GE Fanuc Automation

Computer Numerical Control Products

Series 21*i* / 210*i* – Model A

Connection Manual (Hardware)

GFZ-63083EN/01 March 1997

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 damage 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 FANUC Series 21*i*/210*i*-TA/MA 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 with the Series 21*i*/210*i*. See Connection Manual (Loader Control) (B–62443EN–2), for details of loader control option. Refer to individual manuals for the detailed specifications of each model.

Product name	Abbreviation	
FANUC Series 21*i*–TA	21*i*–TA	Series 21*i*
FANUC Series 21*i*–MA	21*i*–MA	
FANUC Series 210*i*–TA	210*i*–TA	Series 210*i*
FANUC Series 210*i*–MA	210*i*–MA	

Configuration of the manual

This manual consists of Chapters 1 to 12 and Appendixes.

Chapter title	Description
Chapter 1 CONFIGURATION	Outlines connections for the Series 21*i*/210*i* and guides the reader concerning additional details.
Chapter 2 TOTAL CONNECTION DIAGRAM	This chapter shows the total connection diagram.
Chapter 3 INSTALLATION	This chapter describes the installation conditions for the Series 21*i*/210*i*. 1) Required power supply 2) Heat generated 3) Connector arrangement on the control unit 4) Noise prevention
Chapter 4 CONNECTING THE POWER SUPPLY	This chapter describes how to connect the power supply.
Chapter 5 CONNECTING PERIPHERAL UNITS	This chapter describes how to connect the following peripheral devices: 1) MDI units 2) I/O devices (via RS232C) 3) High–speed skip
Chapter 6 CONNECTING THE SPINDLE UNIT	This chapter describes how to connect the spindle servo unit, the spindle motor.
Chapter 7 SERVO INTERFACE	This chapter describes how to connect the servo unit.
Chapter 8 CONNECTING THE PC INTERFACE	This chapter describes the interface of the Series 210*i* control unit which incorporates personal computer functions.
Chapter 9 CONNECTION TO FANUC I/O Link	This chapter describes the use of FANUC I/O Link to expand the machine interface I/O.
Chapter 10 EMERGENCY STOP SIGNAL	This chapter describes the handling of emergency stop signals. The user must read this chapter before attempting to operate the CNC.
Chapter 11 REMOTE BUFFER INTERFACE	This chapter describes the remote buffer interface supported by the Series 21*i*.
Chapter 12 HIGH–SPEED SERIAL BUS (HSSB)	This chapter describes the high–speed serial bus (HSSB) supported by the Series 210*i*.
Appendix	A External dimensions of units B 20–pin interface connectors and cables C Connection cables D Optical fiber cable

Related manuals

The table below lists manuals related to the 21*i*–TA, 21*i*–MA, 210*i*–TA, and 210*i*–MA. In the table, this manual is marked with an asterisk (*).

Manuals related to the Series 21*i*/210*i*

Manual name	Specification number	
DESCRIPTIONS	B–63002EN	
CONNECTION MANUAL (Hardware)	B–63083EN	*
CONNECTION MANUAL (Function)	B–63003EN–1	
OPERATOR’S MANUAL (For Lathe)	B–63084EN	
OPERATOR’S MANUAL (For Machining Center)	B–63094EN	
MAINTENANCE MANUAL	B–63085EN	
PARAMETER MANUAL	B–63090EN	
PROGRAMMING MANUAL (Macro Compiler / Macro Executer)	B–61803E–1	
FAPT MACRO COMPILER PROGRAMMING MANUAL	B–66102E	
CONVERSATIONAL AUTOMATIC PROGRAMMING FUNCTION I FOR MACHINING CENTER OPERATOR’S MANUAL	B–61874E–1	
FANUC Symbolic CAPT OPERATOR’S MANUAL	B–62824EN	

Manuals related to control motor α series

Manuals related to control motor α 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 CONTROL MOTOR AMPLIFIER α series DESCRIPTIONS	B–65162E
FANUC CONTROL MOTOR α series MAINTENANCE MANUAL	B–65165E

Manual related to loader control option

Manual name	Specification number
FANUC Series 21/16/18/160/180 CONNECTION MANUAL Loader Control	B–62443EN–2

Manuals related to I/O Unit

Manual name	Specification number
FANUC I/O Unit–MODEL A CONNECTION·MAINTENANCE MANUAL	B–61813E
FANUC I/O Unit–MODEL B CONNECTION MANUAL	B–62163E

Manual related to FANUC high–speed serial bus

Manual name	Specification number
FANUC MMC–IV OPERATOR’S MANUAL	B–62494E

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APPENDIX

1 CONFIGURATION

1.1 NAME OF EACH PART OF CONTROL UNIT

The following table lists the main differences between the types of FANUC Series 21*i*/210*i* control units.

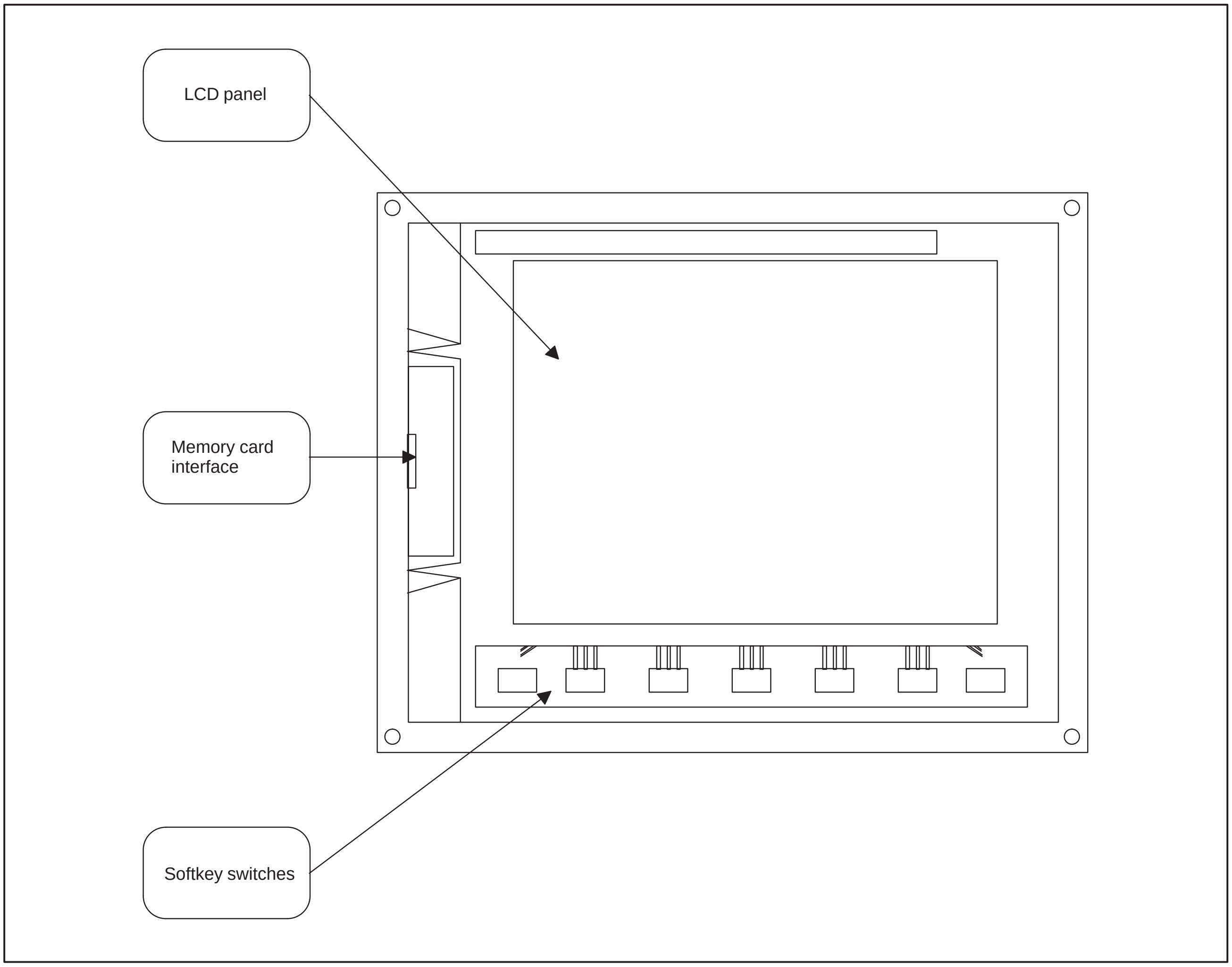
The figures on the subsequent pages show the configurations of the Series 21*i*/210*i* control units. The descriptions in this manual focus on how to connect the units illustrated in these figures. Within the figures, the numbers in parentheses correspond to the section references in the manual.

Control Unit Name	Option Slots	Display Device	Remark
Series 21*i* control unit	Without option slot	7.2″ STN monochrome LCD	
		8.4″ TFT color LCD	
		9.5″ STN monochrome LCD	
		10.4″ TFT color LCD	
	With option 2 slots	7.2″ STN monochrome LCD	
		8.4″ TFT color LCD	
		9.5″ STN monochrome LCD	
		10.4″ TFT color LCD	
Series 210*i* control unit	With option 2 slots	7.2″ STN monochrome LCD	Note 1)
		8.4″ TFT color LCD	Note 1)
		9.5″ STN monochrome LCD	Note 1)
		10.4″ TFT color LCD	Note 1)
	Without option slot	10.4″ TFT color LCD	Note 2)
	With option 2 slots	10.4″ TFT color LCD	Note 2)

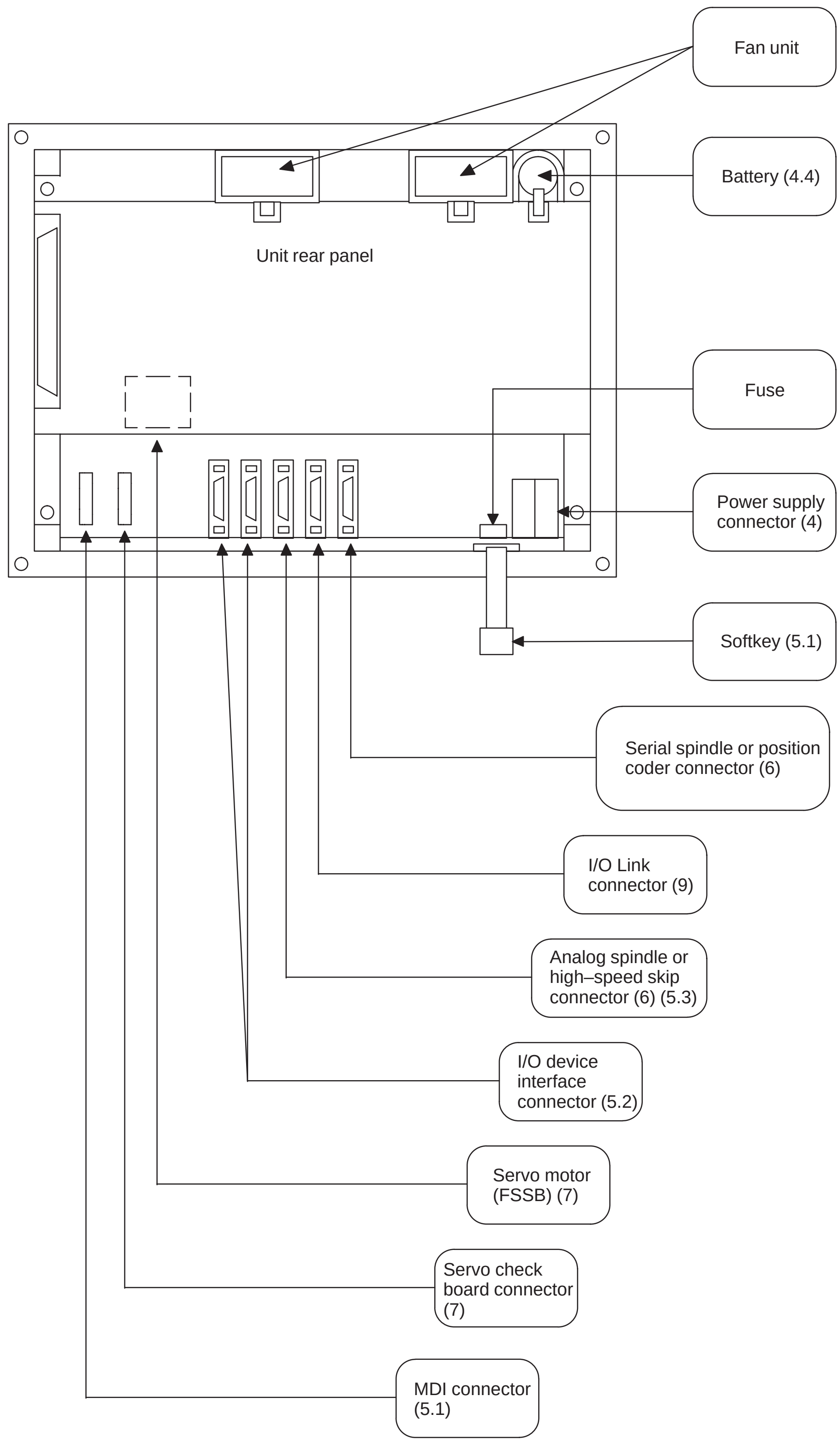
NOTE

1 Model with HSSB option card for high–speed data communication with a PC.

2 Model incorporating PC function in the control unit.



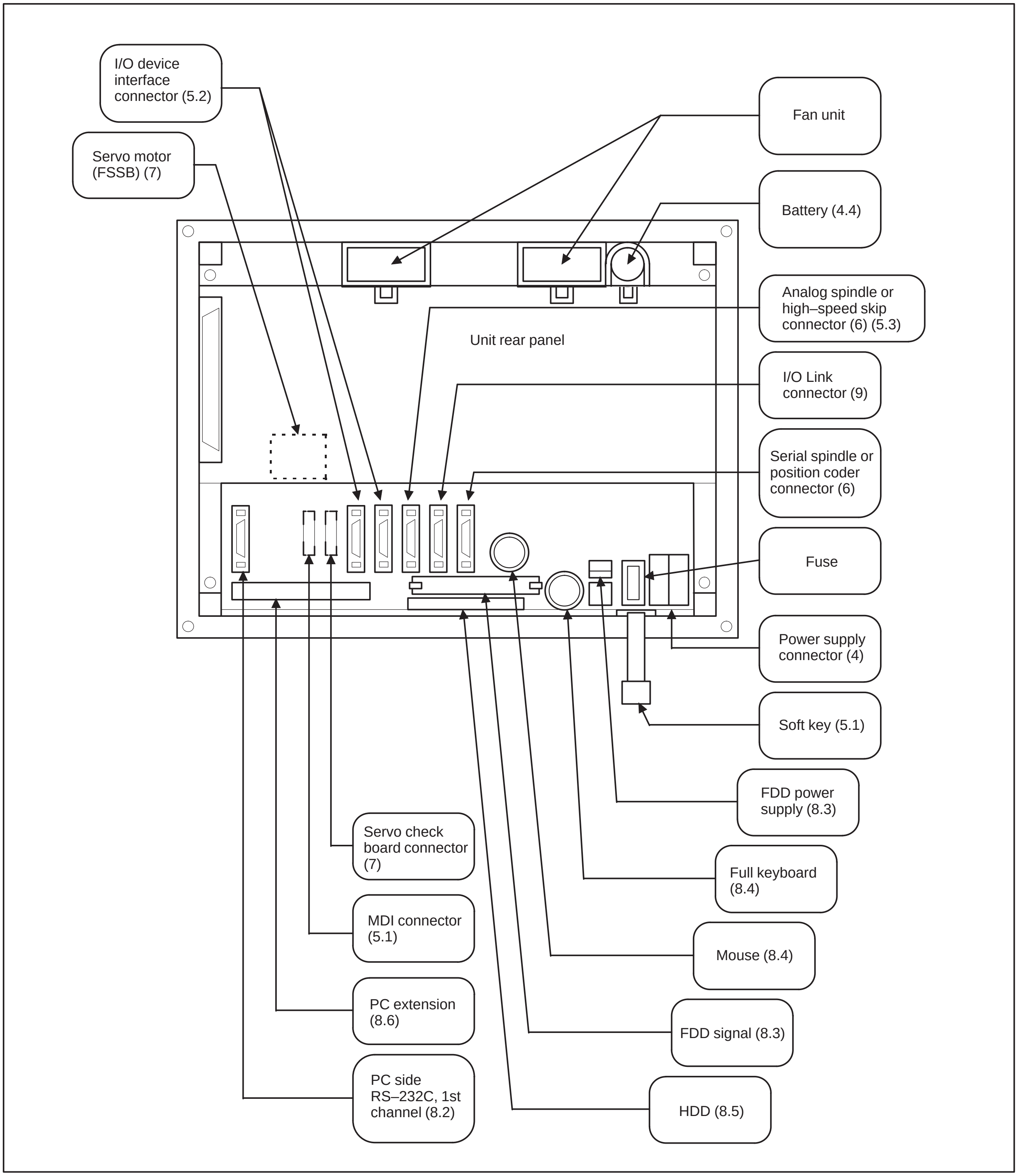
NOTE
This figure shows a front view of the Series 21*i* control unit having an 8.4″ TFT color LCD. The basic configuration of the other control units is identical to that shown above.



NOTE

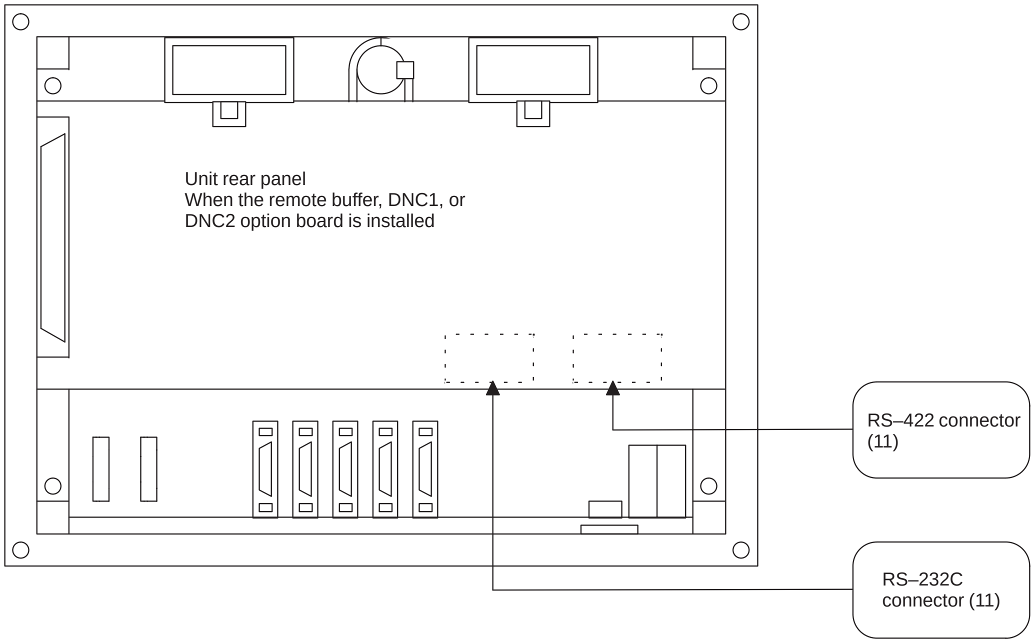
This figure shows the rear view of the Series 21*i* control unit with no option slot having an 8.4″ TFT color LCD.

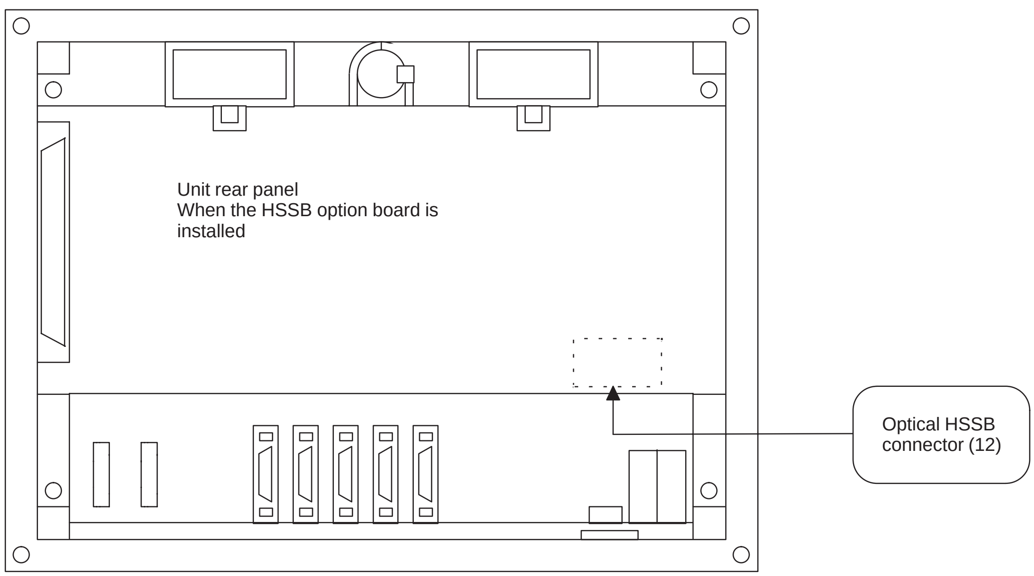
The basic configuration of the control units of the other 21*i* models and 210*i* models with the HSSB option card is identical to that shown above.



NOTE

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



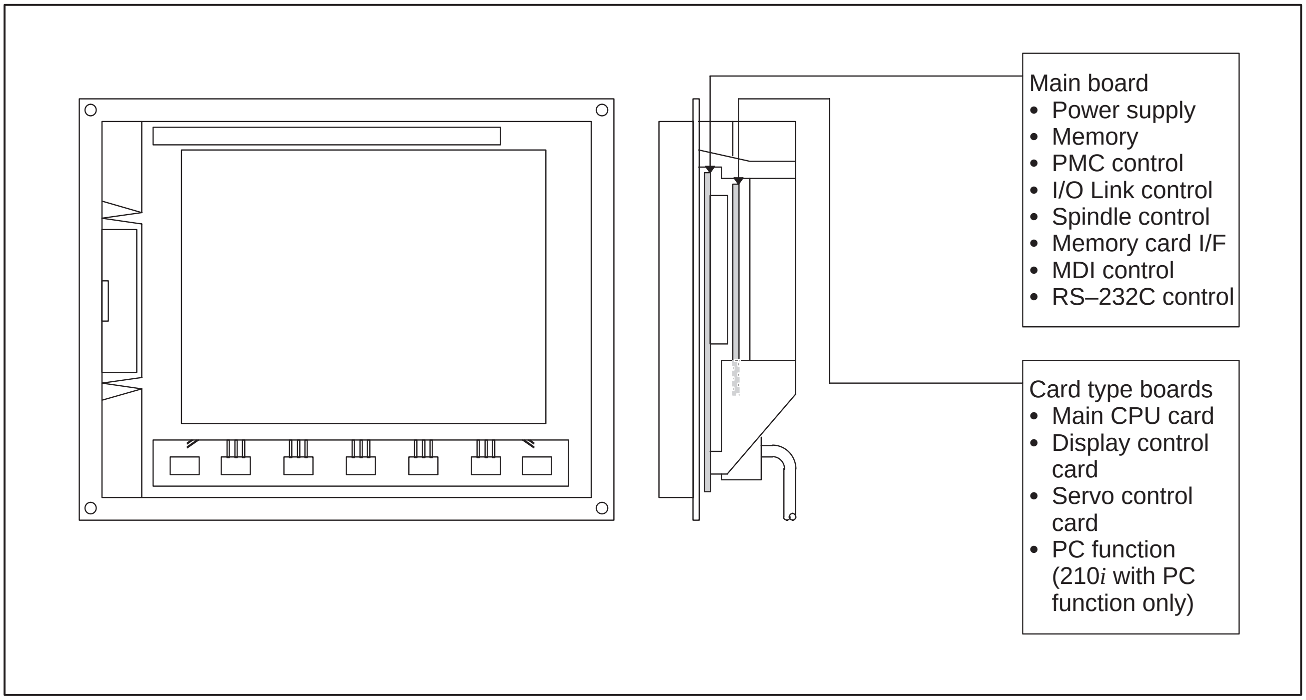


NOTE

1 This figure shows a rear view of the Series 21*i* control unit with option 2 slots having an 8.4″ TFT color LCD. The configuration of the option slot section of other 21*i* and 210*i* control units is identical to that shown above.

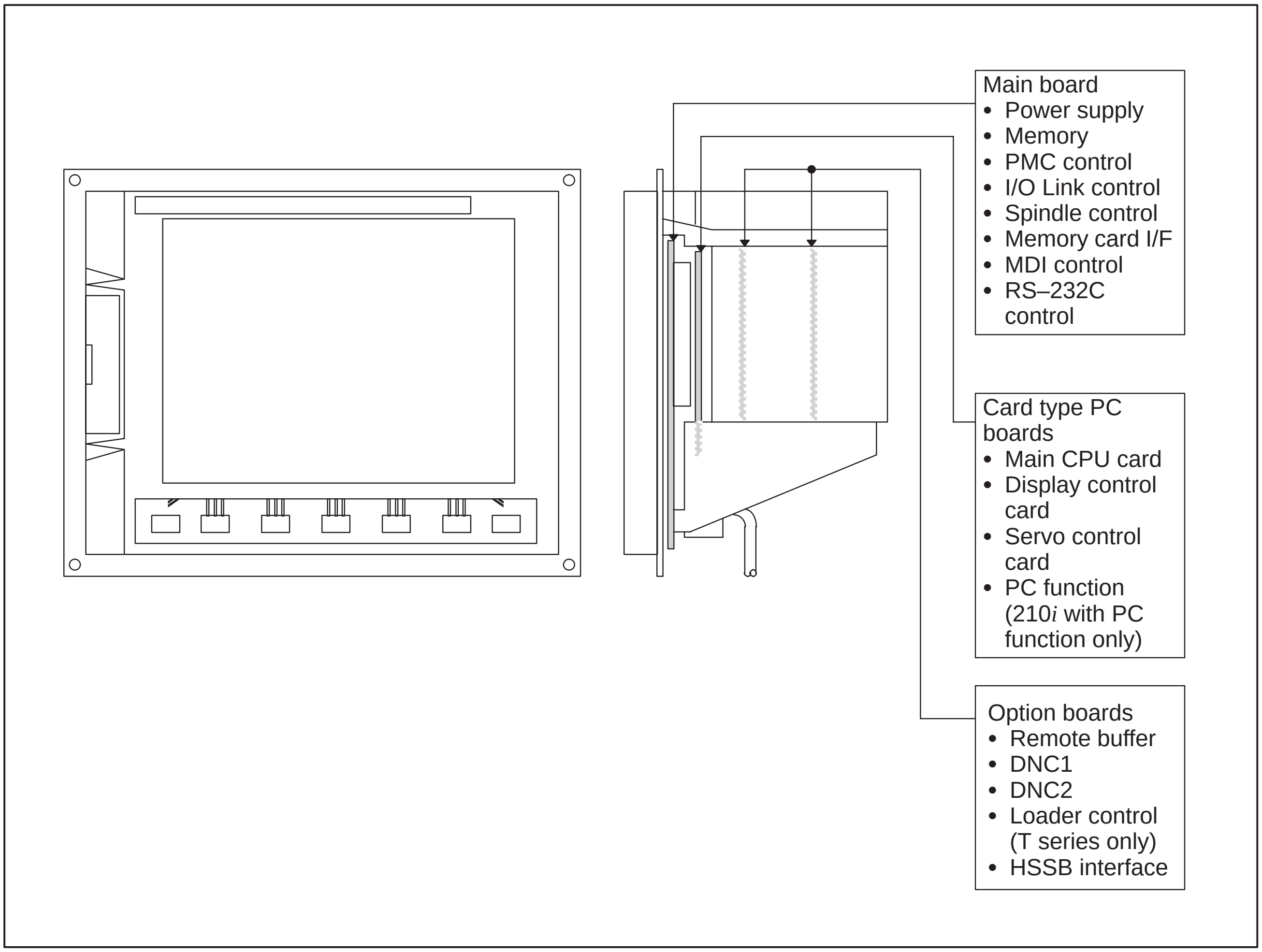
2 When the loader control board is used, refer to the Loader Control Connection Manual.

1.2 OVERVIEW OF HARDWARE



NOTE

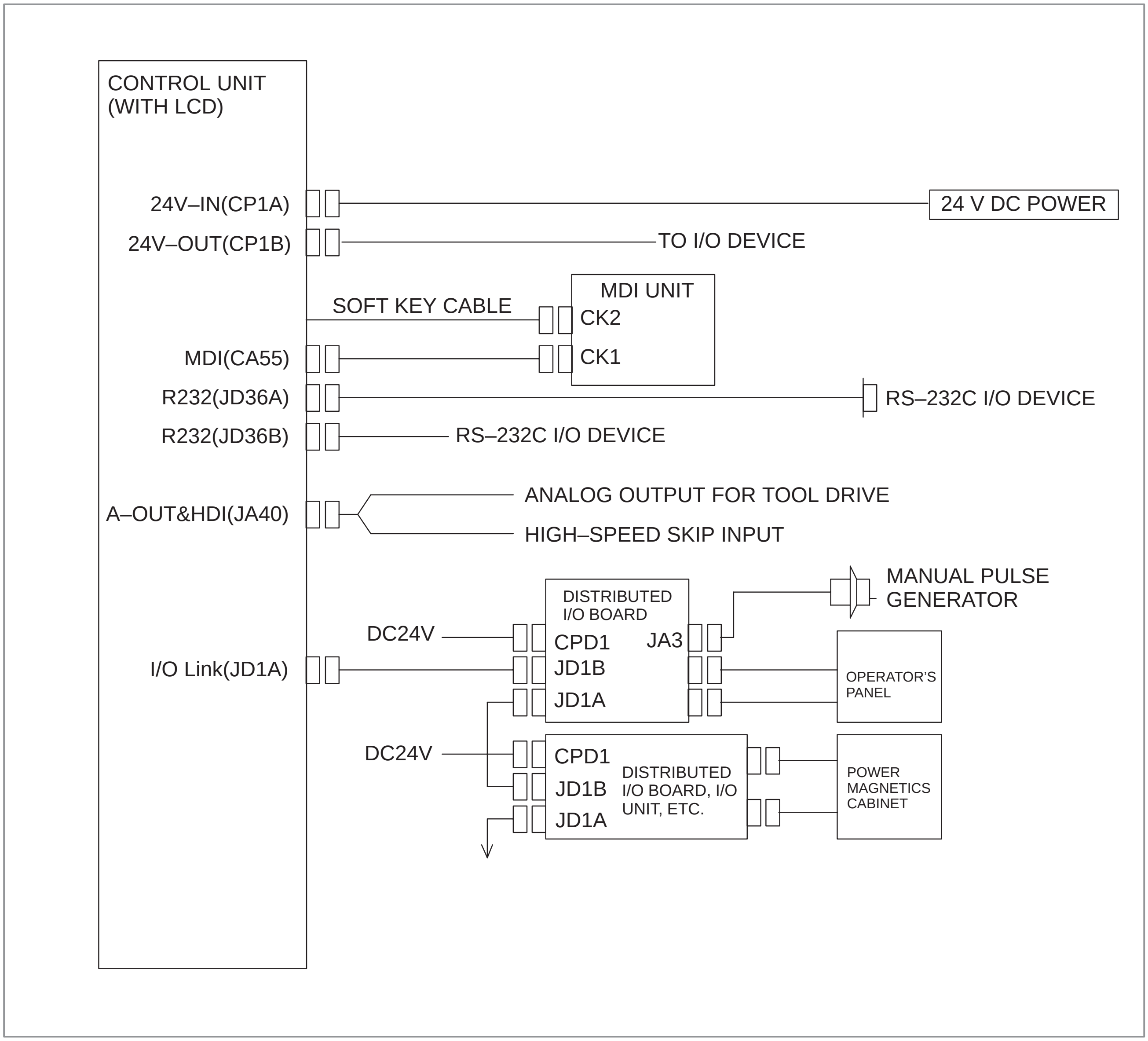
This figure shows, as an example, the Series 21*i* control unit with no option slot having an 8.4″ TFT color LCD.

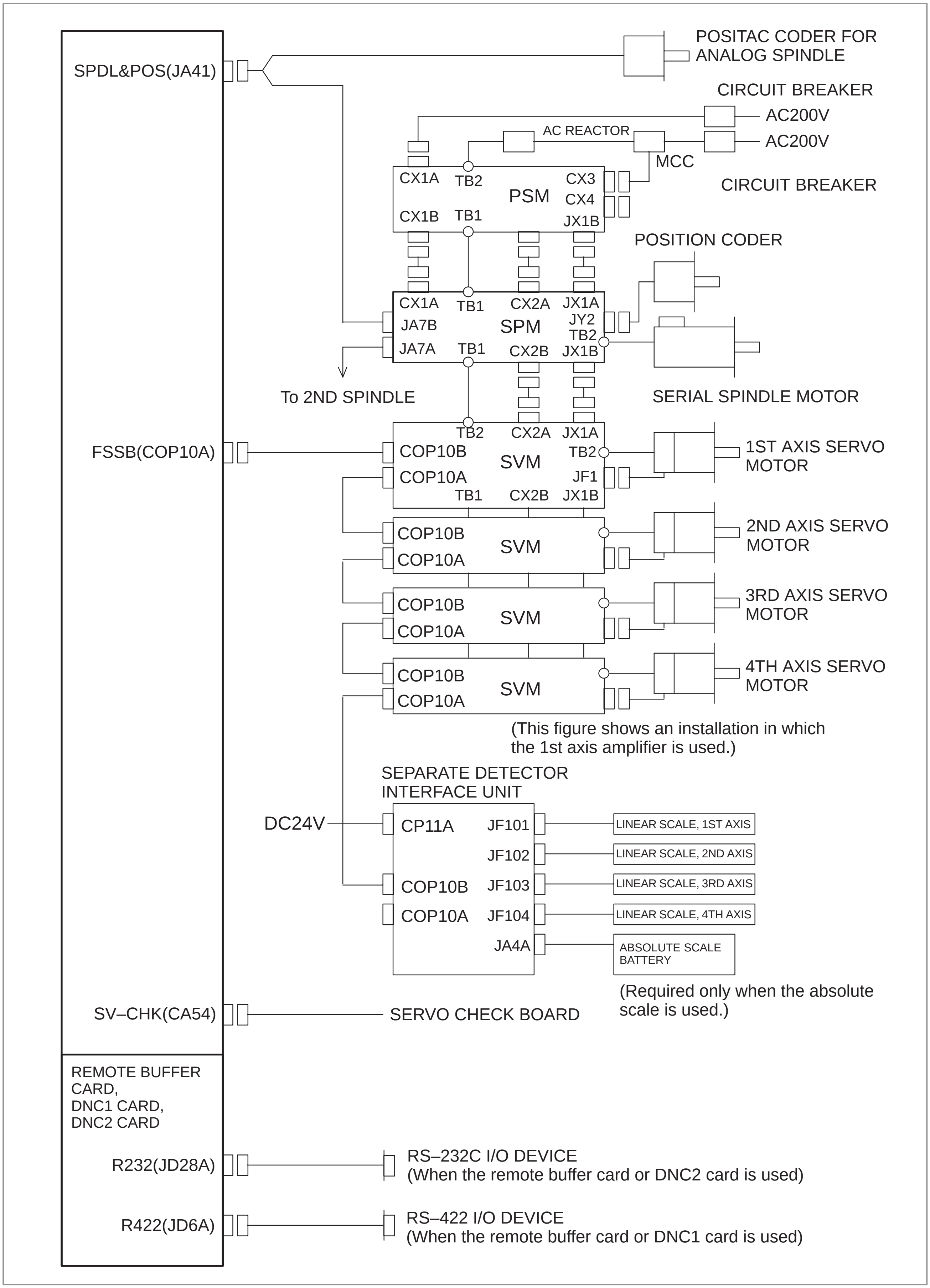


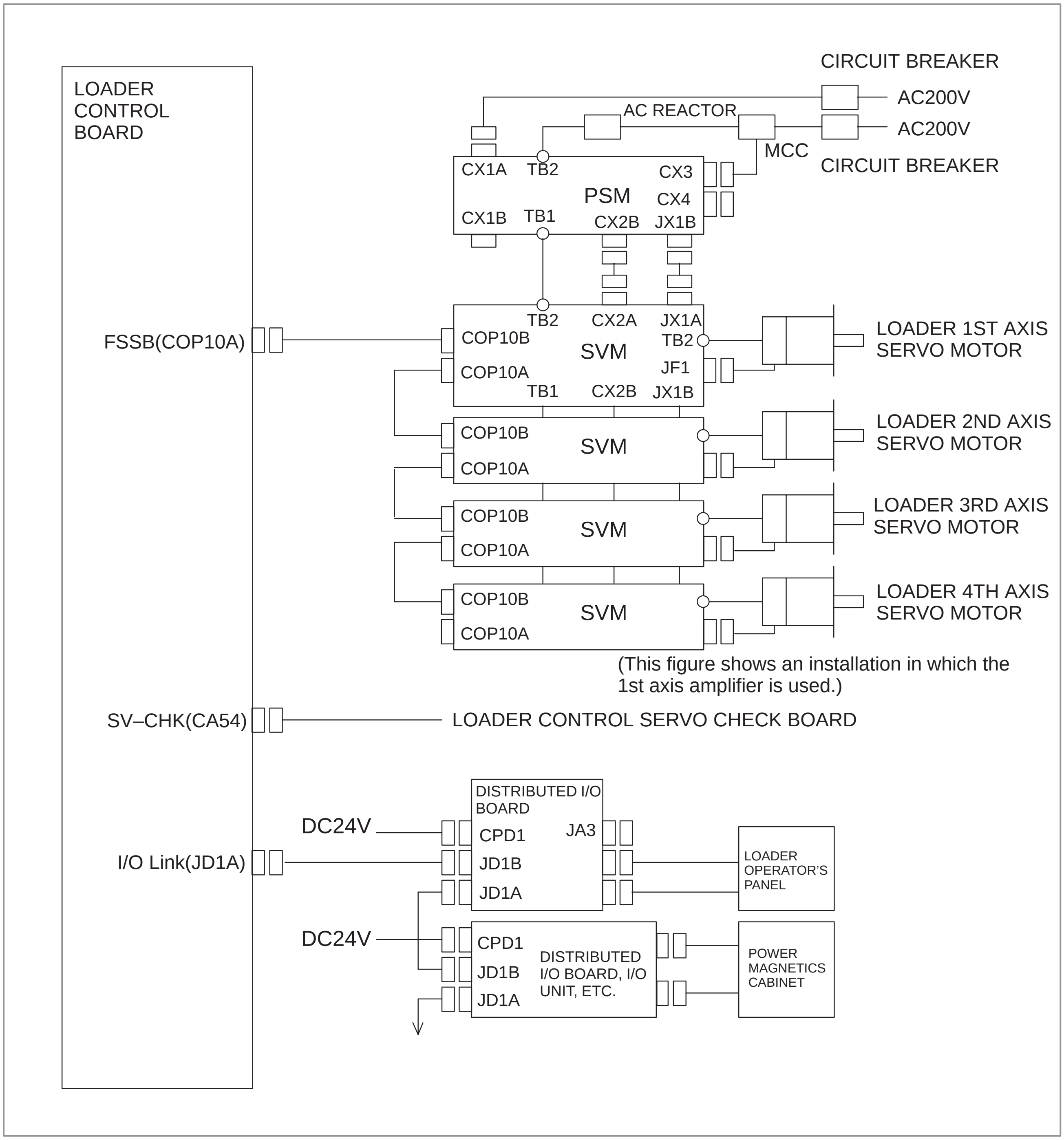
NOTE

This figure shows, as an example, the Series 21*i* control unit with option 2 slots having an 8.4″ TFT color LCD.

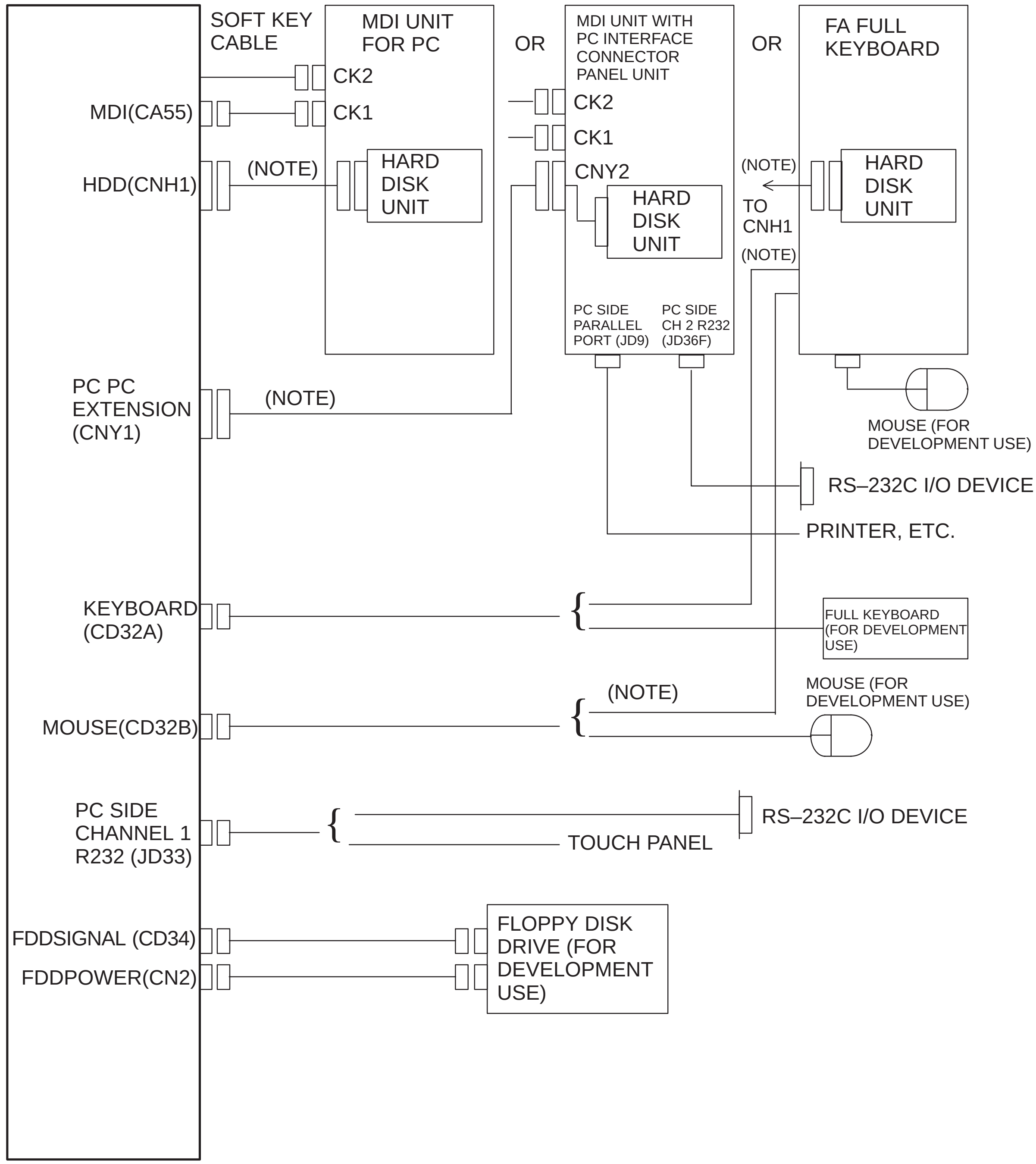
2 TOTAL CONNECTION DIAGRAM




SPDL&POS(JA41)
POSITAC CODER FOR ANALOG SPINDLE
CIRCUIT BREAKER
AC200V
AC REACTOR
AC200V
MCC
CIRCUIT BREAKER
CX1A TB2 PSM CX3 CX4
CX1B TB1 JX1B
POSITION CODER
CX1A TB1 CX2A JX1A
JA7B SPM JY2 TB2
JA7A TB1 CX2B JX1B
To 2ND SPINDLE
SERIAL SPINDLE MOTOR
FSSB(COP10A)
TB2 CX2A JX1A
COP10B SVM TB2
COP10A JF1
TB1 CX2B JX1B
1ST AXIS SERVO MOTOR
COP10B SVM COP10A
2ND AXIS SERVO MOTOR
COP10B SVM COP10A
3RD AXIS SERVO MOTOR
COP10B SVM COP10A
4TH AXIS SERVO MOTOR
(This figure shows an installation in which the 1st axis amplifier is used.)
SEPARATE DETECTOR INTERFACE UNIT
DC24V
CP11A JF101
JF102
COP10B JF103
COP10A JF104
JA4A
LINEAR SCALE, 1ST AXIS
LINEAR SCALE, 2ND AXIS
LINEAR SCALE, 3RD AXIS
LINEAR SCALE, 4TH AXIS
ABSOLUTE SCALE BATTERY
(Required only when the absolute scale is used.)
SV–CHK(CA54)
SERVO CHECK BOARD
REMOTE BUFFER CARD,
DNC1 CARD,
DNC2 CARD
R232(JD28A)
RS–232C I/O DEVICE
(When the remote buffer card or DNC2 card is used)
R422(JD6A)
RS–422 I/O DEVICE
(When the remote buffer card or DNC1 card is used)


LOADER CONTROL BOARD
CIRCUIT BREAKER
AC200V
AC REACTOR
AC200V
MCC
CIRCUIT BREAKER
CX1A
TB2
CX3
PSM
CX4
CX1B
TB1
CX2B
JX1B
FSSB(COP10A)
TB2
CX2A
JX1A
COP10B
TB2
SVM
COP10A
JF1
TB1
CX2B
JX1B
LOADER 1ST AXIS SERVO MOTOR
COP10B
SVM
COP10A
LOADER 2ND AXIS SERVO MOTOR
COP10B
SVM
COP10A
LOADER 3RD AXIS SERVO MOTOR
COP10B
SVM
COP10A
LOADER 4TH AXIS SERVO MOTOR
(This figure shows an installation in which the 1st axis amplifier is used.)
SV–CHK(CA54)
LOADER CONTROL SERVO CHECK BOARD
DISTRIBUTED I/O BOARD
DC24V
CPD1
JA3
I/O Link(JD1A)
JD1B
JD1A
LOADER OPERATOR'S PANEL
DC24V
CPD1
DISTRIBUTED I/O BOARD, I/O UNIT, ETC.
JD1B
JD1A
POWER MAGNETICS CABINET

(The following figure shows the specific connection to the Series 210*i* control unit having PC functions.)



NOTE

The cables for the hard disk unit, PC interface connector unit and FA full keyboard are provided by FANUC.

3 INSTALLATION

3.1 ENVIRONMENT FOR INSTALLATION

3.1.1 Environmental Requirements Outside the Cabinet

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

(1) Cabinet manufactured by the machine tool builder for housing the control unit or peripheral units;

(2) Cabinet for housing the flexible turnkey system provided by FANUC ;

(3) Operation pendant, manufactured by the machine tool builder, for housing the CRT/MDI unit or operator's panel.

(4) 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	Series 21*i*, Series 210*i* with HSSB	Series 210*i* with PC Function
Ambient Tempera-ture	Operating	0°C to 58°C	5°C to 53°C
	Storage, Transport	–20°C to 60°C	
Tempera-ture Change		Max. 1.1°C/min.	Max. 0.3°C/min.
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	
Atmosphere		Normal factory environment (Special consideration is required if the machine is used in an environment with a high concentration of airborne dust, coolant and/or organic solvent.)	
Altitude	Operating		–60 m to 3000 m
	Non–operating		–60 m to 12000 m

3.2 POWER SUPPLY

3.2.1 Power Supply for CNC Control Units

The following units, related to the CNC control unit, require the input of 24 V DC±10%.

Table 3.2(a) Power Supply

Unit	Power Supply Voltage	Power Supply
Series 21*i* control unit without option slot	24 V DC ± 10% (± 10% includes momentary surges and ripples.)	1.7 A including LCD and MDI unit.
Series 21*i* control unit with option 2 slots		1.7 A including LCD and MDI unit.
Series 210*i* control unit (with PC functions) without option slot		2.3 A including LCD, MDI unit, hard disk drive and floppy disk drive.
Series 210*i* control unit (with PC functions) with option 2 slots		2.3 A including LCD, MDI unit, hard disk drive and floppy disk drive.
Option board (Remote buffer, DNC1, DNC2)		0.3 A
Loader control board		0.5 A
HSSB board		0.2 A
ISA extension		Max. 1.5 A (NOTE 2)
Separate detector interface unit		0.9 A (NOTE 4)
PC interface connector panel unit		0 A

NOTE

1 For other peripheral devices (I/O, etc.), refer to the power supply data for each device and add the value to the above.

2 Variable depending on the ISA board in use.

3 The power supply to the Series 210*i* control unit with HSSB is identical to the sum of that of the Series 21*i* control unit and that of the HSSB board.

4 The maximum current which can be used by up to 4 axes in the separate detector is 1.4 A (+5 V DC).

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 Sec. 3.1. In addition, the magnetic interference on the CRT screen, noise resistance, and maintenance requirements must be considered. The cabinet design must meet the following conditions :

(1) The cabinet must be fully closed.

The cabinet must be designed to prevent the entry of airborne dust,coolant,and organic solvent.

(2) The cabinet must be designed so that the allowable temperature for each unit is not exceeded.

See Section 3.4 for details of thermal design of the cabinet.

(3) A closed cabinet must be equipped with a fan to circulate the air within.

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 abheres to the unit. This may cause the unit to fail.

(4) For the air to move easily, a clearance of 100 mm is required between each unit and the wall of the cabinet.

(5) Packing materials must be used for the cable port and the door in oreder to seal the cabinet.

(6) Display units must be installed in a location where coolant cannot be poured directly on it. The unit does have a dust–proof front panel.

(7) 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.

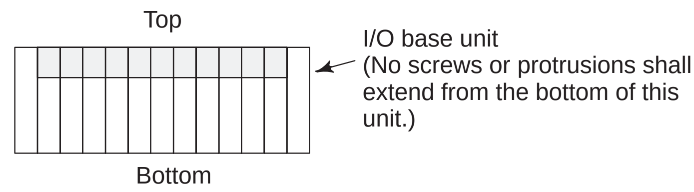
The CNC unit is built to protect it from external noise. Cabinet design to minimize noise generation and to prevent it from being transmitted to the CNC unit is necessary. See Sec. 3.6 for details of noise elimination/management.

(8) The units must be installed or arranged in the cabinet so that they are easy to inspect and maintain.

(9) The hard disk drive and floppy disk drive must not be installed near the source of a strong magnetic field.

(10) 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 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.



(11) 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.

(a) 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.

(b) If the temperature drifts out of range after normal start–up
Error occurs when the hard disk is accessed.

(12) 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 while the hard disk is being accessed, 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.

(13) For a control unit with PC functions, be particularly careful when installing the MDI unit.

(a) The MDI unit should be installed immediately below the control unit, with no space between the units.

(b) The MDI unit should 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 10°C or less when the temperature in the cabinet rises:

$$\text{Internal heat loss P [W]} \leqq = 6\ [\text{W/m}^{2\ S} \cdot {}^\circ\text{C}] \times \text{surface area S [m}^2] \times 13\ [{}^\circ\text{C}] \text{ of rise in temperature}$$

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 described next.

3.4.2 Cooling by Heat Exchanger

If the temperature rise cannot be limited to 10°C by the cooling capacity of the cabinet, a heat exchanger must be added. The heat exchanger forcibly applies the air from both the inside and outside of the cabinet to the cooling fin to obtain effective cooling. The heat exchanger enlarges the surface area. Sec. 3.5 explains five heat exchangers supplied by FANUC. Select one of these according to the application.
If cooling fin A is used for the cabinet, the total cooling capacity of a cabinet having a surface area of 4 m^2 in the example above is improved as follows:

$$6\text{W/m}^2 \cdot {}^\circ\text{C} \times 4\text{m}^2 + 9.1\text{W/}^\circ\text{C} = 33.1\text{W/}^\circ\text{C}$$

The calculated value verifies that even if the internal heat is 360 W, the temperature rise can be limited to less than 11°C.
See Sec. 3.5 for installing the heat exchanger.

3.4.3 Heat Dissipated by Each Unit

Unit	Power Consumption (W)
Series 21*i* control unit without option slot	33 W including LCD and MDI unit.
Series 21*i* control unit with option 2 slots	33 W including LCD and MDI unit.
Series 210*i* control unit (with PC functions) without option slot	45 W including LCD, MDI unit, hard disk drive and floppy disk drive.
Series 210*i* control unit (with PC functions) with option 2 slots	45 W including LCD, MDI unit, hard disk drive and floppy disk drive.
Option board (Remote buffer, DNC1, DNC2)	6 W
Loader control board	10 W
HSSB board	3 W
ISA extension	(Note 2)
Separate detector interface unit	9 W (Note 4)
PC interface connector panel unit	0 W

NOTE
1 For other peripheral devices (I/O, etc.), see the heat dissipation data for each device and add the value to the above.
2 As this value varies depending on the ISA board being used, add the dissipation value for the installed ISA board.
3 The heat dissipation of the Series 210*i* control unit with HSSB is identical to the sum of that of the Series 21*i* control unit and that of the HSSB board.
4 Not including the heat dissipation of the separate detector itself.

3.4.4 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.

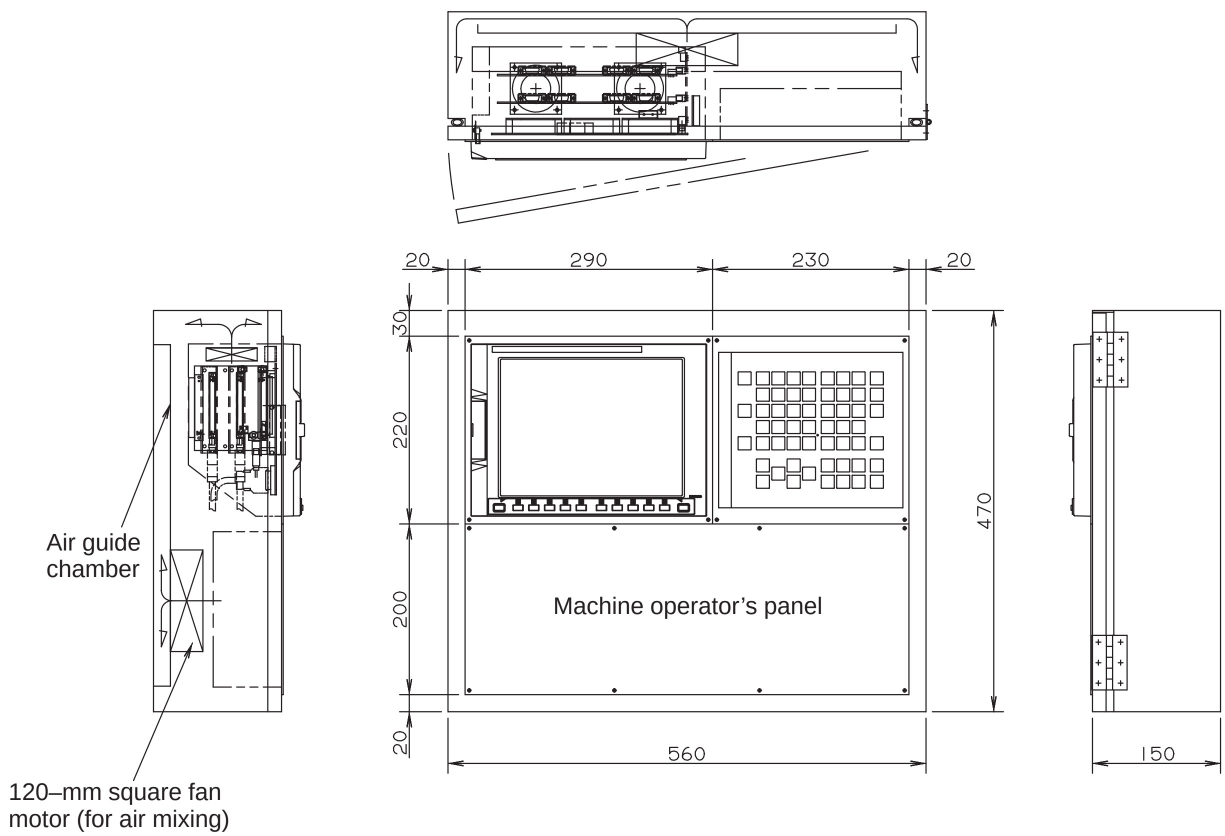


Fig.3.4.4

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 3.4.4

Series 21*i* control unit with option 2 slots	33 W
Option board (Remote buffer)	6 W
Loader control board	10 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	69 W(<72 W)

3.5 INSTALLING THE HEAT EXCHANGER

Table 3.5 lists the heat exchangers.
Cooling fins A, B and C are not provided with a fan. Note that a fan motor is required for any of these cooling fins when it is used as a heat exchanger.

Table 3.5 List of heat exchangers

Name	Ordering specification	Cooling capacity	Size	Fan
Cooling fin A	A02B–0053–K303	9.1W/°C	196×90×1000mm	–
Cooling fin B	A02B–0053–K304	10.1W/°C	444×90×650mm	–
Cooling fin C	A02B–0053–K305	25.2W/°C	560×90×970mm	–
Heat pipe type heat exchanger	A02B–0094–C901	9.0W/°C	226×132×415mm	Built–in
(CE marking compatible)	A02B–0200–C901	9.0W/°C	226×132×415mm	Built–in

3.5.1 Cooling Fin A/B/C

The cooling fin is shown in Fig. 3.5.1 (a).

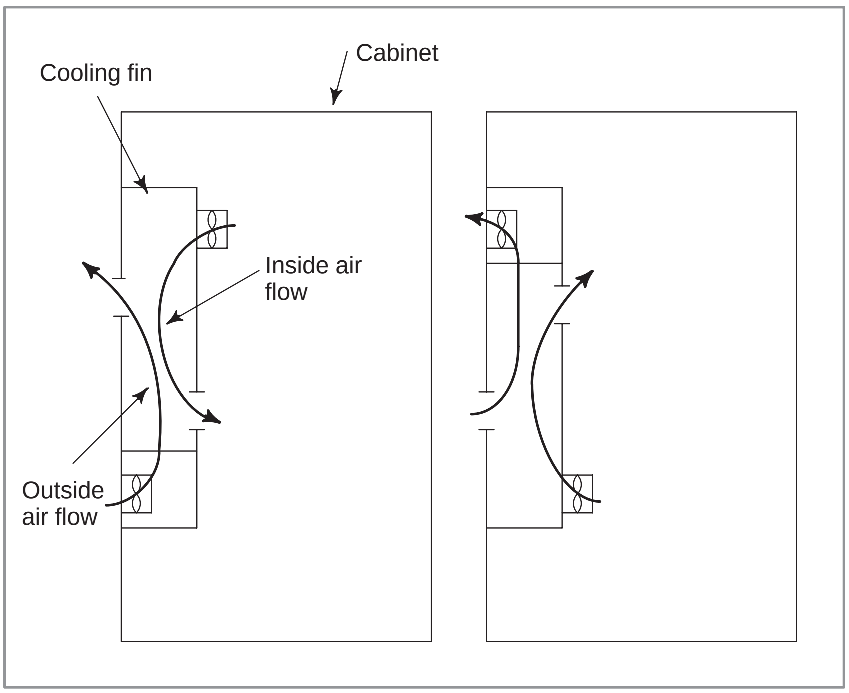


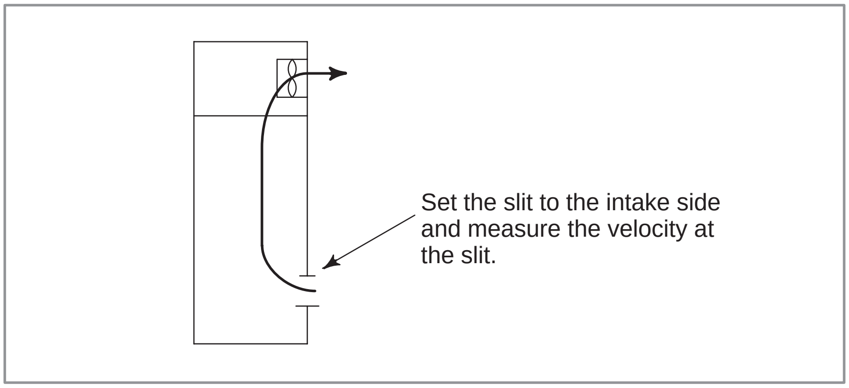
Fig.3.5.1(a) Internal view of cooling fin

The cooling fin can be installed in two ways, as shown in Fig.3.5.1(a). The following lists the general precautions to be observed when using the cooling fins :

1) The fans are not included with the cooling fin. They should be provided by the machine tool builder.
2) Bring in the outside air from the bottom and exhaust the hot air from the top.

3) The inside air may flow from top to bottom or bottom to top. However, generally decide the direction as follows :
   a) Bring in the air near high heat loss components.
   b) Exhaust the air toward the most important components to be cooled.
4) For the cooling fin to display the specified cooling capacity, the air inside the cooling fins must flow at a velocity of 2.5 m/sec or greater.

(velocity of air flow measurement)



5) Generally, install the cooling fins to the door. But be sure that the door does not bend when installing the cooling fin. The cooling fins are equipped with packing.

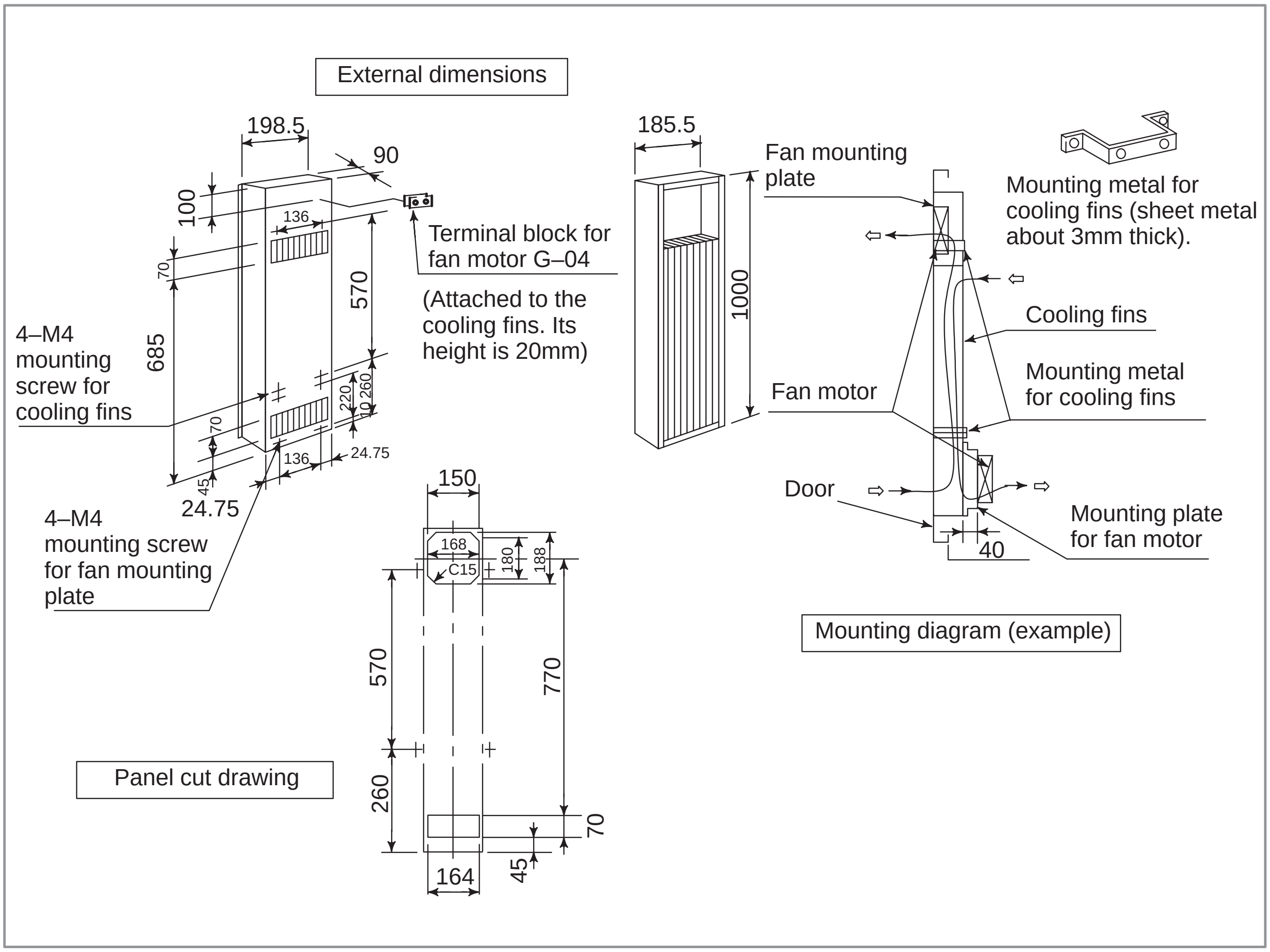


Fig.3.5.1 (b) External dimension and mounting method of cooling fin A (02B–0053–K303)

NOTE

1 Fan motor, mounting plate for fan motor and mounting metal for cooling fins are not attached to the collingfins.
So, prepare them at the machine tool builder.

2 Use two fan motors with about 50W power.

3 Weight : 6.5kg

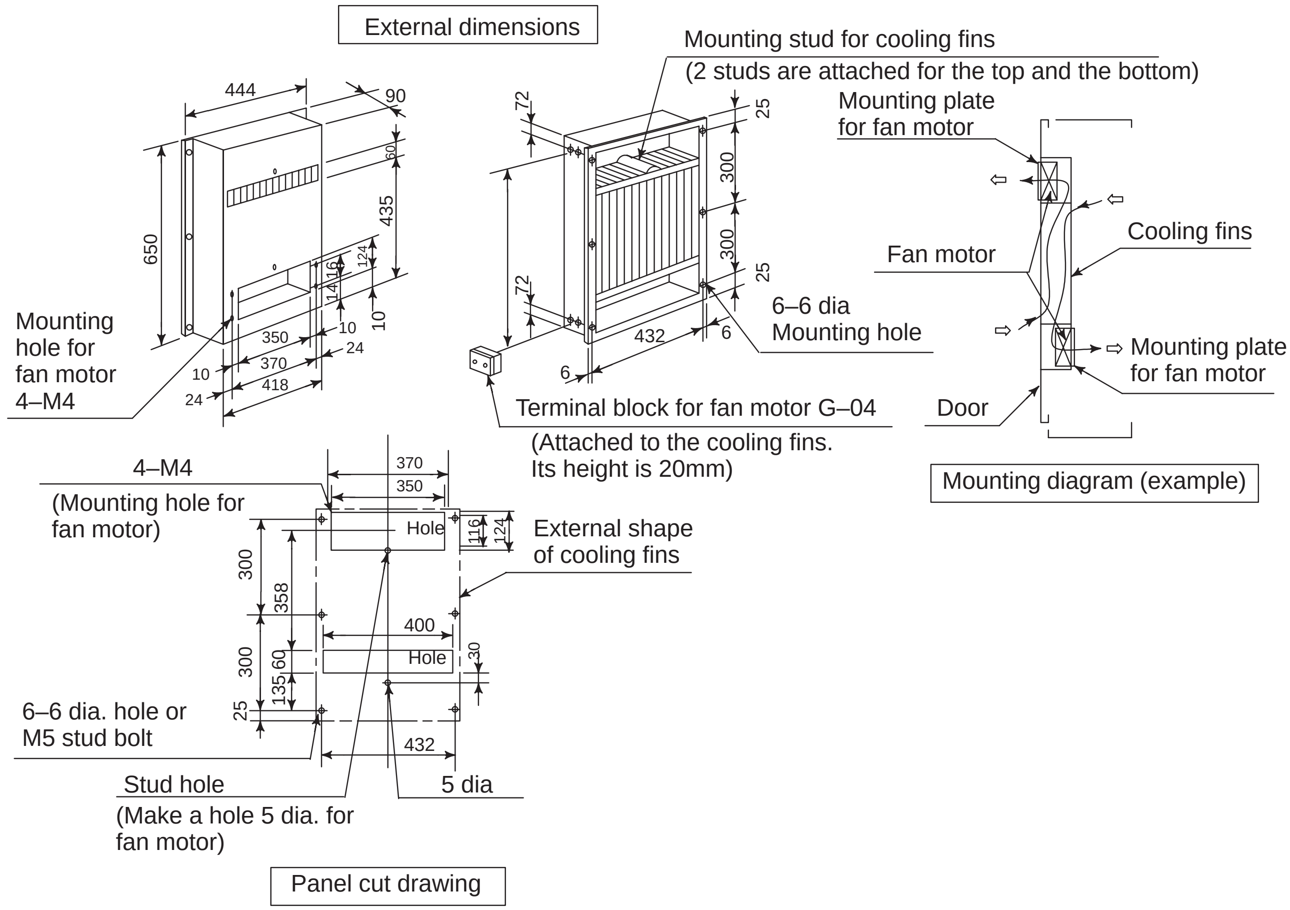


Fig.3.5.1(c) External dimension and mounting method of cooling fin B (A02B–0053–K304)

NOTE

1 Fan motor and mounting plate are not attached to the cooling fins.So, prepare them, at the machine tool builder.
2 Use four fan motors with about 20W power.
3 Weight : 7.5kg

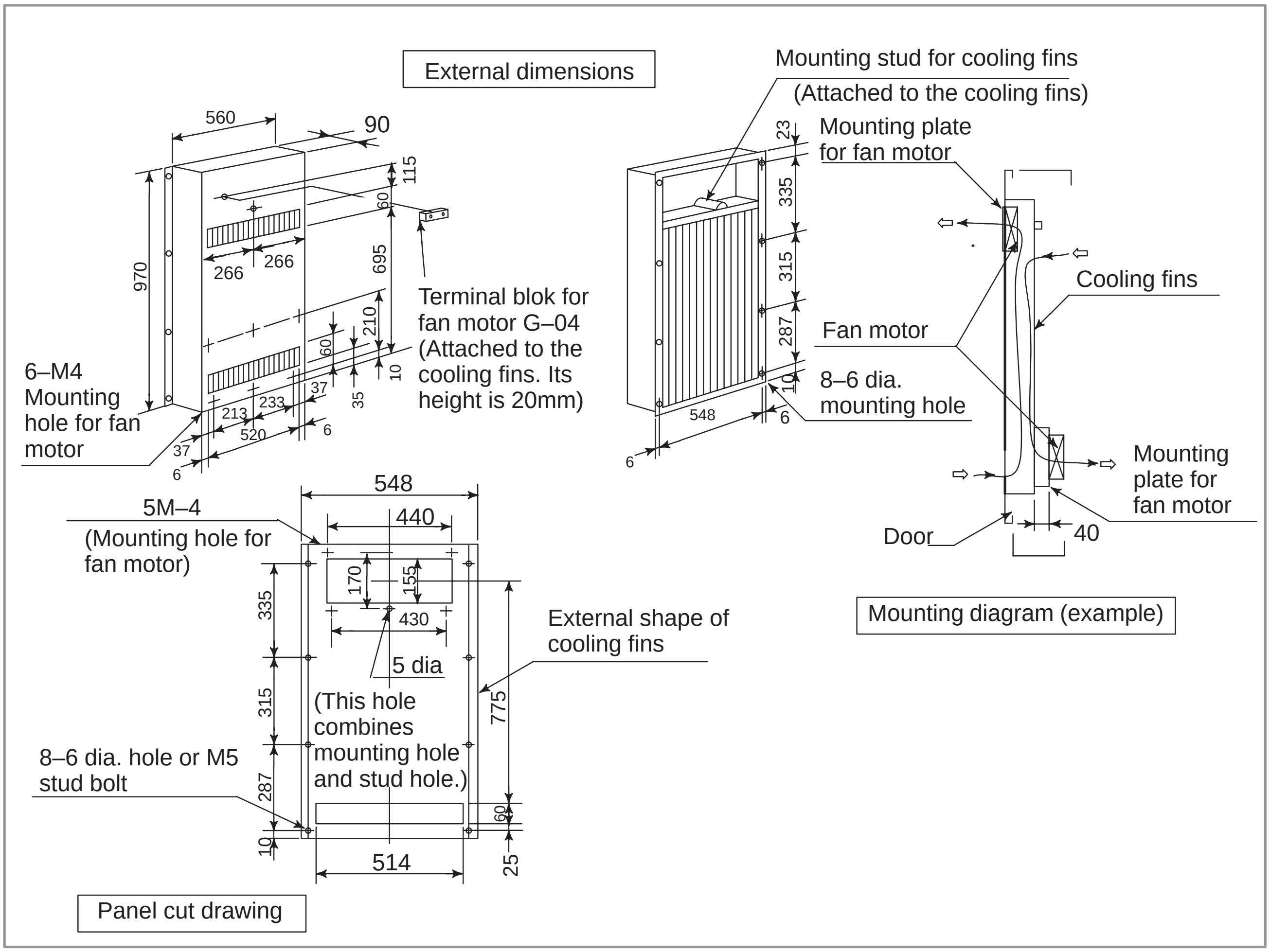


Fig.3.5.1(d) External dimension and mounting method of cooling fin C (A02B–0053–K305)

NOTE

1 Fan motor and mounting plate for fan motor are not attached to the cooling fins. Prepare them at the machine tool builder.
2 Use two fan motors with about 40W power.
3 Weight : 13.5kg

3.5.2 The Heat Pipe Type Heat Exchanger

3.5.2.1 Installation

The heat pipe type heat exchanger is used for cooling the airtight cabinet of small sized electronic devices. It is a compact, lightweight, and heat–efficient unit. Because the fan is built–in, it is used simply by installing it, performing the “panel cut” operation.

Specifications

Installation format		Installation type in board	
Fan specifi-cations	Coolign ability (W/°C)	9	
	Voltage (V)	200VAC	
	Frequency (Hz)	50	60
	Rating current (A)	0.28	0.24
	Rating input (W)	28	26
Weight (kg)		4	
Color		Munsell signal N1.5	

Order specifications: Heat exchanger A02B–0094–C901

CE marking–compatible heat exchanger A02B–0200–C901

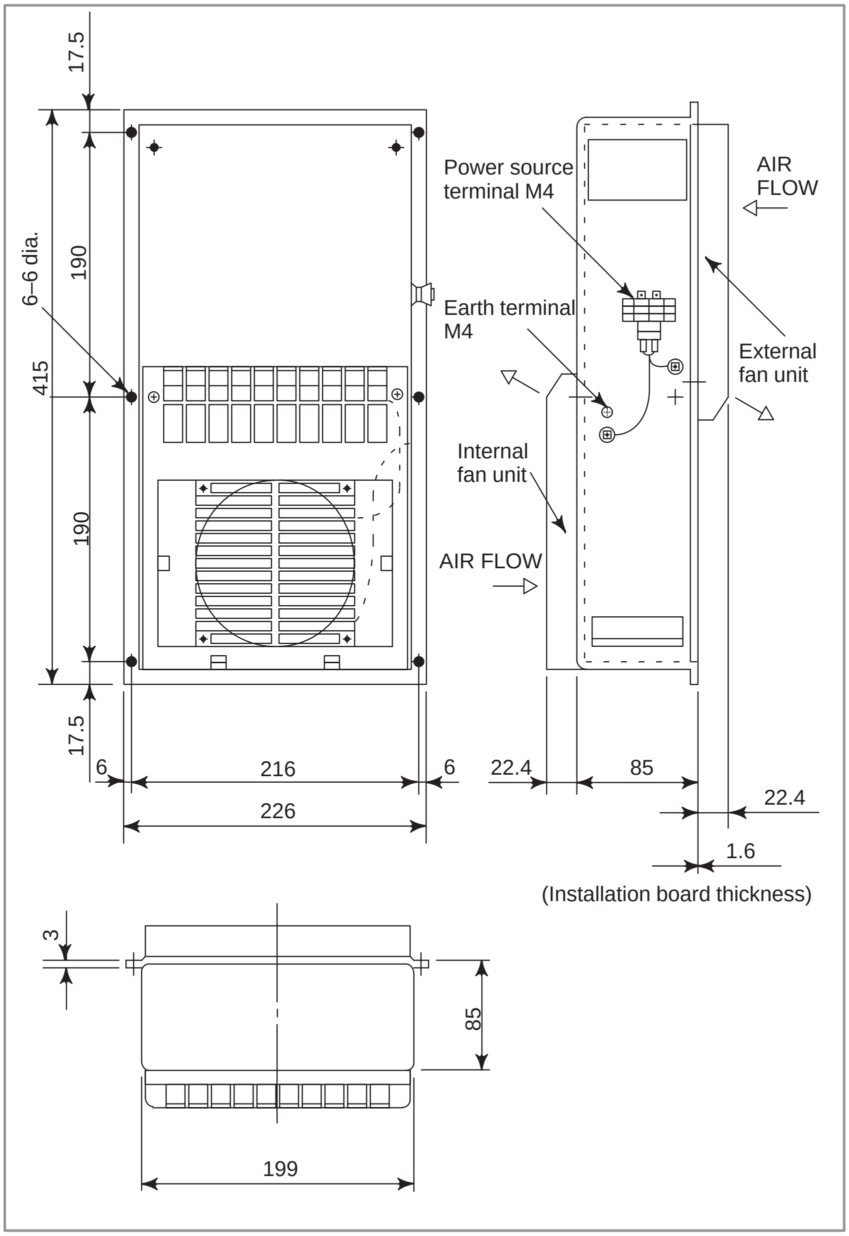
Remarks

- A filter is installed on the outside air inhalation side.
- The installation board thickness is the standard 1.6 t.
- When a fan motor and filter are necessary for maintenance, prepare them separately.

  Fan motor specifications
  A90L–0001–0219#A

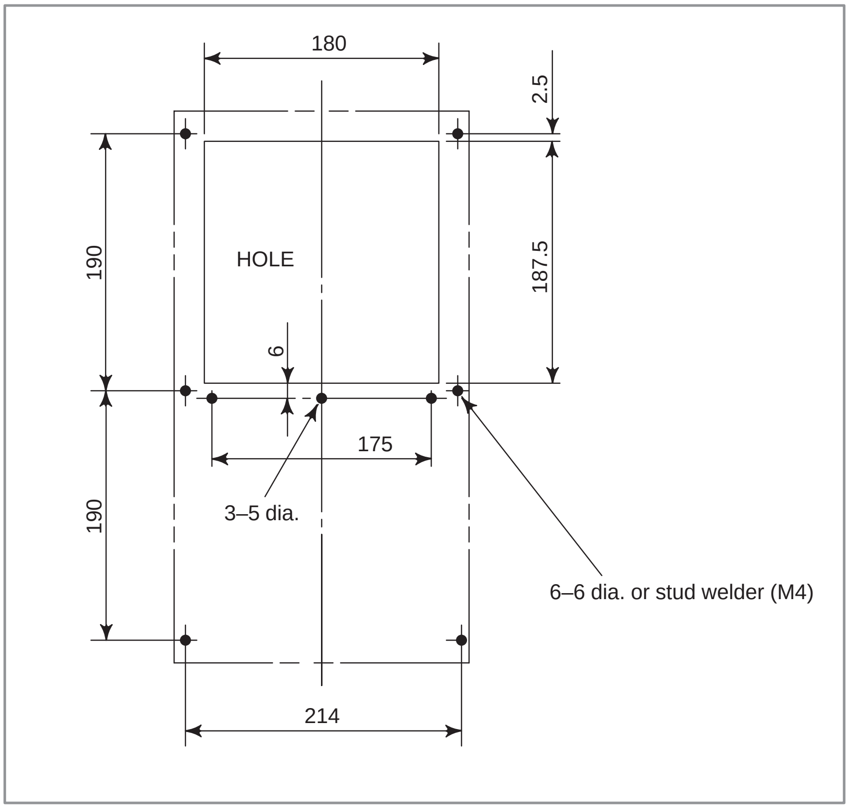
  Filter specifications
  A250–0689–X004

External dimensions



NOTE
The CE marking–compatible heat exchanger uses a wire–locked power supply terminal. Wire of between 0.25 and 4 mm^2 can be used.

Panel cut dimensions



Installation method

Please install the heat exchanger by the following sequence:

(1) Take out the external fan unit from the heat exchanger main unit. (Fig. 1)

Detach the external fan unit installation screws A (2 pieces), take out the unit from the main unit by sliding it down, and detach the earth cable and the power cable to the fan. Also detach the installation screw B (1 piece).

(2) Install the heat exchanger main unit in the installation section which has been panel cut. (Fig. 2)

When fastening down the heat exchanger main unit with the screws, first, temporarily secure the panel and the heat exchanger main unit with the installation screw B, which was taken out in (1)). After that, secure the main unit by the installation screws. In this case, the external fan unit installation screw holes should be aligned with the main unit screw holes. (Please provide the installation screws for the heat exchanger main unit.)
Because this product is composed of plastic, set the value shown below for the screw tightening torque.

Heat exchanger main unit (M4 screw): 11 kgf.cm

External fan unit (M3 screw): 5 kgf.cm

(3) Connect the power cable and the earth cable to the external fan unit (the unit detached in (1)), and secure the installation screw A to the main unit from the outside.

The installation is now complete.

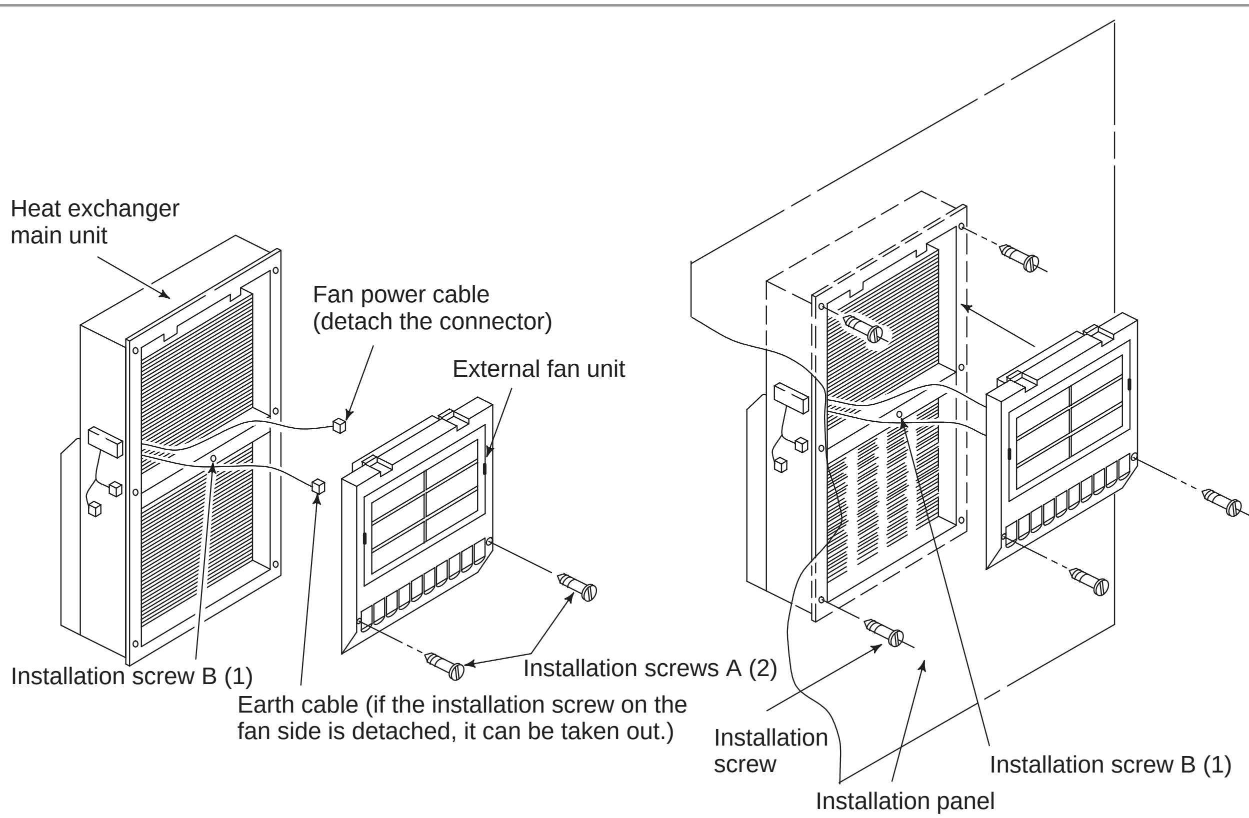


Fig. 1 Take out the external fan unit from the heat exchanger main unit

Fig. 2 Install the heat exchanger main unit and the external fan unit

3.6 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.

3.6.1 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 Subsec. 3.6.4 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	

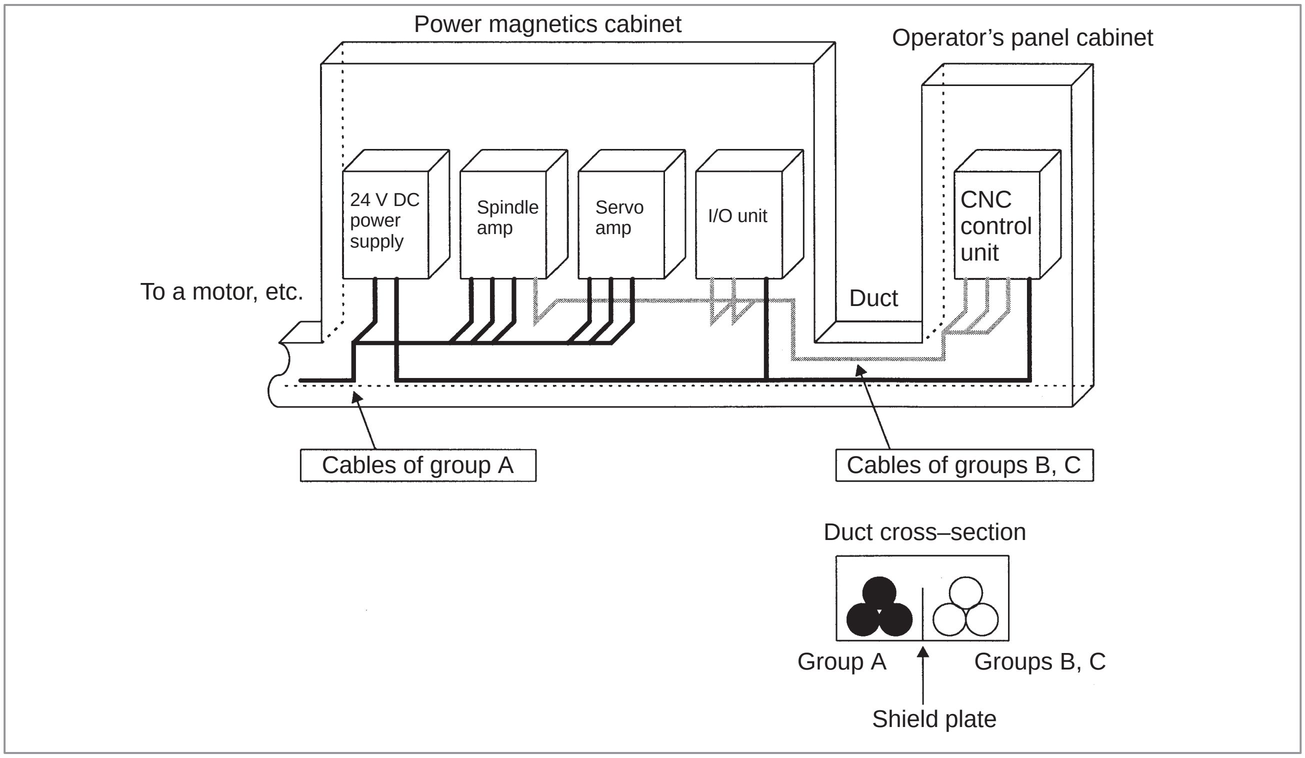
Group	Signal line	Action
C	Cable between the CNC and servo amplifier	Bind the cables in group C separately from group A, or cover group C with an electromagnetic shield. Separate group C as far from Group B as possible. Be sure to perfrom shield processing in Subsec. 3.6.5.
	Cable for position and velocity 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 CRT/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.


