# GE Fanuc Automation

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Computer Numerical Control Products

# Power Mate i-Model D
# Power Mate i-Model H

## Connection Manual (Hardware)

GFZ-63173EN/03 June 2002

GFL-001

# *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.

# DEFINITION OF WARNING, CAUTION, AND NOTE

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

## WARNING

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

## CAUTION

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

## NOTE

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

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

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# APPENDIX

# 1 PREFACE

This manual describes the electrical and structural specifications required for connecting the FANUC Power Mate *i*–MODEL D/H to a machine. The manual outlines the components commonly used for FANUC Power Mate *i*–MODEL D/H, as shown in the configuration diagram in Chapter 2, and supplies additional information on using these components. Refer to individual manuals for the detailed specifications of each component. The devices should be connected and installed according to this connection manual.

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

| Product Name | Abbreviations | |
|---|---|---|
| FANUC Power Mate *i*–MODEL D | Power Mate *i*–D | Power Mate *i*<br>Power Mate |
| FANUC Power Mate *i*–MODEL H | Power Mate *i*–H | |

## Backing up data

**CAUTION**

Take a backup copy of SRAM data including parameters and programs to protect against loss of data. Make sure that the most recent data is backed up.

## Configuration of the manual

This manual consists of Chapters 1 to 11 and Appendixes.

| Chapter title | Description |
|---|---|
| Chapter 2<br>CONFIGURATION | Outlines connections for the Power Mate–*i* and guides the reader concerning additional details. |
| Chapter 3<br>INSTALLATION | This chapter describes the installation conditions for the Power Mate–*i*<br>1) Environmental requirements<br>2) Required power supply<br>3) Heat generated<br>4) Noise prevention<br>5) Connector arrangement on the control unit |
| Chapter 4<br>TOTAL CONNECTION DIAGRAM | This chapter shows the total connection diagram. |
| Chapter 5<br>CONNECTING THE POWER SUPPLY | This chapter describes how to connect the power supply. |
| Chapter 6<br>CONNECTION OF I/O UNITS TO MACHINE INTERFACE | This chapter describes how to connect the machine operator's panel and power magnetics. |
| Chapter 7<br>CONNECTION TO FA NETWORKS | This chapter introduces FA networks such as Ethernet and DeviceNet and lists reference manuals. |
| Chapter 8<br>CONNECTION TO SETTING AND DISPLAY UNIT | This chapter describes how to connect the following setup/display devices to the Power Mate *i*:<br>1) CRT/MDI unit interface<br>2) Interface between stand–alone type CRT, stand–alone type MDI, and Power Mate<br>3) Interface between stand–alone type PDP, stand–alone type MDI, and Power Mate<br>4) LCD/MDI, stand–alone type LCD, and stand–alone type MDI interface<br>5) Connection to a detachable LCD/MDI unit<br>6) Detachable LCD/MDI type B<br>7) Connection to the handy operator's panel<br>8) Connection to the handy operator's panel type B<br>9) Connection to an LCD with a touch panel |
| Chapter 9<br>CONNECTION TO SERVO OR SPINDLE | This chapter describes how to connect servo–amplifier– and spindle–amplifier–related devices to the Power Mate *i*.<br>1) Servo interface (FSSB)<br>2) Separate detector interface unit<br>3) Connecting the FANUC servo unit β series with I/O link<br>4) Spindle interface<br>5) Analog servo interface unit<br>6) Connecting servo check boards |
| Chapter 10<br>CONNECTION TO PERIPHERALS | This chapter describes how to connect peripheral devices to the Power Mate *i*.<br>1) I/O device interface<br>2) External pulse input interface<br>3) Manual pulse generator interface<br>4) Analog input function<br>5) Connection to a commercially available touch panel<br>6) Connection by multiaxis synchronization function (Power Mate *i*–H only)<br>7) Handy machine operator's panel |

| Chapter title | Description |
|---|---|
| Chapter 11<br>EMERGENCY STOP SIGNAL | This chapter describes the handling of emergency stop signals. The user must read this chapter before attempting to operate the CNC. |
| Appendix | A External dimensions of units<br>B 20–pin interface connectors and cables<br>C Connection cables<br>D Optical cable |

## Related manuals

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

**Table 1 Manuals Related**

| Manual name | Specification Number | |
|---|---|---|
| DESCRIPTIONS | B–63172EN | |
| CONNECTION MANUAL (HARDWARE) | B–63173EN | * |
| CONNECTION MANUAL (FUNCTION) | B–63173EN–1 | |
| OPERATOR’S MANUAL | B–63174EN | |
| MAINTENANCE MANUAL | B–63175EN | |
| PARAMETER MANUAL | B–63180EN | |

# 2 CONFIGURATION

The following figure shows the configuration of the electrical system of the machine tool and industrial machine with which this control is used. This manual describes how to connect the units illustrated in Fig. 2. The machine body, machine operator's panel, power magnetic circuit, and sensor/actuator are specific to the machine and are the builder's responsibility. This manual does not cover the internal connection of these units to the machine tool. The numbers in parentheses shown in the diagram are section references for this manual.

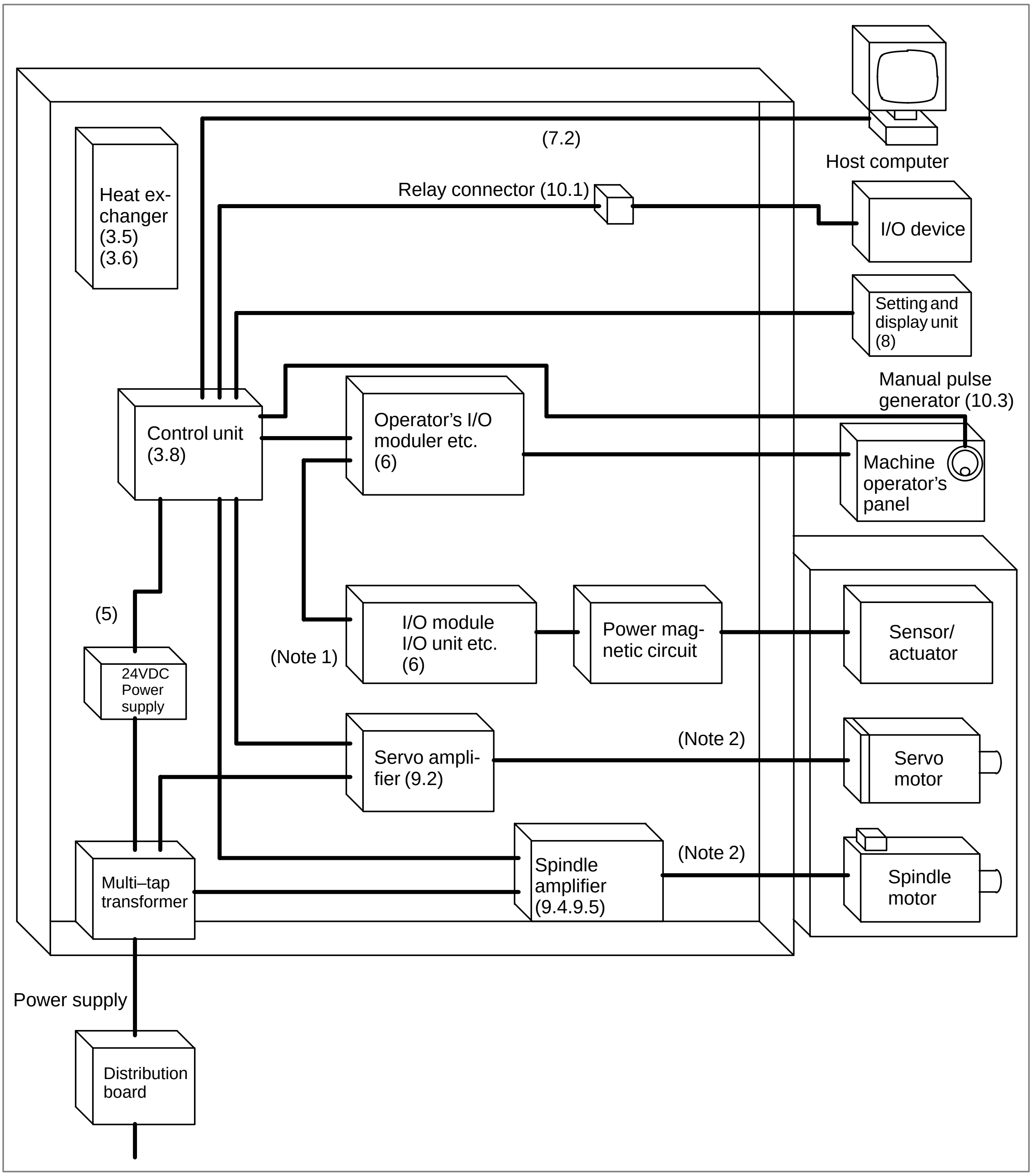


**Fig. 2 Configuration**

**NOTE**

1 For the I/O unit, refer to “FANUC I/O Unit Model A Connection/Maintenance Manual (B–61813E)” and “FANUC I/O Unit Model B Connection Manual (B–62163E).”

2 For the connection between the amplifier and motor, see the following manuals:
   - FANUC AC Servo Motor α series Descriptions (B–65142E)
   - FANUC AC Spindle Motor α series Descriptions (B–65152E)
   - FANUC Servo Amplifier α series (B–65162E)
   - FANUC SERVO MOTOR β series DESCRIPTION (B–65232EN)
   - FANUC SERVO MOTOR β series MAINTENANCE MANUAL (B–65235EN)
   - FANUC SERVO MOTOR β series (I/O Link Option) MAINTENANCE MANUAL (B–65245EN)

# 3 INSTALLATION

## 3.1 ENVIRONMENTAL REQUIREMENTS

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

- Cabinet for housing the control unit or peripheral units;
- Operation pendant for housing the control unit or operator's panel.
- Equivalent to the above.

| | | |
|---|---|---|
| **Ambient Temperature** | In operation | 0°C to 55°C |
| | In store or transportation | –20°C to 60°C |
| **Relative humidity** | 30% to 95% (no condensation) | |
| **Vibration** | In operation | 0.5 G or less |
| | In store or transportation | 1.0 G or less |
| **Meters above sea level** | In operation | Up to 1000 m |
| | In store or transportation | Up to 12000 m |
| **Environment** | Inter of units: Each unit should be placed in a cabinet to keep it from pollutants (such as dust, coolant, organic solvents, acid, corrosive gas, amd salt).<br>Heat sink of outer of cabinet: The heat sinks should be protected from direct exposure to coolant, lubricant, and metal chips. | |
| **Radiation (ionizing or nonionizing)** | If a unit is to be used in an environment where it is likely to be exposed to radiations (such as micro-wave, ultraviolet rays, laser beams, and X–rays), a shielding provision should be available for it. | |

The environmental conditions when installing these internal cabinets shall conform to the following table. Section 3.5 describes the installation and design conditions of a cabinet satisfying these conditions.

## 3.2
## POWER SUPPLY FOR CNC CONTROL UNITS

The following unit requires a power supply of 24 VDC ± 10% (including instantaneous change and ripple).

**NOTE**

1 The Power Mate–*i* requires an additional 24–V power supply for DOs.

2 Use memory cards that consume no more than 2 W.

**Table 3.2 (a) Power supply capacity for control unit**

| Unit | | Power supply capacity |
|---|---|---|
| Control unit<br>(Option board is not included) | | 1.8 A (Another 1A required for the FANUC RS–232–C device is used) |
| Option board | | |
| | HSSB board | 0.2A |
| | I/O Link–II slave board | 0.3A |
| | I/O Link–II slave board B | 0.3A |
| | Profibus–DP master board | 0.3A |
| | Profibus–DP slave board | 0.3A |
| | DeviceNet master board<br>DeviceNet master board B<br>DeviceNet slave board<br>DeviceNet slave board B<br>DeviceNet slave board C | 0.2A |
| | Ethernet board | 0.3A |
| | FL–net board | 0.3A |

**Table 3.2 (b)  Power supply capacity for peripheral unit**

| Unit | Power supply capacity |
|---|---|
| External I/O card D, E | 500 + 7.3 x n (mA) where n is the number of input points that are turned on simultaneously |
| I/O Unit–A | The required current varies depending on the number of modules. Refer to the I/O Unit–MODEL A Connection and Maintenance Manual (B–61813E). |
| I/O Link connection unit | 0.2 A |
| Basic connector panel I/O module | 200 + 7.3 x n (mA) where n is the number of input points that are turned on simultaneously |
| Branch–out I/O module expansion A/B | 100 + 7.3 x n (mA) where n is the number of input points that are turned on simultaneously |
| Branch–out I/O module expansion C/D | 0.1A |
| Operator's panel I/O module A1 | 0.35A |
| Operator's panel I/O module B1/B2 | 300 + 7.3 x n (mA) where n is the number of input points that are turned on simultaneously |
| FSSB I/O module basic unit | 300 + 7.3 x n (mA) where n is the number of input points that are turned on simultaneously |
| FSSB I/O module basic unit + expansion unit | |
| Separate detector interface unit, basic unit | 0.9A |
| Separate detector interface unit, basic unit + additional unit | 1.5A |
| Analog servo interface unit, basic unit | 0.7A (type F)<br>1.2A (type M) |
| Analog servo interface unit, basic unit + expansion unit | 1.0A (type F)<br>2.0A (type M) |

**Table 3.2 (c)  Power supply capacity for setting and display unit**

| Unit | Power supply capacity |
|---|---|
| CRT/MDI<br>Picture display CRT/MDI | 1.0A |
| Stand–alone type CRT | 0.8A |
| Stand–alone type MDI<br>Picture display stand–alone type MDI | 0.2A |
| Stand–alone type PDP | 2.0A |
| Stand–alone type LCD | 0.8A |
| Detachable LCD/MDI | 1.0A |
| Handy operator's panel (type B) | 0.2A |

## 3.3
## DESIGN AND INSTALLATION CONDITIONS OF THE MACHINE TOOL MAGNETIC CABINET

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

- The cabinet must be fully closed.

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

  Cabinets that let in air may be designed for the servo amplifier and servo transformer provided that they (This applies only to cabinets not certified for the CE marking, however.) :

  ☐ 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

- Design the cabinet so that the allowable environment temperature ranges for each unit accommodated in it will not be exceeded.
  For details of the thermal design, see Sections 3.4 to 3.5.

- 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 adheres to the unit. This may cause the unit to fail.

- For the air to move easily, a clearance of 100 mm is required between each unit and the wall of the cabinet. (This is not necessary for a unit with fan.)

- Packing materials must be used for the cable port and the door in order to seal the cabinet.

- The setting and display unit (CRT/MDI and etc.) must not be installed in such a place that coolant would directly fall onto the unit. The setting and display unit has a dust–proof front panel, but the unit should not be placed in a location where coolant would directly fall onto it.

- Noise must be minimized.
  As the machine and the CNC unit are reduced in size, the parts that generate noise may be placed near noise–sensitive parts in the magnetics cabinet.
  The CNC unit is built to protect it from external noise. Cabinet design to minimize noise generation and to prevent it from being transmitted to the CNC unit is necessary. See section 3.7 for details of noise elimination/management.

- The units must be installed or arranged in the cabinet so that they are easy to inspect and maintain.
  When, especially, the I/O Link slave function is used, its cable is connected at the bottom of the unit. So, be sure to allow a space large enough to attach and detach the cable easily.

- 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 generally 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.
- The installation conditions of the I/O unit, connector panel I/O module, and FSSB I/O module must be satisfied.
  To provide ventilation for the units, leave a space of 100 mm or greater for wiring and ventilation both above and below the I/O module for local lines, I/O unit, and FSSB I/O module.
  Equipment radiating too much heat must not be put below these units.
- A control unit must be carefully isolated against vibration.
  The CNC control unit itself may resonate at certain frequencies. Perform a thorough check after mounting the CNC control unit on the machine.
- To ensure conformity to the EMC command, refer to “Conforming to the EMC Command (A–72937).”

## 3.4
## HEAT DISSIPATED BY EACH UNIT

| Unit | | Heat loss |
|---|---|---|
| Control unit<br>(Option board is not included) | | 25W |
| Option board | | |
| | HSSB board | 4W |
| | I/O Link–II slave board | 6W |
| | I/O Link–II slave board B | 7W |
| | Profibus–DP master board | 6W |
| | Profibus–DP slave board | 6W |
| | DeviceNet master board<br>DeviceNet master board B<br>DeviceNet slave board<br>DeviceNet slave board B<br>DeviceNet slave board C | 5W |
| | Ethernet board | 6W |
| | FL–net board | 6W |

| Unit | | Heat loss |
|---|---|---|
| External I/O card D/E | | 5 + 0.175(W)<br>where n is the number of input points that are turned on simultaneously |
| I/O Unit | AIF01A, AIF01B | 1.2W |
| | AID32A, AID32B | 1.2 + 0.23(W)<br>where n is the number of input points that are turned on simultaneously |
| | AID16C, AID16D | 0.1 + 0.21(W)<br>where n is the number of input points that are turned on simultaneously |
| | AID32E, AID32F | 0.1 + 0.23(W)<br>where n is the number of input points that are turned on simultaneously |
| I/O Link connection unit | | 4W |
| Basic connector panel I/O module | | 5 + 0.175 x n (W) where n is the number of input points that are turned on simultaneously |
| Branch–out I/O module expansion B/C/D | | 2.5W |
| Operator’s panel I/O module A1 | | 8.5W |
| Operator’s panel I/O module B1/B2 | | 7.5 + 0.175 x n (W) where n is the number of input points that are turned on simultaneously |
| Separate detector interface unit, basic unit | | 9W |
| Separate detector interface unit, basic unit + additional unit | | 14W |

| | |
|---|---|
| FSSB I/O module basic unit | 7.5 + 0.175 x n (W) where n is the number of input points that are turned on simultaneously |
| FSSB I/O module basic unit + expansion unit | |
| Analog servo interface unit, basic unit | 10W (type F)<br>17W (type M) |
| Analog servo interface unit, basic unit + expansion unit | 14W (type F)<br>28W (type M) |

| Unit | Heat loss |
|---|---|
| CRT/MDI<br>Picture display CRT/MDI | 18W |
| LCD/MDI | 14W |
| Stand alone type CRT | 14W |
| Stand alone type MDI<br>Picture display stand alone type MDI | 4W |
| Stand alone type PDP | 20W |
| Stand alone type LCD | 10W |

**NOTE**

1 For other peripheral devices (I/O, etc.), see the heat dissipation data for each device and add the value to the above.

2 Not including the heat dissipation of the separate detector itself.

3 See FANUC SERVO AMPLIFIER $\alpha$ series DESCRIPTIONS (B–65162E) or FANUC SERVO MOTOR $\beta$ series DESCRIPTIONS (B–65232EN) for heat loss of servo amplifier.

## 3.5 THERMAL DESIGN OF THE CABINET

Heat generated in units and parts installed in a cabinet raises the temperature of the air inside the cabinet, compared with the external air. 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.

### 3.5.1 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 relationship between the temperature rise inside the cabinet and the temperature of the external air is represented in the following expression:

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

For example, a cabinet having a surface area of 4 $m^2$ 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 240 W. If the actual internal heat is 320W, however, the temperature in the cabinet rises by 13°C or more. If the ambient temperature of the unit under the installation environment cannot be satisfied, the cooling capacity of the cabinet must be improved using the heat exchanger described next.

### 3.5.2 Cooling by Heat Exchanger

If the temperature rise cannot be limited to the permissible temperature or lower 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.

A heat exchanger is to be prepared by the customer.

## 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 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.

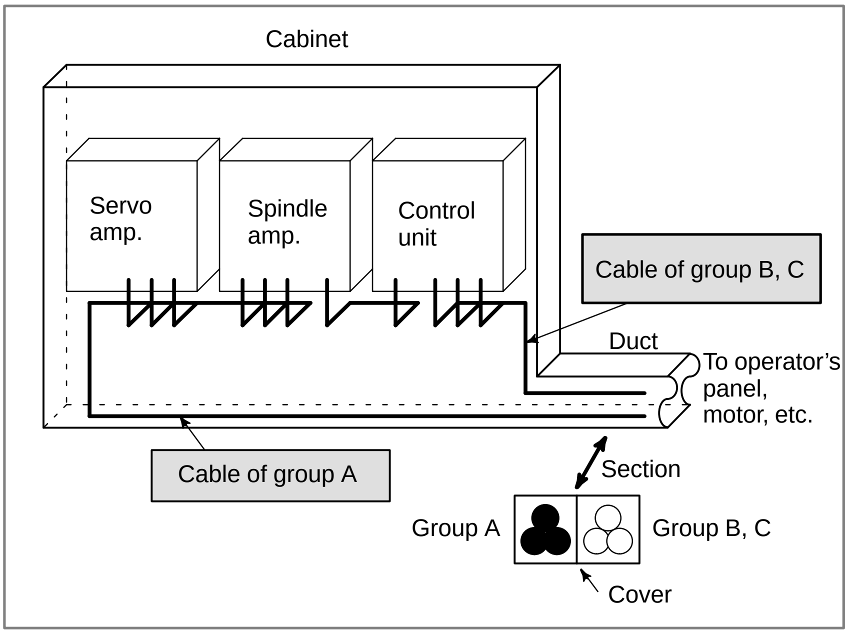
### 3.6.1 Separating Signal Lines

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

| Group | Signal line | Action |
|---|---|---|
| A | Primary AC power line | Bind the cables in group A separately (Note 1) from groups B and C, or cover group A with an electromagnetic shield (Note 2).<br>See Section 3.7.4 and connect spark killers or diodes with the solenoid and relay. |
| | Secondary AC power line | |
| | AC/DC power lines (containing the power lines for the servo and spindle motors) | |
| | AC/DC solenoid | |
| | AC/DC relay | |
| B | DC solenoid (24VDC) | Connect diodes with DC solenoid and relay.<br>Bind the cables in group B separately from group A, or cover group B with an electromagnetic shield.<br>Separate group B as far from Group C as possible.<br>It is more desirable to cover group B with the shield. |
| | DC relay (24VDC) | |
| | DC power line | |
| | DI/DO cable between the I/O Unit and power magnetics cabinet | |
| | DI/DO cable between the I/O Unit and machine | |
| C | Cable between the Power Mate *i* and I/O Unit | Bind the cables in group C separately from group A, or cover group C with an electromagnetic shield.<br>Separate group C as far from Group B as possible.<br>Be sure to perform shield processing in Section 3.7.5. |
| | Cable for position and velocity feedback | |
| | Cable between the Power Mate *i* and spindle amplifier | |
| | Cable for the position coder | |
| | Cable for the manual pulse generator | |
| | Cable between the Power Mate *i* and the setting and display unit | |
| | RS–232–C and RS–422 interface cable | |
| | Cable for the battery | |
| | Other cables to be covered with the shield | |

**NOTE**

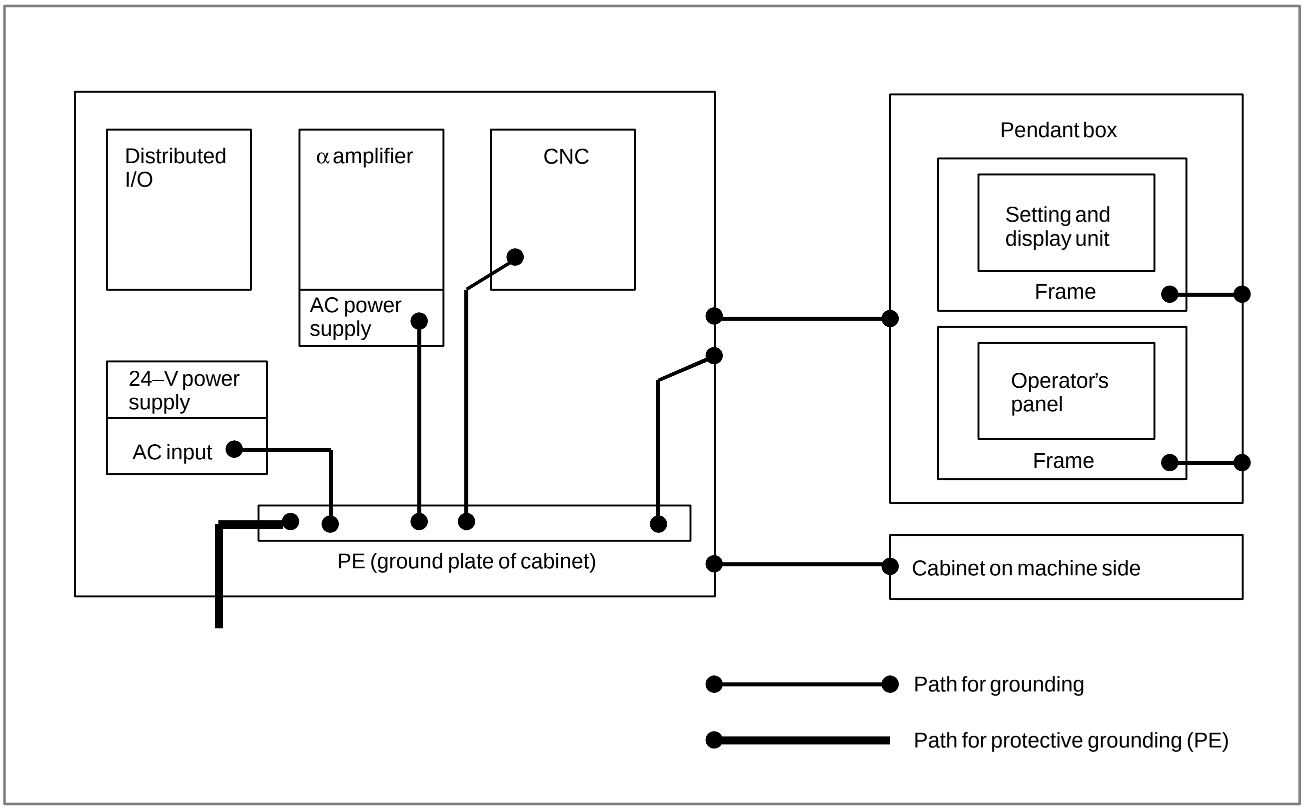
1 The groups must be 10 cm or more apart from one another when binding the cables in each group.
2 The electromagnetic shield refers to shielding between groups with grounded steel plates.



## 3.6.2 Ground

The following ground systems are provided for the machine :

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

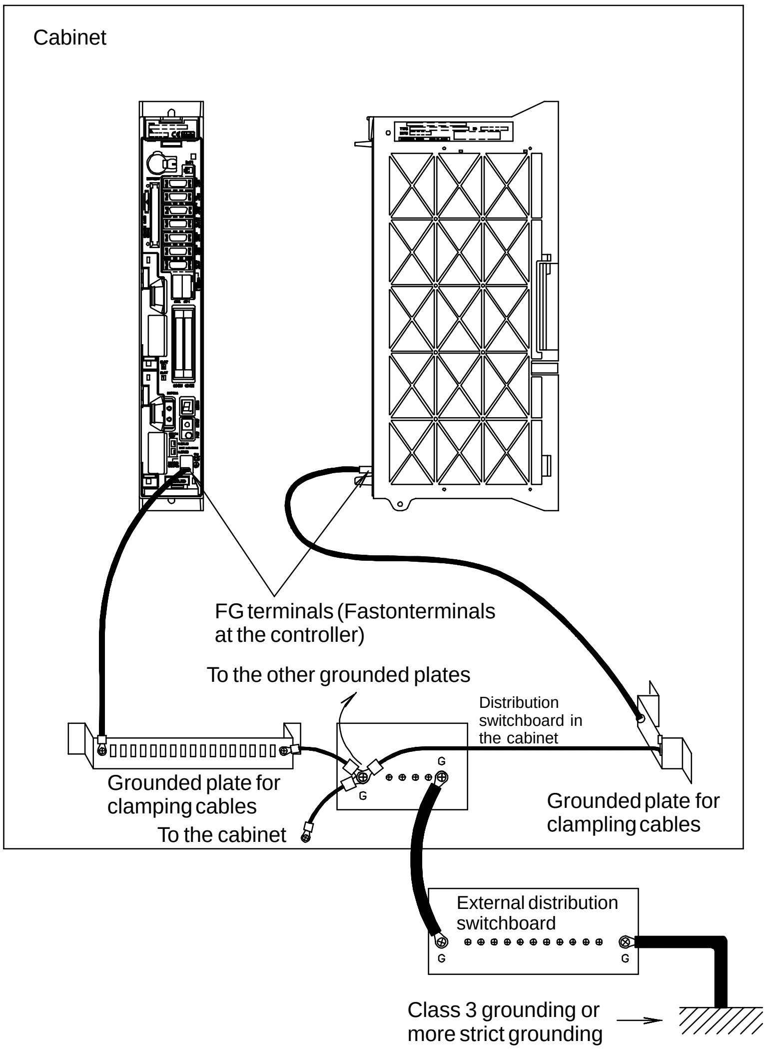


## Notes on grounding

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

## 3.6.3 Connecting the Ground for Signal of the Control Unit

Connect the signal ground (FG) terminal for the Power Mate to the grounded plate of the cabinet. The grounded plate must be connected to the protection ground (PE) as shown below.



**CAUTION**

Use the Faston terminals (A02B–0166–K330) for the frame ground. Also use 100 to 300 mm stranded wire with a cross–section of 2 mm$^2$ or more. Be sure to connect the frame ground of the Power Mate to the grounded plates in the cabinet as shown above.

## 3.6.4
## Noise Suppressor

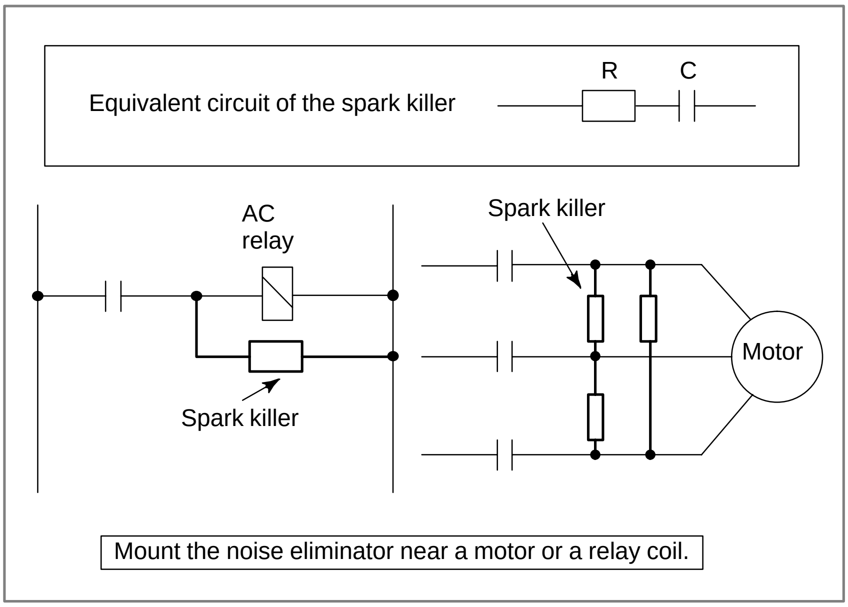
The AC/DC solenoid and relay are used in the power magnetics cabinet. A high pulse voltage is caused by coil inductance when these devices are turned on or off.

This pulse voltage induced through the cable causes the electronic circuits to be disturbed. In general, to reduce this pulse voltage, a spark killer is used in AC circuits, while a diode is used in DC circuits.

### Spark killer

- Use a spark killer consisting of a resistor and capacitor in series. This type of spark killer is called a CR spark killer.(Use it under AC) (A varistor is useful in clamping the peak voltage of the pulse voltage, but cannot suppress the sudden rise of the pulse voltage. FANUC therefore recommends a CR spark killer.)
- The reference capacitance and resistance of the spark killer shall conform to the following based on the current (I (A)) and DC resistance of the stationary coil:
  1) Resistance (R) : Equivalent DC resistance of the coil
  2) Capacitance (C) : $\frac{I^2}{10} \sim \frac{I^2}{20}$ (μF)

  I : Current at stationary state of the coil



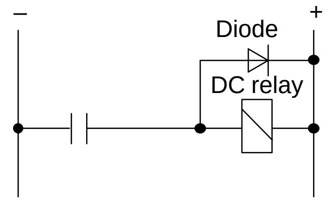
Mount the noise eliminator near a motor or a relay coil.

**NOTE**

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

### Diode

Diode (used for direct–current circuits)



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

## 3.6.5
## Cable Clamp and Shield Processing

If a cable connected to the CNC, servo amplifier, spindle amplifier, or other device requires shielding, clamp the cable as shown below. The clamp both supports and shields the cable. Use this clamp to ensure stable operation of the system.

Partially peel out the sheath and expose the shield. Push and clamp by the plate metal fittings for clamp at the part. The ground plate must be made by the machine tool builder, and set as follows :

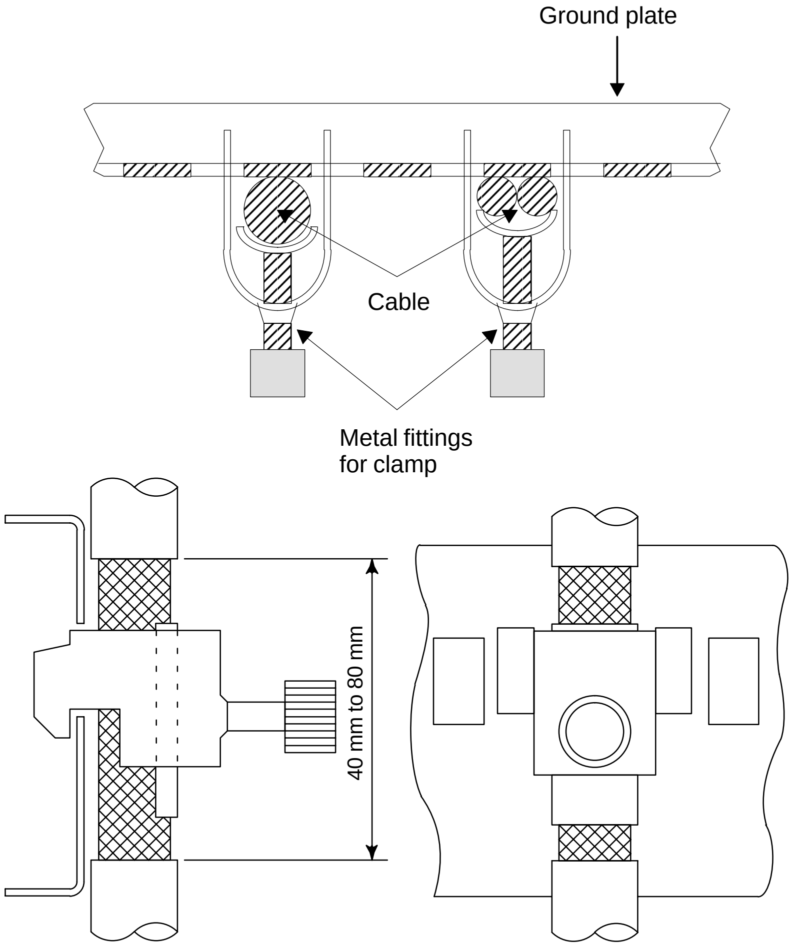


Fig. 3.6.5 (a) Cable clamp (1)

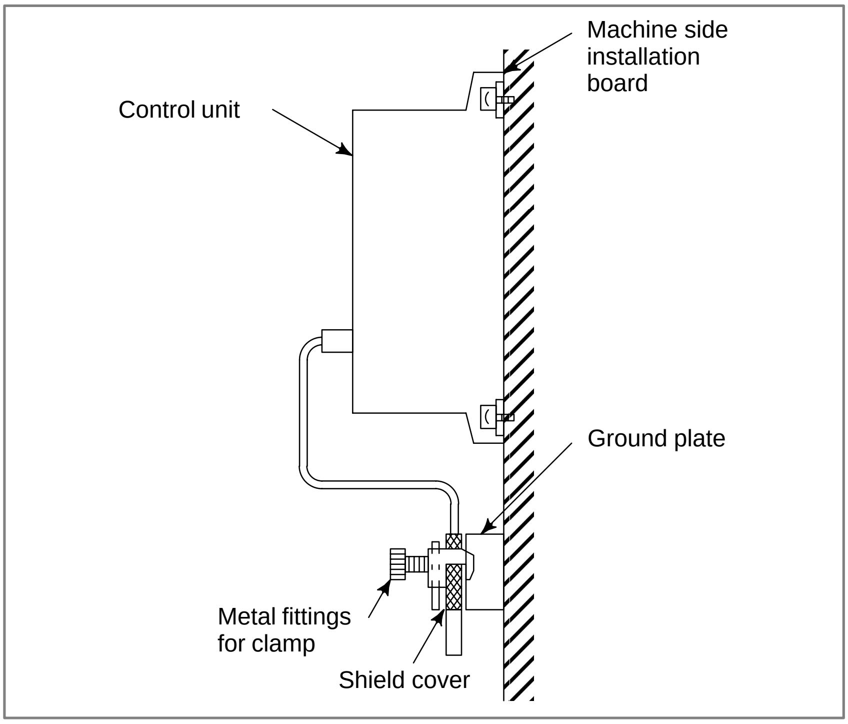


**Fig. 3.6.5 (b)  Cable clamp (2)**

Prepare ground plate like the following figure.

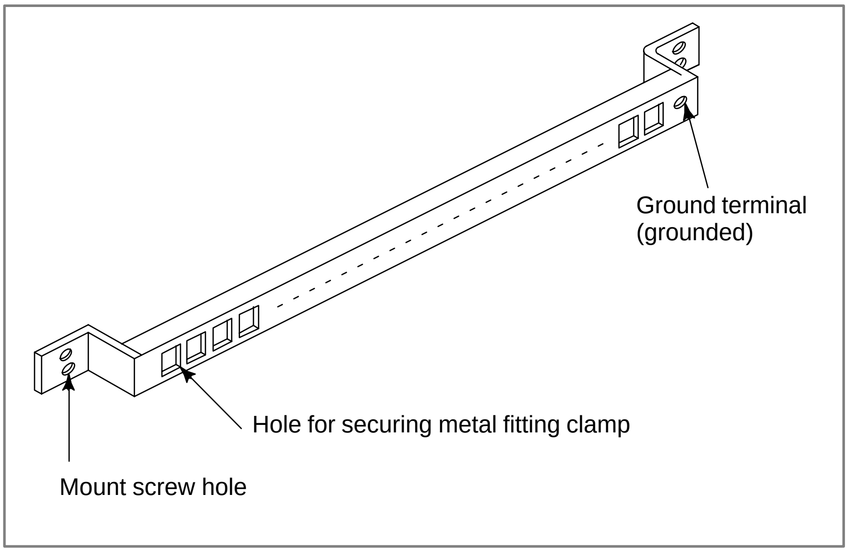


**Fig. 3.6.5 (c)  Ground plate**

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

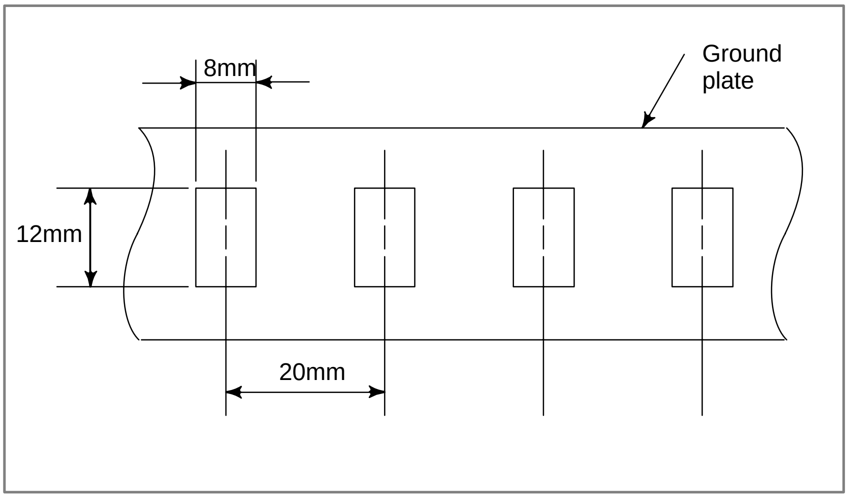


Fig. 3.6.5 (d)  Ground plate holes

(Reference)  Outer drawings of metal fittings for clamp.

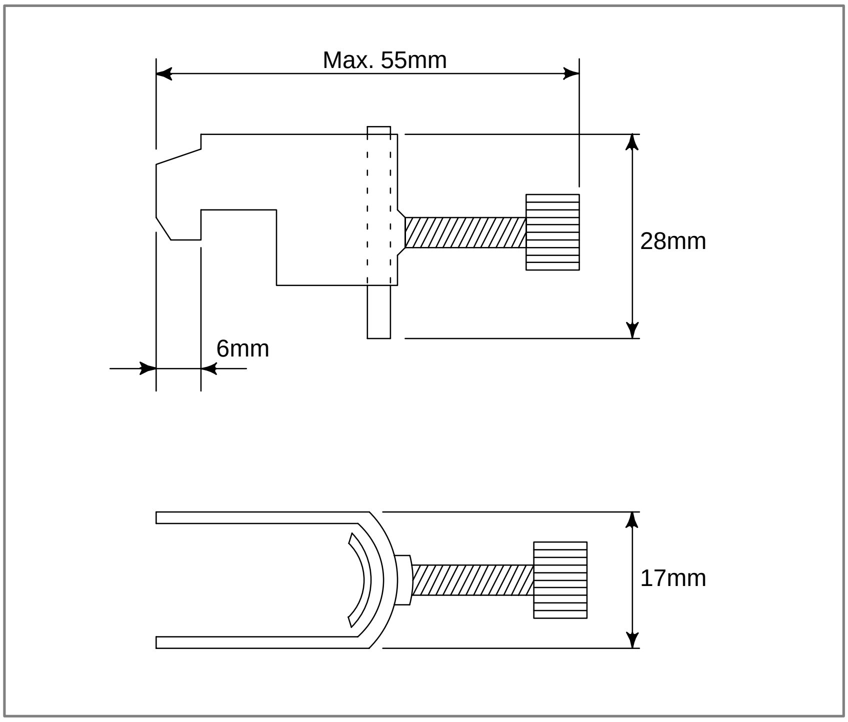


Fig. 3.6.5 (e)  Outer drawings of metal fittings for clamp

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

## 3.6.6
## Measures Against Surges due to Lightning

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

For the 200–V system

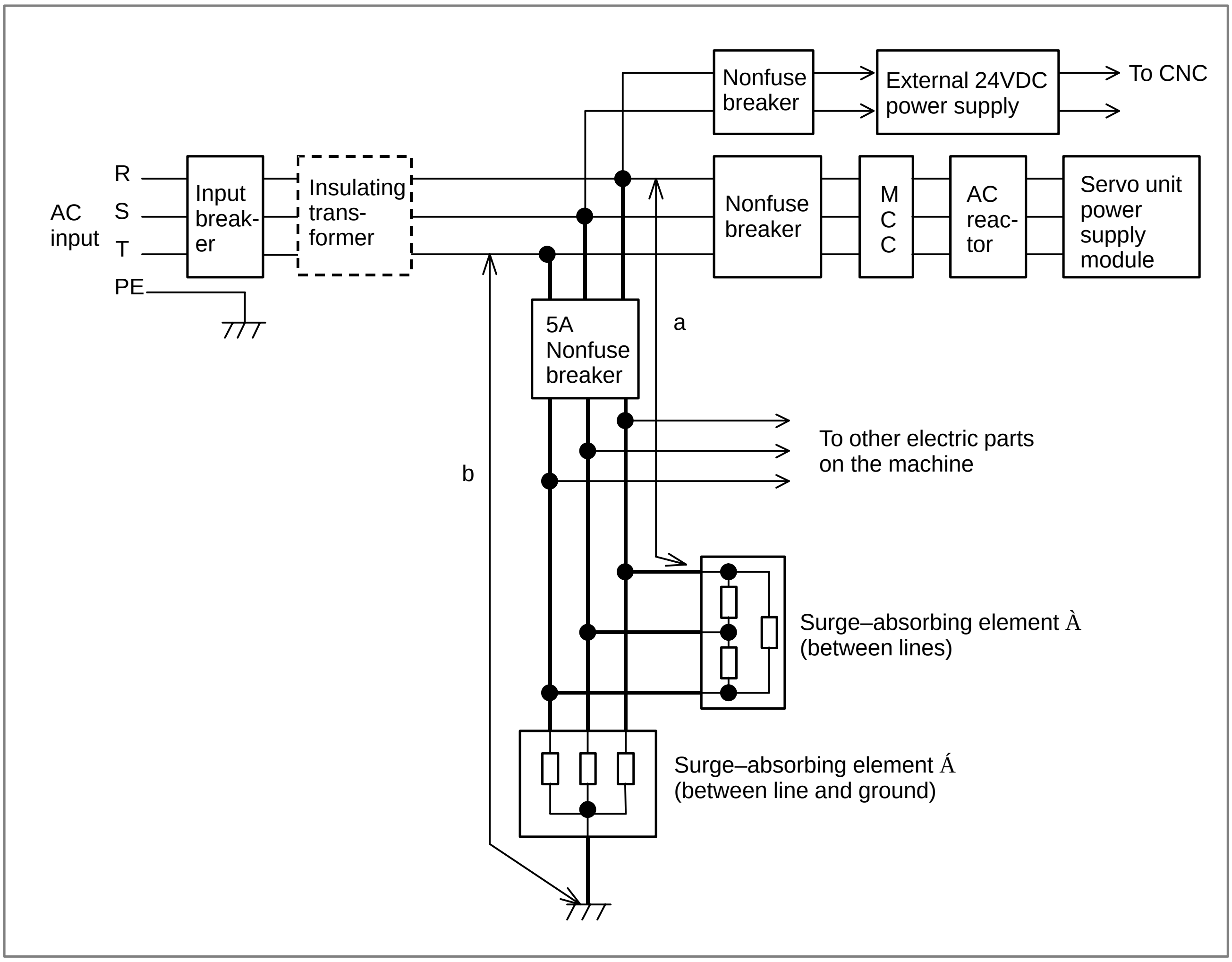
| | |
|---|---|
| Between lines | R • A • V–781BYZ–2 |
| Between line and ground | R • A • V–781BXZ–4 |

For the 400–V system

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

### Installation procedure

The surge–absorbing elements used for measures against surges due to lightening must be installed in the input power unit as shown in the figure below. The figure below shows an example in which an insulating transformer, shown by dotted lines, is not installed. If an insulating transformer is installed, surge–absorbing element 2 (between line and ground) is not required.



**Notes**

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

| | | |
|---|---|---|
| Wire | Size: | The wire diameter must be 2 $mm^2$ or greater. |
| | Wire length: | The sum of the length (a) of the wire for the connection of surge–absorbing element 1 and that (b) of surge–absorbing element 2 must be 2 m or less. |

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

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

(4) Because no current flows through surge–absorbing elements 1 and 2 during normal operation, the nonfuse breaker (5A) can be shared by other electric devices on the machine. It can be used with the control power supply of the servo unit power supply module or with the power supply for the fan motor of the spindle motor.

# 3.7 CONTROL UNIT

## 3.7.1 Configuration of the Control Unit

The control units of the Power Mate *i* consist of below components.

**Table 3.7.1 Configuration of the control unit**

| No. | Name | Remarks |
|---|---|---|
| 1 | Control unit | |
| 2 | Fan unit | |
| 3 | Back panel | May not be provided. |
| 4 | Option slot 1 | Connection port of the first option board.<br>A back panel is required. |
| 5 | Option slot 2 | Connection port of the second option board.<br>A back panel is required. |

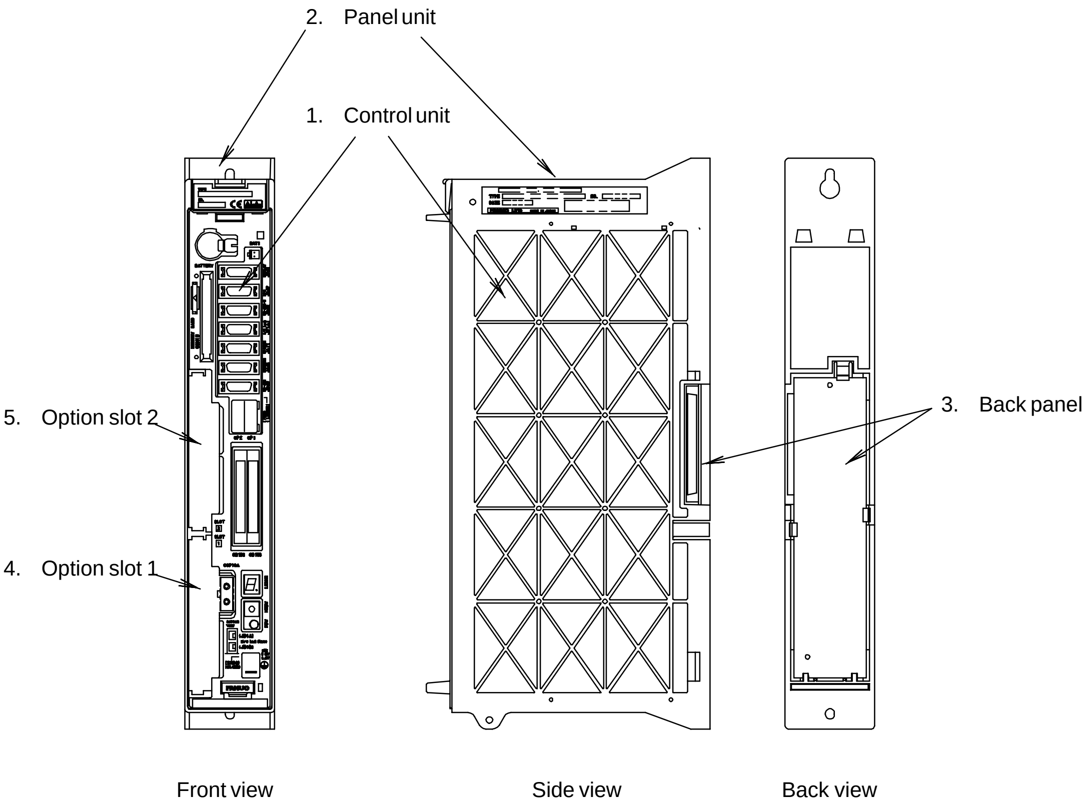
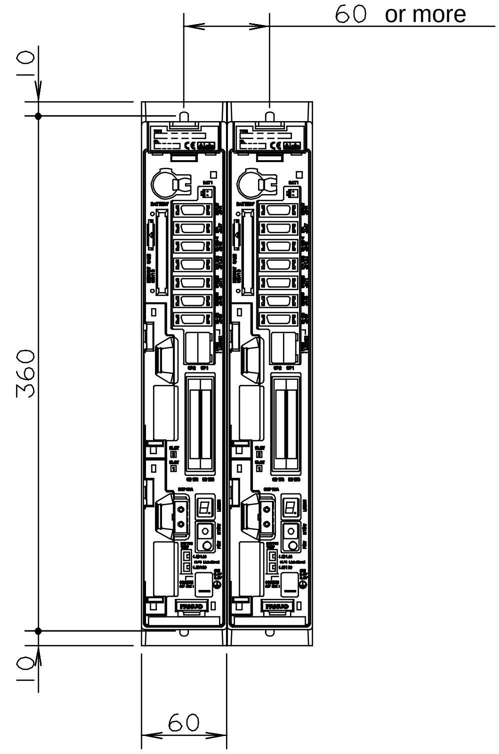


Fig. 3.7.1 Configuration of the control unit

## 3.7.2 Installation of the Control Unit

Space between control units to be installed.



**NOTE**

The unit is narrower than conventional Power Mates, so that the control unit can be mounted using the same mounting holes as those for a 60–mm servo amplifier.

The control unit consists of a plastic box, fan motors and a PCB.
A fan is provided at the top of the control unit. The fan unit incorporates a fan motor.
To enable easy removal and replacement of the fan unit, leave the space (space $\boxed{1}$) shown in the figure below.
The air comes into the control unit from the bottom and goes out through the fan motor, which is located on the top of the control unit. Space as shown in Fig. 3.8.2 must be reserved not to disturb the air flow ($\boxed{1}$,$\boxed{2}$)
To use the I/O Link slave function, allow a space large enough (at least about 80 mm wide) to attach and detach its cable at the bottom of the unit.

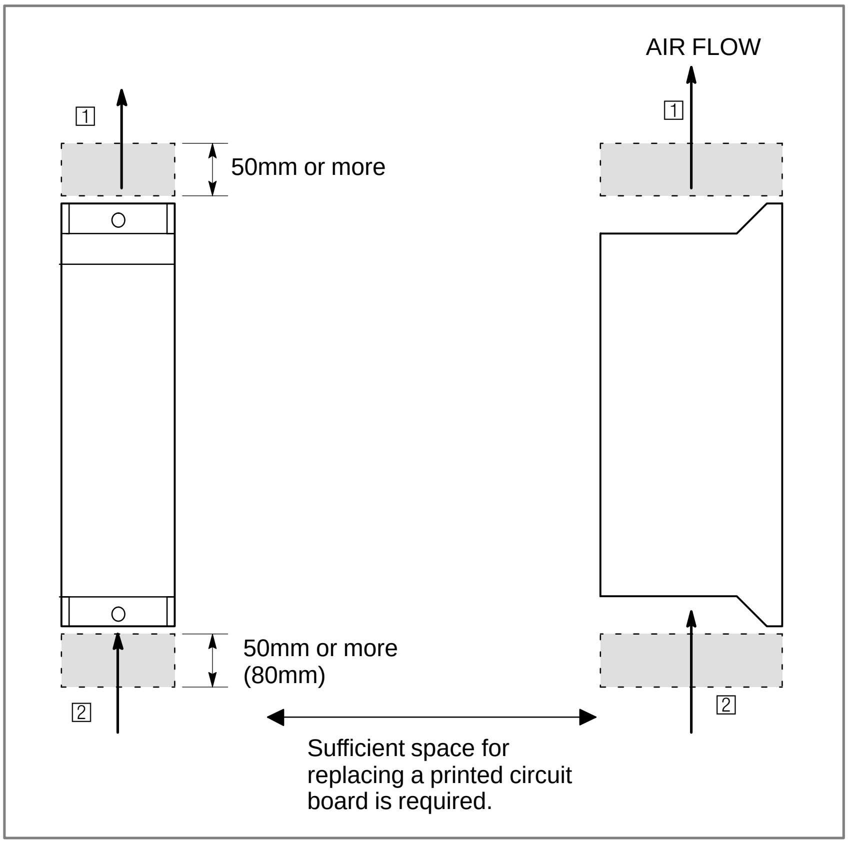
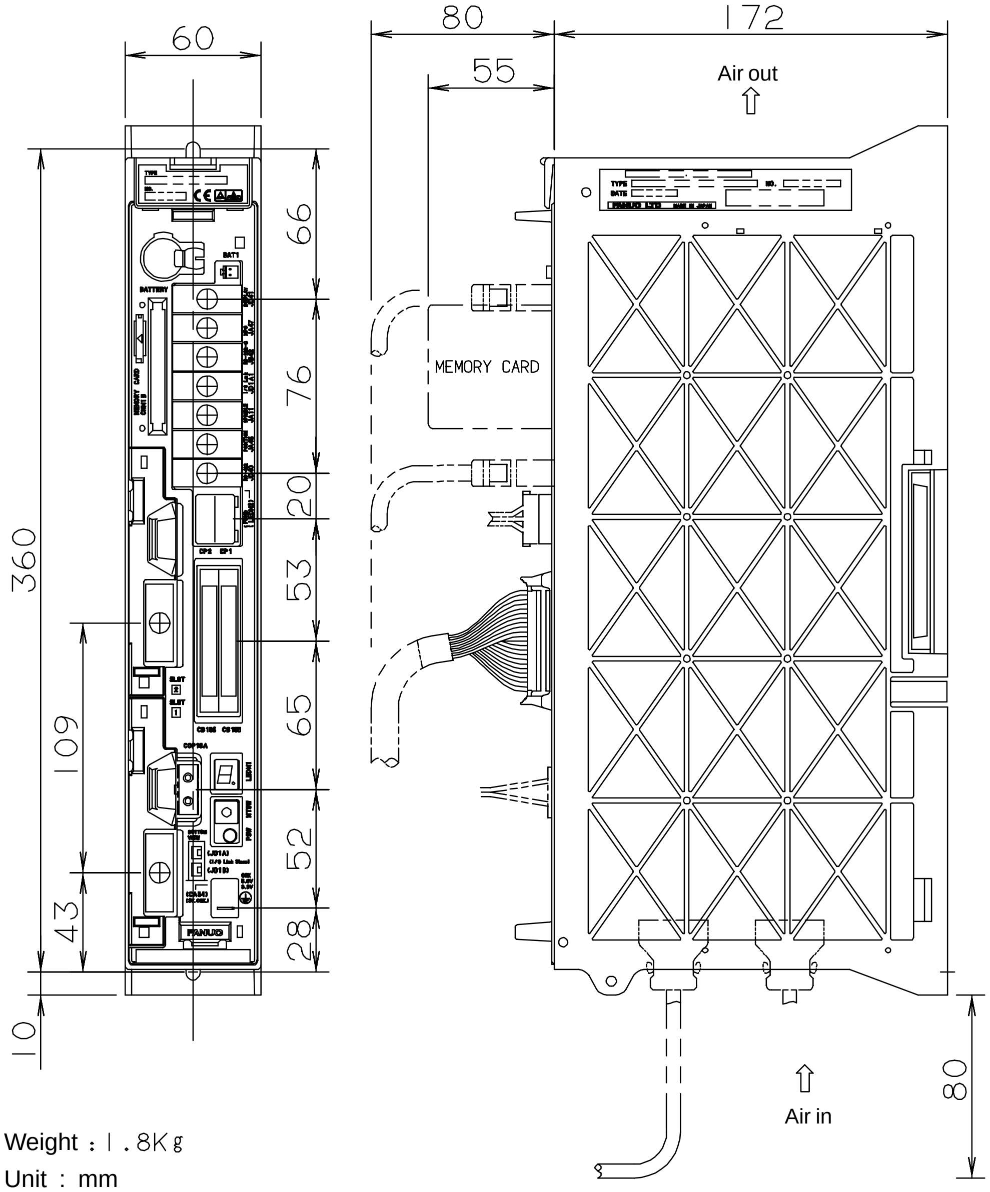


Fig. 3.7.2

**IMPORTANT**

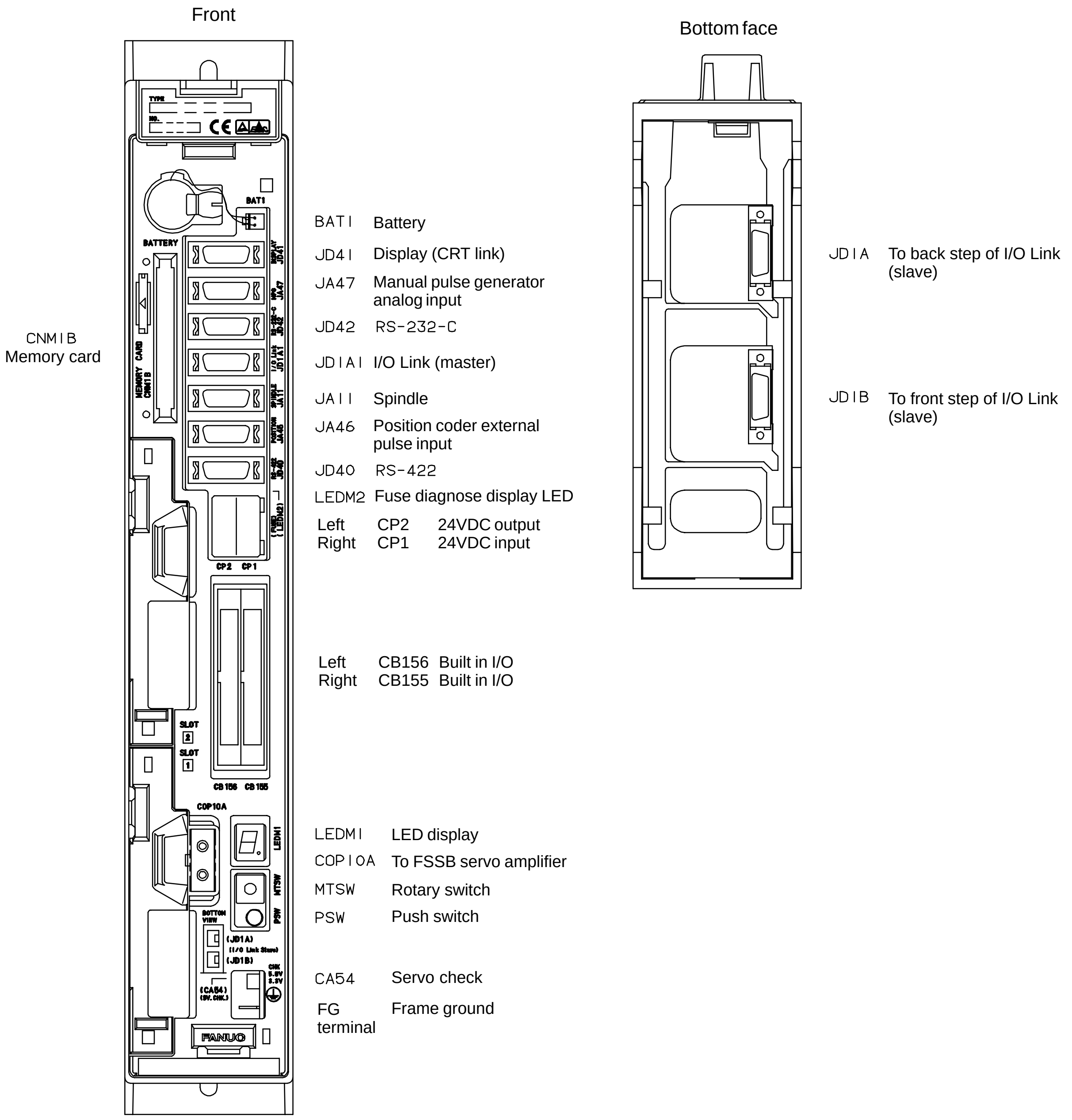
Above the control unit, leave sufficient space (50 mm or greater) to enable easy removal and replacement of the fan unit.
If the fan unit cannot be removed, the fan cannot be replaced. Nor can the fuse and the printed circuit board be replaced.

# 3.8 CABLE–LEAD–IN DIAGRAM

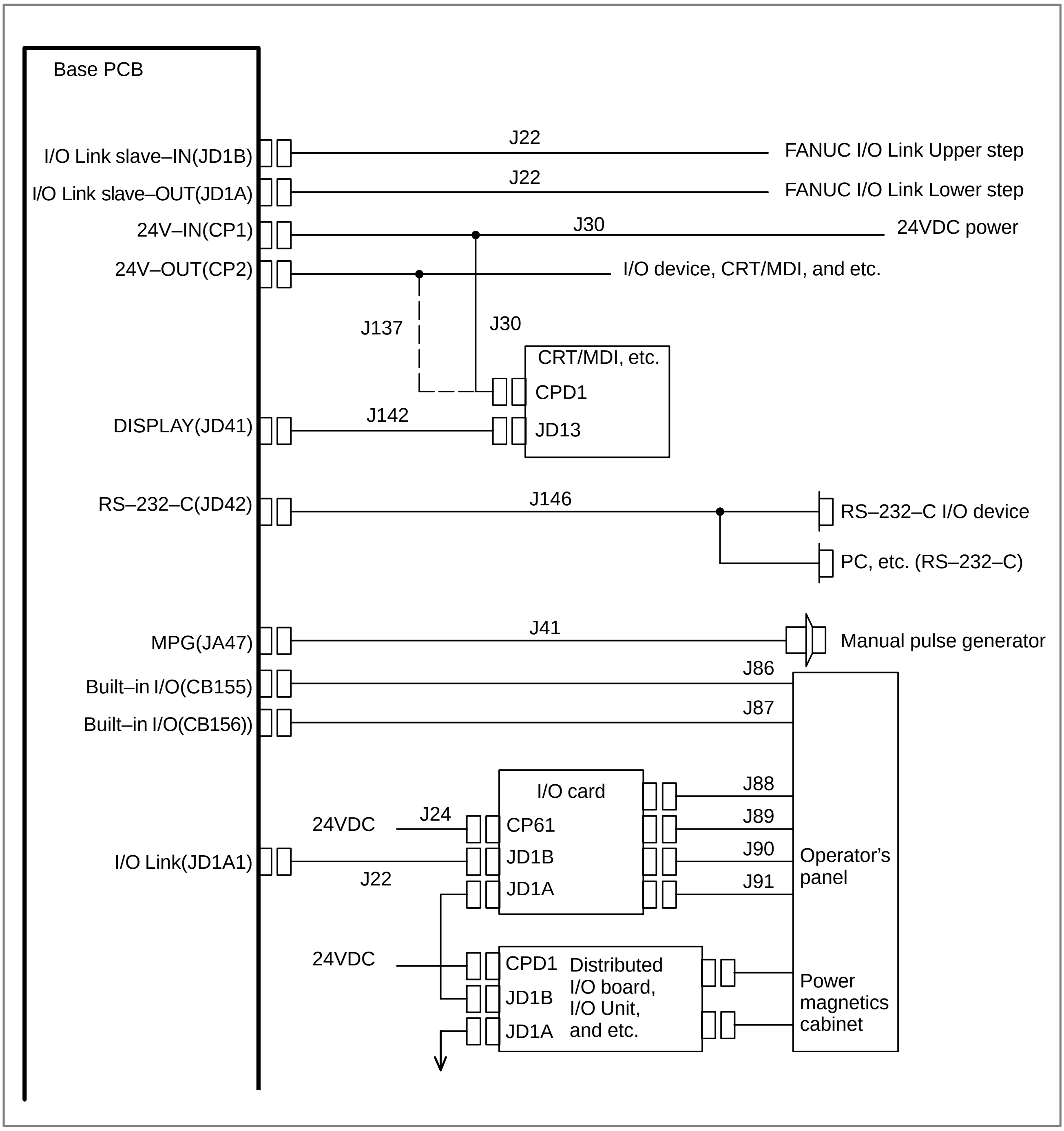


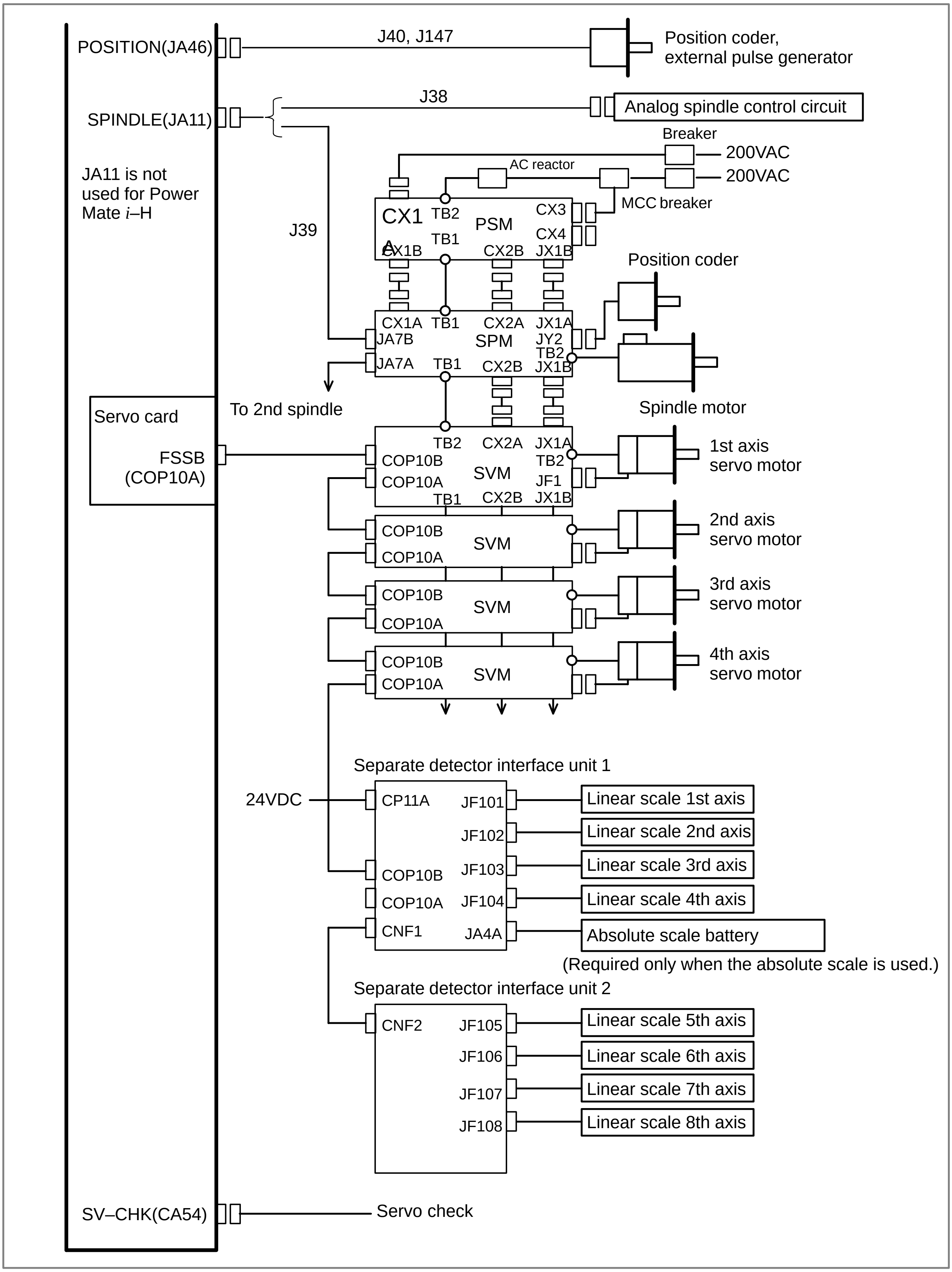
Weight：1.8Kg
Unit : mm

## 3.9 CONNECTOR LAYOUT OF CONTROL UNIT



# 4 TOTAL CONNECTION




POSITION(JA46)
J40, J147
Position coder,
external pulse generator
SPINDLE(JA11)
J38
Analog spindle control circuit
Breaker
200VAC
200VAC
AC reactor
MCC breaker
JA11 is not
used for Power
Mate *i*–H
J39
CX1A
TB2
PSM
CX3
CX4
TB1
CX1B
CX2B
JX1B
Position coder
CX1A
TB1
CX2A
JX1A
JA7B
SPM
JY2
TB2
JA7A
TB1
CX2B
JX1B
Spindle motor
To 2nd spindle
Servo card
FSSB
(COP10A)
TB2
CX2A
JX1A
COP10B
SVM
TB2
COP10A
JF1
TB1
CX2B
JX1B
1st axis
servo motor
COP10B
SVM
COP10A
2nd axis
servo motor
COP10B
SVM
COP10A
3rd axis
servo motor
COP10B
SVM
COP10A
4th axis
servo motor
Separate detector interface unit 1
24VDC
CP11A
JF101
JF102
COP10B
JF103
COP10A
JF104
CNF1
JA4A
Linear scale 1st axis
Linear scale 2nd axis
Linear scale 3rd axis
Linear scale 4th axis
Absolute scale battery
(Required only when the absolute scale is used.)
Separate detector interface unit 2
CNF2
JF105
JF106
JF107
JF108
Linear scale 5th axis
Linear scale 6th axis
Linear scale 7th axis
Linear scale 8th axis
SV–CHK(CA54)
Servo check

**NOTE**

1 Spindle function can not be used for Power Mate *i*–H.
2 The maximum number of controllable axes is two for the Power Mate *i*–D and eight for the Power Mate *i*–H.
3 Boards such as the I/O Link–II board, HSSB board, and Ethernet board are inserted into the option slots. Up to two of them can be installed simultaneously.

