GE FANUC

GE Fanuc Automation

Computer Numerical Control Products

Series 21 / 210 – Model B

Connection Manual (Hardware)

GFZ-62703EN/03 October 1996

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 21/210-TB/MB 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 21/210. 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–TB	21–TB	Series 21
FANUC Series 21–MB	21–MB	
FANUC Series 210–TB	210–TB	Series 210
FANUC Series 210–MB	210–MB	

Configuration of the manual

This manual consists of Chapters 1 to 15 and Appendixes.

Chapter title	Description
Chapter 1 CONFIGURATION	Outlines connections for the Series 21/210 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 21/210. 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) Display devices (CRT and plasma display) 2) MDI units 3) I/O devices (via RS232C) 4) Manual pulse generators
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 and the servo unit.
Chapter 8 CONNECTING THE MACHINE INTERFACE I/O	This chapter describes the addresses and connector pins for signals transferred between the Series 21/210 and the machine. Describes the built–in I/O board and I/O unit.
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 DISPLAY UNIT CHANGE–OVER SWITCH	This chapter describes the connection to the display unit change–over circuit supported by the Series 21 (not supported by the Series 210).
Chapter 12 REMOTE BUFFER INTERFACE	This chapter describes the remote buffer interface supported by the Series 21 (not supported by the Series 210).
Chapter 13 CONNECTING PERIPHERAL UNITS TO THE MMC–IV	This chapter describes how to connect MMC–IV peripherals to the Series 210.
Chapter 14 HIGH–SPEED SERIAL BUS (HSSB)	This chapter describes the high–speed serial bus (HSSB) supported by the Series 210.
Chapter 15 FANUC INTELLIGENT TERMINAL	This chapter describes the FANUC intelligent terminal, which can be connected to the Series 210 by using the high–speed serial bus (HSSB).
Appendix	A External dimensions of units B 20–pin interface connectors and cables C Connection cables D Optical fiber cable E Attaching a CRT protecting cover

Related manuals

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

Manuals Related to the Series 21/210

Manual name	Specification number	
DESCRIPTIONS	B–62702EN	
CONNECTION MANUAL (Hardware)	B–62703EN	*
CONNECTION MANUAL (Function)	B–62703EN–1	
OPERATOR'S MANUAL (For Lathe)	B–62534E	
OPERATOR'S MANUAL (For Machining Center)	B–62704EN	
MAINTENANCE MANUAL	B–62705EN	
PARAMETER MANUAL	B–62710EN	
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	

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 MMC–IV, high–speed serial bus, and intelligent terminal

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

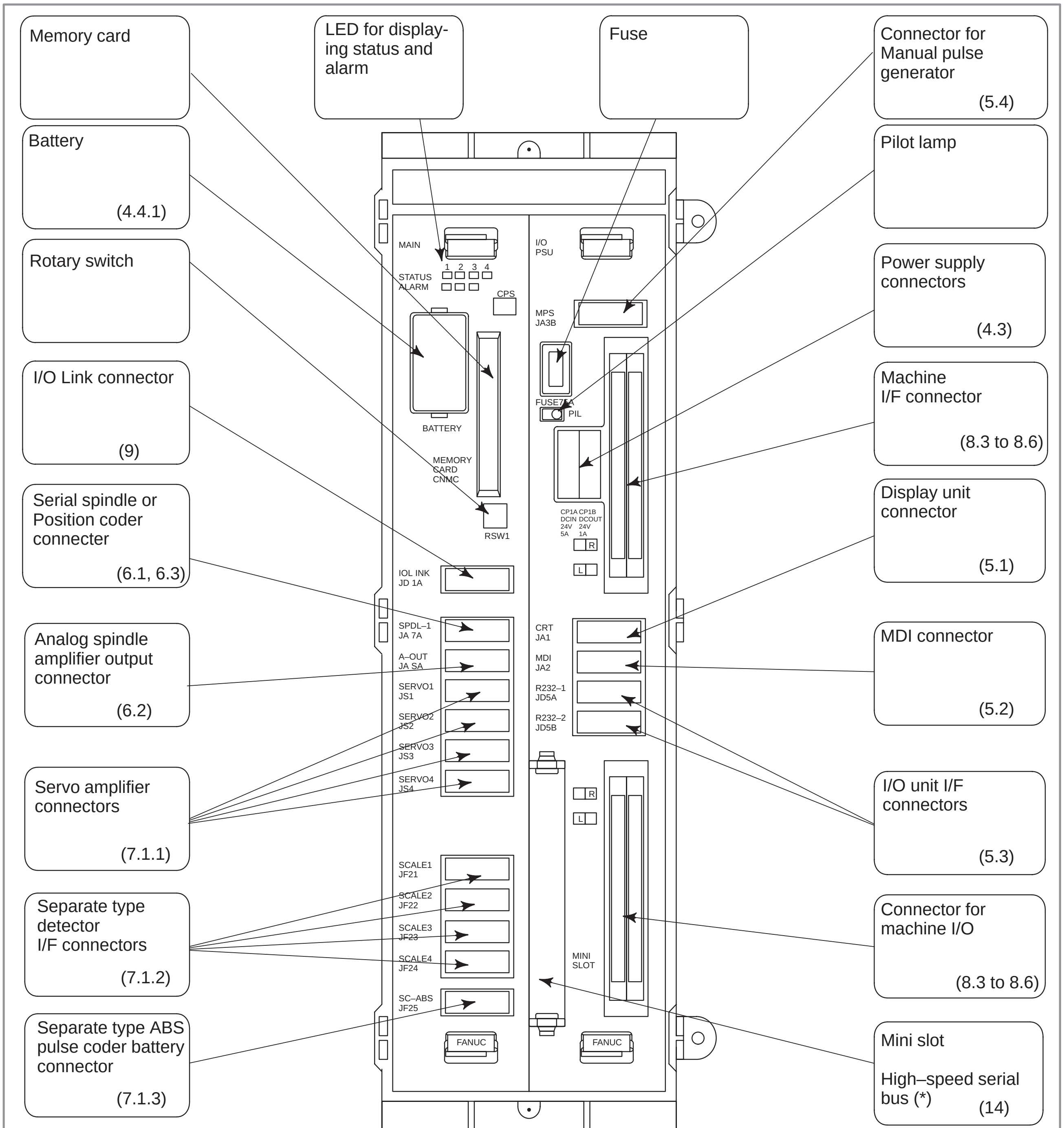
Table of Contents

APPENDIX

1 CONFIGURATION

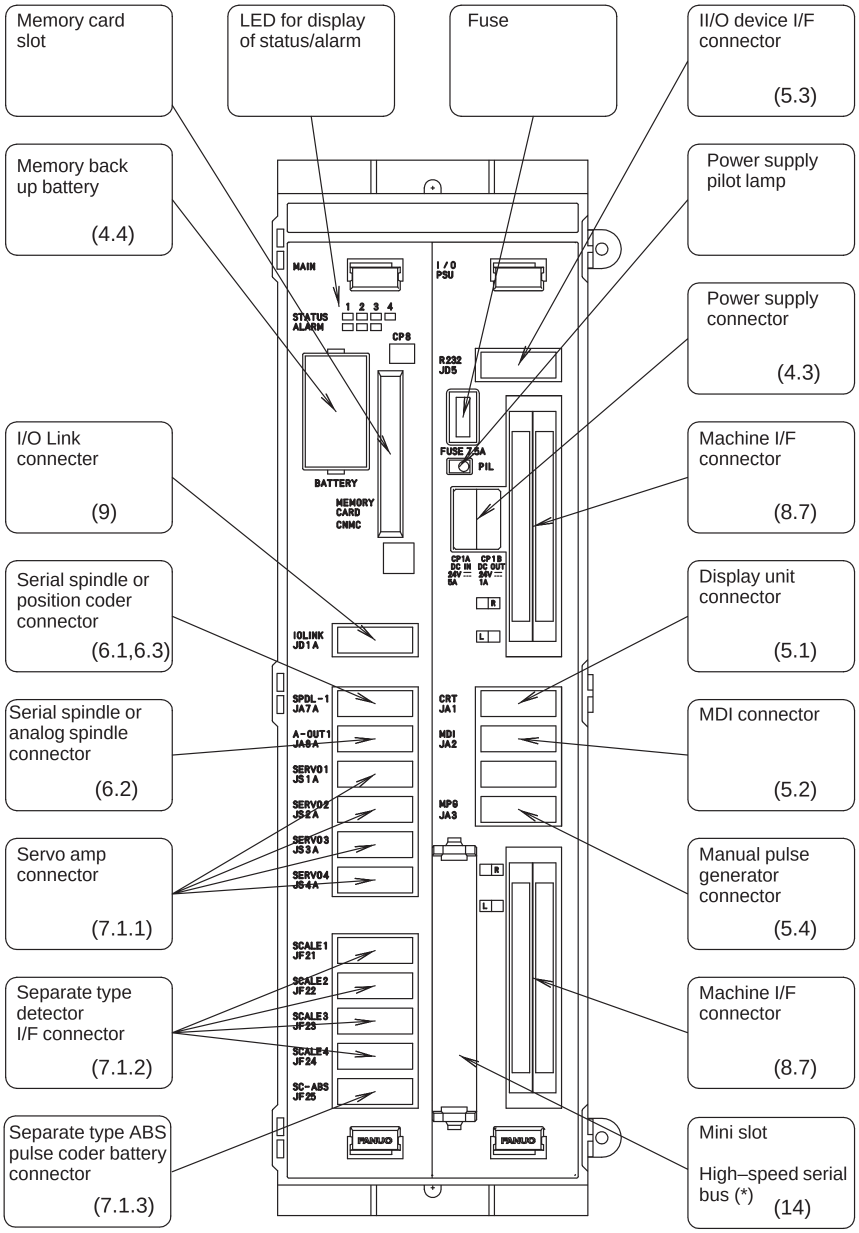
1.1 NAME OF EACH PART OF CONTROL UNIT

The following figure shows the configuration of FANUC Series 21/210–TB/MB control unit.
This manual describes how to connect the units illustrated in this diagram.
The numbers in parentheses shown in the diagram are section references for this manual.



Series 21/210–MB control unit (2–slot)

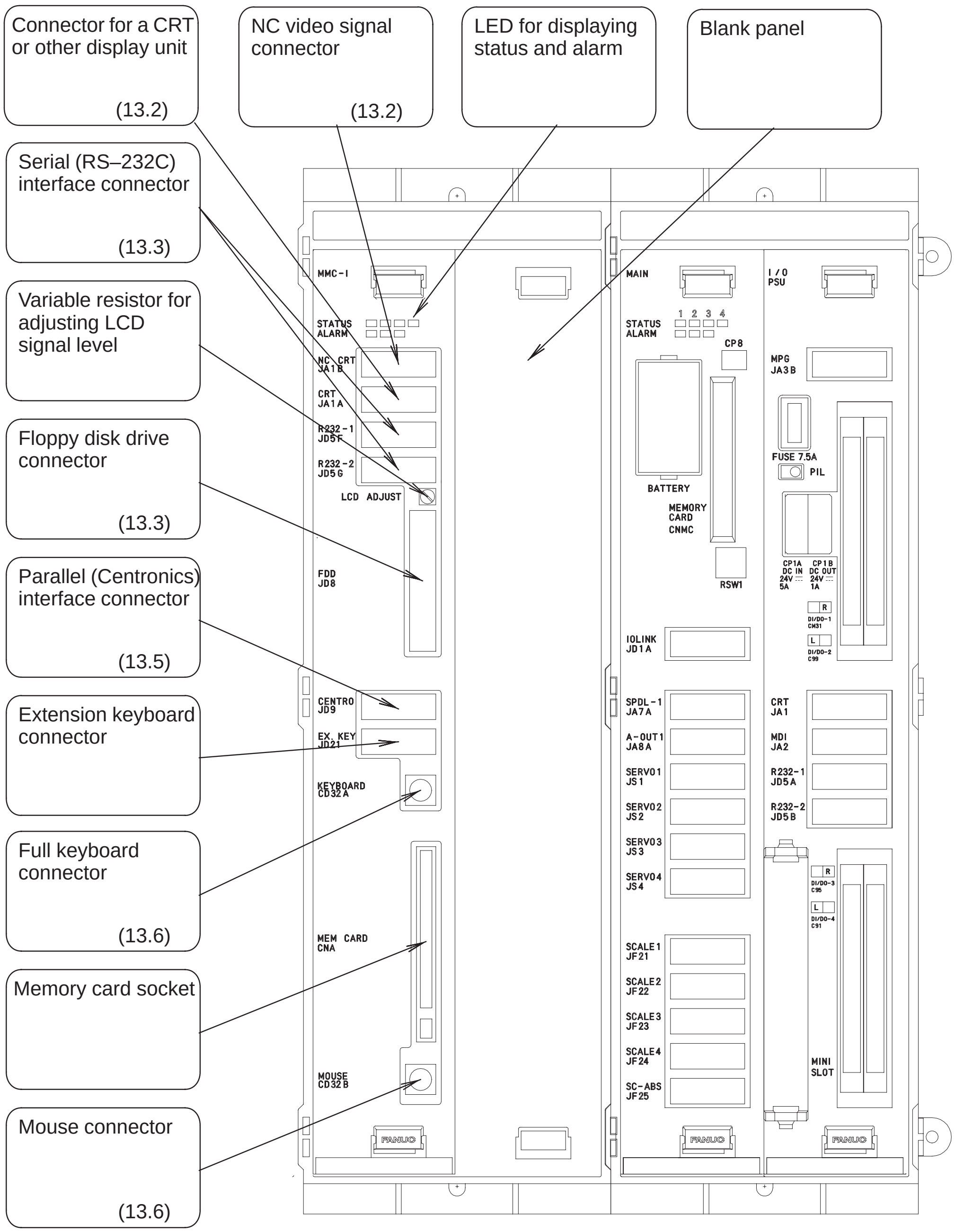
> **NOTE**
> (*) The high–speed serial bus cannot be connected to the Series 21–MB control unit.



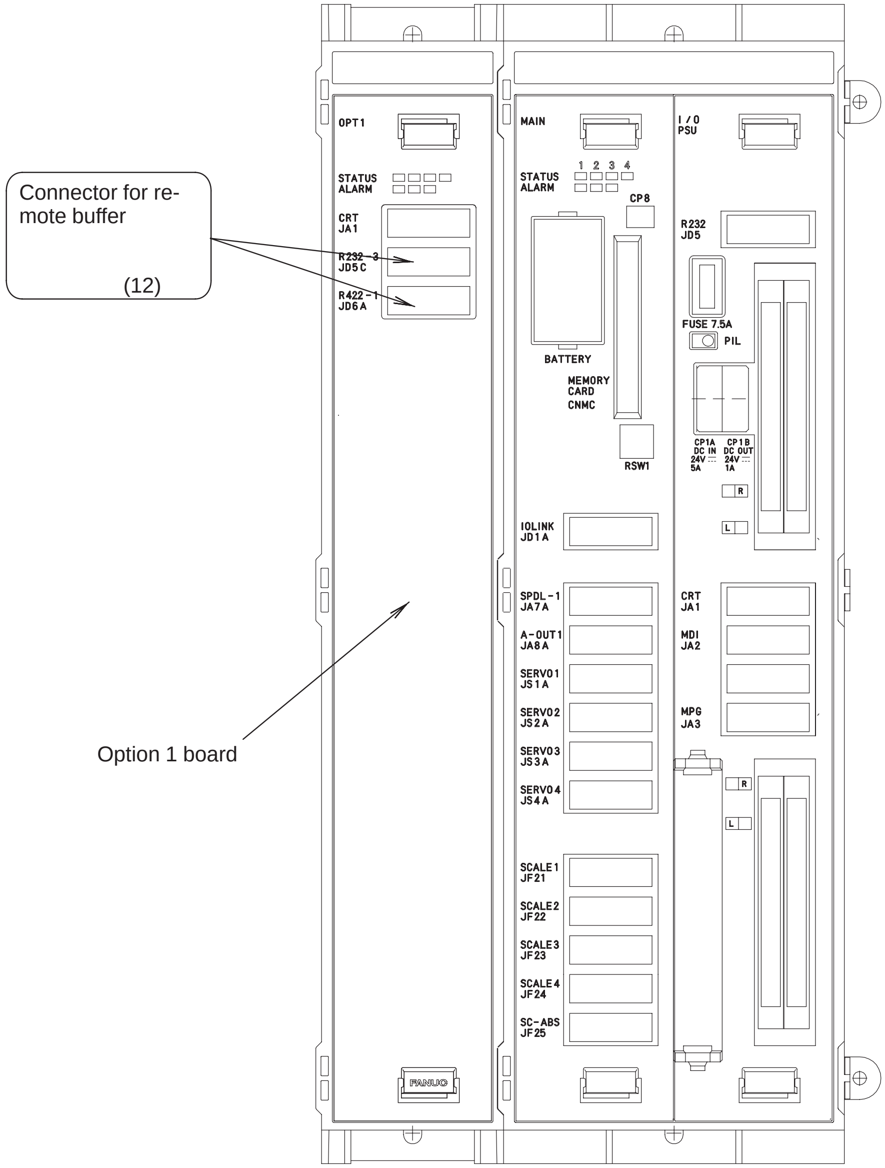
Series 21/210–TB control unit (2–slot)

NOTE

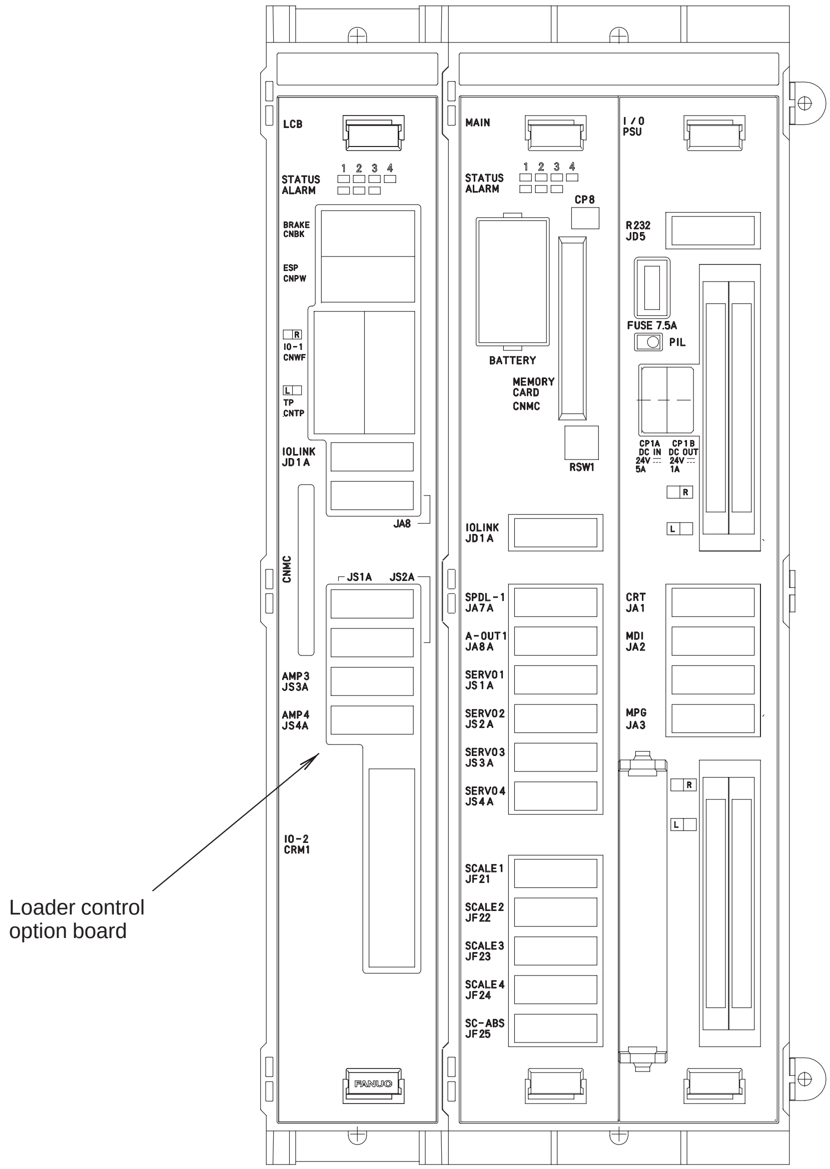
(*) The high–speed serial bus cannot be connected to the Series 21–TB control unit.



Series 210 control unit (with MMC–IV)



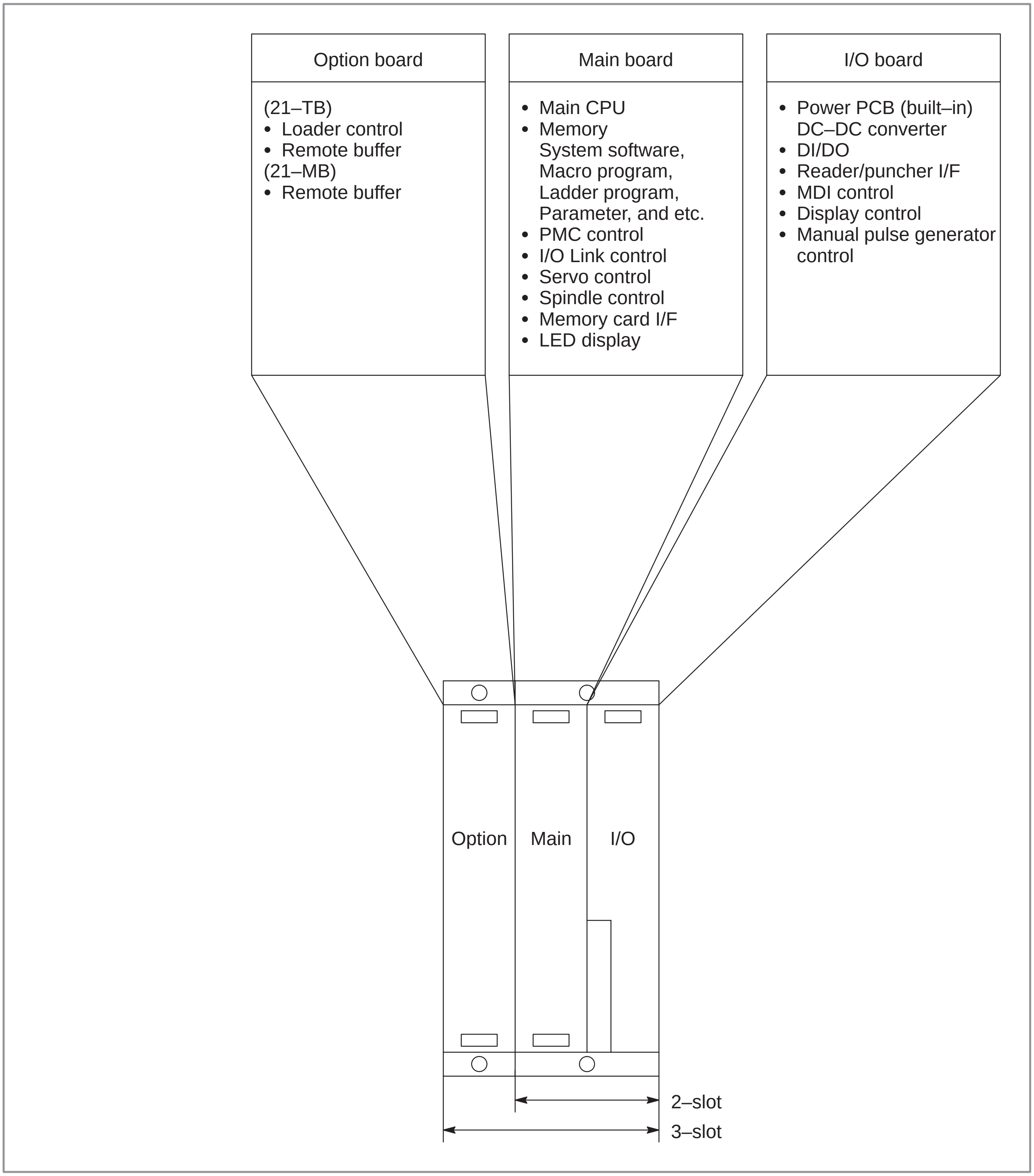
Series 21 control unit (3–slot)



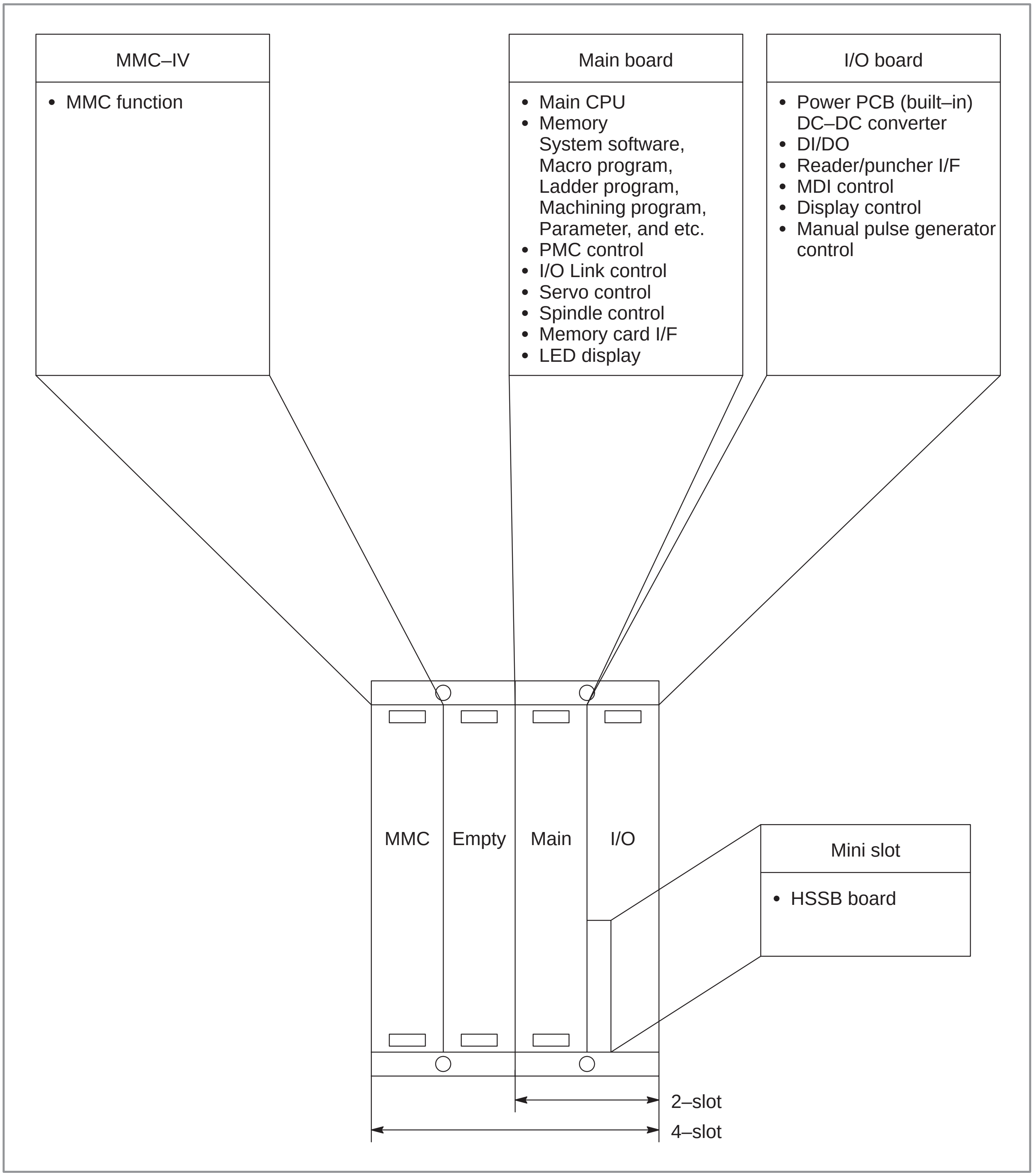
Series 21–TB control unit (with loader control option)

1.2 GENERAL OF HARDWARE

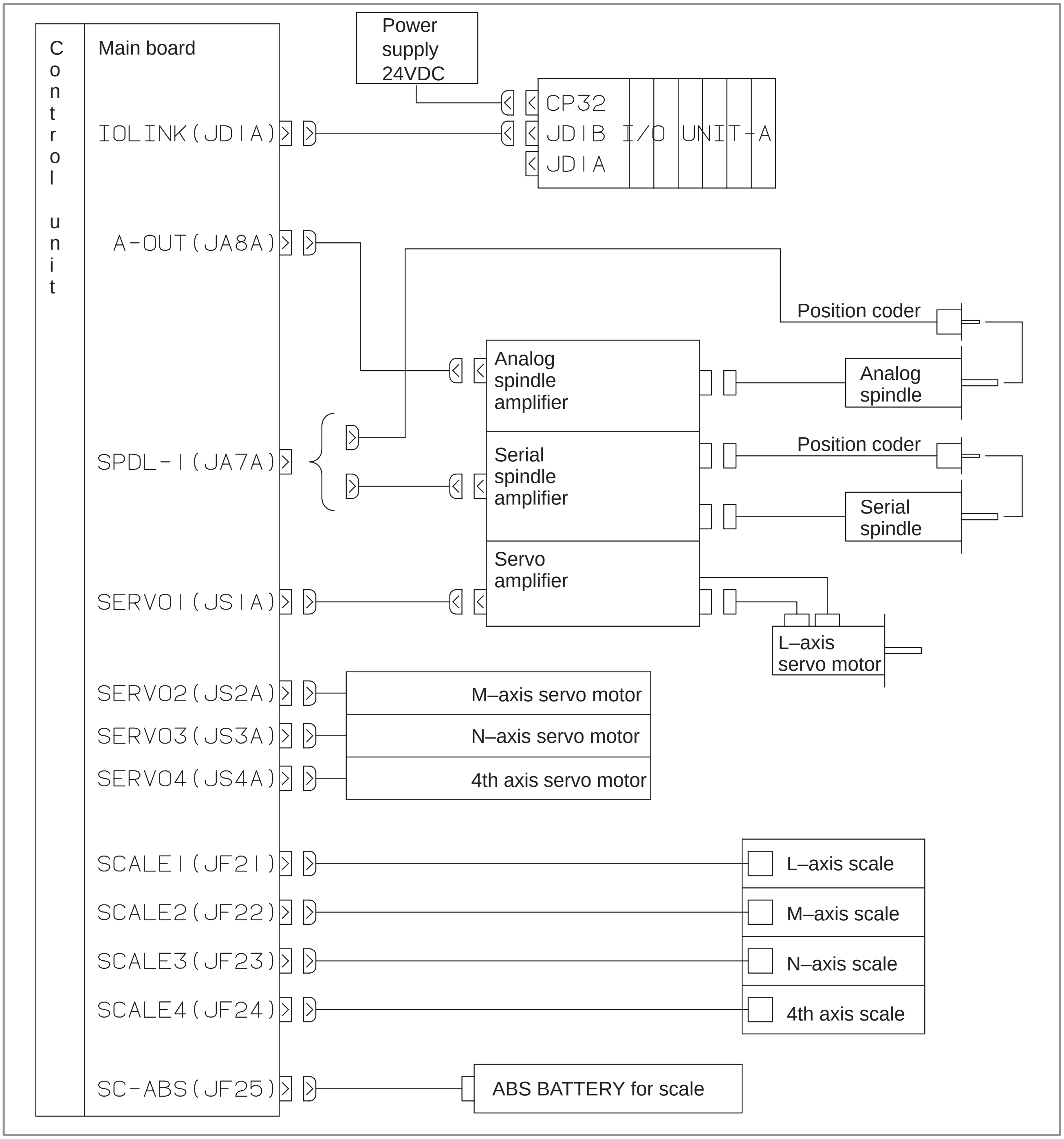
- **Series 21**



- **Series 210**


MMC–IV
• MMC function
Main board
• Main CPU
• Memory
System software,
Macro program,
Ladder program,
Machining program,
Parameter, and etc.
• PMC control
• I/O Link control
• Servo control
• Spindle control
• Memory card I/F
• LED display
I/O board
• Power PCB (built–in)
DC–DC converter
• DI/DO
• Reader/puncher I/F
• MDI control
• Display control
• Manual pulse generator
control
MMC
Empty
Main
I/O
Mini slot
• HSSB board
2–slot
4–slot

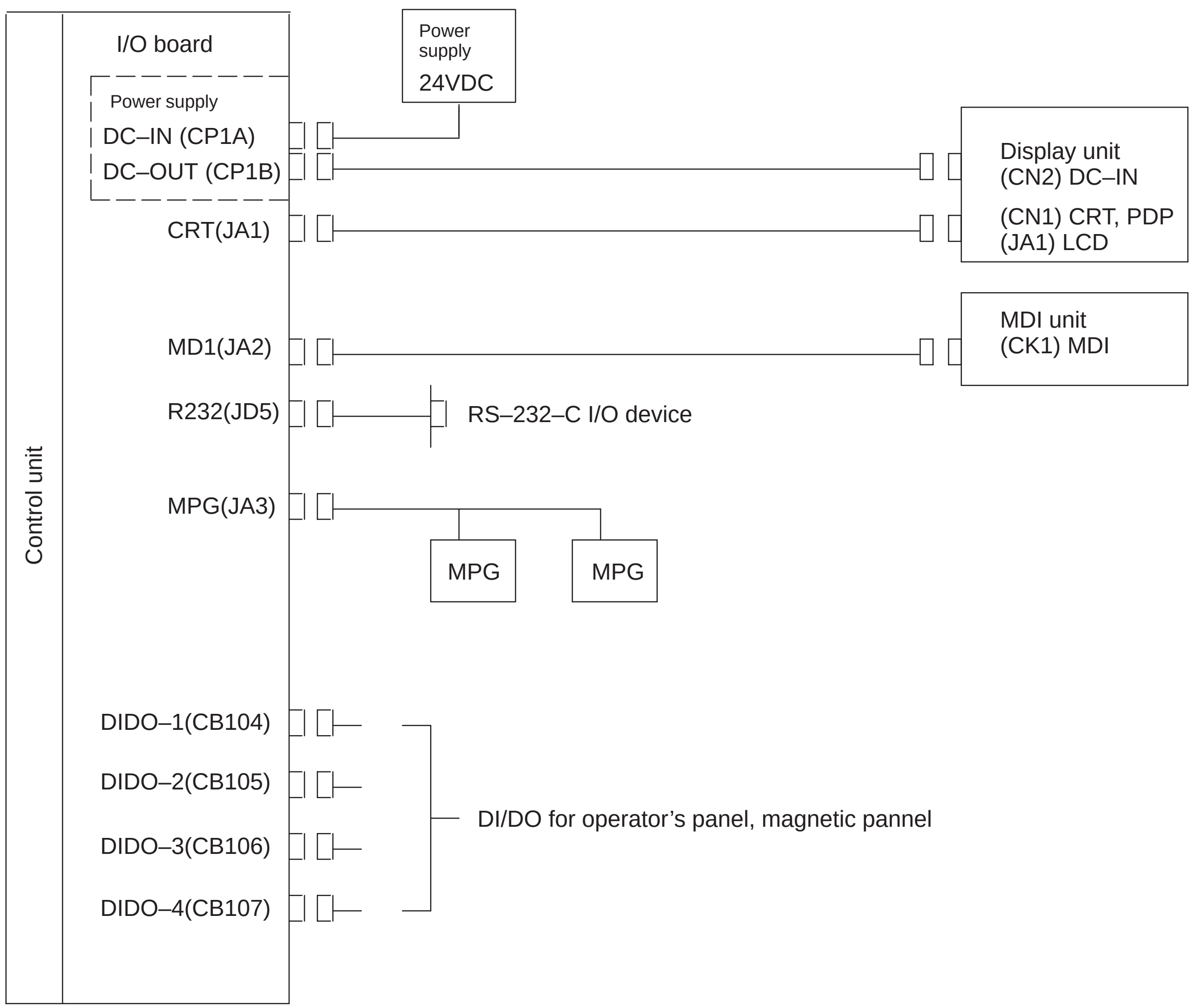
2 TOTAL CONNECTION DIAGRAM

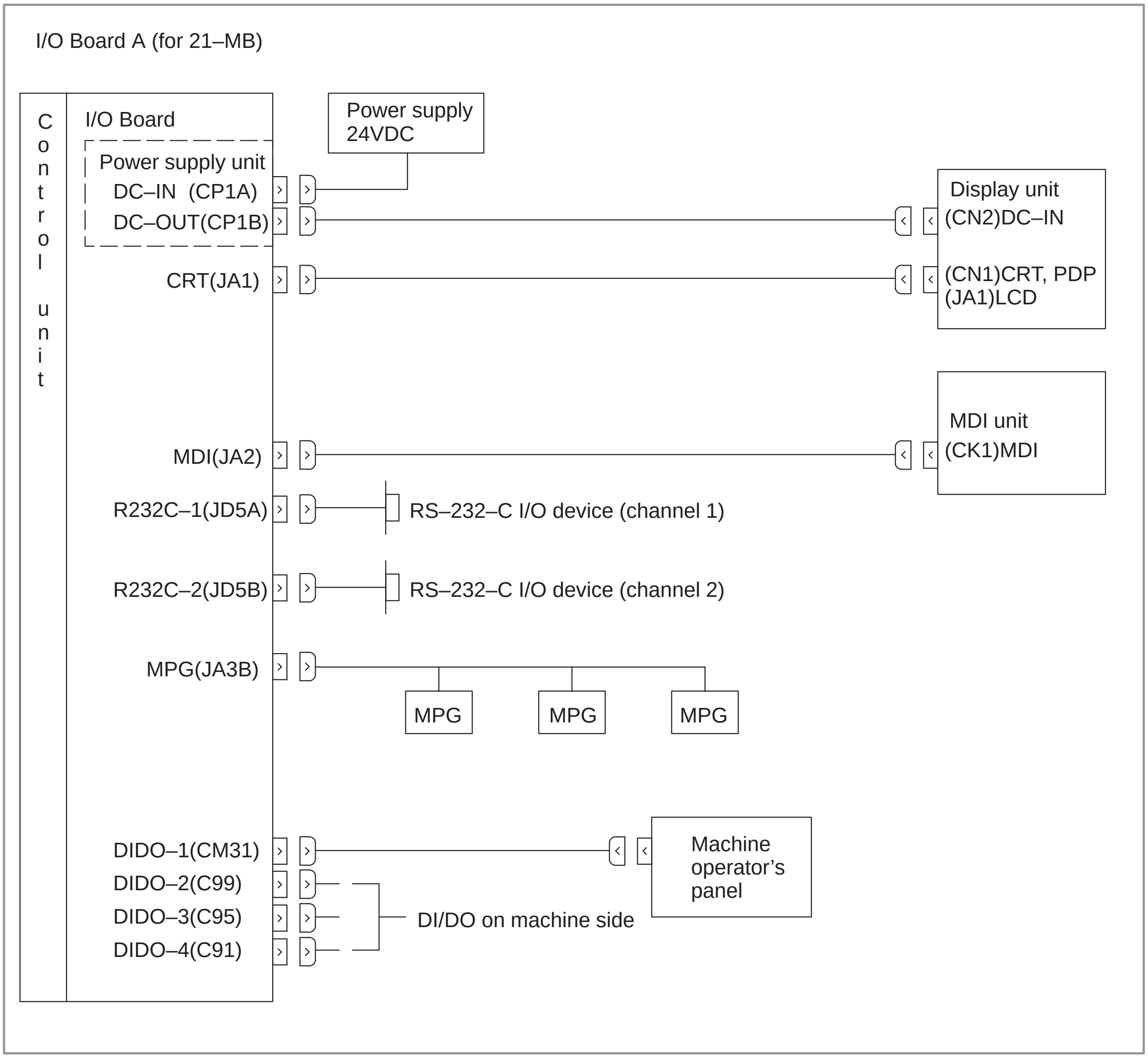


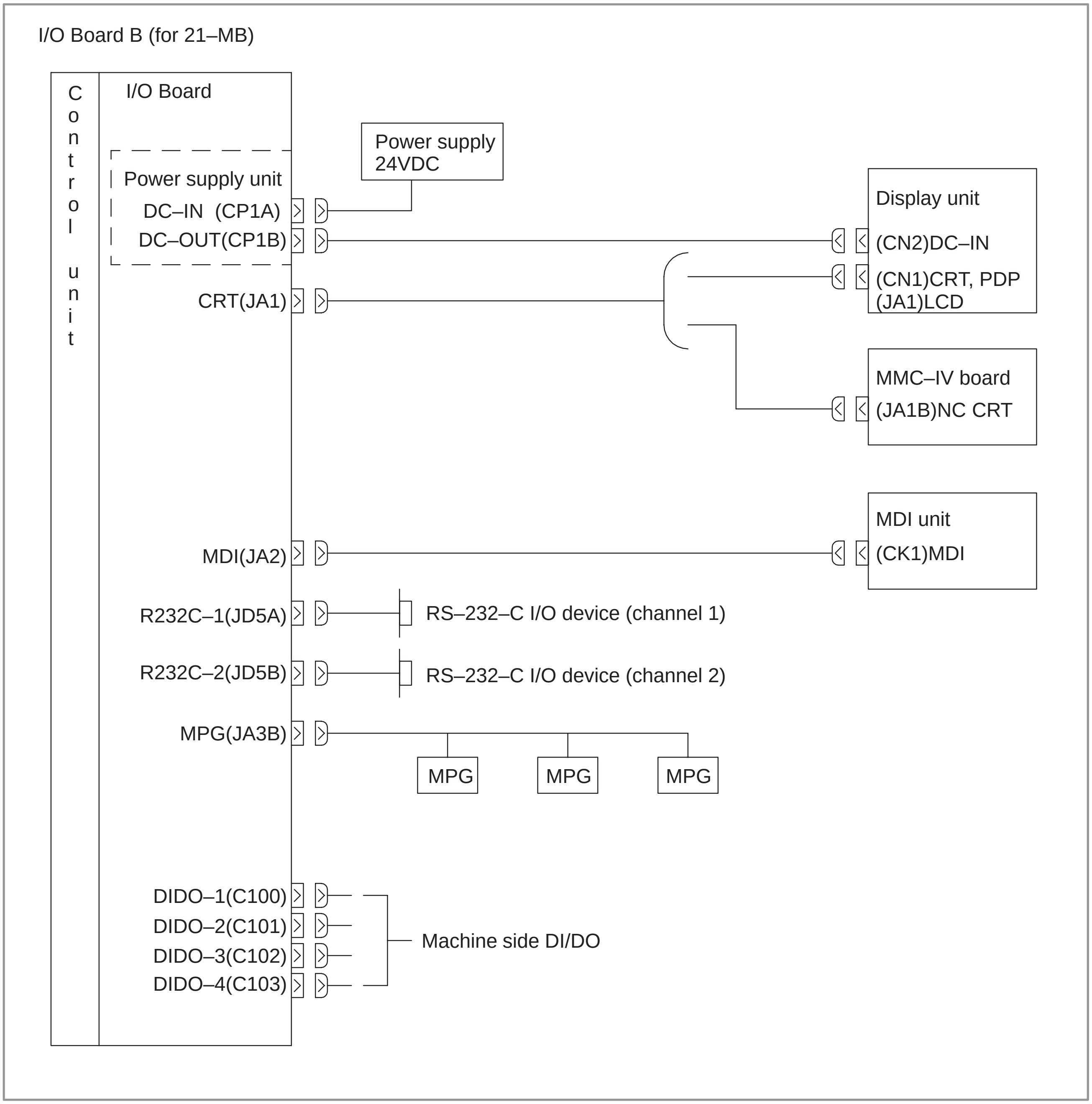
NOTE

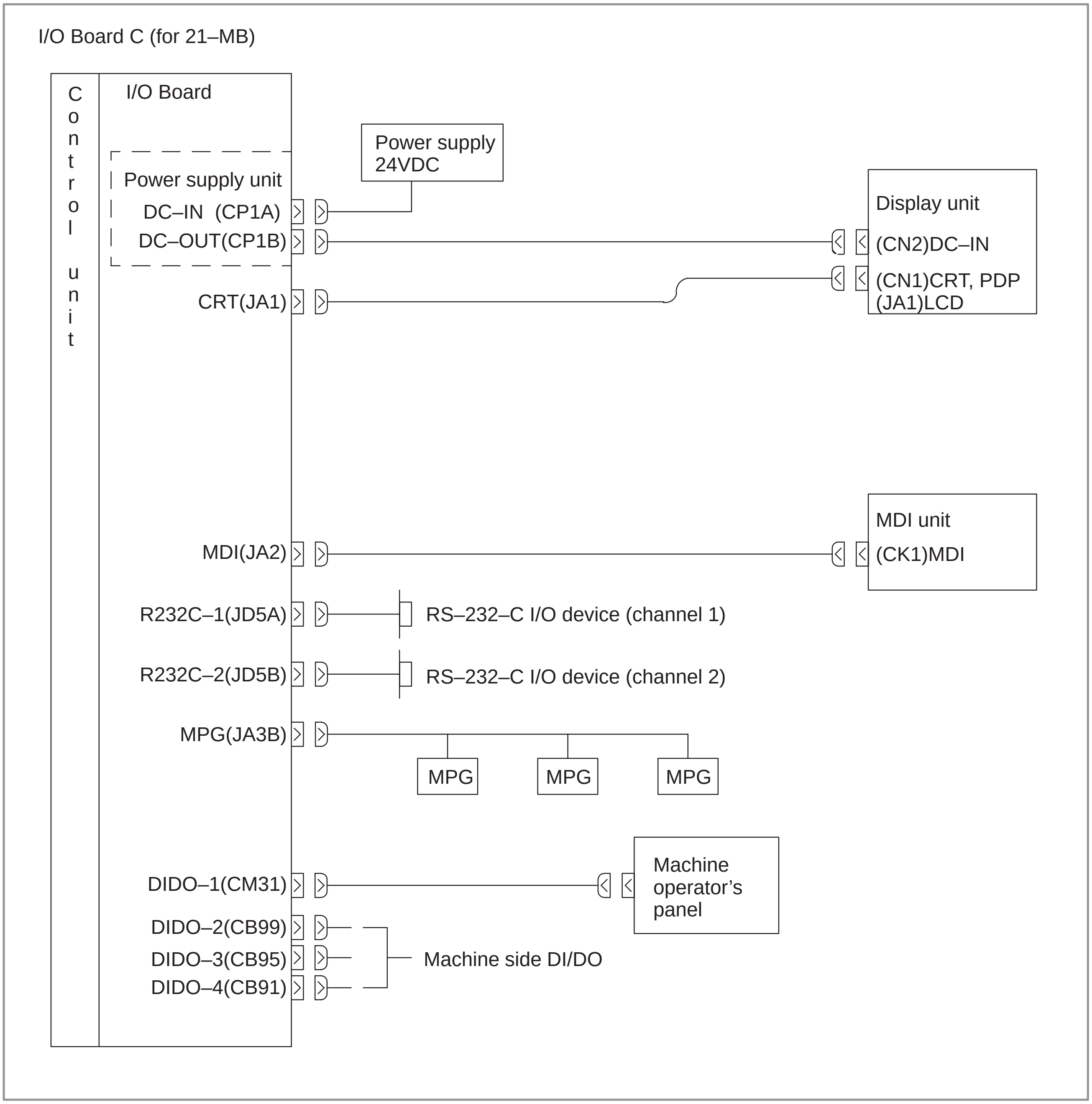
Either an analog or serial spindle can be used. For details of spindle and servo motor connection, refer to the relevant manuals.

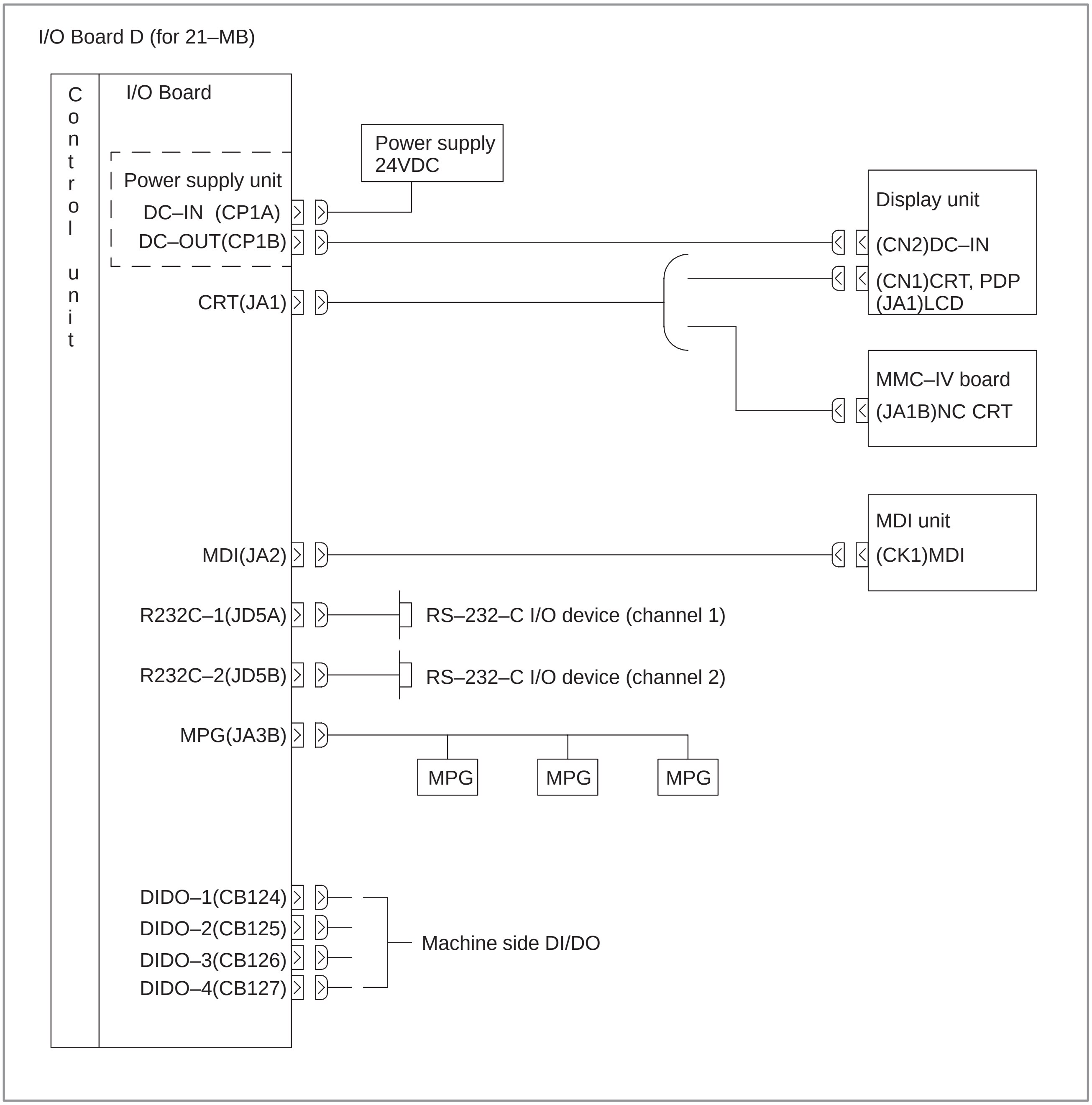
I/O Board (for 21–TB)

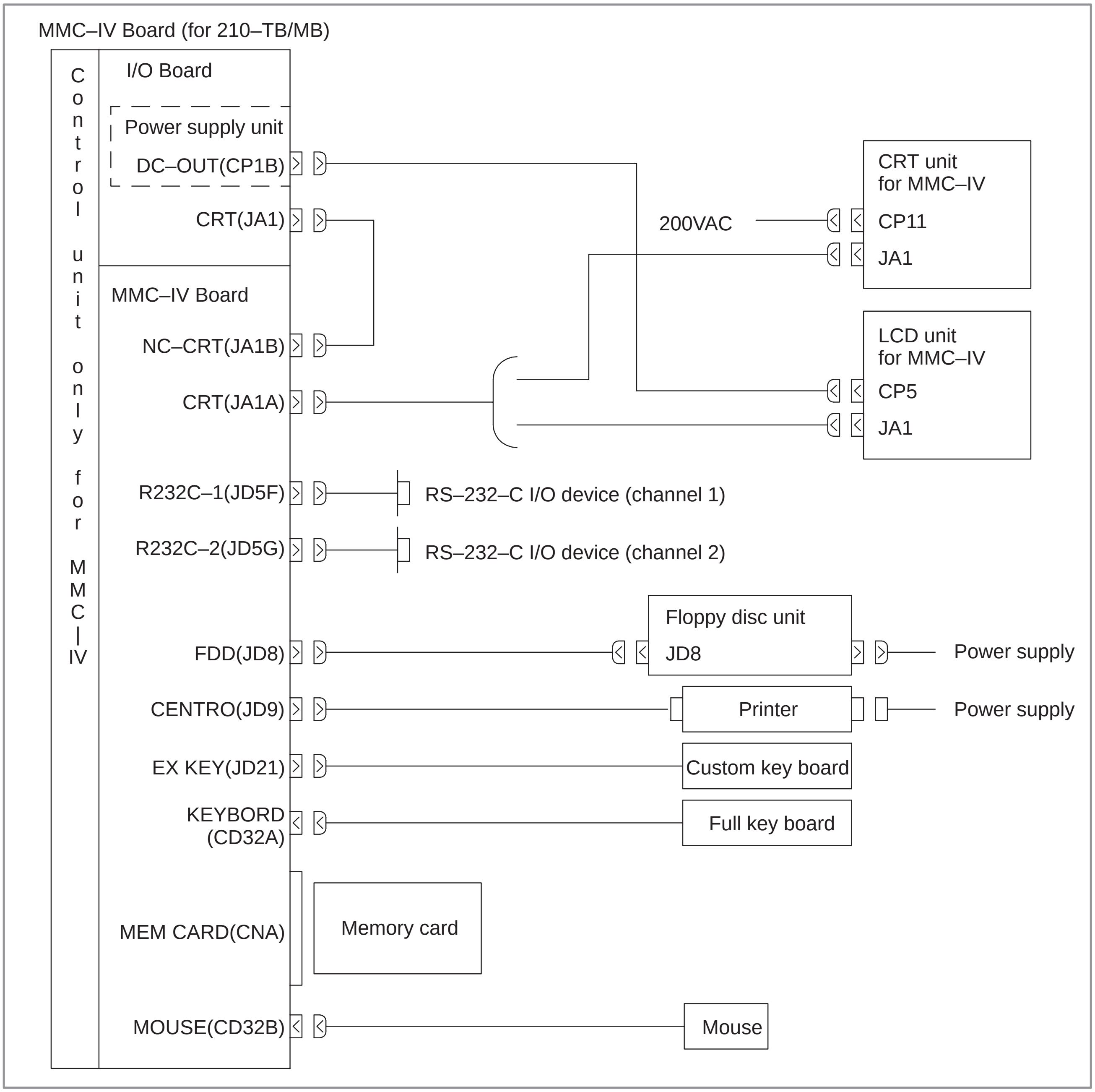


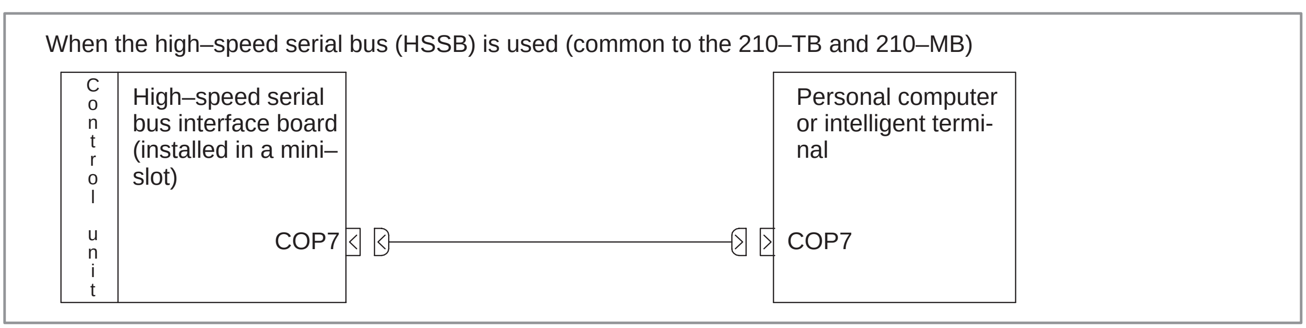

I/O Board A (for 21–MB)
Control unit
I/O Board
Power supply unit
DC–IN (CP1A)
DC–OUT(CP1B)
CRT(JA1)
MDI(JA2)
R232C–1(JD5A)
R232C–2(JD5B)
MPG(JA3B)
DIDO–1(CM31)
DIDO–2(C99)
DIDO–3(C95)
DIDO–4(C91)
Power supply 24VDC
Display unit
(CN2)DC–IN
(CN1)CRT, PDP
(JA1)LCD
MDI unit
(CK1)MDI
RS–232–C I/O device (channel 1)
RS–232–C I/O device (channel 2)
MPG
MPG
MPG
Machine operator’s panel
DI/DO on machine side


I/O Board B (for 21–MB)
Control unit
I/O Board
Power supply unit
DC–IN (CP1A)
DC–OUT(CP1B)
Power supply 24VDC
CRT(JA1)
Display unit
(CN2)DC–IN
(CN1)CRT, PDP
(JA1)LCD
MMC–IV board
(JA1B)NC CRT
MDI(JA2)
MDI unit
(CK1)MDI
R232C–1(JD5A)
RS–232–C I/O device (channel 1)
R232C–2(JD5B)
RS–232–C I/O device (channel 2)
MPG(JA3B)
MPG
MPG
MPG
DIDO–1(C100)
DIDO–2(C101)
DIDO–3(C102)
DIDO–4(C103)
Machine side DI/DO


I/O Board C (for 21–MB)
Control unit
I/O Board
Power supply unit
DC–IN (CP1A)
DC–OUT(CP1B)
CRT(JA1)
MDI(JA2)
R232C–1(JD5A)
R232C–2(JD5B)
MPG(JA3B)
DIDO–1(CM31)
DIDO–2(CB99)
DIDO–3(CB95)
DIDO–4(CB91)
Power supply 24VDC
Display unit
(CN2)DC–IN
(CN1)CRT, PDP
(JA1)LCD
MDI unit
(CK1)MDI
RS–232–C I/O device (channel 1)
RS–232–C I/O device (channel 2)
MPG
MPG
MPG
Machine operator’s panel
Machine side DI/DO

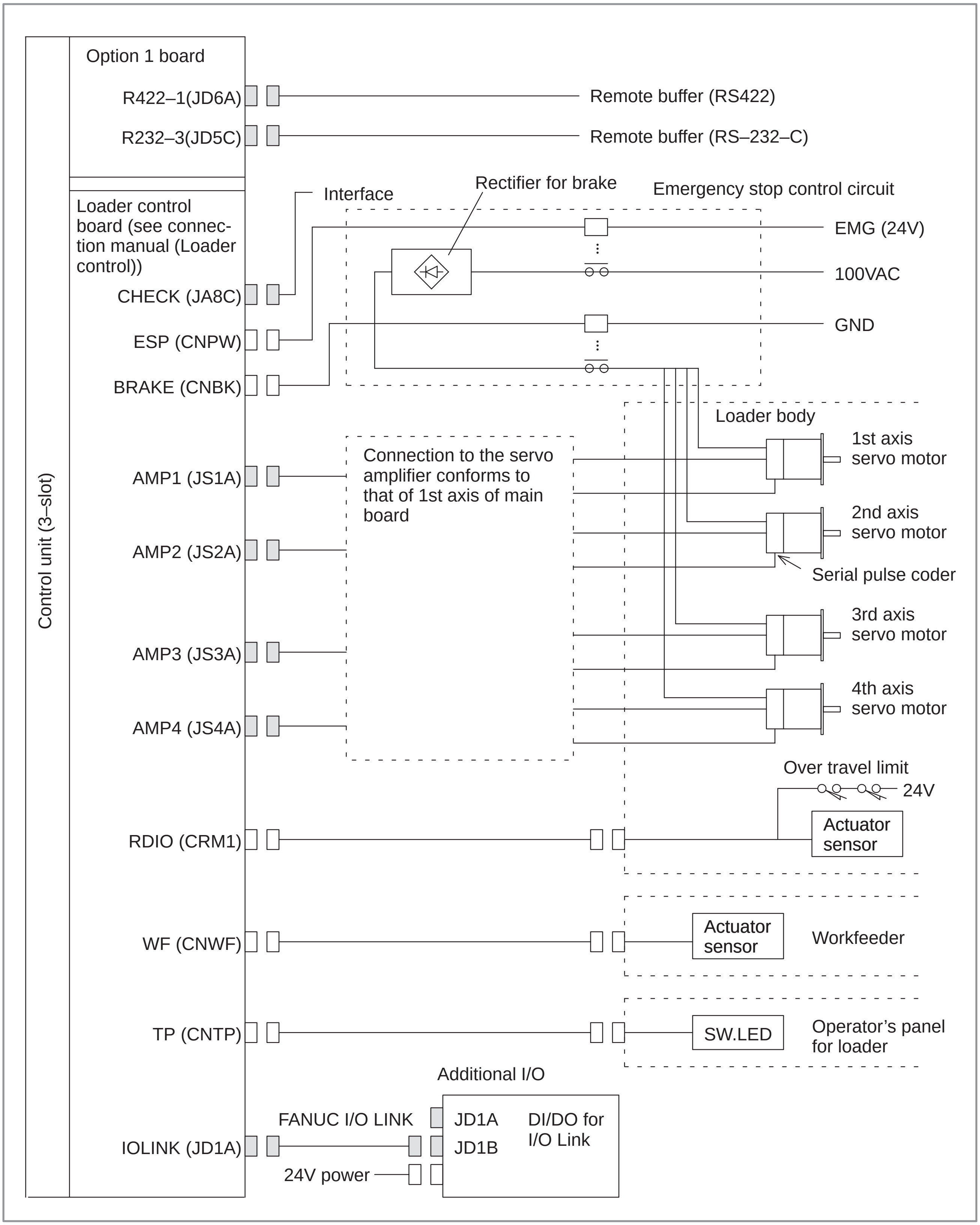

I/O Board D (for 21–MB)
Control unit
I/O Board
Power supply unit
DC–IN (CP1A)
DC–OUT(CP1B)
CRT(JA1)
MDI(JA2)
R232C–1(JD5A)
R232C–2(JD5B)
MPG(JA3B)
DIDO–1(CB124)
DIDO–2(CB125)
DIDO–3(CB126)
DIDO–4(CB127)
Power supply 24VDC
Display unit
(CN2)DC–IN
(CN1)CRT, PDP
(JA1)LCD
MMC–IV board
(JA1B)NC CRT
MDI unit
(CK1)MDI
RS–232–C I/O device (channel 1)
RS–232–C I/O device (channel 2)
MPG
MPG
MPG
Machine side DI/DO





NOTE

Refer to Chapter15 for information about connections specific to intelligent terminals.



NOTE

The option 1 board cannot be used in the Series 210 system. The loader control board can be used only in the 21–TB (in slot 3 of control unit B).

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.

Room temperature	In operation	0°C to 45°C
	In storage or transportation	–20°C to 60°C
Change in temperature	1.1°C /minute max.	
Relative humidity	Normal	75% or less
	Temporary(within 1 month)	95% or less
Vibration	In operation: 0.5G or less	
Environment	Normal machine shop environment (The environment must be considered if the cabinets are in a location where the density of dust, coolant, and/or organic solvent is relatively high.)	

3.1.2 Installation Requirements of CNC and Servo Unit

Room temperature	In operation	0°C to +55°C
	In storage or transportation	–20°C to +60°C
Relative humidity	95% RH or less (no condensation)	
Vibration	0.5 G or less	
Environment	The unit shall not be exposed direct to cutting oil, lubricant or cutting chips.	

NOTE
See Subsec. 3.1.3 for Series 210.

3.1.3 Environmental Requirements of Control Unit Built–in MMC–IV (for Series 210)

When the MMC–IV is incorporated into the system, the environment in which the control unit is installed must satisfy the following conditions (within the cabinet):

Room temperature	In operation	5°C to 50°C Note 1)
	In storage or transportation	–20°C to 60°C
Change in temperature	20°C /hour max.	
Relative humidity	Normal	Relative humidity: 10% to 75%, non–condensing.
	Temporary (within 1 month)	Relative humidity: 10% to 90%, non–condensing.
Vibration	In operation	0.5G or less Note 2)
	Not operation	1.0G or less
Environment	The control unit shall be housed in a sealed cabinet.	

CAUTION

Data stored on the hard disk may be damaged or destroyed as a result of a mis–operation or system failure, even when the above–listed conditions are satisfied. In particular, turning off the power while the hard disk is being accessed is extremely likely to damage stored data. Do not, therefore, turn off the power while the hard disk is being accessed. Ensure that your end users are also aware of this precaution.
Important data on the hard disk should be regularly backed up to another medium.

NOTE

1 Operating ambient temperature
The temperature sensor on the MMC–IV printed circuit board monitors whether the temperature is within the specified range. (The operator can check the state using the CNC diagnosis screen.)
(1) If the ambient temperature is outside the specified range at power–on
Only the CNC and PMC are turned on.
Once the temperature moves within the specified range, the MMC–IV is automatically turned on.
(2) If the ambient temperature moves outside the specified range during operation after normal power–on
An error occurs when the system attempts to access the hard disk.

2 Vibration
The CNC control unit or built–in hard disk drive may exhibit vibration at an arbitrary frequency.
Once the CNC control unit has been installed in the machine, check that no vibration occurs.
Be particularly careful to eliminate any vibration when using the memory card socket.

3.2 POWER SUPPLY

3.2.1 Power Supply for CNC Control Units

The following units related to the CNC control unit require input power of 24 VDC ±10% (excluding the 14″ CRT/MDI unit):

Table 3.2.1 Power supply

Unit	Power supply voltage	Power supply
21–TB control unit A	24 VDC ±10% ±10% includes momentary surges and ripples.	2.4A (only control unit)
21–TB control unit B		3.4A (only control unit)
21–MB control unit		3.4A (only control unit)
Series 210 control unit		3.5A (only control unit) When MMC–IV is used.
Series 210 control unit		5.5A (only control unit) When MMC–IV is used.
Loader control option board		0.7A (only 21–TB)
9″ CRT/MDI unit		0.8A
9″ PDP unit		2.0A
7.2″ STN unit		0.8A
9.5″ STN unit		0.8A
8.4″ TFT color unit		0.8A
14″ CRT/MDI unit	170 to 264VAC	0.6A
9.5″ TFT/MDI unit	24 VDC ±10% ±10% includes momentary surges and ripples.	0.8A
I/O Unit–A		Depends on the type and number of modules. Refer to “I/O unit–MODEL A connection and Maintenance Manual” (B–61813E)

NOTE
See Chapter 13 for details of intelligent terminal unit.

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.
Cabinets that let in air may be desined for the servo amplifier and servo transformer provided that they :

- Use an air filter on the air inlet ;
- Place the ventilating fan so that it does not blow air directly toward the unit;
- Control the air flow so that no dust or coolant enters the air outlet

(2) The cabinet must be designed to maintain a difference in temperature of 10°C or less between the air in the cabinet and the outside air when the temperature in the cabinet increases.

See Sec. 3.4 for the details on 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.

Because the CRT unit uses a voltage of approximatery 11 kV, airborne dust gathers easily. If the cabinet is insufficiently sealed, dust passes through the gap and abheres to the unit. This may cause the insulation of the unit to deteriorate.

(6) The CRT/MDI unit and other 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 CRT screen can be distorted by magnetic interference.

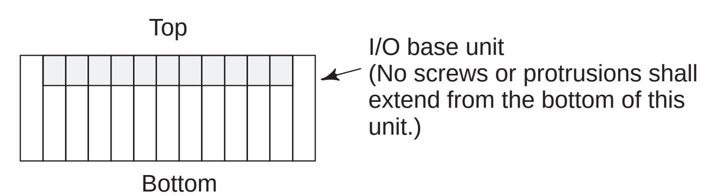
Arranging magnetic sources must be done with care.

If magnetic sources (such as transformers, fan motors, electromagnetic contactors, solenoids, and relays) are located near the CRT display, they frequently distort the display screen. To prevent this, the CRT display and the magnetic sources generatlly must be kept 300 mm apart. If the CRT display and the magnetic sources are not 300 mm apart, the screen distortion may be suppressed by changing the direction in which the magnetic sources are installed.

The magnetic intensity is not constant, and it is often increased by magnetic interference from multiple magnetic sources interacting with each other. As a result, simply keeping the CRT and the magnetic sources 300 mm apart may not be enough to prevent the distortion. If they cannot be kept apart, or if the CRT screen remains distorted despite the distance, cover the screen with a magnetic shield.

(10) The installation conditions of the I/O unit 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.



3.4 THERMAL DESIGN OF THE CABINET

The purpose of the thermal design of the cabinet is 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 increases.
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:

$$\text{Internal heat loss P [W]} \leqq 6\ [\text{W/m}^{2\,\text{S}} \cdot {}^\circ\text{C}] \times \text{surface area S [m}^2] \times 10\ [{}^\circ\text{C}] \text{ of rise in temperature}$$

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 10°C under these conditions, the internal heat must not exceed 240W. If the actual internal heat is 320W, however, the temperature in the cabinet rises by 13°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 320 W, the temperature rise can be limited to less than 10°C.
See Sec. 3.5 for installing the heat exchanger.

3.4.3 Heat Loss of Each Unit

Name		Heat loss
Control unit	Series 21	60W
	Series 210	90W
Display unit	9″CRT/MDI unit	14W
	9″PDP unit	20W
	7.2″STN unit	10W
	8.4″TFT color unit	20W
	9.5″STN unit	10W
	9.5″TFT unit	20W
	14″CRT unit	70W
I/O unit	AIF01A, AIF01B	1.2W
	AID32A, AID32B	1.2W+0.23W × number of ON points
	AID16C, AID16D	0.1W+0.21W × number of ON points
	AID32E, AID32F	0.1W+0.23W × number of ON points
Multi–tap transformer		51W

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

3.5.1 Cooling Fin A/B/C

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

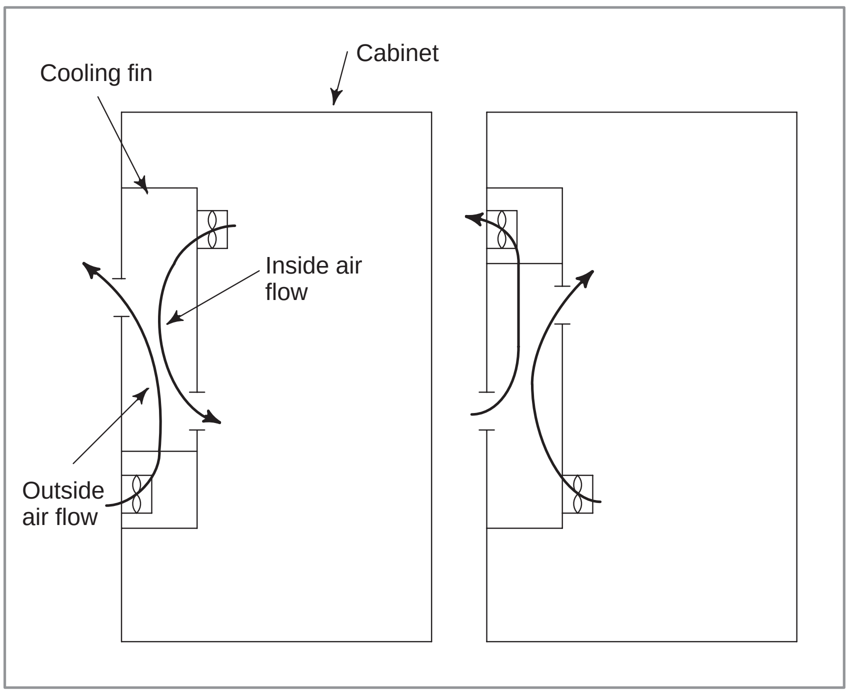


Fig.3.5.1(a) Internal view of cooling fin

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 :

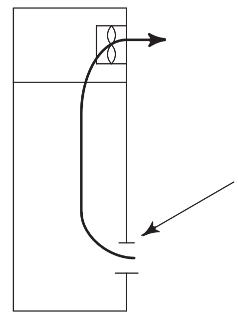
1) The fans are not included with the cooling fin. They should be provided by the machine tool builder.
2) Bring in the outside air from the bottom and exhaust the hot air from the top.
3) The inside air may flow from top to bottom or bottom to top. However, generally decide the direction as follows :

a) Bring in the air near high heat loss components.

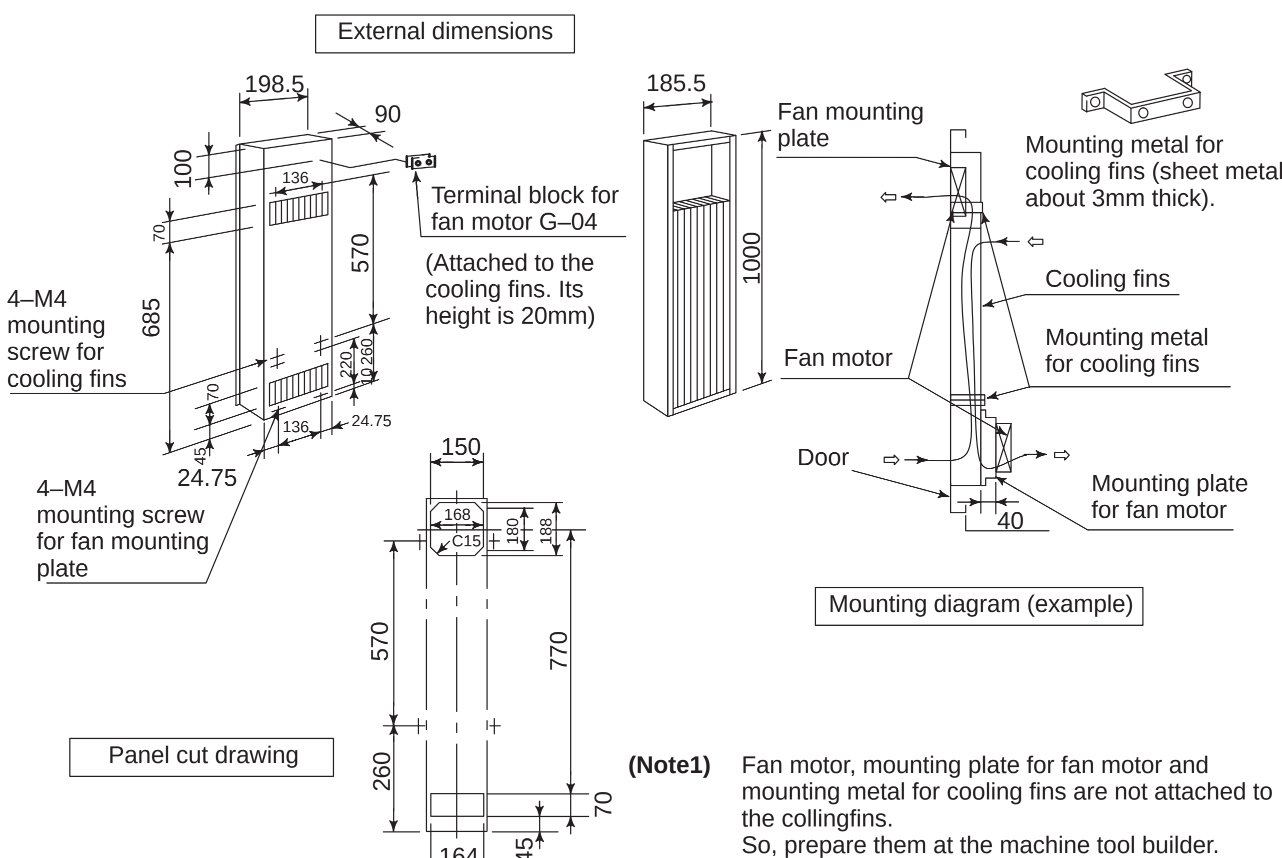
b) Exhaust the air toward the most important components to be cooled.

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.

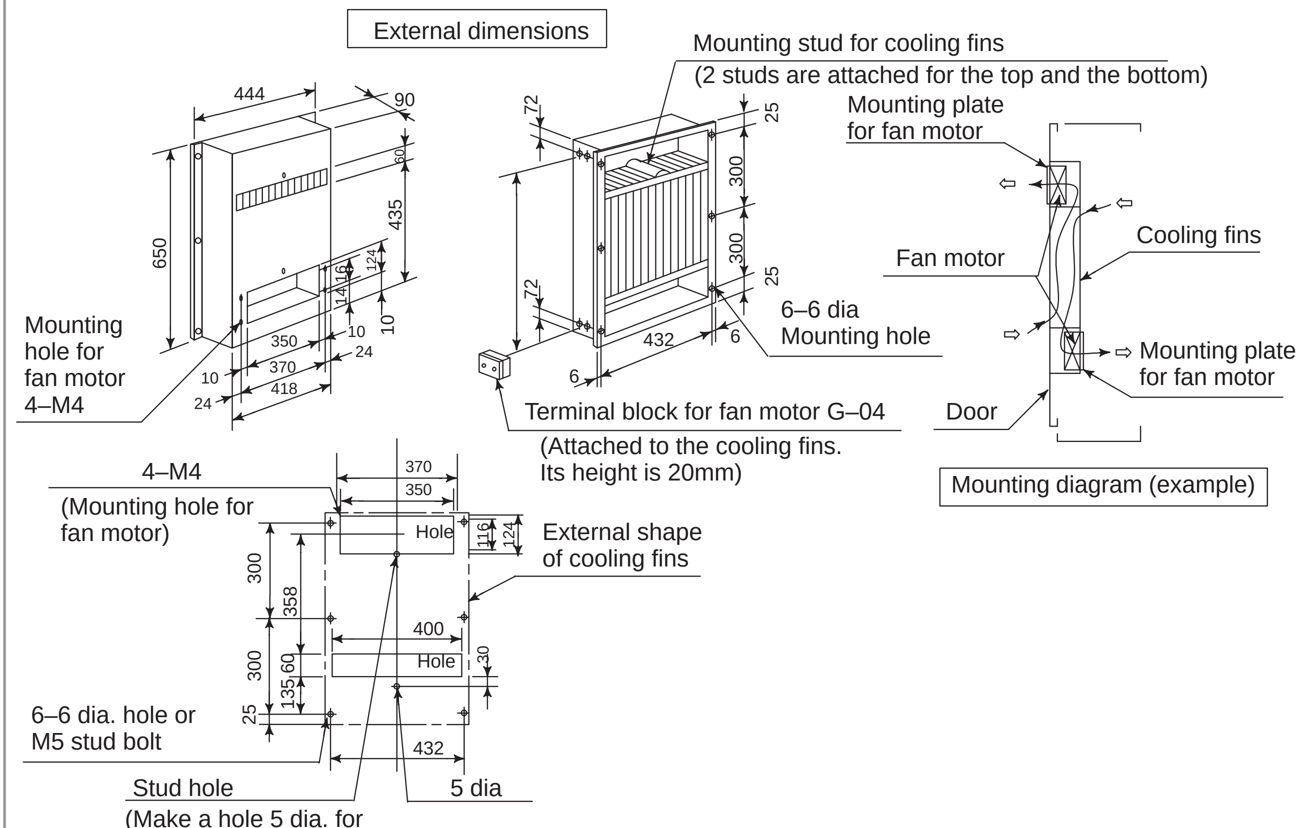


(Note1) Fan motor, mounting plate for fan motor and mounting metal for cooling fins are not attached to the collingfins.
So, prepare them at the machine tool builder.

(Note2) Use two fan motors with about 50W power.

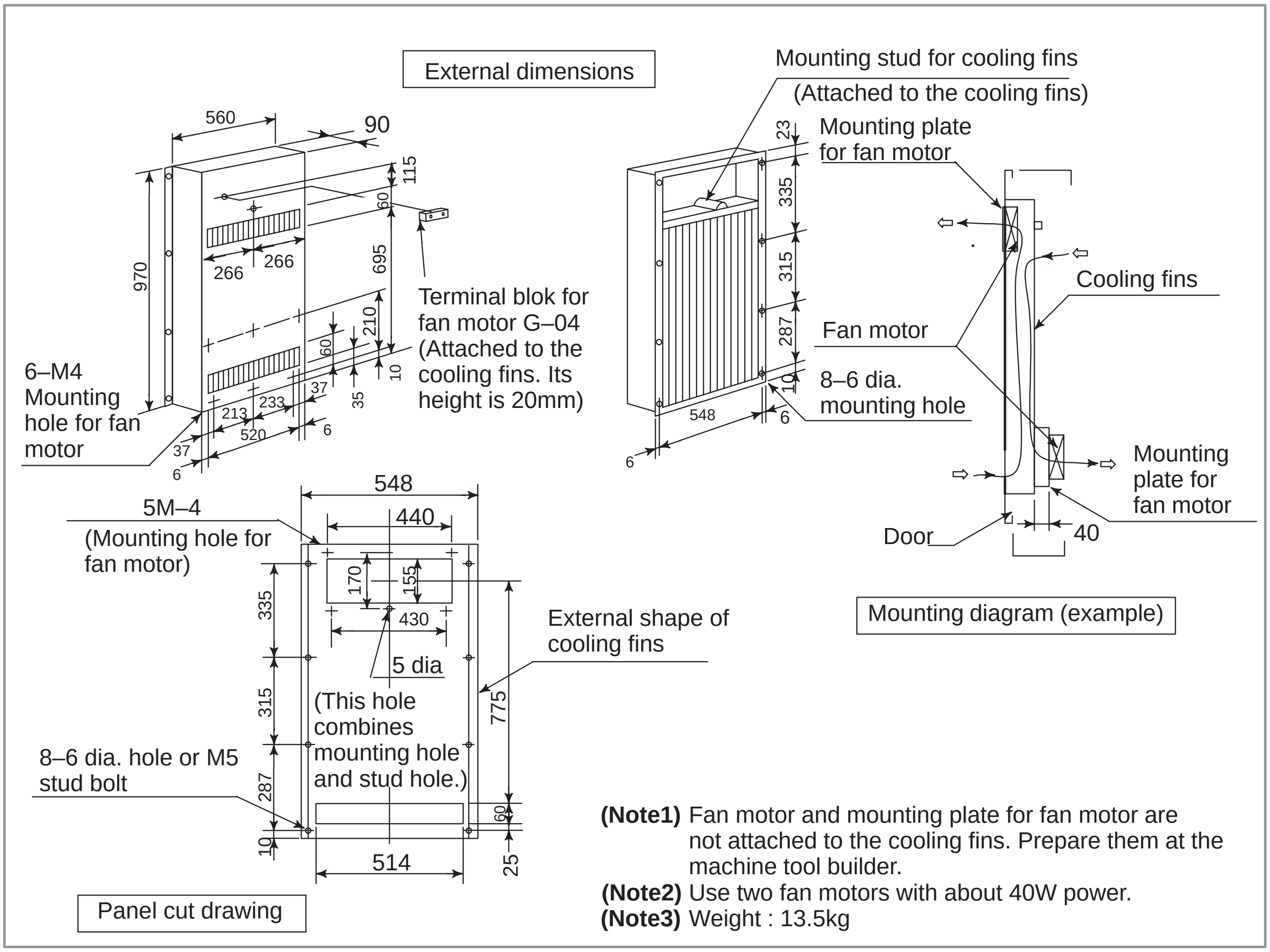
(Note3) Weight : 6.5kg

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



(Note1) Fan motor and mounting plate are not attached to the cooling fins.So, prepare them, at the machine tool builder.
(Note2) Use four fan motors with about 20W power.
(Note3) Weight : 7.5kg

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



(Note1) Fan motor and mounting plate for fan motor are not attached to the cooling fins. Prepare them at the machine tool builder.
(Note2) Use two fan motors with about 40W power.
(Note3) Weight : 13.5kg

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

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

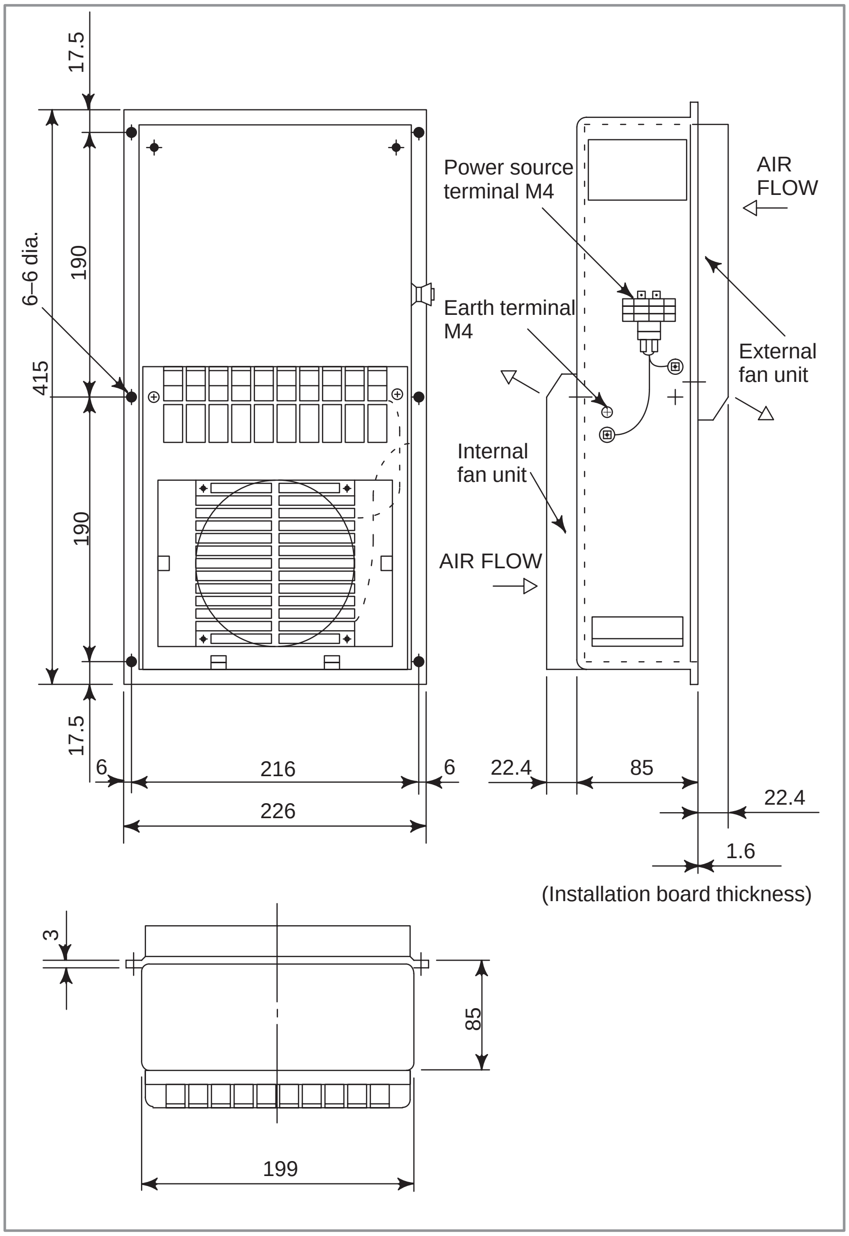
Remarks

- 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.

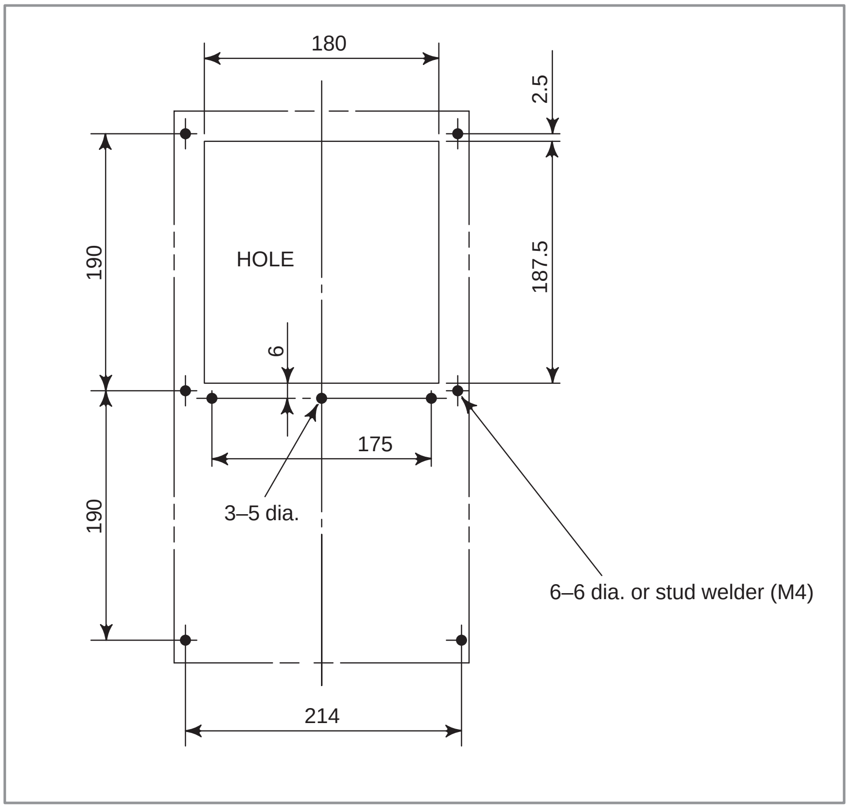
  Fan motor specifications
  A90L–0001–0219#A

  Filter specifications
  A250–0689–X004
- If the heat exchanger is installed near the CRT, screen distortion may occur due to magnetic flux leakage from the fan motor.

External dimensions



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.

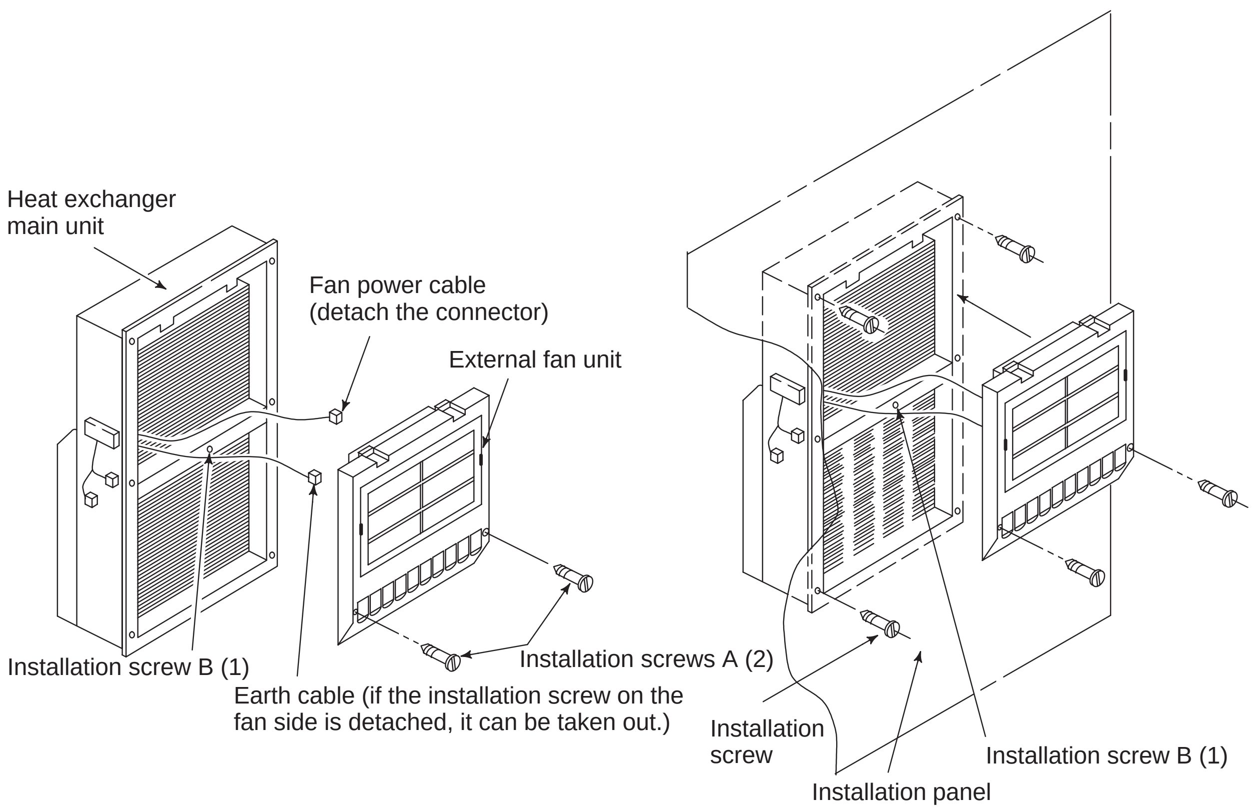


Fig. 1 Take out the external fan unit from the heat exchanger main unit

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

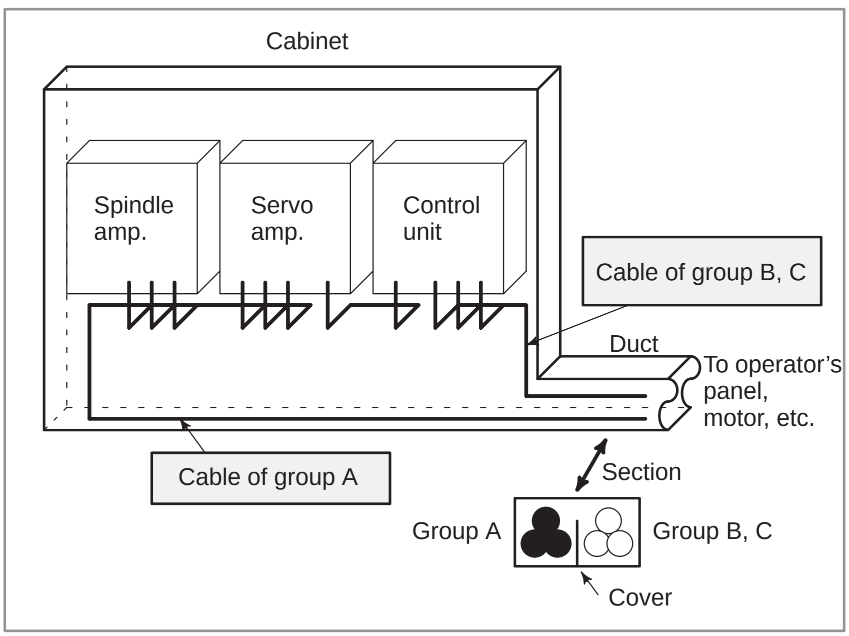
The cables used for the CNC machine tool are classified as listed in the following table:

Process the cables in each group as described in the action column.

<table>
<tr><th>Group</th><th>Signal line</th><th>Action</th></tr>
<tr><td rowspan="5">A</td><td>Primary AC power line</td><td rowspan="5">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.</td></tr>
<tr><td>Secondary AC power line</td></tr>
<tr><td>AC/DC power lines (containing the power lines for the servo and spindle motors)</td></tr>
<tr><td>AC/DC solenoid</td></tr>
<tr><td>AC/DC relay</td></tr>
<tr><td rowspan="4">B</td><td>DC solenoid (24VDC)</td><td rowspan="4">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.</td></tr>
<tr><td>DC relay (24VDC)</td></tr>
<tr><td>DI/DO cable between the CNC and power magnetics cabinet</td></tr>
<tr><td>DI/DO cable between the CNC and machine</td></tr>
</table>

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–232–C 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.



3.6.2 Ground

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

(1) Signal ground system (SG)

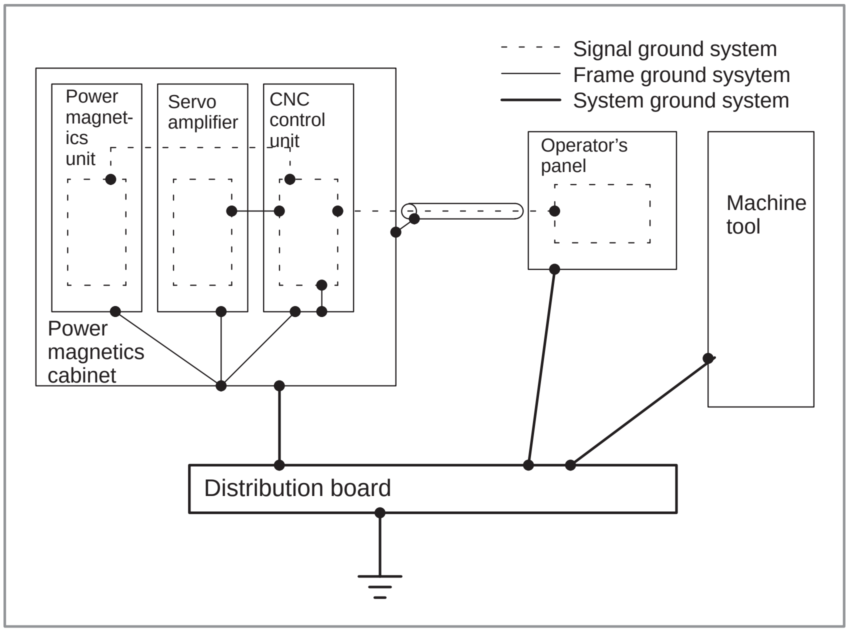
The signal ground (SG) supplies the reference voltage (0 V) of the electrical signal system.

(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

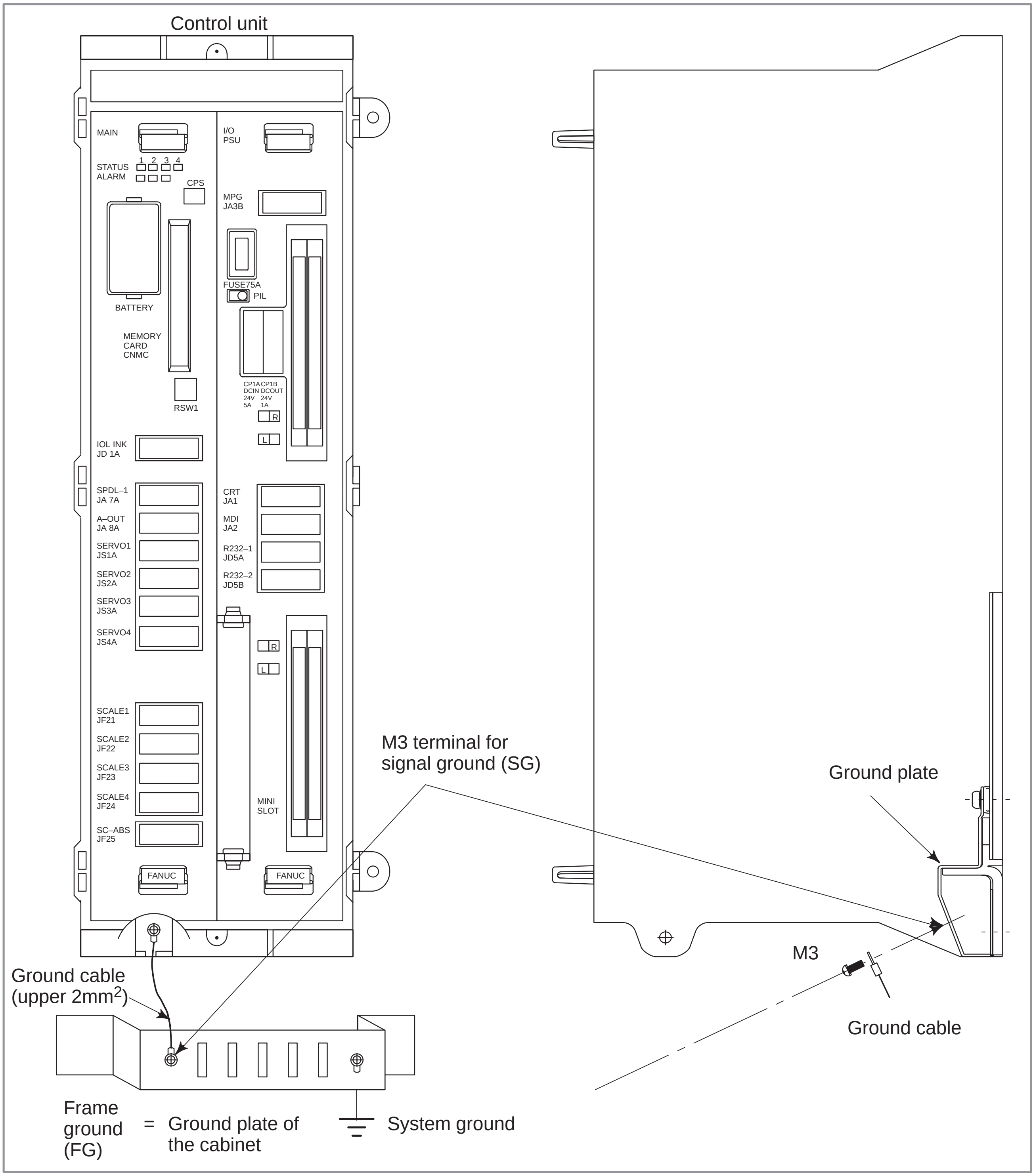
The system ground system is used to connect the frame ground systems connected between devices or units with the ground.



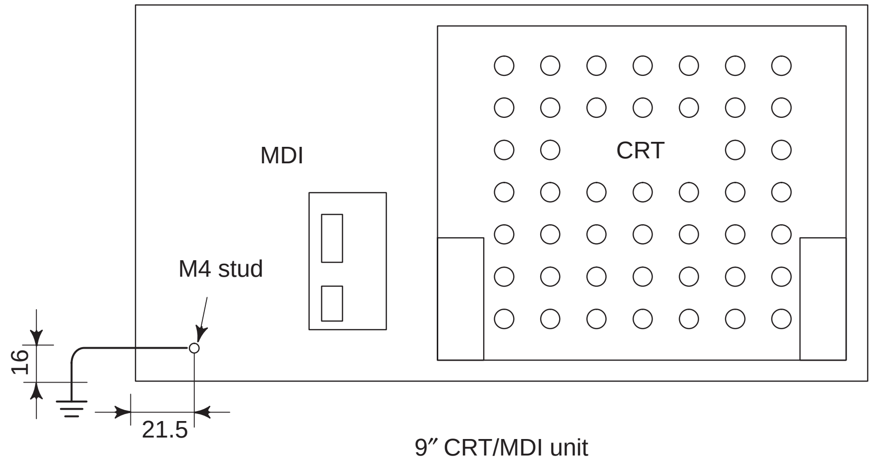
Notes on connecting the ground systems

- 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.

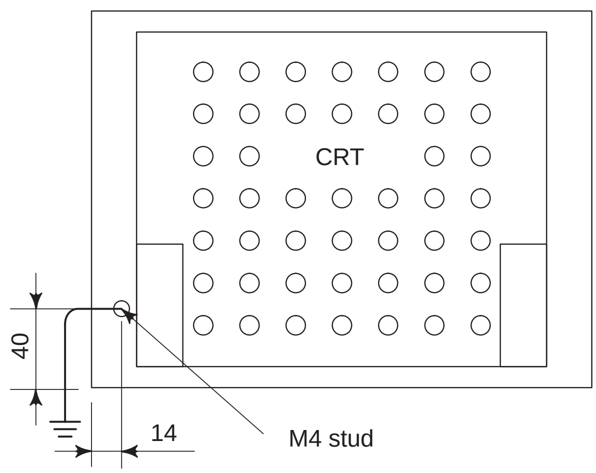
3.6.3 Connecting the Signal Ground (SG) of the Control Unit



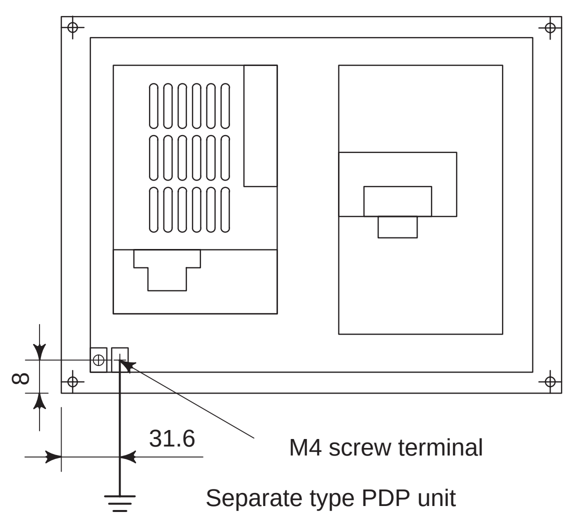
Connect the 0 V line of the electronic circuit in the control unit with the ground plate of the cabinet via the signal ground (SG) terminal.
The SG terminal is located below the main board of the control unit.



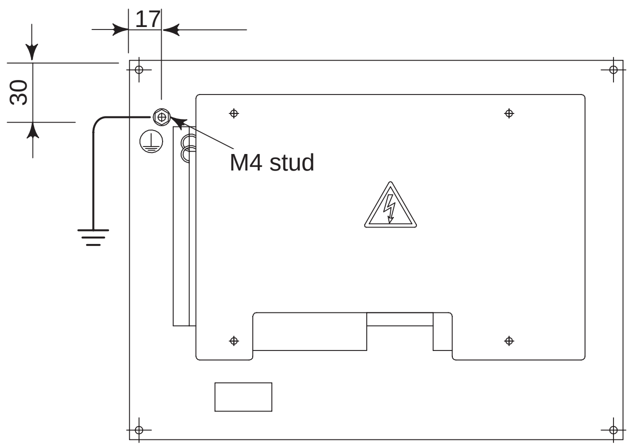
9″ CRT/MDI unit



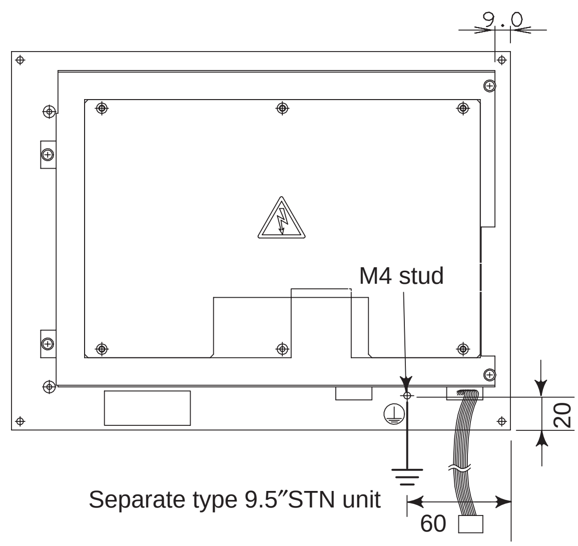
Separate type 9″ CRT unit



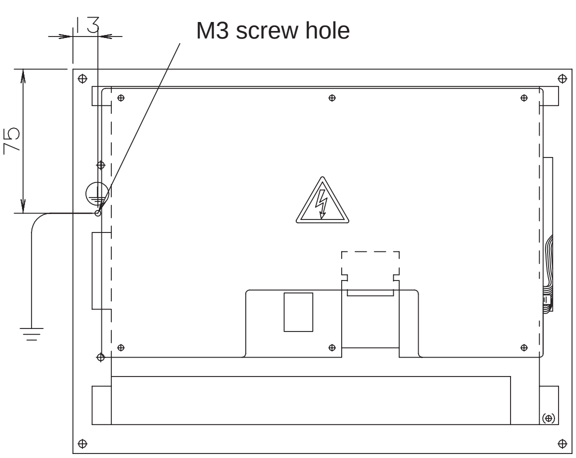
Separate type PDP unit



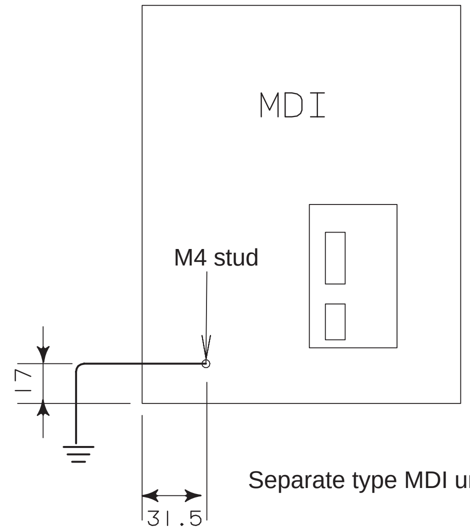
Separate type 7.2″STN unit



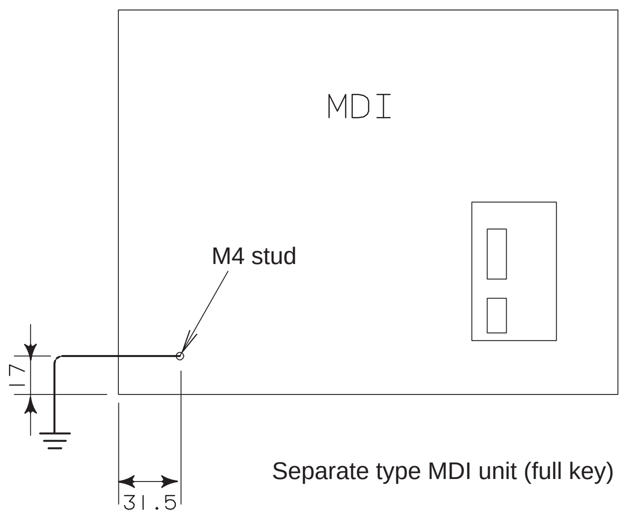
Separate type 9.5″STN unit



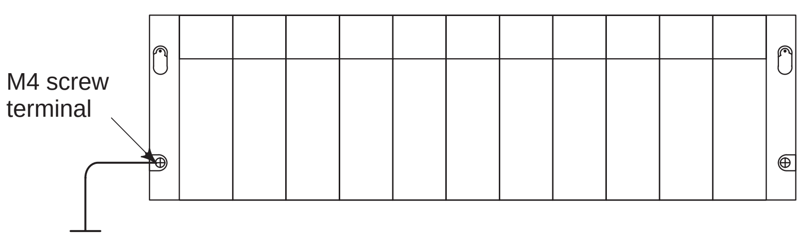
Separate type 8.4″ TFT color LCD unit



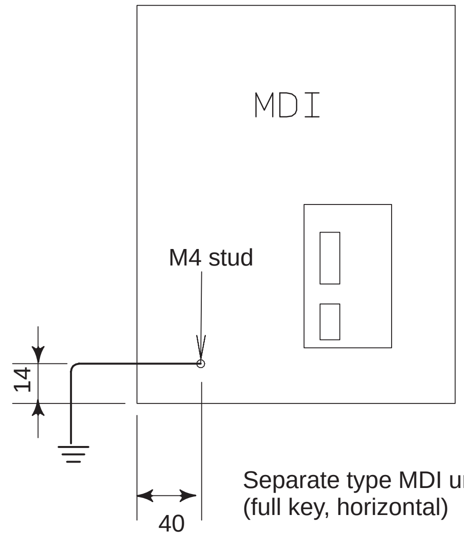
Separate type MDI unit (small type)



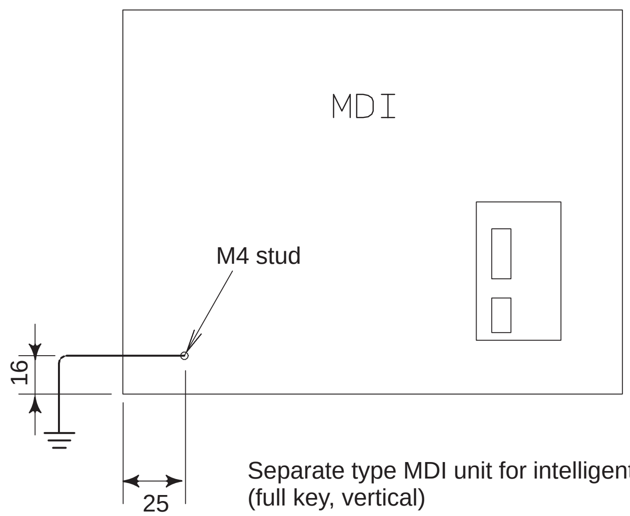
Separate type MDI unit (full key)



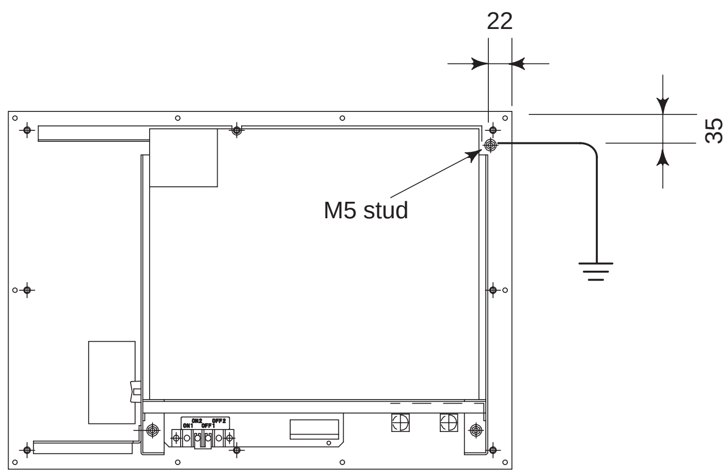
I/O unit



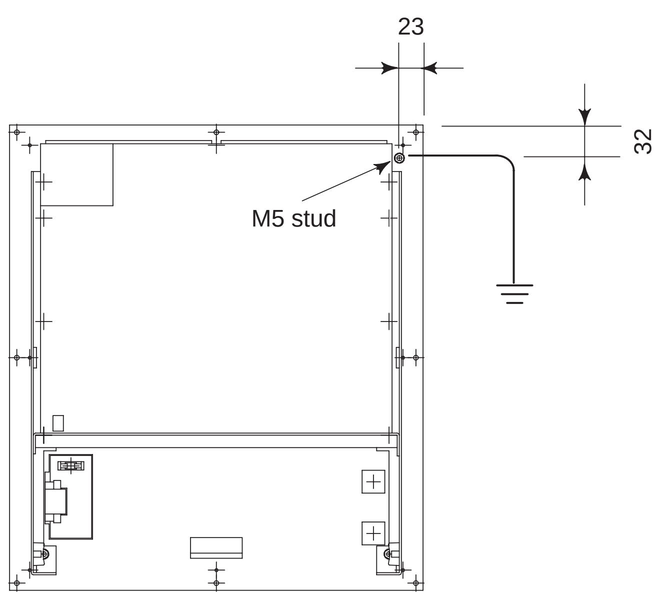
Separate type MDI unit for intelligent terminal
(full key, horizontal)



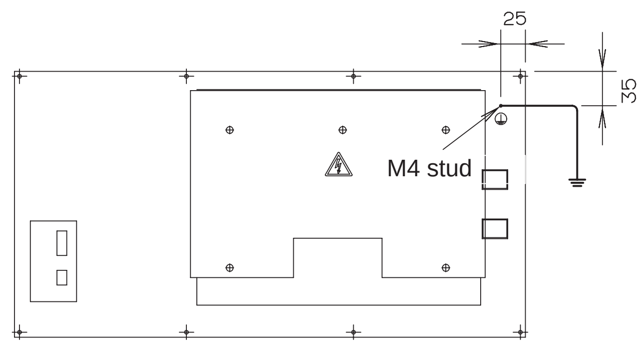
Separate type MDI unit for intelligent terminal
(full key, vertical)



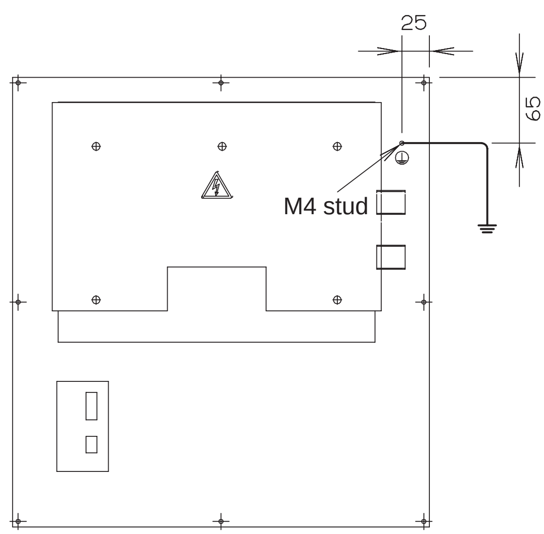
14″CRT/MDI unit (horizontal type)



14″CRT/MDI unit (vertical type)



9.5″TFT/MDI unit (horizontal type)



9.5″TFT/MDI unit (vertical type)

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

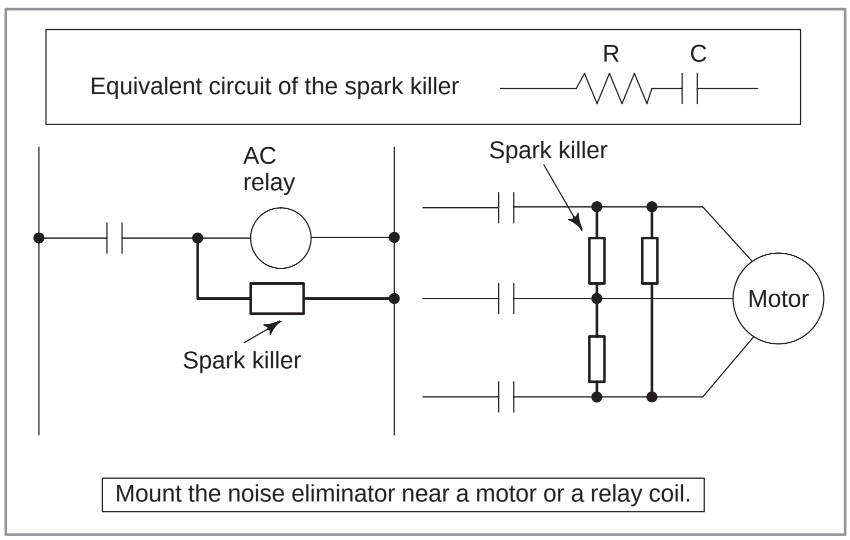
- Use a spark killer consisting of a resistor and capacitor in series. This type of spark killer is called a CR spark killer.(Use it under AC)

  (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:

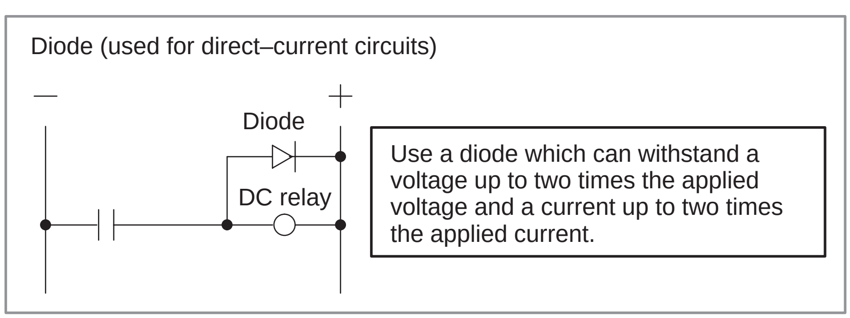
  1) Resistance (R) : Equivalent DC resistance of the coil

  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.



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 :

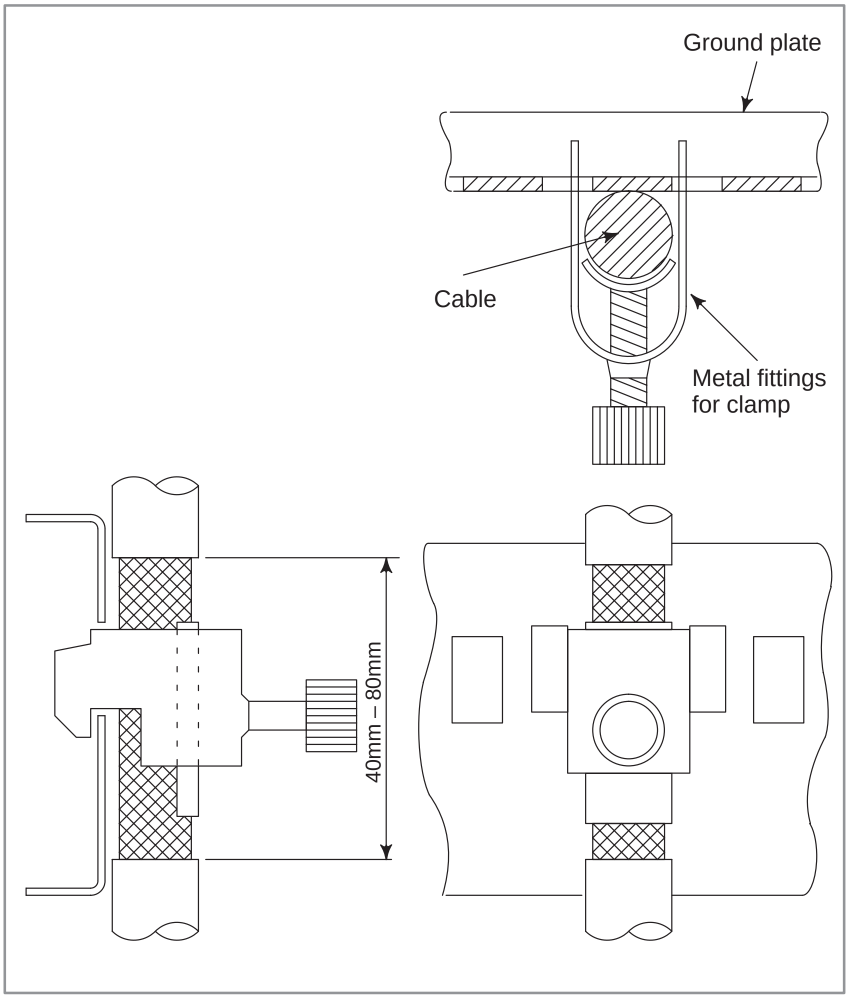


Fig.3.6.5(a) Cable clamp (1)

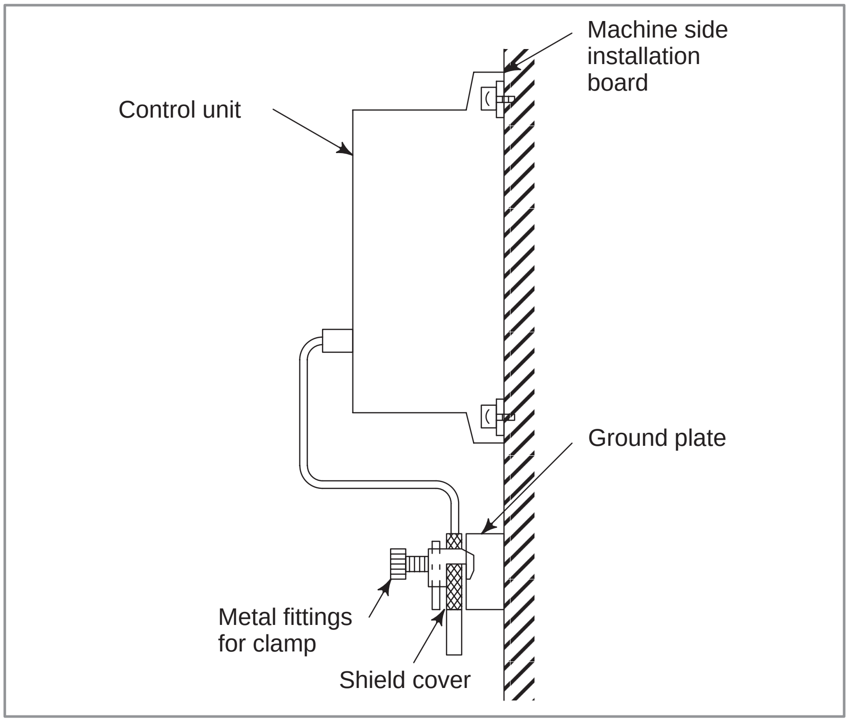


Fig.3.6.5(b) Cable clamp (2)

Prepare ground plate like the following figure.

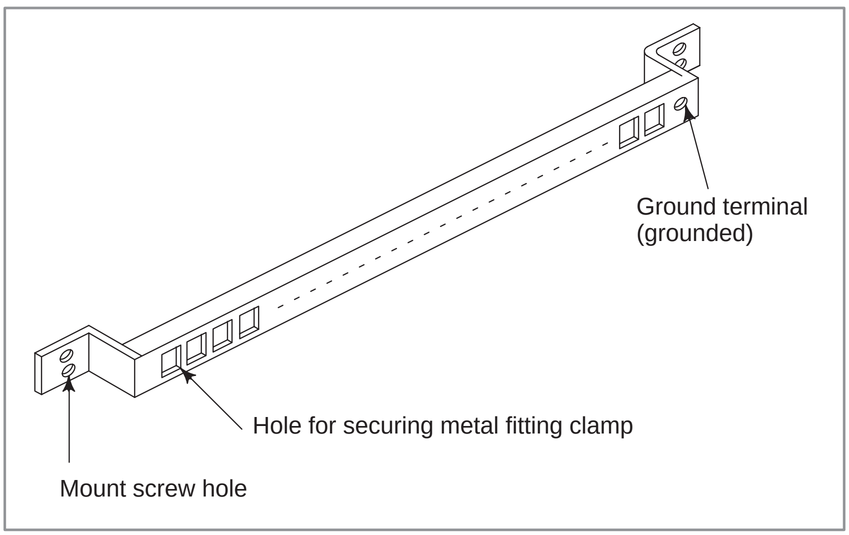


Fig.3.6.5(c) Ground plate

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

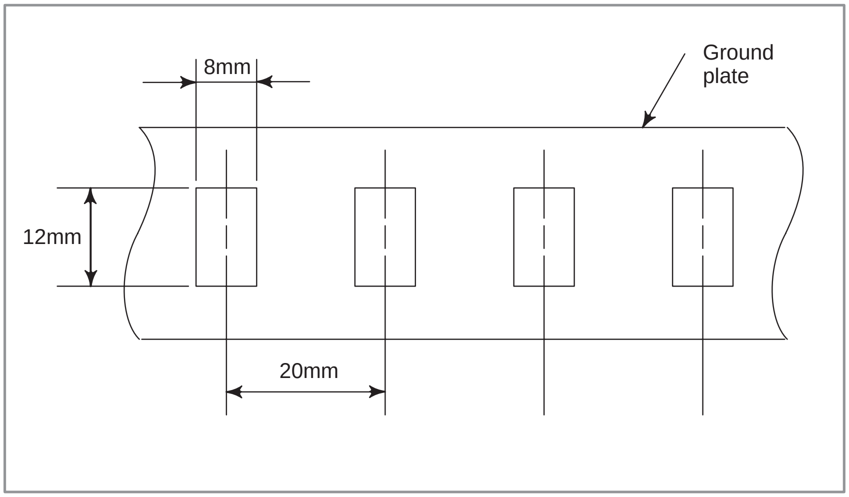


Fig.3.6.5(d) Ground plate holes

(Reference) Outer drawings of metal fittings for clamp.

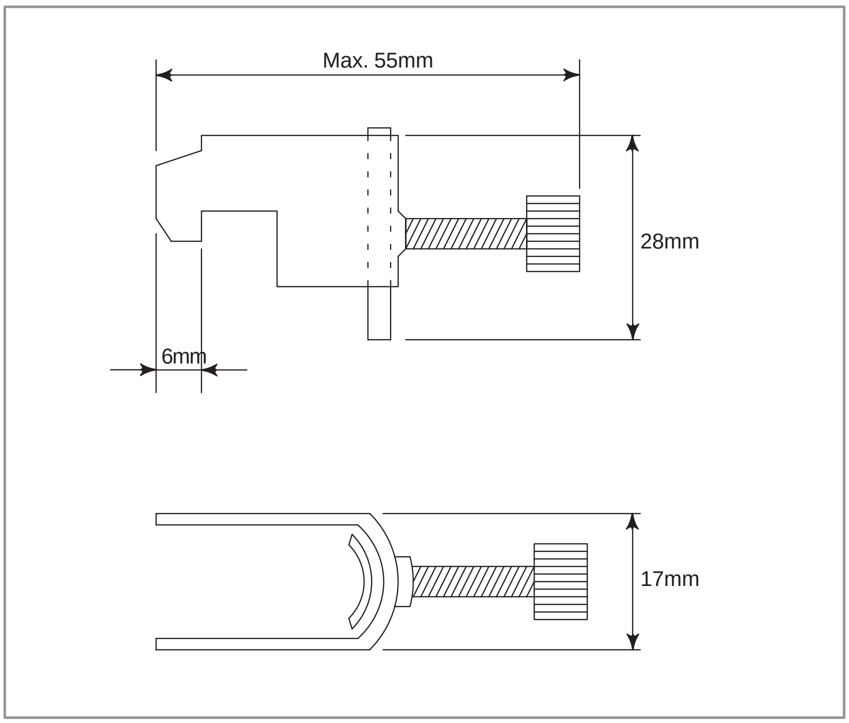


Fig.3.6.5(e) Outer drawings of metal fittings for clamp

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 rack consists of a plastic box, fan motors and a backplane PCB. Since the rack is provided with built–in fan motors, it does not require the external air flow conditions described in Section 3.5. The air comes into the rack from the bottom and goes out through the fan motor, which is located on the top of the rack. Space as shown in Fig. 3.7.1 must be reserved not to disturb the air flow ((A), (B))

The backplane PCB, which is located on the rear side of the rack, interconnects the PCBs installed in the rack. It has another connector which appears at the left side panel of the rack (except for 21–TB control unit). This connector is used for testing the controller, connecting other purposes. The space for this shall be reserved as shown in (c) of Fig. 3.7.1.

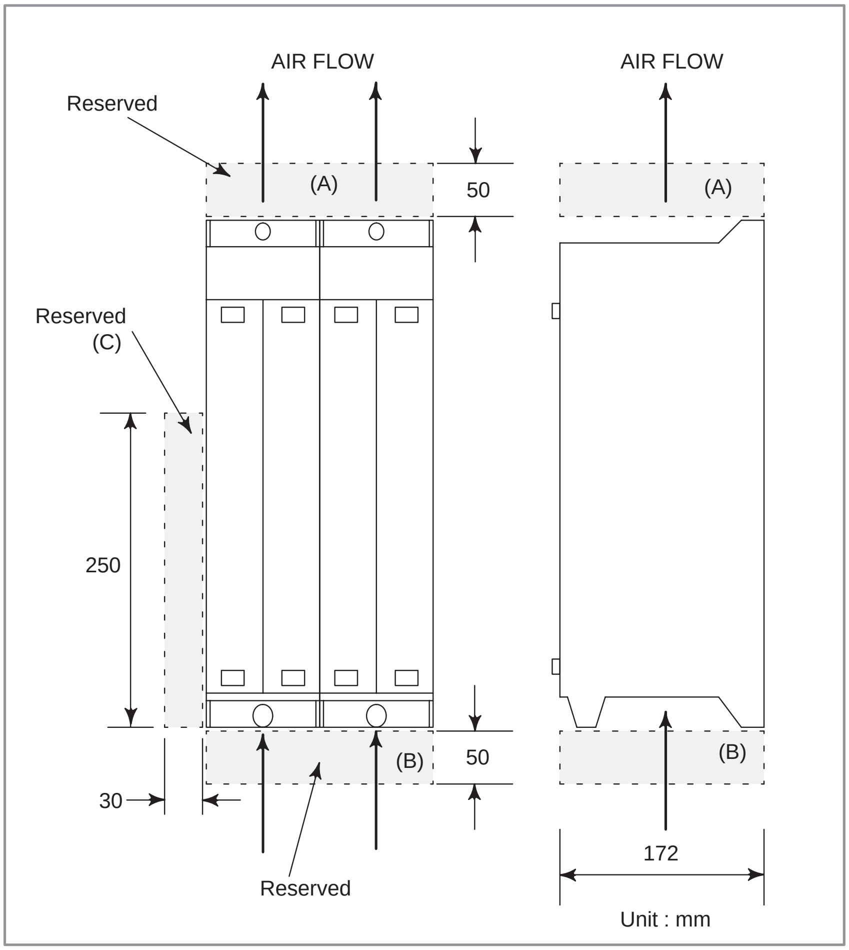


Fig.3.7.1

3.8 CABLE LEAD–IN DIAGRAM

Fig. 3.8 (a) shows the grid of connector location.
Control board may not have all connectors as shown in Fig. 3.8 (a).
For actual connector layout of each board, please see the connector layout diagrams in Fig. 3.9 (a) or later.