Power magnetics cabinet
Operator's panel cabinet
24 V DC power supply
Spindle amp
Servo amp
I/O unit
CNC control unit
To a motor, etc.
Duct
Cables of group A
Cables of groups B, C
Duct cross–section
Group A
Groups B, C
Shield plate

3.6.2 Ground

The following ground systems are provided for the CNC machine tool:

(1) Signal ground system (SG)

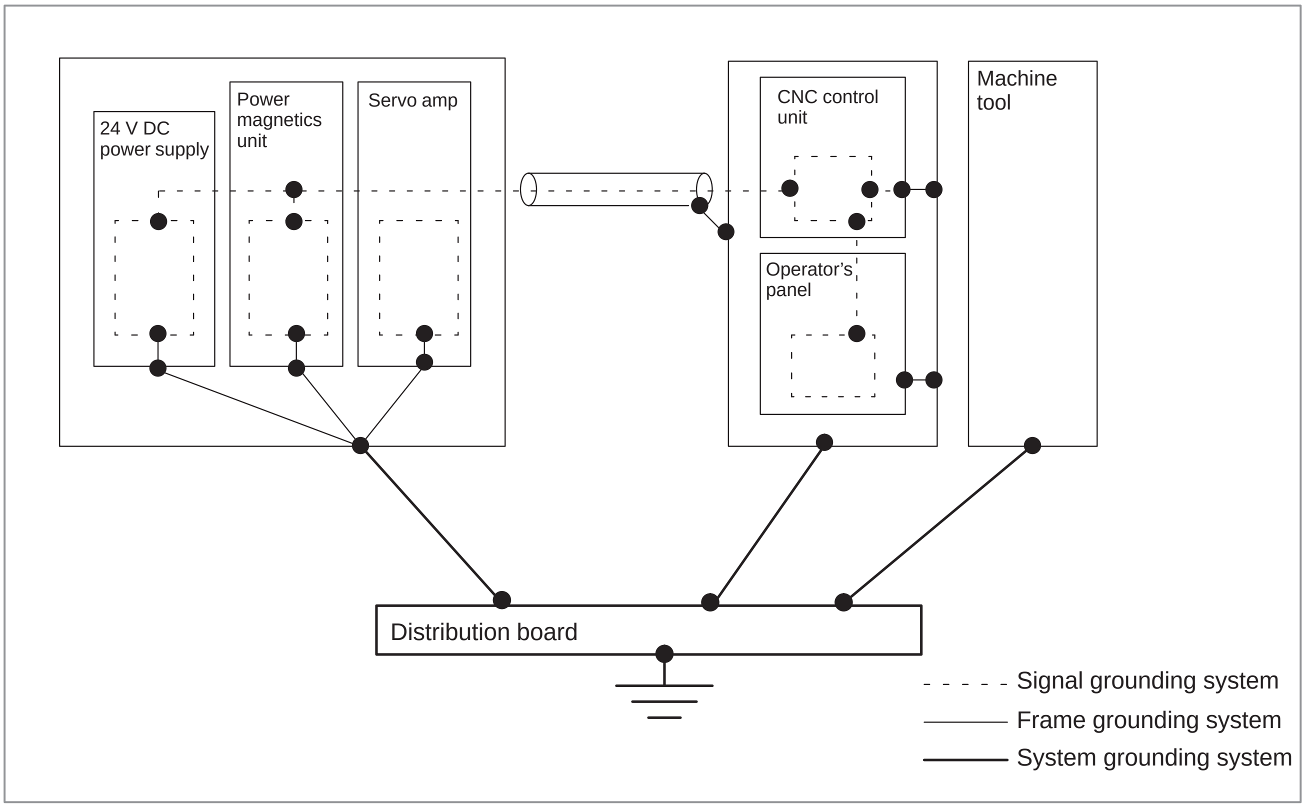
The signal ground (SG) supplies the reference voltage (0 V) of the electrical signal system.

(2) Frame ground system (FG)

The frame ground system (FG) is used for safety, and suppressing external and internal noises. In the frame ground system, the frames, cases of the units, panels, and shields for the interface cables between the units are connected.

(3) System ground system

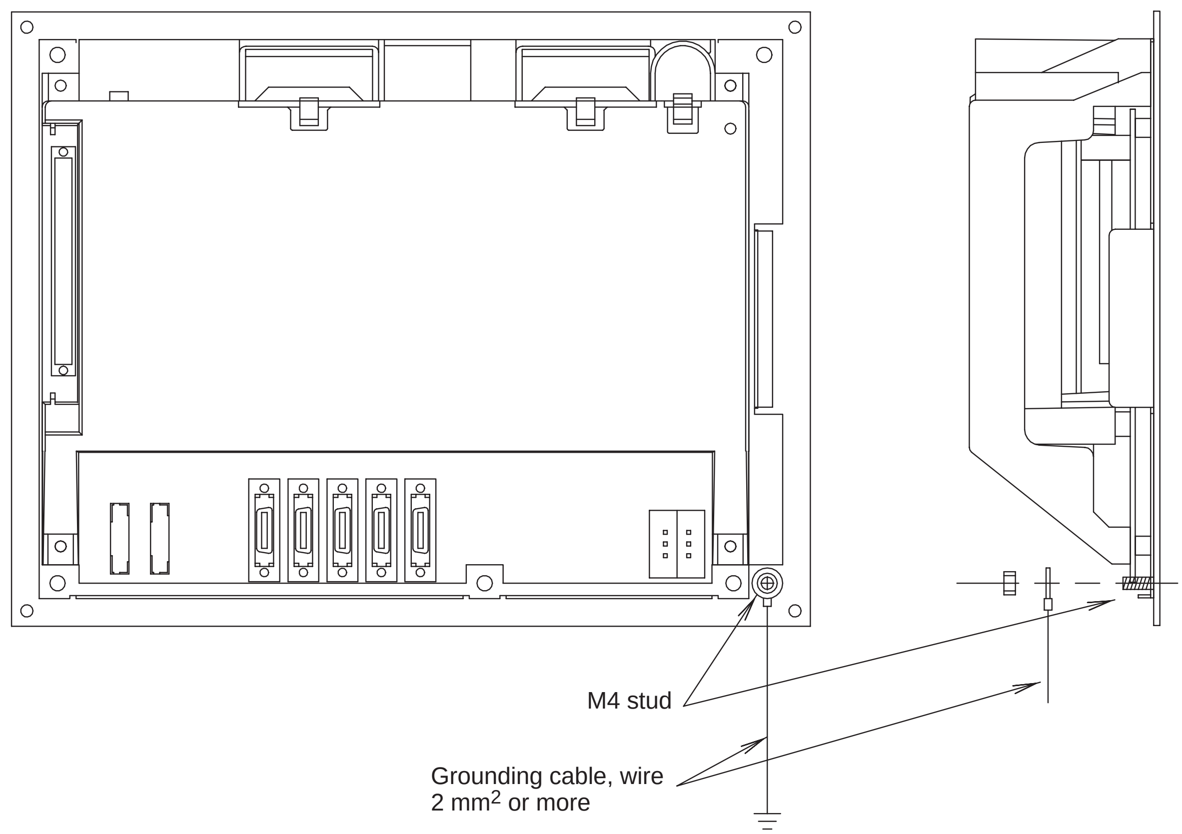
The system ground system is used to connect the frame ground systems connected between devices or units with the ground.



Notes on connecting the ground systems

- Connect the signal ground with the frame ground (FG) at only one place in the CNC control unit.
- The grounding resistance of the system ground shall be 100 ohms or less (class 3 grounding).
- The system ground cable must have enough cross–sectional area to safely carry the accidental current flow into the system ground when an accident such as a short circuit occurs.
(Generally, it must have the cross–sectional area of the AC power cable or more.)
- Use the cable containing the AC power wire and the system ground wire so that power is supplied with the ground wire connected.

3.6.3 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.

3.6.4 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

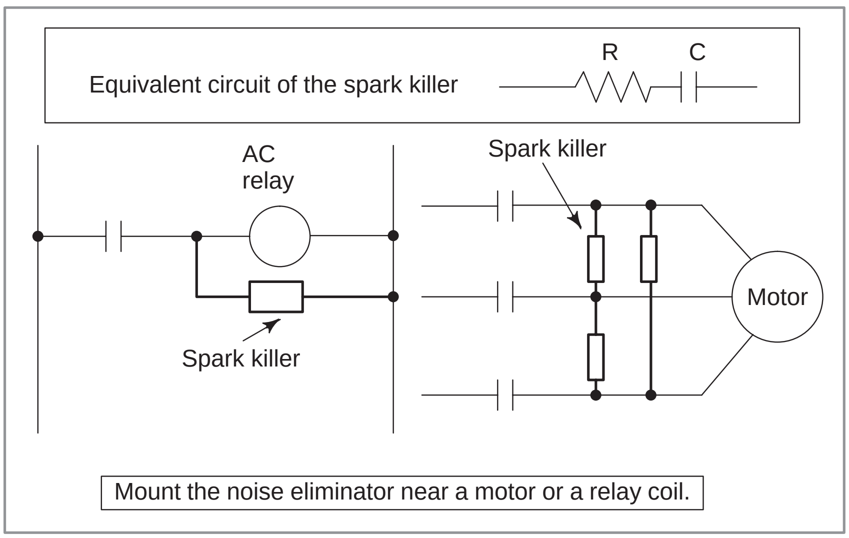
- Use a spark killer consisting of a resistor and capacitor in series. This type of spark killer is called a CR spark killer.(Use it under AC)

  (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

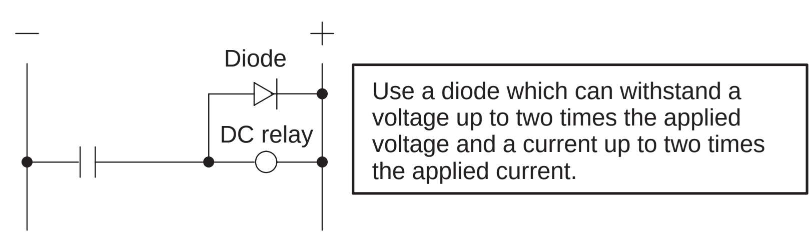
  2) Capacitance (C) : $\frac{I^2}{10}$ to $\frac{I^2}{20}$ (μF)

  I : Current at stationary state of the 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)



3.6.5 Cable Clamp and Shield Processing

The CNC cables that require shielding should be clamped by the method shown below. This cable clamp treatment is for both cable support and proper grounding of the shield. To insure stable CNC system operation, follow this cable clamp method.

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 :

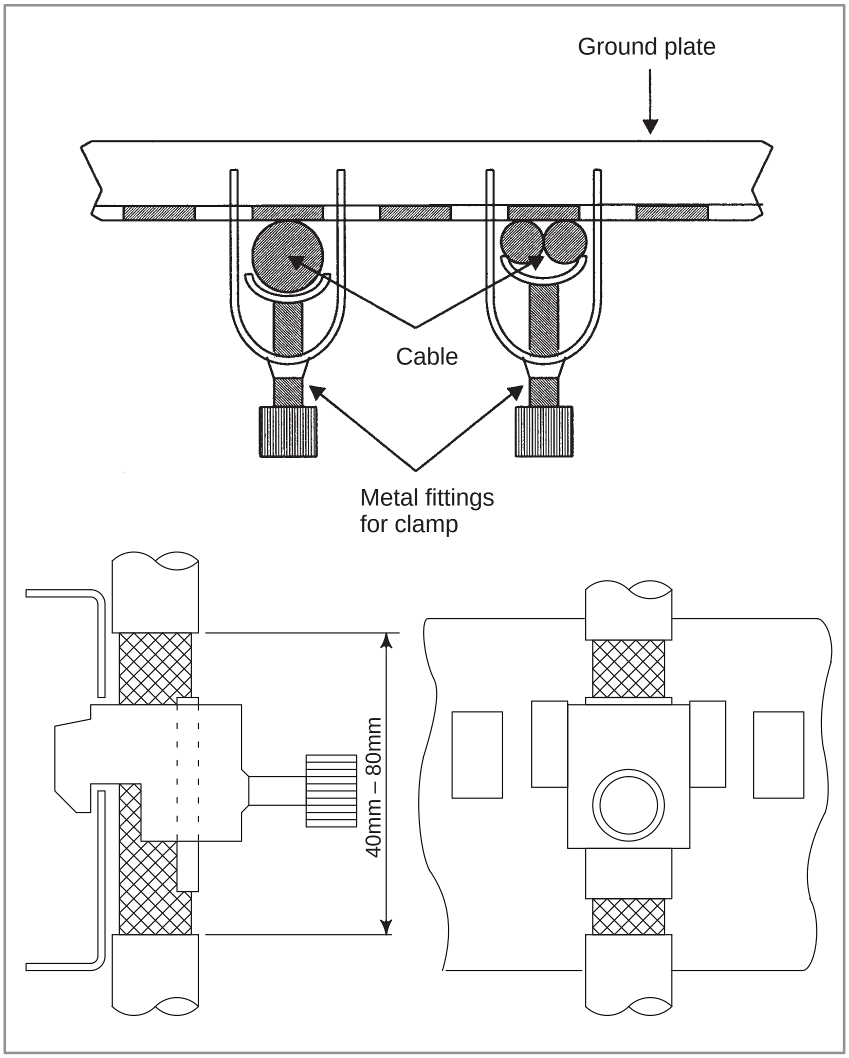


Fig.3.6.5(a) Cable clamp (1)

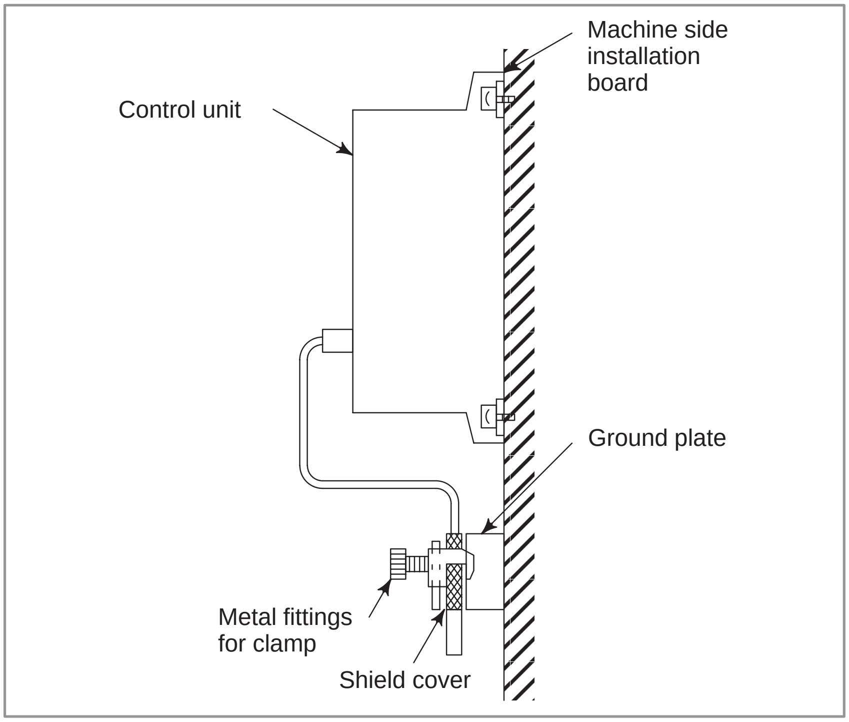


Fig.3.6.5(b) Cable clamp (2)

Prepare ground plate like the following figure.

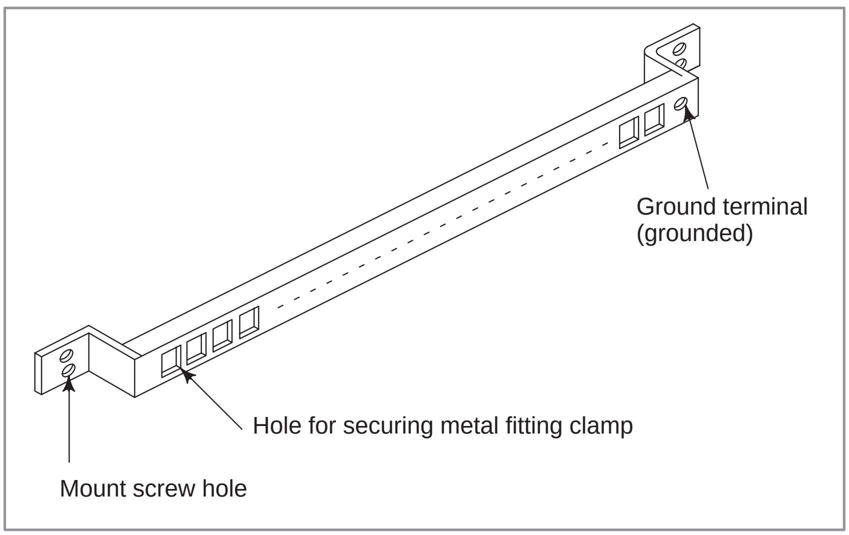


Fig.3.6.5(c) Ground plate

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

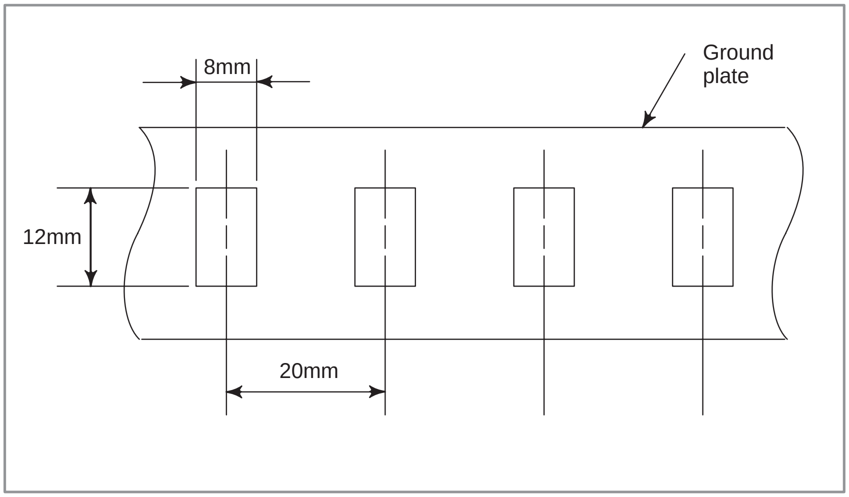


Fig.3.6.5(d) Ground plate holes

(Reference) Outer drawings of metal fittings for clamp.

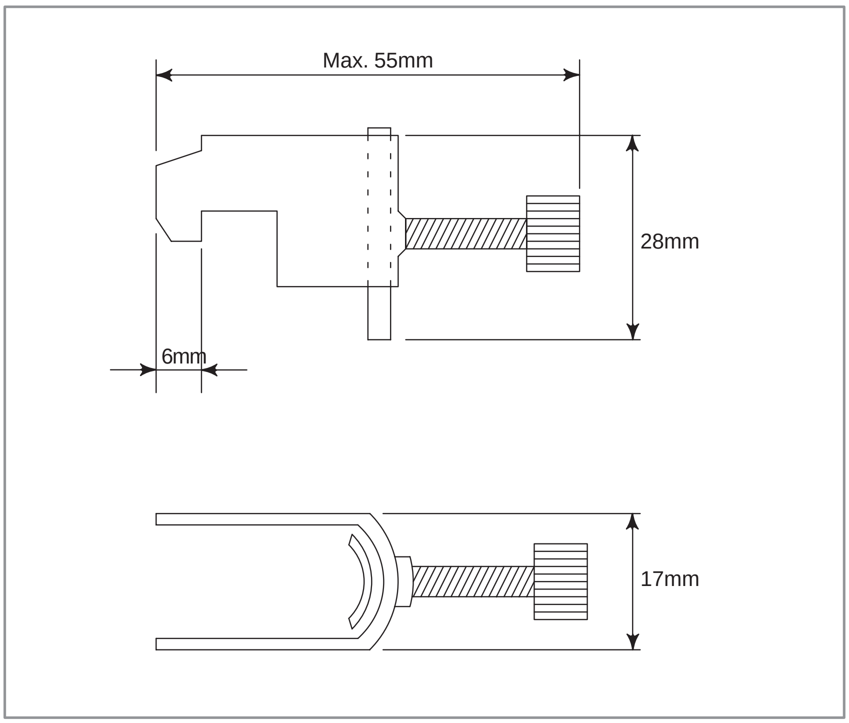


Fig.3.6.5(e) Outer drawings of metal fittings for clamp

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

3.7 CONTROL UNIT

3.7.1 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. 3.7.1, 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.

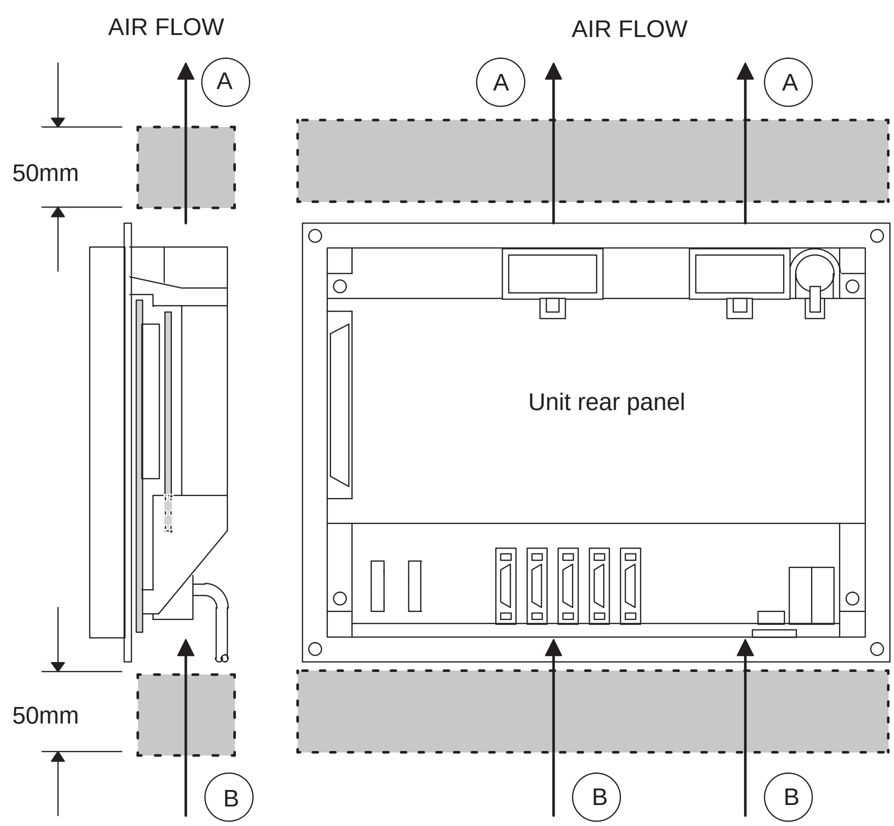


Fig.3.7.1

3.8 CABLE LEAD–IN DIAGRAM

Figs. 3.8(a) to (f) show the layouts of the connectors.
Control board may not have all connectors as shown in Fig. 3.8 (a).

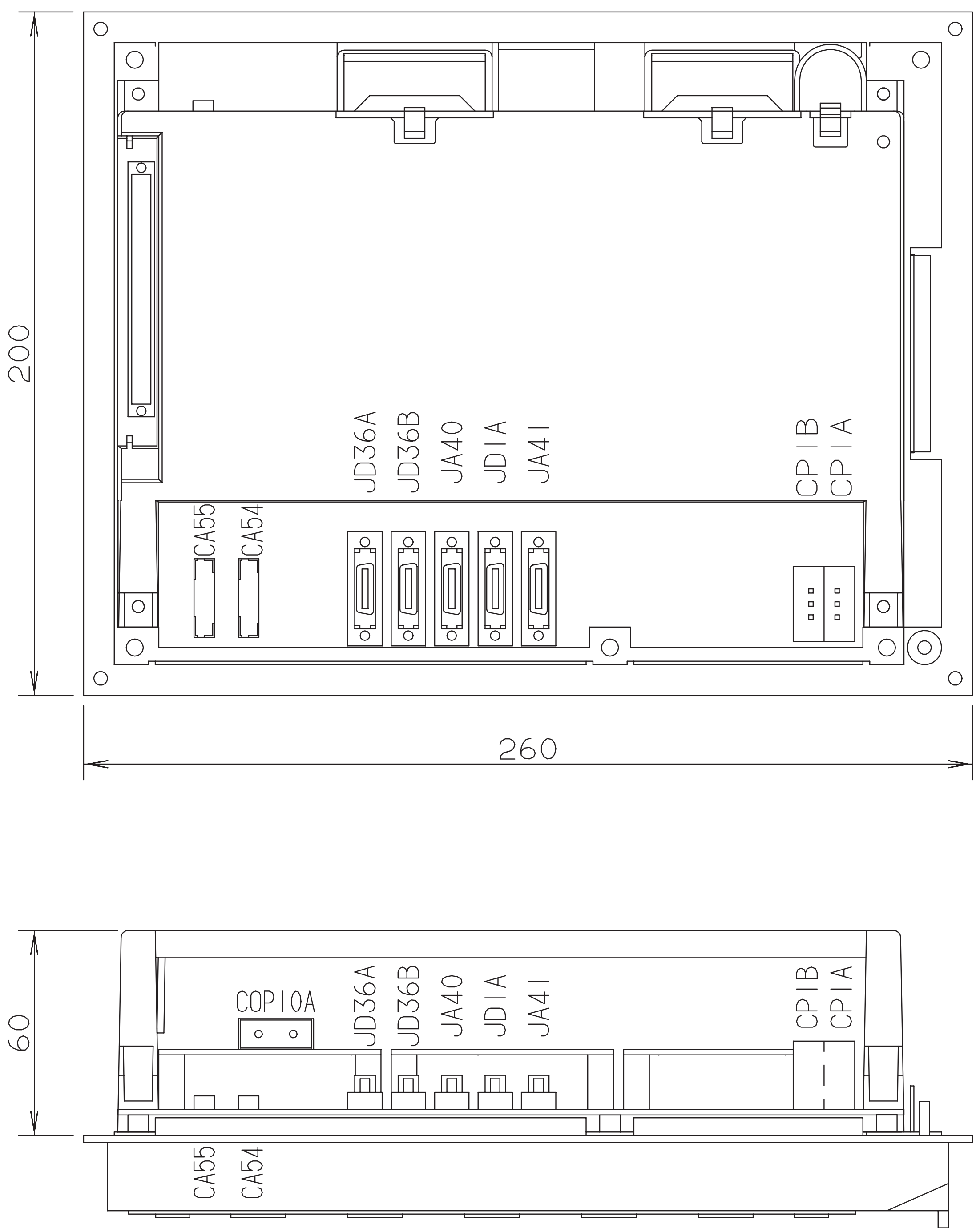


Fig. 3.8(a) Connector layout control unit with 7.2″/8.4″ LCD

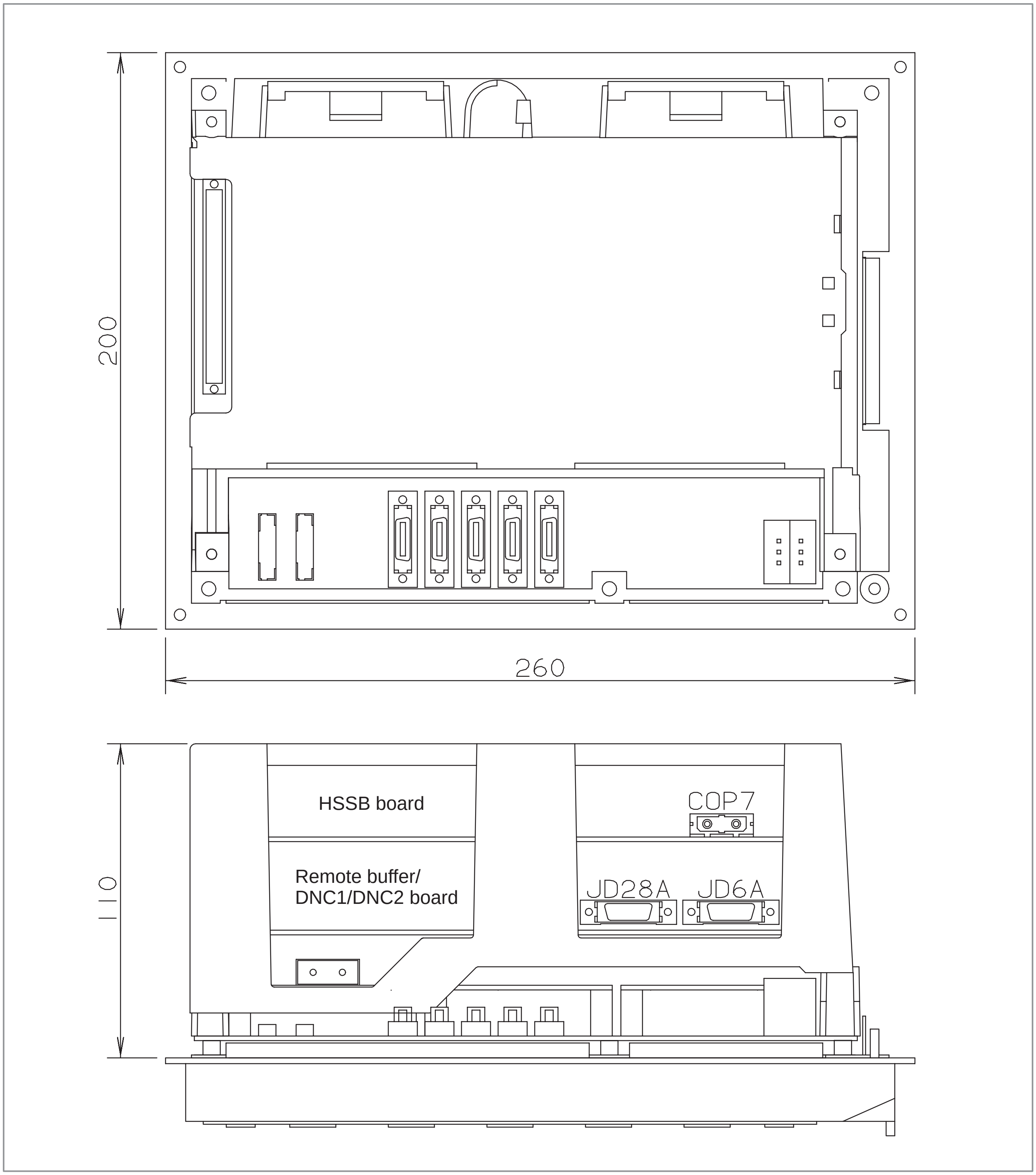


Fig. 3.8(b) Connector layout option part of control unit with 7.2″/8.4″ LCD

NOTE

1 The two option cards are interchangeable.

2 For details of the connector layout on the loader control board, refer to the Loader Control Connection Manual.

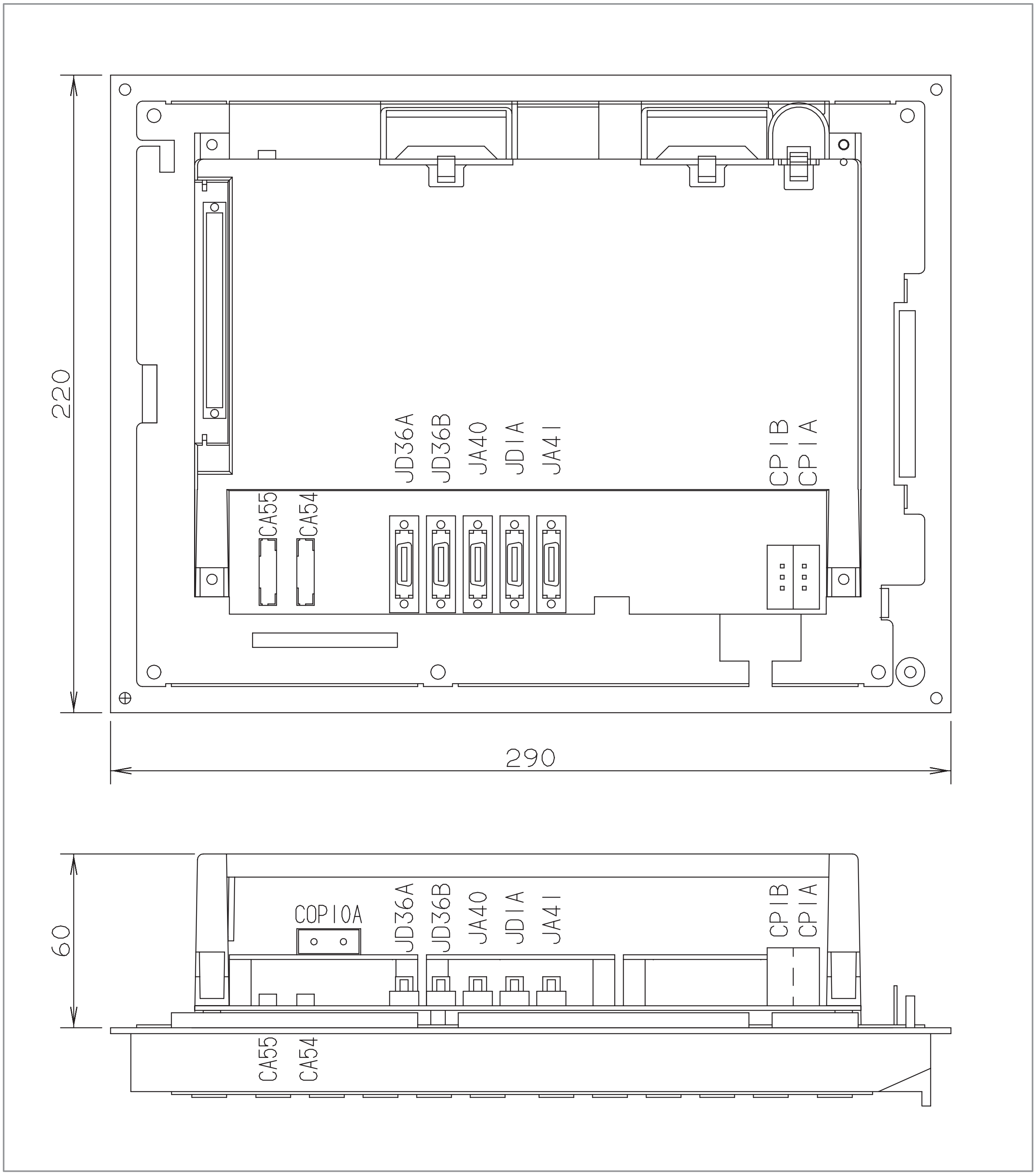


Fig. 3.8(c) Connector layout control unit with 9.5″/10.4″ LCD

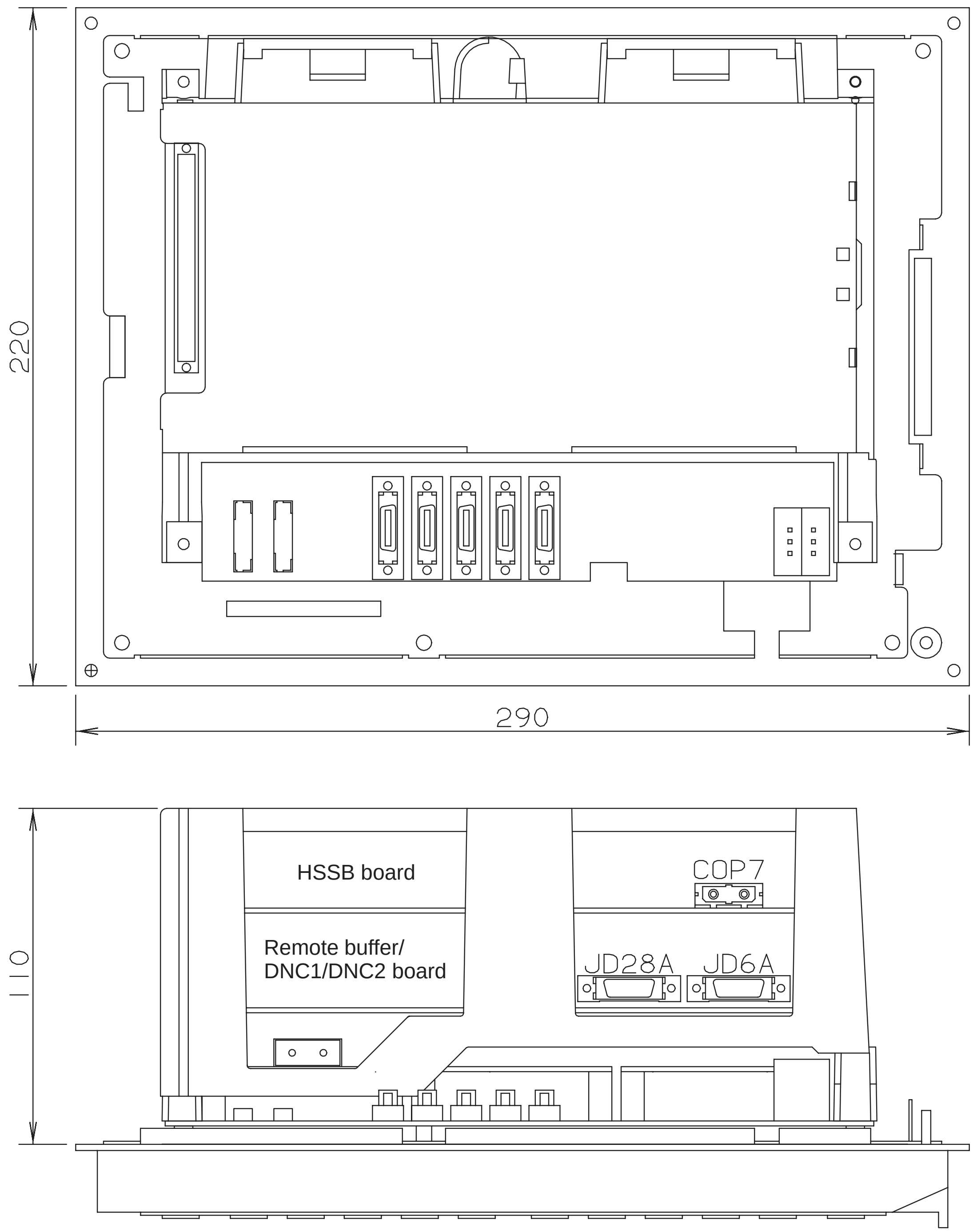


Fig. 3.8(d) Connector layout
control unit with 9.5″/10.4″ LCD

NOTE

1 The two option cards are interchangeable.

2 For details of the connector layout on the loader control board, refer to the Loader Control Connection Manual.

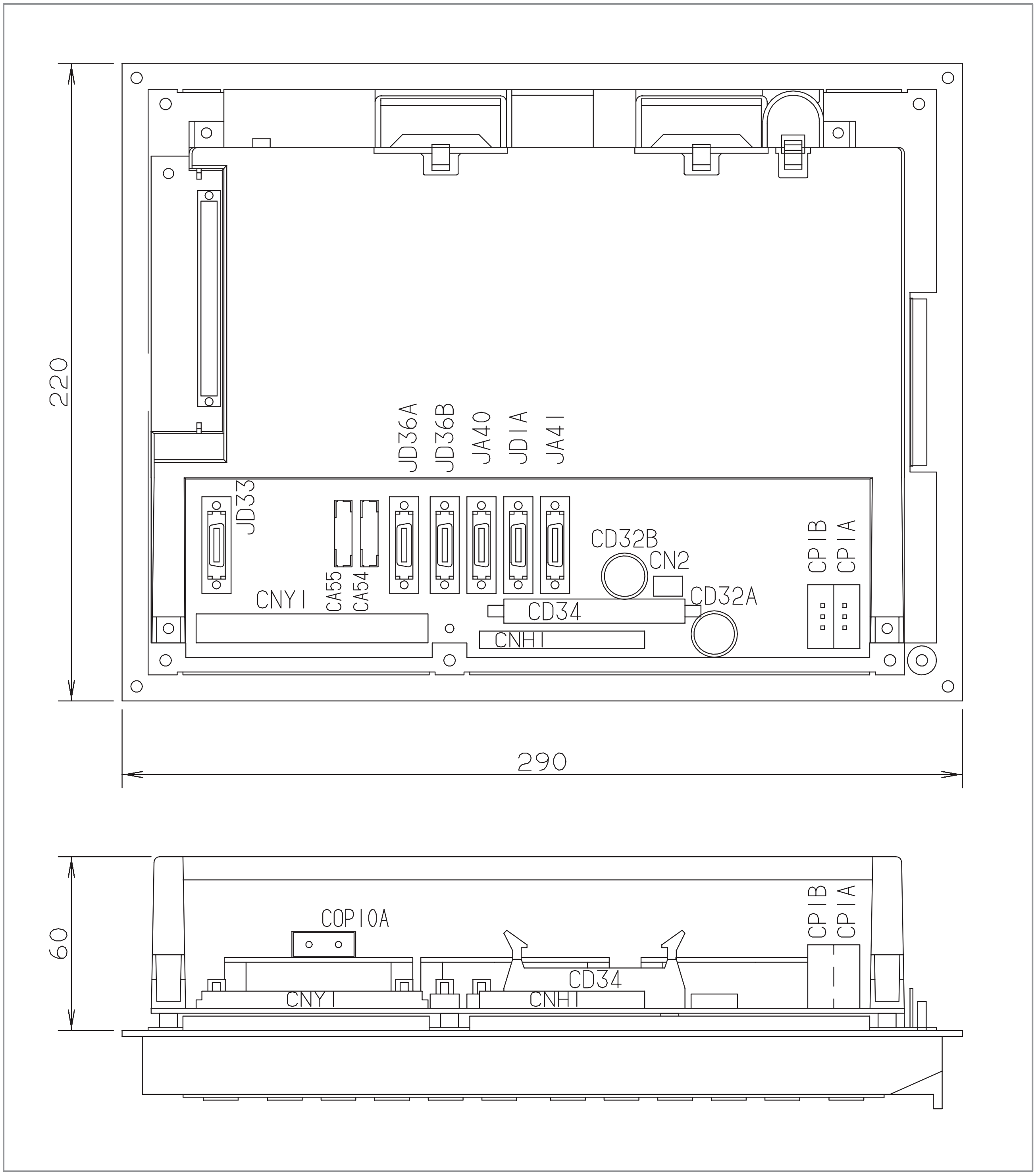


Fig. 3.8(e) Connector layout
Series 210*i* control unit with PC functions having 10.4″ LCD

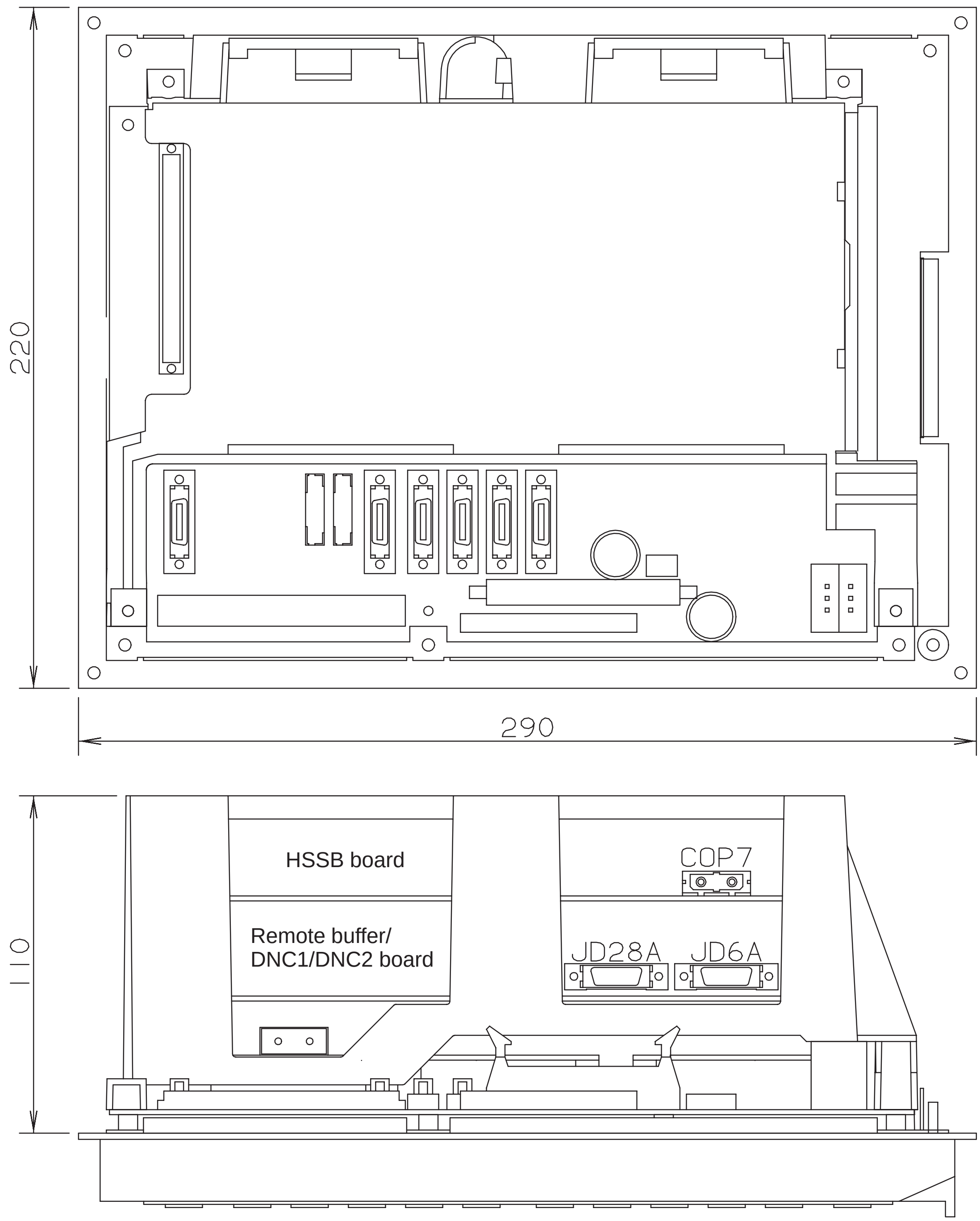


Fig. 3.8(f) Connector layout
Series 210*i* control unit with PC functions having 10.4″ LCD

> **NOTE**
> 1 The two option cards are interchangeable.
> 2 For details of the connector layout on the loader control board, refer to the Loader Control Connection Manual.

4 POWER SUPPLY CONNECTION

4.1 GENERAL

This section explains the connection of power supply for Series 21*i*/210*i* 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.

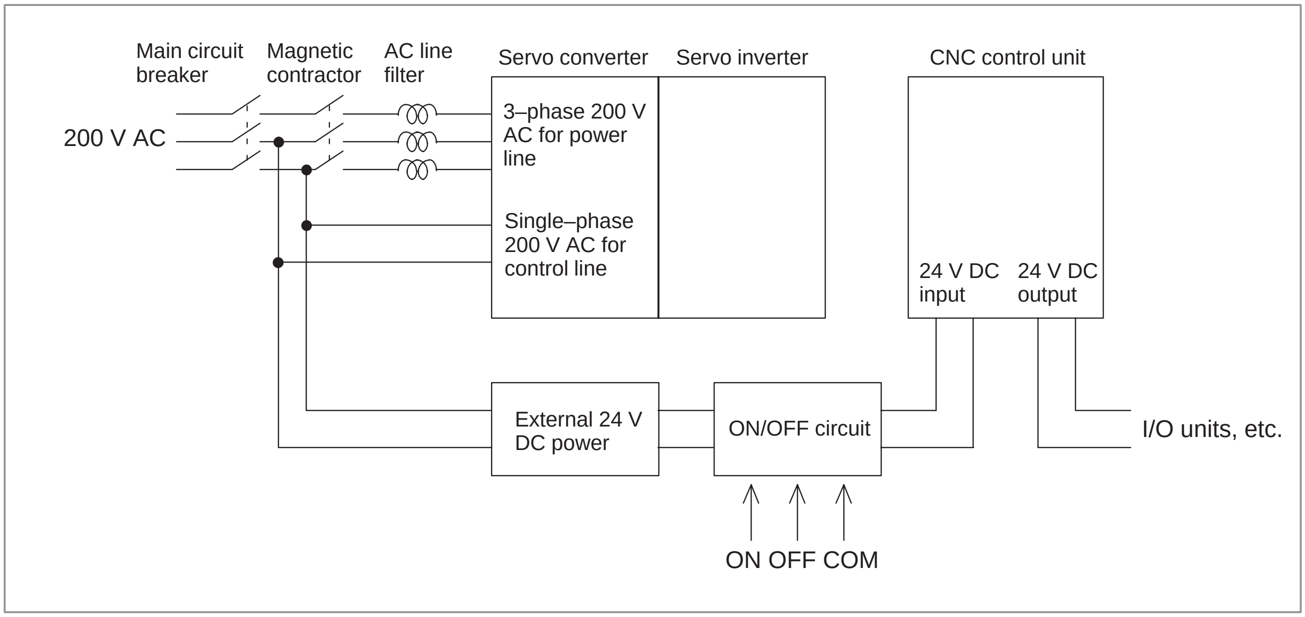


Fig. 4.2.1 (a)

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.

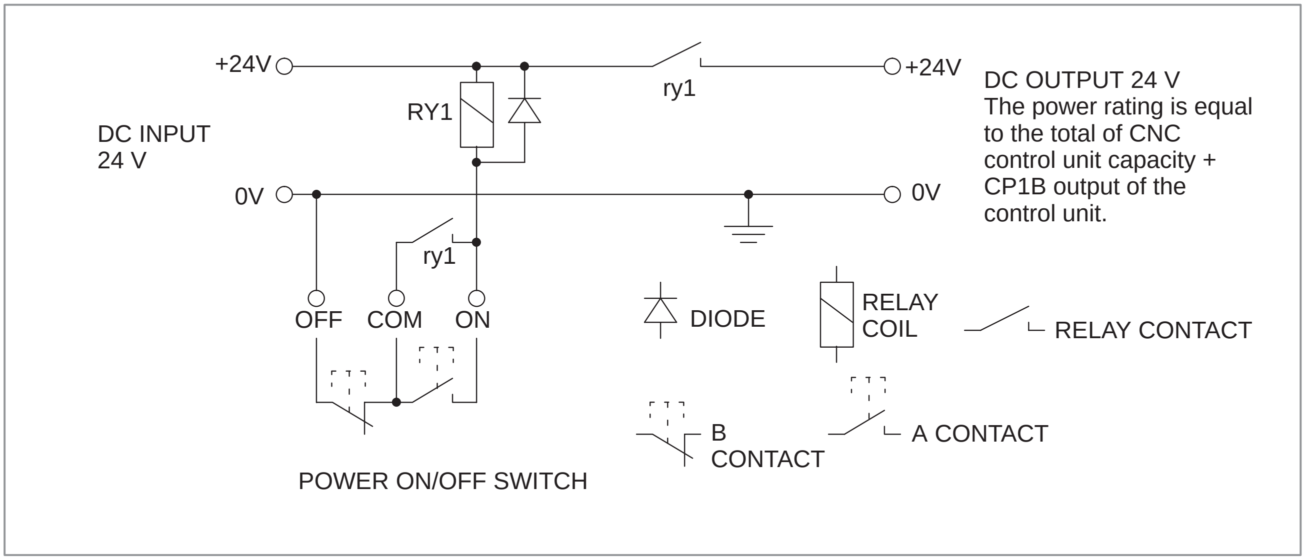


Fig. 4.2.1 (b)

4.2.2 Procedure for Turning On the Power

Turn on the power to each unit in the following order or all at the same time.

1. Power supplies (200 VAC) for the entire machine
2. Power supplies (24 VDC) for slave I/O devices connected using the FANUC I/O Link (such as the I/O Unit–MODEL A)
3. Power supplies (24 VDC) for the control unit and CRT unit

Do not disconnect the battery for memory backup (3 VDC) or the battery for the separate absolute pulse coders (6 VDC) regardless of whether the power to the control unit is on or off. If batteries are disconnected when the power to the control unit is turned off, current data stored in the control unit for the pulse coders, parameters, programs etc, are lost.

Make sure that the power to the control unit is on when replacing batteries.

See Section 4.4.1 for how to replace the batteries for memory backup.

4.2.3 Procedure for Turning Off the Power

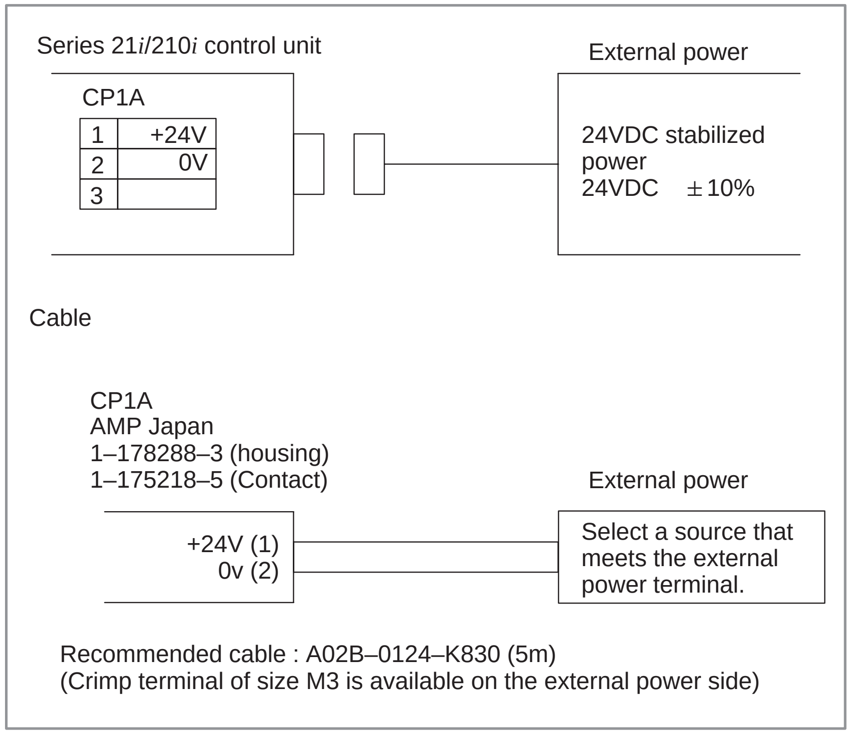
Turn off the power to each unit in the following order or all at the same time.

1. Power supplies (24 VDC) for slave I/O devices connected using the FANUC I/O Link (such as the I/O Unit–MODEL A)
2. Power supplies (24 VDC) for the control unit and CRT unit
3. Power supplies (200 VAC) for the entire machine

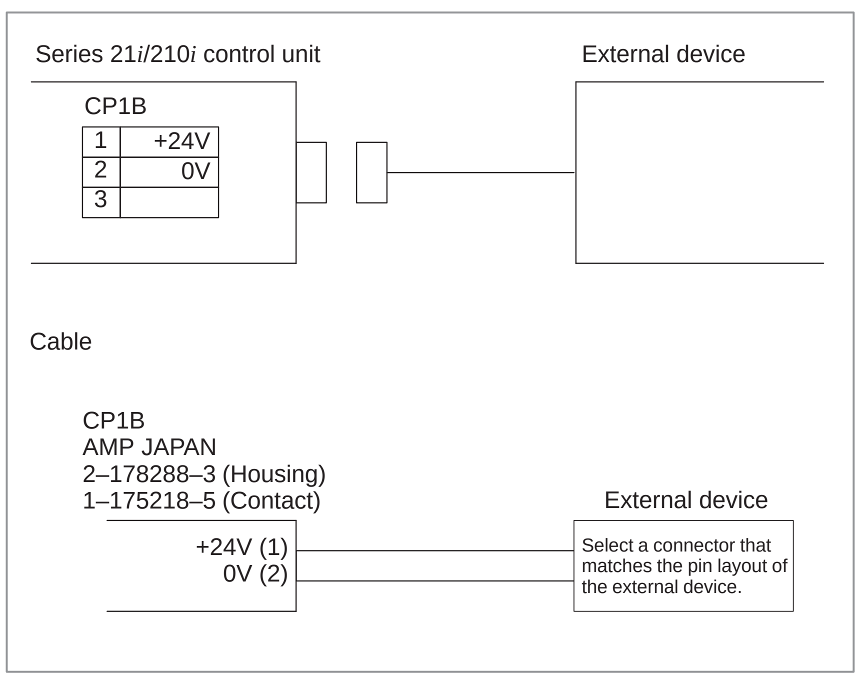
Motors cannot be controlled when the power is turned off or momentarily interrupted. Take appropriate action on the machine side when necessary. For example, when the tool is moved along a gravity axis, apply brakes to prevent the axis from falling. Apply a brake that clamps the motor when the servo is not operating or the motor is not rotating. Release the clamp only when the motor is rotating. When the servo axis cannot be controlled when the power is turned off or momentarily interrupted, clamp the servo motor. In this case, the axis may fall before the relay for clamping starts operating. The designer should make sure if the distance results in trouble.

4.3 CABLE FOR POWER SUPPLY TO CONTROL UNIT

Supply power to the control unit from external resouce.



The 24 V DC input to CP1A can be output from CP1B for use in branching. The connection of CP1B 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.



4.4 BATTERY

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 CRT 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).

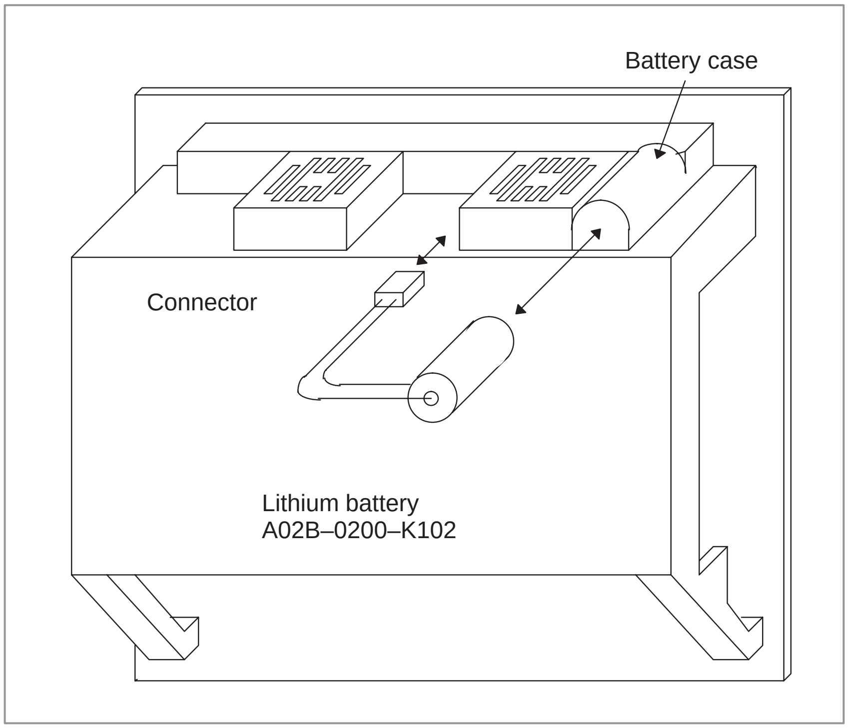
(2) Turn the Series 21*i*/210*i* on for about 30 seconds.

(3) Turn the Series 21*i*/210*i* off.

(4) 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).

(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 21*i*: Within 30 minutes
> Series 210*i* with HSSB board: Within 30 minutes
> Series 210*i* with PC functions: Within 5 minutes



WARNING

Using other than the recommended battery may result in the battery exploding.
Replace the battery only with the specified battery (A02B–0200–K102).

Dispose of used batteries as follows.

(1) Small quantities (less than 10)
Discharge the batteries and dispose of them as ordinary unburnable waste.

(2) Large quantities
Please consult FANUC.

Replacing the alkaline dry cells (size D)

(1) Prepare two new alkaline dry cells (size D)

(2) Turn the Series 21*i*/210*i* on.

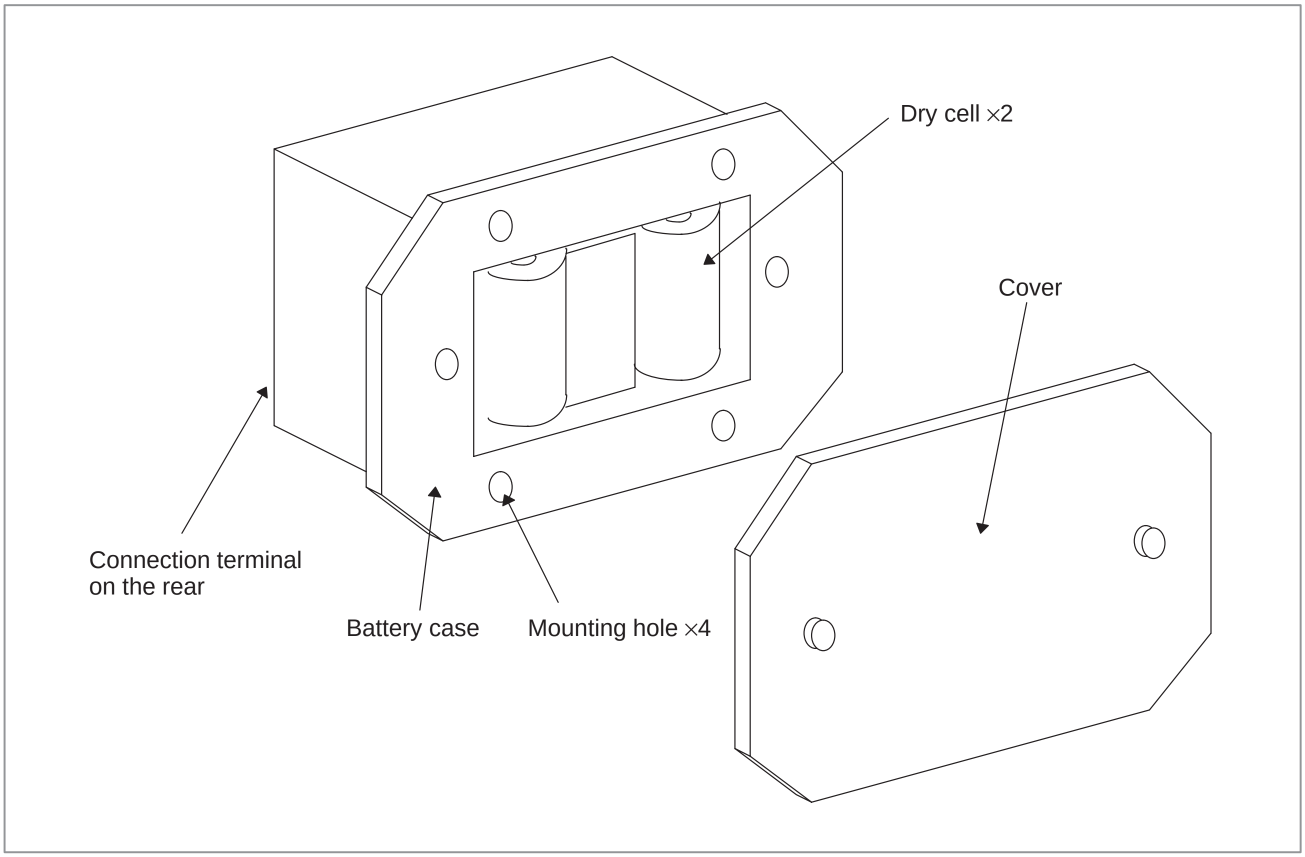
(3) Remove the battery case

(4) Replace the batteries, paying careful attention to their orientation.

(5) Replace the battery case cover.

NOTE

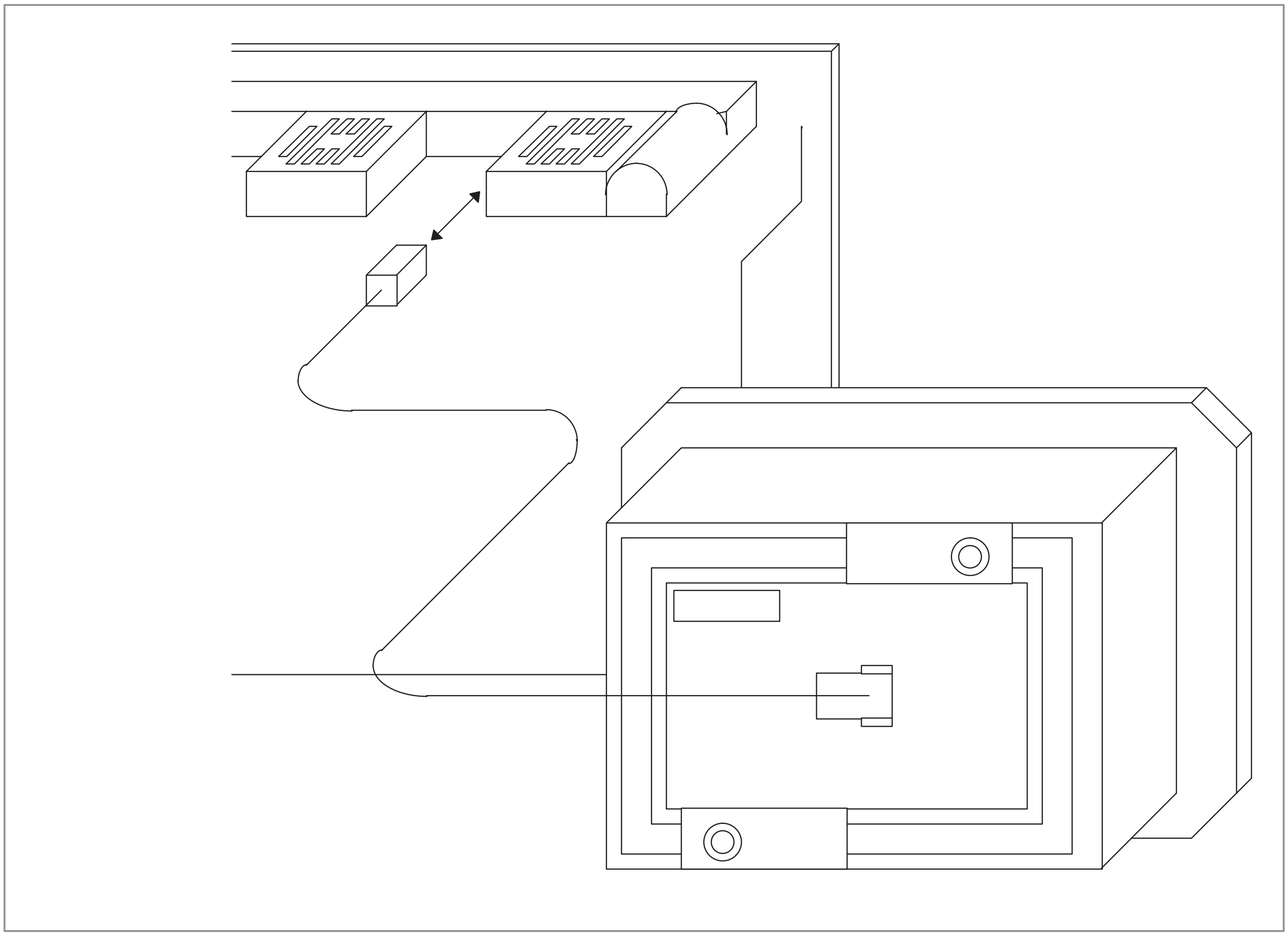
When replacing the dry cells while the power is off, use the same procedure as that for lithium battery replacement procedure, described above.


Dry cell ×2
Cover
Connection terminal
on the rear
Battery case
Mounting hole ×4

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 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 CRT display. When APC alarm 3n7 is displayed, replace the battery as soon as possible. In general, the battery should be replaced within two or three 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.

See Section 7.1.3 for details of connecting the battery to separate absolute pulse coders. The battery for the built–in absolute pulse coder is installed in the servo amplifier. For an explanation of the replacement procedure, refer to the FANUC CONTROL MOTOR AMPLIFIER α Series Maintenance Manual.

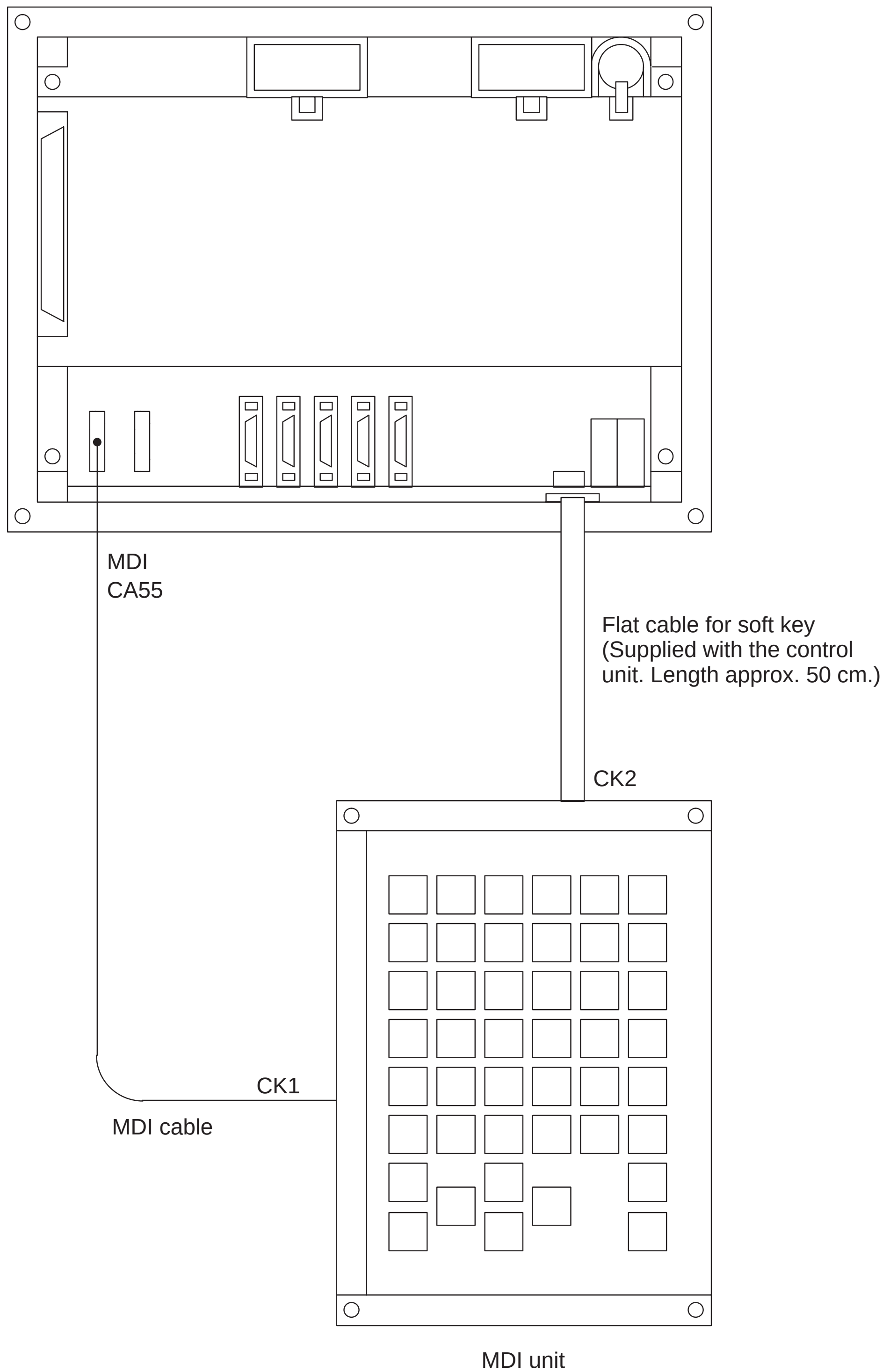
5 CONNECTION TO CNC PERIPHERALS

5.1 CONNECTION OF MDI UNIT

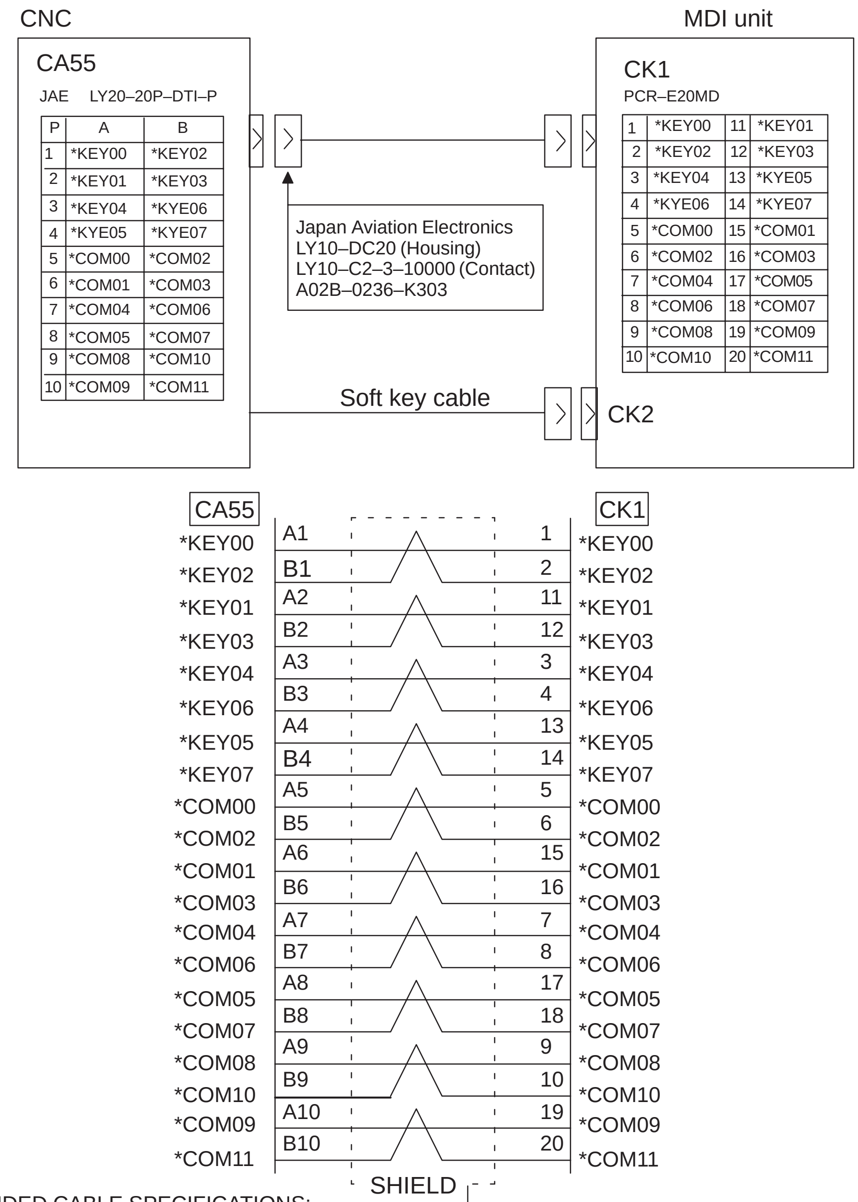
5.1.1 General

"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 Series 21*i*/210*i* models 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 210*i*.

5.1.2 Connection to the MDI Unit



5.1.3 Connection to the Standard MDI Unit



CA55 (JAE LY20–20P–DTI–P)

P	A	B
1	*KEY00	*KEY02
2	*KEY01	*KEY03
3	*KEY04	*KYE06
4	*KYE05	*KYE07
5	*COM00	*COM02
6	*COM01	*COM03
7	*COM04	*COM06
8	*COM05	*COM07
9	*COM08	*COM10
10	*COM09	*COM11

CK1 (PCR–E20MD)

1	*KEY00	11	*KEY01
2	*KEY02	12	*KEY03
3	*KEY04	13	*KYE05
4	*KYE06	14	*KYE07
5	*COM00	15	*COM01
6	*COM02	16	*COM03
7	*COM04	17	*COM05
8	*COM06	18	*COM07
9	*COM08	19	*COM09
10	*COM10	20	*COM11

RECOMMENDED CABLE SPECIFICATIONS:
A02B–0236–K811 (15 cm)
A02B–0236–K812 (25 cm)
RECOMMENDED CABLE MATERIAL:
A66L–0001–0284#10P (#28AWG x 10 pairs)

NOTE

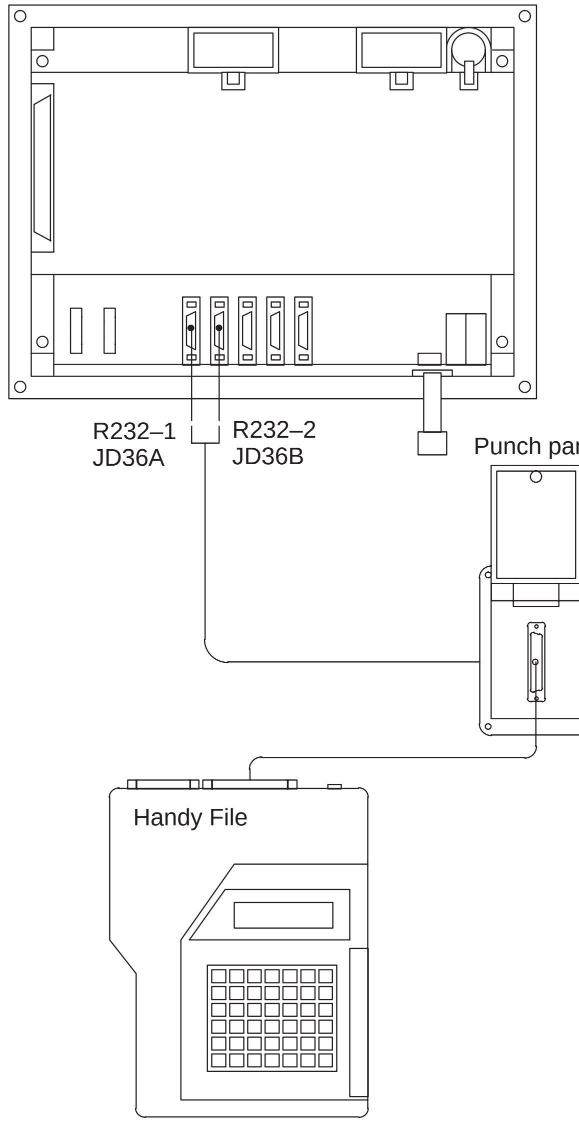
As the connector on the CA55 side of the MDI cable is attached by means of a simple lock system, it should not be subjected to a force of more than 1 kg. Also, clamp the connector to prevent vibration from possibly loosening the connection. Note, however, that shielding and clamping are not required if the cable length is less than 30 cm.

5.2 CONNECTING I/O DEVICES

5.2.1 General

I/O devices are used for inputting various data such as CNC programs and parameters from external devices to the CNC or outputting data from the CNC to external devices.
The Handy File is one of the I/O devices for the Series 21*i*/210*i*. The interface for I/O devices complies with RS–232C. The Series 21*i*/210*i* can therefore be connected to devices which have an RS–232C interface.

5.2.2
Connecting I/O Devices

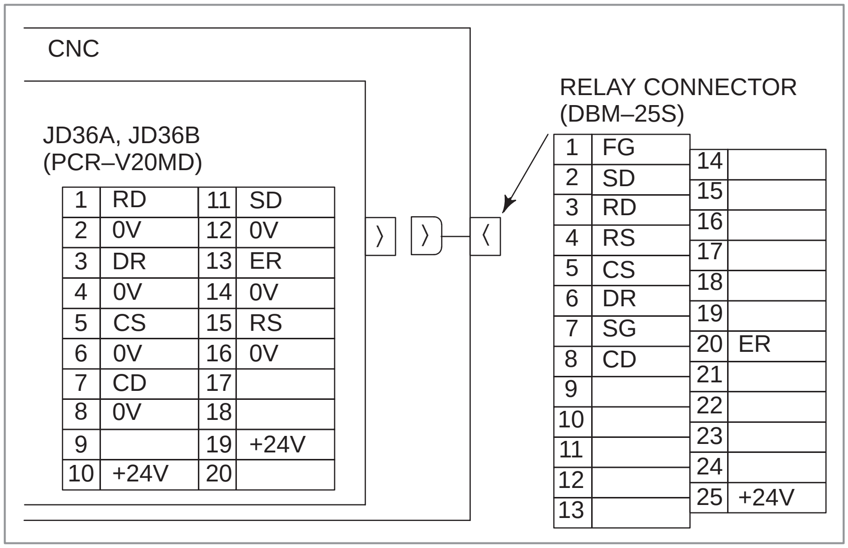


NOTE

This interface is based on the RS–232C 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–232C 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–232C interface is used when a Series 210*i* with PC functions is used

Ladder uploading or downloading via RS–232C using FAPT–LADDER or FAPT–LADDER II
Ladder monitoring from an external PC using FAPT–LADDER II
DNC operation via RS–232C, external I/O device control

5.2.3 RS–232C Serial Port



JD36A, JD36B (PCR–V20MD)

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	

RELAY CONNECTOR (DBM–25S)

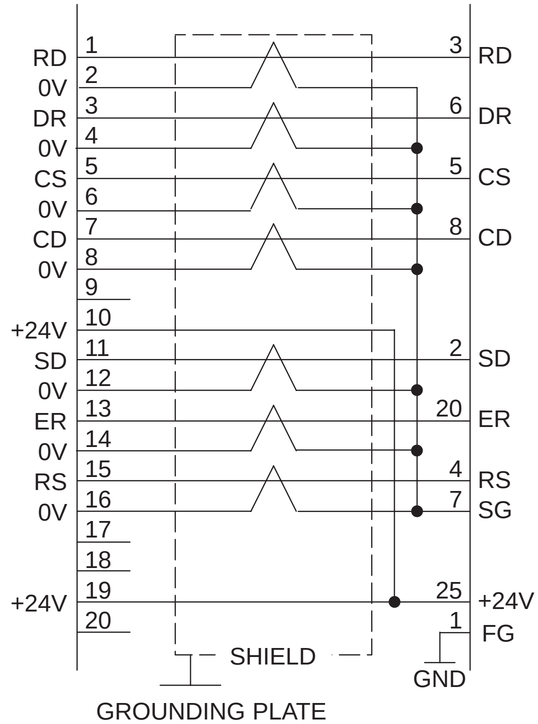
1	FG	14	
2	SD	15	
3	RD	16	
4	RS	17	
5	CS	18	
6	DR	19	
7	SG	20	ER
8	CD	21	
9		22	
10		23	
11		24	
12		25	+24V
13			

NOTE

1 +24 V can be used as the power supply for FANUC RS–232C equipment.

2 Do not connect anything to those pins for which signal names are not indicated.

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)
<Narrow width type>
A02B–0236–C191 (1 m)
A02B–0236–C192 (2 m)
A02B–0236–C193 (5 m)

NOTE
Do not connect anything to those pins for which signal names are not indicated.

5.2.4 RS–232C Interface Specification

RS–232C Interface signals

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

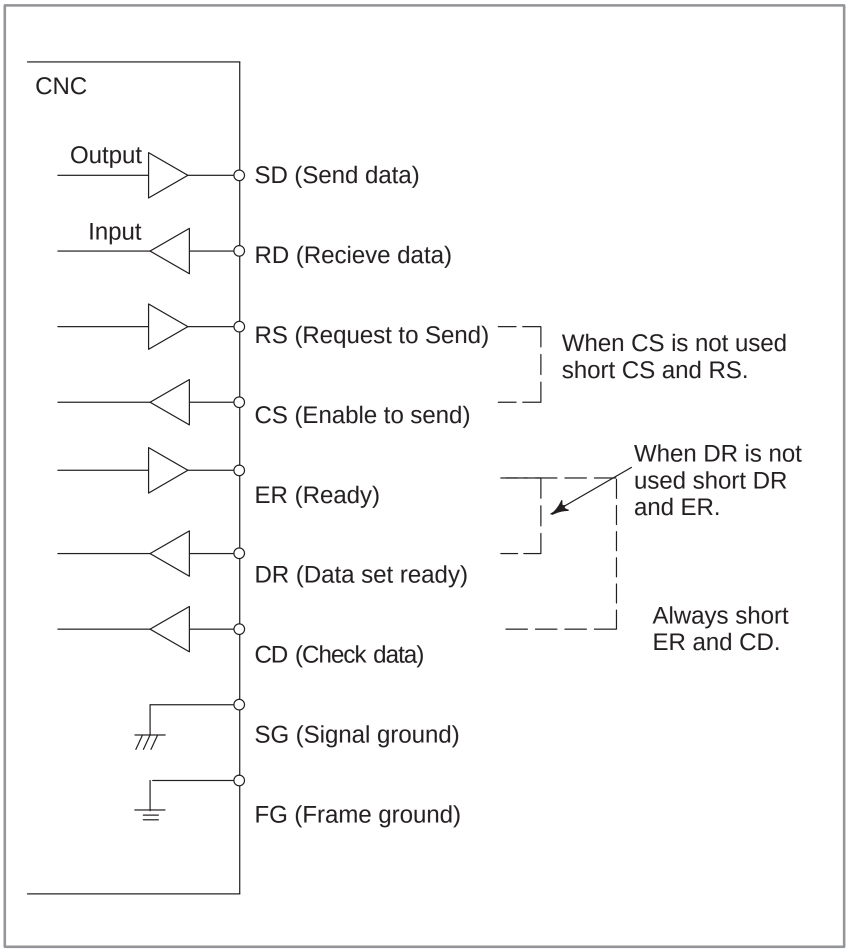
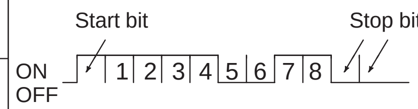


Fig.5.2.4 RS–232C interface

Signal description of RS–232C interface

Signal name	RS–232C circuit number	I/O	Description	
SD	103	Output	Sending data	 (When ISO code “0” is sent)
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

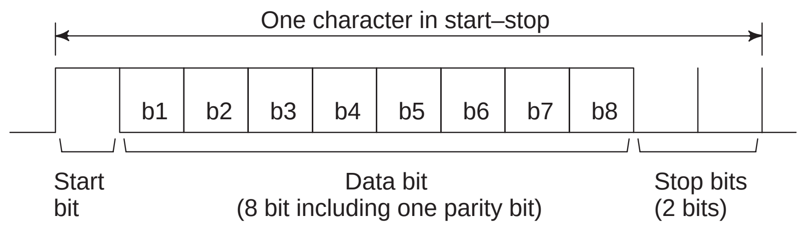
Signal on/off state is defined as follows;

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

Transmission Method of RS–232C interface

Start–stop

Generally, two transmission methods are available at the serial interface. Series 21*i*/210*i* 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.

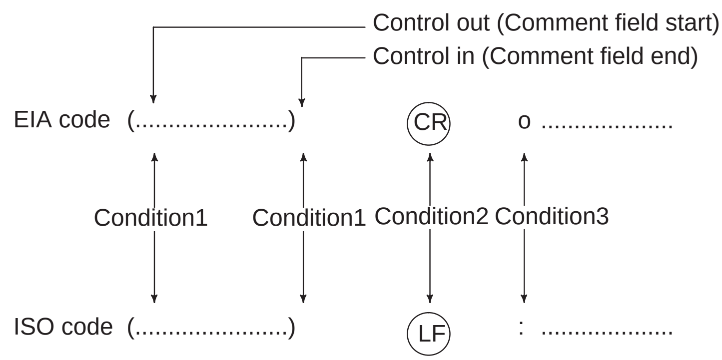
(c) When the external device is equipped with an ISO/EIA converter, the external device must satisfy the specification shown in Table 5.2.4 (a).

Table 5.2.4(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 5.2.4(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.

NOTE

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
	60m 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.

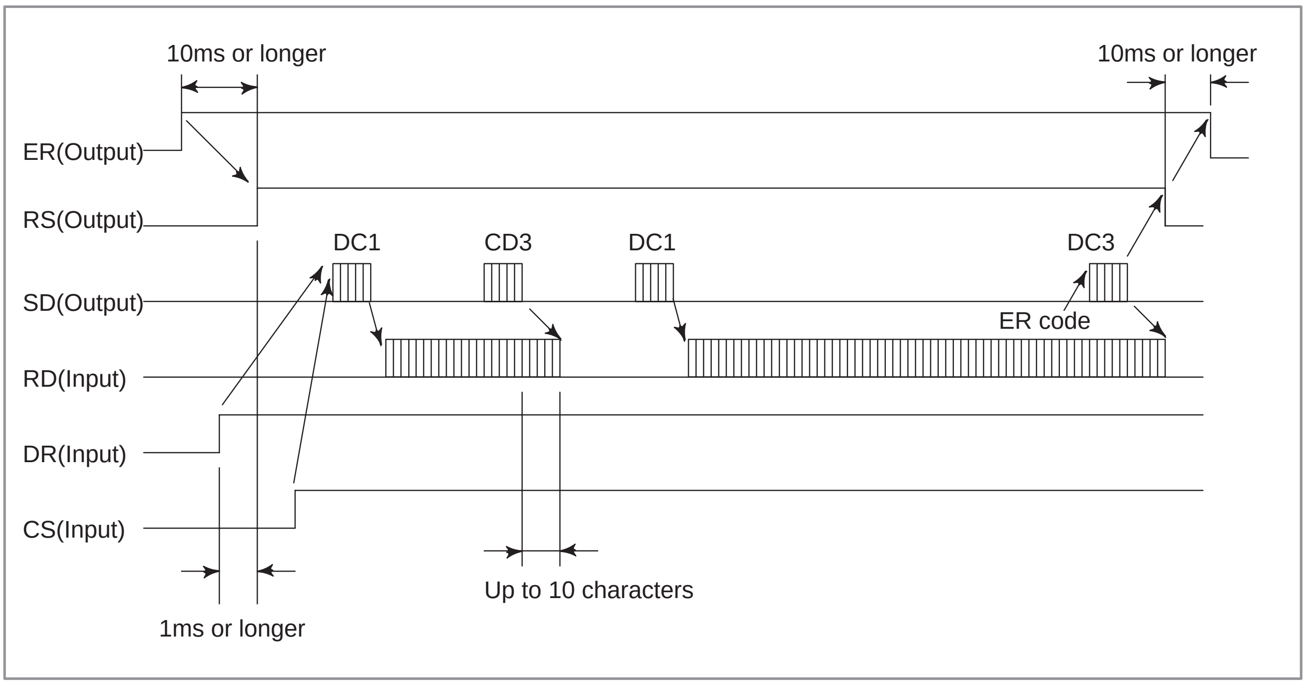
(4) The external device stops sending data to NC after receiving DC3. The device may send up to 10 characters after receiving DC3. If it sends more than 10 characters, alarm 087 will occur.

(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.A)

(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.B)

(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.

