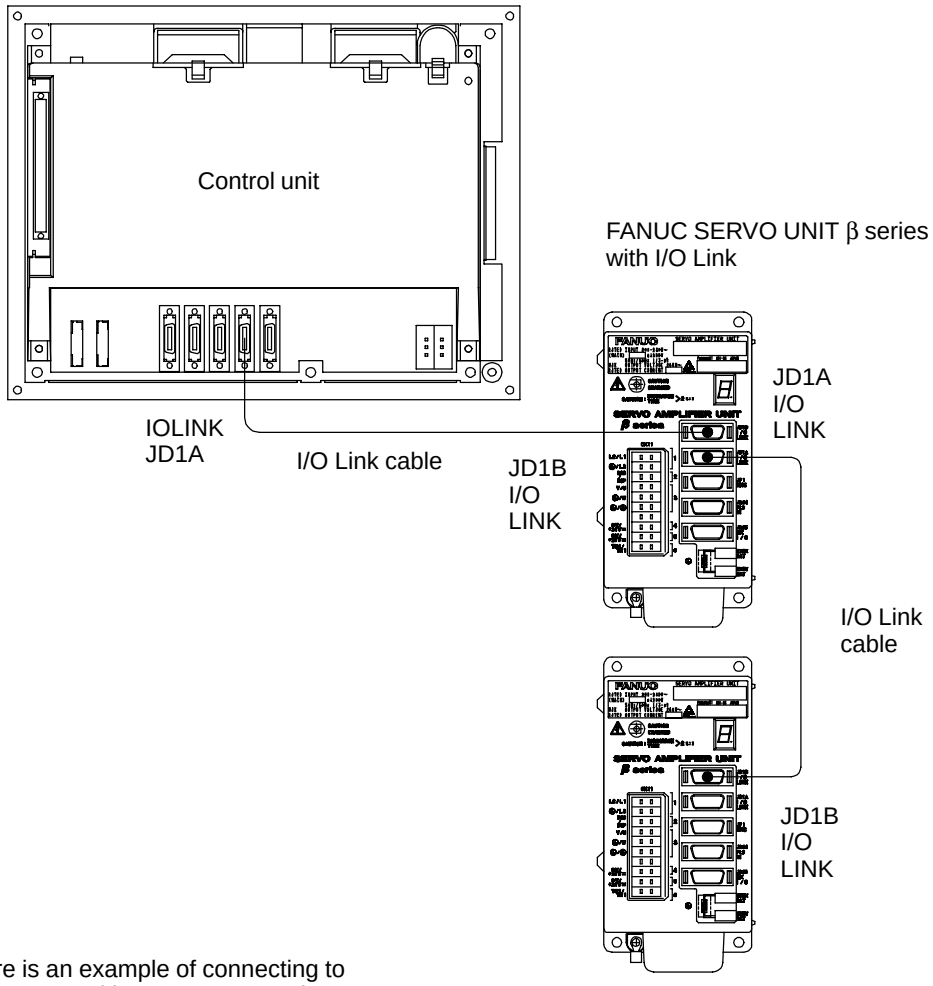
10.11.1 Overview

The FANUC servo unit β series with I/O Link (called the β amplifier with I/O Link) is a power motion control servo unit that can be easily connected to a CNC control unit via the FANUC I/O Link.
The β amplifier with I/O Link can be connected to the *i* Series using the FANUC I/O Link.

NOTE
Using the β amplifier requires that the power mate CNC manager software function be installed in the *i* Series. This function is included as one of the *i* Series option functions. Note that this function is not supported by the *i* Series with personal computer functions also requires an optional CNC screen display function.

10.11.2 Connection

The β amplifier with I/O Link is connected to the *i* Series using the usual FANUC I/O Link connection.



This figure is an example of connecting to an *i* Series CNC with a LCD–mounted type panel.

Connection to β series amplifier

10.11.3 Maximum Number of Units that can be Connected

The maximum number of β amplifiers with I/O Link that can be connected to a control unit depends on the maximum number of FANUC I/O Link points provided by that control unit, as well as their assignments. For the *i* Series, the maximum number of FANUC I/O Link DI and DO points are 1024 and 1024, respectively. One β amplifier with I/O Link occupies 128 DI/DO points in the FANUC I/O Link. If no units other than the β amplifiers with I/O Link are connected to the control unit, up to eight β amplifiers can be connected.

10.11.4 Address Assignment by Ladder

If the β amplifier with I/O Link is used as an I/O Link slave, I/O addresses are assigned in the PMC in the CNC. Because data output from the slave is made in 16–byte units, the number of input/output points must be set to 128.

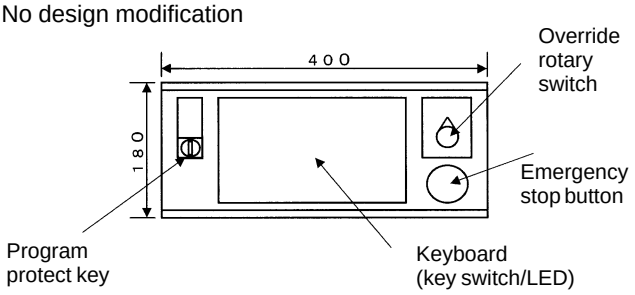
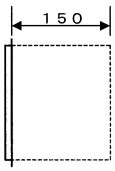
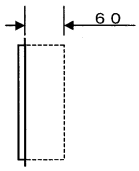
The module names are OC02I (input) and OC02O (output).
The BASE is always 0, and the SLOT is 1.

10.12 CONNECTION OF THE DISTRIBUTION I/O MACHINE OPERATOR'S PANEL

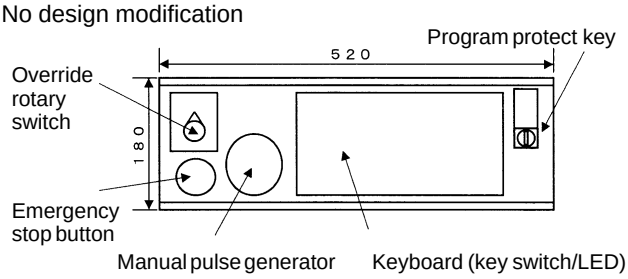
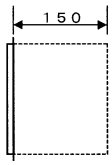
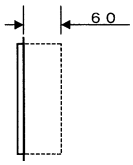
10.12.1 Differences between the FS0 Standard Machine Operator's Panel and Distribution I/O Machine Operator Panel

The distribution I/O machine operator's panel is of distribution I/O type that is connected via I/O Link to the CNC. Its panel is the same as that of the FS0 standard machine operator's panel. The distribution I/O machine operator's panel has features both common to and different from those of the FS0 standard machine operator's panel, as indicated below.

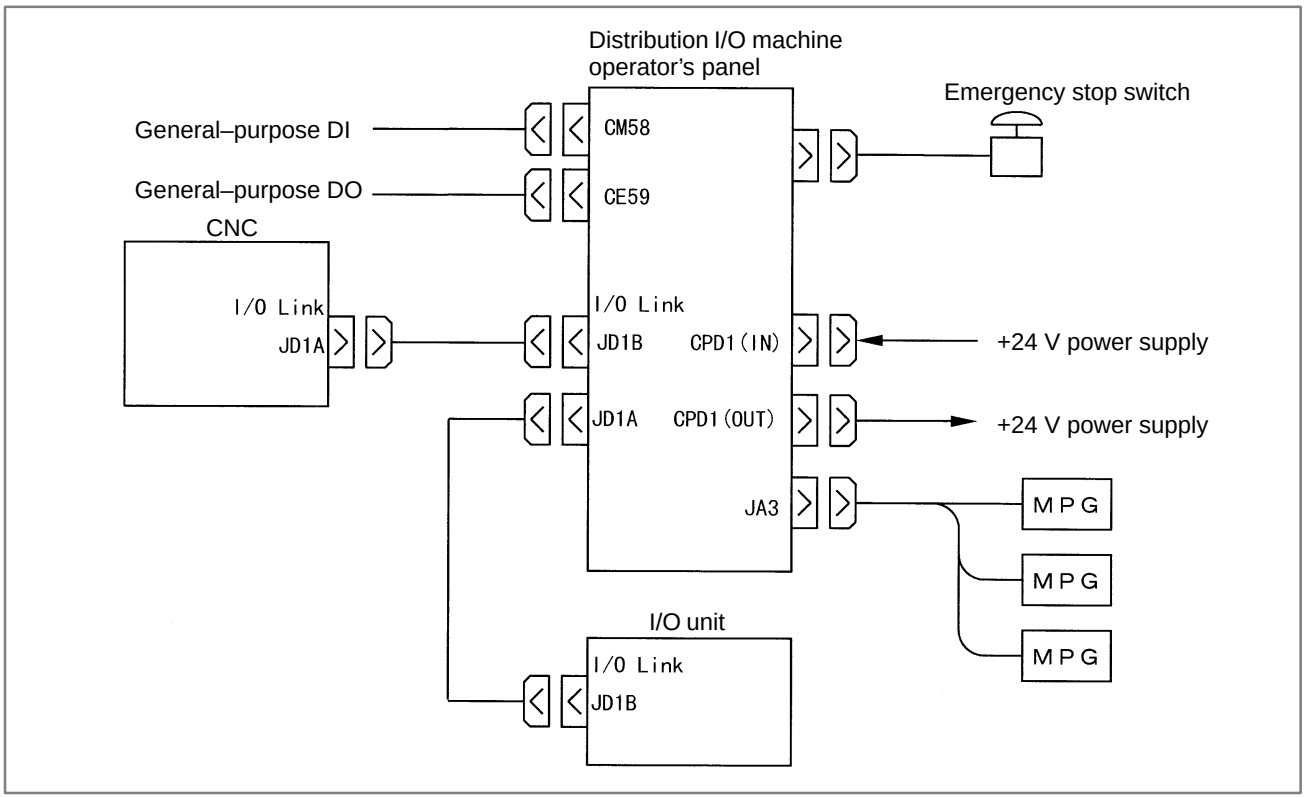
(Small machine operator's panel)

Item	FS0 standard machine operator's panel	Distribution I/O machine operator's panel
Panel	No design modification 	
Depth		
Override	150% maximum, binary code output	200% maximum, gray code output
Key sheet	The key sheet is compatible, so that a machine tool builder's custom key sheet, designed for the FS0 standard machine operator's panel, can be used as is. When a new unit is to be built using the existing key sheet and distribution I/O machine operator's panel, however, redesign is required for this combination.	
Connection with CNC	DI/DO connection	I/O Link connection
Emergency stop	Already wired	Not wired. Perform wiring for the system as described in Section 10.12.5.
MPG interface	None	Up to three units can be connected. However, only *i* series CNCs can be connected.

(Standard–size machine operator's panel)

Item	FS0 standard machine operator's panel	Distribution I/O machine operator's panel
Panel	No design modification 	
Depth		
Override	150% maximum, binary code output	200% maximum, gray code output
Key sheet	The key sheet is compatible, so that a machine tool builder's custom key sheet designed for the FS0 standard machine operator's panel, can be used as is. When a new unit is to be built using the existing key sheet and distribution I/O machine operator's panel, however, redesign is required for this combination.	
Connection with CNC	DI/DO connection	I/O Link connection
Emergency stop	Already wired	Not wired. Perform wiring suitable for the system as described in Section 10.12.5.
Manual pulse generator	One unit is available. No wiring is performed.	One unit is available. No wiring is performed.
MPG interface	None	Up to three units can be connected. However, only *i* series CNCs can be connected.

10.12.2 Overall Connection Diagram



NOTE

CNCs of the i series only allow the distribution I/O machine operator's panel to be used with connected MPG units. When other units (such as I/O modules for connection) that have an MPG interface and which are connected via I/O Link are used together with this machine operator's panel, only the MPG interface of the unit (module) closest to the CNC on the I/O Link connection is valid. For I/O Link connection and manual pulse generator connection, the screw connector indicated below, which has been newly added to the main board of the *i* series, cannot be used.

Connectors that cannot be used on the cable side

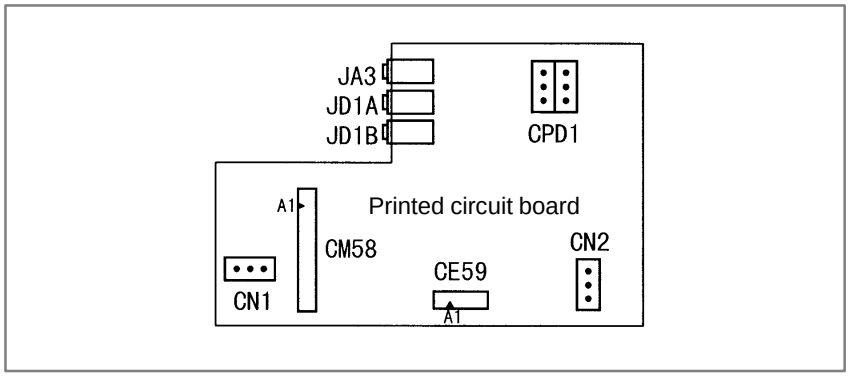
	Specification	Manufacturer
Connector case	FI–20–CV7	Hirose Electric
Connector case + connector	FI30–20S–CV7	Hirose Electric

10.12.3 Connector Mounting Diagram

(1) Small machine operator's panel

Specification of the printed circuit board:
A20B–8001–0721 (with general–purpose DO)

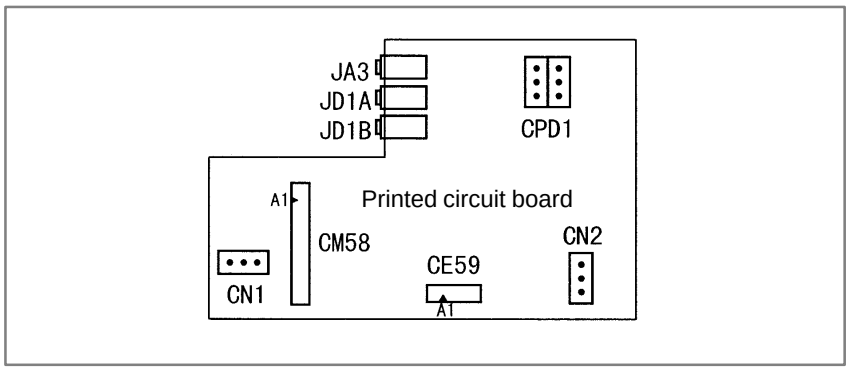
Viewed from behind



(2) Standard–size machine operator's panel

Specification of the printed circuit board:
A20B–8001–0721 (with general–purpose DO)

Viewed from behind



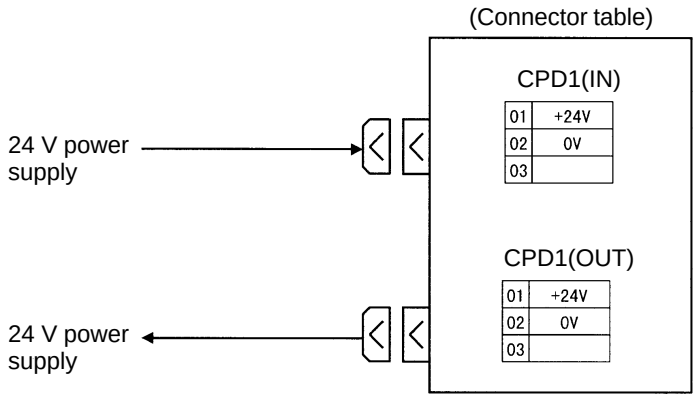
NOTE

Machine operator's panels shipped in April, 1998 and later use the A20B–8001–0721 printed circuit board. The A20B–8001–0721 printed circuit board features a general–purpose DO, and has connector CE59 dedicated to general–purpose DO. Machine operator's panels shipped before April, 1998, used the printed circuit boards listed below.

Specification of printed circuit board	Description
A20B–8001–0210	● Without general–purpose DO ● The other input/output interface specifications are the same as those of the A20B–8001–0721 printed circuit board. ● The outer shape of the printed circuit board is rectangular.
A20B–8001–0720	● Without general–purpose DO ● The other input/output interface specifications and outer shape of the printed circuit board are the same as those of the A20B–8001–0721 printed circuit board.

10.12.4 Power Supply Connection

To connector CPD1(IN) shown below, supply the power required for the operator's panel and general–purpose DI. To facilitate power distribution, the power applied to CPD1(IN) is directly output to CPD1(OUT). Use CPD1(OUT) if power distribution is required.



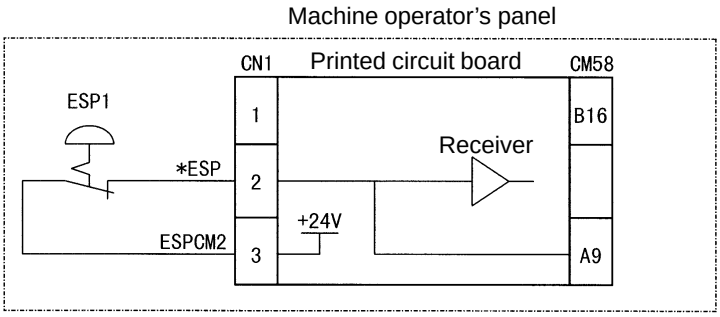
Connector recommended for use on the cable side: A02B–0120–K324
(The following connector housing and case are provided:)
(Housing: 1–178288–3 (AMP Japan))
(Contact: 1–175218–5 (AMP Japan))

NOTE
1 Power connectors CPD1(IN) and CPD1(OUT) have the same specification. On the actual printed circuit board, (IN) and (OUT) are not distinguished from each other.
2 During operation, never turn off the +24 V power supply to the connector. Otherwise, a CNC communication alarm is issued. Ensure that +24 V is supplied either when or before the power to the CNC is turned on, and that the +24 V supply is removed either when or after the power to the CNC is turned off.

10.12.5 Emergency Stop Signal Connection

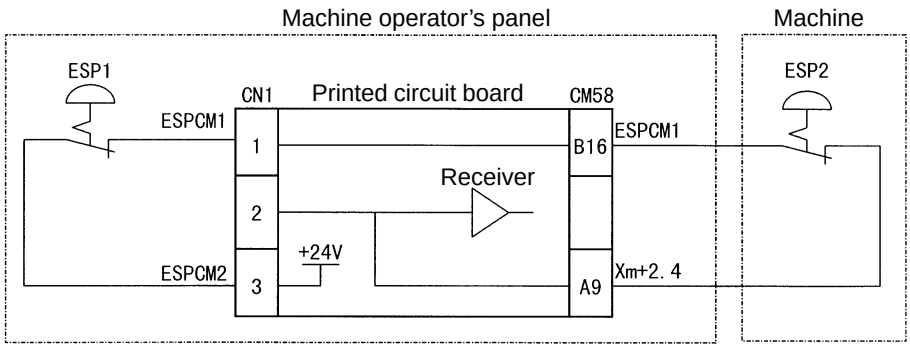
The emergency stop switch is not wired when the unit leaves the factory. Perform wiring suitable for the system.
For an emergency stop signal, a common pin and emergency stop signal pin are available with connectors CN1 and CM58 on the machine operator's panel. So, the wiring described below is recommended.

(1) When the emergency stop switch on the machine is not used, and only the emergency stop switch on the operator's panel is used
Connect contact B of the emergency stop switch to pins 2 and 3 of CN1.



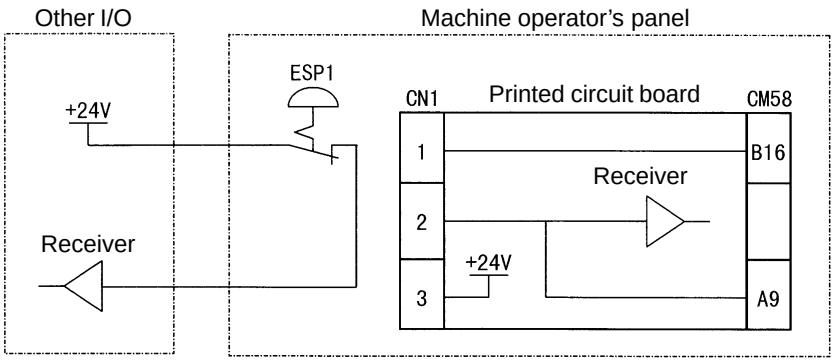
Connector recommended for use on the CN1 cable side
Housing: 2–178288–3 (AMP Japan), Contact: 1–175218–5 (AMP Japan)

(2) When the emergency stop switch on the machine and that on the operator's panel are used
Connect contact B of the emergency stop switch to pins 1 and 3 of CN1 and to pins A9 and B16 of CM58.



Connector recommended for use on the CN1 cable side
Housing: 2–178288–3 (AMP Japan), Contact: 1–175218–5 (AMP Japan)
Connector recommended for use on the CM58 cable side
HIF3BA–34DA–2.54R (Hirose Electric)

(3) When an emergency stop signal is output to other I/O



NOTE

In the examples (1) and (2) above, an emergency stop signal is applied to the DI address (Xm+2.4) tied to the 24V common signal. So, allocate DI addresses as described in Section 10.12.12. For details of the wiring used to apply an emergency stop signal to a DI address other than Xm+2.4, see Sections 10.12.6 and 10.12.12. In the example of (3), Xm+2.4 can be used as a general–purpose DI address.

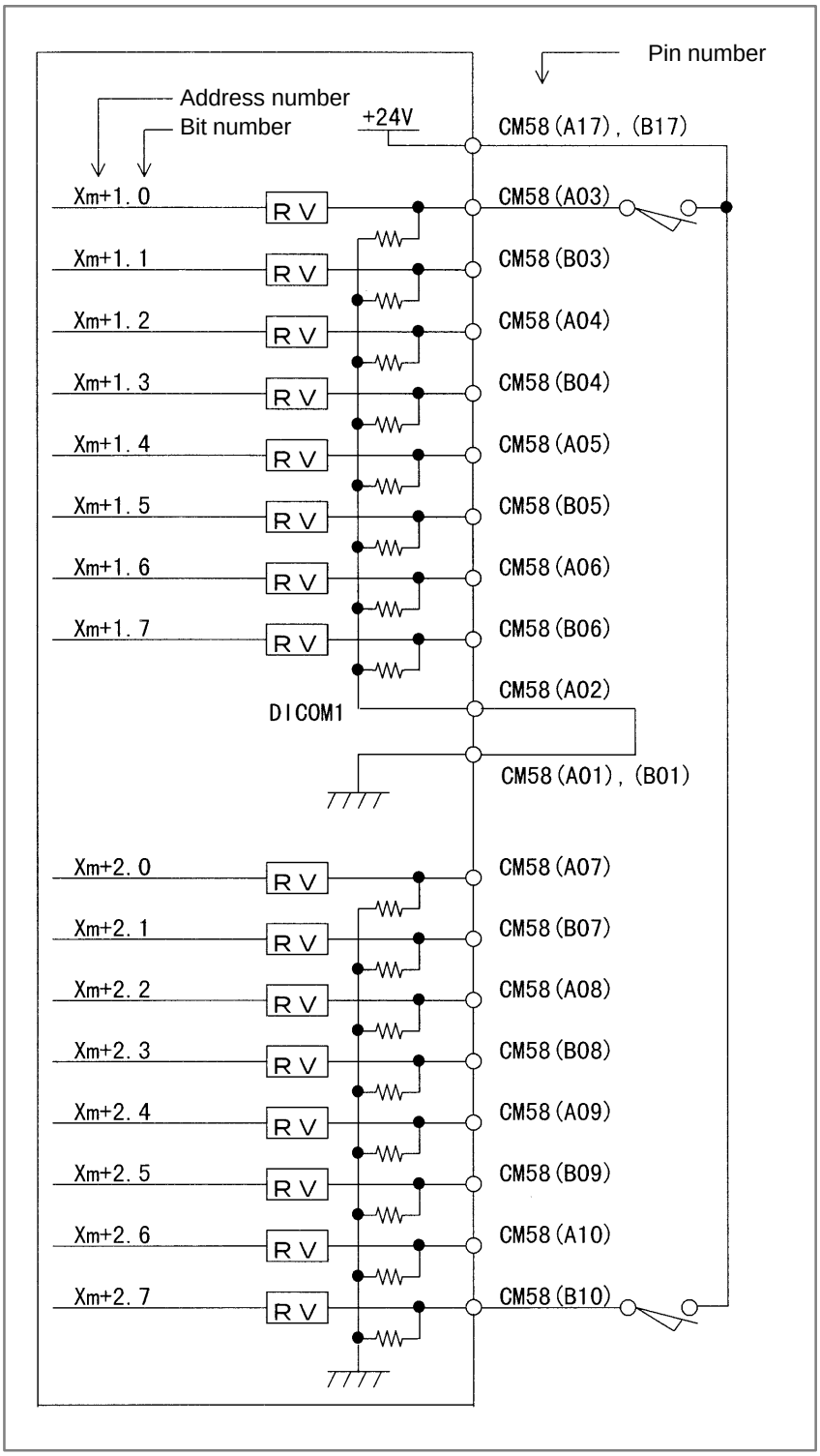
10.12.6 General–purpose DI Signal Connection

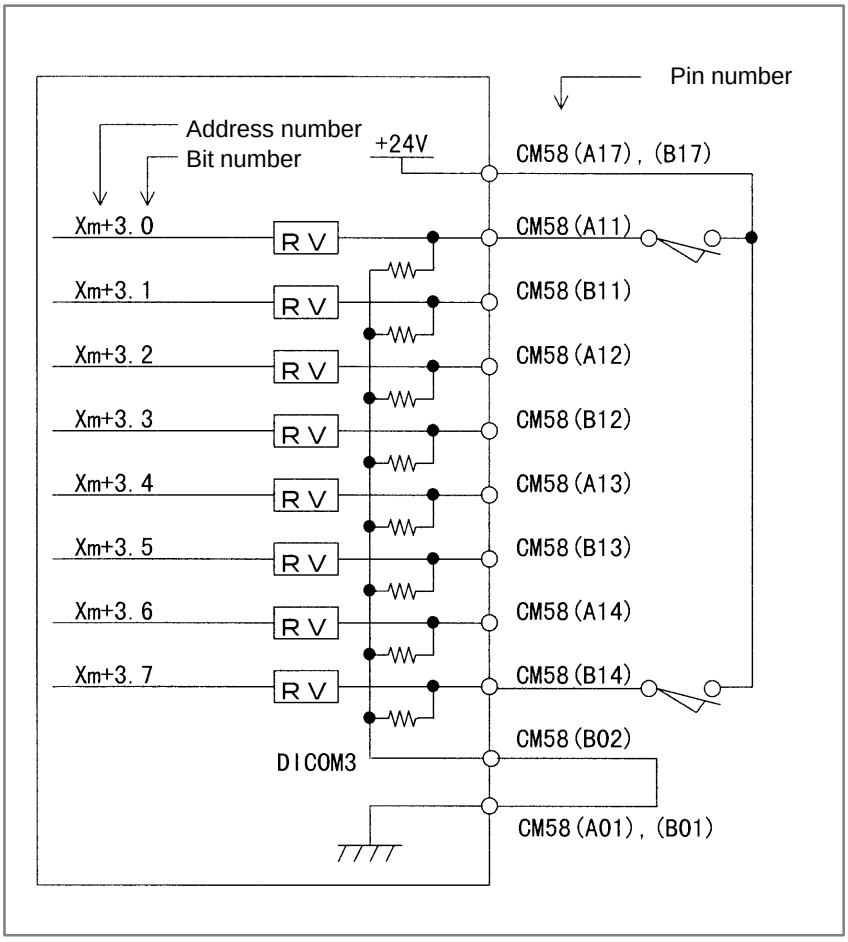
The machine operator's panel has 24 general–purpose DI points. The interface is as follows:

CM58

	A	B
01	0V	0V
02	DICOM1	DICOM3
03	Xm+1.0	Xm+1.1
04	Xm+1.2	Xm+1.3
05	Xm+1.4	Xm+1.5
06	Xm+1.6	Xm+1.7
07	Xm+2.0	Xm+2.1
08	Xm+2.2	Xm+2.3
09	Xm+2.4	Xm+2.5
10	Xm+2.6	Xm+2.7
11	Xm+3.0	Xm+3.1
12	Xm+3.2	Xm+3.3
13	Xm+3.4	Xm+3.5
14	Xm+3.6	Xm+3.7
15	TR1	TR2
16	TR3	ESPCM1
17	+24V	+24V

Connector recommended for use on the CM58 cable side:
HIF3BA–34D–2.54R (Hirose Electric)


Pin number
Address number
Bit number
+24V
CM58 (A17), (B17)
Xm+1. 0
R V
CM58 (A03)
Xm+1. 1
CM58 (B03)
Xm+1. 2
CM58 (A04)
Xm+1. 3
CM58 (B04)
Xm+1. 4
CM58 (A05)
Xm+1. 5
CM58 (B05)
Xm+1. 6
CM58 (A06)
Xm+1. 7
CM58 (B06)
CM58 (A02)
DICOM1
CM58 (A01), (B01)
Xm+2. 0
CM58 (A07)
Xm+2. 1
CM58 (B07)
Xm+2. 2
CM58 (A08)
Xm+2. 3
CM58 (B08)
Xm+2. 4
CM58 (A09)
Xm+2. 5
CM58 (B09)
Xm+2. 6
CM58 (A10)
Xm+2. 7
CM58 (B10)


Pin number
Address number
Bit number
+24V
CM58(A17), (B17)
Xm+3.0
RV
CM58(A11)
Xm+3.1
RV
CM58(B11)
Xm+3.2
RV
CM58(A12)
Xm+3.3
RV
CM58(B12)
Xm+3.4
RV
CM58(A13)
Xm+3.5
RV
CM58(B13)
Xm+3.6
RV
CM58(A14)
Xm+3.7
RV
CM58(B14)
CM58(B02)
DICOM3
CM58(A01), (B01)

NOTE

1 Xm+1.0 to Xm+1.7 and Xm+3.0 to Xm+3.7 are DI points that allows common selection. This means that by connecting the DICOM1 pin (CM58–A02) and DICOM3 pin (CM58–B02) to +24 V, the DI signal whose logic is inverted can be applied. In this case, however, if the cable is struck by lightning, it has the effect of turning on the DI signal. For safety reasons, therefore, the connection of the DICOM1 and DICOM3 pins to 0 V is recommended whenever possible.

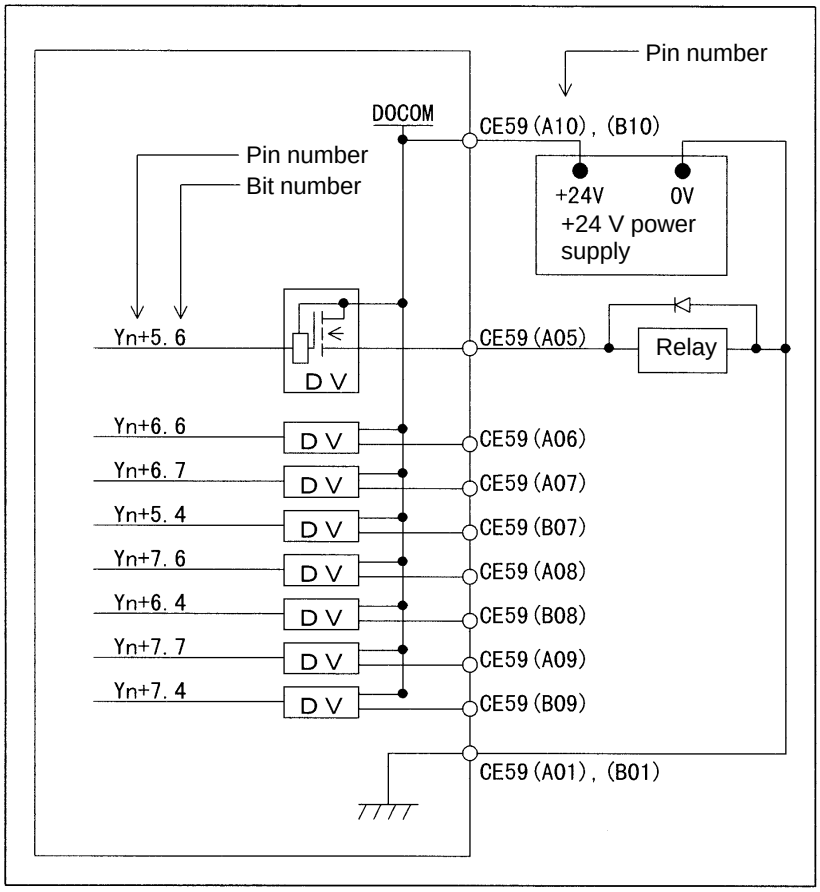
2 From the viewpoint of safety, an emergency stop signal needs to assigned to the corresponding bit of addresses Xm+2.0 to Xm+2.7 tied to the common signal. Determine the location of an emergency stop signal as described in Section 10.12.12.

3 The unused DI points of addresses Xm+2.0 to Xm+2.7 tied to the common signal are used as inputs tied to 0. The unused DI points of addresses Xm+1.0 to Xm+1.7 and Xm+3.0 to Xm+3.7 that allow common selection are input signals tied to 0 when the DICOM1 pin (CM58–A02) and DICOM3 pin (CM58–B02) are connected to 0 V; the unused DI points are input signals tied to 1 when the DICOM1 pin (CM58–A02) and DICOM3 pin (CM58–B02) are connected to +24 V. When the DICOM1 pin (CM58–A02) and DICOM3 pin (CM58–B02) are open, the logic of the unused DI points at addresses Xm+1.0 to Xm+1.7 and Xm+3.0 to Xm+3.7 is undefined.

10.12.7 General–purpose DO Signal Connection

CE59

	A	B
01	0V	0V
02		
03		
04	(Note)	
05	Yn+5. 6	
06	Yn+6. 6	
07	Yn+6. 7	Yn+5. 4
08	Yn+7. 6	Yn+6. 4
09	Yn+7. 7	Yn+7. 4
10	DOCOM	DOCOM



Cable recommended for use on the CE59 cable side: HIF3BA–20D–2.54R (Hirose Electric)

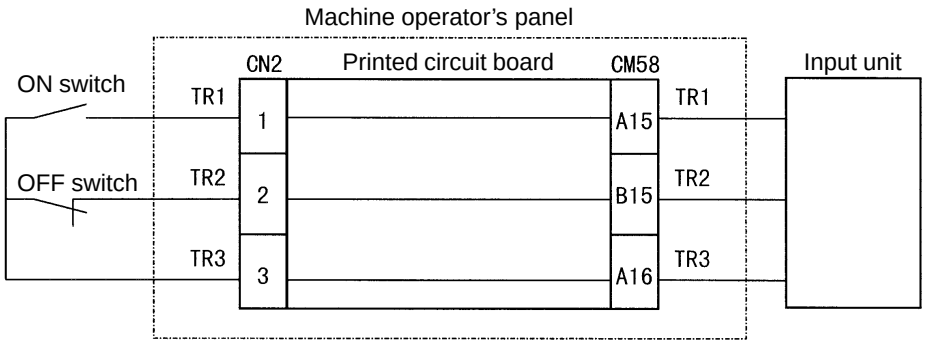
NOTE
With the small machine operator's panel, all of the eight general–purpose DO points indicated above can be used. With the standard–size machine operator's panel, only the five general–purpose DO points enclosed in the bold rectangle can be used.

10.12.8 Manual Pulse Generator Connection

See Section 10.4.15.

10.12.9 Relay Terminal Connection

A relay terminal is used to relay signals on the machine operator's panel. Relayed signals are not output to the CNC via I/O Link. An example of using a relay terminal to relay a power ON/OFF control signal is provided here.



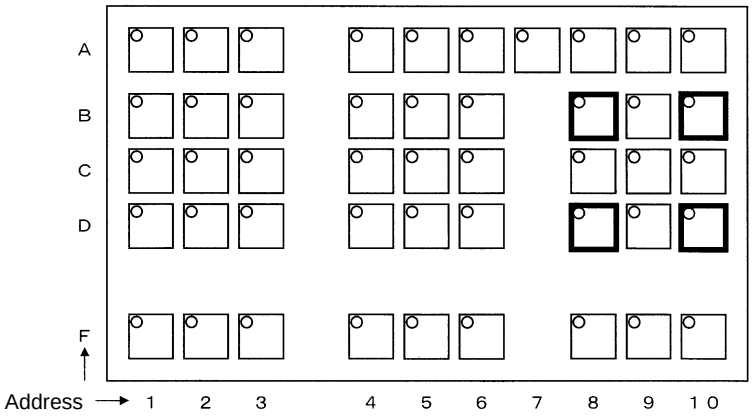
Connector recommended for use on the CN2 cable side:
Housing: 2–178288–3 (AMP Japan), Contact: 1–175218–5 (AMP Japan)
Connector recommended for use on the CM58 cable side:
Housing: HIF3BA–34DA–2.54R (Hirose Electric)

10.12.10 Keyboard Addresses

(Small machine operator's panel)
The relationship of the keyboard key switches and LED I/O addresses is as follows:

Key/LED \ BIT	7	6	5	4	3	2	1	0
Xm+4/Yn	F3	F2	F1		D1	C1	B1	A1
Xm+5/Yn+1	F4				D2	C2	B2	A2
Xm+6/Yn+2	D4	D3	C4	C3	B4	B3	A4	A3
Xm+7/Yn+3		F6	F5		D5	C5	B5	A5
Xm+8/Yn+4	F8				D6	C6	B6	A6
Xm+9/Yn+5	D8		C8		B8		A8	A7
Xm+10/Yn+6			F9		D9	C9	B9	A9
Xm+11/Yn+7			F10		D10	C10	B10	A10

Key switch/LED arrangement

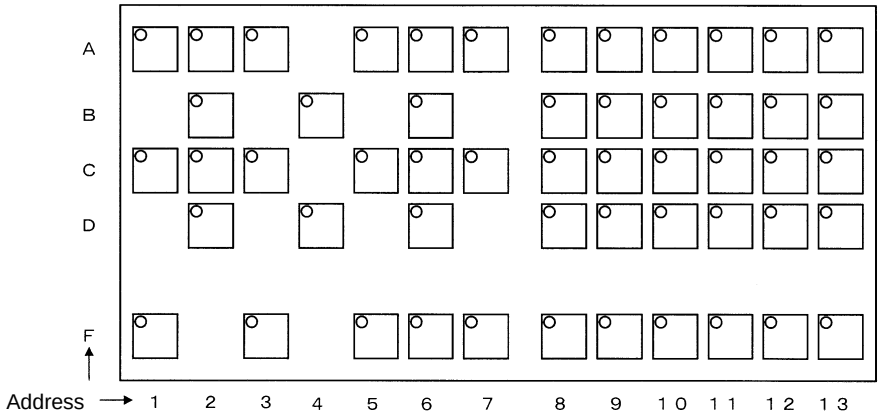


NOTE
T series: 42 keys
M series: 46 keys
On the machine operator's panel of the T series, the keys enclosed in the bold rectangles are not available.

(Standard–size machine operator’s panel)
The relationship between the keyboard key switches and LED I/O addresses is as follows:

Key/LED \ BIT	7	6	5	4	3	2	1	0
Xm+4/Yn	F1	C1	A1	F6	D6	C6	B6	A6
Xm+5/Yn+1		C2	A2	F7		C7		A7
Xm+6/Yn+2	F3	C3	A3	F8	D8	C8	B8	A8
Xm+7/Yn+3	F5			F9	D9	C9	B9	A9
Xm+8/Yn+4	D2	C5	A5	F10	D10	C10	B10	A10
Xm+9/Yn+5	D4		B2	F11	D11	C11	B11	A11
Xm+10/Yn+6			B4	F12	D12	C12	B12	A12
Xm+11/Yn+7				F13	D13	C13	B13	A13

Key switch/LED arrangement



NOTE
53 keys for both the T series and M series

10.12.11 Other Signal Addresses

DI address	Signal	Name
Xm+0.0	*OVA	Override signal (Note)
Xm+0.1	*OVB	
Xm+0.2	*OVC	
Xm+0.3	*OVD	
Xm+0.4	*OVE	
Xm+0.5	KEY	Program protect signal

NOTE
Override signal (*OVA to *OVE)

Gray codes are output according to the table below.

%	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
*OVA	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0
*OVB	0	0	1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1
*OVC	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1
*OVD	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
*OVE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1

10.12.12 Allocation

The I/O address maps of the distribution I/O machine operator's panel are as follows:

DI space map

Xm	Override, etc.
Xm+1	General–purpose DI signals
Xm+2	
Xm+3	
Xm+4	Keyboard (key switch)
Xm+5	
Xm+6	
Xm+7	
Xm+8	
Xm+9	
Xm+10	
Xm+11	
Xm+12 (first MPG)	MPG
Xm+13 (second MPG)	
Xm+14 (third MPG)	
Xm+15	Not used

DO space map

Yn	Keyboard (LED) General–purpose DO signals
Yn+1	
Yn+2	
Yn+3	
Yn+4	
Yn+5	
Yn+6	
Yn+7	

With the distribution I/O machine operator's panel, basically allocate a group of 16 bytes as a DI area, and allocate a group of 8 bytes as a DO area. The reason for this is described below. The MPG interface (MPG counter) uses Xm+12 through Xm+14 of the DI space. These addresses are fixed. Xm+12 through Xm+14 must be allocated before the MPG interfaces can be used. So, when using MPG interfaces with the i series, allocate a group of 16 bytes as a DI area. The value of an MPG counter is directly processed by the CNC, so the ladder must not use this area.
When MPG interfaces are not used, the DI area may be allocated to other I/O groups.

Basically, arbitrary I/O addresses can be allocated on the distribution I/O machine operator's panel. For connection with the fixed addresses directly monitored by the CNC, however, DI addresses must be allocated as indicated below.
Fixed addresses directly monitored by the CNC (with FS21*i*/210*i*)

	7	6	5	4	3	2	1	0
X0004	SKIP	ESKIP SKIP6	–MIT2 SKIP5	+MIT2 SKIP4	–MIT1 SKIP3	+MIT1 SKIP2	ZAE SKIP8	XAE SKIP7
	SKIP	ESKIP SKIP6	SKIP5	SKIP4	SKIP3	ZAE SKIP2	YAE SKIP8	XAE SKIP7
X0005								
X0006								
X0007								
X0008				*ESP				
X0009					*DEC4	*DEC3	*DEC2	*DEC1

The upper row is for the T series, while the lower row is for the M series.

Example)
When 16 bytes, starting from X0006, are allocated as DI addresses

X0006	Override, etc.	
X0007	General–purpose input signals	← Fixed signal of *DECn#2
X0008		← Fixed signal of *ESP
X0009		← Fixed signal of *DECn#1
X0010	Keyboard (key switch input signals)	
X0012		
X0013		
X0014		
X0015		
X0016		
X0017		
X0018 (first MPG)	MPG	
X0019 (second MPG)		
X0020 (third MPG)		
X0021	Not used	

When addresses starting from X0006 are allocated, the fixed signals of *DECn#1 and DECn#2 can be used, and the fixed signal of *ESP can be used after allocation at an address tied to the 24 V common signal.
However, fixed signals such as SKIP cannot be used. Allocate addresses according to this example when employing the wiring shown in Section 10.12.5.
(No fixed signal can be allocated to the key switch input section.)

10.12.13 Specifications

Setting environment

Ambient temperature	Operation: 0°C to 58°C Storage and transportation: –20°C to 60°C
Temperature change	1.1°C/minute maximum
Humidity	Normal condition: 75% (relative humidity) Short term (no more than one month): 95% (relative humidity)
Vibration	Operation: 0.5 G or less
Atmosphere	Normal machining factory environment (For use in an environment with relatively high levels of dust, coolant, organic solutions, and so forth, special consideration is required.)

Ordering information

Name	Ordering code	Remarks
Distribution I/O machine operator's panel	A02B–0236–C141#TBS	Small, used for T, symbol key sheet
	A02B–0236–C141#TBR	Small, used for T, English key sheet
	A02B–0236–C141#MBS	Small, used for M, symbol key sheet
	A02B–0236–C141#MBR	Small, used for M, English key sheet
Distribution I/O machine operator's panel	A02B–0236–C140#TBS	Standard–size, used for T, symbol key sheet
	A02B–0236–C140#TBR	Standard–size, used for T, English key sheet
	A02B–0236–C140#MBS	Standard–size, used for M, symbol key sheet
	A02B–0236–C140#MBR	Standard–size, used for M, English key shee
Fuse (accessory)	A03B–0815–K001	1A

Machine operator's panel specifications

Item	Specifications	Remarks
Number of general–purpose DI points	24 points	24 V input
Number of general–purpose DO points	Small machine operator's panel: 8 points Standard–size machine operator's panel: 5 points	24 V output
Key switch	Small machine operator's panel: 42 keys (for T) 46 keys (for M) Standad–size machine operator's panel: 53 keys (common to T and M)	Sheet key type. Matrix DI.
LED	Red	Attached to all key switches. Matrix DO.
Override rotary switch	5 bits	Gray code output
Emergency stop switch	1 bit	
Program protect key	1 bit	
MPG interface	3 units maximum	Usable only with *i* series CNCs
Interface with CNC	FANUC I/O Link connection	Up to 16 units as CNC slaves. Expandable up to 1024/1024 points.
Manual pulse generator	1 unit	Standard–size machine operator's panel only

Power supply capacity

Power supply voltage	Power supply capacity	Remarks
24 VDC ±10% is fed from the power connector CPD1; ±10% includes momentary variations and ripples.	0.4A	All DI signal consumption is included.

General–purpose DI signal specifications

Contact capacity	30 VDC. 16 mA or more
Leakage current between contacts when opened	1 mA or less (26.4 V)
Voltage decrease between contacts when closed	2 V or less (including voltage drop in the cable)
Delay	The receiver delay is 2 ms (maximum). In addition, [I/O Link transfer time between CNC and machine operator's panel (2 ms maximum)] + [ladder scan period (depending on CNC)] must be considered.

General–purpose DO signal specifications

Maximum load current when ON	200 mA or less including momentary variations
Saturation voltage when ON	1 V (maximum) when the load current is 200 mA
Withstand voltage	24 V +20% or less including momentary variations
Leakage current when OFF	20 μA or less
Delay time	The driver delay is 50 s (maximum). In addition, [I/O Link transfer time between CNC and I/O module (2 ms maximum)] + [ladder scan period (depending on CNC)] needs to be considered.

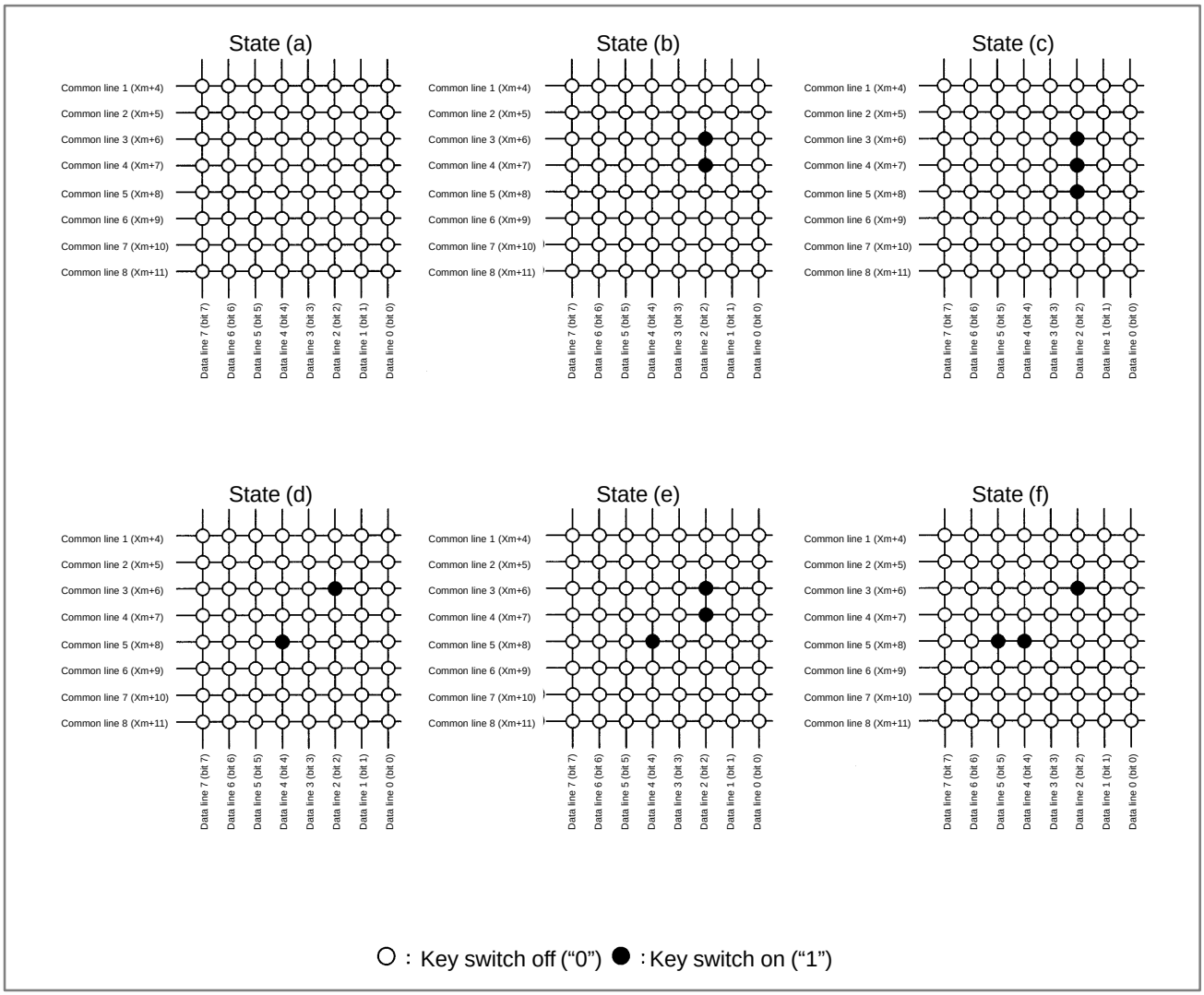
NOTE
The maximum current for each of the DOCOM power supply pins for the DO signals must not exceed 0.7 A.

10.12.14 Other Notes

The keyboard of the machine operator's panel employs a matrix configuration. If three or more keys are simultaneously entered in the matrix DI configuration, a DI signal is erroneously entered due to an abnormal current flow. A countermeasure for this malfunction can be implemented using a ladder program.

(Protection against malfunction)

If three or more keys are entered in the matrix DI configuration, all key inputs after the first two are invalidated. If there are no additional key inputs after three or more invalidated key inputs, and if the total number of inputs is two or less, all key inputs that have been performed up to that time are valid.



(Ladder operation)

The following provides examples of ladder operation based on the DI matrix of 8 (bits) × 8 (common), indicated on the next page.

(1) The number of data lines where keys are entered is checked.
The OR (R1) of the data of all the addresses is found. Among the eight bits of the R1 data, the number of bits set to 1 represents the number of data lines where keys are entered.

1 The R1 data is compared with 00h. If a match is found, the number of R1 data bits set to 1 is 0.

Example) State (a): R1 = (00000000) →
The number of data lines where keys are entered is 0.

2 The R1 data is compared with the data tables below. If the R1 data matches the data in data table 1, the number of R1 data bits set to 1 is 1. Similarly, if the R1 data matches the data in data table 2, the number of R1 data bits set to 1 is 2.

Example) State (b) or (c): R1 = (00000100) →
The number of data lines where keys are entered is 1.

Example) State (d) or (e): R1 = (00010100) →
The number of lines where keys are entered is 2.

3 If the R1 data is not 00h, and does not match the data of either data table, the number of R1 data bits set to 1 is 3 or more.

Example) State (f): R1 = (00110100) →
The number of lines where keys are entered is 3.

Data table 1

00000001	00000010
00000100	00001000
00010000	00100000
01000000	10000000

Data table 2

00000011	00000110	00001100	00011000
00110000	01100000	11000000	10000001
00000101	00001010	00010100	00101000
01010000	10100000	01000001	10000010
00001001	00010010	00100100	01001000
10010000	00100001	01000010	10000100

(2) Decision 1

1 When there is no line where keys are entered
→ No key switch is pressed.
Example) State (a)

2 When there are two or less lines where keys are entered
→ Go to (3)

3 When there are three or more lines where keys are entered
→ Three or more keys are entered. This case is invalid.
Example) State (f)

(3) When there are two or less data lines where keys are entered, whether multiple keys are entered on a data line is checked.
The data of all addresses are subtracted from the OR (R1) to obtain result R2. When R2 = 00h, there is no data line where multiple keys are entered.

Example) When there is one data line where a key is entered
State (b): R2 = FCh
State (c): R2 = F8h

When there are two data lines where keys are entered
State (d): R2 = 00h
State (e): R2 = FCh

(4) Decision 2

1 When R2 = 00h

→ There are two or less data lines where keys are entered, and no multiple keys are entered on a data line. In this case, the total number of keys entered is 1 or 2, thus representing valid key input.
Example) State (d)

2 When R2 ≠ 00h

→ There are two or less data lines where keys are entered, and multiple keys are entered on a data line. Go to (5).

(5) Decision 3

1 When there is one data line where keys are entered → Go to (6).

2 When there are two data lines where keys are entered

→ Three or more keys are entered, thus representing invalid key input.
Example) State (e)

(6) The result of subtraction (R2) is added to the OR (R1). When the result of addition is 00h, the total number of keys entered is 2.

Example) State (b): R1 + R2 = 04h + FCh = 00h
State (c): R1 + R2 = 04h + F8h = FCh

(7) Decision 4

1 When R1 + R2 = 00h

→ There is one data line where keys are entered, and two keys are entered on the data line. This means that the total number of keys entered is 2, representing valid key input.
Example) State (b)

2 R1 + R2 ≠ 00h

→ Three or more keys are entered on a data line, thus representing invalid key input.
Example) State (c)

(8) Only when valid key input is confirmed by decisions 1 through 4, all DI data (Xm+4 to Xm+11) is used by the ladder program.

10.12.15
Operator's Panel

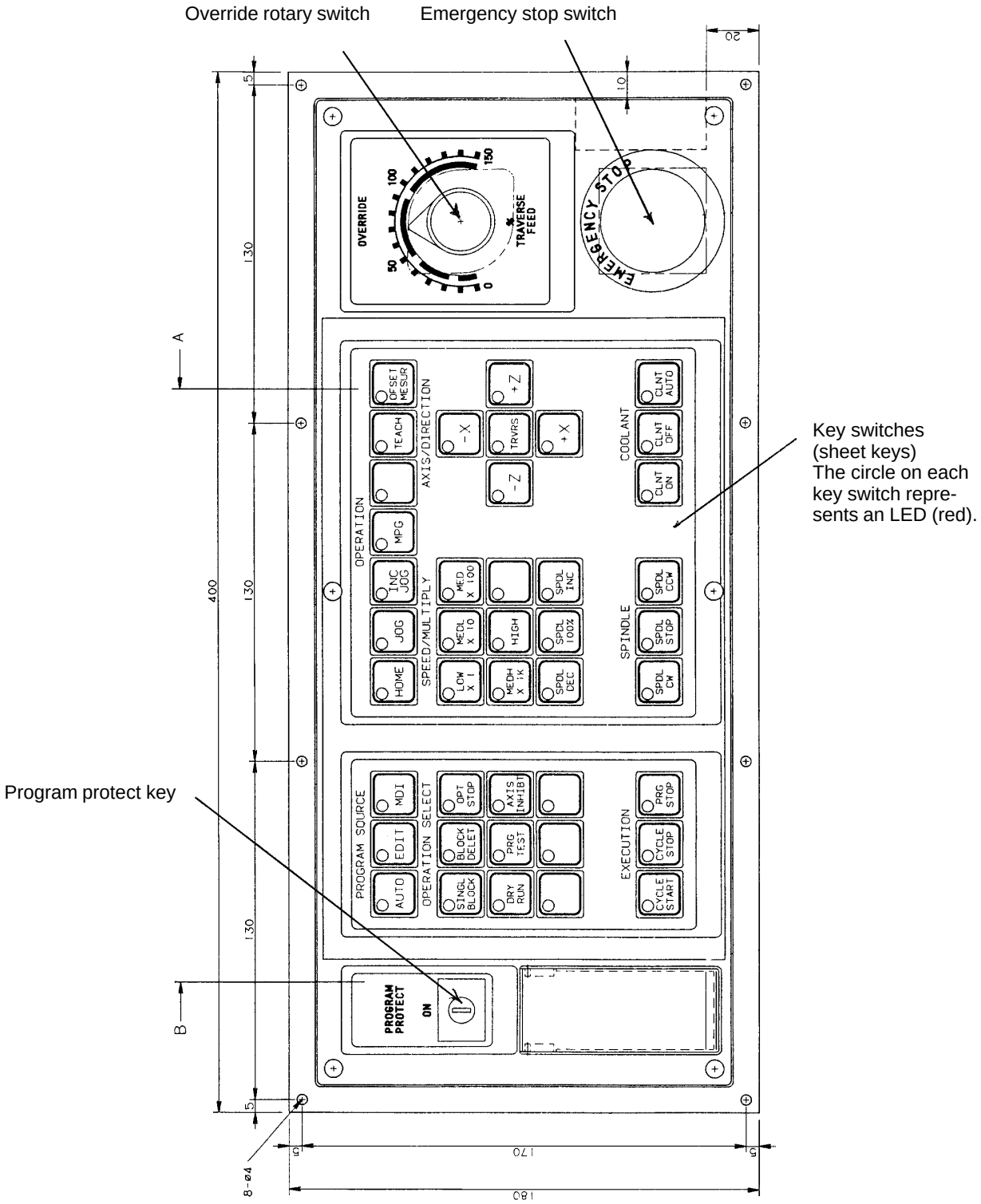


Fig. 10.12.15 (a) Front view of machine operator's panel for small unit (T series)

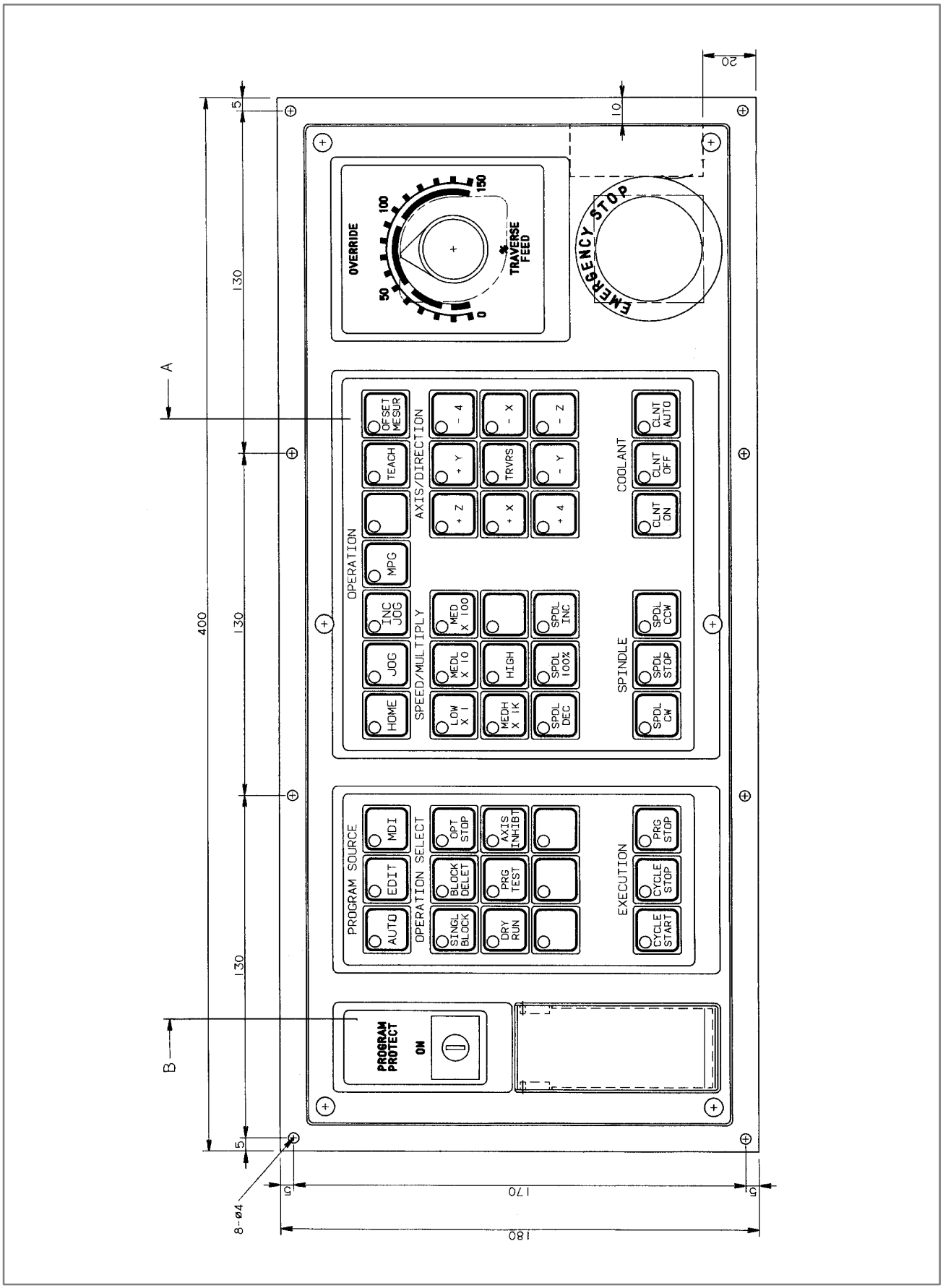


Fig. 10.12.15 (b) Front view of machine operator's panel for small unit (M series)

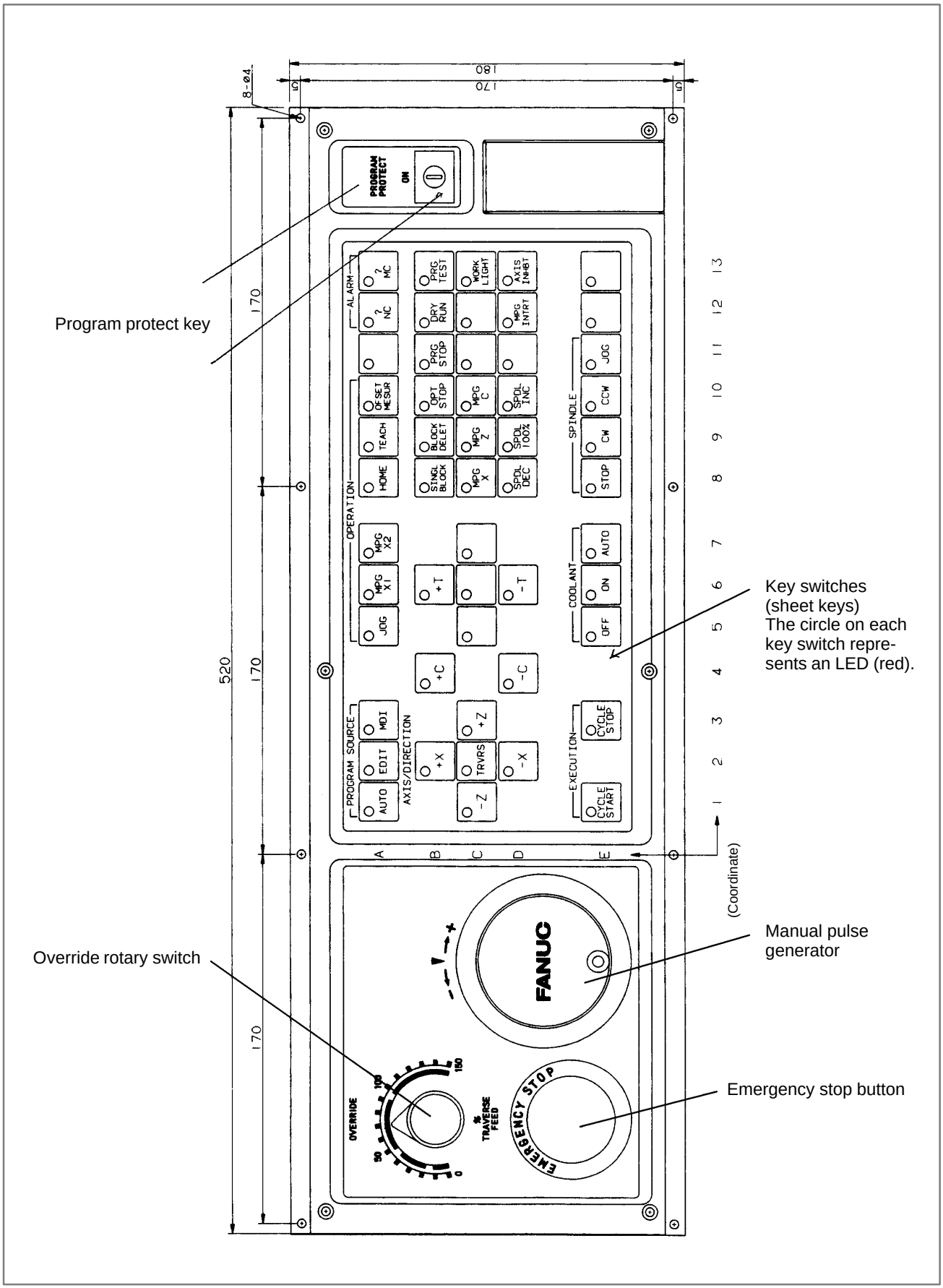


Fig. 10.12.15 (c) Front view of machine operator's panel for standard unit (T series)

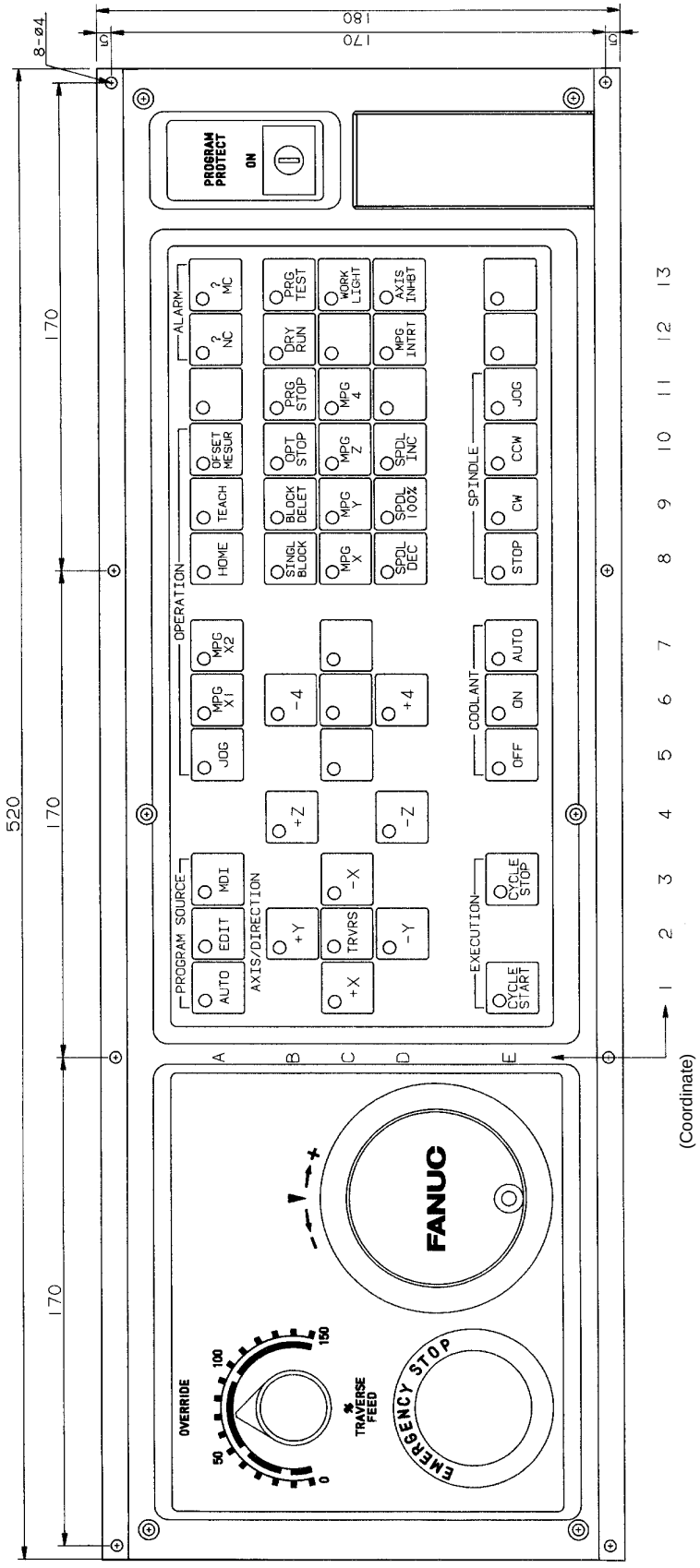
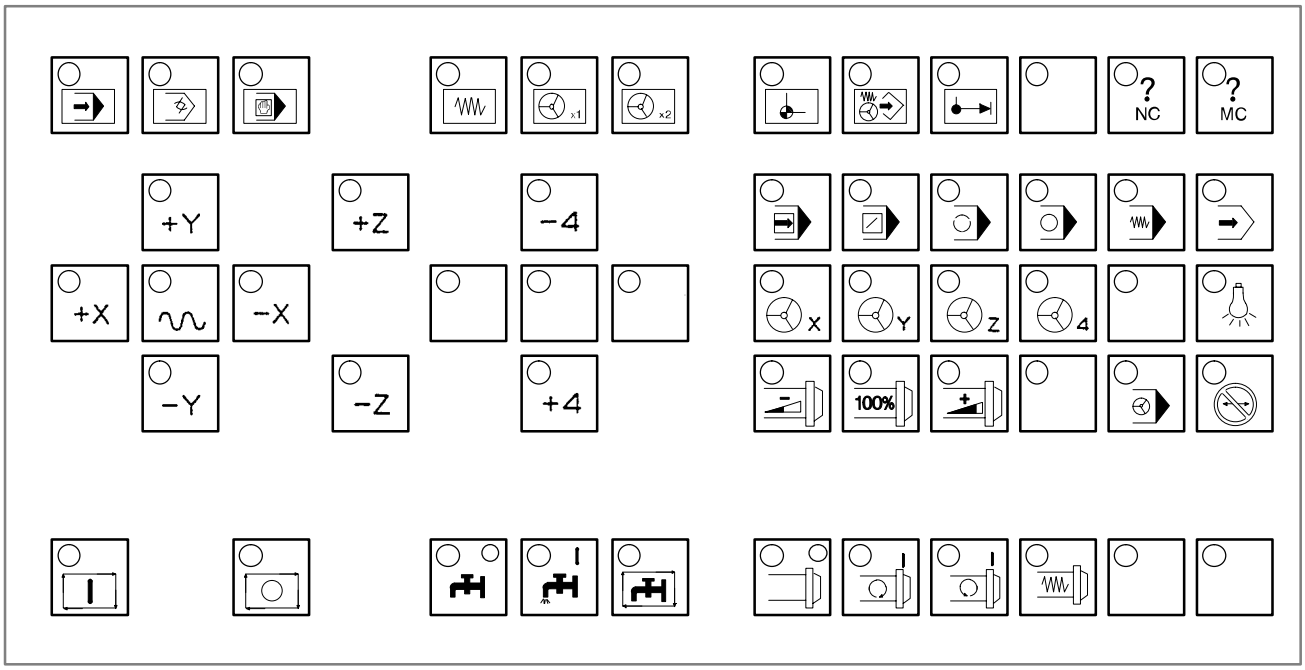


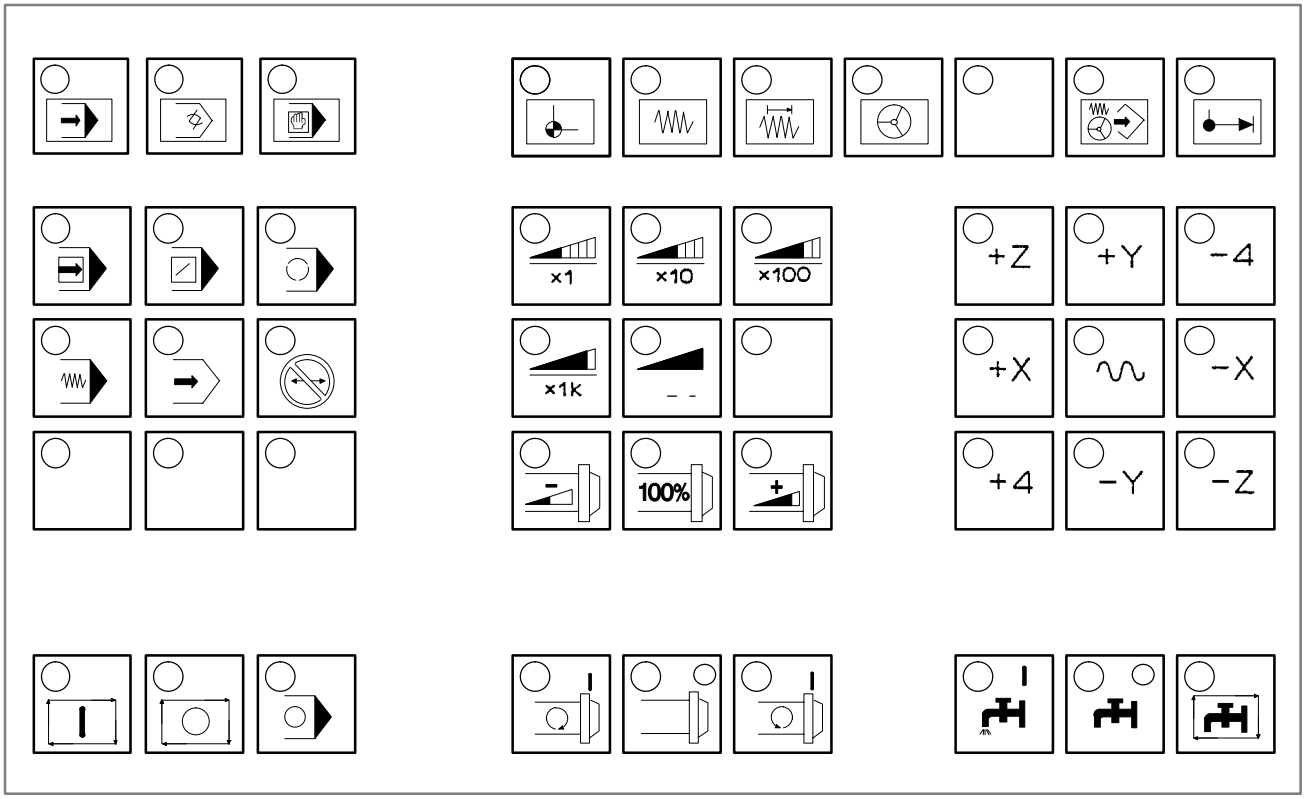
Fig. 10.12.15 (d) Front view of machine operator's panel for standard unit (M series)

- **Symbol indication on machine operator's panel**
  Front view of the key sheets

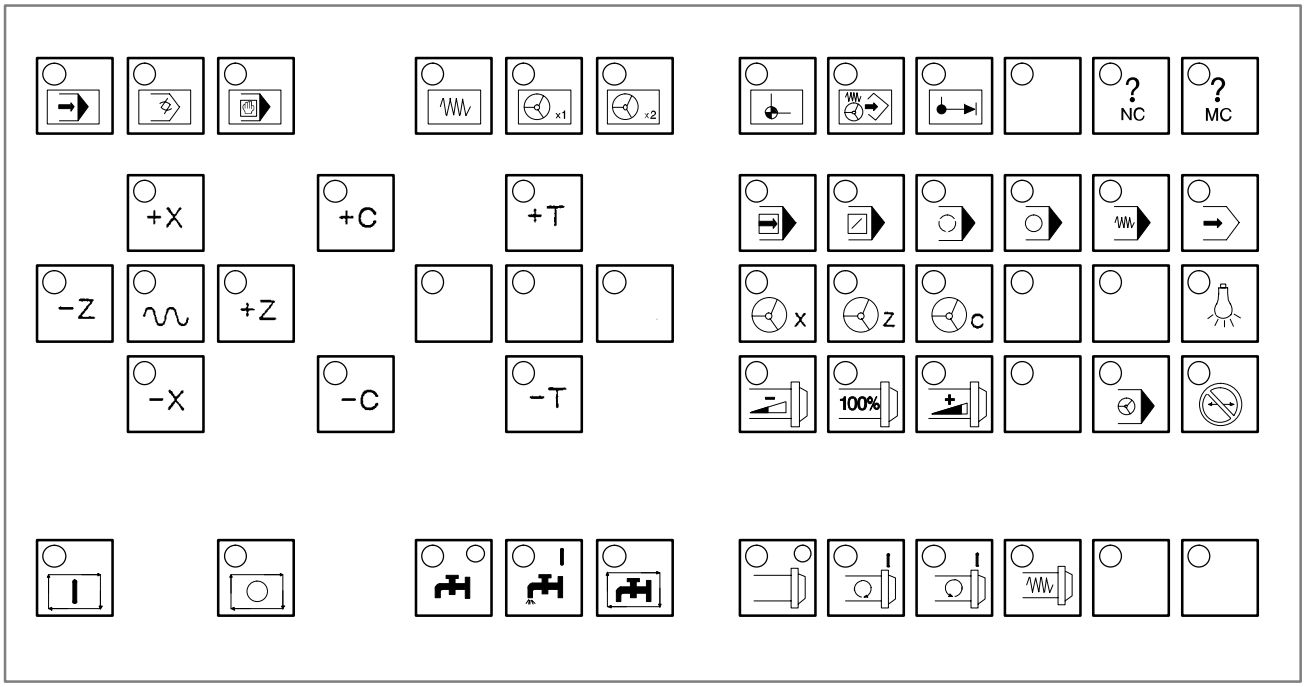
(1) M series, full keypad



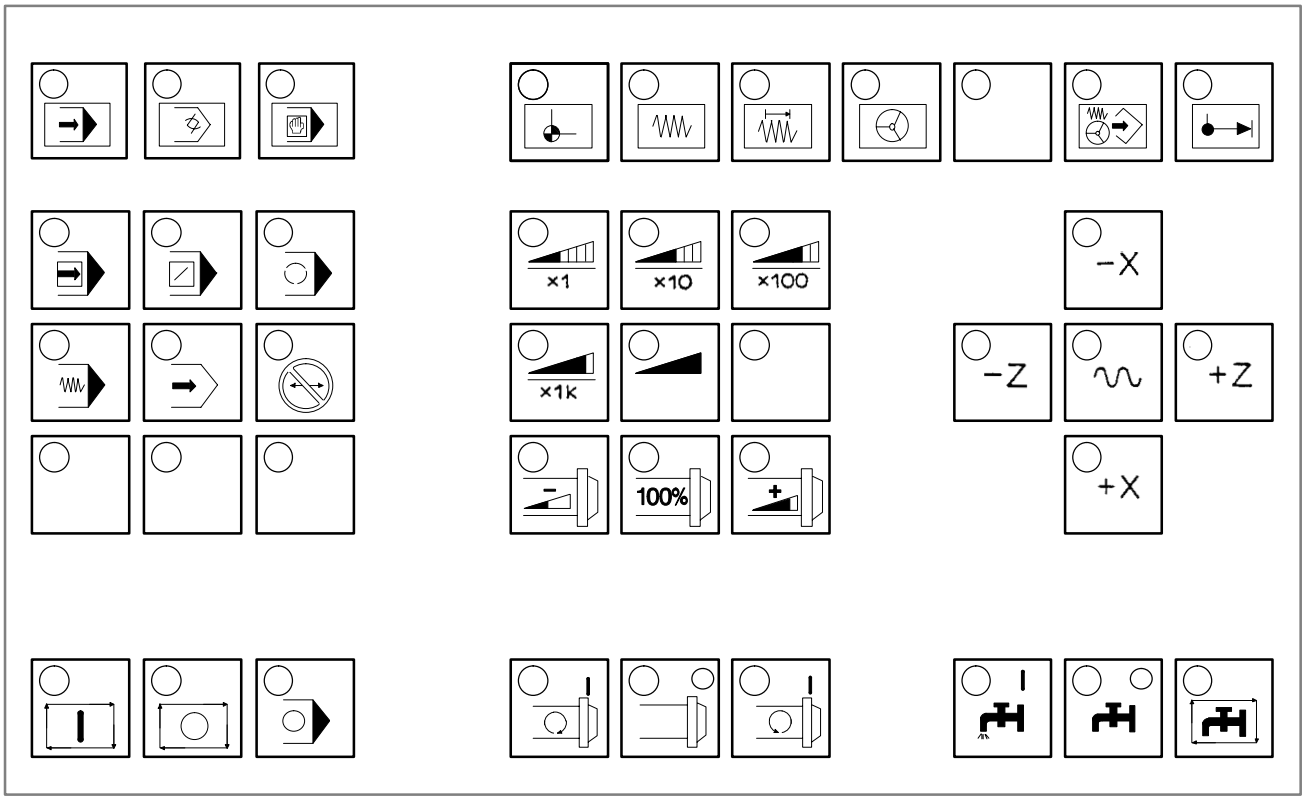
(2) M series, small keypad



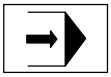
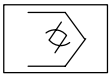
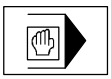
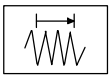
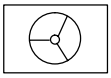
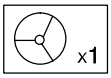
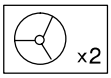
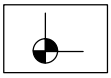
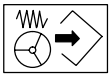
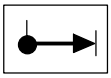
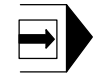
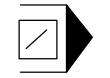
(3) T series, full keypad

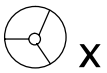
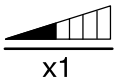
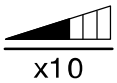
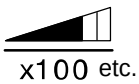
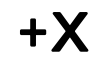


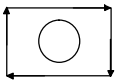
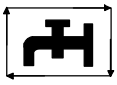
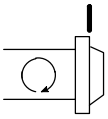
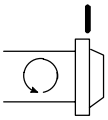
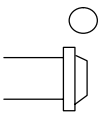
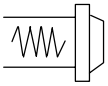
(4) T series, small keypad



- **Meanings of keys**

English indication	Symbol indication	Meaning of key
AUTO		AUTO mode selection signal: Sets automatic operation mode.
EDIT		EDIT mode selection signal: Sets program edit mode.
MDI		MDI mode selection: Sets MDI mode.
JOG		JOG feed mode selection: Sets jog feed mode.
INC JOG		Step feed mode selection: Sets step feed mode.
MPG		Manual handle feed mode selection: Sets manual handle feed mode.
MPG X1		First handle selection in manual handle feed mode: Sets manual handle feed mode, then enables the first handle.
MPG X2		Second handle selection in manual handle feed mode: Sets manual handle feed mode, then enables the second handle.
HOME		Reference position return mode selection: Sets reference position return mode.
TEACH		Teach–in jog (teach–in handle) mode selection signal: Sets teach–in jog (teach–in handle) mode.
OFSET MESUR		Offset write mode selection signal: Sets tool offset value setting mode.
? NC		NC alarm signal (output only): Turns on the LED lamp on the button when an alarm is issued on the NC.
? MC		Machine alarm signal (output only): Turns on the LED on the button when an alarm is issued on the machine.
SINGL BLOCK		Single block signal: Executes programs one by one. This key is used to check a program.
BLOCK DELET		Block delete (optional block skip): Skips the execution of the blocks starting with the first block prefixed with / and ending with the end of block (;) when this button is pressed during automatic operation.