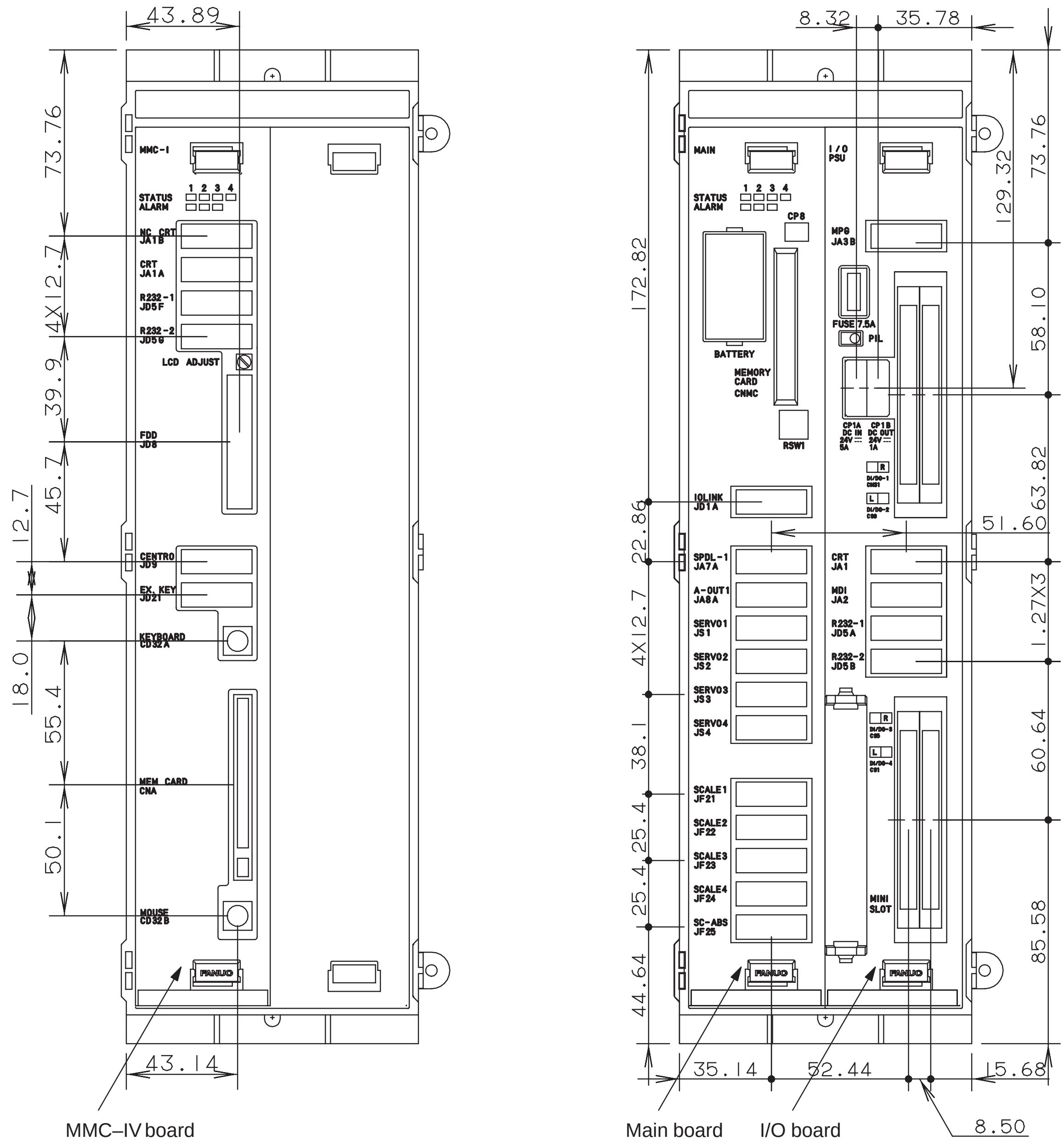


Fig.3.8 (a)

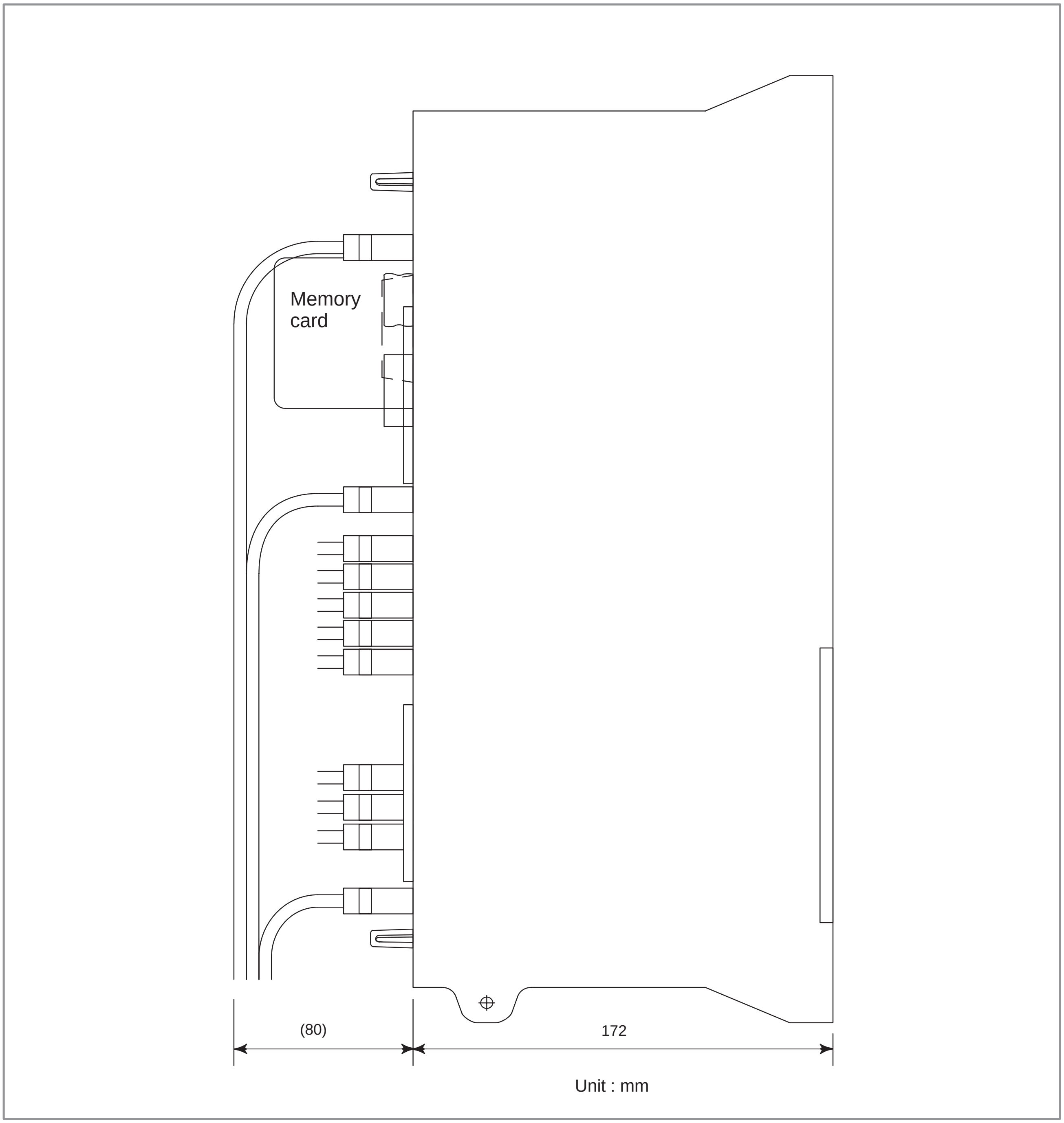
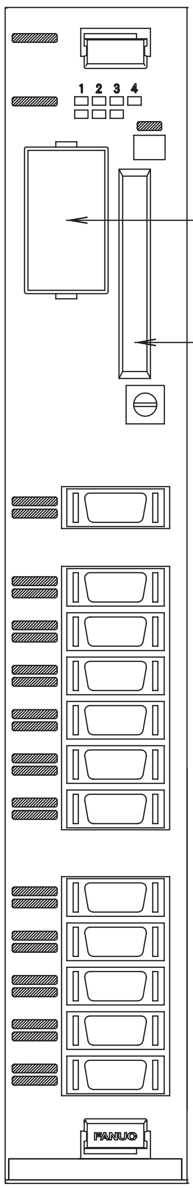


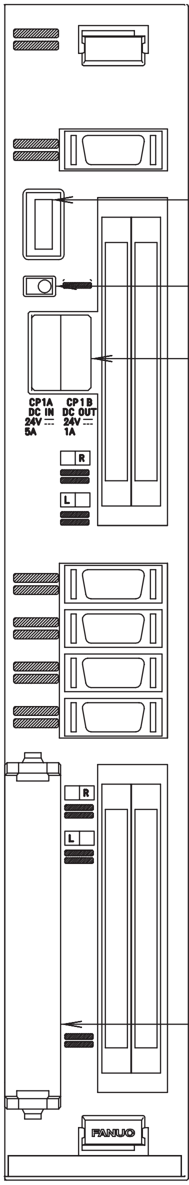
Fig.3.8 (b)

3.9 CONNECTOR LAYOUT DIAGRAM



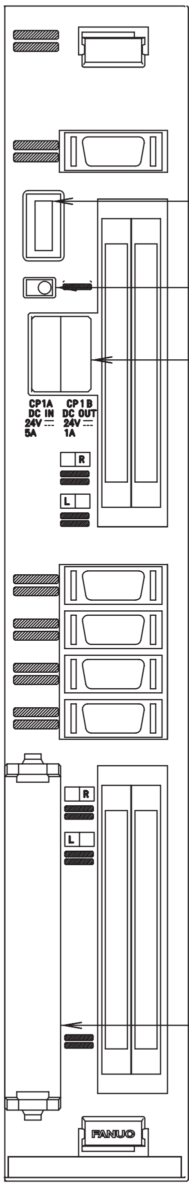
LED display Function	Connector name and comment Upper	 Lower
LED	STATUS/ALARM	
Battery for memory		CPB
Battery	BATTERY	
Memory card	MEMORY/CARD	CNMC
Rotary switch for maintenance		RSW1
Serial I/O Link	IOLINK	JD1A
Serial spindle	SPDL–1	JA7A
Analog output	A–OUT1	JA8A
Servo amp.1	SERVO1	JS1A
Servo amp.2	SERVO2	JS2A
Servo amp.3	SERVO3	JS3A
Servo amp.4	SERVO4	JS4A
Linear scale1	SCALE1	JF21
Linear scale2	SCALE2	JF22
Linear scale3	SCALE3	JF23
Linear scale4	SCALE4	JF24
APC battery for linear scale	SC–ABS	JF25

Fig.3.9 (a) Main board



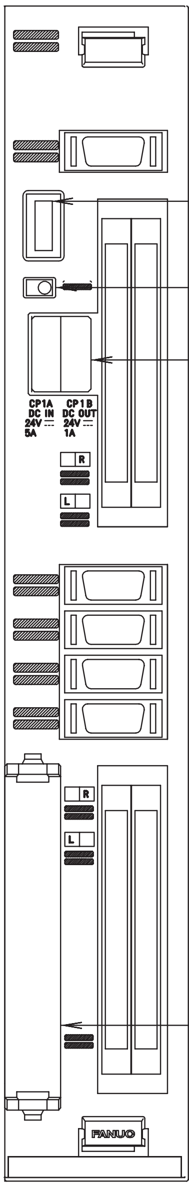
Function	Connector name and comment Upper	Lower
Manual pulse generator	MPG	JA3B
Fuse	FUSE	
Pilot lamp	PIL	
24VDC output (R side)	DC OUT	CP1B
24VDC input (R side)	DC IN	CP1A
Operator's panel I/O (R side)	DI/DO–1	CM31
Operator's panel I/O (L side)	DI/DO–2	C99
CRT display	CRT	JA1
MDI	MDI	JA2
Serial port 1	R232–1	JD5A
Serial port 2	R232–2	
Operator's panel I/O (R side)	DI/DO–3	C95
Operator's panel I/O (L side)	DI/DO–4	C91
Mini slot	MINI/SLOT	

Fig.3.9 (b) I/O board A (for 21/210–MB)



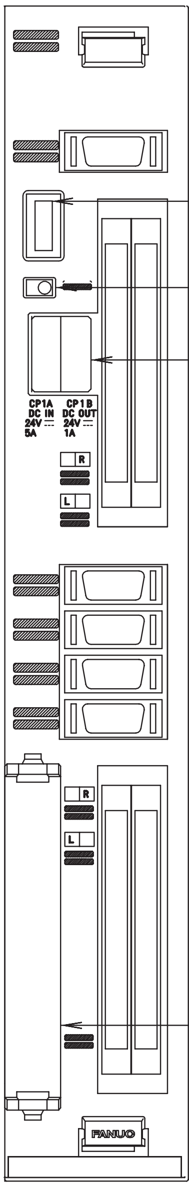
Function	Connector name and comment Upper	Lower
Manual pulse generator	MPG	JA3B
Fuse	FUSE	
Pilot lamp	PIL	
24VDC output (R side)	DC OUT	CP1B
24VDC input (R side)	DC IN	CP1A
Operator's panel I/O (R side)	DI/DO–1	C102
Operator's panel I/O (L side)	DI/DO–2	C103
CRT display	CRT	JA1
MDI	MDI	JA2
Serial port 1	R232–1	JD5A
Serial port 2	R232–2	
Operator's panel I/O (R side)	DI/DO–3	C100
Operator's panel I/O (L side)	DI/DO–4	C101
Mini slot	MINI/SLOT	

Fig.3.9 (c) I/O board B (for 21/210–MB)



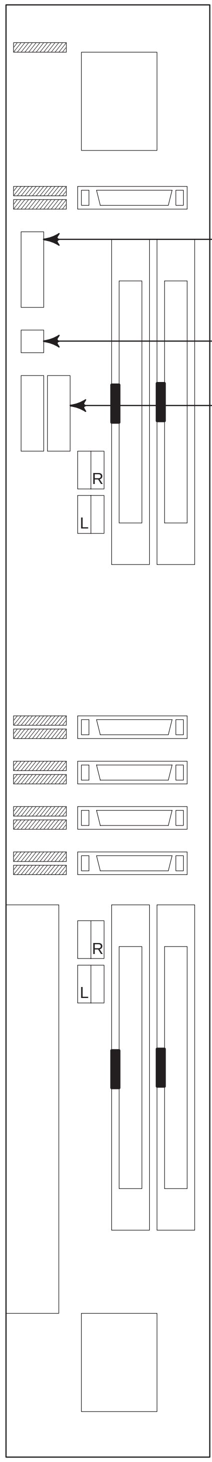
Function	Connector name and comment Upper	Lower
Manual pulse generator	MPG	JA3B
Fuse	FUSE	
Pilot lamp	PIL	
24VDC output (R side)	DC OUT	CP1B
24VDC input (R side)	DC IN	CP1A
Operator's panel I/O (R side)	DI/DO–1	CM31
Operator's panel I/O (L side)	DI/DO–2	CB99
CRT display	CRT	JA1
MDI	MDI	JA2
Serial port 1	R232–1	JD5A
Serial port 2	R232–2	
Operator's panel I/O (R side)	DI/DO–3	CB95
Operator's panel I/O (L side)	DI/DO–4	CB91
Mini slot	MINI/SLOT	

Fig.3.9 (d) I/O board C (for 21/210–MB)



Function	Connector name and comment: Upper	Connector name and comment: Lower
Manual pulse generator	MPG	JA3B
Fuse	FUSE	
Pilot lamp	PIL	
24VDC output (R side)	DC OUT	CP1B
24VDC input (R side)	DC IN	CP1A
Operator's panel I/O (R side)	DI/DO–1	CB126
Operator's panel I/O (L side)	DI/DO–2	CB127
CRT display	CRT	JA1
MDI	MDI	JA2
Serial port 1	R232–1	JD5A
Serial port 2	R232–2	
Operator's panel I/O (R side)	DI/DO–3	CB124
Operator's panel I/O (L side)	DI/DO–4	CB125
Mini slot	MINI/SLOT	

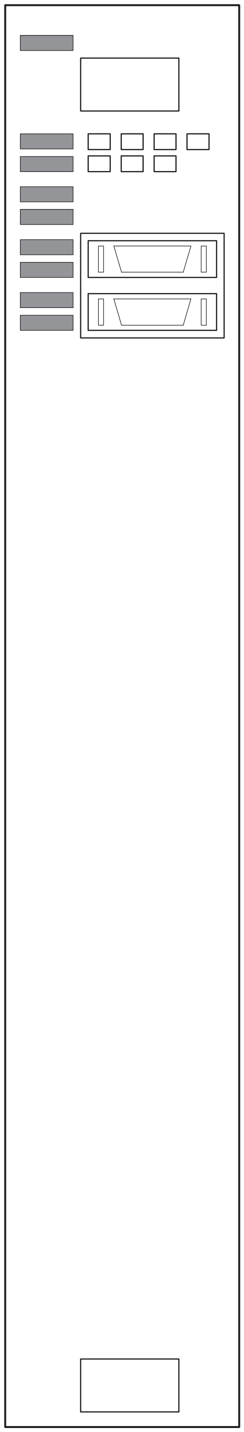
Fig.3.9 (e) I/O board D (for 21/210–MB)



		Connector name and comment	
	Function	Upper	Lower
Position 1	Serial port	R232	JD5
2	Fuse	FUSE	
3			
4	Pilot lamp	PIL	
5	24VDC output (R side)	DC OUT	CP1B
6	24VDC input (L side)	DC IN	CP1A
7	Operator’s panel I/O (R side)	DI/DO–1	CB104
8	Machine side I/O (L side)	DI/DO–2	CB105
9			
10	CRTdisplay	CRT	JA1
11	MDI	MDI	JA2
12	±	±	±
13	Manual pulse generator	MPG	JA3
14			
15	Machine side I/O (R side)	DI/DO–3	CB106
16	Machine side I/O (L side)	DI/DO–4	CB107
17			
18			
19			
20			
21			

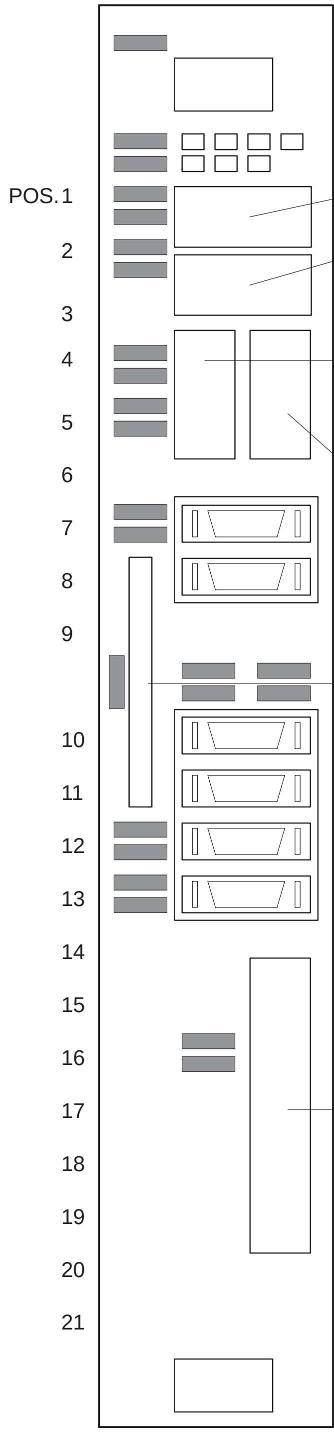
Fig.3.9 (f) I/O board (for 21/210–TB)

Remote buffer function



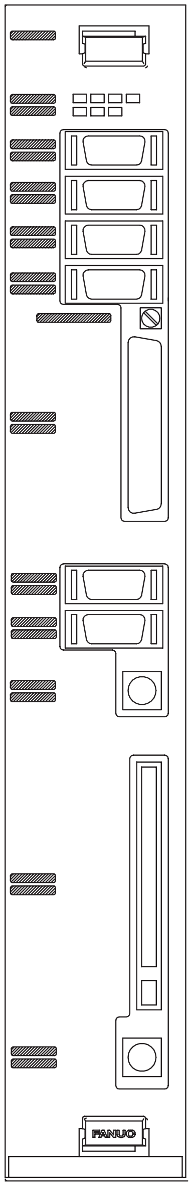
Function	Connector name and comment Upper	Lower
LED INDICATORS	STATUS/ALARM	
RS232C PORT3	R232-3	JD5C
RS422 PORT1	R422-1	JD6A

Fig.3.9 (g) Option 1 board



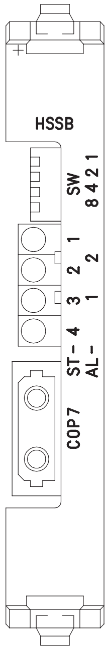
Function	Connector name and comment Upper	Lower
LED INDICATOR	STATUS/ALARM	
BRAKE DRIVE OUTPUT	BRAKE	CNBK
EMERGENCY STOP CONTROL	ESP	CNPW
OPERATOR'S PANEL INTERFACE	TP	CNTP
WORKPIECE FEEDER	WF	CNWF
SERIAL I/O LINK	IOLNK	JD1A
SERVO CHECK	CHECK	JA8C
MEMORY CARD		CNMC
SERVO AMP 1	AMP1	JS1A
SERVO AMP 2	AMP2	JS2A
SERVO AMP 3	AMP3	JS3A
SERVO AMP 4	AMP4	JS4A
DI/DO	RDIO	CRM1

Fig.3.9 (h) Loader control board



Function	Connector name and comment Upper	Lower
LED display	STATUS/ALARM	
NC video signal input	NC CRT	JA1B
Video signal output	CRT	JA1A
Serial port 1	R232–1	JD5F
Serial port 2	R232–2	JD5G
LCD adjustment		LCD ADJUST
Floppy disk drive unit	FDD	JD8
Parallel port	CENTRO	JD9
Extension key board	EX KEY	JD21
Full key board	KEYBOARD	CD32A
Memory card (PCMCIA)	MEM CARD	CNA
Mouse	MOUSE	CD32B

Fig.3.9 (i) MMC–IV board



Function	Comment
Mode switch	SW
LED display	ST– 4 3 2 1 AL– 1 2
High–speed serial bus interface	COP7

Fig.3.9 (j) High–speed serial bus interface board

4 POWER SUPPLY CONNECTION

4.1 GENERAL

This section explains the connection of power supply for Series 21/210 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 21/210 from an external sources.

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

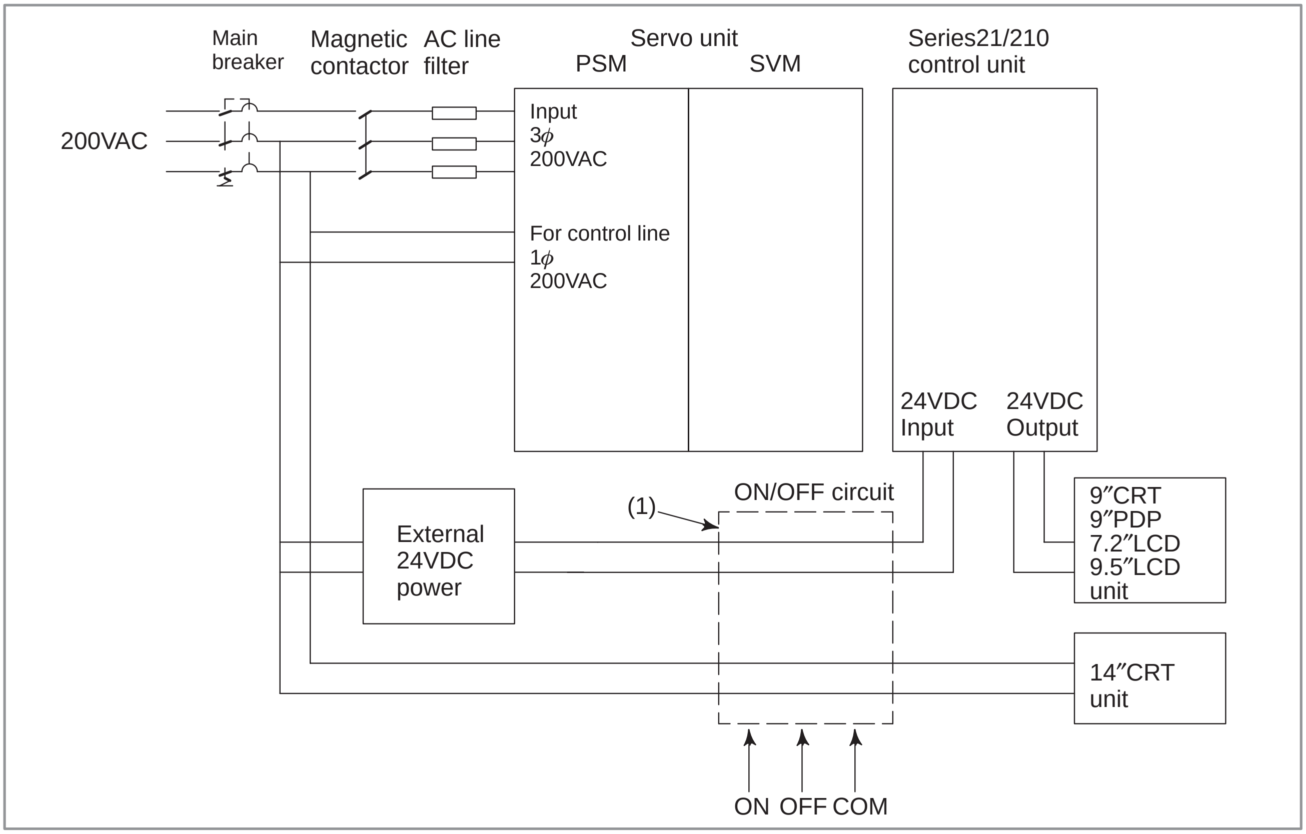


Fig.4.2.1 (a)

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.

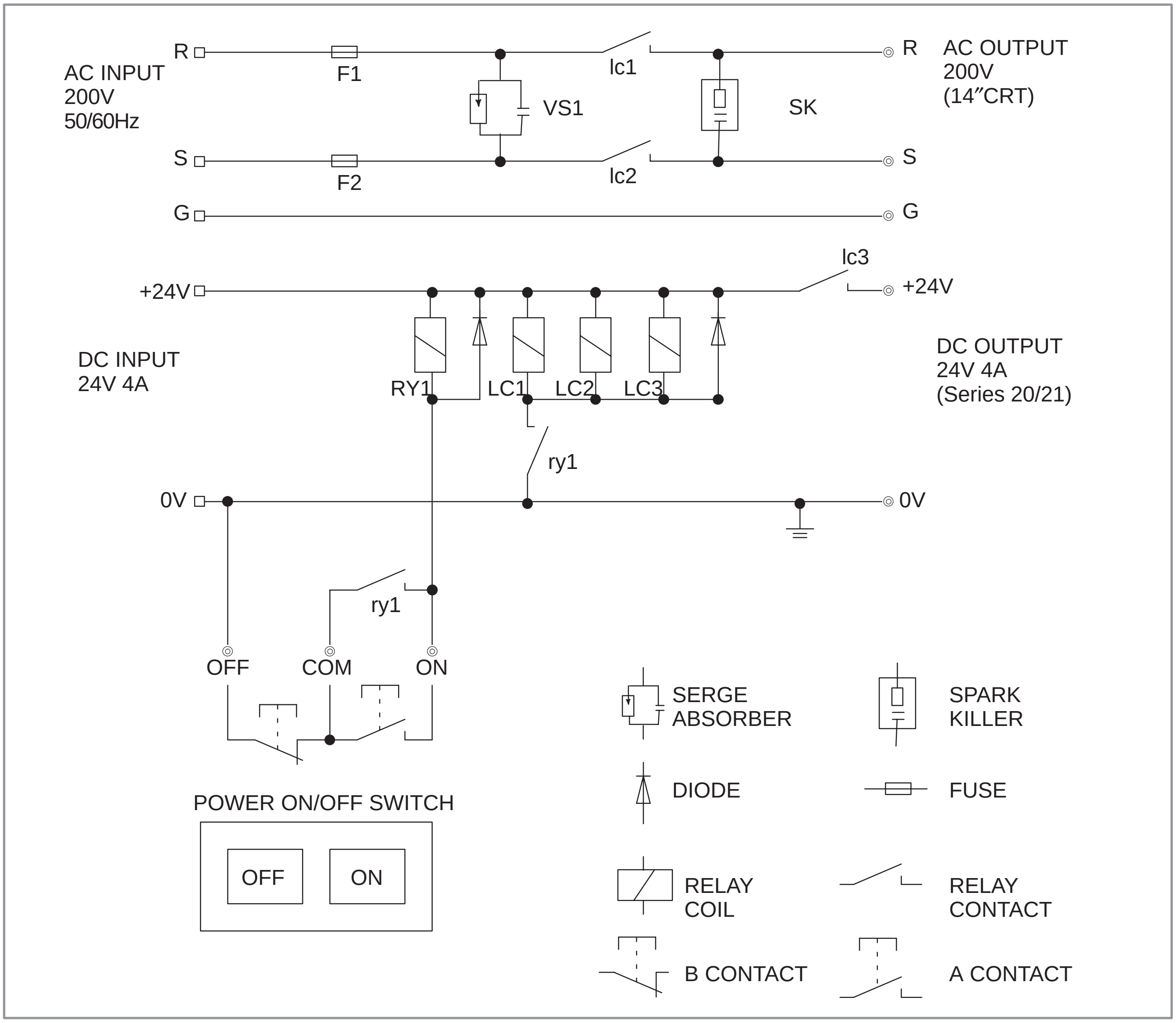


Fig.4.2.1 (b)

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.

CAUTION
(Except for 21–TB control unit A)
The maintenance rotary switch must be always set to 0 (set to 0 at shipping from factory).
Changing this setting may cause the contents of memory to be lost.

4.2.3 Procedure for Turning Off the Power

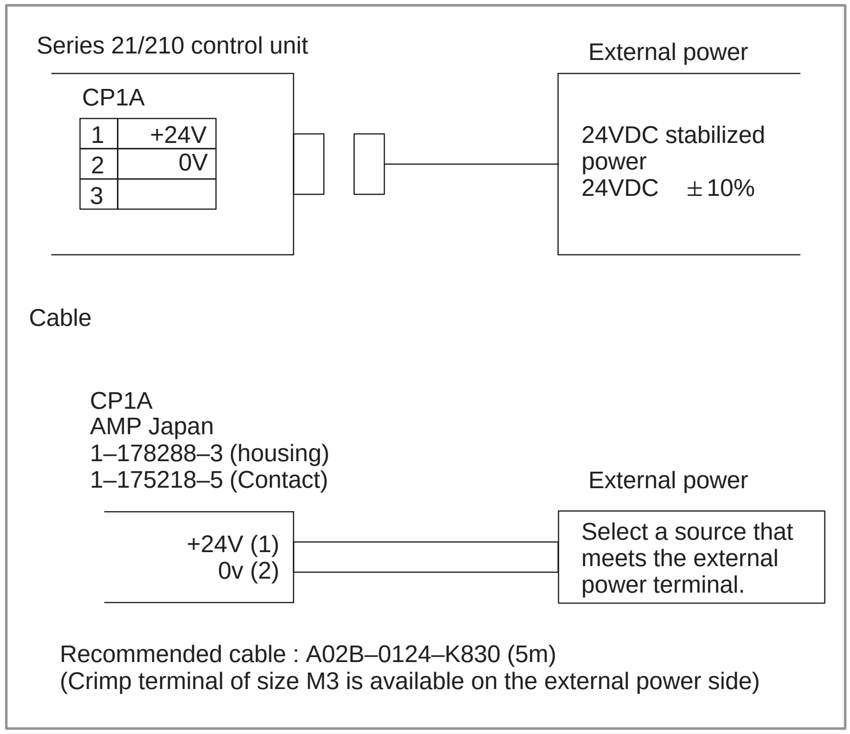
Turn off the power to each unit in the following order or all at the same time.

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.



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 power to the control unit must be turned on when the battery is replaced. If the battery is disconnected when the power is turned off, the contents of memory are lost.
Observe the following precautions for lithium batteries:

WARNING
If an unspecified battery is used, it may explode.
Replace the battery only with the specified battery (A02B–0177–K106.)

Dispose of used batteries as follows:

(1) Small quantities

Discharge the batteries and dispose of them as ordinary nonflammable garbage.

(2) Large quantities

Consult FANUC.

Replacing the battery

1 Use a litium battery (ordering drawing number : A02B–0177–K106)

2 Turn on the Series 21/210.

3 Remove the battery case from the front panel of the power supply unit. The case can be removed easily by holding the top and bottom of it and pulling.

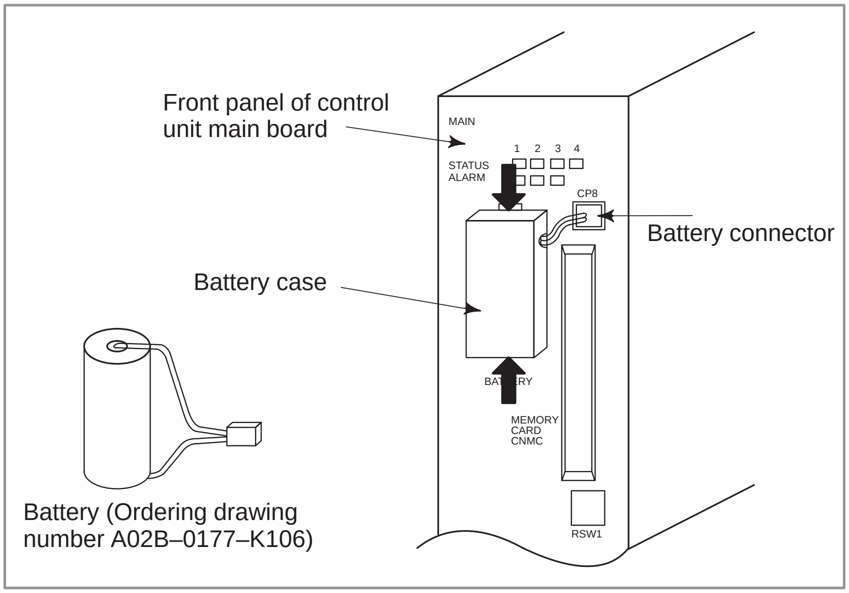


Fig.4.4.1(a) Replacing the battery(1)

4 Remove the connector from the battery.

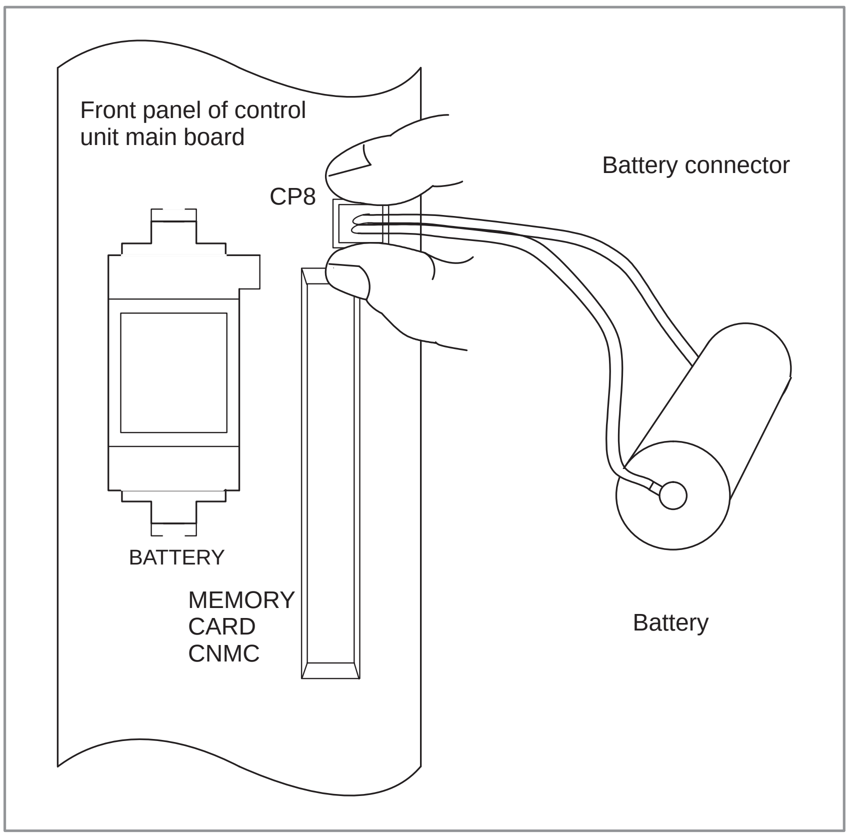


Fig.4.4.1(b) Replacing the battery(2)

5 Replace the battery and reconnect the connector.
6 Install the battery case.
7 Turn off the Series 21/210.

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 Subsec. 7.1.3 for connecting the battery for separate absolute pulse coders.

5 CONNECTION TO CNC PERIPHERALS

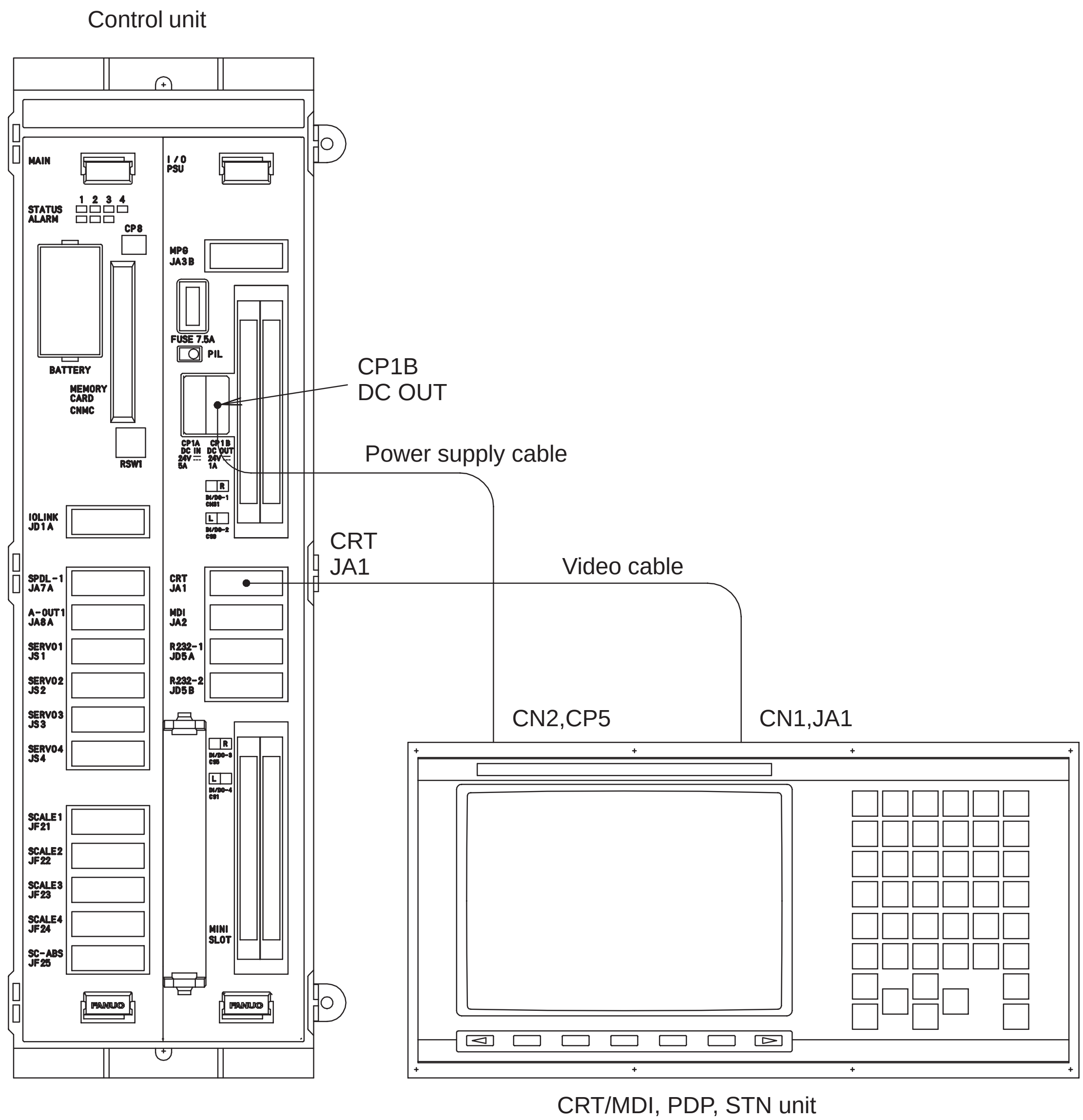
5.1 CONNECTION TO THE DISPLAY UNIT

5.1.1 Outline

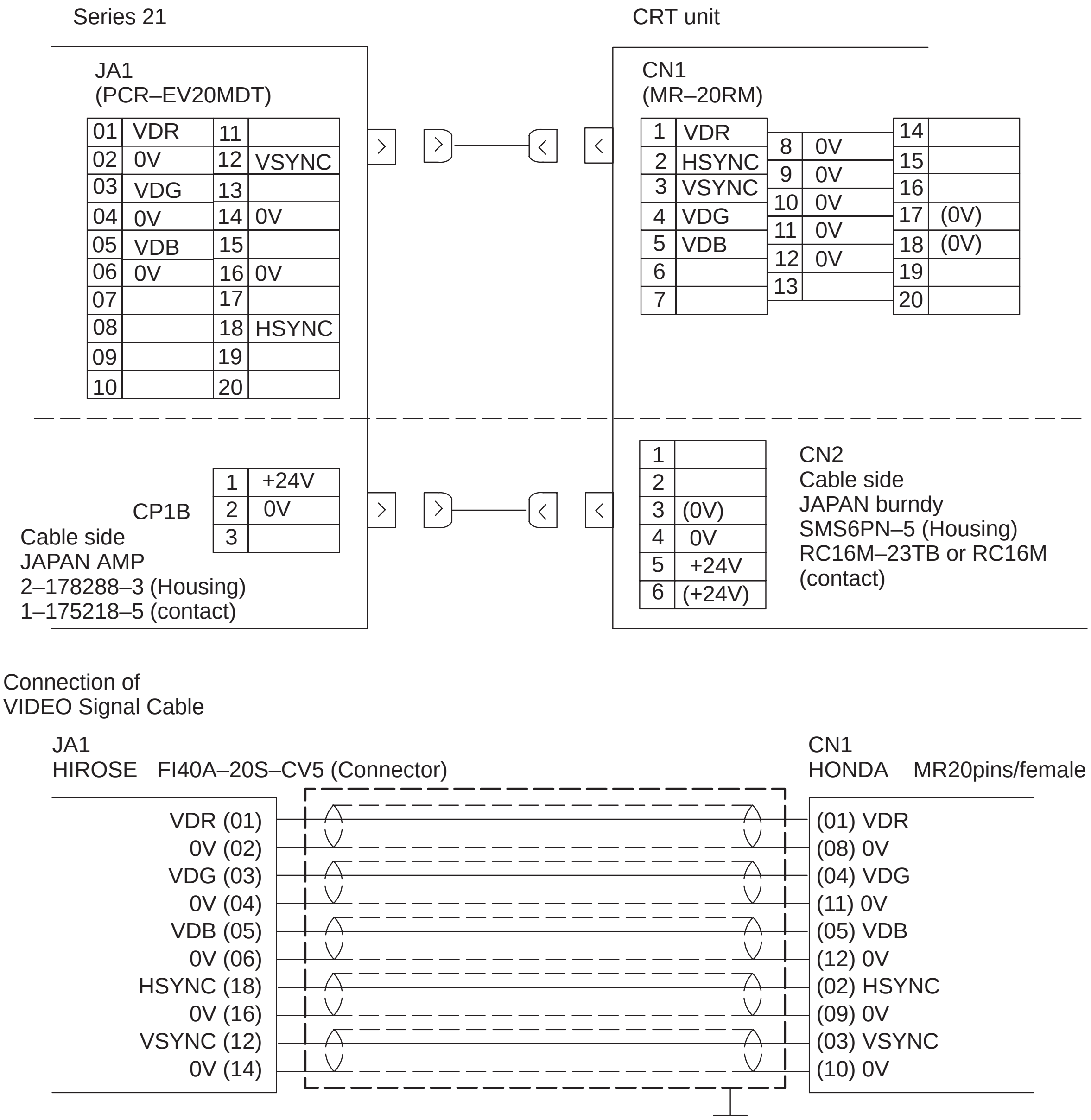
The display unit is used for displaying the programs, parameters etc, and supporting the machine operation.
The Series 21 supports the following display units: 9″ CRT, 9″ plasma display (PDP), 7.2″ STN, and 9.5″STN.
The Series 210 supports the following display units: 14″ CRT and 9.5″ TFT.
See Section 13.1 for an explanation of how to connect a display unit to the Series 210.

5.1.2 Connection to Display Unit

Connection to Series 21

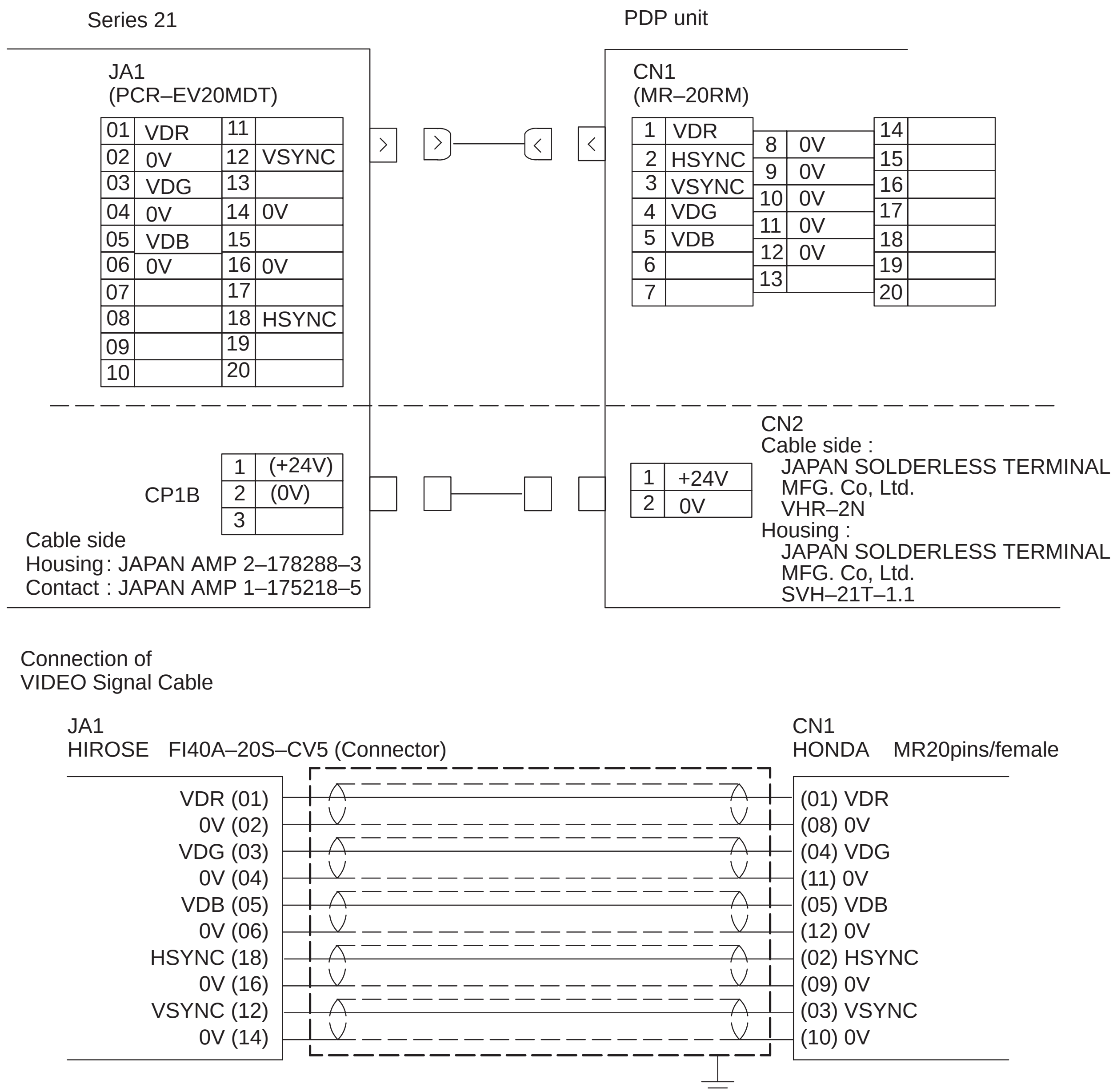


5.1.3 9″ CRT Display Unit Interface



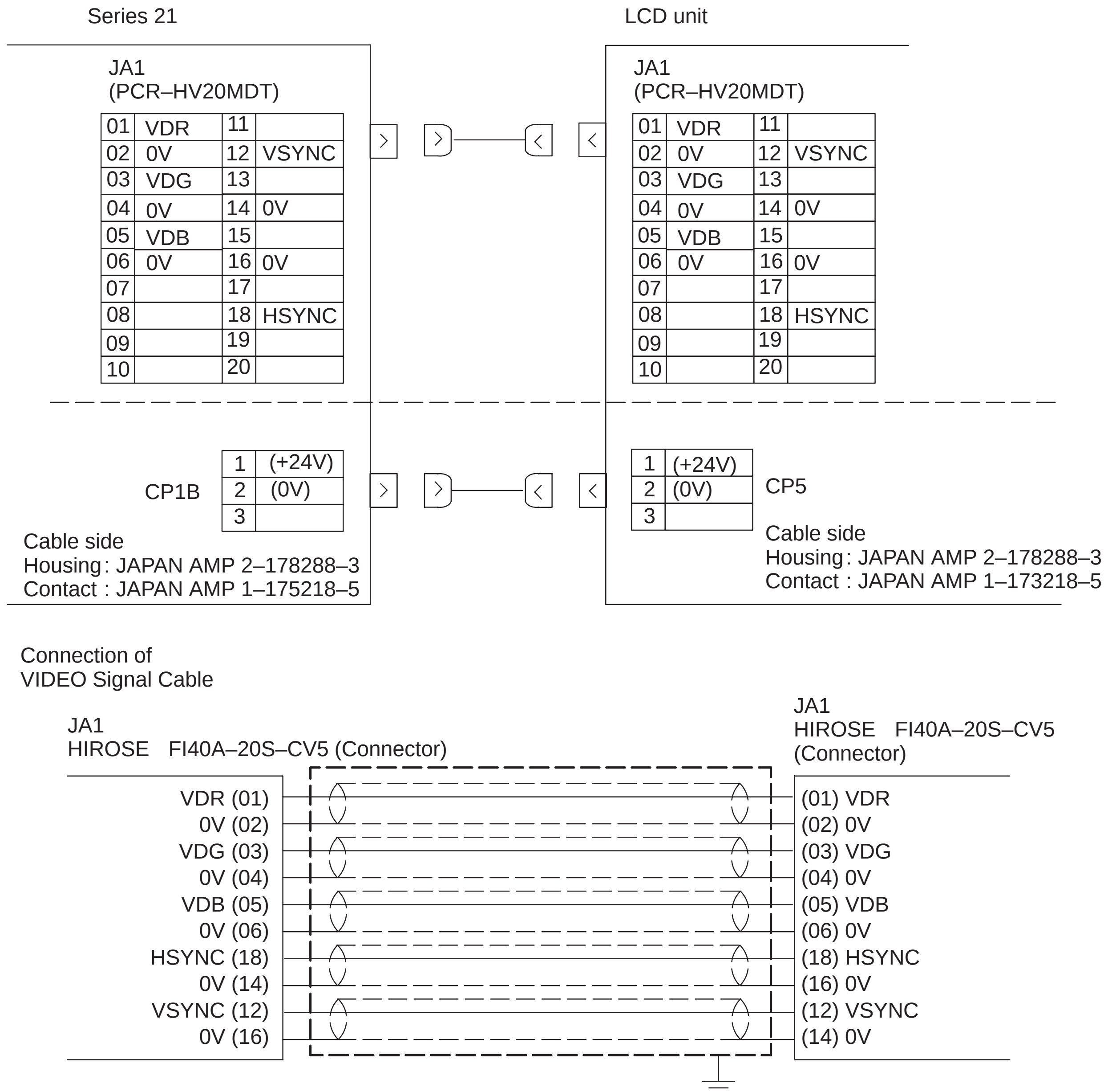
RECOMMENDED CABLE MATERIAL
A66L–0001–0371 COAXIAL CABLE (MAX : 50m)
RECOMMENDED CABLE MATERIAL
A02B–0120–K819 CRT VIDEO SIGNAL CABLE (5m)

5.1.4 9″ PDP Display Unit Interface



RECOMMENDED CABLE MATERIAL
A66L–0001–0371 COAXIAL CABLE (MAX : 50m)
RECOMMENDED CABLE MATERIAL
A02B–0120–K819 CRT/PDP VIDEO SIGNAL CABLE (5m)

5.1.5 Varied LCD Units Interface



RECOMMENDED CABLE MATERIAL
A66L–0001–0371 COAXIAL CABLE (MAX : 50m)
RECOMMENDED CABLE MATERIAL
A02B–0120–K818 LCD/VIDEO SIGNAL CABLE (5m)

5.1.6 Adjusting the Flat Display

Fine adjustment of the video signal is supported to enable its use with color liquid crystal displays and plasma displays. This adjustment is necessary to compensate for errors resulting from the combination of NC devices and cables.
Adjustment of the video signal is necessary if you have replaced the display unit, cable, or a hardware component of the display circuit in the NC, either as part of regular field maintenance or to correct a failure.

Applied unit

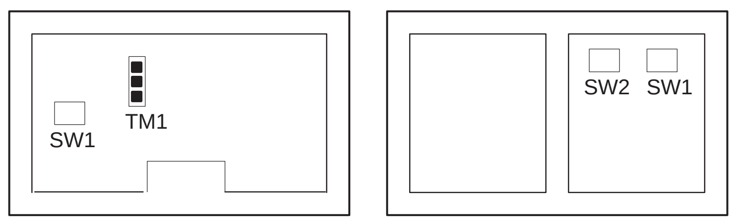
- Analog LCD

Name	Specification number
9.5″ color TFT/MDI unit (For Series 210 with MMC–IV)	A02B–0200–C065#□□□ A02B–0200–C066#□□□ (□□□ : Arbitrary number)

- PDP

Name	Specification number
Separate type 9″ PDP unit	A02B–0200–C1000

Locations of switches and jumper pins



Color liquid crystal display (rear view) Plasma display (rear view)

Adjustment

● Eliminating flicker

- Analog color liquid crystal display: Jumper pin TM1
  Change the jumper pin to another side.
  Normally one of these settings will eliminate flicker.
- Plasma display: Switch SW1
  1 Change the jumper pin and search for a range such that flicker is eliminated. .
  2 If you find that flicker is eliminated by two or more different settings, select the setting approximating to the midpoint of those settings.
  Example : If flicker is eliminated by all of settings 2 to 6, select 4.

● Adjusting the horizontal position

- Analog color liquid crystal display : Switch SW1
- Plasma display : Switch SW2
  1 The screen can be shifted horizontally in units of dots.
  2 Adjust the horizontal position such that the entire screen is visible. Only one setting can successfully realize this positioning.

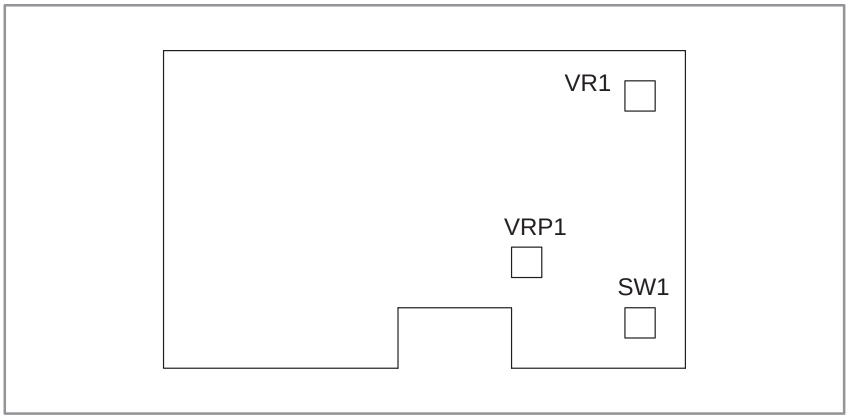
> **CAUTION**
> Do not attempt to change any controls or settings other than those described above.

5.1.7 Adjusting the STN Monochrome LCD

(1) Applied unit

Name	Specification number
Separate type 7.2″ STN monochrome LCD unit	A02B–0200–C081
Separate type 9.5″ STN monochrome LCD unit	A02B–0200–C115

(2) Adjustment point (as viewed from the rear of the display unit)



(3) Adjustment method

(a) Display mode and horizontal setting
The mode and horizontal position of the display can be set as listed below, using SW1. When inverted, text is displayed in black against a white background.
The standard setting is 9.

Mode		8–level gray scale	4–level gray scale	Inverted 8–level gray scale	Inverted 4–level gray scale
Horizontal position	Shifted one dot to the right	0	4	8	C
	Standard	1	5	9	D
	Shifted one dot to the left	2	6	A	E
	Shifted two dots to the left	3	7	B	F

(b) Contrast control
The contrast of the display is adjusted using VRP1.

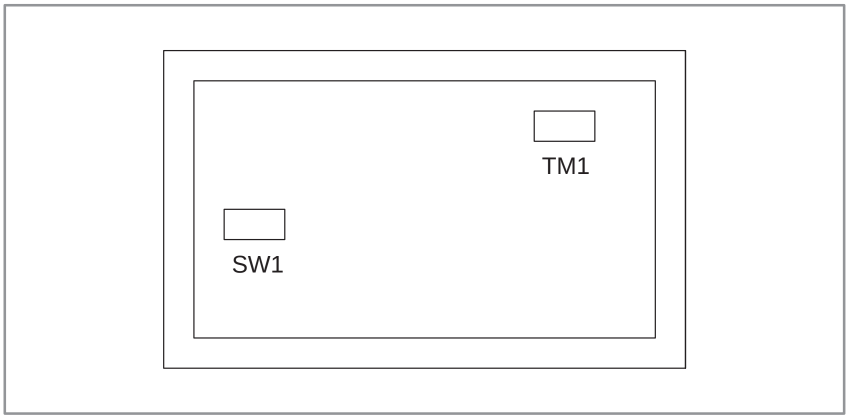
(c) Flicker adjustment
Flicker is eliminated using VR1. Do not change the VR1 setting when no flicker is evident.

5.1.8 Adjusting the TFT Color LCD

(1) Applied unit

Name	Specification number
Separate type 8.4″ TFT color LCD unit	A02B–0218–C050

(2) Adjustment point (as viewed from the rear of the display unit



(3) Adjustment method

(a) Display horizontal setting

- The horizontal position of the display is set as described below, using SW1. Rotating SW1 one notch in the positive (+) direction shifts the display one dot to the right. Rotating SW1 one notch in the negative (–) direction shifts the display one dot to the left.
- Set SW1 such that the entire display is visible. There is only one optimum setting position.

(b) Flickering adjustment

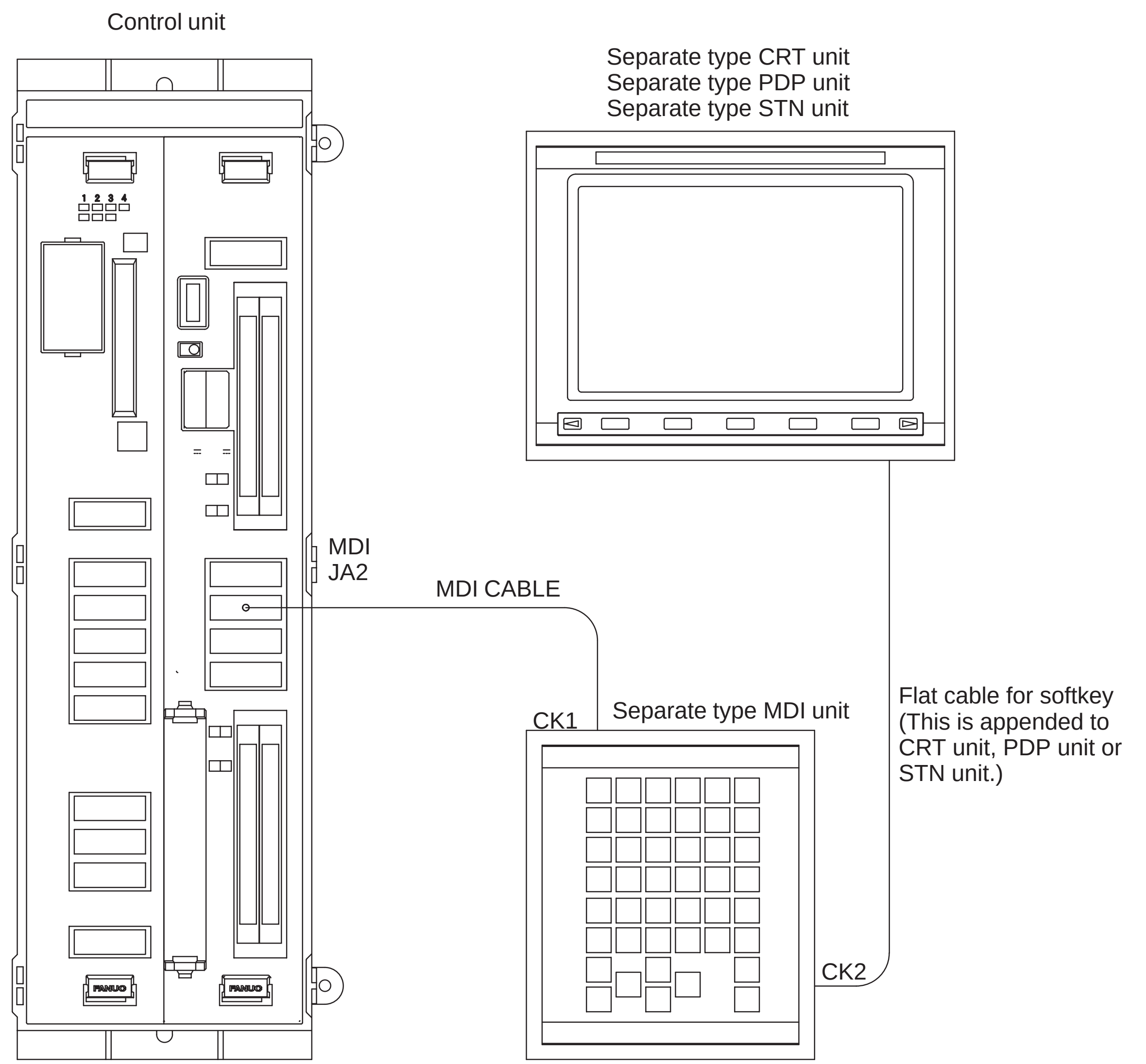
Flickering is eliminated by setting jumper pin TM1. One side of TM1 is marked A, while the other side is marked B. TM1 is factory–set to the B position. If the screen flickers, set TM1 to the A position.

5.2 CONNECTION OF MDI UNIT

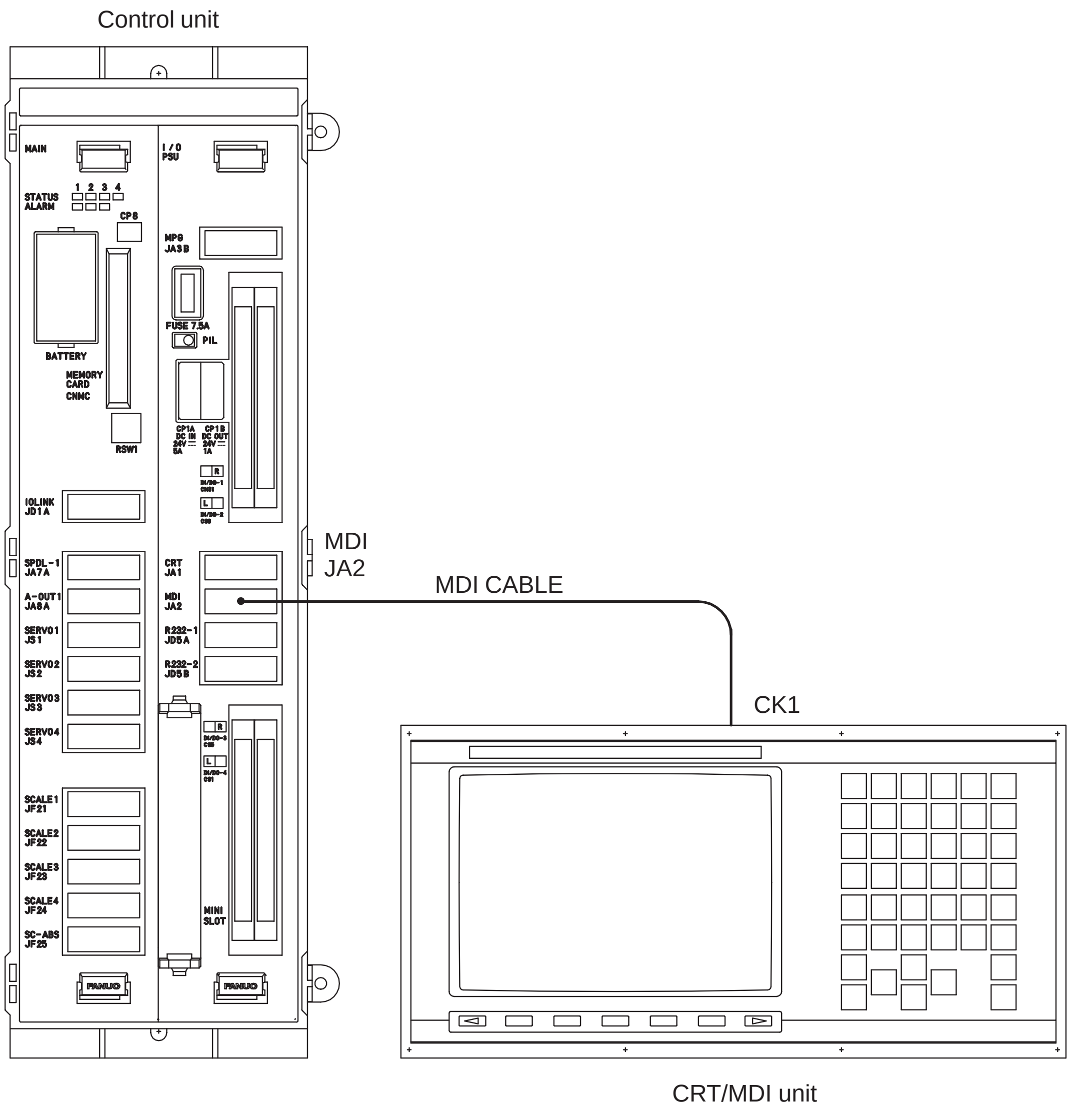
5.2.1 General

Manual data input devices for the Series 21 are called MDI units. MDI units are keyboards used to enter data such as CNC programs and parameters into the CNC.
Various standard MDI units are provided for each model of the Series 21.

5.2.2 Connection to the MDI Unit



Connection to the separate type MDI



Connection to the MDI

5.2.3 Connection to the Standard MDI Unit

Series 21/210 control unit

JA2

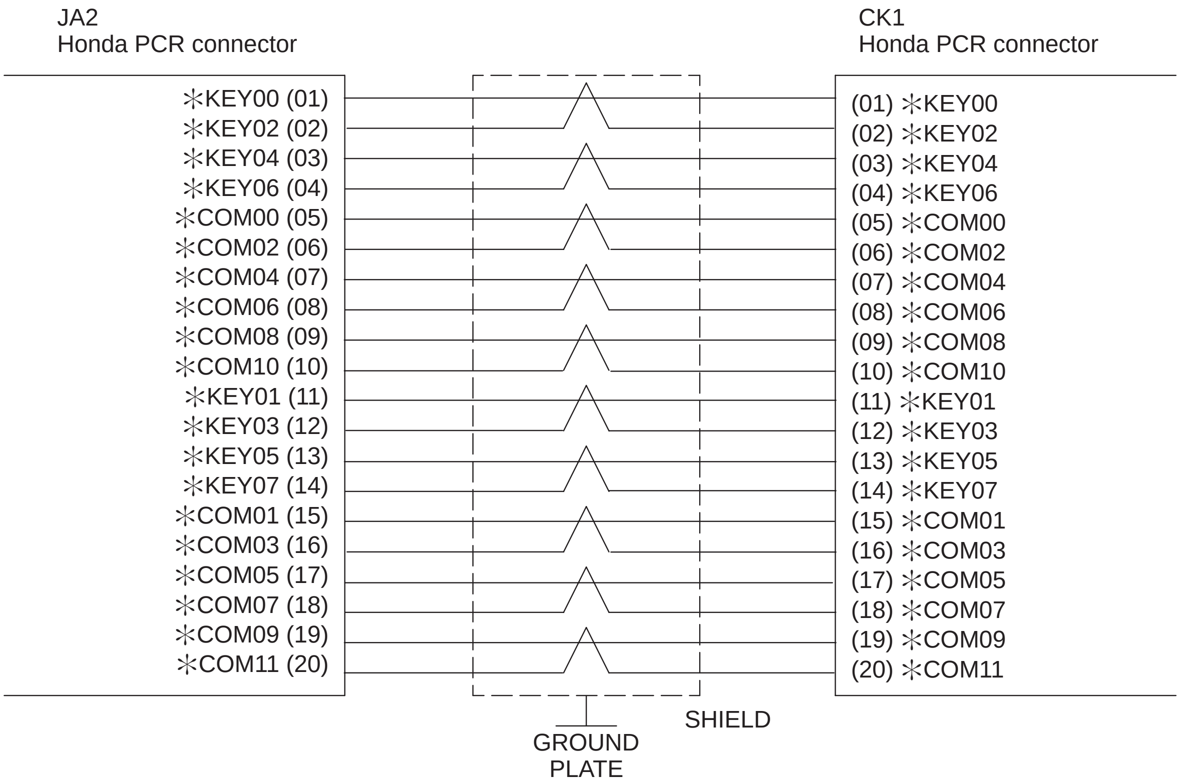
01	*KEY00	11	*KEY01
02	*KEY02	12	*KEY03
03	*KEY04	13	*KEY05
04	*KEY06	14	*KEY07
05	*COM00	15	*COM01
06	*COM02	16	*COM03
07	*COM04	17	*COM05
08	*COM06	18	*COM07
09	*COM08	19	*COM09
10	*COM10	20	*COM11

MDI unit

CK1

01	*KEY00	11	*KEY01
02	*KEY02	12	*KEY03
03	*KEY04	13	*KEY05
04	*KEY06	14	*KEY07
05	*COM00	15	*COM01
06	*COM02	16	*COM03
07	*COM04	17	*COM05
08	*COM06	18	*COM07
09	*COM08	19	*COM09
10	*COM10	20	*COM11

Cable

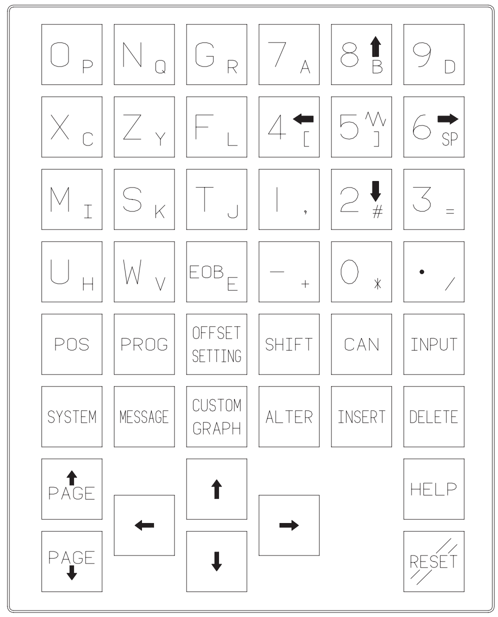


RECOMMENDED CABLE SPECIFICATION : A02B–0120–K810 (5m)
RECOMMENDED CABLE MATERIAL : A66L–0001–0284#10P (#28AWG × 10pair)

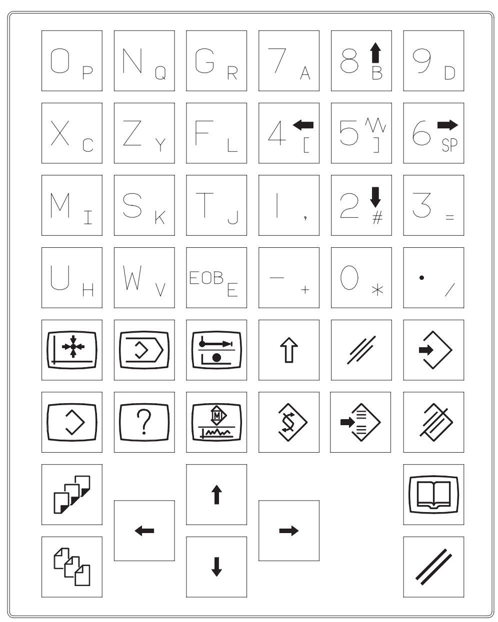
5.2.4 Varied MDI Key Switch

- **9″CRT/MDI unit for Series 21–TB**
- **Separate type small MDI unit for Series 21–TB**

English display



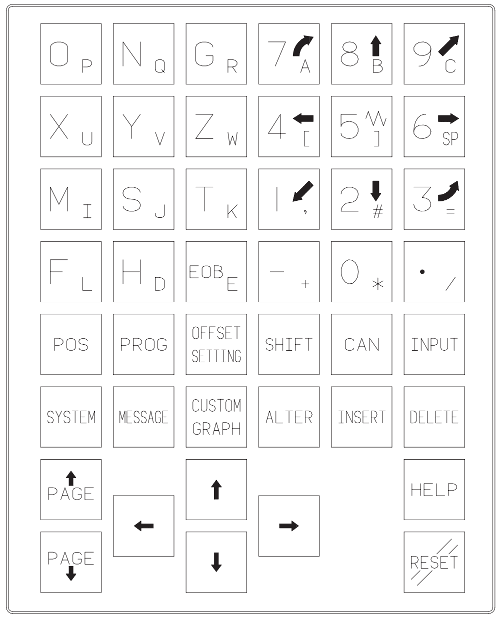
Symbol display



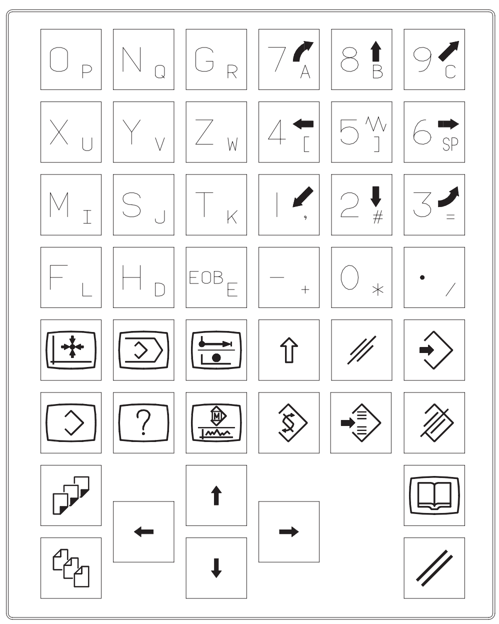
- **9″CRT/MDI unit for Series 21–MB**

- **Separate type small MDI unit for Series 21–MB**

English display

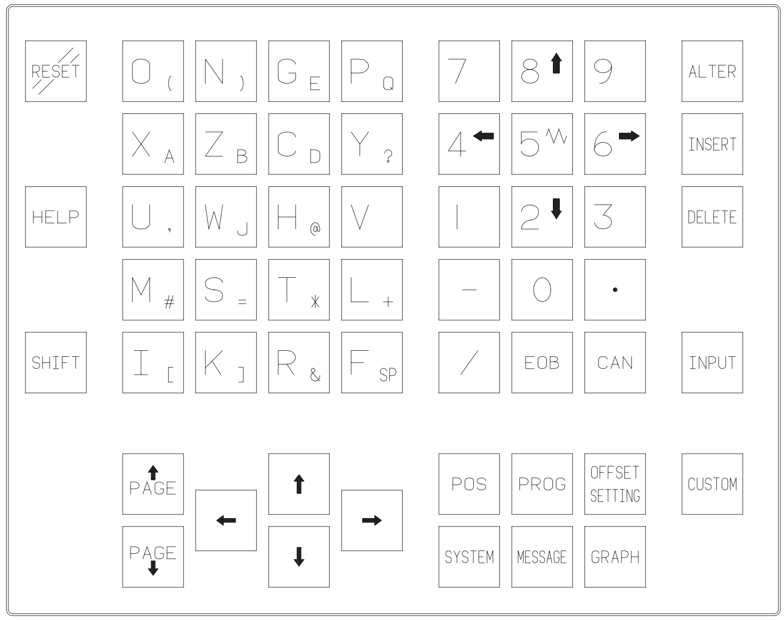


Symbol display

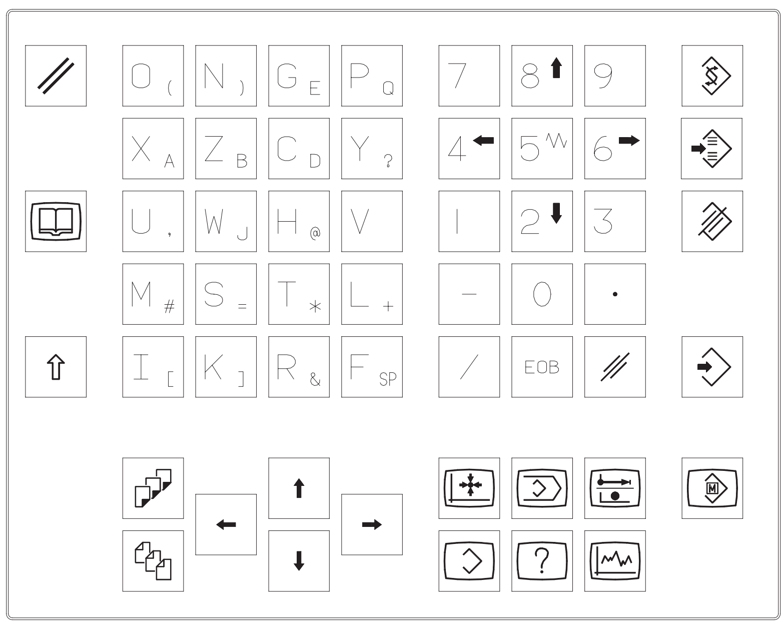


- **Separate type full key for 21–TB**

English display

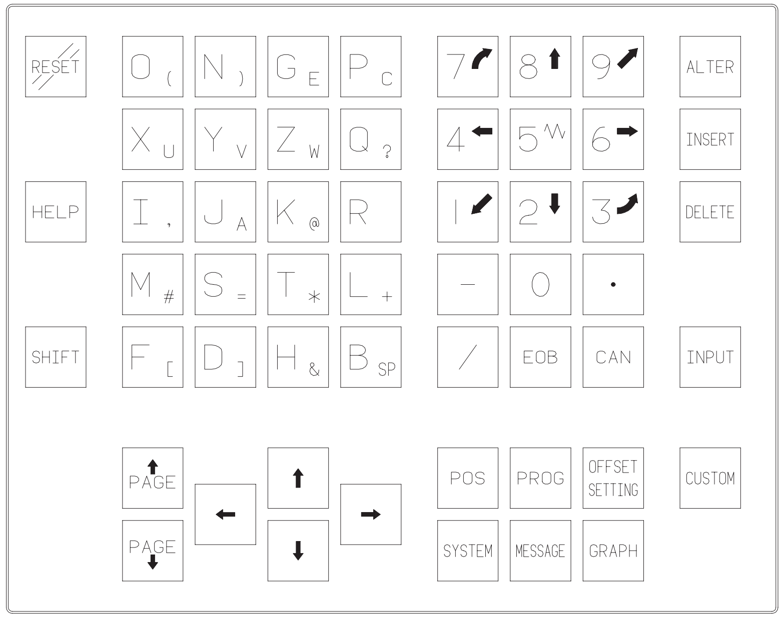


Symbol display

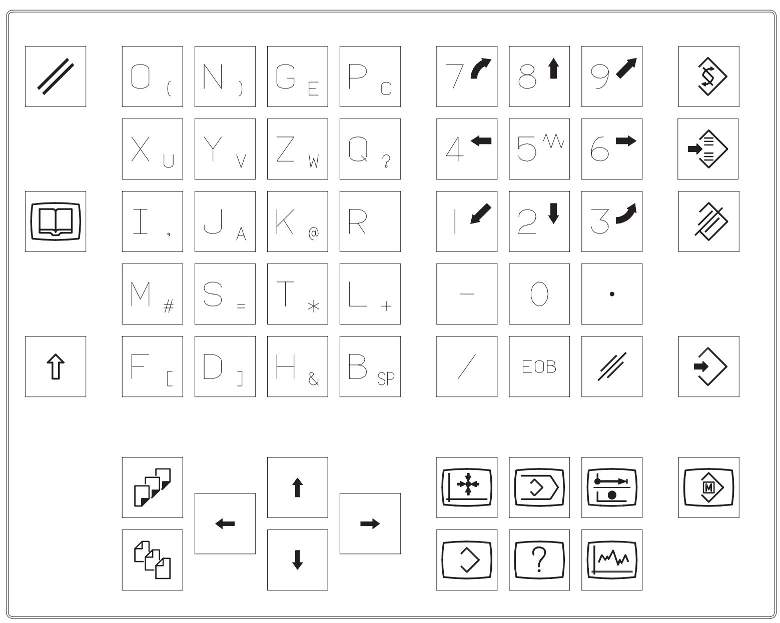


- **Separate type full key for 21–MB**

English display

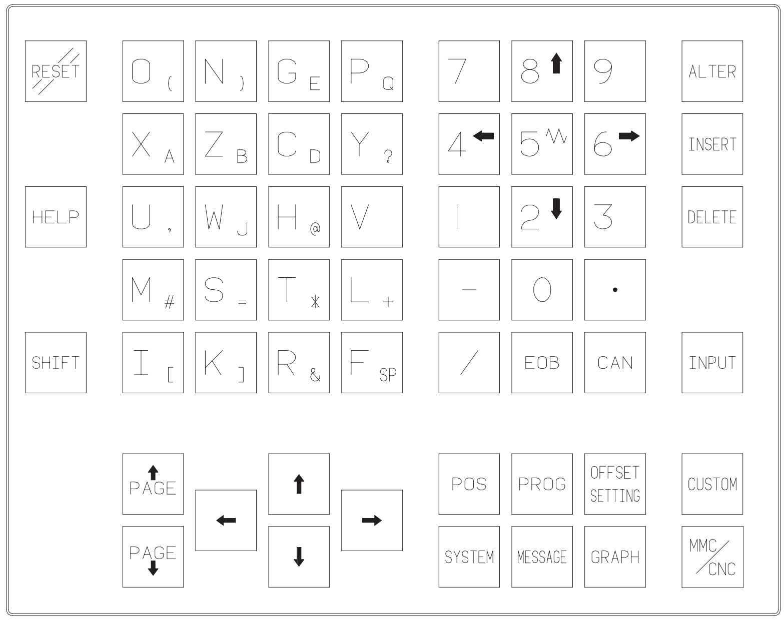


Symbol display

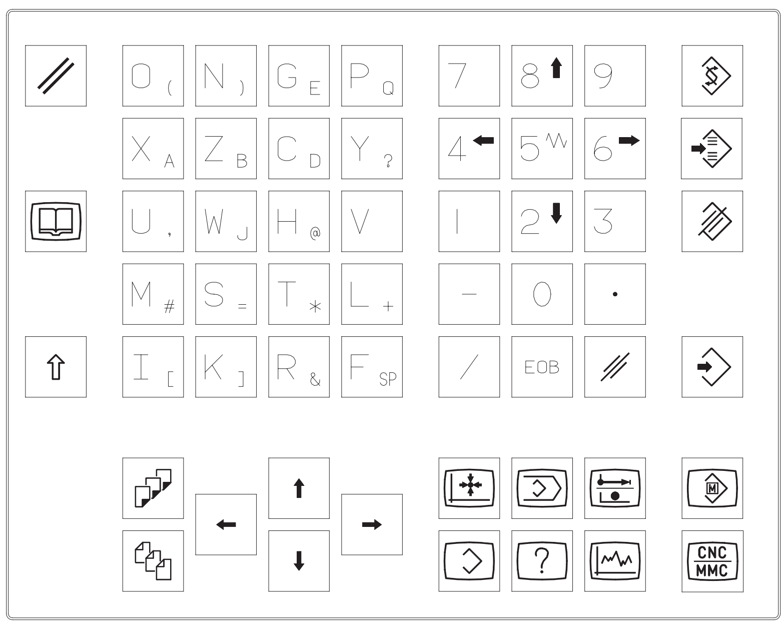


- **Separate type full key for 210–TB**

English display

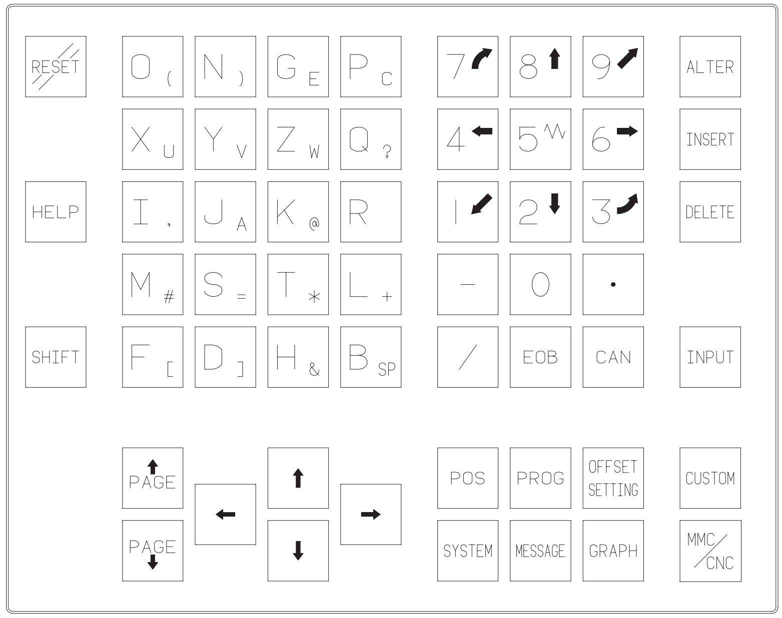


Symbol display

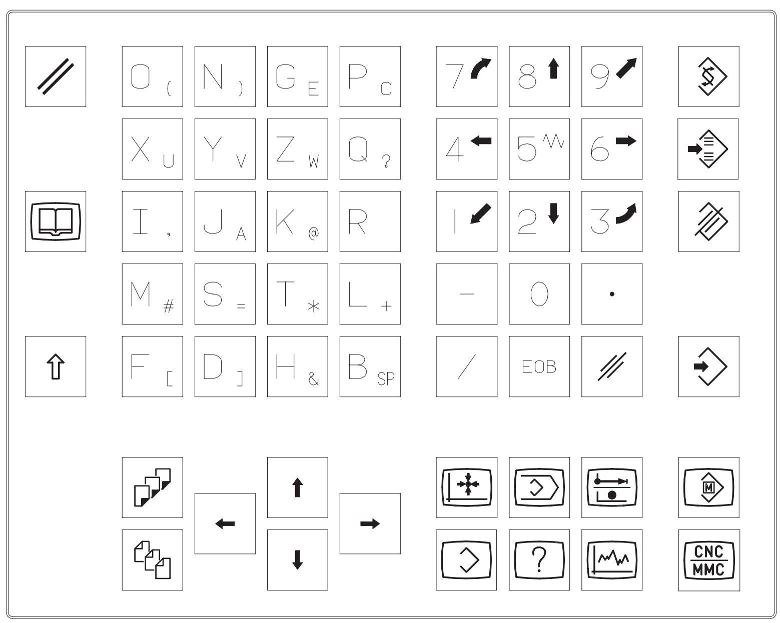


- **Separate type full key for 210–MB**

English display

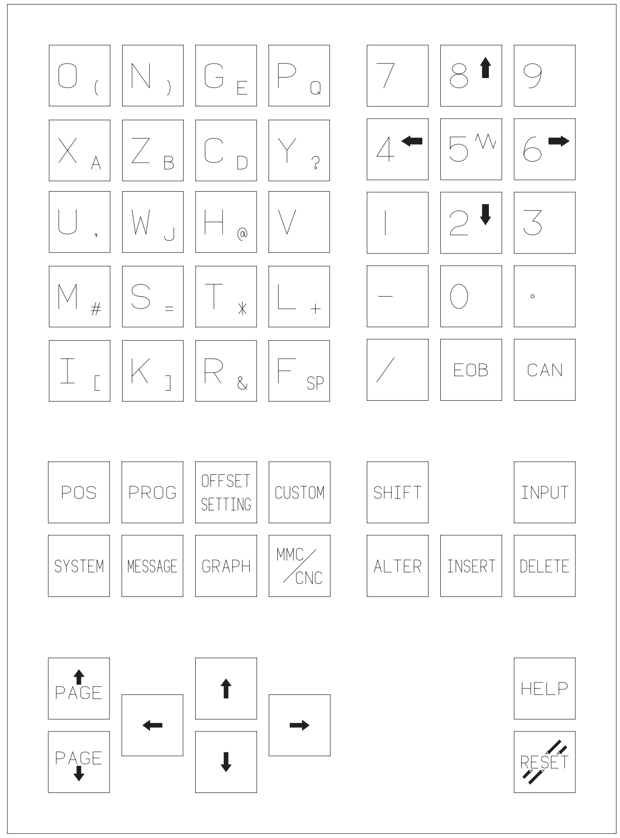


Symbol display

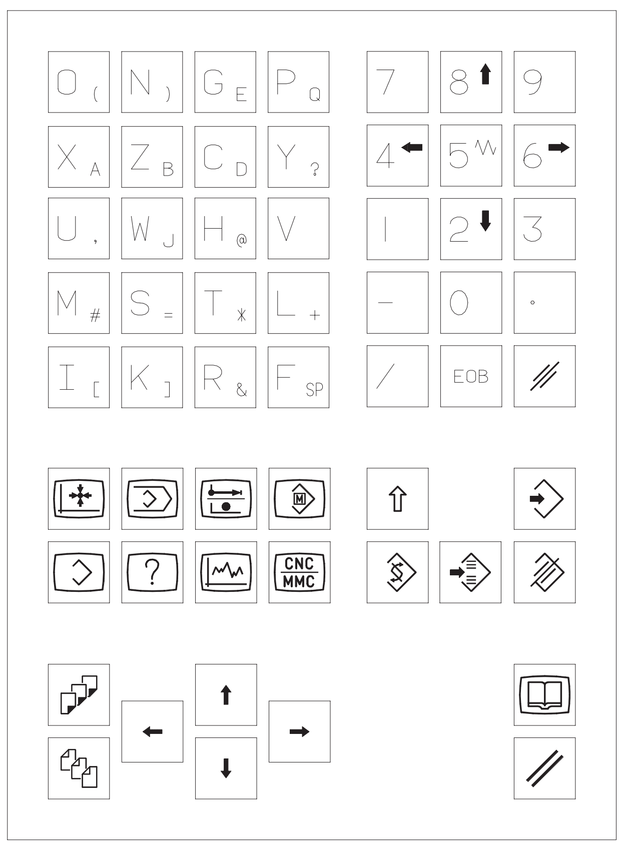


- **9.5″ color TFT/MDI unit (horizontal type) for 210–TB**

English display

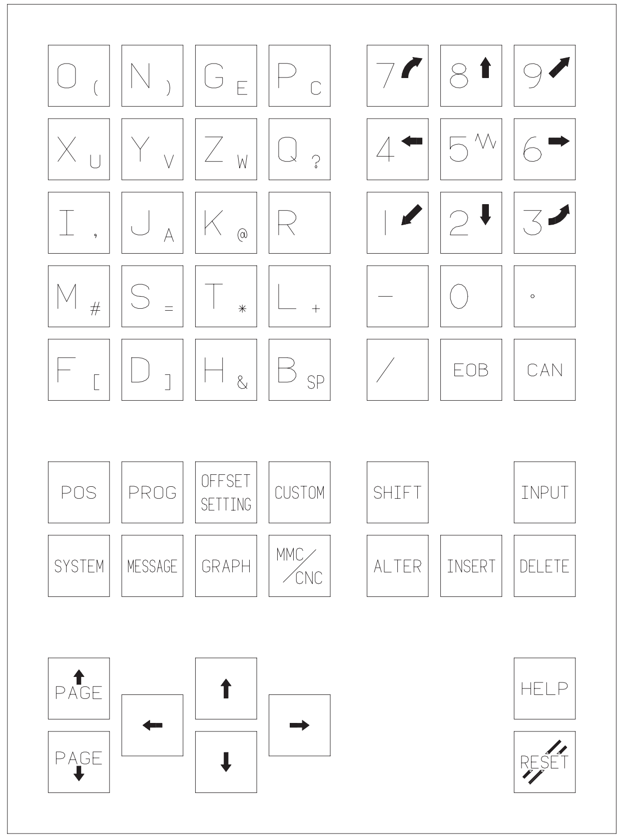


Symbol display

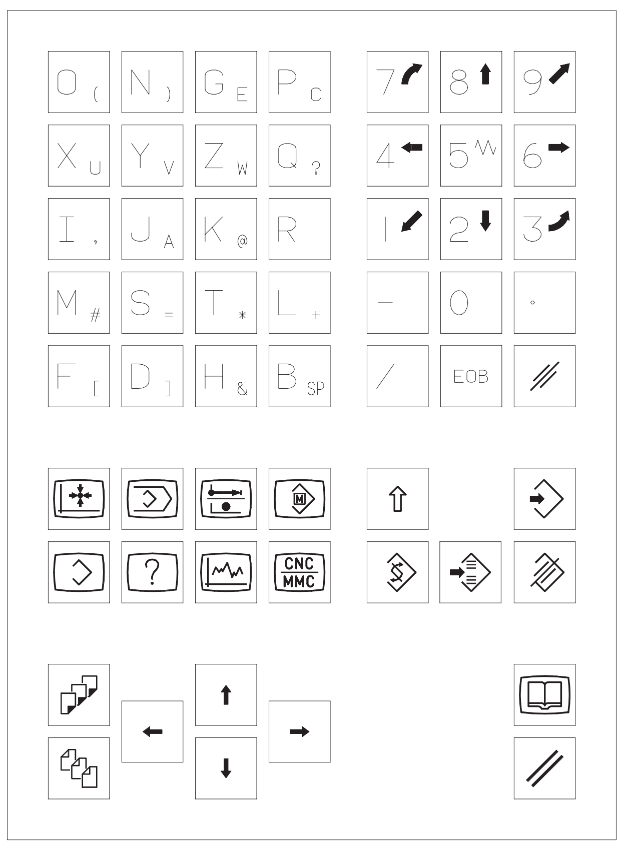


- **9.5″ color TFT/MDI unit (horizontal type) for 210–MB**

English display

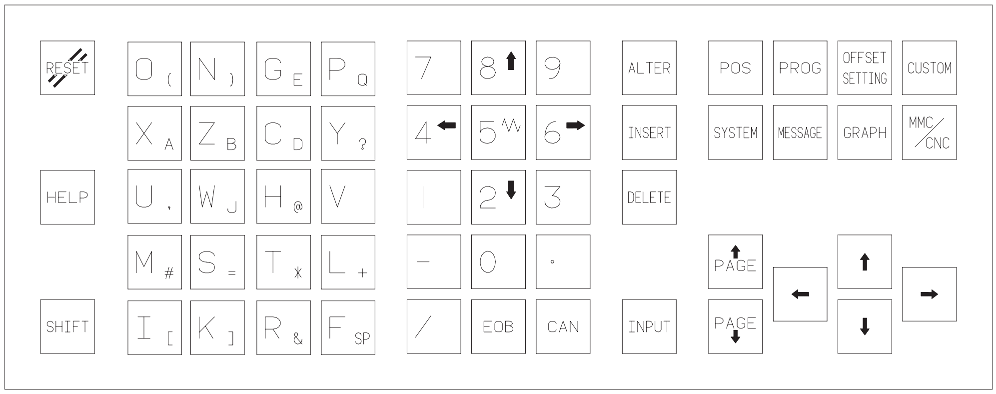


Symbol display

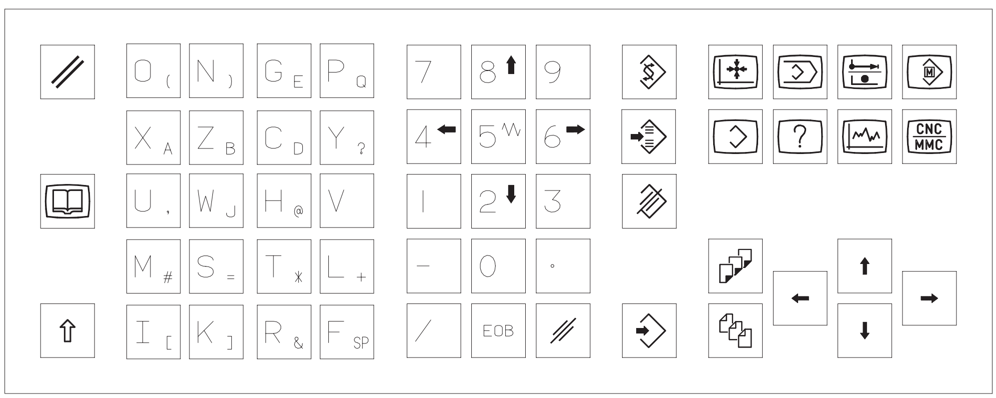


- **14″ color CRT/MDI unit for 210–TB (vertical type)**
- **9.5″ color TFT/MDI unit for 210–TB (vertical type)**

English display

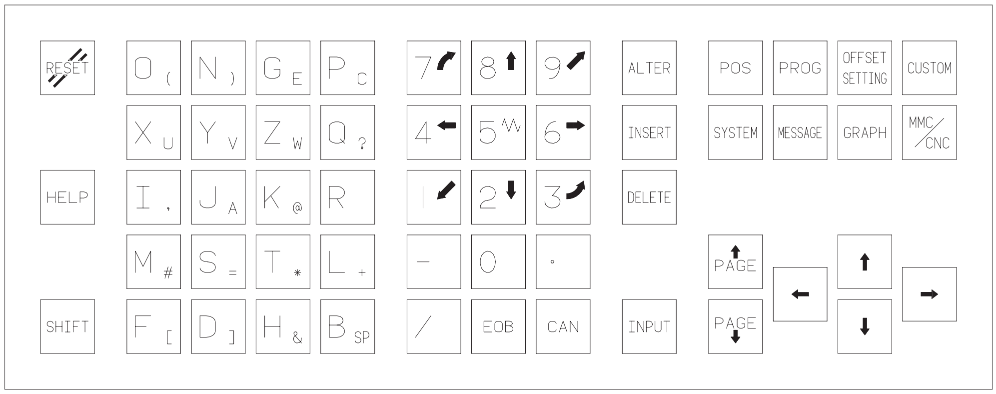


Symbol display

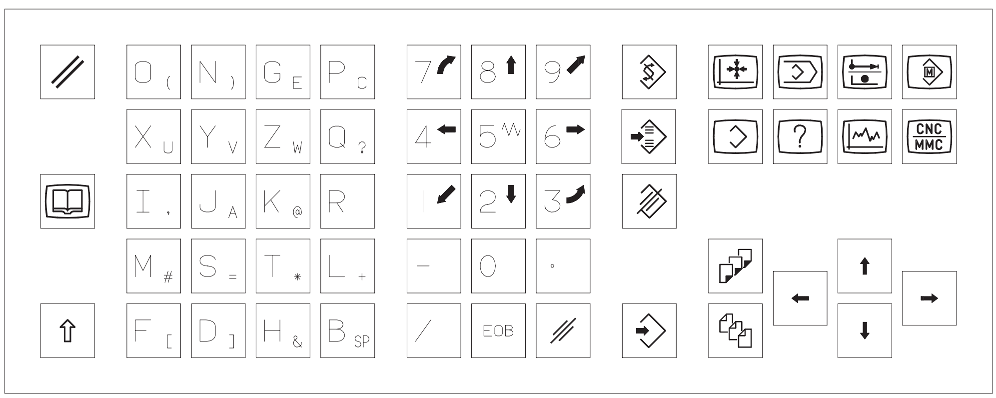


- **14″ color CRT/MDI unit for 210–MB (vertical type)**
- **9.5″ color TFT/MDI unit for 210–MB (vertical type)**

English display

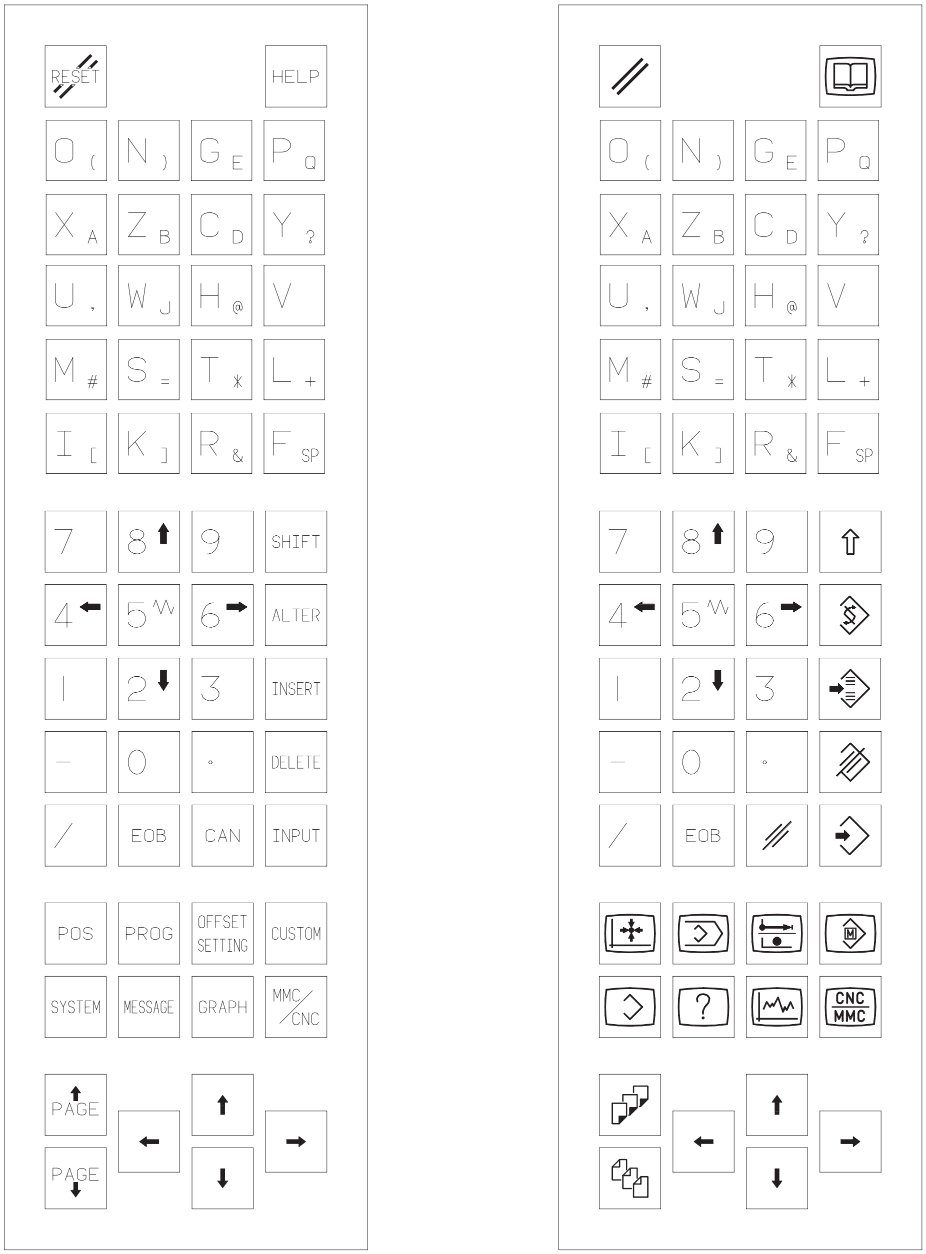


Symbol display



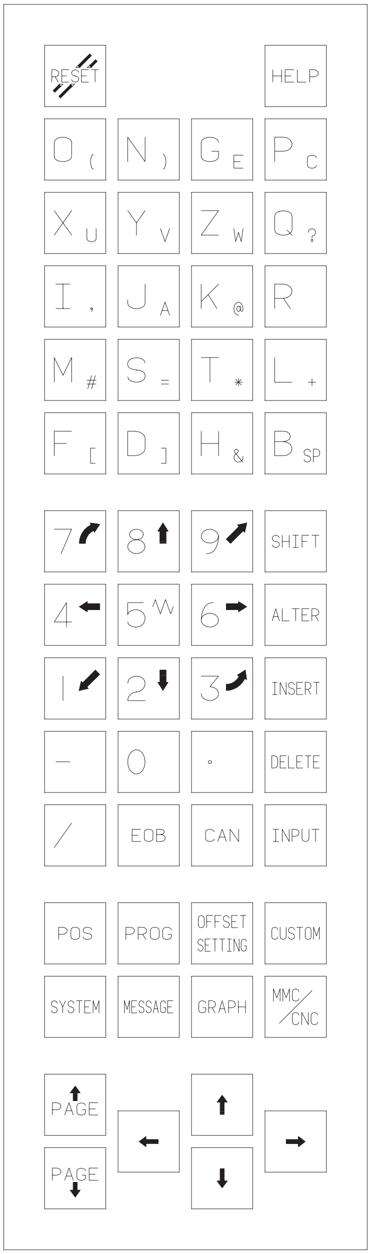
- **14″ color CRT/MDI unit (horizontal type) for 210–TB**

English display **Symbol display**

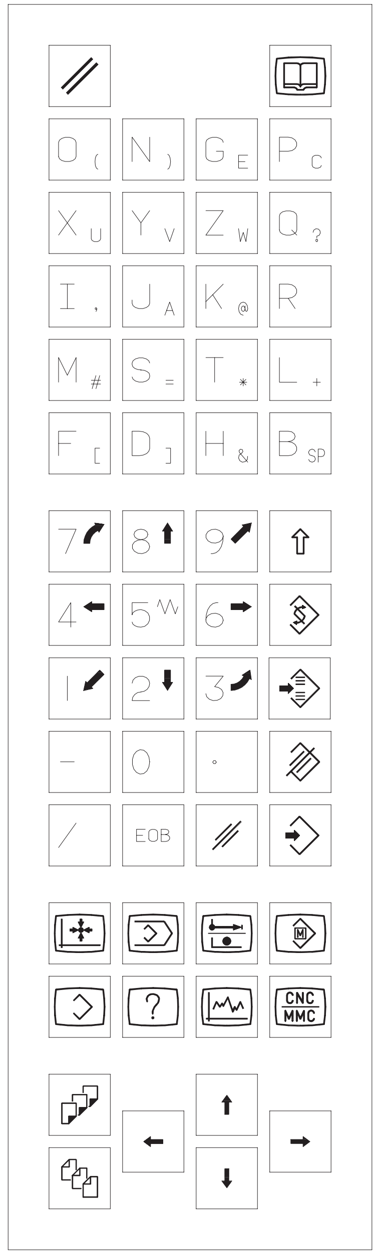


- **14″ color CRT/MDI unit (horizontal type) for 210–MB**

English display



Symbol display



5.3 CONNECTING I/O DEVICES

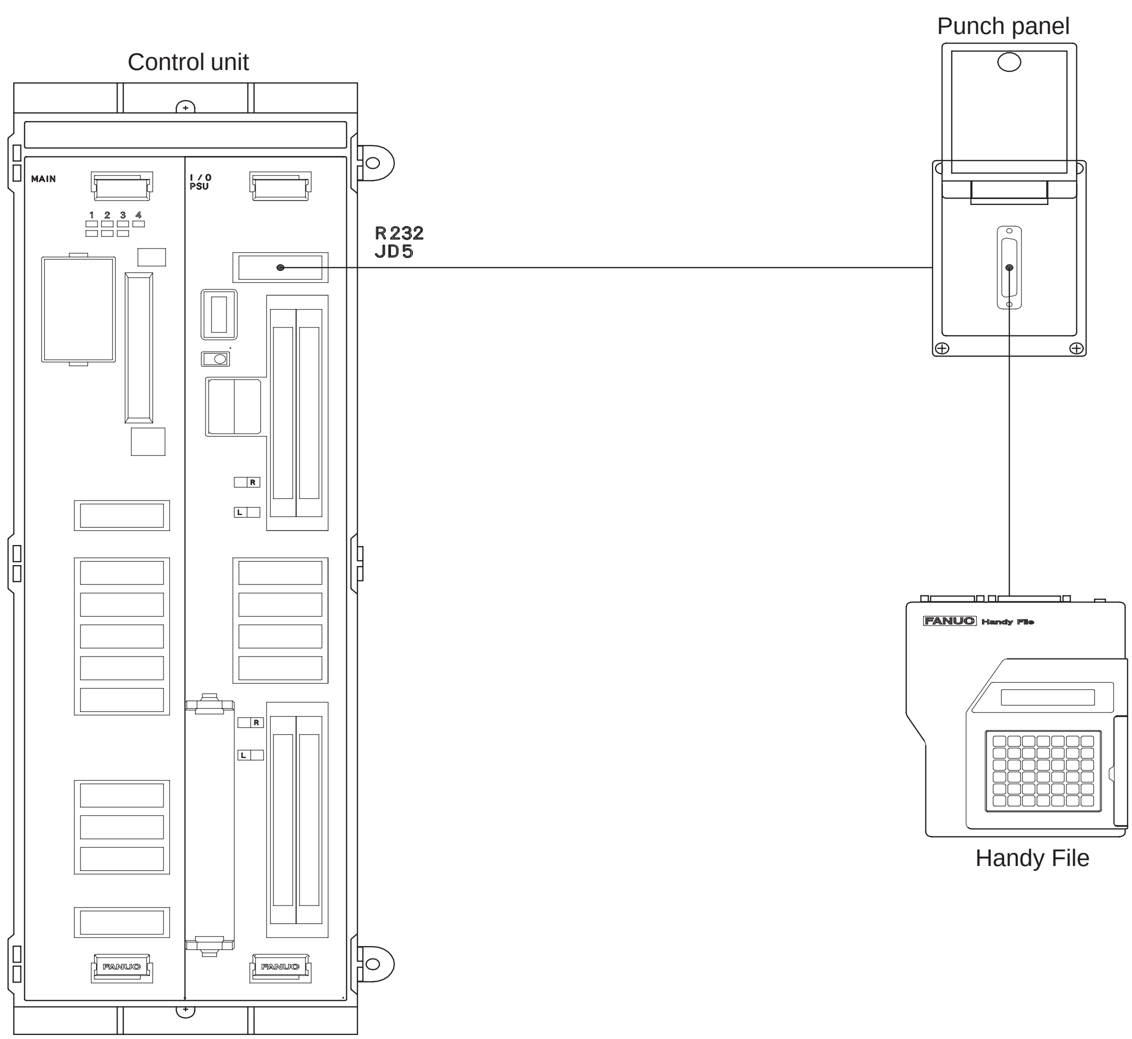
5.3.1 General

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.

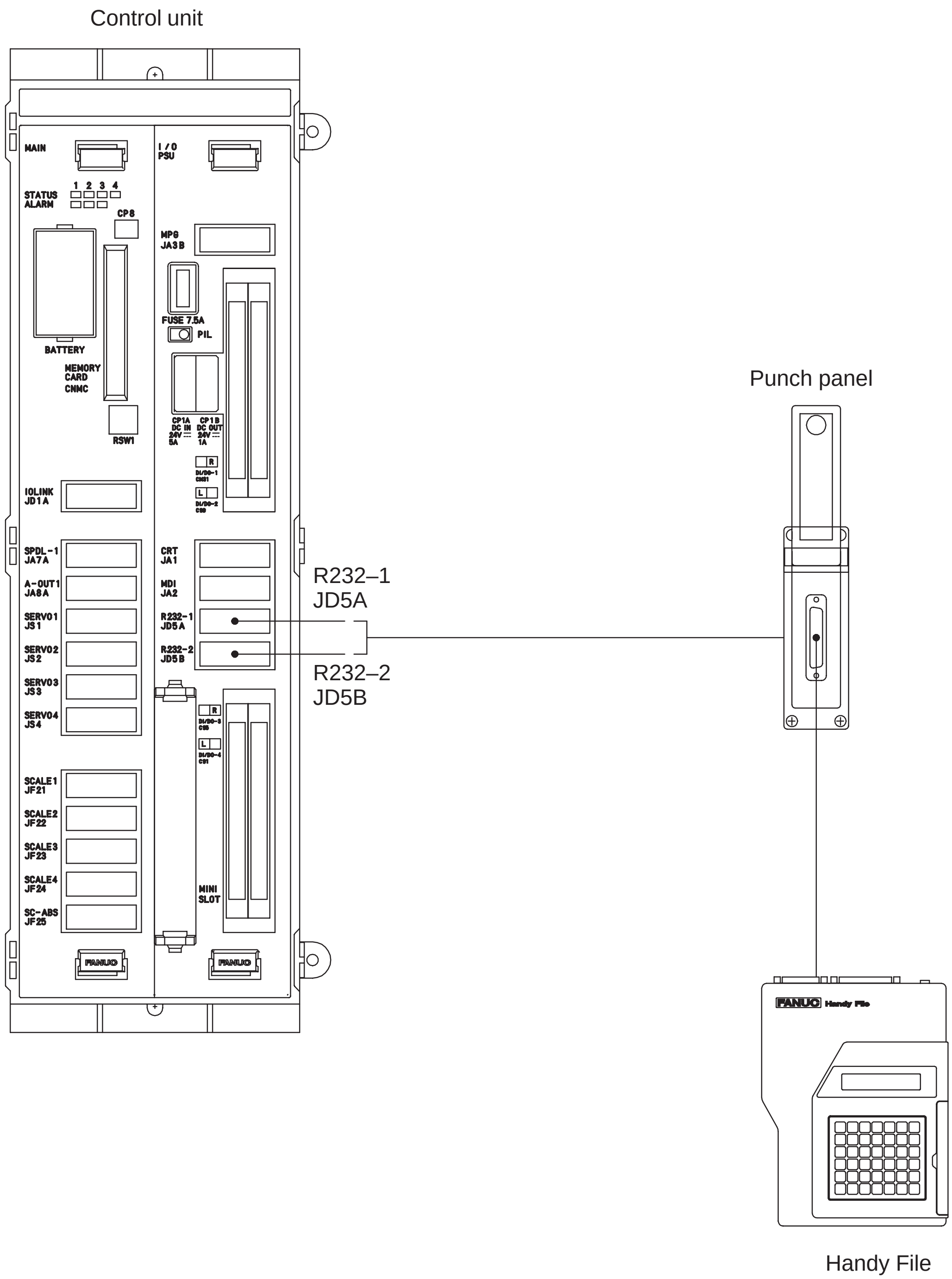
The Handy File is one of the I/O devices for the Series 21/210. The interface for I/O devices complies with RS–232–C. The Series 21/210 can therefore be connected to devices which have an RS–232–C interface.

5.3.2 Connecting I/O Devices

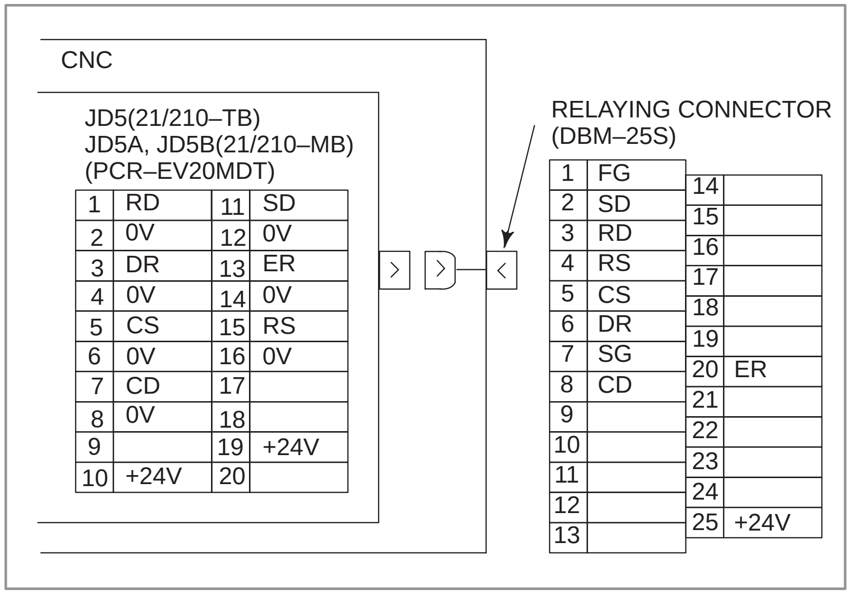
For 21/210–TB

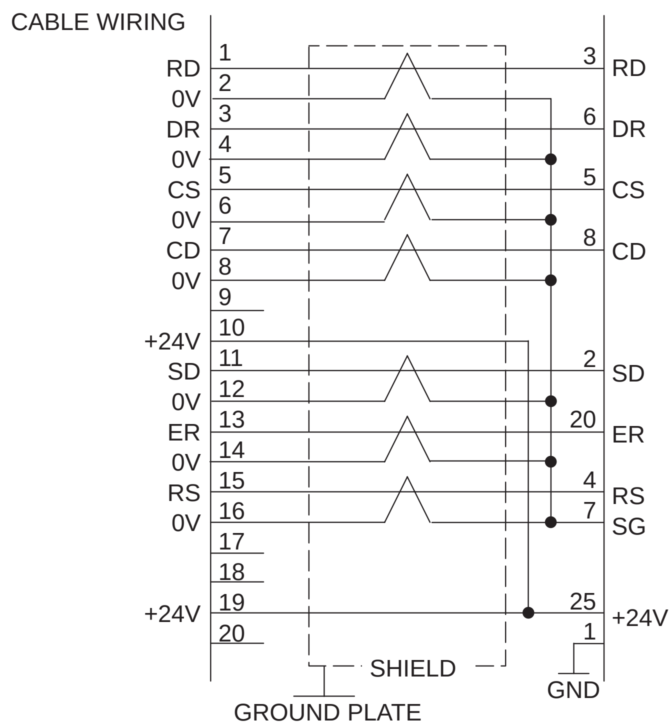


For 21/210–MB



5.3.3 RS–232–C Serial Port





RECOMMENDED CABLE MATERIAL
A66L–0001–0284#10P(#28AWG × 10–pair)
RECOMMENDED CABLE SPECIFICATION (PUNCH PANEL)

<Narrow width type>
- A02B–0120–C191 (1m)
- A02B–0120–C192 (2m)
- A02B–0120–C193 (5m)

<Wide width type>
- A02B–0120–C181 (1m)
- A02B–0120–C182 (2m)
- A02B–0120–C183 (5m)

5.3.4 RS–232–C Interface Specification

RS–232–C Interface signals

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

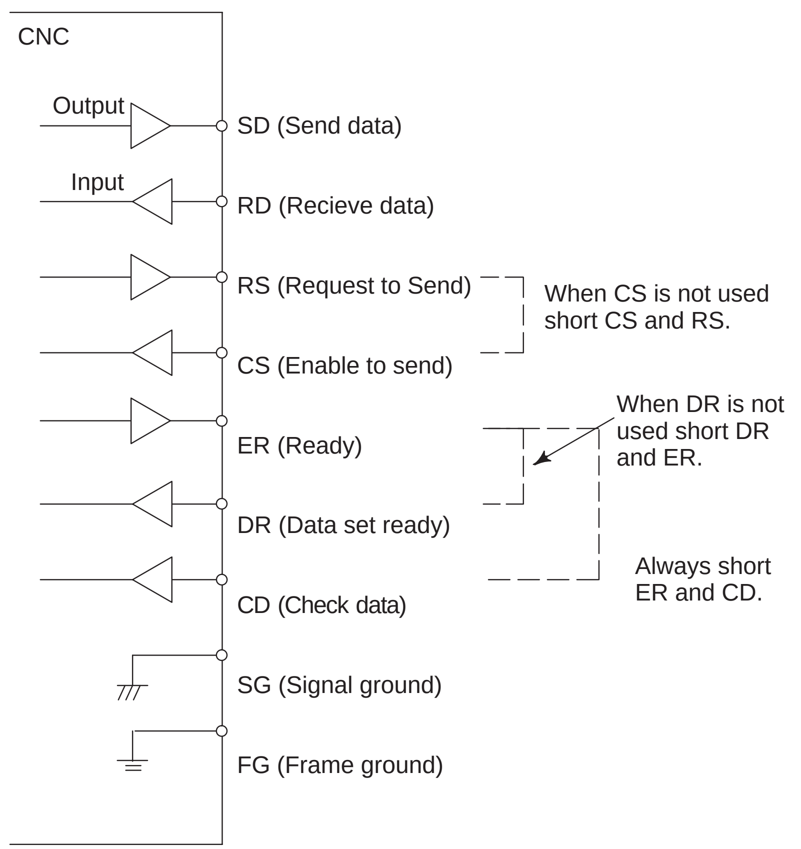
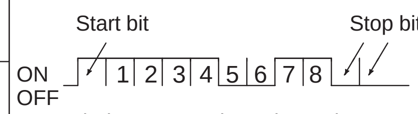


Fig.5.3.4 RS–232–C interface

Signal description of RS–232–C interface

Signal name	RS–232–C circuit number	I/O	Description	
SD	103	Output	Sending data	 (When ISO code “0” is sent)
RD	104	Input	Receiv-ing 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 cir-cuit.
DR	107	Input	Data set ready	When external device is ready to op-erate, this signal is set. This signal should usually be connected to the signal indicating external device pow-er supply being on. (ER signal of ex-ternal device). See Note below. The NC transfers data when this sig-nal is set. If the signals turned off dur-ing 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 con-nections with external device, the sig-nal circuit must be strapped, inside the connecting cable, to the ER sig-nal circuit.
SG	102		Signal grounding	
FG	101		Frame grounding	

NOTE

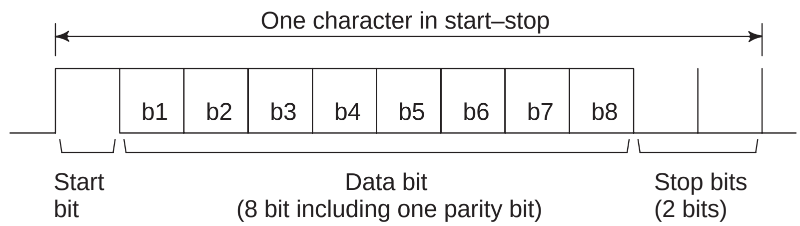
Signal on/off state is defined as follows;

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

Transmission Method of RS–232–C interface

Start–stop

Generally, two transmission methods are available at the serial interface. Series 21 use the start–stop method. With this method, start and stop signals are output before and after each data bit.



Codes

Transmission codes are as follows:

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

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

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

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

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

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

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

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

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

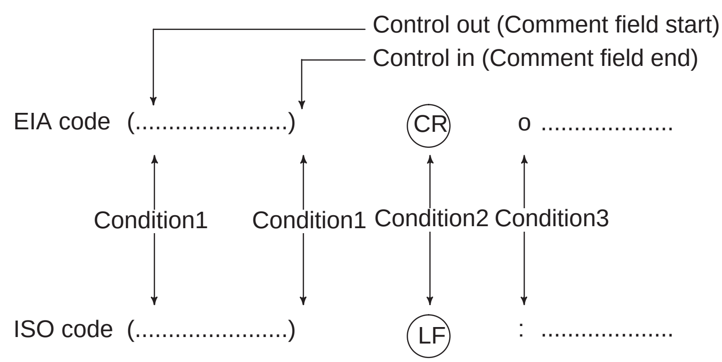
(ii) If control code DC3 is input to NC, NC stops data output within ten characters. When control code DC1 is input to NC, NC starts sending data again.

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

Table 5.3.4(a)

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

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



Condition1

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

Condition2

EIA code CR is LF in ISO code.

Condition3

EIA code O is : in ISO code.

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):

Transmission characters/second= $\frac{110}{11}$ =10 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–232–C	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.

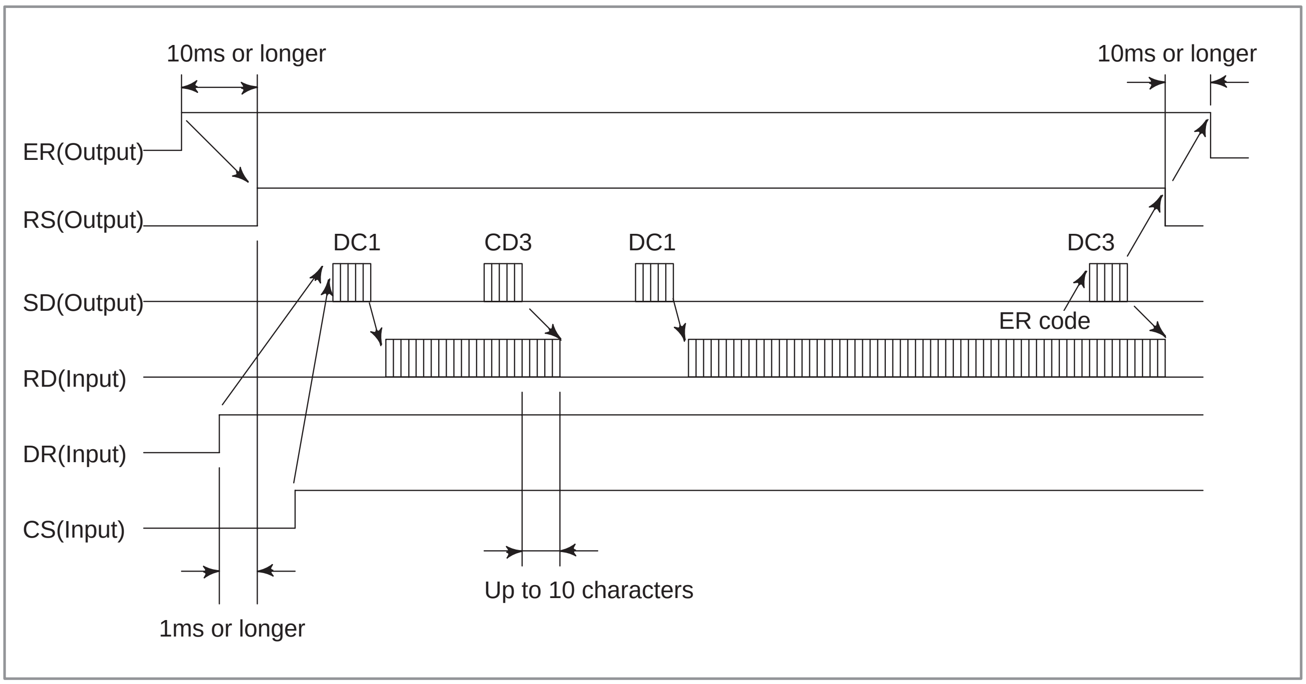
(4) The external device stops sending data to NC after receiving DC3. The device may send up to 10 characters after receiving DC3. If it sends more than 10 characters, alarm 087 will occur.

(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.

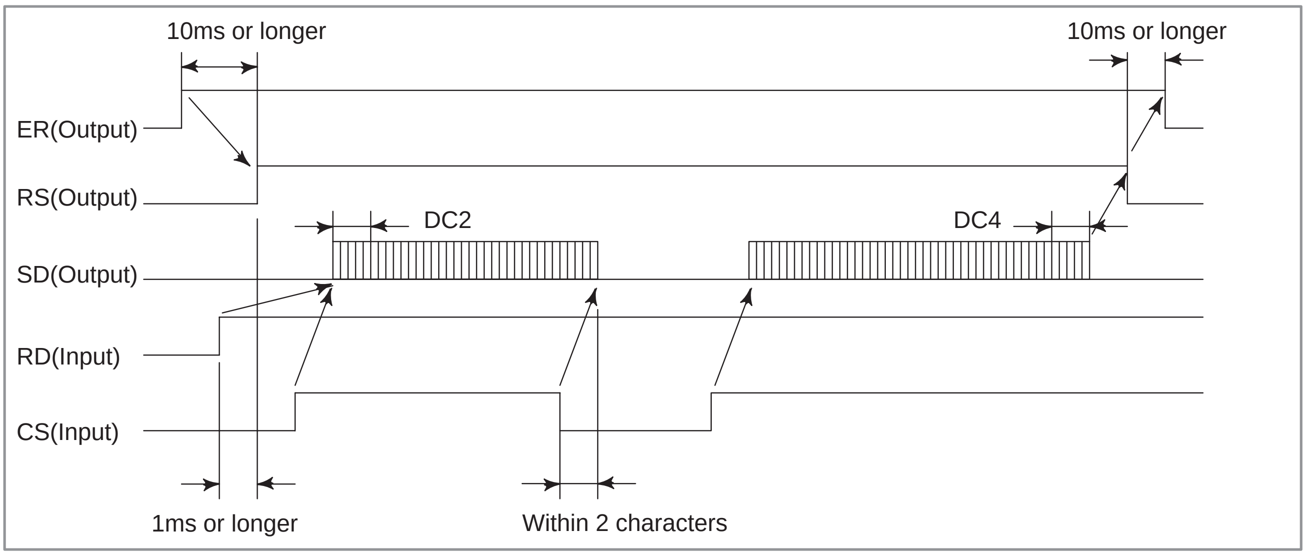


Fig.A

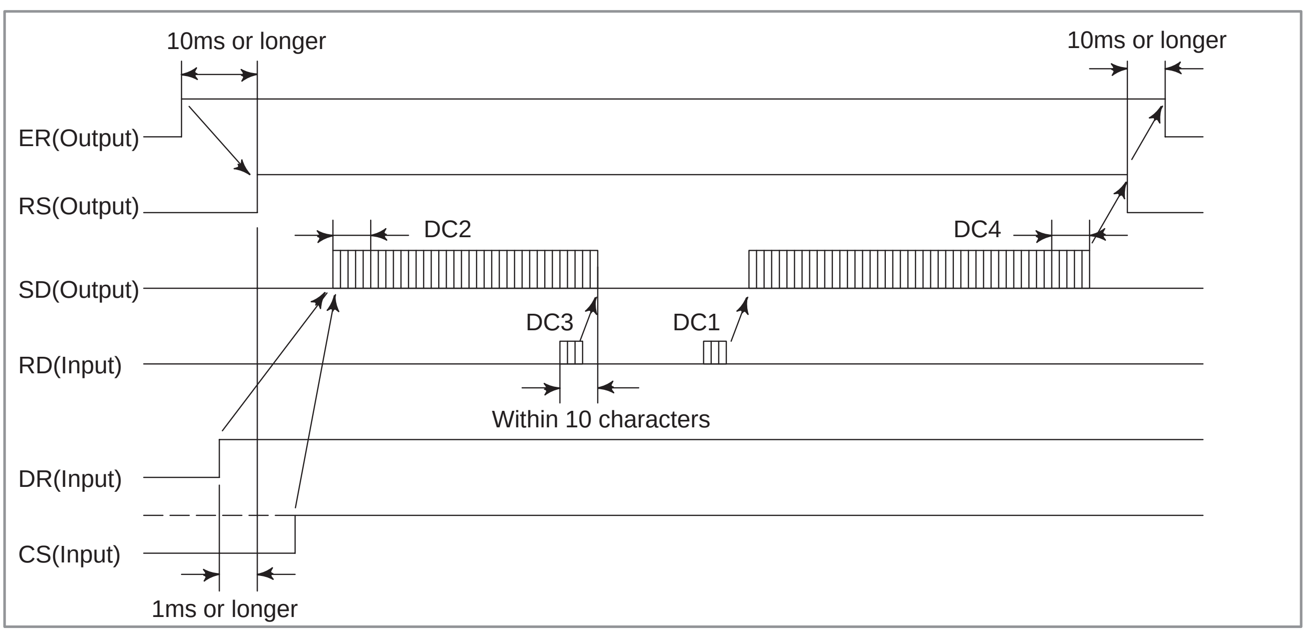
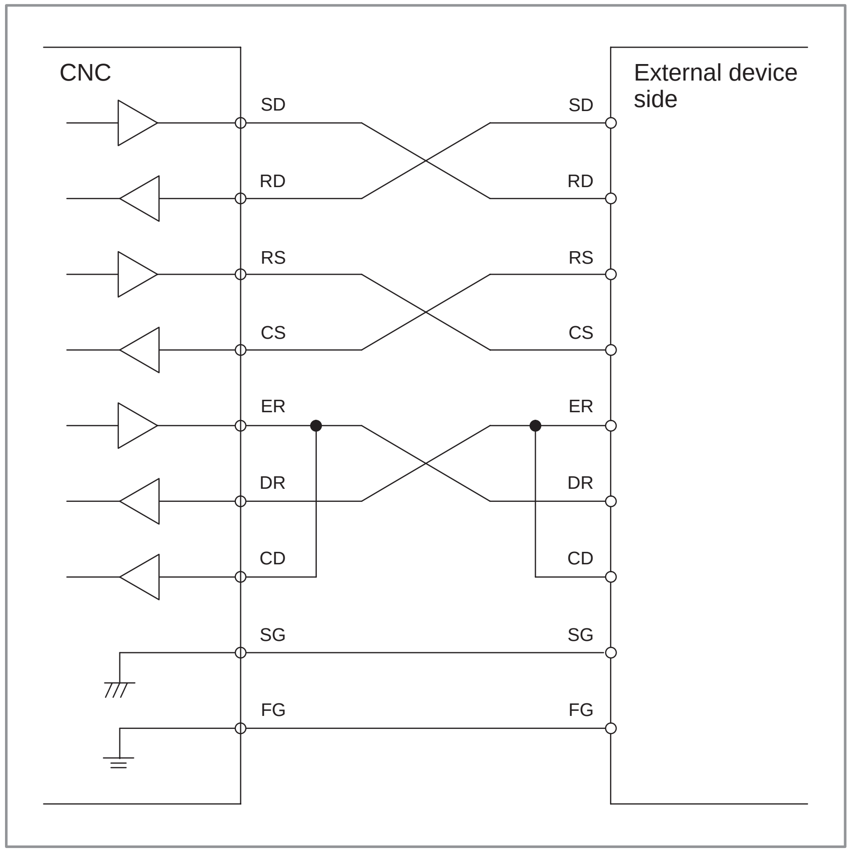
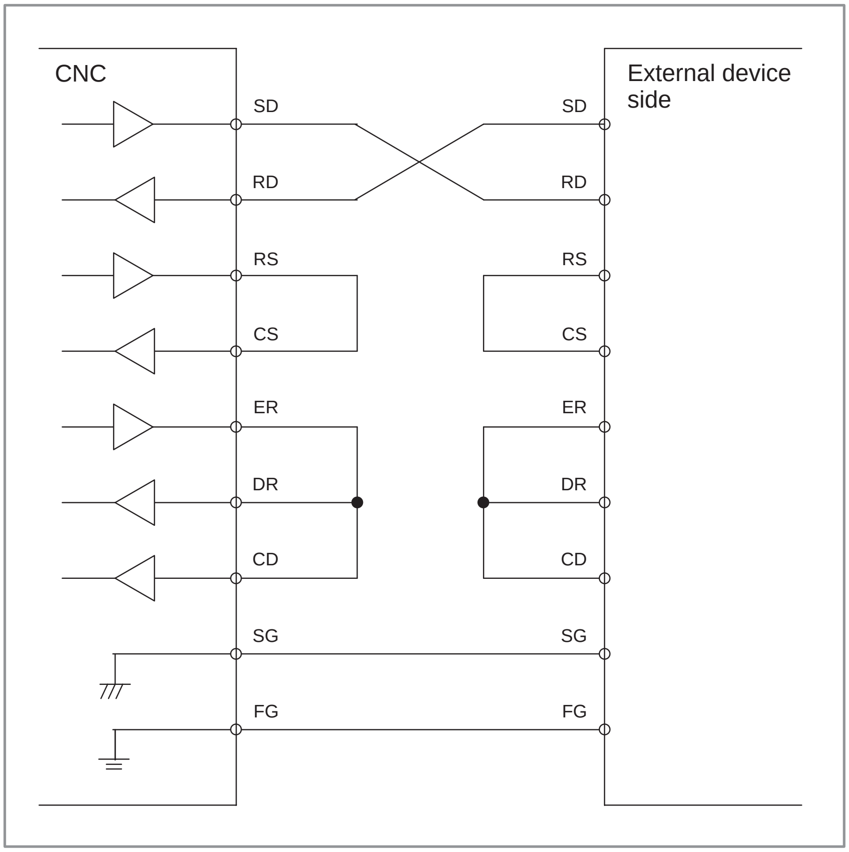


Fig.B

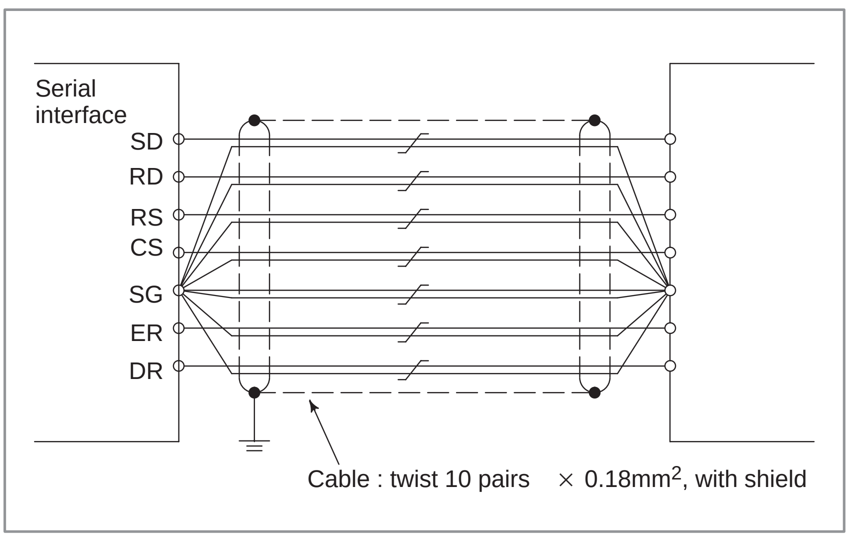
Connection between RS–232–C interface and external device



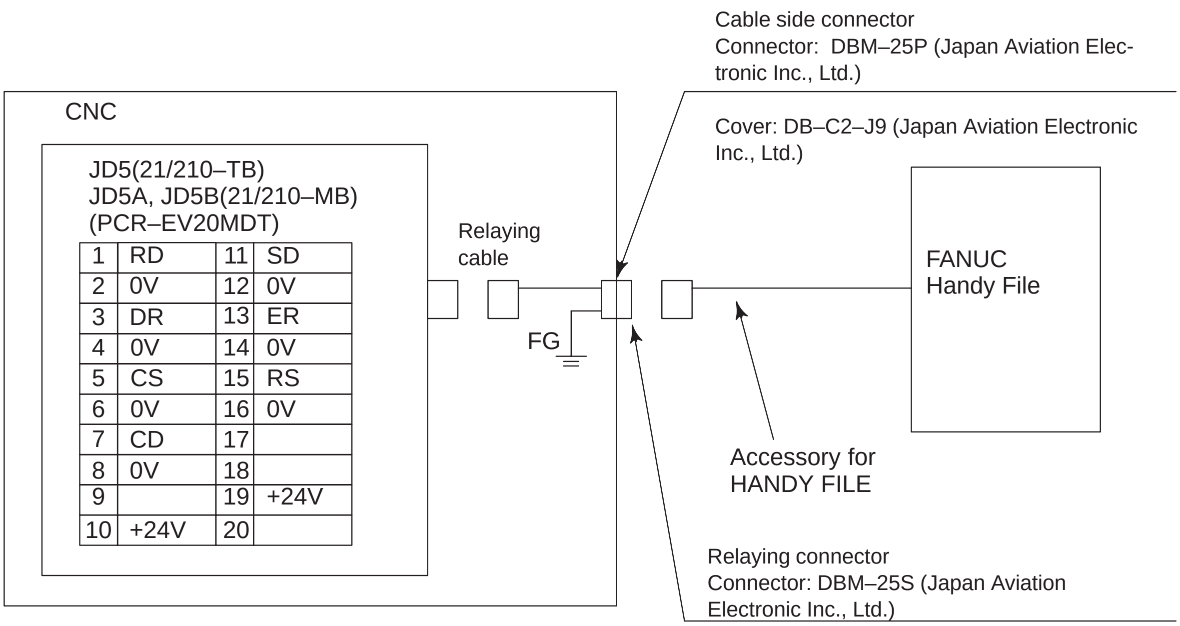
- The cable for connecting the PG–Mate to the NC should be connected as shown in the below diagram.