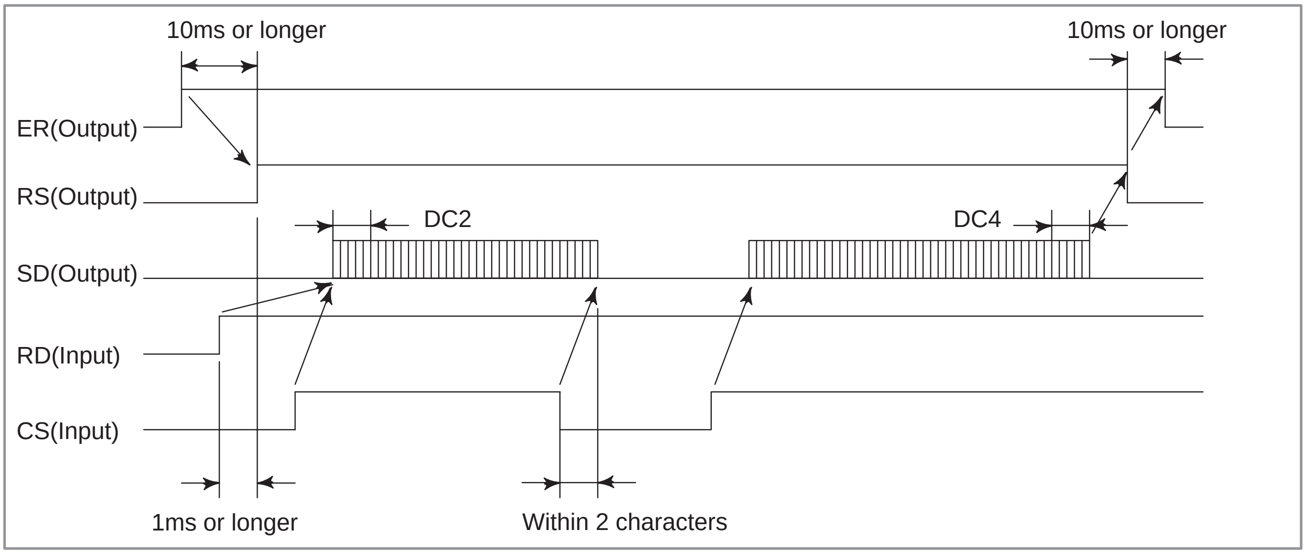


Fig.A

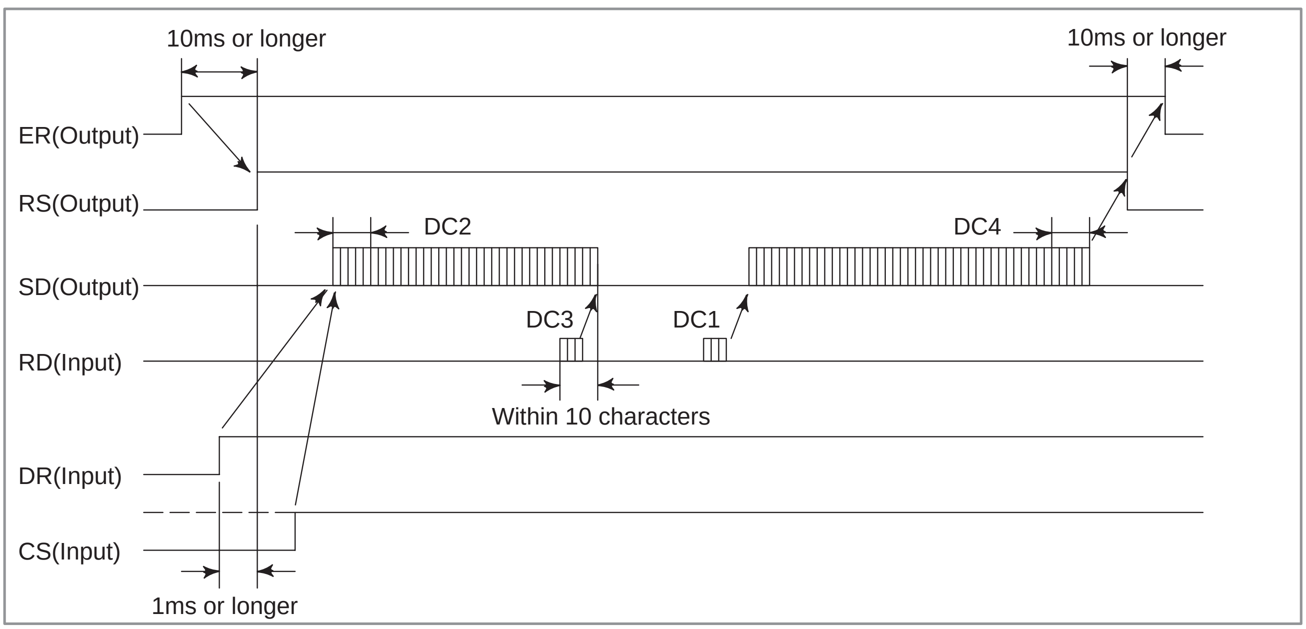
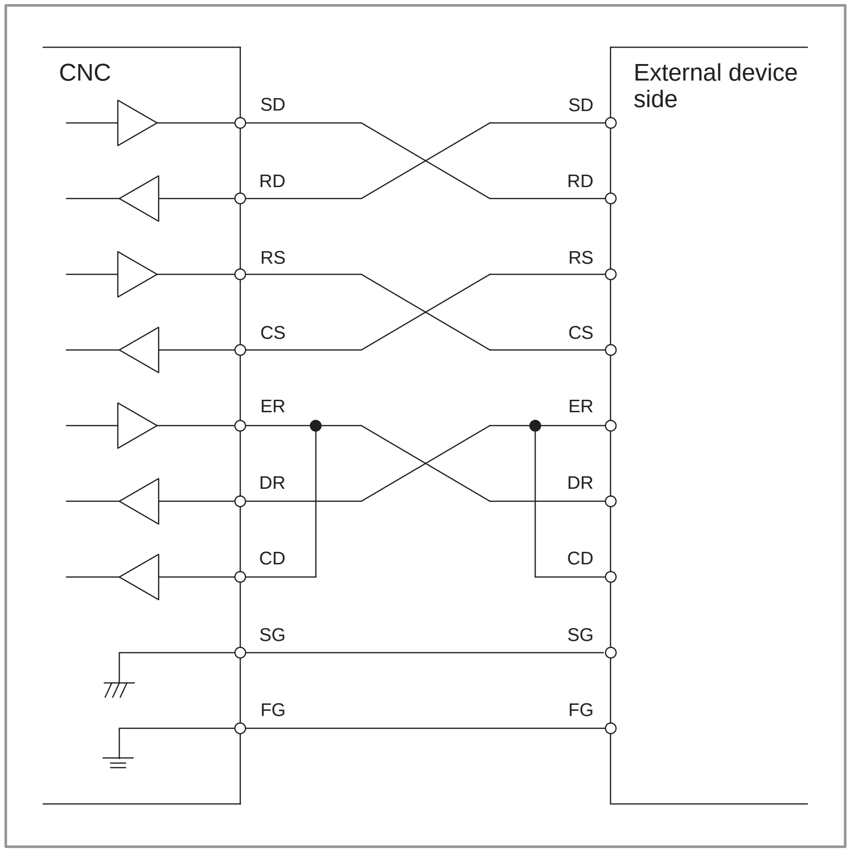
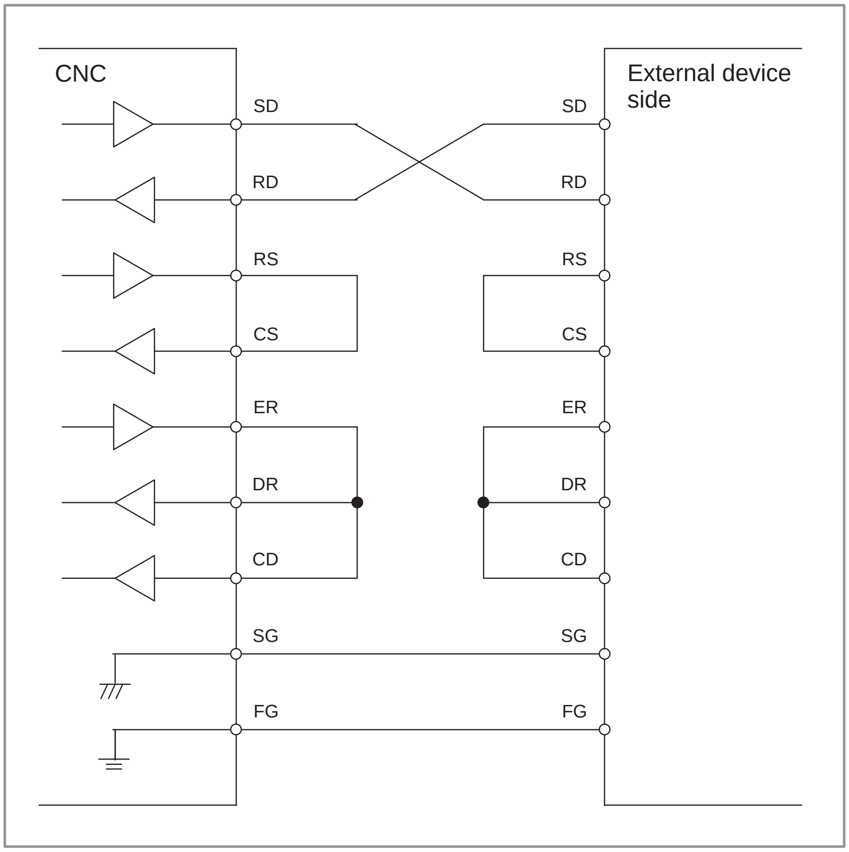


Fig.B

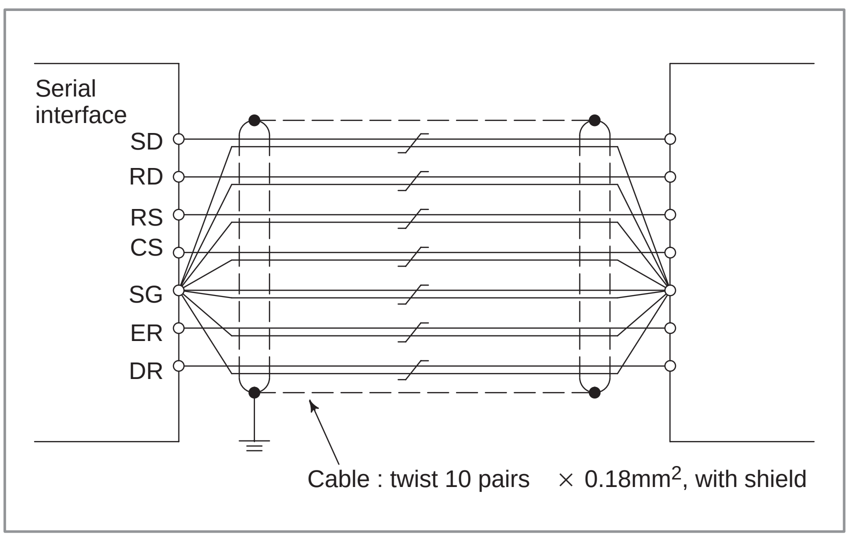
Connection between RS–232C interface and external device



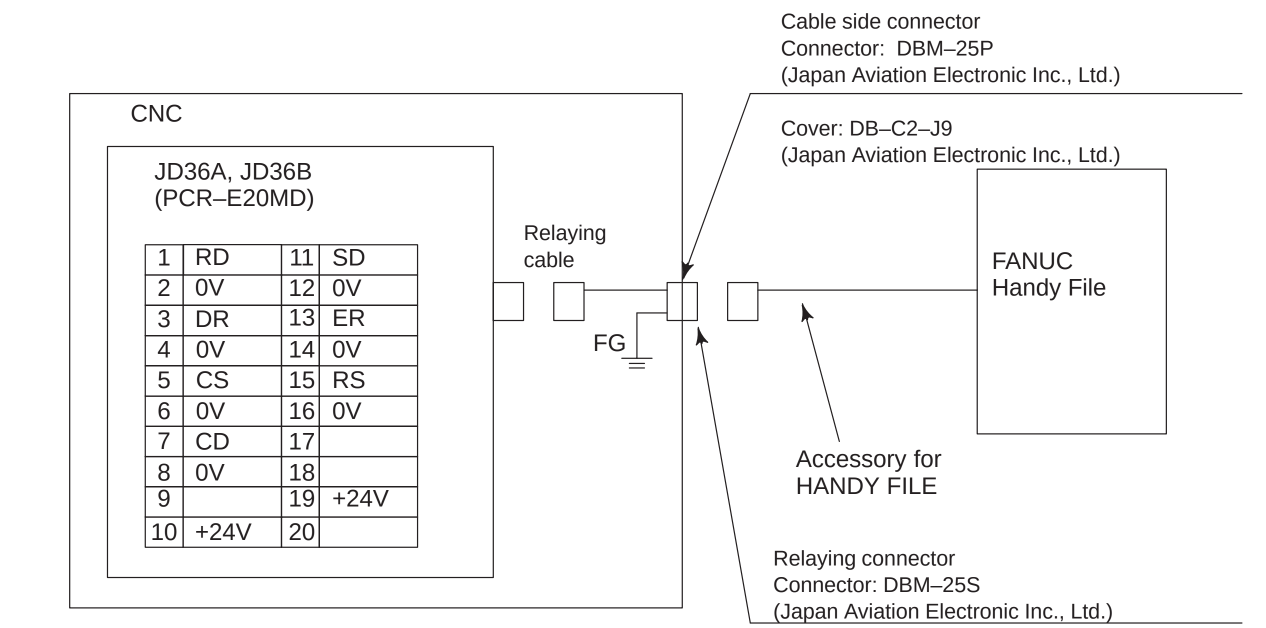
- The cable for connecting the PG–Mate to the NC should be connected as shown in the below diagram.



Prepare the cable with I/O device as follows :



5.2.5 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

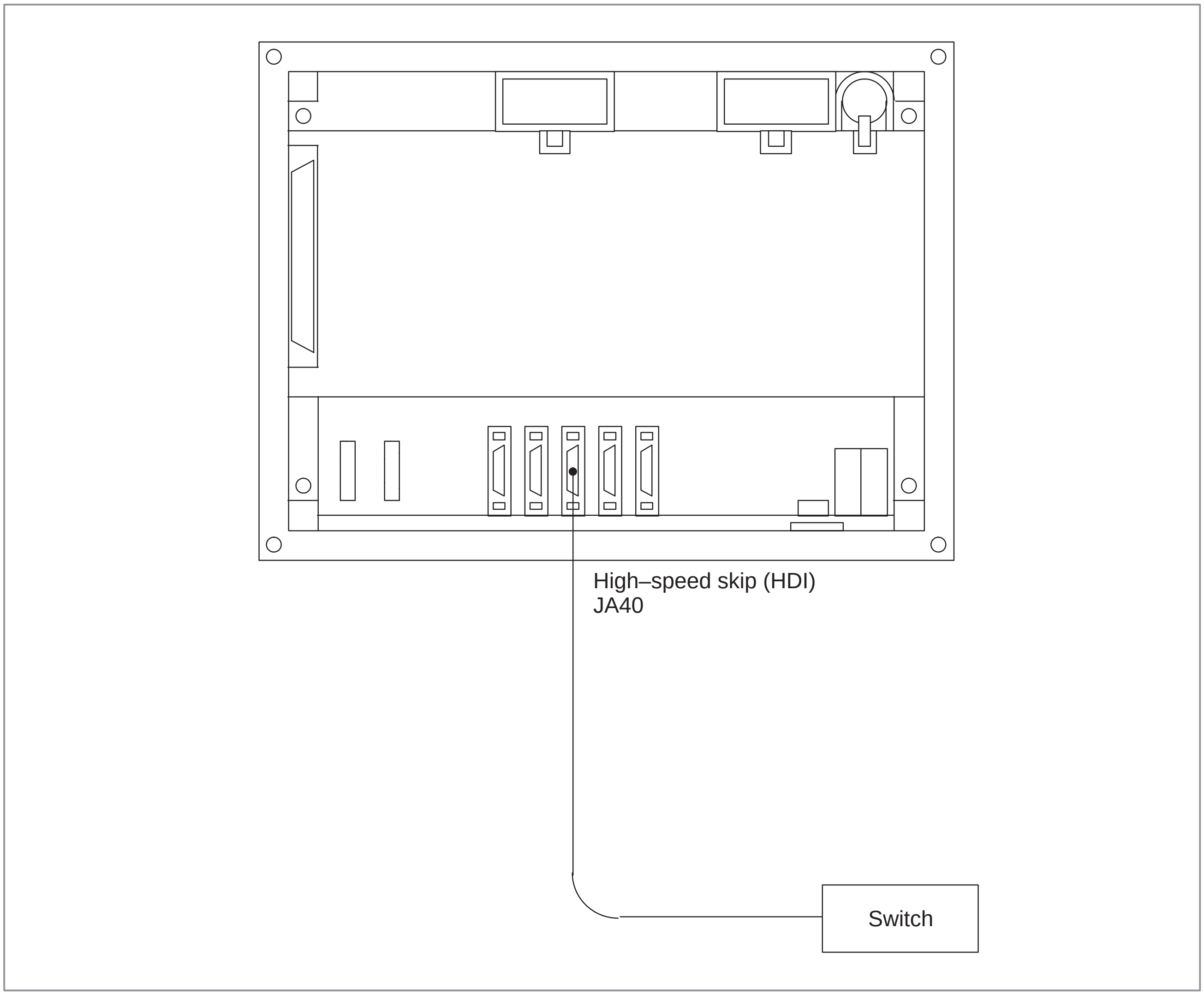
3 Open all terminals other than illustrated.

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.

5.3 CONNECTING THE HIGH–SPEED SKIP (HDI)

5.3.1 General



5.3.2 Connection to the High–Speed Skip (HDI)

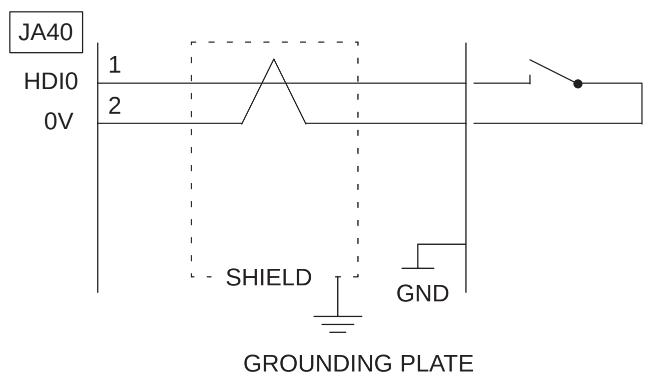
CNC

JA40
PCR–E20MD

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	

Signals inside ( ) are used with the analog spindle.

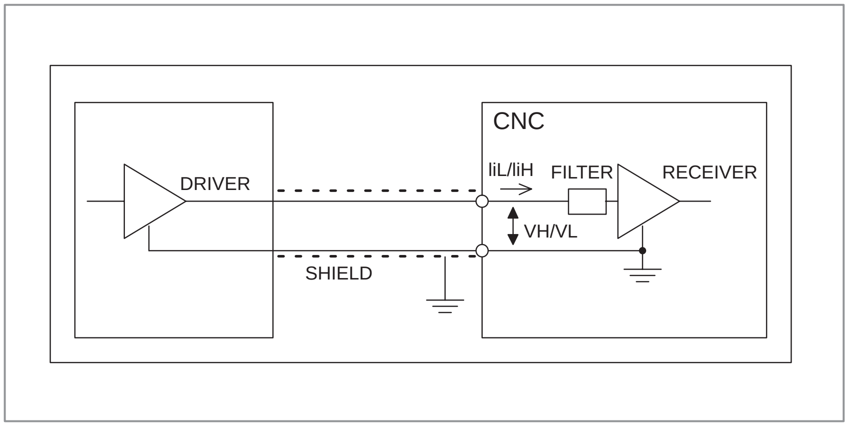
Cable connection



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.)

5.3.3 Input Signal Rules for the High–Speed Skip (HDI)

Circuit configuration

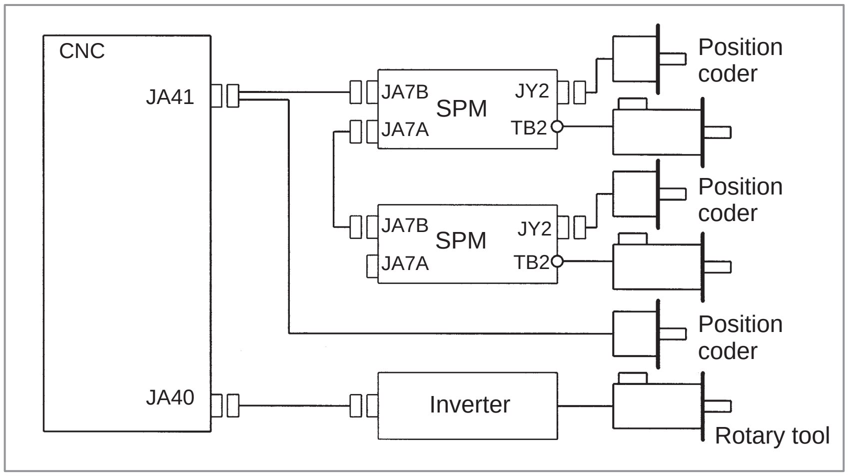


Absolute maximum rating
Input voltage range Vin: –3.6 to +13.6 V
Input characteristics

Unit	Symbol	Specification	Unit	Remark
High level input voltage	VH	3.6～11.6	V	
Low level input voltage	VL	0～1.0	V	
High level input current	IiH	0.5 max	mA	Vin=5 V
		9.3 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	

6 SPINDLE CONNECTION

The following configuration can be used to connect the spindles.



> **NOTE**
> For details of the connections between the spindle amplifiers and spindle motors, and between the spindle amplifiers and position coders, refer to the SPINDLE MOTOR α Series Descriptions manual.

6.1 SERIAL SPINDLE INTERFACE

CNC

JA41(Main board)
(PCR–E20MD)

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

Spindle amplifier module

JA7B
(PCR–E20MDT)

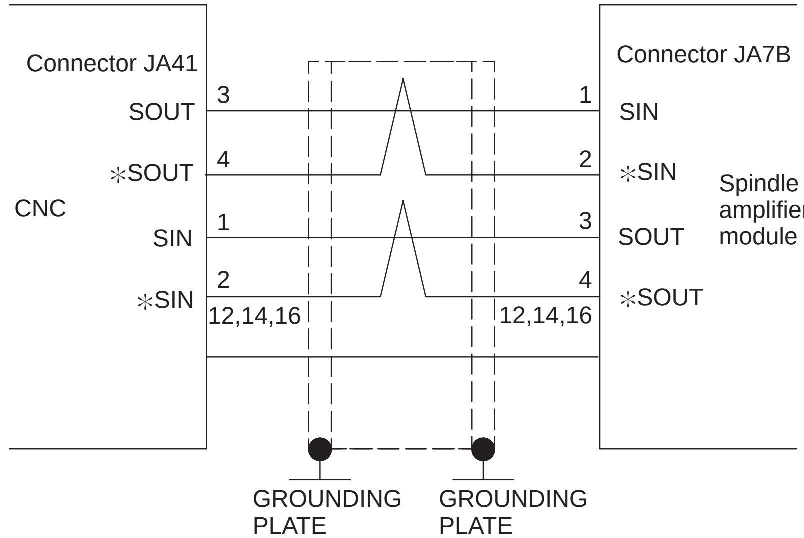
1	SIN	11	0V
2	*SIN	12	0V
3	SOUT	13	0V
4	*SOUT	14	0V
5		15	0V
6		16	0V
7		17	
8		18	(+5V)
9	(+5V)	19	
10		20	(+5V)

NOTE

The +5 V signals inside ( ) are power supply signals to the optical I/O link adapter to be used when an optical I/O link adapter is used for the connection between NC and the spindle amplifier. Do not connect this signal when the optical cable is not used.

The signals inside [ ] are for use when position coders are used.

Cable connection



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

In the following cases, use optical fiber cable connection through an optical I/O link adapter.

- When the cable length exceeds 20 m.
- When the power magnetics cabinet where the spindle amplifier is installed and the operator's panel cabinet where the CNC control unit is installed cannot be connected through a grounding wire of 5.5 mm^2 or more.
- When the cable may be affected by noise.
  For instance, this applies when there is a source of strong magnetic noise, such as a welder, near the cable or when the cable is routed, for a long distance, in parallel with a power line or ferroelectric cable which may generate noise.

6.2 ANALOG SPINDLE INTERFACE

CNC

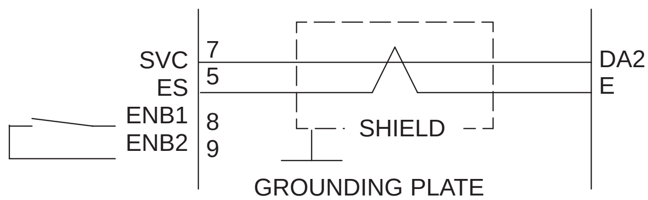
JA40(Main board)
(PCR–E20MD)

1		11	
2		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

Signals ENB1 and 2 turn on when the spindle command voltage is effective. These signals are used when the FANUC Spindle Servo Unit is used.

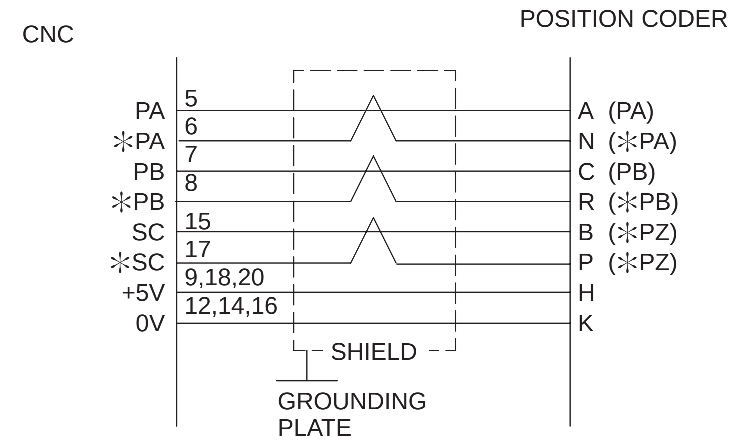
6.3 POSITION CODER INTERFACE

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)



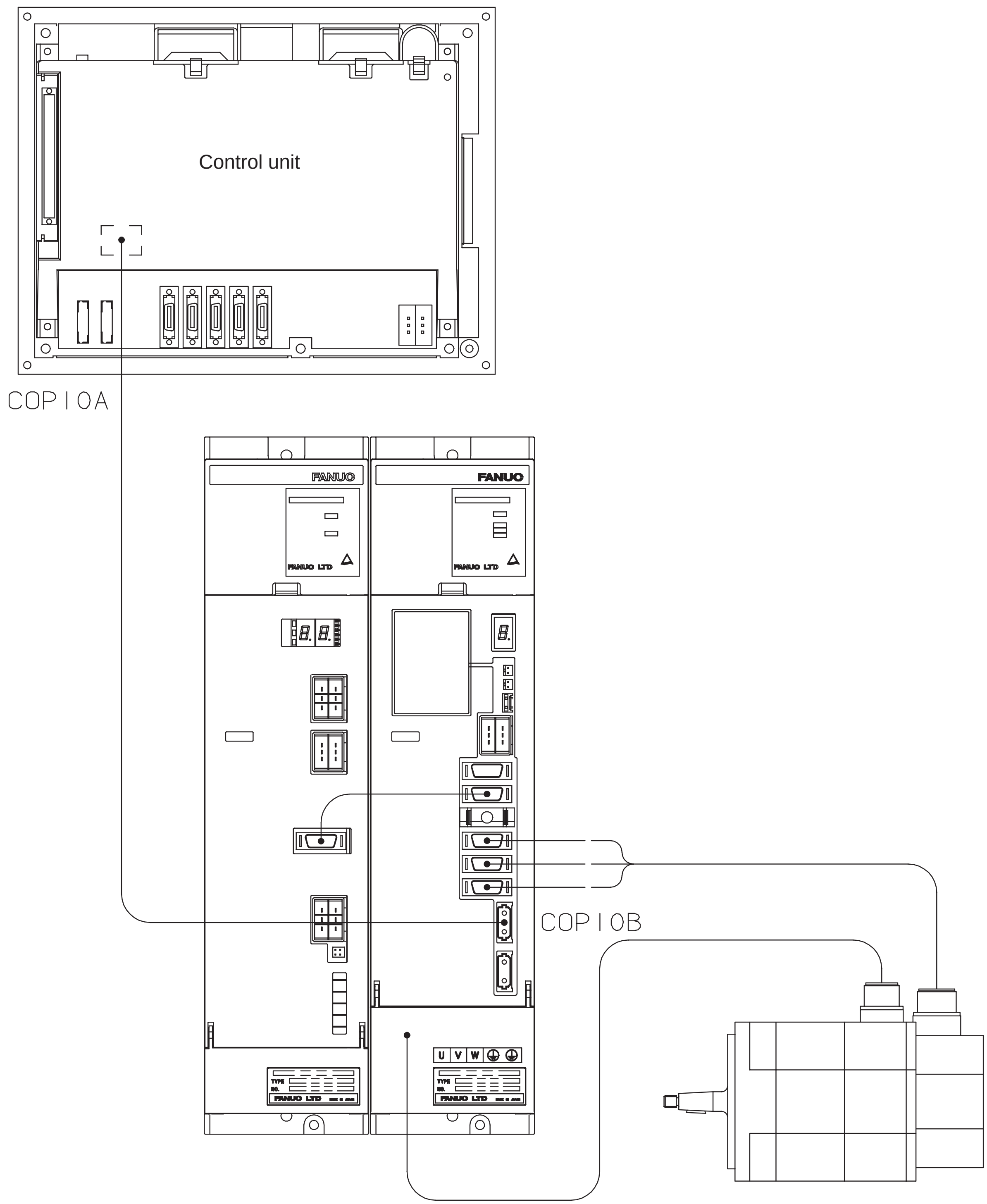
RECOMMENDED CABLE–SIDE CONNECTOR
PCR–E20FA (Honda Tsushin Kogyo Co., Ltd.)
FI30–20S (Hirose Electric Co., Ltd.)
FCN–247J020–G/E (Fujitsu, Ltd.)
52622–2011 (Molex Japan Co., Ltd.)
RECOMMENDED CABLE SPECIFICATION:
A66L–0001–0286 (#20AWG × 6 + #24AWG × 3),
MAX. LENGTH 20 m

NOTE

Signals SIN, *SIN, SOUT and *SOUT are for a serial spindle. These signals are not used for an analog spindle.

7 SERVO INTERFACE

7.1 CONNECTION TO THE SERVO AMPLIFIERS

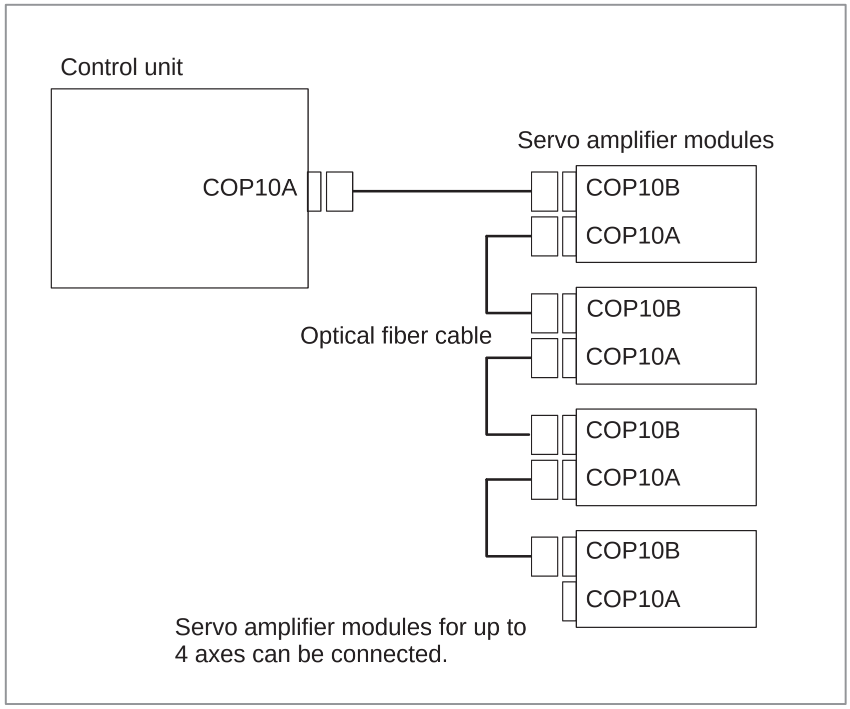


Connection of FSSB

7.1.1 General

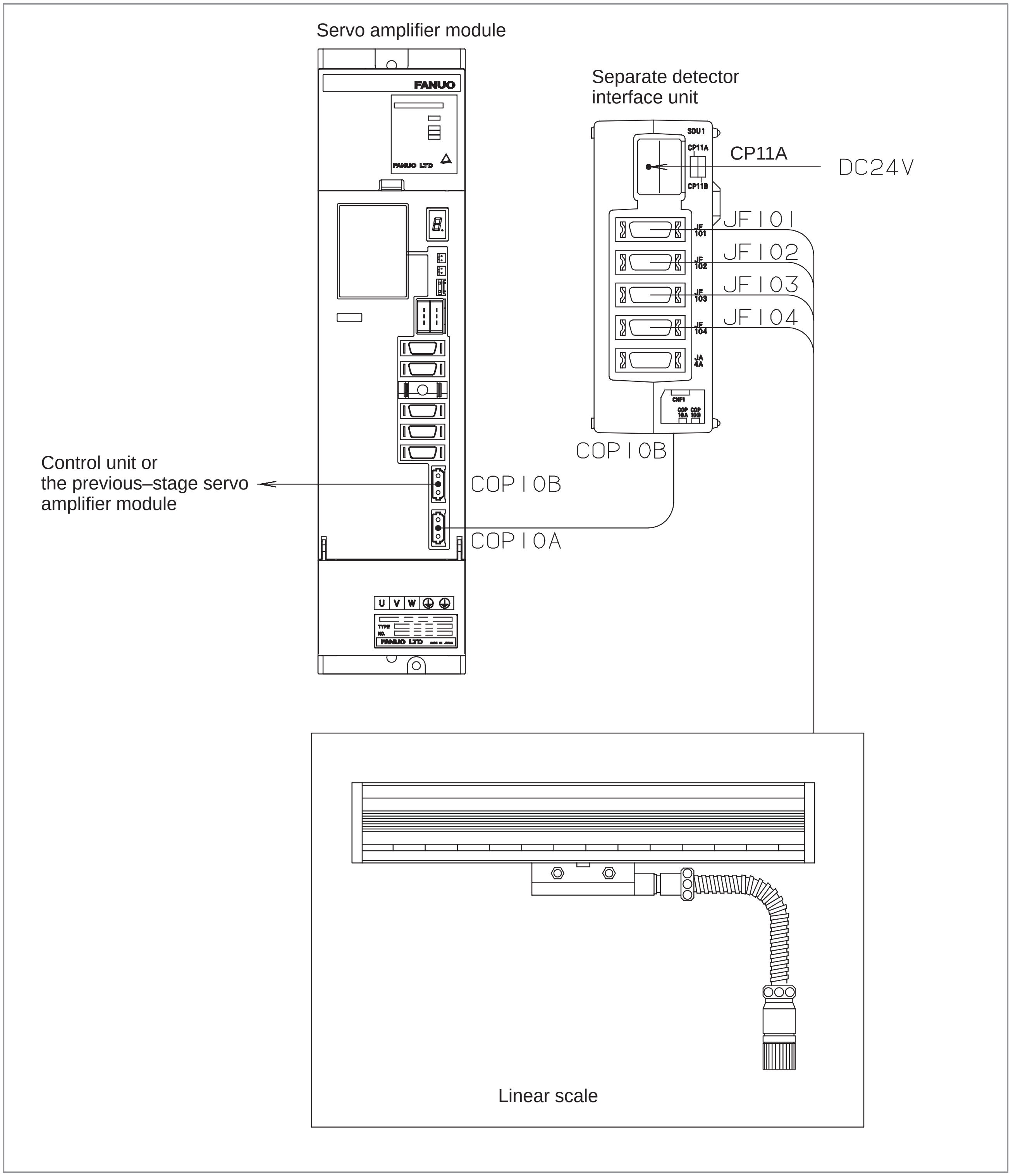
This chapter describes how to connect the servo units to the Series 21*i*/210*i* control unit. For details of the connection of the α Series control motor amplifier, refer to the relevant manual.

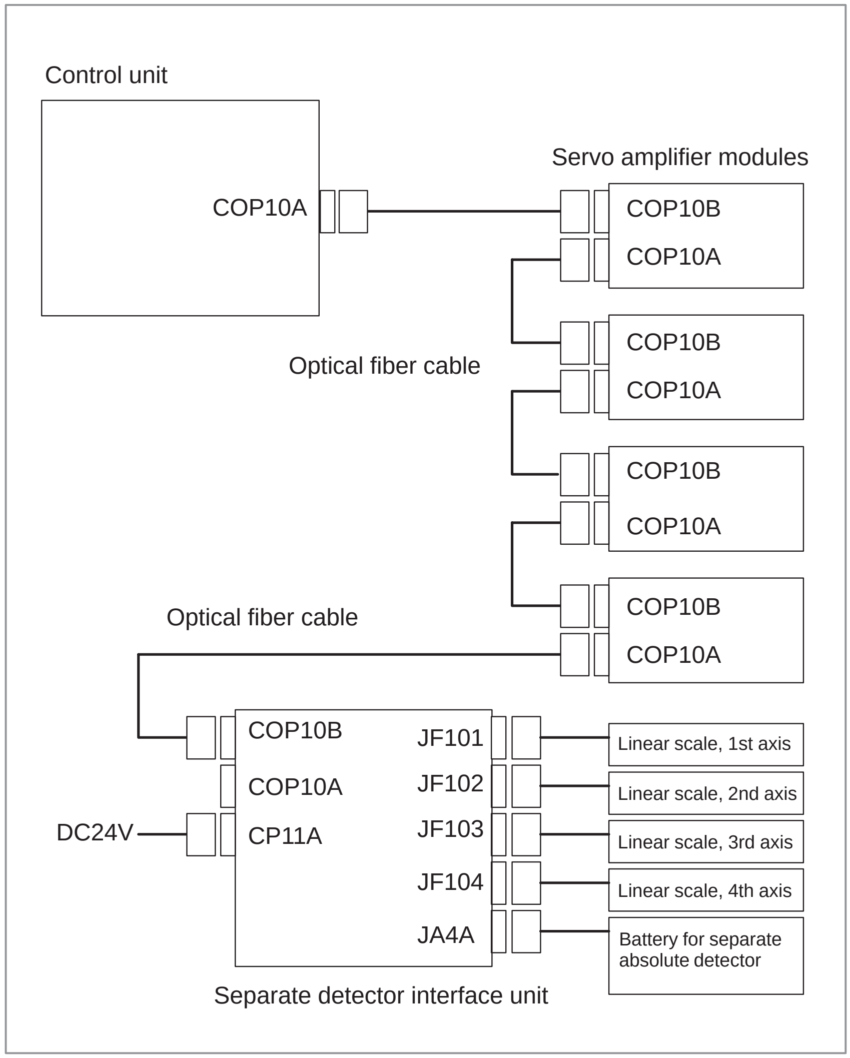
7.1.2 Interface to the Servo Amplifiers



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.

7.1.3 Separate Detector Interface





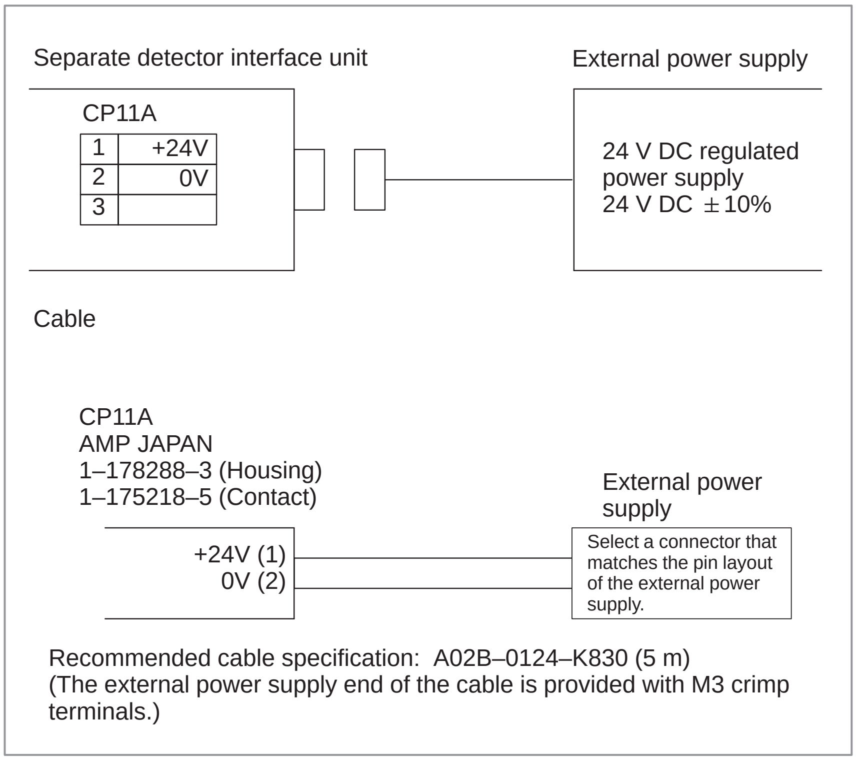
When a separate pulse coder or linear scale is used, a separate detector interface unit, as shown above, is required. The separate detector interface unit should be connected to the CNC control unit through an optical fiber cable, as one of the units on the servo interface (FSSB). Although the above 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 Specifications of the Separate Detector

Item	Use
Power supply	+24 V DC, 0.9 A. The total current which can be drawn by a separate detector for up to 4 axes is 1.4 A (+5 V DC).
Ordering specification	A02B–0236–C201
Installation	See Fig. U16 in APPENDIX A.

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

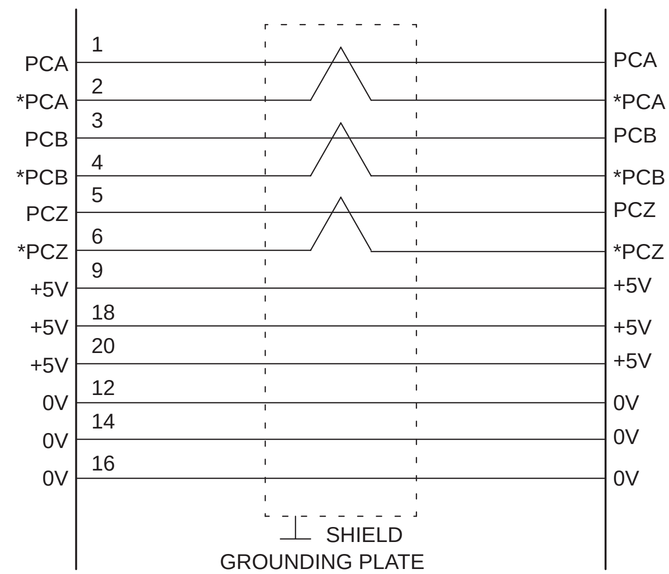
JF101 to JF104
(PCR-EV20MDT)

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

Linear scale

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

Cable wiring



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

7.1.7 Separate Type Pulse Coder Interface

- **For absolute detector**

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

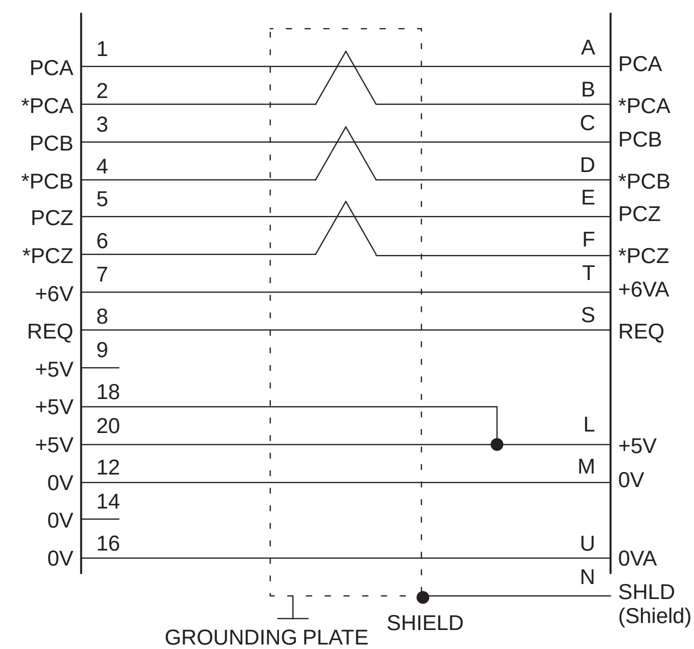
Separate type detector

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)

• For incremental detector

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

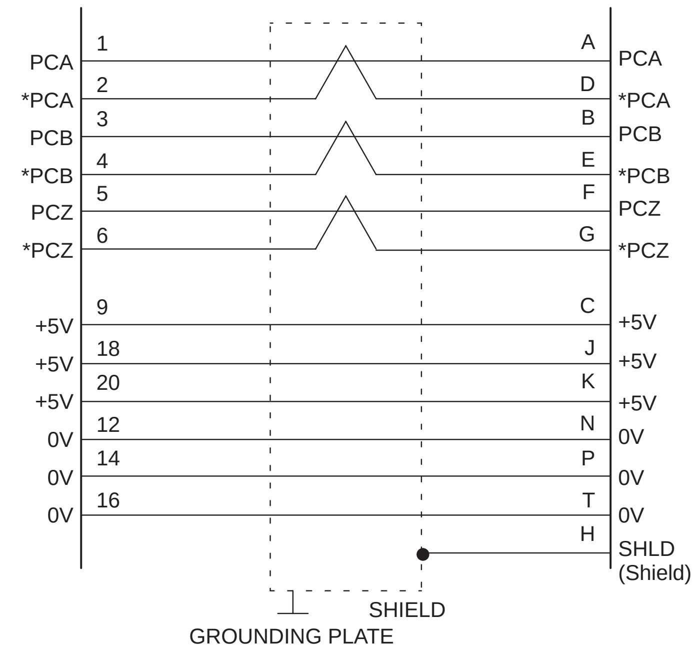
Separate type detector

Pulse coder
(MS3102A–20–29P)

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

MS3106B20–29SW
REQ is not used.

Cable wiring



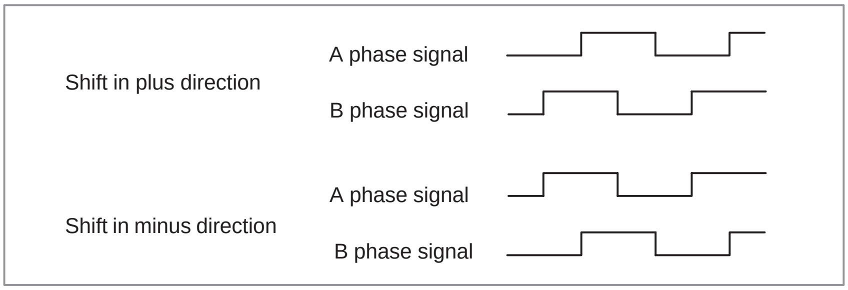
RECOMMENDED CABLE MATERIAL
A66L-0001-0286 (#20AWG × 6 + #24AWG × 3–pair)

7.1.8 Input Signal Requirements

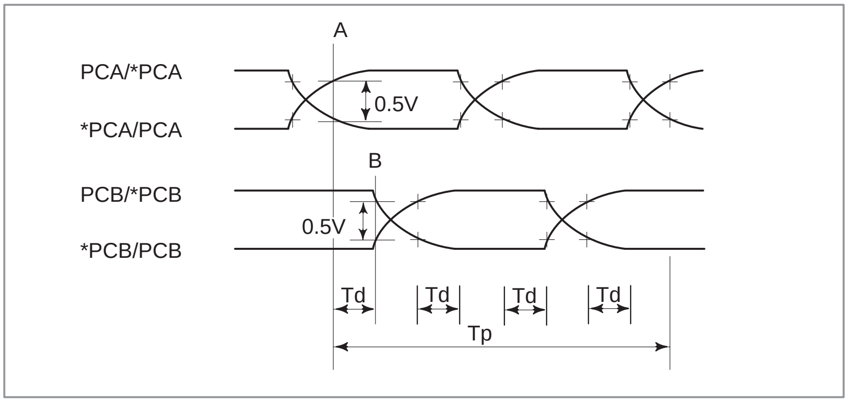
The standard of the feedback signal from the additional detector is as shown below.

(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.

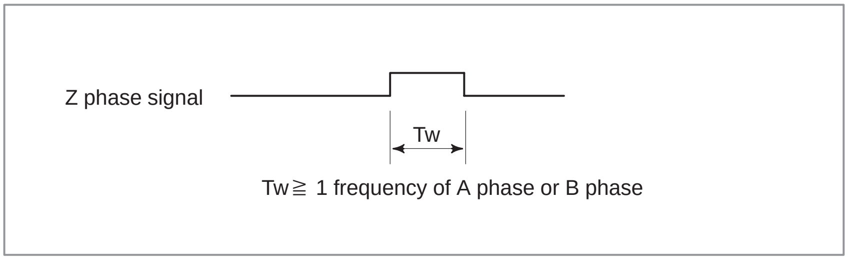


(2) Phase difference and minimum repeat frequency



(3) Z phase signal input

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



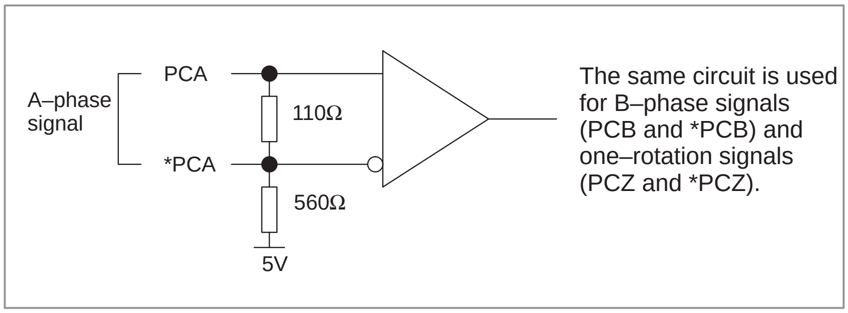
Time requirements

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

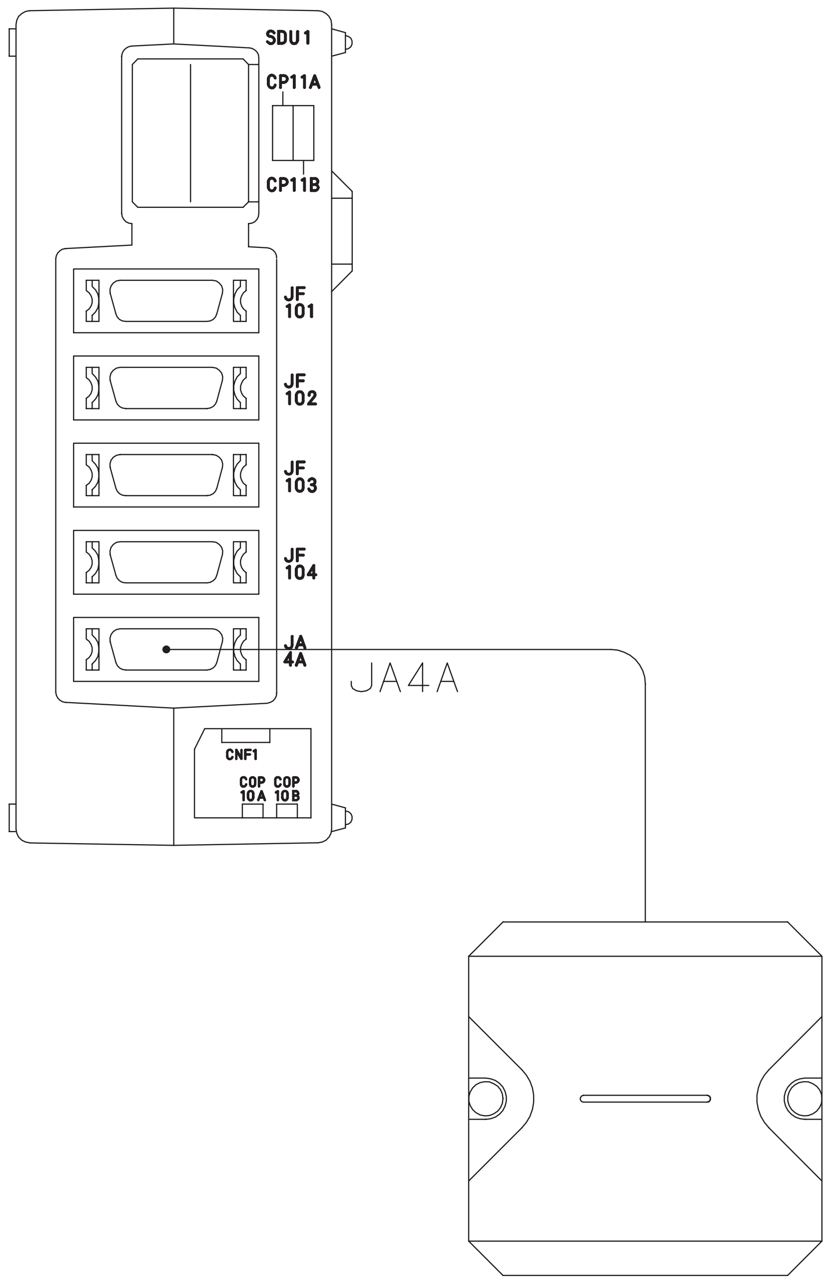
If the separate pulse coder rotates in the opposite direction to that of the servo motor, reconnect the interface cable of the separate pulse coder as described below.

(1) Exchange signal PCA with signal PCB.

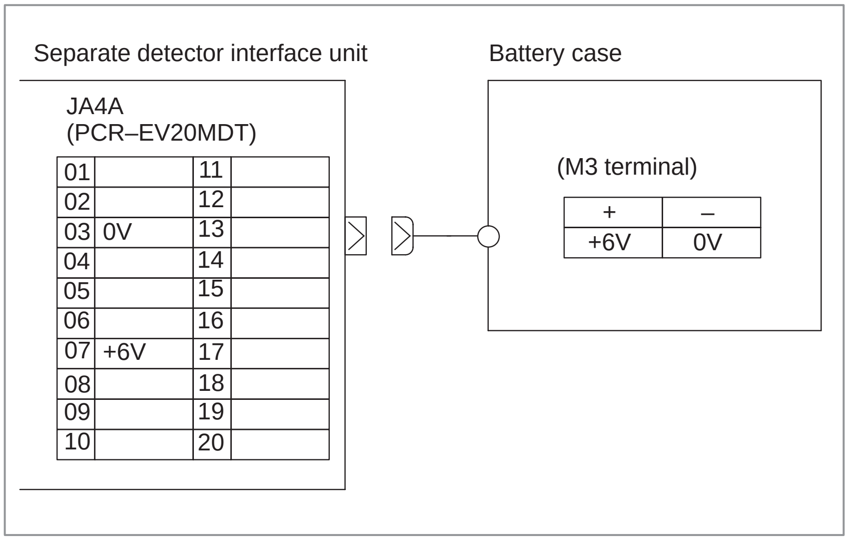
(2) Exchange signal *PCA with signal *PCB.

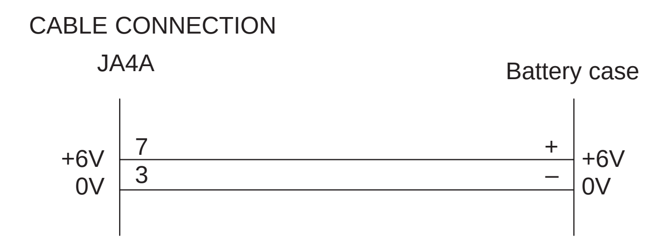
7.1.9 Connection of Battery for Separate Absolute Detector

Separate detector interface unit



Absolute pulse coder battery case





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

NOTE

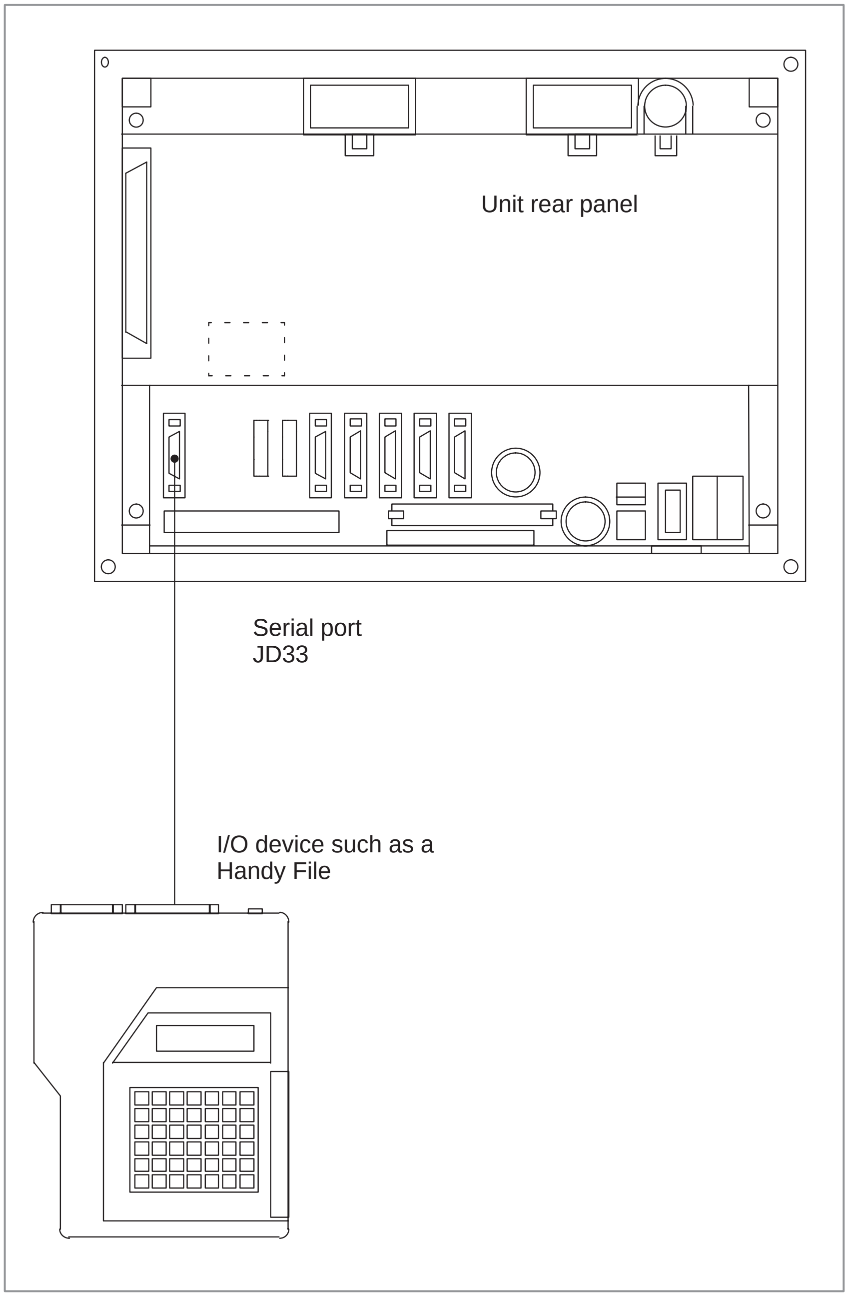
The battery for the separate absolute detector is required only when the separate absolute detector is used. When an absolute pulse coder with built–in motor is used, it is powered by the built–in battery of the amplifier, such that the battery for the separate absolute detector is not required.

8 CONNECTING THE PC INTERFACE

8.1 GENERAL

The control unit of some Series 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–232C 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–232C 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.

CNC

JD33
(PCR–E20MD)

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.

Connector panel (Example)

Serial port
(D–Sub 25)

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

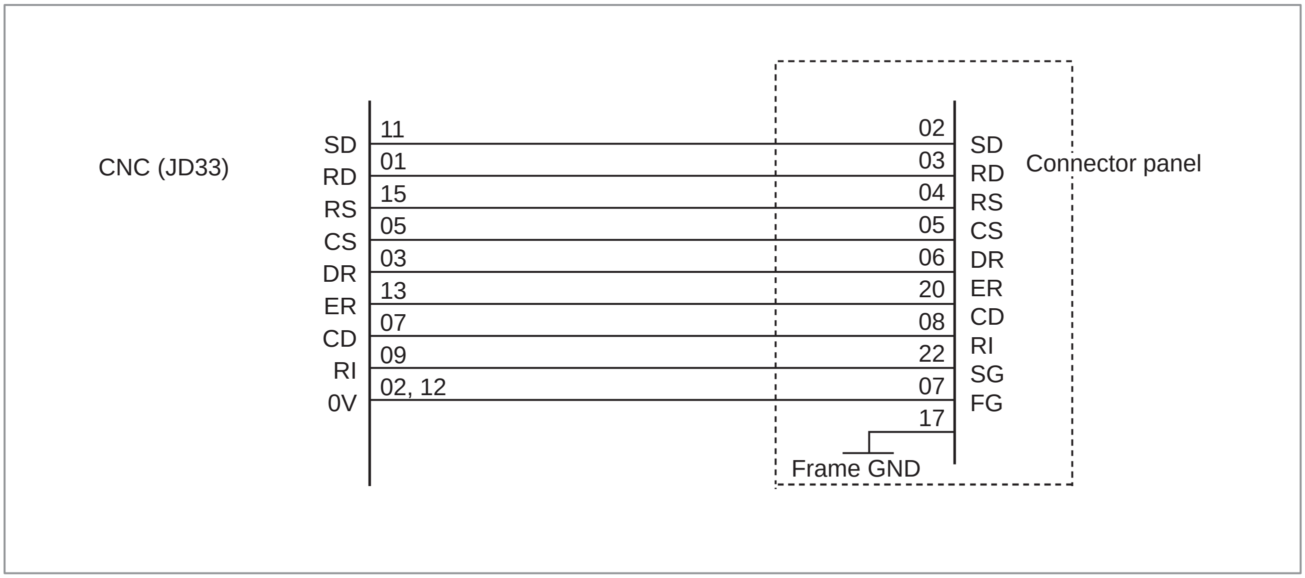
1 The +24 V power of the interface shown in the above figure is exclusively for use by a FANUC I/O device (FANUC Cassette, FANUC Handy File, etc.). Do not use it for any other purpose. Also, do not connect more than one FANUC I/O device to a CNC control unit, as the rating of the +24 V power supply may 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–232C interface on the CNC side (JD36A, JD36B).

4 Do not connect any signal to those pins which are marked (RESERVE).

(1) Cable connection (Example)



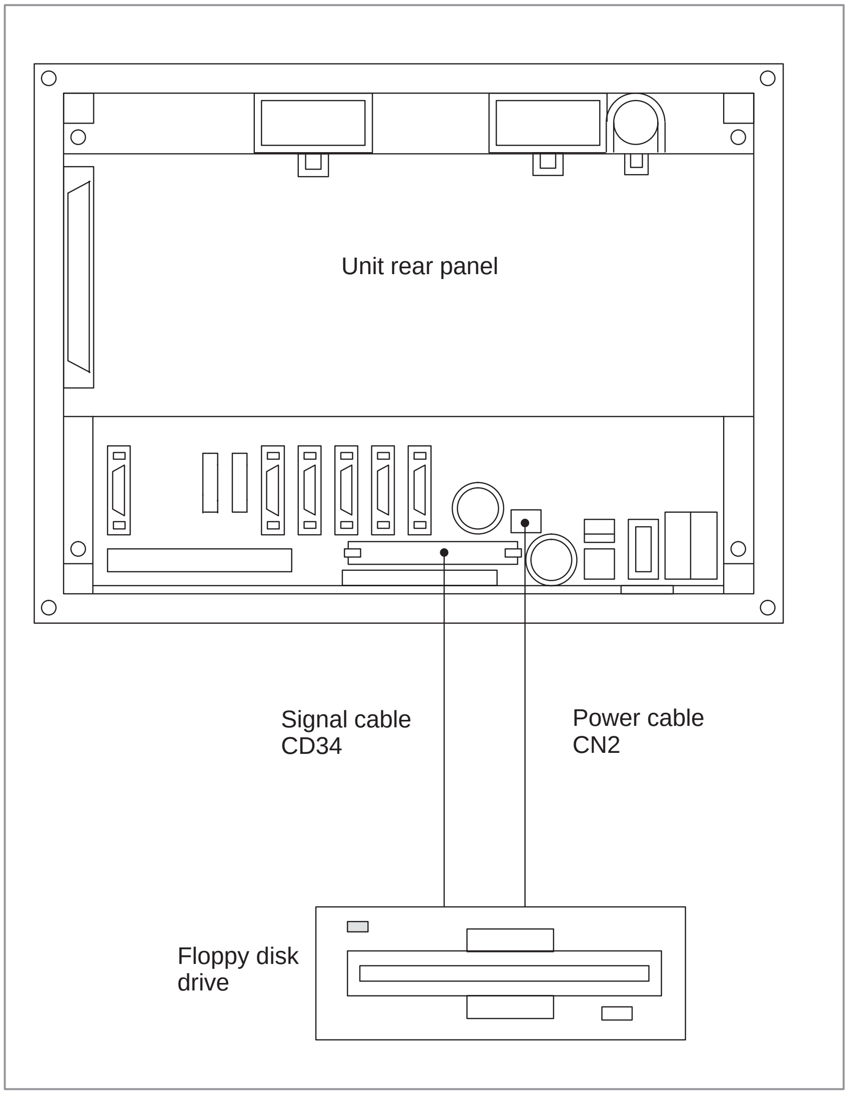
(2) Recommended cable specification

A66L–0001–0284#10P: 0.08 mm^2 × 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)



CNC

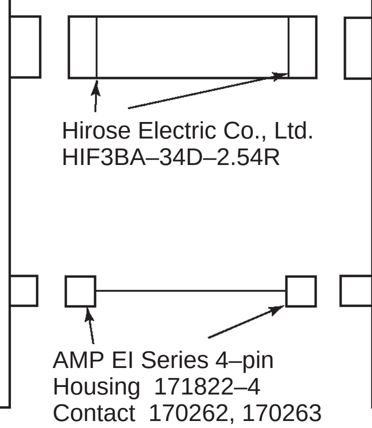
CD34

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

CN2

1 2 3 4

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



3.5″ floppy disk drive A

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

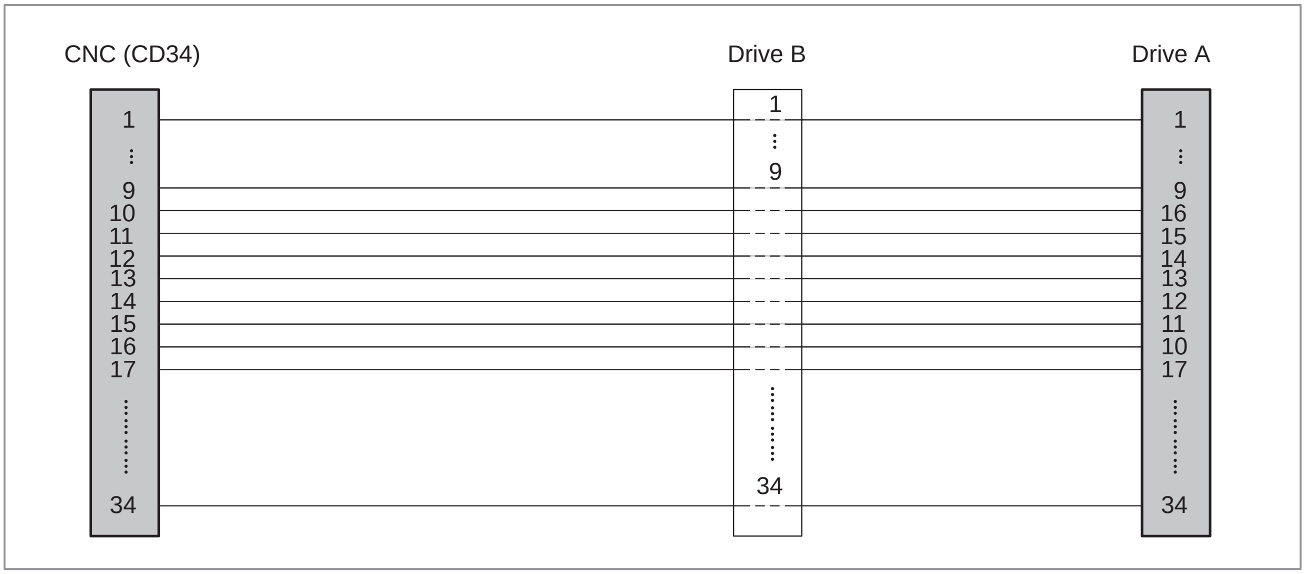
NOTE

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.

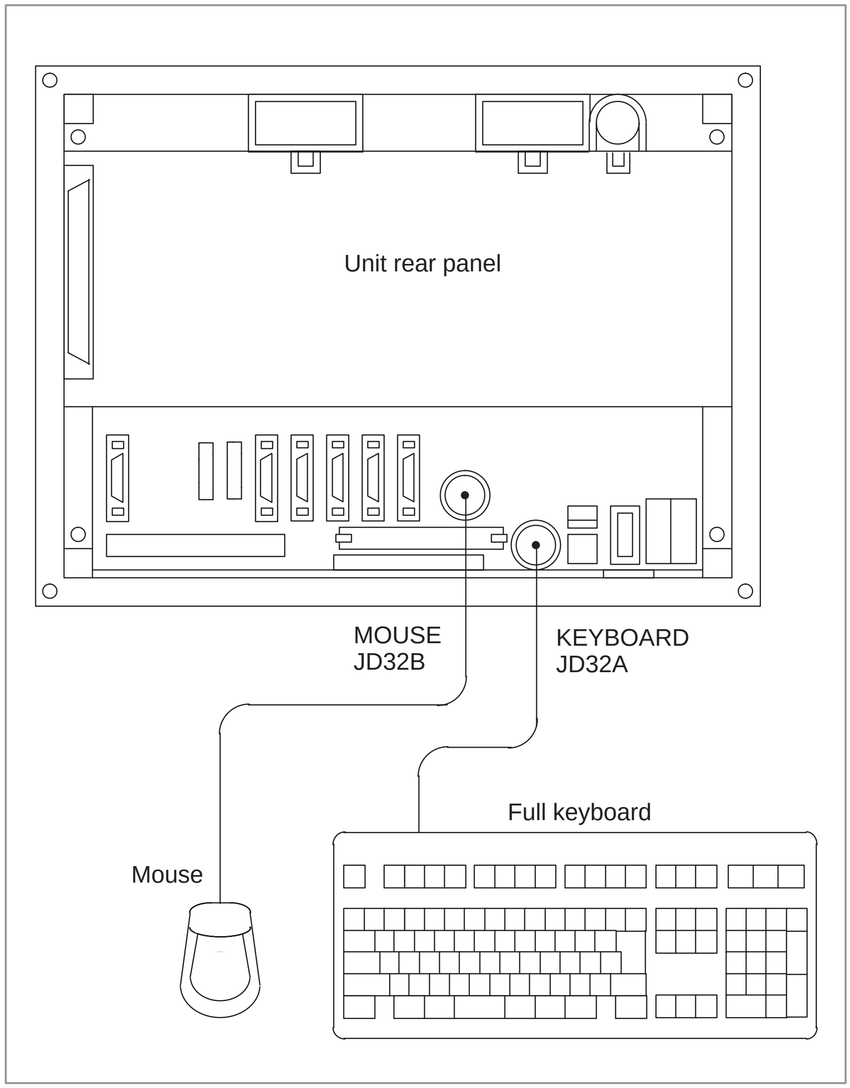
3 The FDD–side interface shown above is merely an example. Each cable should be designed according to the interface of the actual drive to be used.

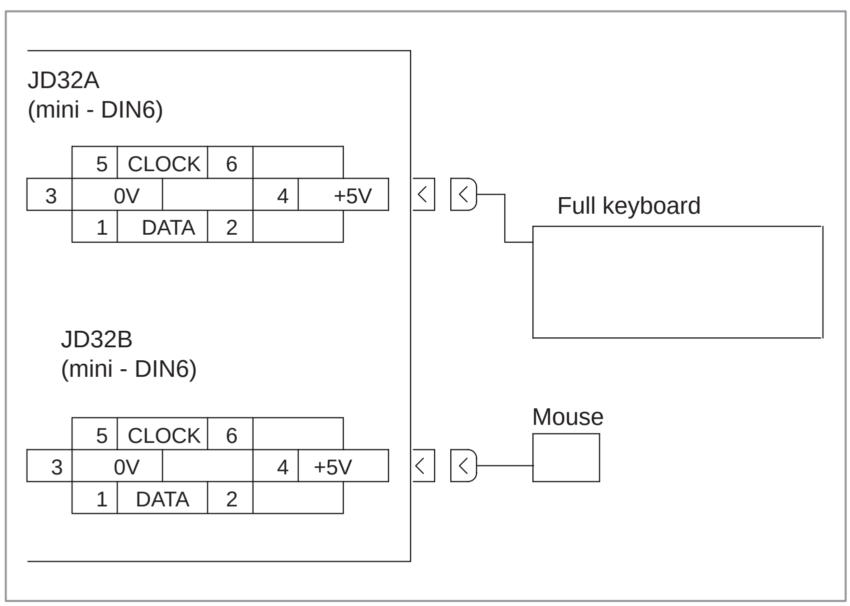
(1) Floppy disk drive cable connection



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).

8.4 CONNECTION TO THE FULL–KEYBOARD AND MOUSE





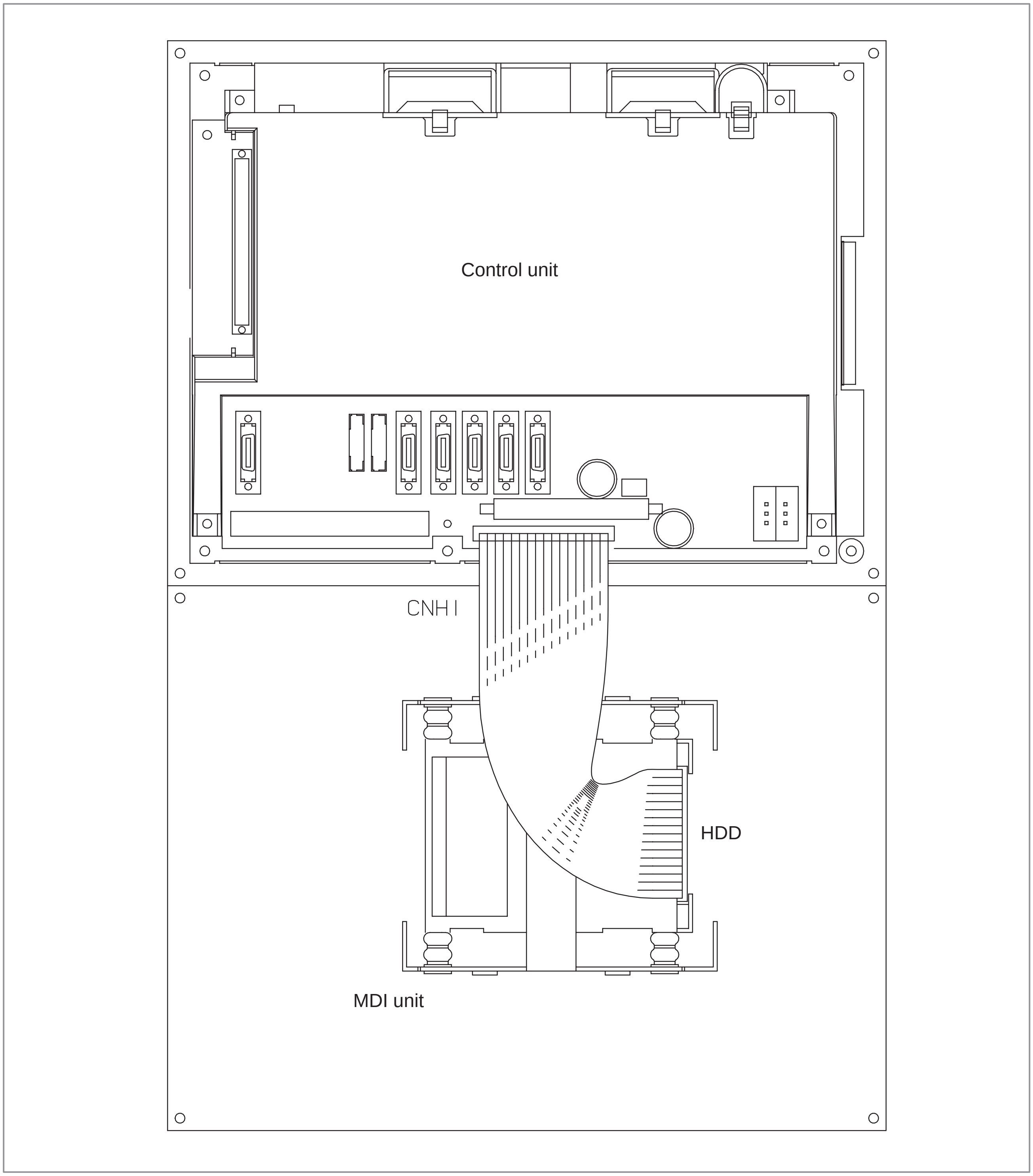
(1) Recommended full keyboard
A86L–0001–0210: 101–key type
A86L–0001–0211: 106–key type

(2) Recommended mouse
A86L–0001–0212: Standard PS/2 mouse

NOTE

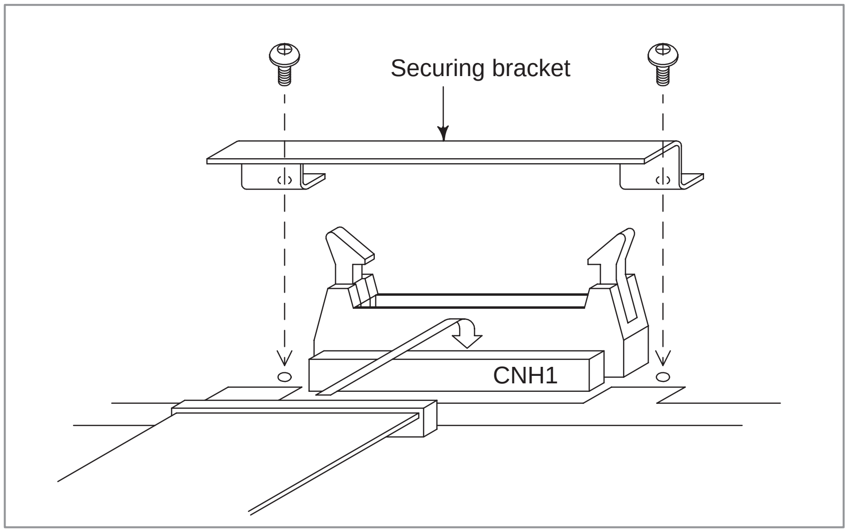
This interface and the recommended devices are exclusively for applications development and maintenance. However, their use is possible only when the A02B–0236–C130#JC or A02B–0236–C130EC FA full keyboard is used as the full keyboard.

8.5 CONNECTION OF HDD (HARD DISK DRIVE)



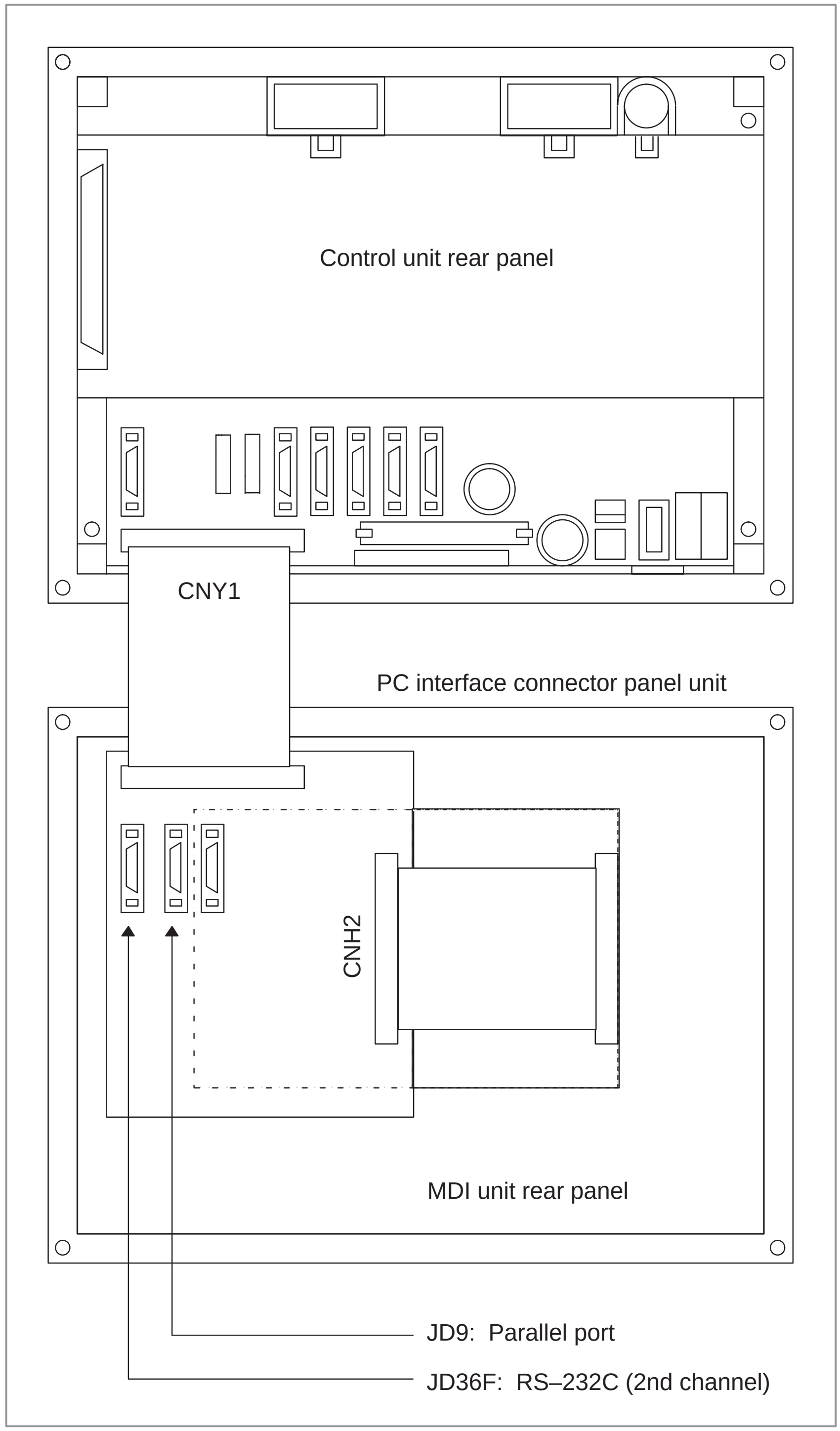
Connection

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.



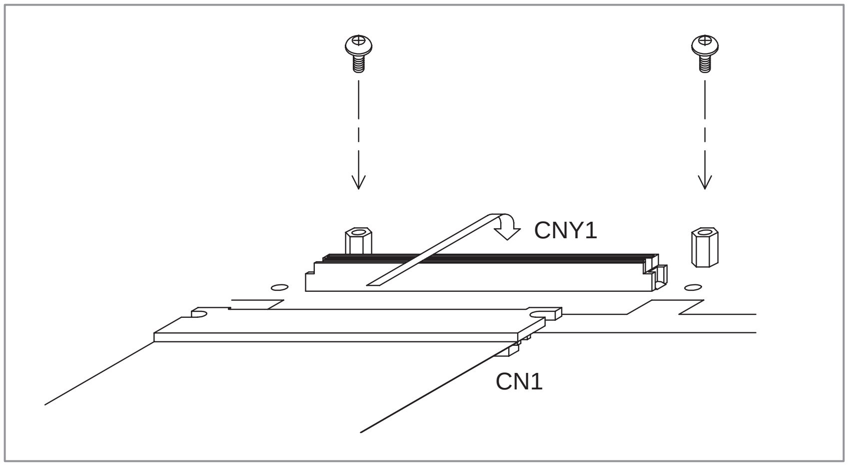
1. Remove the securing bracket from connector “CNH1”. (Remove the two screws for this.)
2. Plug the cable from the hard disk drive into connector “CNH1” of the control unit.
3. Place the securing bracket on the connector and tighten the two screws.

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.
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).



8.6.1 Centronics Parallel Port

210*i* (PC interface connector panel unit)

JD9
(PCR–EV20MDT)

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

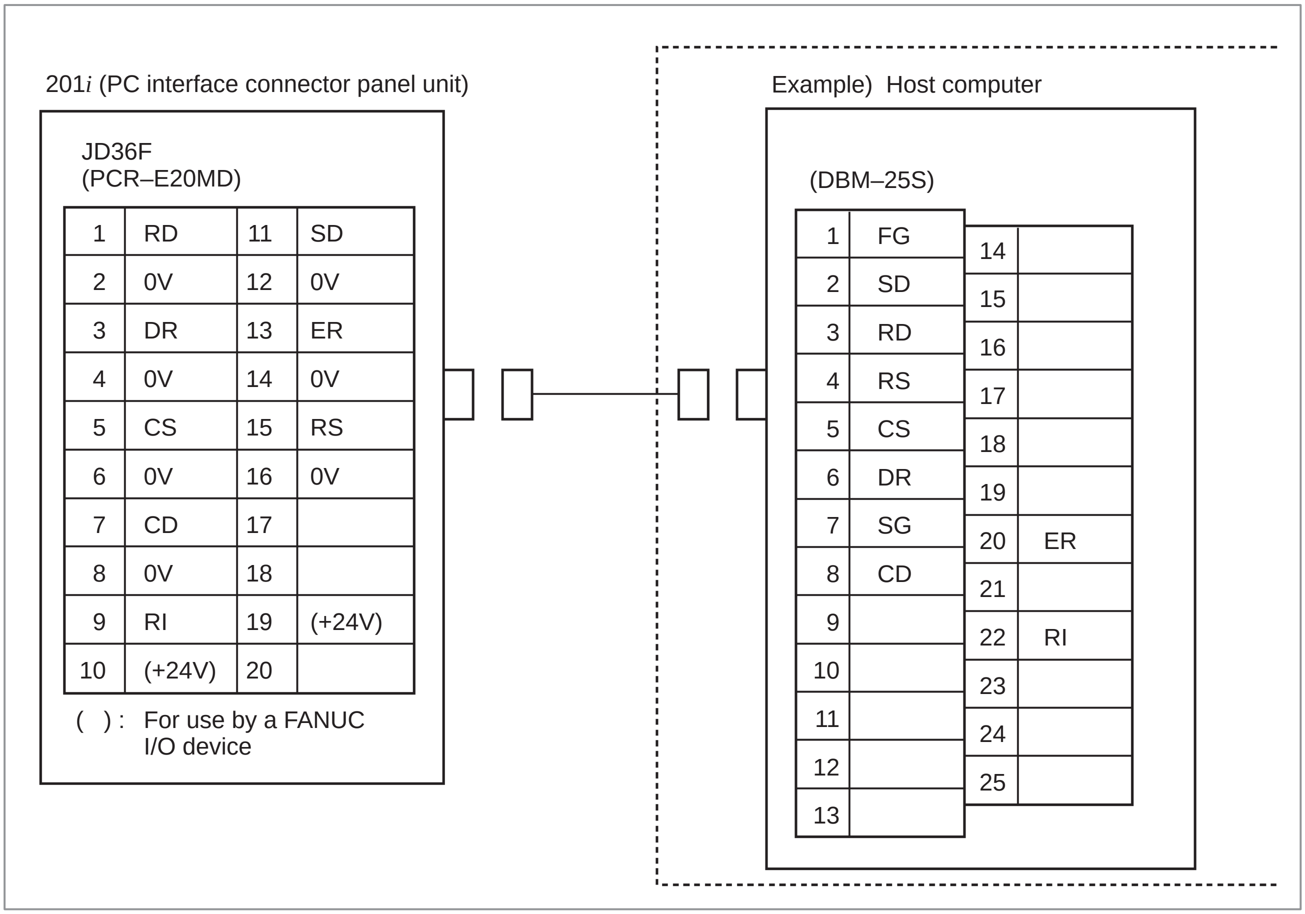
1	*STB	19	0V
2	STD	20	0V
3	STD1	21	0V
4	STD2	22	0V
5	STD3	23	0V
7	STD5	25	0V
6	STD4	24	0V
8	STD6	26	0V
9	STD7	27	0V
10	*ACK	28	0V
11	BUSY	29	0V
12	PE	30	0V
13	SLCT	31	*INIT
14	*AFD	32	*ERROR
15		33	0V
16	0V	34	
17	FG	35	
18		36	*SLIN

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



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.

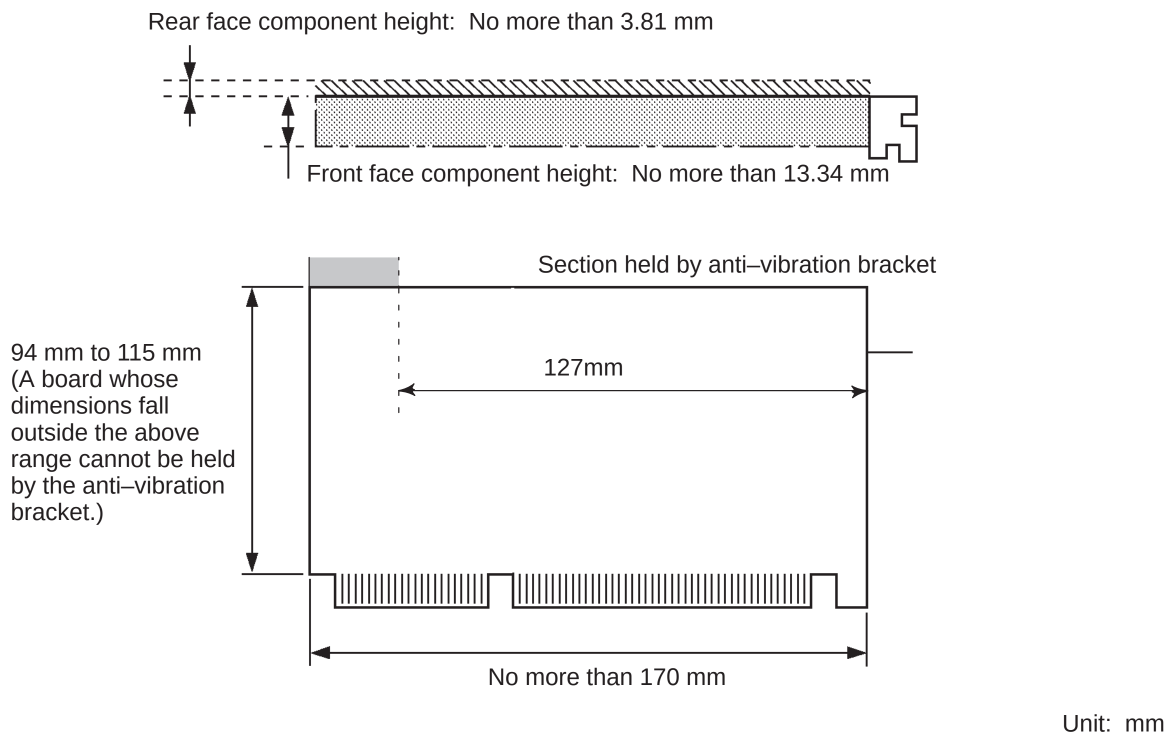
2 The +24 V power of the interface on the PC interface connector panel unit side in the above figure is exclusively for use by a FANUC I/O device (FANUC Cassette, FANUC Handy File, etc.). Do not use it for other purpose. Also, do not to connect more than one FANUC I/O device to a CNC control unit, as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



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.