# 5

# POWER SUPPLY UNIT CONNECTION

## 5.1 SPECIFICATIONS AND CIRCUIT CONFIGURATION OF EXTERNAL 24–VDC POWER SUPPLY

Specifications of a recommended external 24–VDC power supply (regulated power supply) (The requirements of the UL 1950 standard must be satisfied.)

| | |
|---|---|
| Output voltage: | Output voltage: 24 VDC (10% (21.6 to 26.4 V) (Including ripple voltage and noise. See the figure given below.) |
| Output current: | Continuous load current must be the current consumption level of the Power Mate *i* and units or higher.<br>(At the maximum temperature within the power magnetics cabinet in which the power supply is placed) |
| Load fluctuation (including surge current): | The above output voltage range must not be exceeded by any load fluctuations due to external DO and so forth. |
| Instantaneous AC input disconnection hold time: | 10 ms (for –100%)<br>20 ms (for –50%) |

**CAUTION**

The power supplies for the Power Mate *i* and related units using 24 VDC input must all satisfy the specifications described here.

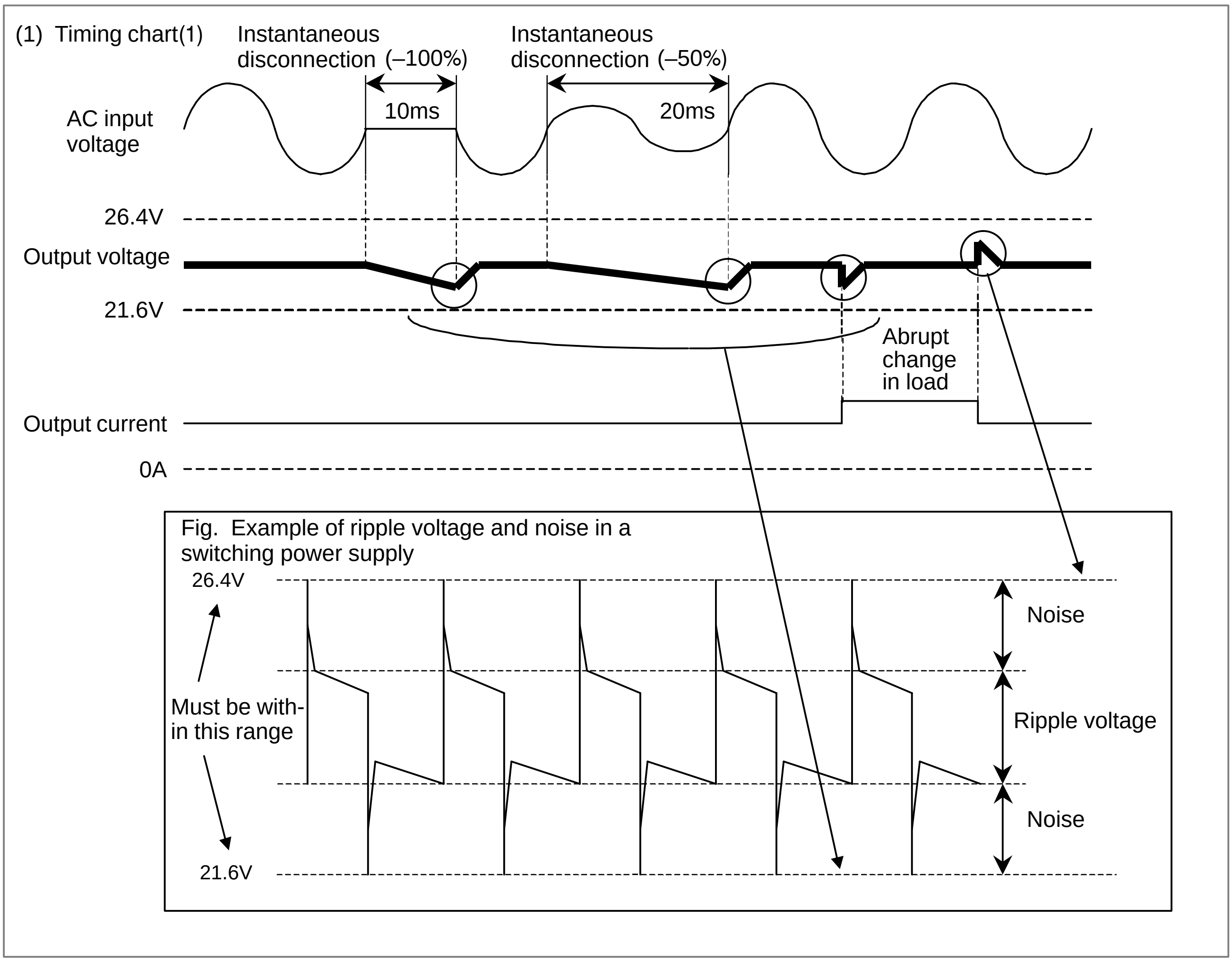


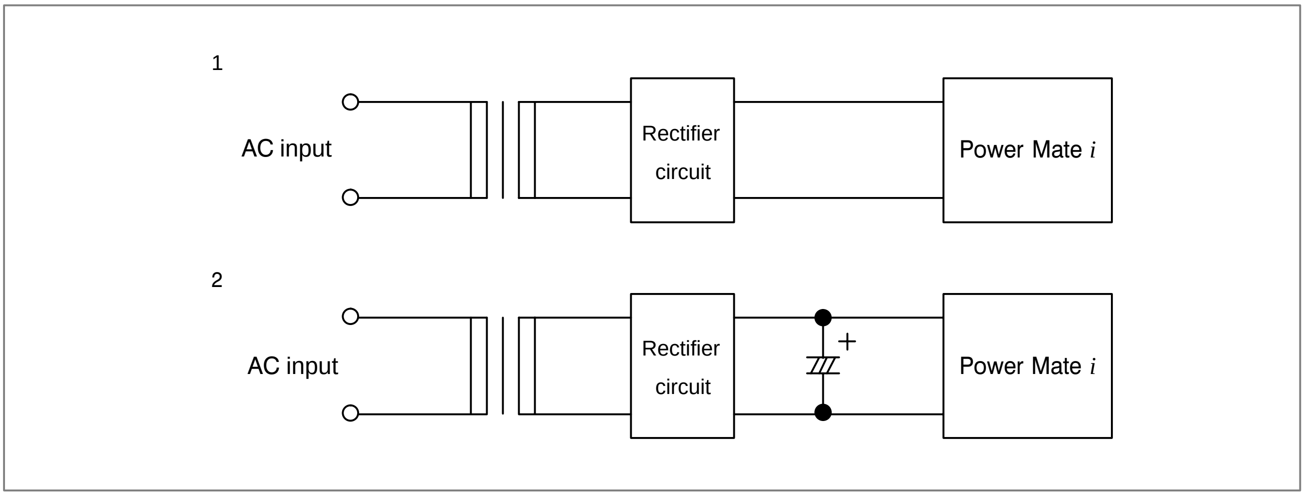
Fig. 5.1 Timing chart

- **Circuit configuration**

Prohibition

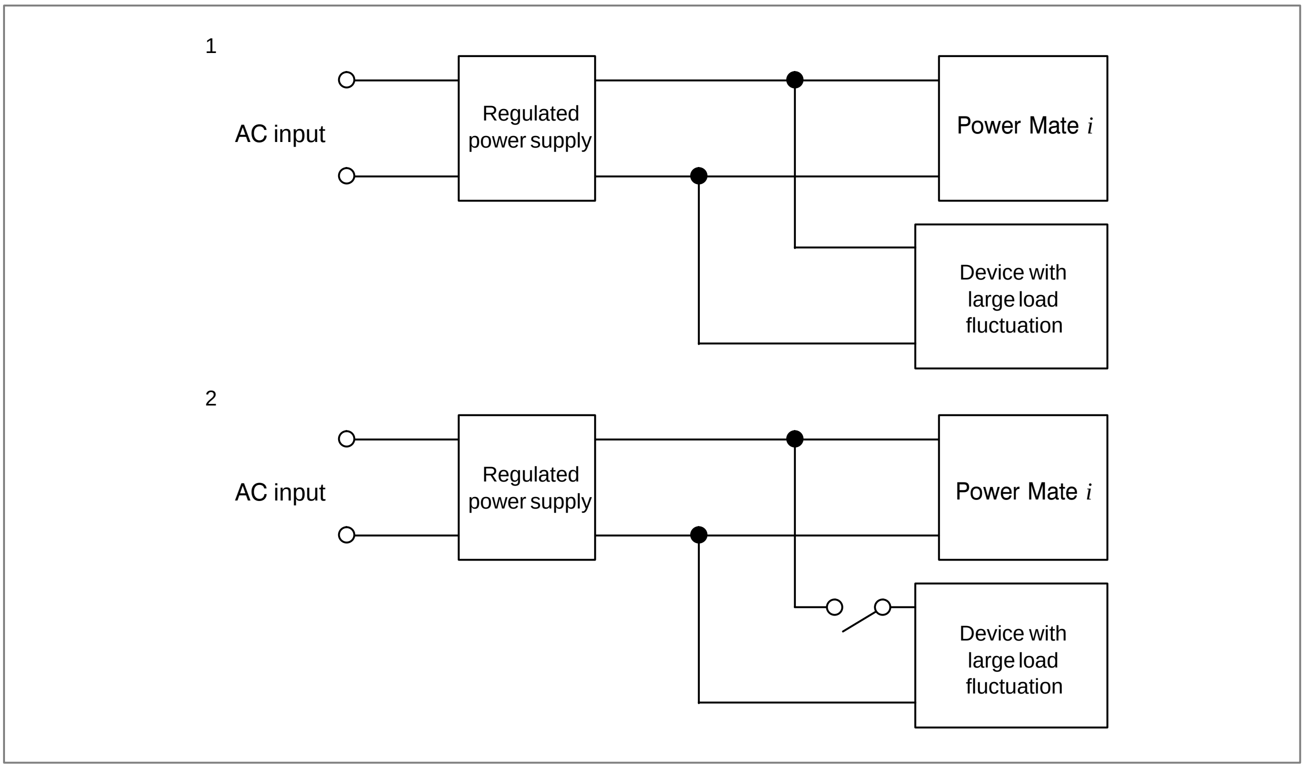
The circuit configurations shown in <1> and <2> below are prohibited.

<1> Circuit example in which the specified output voltage level cannot be maintained at instantaneous disconnection (the output voltage drops to below 21.6 V.)



Rectifier circuits perform full–wave rectification by using diodes.

<2> Circuit example in which an abrupt change in load causes the output voltage to exceed the output voltage specification (21.6 to 26.4 V)

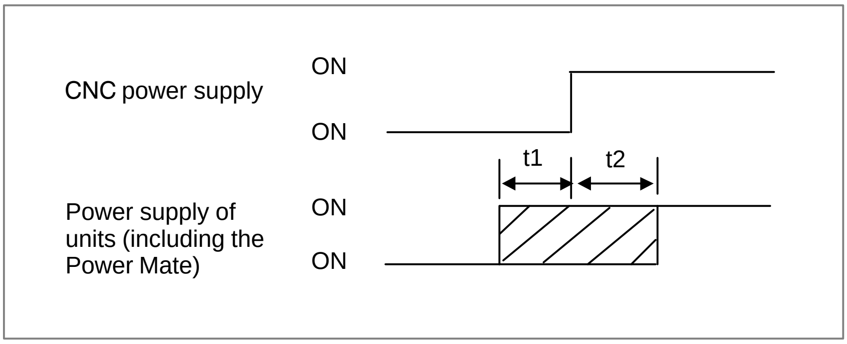


In case of <2>, prepare another regulated power supply specially for the device with abrupt change in load to prevent the change from influencing the Power Mate *i* and other units.

Recommendation

The description of a unit having a 24–VDC power supply, indicating that the unit must be turned on at the same time as the Power Mate *i* or before the CNC power–on operation, has been modified as follows: Turn on the unit at the same time as the Power Mate *i*. When the unit is turned on at the same time as the Power Mate *i*, it is recommended that connections be made on the power line of the same line.

Turning on the power at the same time:
If the following power–on timing is satisfied, the CNC and units are regarded as being turned on at the same time:



| | |
|---|---|
| t1: 200 ms | The units (including the other Power Mate as slave) are turned on within<br>200 ms before the power to the Power Mate *i* is turned on. |
| t2: –500 ms | The units (including the other Power Mate as slave) are turned on within<br>500 ms after the power to the Power Mate *i* is turned on. |

The description of a unit having a 24–VDC power supply, indicating that the unit must be turned off at the same time as the Power Mate *i* or after the CNC power–on, remains unchanged. (When power is turned off at the same time, the power to the unit may be disconnected within 500 ms before the power to the Power Mate *i* is turned off.)

## 5.2
## POWER CONNECTION DIAGRAMS OF SYSTEMS CONTAINING THE Power Mate *i*

1) If the Power Mate *i* is not a FANUC I/O Link slave

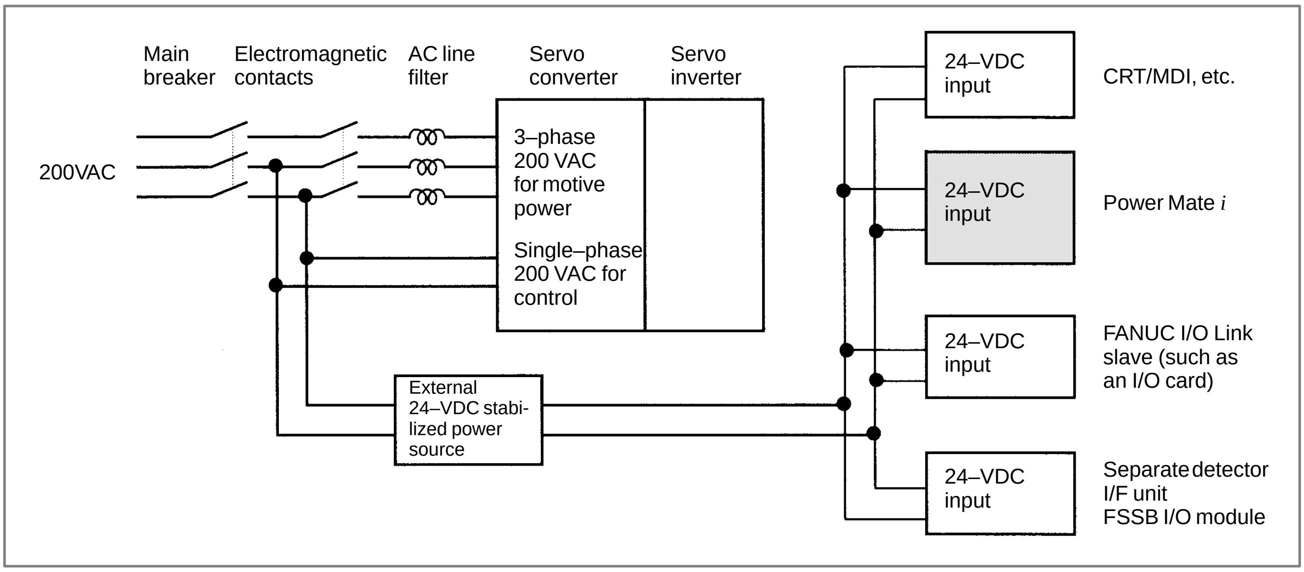


**Fig. 5.2 (a)**

2) If the Power Mate *i* is a FANUC I/O Link slave

- If the FANUC I/O Link master uses 24–VDC power

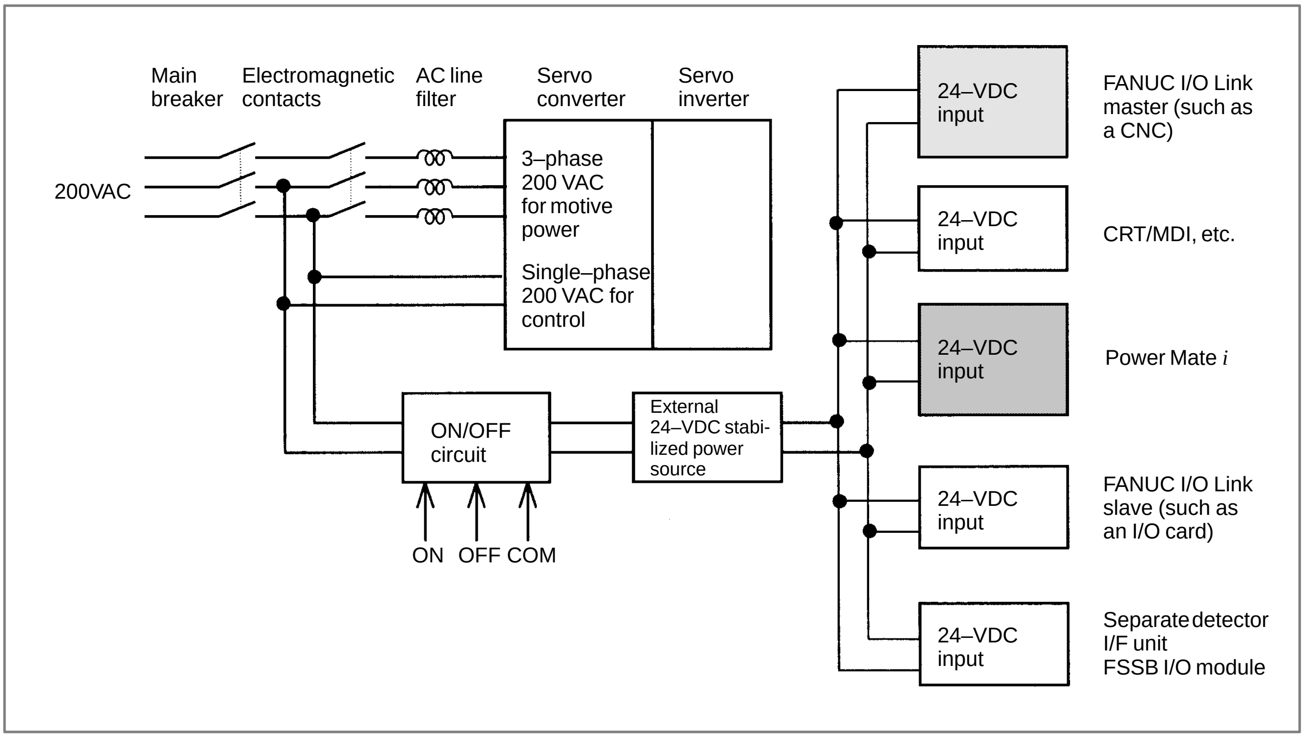


**Fig. 5.2 (b)**

- If the FANUC I/O Link master uses 200–VAC power

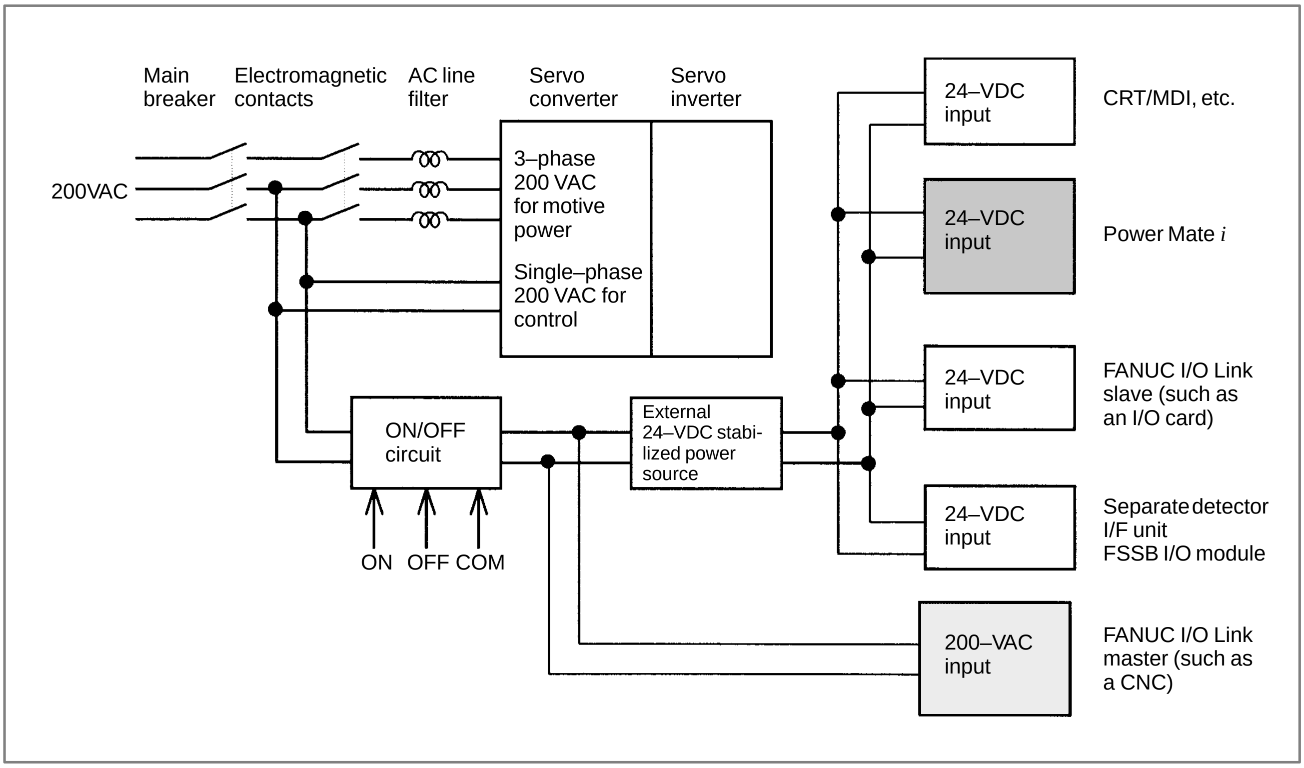


**Fig. 5.2 (c)**

**NOTE**

1. In Fig. 5.2 (c), the 24–VDC power source must have a startup time not exceeding 500 ms.
2. In Figs. 5.2 (a) to 5.2 (c), the FANUC I/O Link slave (such as an I/O card) is a slave of the Power Mate *i*.
3. In Figs. 5.2 (b) and 5.2 (c), the FANUC I/O Link master (such as a CNC) acts as the master for the Power Mate *i*.

The power to separate detectors (scales) can be supplied from the separate detector interface unit, provided that the current (voltage) is 0.35 A (5 V) or less per scale. Note that the separate detector (scale) to which the power is to be supplied from the separate detector interface unit must be such that the A/B–phase signal is stabilized within 500 ms of the power being turned on.

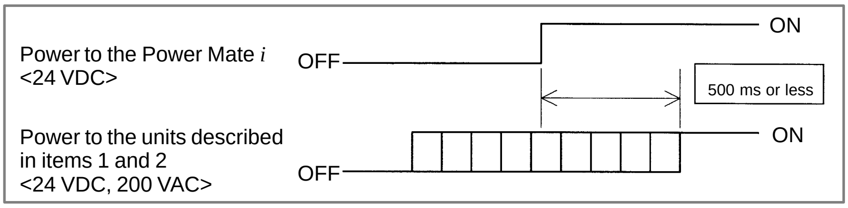
## 5.3 POWER–ON SEQUENCE

Apply the following power–on sequence. Alternatively, turn on the power to all the units simultaneously.

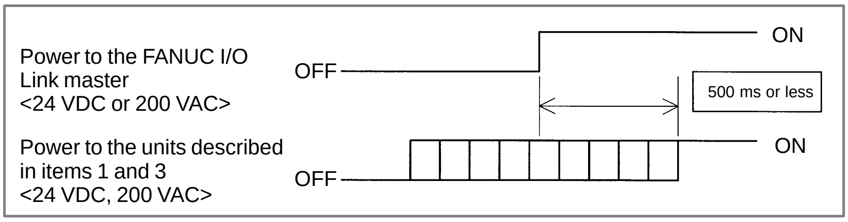
1 Power to the Entire machine <200 VAC>
  Power to the servo amplifier <200 VAC> , power to the separate detector
2 Power to the FANUC I/O Link slaves (such as an I/O card) of the Power Mate *i* <24 VDC>
  Power to the separate detector interface unit <24 VDC>
  Power to the FSSB I/O module <24 VDC>
3 Power to the Power Mate *i* <24 VDC>
4 Power to the FANUC I/O Link master (such as a CNC) <24 VDC or 200 VAC>

“Simultaneously,” as used here, refers to the following:

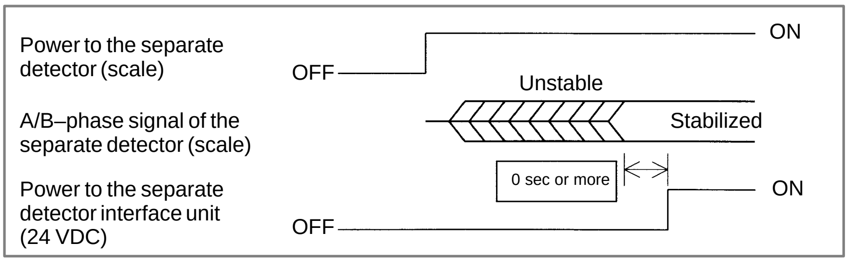
1) If the Power Mate *i* is not a FANUC I/O Link slave (item 4 is not applicable)
   The units described in items 1 and 2 are turned on within 500 ms of the Power Mate *i* in item 3 being turned on.



2) If the Power Mate *i* is a FANUC I/O Link slave (item 4 is applicable)
   The Power Mate *i* in item 3 and the units described in item 2 use the same 24–VDC power source. The units described in items 1 to 3 are turned on within 500 ms of the FANUC I/O Link master (such as a CNC) in item 4 being turned on.



If a separate detector (scale) of paraliel interface is used and its power is supplied from a power source other than a separate detector interface unit, turn on the power to the separate detector (scale) before turning on the power to the separate detector interface unit. The A/B–phase signal of the separate detector (scale) must be stabilized before the separate detector interface unit is turned on.

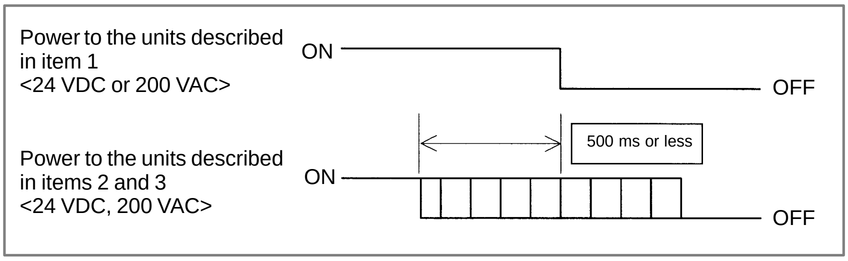


## 5.4 POWER–OFF SEQUENCE

Apply the following power–off sequence. Alternatively, turn off the power to all the units simultaneously.

1. Power to the FANUC I/O Link master (such as a CNC) <24 VDC or 200 VAC>
   Power to the Power Mate *i* <24 VDC>
   Power to the FANUC I/O Link slaves (such as an I/O card) of the Power Mate *i* <24 VDC>
2. Power to the separate detector interface unit <24 VDC>
   Power to the FSSB I/O module <24 VDC>
   Power to the servo amplifier <200 VAC>
3. Power to the entire machine <200 VAC>

"Simultaneously," as used here, refers to the following: The units described in items 2 and 3 may be turned off within 500 ms before the units described in item 1 are turned off.



**NOTE**

1. The units described in item 1 are connected to a FANUC I/O Link. If some of the units connected to a FANUC I/O Link are turned off first, the Power Mate *i* generates system alarm 930 or 973.
2. When the power to the servo amplifier is turned off more than 500 ms before the Power Mate *i* is turned off, the operation of turning off the servo amplifier is recorded in the alarm history of the Power Mate *i*.

The power–on sequence of a setting and display unit supporting the display link is undefined in the power–on sequence of the Power Mate *i* control unit.

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

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

## 5.5
## TURNING OFF/ON THE POWER TO THE Power Mate *i* ONLY

The power to the Power Mate *i* only can be turned OFF/ON only when the separate detector interface unit, FSSB I/O module, and servo amplifier are all ON.
Note, however, that turning OFF/ON the power to the FANUC I/O Link master/slaves connected to the Power Mate *i* must be synchronized with turning OFF/ON the power to the Power Mate *i*. (When the power to the FANUC I/O Link master or slaves is turned off, the Power Mate *i* may generate system alarm 930 or 973.)

## 5.6
## MOMENTARY POWER FAILURE

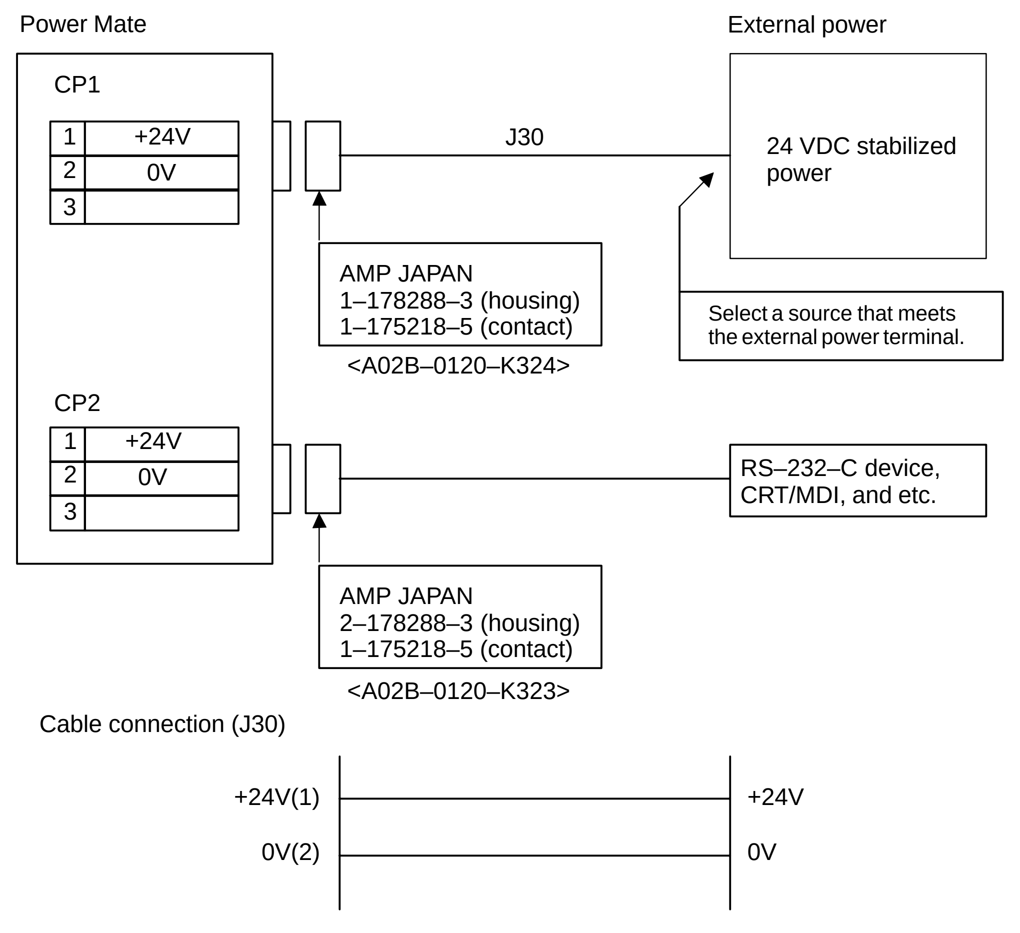
The Power Mate controller has a circuit for protection against momentary power failures.

When a momentary power failure is detected, the Power Mate controller turns off the output signals to the servo system and machine. Upon recovery from the momentary power failure, the system is automatically reset to turn on the output signals to the servo system and machine. Then the Power Mate waits for automatic operation to be restarted. (The operator restarts operation after checking the status.)

The signal ACT on the PMC is available to check if a momentary power failure has occurred.

## 5.7 POWER CONNECTIONS

Supply power to the control unit from external resource.
It is possible to divert a voltage of RS–232–C device at CP1 to CP2 for use in units, such as a CRT and MDI, that are designed to operate on 24 VDC.
In this case, the external 24 VDC power supply should have a rating which is equal to the sum of the current consumed by the control unit and the current used via CP2.



Recommended cable: A02B–0124–K830 (5 m)
(Crimp terminal of size M3 is available on the external power side)

**CAUTION**
Be sure to ground for signals of the control unit (see Section 3.6).

## 5.8 PROTECTION GROUND CONNECTION

The stud for the protection ground is located at the rear of the setting and display unit (such as a CRT/MDI) installed in the cabinet. Use a twisted wire that is 2 mm$^2$ or larger and has a length of approximately 100 mm to connect the ground. See Appendix A for the location of the stud.

## 5.9 BATTERIES

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

| Use | Component connected to battery |
|---|---|
| Backup in the CNC data | CNC |
| Preservation of the current position indicated by the absolute pulse coder built into the motor | Servo amplifier |
| Preservation of the current position indicated by the separate absolute pulse coder | Separate detector interface unit |
| Preservation of the current position in analog servo mode | Analog servo interface unit |

### 5.9.1 Battery for Data Backup (3VDC) in CNC

Part programs, offset data, and system parameters are stored in SRAM memory in the control unit. The power to the SRAM memory is backed up by a lithium battery mounted on the front panel of the control unit. If the battery is connected correctly, the data above is not lost when the main power is turned off. 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 or LCD screen and the battery alarm signal BAL<F001#2> is output to the PMC. When this alarm is displayed, replace the battery as soon as possible.

If the voltage of the battery becomes any lower, contents of SRAM memory can no longer be backed up. Turning on the power to the Power Mate *i* in this state causes system alarm 910 (SRAM parity alarm or SRAM ECC alarm) to occur because the contents of SRAM memory are lost. Clear the entire memory and reenter data after replacing the battery.

**CAUTION**
1 Be sure to back up the latest data of the SRAM memory to a flash memory card or Handy File to protect against a dead battery or accident. (Data cannot be backed up to an SRAM memory card. An SRAM memory card is used to copy data to the hard disk of a personal computer.)
2 When the Power Mate *i* with a setting/display unit not connected at all times is used, display a battery alarm on the machine operator's panel by using the battery alarm signal BAL.
3 The battery is secured onto the base printed circuit board. When attaching/detaching the base printed circuit board with the battery connected, back up the latest data beforehand to protect against loss of data.
4 If the power to the Power Mate *i* is turned off with the battery removed, data backup for more than 30 minutes is impossible. If the battery is removed when the power to the Power Mate *i* is off, data cannot be backed up.
5 When the SRAM memory contents are backed up to the built–in FROM of the Power Mate *i*, memory data can be recovered easily if it is lost. For the backup method, refer to the maintenance manual (B–62175EN). This backup operation, however, does not mean that the backup to a flash memory card or Handy File becomes unnecessary.

The following two kinds of batteries can be used.

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

**NOTE**
1 When the battery case is mounted on the cabinet so that batteries can be replaced outside the cabinet, battery replacement can be performed without opening the cabinet. (When the power to the machine is on, only persons who have received a maintenance and safety education course can open the cabinet to perform battery replacement.)
2 When the Power Mate i is shipped from FANUC, one lithium battery is included in the controller. When you want to use alkaline dry cells for backup, you need prepare an externally–installed battery case for the control unit and two alkaline dry cells (size D).

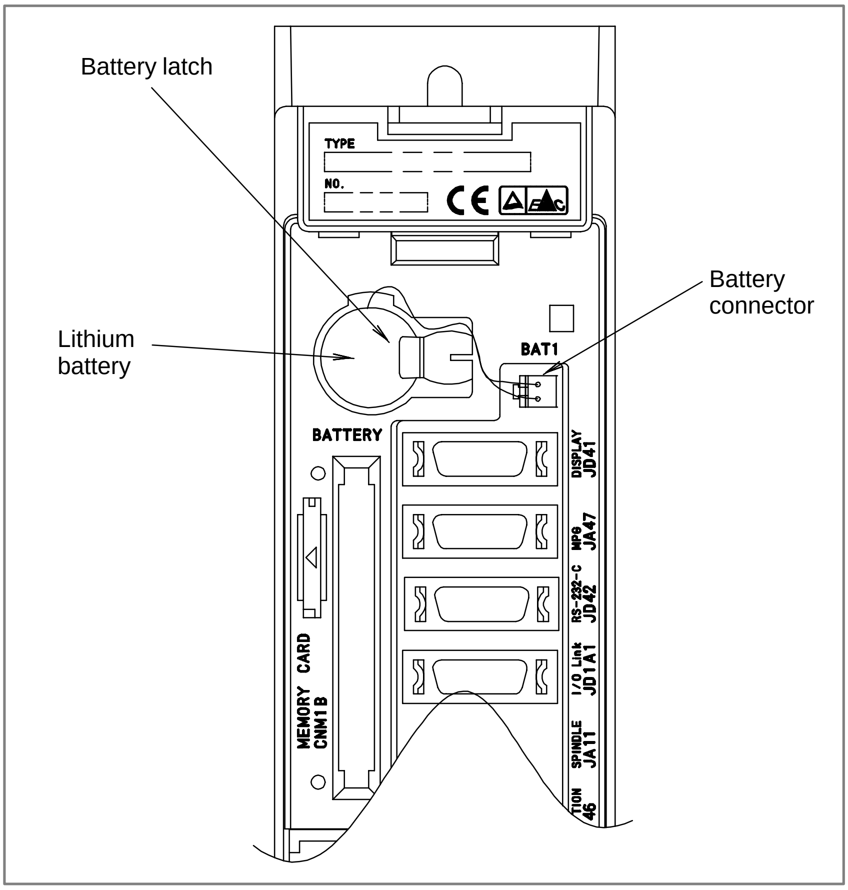
### Replacing the lithium battery

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

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

(3) Turn the Power Mate *i* off.

(4) Remove the old battery from the top of the Power Mate control unit. First unlatch the battery, remove it from the battery holder, and detach its connector. The battery holder is on top of the face plate (or the memory connector) on the base printed–circuit board.



(5) Remove the old battery, insert a new one into the battery holder, and attach the connector. Confirm that the battery is latched firmly.

**WARNING**

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

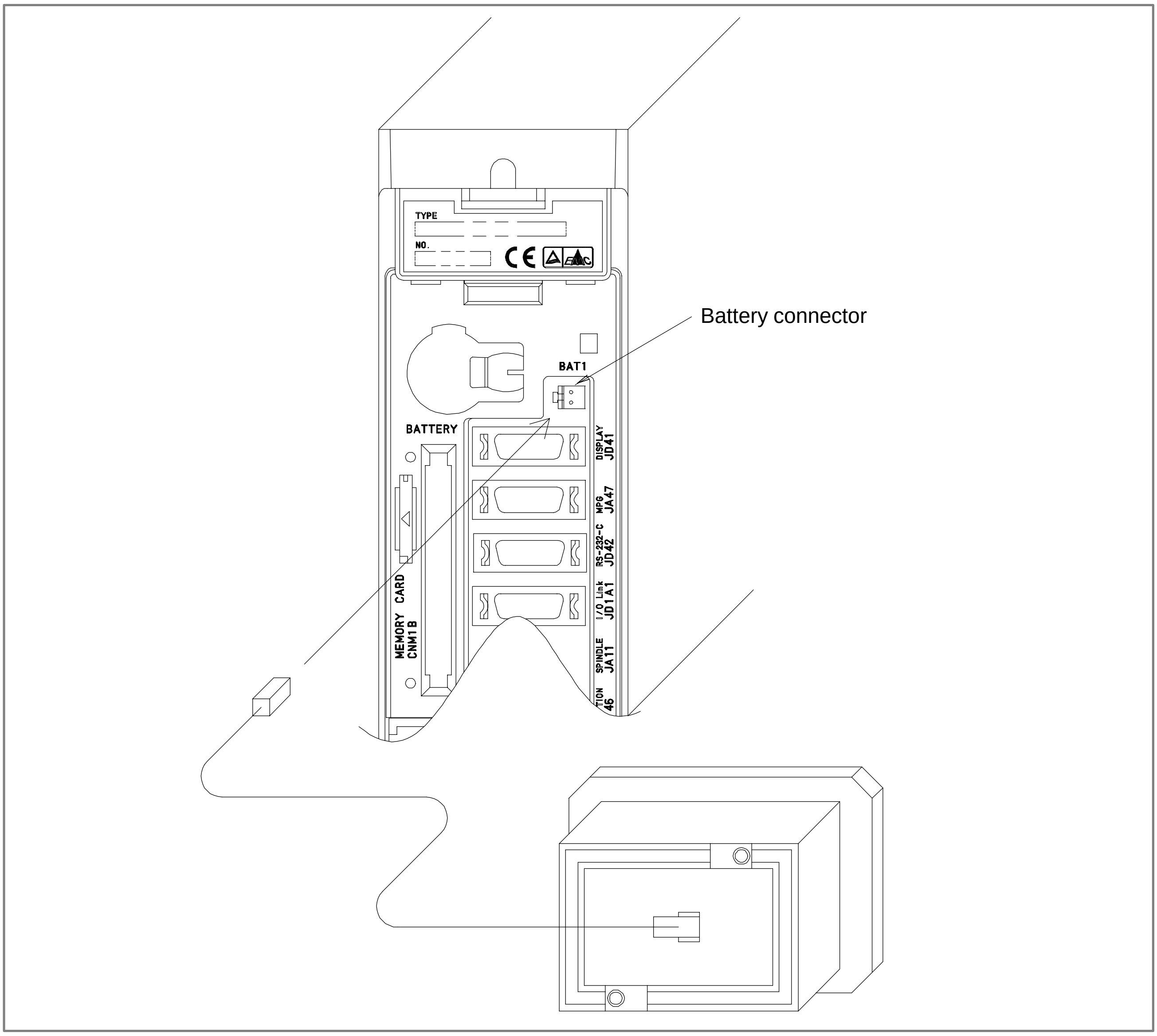
**CAUTION**

1. Before replacing the battery, check that the latest data of the SRAM memory is already backed up.
2. Turn off the power to the machine before replacing the battery. Only personnel trained in maintenance and safety can replace the battery when the power to the machine is on.
3. Complete steps (3) to (5) above within 30 minutes. If the battery is detached for a long time, the contents of the SRAM memory are lost.

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

### Use of alkaline dry cells (size D)

To use commercially available alkaline dry cells in the externally–installed battery case for the control unit to back up the SRAM memory of the Power Mate *i*, connect the external battery by using the connector connected to the lithium battery. The lithium battery, provided as standard, can be replaced with external batteries in the battery case (A02B–0236–C281) according to the battery replacement procedures described above.



**NOTE**

Install the battery case (A02B–0236–C281: 14–m cable) in a safety location where the batteries can be replaced even when the Power Mate *i* power is on.

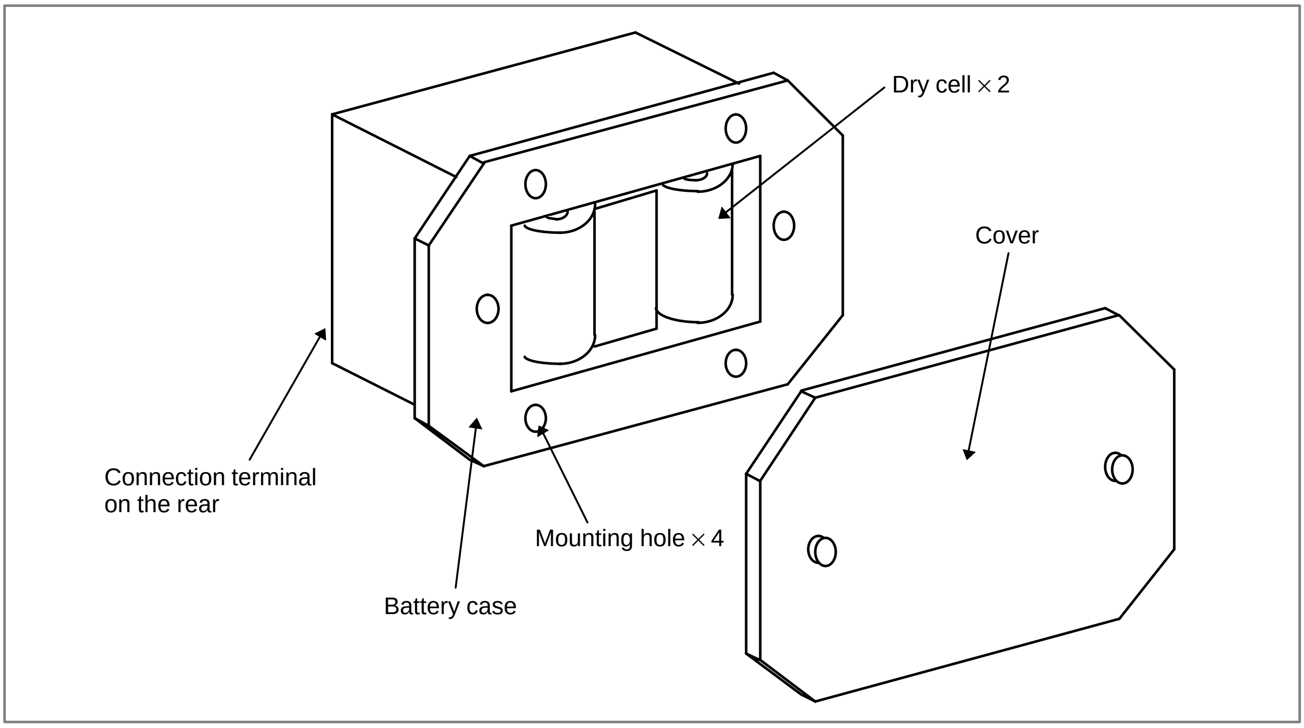
The battery cable connector is attached to the control unit by means of a simple lock system. To prevent the connector from being disconnected due to the weight of the cable or tension within the cable, fix the cable section within 50 cm of the connector.

## Replacing the alkaline dry cells (size D)

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

**CAUTION**

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



## 5.9.2
## Battery for Absolute Pulse Coder Built into the Motor (6 VDC)

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

- FANUC SERVO MOTOR α series Maintenance Manual
- FANUC SERVO MOTOR β series Maintenance Manual

**NOTE**

1 Clearly specify the method of reference position return operation beforehand to protect against a dead battery or accident. Before replacing the battery, in particular, check that the method of reference position return operation is clearly specified.

2 When the setting indicator is not kept connected with the Power Mate *i*, monitor APC alarm type signals APBZn, APBVn, and APBLn. If an alarm indicating a battery voltage drop in the absolute pulse coder is detected, display a battery alarm on the machine operator's panel and so on.

## 5.9.3
## Battery for Separate Absolute Pulse Coders (6 VDC)

For the battery connection method, see Section 9.2.

When the voltage of the battery becomes low, APC alarms 306 to 308 are displayed on the CRT display. When APC alarm 307 is displayed, replace the battery as soon as possible. In general, the battery should be replaced within one or two weeks, however, this depends on the number of pulse coders used.

If the voltage of the battery becomes any lower, the current positions for the pulse coders can no longer be maintained. Turning on the power to the control unit in this state causes APC alarm 300 (reference position return request alarm) to occur. Return the tool to the reference position after replacing the battery.

**NOTE**

1 Clearly specify the method of reference position return operation beforehand to protect against a dead battery or accident. Before replacing the battery, in particular, check that the method of reference position return operation is clearly specified.

2 When the setting indicator is not kept connected with the Power Mate *i*, monitor APC alarm type signals APBZn, APBVn, and APBLn. If an alarm indicating a battery voltage drop in the absolute pulse coder is detected, display a battery alarm on the machine operator’s panel and so on.

3 When the battery is removed and the power to the separate detector interface unit is off, data cannot be backed up.

4 Battery replacement is done with the cabinet left closed while the machine is on.

### 5.9.4

### Battery for the Analog Servo Interface Unit

For how to connect the battery, see Section 9.5.

For other information, see the previous subsection, ”Battery for Separate Absolute Pulse Coder”.

# 6

# CONNECTION OF I/O UNITS TO MACHINE INTERFACE

## 6.1 MACHINE INTERFACE I/O

### 6.1.1 General

Combinations of the units listed in Table 6.1 can be used as the machine interface I/O.

The I/O units can be classified into two types: the I/O units tailored to the FANUC I/O Link, and the built-in I/O unit. The I/O unit for the FANUC I/O Link is installed separately from the control unit, and the two units are mutually connected by a specialized serial link (FANUC I/O Link). Multiple units can be placed in separate locations as shown Fig. 6.2.1.

The FANUC I/O Link enables high–speed data transfer between the control unit and an external unit. The statuses of signals input from the machine are transferred to the control unit at constant intervals. The output signals from the control unit are sent to the external unit at constant intervals.

For details of the units which are not listed in Table 6.1, see the corresponding operating manual.

The built–in I/O unit is installed in the control unit.

The Power Mate supports the simultaneous use of the built–in I/O unit and I/O units tailored to the FANUC I/O Link.

An I/O unit for FSSB is mounted on the FSSB line connected to a servo amplifier. It is, therefore, useful if the Power Mate *i* is remote from the servo amplifier cabinet.

**Table 6.1.1 Types of machine interface I/O**

| Unit | Description | Reference |
|---|---|---|
| Built–in I/O | | |
| Built–in I/O | This I/O module is incorporated in the Power Mate.<br>32 DI points<br>24 DO points | Sec. 6.4 |
| High speed DI | The Power Mate has eight high–speed DI points. These DI points can operate independently of one another. | Sec. 6.5 |
| I/O supporting the FANUC I/O Link | | |
| I/O card D | This I/O card has 48 DI points and 32 DO points. | Sec.6.6 |
| I/O card E | This I/O card has 96 DI points and 64 DO points. | Sec.6.6 |
| Connector panel I/O module | Distribution type I/O unit that handles the input/output signals required by the power magnetics circuit; it has an interface with a manual pulse generator. | Sec. 6.7 |
| Operator's panel I/O module (for matrix input) | Unit having an interface with a machine operator's panel; it has an interface with a manual pulse generator. | Sec. 6.8 |

**Table 6.1.1  Types of machine interface I/O**

| Unit | Description | Reference |
|---|---|---|
| Operator’s panel I/O module | Unit having an interface with a machine operator’s panel that handles the input/output signals required by the power magnetics circuit; it has an interface with a manual pulse generator. | Sec. 6.9 |
| 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. | Sec. 6.10<br>(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. | B–62163E |
| FANUC I/O Link connection unit | Unit connecting FANUC I/O Link masters to enable the transfer of DI/DO signals | Sec. 6.11 |
| I/O supporting the FSSB | | |
| FSSB I/O module | This is an I/O module for connection to the serial servo bus (FSSB) line.<br>Basic unit DI: 32 points, DO: 24 points<br>Extended unit DI: 32 points, DO: 24 points | Sec. 6.12 |

**CAUTION**

1 The emergency stop signal should be simultaneously input to the Power Mate control unit and servo unit so that the power supply to the motor is interrupted. For detailed connection of the servo emergency stop signal, refer to “FANUC Servo Amplifier α Series (B–65162E).”

2 Some I/O boards that support the FANUC I/O Link can switch the input common voltage lines. They cannot be used with X000 for safety reasons, if they are designed to switch the common voltage lines for the X000.4 emergency stop signal.

## 6.1.2
## Addresses between the Machine and the PMC

The addresses between the machine and the PMC are explained for each I/O unit.
When the following functions are used, the machine–to–PMC addresses are fixed. If the functions are not used, these addresses can be used for other purposes.

Functions for which the machine–to–PMC addresses are fixed

| **Function name** | **Signal name** | **Relevant Section in Connection Manual (Functions)** |
|---|---|---|
| Emergency stop | *ESP | Section 2.1 |
| Deceleration signal for returning to the reference point | *DEC#n | Section 4.1 |
| High speed interlock signal | *RILK | Section 2.5 |
| Skip signal | SKIP, SKIP2 to SKIP4 | Section 14.2 |
| Skip signal (PMC control) | ESKIP | Section 15.1 |

**NOTE**

Whether the above functions are to be input from a built–in I/O unit or from an I/O unit for the FANUC I/O Link is specified with bit 3 (BIO) of parameter No. 3008.

1) Built–in I/O unit
The following addresses can be used between the machine and the PMC:
DI: 32 addresses from X1000 to X1003
DO: 24 addresses from Y1000 to Y1002
Machine–to–PMC addresses

1 For the Power Mate *i*–D (1 path)

| | #7 | #6 | #5 | #4 | #3 | #2 | #1 | #0 |
|---|---|---|---|---|---|---|---|---|
| X1000 | SKIP | *RILK | *DEC1 | *ESP | ESKIP | SKIP4 | SKIP3 | SKIP2 |
| X1001 | | | *DEC2 | | | | | |

2 For the Power Mate *i*–D (2 paths)

| | #7 | #6 | #5 | #4 | #3 | #2 | #1 | #0 |
|---|---|---|---|---|---|---|---|---|
| X1000 | SKIP #1 | *RILK #1 | *DEC1 #1 | *ESP #1 | | SKIP4 #1 | SKIP3 #1 | SKIP2 #1 |
| X1001 | SKIP #2 | *RILK #2 | *DEC1 #2 | *ESP #2 | | SKIP4 #2 | SKIP3 #2 | SKIP2 #2 |

3 For the Power Mate *i*–H

| | #7 | #6 | #5 | #4 | #3 | #2 | #1 | #0 |
|---|---|---|---|---|---|---|---|---|
| X1000 | SKIP | *RILK | | *ESP | ESKIP | SKIP4 | SKIP3 | SKIP2 |
| X1001 | | | | | | | | |
| X1002 | *DEC8 | *DEC7 | *DEC6 | *DEC5 | *DEC4 | *DEC3 | *DEC2 | *DEC1 |

2) I/O unit for FANUC I/O Link

The following addresses can be used between the machine and the PMC:

DI: 1024 addresses from X000 to X127

DO: 1024 addresses from Y000 to Y127

Machine–to–PMC addresses

1 For the Power Mate *i*–D (1 path)

| | #7 | #6 | #5 | #4 | #3 | #2 | #1 | #0 |
|---|---|---|---|---|---|---|---|---|
| X000 | SKIP | *RILK | *DEC1 | *ESP | ESKIP | SKIP4 | SKIP3 | SKIP2 |
| X001 | | | *DEC2 | | | | | |

2 For the Power Mate *i*–D (2 paths)

| | #7 | #6 | #5 | #4 | #3 | #2 | #1 | #0 |
|---|---|---|---|---|---|---|---|---|
| X000 | SKIP #1 | *RILK #1 | *DEC1 #1 | *ESP #1 | | SKIP4 #1 | SKIP3 #1 | SKIP2 #1 |
| X001 | SKIP #2 | *RILK #2 | *DEC1 #2 | *ESP #2 | | SKIP4 #2 | SKIP3 #2 | SKIP2 #2 |

3 For the Power Mate *i*–H

| | #7 | #6 | #5 | #4 | #3 | #2 | #1 | #0 |
|---|---|---|---|---|---|---|---|---|
| X000 | SKIP | *RILK | | *ESP | ESKIP | SKIP4 | SKIP3 | SKIP2 |
| X001 | | | | | | | | |
| X002 | *DEC8 | *DEC7 | *DEC6 | *DEC5 | *DEC4 | *DEC3 | *DEC2 | *DEC1 |

3) I/O unit for FSSB

The following addresses can be used between the machine and the PMC:

DI: Up to 128 addresses. The R area is specified with a parameter. (See Section 6.13.)

DO: Up to 96 addresses. The R area is specified with a parameter. (See Section 6.13.)

The functions for which the machine–to–PMC addresses are fixed cannot be used in this I/O unit.

# 6.2 CONNECTION OF THE FANUC I/O LINK

## 6.2.1 General

In FANUC I/O Link (omit as I/O Link) there are the master station and its slave stations. The master is the Controller of the Power Mate or others, and the slaves are the I/O unit and I/O card. Power Mate can be used as slave. 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 card and FANUC SERVO AMPLIFIER β series (I/O Link Option) are each counted as one group.

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 JD1B of the last unit is not used and left open, it need not be connected with a terminator. Power Mate uses JD1A1 to connect I/O card etc... as a master, and uses JD1A and JD1B to be slave controller of other CNC controller.

The pin assignments of connectors JD1A and JD1B are common to all units on the I/O Link, and are illustrated on the next page. Use the figures when connecting the I/O Link irrespective of the type of unit.

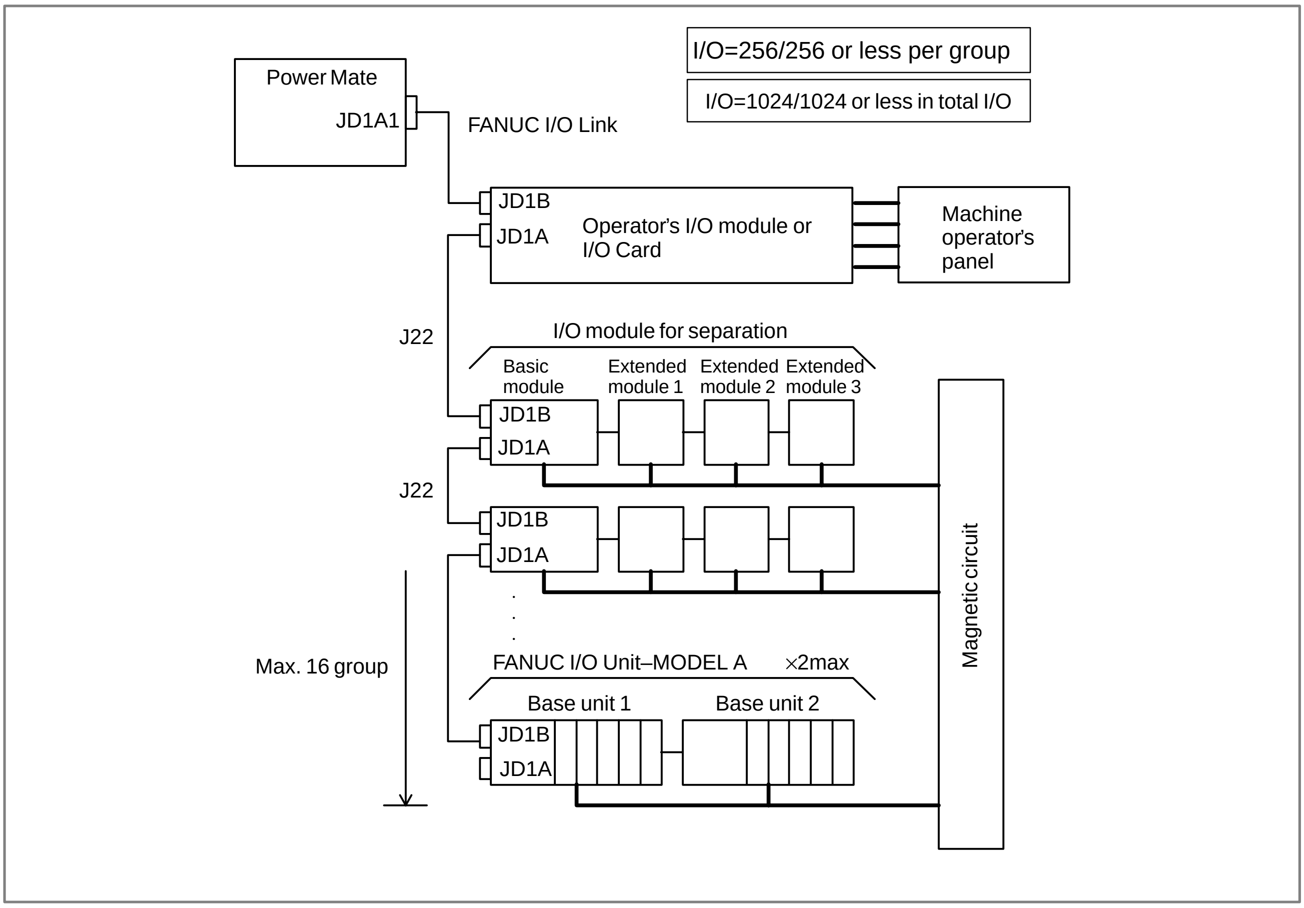
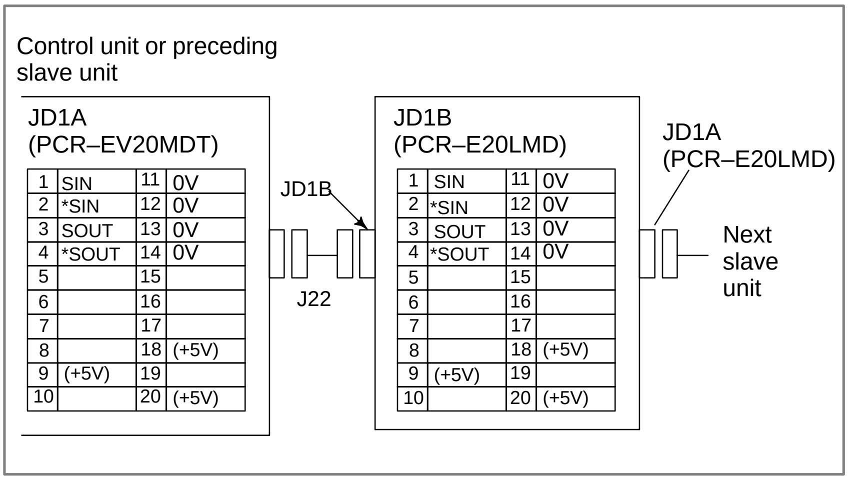


Fig. 6.2.1 I/O Link connection diagram

## 6.2.2 Connection of FANUC I/O Link by Electric Cable



JD1A (PCR–EV20MDT)

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

JD1B (PCR–E20LMD)

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

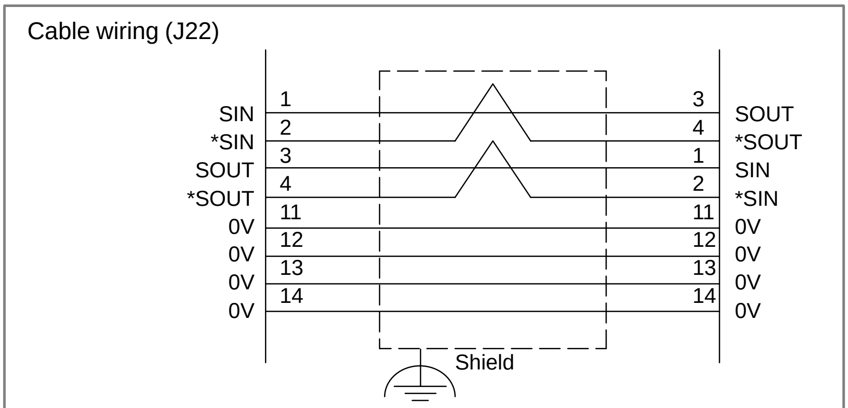
+5 V terminals are for an optical I/O link adapter. They are not necessary when connecting with a optical cable.

**CAUTION**

Do not connect the +5V terminal when the Optical I/O Link Adapter is not used.

Otherwise, the +5–V terminals are short–circuited, thus damaging the unit.

Cable wiring (J22)



Recommended Cable Material

A66L–0001–0284#10P(#28AWG×10pair)

**NOTE**

In the cable, pins 1 and 2 are cross–connected to pins 3 and 4, respectively.

- Recommended connector for cable side :
  PCR–E20FA (made by HONDA TSUSIN KOGYO CO., LTD.)
  FI30–20S (made by HIROSE ELECTRIC CO., LTD.)
  FCN–247J020–G/E (made by FUJITSU CO., LTD.)
  52622–2011 (made by MOLEX)

## 6.2.3 Connection of FANUC I/O Link Optical Cable

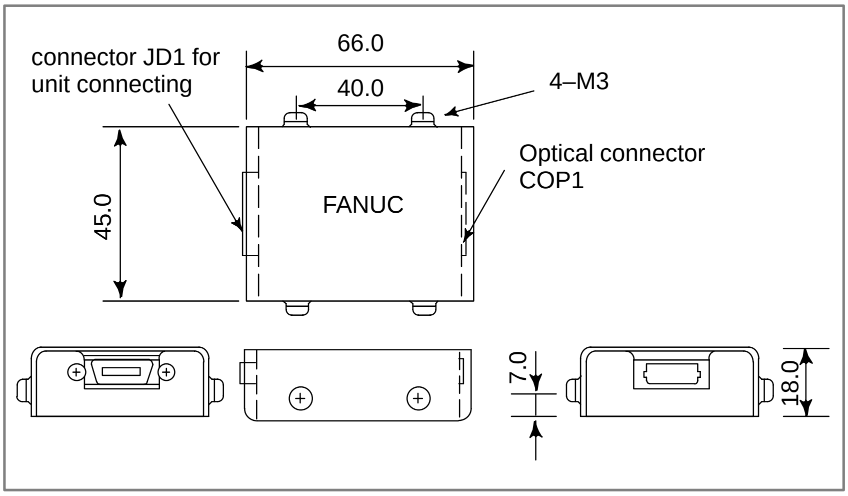
The FANUC I/O Link can be extended to the maximum length of 200 m with optical cables using an optical I/O link adapter.