Prepare the cable with I/O device as follows :



5.3.5 FANUC Handy File Connection



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

RELAYING CONNECTOR SIGNAL LAYOUT

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

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

NOTE

1. Machine tool builder shall furnish relay connector and relay cable.
2. Use a totally shielded cable for the signal cable.
   Recommended cable specification:
   A66L–0001–0284#10P
3. Open all terminals other than illustrated.
4. Set suitable parameters on reader/puncher interface for FANUC Handy File. The baud rate is 4800 baud in standard.
5. Connect the FANUC Handy File to either JD5A or JD5B. Do not use both pins; the power capacity may exceed that of +24V and blow the fuse.

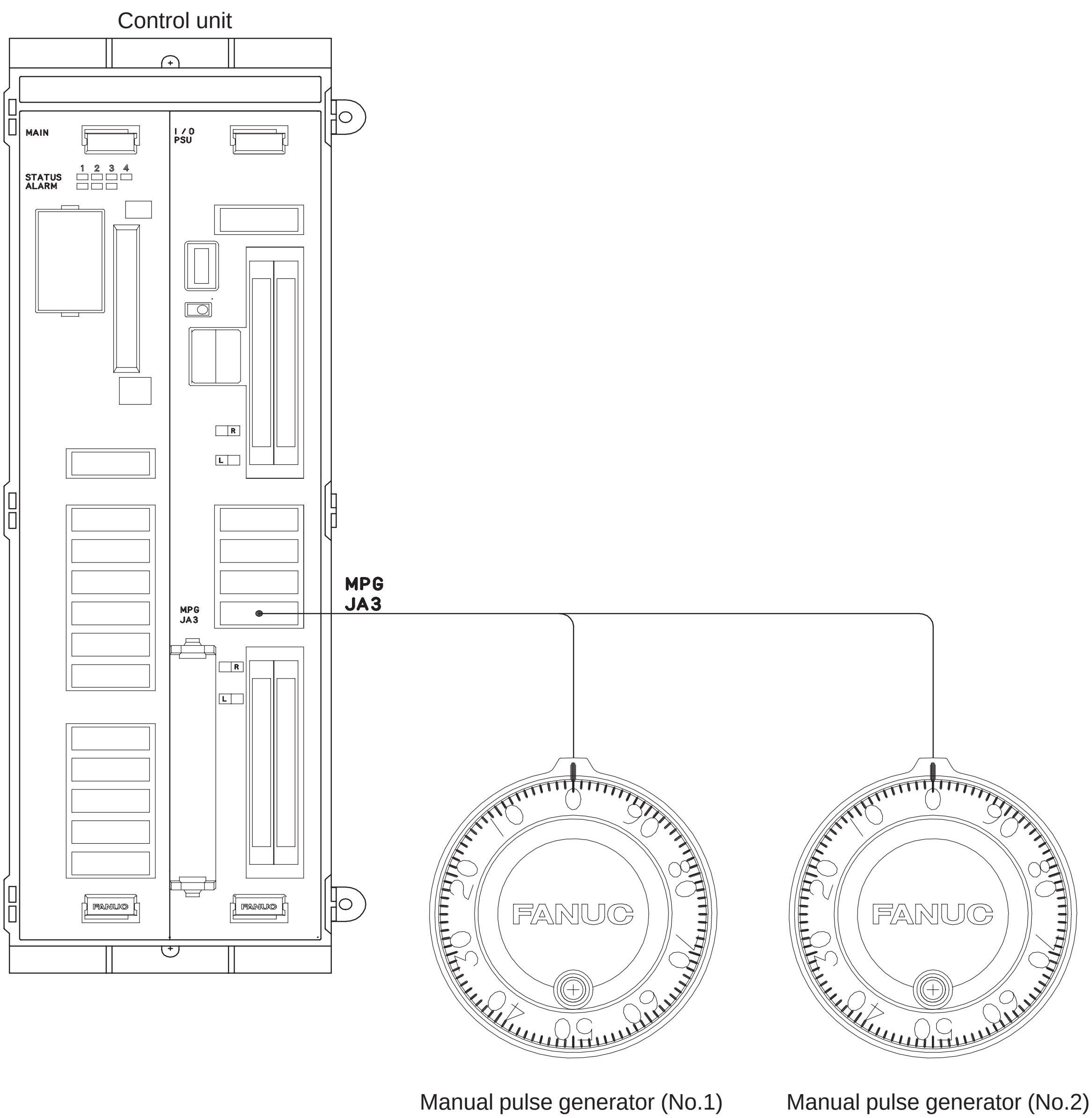
5.4 CONNECTING THE MANUAL PULSE GENERATOR

5.4.1 General

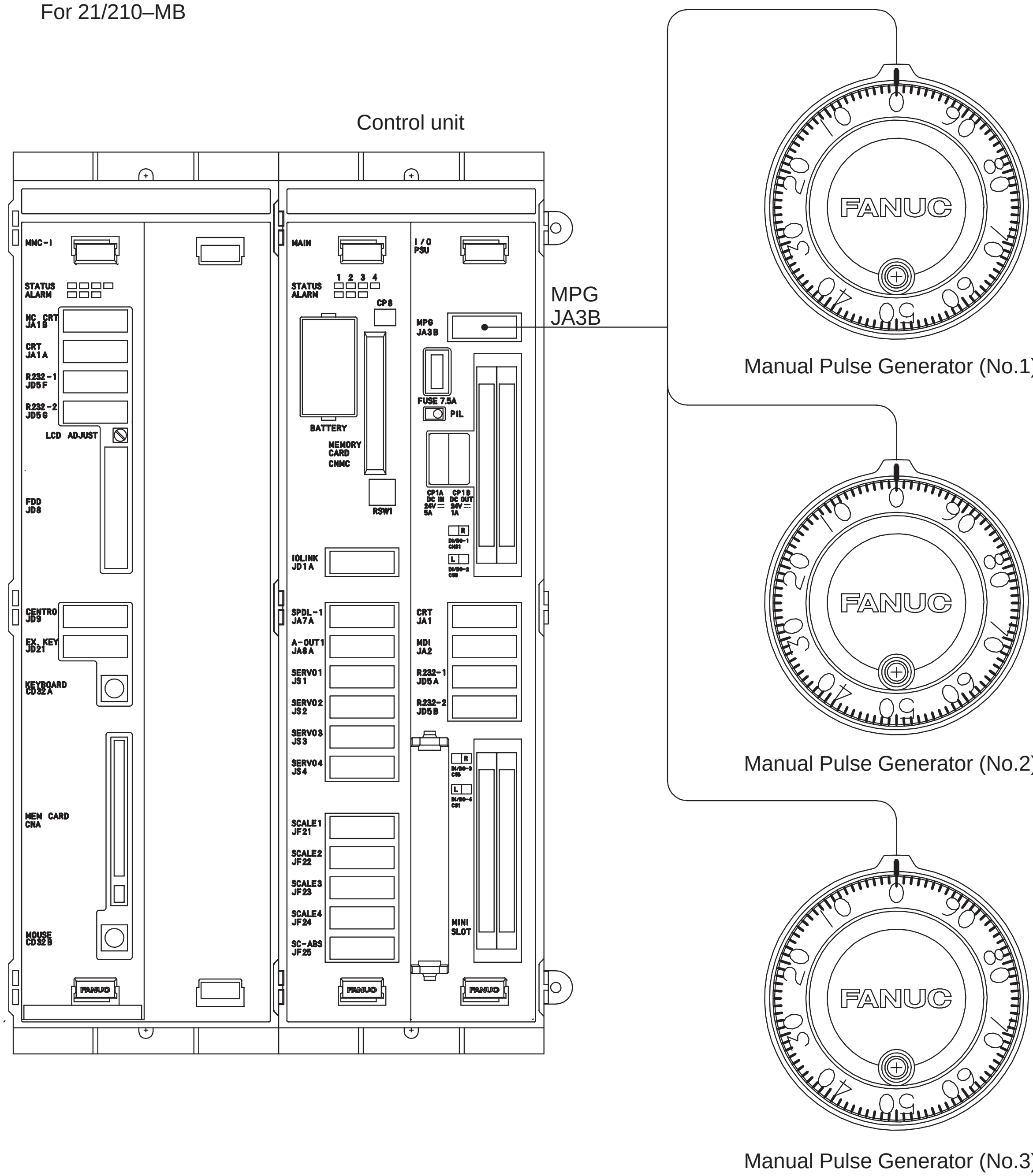
Manual pulse generators are used to manually move an axis in the handle feed mode.
Up to two manual pulse generators can be connected with the 21/210–TB.

Up to three manual pulse generators can be connected with the 21/210–MB.

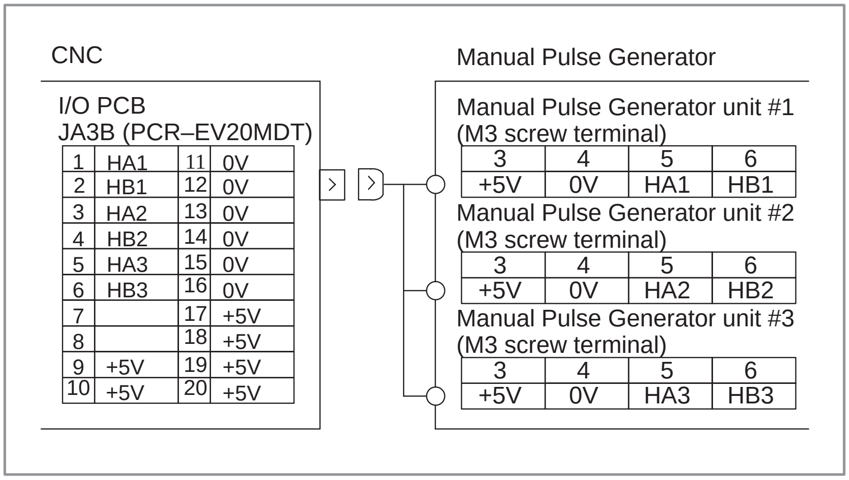
For 21/210–TB

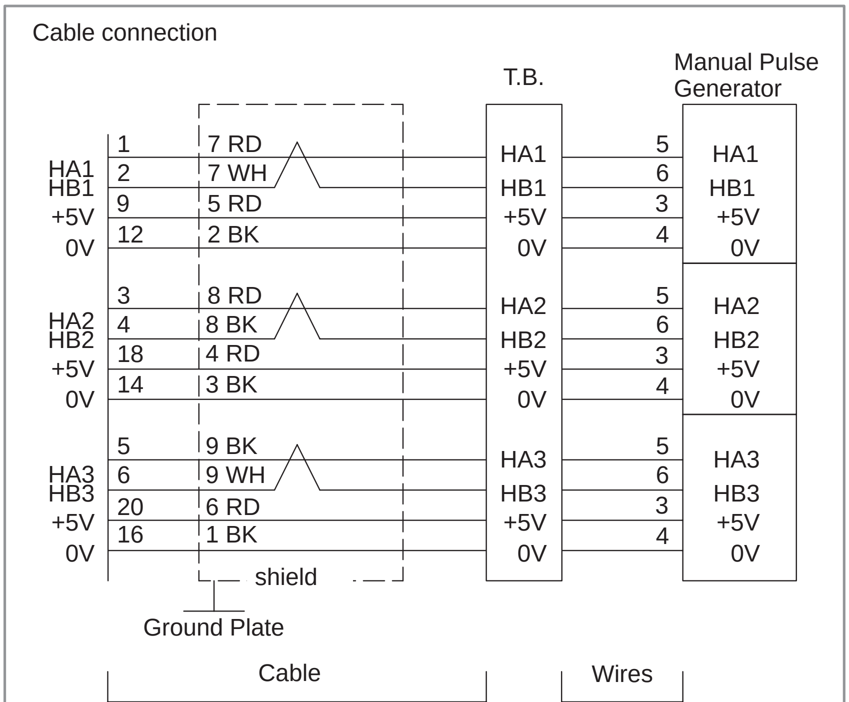


For 21/210–MB


Control unit
MPG
JA3B
MMC-I
STATUS
ALARM
NC CRT
JA1B
CRT
JA1A
R232-1
JD5F
R232-2
JD5G
LCD ADJUST
FDD
JD8
CENTRO
JD9
EX. KEY
JD21
KEYBOARD
CD32A
MEM CARD
CNA
MOUSE
CD32B
MAIN
STATUS
ALARM
CP8
BATTERY
MEMORY
CARD
CNMC
RSW1
IOLINK
JD1A
SPDL-1
JA7A
A-OUT1
JA8A
SERVO1
JS1
SERVO2
JS2
SERVO3
JS3
SERVO4
JS4
SCALE1
JF21
SCALE2
JF22
SCALE3
JF23
SCALE4
JF24
SC-ABS
JF25
I/O
PSU
MPG
JA3B
FUSE 7.5A
PIL
CRT
JA1
MDI
JA2
R232-1
JD5A
R232-2
JD5B
MINI
SLOT
FANUC
Manual Pulse Generator (No.1)
Manual Pulse Generator (No.2)
Manual Pulse Generator (No.3)

5.4.2 Connection to Manual Pulse Generators





Recommended Cable Material (See Appendix B for details of cable material.)
A66L–0001–0286 (#20AWG × 6+#24AWG × 3) Max.20m
A66L–0001–0402 (#18AWG × 6+#24AWG × 3) Max.30m
A66L–0001–0403 (#16AWG × 6+#24AWG × 3) Max.50m

Recommended Cable (except for part of wires)
A02B–0120–K841 (7m) . . . . . With three manual pulse generators
A02B–0120–K847 (7m) . . . . . With two manual pulse generators
A02B–0120–K848 (7m) . . . . . With one manual pulse generators

NOTE
Up to two manual pulse generators can be connected to the 21/210–TB. In such a case, signals HA3 and HB3 are not used.

5.4.3 Cable Length When Only One Manual Pulse Generator is Used

Manual pulse generators are supplied with 5 VDC power the same as pulse coders. The drop in voltage due to cable resistance must not exceed 0.2V (on 0V and 5V lines in total).

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

where 0.1 : Power supply current for the manual pulse generator = 0.1 A
R : Wire resistance per unit length [Ω/m]
m : Number of 0–V wires (= number of 5–V wires)
L : Cable length [m]

Therefore,

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

Example: When cable A66L–0001–0286 is used

This cable consists of three pairs of signal lines and six power wires (20/0.18, 0.0394 Ω/m).

When these three cables are used for 0V and 5V lines, the cable length is:

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

The maximum distance is, however, 50 m for the transmission of a pulse signal from the manual pulse generator. The cable length is, therefore, up to 50 m.

The maximum cable length is 38.37 m when using the two manual pulse generators, or 25.58 m when using the three generators.

5.4.4 Requirements for the Manual Pulse Generator Interface

When using a manual pulse generator manufactured by a manufacturer other than FANUC, it must satisfy the following requirements:

Pulse width requirements

Fig. 5.4.4 (a) shows the relation between signals HAn and HBn and the command pulses for the CNC. Set the pulse period (T_1) to 200 μ s or more (i.e., set T_1/4 to 50μ s or more).

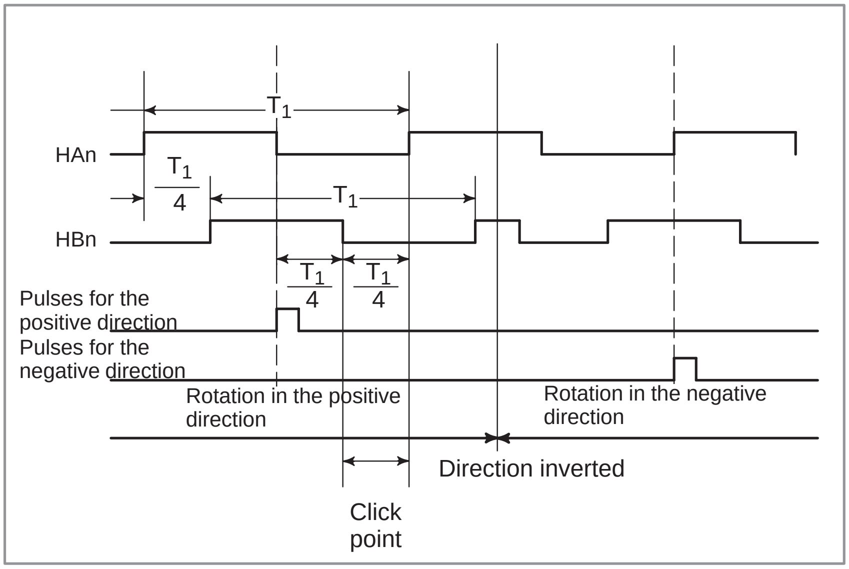


Fig.5.4.4(a)

Receiver requirements

Fig.5.4.4 (b) shows the receiver circuit for signals from the manual pulse generator.

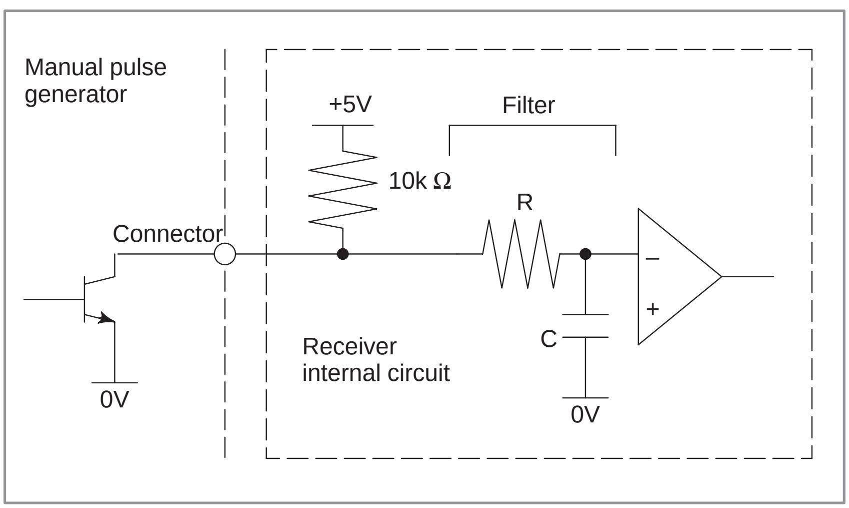


Fig.5.4.4(b)

Switching levels for signals input to the receiver (thresholds)

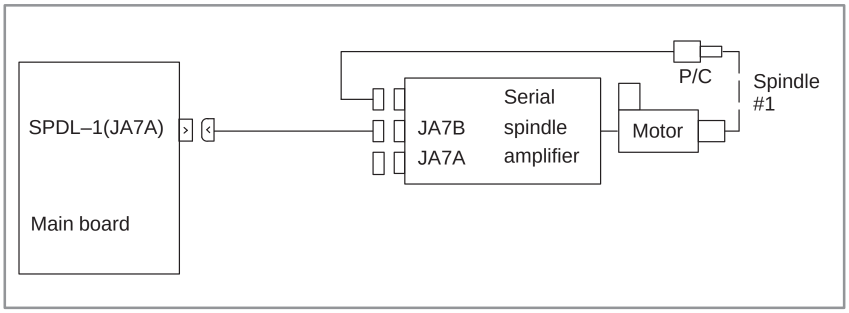
3.7 V or higher when an input signal changes from low to high

1.5 V or lower when an input signal changes from high to low

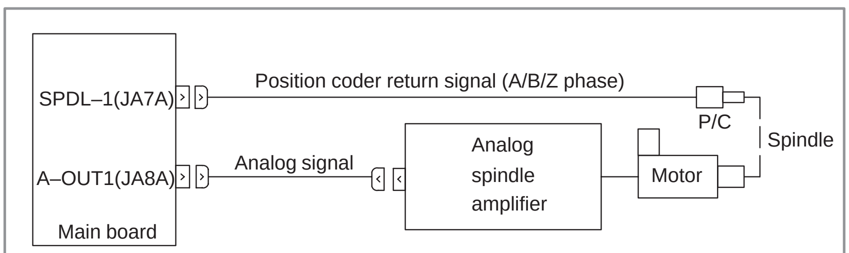
6 SPINDLE CONNECTION

The following two configurations of the spindle interface are available in Series 21.

Serial spindle

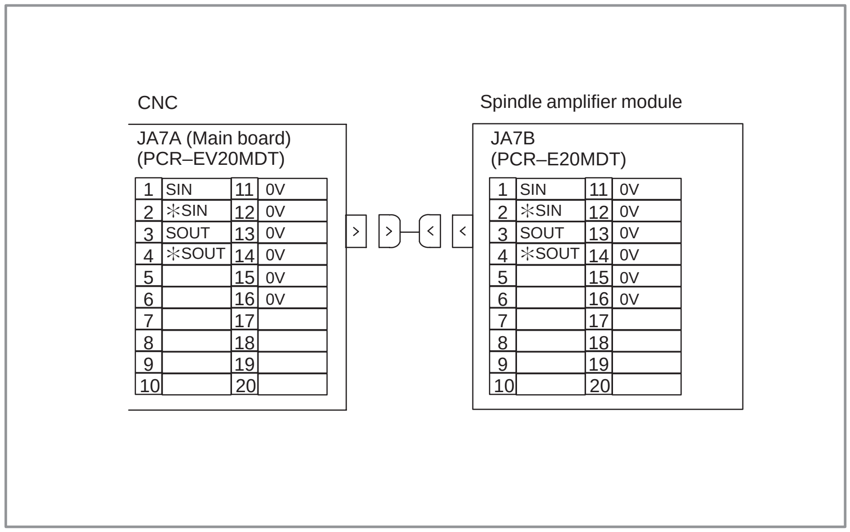


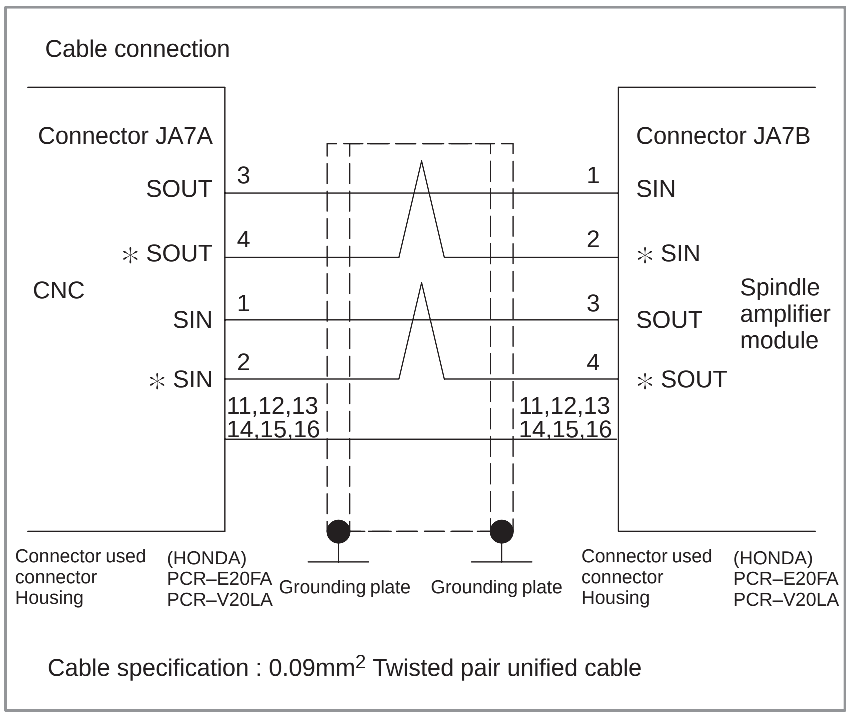
Analog spindle



The position coder return signal is connected to connector JA7A used for connection of the serial spindle.

6.1 SERIAL SPINDLE INTERFACE





6.2 ANALOG SPINDLE INTERFACE

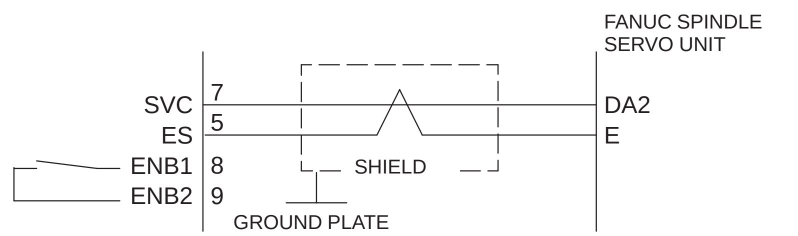
CNC

JA8A (Main board)
(PCR–EV20MDT)

1	0V	11	0V
2	CLKX0	12	CLKX1
3	0V	13	0V
4	FSX0	14	FSX1
5	ES	15	0V
6	DX0	16	DX1
7	SVC	17	–15V
8	ENB1	18	+5V
9	ENB2	19	+15V
10	+15V	20	+5V

Signal name	Description
SVC, ES	Spindle command voltage and common line
ENB1, ENB2	Spindle enable signal (Note 1)
CLKX0, CLKX1, FSX0, FSX1, DX0, DX1, ±15V, +5V, 0V	Feed axis check signal (Note 2)

CABLE WIRING



NOTE

1 ENB1 and 2 turn on when a spindle command voltage is effective. These signals are not used when the FANUC Spindle Servo Unit is used.

2 Feed axis check signal is used when a feed axis is checked or service work is done. This signal is not used for spindle control.

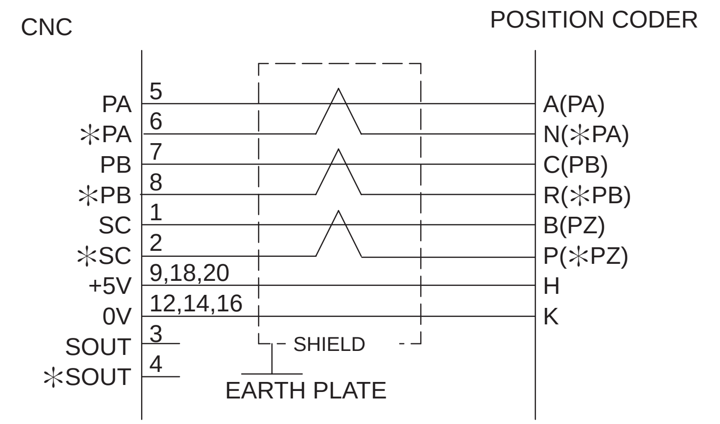
6.3 POSITION CODER INTERFACE

CNC

JA7A(Main board)
(PCR–EV20MDT)

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

Name	Description
SC, *SC	Position coder C–phase signal
PA, *PA	Positon coder A–phase signal
PB, *PB	Position coder B–phase signal
SOUT, *SOUT	Signals for serial spindle (Note)



RECOMMENDED CABLE
A66L–0001–0286 (#20AWG+6×#24AWG×3) MAX LENGTH 20m.

> **NOTE**
> Signals SOUT and *SOUT are for a serial spindle. These signals are not used for an analog spindle.
> This means that if the position coder feedback function is employed in the analog spindle, no serial spindle can be connected.

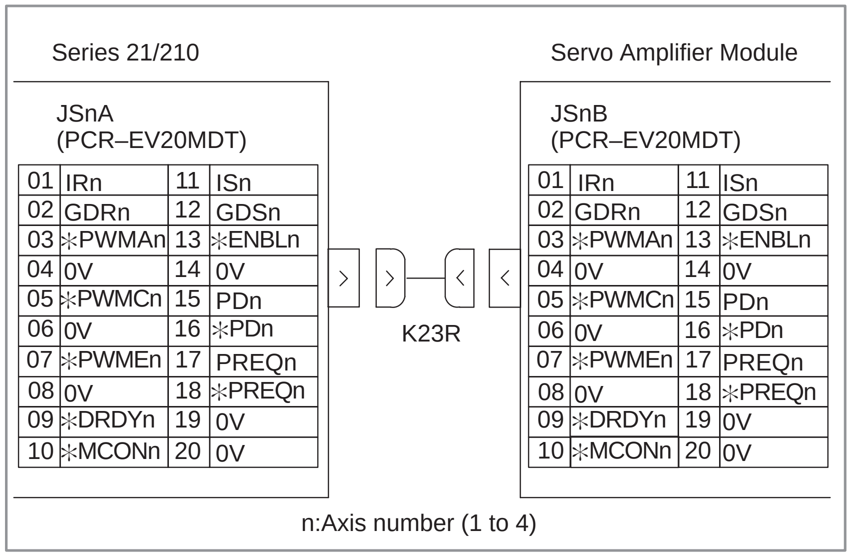
7 SERVO INTERFACE

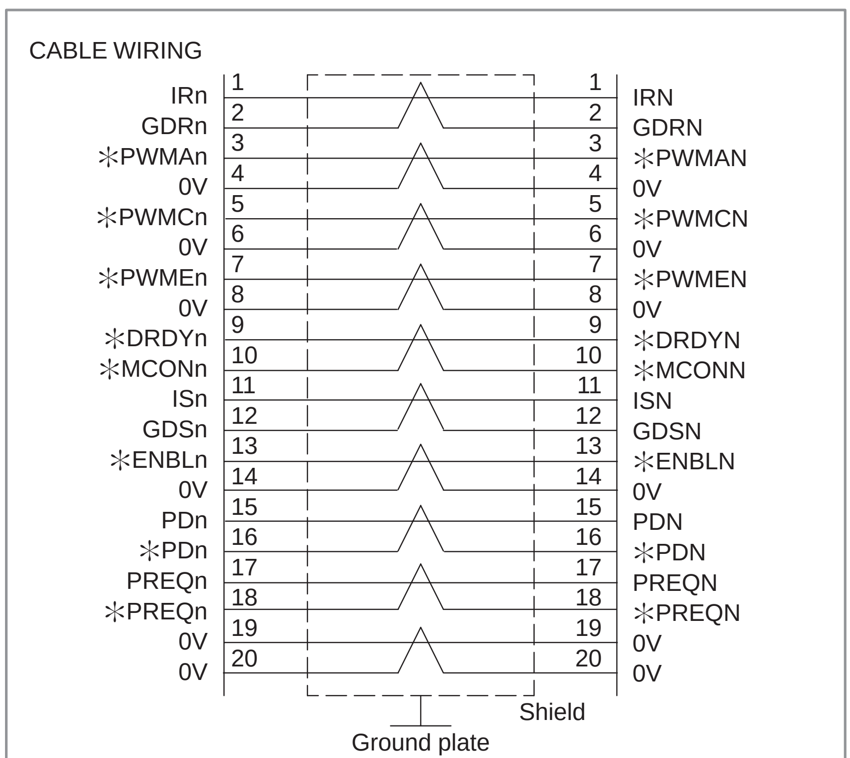
7.1 OUTLINE

This chapter describes how to connect the servo unit to the Series 21/210.

For connection on control motor amplifier α series or β series, refer to the Descriptions manual.

7.1.1 Interface to the Servo Amplifier





RECOMMENDED CABLE MATERIAL
A66L–0001–0284#10P(#28WAG × 10 pair)

RECOMMENDED CABLE SPECIFICATION
A02B–0120–K800(5m)

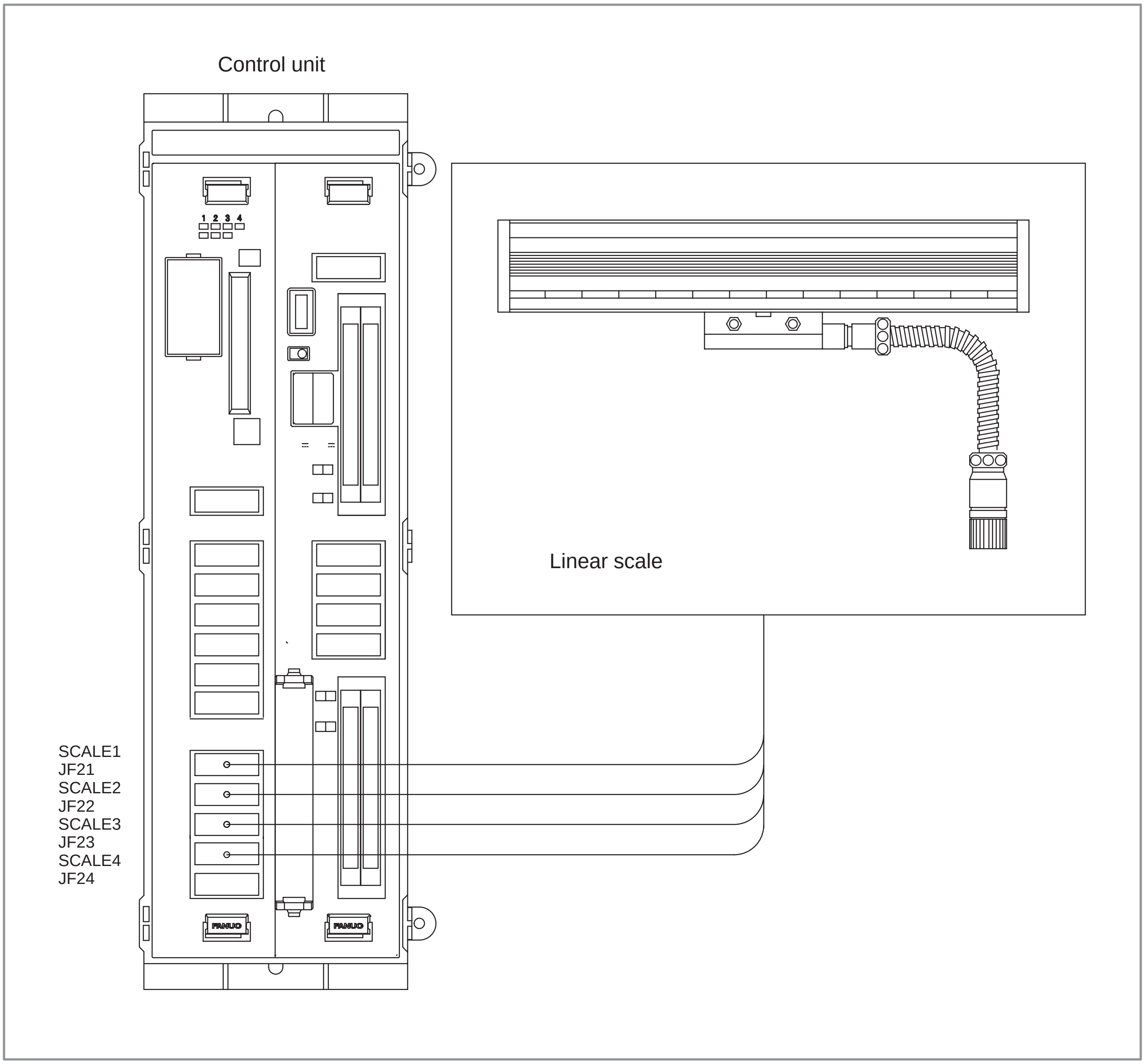
NOTE

1 The total length of the cable between the CNC and amplifier and that between the amplifier and motor shall not exceed 50m.

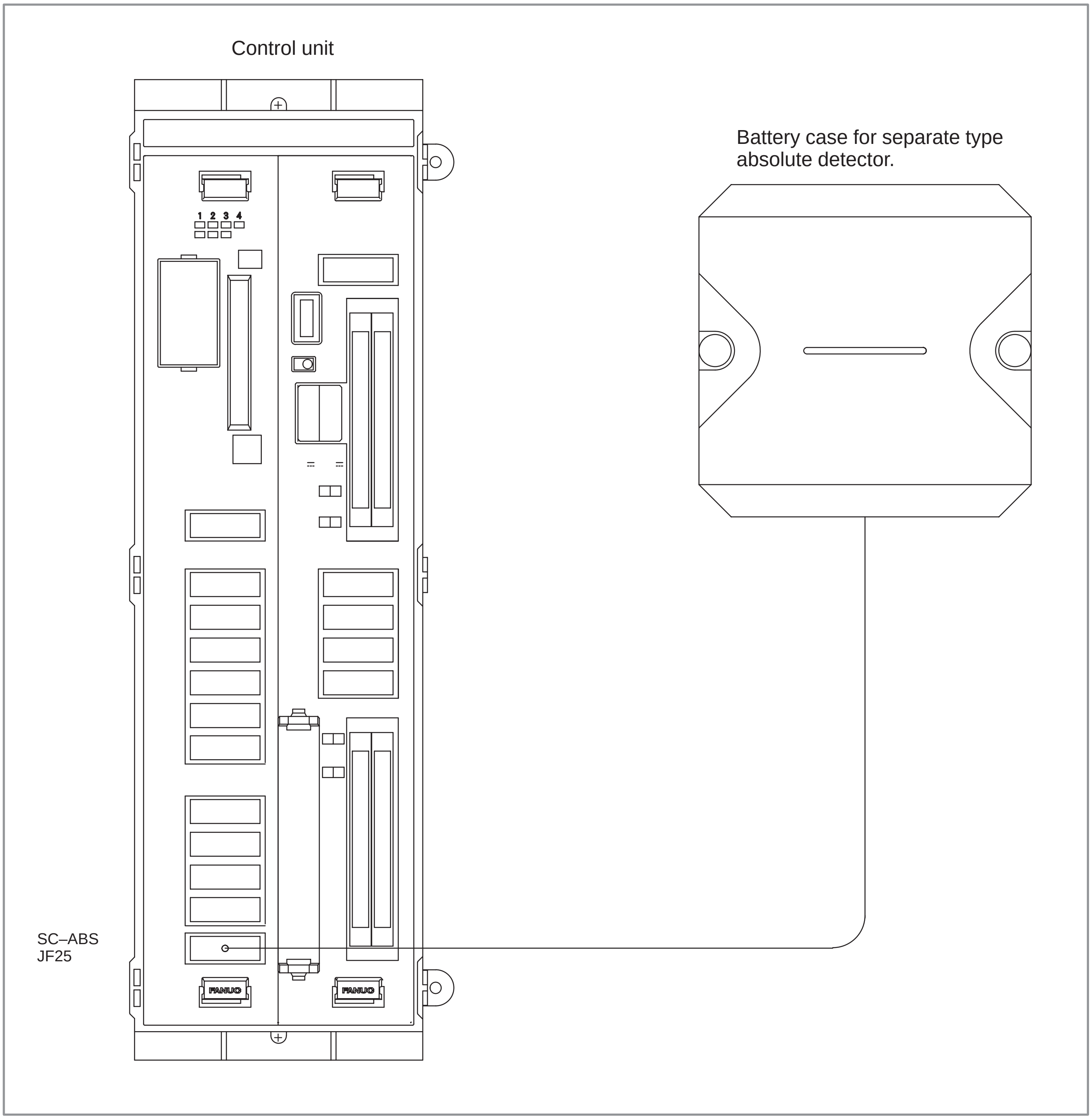
2 As the current feedback lines (IRn and ISn), use the middle twisted pair of the recommended cable. If any other pair is used, abnormal noise or oscillation may occur.

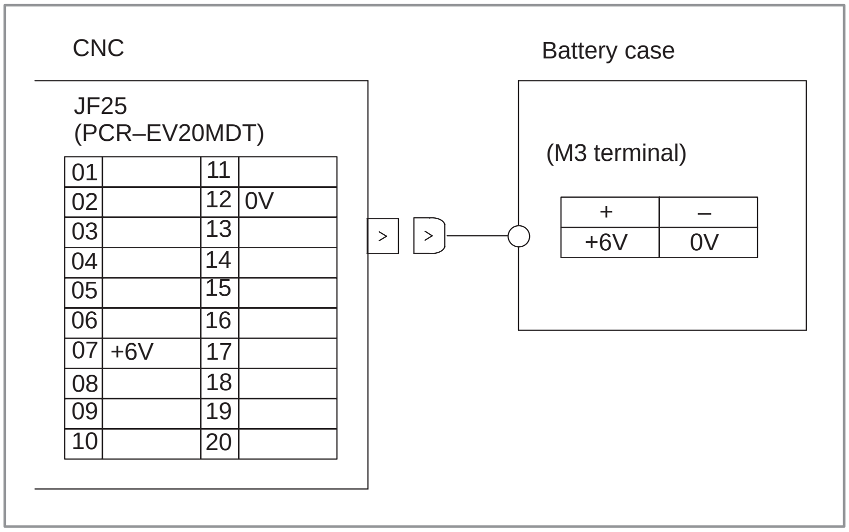
3 The servo interface of the Series 21/210 is type B. Use a servo unit which supports the type–B interface. When using a servo unit which supports both the type–A and type–B interfaces, select the type–B interface. For details, refer to the manual supplied with the servo unit. If the interface setting is incorrect, a servo alarm (AL401 V READY OFF) will be issued.

7.1.2 Separate Type Detector Interface

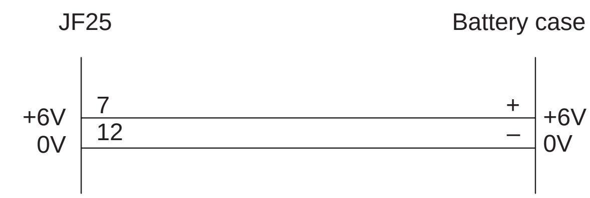


7.1.3 Connection of Battery for Separate Type Absolute Detector





Cable connection



Recommended Cable Material
≧0.2mm²(7/0.18)

Recommended Cable Specification
A02B–0177–K809

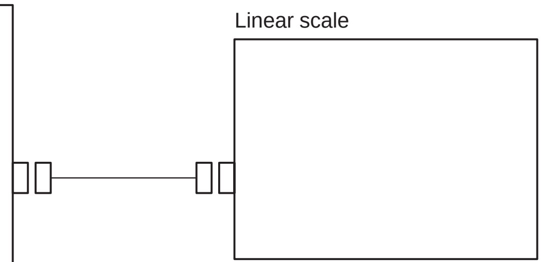
NOTE
This battery is necessary only when a separate–type absolute detector is used. When the absolute pulse coder contained in the motor is used, the battery contained in the amplifier is used; the battery for a separate–type absolute detector is not necessary.

Linear scale interface

CNC

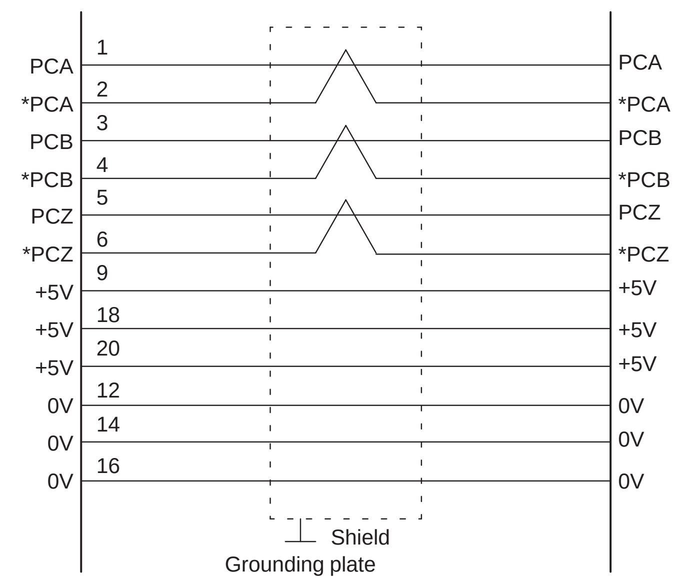
JF21 to JF24
(PCR-EV20MDT)

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



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

Cable wiring



Recommended cable material

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

Separate type pulse coder interface

- **For absolute detector**

CNC

JF21 to JF24,
(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

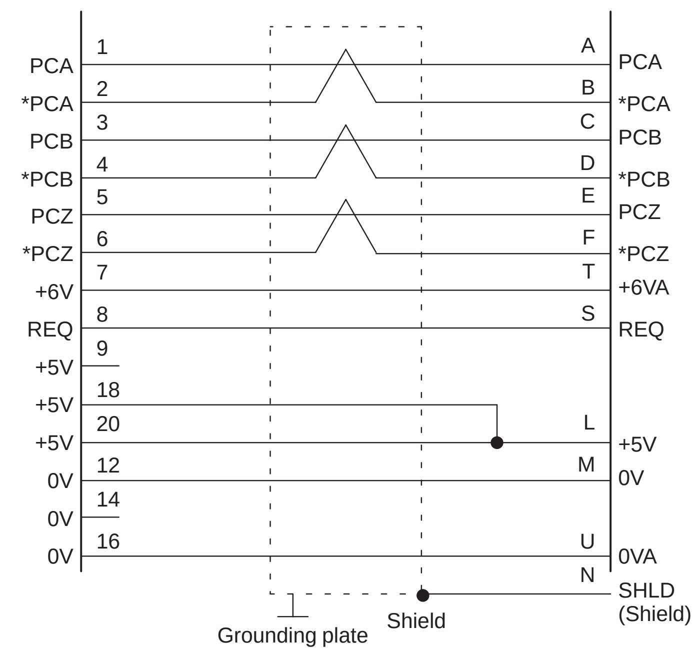
Separate type detector

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

CNC

JF21 to JF24
(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

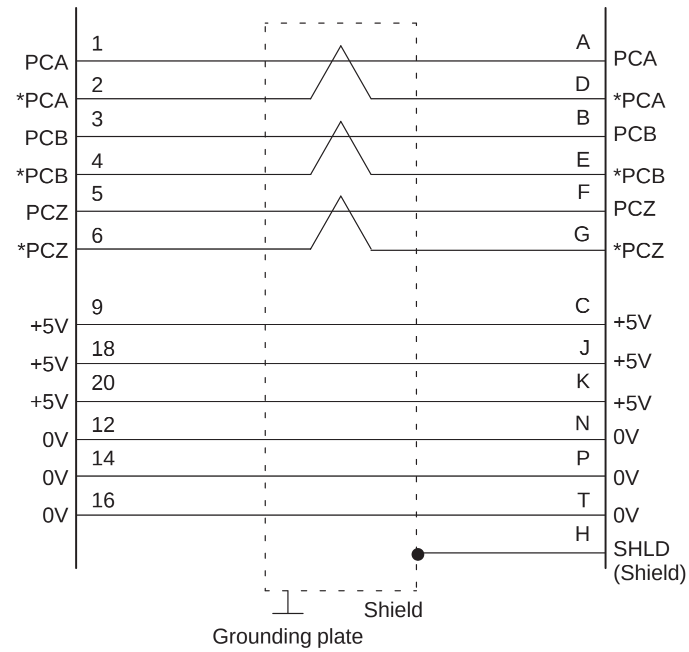
Separate type detector

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



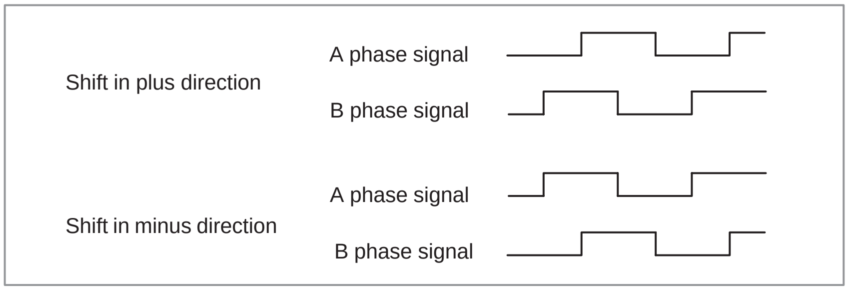
Recommended cable material
A66L-0001-0286 (#20AWG × 6 + #24AWG × 3–pair)

Input signal requirements

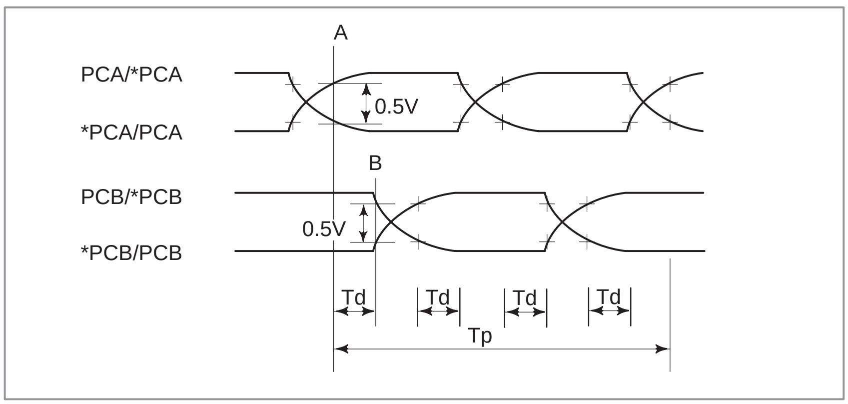
The standard of the feedback signal from the additional detector is as shown below.

(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.

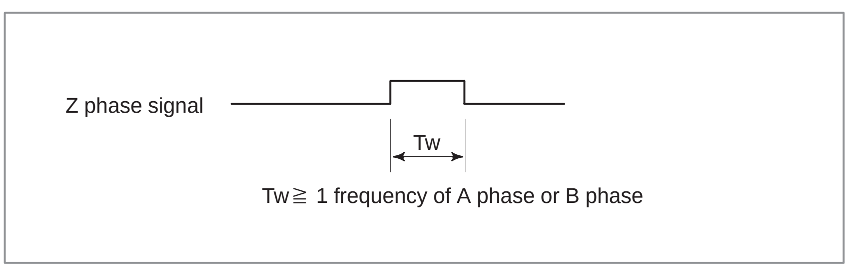


(2) Phase difference and minimum repeat frequency



(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.



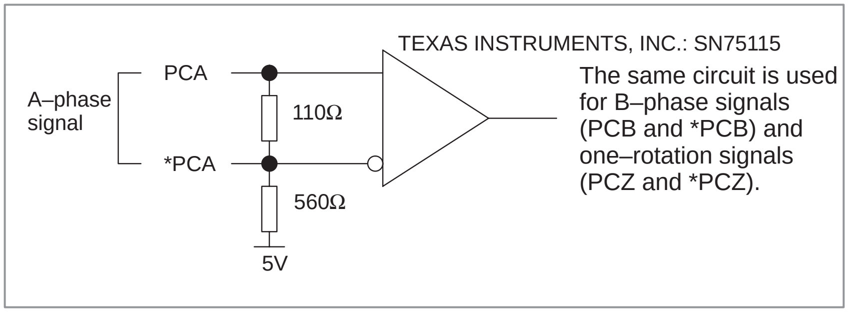
Time requirements

Requirements for the signals at the input pins of input connectors JF21 to JF24

TD $\geqq$ 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.

8 CONNECTING MACHINE INTERFACE I/O

8.1 GENERAL

The Series 21/210 has a built–in I/O board for machine interface I/O. The 21/210–TB has two types of built–in I/O cards, as listed in Table 8.1 (a). The 21/210–MB has four types of built–in I/O cards, as listed in Table 8.1 (b). If the number of DI/DO points is not sufficient, external I/O units such as the FANUC I/O Unit–A can be added using the FANUC I/O Link. MIL ribbon cable connectors are used as the internal connectors for the built–in I/O board to simplify connection with the connector panel.

The built–in I/O board in the Series 21/210–MB includes DI/DO points for the operator's panel. These DI/DO points are provided for connecting switches or LEDs on the operator's panel. The number of signals transferred to or from the operator's panel is reduced by configuring a matrix.

Table 8.1 (a) Machine interface I/O points (for 21/210–TB)

Type	Quantity
External I/O card B	48/32 points
External I/O card A	96/64 points
FANUC I/O Unit–A	1024/1024 (maximum) points per group 1024/1024 (maximum) points in total

Table 8.1 (b) Machine interface I/O points (for 21/210–MB)

<table>
<tr><th>Type</th><th>DI/DO application</th><th>Number of DI/DO points (max.)</th><th>DO type</th></tr>
<tr><td rowspan="2">Built–in I/O board A</td><td>DI/DO for operation panel (matrix)</td><td>64/32</td><td rowspan="2">Sink output</td></tr>
<tr><td>DI/DO for machine</td><td>48/48</td></tr>
<tr><td>Built–in I/O board B</td><td>General purpose DI/DO</td><td>84/64</td><td>Sink output</td></tr>
<tr><td rowspan="2">Built–in I/O board C</td><td>DI/DO for operation panel (matrix)</td><td>64/32</td><td rowspan="2">Source output</td></tr>
<tr><td>DI/DO for machine</td><td>48/48</td></tr>
<tr><td>Built–in I/O board D</td><td>General purpose DI/DO</td><td>96/72</td><td>Source output</td></tr>
<tr><td>I/O unit used with the FANUC I/O Link</td><td>FANUC I/O Link Unit–A</td><td>256/256 per group
1024/1024 in total</td><td></td></tr>
</table>

8.2 CAUTIONS

The following cautions must be observed when using I/O signal receivers and drivers for the machine interface.

8.2.1 DI Signals and Receivers

DI signals are basically of the sink type (a type that drains energy). Some DI signals, however, can be set to either sink type or source type (a type that supplies energy). See the description of the I/O board in the following section for details.

A common signal is provided for selectable receivers. Whether the common signal is connected to 0 V or 24 V determines whether a DI signal is of sink or source type.

A source type DI signal is undesirable from the viewpoint of safety, however, because if the input signal line is grounded, it will be latched in the same state as that existing when the contact is closed. It is recommended that all DI signals be set to sink type.

Always connect the common signal to either 0 or 24 V; do not leave it open.

8.2.2 DO Signals and Drivers

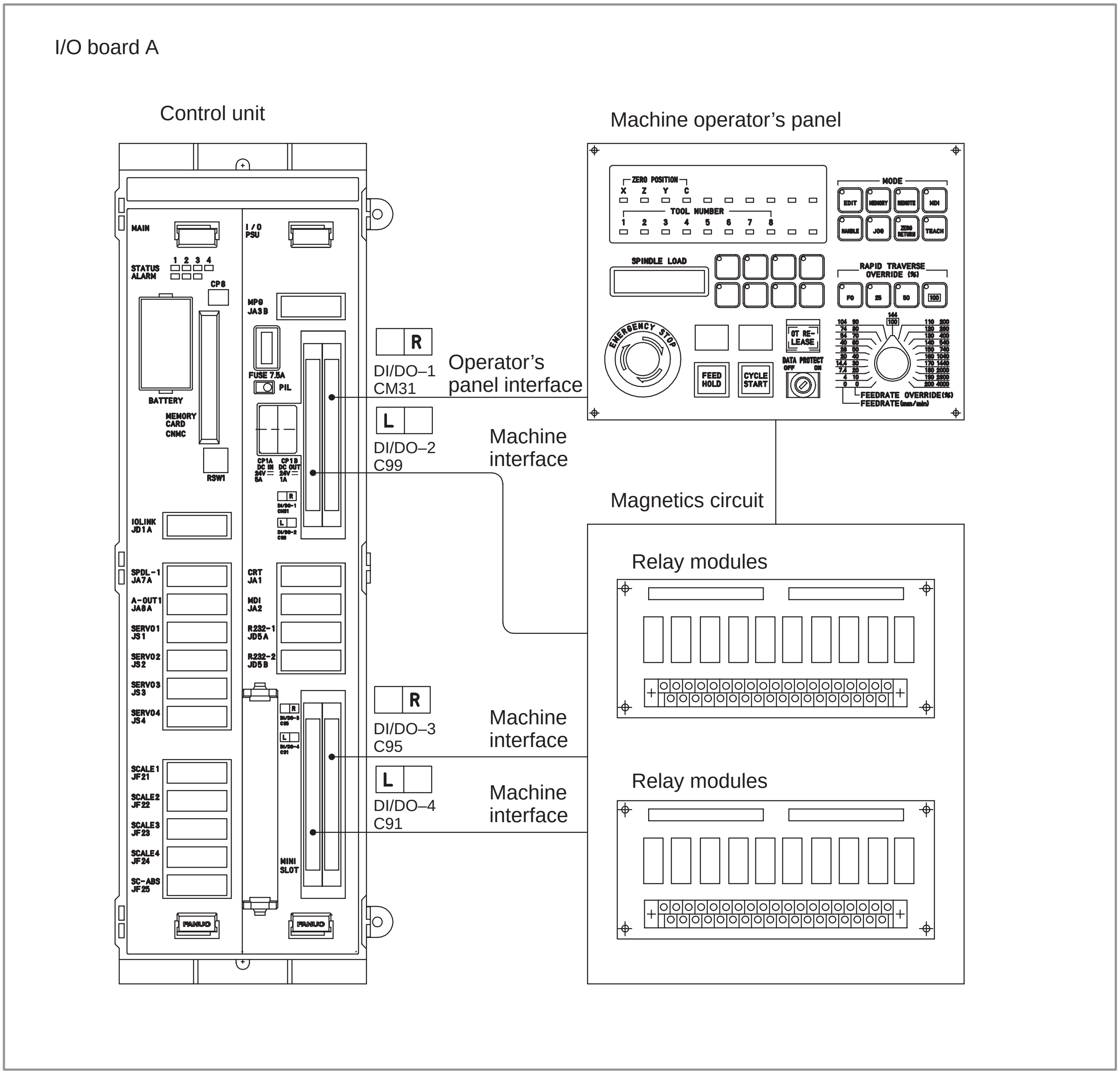
There are two types of DO signals, sink type (a type that drains off energy) and source type (a type that supplies energy). Either type can be selected depending on the type of the built–in I/O board. See the description of the I/O board in the following chapter for details.

A sink type DO signal is undesirable from the viewpoint of safety, however, because if the output signal line is grounded, the output signal remains in the ON state. It is recommended that all DO signals be set to source type.

If a system alarm occurs in a control unit of the Series 21/210, all I/O board drivers are turned off. Keep this in mind when setting up a machine sequence.

The same situation can occur if the power to the control unit is turned off independently.

8.3 BUILT–IN I/O A CONNECTION (FOR 21/210–MB)



8.3.1 Connector Pin Arrangement

C95

HIROSE 50PIN

	A	B
01	+24V	+24V
02	+24V	NET1
03	NET2	NET3
04	NET4	Y1008.0
05	Y1008.1	Y1008.2
06	Y1008.3	Y1008.4
07	Y1008.5	Y1008.6
08	Y1008.7	Y1009.0
09	Y1009.1	Y1009.2
10	Y1009.3	Y1009.4
11	Y1009.5	Y1009.6
12	Y1009.7	Y1010.0
13	Y1010.1	Y1010.2
14	Y1010.3	Y1010.4
15	Y1010.5	Y1010.6
16	Y1010.7	Y1011.0
17	Y1011.1	Y1011.2
18	Y1011.3	Y1011.4
19	Y1011.5	Y1011.6
20	Y1011.7	Y1012.0
21	Y1012.1	Y1012.2
22	Y1012.3	Y1012.4
23	Y1012.5	X1012.4
24	0V	0V
25	0V	0V

C91

HIROSE 50PIN

	A	B
01	+24V	+24V
02	+24V	
03	X1008.0	Y1012.6
04	X1008.1	Y1012.7
05	X1010.7	Y1013.0
06	X1010.6	X1010.5
07	X1010.3	X1008.2
08	X1010.1	X1010.4
09	X1011.0	X1010.2
10	X1008.3	X1010.0
11	X1008.6	X1008.7
12	COM0	X1008.5
13	X1008.4	X1009.4
14	Y1013.1	X1009.0
15	Y1013.2	X1009.1
16	Y1013.3	X1011.1
17	X1011.2	X1011.3
18	X1009.2	X1011.4
19	X1011.5	X1011.6
20	X1011.7	X1012.0
21	X1012.1	X1009.3
22	X1009.7	X1009.6
23	X1009.5	COM1
24	0V	0V
25	0V	0V

CM31

HIROSE 50PIN

	A	B
01	+24V	+24V
02	DICOM1	DICOM2
03	DICOM3	DICOM4
04	DID0	DID1
05	DID2	DID3
06	DID4	DID5
07	DID6	DID7
08	DID8	DID9
09	DID10	DID11
10	DID12	DID13
11	DID14	DID15
12	DOCOM1	DOCOM2
13	DOCOM3	DOCOM4
14	*DOD0	*DOD1
15	*DOD2	*DOD3
16		
17		
18	*DOD8	*DOD9
19	*DOD10	*DOD11
20		
21		
22	NET5	NET6
23	NET7	NET4
24	NET2	NET3
25	0V	0V

C99

HIROSE 50PIN

	A	B
01	+24V	+24V
02	+24V	
03	X1013.0	NET1
04	X1013.1	NET3
05	X1012.7	Y1013.4
06	X1012.6	X1012.5
07	X1012.3	X1013.2
08		
09		X1012.2
10	X1013.3	
11	X1013.6	X1013.7
12	COM2	X1013.5
13	X1013.4	
14	Y1013.5	
15	Y1013.6	
16	Y1013.7	NET2
17		NET4
18		NET5
19	NET6	NET7
20		
21		
22		
23		
24	0V	0V
25	0V	0V

NET1 to NET7 are each connected to the pins with the same name in other connectors.

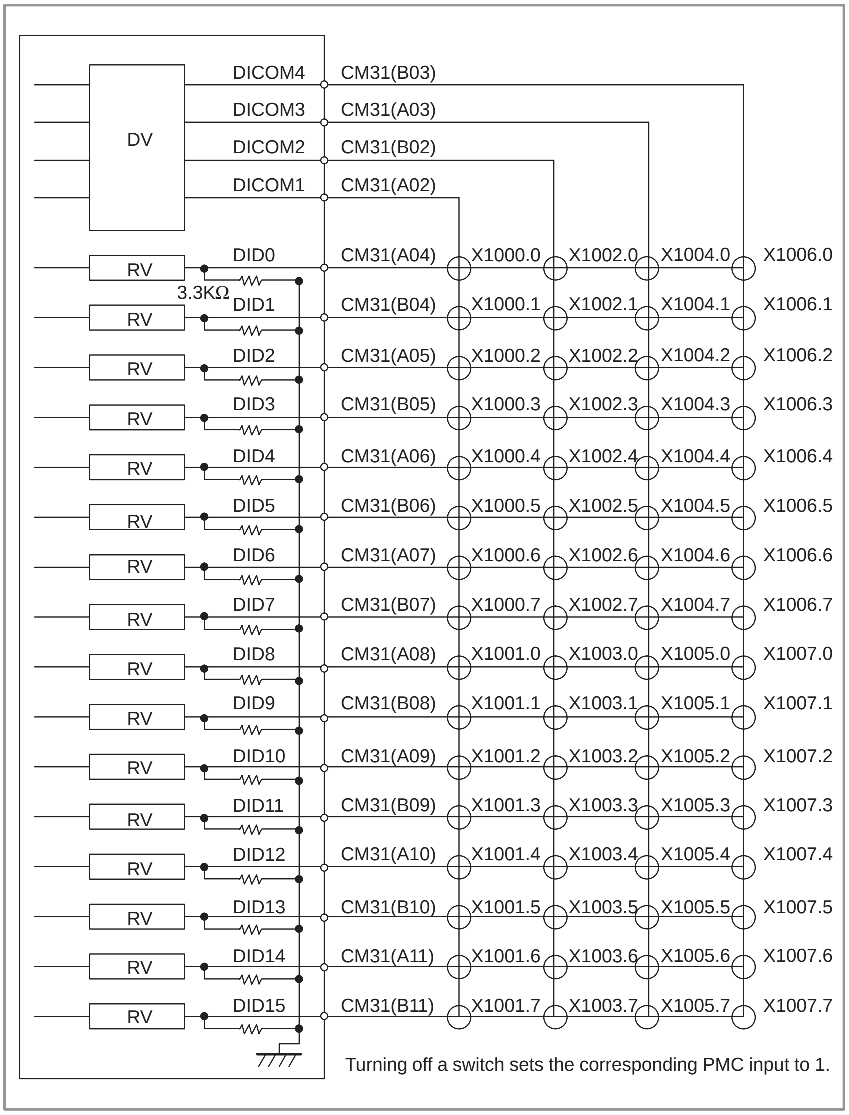
Use these pins to transfer signals between connectors when, for example, sending a signal from the machine operator's panel to the machine.

A receiver having a long delay (5 to 22 ms) is used for X1013. Normal receivers have a delay of 2 ms or less.

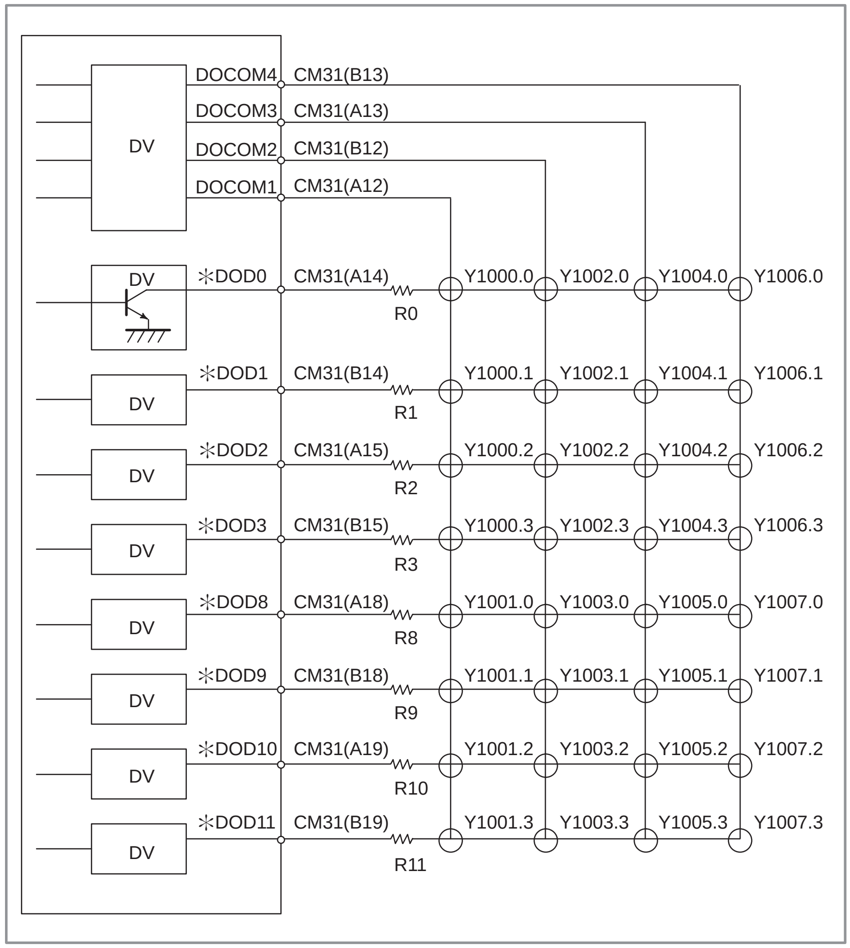
8.3.2 Connection of DI/DO for Operation Panel

The DI/DO points on the operator's panel are provided for connecting switches or LEDs on the machine operator's panel. Connections between the Series 21/210 and the operator's panel are simplified by using a matrix configuration.
The common signals for the DI/DO points on the operator's panel are sequentially turned on or off every 4 ms. The scan cycle is therefore 16 ms.

Example of DI connection



Example of connecting DO for operation panel



Requirements for the DI signals for the operator's panel

Contact capacity: 30 VDC, 16 mA or more

Leakage current between contacts for an open circuit: 1 mA or less (at 26.4 V)

Voltage drop between contacts for a closed circuit: 2 V or less (with 8.5 mA), including the voltage drop from the cables

> Connect a diode for preventing unexpected current flow at each matrix DI point as shown in Fig. 8.3.2 (a). If no diode is connected, more than two switches cannot be on at the same time.
> When three or more switches are on at the same time, data is not entered correctly.
> Use a diode with the following ratings:
> Reverse bias voltage: 30 V
> Reverse current: 1 mA (at 30 V)

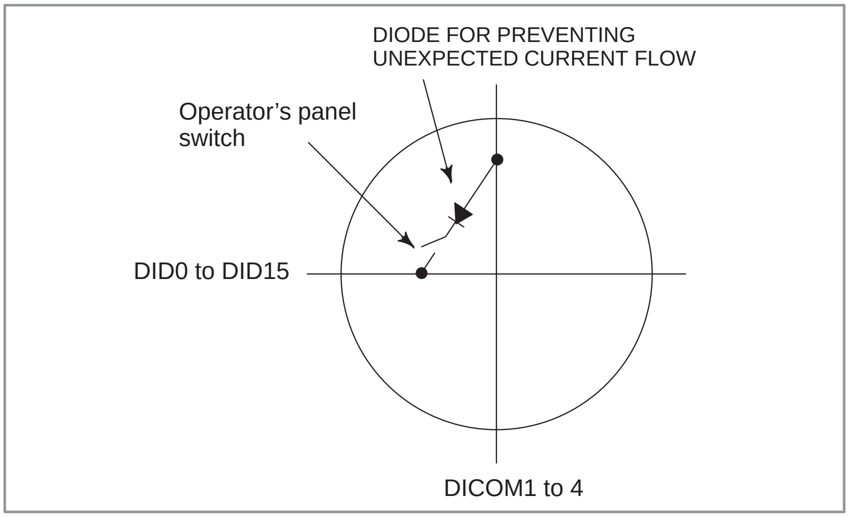


Fig.8.3.2 (a)

Requirements for indicators on the operator's panel that use DO signals

Rated voltage: 24 V or more

Forward current: 25 mA or less

> **NOTE**
> 1 The printed circuit board does not contain resistors for limiting current. Connect resistors R0 to R3 or R8 to R11 shown in the figure below to restrict the current flowing into the indicators.
> Each common line can handle current of up to 160 mA. Select resistors R0 to R3 or R3 to R11 so that the total current flowing into the Y000.0 to Y000.3 and Y001.0 to Y001.3 indicators does not exceed 160 mA.
> 2 For indicators other than LEDs (indicators which light up with current in both directions), a diode for preventing unexpected current flow is necessary in the same way as for matrix DI points.

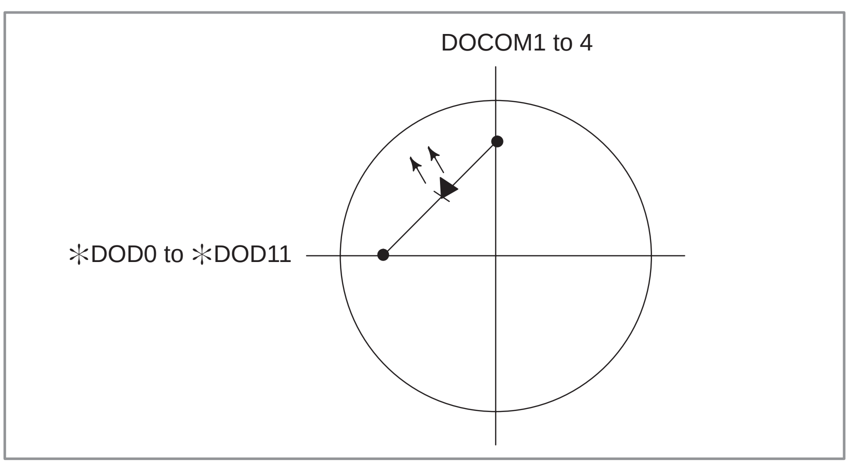
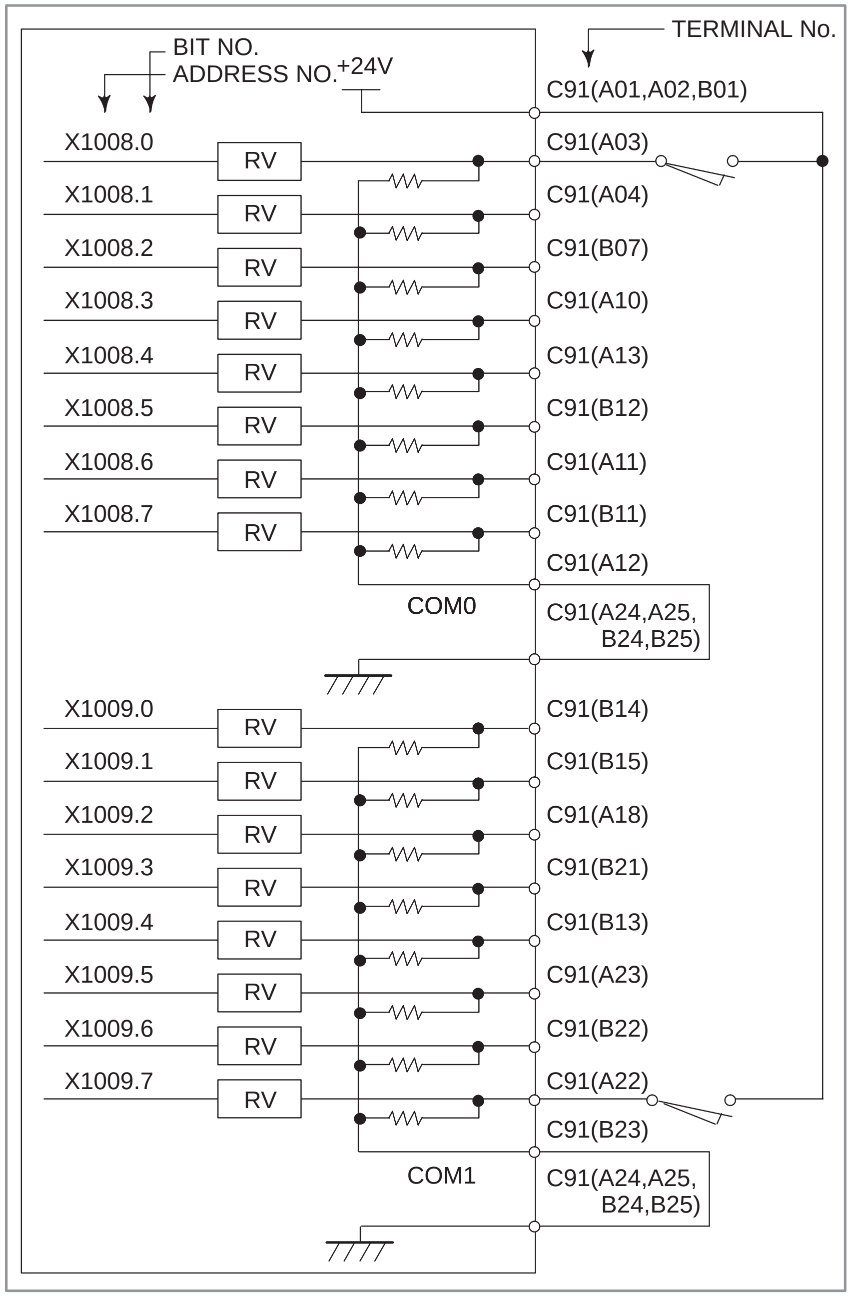


Fig.8.3.2 (b)

8.3.3 Connecting DI/DO Points for the Machine

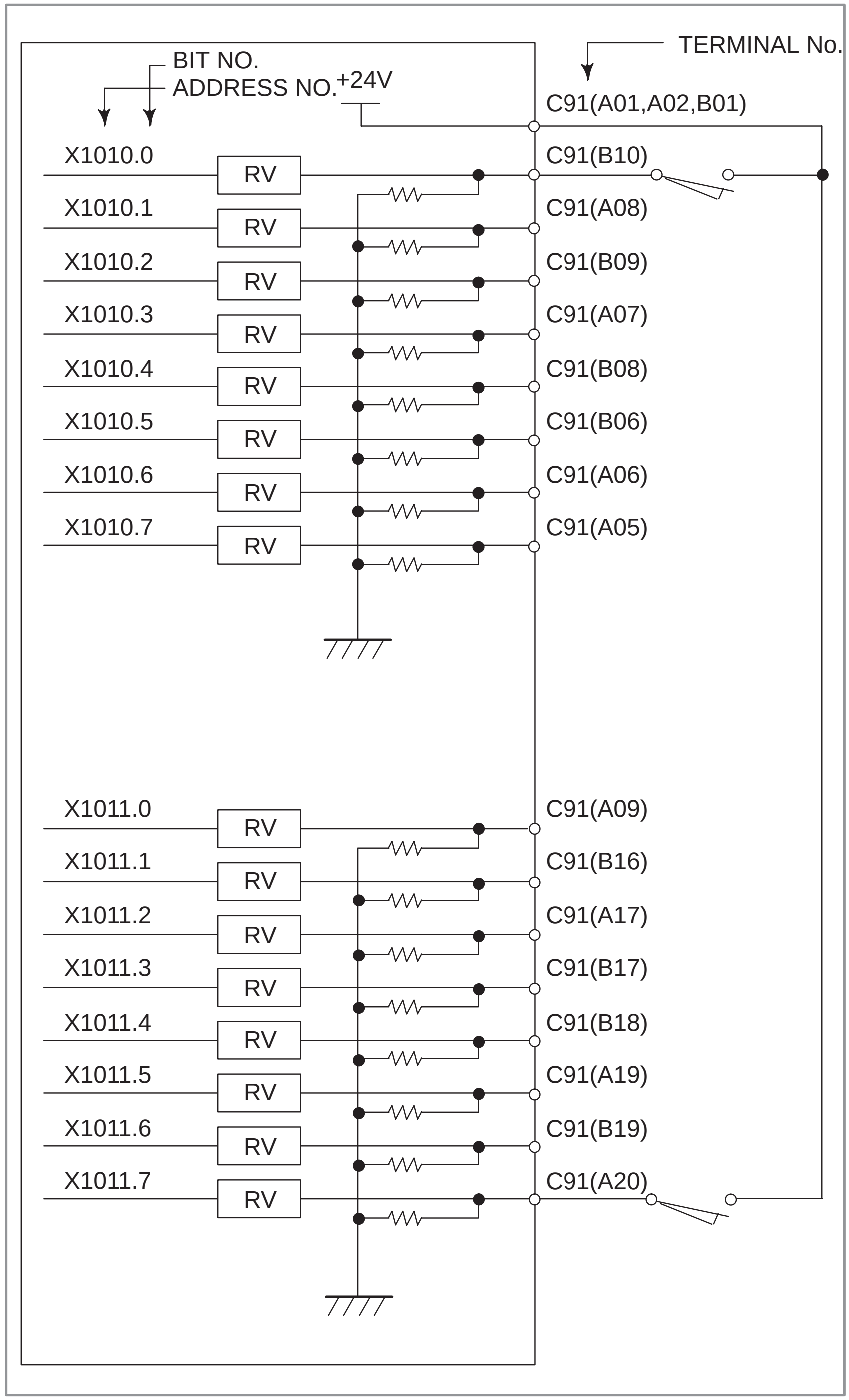
The DI/DO points for the machine include 24 points with sink type (24–V common voltage) and 24 points for which source type or sink type (0–V or 24–V common voltage) can be selected.

Example of DI connection

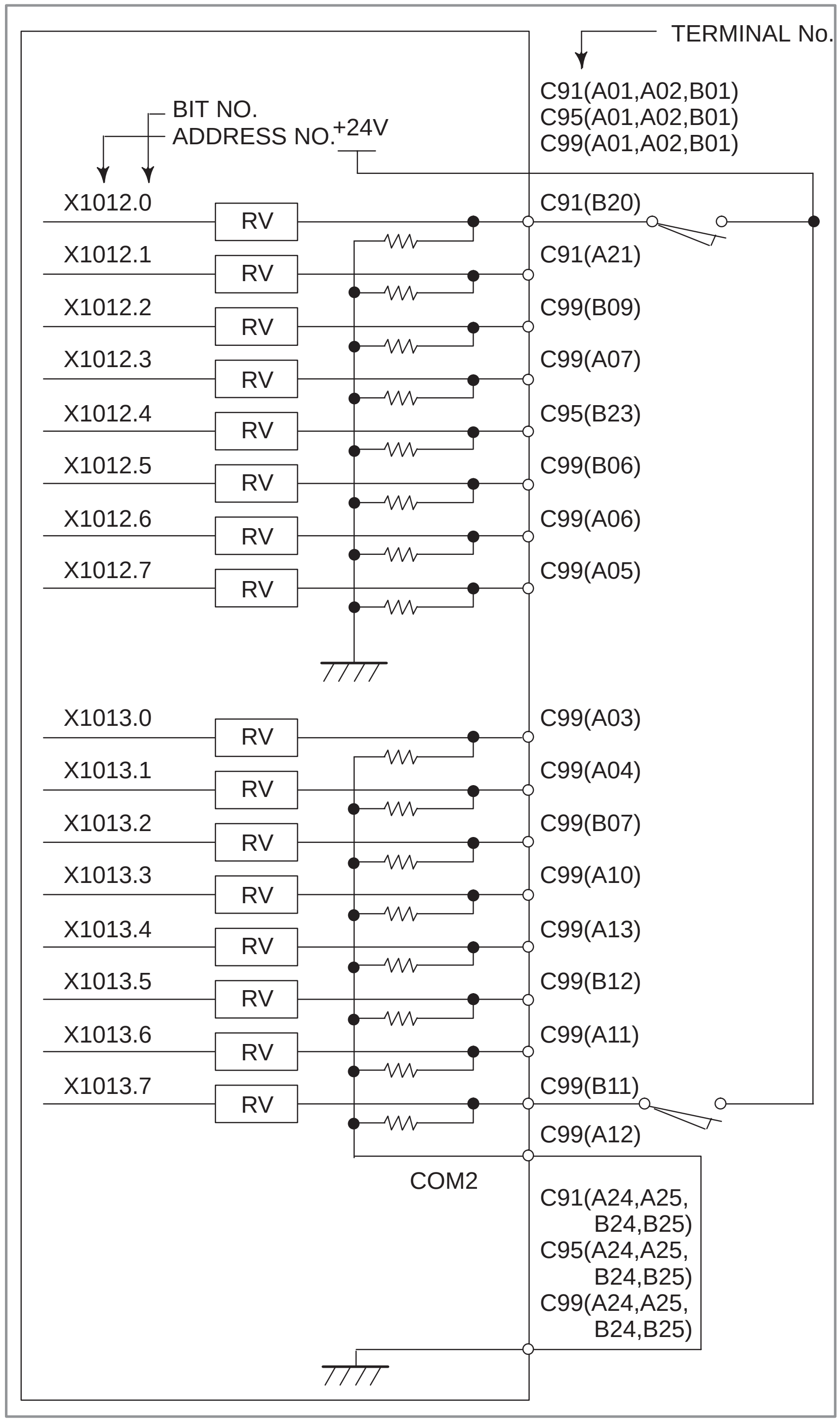


NOTE

For addresses X1008 and X1009, either source or sink type (with a 0– or 24–V common voltage) can be selected. COM0 and COM1 must be connected to either 24 or 0 V; never leave them open. The above diagram shows an example in which the signals are of sink type (with a 24–V common voltage).



The above diagram shows an example in which the signals are of sink type (with a 24–V common voltage).

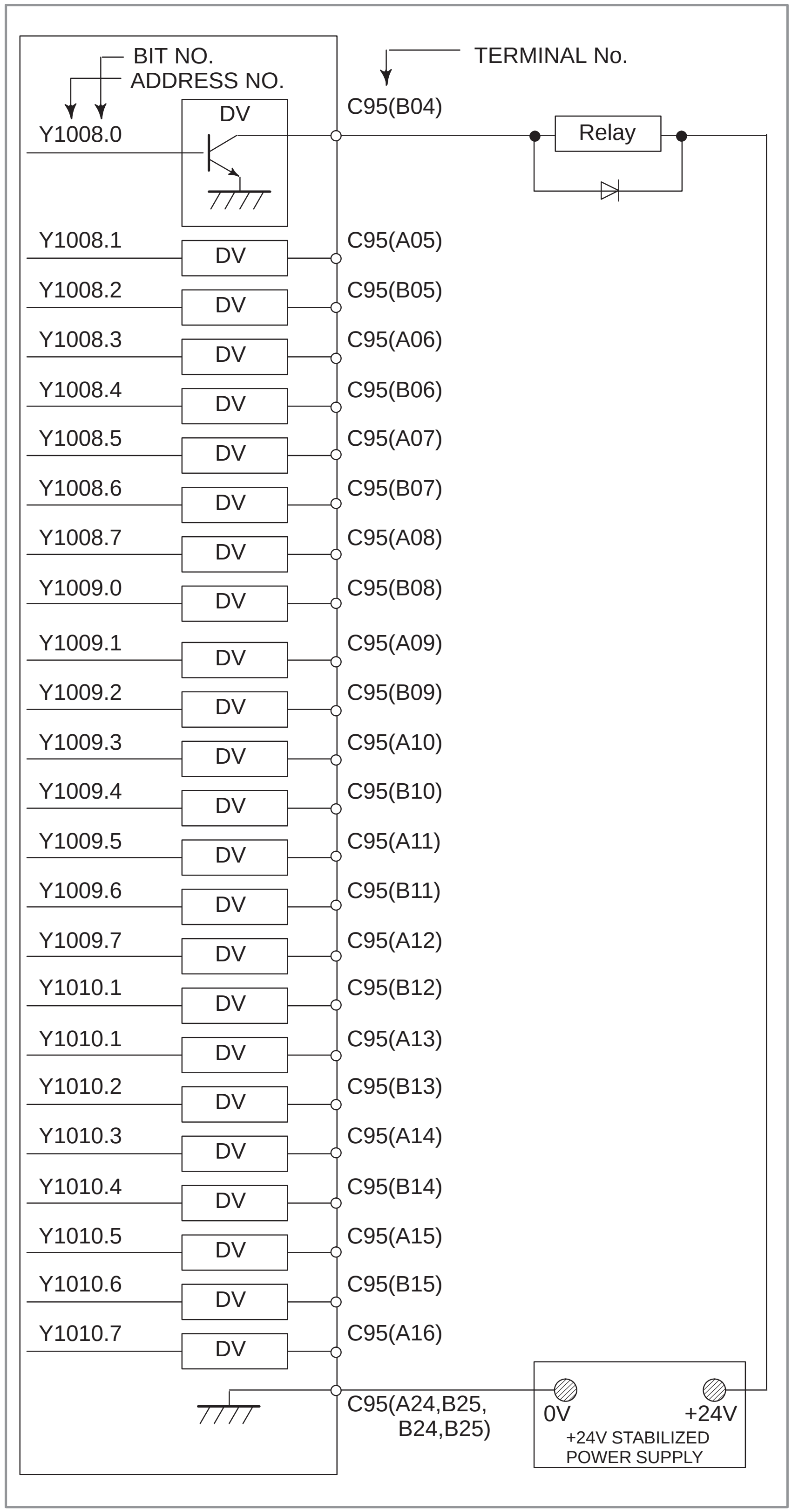


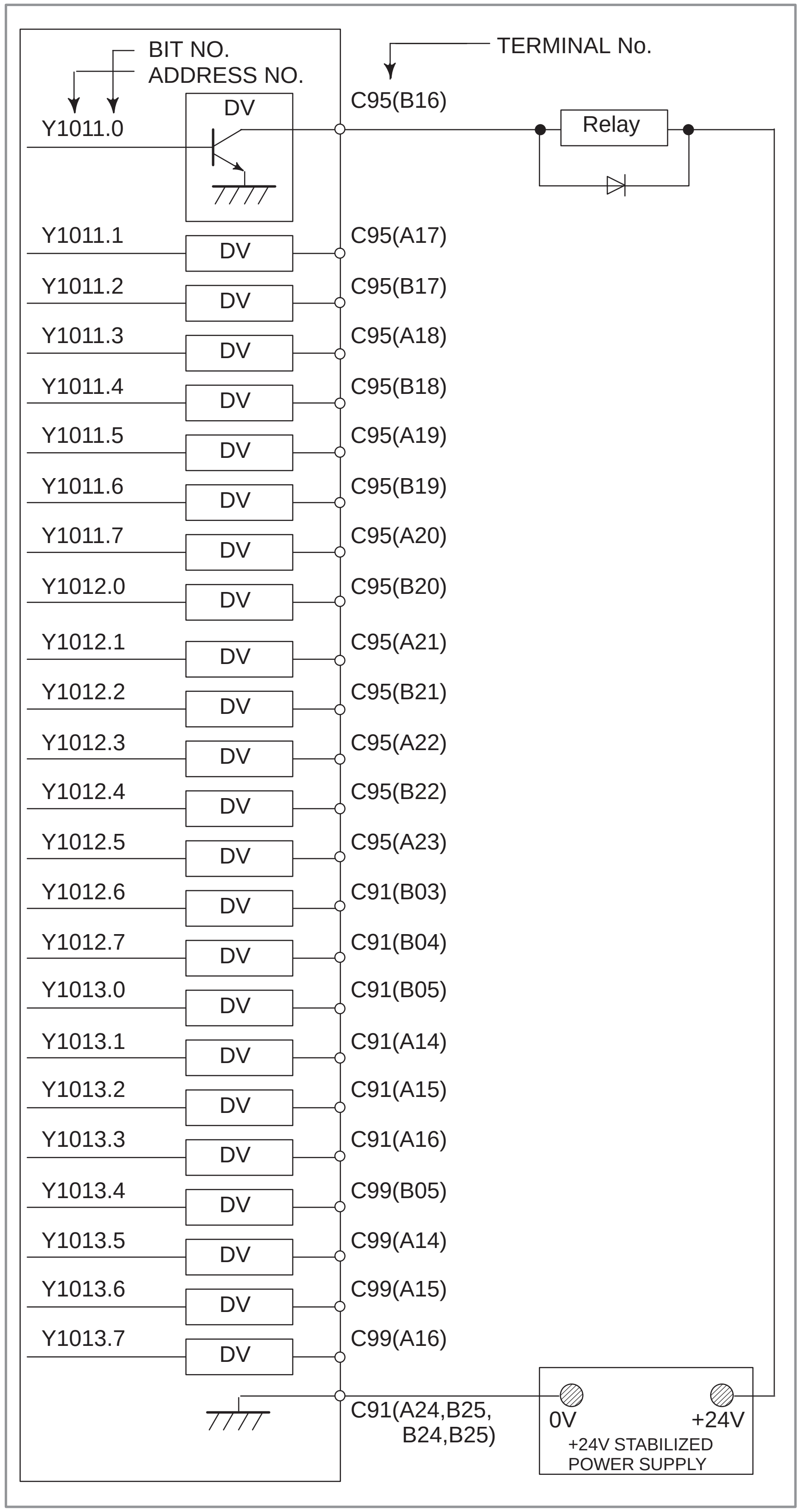
NOTE

A receiver having a long delay (5 to 22 ms) is used for X1013. Normal receivers have a delay of 2 ms or less.

For address X1013, either source or sink type (with a 0– or 24–V common voltage) can be selected. COM2 must be connected to either 24 or 0 V; never leave it open. The above diagram shows an example in which the signal is of sink type (with a 24–V common voltage).

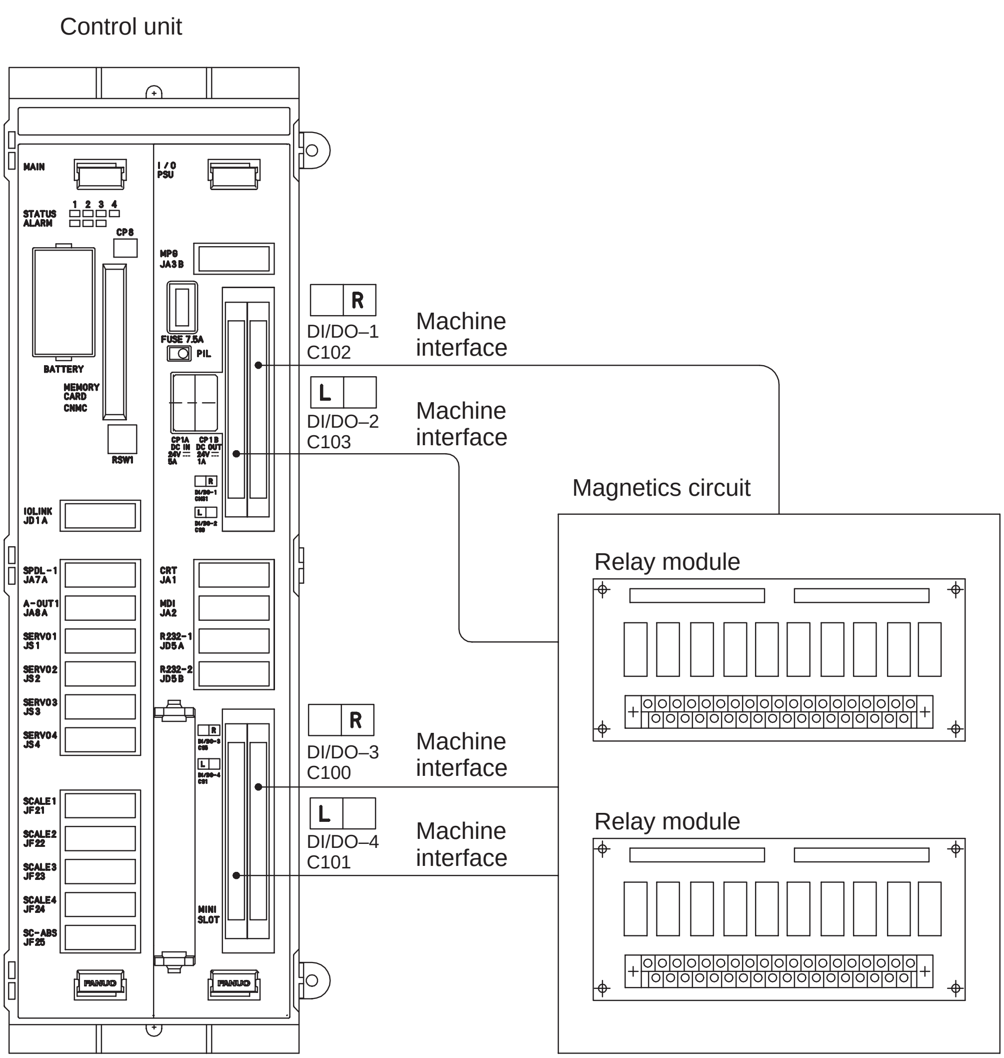
Example of connecting DO for machine




BIT NO.
ADDRESS NO.
TERMINAL No.
Y1011.0
DV
C95(B16)
Relay
Y1011.1 DV C95(A17)
Y1011.2 DV C95(B17)
Y1011.3 DV C95(A18)
Y1011.4 DV C95(B18)
Y1011.5 DV C95(A19)
Y1011.6 DV C95(B19)
Y1011.7 DV C95(A20)
Y1012.0 DV C95(B20)
Y1012.1 DV C95(A21)
Y1012.2 DV C95(B21)
Y1012.3 DV C95(A22)
Y1012.4 DV C95(B22)
Y1012.5 DV C95(A23)
Y1012.6 DV C91(B03)
Y1012.7 DV C91(B04)
Y1013.0 DV C91(B05)
Y1013.1 DV C91(A14)
Y1013.2 DV C91(A15)
Y1013.3 DV C91(A16)
Y1013.4 DV C99(B05)
Y1013.5 DV C99(A14)
Y1013.6 DV C99(A15)
Y1013.7 DV C99(A16)
C91(A24,B25,
B24,B25)
0V
+24V
+24V STABILIZED
POWER SUPPLY

8.4 BUILT–IN I/O CARD B CONNECTION (FOR 21/210–MB)

I/O card B



8.4.1 Connector Pin Arrangement

C100

HIROSE50PIN

	A	B
01	+24V	+24V
02		X1008.0
03	X1008.1	X1008.2
04	X1008.3	X1008.4
05	X1008.5	X1008.6
06	X1008.7	COMX08
07		X1009.0
08	X1009.1	X1009.2
09	X1009.3	X1009.4
10	X1009.5	X1009.6
11	X1009.7	COMX09
12	X1010.0	X1010.1
13	X1010.2	X1010.3
14	Y1008.0	Y1008.1
15	Y1008.2	Y1008.3
16	Y1008.4	Y1008.5
17	Y1008.6	Y1008.7
18	Y1009.0	Y1009.1
19	Y1009.2	Y1009.3
20	Y1009.4	Y1009.5
21	Y1009.6	Y1009.7
22	Y1010.0	Y1010.1
23	Y1010.2	X1010.3
24	0V	0V
25	0V	0V

C101

HIROSE50PIN

	A	B
01	+24V	+24V
02		X1012.0
03	X1012.1	X1012.2
04	X1012.3	X1012.4
05	X1012.5	X1012.6
06	X1012.7	
07		X1013.0
08	X1013.1	X1013.2
09	X1013.3	X1013.4
10	X1013.5	X1013.6
11	X1013.7	COMX13
12	X1010.4	X1010.5
13	X1010.6	X1010.7
14	Y1012.0	Y1012.1
15	Y1012.2	Y1012.3
16	Y1012.4	Y1012.5
17	Y1012.6	Y1012.7
18	Y1013.0	Y1013.1
19	Y1013.2	Y1013.3
20	Y1013.4	Y1013.5
21	Y1013.6	Y1013.7
22	Y1010.4	Y1010.5
23	Y1010.6	Y1010.7
24	0V	0V
25	0V	0V

C102

HIROSE50PIN

	A	B
01	+24V	+24V
02	X1000.0	X1000.1
03	X1000.2	X1000.3
04	X1000.4	X1000.5
05	X1000.6	X1000.7
06	X1001.0	X1001.1
07	X1001.2	X1001.3
08	X1001.4	X1001.5
09	X1001.6	X1001.7
10	X1002.0	X1002.1
11	X1002.2	X1002.3
12	X1002.4	X1002.5
13	X1002.6	X1002.7
14	X1004.0	X1004.1
15	X1004.2	X1004.3
16	Y1000.0	Y1000.1
17	Y1000.2	Y1000.3
18	Y1000.4	Y1000.5
19	Y1000.6	Y1000.7
20	Y1001.0	Y1001.1
21	Y1001.2	Y1001.3
22	Y1001.4	Y1001.5
23	Y1001.6	Y1001.7
24	0V	0V
25	0V	0V

C103

HIROSE50PIN

	A	B
01	+24V	+24V
02	X1003.0	X1003.1
03	X1003.2	X1003.3
04	X1003.4	X1003.5
05	X1003.6	X1003.7
06		
07		
08		
09		
10	X1011.0	X1011.1
11	X1011.2	X1011.3
12	X1011.4	X1011.5
13	X1011.6	X1011.7
14		
15		
16		
17		
18		
19		
20	Y1011.0	Y1011.1
21	Y1011.2	Y1011.3
22	Y1011.4	Y1011.5
23	Y1011.6	Y1011.7
24	0V	0V
25	0V	0V

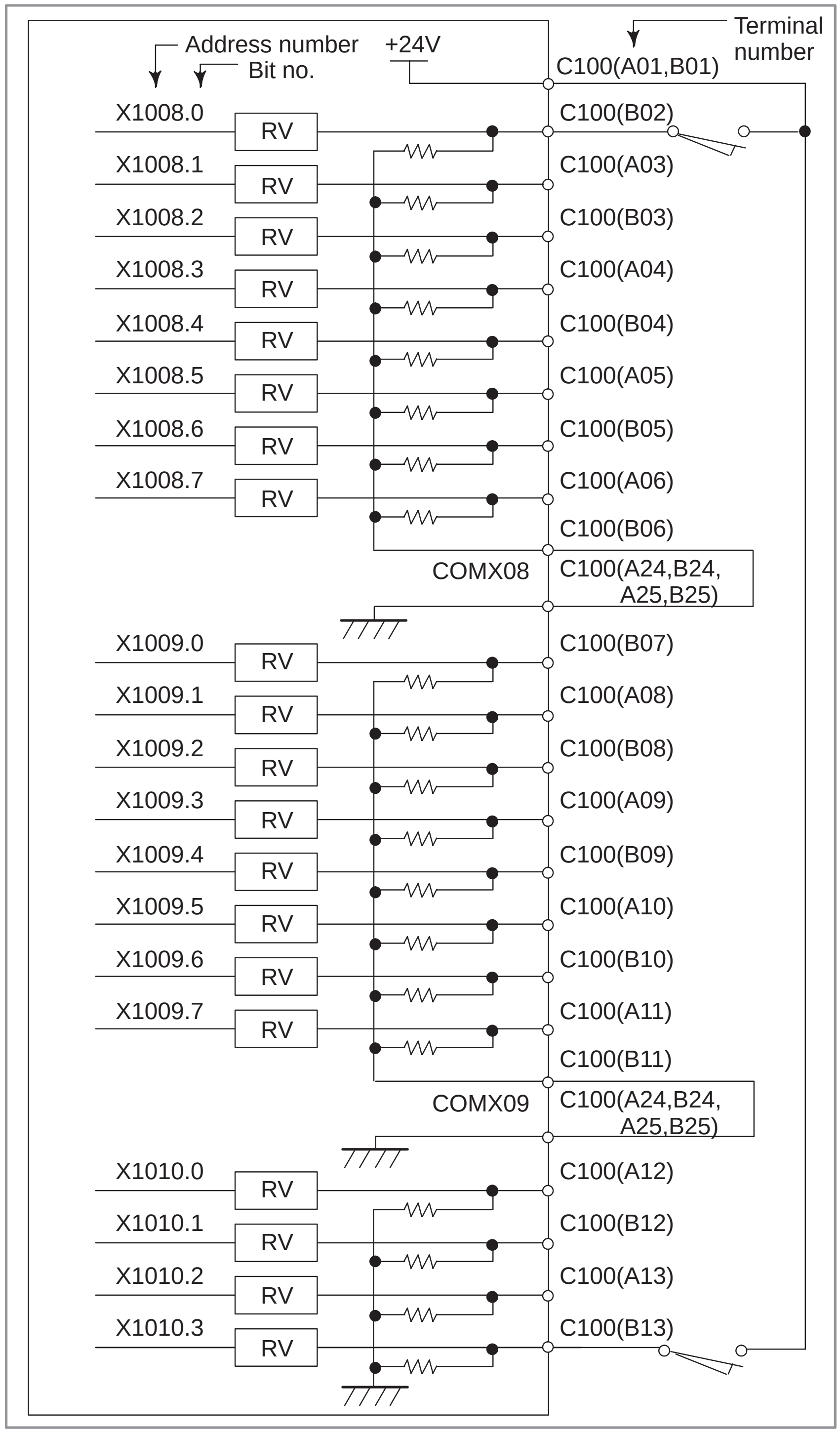
NOTE

1 The following DIs cannot be used (addresses not listed in above pin layout).
X1004.4 to X1004.7, X1005.0 to X1005.7
X1006.0 to X1006.7, X1007.0 to X1007.7
X1014.0 or later

2 The following DOs cannot be used (addresses not listed in above pin layout)
Y1002.0 to Y1002.7, Y1003.0 to Y1003.7
Y1004.4 to Y1004.7, Y1005.0 to Y1005.7
Y1006.0 to Y1006.7, Y1007.0 to Y1007.7
Y1014.0 or later

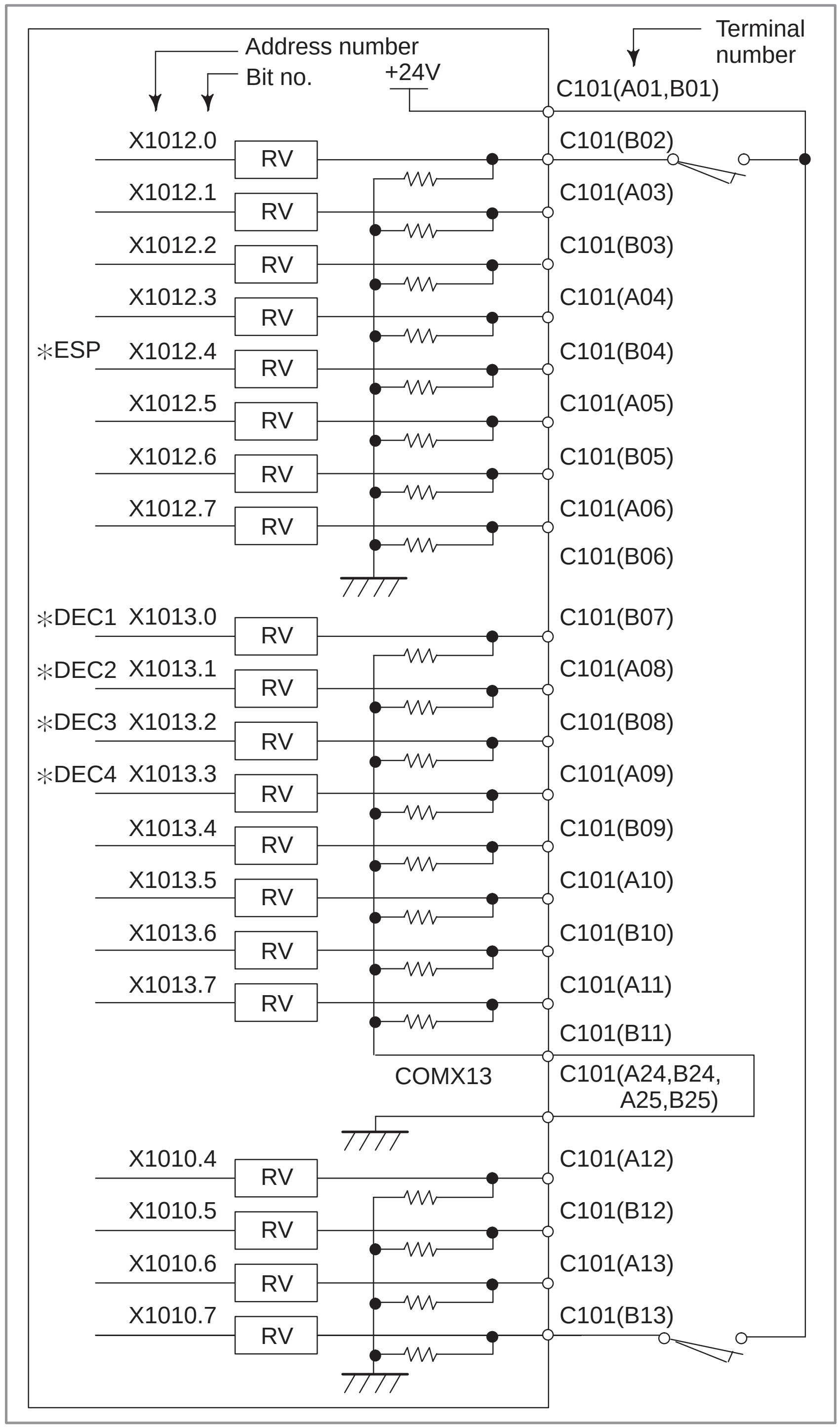
A receiver having a long delay (5 to 22 ms) is used for X1013. Normal receivers have a delay of 2 ms or less.

8.4.2 Connection of DI



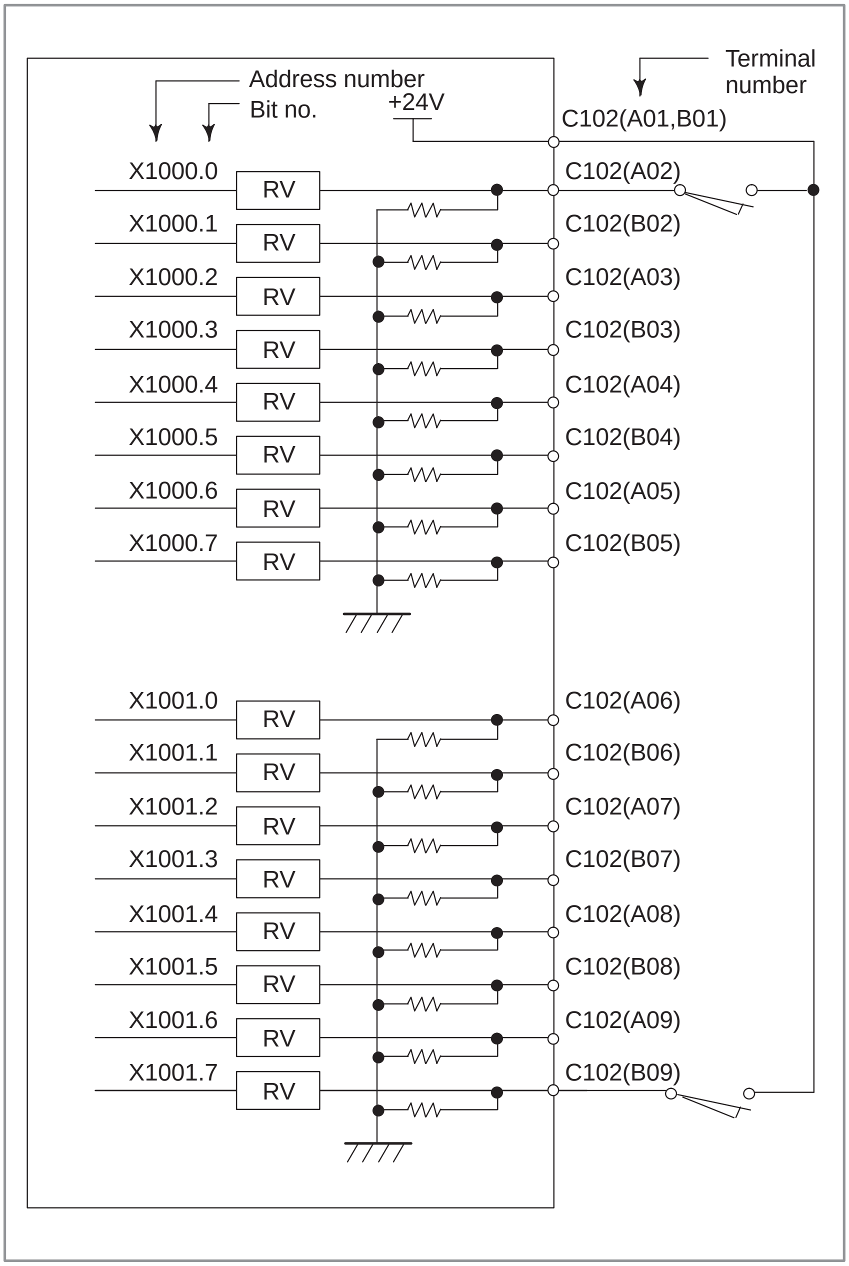
NOTE

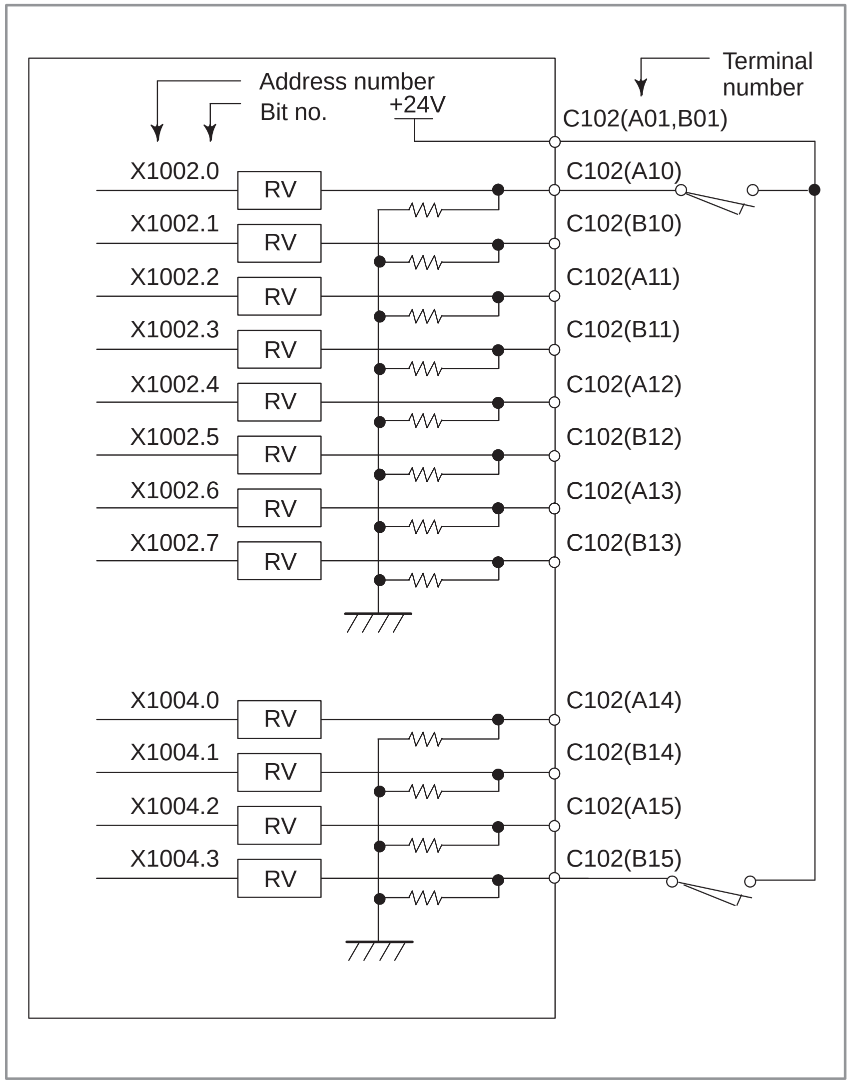
For addresses X1008 and X1009, either source or sink type (with a 0– or 24–V common voltage) can be selected. COMX08 and COMX09 must be connected to either 24 or 0 V; never leave them open. The above diagram shows an example in which the signals are of sink type (with a 24–V common voltage).



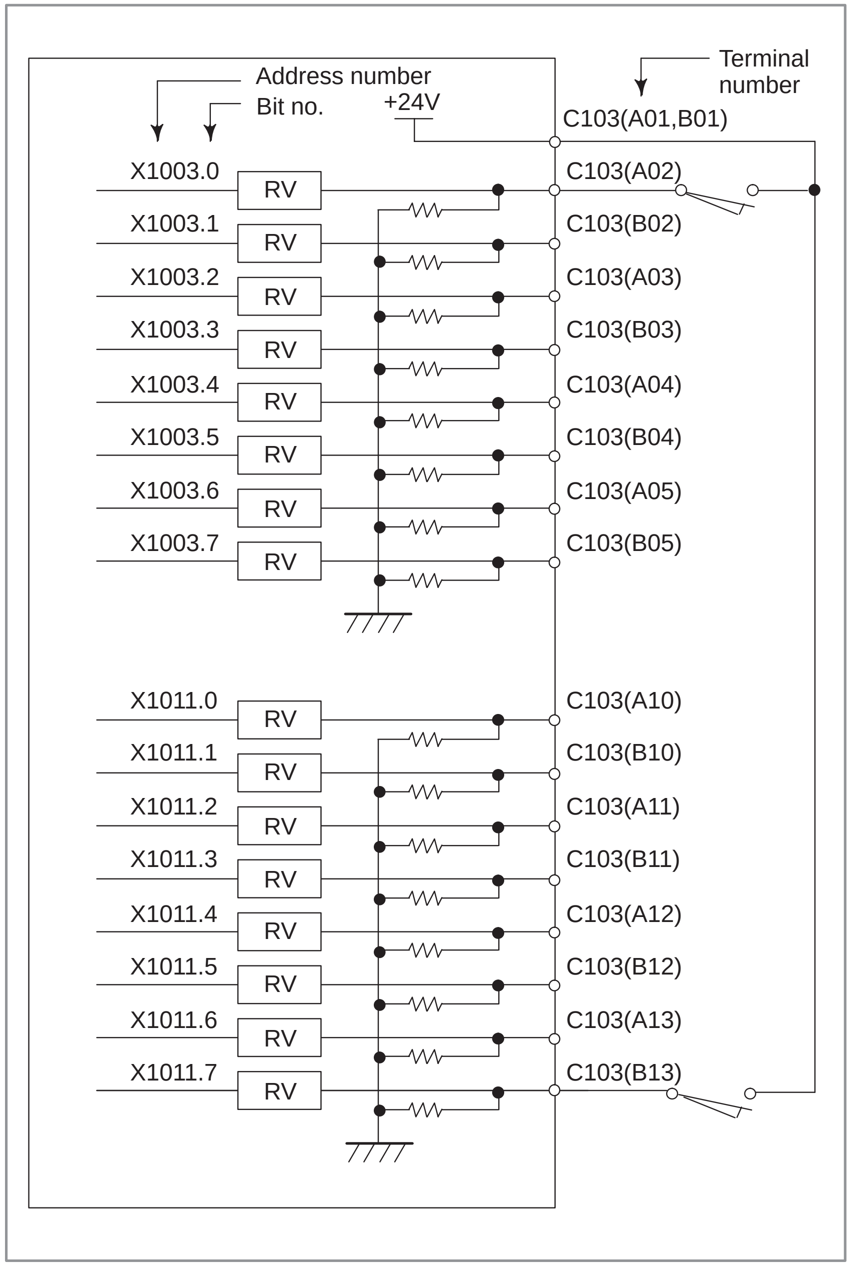
NOTE

A receiver having a long delay (5 to 22 ms) is used for X1013. Normal receivers have a delay of 2 ms or less.
For address X1013, either source or sink type (with a 0– or 24–V common voltage) can be selected. COMX13 must be connected to either 24 or 0 V; never leave it open. The above diagram shows an example in which the signal is of sink type (with a 24–V common voltage).