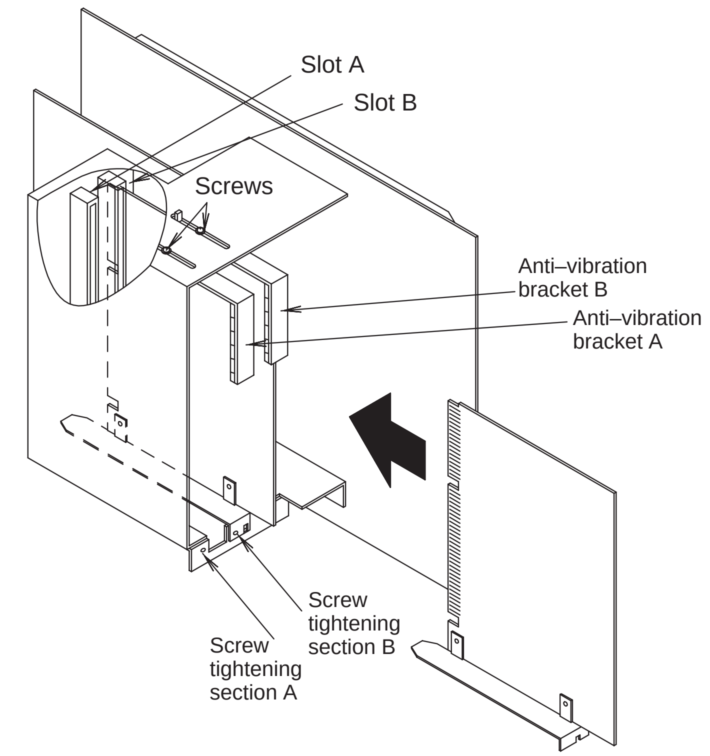
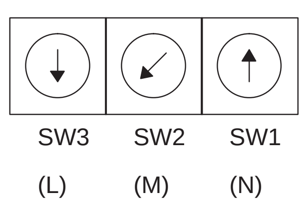


Fig.8.7.1 Installing ISA Expansion Boards

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) 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 CONNECTION TO FANUC I/O Link

9.1 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.

9.2 CONNECTION

On Series 21*i*/210*i*, 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. 9.2.1. Use the figures when connecting the I/O Link irrespective of the type of unit.

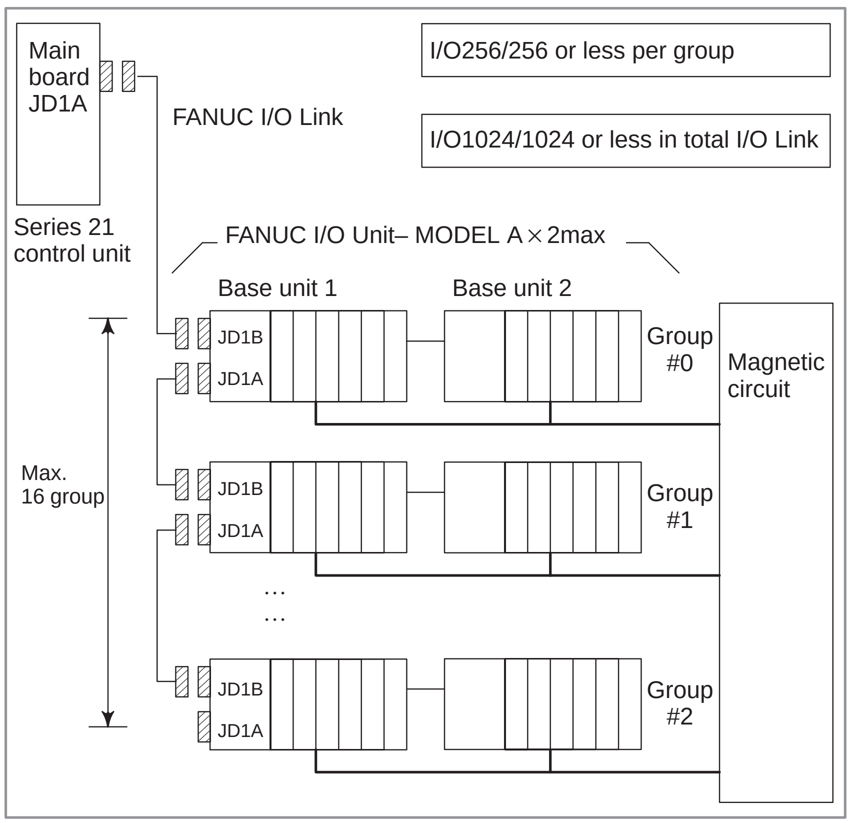
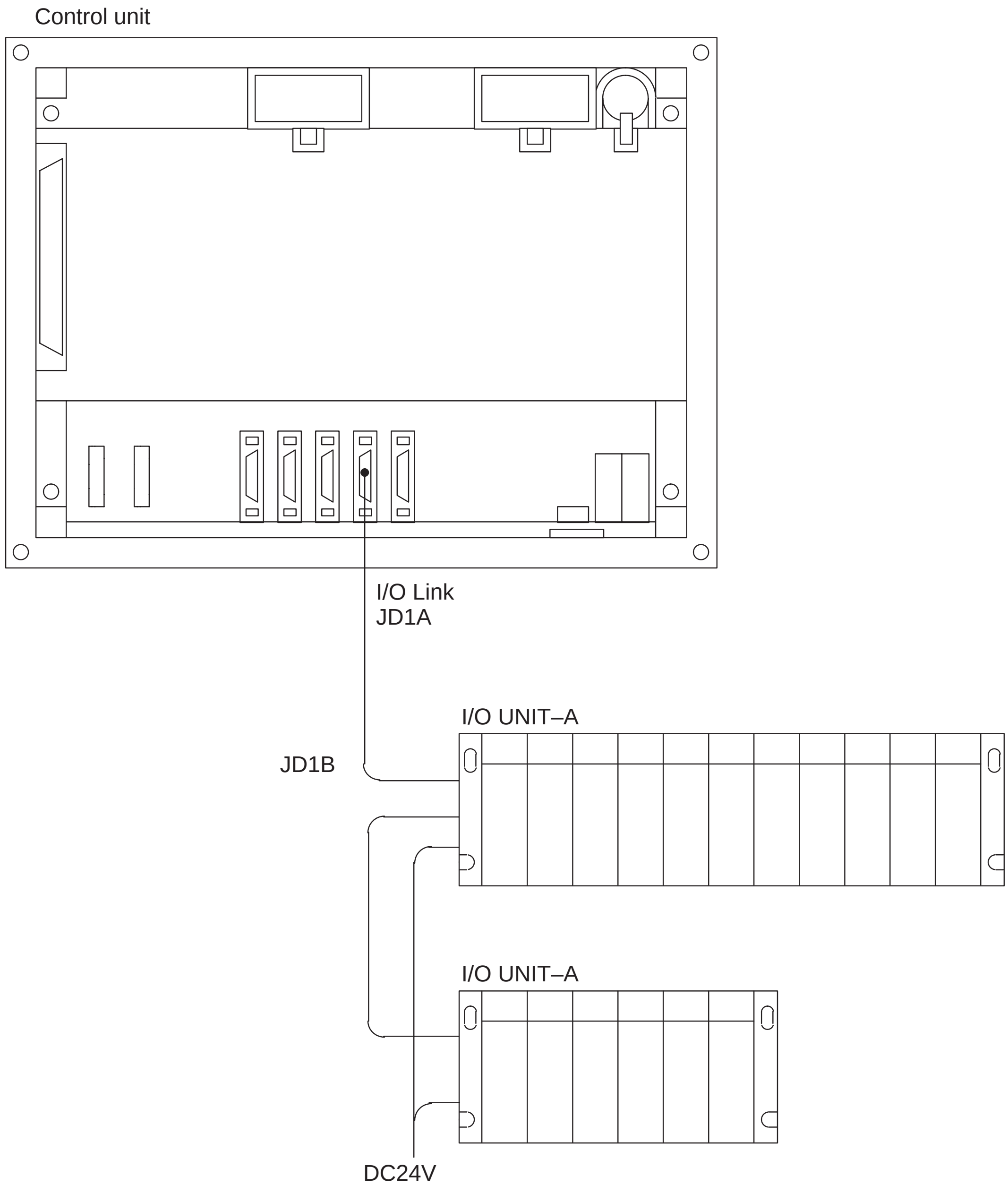
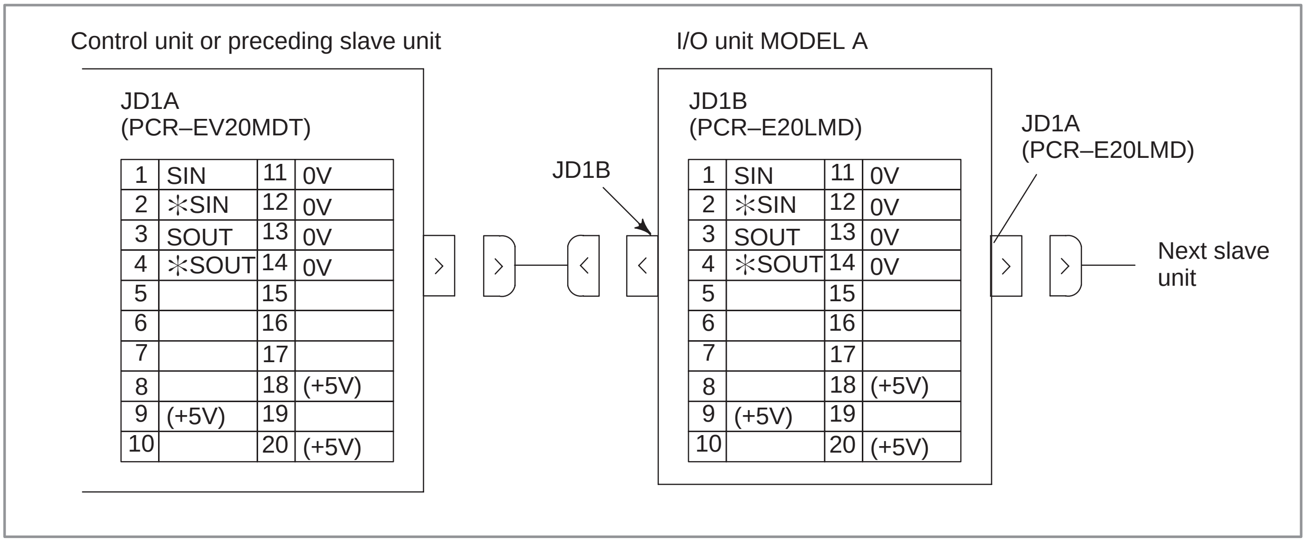


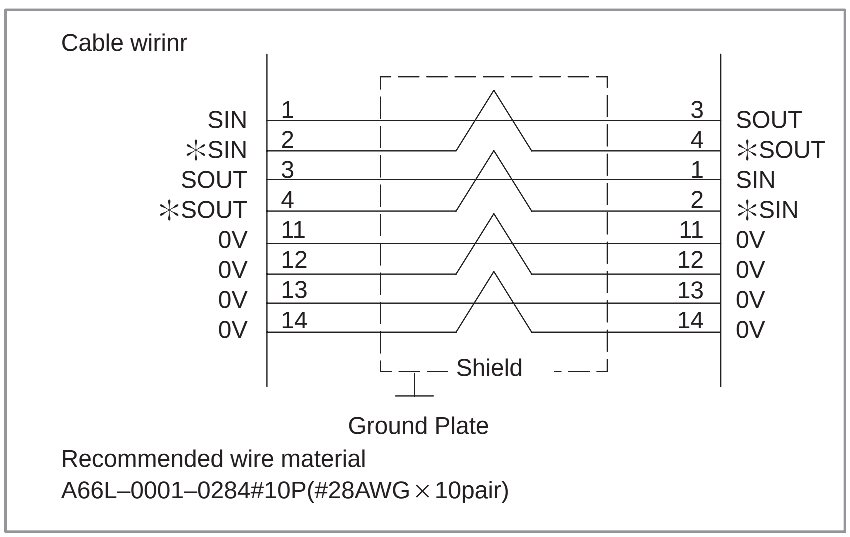
Fig.9.2 I/O Link connection diagram


Control unit
I/O Link
JD1A
I/O UNIT–A
JD1B
I/O UNIT–A
DC24V

9.2.1 Connection of FANUC I/O Link by Electric Cable



+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.)

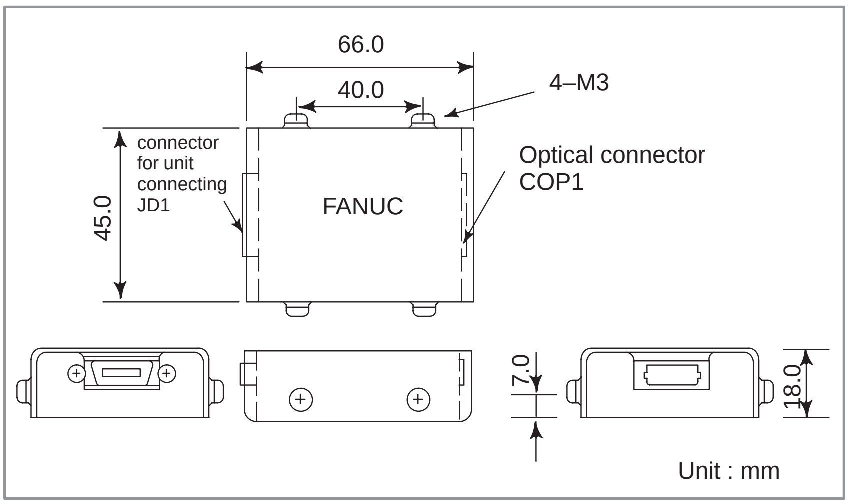
9.2.2 Connection of FANUC I/O Link Optical Fiber Cable

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 10 meters long.
- When the cabinet housing the I/O unit and the operator's panel cabinet housing the CNC control unit cannot be connected by means of a 5.5–mm^2 or thicker grounding wire.
- 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

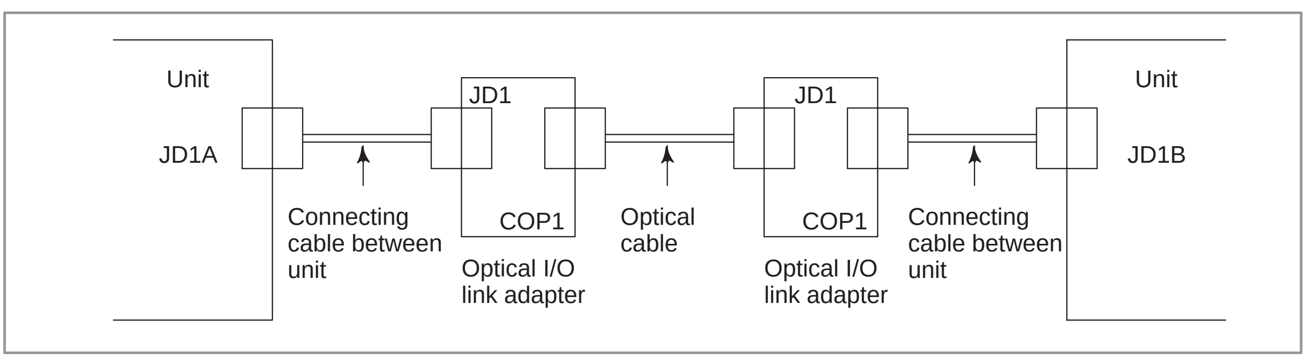


Weight of optical link adapter

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

Unit side JD1A,JD1B	Adapter side JD1
SIN(01)	(03)SOUT
*SIN(02)	(04)*SOUT
SOUT(03)	(01)SIN
*SOUT(04)	(02)*SIN
+5V(09)	(09)+5V
+5V(18)	(18)+5V
+5V(20)	(20)+5V
0V(11)	(11)0V
0V(12)	(12)0V
0V(13)	(13)0V
0V(14)	(14)0V
0V(15)	(15)0V
0V(16)	(16)0V

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.)

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 – 0008 or A66L – 6001 – 0026
 (Make sure to use one with this specification)

2 Cable length : Max. 200m.

Power source

(a) Power voltage: 4.75V to 5.25V (at the receiving end)

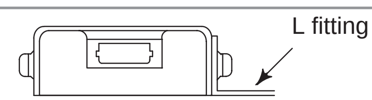
(b) Consumption current: 200mA

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

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

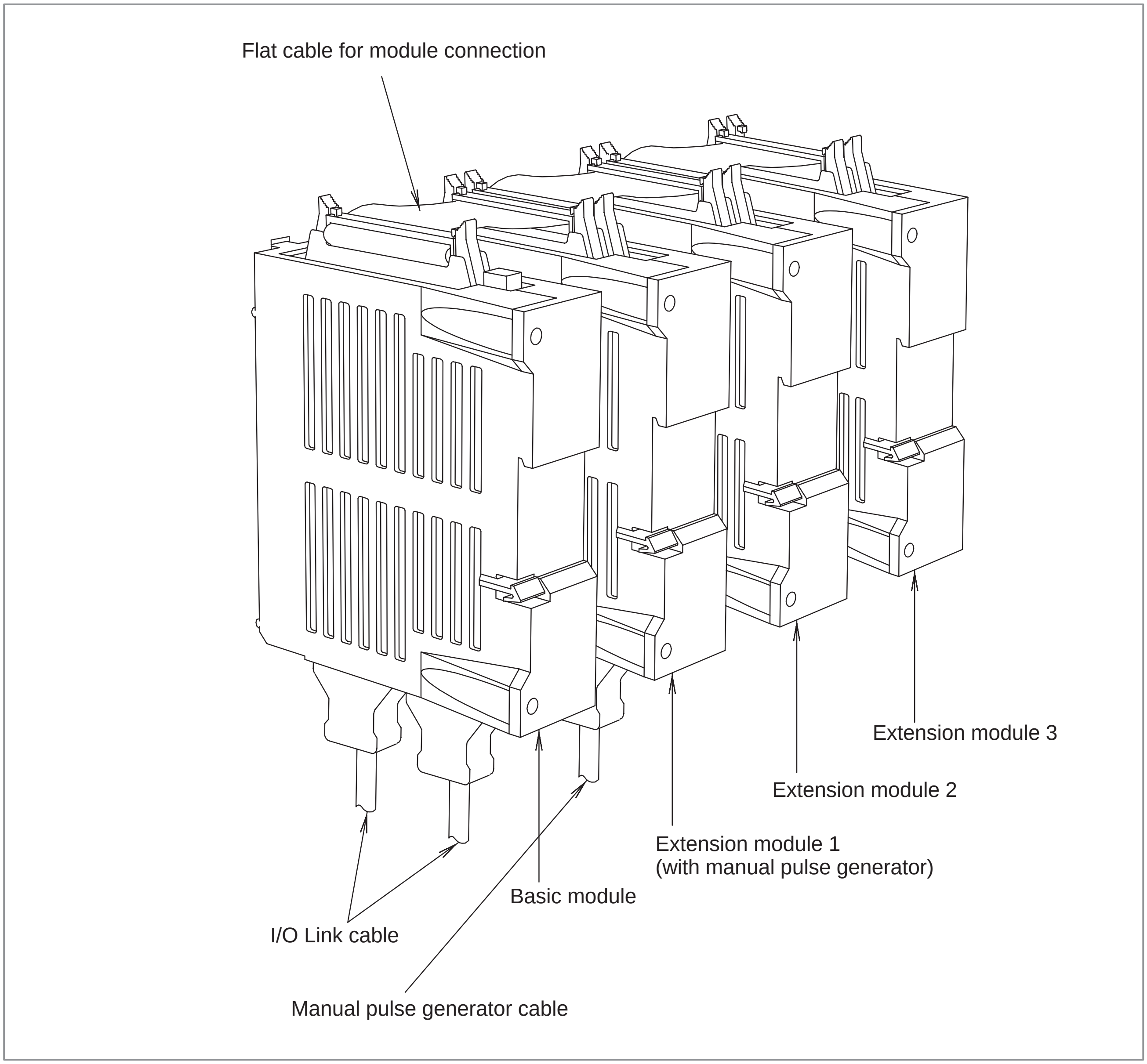
Basically, the Series 21*i*/210*i* can be connected to any unit that has a FANUC I/O Link slave interface. The following table lists general units that can be connected to the Series 21*i*/210*i*. Detailed descriptions of each unit are given later in this section. For details of other units, refer to the documentation provided with the unit.

General units that can be connected to the Series 21*i*/210*i*

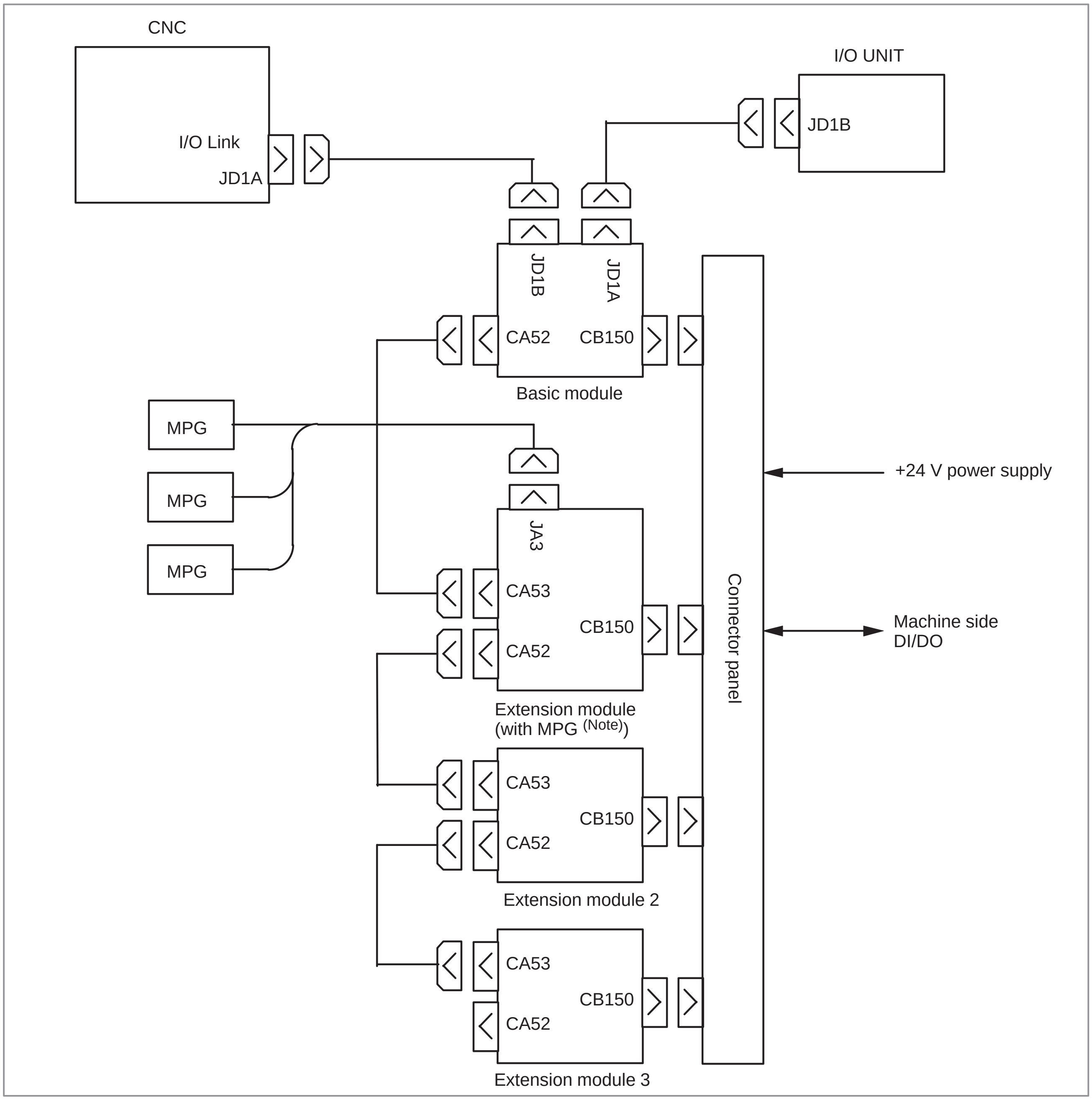
Unit	Description	Reference
FANUC I/O Unit–MODEL A	Modular I/O unit that supports a combination of the input/output signals required by a power magnetics circuit.	Connection and maintenance manual B–61813E
FANUC I/O Unit–MODEL B	Distribution type I/O unit that supports a combination of input/output signals required by a power magnetics circuit.	Connection 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. 9.4
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. 9.5
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. 9.6
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. 9.7
Operator's panel connection unit	Unit having an interface with a machine operator's panel	Sec. 9.8
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. 9.9
FANUC I/O Link connection unit	Unit connecting FANUC I/O Link masters to enable the transfer of DI/DO signals	Sec. 9.10
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. 9.11

9.4 CONNECTION OF CONNECTOR PANEL I/O MODULE

9.4.1 Configuration



9.4.2 Connection Diagram



NOTE

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.

9.4.3 DI/DO Connector Pin Assignment

CB150 (HONDA MR–50RMA)

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

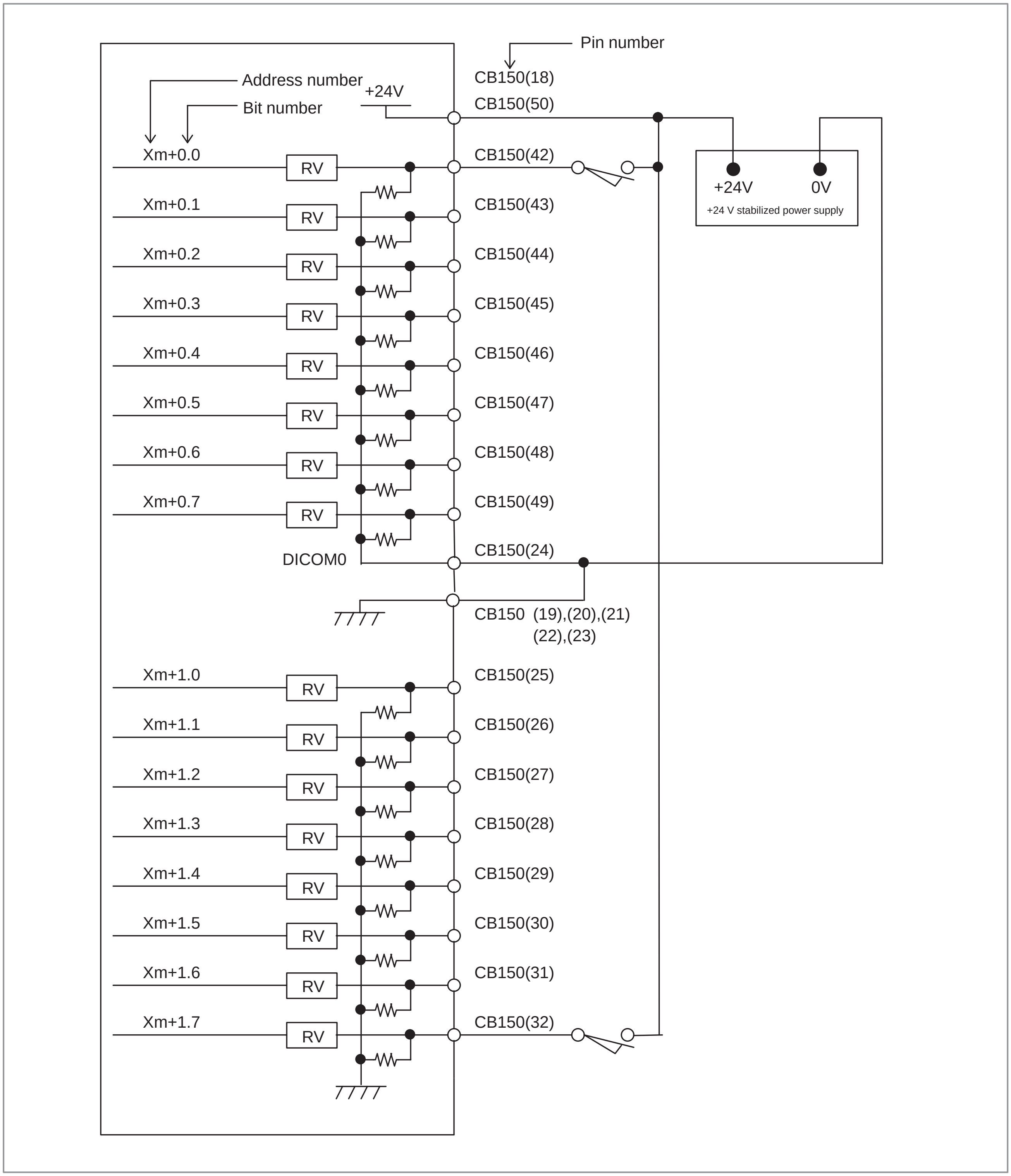
NOTE

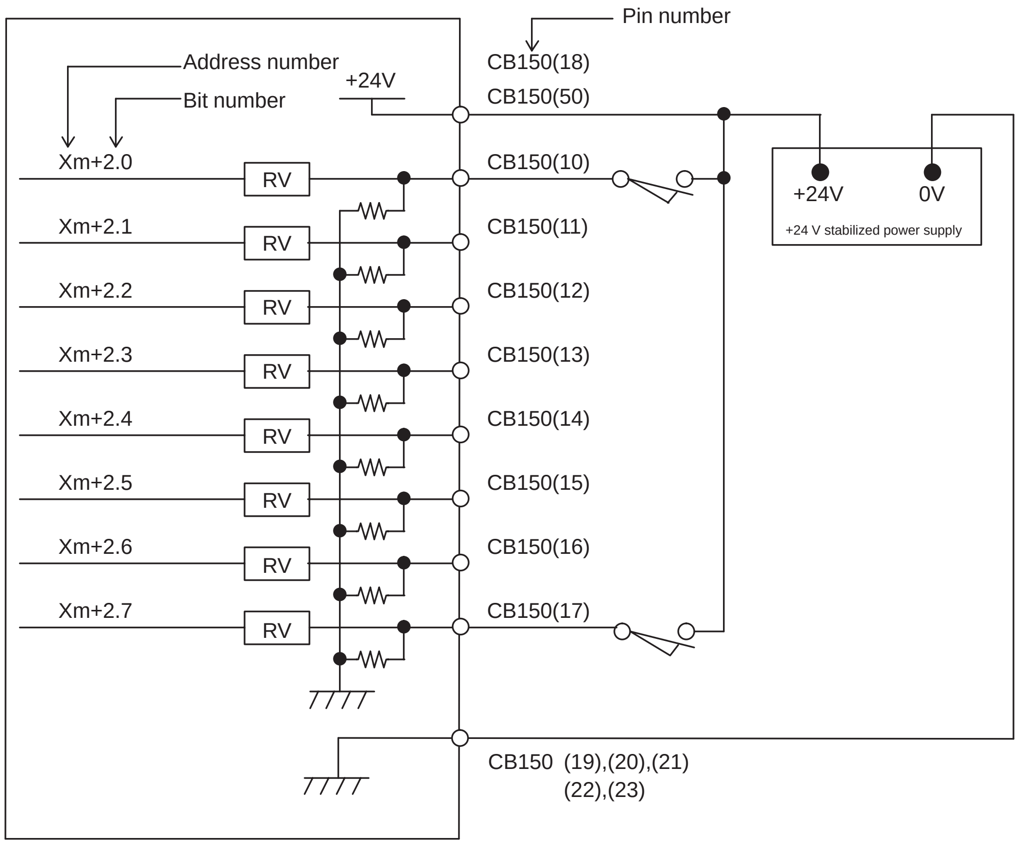
The DI and DO addresses for the basic and extension modules run contiguously. These basic and extension module DI and DO addresses are allocated to the I/O Link as a group. For example, when the DI and DO top addresses are X0004 and Y0000 (m = 4 and n = 0), respectively, then the addresses are allocated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

	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

9.4.4 DI (Input Signal) Connection

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





NOTE

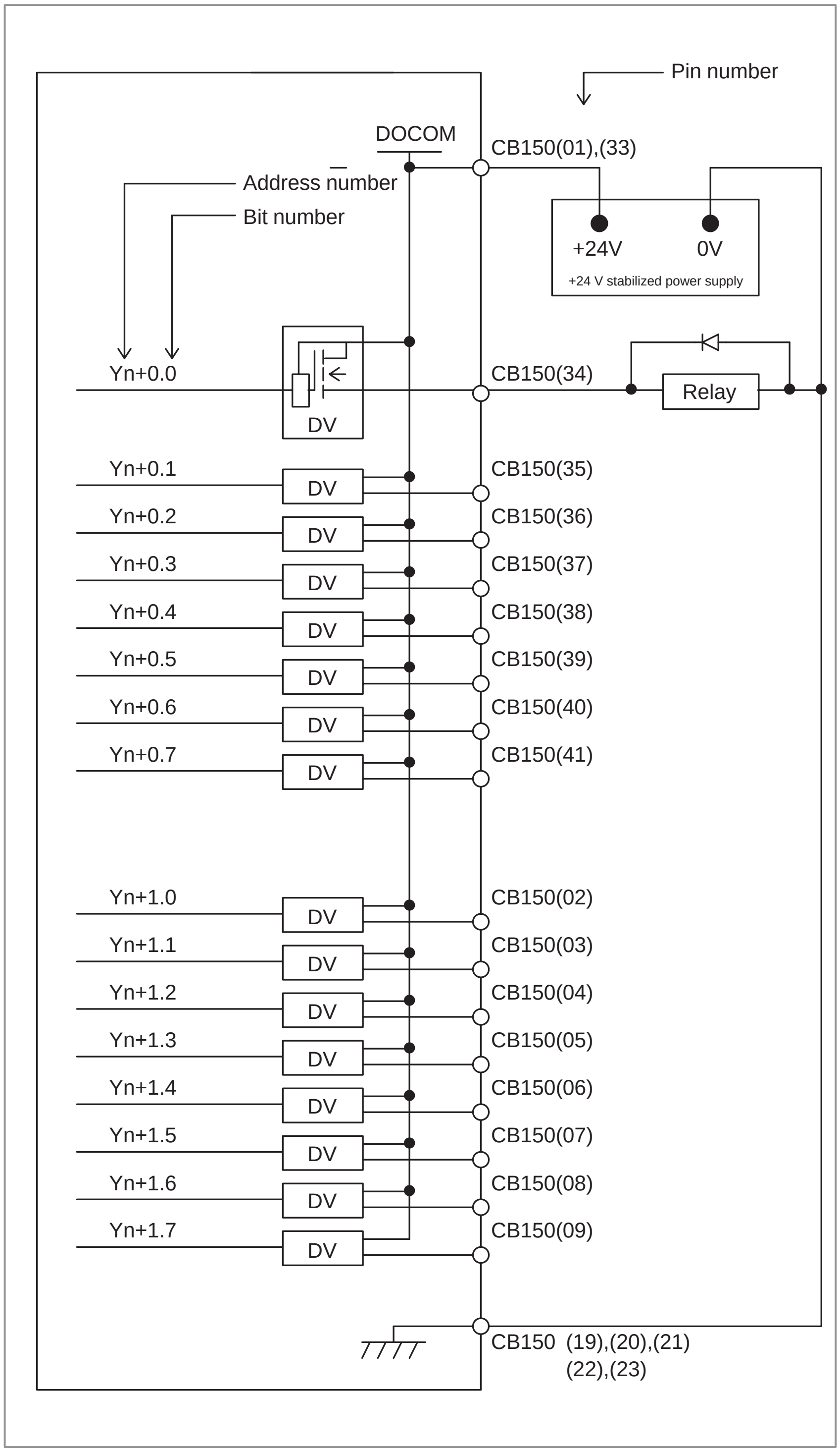
Xm+0.0 through Xm+0.7 are DI pins for which a common voltage can be selected. That is, by connecting the DICOM0 CB150(24) pin to the +24 V power supply, a DI signal can be input with its logical state reversed. If, however, a cable is connected to ground, it has the same effect as inputting an ON state 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 9.4.12 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.

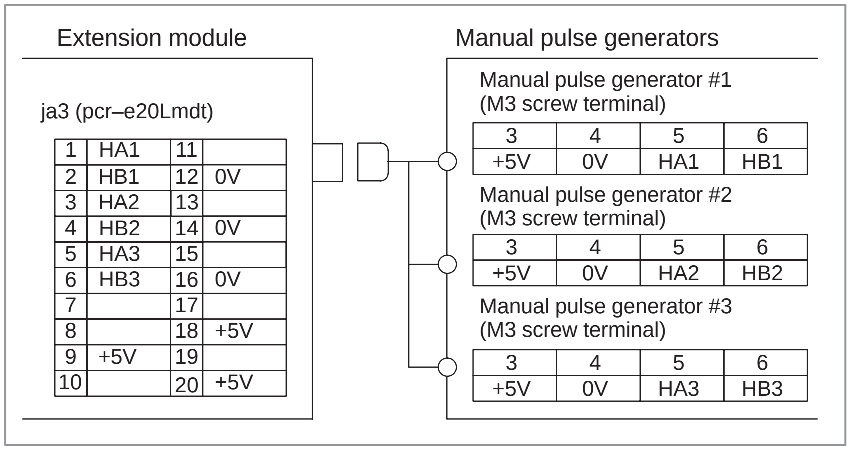
9.4.5 DO (Output Signal) Connection

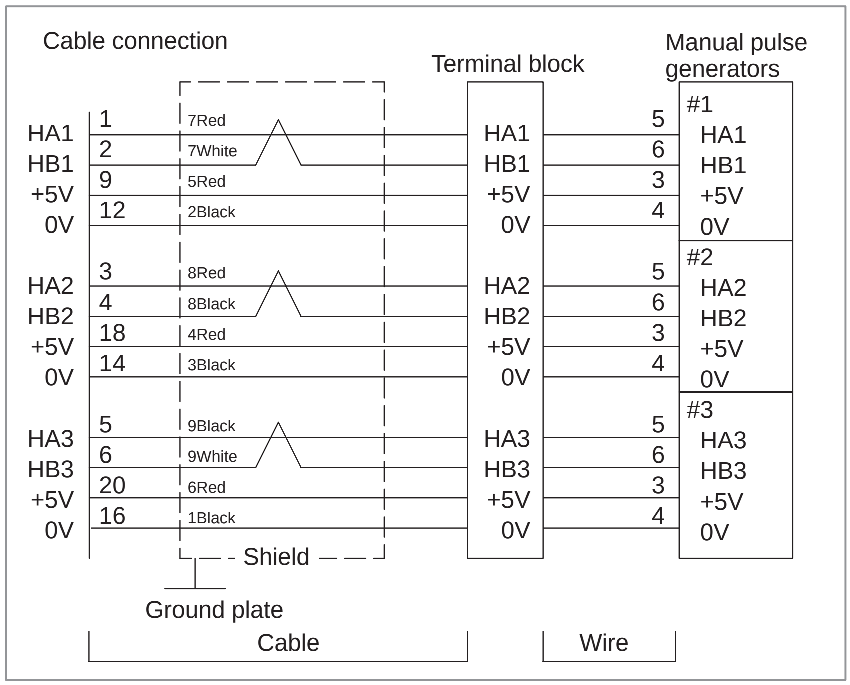
○ A maximum of 64 points are provided (16 points per module; 1 basic module + 3 extension modules).



9.4.6 Manual Pulse Generator Connection

An example in which three manual pulse generators are connected 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 series 21*i* and 210*i*–TA CNCs support the connection of only two manual pulse generators. In such cases, signals HA3 and HB3 are not used.

9.4.7 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:

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

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).

9.4.8 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. 9.4.8 (a).
Pulse cycle T_1 shall be 200μsec or more. Pulse cycle T_1/4–direction pulse shall be 50 μsec or more.

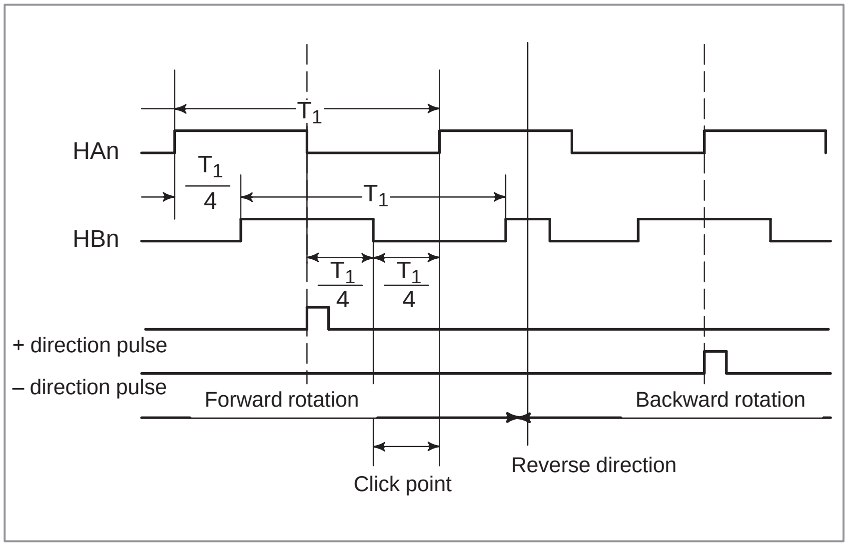


Fig. 9.4.8 (a)

Receiver

The circuit that receives signals input from the manual pulse generator shall be configured as shown in Fig. 9.4.8 (b).

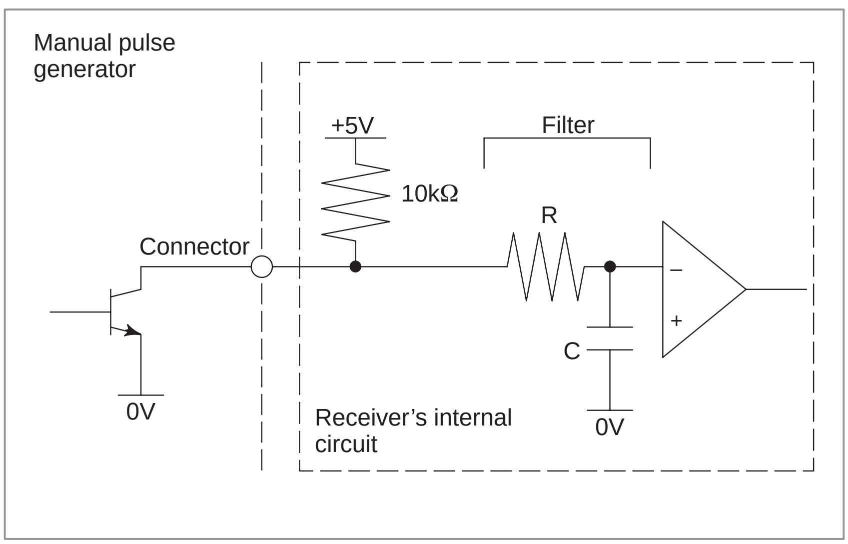
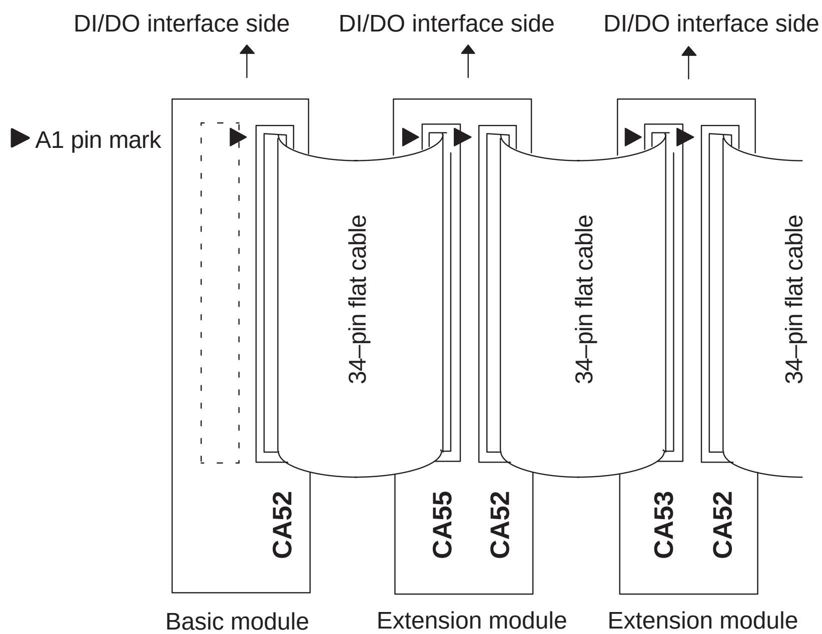


Fig. 9.4.8 (b)

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.

9.4.9 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.



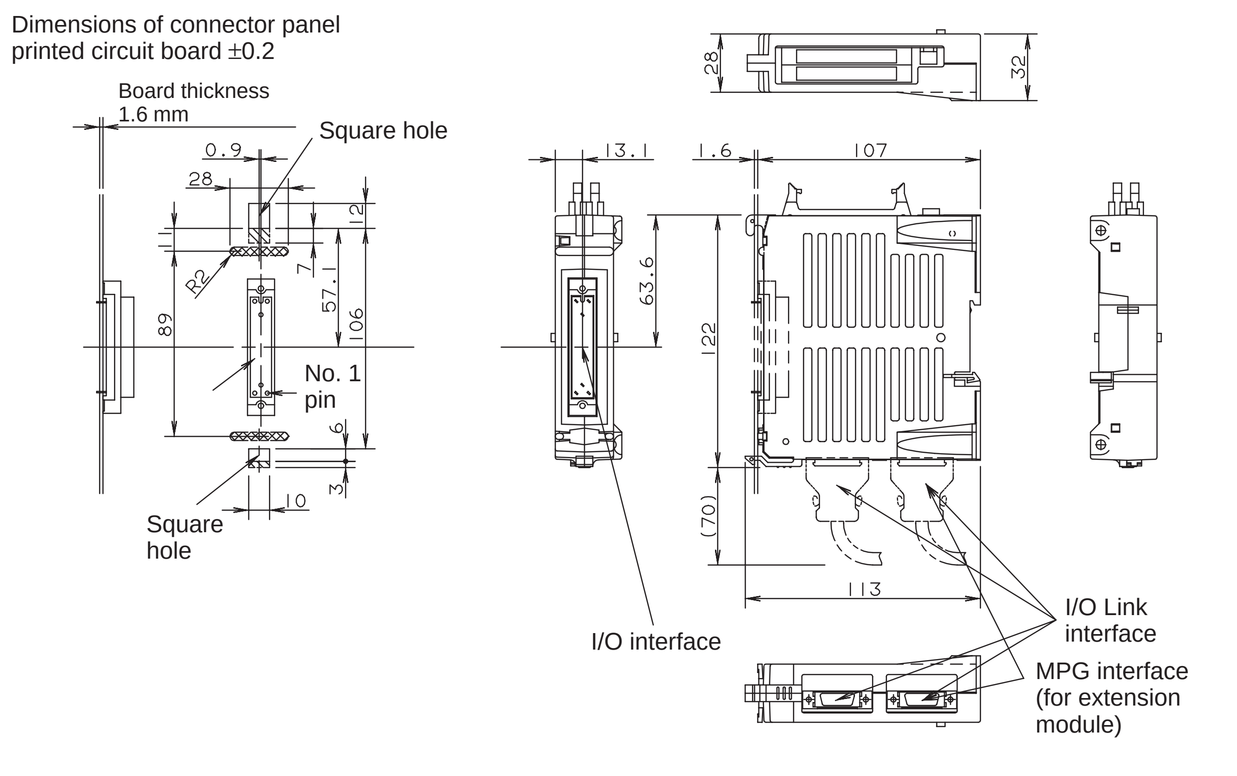
Top view

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.

9.4.10 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

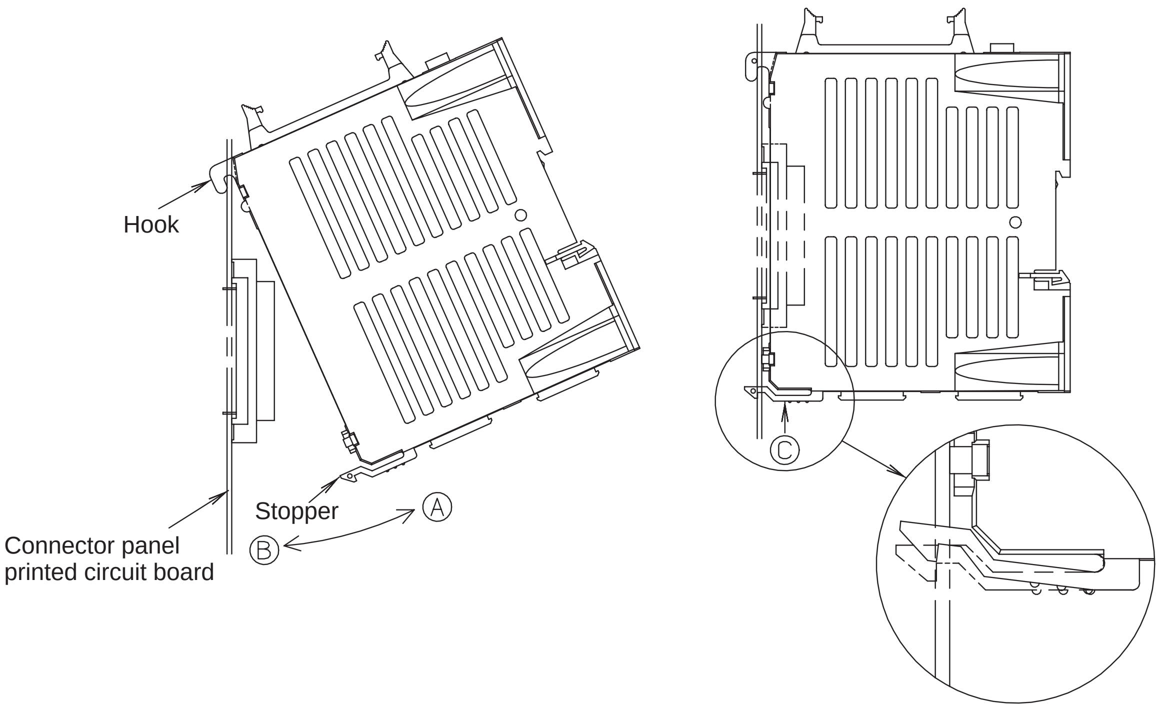
1 A connector with a fitting (HONDA MRH–50RMA) is used for the module–side I/O interface. Always use a connector having no fitting for the connector panel printed circuit board.

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 B, 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.

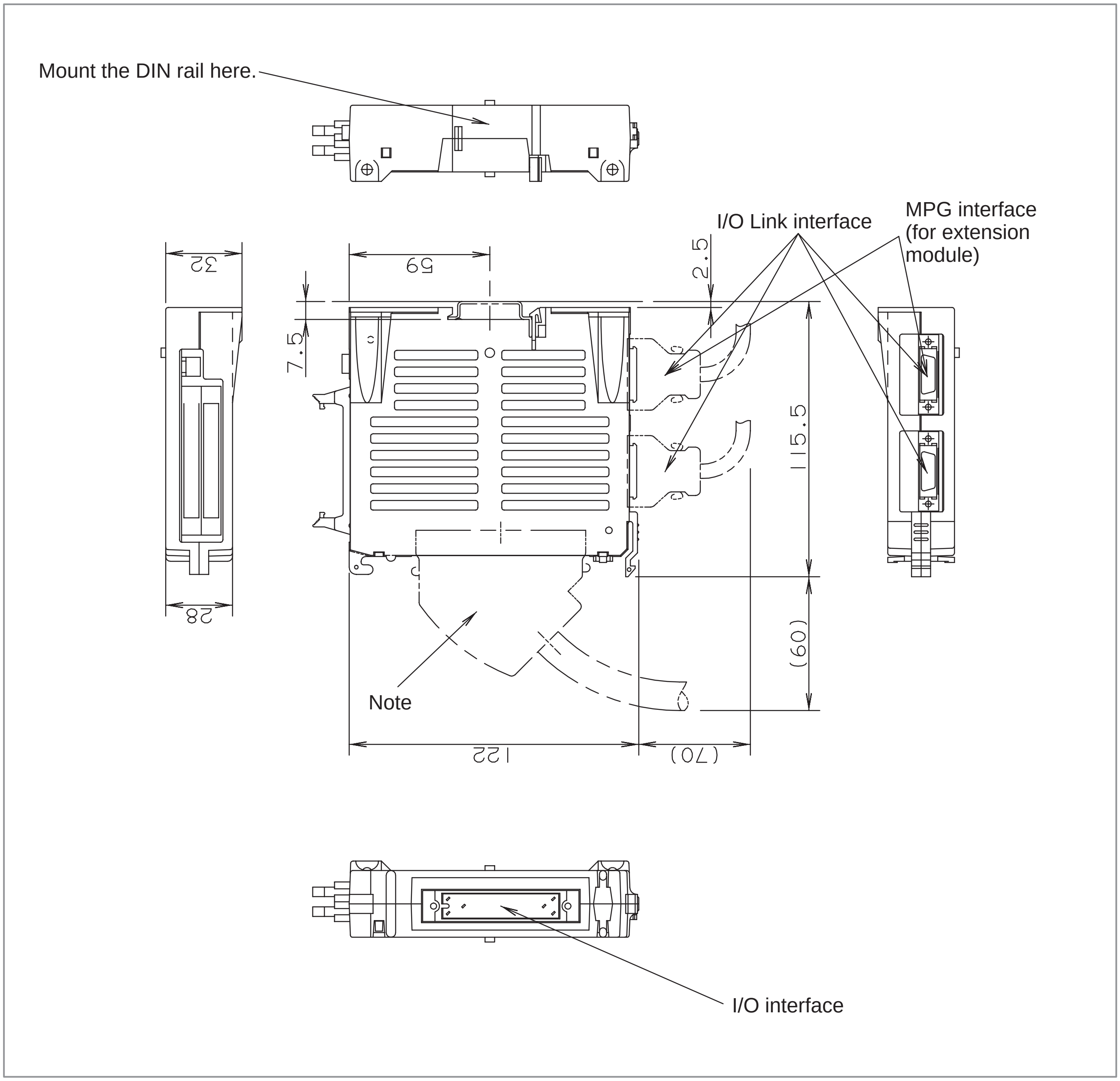
Dismounting the module

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

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.

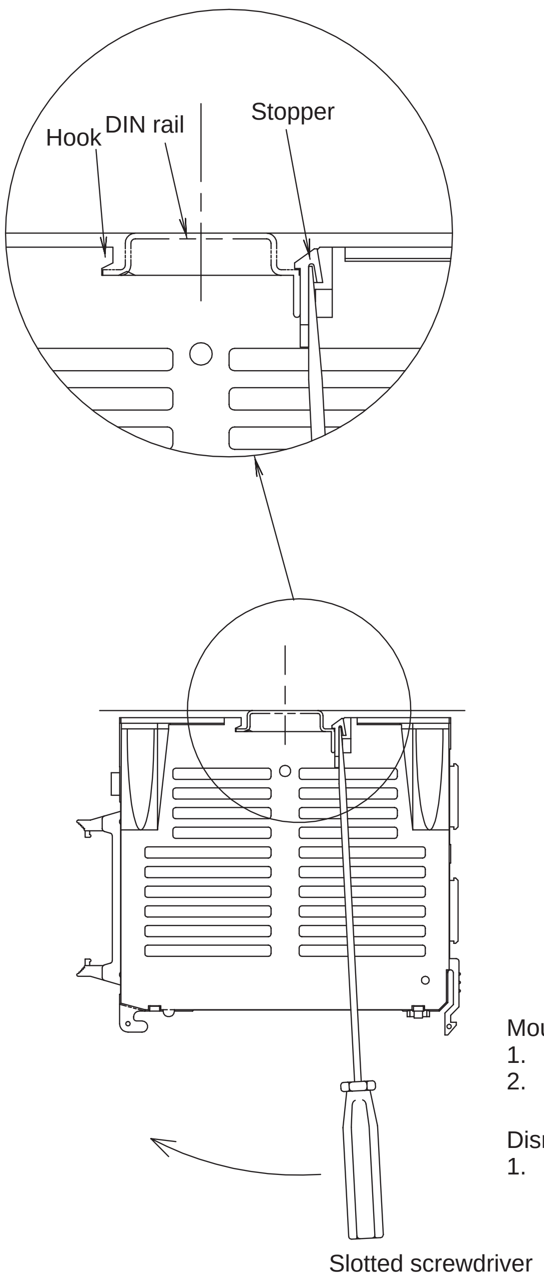
When mounting a DIN rail (external module view and mounting diagram)



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

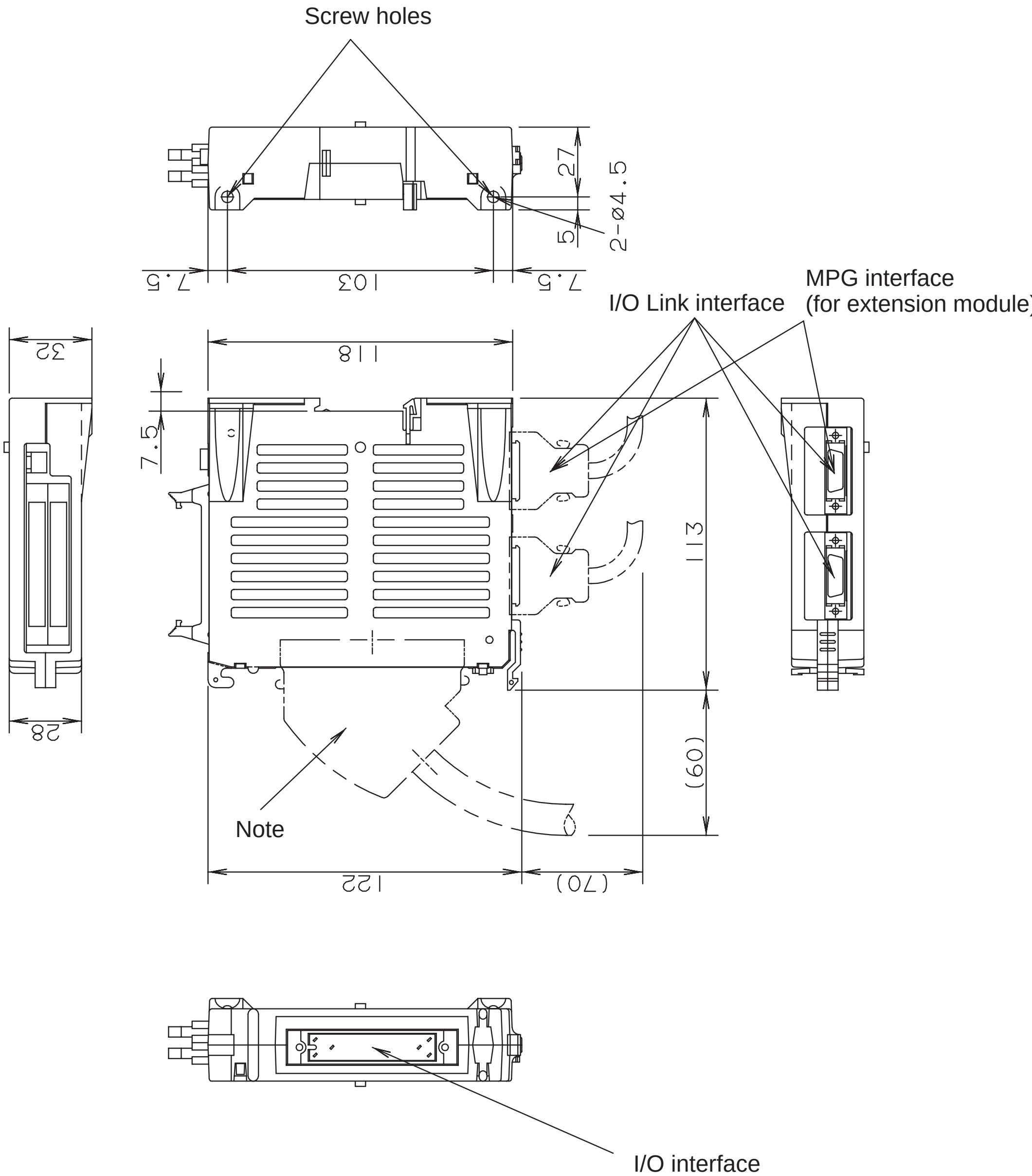
1. Insert the tip of the slotted screwdriver and push out the stopper in the direction indicated by the arrow.

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)



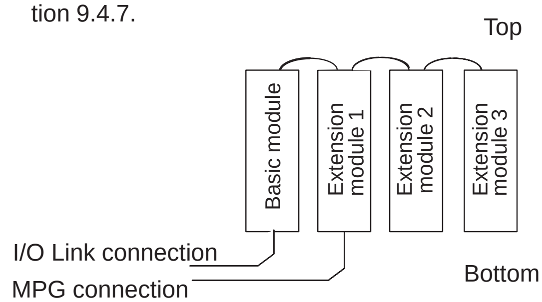
NOTE

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)

9.4.11 Specifications

Installation specifications

Ambient temperature	During operation 0° to 55°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. (2) To ensure adequate ventilation between I/O modules, install them as shown in the figure below. Allow a minimum of 100 mm above and below each module for wiring and ventilation. Do not place heat–generating apparatus under the I/O modules. (3) Ensure that the flat cables do not cover the vents of the basic module. For details, see Section 9.4.7. 

Ordering specifications

Item	Specification	Remarks
Connector panel I/O module (basic module)	A03B–0815–C001	DI/DO: 24/16
Connector panel I/O module (extension module with MPG interface)	A03B–0815–C002	DI/DO: 24/16
Connector panel I/O module (extension module without MPG interface)	A03B–0815–C003	DI/DO: 24/16
Fuse (replacement part)	A03B–0815–K002	1 A
Flat cable for module connection	A03B–0815–K100	Cable length: 20 mm (when modules are spaced 32 mm apart)

Module specifications

Item	Specification	Remarks
DI points	24 points	24 points per module (both basic and extension modules)
DO points	16 points	16 points per module (both basic and extension modules/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.
Interface between basic and extension modules	Bus connection using flat cables	Up to three extension modules can be connected to one basic module. Four modules can support up to 96 DI and 64 DO points.
MPG interface (for extension modules)	Max. 3 modules	Extension modules can be connected only for the *i* series CNC.

Power supply rating

Module	Supply voltage	Power supply rating	Remarks
Basic module	24 VDC ±10% is supplied from I/O connector CB150. The ±10% tolerance includes momentary and ripple currents.	0.2 A+7.3 mA×DI	DI = number of DI points in the ON state
Extension module		0.1 A+7.3 mA×DI	DI = number of DI points in the ON state

DI (input signal) specifications

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.

9.4.12 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	SKIPn and other fixed signals
X0005	Basic module	
X0006	Basic module	
X0007	Extension module 1	
X0008	Extension module 1	*ESP fixed signal
X0009	Extension module 1	*DECn fixed signal
X0010	Extension module 2	
X0011	Extension module 2	
X0012	Extension module 2	
X0013	Extension module 3	
X0014	Extension module 3	
X0015	Extension module 3	
X0016 (for 1st MPG)	Extension module 1	
X0017 (for 2nd MPG)	Extension module 1	
X0018 (for 3rd MPG)	Extension module 1	
X0019 (DO alarm detection)	Basic module	

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.

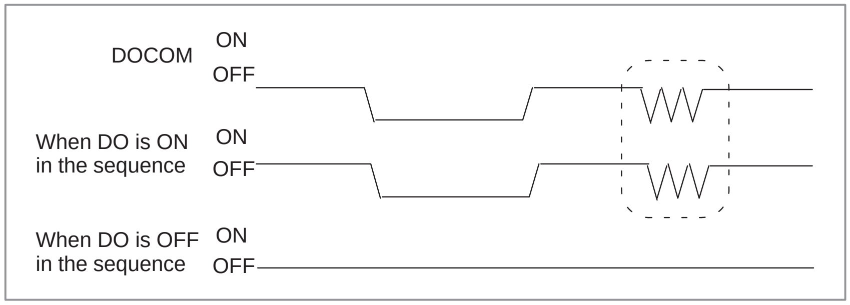
When DI addresses are allocated in units of 16 bytes, starting at X0007

X0007	Basic module	
X0008	Basic module	*ESP fixed signal
X0009	Basic module	*DECn fixed signal
X0010	Extension module 1	
X0011	Extension module 1	
X0012	Extension module 1	
X0013	Extension module 2	
X0014	Extension module 2	
X0015	Extension module 2	
X0016	Extension module 3	
X0017	Extension module 3	
X0018	Extension module 3	
X0019 (for 1st MPG)	Extension module 1	
X0020 (for 2nd MPG)	Extension module 1	
X0021 (for 3rd MPG)	Extension module 1	
X0022 (DO alarm detection)	Basic module	

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.

Turning the DO (output signal) power on and off (DOCOM)

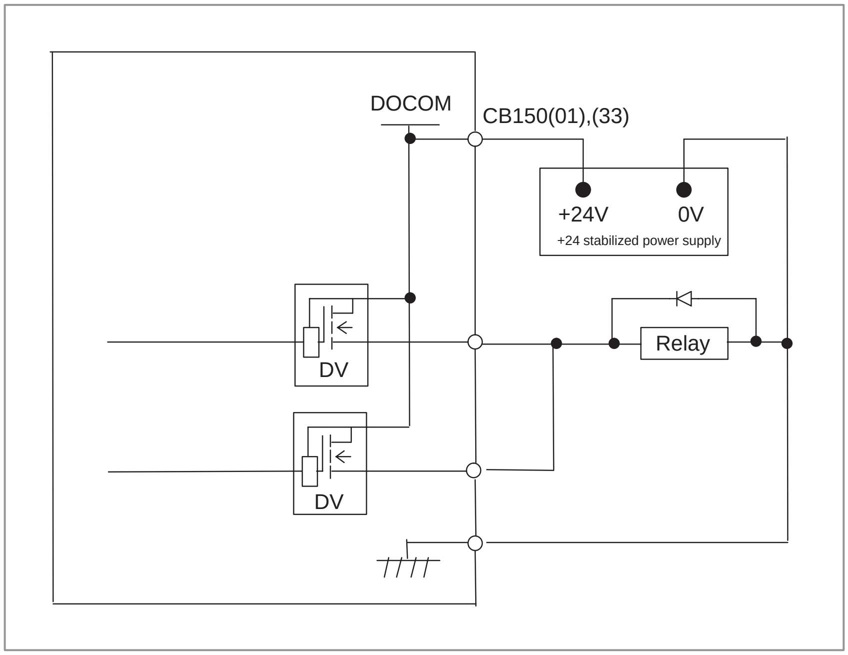
All the DO signals of each module can be turned off simultaneously by turning off (opening) the DO (output signal) power supply pin “DOCOM”. Doing so causes the DO signal status to change as shown below.



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 the dotted lines in the above figure. Do not turn off the +24 V supply to the I/O module during this 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 started 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 stopped 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).



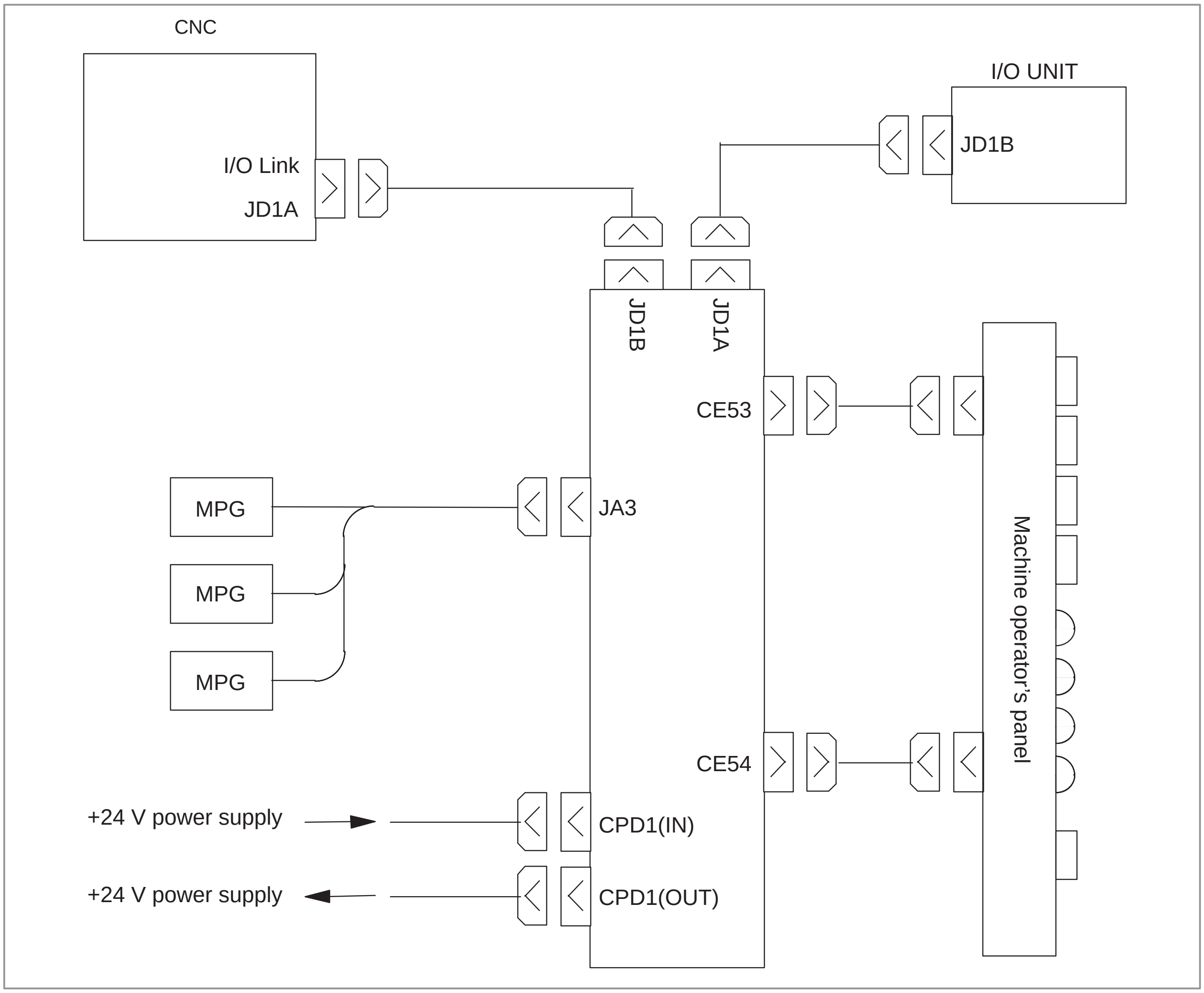
DO (output signal) alarm detection

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	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

9.5 CONNECTION OF OPERATOR’S PANEL I/O MODULE (FOR MATRIX INPUT)

9.5.1 Overall Connection Diagram



NOTE

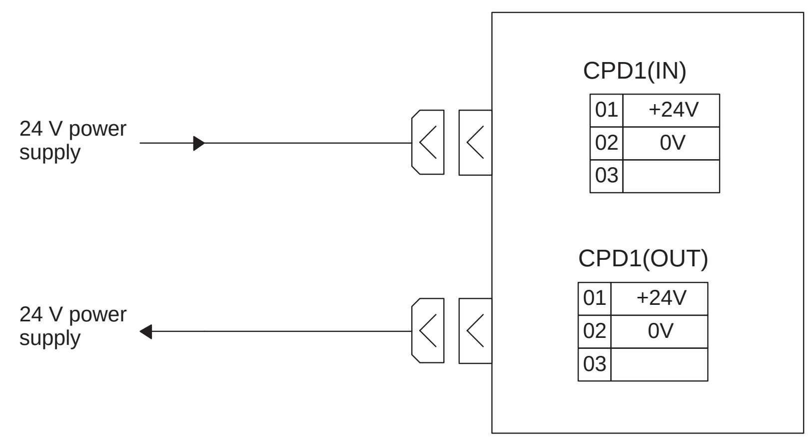
The MPG can be connected to this operator’s panel I/O module only when the *i* series CNC is used. When the operator’s panel I/O module is used together with a unit (connector panel I/O module) connected to the I/O Link supporting another MPG interface, only the MPG interface of the unit (module) closest 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.

9.5.2 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.

9.5.3 DI/DO Connector Pin Arrangement

CE53

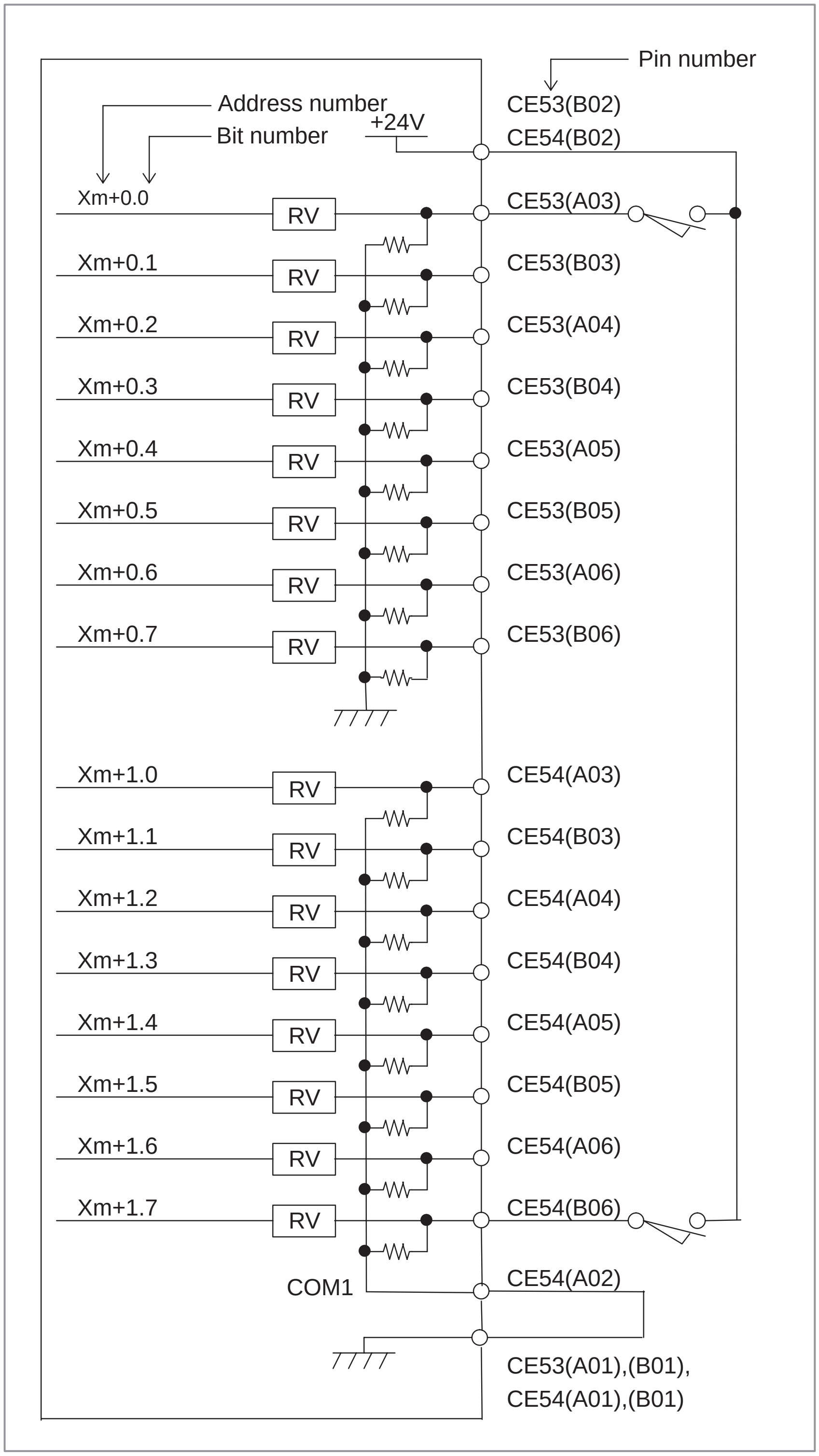
	A	B
01	0V	0V
02	N.C.	+24V
03	Xm+0.0	Xm+0.1
04	Xm+0.2	Xm+0.3
05	Xm+0.4	Xm+0.5
06	Xm+0.6	Xm+0.7
07	Yn+0.0	Yn+0.1
08	Yn+0.2	Yn+0.3
09	Yn+0.4	Yn+0.5
10	Yn+0.6	Yn+0.7
11	Yn+1.0	Yn+1.1
12	Yn+1.2	Yn+1.3
13	Yn+1.4	Yn+1.5
14	Yn+1.6	Yn+1.7
15	Yn+2.0	Yn+2.1
16	Yn+2.2	Yn+2.3
17	Yn+2.4	Yn+2.5
18	Yn+2.6	Yn+2.7
19	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.))

9.5.4 DI (General–Purpose Input Signal) Connection



NOTE

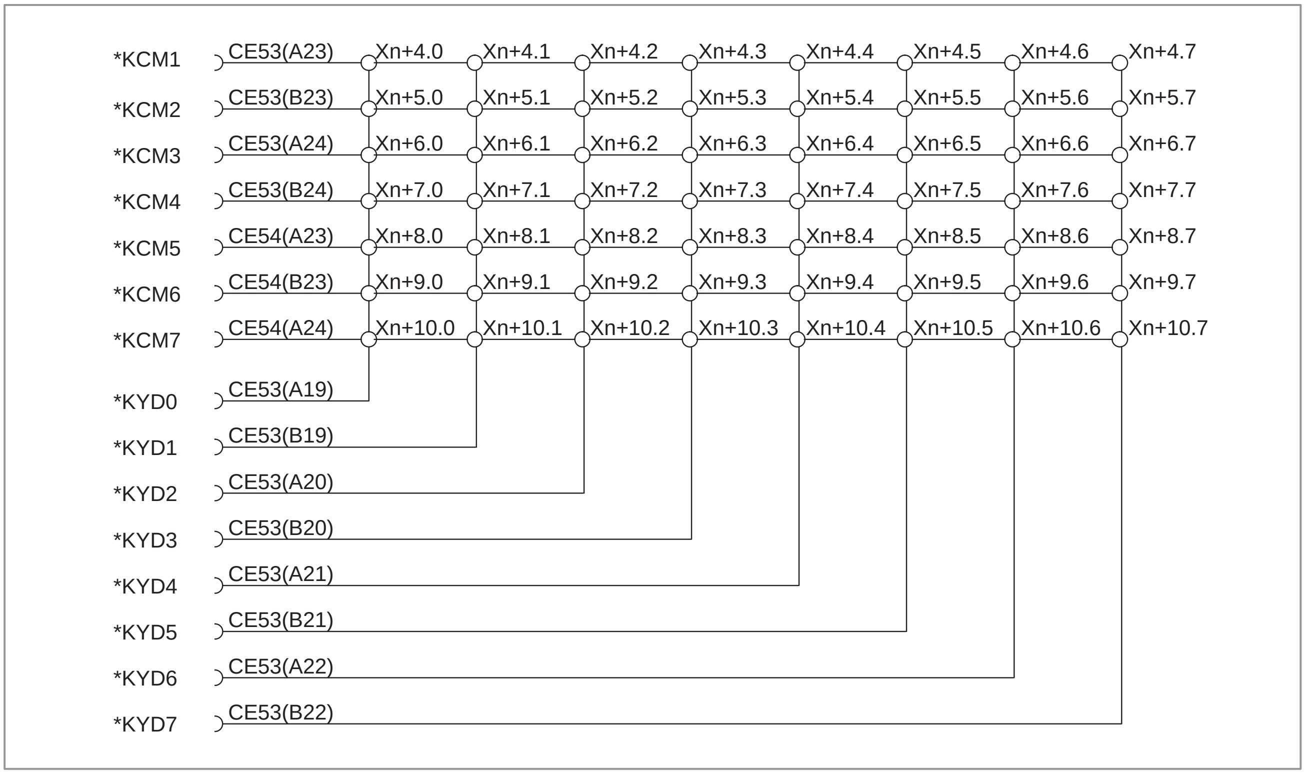
Xm+1.0 through Xm+1.7 are DI pins for which a common voltage can be selected. That is, by connecting the COM1 CE54(A02) pin to the +24 V power supply, a DI signal can be input with its logical state reversed. If, however, a cable is connected to ground, it has the same effect as inputting an ON state 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.

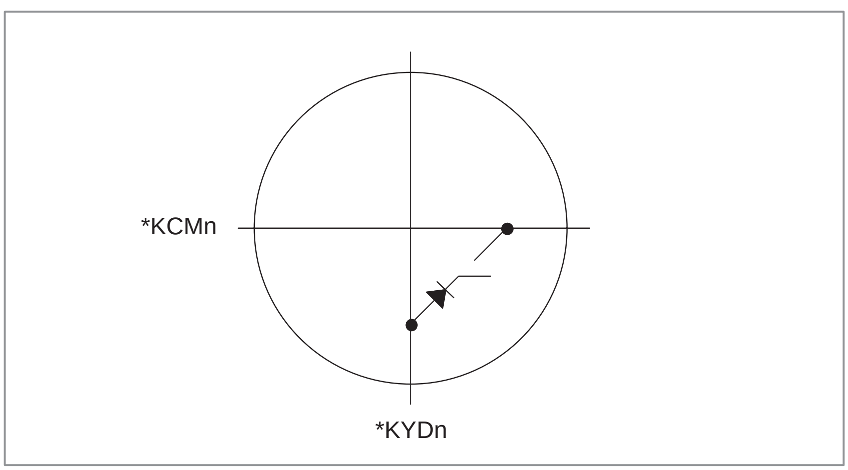
9.5.5 DI (Matrix Input Signal) Connection

○ A maximum of 56 points are provided.



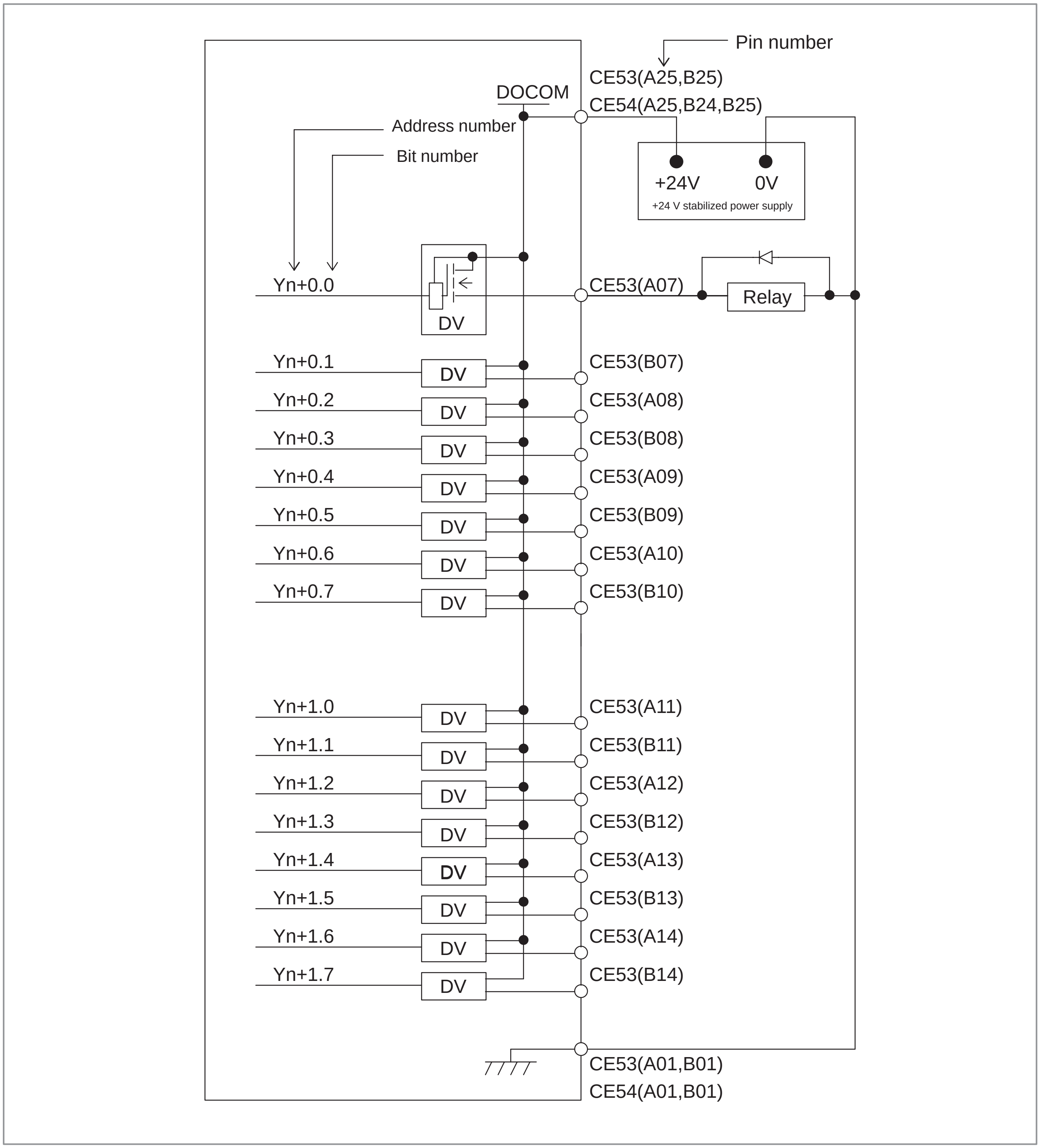
NOTE

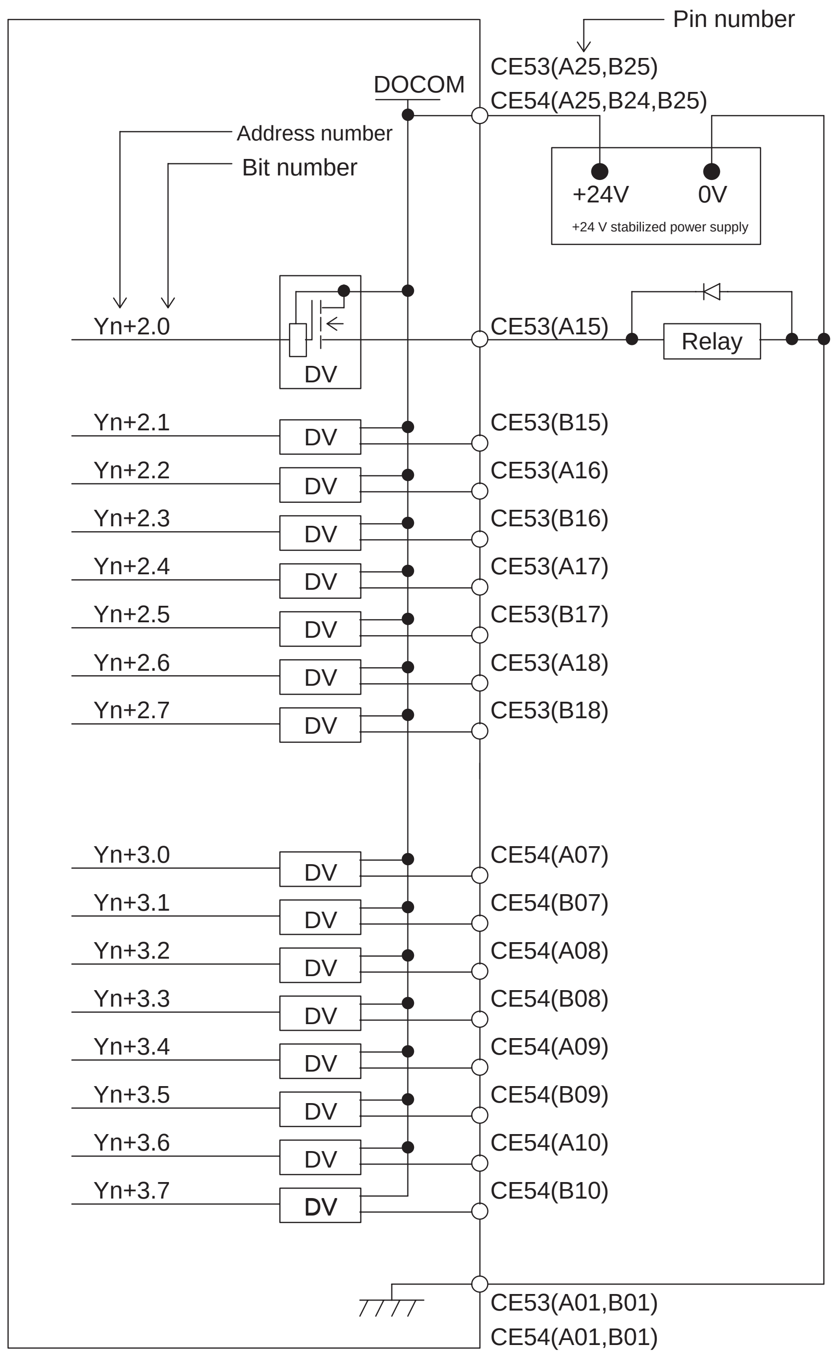
Detour prevention diodes must be incorporated for matrix signal input, as shown in the following figure. Otherwise, only two signals can be input at the same time. Inputting three or more signals simultaneously without using detour prevention diodes may result in data input errors.