English indication	Symbol indication	Meaning of key
PRG STOP		Program stop (output only): Turns on the LED on the button when automatic operation is stopped by M00 specified in the program.
OPT STOP		Optional stop: Stops automatic operation after execution of the block of a program where M01 is specified, when this button is pressed.
DRY RUN		Dry run: Sets the axis feedrate to the jog feedrate instead of a programmed feedrate when automatic operation is performed by setting this button to on. This function is used to check only the movement of the tool when no workpiece is mounted.
PRG TEST		Machine lock: Updates only position display on the screen without making any axis movement, when automatic operation is performed by setting this button to on. This function is used to check a program.
MPG X		Manual handle feed X–axis selection: Performs movement along the X–axis when this button is set to on in manual handle feed mode. (The same operation is performed for the Y–axis, Z–axis, C–axis, and four axes).
WORK LIGHT		Workpiece light: Illuminates the workpiece.
MPG INTRT		Manual handle interrupt: Adds the amount of travel made by turning the manual handle to the amount of travel specified in the program, when this button is set to on in manual operation.
AXIS INHBT		Axis movement inhibition: Inhibits movement on a particular axis or all axes.
LOW X1 MEDL X10 MED X100	  	Upper) Jog feed (step feed) override: Overrides jog feed (or step feed). Five–step indication Lower) Manual handle feed magnification: Magnification for manual handle feed. Magnified by 1, 10, 100, 1000.
+X		Manual feed axis direction selection: Performs movement along the selected axis in the selected direction by jog feed (or step feed) when this button is set to on in the jog feed mode (or step feed mode). (The same operation is performed for –X, +Y, –Y, +Z, and so forth.)
TRVRS		Traverse: Performs jog feed at rapid traverse rate when this button is set to on.

English indication	Symbol indication	Meaning of key
CYCLE START		Cycle start: Starts automatic operation.
CYCLE STOP		Cycle stop: Stops automatic operation.
CLNT ON		Coolant on: Start the supply of coolant.
CLNT OFF		Coolant off: Stops the supply of coolant.
CLNT AUTO		Coolant automatic: Starts and stops the supply of coolant automatically.
SPDL 100%		Spindle override 100%: Sets an override of 100% for the spindle motor speed.
SPDL DEC		Spindle deceleration: Decelerates the spindle motor rotation.
SPDL INC		Spindle acceleration: Accelerates the spindle motor rotation.
SPDL CW		Positive spindle rotation direction: Rotates the spindle motor in the positive direction.
SPDL CCW		Negative spindle rotation direction: Rotates the spindle motor in the negative direction.
SPDL STOP		Spindle stop: Stops the spindle motor rotation.
SPDL JOG		Manual spindle feed: Rotates the spindle motor manually.

11 EMERGENCY STOP SIGNAL

WARNING

Using the emergency stop signal effectively enables the design of safe machine tools.
The emergency stop signal is provided to bring a machine tool to an emergency stop. It is input to the CNC controller, servo amplifier, and spindle amplifier. An emergency stop signal is usually generated by closing the B contact of a pushbutton switch.
When the emergency stop signal (*ESP) contact is closed, the CNC controller enters the emergency stop released state, such that the servo and spindle motors can be controlled and operated.
When the emergency stop signal (*ESP) contact opens, the CNC controller is reset and enters the emergency stop state, and the servo and spindle motors are decelerated to a stop.
Shutting off the servo amplifier power causes a dynamic brake to be applied to the servo motor. Even when a dynamic brake is applied, however, a servo motor attached to a vertical axis can move under the force of gravity. To overcome this problem, use a servo motor with a brake.
While the spindle motor is running, shutting off the motor–driving power to the spindle amplifier allows the spindle motor to continue running under its own inertia, which is quite dangerous. When the emergency stop signal (*ESP) contact opens, it is necessary to confirm that the spindle motor has been decelerated to a stop, before the spindle motor power is shut off.
The FANUC servo amplifier α series products are designed to satisfy the above requirements. The emergency stop signal should be input to the power supply module (called the PSM). The PSM outputs a motor power MCC control signal, which can be used to switch the power applied to the power supply module on and off.
The CNC controller is designed to detect overtravel by using a software limit function. Normally, no hardware limit switch is required to detect overtravel. If the machine goes beyond a software limit because of a servo feedback failure, however, it is necessary to provide a stroke end limit switch, connected so that the emergency stop signal can be used to stop the machine.
Fig. 11 shows an example showing how to use the emergency stop signal with this CNC controller and α series control amplifier.

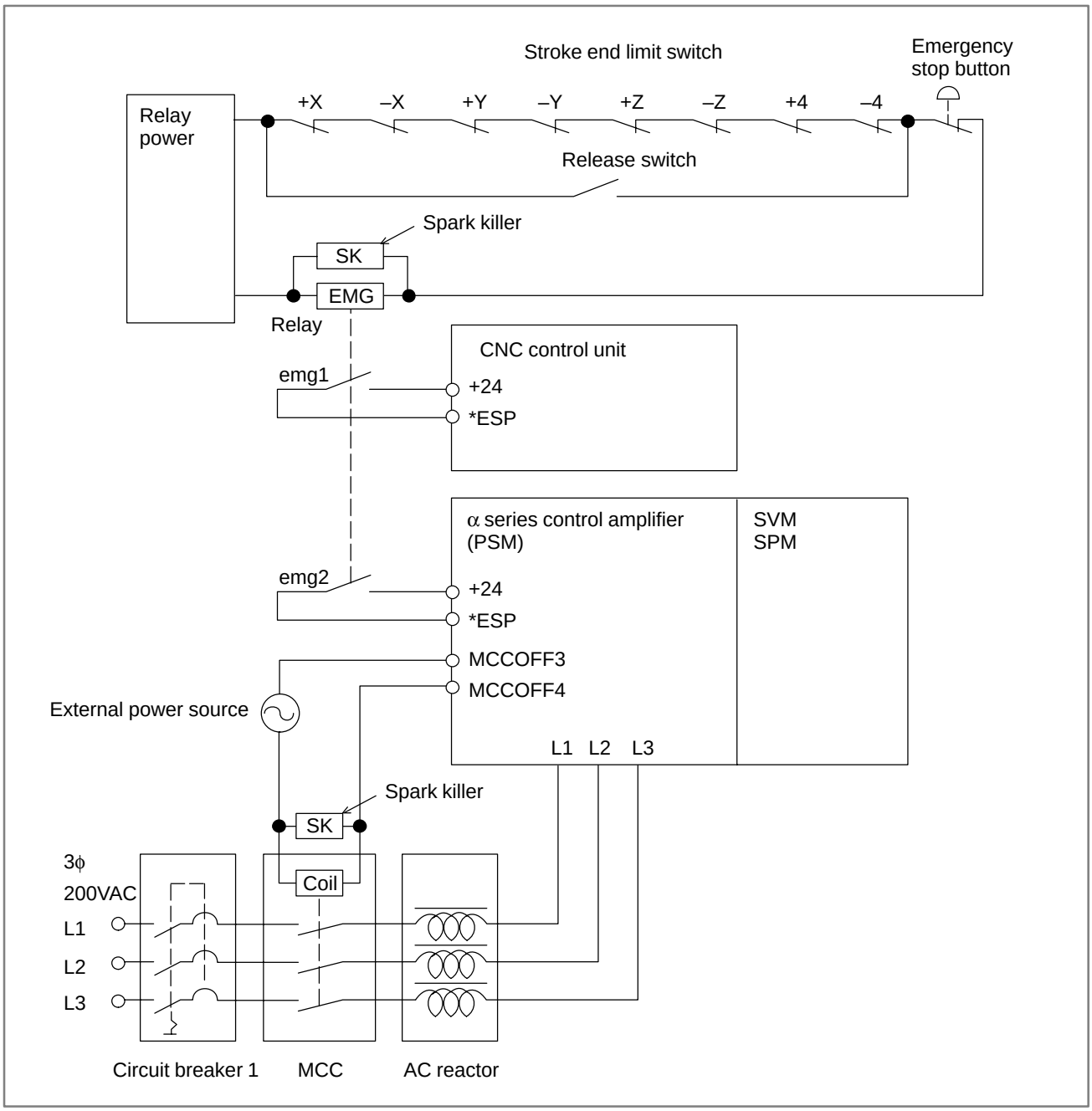


Fig. 11

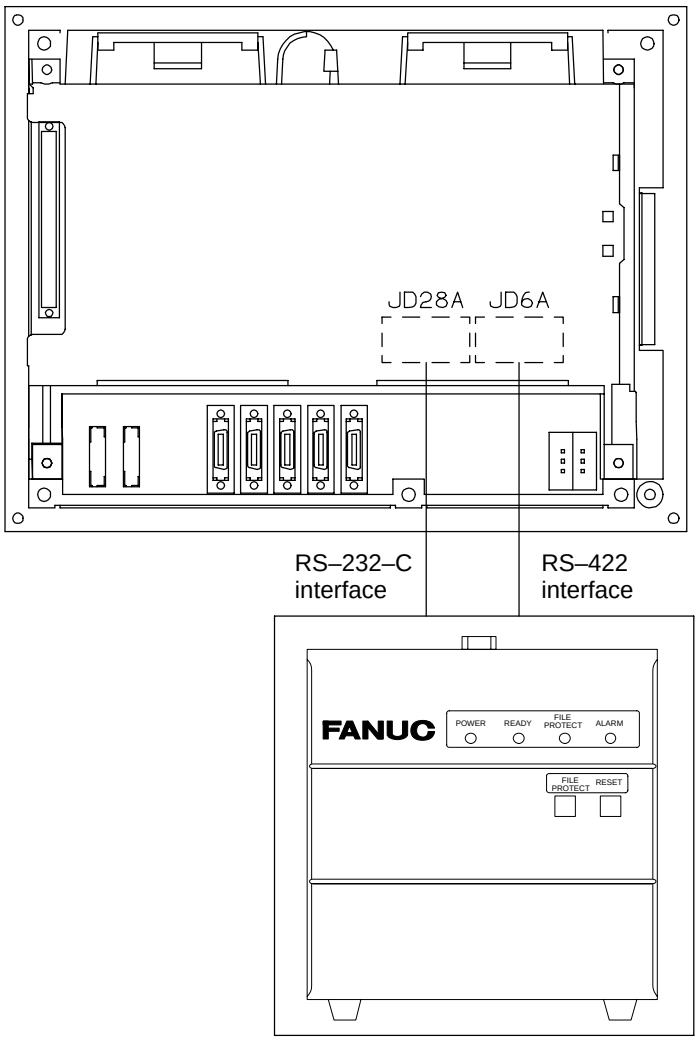
WARNING

To use a spindle motor and amplifier produced by a manufacturer other than FANUC, refer to the corresponding documentation as well as this manual. Design the emergency stop sequence such that, if the emergency stop signal contact opens while the spindle motor is rotating, the spindle motor is decelerated until it stops.

12 REMOTE BUFFER INTERFACE (INCLUDING FANUC DNC1 AND DNC2)

12.1 GENERAL

When the remote buffer is connected to the host computer or input/output device via serial interface, a great amount of data can be sent to CNC consecutively at a high speed.



Use either the RS–232–C or RS–422 interface.
(Case of Remote Buffer)

The remote buffer enables the following operations:

- When connected to the host computer online, it performs DNC operation with high reliability and at a high speed.
- The CNC program and parameters can be down–loaded from the host computer.
- When connected to an input/output device, it enables DNC operation, and various data can be down–loaded. The following input/output devices can be connected.
  - ❑ FANUC PPR
  - ❑ FANUC FA Card
  - ❑ FANUC FLOPPY CASSETTE
  - ❑ FANUC PROGRAM FILE Mate
  - ❑ FANUC Handy File

  Hereafter, the device to which the remote buffer is connected is called the host computer.

Explanations

- **Interface between the remote buffer and host computer**

❑ Electrical interface

The following two types of interface are prepared as standard specifications.

- RS–232–C Interface
- RS–422 Interface

	RS–233C	RS–422
Interface	Serial voltage interface (start–stop)	Balanced transmission serial interface (start–stop)
Baud rate	50 to 19,200 BPS	50 to 86,400 BPS (*)
Cable length	100m (4800BPS or less) 50m (9600BPS) Varies according to I/O device.	Approx. 800 m (9600 BPS or less) 50m (19,200 BPS or more)

❑ Software interface

The following three protocols are prepared as the communication protocols between the remote buffer and host computer. The protocol can be selected by a parameter according to the specifications of the device to be connected.

Protocol	Features	Interface	Maximum transfer rate
Protocol A	Handshake method. Sending and receiving are repeated between two stations.	RS–232–C	19200 BPS
		RS–422	86400 BPS
Extended protocol A	Similar to protocol A. Enables high–speed transfer of the NC program to meet high–speed DNC operation.	RS–422	86400 BPS
Protocol B	Controls communication with control codes output from the remote buffer.	RS–232–C	19200 BPS
		RS–422	86400 BPS

NOTE
(*) The average data transfer rate is lower than the maximum transfer rate.

FANUC DNC2 is a communication protocol that provides an RS–232–C interface between the CNC and a personal computer (PC). This interface enables the CNC and PC to exchange data with each other. The hardware used to connect the CNC and PC is the same as that used for remote buffer connection.

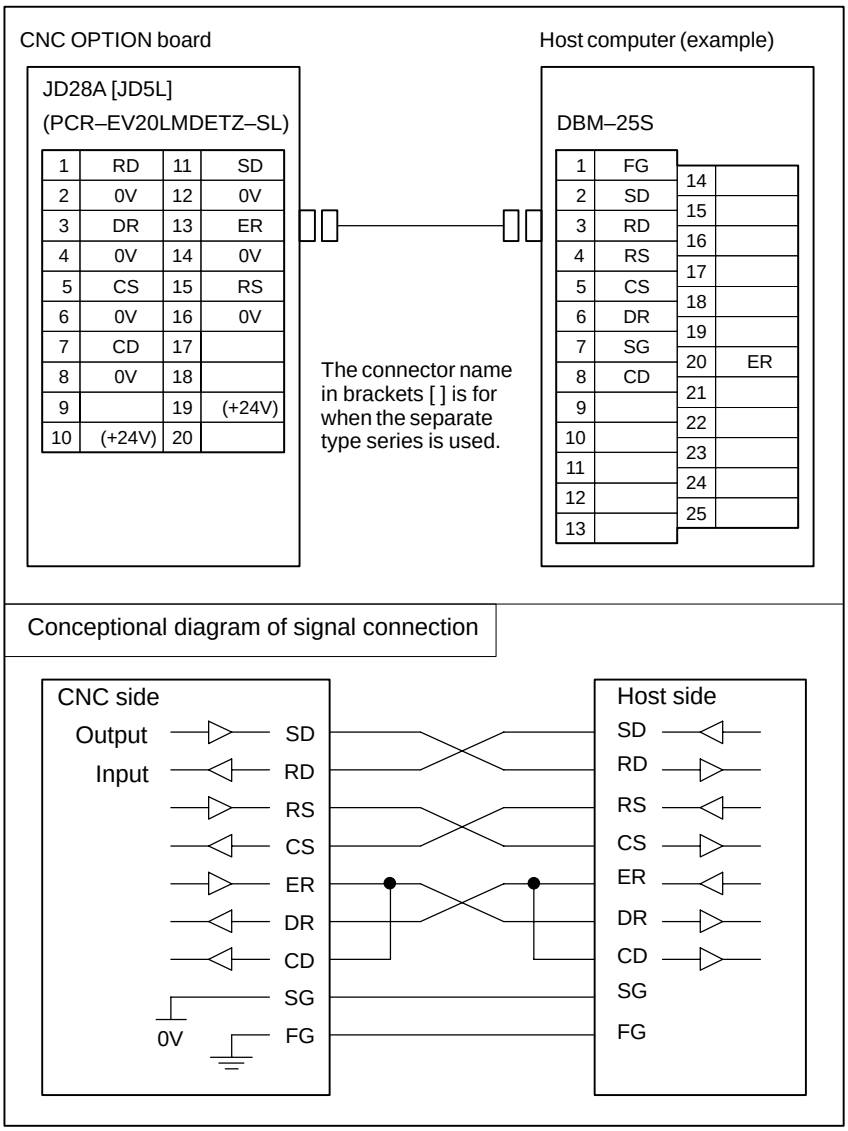
For information about the specifications and other details of FANUC DNC2, refer to “FANUC DNC2 Description (B–61992E).”

FANUC DNC1, developed by FANUC, is a high–speed network supporting cell–based communication.

The hardware connection and other specifications of the DNC1 function are explained. When using DNC1, refer to the following document.

Title	Number
FANUC DNC1 Description	B–61782E

12.2 REMOTE BUFFER INTERFACE (RS–232–C)

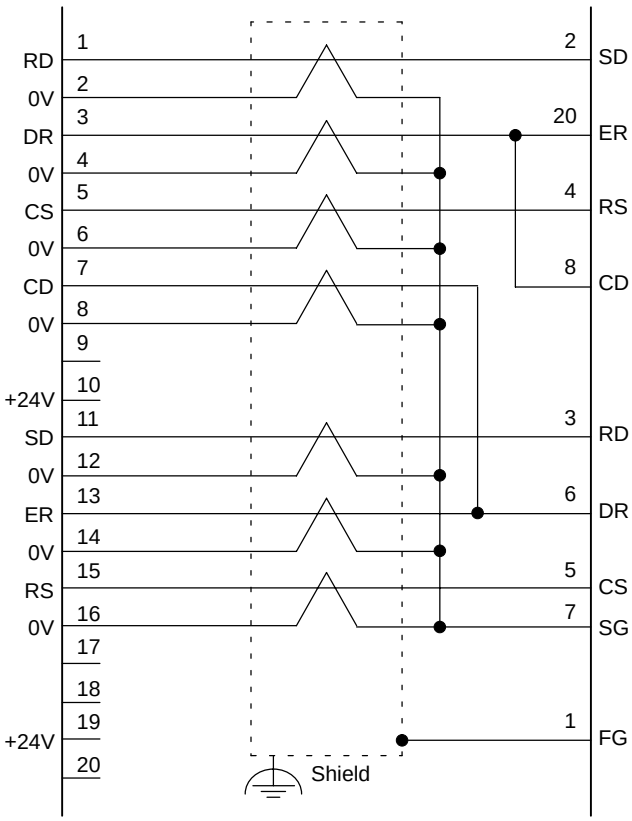


NOTE

1 24V power supply of the equipment made by FANUC RS–232–C is not prepared in CNC side connector JD28A or JD5L. Set up the power supply by the machine tool builder if it is necessary. No.10 and No.19 (+24V) cannot be used. Do not connect to these pins.

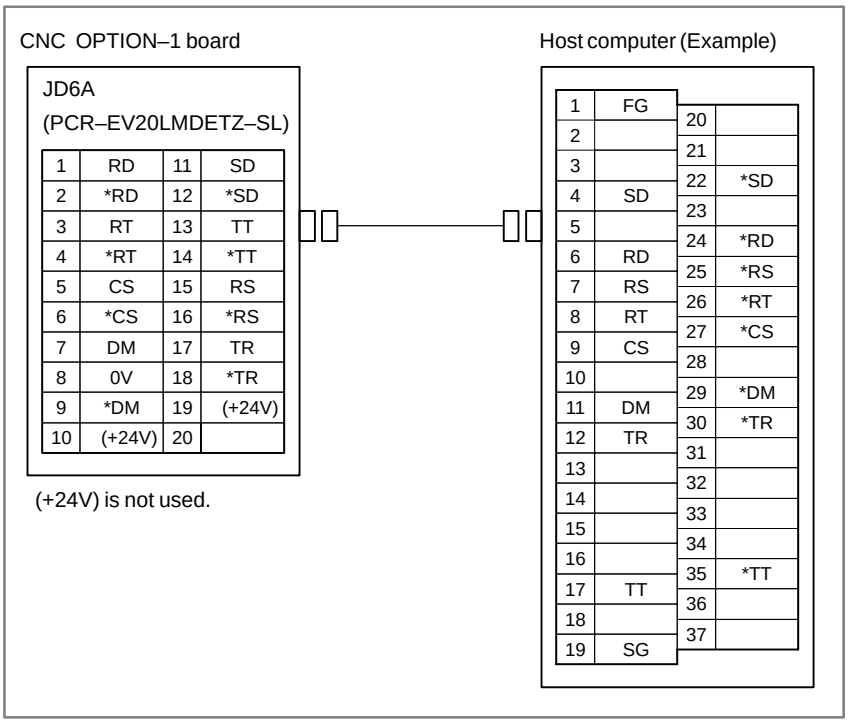
2 Do not connect to any pins not marked with a signal name.

Cable wiring



Connect CS to RS if CS is not used. However, when protocol A or expanded protocol A is used, connect as shown above because CS is used for busy control. Connect DR to ER when DR is not used. Be sure to connect CD to ER.

12.3 REMOTE BUFFER INTERFACE (RS–422)

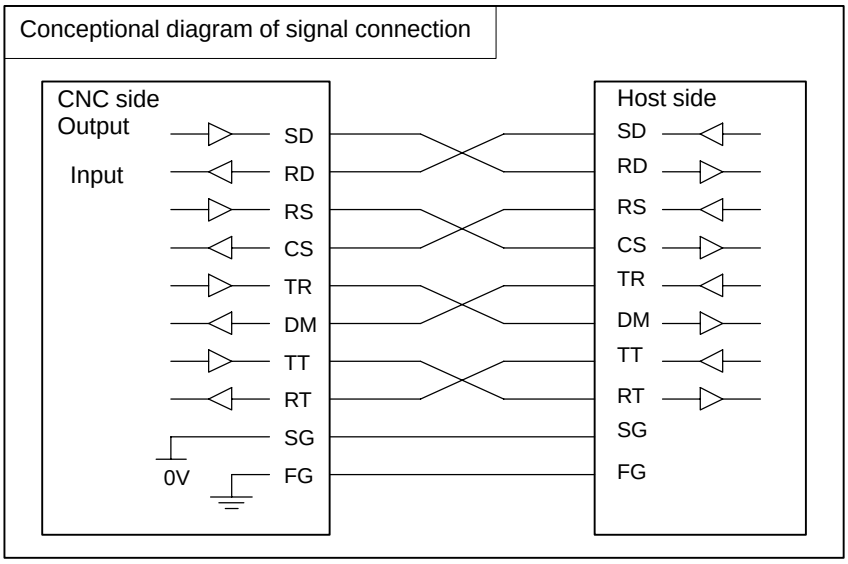


1	RD	11	SD
2	*RD	12	*SD
3	RT	13	TT
4	*RT	14	*TT
5	CS	15	RS
6	*CS	16	*RS
7	DM	17	TR
8	0V	18	*TR
9	*DM	19	(+24V)
10	(+24V)	20	

1	FG	20	
2		21	
3		22	*SD
4	SD	23	
5		24	*RD
6	RD	25	*RS
7	RS	26	*RT
8	RT	27	*CS
9	CS	28	
10		29	*DM
11	DM	30	*TR
12	TR	31	
13		32	
14		33	
15		34	
16		35	*TT
17	TT	36	
18		37	
19	SG		

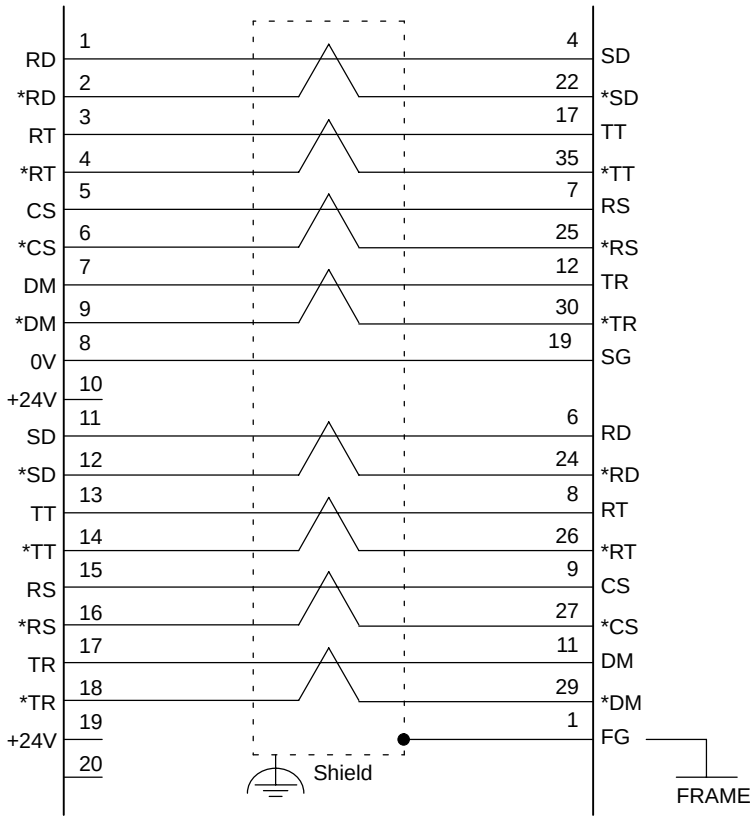
Conceptional diagram of signal connection

The figure below shows a signal connection between CNC and a host computer. Since signals other than FG and SG perform differential signal transmission, two wires of signal lines are used for those signals.



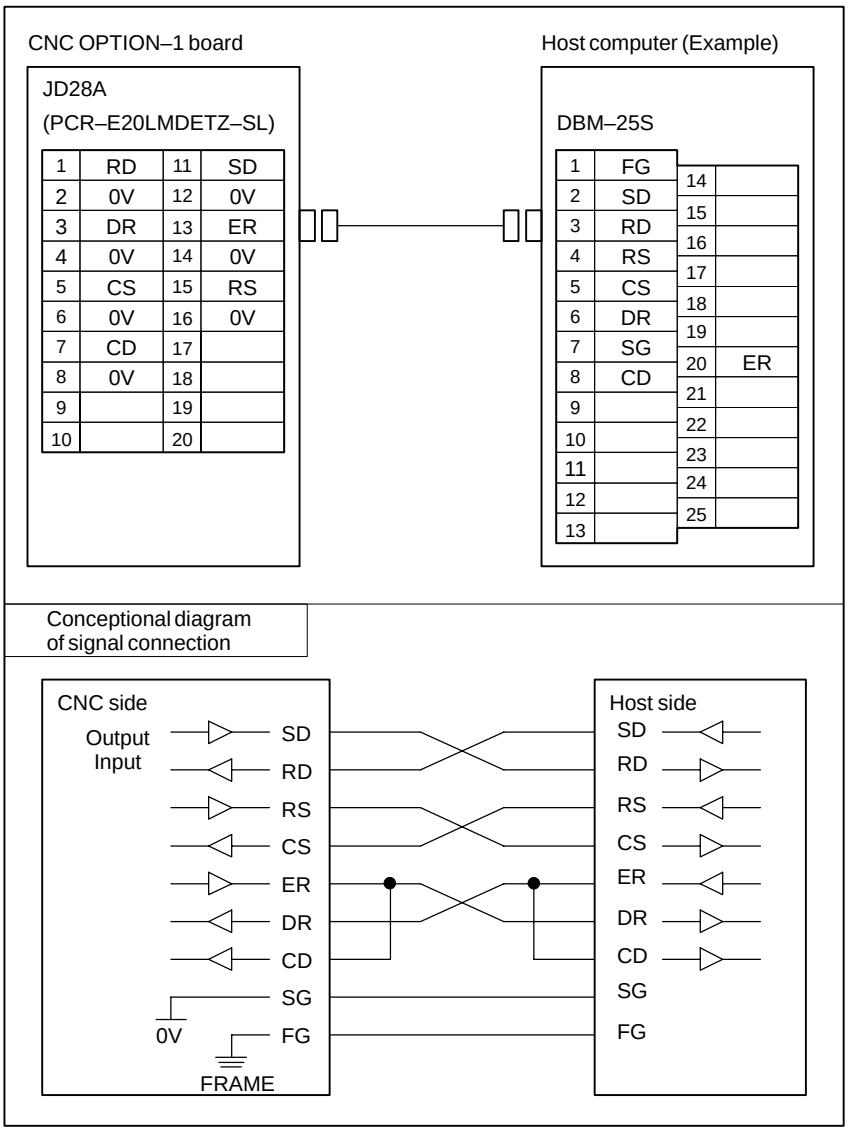
Actual example of RS–422 signal wiring

Cable wiring



NOTE
1 Be sure to use twisted pair cable.
2 Note that the pin position of the *DM signal on the CNC side is positioned irregularly relative to the other signals. This is to reduce the risk of damage to the circuit when this connector is erroneously connected to the connector on the other side.

12.4 DNC2 INTERFACE (RS–232–C)

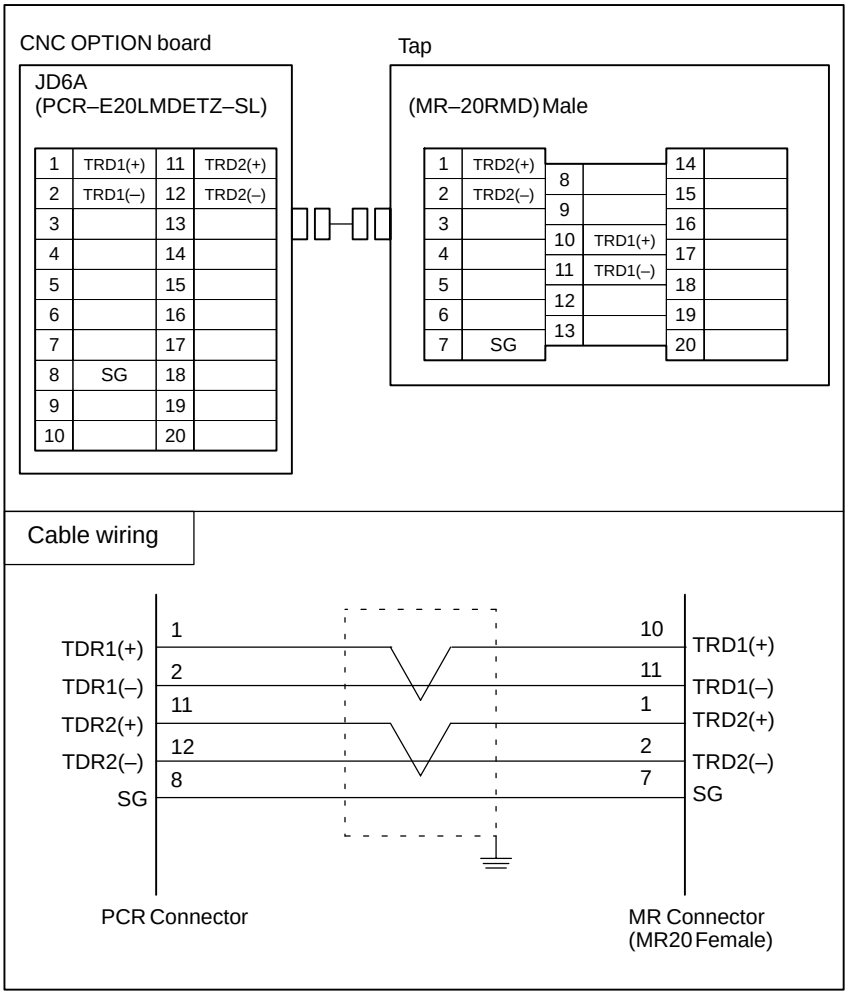


Connect CS to RS when CS is not used.
Connect DR to ER when DR is not used.
Always connect CD to ER.

NOTE
When an IBM PC/AT is used, the RS signal goes low in the reception phase. In this case, connect CS on the host side to ER on the same side.

12.5 DNC1 INTERFACE

12.5.1 Multipoint Connection



12.5.2 Point–to–point Connection

CNC OPTION board

JD6A
(PCR–E20LMDETZ–SL)

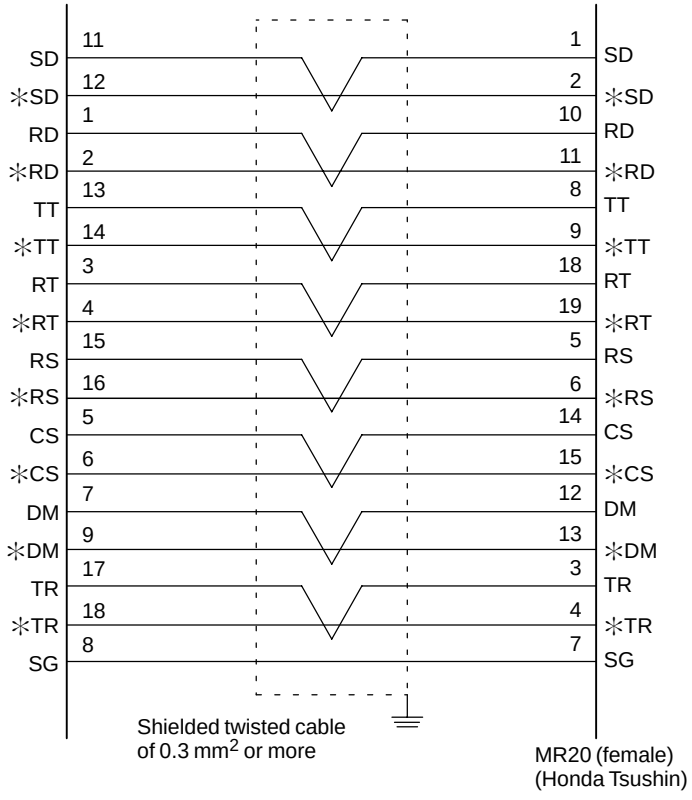
1	RD	11	SD
2	∗RD	12	∗SD
3	RT	13	TT
4	∗RT	14	∗TT
5	CS	15	RS
6	∗CS	16	∗RS
7	DM	17	TR
8	SG	18	∗TR
9	∗DM	19	
10		20	

Tap

(MR–20RMD) Male

1	SD	8	TT	14	CS
2	∗SD	9	∗TT	15	∗CS
3	TR	10	RD	16	
4	∗TR	11	∗RD	17	
5	RS	12	DM	18	RT
6	∗RS	13	∗DM	19	∗RT
7	SG			20	

Cable wiring



13 HIGH–SPEED SERIAL BUS (HSSB)

13.1 OVERVIEW

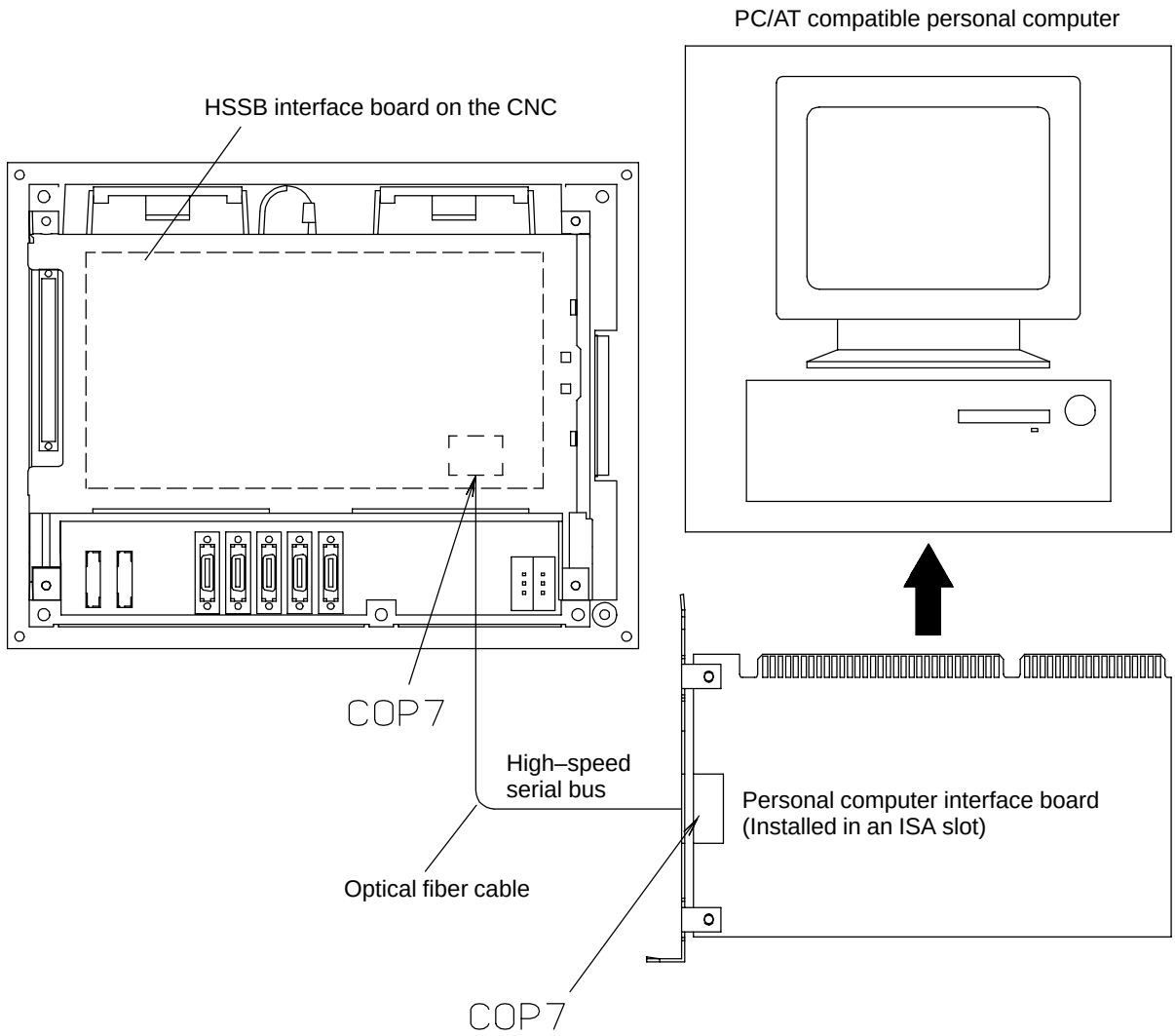
The high–speed serial bus (HSSB) enables the high–speed transfer of large amounts of data between a commercially available IBM PC or compatible personal computer and a CNC, by connecting them via a high–speed optical fiber.
On the CNC, the HSSB interface board is installed in a minislot. On the personal computer, an appropriate interface board is installed.

13.2 CAUTIONS

The use of the HSSB requires an IBM PC/AT compatible computer or FANUC intelligent terminal. The machine tool builder or end user is required to procure and maintain the personal computer.
To enable the use of the HSSB, Windows 95 or Windows NT must have been installed on the personal computer.
FANUC owns the copyright for the HSSB device driver.
The software mentioned above and the contents of the related manuals may not be used or reproduced in part or whole without the prior written permission of FANUC.

NOTE
1 IBM is a registered trademark of IBM Corp. of the US.
2 Windows 95 are registered trademarks of Microsoft Corp. of the US.
3 The company and product names mentioned in this manual are trademarks or registered trademarks of the respective companies.

13.3 CONNECTION DIAGRAM



This figure is an example of connecting the I/O Link to an *i* Series CNC with a LCD–mounted type panel.

13.4 PERSONAL COMPUTER SPECIFICATION

CAUTION
1 The machine tool builder or end user is required to procure and maintain the personal computer.
2 FANUC is not liable for any problems resulting from the operation of users' personal computers, regardless of whether the operations are normal or abnormal.

(1) The personal computer interface board complies with the ISA standard. It can be used in the PC/AT and compatibles. (The CPU of the personal computer must be a 486 or better.

(2) The following address space is used to control the high–speed serial bus. This space cannot be used by other functions or extension boards.
- 16 bytes of ISA I/O space corresponding to the addresses specified with the setting switch, as explained in Section 13.6

(3) The connections between the selected personal computer and CNC controller should be tested before they are used for actual production.

(4) The personal computer interface boards require as below.

1ch	+5V, 1A
2ch	+5V, 1.5A

13.5 INSTALLATION ENVIRONMENT

(1) Personal computer interface boards

The same environmental conditions as those for the installation of the personal computer must be satisfied.

(2) CNC interface board

The same environmental conditions as those described earlier for the installation of the CNC control unit must be satisfied.

13.6 PROCEDURE FOR INSTALLING PERSONAL COMPUTER INTERFACE BOARDS

WARNING

Before starting to mount or remove a personal computer interface board, switch off the personal computer and its peripheral devices, and disconnect their power supply cables. Otherwise, there is a serious danger of electric shock.

(1) Set the I/O addresses before installing the board. Set I/O base addresses which do not overlap the I/O address areas exclusively used by the personal computer and ISA expansion board. (See the figure below.)
When using multiple personal computer interface boards, set the I/O base addresses so that those addresses do not overlap each other.

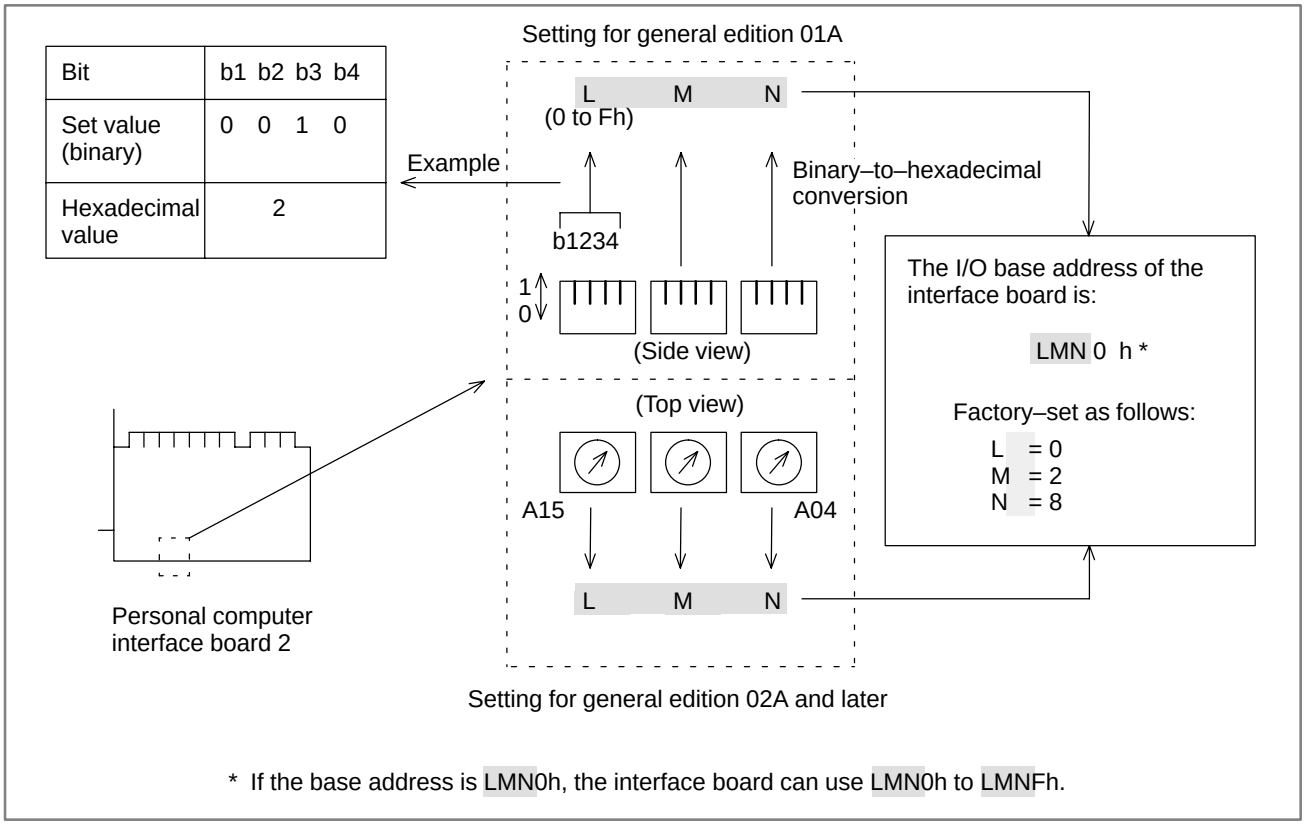
(2) Remove the blank panel from the expansion slot of the personal computer.

(3) Insert the interface board. Ensure that it has been completely inserted into the ISA connector.

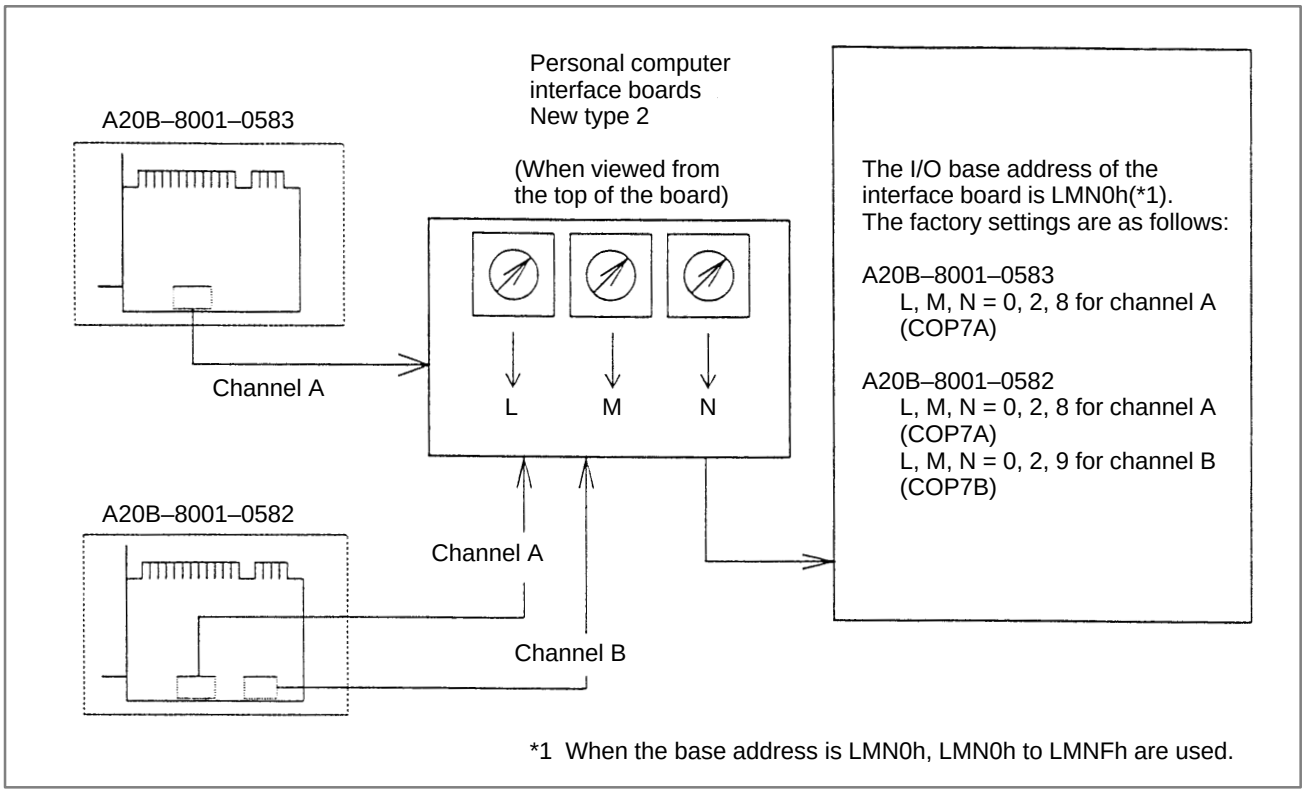
(4) Fix the metal brackets with screws.

CAUTION

Do NOT touch the edge terminals (the contacts that engage with a mating connector) of the interface board.



I/O base address setting
(for personal computer interface board type 2 (A20B–8100–0100))



I/O base address setting
(for personal computer interface board of new type 2 (A20–B–8100–0582, –0583))

13.7 HANDLING PRECAUTIONS

(1) Personal computer interface board

(A) Electrostatic interference

The personal computer interface board is shipped in an anti–static bag. To store or transport the interface board, always place it in the anti–static bag. Before removing the interface board from the anti–static bag, ground your body.

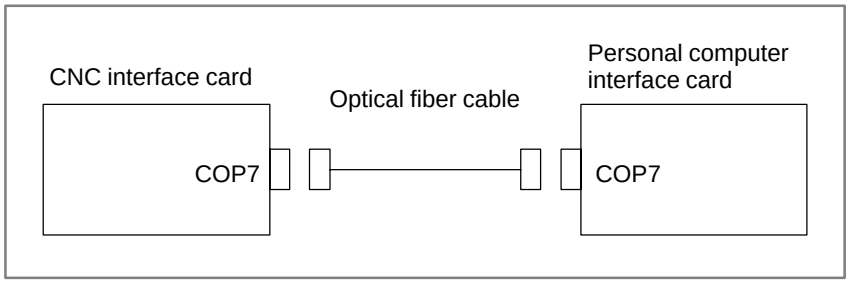
(B) Protection of card edge terminals

When handling the personal computer interface board, do NOT touch its card edge terminals (the gold–plated contacts which engage with a mating connector). If you accidentally touch any card edge terminal, wipe it gently with clean or ethyl alcohol–dipped tissue paper or absorbent cotton. Do not use any organic solvent other than ethyl alcohol.

(2) Optical connector and fiber cable

See Appendix D.

13.8 RECOMMENDED CABLES



Compatible cables (optical fiber cables, used for interconnections)

A66L–6001–0026#L

For an explanation of the cable length and other related information, see Appendix D.

NOTE

An optical fiber cable of up to 100 m can be used only when the NC side interface board A02B–0236–J202 (printed circuit board drawing number: A20B–8001–0641) is used with the personal computer interface board (A20B–8001–0582 or –0583).

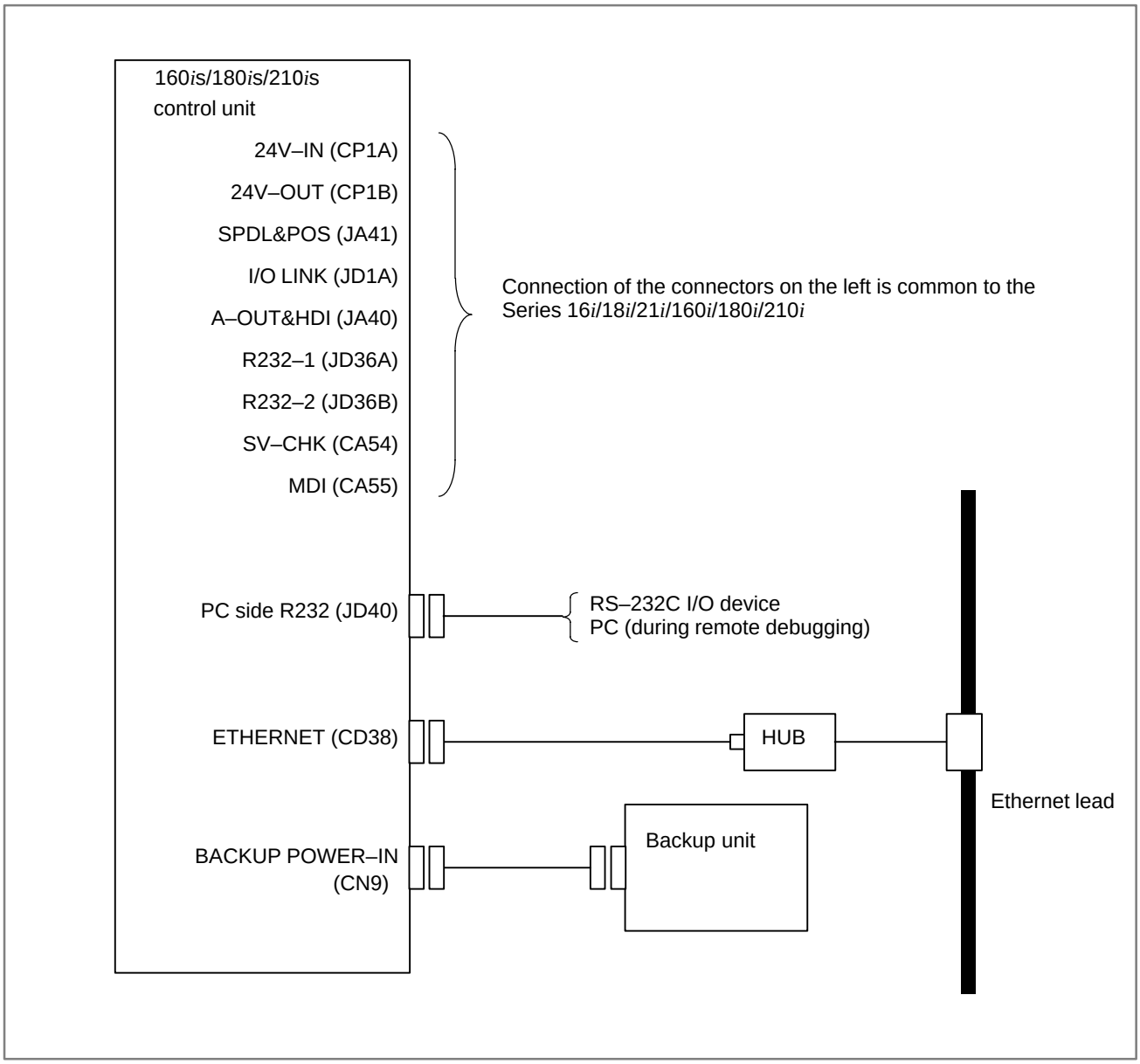
14 CONNECTION TO OTHER NETWORKS

The *i* Series CNC can be connected to the following networks. For an explanation of how to make the connection, refer to the manuals listed below:

Manual title	Manual code
FANUC I/O Link–II Connection Manual	B–62714EN
FANUC Data Server Operator's Manual	B–62694EN
FANUC Ethernet Board Operator's Manual	B–63354EN
FANUC Profibus–DP Board Operator's Manual	B–62924EN
FANUC DeviceNet Board Operator's Manual	B–63404EN

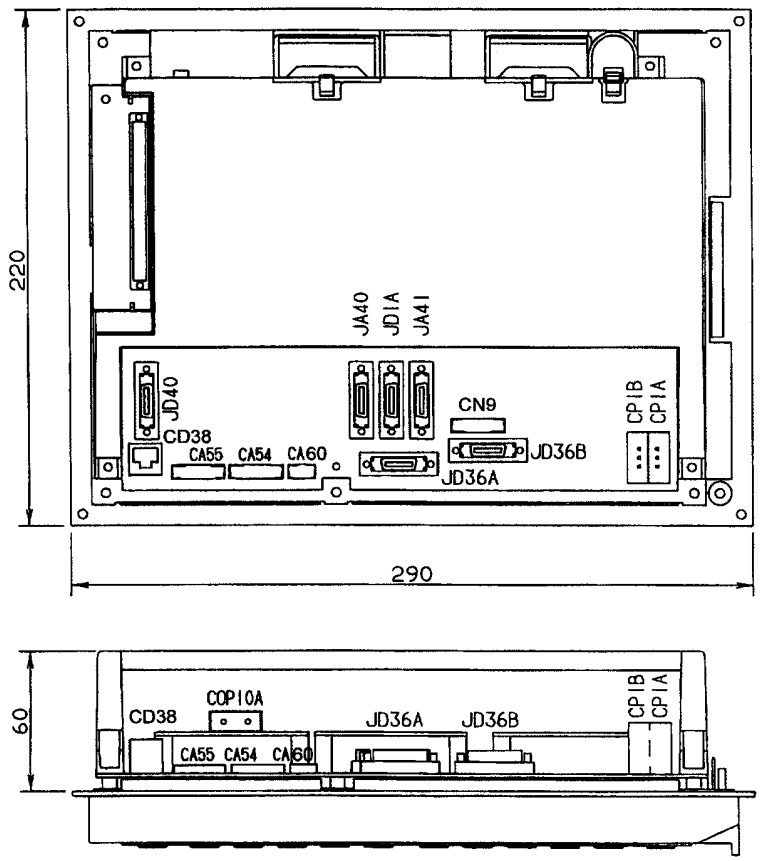
15 CONNECTING TO THE INTEGRATED TYPE Series 160*i*s/180*i*s/210*i*s

15.1 OVERALL CONNECTION DIAGRAM



15.2 INSTALLATION

15.2.1 Names of Control Unit Parts and Connector Layout



CNC control unit (rear view)
(This figure shows basic parts without option slots.)

* The depth of the unit varies according to the number of option slots.

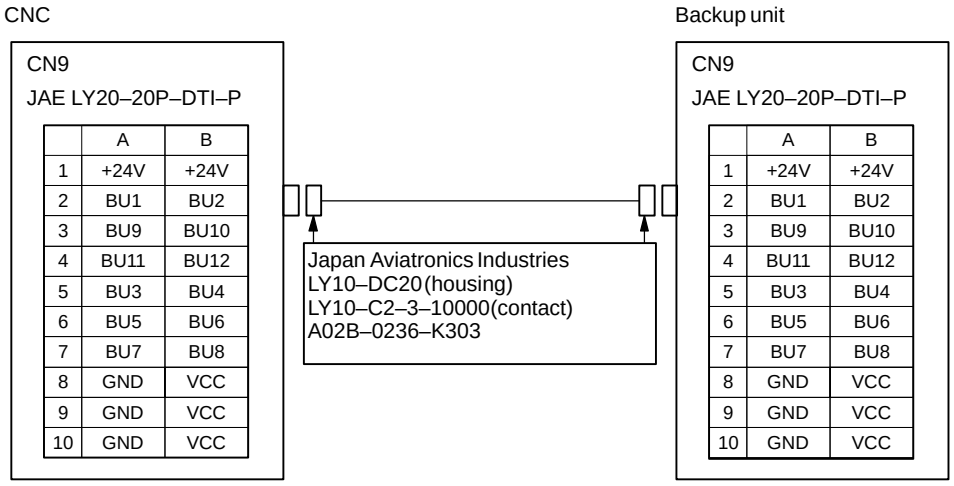
* For details on the external dimensions of the unit, refer to Appendix A “External Dimensions of Units, Figure U4.”

15.2.2 Installation Environment Conditions of Control Unit

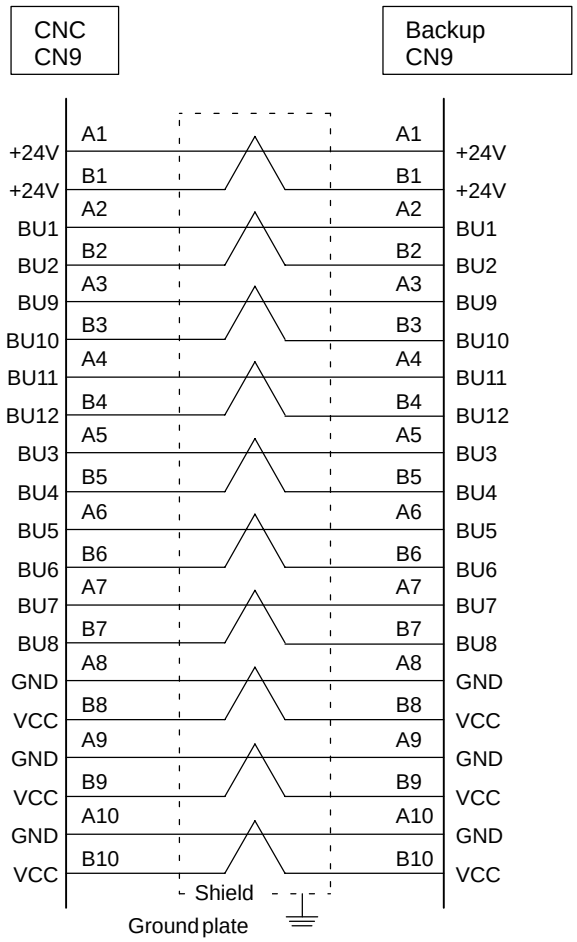
For details on the installation environment conditions, refer to the environment conditions of the displayed–integrated type control unit with PC functions.

15.3 CONNECTING TO PERIPHERAL DEVICES

15.3.1 Backup Unit



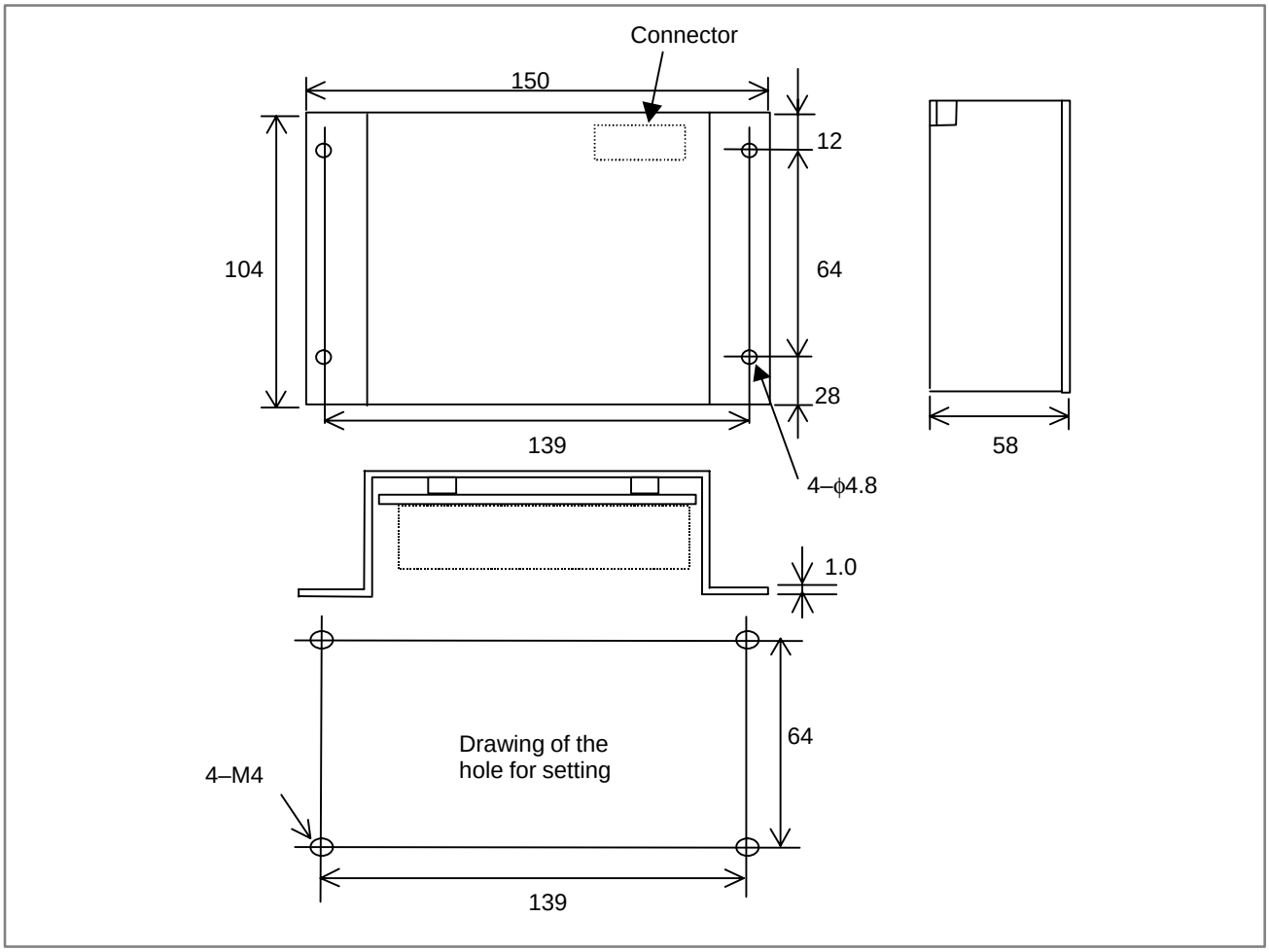
	A	B
1	+24V	+24V
2	BU1	BU2
3	BU9	BU10
4	BU11	BU12
5	BU3	BU4
6	BU5	BU6
7	BU7	BU8
8	GND	VCC
9	GND	VCC
10	GND	VCC



Recommended cable specifications:
A02B–0269–K801 (50cm)
Recommended wire material specifications:
A66L–0001–0284#10P
(#28AWGX10 pair)

Note) Keep the cable lead to within 50 cm.