**NOTE**

In the following cases, use an optical 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 I/O Link adapter

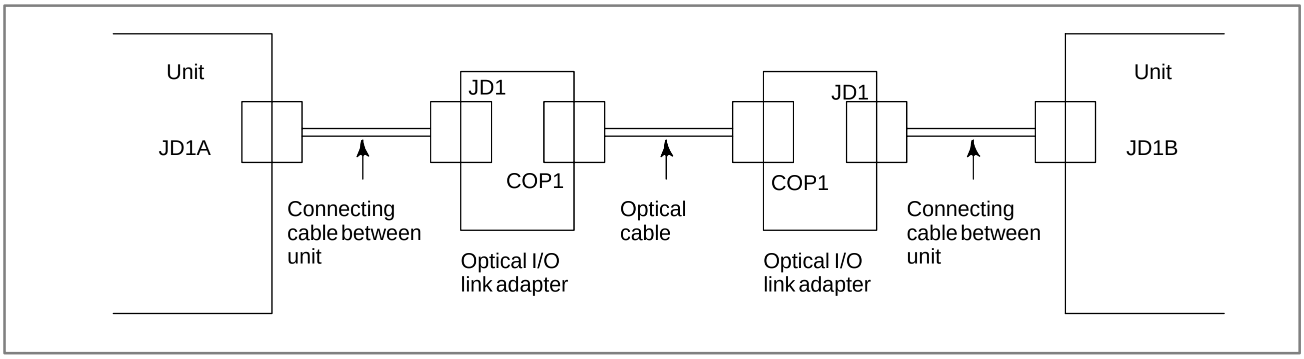


### Weight of optical I/O Link adapter

Main body : Approx. 100 g.

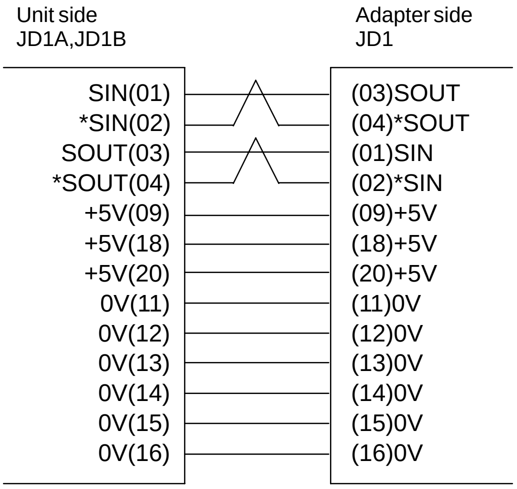
### Connection

- **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 |



- Recommended connector for cable side :
  PCR–E20FA (made by HONDA TSUSIN KOGYO CO., LTD.)
  FI30–20S (made by HIROSE ELECTRIC CO., LTD.)
  FCN–247J020–G/E (made by FUJITSU CO., LTD.)
  52622–2011 (made by MOLEX)
- Recommended wire material : A66L–0001–028A#10P
  (#28AWG × 10 pair)
- Cable length : Max. 2 m (when the recommended wire material is used)

**NOTE**
Cross the cables for pins 1 and 2 as well as those for pins 3 and 4.

- **Optical cable**

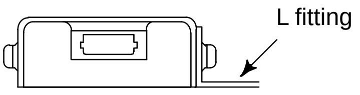
- Cables are available in various lengths.
  Refer to the ordering list.
  For the cables for external lines, also see Appendix D.
- Cable length: Max. 200 m

## Power source

- Power voltage : 4.75V to 5.25V (at the receiving end)
- Consumption current : 200mA

## Installation conditions

- The optical I/O Link adapter enclosure is not fully sealed ; install it with the Power Mate control unit in the fully enclosed cabinet.
- Ground the case using the case fixing screw of the optical I/O Link adapter.
- The optical I/O 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 I/O Link adapter in a cabinet, attach it with an L–type fitting using the case fixing screws (M3) of the optical I/O Link adapter.



### Required parts

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

| | |
|---|---|
| Optical I/O Link adapter | 2 |
| Interunit connecting cable | 2 |
| Optical cable | 1 |

# 6.3 INPUT/OUTPUT SIGNAL SPECIFICATIONS

## 6.3.1 Input Signal Specifications

1) DC input signal A

DC input signal A is a category of signals sent from machine components (such as pushbutton, limit switch, relay contact) to the Power Mate.

2) DC input signal B

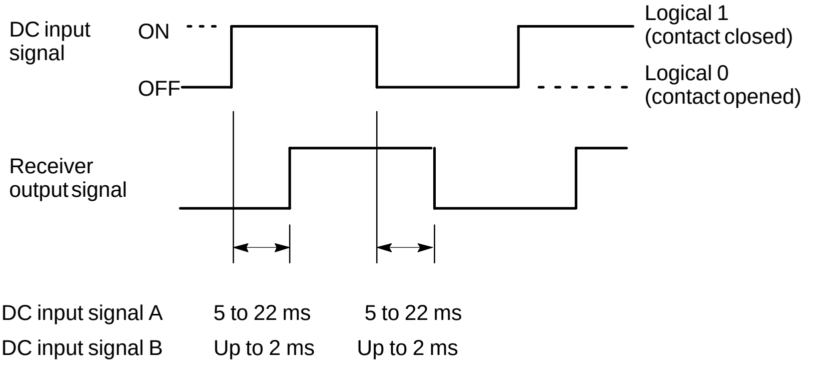
DC input signal B is a category of signals sent from the machine to the Power Mate for high–speed operation.

This category uses a noninsulated interface in which the signals can be switched between a sink type (24 V common) and a source type (0 V common). However, the emergency stop input must be fixed to a sink type (24 V common). In addition, safety standards require the sink type be used.

Both DC input signals A and B should satisfy the following conditions for contacts on the machine side

Contact capacity:
 30 VDC, 16 mA or greater
Open–circuit contact–to–contact leakage:
 1 mA or less (for 26.4 V)
Closed–circuit contact–to–contact voltage drop:
 2 V or less (for 8.5 mA, including a voltage drop across the cable)

DC input signal width and delay



| | | |
|---|---|---|
| DC input signal A | 5 to 22 ms | 5 to 22 ms |
| DC input signal B | Up to 2 ms | Up to 2 ms |

**NOTE**

The DC input signal, B, can be used under the following input ratings:

Closed–circuit contact voltage drop: 3.5 V or lower (including a voltage drop across the cable, at 8.5 mA)

Receiver delay time: 4 ms (maximum)

---

## 6.3.2 Output Signal Specifications

The Power Mate uses source–type output signals that comply with safety standards.

The output signals are rated as follows:

Maximum load current with the driver turned on:
200 mA (including an instantaneous value and ripple)
Saturation voltage with the driver turned on:
1.0 V (maximum)
Dielectric strength:
24 V +20% (including an instantaneous value)
Leakage current with the driver turned off:
100 μA (maximum)

The output signals require an external power supply rated as follows:

Supply voltage:
+24 V +10% (including an instantaneous value)
Supply current:
At least the total maximum load current (including an instantaneous value) + 100 mA
Turn–on timing:
Before the Power Mate power supply is turned on (with a maximum allowable time lag of 500 ms)
Turn–off timing: Same time or after the Power Mate power supply is turned off

Connect the power supply that meets the above requirements to the output signal power supply pins (DOC and 0V) of each DI/DO connector. Note that the total load current varies with the type of a DI/DO card used. It is necessary to connect 24 VDC to all DOC pins.

**NOTE**

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

## Output signal driver

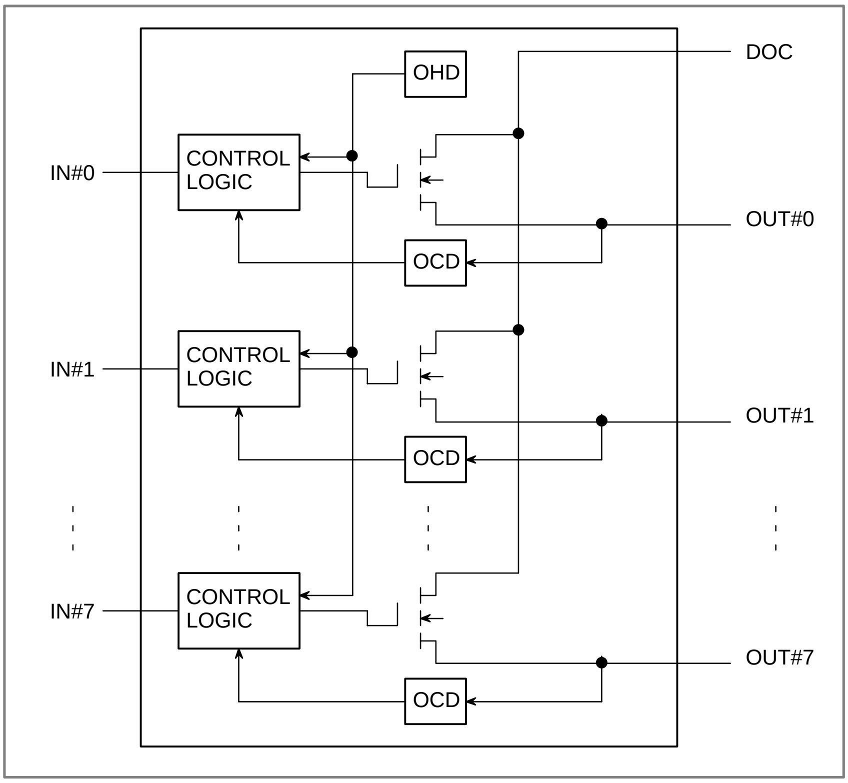
The output signal driver can output up to eight signals.

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.

If the output of a signal cannot be turned on even though the 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

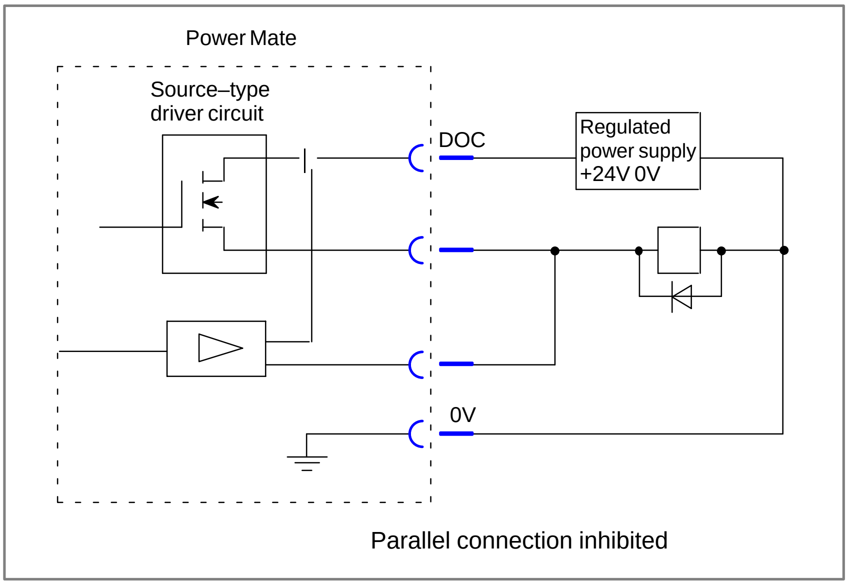


OHD: Overheat detection circuit
OCD: Overcurrent detection circuit

The power for operating this driver element is supplied from DOC (24 VDC).

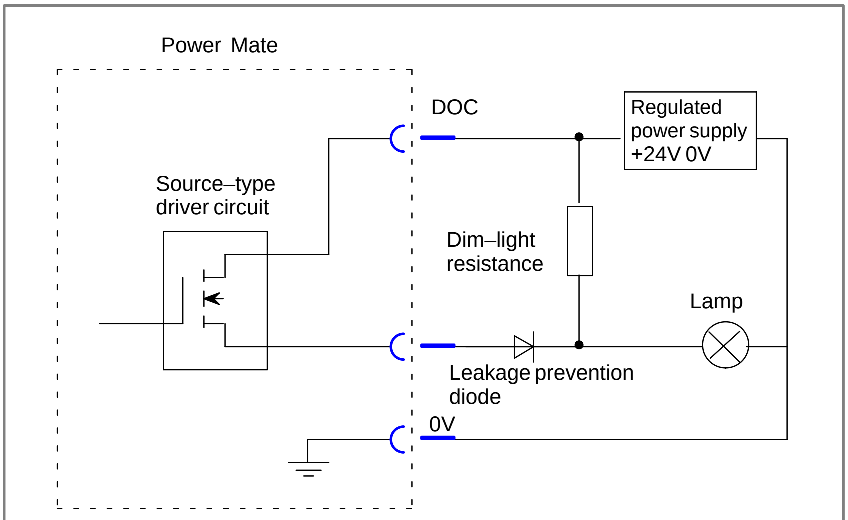
The following restriction applies to the connection of the output signals.

The following parallel connection of output pins shall not be used.



Parallel connection inhibited

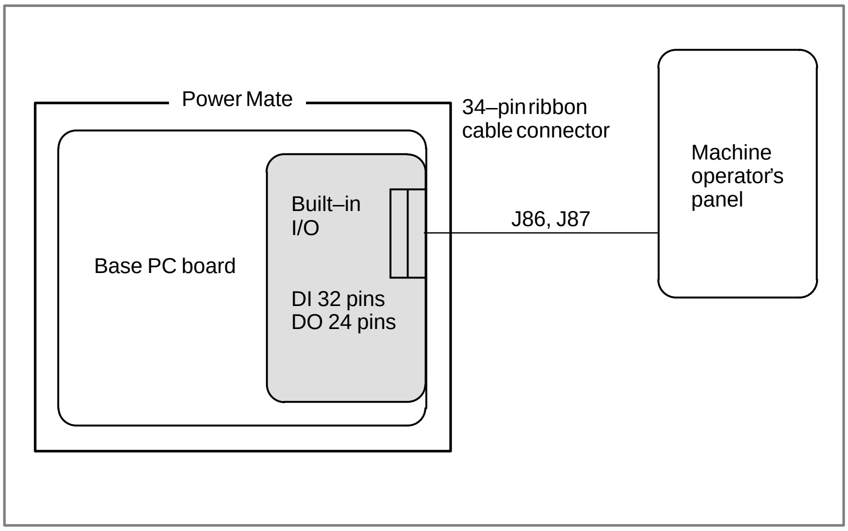
When using a dark–light resistance, connect a leakage prevention diode to it.



When a dim–light resistance is used

# 6.4 CONNECTION OF BUILT–IN I/O

## 6.4.1 Outline



This is built–in I/O mounted on the base PC board of Power Mate.

The DO signals are of source type and conform to the safety requirements.

This built–in I/O is designed such that a connector panel is used to relay the signals between the I/O card and terminal block or another connector. In particular, to facilitate connection to a connector panel, MIL–standard ribbon–cable connectors are employed as the interface connectors.

(1) DI 32 pins and DO 24 pins are available.

(2) Maximum DO load current: 2.1 A

(3) Connector specification:

Connector conforming to MIL–C–83503 standard, equipped 34 pins with center key for protection against reverse insertion

Use the cable connector conforming to the equivalent standard.

Recommended connector

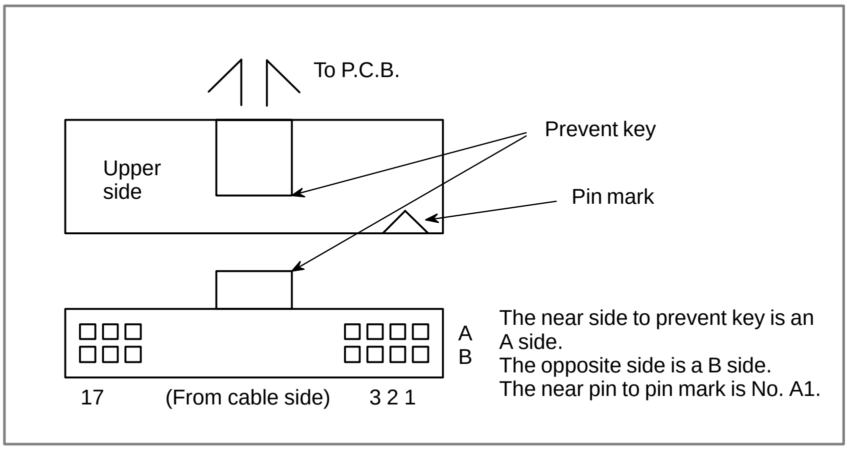
A02B–0124–K300

(HIROSE HIF3BA–34D–2.54R × 1)

(4) The built–in I/O module can be used simultaneously with the I/O module supporting the FANUC I/O Link or FSSB.

(5) Signals for which the machine–to–PMC addresses are fixed, such as the emergency stop signal, can be input from a built–in I/O unit or I/O unit for FANUC I/O Link. To input the signal from the built–in I/O module, set bit 3 (BIO) of parameter 3008 to 1.

(6) Pin No. of connector



(7) When the cable is run outside the cabinet, use a common shield cable.

34 pin cable with shild (soldering type)

| | |
|---|---|
| OKI DENSEN CO., LTD. | SFX–S 34–7/0.127 3030–SV (20266) K |
| FANUC SPECIFICATION | A66L–0001–0308#S34S |

Clamp the cable shield with the cable clamp on the grounding plate of the cabinet on the built–in I/O side.
When the cable used is not a shield cable, it must be used only within the cabinet.

(8) For details of the signal specifications, see Section 6.3.

(9) Ensure that the cable is securely plugged into the unit. Otherwise, problems such as DI/DO signal transfer errors may occur.

(10) The DO points of this built–in I/O module are designed to be turned off when a system alarm occurs in the Power Mate and when the Power Mate power is switched off.

(11) The DO driver of the built–in I/O is capable of detecting an overcurrent and measuring its own temperature. If an accident, such as connecting the cable to ground, causes an abnormal increase in the load current or in the driver temperature, a protection circuit, which is provided for each DO driver (1 byte), is activated which keeps the DO signal for the relevant 1 byte in the OFF state until the cause of the problem is eliminated. Even if this occurs, the Power Mate continues operating. The DI address (F248) identifies which DO driver has detected an alarm. The following table shows the correspondence between the PMC address (F248) bits and the DO addresses. Bit value “1” indicates that the corresponding DO driver has detected an alarm. If a DO error occurs, the F248 area can be checked on the DGN screen of the Power Mate. Performing alarm processing for F248 in advance by using Ladder ensures safety and assists in fault investigation and recovery.

| Alarm detection address and bit | DO address |
|---|---|
| F248.0 | Y1000 |
| F248.1 | Y1001 |
| F248.2 | Y1002 |

**CAUTION**

If the ladder program does not perform alarm processing for F248, the Power Mate cannot detect an error (if occurs) in the DO driver.

## 6.4.2 Signals

(1) DI signals

| PMC ADDRESS | #7 | #6 | #5 | #4 | #3 | #2 | #1 | #0 |
|---|---|---|---|---|---|---|---|---|
| X1000 | ▨ | ▨ | ▨ | ▨ | ▨ | ▨ | ▨ | ▨ |
| | 155–B05 | 155–A06 | 155–B04 | 155–A04 | 155–B03 | 155–A03 | 155–B02 | 155–A02 |
| X1001 | ▨ | ▨ | ▨ | ▨ | ▨ | ▨ | ▨ | ▨ |
| | 155–B10 | 155–A10 | 155–B09 | 155–A09 | 155–B08 | 155–A08 | 155–B07 | 155–A07 |
| X1002 | | | | | | | | |
| | 156–B05 | 156–A05 | 156–B04 | 156–A04 | 156–B03 | 156–A03 | 156–B02 | 156–A02 |
| X1003 | | | | | | | | |
| | 156–B10 | 156–A10 | 156–B09 | 156–A09 | 156–B08 | 156–A08 | 156–B07 | 156–A07 |

☐ DC input signal A

▨ DC input signal B

(2) DO signals

| PMC ADDRESS | #7 | #6 | #5 | #4 | #3 | #2 | #1 | #0 |
|---|---|---|---|---|---|---|---|---|
| Y1000 | | | | | | | | |
| | 155–B14 | 155–A14 | 155–B13 | 155–A13 | 155–B12 | 155–A12 | 155–B11 | 155–A11 |
| Y1001 | | | | | | | | |
| | 156–B16 | 156–A16 | 156–B15 | 156–A15 | 155–B16 | 155–A16 | 155–B15 | 155–A15 |
| Y1002 | | | | | | | | |
| | 156–B14 | 156–A14 | 156–B13 | 156–A13 | 156–B12 | 156–A12 | 156–B11 | 156–A11 |

## 6.4.3
## Machine Interface

Built–in I/O

CB155 / CB156

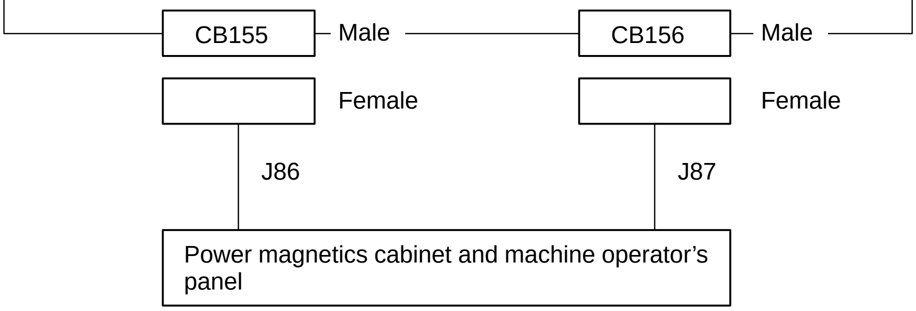
34–pin flat cable connector

CB155

| | A | B |
|---|---|---|
| 01 | +24E | +24E |
| 02 | X1000.0 | X1000.1 |
| 03 | X1000.2 | X1000.3 |
| 04 | X1000.4 | X1000.5 |
| 05 | —— | X1000.7 |
| 06 | X1000.6 | DOC |
| 07 | X1001.0 | X1001.1 |
| 08 | X1001.2 | X1001.3 |
| 09 | X1001.4 | X1001.5 |
| 10 | X1001.6 | X1001.7 |
| 11 | Y1000.0 | Y1000.1 |
| 12 | Y1000.2 | Y1000.3 |
| 13 | Y1000.4 | Y1000.5 |
| 14 | Y1000.6 | Y1000.7 |
| 15 | Y1001.0 | Y1001.1 |
| 16 | Y1001.2 | Y1001.3 |
| 17 | 0V | 0V |

CB156

| | A | B |
|---|---|---|
| 01 | +24E | +24E |
| 02 | X1002.0 | X1002.1 |
| 03 | X1002.2 | X1002.3 |
| 04 | X1002.4 | X1002.5 |
| 05 | X1002.6 | X1002.7 |
| 06 | DOC | DOC |
| 07 | X1003.0 | X1003.1 |
| 08 | X1003.2 | X1003.3 |
| 09 | X1003.4 | X1003.5 |
| 10 | X1003.6 | X1003.7 |
| 11 | Y1002.0 | Y1002.1 |
| 12 | Y1002.2 | Y1002.3 |
| 13 | Y1002.4 | Y1002.5 |
| 14 | Y1002.6 | Y1002.7 |
| 15 | Y1001.4 | Y1001.5 |
| 16 | Y1001.6 | Y1001.7 |
| 17 | 0V | 0V |



**NOTE**

1 +24E (output)
A voltage of 24 VDC supplied to the Power Mate main unit is connected through a fuse and used for DI signals. Do not connect an external 24 VDC output to this pin. Do not connect it to DOC either.

2 DOC (external 24 VDC input)
An external voltage of 24 VDC should be supplied for DO signals.

3 X1000.6 is assigned to CB155–A06, not to CB155–A05.

## 6.4.4 Details of DI Connection

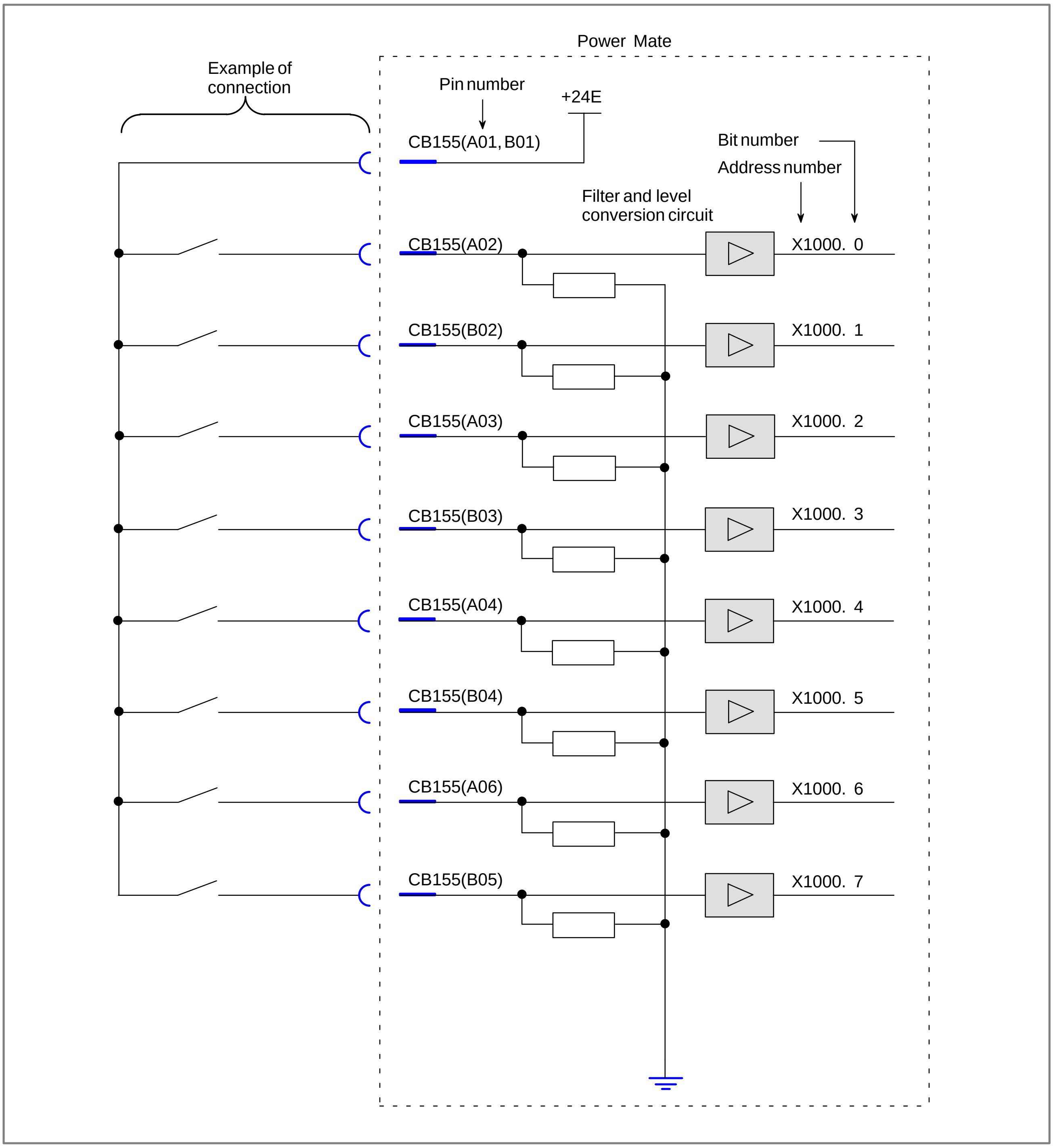


**Fig. 6.4.4 (a) Built–in I/O machine interface (1)**

X1000 is DC input signal B (for high–speed signal input).

**NOTE**
X1000.6 is assigned to CB155(A06), not to CB155(A05).

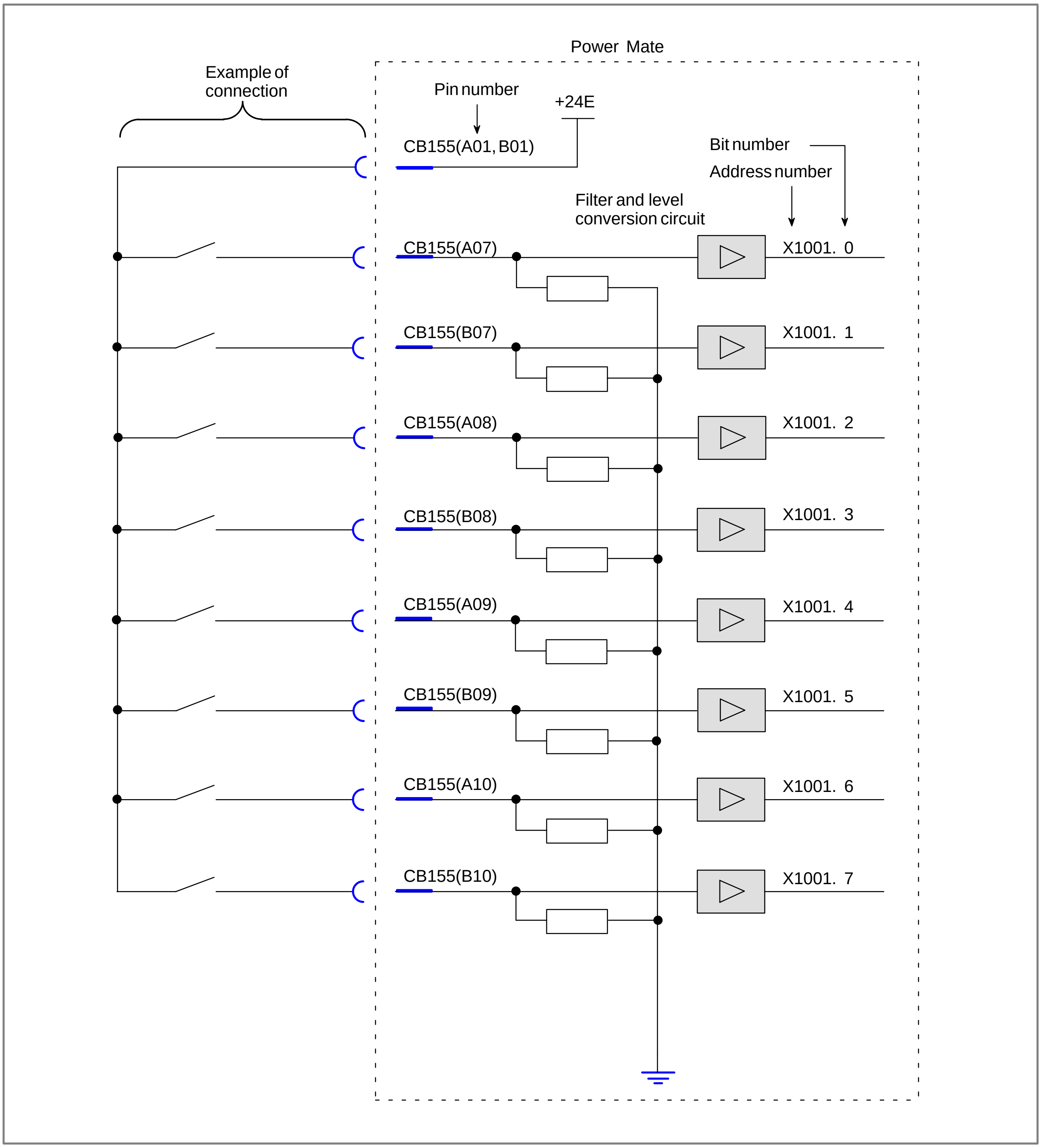


**Fig. 6.4.4 (b)  Built–in I/O machine interface (2)**

X1001 is DC input signal B (for high–speed signal input).

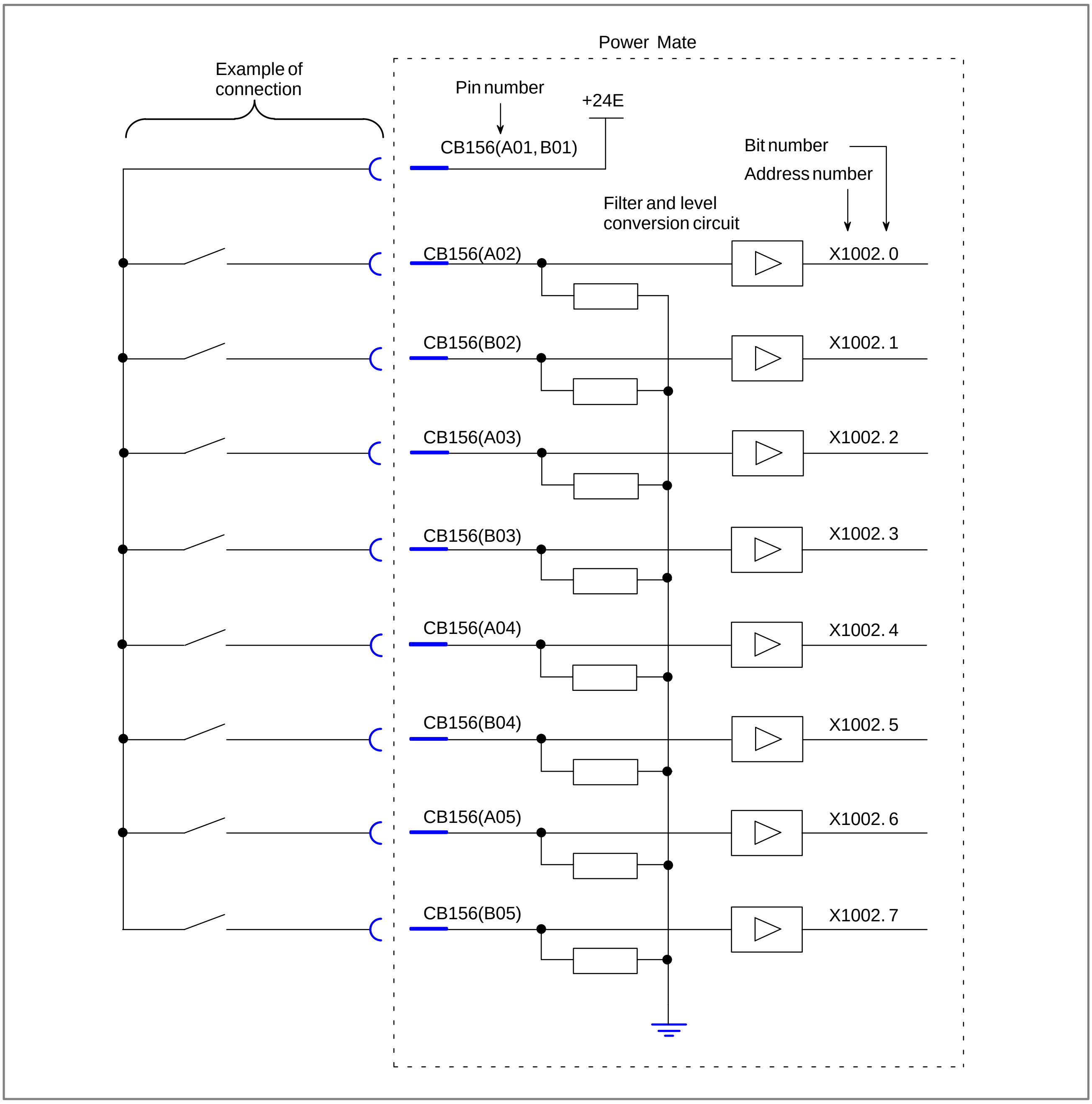
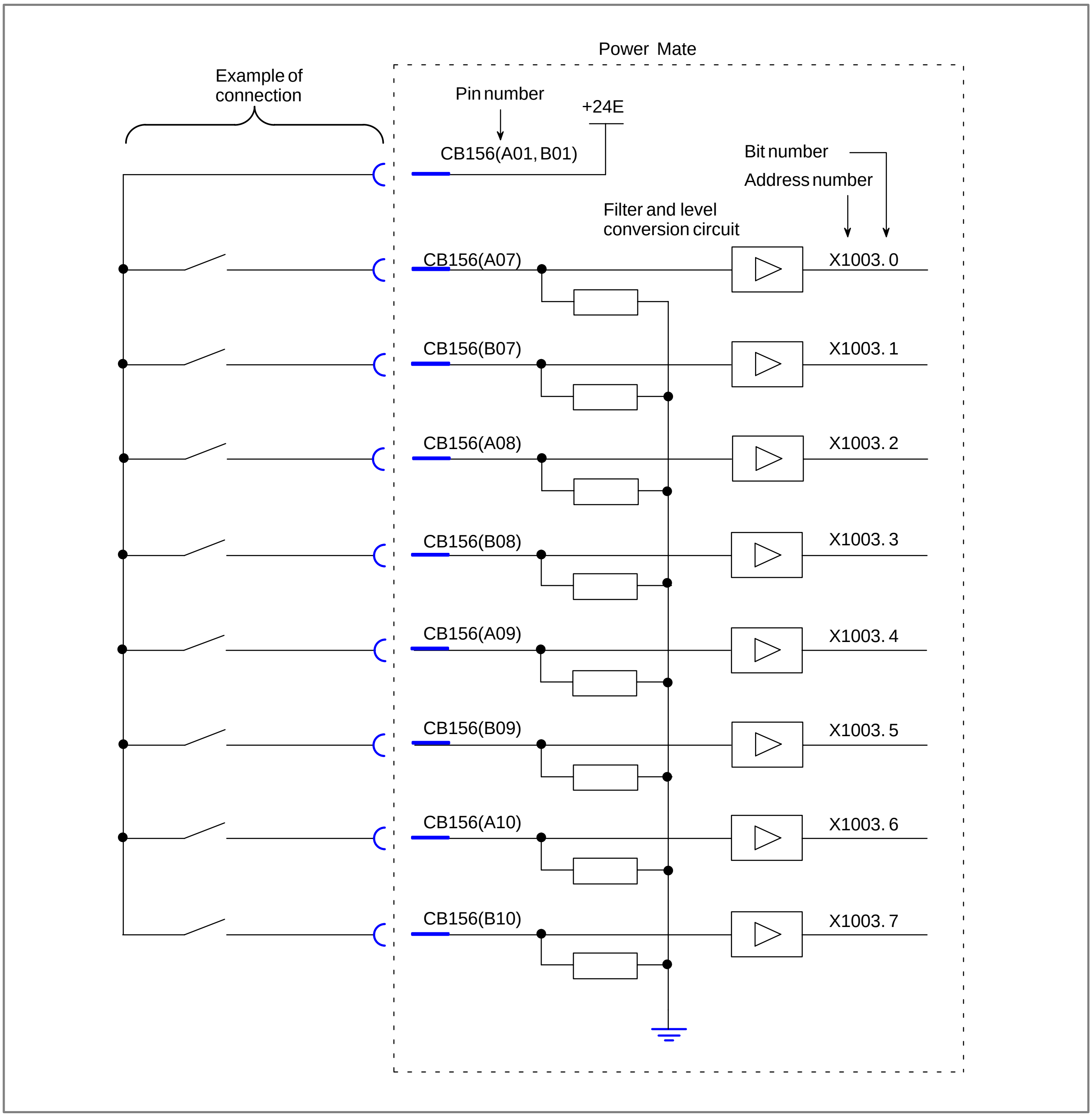


Fig. 6.4.4 (c) Built–in I/O machine interface (3)

X1002 is DC input signal A.



**Fid. 6.4.4 (d)  Built–in I/O machine interface (4)**

X1003 is DC input signal A.

## 6.4.5 Details of DO Connection

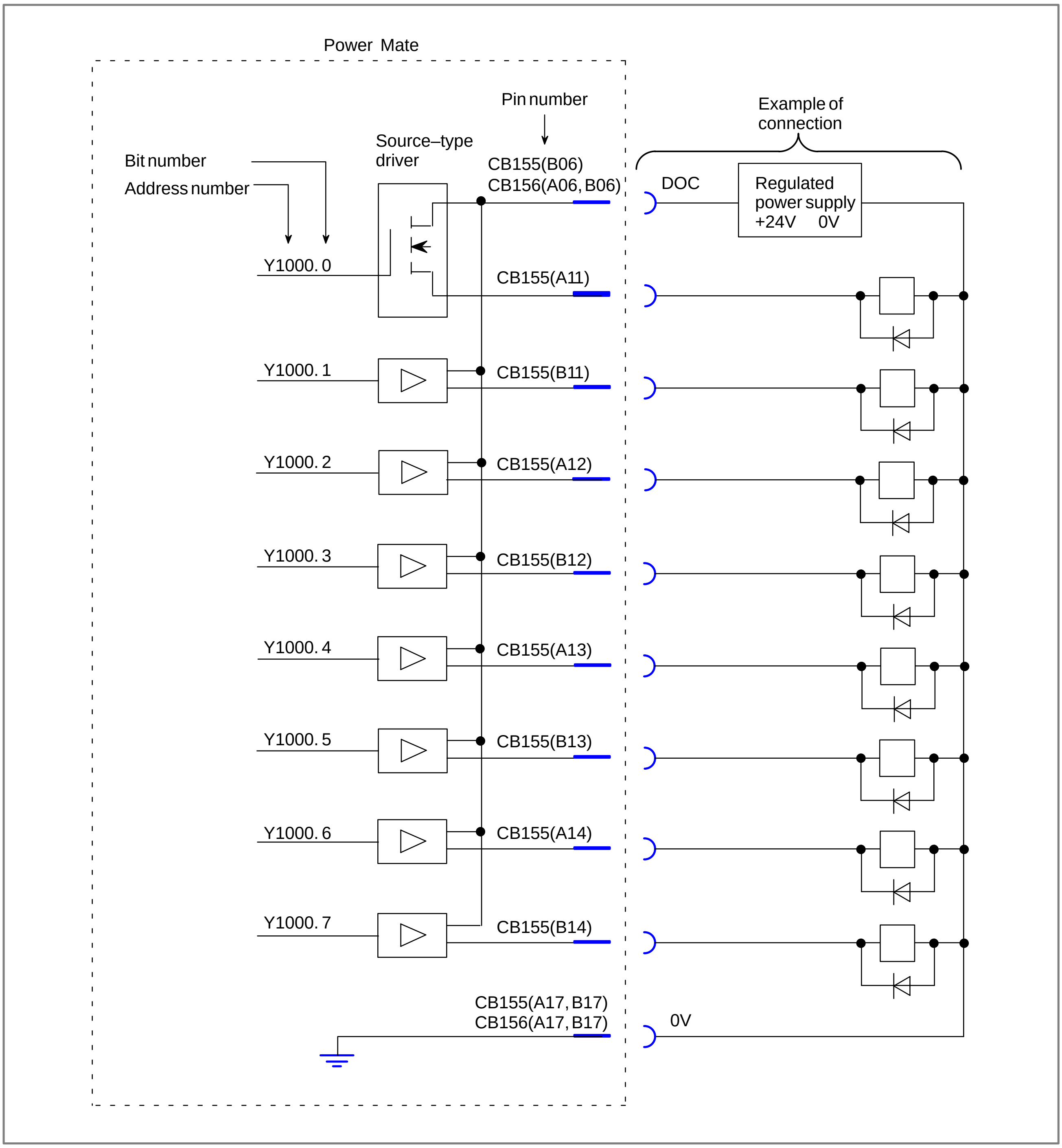


Fig. 6.4.5 (a) Built–in I/O machine interface (5)

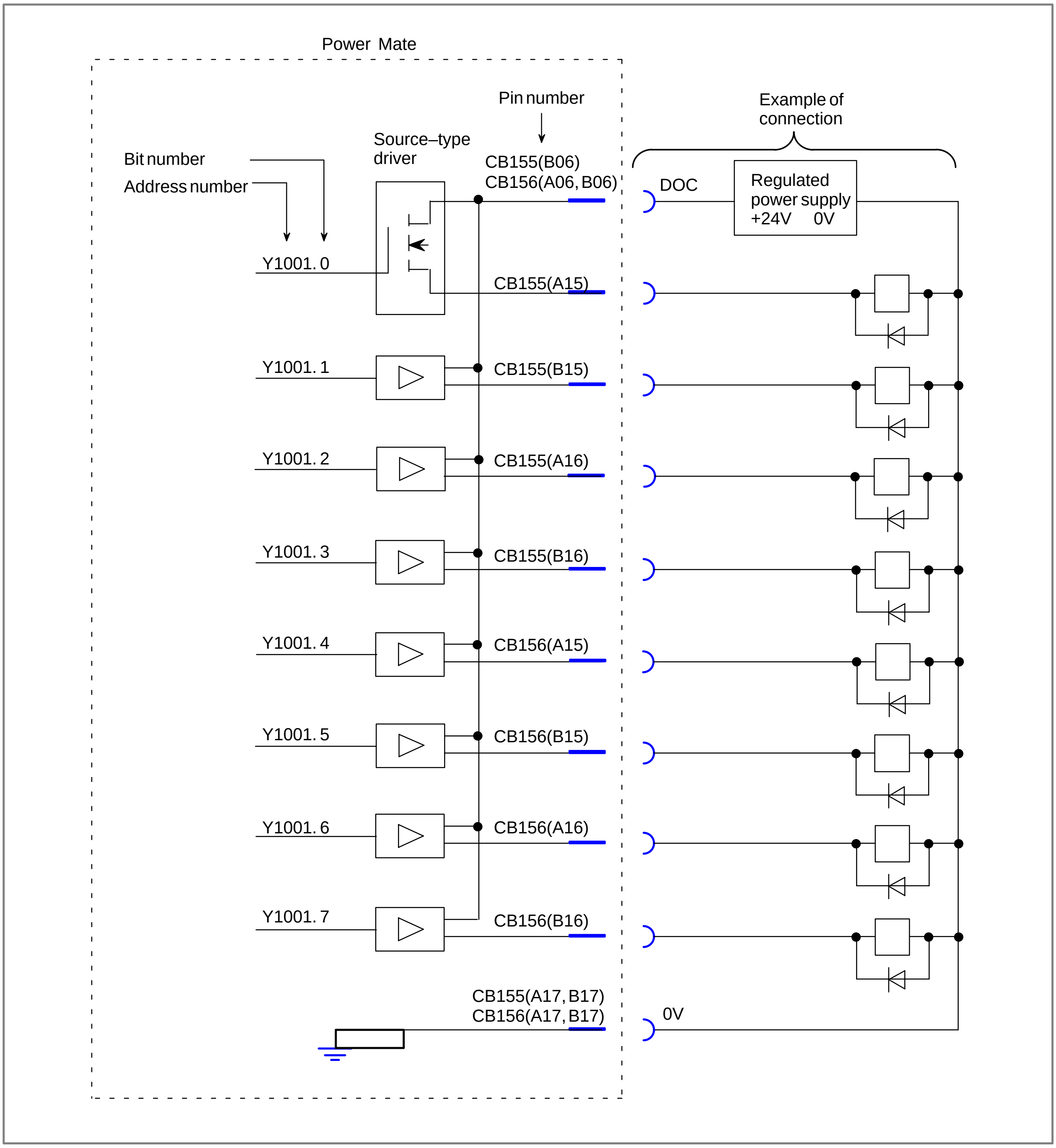


Fig. 6.4.5 (b) Built–in I/O machine interface (6)

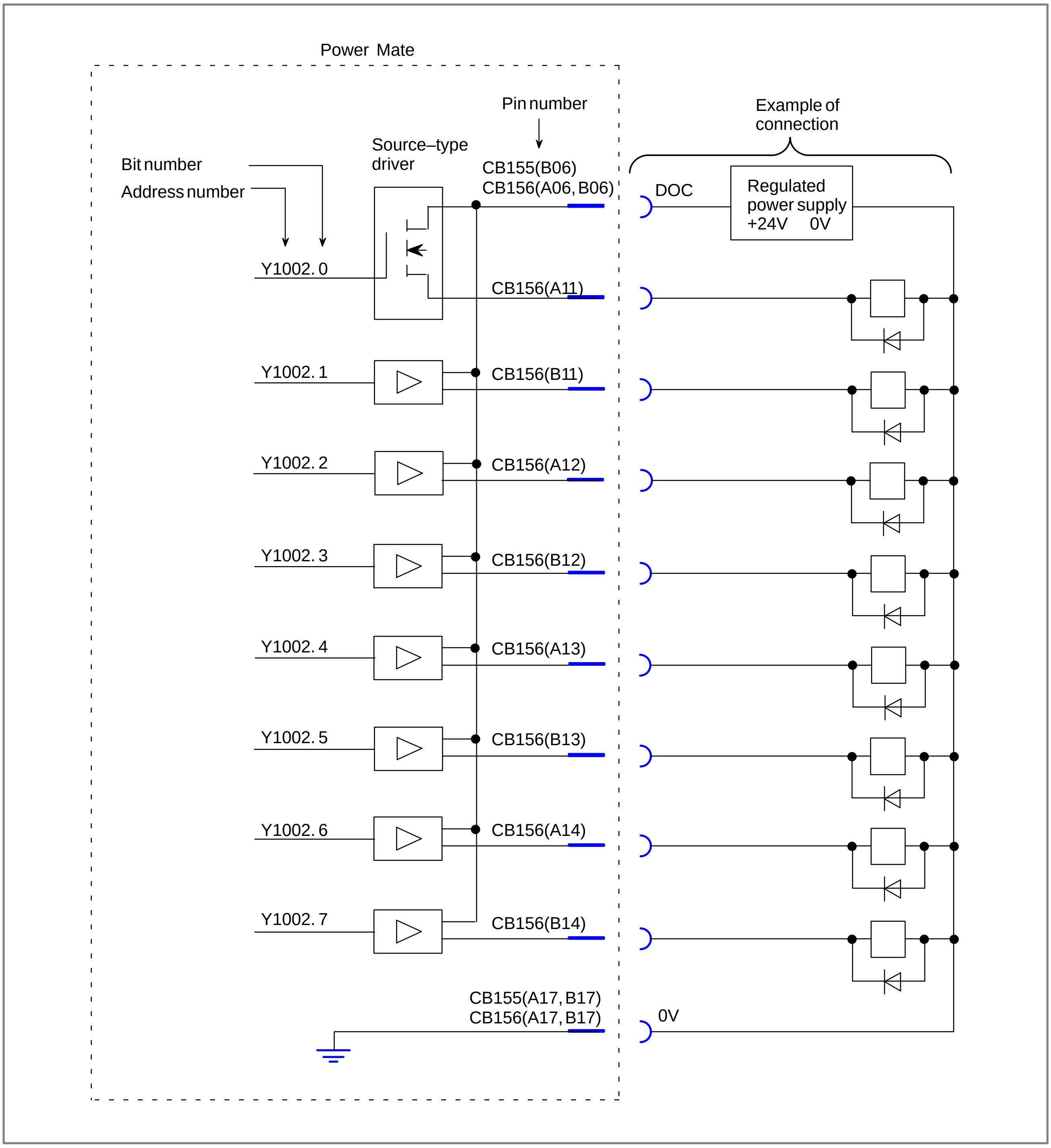
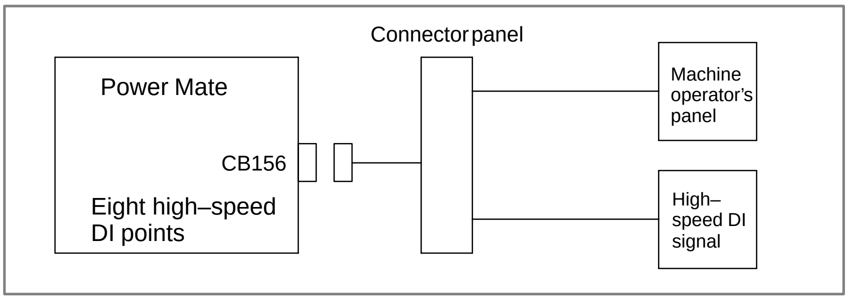


Fig. 6.4.5 (c) Built–in I/O machine interface (7)

# 6.5 HIGH–SPEED DI SIGNAL INTERFACE

## 6.5.1 General



The Power Mate has eight high–speed DI signal interface points. They are accommodated in the CB156 connector, which is also used for the built–in DI/DO signals. See Section 6.4.1 for the connector specification, pin assignment, and the cable between the connector and connector panel. The high–speed DI signal interface shares input pins with the X1003 signals for the built–in DI points. Whether the high–speed DI signal interface or the built–in DI points use the input pins is specified using a parameter. So, when the high–speed DI signal interface uses the input pins, the X1003 signals for the built–in DI points cannot use them.

## 6.5.2 High–speed DI Signal Specification

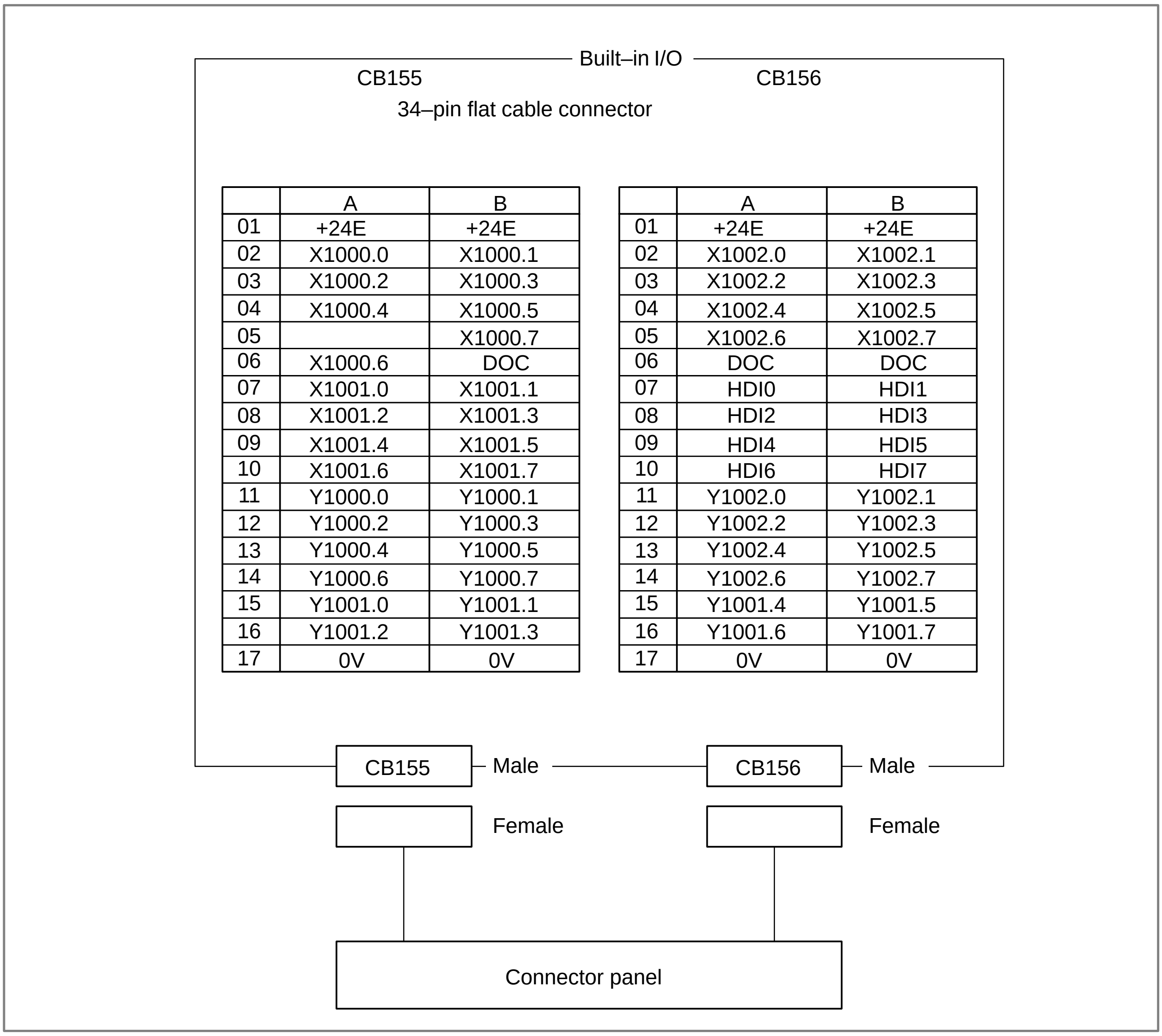
The high–speed DI signals shall be free of chattering. The following are requirements for the contacts for the signals on the machine side. (24 VDC system)

Contact capacity:
30 VDC, 16 mA or greater
Open–circuit contact–to–contact leakage:
1 mA or less (for 26.4 V)
Closed–circuit contact–to–contact voltage drop:
3.5 V or less (for 8.5 mA, including a voltage drop across the cable)

## 6.5.3 Signal List

| Signal | Connector pin number |
|---|---|
| HDI0 | CB156–A07 |
| HDI1 | CB156–B07 |
| HDI2 | CB156–A08 |
| HDI3 | CB156–B08 |
| HDI4 | CB156–A09 |
| HDI5 | CB156–B09 |
| HDI6 | CB156–A10 |
| HDI7 | CB156–B10 |

## 6.5.4
## Machine Interface



CB155

| | A | B |
|---|---|---|
| 01 | +24E | +24E |
| 02 | X1000.0 | X1000.1 |
| 03 | X1000.2 | X1000.3 |
| 04 | X1000.4 | X1000.5 |
| 05 | | X1000.7 |
| 06 | X1000.6 | DOC |
| 07 | X1001.0 | X1001.1 |
| 08 | X1001.2 | X1001.3 |
| 09 | X1001.4 | X1001.5 |
| 10 | X1001.6 | X1001.7 |
| 11 | Y1000.0 | Y1000.1 |
| 12 | Y1000.2 | Y1000.3 |
| 13 | Y1000.4 | Y1000.5 |
| 14 | Y1000.6 | Y1000.7 |
| 15 | Y1001.0 | Y1001.1 |
| 16 | Y1001.2 | Y1001.3 |
| 17 | 0V | 0V |

CB156

| | A | B |
|---|---|---|
| 01 | +24E | +24E |
| 02 | X1002.0 | X1002.1 |
| 03 | X1002.2 | X1002.3 |
| 04 | X1002.4 | X1002.5 |
| 05 | X1002.6 | X1002.7 |
| 06 | DOC | DOC |
| 07 | HDI0 | HDI1 |
| 08 | HDI2 | HDI3 |
| 09 | HDI4 | HDI5 |
| 10 | HDI6 | HDI7 |
| 11 | Y1002.0 | Y1002.1 |
| 12 | Y1002.2 | Y1002.3 |
| 13 | Y1002.4 | Y1002.5 |
| 14 | Y1002.6 | Y1002.7 |
| 15 | Y1001.4 | Y1001.5 |
| 16 | Y1001.6 | Y1001.7 |
| 17 | 0V | 0V |

## 6.5.5 Connection Details

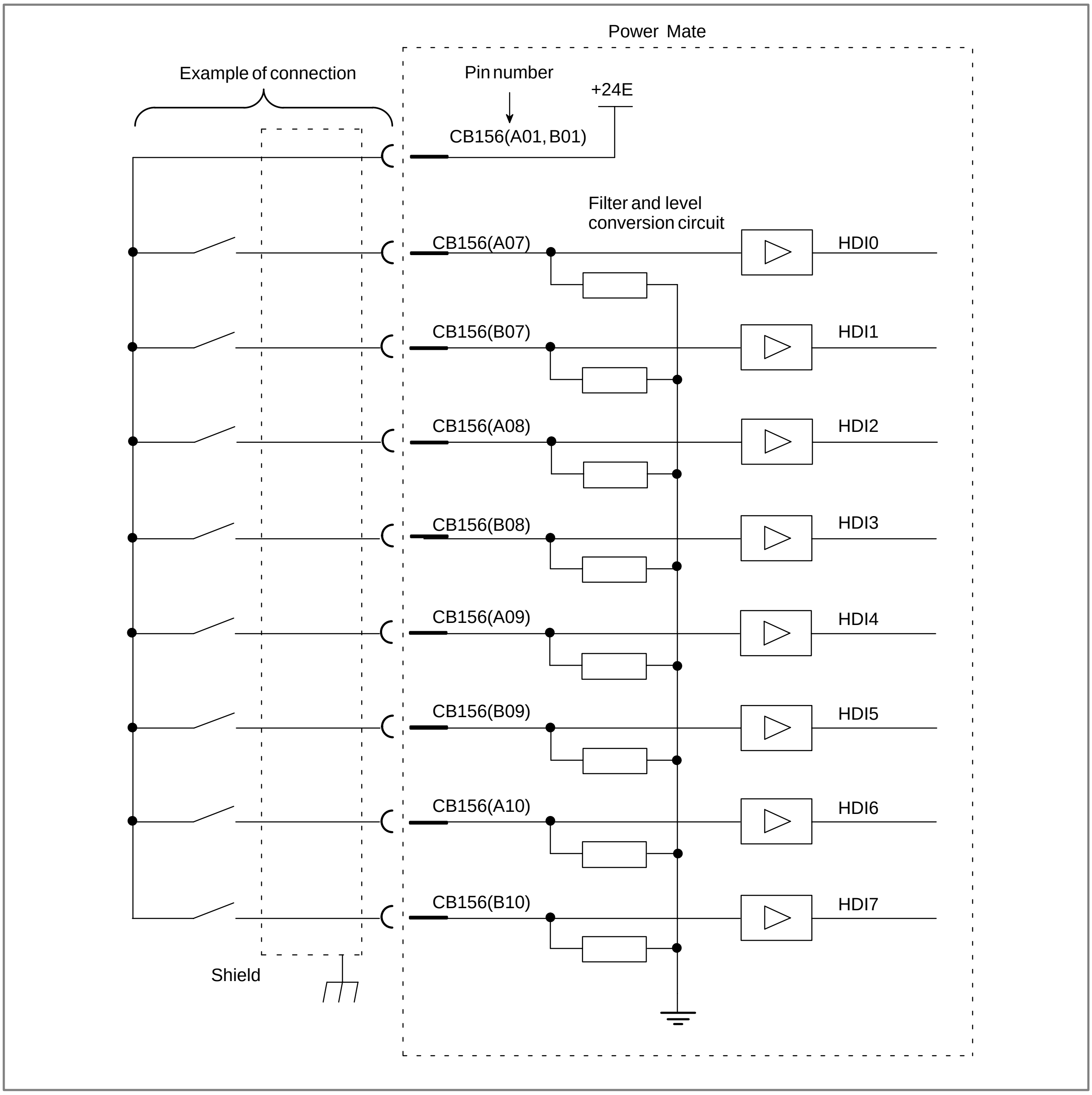


Fig. 6.5.5 High–speed DI signal interface

## 6.6 CONNECTION OF I/O CARD D/E

### 6.6.1 General

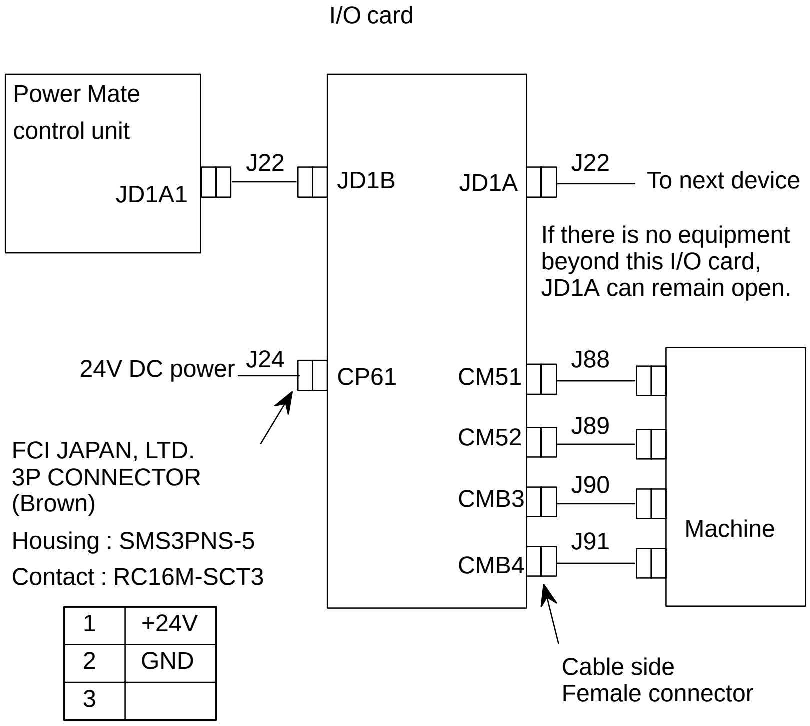
The I/O card (D, E) is connected to the Power Mate–D through the FANUC I/O Link and is used for interfacing with the machine. The DO is of source type conforming to the safety requirements. Most DI points are a sink–type uninsulated interface (with the common line at 24 V) conforming to safety standards. Some inputs can be switched between sink and source types. (The European safety standard requires use of sink types.)

**CAUTION**

To conform to the safety standard, switchable input signals must be used as sink type.

There are two cards available depending on the number of I/O points.

| I/O Card | Specification | Input | Output | Maximum load current of DO |
|---|---|---|---|---|
| I/O Card E | A16B-2202–0732 | 96 points | 64 points | 6A |
| I/O Card D | A16B-2202–0733 | 48 points | 32 points | 4A |



| | |
|---|---|
| 1 | +24V |
| 2 | GND |
| 3 | |

Power supply input specification

Voltage : 24 VDC ± 10% (including an instantaneous value and ripple)

Capacity : 500 + 7.3 × n (mA)
n : number of inputs ON simultaneously

- For power cable J24, use a wire of at least 30/0.18 (0.75 $mm^2$).
- For information about the connection between the control unit and I/O card, see Subsec. 6.2.2.
- To connect with the machine, use a multi–core shielded cable.
  Recommended wires:
  A66L–0001–0041 (70/0.18, 20 conductors)
  A66L–0001–0042 (70/0.18, 50 conductors)
- On the I/O card, the shield of the cable used to connect the machine must be clamped to the ground plate of the cabinet, using a cable clamp.
- For details of the I/O signal specifications, see Section 6.3.
- CM51, CM52, CMB3
  50–pin female connector manufactured by Honda Tsushin
  Solder type: A02B–0029–K891 (MR–50LFH)
  Crimp type: A02B–0029–K893 (MRP–50F01, MR–50L, MRP–F112, 50 pins)
- CMB4
  20–pin female connector manufactured by Honda Tsushin
  Solder type: A02B–0029–K890 (MR–20LFH)
  Crimp type: A02B–0029–K892 (MRP–20F01, MR–20L, MRP–F112, 20 pins)
- The frame of this I/O card is grounded by attaching its metal fixture to the cabinet.
- On the PCB, a red LED beside the driver element lights once the over current or overheat detection circuit operates.

| Red LED name | DO signals |
|---|---|
| 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 Power Mate are supported by PCBs of version 03B and later.

- If the overheat detection circuit in the output driver detects over current or overheat (see Section 6.3.2), an alarm is sent to the Power Mate, resulting in a system error. Closing the jumper bar at CP1 on this printed–circuit board can keep this alarm from being sent to the Power Mate. In this case, therefore, a system alarm will not occur. See Section 6.6.5 for the location of CP1.

**CAUTION**

If pin CP1 is short–circuited, the Power Mate cannot detect an error in the DO driver.

- If a system alarm occurs in the Power Mate when it is using this I/O card, or an I/O Link communication alarm occurs between the Power Mate and this I/O card, all the DO points of the I/O card are turned off. This is also true when the power of the Power Mate or the I/O card is switched off.

## 6.6.2
## Connector Layout for I/O Card D/E

CM51

| | | | | | |
|---|---|---|---|---|---|
| 1 | DI00 | | | 33 | DIC1 |
| 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 | +24E | | | 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 |

| | |
|---|---|
| ░ | Switchable–commonDC input signal B;<br>12 points switched by DIC1 |
| ▒ | Switchable–common DC input signal A, 8<br>points switched by DIC2 |
| □ | DC input signal A |

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 | +24E | | | 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**

Addresses can be 0 to 127.

48 points (DI00 to DI57) can be used for the A16B–2202–0733. Without connector CM52.

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 | DOC | | | 9 | DO55 |
| 18 | DIC2 | | | 50 | DOC |

| 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 |

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 | DOC |

| 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**

Addresses can be 0 to 127.
32 points (DO00 to DO37) can be used for the A16B–2202–0733. Without connector CMB4.

DIC1 and DIC2:
Usually connect these pins to a potential of 0 V, so that the signal pins can be used as sink type, conforming to safety standards. (Input)

+24E:
24 VDC output pin. Its use should be restricted to DI signal common connection.

DOC:
24 VDC power supply input pin for the DO driver. All DOC pins are internally connected.

**CAUTION**

The DIC1 and DIC2 pins are connected to the +24 V or 0 V power supply. The contact of these pins is not opened.