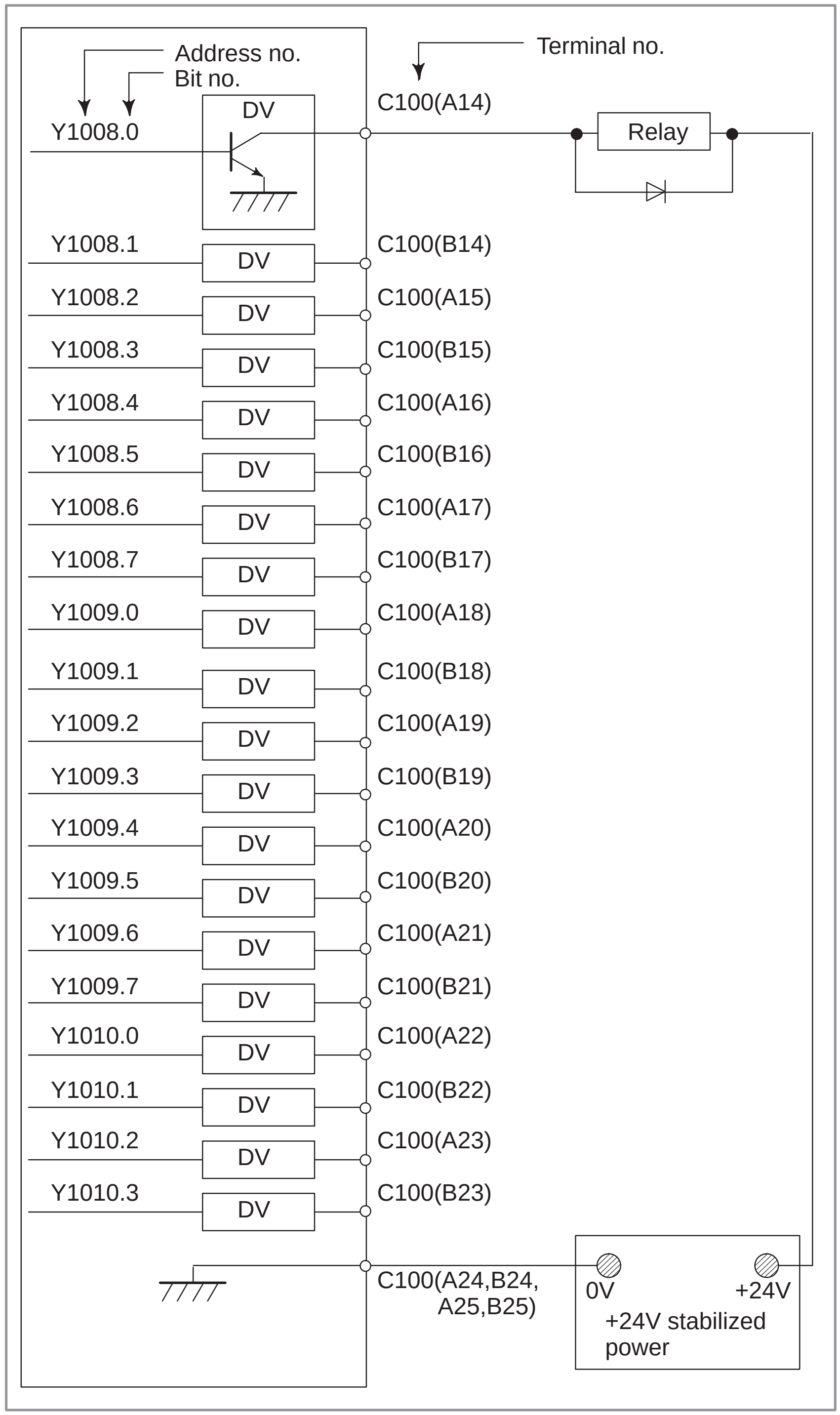

Address number
Bit no.
+24V
Terminal number
C102(A01,B01)
X1000.0
X1000.1
X1000.2
X1000.3
X1000.4
X1000.5
X1000.6
X1000.7
RV
C102(A02)
C102(B02)
C102(A03)
C102(B03)
C102(A04)
C102(B04)
C102(A05)
C102(B05)
X1001.0
X1001.1
X1001.2
X1001.3
X1001.4
X1001.5
X1001.6
X1001.7
C102(A06)
C102(B06)
C102(A07)
C102(B07)
C102(A08)
C102(B08)
C102(A09)
C102(B09)

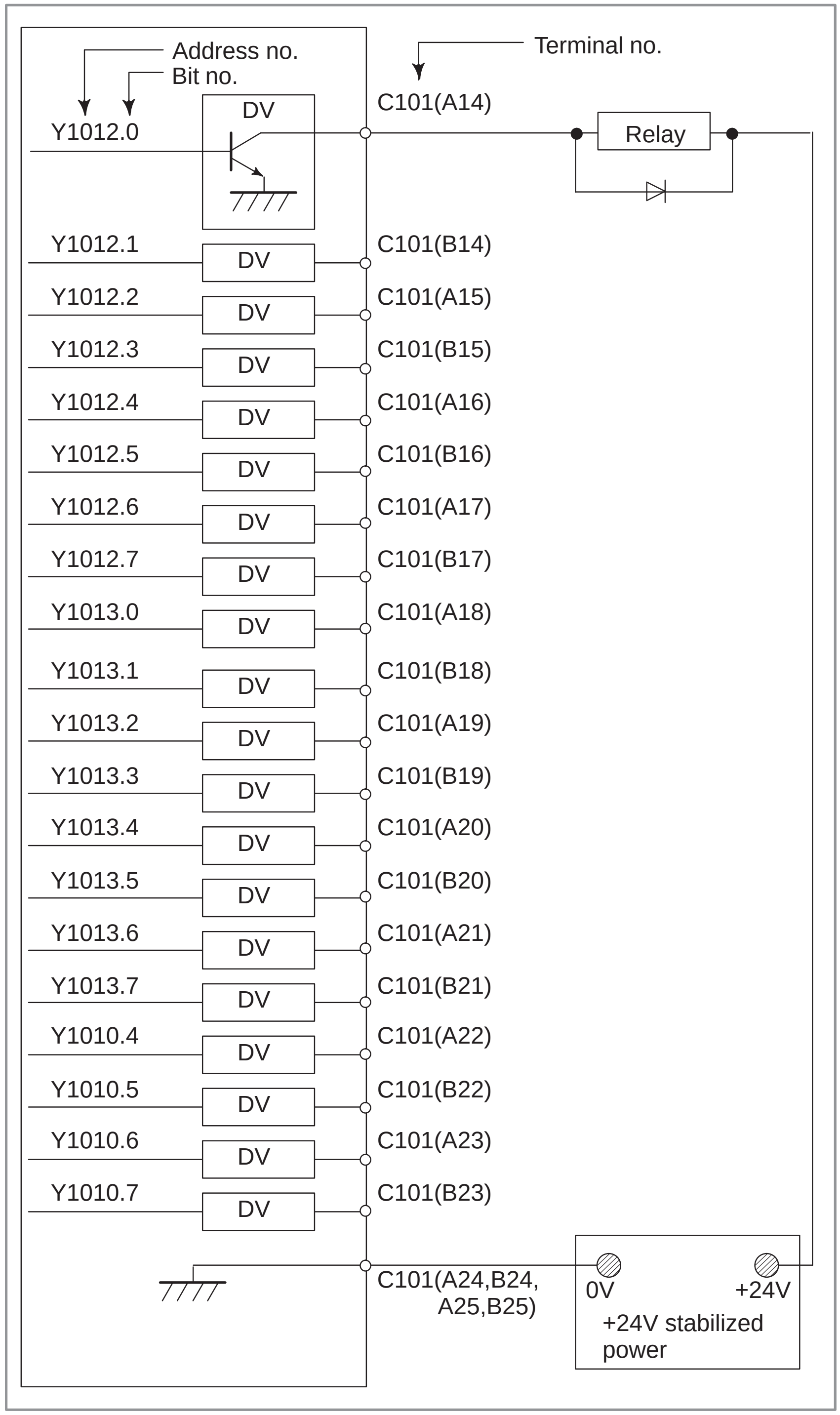


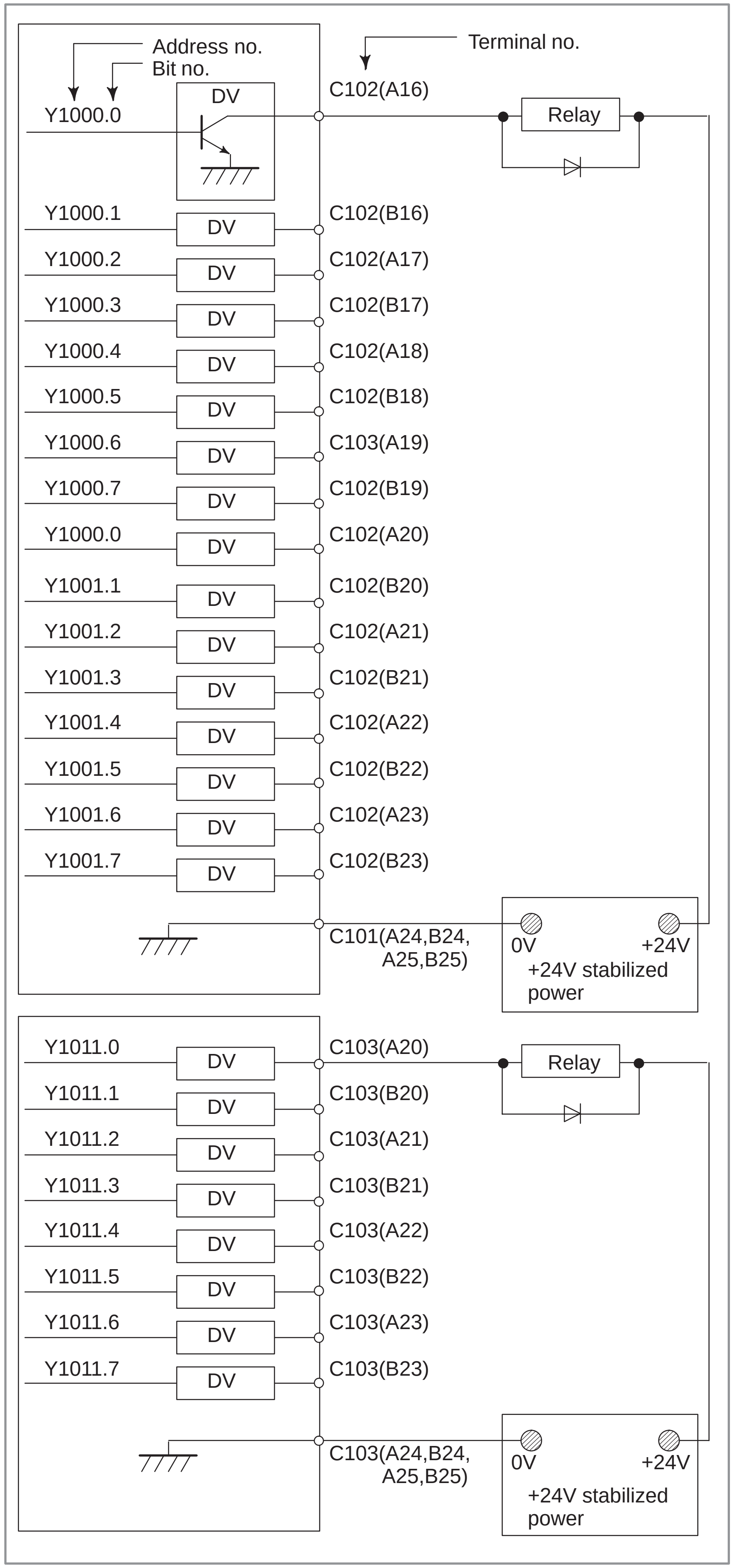
Address number
Bit no.
+24V
Terminal number
C102(A01,B01)
X1002.0
X1002.1
X1002.2
X1002.3
X1002.4
X1002.5
X1002.6
X1002.7
RV
C102(A10)
C102(B10)
C102(A11)
C102(B11)
C102(A12)
C102(B12)
C102(A13)
C102(B13)
X1004.0
X1004.1
X1004.2
X1004.3
C102(A14)
C102(B14)
C102(A15)
C102(B15)


Address number
Bit no.
+24V
Terminal number
C103(A01,B01)
X1003.0
RV
C103(A02)
X1003.1
C103(B02)
X1003.2
C103(A03)
X1003.3
C103(B03)
X1003.4
C103(A04)
X1003.5
C103(B04)
X1003.6
C103(A05)
X1003.7
C103(B05)
X1011.0
C103(A10)
X1011.1
C103(B10)
X1011.2
C103(A11)
X1011.3
C103(B11)
X1011.4
C103(A12)
X1011.5
C103(B12)
X1011.6
C103(A13)
X1011.7
C103(B13)

8.4.3 Connection of DO




Address no.
Bit no.
Terminal no.
DV
Y1012.0
C101(A14)
Relay
Y1012.1
C101(B14)
Y1012.2
C101(A15)
Y1012.3
C101(B15)
Y1012.4
C101(A16)
Y1012.5
C101(B16)
Y1012.6
C101(A17)
Y1012.7
C101(B17)
Y1013.0
C101(A18)
Y1013.1
C101(B18)
Y1013.2
C101(A19)
Y1013.3
C101(B19)
Y1013.4
C101(A20)
Y1013.5
C101(B20)
Y1013.6
C101(A21)
Y1013.7
C101(B21)
Y1010.4
C101(A22)
Y1010.5
C101(B22)
Y1010.6
C101(A23)
Y1010.7
C101(B23)
C101(A24,B24,
A25,B25)
0V
+24V
+24V stabilized
power


Address no.
Bit no.
Terminal no.
Y1000.0
DV
C102(A16)
Relay
Y1000.1
C102(B16)
Y1000.2
C102(A17)
Y1000.3
C102(B17)
Y1000.4
C102(A18)
Y1000.5
C102(B18)
Y1000.6
C103(A19)
Y1000.7
C102(B19)
Y1000.0
C102(A20)
Y1001.1
C102(B20)
Y1001.2
C102(A21)
Y1001.3
C102(B21)
Y1001.4
C102(A22)
Y1001.5
C102(B22)
Y1001.6
C102(A23)
Y1001.7
C102(B23)
C101(A24,B24,
A25,B25)
0V
+24V
+24V stabilized
power
Y1011.0
C103(A20)
Relay
Y1011.1
C103(B20)
Y1011.2
C103(A21)
Y1011.3
C103(B21)
Y1011.4
C103(A22)
Y1011.5
C103(B22)
Y1011.6
C103(A23)
Y1011.7
C103(B23)
C103(A24,B24,
A25,B25)
0V
+24V
+24V stabilized
power

Requirements for the DI signals for the machine

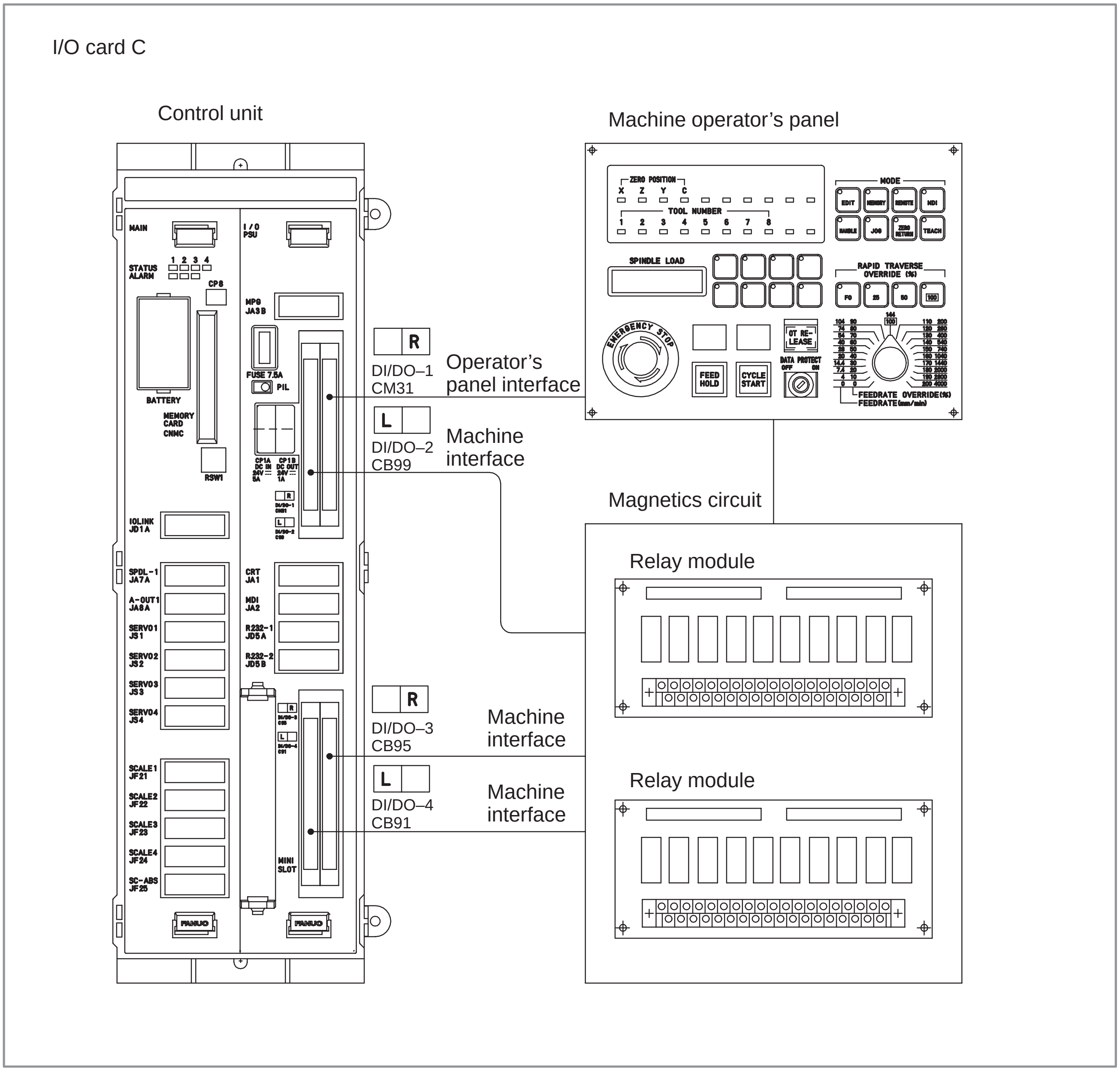
Contact capacity: 30 VDC, 16 mA or more
Leakage current between contacts for an open circuit : 1 mA or less (at 26.4V)
Voltage drop between contacts for a closed circuit :

2V or less (with 8.5 mA), including the voltage drop in the cables

Ratings for the DO transistors for the machine

Maximum load current when turned on	:	200 mA or less, including momentary surges
Saturation voltage when turned on	:	1.6 V (max.), 1.0 V (typ.) when the load current is 200 mA
Dielectric strength when turned off	:	24 V +20% or less, including momentary surges
Leakage current when turned off	:	100 μ A or less

8.5 BUILT–IN I/O CARD C CONNECTION (FOR 21/210–MB)



8.5.1 Connector Pin Arrangement

CB95 HIROSE50PIN

	A	B
01	0V	+24V
02	+24V	NET1
03	NET2	NET3
04	NET4	Y1008.0
05	Y1008.1	Y1008.2
06	Y1008.3	Y1008.4
07	Y1008.5	Y1008.6
08	Y1008.7	Y1009.0
09	Y1009.1	Y1009.2
10	Y1009.3	Y1009.4
11	Y1009.5	Y1009.6
12	Y1009.7	Y1010.0
13	Y1010.1	Y1010.2
14	Y1010.3	Y1010.4
15	Y1010.5	Y1010.6
16	Y1010.7	Y1011.0
17	Y1011.1	Y1011.2
18	Y1011.3	Y1011.4
19	Y1011.5	Y1011.6
20	Y1011.7	Y1012.0
21	Y1012.1	Y1012.2
22	Y1012.3	Y1012.4
23	Y1012.5	X1012.4
24	DOCOM	DOCOM
25	DOCOM	DOCOM

CB91 HIROSE50PIN

	A	B
01	0V	+24V
02	+24V	
03	X1008.0	Y1012.6
04	X1008.1	Y1012.7
05	X1010.7	Y1013.0
06	X1010.6	X1010.5
07	X1010.3	X1008.2
08	X1010.1	X1010.4
09	X1011.0	X1010.2
10	X1008.3	X1010.0
11	X1008.6	X1008.7
12	COMO	X1008.5
13	X1008.4	X1009.4
14	Y1013.1	X1009.0
15	Y1013.2	X1009.1
16	Y1013.3	X1011.1
17	X1011.2	X1011.3
18	X1009.2	X1011.4
19	X1011.5	X1011.6
20	X1011.7	X1012.0
21	X1012.1	X1009.3
22	X1009.7	X1009.6
23	X1009.5	COM1
24	DOCOM	DOCOM
25	DOCOM	DOCOM

CM31 HIROSE50PIN

	A	B
01	+24V	+24V
02	DICOM1	DICOM2
03	DICOM3	DICOM4
04	DID0	DID1
05	DID2	DID3
06	DID4	DID5
07	DID6	DID7
08	DID8	DID9
09	DID10	DID11
10	DID12	DID13
11	DID14	DID15
12	DOCOM1	DOCOM2
13	DOCOM3	DOCOM4
14	*DOD0	*DOD1
15	*DOD2	*DOD3
16		
17		
18	*DOD8	*DOD9
19	*DOD10	*DOD11
20		
21		
22	NET5	NET6
23	NET7	NET4
24	NET2	NET3
25	0V	0V

CB99 HIROSE50PIN

	A	B
01	0V	+24V
02	+24V	
03	X1013.0	NET1
04	X1003.1	NET3
05	X1012.7	Y1013.4
06	X1012.6	X1012.5
07	X1012.3	X1013.2
08		
09		X1012.2
10	X1013.3	
11	X1013.6	X1013.7
12	COM2	X1013.5
13	X1013.4	
14	Y1013.5	
15	Y1013.6	
16	Y1013.7	NET2
17		NET4
18		NET5
19	NET6	NET7
20		
21		
22		
23		
24	DOCOM	DOCOM
25	DOCOM	DOCOM

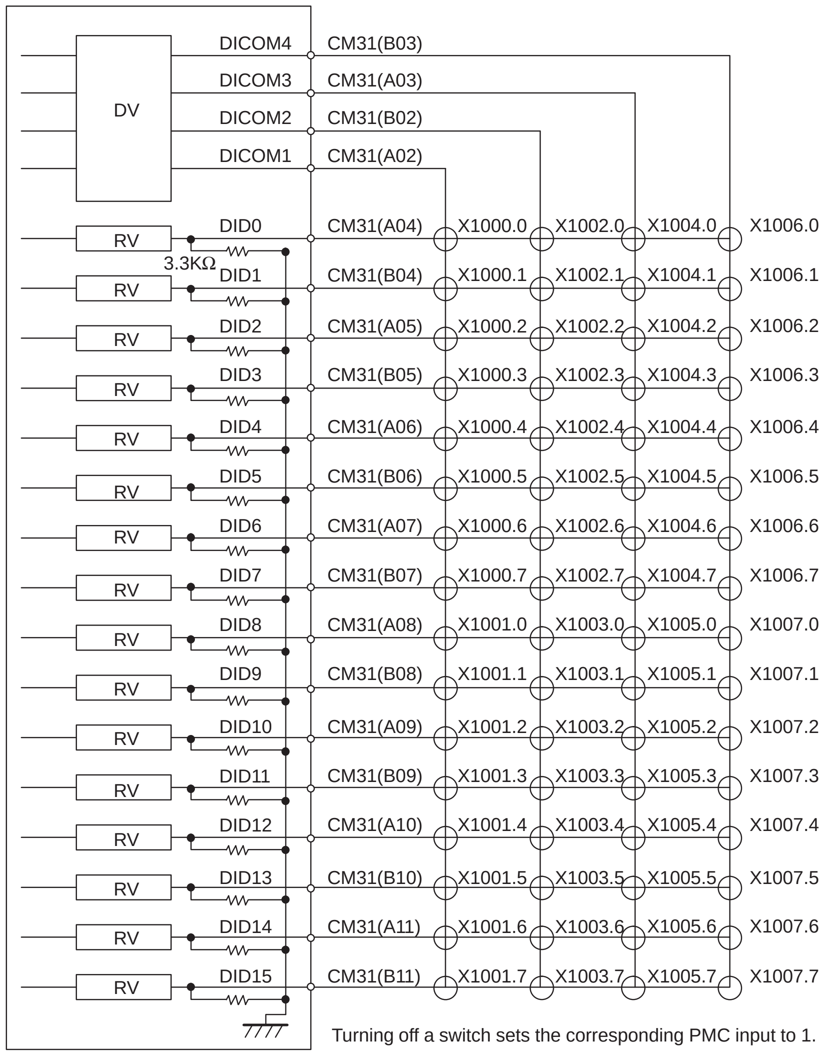
- Pins NET1 to NET7 are respectively connected to identically named pins of other connectors. Use these pins to transfer signals between connectors when, for example, sending a signal from the operator’s panel to the machine.
- A receiver having a long delay (5 to 22 ms) is used for X1013. Normal receivers have a delay of 2 ms or less.

8.5.2 Connection of DI/DO for Operation Panel

The DI/DO points on the operator's panel are provided for connecting switches or LEDs on the machine operator's panel. Connections between the Series 21/210 and the operator's panel are simplified by using a matrix configuration.

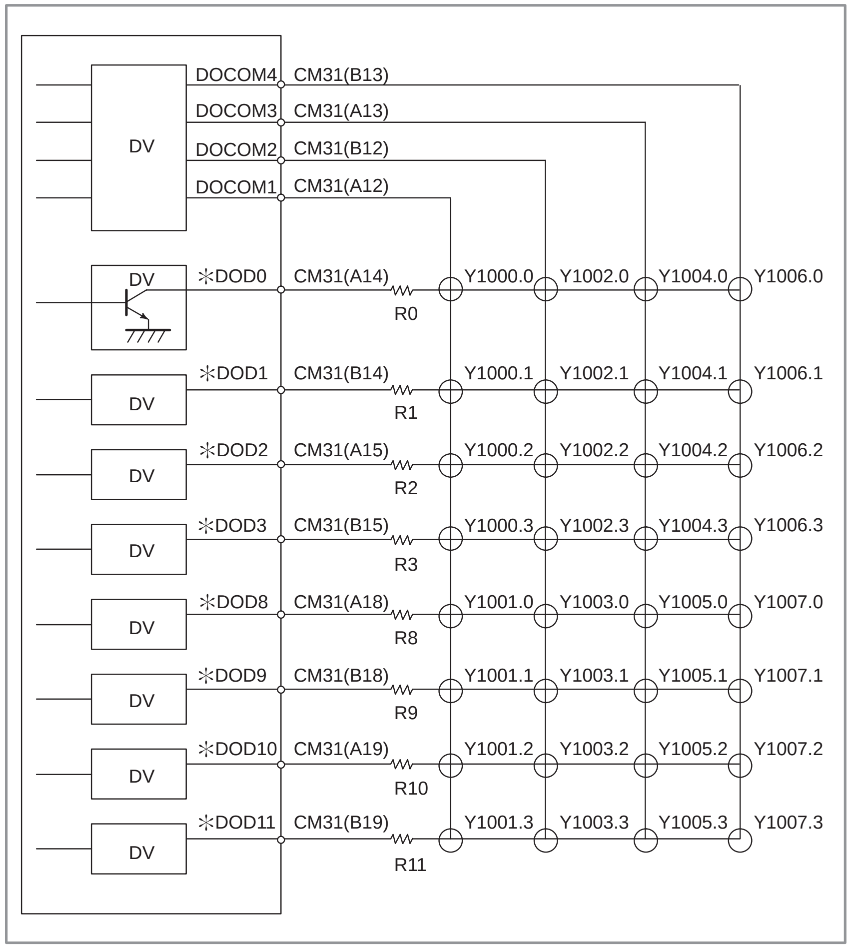
The common signals for the DI/DO points on the operator's panel are sequentially turned on or off every 4 ms. The scan cycle is therefore 16 ms.

Example of DI connection



Turning off a switch sets the corresponding PMC input to 1.

Example of connecting DO for operation panel



Requirements for the DI signals for the operator's panel

Contact capacity: 30 VDC, 16 mA or more

Leakage current between contacts for an open circuit: 1 mA or less (at 26.4 V)

Voltage drop between contacts for a closed circuit: 2 V or less (with 8.5 mA), including the voltage drop from the cables

> Connect a diode for preventing unexpected current flow at each matrix DI point as shown in Fig. 8.5.2 (a). If no diode is connected, more than two switches cannot be on at the same time.
> When three or more switches are on at the same time, data is not entered correctly.
> Use a diode with the following ratings:
> Reverse bias voltage: 30 V
> Reverse current: 1 mA (at 30 V)

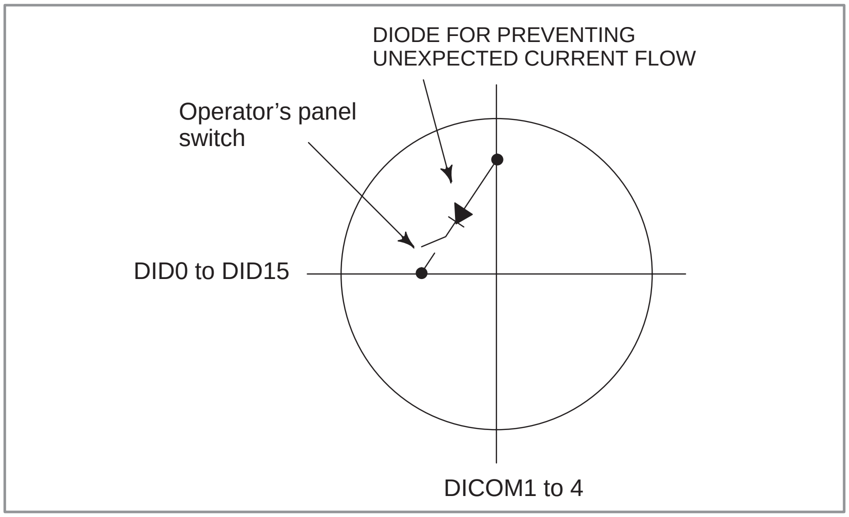


Fig.8.5.2 (a)

Requirements for indicators on the operator's panel that use DO signals

Rated voltage: 24 V or more
Forward current: 25 mA or less

> **NOTE**
> 1 The printed circuit board does not contain resistors for limiting current. Connect resistors R0 to R3 or R8 to R11 shown in the figure below to restrict the current flowing into the indicators.
> Each common line can handle current of up to 160 mA. Select resistors R0 to R3 or R3 to R11 so that the total current flowing into the Y000.0 to Y000.3 and Y001.0 to Y001.3 indicators does not exceed 160 mA.
> 2 For indicators other than LEDs (indicators which light up with current in both directions), a diode for preventing unexpected current flow is necessary in the same way as for matrix DI points.

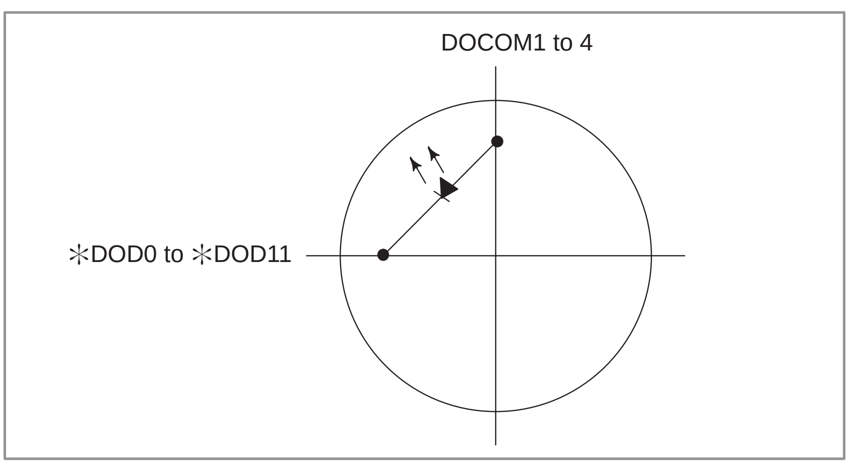
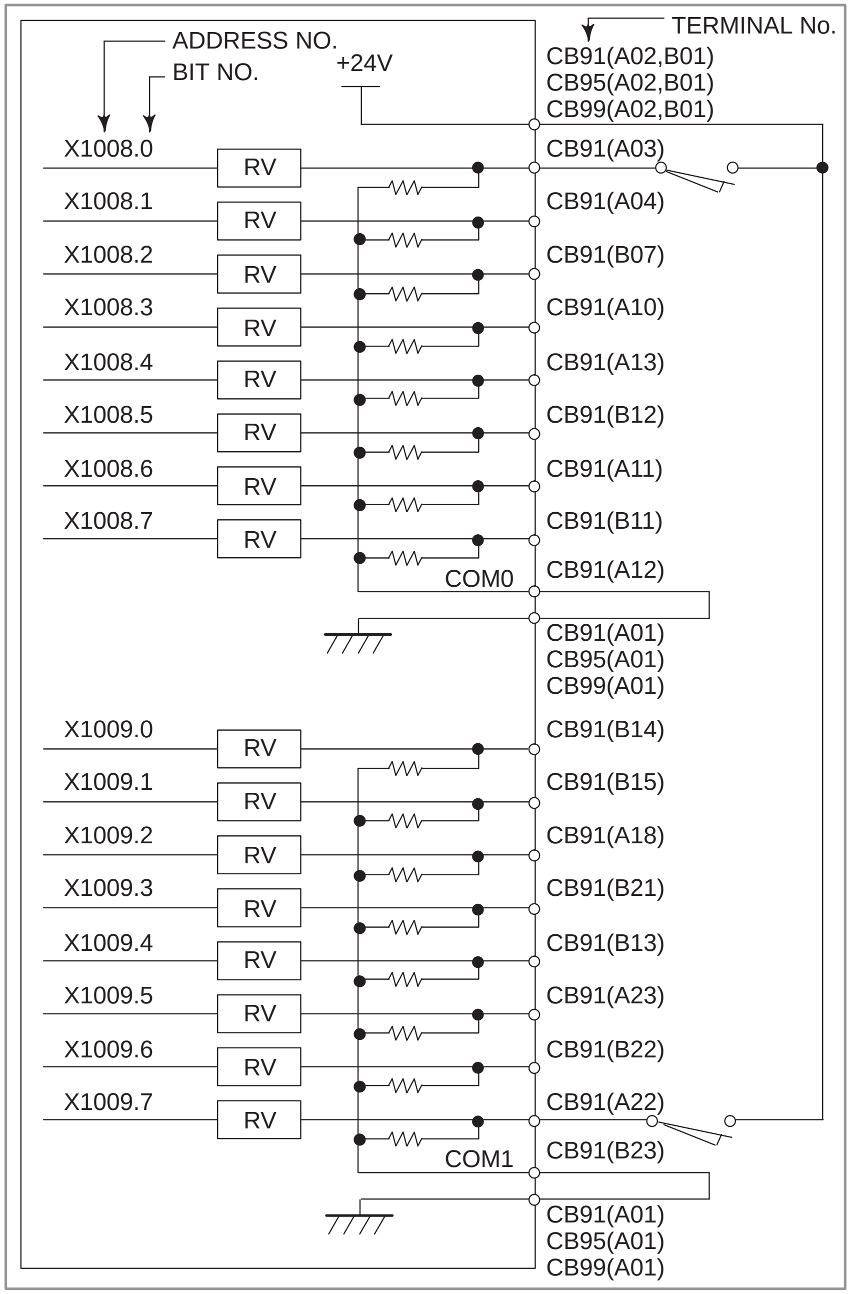


Fig.8.5.2 (b)

8.5.3 Connecting DI/DO Points for the Machine

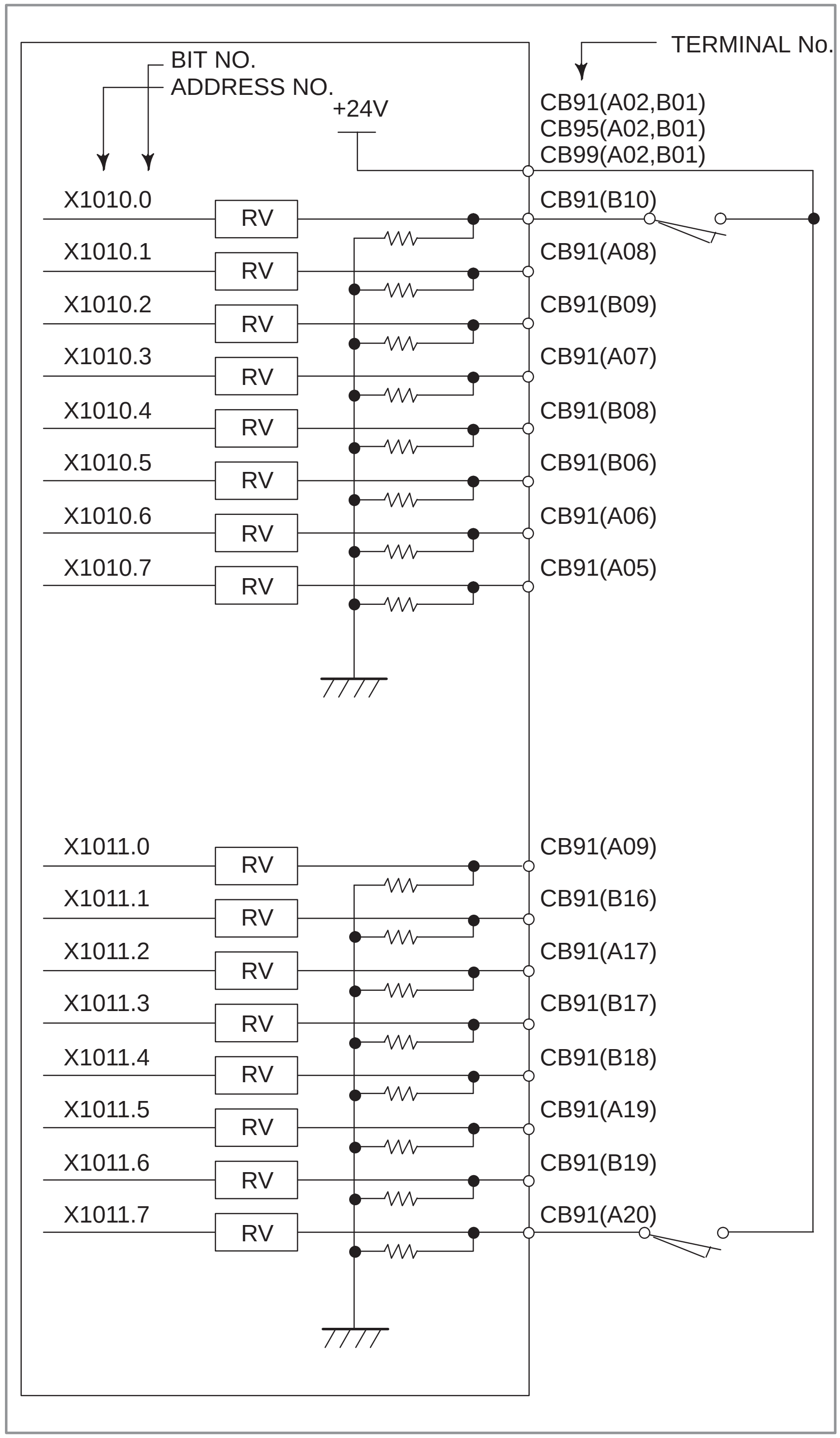
Example of DI connection

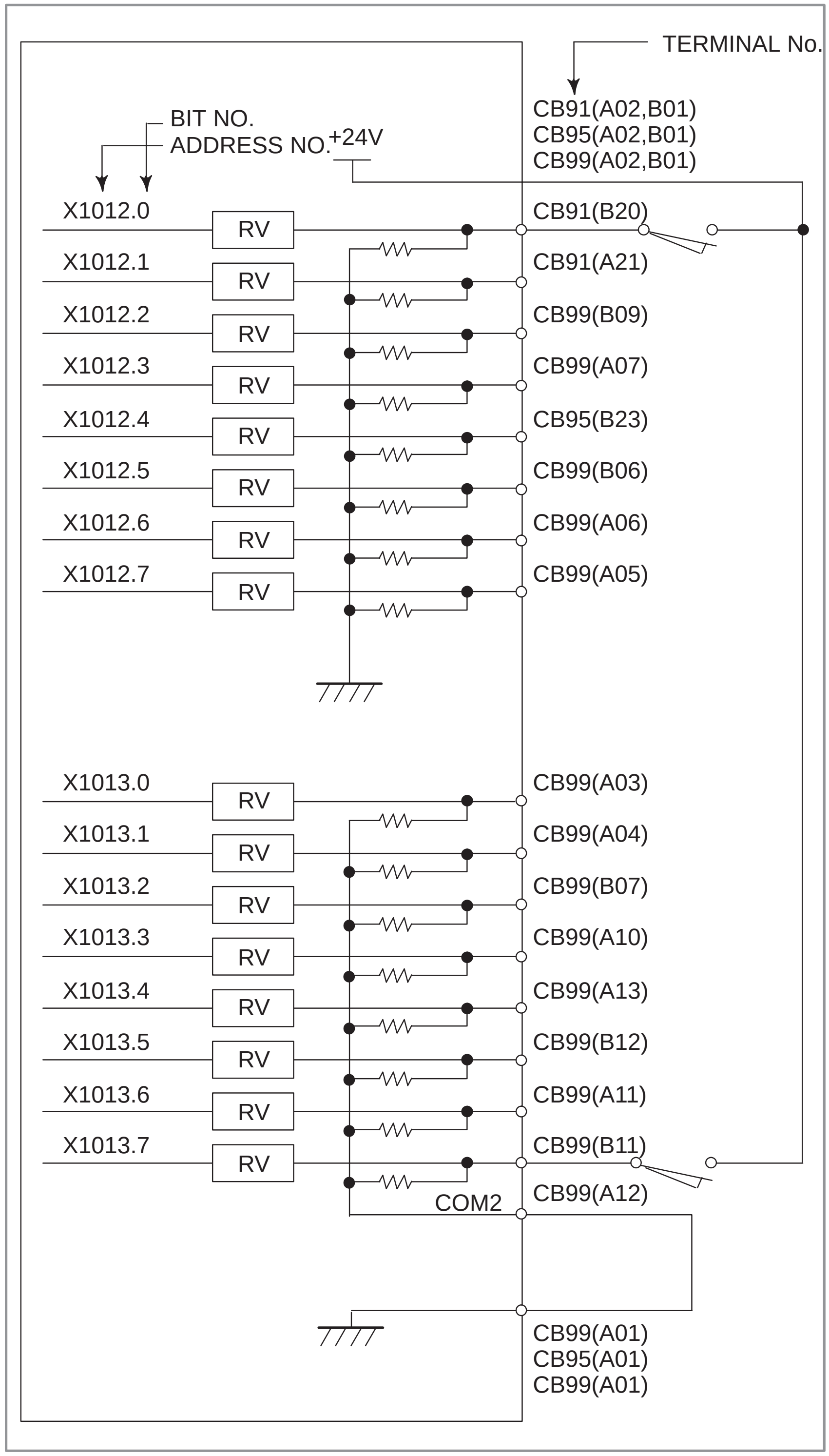
The DI/DO points for the machine include 24 points with sink type (24–V common voltage) and 24 points for which source type or sink type (0–V or 24–V common voltage) can be selected.



For addresses X1008 and X1009, either source or sink type (with a 0– or 24–V common voltage) can be selected. COM0 and COM1 must be connected to either 24 or 0 V; never leave them open. The above diagram shows an example in which the signals are of sink type (with a 24–V common voltage).

From the viewpoint of safety standards, it is recommended that the signals be set to sink type.

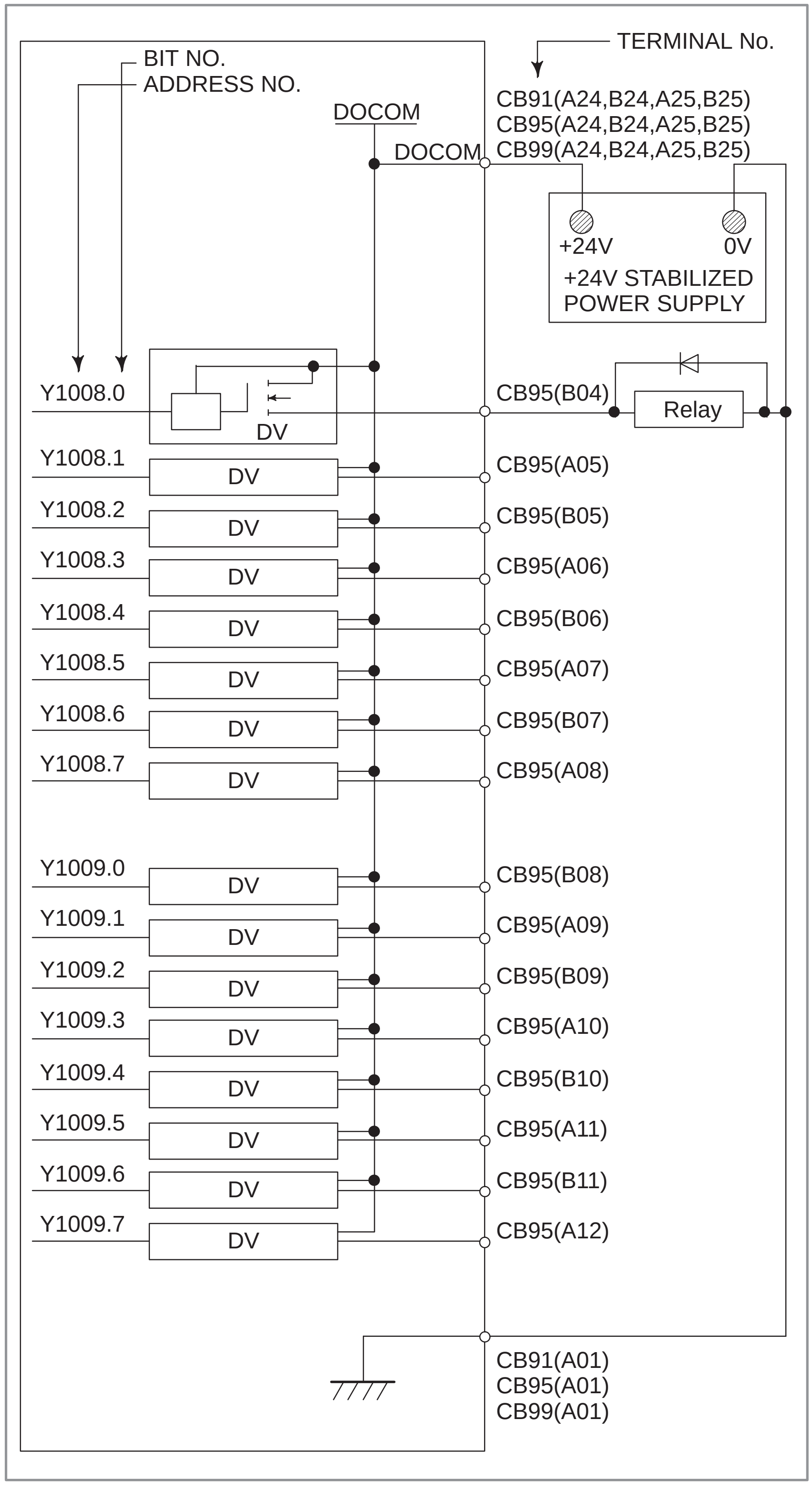

BIT NO.
ADDRESS NO.
+24V
TERMINAL No.
CB91(A02,B01)
CB95(A02,B01)
CB99(A02,B01)
X1010.0
X1010.1
X1010.2
X1010.3
X1010.4
X1010.5
X1010.6
X1010.7
RV
CB91(B10)
CB91(A08)
CB91(B09)
CB91(A07)
CB91(B08)
CB91(B06)
CB91(A06)
CB91(A05)
X1011.0
X1011.1
X1011.2
X1011.3
X1011.4
X1011.5
X1011.6
X1011.7
CB91(A09)
CB91(B16)
CB91(A17)
CB91(B17)
CB91(B18)
CB91(A19)
CB91(B19)
CB91(A20)

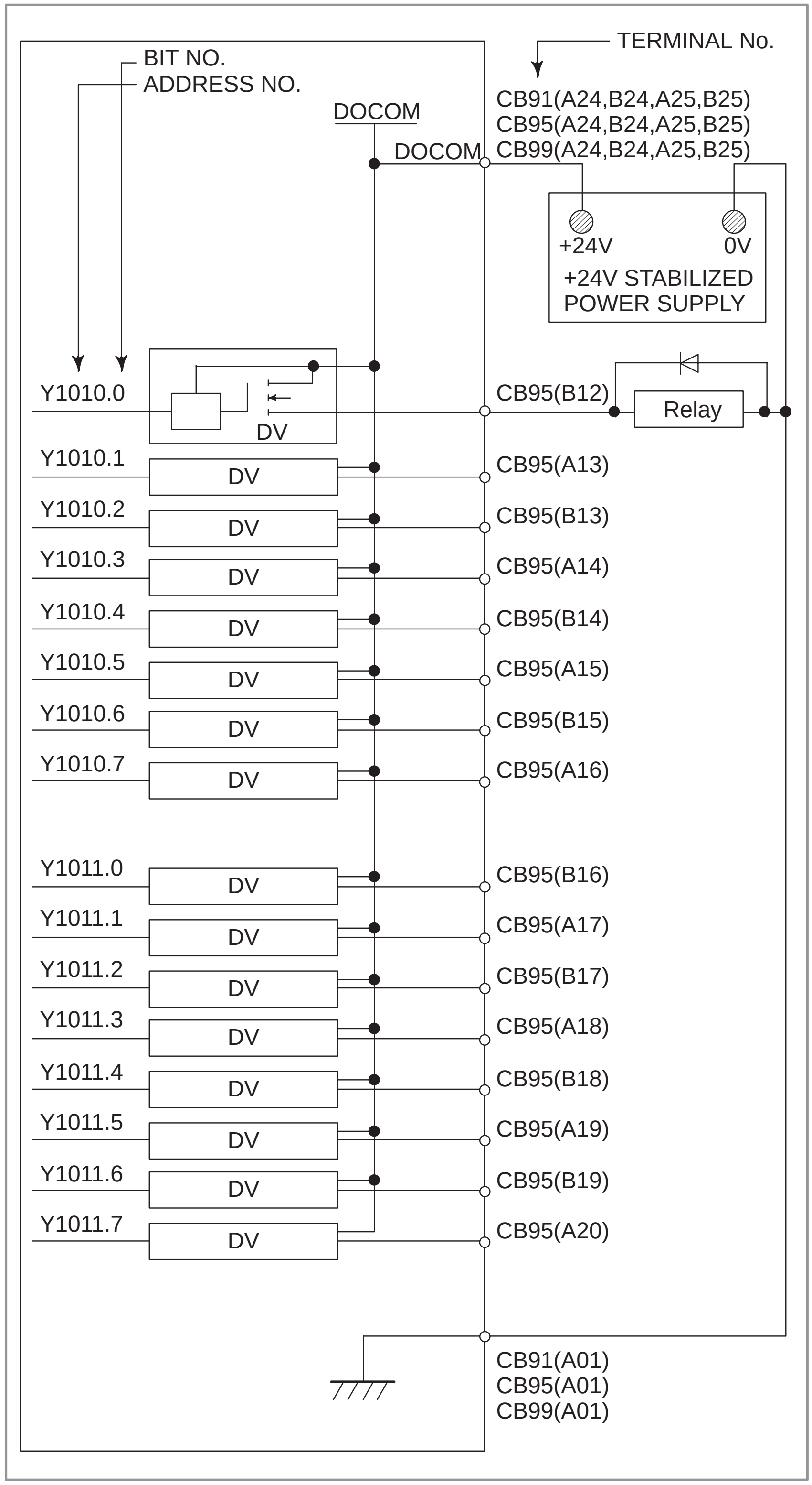


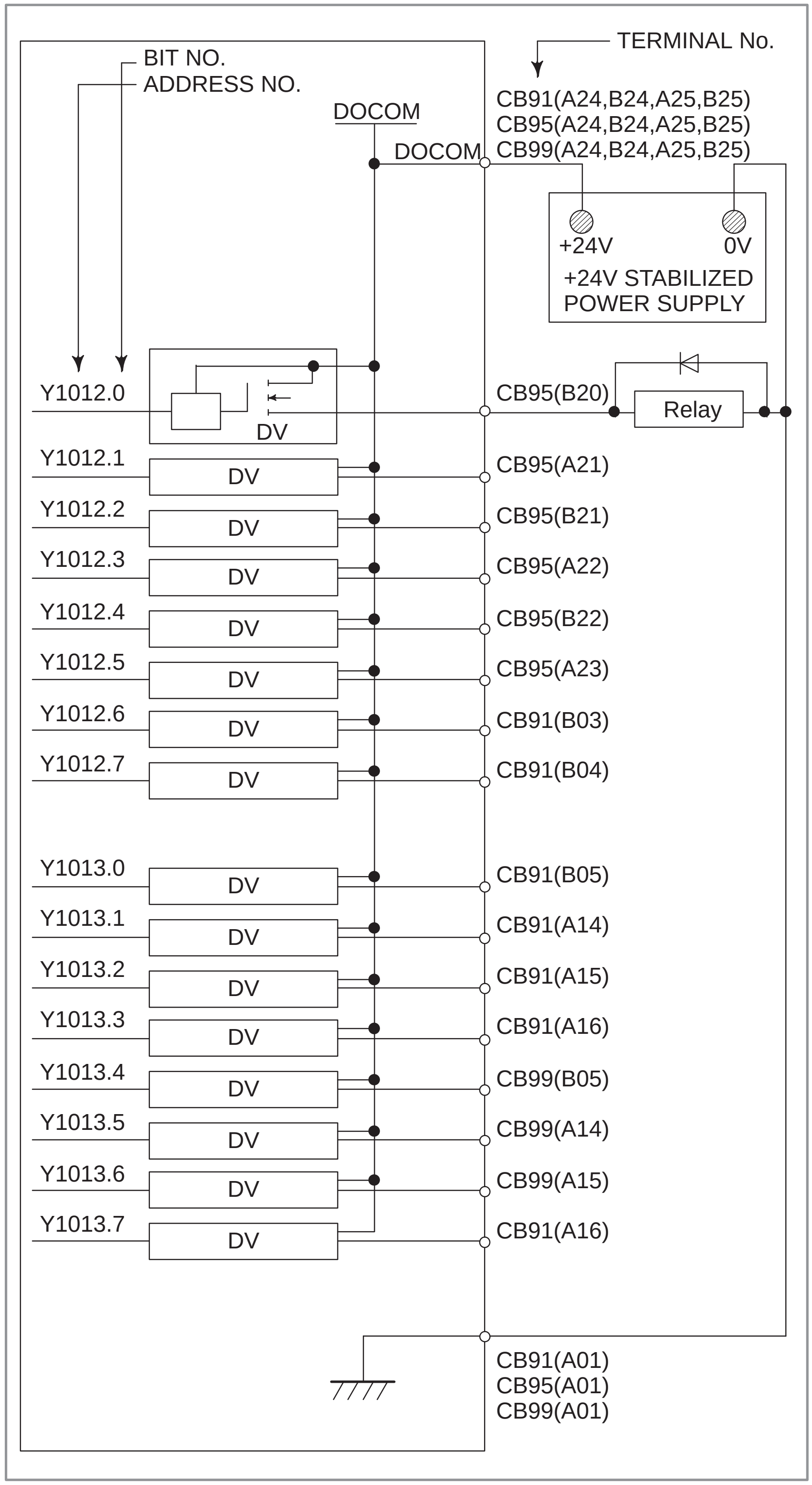
A receiver having a long delay (5 to 22 ms) is used for X1013. Normal receivers have a delay of 2 ms or less.
For address X1013, either source or sink type (with a 0– or 24–V common voltage) can be selected. COM2 must be connected to either 24 or 0 V; never leave it open. The above diagram shows an example in which the signal is of sink type (with a 24–V common voltage).

From the viewpoint of safety standards, it is recommended that the signals be set to sink type.

Example of connecting DO for machine




BIT NO.
ADDRESS NO.
TERMINAL No.
DOCOM
DOCOM
CB91(A24,B24,A25,B25)
CB95(A24,B24,A25,B25)
CB99(A24,B24,A25,B25)
+24V
0V
+24V STABILIZED
POWER SUPPLY
Y1010.0
DV
CB95(B12)
Relay
Y1010.1
DV
CB95(A13)
Y1010.2
DV
CB95(B13)
Y1010.3
DV
CB95(A14)
Y1010.4
DV
CB95(B14)
Y1010.5
DV
CB95(A15)
Y1010.6
DV
CB95(B15)
Y1010.7
DV
CB95(A16)
Y1011.0
DV
CB95(B16)
Y1011.1
DV
CB95(A17)
Y1011.2
DV
CB95(B17)
Y1011.3
DV
CB95(A18)
Y1011.4
DV
CB95(B18)
Y1011.5
DV
CB95(A19)
Y1011.6
DV
CB95(B19)
Y1011.7
DV
CB95(A20)
CB91(A01)
CB95(A01)
CB99(A01)

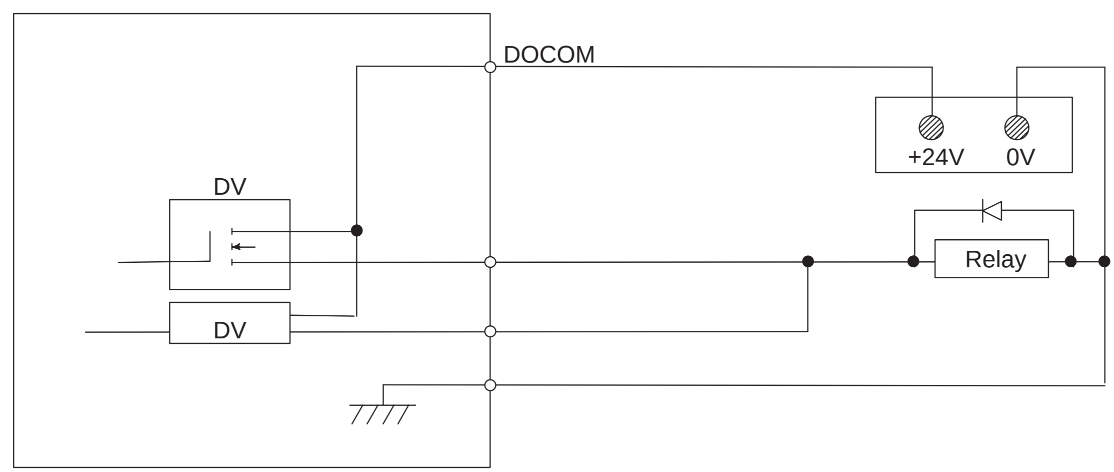


BIT NO.
ADDRESS NO.
TERMINAL No.
DOCOM
DOCOM
CB91(A24,B24,A25,B25)
CB95(A24,B24,A25,B25)
CB99(A24,B24,A25,B25)
+24V
0V
+24V STABILIZED POWER SUPPLY
Y1012.0
DV
CB95(B20)
Relay
Y1012.1
CB95(A21)
Y1012.2
CB95(B21)
Y1012.3
CB95(A22)
Y1012.4
CB95(B22)
Y1012.5
CB95(A23)
Y1012.6
CB91(B03)
Y1012.7
CB91(B04)
Y1013.0
CB91(B05)
Y1013.1
CB91(A14)
Y1013.2
CB91(A15)
Y1013.3
CB91(A16)
Y1013.4
CB99(B05)
Y1013.5
CB99(A14)
Y1013.6
CB99(A15)
Y1013.7
CB91(A16)
CB91(A01)
CB95(A01)
CB99(A01)

8.5.4 Notes on DO Connection

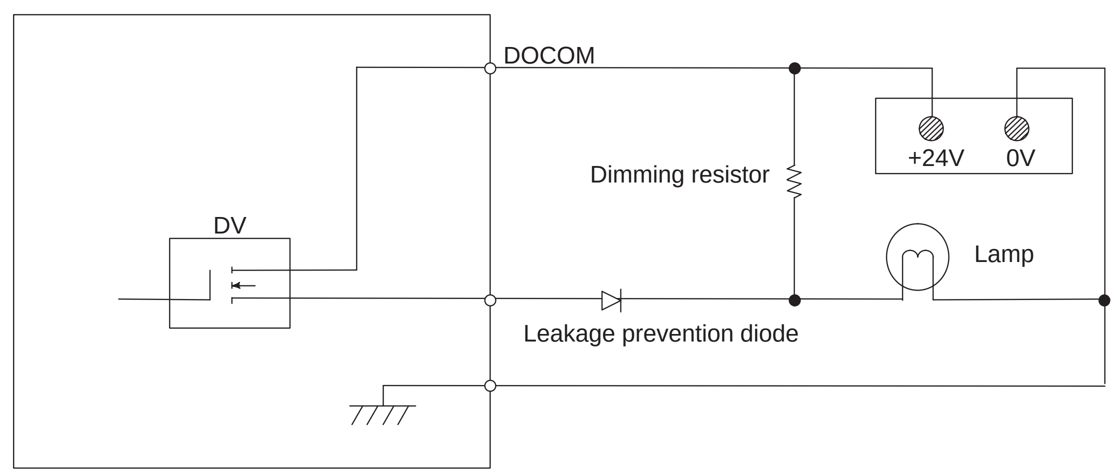
CAUTION

Do not connect DOs in parallel, as shown below.



CAUTION

When using a dimming resistor, as shown below, connect a diode to prevent leakage.



8.5.5 Requirements Imposed on Input/Output Signals and the External Power Supply for Output Signals

8.5.5.1 Input signal requirements

- Contact rating: 30VDC, 16mA or more
- Leakage current between contacts for open circuit: 1mA or less (at 26.4V)
- Voltage drop between contacts for closed circuit: 2V or less (including voltage drop in the cables)

8.5.5.2 Output signal driver ratings

- Maximum on–state load current: 200mA or less, including momentary surges
  (For the DOCOM power supply pins, the maximum current per pin shall not exceed 0.7A.)
- On–state saturation voltage: 1.0V or less for a load current of 200mA
- Dielectric strength: 24V +20% or less, including momentary surges
- Off–state leakage current: 20μA or less

8.5.5.3 External power supply for output signals

- Supply voltage: 24V ± 10%
- Supply current: Total of the maximum load current for each signal (including momentary surges) + 100mA, or higher

8.5.5.4 Output signal driver

Each output signal driver element on the I/O board outputs eight signals.

The driver elements each monitor the current of an output signal. If a driver element detects a signal overcurrent, it stops output of that signal. Once output of that signal has been turned off, an overcurrent no longer flows, at which point the driver element will again turn on the output of the signal. This means that the signal output will be repeatedly turned on and off upon the occurrence of a ground fault or overload. Connecting a load which induces a large surge current will also produce this effect.

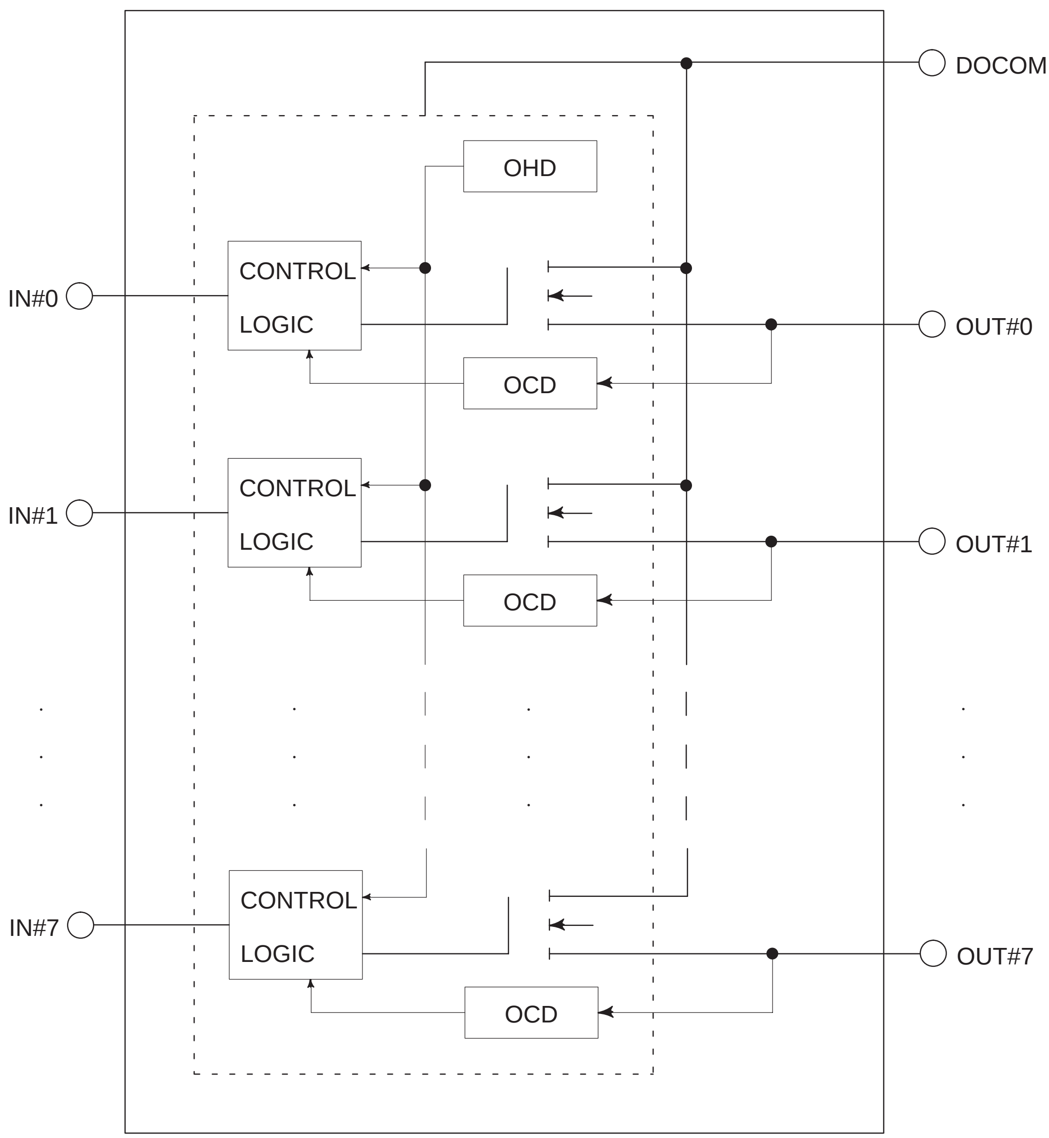
Each driver element contains an overheat detection circuit. If an overcurrent flows continuously, as a result of a ground fault or some other cause, such that the temperature of the element increases beyond the specified range, the element turns off all eight of its output signals. The signals remain off even after the element temperature drops back to within the specified range. Logically turning the signals off, after the temperature has dropped sufficiently, resets the overheat detection circuit, after which the signals can be turned on again. The detection circuit can also be reset by turning off the system power.

The following signals are assigned to the driver elements:

Element #0: 1008.0 to 1008.7
Element #1: 1009.0 to 1009.7
Element #2: 1010.0 to 1010.7
Element #3: 1011.0 to 1011.7
Element #4: 1012.0 to 1012.7
Element #5: 1013.0 to 1013.7

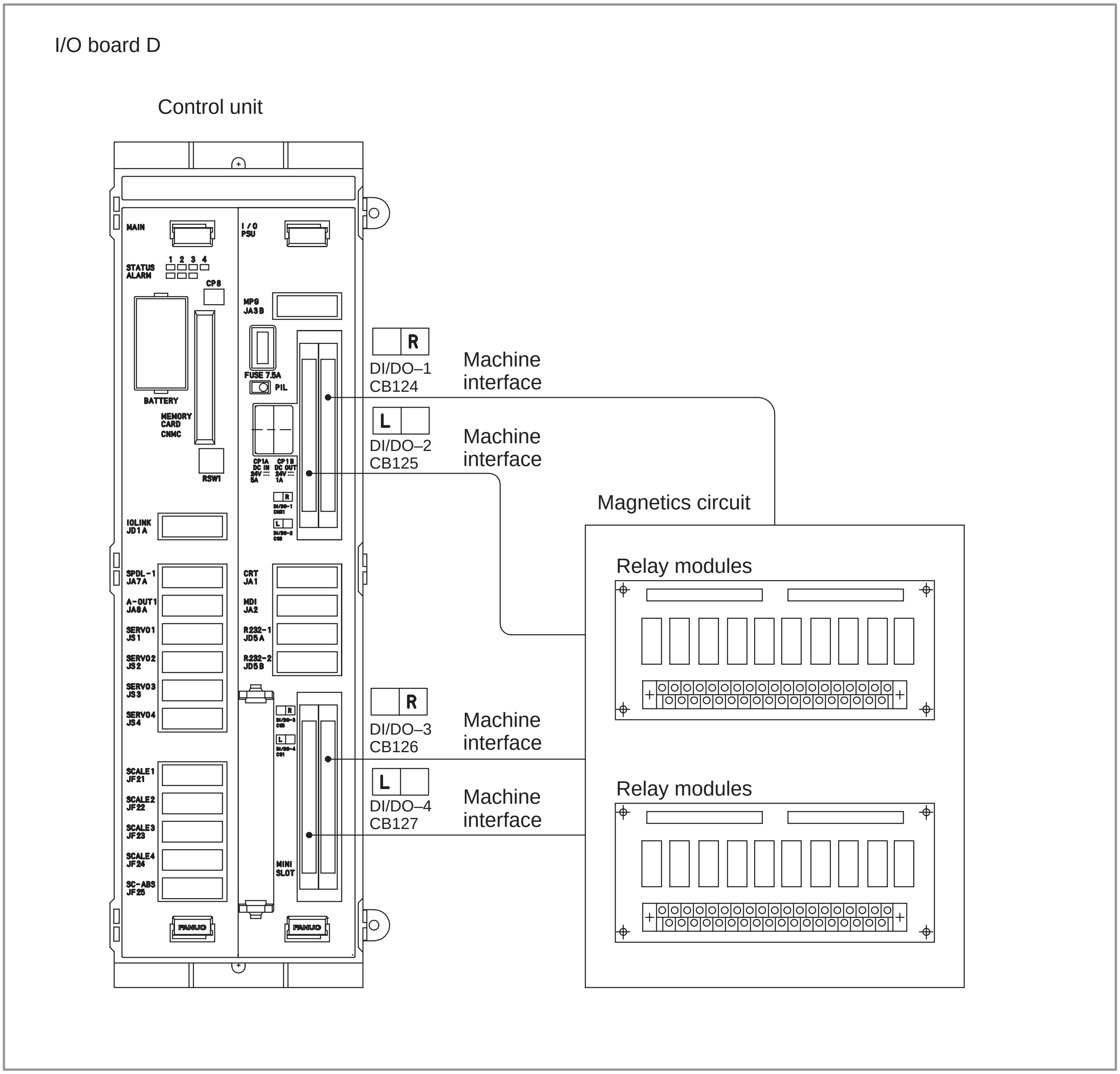
If the output of a signal cannot be turned on even when NC diagnosis indicates that the output is being turned on, that signal, or another signal assigned to the same element, may be overloaded, causing all eight output signals of that element to be turned off. In such a case, turn the system power off, then determine and eliminate the cause of the overload.

[Internal block diagram of driver element]



OHD : Overheat detection circuit, OCD : Overcurrent detection circuit

8.6 BUILT–IN I/O D CONNECTION (FOR 21/210–MB)



8.6.1 Connector Pin Arrangement

CB124

HIROSE50PIN

	A	B
01	+0V	+24V
02	X1000.0	X1000.1
03	X1000.2	X1000.3
04	X1000.4	X1000.5
05	X1000.6	X1000.7
06	X1001.0	X1001.1
07	X1001.2	X1001.3
08	X1001.4	X1001.5
09	X1001.6	X1001.7
10	X1002.0	X1002.1
11	X1002.2	X1002.3
12	X1002.4	X1002.5
13	X1002.6	X1002.7
14	Y1013.0	Y1013.1
15	Y1013.2	Y1013.3
16	Y1000.0	Y1000.1
17	Y1000.2	Y1000.3
18	Y1000.4	Y1000.5
19	Y1000.6	Y1000.7
20	Y1001.0	Y1001.1
21	Y1001.2	Y1001.3
22	Y1001.4	Y1001.5
23	Y1001.6	Y1001.7
24	DOCOM	DOCOM
25	DOCOM	DOCOM

CB125

HIROSE50PIN

	A	B
01	0V	+24V
02	X1003.0	X1003.1
03	X1003.2	X1003.3
04	X1003.4	X1003.5
05	X1003.6	X1003.7
06	X1010.0	X1010.1
07	X1010.2	X1010.3
08	X1010.4	X1010.5
09	X1010.6	X1010.7
10	X1011.0	X1011.1
11	X1011.2	X1011.3
12	X1011.4	X1011.5
13	X1011.6	X1011.7
14	Y1013.4	Y1013.5
15	Y1013.6	Y1013.7
16	Y1002.0	Y1002.1
17	Y1002.2	Y1002.3
18	Y1002.4	Y1002.5
19	Y1002.6	Y1002.7
20	Y1008.0	Y1008.1
21	Y1008.2	Y1008.3
22	Y1008.4	Y1008.5
23	Y1008.6	Y1008.7
24	DOCOM	DOCOM
25	DOCOM	DOCOM

CB126

HIROSE50PIN

	A	B
01	0V	+24V
02	X1004.0	X1004.1
03	X1004.2	X1004.3
04	X1004.4	X1004.5
05	X1004.6	X1004.7
06	X1005.0	X1005.1
07	X1005.2	X1005.3
08	X1005.4	X1005.5
09	X1005.6	X1005.7
10	X1008.0	X1008.1
11	X1008.2	X1008.3
12	X1008.4	X1008.5
13	X1008.6	X1008.7
14		COMX08
15		
16	Y1009.0	Y1009.1
17	Y1009.2	Y1009.3
18	Y1009.4	Y1009.5
19	Y1009.6	Y1009.7
20	Y1010.0	Y1010.1
21	Y1010.2	Y1010.3
22	Y1010.4	Y1010.5
23	Y1010.6	Y1010.7
24	DOCOM	DOCOM
25	DOCOM	DOCOM

CB127

HIROSE50PIN

	A	B
01	0V	+24V
02	X1009.0	X1009.1
03	X1009.2	X1009.3
04	X1009.4	X1009.5
05	X1009.6	X1009.7
06	X1012.0	X1012.1
07	X1012.2	X1012.3
08	X1012.4	X1012.5
09	X1012.6	X1012.7
10	X1013.0	X1013.1
11	X1013.2	X1013.3
12	X1013.4	X1013.5
13	X1013.6	X1013.7
14	COMX09	COMX13
15		
16	Y1011.0	Y1011.1
17	Y1011.2	Y1011.3
18	Y1011.4	Y1011.5
19	Y1011.6	Y1011.7
20	Y1012.0	Y1012.1
21	Y1012.2	Y1012.3
22	Y1012.4	Y1012.5
23	Y1012.6	Y1012.7
24	DOCOM	DOCOM
25	DOCOM	DOCOM

NOTE

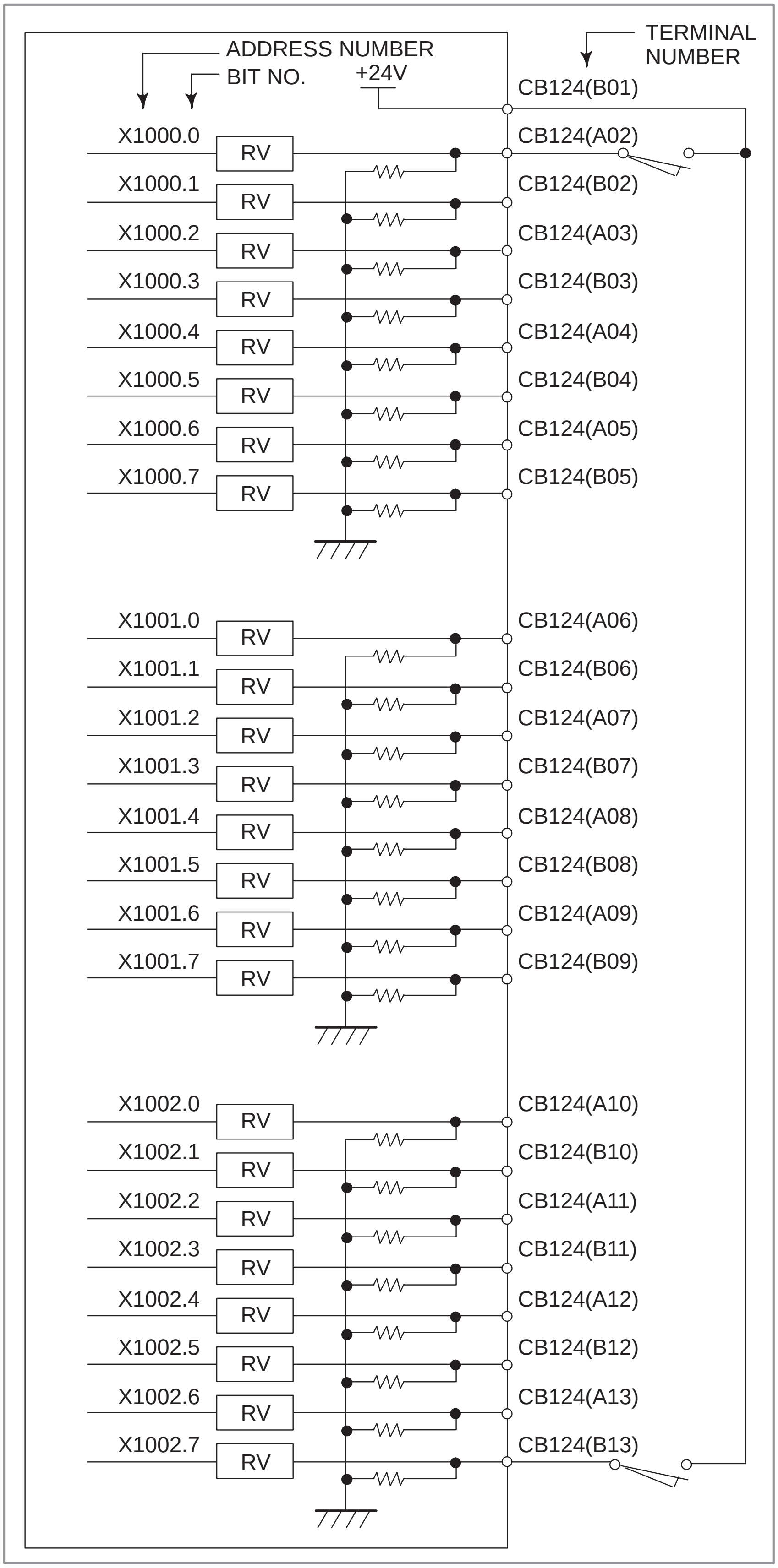
1 The following DIs cannot be used (addresses not listed in above pin layout).
X1006.0 to X1006.7, X1007.0 to X1007.7
X1014.0 or later

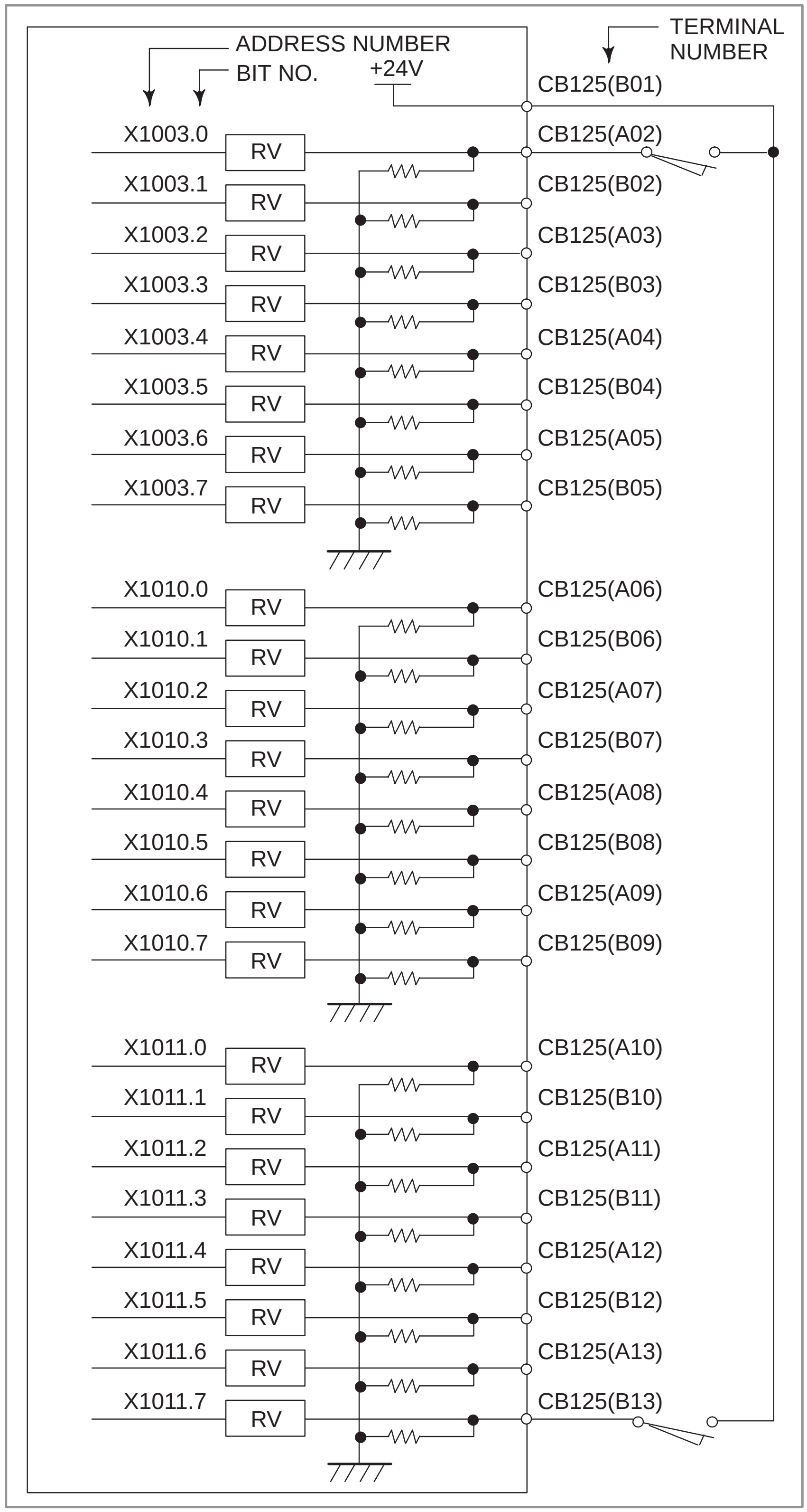
2 The following DOs cannot be used (addresses not listed in above pin layout)
Y1003.0 to Y1003.7
Y1004.0 to Y1004.7, Y1005.0 to Y1005.7
Y1006.0 to Y1006.7, Y1007.0 to Y1007.7
Y1014.0 or later

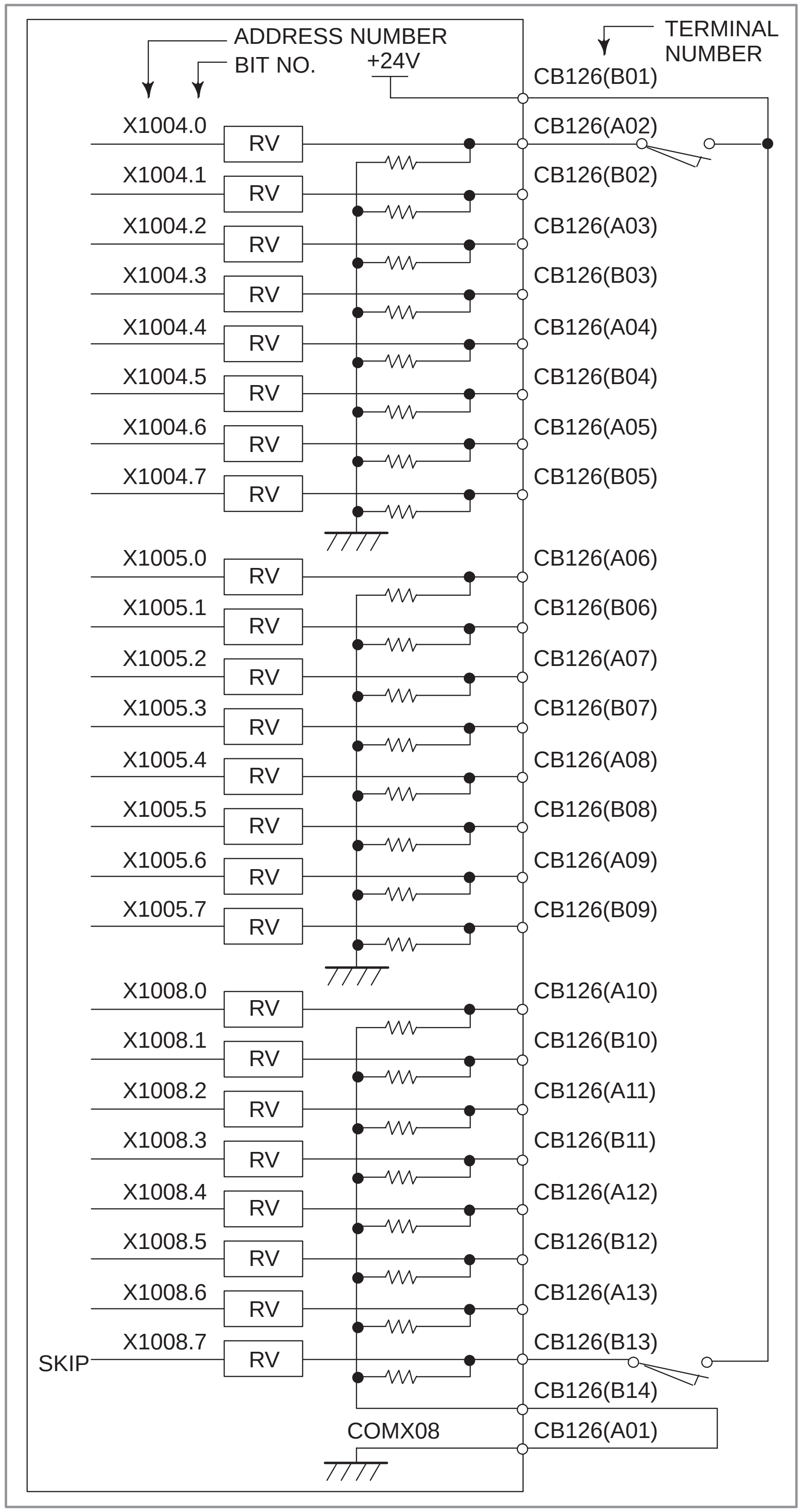
3 Blanks in the above table indicate that the corresponding pins cannot be used.

A receiver having a long delay (5 to 22 ms) is used for X1013. Normal receivers have a delay of 2 ms or less.

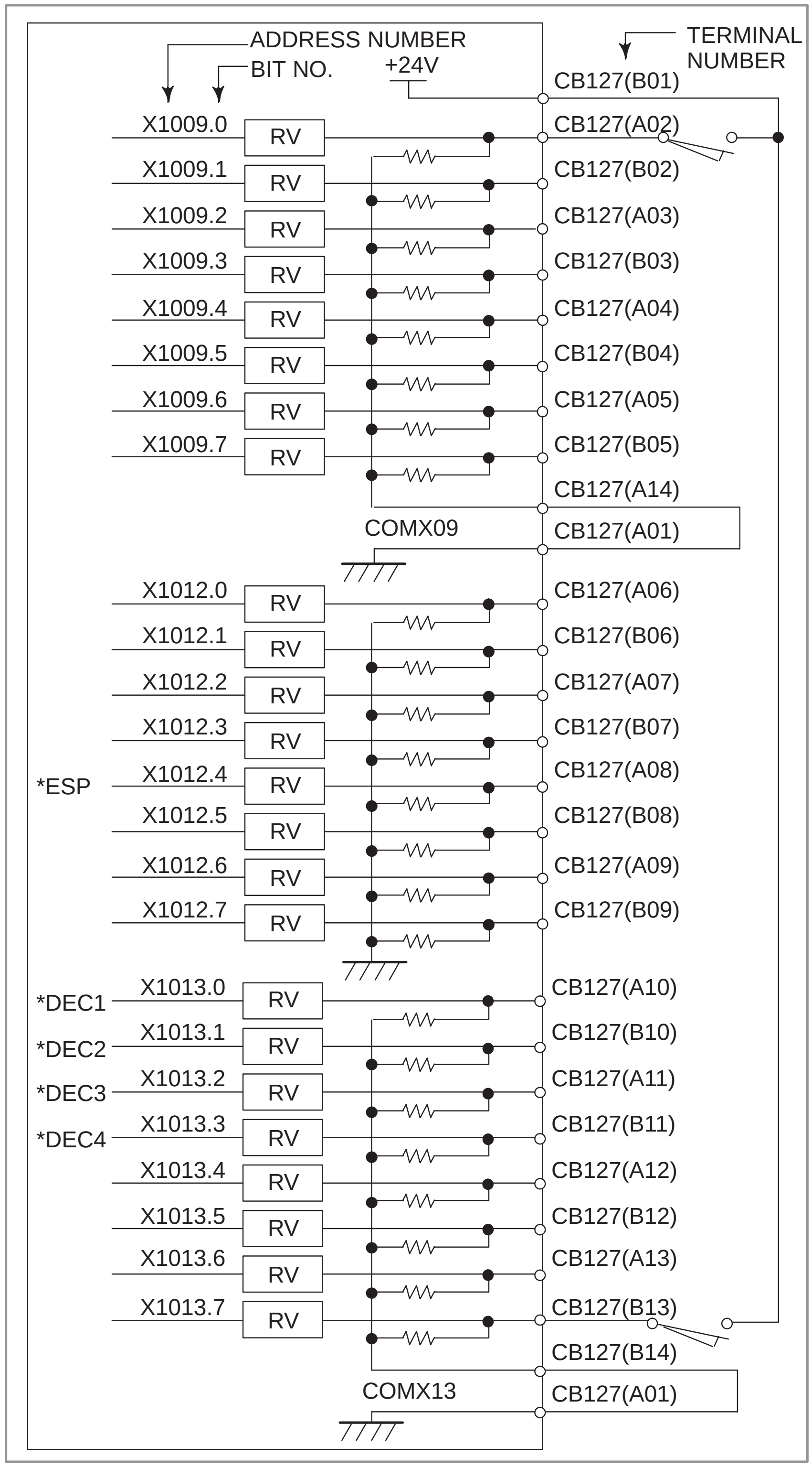
8.6.2 Example of DI Connection




ADDRESS NUMBER
BIT NO.
+24V
TERMINAL NUMBER
CB125(B01)
X1003.0
X1003.1
X1003.2
X1003.3
X1003.4
X1003.5
X1003.6
X1003.7
CB125(A02)
CB125(B02)
CB125(A03)
CB125(B03)
CB125(A04)
CB125(B04)
CB125(A05)
CB125(B05)
X1010.0
X1010.1
X1010.2
X1010.3
X1010.4
X1010.5
X1010.6
X1010.7
CB125(A06)
CB125(B06)
CB125(A07)
CB125(B07)
CB125(A08)
CB125(B08)
CB125(A09)
CB125(B09)
X1011.0
X1011.1
X1011.2
X1011.3
X1011.4
X1011.5
X1011.6
X1011.7
CB125(A10)
CB125(B10)
CB125(A11)
CB125(B11)
CB125(A12)
CB125(B12)
CB125(A13)
CB125(B13)
RV



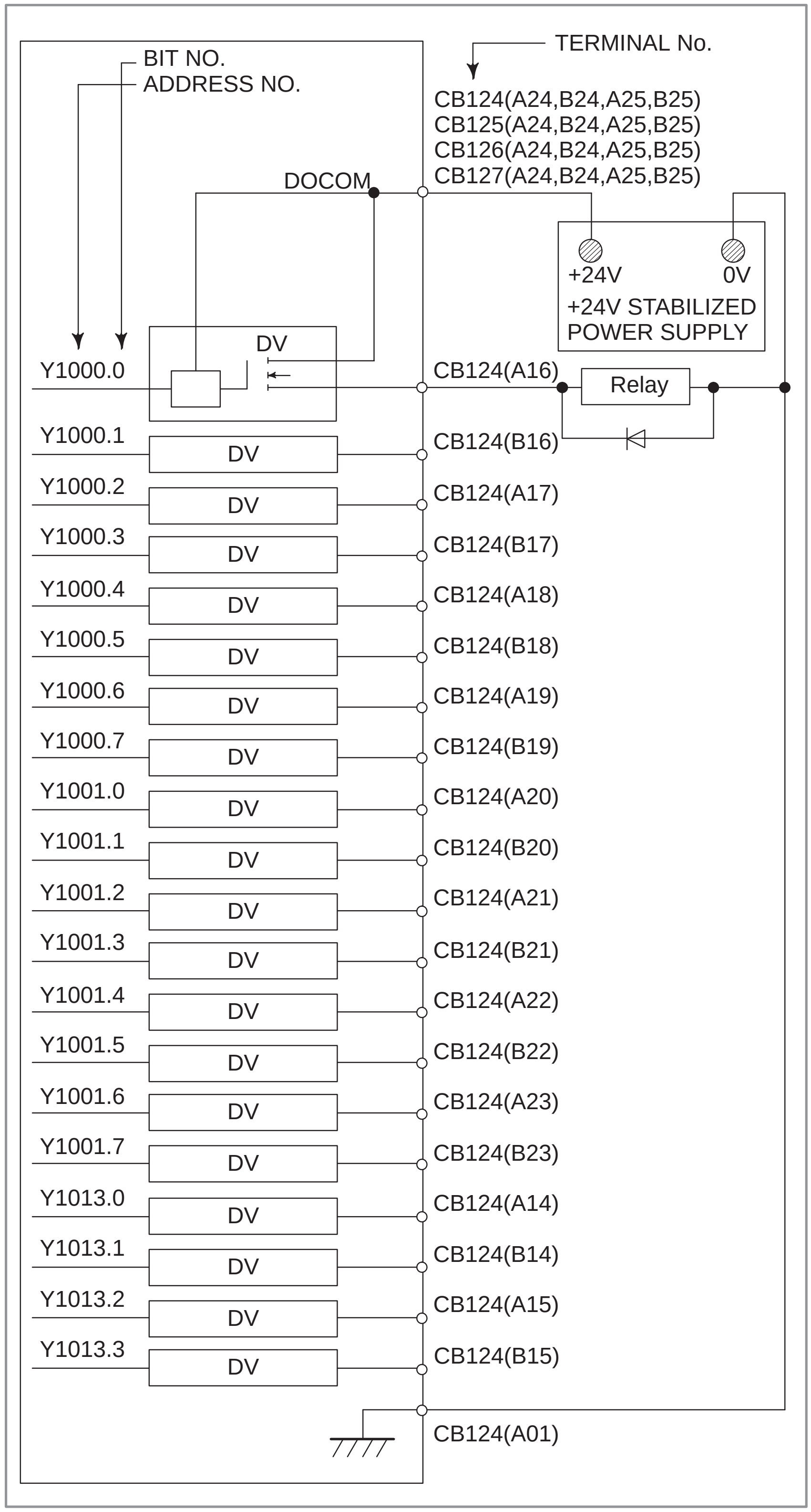
For address X1008, either source or sink type (with a 0– or 24–V common voltage) can be selected. COMX08 must be connected to either 24 or 0 V; never leave it open. From the viewpoint of safety standards, it is recommended that a sink type signal be used. The above diagram shows an example in which the signal is of sink type (with a 24–V common voltage).

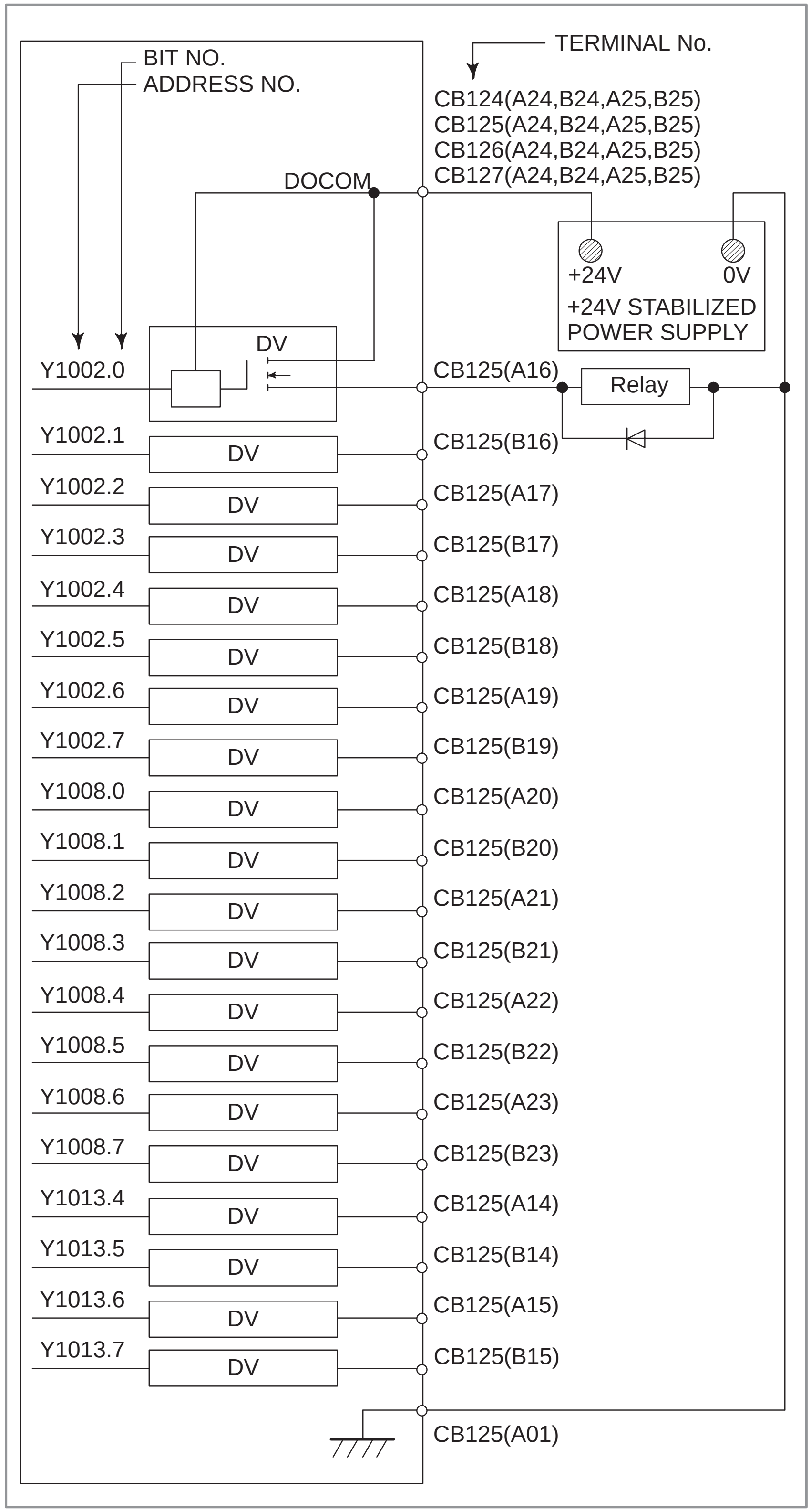


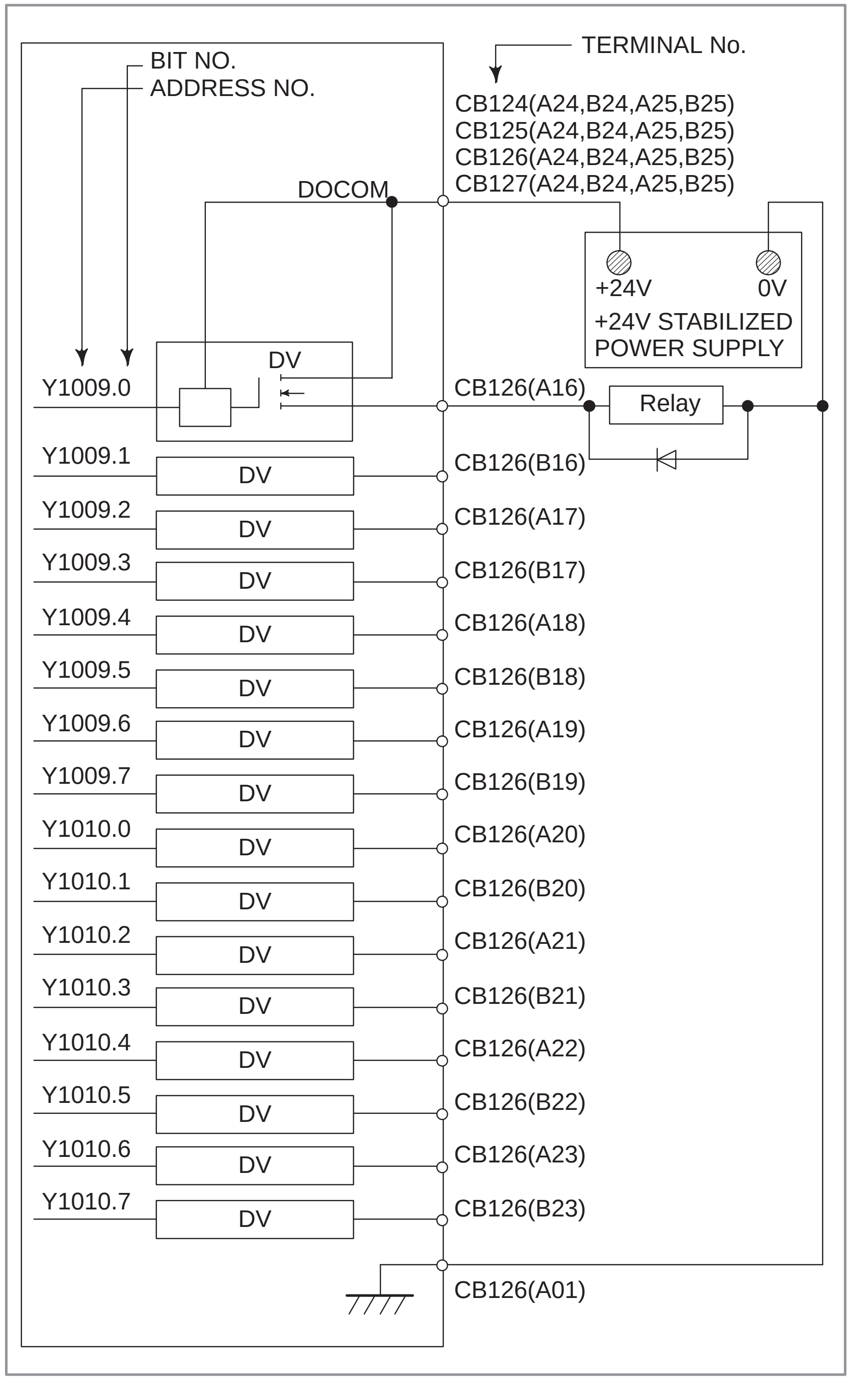
A receiver having a long delay (5 to 22 ms) is used for X1013. Normal receivers have a delay of 2 ms or less.

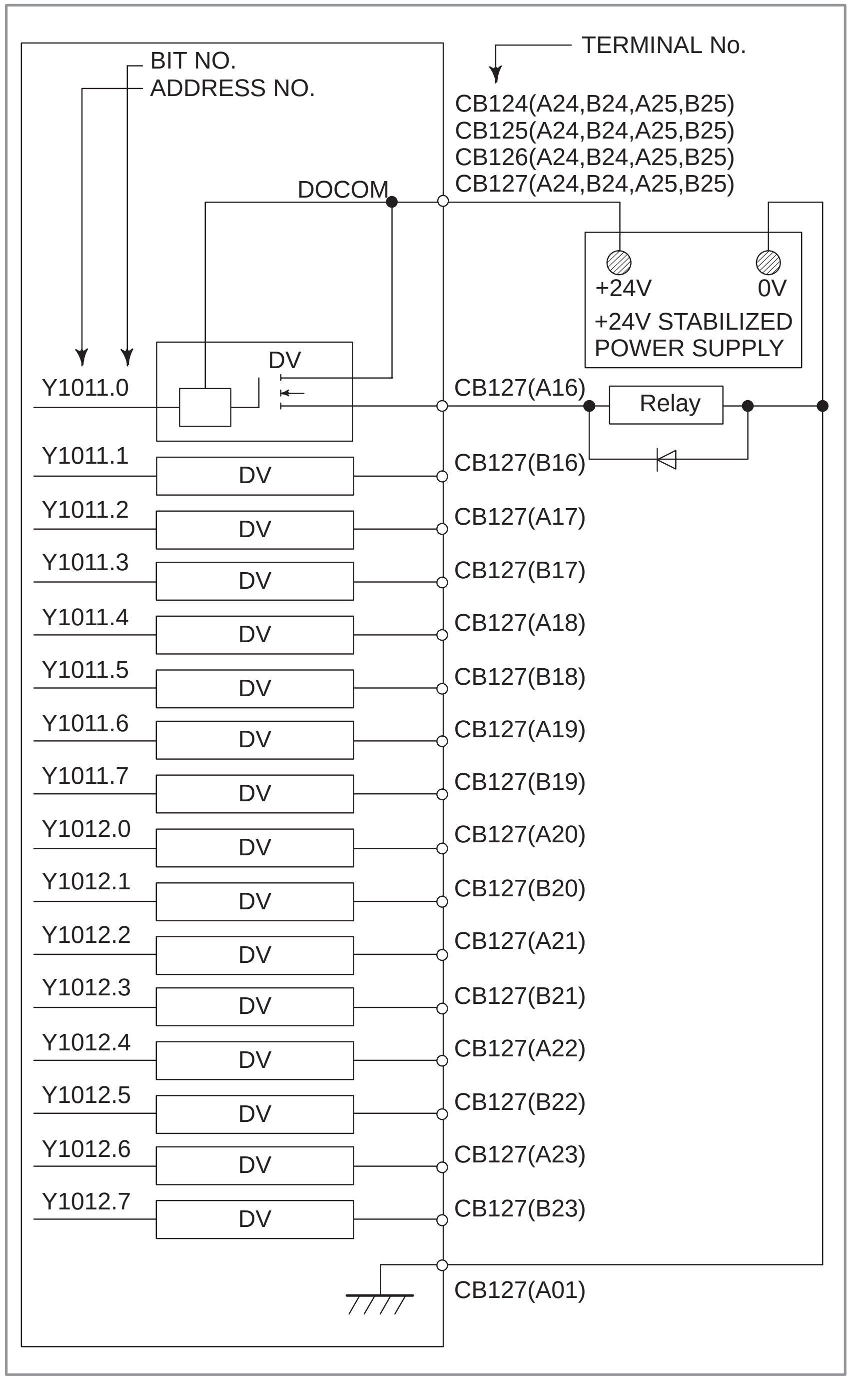
For addresses X1009 and X1013, either a source or sink type (with a 0– or 24–V common voltage) can be selected. COMX09 and COMX13 must be connected to either 24 or 0 V; never leave them open. From the viewpoint of safety standards, it is recommended that sink type signals be used. The above diagram shows an example in which the signals are of sink type (with a 24–V common voltage).

8.6.3 Example of DO Connection



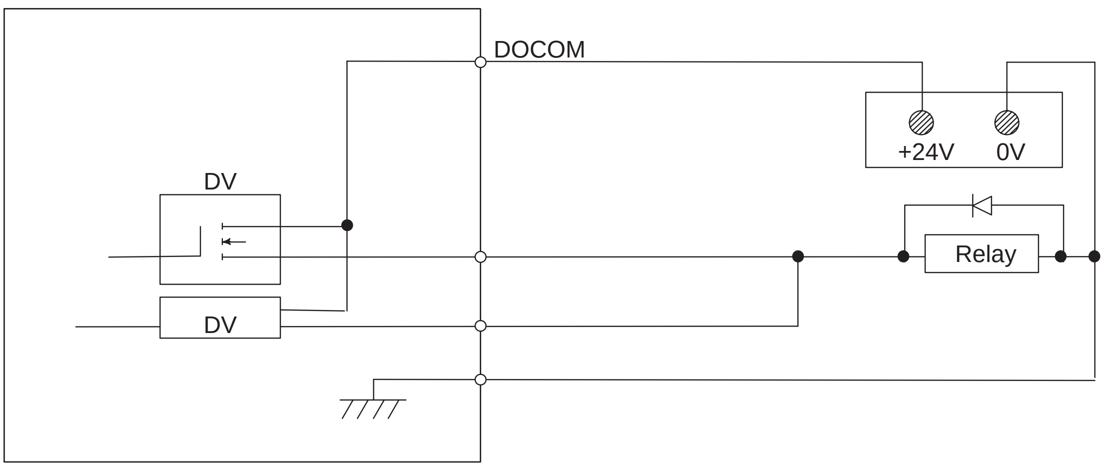

BIT NO.
ADDRESS NO.
TERMINAL No.
CB124(A24,B24,A25,B25)
CB125(A24,B24,A25,B25)
CB126(A24,B24,A25,B25)
CB127(A24,B24,A25,B25)
DOCOM
+24V
0V
+24V STABILIZED POWER SUPPLY
DV
Y1002.0
CB125(A16)
Relay
Y1002.1
CB125(B16)
Y1002.2
CB125(A17)
Y1002.3
CB125(B17)
Y1002.4
CB125(A18)
Y1002.5
CB125(B18)
Y1002.6
CB125(A19)
Y1002.7
CB125(B19)
Y1008.0
CB125(A20)
Y1008.1
CB125(B20)
Y1008.2
CB125(A21)
Y1008.3
CB125(B21)
Y1008.4
CB125(A22)
Y1008.5
CB125(B22)
Y1008.6
CB125(A23)
Y1008.7
CB125(B23)
Y1013.4
CB125(A14)
Y1013.5
CB125(B14)
Y1013.6
CB125(A15)
Y1013.7
CB125(B15)
CB125(A01)


BIT NO.
ADDRESS NO.
TERMINAL No.
CB124(A24,B24,A25,B25)
CB125(A24,B24,A25,B25)
CB126(A24,B24,A25,B25)
CB127(A24,B24,A25,B25)
DOCOM
+24V
0V
+24V STABILIZED POWER SUPPLY
DV
Y1009.0
CB126(A16)
Relay
Y1009.1
CB126(B16)
Y1009.2
CB126(A17)
Y1009.3
CB126(B17)
Y1009.4
CB126(A18)
Y1009.5
CB126(B18)
Y1009.6
CB126(A19)
Y1009.7
CB126(B19)
Y1010.0
CB126(A20)
Y1010.1
CB126(B20)
Y1010.2
CB126(A21)
Y1010.3
CB126(B21)
Y1010.4
CB126(A22)
Y1010.5
CB126(B22)
Y1010.6
CB126(A23)
Y1010.7
CB126(B23)
CB126(A01)

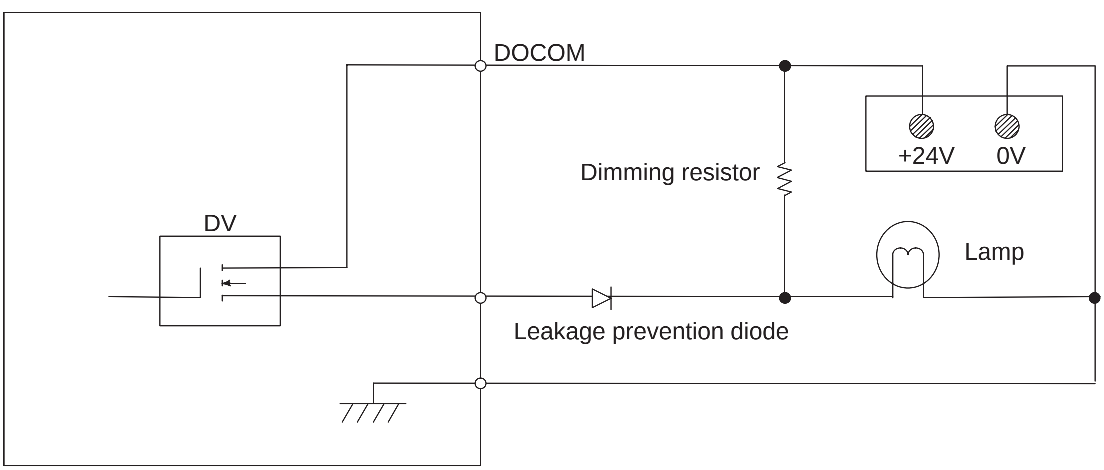

BIT NO.
ADDRESS NO.
TERMINAL No.
CB124(A24,B24,A25,B25)
CB125(A24,B24,A25,B25)
CB126(A24,B24,A25,B25)
CB127(A24,B24,A25,B25)
DOCOM
+24V
0V
+24V STABILIZED
POWER SUPPLY
DV
Y1011.0
CB127(A16)
Relay
Y1011.1
DV
CB127(B16)
Y1011.2
DV
CB127(A17)
Y1011.3
DV
CB127(B17)
Y1011.4
DV
CB127(A18)
Y1011.5
DV
CB127(B18)
Y1011.6
DV
CB127(A19)
Y1011.7
DV
CB127(B19)
Y1012.0
DV
CB127(A20)
Y1012.1
DV
CB127(B20)
Y1012.2
DV
CB127(A21)
Y1012.3
DV
CB127(B21)
Y1012.4
DV
CB127(A22)
Y1012.5
DV
CB127(B22)
Y1012.6
DV
CB127(A23)
Y1012.7
DV
CB127(B23)
CB127(A01)

8.6.4 Notes on DO Connection

CAUTION
Do not connect DOs in parallel, as shown below.



CAUTION
When using a dimming resistor, as shown below, connect a diode to prevent leakage.



8.6.5 Requirements Imposed on I/O Signals and Driver

8.6.5.1 Signal requirements

Requirements for the DI signals

- Contact capacity : 30VDC, 16mA or more
- Leakage current between contacts for an open circuit :
  1mA or less (at 26.4V)
- Voltage drop between contacts for a closed circuit :
  2V or less (with 8.5mA), including the voltage drop in the cables.

DO output signal driver ratings

- Maximum on–state load current :
  200mA or less, including momentary surges

  (For the DOCOM power supply pins, the maximum current per pin shall not exceed 0.7A.)
- On–state saturation voltage : 1.0V or less for a load current of 200mA
- Dielectric strength : 24V +20% or less, including momentary surges
- Off–state leakage current : 20μA or less

8.6.5.2 External power supply for output signals

- Supply voltage : 24 V+10%
- Supply current : Total of the maximum load current for each signal (including momentary surges) + 150mA, or higher

8.6.5.3 Output signal driver

Each output signal driver element on the I/O board outputs eight signals.

The driver elements each monitor the current of an output signal. If a driver element detects a signal overcurrent, it stops output of that signal. Once output of that signal has been turned off, an overcurrent no longer flows, at which point the driver element will again turn on the output of the signal. This means that the signal output will be repeatedly turned on and off upon the occurrence of a ground fault or overload. Connecting a load which induces a large surge current will also produce this effect.

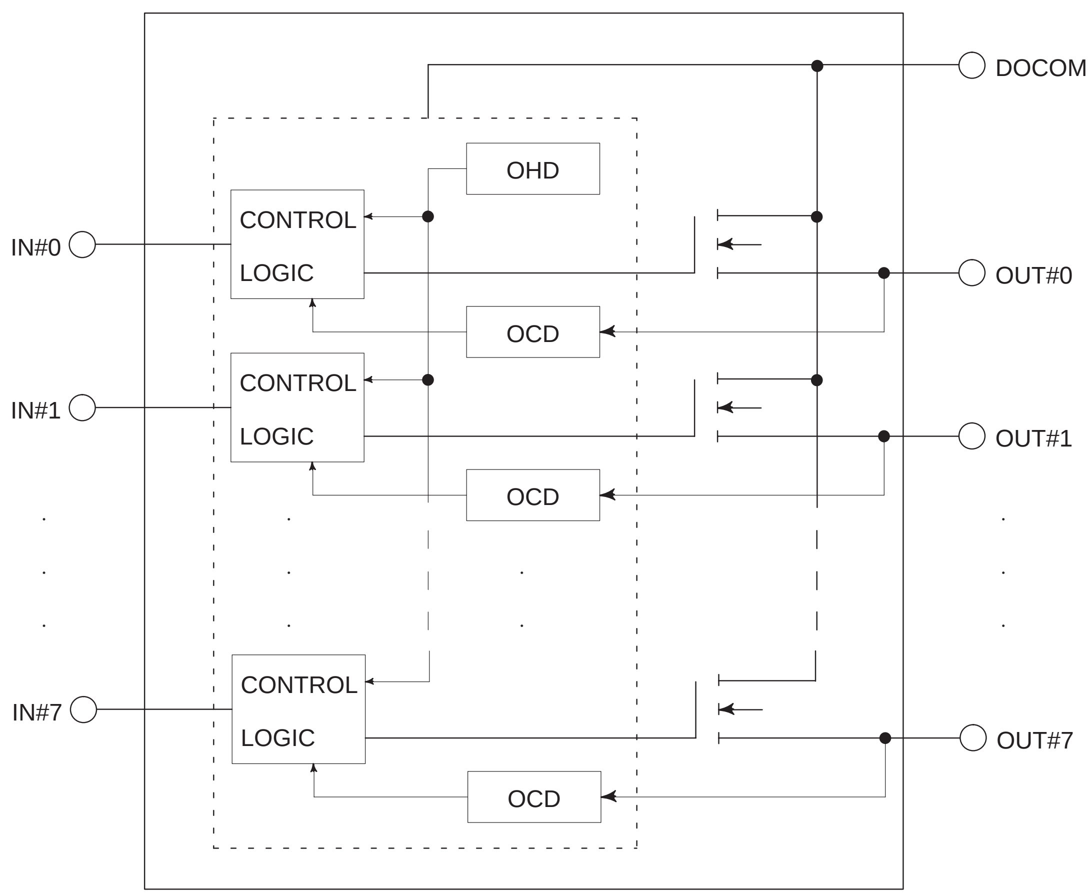
Each driver element contains an overheat detection circuit. If an overcurrent flows continuously, as a result of a ground fault or some other cause, such that the temperature of the element increases beyond the specified range, the element turns off all eight of its output signals. The signals remain off even after the element temperature drops back to within the specified range. Logically turning the signals off, after the temperature has dropped sufficiently, resets the overheat detection circuit, after which the signals can be turned on again. The detection circuit can also be reset by turning off the system power.

The following signals are assigned to the driver elements:

Element #0: Y1000.0 to 7	Element #1: Y1001.0 to 7
Element #2: Y1002.0 to 7	Element #3: Y1008.0 to 7
Element #4: Y1009.0 to 7	Element #5: Y1010.0 to 7
Element #6: Y1011.0 to 7	Element #7: Y1012.0 to 7
Element #8: Y1013.0 to 7	

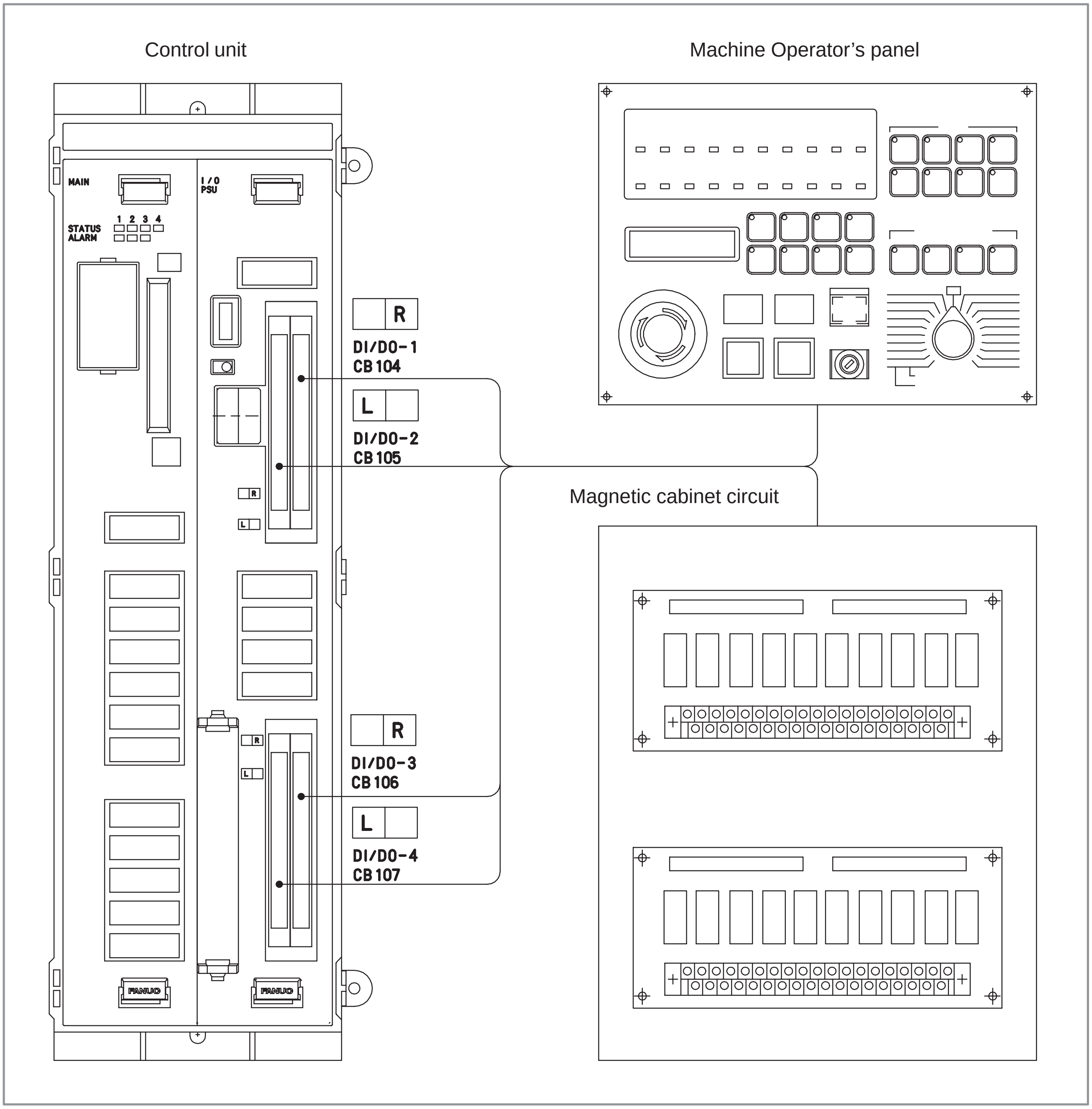
If the output of a signal cannot be turned on even when NC diagnosis indicates that the output is being turned on, that signal, or another signal assigned to the same element, may be overloaded, causing all eight output signals of that element to be turned off. In such a case, turn the system power off, then determine and eliminate the cause of the overload.

[Internal block diagram of driver element]



OHD : Overheat detection circuit, OCD : Overcurrent detection circuit

8.7 BUILT–IN I/O CARD CONNECTION (FOR 21/210–TB)



8.7.1 Connector Pin Arrangement

CB104

HIROSE 50PIN

	A	B
01	0V	+24V
02	X1000.0	X1000.1
03	X1000.2	X1000.3
04	X1000.4	X1000.5
05	X1000.6	X1000.7
06	X1001.0	X1001.1
07	X1001.2	X1001.3
08	X1001.4	X1001.5
09	X1001.6	X1001.7
10	X1002.0	X1002.1
11	X1002.2	X1002.3
12	X1002.4	X1002.5
13	X1002.6	X1002.7
14		
15		
16	Y1000.0	Y1000.1
17	Y1000.2	Y1000.3
18	Y1000.4	Y1000.5
19	Y1000.6	Y1000.7
20	Y1001.0	Y1001.1
21	Y1001.2	Y1001.3
22	Y1001.4	Y1001.5
23	Y1001.6	Y1001.7
24	DOCOM	DOCOM
25	DOCOM	DOCOM

CB105

HIROSE 50PIN

	A	B
01	0V	+24V
02	X1003.0	X1003.1
03	X1003.2	X1003.3
04	X1003.4	X1003.5
05	X1003.6	X1003.7
06	X1008.0	X1008.1
07	X1008.2	X1008.3
08	X1008.4	X1008.5
09	X1008.6	X1008.7
10	X1009.0	X1009.1
11	X1009.2	X1009.3
12	X1009.4	X1009.5
13	X1009.6	X1009.7
14		
15		
16	Y1002.0	Y1002.1
17	Y1002.2	Y1002.3
18	Y1002.4	Y1002.5
19	Y1002.6	Y1002.7
20	Y1003.0	Y1003.1
21	Y1003.2	Y1003.3
22	Y1003.4	Y1003.5
23	Y1003.6	Y1003.7
24	DOCOM	DOCOM
25	DOCOM	DOCOM

CB106

HIROSE 50PIN

	A	B
01	0V	+24V
02	X1004.0	X1004.1
03	X1004.2	X1004.3
04	X1004.4	X1004.5
05	X1004.6	X1004.7
06	X1005.0	X1005.1
07	X1005.2	X1005.3
08	X1005.4	X1005.5
09	X1005.6	X1005.7
10	X1006.0	X1006.1
11	X1006.2	X1006.3
12	X1006.4	X1006.5
13	X1006.6	X1006.7
14	COM4	
15		
16	Y1004.0	Y1004.1
17	Y1004.2	Y1004.3
18	Y1004.4	Y1004.5
19	Y1004.6	Y1004.7
20	Y1005.0	Y1005.1
21	Y1005.2	Y1005.3
22	Y1005.4	Y1005.5
23	Y1005.6	Y1005.7
24	DOCOM	DOCOM
25	DOCOM	DOCOM

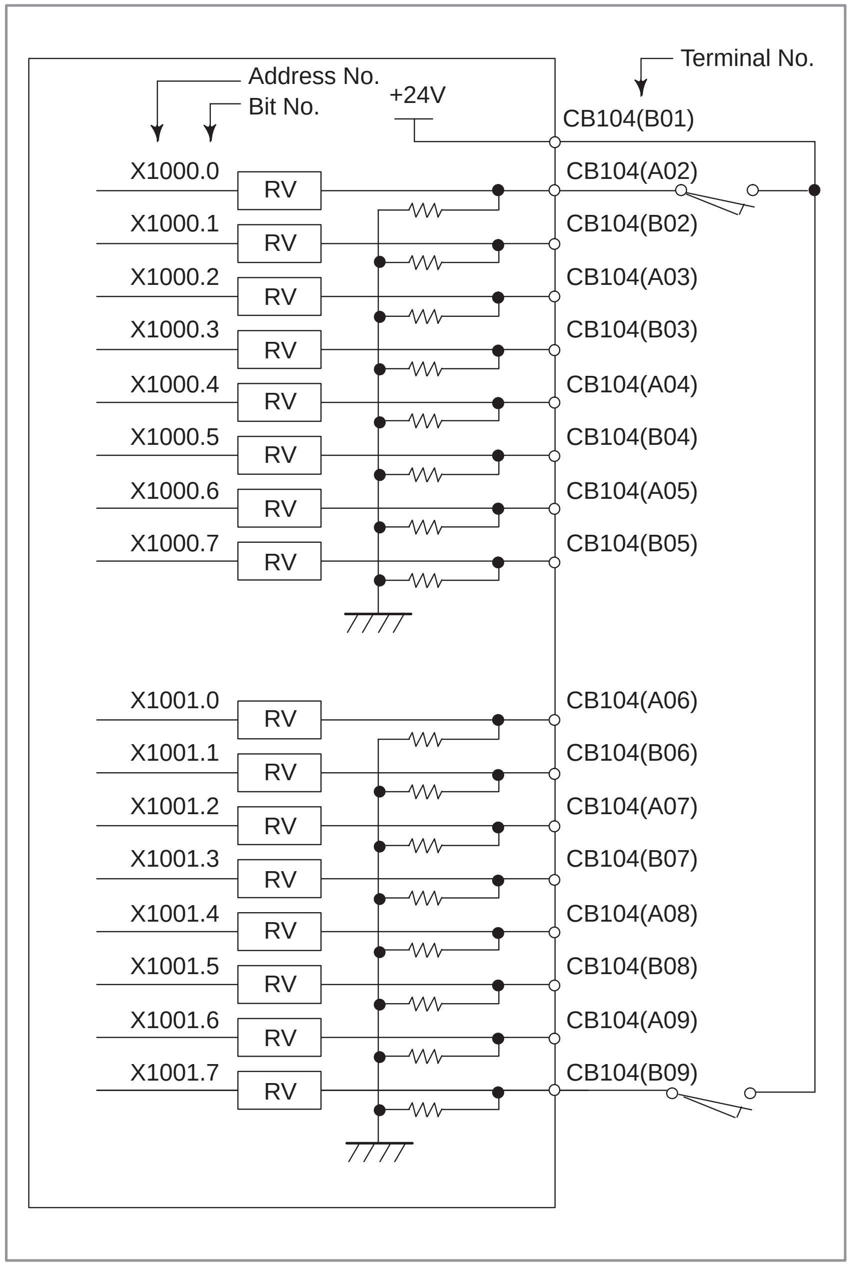
CB107

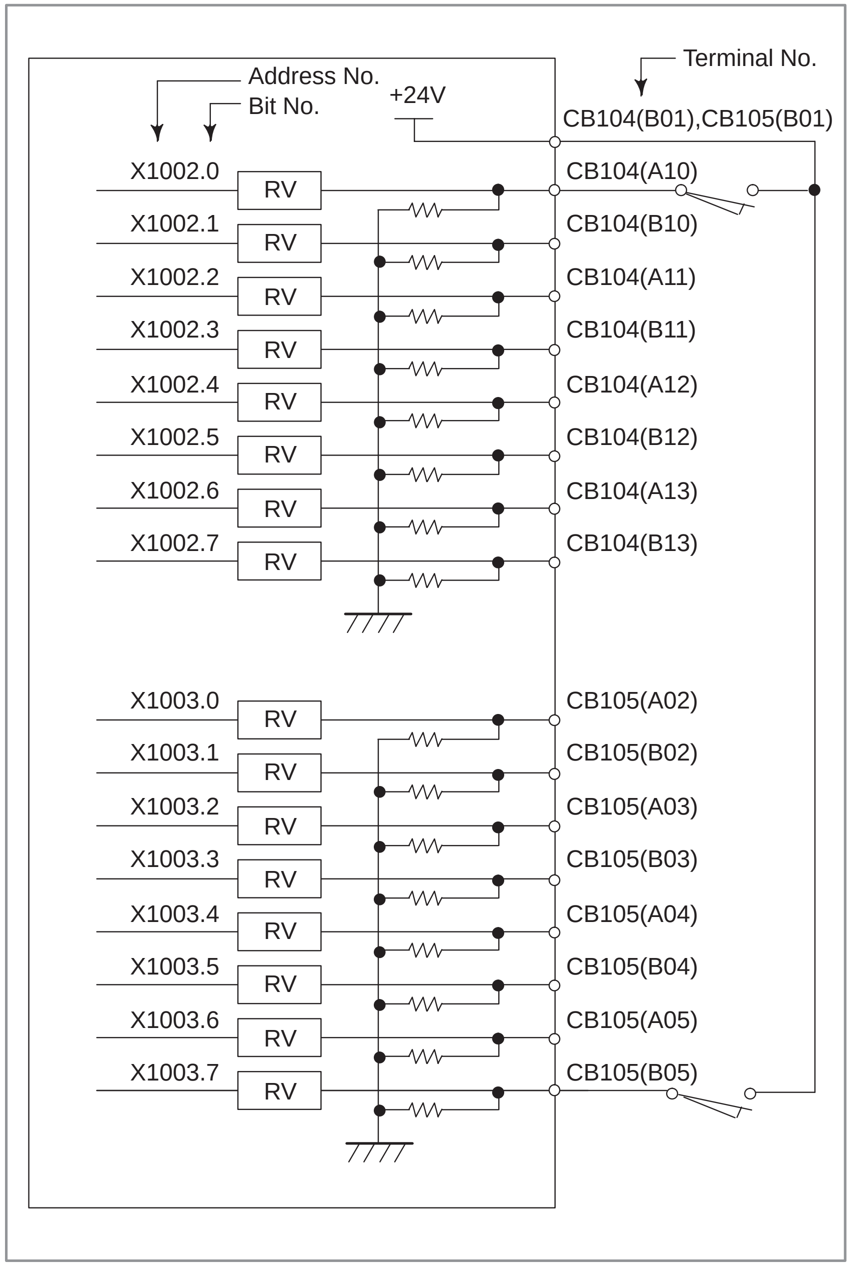
HIROSE 50PIN

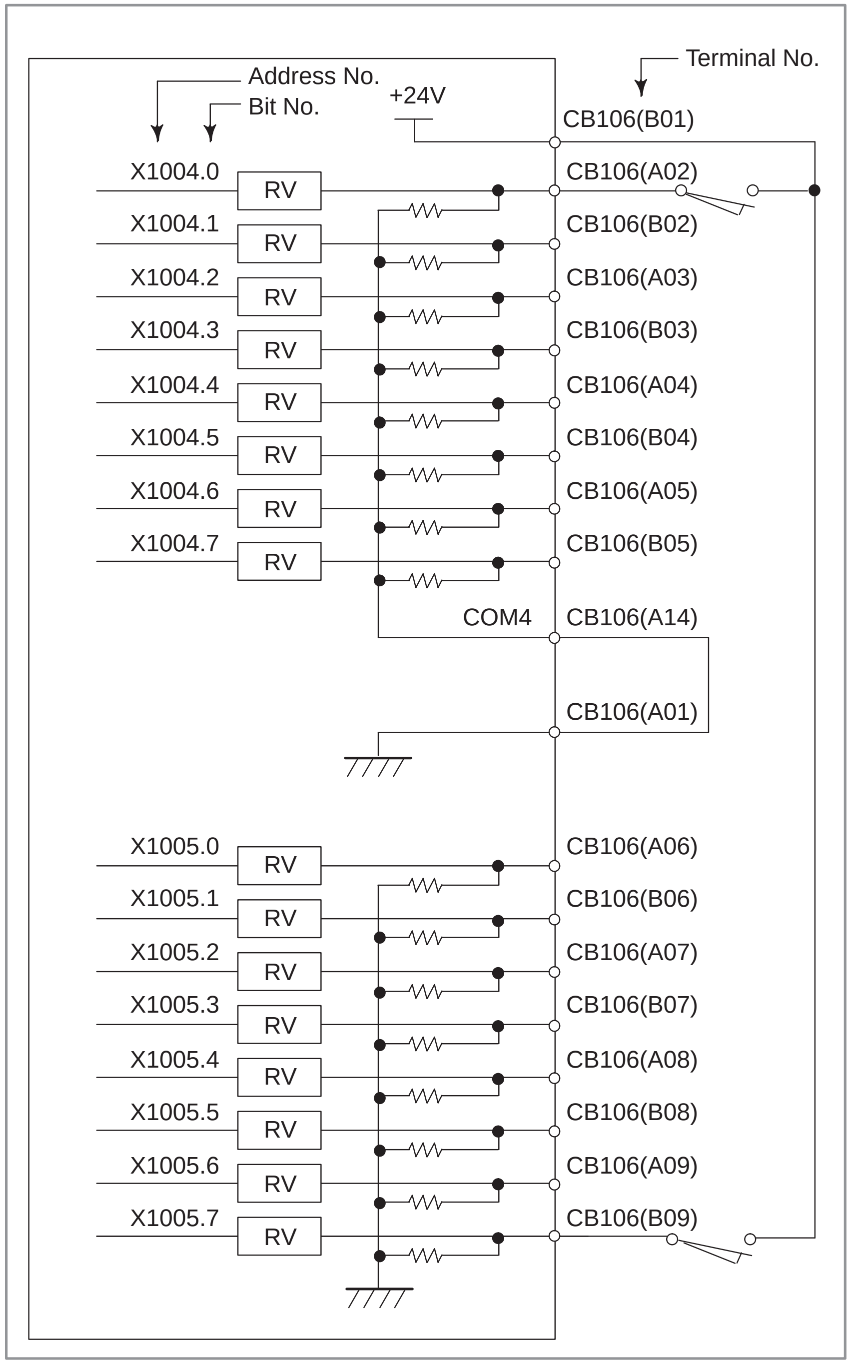
	A	B
01	0V	+24V
02	X1007.0	X1007.1
03	X1007.2	X1007.3
04	X1007.4	X1007.5
05	X1007.6	X1007.7
06	X1010.0	X1010.1
07	X1010.2	X1010.3
08	X1010.4	X1010.5
09	X1010.6	X1010.7
10	X1011.0	X1011.1
11	X1011.2	X1011.3
12	X1011.4	X1011.5
13	X1011.6	X1011.7
14		
15		
16	Y1006.0	Y1006.1
17	Y1006.2	Y1006.3
18	Y1006.4	Y1006.5
19	Y1006.6	Y1006.7
20	Y1007.0	Y1007.1
21	Y1007.2	Y1007.3
22	Y1007.4	Y1007.5
23	Y1007.6	Y1007.7
24	DOCOM	DOCOM
25	DOCOM	DOCOM

8.7.2 Connecting DI/DO

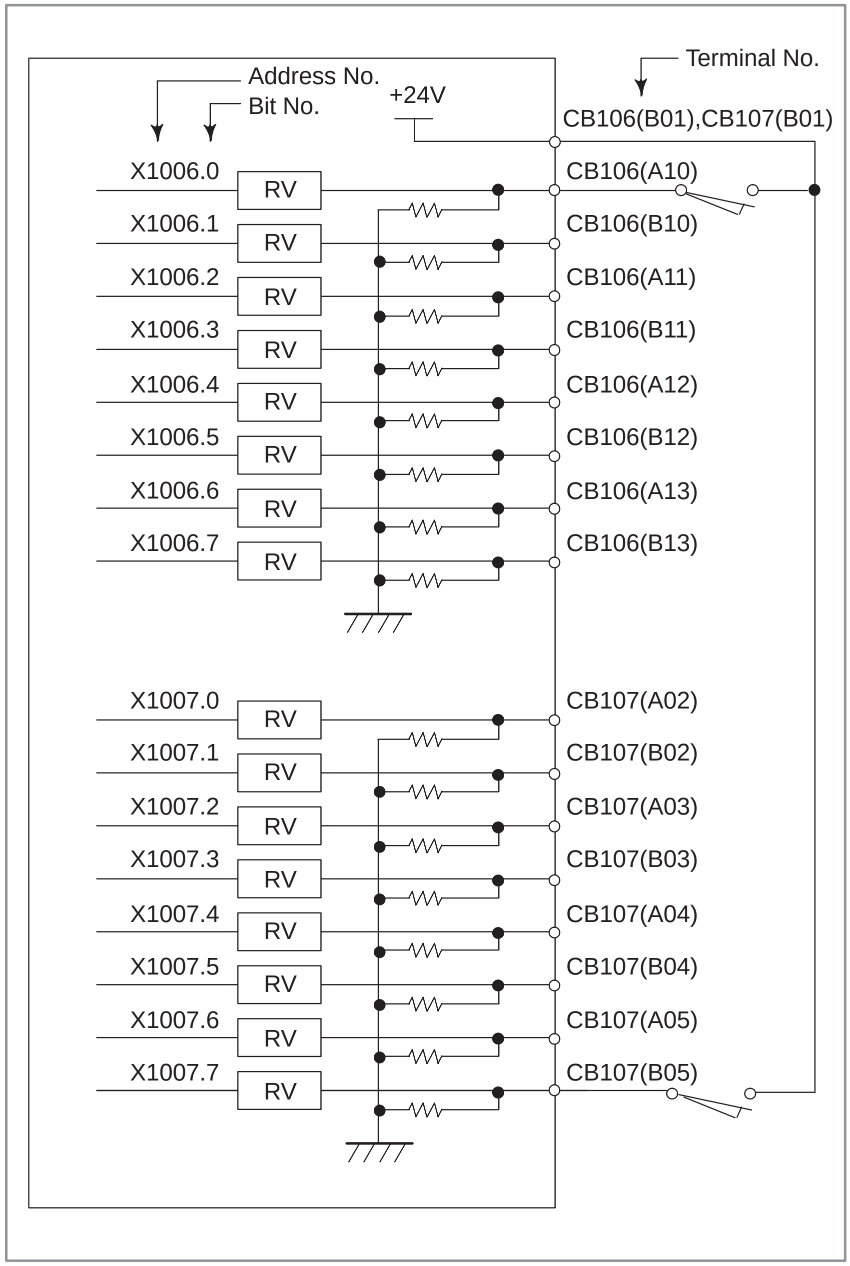
For example, connecting DI

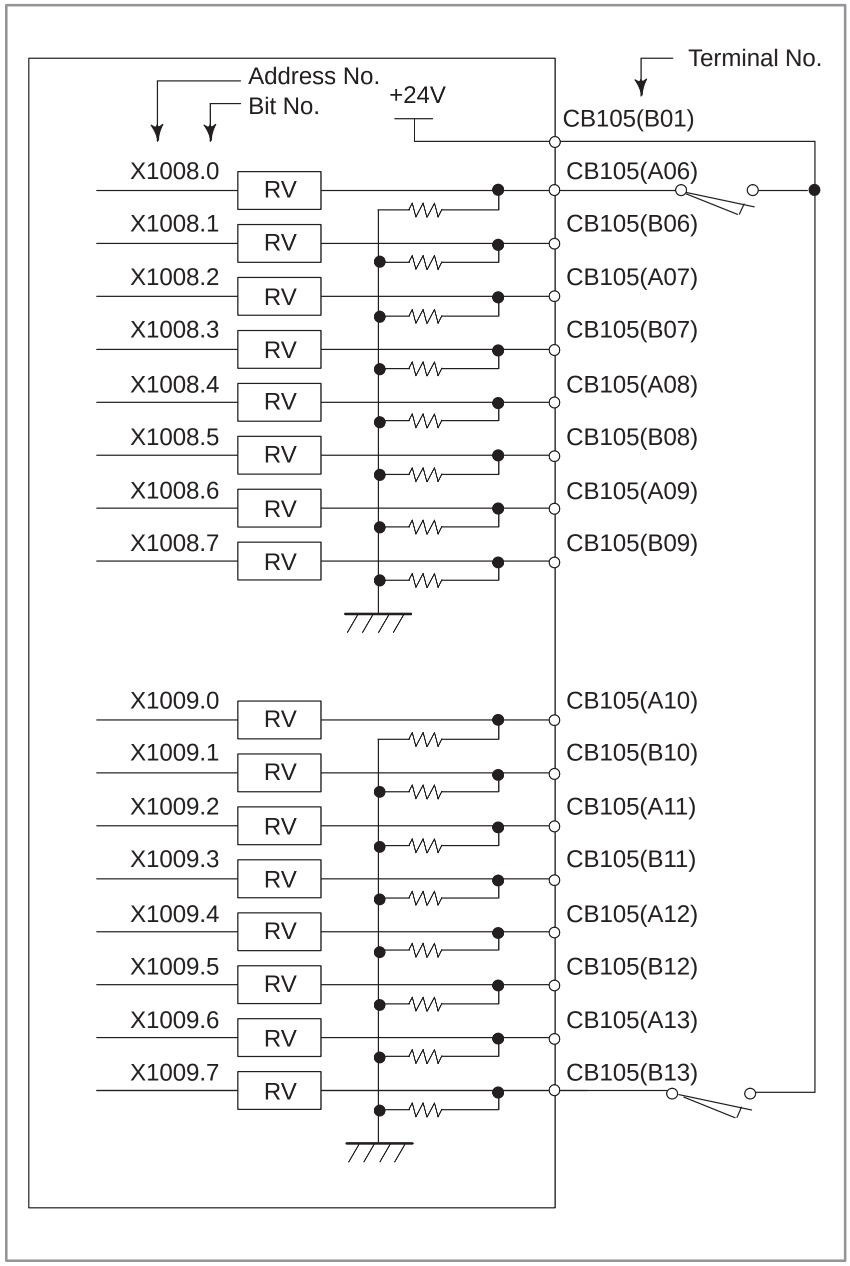


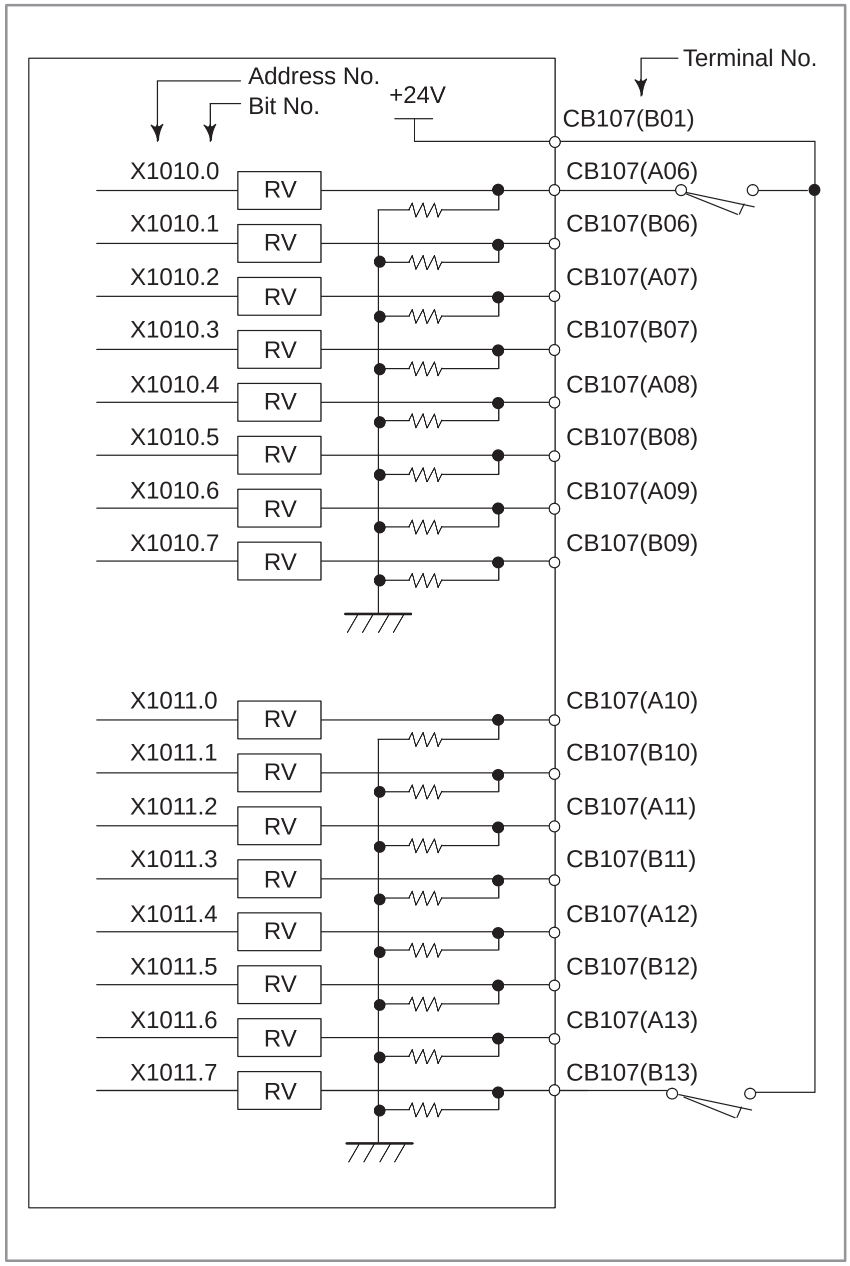

Address No.
Bit No.
+24V
Terminal No.
CB104(B01),CB105(B01)
X1002.0
X1002.1
X1002.2
X1002.3
X1002.4
X1002.5
X1002.6
X1002.7
RV
CB104(A10)
CB104(B10)
CB104(A11)
CB104(B11)
CB104(A12)
CB104(B12)
CB104(A13)
CB104(B13)
X1003.0
X1003.1
X1003.2
X1003.3
X1003.4
X1003.5
X1003.6
X1003.7
CB105(A02)
CB105(B02)
CB105(A03)
CB105(B03)
CB105(A04)
CB105(B04)
CB105(A05)
CB105(B05)



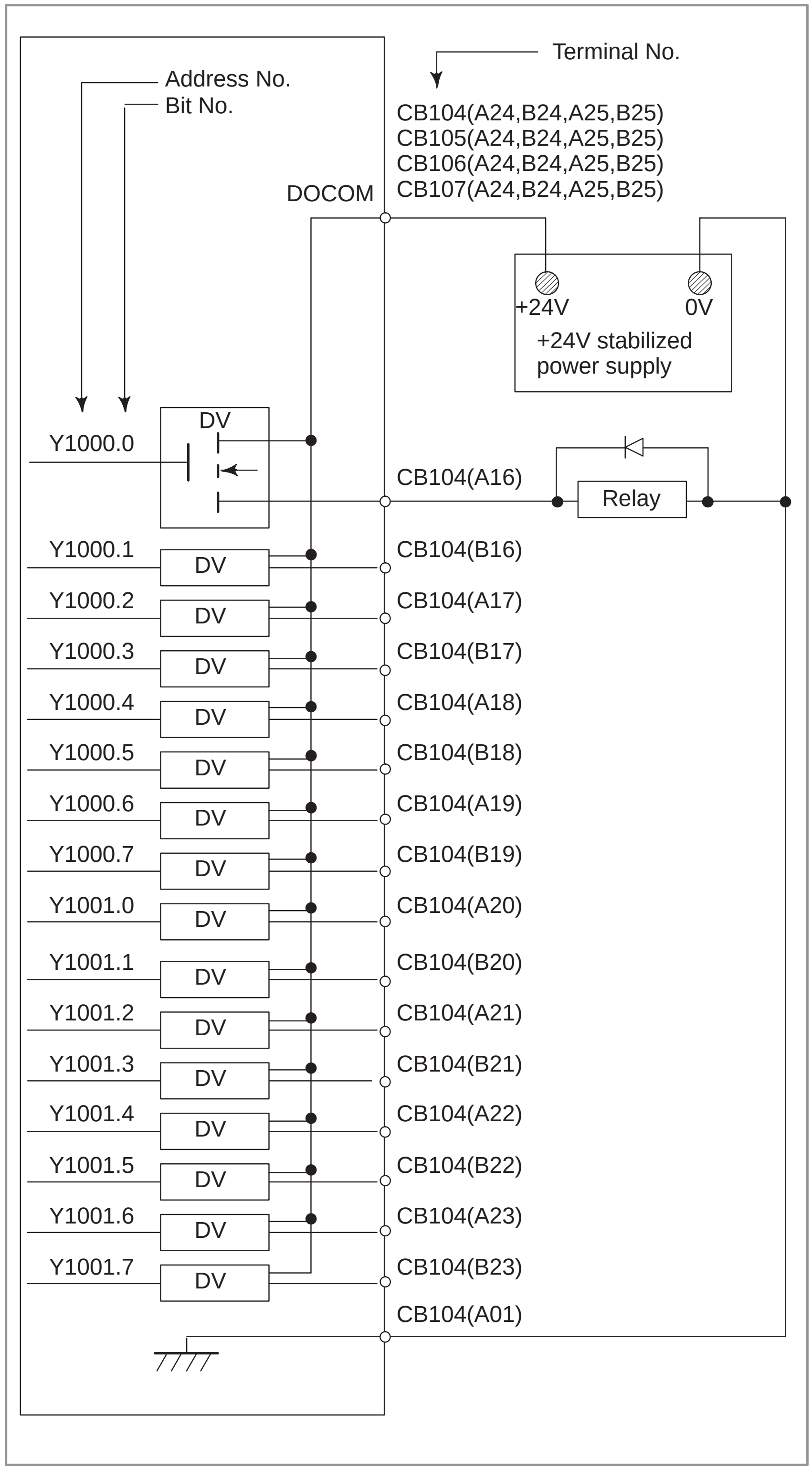
For address X1004, either a source or sink type (with a 0– or 24–V common voltage) can be selected. COM4 must be connected to either 24 or 0 V; never leave it open. From the viewpoint of safety standards, it is recommended that a sink type signal be used. The above diagram shows an example in which the signal is of sink type (with a 24–V common voltage).