(i) Backup unit external dimensions

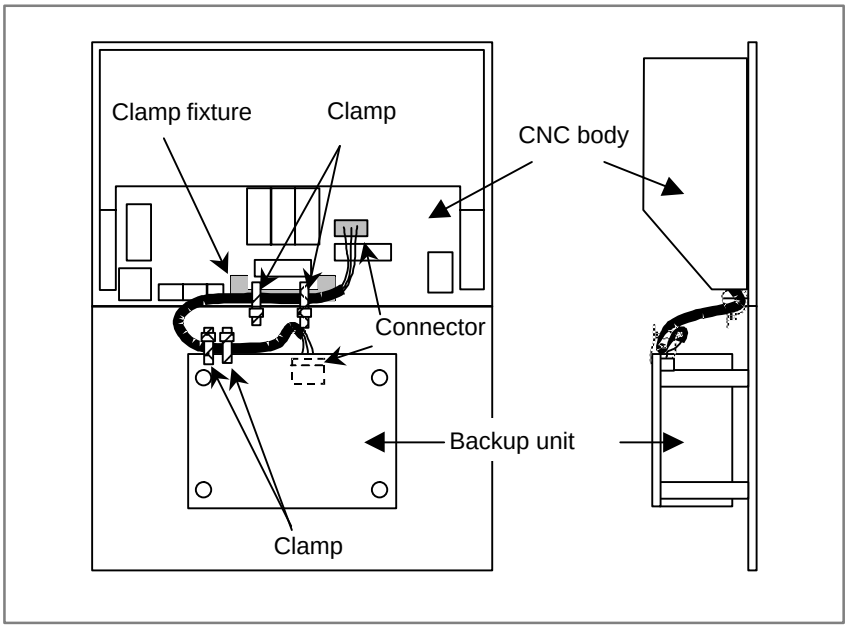


(ii) Installation of backup unit

Install the backup unit either on the rear side of the MDI unit or in the pendant box housed in the CNC body.

The backup unit uses parts that have a fixed service life. So, decide on an installation position where the backup unit can be easily replaced.

(Example of installation on rear side of MDI unit)

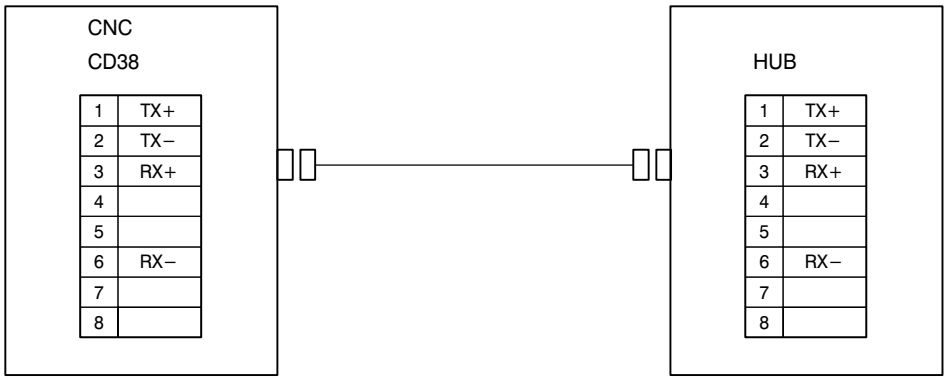


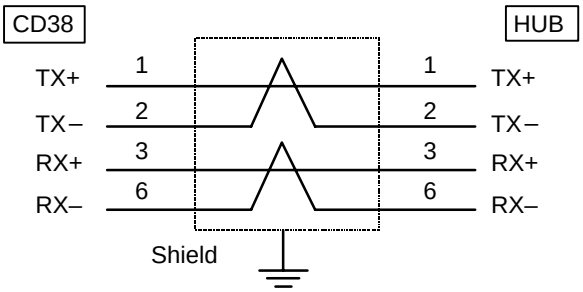
NOTE

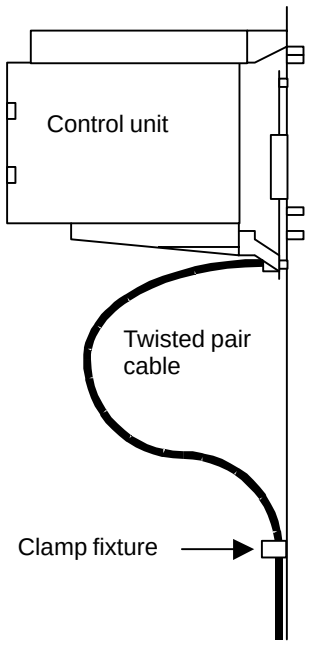
1 As the fitting on the connector of the backup unit cable is a simple lock type, be sure to clamp near to the connector as shown in the figure to prevent the connector from being tugged by the cable's weight.

2 M4 screw holes are drilled on the rear of the MDI unit for installation.

15.3.2
Ethernet (10Base–T)

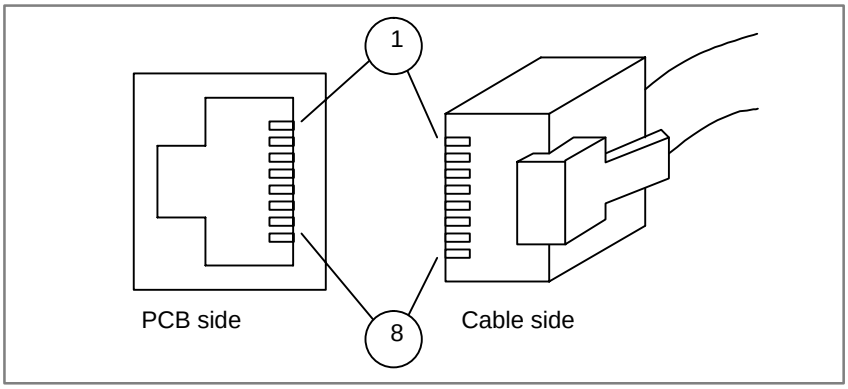






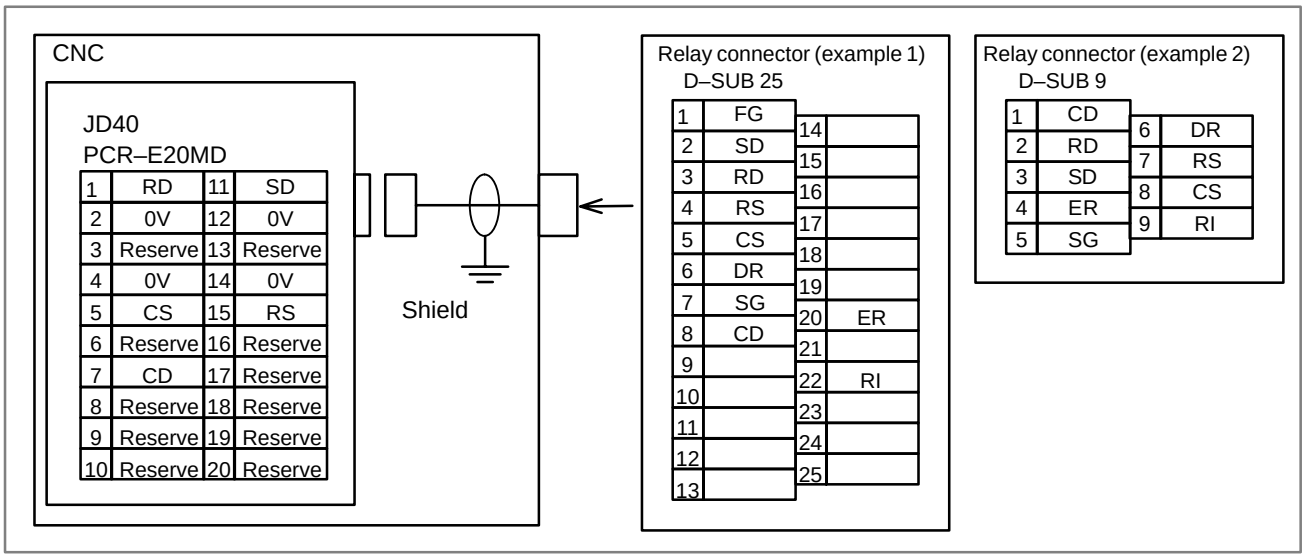
Recommended connector:
CL222–1328–1328 (for STP cable)
(Hirose Electronics Co., Ltd.) or equivalent part
Recommended wire material specifications:
DTS5087 (Furukawa Electric Industries)
F–4PFWMF (Shiroboshi Electric Co., Ltd.)

NOTE
1 Shield or clamp the Ethernet cable in the same way as other cables that are led into the CNC. For details on how to clamp the cable, refer to the top right figure.
2 The recommended cable cannot be used on moving parts.
3 The connector pin Nos. are as follows.

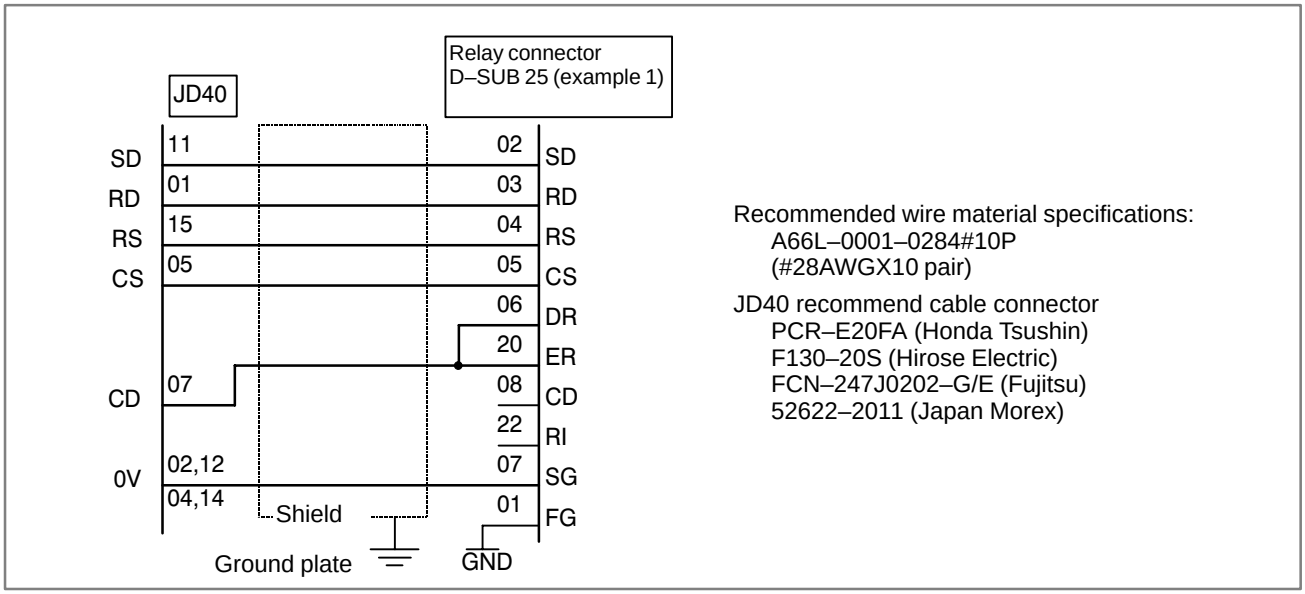


15.3.3 Serial Port

This connector (JD40) is for the RS–232C serial port on the personal computer. Use this port for remote debugging when developing application software.



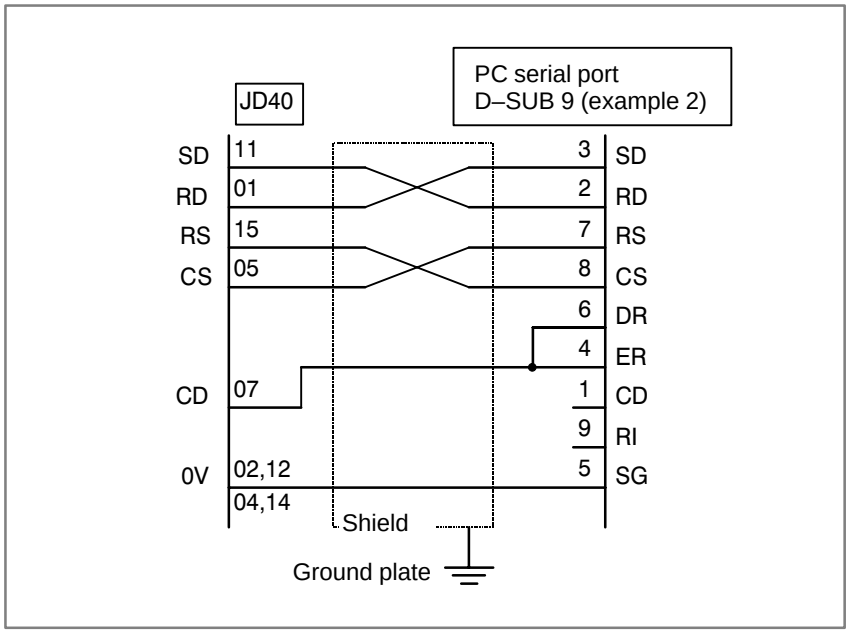
(i) Wiring (example 1: when converting to D–SUB 25–pin)



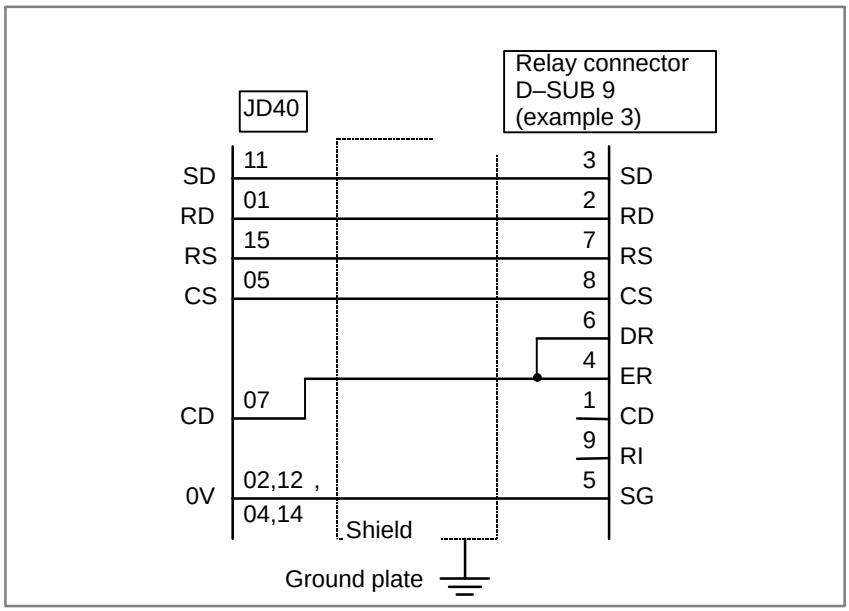
Recommended wire material specifications:
A66L–0001–0284#10P
(#28AWGX10 pair)

JD40 recommend cable connector
PCR–E20FA (Honda Tsushin)
F130–20S (Hirose Electric)
FCN–247J0202–G/E (Fujitsu)
52622–2011 (Japan Morex)

(ii) Wiring (example 2: when converting to D–SUB 9–pin)



(iii) Wiring (example 3: when connecting to a PC for remote debugging)



NOTE
Before you make the cable, check the pin layout of the connector on the PC when the control unit is connected to a PC for use.

APPENDIX

A EXTERNAL DIMENSIONS OF EACH UNIT

(Outline Drawings of the *i* Series CNC with a LCD–mounted Type Panel)

Outline drawing title		Specification drawing number	Figure
Series 16*i*/18*i*/21*i*/20*i* control unit	7.2″ STN monochrome LCD panel	A02B–0236–B531, B532, B533, B538 A02B–0238–B531, B532, B533, B538 A02B–0247–B531, B532, B535, B536	Fig. U1
	8.4″ TFT color LCD panel	A02B–0236–B501, B502, B503, B508 A02B–0238–B501, B502, B503, B508 A02B–0247–B501, B502, B505, B506 A02B–0277–B501, B502, B505, B506	Fig. U2
	9.5″ STN monochrome LCD panel	A02B–0236–B541, B542, B543, B548 A02B–0238–B541, B542, B543, B548 A02B–0247–B541, B542, B545, B546	Fig. U3
	10.4″ TFT color LCD panel	A02B–0236–B611, B612, B613, B618 B621, B622, B623, B628 A02B–0238–B611, B612, B613, B618 B621, B622, B623, B628 A02B–0247–B611, B612, B615, B615 B621, B622, B625, B625	Fig. U4
Series 160*i*/180*i*/210*i* control unit	10.4″ TFT color LCD panel	A02B–0236–B751, B752, B753, B758 B761, B762, B763, B768 B771, B772, B773, B778 A02B–0238–B751, B752, B753, B758 B761, B762, B763, B768 B771, B772, B773, B778 A02B–0247–B751, B752, B755, B756 B761, B762, B765, B766 B771, B772, B775, B776	

(Outline Drawings of the *i* Series CNC with a Stand–alone Type Unit)

Series 16*i*/18*i*/21*i* and Series 160*i*/180*i*/210*i* control units	A02B–0265–B501, B503, A02B–0266–B501, B503 A02B–0267–B501	Fig. U6
10.4″/9.5″ LCD unit	A02B–0265–C071, C061	Fig. U7
7.2″ LCD/MDI unit	A02B–0166–C261#TR, R, TS, S	Fig. U8
7.2″ monochrome LCD unit	A02B–0166–C251	Fig. U9
MDI unit (for 7.2″ LCD)	A02B–0166–C210#TR, TS, R, S	Fig. U10
Detachable 7.2″ LCD/MDI unit	A02B–0166–C271#TR, TS, R, S	Fig. U11
Intelligent terminal (without ISA expansion)	A13B–0178–B025, B026, B027 A13B–0178–H040	Fig. U12
Intelligent terminal (with ISA expansion)		

(Outline drawings of other units)

Stand–alone type small MDI unit	For 7.2″/8.4″ panel	A02B–0236–C120#TBR, MBR, TBS, MBS	Fig. U13
Stand–alone type standard MDI unit	For 7.2″/8.4″ panel	A02B–0236–C121#TBR, MBR, TBS, MBS	Fig. U14
Stand–alone type standard MDI unit (horizontal type)	For 9.5″/10.4″ LCD panel	A02B–0236–C125#TBR, MBR, TBS, MBS	Fig. U15
Stand–alone type standard MDI unit (vertical type)	For 9.5″/10.4″ LCD panel	A02B–0236–C126#TBR, MBR, TBS, MBS A02B–0236–C127#TBR, MBR, TBS, MBS	Fig. U16
FA typewriter–style keyboard		A02B–0236–C130#EC, JC, A02B–0234–C120#EC, JC	Fig. U17 (a)
FA typewriter–style keyboard (with hard disk + personal computer interface connection unit + ISA expansion board)			Fig. U17 (b)
Typewriter–style keyboard (for debugging purposes)		A86L–0001– 0210, 0211	Fig. U18
Mouse (for debugging purposes)		A86L–0001– 0212	Fig. U19
Floppy disk unit (for debugging purposes)		A02B–0207–C006	Fig. U20
HSSB interface board type 2 on the personal computer side		A02B–8100–0100	Fig. U21 (a)
HSSB interface board type 2 (1CH) on the personal computer side		A02B–8001–0583	Fig. U21 (b)
HSSB interface board type 2 (2CH) on the personal computer side		A02B–8001–0582	
Position coder	4000 rpm	A86L–0027– 0001#102	Fig. U22 (a)
	6000 rpm	A86L–0027– 0001#002	
α position coder	10000 rpm	A860–0309– T302	Fig. U22 (b)
Manual pulse generator		A860–0202– T001	Fig. U23
Pendant manual pulse generator		A860–0202– T004 to T015	Fig. U24
Separate detector interface unit		A02B–0236–C203, C204	Fig. U25
Battery case for separate detector interface unit (ABS)		A06B–6050–K060	Fig. U26
Tap unit for DNC1		A13B–0156–C100	Fig. U27
Terminating resistance unit for DNC1		A13B–0156–C200	Fig. U28
CNC battery unit for external installation		A02B–0236–C281	Fig. U29
Punch panel (narrow type)	1 m	A02B–0236–C191	Fig. U30
	2 m	A02B–0236–C192	
	5 m	A02B–0236–C193	
Punch panel (narrow type)	1 m	A02B–0120–C191	Fig. U31
	2 m	A02B–0120–C192	
	5 m	A02B–0120–C193	
Distribution I/O small machine operator’s panel		A02B–0236–C141#TBR, #MBR#TBS, #MBS	Fig. U32
Distribution I/O standard machine operator’s panel		A02B–0236–C140#TBR, #MBR#TBS, #MBS	Fig. U33

61–key MDI unit (vertical type)	For use with the FS16*i*/18*i*/21*i*. Can be used as either the stand–alone or LCD–mounted type. For use with the FS160*i*/180*i*/210*i*. Can be used as either the 10.4" LCD–separated or LCD–mounted type.	A02B–0261–C161#MCR, #MCS A02B–0261–C163#MCR, #MCS	Fig. U34
61–key MDI unit (horizontal type)	For use with the FS16*i*/18*i*/21*i*. Can be used as either the stand–alone or LCD–mounted type. For use with the FS160*i*/180*i*/210*i*. Can be used as the 10.4" LCD–separated type only.	A02B–0261–C162#MCR, #MCS A02B–0261–C164#MCR, #MCS	Fig. U35
61–key MDI unit (vertical type)	For use with the FS160*i*/180*i*/210*i*. Can be used as either the 12.1" LCD–separated or LCD–mounted type.	A02B–0261–C165#MCR, #MCS	Fig. U36
61–key MDI unit (horizontal type)	For use with the FS160*i*/180*i*/210*i*. Can be used as the 12.1" LCD–separated type only.	A02B–0261–C166#MCR, #MCS	Fig. U37
Blank panel	Supplied with the 61–key MDI unit (A02B–0261–C165 and C166).		Fig. U38
Distributed I/O machine operator's panel (290 mm wide)		A02B–0236–C150#TBR, #MBR#TBS, #MBS	Fig. U39

Number of option slots	Depth (D) (mm)
2	110
3	125
4	170

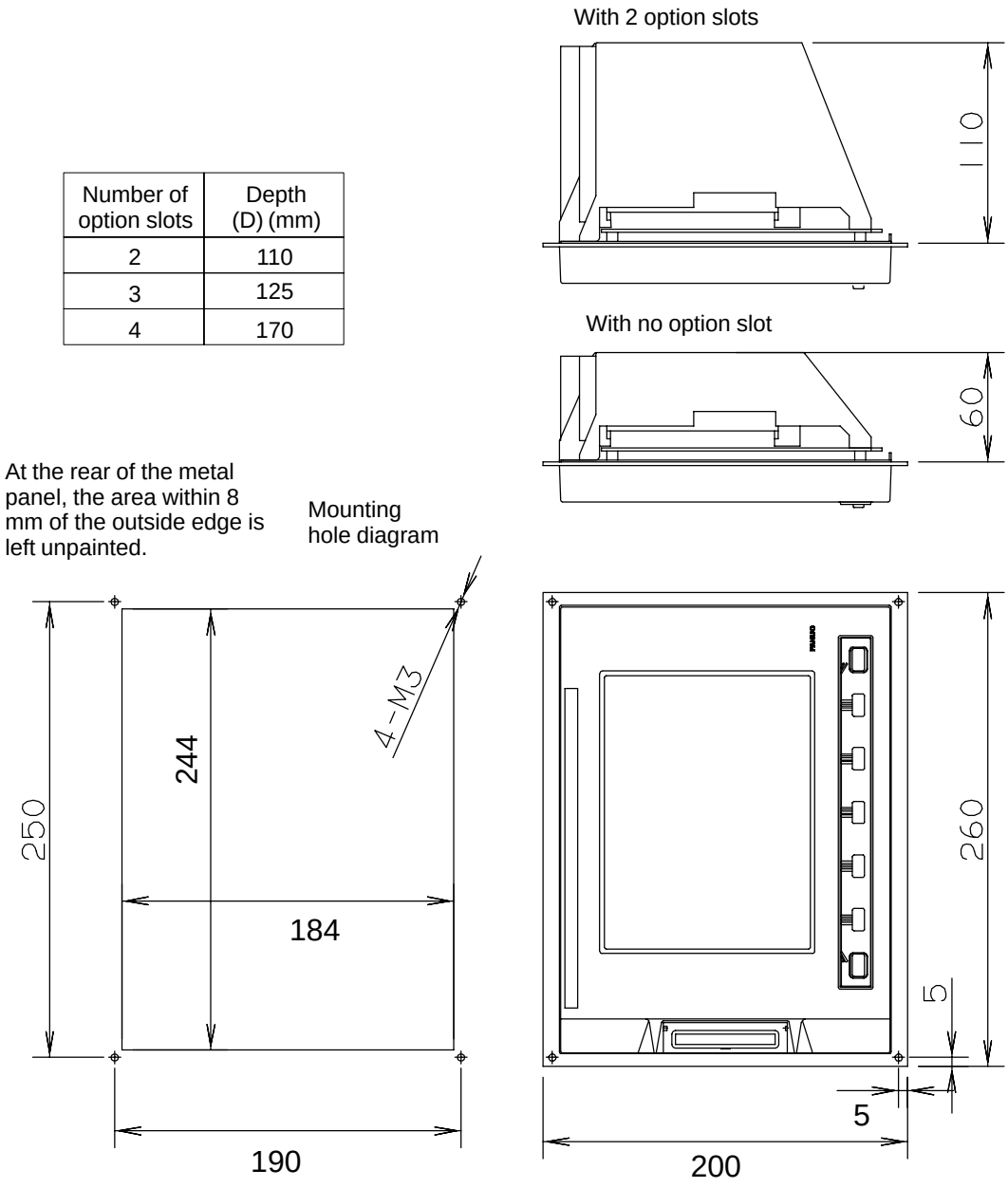


Fig. U1 External dimensions of CNC control unit with 7.2″ LCD

Number of option slots	Depth (D) (mm)
2	110
3	125
4	170

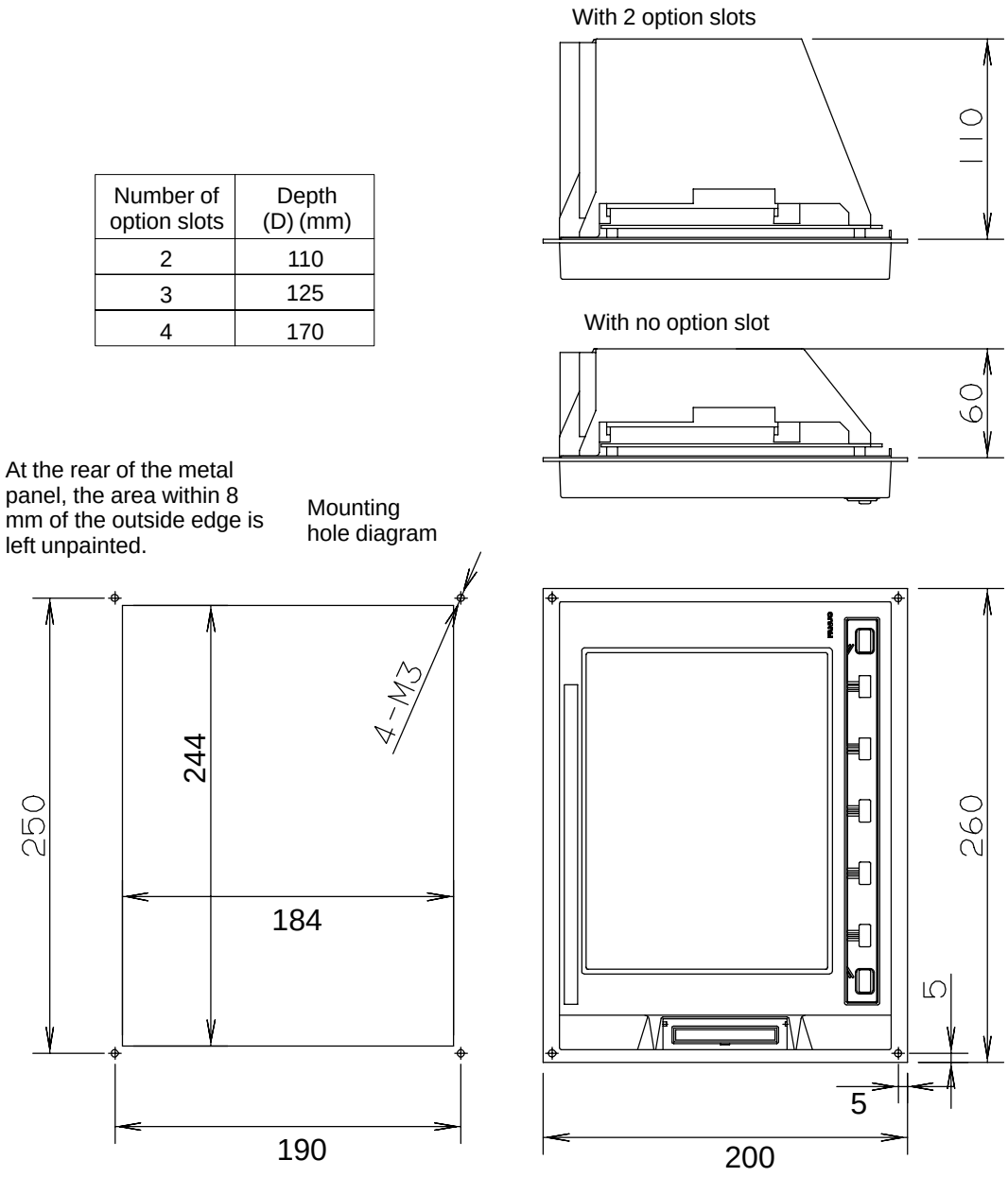


Fig. U2 External dimensions of CNC control unit with 8.4″ LCD

Number of option slots	Depth (D) (mm)
2	110
3	125
4	170

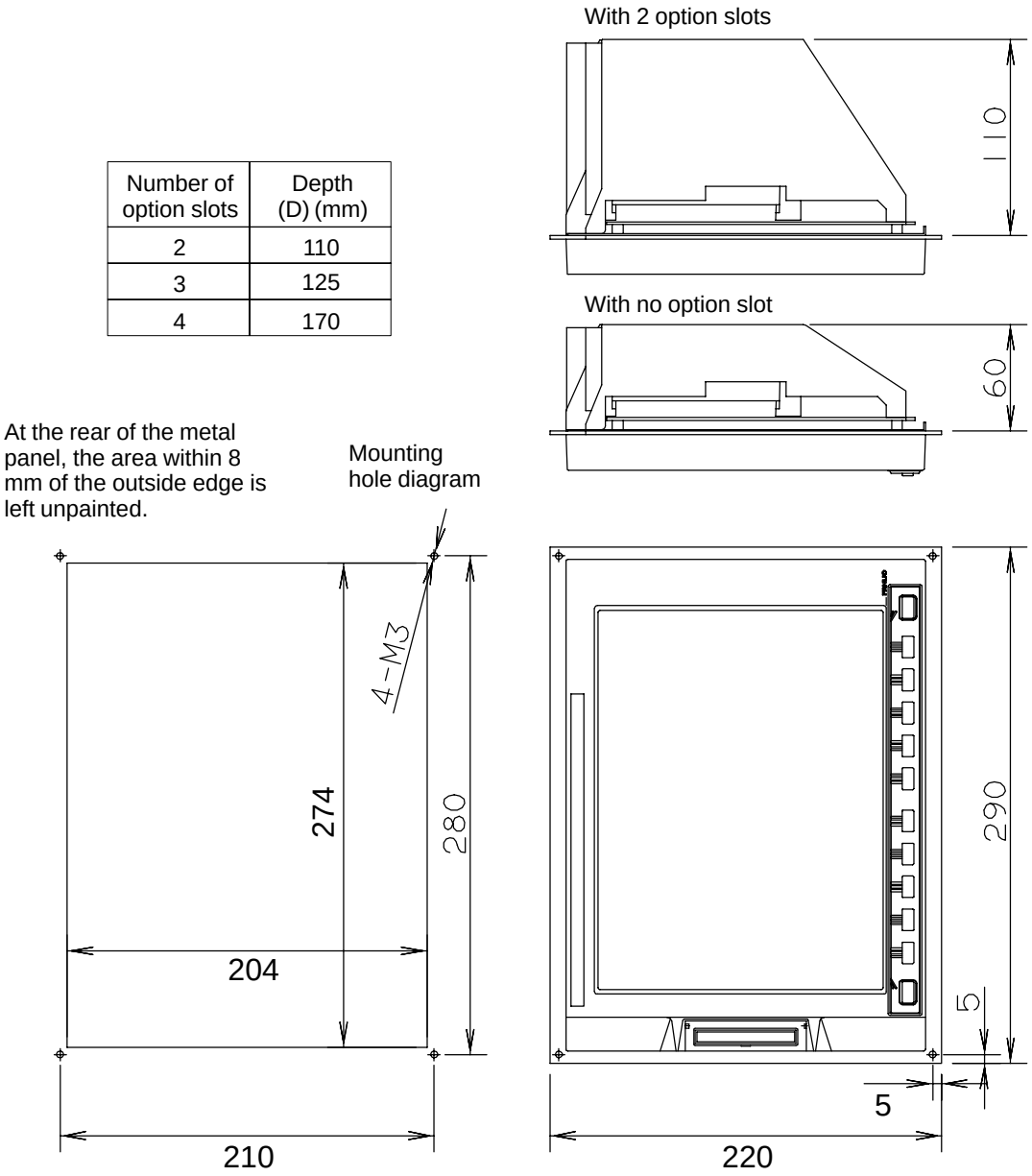


Fig. U3 External dimensions of CNC control unit with 9.5″ LCD

Number of option slots	Depth (D) (mm)
2	110
3	125
4	170

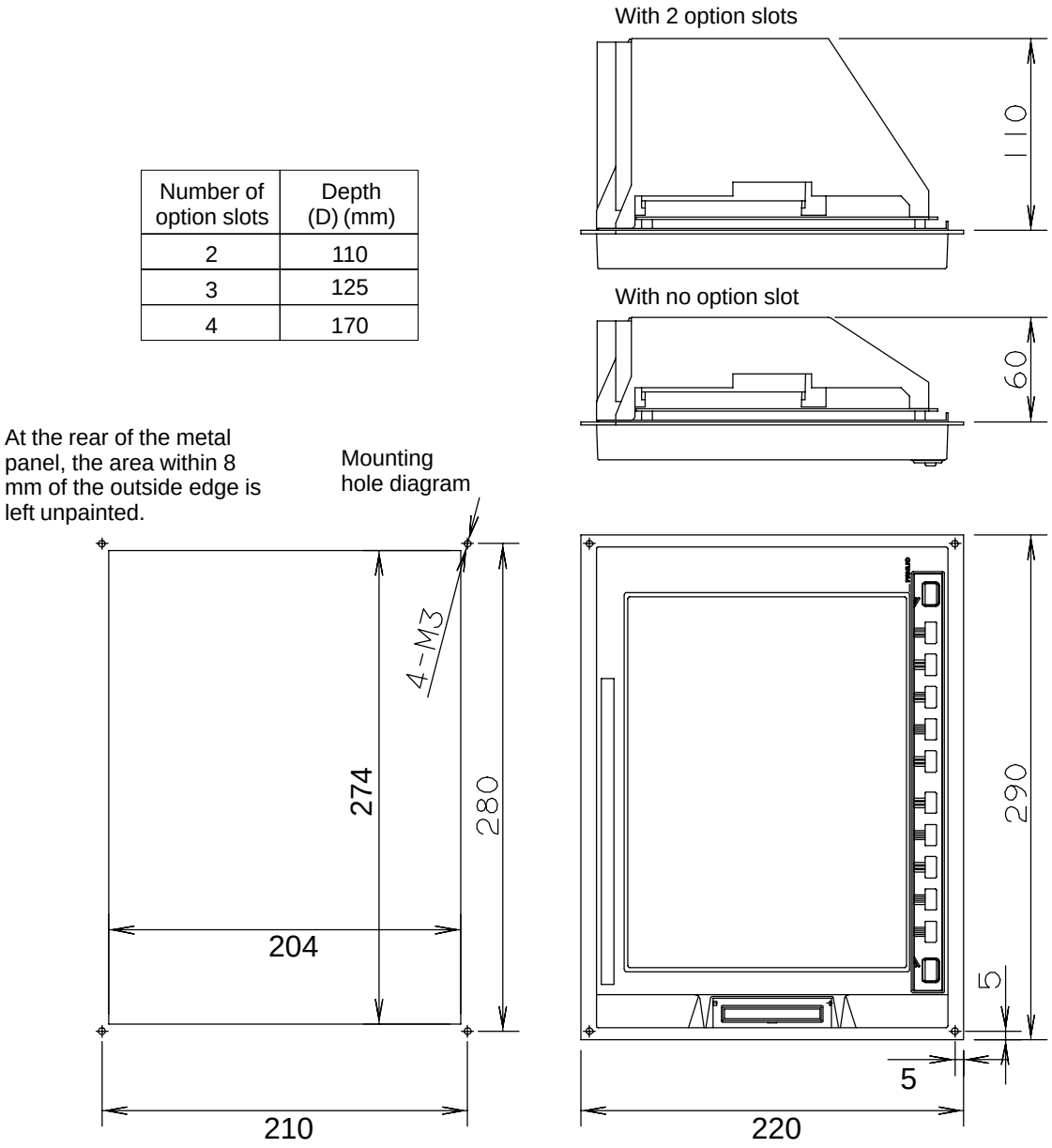


Fig. U4 External dimensions of CNC control unit with 10.4″ LCD

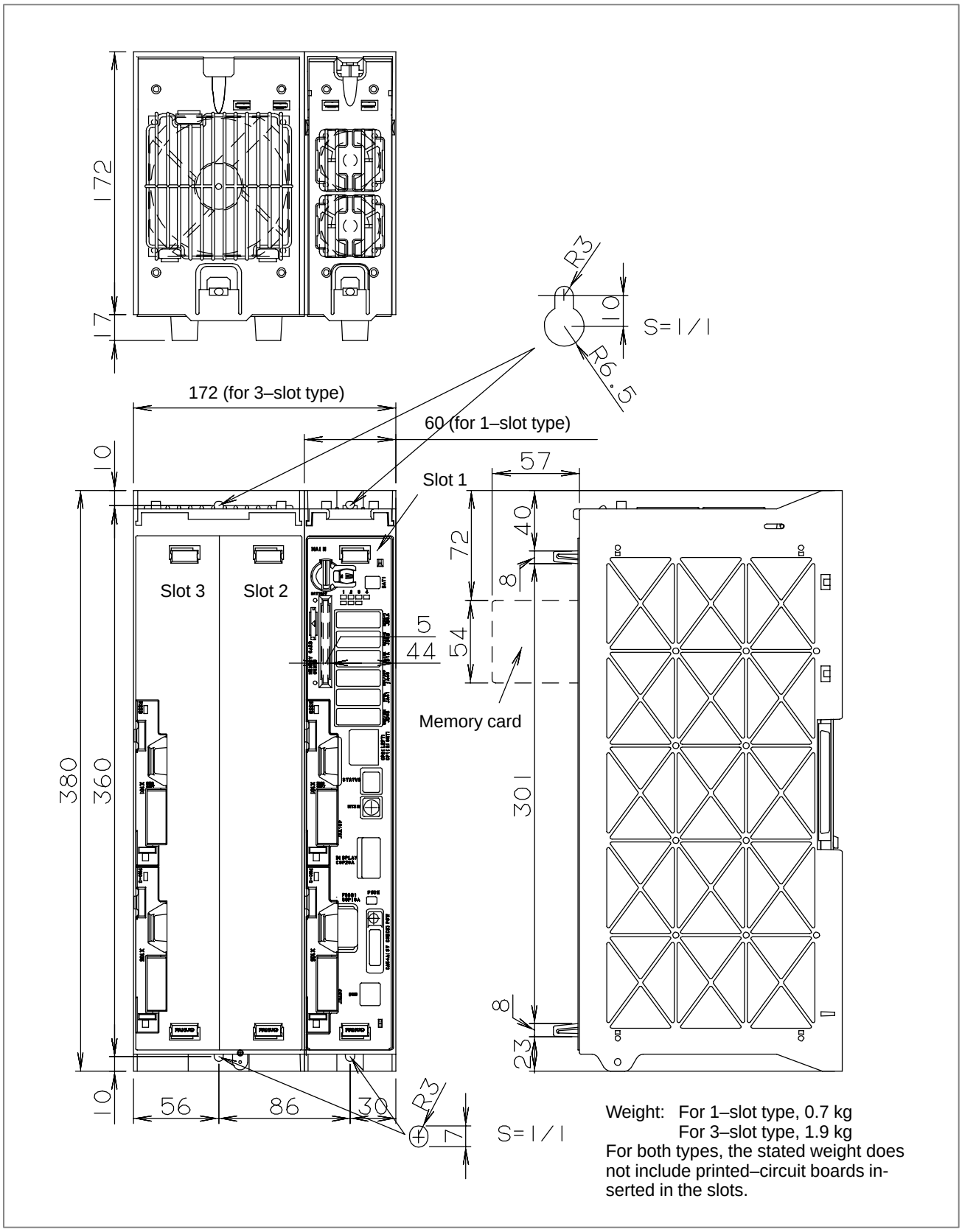
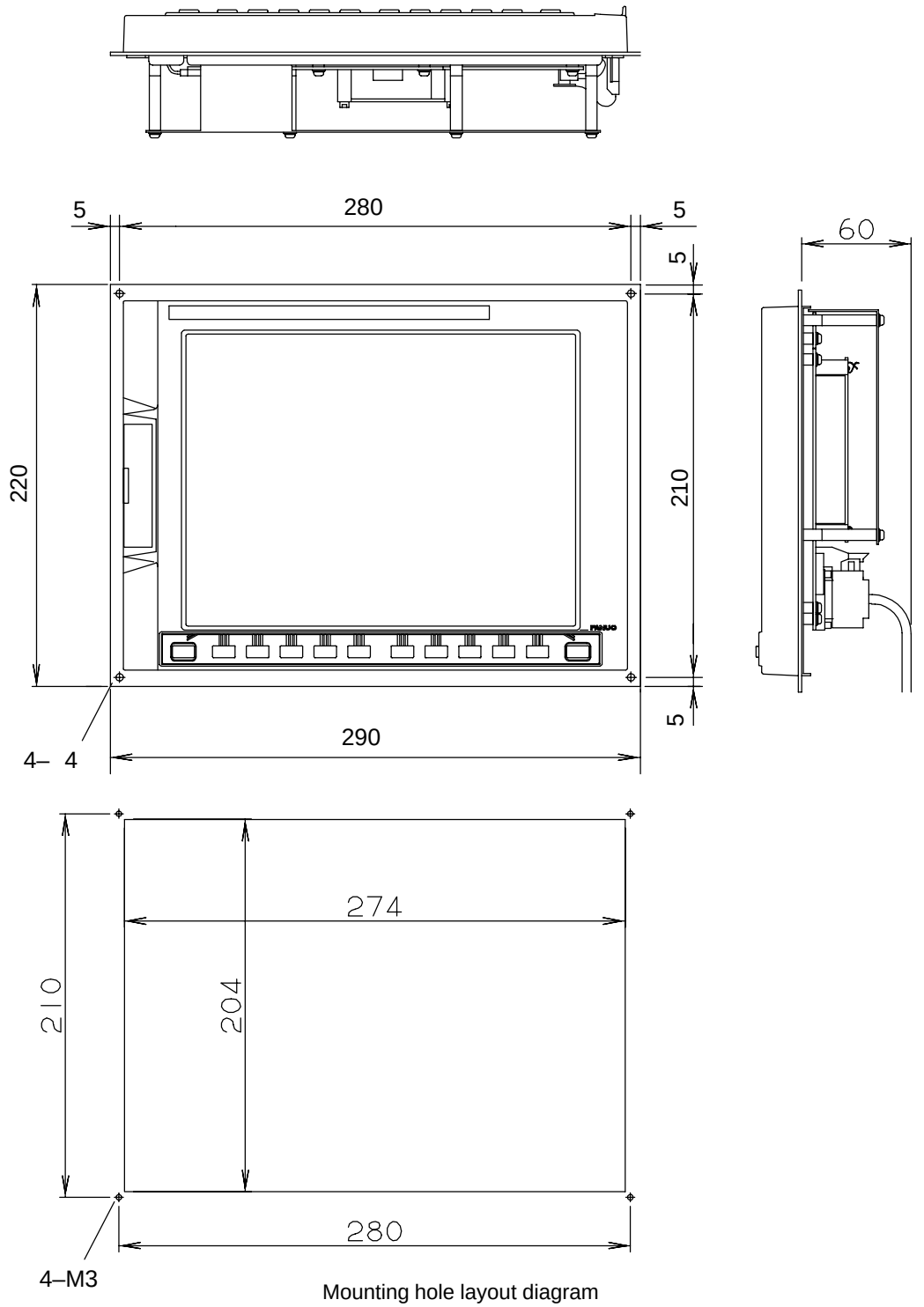


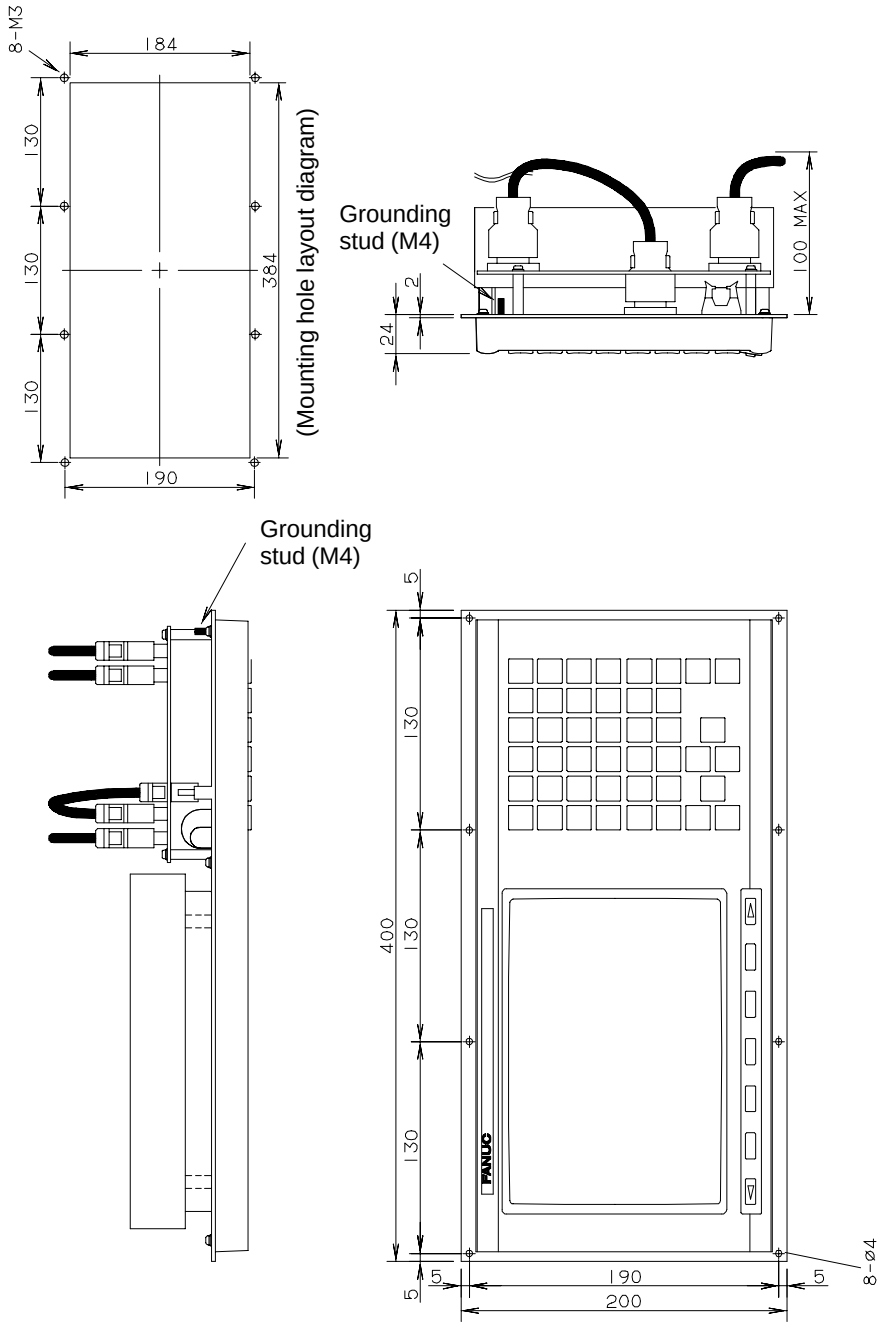
Fig. U6 *i* Series Control Unit with Stand–alone Type LCD Unit



Mounting hole layout diagram
(The unit shall be fastened to the cabinet from the outside.)
Painting shall be masked 8 mm from the edges of the panel sheet metal on the rear surface.

Paint color: Munsell code N3, medium gloss

Fig. U7 10.4″/9.5″ LCD Unit

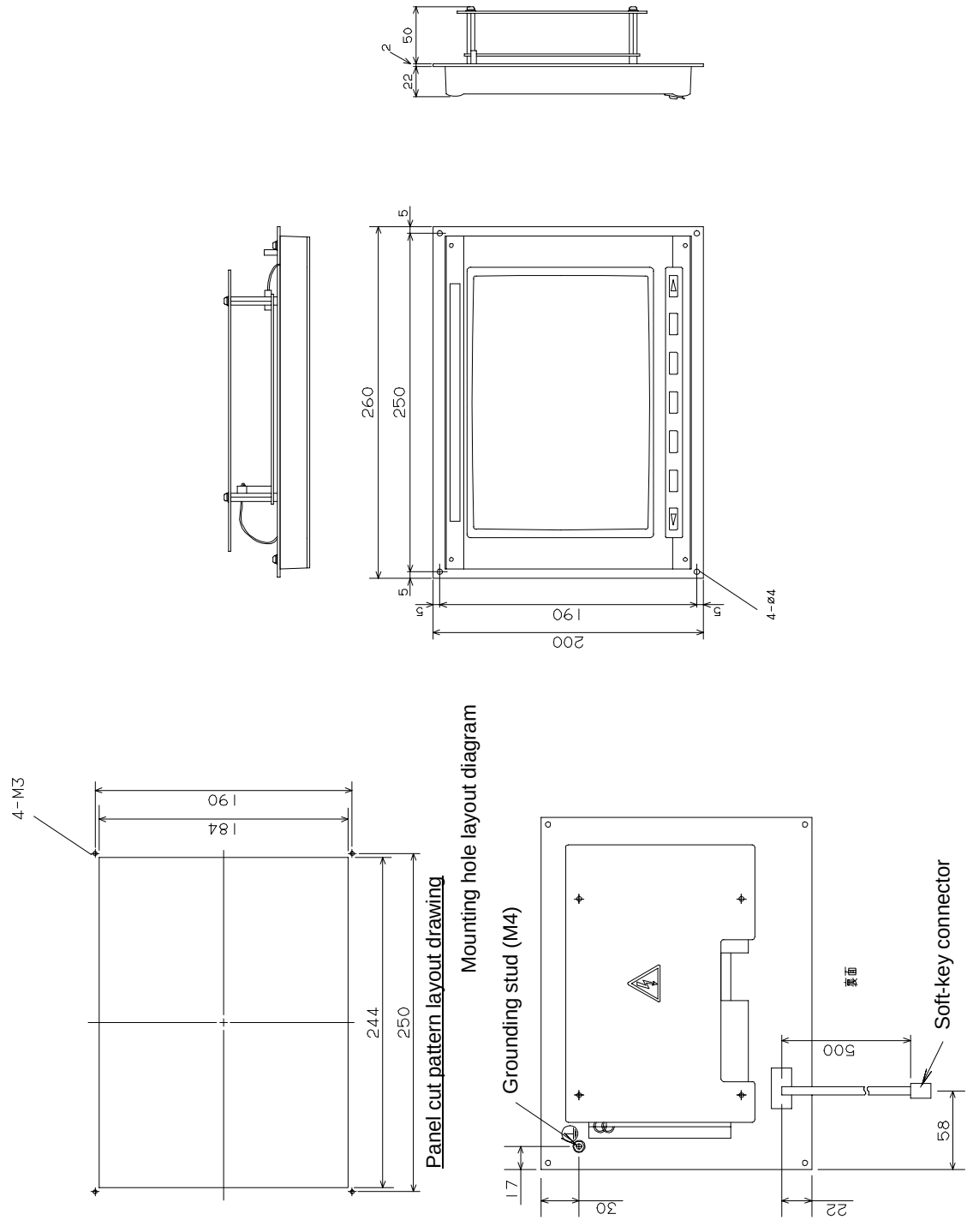


The unit shall be fastened to the cabinet from the outside.

Weight: 3.9 kg

Paint color: Munsell code N3, medium gloss

Fig. U8 7.2″ LCD/MDI Unit Outline Drawing

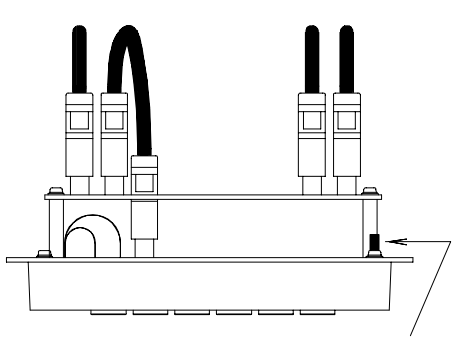


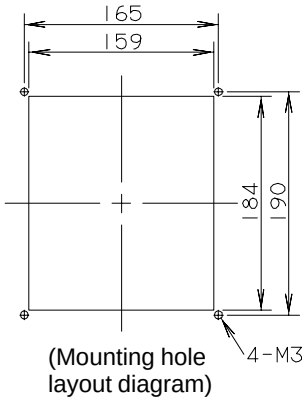
The unit shall be fastened to the cabinet from the outside.

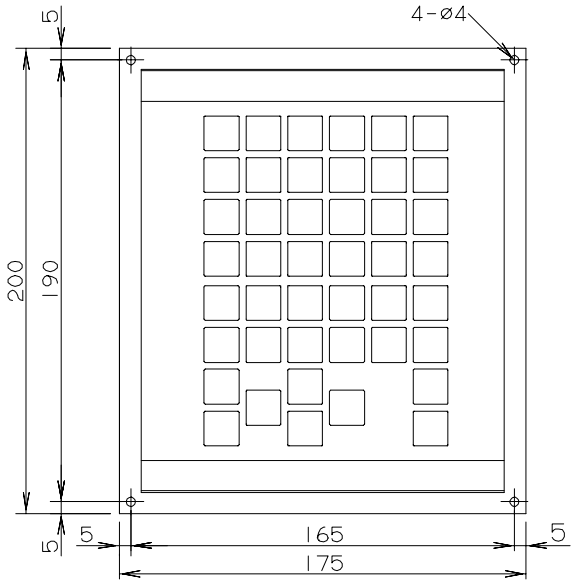
Weight: 1.6 kg

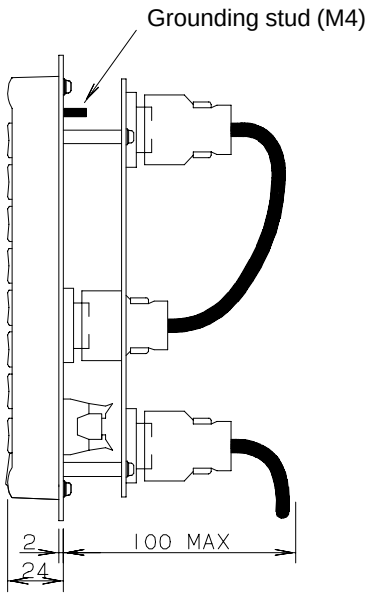
Paint color: Munsell code N3, medium gloss

Fig. U9 7.2″ Monochrome LCD Unit Outline Drawing







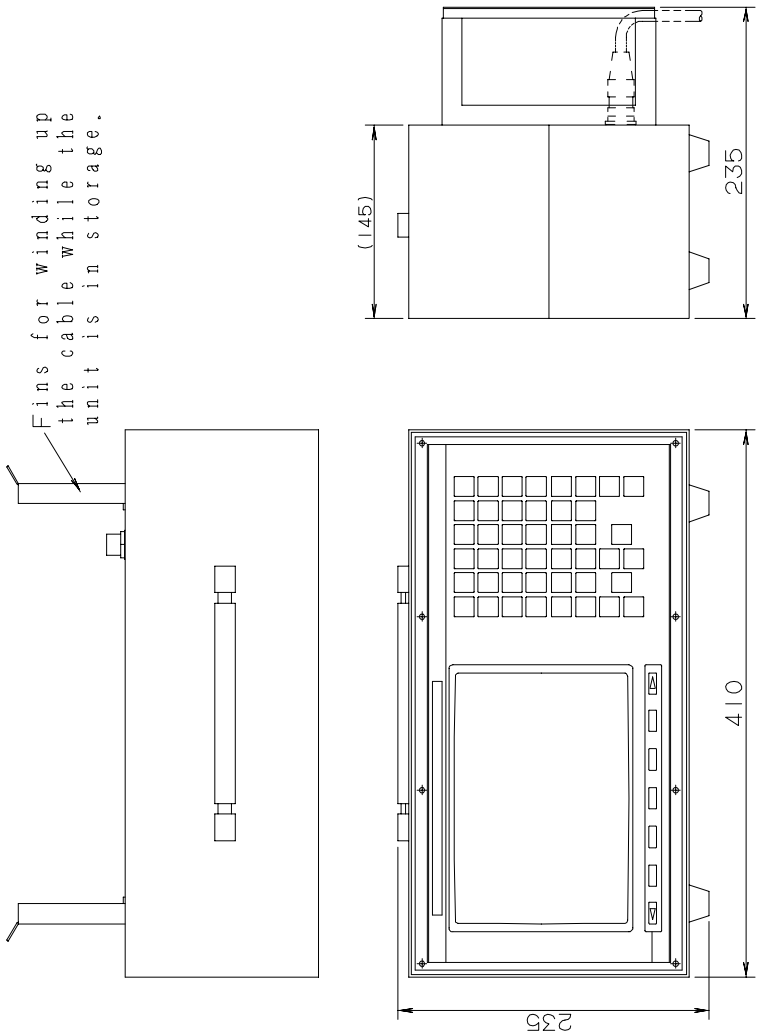


Paint color: Munsell code N3, medium gloss

The unit shall be fastened to the cabinet from the outside.

Weight: 1.3 kg

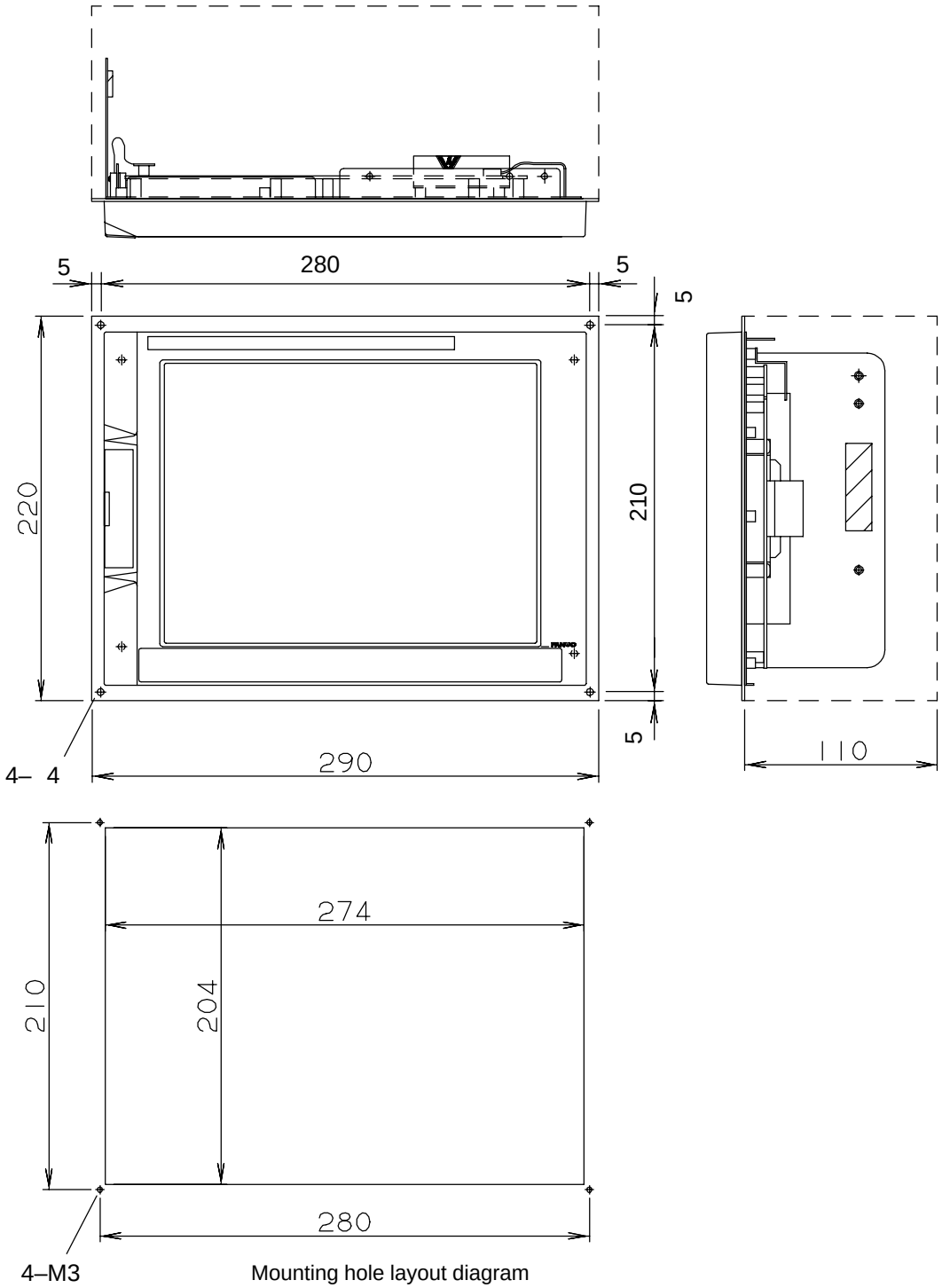
Fig. U10 MDI Unit (for 7.2″ LCD)



Paint color: For case, Munsell code 5GY3.5/0.5, medium gloss
For panel, Munsell code N3, medium gloss

Weight: 7 kg

Fig. U11 Detachable 7.2″ LCD/MDI Unit



Mounting hole layout diagram
(The unit shall be fastened to the cabinet from the outside.)

Painting shall be masked 8 mm from the edges of the panel sheet metal on the rear surface.
The dashed lines in the drawing indicate the maximum outline if options are added to the intelligent terminal.