## 6.6.3
## Details of DI Connection

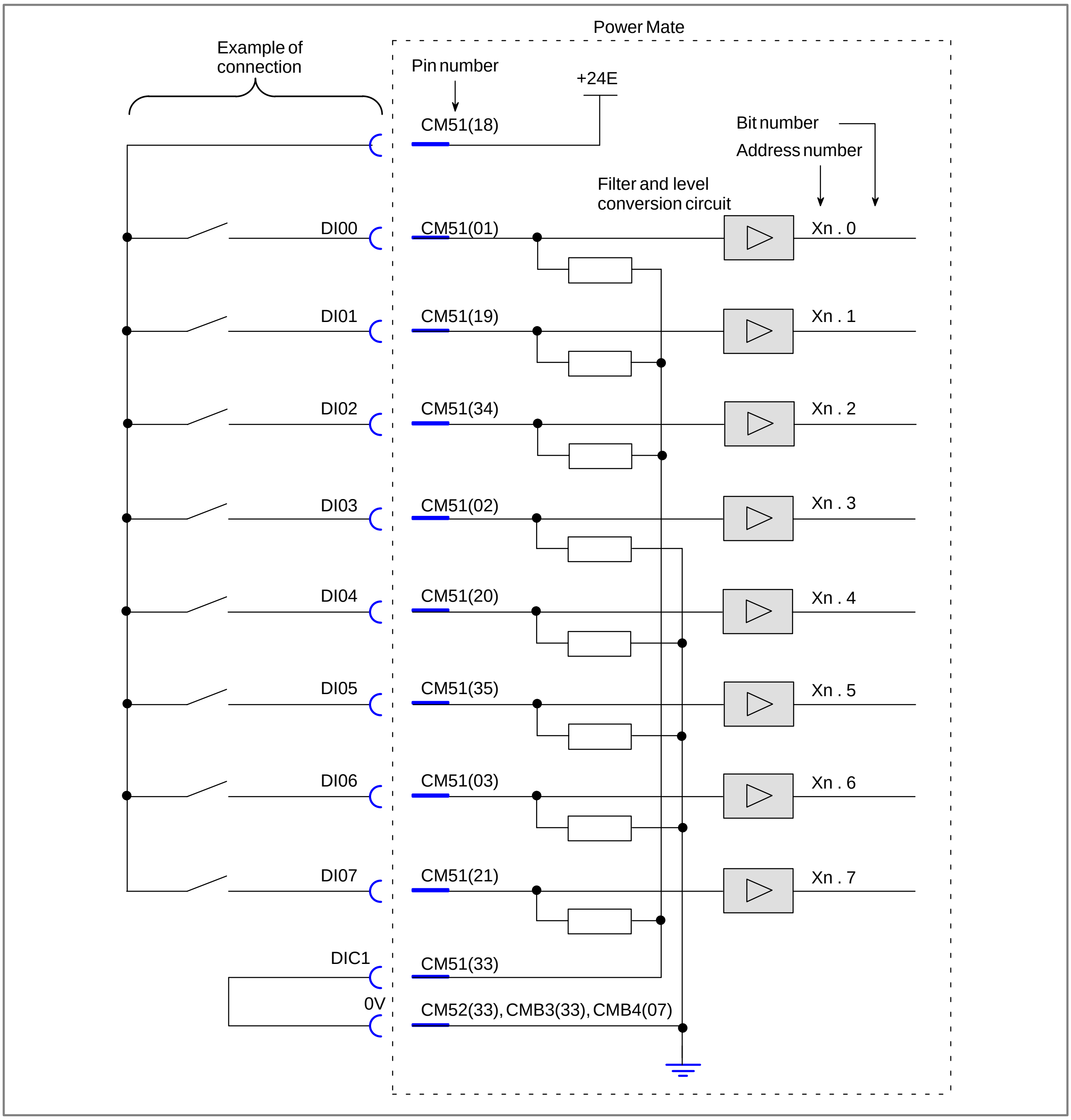


**Fig. 6.6.3 (a)  I/O card machine interface (1)**

Xn is DC input signal B (for high–speed signal input).

Xn.0 to Xn.2 and Xn.7 are switchable–common signals; shown above are examples of sink–type inputs.

DIC1 serves as a common input for Xn+1.0 to Xn+1.2, Xn+1.7, and Xn+11.4 to Xn11.7.

DIC1 pin must be connected to 0V or 24V.

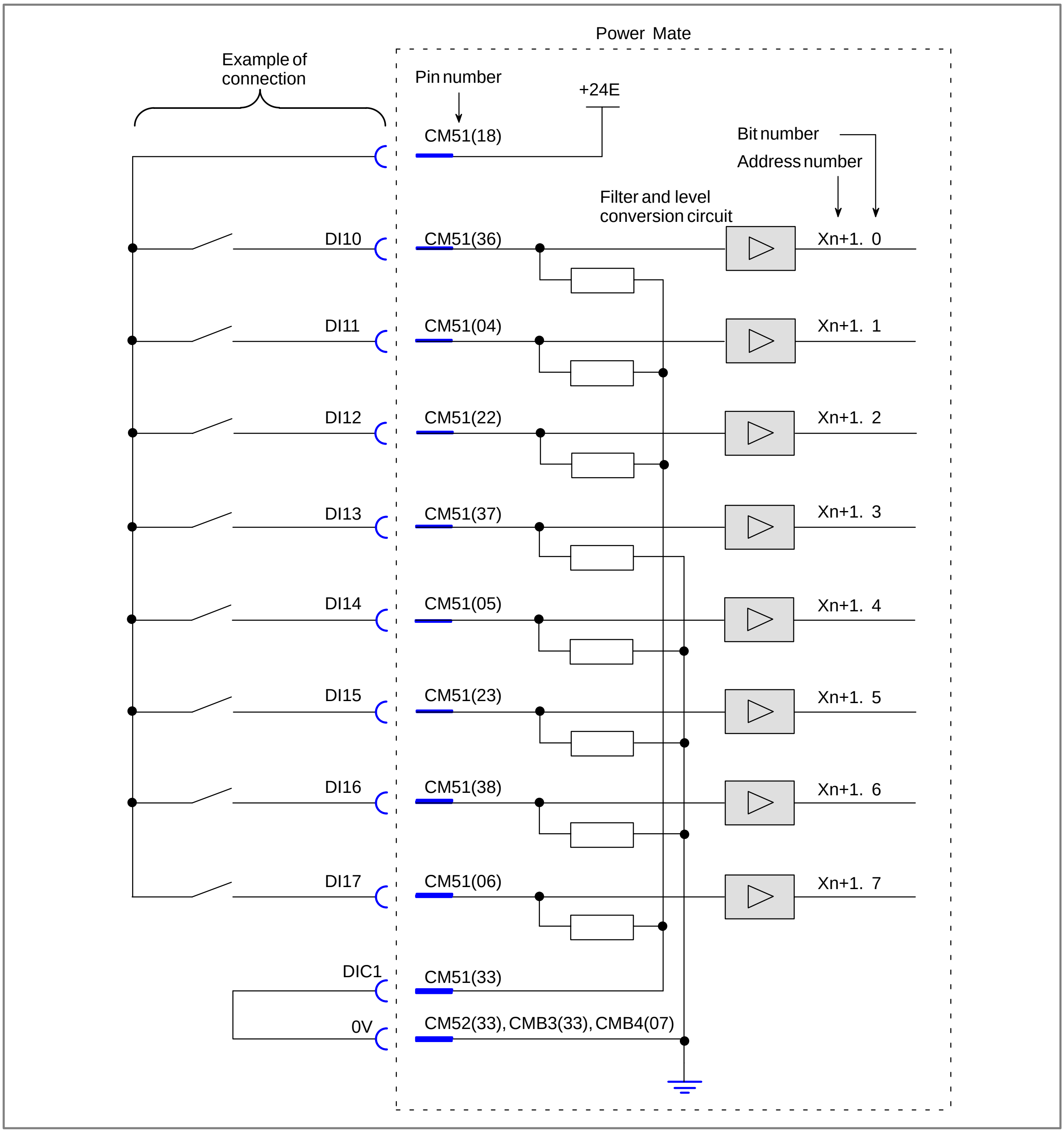


**Fig. 6.6.3 (b) I/O card machine interface (2)**

Xn+1 is DC input signal B (for high–speed signal input). Shown above are examples of sink–type inputs.

Xn+1.0 to Xn+1.2 and Xn+1.7 are switchable–common signals.

DIC1 serves as a common input for Xn.0 to Xn.2, Xn+0.7, and Xn+11.4 to Xn11.7.

DIC1 pin must be connected to 0V or 24V.

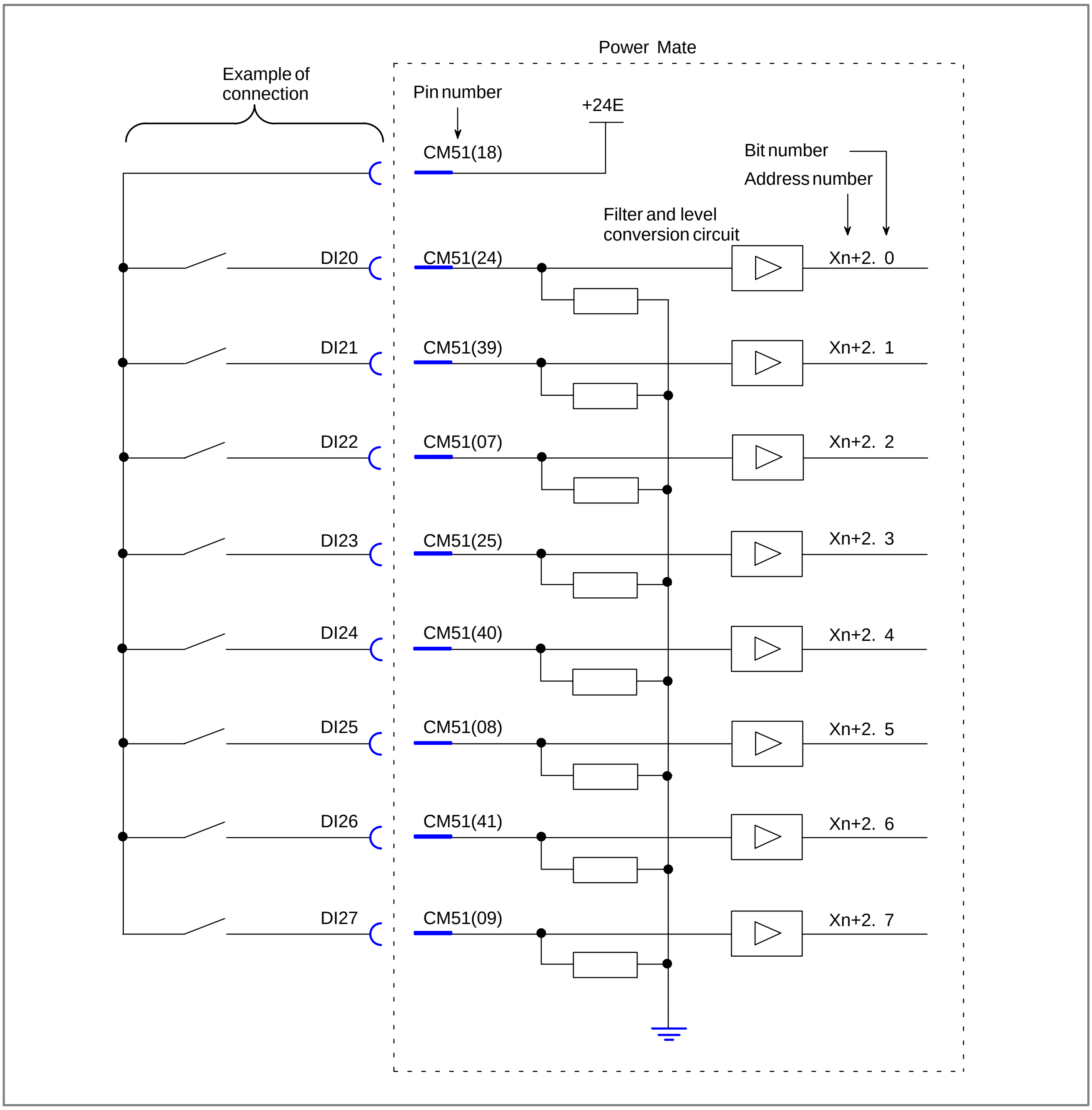


**Fig. 6.6.3 (c) I/O card machine interface (3)**

Xn+2 is DC input signal A.

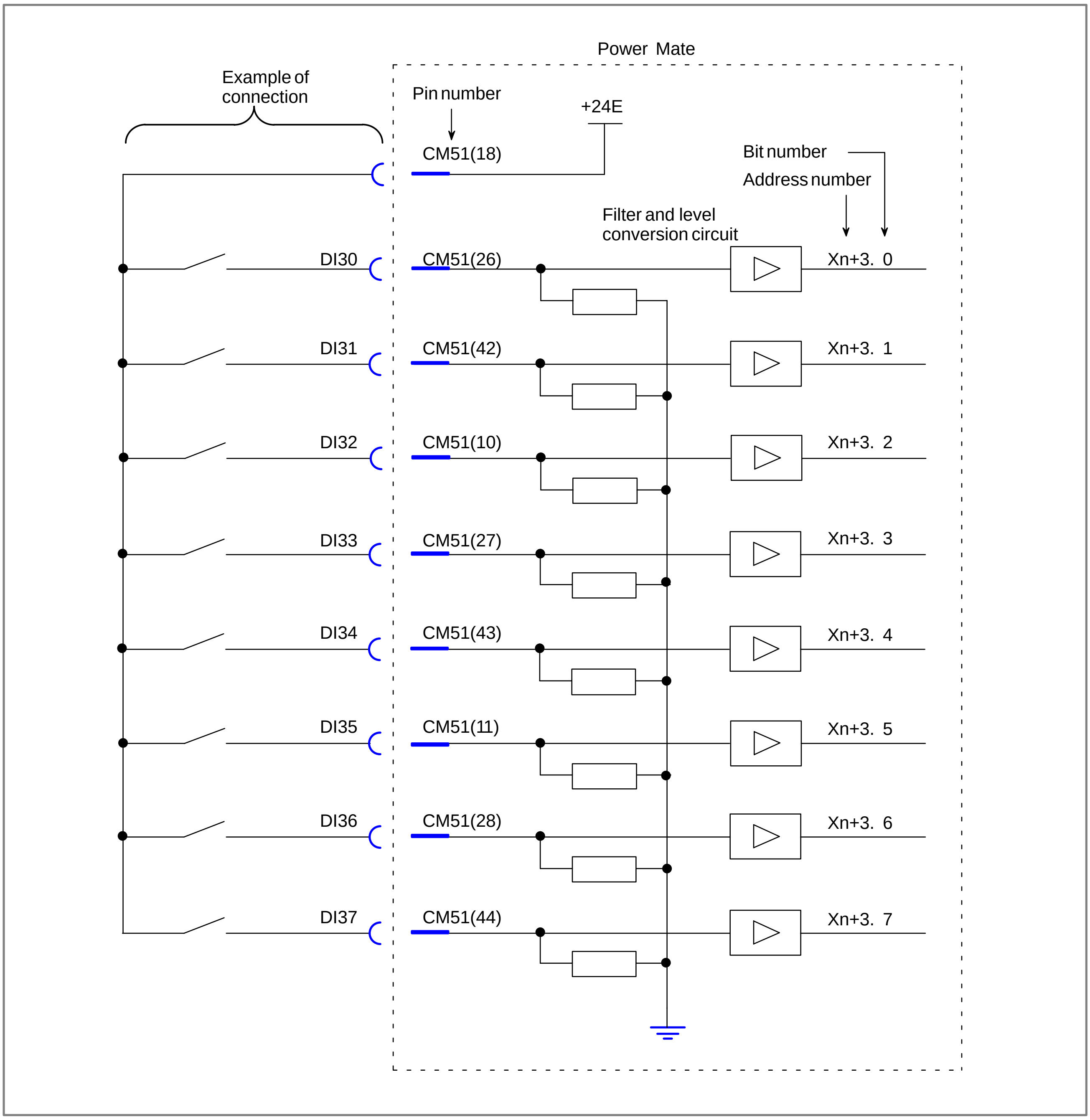


**Fig. 6.6.3 (d)  I/O card machine interface (4)**

Xn+3 is DC input signal A.

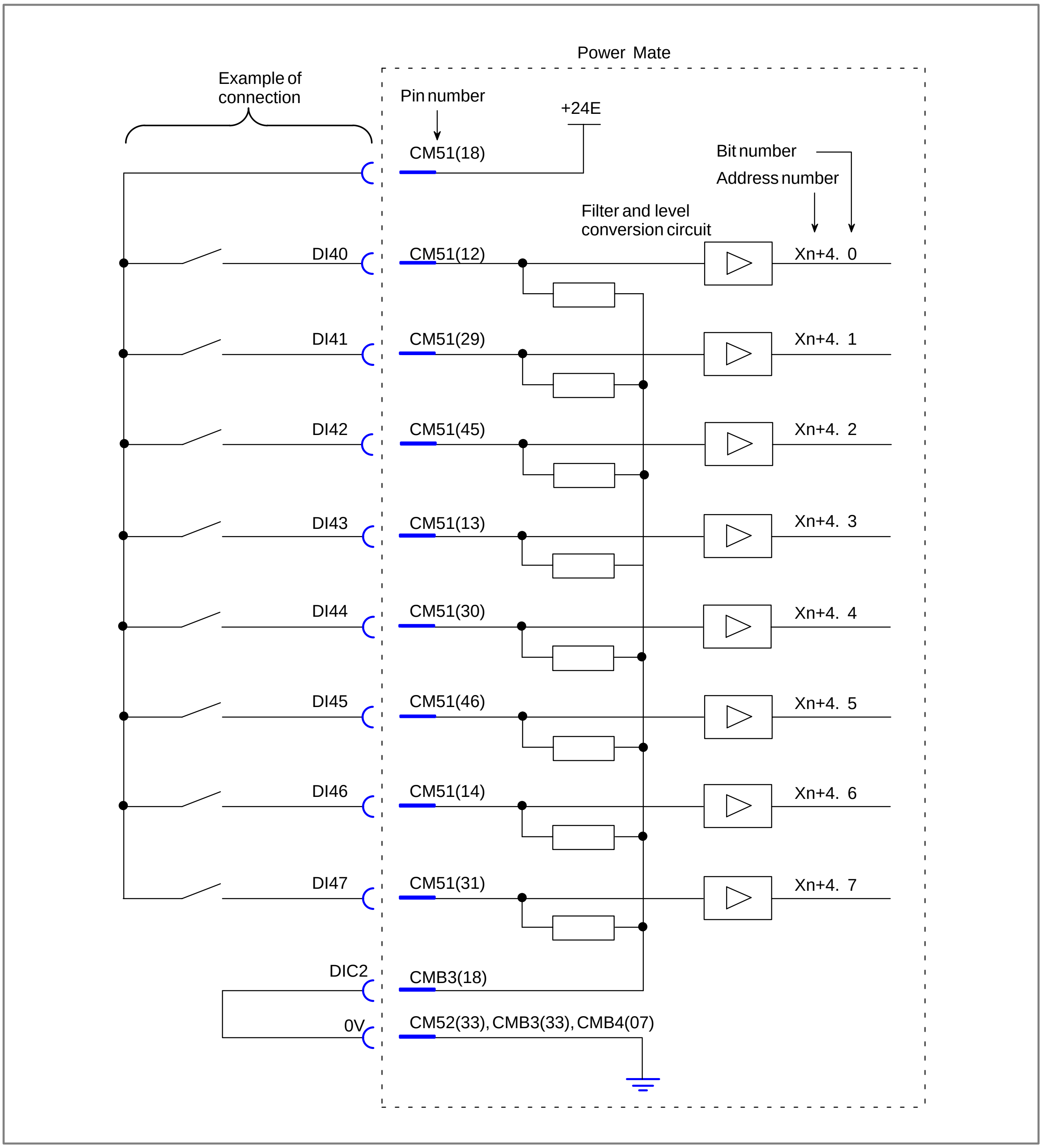


**Fig. 6.6.3 (e) I/O card machine interface (5)**

Xn+4 is DC input signal A.

DIC2 pin must be connected to 0V to 24V.

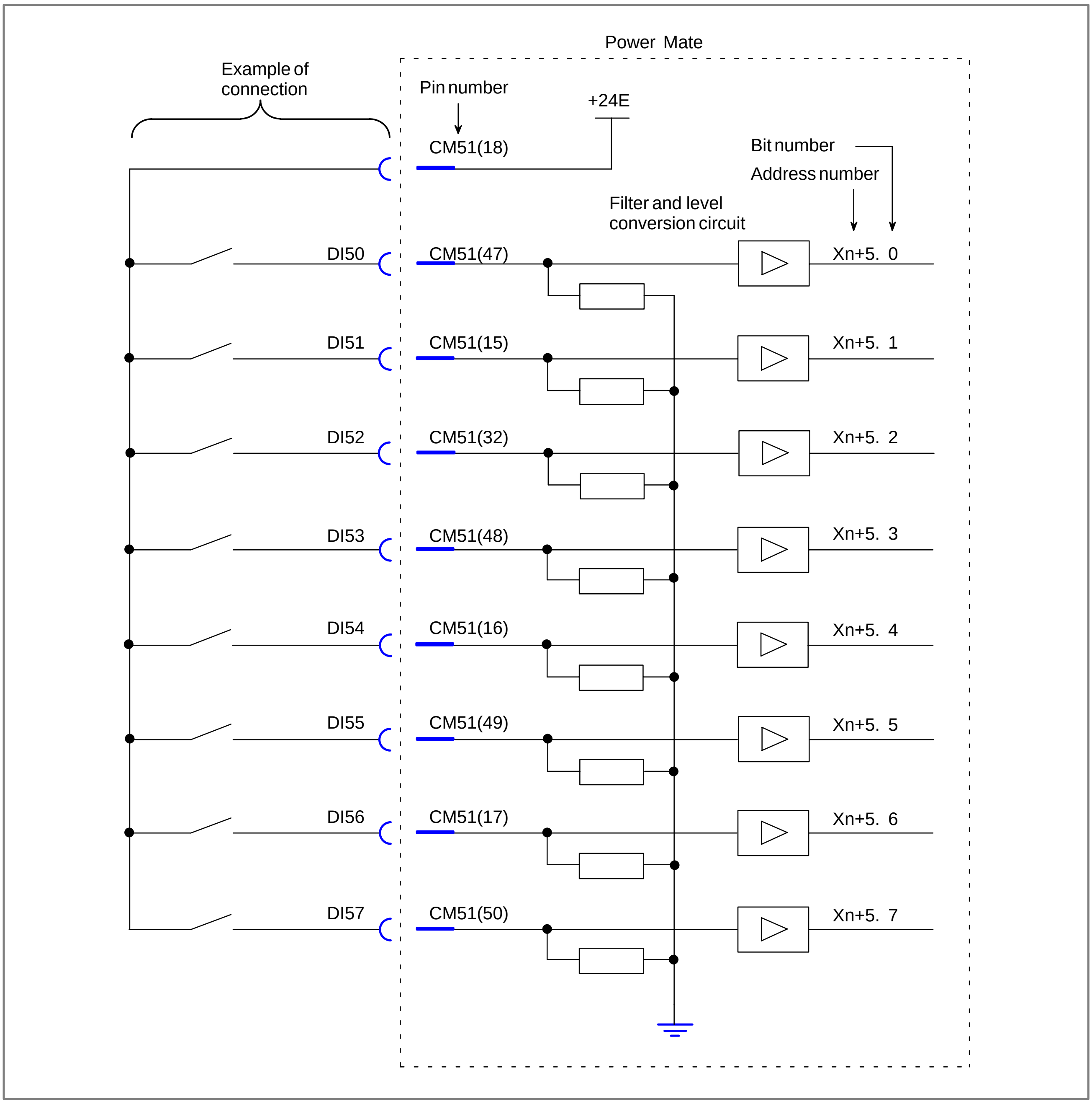


**Fig. 6.6.3 (f)  I/O card machine interface (6)**

Xn+5 is DC input signal A.

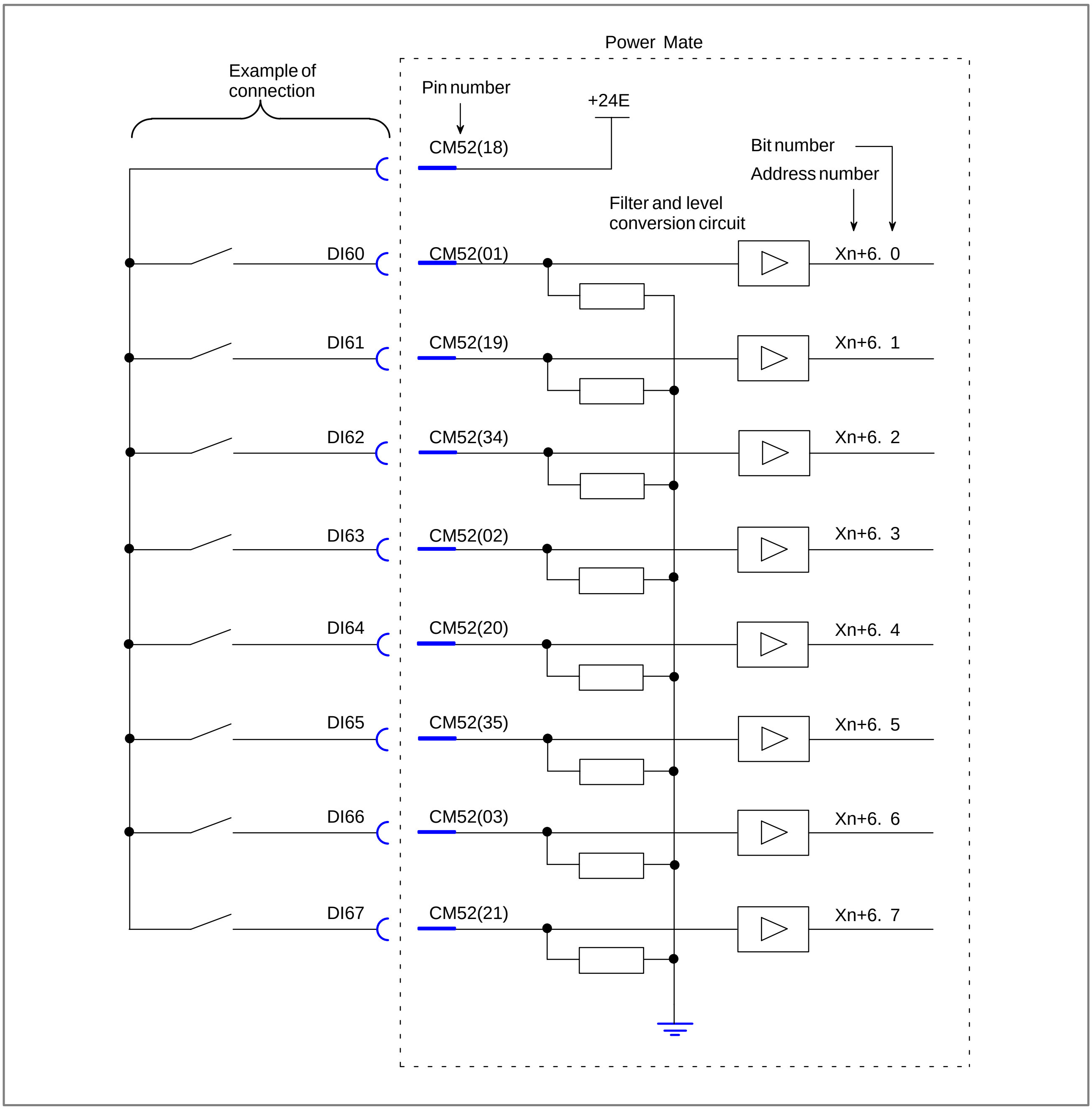


**Fig. 6.6.3 (g) I/O card machine interface (7)**

Xn+6 is DC input signal A.

**NOTE**

This connection cannot be used for I/O card D (A16B–2202–0733).

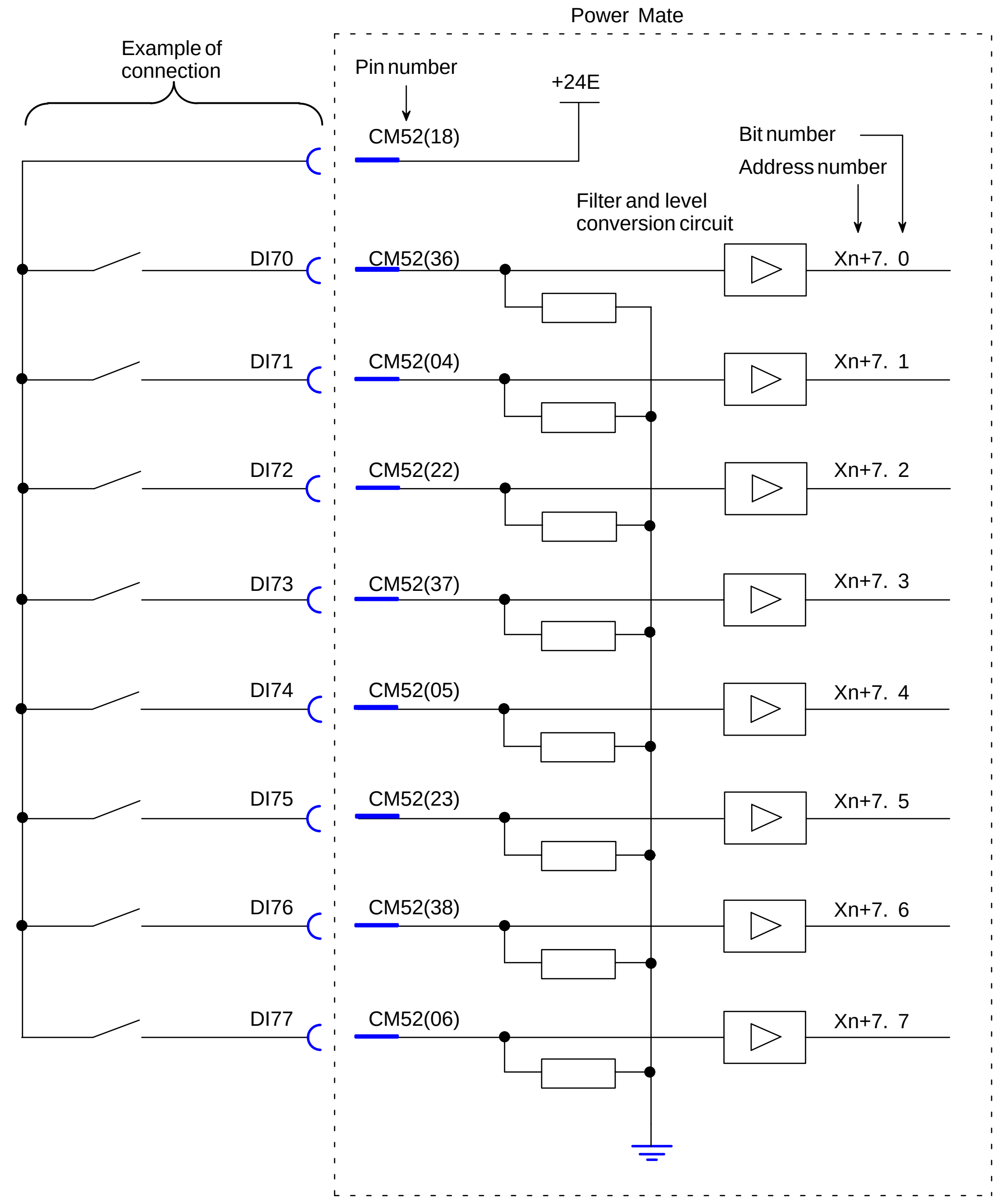


**Fig. 6.6.3 (h)  I/O card machine interface (8)**

Xn+7 is DC input signal A.

**NOTE**
This connection cannot be used for I/O card D (A16B–2202–0733).

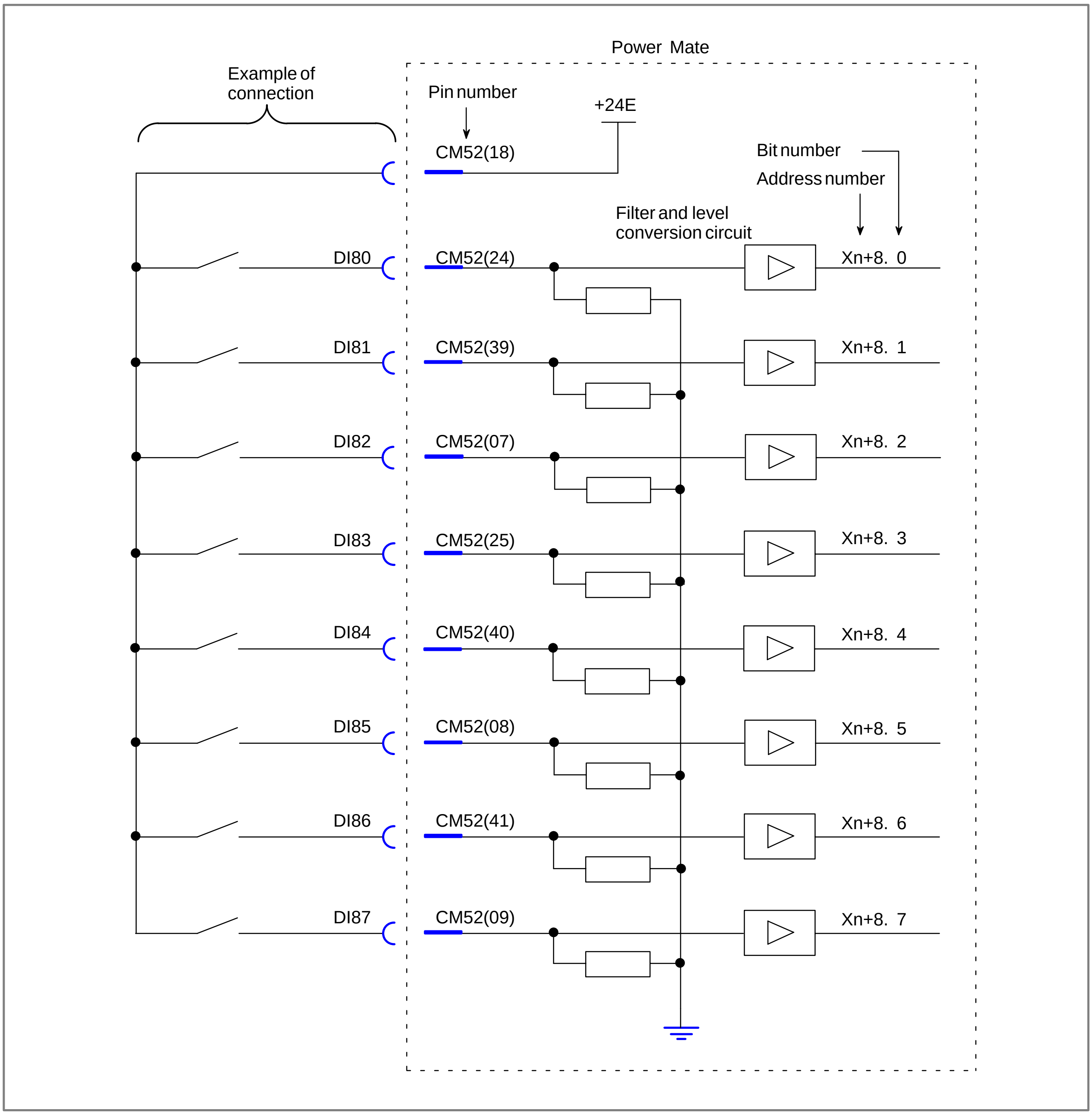


**Fig. 6.6.3 (i) I/O card machine interface (9)**

Xn+8 is DC input signal A.

**NOTE**
This connection cannot be used for I/O card D (A16B–2202–0733).

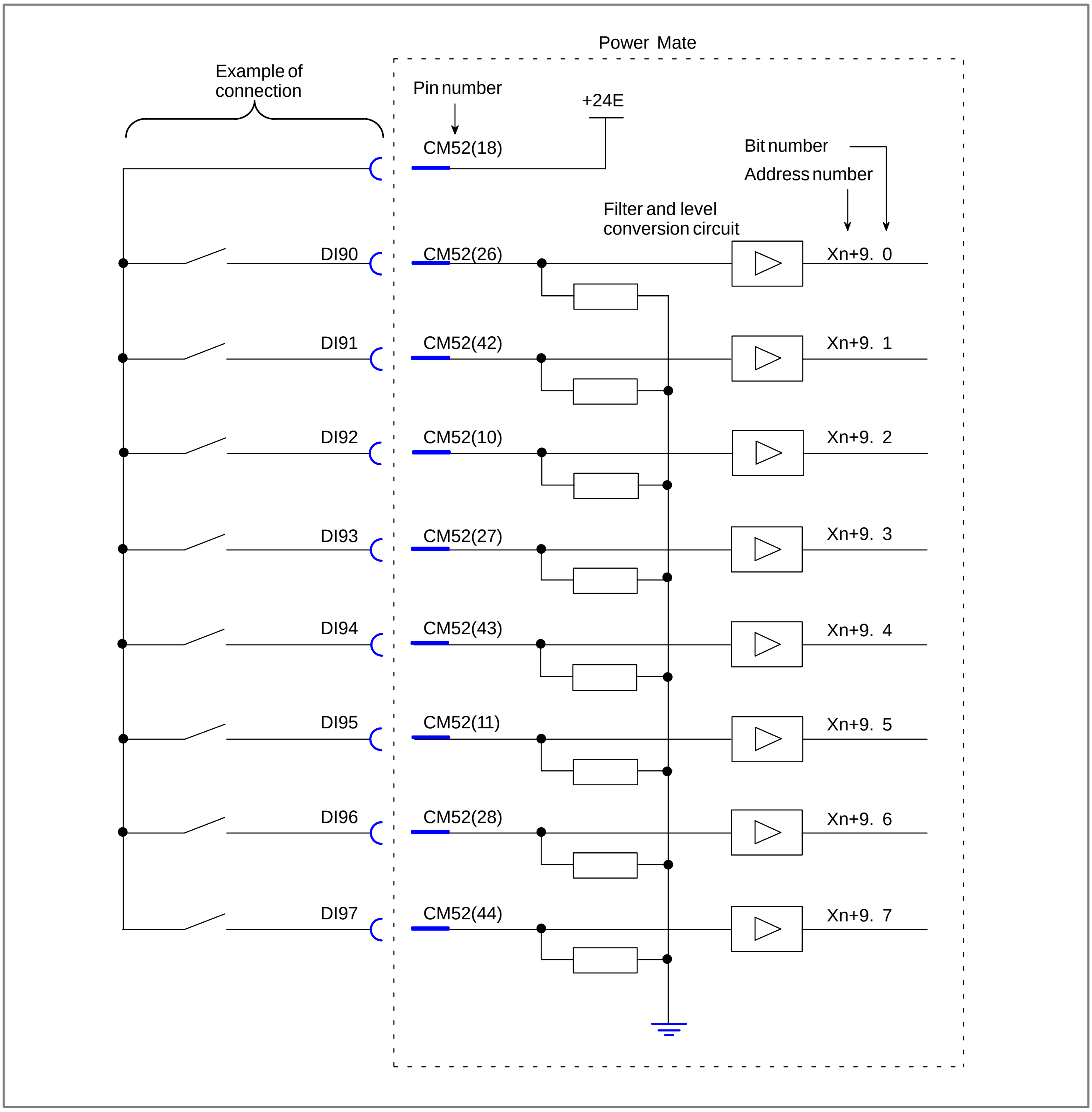


**Fig. 6.6.3 (j)  I/O card machine interface (10)**

Xn+9 is DC input signal A.

**NOTE**

This connection cannot be used for I/O card D (A16B–2202–0733).

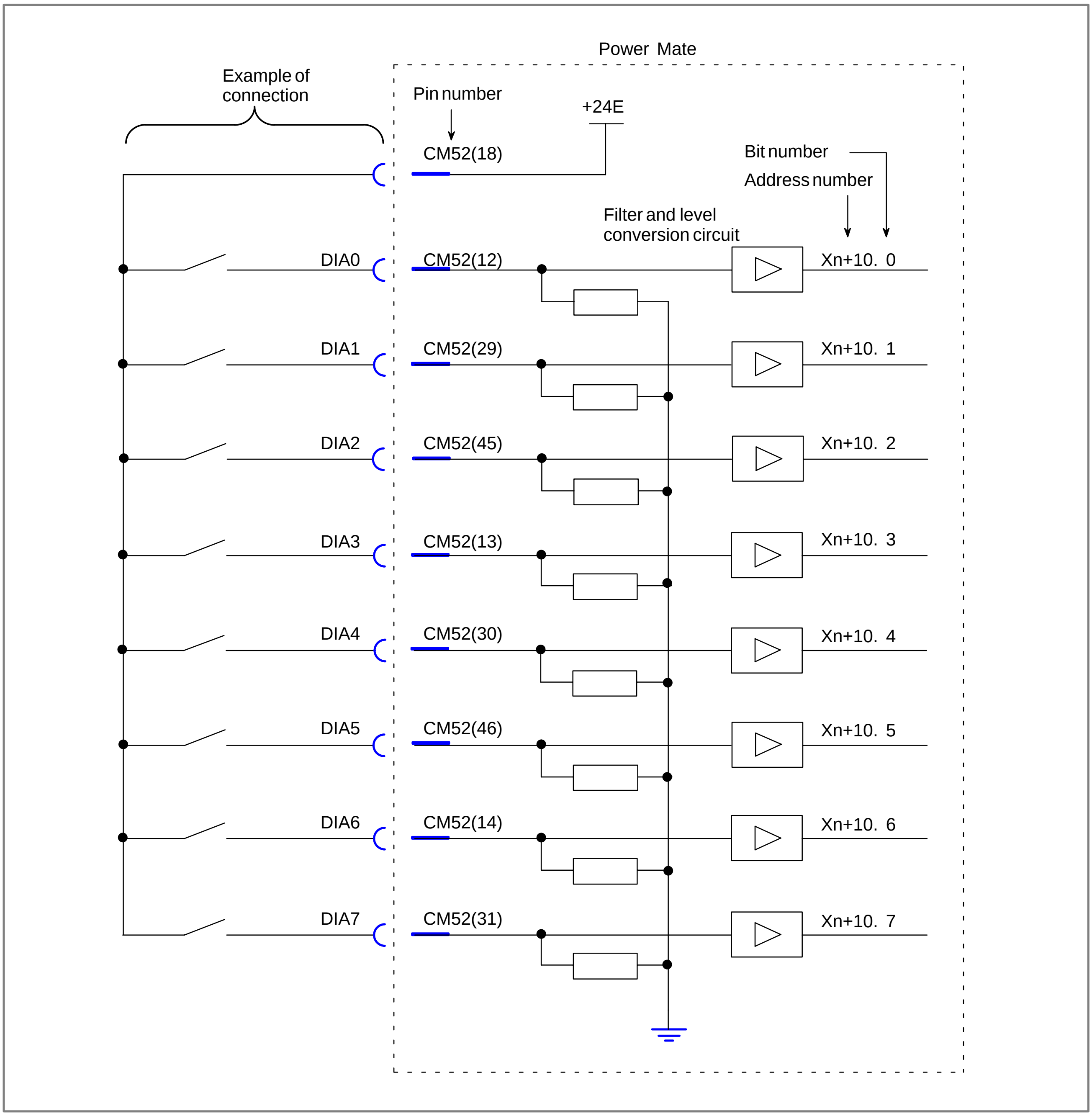


**Fig. 6.6.3 (k)  I/O card machine interface (11)**

Xn+10 is DC input signal A.

**NOTE**
This connection cannot be used for I/O card D (A16B–2202–0733).

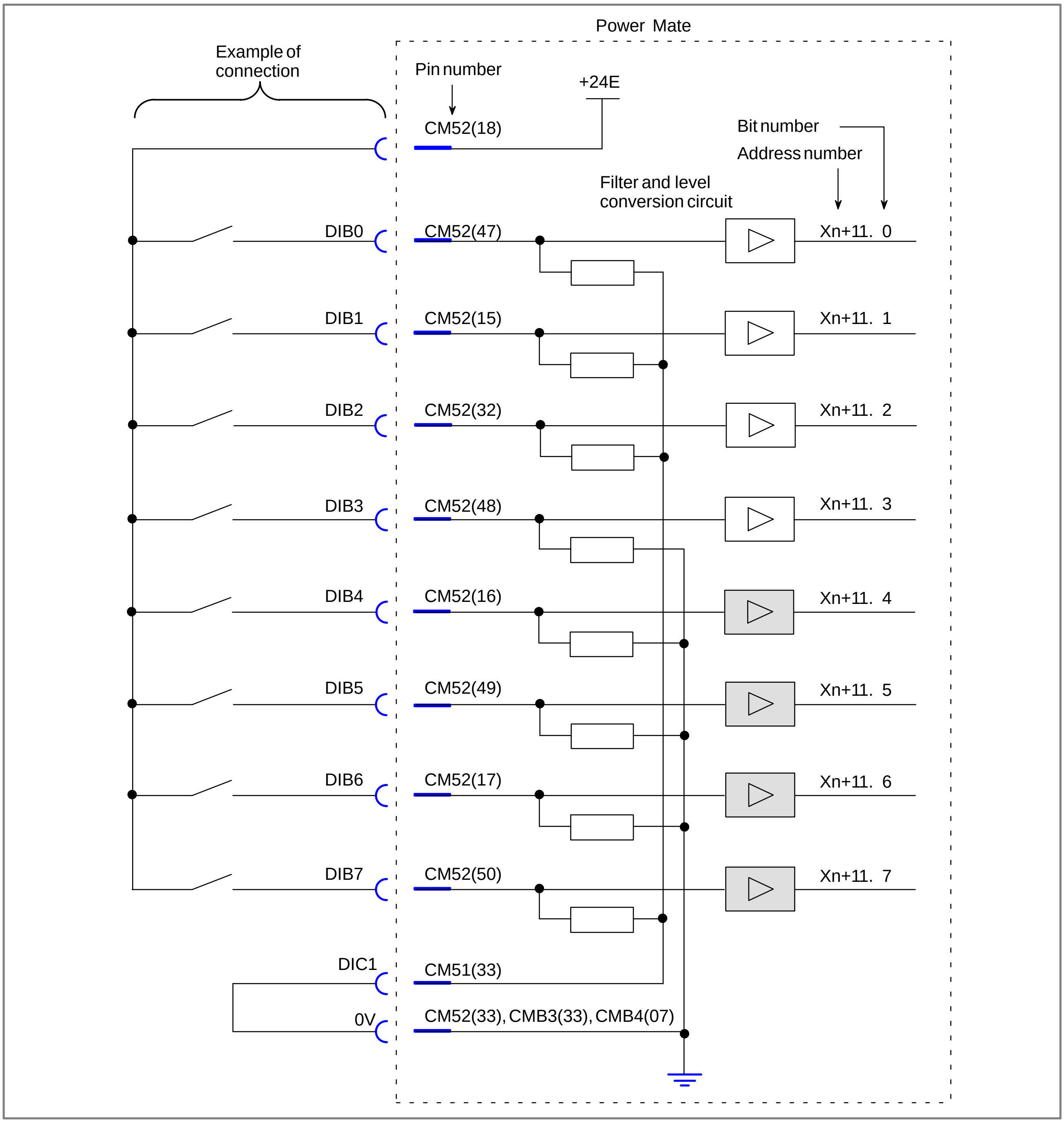


**Fig. 6.6.3 (l)  I/O card machine interface (12)**

Xn+11.4 to Xn+11.7 are DC input signal B (for high–speed signal input).

Xn+11.4 to Xn+11.7 are switchable–common signals; shown above are examples of sink–type inputs.

Xn+11.0 to Xn+11.3 are DC input signal A.

DIC1 serves as a common input for Xn.0 to Xn.2, Xn.7, Xn+1.0 to Xn+1.2, and Xn+1.7.

**NOTE**
This connection cannot be used for I/O card D (A16B–2202–0733).

## 6.6.4
## Details of DO Connection

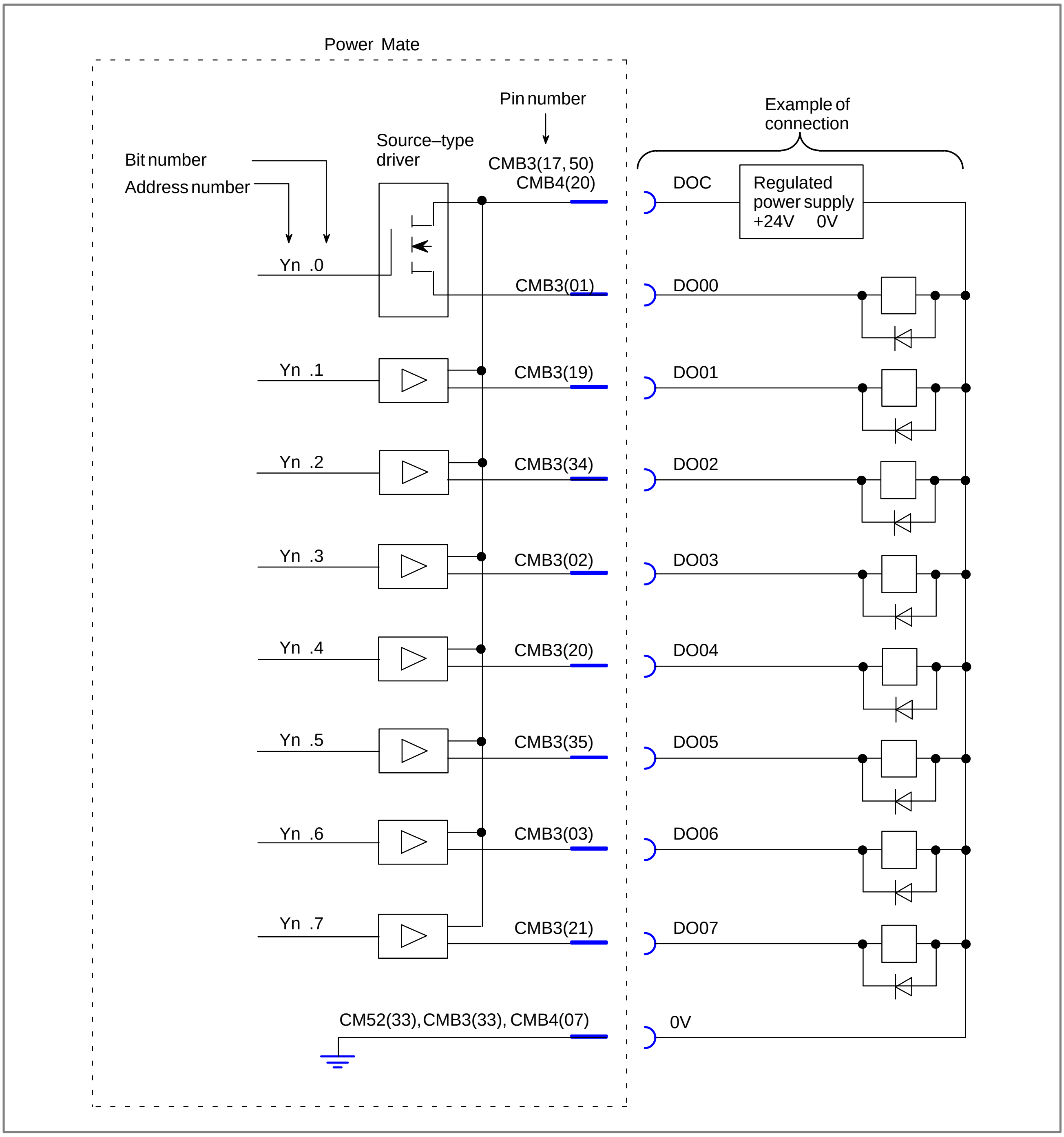


Fig. 6.6.4 (a) I/O card machine interface (13)

Yn.0 to Yn.7 correspond to one driver device.

If an error occurs in the device, the DAL1 LED on the PC board lights.

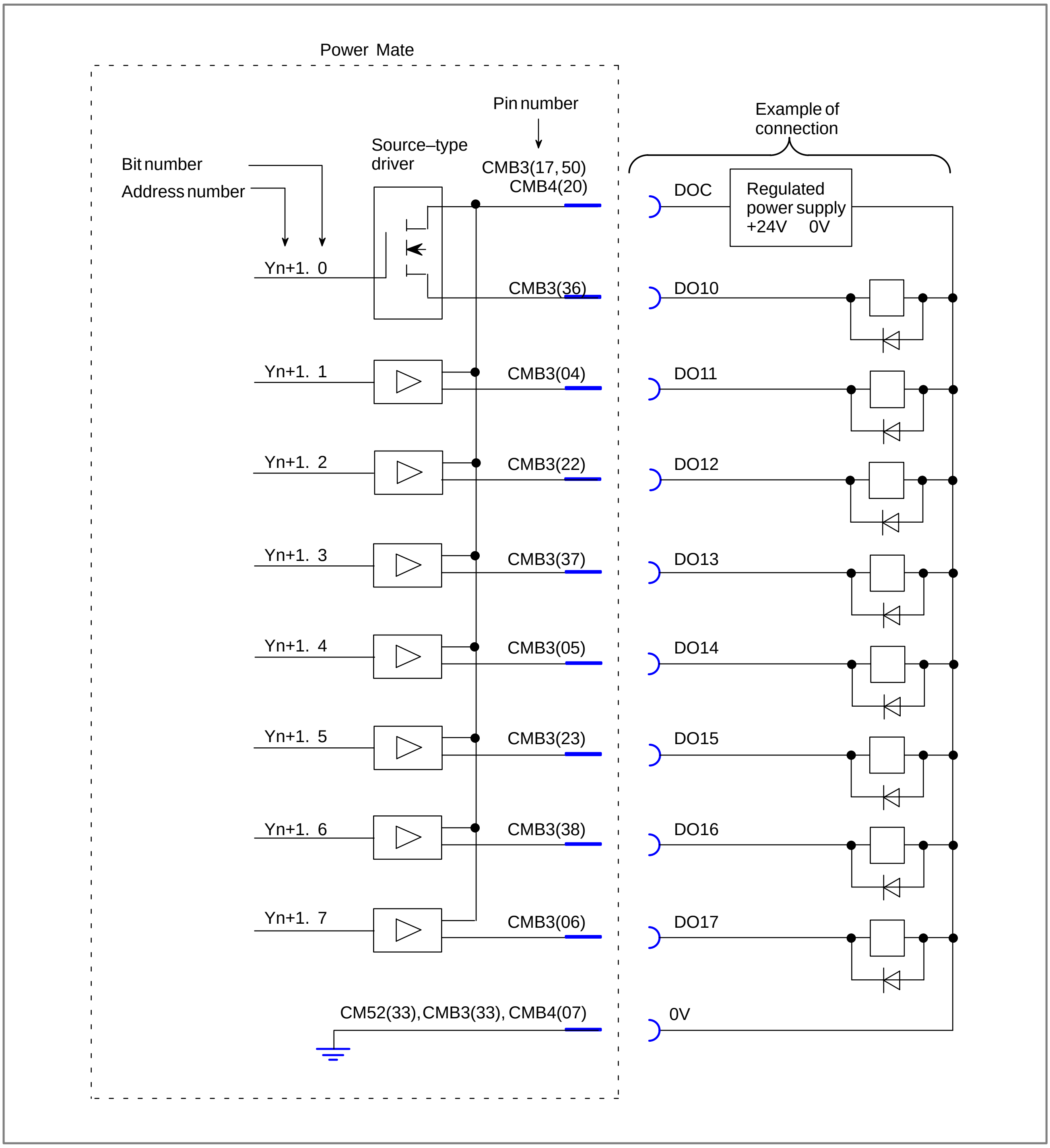


**Fig. 6.6.4 (b)  I/O card machine interface (14)**

Yn+1.0 to Yn+1.7 correspond to one driver device.

If an error occurs in the device, the DAL2 LED on the PC board lights

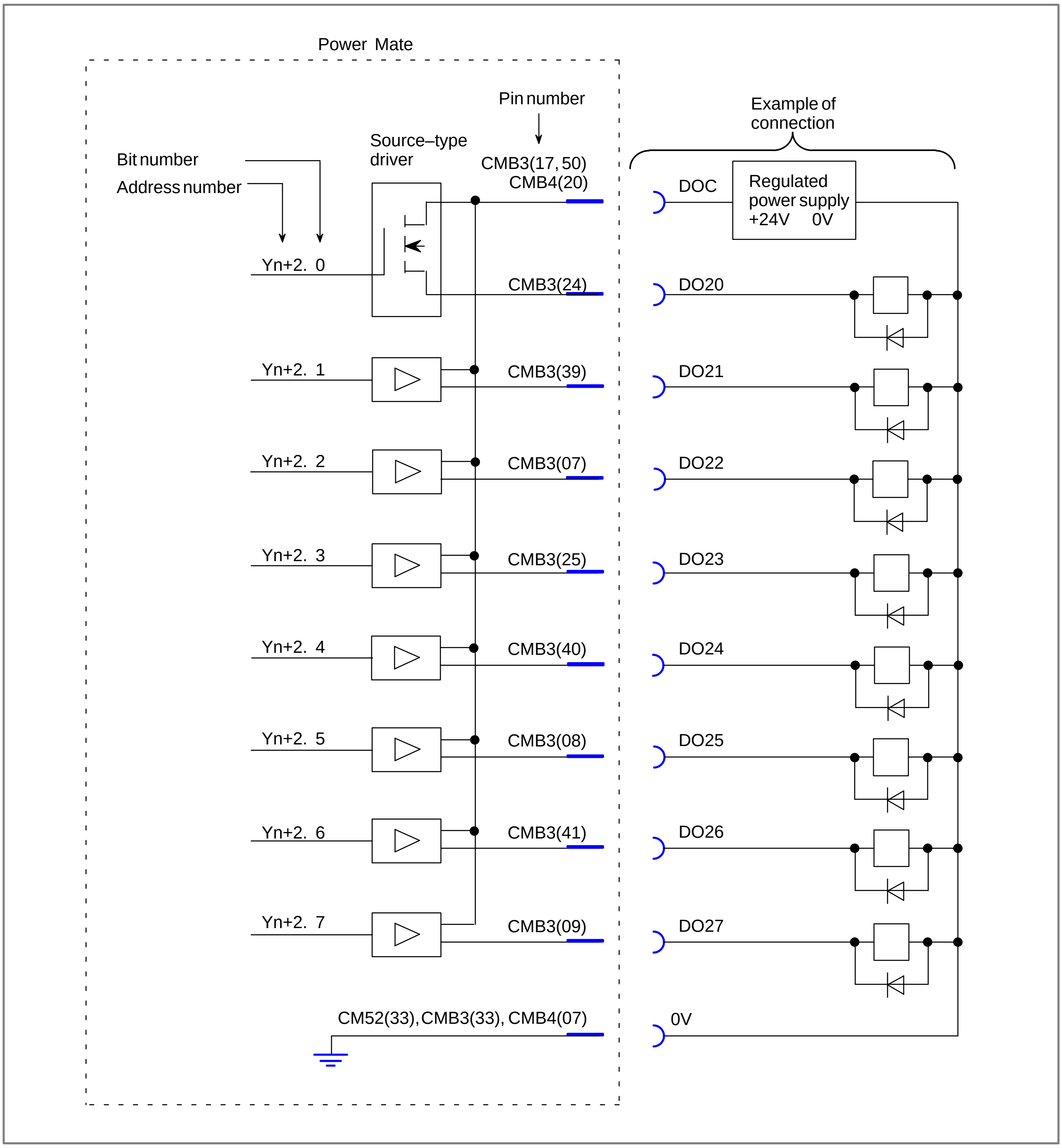


**Fig. 6.6.4 (c) I/O card machine interface (15)**

Yn+2.0 to Yn+2.7 correspond to one driver device.
If an error occurs in the device, the DAL3 LED on the PC board lights.

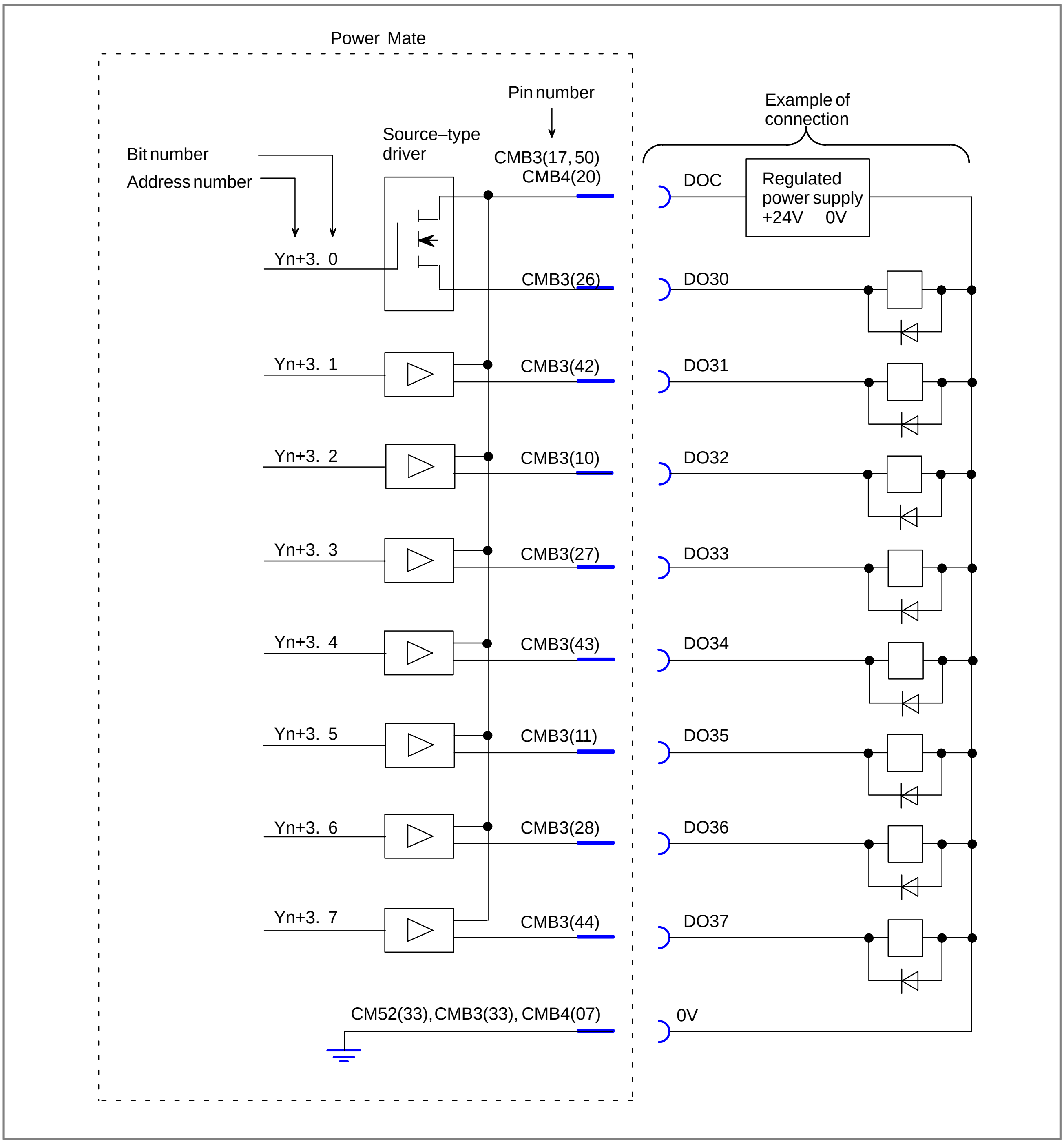


**Fig. 6.6.4 (d) I/O card machine interface (16)**

Yn+3.0 to Yn+3.7 correspond to one driver device.

If an error occurs in the device, the DAL4 LED on the PC board lights.

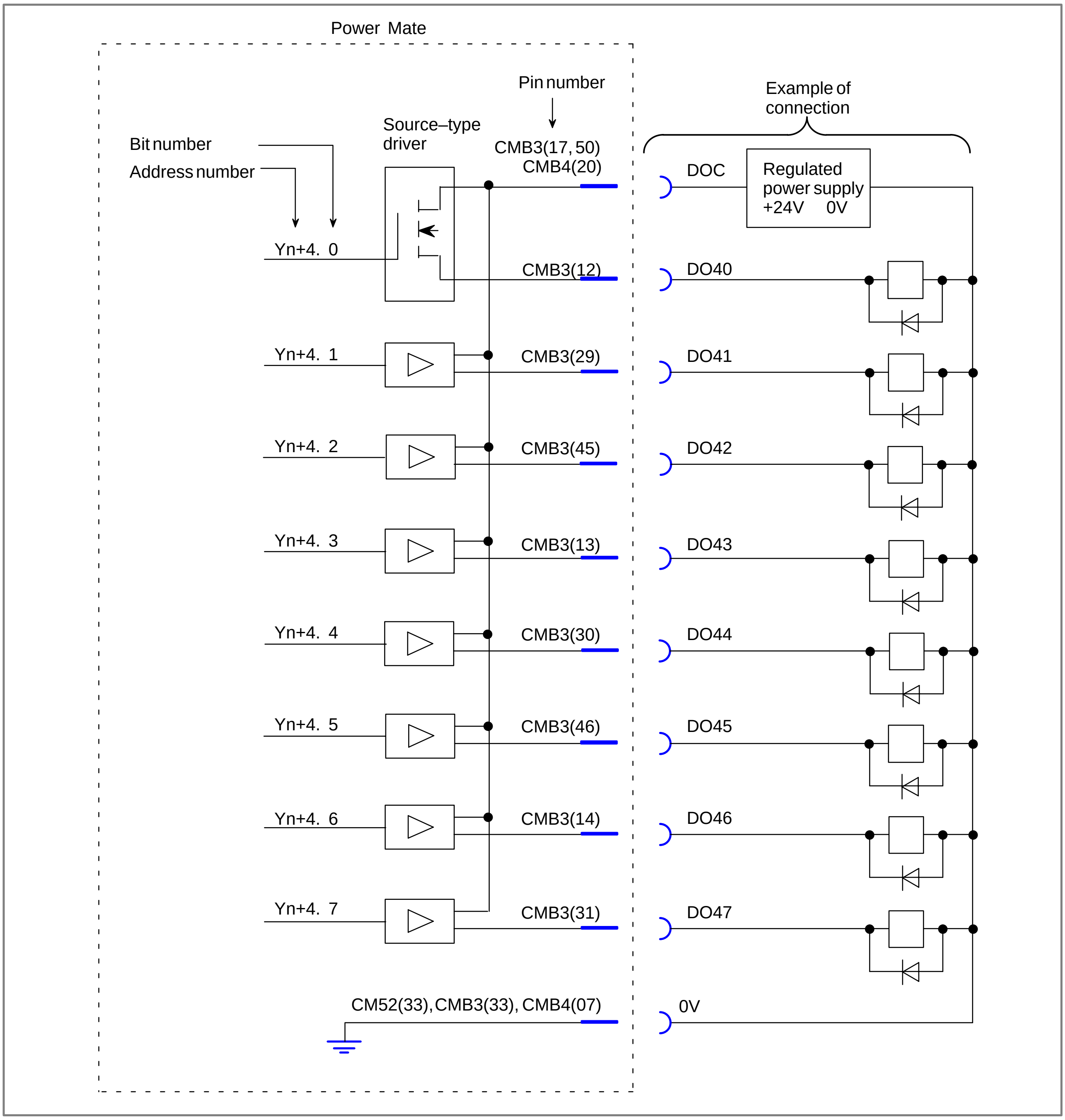


**Fig. 6.6.4 (e) I/O card machine interface (17)**

Yn+4.0 to Yn+4.7 correspond to one driver device.
If an error occurs in the device, the DAL5 LED on the PC board lights.