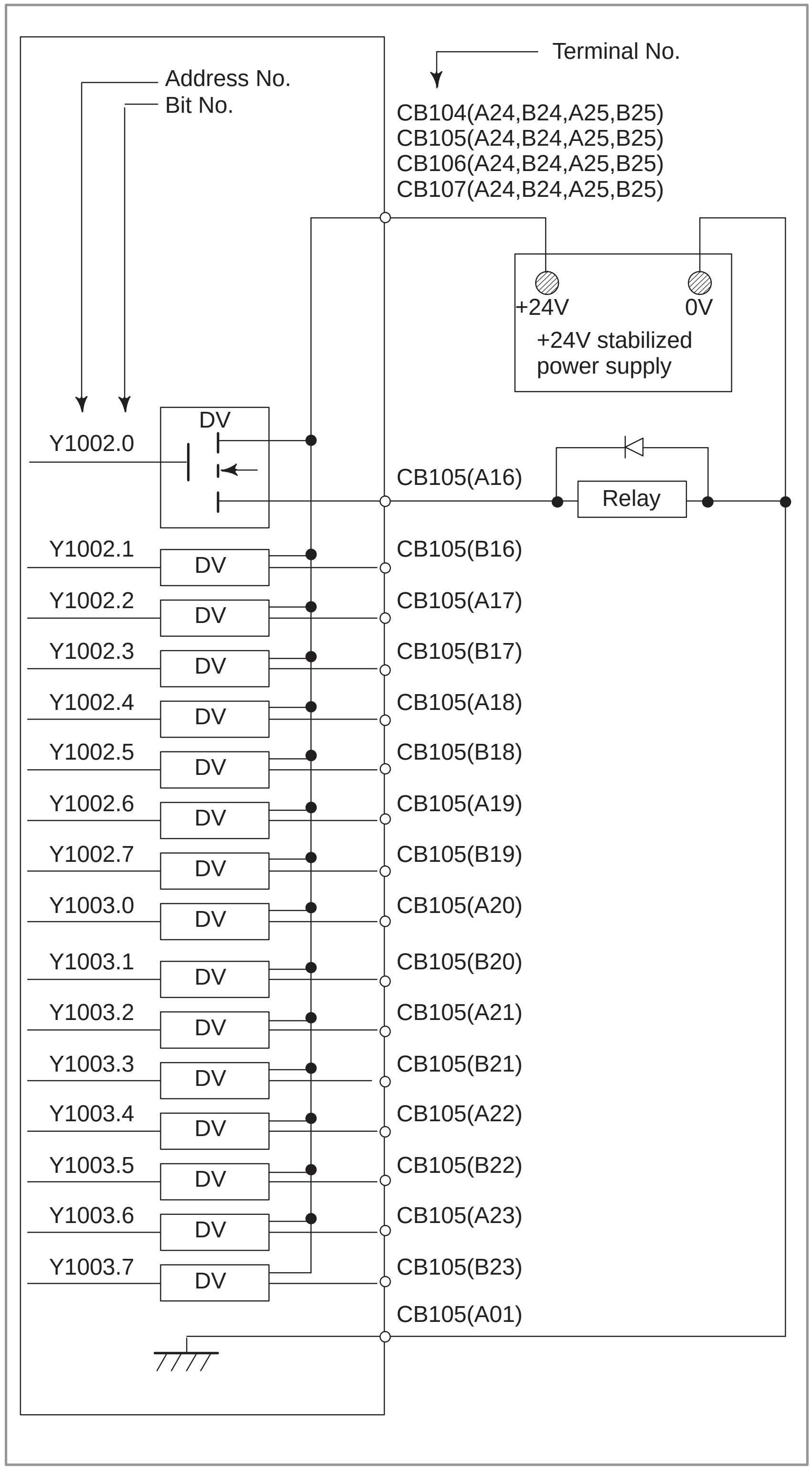

Address No.
Bit No.
+24V
Terminal No.
CB106(B01),CB107(B01)
X1006.0
X1006.1
X1006.2
X1006.3
X1006.4
X1006.5
X1006.6
X1006.7
RV
CB106(A10)
CB106(B10)
CB106(A11)
CB106(B11)
CB106(A12)
CB106(B12)
CB106(A13)
CB106(B13)
X1007.0
X1007.1
X1007.2
X1007.3
X1007.4
X1007.5
X1007.6
X1007.7
CB107(A02)
CB107(B02)
CB107(A03)
CB107(B03)
CB107(A04)
CB107(B04)
CB107(A05)
CB107(B05)

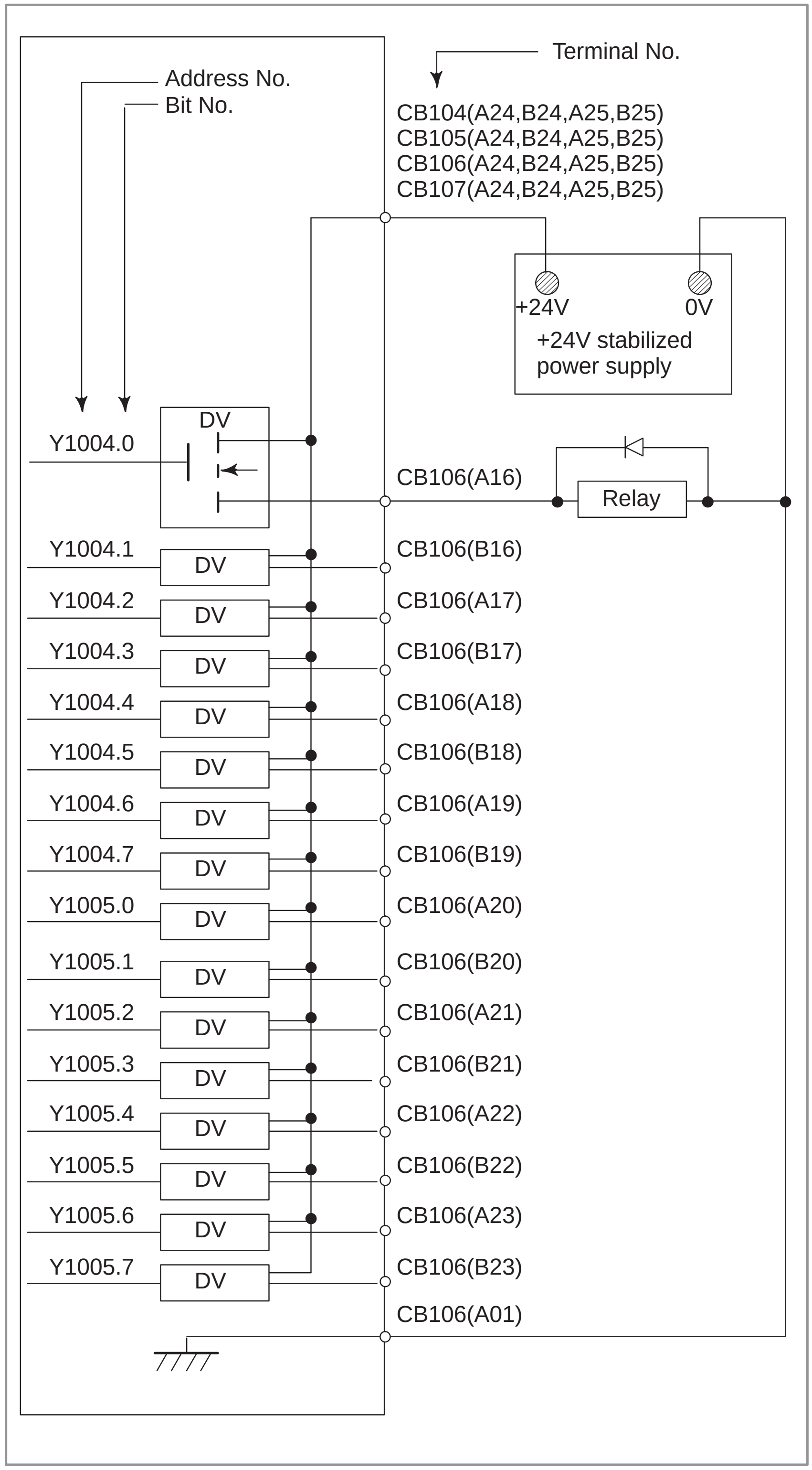

Address No.
Bit No.
+24V
Terminal No.
CB105(B01)
X1008.0
CB105(A06)
X1008.1
CB105(B06)
X1008.2
CB105(A07)
X1008.3
CB105(B07)
X1008.4
CB105(A08)
X1008.5
CB105(B08)
X1008.6
CB105(A09)
X1008.7
CB105(B09)
X1009.0
CB105(A10)
X1009.1
CB105(B10)
X1009.2
CB105(A11)
X1009.3
CB105(B11)
X1009.4
CB105(A12)
X1009.5
CB105(B12)
X1009.6
CB105(A13)
X1009.7
CB105(B13)
RV

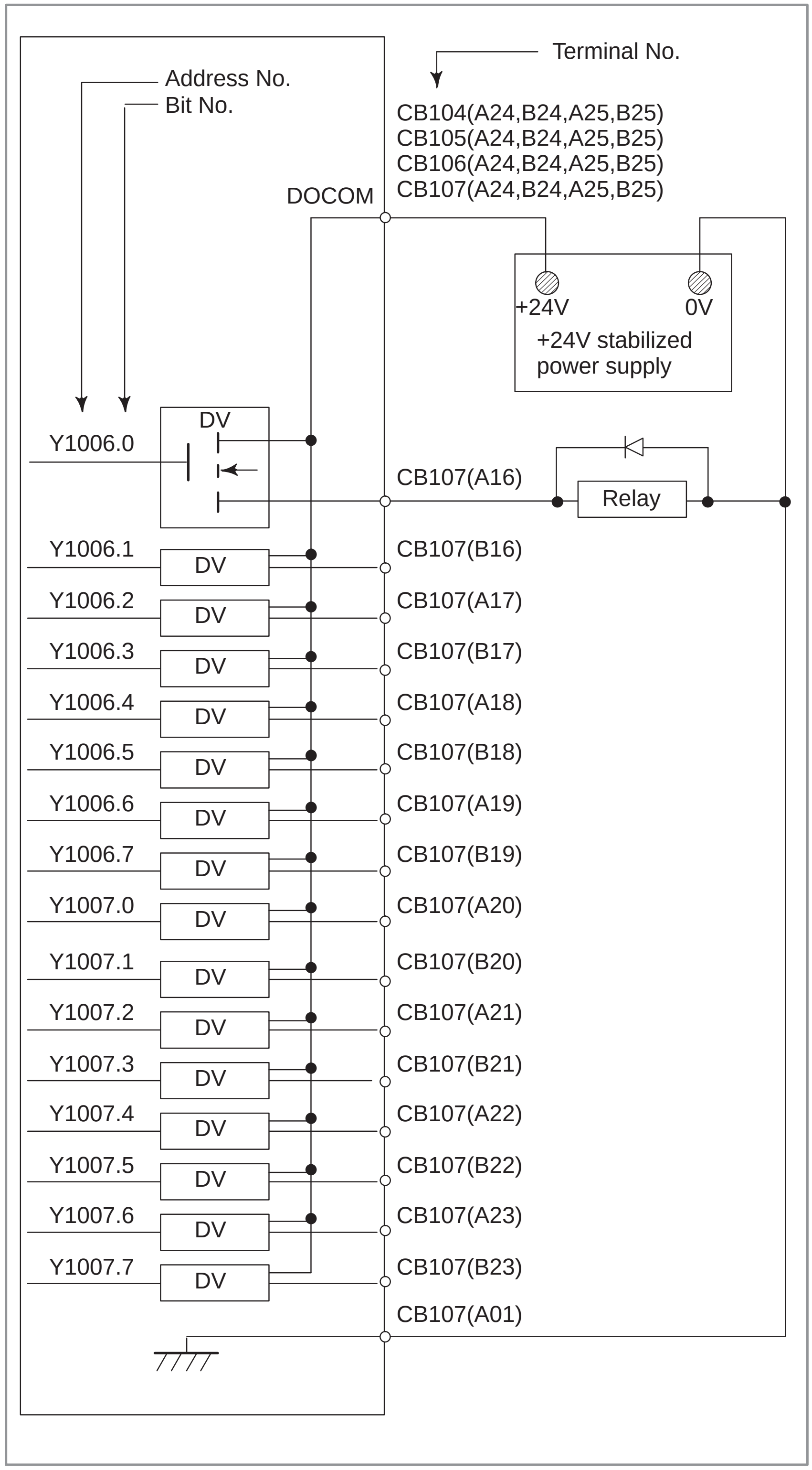

Address No.
Bit No.
+24V
Terminal No.
CB107(B01)
X1010.0
CB107(A06)
X1010.1
CB107(B06)
X1010.2
CB107(A07)
X1010.3
CB107(B07)
X1010.4
CB107(A08)
X1010.5
CB107(B08)
X1010.6
CB107(A09)
X1010.7
CB107(B09)
X1011.0
CB107(A10)
X1011.1
CB107(B10)
X1011.2
CB107(A11)
X1011.3
CB107(B11)
X1011.4
CB107(A12)
X1011.5
CB107(B12)
X1011.6
CB107(A13)
X1011.7
CB107(B13)
RV

For example, connecting DO




Address No.
Bit No.
Terminal No.
CB104(A24,B24,A25,B25)
CB105(A24,B24,A25,B25)
CB106(A24,B24,A25,B25)
CB107(A24,B24,A25,B25)
+24V
0V
+24V stabilized power supply
DV
Y1002.0
CB105(A16)
Relay
Y1002.1
CB105(B16)
Y1002.2
CB105(A17)
Y1002.3
CB105(B17)
Y1002.4
CB105(A18)
Y1002.5
CB105(B18)
Y1002.6
CB105(A19)
Y1002.7
CB105(B19)
Y1003.0
CB105(A20)
Y1003.1
CB105(B20)
Y1003.2
CB105(A21)
Y1003.3
CB105(B21)
Y1003.4
CB105(A22)
Y1003.5
CB105(B22)
Y1003.6
CB105(A23)
Y1003.7
CB105(B23)
CB105(A01)


Terminal No.
Address No.
Bit No.
CB104(A24,B24,A25,B25)
CB105(A24,B24,A25,B25)
CB106(A24,B24,A25,B25)
CB107(A24,B24,A25,B25)
+24V
0V
+24V stabilized power supply
DV
Y1004.0
CB106(A16)
Relay
Y1004.1
CB106(B16)
Y1004.2
CB106(A17)
Y1004.3
CB106(B17)
Y1004.4
CB106(A18)
Y1004.5
CB106(B18)
Y1004.6
CB106(A19)
Y1004.7
CB106(B19)
Y1005.0
CB106(A20)
Y1005.1
CB106(B20)
Y1005.2
CB106(A21)
Y1005.3
CB106(B21)
Y1005.4
CB106(A22)
Y1005.5
CB106(B22)
Y1005.6
CB106(A23)
Y1005.7
CB106(B23)
CB106(A01)


Address No.
Bit No.
Terminal No.
CB104(A24,B24,A25,B25)
CB105(A24,B24,A25,B25)
CB106(A24,B24,A25,B25)
CB107(A24,B24,A25,B25)
DOCOM
+24V
0V
+24V stabilized power supply
DV
Y1006.0
CB107(A16)
Relay
Y1006.1
CB107(B16)
Y1006.2
CB107(A17)
Y1006.3
CB107(B17)
Y1006.4
CB107(A18)
Y1006.5
CB107(B18)
Y1006.6
CB107(A19)
Y1006.7
CB107(B19)
Y1007.0
CB107(A20)
Y1007.1
CB107(B20)
Y1007.2
CB107(A21)
Y1007.3
CB107(B21)
Y1007.4
CB107(A22)
Y1007.5
CB107(B22)
Y1007.6
CB107(A23)
Y1007.7
CB107(B23)
CB107(A01)

8.7.3 I/O Signal Requirements and External Power Supply for DO

Requirements for DI signals

Contact capacity :
30 VDC 16 mA or more

Leakage current between contact points for an open circuit :
1 mA or less (at 26.4 V)

Voltage drop between contact points for a closed circuit :
2 V or less (including the voltage drop in the cables)

Ratings for the DO output driver

Maximum load current when turned on :
200 mA or less, including momentary surges (The-maximum current for one DOCOM (power supply) pin must be 0.7 A or less.)

Saturation voltage when turned on :
1.0 V max when the load current is 200 mA

Dielectric strength :
24 V +20% or less, including momentary surges

Leakage current when turned off :
100 A or less

External power supply for DO

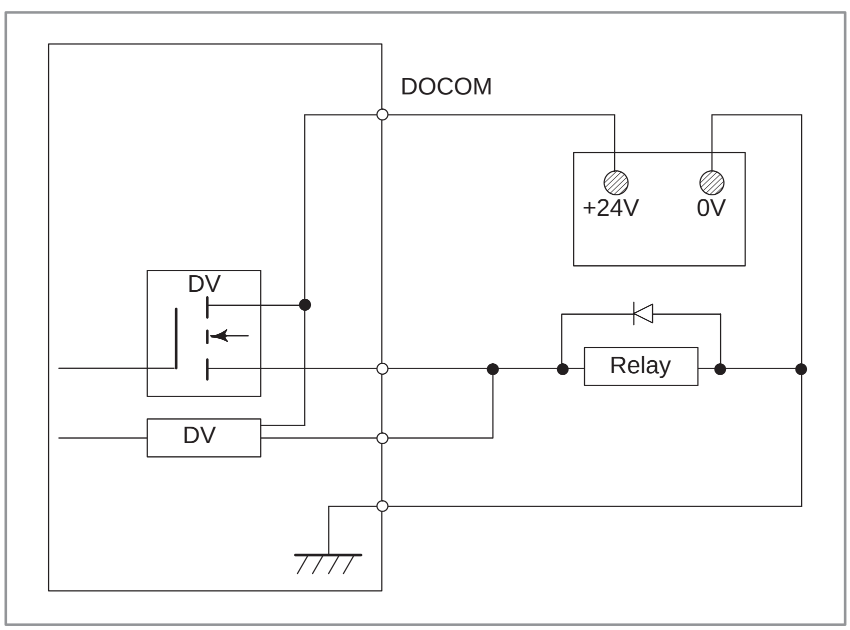
Power supply voltage :
24 V +10%

Power supply current :
(Sum of maximum load current including momentary surges + 100 mA) or more

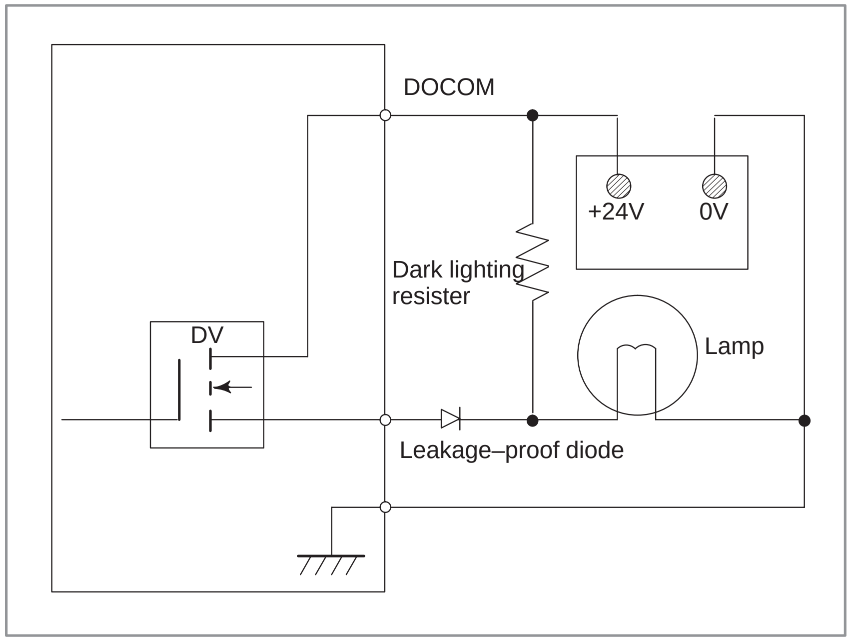
Power–on sequence :
Turn on the external power supply at the same time or before turning on the control unit.

Power–off sequence :
Turn off the external power supply at the same time or after turning off the control unit.

CAUTION
1 Never use the following DO parallel connection.



CAUTION
2 When using a dark lighting resistor as shown in the following figure, use a leakage–proof diode.



NOTE

Output signal driver

Each of the output signal driver devices used on this I/O board outputs eight signals.

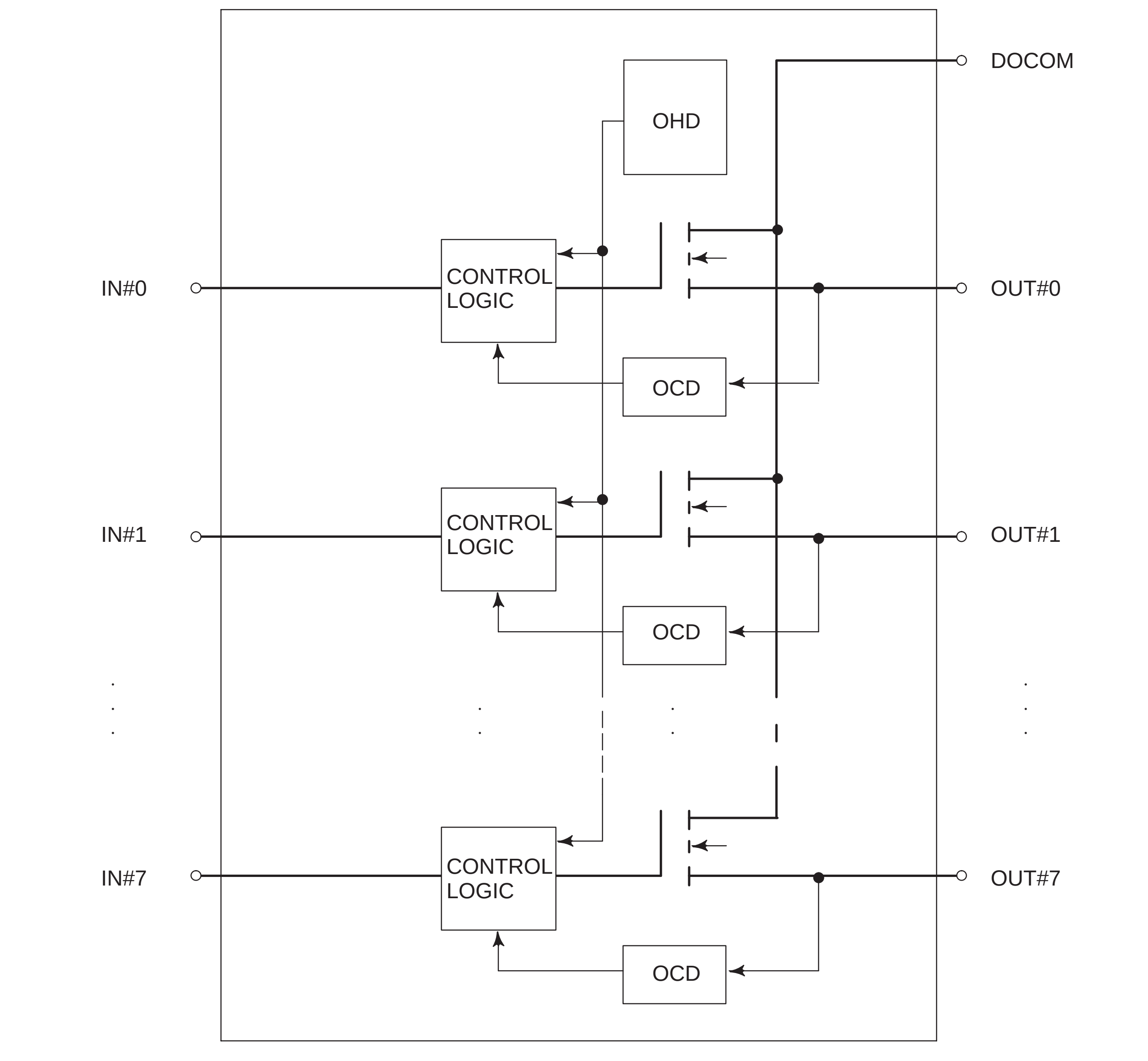
A driver device monitors the current of each output signal. If it detects an overcurrent on an output, it turns off the output. Once an overcurrent causes an output to turn off, the overcurrent is no longer present. Then, the output is turned on again. In ground–fault or overload conditions, outputs may turn on and off alternately. This phenomenon also occurs when a load with a high surge current is connected.

Each driver device contains an overheat detector circuit. If an overcurrent is observed on an output continuously because of a ground–fault or similar reason and the temperature in the device rises, the overheat detector circuit turns off all eight outputs. The output–off state is maintained. This state can be released by logically turning off then on again the outputs after the internal temperature of the device drops to a specified level. This state can also be released by turning off the system power supply.

The output signals of the driver devices are assigned the following addresses:

Device #0: Y1000.0 to Y1000.7
Device #1: Y1001.0 to Y1001.7
Device #2: Y1002.0 to Y1002.7
Device #3: Y1003.0 to Y1003.7
Device #4: Y1004.0 to Y1004.7
Device #5: Y1005.0 to Y1005.7
Device #6: Y1006.0 to Y1006.7
Device #7: Y1007.0 to Y1007.7

If NC diagnosis shows that an output is on but the output is actually not turned on, an overload on that output or another output in the same device may have turned off the eight outputs of that device. In such a case, turn off the system power supply and remove the cause of the overload.



HD : Over –heat detector circuit OCD : Over–current detector circuit

8.8 CONNECTION OF Series 0 OPERATOR'S PANEL

Outline

The FANUC Series 0 operator's panel is provided with a lot of key switches, LEDs, rotary switches, etc. For key switches and LEDs, they are coded, and connected to the CNC with less signal lines than the actual number of theses signals. The coding and data transfer are executed by the PMC management software automatically. Therefore, it is only necessary for the PMC ladder program to operate with the simple bit image for the key switches and LEDs.
This chapter describes how the Series 21/210 users connect and assign the key switches and LEDs signal address and their bit image address to the PMC address.

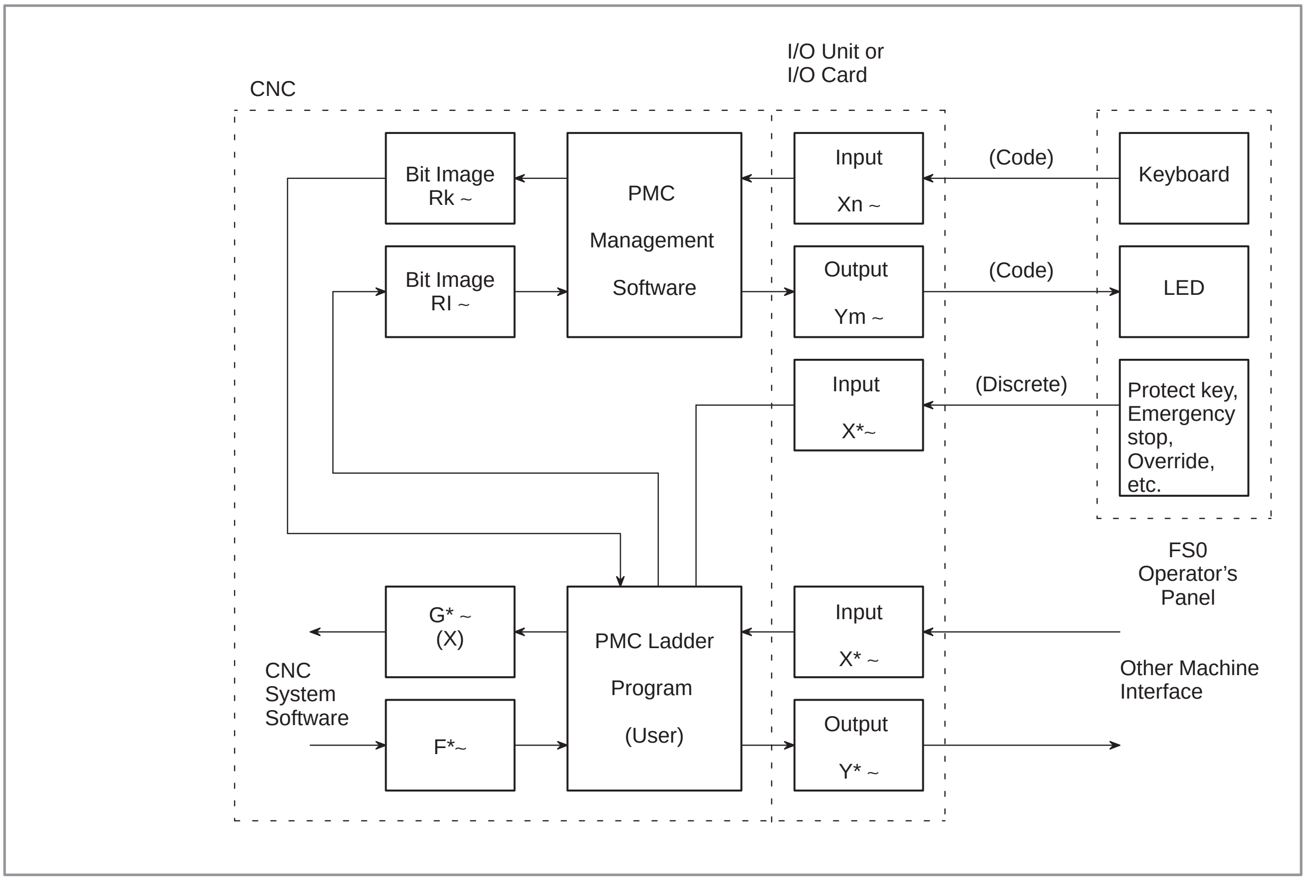
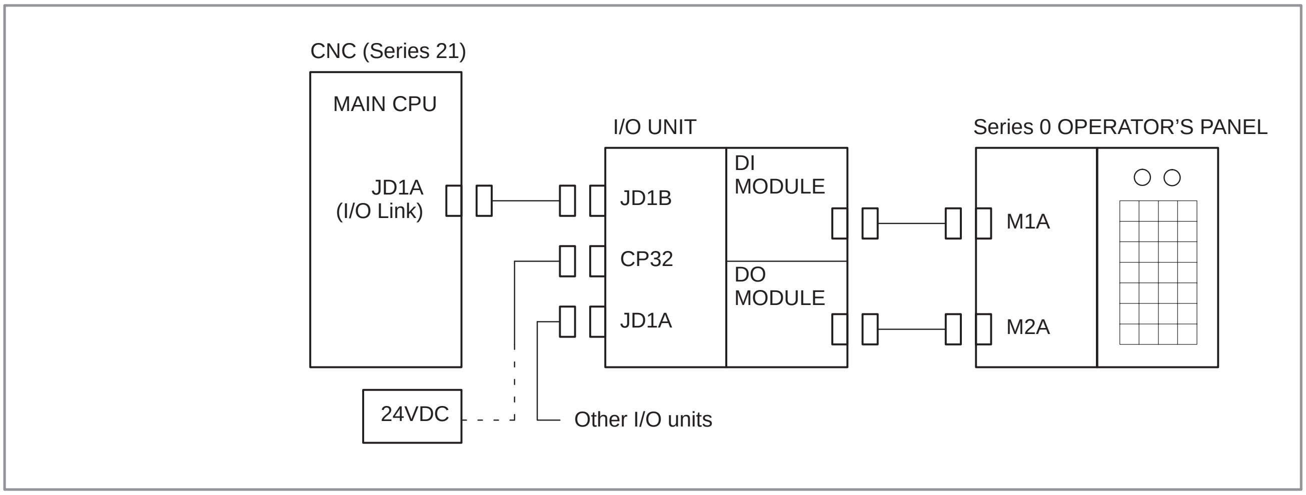


Fig. 8.8 Block diagram

Connection

● Conection to I/O Unit–A

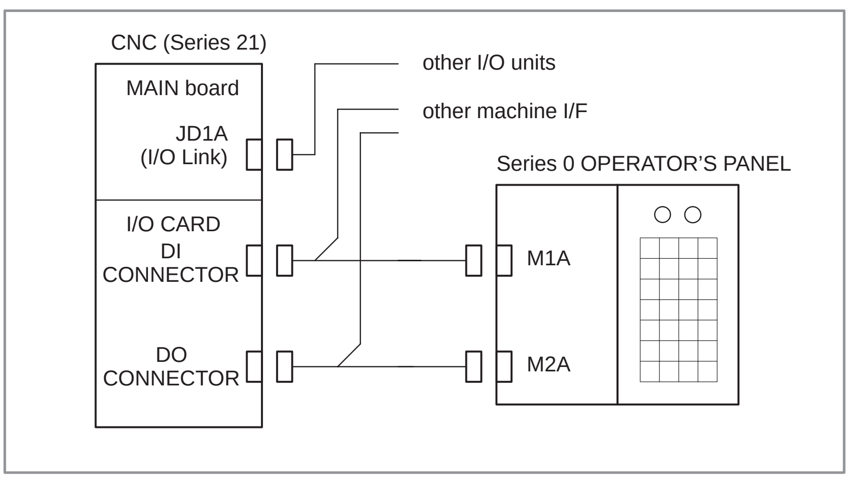


DI Module : +24V common, 20ms
(ex.) AID32A1

DO Module : 0V common
(ex.) AOD32A1

	Type of operator's panel	
	Type A	**Type B (for CE Marking)**
DI module	Sink type, 20ms (Example) AID32A1	Sink type (Example) AID32A1
DO module	Sink type (Example) AOD32A1	Sink type (Example) AOD32D1

● Connection to built–in I/O card



	Type of operator's panel	
	Type A	**Type B (for CE Marking)**
21–TB	Not to connected	I/O card
21–MB	I/O–A, I/O–B	I/O–C, I/O–D

Signal assignment of Series 0 Operator’s panel

- **Signal assignment**

M1A

Pin	Signal	Pin	Signal	Pin	Signal
1	0V			33	*0V8
2	0V	19	*ESP	34	*0V4
3	0V	20		35	*0V2
4	0V	21		36	*0V1
5	Xn.5	22		37	Xn.6
6		23		38	
7		24		39	
8		25		40	
9		26		41	KEY
10		27		42	Xn+2.7
11		28		43	
12		29	+24V	44	
13	Xn.7	30	+24V	45	
14	Xn.4	31	+24V	46	Xn+2.3
15	Xn.3	32	+24V	47	Xn+2.2
16	Xn.2			48	Xn+2.1
17	Xn.1			49	Xn+2.0
18	Xn.0			50	

M2A

Pin	Signal	Pin	Signal	Pin	Signal
1	0V			33	Ym.7
2	0V	19		34	Ym.6
3	0V	20		35	Ym.5
4	0V	21		36	Ym.4
5		22		37	Ym.3
6		23		38	Ym.2
7		24		39	Ym.1
8		25		40	Ym.0
9		26		41	
10		27		42	
11		28		43	
12		29		44	
13		30		45	
14		31		46	
15		32		47	
16				48	
17				49	
18				50	

The signals boxed in thick lines in the above figure are used in the Series 0 operator’s panel.

+24V is used as the common of such signals and the power source of the inside of the operator’s panel. Therefore, 0V and +24V of upper figure must be connected.
For +24V, this operator’s panel requires 0.5A. In the above figure, each of +24V and 0V uses one pin only. For securer connection, however, it is recommended to use as many pins as possible in addition to the above.

- **Emergency (*ESP)**

The CNC directly monitors this signal at fixed address.
For the connection, refer to the Function volume (B–62703EN–1) of the connection manual.

- **Override (*OV1 to *OV8), protect key (KEY)**

Since these signals are directly input to the PMC, process them directly by the PMC ladder program.
For the connection, refer to the Function volume (B–62703EN–1) of the connection manual.

- **Key switch signal (Xn, Xn+2)**

The key switch signal is decoded into the bit image at the PMC address R by the management software of the PMC. Whether the necessary key is depressed or not can be known by checking the bit image of the key switch by the PMC ladder program of the user. (Refer to Table 8.8(a), (b), (c))

The key switch signal address (Xn ~ Xn+2 on Table 8.8(a)) and its bit image address (Rk ~ Rk+7 on Table 8.8(b), (c)) are optionally assigned to the proper and unused address. (On Series 0, each address is fixed to X20 ~, F292~.)

- **LED signal (Ym)**

Generate the LED signal by the bit image at the PMC address R by the PMC ladder program of the user. The management software of the PMC encodes that LED bit image to the coded output signal. (Refer to Table 8.8(a), (b), (c))

The LED signal address (Ym on Table 8.8(a)) and its bit image address (RI ~ RI+7 on Table 8.8(b), (c)) are optionally assigned to the proper and unused address.
(On Series 0, each address is fixed to Y51, G242~.)

Table 8.8(a) The key switch and LED signal address

	7	6	5	4	3	2	1	0
Xn	KD7	KD6	KD5	KD4	KD3	KD2	KD1	KD0
Xn+1								
Xn+2	KST				KA3	KA2	KA1	KA0

	7	6	5	4	3	2	1	0
Ym	LD7	LD6	LD5	LD4	LD3	LD2	LD1	LD0

Table 8.8(b) The key switch and LED signal bit image address (For the small type operator's panel)

KEY/LED	7	6	5	4	3	2	1	0
Rk/RI	F3	F2	F1		D1	C1	B1	A1
Rk+1/RI+1	F4				D2	C2	B2	A2
Rk+2/RI+2	D4	D3	C4	C3	B4	B3	A4	A3
Rk+3/RI+3		F6	F5		D5	C5	B5	A5
Rk+4/RI+4	F8				D6	C6	B6	A6
Rk+5/RI+5	D8		C8		B8		A8	A7
Rk+6/RI+6			F9		D9	C9	B9	A9
Rk+7/RI+7			F10		D10	C10	B10	A10

Table 8.8(c) The key switch and LED signal bit image address (For the full key type operator's panel)

KEY/KED	7	6	5	4	3	2	1	0
Rk/RI	E1	C1	A1	E6	D6	C6	B6	A6
Rk+1/RI+1	E2	C2	A2	E7	D7	C7	B7	A7
Rk+2/RI+2	E3	C3	A3	E8	D8	C8	B8	A8
Rk+3/RI+3	E5	C4	A4	E9	D9	C9	B9	A9
Rk+4/RI+4	D2	C5	A5	E10	D10	C10	B10	A10
Rk+5/RI+5	D4	D5	B2	E11	D11	C11	B11	A11
Rk+6/RI+6	D1	B1	B4	E12	D12	C12	B12	A12
Rk+7/RI+7	D3	B3	B5	E13	D13	C13	B13	A13

How to assign

Assign the signal address and the bit image address of the key switch and LED signal as follows.
(It is available from vers. 2.3 of FAPT LADDER on the P–G Mate)

• Parameter screen

```
KEY IN ONE OF THE FOLLOWING NO.S WHICH YOU WANT TO SET PARA, S.

NO. ITEMS                                  CURRENT PARAMETERS
01  (UNUSED)                             ;
02  COUNTER DATA TYPE                    ;  BINARY
03  OPERATOR PANEL                       ;  YES
      KEY/LED ADDRESS                    ;  X0000/Y0000
      KEY/LED BIT IMAGE ADRS.            ;  R0900/R0910
04  PMC TYPE                             ;  PMC–RB
05  (UNUSED)                             ;
06  (UNUSED)                             ;
07  LADDER EXEC.                         ;  100%
08  (UNUSED)                             ;
09  IGNORE DIVIDED CODE                  ;  NO
10  (UNUSED)                             ;
00  NOTHING TO SET                       ;

NO.=
```

• Operation

1) Select menu No. “3” on Parameter Screen.
   Then, following message appears.

```
EXAMPLE  0:NO, 1:YES
OP.PANEL=_
```

2) Select “1” on example menu.
   Then , following message appears.

```
SET  KEY/LED  ADDRESS (KEY  ADRS. , LED  ADRS.)
ADDR=_
```

3) Set PMC ADDRESS (X and Y) for KEY and LED signals.
   For example, if you want to set X0 for key switches and Y0 for LEDs, type “X0, Y0” and [NL].
   Then, following message appears.

```
SET  KEY/LED  BIT  IMAGE  ADDRESS (KEY  ADRS.  , LED  ADRS.)
ADDR=_
```

4) Set PMC ADDRESS for BIT IMAGE.
   For example R900 and R910 if you want. Set “R900, R910” [NL].
   Then, return to Parameter Screen and following message appears.

```
  :          :          :
03 OPERATOR PANEL                ;  YES
     KEY/LED ADDRESS             ;  X0000/Y0000
     KEY/LED BIT  IMAGE  ADRS.   ;  R0900/R0910
  :          :          :
```

NOTE

1 As a result of above operation, Table 8.8(a), (b), (c) are assigned for the PMC address as follows.

Xn	→ X0000	Rk	/	Rl	→ R0900/ R0910
Xn+1	→ X0001	Rk+1	/	Rl+1	→ R0901/ R0911
Xn+2	→ X0002	Rk+2	/	Rl+2	→ R0902/ R0912
		Rk+3	/	Rl+3	→ R0903/ R0913
Ym	→ Y0000	Rk+4	/	Rl+4	→ R0904/ R0914
		Rk+5	/	Rl+5	→ R0905/ R0915
		Rk+6	/	Rl+6	→ R0906/ R0916
		Rk+7	/	Rl+7	→ R0907/ R0917

2 In case of I/O card

PMC address in the I/O Card is fixed. Therefore, set the fixed address for the used signal at operation 3) in above operation.

ex) If X1000, X1001, X1002, Y1000 are used for the key switches and LEDs, type as follows.

```
SET  KEY/LED  ADDRESS (KEY  ADRS.  , LED  ADRS.)
ADDR=  X1000, Y1000  [NL]
```

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 21/210, 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.

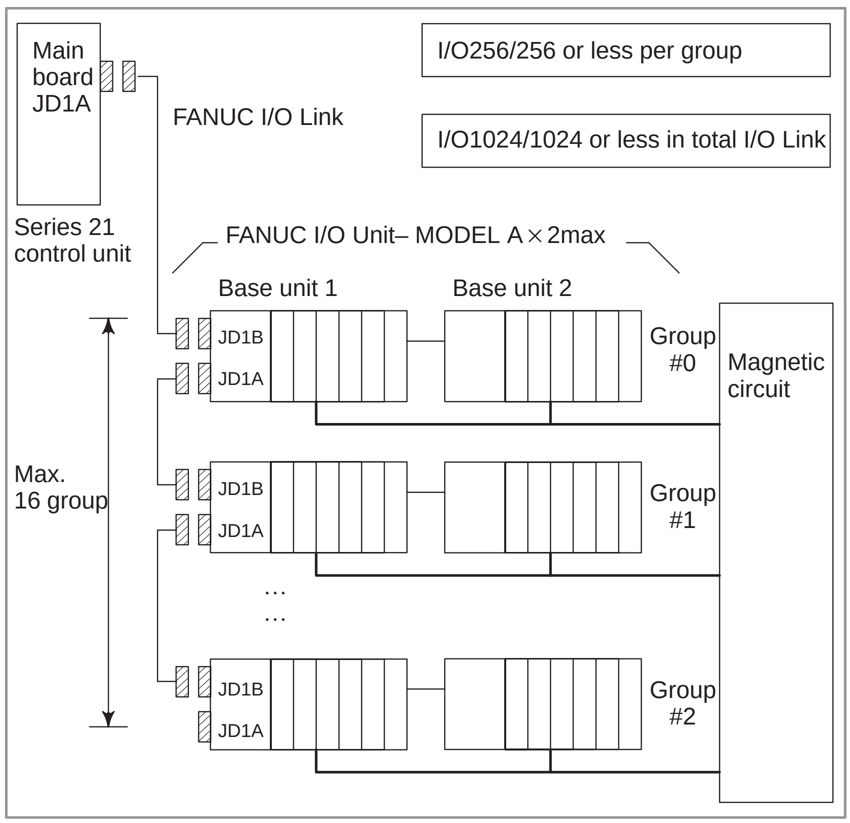
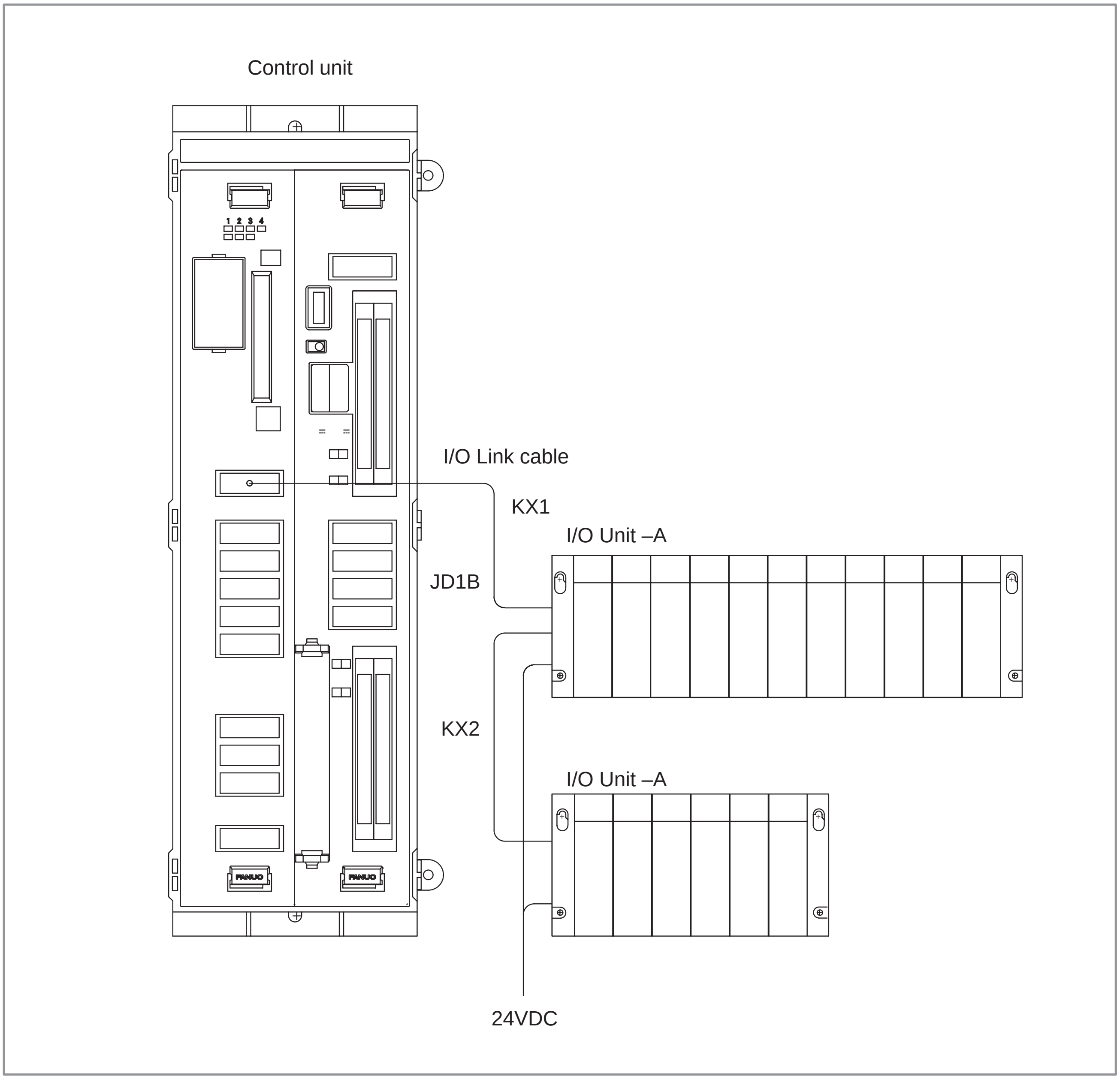
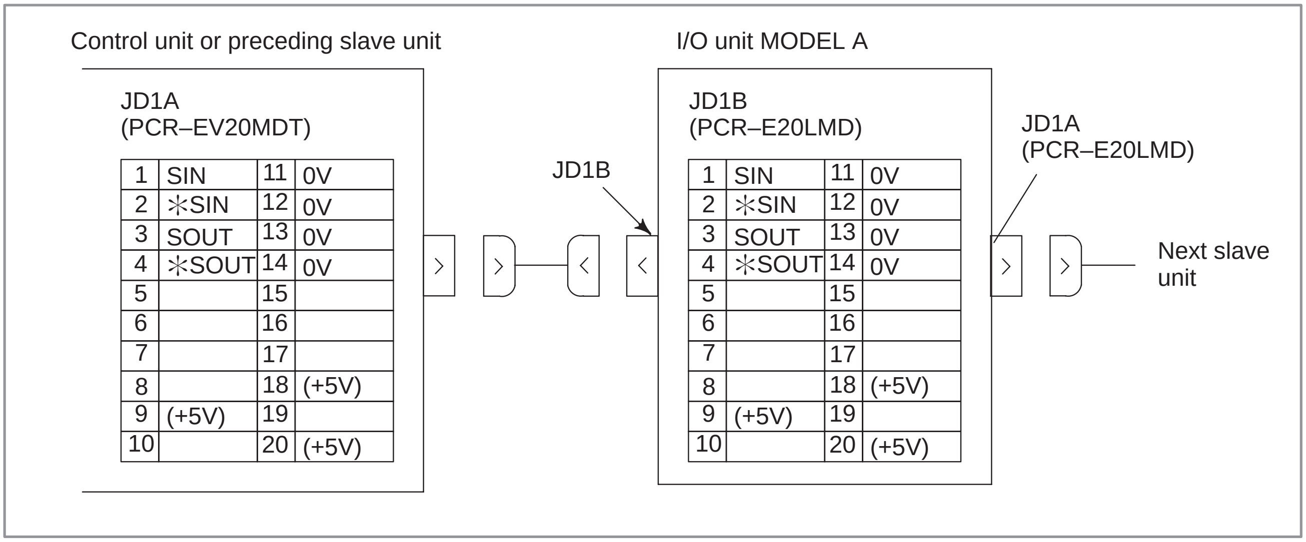


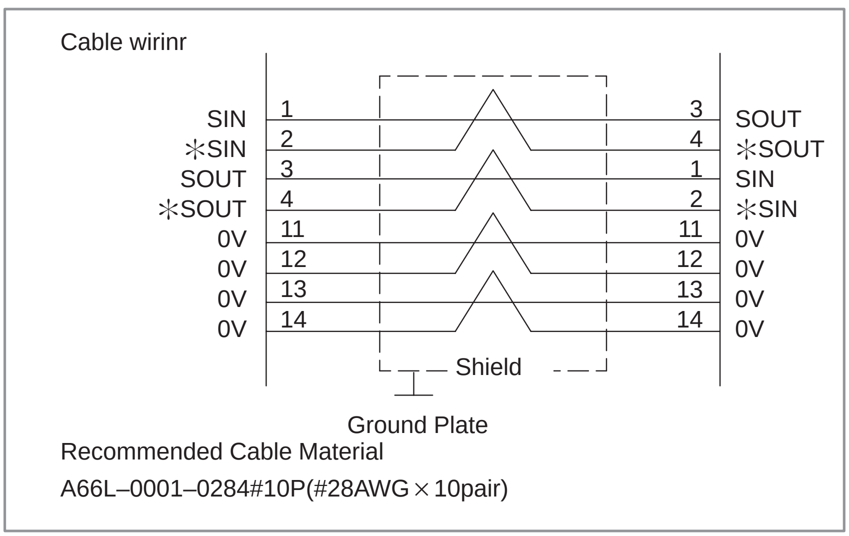
Fig.9.2 I/O Link connection diagram


Control unit
I/O Link cable
KX1
I/O Unit –A
JD1B
KX2
I/O Unit –A
24VDC

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.



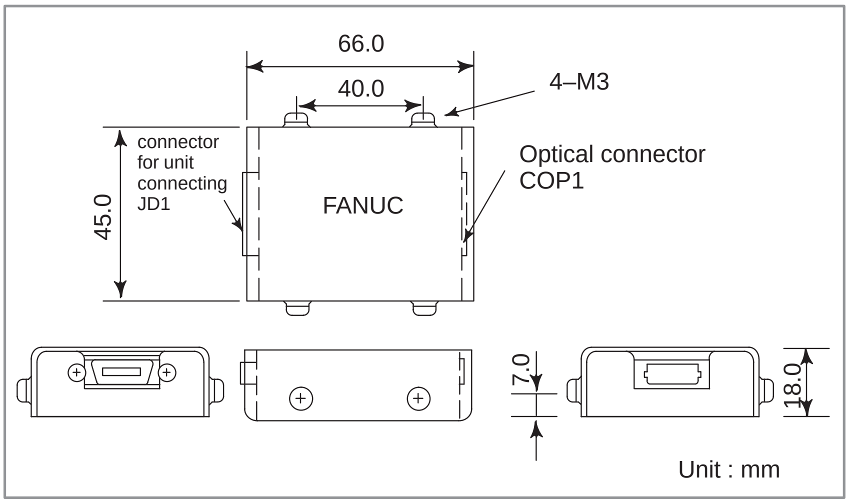
9.2.2 Connection of FANUC I/O Link Optical Fiber Cable

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.

In the following cases, use an optical fiber cable.

- When the cable is more than 10 meters long.
- When the cable runs between different cabinets and it is impossible to connect the cabinets with a grounding wire of 5.5 mm^2 or thicker.
- When there is concern that the cable is influenced by strong noise; for example :
  When there is a strong electromagnetic noise source beside the cable such as a welding machine.
  When a noise generating cable such as a power cable runs for a long distance in parallel with the cable.

External dimension of optical link adapter

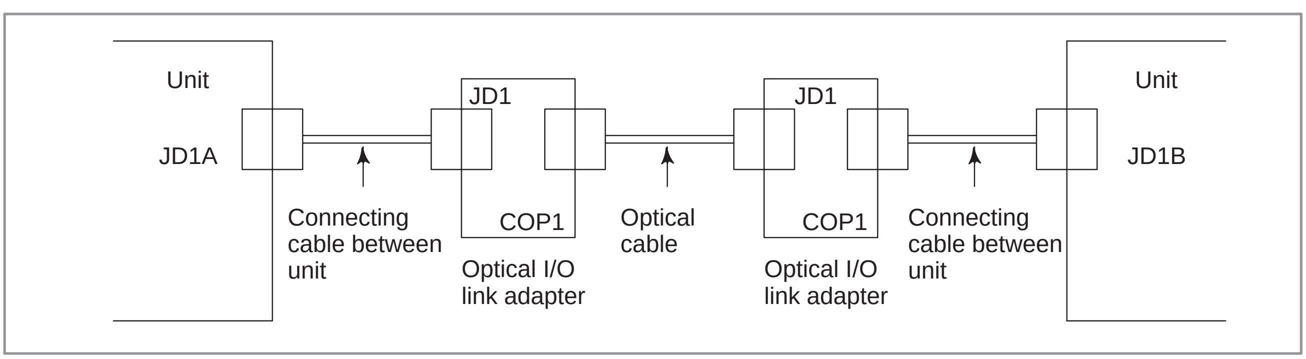


Weight of optical link adapter

Main body: Approx. 100 g.

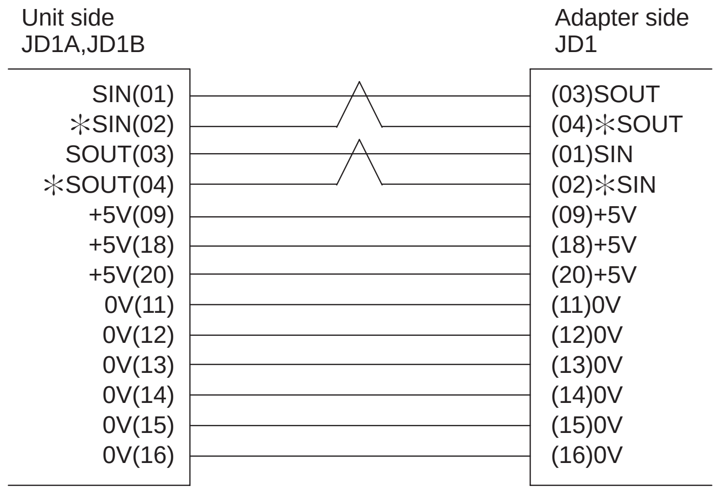
Connection

- **Connection diagram**



- **Interunit connecting cables**

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



1 Recommended connector for cable side : PCR–E20FS (made by HOND Communication 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 – 0009
(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)

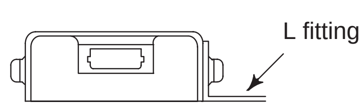
(b) Consumption current: 200mA

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

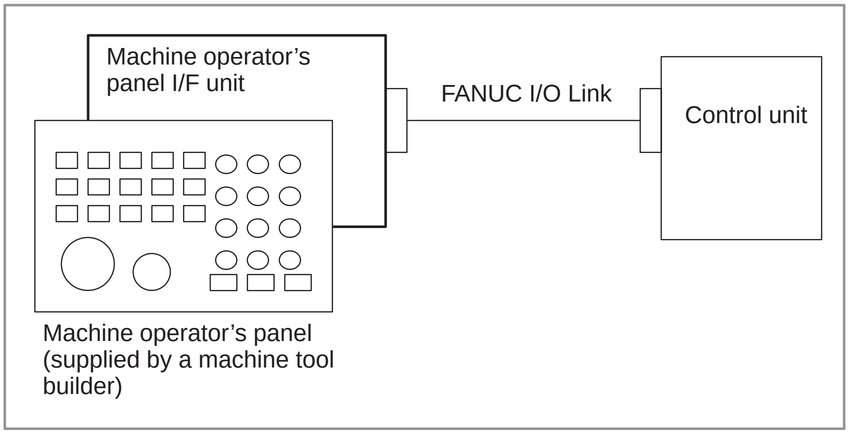
Basically, the Series 21/210 can be connected to any unit that has a FANUC I/O Link slave interface. The following table lists general units that can be connected to the Series 21/210. Detailed descriptions of each unit are given later in this section. For details of other units, refer to the documentation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

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

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
Machine operator's panel interface unit	Unit having an interface with a matrix of key switches and LEDs on the machine operator's panel, and a manual pulse generator	Sec. 9.4
Operator's panel connection unit	Unit having an interface with a machine operator's panel	Sec. 9.5
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. 9.6
FANUC I/O Link connection unit	Unit for connecting FANUC I/O Link masters to transfer DI/DO signals	Sec. 9.7

9.4 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.



9.4.1 Function Overview

Number of DI/DO points

DI or DO \ Operator's panel control PCB allocation to the I/O Link DI/DO (module name)	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.

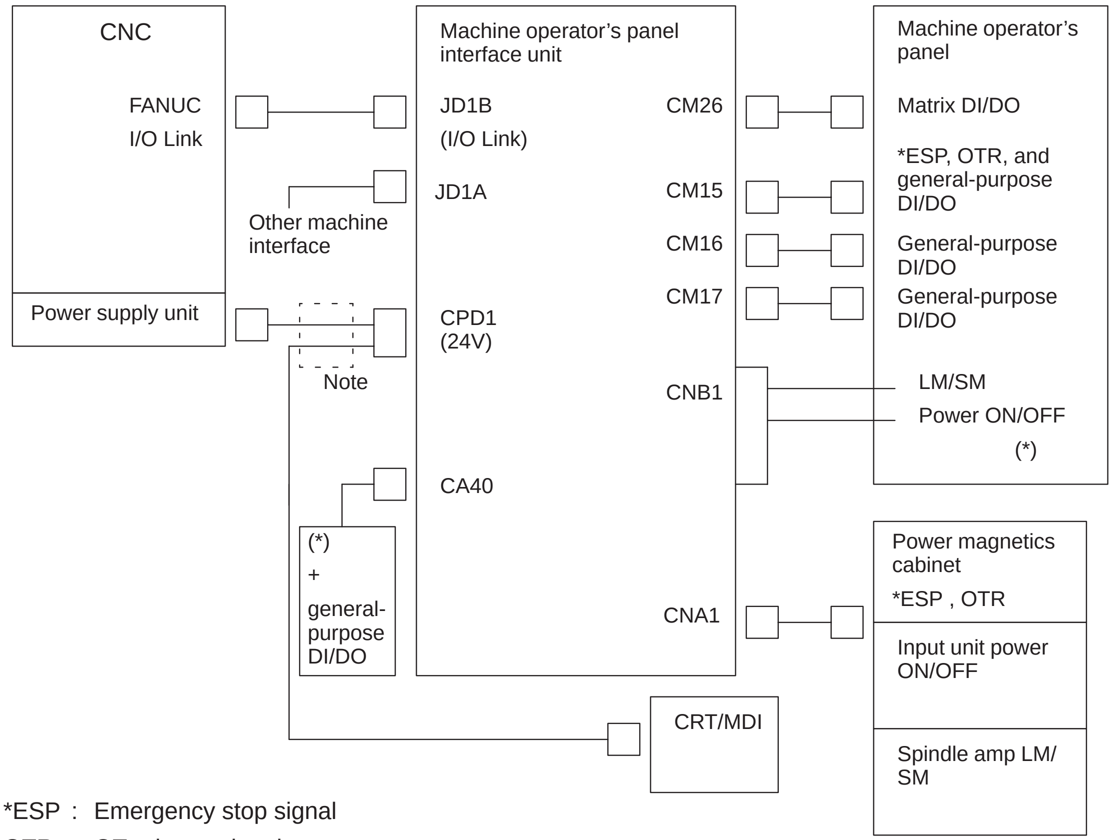
Terminal for signal forwarding

- 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.

9.4.2 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"
(not including the current required by the CRT and MDI).

9.4.3 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 [gray box] 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.
Note 2 OM is connected to 0 V on the PCB.

Input/output pins shaded by [hatched box] are in pairs. Only one in each pair is usable.

JD1A (FANUC I/O Link : NEXT SLAVE)

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

JD1B (FANUC I/O Link : BEFORE SLAVE)

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

CM26 (Matrix DI/DO)

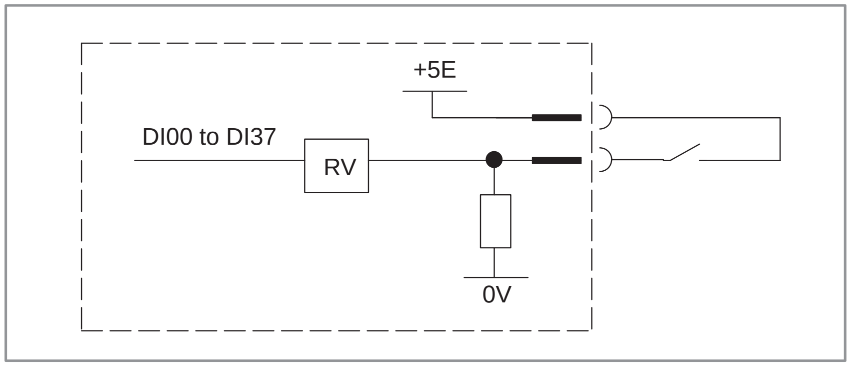
	A	B
01	0V	*MND1
02	*KYD0	*KYD1
03	*KYD2	*KYD3
04	*KYD4	*KYD5
05	*KYD6	*KYD7
06	*KYC0	*KYC1
07	*KYC2	*KYC3
08	*KYC4	*KYC5
09	*KYC6	*KYC7
10	*KYC8	*KYC9
11	*KYCA	*KYCB
12	*BZMD	0V
13	*LD0	*LD8
14	*LD1	*LD9
15	*LD2	*LD10
16	*LD3	*LD11
17	*LD4	*LD12
18	*LD5	*LD13
19	*LD6	*LD14
20	*LD7	*LD15
21	LC1L	LC1H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

9.4.4 Interface

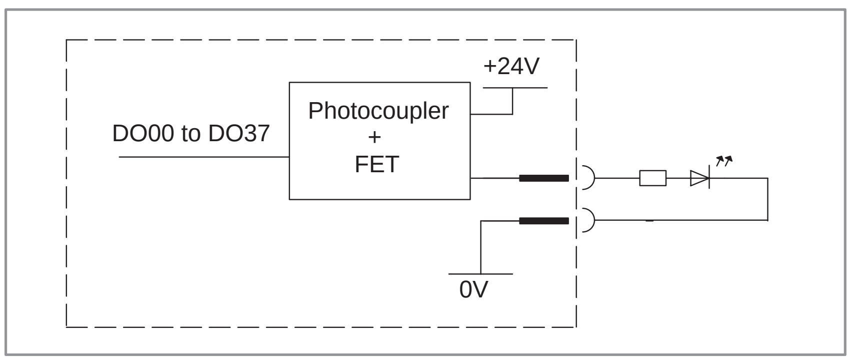
General–purpose DI



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



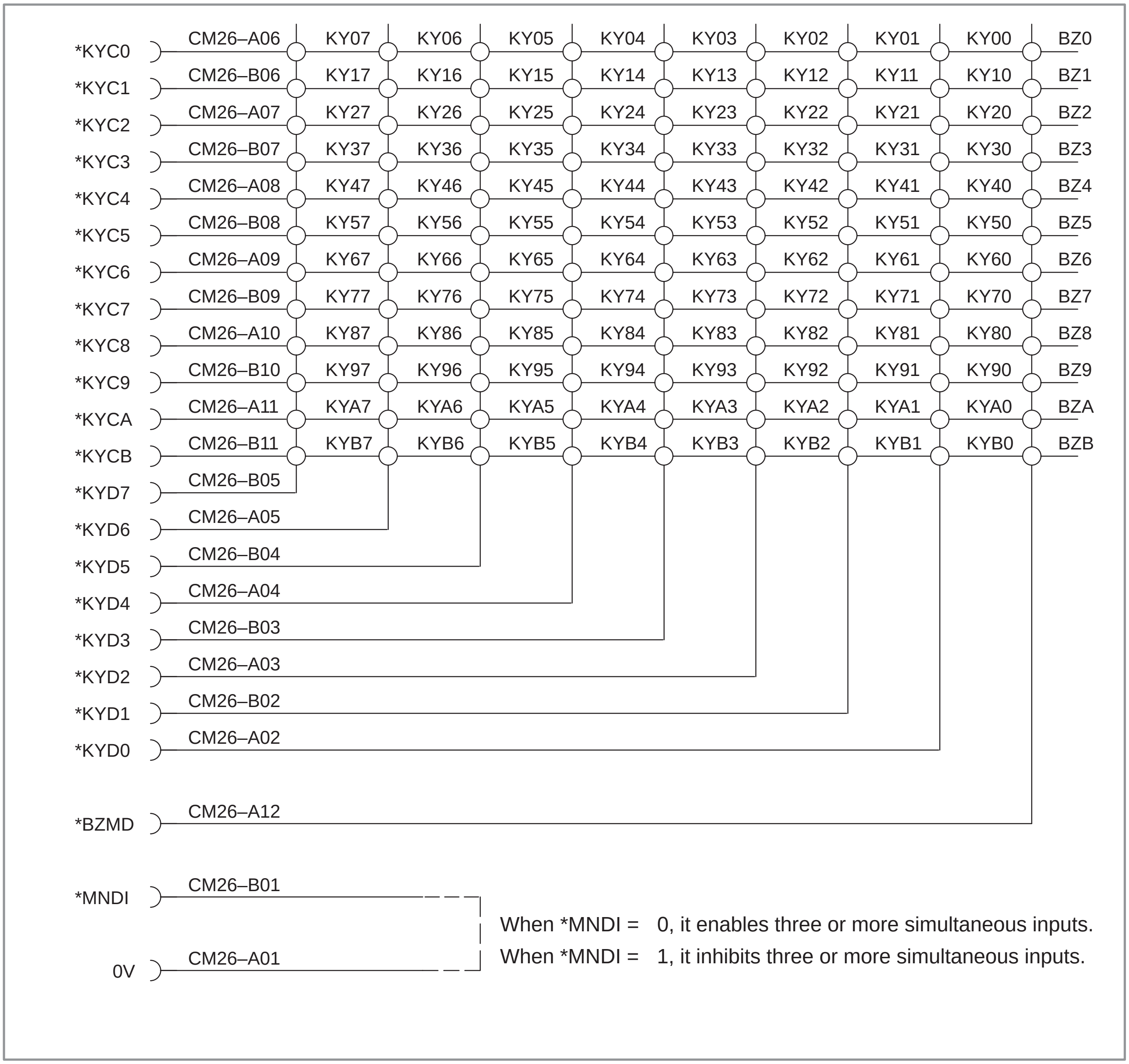
Output signal specifications

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. 9.4.5 for the corresponding PMC addresses.

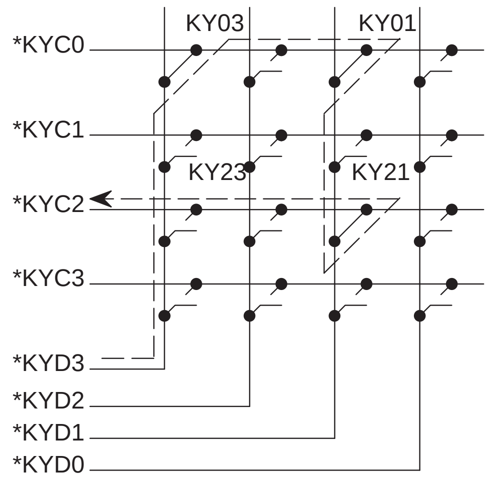


• Mode selection

❑ 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")

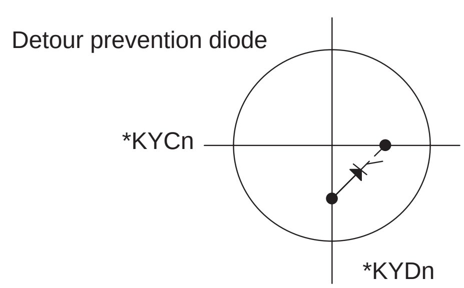
> If there are two inputs and a third is added, all three are ignored. When one of the three inputs is removed, two are accepted.

[Method 2]

- Attaching detour prevention diodes to enable three simultaneous inputs

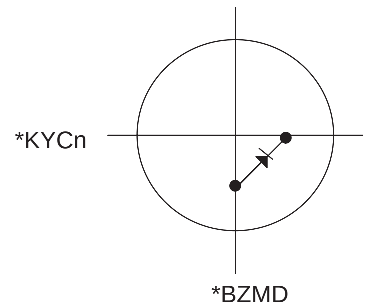
  Action : Connect the *MNDI signal (see item "● Key switch addresses") to 0V.

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

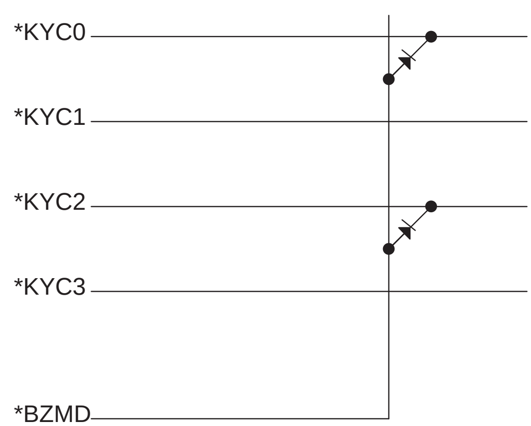


❑ This PCB can raise a confirmation sound when a key is pressed. The condition to raise an audible alarm is set in 8-bit units, or in *KYCn units. If *BZMD and common *KYCn are disconnected, a KYnx input causes a sound to generate. If they are connected, a KYnx input does not generate the sound.
To generate a confirmation sound for key input, the DO (PMC address DO + 00.7) “MD07” must have been turned to “1” (see Subsec. 9.4.5).

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**

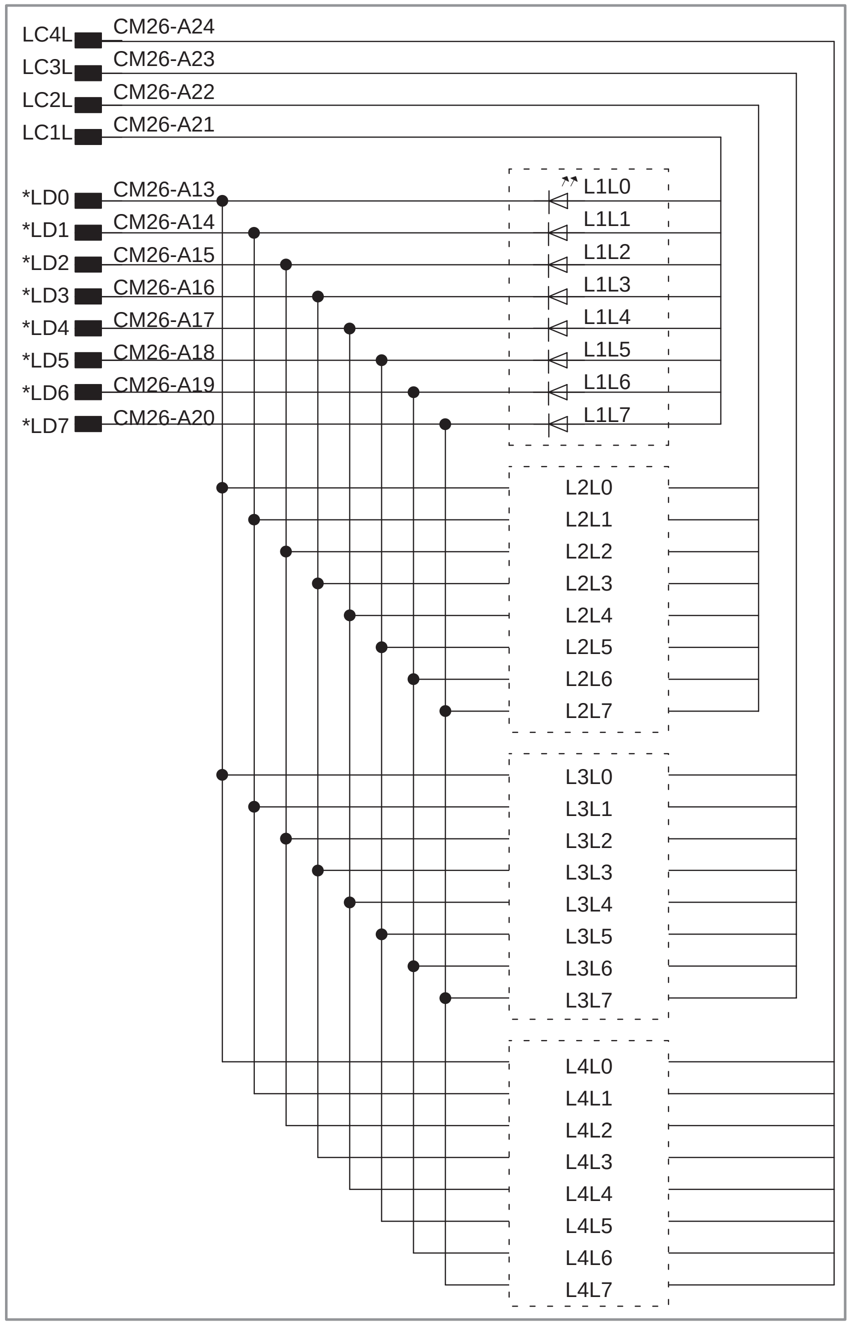
Contact rating	6VDC, 2mA or higher
Leakage current between open contacts	0.2mA or lower (6VDC)
Voltage drop across closed contacts	0.9V or lower (1 mA) Note)

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

Matrix DO

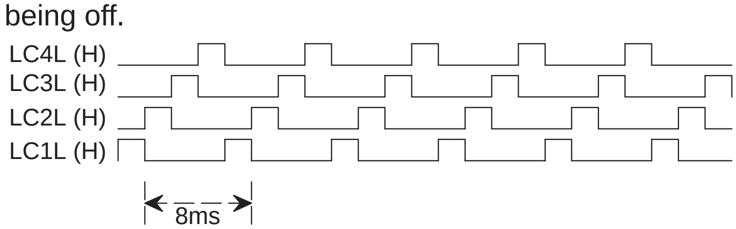
- **LED addresses**

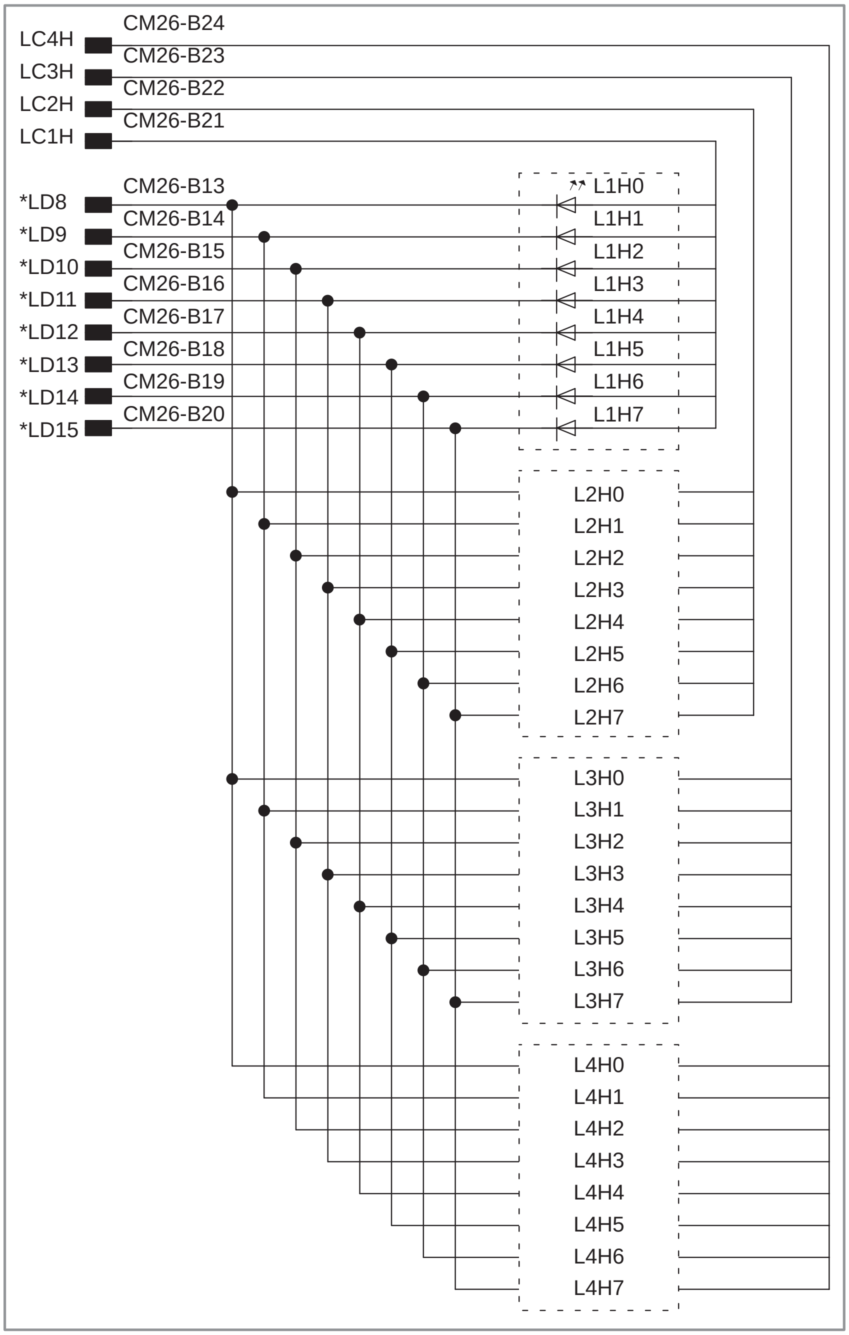
See Subsec. 9.4.5 for the corresponding PMC addresses.



NOTE

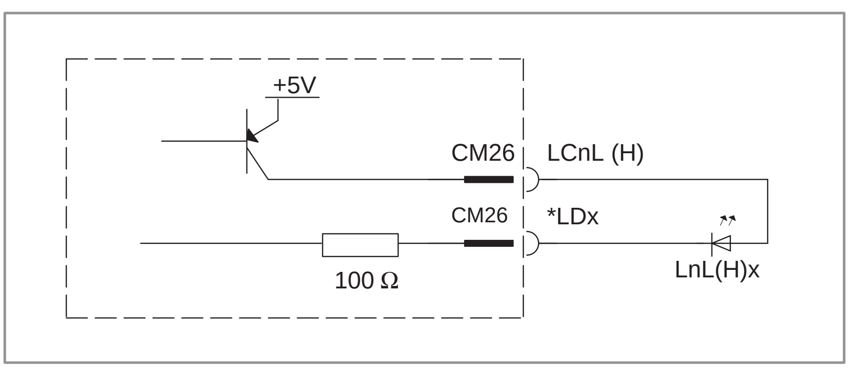
The timing for the common signals are shown below. Their duty cycle is 2 ms for LEDs being on and 6 ms for LEDs being off.





- **Internal circuit**

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



- **Signal specifications**

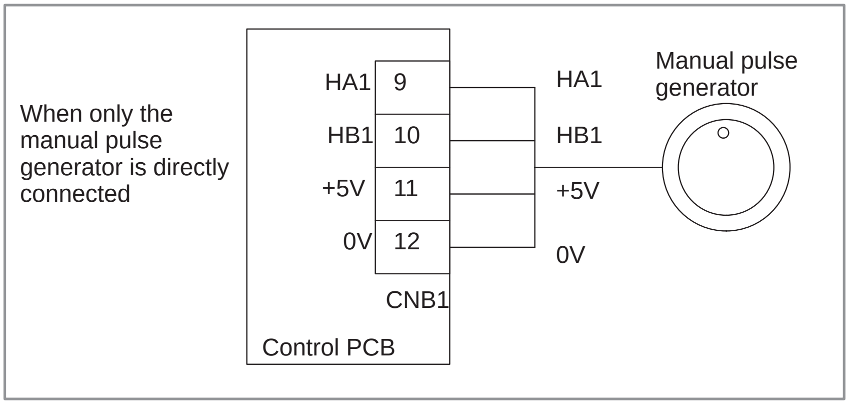
The LEDs must have the following rating

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

Interface for manual pulse generator

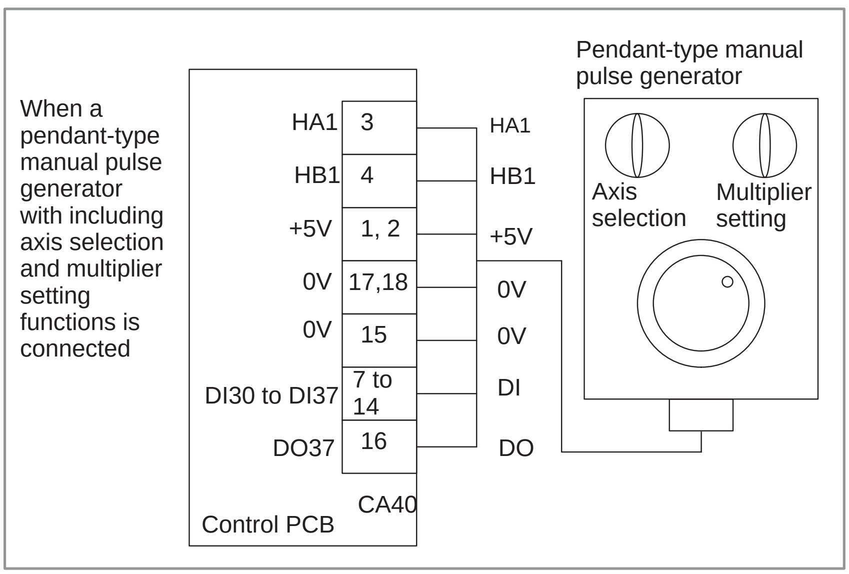
- **Connection of connector CNB1**

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

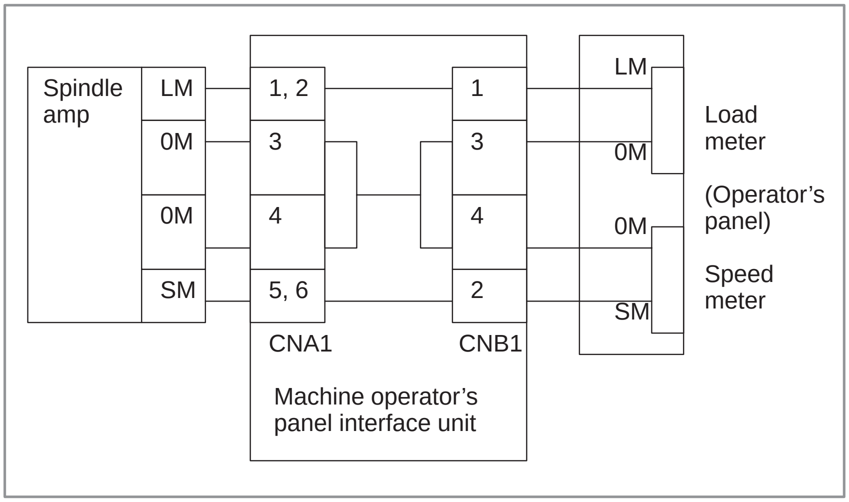
1. When DI30 to DI37 of connector CA40 are allocated as the DIs used for the axis selection and multiplier setting, DI30 to DI37 of connector CM17 cannot be used.
2. One DO is available for the manual pulse generator side at the user's discretion. When this is used, DO37 of CM17 cannot be used, as in 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. 9.4.5 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)

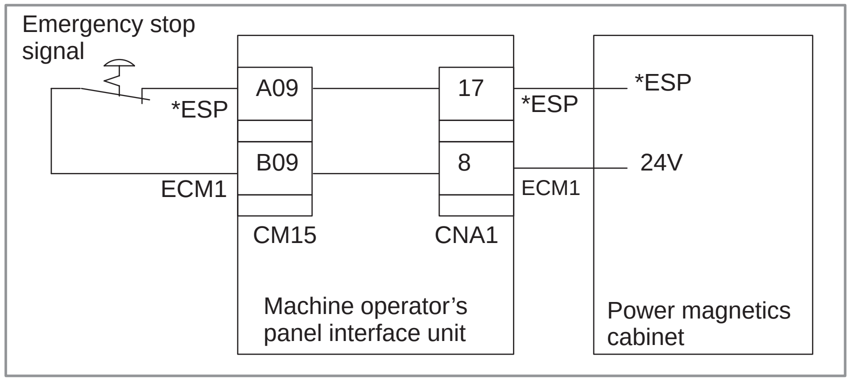
NOTE
Any voltage higher than +10V is converted to the same digital value as +10V is.

- **A/D conversion specifications**

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

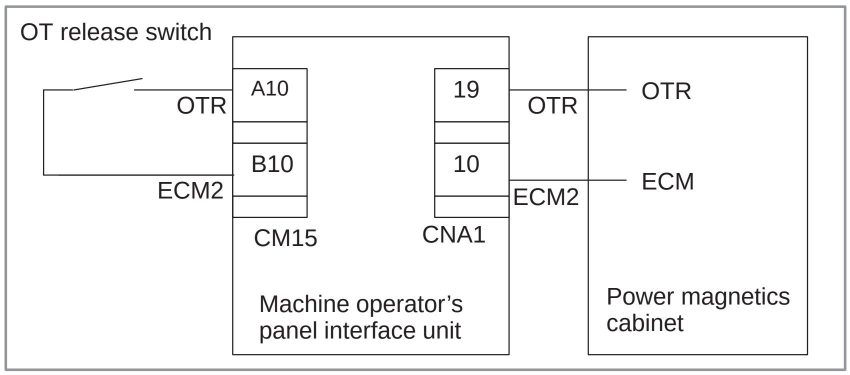
• Emergency stop

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.)



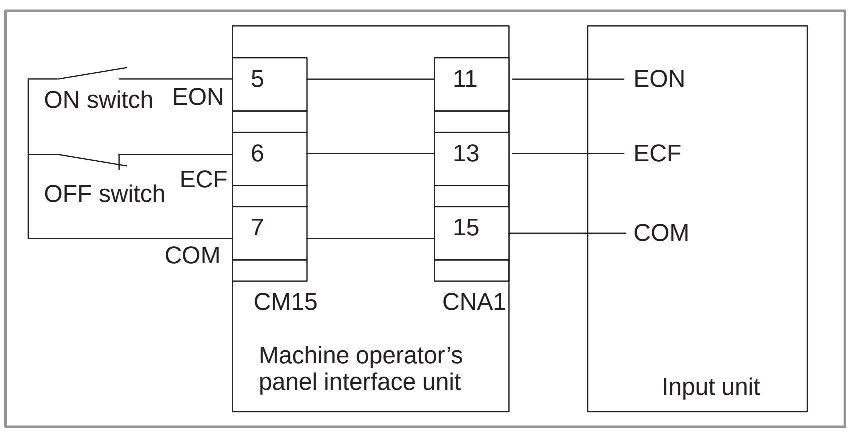
• OT release

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.

9.4.5 PMC Addresses

Scope in which PMC addresses can be used

I/O Link allocation: 128/128, 256/256

PMC ADDRESS	BIT NUMBER 7	6	5	4	3	2	1	0
DI+00			FUSE					
DI+01	KY07	KY06	KY05	KY04	KY03	KY02	KY01	KY00
DI+02	KY17	KY16	KY15	KY14	KY13	KY12	KY11	KY10
DI+03	KY27	KY26	KY25	KY24	KY23	KY22	KY21	KY20
DI+04	KY37	KY36	KY35	KY34	KY33	KY32	KY31	KY30
DI+05	KY47	KY46	KY45	KY44	KY43	KY42	KY41	KY40
DI+06	KY57	KY56	KY55	KY54	KY53	KY52	KY51	KY50
DI+07	KY67	KY66	KY65	KY64	KY63	KY62	KY61	KY60
DI+08	KY77	KY76	KY75	KY74	KY73	KY72	KY71	KY70
DI+09	DI07	DI06	DI05	DI04	DI03	DI02	DI01	DI00
DI+10	DI17	DI16	DI15	DI14	DI13	DI12	DI11	DI10
DI+11	DI27	DI26	DI25	DI24	DI23	DI22	DI21	DI20
DI+12	DI37	DI36	DI35	DI34	DI33	DI32	DI31	DI30
DI+13	LM07	LM06	LM05	LM04	LM03			
DI+14	SM07	SM06	SM05	SM04	SM03			
DI+15	MP17	MP16	MP15	MP14	MP13	MP12	MP11	MP10
DI+16			Reserved for use by FANUC					
DI+17								
DI+18	KY87	KY86	KY85	KY84	KY83	KY82	KY81	KY80
DI+19	KY97	KY96	KY95	KY94	KY93	KY92	KY91	KY90
DI+20	KYA7	KYA6	KYA5	KYA4	KYA3	KYA2	KYA1	KYA0
DI+21	KYB7	KYB6	KYB5	KYB4	KYB3	KYB2	KYB1	KYB0

PMC ADDRESS	7	6	5	4	3	2	1	0
DO+00	MD07	MD06	FUSE					
DO+01	L1L7	L1L6	L1L5	L1L4	L1L3	L1L2	L1L1	L1L0
DO+02	L2L7	L2L6	L2L5	L2L4	L2L3	L2L2	L2L1	L2L0
DO+03	L3L7	L3L6	L3L5	L3L4	L3L3	L3L2	L3L1	L3L0
DO+04	L4L7	L4L6	L4L5	L4L4	L4L3	L4L2	L4L1	L4L0
DO+05	L1H7	L1H6	L1H5	L1H4	L1H3	L1H2	L1H1	L1H0
DO+06	L2H7	L2H6	L2H5	L2H4	L2H3	L2H2	L2H1	L2H0
DO+07	L3H7	L3H6	L3H5	L3H4	L3H3	L3H2	L3H1	L3H0
DO+08	L4H7	L4H6	L4H5	L4H4	L4H3	L4H2	L4H1	L4H0
DO+09	DO07	DO06	DO05	DO04	DO03	DO02	DO01	DO00
DO+10	DO17	DO16	DO15	DO14	DO13	DO12	DO11	DO10
DO+11	DO27	DO26	DO25	DO24	DO23	DO22	DO21	DO20
DO+12	DO37	DO36	DO35	DO34	DO33	DO32	DO31	DO30

FUSE : When 1, it indicates the +5E fuse has blown.
Shorting of the general-purpose DI input is considered as a possible cause. Turn off the power at once, check the general-purpose DI input and its vicinity, replace the fuse and turn the power on.

DInx : General-purpose DI
LM0x : Load meter indication
SM0x : Speed meter indication
KYnx : Ky signal (matrix)
LnL (H) x : LED signal (matrix)
DOnx : General-purpose DO
MD07 : Buzzer mode selection (It is possible to sound the key entry confirmation tone at the matrix DI input by turning this to “1”.)
MD06 : Buzzer ON/OFF setting (The buzzer sounds as this is turned to “1” and stops as it is turned to “0”. This operation is performed irrespective of MD07.)
MP1X : First manual pulse generator

9.4.6 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. 9.4.3 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. 9.4.10.

9.4.7 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.

9.4.8 Connector (on the Cable Side) Specifications

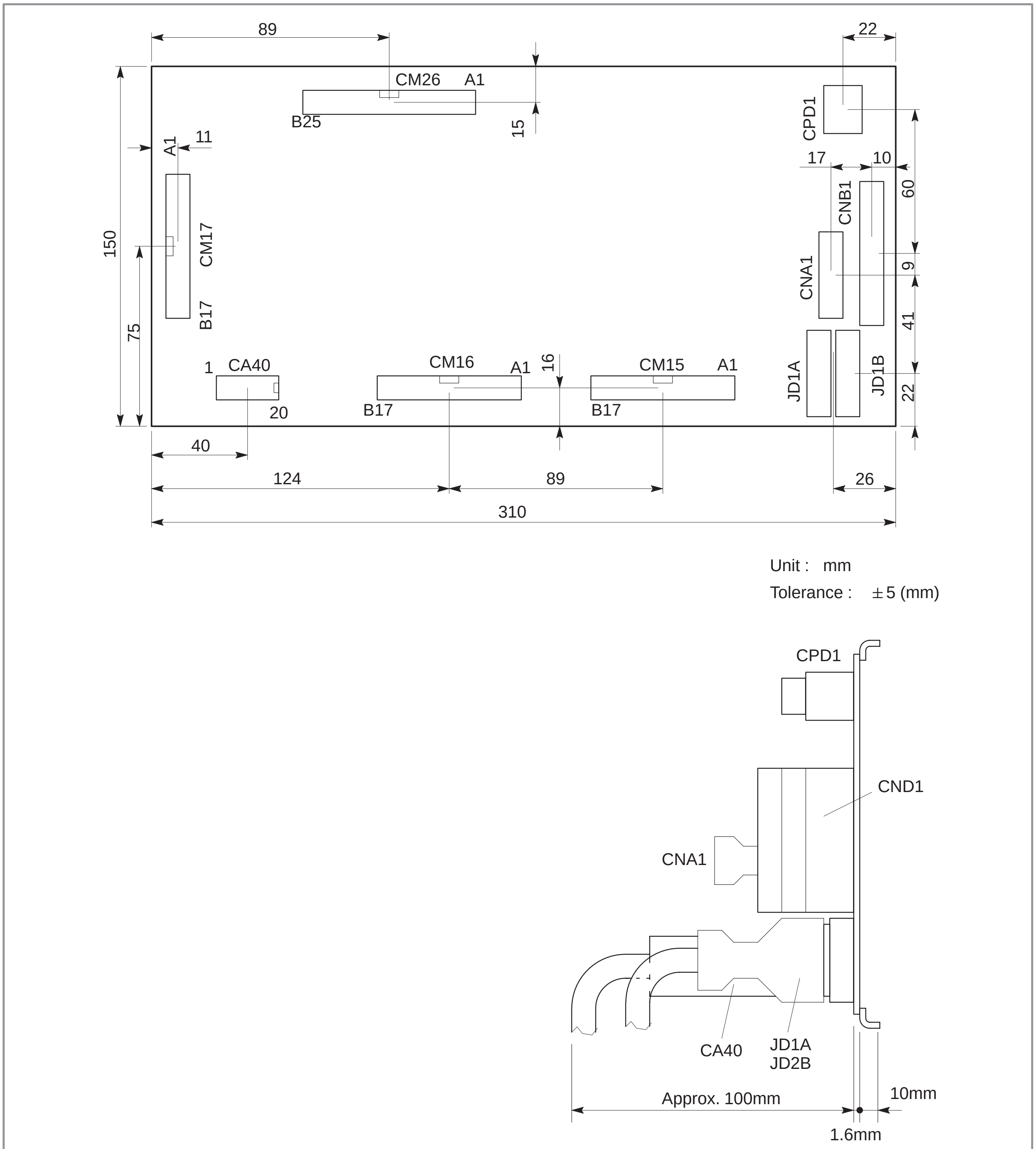
Connector	Major use	Specification
CM15, CM16, CM17	General-purpose DI/DO	HIF3BA-34D-2.54R : Manufactured by HIROSE ELECTRIC CO., LTD.
CNA1	Relay terminal (to the machine)	PCR-E20FS : Manufactured by HONDA TSUSHIN KOGYO CO., LTD.
CNB1	Relay terminal (to the machine operator's panel)	MVSTBR2.5/12-ST-5.08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

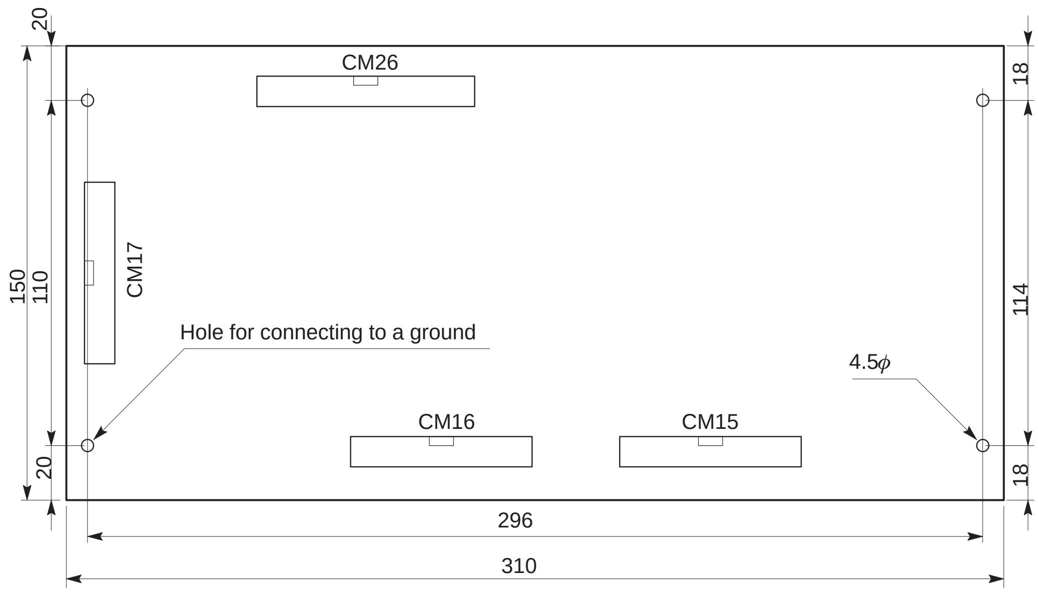
2 Crimped type cable connector is available for CA40. For purchase from FANUC, please specify as below.
A02B-0029-K890 : Solder type
A02B-0029-K892 : Crimped type

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



9.4.10 Machine Operator's Panel Interface Unit Mounting Dimension Diagram

Mounting hole position

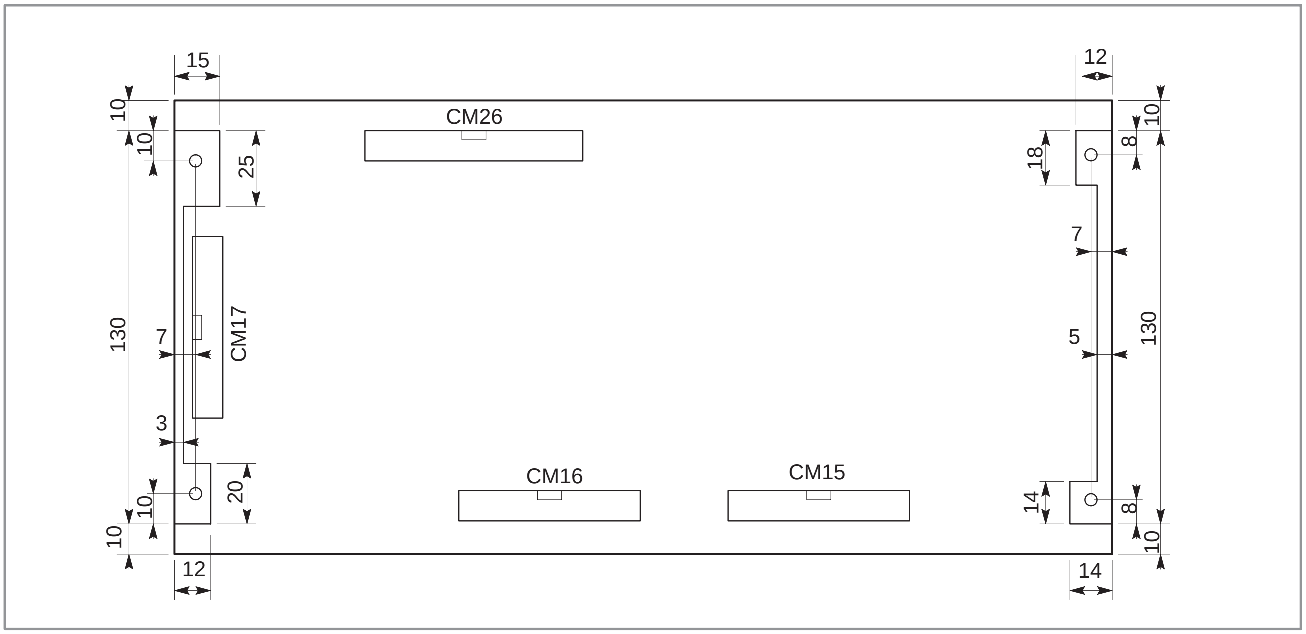


Fasten the PCB with four M4 screws.

Unit : mm

Sheet fixing area (mounting face side)

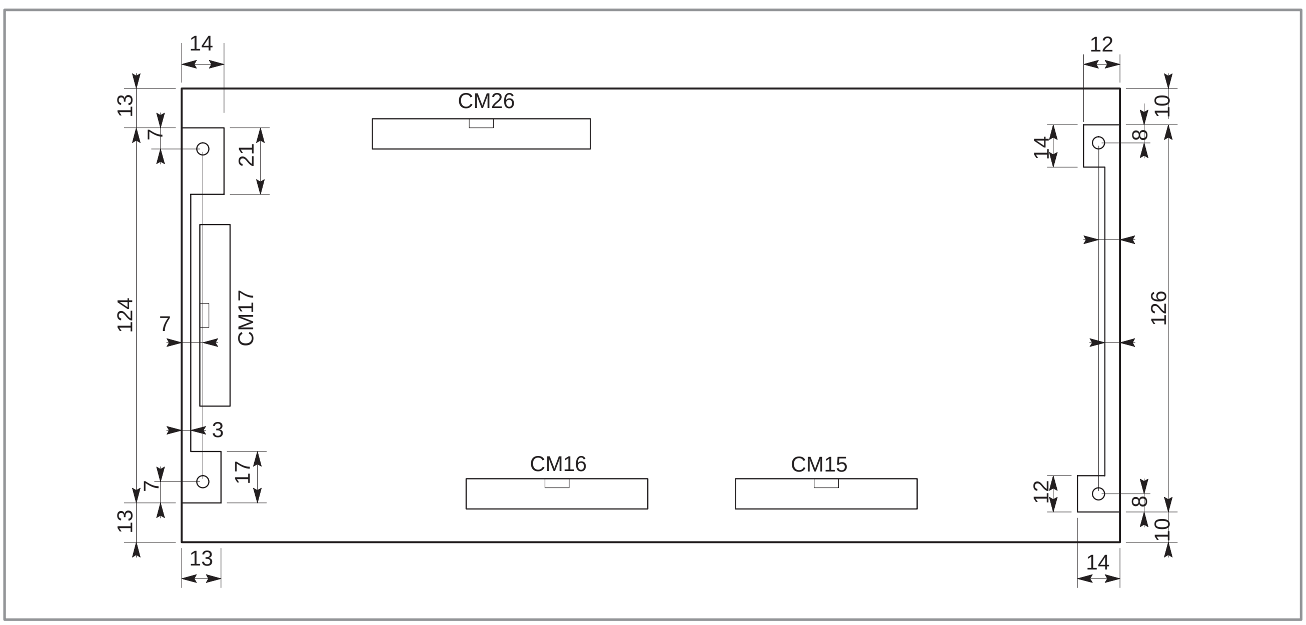
It is possible to fix the sheet, spacer, etc. only in the area shown in the diagram below.



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

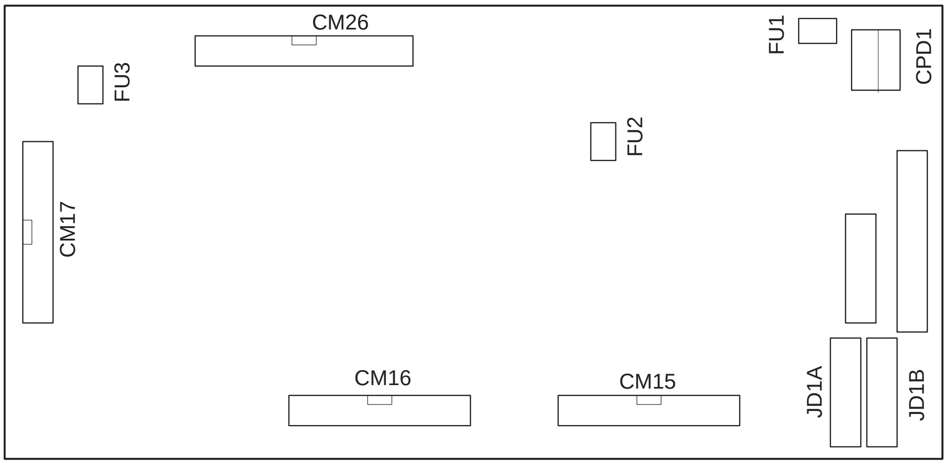
Sheet fixing area (Soldering face side)

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.

9.4.11 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)

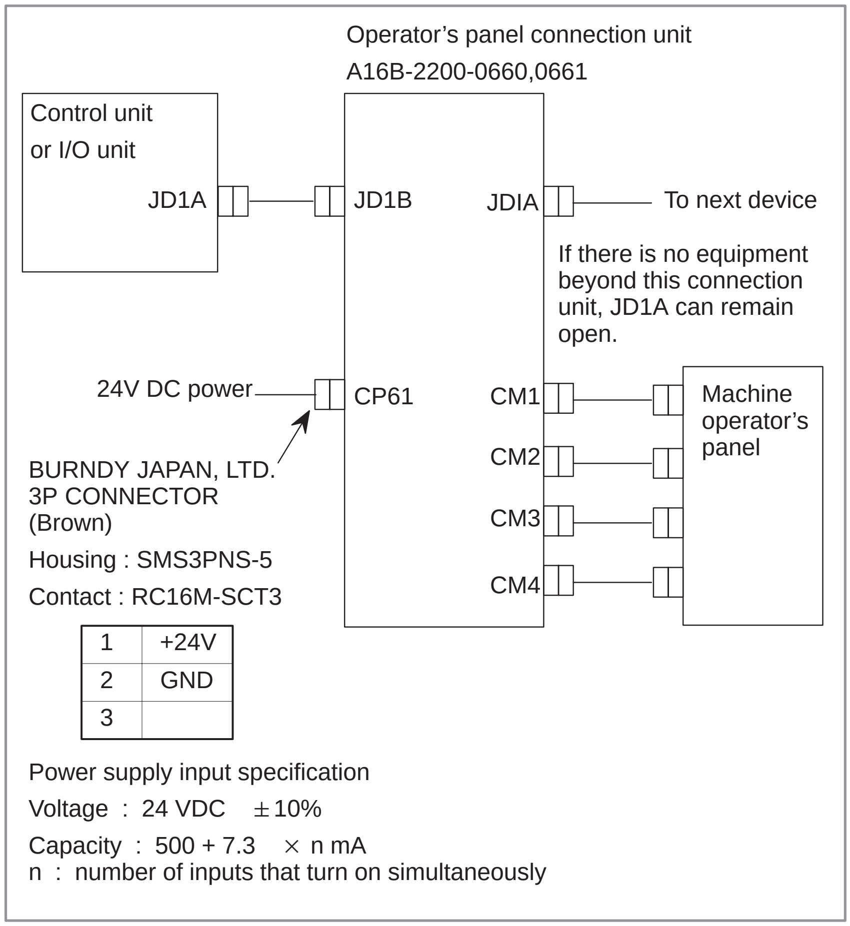
> **NOTE**
> FU2 is not mounted on Revision 05A or later.

9.5 CONNECTION OF OPERATOR'S PANEL CONNECTION UNIT

The operator's panel connection unit (A16B-2200-0660, 0661) is connected to the control unit through the FANUC I/O Link and is used for interfacing with the machine operator's panel.

The electric interface and pin layout of the connectors CM1 to CM4 are fully compatible with those for Series 15. There are two units available depending on the number of I/O points.

Specification	Input	Output
A16B-2200-0660	96 points	64 points
A16B-2200-0661	64 points	32 points



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

9.5.1 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.

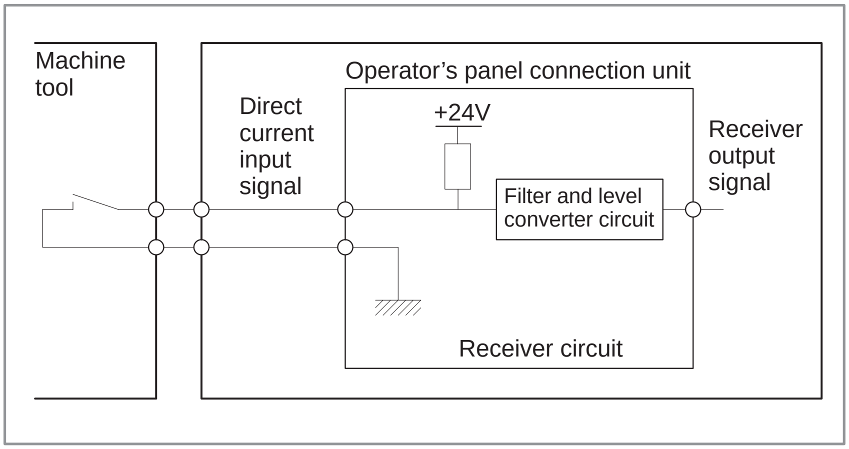


Fig. 9.5.1 (a) Receiver circuit

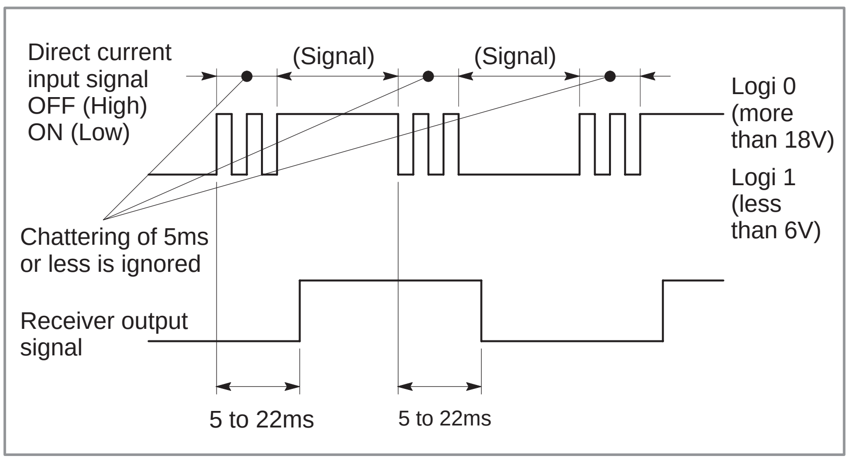


Fig. 9.5.1 (b) Width of input signals and delay time

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.

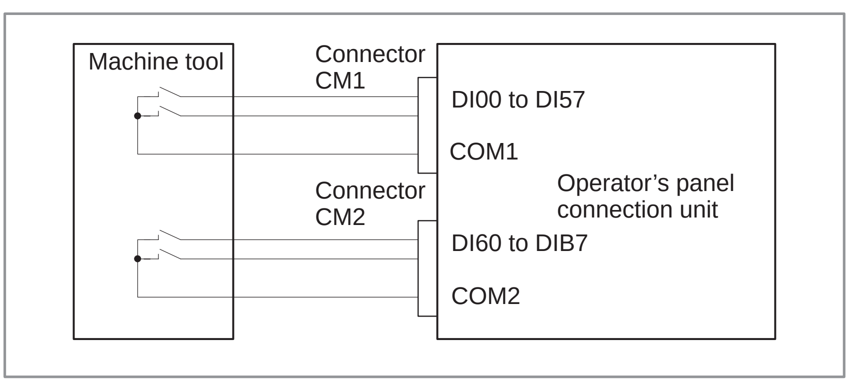


Fig. 9.5.1 (c) Connection of common lines

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.

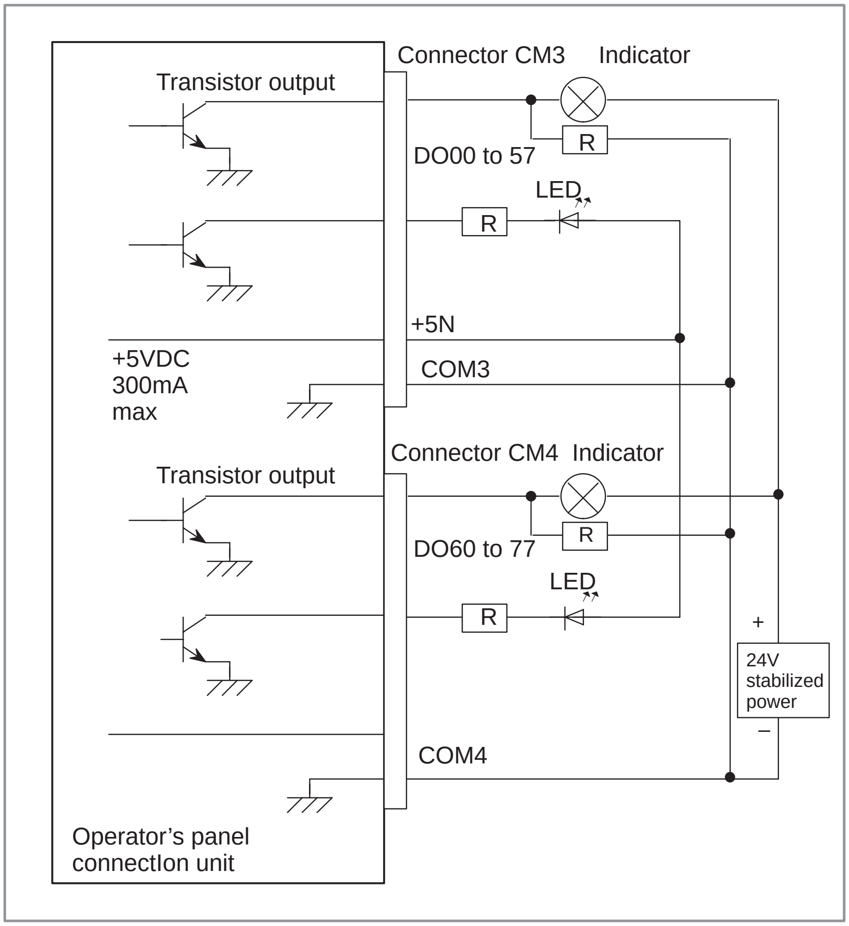
Do not use this operator's panel connection unit for safety–critical input signals (such as an emergency stop signal).

9.5.2 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.

9.5.3 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			33	+5N
2	DO03	19	DO01	34	DO02
3	DO06	20	DO04	35	DO05
4	DO11	21	DO07	36	DO10
5	DO14	22	DO12	37	DO13
6	DO17	23	DO15	38	DO16
7	DO22	24	DO20	39	DO21
8	DO25	25	DO23	40	DO24
9	DO27	26	DO30	41	DO26
10	DO32	27	DO33	42	DO31
11	DO35	28	DO36	43	DO34
12	DO40	29	DO41	44	DO37
13	DO43	30	DO44	45	DO42
14	DO46	31	DO47	46	DO45
15	DO51	32	DO52	47	DO50
16	DO54			48	DO53
17	DO56			9	DO55
18	COM3			50	DO57

Address	7	6	5	4	3	2	1	0
Yn	DO07	DO06	DO05	DO04	DO03	DO02	DO01	DO00
Yn+1	DO17	DO16	DO15	DO14	DO13	DO12	DO11	DO10
Yn+2	DO27	DO26	DO25	DO24	DO23	DO22	DO21	DO20
Yn+3	DO37	DO36	DO35	DO34	DO33	DO32	DO31	DO30
Yn+4	DO47	DO46	DO45	DO44	DO43	DO42	DO41	DO40
Yn+5	DO57	DO56	DO55	DO54	DO53	DO52	DO51	DO50

CM4

1	DO60	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		13		19	DO77
7	COM4			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.

9.5.4 External View of Operator's Panel Connection Unit

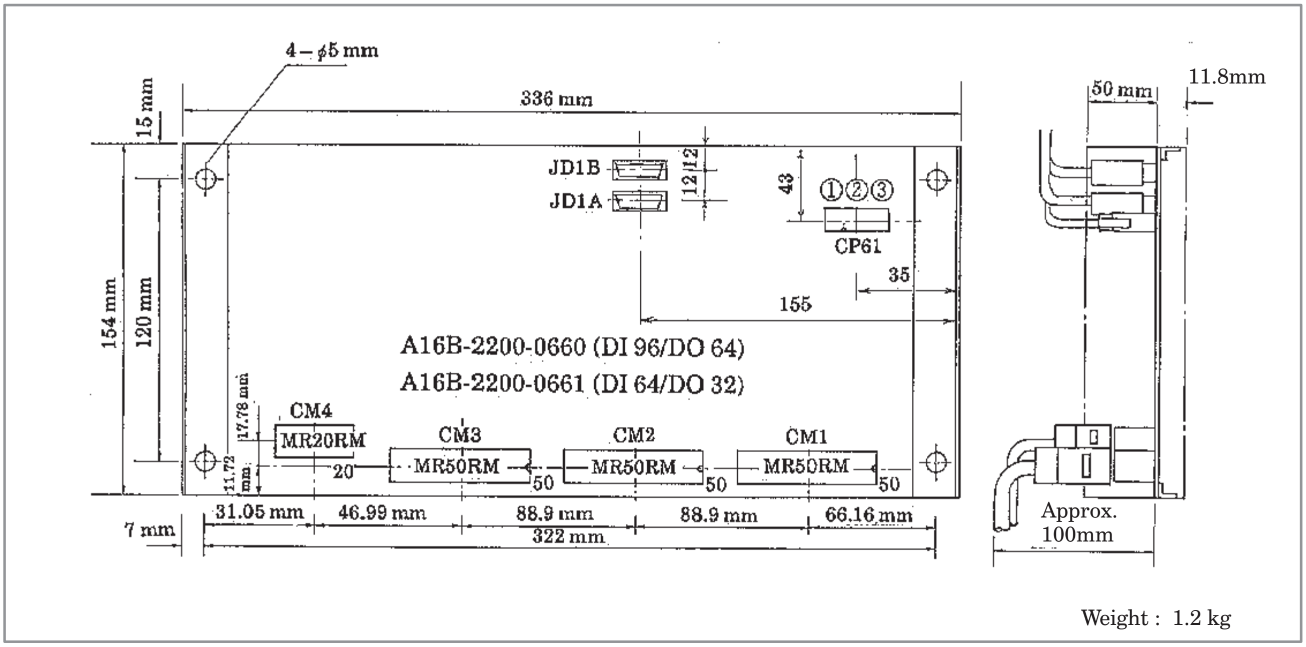
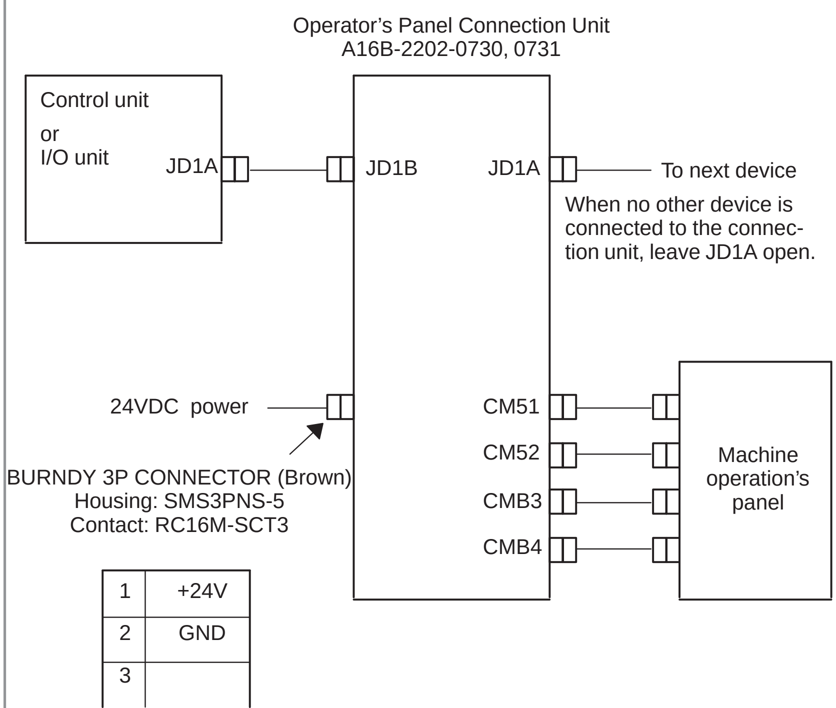


Fig. 9.5.4 External view of operator's panel connection unit

9.6 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 $\pm$10%
Capacity : 500+7. 3$\times$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.

9.6.1 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)

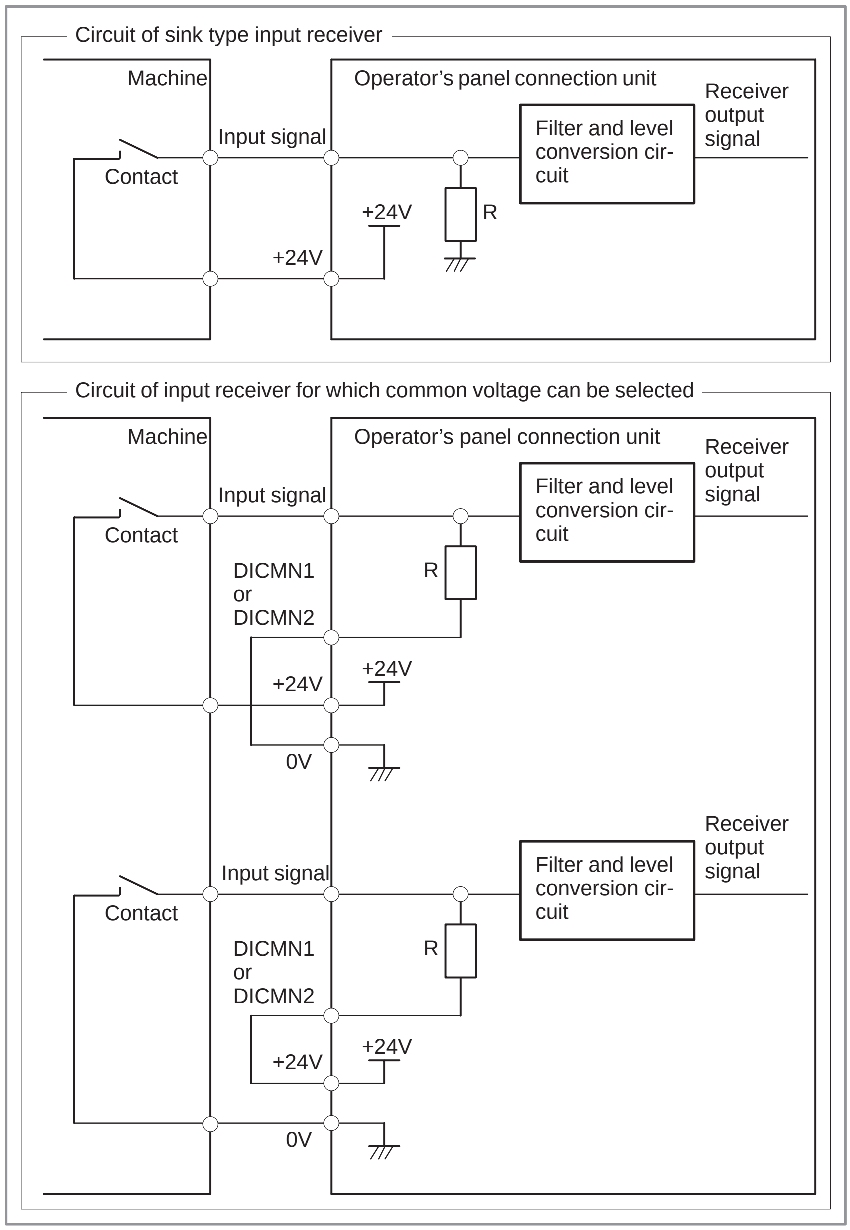


Fig. 9.6.1(a) Receiver circuit

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

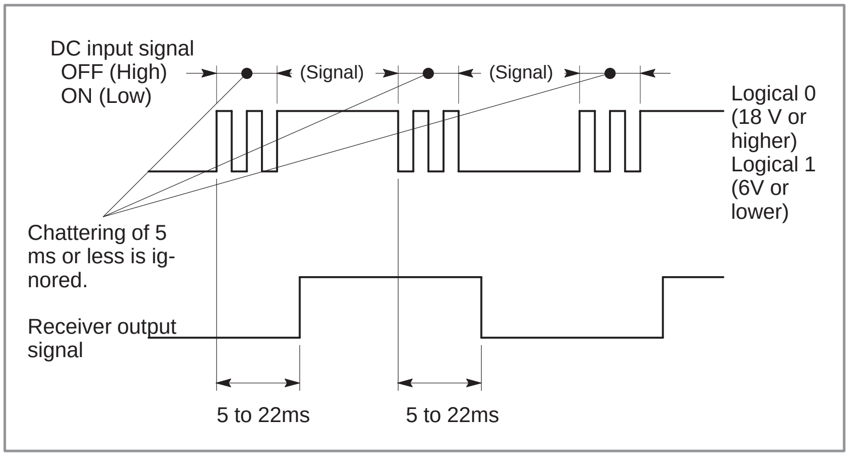


Fig. 9.6.1 (b) Signal width and delay of input signal

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.

9.6.2 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.)

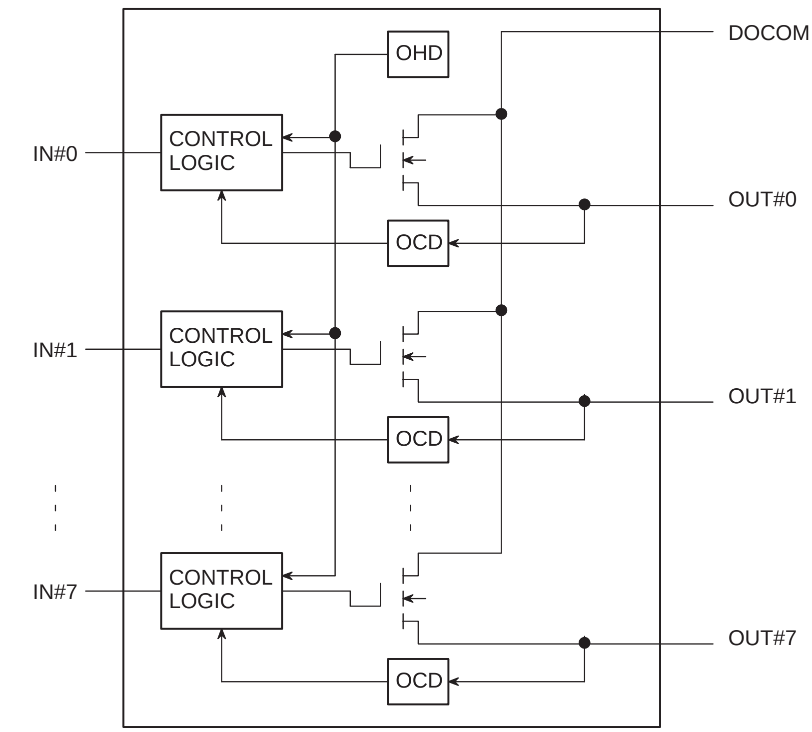
Correspondence between red LEDs and DO signals

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.