Paint color: Munsell code N3, medium gloss

Fig. U12 Intelligent Terminal

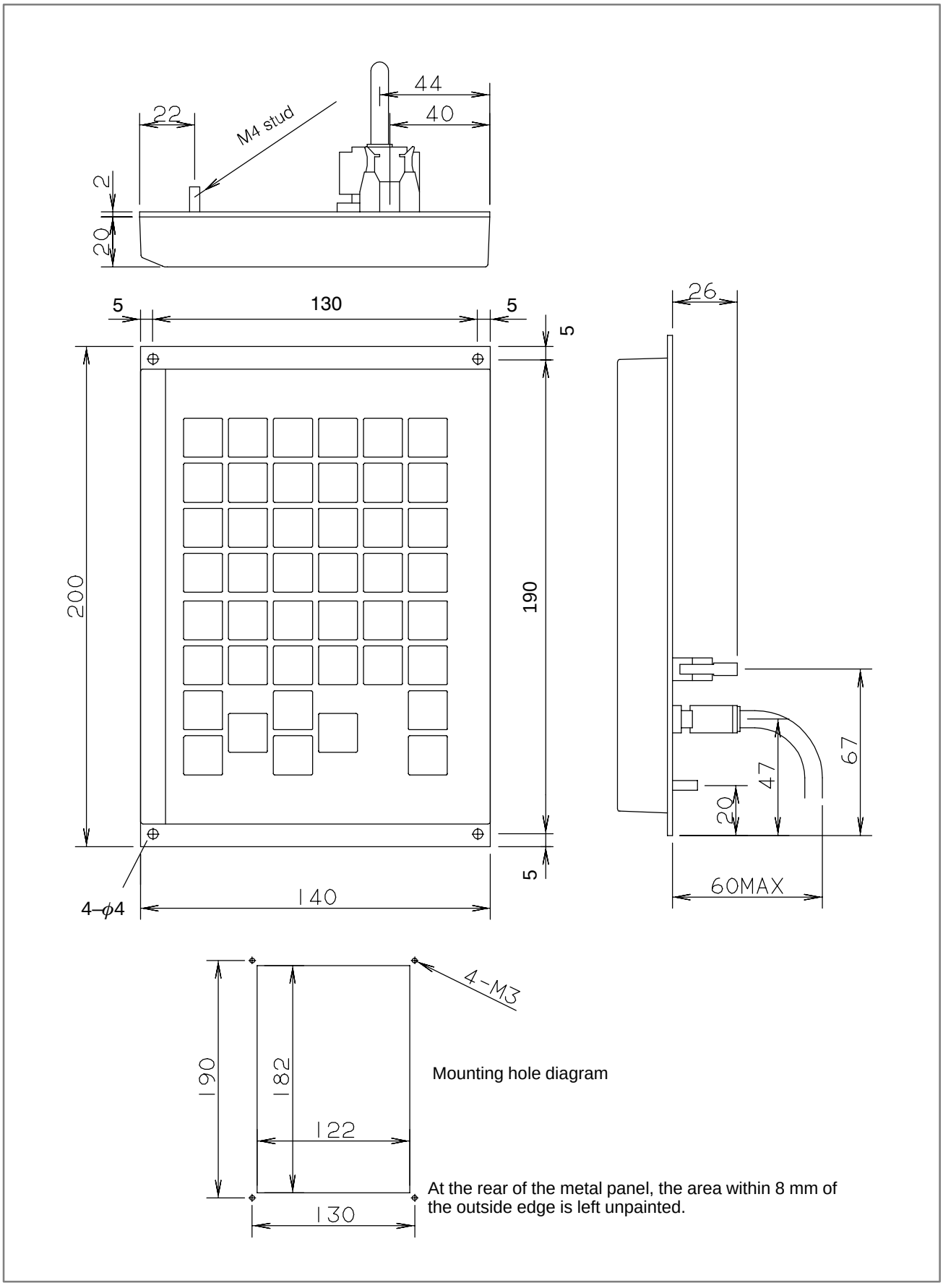


Fig. U13 External dimensions of stand–alone type small–size MDI unit

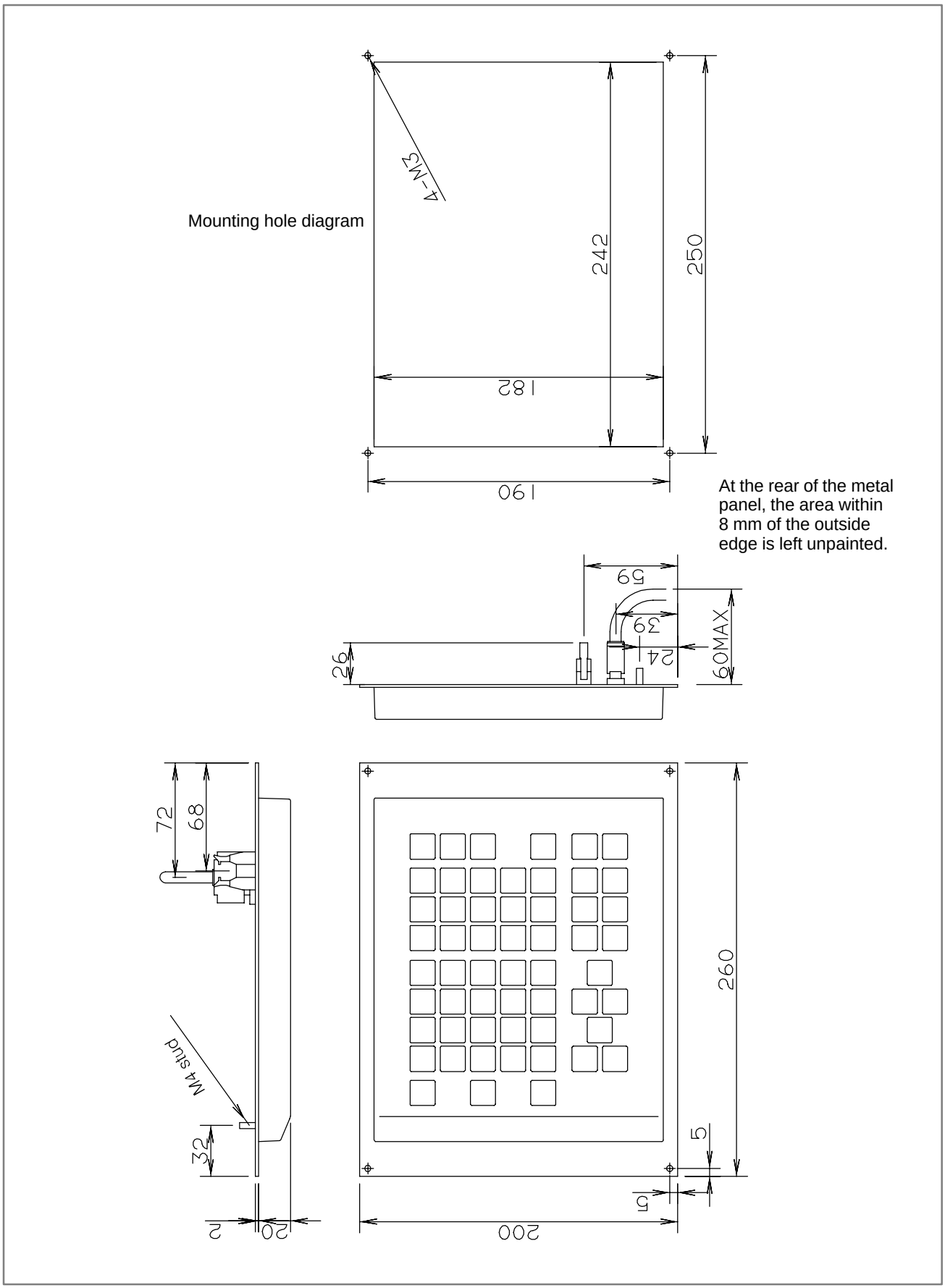


Fig. U14 External dimensions of stand–alone type standard MDI unit

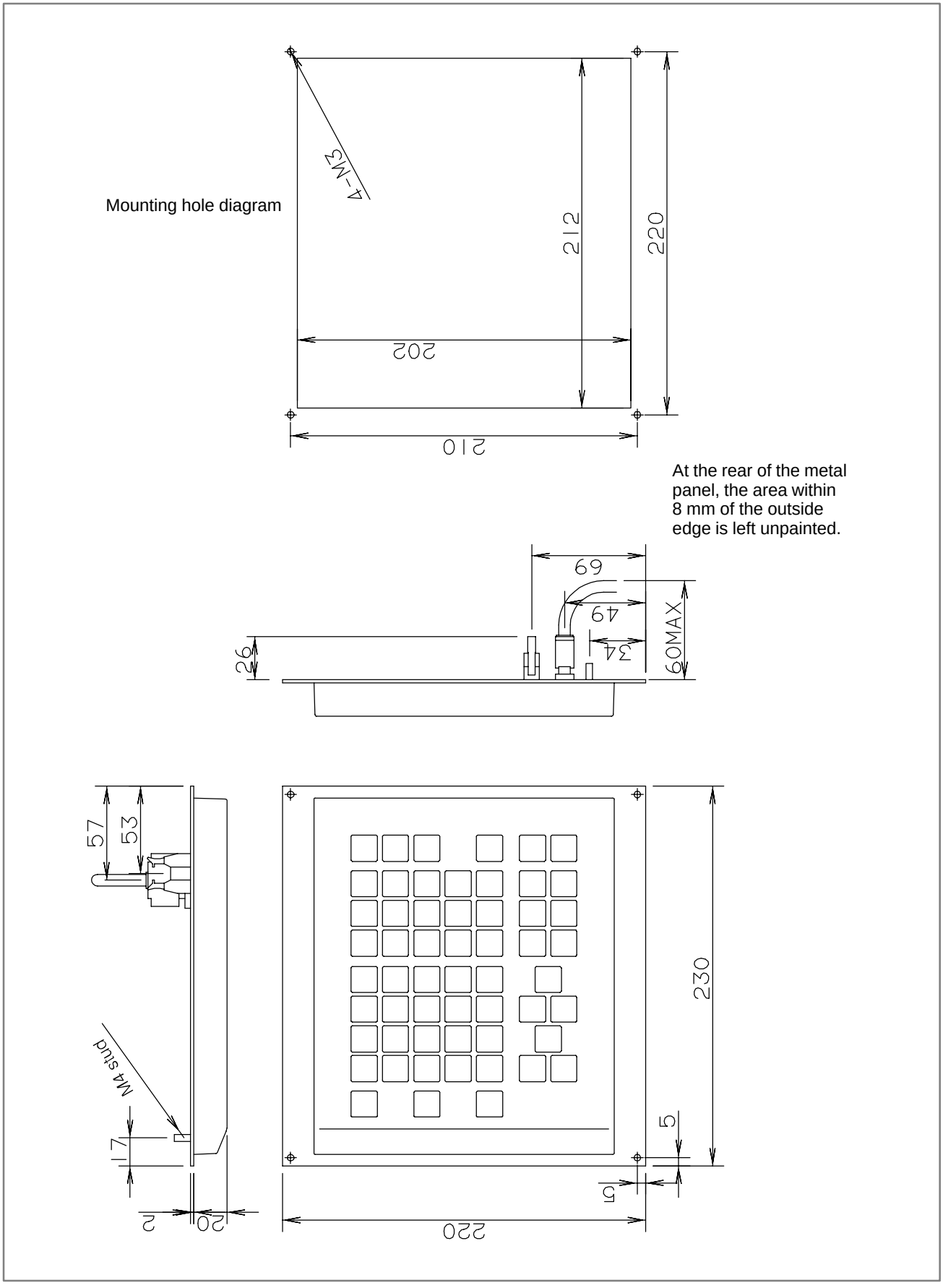


Fig. U15 External dimensions of stand–alone type standard MDI unit (horizontal type)

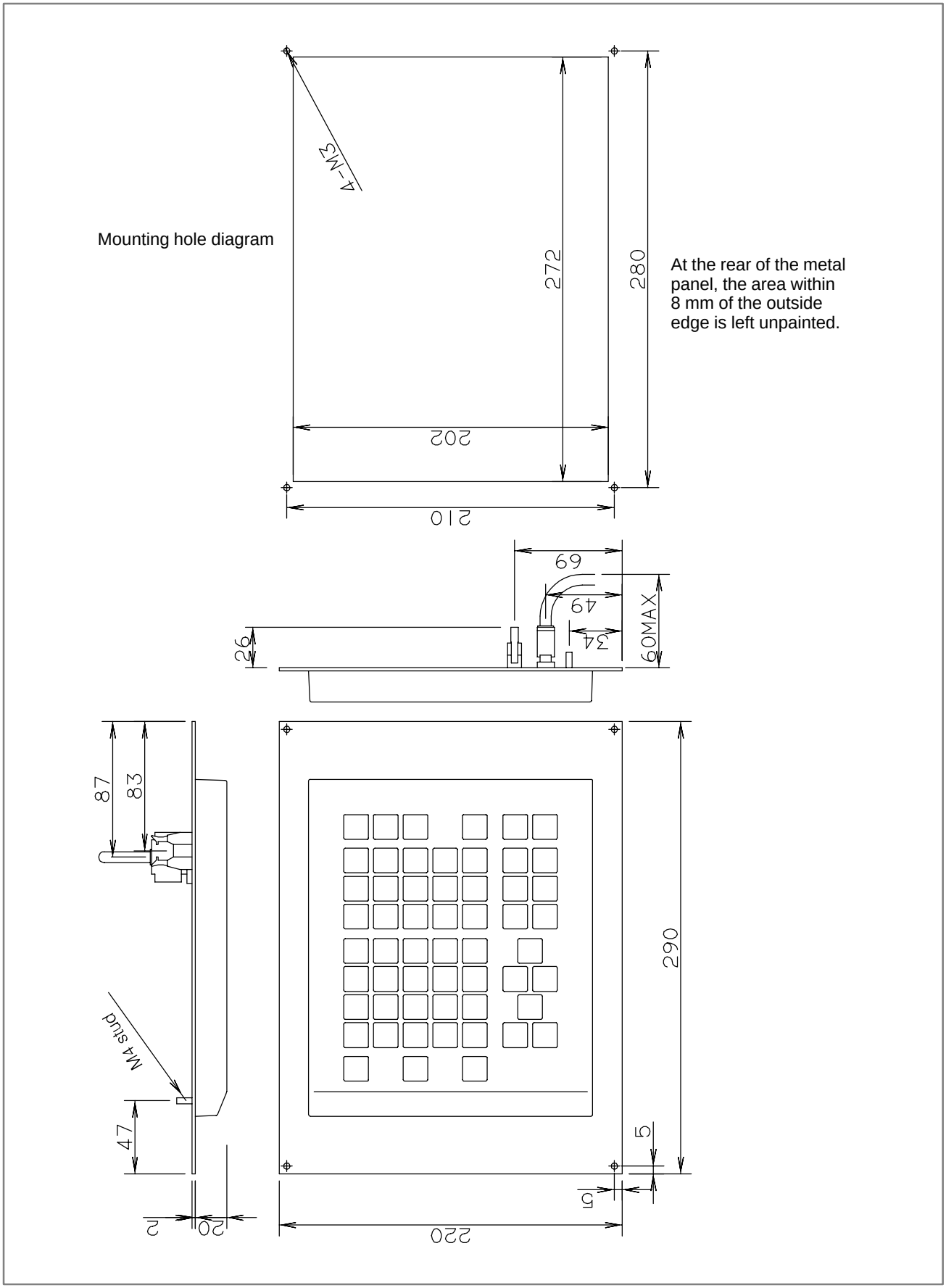


Fig. U16 External dimensions of stand–alone type standard MDI unit (vertical type)

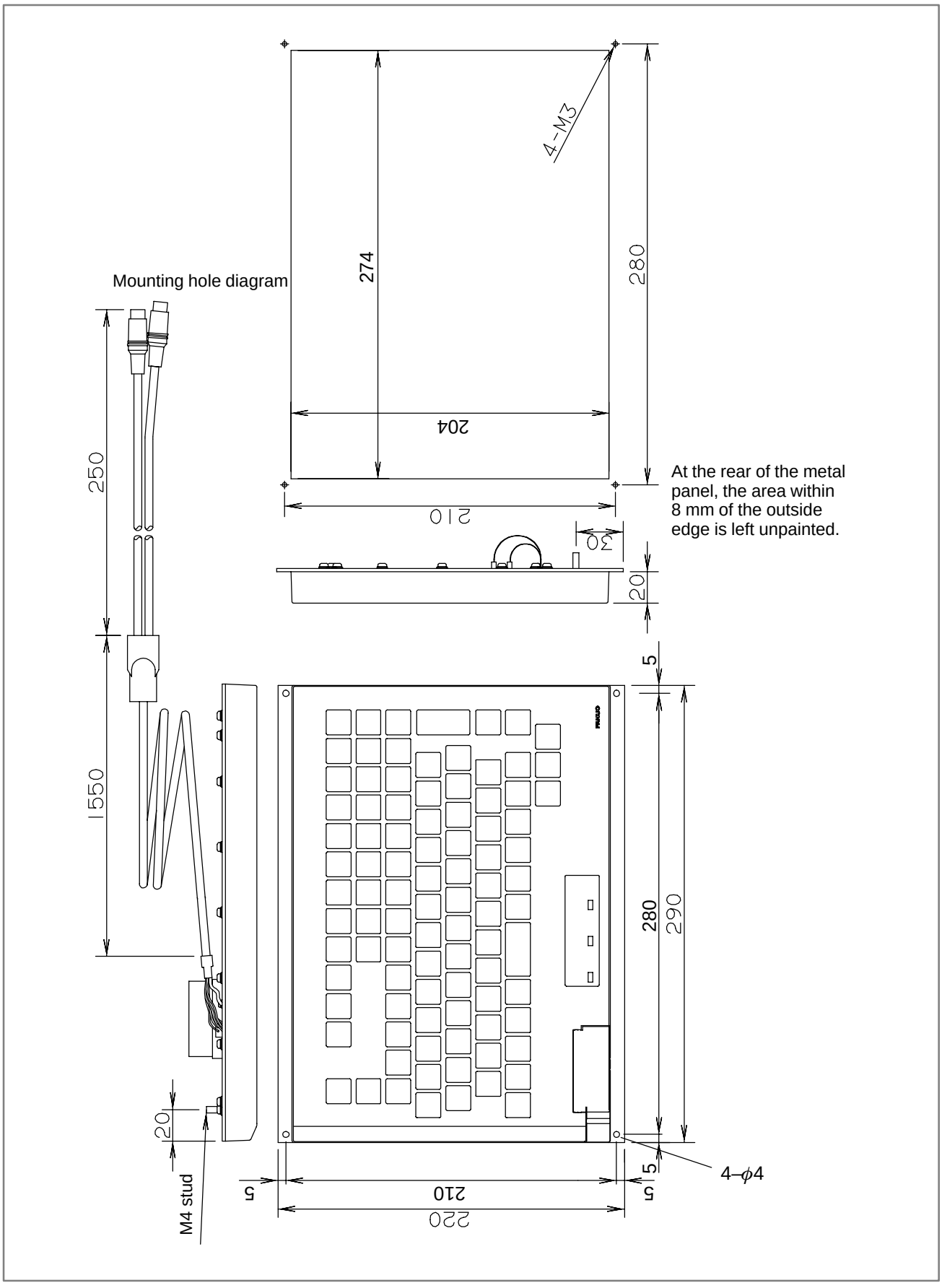
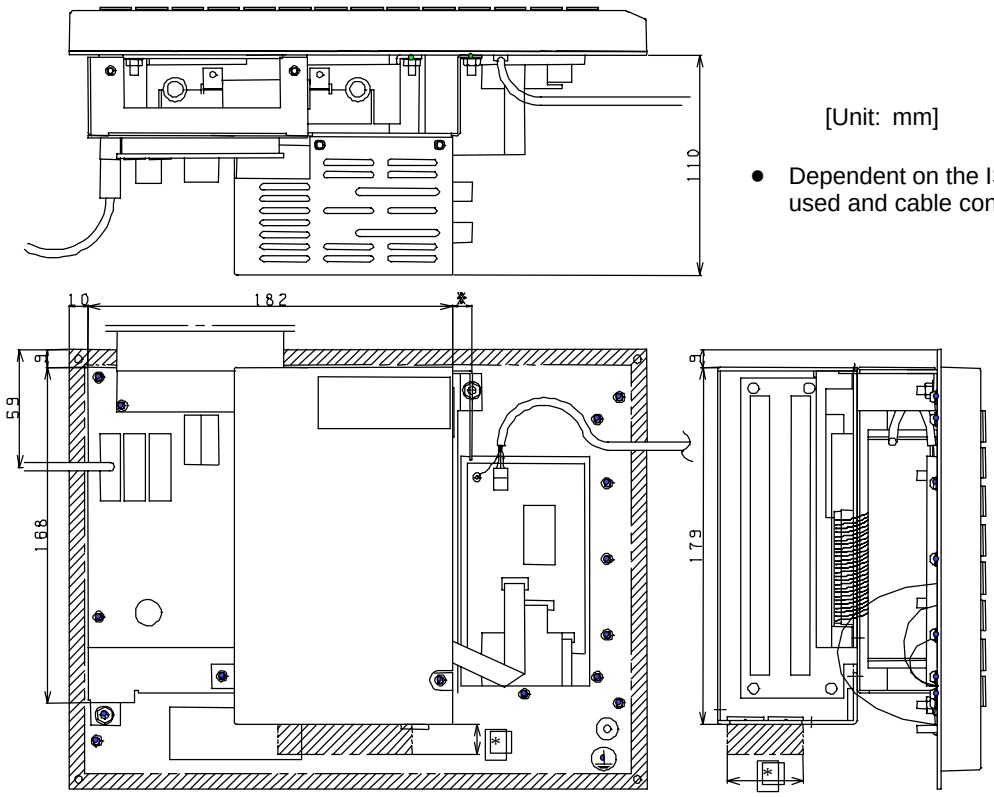


Fig. U17 (a) External dimensions of FA full keyboard

- The personal computer interface connection unit and ISA expansion unit are installed on the back of the separate MDI unit or FA full keyboard when shipped.
- For panel cutting information, see the panel cut drawing of the separate MDI unit or FA full keyboard.



[Unit: mm]

- Dependent on the ISA board used and cable connected

- The separate MDI unit or FA full keyboard with a personal computer interface connection unit and ISA expansion unit installed can be mounted only under the main body of the CNC.

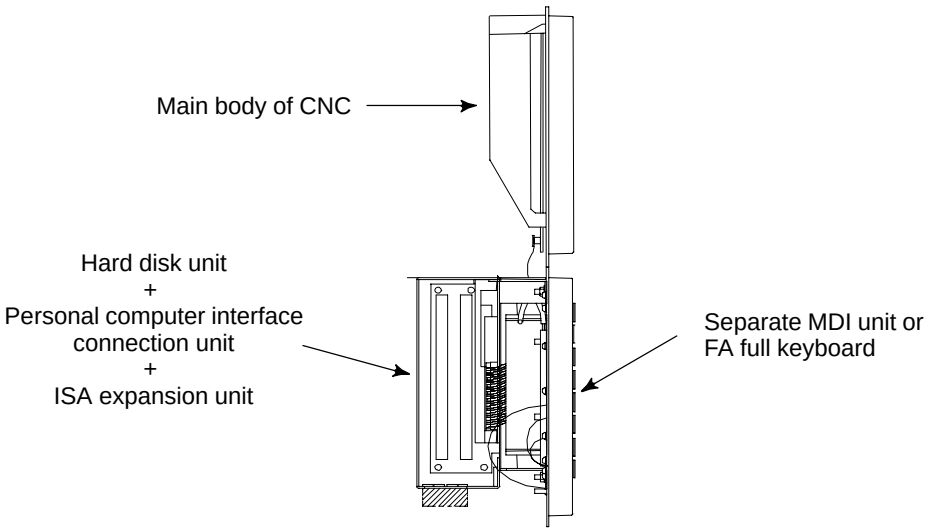


Fig. U17 (b) FA full keyboard
(with hard disk + personal computer interface connection unit + ISA expansion unit)

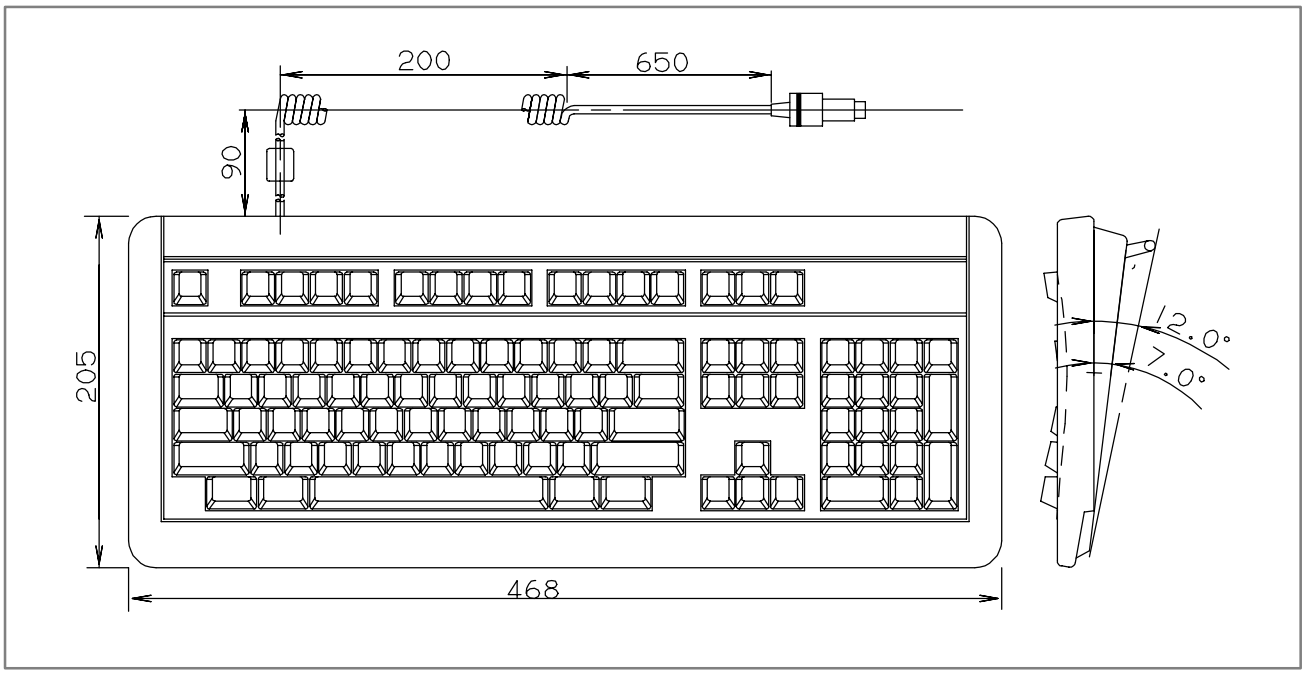


Fig. U18 (a) External dimensions of 101–type full keyboard (English)
Specification No.: A86L–0001–0210

NOTE
This keyboard is not dust–proof. It should be used for program development only. It can be used at temperatures of between 0 and 40°C.

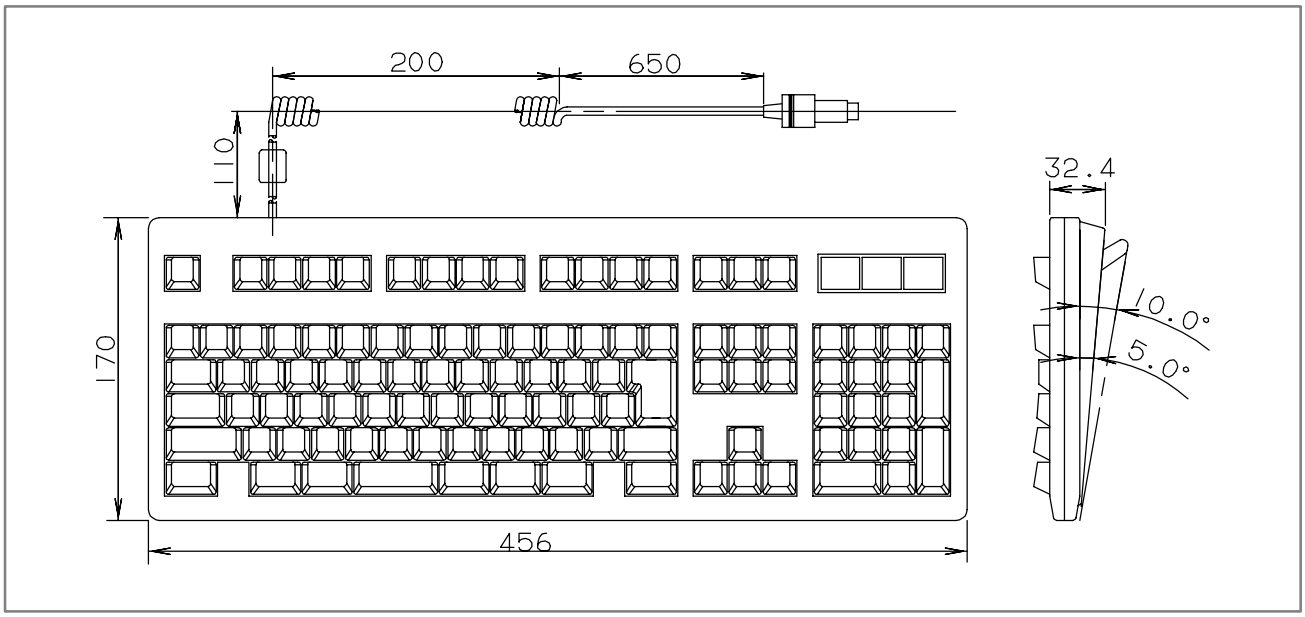


Fig. U18 (b) External dimensions of 106–type full keyboard (Japanese)
Specification No.: A86L–0001–0211

NOTE
This keyboard is not dust–proof. It should be used for program development only. It can be used at temperatures of between 0 and 40°C.

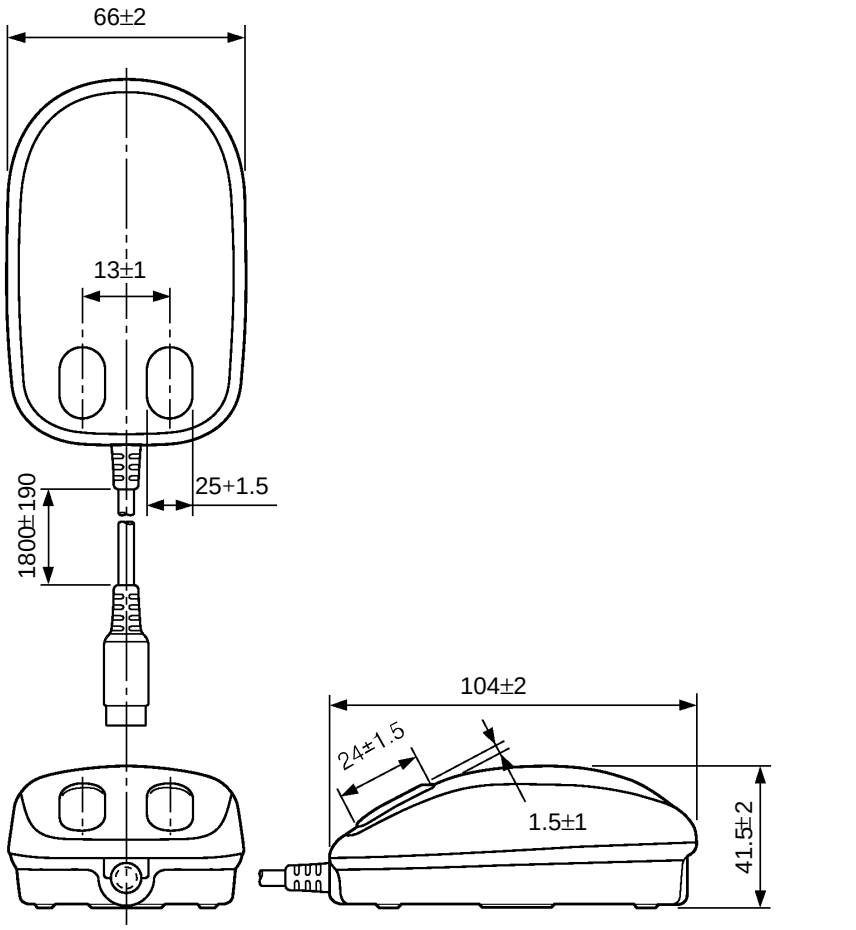
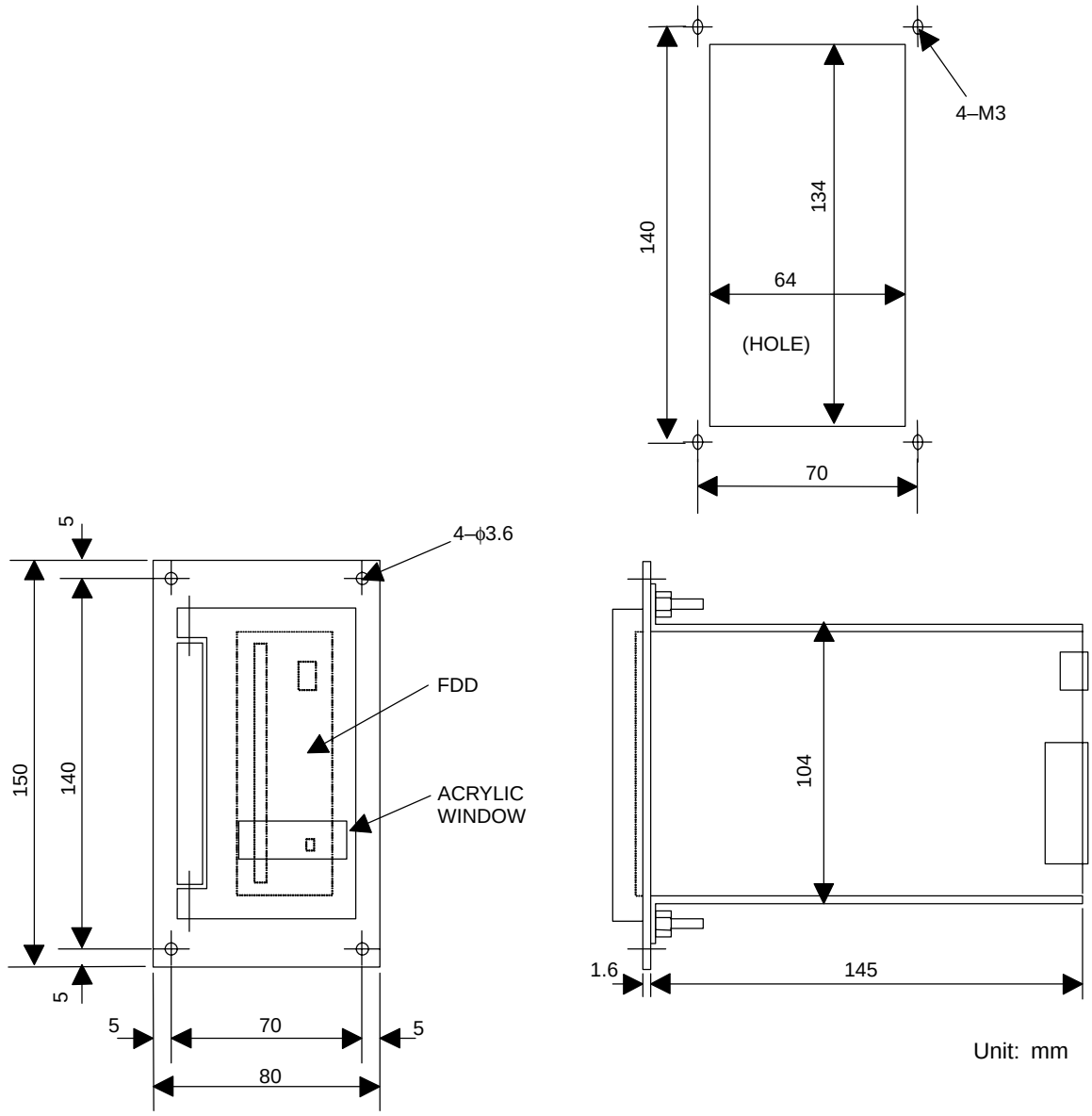


Fig. U19 External dimensions of mouse
Specification No.: A86L–0001–0212

NOTE
This mouse is not dust–proof. It should be used for program development only. It can be used at temperatures of between 0 and 40°C. The mouse is fitted with a 1.8–m cable.



Mounting direction
When using the floppy disk unit attached to the machine, mount the floppy disk unit in one of the following directions:

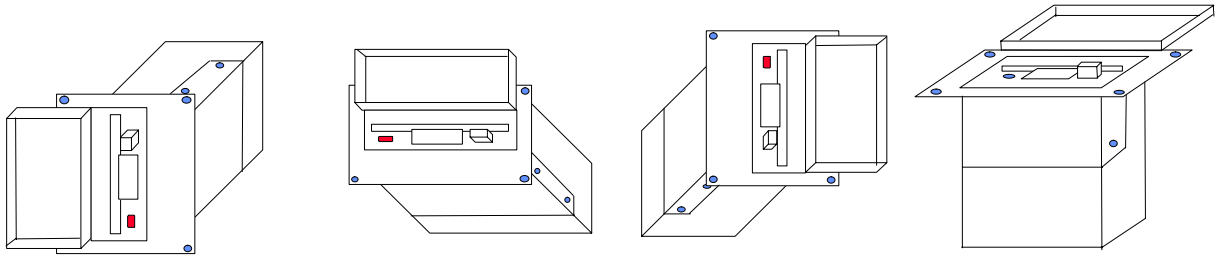


Fig. U20 Floppy disk unit

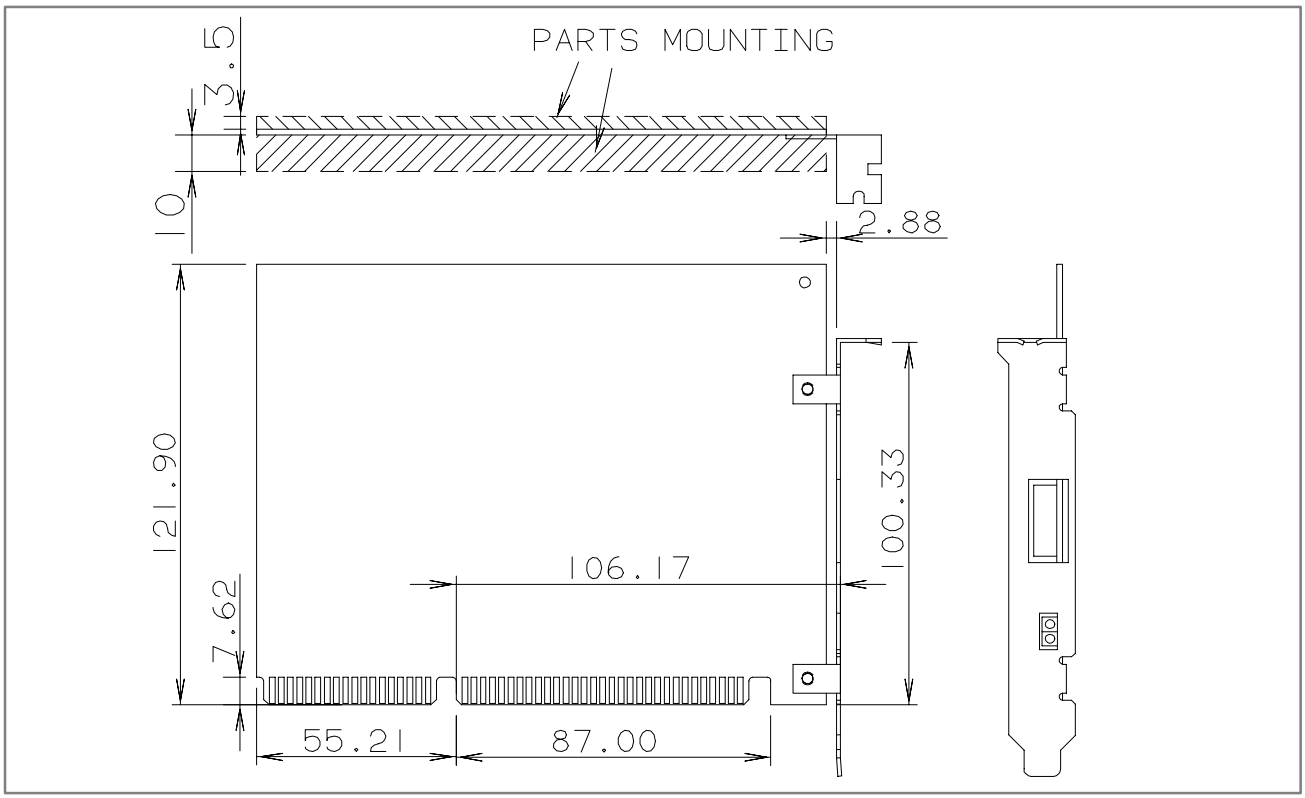


Fig. U21 (a) External dimensions of high–speed serial bus interface board type 2 (for PC)
Specification No.: A20B–8100–0100

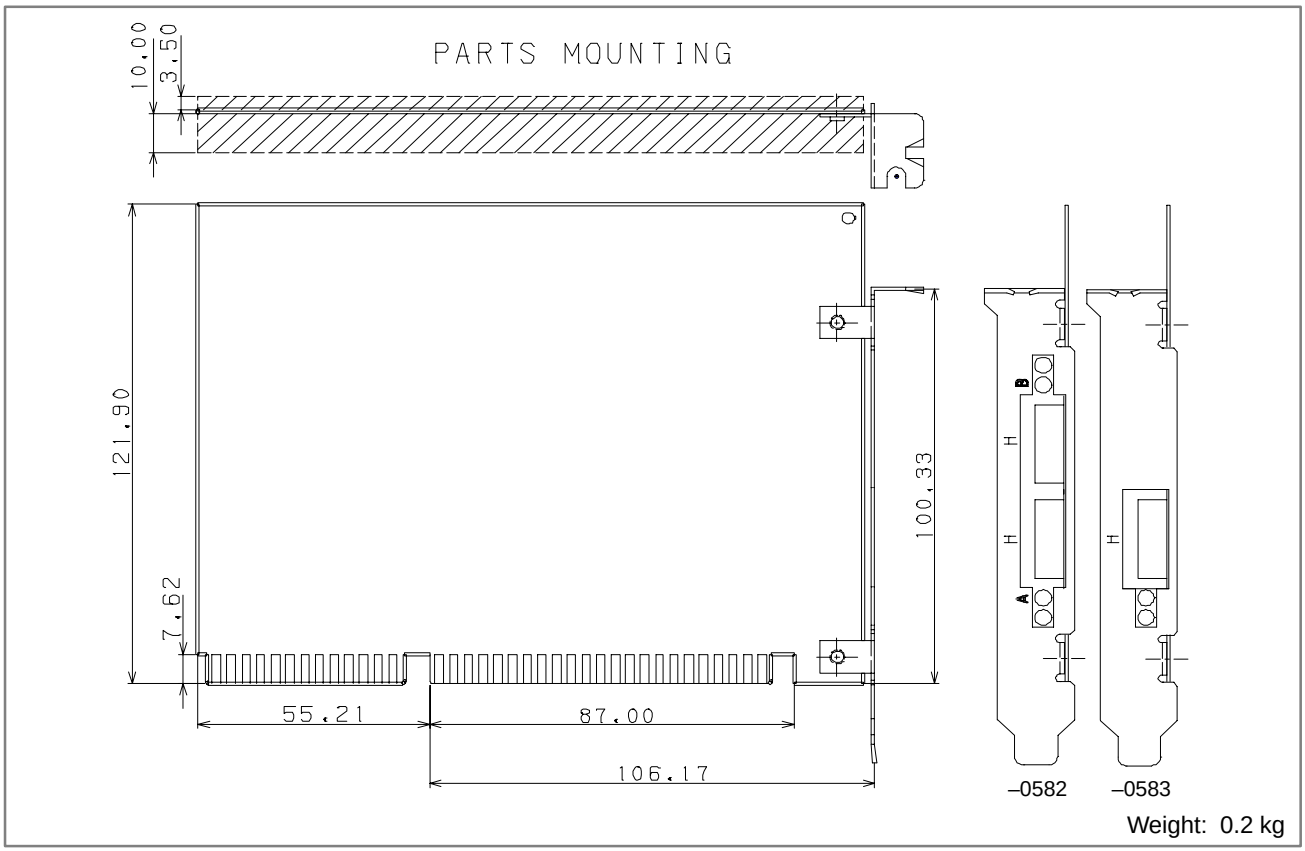
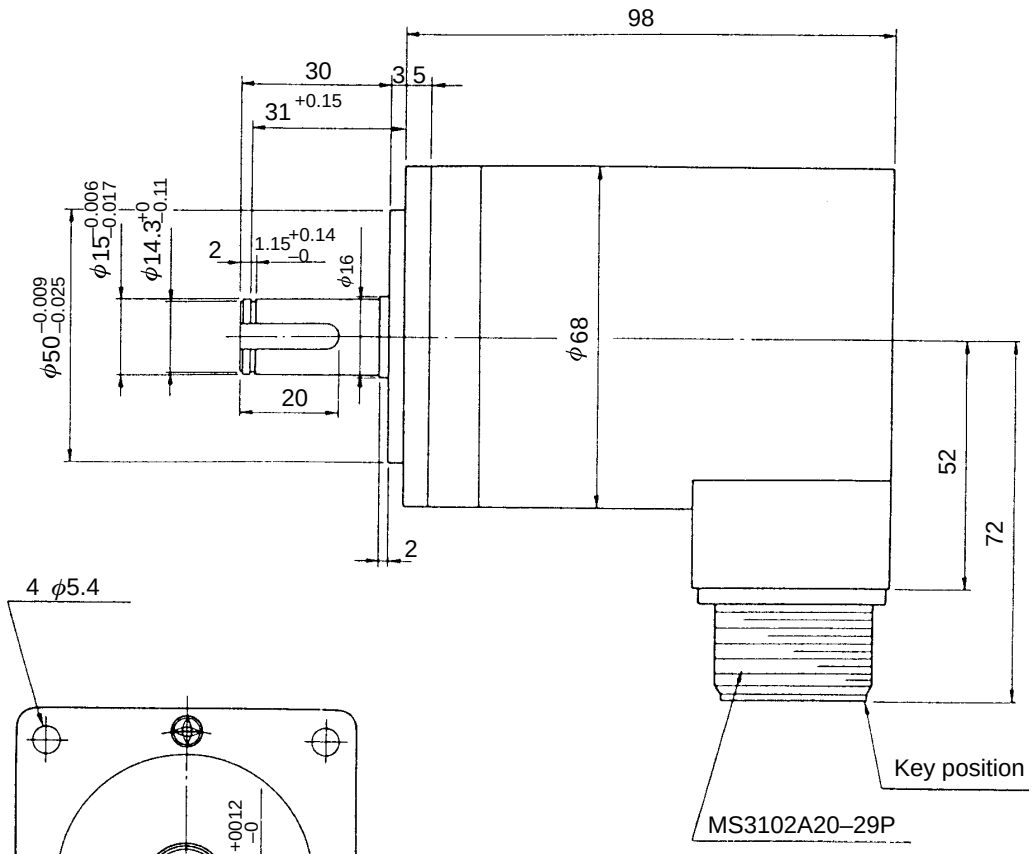


Fig. U21 (b) High–speed serial bus interface board type 2 (PC)
Specification No.: A20B–8001–0583 (1 CH)
A20B–8001–0582 (2 CH)



Note: Mechanical specifications of the position coder are as follows:

(1) Input axis inertia
1.0×10^{-3} kg·cm·sec^2 or less

(2) Input axis starting torque
1000 g·cm or less

(3) Allowable input axis load

	Radial load	Thrust load
Operating	10 kg or less	5 kg or less
Idle	20 kg or less	10 kg or less

Driving the timing belt with a pulley directly attached to the position coder shaft may produce an axis load greater than the allowed maximum.

(4) Weight: Approx. 1 kg (without the flange)

Fig. U22 (a) External dimensions of position coder
Specification No.: A86L–0027–0001#102 (Max. 4000 rpm)
A86L–0027–0001#002 (Max. 6000 rpm)

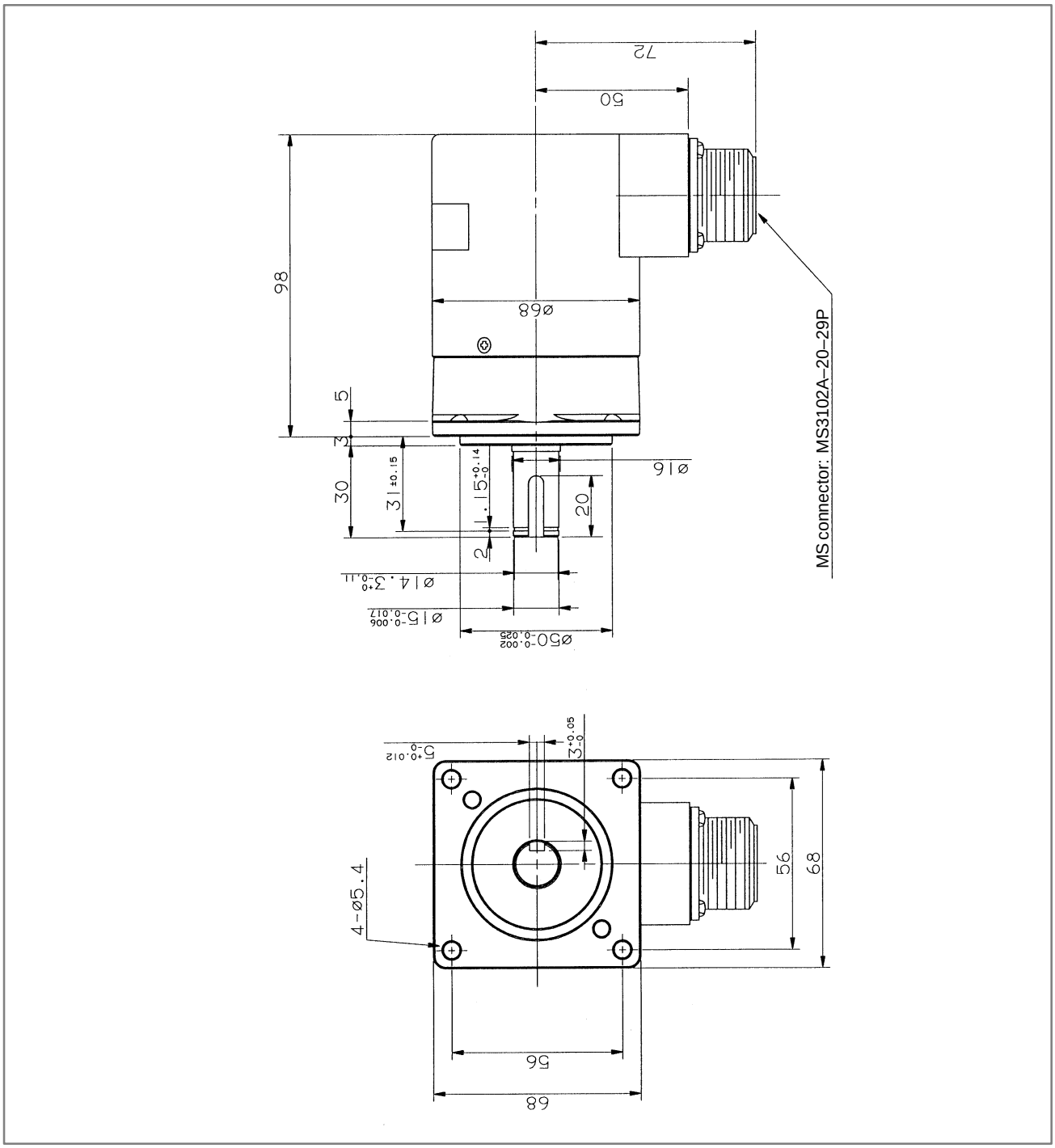


Fig. U22 (b) α position coder
Specification No.: A860–0309–T302 (10000 rpm maximum)

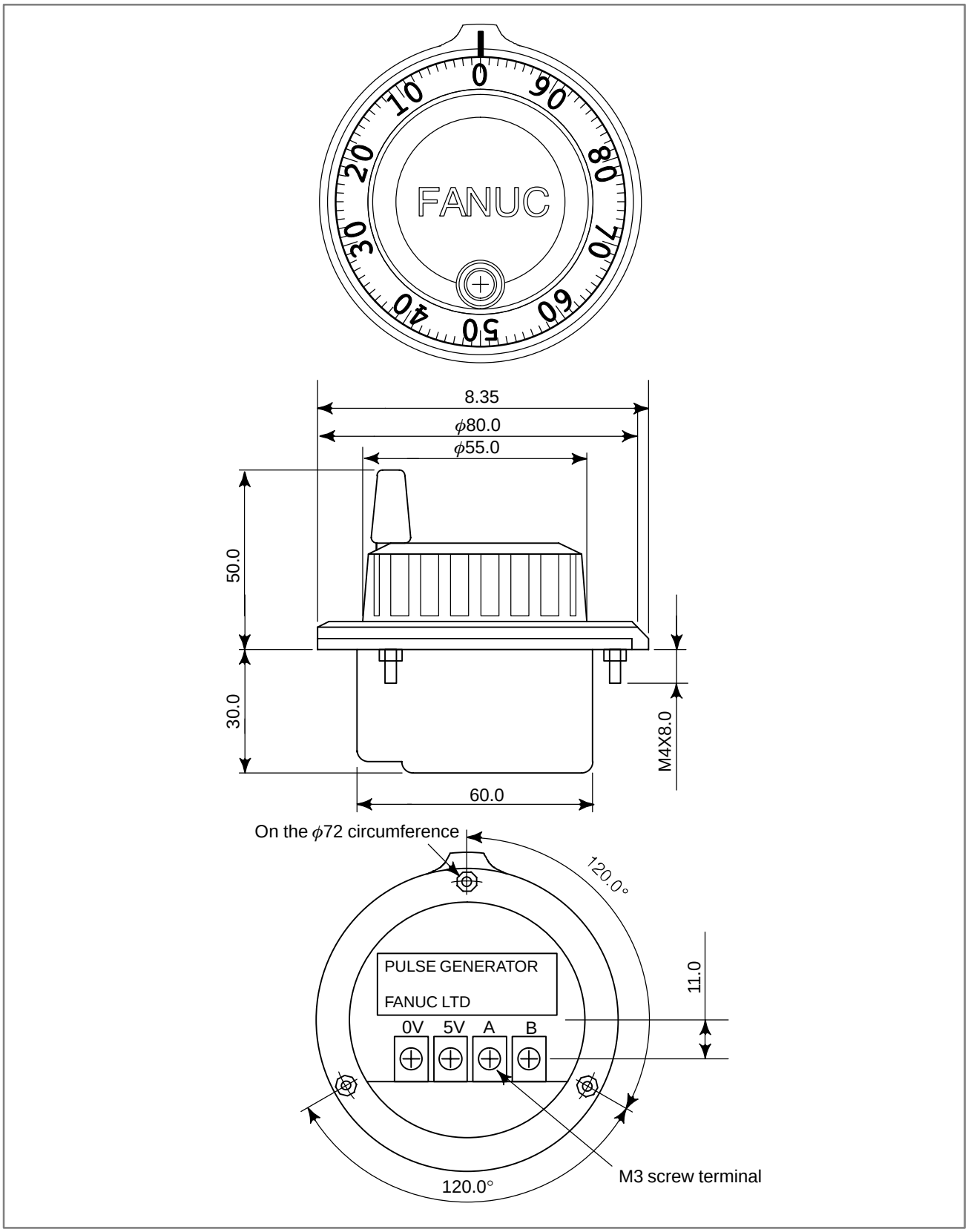


Fig. U23 External dimensions of manual pulse generator
Specification No.: A860–0202–T001

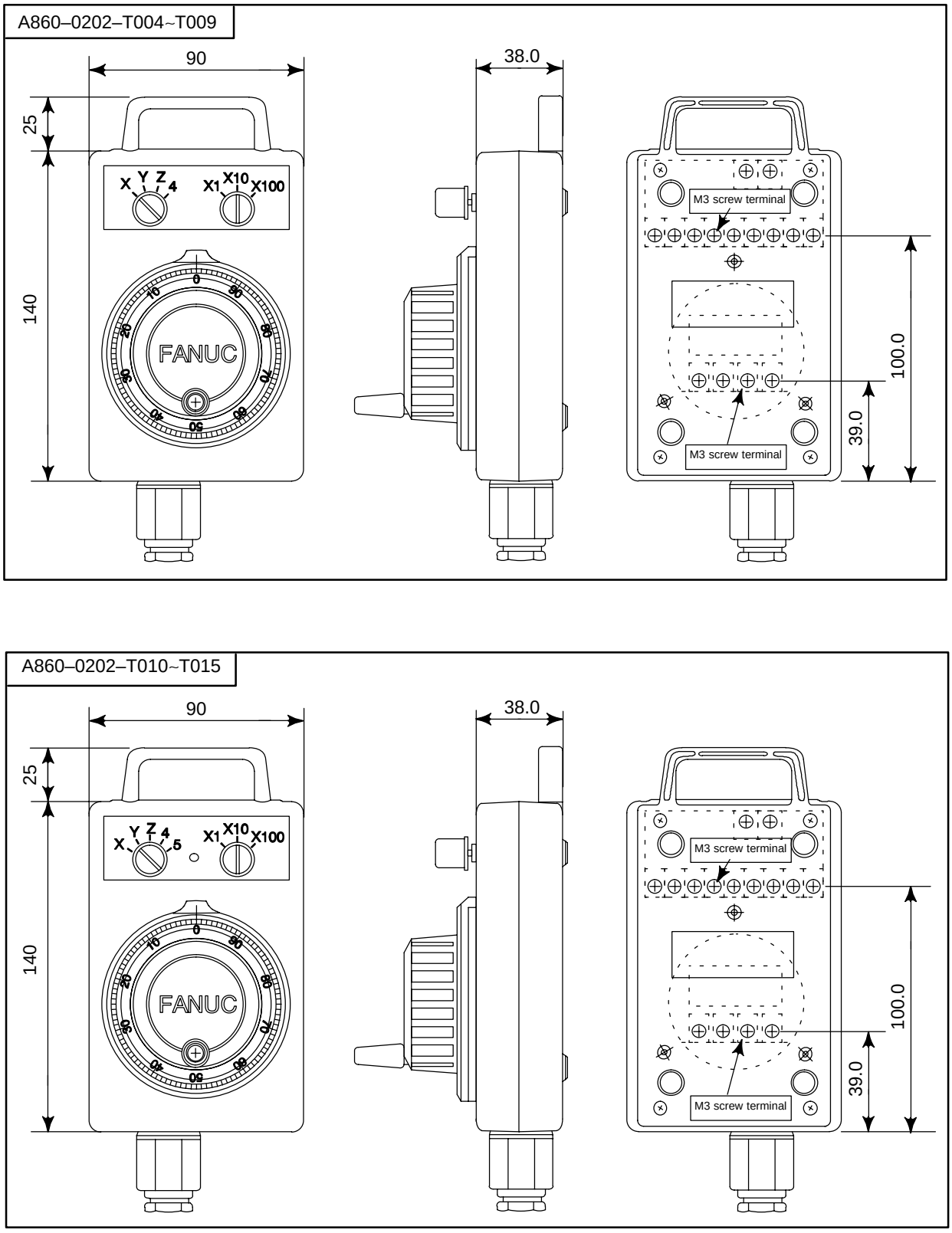


Fig. U24 External dimensions of pendant–type manual pulse generator
Specification No.: A860–0202–T004 to TT015

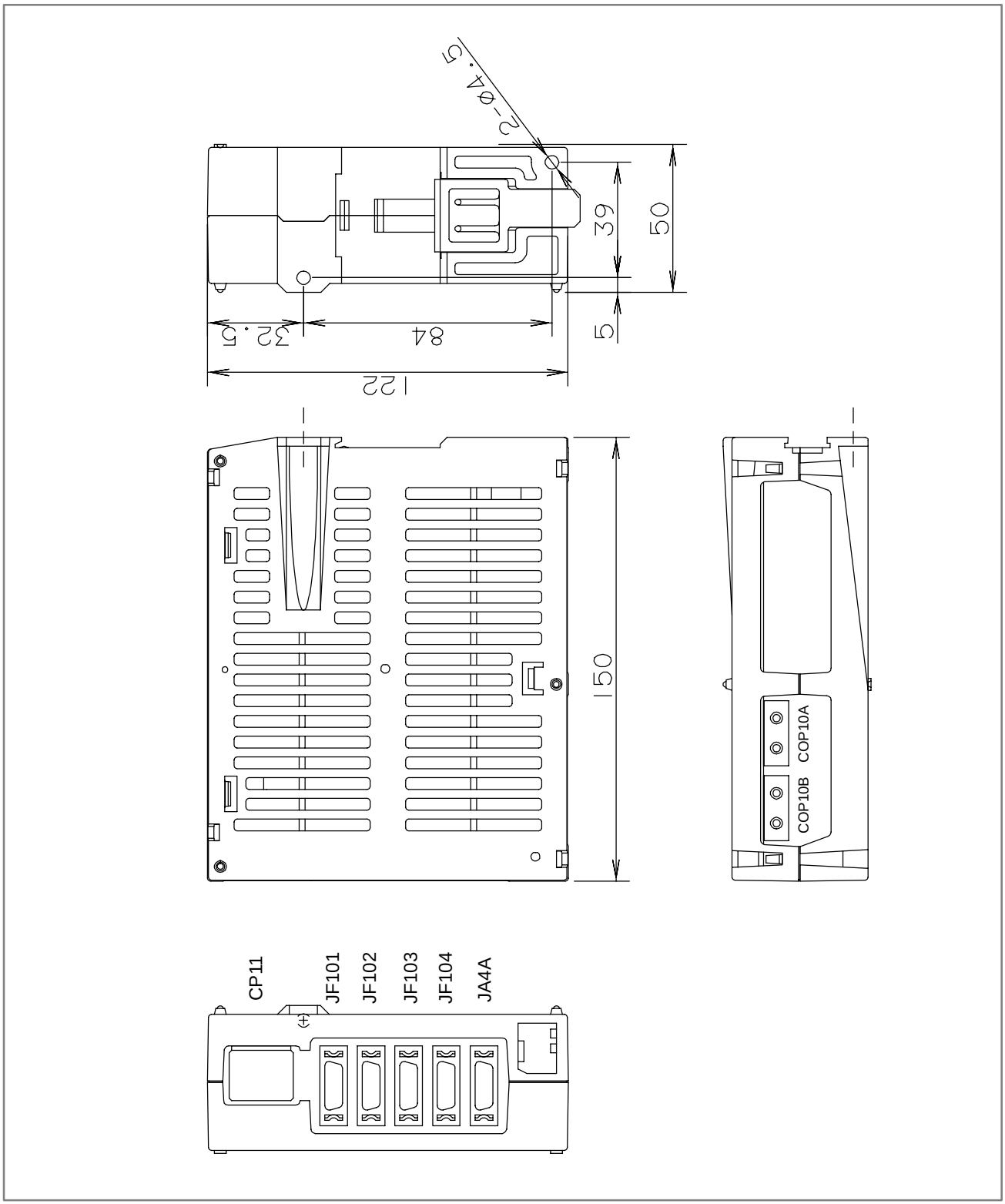


Fig. U25 External dimensions of separate detector interface unit

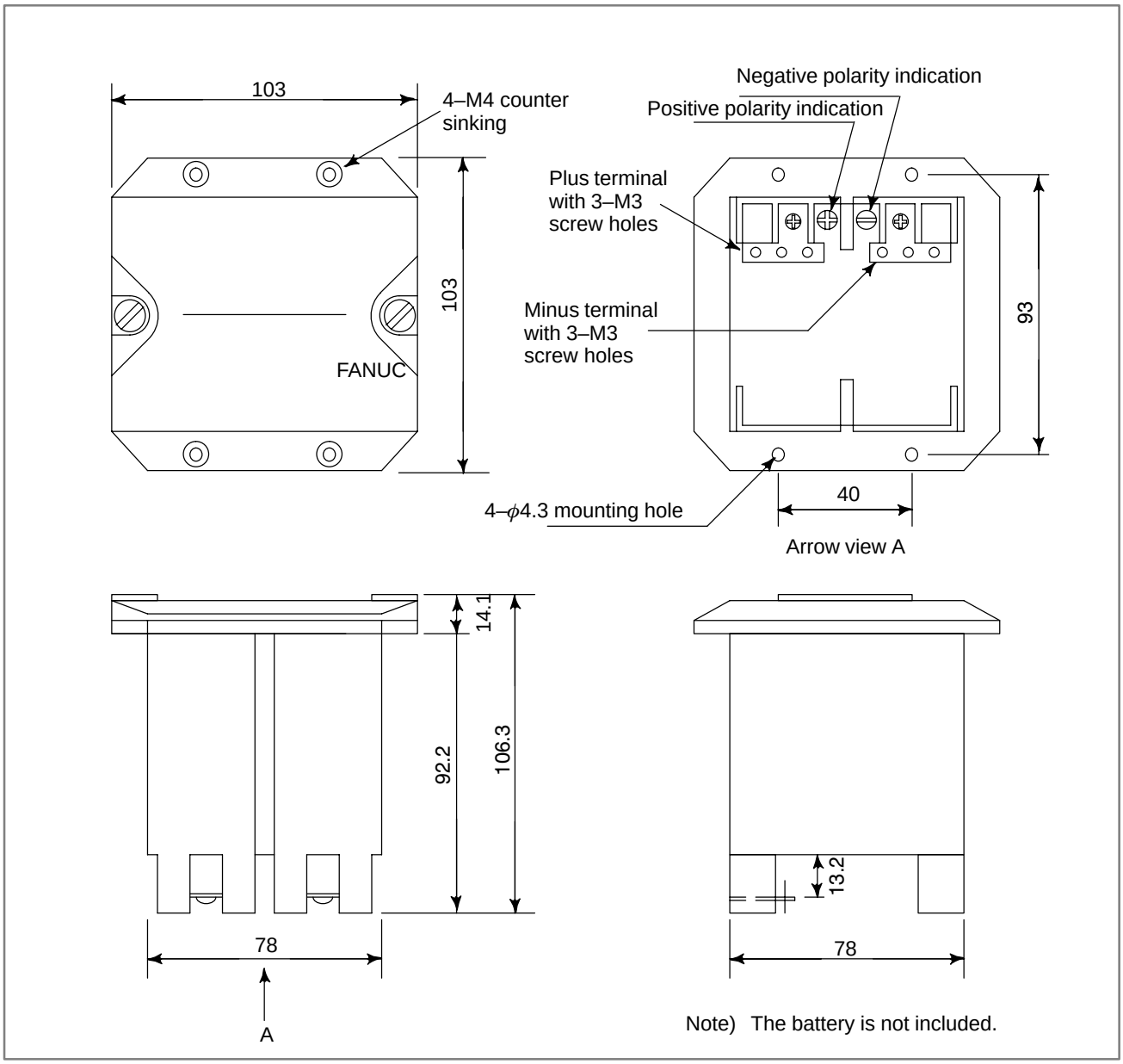


Fig. U26 External dimensions of ABS battery case for separate detector
Specification No.: A06B–6050–K060

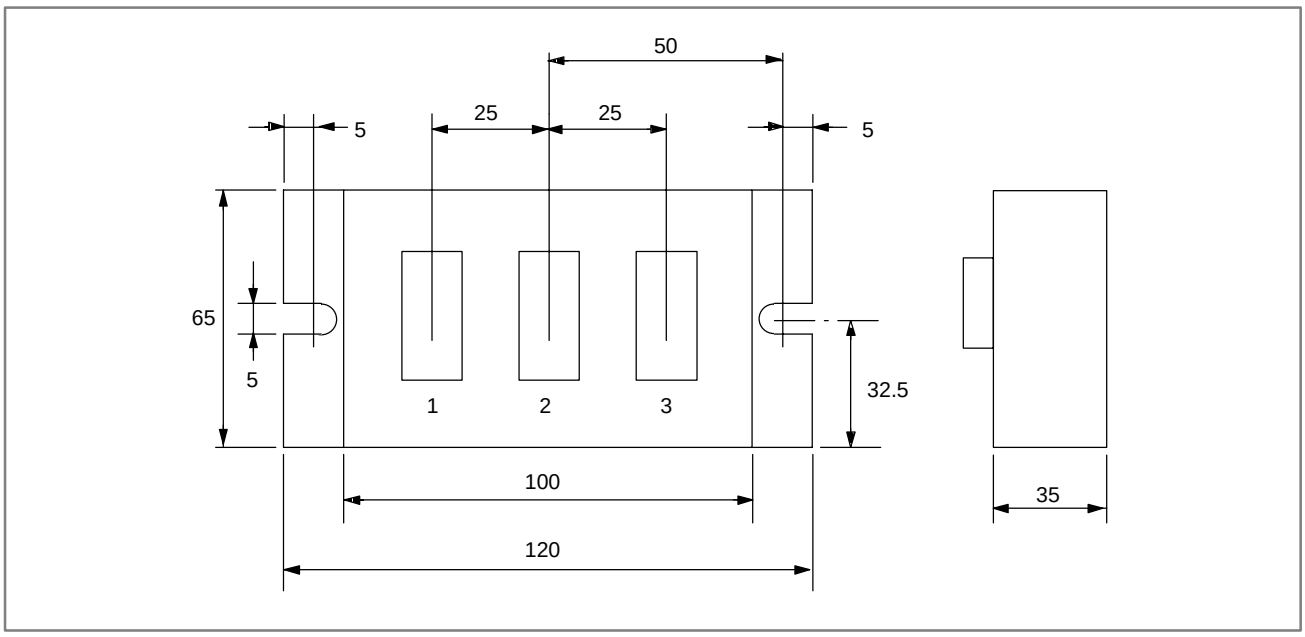


Fig. U27 External dimensions of tap

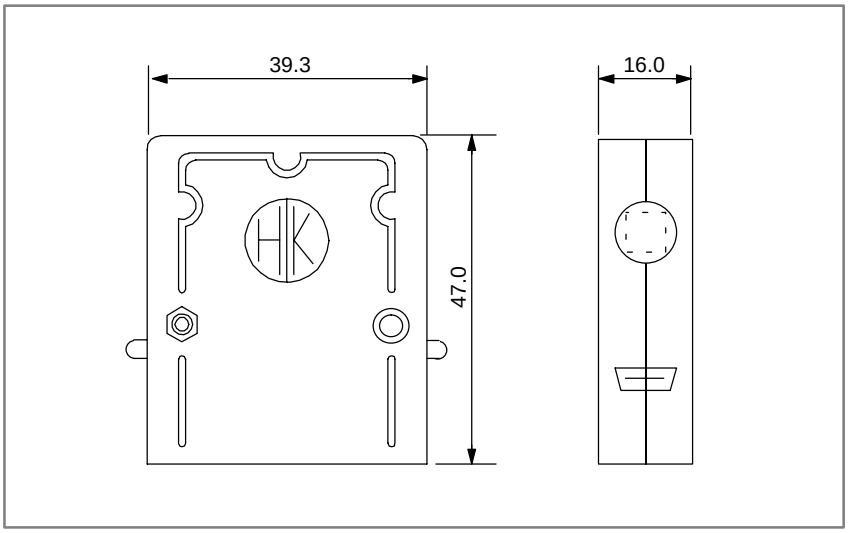


Fig. U28 External dimensions of terminal resistance unit

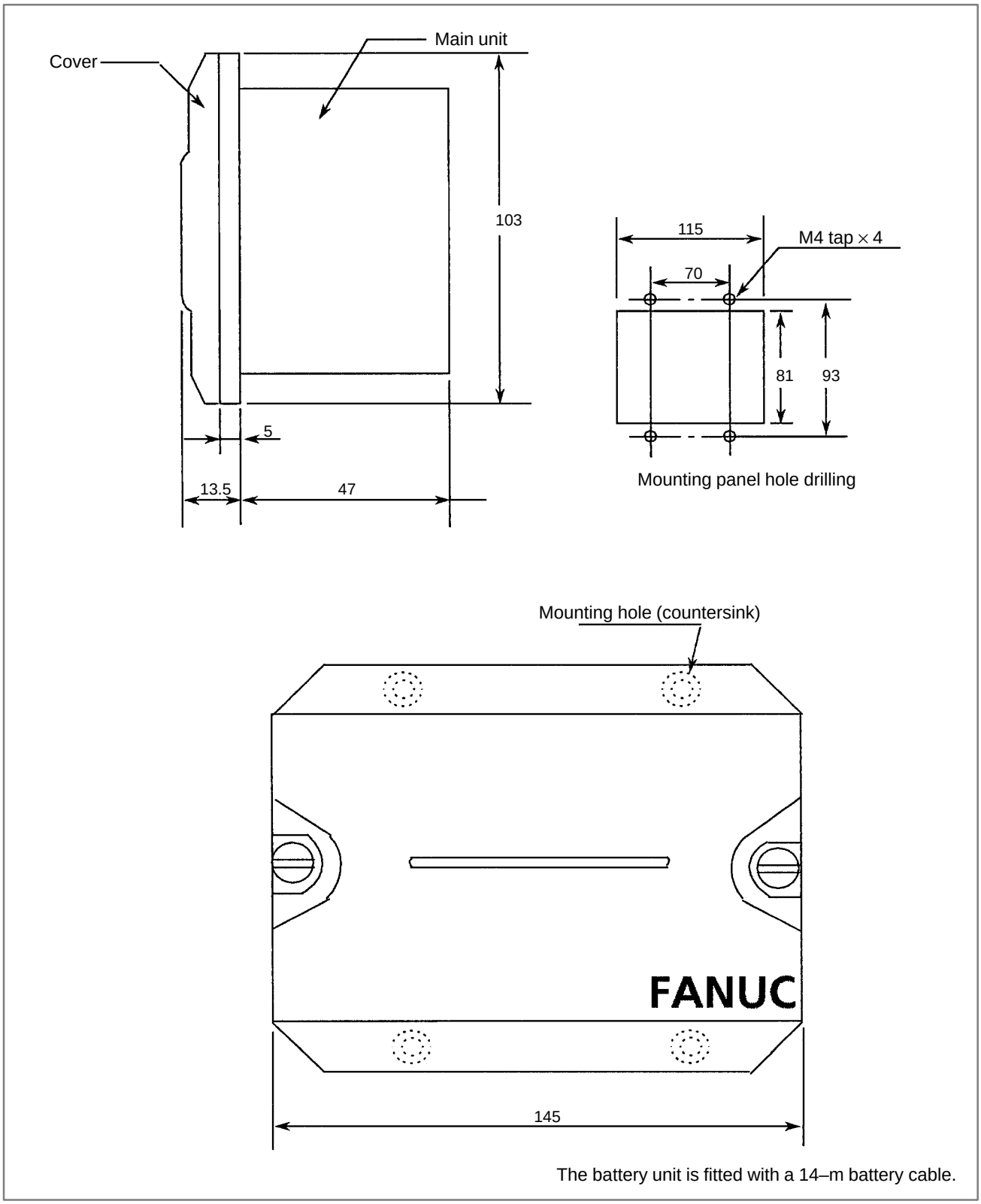


Fig. U29 External dimensions of external CNC battery unit

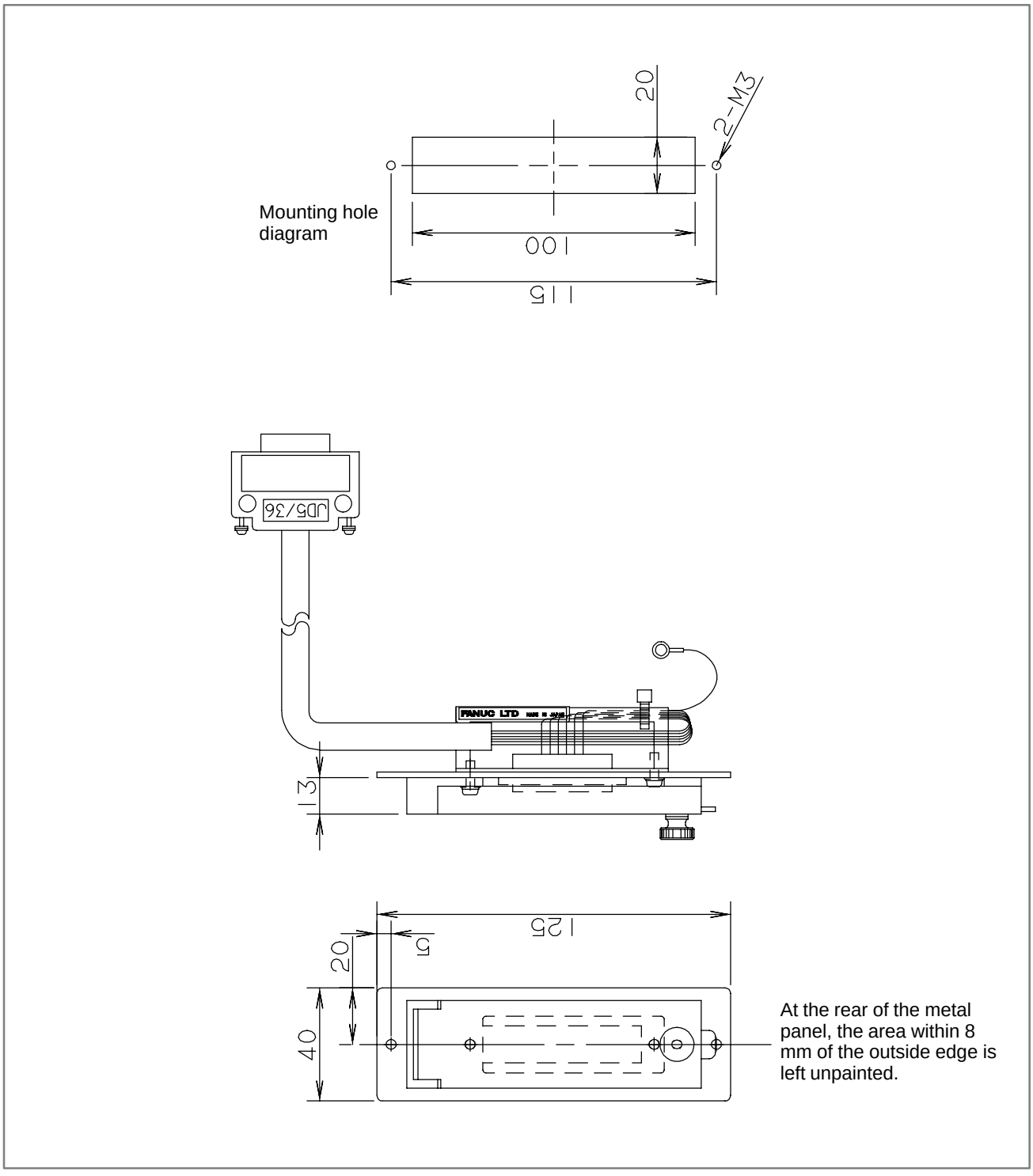
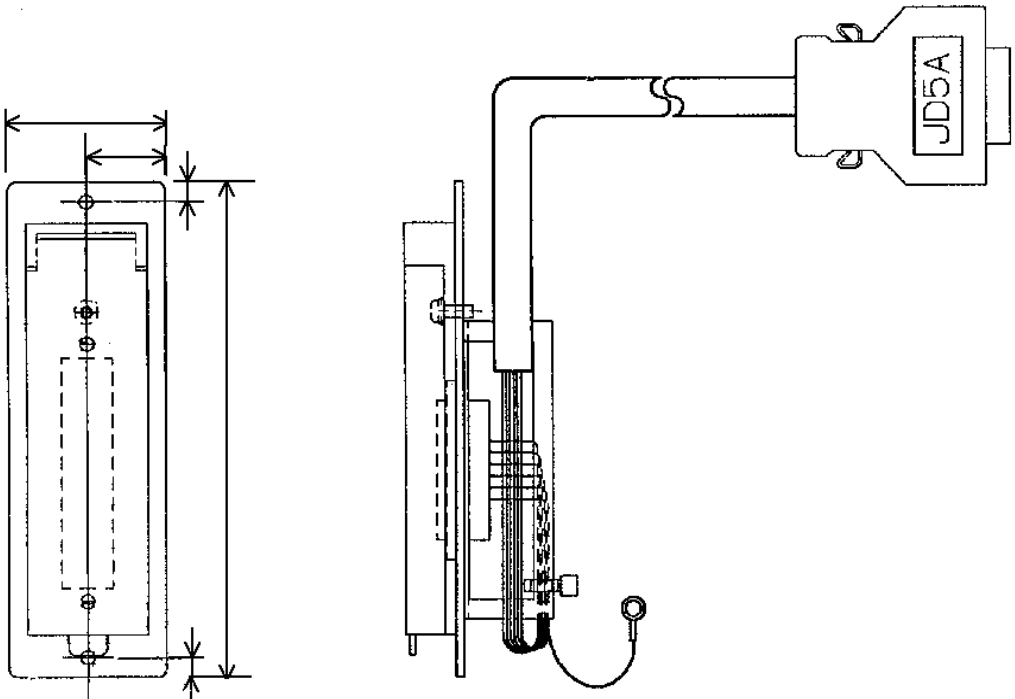


Fig. U30 External dimensions of punch panel (narrow type)



Painting shall be masked 8 mm from the edges of the panel sheet metal on the rear surface.