**NOTE**
This connection cannot be used for I/O card D (A16B–2202–0733).

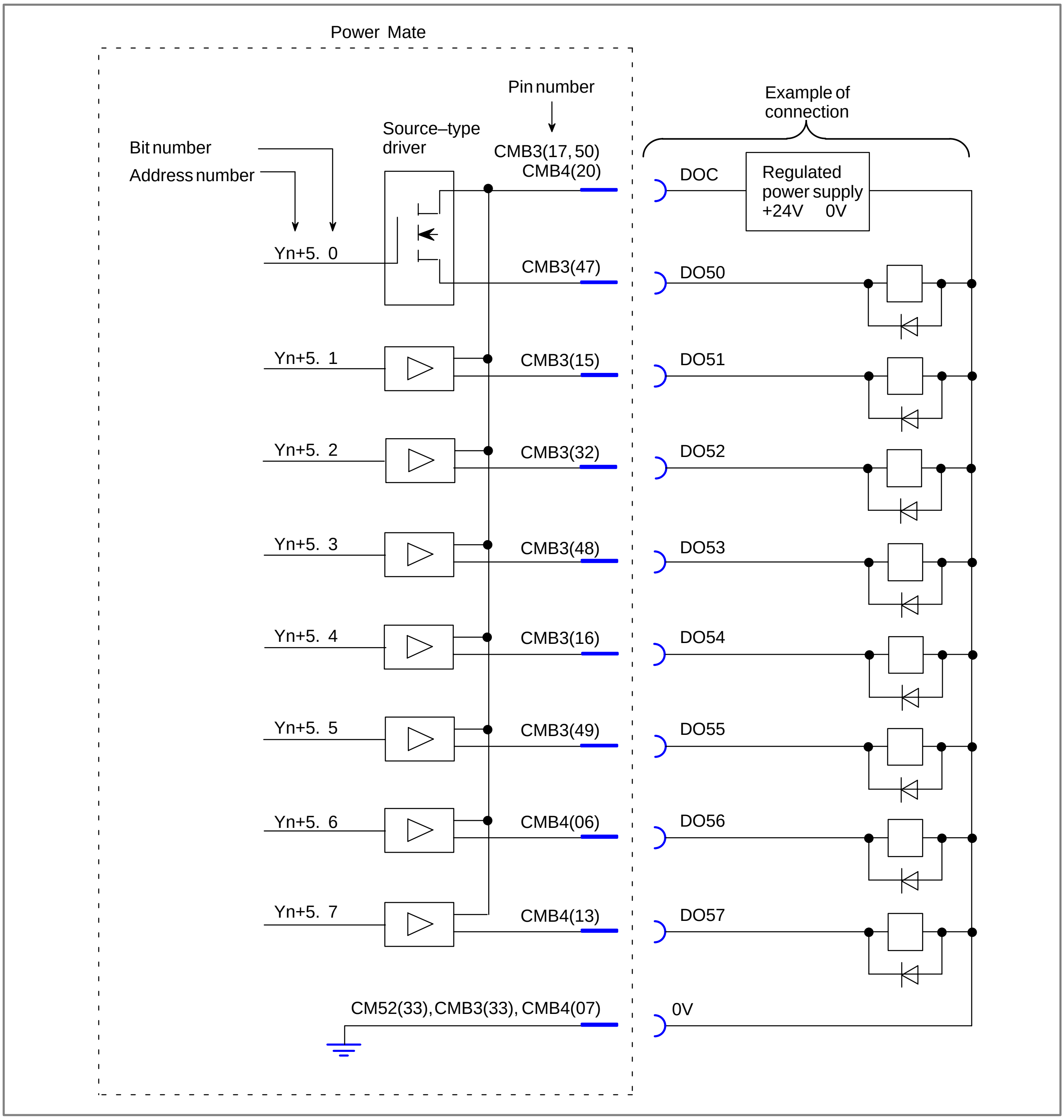


**Fig. 6.6.4 (f)  I/O card machine interface (18)**

Yn+5.0 to Yn+5.7 correspond to one driver device.
If an error occurs in the device, the DAL6 LED on the PC board lights.

**NOTE**
This connection cannot be used for I/O card D (A16B–2202–0733).

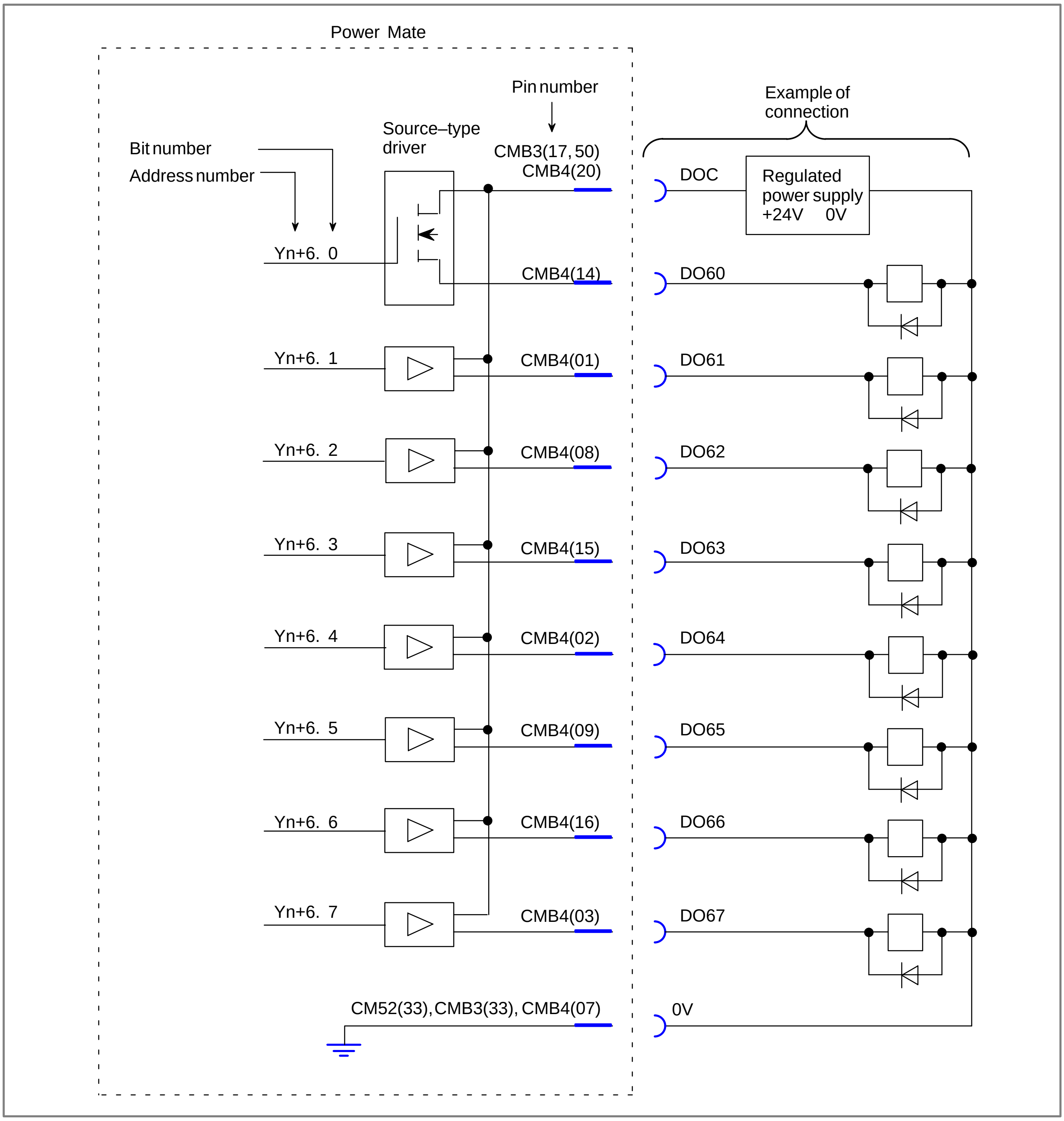


**Fig. 6.6.4 (g) I/O card machine interface (19)**

Yn+6.0 to Yn+6.7 correspond to one driver device.
If an error occurs in the device, the DAL7 LED on the PC board lights.

**NOTE**
This connection cannot be used for I/O card D (A16B–2202–0733).

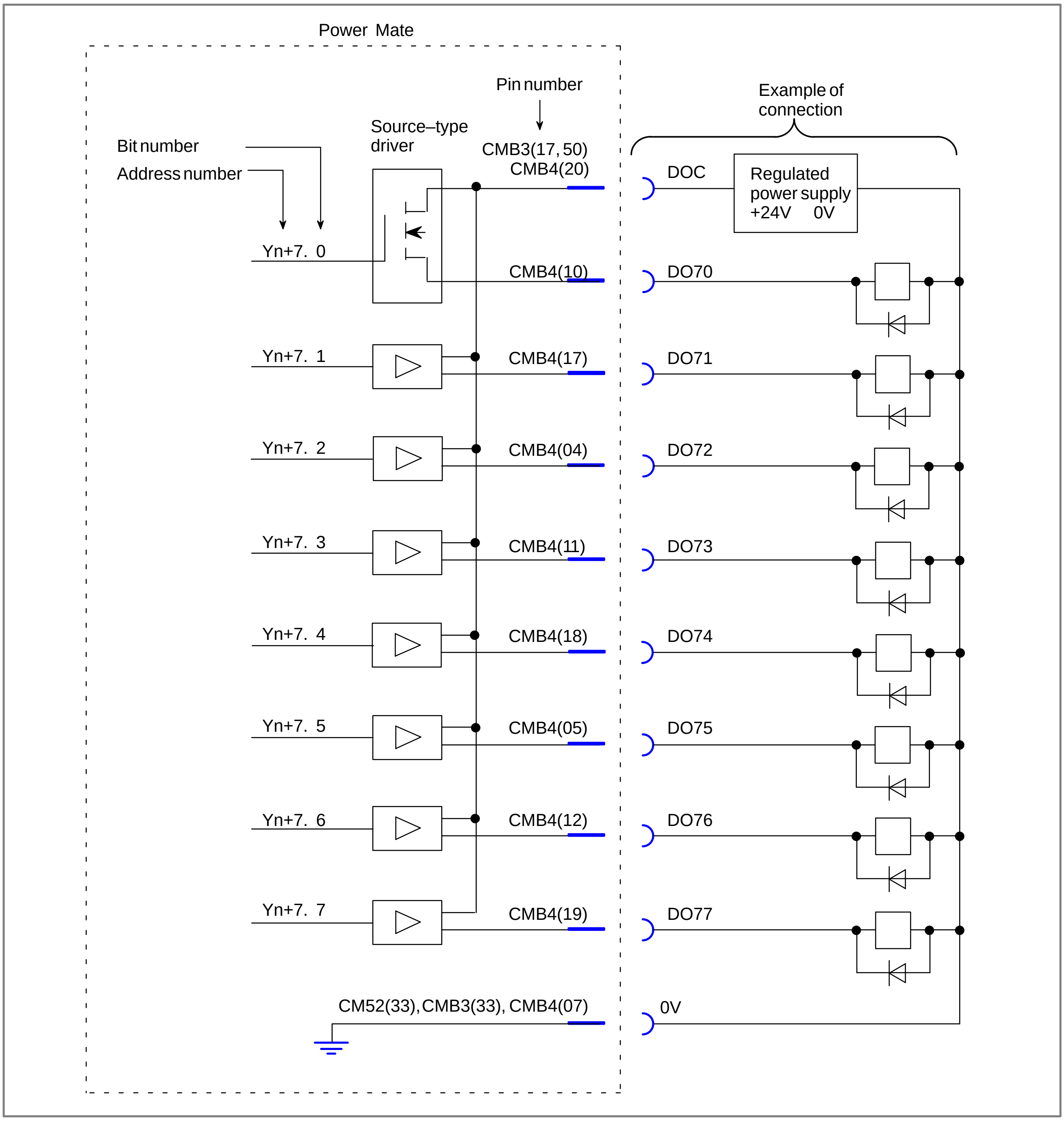
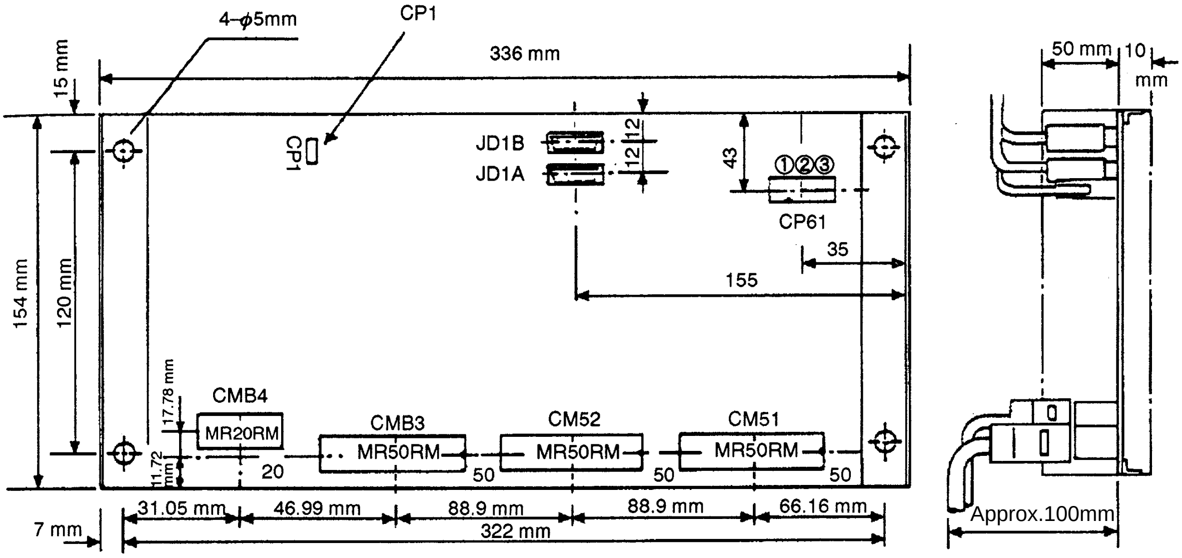


**Fig. 6.6.4 (h)  I/O card machine interface (20)**

Yn+7.0 to Yn+7.7 correspond to one driver device.
If an error occurs in the device, the DAL8 LED on the PC board lights.

**NOTE**
This connection cannot be used for I/O card D (A16B–2202–0733).

## 6.6.5 Dimensions of I/O Card D, E



The following LEDs, fuses, variable resistors, and setting pins are mounted on the PCB:

[LEDs]

DB2 (green, pilot) : Lights while the power to the PCB is on.
DB1 (red, alarm) : Lights if an error occurs in the PCB or Power Mate.
DAL1 to DAL8 : Do driver at overheat

[Fuses]

FU1 (3.2 A) : Used for external 24–V input.
(Order number : A02B–0200–K103)
FU2 (5.0 A) : Used for +5 V on the PCB.
(Order number : A02B–0200–K103)

[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 Power Mate will be notified of a DO signal error as a system alarm.
Open : Notify
Short : Not notify

## 6.7

## CONNECTION OF CONNECTOR PANEL I/O MODULE

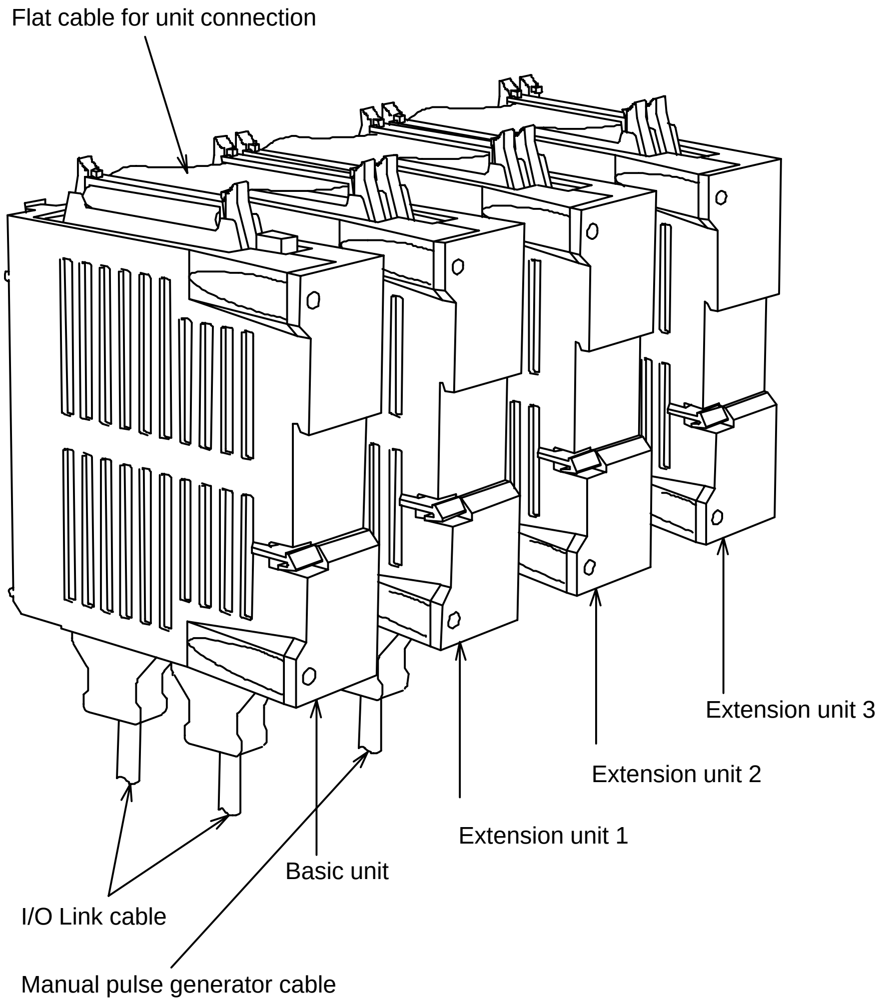
### 6.7.1

### General

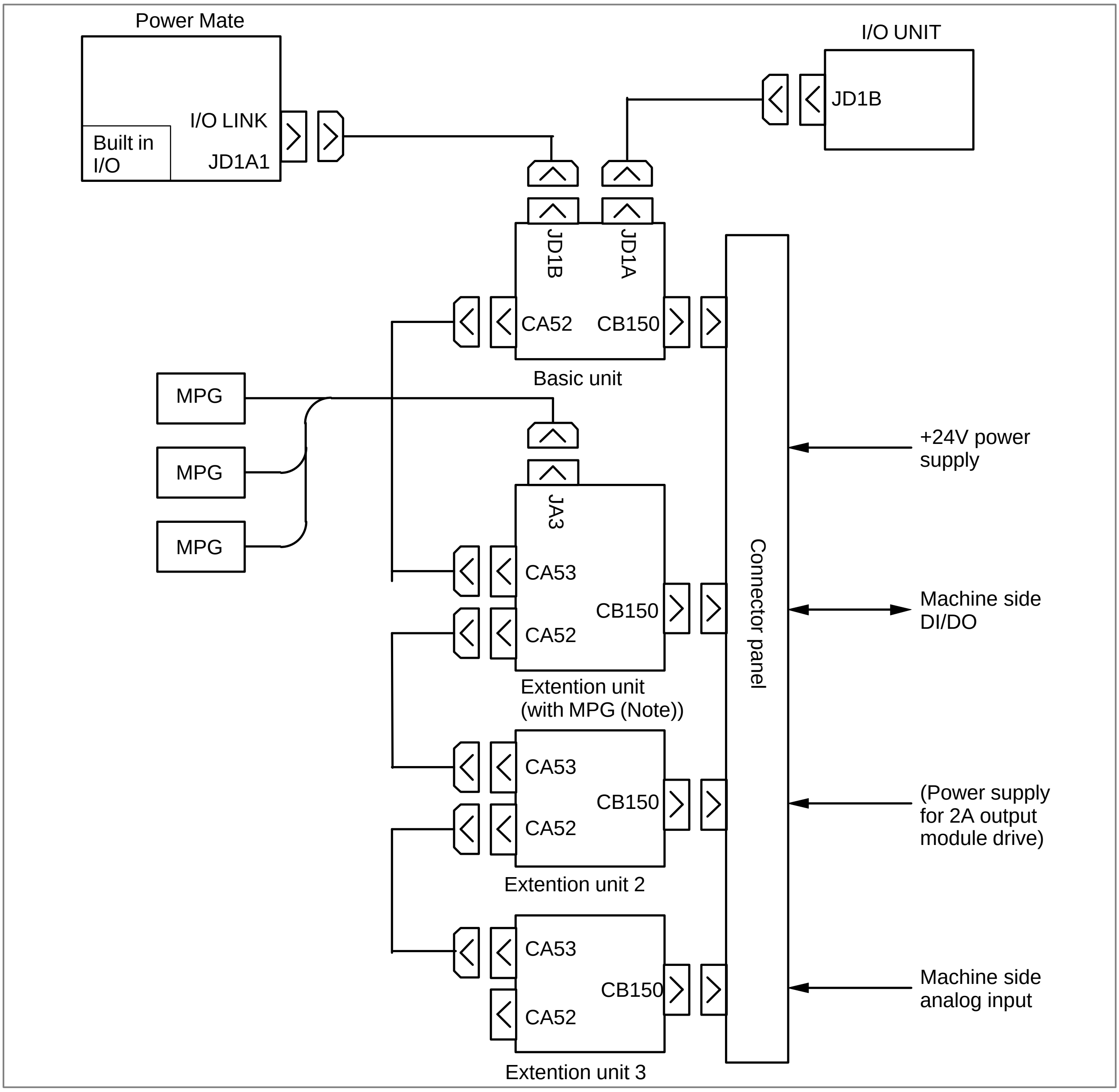
The connector panel I/O module can be connected directly to a customer–designed connector panel printed–circuit board. It can also be installed on the DIN rail.

In an I/O module for local lines, up to three extended units can be added to a single basic unit. The basic unit and the additional extended units form a single FANUC I/O Link group. The following basic unit and extended units are available. (Multiple extended units of the same type can be added.)

| Unit name | Drawing No. | Specifications |
|---|---|---|
| Basic | A03B–0815–C001 | DI/DO : 24/16 |
| Extended A | A03B–0815–C002 | DI/DO : 24/16<br>MPG interface incorporated |
| Extended B | A03B–0815–C003 | DI/DO : 24/16<br>MPG interface not incorporated |
| Extended C | A03B–0815–C004 | DO : 16<br>2A output |
| Extended D | A03B–0815–C005 | Analog input |


Flat cable for unit connection
Extension unit 3
Extension unit 2
Extension unit 1
Basic unit
I/O Link cable
Manual pulse generator cable

## 6.7.2 Connection Diagram



**NOTE**

Ensure that the extension module with the MPG interface is located nearest to the basic unit, as shown in the figure. When the connector panel I/O module is used together with a unit (such as an operator's panel I/O module) connected to the I/O Link supporting another MPG interface, only the MPG interface of the module closest to the Power Mate connected to the I/O Link is effective.

## 6.7.3
## Connector Pin Assignment

1) Basic, expansion A, and expansion B units

CB150 (HONDA MR–50RMA)

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

50 male pins with fittings for fixing the connector covers

2) Extended C

CB154 (HONDA MR–50RMA)

| | | | | | |
|---|---|---|---|---|---|
| 33 | DOCOMA | | | 01 | DOCOMA |
| 34 | Yn+0. 0 | 19 | GNDA | 02 | Yn+1. 0 |
| 35 | Yn+0. 1 | 20 | GNDA | 03 | Yn+1. 1 |
| 36 | Yn+0. 2 | 21 | GNDA | 04 | Yn+1. 2 |
| 37 | Yn+0. 3 | 22 | GNDA | 05 | Yn+1. 3 |
| 38 | Yn+0. 4 | 23 | GNDA | 06 | Yn+1. 4 |
| 39 | Yn+0. 5 | 24 | | 07 | Yn+1. 5 |
| 40 | Yn+0. 6 | 25 | | 08 | Yn+1. 6 |
| 41 | Yn+0. 7 | 26 | | 09 | Yn+1. 7 |
| 42 | | 27 | | 10 | |
| 43 | | 28 | | 11 | |
| 44 | | 29 | | 12 | |
| 45 | | 30 | | 13 | |
| 46 | | 31 | | 14 | |
| 47 | | 32 | | 15 | |
| 48 | | | | 16 | |
| 49 | DOCOMA | | | 17 | DOCOMA |
| 50 | DOCOMA | | | 18 | DOCOMA |

50 male pins
Hardware for fastening the connector cover attached

3) Extended D

CB157 (HONDA MR–50RMA)

| | | | | | |
|---|---|---|---|---|---|
| 33 | INM3 | | | 01 | INM1 |
| 34 | COM3 | 19 | FGND | 02 | COM1 |
| 35 | FGND3 | 20 | FGND | 03 | FGND1 |
| 36 | INP3 | 21 | FGND | 04 | INP1 |
| 37 | JMP3 | 22 | FGND | 05 | JMP1 |
| 38 | INM4 | 23 | FGND | 06 | INM2 |
| 39 | COM4 | 24 | | 07 | COM2 |
| 40 | FGND4 | 25 | | 08 | FGND2 |
| 41 | INP4 | 26 | | 09 | INP2 |
| 42 | JMP4 | 27 | | 10 | JMP2 |
| 43 | | 28 | | 11 | |
| 44 | | 29 | | 12 | |
| 45 | | 30 | | 13 | |
| 46 | | 31 | | 14 | |
| 47 | | 32 | | 15 | |
| 48 | | | | 16 | |
| 49 | | | | 17 | |
| 50 | | | | 18 | |

50 male pins
Hardware for fastening the
connector cover attached

**NOTE**

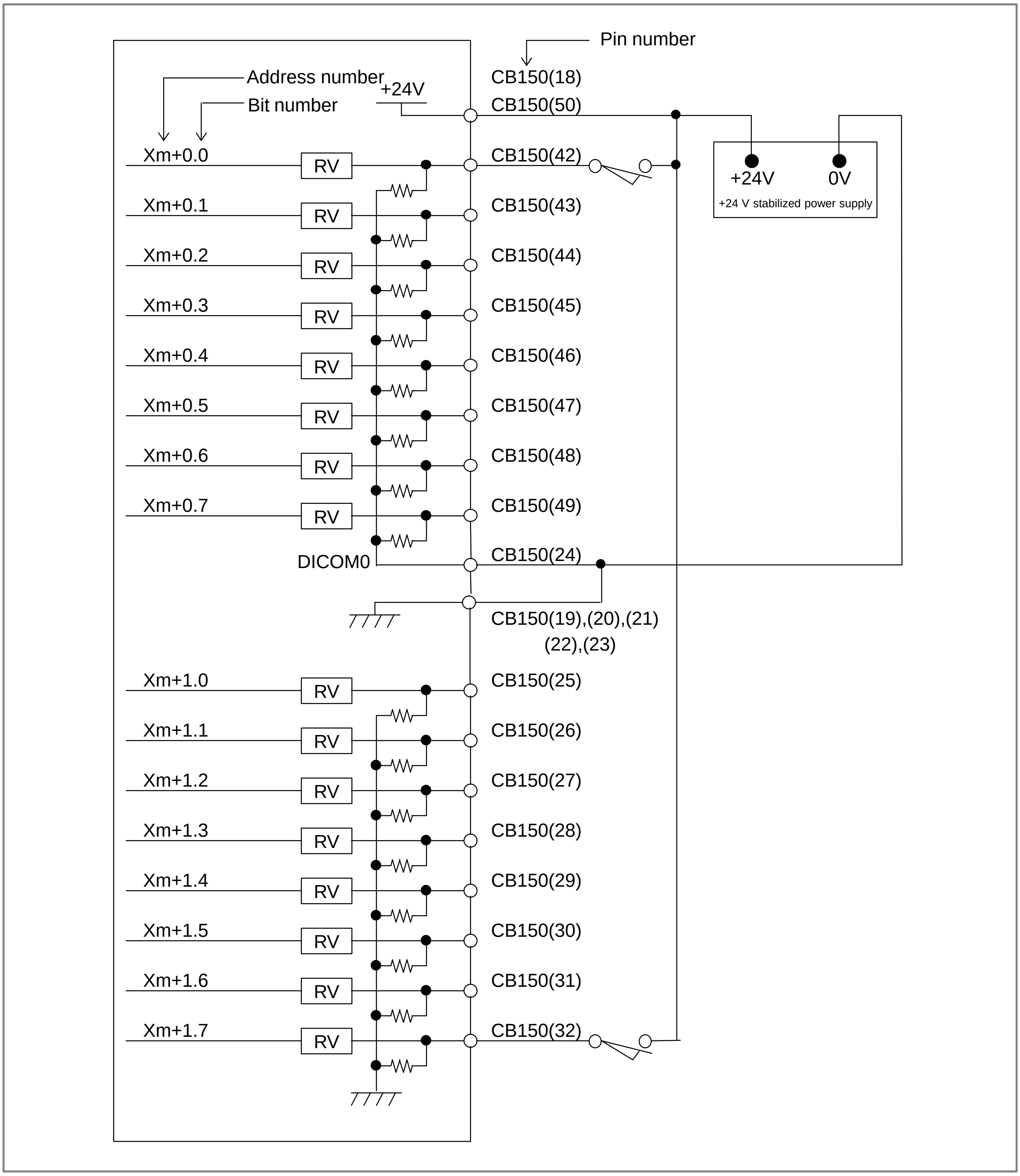
1 The DI and DO addresses for the basic and extension units run contiguously. These basic and extension unit DI and DO addresses are allocated to the I/O Link as a group. For example, when the DI and DO top addresses are X0004 and Y0000 (m = 4 and n = 0), respectively, then the addresses are allocated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

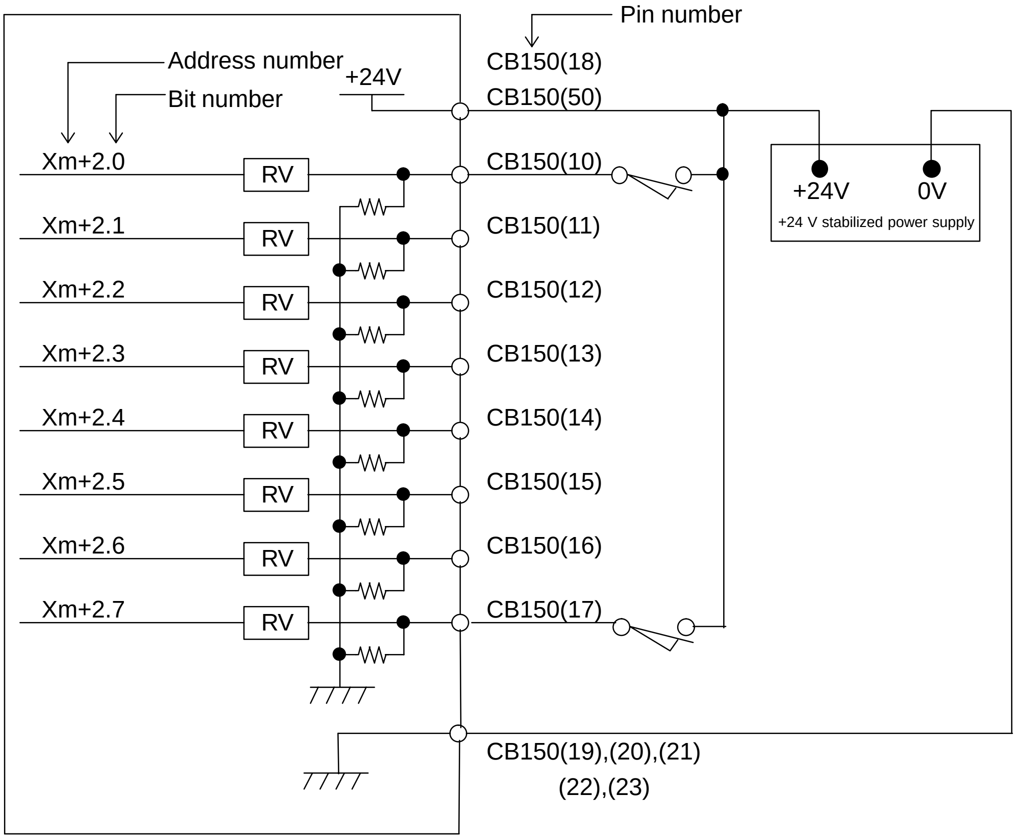
2 When the 2A output module is used, the addresses for the DIs of the module cannot be used. (When the 2A output module is used as extended unit 3, X13 to X15 cannot be used.)

3 In the analog input module, the DO space is used as an input channel selection area.

| | DI | DO |
|---|---|---|
| Basic unit | X4 to X6 | Y0 to Y1 |
| Extension unit 1 | X7 to X9 | Y2 to Y3 |
| Extension unit 2 | X10 to X12 | Y4 to Y5 |
| Extension unit 3 | X13 to X15 | Y6 to Y7 |

## 6.7.4 Basic, Expansion A, and Expansion B Units Connection



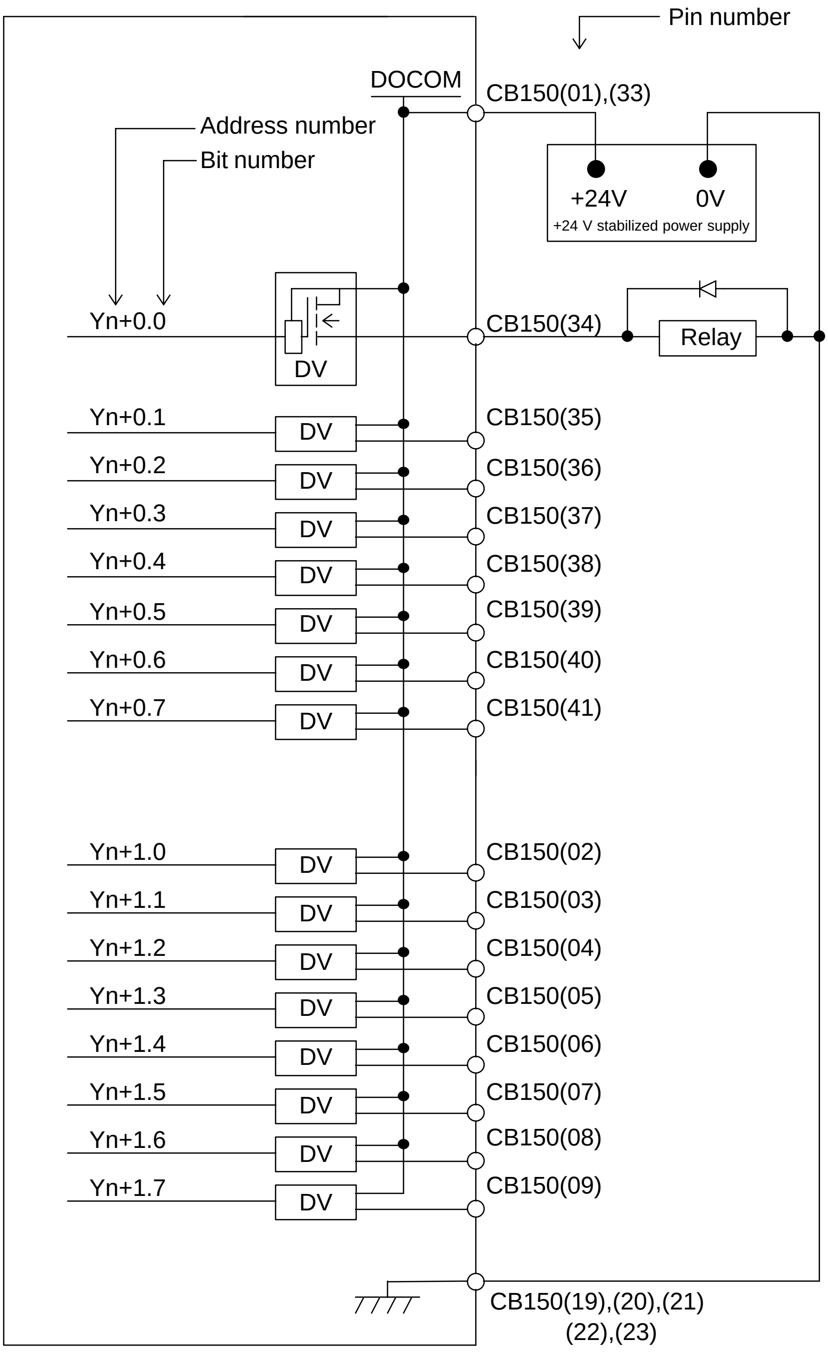


**NOTE**

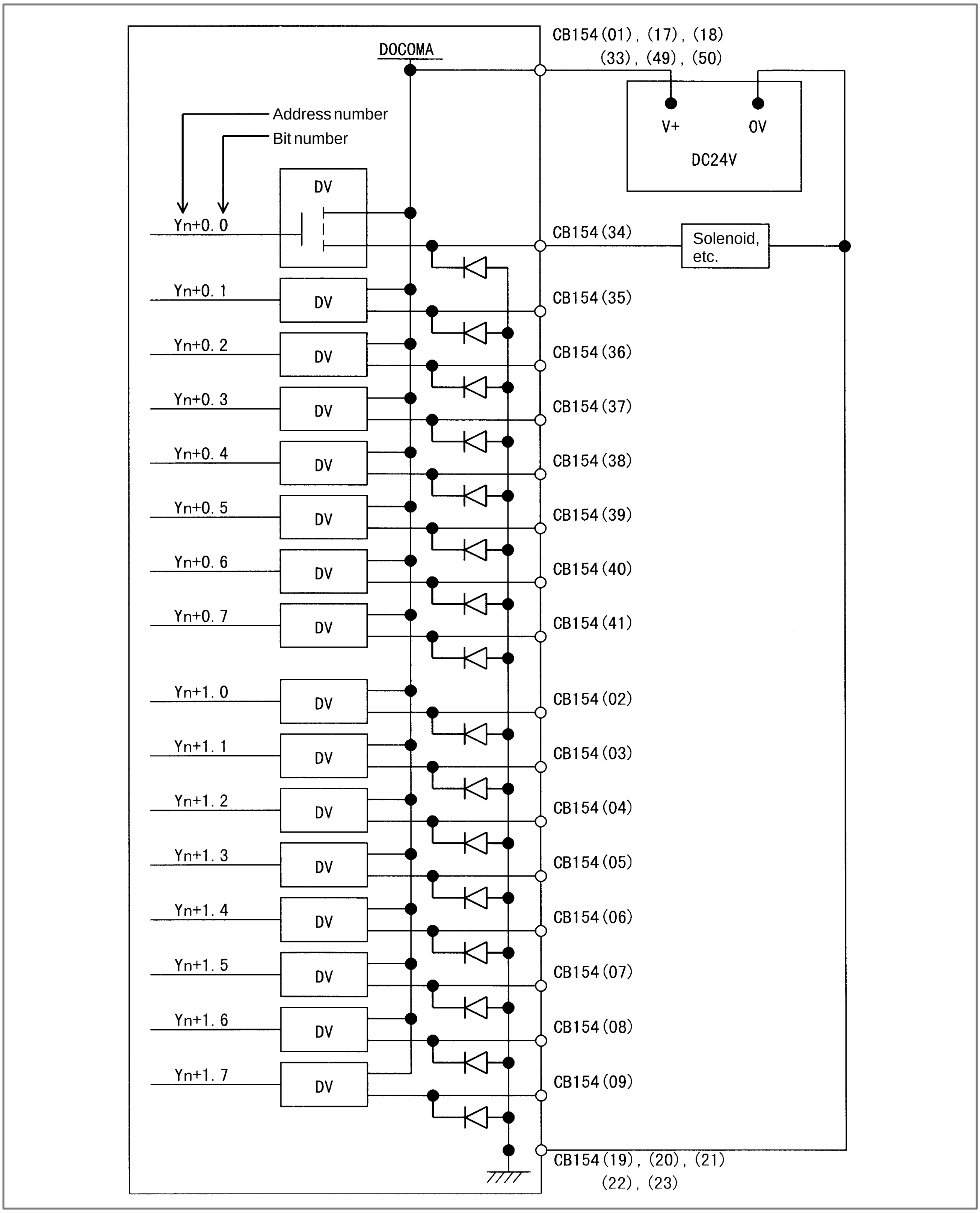
1 Xm+0.0 through Xm+0.7 are DI pins for which a common voltage can be selected. That is, by connecting the DICOM0 CB150(24) pin to the +24 V power supply, a DI signal can be input with its logical state reversed. If, however, a cable is connected to ground, it has the same effect as inputting an ON state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

2 For safety reasons, the emergency stop signal needs to be allocated to an appropriate bit X0.4 of the addresses for which the common voltage is fixed. To put it another way, no emergency stop signal can be input from this connector panel I/O module. An emergency stop signal should be allocated to the built–in I/O module of the Power Mate or an I/O module supporting the FANUC I/O Link.

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


Pin number
DOCOM
CB150(01),(33)
Address number
Bit number
+24V
0V
+24 V stabilized power supply
Yn+0.0
DV
CB150(34)
Relay
Yn+0.1
CB150(35)
Yn+0.2
CB150(36)
Yn+0.3
CB150(37)
Yn+0.4
CB150(38)
Yn+0.5
CB150(39)
Yn+0.6
CB150(40)
Yn+0.7
CB150(41)
Yn+1.0
CB150(02)
Yn+1.1
CB150(03)
Yn+1.2
CB150(04)
Yn+1.3
CB150(05)
Yn+1.4
CB150(06)
Yn+1.5
CB150(07)
Yn+1.6
CB150(08)
Yn+1.7
CB150(09)
CB150(19),(20),(21)
(22),(23)

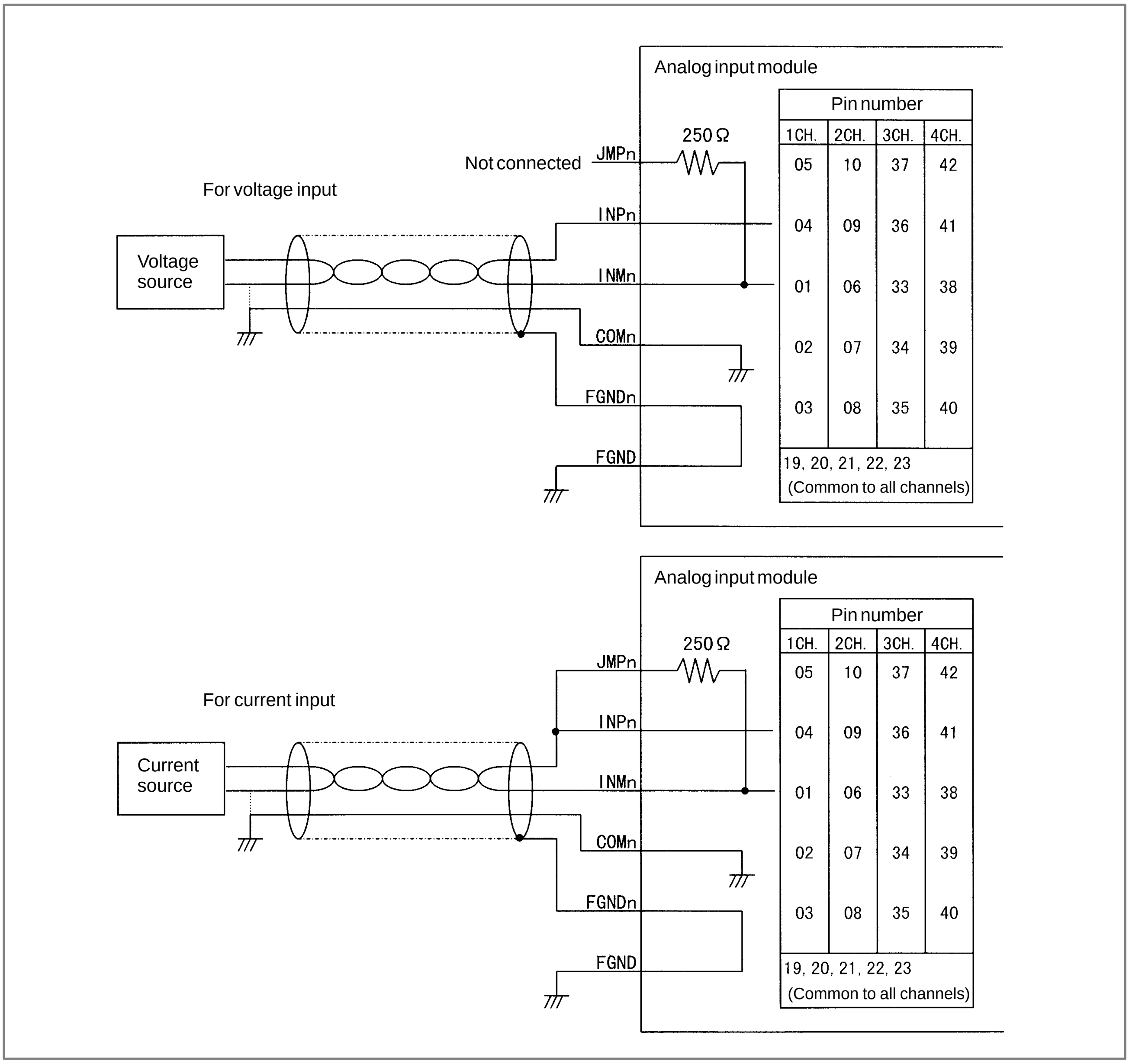
### 6.7.5 Connecting the Extended C (2A Output) Unit



## 6.7.6

## Connecting the Extended D (Analog Input) Unit

1) Connection diagrams



| Pin number | | | |
|---|---|---|---|
| 1CH. | 2CH. | 3CH. | 4CH. |
| 05 | 10 | 37 | 42 |
| 04 | 09 | 36 | 41 |
| 01 | 06 | 33 | 38 |
| 02 | 07 | 34 | 39 |
| 03 | 08 | 35 | 40 |
| 19, 20, 21, 22, 23<br>(Common to all channels) | | | |

| Pin number | | | |
|---|---|---|---|
| 1CH. | 2CH. | 3CH. | 4CH. |
| 05 | 10 | 37 | 42 |
| 04 | 09 | 36 | 41 |
| 01 | 06 | 33 | 38 |
| 02 | 07 | 34 | 39 |
| 03 | 08 | 35 | 40 |
| 19, 20, 21, 22, 23<br>(Common to all channels) | | | |

**NOTE**

In the figure above, n represents a channel (n = 1, 2, 3, 4).

- Either voltage or current input can be selected for each channel. For current input, short–circuit JMPn and INPn.
- Use shielded twisted pair cables for the connection.
- In the figure above, the shield for each channel is connected to FGNDn, which is connected to FGND. Alternatively, the shield may be connected directly to the frame ground by using a cable clamp, without using FGNDn.

2) Digital output

This analog input module has four input channels. The digital output block is a single 12–bit output in the occupied input points of three bytes. The output format is as follows:

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

D00 to D11 are 12–bit digital output data. D00 corresponds to $2^0$ weight and D11 to $2^{11}$ weight.

D11 corresponds to the sign bit of a twos complement representation.

CHA and CHB represent an analog input channel. Thus, when the PMC program reads the above two bytes, it can read from D11 to D00 the A/D–converted data on the input channel represented by CHA and CHB. For an explanation of CHA and CHB, see “Channel selection” below.

3) Channel selection

This analog input module requires that the PMC program specify which of the four channels is to output data to the digital output block. The DOs for this specification are CHA and CHB in the occupied output points of two bytes. They are mapped as follows:

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

By writing one of the following values to each of CHA and CHB, the corresponding channel is selected and the A/D–converted data on the channel and the data for the selected channel are read as DI data. The Xs above are unused bits and, therefore, either 1 or 0 may be written.

| CHB | CHA | Selected channel |
|---|---|---|
| 0 | 0 | Channel 1 |
| 0 | 1 | Channel 2 |
| 1 | 0 | Channel 3 |
| 1 | 1 | Channel 4 |

4) Allocation

The start address of the X (DI) of the basic unit containing the analog input module must always be allocated to an even address.

If the start address is allocated in this way, the digital output addresses of the analog input module are as shown below, depending on where the module is mounted.

- If the analog input module is mounted as extended unit 1 (m is the start address for allocation)

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

- If the analog input module is mounted as extended unit 2 (m is the start address for allocation)

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

- If the analog input module is placed as extended unit 3 (m is the start address for allocation)

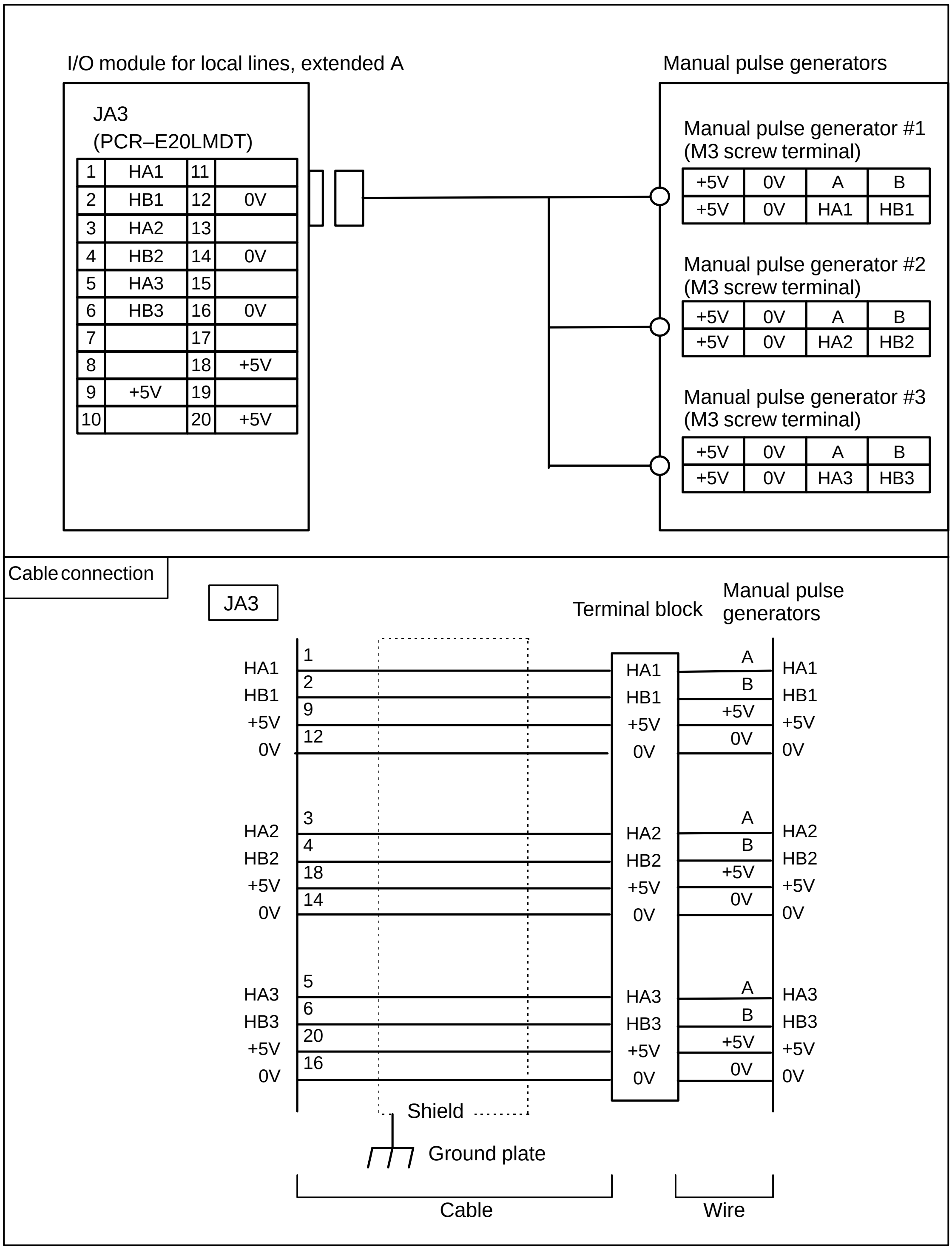
| Address within the module | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| Xm+9 (odd address) | Undefined | | | | | | | |
| Xm+10 (even address) | D07 | D06 | D05 | D04 | D03 | D02 | D01 | D00 |
| Xm+11 (odd address) | 0 | 0 | CHB | CHA | D11 | D10 | D09 | D08 |

**NOTE**

If 2–byte digital output addresses are to be referenced with the PMC program, read them in units of words (16 bits).

## 6.7.7
## Manual Pulse Generator Connection

The extended A unit of the I/O module for local lines has a manual pulse generator I/F.
An example in which three manual pulse generators are connected is shown below.



JA3 (PCR–E20LMDT)

| | | | |
|---|---|---|---|
| 1 | HA1 | 11 | |
| 2 | HB1 | 12 | 0V |
| 3 | HA2 | 13 | |
| 4 | HB2 | 14 | 0V |
| 5 | HA3 | 15 | |
| 6 | HB3 | 16 | 0V |
| 7 | | 17 | |
| 8 | | 18 | +5V |
| 9 | +5V | 19 | |
| 10 | | 20 | +5V |

Manual pulse generator #1 (M3 screw terminal)

| | | | |
|---|---|---|---|
| +5V | 0V | A | B |
| +5V | 0V | HA1 | HB1 |

Manual pulse generator #2 (M3 screw terminal)

| | | | |
|---|---|---|---|
| +5V | 0V | A | B |
| +5V | 0V | HA2 | HB2 |

Manual pulse generator #3 (M3 screw terminal)

| | | | |
|---|---|---|---|
| +5V | 0V | A | B |
| +5V | 0V | HA3 | HB3 |

Recommended wire:

A66L–0001–0286 (6 pairs of #20AWG wires and 3 pairs of #24AWG wires)

Recommended connector:

A02B–0120–K303 (such as the following connector and its housing)
(Connector:Soldering–type FI40–2015S, manufactured by Hirose Electric Co., Ltd.)
(Housing:FI–20–CV, manufactured by Hirose Electric Co., Ltd.)

Recommended cables:

A02B–0120–K841 (7 m) (for connecting three manual pulse generators)
A02B–0120–K848 (7 m) (for connecting two manual pulse generators)
A02B–0120–K847 (7 m) (for connecting one manual pulse generator)
(These cables do not include the wire shown in the above figure.)

**NOTE**

1. The Power Mate *i*–D supports the connection of only two manual pulse generators. In such cases, signals HA3 and HB3 are not used.
2. The interface cannot be used together with the manual pulse generator interface of the Power Mate *i*.

## Cable length for manual pulse generator

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

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

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

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

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

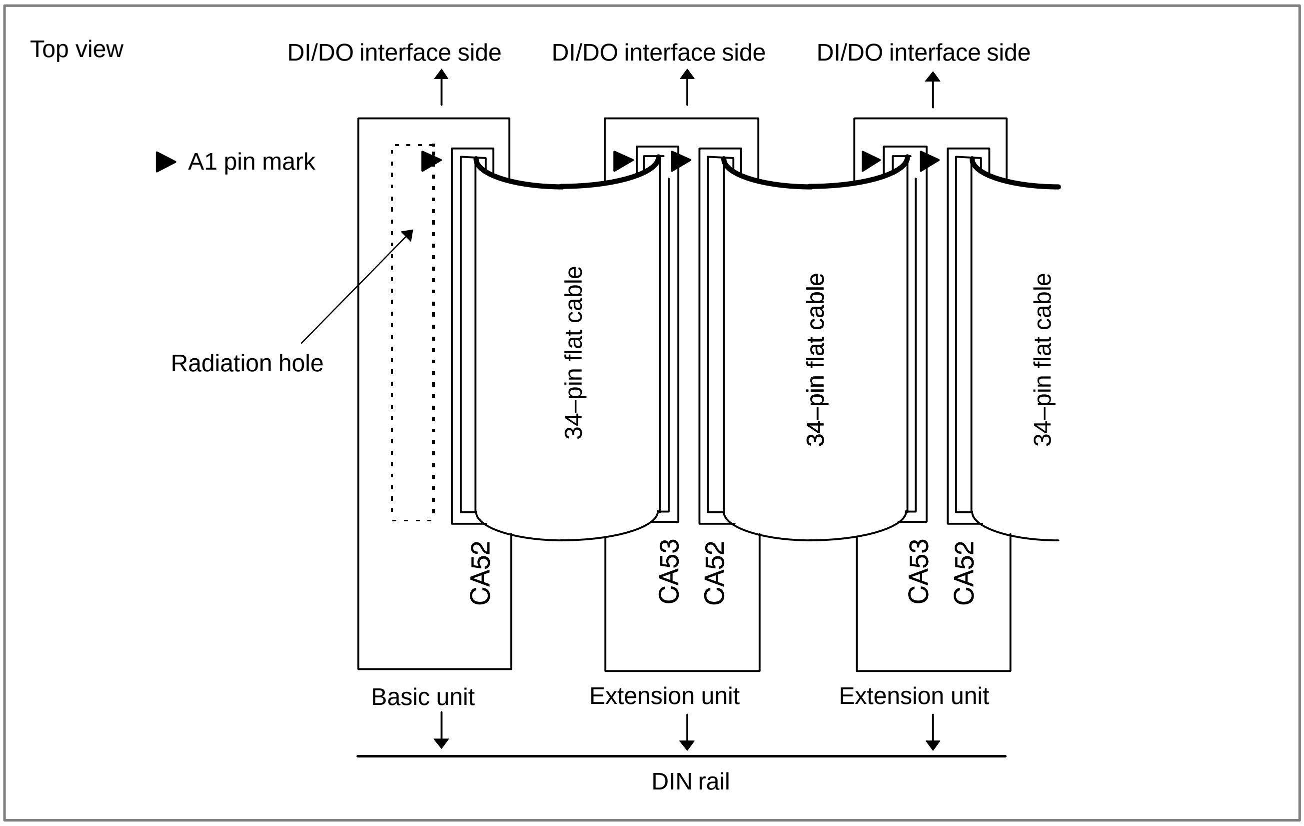
In the case of the A66L–0001–0286 cable, for example, when three pairs of signal wires and six power supply wires (20/0.18, 0.0394 Ω/m) are used (three power supply wires connected to 5 V and the other three to 0 V when one manual pulse generator is used), the cable length is:

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

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

## 6.7.8 Connection of Units

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



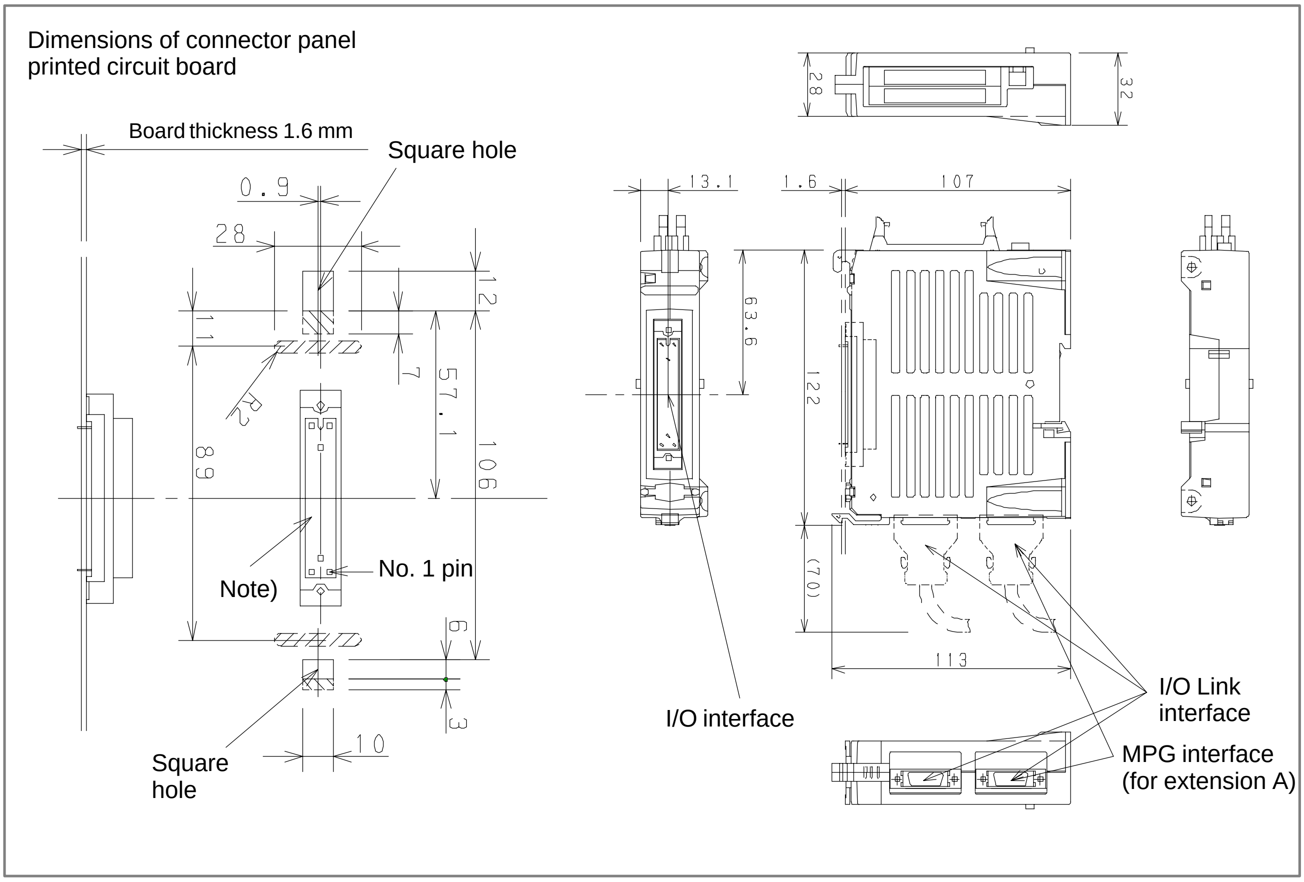
Flat cable–side connector specification:
HIF3BA–34DA–2.54R (Hirose Electric Co., Ltd.)
Unit connector–side specification:
HIF3BA–34PA–2.54DS (Hirose Electric Co., Ltd.) or
FAP–3403–1202–OBS (Yamaichi Denki Co., Ltd.)

**NOTE**

1 Units need to be spaced at least 32 mm apart, in which case a flat cable of about 20 mm in length is required. To install units further away from each other, the cable length will be 20 mm plus the extra distance. Note that the maximum length of a flat cable is 100 mm.
2 To ensure adequate ventilation, install the units in such a way that the flat cables lie on top of them. The basic unit is provided with a heat radiation hole on the upper side (area indicated using the dotted line in the above figure). When installing a flat cable, be careful not to block the hole with the cable. In other words, an expansion unit should be placed for such a direction that the flat cable of the expansion unit will not block the heat radiation hole of the basic unit, as shown above. To be specific, when a connector panel printed–circuit board is connected directly, the expansion unit shall be placed on the right–hand side of the basic unit as viewed when you face the mounting surface. If the DIN rail or screws are used to mount the expansion unit, it shall be placed on the left–hand side.