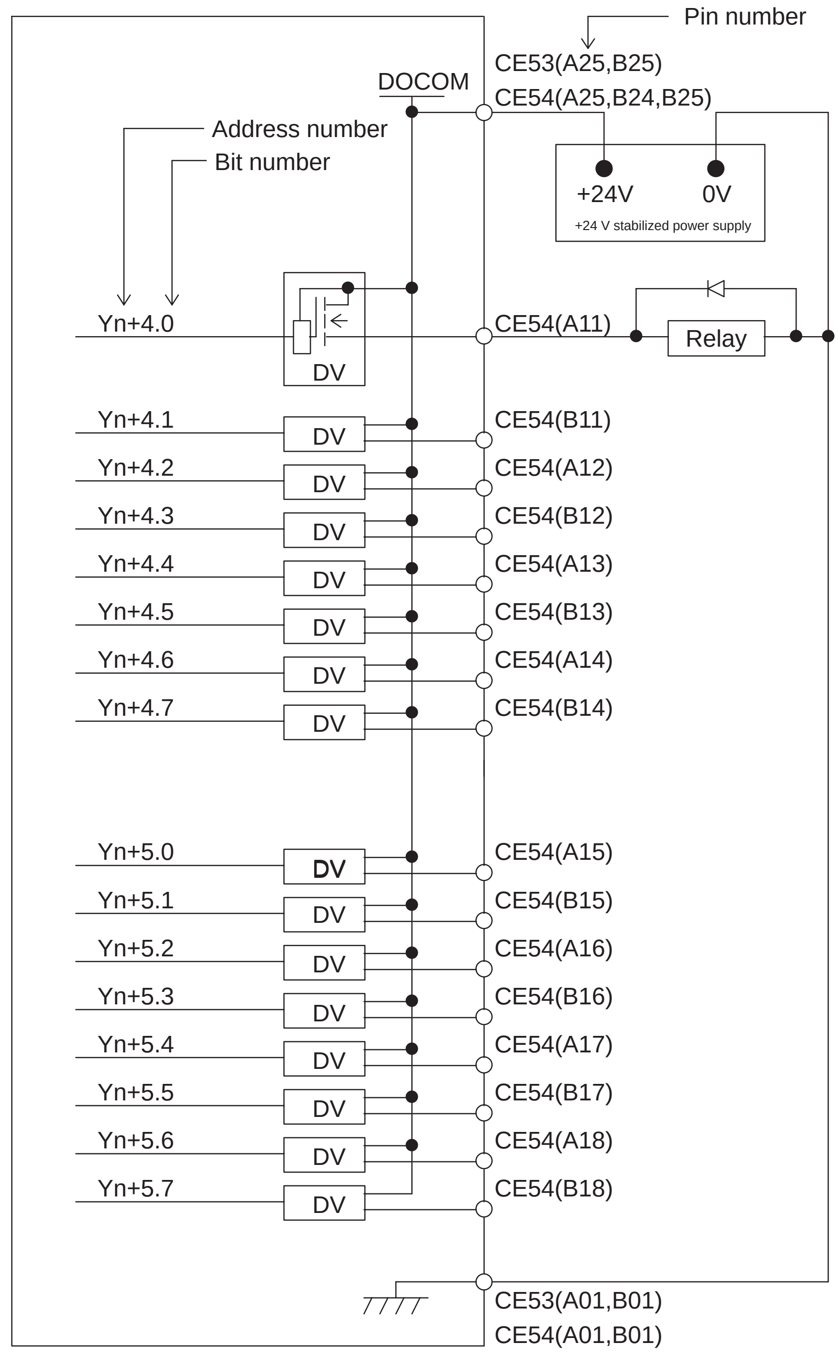
9.5.6 DO (Output Signal) Connection

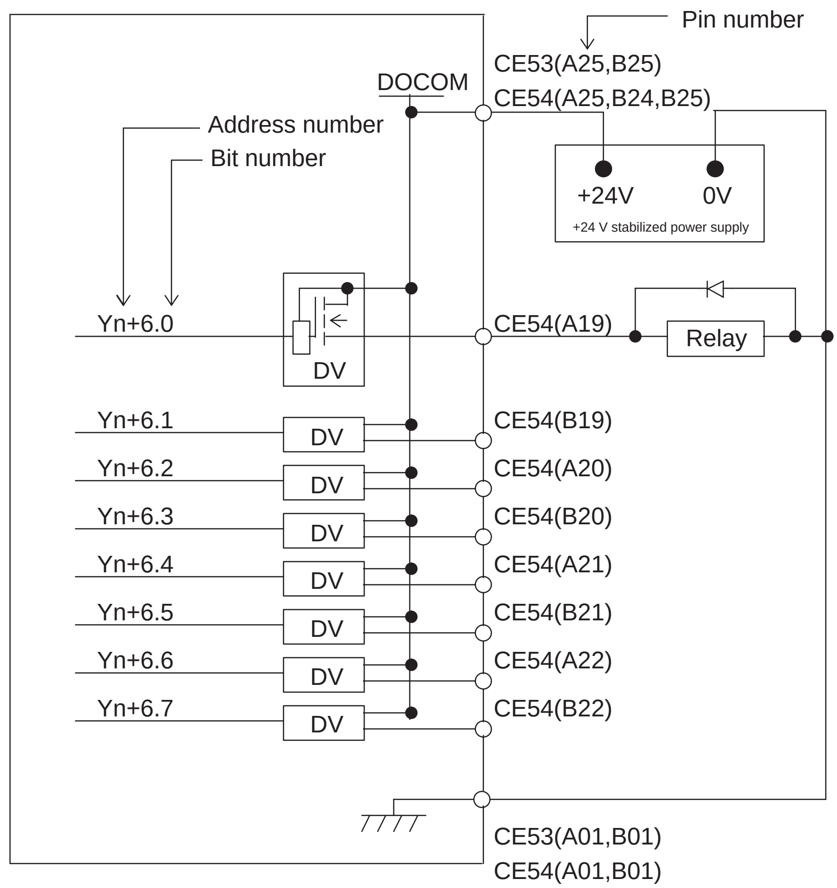
○ A maximum of 56 points are provided.





Pin number
CE53(A25,B25)
DOCOM
CE54(A25,B24,B25)
Address number
Bit number
+24V
0V
+24 V stabilized power supply
Yn+2.0
DV
CE53(A15)
Relay
Yn+2.1
DV
CE53(B15)
Yn+2.2
DV
CE53(A16)
Yn+2.3
DV
CE53(B16)
Yn+2.4
DV
CE53(A17)
Yn+2.5
DV
CE53(B17)
Yn+2.6
DV
CE53(A18)
Yn+2.7
DV
CE53(B18)
Yn+3.0
DV
CE54(A07)
Yn+3.1
DV
CE54(B07)
Yn+3.2
DV
CE54(A08)
Yn+3.3
DV
CE54(B08)
Yn+3.4
DV
CE54(A09)
Yn+3.5
DV
CE54(B09)
Yn+3.6
DV
CE54(A10)
Yn+3.7
DV
CE54(B10)
CE53(A01,B01)
CE54(A01,B01)

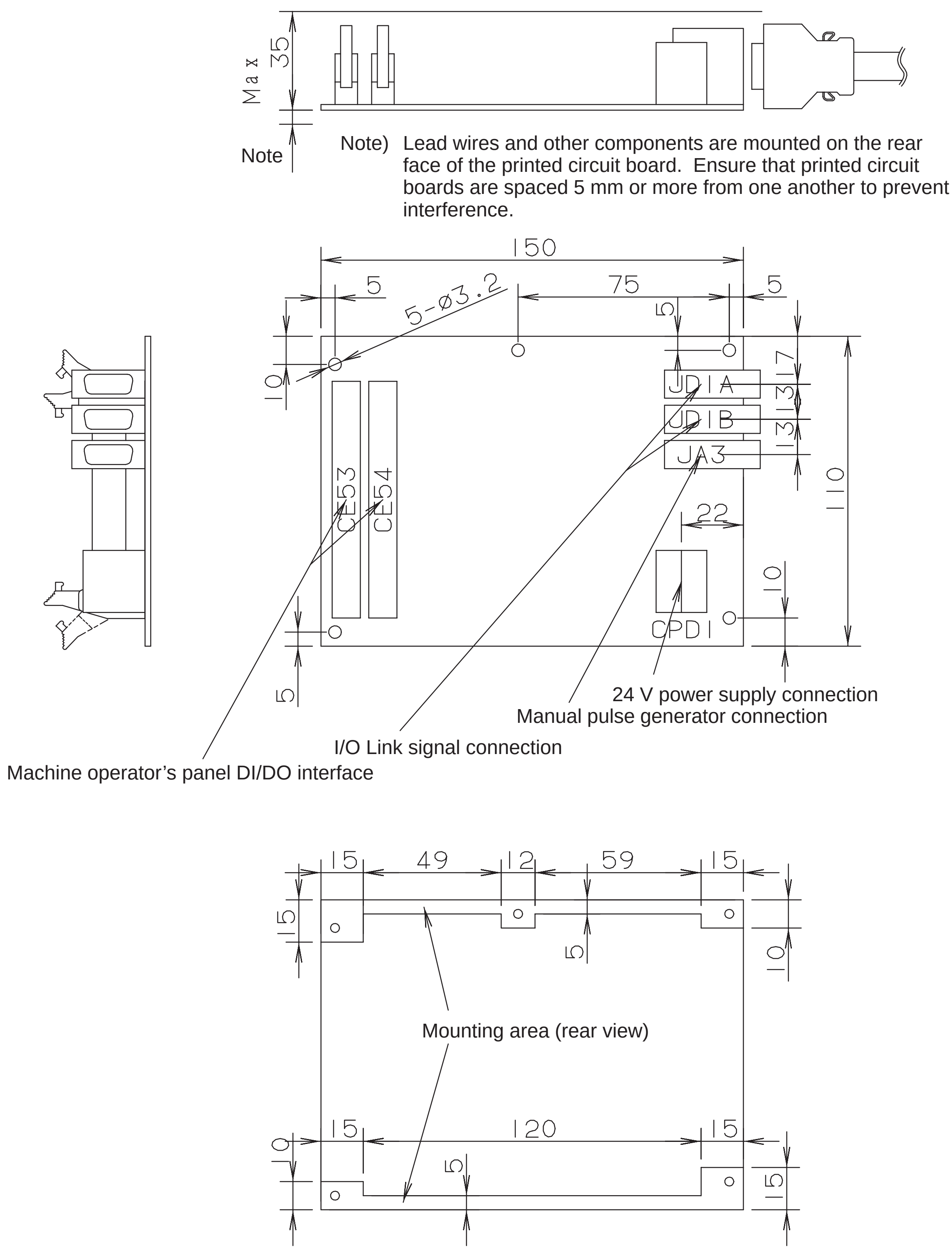

Pin number
CE53(A25,B25)
DOCOM
CE54(A25,B24,B25)
Address number
Bit number
+24V
0V
+24 V stabilized power supply
Yn+4.0
CE54(A11)
Relay
DV
Yn+4.1
CE54(B11)
Yn+4.2
CE54(A12)
Yn+4.3
CE54(B12)
Yn+4.4
CE54(A13)
Yn+4.5
CE54(B13)
Yn+4.6
CE54(A14)
Yn+4.7
CE54(B14)
Yn+5.0
CE54(A15)
Yn+5.1
CE54(B15)
Yn+5.2
CE54(A16)
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)



9.5.7 Manual Pulse Generator Connection

For details of the connection of the manual pulse generator, see Section 9.4.6.

9.5.8 External View



9.5.9 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	

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.

9.5.10 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.

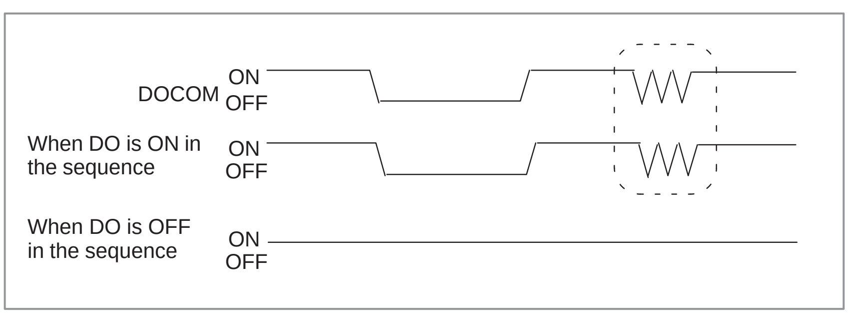
When DI addresses are allocated in units of 16 bytes, starting at X0008

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.

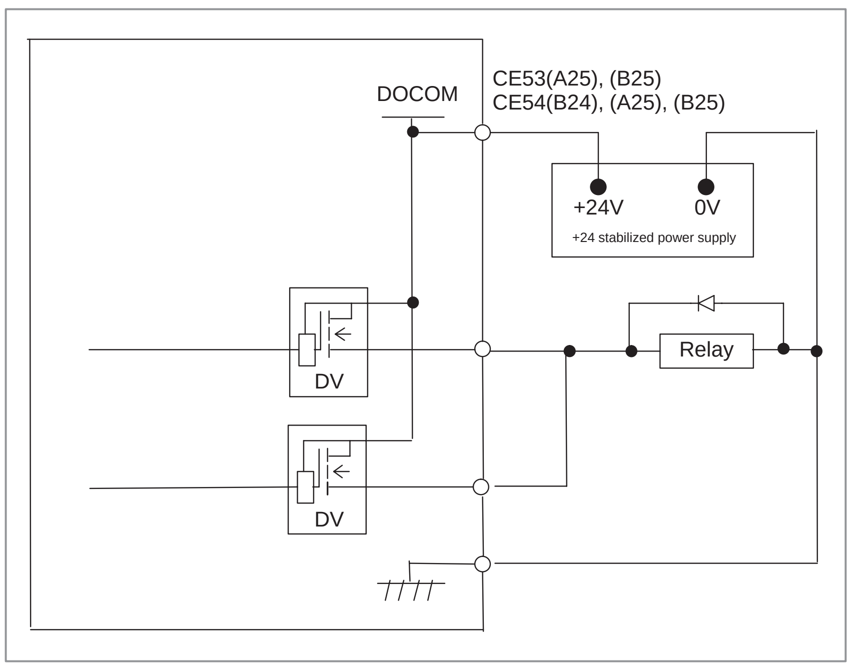


NOTE

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).



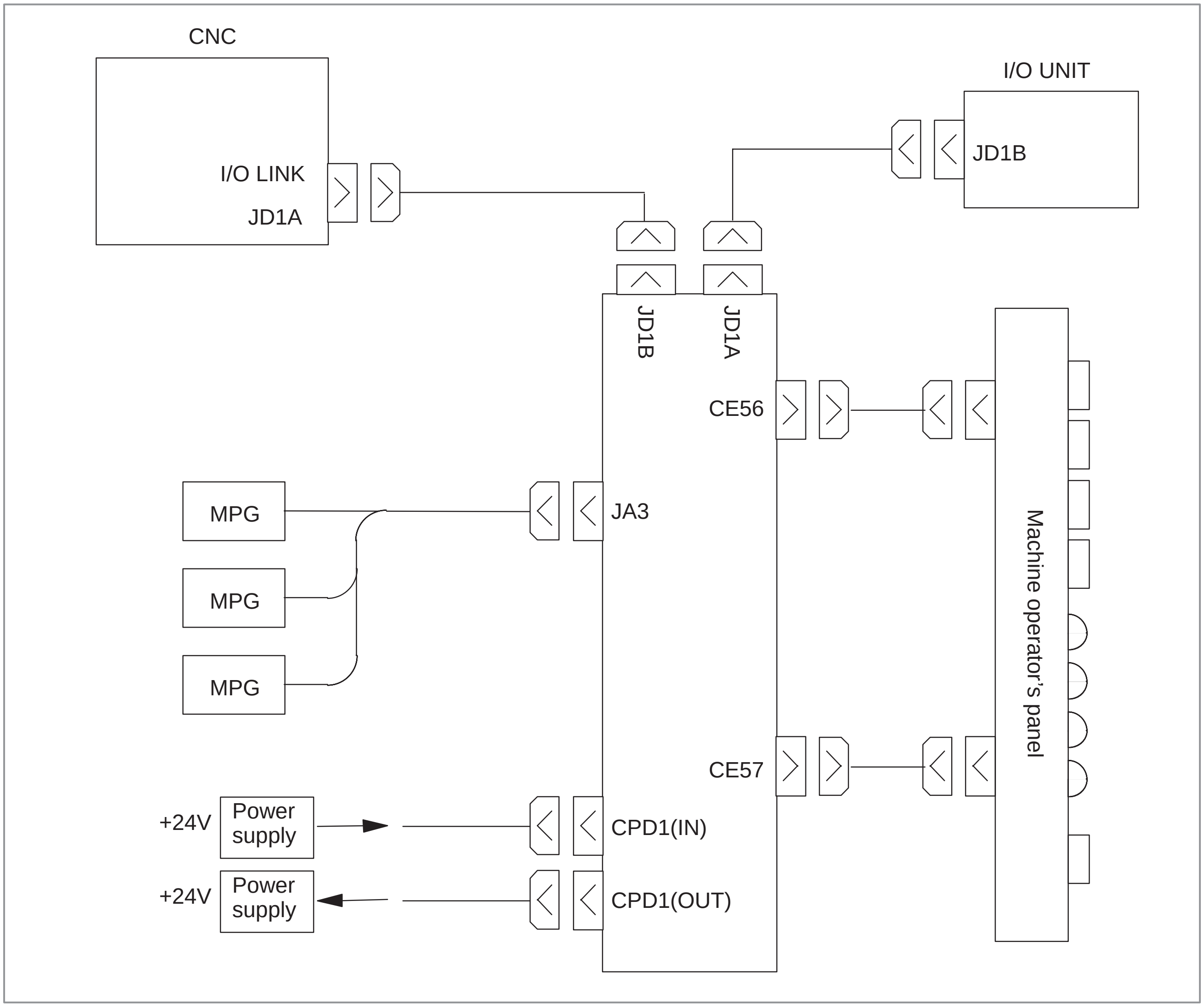
DO (output signal) alarm detection

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

9.6 CONNECTION OF OPERATOR'S PANEL I/O MODULE

9.6.1 Overall Connection Diagram



NOTE

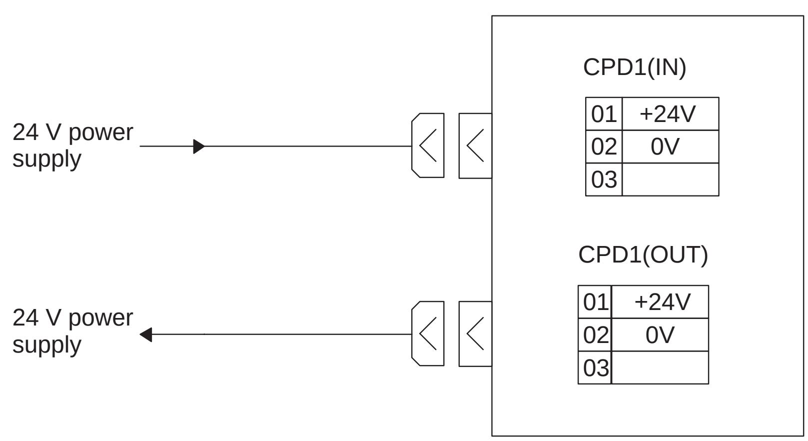
The MPG can be connected to this operator's panel I/O module only when the *i* series CNC is used. When the operator's panel I/O module is used together with a unit (connector panel I/O module) connected to the I/O Link supporting another MPG interface, only the MPG interface of the unit (module) closest 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.

9.6.2 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.

9.6.3 DI/DO Connector Pin Arrangement

CE56

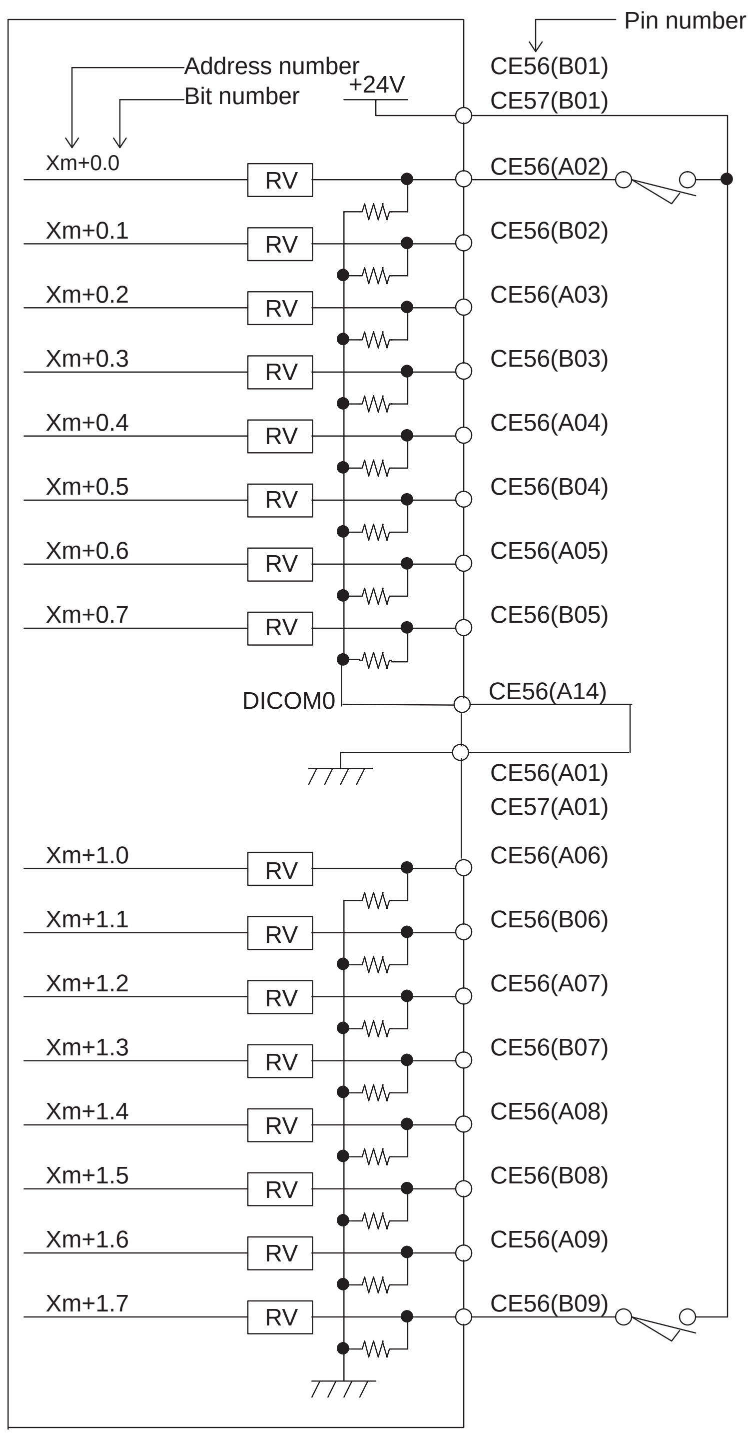
	A	B
01	0V	+24V
02	Xm+0.0	Xm+0.1
03	Xm+0.2	Xm+0.3
04	Xm+0.4	Xm+0.5
05	Xm+0.6	Xm+0.7
06	Xm+1.0	Xm+1.1
07	Xm+1.2	Xm+1.3
08	Xm+1.4	Xm+1.5
09	Xm+1.6	Xm+1.7
10	Xm+2.0	Xm+2.1
11	Xm+2.2	Xm+2.3
12	Xm+2.4	Xm+2.5
13	Xm+2.6	Xm+2.7
14	DICOM0	
15		
16	Yn+0.0	Yn+0.1
17	Yn+0.2	Yn+0.3
18	Yn+0.4	Yn+0.5
19	Yn+0.6	Yn+0.7
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

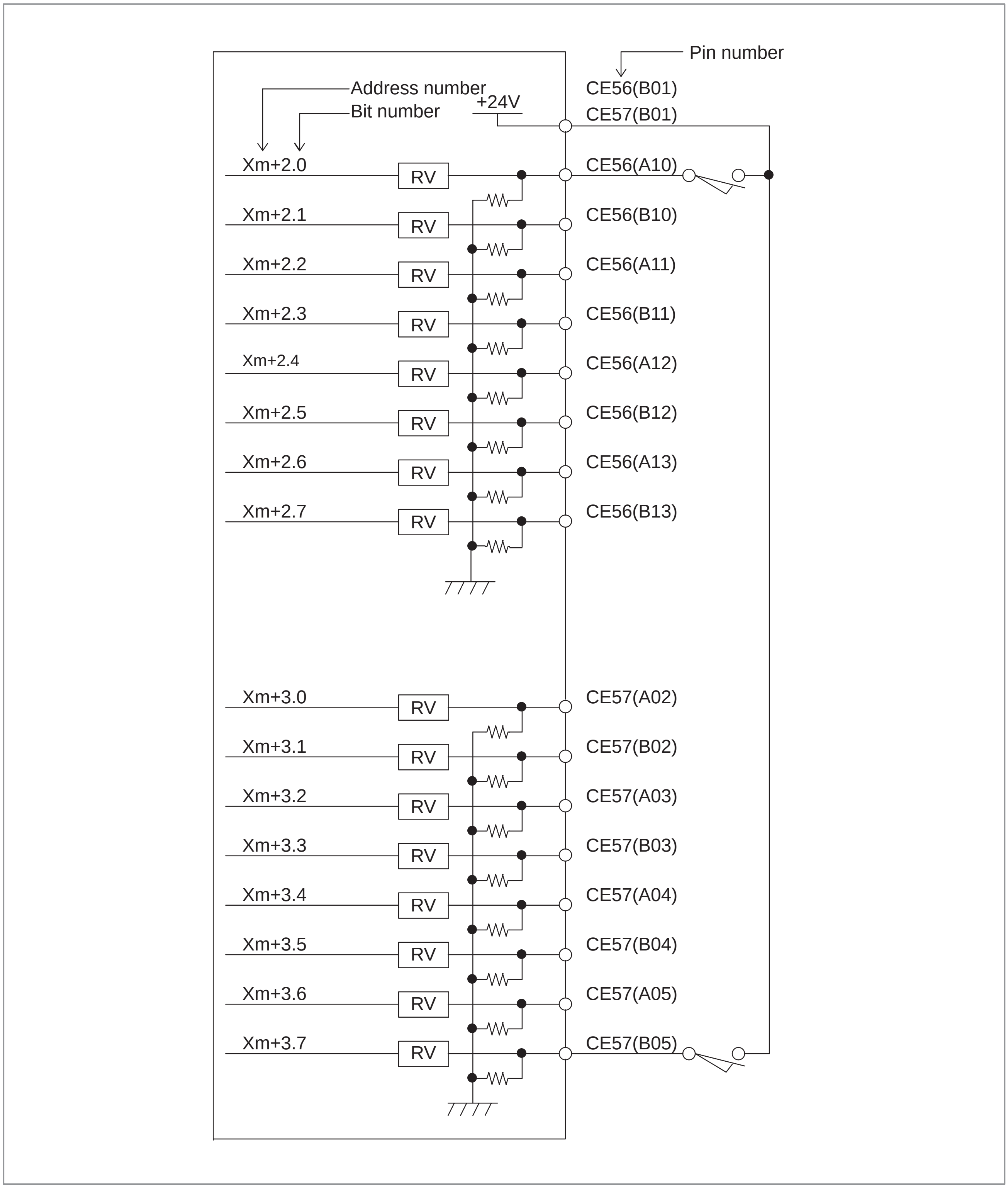
CE57

	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

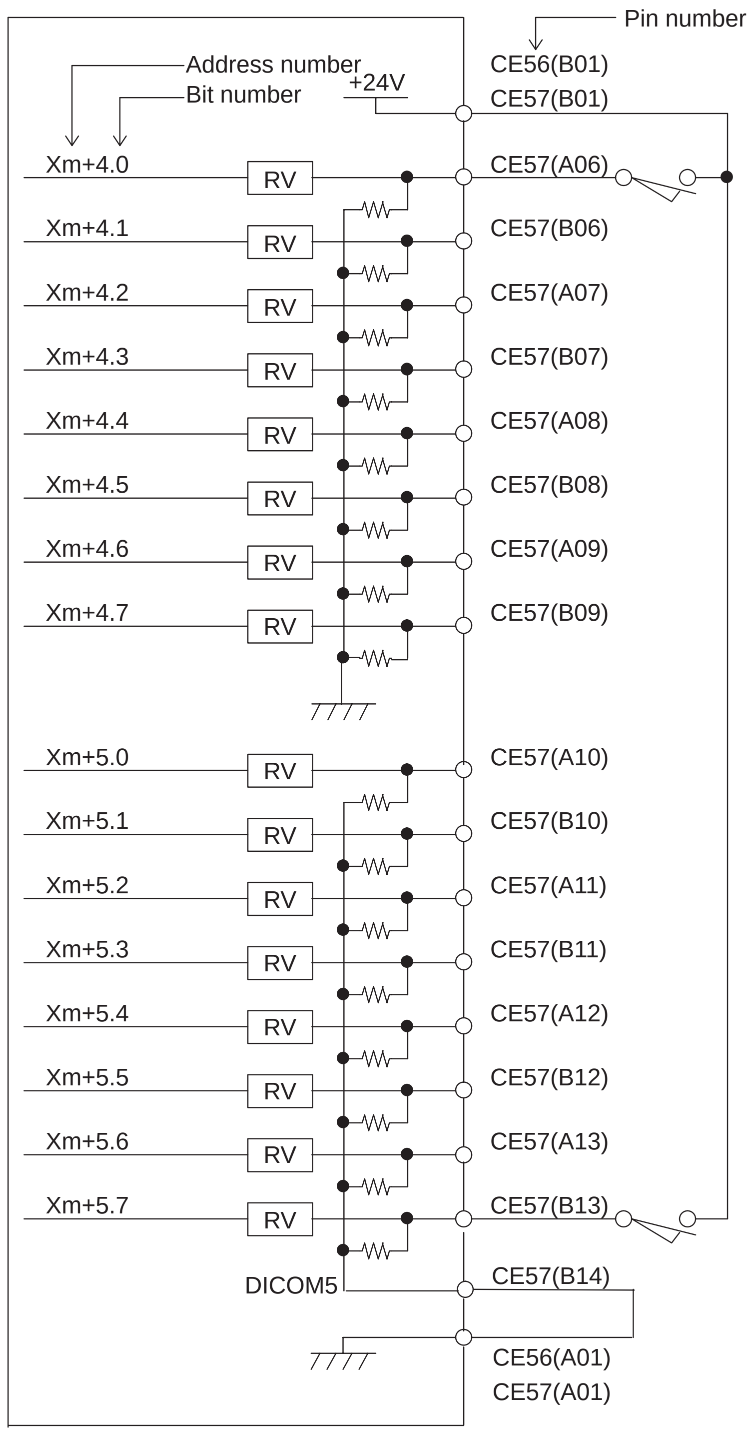
Flat cable–side connector specification:
A02B–0120–K342
(HIFBB–50D–2.54R (Hirose Electric Co., Ltd.))
50 contacts
Cable material specification:
A02B–0120–K886
(61–meter, 50–pin cable
(Hitachi Cable, Ltd. or Oki Electric Cable Co., Ltd.))

9.6.4 DI (General–Purpose Input Signal) Connection





Pin number
Address number
Bit number
+24V
CE56(B01)
CE57(B01)
Xm+2.0
Xm+2.1
Xm+2.2
Xm+2.3
Xm+2.4
Xm+2.5
Xm+2.6
Xm+2.7
RV
CE56(A10)
CE56(B10)
CE56(A11)
CE56(B11)
CE56(A12)
CE56(B12)
CE56(A13)
CE56(B13)
Xm+3.0
Xm+3.1
Xm+3.2
Xm+3.3
Xm+3.4
Xm+3.5
Xm+3.6
Xm+3.7
CE57(A02)
CE57(B02)
CE57(A03)
CE57(B03)
CE57(A04)
CE57(B04)
CE57(A05)
CE57(B05)


Pin number
Address number
Bit number
+24V
CE56(B01)
CE57(B01)
Xm+4.0
RV
CE57(A06)
Xm+4.1
CE57(B06)
Xm+4.2
CE57(A07)
Xm+4.3
CE57(B07)
Xm+4.4
CE57(A08)
Xm+4.5
CE57(B08)
Xm+4.6
CE57(A09)
Xm+4.7
CE57(B09)
Xm+5.0
CE57(A10)
Xm+5.1
CE57(B10)
Xm+5.2
CE57(A11)
Xm+5.3
CE57(B11)
Xm+5.4
CE57(A12)
Xm+5.5
CE57(B12)
Xm+5.6
CE57(A13)
Xm+5.7
CE57(B13)
DICOM5
CE57(B14)
CE56(A01)
CE57(A01)

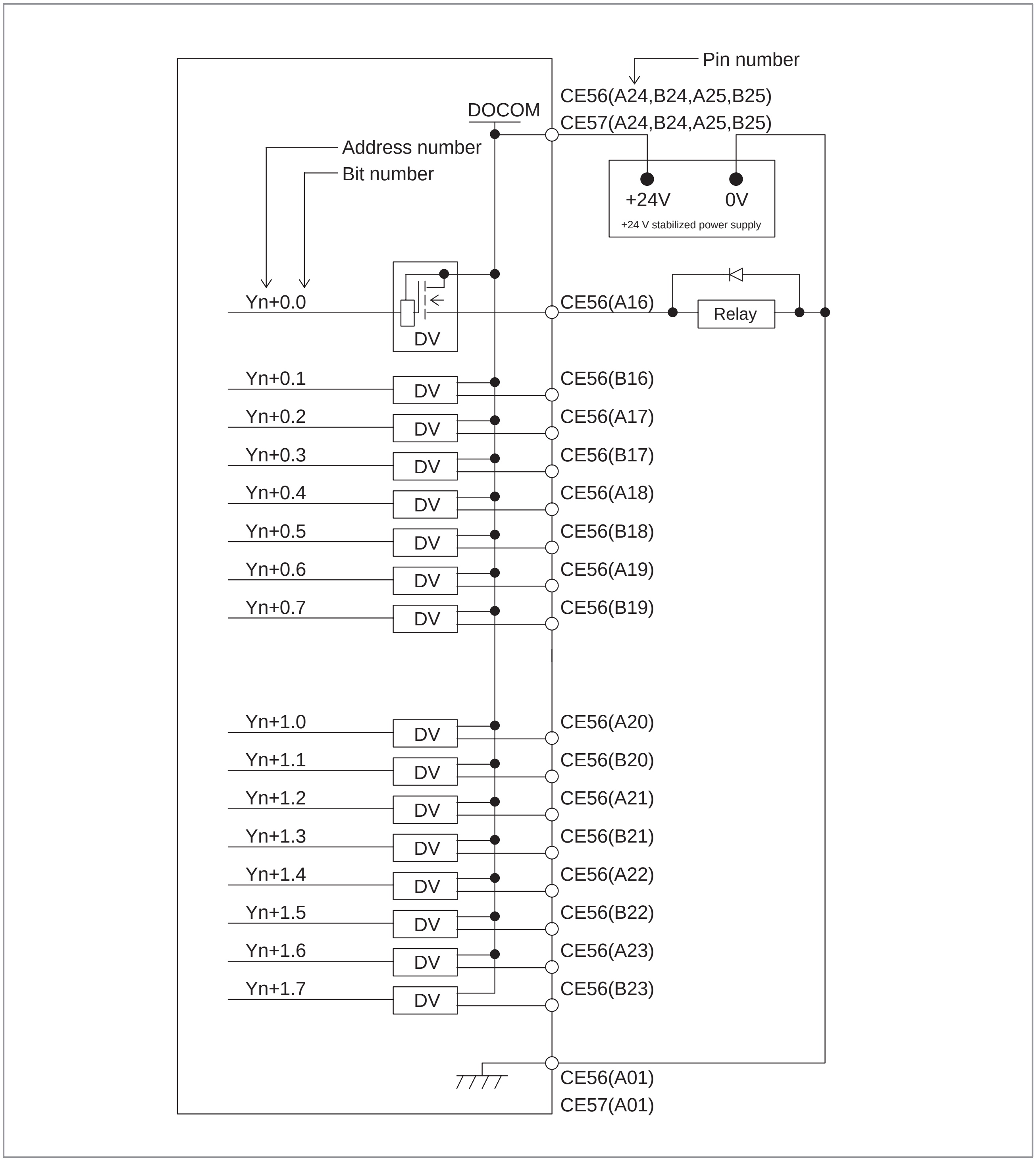
NOTE

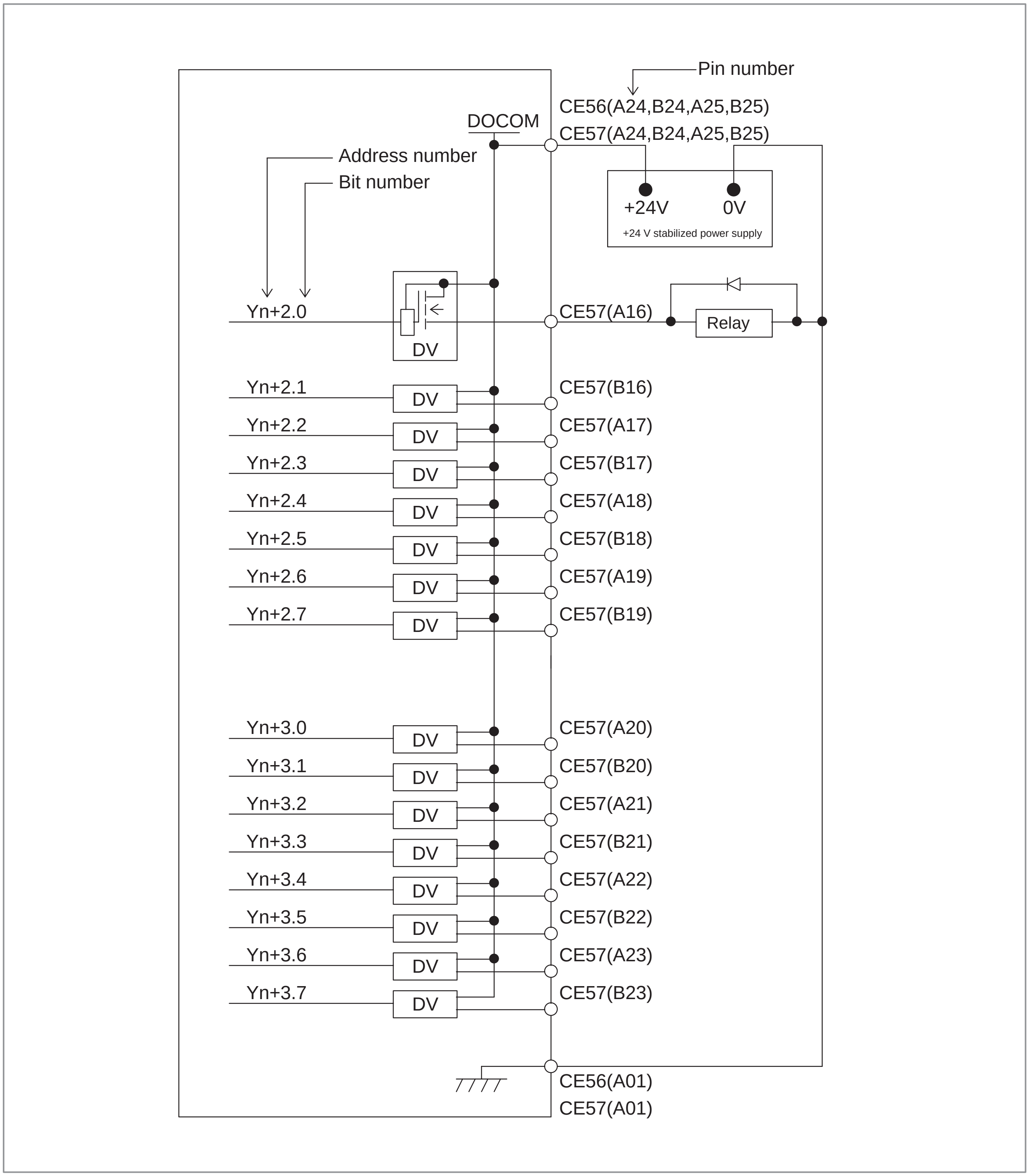
Xm+0.0 through Xm+0.7 and Xm+5.0 through Xm+5.7 are DI pins for which a common voltage can be selected. That is, by connecting the DICOM0 CE56(A14) or DICOM5 CE57(B14) pin to the +24 V power supply, a DI signal can be input with its logical state reversed. If, however, a cable is connected to ground, 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.

9.6.5 DO (Output Signal) Connection

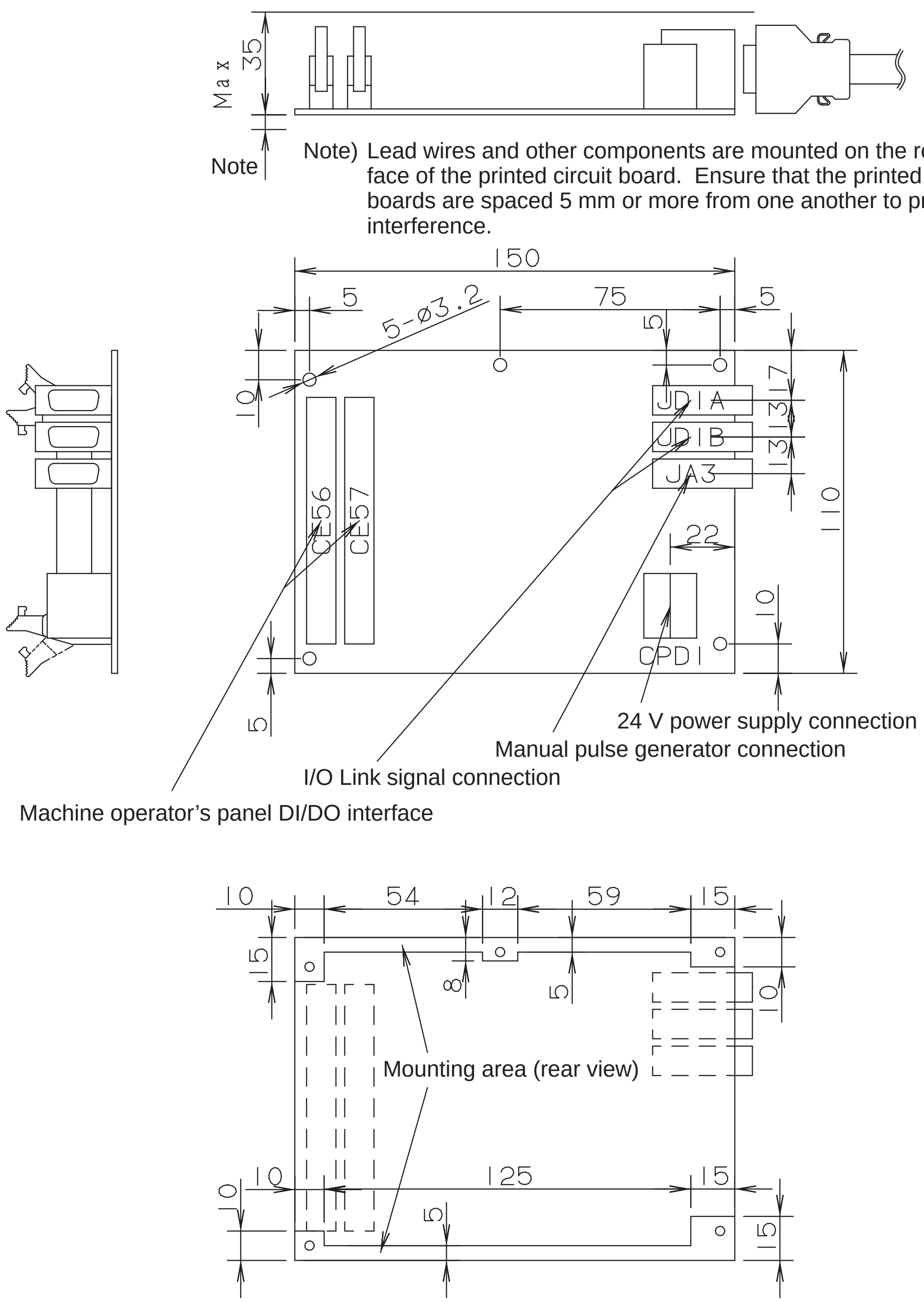



Pin number
CE56(A24,B24,A25,B25)
CE57(A24,B24,A25,B25)
DOCOM
Address number
Bit number
+24V
0V
+24 V stabilized power supply
Yn+2.0
DV
CE57(A16)
Relay
Yn+2.1
CE57(B16)
Yn+2.2
CE57(A17)
Yn+2.3
CE57(B17)
Yn+2.4
CE57(A18)
Yn+2.5
CE57(B18)
Yn+2.6
CE57(A19)
Yn+2.7
CE57(B19)
Yn+3.0
CE57(A20)
Yn+3.1
CE57(B20)
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)

9.6.6 Manual Pulse Generator Connection

For details of the connection of the manual pulse generator, see Section 9.4.6.

9.6.7 External View



9.6.8 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.
Operator's 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.

9.6.9 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.

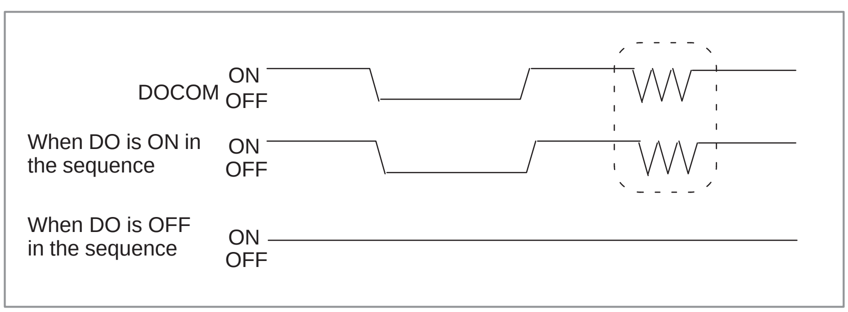
When DI addresses are allocated in units of 16 bytes, starting at X0004

X0004	Input signal
X0005	
X0006	
X0007	
X0008	← *ESP fixed signal
X0009	← *DECn fixed signal
X0010	Not used
X0011	
X0012	
X0013	
X0014	
X0015	
X0016 (for 1st MPG)	MPG
X0017 (for 2nd MPG)	
X0018 (for 3rd MPG)	
X0019 (DO alarm detection)	DO alarm detection

Allocating DI addresses from X0004 allows the fixed signals, such as SKIP and *DECn, to be used and the *ESP fixed signal to be allocated to an address for which the common voltage in fixed to 24 V.

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.

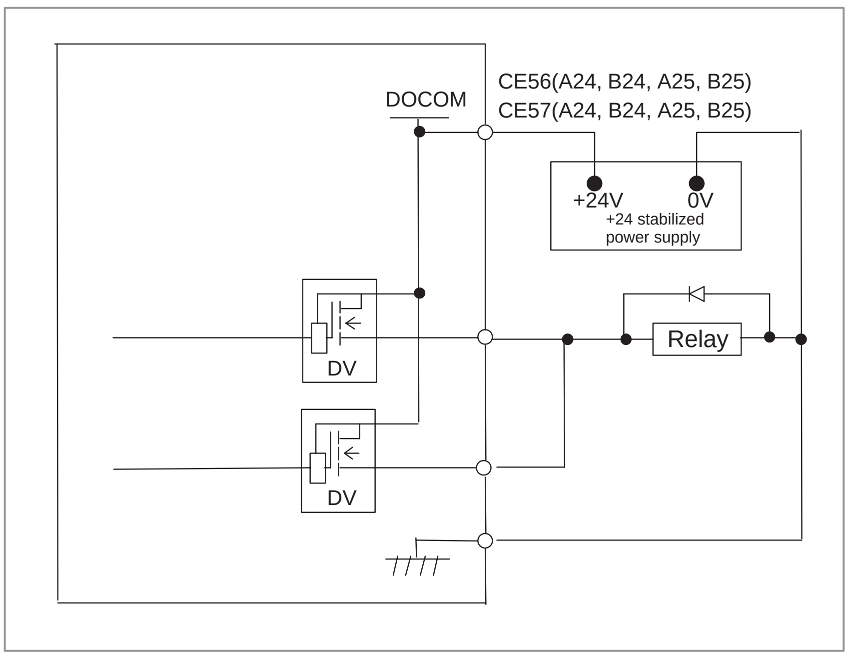


NOTE

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).



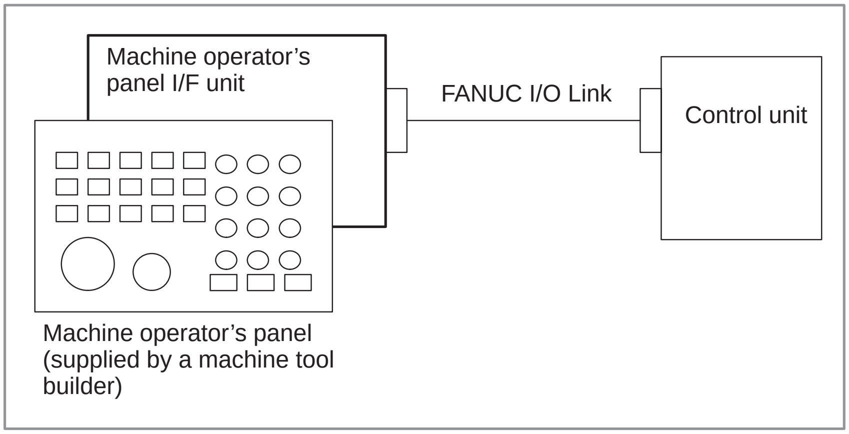
DO (output signal) alarm detection

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

9.7 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.



9.7.1 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

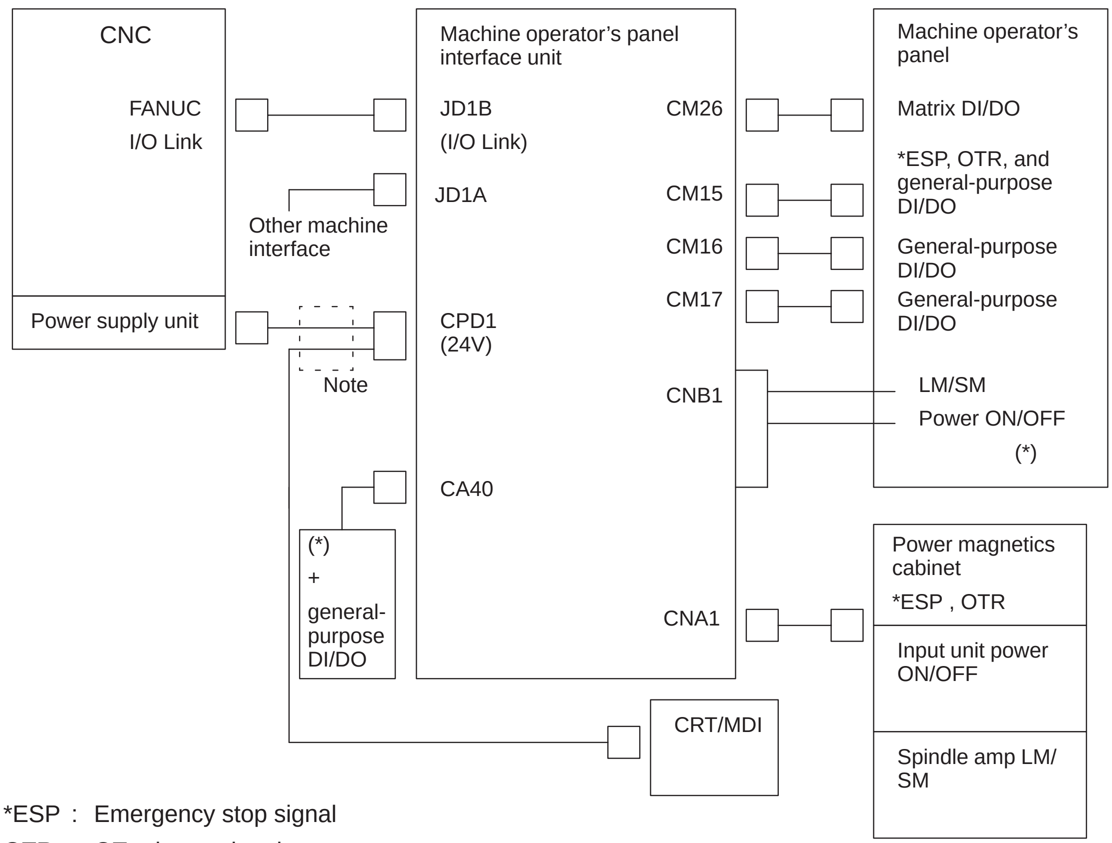
- Emergency stop and OT release signals are forwarded without change to the power magnetics cabinet.
- Power ON/OFF control signals are forwarded without change to an input unit.
- Analog signal inputs described in item “Analog signal inputs” can be sent out without being changed.

First manual pulse generator

Pulse information from the manual pulse generator is transferred via an I/O Link. This is selected according to the interface with the manual pulse generator in the control unit, and the set parameters.

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.

9.7.2 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
Power requirements
When 60% of the DI/DO points are on, this interface unit requires "1.0 A"

9.7.3
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.

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)

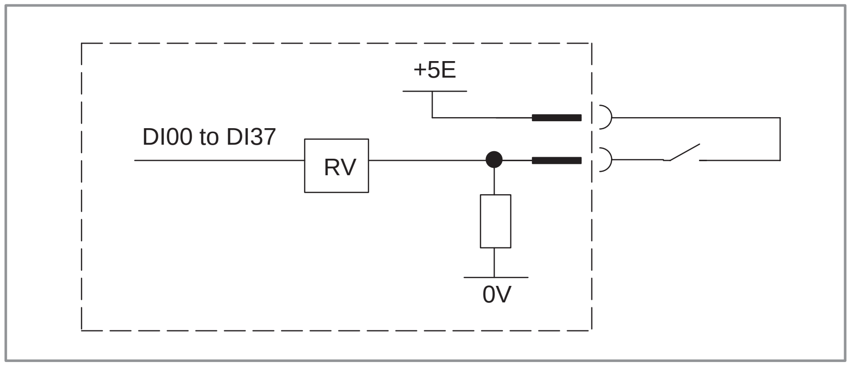
	A	B
01	0V	*MND1
02	*KYD0	*KYD1
03	*KYD2	*KYD3
04	*KYD4	*KYD5
05	*KYD6	*KYD7
06	*KYC0	*KYC1
07	*KYC2	*KYC3
08	*KYC4	*KYC5
09	*KYC6	*KYC7
10	*KYC8	*KYC9
11	*KYCA	*KYCB
12	*BZMD	0V
13	*LD0	*LD8
14	*LD1	*LD9
15	*LD2	*LD10
16	*LD3	*LD11
17	*LD4	*LD12
18	*LD5	*LD13
19	*LD6	*LD14
20	*LD7	*LD15
21	LC1L	LC1H
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. 9.7.4 for details of connection and signal meanings.

9.7.4 Interface

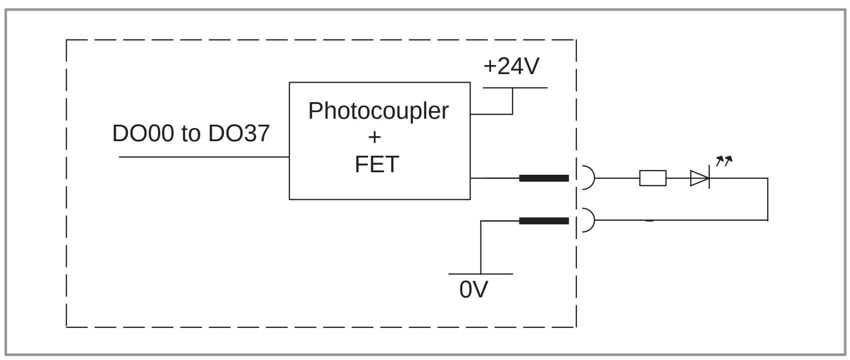
General–purpose DI



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



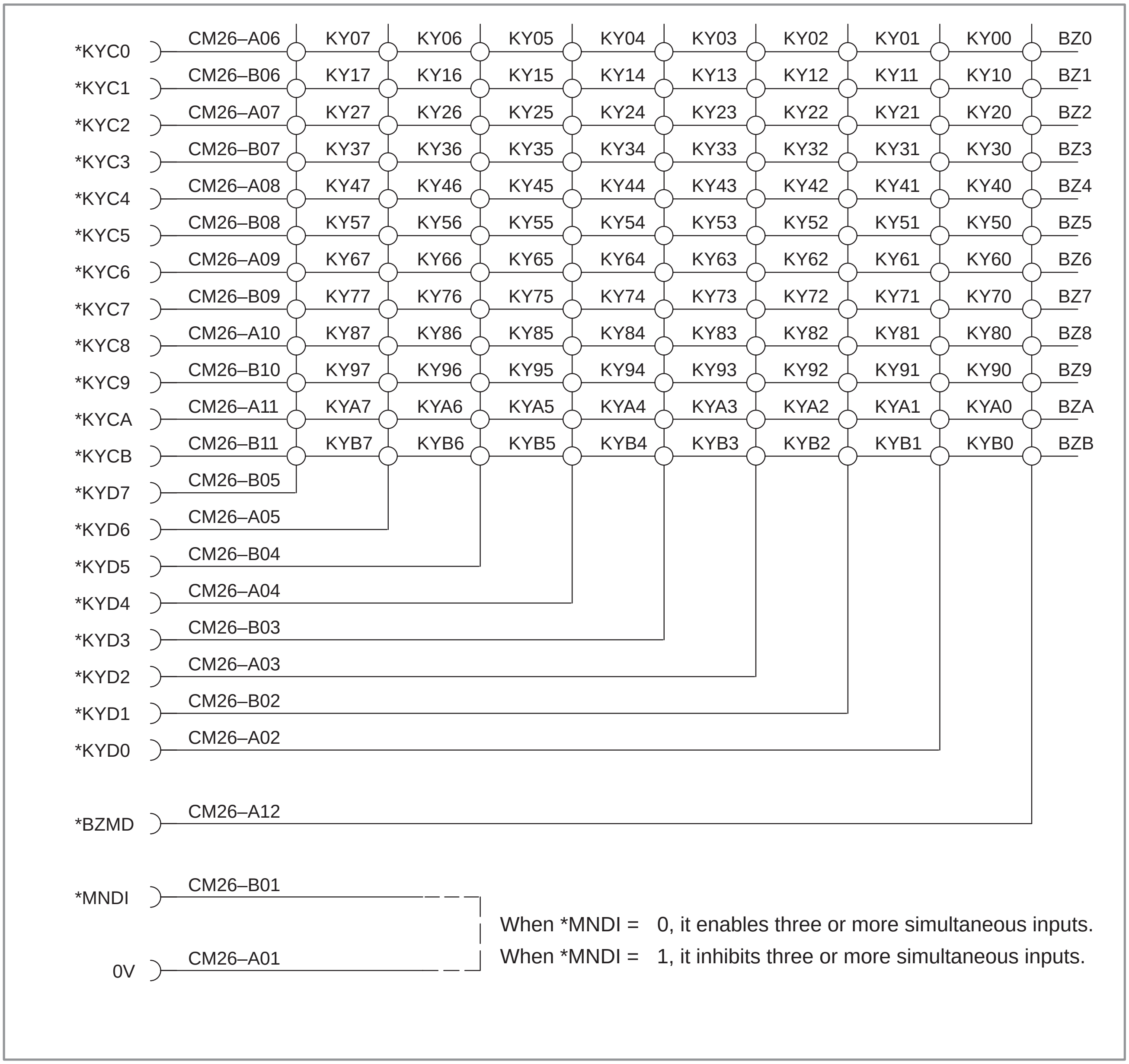
Output signal specifications

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. 9.7.5 for the corresponding PMC addresses.

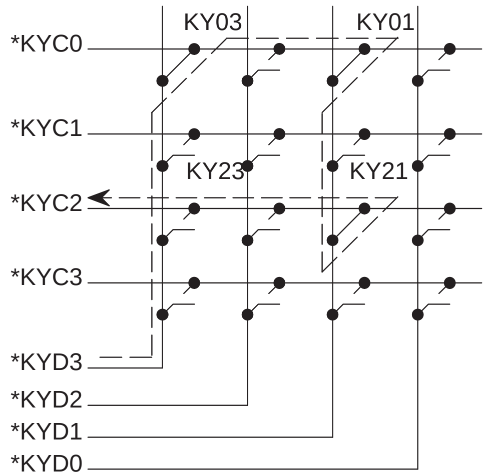


● Mode selection

❑ 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")

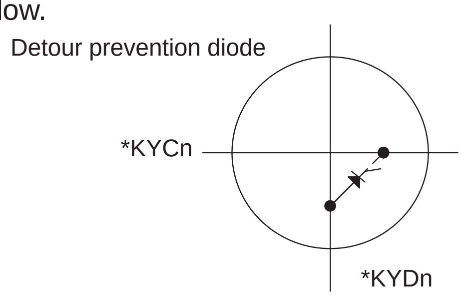
> **NOTE**
> If there are two inputs and a third is added, all three are ignored. When one of the three inputs is removed, two are accepted.

[Method 2]

- Attaching detour prevention diodes to enable three simultaneous inputs

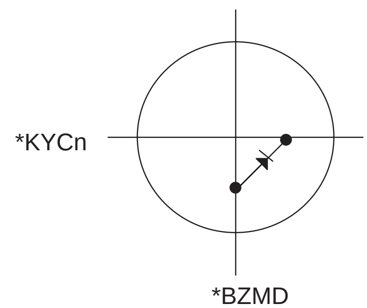
  Action : Connect the *MNDI signal (see item "● Key switch addresses") to 0V.

A diode must be connected in series with a switch, as shown below.

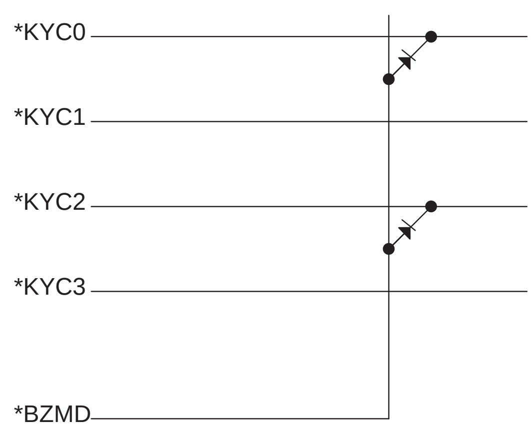


❑ This PCB can raise a confirmation sound when a key is pressed. The condition to raise an audible alarm is set in 8-bit units, or in *KYCn units. If *BZMD and common *KYCn are disconnected, a KYnx input causes a sound to generate. If they are connected, a KYnx input does not generate the sound.
To generate a confirmation sound for key input, the DO (PMC address DO + 00.7) "MD07" must have been turned to "1" (see Subsec. 9.7.5).

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**

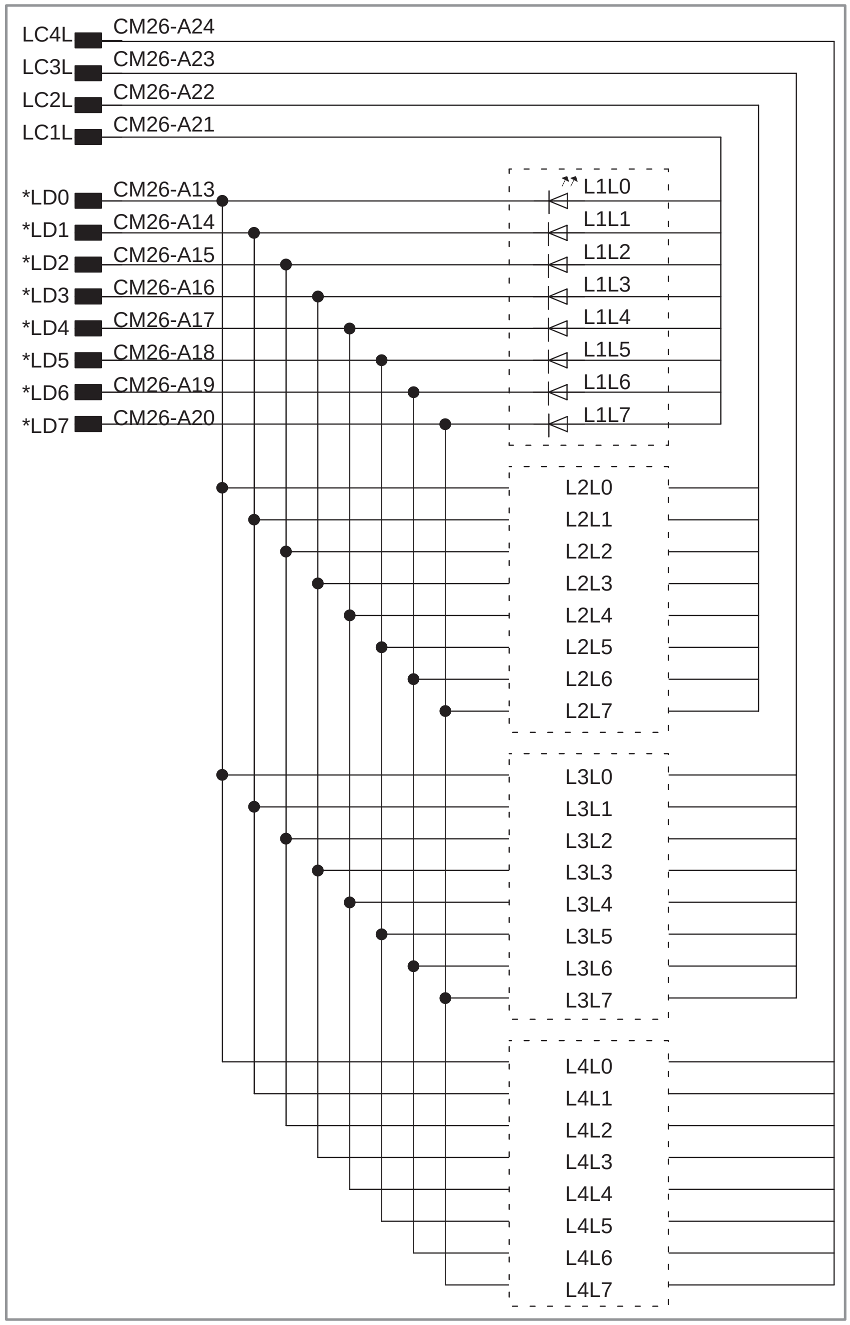
Contact rating	6VDC, 2mA or higher
Leakage current between open contacts	0.2mA or lower (6VDC)
Voltage drop across closed contacts	0.9V or lower (1 mA) Note)

NOTE
This voltage must be maintained even when detour prevention diodes are used.

Matrix DO

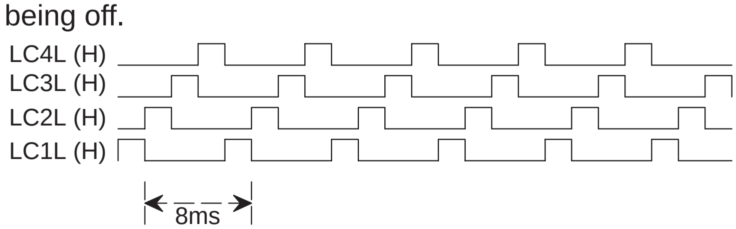
- **LED addresses**

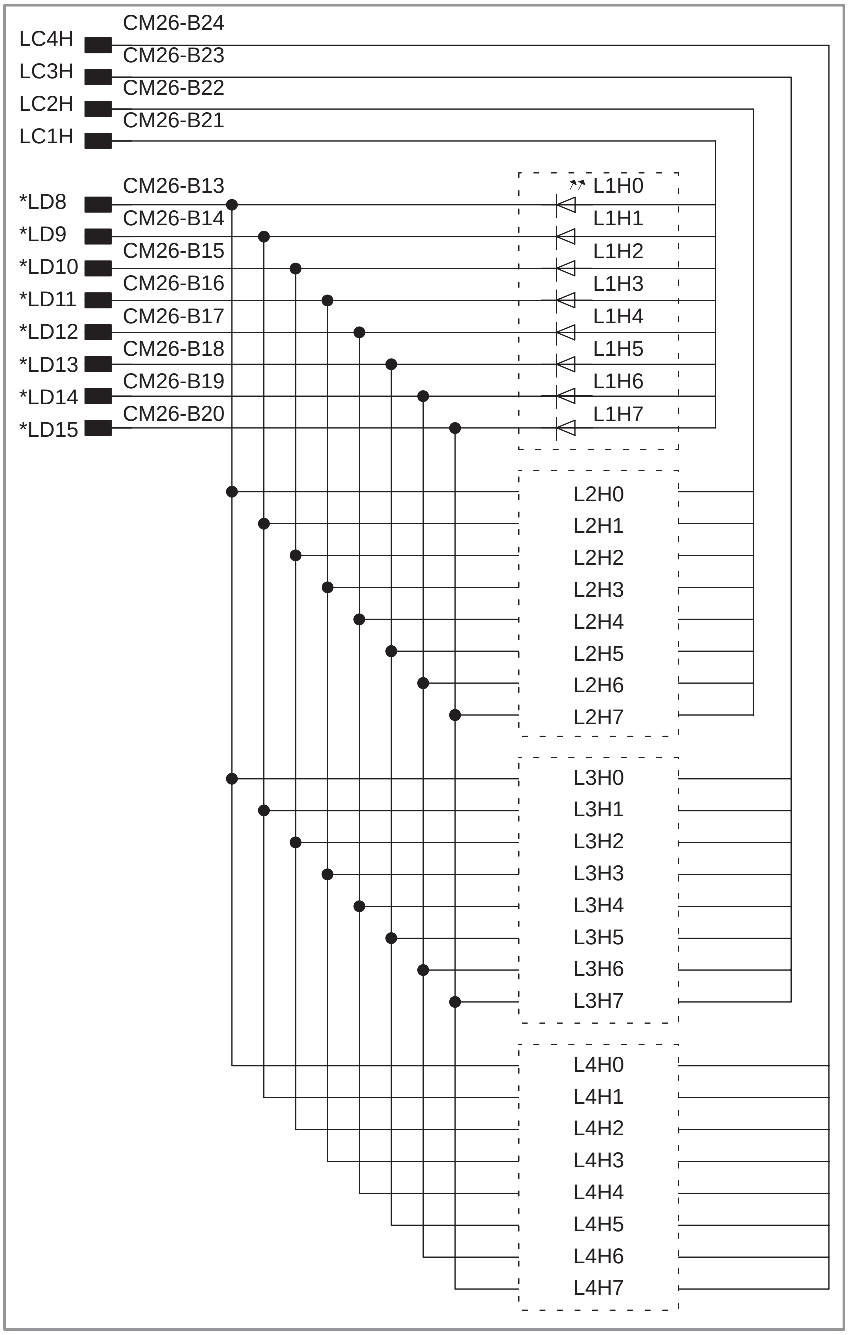
See Subsec. 9.7.5 for the corresponding PMC addresses.



NOTE

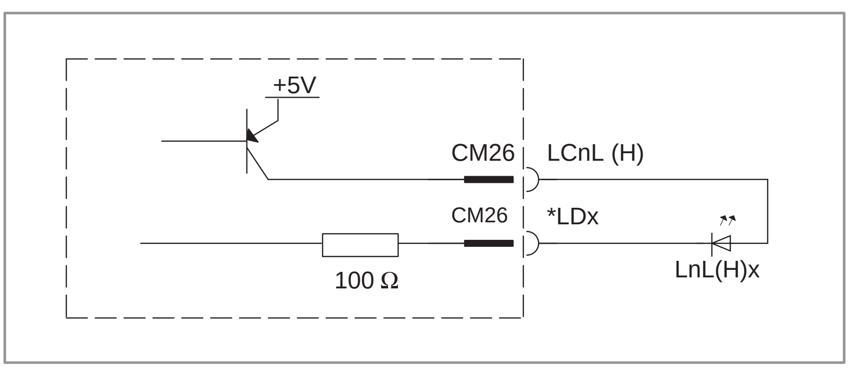
The timing for the common signals are shown below. Their duty cycle is 2 ms for LEDs being on and 6 ms for LEDs being off.





- **Internal circuit**

The circuit contains a 100-ohm resistor, as shown below. Connecting an LED does not require an external resistor.



- **Signal specifications**

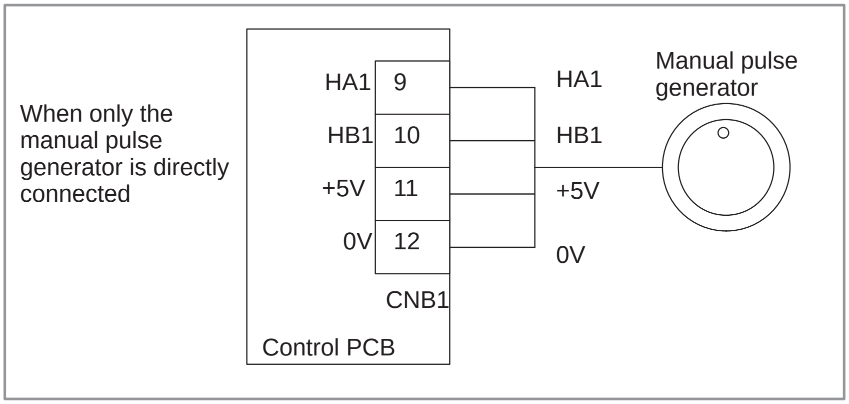
The LEDs must have the following rating

Forward voltage	2.4V max (I_f=5mA)(Typical value)
Forward current	30mA max
Reverse voltage	3V max

Interface for manual pulse generator

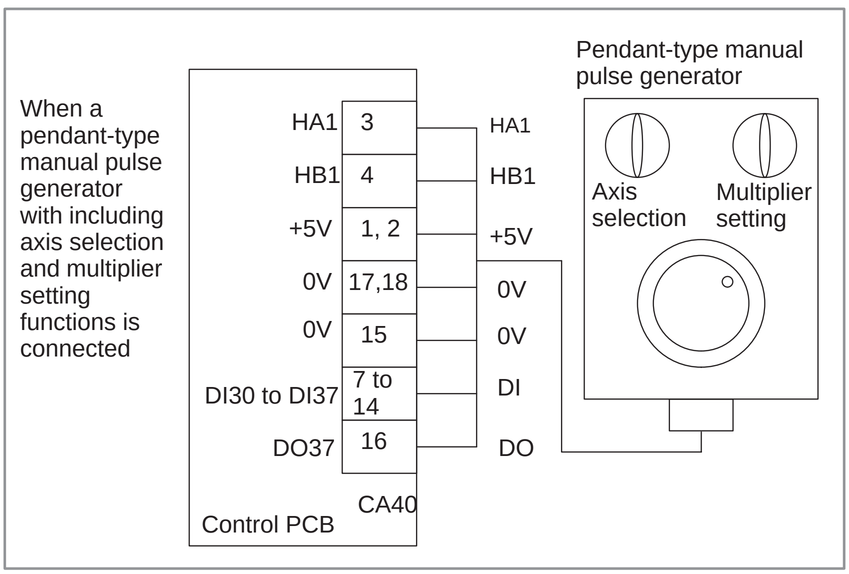
- **Connection of connector CNB1**

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.



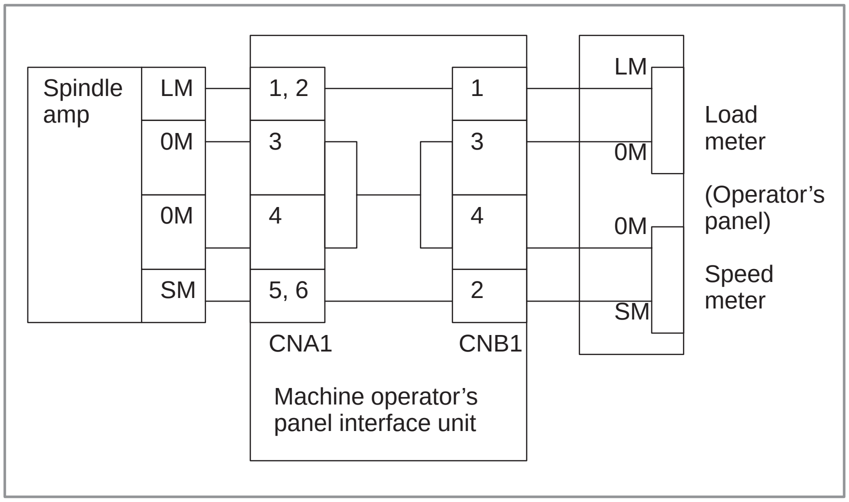
> **NOTE**
> 1 When DI30 to DI37 of connector CA40 are allocated as the DIs used for the axis selection and multiplier setting, DI30 to DI37 of connector CM17 cannot be used.
> 2 One DO is available for the manual pulse generator side at the user's discretion. When this is used, DO37 of CM17 cannot be 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)

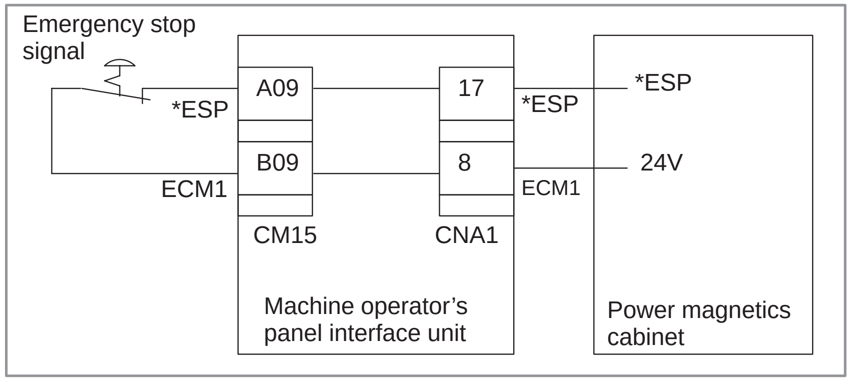
NOTE
Any voltage higher than +10V is converted to the same digital value as +10V is.

• A/D conversion specifications

Conversion error	5% (max)
Resolution	5 bit (min)

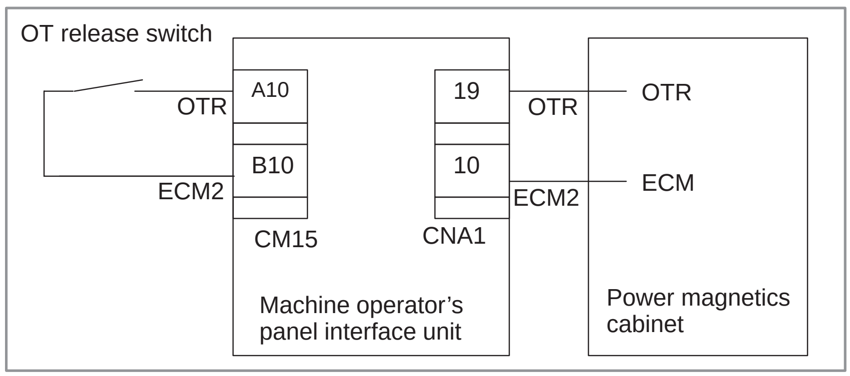
- **Emergency stop**

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.)



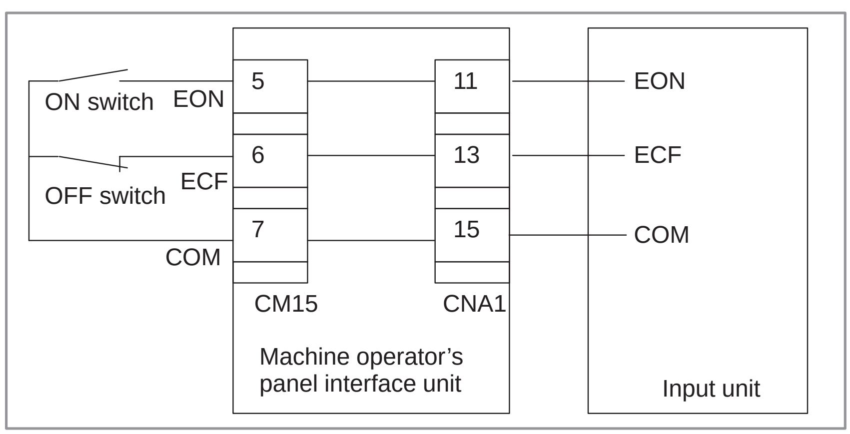
- **OT release**

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.

9.7.5 PMC Addresses

PMC ADDRESS	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

Scope in which PMC addresses can be used (I/O Link allocation):

Range	128/128	256/256
DI+00 to DI+15	✓	✓
DI+16 to DI+21		✓
DO+00 to DO+12	✓	✓

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

9.7.6 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. 9.7.3 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. 9.7.10.

9.7.7 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.

9.7.8 Connector (on the Cable Side) Specifications

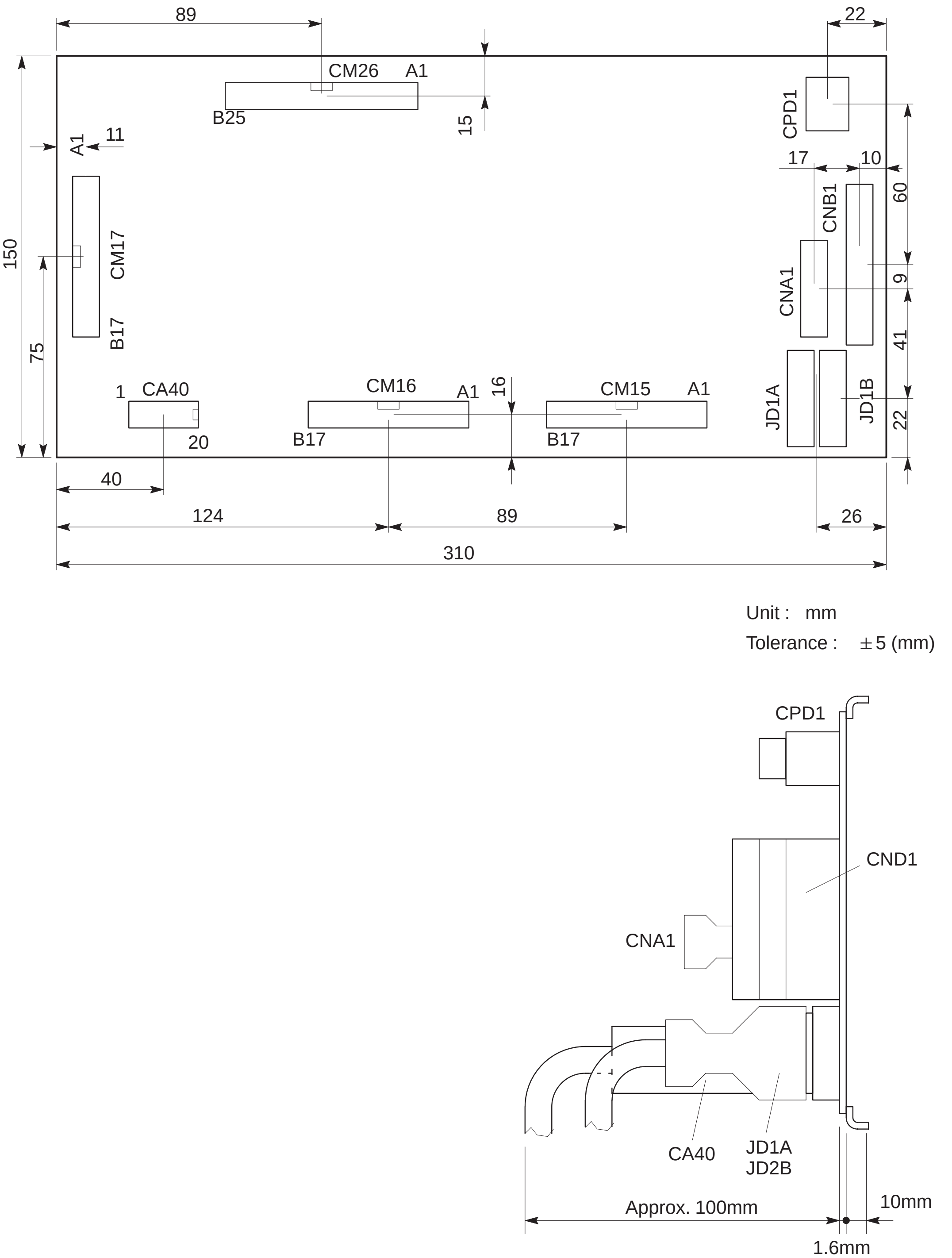
Connector	Major use	Specification
CM15, CM16, CM17	General-purpose DI/DO	HIF3BA-34D-2.54R : Manufactured by HIROSE ELECTRIC CO., LTD.
CNA1	Relay terminal (to the machine)	PCR-E20FS : Manufactured by HONDA TSUSHIN KOGYO CO., LTD.
CNB1	Relay terminal (to the machine operator's panel)	MVSTBR2.5/12-ST-5.08 : 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.

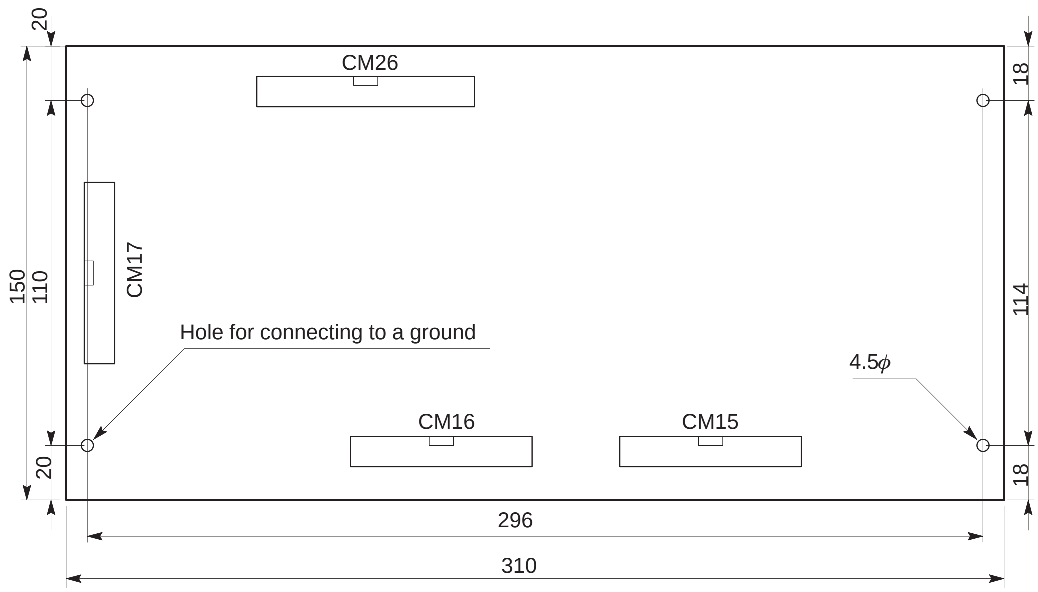
2 Crimped type cable connector is available for CA40. For purchase from FANUC, please specify as below.
A02B-0029-K890 : Solder type
A02B-0029-K892 : Crimped type

9.7.9 Machine Operator's Panel Interface Unit Dimension Diagram (Including Connector Locations)



9.7.10 Machine Operator's Panel Interface Unit Mounting Dimension Diagram

Mounting hole position

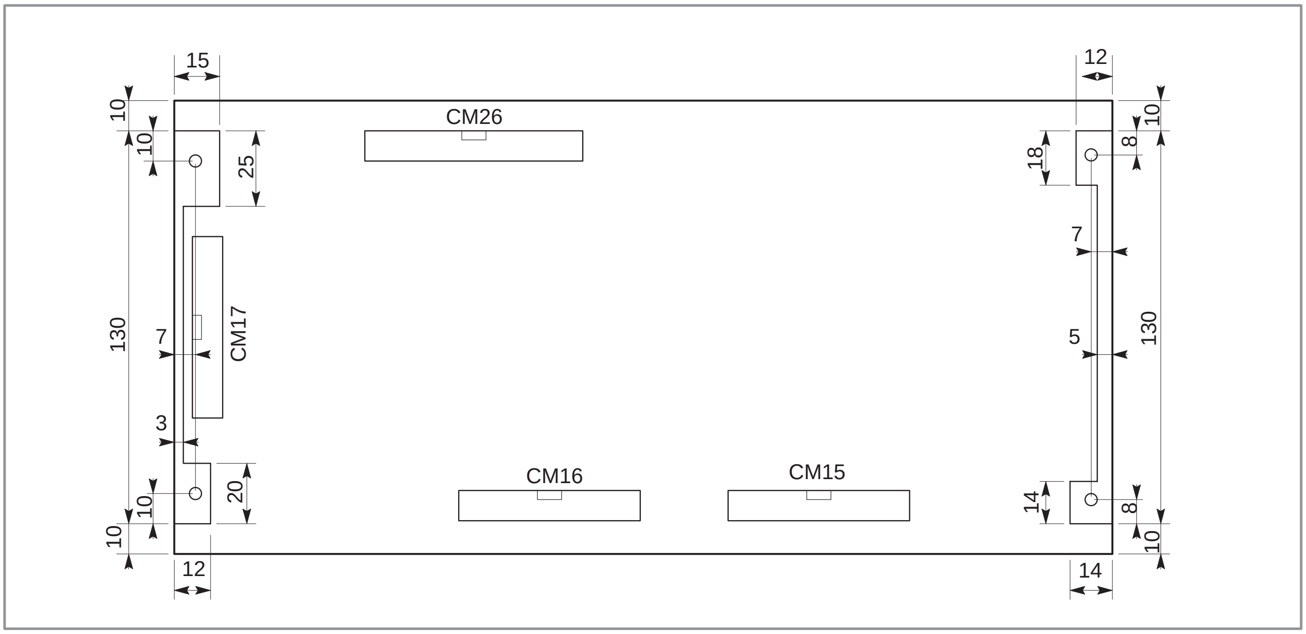


Fasten the PCB with four M4 screws.