The following is the panel cut layout drawing of this punch panel.

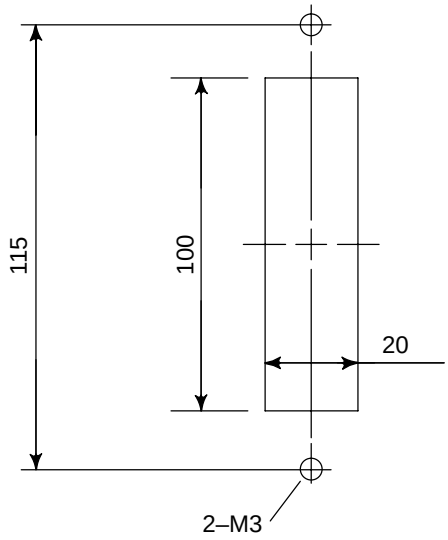


Fig. U31 Punch Panel (Narrow Type)
Specification No.: A02B–0120–C191 (cable length 1 m)
A02B–0120–C192 (cable length 2 m)
A02B–0120–C193 (cable length 5 m)

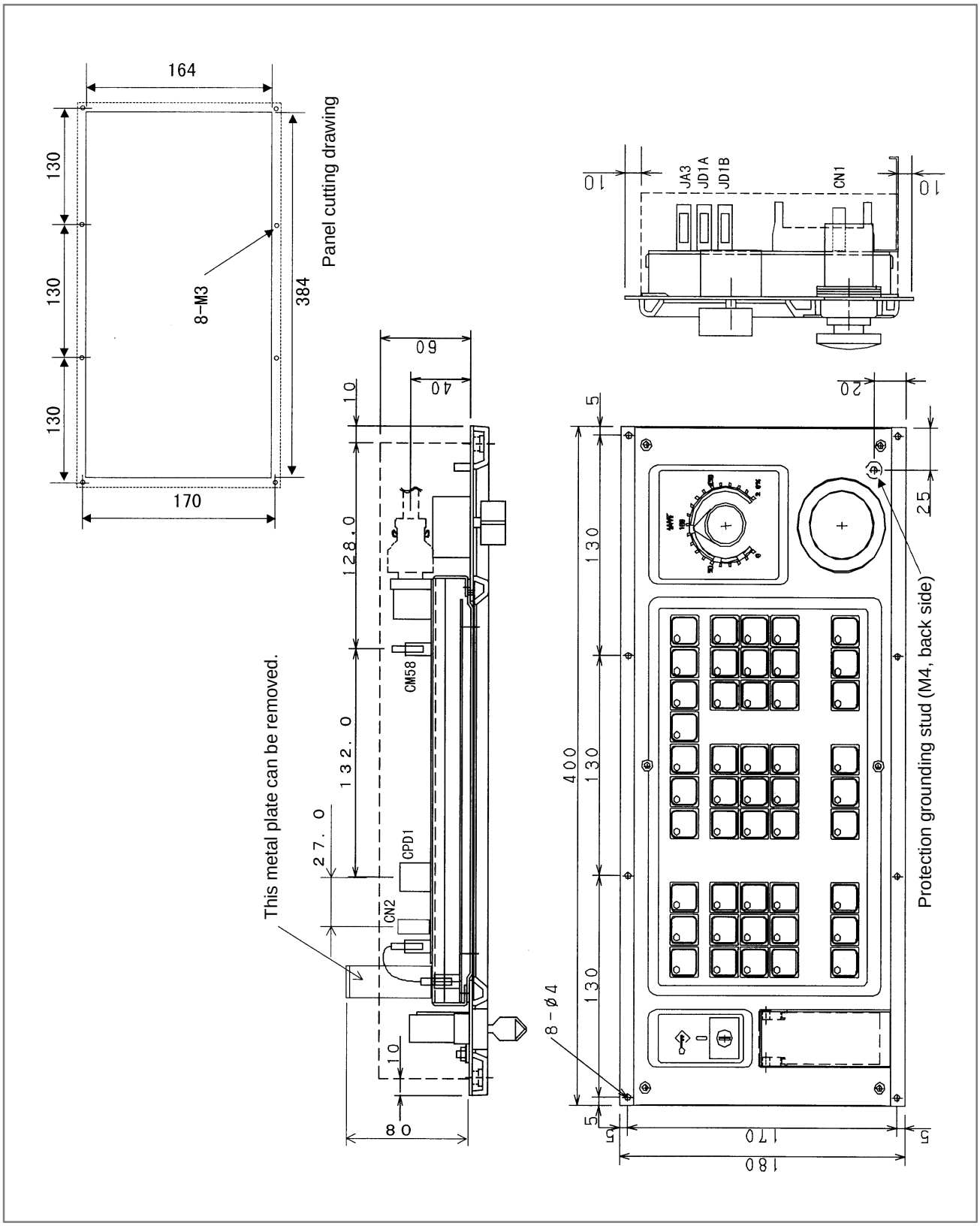


Fig. U32 Distribution I/O small machine operator's panel

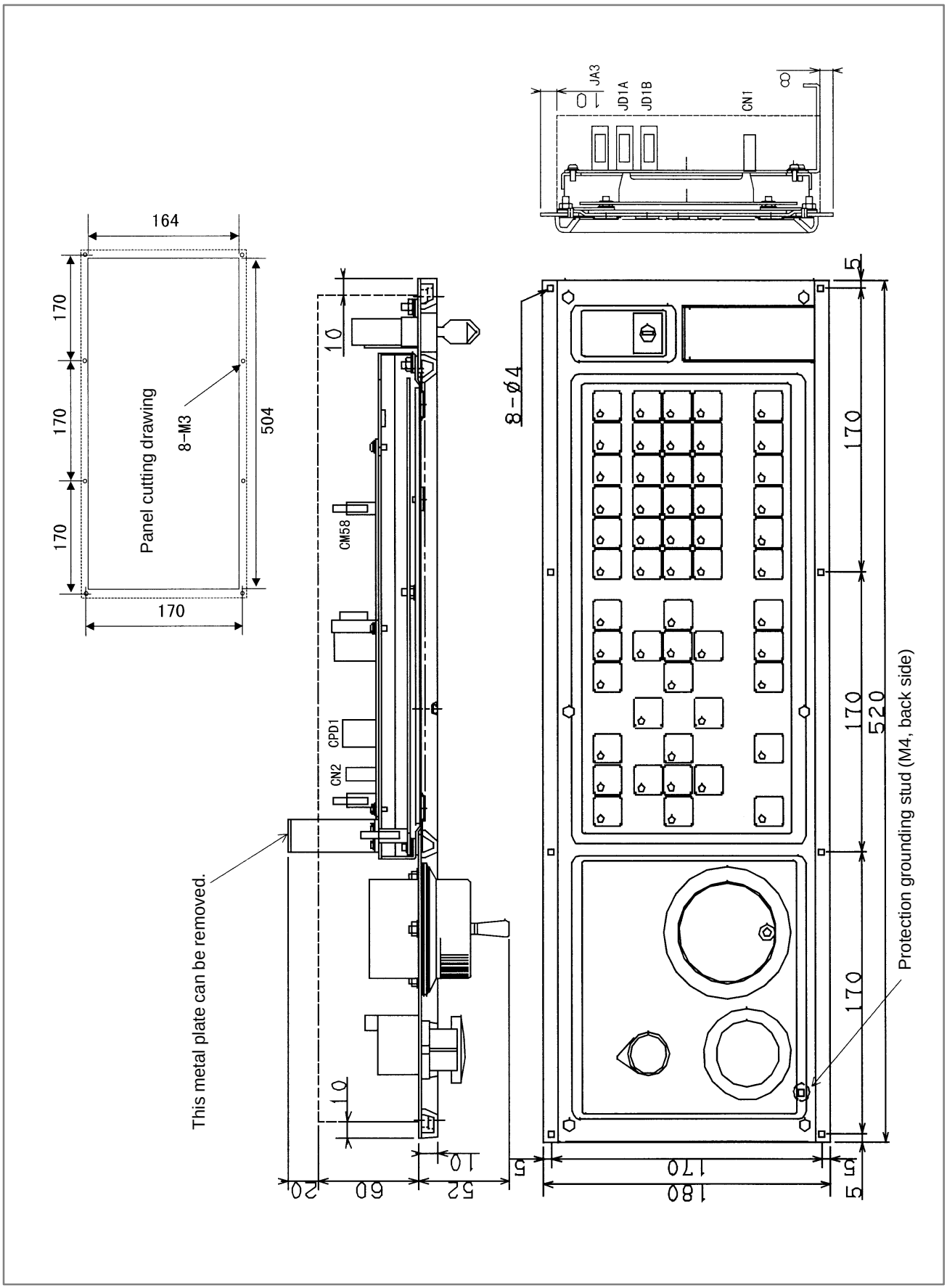


Fig. U33 Distribution I/O standard machine operator’s panel

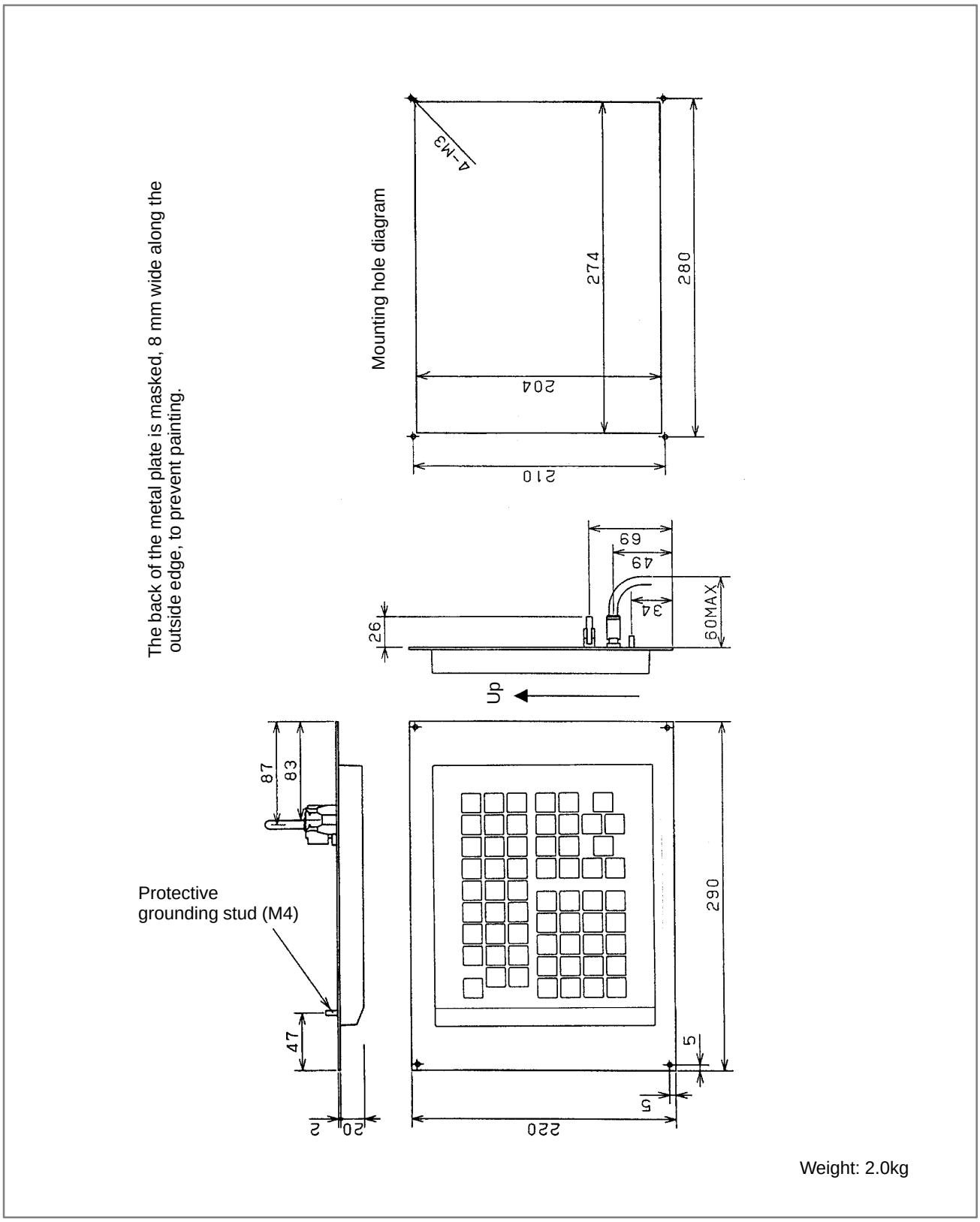


Fig. U34 61–key MDI unit (vertical type)

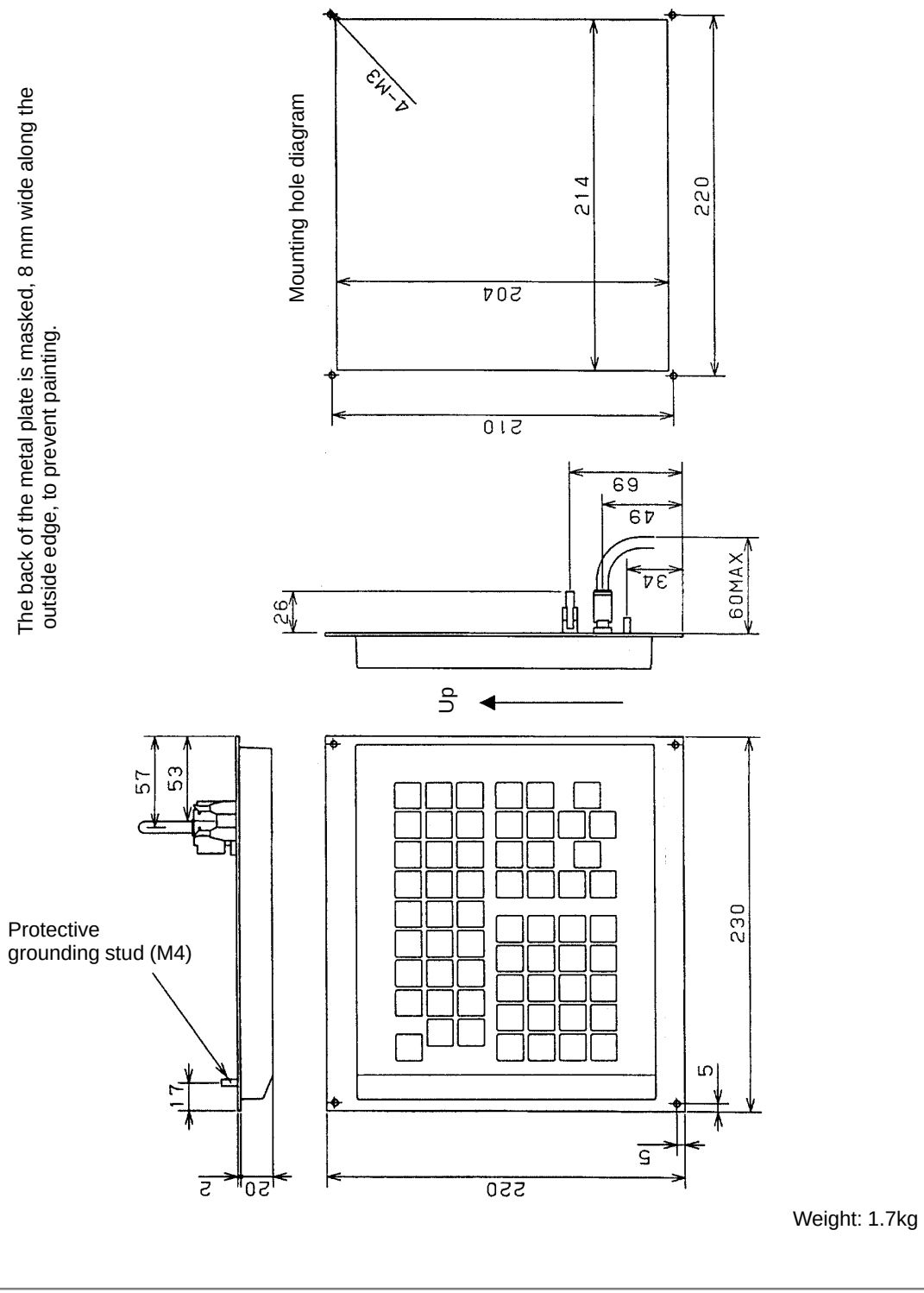


Fig. U35 61–key MDI unit (horizontal type)

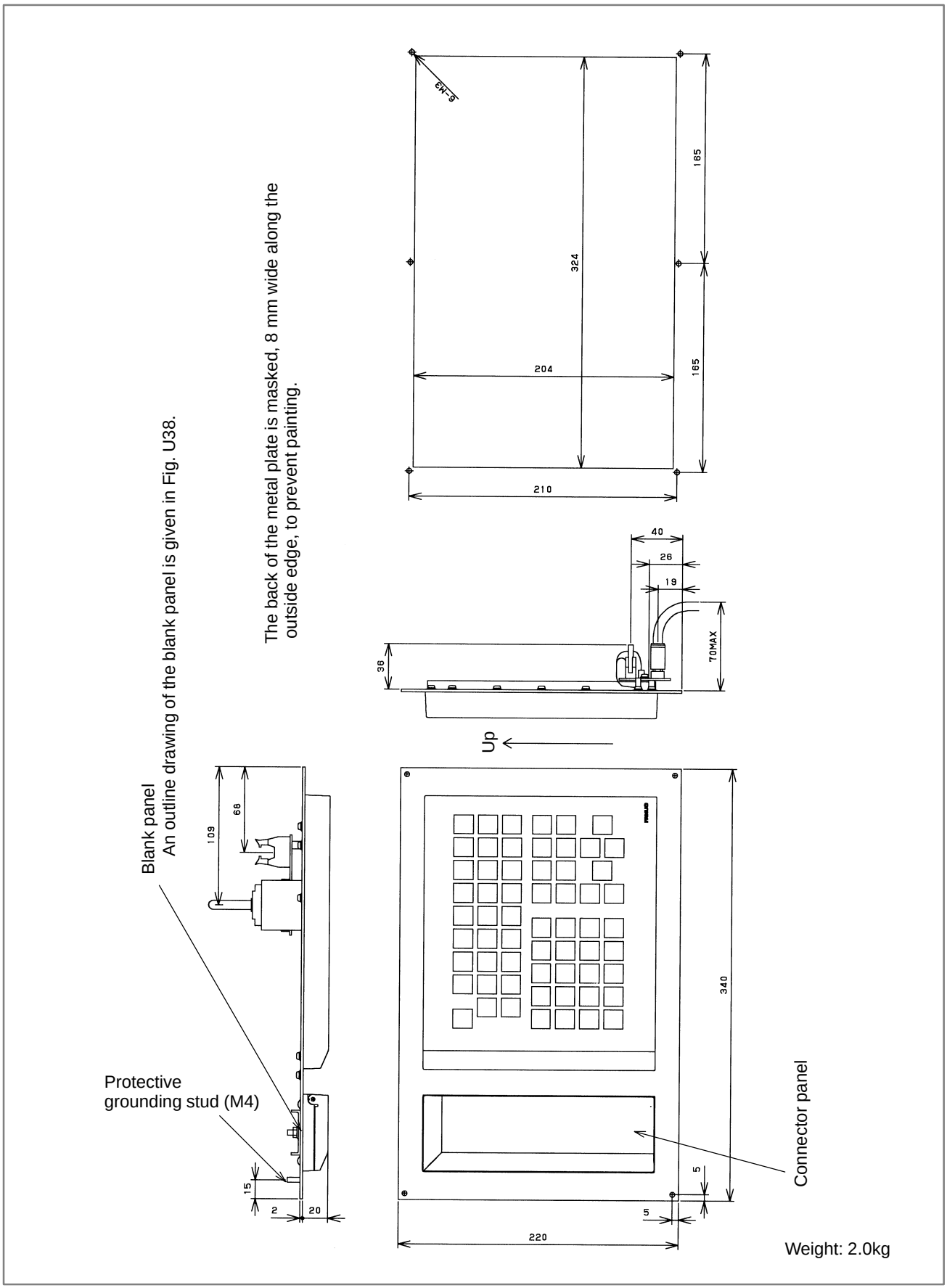


Fig. U36 61–key MDI unit (vertical type)

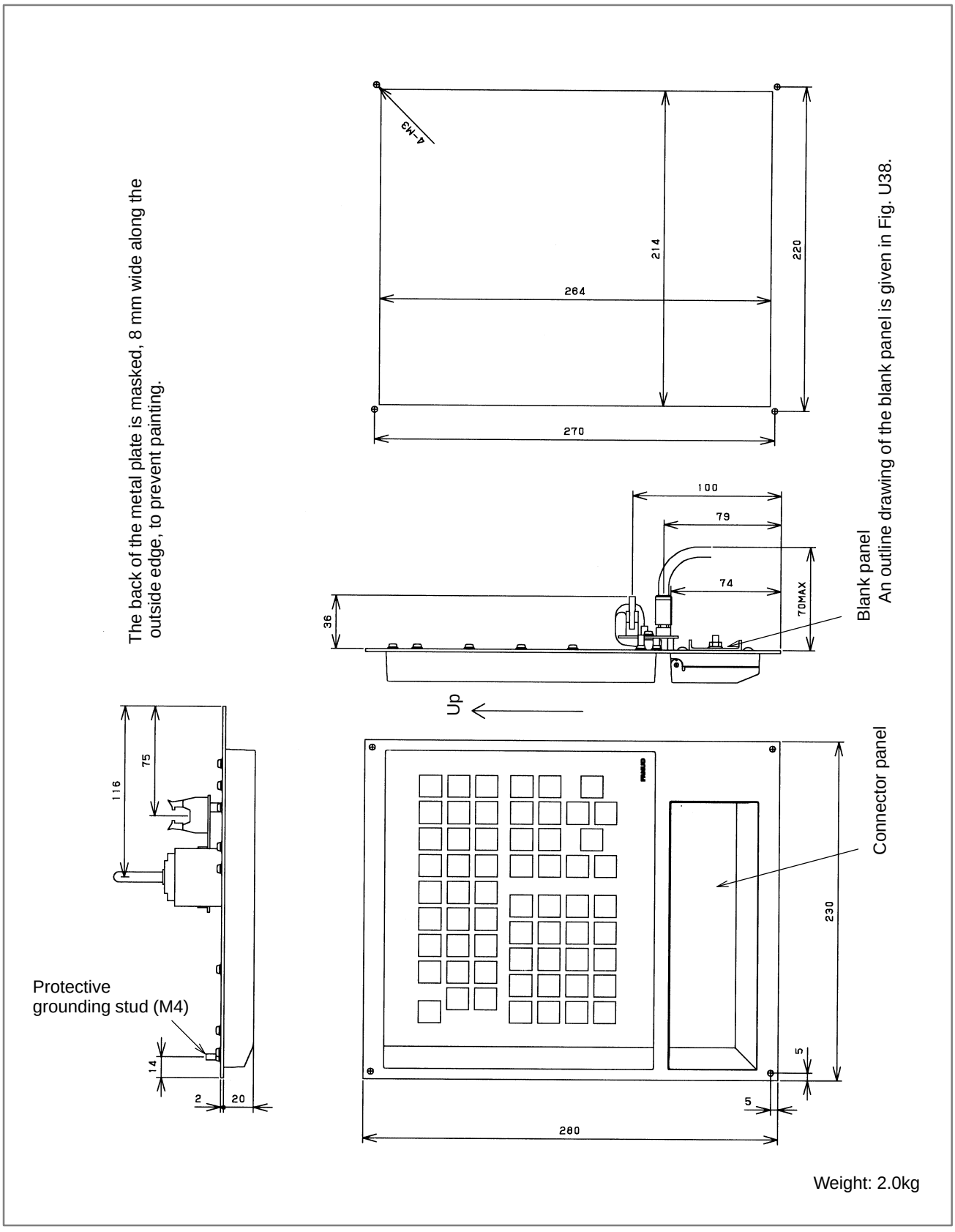


Fig. U37 61–key MDI unit (horizontal type)

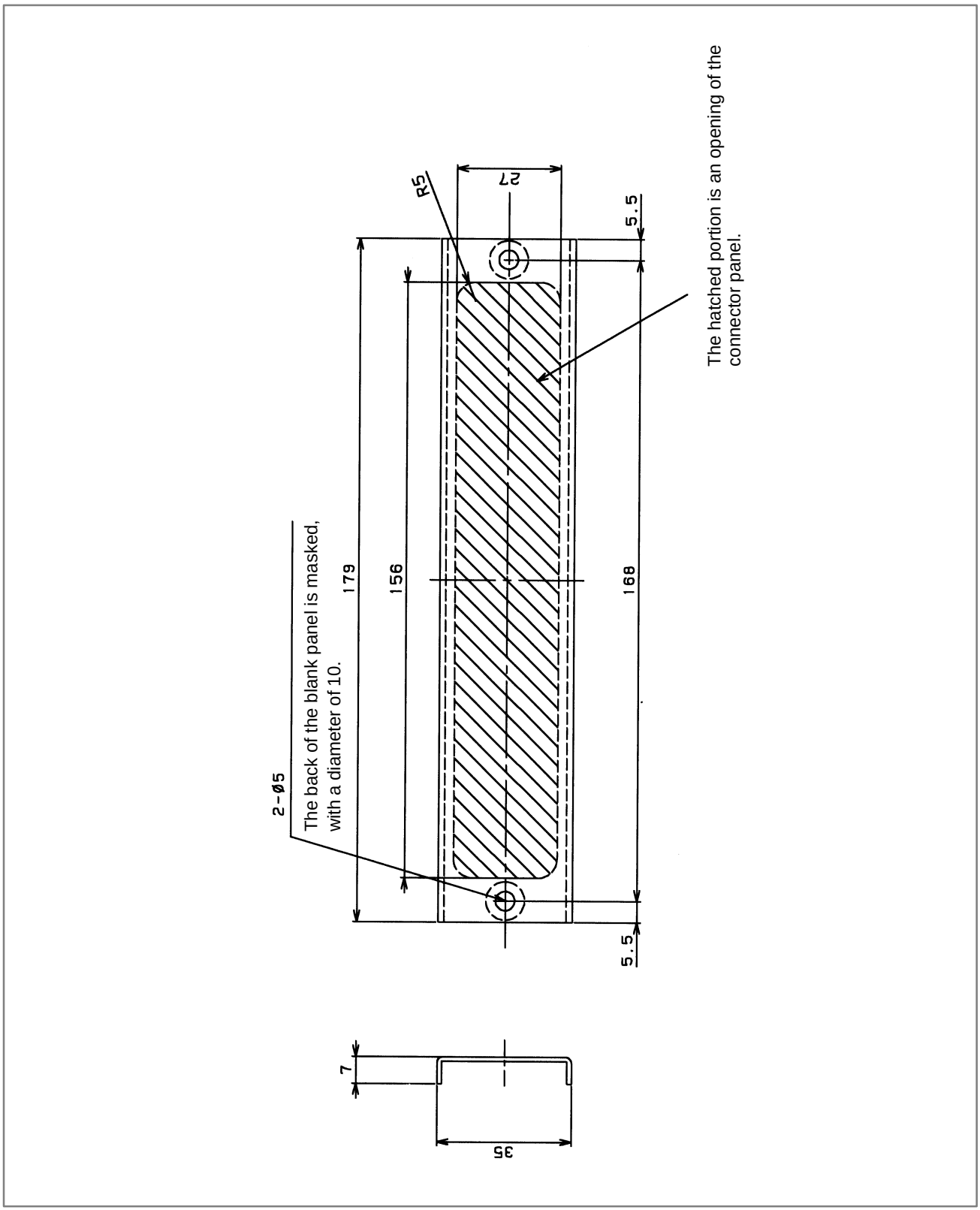


Fig. U38 Blank panel

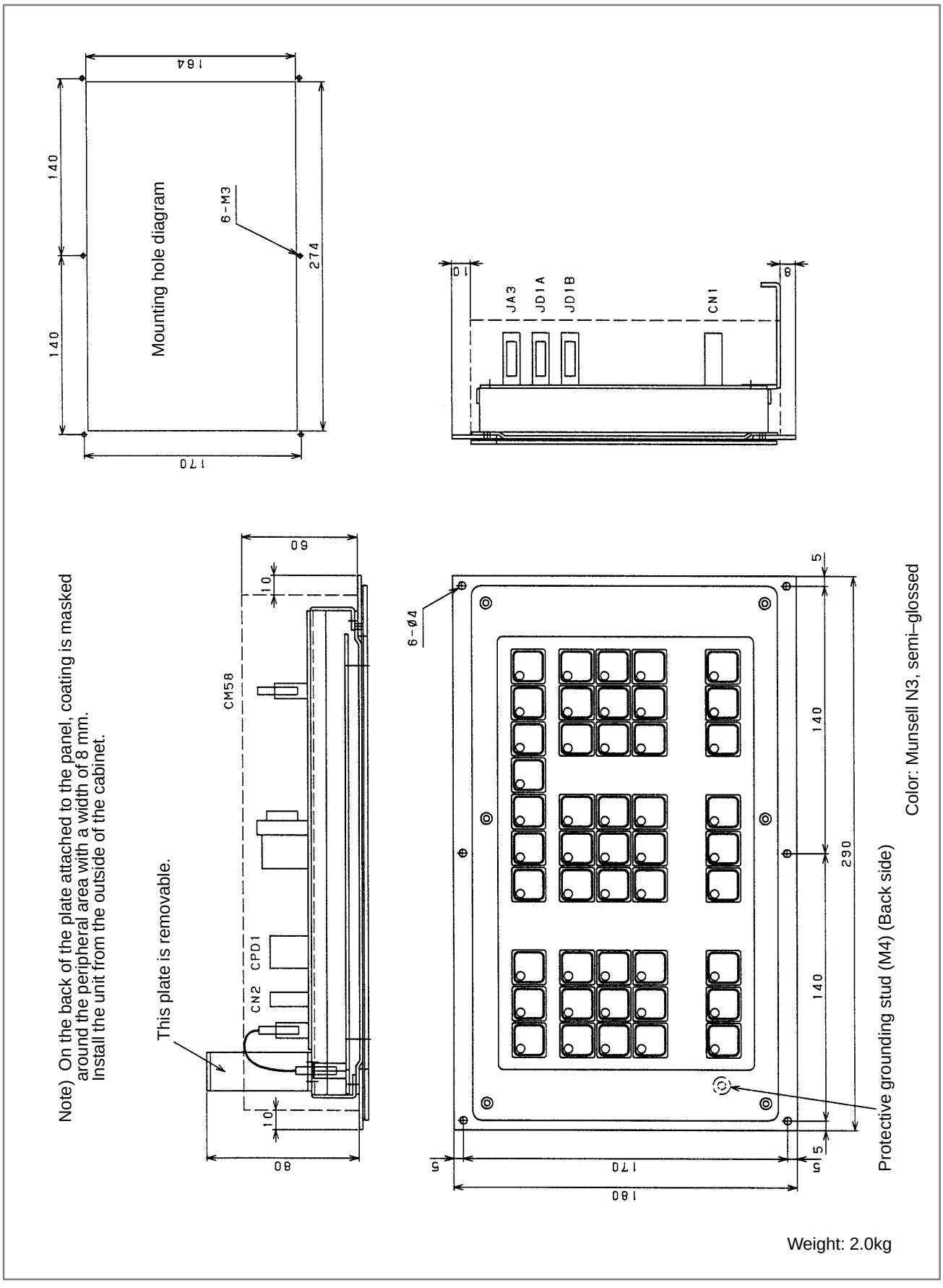
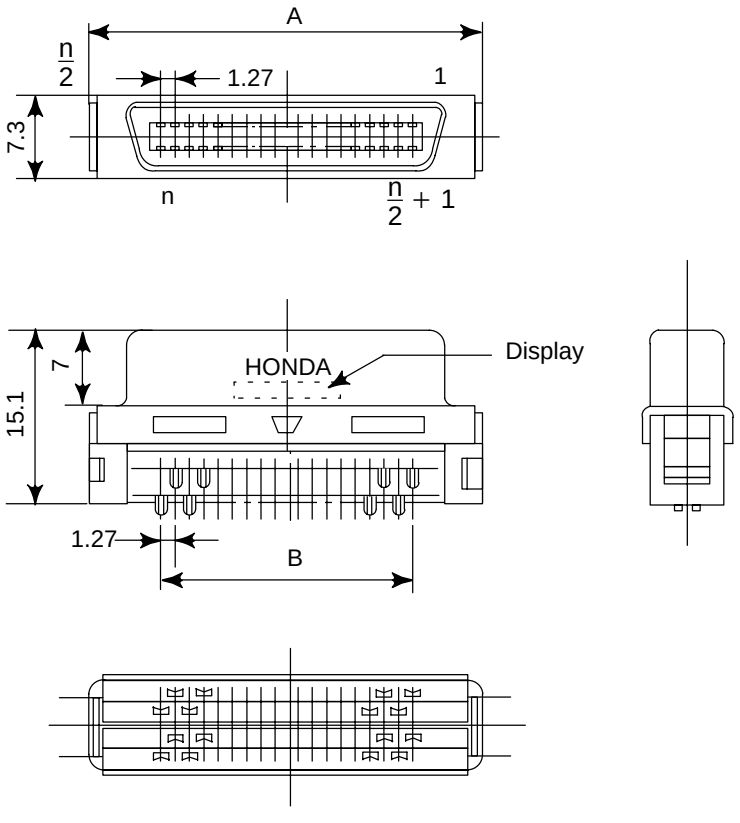


Fig. U39 Distributed I/O machine operator's panel (290 mm wide)

Connectors

Fig. title	Specification No.	Fig. No.
PCR connector (soldering type)	PCR–E20FS	Fig.C1 (a)
FI40 connector	FI40–2015S	Fig.C1 (b)
Connector case (HONDA PCR type)	PCR–V20LA/PCR–V20LB	Fig.C2 (a)
Connector case (HIROSE FI type)	FI–20–CV	Fig.C2 (b)
Connector case (FUJITSU FCN type)	FCN–240C20–Y/S	Fig.C2 (c)
Connector case (HIROSE PCR type)	FI–20–CV7	Fig.C2 (d)
AMP connector (1) for servo side	AMP1–178128–3	Fig.C3 (a)
AMP connector (2) for servo side	AMP2–178128–3	Fig.C3 (b)
AMP connector (3) for +24 V power supply	AMP1–178128–3	Fig.C3 (c)
AMP connector (4) for +24 V power supply	AMP2–178288–3	Fig.C3 (d)
Contact for AMP connector	AMP1–175218–2/5 AMP1–175218–2/5	Fig.C3 (e)
HONDA connector (case)		Fig.C4 (a)
HONDA connector (angled case)		Fig.C4 (b)
HONDA connector (male)		Fig.C4 (c)
HONDA connector (female)		Fig.C4 (d)
HONDA connector (terminal layout)		Fig.C4 (e)
Connector (Burndy Japan)(3 pins/brown)	SMS3PN–5	Fig.C5
Connector for HIROSE flat cable	HIF3BB–50D–2.54R HIT3BB–34D–2.54R	Fig.C6
Connector (Japan Aviation Electronics)(for MDI)	LY10–DC20	Fig.C7 (a)
Contact (Japan Aviation Electronics)(for MDI)	LY10–C2–3	Fig.C7 (b)
Punch panel connector for reader/punch interface		Fig.C8 (a)
Locking plate for reader/punch interface connector		Fig.C8 (b)
Honda connector (for distribution I/O connection printed circuit board)	MRH–50FD	Fig. C9
AMP connector (for loader I/O board)	AMP178214–1	Fig. C10
	A02B–0166–K330	Fig. C11

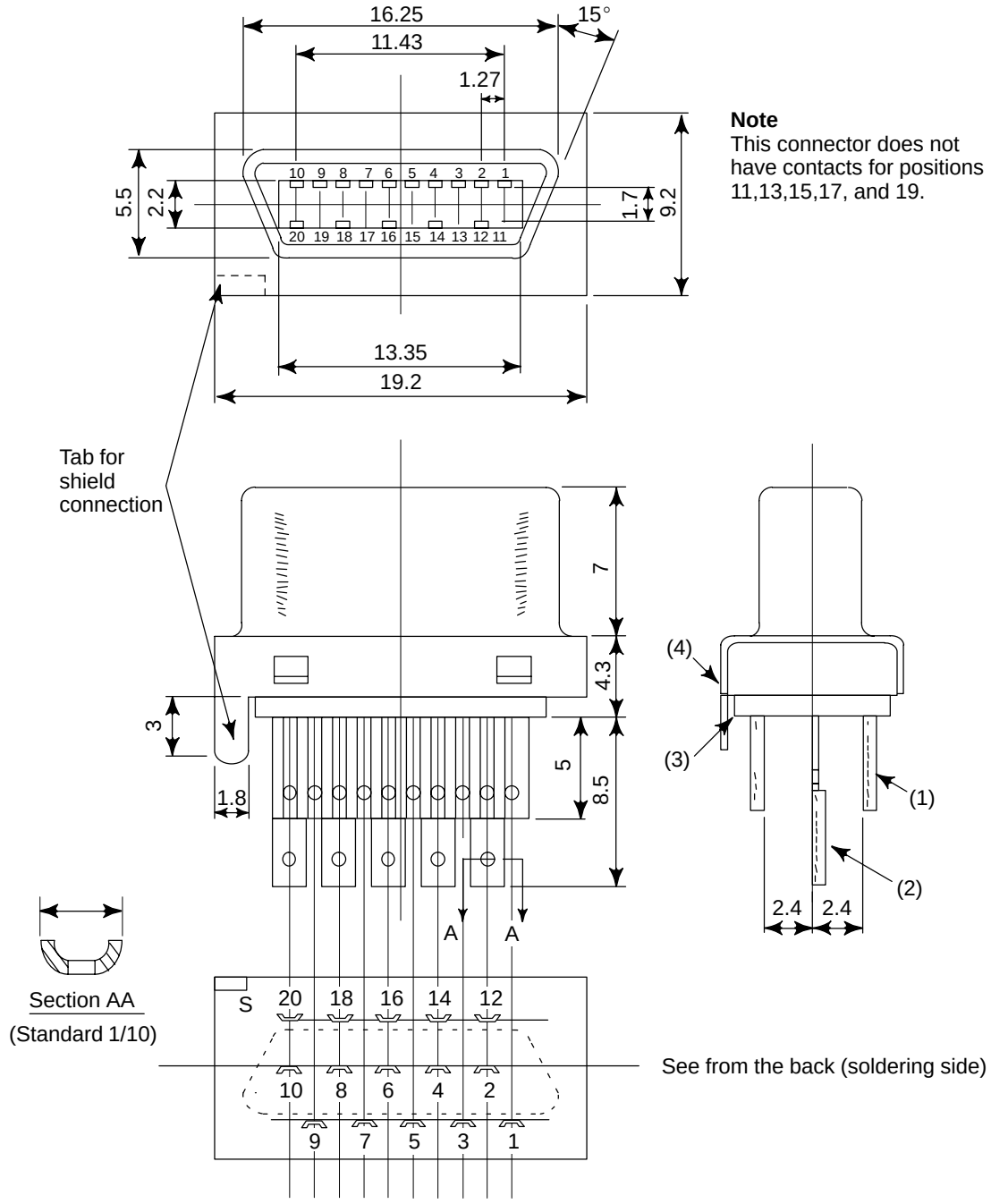
TYPE : HONDA PCR–E20FS (SOLDERING TYPE)
USAGE : GENERAL
MATING
HOUSING : HONDA PCR–E20L (PLASTIC)



	A	B
PCR–E20FS	21.65	11.43

Fig. C1 (a) PCR connector (soldering type)

TYPE : HIROSE FI40–2015S
USAGE : PULSE CODER INTERFACE
LINEAR SCALE INTERFACE
MPG INTERFACE
MATING/HOUSING : HIROSE FI–20–CV



Note
This connector does not have contacts for positions 11,13,15,17, and 19.

Fig. C1 (b) FI40 connector

TYPE : HONDA PCR–V20LA (for 6 dia. cable)
USAGE : GENERAL

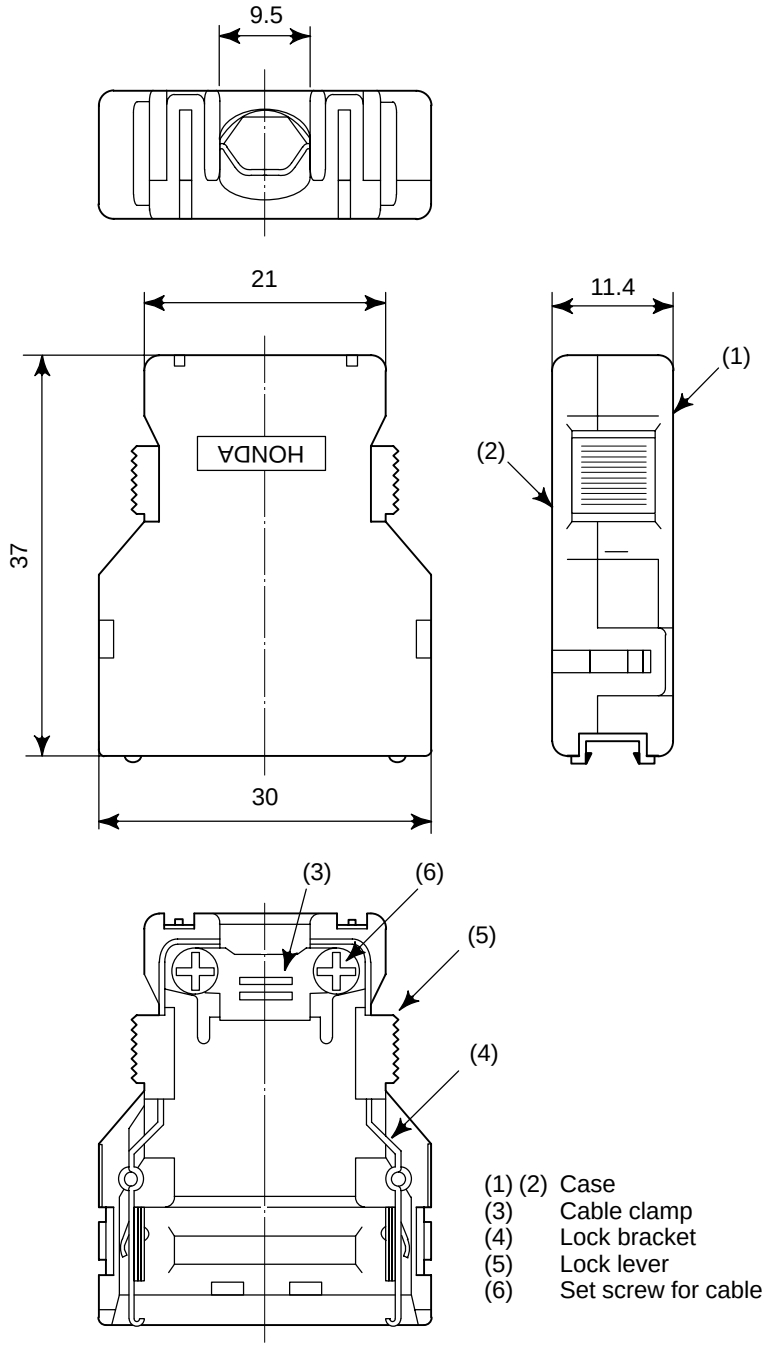


Fig. C2 (a) Connector case (HONDA PCR type)

TYPE : HIROSE FI–20–CV
USAGE : PULSE CODER INTERFACE
LINEAR SCALE INTERFACE
MANUAL PULSE GENERATOR INTERFACE

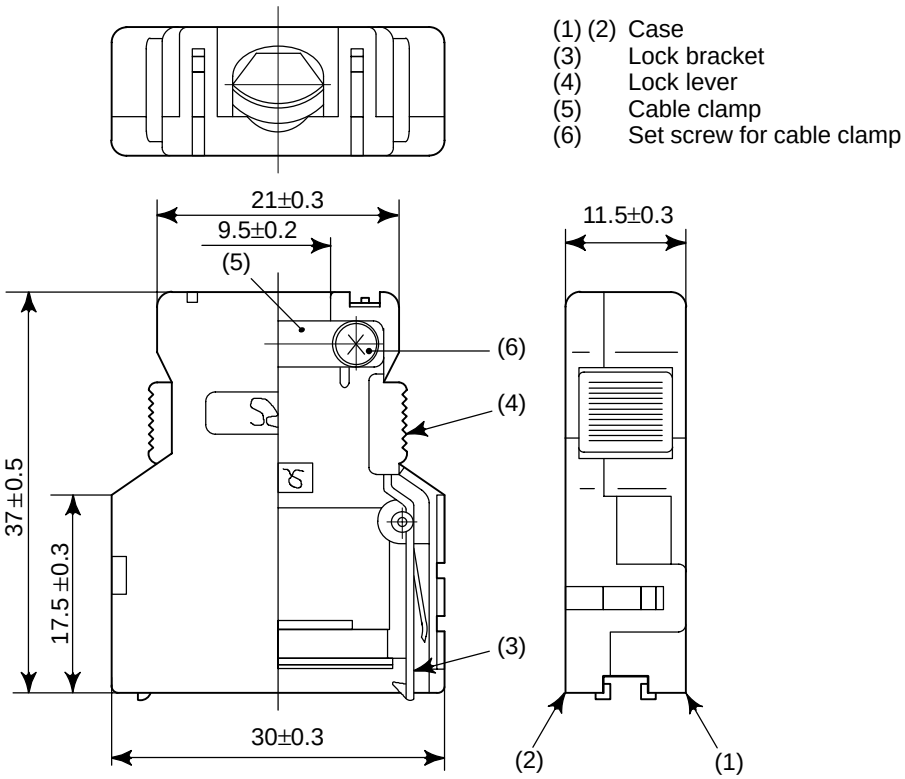


Fig. C2 (b) Connector case (HIROSE FI type)

TYPE : FUJITSU FCN–240C20–Y/S (for 5.8 dia. cable)
USAGE : GENERAL

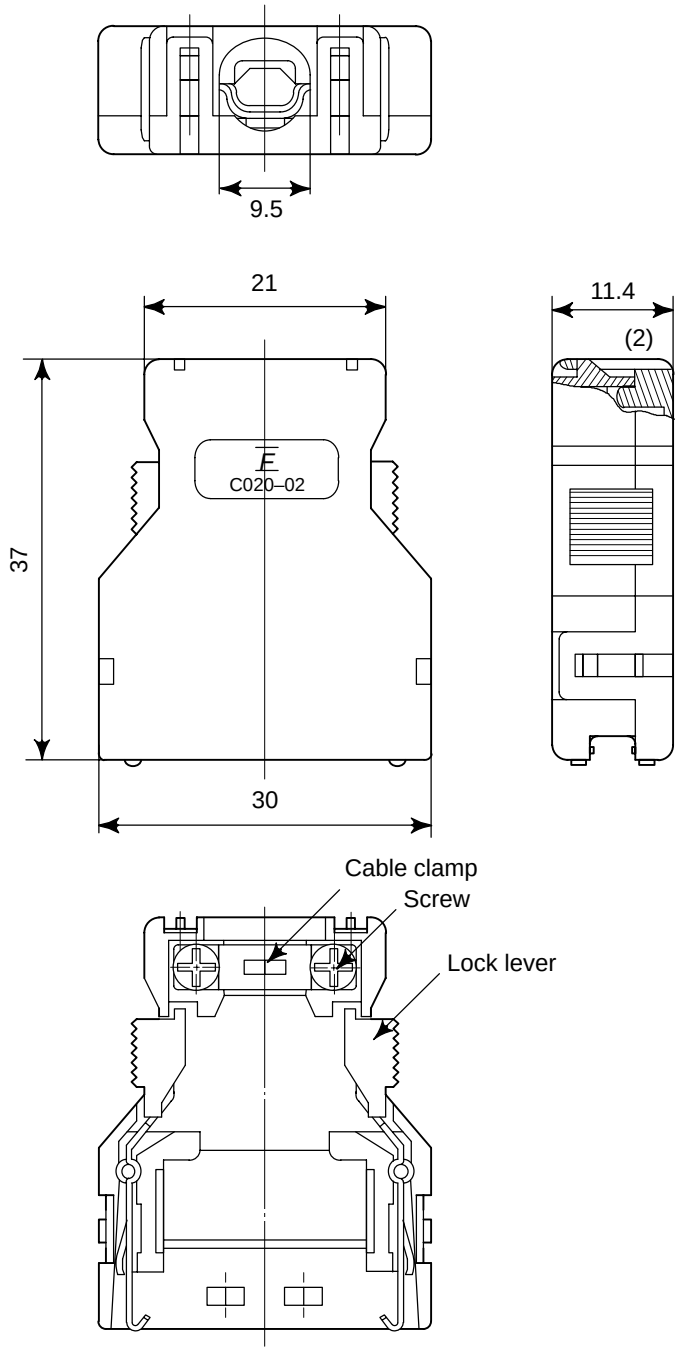


Fig. C2 (c) Connector case (FUJITSU FCN type)

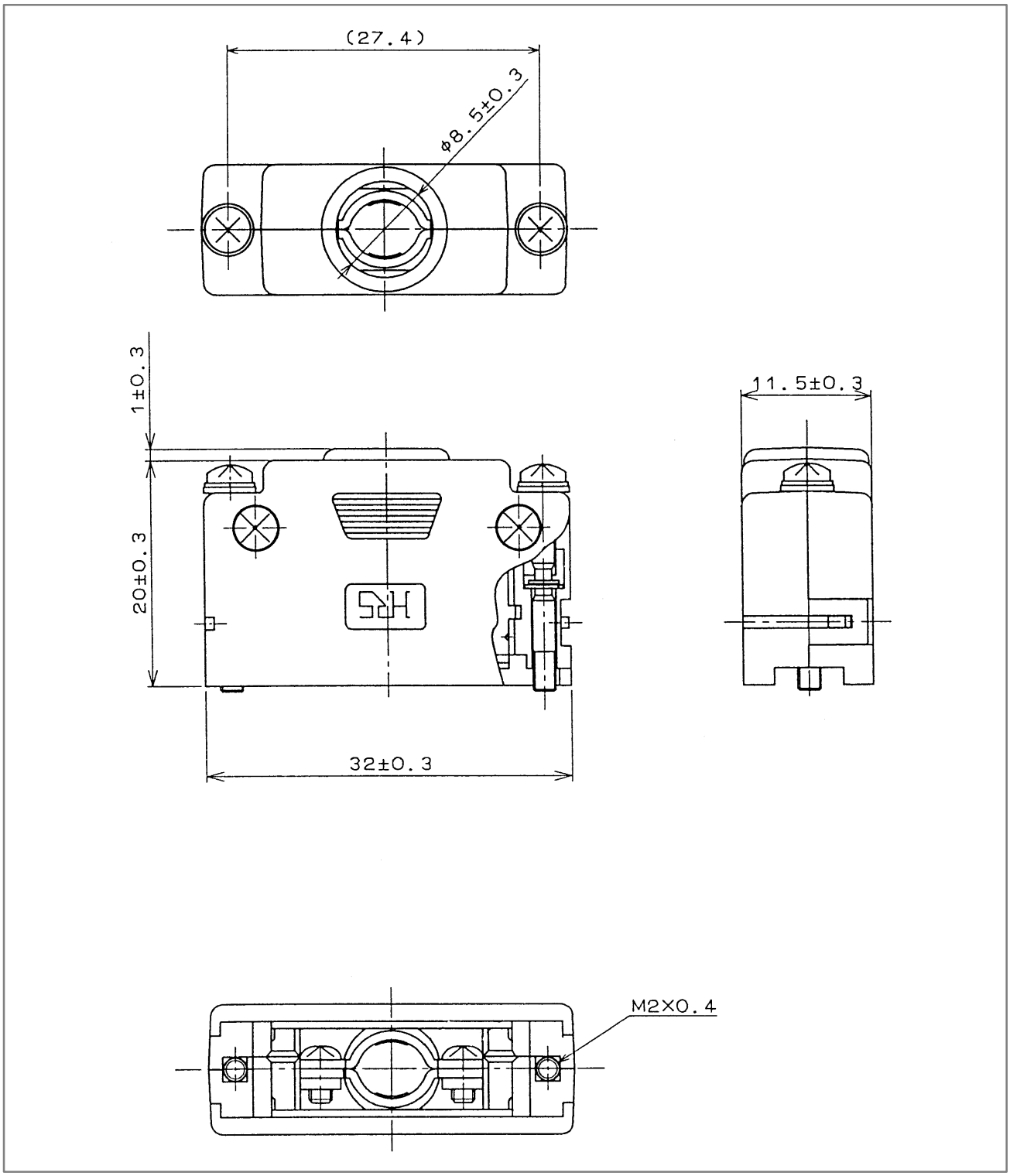


Fig. C2 (d) Connector case (PCR type (Hirose Electric))

TYPE : AMP1–178128–3

DIMENSION

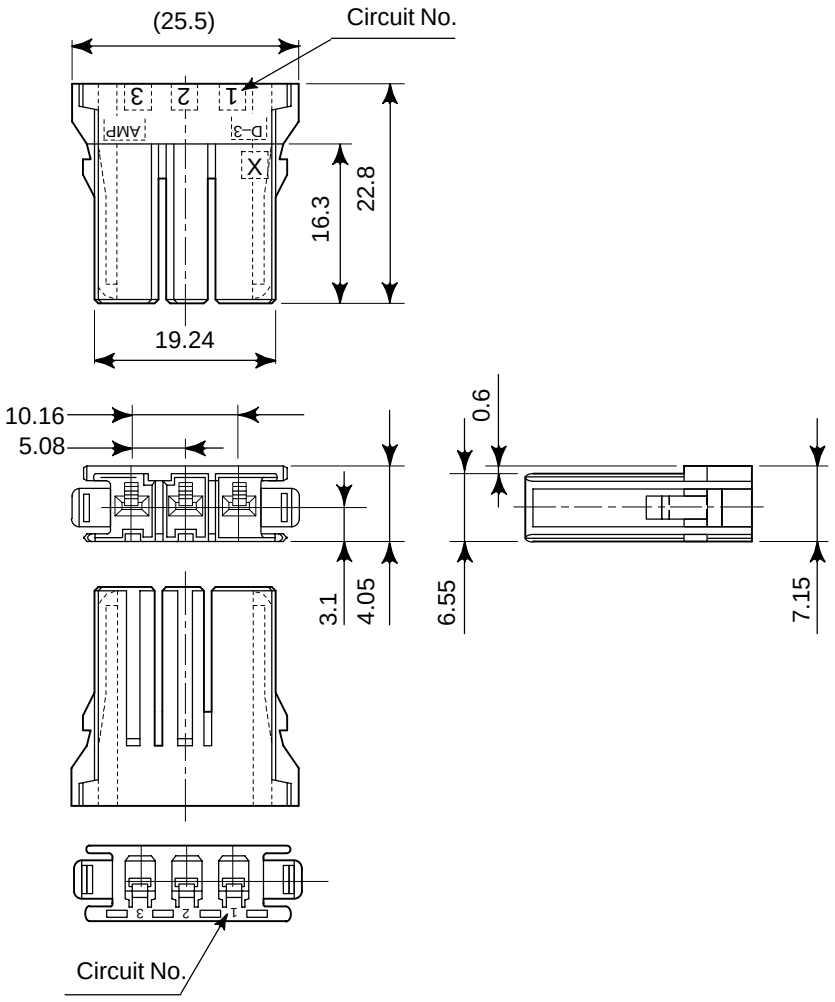


Fig. C3 (a) AMP connector (1)

TYPE : AMP2–178128–3

DIMENSION

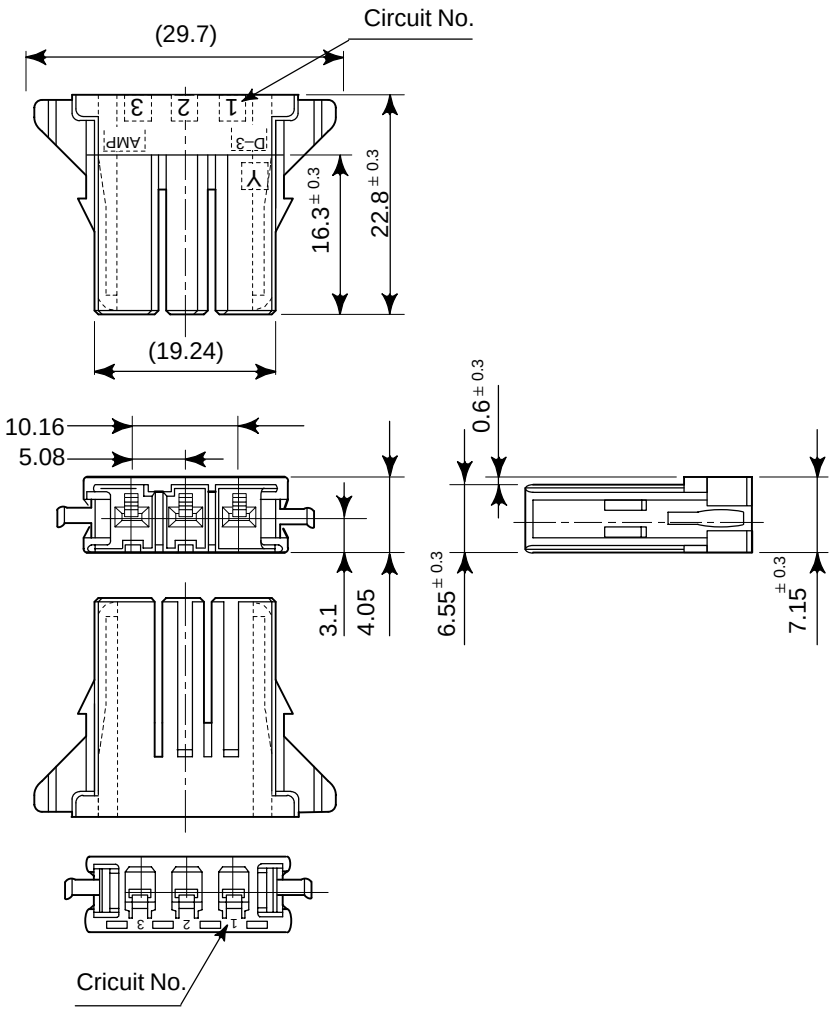


Fig. C3 (b) AMP connector (2)

TYPE : AMP1–178288–3

USAGE : POWER SUPPLY UNIT CP1A
+24V INPUT

3	
2	0V
1	+24V

DIMENSION

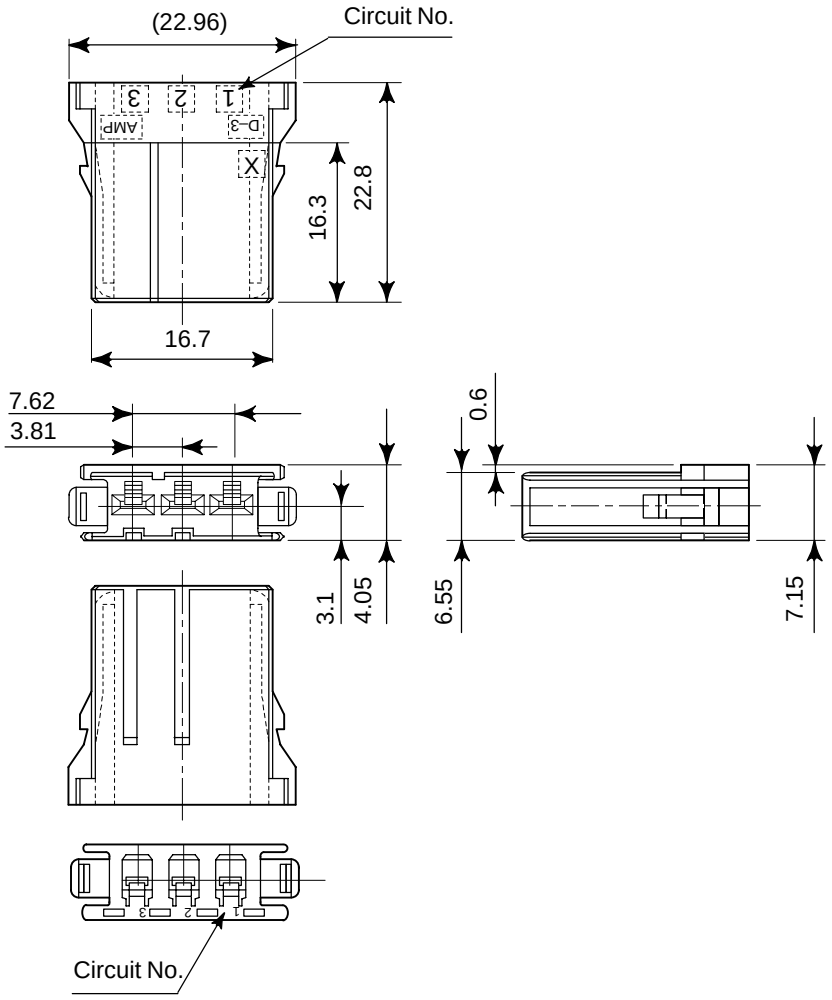


Fig. C3 (c) AMPconnector (3)

TYPE : AMP2–178288–3

USAGE : POWER CP1B
+24V OUTPUT

3	
2	0V
1	+24V

DIMENSION

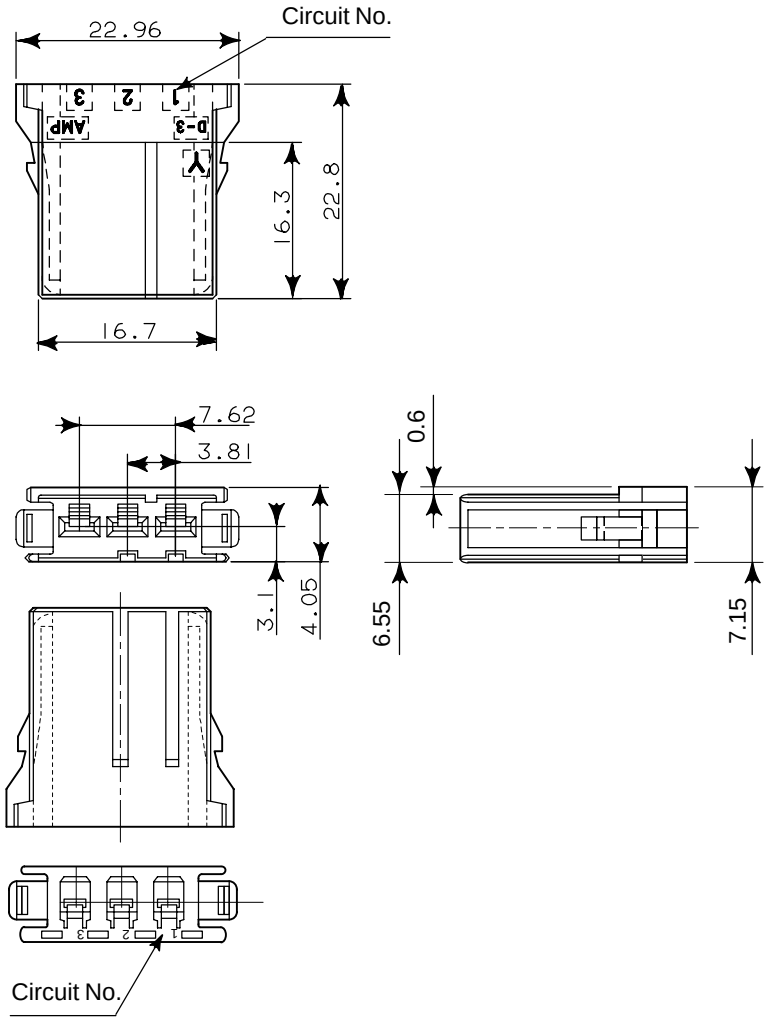


Fig. C3 (d) AMP connector (4)

SEPARATE : AMP1–175218–2(Gold coated)
AMP1–175218–5(Tin coated)
REEL : AMP1–175196–2(Gold coated)
AMP1–175196–5(Tin coated)
WIRE : AWG 16, 18, 20

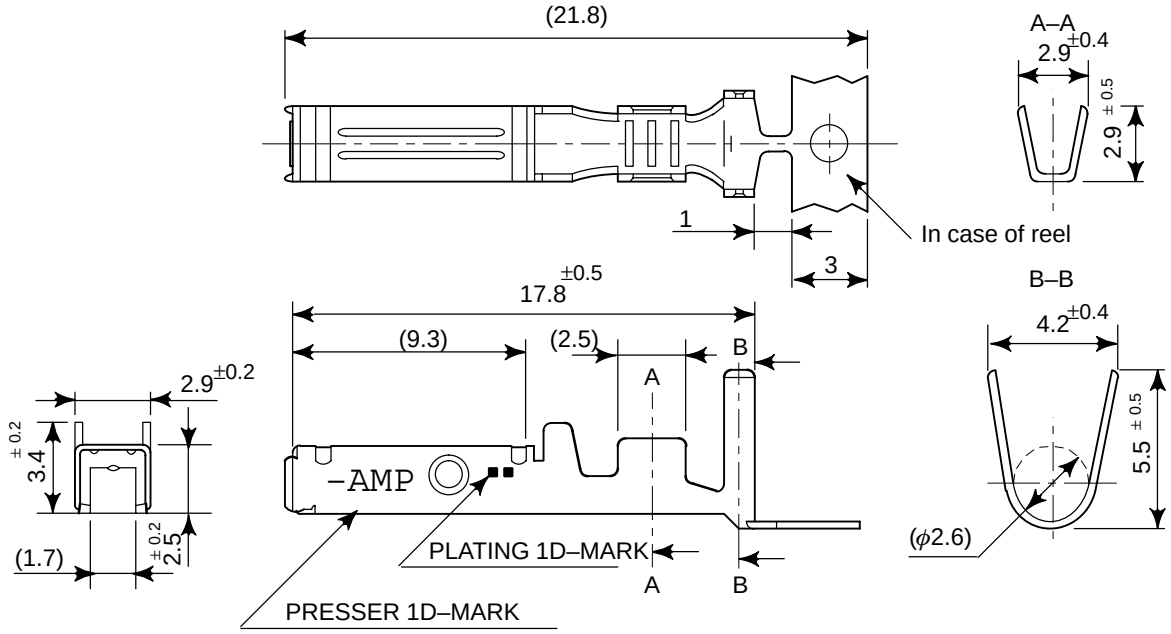
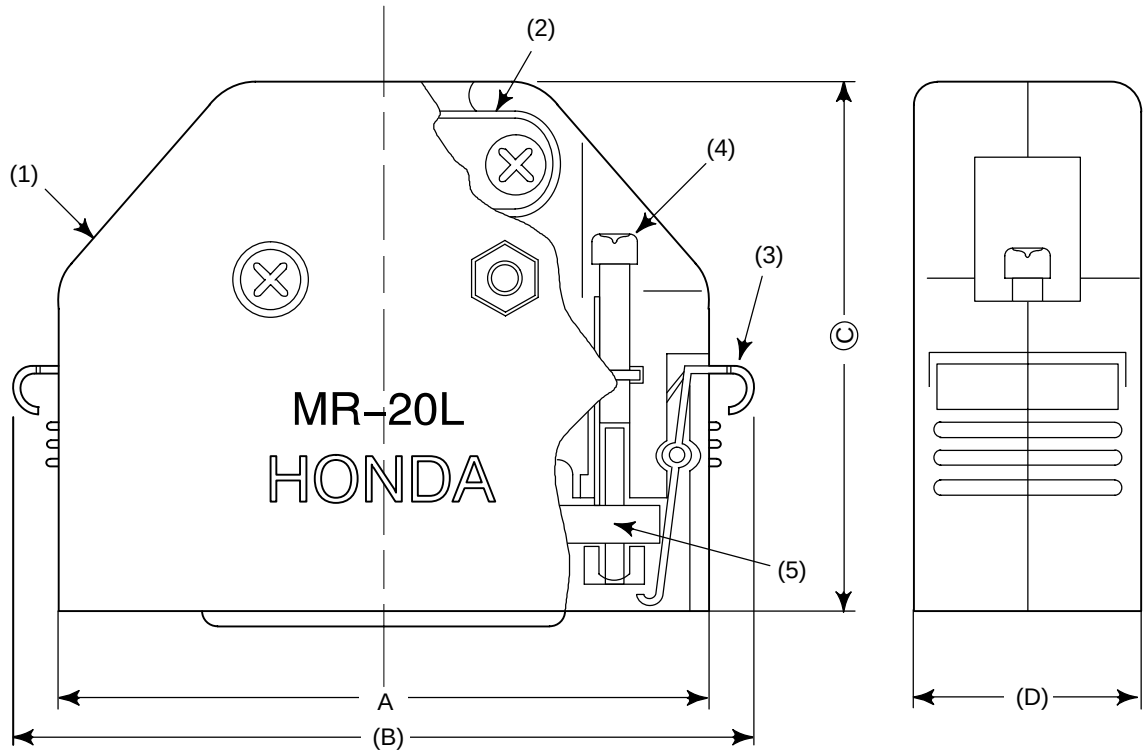


Fig. C3 (e) Contact for AMP connector

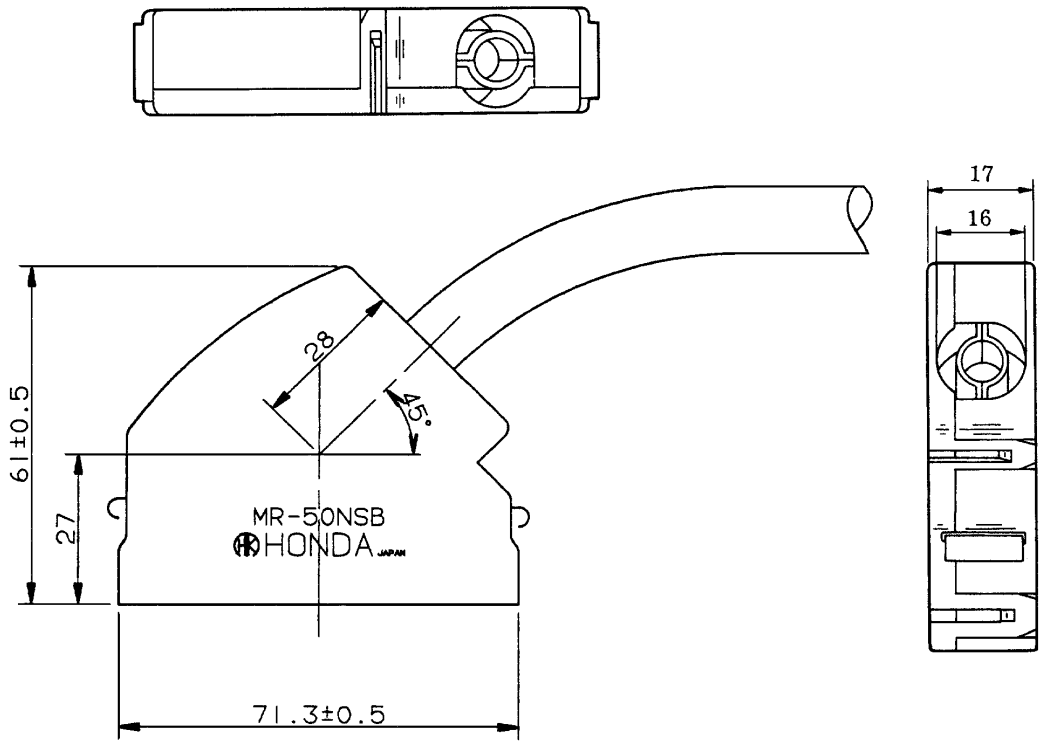


Specification \ Symbol	A	(B)	C	(D)	Number of terminals
MR–20LMH (Plug)	39.3	44.9	39.8	17	20
MR–20LFH (Jack)					
MR–50LMH (Plug)	67.9	73.5	44.8	18	50
MR–50LFH (Jack)					