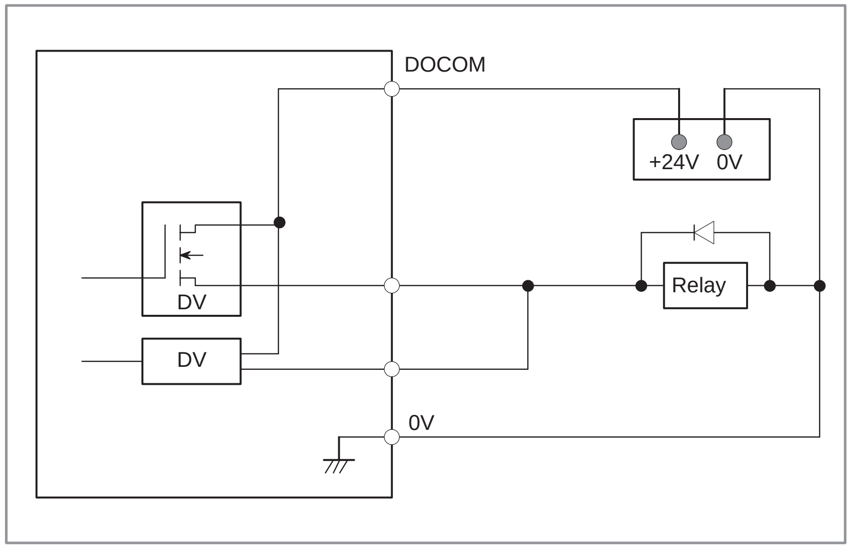
- **Driver element block diagram**



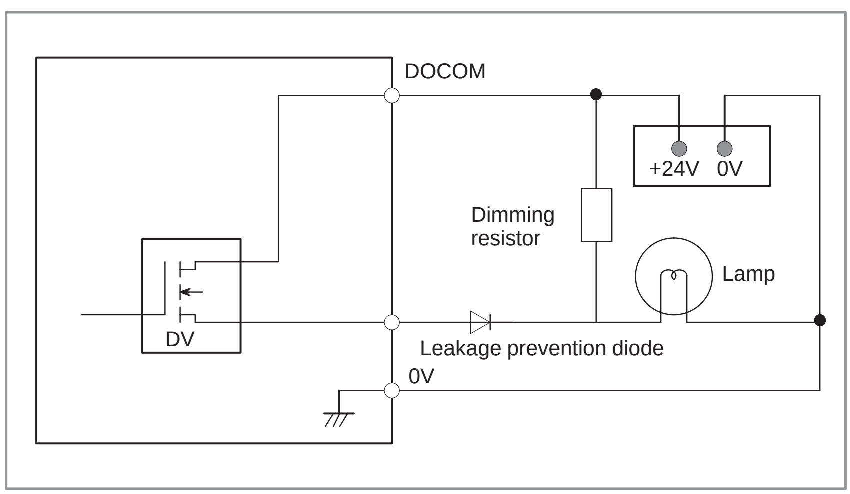
OHD: Overheat detection circuit
OCD: Overcurrent detection circuit
The power for operating this driver element is supplied from DOCOM (24 VDC).

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.



9.6.3 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	DI: 64 points		7	6	5	4	3	2	1	0
DI: 96 points	DI: 64 points	X p	DI07	DI06	DI05	DI04	DI03	DI02	DI01	DI00
DI: 96 points	DI: 64 points	X p+1	DI17	DI16	DI15	DI14	DI13	DI12	DI11	DI10
DI: 96 points	DI: 64 points	X p+2	DI27	DI26	DI25	DI24	DI23	DI22	DI21	DI20
DI: 96 points	DI: 64 points	X p+3	DI37	DI36	DI35	DI34	DI33	DI32	DI331	DI30
DI: 96 points	DI: 64 points	X p+4	DI47	DI46	DI45	DI44	DI43	DI42	DI41	DI40
DI: 96 points	DI: 64 points	X p+5	DI57	DI56	DI55	DI54	DI53	DI52	DI51	DI50
DI: 96 points	DI: 64 points	X p+6	DI67	DI66	DI65	DI64	DI63	DI62	DI61	DI60
DI: 96 points	DI: 64 points	X p+7	DI77	DI76	DI75	DI74	DI73	DI72	DI71	DI70
DI: 96 points		X p+8	DI87	DI86	DI85	DI84	DI83	DI82	DI81	DI80
DI: 96 points		X p+9	DI97	DI96	DI95	DI94	DI93	DI92	DI91	DI90
DI: 96 points		X p+10	DIA7	DIA6	DIA5	DIA4	DIA3	DIA2	DIA1	DIA0
DI: 96 points		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

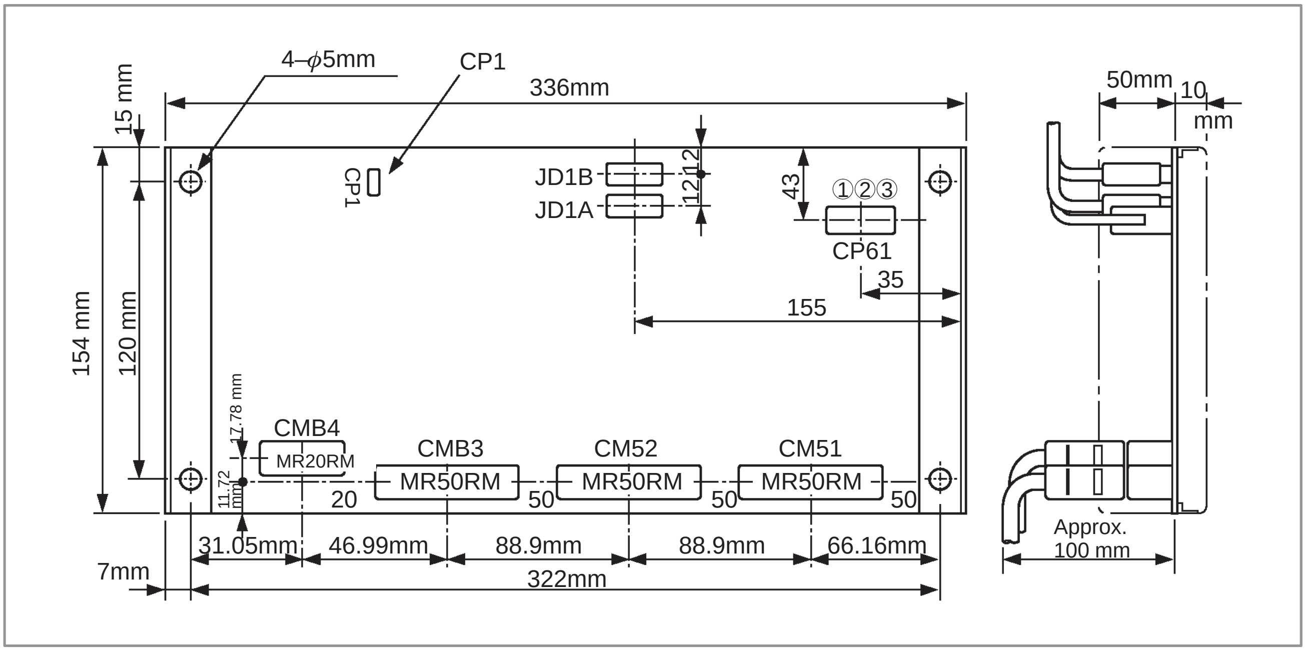
[DO address]

			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).

9.6.4 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. 9.6.2

[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. 9.6.2).

9.7 FANUC I/O Link CONNECTION UNIT

9.7.1 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.

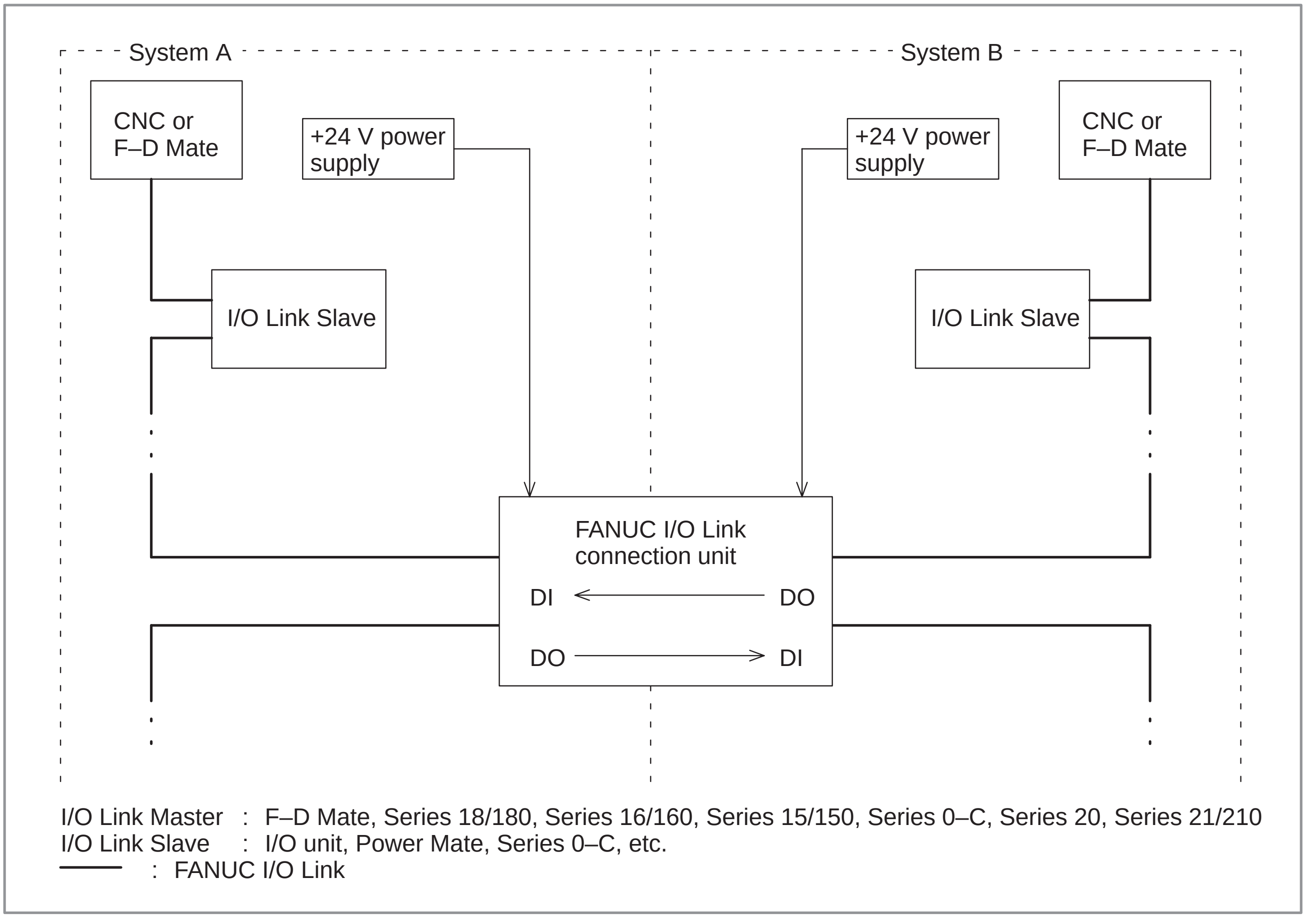


Fig. 9.7.1 System which uses FANUC I/O Link connection units

> **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.

9.7.2 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

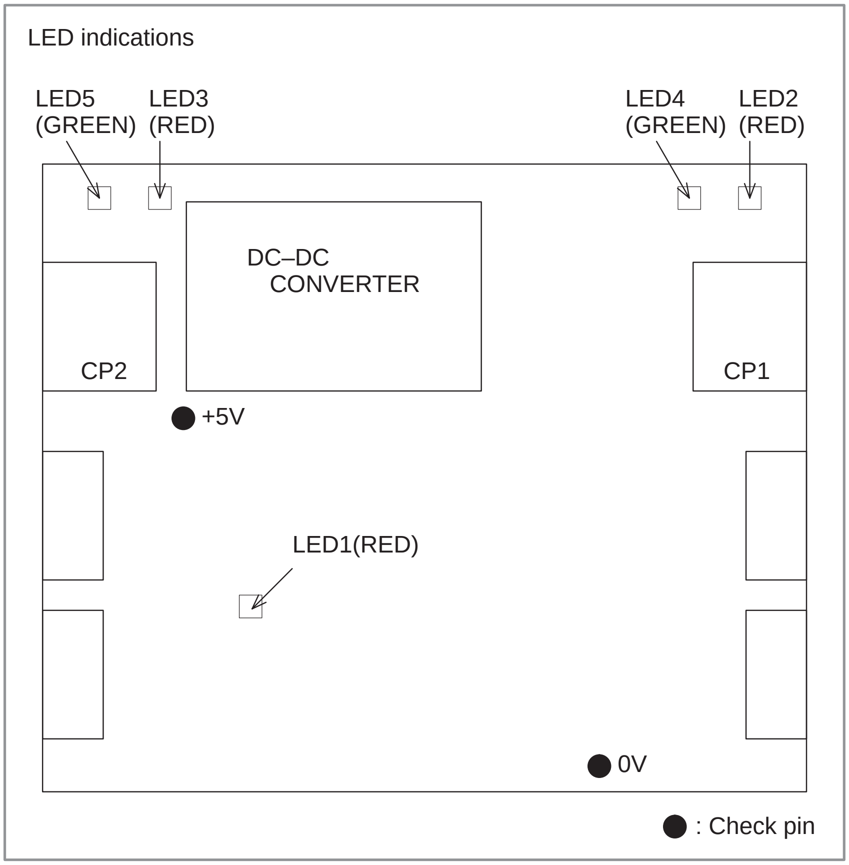


Fig 9.7.2 (a) LED locations

	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

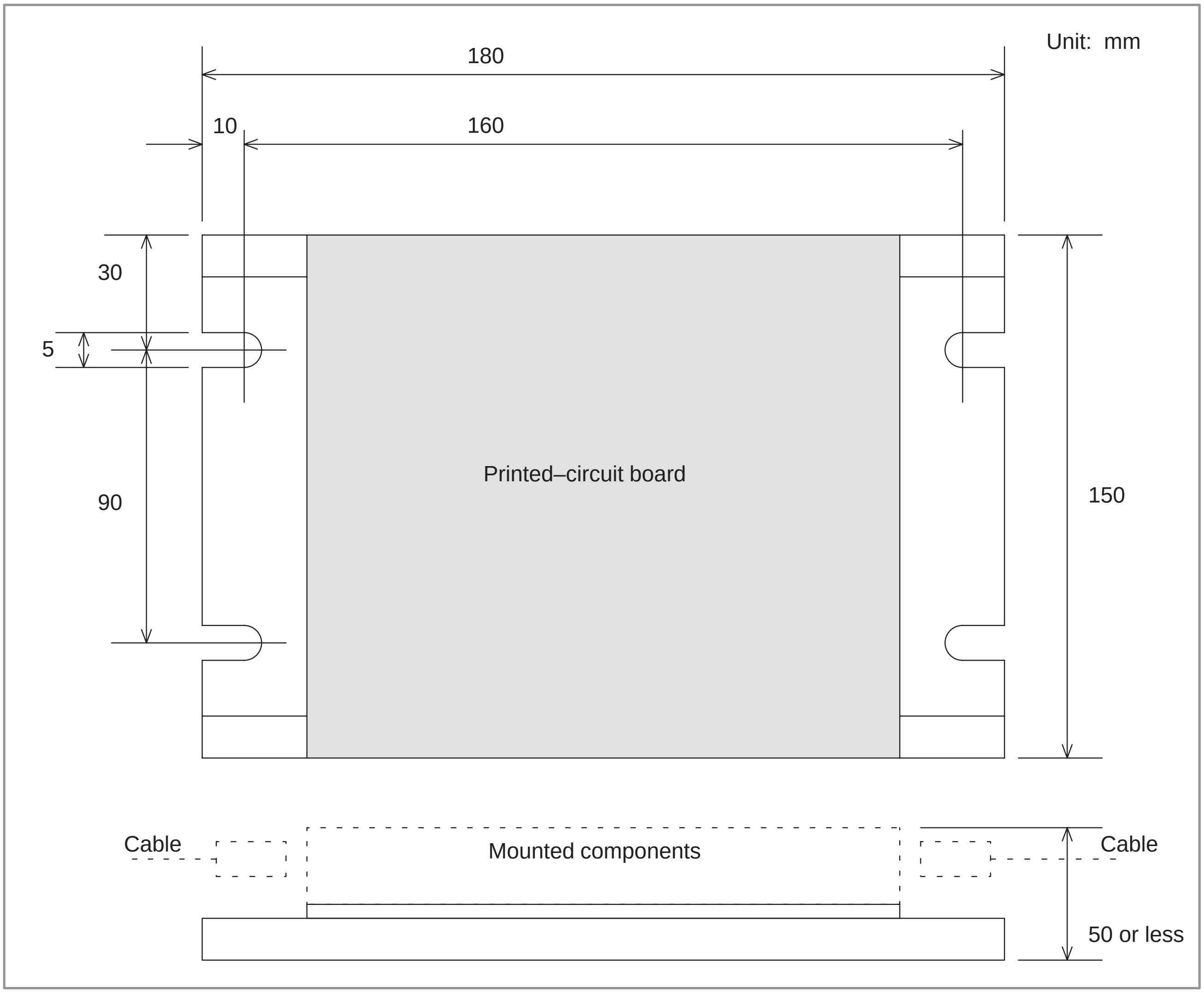


Fig. 9.7.2 (b) Outline drawing

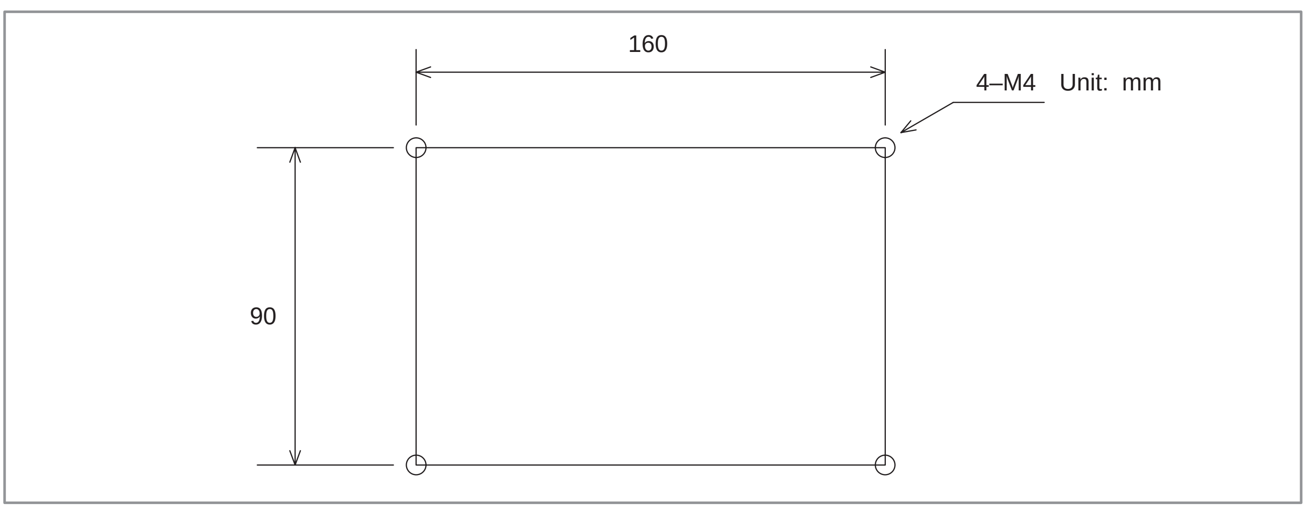
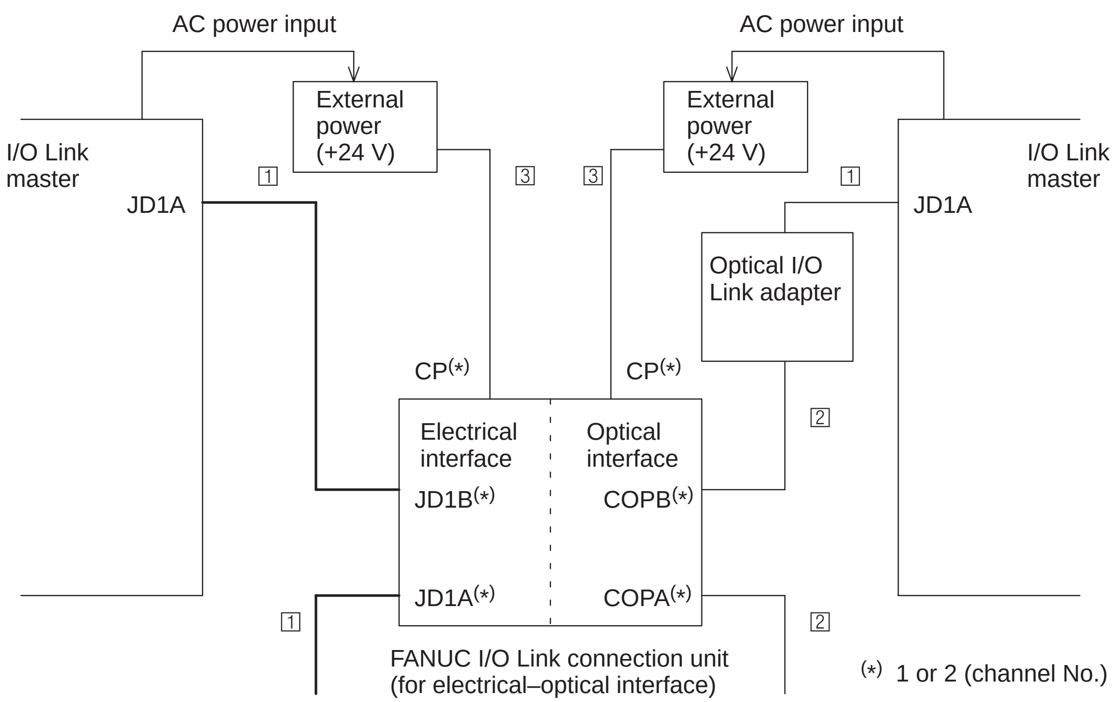


Fig. 9.7.2 (c) Mounting location

9.7.3 Connection

9.7.3.1 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	

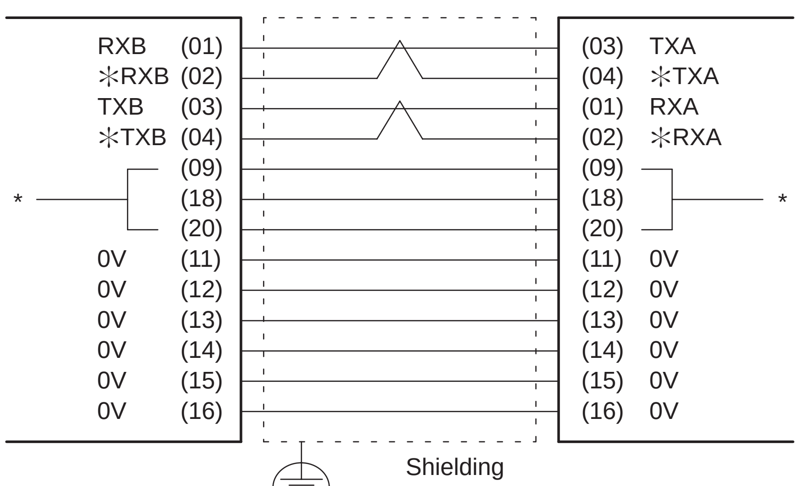
JD1B1/JD1B2

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)

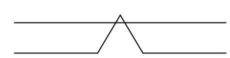
or

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



Shielding

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.

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

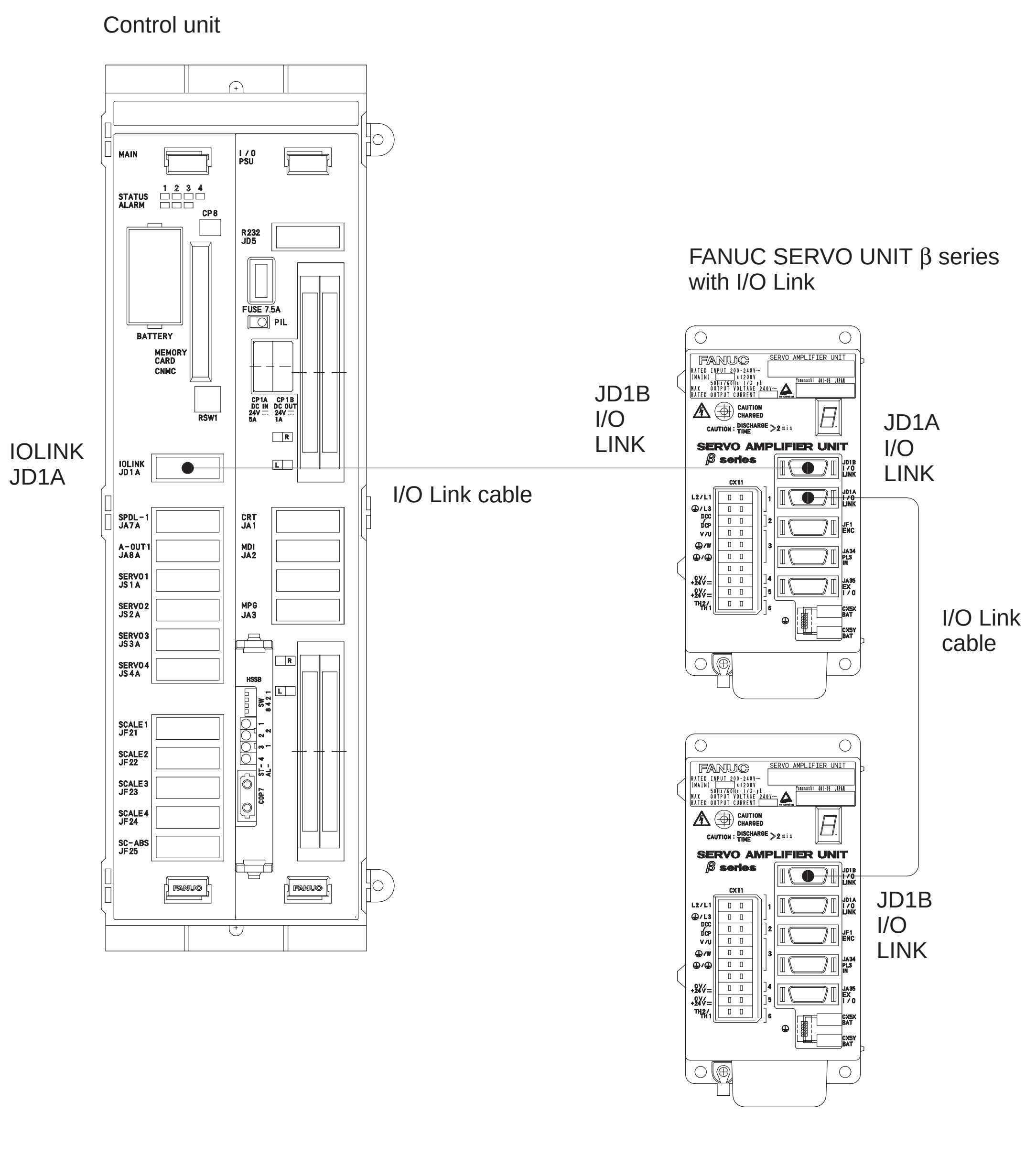
9.8.1 Overview

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 21/210 using the FANUC I/O Link.

NOTE
Using the β amplifier requires that the power motion manager software function be installed in the Series 21/210. This function is included as one of the Series 21/210 option functions. Note that this function was not featured by early versions.

9.8.2 Connection

The β amplifier with I/O Link is connected to the Series 21/210 using the usual FANUC I/O Link connection.



Connection to β series amplifier

9.8.3 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 21/210, 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.

9.8.4 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.

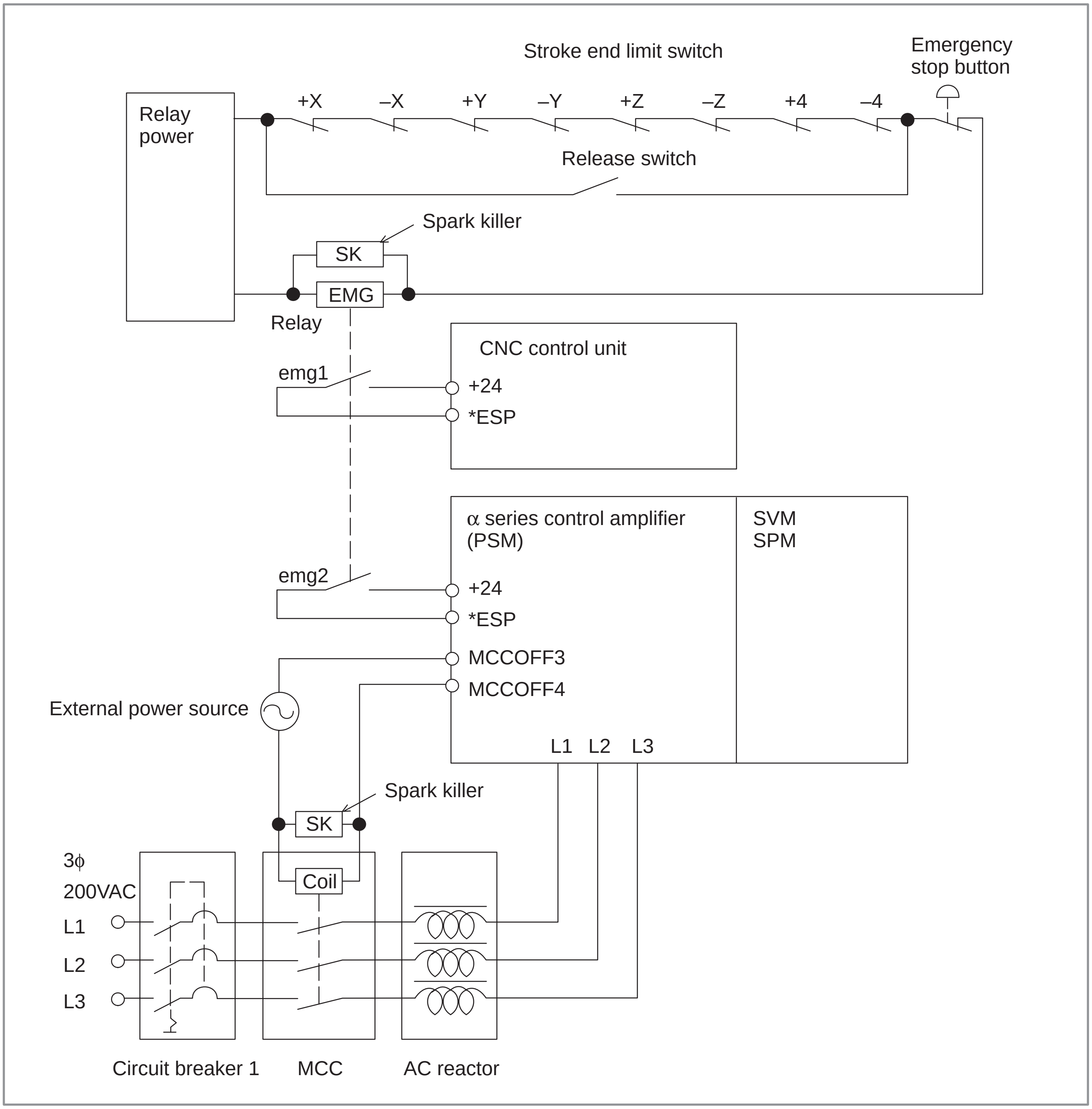


Fig. 10

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 DISPLAY UNIT CHANGE–OVER SWITCH

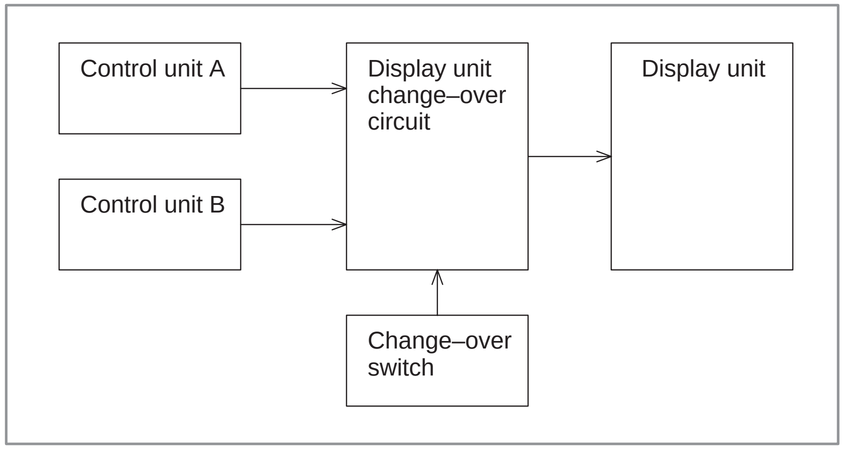
11.1 OVERVIEW

In a system containing two CNC control units, a single display unit (including the MDI section) can be switched between the control units. Likewise, using a display unit change–over circuit enables the switching of a CNC control unit between two display unit MDI sections. This display change–over circuit is different from that used in the former case. Both types of changer–over circuits can be used with the Series 21, but not with the Series 210.

11.2 CONNECTING ONE DISPLAY UNIT TO TWO CONTROL UNITS

The following block diagram shows an example of a system in which a single display unit (including an MDI section) is switched between two CNC control units.

Block diagram

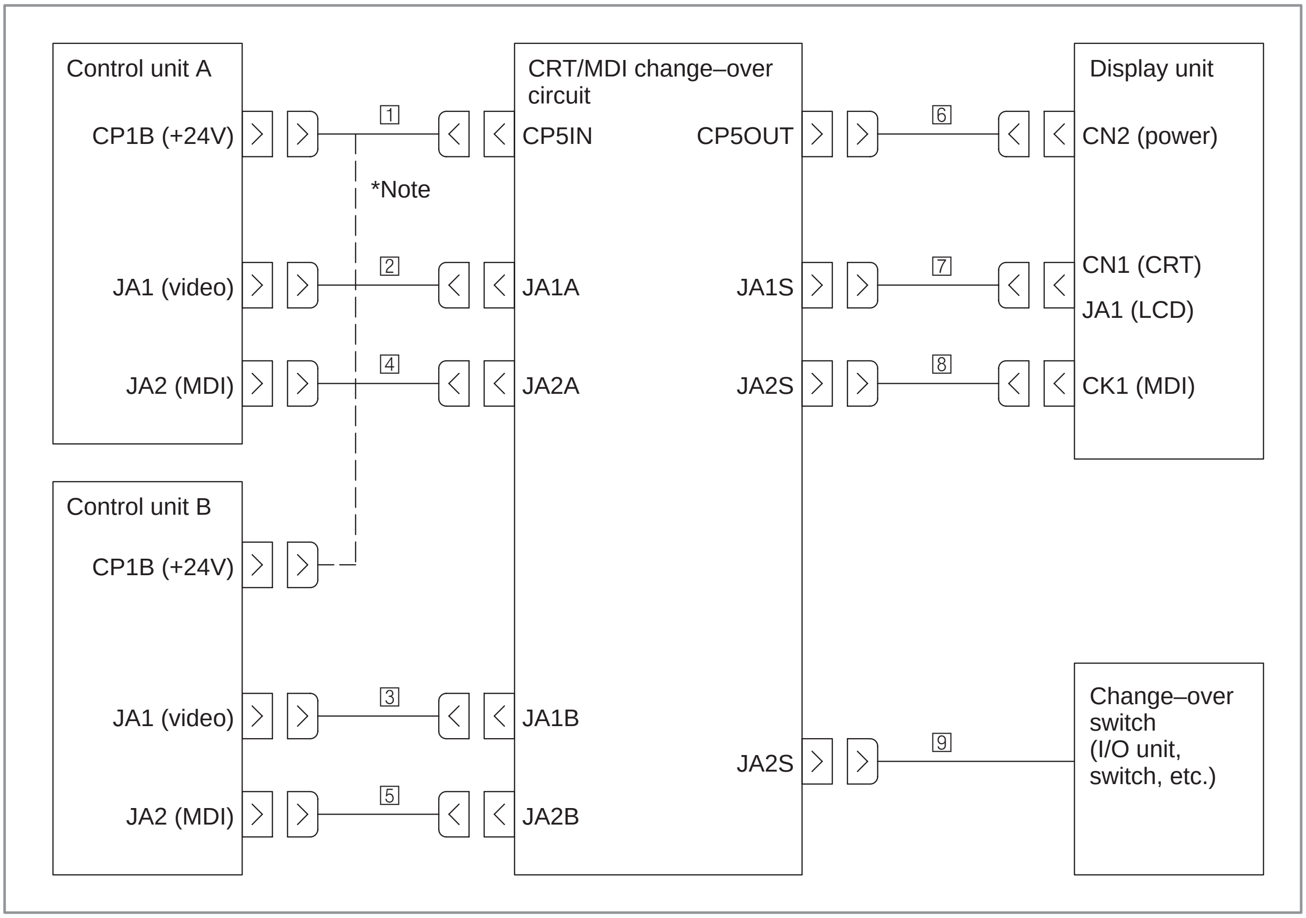


11.2.1 Ordering Information

Name	Ordering information
CRT/MDI change–over circuit	A02B–0120–C170

NOTE
Although the above is named the CRT/MDI change–over circuit, it can also be used to connect a plasma display panel (PDP) and liquid crystal display panel (LCD), not only a CRT unit. Note that the required connection cables are not shipped with the circuit.

11.2.2 Connection Diagram



NOTE
Either control unit A or B can supply +24 V power to the CRT/MDI change–over circuit unit from CP5IN.

Cables

No.	Cable	Connector name	Connector model (on cable side)	Recommended cable specification
1	Power cord	CP5IN	2–178288–3 produced by AMP	A02B–0120–K823
2, 3	Video signal cable	JA1A, JA1B	FI40–2015S produced by Hirose	A02B–0120–K818 (See Section 5.1.5.)
4, 5, 8	MDI signal cable	JA2A, JA2B	PCR–E20FA produced by Honda	A02B–0120–K810 (See Section 5.2.3.)
6	Power cord	CP5OUT	2–178288–3 produced by AMP	To be designed by the machine tool builder. (See Sections 5.1.3 to 5.1.5.)
7	Video signal cable	JA1S	FI40–2015S produced by Hirose	A02B–0120–K819 or A02B–0120–K818. (See Sections 5.1.3 to 5.1.5.)
9	Change–over signal cable	SW	PCR–E20FA produced by Honda	To be designed by the machine tool builder.

Connector tables

JA1A, JA1B, JA1S (PCR–20 female)

		10				20	
9		8		19		18	HSYNC
7		6	GND	17		16	GND
5	VDOB	4	GND	15		14	GND
3	VDOG	2	GND	13		12	VSYNC
1	VDOR			11			

JA2A, JA2B, JA2S (PCR–20 female)

		10	*KCM10			20	*KCM11
9	*KCM8	8	*KCM6	19	*KCM9	18	*KCM7
7	*KCM4	6	*KCM2	17	*KCM5	16	*KCM3
5	*KCM0	4	KEYD6	15	*KCM1	14	KEYD7
3	KEYD4	2	KEYD2	13	KEYD5	12	KEYD3
1	KEYD0			11	KEYD1		

SW (PCR–20 female)

		10				20	
9		8		19		18	
7		6		17		16	GND
5		4		15		14	GND
3		2		13		12	SELECT
1				11			

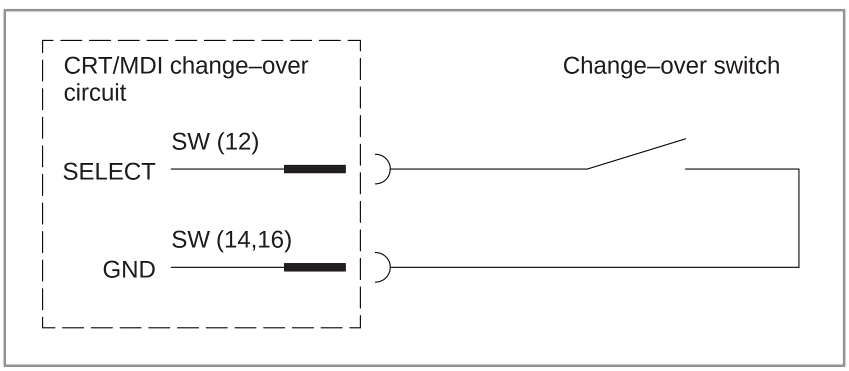
CP5IN, CP5OUT (AMP D–3000 DP Y–KEY)

1	+24V
2	0V
3	

Cautions regarding connection

(1) Correspondence between state of the change–over switch contact and the selected control unit

Change–over switch open → control unit A is selected.
Change–over switch closed → control unit B is selected.



(2) Maximum cable length for video and MDI signals
The sum of the cable length between the control unit and CRT/MDI change–over circuit unit and that between the CRT/MDI change–over circuit unit and the display unit must be less than 50 m.

(3) Power supply cable length
The material for the power supply cable shall be vinyl–insulated electric wire of 30/0.18 (0.75 mm^2) or thicker. The cable length shall not exceed 50 m.

(4) Change–over signal cable length
The material for the signal cable shall be vinyl–insulated electric wire of 30/0.18 (0.75 mm^2) or thicker. The cable length shall not exceed 10 m.

(5) There are two I/O board types for the CNC control unit (Series 21), the CRT type and LCD type. An appropriate I/O board shall be selected according to the type of the display unit to be used. For a PDP, select CRT type.
If CNC control units have different I/O boards, they cannot be connected.

(6) The change–over circuit can be used to switch between the CNC control unit (Series 21) and a different CNC control unit model, with the exception of those listed below.

Control units switchable with the FANUC Series 21

Model	Video signal	MDI signal	Note
FANUC Series 0–C	Possible with a CRT Not possible with an LCD	Not possible	
FANUC Series 16/18	Possible	Possible	
FANUC Series 20	Possible	Possible	
FANUC Series 15	Possible	Not possible	
Power Mate–D	Possible	Possible	Note 3

NOTE

1 Connectable display units (including the MDI section) are those for the FANUC Series 21, with the exception of the following:
- 9″ monochrome CRT and CRT/MDI for the FANUC Series 16/18
- 9″ PDP and monochrome PDP/MDI for the FANUC Series 16/18
- MDI for the FANUC Series 16/18

2 The key arrangement varies between the MDI for the machining center (M) CNC and that for the lathe (T) CNC. They are not interchangeable.

3 For the Power Mate–D, the display unit change–over circuit is connected to the CRT/MDI control unit of the Power Mater D. Some restrictions are imposed on the Power Mate–D side. For details, refer to the Power Mate–D Connection Manual (B–62833EN).

Operation

The control unit is switched using a change–over switch.

Adjustment

If the display unit being used is a CRT, no adjustment is needed. If the display unit being used is an LCD, however, adjustment is necessary. The adjustment procedure is as follows:

1 Set the change–over switch of the display unit change–over circuit unit to control A.

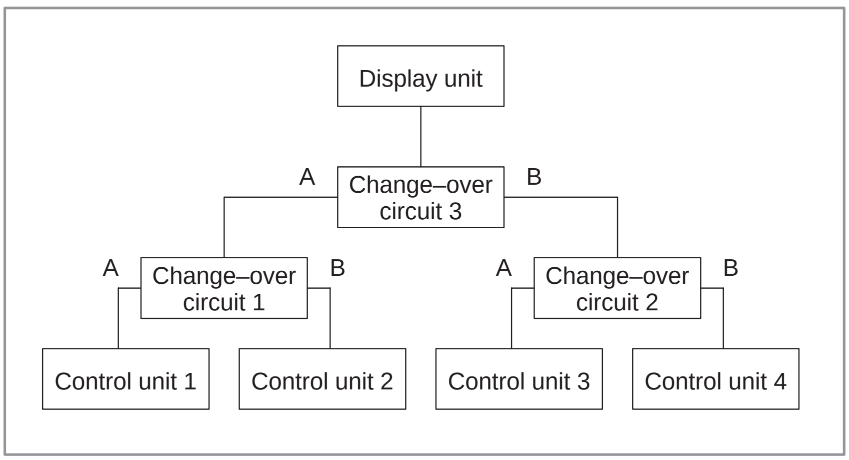
2 Adjust the LCD unit to eliminate flicker, using the potentiometer or jumper pin on the rear of the LCD unit. (See Subsections 5.1.7 and 5.1.8.)

3 Set the change–over switch of the display unit change–over circuit unit to control B.

4 Rotate rotary switch SW1 of the change–over circuit unit to identify the range where no flicker occurs. Then, set the switch to the midpoint of that range. (For example, if no flicker occurs in the range between 5 and 9, set the switch to 7.)

Example of application

Linking CRT/MDI change–over circuit units enables the connection of up to four control units. Up to two CRT/MDI change–over circuit units can be connected in series.



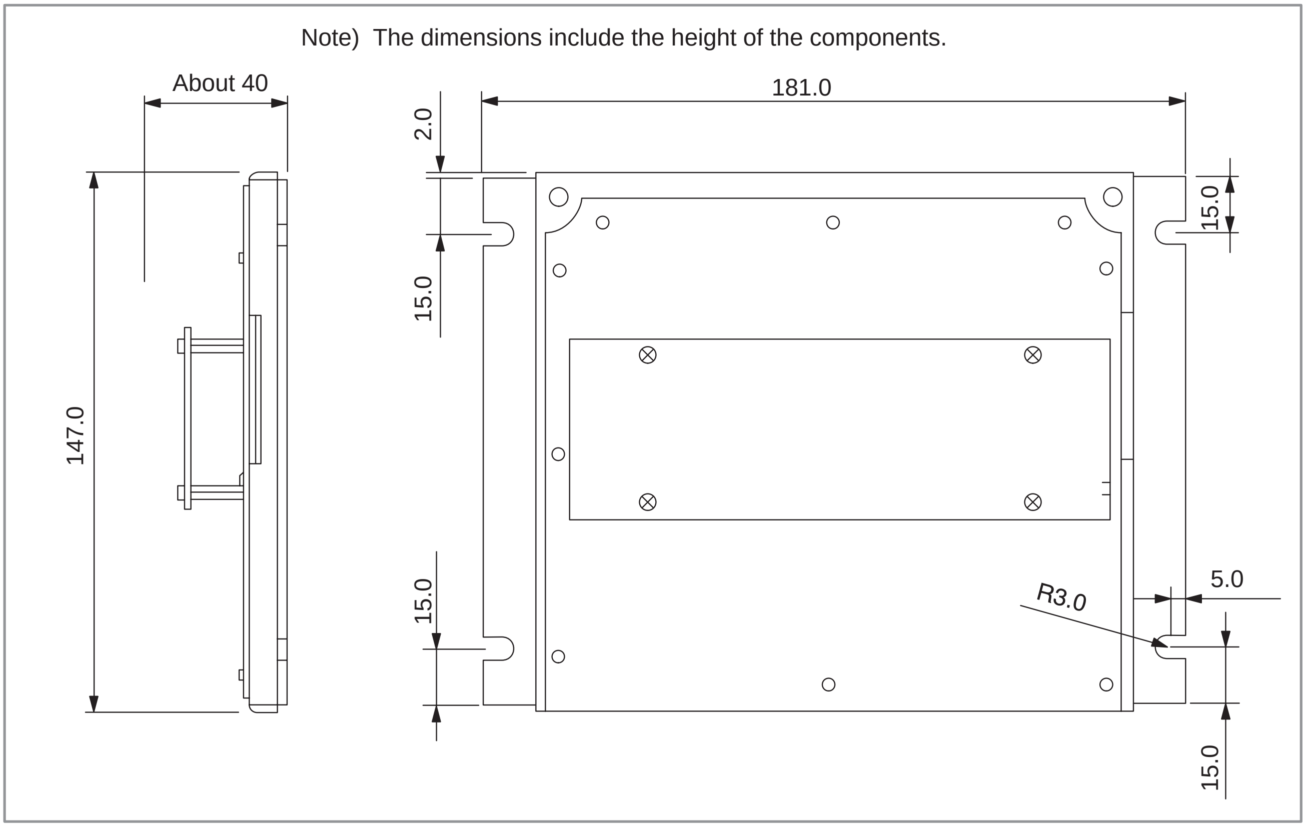
Block diagram of a system in which four control units share a single display unit

Assume that the change–over switches in change–over circuits 1, 2, and 3 are SW1, SW2, and SW3, respectively. The relationships between the contact states of SW1, SW2, and SW3 and the selected control units are as listed below:

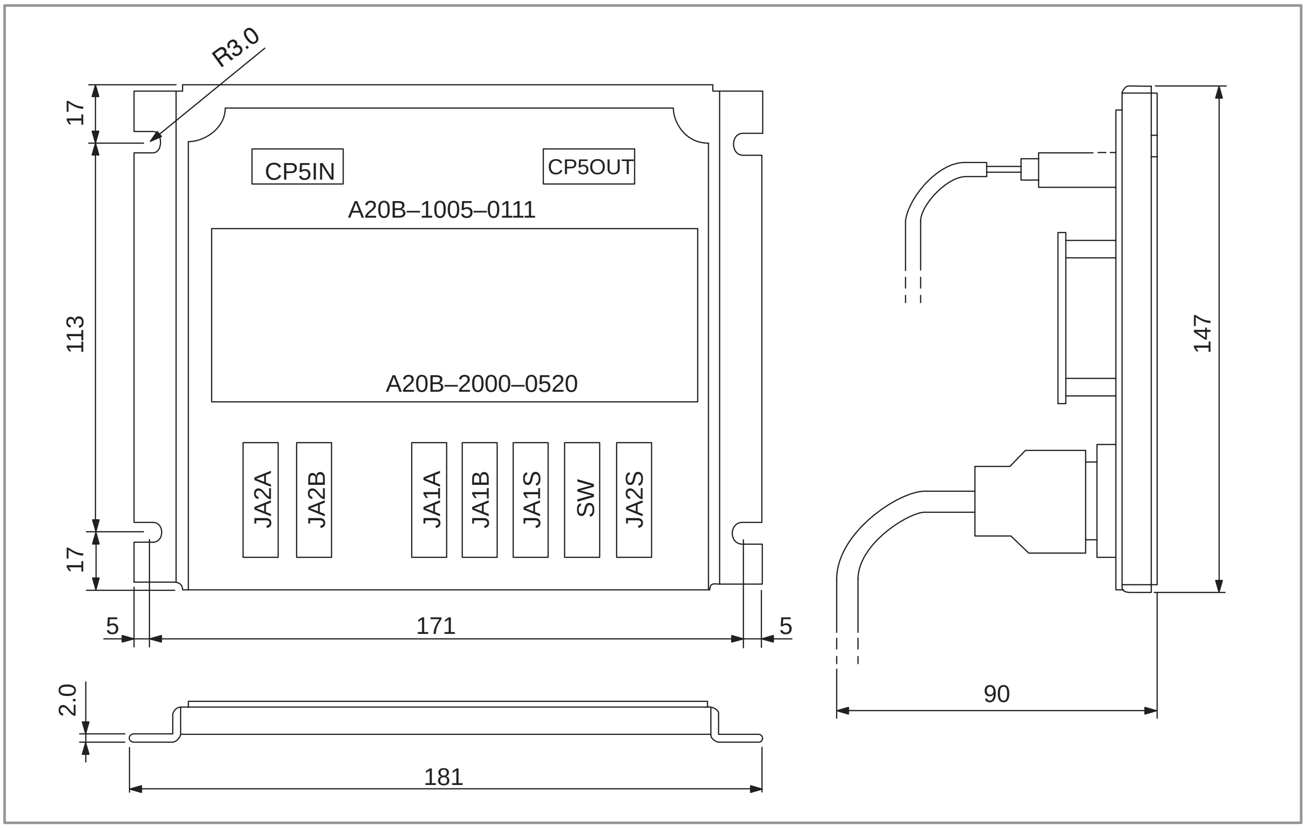
Selected control units	SW1	SW2	SW3
Control unit 1	1	×	1
Control unit 2	0	×	1
Control unit 3	×	1	0
Control unit 4	×	0	0

Legend:
1 : Switch open
0 : Switch closed
× : Don't care.

Outline drawing



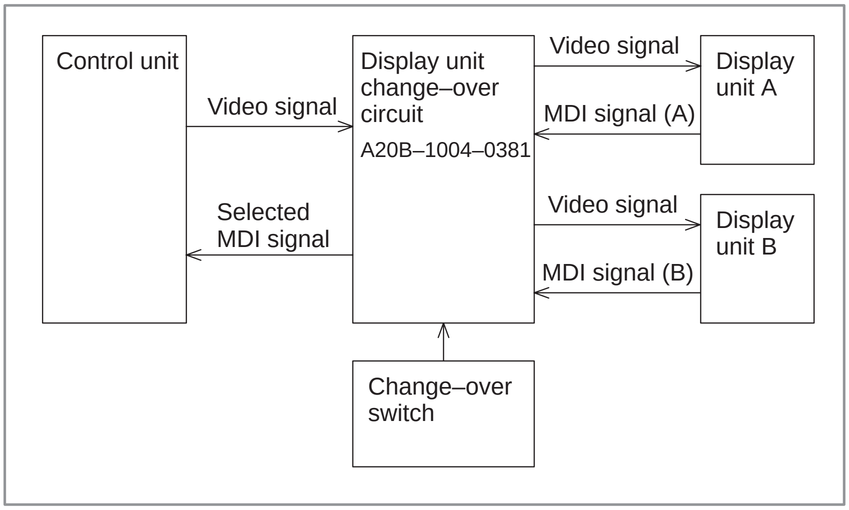
Cable lead–in diagram



11.3 CONNECTING TWO DISPLAY UNITS TO ONE CONTROL UNIT

The following block diagram shows an example of a system in which a CNC control unit is connected to two display units by switching the MDI section. The change–over switch is used to switch the MDI signal between display units A and B.

Block diagram



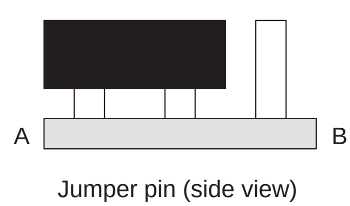
11.3.1 Ordering Information

Name	Ordering information
CRT/MDI change–over circuit	A02B–1004–0381

NOTE
Although the above circuit is named the CRT/MDI change–over circuit, it can also be used to connect a plasma display panel (PDP) and liquid crystal display panel (LCD), not only a CRT unit. Note that the required connection cables are not shipped with the circuit.

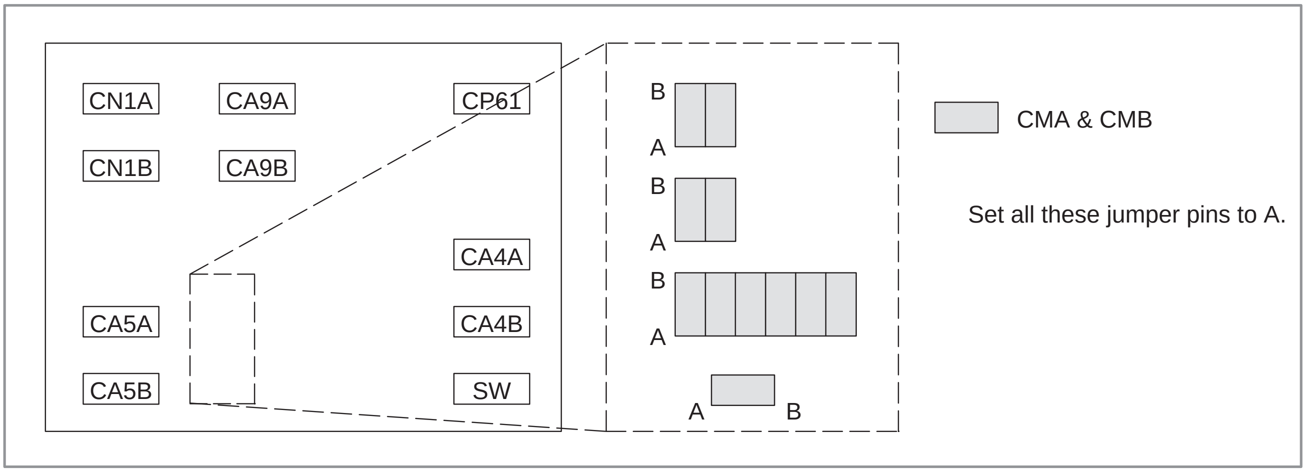
11.3.2 Jumper Pins

Set all the CMA and CMB jumper pins on the change–over circuit board to A.



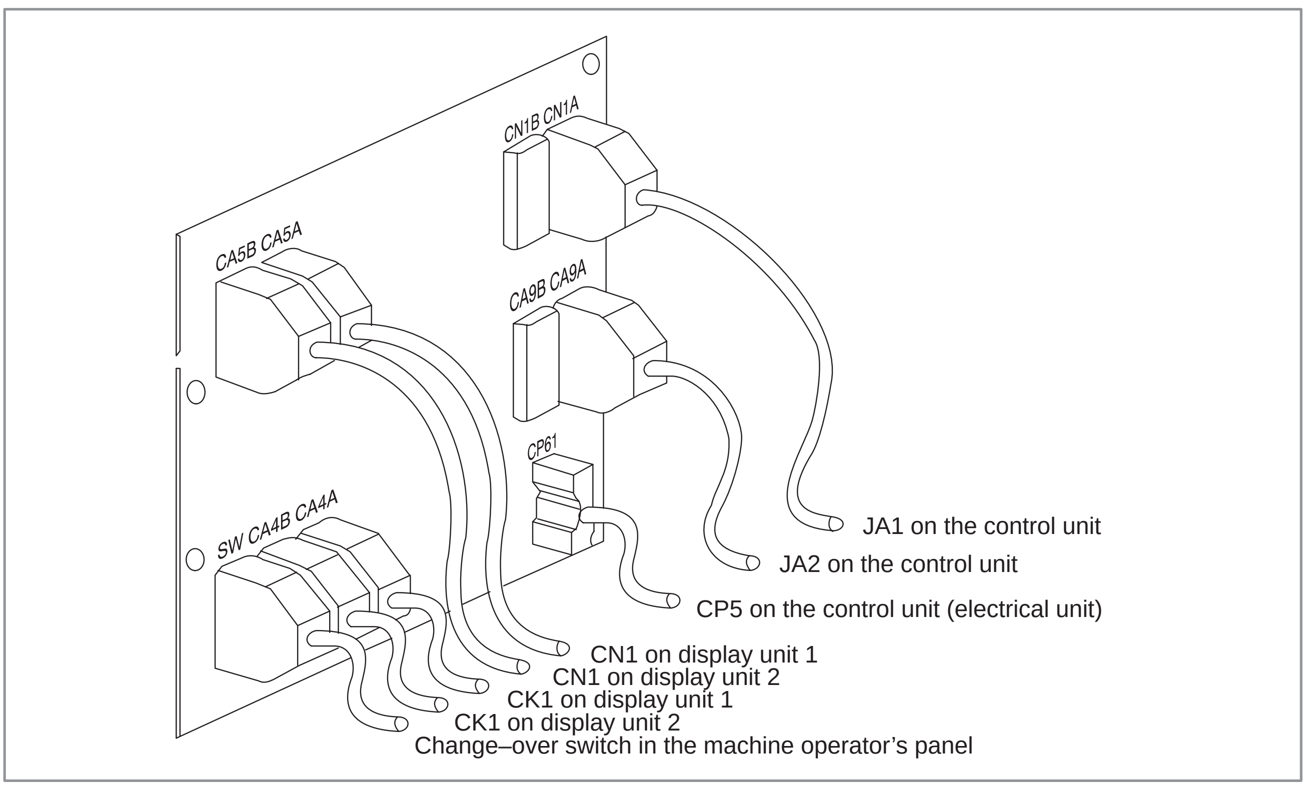
This diagram shows a jumper pin that is set to A.

Jumper pins CMA and CMB are located on the printed–circuit board as shown below.

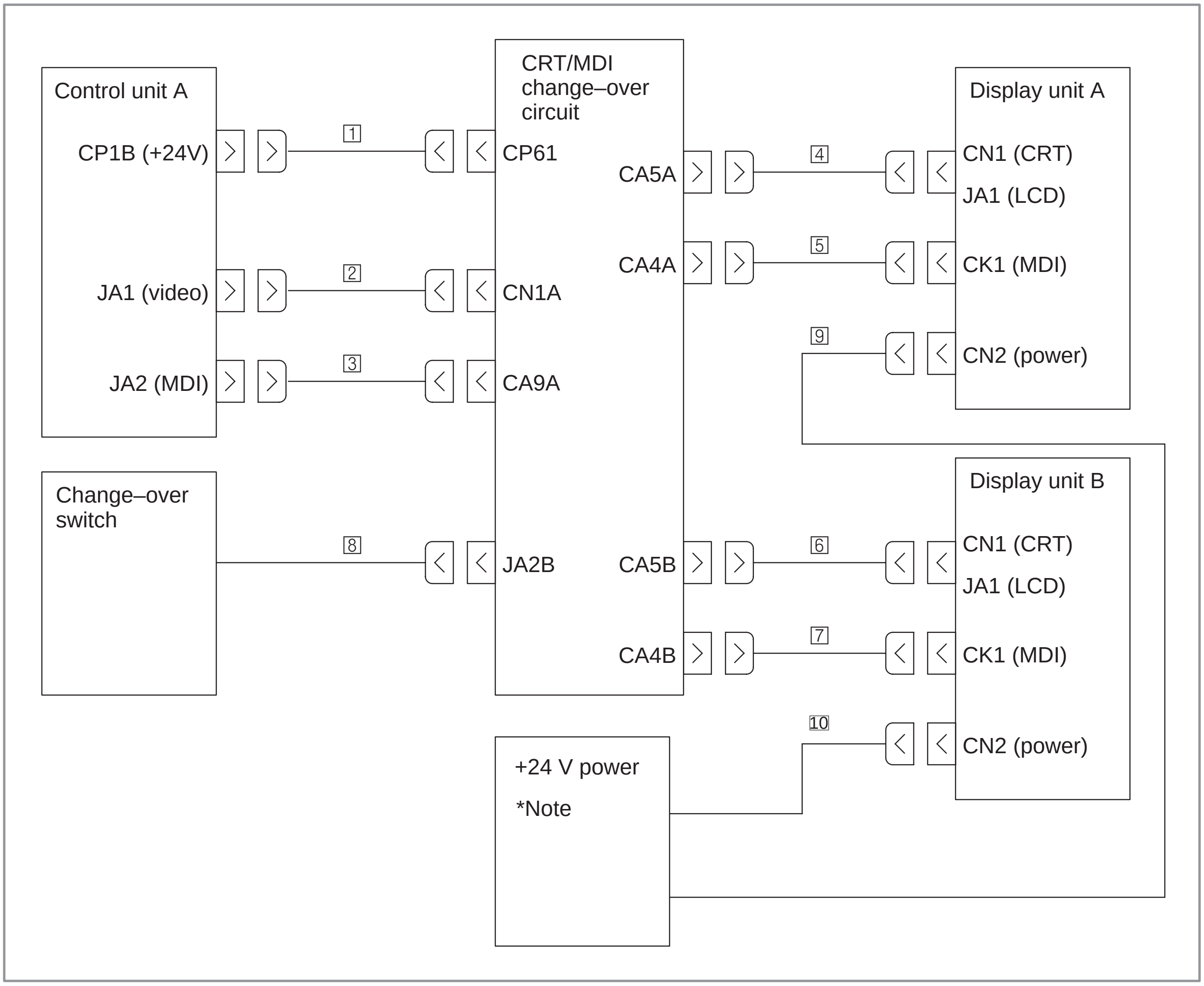


11.3.3 Connections

The change–over circuit board should be installed inside the machine. It receives CRT signals from a control unit and sends video signals to two display units. It also selects the MDI signal of each display unit according to a change–over signal and sends it to the control unit.
A change–over switch for signal change–over should be installed in the machine operator's panel.



11.3.4 Connection Diagram



CAUTION

The +24 V output connector pin (CP1B) of the power supply unit in the Series 21/210 can supply a current of 1.0 A (maximum). The CRT/MDI change–over circuit unit requires at least 0.4 A, and each display unit uses 0.8 A or more. (See Section 3.2.1.) Therefore, connect the power supply of the CRT/MDI change–over unit to the control unit, and supply the power for each display unit from an external 24 VDC power supply unit.

Switch the power supplied to the control unit, CRT/MDI change–over circuit unit, and display units, on and off simultaneously.

Cables

No.	Cable	Connector name	Connector model (on cable side)	Recommended cable specification
1	Power supply cable	CP61	SMS3PNS–5 produced by Burndy	To be designed by the machine tool builder.
2	Video signal cable	CN1A	MR–20LFH produced by Honda	A02B–0120–K819 (See Subsec. 5.1.3.)
3	MDI signal cable	CA9A	MR–20LMH produced by Honda	To be designed by the machine tool builder.
4, 6	Video signal cable	CA5A, CA5B	MR–20LFH produced by Honda	To be designed by the machine tool builder.
5, 7	MDI signal cable	CA4A, CA4B	MR–20LMH produced by Honda	To be designed by the machine tool builder.
8	Change–over signal cable	SW	PCR–E20FA produced by Honda	To be designed by the machine tool builder.
9, 10	Power supply cable			To be designed by the machine tool builder.

Connector tables

CP61

1	+24V	2	0V	3	

CN1A, CA5A, CA5B

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

CA9A, CA4A, CA4B

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

SW

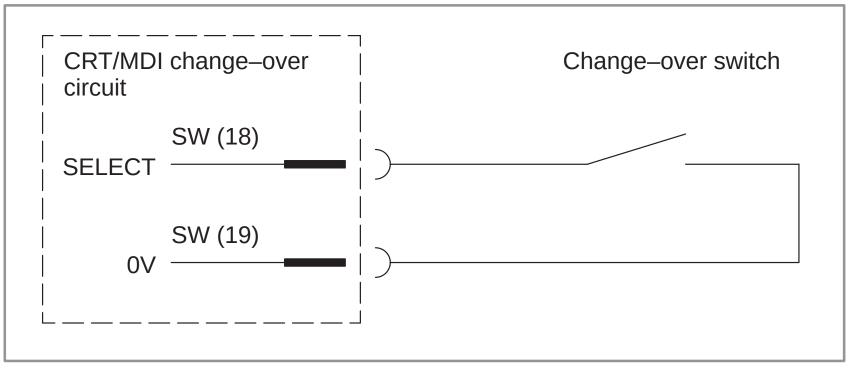
1		8	0V	14	
2		9	0V	15	
3		10	0V	16	
4		11	0V	17	
5		12	0V	18	SELECT
6		13	0V	19	0V
7				20	

Cautions regarding connection

(1) Correspondence between state of the change–over switch contact and the selected display unit

Change–over switch open → Display unit A is selected.
Change–over switch closed → Display unit B is selected.

Do not operate the change–over circuit switch while any MDI key is held down.



(2) Maximum cable length for video and MDI signals
The sum of the cable length between the control unit and CRT/MDI change–over circuit unit and that between the CRT/MDI change–over circuit unit and the display unit must be less than 50 m.

(3) Power supply cable length
The material for the power supply cable shall be vinyl–insulated electric wire of 30/0.18 (0.75 mm^2) or thicker. The cable length shall not exceed 50 m.

(4) Change–over signal cable length
The material for the signal cable shall be vinyl–insulated electric wire of 30/0.18 (0.75 mm^2) or thicker. The cable length shall not exceed 1 m.

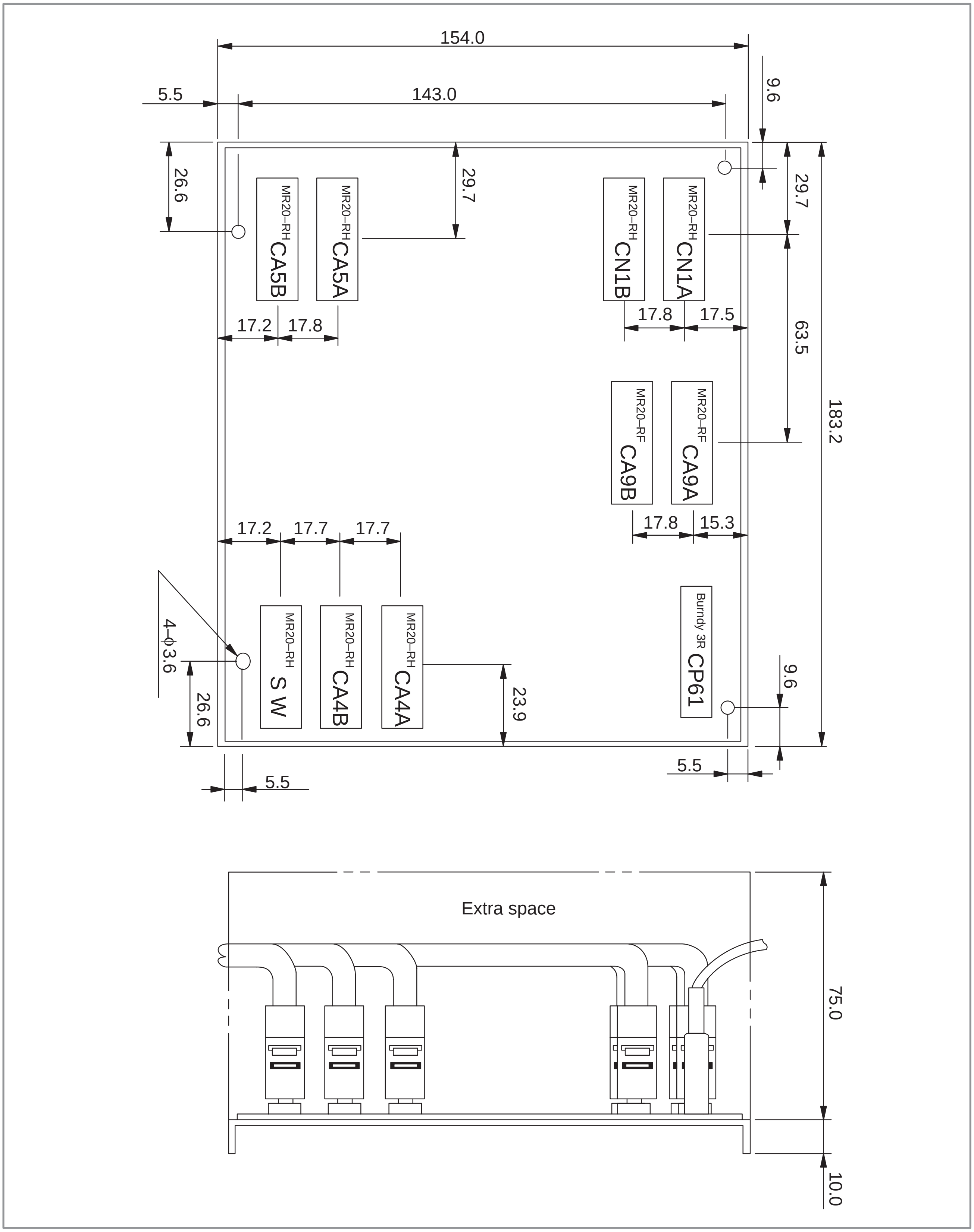
(5) This change–over circuit cannot be used with the following combinations:

- CRT and LCD
- PDP and LCD
- MDI having a small keypad and that having a full keypad
- MDI of a machining center (M) CNC and that of a lathe (T) CNC

A wide variety of LCD panels is available. Basically, these LCD panels can be used in any combination. If monochrome and color types are combined, however, the monochrome LCD panel will appear dim. It is recommended, therefore, that LCD panels of the same type be combined.

(6) When an LCD panel is used, screen adjustment should be made on the LCD side.

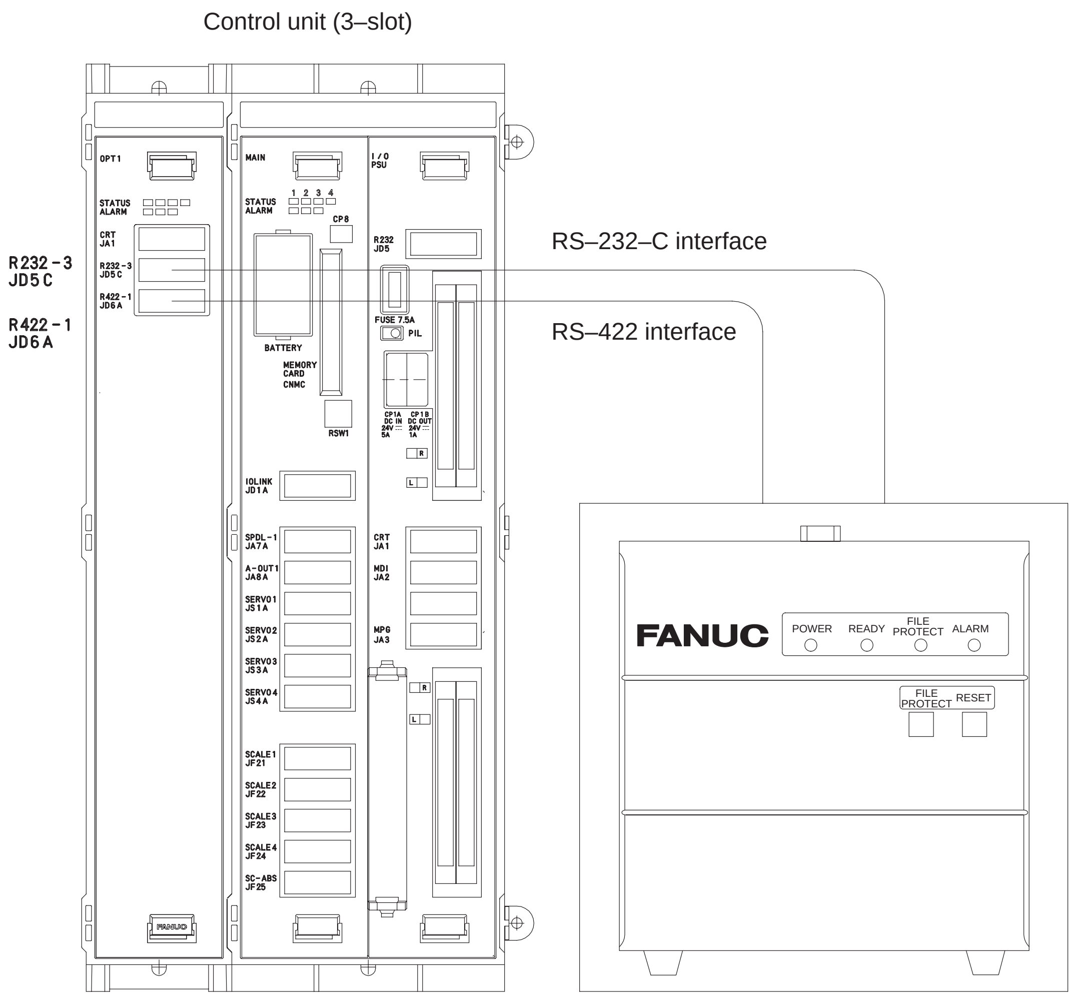
Outline drawing



12 REMOTE BUFFER INTERFACE

12.1 GENERAL

When the remote buffer is connected to the host computer or input/output device via serial interface, a great amount of data can be sent to CNC consecutively at a high speed.



Use either the RS–232C or RS–422 interface.

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–233–C	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)

NOTE
(*) The average data transfer rate is lower than the maximum transfer rate.

❑ Software interface

The following three protocols are prepared as the communication protocols between the remote buffer and host computer. The protocol can be selected by a parameter according to the specifications of the device to be connected.

Protocol	Features	Interface	Maximum transfer rate
Protocol A	Handshake method. Sending and receiving are repeated between two stations.	RS–232–C	19200 BPS
		RS–422	86400 BPS
Extended protocol A	Similar to protocol A. Enables high–speed transfer of the NC program to meet high–speed DNC operation.	RS–422	86400 BPS
Protocol B	Controls communication with control codes output from the remote buffer.	RS–232–C	19200 BPS
		RS–422	86400 BPS

12.2 REMOTE BUFFER INTERFACE (RS–232–C)

CNC OPTION–1 board

JD5C
(PCR-EV20MDT)

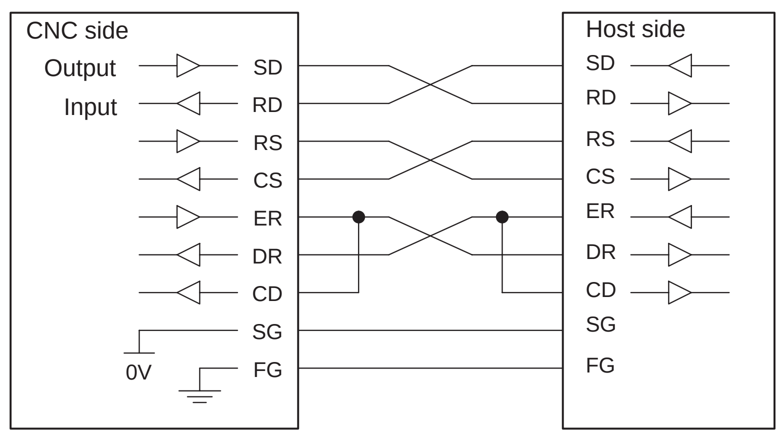
1	RD	11	SD
2	0V	12	0V
3	DR	13	ER
4	0V	14	0V
5	CS	15	RS
6	0V	16	0V
7	CD	17	
8	0V	18	
9		19	(+24V)
10	(+24V)	20	

Host computer (example)

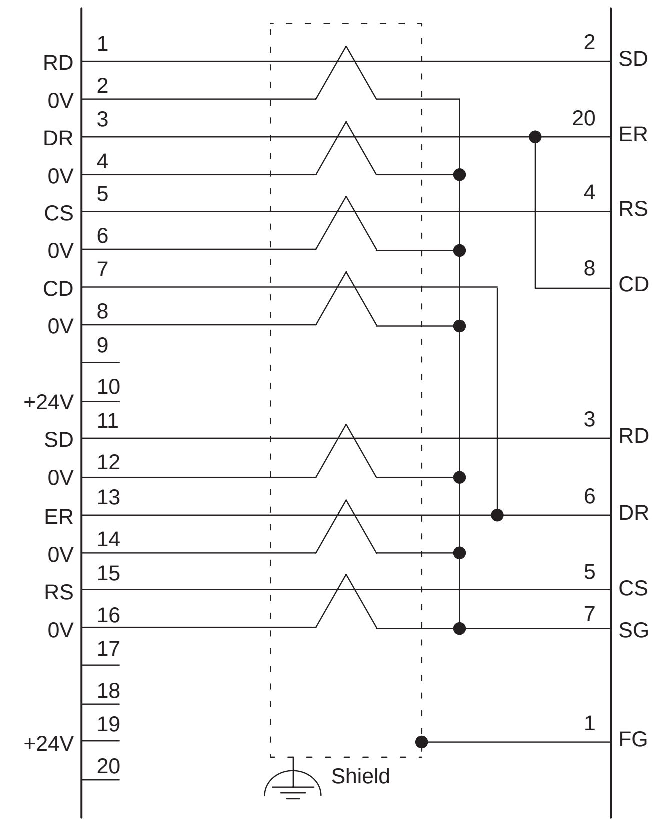
DBM–25S

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



Cable wiring



Connect CS to RS if CS is not used. However, when protocol A or expanded protocol A is used, connect as shown above because CS is used for busy control. Connect DR to ER when DR is not used. Be sure to connect CD to ER.

12.3 REMOTE BUFFER INTERFACE (RS–422)

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.

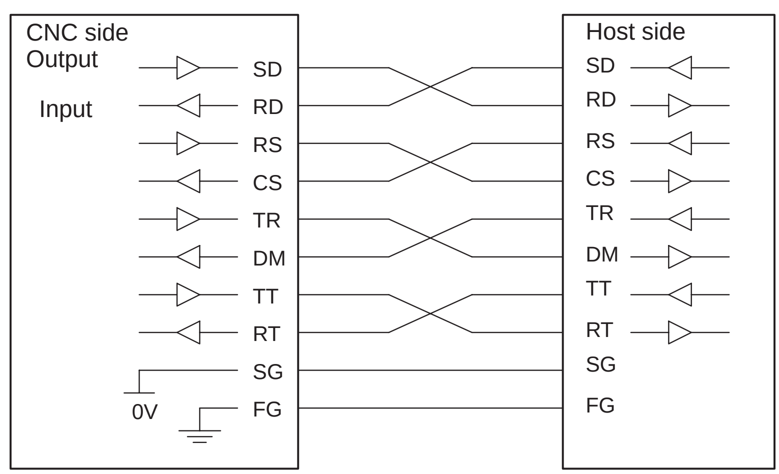
Host computer (Example)

1	FG	20	
2		21	
3		22	*SD
4	SD	23	
5		24	*RD
6	RD	25	*RS
7	RS	26	*RT
8	RT	27	*CS
9	CS	28	
10		29	*DM
11	DM	30	*TR
12	TR	31	
13		32	
14		33	
15		34	
16		35	*TT
17	TT	36	
18		37	
19	SG		

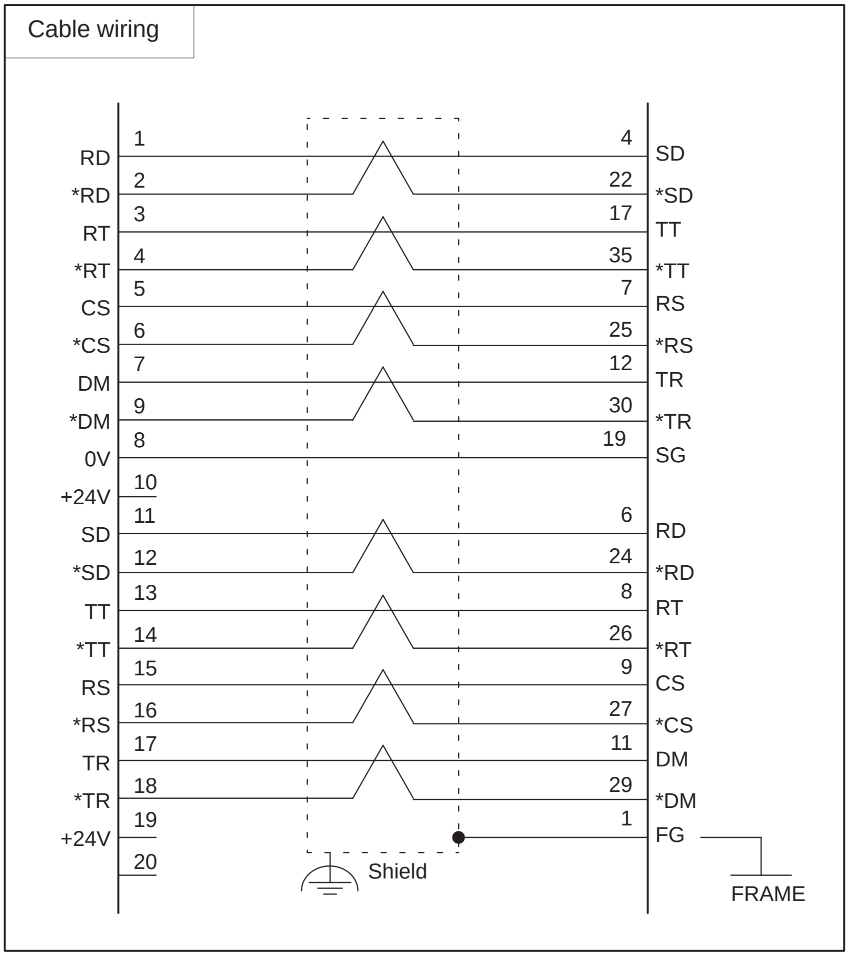
Conceptional diagram of signal connection

The figure below shows a signal connection between CNC and a host computer. Since signals other than FG and SG perform differential signal transmission, two wires of signal lines are used for those signals.

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.

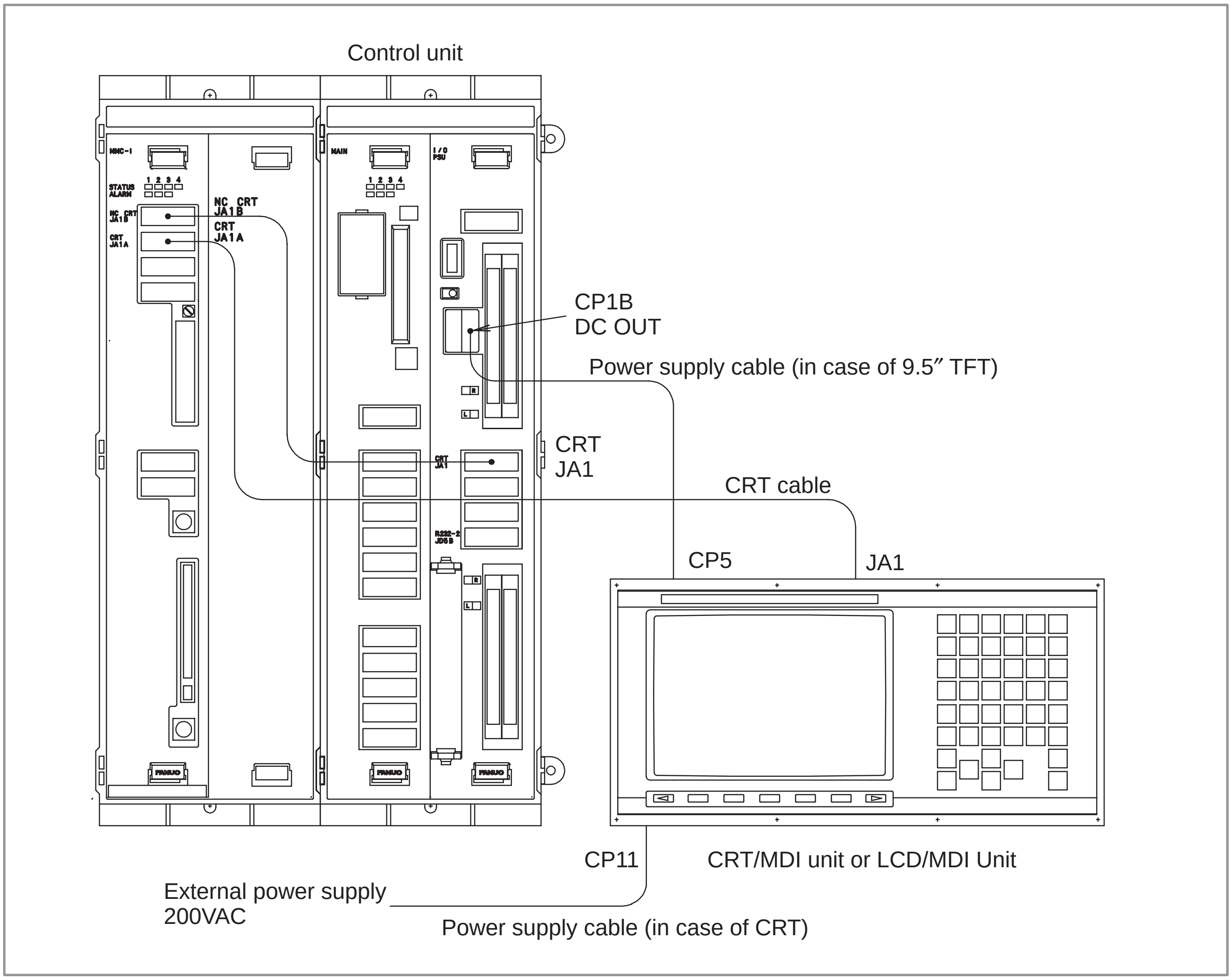
13 CONNECTING PERIPHERAL UNITS TO THE MMC–IV

13.1 GENERAL

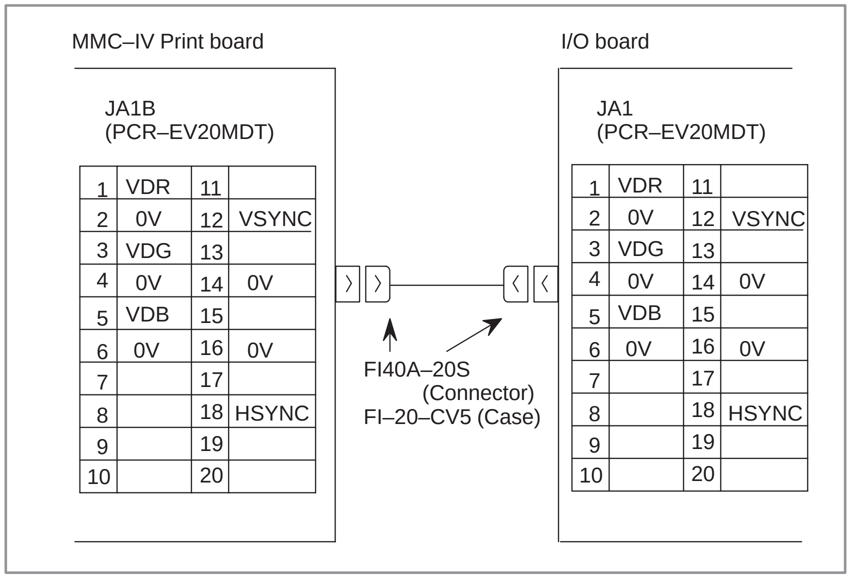
The MMC–IV is a personal computer designed for installation in a FANUC CNC. It is compatible with the IBM PC (*). It can be installed in the control unit of the Series 210.

* IBM is a registered trademark of IBM Corp. of the US.

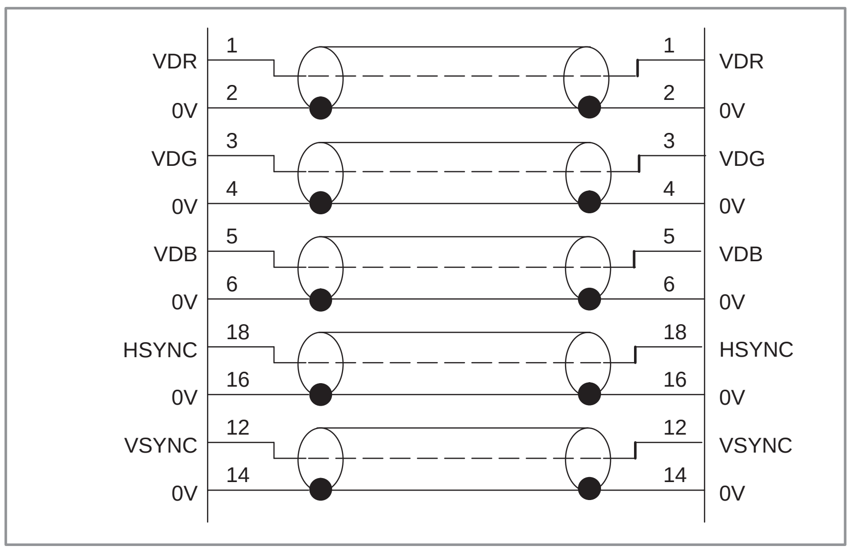
13.2 CONNECTING A DISPLAY UNIT



13.2.1 I/O Board (Video Signal Output Board in NC) Interface



1) Cable



2) Recommended cable material

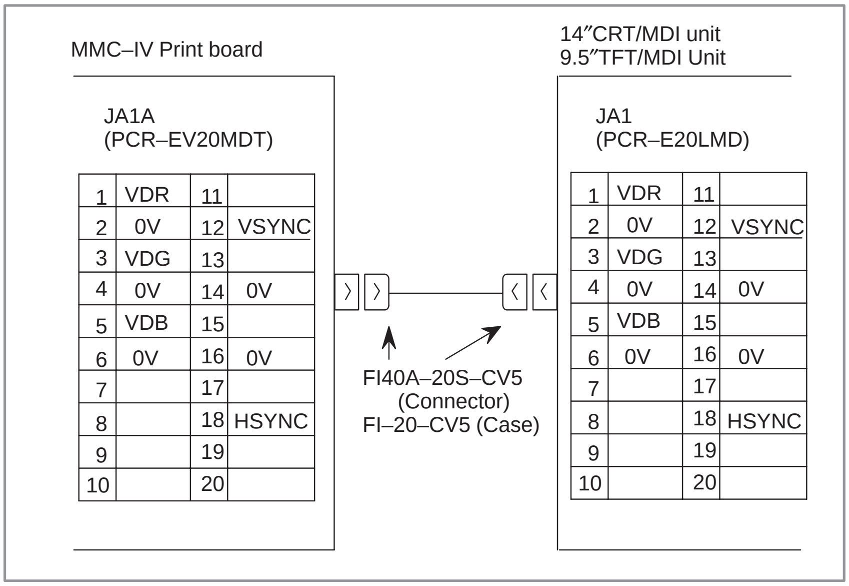
A66L–0001–0371…Coaxial cable (5–core, shielded)

> **NOTE**
> The cable length shall not exceed 400mm.

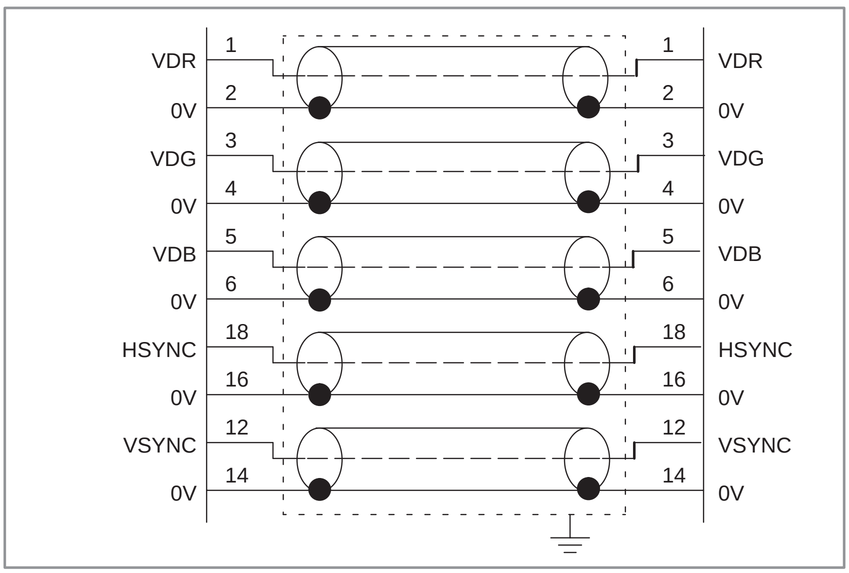
3) Recommended cable specification

A02B–0161–K810…Video signal cable (350mm)

13.2.2 Connecting the Display Unit (Video Signal)



1) Cable



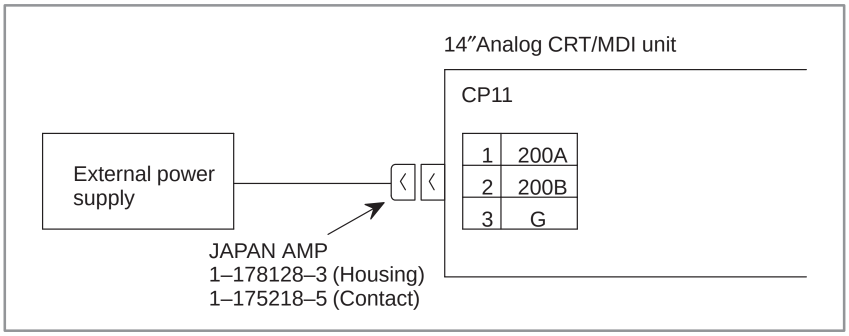
2) Recommended cable material

A66L–0001–0371…Coaxial cable (5–core, shielded)

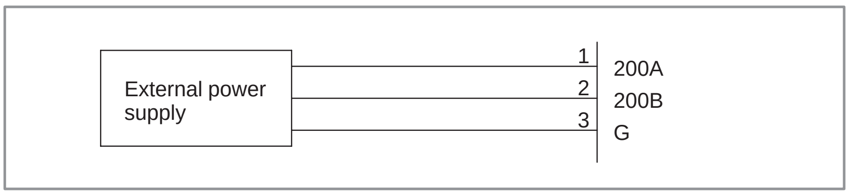
NOTE
1 With this type of cable, only A02B–0120–K305 connectors can be used.
2 The cable length shall not exceed 20 m.
When using an LCD unit, however, adjustment may be required even when the cable length does not exceed 20 m.

13.2.3
Connecting a Display Unit (Power Supply)

13.2.3.1
14″ analog CRT/MDI unit



1) Cable



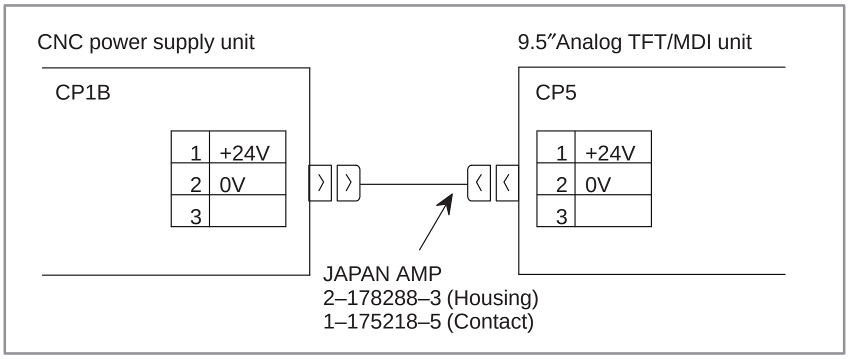
2) Recommended cable material

The cable used shall be of 30/0.18 ($0.75mm^2$) grade or heavier.

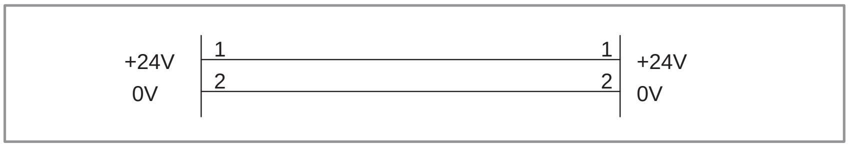
NOTE

The power supply connector (1–178128–3) on the 14″analog CRT/MDI unit is manufactured by JAPAN AMP. When connecting an external power supply, select a connector to fit the terminal on the external power supply.

13.2.3.2
9.5″ analog TFT/MDI unit



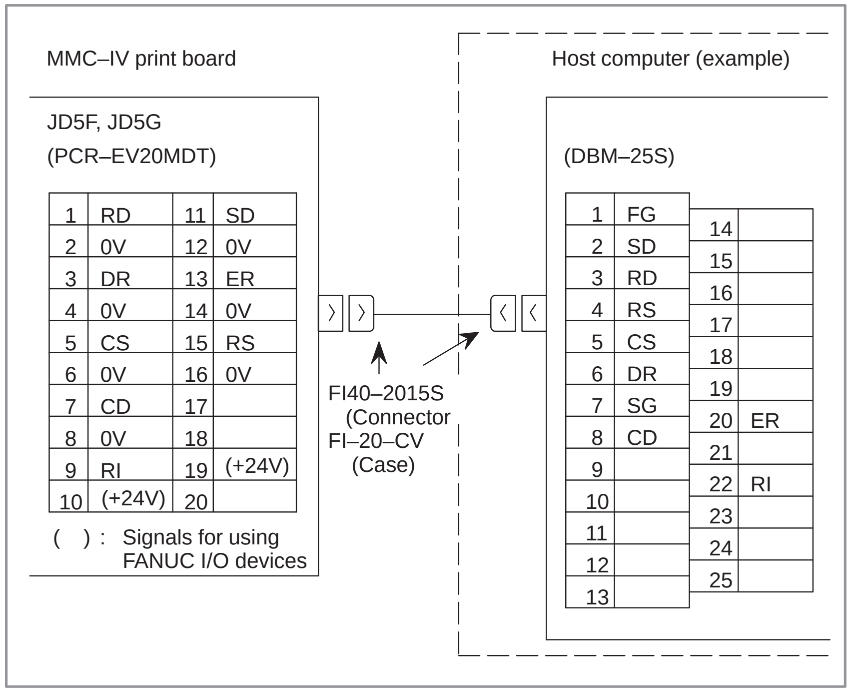
1) Cable



2) Recommended cable material

The cable used shall be of 30/0.18 (0.75mm^2) grade or heavier.

13.3 CONNECTION TO RS–232C SERIAL PORT



NOTE

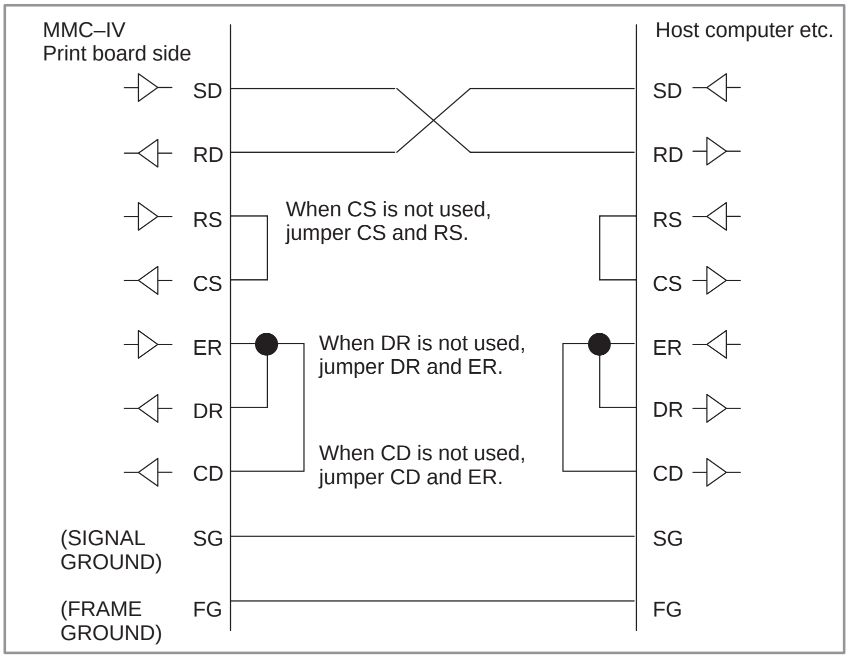
1 The above figure shows an example of the host computer interface. A cable should be fabricated to suit the interface of the unit to be connected.

2 The +24V pins of the interface on the MMC–IV printed circuit board, shown in the above figure, can only be used for FANUC I/O devices. Do not attempt to connect any other devices. At any one time, only one FANUC I/O device can be connected to a CNC control unit.

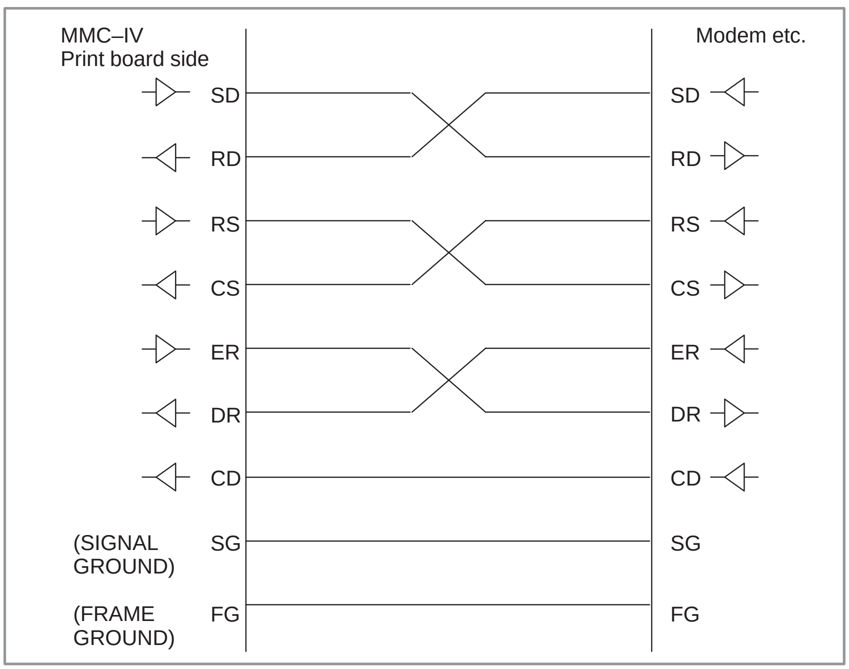
3 When a FANUC punch panel is being connected, any unit which uses the RI signal (such as a modem) cannot be used.

1) Concept of signal connection

- When CS, DR, and CD are not used (Connect CS to RS, and DR and CD to ER.)



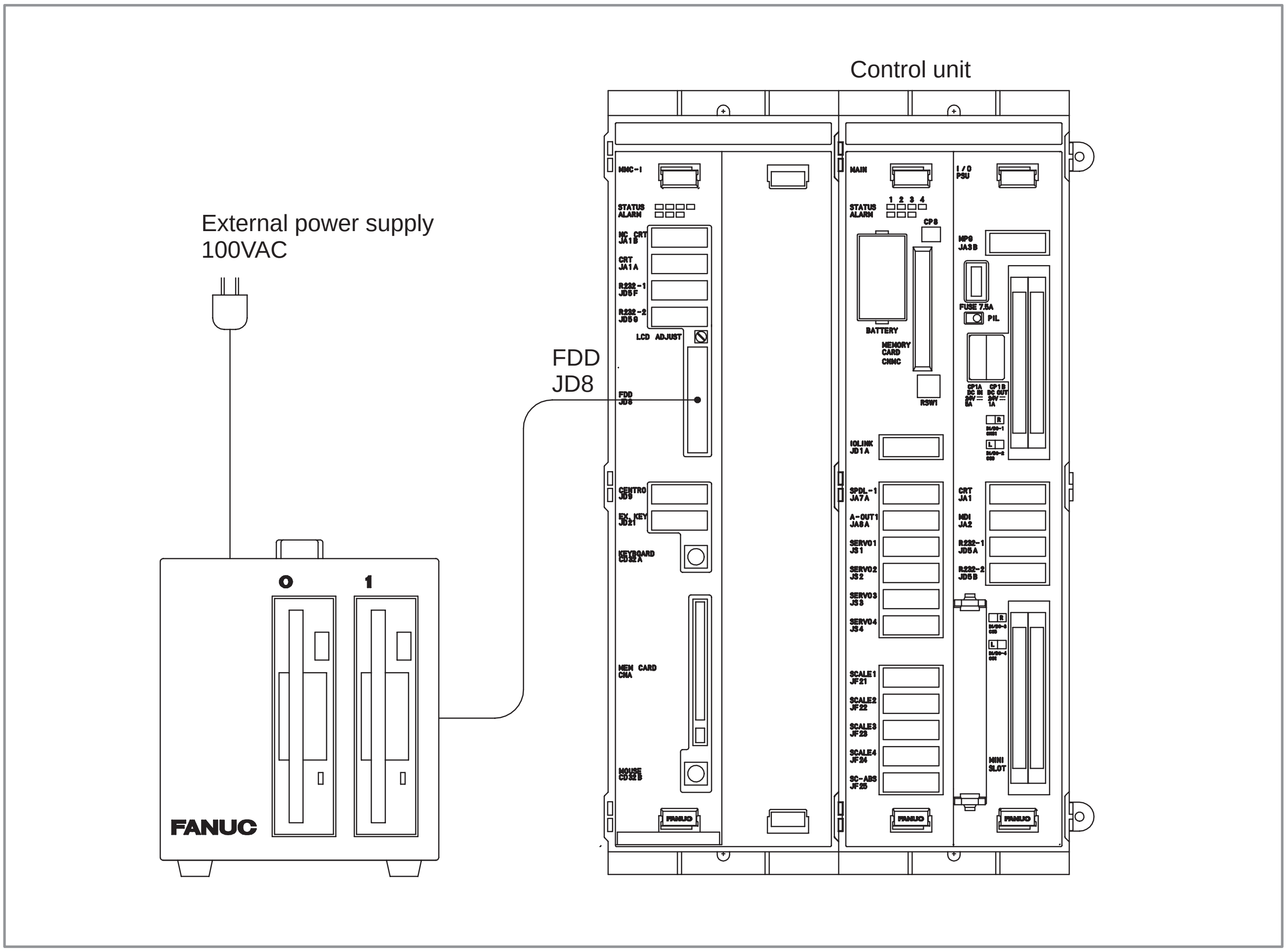
- When all signals are used (for a modem, etc.)



NOTE

When connecting any unit which requires a straight cable for connection (such as a commercially available modem) to MMC–IV, the signal correspondence differs from the above. In such a case, connect between each pair of signals having the same name.

13.4 CONNECTING A PORTABLE–TYPE 3.5″ FLOPPY DISK UNIT



MMC–IV print board

JD8
(PCR–E50LMDET)

1	*DSKCH	26	HDSEL
2	0V	27	0V
3	*WPRT	28	*TRK0
4	0V	29	0V
5	*WDATA	30	*STEP
6	0V	31	0V
7	*MEN0	32	*INDEX
8	0V	33	0V
9	*DS0	34	*INUSE
10	0V	35	0V
11	*RDATA	36	*DS1
12	0V	37	0V
13	*WE	38	DENSEL
14	0V	39	0V
15	*DIR	40	
16	0V	41	0V
17		42	0V
18	0V	43	0V
19	0V	44	0V
20	0V	45	0V
21	(+5V)	46	0V
22	(+5V)	47	(+5V)
23	(+5V)	48	(+5V)
24		49	
25		50	

HONDA TSUSHIN
PCR–E50FS (Connector)
For soldering wires of up to #20AWG
PCR–E50FA (Connector)
For crimping separate wires of #28AWG
PCR–E50LA(OLA(Case))

Portable type 3.5″ floppy disc unit

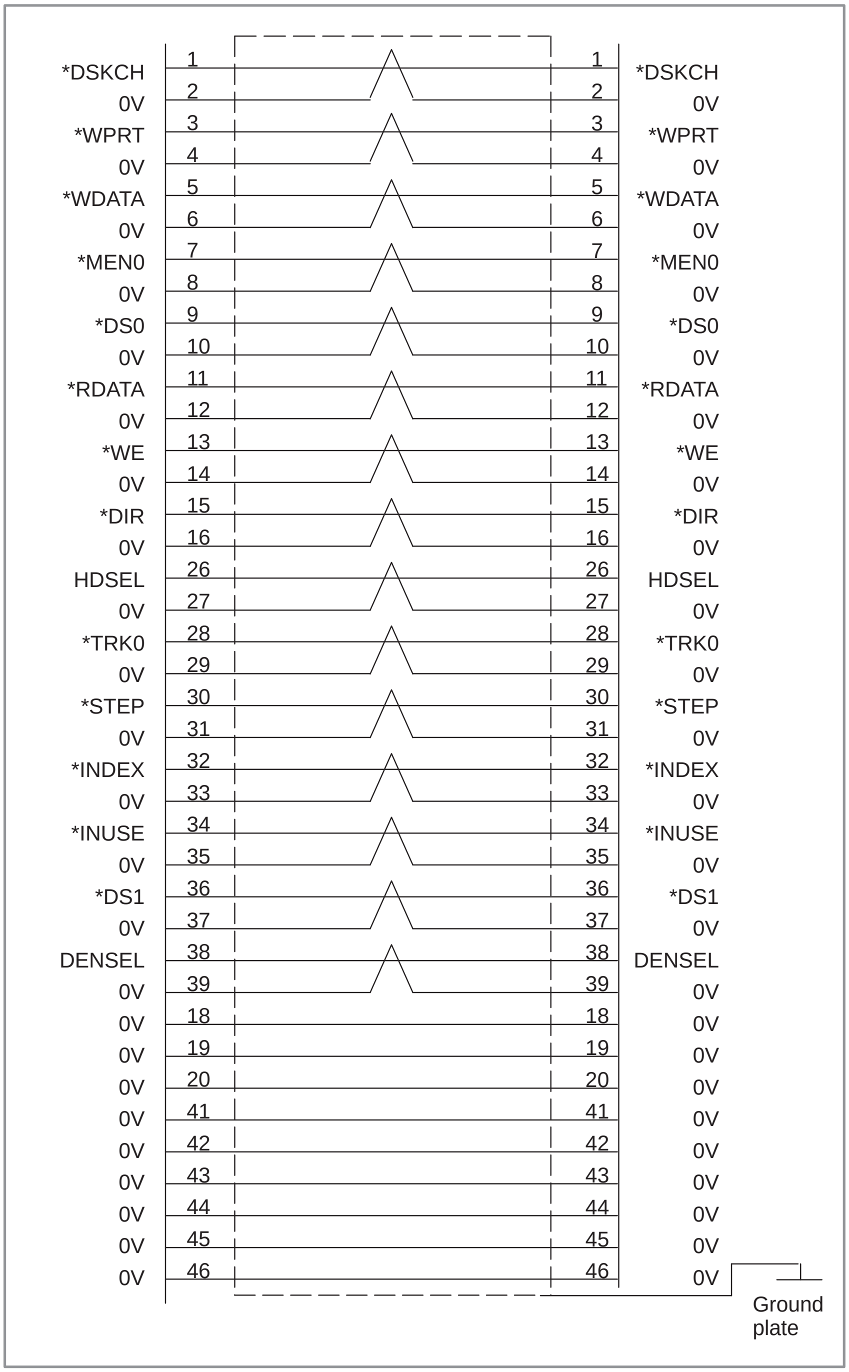
JD8
(PCR- E50LMDET)

1	*DSKCH	26	HDSEL
2	0V	27	0V
3	*WPRT	28	*TRK0
4	0V	29	0V
5	*WDATA	30	*STEP
6	0V	31	0V
7	*MEN0	32	*INDEX
8	0V	33	0V
9	*DS0	34	*INUSE
10	0V	35	0V
11	*RDATA	36	*DS1
12	0V	37	0V
13	*WE	38	DENSEL
14	0V	39	0V
15	*DIR	40	
16	0V	41	0V
17		42	0V
18	0V	43	0V
19	0V	44	0V
20	0V	45	0V
21		46	0V
22		47	
23		48	
24		49	
25		50	

NOTE

The +5V pins of the interface on the MMC–IV printed circuit board, shown in the above figure, cannot be used for a portable–type 3.5″ floppy disk unit.

Cable connection

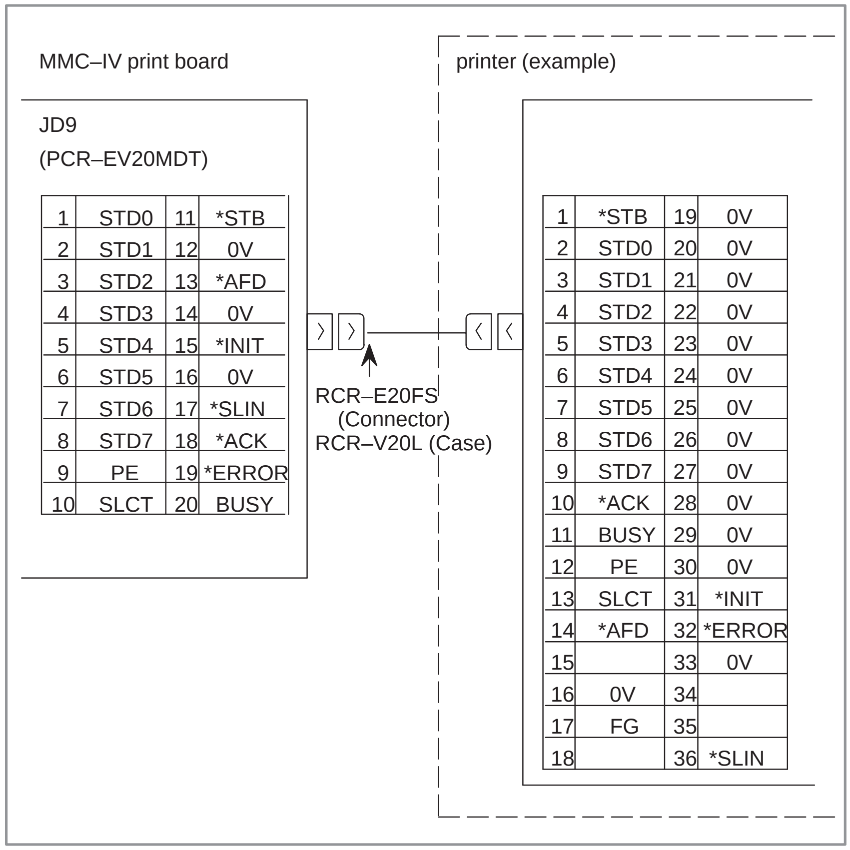


2) Recommended cable material
(Cable kit for portable–type 3.5″floppy disk unit)

A08B–0047–K822…100VAC power supply cables and signal cables
(each cable measuring 1.5 m)

> **NOTE**
> The cable length shall not exceed 1.5m.

13.5 CONNECTION TO CENTRONICS PARALLEL PORT



JD9 (PCR–EV20MDT):

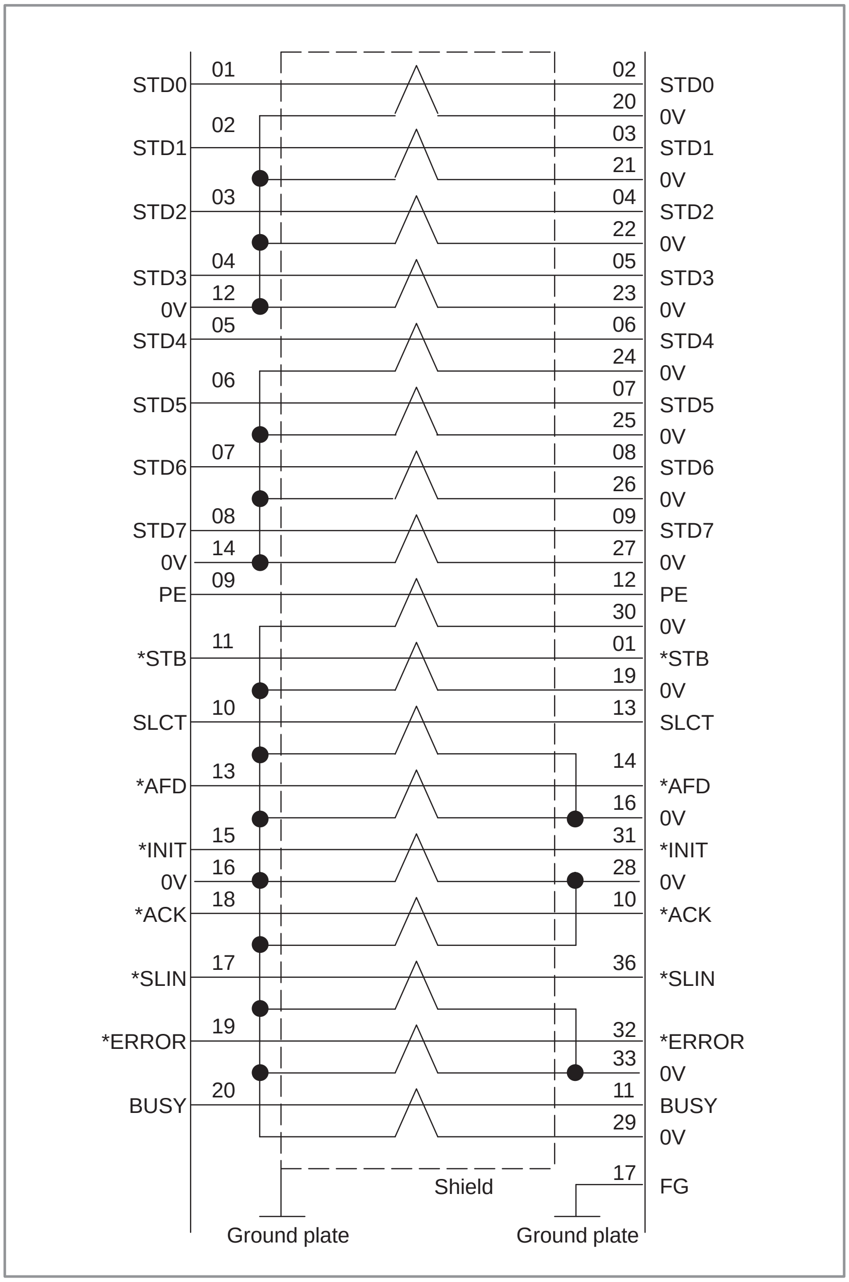
1	STD0	11	*STB
2	STD1	12	0V
3	STD2	13	*AFD
4	STD3	14	0V
5	STD4	15	*INIT
6	STD5	16	0V
7	STD6	17	*SLIN
8	STD7	18	*ACK
9	PE	19	*ERROR
10	SLCT	20	BUSY

printer (example):

1	*STB	19	0V
2	STD0	20	0V
3	STD1	21	0V
4	STD2	22	0V
5	STD3	23	0V
6	STD4	24	0V
7	STD5	25	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 above figure shows an example of the printer interface. Fabricate a cable to suit the interface of the unit to be connected.
2. The above interface differs from the Centronics interface of the FANUC MMC–II.

Example cable connection (printer)

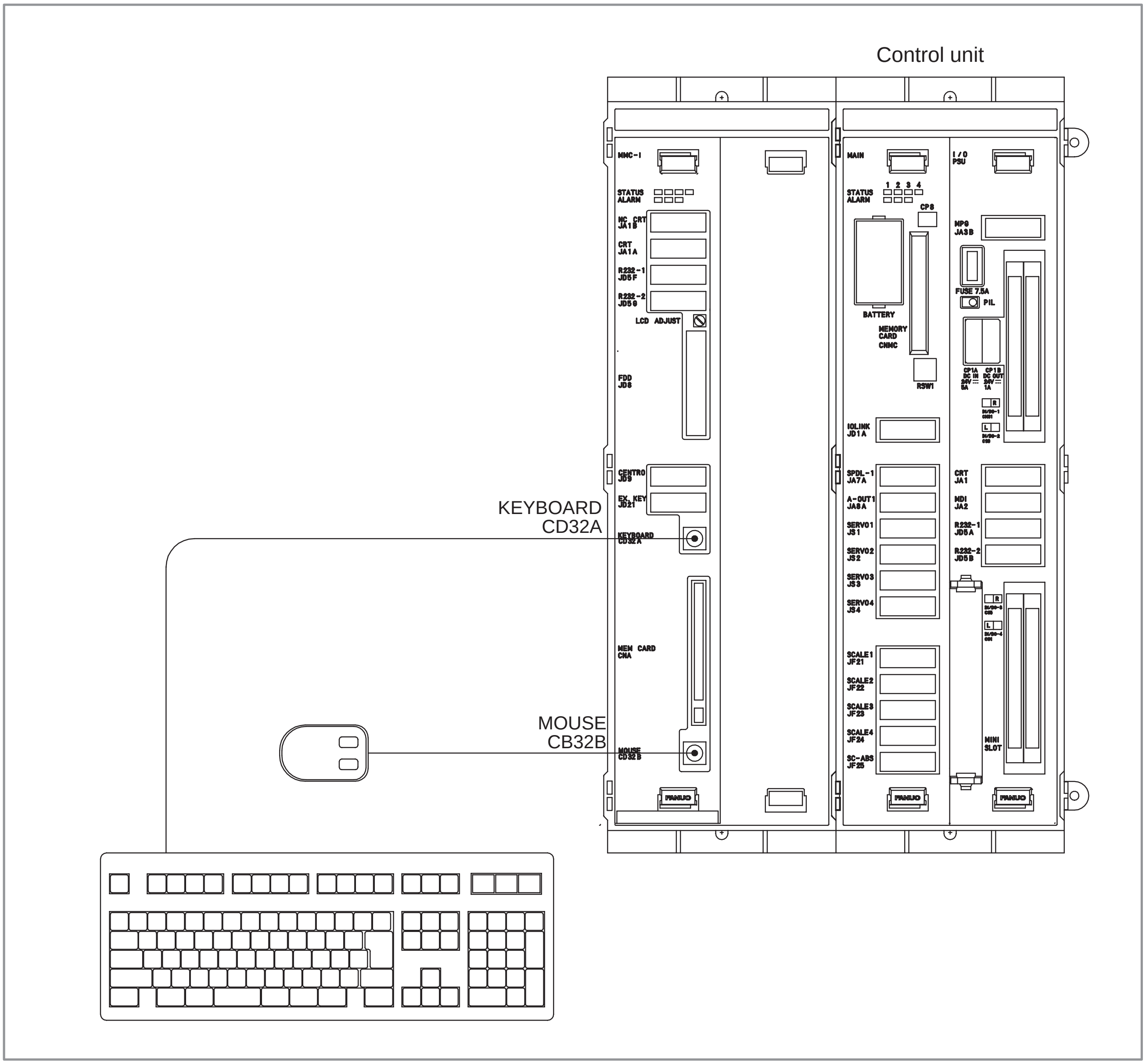


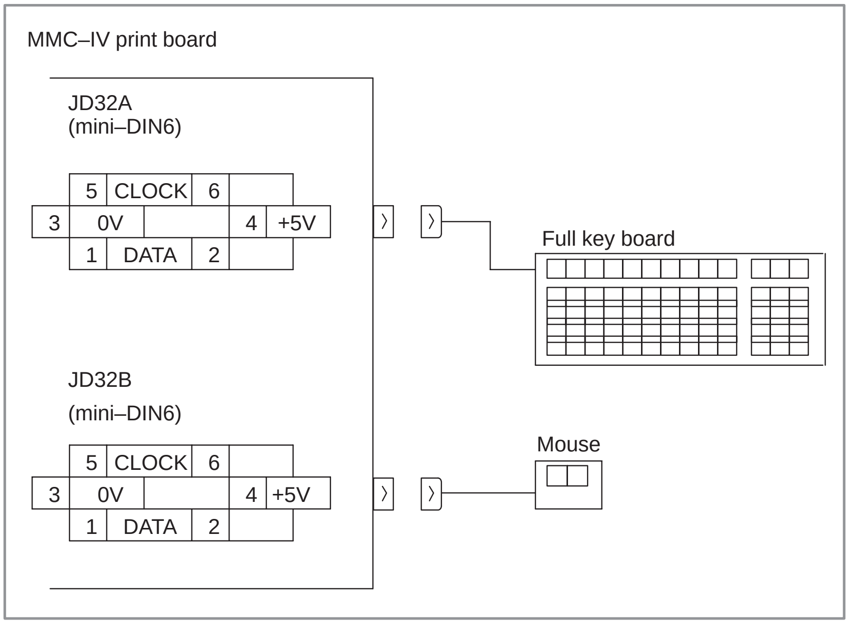
2) Recommended cable material

A66L–0001–0285#25P…AWG28×25pair

> **NOTE**
> The cable length shall not exceed 1.5 m.
> Note that some units may malfunction even when connected with cables that do not exceed 1.5 m.

13.6 CONNECTING A FULL KEYBOARD OR MOUSE





1) Recommended full key board

A86L–0001–0210…101type
A86L–0001–0211…106type

2) Recommended mouse

A86L–0001–0212…Standard PS/2 mouse

NOTE
The above interface and recommended units are used only for application development and maintenance.

14 HIGH–SPEED SERIAL BUS (HSSB)

14.1 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. A FANUC intelligent terminal can be used in place of the IBM–compatible personal computer. See Chapter 12 for more information.

On the CNC, the HSSB interface board is installed in a minislot. On the personal computer, an appropriate interface board is installed. The FANUC intelligent terminal can be connected directly to the HSSB.

The HSSB can be used with a Series 210 system, but not with a Series 21 system.

14.2 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, MS–DOS (version 6.2 or later) or Windows (version 3.1 or later) must have been installed on the personal computer.

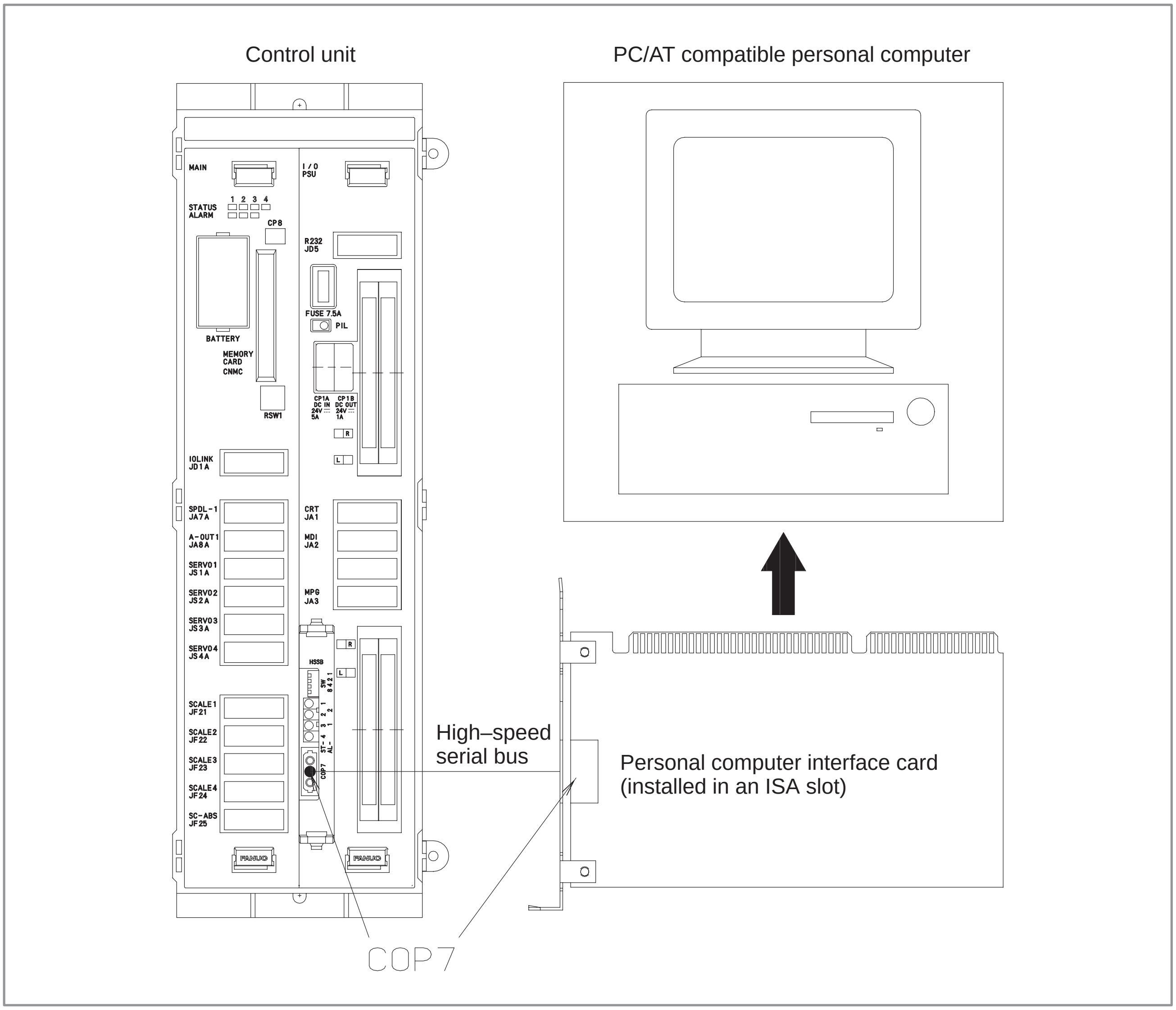
FANUC owns the copyright for the HSSB device driver.

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 MS–DOS and Windows 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.

14.3 CONNECTION DIAGRAM



See Chapter 15 for details of the intelligent terminal.

14.4 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.

- When using personal computer interface board type 1

  D00000h to EFFFFFh in the ISA memory space

NOTE

When using personal computer interface board type 1, restrict the amount of personal computer main memory to within 12 MB.

- When using personal computer interface board type 2

  Sixteen bytes, the base of which is an address selected from the ISA I/O space using the jumper switch described in Sec. 14.6.

(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.

14.5 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 for the installation of the CNC must be satisfied.

14.6 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) When using an interface board of type 2 on the personal computer, 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.)

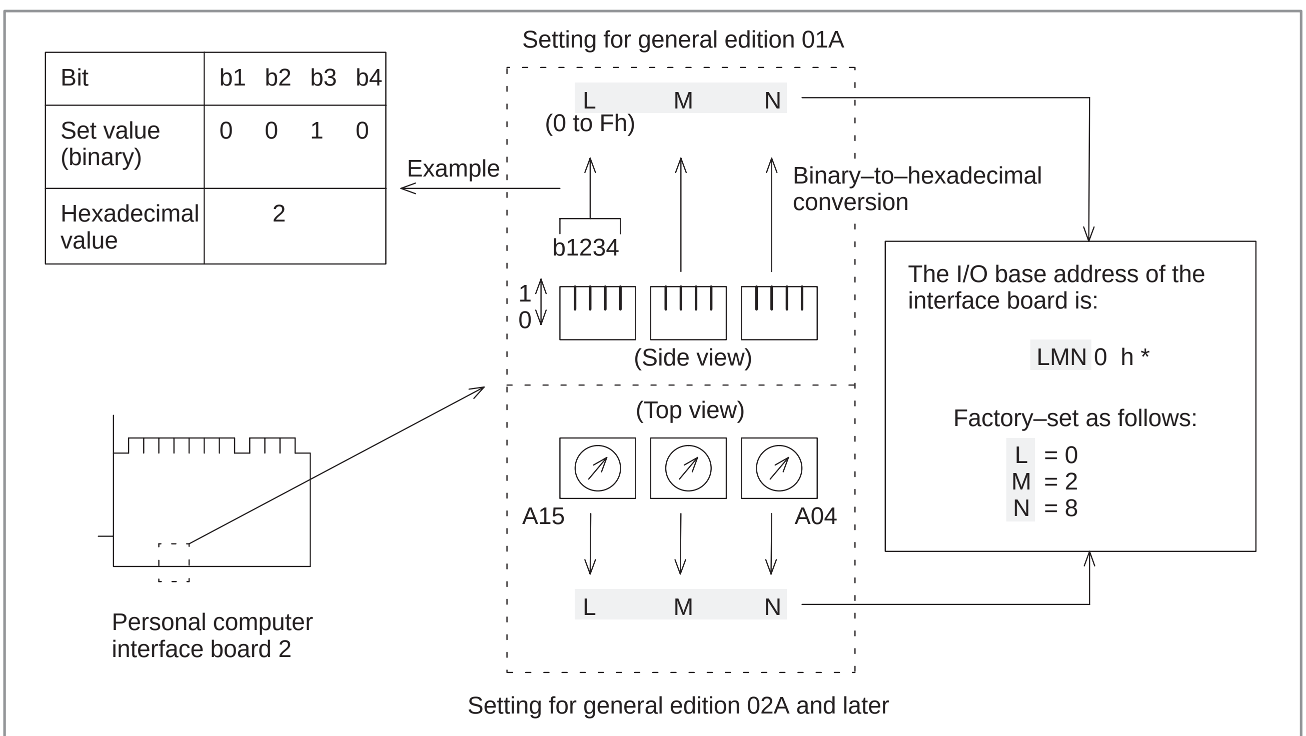
(2) Remove the blank panel from the expansion slot of the personal computer.