Unit : mm

Sheet fixing area (mounting face side)

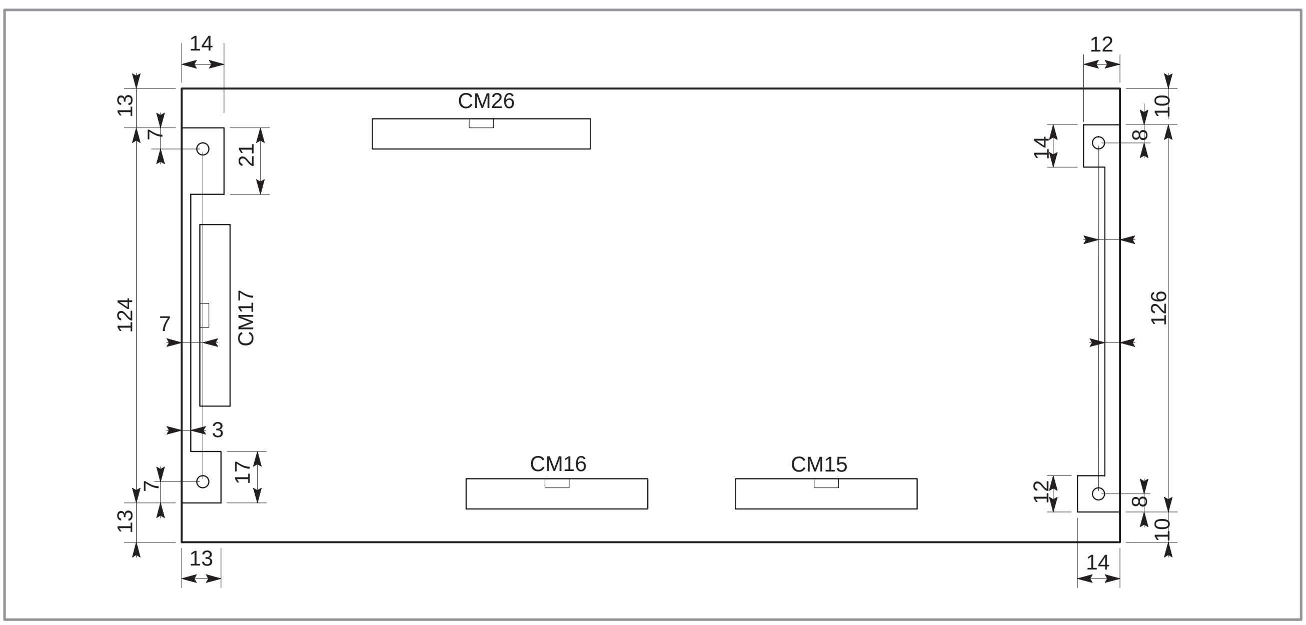
It is possible to fix the sheet, spacer, etc. only in the area shown in the diagram below.



NOTE
Applied to the PCB version number "03A" and beyond.

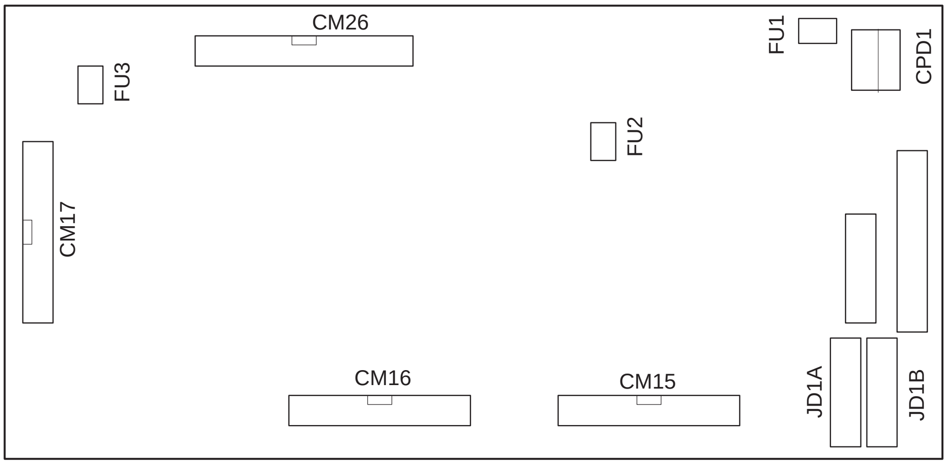
Sheet fixing area (Soldering face side)

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.

9.7.11 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)

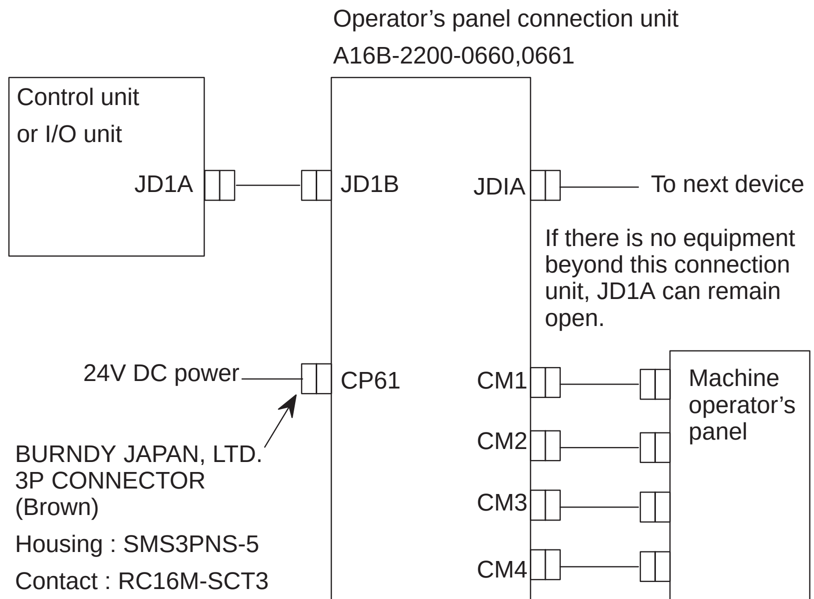
NOTE
FU2 is not mounted on Revision 05A or later.

9.8 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



1	+24V
2	GND
3	

Power supply input specification
Voltage : 24 VDC ±10%
Capacity : 500 + 7.3 × n mA
n : number of inputs that turn on simultaneously

CAUTION
For a power cable, use a cable of 30/0.18 (0.75 mm^2) or thicker.

9.8.1 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.

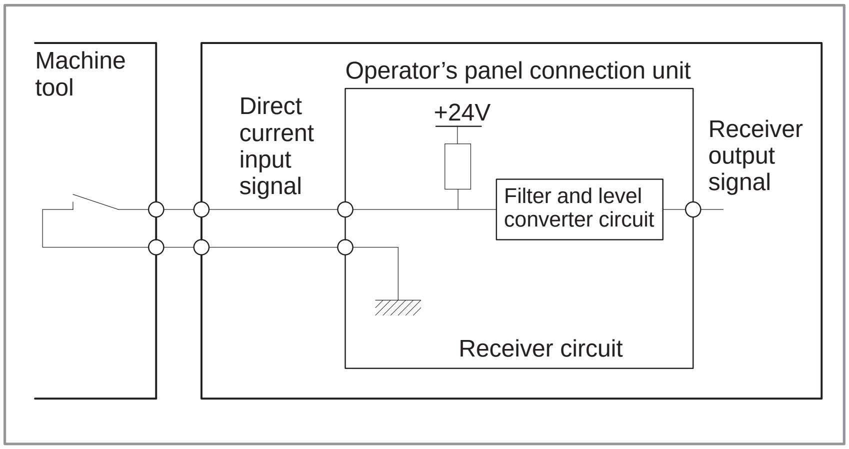


Fig. 9.8.1 (a) Receiver circuit

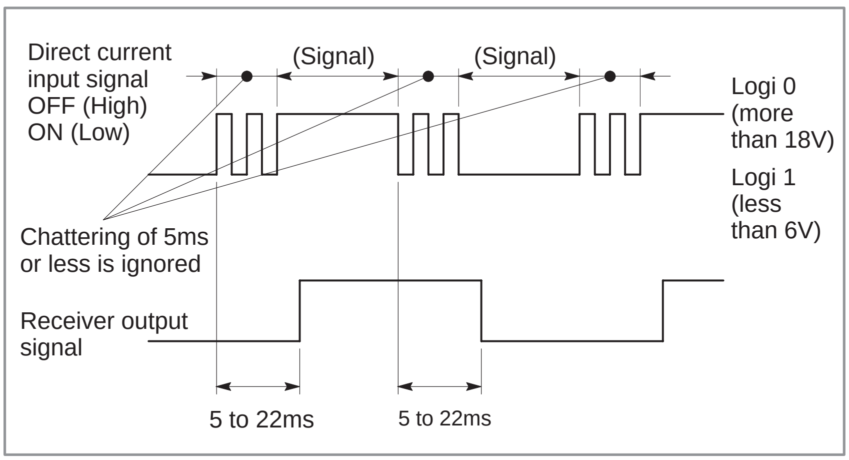


Fig. 9.8.1 (b) Width of input signals and delay time

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.

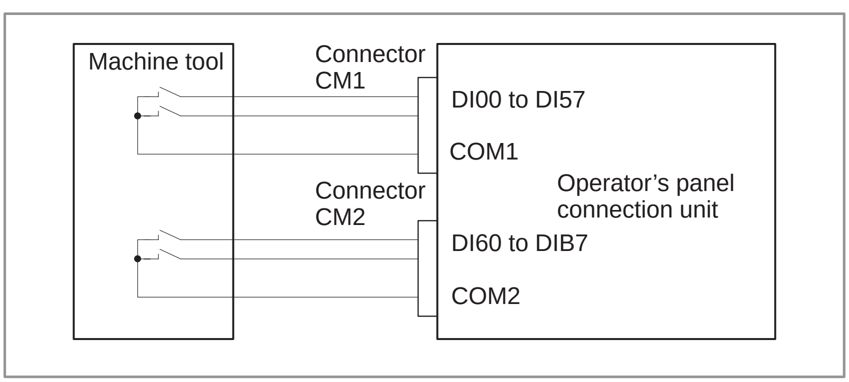


Fig. 9.8.1 (c) Connection of common lines

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.

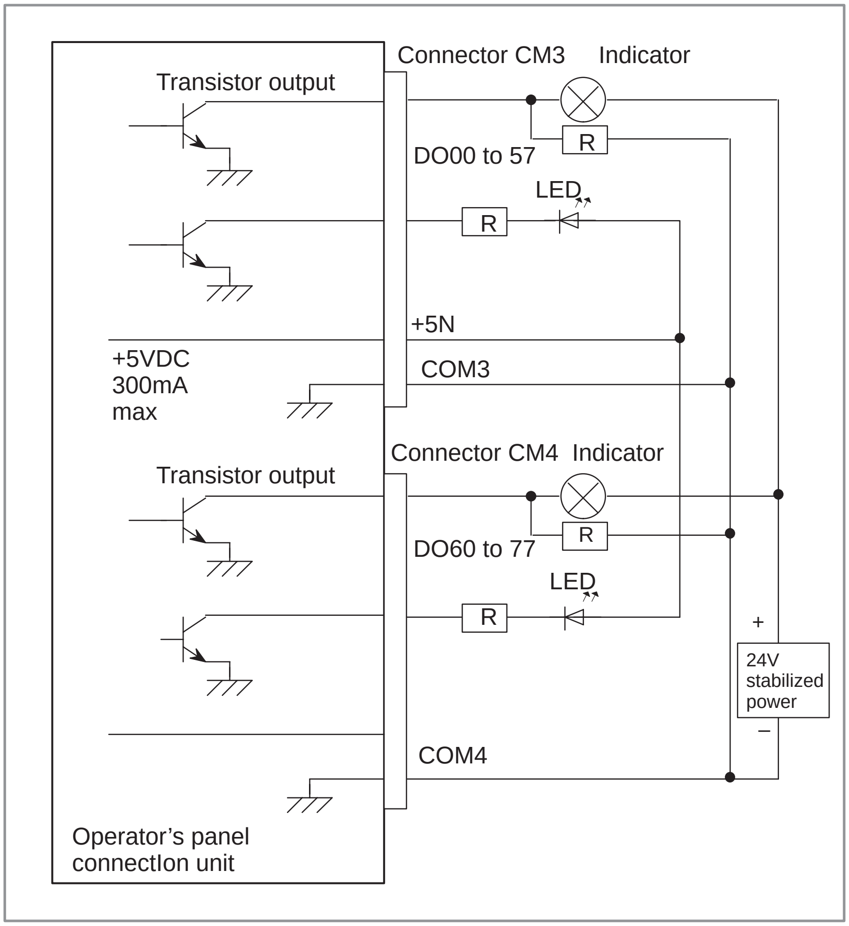
Do not use this operator's panel connection unit for safety–critical input signals (such as an emergency stop signal).

9.8.2 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.

9.8.3 Connector Layout for Operator's Panel Connection Unit

CM1

1	DI00			33	
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			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	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			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
2	DO03
3	DO06
4	DO11
5	DO14
6	DO17
7	DO22
8	DO25
9	DO27
10	DO32
11	DO35
12	DO40
13	DO43
14	DO46
15	DO51
16	DO54
17	DO56
18	COM3

19	DO01
20	DO04
21	DO07
22	DO12
23	DO15
24	DO20
25	DO23
26	DO30
27	DO33
28	DO36
29	DO41
30	DO44
31	DO47
32	DO52

33	+5N
34	DO02
35	DO05
36	DO10
37	DO13
38	DO16
39	DO21
40	DO24
41	DO26
42	DO31
43	DO34
44	DO37
45	DO42
46	DO45
47	DO50
48	DO53
9	DO55
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
2	DO64
3	DO67
4	DO72
5	DO75
6	
7	COM4

8	DO62
9	DO65
10	DO70
11	DO73
12	DO76
13	

14	DO60
15	DO63
16	DO66
17	DO71
18	DO74
19	DO77
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.

9.8.4 External View of Operator's Panel Connection Unit

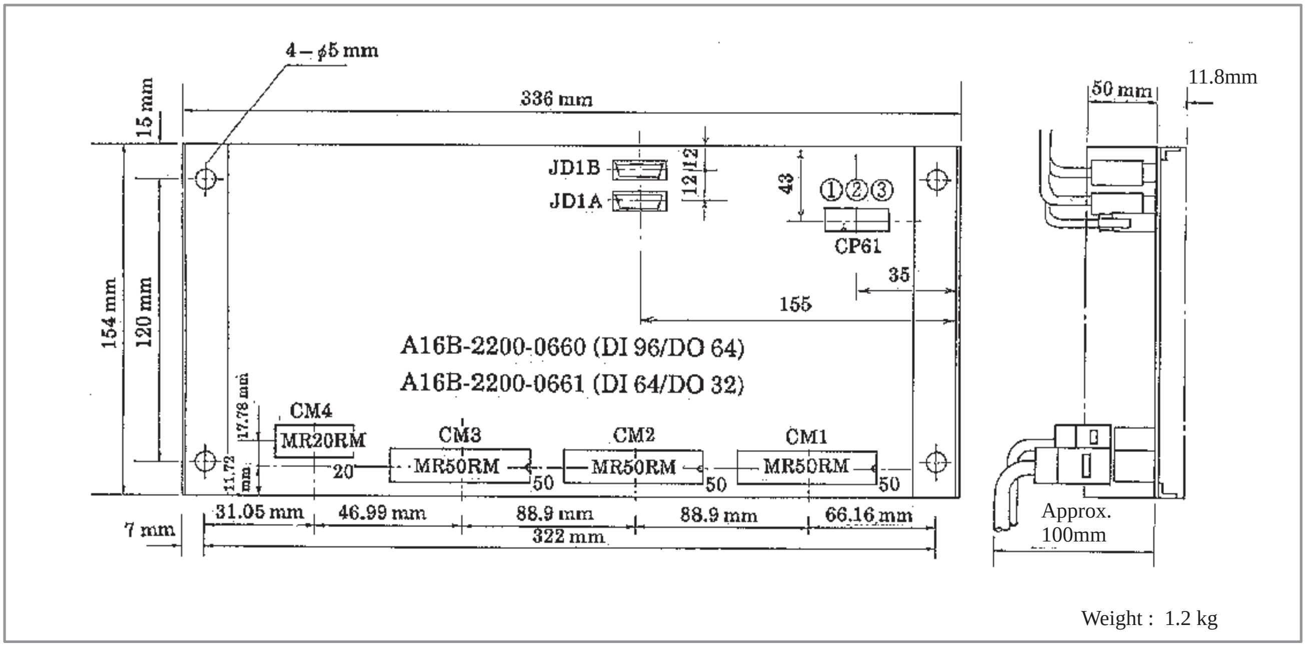
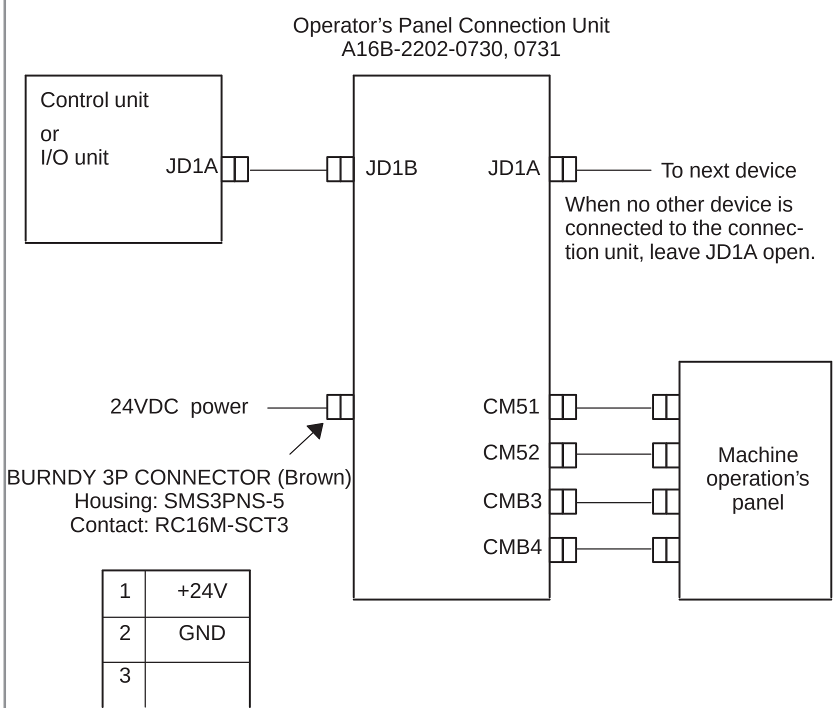


Fig. 9.8.4 External view of operator's panel connection unit

9.9 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



Power input regulations
Voltage : 24VDC ± 10%
Capacity : 500+7. 3 × n (mA)
n: Number of input points which are simultaneously turned on

CAUTION
Use 30/0.18 (0.75 mm^2) or heavier wire as the power cable.

9.9.1 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)

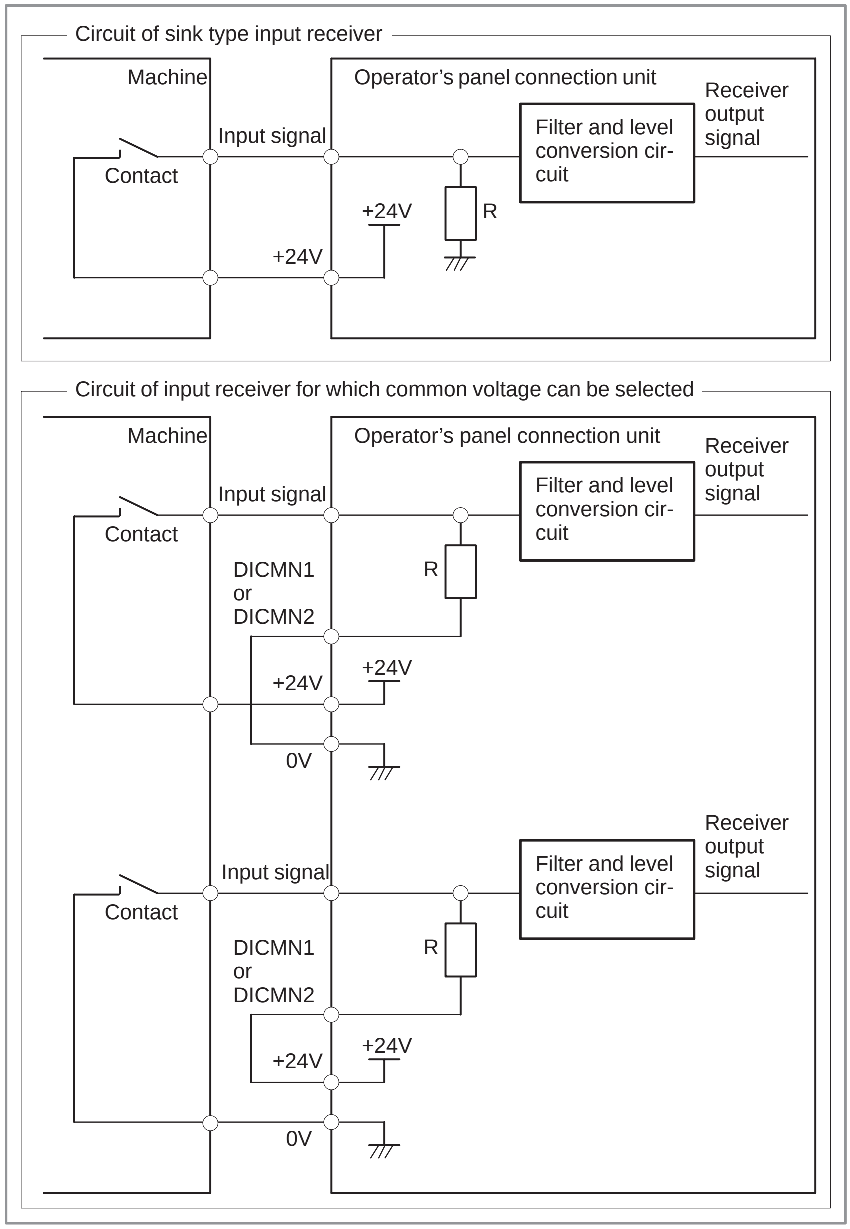


Fig. 9.9.1(a) Receiver circuit

Always connect both DICMN1 and DICMN2 to 24 V or 0 V. Do not leave them open.

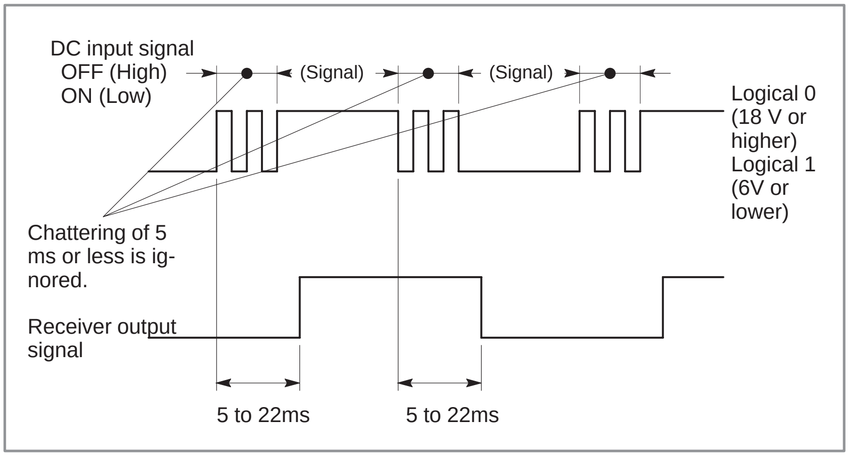


Fig. 9.9.1 (b) Signal width and delay of input signal

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.

9.9.2 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.)

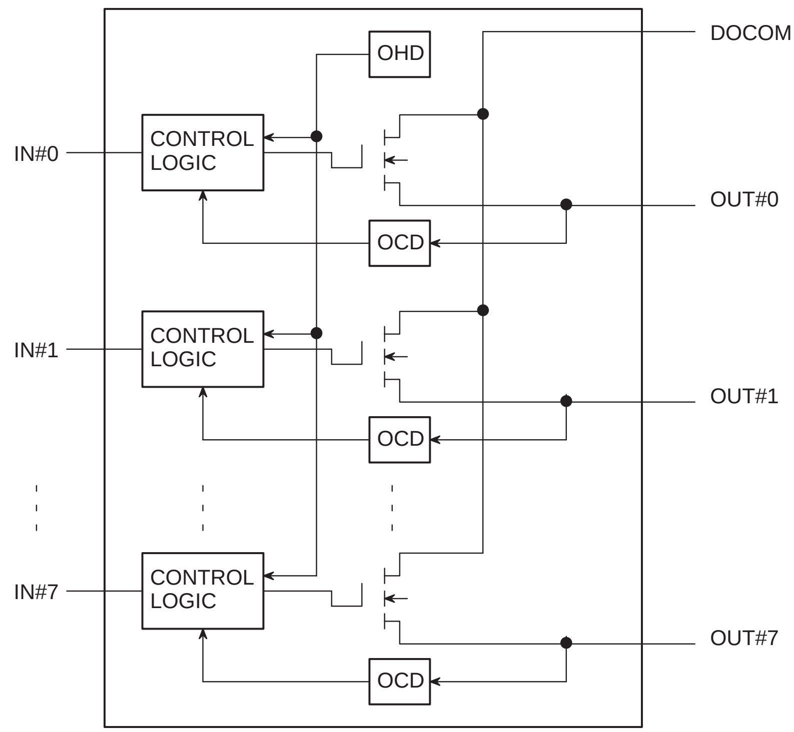
Correspondence between red LEDs and DO signals

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.

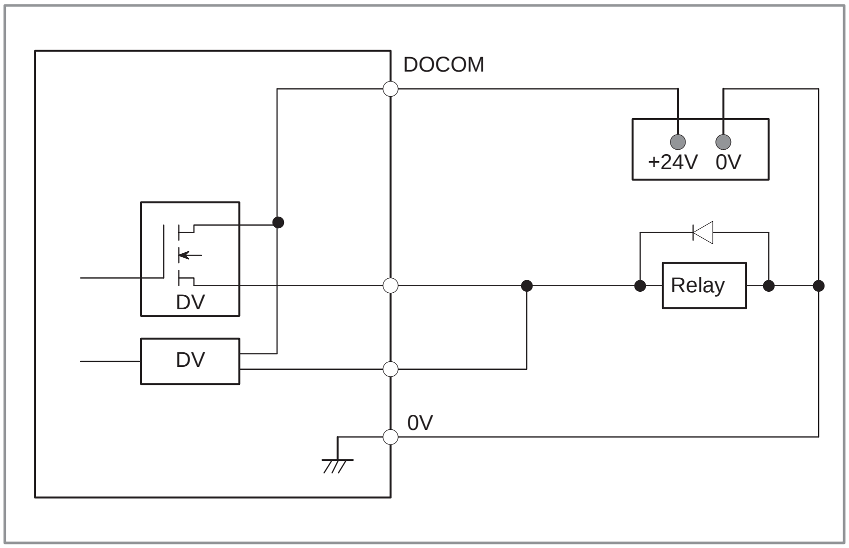
- **Driver element block diagram**



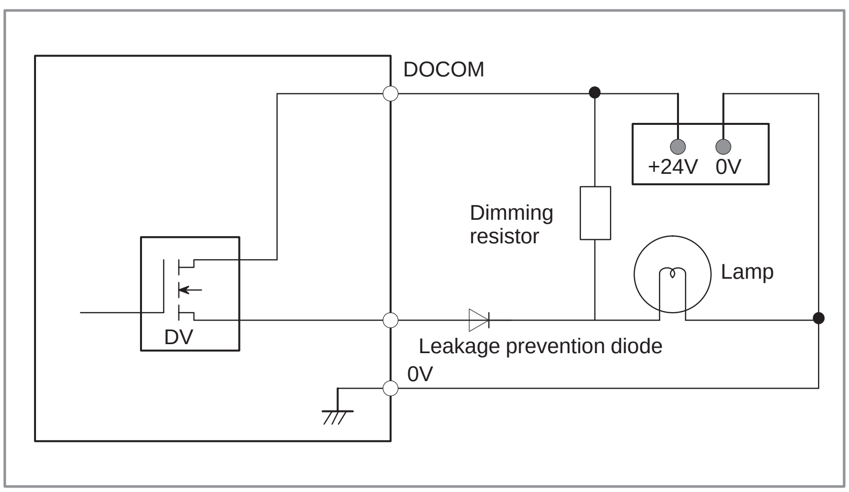
OHD: Overheat detection circuit
OCD: Overcurrent detection circuit
The power for operating this driver element is supplied from DOCOM (24 VDC).

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.



9.9.3 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	8	DO62	14	DO60
2	DO64	9	DO65	15	DO63
3	DO67	10	DO70	16	DO66
4	DO72	11	DO73	17	DO71
5	DO75	12	DO76	18	DO74
6	DO56	13	DO57	19	DO77
7	0V			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 (X p to X p+11)
DI: 64 points (X p to X p+7)

	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

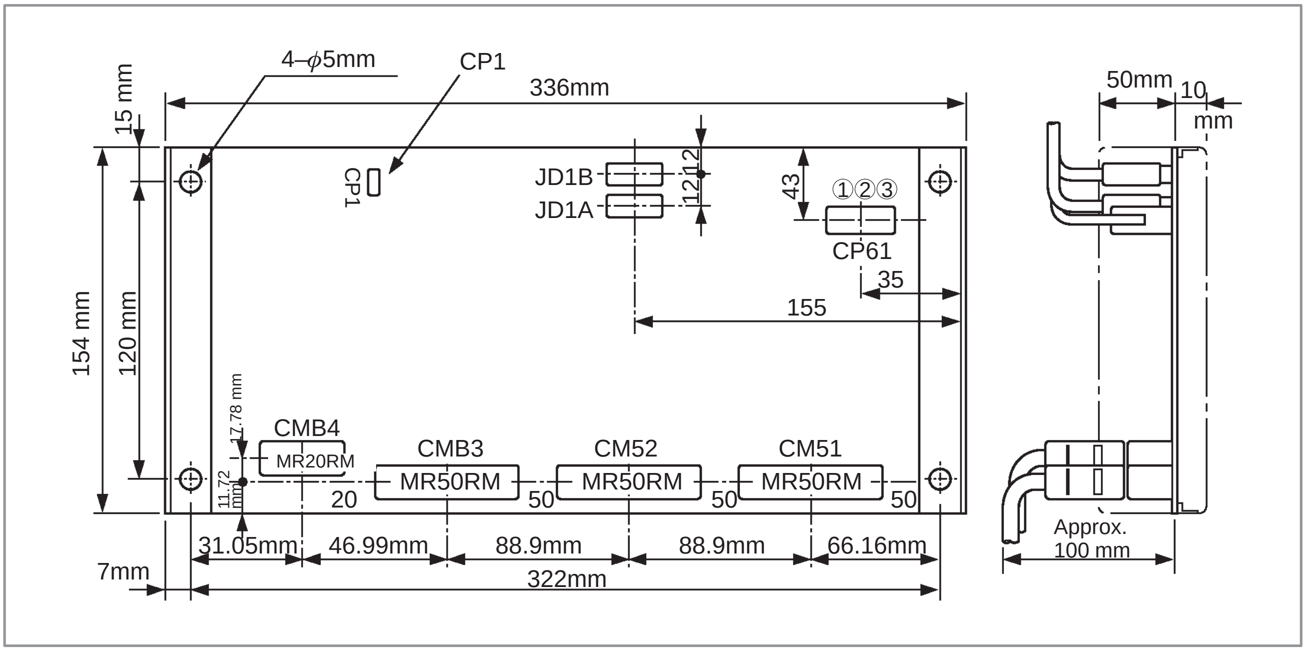
[DO address]

		Address	7	6	5	4	3	2	1	0
DO: 64 points	DO: 32 points	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).

9.9.4 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. 9.9.2

[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. 9.9.2).

9.10 FANUC I/O Link CONNECTION UNIT

9.10.1 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.

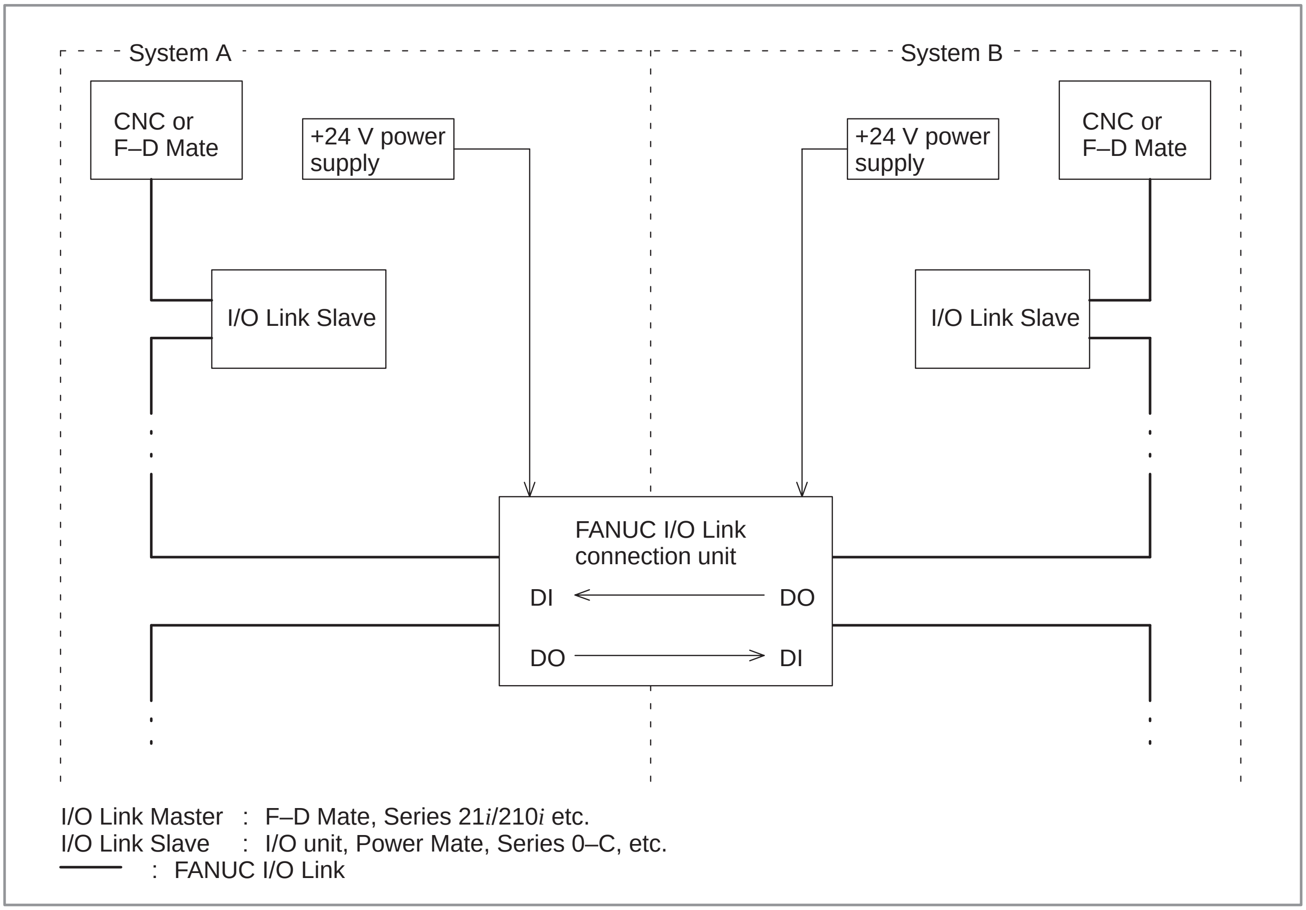


Fig. 9.10.1 System which uses FANUC I/O Link connection units

> **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.

9.10.2 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. 9.7.2 (b) is an outline drawing of the unit.
Installation	The unit, which is a separate type, is installed in the power magnetics cabinet. Fig. 9.7.2 (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

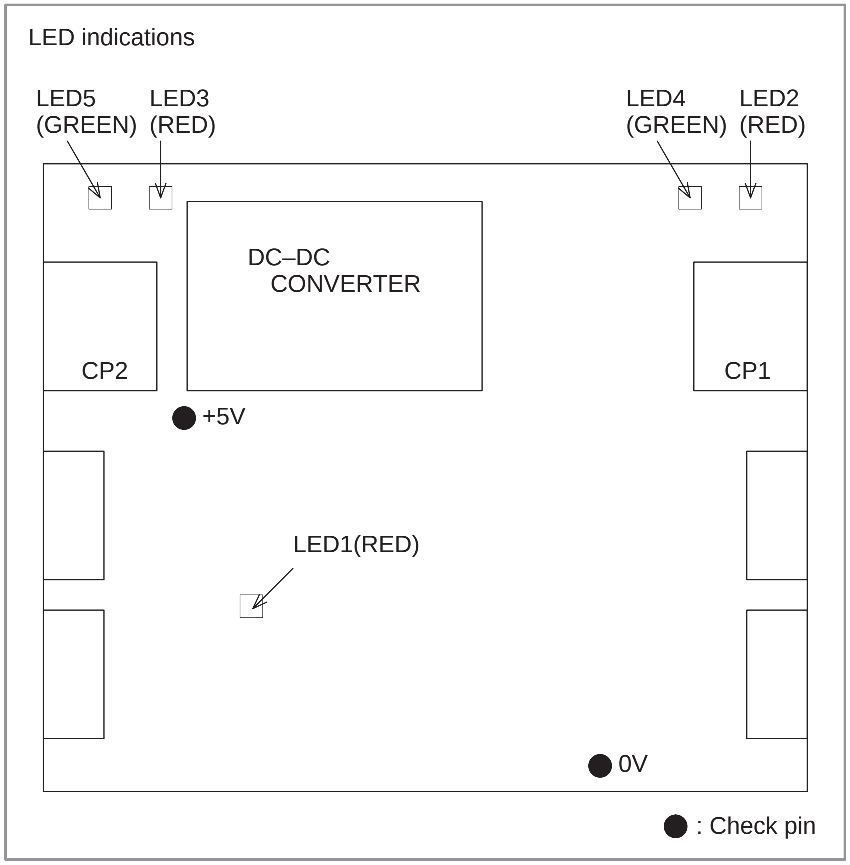


Fig 9.10.2 (a) LED locations

	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

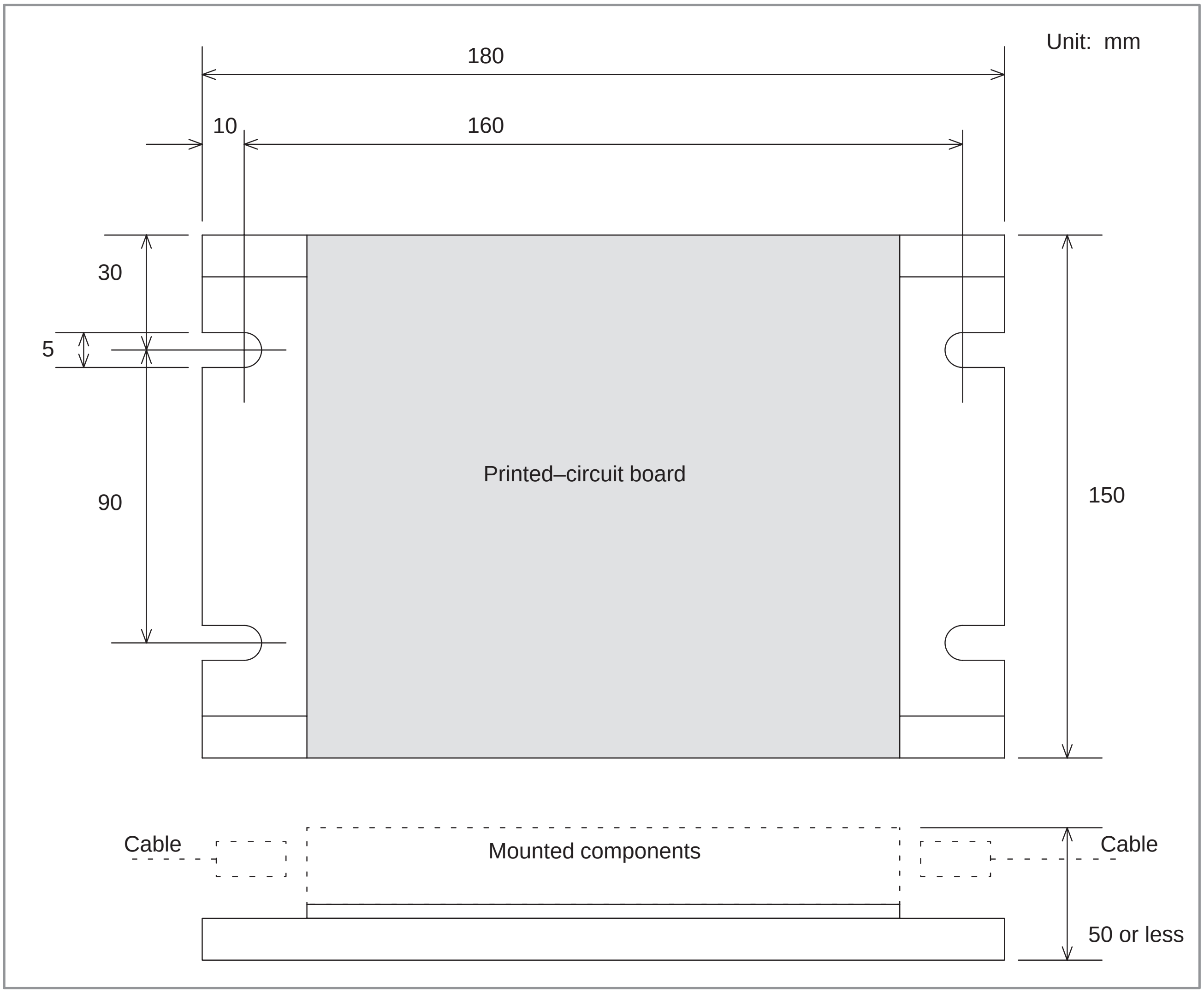


Fig. 9.10.2 (b) Outline drawing

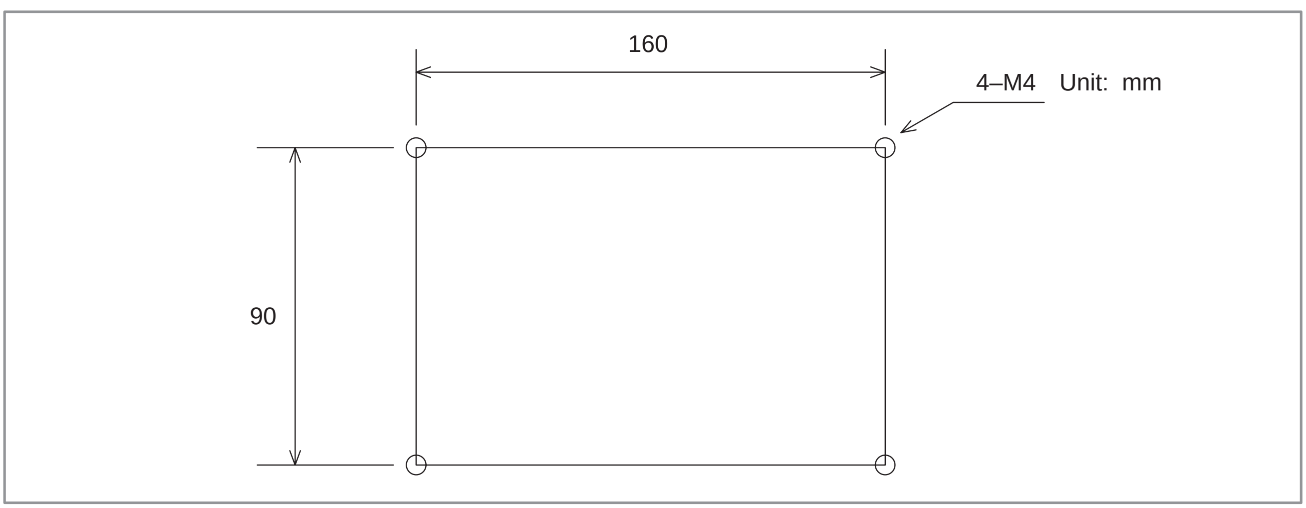
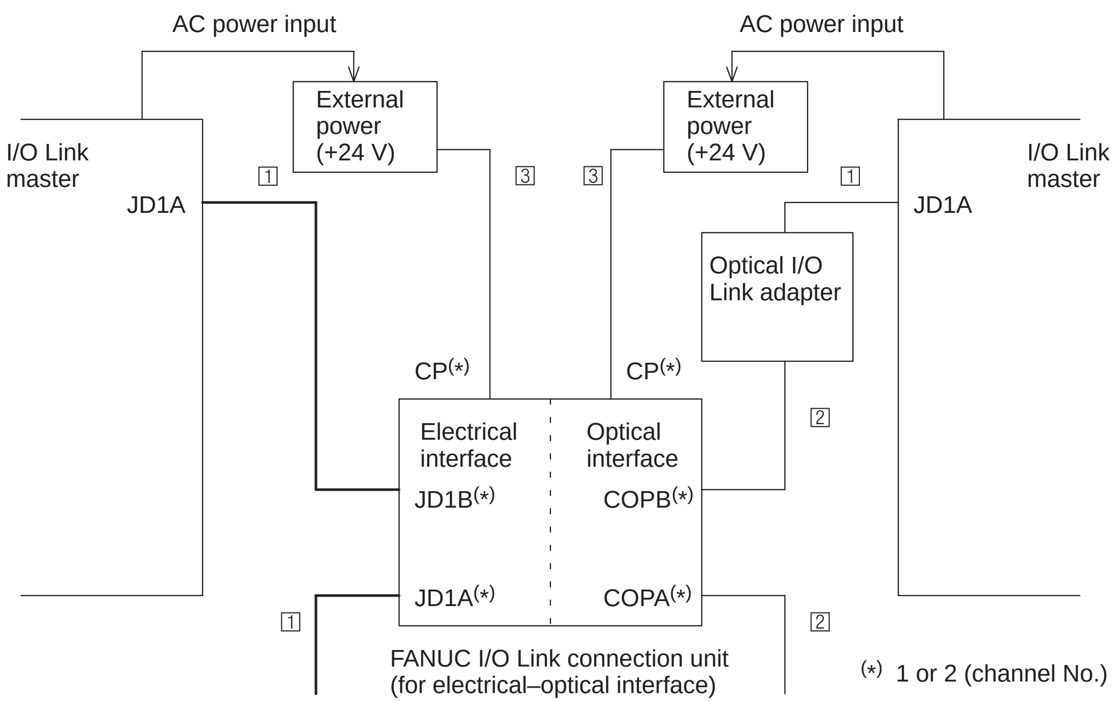


Fig. 9.10.2 (c) Mounting location

9.10.3 Connection

9.10.3.1 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	

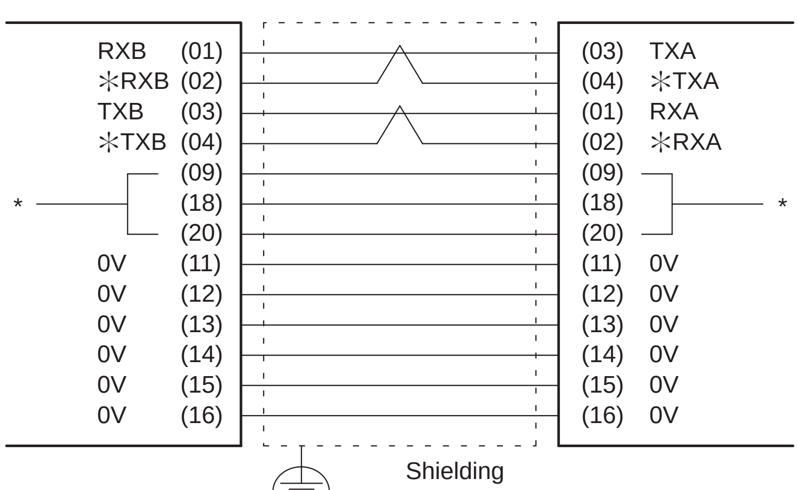
JD1B1/JD1B2

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	

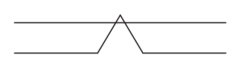
This unit (JD1A1/JD1A2) ⟷ Another device (JD1B)

or

Another device (JD1A) ⟷ This unit (JD1B1/JD1B2)



Frame ground (the shielding must be grounded at either end of the cable)



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.

9.11 CONNECTING THE FANUC SERVO UNIT β SERIES WITH I/O Link

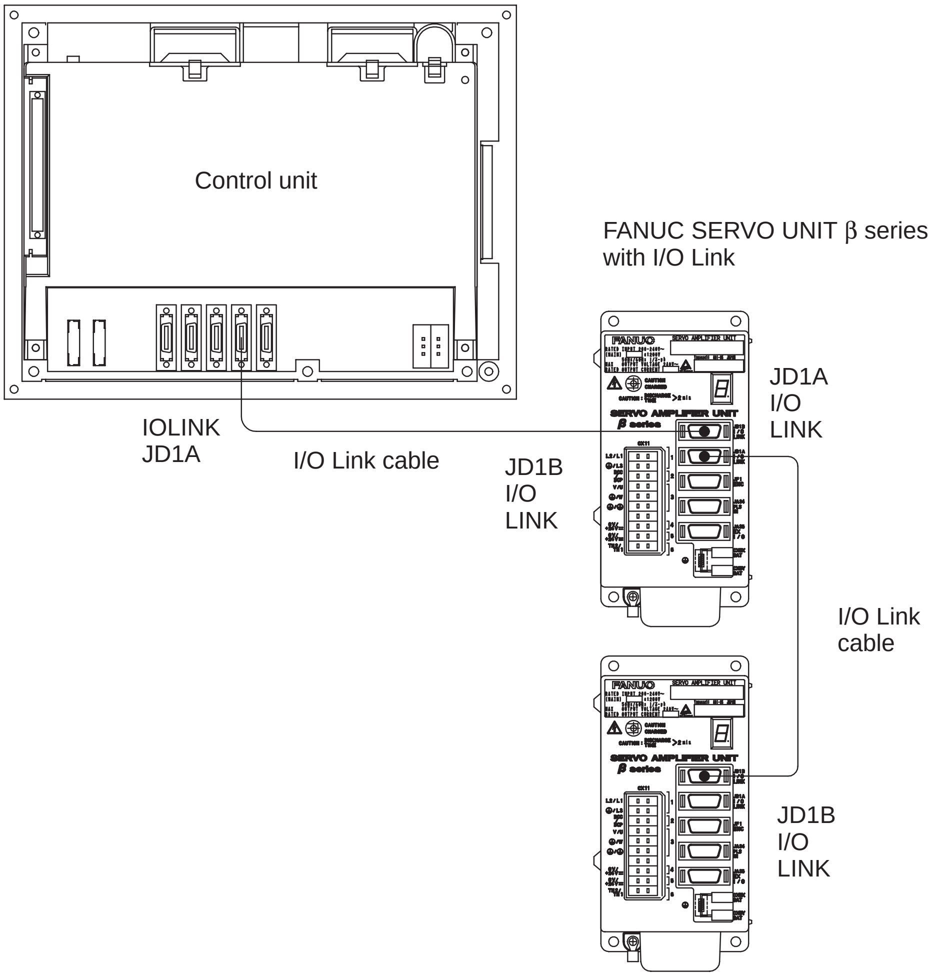
9.11.1 Overview

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 Series 21*i* using the FANUC I/O Link.

NOTE
Using the β amplifier requires that the power motion manager software function be installed in the Series 21*i*. This function is included as one of the Series 21*i* option functions. Note that this function is not supported by the Series 210*i* with personal computer capabilities.

9.11.2 Connection

The β amplifier with I/O Link is connected to the Series 21*i* using the usual FANUC I/O Link connection.



Connection to β series amplifier

9.11.3 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 Series 21*i*, 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.

9.11.4 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 PM161 (input) and PM160 (output).
The BASE is always 0, and the SLOT is 1.

10 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 control 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. 10 shows an example showing how to use the emergency stop signal with this CNC controller and α series control amplifier.

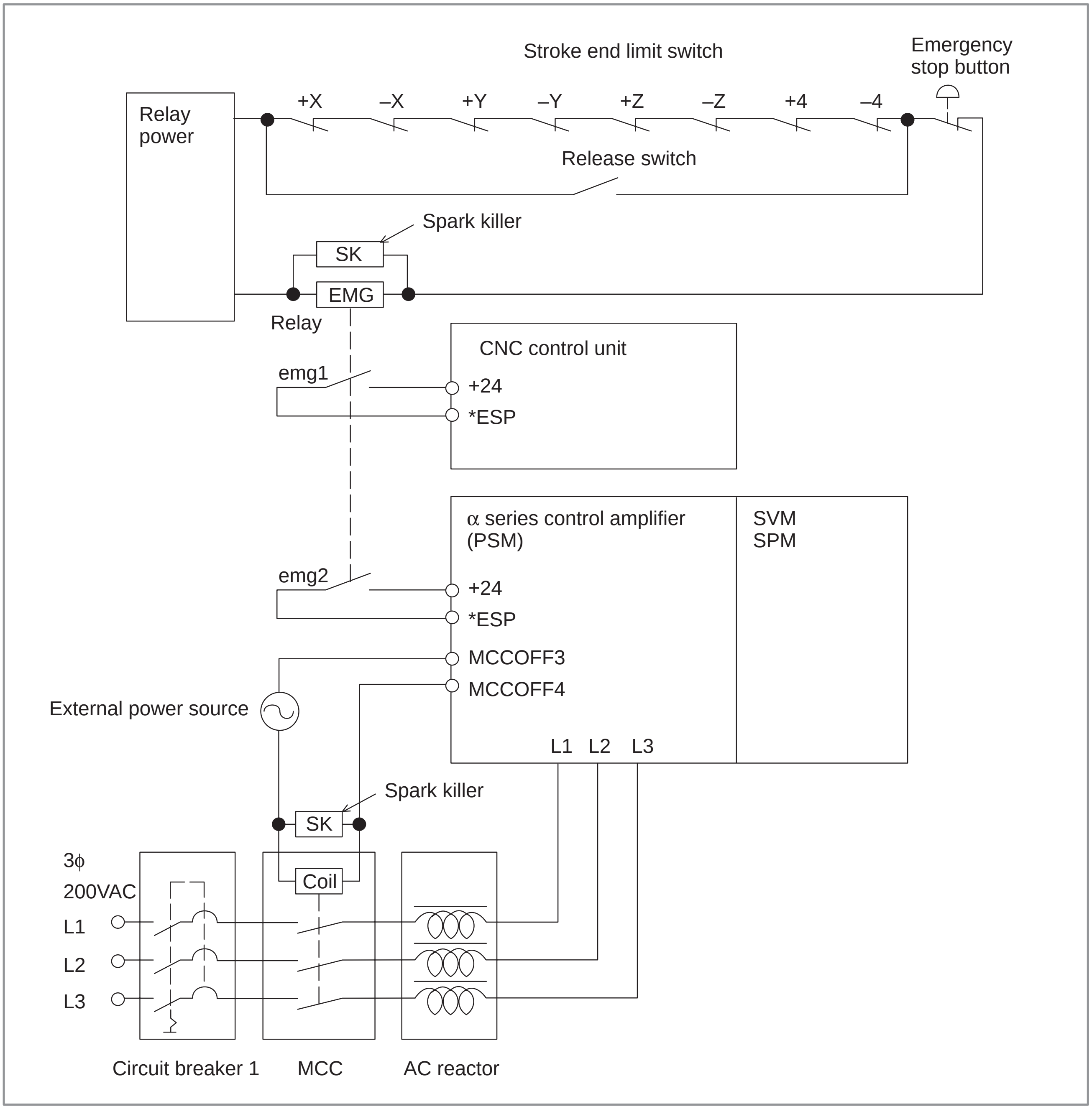


Fig. 10

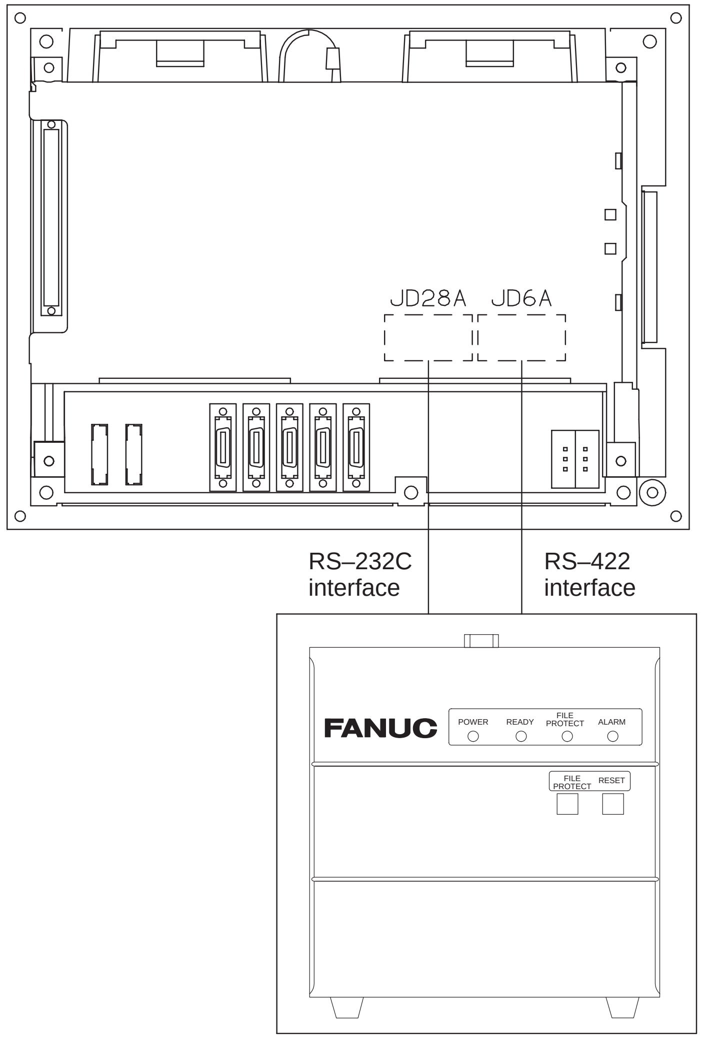
WARNING

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.

11 REMOTE BUFFER INTERFACE (INCLUDING FANUC DNC1 AND DNC2)

11.1 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–232C 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–232C	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–232C	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–232C 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

11.2 REMOTE BUFFER INTERFACE (RS–232C)

CNC OPTION–1 board

JD5C
(PCR-EV20MDT)

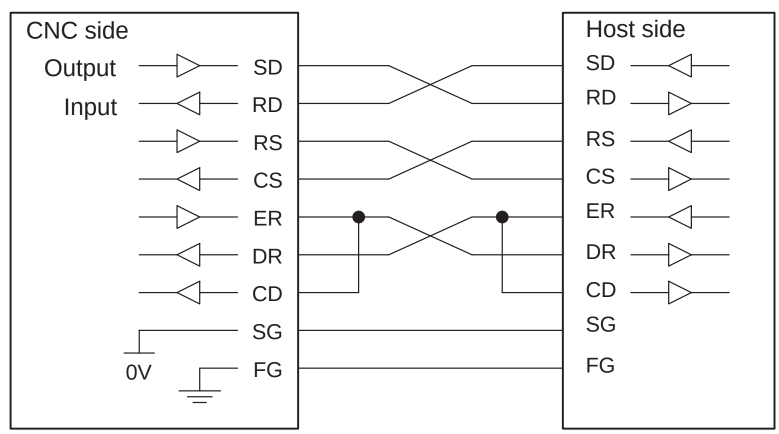
1	RD	11	SD
2	0V	12	0V
3	DR	13	ER
4	0V	14	0V
5	CS	15	RS
6	0V	16	0V
7	CD	17	
8	0V	18	
9		19	(+24V)
10	(+24V)	20	

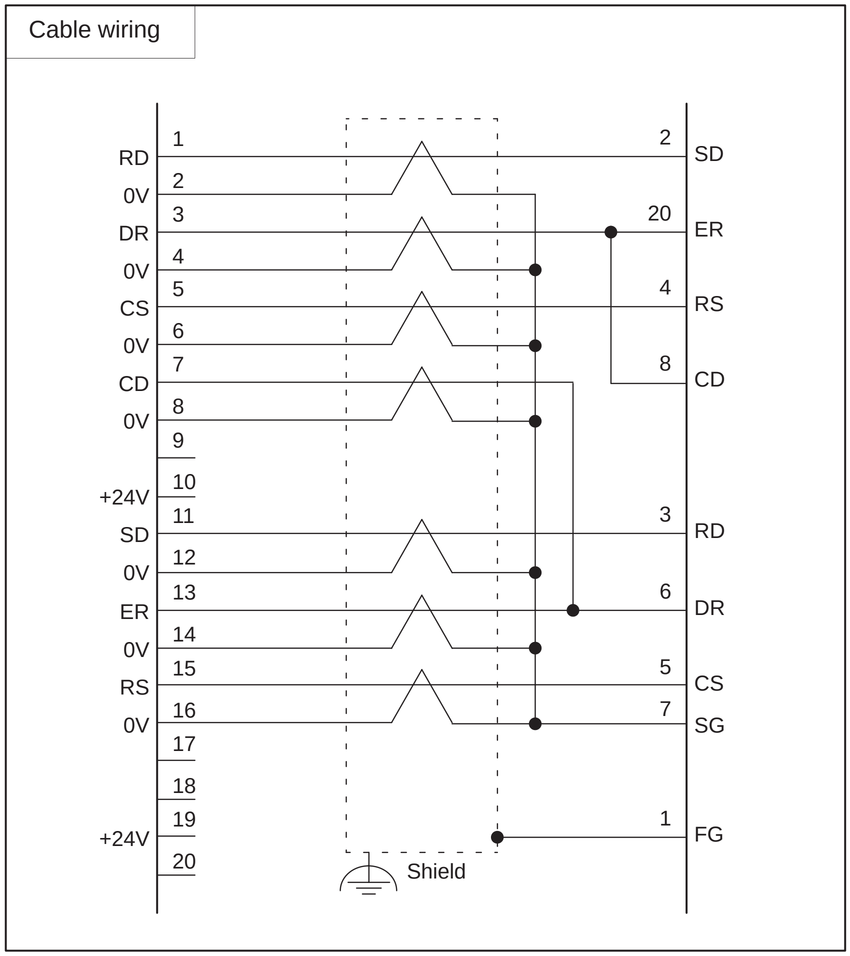
Host computer (example)

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	
10		23	
11		24	
12		25	
13			

Conceptional diagram of signal connection





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.

11.3 REMOTE BUFFER INTERFACE (RS–422)

CNC OPTION–1 board

JD6A
(PCR-EV20MDT)

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	

(+24V) is not used.

Host computer (Example)

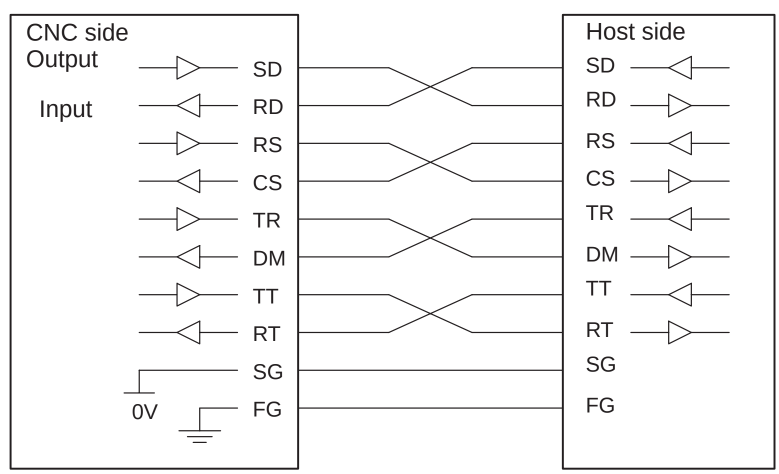
1	FG
2	
3	
4	SD
5	
6	RD
7	RS
8	RT
9	CS
10	
11	DM
12	TR
13	
14	
15	
16	
17	TT
18	
19	SG

20	
21	
22	*SD
23	
24	*RD
25	*RS
26	*RT
27	*CS
28	
29	*DM
30	*TR
31	
32	
33	
34	
35	*TT
36	
37	

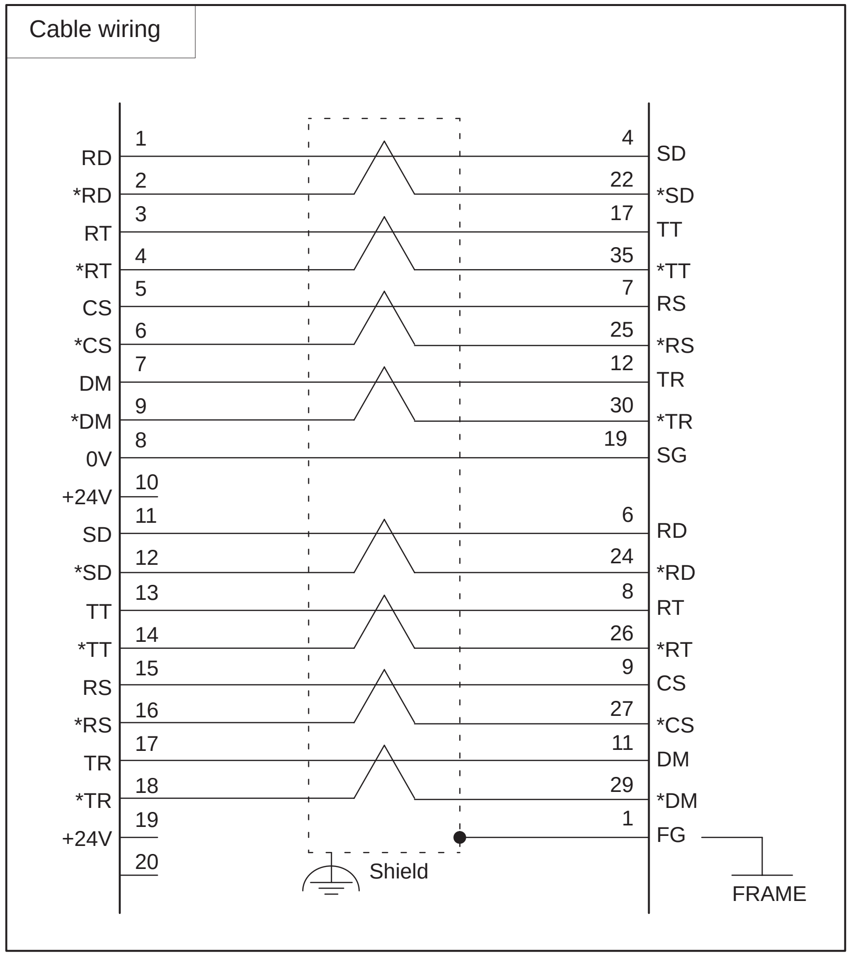
Conceptional diagram of signal connection

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.

Conceptional diagram of signal connection



Actual example of RS–422 signal wiring

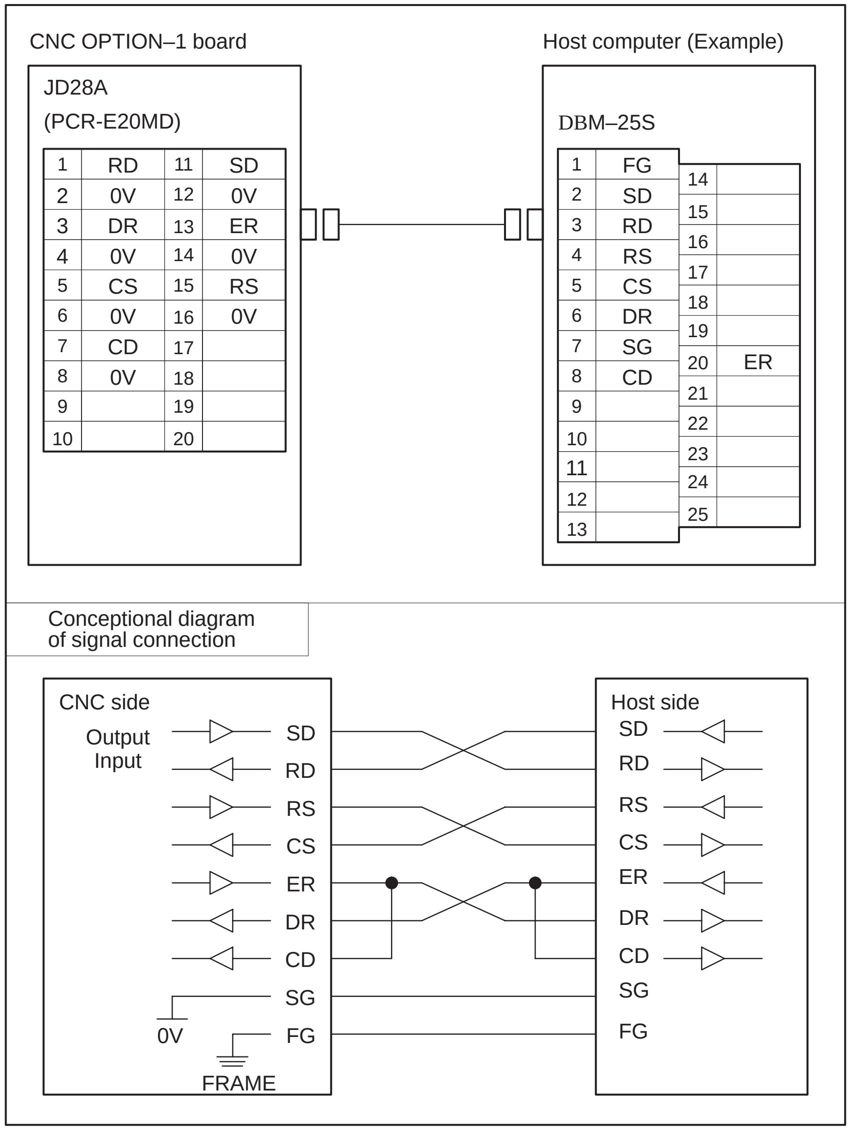


NOTE

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.

11.4 DNC2 INTERFACE (RS–232C)



Connect CS to RS when CS is not used.

Connect DR to ER when DR is not used.

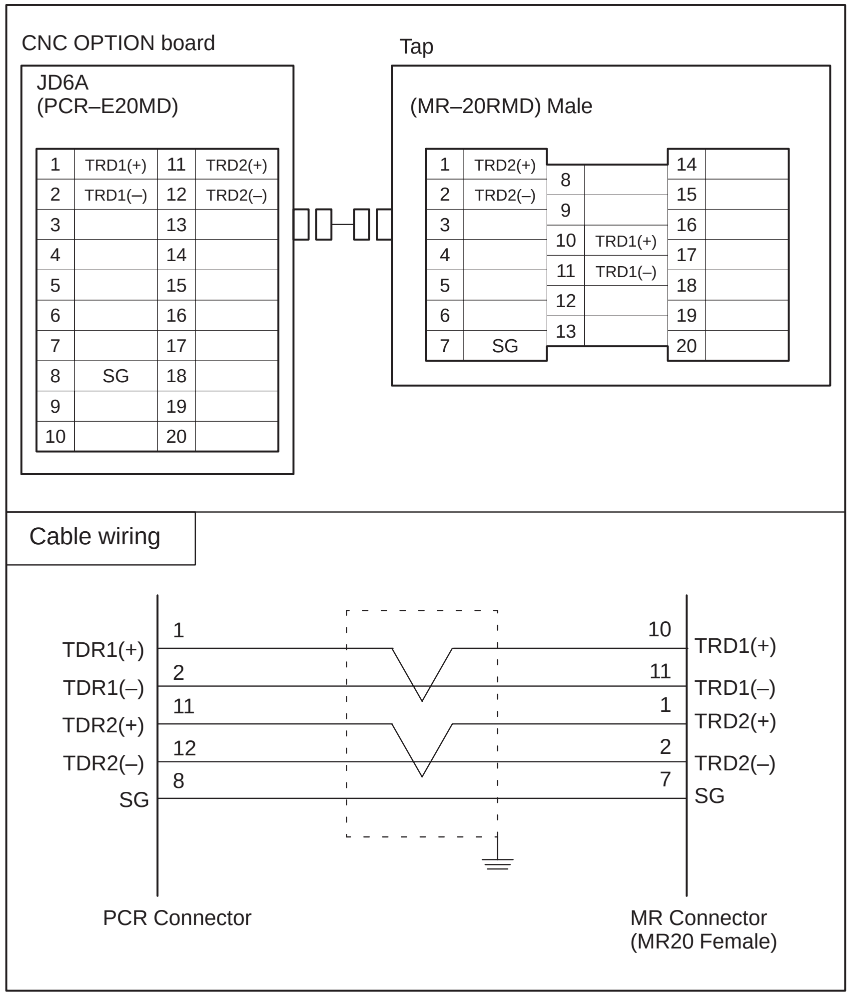
Always connect CD to ER.

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.

11.5 DNC1 INTERFACE

11.5.1 Multipoint Connection



11.5.2 Point–to–point Connection

CNC OPTION board

JD6A
(PCR–E20MD)

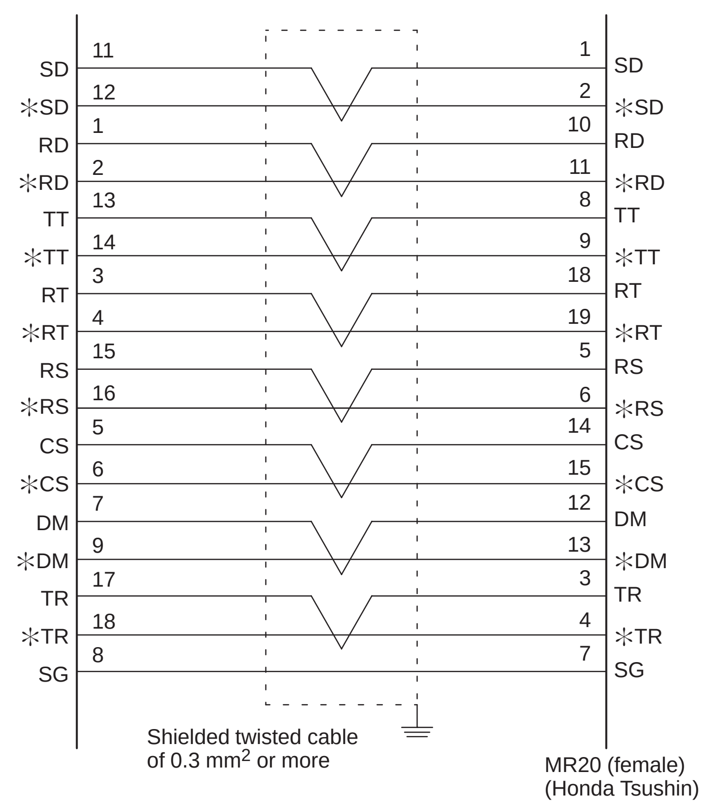
1	RD	11	SD
2	✻RD	12	✻SD
3	RT	13	TT
4	✻RT	14	✻TT
5	CS	15	RS
6	✻CS	16	✻RS
7	DM	17	TR
8	SG	18	✻TR
9	✻DM	19	
10		20	

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



12 HIGH–SPEED SERIAL BUS (HSSB)

12.1 OVERVIEW

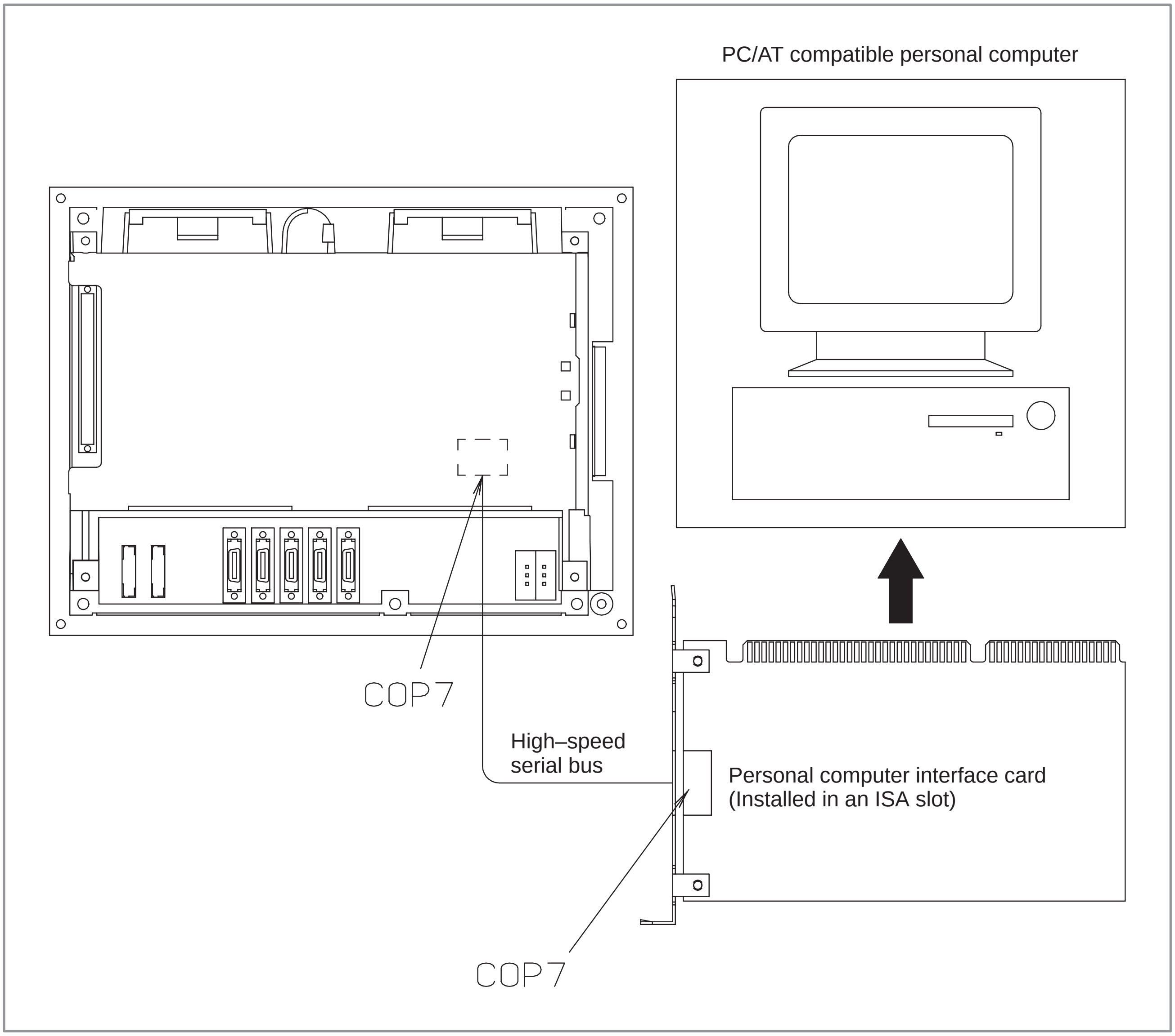
The high–speed serial bus (HSSB) enables the high–speed transfer of large amounts of data between a commercially available IBM PC or compatible personal computer and a CNC, by connecting them via a high–speed optical fiber.
On the CNC, the HSSB interface board is installed in a minislot. On the personal computer, an appropriate interface board is installed.
The HSSB can be used with a Series 210*i* system, but not with a Series 21*i* system.

12.2 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 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.

12.3 CONNECTION DIAGRAM



12.4 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 386 or better. The interface board does not work with a 286 CPU.)

(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 12.6

(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 +5 V at 1 A.

12.5 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.

12.6 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.)

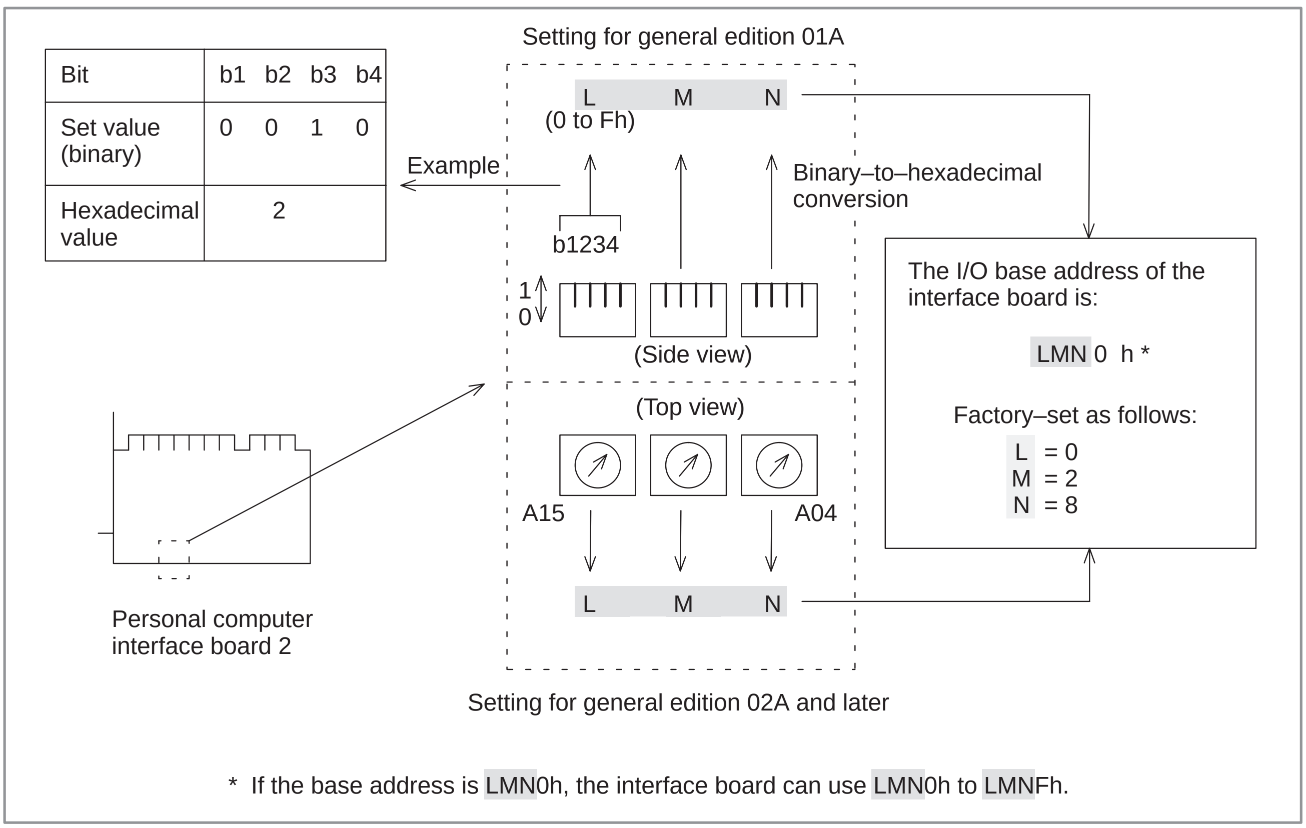
(2) Remove the blank panel from the expansion slot of the personal computer.

(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.



Bit	b1	b2	b3	b4
Set value (binary)	0	0	1	0
Hexadecimal value	2			

I/O base address setting
(for personal computer interface board type 2 only)

12.7 HANDLING PRECAUTIONS

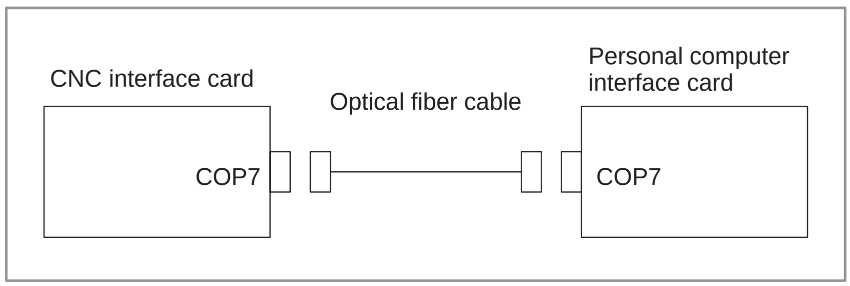
(1) Personal computer interface board

(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.

12.8 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.