Symbol	Name
1	Connector cover
2	Cable clamp
3	Stopper
4	Screw for cable clamp
5	Plug (MR–20, 50MH)
	Jack (MR–20, 50FH)

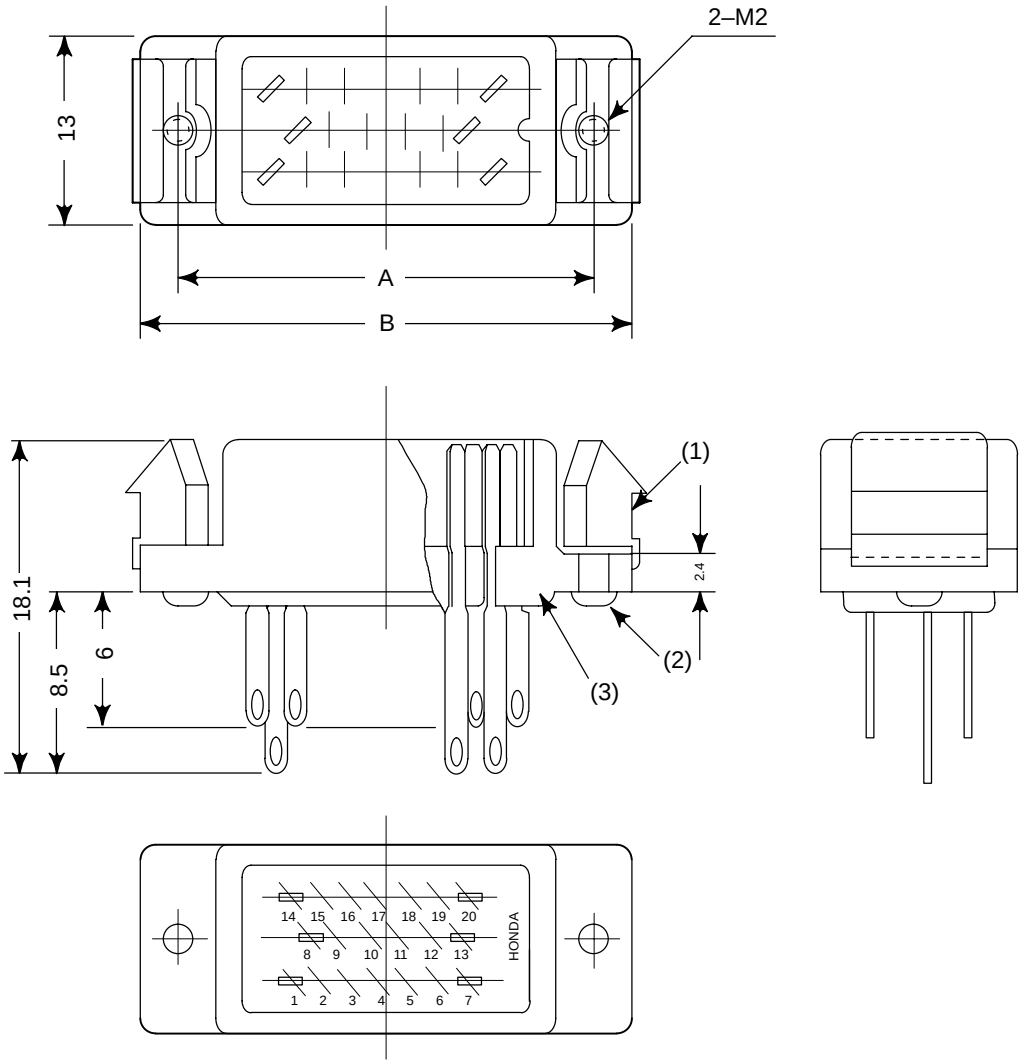
Outer diameter of the cable
MR–20L dia.10mm max
MR–50L dia.16mm max

Fig. C4 (a) HONDA connector (case)



External dimensions of 50–pin connector

Fig. C4 (b) Honda connector (angled–type case)

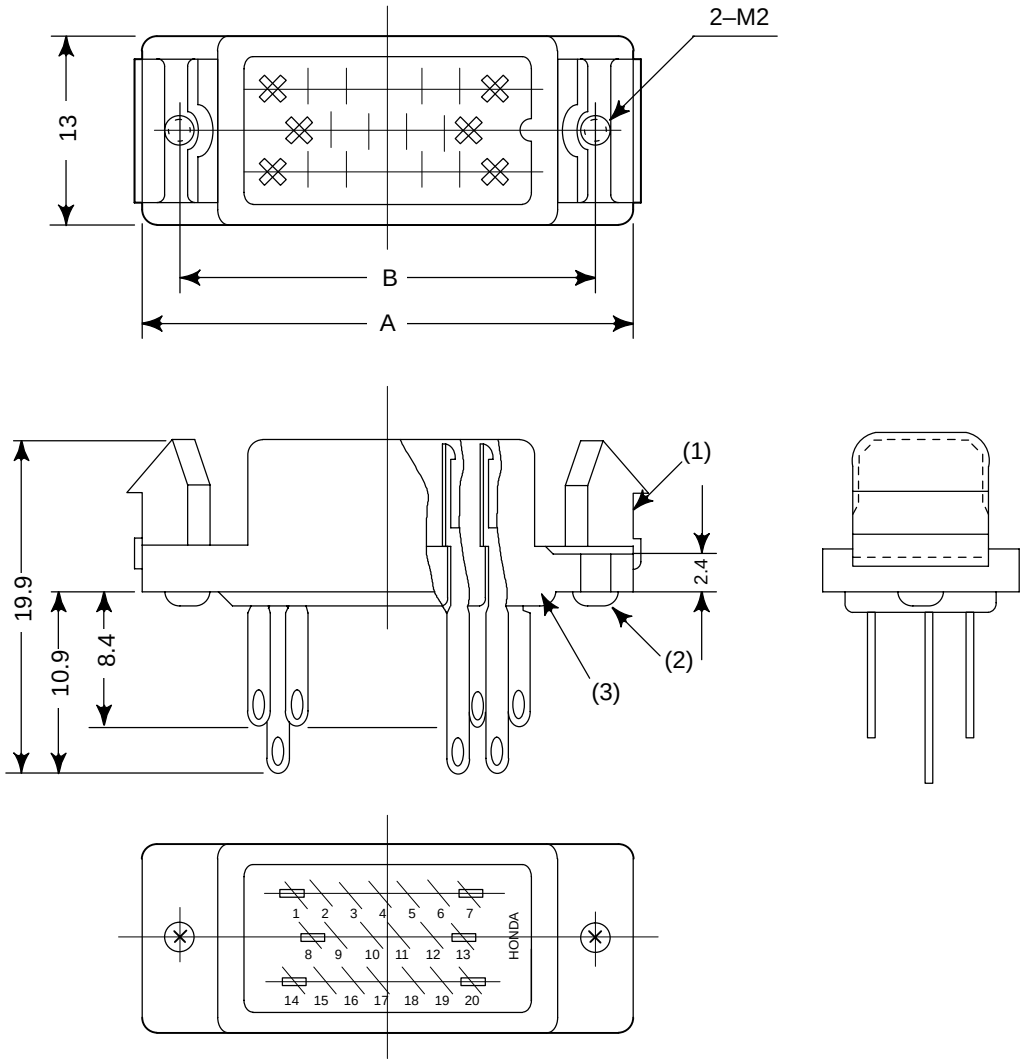


	A	B
MR–20RMH	32.8	27.8
MR–50RHF	61.4	56.4

Number of terminals
20
50

Symbol	Name
1	Cable clamp
2	Screw 2.6dia.×8
3	Connector (MR–20,–50MH)

Fig. C4 (c) HONDA connector (male)



	A	B	Number of terminals
MR–20RMH	32.8	27.8	20
MR–50RMH	61.4	56.4	50

Symbol	Name
1	Cable clamp
2	Screw 2.6dia.×8
3	Connector (MR–20,– 50FH)

Fig. C4 (d) HONDA connector (female)

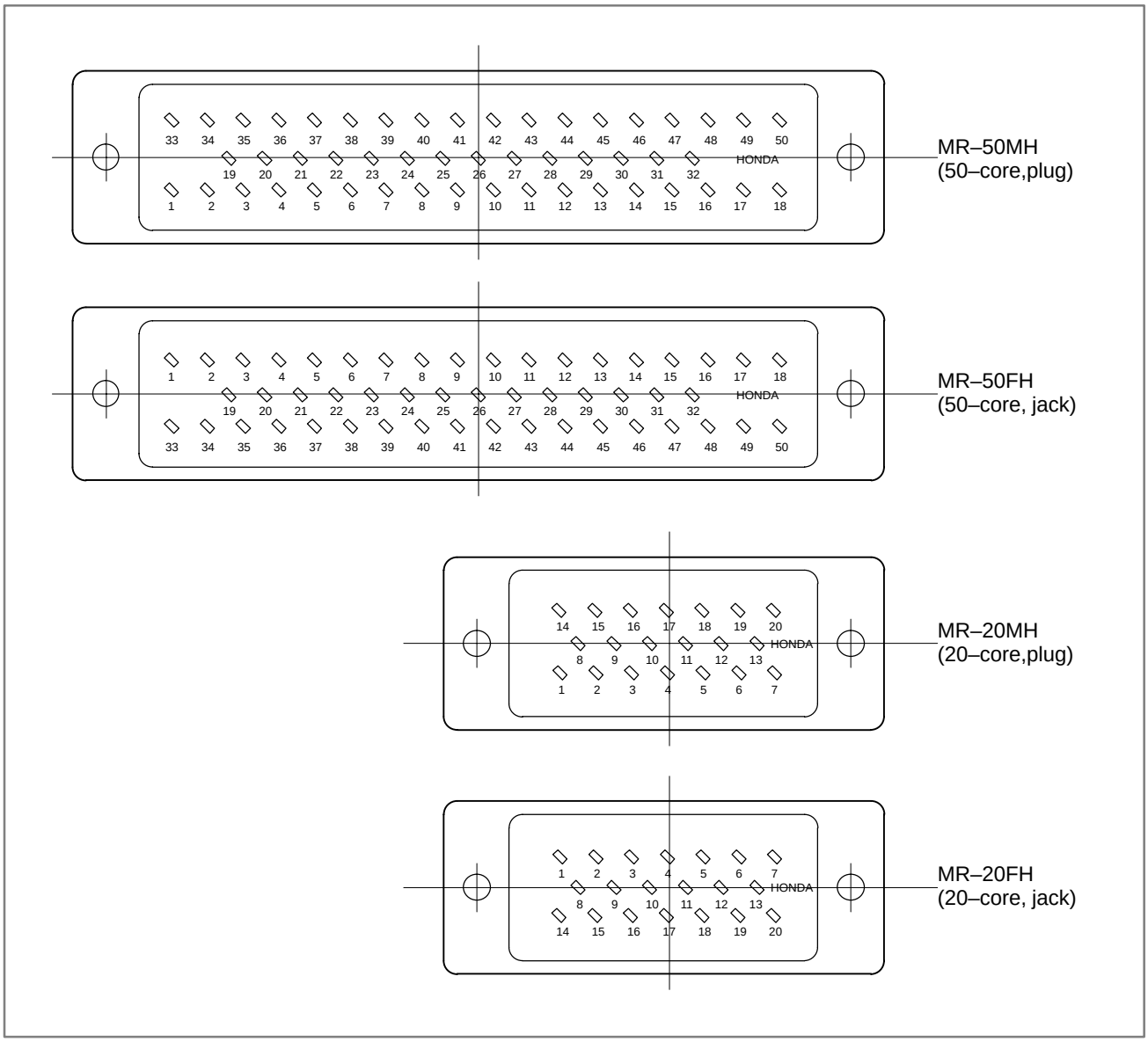
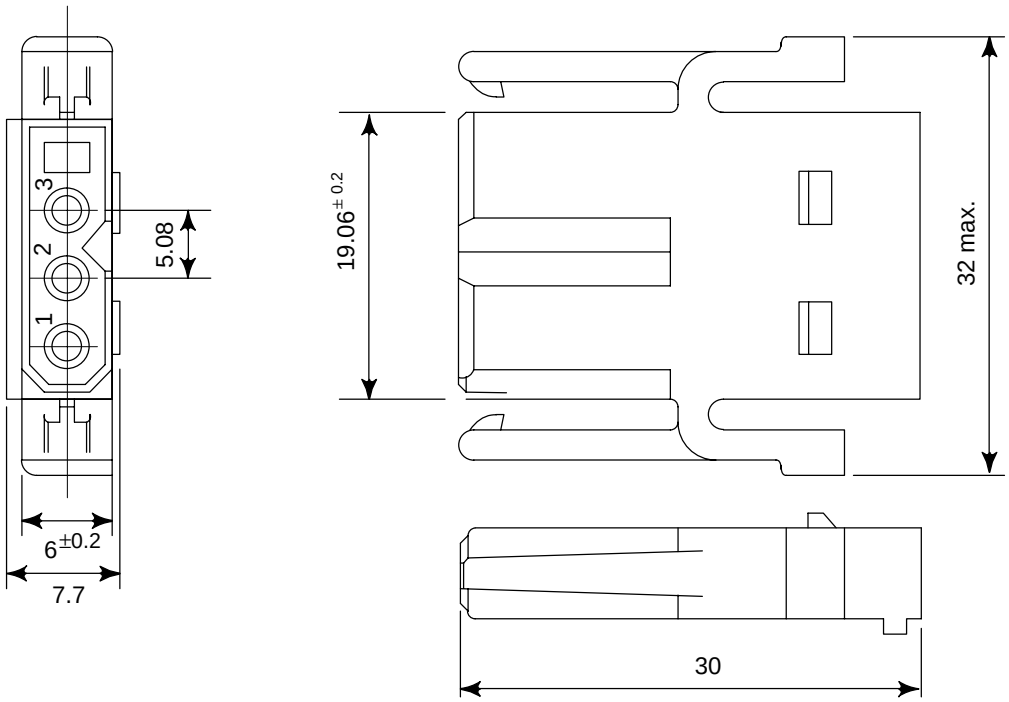


Fig. C4 (e) HONDA connector (terminal layout)



Manufacturer : Burndy Japan Corp.

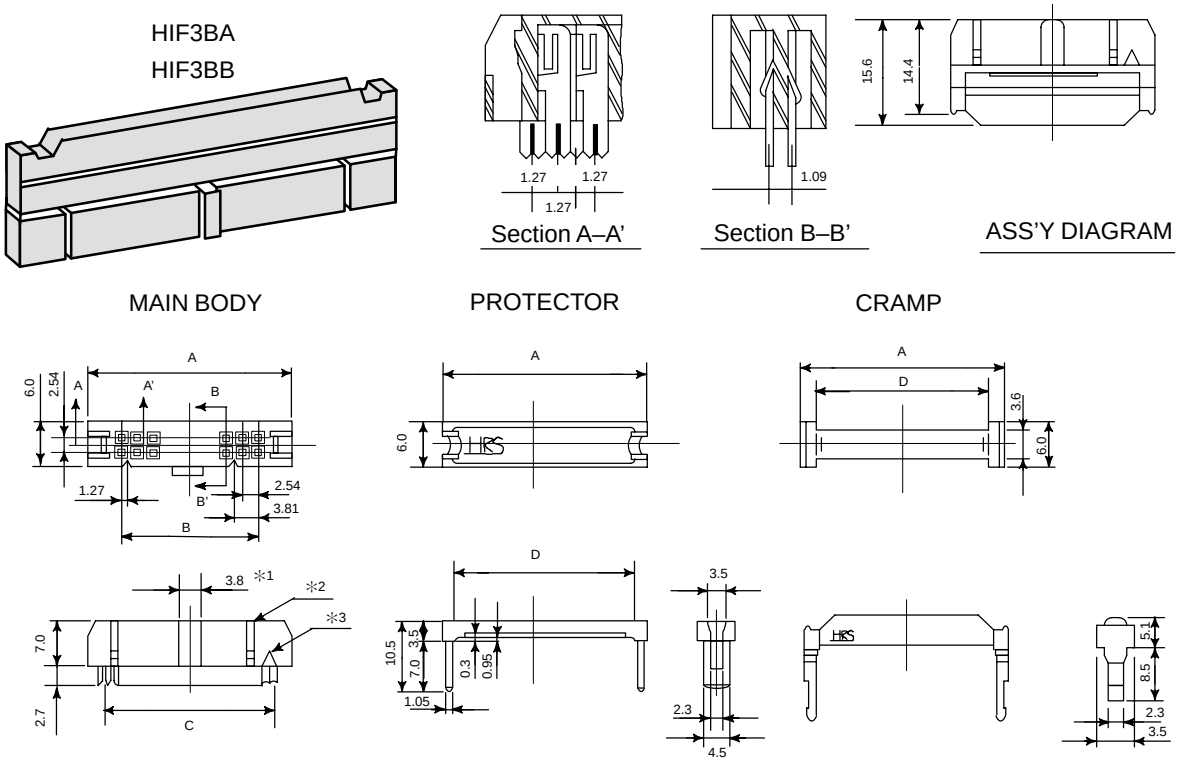
Name		Specification (Connector maker number)	Remarks
Connector housing for cable		SMS3PNS–5	Brown
Contact	(Crimp type)	RC16M–23T3	For details on tools required for crimp terminals,contact the manufacturer.
	(Solder type)	RC16M–SCT3	

Cables : Cross sectional area : 0.75mm^2(30/0.18)
Insulation diameter : 2.8mm max
Peeling length : 7.2mm

Fig. C5 Connector made by Burndy Japan (3 pins,black)

CONNECTOR FOR FLAT CABLE (HIROSE ELEC. CO.)

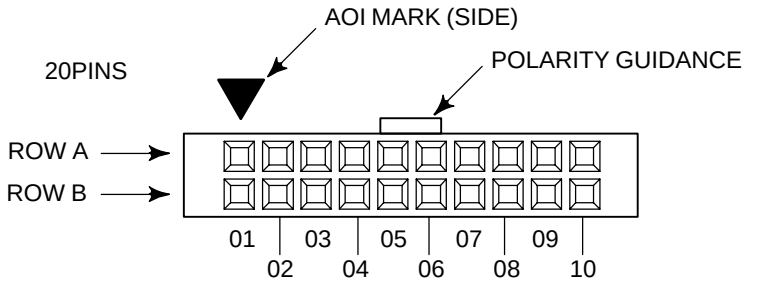
Specification HIROSE ELEC. CO.
HIF3BB–50D–2. 54R (50contacts)



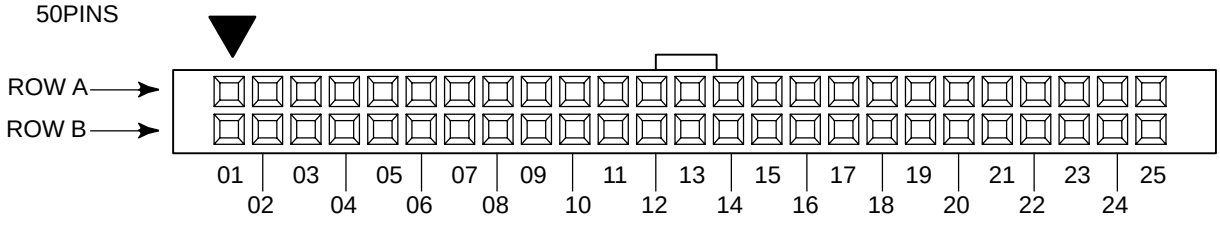
Dimensions

Description	No.of contact	A	B	C	D
HIF3BB–50D–2.54R	50	68.07	60.96	62.23	63.6

FLAT CABLE CONNECTOR CONTACT NUMBER (HIROSE)



OUTVIEW FROM CONNECTOR SIDE.



OUTVIEW FROM CONNECTOR SIDE.

Fig. C6 Connector for HIROSE Flat cable

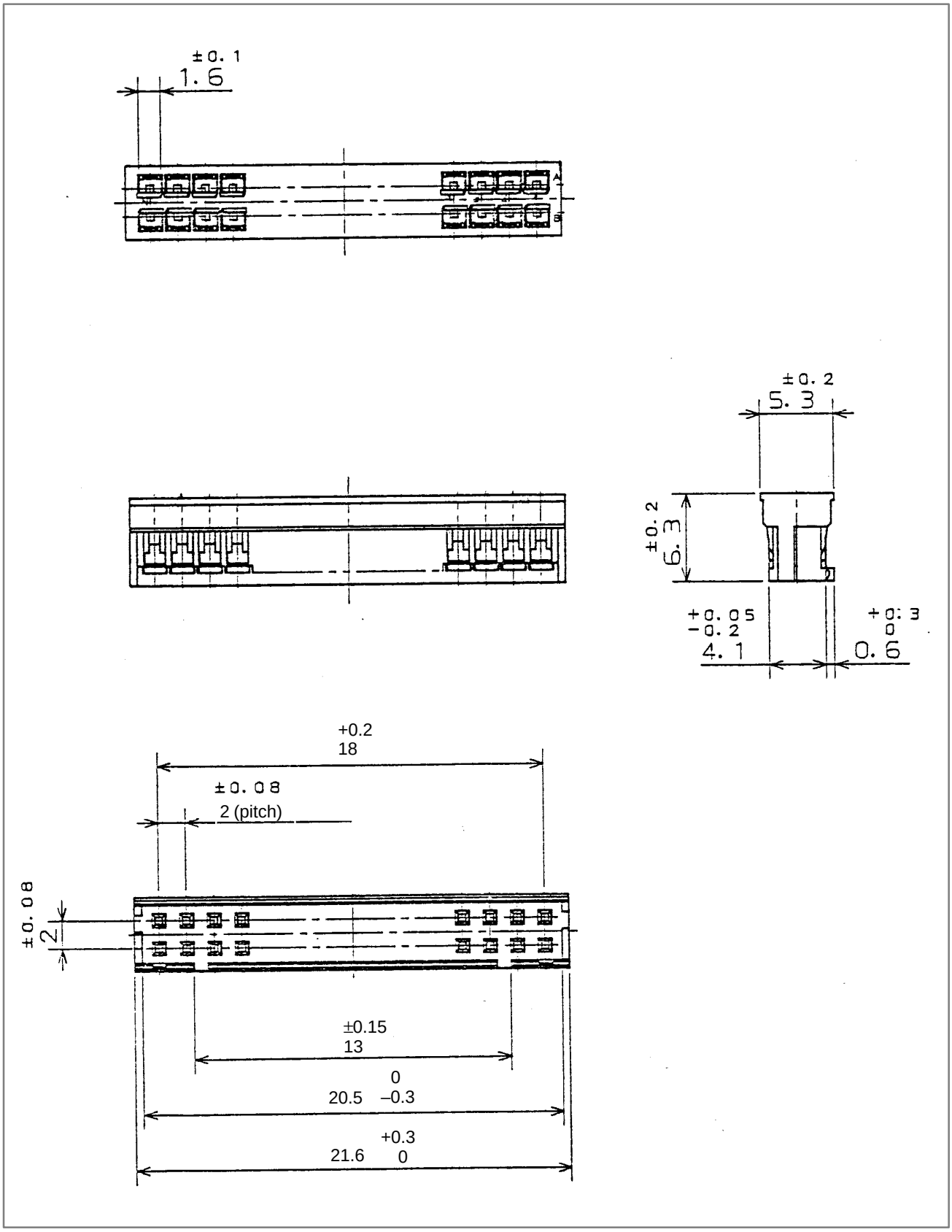


Fig. C7 (a) Connector (Japan Aviation Electronics)(for MDI)

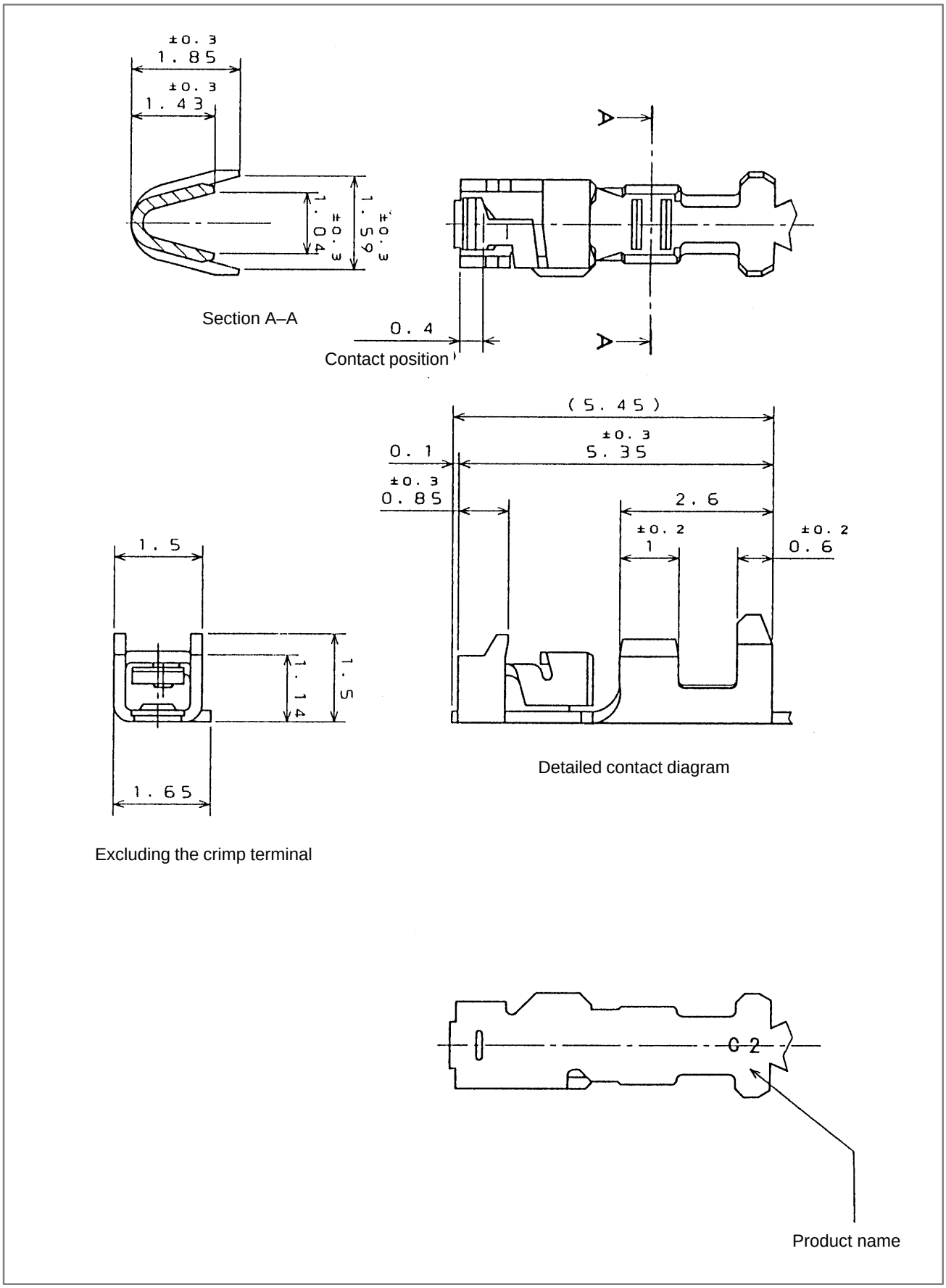


Fig. C7 (b) Contact (Japan Aviation Electronics)(for MDI)

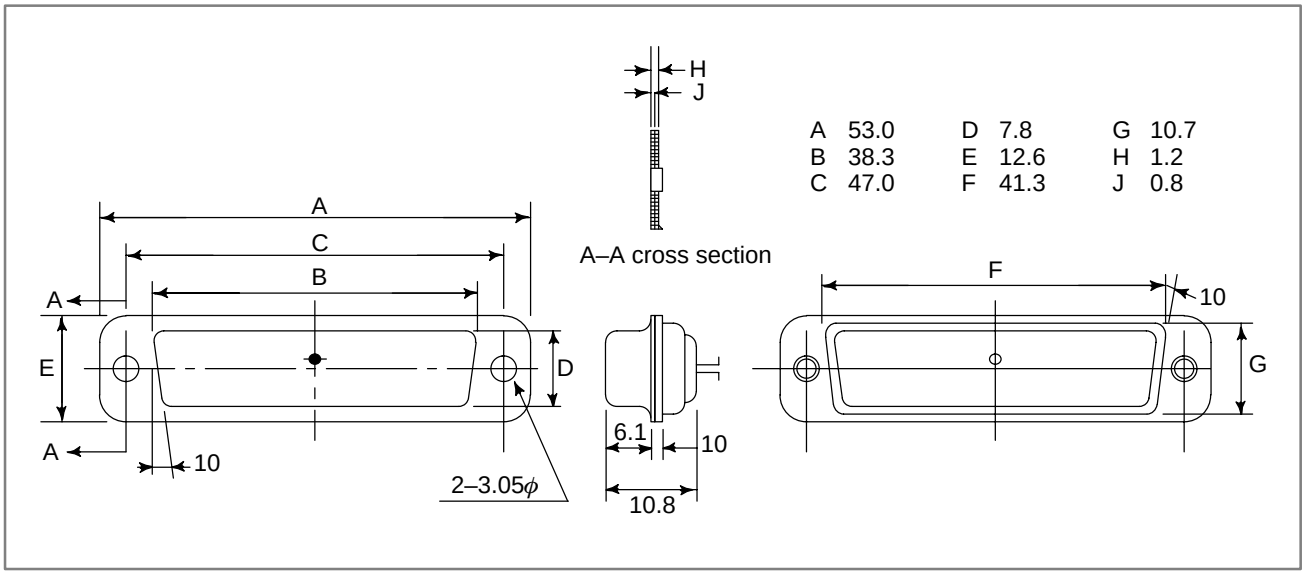


Fig. C8 (a) Punch panel connector for reader/puncher interface

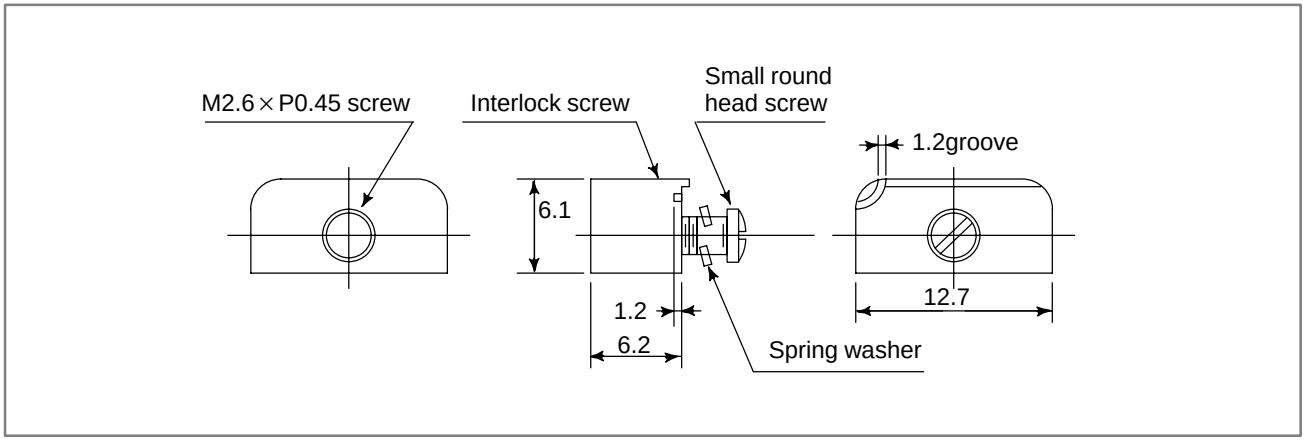
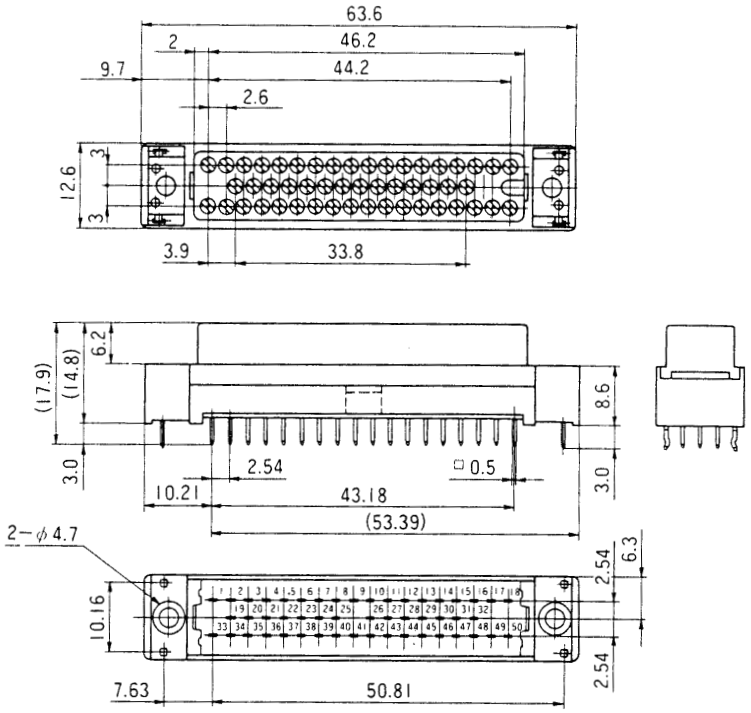


Fig. C8 (b) Locking plate plate for reader/puncher interface connector

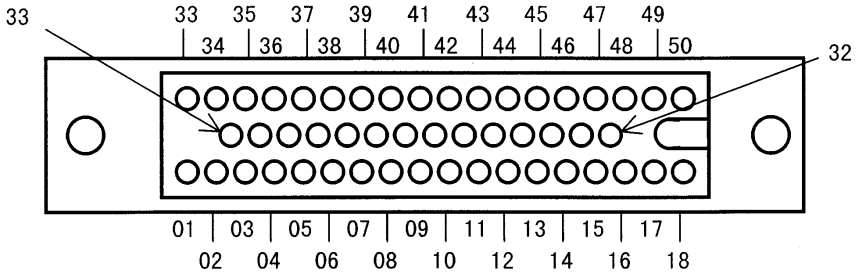
Honda MR type, 50 pins, male, connection printed circuit board soldering type connector

Type No. Honda Tsushin Kogyo Co., Ltd.
MRH–50FD



MRH-50FD

Pin configuration of Honda MR connector, 50 pins, male



Viewed from the connector side

Fig. C9 Honda connector

Type: AMP 178214–1
Application: Used for the loader I/O board
Dimensions:

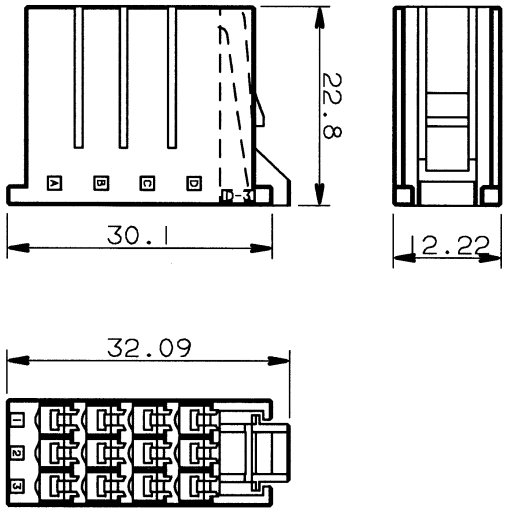


Fig. C10 AMP connector

Type: Faston terminal
Use: Frame grounding
Applicable housing: 170604–1 manufactured by AMP Japan, Ltd. or
FVDDF2–250 TYPE I (blue) manufactured by Japan Solderless terminal MFG. co.Ltd.
Dimensions:

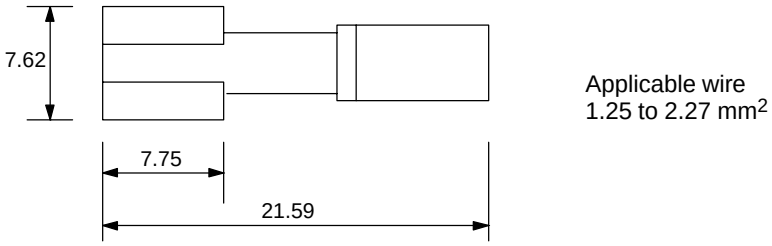


Fig. C11 Faston Terminal

B 20–PIN INTERFACE CONNECTORS AND CABLES

B.1 OVERVIEW

This section provides supplementary information about the recommended (FANUC–approved) 20–pin interface connectors used with the following target model.

B.2 ADDITIONAL TARGET MODEL

FANUC *i* series

B.3 BOARD–MOUNTED CONNECTORS

B.3.1 Vertical–type Connectors

Models: PCR–EV20MDT (Honda Tsushin)
52618–2011 (Molex Japan)

These board–mounted connectors have been specially developed to achieve the high packing density required for FANUC products. As explained in the following subsection, Honda PCR series connectors can be used as cable connectors because the mating mechanism of the newly developed connectors is compatible with that of the Honda PCR series connectors. To support this specification extensively, many connector manufacturers are now developing custom–tailored cable connectors. (Note that these cables cannot be used with screw–fixing cable connector housings.)

B.3.2 Straight and Right–angled Connectors (for Spring and Screw–fixing Connector Housings)

Models: PCR–E20MDK–SL–A (Honda Tsushin)(straight connector)
PCR–E20LMDETZ–SL (Honda Tsushin)
(right–angled connector)

These connectors are used for the main and option boards of the *i* series. As cable connectors, they are compatible with screw–fixing connector housings as well as the spring locking connector housings.

B.4 CABLE CONNECTORS

Cable connectors consist of a connector main body and housing. The models listed below are available. Those connectors not marked with an asterisk are currently being mass–produced as manufacturer's standard models. Those marked with an asterisk are produced according to custom specifications by FANUC.

Use	Type	Manufacturer	Connector model	Housing model	Applicable cable outside diameter
Cable connector – General use (MDI, IOLINK, AMP, SPDL, etc.)	Strand wire press–mount type	Honda	PCR–E20FA	PCR–V20LA*	ϕ 6mm (ϕ5.7 to 6.5)
		Hirose	FI30–20S*	FI–20–CV2*	ϕ 6.2mm (ϕ5.5 to 6.5)
		Fujitsu	FCN–247J020–G/E	FCN–240C020–Y/S*	ϕ 5.8mm (ϕ5.5 to 6.5)
		Molex	52622–2011*	52624–2015*	ϕ 6.2mmϕ (5.9 to 6.5)
	Strand wire press–mount type	Hirose	FI30–20S*	FI–20–CV7* (Low screw–fixing housing)	ϕ 6.2mm (ϕ5.5 to 6.5)
	Soldering type	Honda	PCR–E20FS	PCR–V20LA*	ϕ 6mm (ϕ5.7 to 6.5)
		Hirose	FI40–20S*	FI–20–CV2*	ϕ 6.2mm (ϕ5.5 to 6.5)
			FI40B–20S* (FI40A–20S*)	FI–20–CV5*	ϕ 9.2mm (ϕ8.9 to 9.5)
			FI40B–20S*	FI–20–CV6*	ϕ 10.25mm (ϕ9.5 to 11.0)
For pulse coder, coaxial cable, linear scale, manual pulse generator, etc.	Soldering type	Hirose	FI40B–2015S* (FI40–2015S*)	FI–20–CV*	ϕ 8.5mm (ϕ8.0 to 9.0)
			FI40B–20S* (FI40A–20S*)	FI–20–CV5*	ϕ 9.2mm (ϕ8.9 to 9.5)
			FI40B–20S*	FI–20–CV6*	ϕ 10.25mm (ϕ9.5 to 11.0)
		Honda	PCR–E20FS	PCR–V20LA*	ϕ 6mm (ϕ5.7 to 6.5)

Fig. B.4 Cable connectors

Cable Connectors

Strand wire press–mount connector :

With this connector, #28AWG wires are press–connected to each pin at the same time. The cost of producing a cable/connector assembly with this connector model is much lower than with connectors designed for crimping or soldering.
Also, the following connector housing has been newly developed for use with the *i* series.

Connector model (manufacturer)	Supplementary description
FI–20–CV7 (Hirose)	Low connector housing, more compact than conventional models. The housing can be fastened to a board–mounted connector by means of a screw lock. It is intended mainly for connecting the board–mounted connectors used on the main and option boards of the LCD–mounted type *i* series (see Section B.3.2). Note that this connector housing cannot be used for conventional board–mounted connectors.

Soldering type connector : Details of soldering type connectors and their housings are summarized below.

Table B.4 Details of soldering type connectors and housings

- **Connectors**

Connector model (manufacturer)	Supplementary description
PCR–E20FS (Honda)	Soldering type connector for general signals. This is suitable for producing cable assemblies in small quantities, as well as on–site.
FI40–20S (Hirose)	Equivalent to Honda PCR–E20FS
FI40B–20S (Hirose) (formerly, FI40A–20S)	Has the same number of pins as the FI40–20S, but features a wider soldering pitch, facilitating soldering and enabling the use of thicker wires. Its reinforced pins allow wires as thick as #17AWG to be soldered to the FI40B–20S (wires no thicker than #20AWG can be used with the FI40A–20S). Note, however, that a thick wire, such as #17AWG, should be used with a more robust housing like the FI–20–CV6.
FI40B–2015S (Hirose) (formerly, FI40–2015S)	Features a wider soldering pitch, attained by using the space provided by thinning out some pins. Also features tougher pins, compared with its predecessor, the FI40–2015S. These pins can be soldered to wires as thick as #17AWG, provided that the cable diameter does not exceed 8.5 mm.

- **Housings**

Housing model (manufacturer)	Supplementary description
FI–20–CV5 (Hirose)	Should be used with the FI40B–20S. This is a plastic housing designed for use with a cable that is 9.2 mm in diameter.
FI–20–CV6 (Hirose)	Should be used with the FI40B–20S. This housing, however, can be used with a thicker cable (such as 10.25 mm) than is possible with the FI–20–CV5. Its components are die cast.

In addition to the combinations shown in Fig. B.4, Hirose soldering–type connectors can be combined with the housings listed below. Ensure that the diameter of the cable used with each housing satisfies the requirements of that housing.

Connector model		Housing model (applicable cable diameter)	
• FI40B–2015S (formerly FI40–2015S)	⟷	FI–20–CV (8.5 mm in diameter) only	
• FI40–20S, FI40B–20S (formerly FI40A–20S)	⟷	FI–20–CV2 (ϕ6.2mm), FI–20–CV5 (ϕ9.2mm), FI–20–CV6 (ϕ10.25mm)	Those listed on the left can be used.

B.5 RECOMMENDED CONNECTORS, APPLICABLE HOUSINGS, AND CABLES

Table B.5 Recommended connectors, applicable housings, and cables

Connector name referenced in the Connection Manual	FANUC–approved connector (manufacturer)	FANUC–approved housing (manufacturer)	Compatible cable (cable diameter) FANUC development FANUC specification number	Remark
PCR–E20FA Strand press–mount type	PCR–E20FA (Honda Tsushin)	PCR–V20LA (Honda Tsushin)	A66L–0001–0284#10P (6.2 mm in diameter)	Plastic housing
	FI30–20S (Hirose Electric)	FI–20–CV2 (Hirose Electric)	A66L–0001–0284#10P (6.2 mm in diameter)	Plastic housing
	FCN–247J020–G/E (Fujitsu Takamizawa)	FCN–240C020–Y/S (Fujitsu Takamizawa)	A66L–0001–0284#10P (6.2 mm in diameter)	Plastic housing
	52622–2011 (Molex)	52624–2015 (Molex)		Plastic housing
PCR–E20FA Strand wire press–mount type	FI30–20S (Hirose Electric)	FI–20–CV7 (Hirose Electric)		Plastic housing
PCR–E20FS Soldering type	PCR–E20FS (Honda Tsushin)	PCR–V20LA (Honda Tsushin)		Plastic housing
	FI40–20S (Hirose Electric)	FI–20–CV2 (Hirose Electric)		Plastic housing
FI40B–2015S (formerly FI40–2015S) 15–pin soldering type	FI40B–2015S (formerly FI40–2015S) (Hirose Electric)	FI–20–CV5 (Hirose Electric)	A66L–0001–0367 A66L–0001–0368 (9.2 mm in diameter)	Plastic housing
	FI40B–20S (Hirose Electric)	FI–20–CV6 (Hirose Electric)	A66L–0001–0403 (*1) (9.8 mm in diameter)	Metal housing

NOTE

*1 Cable A66L–0001–0286 has been recommended for use as a pulse coder cable. It can be up to 20 m long. Two cables, A66L–0001–0402 and A66L–0001–0403, have recently been developed. A66L–0001–0402 and A66L–0001–0403 can be as long as 30 m and 50 m, respectively. (See Fig. 4 for detailed specifications.)
Both cables have the same level of oil and bending resistance (cable, 100 mm in diameter, capable of withstanding at least 10 million bending cycles) as conventional cables, and are UL– and CSA–certified.

Press–mount type connector assembly tools and jigs

Connector model referenced in the Connection Manual	FANUC–approved connector (manufacturer)	Wire forming tool	Press–mounting tool	Remark
PCR–E20FA	PCR–E20FA (Honda Tsushin)	PCS–K2A	FHPT–918A	Low cost
		JGPS–015–1/1–20 JGPS–014	MFC–K1 PCS–K1	(Note 1)
		FHAT–918A		
	FI30–20S (Hirose Electric)	FI30–20CAT	FI30–20/ID	Low cost
		FI30–20CAT1	HHP–502 FI30–20GP	
	FCN–247J020–G/S (Fujitsu)	FCN–237T–T043/H	FCN–237T–T109/H FCN–247T–T066/H	
		FCN–237T–T044/H		
		FCN–237T–T062/H		
	52622–2011 (Molex)	57829–5000	57830–5000	Low cost
		57823–5000	57824–5000	

NOTE
1 Those tools indicated by shading are available from FANUC (specification number A02B–0120–K391).
2 The tools available from each manufacturer are specifically designed for use with the connectors manufactured by that manufacturer.

Materials for cable assemblies

Machine tool builders are required to manufacture or procure the materials for the cable assemblies to be used with their products. FANUC recommends the following materials as being suitable for interface connectors. Individual machine tool builders are encouraged to contact each cable manufacturer for themselves, as required.

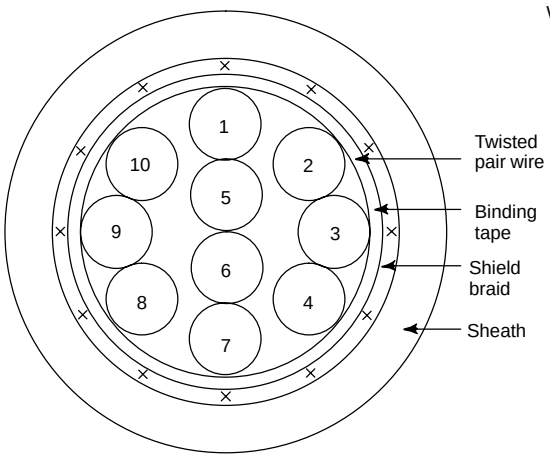
Material	Use	Constitution	FANUC specification number	Manufacturer	Remark
10–pair cable	General use	0.08mm^2 10–pair	A66L–0001–0284 #10P	Hitachi Cable, Ltd. Oki Electric Cable Co., Ltd.	
12–conductor composite cable	Pulse coder, linear scale, manual pulse generator	0.5mm^2 6–conductor 0.18mm^2 3–pair	A66L–0001–0286	Hitachi Cable, Ltd. Oki Electric Cable Co., Ltd.	20 m or less
		0.75mm^2 6–conductor 0.18mm^2 3–pair	A66L–0001–0402	Oki Electric Cable Co., Ltd.	30 m or less Usable on movable parts
		1.25mm^2 6–conductor 0.18mm^2 3–pair	A66L–0001–0403	Oki Electric Cable Co., Ltd.	50 m or less Usable on movable parts
5–core coaxial cable	CRT interface	5–conductor coaxial	A66L–0001–0371	Hitachi Cable, Ltd.	50 m or less

10–pair cable

(a) Specifications

Item		Unit	Specifications
Product No.		–	A66L–0001–0284#10P
Manufacturer			Hitachi Cable,Ltd. Oki Electric Cable, Co.,Ltd.
Rating		–	60°C 30V:UL2789 80°C 30V:UL80276
Material	Conductor	–	Stranded wire of tinned annealed copper (ASTM B–286)
	Insulator	–	Cross–linked vinyl
	Shield braid	–	Tinned annealed copper wire
	Sheath	–	Heat–resistant oilproof vinyl
Number of pairs		Pairs	10
Conductor	Size	AWG	28
	Structure	Conductors /mm	7/0.127
	Outside diameter	mm	0.38
Insulator	Thickness	mm	0.1 Thinnest portion : 0.8 (3.1mm)
	Outside diameter (approx.)	mm	0.58
	Core style (rating)	mm	UL15157(80°C, 30V)
Twisted pair	Outside diameter (approx.)	mm	1.16
	Pitch	mm	20 or less
Lay		–	Collect the required number of twisted pairs into a cable, then wrap binding tape around the cable. To make the cable round, apply a cable separator as required.
Lay diameter (approx.)		mm	3.5
Drain wire		Conductors /mm	Hitachi Cable : Not available Oki Electric Cable : Available,10/0.12
Shield braid	Element wire diameter	mm	0.12
	Braid density	%	85 or more
Sheath	Color	–	Black
	Thickness	mm	1.0
	Outside diameter (approx.)	mm	6.2
Standard length		m	200
Packing method		–	Bundle
Electrical performance	Electric resistance (at 20°C)	Ω/km	233 or less
	Insulation resistance (at 20°C)	MΩ–km	10 or less
	Dielectricstrength (AC)	V/min.	300
Flame resistance		–	Shall pass flame resistance test VW–1SC of UL standards.

(b) Cable structure

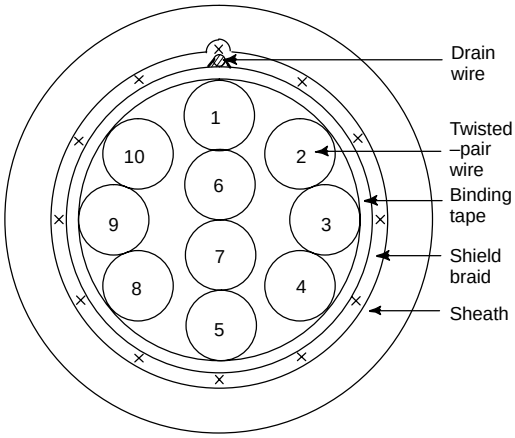


Wire identification table (Hitachi)

Wire No.	Insulator color	
	First wire	Second wire
1	Blue	White
2	Yellow	White
3	Green	White
4	Red	White
5	Purple	White
6	Blue	Brown
7	Yellow	Brown
8	Green	Brown
9	Red	Brown
10	Purple	Brown

The numbers assigned to the wires correspond to the numbers in the table at right.

Fig. B.5 (a) Cable made by Hitachi Cable



Wire identification table (Oki)

Pair No.	Insulator color	Dot mark (1 pitch)	Dot mark color	
			First wire	Second wire
1	Orange	—	Red	Black
2	Gray	—	Red	Black
3	white	—	Red	Black
4	Yellow	—	Red	Black
5	Pink	—	Red	Black
6	Orange	— —	Red	Black
7	Gray	— —	Red	Black
8	White	— —	Red	Black
9	Yellow	— —	Red	Black
10	Pink	— —	Red	Black

The numbers assigned to the wires correspond to the numbers in the table at right.

Fig. B.5 (b) Cable made by Oki Electric Cable

Composite 12–core cable

(a) Specifications

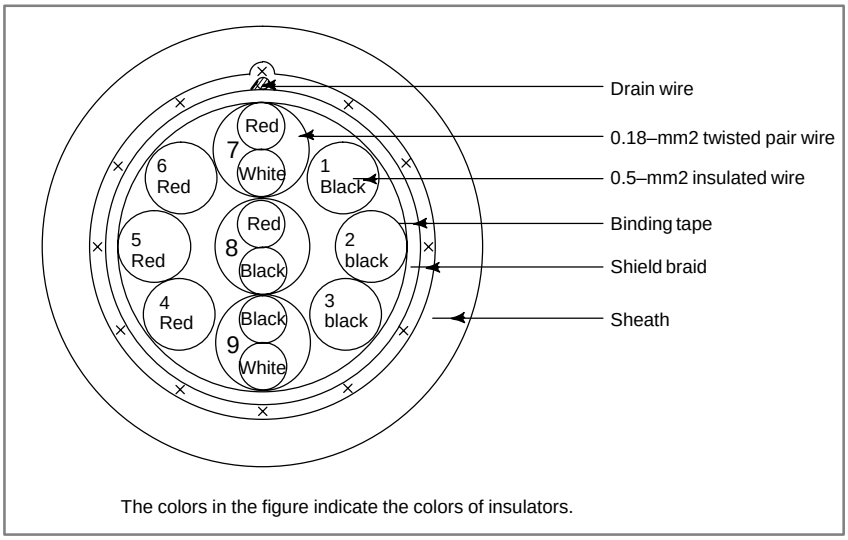
Item		Unit	Specifications	
Product No.		–	A66L–0001–0286	
Manufacturer		–	Oki Cable, Ltd. Hitachi Electric Cable Co., Ltd.	
Rating		–	80°C, 30V	
Material	Conductor,braid–shielded wire,drain wire	–	Strand wire of tinned annealed copper (JIS C3152)	
	Insulator	–	Heat–resistant flame–retardant vinyl	
	Sheath	–	Oilproof, heat–resistant, flame–retardant vinyl	
Number of wires (wire ons.)		Cores	6 (1 to 6)	6 (three pairs) (7 to 9)
Conductor	Size	mm^2	0.5	0.18
	Structure	Conductors /mm	20/0.18	7/0.18
	Outside diameter	mm	0.94	0.54
Insulator	Standard thickness (The minimum thickness is at least 80% of the standard thickness.)	mm	0.25	0.2
	Outside diameter	mm	1.50	0.94
Twisted pair	Outside diameter	mm		1.88
	Direction of lay	–		Left
	Pitch	mm		20 or less
Lay		–	Twist the wires at an appropriate pitch so the outermost layer is right–twisted, and wrap tape around the outermost layer. Apply a cable separator as required.	
Lay diameter		mm	5.7	
Drain wire	Size	mm^2	0.3	
	Structure	Wires/mm	12/0.18	
	Outside diameter	mm	0.72	
Shield braid	Element wire diameter	mm	0.12	
	Thickness	mm	0.3	
	Braid density	%	70	
	Outside diameter	mm	6.3	

Item		Unit	Specifications	
Sheath	Color	–	Black	
	Standard thickness (The minimum thickness is at least 85% of the standard thickness.)	mm	1.1	
	Outside diameter	mm	8.5Max. 9.0(1)	
Standard length		m	100	
Packing method		–	Bundle	
Electrical performance	Electric resistance (at 20°C) (wire nos.)	Ω/km	39.4(1 to 6)	113(7 to 9)
	Insulation resistance (at 20°C)	MΩ–km	15	
	Dielectric strength (AC)	V/min.	500	
Flame resistance		–	Shall pass flame resistance test VW–1SC of UL standards,	

NOTE
The maximum outside diameter applies to portions other than the drain wire.

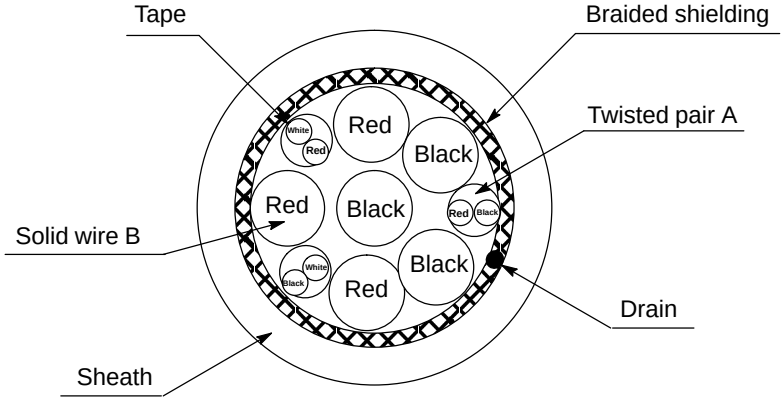
(b) Cable structure

The cable structure is shown below.



(c) Specifications

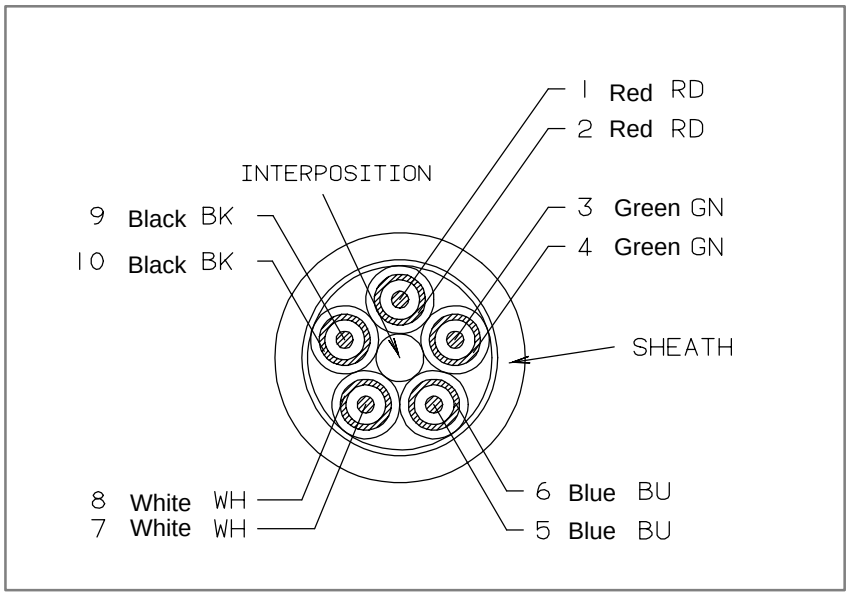
Item		Specification			
FANUC specification number		A66L–0001–0402		A66L–0001–0403	
Manufacturer		Oki Electric Cable Co., Ltd.			
		A–conductor	B–conductor	A–conductor	B–conductor
Conductor	Constitution Number of conductors/mm	16/0.12 ($0.18mm^2$)	3/22/0.12 ($0.75mm^2$)	16/0.12 ($0.18mm^2$)	7/16/0.12 ($1.25mm^2$)
	Typical outside diameter (mm)	0.55	1.20	0.55	1.70
Insulation (polyester)	Color	White, red, black	Red, black	White, red, black	Red, black
	Typical thickness (mm)	0.16	0.23	0.16	0.25
	Typical outside diameter (mm)	0.87	1.66	0.87	2.20
Pair twisting	Constitution	White–red, white–black, and black–red		White–red, white–black, and black–red	
	Direction of twisting	Left Typical pitch: 20 mm		Left Typical pitch: 20 mm	
Assembling by twisting	Number of strands or conductors	3	6	3	6
	Direction of twisting	Left		Left	
	Taping	Twisting is wrapped with washi, or Japanese paper, tape.		Twisting is wrapped with washi, or Japanese paper, tape.	
	Typical outside diameter (mm)	5.7		6.9	
Braided shielding	Typical strand diameter (mm)	0.14			
	Typical density (mm)	80			
	Drain	A 12/0.18 mm wire is roughly wrapped under braided shielding.			
	Typical outside diameter (mm)	6.4		7.6	
Sheath (polyurethane)	Color	Black (matted)			
	Typical thickness (mm)	1.05		1.1	
	Vertical taping	Vertically taped with washi under sheathing.			
	Outside diameter (mm)	8.5 ± 0.3		9.8 ± 0.3	
Finished assembly	Typical length (m)	100			
	Short size	Basically not approved.			

Item		Specification			
FANUC specification number		A66L–0001–0402		A66L–0001–0403	
Manufacturer		Oki Electric Cable Co., Ltd.			
		A–conductor	B–conductor	A–conductor	B–conductor
Finished assembly performance	Rating	80°C 30V			
	Standard	Shall comply with UL STYLE 20236 and CSA LL43109 AWM I/II A 80°C 30V FT–1.			
	Flame resistance	Shall comply with VW–1 and FT–1.			
Electrical performance	Conductor resistance Ω/km (20°C)	103 or lower	25.5 or lower	103 or lower	15.0 or lower
	Insulation resistance MΩ/km (20°C)	1 or higher			
	Dielectric strength V–min	A. C 500			
Insulation performance	Tensile strength N/mm^2	9.8 or higher			
	Elongation %	100 or higher			
	Tensile strength after aging %	At least 70% of that before aging			
	Elongation after aging %	At least 65% of that before aging			
	Aging condition	For 168 hours at 113°C			
Sheathing performance	Tensile strength N/mm^2	9.8 or higher			
	Elongation %	100 or higher			
	Tensile strength after aging %	At least 70% of that before aging			
	Elongation after aging %	At least 65% of that before aging			
	Aging condition	For 168 hours at 113°C			
Cable cross section					

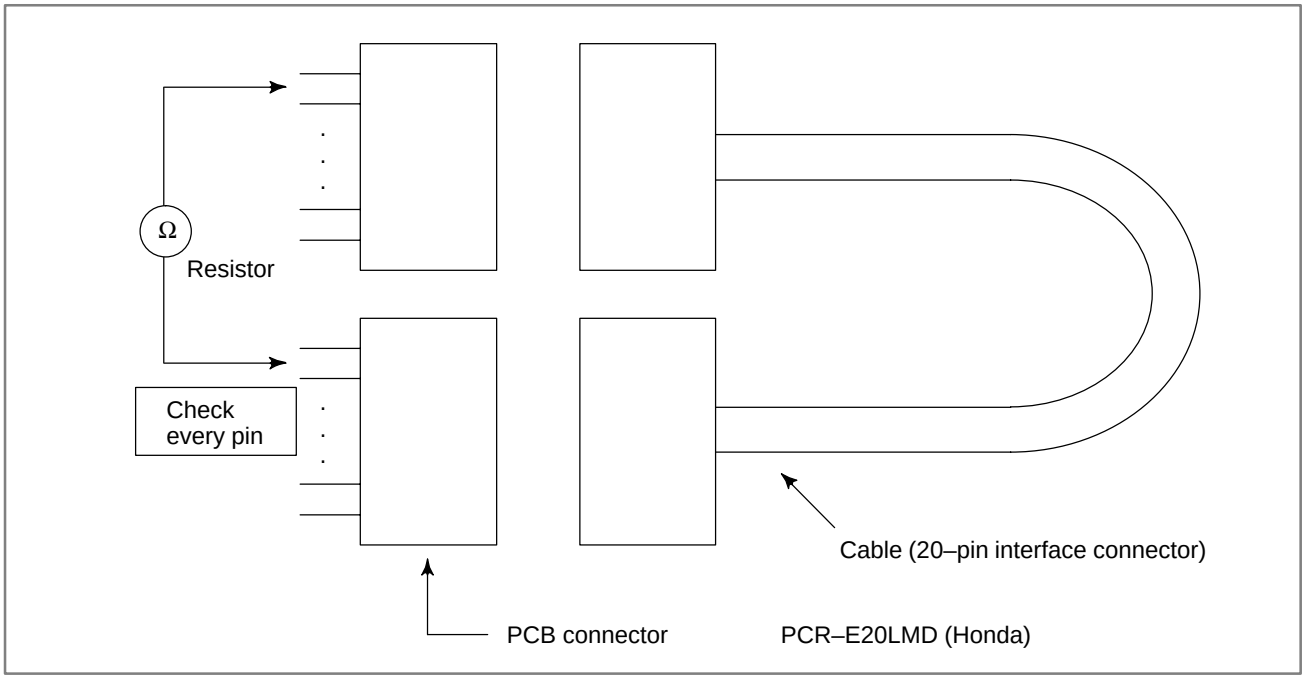
5–core coaxial cable

- **Specifications**

Item		Unit	Description
Specification		–	A66L–0001–0371
Manufacture		–	HITACHI CABLE CO., LTD.
Manufacture's specification		–	CO–IREFV(0)–CX–75–SB5X0.14SQ
Number of Conductors		Core	5
Inside Conductor	Size	mm^2	0.14
	Components	Conductors (PCS)/mm	7/0.16
	Material	–	Tin–coated Soft Copper Wire
	Diameter	mm	0.48
Insulator	Material (Color)	–	Polyethylene (White)
	Thickness	mm	0.71
	Diameter	mm	1.90
Outside Conductor	Material	–	Tin–coated Soft Copper Wire (Rolled)
	Diameter of Component–Wire	mm	0.08
	Density	%	95 or more
	Diameter	mm	0.2
Jacket	Material	–	Vinyl
	Color	–	Black. White. Red. Green. Blue
	Thickness	mm	0.15
	Diameter	mm	2.6
Twisted Assembly Diameter		mm	7.1
Thickness of Paper Tape		mm	0.05
Shield braid	Wire dia. Material	mm	0.12 Tin–coaded soft copper wire
	Density	%	80 or more
	Thickness	mm	0.3
	Diameter	mm	7.8
Sheath	Material, Color	–	Oil Tight Vinyl Black
	Thickness	mm	0.7 (Min. thickness: 0.56)
Finish Diameter		mm	9.2 ±0.3
Conductor Resistance (20°C)		Ω/km	143 or less
Withstand Voltage (A.C.)		V/min.	1000
Insulation Resistance (20°C)		MΩ–km	1000 or more
Impedance (10MHz)		Ω	75±5
Standard Capacitance (1MHz)		nF/km	56
Standard Attention (10MHz)		dB/km	53
Weight		kg/km	105
Standard Length		m	200
Package form		–	Bundle



An example of circuit testing 20–pin interface cable

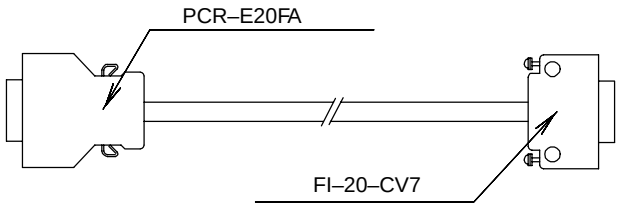
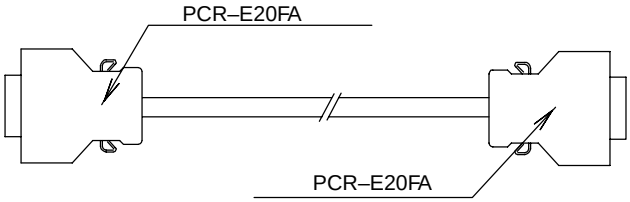
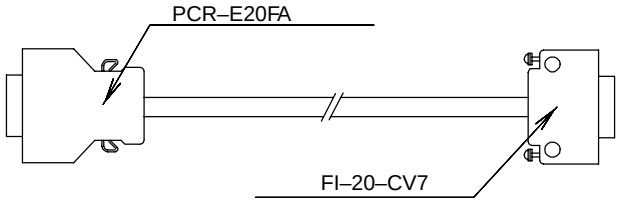
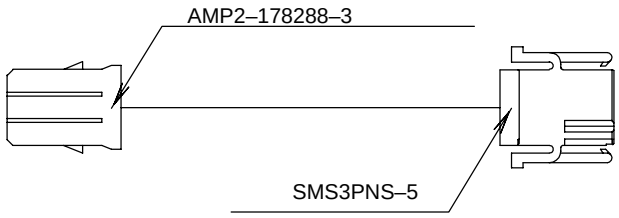
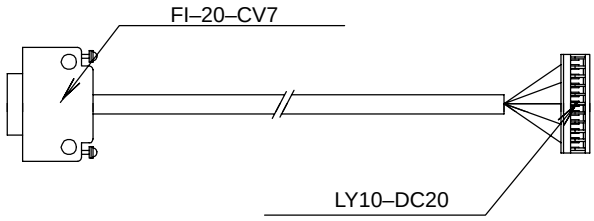
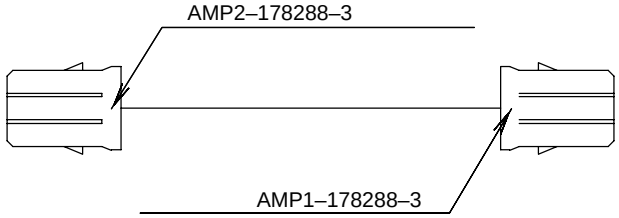


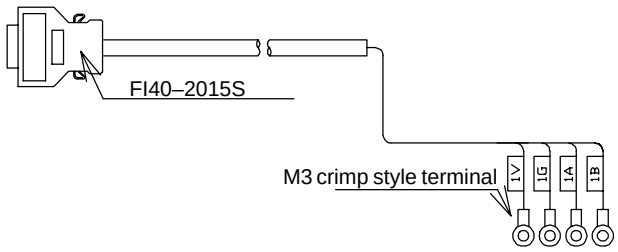
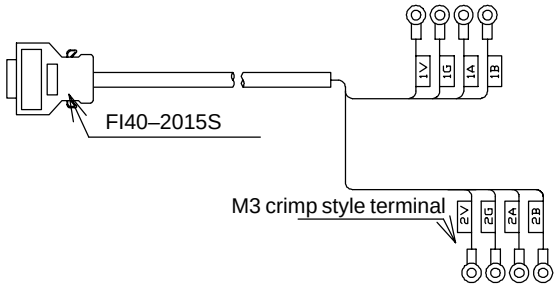
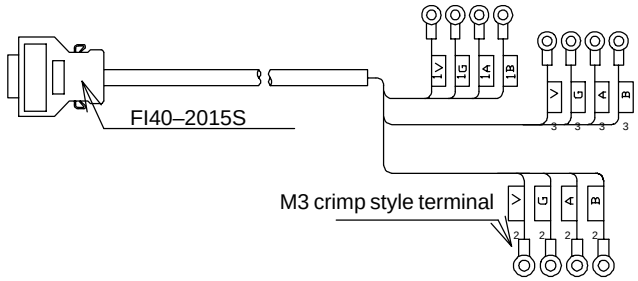
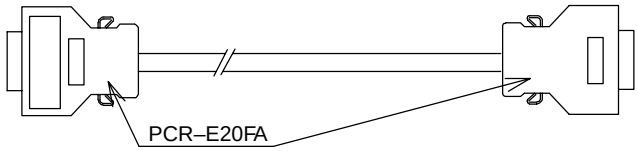
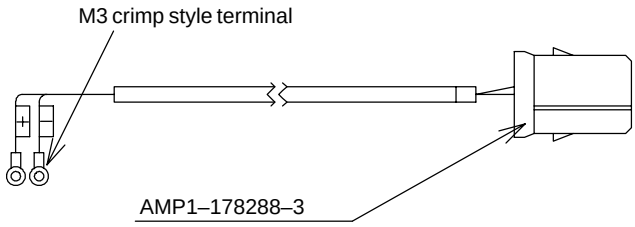
C CONNECTION CABLE (SUPPLIED FROM US)

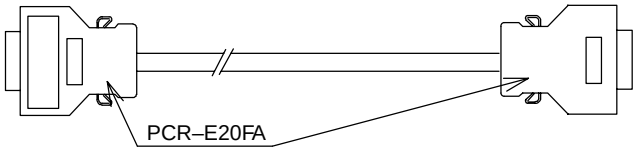
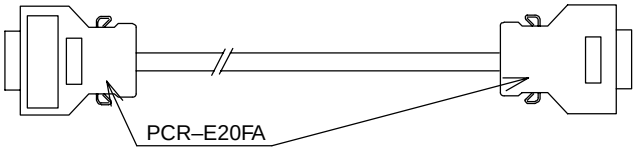
Maximum allowable cable length between units

Cable type	Use and condition	Maximum cable length (m)
MDI cable	Control unit–to–MDI unit	50 m
I/O Link cable	Electrical cable	10 m Note 2
	Electrical–to–optical conversion adapter	2 m
	Optical cable	200 m
Serial spindle cable	Electrical cable (control unit–to–spindle servo unit)	20 m
	Electrical–to–optical conversion adapter	2 m
	Optical cable	200 m
Position coder cable	Control unit position coder	50 m
MPG cable	Connector panel I/O operator's panel I/O module–to–manual pulse generator	50 m
FSSB cable	See APPENDIX D.	
HSSB cable	See APPENDIX D.	
RS–232C communication cable	4800 baud or less	100 m
	9600 baud or less	50 m
RS–422 communication cable	9600 baud or less	800 m
	19.2 kbaud	50 m

NOTE
1 The maximum cable lengths listed above apply only when the respective recommended cables stated in the text are used. If a non–recommended cable is used, the maximum cable length may not be guaranteed. Cables other than those listed above are used between units in the *i* series CNC. See the respective descriptions in this manual for details of these cables.
2 This cable can be extended to up to 15 m if it is used within the cabinet.