(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.



* If the base address is LMN0h, the interface board can use LMN0h to LMNFh.

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

14.7 HANDLING PRECAUTIONS

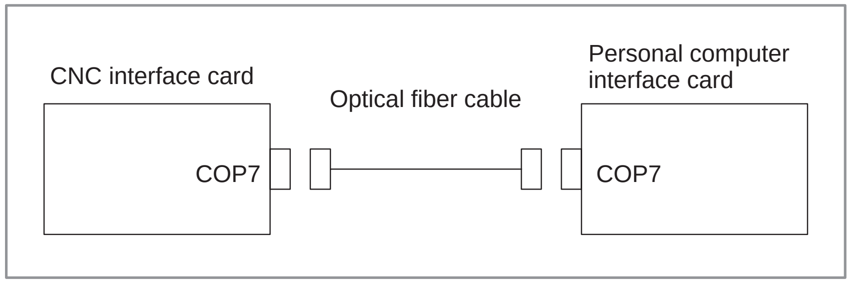
(1) Personal computer interface board

(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.

14.8 RECOMMENDED CABLES



Compatible cables (optical fiber cables, used for interconnections)

AA66L–6001–0021#L5R003 : Cable length = 5 m
AA66L–6001–0021#L20R03 : Cable length = 20 m
AA66L–6001–0022#L50R03 : Cable length = 50 m

NOTE

1 The optical fiber cables for the FANUC I/O Link cannot be used with the HSSB.

2 Optical fiber cables cannot be cut or connected without specialized equipment, usually not available to machine tool builders. Therefore, use only the cables listed above.

15 FANUC INTELLIGENT TERMINAL

15.1 OVERVIEW

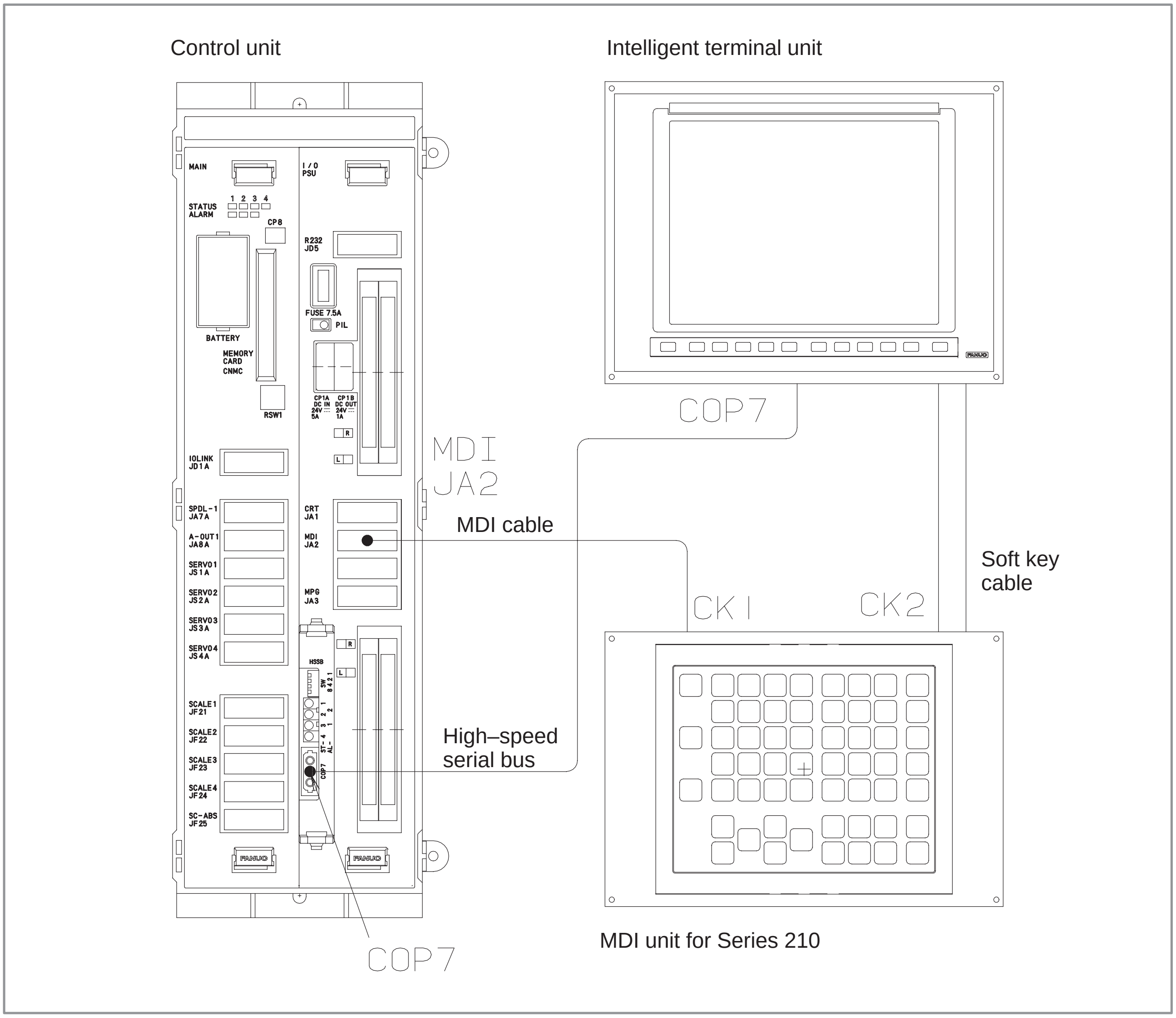
The FANUC intelligent terminal is a panel computer that is compatible with the IBM PC. It can be combined with a Series 21 system via a high–speed optical fiber (high–speed serial bus) to configure a Series 210 system.

15.2 CAUTIONS

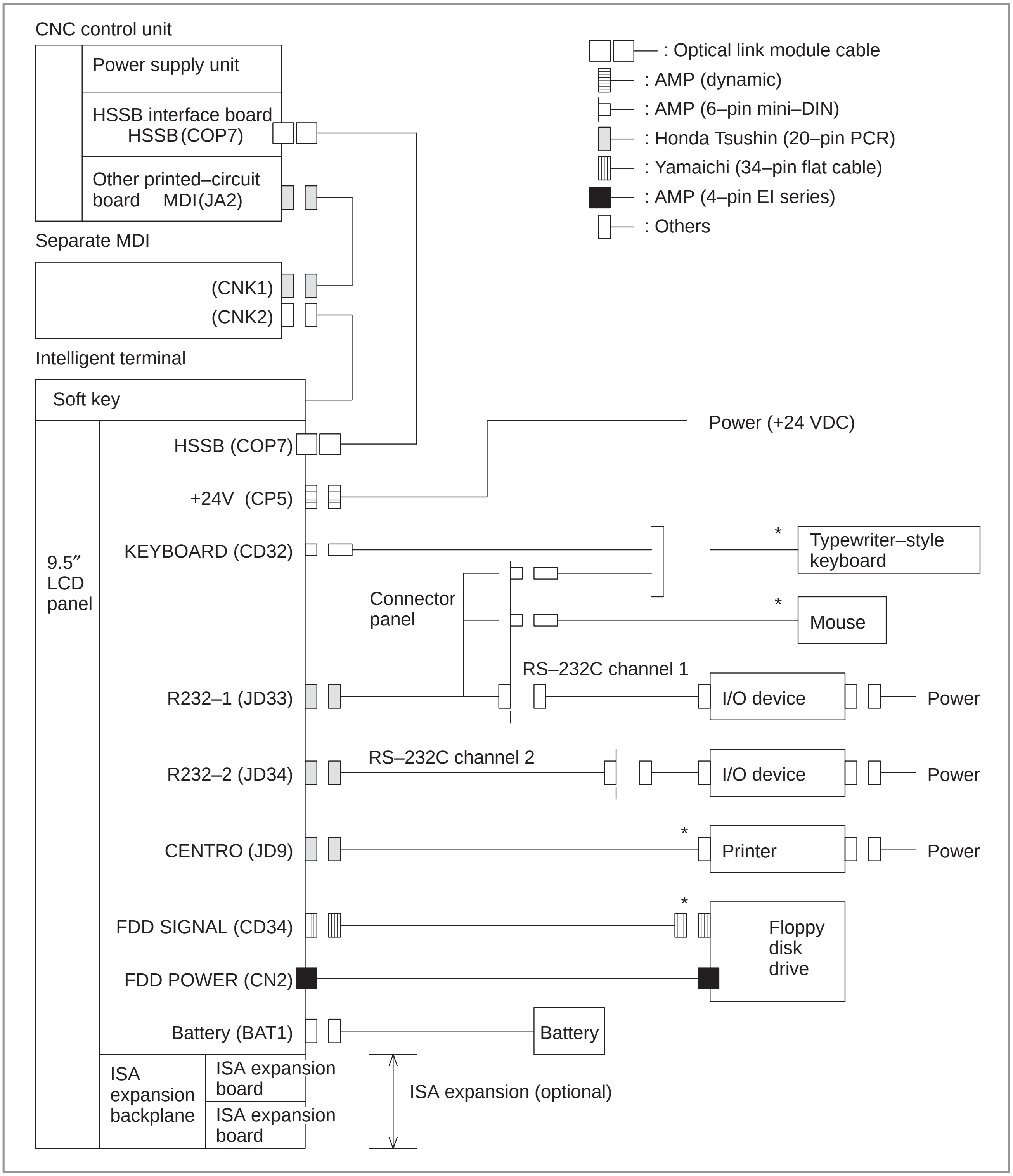
The FANUC intelligent terminal must be used with MS–DOS and the software shipped with the intelligent terminal. The copyright for this software is owned by Microsoft Corp. of the US, Chips and Technologies Corp. of the US, IBM Corp. of the US, Matsushita Electric Industrial, and FANUC.
The software mentioned above and the contents of the related manuals may not be used or reproduced in part or whole without the prior written permission of the copyright owner.
The software mentioned above and the related manuals are not available separately. They are provided only with the intelligent terminal.
The software mentioned above and the related manuals can be used only after the user agrees to the terms of the license shipped with the intelligent terminal.
Note that the act of switching on the intelligent terminal is construed as agreeing to the terms of the license mentioned above.

NOTE
1 IBM is a registered trademark of IBM Corp. of the US.
2 MS–DOS is a registered trademark 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.

15.3 CONNECTION



15.4 OVERALL CONNECTION DIAGRAM



* These devices can be used only for applications development. They cannot be assembled into a system.

See Chapter 2 for details of other connections.

15.5 SPECIFICATION

15.5.1 Installation Environment

When using the intelligent terminal, ensure that the following environmental conditions are satisfied by the cabinet that contains the intelligent terminal.

Ambient temperature	Operating : 5 to 45°C (*1) Storage : –20 to 60°C
Temperature drift	20°C/hour (maximum)
Ambient relative humidity	Usually : 10 to 75% RH (non–condensing) Short term (within one month) : 10 to 90% RH (non–condensing)
Vibration	Operating : 0.5 G or less (*2) Storage : 1.0 G or less
Atmosphere	Shall be encased in a tightly closed cabinet.

*1 Operating ambient temperature

A thermal sensor in the intelligent terminal is used to monitor whether the ambient temperature falls within the prescribed range. (The status is indicated by the LEDs of the high–speed serial bus interface board in the CNC.)

1) If the ambient temperature falls outside the specified range when the intelligent terminal is switched on, it stops automatically and nothing is displayed on the screen. The error status is indicated by the LEDs mentioned above. When the ambient temperature moves to within the specified range, the system (including the intelligent terminal) starts up automatically.
2) If the ambient temperature moves out of the specified range after the system has started, an error is reported when the hard disk is accessed.

*2 Vibration

The intelligent terminal and built–in hard disk may vibrate at arbitrary frequencies. After installing the intelligent terminal on the machine, ensure that it cannot vibrate. If an ISA expansion board is installed, the maximum allowable vibration may be lower than that listed above, depending on the specification.

CAUTION

Even in the specified operating environment, records on the hard disk may be damaged or destroyed due to operator errors or malfunctions. Switching off the power while the hard disk is being accessed is extremely likely to damage the data on the disk. Do NOT switch off the power while the hard disk is being accessed. To guard against such an accident, make regular backups of important data on the disk.

Note that some development and maintenance options may require stricter environmental conditions than those listed above.

15.5.2 Power Supply Specifications

(1) Input power

(a) Requirements

To use the intelligent terminal, prepare a power supply that satisfies the following requirements.

Input voltage		+24 VDC ± 10%
Input current	When no ISA expansion is installed	2 A (maximum)
	When an ISA expansion is installed	3 A (maximum)

NOTE
The use of the FANUC I/O device requires an additional 1 A capacity.

(b) Timing

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

(2) Supply power

The power supply capacity of the intelligent terminal is as listed below. When connecting a peripheral unit, confirm its current requirements.

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

(3) Heat dissipation

25 W (during normal operation)

NOTE
The heat dissipation increases with the addition of a peripheral device or ISA expansion board.

15.6 INSTALLATION SPACE

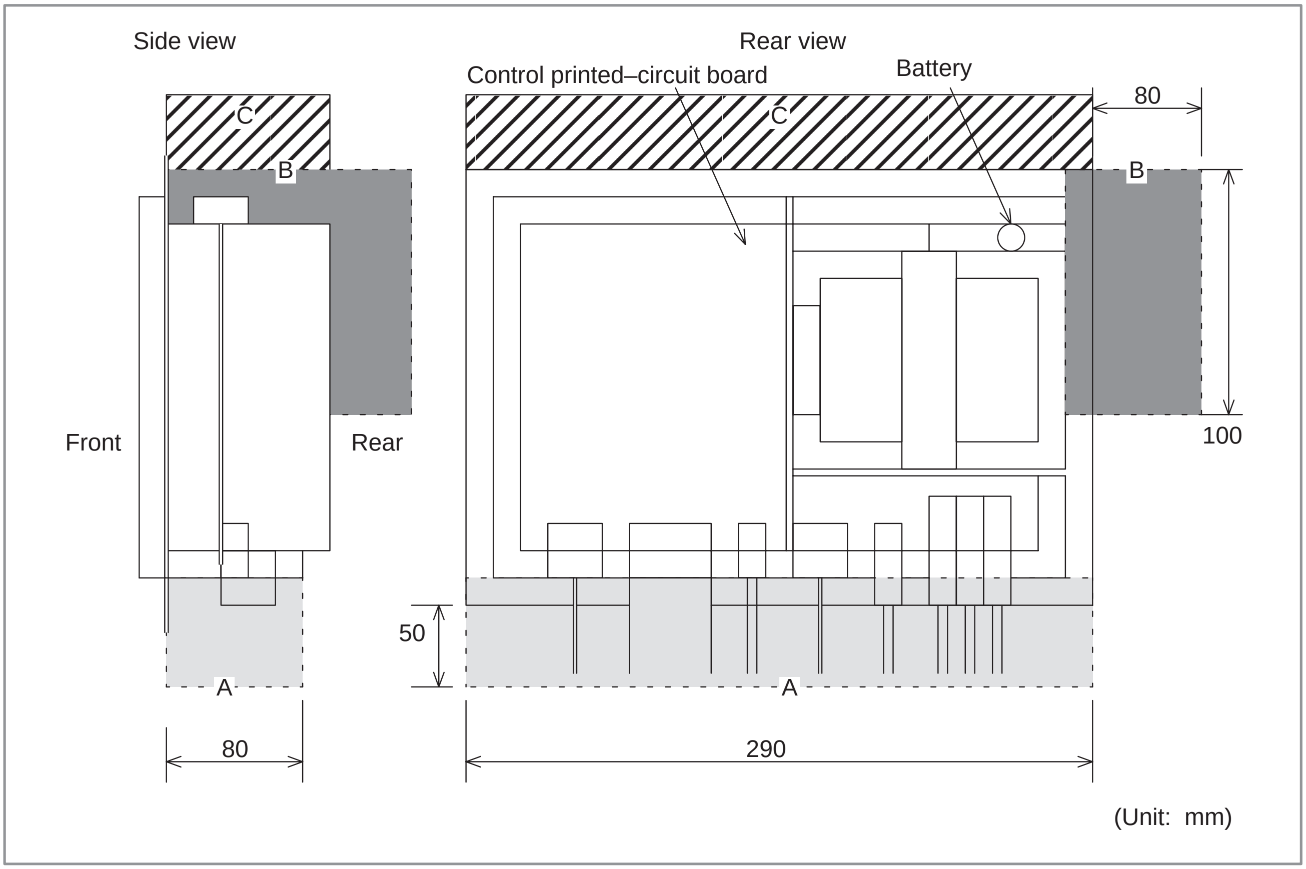
When installing the intelligent terminal, provide the space shown below.

A: This space is used to lead in cables. The size of section A in the diagram below should be appropriate for the cables to be installed.

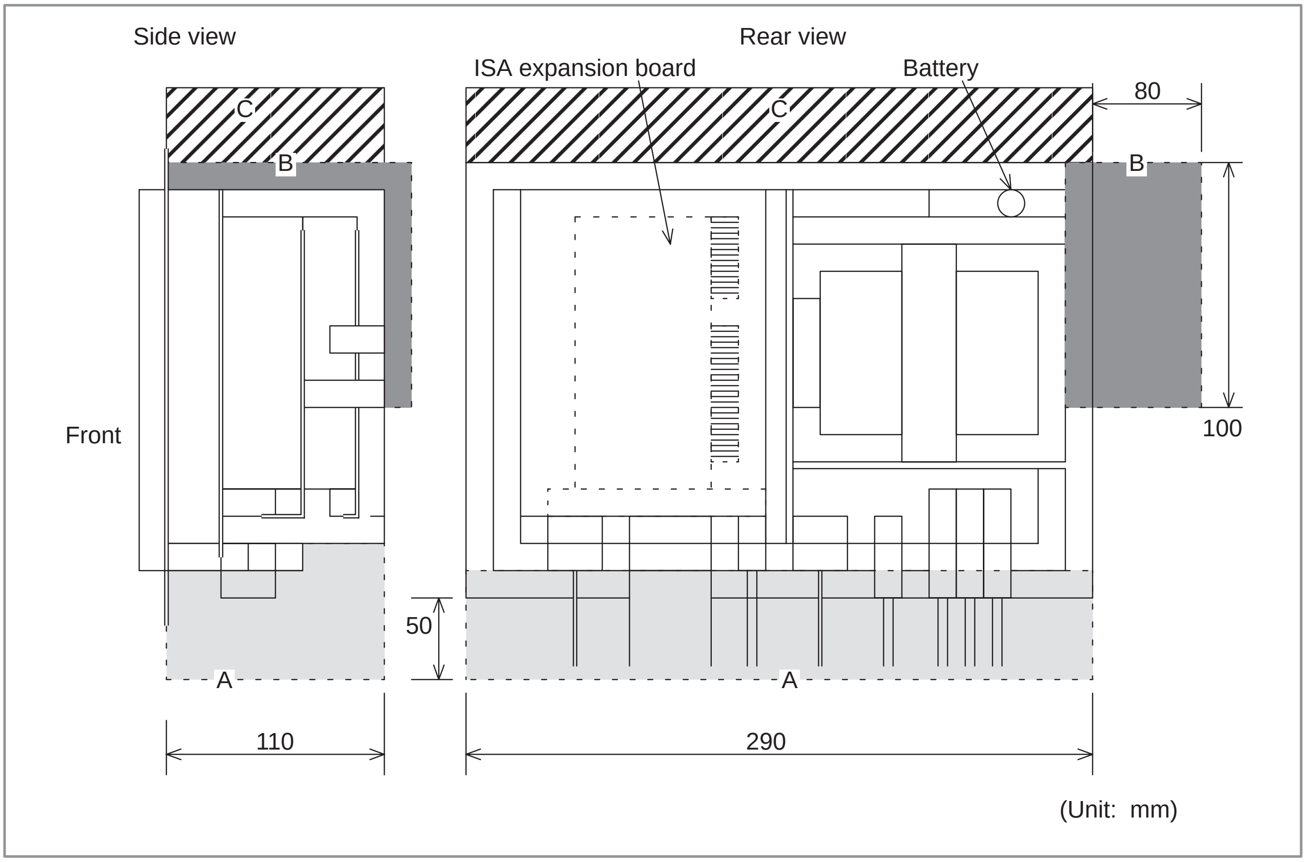
B: This space is provided to enable replacement of the batteries without removing the intelligent terminal from the panel. Battery replacement must be possible from the rear of the intelligent terminal.

C: This space is required for the radiating fan of the intelligent terminal.

15.6.1 When No ISA Expansion is Installed

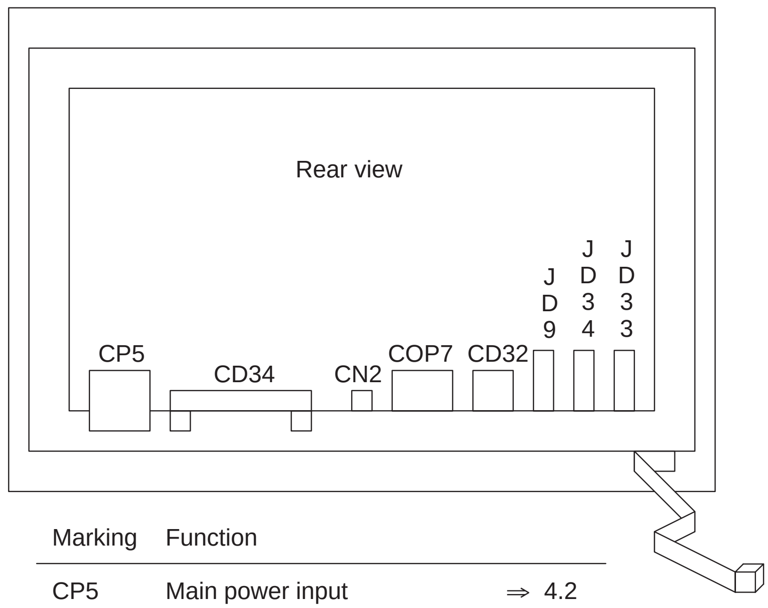


15.6.2 When an ISA Expansion is Installed



15.7 PERIPHERAL DEVICES AND THEIR CONNECTIONS

15.7.1 Connector Layout Diagram

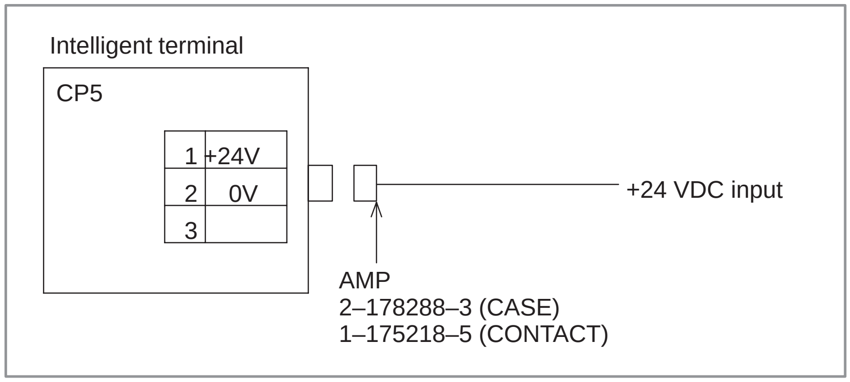


Marking	Function	
CP5	Main power input	⇒ 4.2
CD34	Floppy disk drive signal	⇒ 4.3
CN2	Floppy disk drive power output	⇒ 4.3
COP7	High–speed serial bus	⇒ 4.4
CD32	Typewriter–style keyboard	⇒ 4.5
JD9	Parallel port	⇒ 4.6
JD34	Serial port 2	⇒ 4.7
JD33	Serial port 1	⇒ 4.8
	(typewriter–style keyboard, mouse)	⇒ 4.9

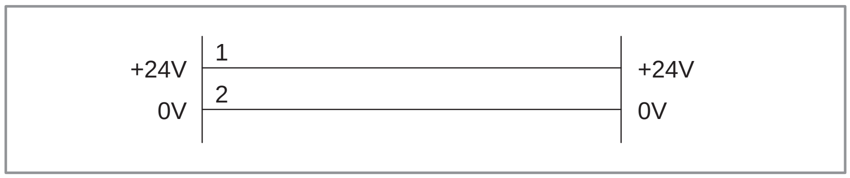
NOTE

1. Connect the typewriter–style keyboard to either CD32 or JD33.
2. This diagram applies when there is no ISA expansion unit.

15.7.2 Main Power Input



1) Cable connection



2) Recommended wires for cables
Use wires of 30/0.18 (0.75 mm^2) or larger.

NOTE
Route this power supply cable well away from the signal lines connected to the intelligent terminal.

15.7.3
Floppy Disk Drive (Signal and Power)

Intelligent terminal

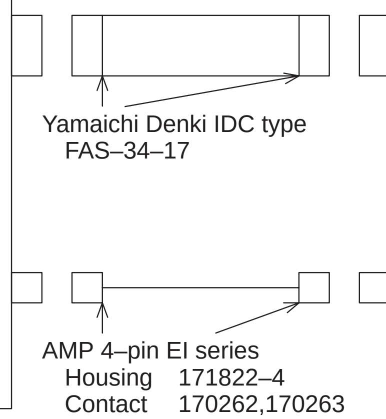
CD34

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

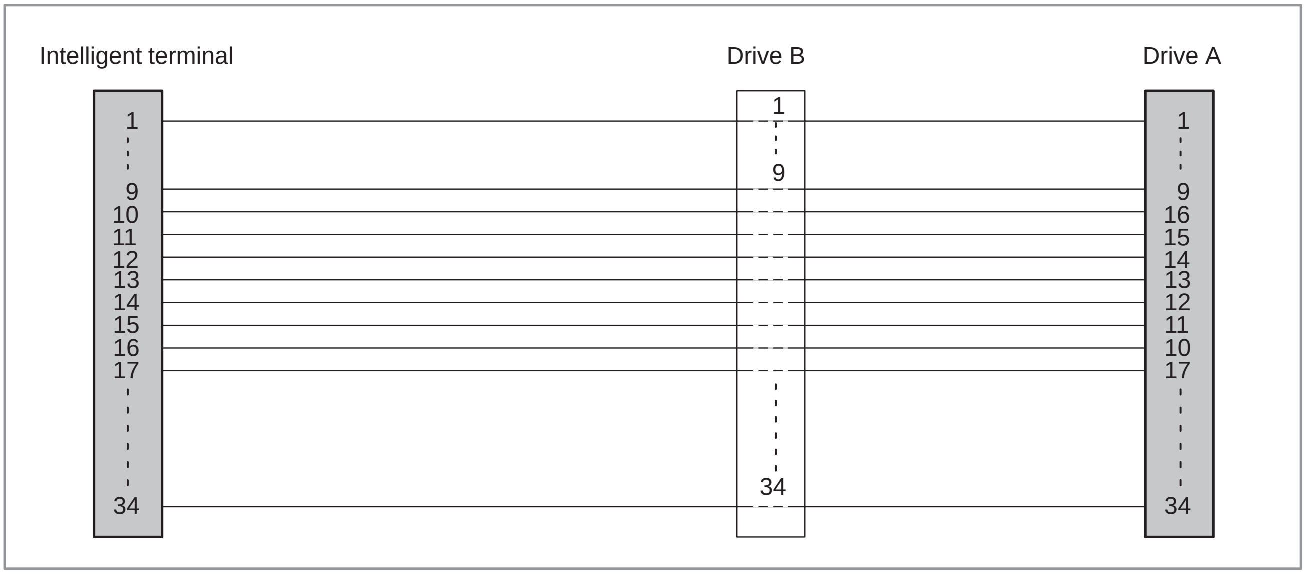
NOTE

1 This is the standard interface for IBM PC compatibles. Note the following:
   1) Only two modes (720–Kbyte mode and 1.44–Mbyte mode) can be used.
   2) DENSEL is fixed to low level.
   3) Not all commercial floppy disk drives require both +12 and +5 VDC. When using a floppy disk drive operating on +12 VDC, pay close attention to the power supply capacity.

2 Some commercial floppy disk drives are incompatible with the intelligent terminal. Not all of their operations can be guaranteed with the intelligent terminal. The machine tool builder is requested to confirm the compatibility of each device to be used. Note also that most commercial floppy disk drives are neither dust– nor waterproof.

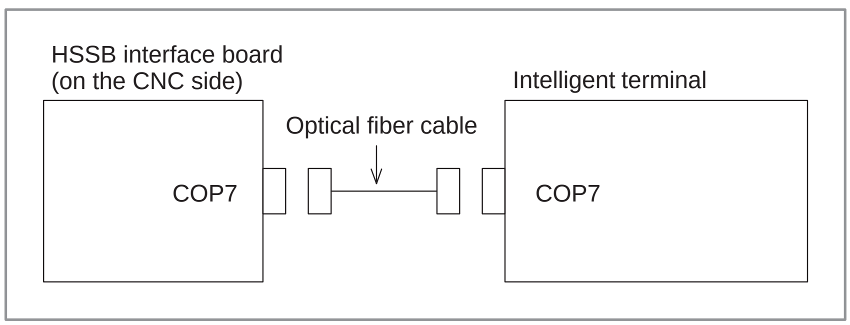
3 The drive interface shown above is only an example. When designing a cable, observe the requirements of the drive interface being used.

1) Floppy disk drive cable connection



This is the standard IBM PC interface. Pins 10 and 16 of a commercially available connection cable for this interface are crossed between the intelligent terminal (personal computer) and drive A, as shown above. When using this cable, set the drive number set pin on drive A to 1 (second drive).

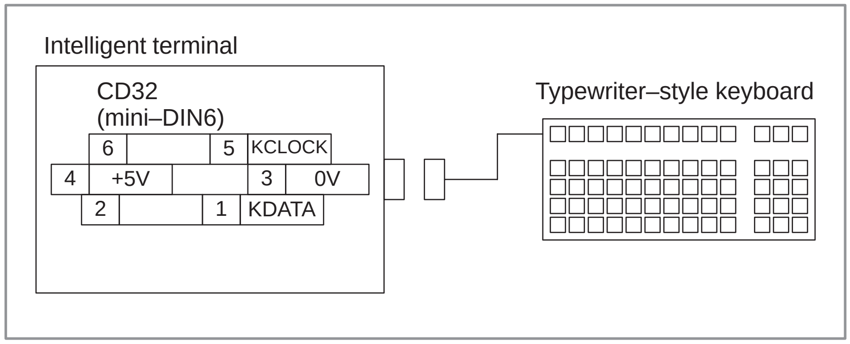
15.7.4 High–speed Serial Bus (HSSB)



(1) Recommended cables (optical fiber cables)

A66L–6001–0021#L5R003: Cable length = 5 m
A66L–6001–0021#L20R03: Cable length = 20 m
A66L–6001–0022#L50R03: Cable length = 50 m

15.7.5 Typewriter–style Keyboard



NOTE

1. The signals for the typewriter–style keyboard are also connected to serial port 1 (JD33), as described later. Therefore, the typewriter–style keyboard should be connected to either CD32, shown above, or serial port 1 (JD33).
2. Some commercial typewriter–style keyboards are incompatible with the intelligent terminal. Not all of their operations can be guaranteed with the intelligent terminal. The machine tool builder is requested to confirm the compatibility of each device to be used. Note also that most commercial typewriter–style keyboards are neither dust– nor waterproof.

1) Recommended typewriter–style keyboards

A86L–0001–0210: Type 101
A86L–0001–0211: Type 106

NOTE

The use of this interface and typewriter–style keyboards should be restricted to development and maintenance.

15.7.6 Centronics Parallel Port

Intelligent terminal

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

Ex.) Printer

1	*STB	19	0V
2	STD0	20	0V
3	STD1	21	0V
4	STD2	22	0V
5	STD3	23	0V
6	STD4	24	0V
7	STD5	25	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 interface shown above is only an example. When designing a cable, observe the requirements of the interface actually being used.

2 Some commercial printers and other external devices are incompatible with the intelligent terminal. Not all of their operations can be guaranteed with the intelligent terminal. The machine tool builder is requested to confirm the compatibility of each device to be used. Note also that most commercial external devices are neither dust– nor waterproof.

15.7.7 Serial Port 2

Intelligent terminal

JD34
(PCR–EV20MDT)

1	RD	11	SD
2	0V	12	0V
3	DR	13	ER
4	0V	14	0V
5	CS	15	RS
6		16	(RSV1)
7	CD	17	(RSV2)
8		18	
9	RI	19	(+24V)
10	(+24V)	20	

(　) : Used with FANUC I/O device

Ex.) Host computer

(DBM–25S)

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

CAUTION

Pins 16 and 17 are reserved for a specific purpose. Do not attempt to connect them for your own purposes.

NOTE

1 The host computer interface shown above is only an example. When designing a cable, observe the requirements of the interface actually being used.

2 The +24V supply of the intelligent terminal interface, shown above, is provided specifically for a FANUC I/O device (such as FANUC cassette or FANUC Handy File). Do not attempt to use it for your own purposes. Do not connect more than one such I/O device to a single CNC control unit or intelligent terminal. If more than one is connected, their total power requirement may exceed the +24V power capacity.

15.7.8 Serial Port 1

This connector accommodates mouse and full keyboard ports as well as RS–232–C serial port 1. For full keyboard signals, this connector has the same arrangement as the dedicated connector, CD32. Therefore, a full keyboard can be connected using either this connector or CD32. The mouse is connected to this connector via a connector panel, shown below.

Intelligent terminal

JD33
(PCR–EV20MDT)

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

( ) : Used for a FANUC I/O device.

Connector panel (example)

Serial port 1
(D–Sub25)

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			

Typewriter–style keyboard
(mini–DIN6)

	6		5	KCLOCK
4	+5V		3	0V
	2		1	KDATA

Mouse (mini–DIN6)

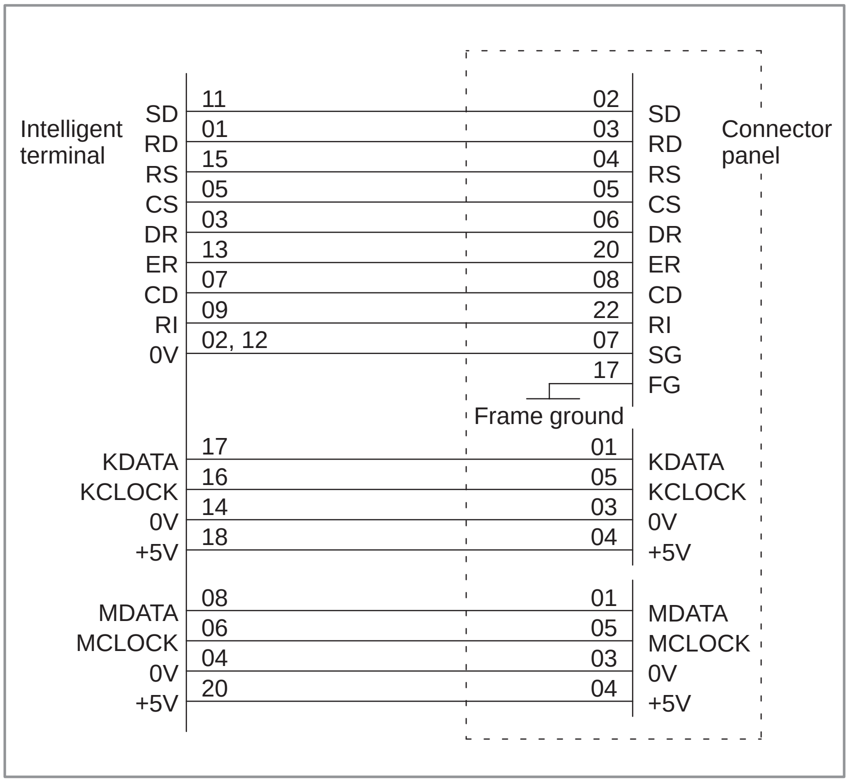
	6		5	MCLOCK
4	+5V		3	0V
	2		1	MDATA

CAUTION

1 The +24V supply of the intelligent terminal interface, shown on the previous page, is provided specifically for a FANUC I/O device (such as FANUC cassette or FANUC Handy File). Do not attempt to use it for your own purposes. Do not connect more than one such I/O device to a single CNC control unit or intelligent terminal. If more than one is connected, their total power requirement may exceed the +24V power capacity.

2 Some commercial full keyboards and mice are incompatible with the intelligent terminal. Not all of their operations can be guaranteed with the intelligent terminal. The machine tool builder is requested to confirm the compatibility of each device to be used. Note also that most commercial full keyboards and mice are neither dust– nor waterproof.

1) Cable connection (example)



2) Recommended wires for the cable

A66L–0001–0284#10P . . . . . 10 pairs of 0.08 mm^2 wires

NOTE

Restrict the cable length to within 0.5 m. Some devices may not operate normally even within this limit. Note that the conventional CNC punch panel cannot be used with this interface.

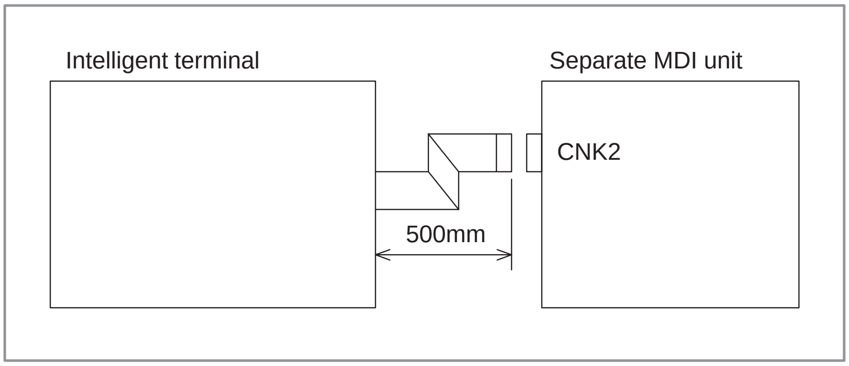
3) Recommended full keyboards and mice

A86L–0001–0210 . . . . Type 101 full keyboard
A86L–0001–0211 . . . . Type 106 full keyboard
A86L–0001–0212 . . . . Standard PS/2 mouse

NOTE

The use of this interface and the recommended devices should be restricted to development and maintenance.

15.7.9 Soft Keys



1) Cable length: 500 mm
2) Separate MDI units
   MDI units usable with the FS210

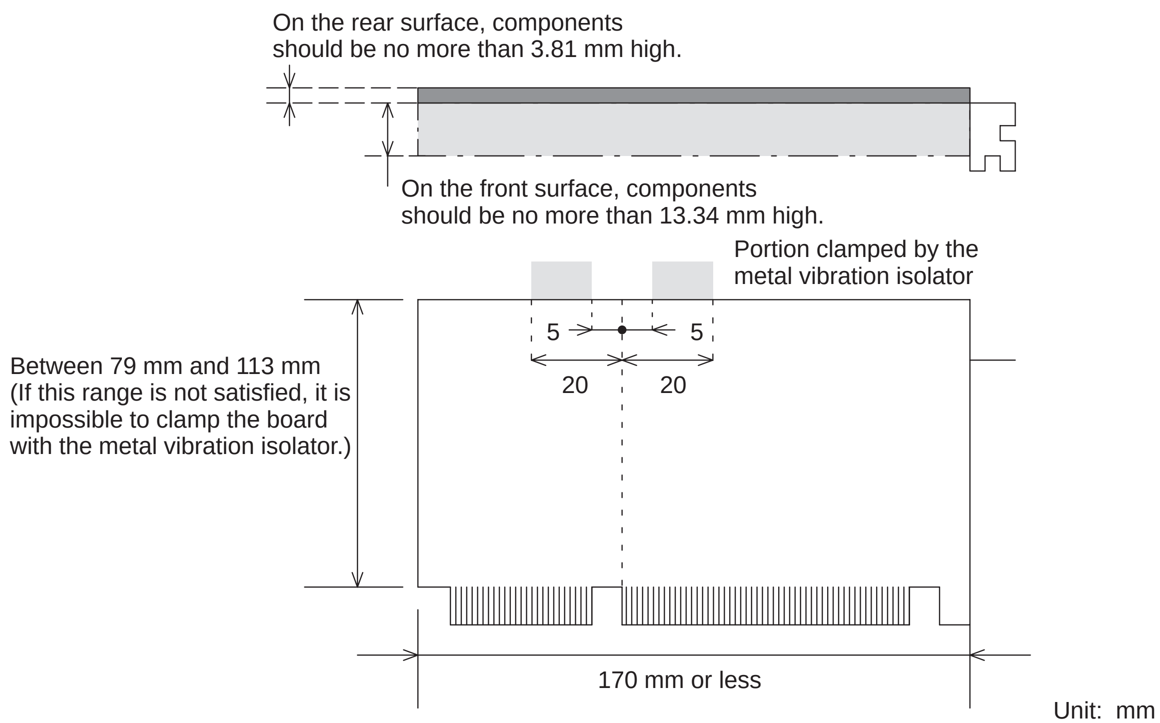
	MDI key	Type	Model	
Separate full MDI unit	English–language legends	Horizontal type	210–MB	A02B–0218–C120#MR
	Symbolic legends	Horizontal type	210–MB	A02B–0218–C120#MS
	English–language legends	Horizontal type	210–TB	A02B–0218–C120#TR
	Symbolic legends	Horizontal type	210–TB	A02B–0218–C120#TS
	English–language legends	Vertical type	210–MB	A02B–0218–C121#MR
	Symbolic legends	Vertical type	210–MB	A02B–0218–C121#MS
	English–language legends	Vertical type	210–TB	A02B–0218–C121#TR
	Symbolic legends	Vertical type	210–TB	A02B–0218–C121#TS

15.8 ISA EXPANSION BOARDS

15.8.1 Installation Method

(1) Usable boards

Two of the ISA expansion boards shown below can be used with the intelligent terminal.



NOTE

FANUC does not guarantee the operation of commercial ISA expansion boards, and cannot provide maintenance for such boards.

(2) ISA expansion board installation procedure

(See the diagram on the following page.)

1 Remove the metal vibration isolator.

2 Insert the board fully into its connector.

3 Tighten the board retaining screw.

4 Tighten the screw while pressing the metal vibration isolator against the board.

When installing more than one ISA expansion board, the board in slot A must be shorter than that in slot B. Otherwise, the boards cannot be clamped by the metal vibration isolator.

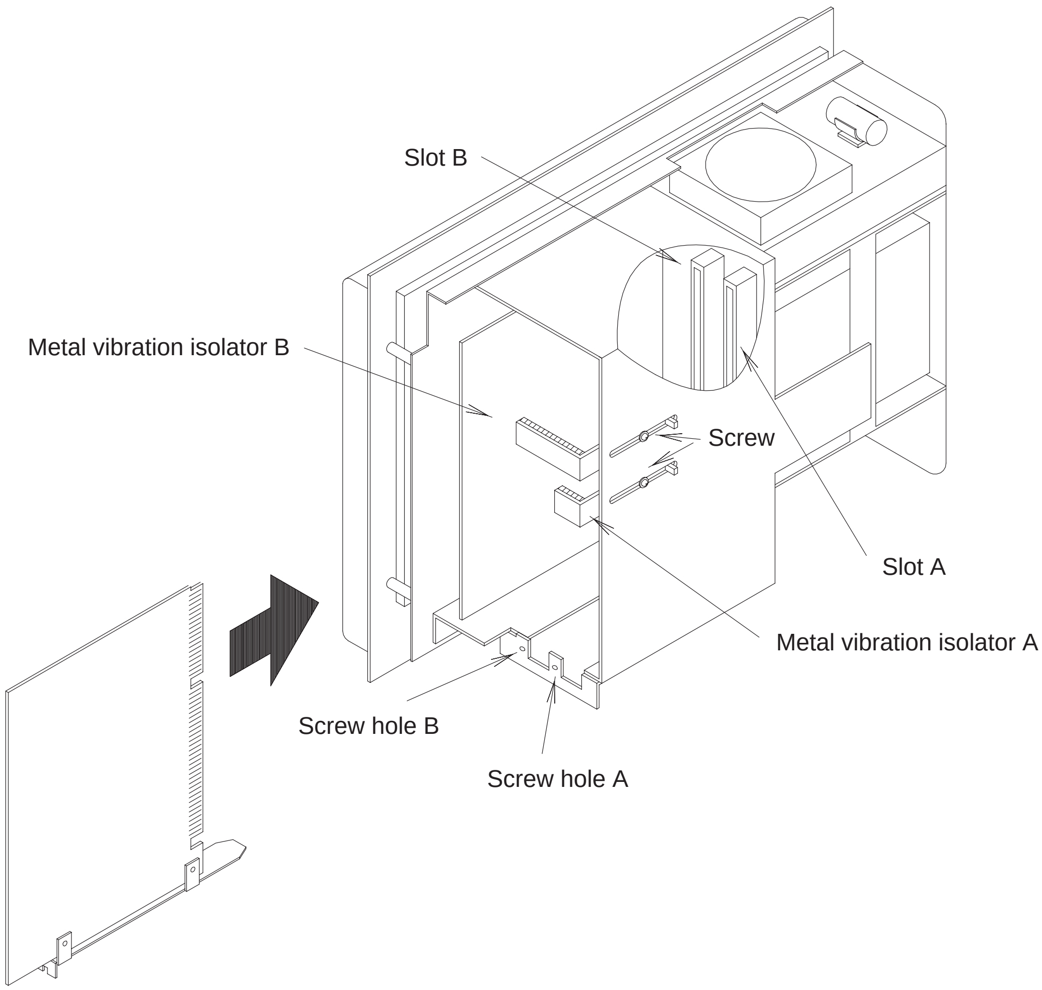


Fig.15.8.1 Installing the ISA expansion board

15.8.2 Handling Precautions

(1) Address map

- The memory space between D00000h and FFFFFFh is used for the intelligent terminal. It cannot be used for the ISA board. The assignment of all other areas is the same as that for IBM–PC compatibles.
- The assignment of the I/O address space for the intelligent terminal is the same as that for IBM–PC compatibles. The intelligent terminal does not use any special areas.
- Three ports, COM1, COM2, and parallel port 3, are set at set–up. (Refer to the Series 21/210 Maintenance Manual (B–62705EN) for details.)

(2) Interrupt and DMA requests

- The intelligent terminal uses the following IRQ signals:

  IRQ1 : Keyboard
  IRQ3 : COM2
  IRQ4 : COM1
  IRQ6 : Floppy disk drive
  IRQ7 : Parallel port
  IRQ12 : Mouse
  IRQ14 : Built–in hard disk drive

  IRQ3, IRQ4, and IRQ7 can be re–set at BIOS set–up.
- The intelligent terminal uses the following DRQ signal:

  DRQ2 : Floppy disk drive

(3) Maximum current
See Subsec. 15.5.2 for details of the maximum current.

(4) Cable lead–in direction
See Sec. 15.6 for details of the direction in which the cables should be led in.

(5) ISA expansion board installation environment
Refer to the applicable ISA board expansion specification for details of the ISA expansion board installation environment. If the ISA expansion board specification is stricter than the environmental conditions described in Subsec. 15.5.1, the ISA expansion board conditions are applied to the entire CNC control unit environment.

(6) Others
In addition to the items stated in the cautions above, the following cases impede normal operation.

- When an ISA bus signal is pulled up or down
- When the ISA bus refresh cycle is used

More conditions may be added.

APPENDIX

A EXTERNAL DIMENSIONS OF EACH UNIT

Name			Specification	Fig., No.
Basic unit (2–slot)			A02B–0210–B501	Fig. U1
			A02B–0210–B511	
			A02B–0218–B502	
Basic unit (3–slot)			A02B–0218–B505	Fig. U2
Basic unit (4–slot) for 210–MB			A02B–0218–B524	Fig. U3
9″ monochrome CRT/MDI (small size)	21–TB	English display MDI	A02B–0210–C041#TA	Fig. U4
		Symbol display MDI	A02B–0210–C041#TAS	
	21–MB	English display MDI	A02B–0210–C041#MA	
		Symbol display MDI	A02B–0210–C041#MAS	
9″ monochrome CRT (separate type)			A02B–0210–C111	Fig. U5
9″ monochrome PDP (separate type)			A02B–0200–C100	Fig. U6
7.2″ STN monochrome LCD (separate type)			A02B–0200–C081	Fig. U7
8.4″ TFT color LCD (separate type)			A02B–0218–C050	Fig. U8
9.5″ STN monochrome LCD (separate type)			A02B–0200–C115	Fig. U9
Separate MDI (small size)	21–TB	English display MDI	A02B–0210–C120#TA	Fig. U10
		Symbol display MDI	A02B–0210–C120#TAS	
	21–MB	English display MDI	A02B–0210–C120#MA	
		Symbol display MDI	A02B–0210–C120#MAS	
Separate MDI (full key)	21–TB	English display MDI	A02B–0210–C122#TA	Fig. U11
		Symbol display MDI	A02B–0210–C122#TAS	
	21–MB	English display MDI	A02B–0210–C122#MA	
		Symbol display MDI	A02B–0210–C122#MAS	
Separate MDI (horizontal type, full key)	210–TB	English display MDI	A02B–0218–C120#TR	Fig. U12
		Symbol display MDI	A02B–0218–C120#TS	
	210–MB	English display MDI	A02B–0218–C120#MR	
		Symbol display MDI	A02B–0218–C120#MS	
Separate MDI (vertical type, full key)	210–TB	English display MDI	A02B–0218–C121#TR	Fig. U13
		Symbol display MDI	A02B–0218–C121#TS	
	210–MB	English display MDI	A02B–0218–C121#MR	
		Symbol display MDI	A02B–0218–C121#MS	
14″ color CRT/MDI (horizontal type)	21/210–TB	English display MDI	A02B–0200–C071#TBR	Fig. U14
		Symbol display MDI	A02B–0200–C071#TBS	
	21/210–MB	English display MDI	A02B–0200–C071#MBR	
		Symbol display MDI	A02B–0200–C071#MBS	

Name			Specification	Fig., No.
14″ color CRT/MDI (vertical type)	21/210–TB	English display MDI	A02B–0200–C072#TBR	Fig. U15
		Symbol display MDI	A02B–0200–C072#TBS	
	21/210–MB	English display MDI	A02B–0200–C072#MBR	
		Symbol display MDI	A02B–0200–C072#MBS	
9.5″ color TFT/MDI (horizontal type)	21/210–TB	English display MDI	A02B–0200–C065#TBR	Fig. U16
		Symbol display MDI	A02B–0200–C065#TBS	
	21/210–MB	English display MDI	A02B–0200–C065#MBR	
		Symbol display MDI	A02B–0200–C065#MBS	
9.5″ color TFT/MDI (vertical type)	21/210–TB	English display MDI	A02B–0200–C066#TBR	Fig. U17
		Symbol display MDI	A02B–0200–C066#TBS	
	21/210–MB	English display MDI	A02B–0200–C066#MBR	
		Symbol display MDI	A02B–0200–C066#MBS	
Intelligent terminal		Without ISA extension	A13B–0172–B001	Fig. U18
			A13B–0172–B002	
			A13B–0172–B021	
			A13B–0172–B022	
		With ISA extension	A13B–0172–B101	Fig. U19
			A13B–0172–B102	
			A13B–0172–B121	
			A13B–0172–B122	
Full keyboard		English	A86L–0001–0210	Fig. U20
		Japanese	A86L–0001–0211	Fig. U21
Mouse			A86L–0001–0212	Fig. U22
Interface board for high–speed serial bus (for PC)		Type 1	A20B–8001–0300	Fig. U23
		Type 2	A20B–8100–0100	Fig. U24
Position coder		4000 rpm	A86L–0027–0001#102	Fig. U25
		6000 rpm	A86L–0027–0001#002	
Manual pulse generator			A860–0202–T001	Fig. U26
Pendant type manual pulse generator			A860–0202–T004	Fig. U27
			A860–0202–T005	
			A860–0202–T007	
			A860–0202–T010	
			A860–0202–T012	
			A860–0202–T013	
ABS battery case for separate type detector			A06B–6050–K060	Fig. U28
Punch panel	Wide width type	Cable length : 1m	A02B–0120–C181	Fig. U29
		Cable length : 2m	A02B–0120–C182	
		Cable length : 5m	A02B–0120–C183	
	Narrow width type	Cable length : 1m	A02B–0120–C191	Fig. U30
		Cable length : 2m	A02B–0120–C192	
		Cable length : 5m	A02B–0120–C193	

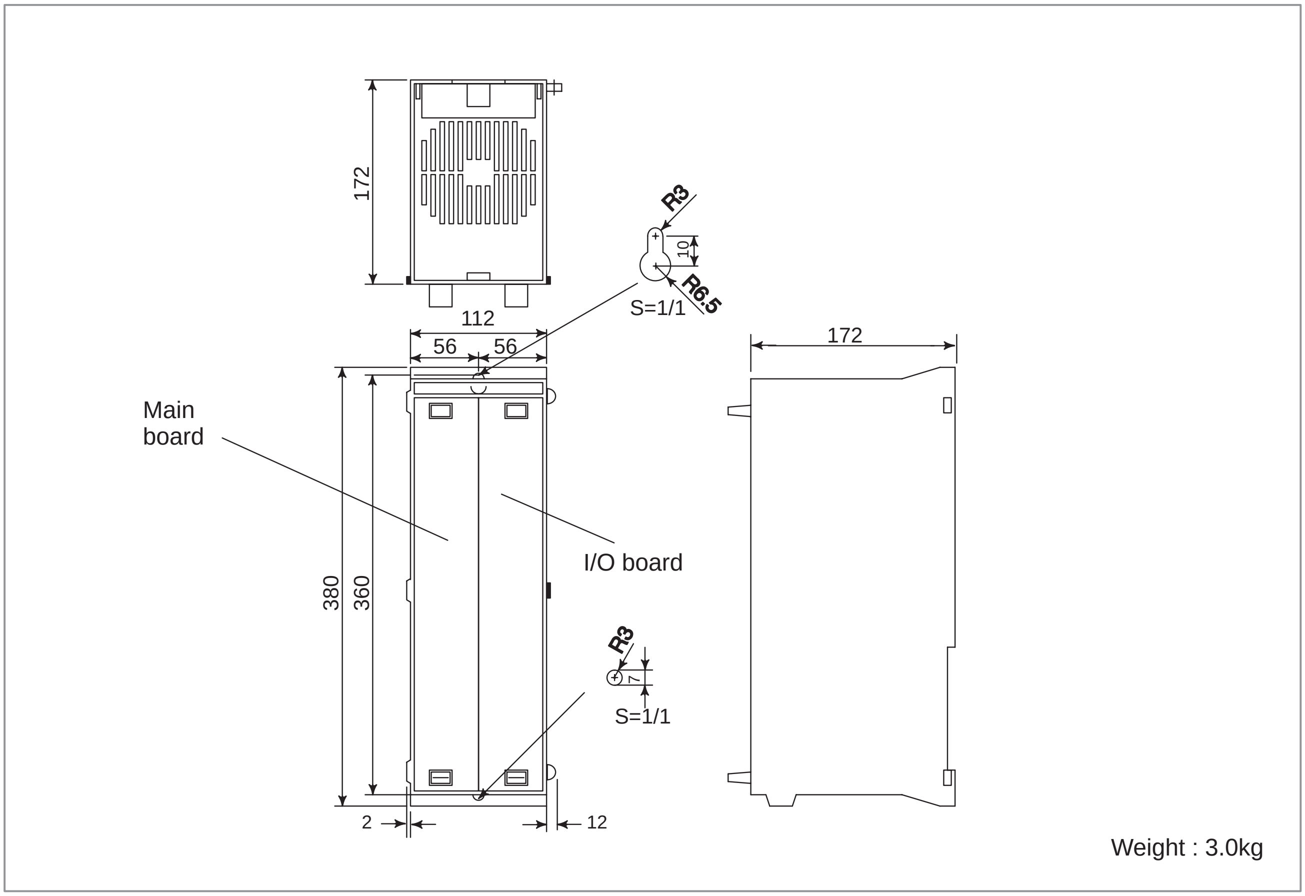


Fig.U1 Basic unit (2–slot)
Specification No. : A02B–0210–B501
A02B–0210–B511
A02B–0218–B502

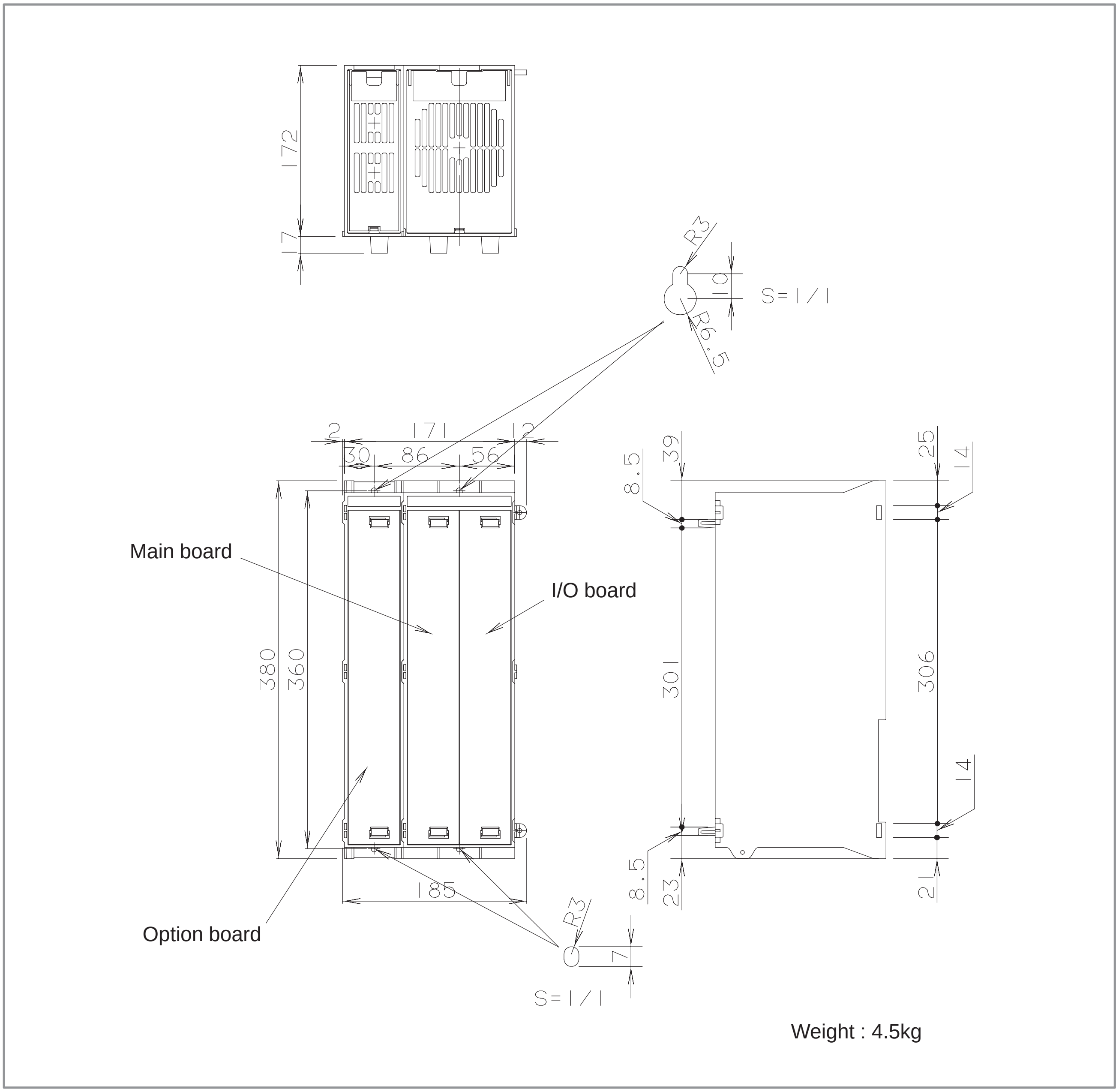


Fig.U2 Basic unit (3–slot)
Specification No. : A02B–0218–B505

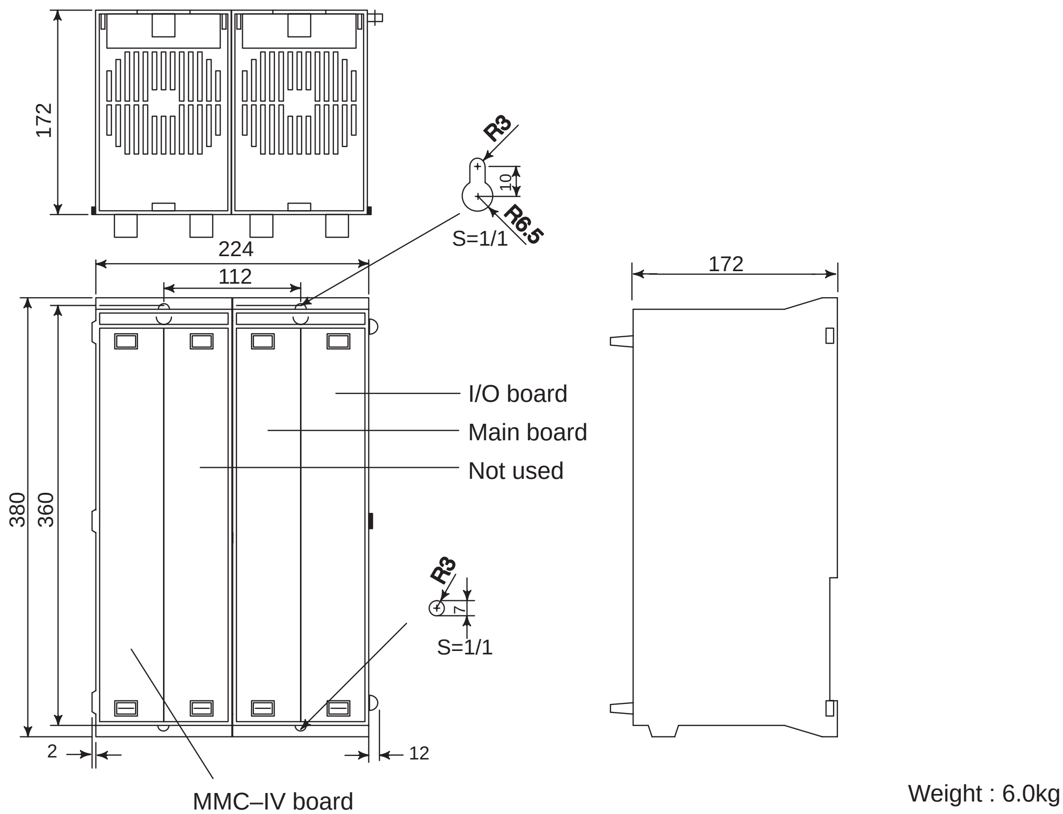
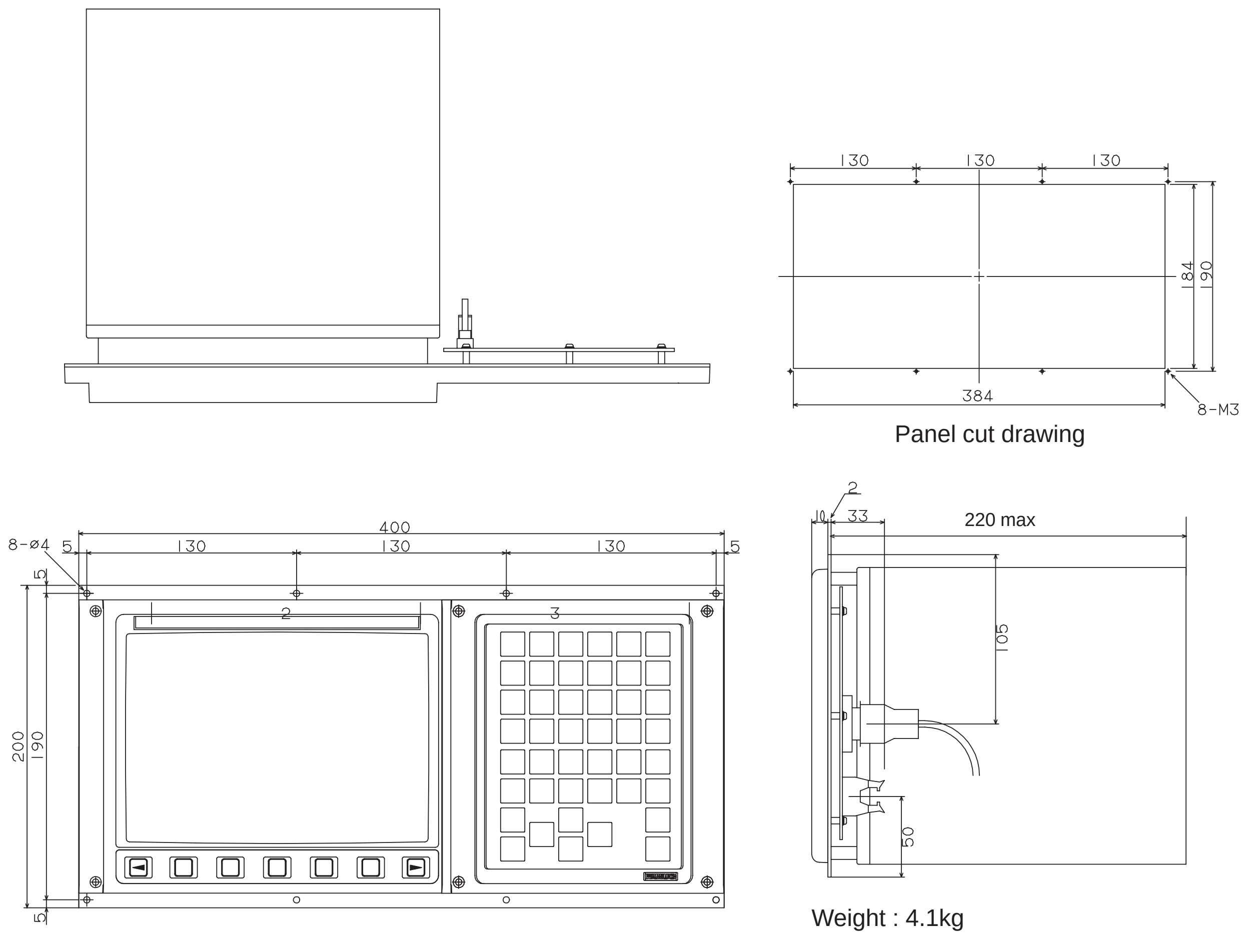
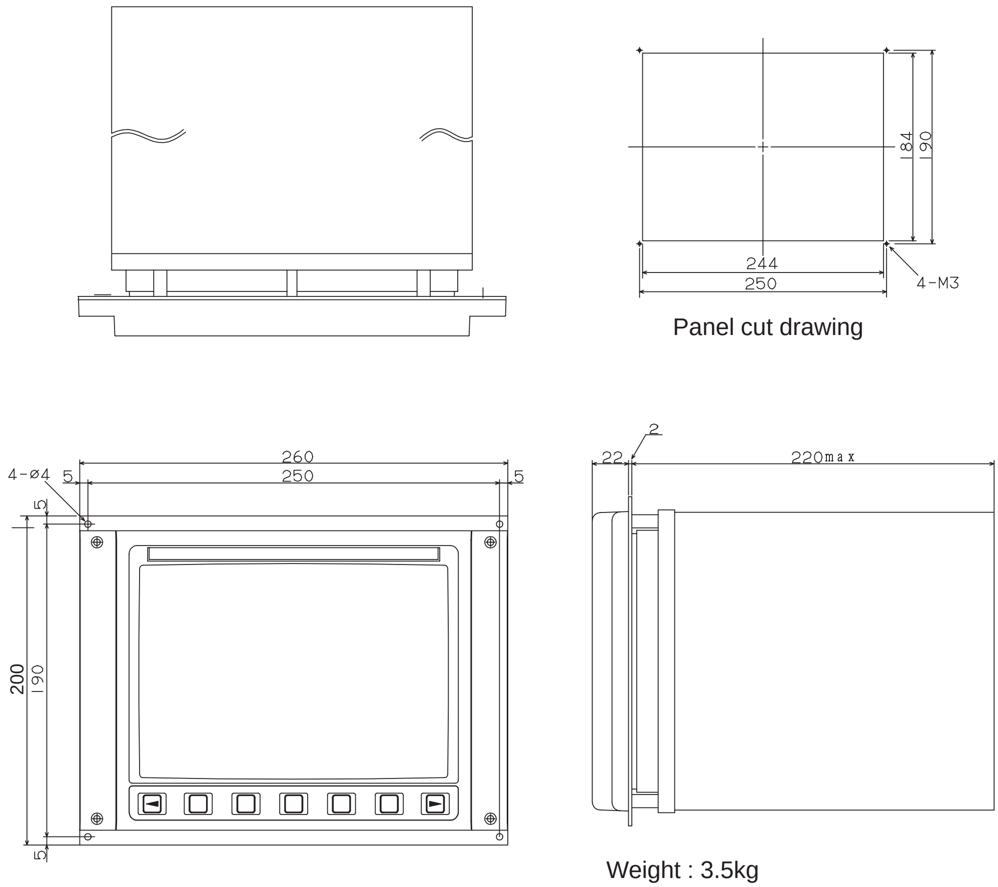


Fig.U3 Basic unit (4–slot) for 210–MB
Specification No. : A02B–0218–B524



At the rear of the metal plate of the panel, the area within 8 mm of the perimeter is left unpainted

Fig.U4 9″ monochrome CRT/MDI (small size)
Specification No. : A02B–0210–C041#TA (English display MDI)
A02B–0210–C041#TAS (Symbol display MDI)
A02B–0210–C041#MA (English display MDI)
A02B–0210–C041#MAS (Symbol display MDI)



At the rear of the metal plate of the panel, the area within 8 mm of the perimeter is left unpainted

Fig.U5 9″ monochrome CRT (separate type)
Speification No. : A02B–0210–C111

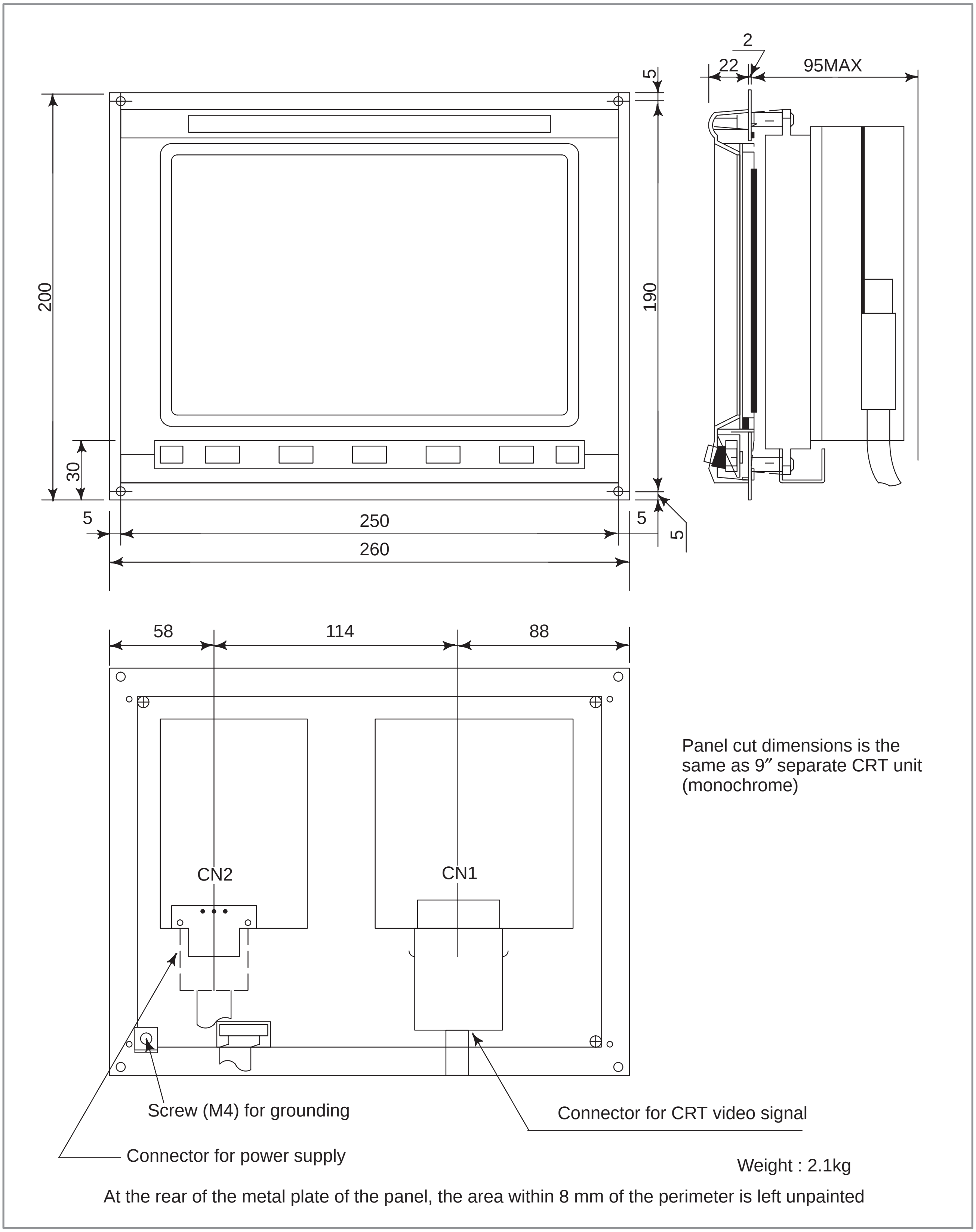
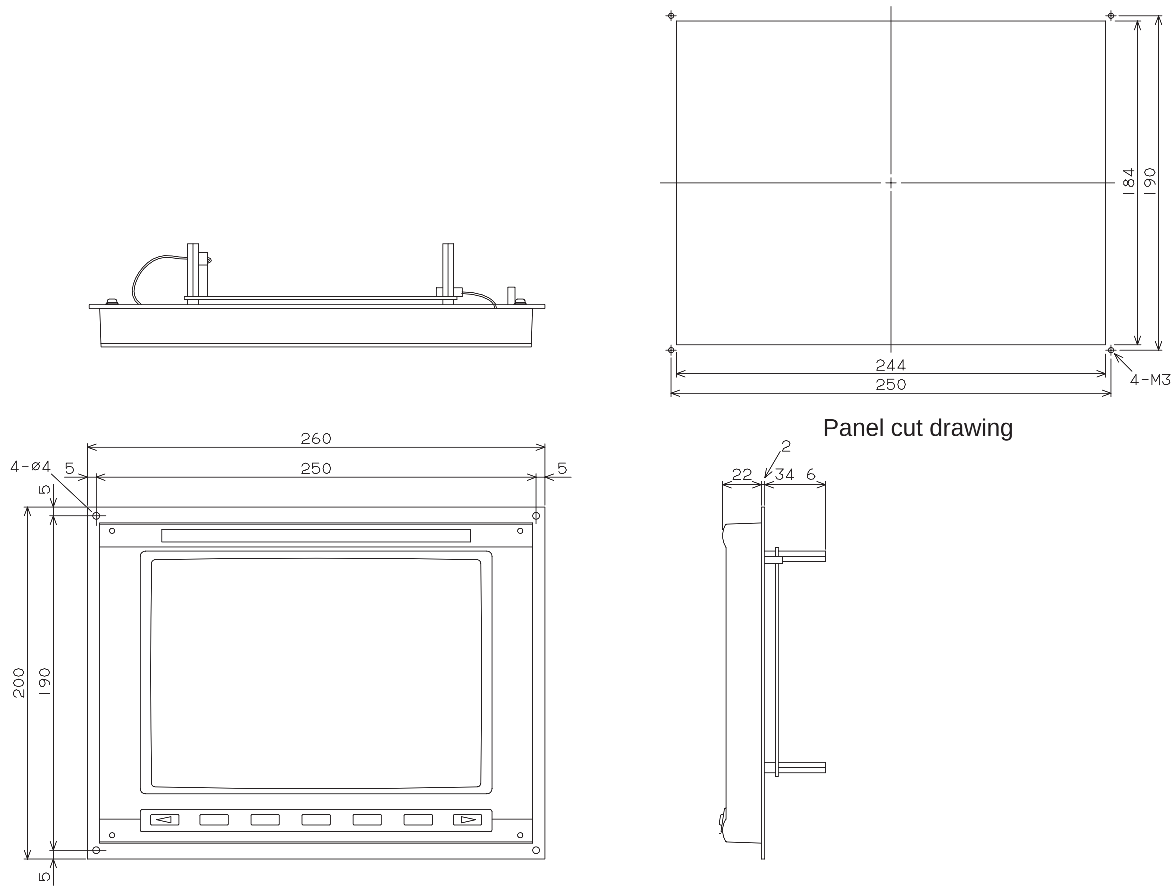


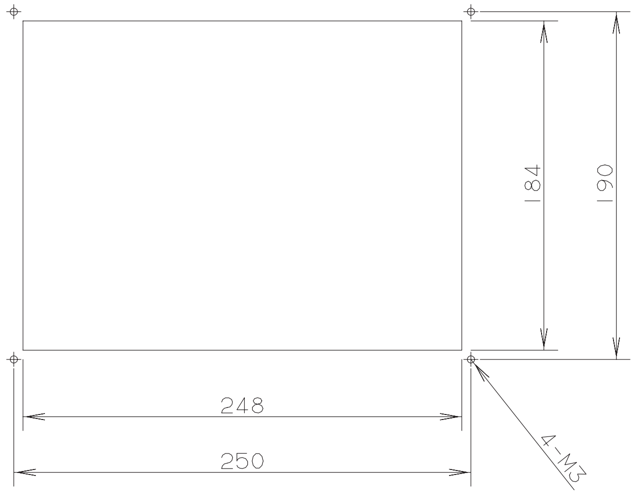
Fig.U6 9″ monochrome PDP (separate type)
Specification No. : A02B–0200–C100



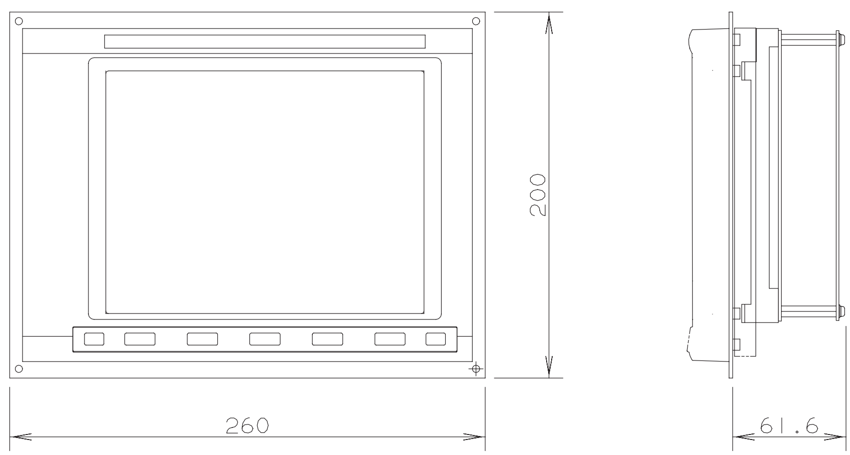
At the rear of the metal plate of the panel, the area within 8 mm of the perimeter is left unpainted

Weight : 1.3kg

Fig.U7 7.2″ STN monochrome LCD (separate type)
Specification No. : A02B–0200–C081

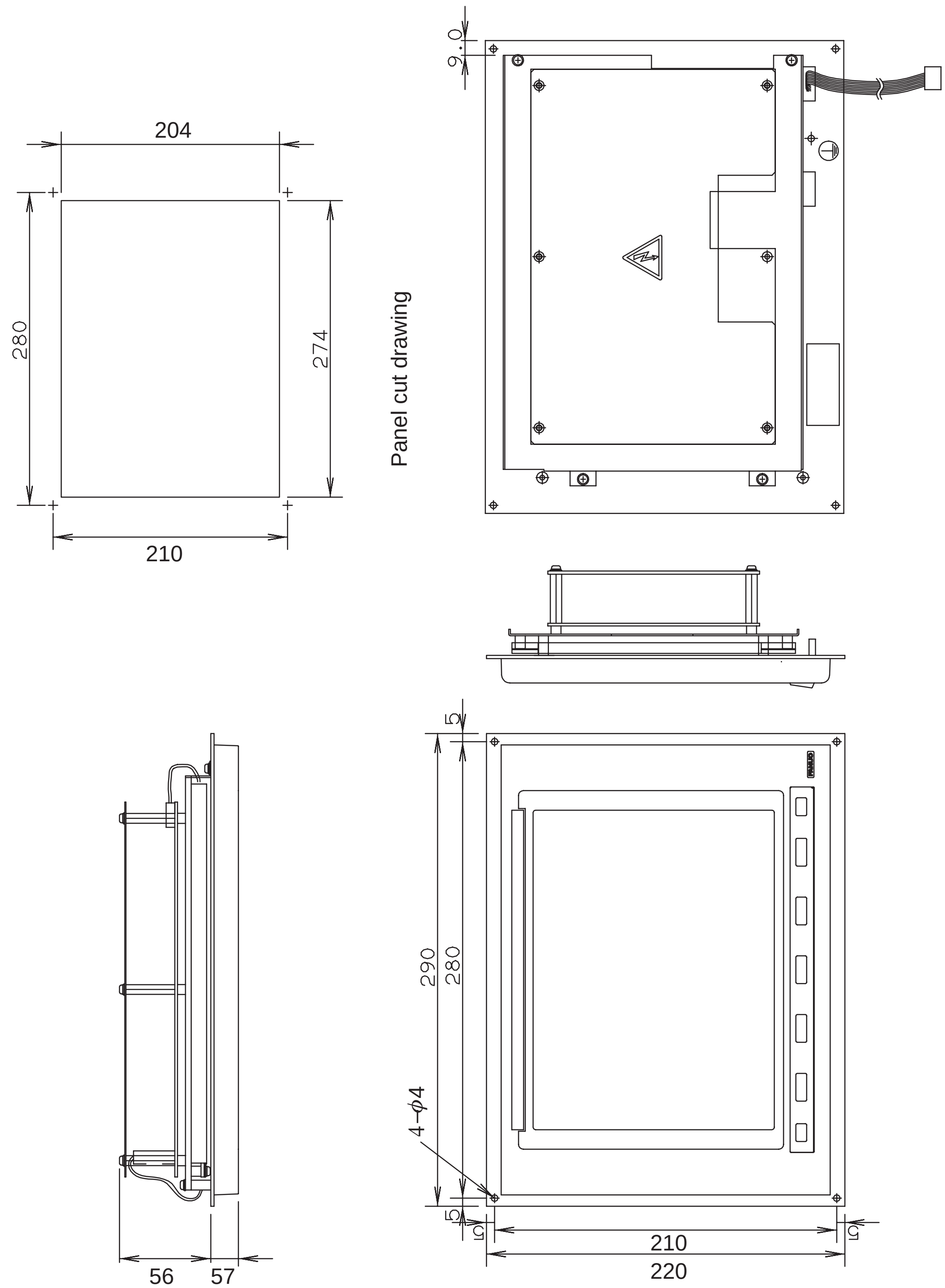


Panel cut drawing



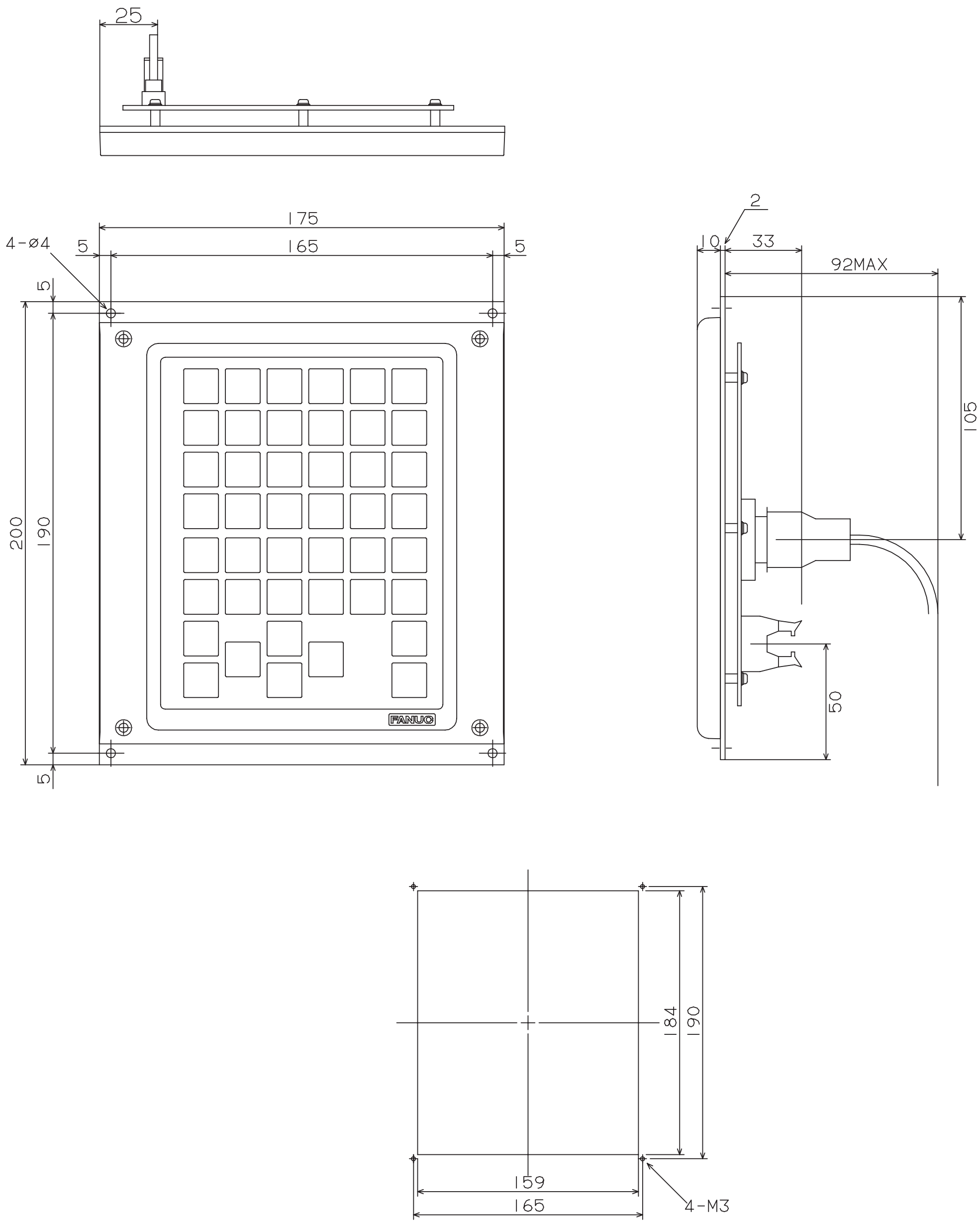
At the rear of the metal plate of the panel, the area within 8 mm of the perimeter is left unpainted

Fig.U8 8.4″ TFT color LCD (separate type)
Specification No. : A20B–0218–C050



At the rear of the metal plate of the panel, the area within 8 mm of the perimeter is left unpainted

Fig.U9 9.5″ STN monochrome LCD (separate type)
Specification No. : A02B–0200–C115



Panel cut drawing

Weight : 0.6kg

At the rear of the metal plate of the panel, the area within 8 mm of the perimeter is left unpainted

Fig.U10 Separate MDI (small size)
Specification No. : A02B–0210–C120#TA (English display MDI)
A02B–0210–C120#TAS (Symbol display MDI)
A02B–0210–C120#MA (English display MDI)
A02B–0210–C120#MAS (Symbol display MDI)

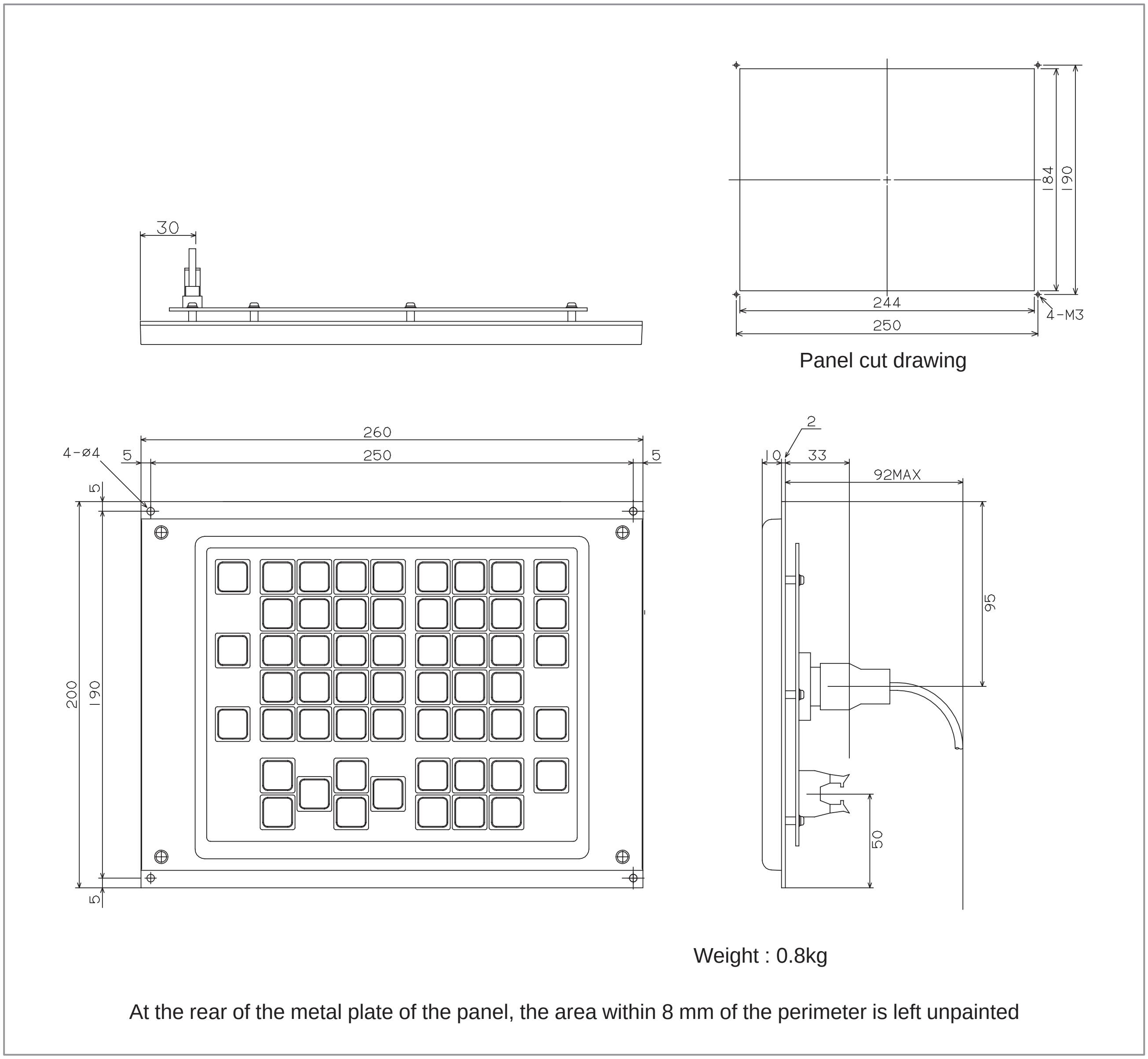


Fig.U11 Separate MDI (full key)
Specification No. : A02B–0210–C122#TA (English display MDI)
A02B–0210–C122#TAS (Symbol display MDI)
A02B–0210–C122#MA (English display MDI)
A02B–0210–C122#MAS (Symbol display MDI)

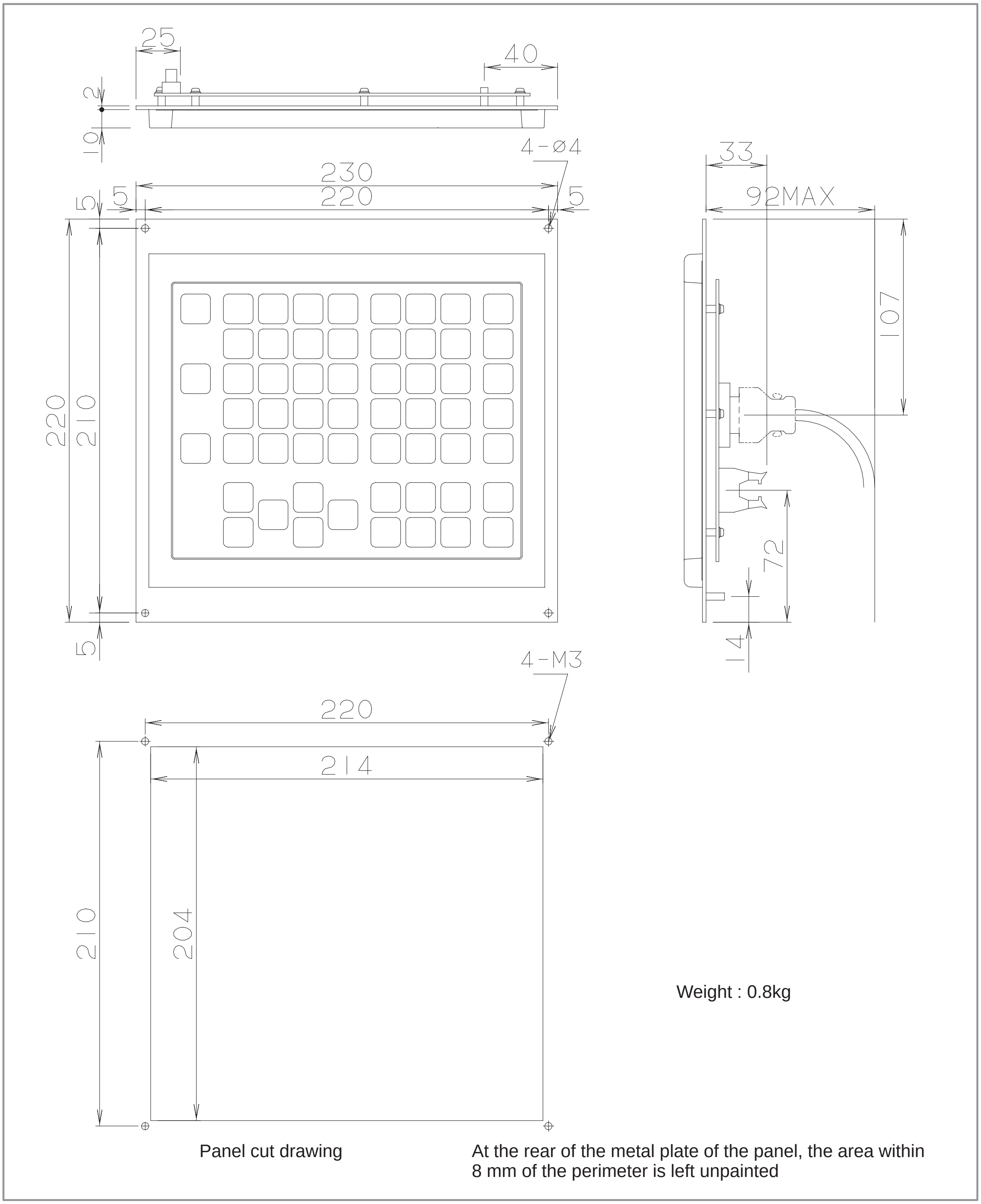
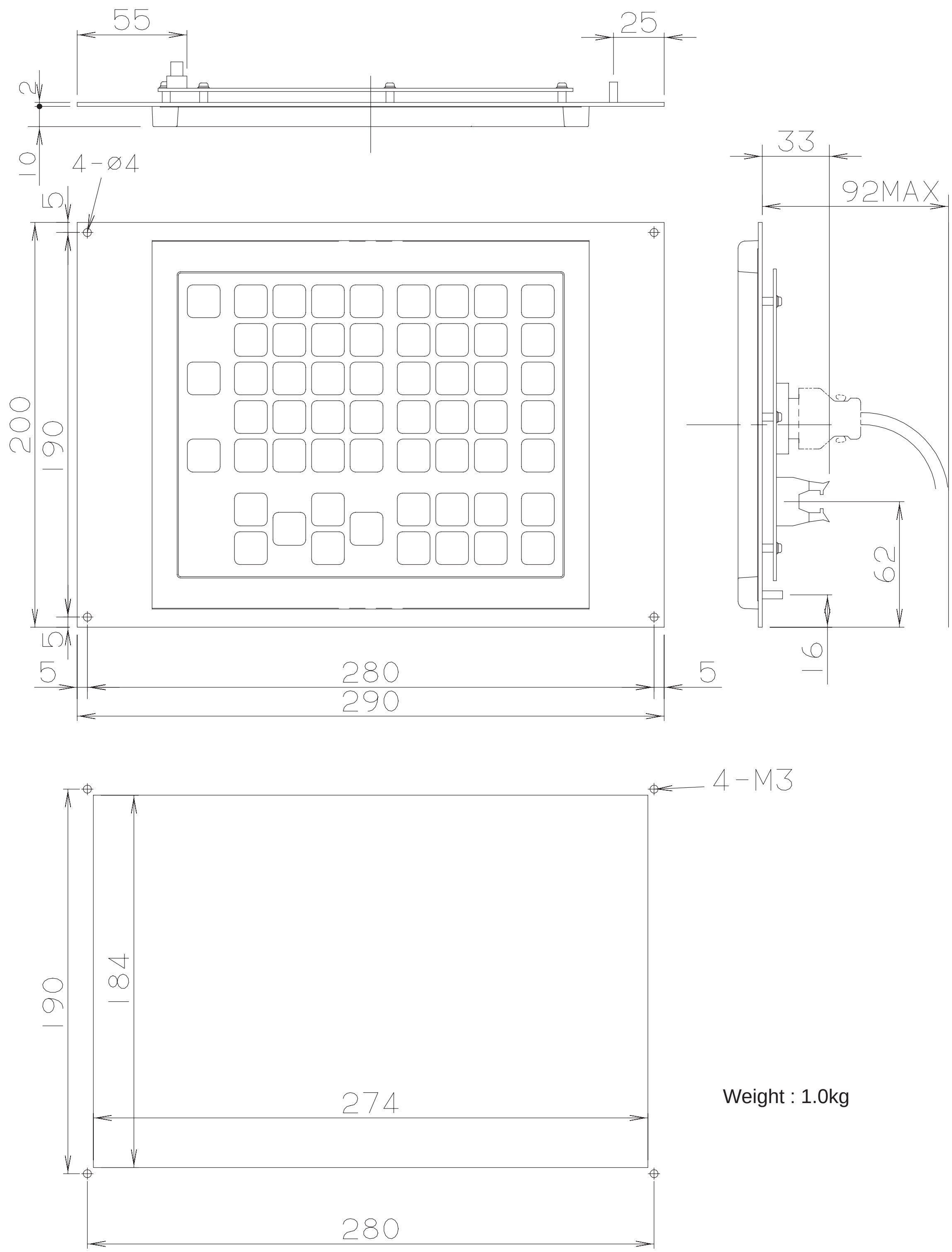


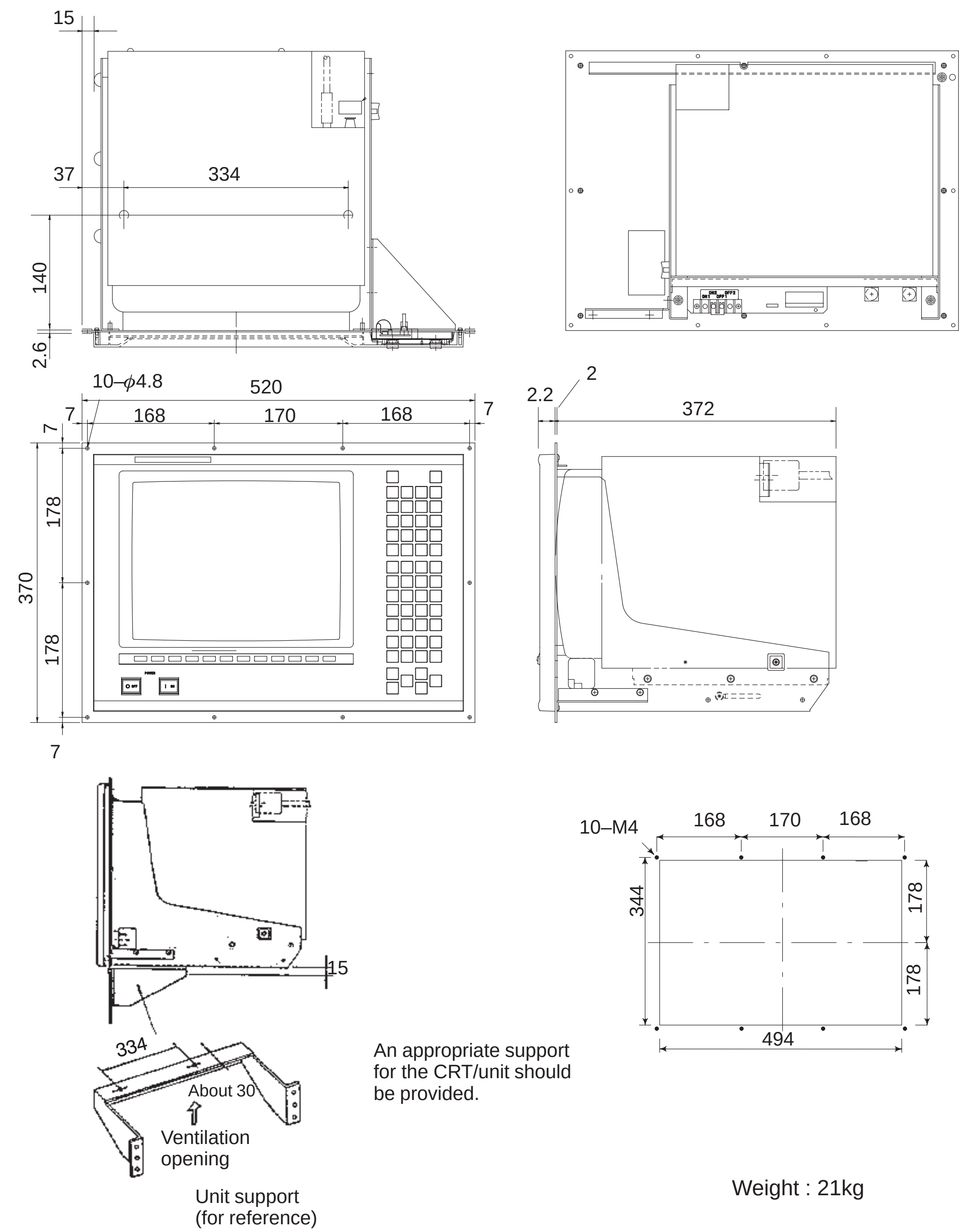
Fig.U12 Separate MDI (horizontal type, full key)
Specification No. : A02B–0218–C120#TR (English display MDI)
A02B–0218–C120#TS (Symbol display MDI)
A02B–0218–C120#MR (English display MDI)
A02B–0218–C120#MS (Symbol display MDI)



Panel cut drawing

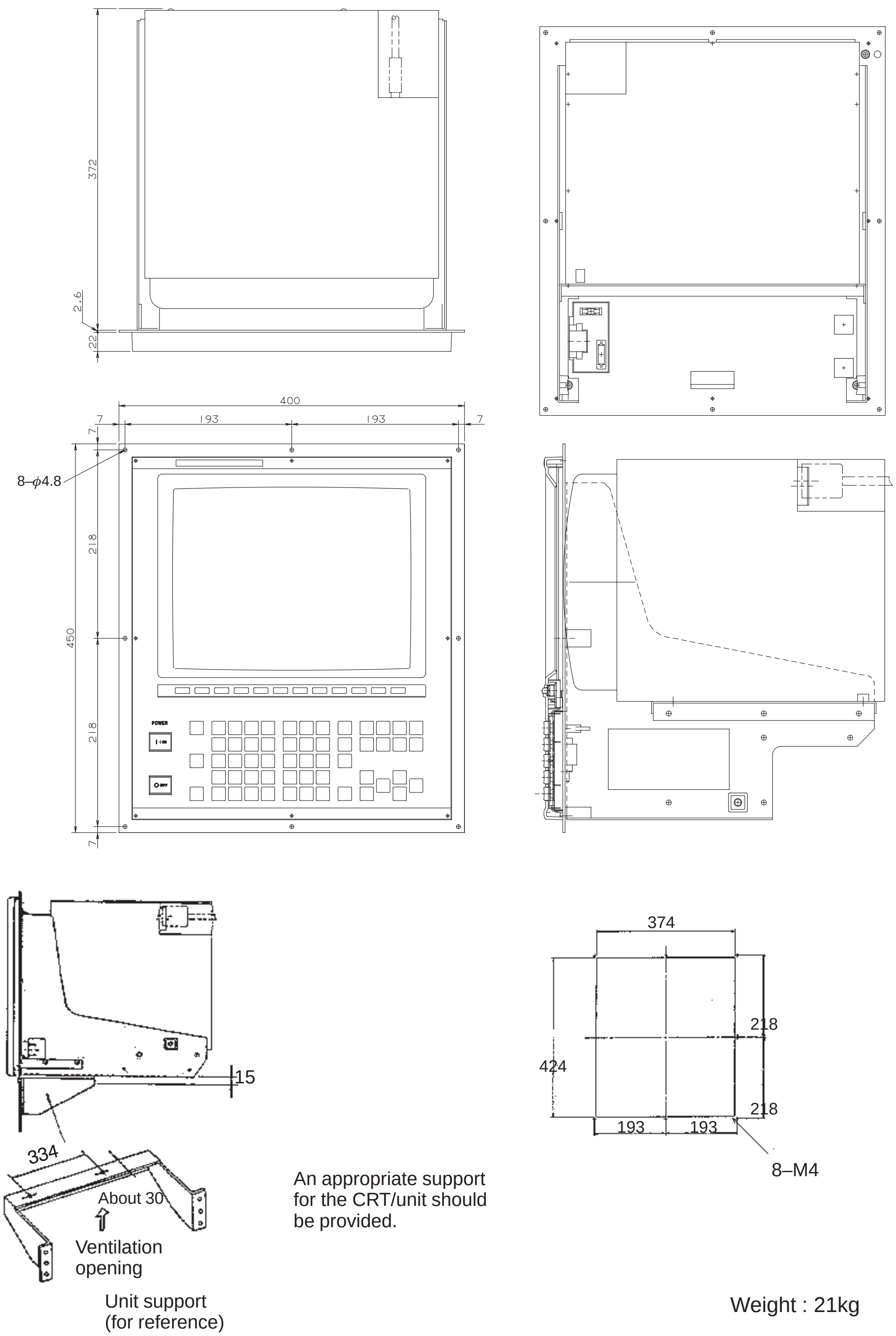
At the rear of the metal plate of the panel, the area within 8 mm of the perimeter is left unpainted

Fig.U13 Separate MDI (vertical type, full key)
Specification No. : A02B–0218–C121#TR (English display MDI)
A02B–0218–C121#TS (Symbol display MDI)
A02B–0218–C121#MR (English display MDI)
A02B–0218–C121#MS (Symbol display MDI)



At the rear of the metal plate of the panel, the area within 8 mm of the perimeter is left unpainted

Fig.U14 14″ color CRT/MDI (horizontal type)
Specification No. : A02B–0200–C071#TBR (English display MDI)
A02B–0200–C071#TBS (Symbol display MDI)
A02B–0200–C071#MBR (English display MDI)
A02B–0200–C071#MBS (Symbol display MDI)



At the rear of the metal plate of the panel, the area within 8 mm of the perimeter is left unpainted

Fig.U15 14″ color CRT/MDI (vertical type)
Specification No. : A02B–0120–C072#TBR (English display MDI)
A02B–0120–C072#TBS (Symbol display MDI)
A02B–0120–C072#MBR (English display MDI)
A02B–0120–C072#MBS (Symbol display MDI)

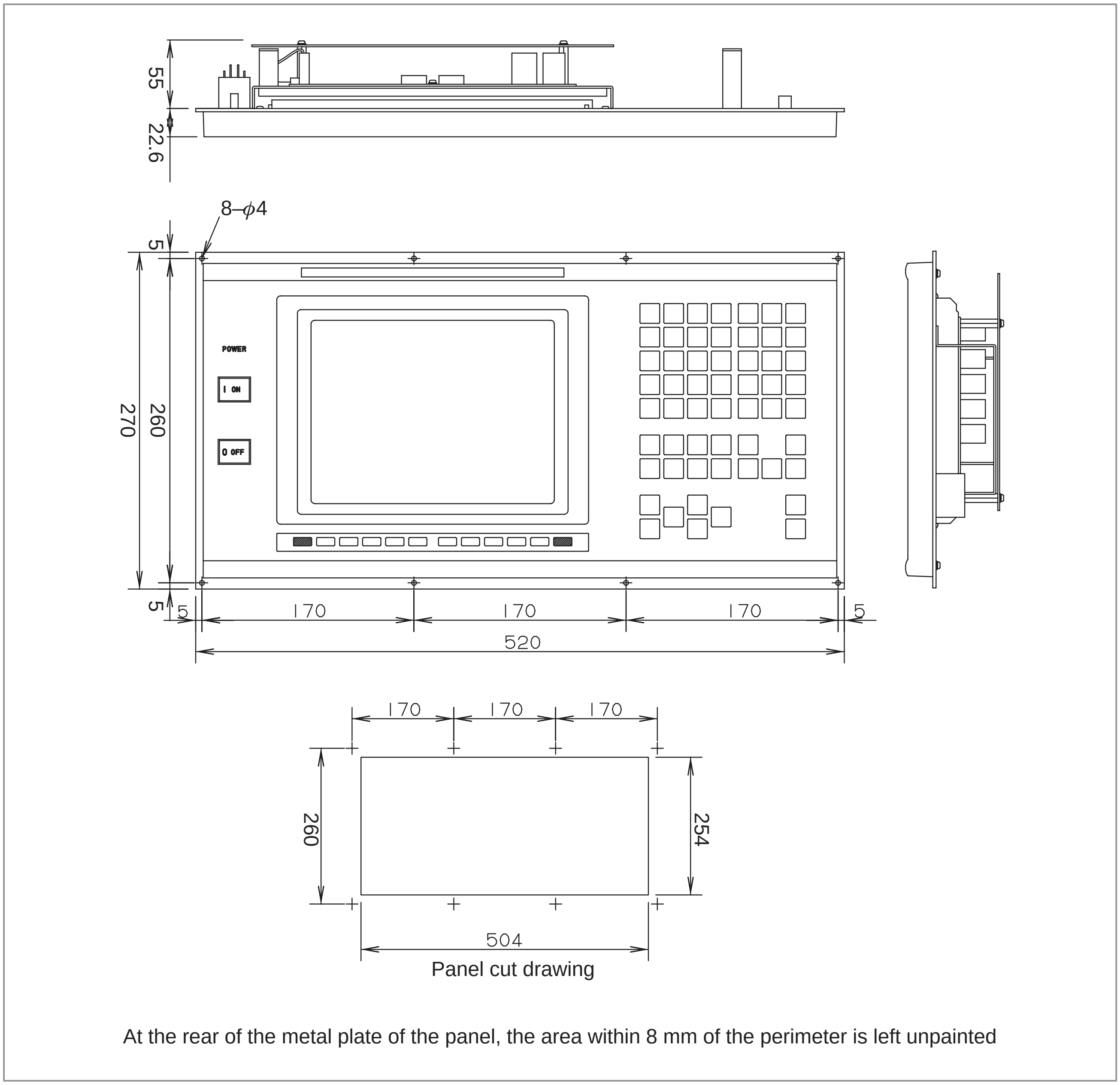
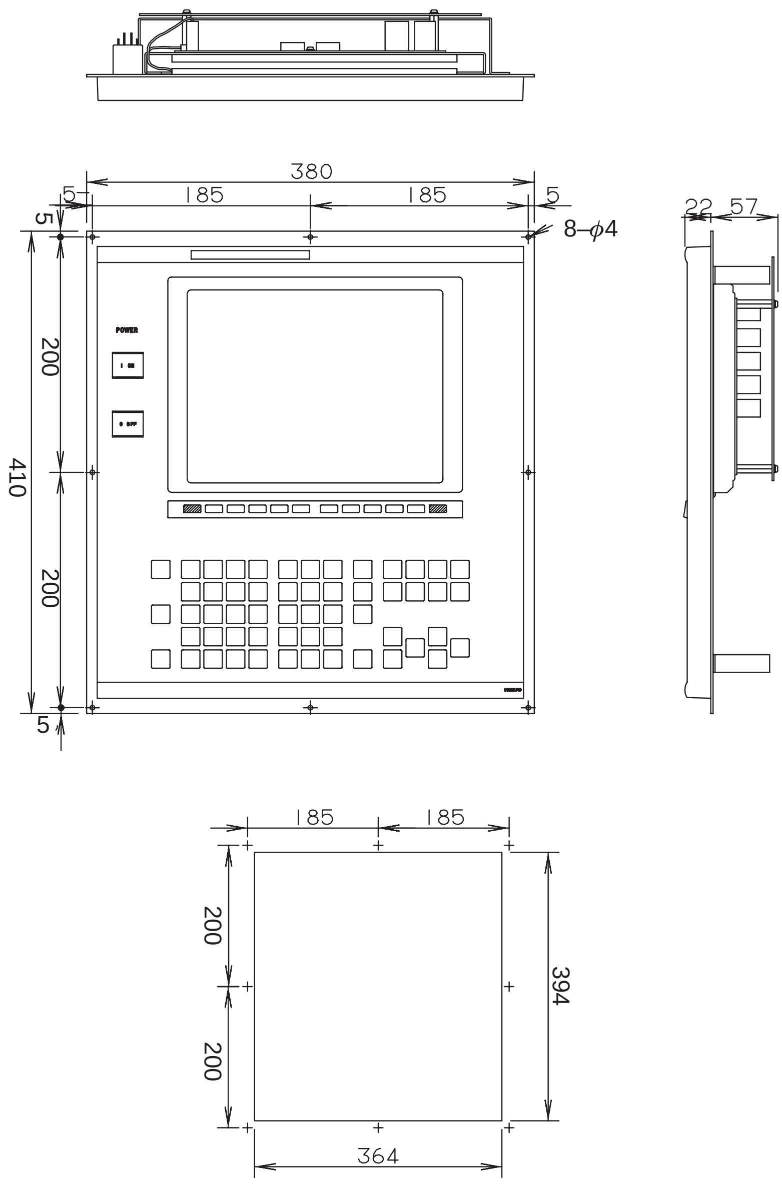


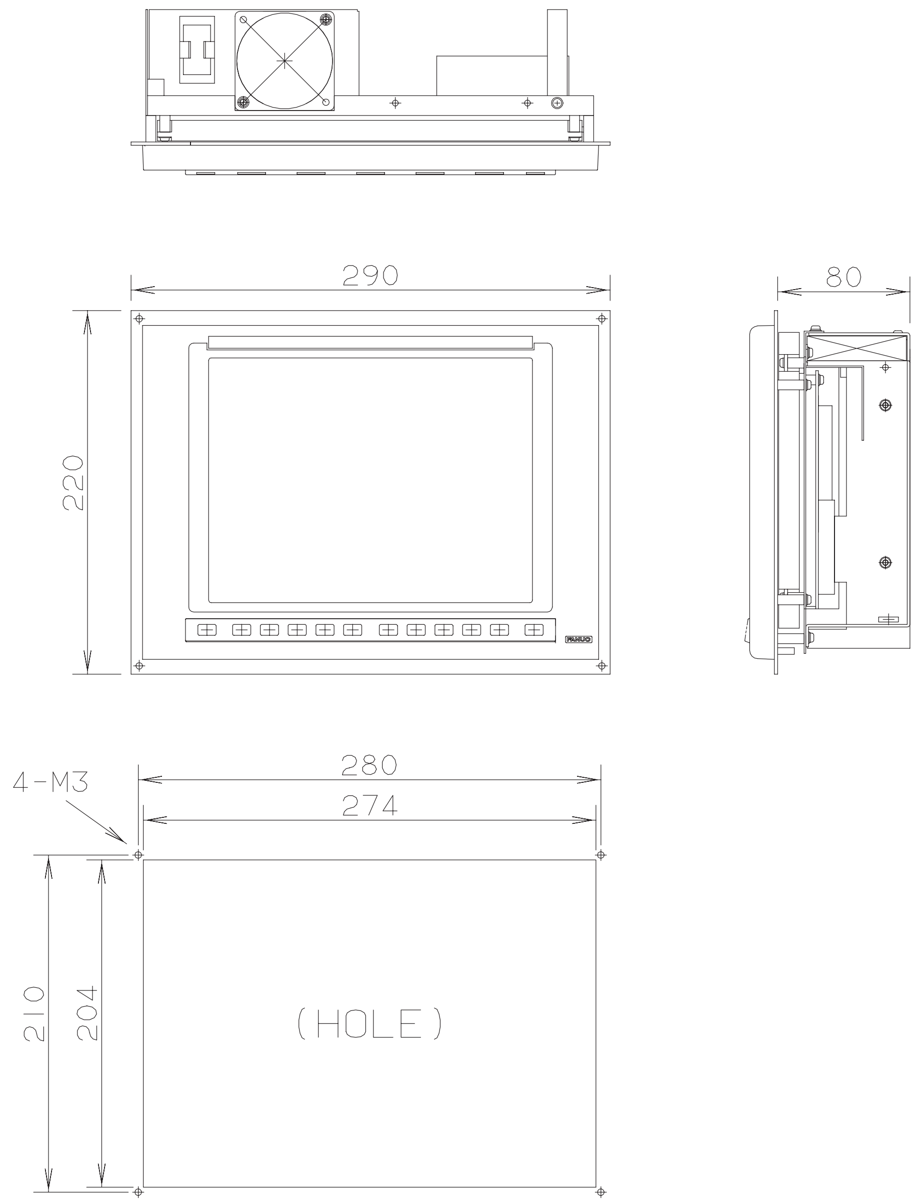
Fig.U16 9.5″ color TFT/MDI (horizontal type)
Specification No. : A02B–0200–C065#TBR (English display MDI)
A02B–0200–C065#TBS (Symbol display MDI)
A02B–0200–C065#MBR (English display MDI)
A02B–0200–C065#MBS (Symbol display MDI)



Panel cut drawing

At the rear of the metal plate of the panel, the area within 8 mm of the perimeter is left unpainted

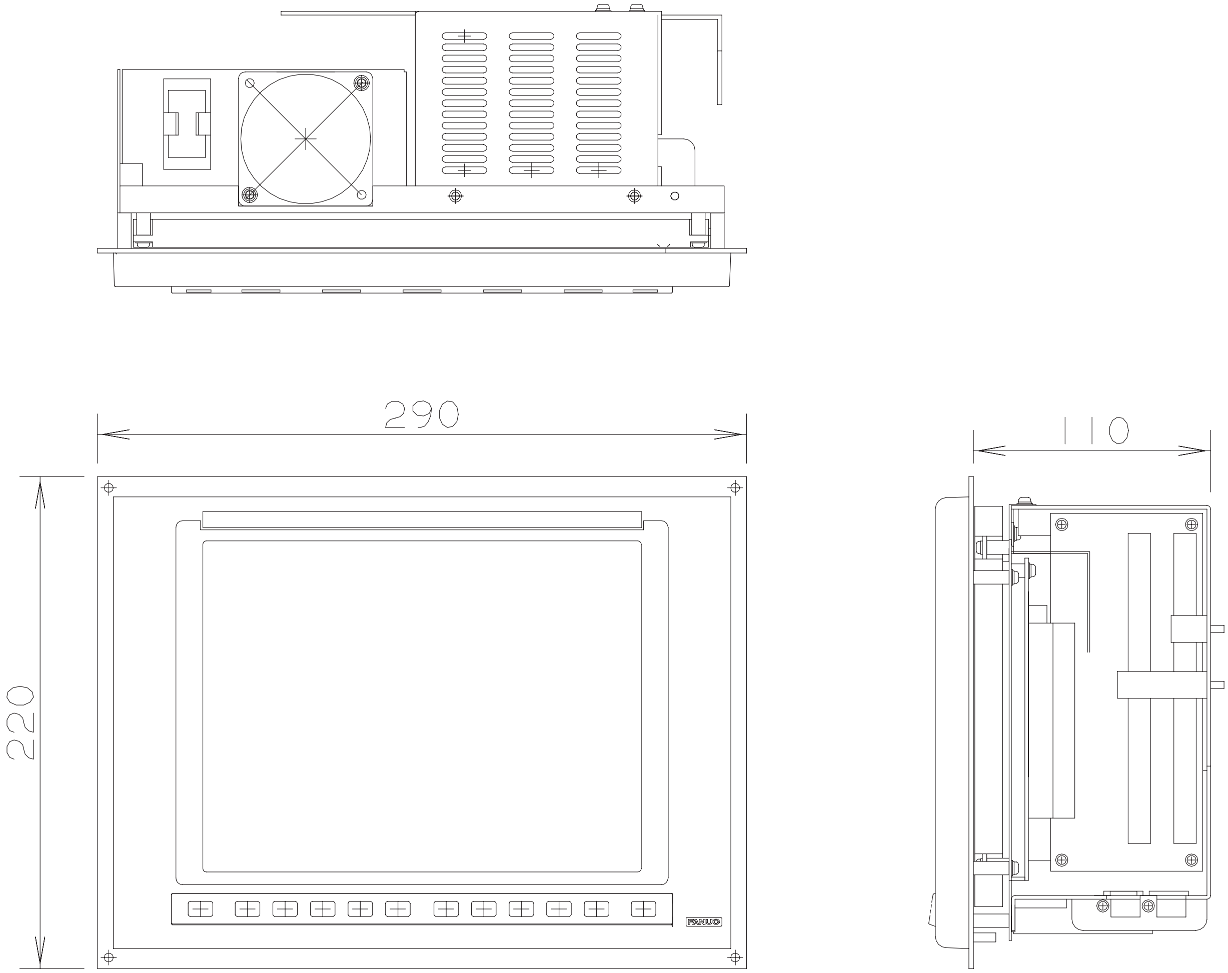
Fig.U17 9.5″ color TFT/MDI (Vertical type)
Specification No. : A02B–0200–C066#TBR (English display MDI)
A02B–0200–C066#TBS (Symbol display MDI)
A02B–0200–C066#MBR (English display MDI)
A02B–0200–C066#MBS (Symbol display MDI)



At the rear of the metal plate of the panel, the area within 8 mm of the perimeter is left unpainted

Unit : mm

Fig.U18 Intelligent terminal (without ISA extension)
Specification No. : A13B–0172–B001
A13B–0172–B002
A13B–0172–B021
A13B–0172–B022



At the rear of the metal plate of the panel, the area within 8 mm of the perimeter is left unpainted

Unit : mm

Fig.U19 Intelligent terminal (with ISA extension)
Specification No. : A13B–0172–B101
A13B–0172–B102
A13B–0172–B121
A13B–0172–B122

NOTE

The panel shall be cut in the same way as when no ISA expansion is installed.

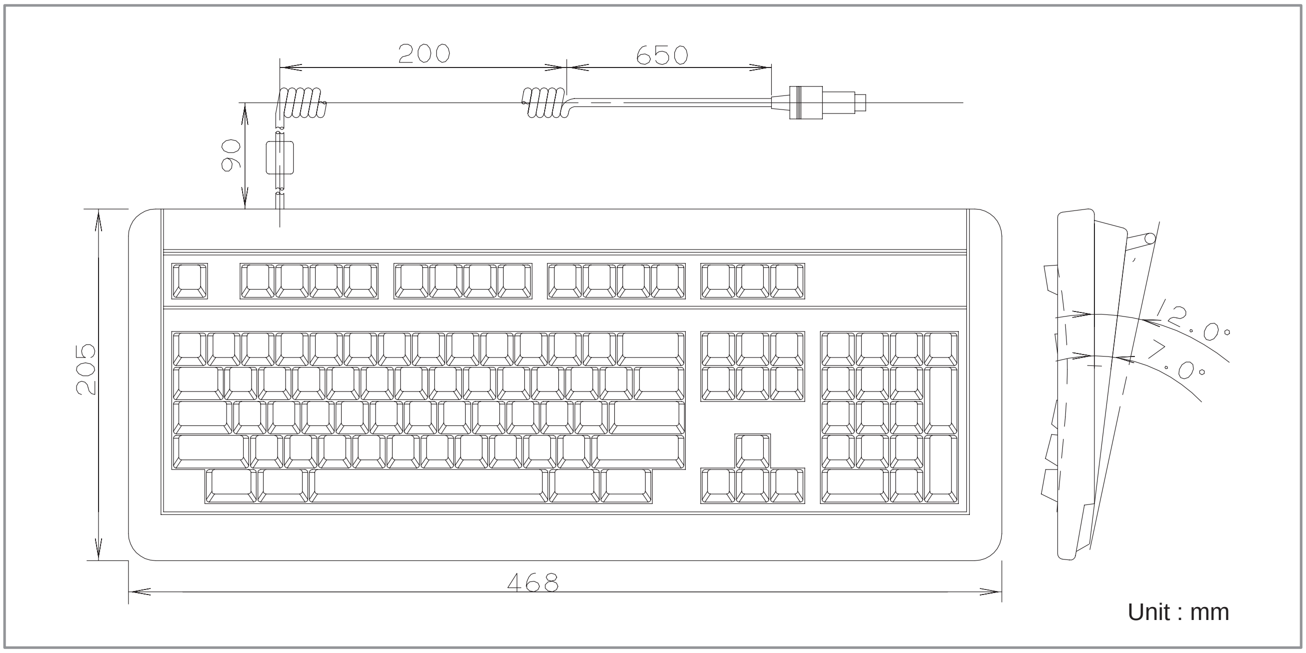


Fig.U20 Full keyboard (English)
Specification No. : A86L–0001–0210

NOTE
This keyboard is not dust–proof. Its use should be limited to program development. It should be used in an ambient temperature range of between 0°C and 40°C.

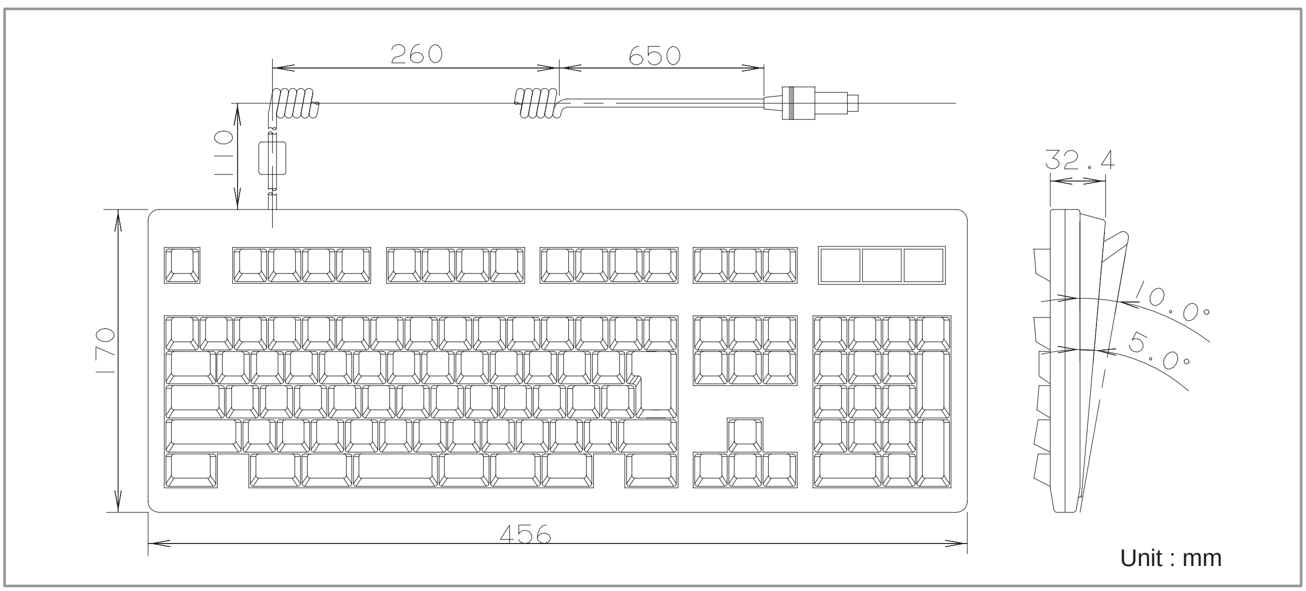


Fig.U21 Full keyboard (Japanese)
Specification No. : A86L–0001–0211

NOTE
This keyboard is not dust–proof. Its use should be limited to program development. It should be used in an ambient temperature range of between 0°C and 40°C.

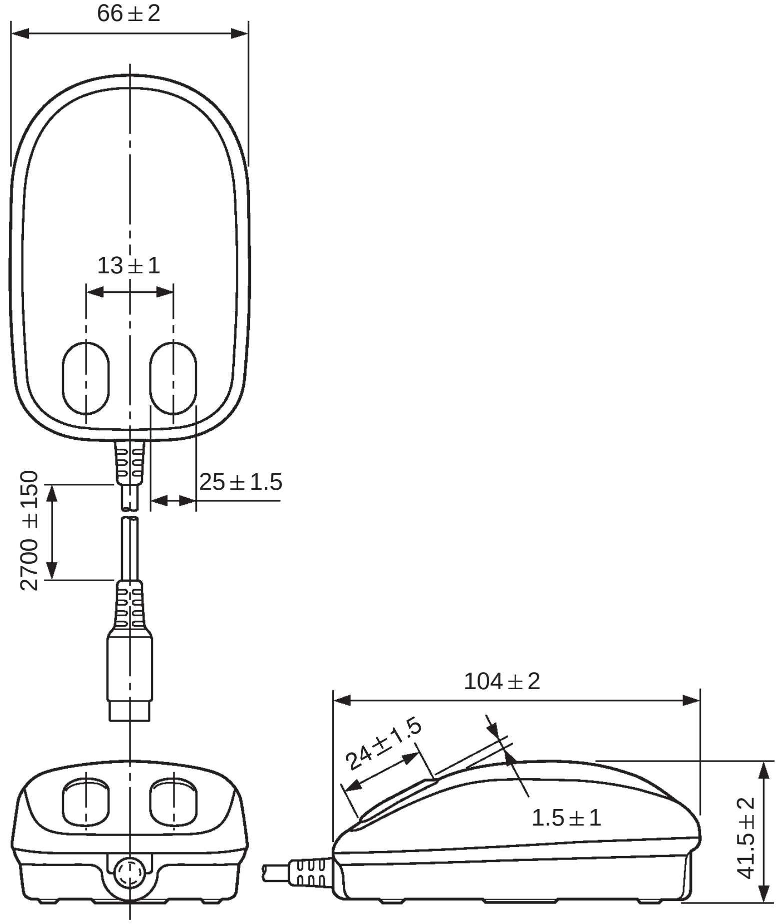


Fig.U22 Mouse
Specification No. : A86L–0001–0212

NOTE

This mouse is not dust–proof. Its use should be limited to program development. It should be used in an ambient temperature range of between 0 °C and 40 °C. It is provided together with a 2.7 mm signal cable.