## 6.7.9 Module Installation

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



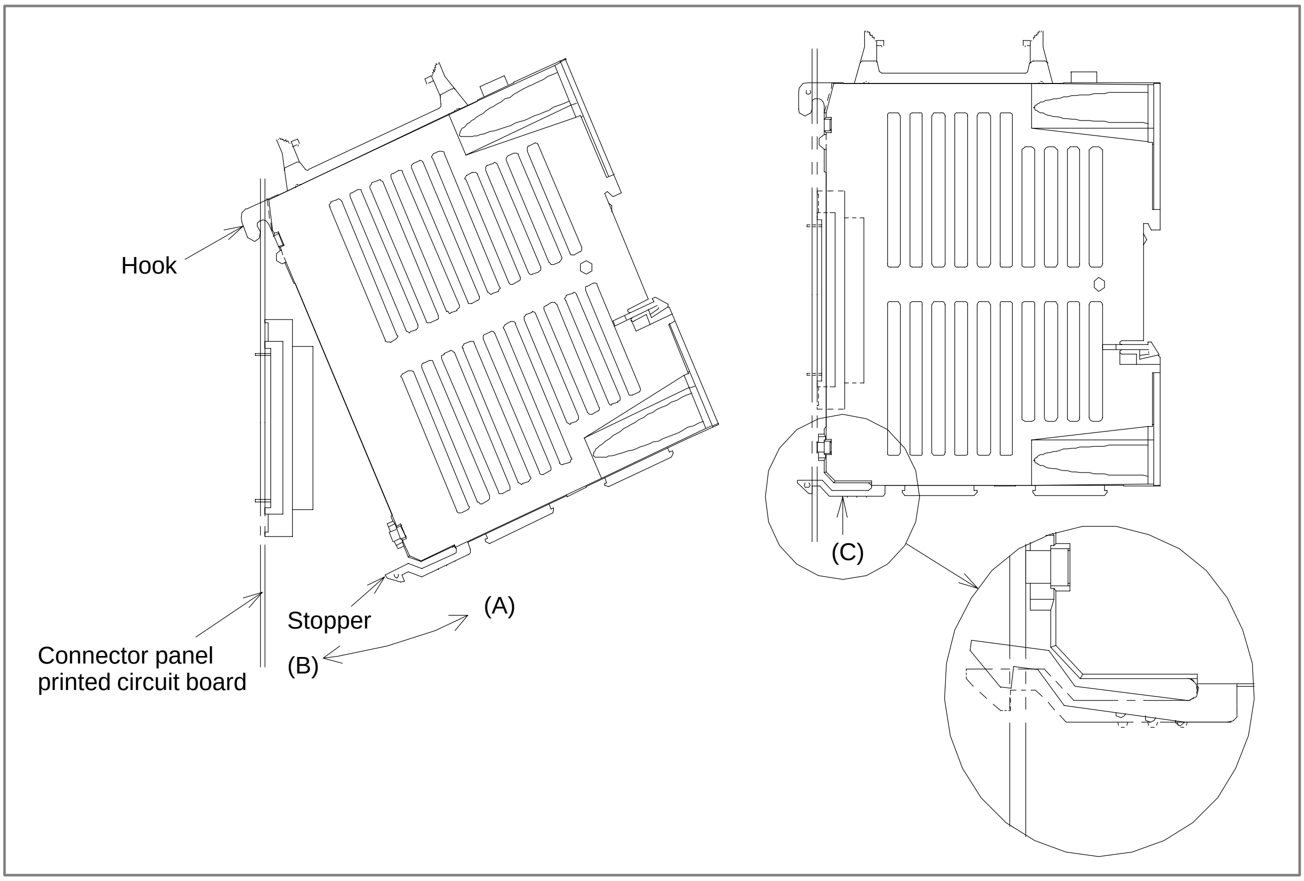
Connector panel printed circuit board connector specification:
HONDA MRH–50FD
(50–pin female straight connector without fitting)

**NOTE**

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

| | |
|---|---|
| ▨ | Prohibited area on component side |
| ▧ | Prohibited area on soldered side |

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



Mounting the module

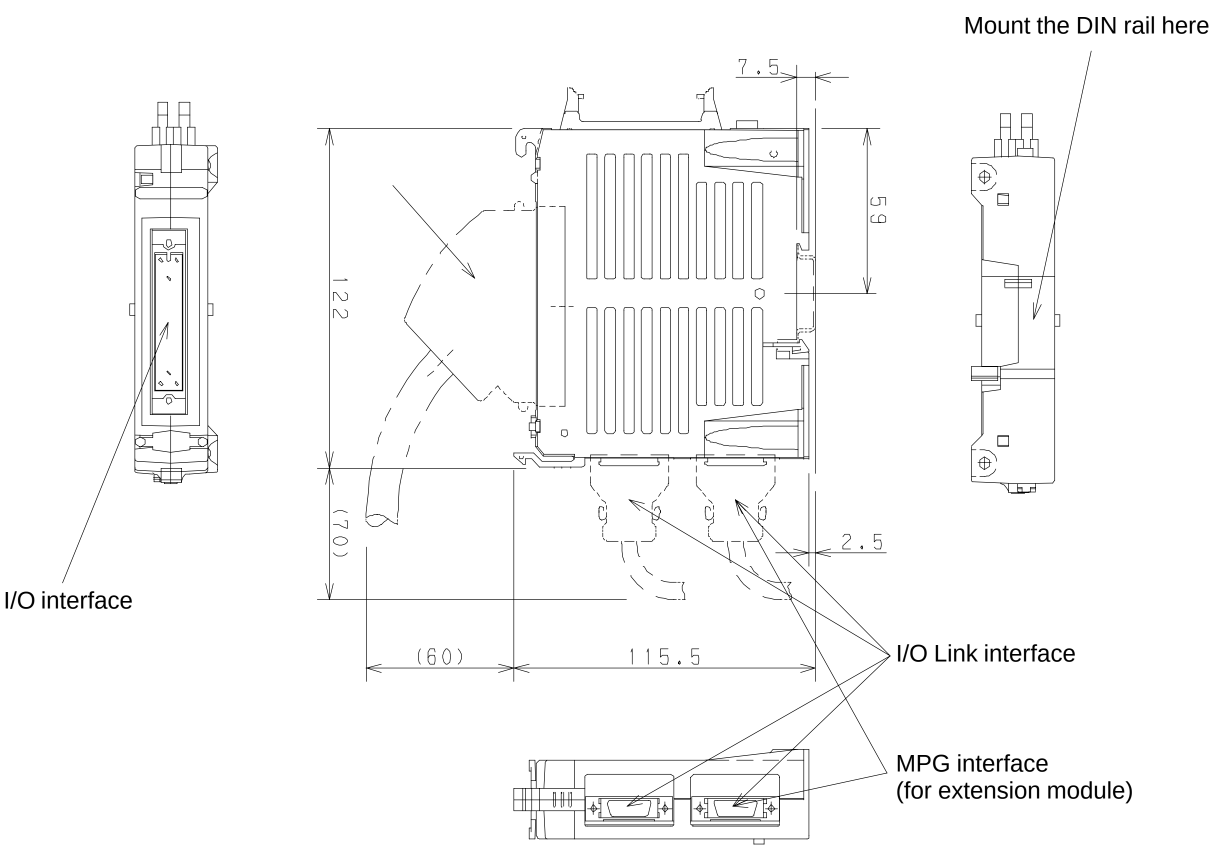
1. Insert the hook of the module into the square hole located at the upper part of the connector panel printed circuit board.
2. Using the hook as a fulcrum, push the module in the direction of (B), and attach the module's connector to the connector on the printed circuit board.
3. Push the stopper into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

Dismounting the module

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

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

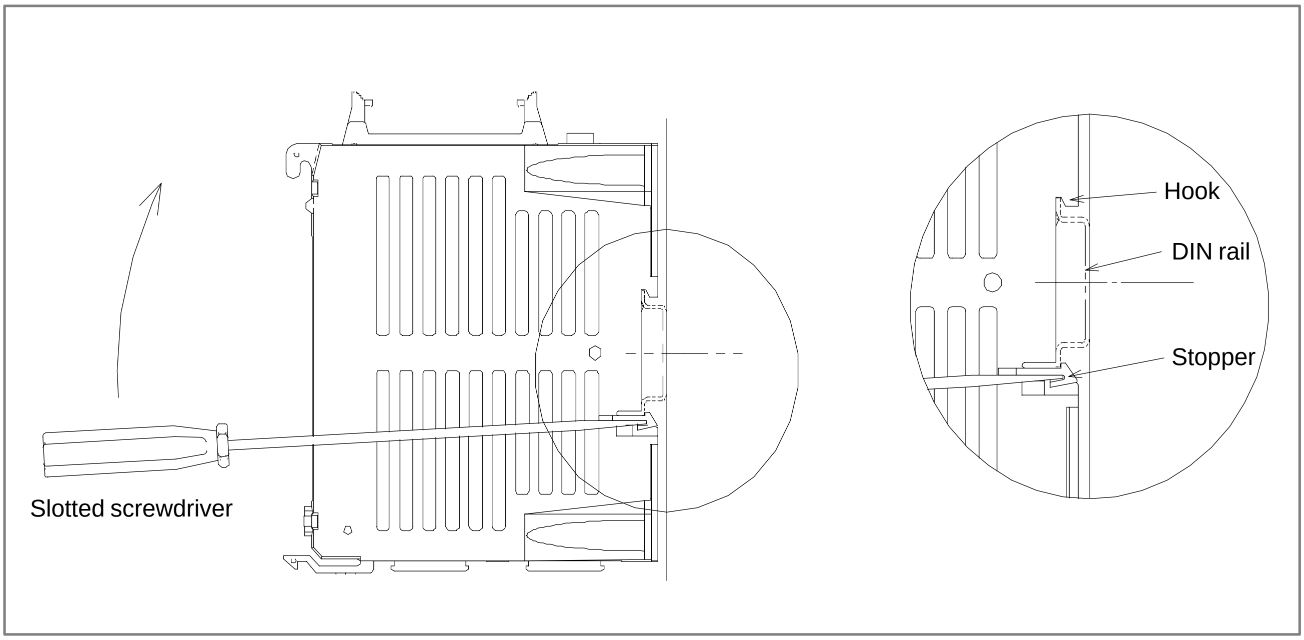
When mounting a DIN rail (external module view and mounting diagram)



**NOTE**

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

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



Mounting the module

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

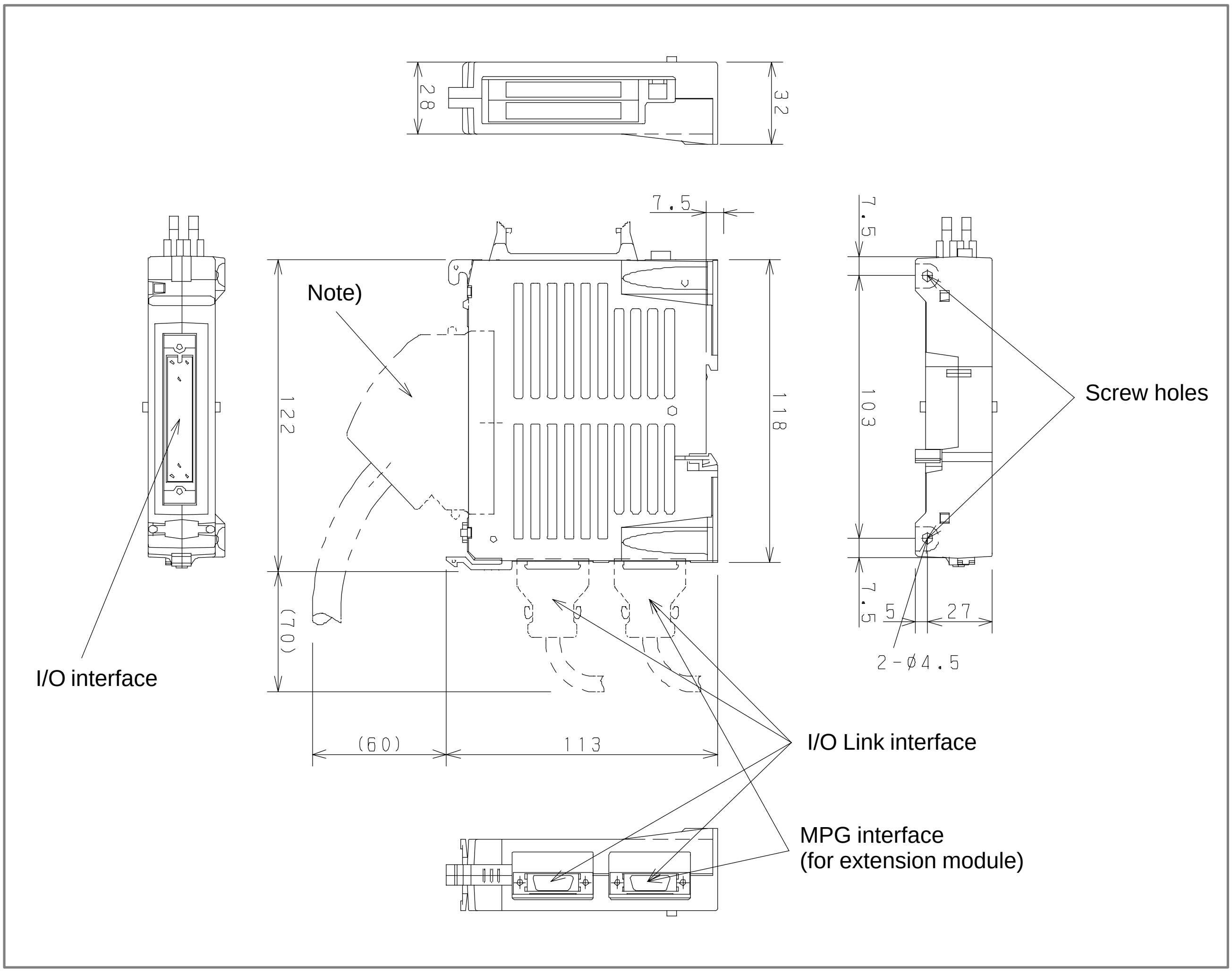
Dismounting the module

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

**NOTE**

When dismounting the module, take care not to damage the stopper by applying excessive force with the screwdriver. When mounting and dismounting a module, hold the module by its top and bottom surfaces. Avoid applying force to the sides where there are slits.

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

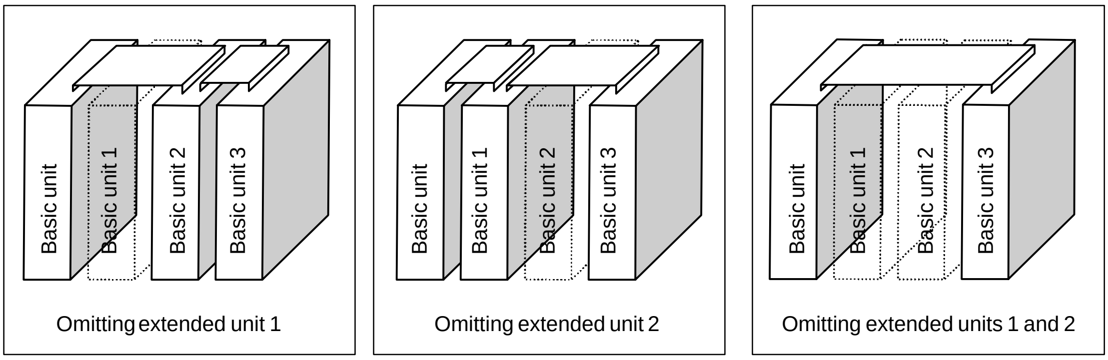


**NOTE**

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

## 6.7.10 Omitting Units

An extended unit or units may be omitted as shown below by changing the setting of the rotary switch on the appropriate extended unit.



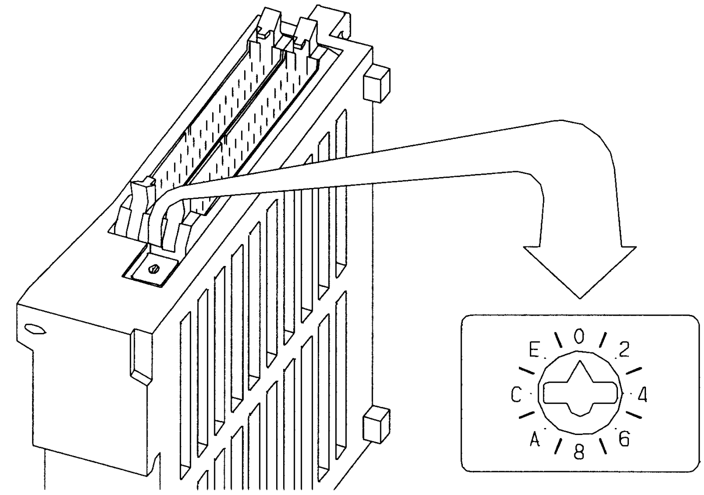
Omitting extended unit 1

Omitting extended unit 2

Omitting extended units 1 and 2

**Changing the setting of the rotary switch**

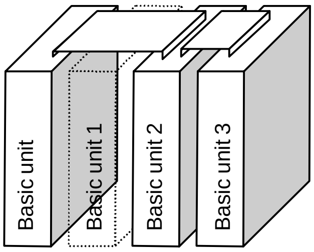
In an extended unit, a rotary switch is located as shown in the figure below. To change the setting of the rotary switch, use a slotted screwdriver with a blade width of about 2.5 mm.



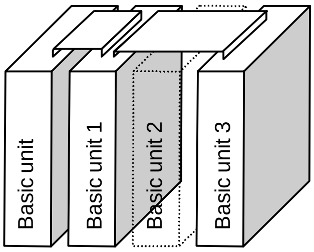
The positions of the rotary switch are described below.

| Position | Indication on the switch | Description |
|---|---|---|
| 0 | 0 | Default position. The rotary switch is set to this position prior to shipment.<br>Set the rotary switch to this position when not omitting an extended unit. |
| 1 | – | To omit one extended unit to be mounted on the preceding stage, set the rotary switch to this position |
| 2 | 2 | To omit two extended units to be mounted on the preceding stage, set the rotary switch to this position. |
| 3 | – | Not allowed. |
| 4 to F | 4, –, 6, –, 8, –, A, –, C, –, E, –, | Not allowed. |

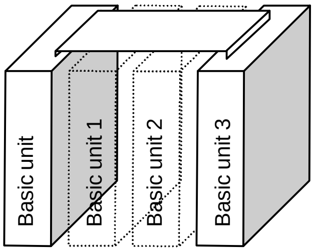
Examples



To omit extended unit 1:
On extended unit 2, set the rotary switch to position 1. On extended unit 3, the rotary switch need not be changed from position 0.



To omit extended unit 2:
On extended unit 3, set the rotary switch to position 1. On extended unit 1, the rotary switch need not be changed from position 0.



To omit extended units 1 and 2:
On extended unit 3, set the rotary switch to position 2.

This is a new function. It will be added according to the unit type, as follows:

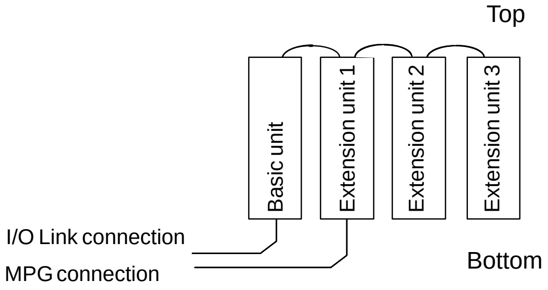
| | | |
|---|---|---|
| Extended B (DI/DO=24/16, manual pulse generator I/F not attached) | A03B–0815–C003 | June 1998 |
| Extended C (DO=16, 2A output) | A03B–0815–C004 | August 1998 |
| Extended D (analog input) | A03B–0815–C005 | August 1998 |

**NOTE**

Extended A unit will be provided with the rotary switch due to the changes in the other units. Because, however, the extended A unit is always mounted in extended unit 1 position, the setting of the rotary switch need not be changed.

## 6.7.11 Specifications

### Installation specifications

| | |
|---|---|
| Ambient temperature | During operation 0° to 55°C<br>During storage and transportation –20°C to 60°C |
| Relative humidity | 30 to 95% (no condensation) |
| Vibration | During operation: 0.5 G or less |
| Environment | Inter of units: Each unit should be placed in a cabinet to keep it from pollutants (such as dust, coolant, organic solvents, acid, corrosive gas, and salt). |
| Other requirements | (1) Install the I/O module in a fully enclosed cabinet.<br>(2) To ensure adequate ventilation between I/O modules, install them as shown in the figure below. Allow a minimum of 100 mm above and below each module for wiring and ventilation. Do not place heat–generating apparatus under the I/O modules.<br>(3) Ensure that the flat cables do not cover the vents of the basic unit. For details, see 6.7.8.<br> |

### Ordering specifications

| Item | Specification | Remarks |
|---|---|---|
| Connector panel I/O module basic | A03B–0815–C001 | DI/DO: 24/16 |
| Connector panel I/O module extension A | A03B–0815–C002 | DI/DO: 24/16 with MPG interface |
| Connector panel I/O module extension B | A03B–0815–C003 | DI/DO: 24/16 |
| Connector panel I/O module expansion C | A03B–0815–C004 | DO: 16<br>2A |
| Connector panel I/O module expansion D | A03B–0815–C005 | Analog input |
| Fuse (replacement part) | A03B–0815–K002 | 1 A |
| Flat cable for unit connection | A03B–0815–K100 | Cable length: 20 mm<br>(when units are spaced 32 mm apart) |

## Module specifications

| Item | Specification | Remarks |
|---|---|---|
| DI points | 24 points | 24 points per module (both basic and extension modules) |
| DO points | 16 points | 16 points per module (both basic and extension modules/source type output) |
| Power Mate interface | FANUC I/O Link connection | Up to 16 modules can be connected as Power Mate slaves. Or, a maximum of 1024 points can be supported on both the input and output sides. |
| Interface between basic and extension units | Bus connection using flat cables | Up to three extension units can be connected to one basic unit. Four units can support up to 96 DI and 64 DO points. |
| MPG interface | Max. 3 modules | Available in the extended A unit |

## Power supply rating

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

## Input signal specifications

1) Basic, expansion A, and expansion B

| | |
|---|---|
| Contact rating | 30 VDC, 16 mA or more |
| Open circuit intercontact leakage current | 1 mA or less (at 26.4 V) |
| Closed circuit intercontact voltage drop | 2 V or less<br>(including cable voltage drop) |
| Delay | Receiver delay: Max. 2 ms<br>The time required for I/O Link transmission between the Power Mate and I/O module (max. 2 ms + ladder scan cycle) must also be taken into account. |

2) Extended D

| Item | Specification |
|---|---|
| Analog input | DC–10 to +10V (input resistance 4.7MΩ)<br>DC–20 to +20mA (input resistance 250Ω) |
| Digital output | 12–bit binary<br>2s complement representation |
| Input/output support | <table><tr><th>Analog input</th><th>Digital output</th></tr><tr><td>+10V</td><td>+2000</td></tr><tr><td>+5V or +20mA</td><td>+1000</td></tr><tr><td>0V or 0mA</td><td>0</td></tr><tr><td>–5V or –20mA</td><td>–1000</td></tr><tr><td>–10V</td><td>–2000</td></tr></table> |
| Resolution | 5mV or 20µA |
| Total precision | Voltage input ±0.5%<br>Current input ±1%<br>(of full scale) |
| Maximum input voltage/current | ±15V/±30mA |
| Minimum conversion time | Ladder scan period of the connected CNC |

## Output signal specifications

1) Basic, expansion A, and expansion B

| | |
|---|---|
| Maximum load current in ON state | 200 mA or less (including momentary current) |
| Saturation voltage in ON state | Max. 1 V<br>(when load current is 200 mA) |
| Withstand voltage | 24 V +20% or less<br>(including momentary values) |
| Leakage current in OFF state | 20 µA or less |
| Delay | Driver delay: Max. 50 µs<br>The time for I/O Link transmission between the Power Mate and I/O module (max. 2 ms + ladder scan cycle) must also be taken into account. |

2) Extended C
DO (output signal specification)

| | |
|---|---|
| Number of points | 16 (per module) |
| ON–time maximum load current | 2A per point<br>12A in the entire module (DO: 16 points) (including instantaneous current) |
| Withstand voltage | 24 V + 20% or less (including instantaneous voltage) |
| OFF–time leak current | 100 µA or less |
| Delay time | The I/O Link transfer time of 2 ms (max.) plus the ladder scan period (due to the CNC) must be considered. |

## 6.7.12
## Other Notes

### DO signal reaction to a system alarm

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

### Address allocation

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

DI space map

| | |
|---|---|
| Xm | Basic unit |
| Xm+1 | |
| Xm+2 | |
| Xm+3 | Extension unit 1 |
| Xm+4 | |
| Xm+5 | |
| Xm+6 | Extension unit 2 |
| Xm+7 | |
| Xm+8 | |
| Xm+9 | Extension unit 3 |
| Xm+10 | |
| Xm+11 | |
| Xm+12 (for 1st MPG) | Extension unit 1 |
| Xm+13 (for 2nd MPG) | |
| Xm+14 (for 3rd MPG) | |
| Xm+15 (DO alarm detection) | Basic unit |

DO space map

| | |
|---|---|
| Yn | Basic unit |
| Yn+1 | |
| Yn+2 | Extension unit 1 |
| Yn+3 | |
| Yn+4 | Extension unit 2 |
| Yn+5 | |
| Yn+6 | Extension unit 3 |
| Yn+7 | |

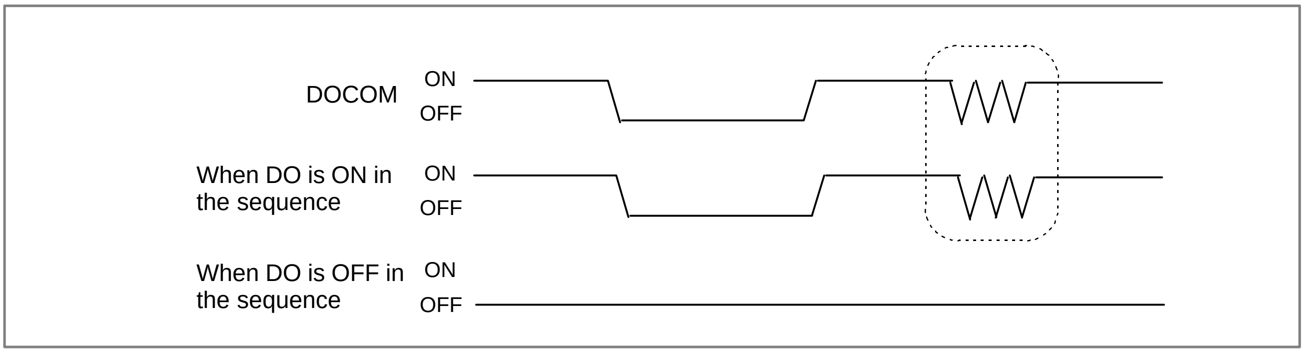
The basic connector panel I/O module is allocated a group of DI addresses (16 bytes) and a group of DO addresses (8 bytes). Up to three hardware extension units can be added or removed as required. The reason for this address allocation is explained below.

The MPG interface (MPG counter) occupies a DI space from Xm+12 through Xm+14. These addresses are fixed regardless of whether extension unit 2 or 3 is used, and Xm+12 through Xm+14 must be allocated as a DI work area to enable the use of the MPG. Therefore, when using an MPG, allocate DI addresses in units of 16 bytes. Do not use the DI space from Xm+12 through Xm+14 for Ladder; the Power Mate processes the MPG counter value directly.

DI address Xm+15 is used for detecting overcurrent and overheating alarms that occur in the IC used in the DO driver. [For details, see the section describing the detection of DO (output signal) alarms.] This address is fixed regardless of whether extension unit 2 or 3 is used, and it must be allocated as a work area before it can be used. When using this area, therefore, allocate DI addresses in units of 16 bytes.

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

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

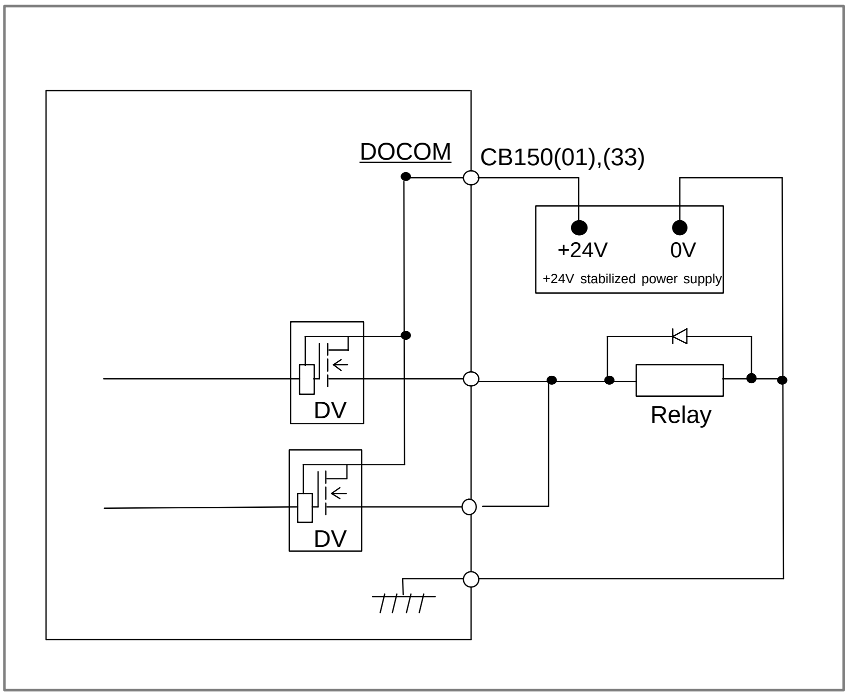


**NOTE**

1. When the DO signal is in the ON state in the sequence, the ON or OFF state of the DOCOM pin determines the state of the signal, as shown within the dotted lines in the above figure.
2. Do not turn off the +24 V supply to the I/O module during this operation. Turning off the +24 V supply causes a Power Mate communication alarm. When turning on the power, the +24 V supply to the I/O module must be started before or at the same time as the power supply to the Power Mate. When turning off the power, the +24 V supply to the I/O module must be stopped after or at the same time as the power supply to the Power Mate.

### Parallel DO (output signal) connection

The DO load current can be doubled by connecting two DO points in parallel and turning them on and off simultaneously in sequence, as shown in the figure below. The maximum load current per DO point is 200 mA. Connecting two DO points in parallel and turning them on at the same time produces a current of 400 mA. Note that, however, when two DO points are connected in parallel, the leakage current also doubles when they are off (max. 40 $\mu$A).



**NOTE**

In the extended C unit, DOs cannot be connected in parallel. The DOs in the extended C unit cannot be connected in parallel with those in the basic unit, extended A unit, or extended B unit.

### DO (output signal) alarm detection

The DO driver of the I/O module is capable of detecting an overcurrent and measuring its own temperature. If an accident, such as the connecting of the cable to ground, causes an abnormal increase in the load current or in the driver temperature, a protection circuit, which is provided for each DO driver (1 byte), is activated and keeps the DO signal for the relevant 1 byte in the OFF state until the cause of the problem is eliminated. Even if this occurs, the Power Mate and I/O module continue operating. The DI address (Xm+15) identifies the DO driver which has detected the alarm. The following table shows the correspondence between the DI address (Xm+15) bits and the DO addresses. Bit value “1” indicates that the corresponding DO driver has detected an alarm. The contents of the Xm+15 area can be checked by using the DGN screen of the Power Mate or by performing alarm processing for the area in advance by using Ladder. This helps alarm detection and recovery.

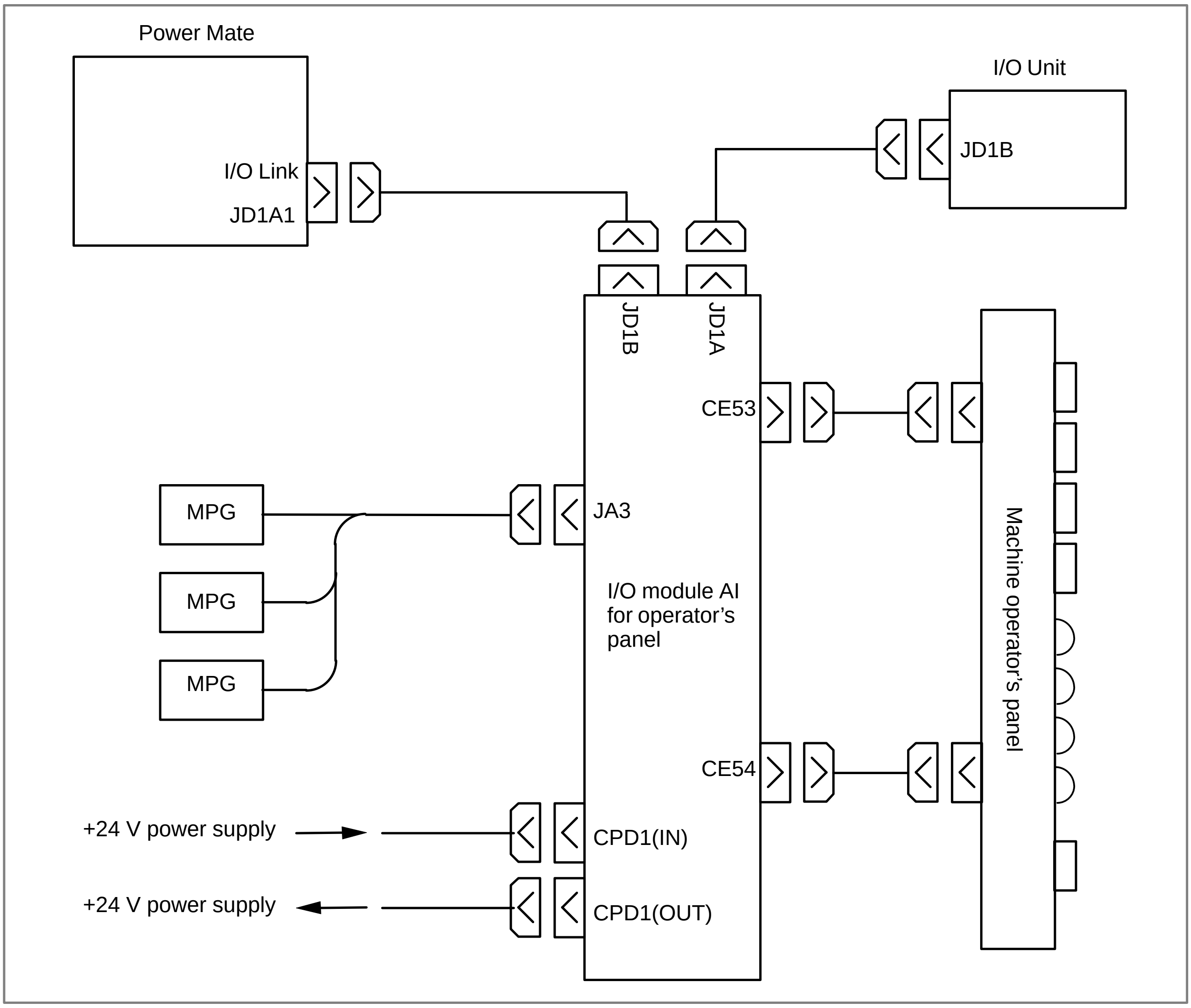
| Alarm detection address and bit | DO address | Location |
|---|---|---|
| Xm+15.0 | Yn+0 | Basic unit |
| Xm+15.1 | Yn+1 | Basic unit |
| Xm+15.2 | Yn+2 | Extension unit 1 |
| Xm+15.3 | Yn+3 | Extension unit 1 |
| Xm+15.4 | Yn+4 | Extension unit 2 |
| Xm+15.5 | Yn+5 | Extension unit 2 |
| Xm+15.6 | Yn+6 | Extension unit 3 |
| Xm+15.7 | Yn+7 | Extension unit 3 |

**CAUTION**

If the ladder program does not perform alarm processing for Xm+15, the Power Mate cannot detect an error (if occurs) in the DO driver.

## 6.8
## CONNECTION OF OPERATOR’S PANEL I/O MODULE A1

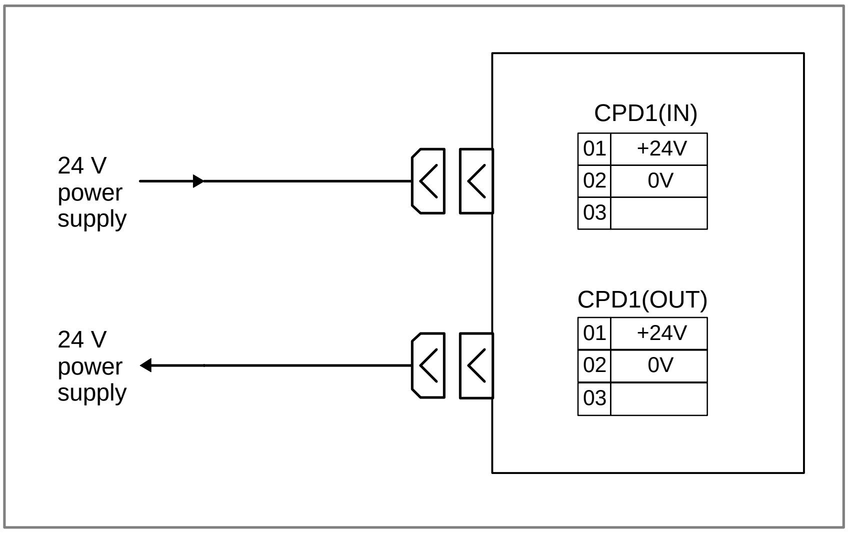
### 6.8.1
### Overall Connection Diagram



> **NOTE**
> When the operator’s panel I/O module is used together with a unit (connector panel I/O module) connected to the I/O Link supporting another MPG interface, only the MPG interface of the unit (module) closest to the Power Mate connected to the I/O Link is enabled.

## 6.8.2
## Power Connection

Provide the CPD1 (IN) connector, shown below, with the power necessary for I/O module operation and that for DI operation. To facilitate power division, the power is output to CPD1 (OUT) exactly as it is input from CPD1 (IN). When power division is required, use CPD1 (OUT).



Recommended cable–side connector: A02B–0120–K324
(including the following connector housing and case)
(Housing: Japan AMP 1–178288–3)
(Contacts: Japan AMP 1–175218–5)

**NOTE**

1 The specification of the power supply connector CPD1 (IN) is the same as that for CPD1 (OUT). There are no indications on the printed circuit board to distinguish between the IN and OUT connectors.

2 Do not turn off the +24 V supply to the connector during operation. Turning off the +24 V supply will cause a Power Mate communication alarm. When turning on the power, the +24 V supply to the I/O module must be turned on before or at the same time as the power supply to the Power Mate. When turning off the power, the +24 V supply to the I/O module must be turned off after or at the same time as the power supply to the Power Mate. (See 5.4.)

## 6.8.3

## DI/DO Connector Pin Arrangement

CE53

| | A | B |
|---|---|---|
| 01 | 0V | 0V |
| 02 | | +24V |
| 03 | Xm+0.0 | Xm+0.1 |
| 04 | Xm+0.2 | Xm+0.3 |
| 05 | Xm+0.4 | Xm+0.5 |
| 06 | Xm+0.6 | Xm+0.7 |
| 07 | Yn+0.0 | Yn+0.1 |
| 08 | Yn+0.2 | Yn+0.3 |
| 09 | Yn+0.4 | Yn+0.5 |
| 10 | Yn+0.6 | Yn+0.7 |
| 11 | Yn+1.0 | Yn+1.1 |
| 12 | Yn+1.2 | Yn+1.3 |
| 13 | Yn+1.4 | Yn+1.5 |
| 14 | Yn+1.6 | Yn+1.7 |
| 15 | Yn+2.0 | Yn+2.1 |
| 16 | Yn+2.2 | Yn+2.3 |
| 17 | Yn+2.4 | Yn+2.5 |
| 18 | Yn+2.6 | Yn+2.7 |
| 19 | KYD0 | KYD1 |
| 20 | KYD2 | KYD3 |
| 21 | KYD4 | KYD5 |
| 22 | KYD6 | KYD7 |
| 23 | KCM1 | KCM2 |
| 24 | KCM3 | KCM4 |
| 25 | DOCOM | DOCOM |

CE54

| | A | B |
|---|---|---|
| 01 | 0V | 0V |
| 02 | COM1 | +24V |
| 03 | Xm+1.0 | Xm+1.1 |
| 04 | Xm+1.2 | Xm+1.3 |
| 05 | Xm+1.4 | Xm+1.5 |
| 06 | Xm+1.6 | Xm+1.7 |
| 07 | Yn+3.0 | Yn+3.1 |
| 08 | Yn+3.2 | Yn+3.3 |
| 09 | Yn+3.4 | Yn+3.5 |
| 10 | Yn+3.6 | Yn+3.7 |
| 11 | Yn+4.0 | Yn+4.1 |
| 12 | Yn+4.2 | Yn+4.3 |
| 13 | Yn+4.4 | Yn+4.5 |
| 14 | Yn+4.6 | Yn+4.7 |
| 15 | Yn+5.0 | Yn+5.1 |
| 16 | Yn+5.2 | Yn+5.3 |
| 17 | Yn+5.4 | Yn+5.5 |
| 18 | Yn+5.6 | Yn+5.7 |
| 19 | Yn+6.0 | Yn+6.1 |
| 20 | Yn+6.2 | Yn+6.3 |
| 21 | Yn+6.4 | Yn+6.5 |
| 22 | Yn+6.6 | Yn+6.7 |
| 23 | KCM5 | KCM6 |
| 24 | KCM7 | DOCOM |
| 25 | DOCOM | DOCOM |

Flat cable–end connector specification:

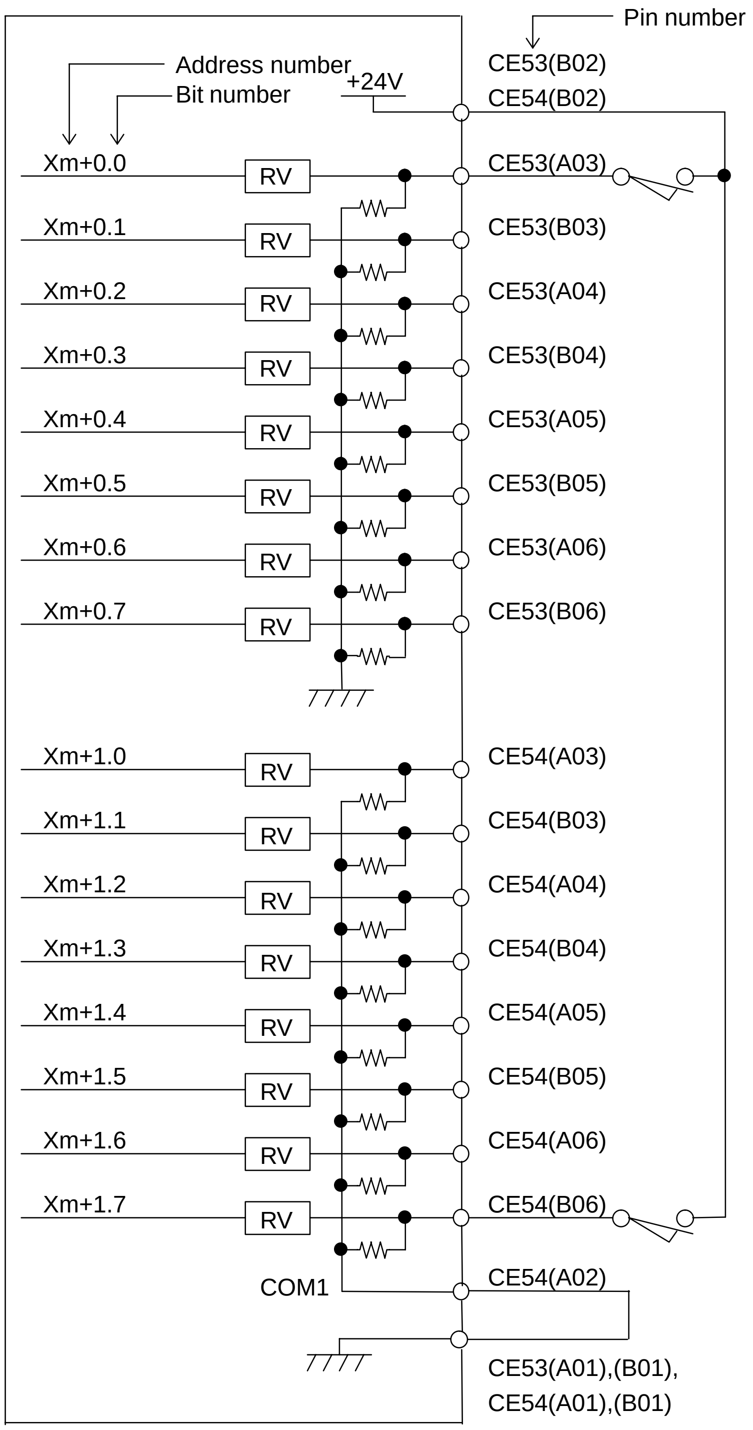
A02B–0120–K342
(HIF3BB–50D–2.54R, manufactured by Hirose Electric Co., Ltd.),
50 contacts

Cable conductor wire specification:

A02B–0120–K886
(50–conductor cable 61 m long, manufactured by Hitachi Cable, Ltd. or Oki Electric Cable Co., Ltd.)

## 6.8.4
## DI (General–purpose Input Signal) Connection

○ 16 points



**NOTE**

1 Xm+1.0 through Xm+1.7 are DI pins for which a common voltage can be selected. That is, by connecting the COM1 CE54(A02) pin to the +24 V power supply, a DI signal can be input with its logical state reversed. If, however, a cable is connected to ground, it has the same effect as inputting an ON state DI signal. To prevent this from occurring, the connection of the COM1 CE54(A02) pin to the 0 V power supply is recommended wherever possible.

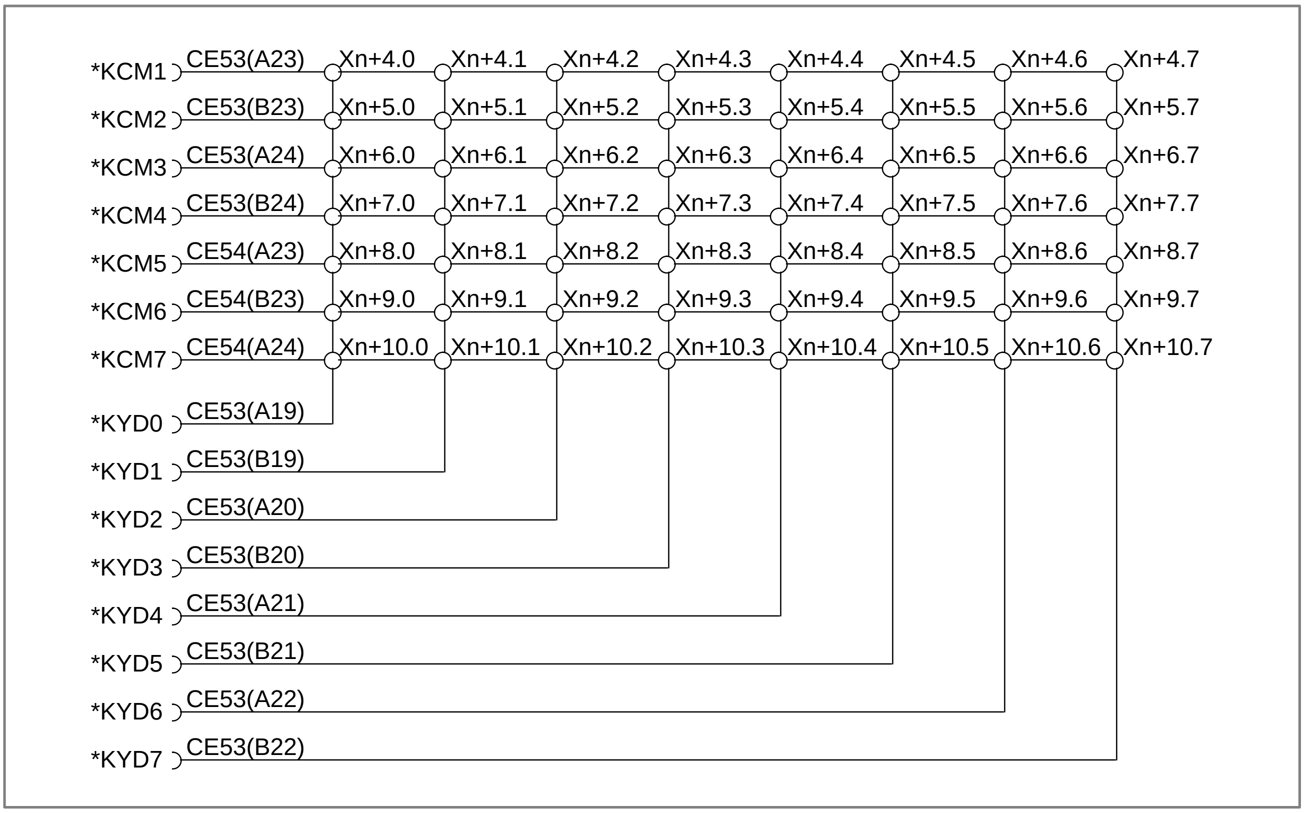
2 If an emergency stop signal is to be input from this operator's panel I/O module, this emergency stop signal must be allocated to address X0.4 with the common voltage line fixed, for safety reasons. See "Address allocation" in 6.7.10 for details of how to allocate the emergency stop signal.

3 In a two–path Power Mate *i*–D, the emergency stop signal for the second Power Mate must be allocated to X1.4. So, it is impossible to allocate the emergency stop signal to a line beginning at X0 in the two–path Power Mate *i*–D two–path for safety reasons, because in this operator's panel I/O module, the common voltage line can be selected for Xm+1.

4 For unused DI pins allocated to the addresses for which the common voltage is fixed (from Xm+1.0 to Xm+1.7), the logic is fixed to "0". For unused pins allocated to Xm+1.0 to Xm+1.7 for which the common voltage can be selected, the logic is fixed to "0" when the COM1 CE54(A02) pin is connected to the 0 V power supply. When the COM1 CE54(A02) pin is connected to the +24 V power supply, the logic is fixed to "1". The logic of the unused pins allocated to Xm+1.0 to Xm+1.7 is variable when the contact of the COM1 CE54(A02) pin is open.

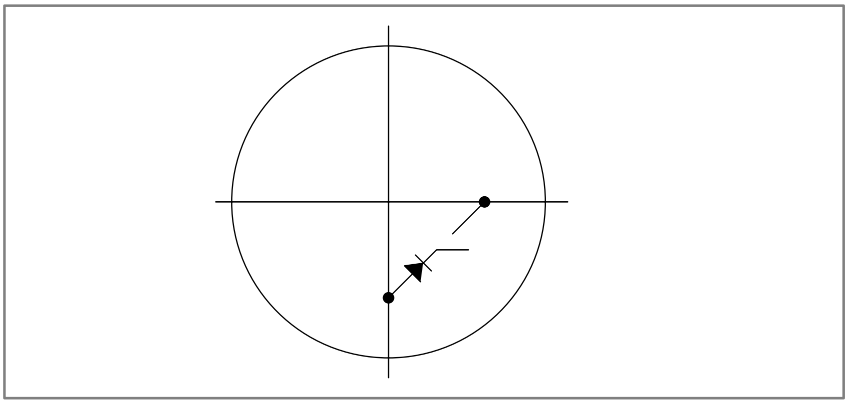
## 6.8.5 DI (Matrix Input Signal) Connection

○ A maximum of 56 points are provided.



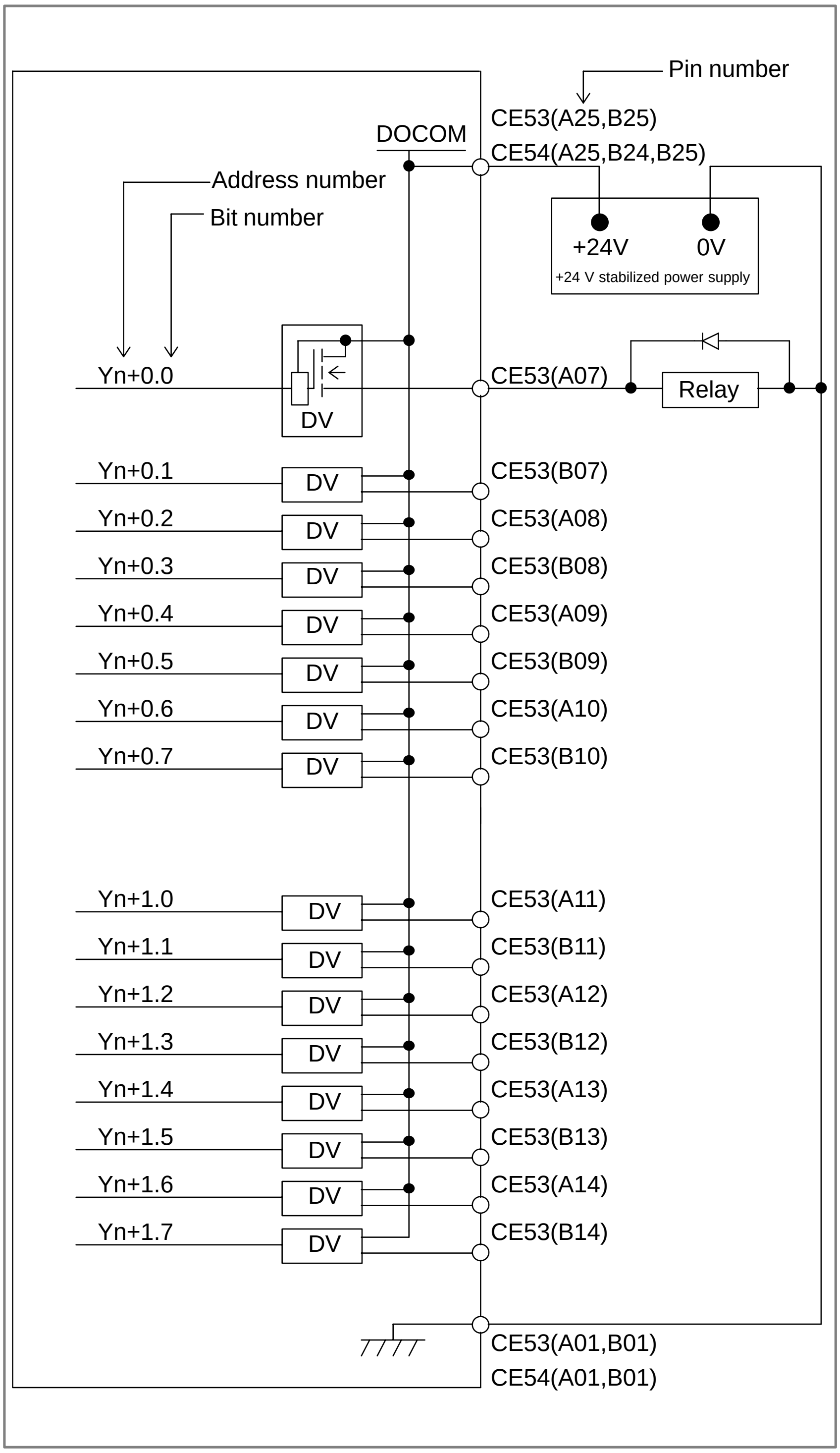
**NOTE**

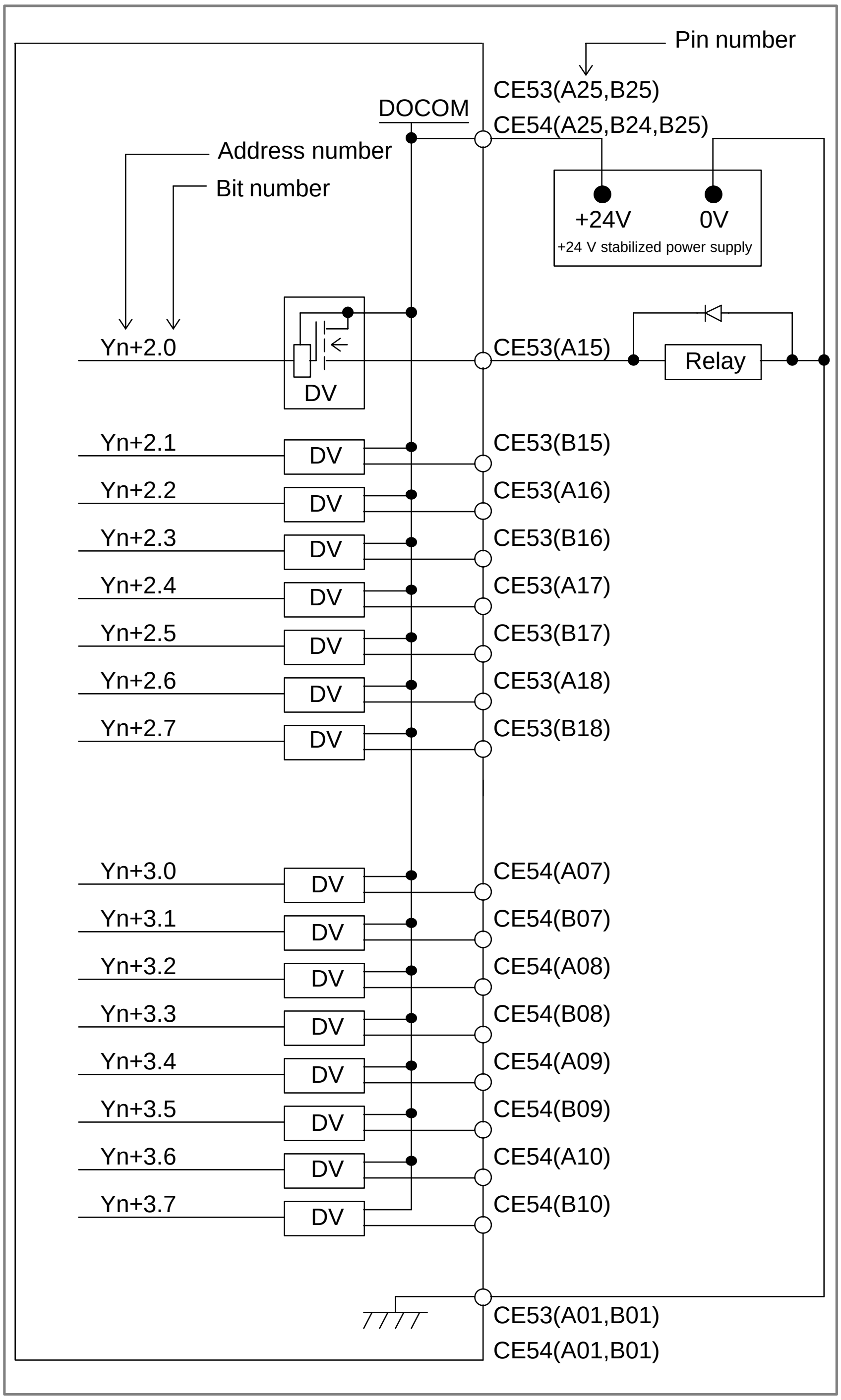
Detour prevention diodes must be incorporated for matrix signal input, as shown in the following figure. Otherwise, only two signals can be input at the same time. Inputting three or more signals simultaneously without using detour prevention diodes may result in data input errors.

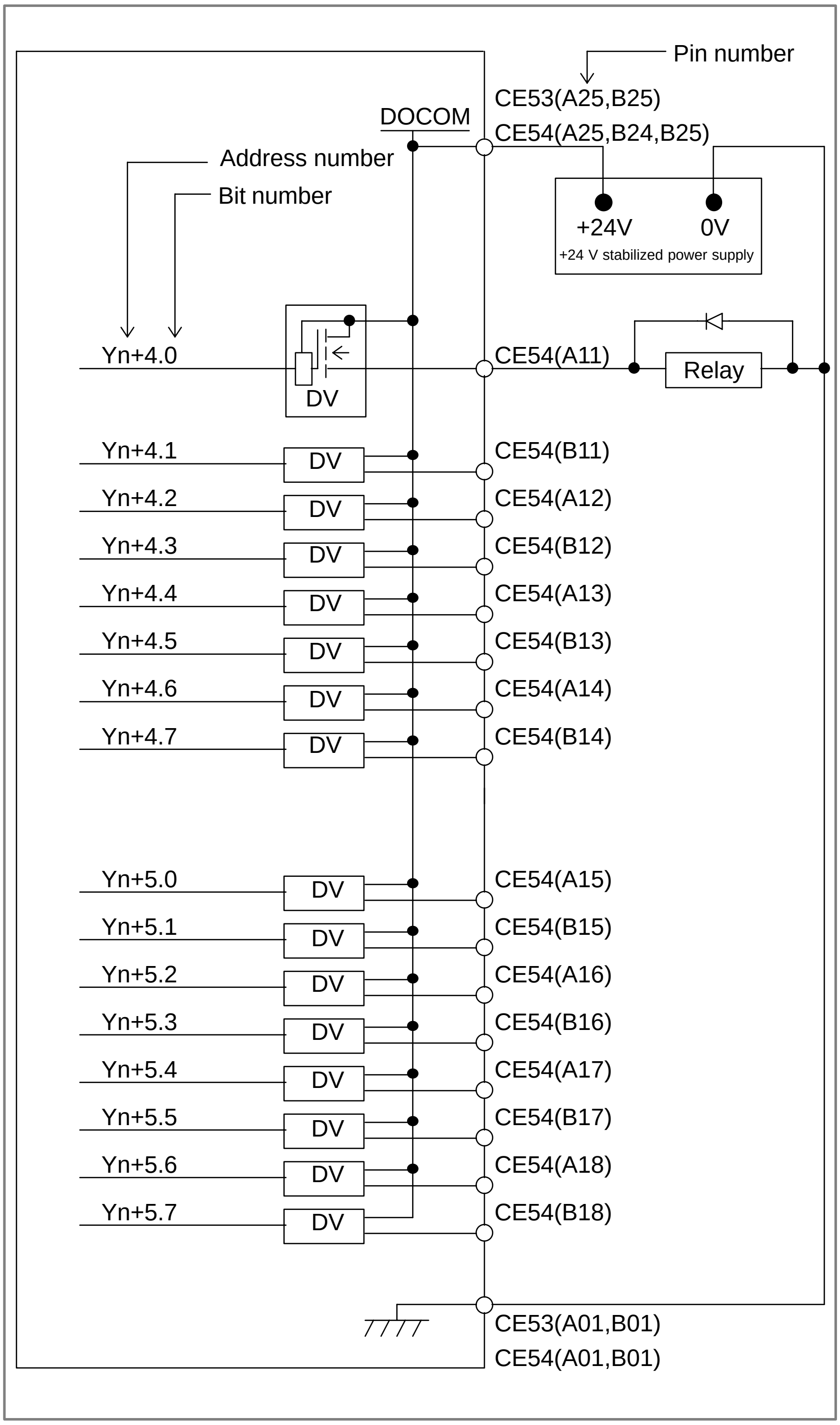


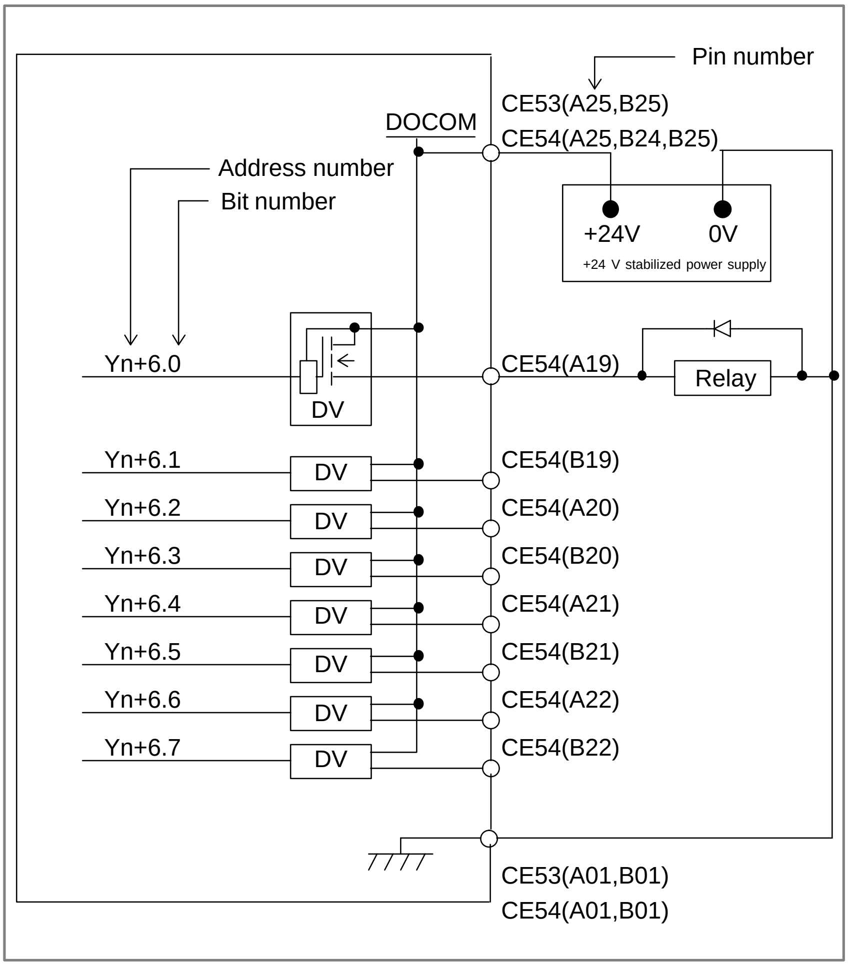
## 6.8.6 DO (Output Signal) Connection

○ A maximum of 56 points are provided.




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

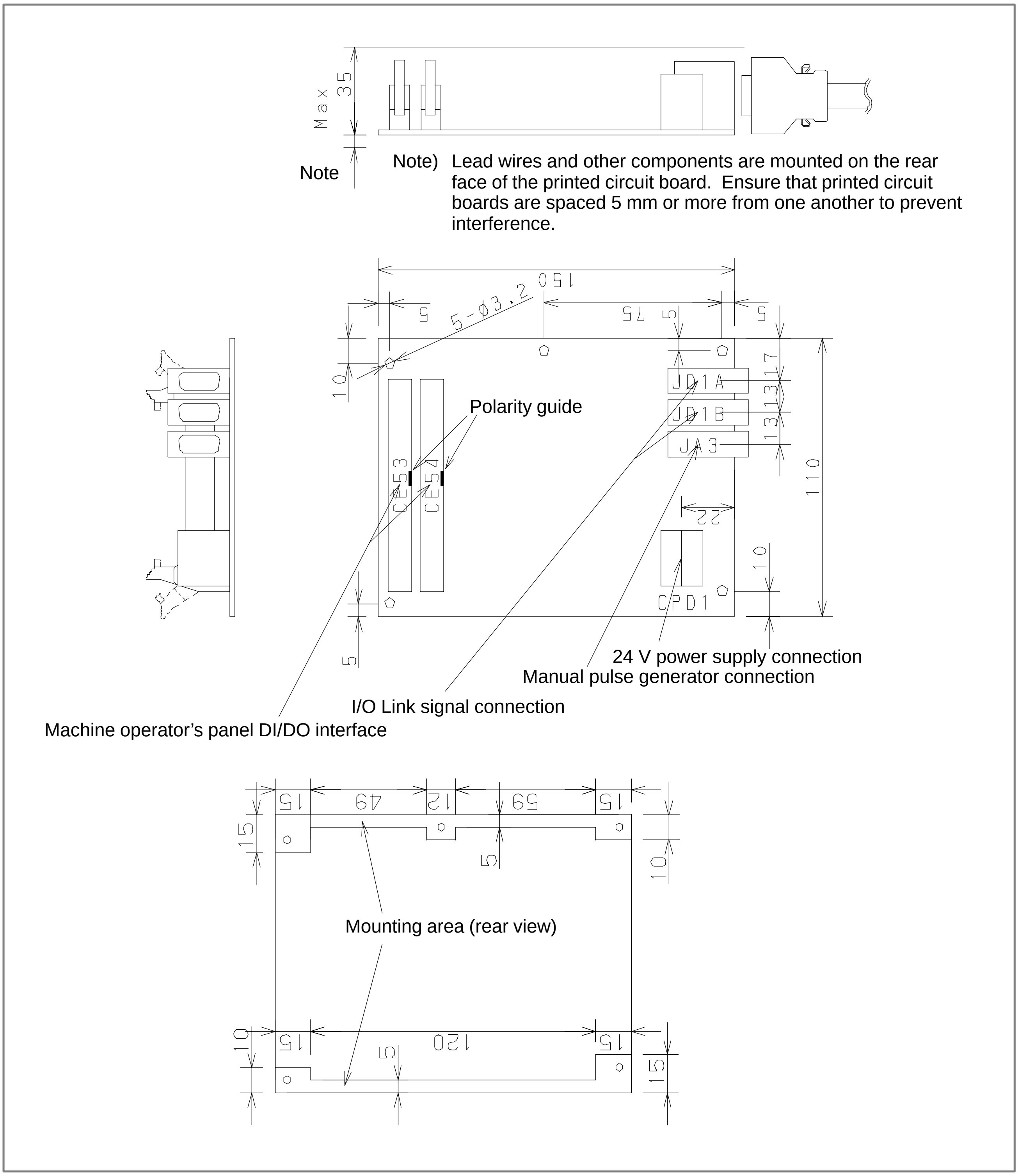

Pin number
CE53(A25,B25)
DOCOM
CE54(A25,B24,B25)
Address number
Bit number
+24V
0V
+24 V stabilized power supply
Yn+4.0
DV
CE54(A11)
Relay
Yn+4.1
DV
CE54(B11)
Yn+4.2
DV
CE54(A12)
Yn+4.3
DV
CE54(B12)
Yn+4.4
DV
CE54(A13)
Yn+4.5
DV
CE54(B13)
Yn+4.6
DV
CE54(A14)
Yn+4.7
DV
CE54(B14)
Yn+5.0
DV
CE54(A15)
Yn+5.1
DV
CE54(B15)
Yn+5.2
DV
CE54(A16)
Yn+5.3
DV
CE54(B16)
Yn+5.4
DV
CE54(A17)
Yn+5.5
DV
CE54(B17)
Yn+5.6
DV
CE54(A18)
Yn+5.7
DV
CE54(B18)
CE53(A01,B01)
CE54(A01,B01)


Pin number
CE53(A25,B25)
DOCOM
CE54(A25,B24,B25)
Address number
Bit number
+24V
0V
+24 V stabilized power supply
Yn+6.0
DV
CE54(A19)
Relay
Yn+6.1
DV
CE54(B19)
Yn+6.2
DV
CE54(A20)
Yn+6.3
DV
CE54(B20)
Yn+6.4
DV
CE54(A21)
Yn+6.5
DV
CE54(B21)
Yn+6.6
DV
CE54(A22)
Yn+6.7
DV
CE54(B22)
CE53(A01,B01)
CE54(A01,B01)

## 6.8.7
## Manual Pulse Generator Connection

For details of the connection of the manual pulse generator, see 6.7.7.

## 6.8.8
## External View



Note) Lead wires and other components are mounted on the rear face of the printed circuit board. Ensure that printed circuit boards are spaced 5 mm or more from one another to prevent interference.

## 6.8.9
## Specifications

### Installation specifications

| | |
|---|---|
| Ambient temperature | During operation 0° to 58°C<br>During storage and transportation –20°C to 60°C |
| Relative humidity | 30 to 95% (no condensation) |
| Vibration | During operation: 0.5 G or less |
| Environment | Inter of units: Each unit should be placed in a cabinet to keep it from pollutants (such as dust, coolant, organic solvents, acid, corrosive gas, and salt). |
| Other requirements | (1) Install the I/O module in a fully enclosed cabinet. |

### Ordering specifications

| Item | Specification | Remarks |
|---|---|---|
| Operator's panel I/O module AI | A20B–2002–0470 | General–purpose DI: 16 points<br>Matrix DI: 56 points<br>DO: 56 points<br>MPG interface is supported. |
| Fuse (replacement part) | A03B–0815–K001 | 1A |

### Module specifications

| Item | Specification | Remarks |
|---|---|---|
| General–purpose DI | 16 points | 24–V input |
| Matrix DI | 56 points (8 × 7) | 5–V input |
| DO points | 56 points | 24 V source type output |
| Power Mate interface | FANUC I/O Link connection | Up to 16 modules can be connected as Power Mate slaves. Or, a maximum of 1024 points can be supported on both the input and output sides. |
| MPG interface | Max. 3 units | |

## Power supply rating

| Module | Supply voltage | Current rating | Remarks |
|---|---|---|---|
| Operator's panel I/O module AI | 24 VDC ±10% supplied from the power supply connector CPD1. The allowance of ±10% should include instantaneous voltage and ripple voltage. | 0.35 A | The total power consumption of DI points is included. The power consumption of DO points is not included. |

## DI (input signal) specifications

(General–purpose input signal)

| | |
|---|---|
| Contact rating | 30 VDC, 16 mA or more |
| Open circuit intercontact leakage current | 1 mA or less (at 26.4 V) |
| Closed circuit intercontact voltage drop | 2 V or less<br>(including cable voltage drop) |
| Delay | Receiver delay: Max. 2 ms<br>The time required for I/O Link transmission between the Power Mate and I/O module (max. 2 ms + ladder scan cycle) must also be taken into account. |

(Matrix input signal)

| | |
|---|---|
| Contact rating | 6 VDC, 2 mA or more |
| Open circuit intercontact leakage current | 0.2 mA or less (at 26 V) |
| Closed circuit intercontact voltage drop | 0.9 V or less (with a current of 1 mA) |
| Delay | The maximum matrix period of 16 ms, the maximum time of I/O Link transfer between Power Mate and I/O module of 2 ms, and the ladder scanning period (by ladder) must be considered. |

**NOTE**

When detour prevention diodes are used, the voltage drop across closed contacts indicated above must be maintained, including the diode voltage drop.

## DO (output signal) specifications

| | |
|---|---|
| Maximum load current in ON state | 200 mA or less (including momentary current) |
| Saturation voltage in ON state | Max. 1 V (when load current is 200 mA) |
| Withstand voltage | 24 V +20% or less (including momentary values) |
| Leakage current in OFF state | 20 $\mu$A or less |
| Delay | Driver delay: Max. 50 $\mu$s<br>The time required for I/O Link transmission between the Power Mate and I/O module (max. 2 ms + ladder scan cycle) must also be taken into account. |

**NOTE**

Ensure that the maximum current per DOCOM pin (DO power supply pin) does not exceed 0.7 A.

## 6.8.10
## Other Notes

### DO signal reaction to a system alarm

If a system alarm occurs in the CNC using the operator's panel I/O module, or if I/O Link communication between the Power Mate and operator's panel I/O module fails, all the DO signals of the I/O module are turned off. Therefore, sufficient care is necessary when setting up the machine sequence. Also, the same phenomenon occurs if the power to the Power Mate or the I/O module is turned off.

### Address allocation

For the operator's panel I/O module, I/O addresses are mapped as follows.