Purpose	Description	Specification	Length
Spindle signal cable (when 3 or 4 serial spindles are connected) Electrical–to–electrical		A02B–0236–K845	5 m
Spindle signal cable (when 3 or 4 serial spindles are connected) For serial connection between the second and third spindles		A02B–0236–K846	5 m
Spindle signal cable (when 3 or 4 serial spindles are connected) When an electrical-to-optical conversion adapter is used		A02B–0236–K847	1 m
Power supply cable for I/O unit Control unit (CP1B) ⇕ I/O Unit (CP31)		A02B–0236–K843	5 m
MDI signal cable Integrated control unit or stand–alone type LCD unit (CA55) ⇕ MDI unit (CK1)		A02B–0236–K812 A02B–0236–K813	25 m 45 m
Power supply cable for stand–alone type LCD unit stand–alone type MDI (CPD2) ⇕ Stand–alone type LCD (CP5)		A02B–0166–K880	55 m

Purpose	Description	Specification	Length
Manual pulse generator cable (for one unit) Control unit (JA3) ⇕ Manual pulse generator terminal board		A02B–0120–K847	7 m
Manual pulse generator cable (for two units) Control unit (JA3) ⇕ Manual pulse generator terminal board		A02B–0120–K848	7 m
Manual pulse generator cable (for three units) Control unit (JA3) ⇕ Manual pulse generator terminal board		A02B–0120–K841	7 m
I/O Link cable Control unit (JD1A) ⇕ I/O unit (JD1B)		A02B–0120–K842	5 m
Control unit power supply cable Stabilized power supply (24 VDC) ⇕ Control unit (CP1A)		A02B–0124–K830	5 m

Purpose	Description	Specification	Length
Serial spindle signal cable Control unit (JA41) ⇕ Electric/optical converter		A02B–0236–K844	1 m
Serial spindle signal cable Control unit (JA41) ⇕ series amplifier (JA7B)		A02B–0236–K810	5 m

D OPTICAL FIBER CABLE

The *i* Series CNC uses optical fiber cables for the following interfaces. This table lists the usable combinations.

Interface	Recommended optical cable	Maximum allowable transmission distance	Applicable junction adapter	Remark
Serial spindle interface	A66L–6001–0026#L~	200 m	A63L–0020–0002	
I/O Link interface	A66L–6001–0026#L~	200 m	A63L–0020–0002	
High–speed serial bus (HSSB) interface (Note)	A66L–6001–0026#L~	100 m	None	
	A66L–6001–0029#L~	55 m	A63L–0020–0002	For junction only
Serial servo bus (FSSB) interface	A66L–6001–0023#L~	10 m	None	
	A66L–6001–0026#L~	100 m	None	

NOTE
For printed–circuit boards with the following former ordering information, the maximum allowable transmission distance with –0026#L~ is lowered to 50 m, and connection with A63L–0020–0004 is impossible.
·A20B–8001–0580 ·A20B–8001–0581
·A20B–8001–0640 ·A20B–8100–0100

Notes on the specifications of optical fiber cable C

(1) Supported optical fiber cables

(a) Internal cord type cable: A66L–6001–0023#L□R□□□
Cable length: 0.15 to 10 m
Code diameter: 2.2 mm × 2 cords
Tensile strength:
Optical fiber cord 7 kg per cord
Between optical fiber cord and connector 2 kg
Minimum bending radius of optical fiber cord: 25 mm
Operating temperature: –20 to 70°C

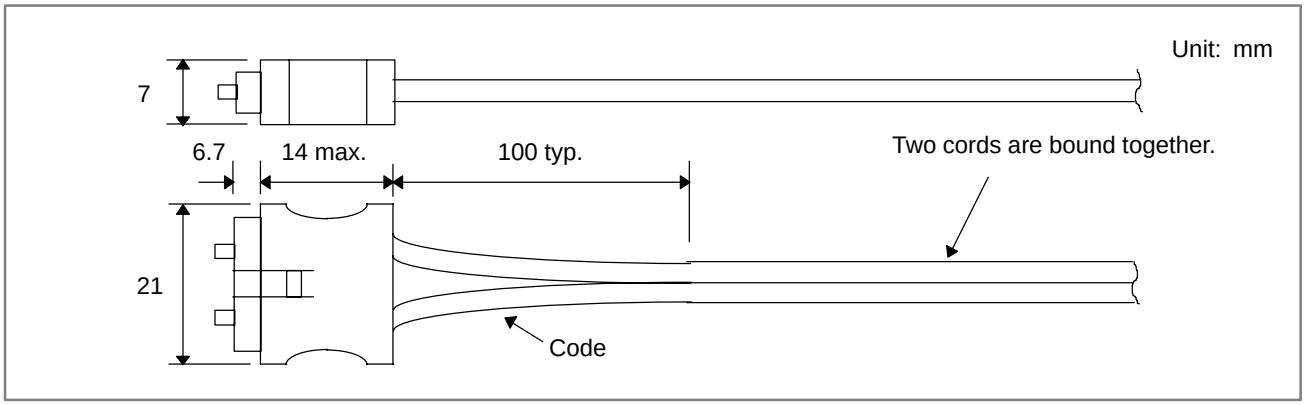


Fig. D.1 External dimensions of internal cord type cable

(b) External type cable: A66L–6001–0026#L□R□□□
Cable length: 1 to 50 m
Optical fiber cord diameter: 2.2 mm × 2 cords
Diameter of cable with reinforced cover: 7.6 mm
Tensile strength: Cable with reinforced cover – 75 kg
Optical fiber cord 7 kg per cord
Between optical fiber cord and connector 2 kg
Minimum bending radius of optical fiber cord: 25 mm
Minimum bending radius of cable with reinforced cover: 50 mm
Bending resistance (cable with reinforced cover): 1
0 million bending cycles at room temperature
(when the bending radius is 100 mm)

Flame resistance: Equivalent to UL VW–1
Operating temperature: –20 to 70°C

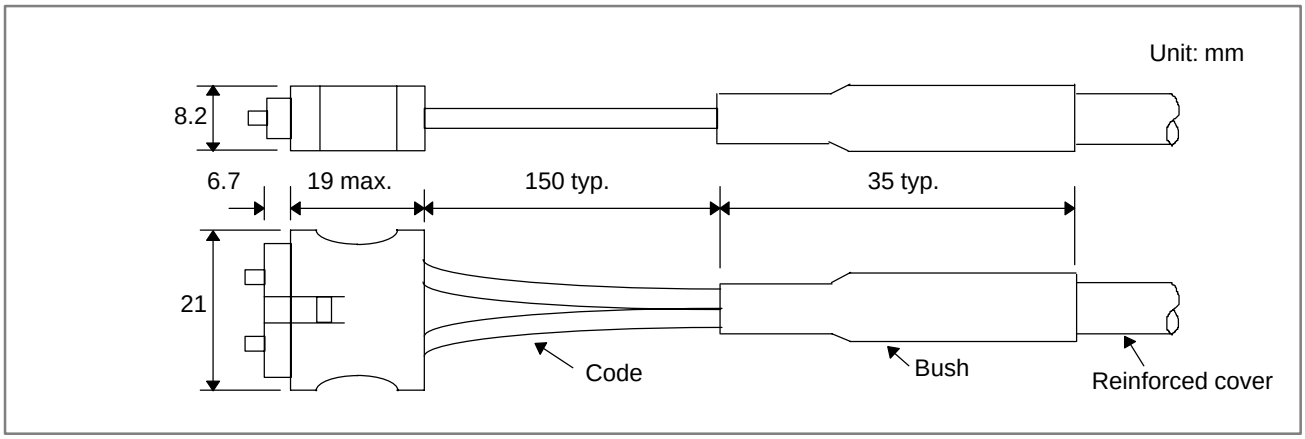


Fig. D.2 External dimensions of external cable

Table D.1 Standard cable length

Internal cord type cable		External cable	
A66L–6001–0023#		A66L–6001–0026#	
Specification	Length	Specification	Length
L150R0	0.15 m	L1R003	1.0 m
L300R0	0.3 m	L2R003	2.0 m
L500R0	0.5 m	L3R003	3.0 m
L1R003	1.0 m	L5R003	5.0 m
L2R003	2.0 m	L7R003	7.0 m
L3R003	3.0 m	L10R03	10.0 m
L5R003	5.0 m	L15R03	15.0 m
L7R003	7.0 m	L20R03	20.0 m
L10R03	10.0 m	L30R03	30.0 m
		L50R03	50.0 m
		L100R03	100.0 m
		L200R03	200.0 m

2. Cable selection
   - Always use an external cable (A66L–6001–0026#) when the cable is to be laid outside the power magnetics cabinet or main unit cabinet, where it may be pulled, rubbed, or stepped on.
   - Use an external cable when part of the cabling is to be subject to movement. For example, when connecting a portable operation pendant box to the power magnetics cabinet, the use of an external cable is desirable because the cable is likely to be bent, pulled, or twisted repeatedly even though frequent system operation is not expected. However, the force likely to be applied when the cable is installed or moved for maintenance purposes does not need to be taken into consideration.
   - Use an external cable in locations where sparks or flame are a danger. Although the internal cord type cable (A66L–6001–0023#) is covered by nonflammable resin, the cover, if exposed to frame for a long time, may melt, allowing the fiber cable inside to burn.
   - Use an external cable when the cable is expected to be pulled with considerable force during installation (the force applied to the cable must be within the specified tensile strength limit at all times). For example, even though installing a cable in a cable duct can be regarded as internal cabling, a cable of the appropriate type must be selected according to the tensile force to be applied to the cable during installation.
   - Both the internal cord type and external cables have the same oil and heat resistance properties.

3. Procuring the cable
   All the optical fiber cables mentioned above are special cable products with optical connectors, which are designed, produced, and tested to ensure the required system performance and reliability. It is technically impossible for users to produce these cables or process (cut and reconnect) them after purchase. Users are requested to purchase cables of the necessary length from an appropriate supplier. Cables are available from either FANUC or any of the FANUC–approved manufacturers listed in Table D.2.

Table D.2 FANUC–approved cable manufacturers and cable model numbers (retail)

(1) Internal cord type cable A66L–6001–0023#L□R□□□

Manufacturer	Model number	Remarks
Japan AMP, Co., Ltd.	⁎–353373–⁎	
Japan Aviation Electronics Industry, Ltd.	PF–2HB209–⁎⁎M–F–1	⁎⁎ indicates the cable length (m).
Hirose Electric Co., Ltd.	H07–P22–F2VCFA–⁎⁎	⁎⁎ indicates the cable length (m).

(2) External Cable A66L–6001–0023#L□R□□□

Manufacturer	Model number	Remarks
Japan AMP, Co., Ltd.	⁎–353199–⁎	
Japan Aviation Electronics Industry, Ltd.	CF–2HB208–⁎⁎M–F–1	⁎⁎ indicates the cable length (m).
Hirose Electric Co., Ltd.	H07–P22–F2NCFA–⁎⁎	⁎⁎ indicates the cable length (m).
Oki Electric Cable Co., Ltd.	OPC201HPXF–⁎⁎MB	⁎⁎ indicates the cable length (m).

4. Handling precautions
   (1) Protection during storage
   When the electrical/optical conversion module mounted on the printed circuit board and the optical fiber cable are not in use, their mating surfaces must be protected with the lid and caps with which they are supplied. If left uncovered, the mating surfaces are likely to become dirty, possibly resulting in a poor cable connection.

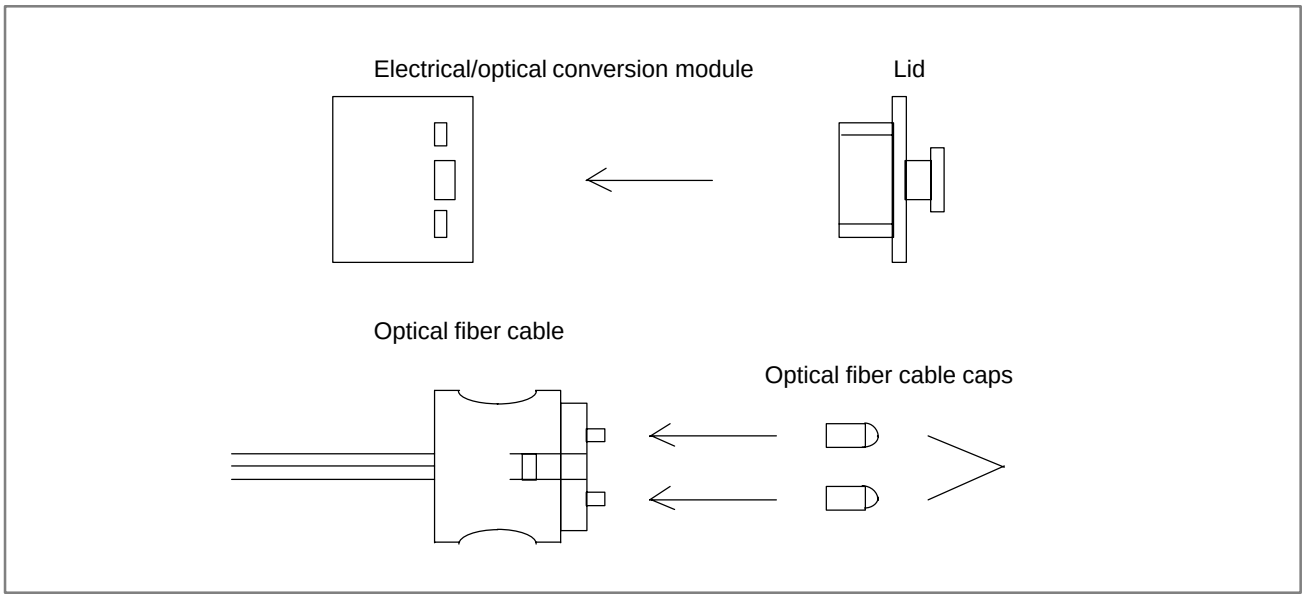


Fig. D.3 Protection of electrical/optical conversion module and optical fiber cable (when not in use)

(2) Optical fiber cable

- Although the reinforcing cover of the external cable has sufficient mechanical strength, be careful not to drop heavy objects on the cable.
- Grasp the optical connector firmly when connecting or disconnecting the cable. Do not pull on the optical fiber cord itself. (The maximum tensile strength between the fiber cord and connector is 2 kg. Applying greater force to the cord is likely to cause the connector to come off, making the cable unusable.)
- Once connected, the optical connector is automatically locked by the lock levers on its top. To remove the connector, release the lock levers and pull the connector.
- Although optical connectors cannot be connected in other than the correct orientation, always take note of the connector's orientation before making the connection.
- Before installing an external cable, fix either a wire with a hook or a tension member to the reinforcing cover of the optical connector and pull the wire or tension member, as shown in Fig. D.4. This is done to prevent a tensile force from being applied between the fiber cord and connector. If no tensile force is applied between the fiber cord and connector when installing the cable, you can hold the reinforcing cover of the connector directly and pull it. In the case of an internal cord, which does not have a reinforcing cover, apply the same protective measures, as instructed in Fig. D.4, for that portion of the cable where the two cords are bound together, in order to prevent a tensile force from being applied between the fiber cord and connector. In the same way as for an external cable, if no tensile force is applied between the fiber cord and connector during installation, you can hold the shielded part of the cable directly and pull it. Because the combined tensile strength of the two cords is only 14 kg, however, avoid applying too great a force to the cable during installation, regardless of whether you have taken the protective measures.

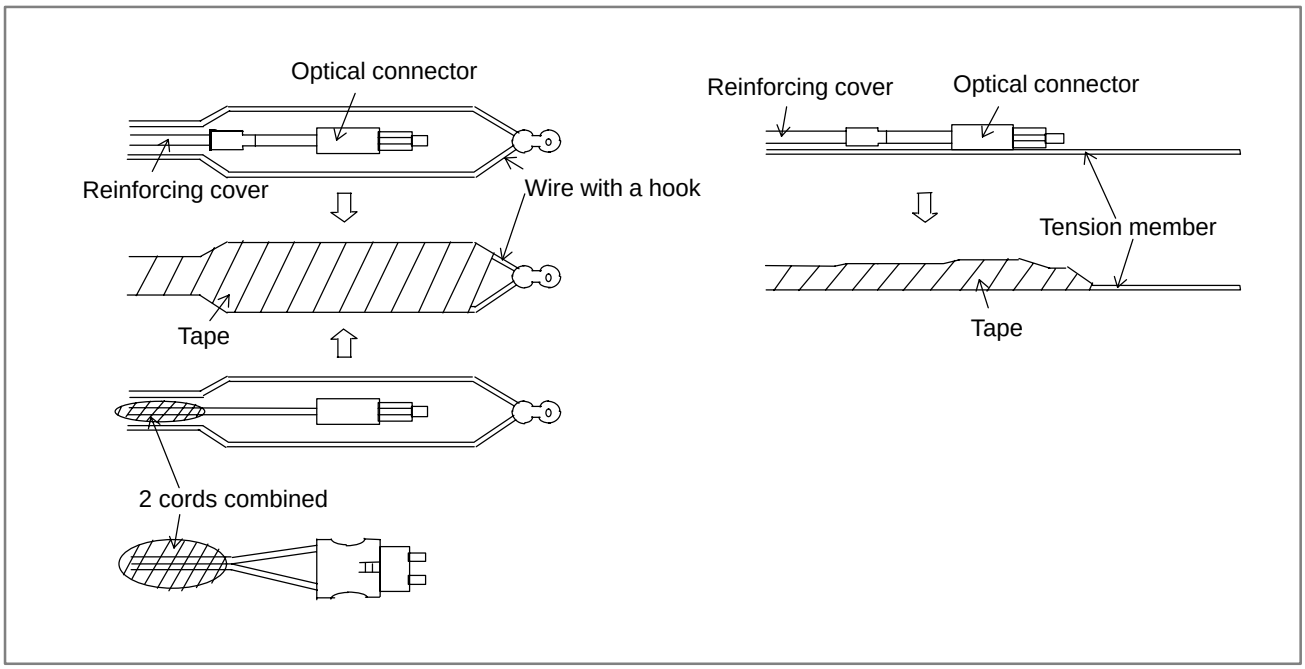


Fig. D.4 Prior to installing a cable

- Take care to keep both parts of the optical connector (cable side and PCB side) clean. If they become dirty, wipe them with tissue paper or absorbent cotton to remove dirt. The tissue paper or absorbent cotton may be moistened with ethyl alcohol. Do not use any organic solvent other than ethyl alcohol.
- Fix the reinforcing cover of the external cable or the cord binding portion of the internal cord type cable by using a cable clamp, as shown in Fig. D.5, to prevent the weight of the optical fiber cable from being applied directly to the connecting part of the optical connector.

  (Recommended cable clamp):

  Recommended cable clamps are listed below. Use a clamp that grasps the optical cable lightly; the clamp should not apply excessive pressure to the cable.

  For an external cable:

  CKN–13SP (with sponge)(Kitagawa Industry Co., Ltd.)

  For an internal cord type cable:

  MN–1 (Kitagawa Industry Co., Ltd.)

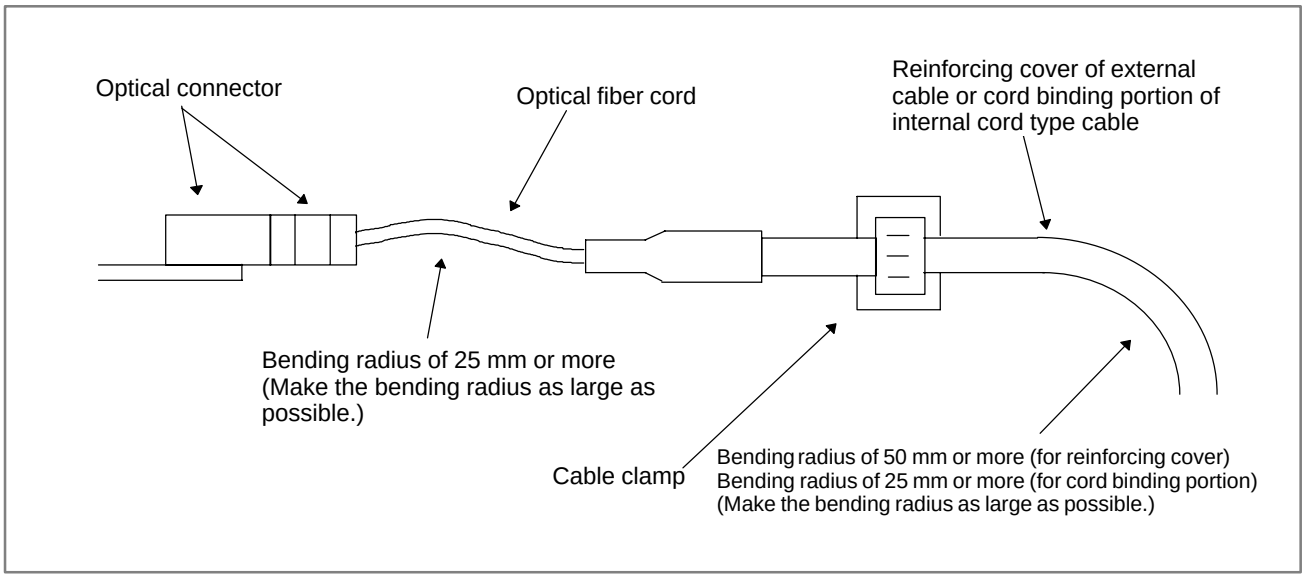
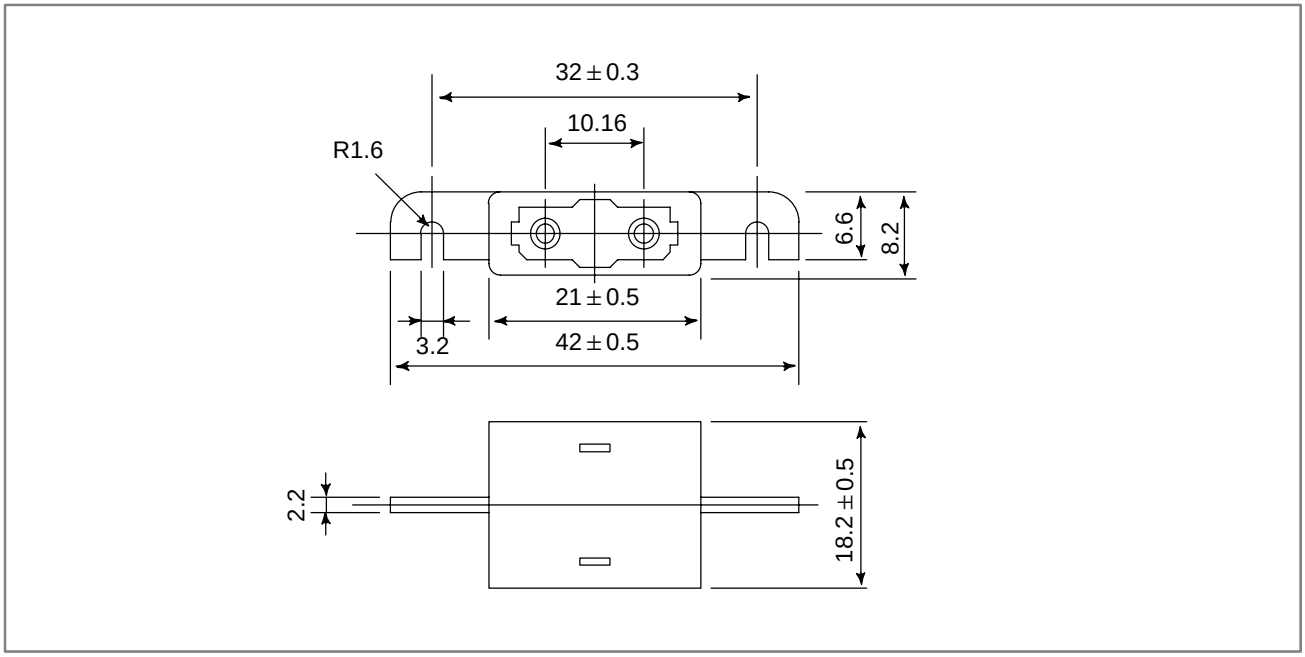


Fig. D.5 Fixing the cable with a clamp

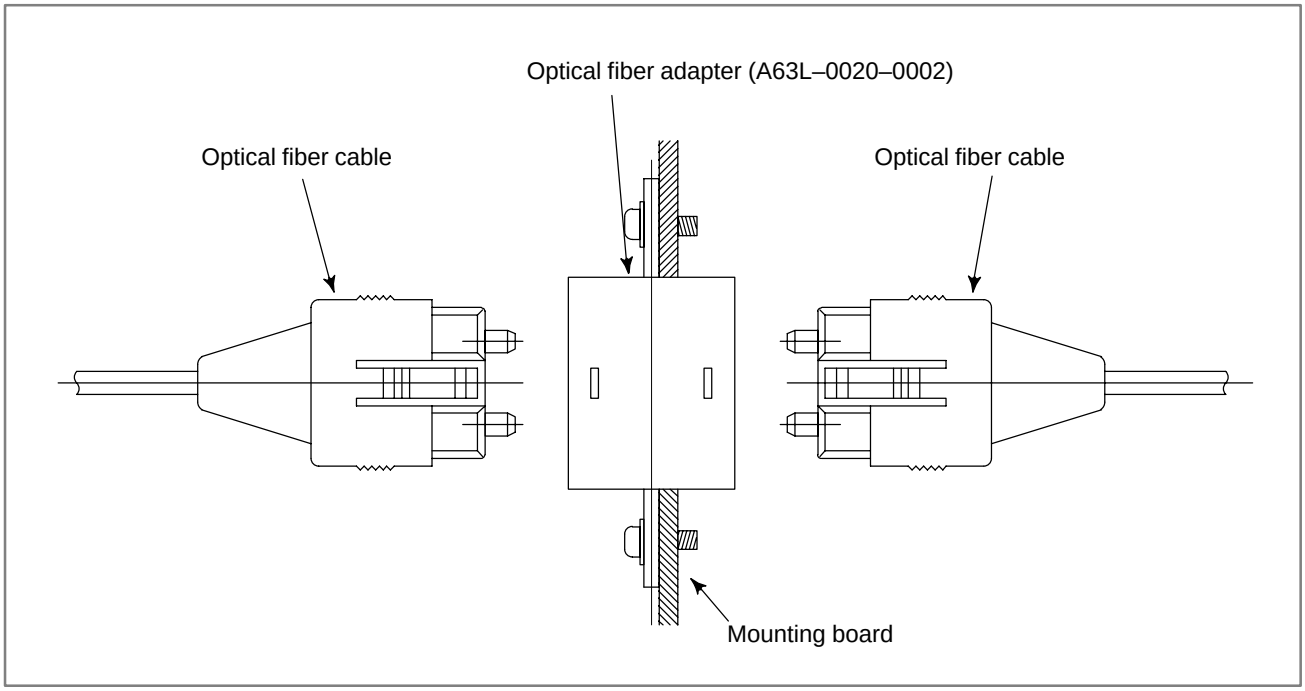
- Any superfluous portion of the cable may be wound into a loops. Should this prove necessary, make sure the diameter of each loop is at least 150 mm (for an external cable) or at least 100 mm (for an internal cord type cable). Winding the cable into smaller loops may produce sharp curves that exceed the specified bending radius limit without the user being aware. Such bending can result in a greater transmission loss, ultimately leading to a communication failure.
- When using a nylon band (cable tie) as a cable clamp, follow the instructions given below. Also, take care not to apply a bending force to one particular part of the cable when fixing it with a clamp. Failing to clamp the cable correctly may cut or damage it.
  External cable:
  Do not clamp the uncovered portion of the cable with a nylon band. When clamping the cable by the reinforcing cover, the clamping force is not an important factor to consider. However, ensure that the clamping force is as small as possible to ensure that the reinforcing cover is not deformed by the clamping. If possible, the clamping force should be 5 kg or less.
  Internal cord type cable:
  Lightly clamp the optical cable with a nylon band so that the cable shield is not deformed. If possible, the clamping force should be 1 or 2 kg (make sure that no force is applied to the cable). Due care is required when clamping the internal cord type cable because its cable shield is weaker than the reinforcing cover of the external cable.

5. Optical fiber cable relay
   When used for the FANUC I/O Link application, optical fiber cables can be connected by using an optical fiber adapter, as follows.

(a) External view of an optical fiber adapter



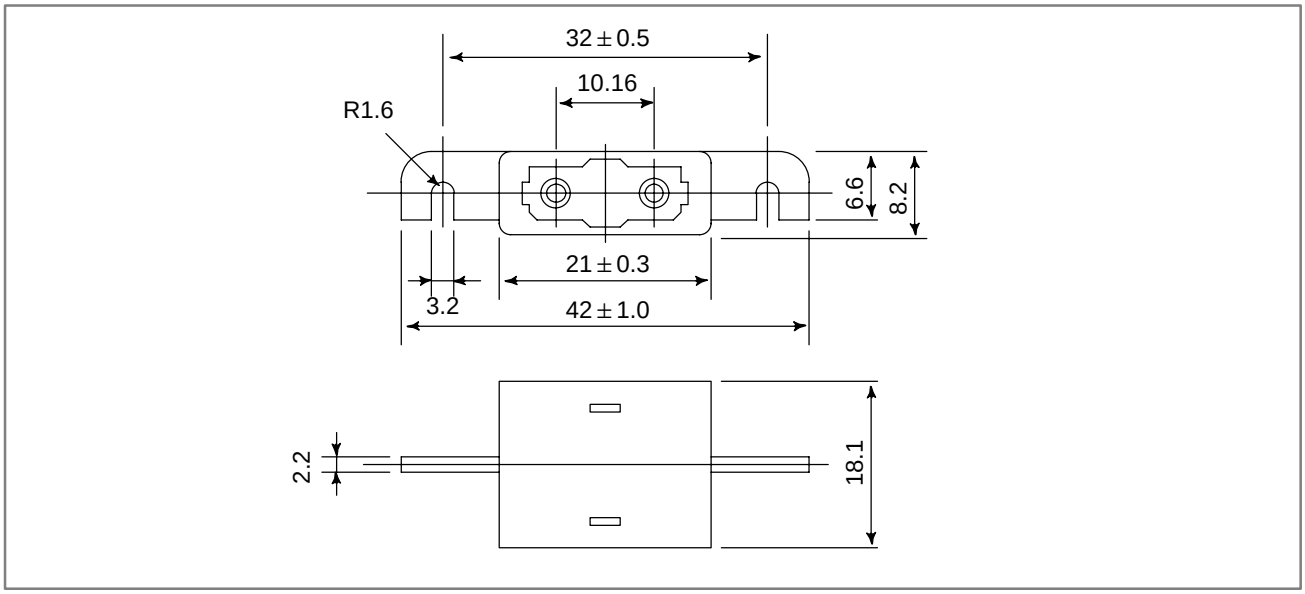
(b) Example of the use of an optical fiber adapter



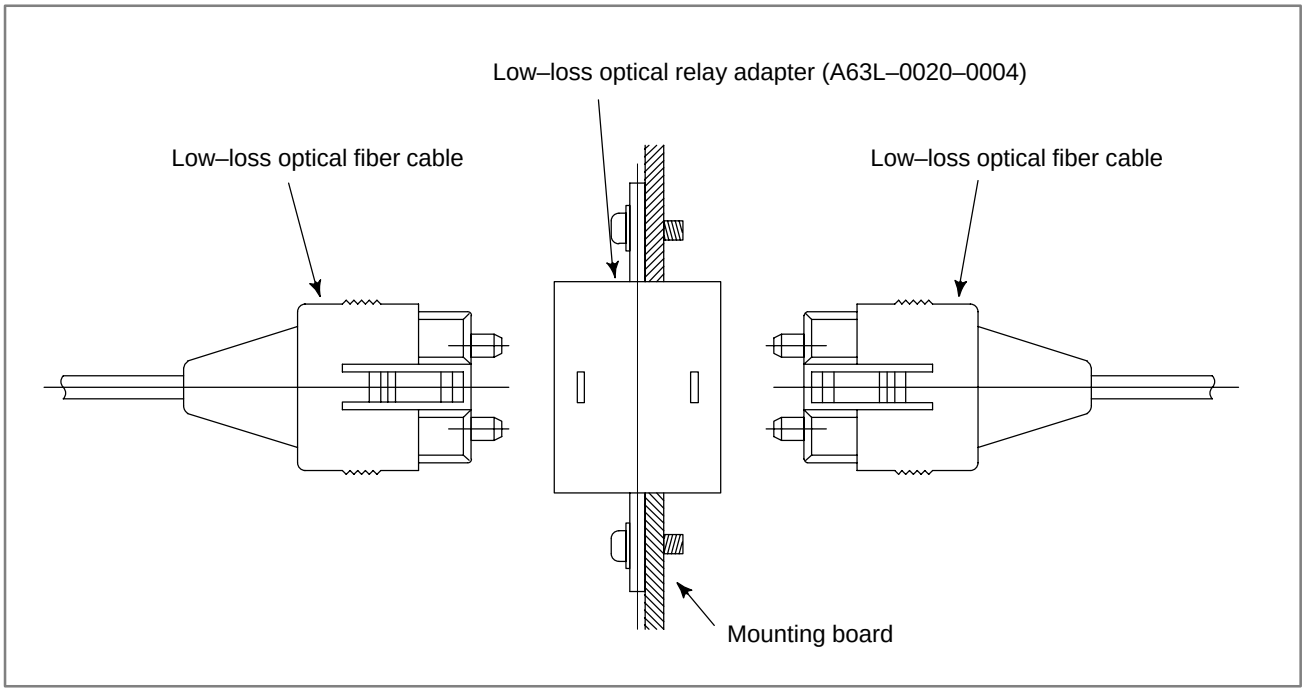
NOTE
Up to one relay points are permitte.

6. Optical fiber cable relay of FANUC high–speed serial bus
   With the FANUC high–speed serial bus, special low–loss optical cables can be connected by using a special low–loss optical relay adapter as an optical fiber relay adapter.

(a) External view of the low–loss optical relay adapter



(b) Example of use of the optical fiber relay adapter

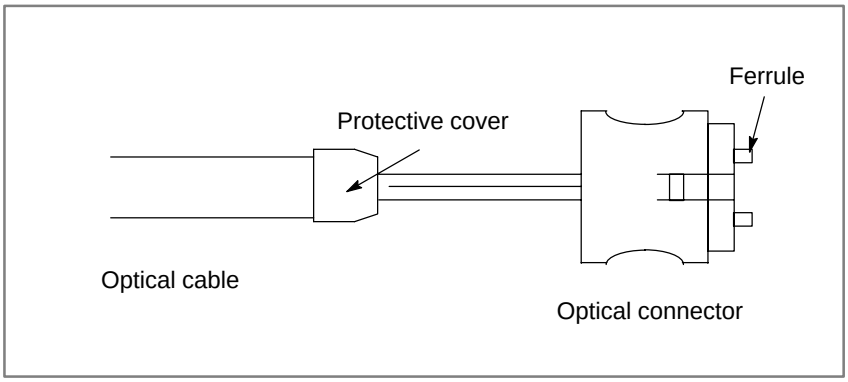


NOTE
Only one relay point is permitted.

7. Precautions for connection with low–loss optical junction adapter

- Features of and handling precautions for low–loss optical junction adapter (A63L–0020–0004)
  When optical connectors for a conventional optical junction adapter (A63L–0020–0002) are jointed, the facing ferrules(Note 1) are located about 60 um from each other. This is because the optical fiber of conventional PCF (plastic clad silica fiber) cables (A66L–6001–0008, –0009, –0026) may protrude from the tip of the ferrules (by up to about several um), resulting in the fiber protrusion being damaged when the ferrules are butted against each other.
  In the low–loss optical junction adapter, the ferrules are butted against each other, thus greatly reducing the reduction in repeater loss. Therefore, the two optical cables used with the low–loss optical junction adapters must be dedicated to the adapters.
  If a conventional PCF (plastic clad silica fiber) cable (A66L–6001–0008, –0009, –0026) is used as even one of the two optical fiber cables for joining the low–loss optical junction adapter, both cables may be damaged, resulting in deteriorated characteristics.

NOTE
Ferrule: Movable metal at the tip of an optical connector; the fiber is bonded to the ferrule.



- Features of low–loss optical cable (A66L–6001–0029)
  A low–loss optical cable is selected from conventional PCF optical cables (A66L–6601–0026). The selected cable offers low loss, and its connector section is given special treatment; the fiber ends are provided with a depression so that the ferrules can be butted against each other. The two optical cables used with the low-loss optical junction adapter must be of low–loss type.
- Appearance of the low–loss optical junction adapter and cable (how to distinguish them from conventional types)
  The body of the conventional optical junction adapter is black, but that of the low–loss optical junction adapter is blue. In addition, the protective cover(Note 1) of the conventional PCF optical cable is black, but that of the low–loss optical cable is blue.

8. Installing the optical fiber junction adapter
   The optical fiber junction adapter should be installed within a cabinet, as a rule. If it is impossible to avoid installing it within a cabinet, protect the adapter and the optical cable portions (such as connectors and cords) not covered with reinforcement coating from the outside air by, for example, covering them with packing.

9. Environmental resistance of the optical fiber junction adapter
   - The optical fiber junction adapter is not waterproof. Even when optical cables are attached to both ends of the adapter, there are very small gaps in the linked portions, so water resistance can not be expected.
   - When optical cables are attached to both ends of the junction adapter installed in a normal environment (such as within a cabinet), it is unlikely that dust will penetrate between the adapter and optical fiber to the degree that it may hamper normal optical linkage. If one or both ends of the adapter are left open, dust and dirt may accumulate even when the adapter is in a normal environment (such as within a cabinet). The dust and dirt on the adapter ends is likely to hamper normal optical linkage when the optical cables are attached. In such a case, clean the junction adapter and the optical connector using the optical fiber junction adapter cleaning method described below.
   - Do not allow cutting fluid to splash over the adapter or those optical cable portions (such as connectors and cords) that are not covered with reinforcement coating. If the inside of the adapter and fiber end surfaces are contaminated with cutting fluid, a malfunction may occur.

10. Cleaning
    If the optical fiber junction adapter, optical–to–electrical conversion module, or optical cable are soiled, clean them according to the following procedures.
    - Cleaning the optical fiber junction adapter and optical-to-electrical conversion module
      First, clean the entire housing by wiping it with a cloth moistened with, or by washing it in, ethyl alcohol or HCFC141B (alternative CFC; High Shower spray can DS–2168, manufactured by Sun Hayato). Similarly, wash the two sleeves in the adapter or wipe them with a cotton swab or the like.

- Cleaning optical cables
  For the optical cables, it is important to clean the connectors at their ends. Any soiling on the optical fiber end surfaces will hamper optical transmission, resulting in a malfunction. Wipe the optical fiber end surfaces (that is, the ferrule end surfaces) thoroughly with a soft, clean cloth (like gauze) moistened with ethyl alcohol or HCFC141B, in the same way as described above. The use of cotton swabs may prove convenient. The fiber end surfaces of low–loss optical cables are lower than the ferrules. To remove any soiling from the fiber end surfaces completely, push the cotton swab or gauze into the depressions all the way through while rotating the ferrule. If the ferrules and optical connectors are contaminated with oily substances, and they may extend over a cleaned fiber end surface when it is attached to the optical-to-electrical conversion module, it is a good idea to wash them before wiping the optical fiber end surfaces, using the procedure stated above.

E LIQUID CRYSTAL DISPLAY (LCD)

Brightness of the monochrome LCD

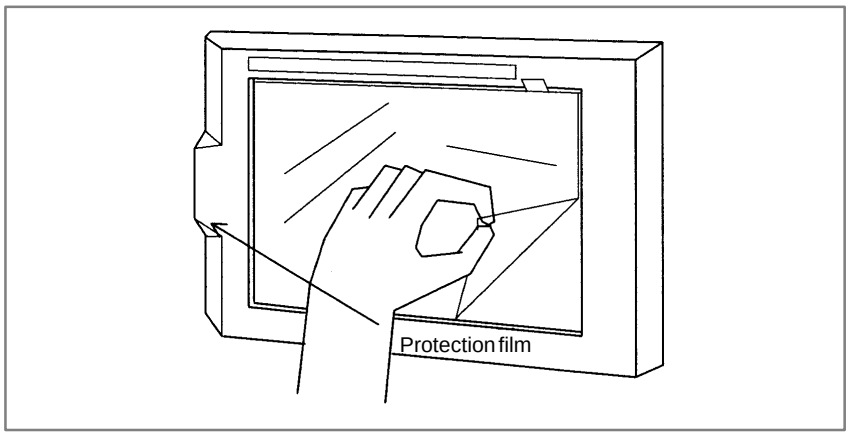
When the ambient temperature is low, the brightness of the LCD decreases. (In particular, the LCD screen immediately after power–on is dark.) This is not a failure but a property of the LCD. As the ambient temperature rises, the LCD screen becomes brighter.
The monochrome LCD provides a function for adjusting its brightness. For an explanation of how to adjust the brightness, refer to the maintenance manual or operator's manual of the *i* Series.

LCD with a touch panel

The touch panel is operated by directly touching the LCD screen. For touch panel operation, be sure to use the FANUC–supplied pen (A02B–0236–K111) provided with the touch panel. If the LCD screen is touched using a sharp–tipped pen, the surface of the LCD screen may be damaged. Moreover, the LCD screen must not be touched by with your fingers. Otherwise, the operability may be degraded, and the screen is likely to become dirty.

Protection sheet for the touch panel

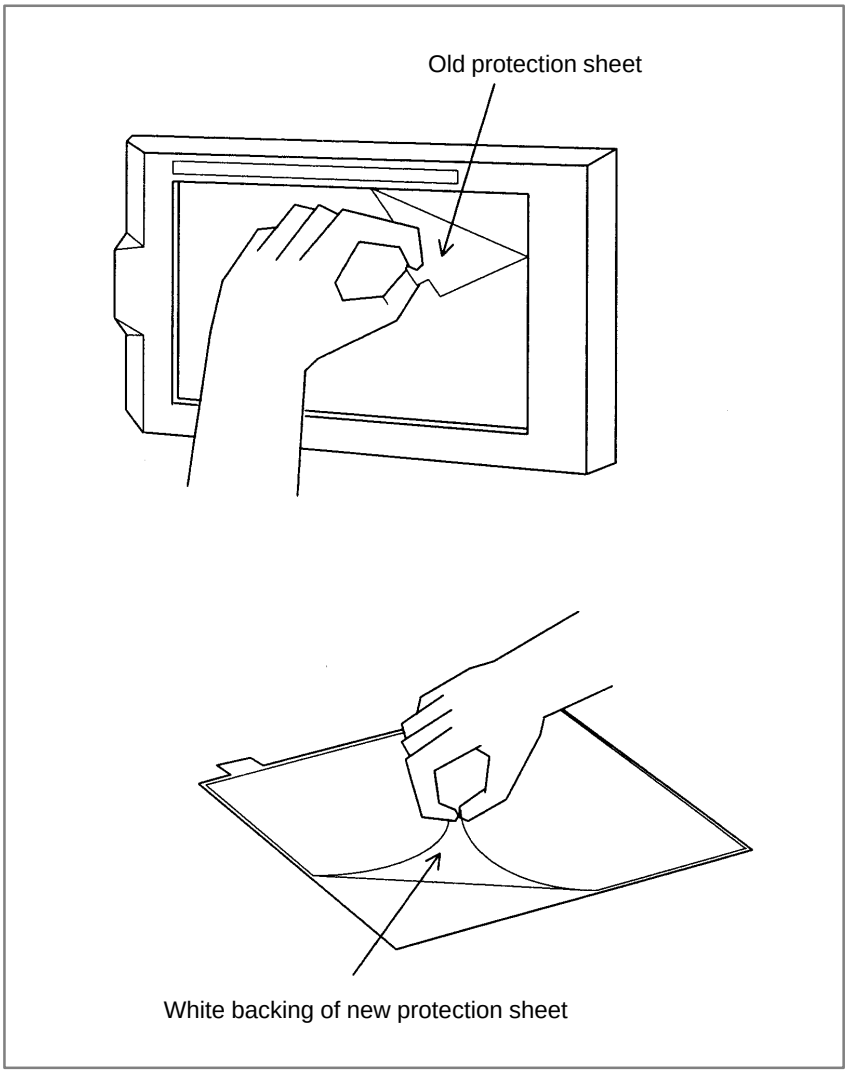
A protection sheet is attached the face of an LCD with a touch panel to protect the thin film of the touch panel and LCD. The protection sheet is itself covered by a film to protect against damage in transit. After connecting the CNC to the machine, peel off the film as shown below. The protection film is less transparent, so the display screen will be less visible if the protection film is not removed.



When replacing the protection sheet, use the procedure below.

- Remove the protection sheet from the front of the LCD. Then, wipe away any moisture or oil from the front of the LCD.
- Peel off the white backing sheet from the back (side which attaches to the LCD) of a new protection sheet.
- When the white protection sheet is removed, the protection sheet is ready to be applied. Attach the protection sheet onto the front of the LCD. At this time, do not allow dirt and dust to enter between the LCD and protection sheet.

- Finally, remove the film from the protection sheet.
  Ordering code of the protection sheet: A02B–0236–K110



F MEMORY CARD INTERFACE

Overview

Using the memory card interface located on the left side of the LCD, input/output of data inside the CNC and remote diagnosis using a modem card can be performed. This appendix describes the memory card interface for data input/output. For an explanation of remote diagnosis using a modem card, see the related document.

Compatible and incompatible cards

SRAM card

- JEIDA (4.0 or later) Type 1 and Type 2
- PCMCIA (2.0 or later) Type 1 and Type 2
- PC Card Standard

SRAM cards conforming to any of the above standards can be used. However, SRAM cards operating only on a power supply voltage of 3.3 V cannot be inserted physically. Such SRAM cards cannot be used.
The operation of the following FANUC–recommended SRAM cards has been confirmed by FANUC:

256KB SRAM card	Fujitsu	MB98A90823–20
512KB SRAM card	Fujitsu	MB98A90923–20
1MB SRAM card	Fujitsu	MB98A91023–20
2MB SRAM card	Fujitsu	MB98A91123–20

Flash memory card
With the *i* Series incorporating personal computer functions, no flash memory card can be used. With the *i* Series, Intel series 2 flash memory cards (or equivalent) can be used. However, flash memory cards operating only on a power supply voltage of 3.3 V cannot be inserted physically. Such flash memory cards cannot be used.
Basically, flash memory cards with non–Intel on–chip flash memories cannot be used. However, such flash memory cards, if formatted or written by a personal computer, may be read with the *i* Series. The operation of the following FANUC–recommended flash memory card has been confirmed by FANUC:

4MB flash memory card	Fujitsu	IMC004FLSA

Memory card capacity

The capacity of a memory card usually indicates an unformatted capacity. After formatting, the usable capacity decreases slightly. So, a memory card with a capacity larger than the size of data and programs actually stored needs to be prepared.

Example:When the size of data to be stored is 512KB
A memory card with a capacity of 1MB or more is required.

When a flash memory card is used, the last 128KB of the memory card is used as a buffer area, so that the usable space decreases additionally by 128KB.

Memory card formatting

The BOOT SYSTEM formats a memory card using method called the FAT file system. The formatting method called the flash file system is also supported. However, the FAT file system and flash file system are not compatible with each other, and the read and list functions cannot be used.

File operation with a flash memory card

Flash memory cards do not allow individual files to be deleted; all the files on a flash memory card need to be deleted at the same time. Accordingly, the following operations cannot be performed:

- Deletion of an existing file
- Renaming of a file
- Overwriting of a file

Notes on formatting a flash memory card with CardPro

CardPro uses the flash file system as standard to format a flash memory card. When using CardPro to format a flash memory card used with the boot system, use the following command to format the card.

A:CPFORMAT drive–name:/F:FLASHFAT/NOCIS

Using a flash memory card formatted with the BOOT SYSTEM on other systems

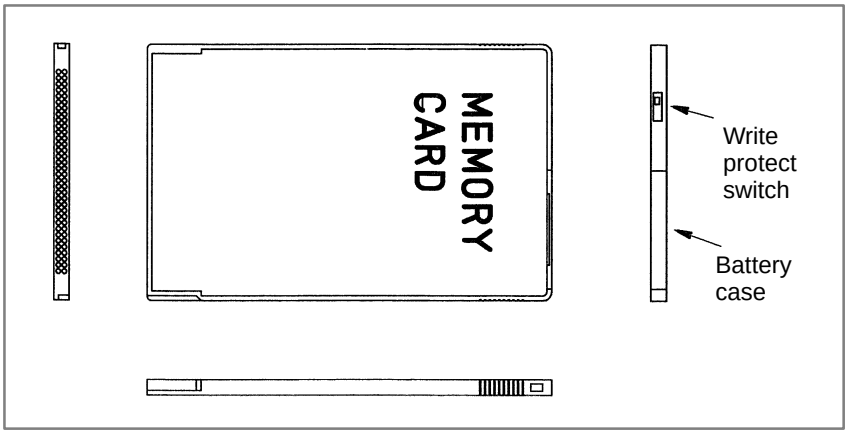
	Ramzo	CardPro
Reading of files	○	○
Addition of files	No file addition function is available.	×
Listing of files	○	○

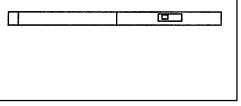
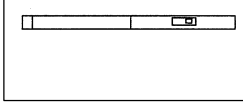
Using a flash memory card formatted with other systems on the BOOT SYSTEM

	Ramzo	CardPro
Reading of files	○	○
Addition of files	○	×
Listing of files	○	○

NOTE
1 Ramzo is a memory card reader/writer manufactured by Adtech System Science.
2 CardPro is a memory card reader/writer manufactured by Data IO.

Names and functions of components



	Name	Function
1	Write protect switch	Writing to the memory card can be disabled by setting the write protect switch. Writing is enabled.  Writing is disabled. 
2	Battery case	A battery for data backup is housed within an SRAM memory card. Flash memory cards do not have a battery case.

Inserting a memory card

A memory card has an insertion guide to protect against reverse insertion. Pay attention to the orientation of the memory card. The front of the memory card must face the LCD of the *i* Series.

Battery

The batteries used with FANUC–supplied SRAM memory cards were of the CR2325 and BR2325 types.
These batteries were difficult to obtain, so the CR2025 battery was introduced to replace these batteries in May, 1997.
By replacing the battery holder, the user can use SRAM memory cards that used the previous batteries (CR2325 and BR2325) with the new battery (CR2025).

SRAM memory cards

1) A87L–0001–0150#□□□
   Manufacturer's model: MB98A9□□33–20

Battery type

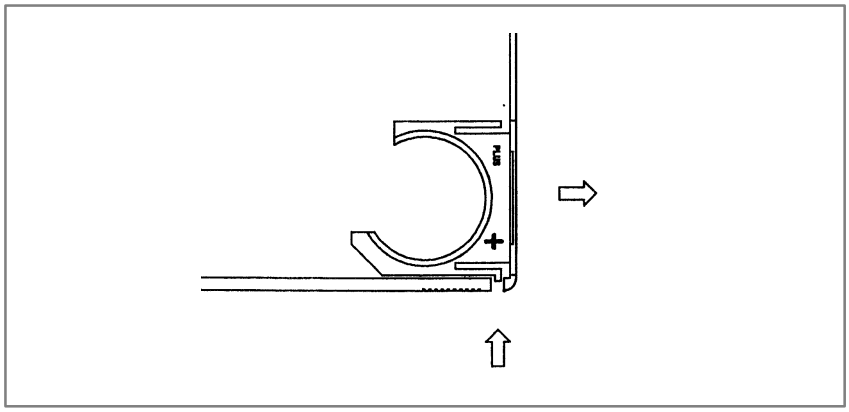
1) Before the change: CR2325 or BR2325
   - Indication on the side of the memory card:
     9□□33–20 S000 □□□ □□□
2) After the change: CR2025 or equivalent
   (common battery intended for use in electronic calculators)
   - Indication on the side of the memory card:
     9□□33–20 9157 □□□ □□□

Battery holder replacement

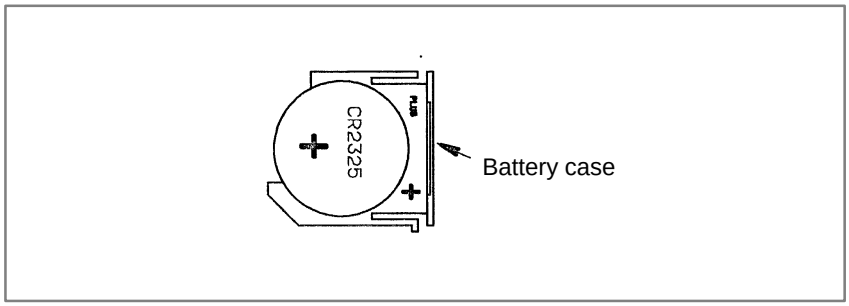
1) By replacing the battery holder, the user can use SRAM memory cards that used the previous batteries (CR2325 and BR2325) with the new battery (CR2025).
2) The battery holder set for CR2025 is available from shops handling Fujitsu electronic devices.
   - Ordering code: MB98XXX–holder set–09146
   - Contents of the set: Battery holder (1), battery (CR2025) (1), manual (1)

Battery replacement

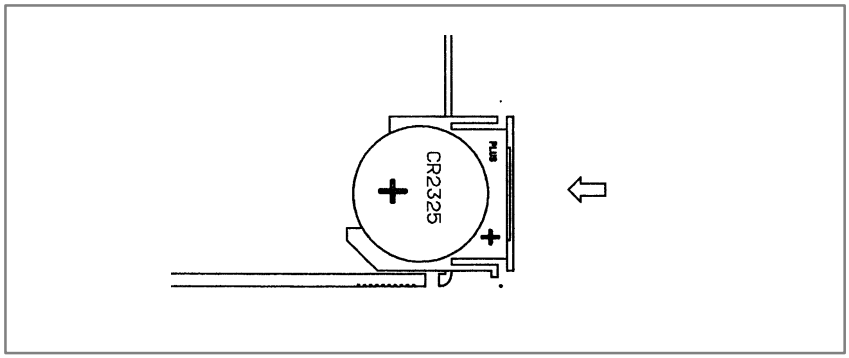
(1) While pressing down the fixing claw, pull out the battery case.



(2) Replace the battery with a new one.
Match the + mark of the battery with the + mark on the battery case.



(3) Return the battery case to its original position, then check that the battery operates normally.



ATA CARD

1. Overview

   Memory card–based data input/output in the current Series CNC can be done only with a flash memory card. For those models shipped from FANUC in and after October 1998, however, a flash ATA card (5 V version) can also be used for data input/output. Because the flash ATA card incorporates a storage device and controller, it enables data input/output for a personal computer equipped with a PCMCIA interface without using any special PC card writer.

2. Supported hardware versions and software editions
   On models other than the FS20*i*, the following conditions must be satisfied.

   2–1 Hardware

   The motherboard must be OF one of the versions listed below.

Model	Printed–circuit board specification	General version
FS16*i*	A20B–8100–0130	12E and later
FS18*i*	A20B–8100–0135	12E and later
FS21*i* (with SA5)	A20B–8100–0136	10E and later
FS21*i* (with SA1)	A20B–8100–0137	10E and later

   2–2 Software

   The software must be OF one of the editions listed below.

   System software

Series/model	Edition
B1F1/FS16*i*–TA	Edition 16 or later
B0F1/FS16*i*–MA	Edition 17 or later
BEF1/FS18*i*–TA	Edition 16 or later
BDF1/FS18*i*–MA	Edition 17 or later
DEF1/FS21*i*–TA	Edition 11 or later
DDF1/FS21*i*–MA	Edition 11 or later

   Boot software

Series	Edition
60M3	Edition 09 or later

3. Inappropriate version/edition combinations

3–1 If neither hardware nor software are supported

No normal operation is guaranteed. For a listing of the symptoms, see Section 3-3, “If the Hardware is Supported, but the Software is Not.”

3–2 If the software is supported, but the hardware is not

An ATA card may not be recognized as such when it is inserted. In this case, a symptom described in Section 3-3 occurs. Even if the ATA card is recognized, however, FANUC does not guarantee its operation.

3–3 If the hardware is supported, but the software is not

The FS16*i*–MA is exemplified below. The symptoms listed below are only examples. They will not always occur.

If the system software is not supported (BOF1/Edition 16)

Operation	Symptom (example)
Memory card–based input/output	MEMORY CARD ERROR
READ/WRITE and other operations on the PMC I/O screen	I/O WRITE (READ, LIST) ERROR
FORMAT on the PMC I/O screen	930 CPU INTERRUPT

If the boot software is not supported (60M3/Edition 08)

Operation	Symptom (example)
SYSTEM DATA LOADING	MEMORY CARD MOUNT ERROR
MEMORY CARD FILE DELETE	PLEASE FORMAT FLASH TYPE CARD. HIT SEL.
MEMORY CARD FORMAT	NMI OCCURRED, PLEASE POWER OFF.

4. Flash ATA card specification

The Flash ATA card must comply with the following standards and must be of one of the following types. However, it is not guaranteed that all ATA cards that comply with these standards will operate normally in the CNC. See Section 5 for those ATA cards whose normal operation has been confirmed by FANUC.

4–1 Card standards

The ATA card to be used in the CNC must comply with PCMCIA (Personal Computer Memory Card International Association) PC Card standard Release 2.1 and PCMCIA PC Card ATA Release 1.02.

4–2 Card Shapes

PCMCIA Type I and Type II

4–3 Card Operation Mode

PC–ATA specification

4–4 Card Operating Voltage

ATA cards that can operate on 5 V (single voltage power source) and 5 V/3.3 V (automatic switching) can be used in the CNC.

5. ATA cards whose normal operation has been confirmed

   The following table lists those ATA cards whose normal operation has been confirmed by FANUC (as of August, 1998). (All the listed ATA cards are 5 V versions.)

Manufacturer	Model	Storage capacity
Hitachi, Ltd.	HB286008A3	8MB
	HB286015A3	15MB
	HB286030A3	30MB
	HB286045A3	45MB
Matsushita Electric Industrial Co., Ltd.	BN–012AB	12MB
	BN–020AB	20MB
	BN–040AB	40MB

NOTE
1 FANUC does not guarantee the normal operation of any ATA card other than those listed above.
2 3.3 V versions of ATA cards cannot be used in the CNC.
3 5 V/3.3 V (automatic switching) versions can be used only in the *i* Series.
For any CNC other than the *i* series, these ATA cards can be inserted into a memory card slot, but they or the CNC control unit may be damaged electrically when the power is switched on. Be very careful when using these cards.

6. Miscellaneous

- The flash ATA card uses a quick format.
  If your flash ATA card has not been formatted, do so using a personal computer.
- It is impossible to use ATA cards with the memory card access function of a C executor application.

G ABOUT THE MMX–Pentium VERSION 160*i*/180*i*/210*i*

G.1 OUTLINE

The MMX–Pentium version has been added to the *i* series with display–integrated PC. This chapter describes the differences between the Pentium version and the MMX–Pentium version, connections and dimensions.

G.2 COMPARISON BETWEEN MMX–Pentium VERSION 160*i*/180*i*/210*i* AND Pentium VERSION

Refer to the following table.

Functional differences between the new and old functions on the 160*i*/180*i*/210*i* with built–in display–integrated PC functions

Item	MMX–Pentium version	Pentium version	Remarks
Hardware differences			
Procurement specifications	On the following options, the procurement drawings differ from those for the Pentium version. Be sure to refer to separate sheet "160*i*/180*i*/210*i* New/Old Order Specifications Comparison Table" before procuring for the MMX–Pentium version. The Pentium version cannot be used on the MMX–Pentium version. • Basic unit • PC card • Hard disk unit • Separate type MDI • FA full keyboard • PC I/F separate wiring unit • ISA expansion unit • Driver disk		
Basic unit			
LCD panel	10.4″ color TFT LCD (640 × 480 dot) or 12.1″ color TFT LCD (800 × 600 dot)	10.4″ color TFT LCD (640 × 480 dot) only	
External dimensions	290 × 200 mm (w/ 10.4″ LCD) 340 × 280 mm (w/ 12.1″ LCD)	290x220mm	Installation is the same for the unit w/ 10.4″ LCD.
PC card			
CPU	MMX–Pentium 166MHz	Pentium 120MHz	
Main memory	32MB, 64MB (16 MB not available)	16MB, 32MB, 64MB	
VGA chip	The Trident Cyber9320 exclusive driver is required.	The NeoMagic NM2093 exclusive driver is required.	Provided on driver disk
Hard disk unit			
Hard disk	3.5″ type used	2.5″ type used	
External dimensions	Installation dimensions differ from those for the Pentium version. (When special installation is performed at MTB, be sure to first check the dimensions.)		For details on installation, see separate sheet.
PC I/F separate wiring unit, ISA expansion unit			
External dimensions	Installation dimensions differ from those for the Pentium version. (When special installation is performed at MTB, be sure to first check the dimensions.)		For details on installation, see separate sheet.

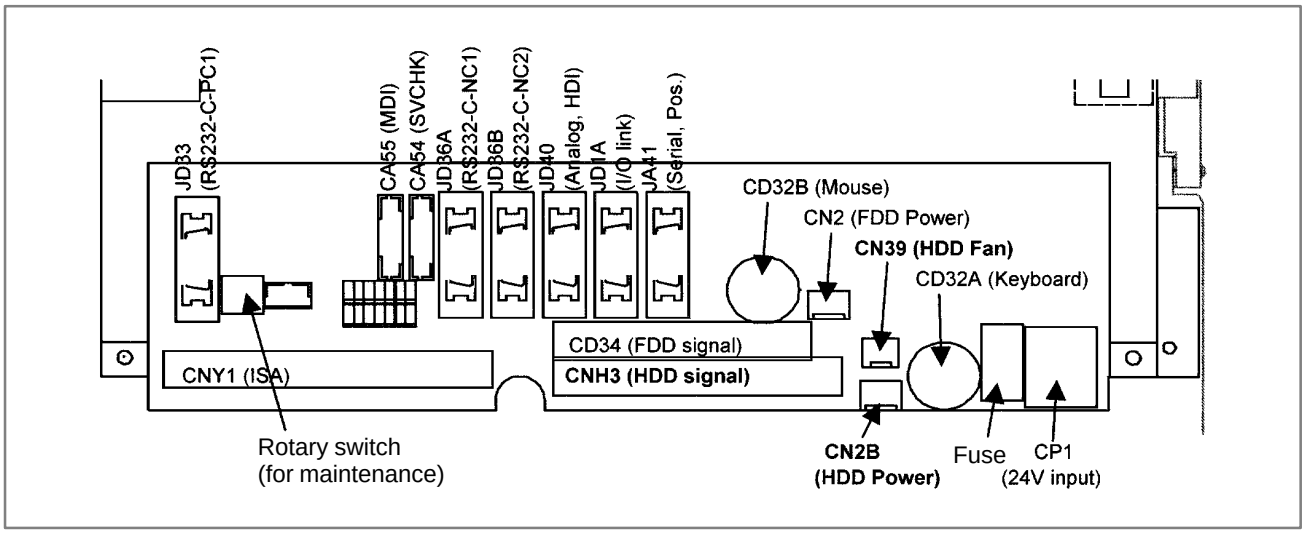
Functional differences between the new and old functions on the 160*i*/180*i*/210*i* with built–in display–integrated PC functions

Item	MMX–Pentium version	Pentium version	Remarks
Separate type MDI unit, FA full keyboard			
MDI unit, FA full keyboard	A special tool is required for mounting 3.5″ HDD to rear.	A special tool is required for mounting 2.5″ HDD to rear.	
Installation dimensions	(vertical type for unit w/ 10.4″ LCD) (vertical type for unit w/ 12.1″ LCD)	290 x 220 mm (vertical type)	
Internal power supply differences			
UMB area	Memory space C8000H to DBFFFH can be used.	Memory space CA000H to CBFFFH and CD000H to DFFFFH can be used.	
Address mapping of printer board	Mapped to I/O space 378H	Mapped to I/O space 3BCH	
Address mapping of PCMCIA driver	C8000H to CBFFFH	CC000H to CFFFFH	Setting for DOS PCMCIA driver “PlayAtWill”
Setting and installation procedure differences			
BIOS setting (1)	Do not enable suspend. If suspend is enabled, the power must be turned OFF and then back ON again to reboot after the suspend state is entered.		
BIOS setting (2)	HDD standby mode migration time is set to 15 minutes (default).	HDD standby mode migration time is 0 minutes (default) and is then set to 15 minutes (factory setting)	Change the setting only when there is a problem on the system. Note, however, that when this setting is shortened, the life of the HDD may become shorter.
OS installation method	The VGA chip must be specified.	No special items need to be specified.	
Windows 95 device manager	The mother board resource and IDE controller are marked by a “|”.		Especially, there is no problem in the operation.
ATA card use	Setting is required.		
Other			
Suspend	When suspend is selected in the Windows Start menu, reboot is possible only to turn the power ON again.		
CNC screen display function	On a 12.1″ LCD type, this function cannot be used.		

There may be other functional differences in addition to the above. Be sure to fully check on an operational machine.

G.3 CONNECTION

G.3.1 Connector Positions (Basic Unit)



	Pentium version	MMX–Pentium version	Remarks
Connector for PC separate wiring unit	CNY1	CNY1	Same
PC serial port ch1	JD33	JD33	Same
MDI connector	CA55	CA55	Same
Servo check connector	CA54	CA54	Same
NC serial port ch1	JD36A	JD36A	Same
NC serial port ch2	JD36B	JD36B	Same
Analog output, HDI	JD40	JD40	Same
I/O link	JD1A	JD1A	Same
Serial spindle, position coder	JA41	JA41	Same
FDD signal	CD34	CD34	Same
HDD signal	CNH1	CNH3	Modified
Mouse	CD32B	CD32B	Same
FDD power supply	CN2	CN2	Same
HDD fan motor	–	CN39	Added
HDD power supply	–	CN2B	Added
Keyboard	CD32A	CD32A	Same
24V input	CP1	CP1	Same

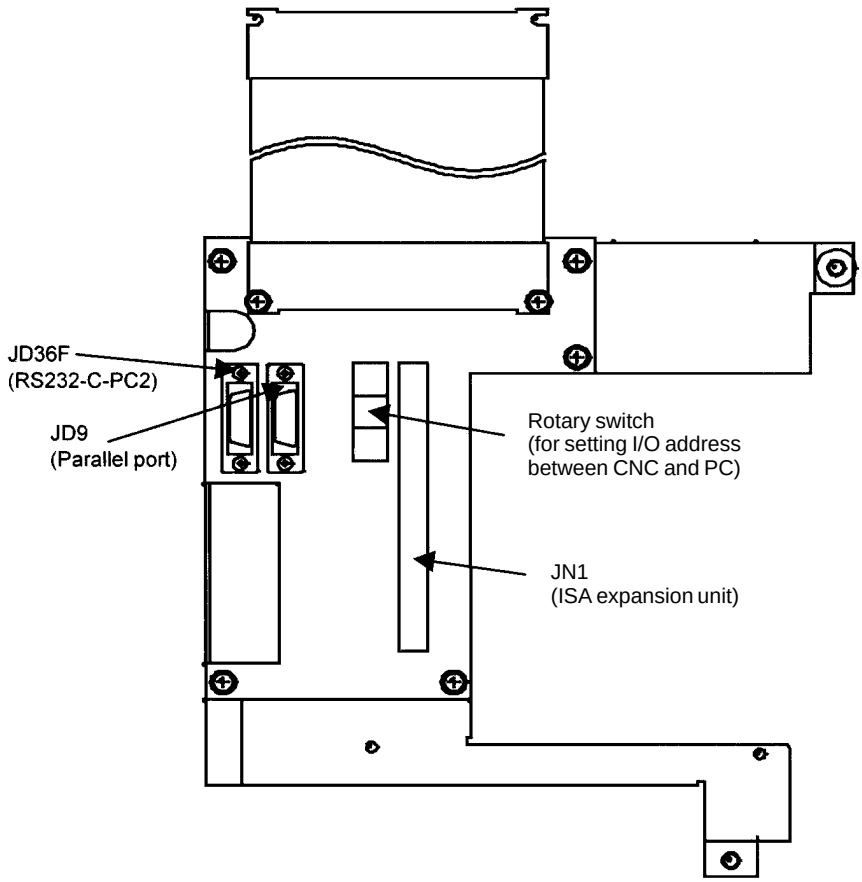
In the MMX–Pentium version, CN2B and CN39 have been added, and CNH1 becomes CNH3.

G.3.2 HDD Unit

1) HDD signal (CNH3)
   In the current Pentium version, the HDD signal connector (CNH1 or CNH2) is provided for the 2.5″ HDD. When there is a PC separate wiring unit, this connector is connected to; when there is no PC separate wiring unit, the main board is connected to.
   In the MMX–Pentium version, a 3.5″ HDD is used, and CNH3 on the main board is connected to at all times.
2) HDD signal (CN2B)
   Power is supplied to the 3.5″ HDD currently used in the MMX–Pentium version by a power cable. (For the 2.5″ HDD currently used in the current Pentium version, a power line is contained in the signal cable.) Connect the power cable to CN2B on the main board.
3) Fan motor for HDD unit (CN39)
   In the MMX–Pentium version, a fan motor is used as a heat countermeasure. Connect the cables coming from the fan unit mounted on the HDD unit or the PC separate wiring unit to CN39 on the main board.

G.3.3 PC Separate Wiring Unit

The PC separate wiring unit for the MMX–Pentium version differs from that for the current Pentium version.
The PC separate wiring unit for the MMX–Pentium version has a serial port on the PC side (2 channels), a parallel port and a connector for the ISA expansion unit.

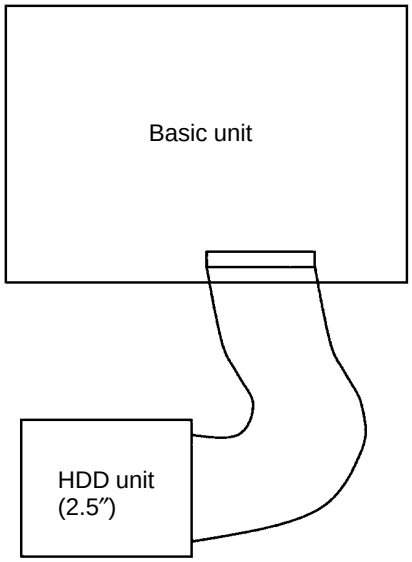
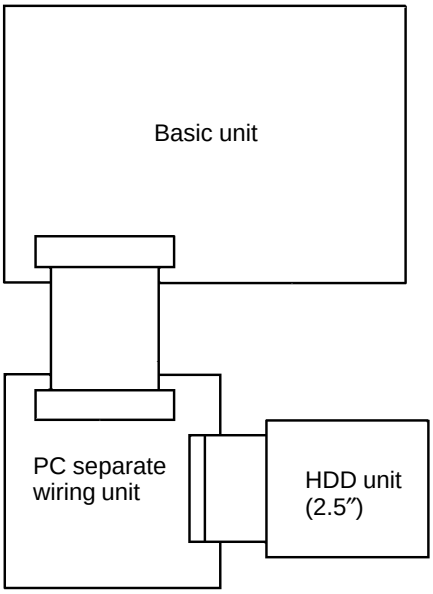


Connector	Pentium Version	MMX–Pentium Version	Remarks
PC serial port ch2	JD36F	JD36F	Same
Parallel port	JD9	JD9	Same
–	JD37	–	Deleted
–	CN3	–	Deleted
ISA expansion unit connector	JN1	JN1	Same
HDD signal	CNH2	–	Deleted

In the MMX–Pentium version, JD37. CN3 and CNH2 have been deleted.

G.3.4 Connecting the HDD Unit and PC Separate Wiring Unit

The figure below shows the differences in the wiring for the HDD unit and PC separate wiring unit in the current Pentium version and new MMX–Pentium version.