APPENDIX

A EXTERNAL DIMENSIONS OF EACH UNIT

Name		Specifications	Fig. No.
Series 21*i* control unit	7.2″ STN monochrome LCD	A02B–0247–B531, B532, B535, B536	Fig. U1
	8.4″ TFT color LCD	A02B–0247–B501, B502, B505, B506	Fig. U2
	9.5″ STN monochrome LCD	A02B–0247–B541, B542, B545, B546	Fig. U3
	10.4″ TFT color LCD	A02B–0247–B511, B512, B515, B516	Fig. U4
Series 210*i* control unit	10.4″ TFT color LCD	A02B–0247–B551, B552 B555, B566 B561, B562 B565, B566 B571, B572 B575, B576	
Separate–type small–size MDI unit	For 7.2″/8.4″	A02B–0236–C120#TBR, #MBR	Fig. U5
Separate–type standard MDI unit	For 7.2″/8.4″	A02B–0236–C121#TBR, #MBR #TBS, #MBS	Fig. U6
Separate–type standard MDI unit (horizontal type)	For 9.5″/10.4″	A02B–0236–C125#TBR, #MBR #TBS, #MBS	Fig. U7
Separate–type standard MDI unit (vertical type)	For 9.5″/10.4″	A02B–0236–C126#TBR, #MBR #TBS, #MBS A02B–0236–C127#TBR, #MBR #TBS, #MBS	Fig. U8
FA full keyboard		A02B–0236–C130#EC, #JC	Fig. U9
Full keyboard (for debugging)		A86L–0001–0210, 0211	Fig. U10
Mouse (for debugging)		A86L–0001–0212	Fig. U11
High–speed serial bus interface board type 2 (for PC)		A20B–8100–0100	Fig. U12
Position coder	4000 rpm	A86L–0027–0001#102	Fig. U13
	6000 rpm	A86L–0027–0001#002	
Manual pulse generator		A860–0202–T001	Fig. U14
Pendant–type manual pulse generator		A860–0202–T004, T005, T006, T007 T010, T011, T012, T013	Fig. U15
Separate detector interface unit		A02B–0236–C201	Fig. U16
ABS battery case for separate detector		A06B–6050–K060	Fig. U17
Tap unit for DNC1		A13B–0156–C100	Fig. U18
Terminal resistance unit for DNC1		A13B–0156–C200	Fig. U19
External CNC battery unit		A02B–0236–C281	Fig. U20
Punch panel (narrow type)	1 m	A02B–0236–C191	Fig. U21
	2 m	A02B–0236–C192	
	5 m	A02B–0236–C193	

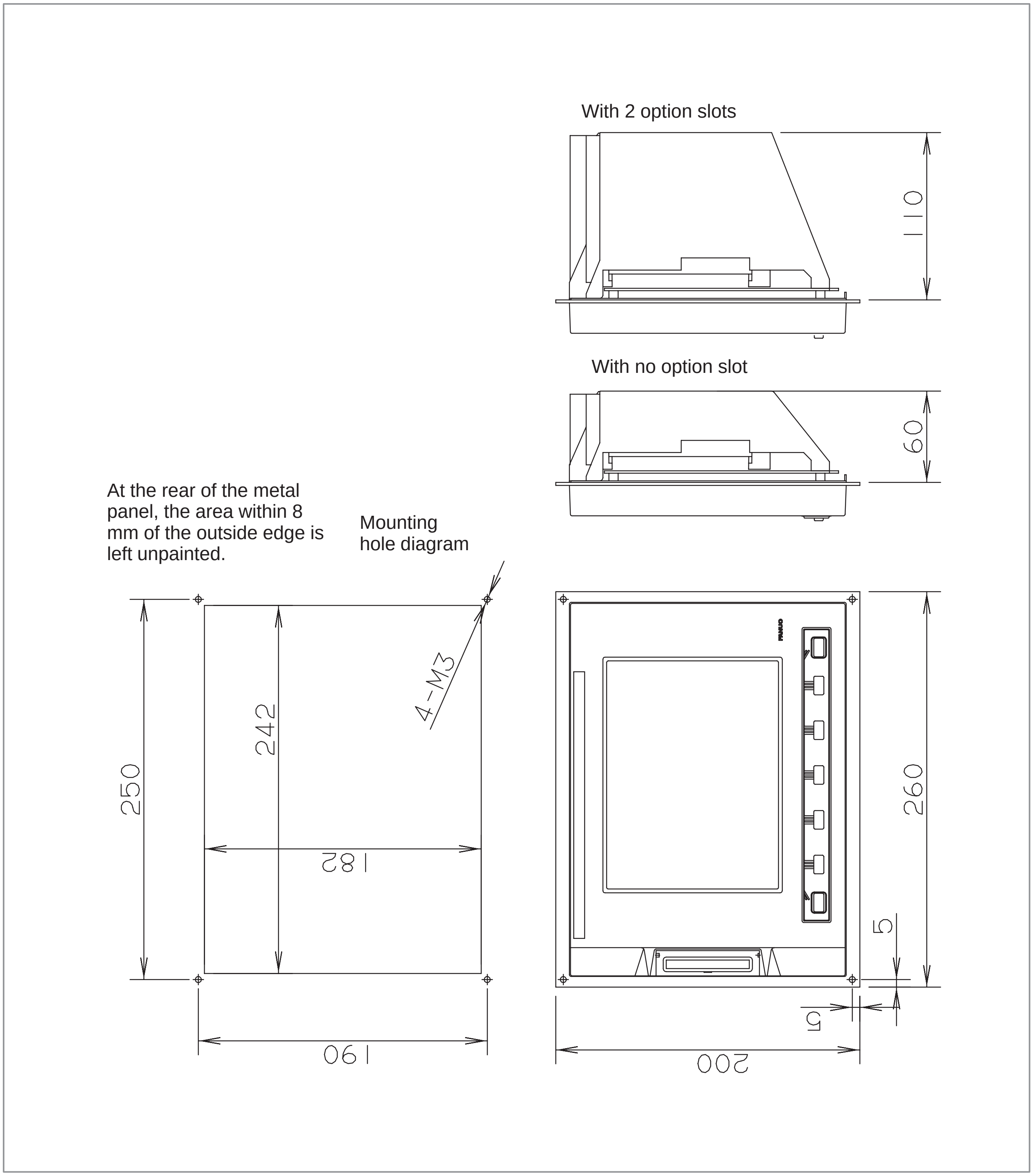


Fig. U1 External dimensions of CNC control unit with 7.2″ LCD

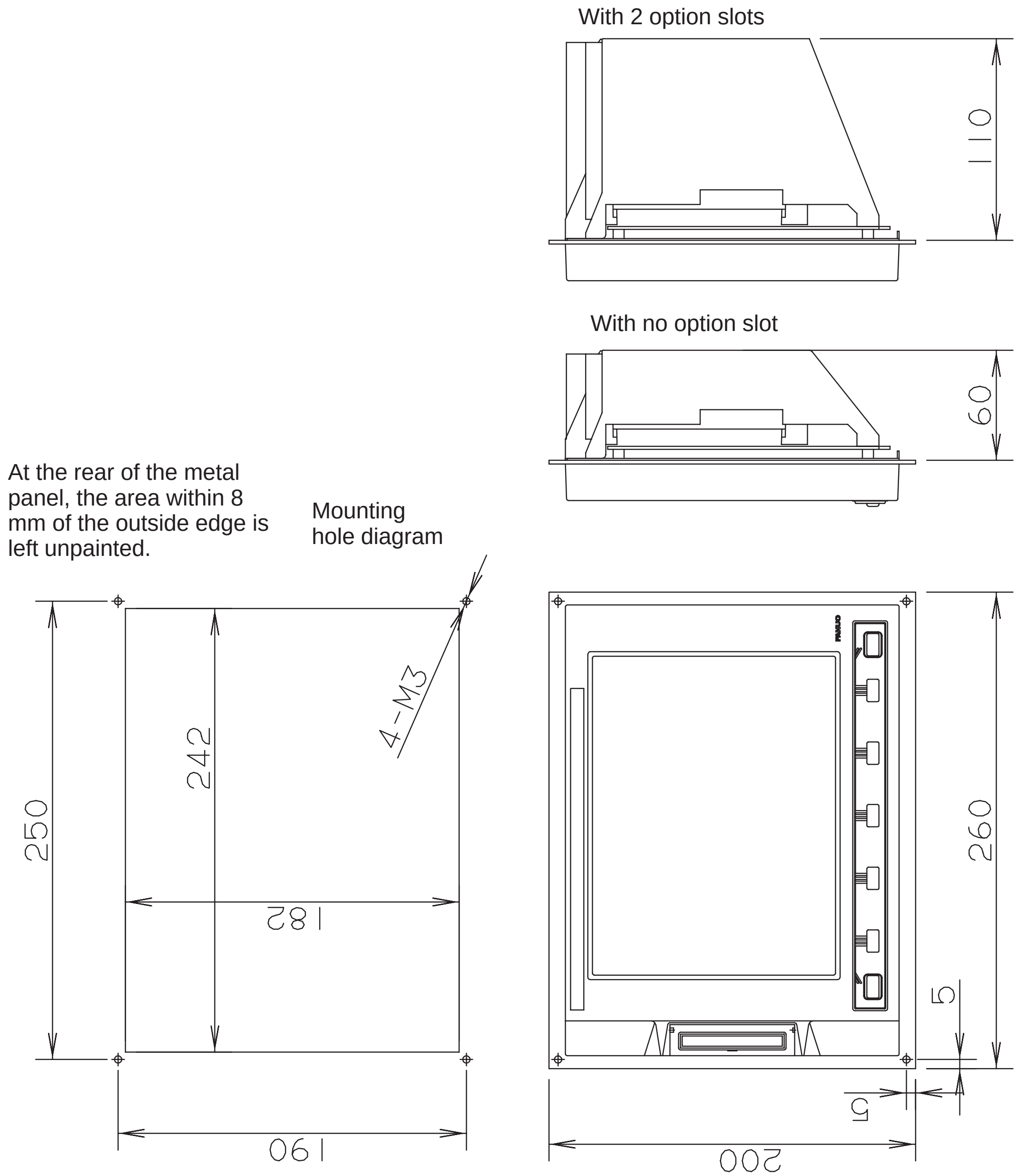


Fig. U2 External dimensions of CNC control unit with 8.4″ LCD

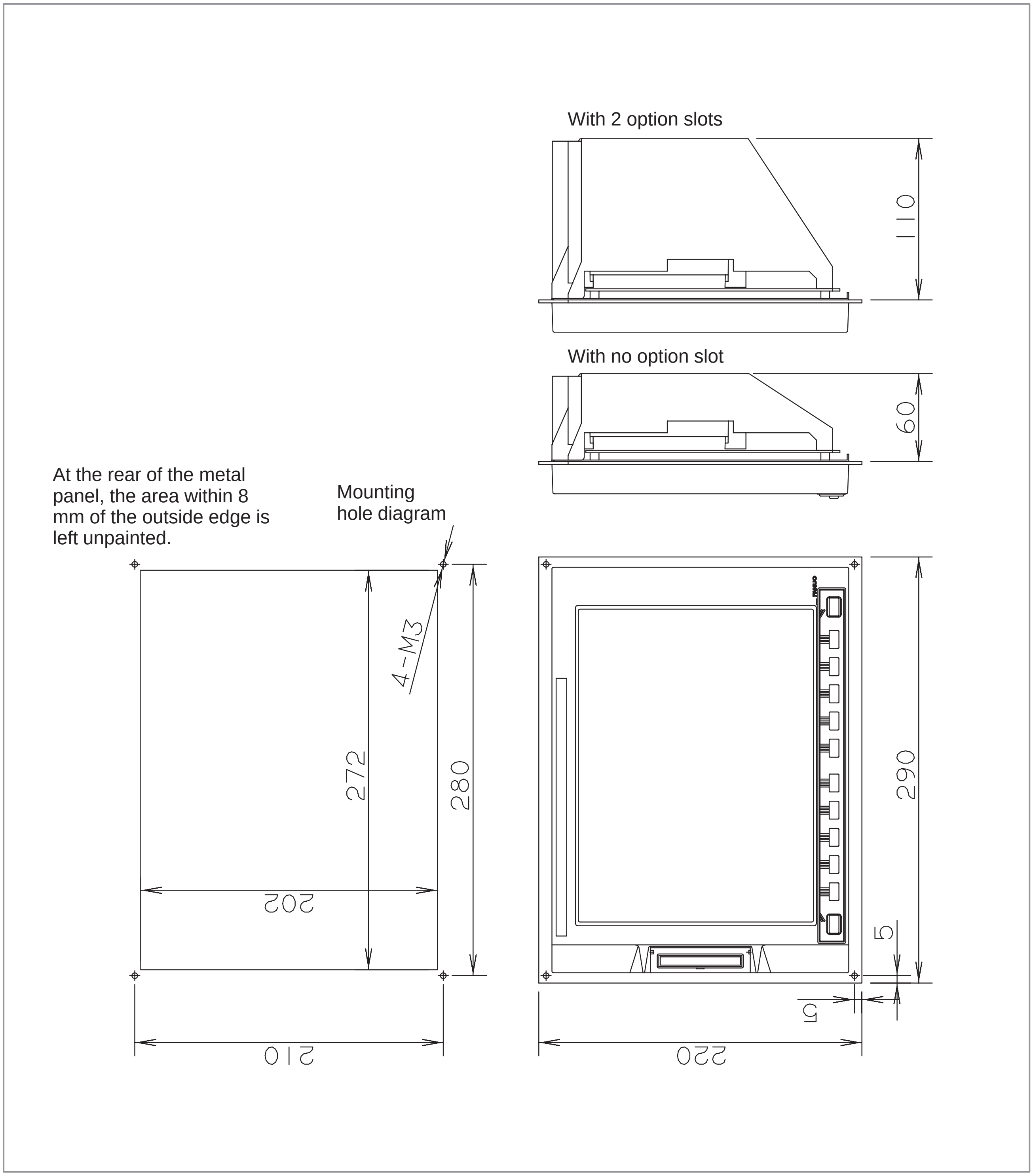


Fig. U3 External dimensions of CNC control unit with 9.5″ LCD

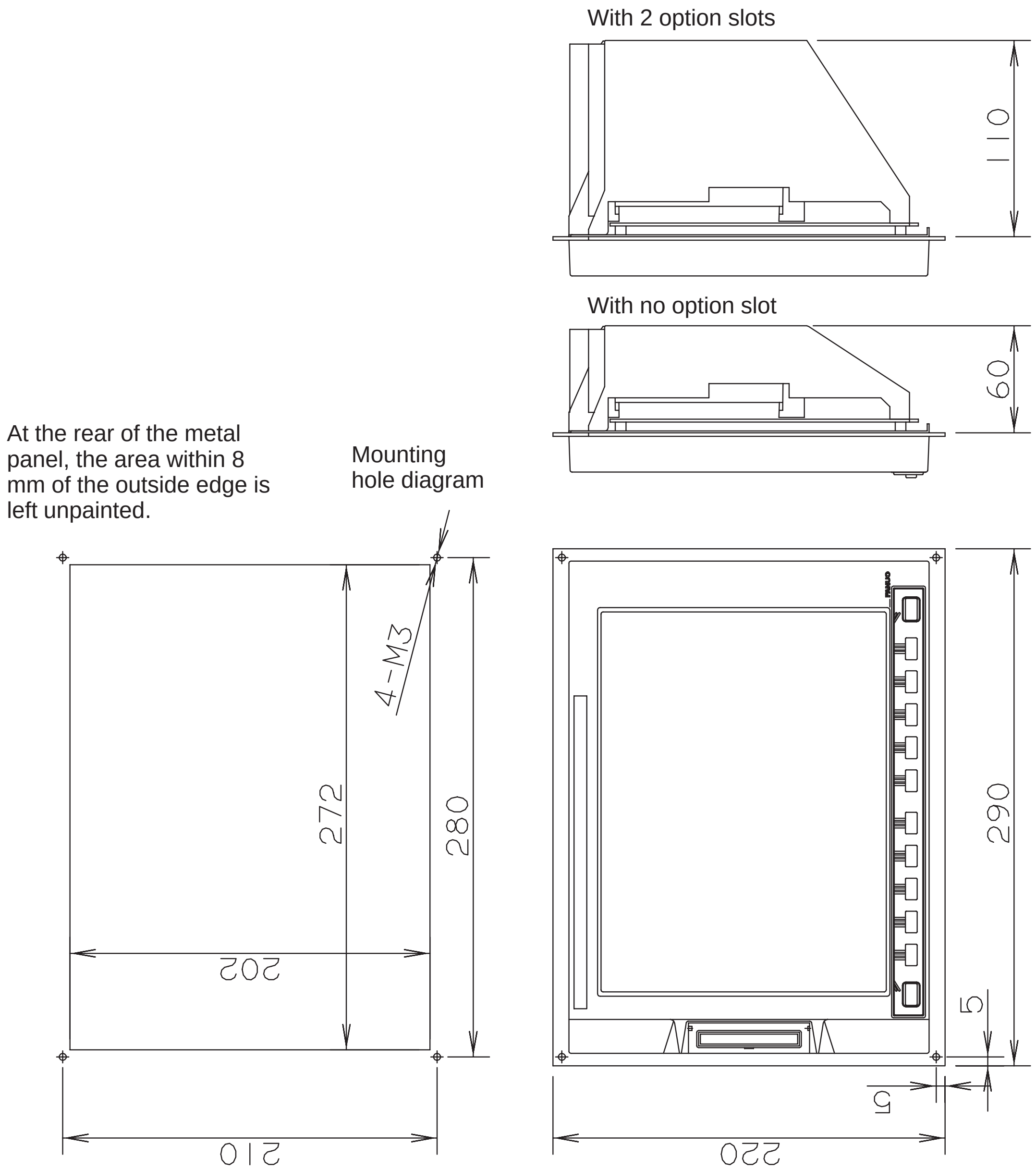


Fig. U4 External dimensions of CNC control unit with 10.4″ LCD

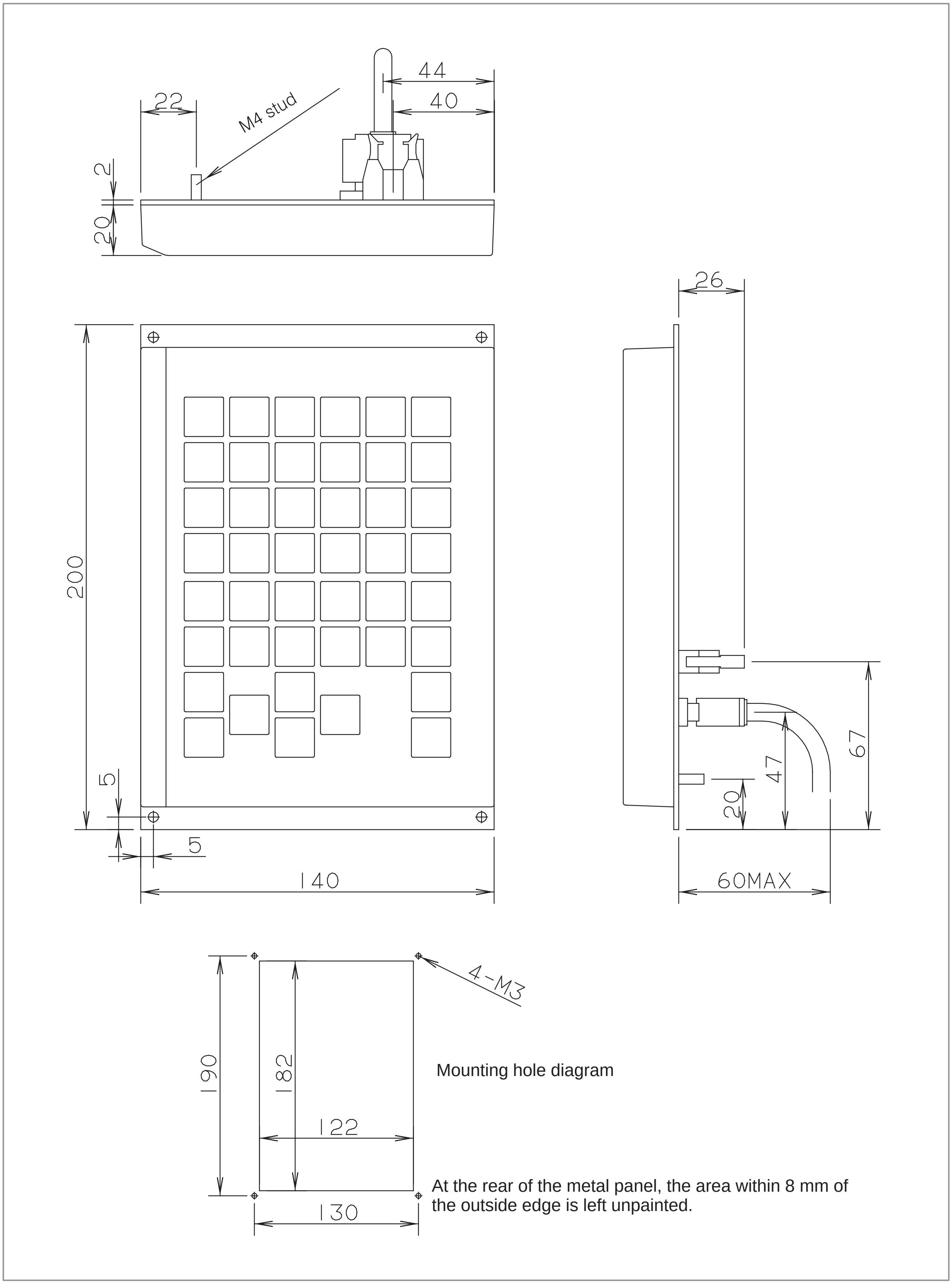


Fig. U5 External dimensions of separate–type small–size MDI unit

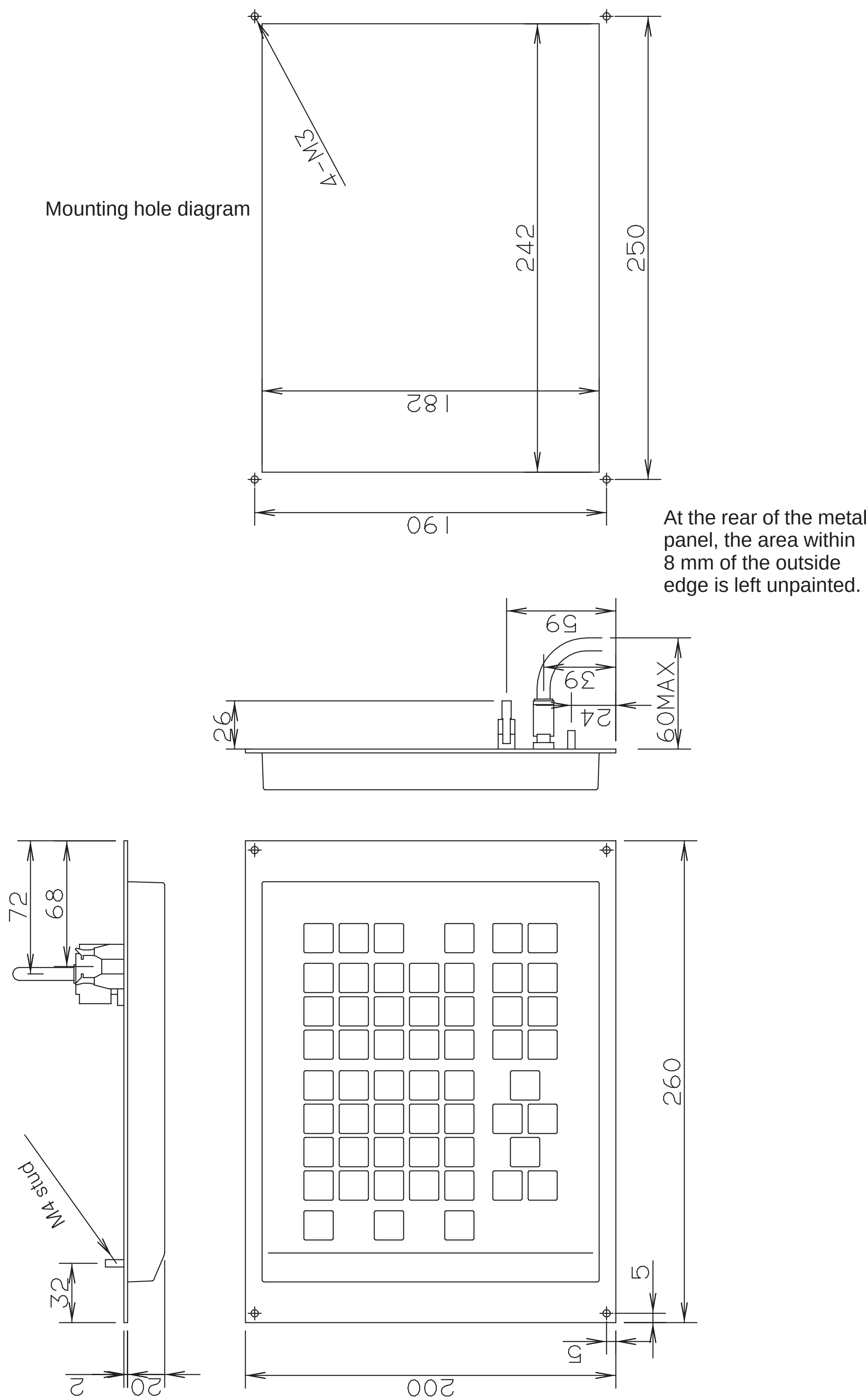


Fig. U6 External dimensions of separate–type standard MDI unit

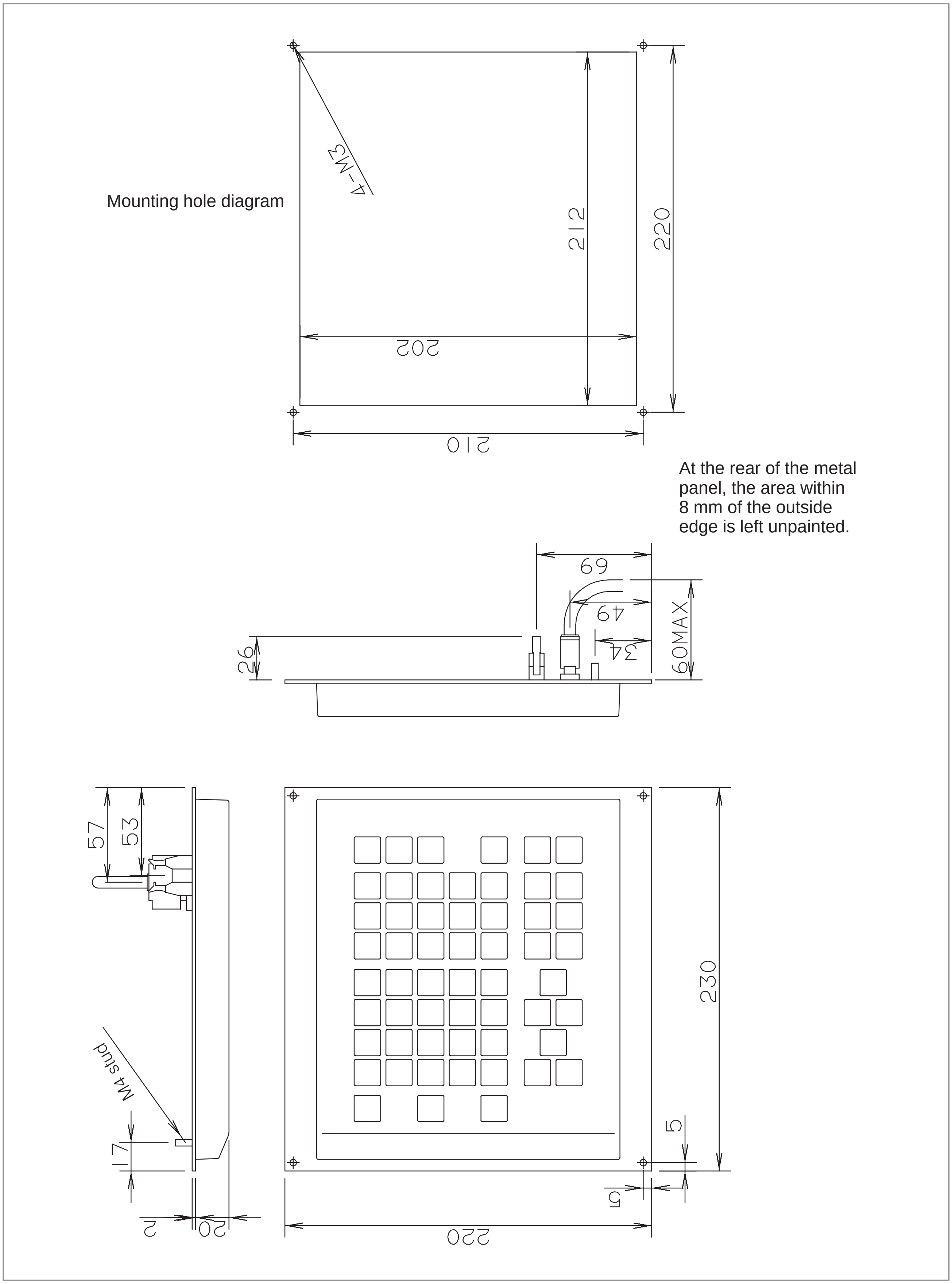


Fig. U7 External dimensions of separate–type standard MDI unit (horizontal type)

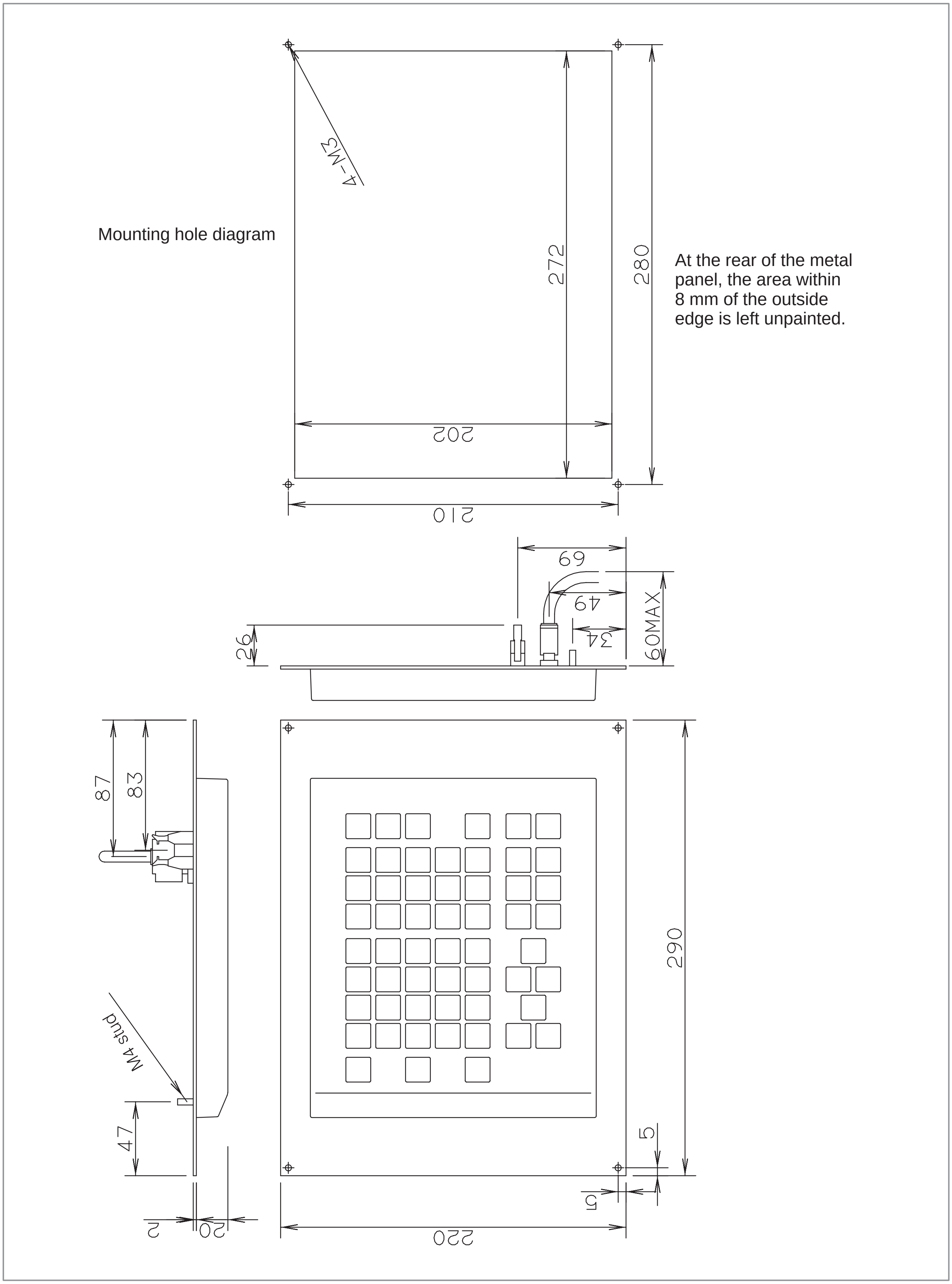


Fig. U8(a) External dimensions of separate–type standard MDI unit (vertical type)

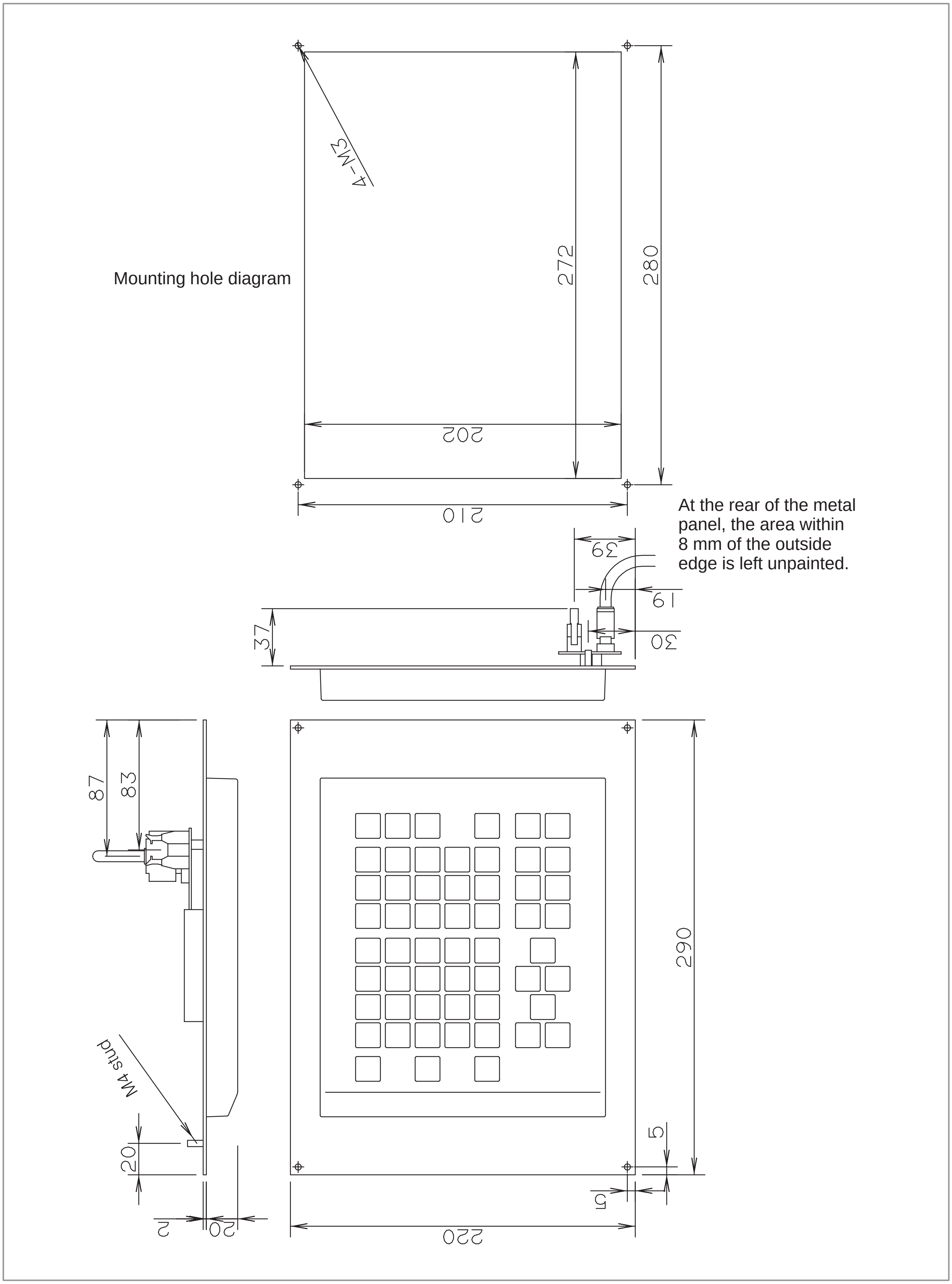


Fig. U8(b) External dimensions of separate–type standard MDI unit (vertical type) for 210*i*

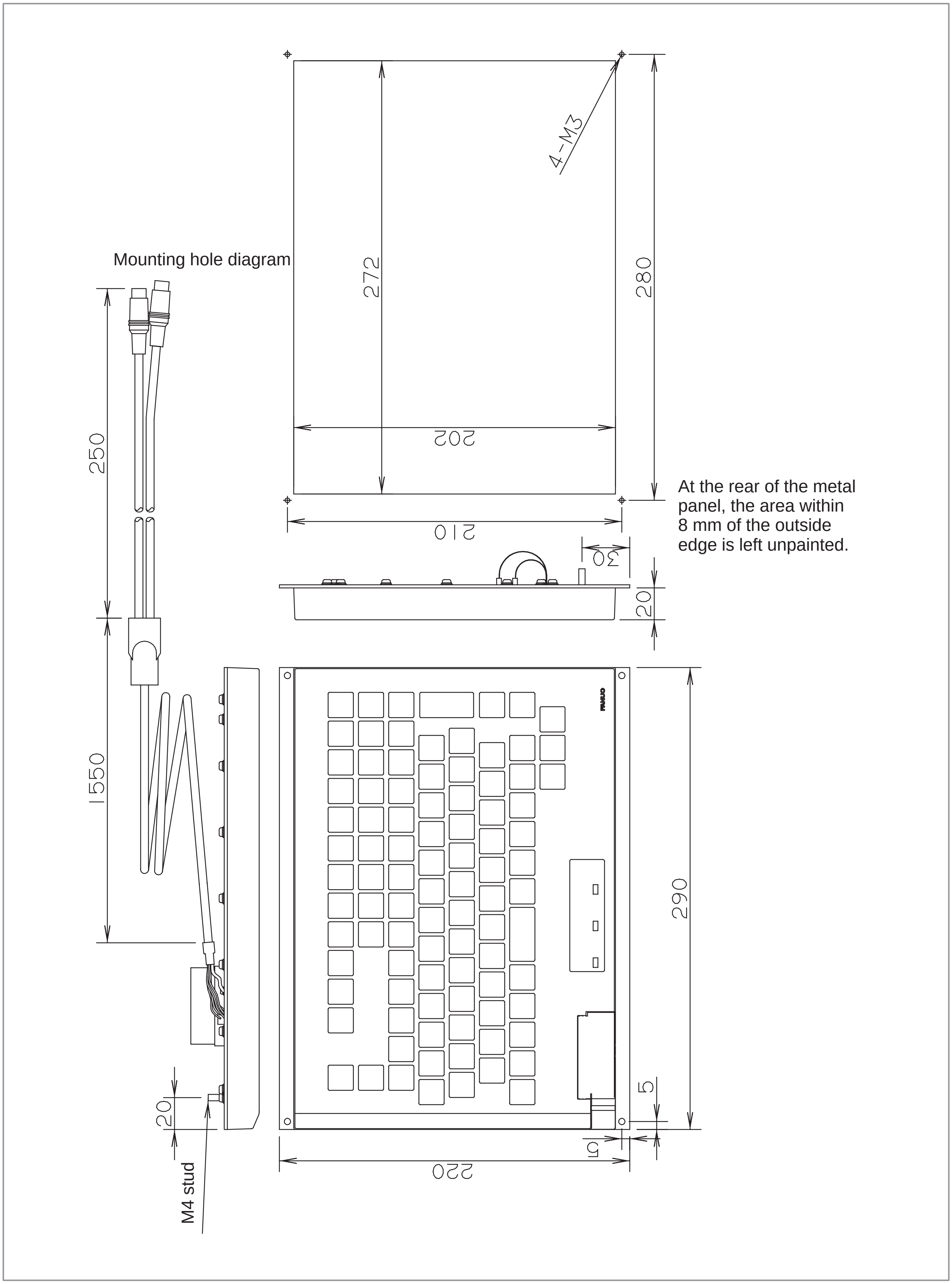


Fig. U9 External dimensions of FA full keyboard

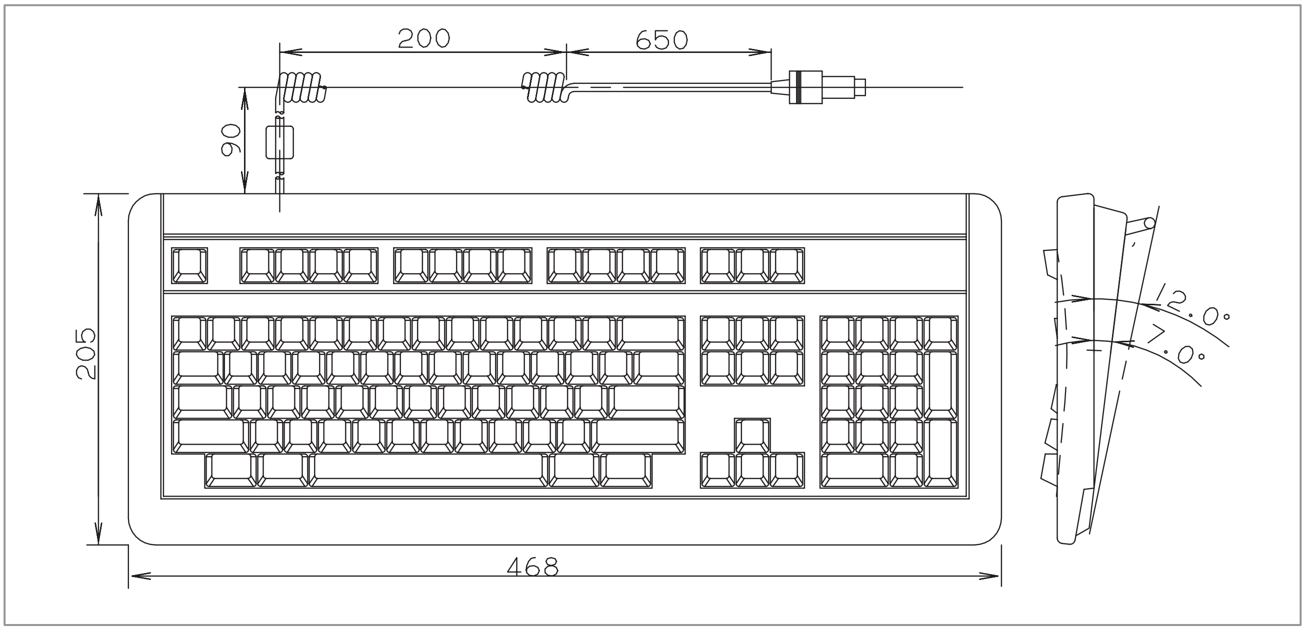


Fig. U10(a) External dimensions of 101–type full keyboard (English)
Specification No.: A86L–0001–0210

> **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.

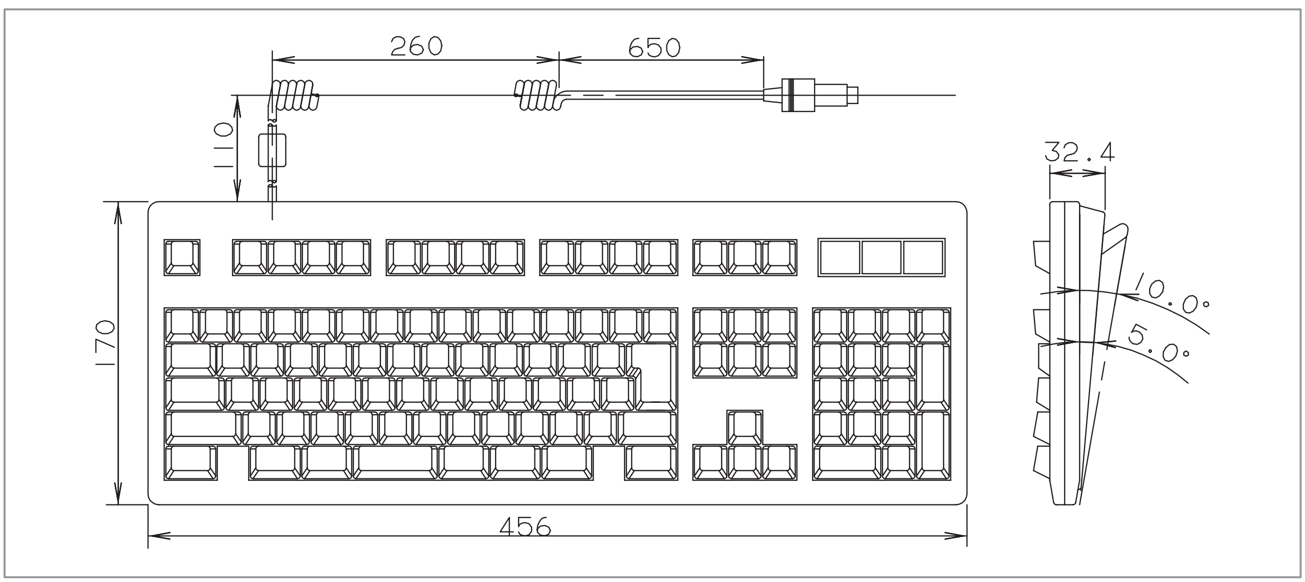


Fig. U10(b) External dimensions of 106–type full keyboard (Japanese)
Specification No.: A86L–0001–0211

> **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.

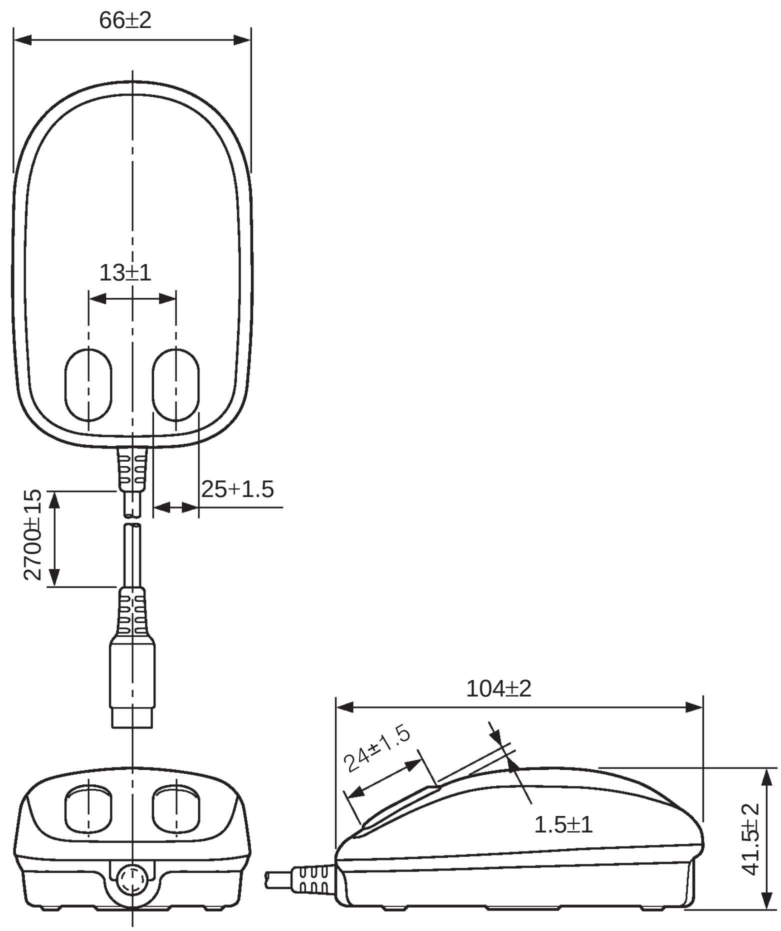


Fig. U11 External dimensions of mouse
Specification No.: A86L–0001–0212

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 2.7–m cable.

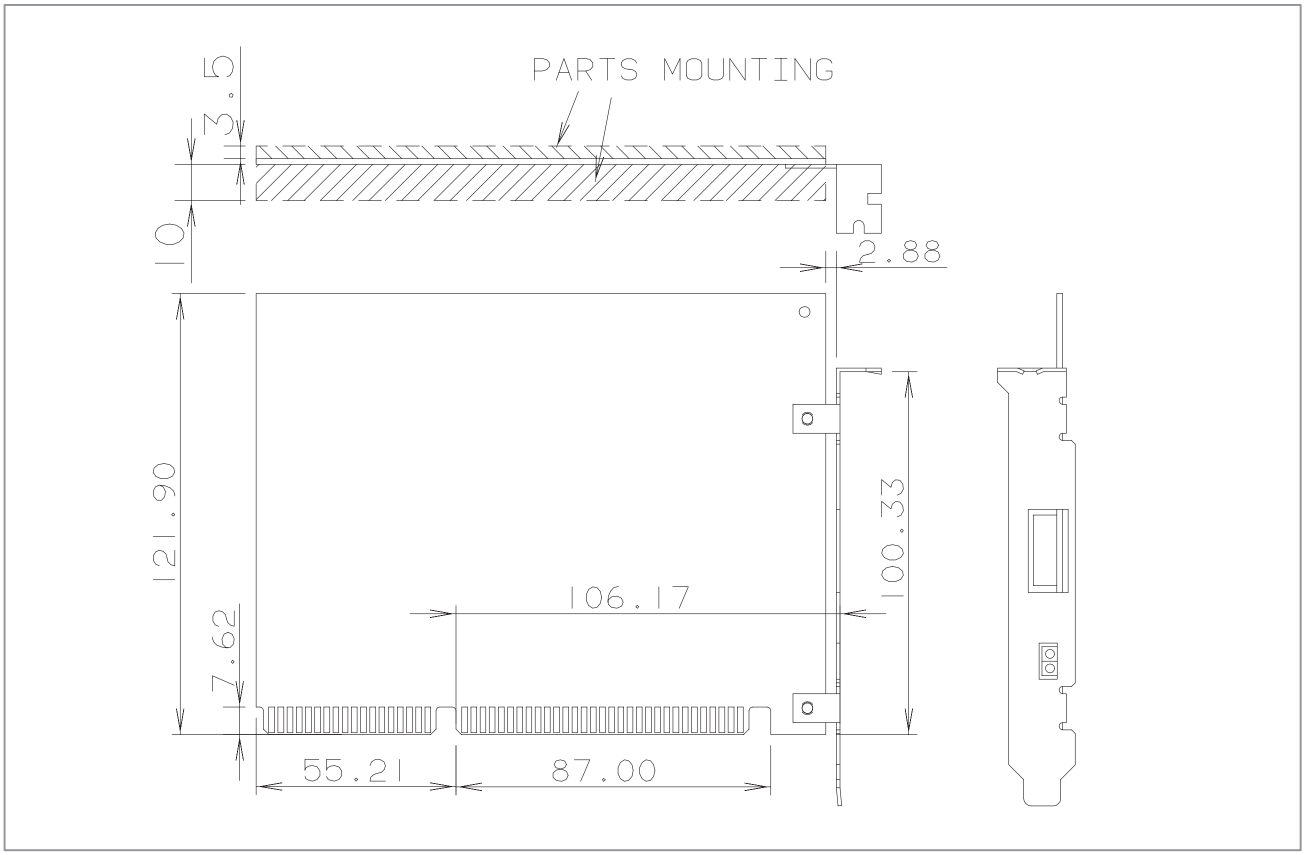
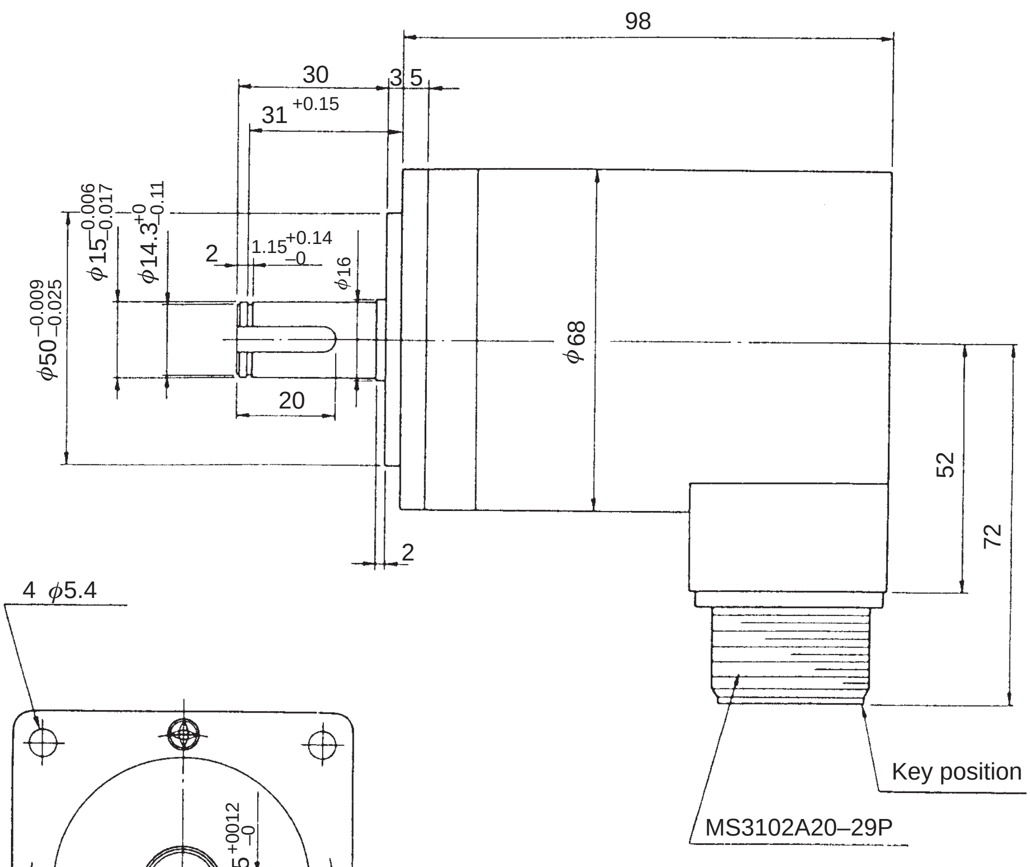
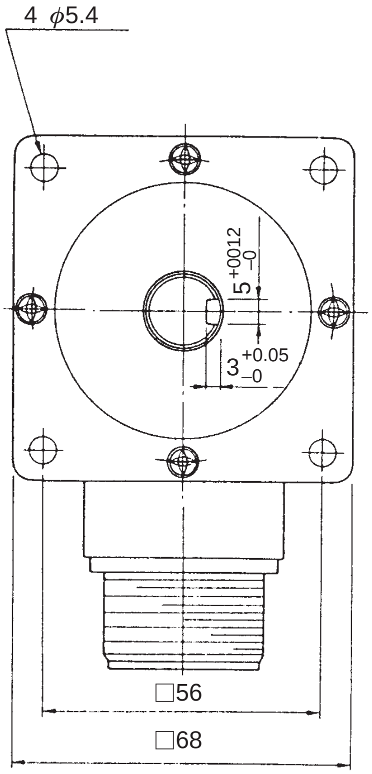


Fig. U12 External dimensions of high–speed serial bus interface board type 2 (for PC)
Specification No.: A20B–8100–0100





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. U13 External dimensions of position coder
Specification No.: A86L–0027–0001#102 (Max. 4000 rpm)
A86L–0027–0001#002 (Max. 6000 rpm)

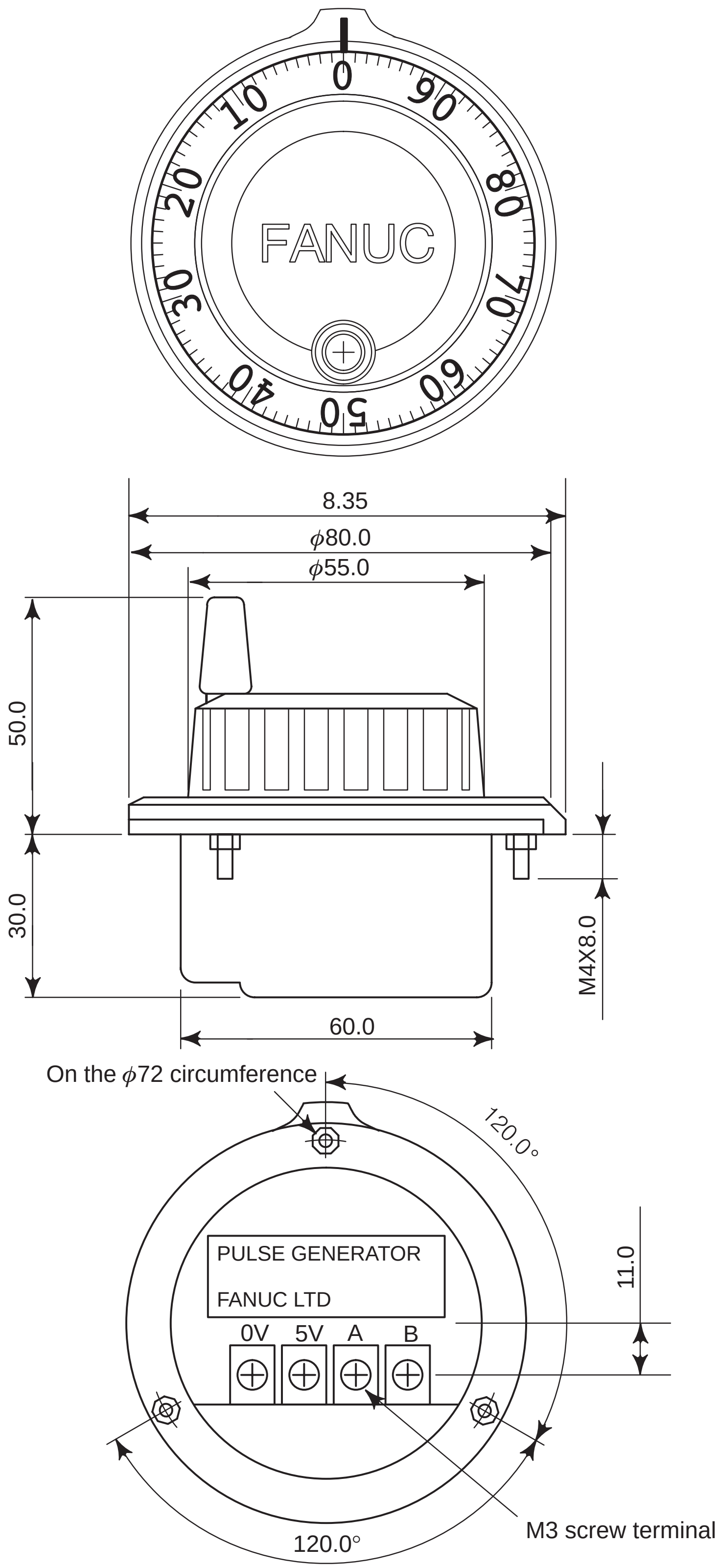
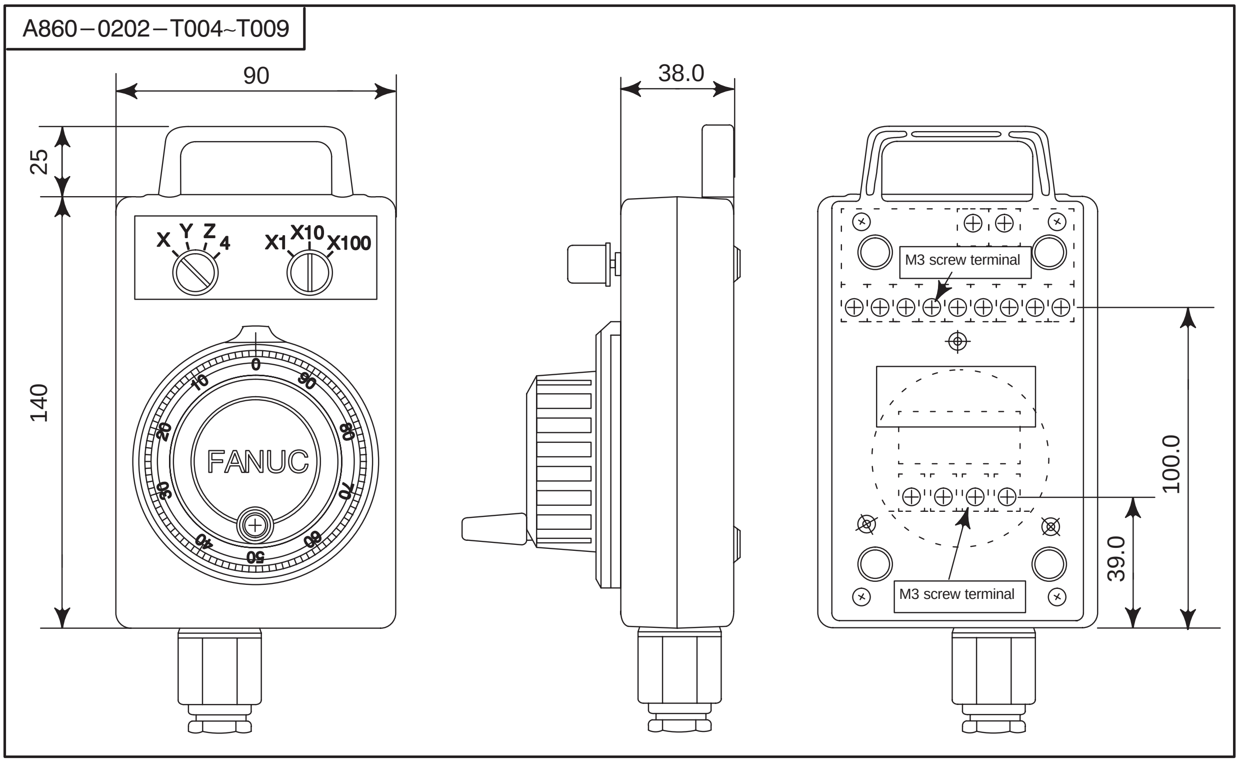


Fig. U14 External dimensions of manual pulse generator
Specification No.: A860–0202–T001



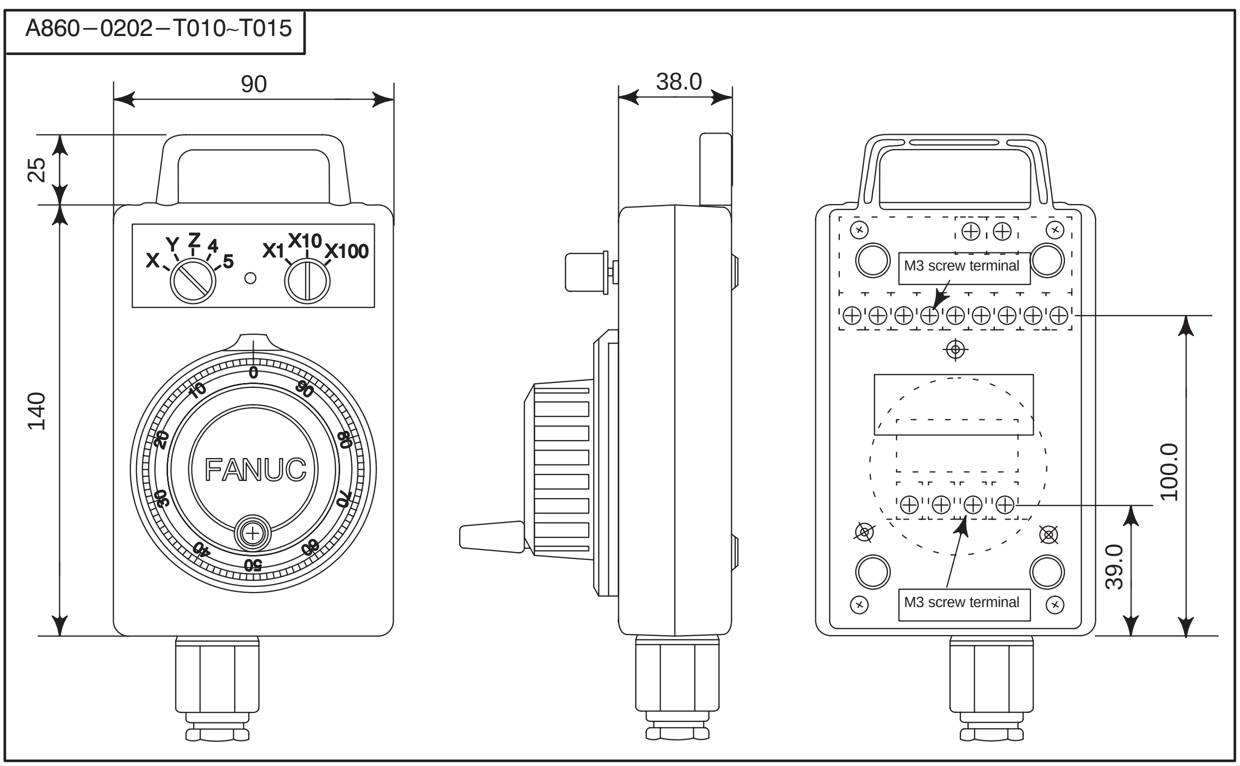


Fig. U15 External dimensions of pendant–type manual pulse generator
Specification No.: A860–0202–T004 to TT015

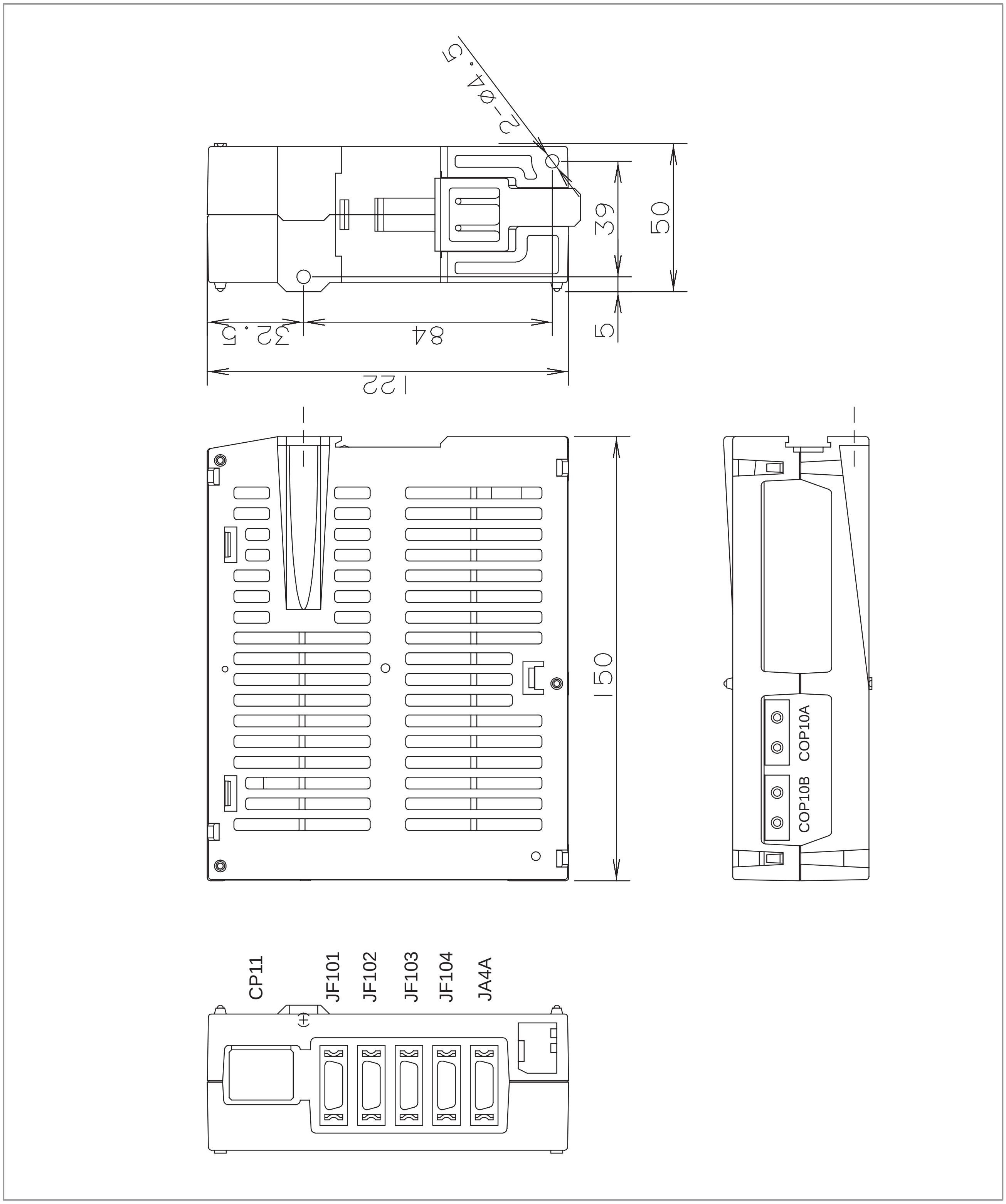


Fig. U16 External dimensions of separate detector interface unit

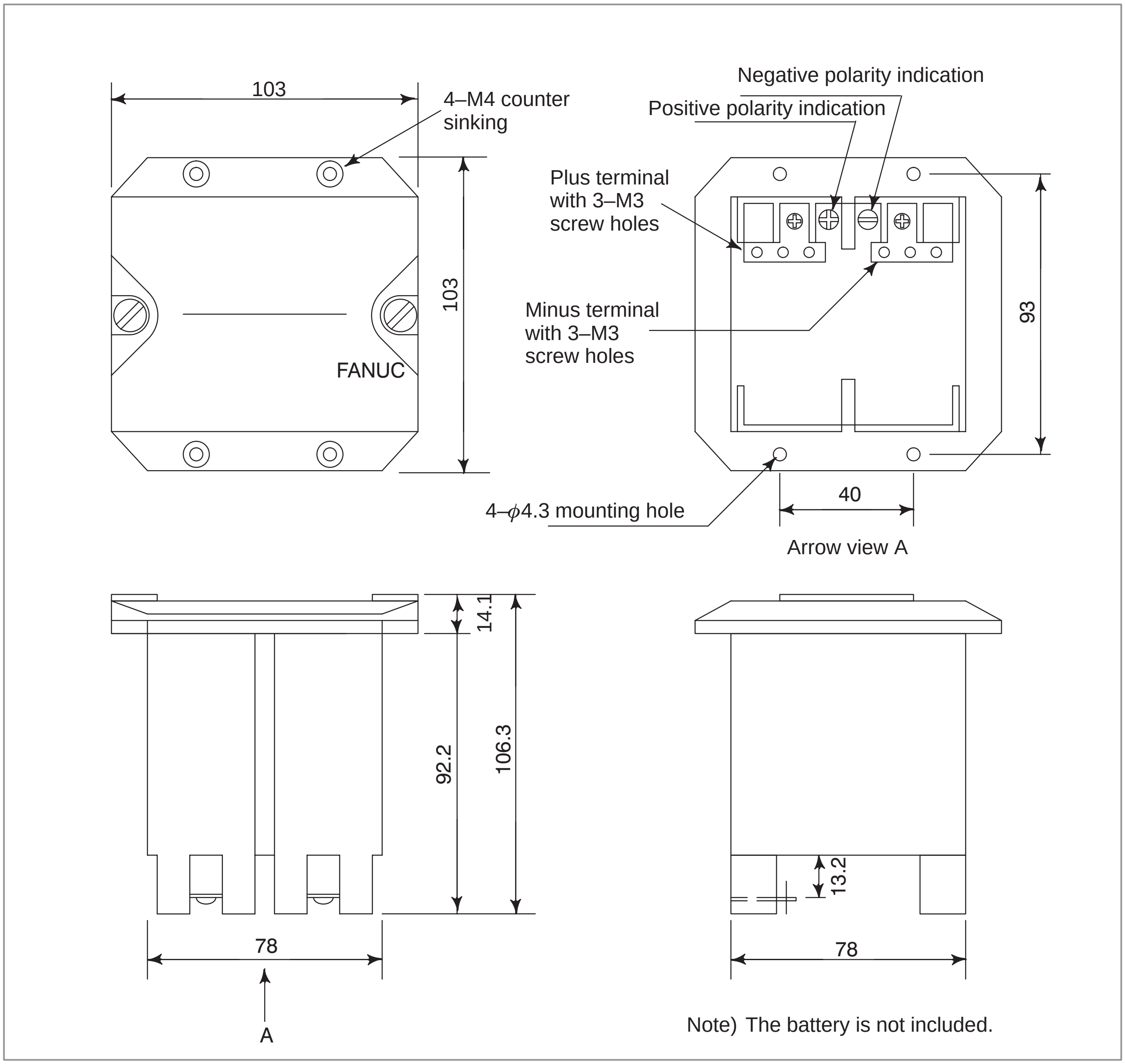


Fig. U17 External dimensions of ABS battery case for separate detector Specification No.: A06B–6050–K060

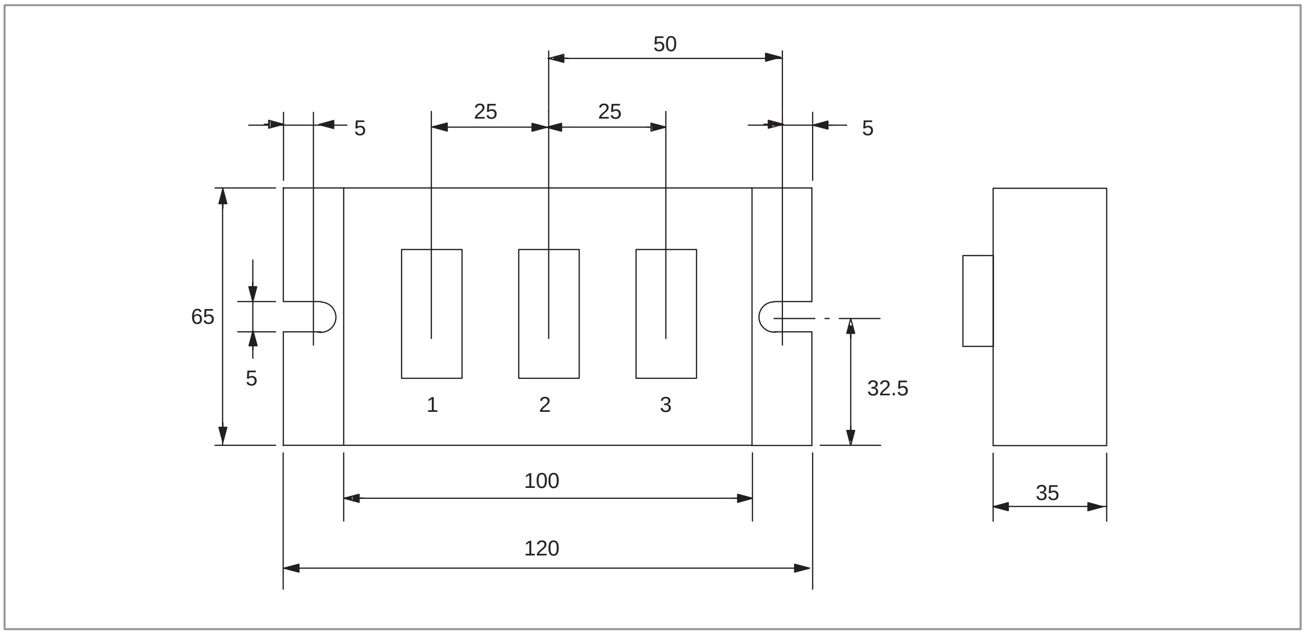


Fig. U18 External dimensions of tap

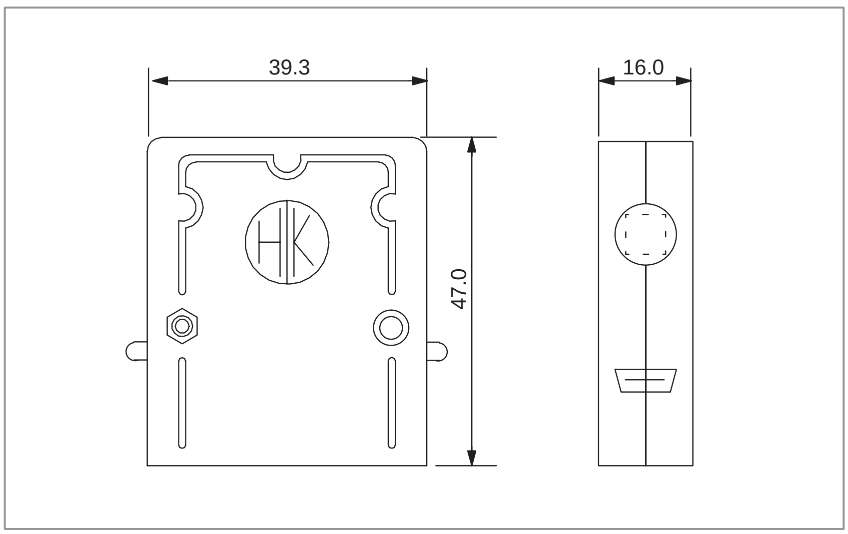
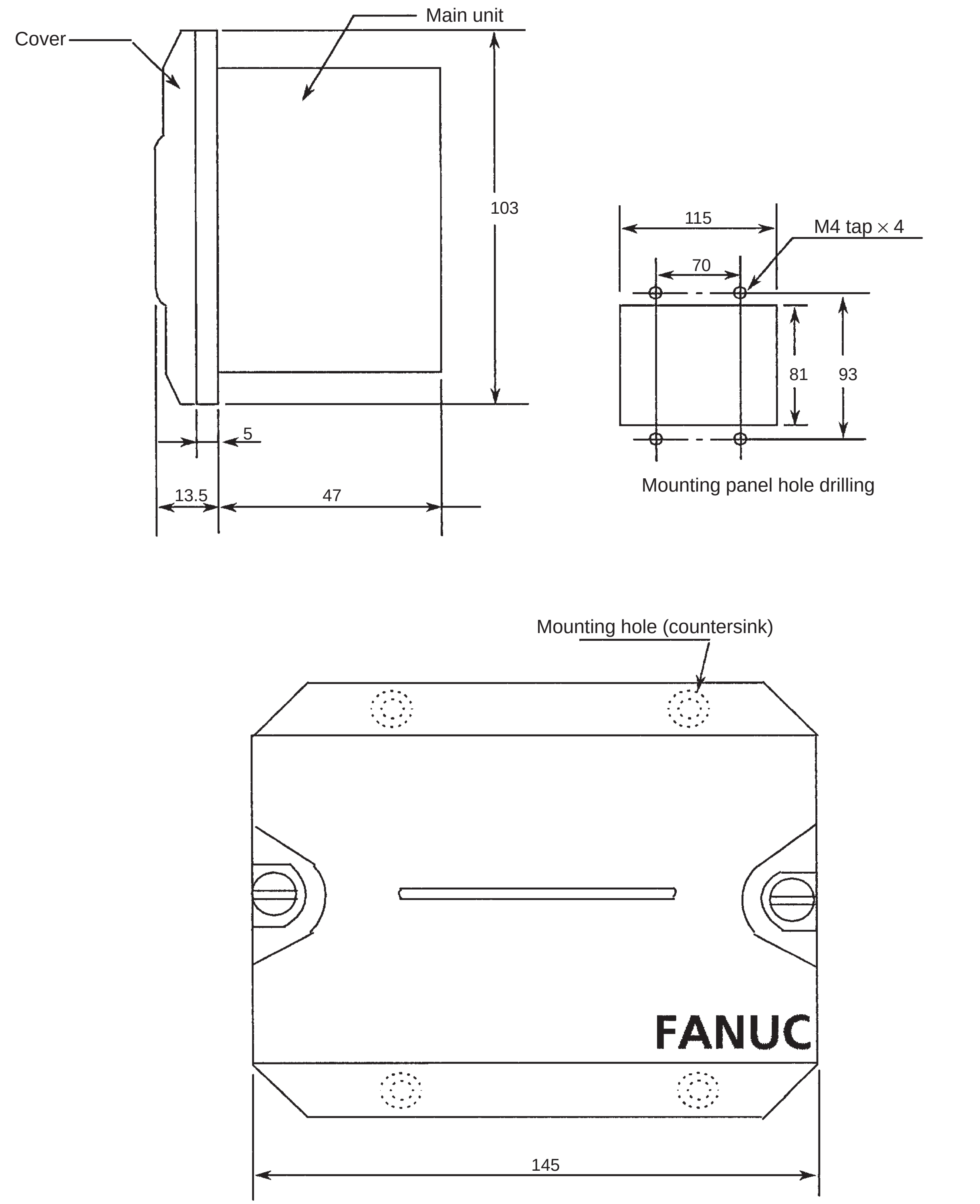


Fig. U19 External dimensions of terminal resistance unit



The battery unit is fitted with a 14–m battery cable.

Fig. U20 External dimensions of external CNC battery unit

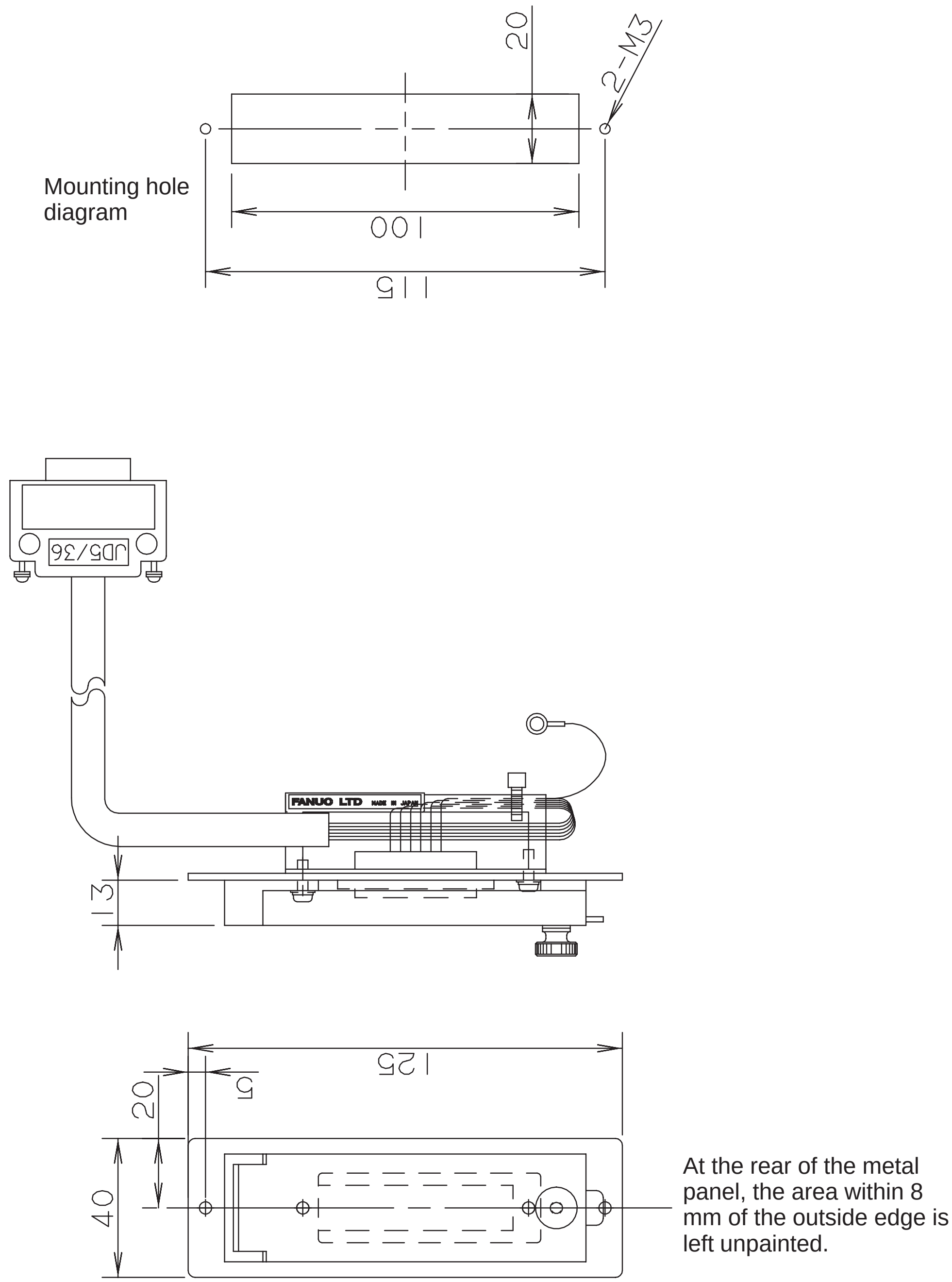
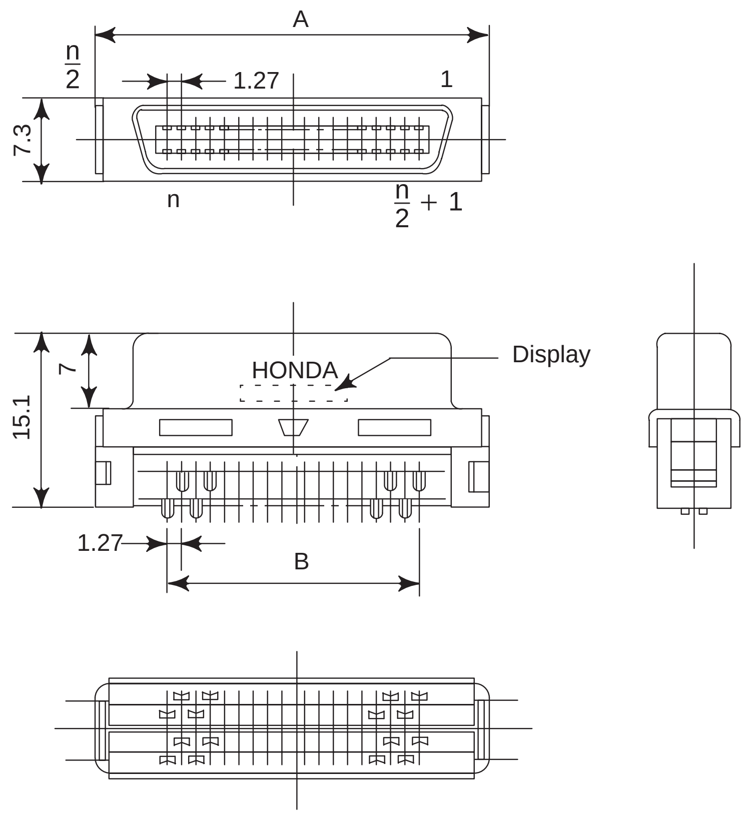


Fig. U21 External dimensions of punch panel (narrow type)

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	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)

TYPE	:	HONDA PCR–E20FS(SOLDERING TYPE)
USAGE	:	GENERAL
MATING	:	HONDA PCS–E20LA(METAL)
HOUSING	:	HONDA PCS–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

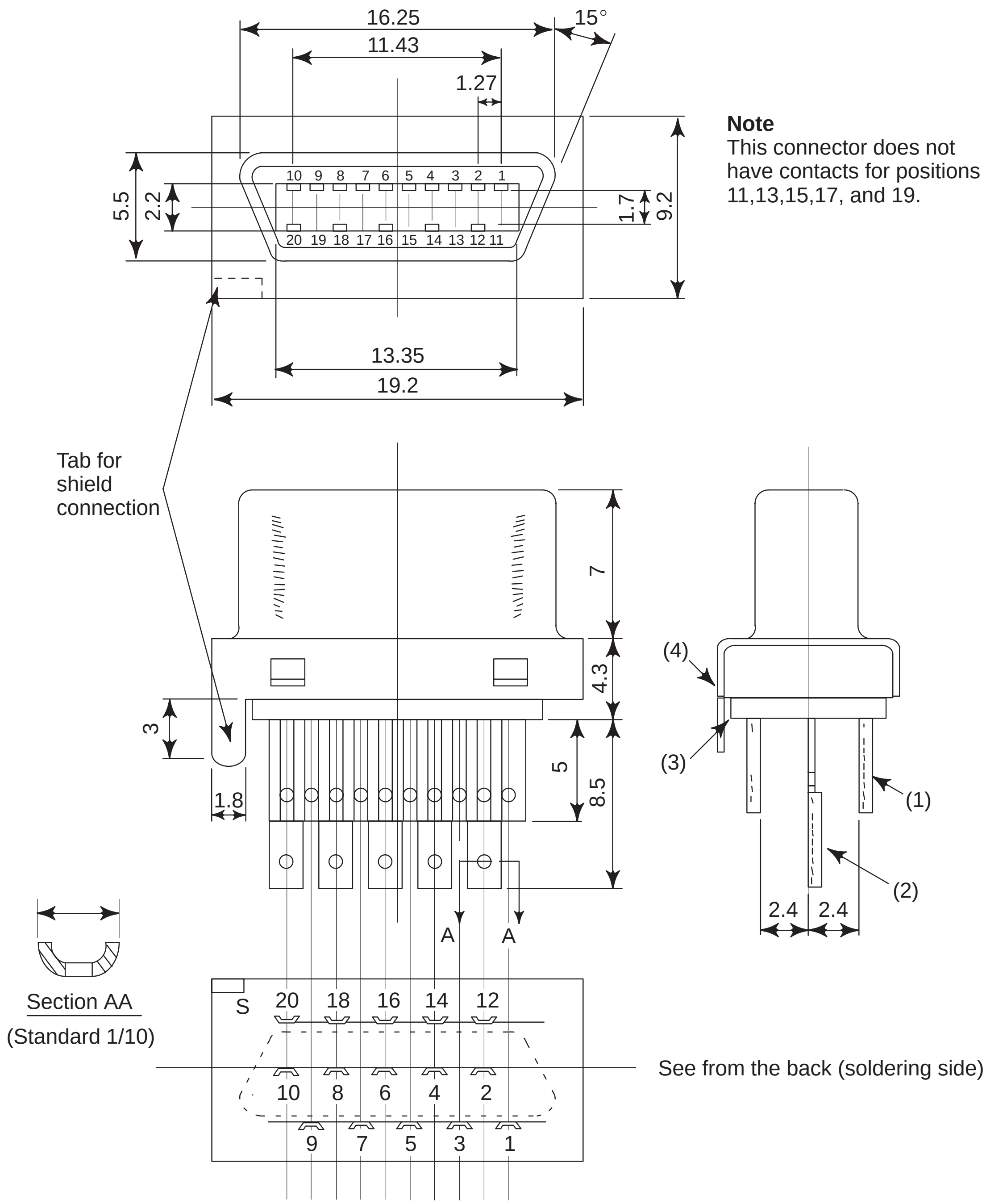
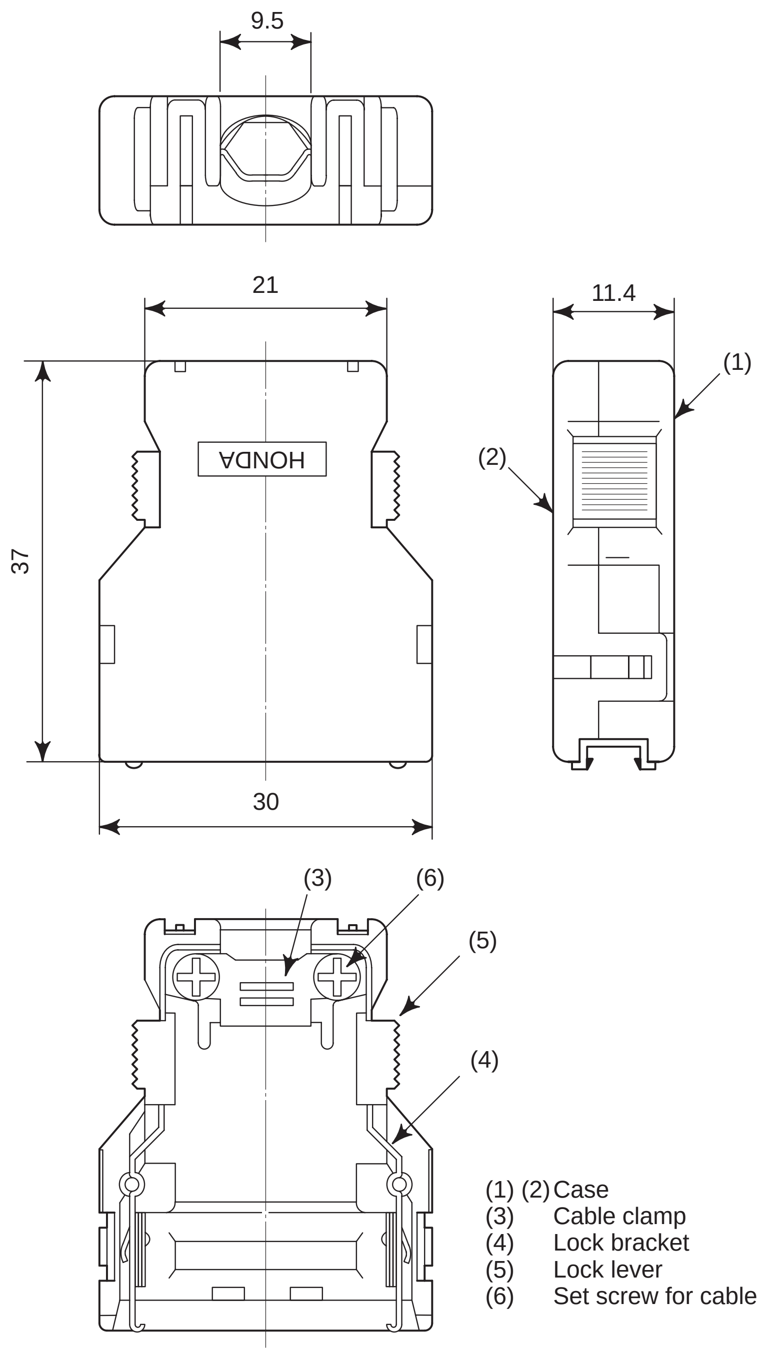


Fig. C1(b) FI40 connector

TYPE : HONDA PCR–V20LA(for 6 dia. cable)
PCR–V20LB(for 8 dia. cable)
USAGE : GENERAL



(1) (2) Case
(3) Cable clamp
(4) Lock bracket
(5) Lock lever
(6) Set screw for cable clamp

Fig. C2(a) Connector case (HONDA PCR type)