DI space map

| | |
|---|---|
| Xm | General–purpose input signal |
| Xm+1 | |
| Xm+2 | Reserved |
| Xm+3 | |
| Xm+4 | Matrix input signal |
| Xm+5 | |
| Xm+6 | |
| Xm+7 | |
| Xm+8 | |
| Xm+9 | |
| Xm+10 | |
| Xm+11 | Reserved |
| Xm+12(for 1st MPG) | MPG |
| Xm+13(for 2nd MPG) | |
| Xm+14(for 3rd MPG) | |
| Xm+15(DO alarm detection) | DO alarm detection |

DO space map

| | |
|---|---|
| Yn | Output signal |
| Yn+1 | |
| Yn+2 | |
| Yn+3 | |
| Yn+4 | |
| Yn+5 | |
| Yn+6 | |
| Yn+7 | Reserved |

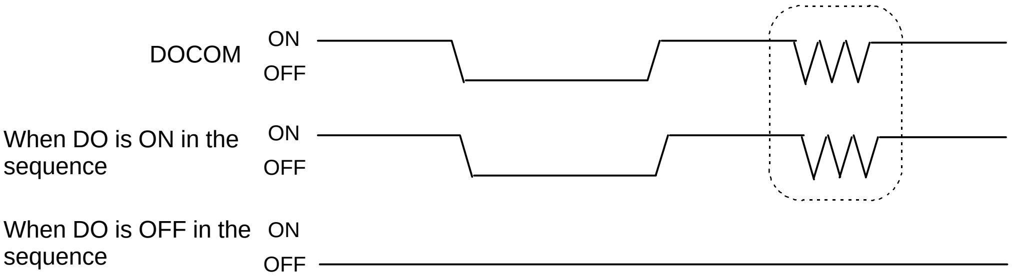
The operator's panel I/O module is allocated a group of DI addresses (16 bytes) and a group of DO addresses (8 bytes). This address allocation is explained below.

The MPG interface (MPG counter) occupies DI space from Xm+12 through Xm+14. These addresses are fixed, and Xm+12 through Xm+14 must be allocated as a DI work area to enable the use of the MPG. Therefore, when using an MPG, allocate DI addresses in units of 16 bytes. Do not use the DI space from Xm+12 through Xm+14 for Ladder; the Power Mate processes the MPG counter value directly.

DI address Xm+15 is used for detecting overcurrent and overheating alarms that may occur in the IC used in the DO driver. [For details, see the section describing the detection of DO (output signal) alarms.] This address is fixed, and must be allocated as a work area before it can be used. Therefore, when using this area, allocate DI addresses in units of 16 bytes.

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

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



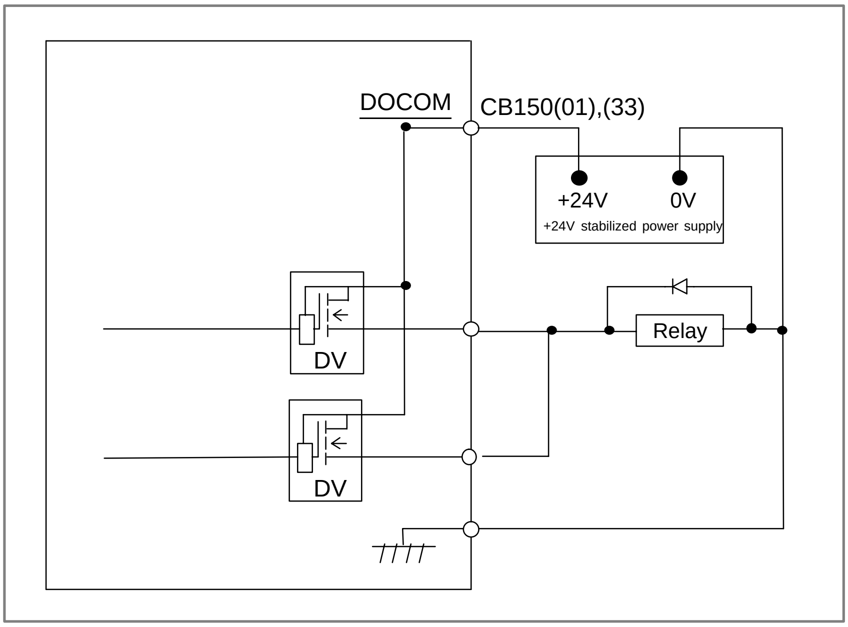
**NOTE**

1 When the DO signal is in the ON state in the sequence, the ON or OFF state of the DOCOM pin determines the state of the signal, as indicated by the dotted lines in the above figure.

2 Do not turn off the +24 V supply, provided by the CPD1 to the I/O module, during the operation. Turning off the +24 V supply would cause a Power Mate communication alarm. When turning on the power, the +24 V supply to the I/O module must be turned on before or at the same time as the power supply to the Power Mate. When turning off the power, the +24 V supply to the I/O module must be turned off after or at the same time as the power supply to the Power Mate.

### Parallel DO (output signal) connection

The DO load current can be doubled by connecting two DO points in parallel and turning them on and off simultaneously in sequence, as shown in the figure below. The maximum load current per DO point is 200 mA. Connecting two DO points in parallel and turning them on at the same time produces a current of 400 mA. Note that, however, when two DO points are connected in parallel, the leakage current also doubles while they are off (max. 40 $\mu$A).



### DO (output signal) alarm detection

The DO driver of the I/O module is capable of detecting an overcurrent and measuring its own temperature. If an accident, such as connecting the cable to ground, causes an abnormal increase in the load current or in the driver temperature, a protection circuit, which is provided for each DO driver (1 byte), is activated which keeps the DO signal for the relevant 1 byte in the OFF state until the cause of the problem is eliminated. Even if this occurs, the Power Mate and the I/O module continue operating. The DI address (Xm+15) identifies which DO driver has detected an alarm. The following table shows the correspondence between the DI address (Xm+15) bits and the DO addresses. Bit value “1” indicates that the corresponding DO driver has detected an alarm. The contents of the Xm+15 area can be checked by using the DGN screen of the Power Mate or by performing the alarm processing for the area in advance by using Ladder. This helps alarm detection and recovery.

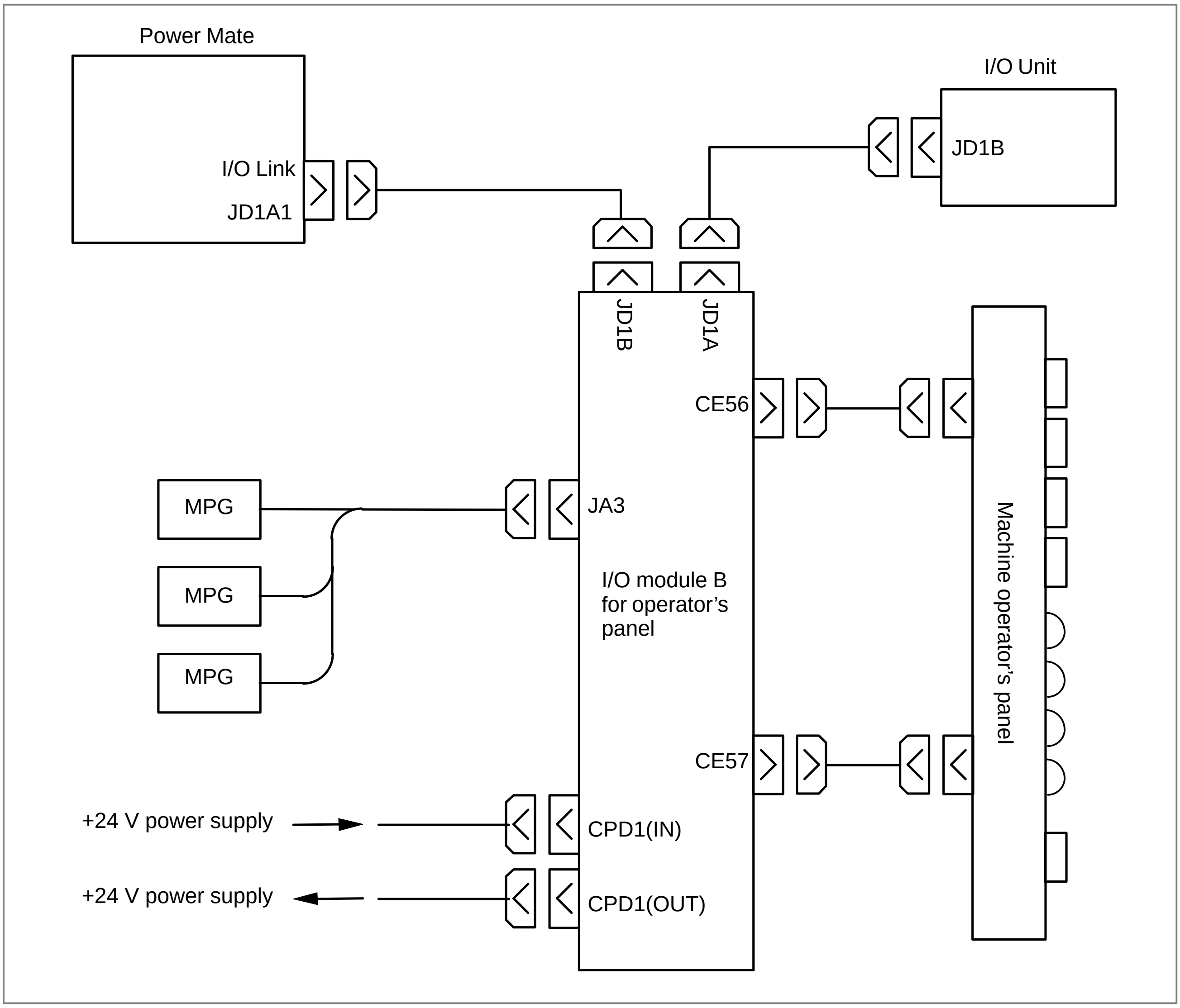
| Alarm detection address and bit | DO address | Remarks |
|---|---|---|
| Xm+15.0 | Yn+0 | |
| Xm+15.1 | Yn+1 | |
| Xm+15.2 | Yn+2 | |
| Xm+15.3 | Yn+3 | |
| Xm+15.4 | Yn+4 | |
| Xm+15.5 | Yn+5 | |
| Xm+15.6 | Yn+6 | |
| Xm+15.7 | Yn+7 | Reserved |

**CAUTION**

If the ladder program does not perform alarm processing for Xm+15, the Power Mate cannot detect an error (if occurs) in the DO driver.

# 6.9
# CONNECTION OF OPERATOR’S PANEL I/O MODULE B

## 6.9.1
## Overall Connection Diagram

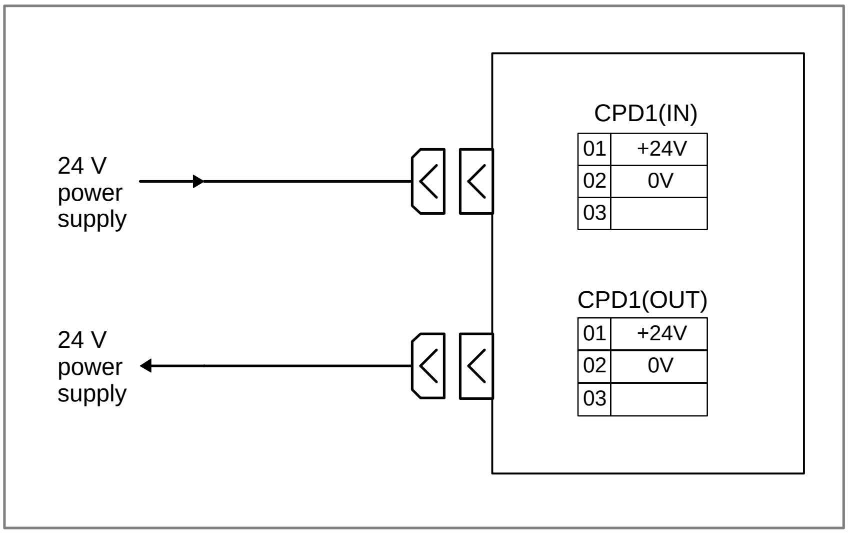


**NOTE**

When the operator’s panel I/O module is used together with a unit (connector panel I/O module) connected to the I/O Link supporting another MPG interface, only the MPG interface of the unit (module) closest to the Power Mate connected to the I/O Link is enabled.

## 6.9.2
## Power Connection

Provide the CPD1 (IN) connector, shown below, with the power necessary for the printed circuit board operation and that for DI operation. To facilitate power division, the power is output to CPD1 (OUT) exactly as it is input from CPD1 (IN). When power division is required, use CPD1 (OUT).



Recommended cable–side connector: A02B–0120–K324
(including the following connector housing and case)
(Housing: Japan AMP 1–178288–3)
(Contacts: Japan AMP 1–175218–5)

**NOTE**

1 The specification of the power supply connector CPD1 (IN) is the same as that for CPD1 (OUT). There are no indications on the printed circuit board to distinguish between the IN and OUT connectors.

2 Do not turn off the +24 V supply to the connector during operation. Turning off the +24 V supply will cause a Power Mate communication alarm. When turning on the power, the +24 V supply to the I/O module must be turned on before or at the same time as the power supply to the Power Mate. When turning off the power, the +24 V supply to the I/O module must be turned off after or at the same time as the power supply to the Power Mate. (See 5.4.)

## 6.9.3

## DI/DO Connector Pin Arrangement

CE56

| | A | B |
|---|---|---|
| 01 | 0V | +24V |
| 02 | Xm+0.0 | Xm+0.1 |
| 03 | Xm+0.2 | Xm+0.3 |
| 04 | Xm+0.4 | Xm+0.5 |
| 05 | Xm+0.6 | Xm+0.7 |
| 06 | Xm+1.0 | Xm+1.1 |
| 07 | Xm+1.2 | Xm+1.3 |
| 08 | Xm+1.4 | Xm+1.5 |
| 09 | Xm+1.6 | Xm+1.7 |
| 10 | Xm+2.0 | Xm+2.1 |
| 11 | Xm+2.2 | Xm+2.3 |
| 12 | Xm+2.4 | Xm+2.5 |
| 13 | Xm+2.6 | Xm+2.7 |
| 14 | DICOM0 | |
| 15 | | |
| 16 | Yn+0.0 | Yn+0.1 |
| 17 | Yn+0.2 | Yn+0.3 |
| 18 | Yn+0.4 | Yn+0.5 |
| 19 | Yn+0.6 | Yn+0.7 |
| 20 | Yn+1.0 | Yn+1.1 |
| 21 | Yn+1.2 | Yn+1.3 |
| 22 | Yn+1.4 | Yn+1.5 |
| 23 | Yn+1.6 | Yn+1.7 |
| 24 | DOCOM | DOCOM |
| 25 | DOCOM | DOCOM |

CE57

| | A | B |
|---|---|---|
| 01 | 0V | +24V |
| 02 | Xm+3.0 | Xm+3.1 |
| 03 | Xm+3.2 | Xm+3.3 |
| 04 | Xm+3.4 | Xm+3.5 |
| 05 | Xm+3.6 | Xm+3.7 |
| 06 | Xm+4.0 | Xm+4.1 |
| 07 | Xm+4.2 | Xm+4.3 |
| 08 | Xm+4.4 | Xm+4.5 |
| 09 | Xm+4.6 | Xm+4.7 |
| 10 | Xm+5.0 | Xm+5.1 |
| 11 | Xm+5.2 | Xm+5.3 |
| 12 | Xm+5.4 | Xm+5.5 |
| 13 | Xm+5.6 | Xm+5.7 |
| 14 | | DICOM5 |
| 15 | | |
| 16 | Yn+2.0 | Yn+2.1 |
| 17 | Yn+2.2 | Yn+2.3 |
| 18 | Yn+2.4 | Yn+2.5 |
| 19 | Yn+2.6 | Yn+2.7 |
| 20 | Yn+3.0 | Yn+3.1 |
| 21 | Yn+3.2 | Yn+3.3 |
| 22 | Yn+3.4 | Yn+3.5 |
| 23 | Yn+3.6 | Yn+3.7 |
| 24 | DOCOM | DOCOM |
| 25 | DOCOM | DOCOM |

Flat cable–end connector specification:

A02B–0120–K342

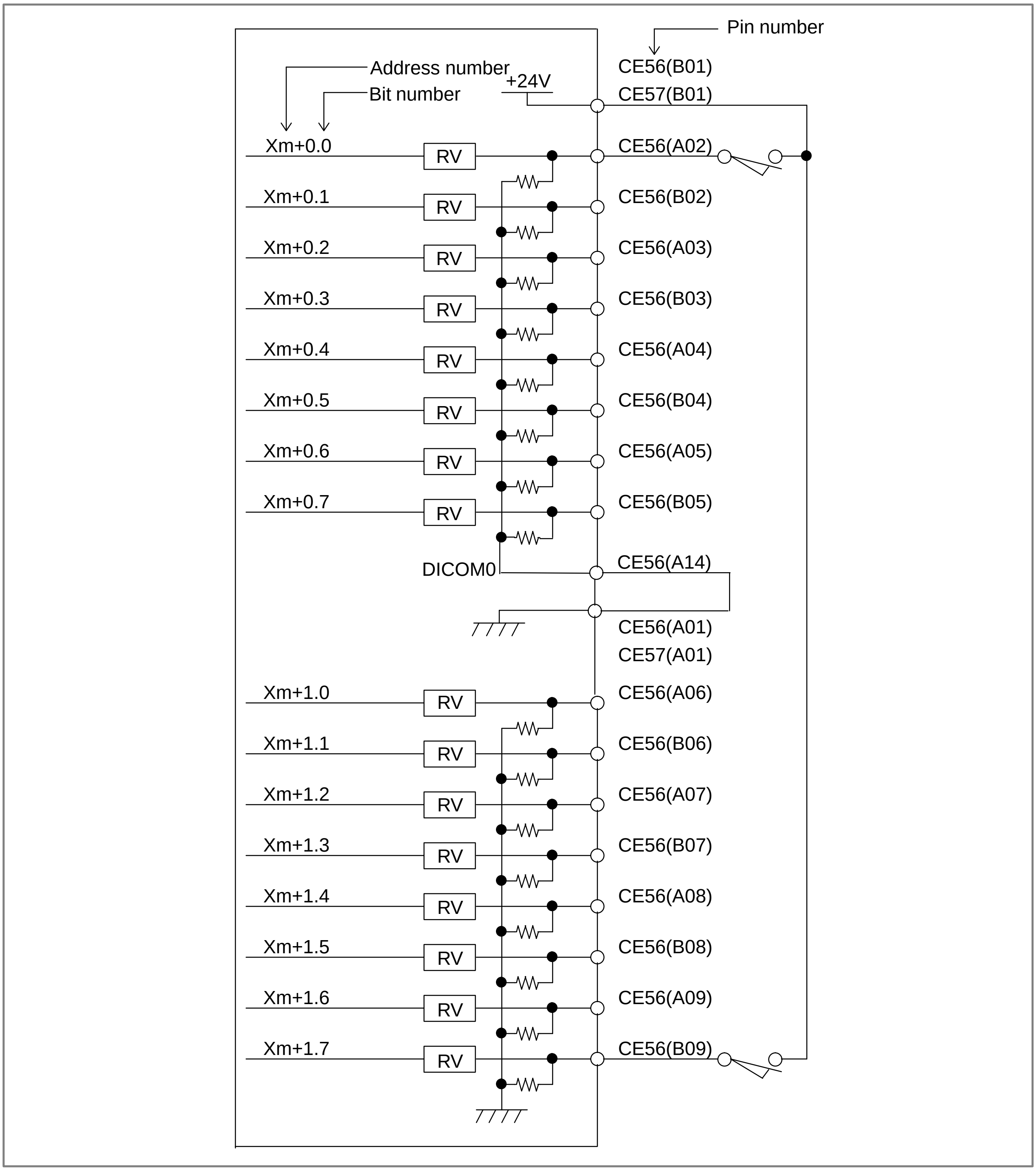
(HIF3BB–50D–2.54R, manufactured by Hirose Electric Co., Ltd.), 50 contacts

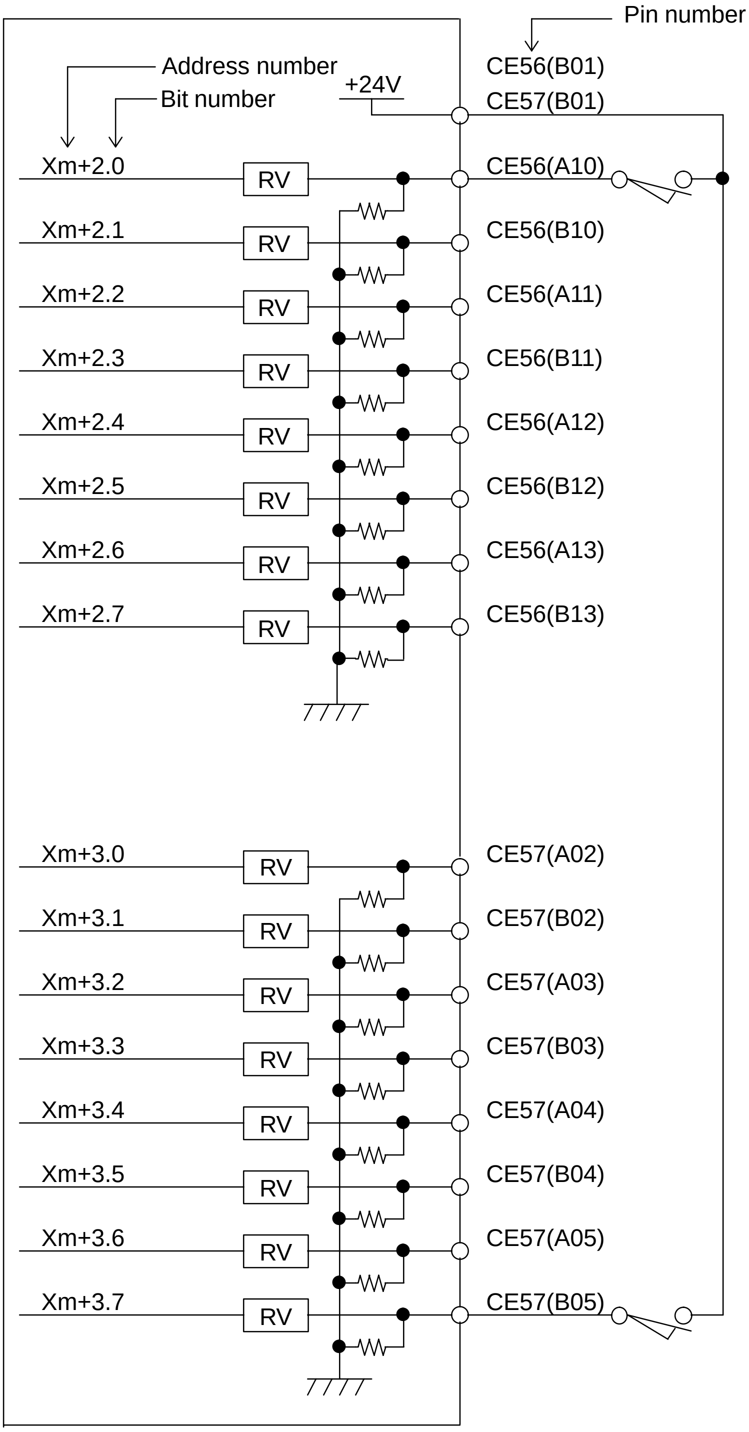
Cable conductor wire specification:

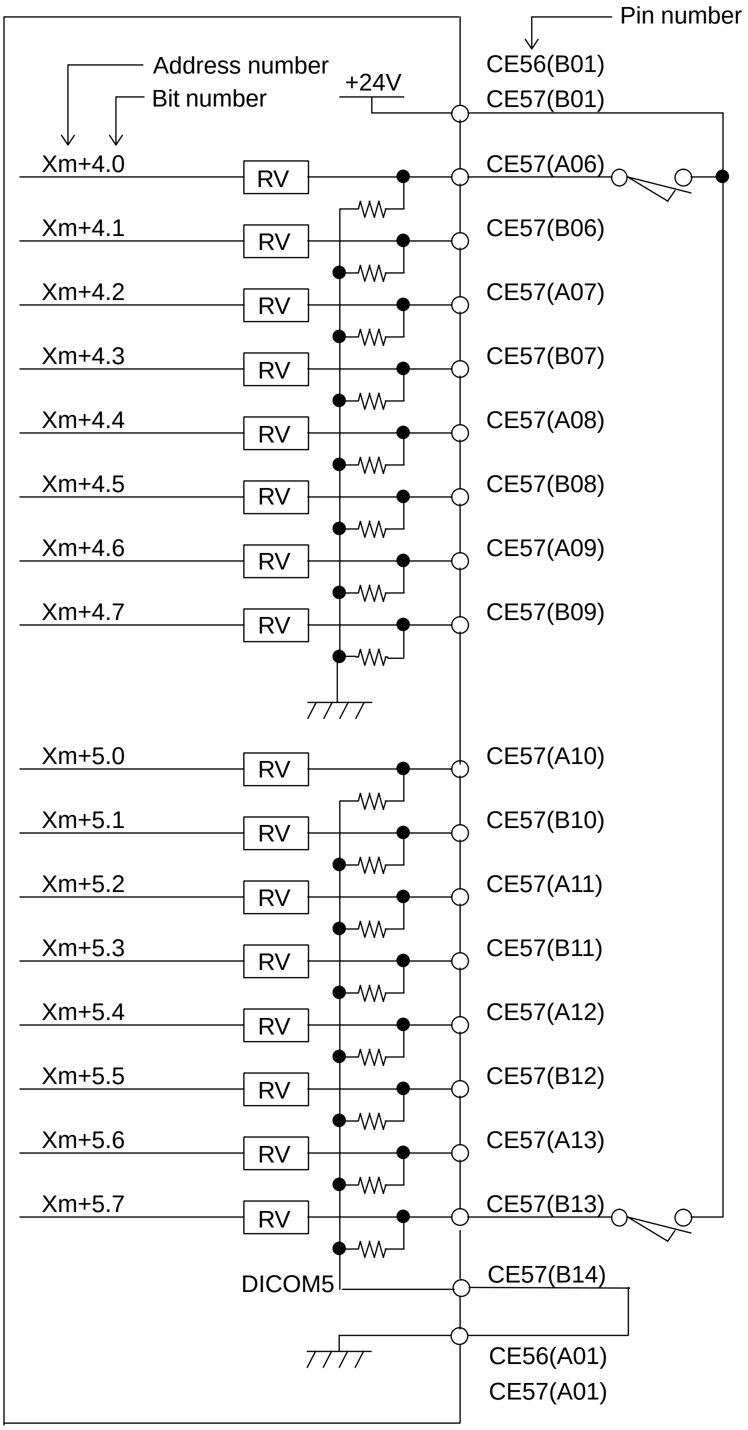
A02B–0120–K886

(50–conductor cable 61 m long, manufactured by Hitachi Cable, Ltd. or Oki Electric Cable Co., Ltd.)

## 6.9.4
## DI (General–purpose Input Signal) Connection




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


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

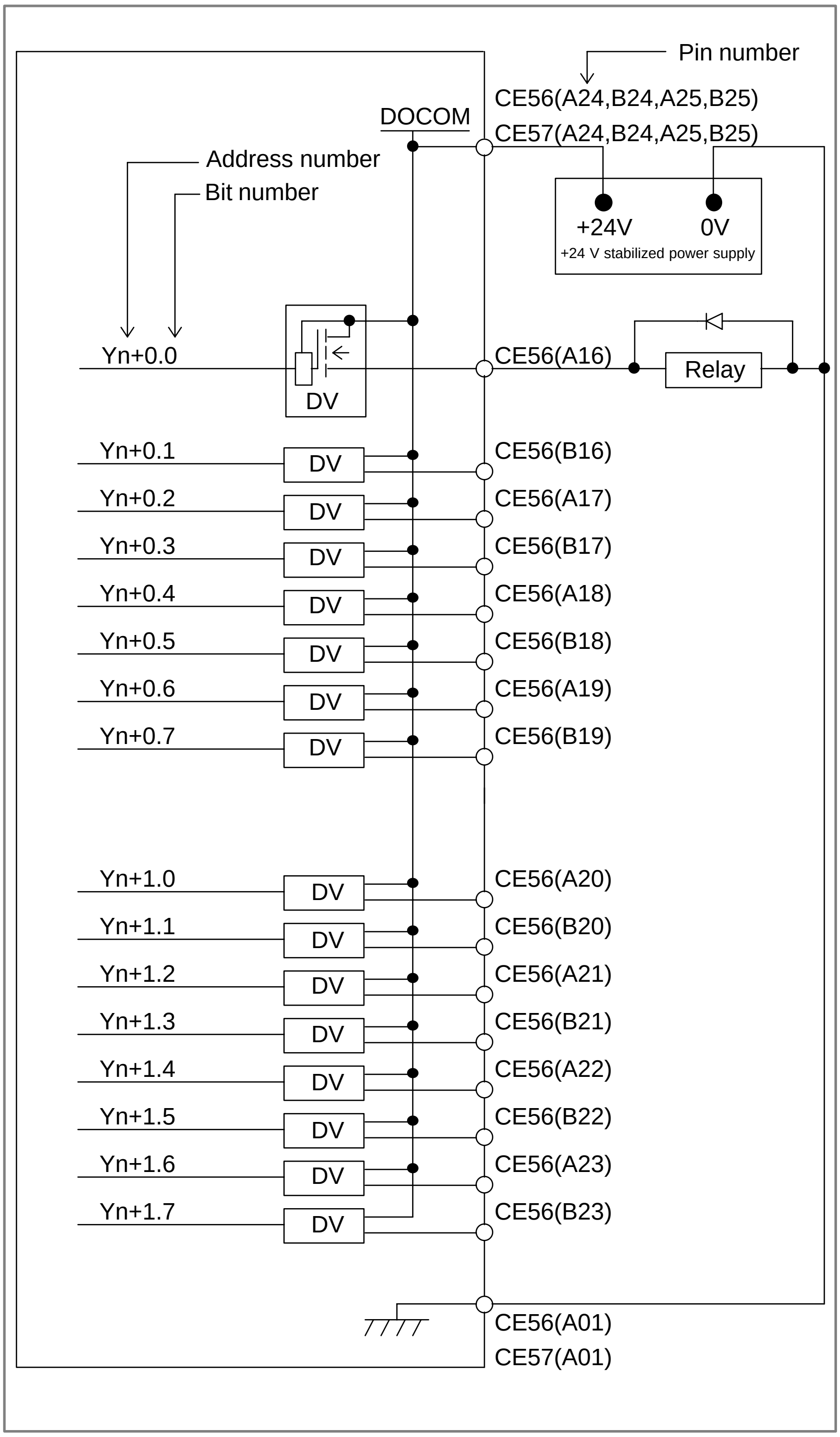
**NOTE**

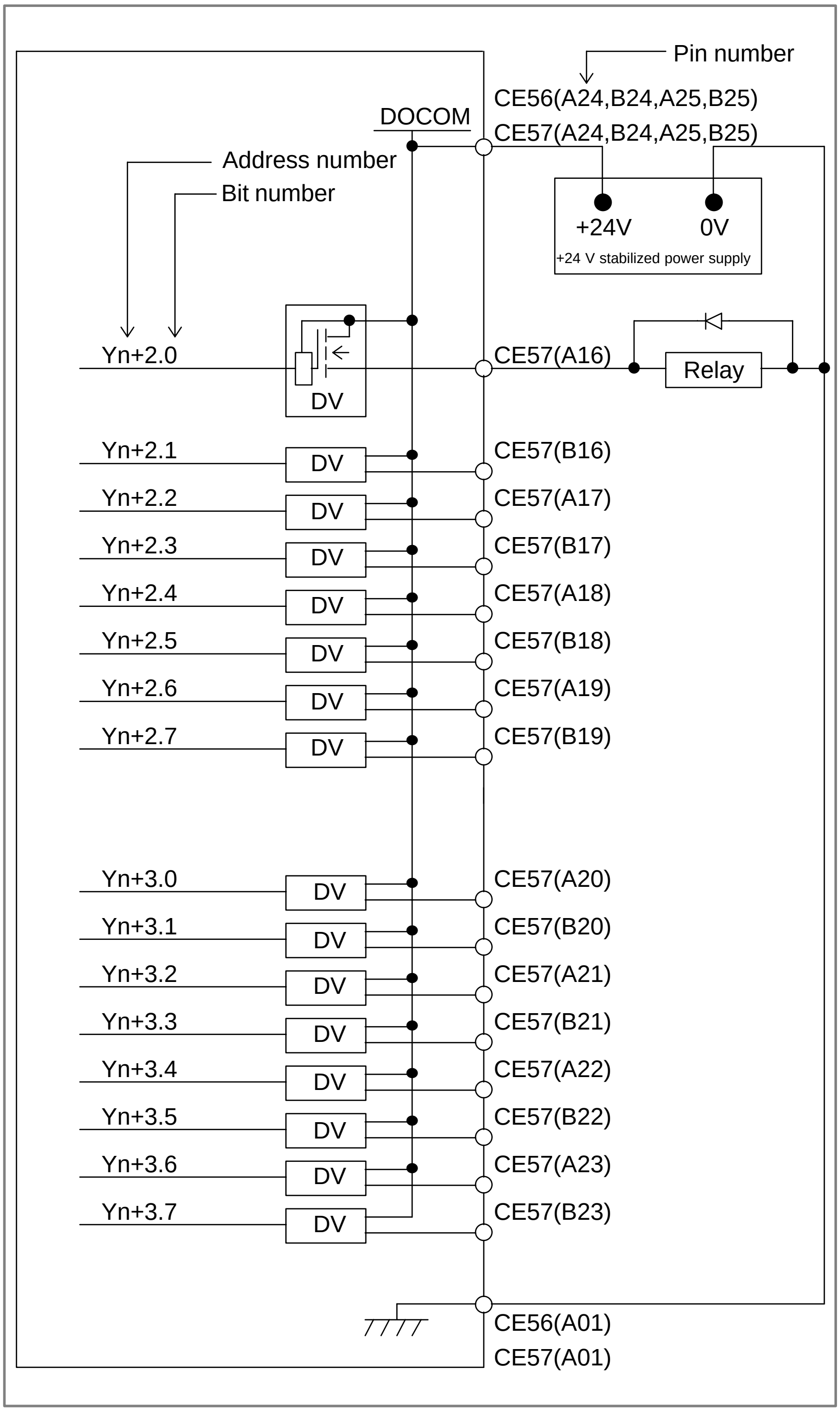
1 Xm+0.0 through Xm+0.7 and Xm+5.0 through Xm+5.7 are DI pins for which a common voltage can be selected. That is, by connecting the DICOM0 CE56(A14) or DICOM5 CE57(B14) pin to the +24 V power supply, a DI signal can be input with its logical state reversed. If, however, a cable is connected to ground, it has the same effect as inputting an ON state DI signal. To prevent this from occurring, the connection of the DICOM0 CE56(A14) and DICOM5 CE57(B14) pins to the 0 V power supply is recommended wherever possible.

2 For safety reasons, the emergency stop signal needs to be allocated to an appropriate bit X0.4 of the addresses for which the common voltage is fixed. So, it is impossible to input an emergency stop signal from this operator's panel I/O module. It should be allocated to the built–in I/O module of the Power Mate or an I/O module supporting the FANUC I/O Link.

3 For unused DI pins allocated to the addresses for which the common voltage is fixed, the logic is fixed to “0”. For unused pins allocated to the addresses for which the common voltage can be selected, the logic is fixed to “0” when the DICOM0 CE56(A14) or DICOM5 CE57(B14) pin is connected to the 0 V power supply. When the DICOM0 CE56(A14) or DICOM5 CE57(B14) pin is connected to the +24 V power supply, the logic is fixed to “1”. The logic of the unused pins is variable when the contact of the DICOM0 and DICOM5 pins is open.

## 6.9.5 DO (Output Signal) Connection

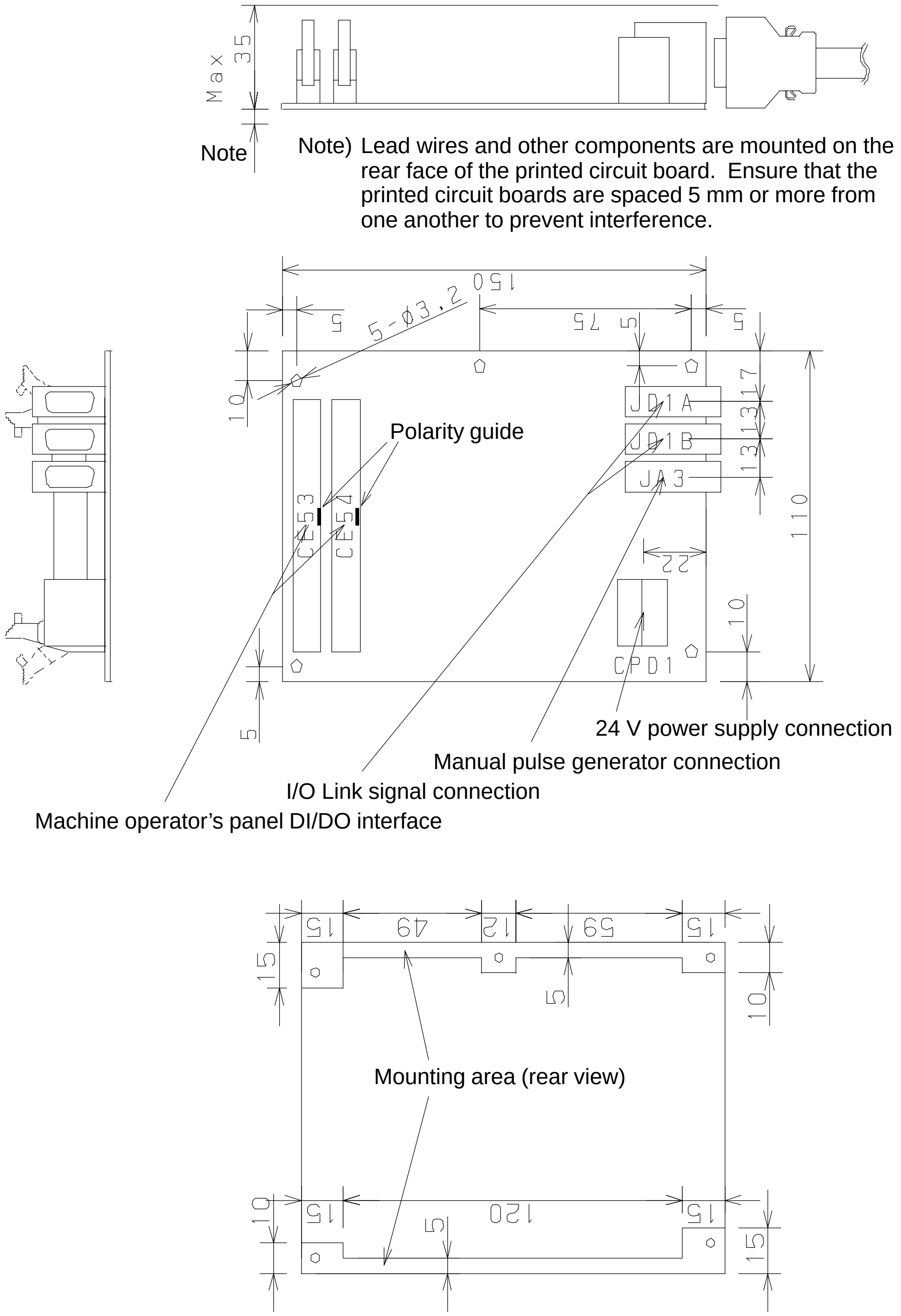



Pin number
CE56(A24,B24,A25,B25)
CE57(A24,B24,A25,B25)
DOCOM
Address number
Bit number
+24V
0V
+24 V stabilized power supply
Yn+2.0
DV
CE57(A16)
Relay
Yn+2.1
CE57(B16)
Yn+2.2
CE57(A17)
Yn+2.3
CE57(B17)
Yn+2.4
CE57(A18)
Yn+2.5
CE57(B18)
Yn+2.6
CE57(A19)
Yn+2.7
CE57(B19)
Yn+3.0
CE57(A20)
Yn+3.1
CE57(B20)
Yn+3.2
CE57(A21)
Yn+3.3
CE57(B21)
Yn+3.4
CE57(A22)
Yn+3.5
CE57(B22)
Yn+3.6
CE57(A23)
Yn+3.7
CE57(B23)
CE56(A01)
CE57(A01)

## 6.9.6
## Manual Pulse Generator Connection

For details of the connection of the manual pulse generator, see 6.7.7.

## 6.9.7
## External View



Note) Lead wires and other components are mounted on the rear face of the printed circuit board. Ensure that the printed circuit boards are spaced 5 mm or more from one another to prevent interference.

## 6.9.8 Specifications

### Installation specifications

| | |
|---|---|
| Ambient temperature | During operation 0 to 58°C<br>During storage and transportation –20 to 60°C |
| Relative humidity | 30 to 95% (no condensation) |
| Vibration | During operation: 0.5 G or less |
| Environment | Inter of units: Each unit should be placed in a cabinet to keep it from pollutants (such as dust, coolant, organic solvents, acid, corrosive gas, and salt). |
| Other requirements | (1) Install the I/O module in a fully enclosed cabinet. |

### Ordering specifications

| Item | Specification | Remarks |
|---|---|---|
| Operator’s panel I/O module B1 | A20B–2002–0520 | DI: 48 points<br>DO: 32 points<br>MPG interface is supported. |
| Operator’s panel I/O module B2 | A20B–2002–0521 | DI: 48 points<br>DO: 32 points<br>MPG interface is not supported. |
| Fuse (replacement part) | A03B–0815–K001 | 1 A |

### Module specifications

| Item | Specification | Remarks |
|---|---|---|
| DI points | 48 points | 24 V input |
| DO points | 32 points | 24 V source type output |
| Power Mate interface | FANUC I/O Link connection | Up to 16 modules can be connected as Power Mate slaves. Or, a maximum of 1024 points can be supported on both the input and output sides. |
| MPG interface | Max. 3 units | |

## Power supply rating

| Module | Supply voltage | Power supply rating | Remarks |
|---|---|---|---|
| Operator's panel I/O module B1/B2 | 24 VDC ±10% is supplied from power supply connector CPD1. The tolerance of ±10% includes momentary and ripple currents. | 0.3 A+7.3 mA×DI | DI = number of DI points in the ON state |

## DI (input signal) specifications

(General–purpose input signal)

| | |
|---|---|
| Contact rating | 30 VDC, 16 mA or more |
| Open circuit intercontact leakage current | 1 mA or less (at 26.4 V) |
| Closed circuit intercontact voltage drop | 2 V or less (including cable voltage drop) |
| Delay | Receiver delay: Max. 2 ms<br>The time required for I/O Link transmission between the Power Mate and I/O module (max. 2 ms + ladder scan cycle) must also be taken into account. |

## DO (output signal) specifications

| | |
|---|---|
| Maximum load current in ON state | 200 mA or less (including momentary current) |
| Saturation voltage in ON state | Max. 1 V (when load current is 200 mA) |
| Withstand voltage | 24 V +20% or less (including momentary values) |
| Leakage current in OFF state | 20 μA or less |
| Delay | Driver delay: Max. 50 μs<br>The time required for I/O Link transmission between the Power Mate and I/O module (max. 2 ms + ladder scan cycle) must also be taken into account. |

**NOTE**

Ensure that the maximum current per DOCOM pin (DO power supply pin) does not exceed 0.7 A.

## 6.9.9
## Other Notes

**DO signal reaction to a system alarm**

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

**Address allocation**

For the operator's panel I/O module, I/O addresses are mapped as follows.

DI space map

| | |
|---|---|
| Xm | Input signal |
| Xm+1 | |
| Xm+2 | |
| Xm+3 | |
| Xm+4 | |
| Xm+5 | |
| Xm+6 | Not used |
| Xm+7 | |
| Xm+8 | |
| Xm+9 | |
| Xm+10 | |
| Xm+11 | |
| Xm+12 (for 1st MPG) | MPG |
| Xm+13 (for 2nd MPG) | |
| Xm+14 (for 3rd MPG) | |
| Xm+15(DO alarm detection) | DO alarm detection |

DO space map

| | |
|---|---|
| Yn | Output signal |
| Yn+1 | |
| Yn+2 | |
| Yn+3 | |

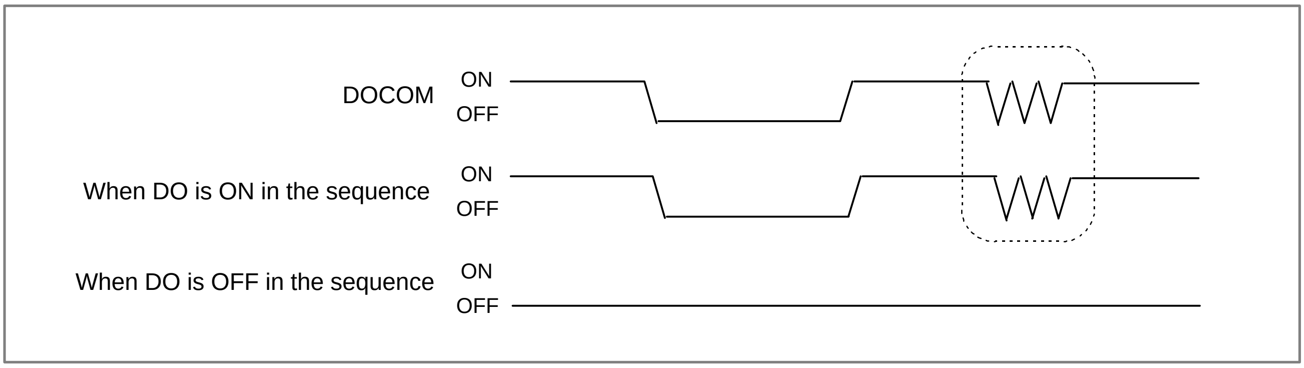
Basically, this operator's panel I/O module is allocated a group of DI addresses (16 bytes) and a group of DO addresses (4 bytes). This address allocation is explained below.

The MPG interface (MPG counter) occupies DI space from Xm+12 through Xm+14. These addresses are fixed, and Xm+12 through Xm+14 must be allocated as a DI work area to enable the use of the MPG. Therefore, when using an MPG, allocate DI addresses in units of 16 bytes. Do not use the DI space from Xm+12 through Xm+14 for Ladder; the Power Mate processes the MPG counter value directly.

DI address Xm+15 is used for detecting overcurrent and overheating alarms that occur in the IC used in the DO driver. [For details, see the section describing the detection of DO (output signal) alarms.] This address is fixed, and must be allocated as a work area before it can be used. When using this area, therefore, allocate DI addresses in units of 16 bytes.

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

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



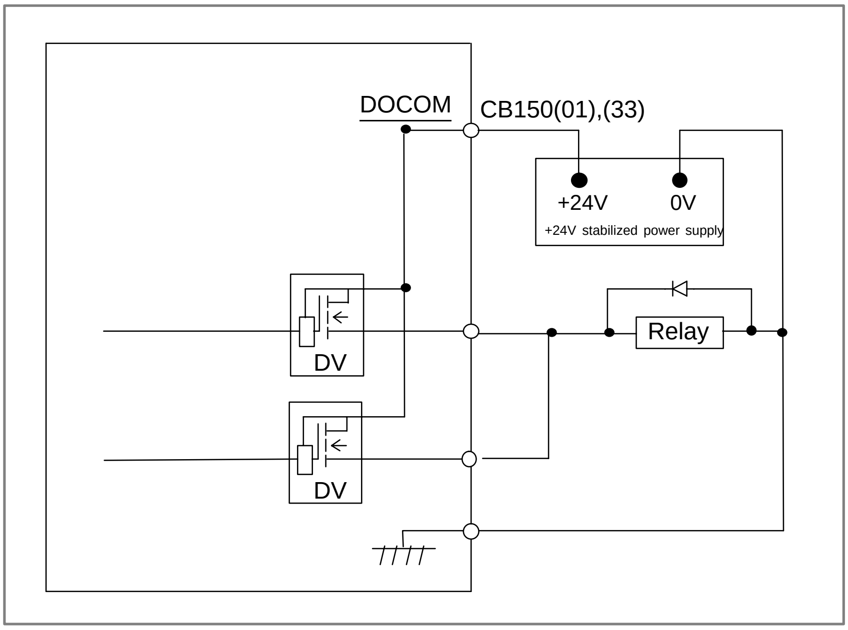
**NOTE**

1 When the DO signal is in the ON state in the sequence, the ON or OFF state of the DOCOM pin determines the state of the signal, as shown within dotted lines in the above figure.

2 Do not turn off the +24 V supply provided by the CPD1 to the I/O module during the operation.  Turning off the +24 V supply causes a Power Mate communication alarm.  When turning on the power, the +24 V supply to the I/O module must be turned on before or at the same time as the power supply to the Power Mate.  When turning off the power, the +24 V supply to the I/O module must be turned off after or at the same time as the power supply to the Power Mate.

### Parallel DO (output signal) connection

The DO load current can be doubled by connecting two DO points in parallel and turning them on and off simultaneously in sequence, as shown in the figure below. The maximum load current per DO point is 200 mA. Connecting two DO points in parallel and turning them on at the same time produces a current of 400 mA. Note that, however, when two DO points are connected in parallel, the leakage current also doubles when they are off (max. 40 $\mu$A).



### DO (output signal) alarm detection

The DO driver of the I/O module is capable of detecting an overcurrent and measuring its own temperature. If an accident, such as the connecting of the cable to ground, causes an abnormal increase in the load current or in the driver temperature, a protection circuit, which is provided for each DO driver (1 byte), is activated and keeps the DO signal for the relevant 1 byte in the OFF state until the cause of the problem is eliminated. Even if this occurs, the Power Mate and I/O module continue operating. The DI address (Xm+15) identifies the DO driver which has detected the alarm. The following table shows the correspondence between the DI address (Xm+15) bits and the DO addresses. Bit value “1” indicates that the corresponding DO driver has detected an alarm. The contents of the Xm+15 area can be checked by using the DGN screen of the Power Mate or by performing alarm processing for the area in advance by using Ladder. This helps alarm detection and recovery.

| Alarm detection address and bit | DO address | Remarks |
|---|---|---|
| Xm+15.0 | Yn+0 | |
| Xm+15.1 | Yn+1 | |
| Xm+15.2 | Yn+2 | |
| Xm+15.3 | Yn+3 | |
| Xm+15.4 | Yn+4 | Reserved |
| Xm+15.5 | Yn+5 | Reserved |
| Xm+15.6 | Yn+6 | Reserved |
| Xm+15.7 | Yn+7 | Reserved |

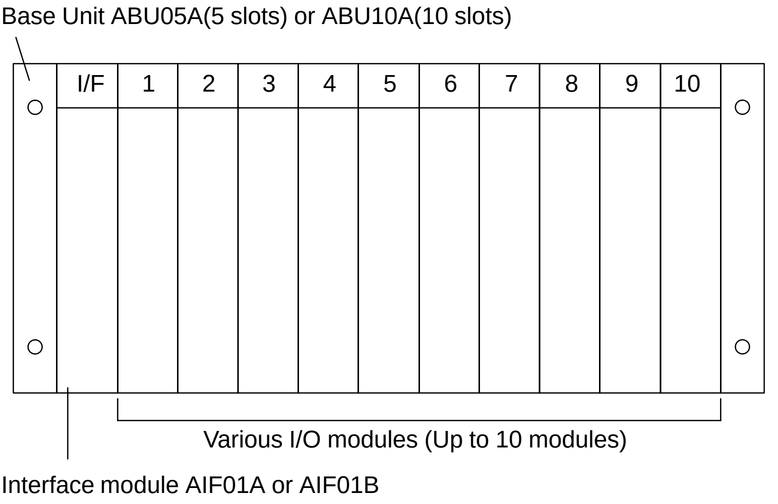
**CAUTION**

If the ladder program does not perform alarm processing for Xm+15, the Power Mate cannot detect an error (if occurs) in the DO driver.

## 6.10 CONNECTION OF THE FANUC I/O UNIT–MODEL A

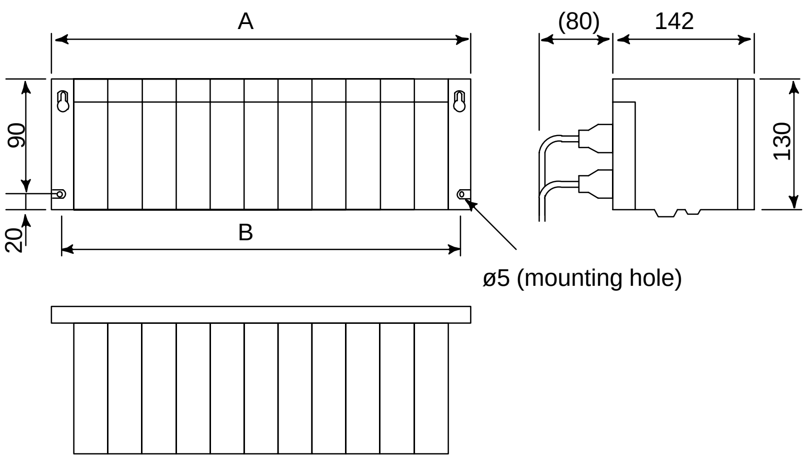
The FANUC I/O Unit–MODEL A (“I/O Unit–A”) is a modular–type I/O unit. It interfaces with the machine when connected to the control unit via the I/O Link. One I/O unit can be configured by mounting the I/O modules required for either the 5– or 10–slot base unit. A variety of I/O modules are provided so appropriate modules can be selected according to the use, points, voltage level, current capacity, and signal specifications.

### 6.10.1 Structure of FANUC I/O Unit–MODEL A



AIF01A is used for connection to FANUC I/O Link
AIF01B expands I/O Units–A in the same group.

### 6.10.2 Outer Dimensions

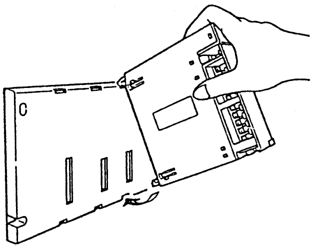


| | A | B |
|---|---|---|
| For 5–slot base unit (ABU05A) | 253 | 238 |
| For 10–slot base unit (ABU10A) | 430 | 415 |

## 6.10.3
## Mounting and Dismounting Modules

Interface modules and various types of I/O modules can be mounted to and dismounted from the base unit easily as shown below.

### Mounting

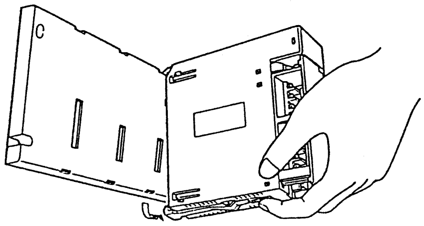


**1** Hang the hook at the top of the module on the groove in the upper side of the base unit.

**2** Make the connector of the module engage with that of the base unit.

**3** Push the module in the lower groove of the base unit till the stopper in the lower side of the module stops.

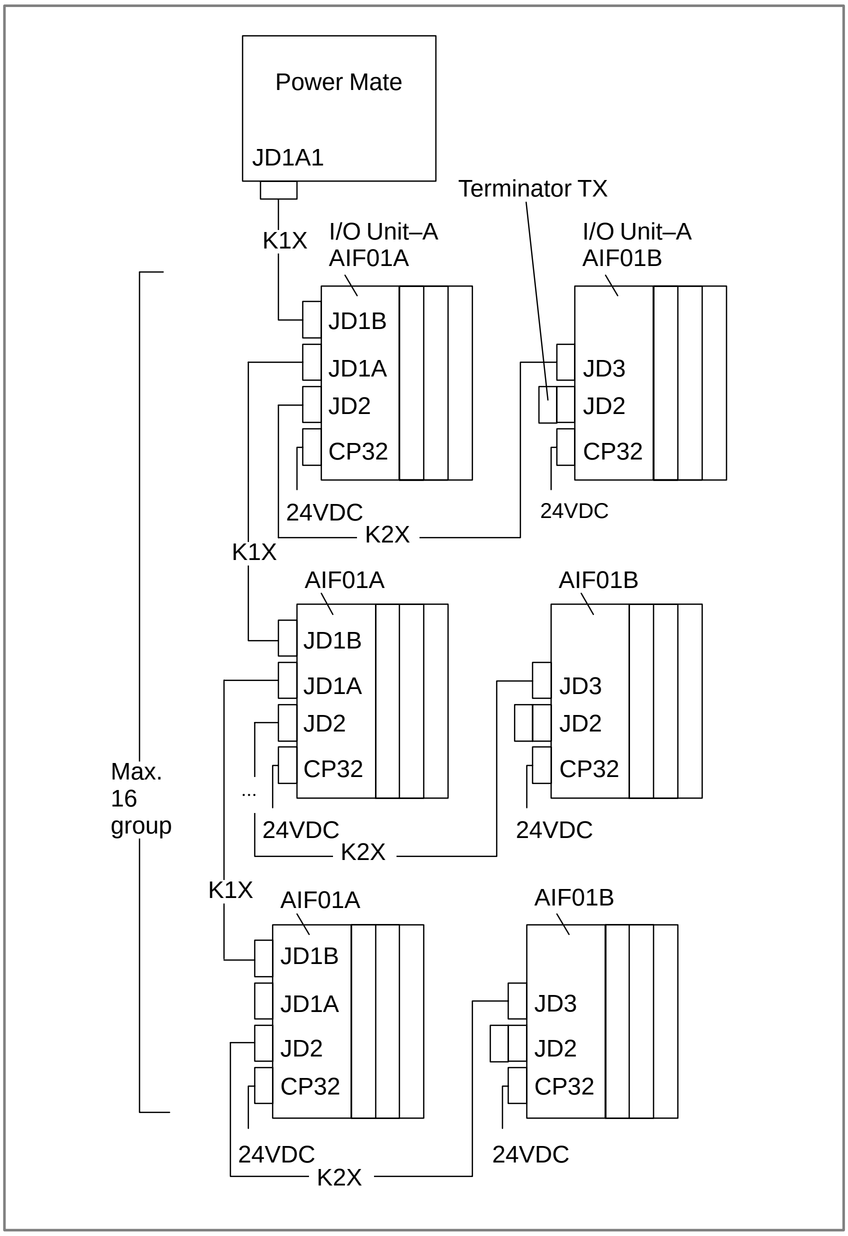
### Dismounting



**1** Release the stopper by pushing the lever at the bottom of the module.

**2** Push the module upwards.

## 6.10.4
## Connection Diagram



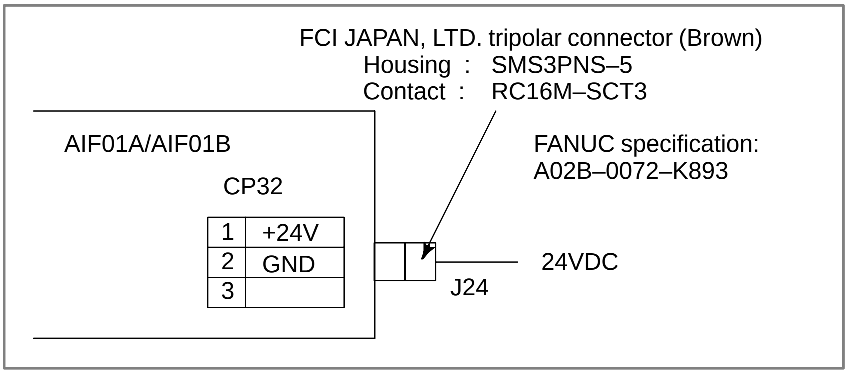
**NOTE**

1. Number of I/O Units and connecting method are restricted depending on the allocation of the I/O points.
   See 6.2 “Connection of FANUC I/O Link” and 6.10.11 “Number of I/O points for the I/O Unit–A”.
2. Cable K1X can be an optical fiber cable by using the optical I/O link adapter.
   Refer to Subsec. 6.2.3.

### 6.10.5
### Connecting Input Power Source

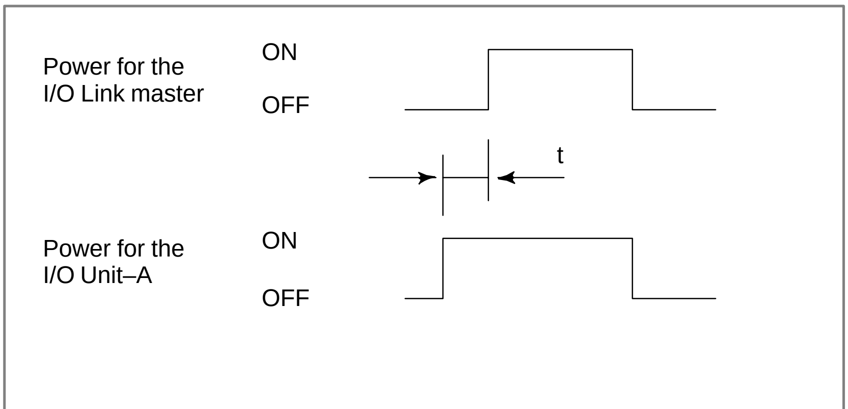
Connect the following stabilizedpower source to the connector CP32 of the interface module (AIF01A or AIF01B).

- Voltage : 24VDC ± 10% (including an instantaneous value and ripple)
- Current : Determine from Table 6.10.6.



**NOTE**

Turn ON the power for the I/O Unit–A just before or when the power for the Power Mate is turned ON. When the Power Mate power is turned OFF, make sure to turn the power to the I/O Unit–A OFF as well.

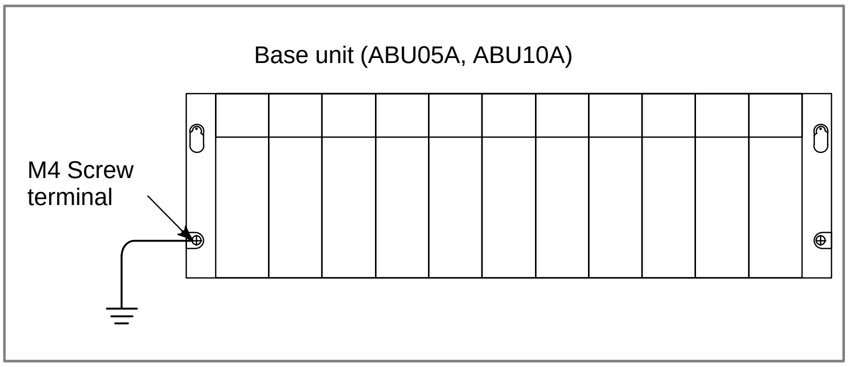


t : more than –500ms
(Turn ON of the power for I/O Unit–A can be late 500ms or less.)

## 6.10.6

## Connection to Frame Ground (Grounding)

- Ground the base unit (ABU05A, ABU10A) by its grounding terminal (frame ground)



- When the cable K1X (see connection diagram in section 6.10.4) runs between different cabinets, make sure to connect the cabinets with a grounding wire more than 5.5 mm$^2$.

**Table 6.10.6 Required current of each module**

| Module name | Required current (mA) of +24V | |
|---|---|---|
| | A | B |
| AIF01A | 50 | |
| AIF01B | 50 | |
| AID32A | 20+0.5×n | 30+7.5×n |
| AID32B | 20+0.5×n | 30+7.5×n |
| AID16C | 5 | |
| AID16D | 5 | |
| AID32E | 5 | |
| AID32F | 5 | |
| AIA16G | 5+1.5×n | |
| AOD08C | 5+2×n | |
| AOD08D | 5+2×n | |
| AOD16C | 5+2×n | |
| AOD16D | 5+2×n | |
| AOD32C | 5+0.5×n | |
| AOD32D | 5+0.5×n | |
| AOA05E | 5+5.5×n | |
| AOA08E | 5+5.5×n | |
| AOA12F | 5+4.5×n | |
| AOR08G | 5 | 10×n |
| AOR16G | 5 | 10×n |
| AAD04A | 5 | 130 |

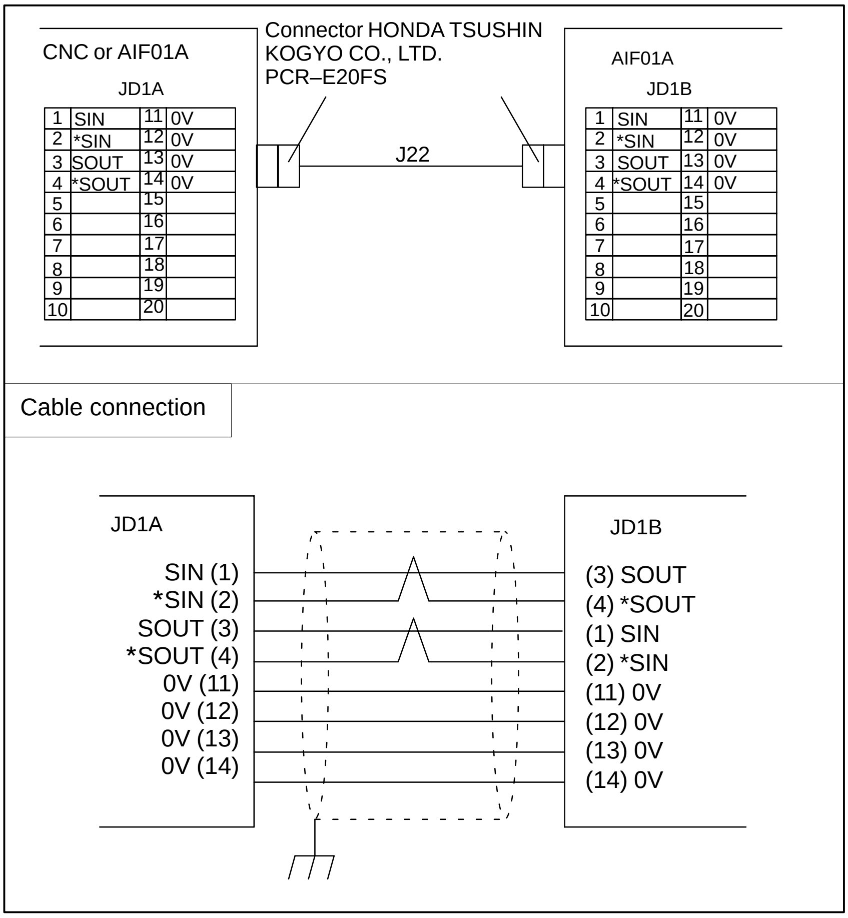
n : Number of the input and output points (for each module) which turn ON simultaneously

- The current sum requirement for modules used in Column A should not exceed 500 mA.
- The current sum requirement for modules used in Column B should not exceed 1500 mA.

## 6.10.7
## Connecting Signal Cables

Details of the cables K1X, K2X and the terminator shown in the general connection diagram are as follows.