<table>
<tr><th></th><th>Without PC separate wiring unit</th><th>With PC separate wiring unit</th></tr>
<tr><td>Pentium version</td><td> 
</td><td> 
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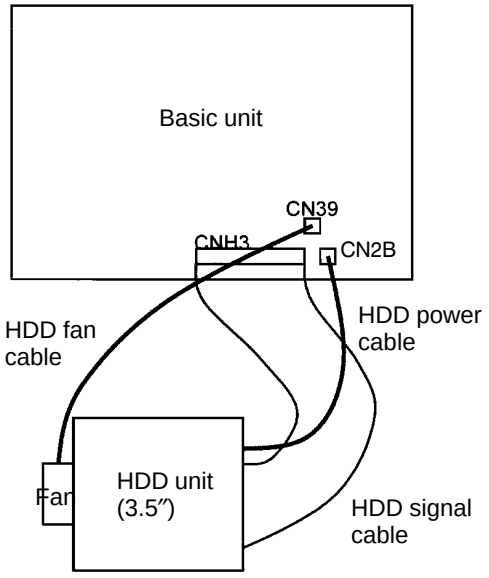
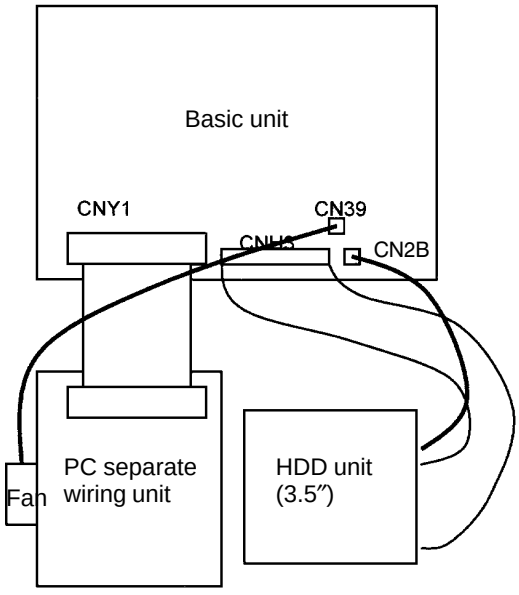
<tr><td>MMX–Pentium version</td><td> 
</td><td> 
</td></tr>
</table>

G.4 EXTERNAL DIMENSIONS OF UNIT

The figures on the following page onwards show the external dimensions of the units for the MMX–Pentium version and the panel cut dimensions. In these figures, space [A] should be ensured for improving the flow of air, and space [B] should be ensured if necessary for wiring cables and connectors. It is also desirable that space [B] be provided for improving the flow of air. Space [C] may sometimes be necessary as space for wiring cables and connectors depending on the ISA expansion board in use by MTB.

1) The external dimensions and panel cut dimensions of the basic unit with 10.4″ LCD are the same as for the current Pentium version.
2) Figures 1 to 6 show the external dimension of the basic unit with 12.1″ LCD.

Number of slots	No slots	2/3/4 slots
Without soft keys and touch panel	Fig. 1	Fig. 4
With soft keys	Fig. 2	Fig. 5
With touch panel	Fig. 3	Fig. 6

3) Figures 7 to 12 show the external dimensions of the FA full keyboard and each of the units mounted on the full keyboard.

LCD size on basic unit	For 10.4″	For 12.1″
HDD unit only	Fig. 7	Fig. 10
HDD unit and PC separate wiring unit	Fig. 8	Fig. 11
HDD unit, PC separate wiring unit and ISA expansion unit	Fig. 9	Fig. 12

4) Figures 13 to 18 show the external dimensions of the MDI and each of the units mounted on the MDI.

LCD size on basic unit	For 10.4″	For 12.1″
HDD unit only	Fig. 13	Fig. 16
HDD unit and PC separate wiring unit	Fig. 14	Fig. 17
HDD unit, PC separate wiring unit and ISA expansion unit	Fig. 15	Fig. 18

5) Figure 19 shows the panel cut dimensions of the basic unit with 12.1″ LCD, FA full keyboard and MDI unit.

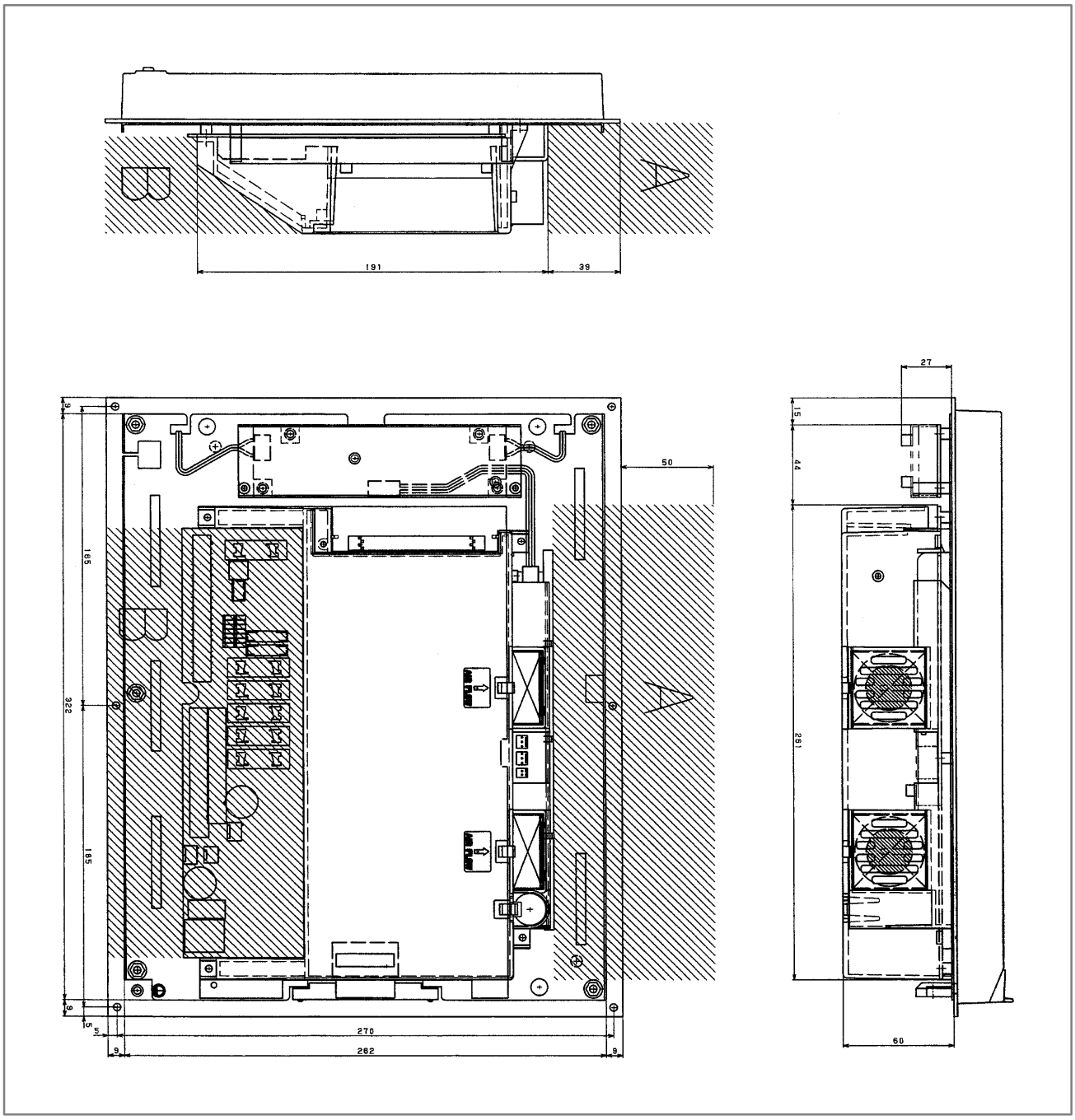


Fig. 1

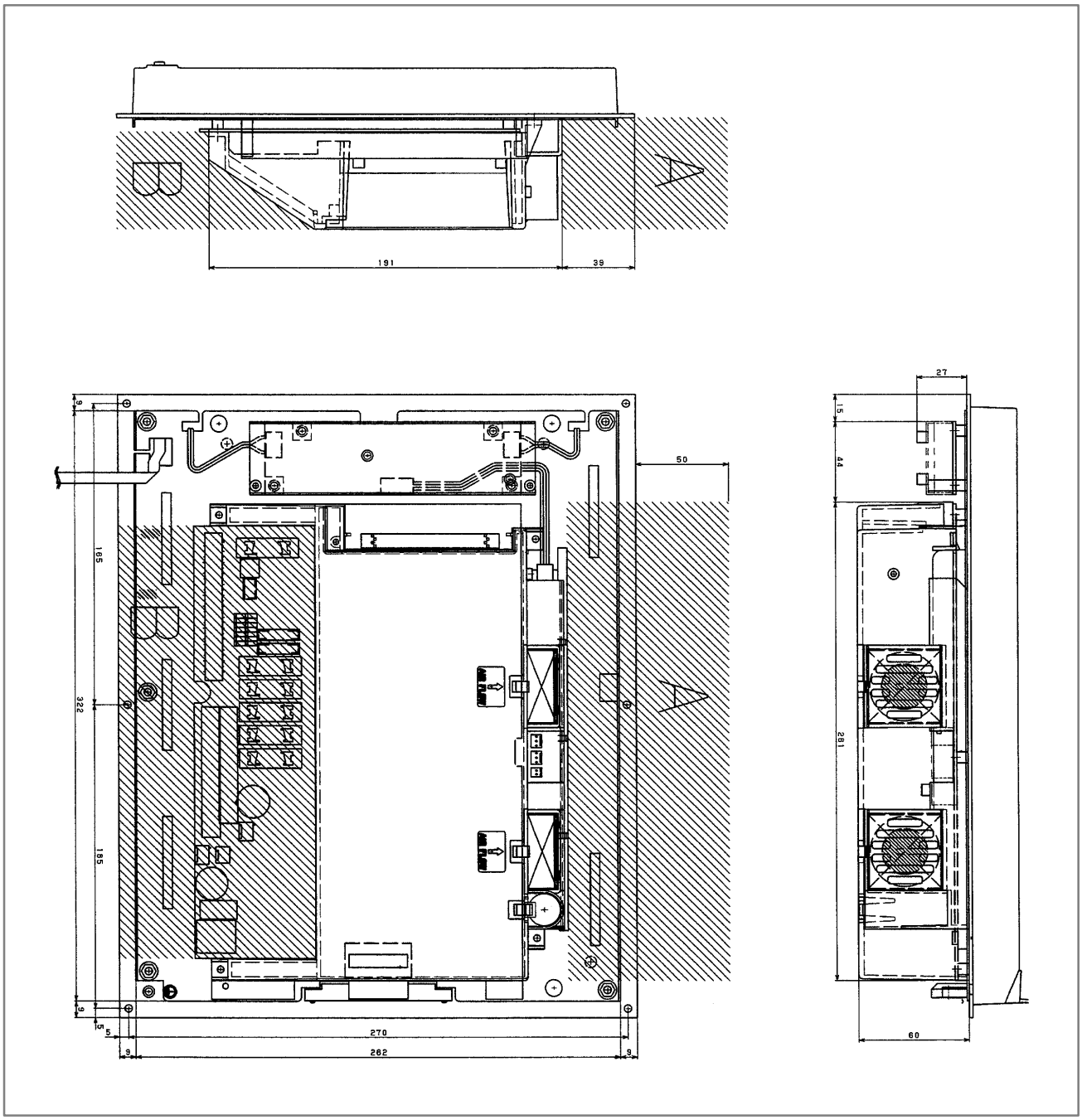


Fig. 2

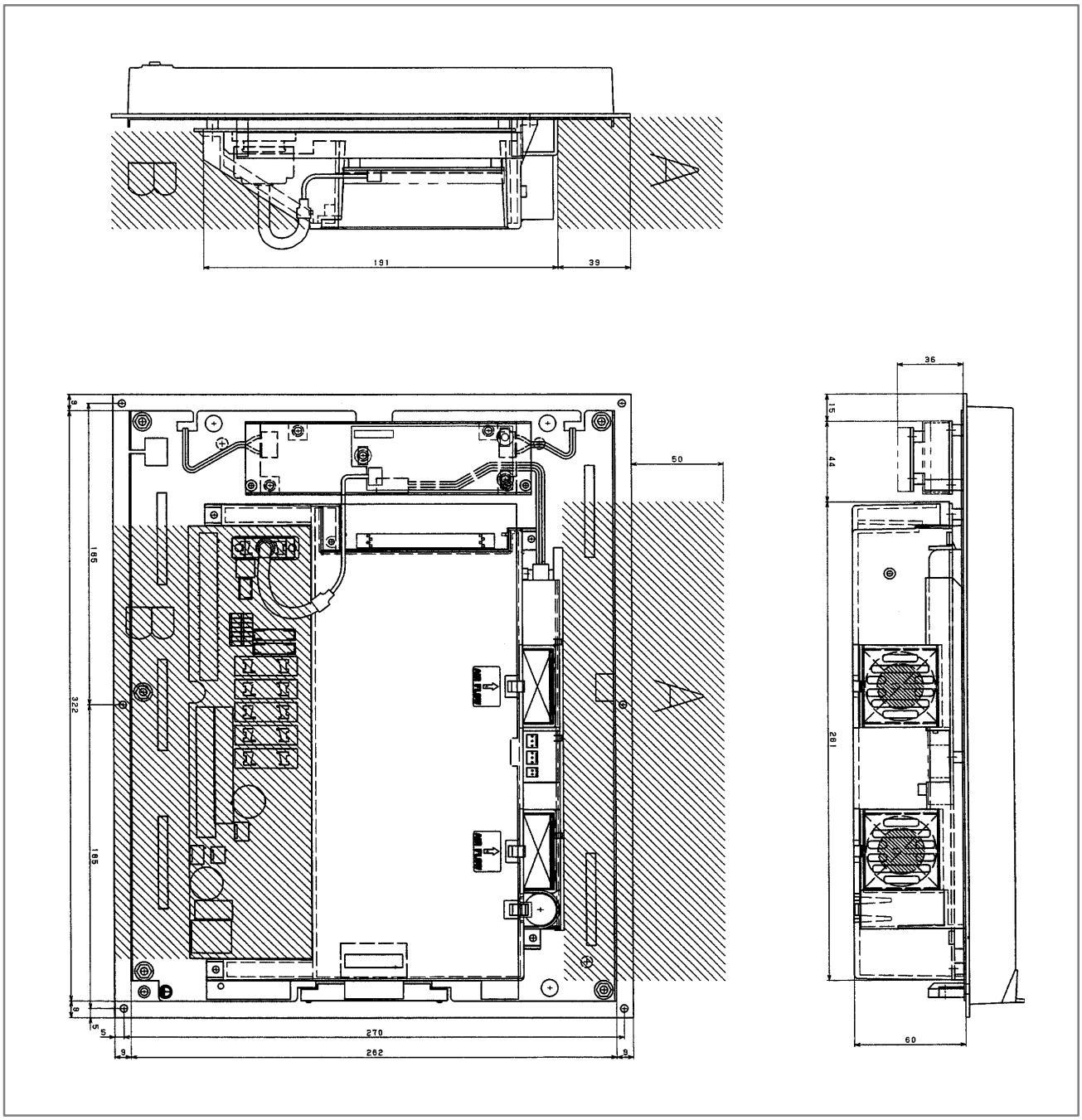
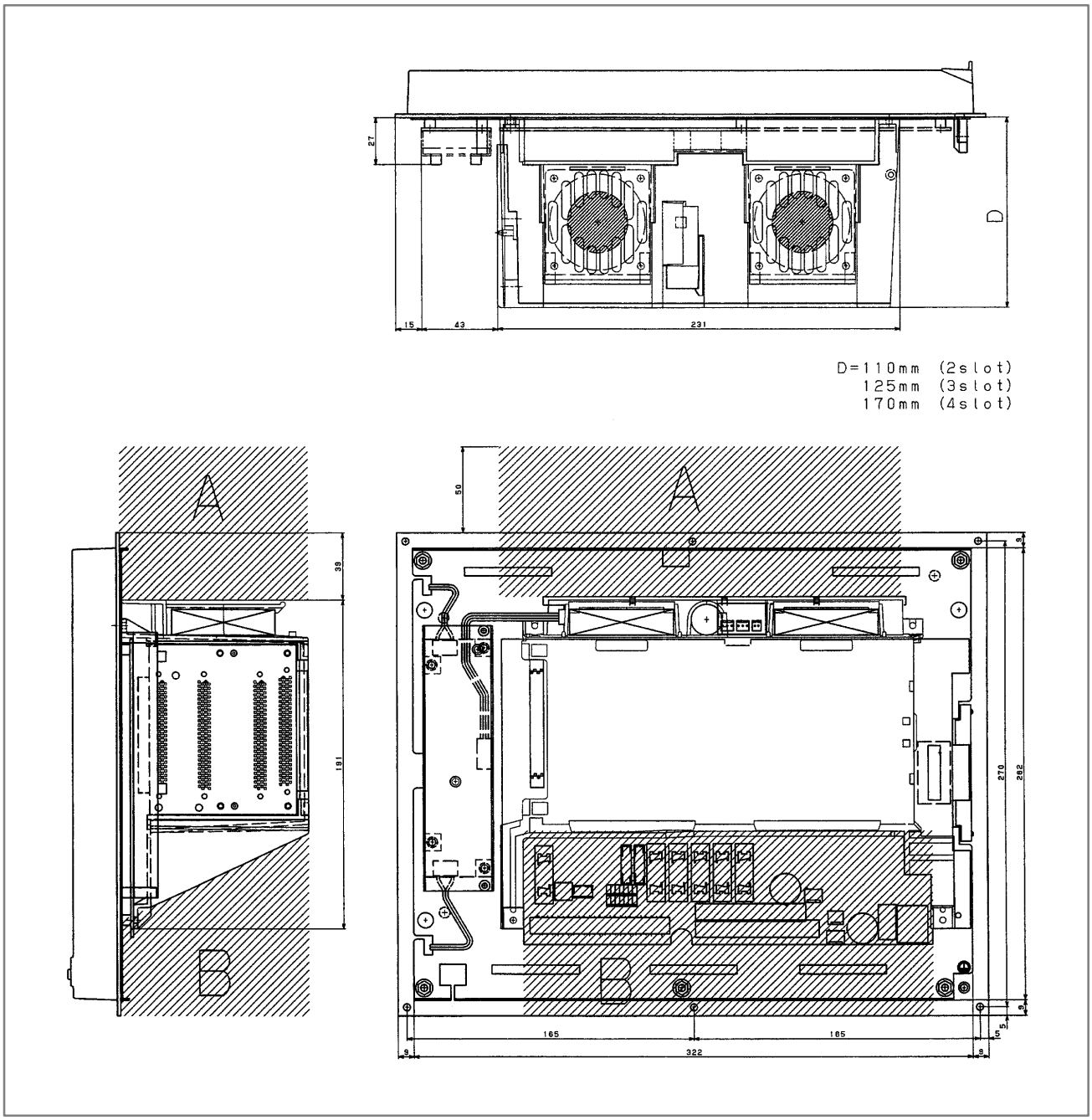


Fig. 3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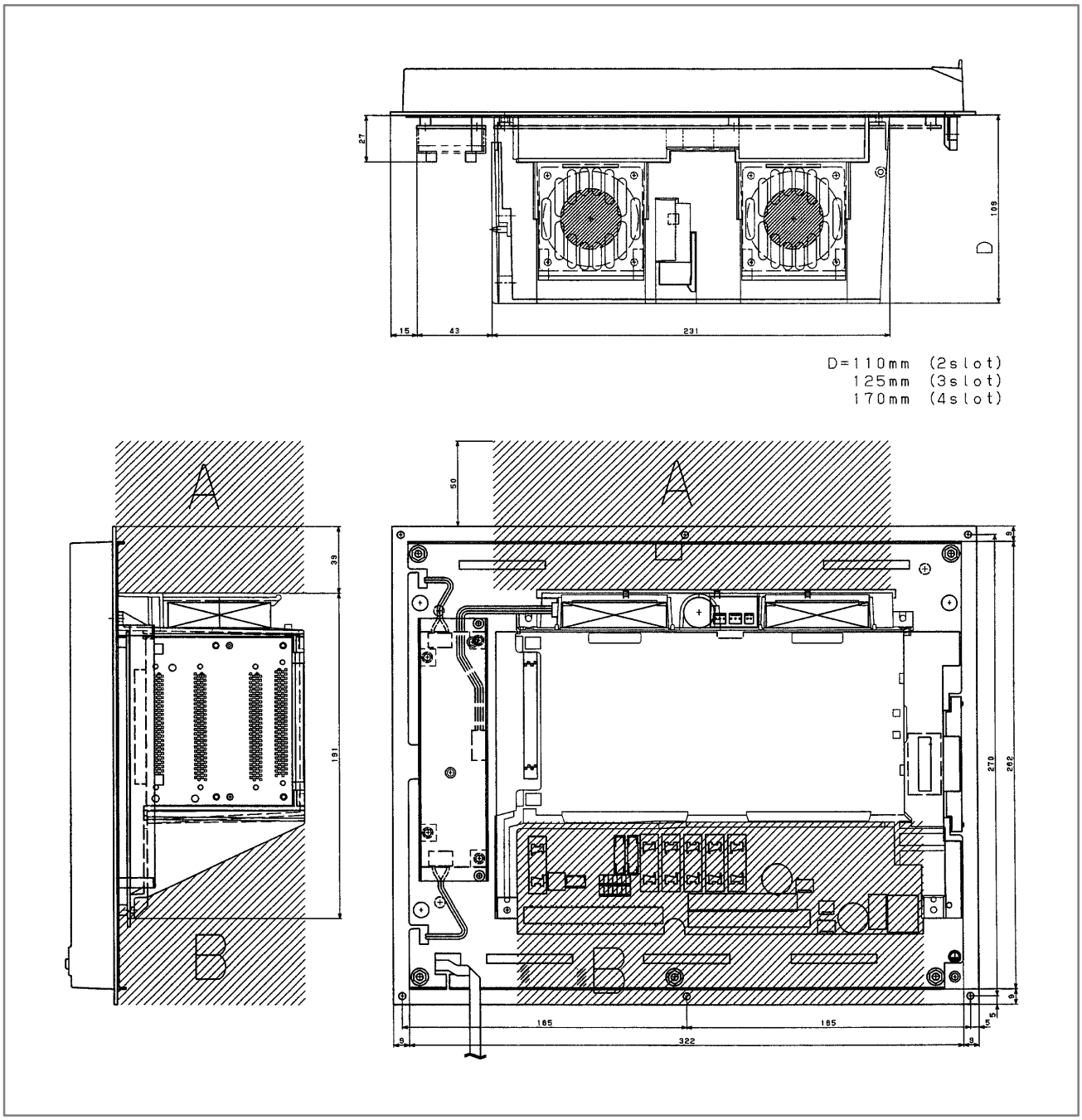
D
15
43
231
D=110mm (2slot)
125mm (3slot)
170mm (4slot)
A
B
39
181
50
270
282
165
165
322
5
9

Fig. 4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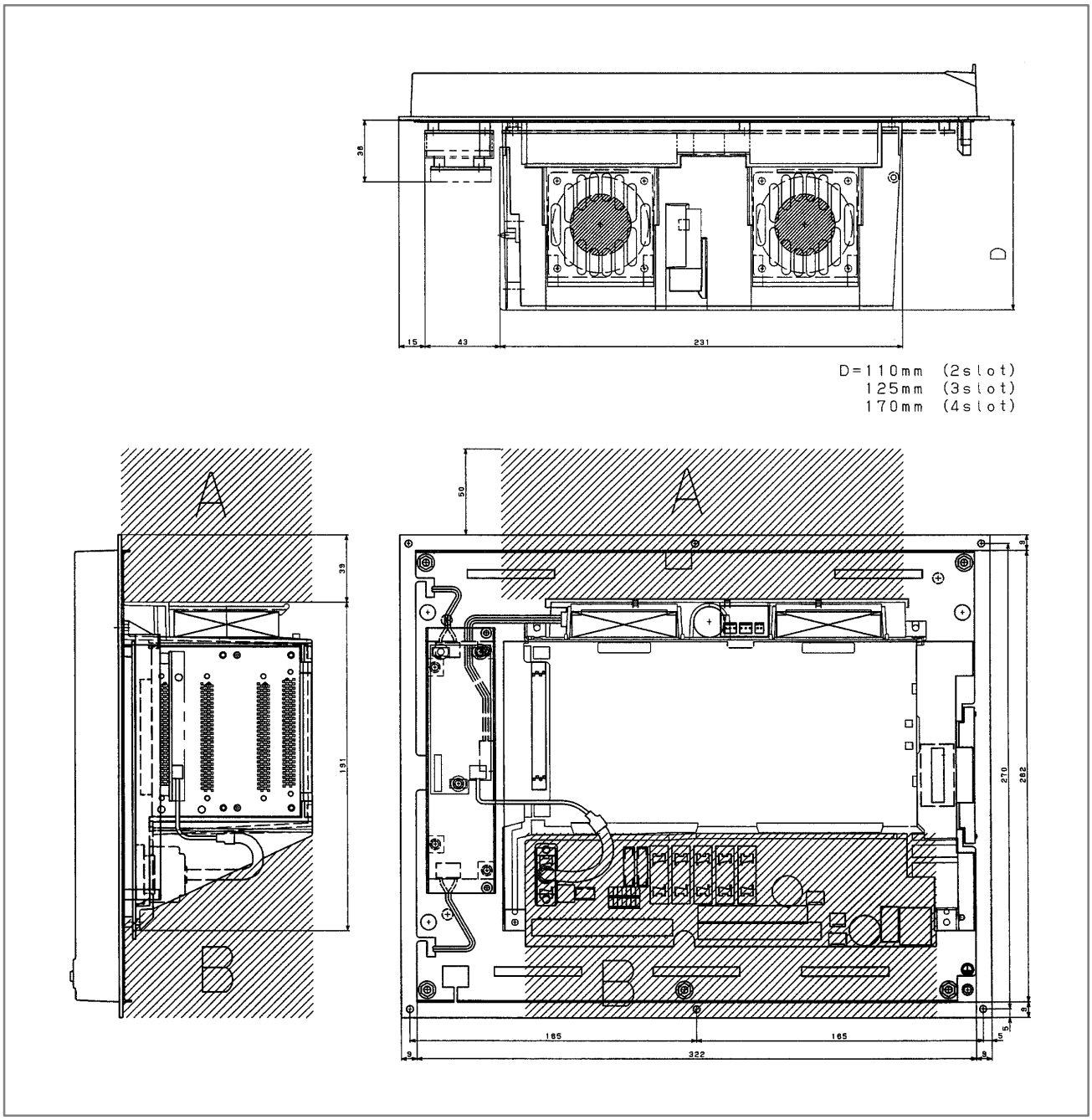
109
D
15
43
231
D=110mm (2slot)
125mm (3slot)
170mm (4slot)
A
B
39
191
50
270
282
165
185
322
9
5

Fig. 5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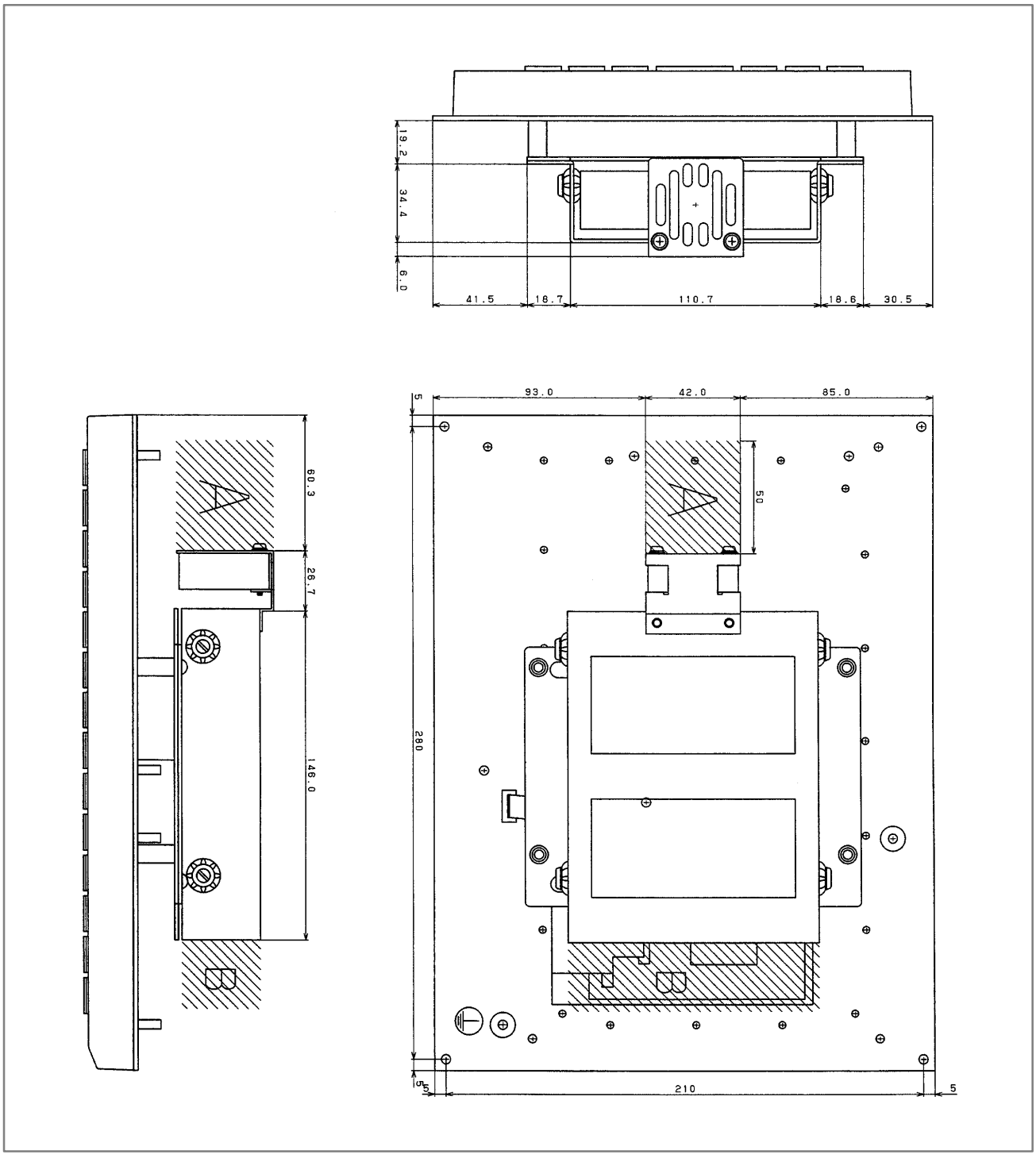
15
43
231
D
D=110mm (2slot)
125mm (3slot)
170mm (4slot)
A
B
39
191
50
270
282
165
165
322
5
9

Fig. 6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18.7
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5
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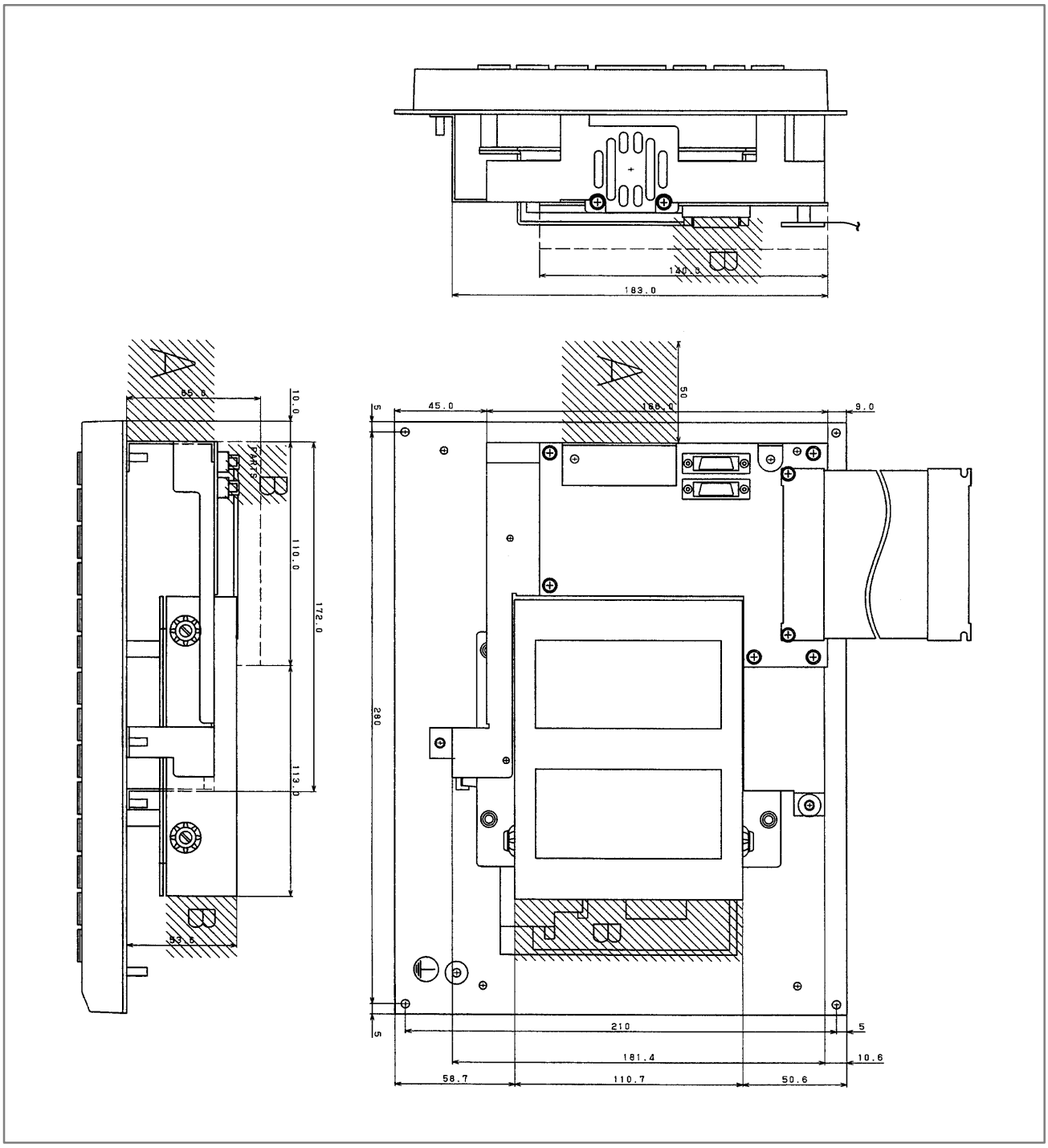
42.0
85.0
50
280
210
5
5

Fig. 7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172.0
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5
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5
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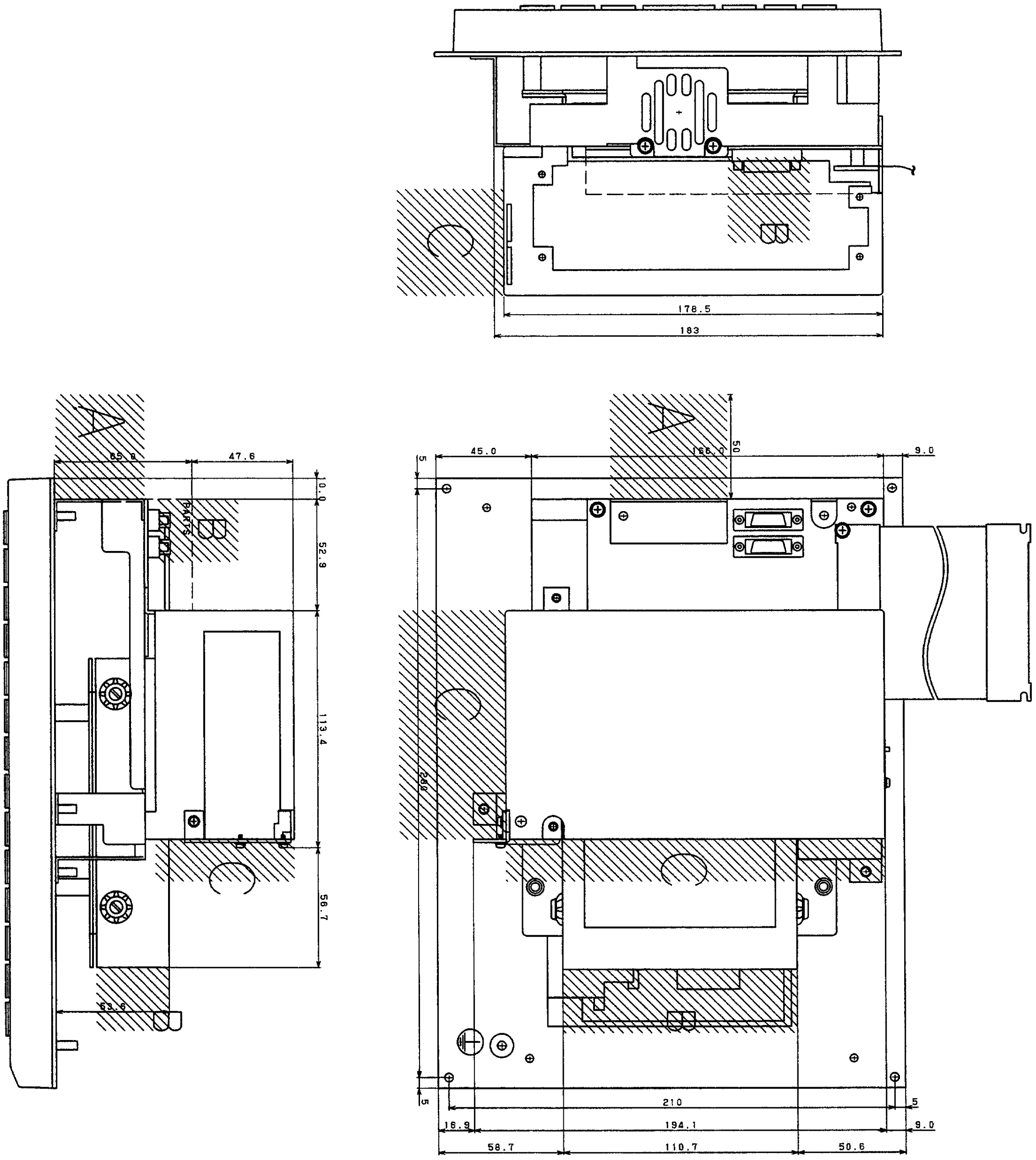
10.6
58.7
110.7
50.6

Fig. 8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53.6
PARTS
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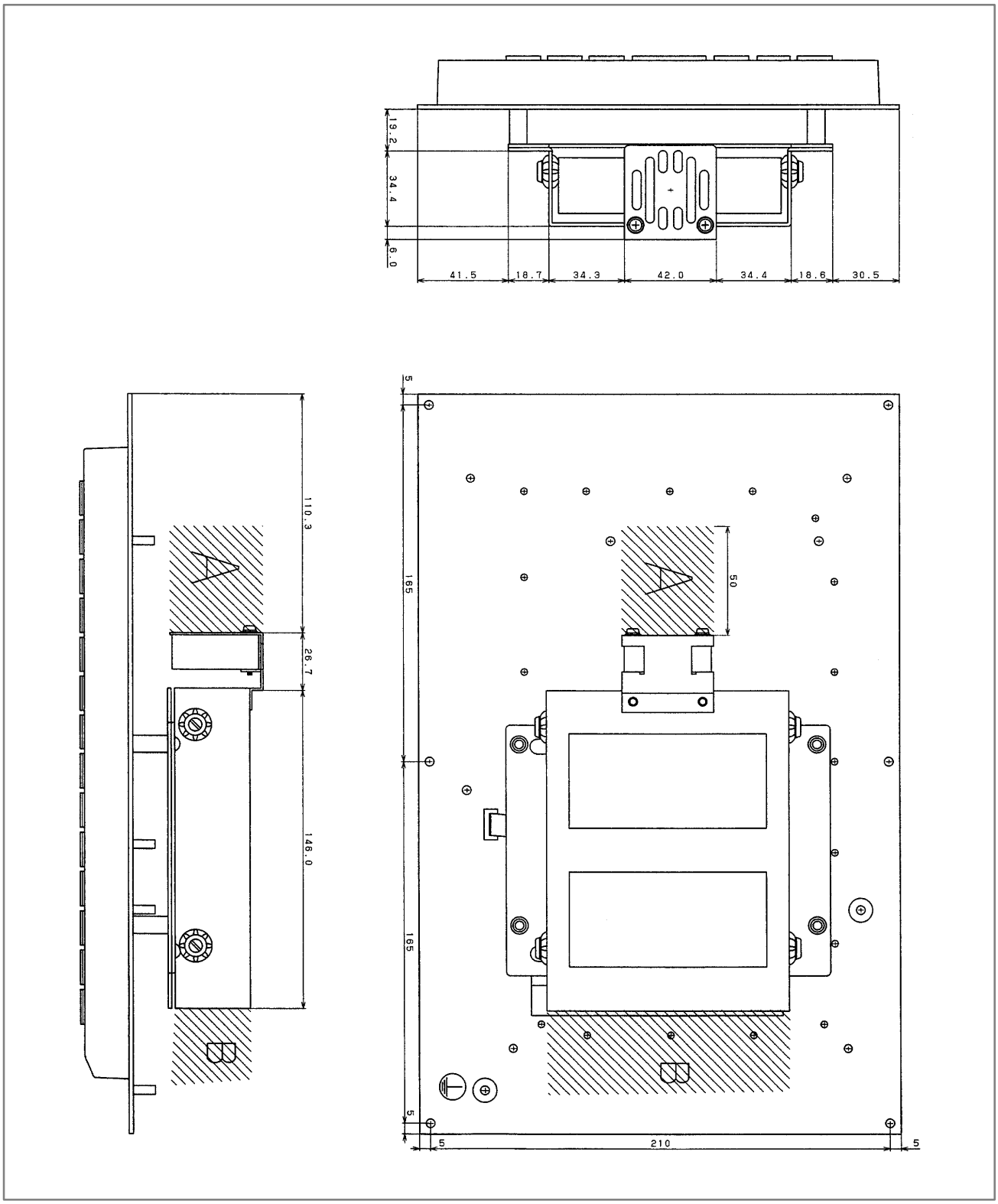
194.1
16.9
58.7
110.7
50.6

Fig. 9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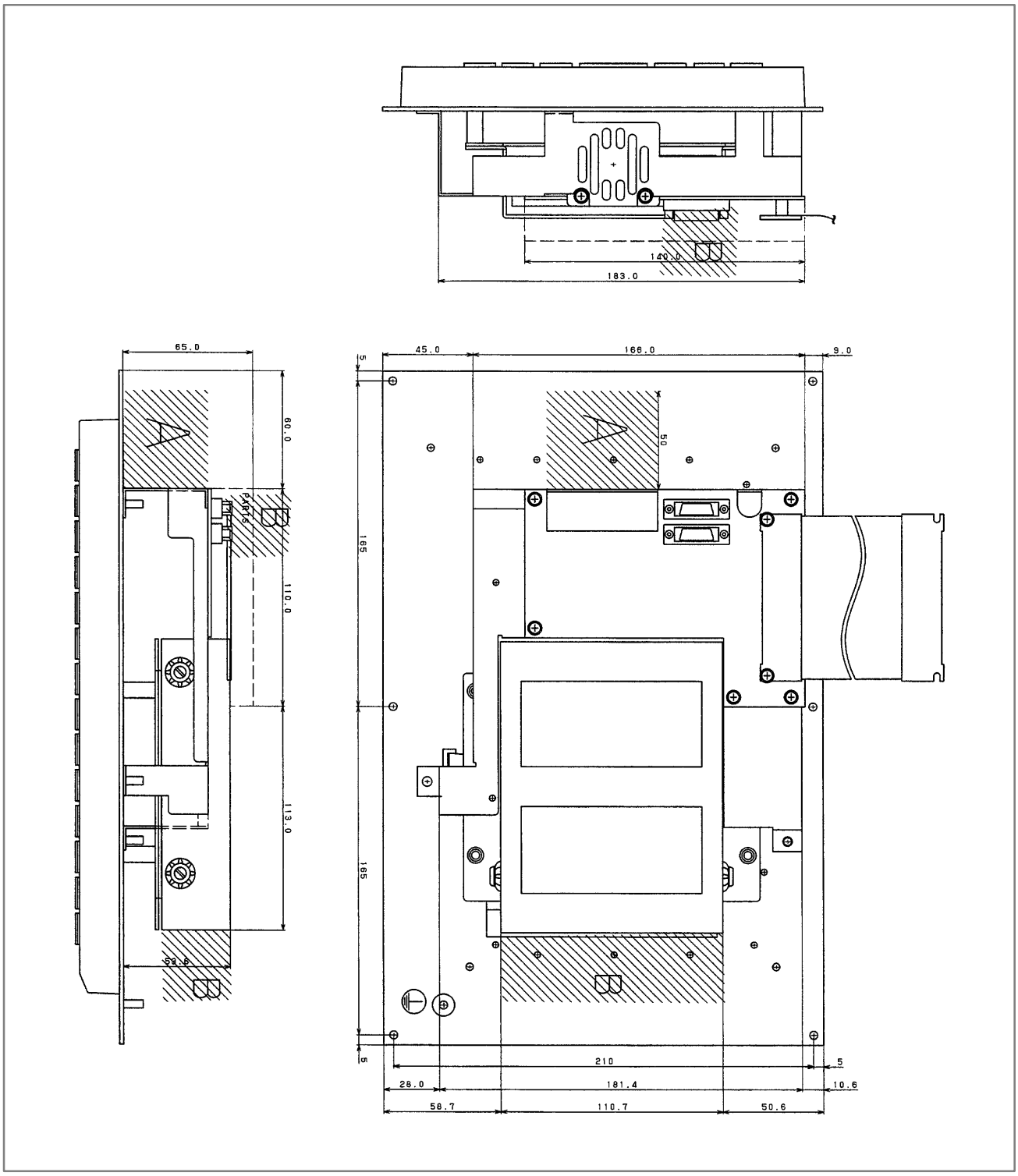
165
5
5
210
5

Fig. 10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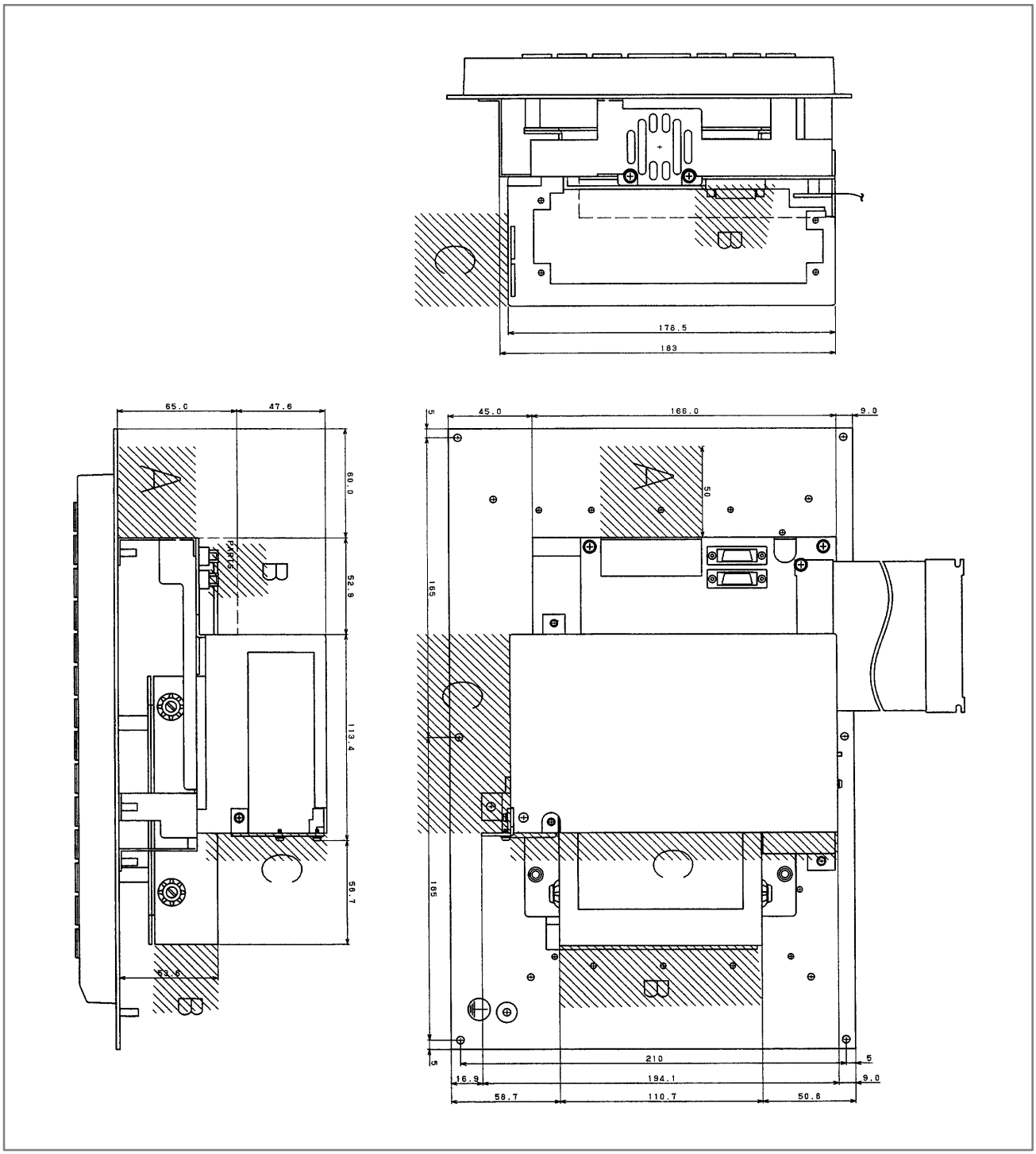
110.7
50.6

Fig. 11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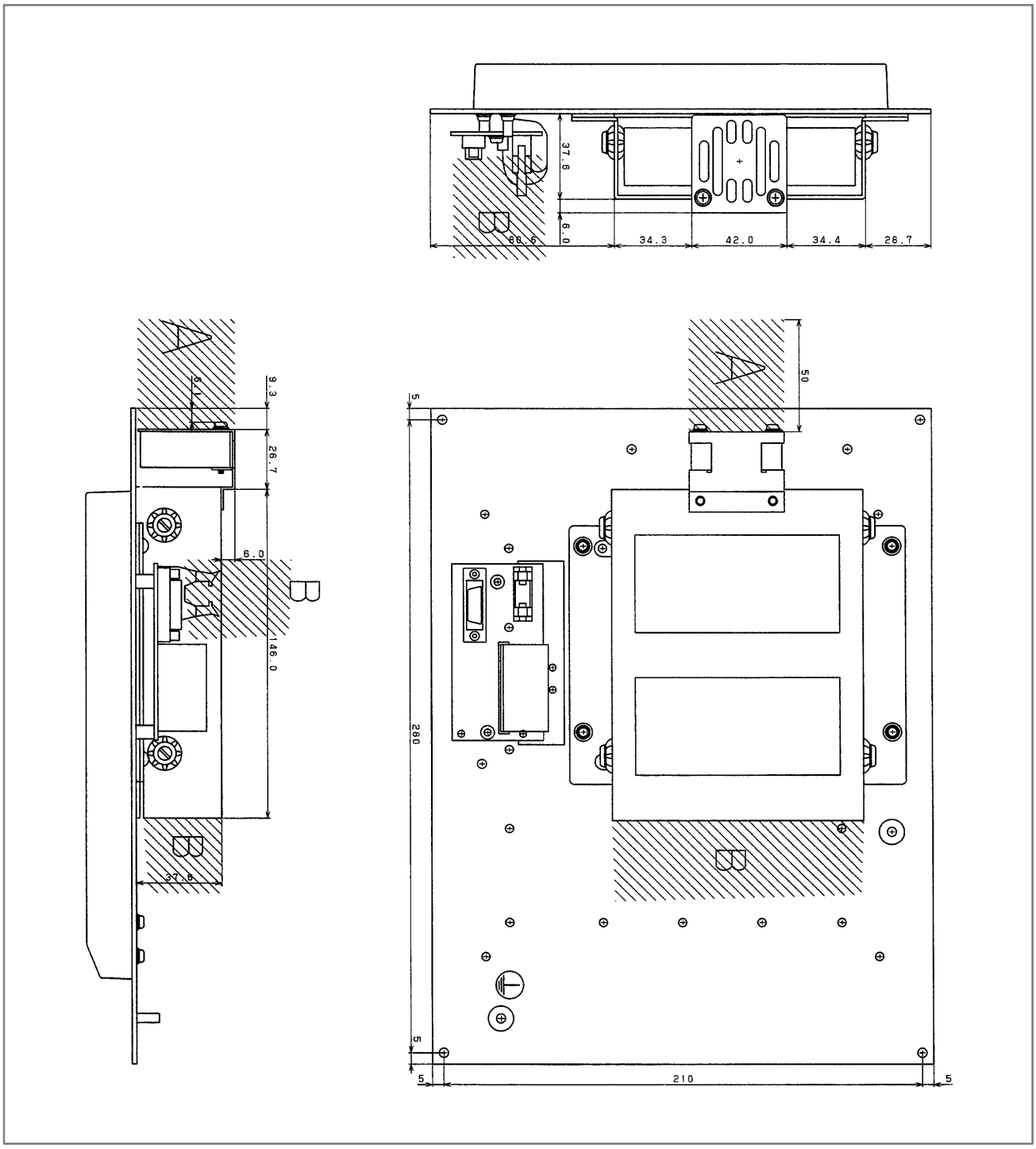

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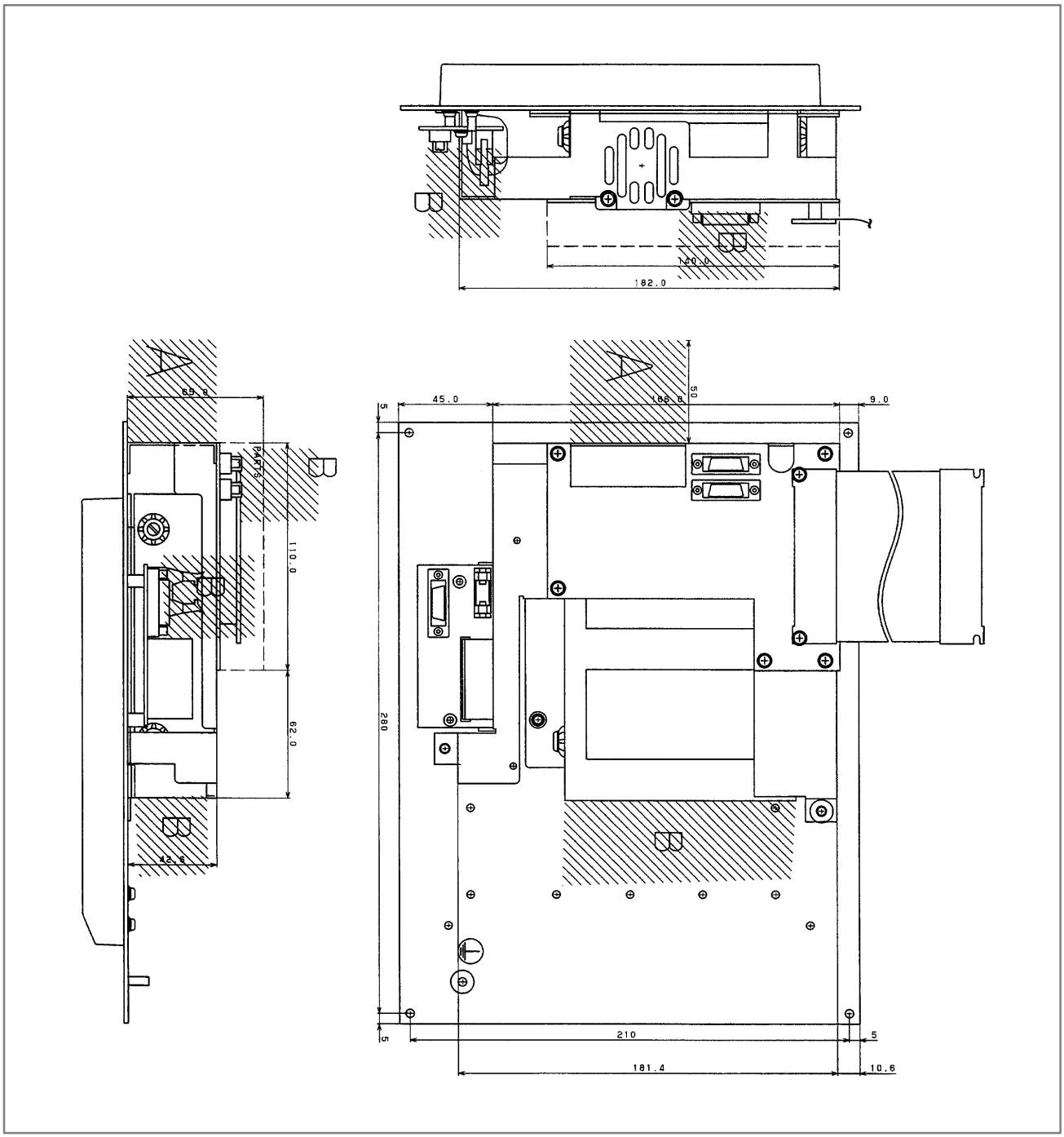
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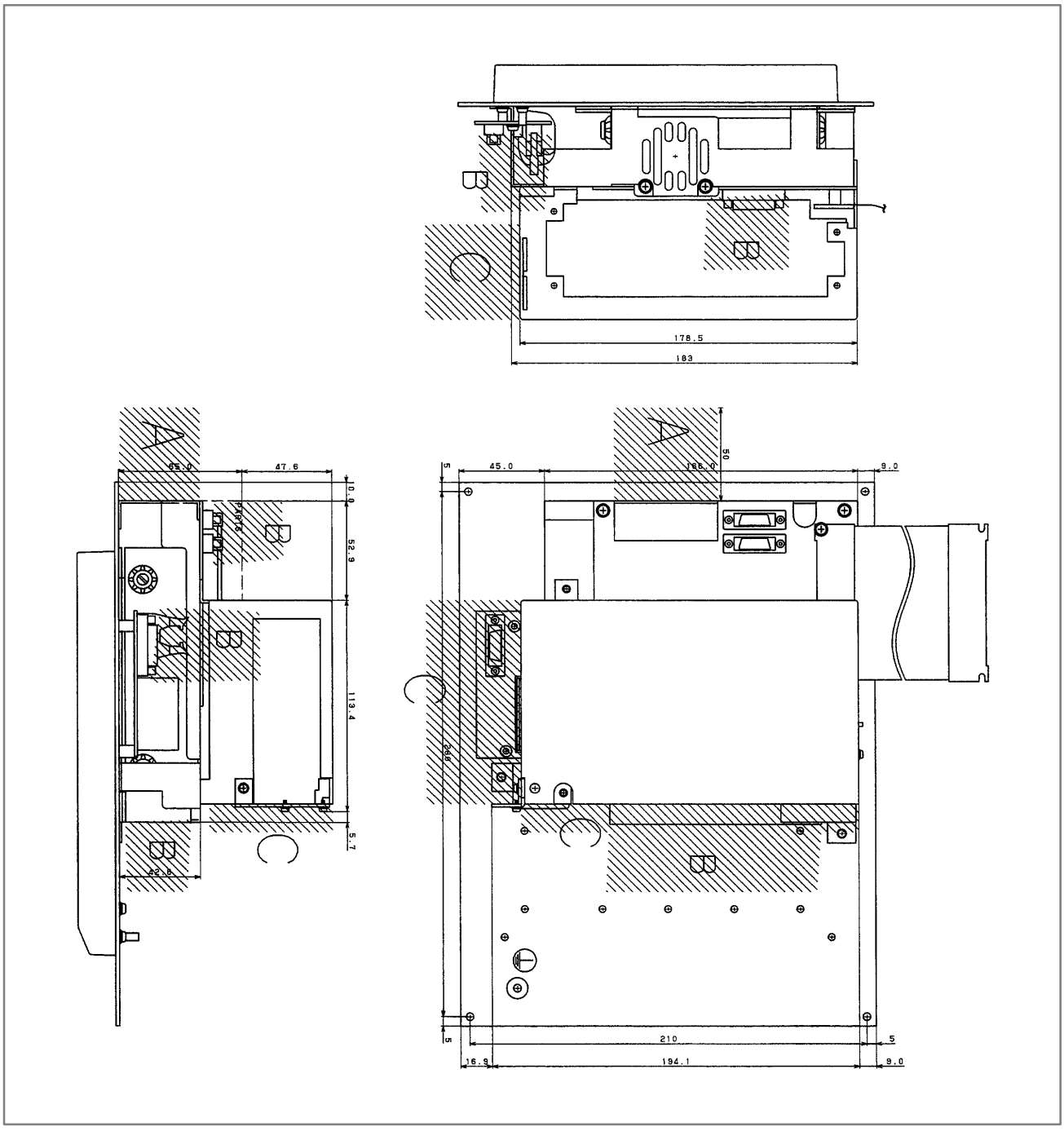
Fig. 14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9.0

Fig. 15

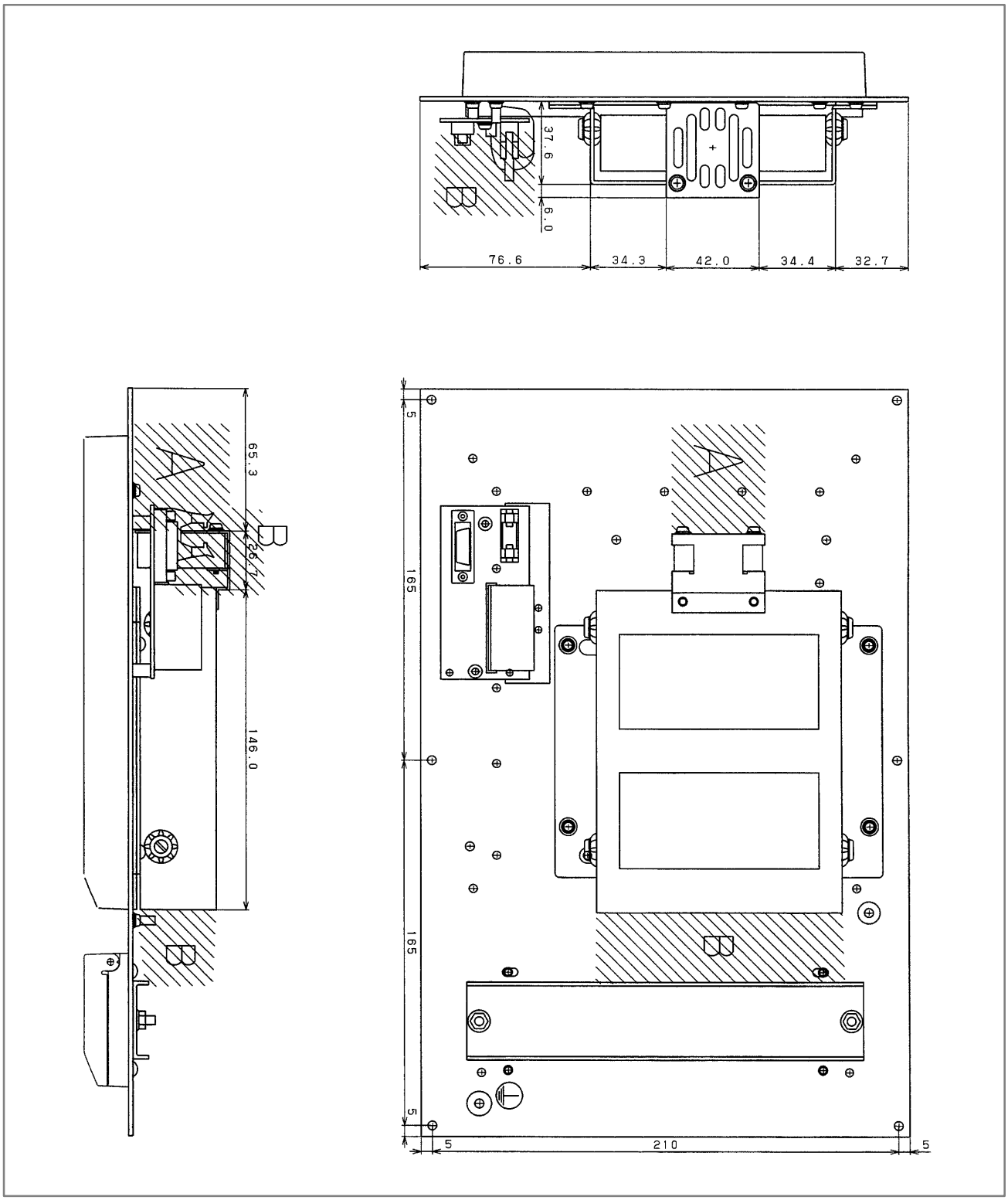

Fig. 16

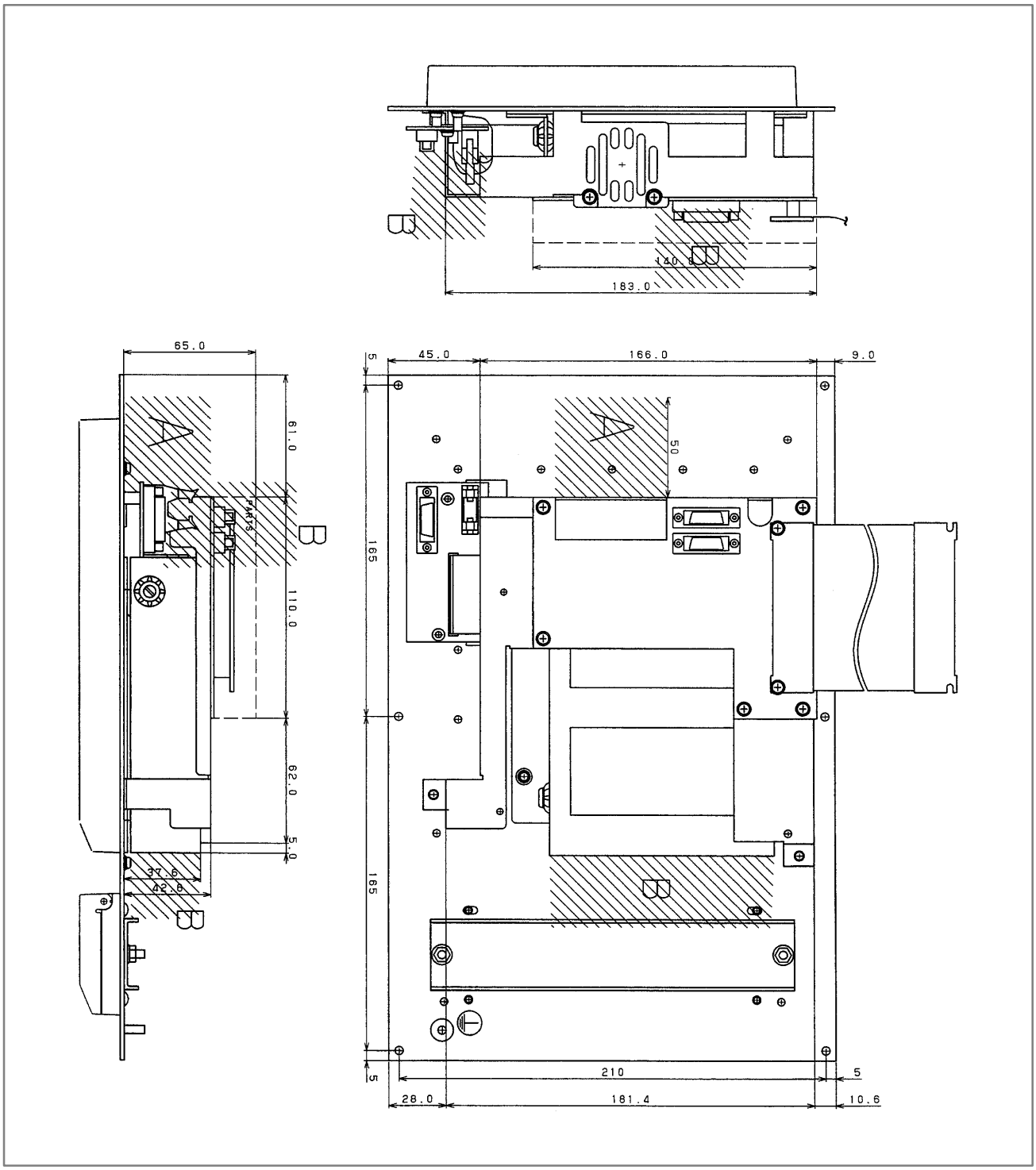
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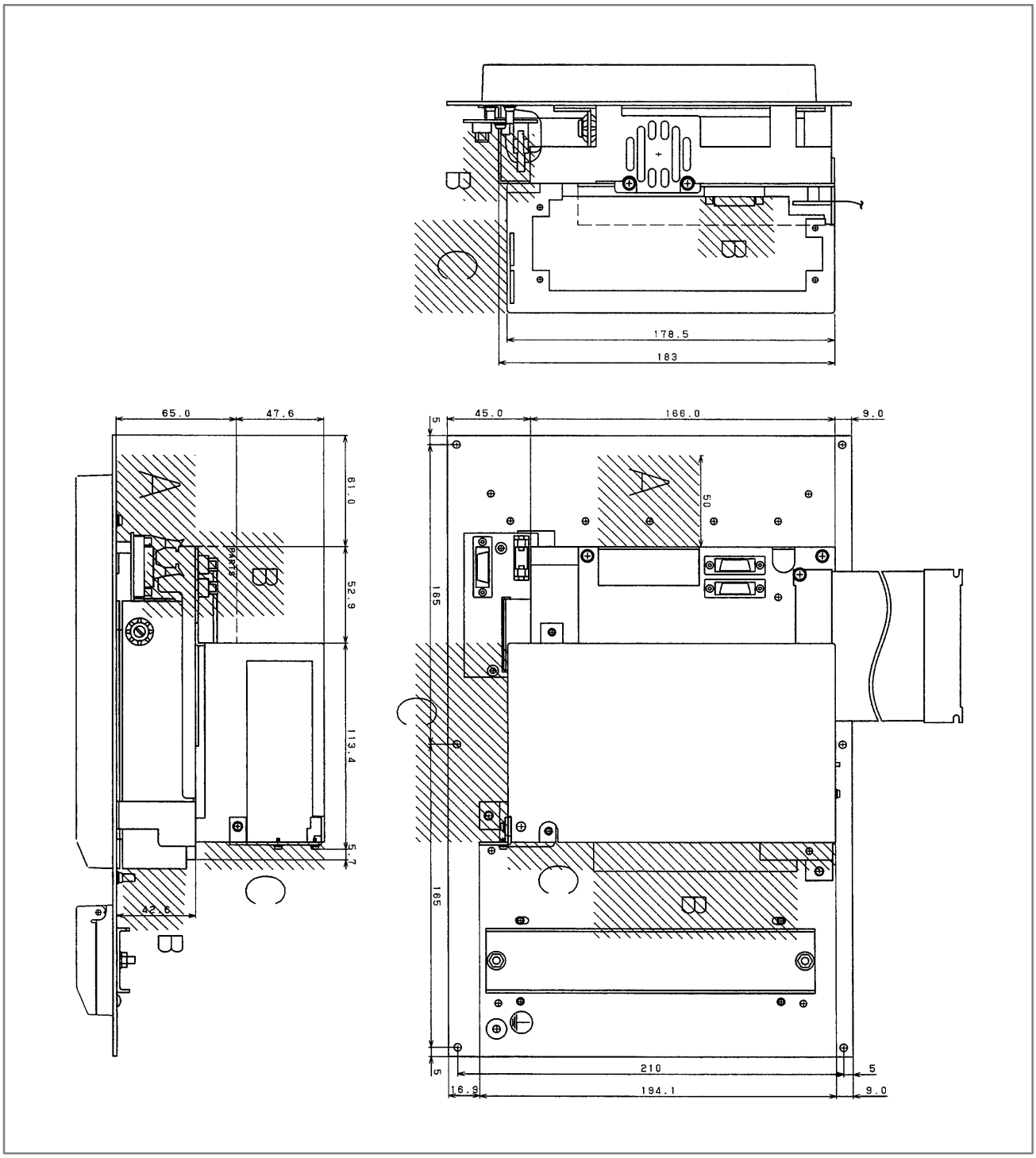
Fig. 17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50
165
165
210
16.9
194.1

Fig. 18

Index

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Revision Record

FANUC Series 16*i*/18*i*/21*i*/20*i*/160*i*/180*i*/210*i*/160*is*/180*is*/210*is*–MODEL A CONNECTION MANUAL (HARDWARE) (B–63003EN)

Edition	Date	Contents	Edition	Date	Contents
04	Jul., 2000	● Deletion of the heat exchanger ● Addition of “Measures against surges due to lightning” ● Addition of “Dustproof measures for cabinets and pendant boxes” ● Addition of “+24V input power specifications” ● Addition of “61–key MDI unit” ● Correction of errors			
03	Aug., 1999	● Addition of Series 20*i*			
02	March, 1999	● Addition of Stand–alone type ● Addition of Series 21*i*/210*i*			
01	Mar., 1997				