TYPE : HIROSE FI–20–CV

USAGE : PULSE CODER INTERFACE
LINEAR SCALE INTERFACE
MANUAL PULSE GENERATOR INTERFACE

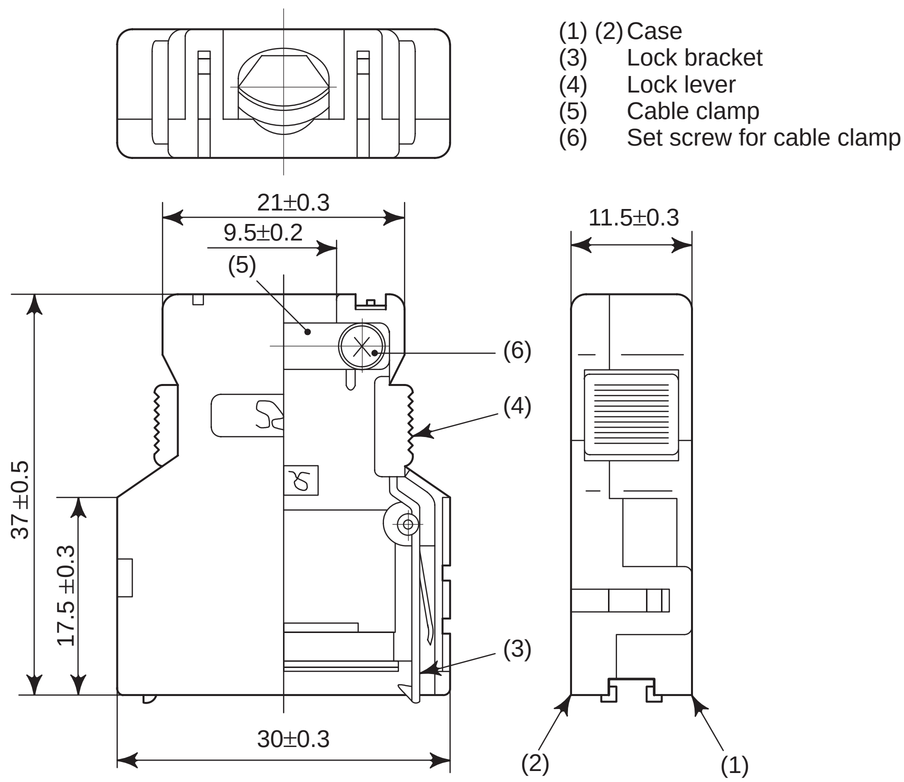


Fig. C2(b) Connector case (HIROSE FI type)

TYPE : FUJITSU FCN–240C20–Y/S(for 5.8 dia. cable)

USAGE : GENERAL

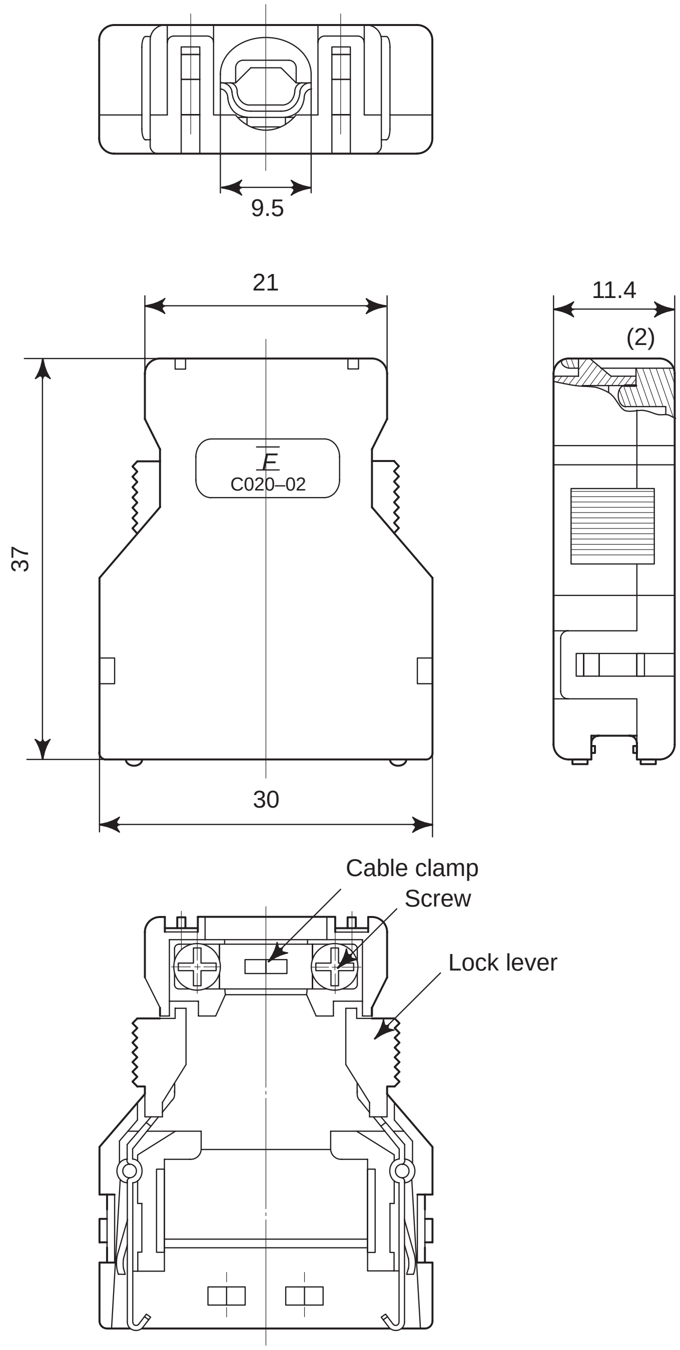


Fig. C2(c) Connector case (FUJITSU FCN type)

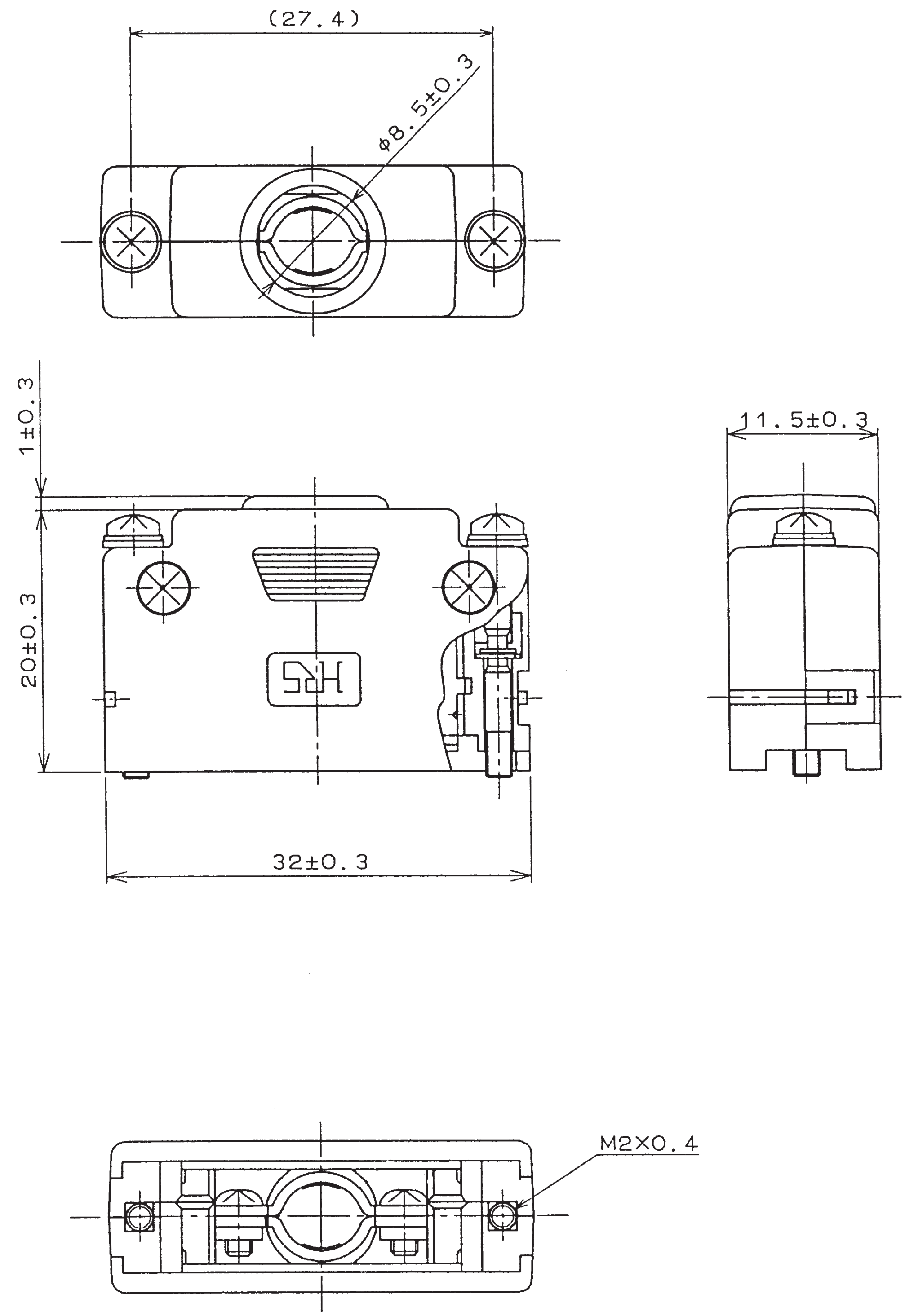


Fig. C2(d) Connector case (PCR type (Hirose Electric))

TYPE : AMP1–178128–3

DIMENSION

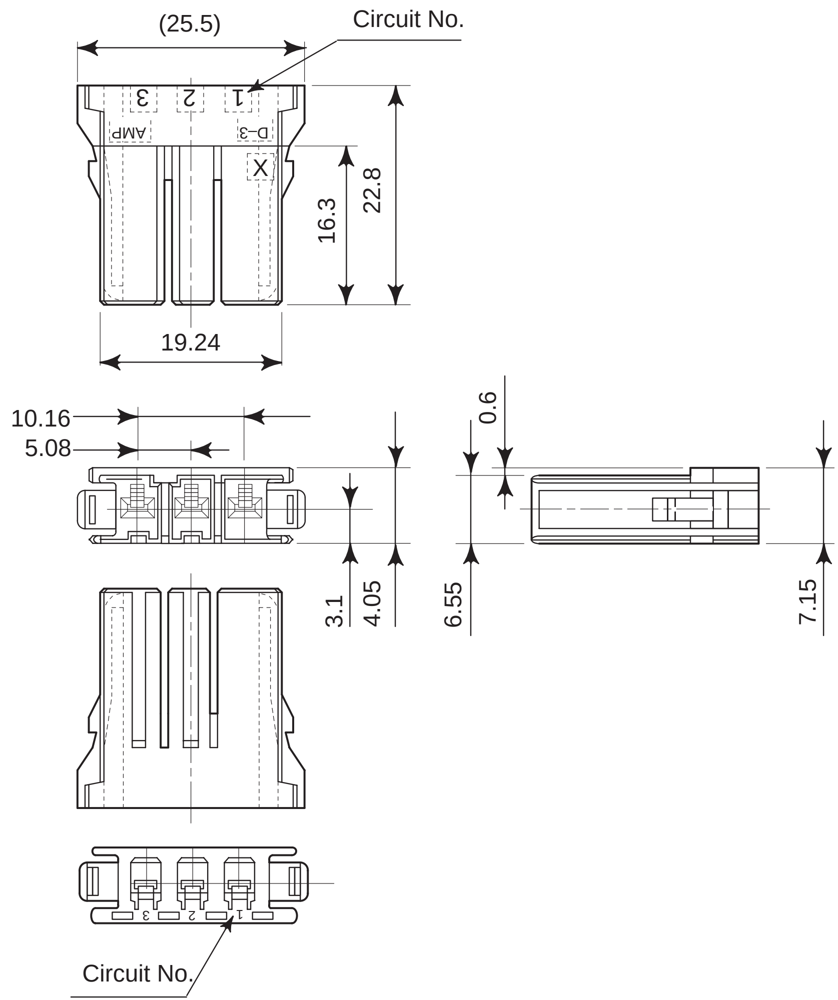


Fig. C3(a) AMP connector (1)

TYPE : AMP2–178128–3

DIMENSION

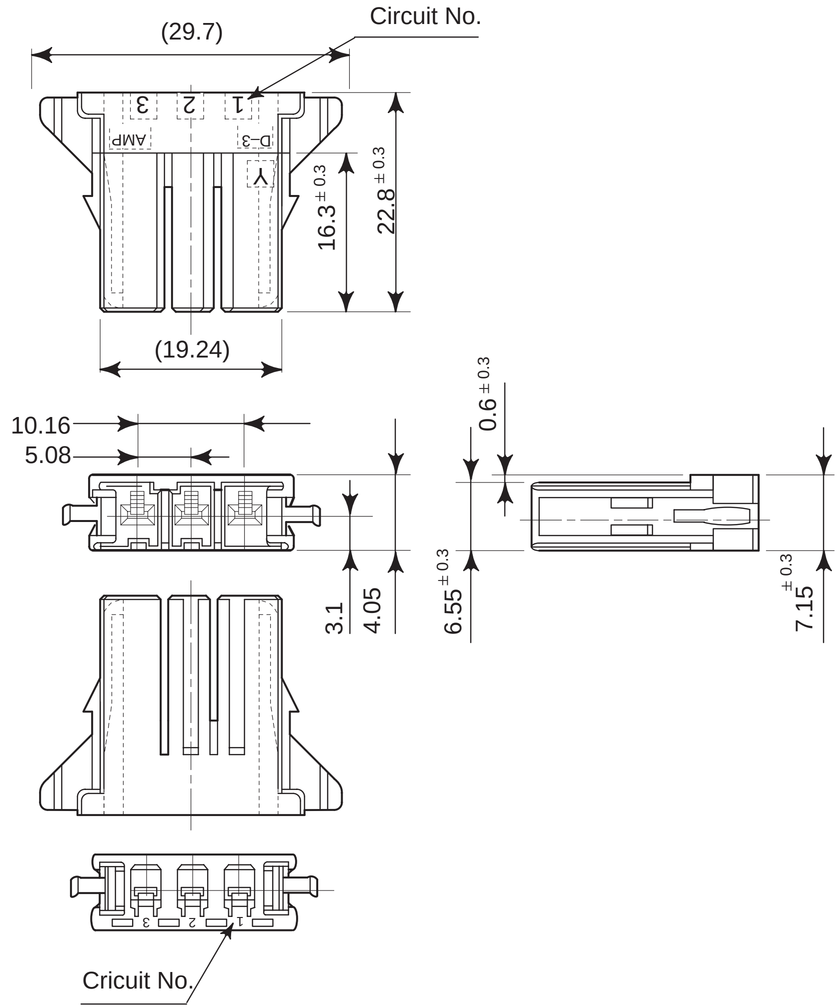


Fig. C3(b) AMP connector (2)

TYPE : AMP1–178288–3

USAGE : POWER SUPPLY UNIT CP1A
+24V INPUT

3	
2	0V
1	+24V

DIMENSION

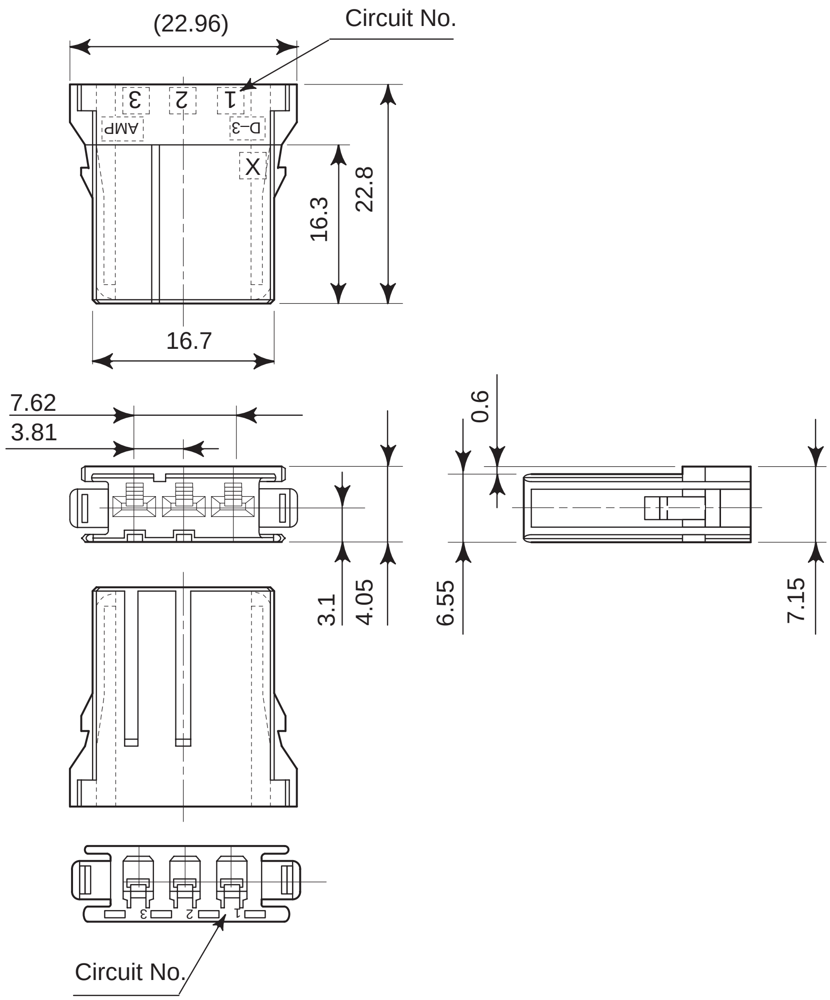


Fig. C3(c) AMPconnector (3)

TYPE : AMP2–178288–3

USAGE : POWER CP1B
+24V OUTPUT

3	
2	0V
1	+24V

DIMENSION

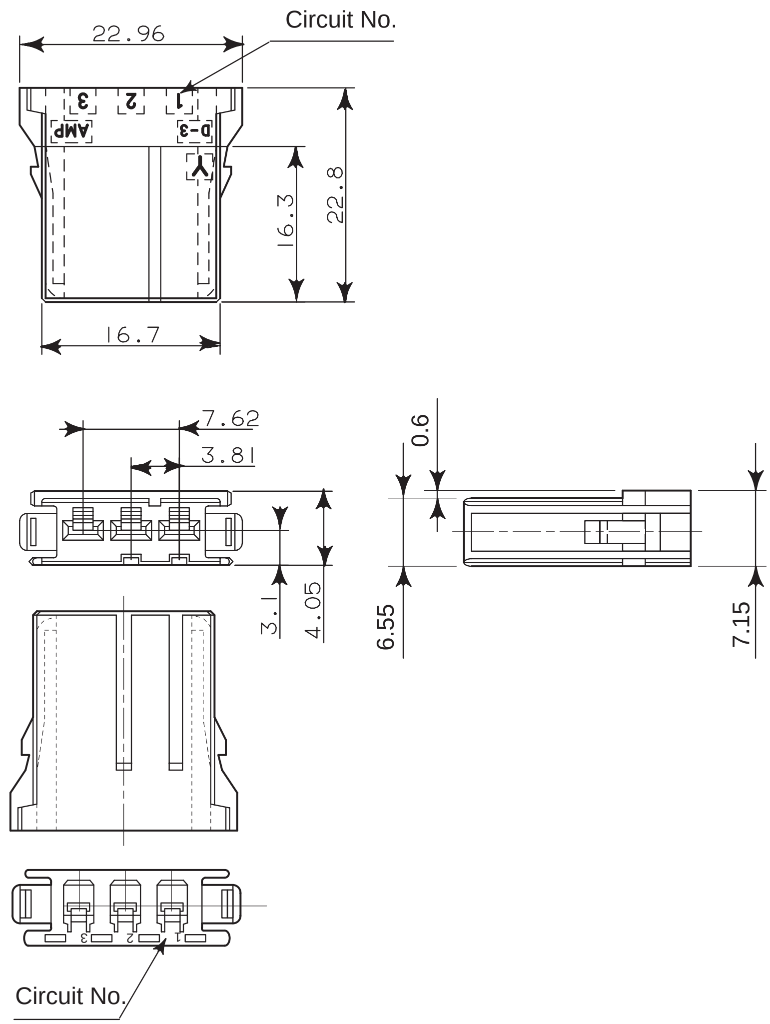


Fig. C3(d) AMP connector (4)

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

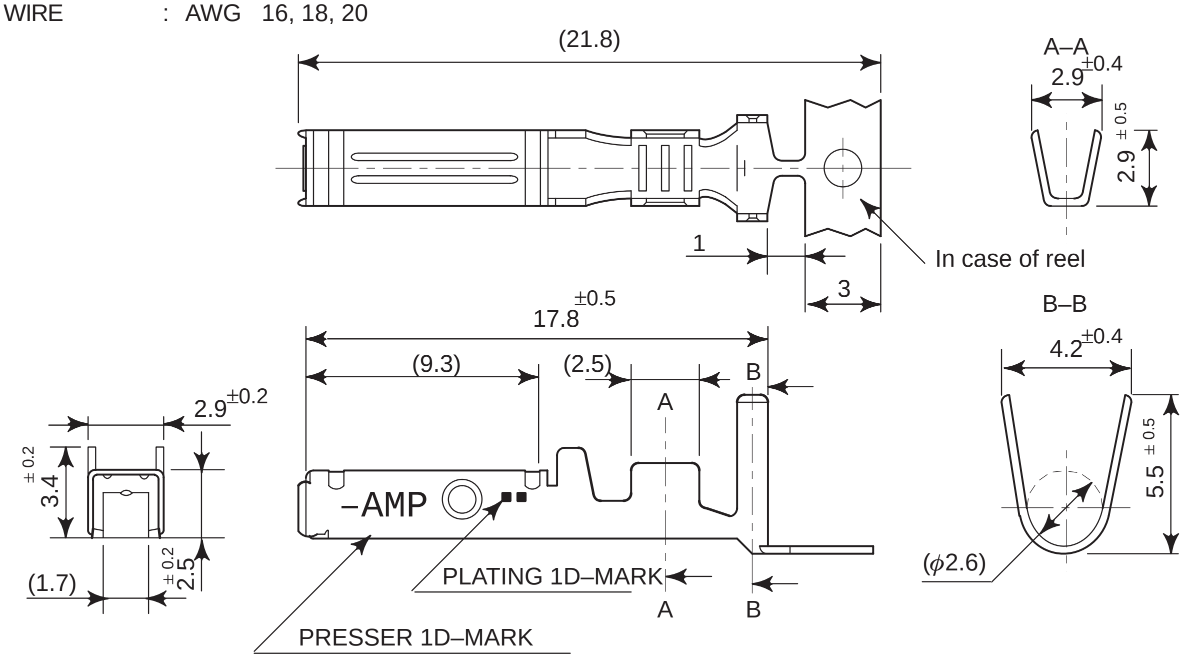
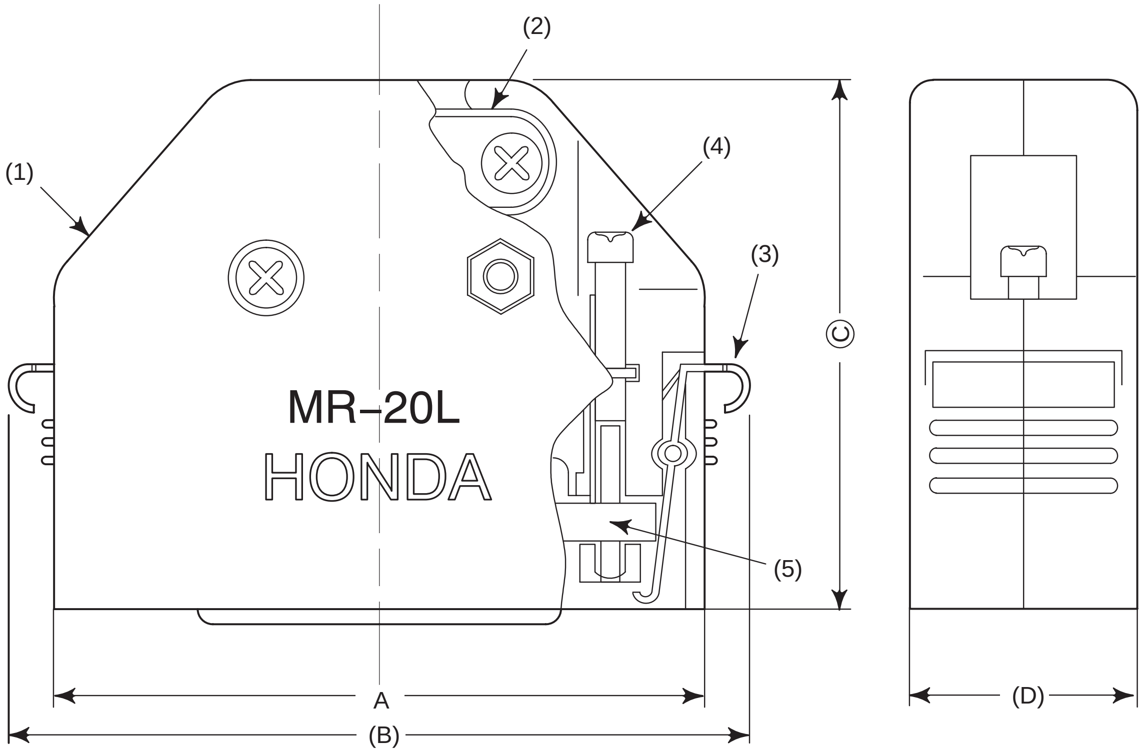


Fig. C3(e) Contact for AMP connector

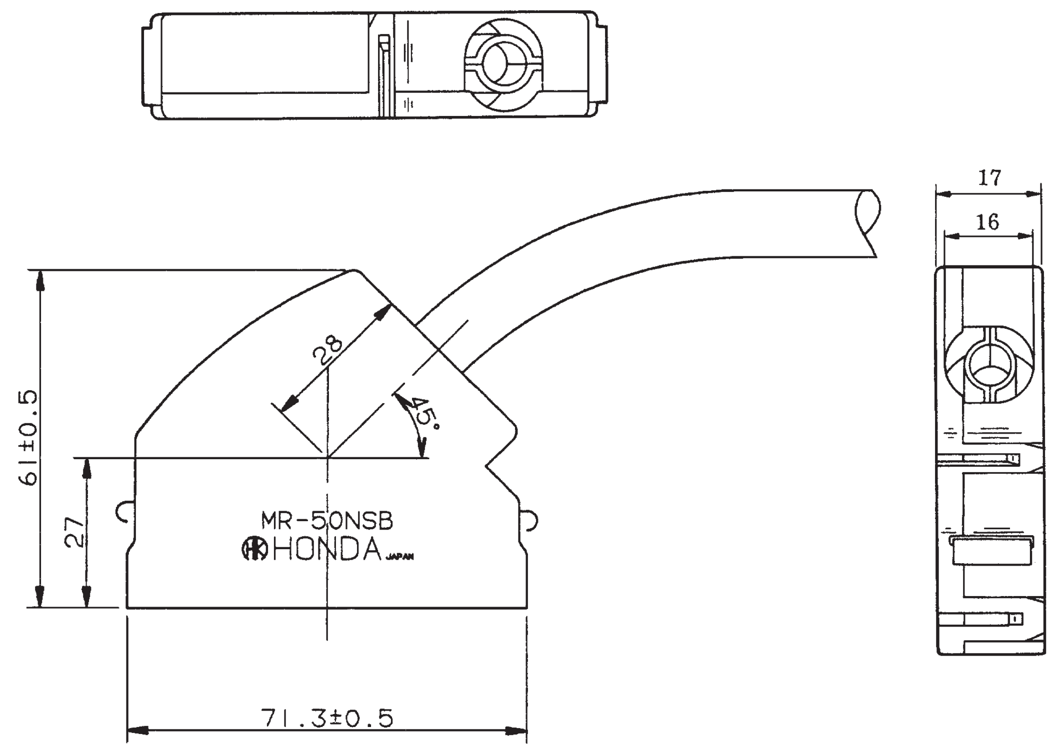


Symbol / Specification	A	(B)	C	(D)	Number of terminals
MR–20LMH (Plug)	39.3	44.9	39.8	17	20
MR–20LFH (Jack)					
MR–50LMH (Plug)	67.9	73.5	44.8	18	50
MR–50LFH (Jack)					

Symbol	Name
1	Connector cover
2	Cable clamp
3	Stopper
4	Screw for cable clamp
5	Plug (MR–20, 50MH)
	Jack (MR–20, 50FH)

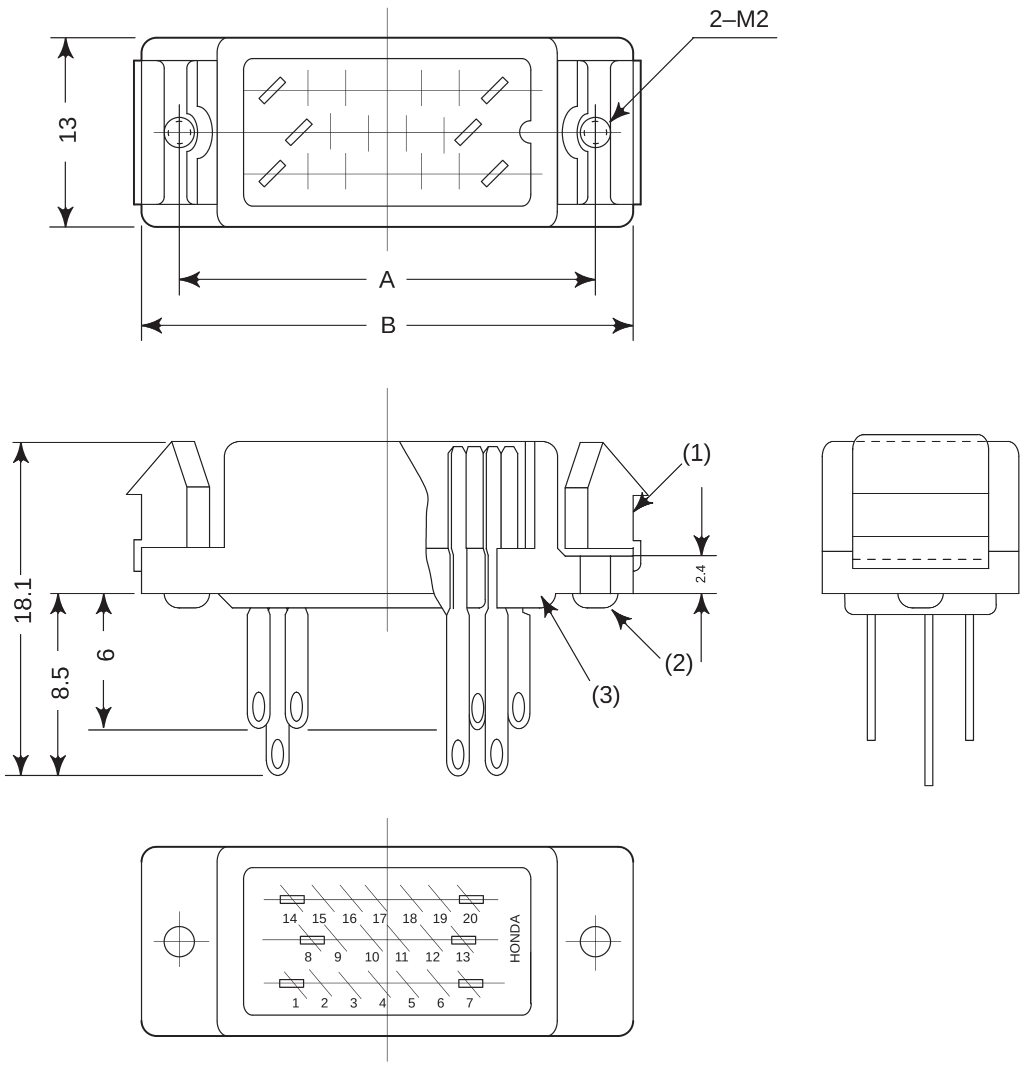
Outer diameter of the cable
MR–20L dia.10mm max
MR–50L dia.16mm max

Fig. C4(a) HONDA connector (case)



External dimensions of 50–pin connector

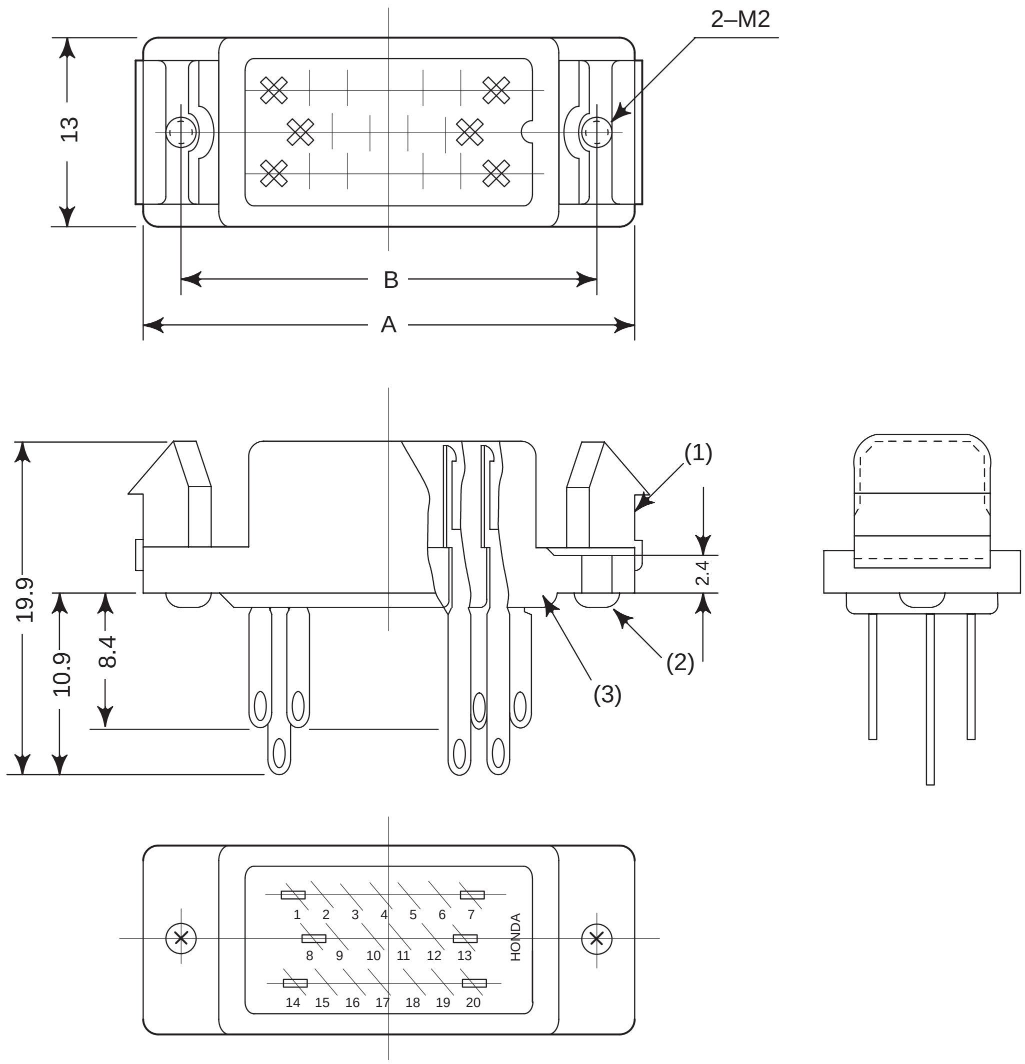
Fig. C4(b) Honda connector (angled–type case)



	A	B	Number of terminals
MR–20RMH	32.8	27.8	20
MR–50RHF	61.4	56.4	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)

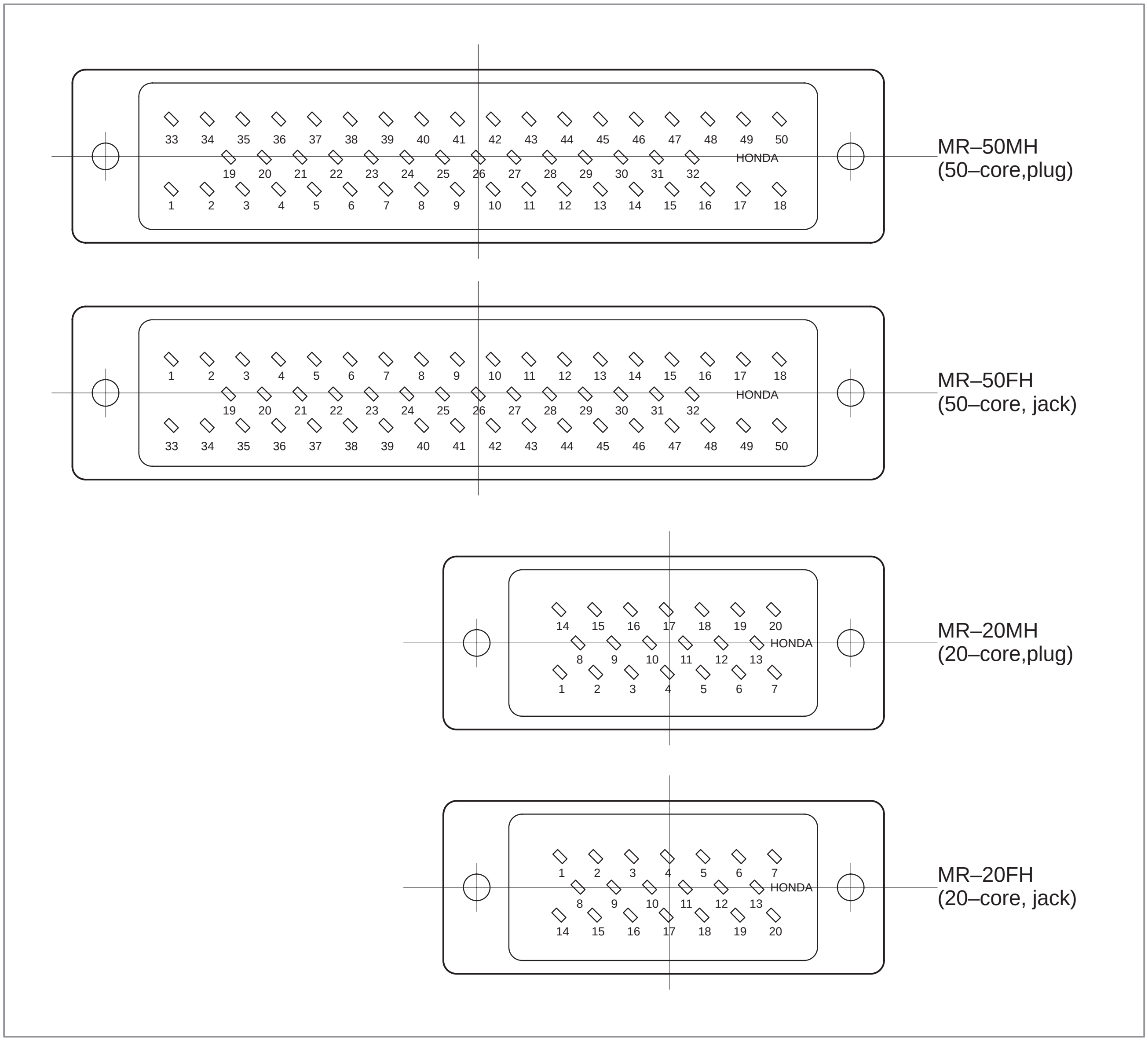
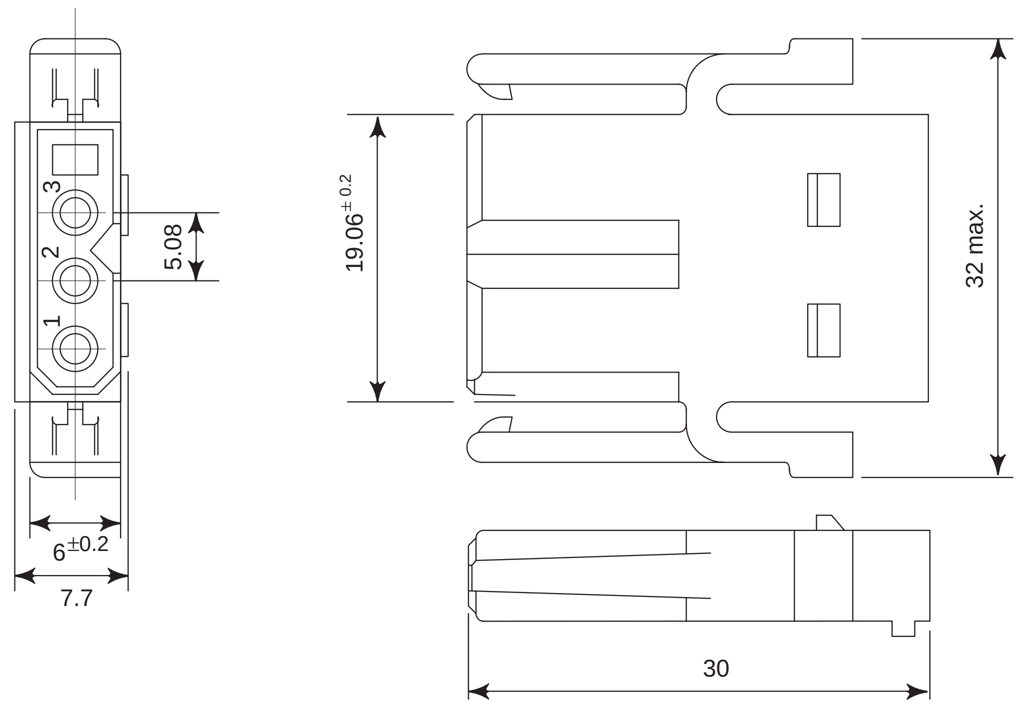


Fig. C4(e) HONDA connector (terminal layout)



Manufacturer : Burndy Japan Corp.

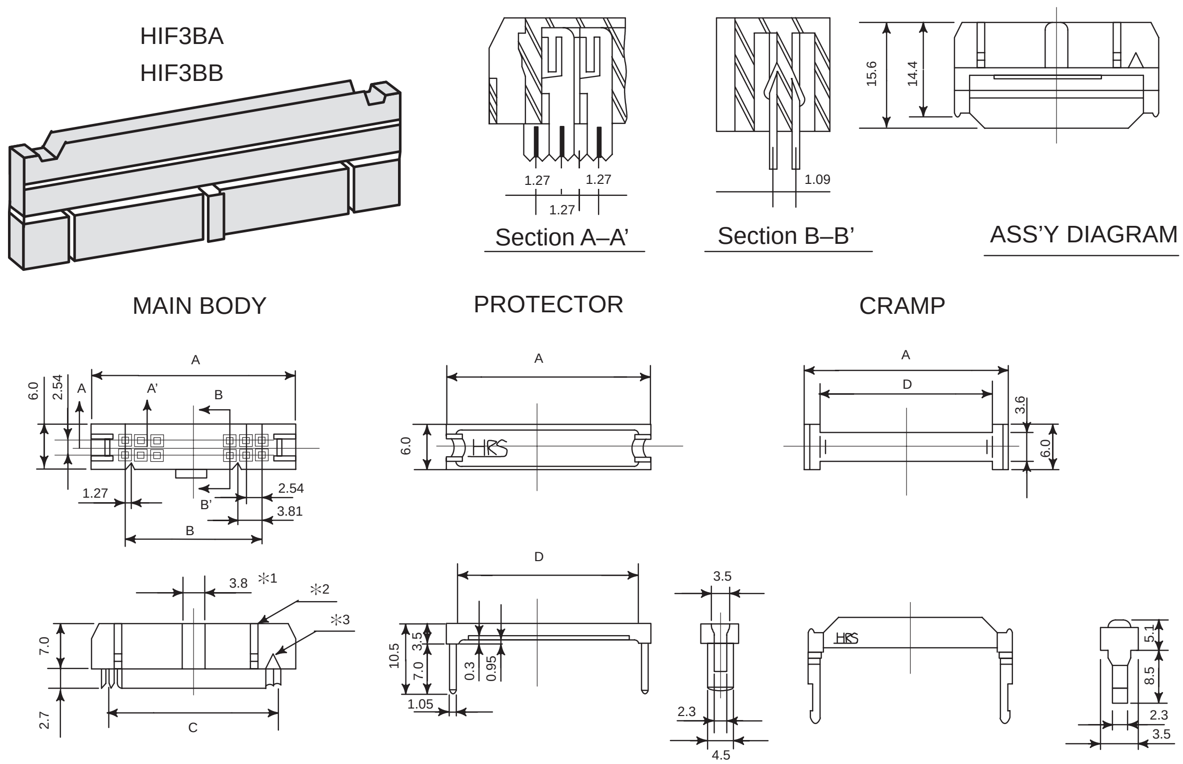
Name		Specification (Connector maker number)	Remarks
Connector housing for cable		SMS3PNS–5	Brown
Contact	(Crimp type)	RC16M–23T3	For details on tools required for crimp terminals,contact the manufacturer.
	(Solder type)	RC16M–SCT3	

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)

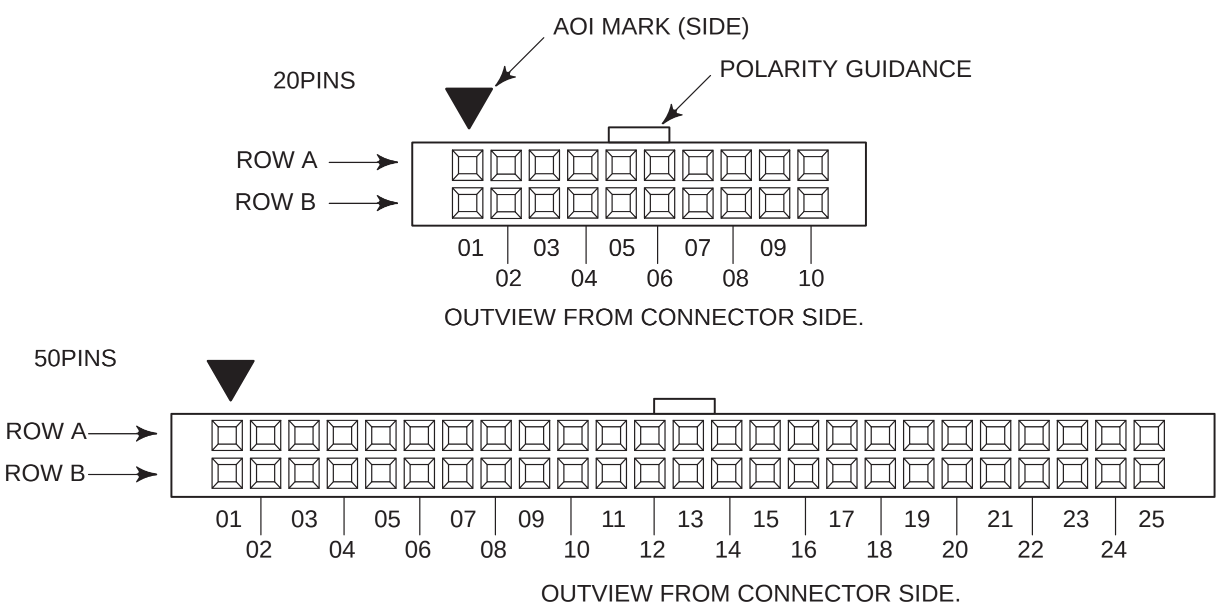


Fig. C6 Connector for HIROSE Flat cable

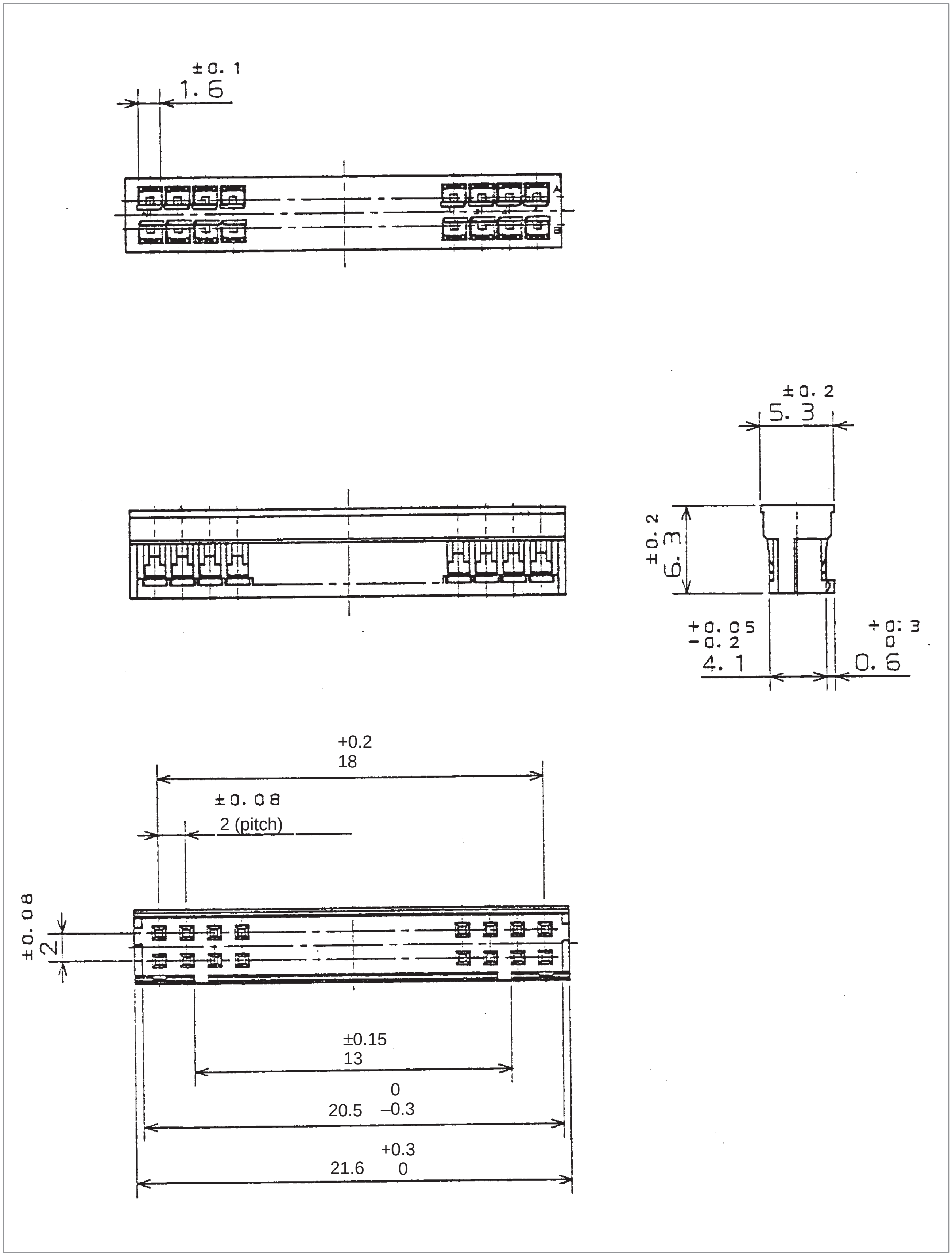


Fig. C7(a) Connector (Japan Aviation Electronics)(for MDI)

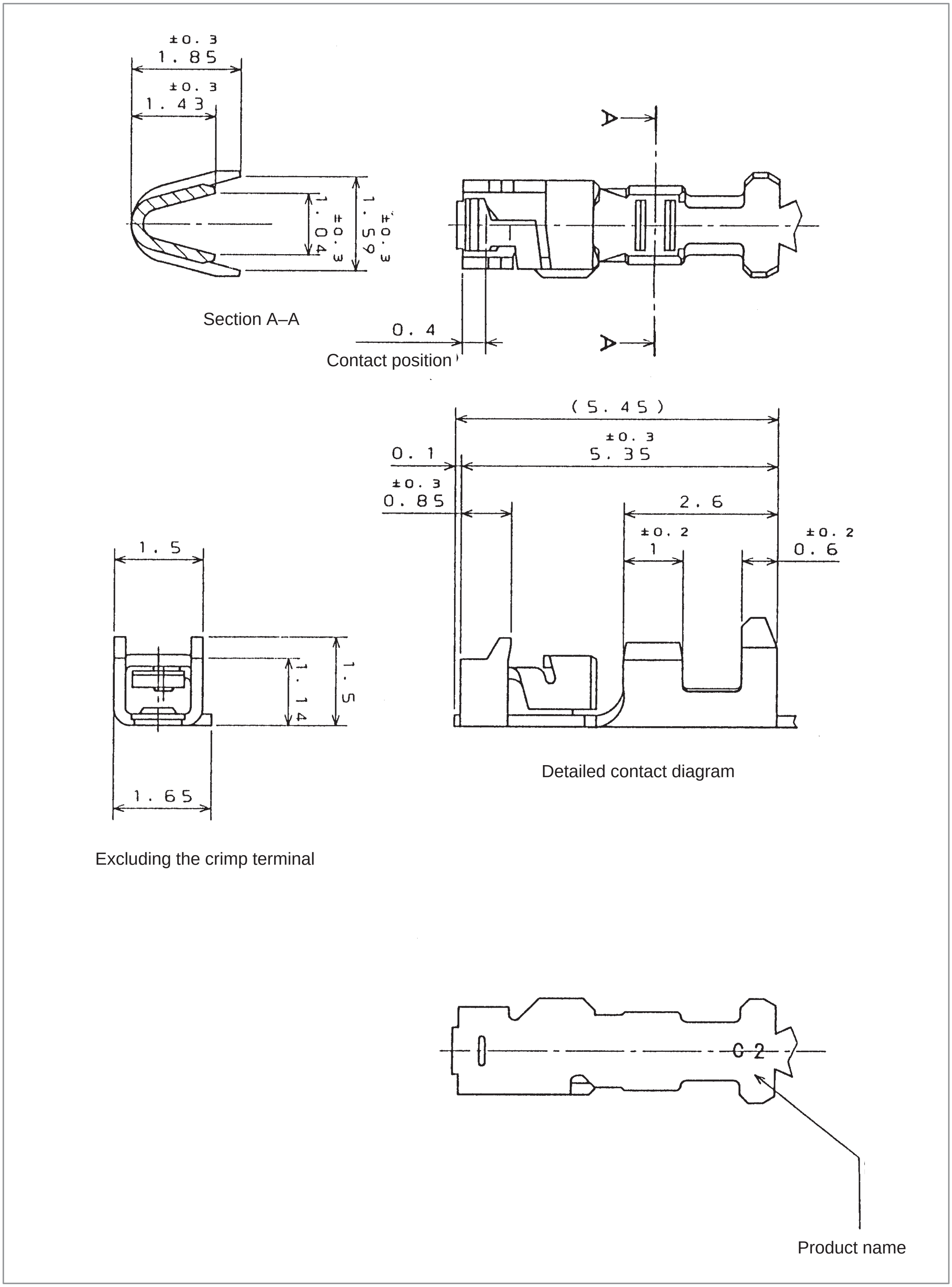


Fig. C7(b) Contact (Japan Aviation Electronics)(for MDI)

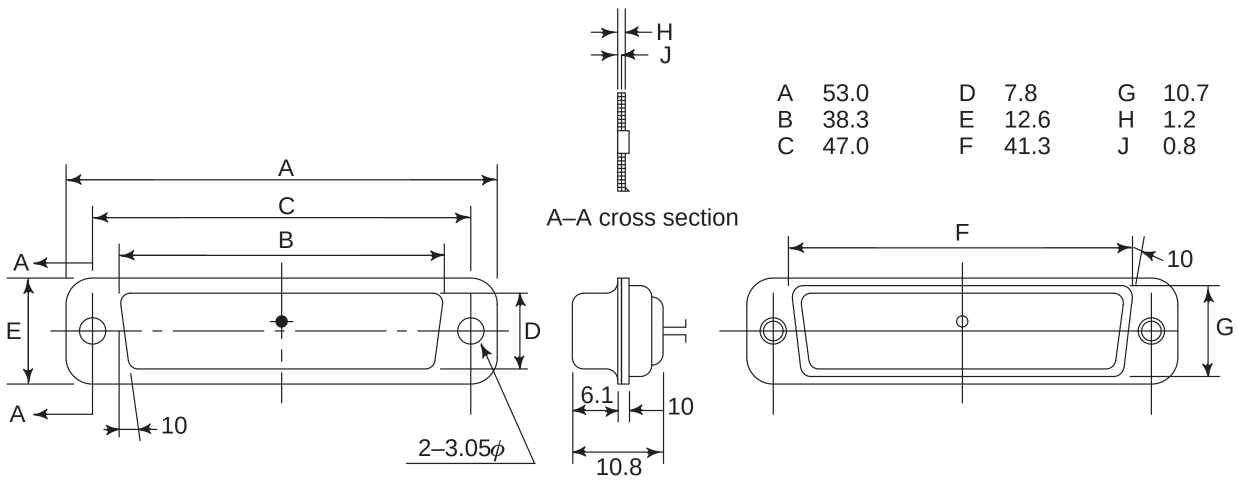


Fig. C8(a) Punch panel connector for reader/puncher interface

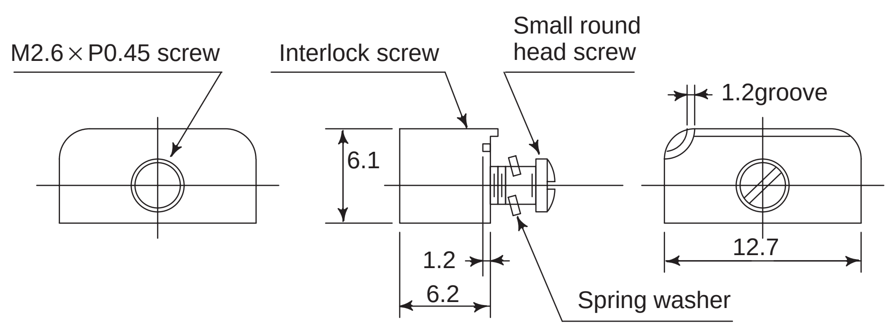


Fig. C8(b) Locking plate plate for reader/puncher interface connector

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)
					PCS–E20LA	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)
					PCS–E20LA	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)
					PCS–E20LA	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 *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
		PCS–E20LA (Honda Tsushin)	A66L–0001–0284#10P (6.2 mm in diameter)	Metal 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)		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
		PCS–E20LA (Honda Tsushin)		Metal 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.

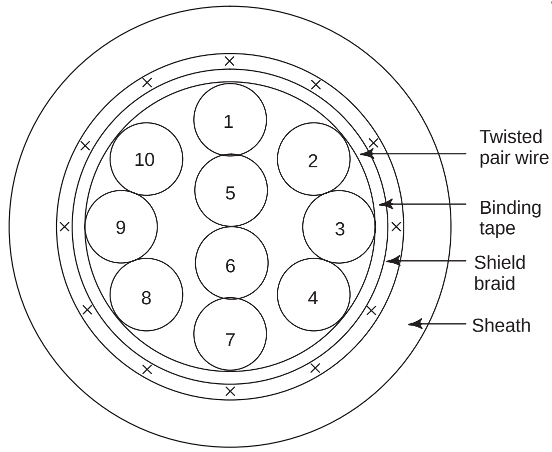
Material	Use	Constitution	FANUC specification number	Manufacturer	Remark
10–pair cable	General use	0.08mm^2 10–pair	A66L–0001–0284 #10P	Hitachi Cable, Ltd. Oki Electric Cable Co., Ltd.	
6–pair cable	CRT interface (press–mount)	0.08mm^2 6–pair	A66L–0001–0295	Hitachi Cable, Ltd.	20 m or less
6–conductor coaxial cable	CRT interface (long–distance)	6–conductor coaxial	A66L–0001–0296	Hitachi Cable, Ltd.	50 m or less
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

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

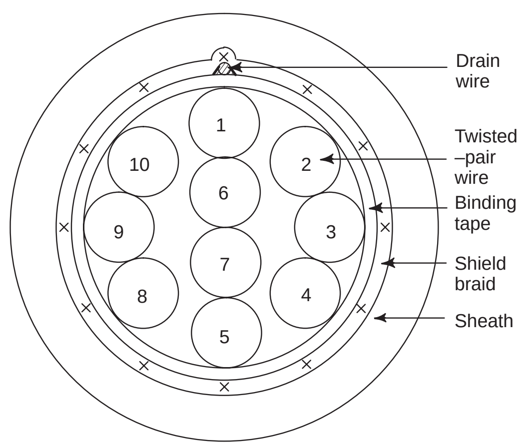


Wire identification table (Hitachi)

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

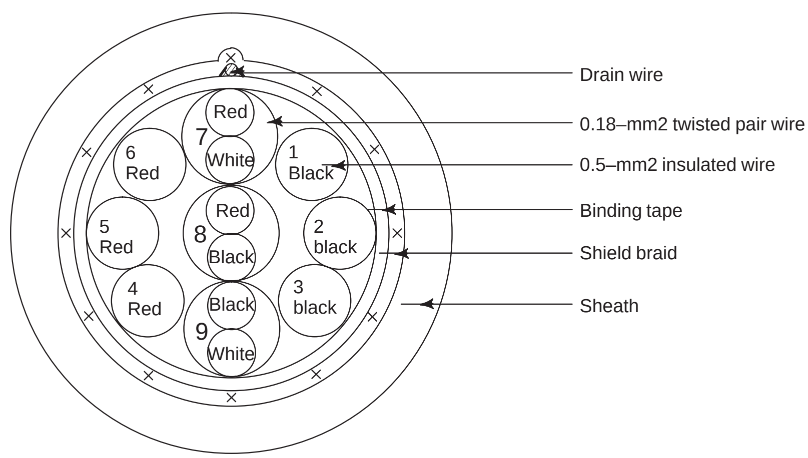
(a) Specifications

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.

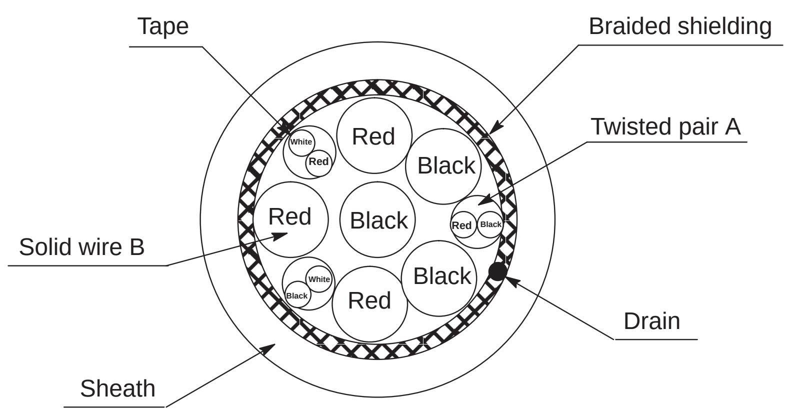
(b) Cable structure
The cable structure is shown below.



The colors in the figure indicate the colors of insulators.

(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.			

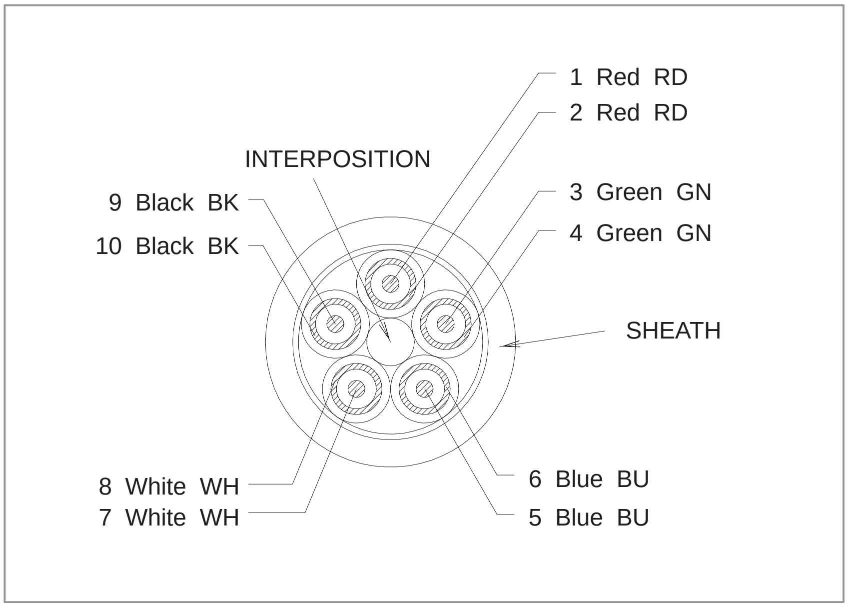
Item		Specification			
FANUC specification number		A66L–0001–0402		A66L–0001–0403	
Manufacturer		Oki Electric Cable Co., Ltd.			
		A–conductor	B–conductor	A–conductor	B–conductor
Finished assembly performance	Rating	80°C 30V			
	Standard	Shall comply with UL STYLE 20236 and CSA LL43109 AWM I/II A 80°C 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

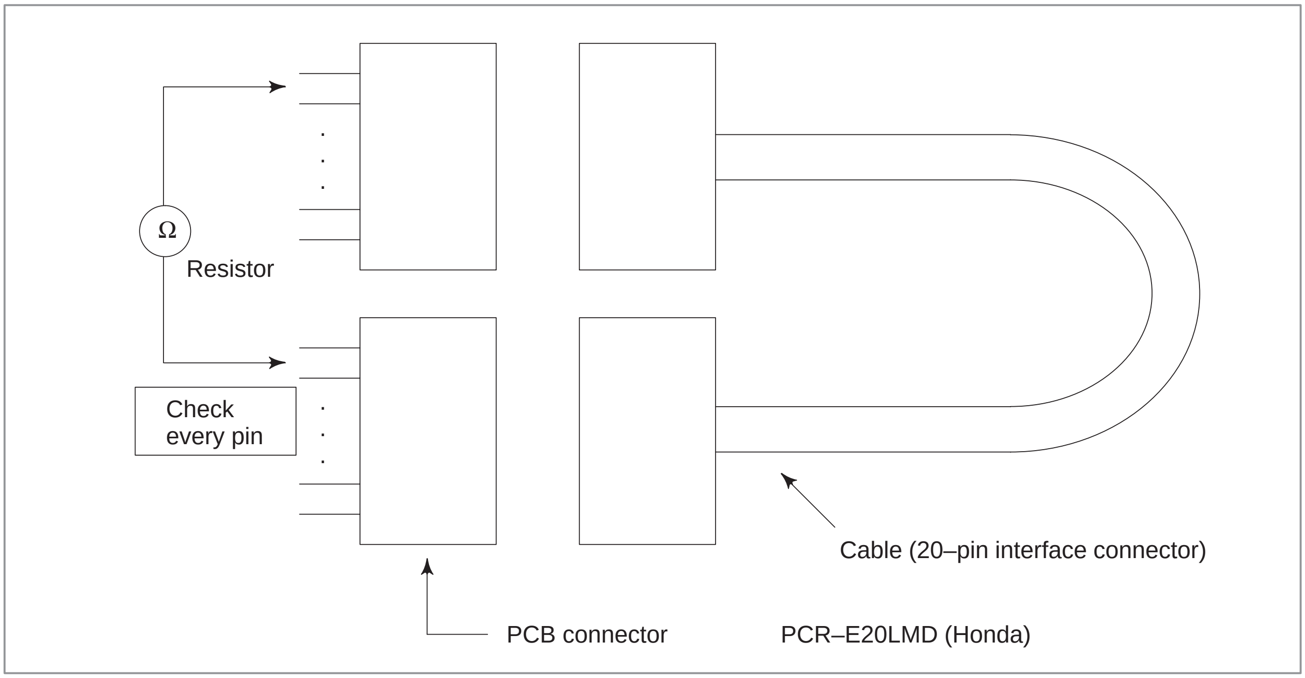
(a) List of specifications

Item		Unit	Description
Specification		–	A66L–0001–0371
Manufacture		–	Hitachi Densen
Number of Conductors		–	5
Inside Conductor	Size	mm^2	0.14
	Components	Conductors(PCS)/mm	7/0.16
	Material	–	Tin–coated Soft Copper Wire
	Diamter	mm	0.48
Insulator	Material (Color)	–	Polyethylene (White) Heat–resistant 80°C
	Thickness	mm	0.71
	Diamter	mm	1.90
Outside Conduc-tor	Material	–	Tin–coated Soft Copper Wire (Rolled)
	Diamter of Component–Wire	mm	0.08
	Density	%	95 or more
	Thickness	mm	0.2
Jacket	Material	–	Vinyl Heart–resistant 80°C
	Color	–	Black, White, Red, Green, Blue
	Thickness	mm	0.15
	Diamter	mm	2.6
Twisted Assembly Diameter		mm	7.1
Thickness of Paper Tape		mm	0.05
Shield braiding	Element wire diameter (material)	mm	0.12 (tinned soft copper wire)
	Density	%	80 or more (typ. 82%)
	Thickness	mm	0.3
	Diameter	mm	7.8
Sheath	Material, Color	–	Oil Tight Vinyl (A) Black Heat–resistant 80°C
	Thickness	mm	0.7 (Min. : 0.56)
Finish Diameter		mm	9.2 ± 0.3
Conductor Resistance (20°C)		Ω/km	143 or less
Withstand Voltage (A.C.)		–	1000VAC
Insulation Resistance (20°C)		MΩ–km	1000 or more

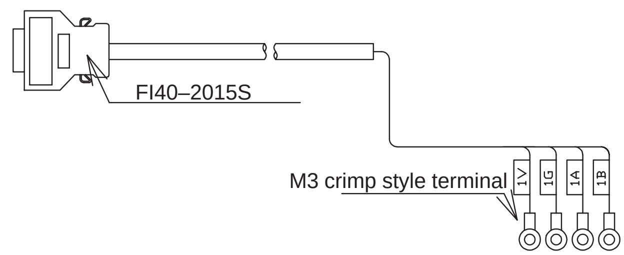
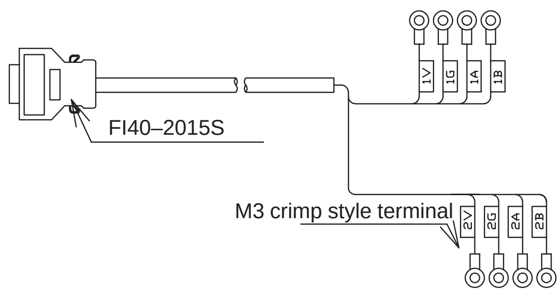
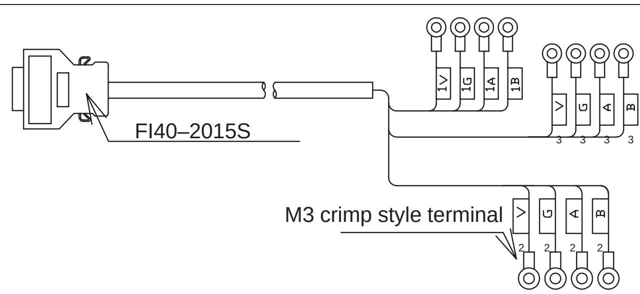
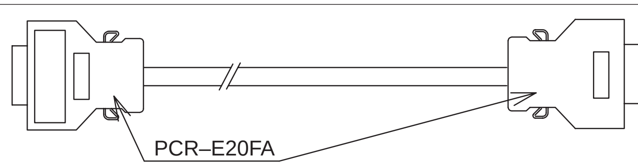
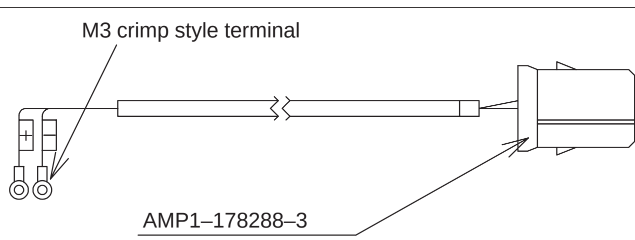
Item	Unit	Description
Impedanse (10MHz)	Ω	75 ± 5
Standard Capacitance (1MHz)	nF/km	56
Standard Attenation (10MHz)	dB/km	53
Estimated weight	kg/km	105
Standard Length	m	200
Package form	–	Bundle

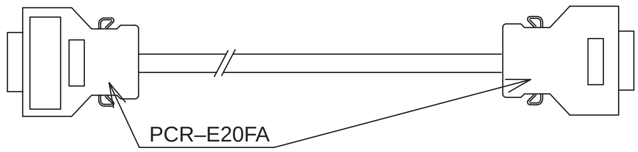
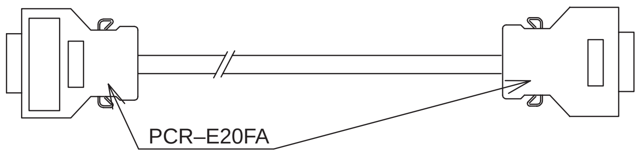


An example of circuit testing 20–pin interface cable



C CONNECTION CABLE (SUPPLIED FROM US)

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) ⇕ α series amplifier (JA7B)		A02B–0236–K810	5 m

D OPTICAL FIBER CABLE

This CNC uses optical fiber cables for the following interfaces.
(1) Serial spindle interface
(2) I/O Link interface
(3) High–speed serial bus (HSSB) interface
(4) Serial servo bus (FSSB) interface
The optical fiber cables used for these interfaces all comply with the same specifications.

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

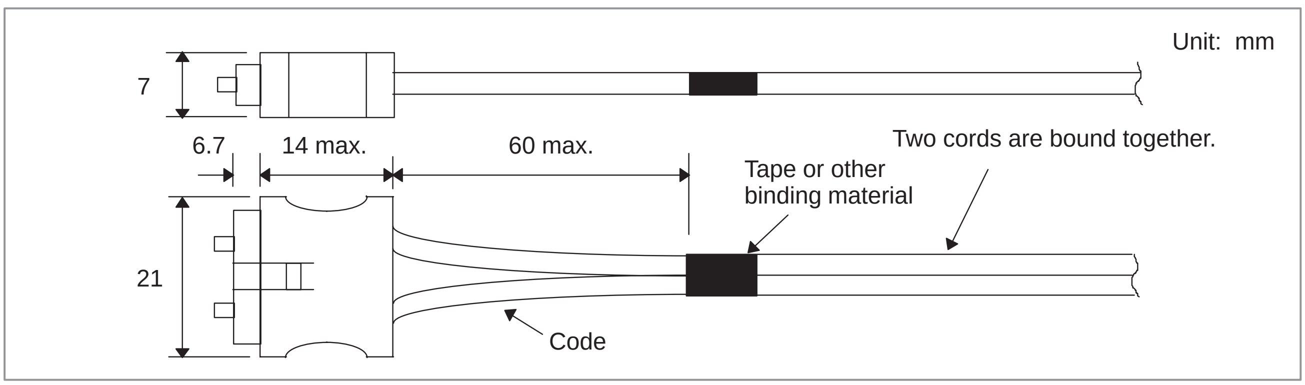


Fig. D.1 External dimensions of internal cord type cable

(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

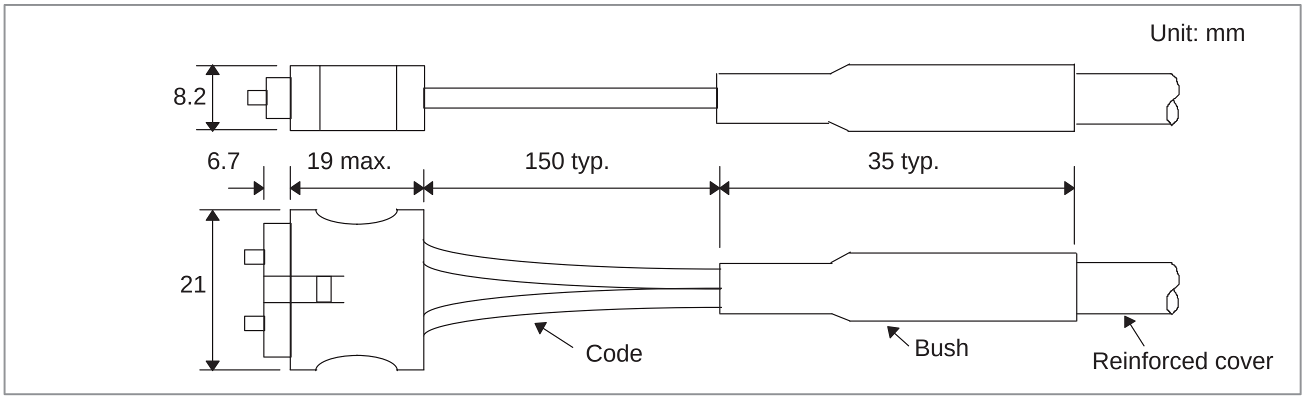


Fig. D.2 External dimensions of external cable

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

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.

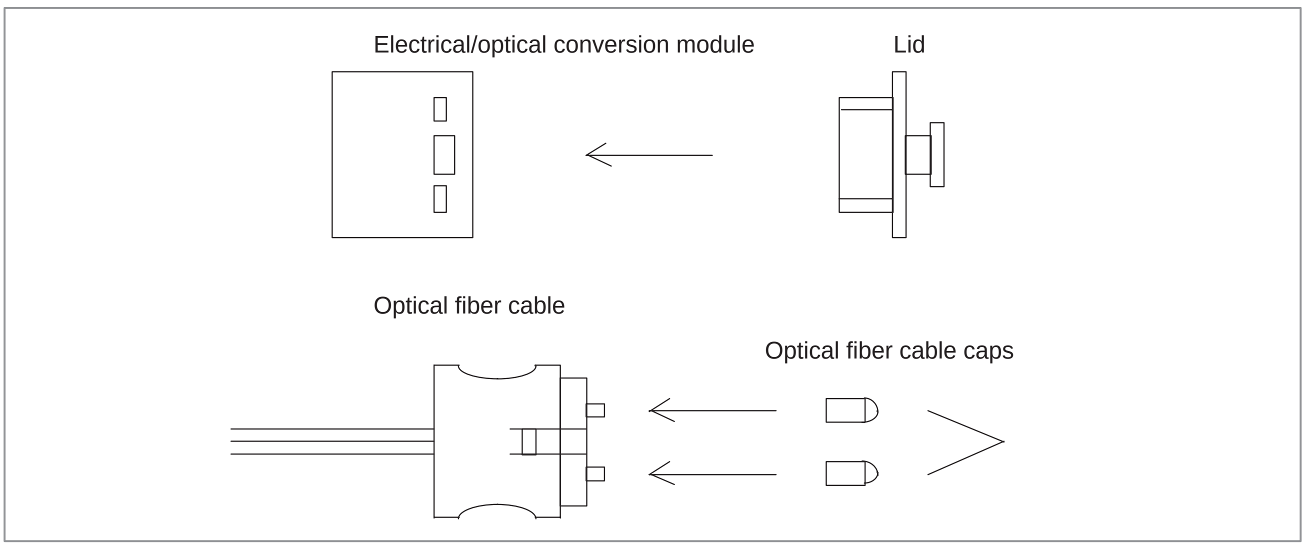


Fig. D.3 Protection of electrical/optical conversion module and optical fiber cable (when not in use)

(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.

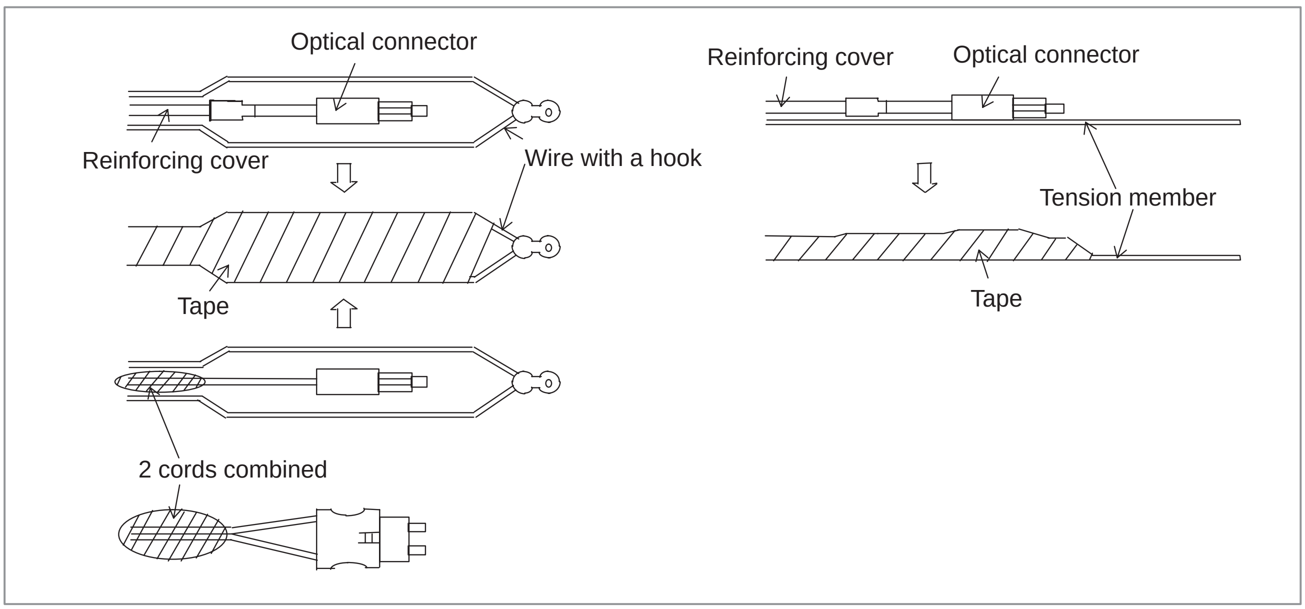


Fig. D.4 Prior to installing a cable

- 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.)

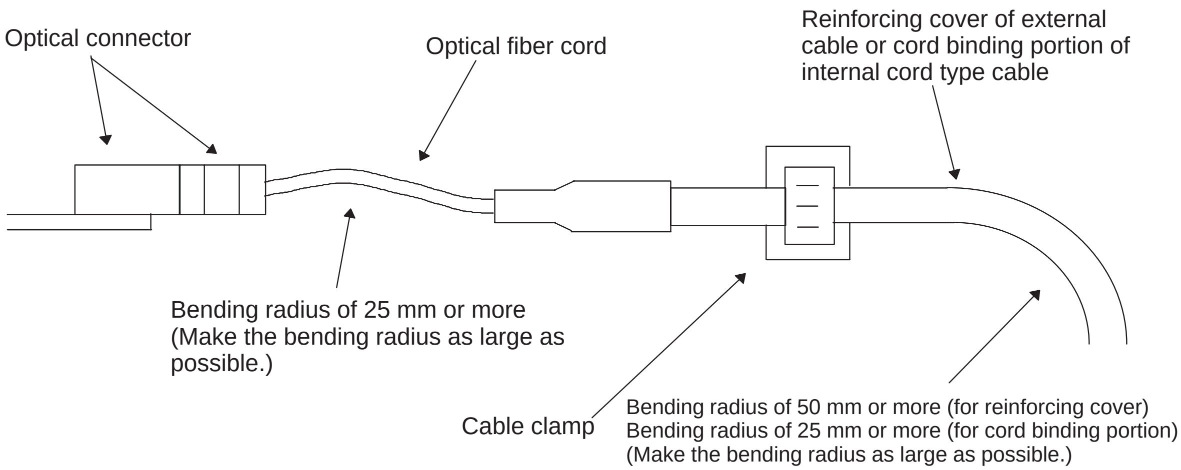


Fig. D.5 Fixing the cable with a clamp

- 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. Compatibility with previous models of FANUC optical fiber cables
FANUC has offered other types of optical cables for different applications (see Table D.3).
Note that the optical cables for FANUC I/O Link and FANUC high–speed serial bus applications cannot be used for the servo interface application. On the other hand, however, the external optical cable for the servo interface application can be used in place of previous cables types, as shown in Table D.4. (The external optical cable for the servo interface application is designed to offer a level of performance equivalent to that of the previous cables. This is not the case with the internal cord type cable, so it cannot replace the previous cables.)

Table D.3 FANUC optical fiber cables

	System application	FANUC specification No.	Specification
Previous optical fiber cables	FANUC I/O Link	A66L–6001–0008#L∼	Internal cable/fixed type
		A66L–6001–0009#L∼	External cable/fixed type
	FANUC high–speed serial bus	A66L–6001–0021#L∼	External cable/fixed type
		A66L–6001–0022#L∼	External cable/fixed type
New optical fiber cables	Servo interface	A66L–6001–0023#L∼	Internal cable/fixed type
		A66L–6001–0026#L∼	External cable/fixed or portable type

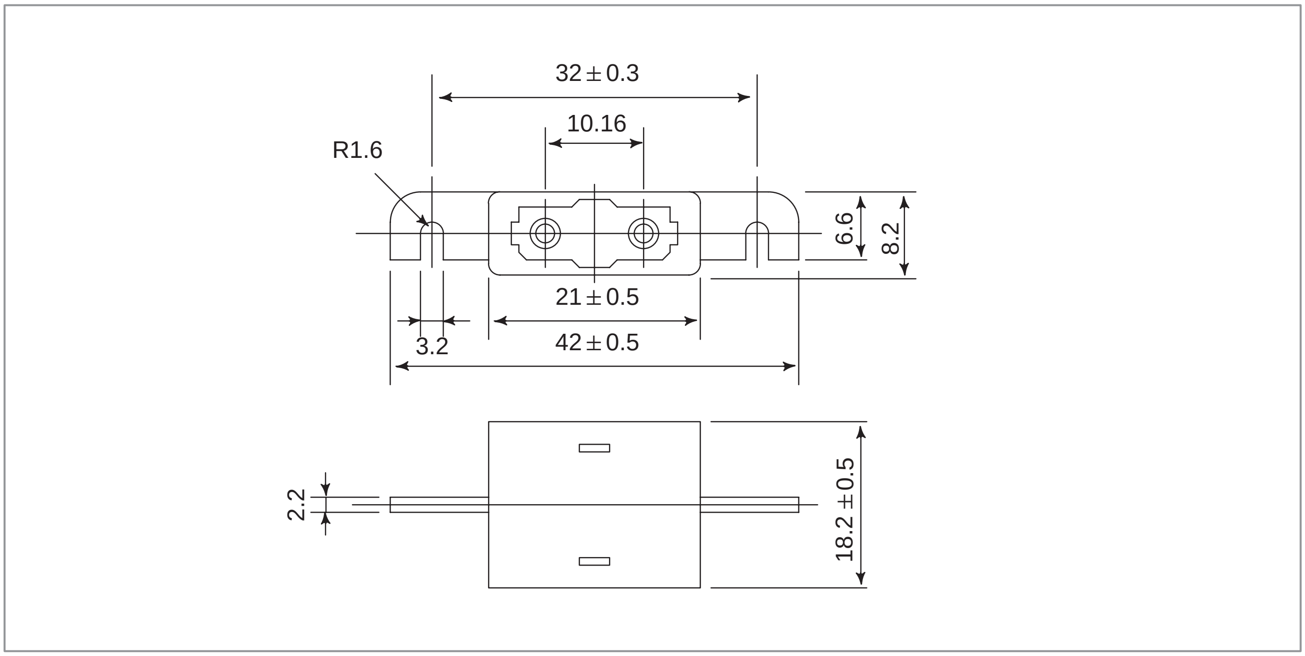
Table D.4 Previous optical fiber cables that can be replaced by the new external cable (A66L–6001–0026#L)

Replaceable optical fiber cables
FANUC I/O Link: 66L–6001–009#L∼
FANUC high–speed serial bus: 66L–6001–021#L∼
FANUC high–speed serial bus: 66L–6001–022#L∼

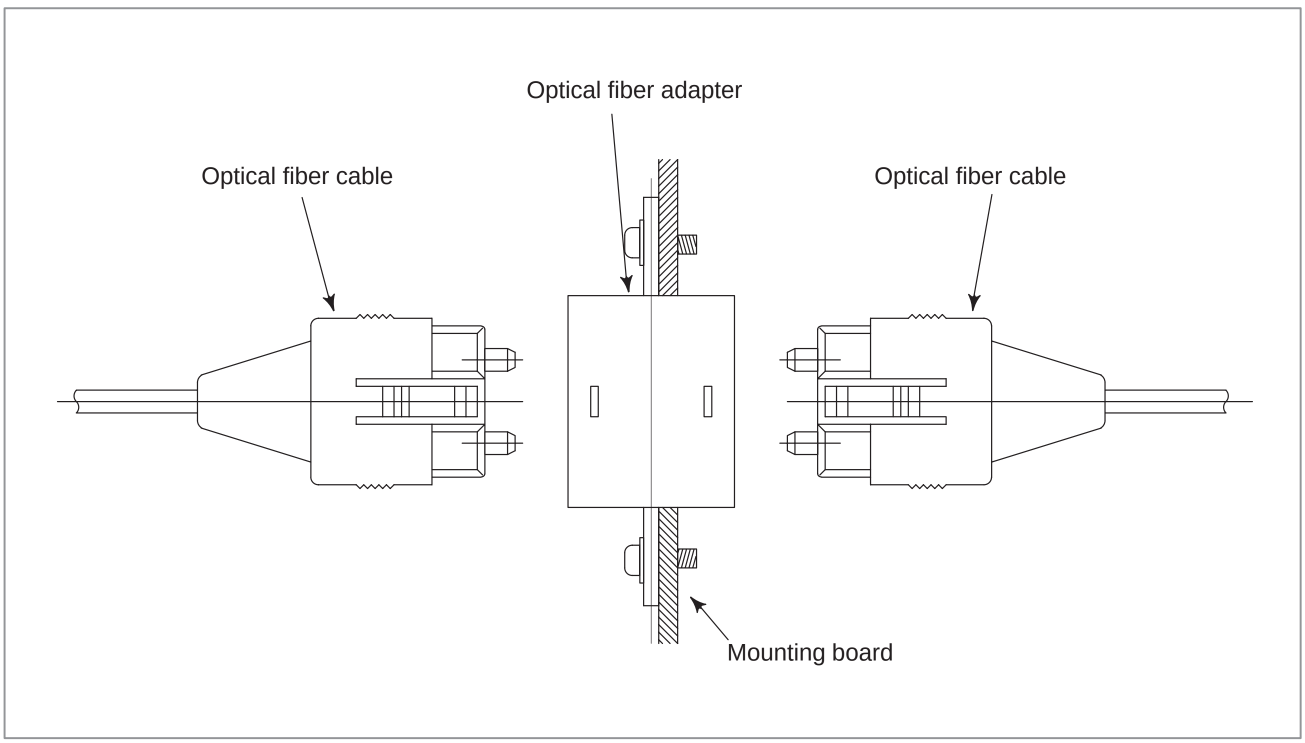
NOTE
The optical fiber cables listed in the above figure cannot be used in place of the new external cable (A66L–6001–0026#L).

6. 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.

Index

≪Numbers≫

≪A≫

≪B≫

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