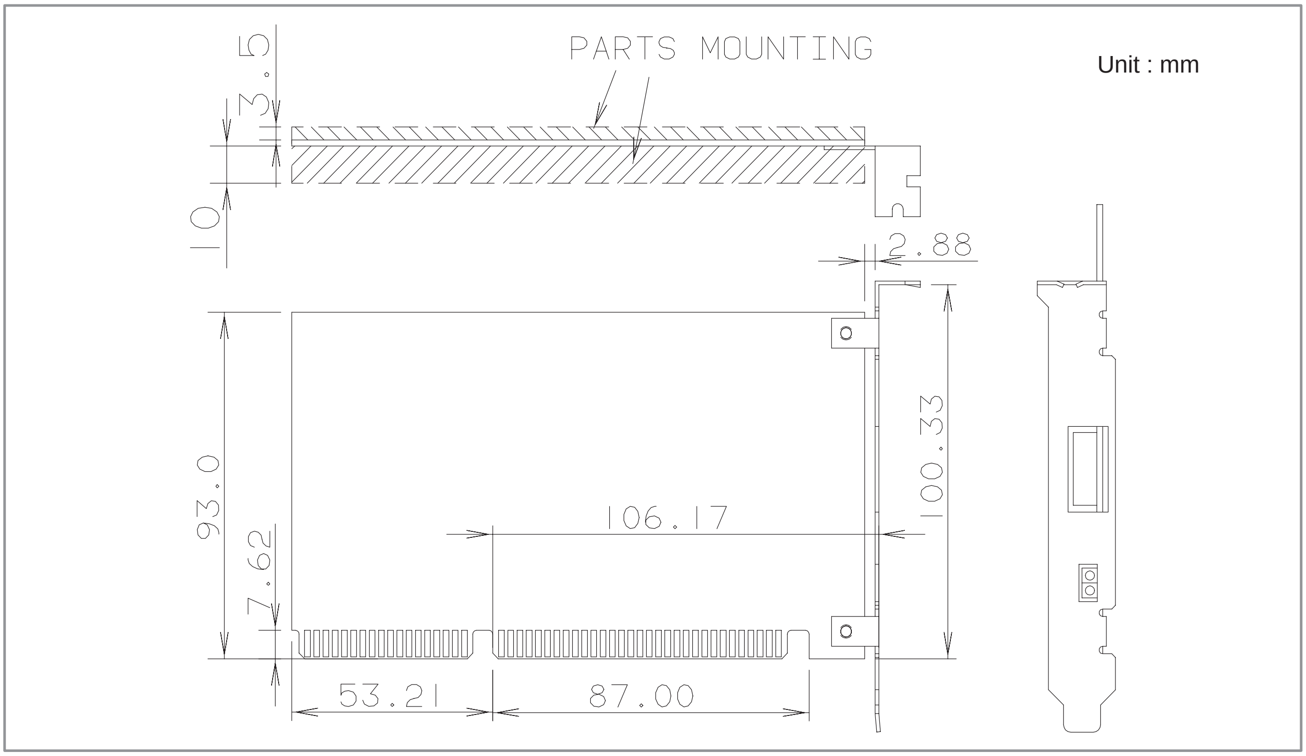


Fig.U23 Interface board for high–speed serial bus (for PC) (type 1)
Specification No. : A20B–8001–0300

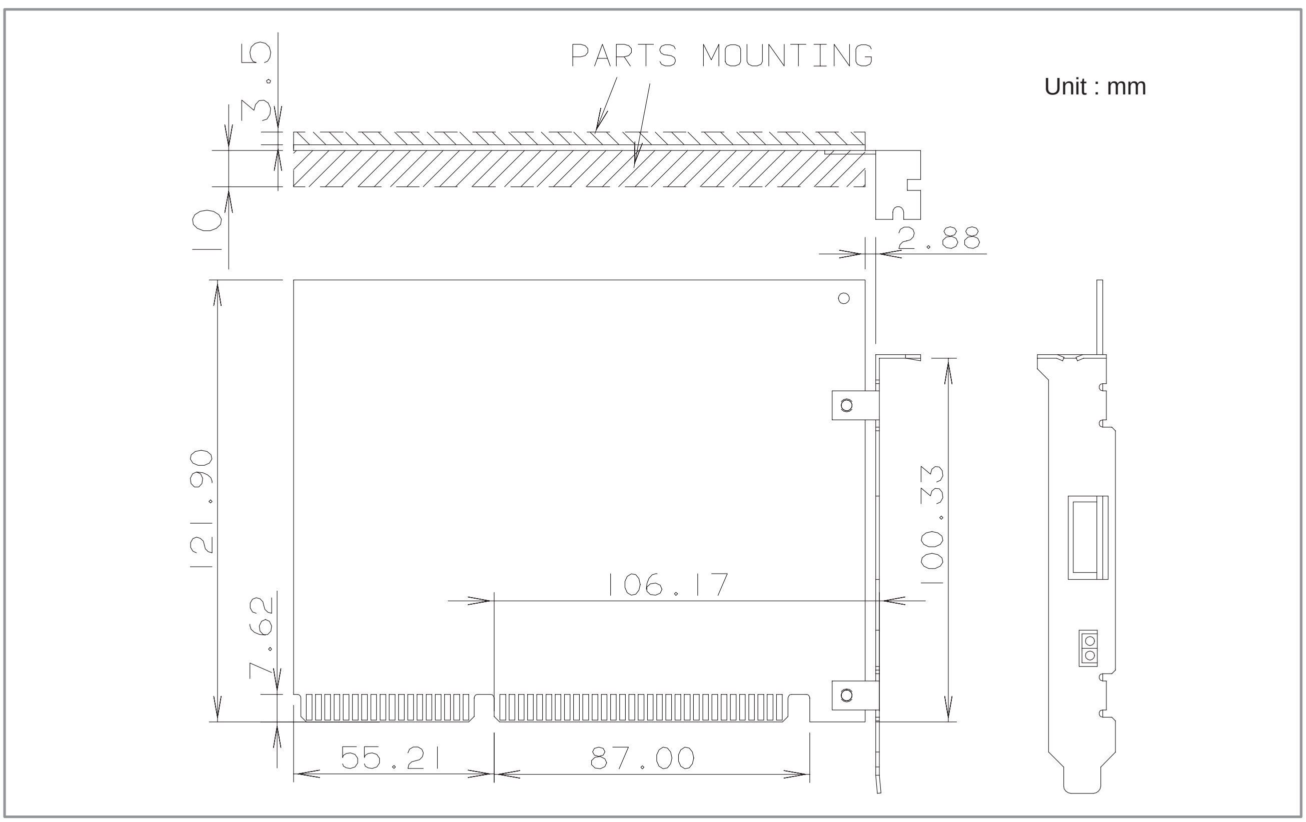
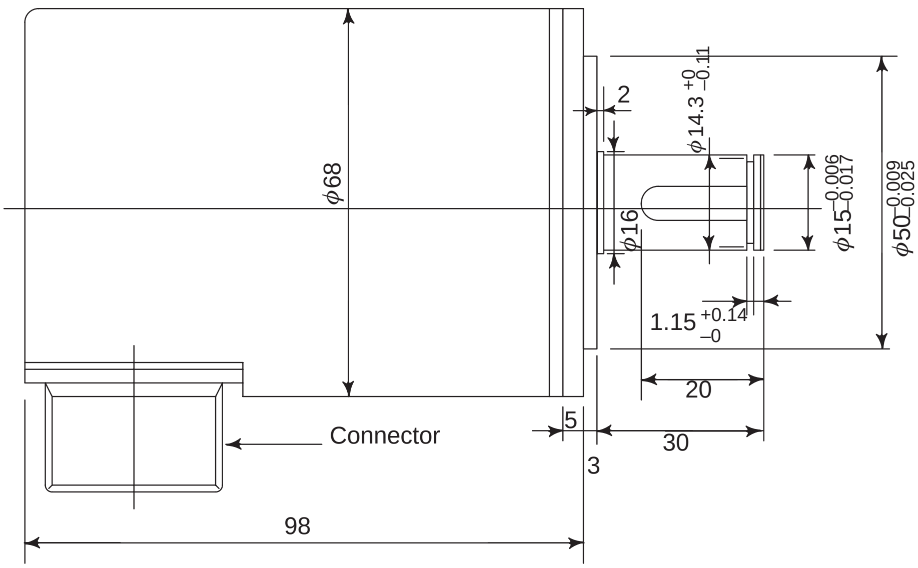
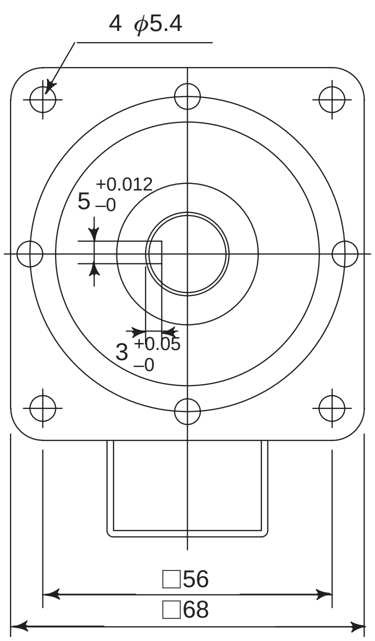


Fig.U24 Interface board for high–speed serial bus (for PC) (type 2)
Specification No. : A20B–8001–0100





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
100g·cm or less
(3) Input axis permissible loads
(4) Weight : 1kg or less

	Radial	Thrust
Operation	1kg or less	1kg or less
Idle	20kg or less	10kg or less

Attach a pulley directly to the position coder shaft and drive the timing belt. Confirm that the loads conform with the above allowable value.

Fig.U25 Position coder
Specification No. : A86L–0026–0001#102 (Max. 4000rpm)
A86L–0026–0001#002 (Max. 6000rpm)

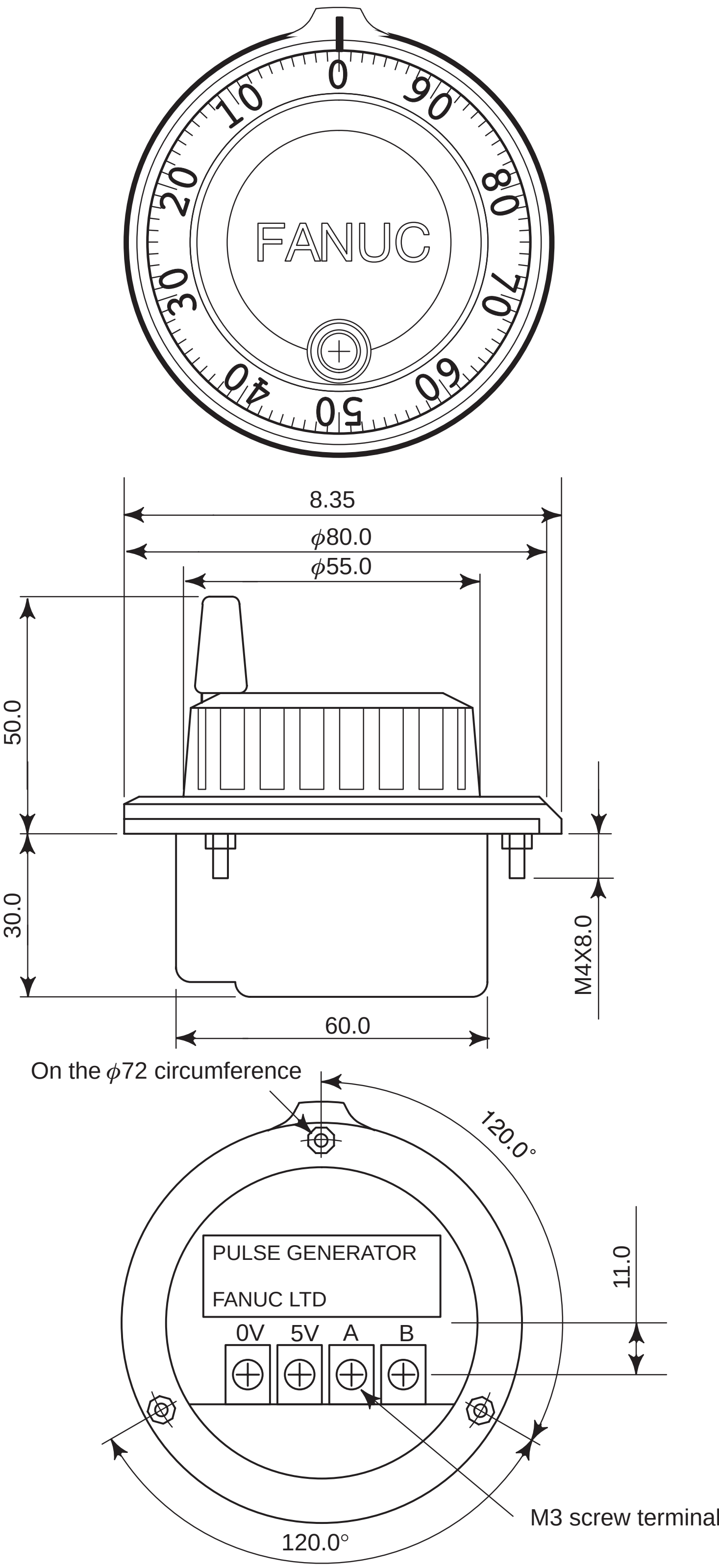
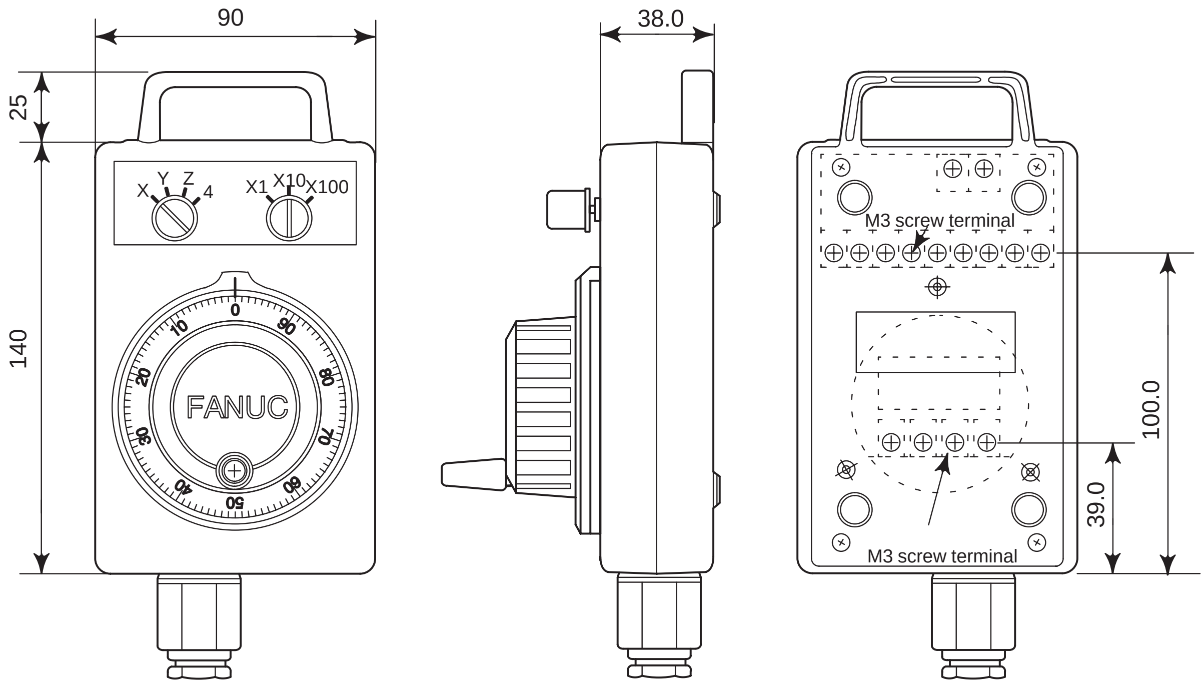


Fig.U26 Manual pulse generator
Specification No. : A860–0202–T001

(1) A860–0202–T004 to T009



(2) A860–0202–T010 to T015

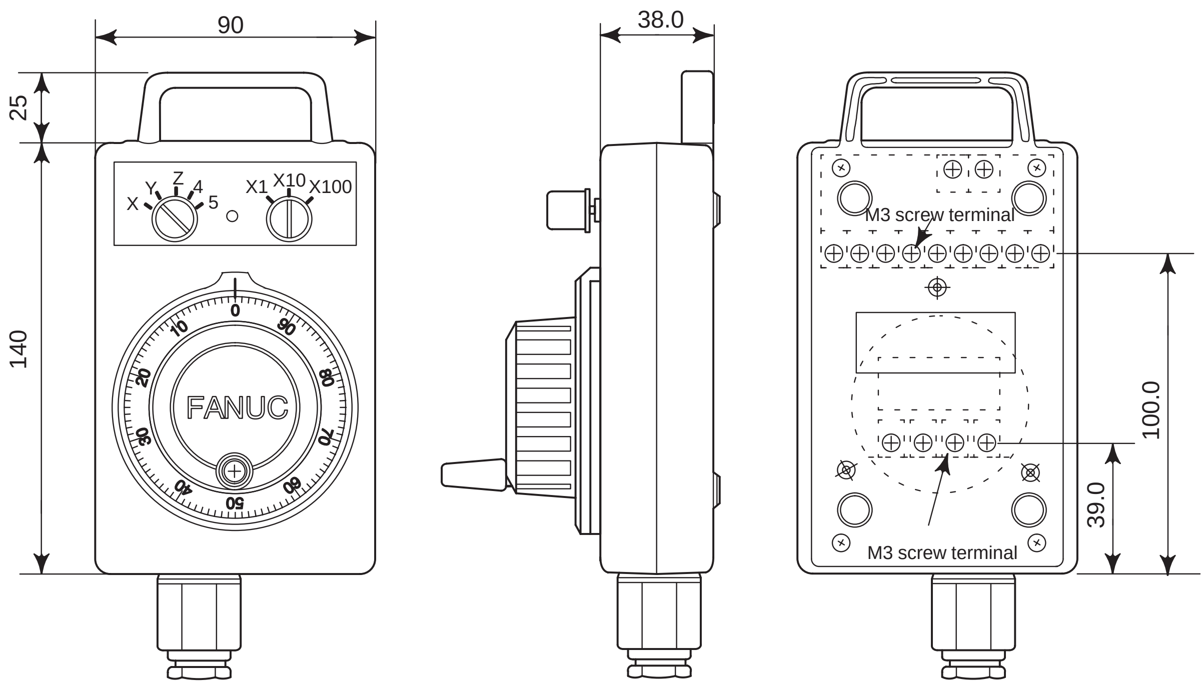


Fig.U27 Pendant type manual pulse generator Specification No. : A860–0202–T004 to T015

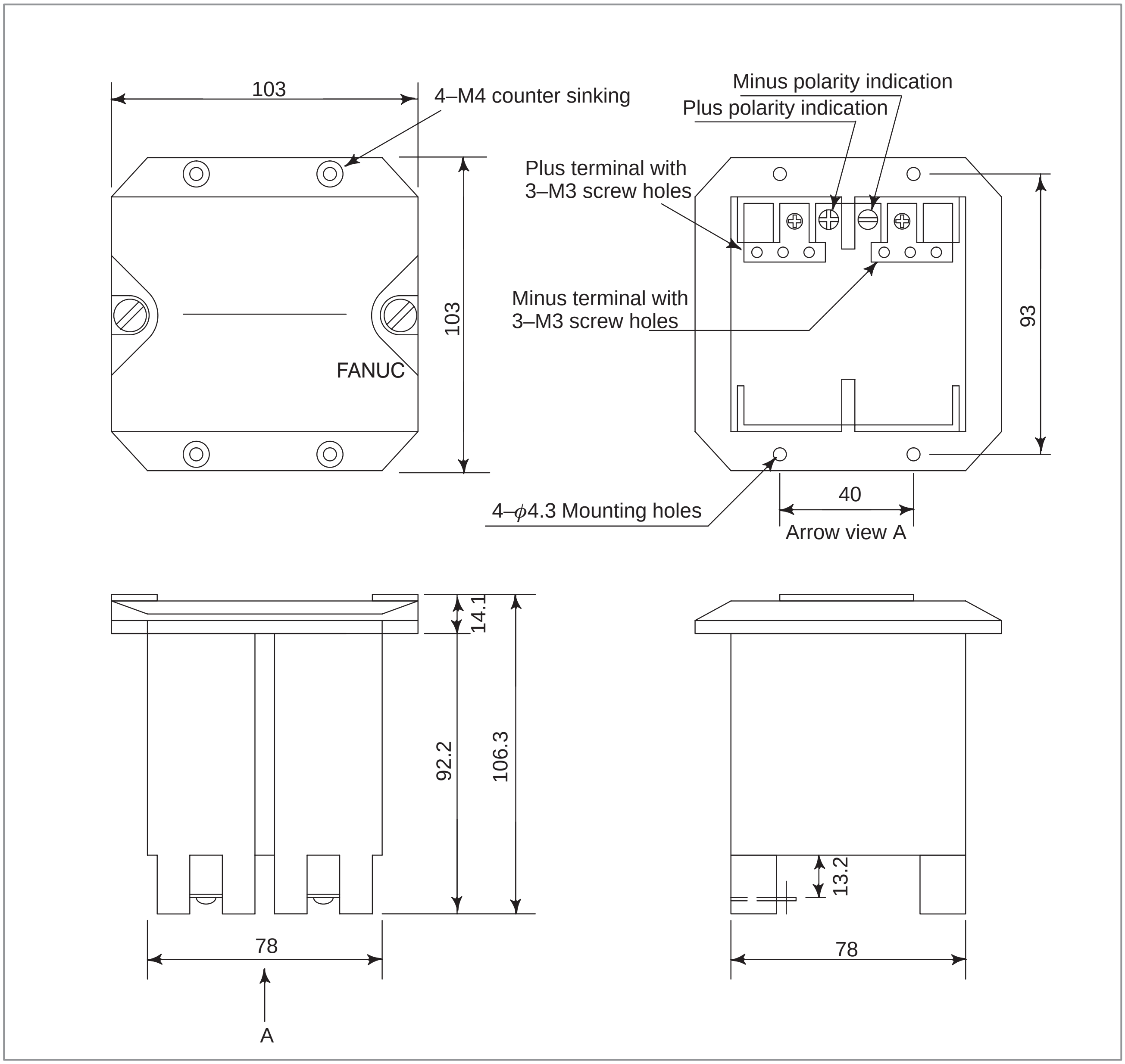
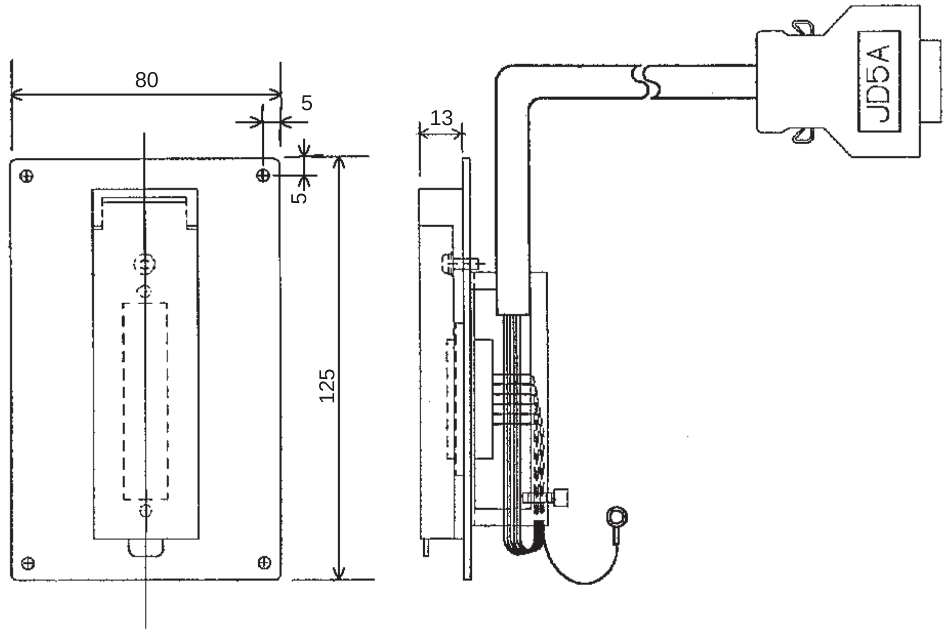


Fig.U28 ABS battery case for separate type detector
Specification No. : A06B–6050–K060



At the rear of the metal plate of the panel, the area within 8 mm of the perimeter is left unpainted

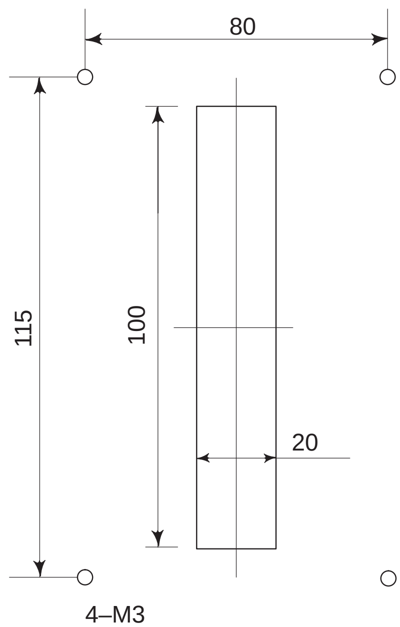
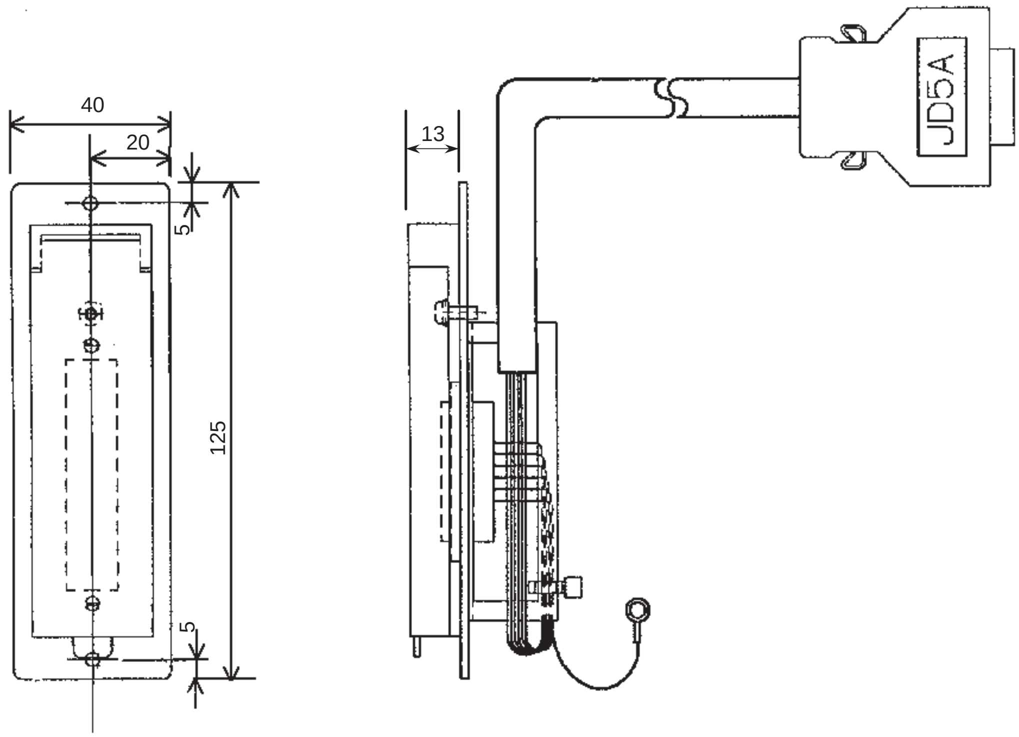


Fig.U29 Punch panel (wide width type)
Specification No. : A02B–0120–C181 (Cable length : 1m)
A02B–0120–C182 (Cable length : 2m)
A02B–0120–C183 (Cable length : 5m)



At the rear of the metal plate of the panel, the area within 8 mm of the perimeter is left unpainted

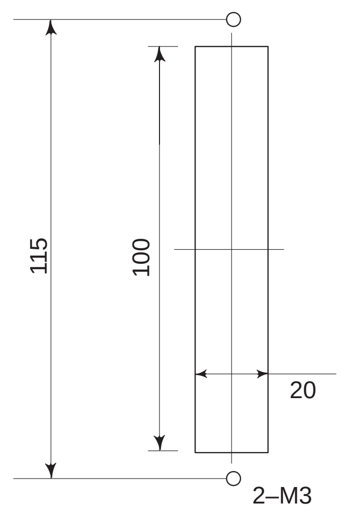
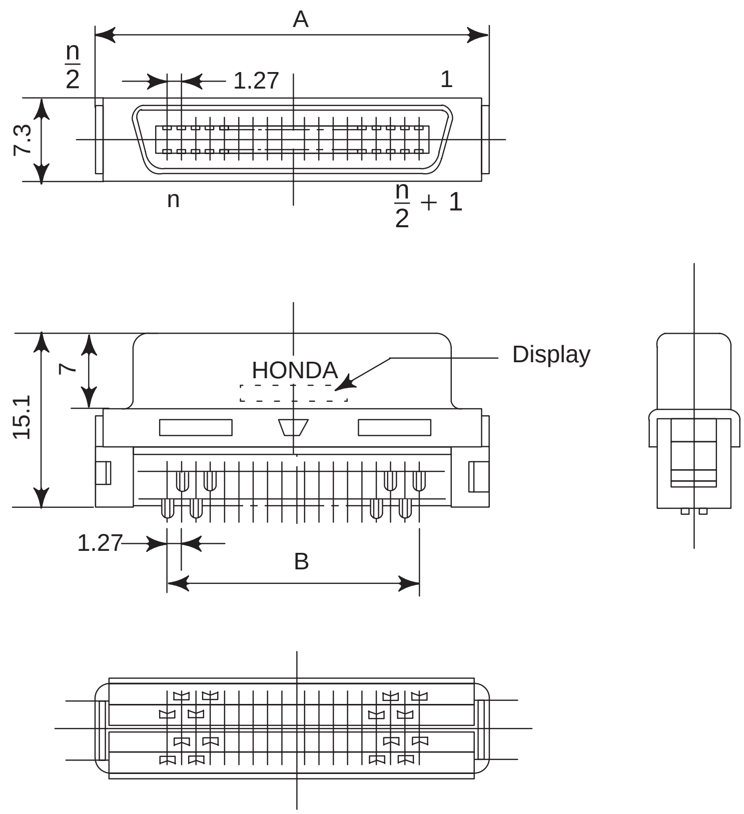


Fig.U30 Punch panel (narrow width type)
Specification No. : A02B–0120–C191 (Cable length : 1m)
A02B–0120–C192 (Cable length : 2m)
A02B–0120–C193 (Cable length : 5m)

Connectors

Name	Specification	Fig.Nos.
PCR connector (soldering type)	PCR–E20FS	Fig.C1(a)
FI40 connector	FI40–2015S	Fig.C1(b)
Connector case (Honda Tushin PCR type)	PCR–V20LA/PCR–V20LB	Fig.C2(a)
Connector case (Hirose Electric PCR type)	FI–20–CV	Fig.C2(b)
Connector case (Fujitsu FCN type)	FCN–240C20–Y/S	Fig.C2(c)
AMP connector 1 200VAC input	AMP1–178128–3	Fig.C3(a)
AMP connector 2 ON/OFF of MCC	AMP2–178128–3	Fig.C3(b)
AMP connector 3 +24V input of power supply unit	AMP1–178288–3	Fig.C3(c)
AMP connector 4 +24V output of power supply unit	AMP2–178288–3	Fig.C3(d)
Contact for AMP connector	AMP1–175218–2/5 AMP1–175196–2/5	Fig.C3(e)
Honda connector (case)		Fig.C4(a)
Honda connector (female connector)		Fig.C4(b)
Honda connector (male connector)		Fig.C4(c)
Honda connector (terminal layout)		Fig.C4(d)
Connector made by Burndy Japan (3 pins, black)	SMS3PK–5	Fig.C5(a)
Connector made by Burndy Japan (3 pins, brawn)	SMS3PN–5	Fig.C5(b)
Connector made by Burndy Japan (6 pins, brawn)	SMS6PN–5	Fig.C5(c)
Connector for Hirose flat cable	HIF3BB–50D–2.54R	Fig.C6
Connector for Yamaich Electric flat cable	NFP–10A–0122,–0124	Fig.C7
Punch panel connector for reader /puncher interface		Fig.C8(a)
Locking plate for reader /puncher interface connector		Fig.C8(b)
Contact for 9″ PDP power supply cable	SVH–21T–1.1	Fig.C9(a)
Housing for 9″ PDP power supply cable	VHR–2N	Fig.C9(b)

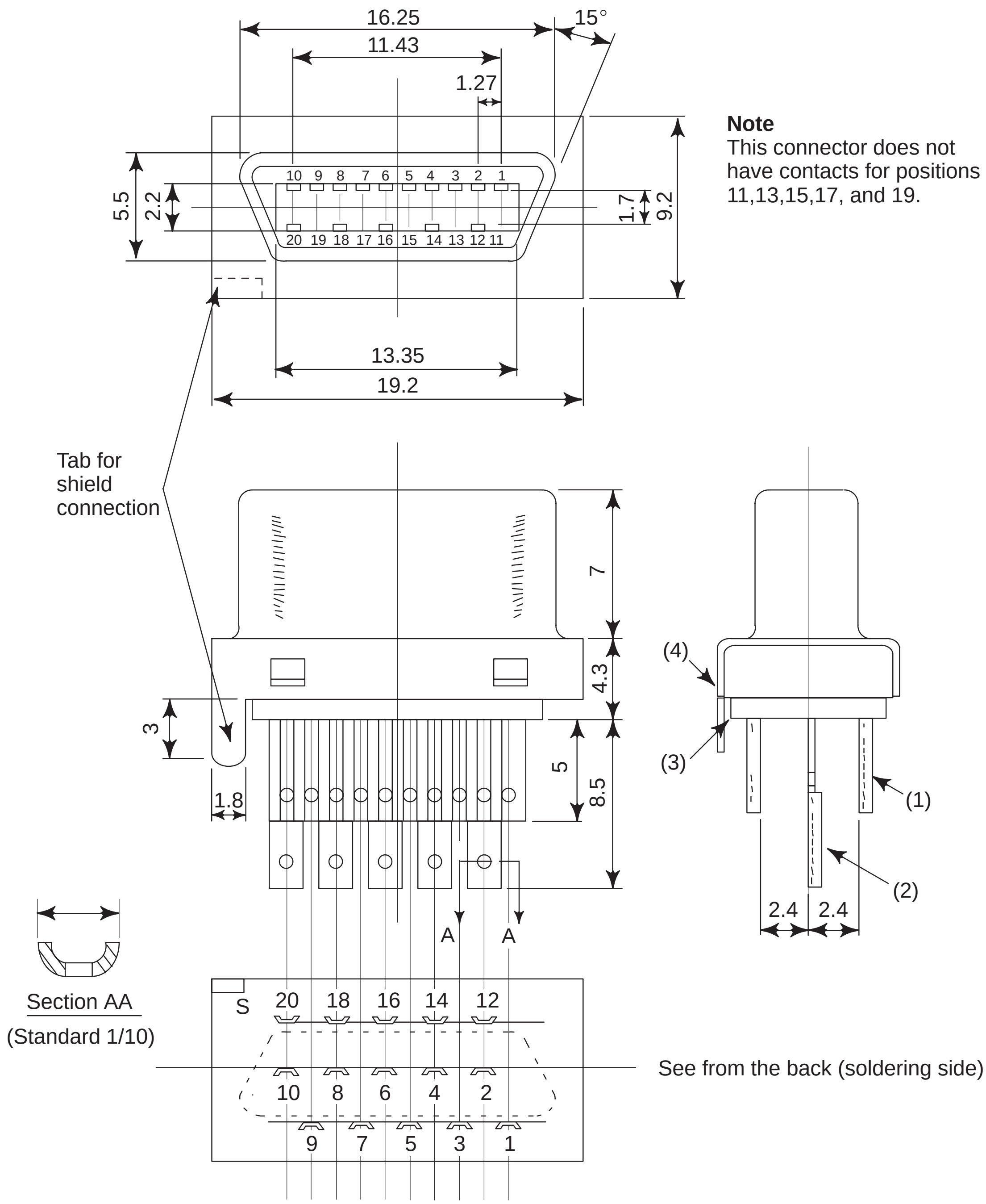
TYPE : HONDA PCR–E20FS(SOLDERING TYPE)
USAGE : GENERAL
MATING : HONDA PCS–E20LA(METAL)
HOUSING : HONDA PCS–E20L(PLASTIC)



	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



Note
This connector does not have contacts for positions 11,13,15,17, and 19.

Fig.C1 (b) FI40 connector

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

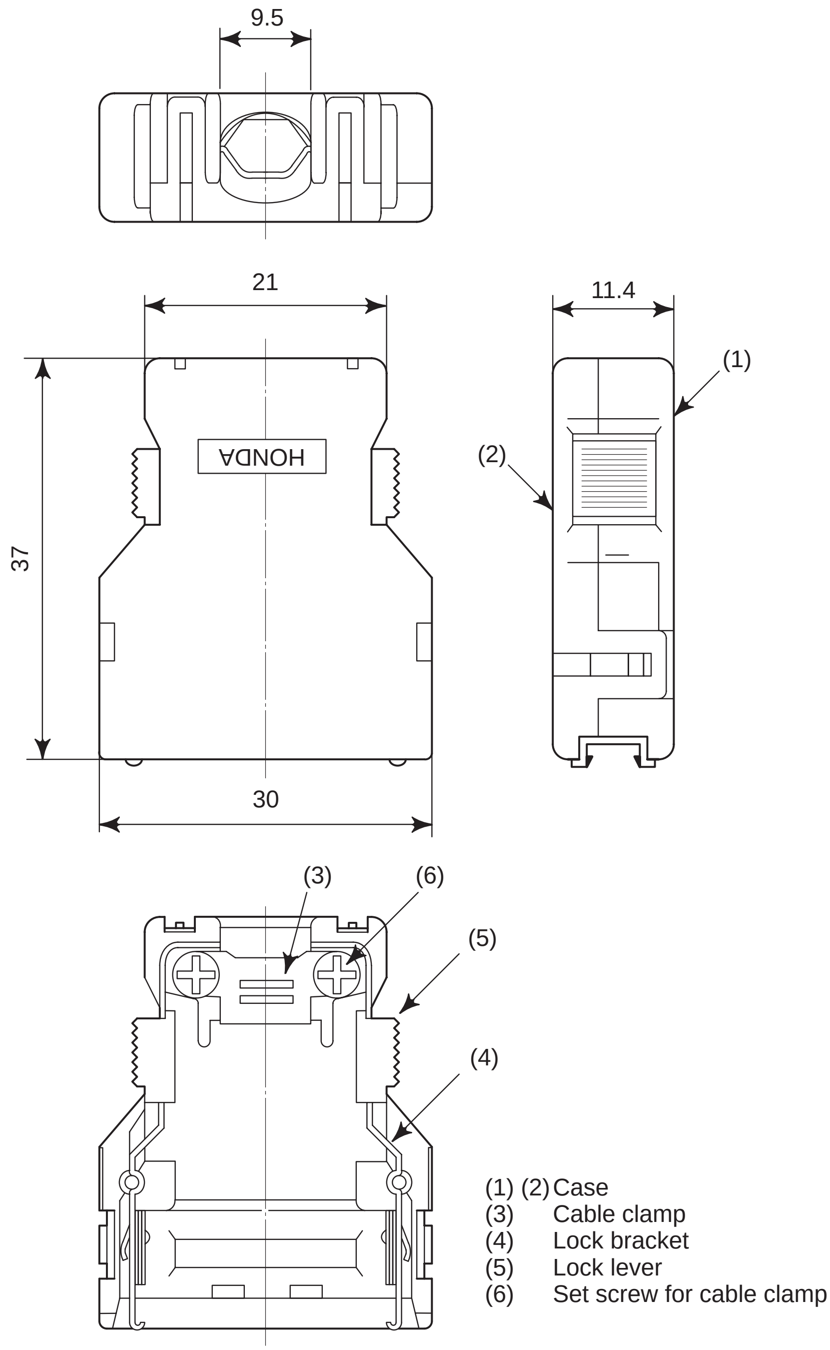


Fig.C2 (a) Connector case (HONDA PCR type)

TYPE : HIROSE FI–20–CV

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

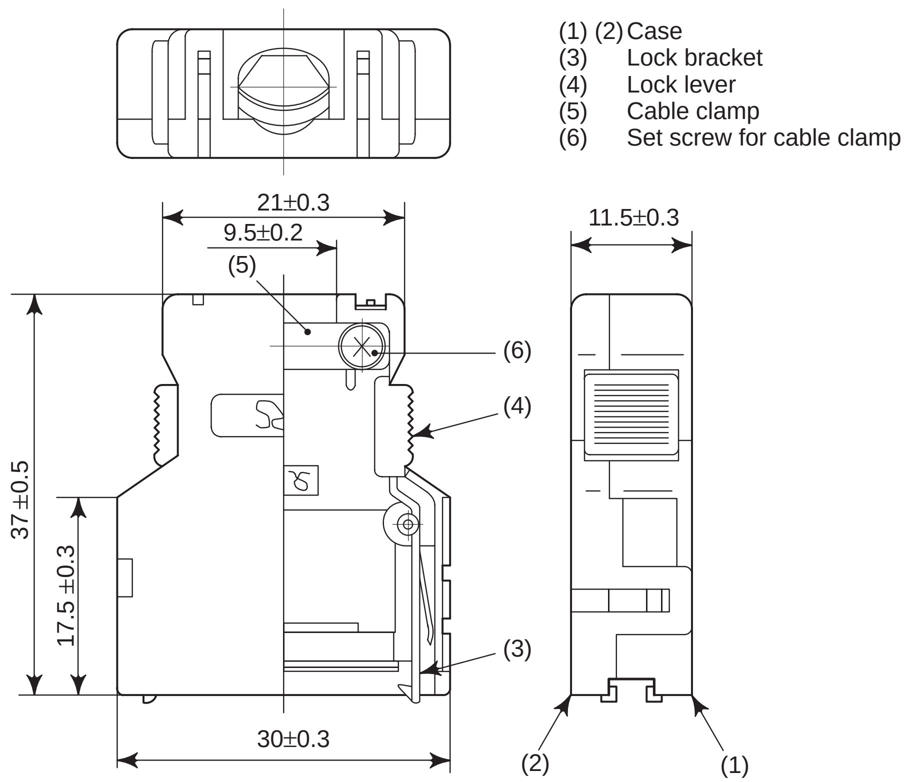


Fig.C2 (b) Connector case (HIROSE FI type)

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

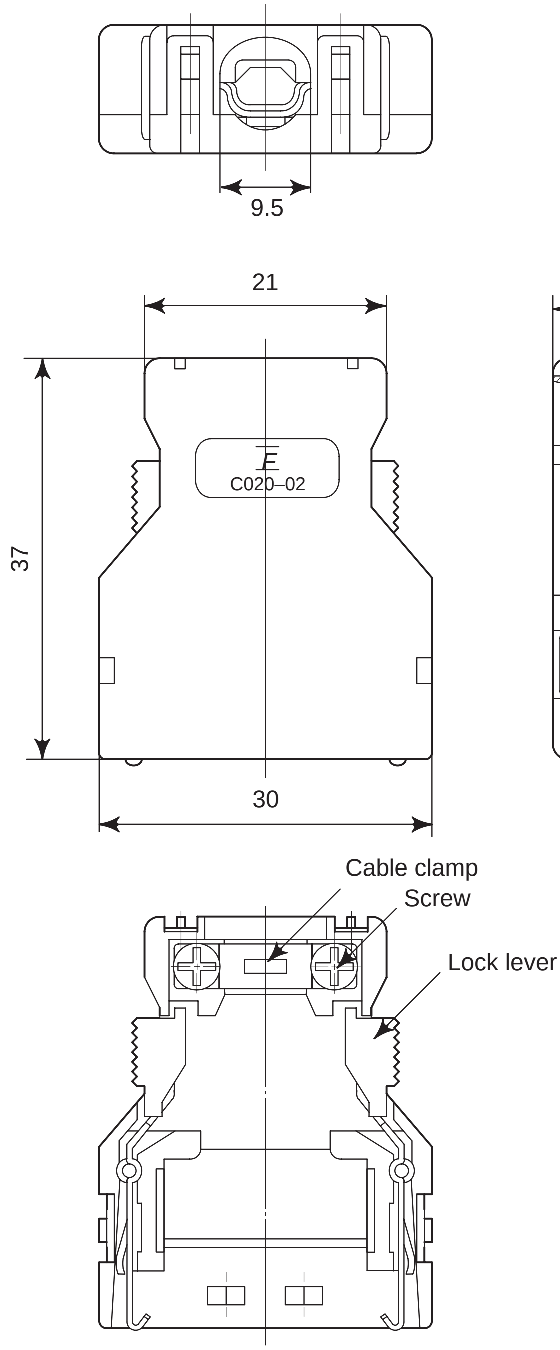


Fig.C2 (c) Connector case (FUJITSU FCN type)

TYPE : AMP1–178128–3

DIMENSION

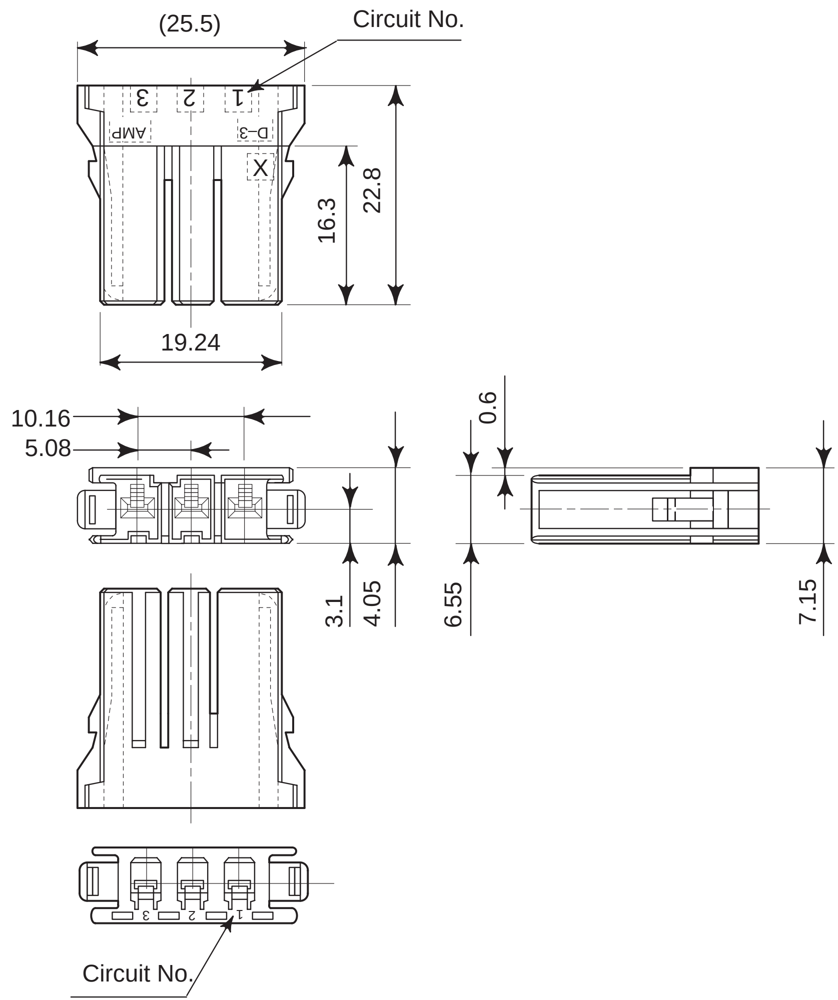


Fig.C3 (a) AMP connector (1)

TYPE : AMP2–178128–3

DIMENSION

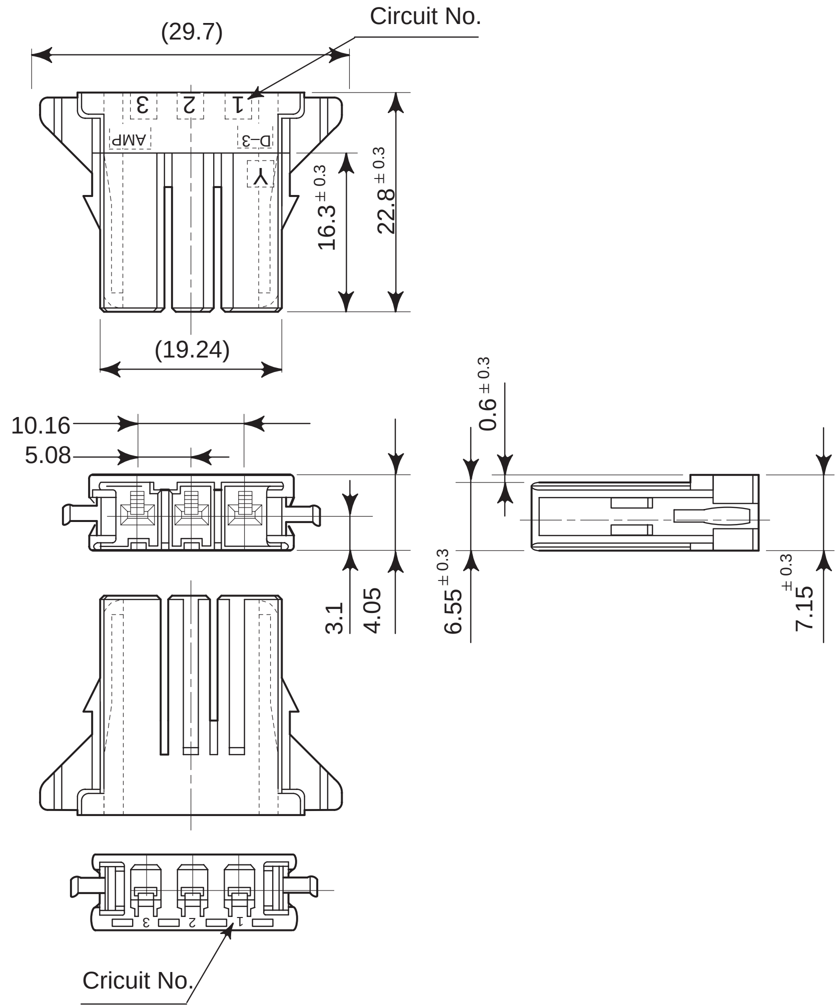


Fig.C3 (b) AMP connector (2)

TYPE : AMP1–178288–3

USAGE : POWER SUPPLY UNIT CP1A
+24V INPUT

3	
2	0V
1	+24V

DIMENSION

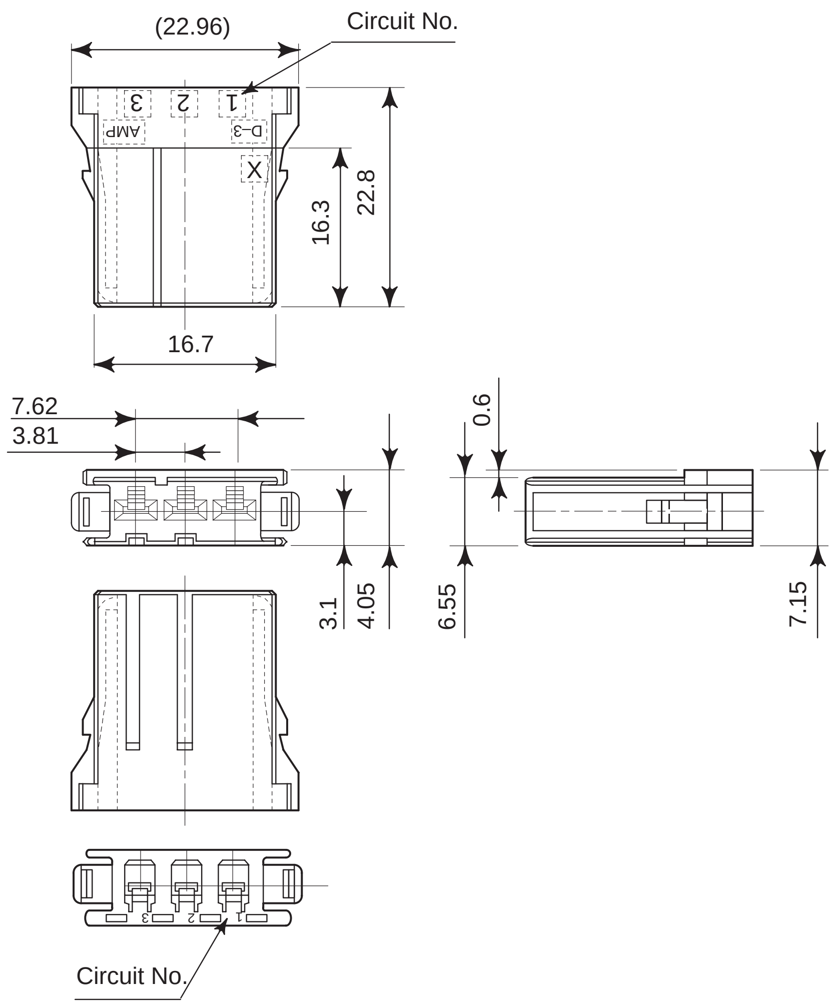


Fig.C3 (c) AMPconnector (3)

TYPE : AMP2–178288–3

USAGE : POWER SUPPLY UNIT CP1B
+24V OUTPUT

3	
2	0V
1	+24V

DIMENSION

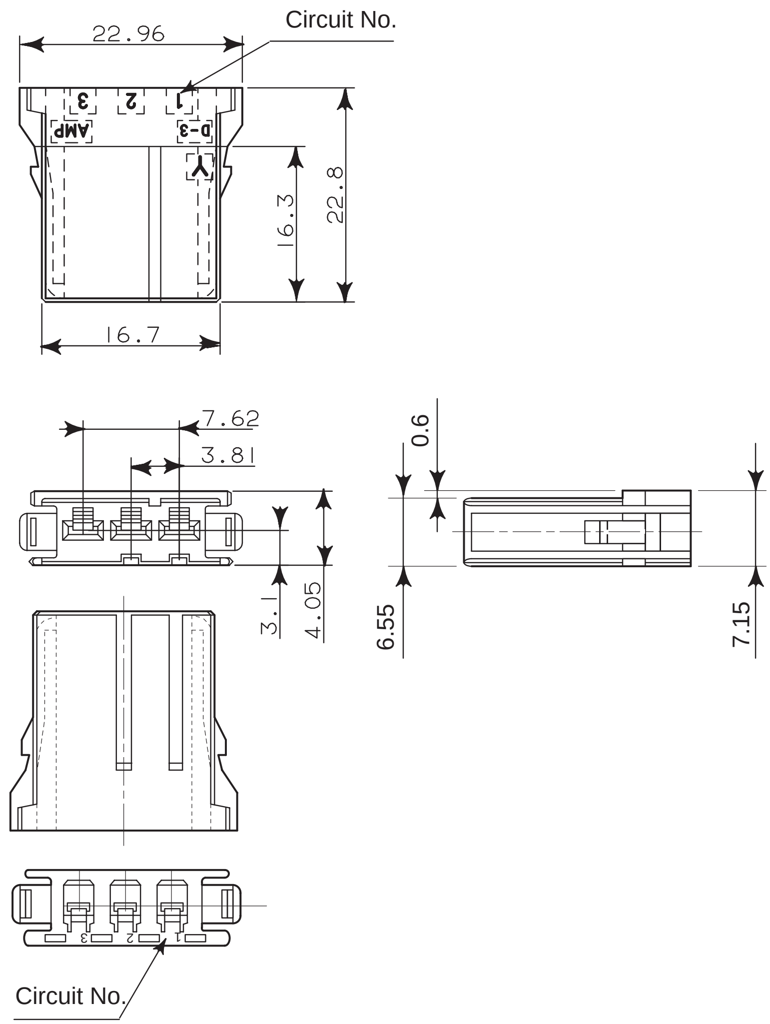


Fig.C3 (d) AMP connector (4)

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

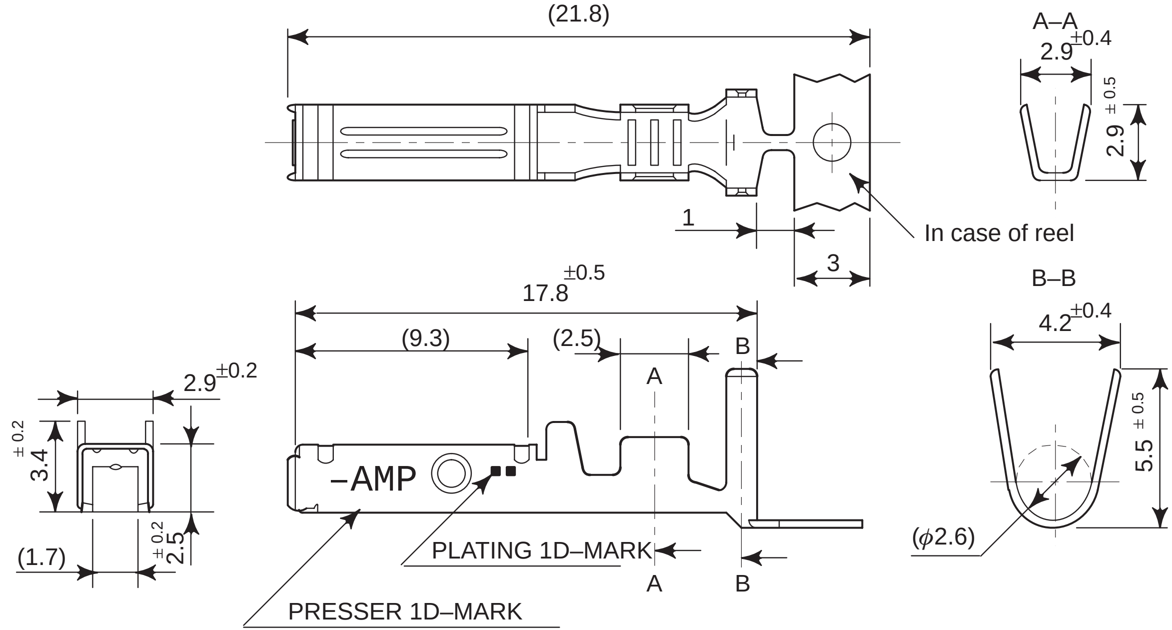
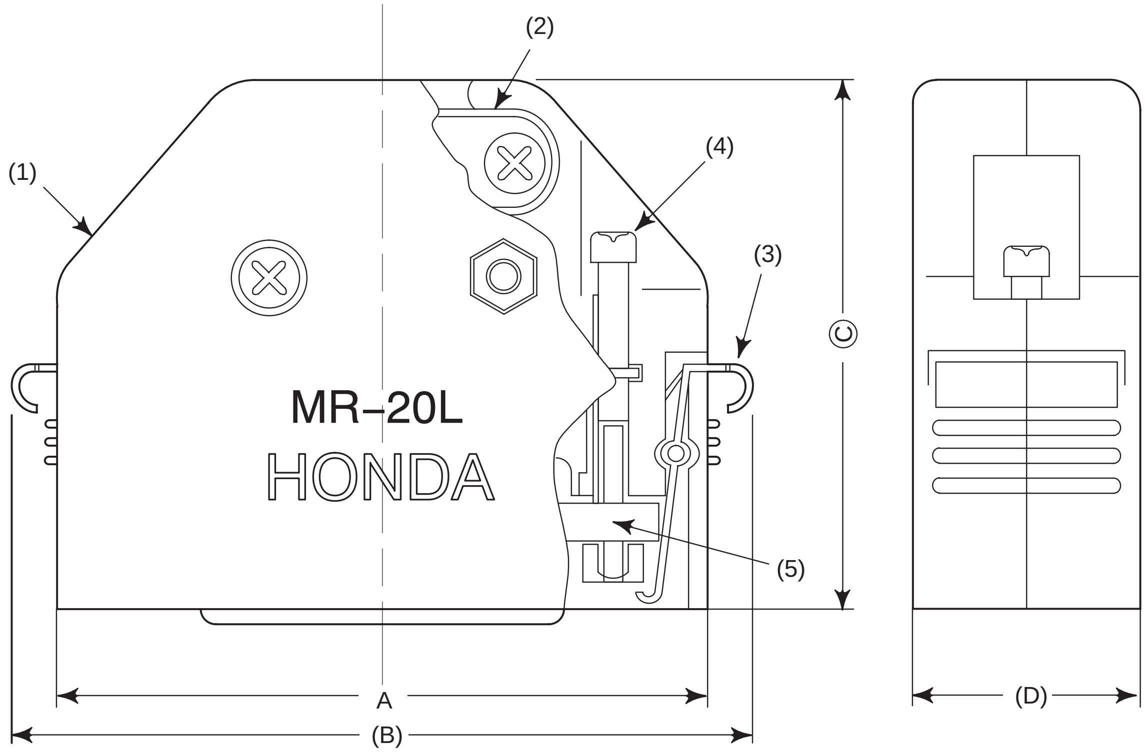


Fig.C3 (e) Contact for AMP connector

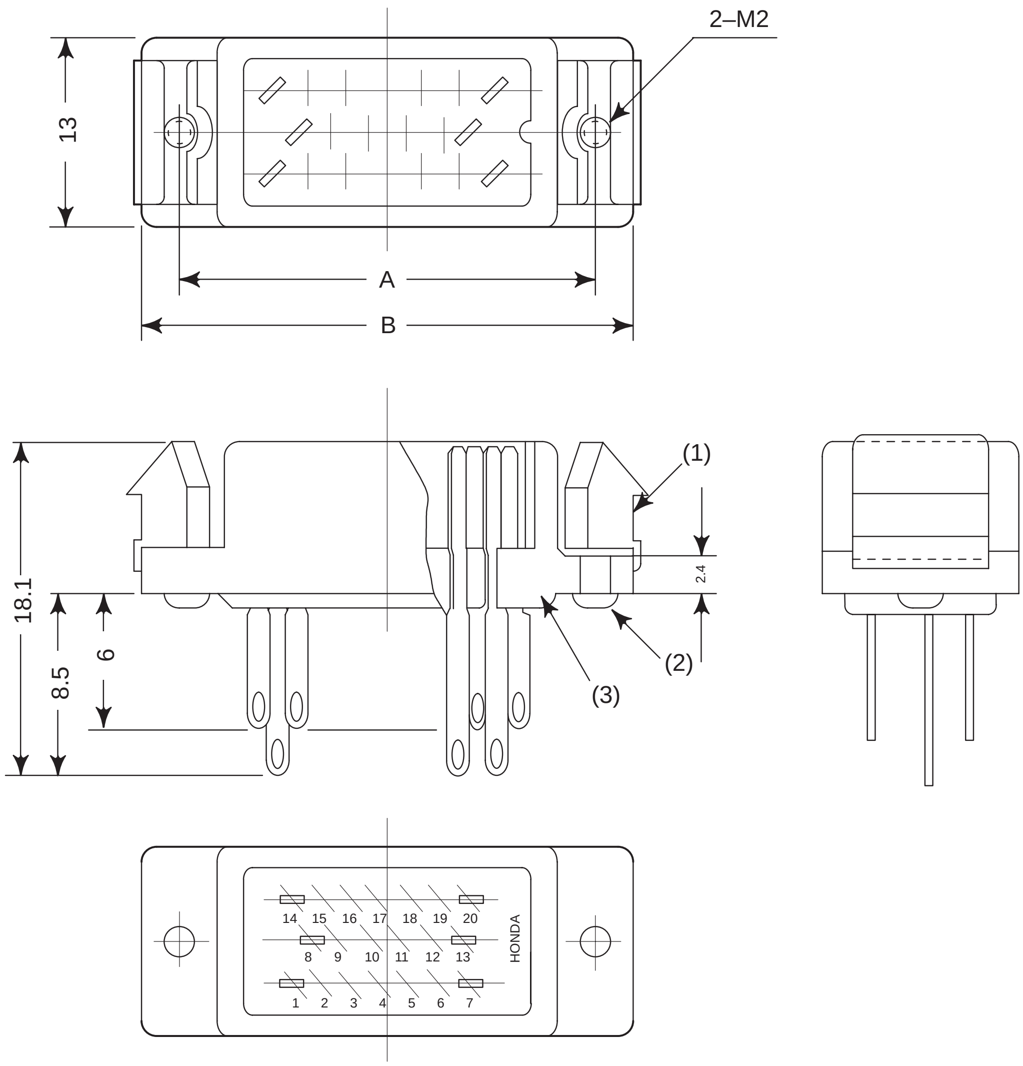


Symbol / Specification	A	(B)	C	(D)	Number of terminals
MR–20LMH (Plug)	39.3	44.9	39.8	17	20
MR–20LFH (Jack)					
MR–50LMH (Plug)	67.9	73.5	44.8	18	50
MR–50LFH (Jack)					

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)

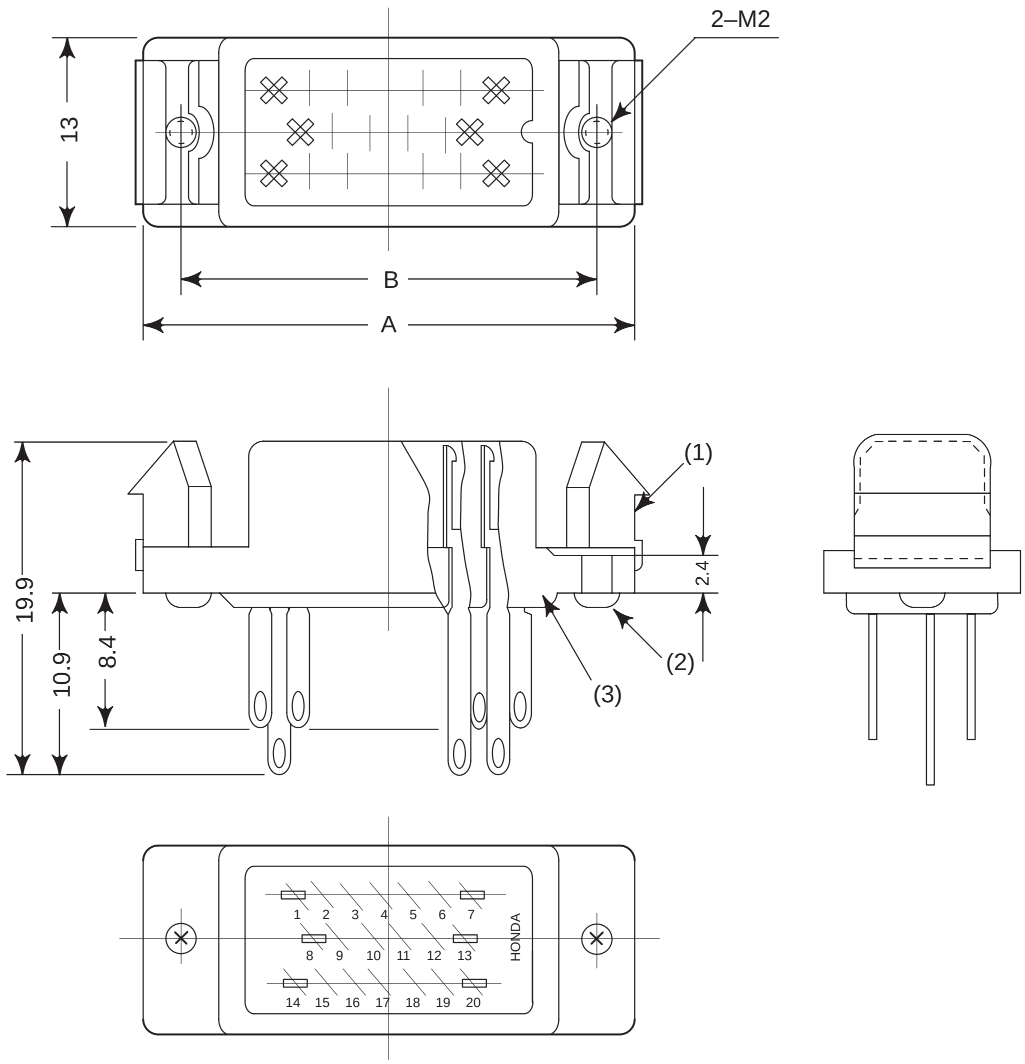


	A	B
MR–20RMH	32.8	27.8
MR–50RHF	61.4	56.4

Number of terminals
20
50

Symbol	Name
1	Cable clamp
2	Screw 2.6dia.×8
3	Connector (MR–20,–50MH)

Fig.C4 (b) 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 (c) HONDA connector (female)

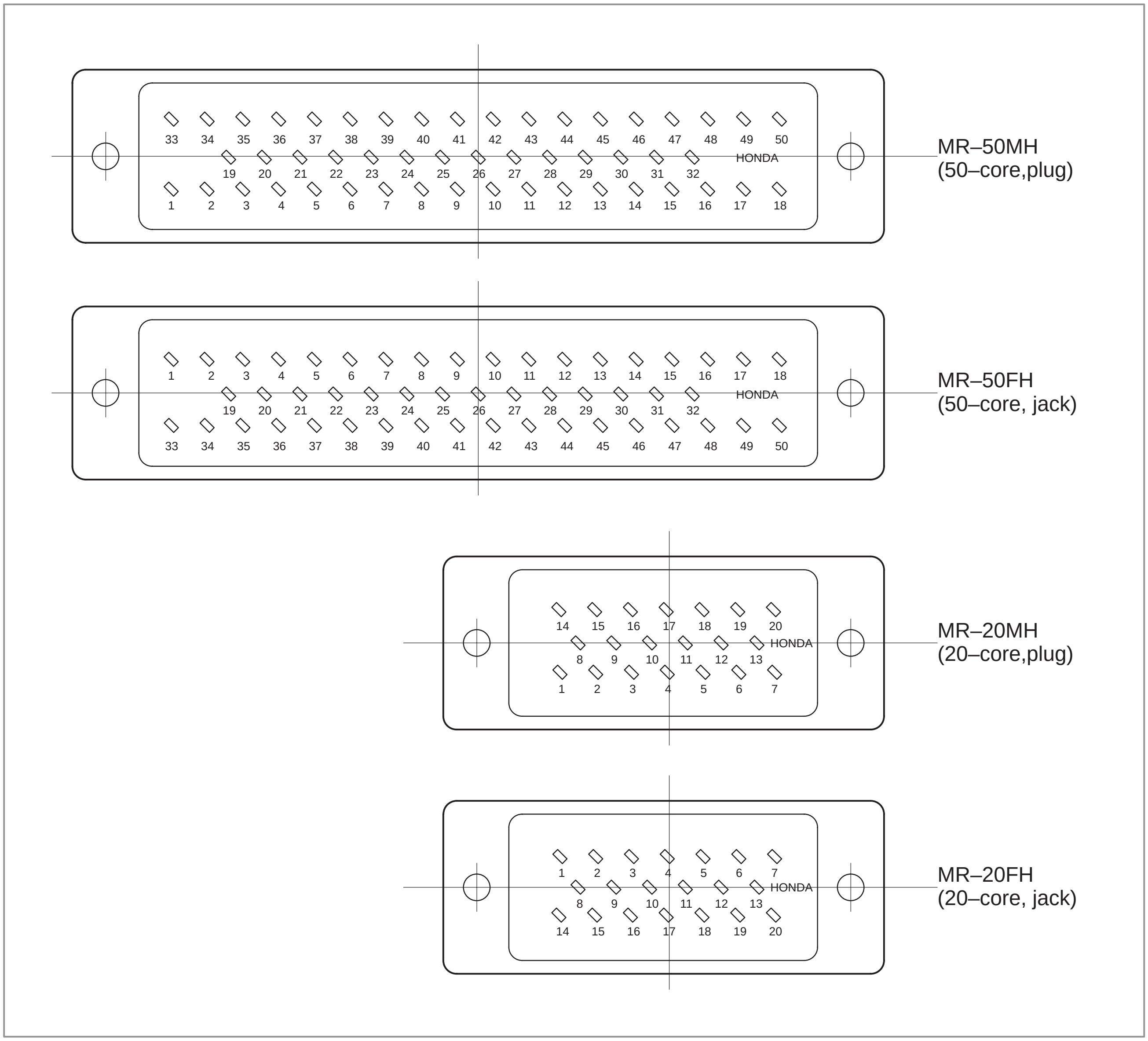
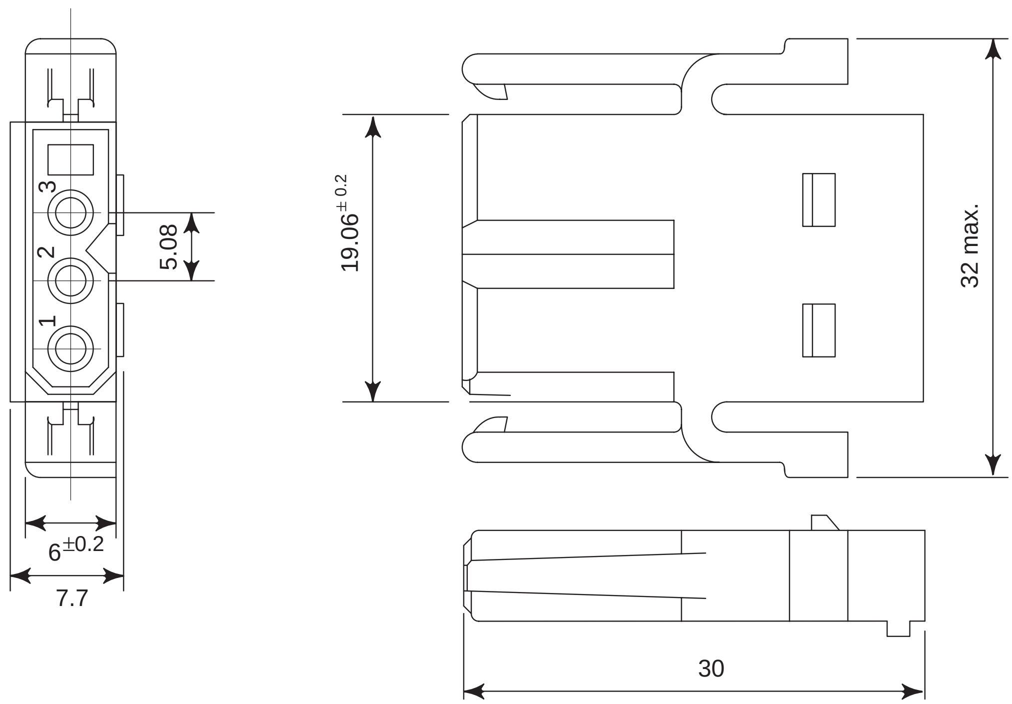


Fig.C4 (d) HONDA connector (terminal layout)

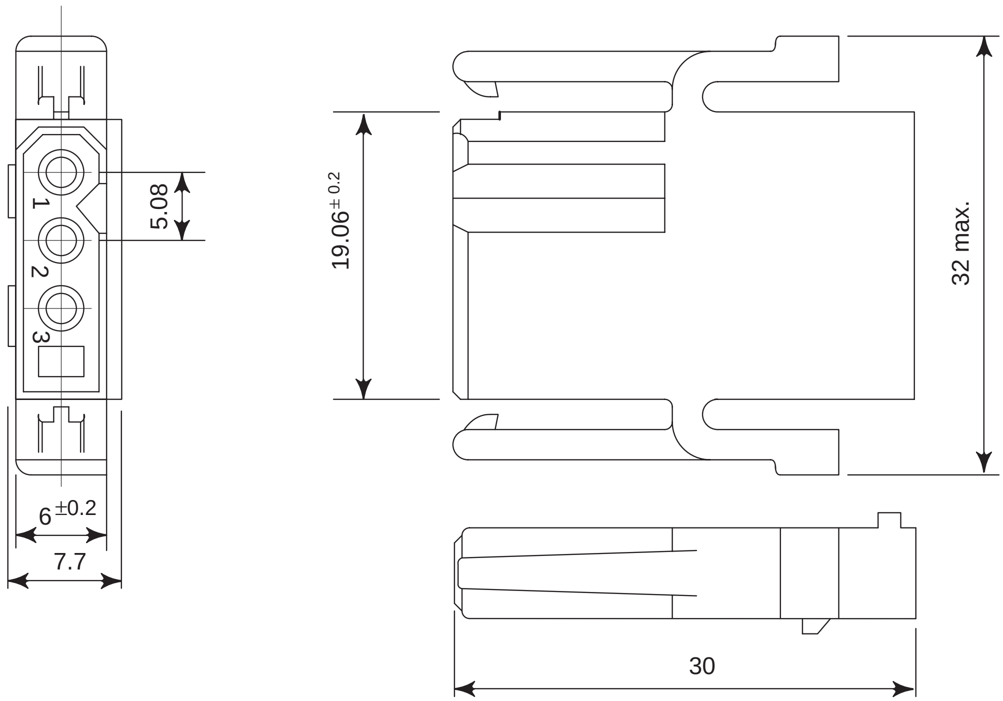


Manufacturer : Burndy Japan Corp.

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 (a) Connector made by Burndy Japan (3 pins,black)

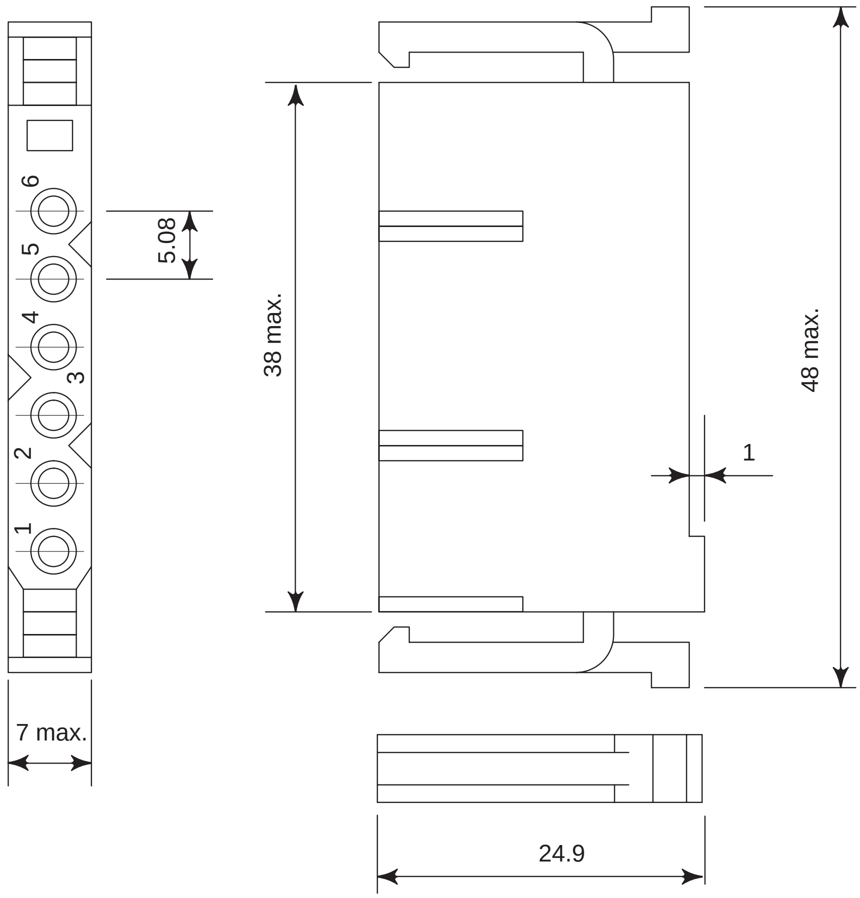


Manufacturer : Burndy Japan Corp.

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(b) Connector made by Burndy Japan (3 pins,brown)



Manufacturer : Burndy Japan Corp.

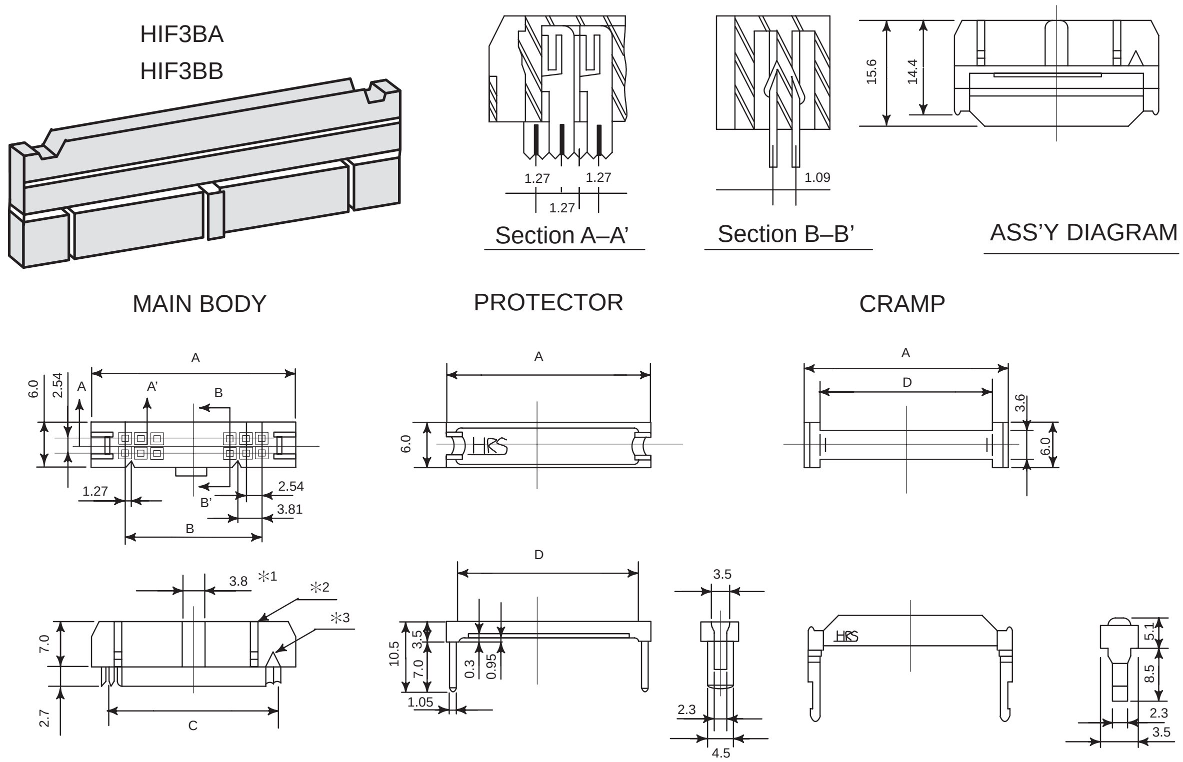
Name		Specification (Connector maker number)	Remarks
Connector housing for cable		SMS6PN–5	Brown
Contact	(Crimp type)	RC16M–23T3	For details on tools required for crimp terminals,contact the manufacturer.
	(Solder type)	RC16M–SCT3	

Cables : Cross sectional area : 1.27mm^2(50/0.18)
Insulation diameter : 2.8mm max
Peeling length : 7.2mm

Fig.C5 (c) Connector made by Burndy Japan (6 pins,brown)

CONNECTOR FOR FLAT CABLE (HIROSE ELEC. CO.)

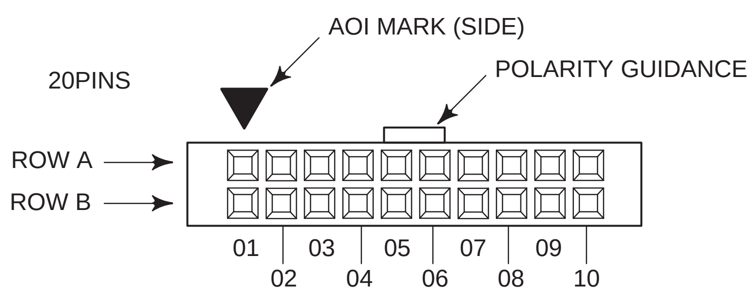
Specification HIROSE ELEC. CO.
HIF3BB–50D–2. 54R (50contacts)



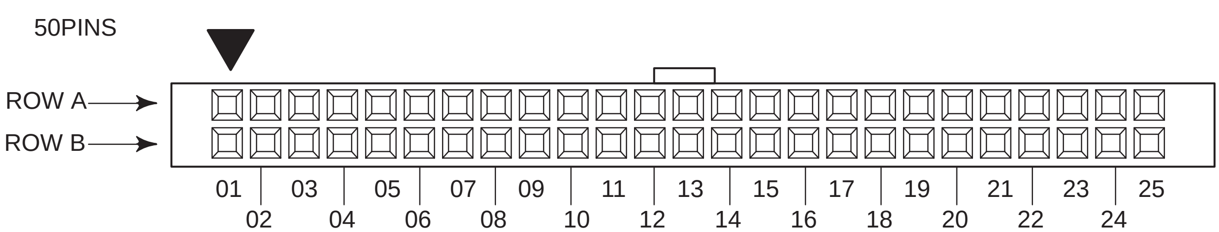
Dimensions

Description	No.of contact	A	B	C	D
HIF3BB–50D–2.54R	50	68.07	60.96	62.23	63.6

FLAT CABLE CONNECTOR CONTACT NUMBER (HIROSE)

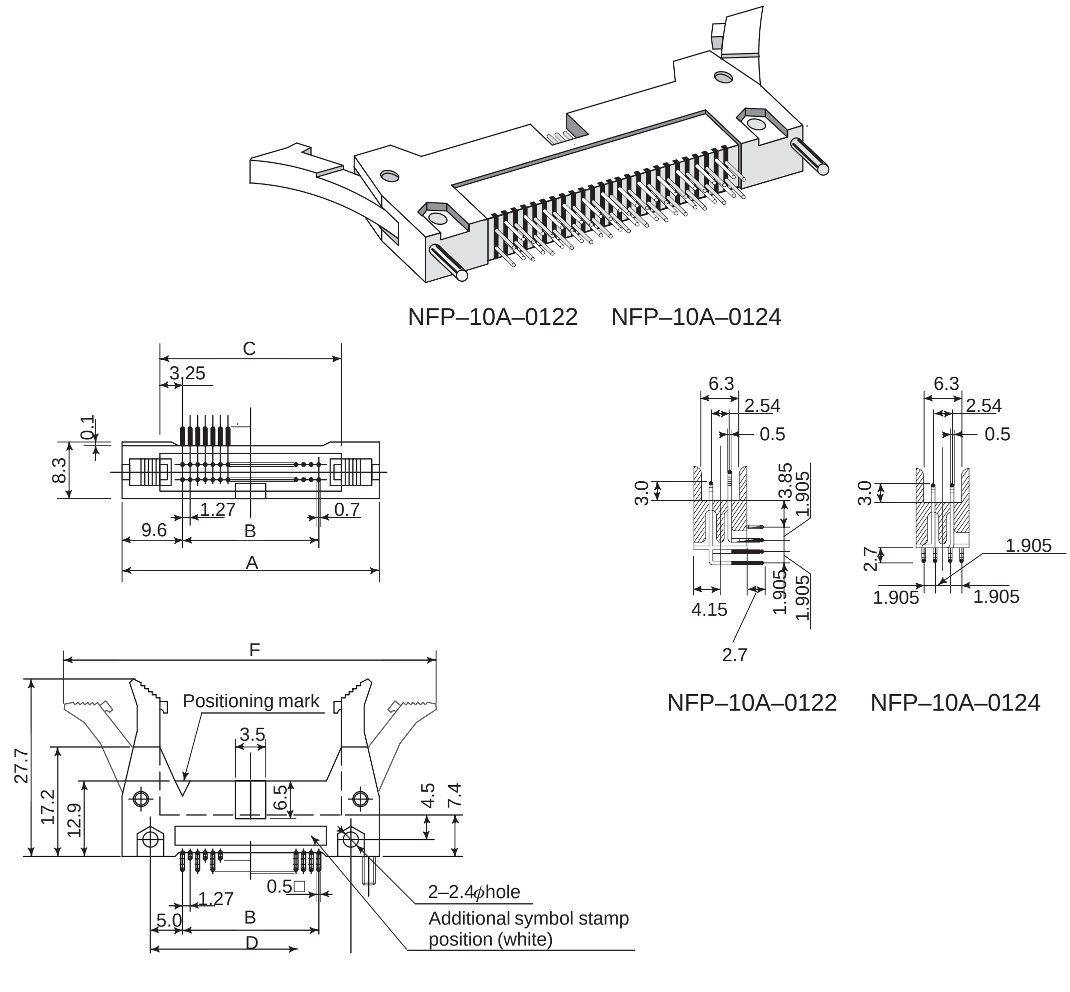


OUTVIEW FROM CONNECTOR SIDE.



OUTVIEW FROM CONNECTOR SIDE.

Fig.C6 Connector for HIROSE Flat cable



Name	A	B	C	D	E	F
NFP–10A–0122·0124	24.28	5.08	11.58	15.08	20.48	40.2

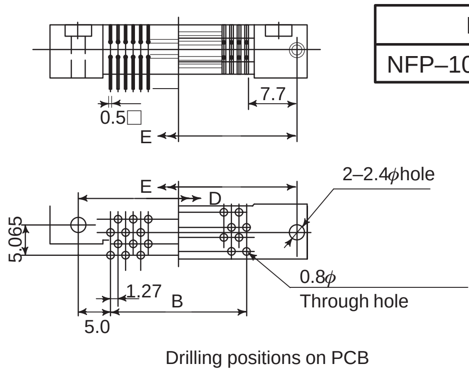


Fig.C7 Connector for Yamaich Electric Flat cable

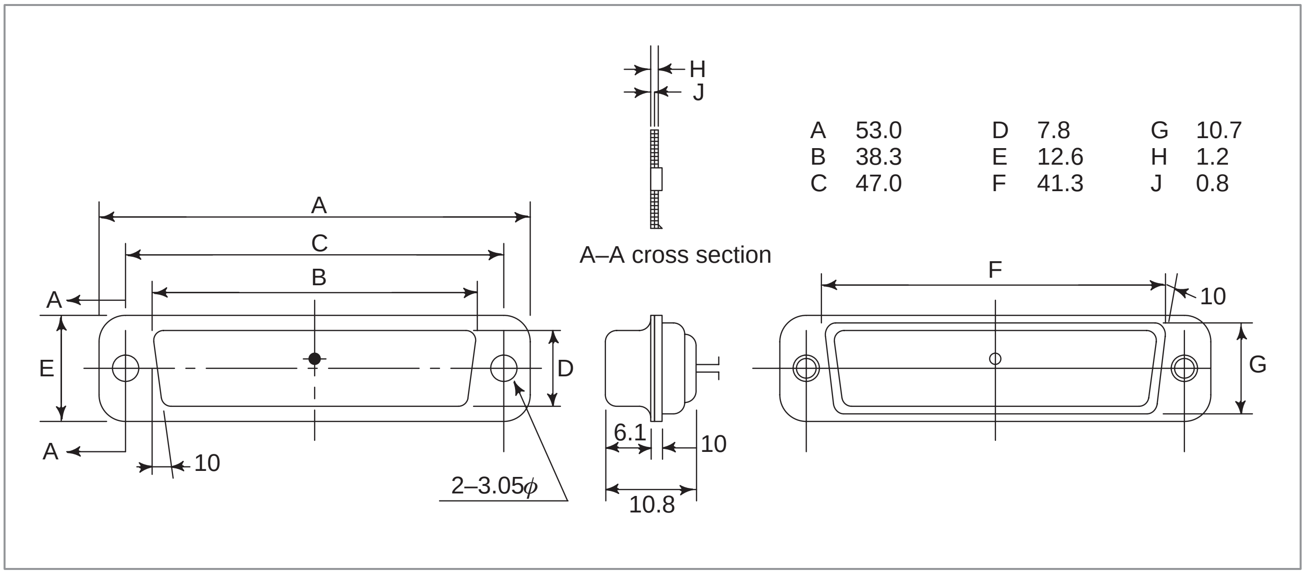


Fig.C8 (a) Punch panel connector for reader/puncher interface

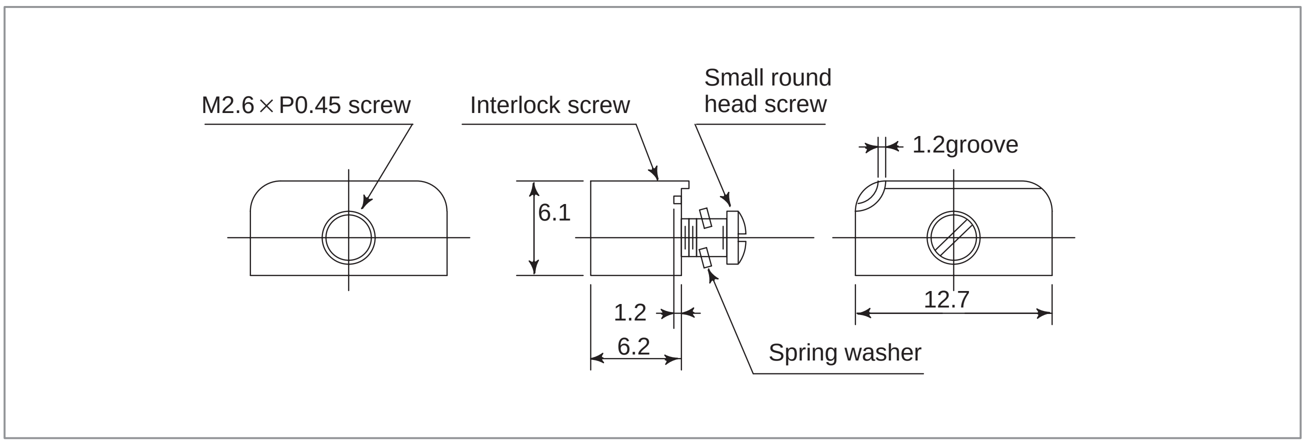
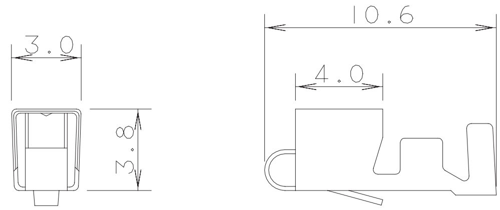
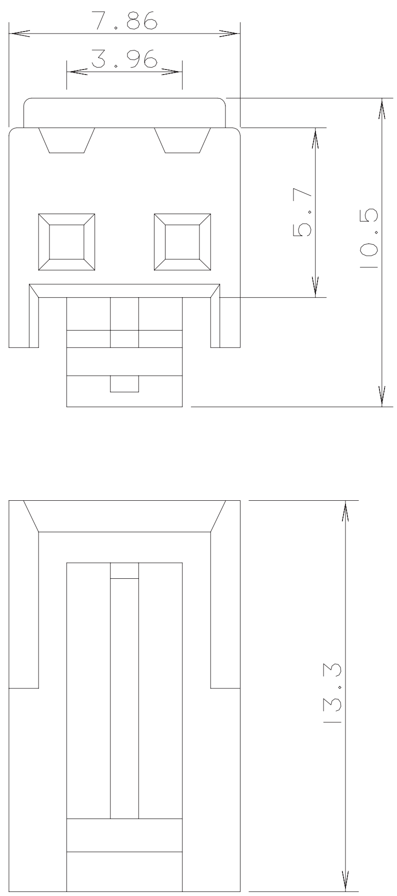


Fig.C8 (b) Locking plate plate for reader/puncher interface connector



Mode	Applicable wire range		Insulation diameter (mm)	Material	Surface treatment	Quantity/reel
	mm^2	AWG#				
SVH–21T–1.1	0.33 to 0.83	22 to 18	1.7 to 3.0	Brass	Tinned	4500
SVH–21T–P1.1				Phosphor bronze		

Fig.C9 (a) Contact for 9″ PDP power supply cable



Specification:
VHR–2N
Material:
Nylon 6
UL94V–0,
natural
Quantity/bag:
1000

Fig.C9 (b) Housing for 9″ PDP power supply cable

B 20–PIN INTERFACE CONNECTORS AND CABLES

B.1 OVERVIEW

This section explains the recommended (FANUC–approved) connectors for the 20–pin interface, used with the following target models, and the corresponding cables.

B.2 ADDITIONAL TARGET MODELS

- FANUC Series 16/18–MODEL A
- FANUC Series 16/18–MODEL B
- FANUC Series 16/18–MODEL C
- FANUC Series 15/150–MODEL A
- FANUC Series 15/150–MODEL B
- FANUC Series 20
- FANUC Series 21/210
- FANUC Power Mate–MODEL C/D/E/F/H/I/J
- FANUC I/O Unit–MODEL A
- FANUC I/O Unit–MODEL B
- FANUC AC SERVO AMPLIFIER C series
- FANUC AC SERVO UNIT D series
- FANUC CONTROL MOTOR AMPLIFIER α series
- FANUC CONTROL MOTOR AMPLIFIER β series

B.3 BOARD–MOUNTED CONNECTORS

Model : PCR–EV20MDT produced by Honda Tsushin or
52618–2011 produced by Japan Molex

The board–mounted connector has been specially developed to achieve the FANUC proprietary high packing density. However, the mating mechanism of the connector is compatible with that of Honda PCR series connectors. Therefore, Honda PCR series connectors can be used as cable connectors. Because cable connectors support this specification extensively, many connector manufacturers offer custom–tailored models.

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)
		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.

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)		Metal housing
	FI30–20S (Hirose Electric)	FI–20–CV2 (Hirose Electric)		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–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.

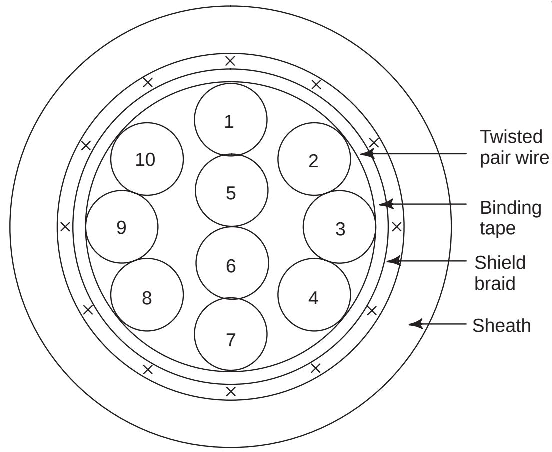
Material	Use	Constitution	FANUC specification number	Manufacturer	Remark
10–pair cable	General use	0.08mm^2 10–pair	A66L–0001–0284 #10P	Hitachi Cable, Ltd. Oki Electric Cable Co., Ltd.	
6–pair cable	CRT interface (press–mount)	0.08mm^2 6–pair	A66L–0001–0295	Hitachi Cable, Ltd.	20 m or less
6–conductor 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 more
	Dielectricstrength (AC)	V/min.	300
Flame resistance		–	Shall pass flame resistance test VW–1SC of UL standards.

(b) Cable structure

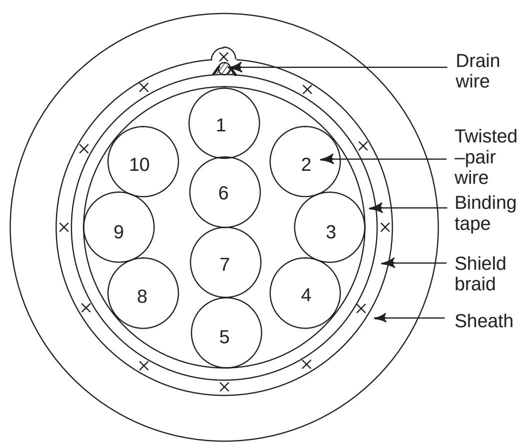


Wire identification table (Hitachi)

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

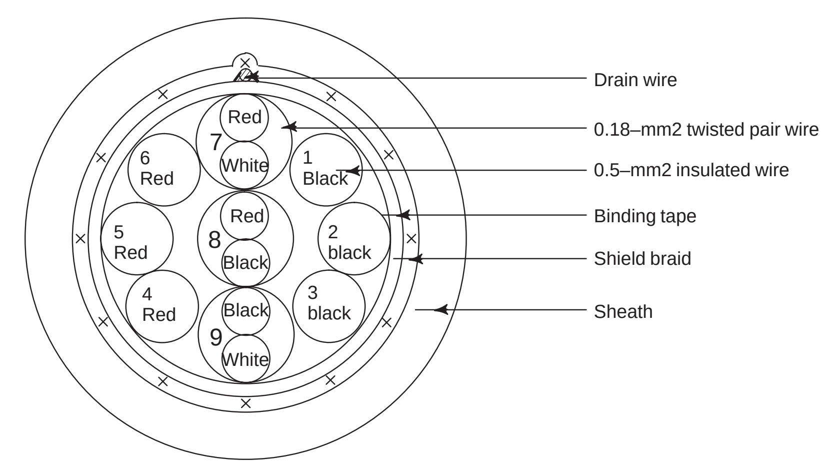
(a) Specifications

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.

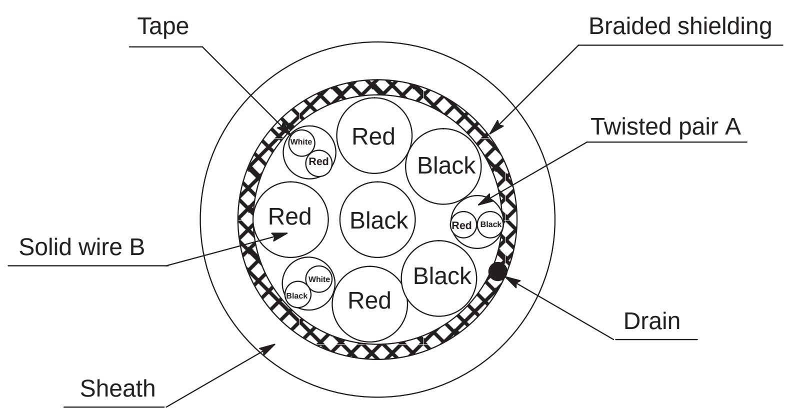
(b) Cable structure
The cable structure is shown below.



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.			

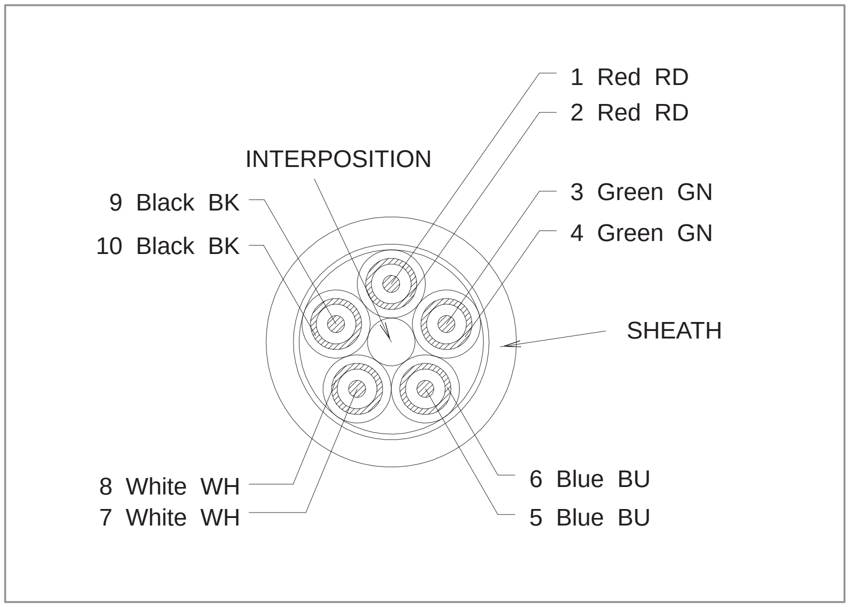
Item		Specification			
FANUC specification number		A66L–0001–0402		A66L–0001–0403	
Manufacturer		Oki Electric Cable Co., Ltd.			
		A–conductor	B–conductor	A–conductor	B–conductor
Finished assembly performance	Rating	80°C 30V			
	Standard	Shall comply with UL STYLE 20236 and CSA LL43109 AWM I/II A 80°C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

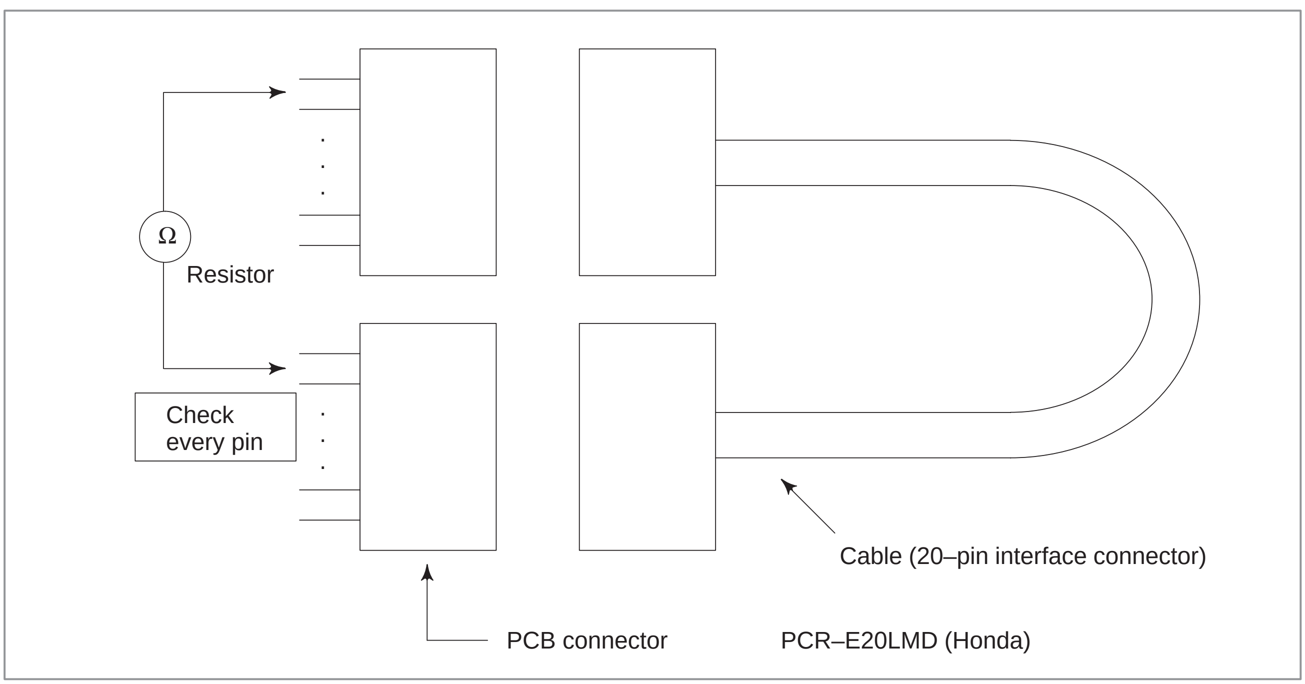
(a) List of specifications

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 Conductor	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

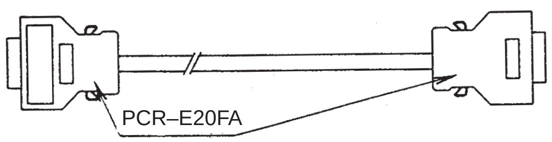
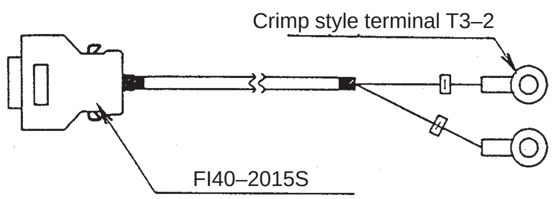


An example of circuit testing 20–pin interface cable

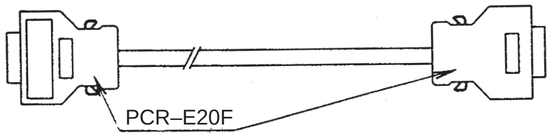
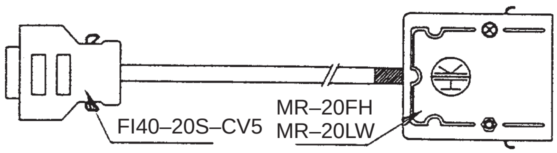
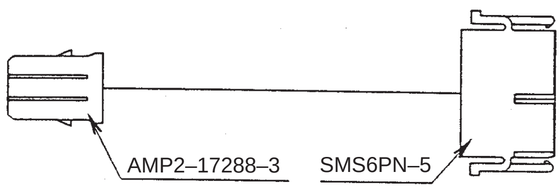


C CONNECTION CABLE (SUPPLIED FROM US)

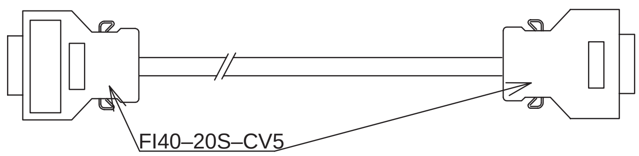
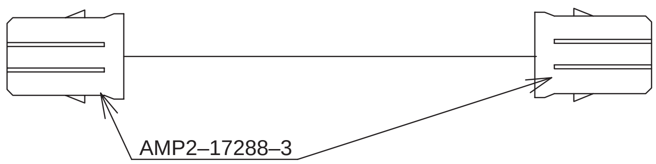
The following connection cables are prepared.
Cables associated with servo

Purpose	Description	Specification	Length
Servo amplifier signal cable Control unit ↕ Servo amplifier (SVM)		A02B–0120–K800	5m
Separated APC battery cable Control unit ↕ APC battery case		A02B–0177–K809	5m

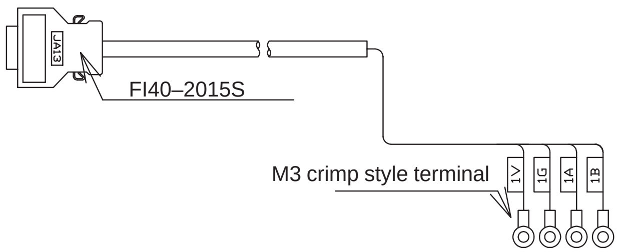
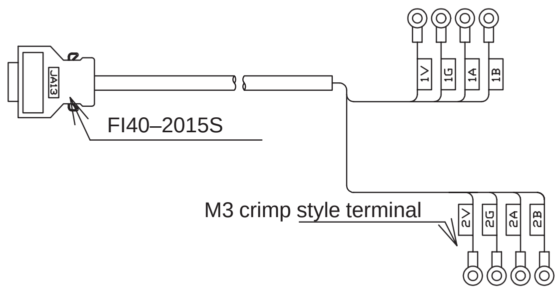
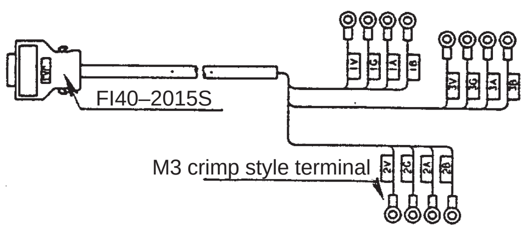
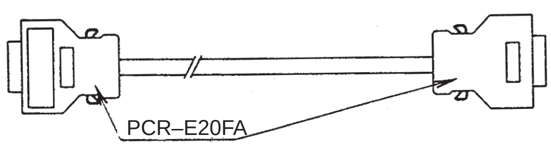
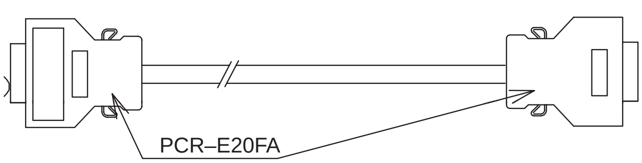
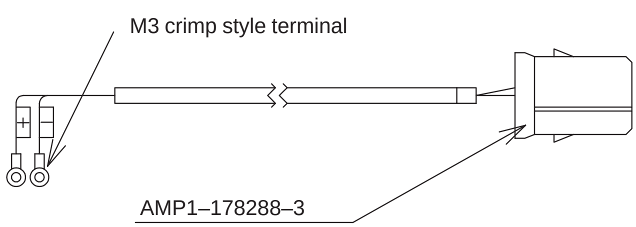
Cables associated with CRT/MDI

Purpose	Description	Specification	Length
MDI signal cable Control unit (JA2) ↕ MDI unit (CK1)		A02B–0120–K810	5m
CRT/PDP video signal cable Control unit (JA1) ↕ CRT/PDP unit (CN1)		A02B–0120–K819	5m
Monochrom CRT power cable Control unit (CP1B) ↕ CRT unit (CN2)		A02B–0120–K820	5m

Cables associated with CRT/MDI

Purpose	Description	Specification	Length
LCD Video signal cable Control unit (JA1) ↕ LCD unit (CN1)		A02B–0120–K818	5m
CNC Video cable (for MMC–IV) Control unit (JA1) ↕ Control unit (JA1B)		A02B–0161–K810	0.35m
LCD Power supply cable Control unit (CP1B) ↕ LCD unit (CP5)		A02B–0120–K823	5m

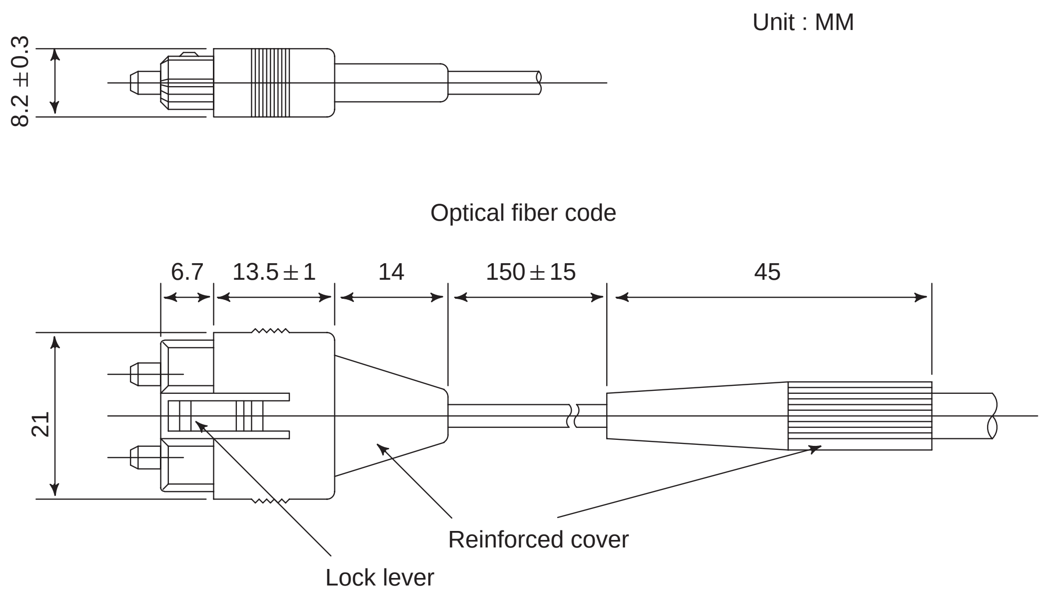
Others

Purpose	Description	Specification	Length
Manual pulse generator cable (for one unit) Control unit (JA3) ↕ Manual pulse generator terminal board		A02B–0120–K847	7m
Manual pulse generator cable (for two units) Control unit (JA3) ↕ Manual pulse generator terminal board		A02B–0120–K848	7m
Manual pulse generator cable (For 3 MGs) Control unit (JA3B) ↕ Manual pulse generator terminal board		A02B–0120–K841	7m
I/O Link cable Control unit (JD1A) ↕ I/O unit (JD1B)		A02B–0120–K842	5m
Spindle signal cable Control unit (JA7A) ↕ Spindle amplifier (JA7B)		A03B–0807–K801	5m
		A03B–0807–K802	10m
Control unit power supply cable Voltage regulator (24VDC) ↕ Control unit (CP1A)		A02B–0124–K830	5m

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
The optical fiber cable used for interfaces (1) and (2) differs from that used for interface (3) in specification. Assume that the former cable is A, and that the latter is B.

External view of optical fiber cable



Reinforced optical fiber code diameter : 8.4mm
Tensile strength : Optical fiber code : 25kg
Optical fiber code–connector : 2kg
Reinforcing cover : 150kg
Bending radious of optical fiber code with reinforcing cover : 50mm

Notes on the specification of optical fiber cable A

(1) Standard length of an optical fiber cable is 5, 10, and 15 meters.
(2) An optical fiber cable cannot be cut and joined at machine manufacturers side.
(3) If it needs to relay on cabling, use optical fiber adapter. Up to one relay points are allowed on a transmission line.

Handling precautions

Unlike the conventional power cables, optical fiber cables need special care in installation and handling.

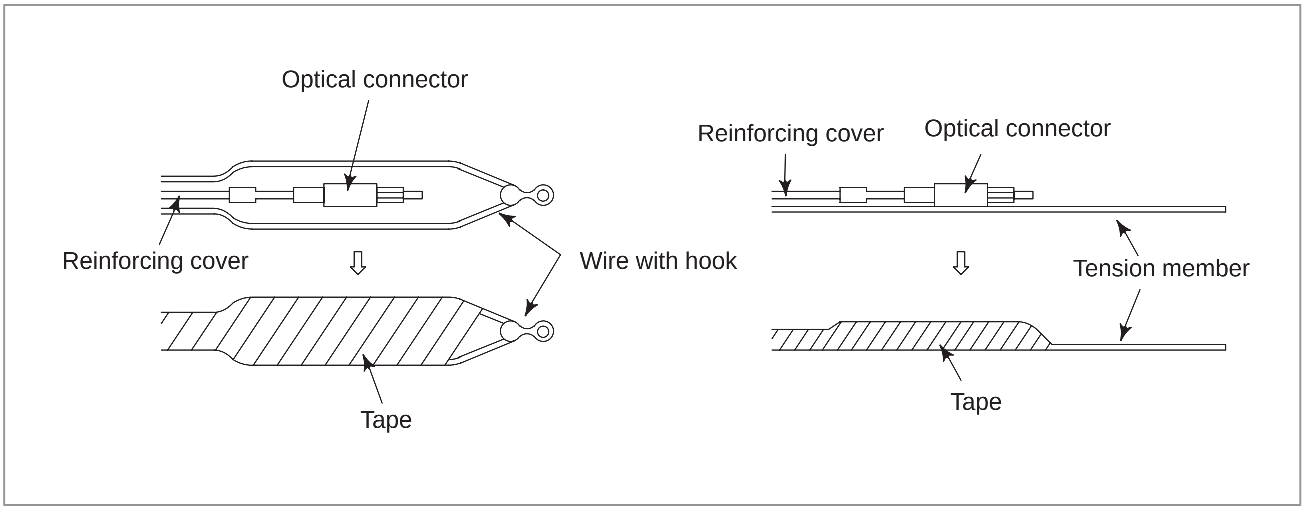
(1) Even though reinforcing cover used on the optical fiber code has enough mechanical strength, be sure not to be damaged by heavy materials drop.

(2) Detaching and attaching of optical connector should always be made by touching connector. Optical fiber code should not be touched when replacement.

(3) Optical connector is automatically locked with upper side lock levels after being connected. It is impossible to pull out the connector without releasing the lock levers.

(4) Optical connector can not be connected oppositely. Be sure the connector direction when connection is done.

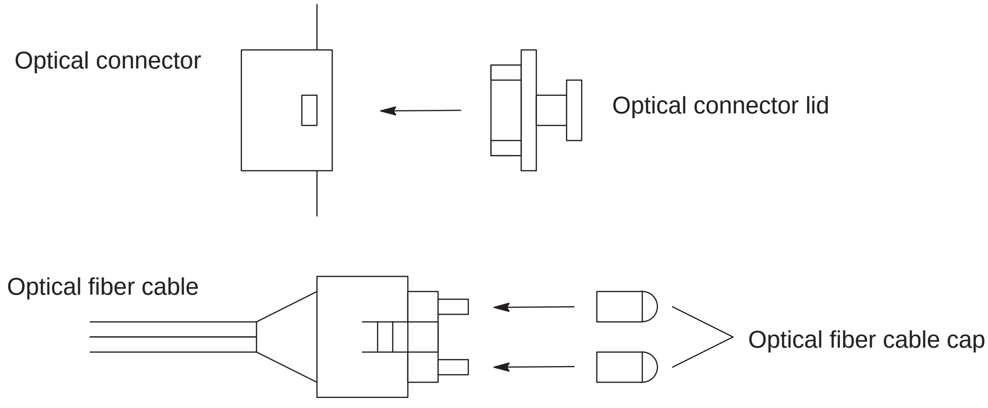
(5) Optical connector should be processed as follows before laying of optical fiber cable.
Fix a reinforcing cover to a wire with hook or tension member by a tape.
At laying hook the wire or pull the tension member taking enough care that optical connector dose not receive pulling strength.



(6) Reinforcing cover is fixed to cable lamp so that optical fiber cable could not weigh directly the connecting part of connector.

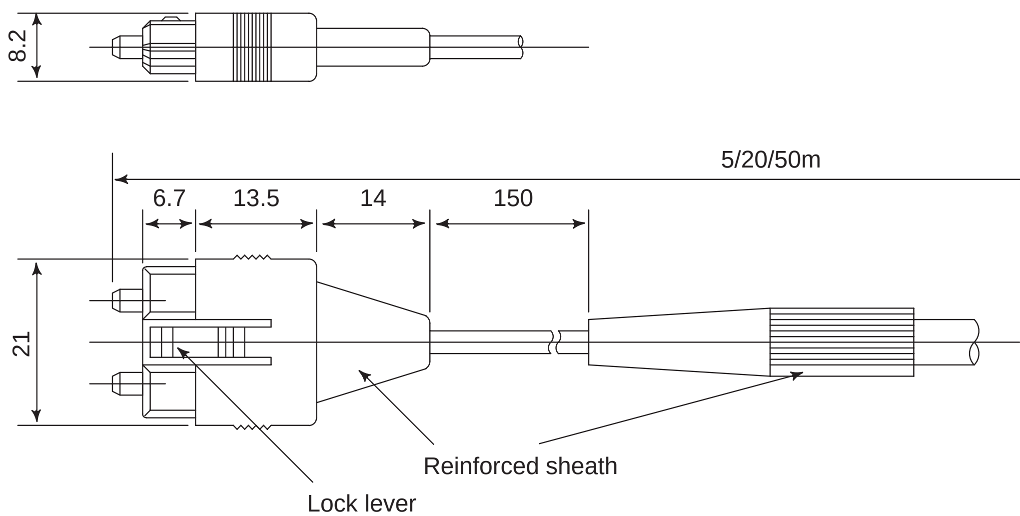
(7) Notice that optical connector's chip is clear.
The attached protect cap must be always put on when optical connector is not used.
Remove dirty with a clear tissue or absorbent cotton (cotton with ethylalcohol is applicable). No other organic solvent than ethyl alcohol can not be used.

(8) Protecting optical connectors and fiber cables when not in use
When optical connectors and optical fiber cables are not in use, cover their mating surfaces with the lid or cap shipped together with them. If they are left uncovered, they are likely to become dirty, which will ultimately result in a poor connection.



Protecting optical connectors and fiber cables when not in use

Outline drawing of optical fiber cable B



Optical fiber cable outline drawing (A66L–6001–0021 or –0022)

(1) A66L–6001–0021 specification
Optical fiber code diameter : 6.0mm
Tensile strength Reinforcing sheath : 49kg

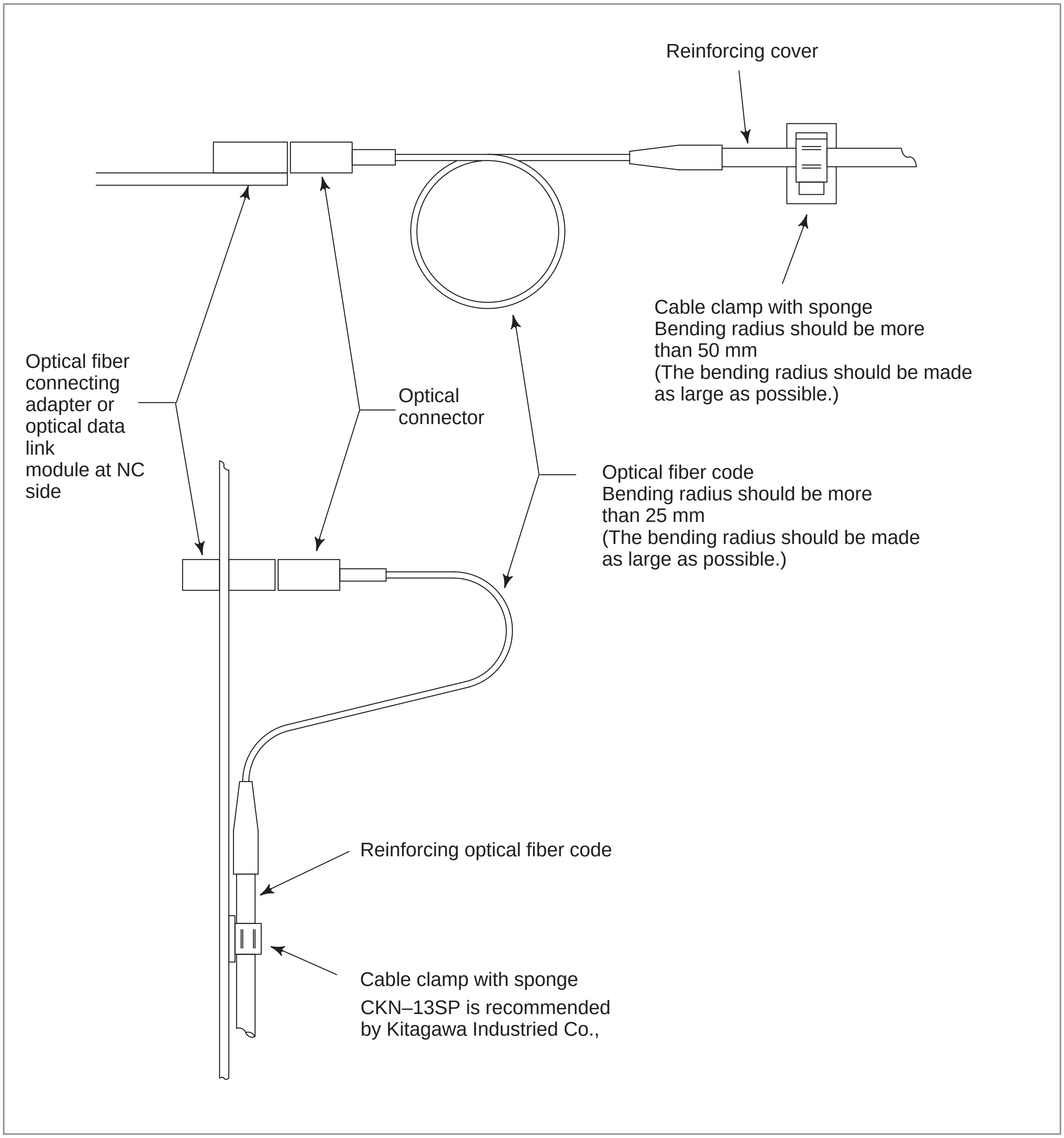
(2) A66L–6001–0022 specification
Optical fiber code diameter : 8.4mm
Tensile strength Optical fiber code : 25kg
Optical fiber cord – connector: 2 kg
Reinforcing sheath : 150kg

Notes on the specification of optical fiber cable B

1 The standard length of the optical fiber cable is 5, 20, or 50m.
2 Optical fiber cables cannot be cut or connected without special equipment, usually not available to machine tool builders.
3 Optical fiber cables cannot be used in tandem.

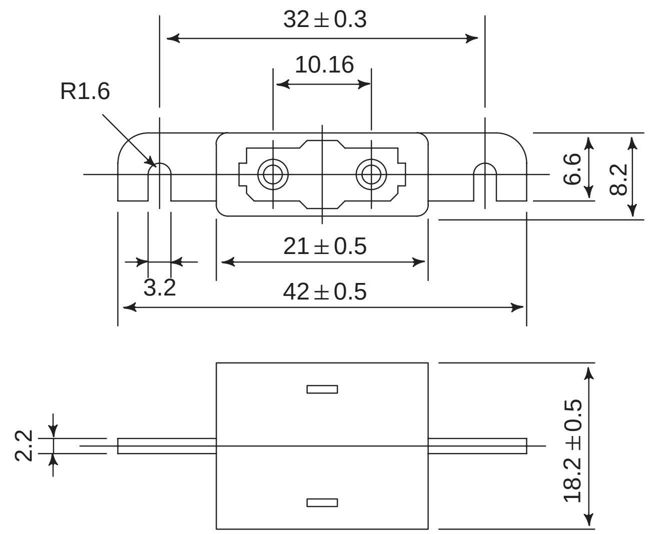
Optical fiber cable clamping method

When reinforcing cover is fixed at cable clamp with sponge, enough sag at optical fiber code as shown below is necessary so that connecting part of optical should not be weighed directly by optical fiber cable.

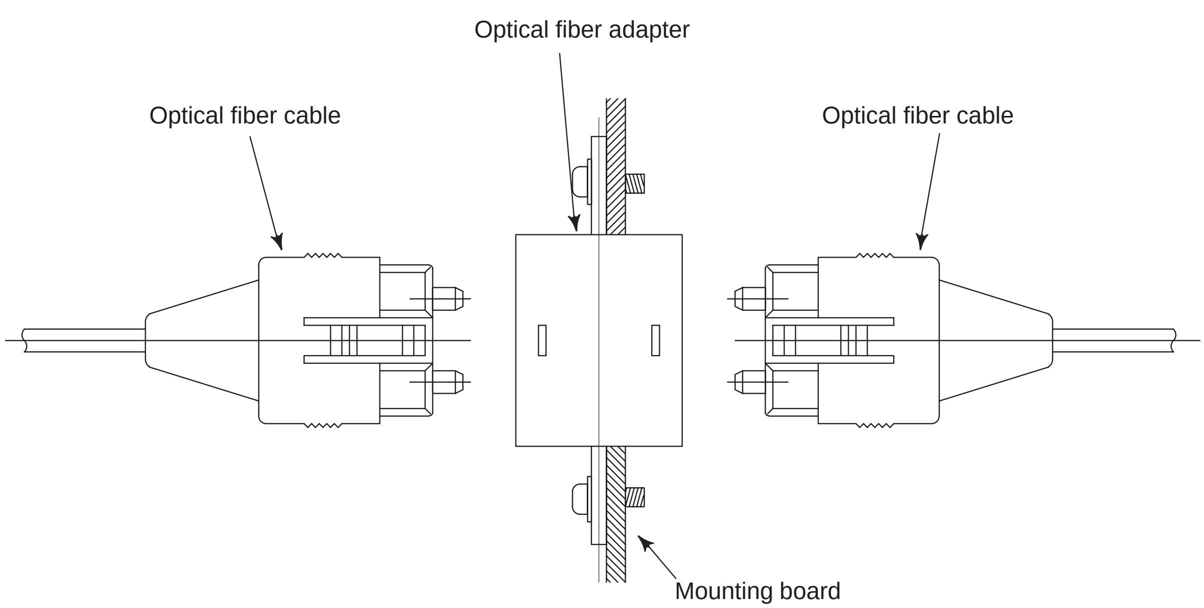


Relay using an optical fiber adapter

(1) External view of an optical fiber adapter



(2) Example of the use of an optical fiber adapter



NOTE
Up to one relay points are permitte.

Maximum transmission distance by optical fiber cable

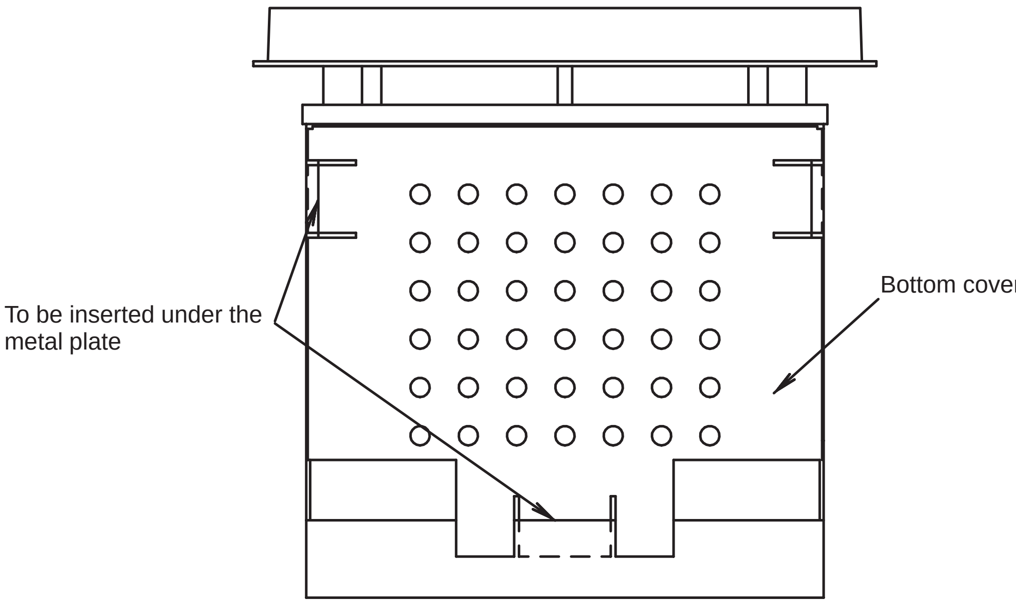
Maximum transmission distance by optical fiber cable A is shown below: Maximum transmission distance varies depend on numbers of relay points by optical fiber adapter.

Relay points	Max. trans. distance (total)
0	200m
1	100m

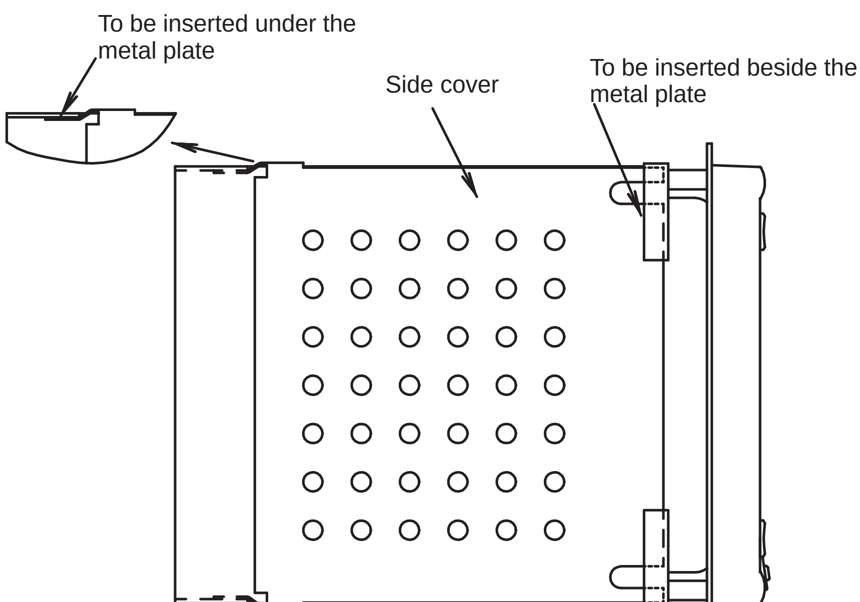
The maximum transmission distance of optical fiber cable B is 50 m. It cannot be used in tandem with another, such as by using a connection adapter.

E ATTACHING A CRT PROTECTIVE COVER

To satisfy the requirements for CE marking (machine directive), it is necessary to attach a CRT protective cover to the 9″ monochrome CRT display unit.
The CRT display unit is already provided with a protective cover at its top and rear surfaces. So, additional covers are required on the bottom and side surfaces.



Attaching a bottom cover (viewed from below)



Attaching a side cover (viewed from the side)

CRT protective cover

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