### Cable K1X



JD1A

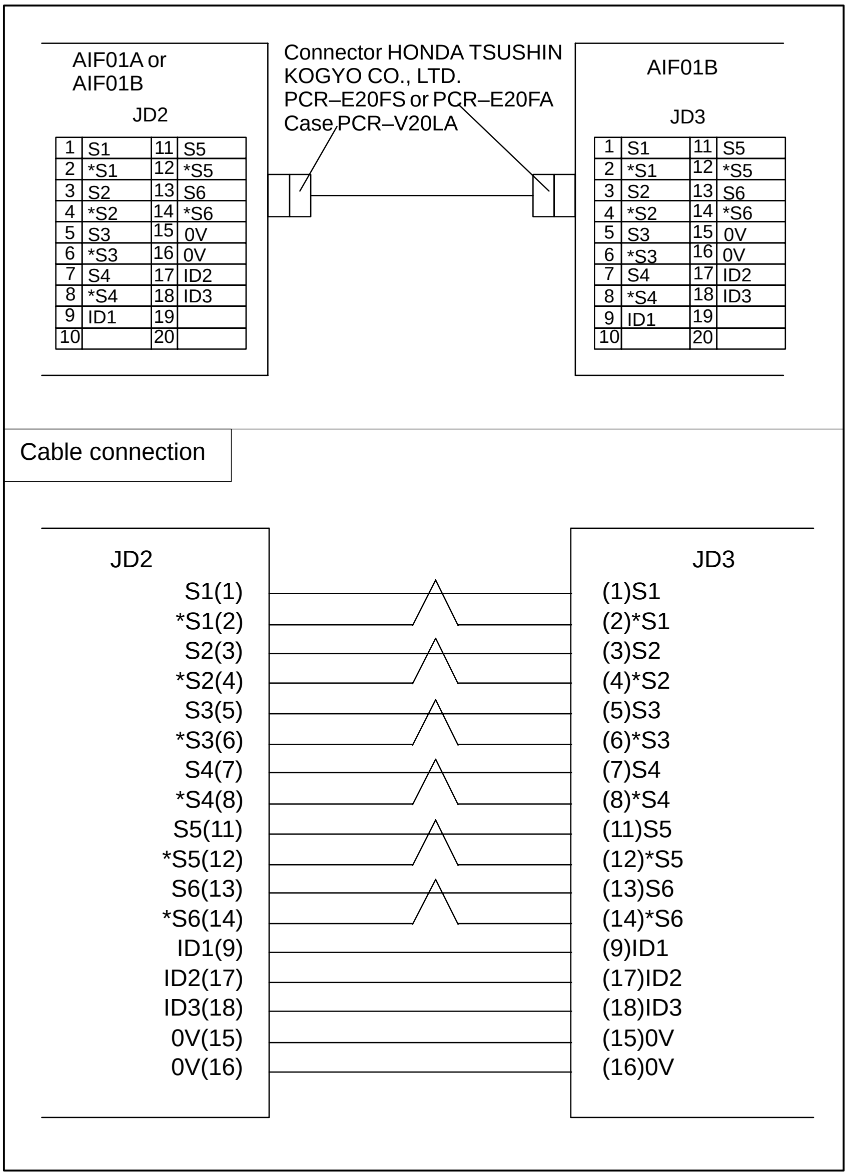
| | | | |
|---|---|---|---|
| 1 | SIN | 11 | 0V |
| 2 | *SIN | 12 | 0V |
| 3 | SOUT | 13 | 0V |
| 4 | *SOUT | 14 | 0V |
| 5 | | 15 | |
| 6 | | 16 | |
| 7 | | 17 | |
| 8 | | 18 | |
| 9 | | 19 | |
| 10 | | 20 | |

JD1B

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

- Use twisted pair wires for signal SIN and *SIN, and signals SOUT and *SOUT.
- Recommended cable material : A66L–0001–0284#10P
  (twisted pair/shielded)
- Shielding wires should be connected with the grounding plate of the cabinet at the JD1A side using a cable clamp.
- Maximum cable length: 10 m
- Do not make any wire connections to the connector spare pins (See Subsec. 6.2.2).
- Use an optical I/O link adapter and an optical fiber cable, [in the following cases] :
  - ☐ When the cable is more than 10 meters long.
  - ☐ When the cable runs between different cabinets and there is no appropriate ground wire between the cabinets.
  - ☐ When there is concern that the cable is influenced by strong noise.

## Cable K2X



JD2

| | | | |
|---|---|---|---|
| 1 | S1 | 11 | S5 |
| 2 | *S1 | 12 | *S5 |
| 3 | S2 | 13 | S6 |
| 4 | *S2 | 14 | *S6 |
| 5 | S3 | 15 | 0V |
| 6 | *S3 | 16 | 0V |
| 7 | S4 | 17 | ID2 |
| 8 | *S4 | 18 | ID3 |
| 9 | ID1 | 19 | |
| 10 | | 20 | |

JD3

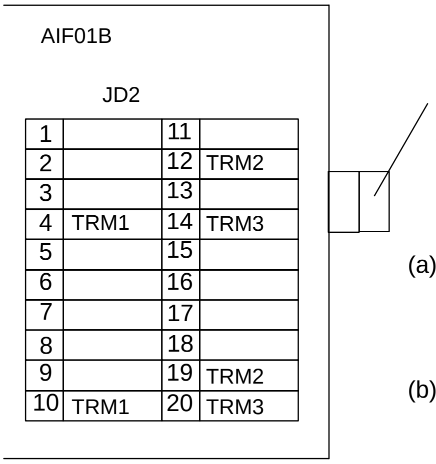
| | | | |
|---|---|---|---|
| 1 | S1 | 11 | S5 |
| 2 | *S1 | 12 | *S5 |
| 3 | S2 | 13 | S6 |
| 4 | *S2 | 14 | *S6 |
| 5 | S3 | 15 | 0V |
| 6 | *S3 | 16 | 0V |
| 7 | S4 | 17 | ID2 |
| 8 | *S4 | 18 | ID3 |
| 9 | ID1 | 19 | |
| 10 | | 20 | |

Cable connection

| JD2 | JD3 |
|---|---|
| S1(1) | (1)S1 |
| *S1(2) | (2)*S1 |
| S2(3) | (3)S2 |
| *S2(4) | (4)*S2 |
| S3(5) | (5)S3 |
| *S3(6) | (6)*S3 |
| S4(7) | (7)S4 |
| *S4(8) | (8)*S4 |
| S5(11) | (11)S5 |
| *S5(12) | (12)*S5 |
| S6(13) | (13)S6 |
| *S6(14) | (14)*S6 |
| ID1(9) | (9)ID1 |
| ID2(17) | (17)ID2 |
| ID3(18) | (18)ID3 |
| 0V(15) | (15)0V |
| 0V(16) | (16)0V |

- Connect the signals with the same name.
- Make sure to use twisted pair wires for the following signals:
  S1 and *S1, S2 and *S2, S3 and *S3
  S4 and *S4, S5 and *S5, S6 and *S6
- Do not connect the pins No. 10, No. 19 and No. 20, as they are used internally.
- Recommended cable material : A66L – 0001 – 0284#10P
  (twisted pair/shielded)
- Maximum cable length : 2 m

## Terminator TX



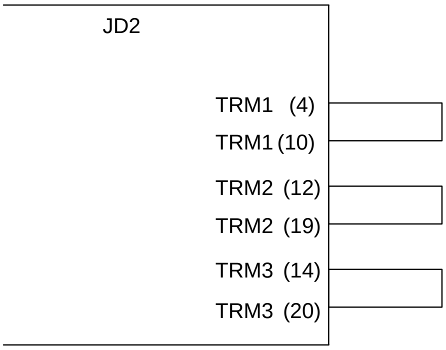
| | | | |
|---|---|---|---|
| 1 | | 11 | |
| 2 | | 12 | TRM2 |
| 3 | | 13 | |
| 4 | TRM1 | 14 | TRM3 |
| 5 | | 15 | |
| 6 | | 16 | |
| 7 | | 17 | |
| 8 | | 18 | |
| 9 | | 19 | TRM2 |
| 10 | TRM1 | 20 | TRM3 |

Connector
HONDA TSUSHIN KOGYO CO., LTD.
PCR–E20FS
Case
PCR–V20LA

(a) Terminate the connector JD2 of the last AIF01B in a single group with the terminator.

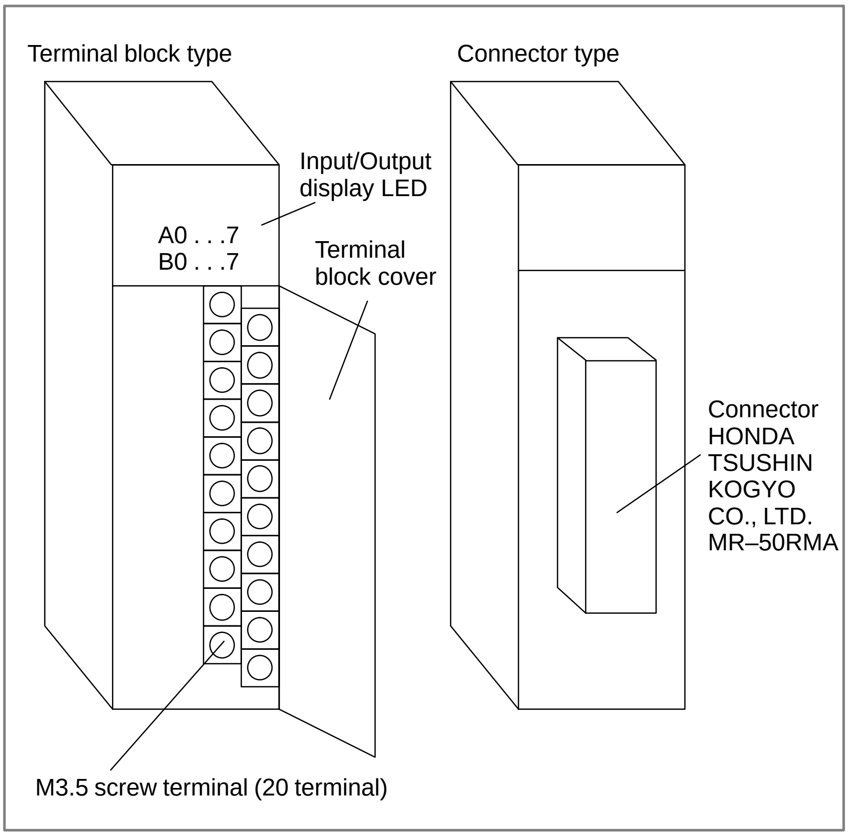
(b) Short–circuit the TRM1 signals as shown. Repeat the shorting procedure for signals TRM2 and TRM3.

Cable connection

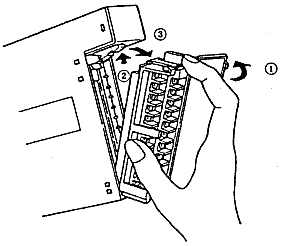


## 6.10.8 Connecting with I/O Modules

For an external connecting method, there are two types of I/O modules : one with a terminal block, and one with a connector.
The terminal block is a removable type.

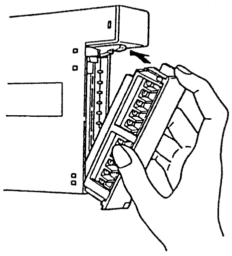


### Mounting the terminal block



1. Insert the protruding portion at the bottom of the terminal block in the groove of the module side.
2. Push the terminal block using the engaging point of the protruding portion and the groove as an axis and mount it in the module firmly.
3. Open the cover of the terminal block and check to make sure the latch at the top of the terminal block is firmly set.

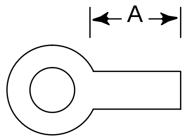
### Dismounting the terminal block



1. Open the cover of the terminal block.
2. Push up the latch at the top of the terminal block.
3. Drag out the tab at the top of the terminal block and pull it out.
   The terminal block will be removed from the module.

### Cautionary points when wiring terminal block type

- Wiring material : AWG22 – 18 (0.3 – 0.75mm$^2$)
  A wire as thin as possible is recommended.
- Crimp style terminal : M3.5
  Crimp style terminal with no insulation sleeve and a short distance “A”, as illustrated in the drawing below, is recommended.



A : Approx. 4.5mm

| | |
|---|---|
| DAIDO SOLDERLESS TERMINAL MFG. CO., LTD | 1.25–S3.5 |
| NICHIFU EUROPE B.V<br>NICHIFU AMERICA, INC. | 1.25–3.5S, etc. |

- Mark tube : As short a mark tube as possible ; cover climped part with the mark tube.

## 6.10.9 Digital Input/Output Module

### Digital input modules

| Input type | Module name | Rated voltage | Rated current | Polarity | Response time | Points | External connection | LED display |
|---|---|---|---|---|---|---|---|---|
| Non–insulation DC input | AID 32A | 24VDC | 7.5mA | Both | Maximum 20ms | 32 | Connector | not provided |
| | AID 32B | 24VDC | 7.5mA | Both | Maximum 2ms | 32 | Connector | not provided |
| Insulation type DC input | AID 16C | 24VDC | 7.5mA | NEG | Maximum 20ms | 16 | Terminal block | provided |
| | AID 16D | 24VDC | 7.5mA | POS | Maximum 20ms | 16 | Terminal block | provided |
| | AID 32E | 24VDC | 7.5mA | Both | Maximum 20ms | 32 | Connector | not provided |
| | AID 32F | 24VDC | 7.5mA | Both | Maximum 2ms | 32 | Connector | not provided |
| AC input | AIA 16G | 100–120VAC | 10.5mA (120V AC) | ON Max 35ms<br>OFF Max 45ms | | 16 | Terminal block | provided |

**NOTE**

1 Polarity
  Negative : 0 V common (current source type)
  – The input is defined as ON when at a low level
  Positive : 24 V common (current sink type)
  – The input is defined as ON when at a high level

2 For the details of the specifications for each module, refer to FANUC I/O Unit–MODEL A Connection·Maintenance Manual (B–61813E).

## Digital output modules

| Output type | Module name | Rated voltage | Rated current | Polarity | Points | Points /common | External connection | LED display | Fuse |
|---|---|---|---|---|---|---|---|---|---|
| Insulation type DC output | AOD 08C | 12–24 VDC | 2A | NEG | 8 | 8 | Terminal block | provided | provided |
| | AOD 08D | | 2A | POS | 8 | 8 | Terminal block | provided | provided |
| | AOD 16C | | 0.5A | NEG | 16 | 8 | Terminal block | provided | not provided |
| | AOD 16D | | 0.5A | POS | 16 | 8 | Terminal block | provided | not provided |
| | AOD 32C | | 0.3A | NEG | 32 | 8 | Connector | not provided | not provided |
| | AOD 32D | | 0.3A | POS | 32 | 8 | Connector | not provided | not provided |
| AC output | AOD 05E | 100–240V AC | 2A | – | 5 | 1 | Terminal block | provided | provided |
| | AOD 08E | | 1A | – | 8 | 4 | Terminal block | provided | provided |
| | AOD 12F | 100–120V AC | 0.5A | – | 12 | 6 | Terminal block | provided | provided |
| Relay output | AOR 08G | Maximum 250VAC/ 30VDC | 4A | – | 8 | 1 | Terminal block | provided | not provided |
| | AOR 16G | | 2A | – | 16 | 4 | Terminal block | provided | not provided |

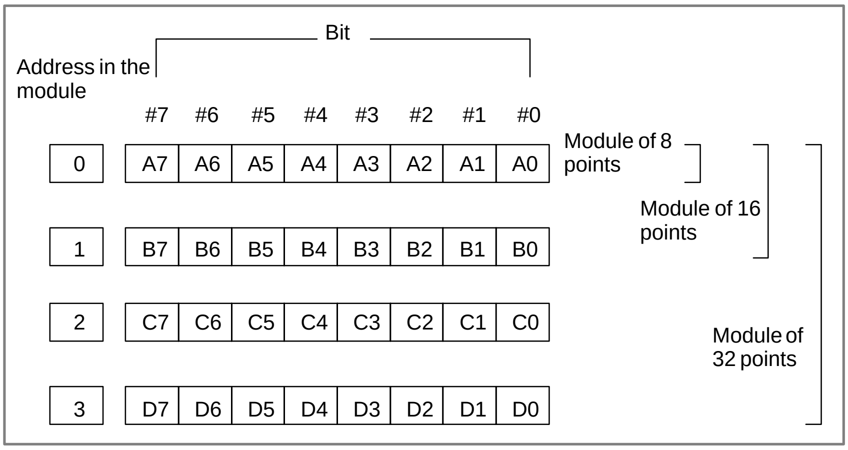
**NOTE**

1 Polarity
Negative : 0 V common (current sink type)
– Output is at low level when ON.
Positive : 24 V common (current source type)
– Output is at high level when ON.

2 For the details of the specifications for each module, refer to FANUC I/O Unit–MODEL A Connection·Maintenance Manual (B–61813E).

## 6.10.10

## Correspondence between I/O Signals and Addresses in a Module



| | #7 | #6 | #5 | #4 | #3 | #2 | #1 | #0 |
|---|---|---|---|---|---|---|---|---|
| 0 | A7 | A6 | A5 | A4 | A3 | A2 | A1 | A0 |
| 1 | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
| 2 | C7 | C6 | C5 | C4 | C3 | C2 | C1 | C0 |
| 3 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |

Addresses in a module are defined relatively, with the beginning address as 0. Real addresses viewed by the sequence program of the PMC are set by the programmer.

For input modules, an input signal becomes “1” when the contact point connected with the input is turned ON. For output modules, an output contact point (or transistor) is turned ON when the output signal is “1”.

## 6.10.11

## Number of Points for I/O Unit–MODEL A

Determine the number of I/O points for the I/O Unit –MODEL A using the following.

- **Output points**

| Sum of the actual output points in a group | | Occupied output points |
|---|---|---|
| 0 to 32 | → | 32 points |
| 40 to 64 | → | 64 points |
| 72 to 128 | → | 128 points |
| 136 to 256 | → | 256 points |

**NOTE**

Count AOA05E as 8 points and AOA12F as 16 points.

- **Input points**

| Sum of the actual input points in a group | | Occupied input points |
|---|---|---|
| 0 to 32 | → | 32 points |
| 40 to 64 | → | 64 points |
| 72 to 128 | → | 128 points |
| 136 to 256 | → | 256 points |

As a result of the calculation above, when the number of input points is smaller than that of the output points in a single group, the number of input points is assumed to be equal to that of the output points.

**Example 1:**

When the following modules are used in the group No. 0

AOD32C . . . . . . . . . . . . . . . . . . . . . . 3
AOA12F . . . . . . . . . . . . . . . . . . . . . . 2
AID32A . . . . . . . . . . . . . . . . . . . . . . 5
AIA16G . . . . . . . . . . . . . . . . . . . . . . 3

[Input points]

32×5+16×3 = 208 → 256 points

[Output points]

32×3+16×2 = 128 → 128 points

**Example 2:**

When the following modules are used in the group No. 2.

AOD16C . . . . . . . . . . . . . . . . . . . . . . 7
AOA05F . . . . . . . . . . . . . . . . . . . . . . 9
AID16A . . . . . . . . . . . . . . . . . . . . . . 4
AIA16G . . . . . . . . . . . . . . . . . . . . . . 3

[Input points]

16×4+16×3 = 112 → 128 points

[Output points]

16×7+8×9 = 184 → 256 points

In this case, as the number of input points is smaller than that of the output points, the number of input points is assumedl to be equal to that of the output points, in other words, 256 points.

## 6.11 FANUC I/O LINK CONNECTION UNIT

### 6.11.1 Overview

This unit connects FANUC I/O Link master devices, such as the CNC and Power Mate, via an I/O Link to enable the transfer of DI/DO signals.

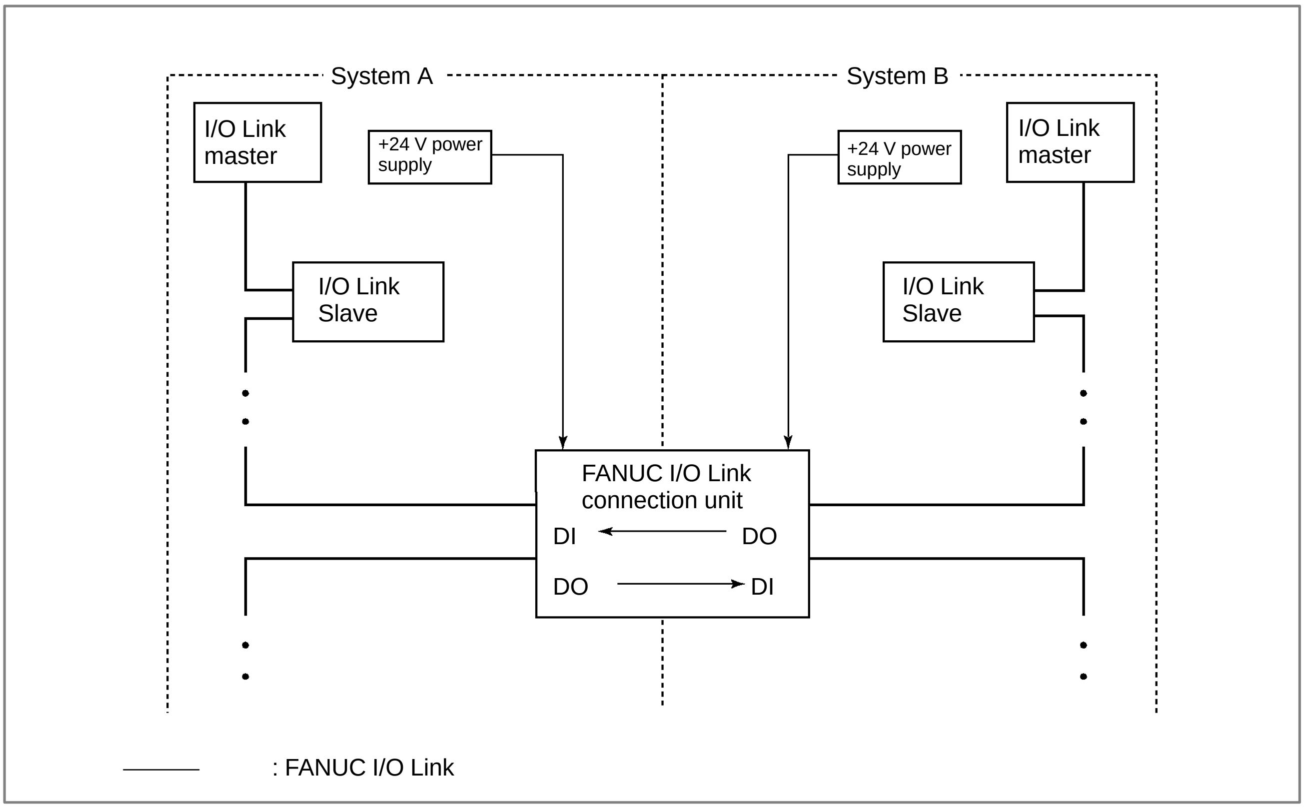


Fig. 6.11.1 System which uses FANUC I/O Link connection units

**NOTE**

This system enable I/O data transfer between two independent FANUC I/O Link master device. 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.

## 6.11.2 Specification

| | |
|---|---|
| I/O Link function | Provided with two slave mode I/O Link interface channels, between which DI/DO data can be transferred.<br>[Interface types]<br>One of the following combinations is selected:<br>Electrical – optical<br>Electrical – electrical<br>Optical – optical |
| Number of DI/DO data items | DI: Up to 256, DO: Up to 256<br>(The number of data items actually used varies depending on the mount of data assigned in the host.) |
| Power supply | Each I/O Link interface must be independently supplied with +24 VDC.<br>Voltage: +24 VDC +10%, –15%<br>Current: 0.2 A (excluding surge)<br>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.<br>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 × 150 × About 50 mm<br>W H D<br>Fig. 6.11.2(b) is an outline drawing of the unit. |
| Installation | The unit, which is a separate type, is installed in the power magnetics cabinet. Fig. 6.11.2(c) shows how to mount the unit. |
| Operating environment | Temperature: 0 to 60°C<br>Humidity : 5 to 75% RH (non–condensing)<br>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 |

## LED indications

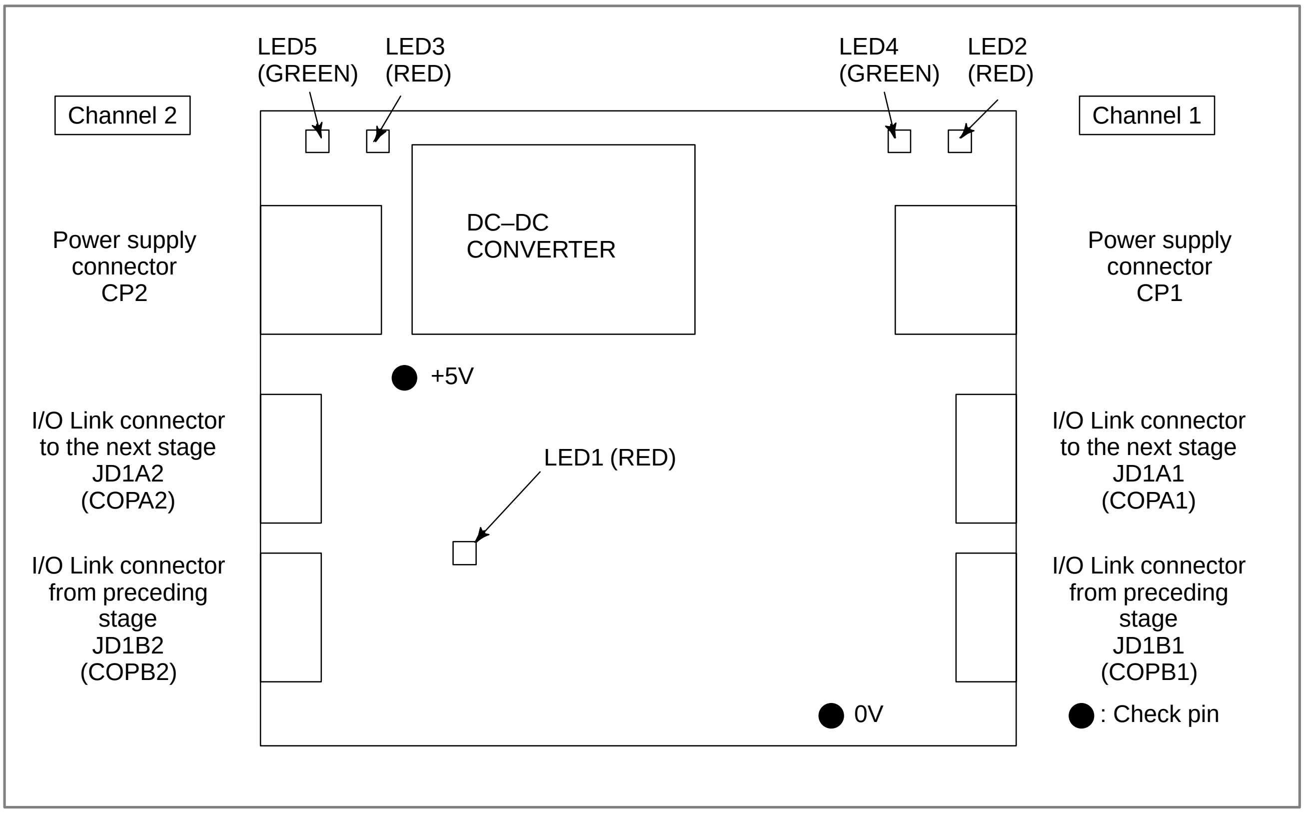


Fig. 6.11.2 (a)  LED locations

| | LED status | Description |
|---|---|---|
| 1 | LED1 □ | Normal |
| | LED1 ■ | A RAM parity error occurred because of a hardware failure. |
| 2 | LED4 LED2<br>■ □ | CP1 is supplied with the specified voltage. (Pilot lamp) |
| | LED4 LED2<br>□ ■ | CP1 is supplied with a voltage that is lower than specified or zero. |
| | LED4 LED2<br>■ ■ | A communication error occurred in a channel of CP1. |
| 3 | LED5 LED3<br>■ □ | CP2 is supplied with the specified voltage. (Pilot lamp) |
| | LED5 LED3<br>□ ■ | CP2 is supplied with a voltage that is lower than specified or zero. |
| | LED5 LED3<br>■ ■ | A communication error occurred in a channel of CP2. |

■: ON    □: OFF

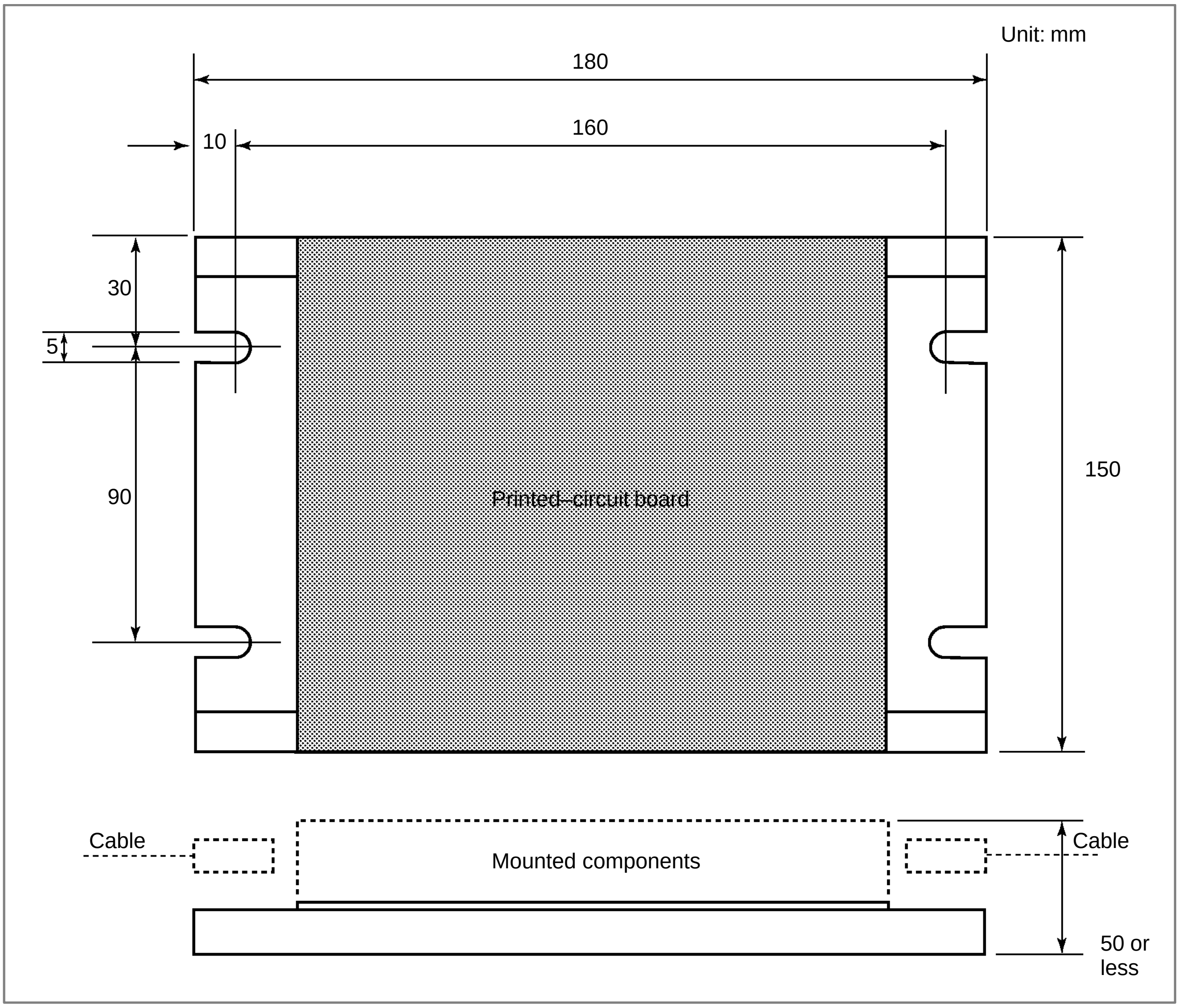


Fig. 6.11.2 (b) Outline drawing

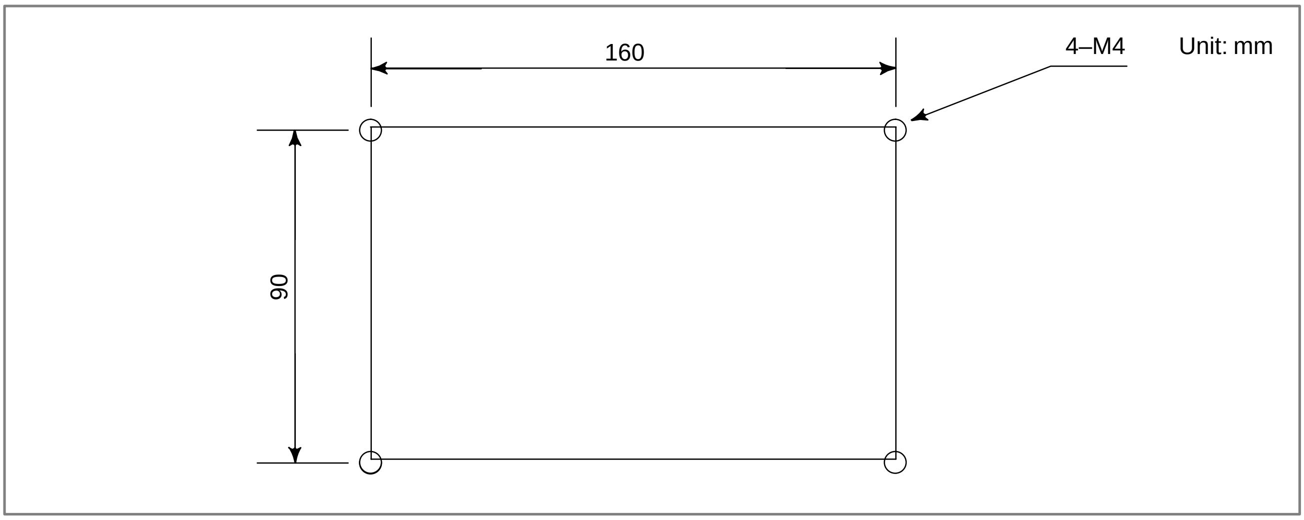
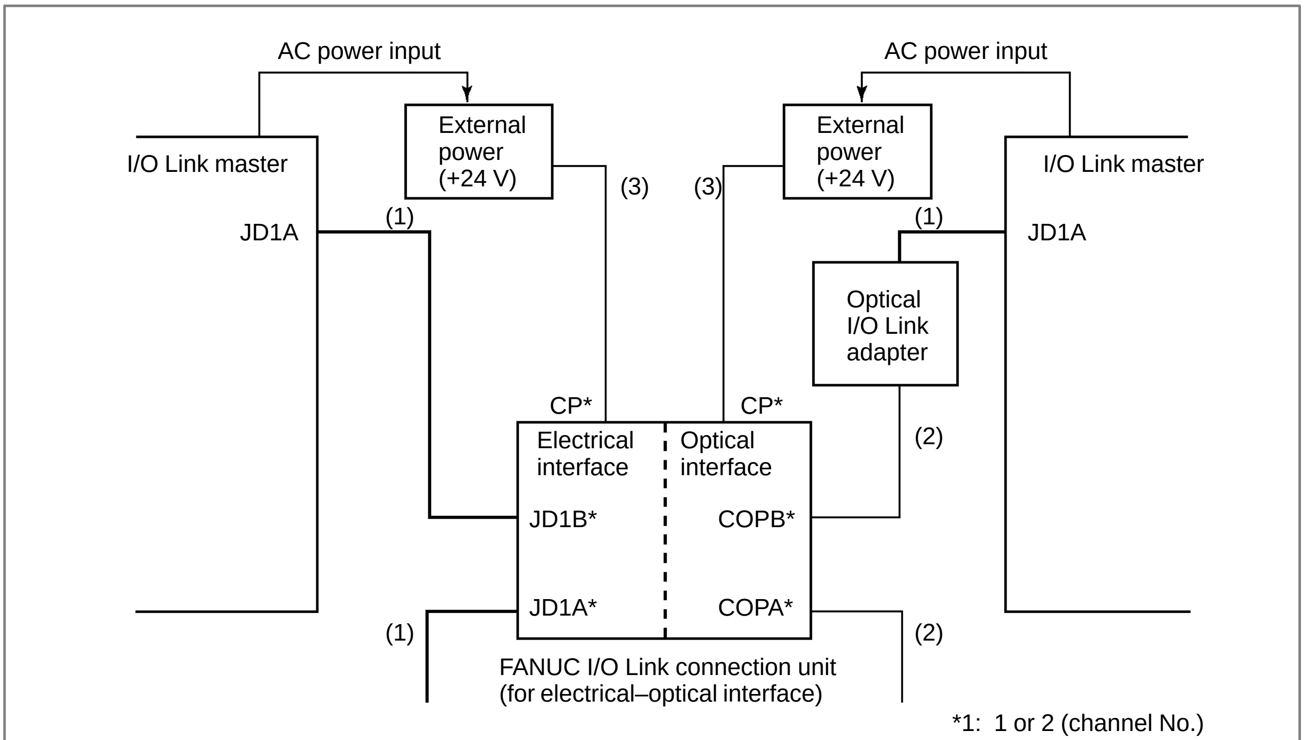


Fig. 6.11.2 (c) Mounting location

## 6.11.3 Connection

### 6.11.3.1 I/O Link interface

(1) Connection diagram (example)



*1: 1 or 2 (channel No.)

(1): Signal cable (electrical)
(2): Signal cable (optical)
(3): Power supply cable

Additionally, the FANUC I/O Link connection unit frame must be grounded.

[Name of I/O Link connection unit connectors]

Electrical–optical

| Connector name I/O Link interface | |
|---|---|
| Channel 1 | Channel 2 |
| JD1A1 | COPA2 |
| JD1B1 | COPB2 |
| CP1 | CP2 |

Electrical–electrical

| Connector name I/O Link interface | |
|---|---|
| Channel 1 | Channel 2 |
| JD1A1 | JD1A2 |
| JD1B1 | JD1B2 |
| CP1 | CP2 |

Optical–optical

| Connector name I/O Link interface | |
|---|---|
| Channel 1 | Channel 2 |
| COPA1 | COPA2 |
| COPB1 | COPB2 |
| CP1 | CP2 |

### (2) Signal cable (electrical)

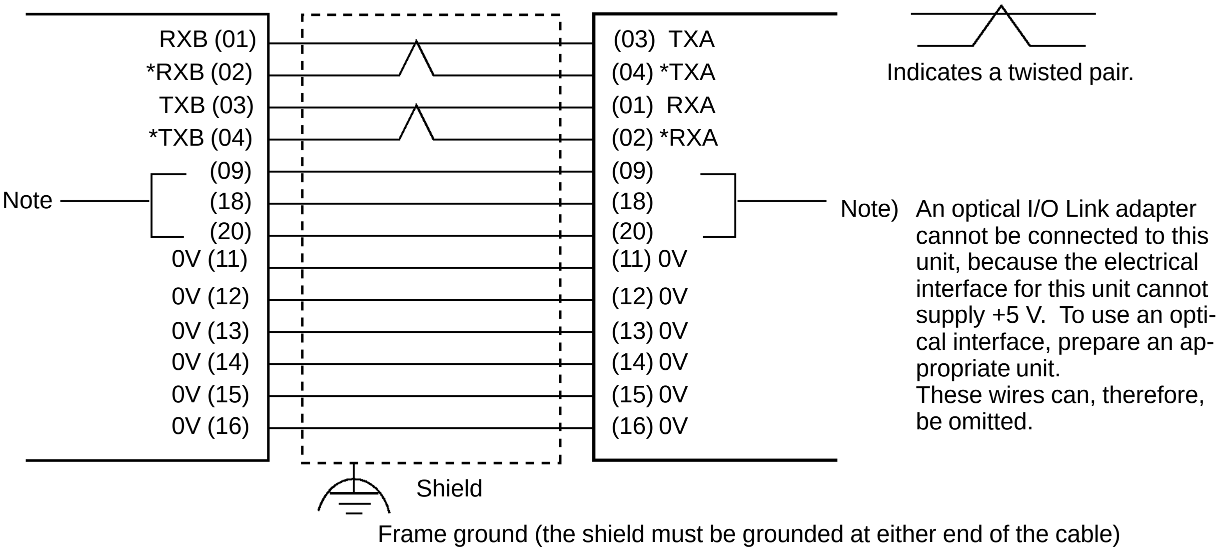
JD1A1/JD1A2

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

JD1B1/JD1B2

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

This unit (JD1A1/JD1A2) ↔ Another device (JD1B)
or
Another device (JD1A) ↔ This unit (JD1B1/JD1B2)



Indicates a twisted pair.

Note) 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 an appropriate unit. These wires can, therefore, be omitted.

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

- Cable–side connector specification: PCR–E20FA (manufactured by Honda Tsushin)
- Recommended cable material specification: A66L–0001–0284#10P
- Cable length: 10 m (maximum)

(3) Signal cable (optical)
See Subsec. 6.2.3.

(4) Power supply cable

CP1/CP2 connector

|   | 1 | 2 | 3 |   |
|---|---|---|---|---|
| Y | +24 V | 0 V |   | (Input) |
| X | +24 V | 0 V |   | (Output) |

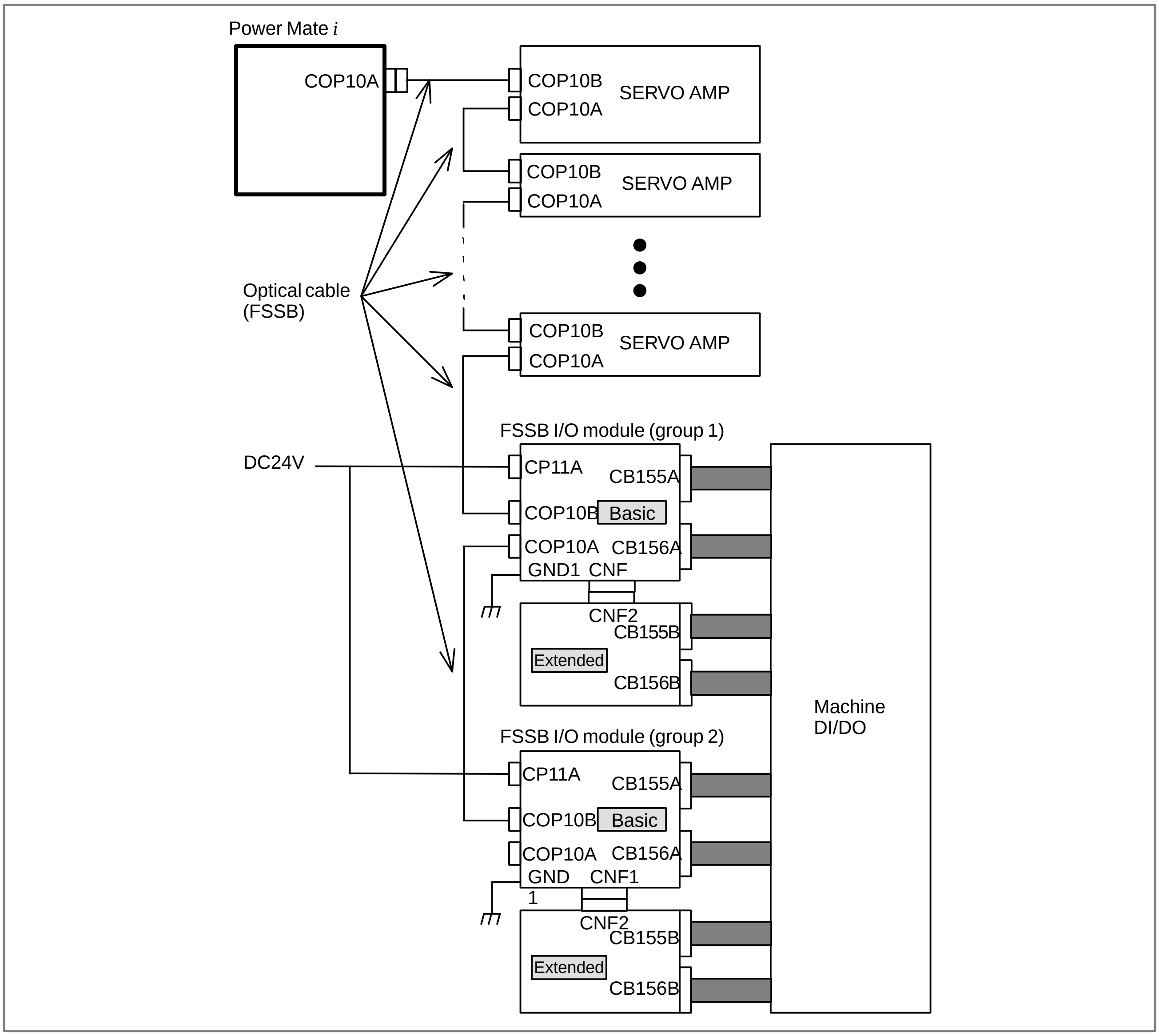
- 24 VDC is supplied via a Y–connector. Provided the power supply has sufficient capacity, power can be supplied to another device with the X–side as output. (On the other hand, the X–connector can be used for input, and the Y–connector, for output.)
- Power must be supplied to both CP1 and CP2.
- Cable–side 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.

## 6.12 FSSB I/O MODULE

The FSSB I/O module is an I/O module that can be connected to the Power Mate with the FANUC serial servo bus (FSSB).

### 6.12.1 Overview



1) The FSSB I/O module is connected to the Power Mate *i* with an optical cable as one unit on the FANUC serial servo bus (FSSB). Although it is mounted on the final stage of the FSSB line in the figure above, it can also be connected to the position nearest the Power Mate *i* or between two servo amplifiers.
2) Up to two FSSB I/O module groups can be used. If, however, a separate detector I/F unit is used, the separate detector I/F unit is regarded as being one group. Up to two groups can be used, including this group.
3) An FSSB I/O module group consists of one basic unit or of one basic unit and one extended unit.

4) The FSSB cable (optical fiber cable) used should be selected from the ordering list.
5) The signals directly seen by the CNC, such as emergency stop and skip signals, must be input from the built–in I/O unit or from the I/O unit for FANUC I/O Link.
6) When it is ON, the FSSB I/O module cannot be removed from the FSSB line.
7) To determine when extended units will be ready for shipment, contact FANUC.

## 6.12.2
## Specifications

1) Installation requirements

| | |
|---|---|
| Ambient temperature | Operating 0°C to 55°C<br>Storage and transit –20°C to 60°C |
| Humidity | Same as that for the Power Mate *i*. (See Section 3.1.) |
| Vibration | Same as above |
| Contamination | Same as above |
| Ionic (nonionic) radiation | Same as above |
| Height above sea level | Same as above |

2) Ordering specifications

| Name | Specification | Remarks |
|---|---|---|
| FSSB I/O module, basic unit | A02B–0236–C211 | DI/DO : 32/24 (points) |
| FSSB I/O module, extended unit | A02B–0236–C212 | DI/DO : 32/24 (points) |
| Flat cable for the FSSB I/O module | A02B–0236–K831 | |
| Spare fuse | A03B–0815–K001 | Fuse for 24 VDC (1.0A) |

3) Unit specifications

| Item | Specification | Remarks |
|---|---|---|
| Power capacity | Voltage DC+24V ± 10% (including an instantaneous value and ripple)<br>Current 0.3A+7.3mA × DI | DI : Number of DI points to be turned ON simultaneously |
| Number of DI points | Basic: 32 points<br>Basic + extended: 64 points | |
| Number of DO points | Basic: 24 points<br>Basic + extended: 48 points | Source type output |
| DO maximum load current | Basic: 2.1 A<br>Extended: 2.1 A | |
| DI/DO connector specifications | Conforms to the MIL–C–83503 standard.<br>Provided with a polarizing key to prevent incorrect insertion<br>FANUC purchasing specification: A02B–0124–K300 | |
| Input/output signal specifications | See Sections 6.3.1 and 6.3.2. | |
| Interface with the CNC | FANUC serial servo bus (FSSB) | |
| Number of units that can be connected | Up to two groups can be connected to the FSSB line.<br>One group consists of one basic unit or of one basic unit and one extended unit | Up to two groups can be used in total, with a separate detector I/F unit being regarded as one group. |
| DI (input signal specifications) | See Section 6.3.1. | In addition, the time of transfer between the FSSB I/O module and the Power Mate, 16 ms (max.), plus the ladder scan period (due to the ladder) must be considered. |
| DO (output signal specifications) | See Section 6.3.2.<br>Driver delay time 50μs (MAX) | Same as above |

4) Notes

1 All the DOs in the unit are designed to be turned OFF if the Power Mate *i* generates a system alarm or if a communication alarm is generated during communication between the Power Mate *i* and the unit. Consider this fully when creating a machine sequence to ensure that the sequence is fail safe. The DOs are also turned OFF when the Power Mate *i* or the unit is turned OFF.

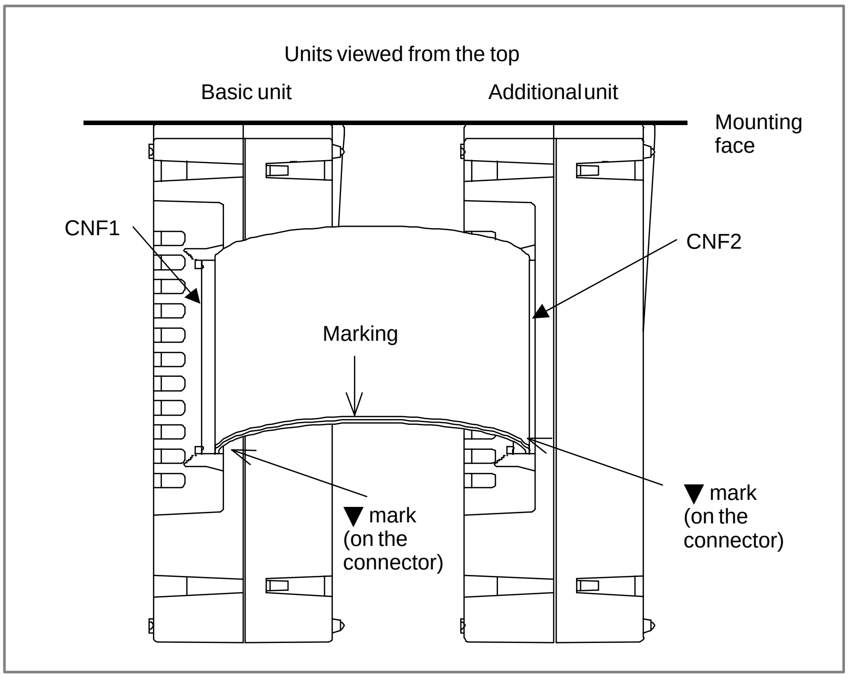
2 When the second group is used as an option, and is removed, a parameter (No. 1905) must be changed. All the DIs from the second group become “0”.

3 When an extended unit is used as an option, and is removed, all the DIs from the extended unit become “0”.

4 The FSSB I/O module on the FSSB line that is nearer the Power Mate is assumed to be group 1, while the farther one is assumed to be group 2. If there is only one FSSB I/O module group, it is assumed to be group 1. (Group 1 cannot be used as an option.)

## 6.12.3
## Connection between Basic and Extended Units

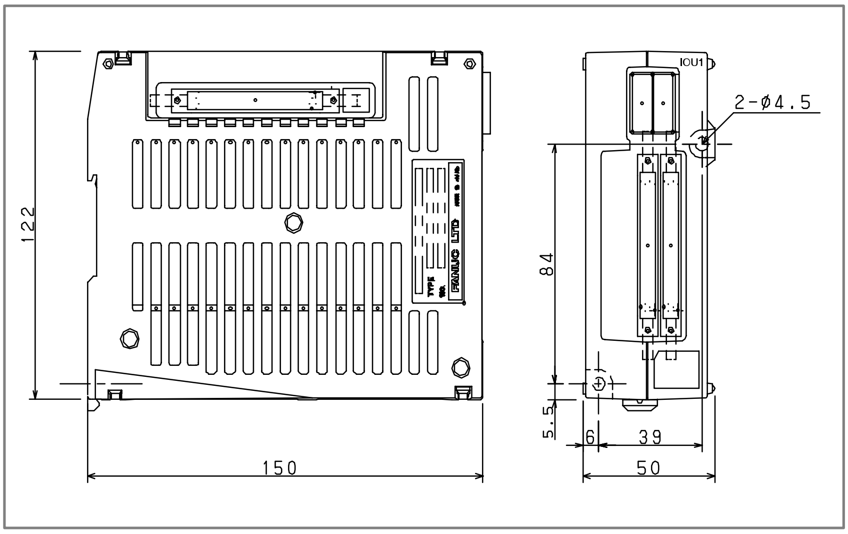
An additional unit must be connected to a basic unit with a flat cable, as shown below. The flat cable is 100 mm long.



**NOTE**
Order the flat cable together with an extended unit.

## 6.12.4 Mounting

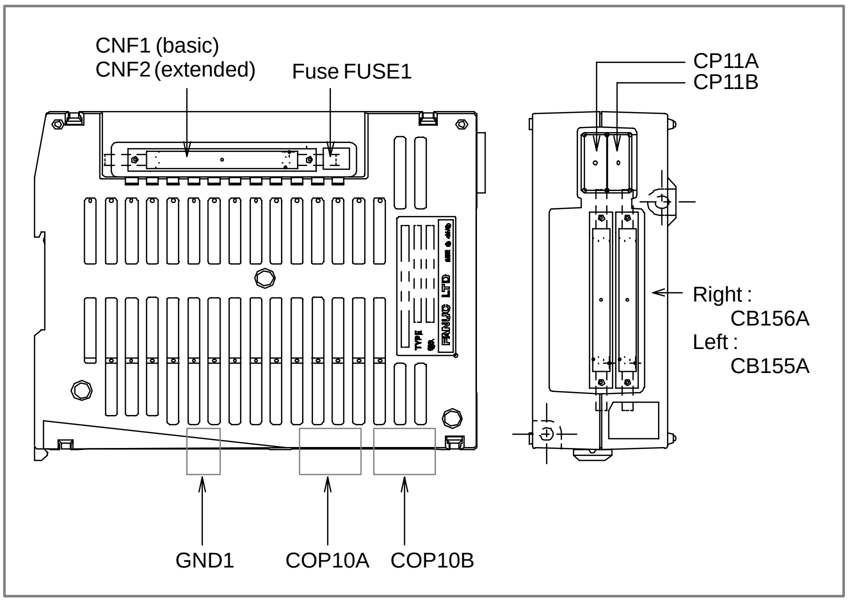
1) Outside dimensions



**NOTE**

The above figure is an outline drawing of the basic unit. The extended unit has the same outside dimensions.

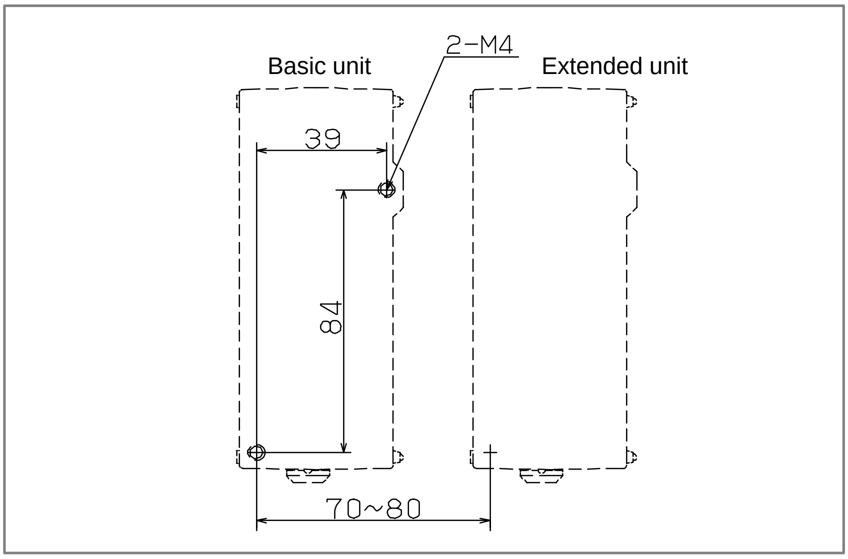
2) Positions of the fuse and connectors



**NOTE**

The above figure shows the positions of the fuse and connectors of the basic unit. The extended unit does not have fuse FUSE1 nor connectors CP11A, CP11B, COP10A, and COP10B.

3) Mounting holes used for mounting with screws



**Mounting hole drilling diagram**

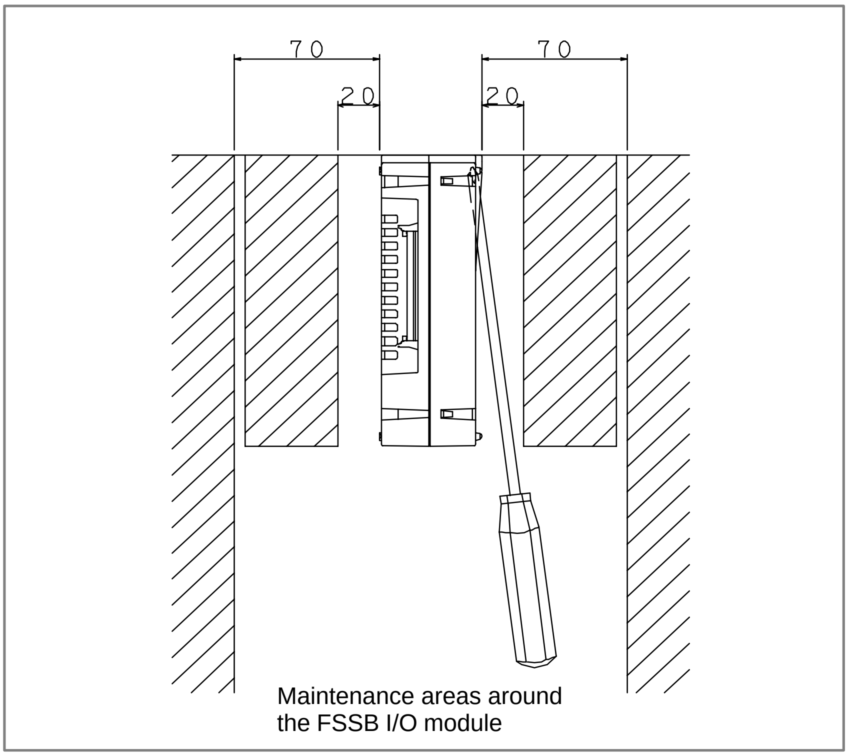
When using both the basic and additional units, the spacing between the mounting holes must be 70 to 80 mm, as shown in the figure above.

**NOTE**

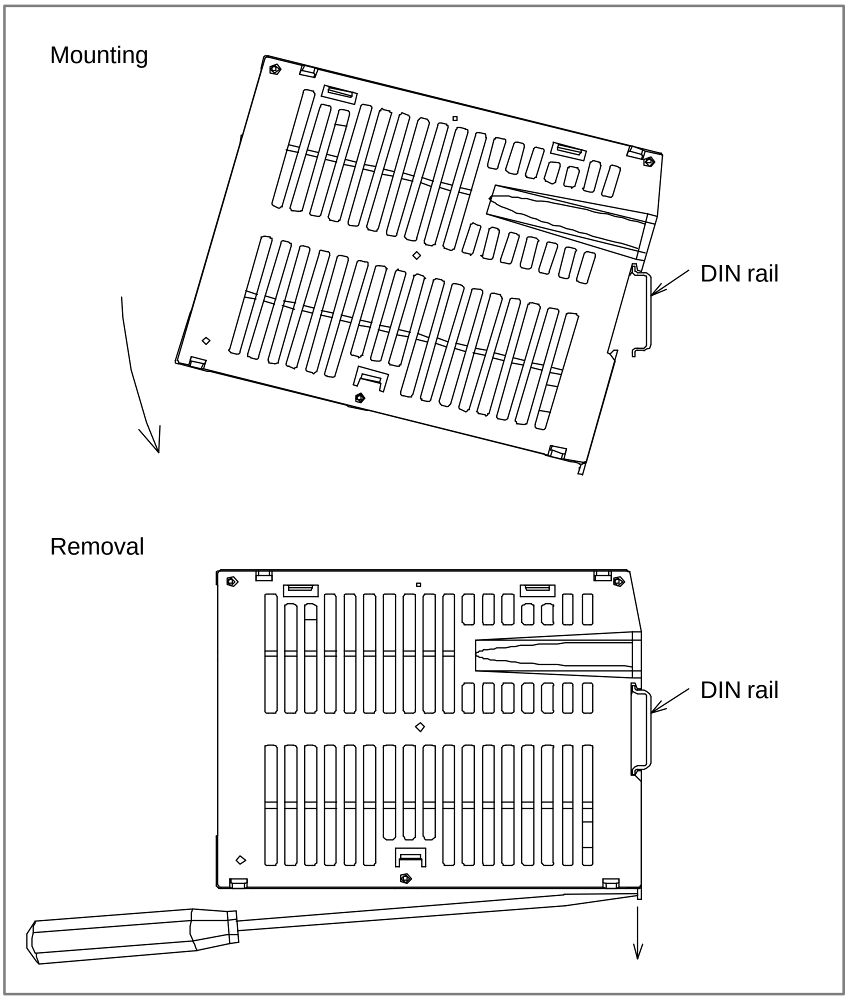
To mount and remove the unit, the screwdriver must be inserted into the right and left areas obliquely. An adequate maintenance area is, therefore, required on both sides of the unit.

As a rough guide, if the depth of the adjacent unit is equal to or less than that of the unit to be mounted, leave a space of about 20 mm between the units. If the depth of the adjacent unit is greater than the unit to be mounted, leave a space of about 70 mm between the units.

When mounting the unit near the side of the cabinet, leave a space of about 70 mm between the unit and the side of the cabinet.



4) Mounting the unit on the DIN rail



**Mounting the unit**

1. Hang the hook of the unit on the top end of the DIN rail.
2. Press the unit firmly until it snaps into place.

**Removing the unit**

1. Pull the lock downward using a slotted screwdriver or similar.
2. Pull the lower part of the unit toward you to remove the unit.

**CAUTION**

1 When removing the unit, take care not to damage the lock by applying excessive force.

2 When mounting and removing the unit, hold the top and bottom whenever possible and avoid applying force to the sides (with slits) of the unit.

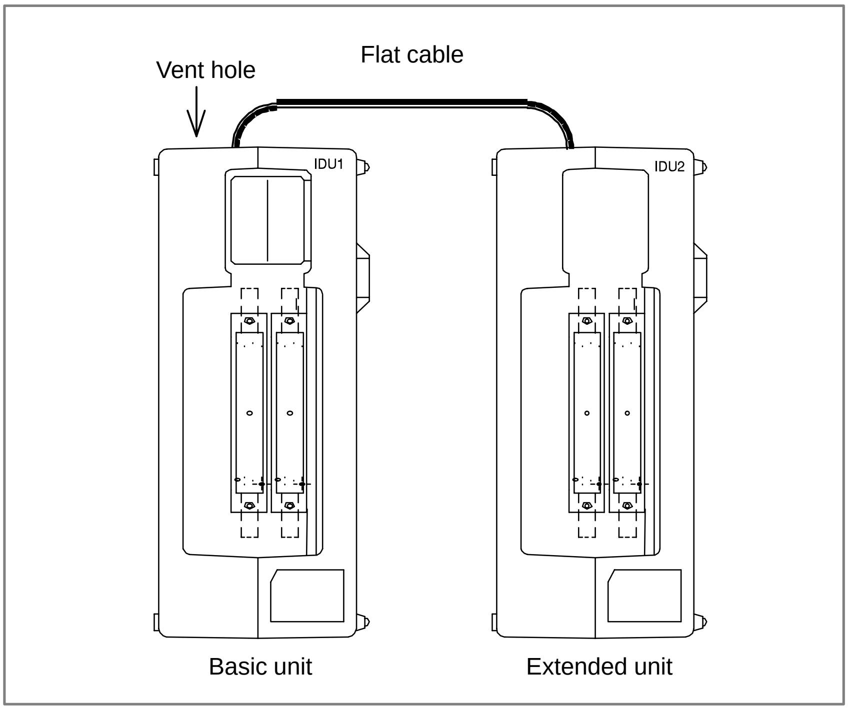
3 Leave a maintenance area of 100 mm or greater below the unit.

5) Notes on mounting

(1) Use the unit inside a hermetically sealed cabinet.

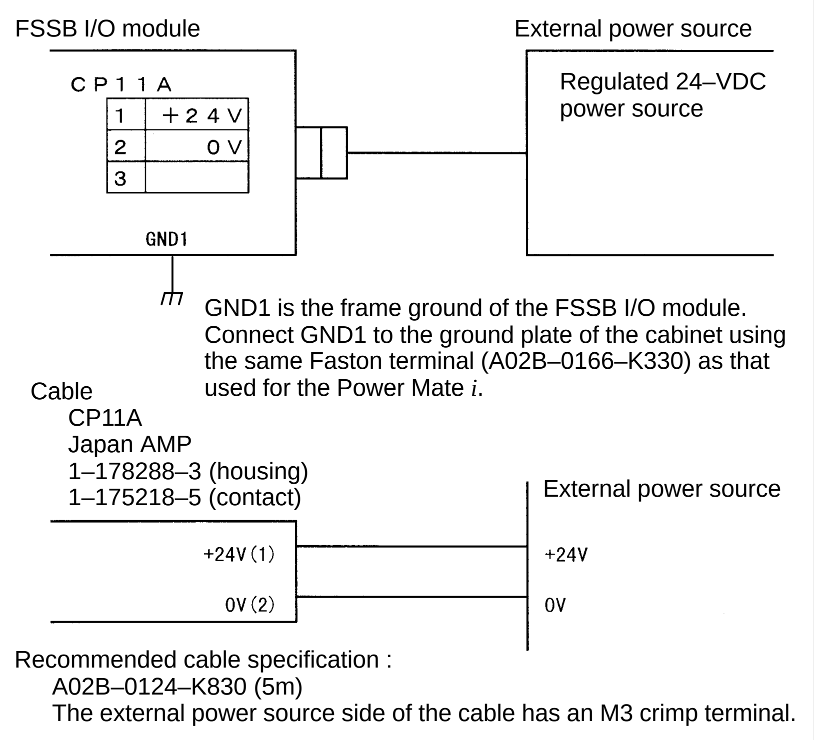
(2) Mount the unit on a vertical face. Leave a space of 100 mm or greater both above and below the unit. Do not place a device that generates large amounts of heat below the unit.

(3) When using both basic and extended units, mount them as shown in the figure below, so that the flat cable connecting the units does not block the vent hole of the basic unit.



## 6.12.5
## Connecting the Power

The power to the FSSB I/O module must be supplied from an external 24–VDC stabilized power source.



GND1 is the frame ground of the FSSB I/O module. Connect GND1 to the ground plate of the cabinet using the same Faston terminal (A02B–0166–K330) as that used for the Power Mate *i*.

Cable
CP11A
Japan AMP
1–178288–3 (housing)
1–175218–5 (contact)

Recommended cable specification :
A02B–0124–K830 (5m)
The external power source side of the cable has an M3 crimp terminal.

The 24–VDC power input to CP11A can be extracted from CP11B. The connection of CP11B is the same as that of CP11A.

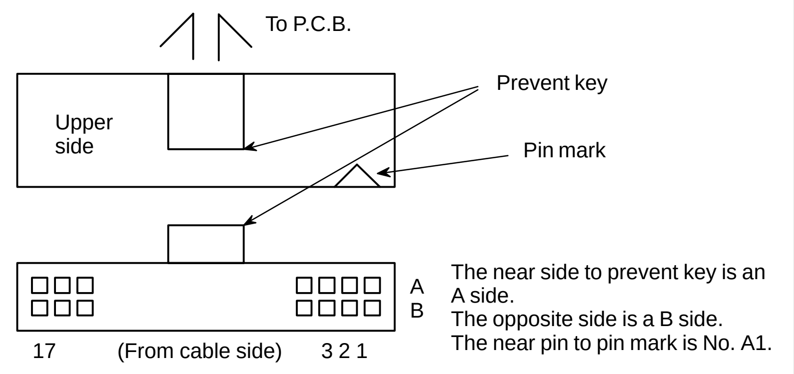
## 6.12.6
## Connection Cable to I/O

(1) When the cable is run outside the cabinet, use a common shield cable.
34 pin cable with shild (soldering type)

| | |
|---|---|
| OKI DENSEN CO., LTD. | SFX–S 34–7/0.127 3030–SV (20266) K |
| FANUC SPECIFICATION | A66L–0001–0308#S34S |

Clamp the cable shield with the cable clamp on the grounding plate of the cabinet on the I/O module side.
When the cable used is not a shield cable, it must be used only within the cabinet.

(2) Pin No. of connector



The near side to prevent key is an A side.
The opposite side is a B side.
The near pin to pin mark is No. A1.

(3) Ensure that the cable is securely plugged into the unit. Otherwise, problems such as DI/DO signal transfer errors may occur.

## 6.12.7 Signals

(1) DI Signals

| PMC ADDRESS | #7 | #6 | #5 | #4 | #3 | #2 | #1 | #0 |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| | 155A–B05 | 155A–A06 | 155A–B04 | 155A–A04 | 155A–B03 | 155A–A03 | 155A–B02 | 155A–A02 |

| | #7 | #6 | #5 | #4 | #3 | #2 | #1 | #0 |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| | 155A–B10 | 155A–A10 | 155A–B09 | 155A–A09 | 155A–B08 | 155A–A08 | 155A–B07 | 155A–A07 |

| | #7 | #6 | #5 | #4 | #3 | #2 | #1 | #0 |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| | 156A–B05 | 156A–A05 | 156A–B04 | 156A–A04 | 156A–B03 | 156A–A03 | 156A–B02 | 156A–A02 |

| | #7 | #6 | #5 | #4 | #3 | #2 | #1 | #0 |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| | 156A–B10 | 156A–A10 | 156A–B09 | 156A–A09 | 156A–B08 | 156A–A08 | 156A–B07 | 156A–A07 |

☐ DC input signal B

(2) DO Signals

| | #7 | #6 | #5 | #4 | #3 | #2 | #1 | #0 |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| | 155A–B14 | 155A–A14 | 155A–B13 | 155A–A13 | 155A–B12 | 155A–A12 | 155A–B11 | 155A–A11 |

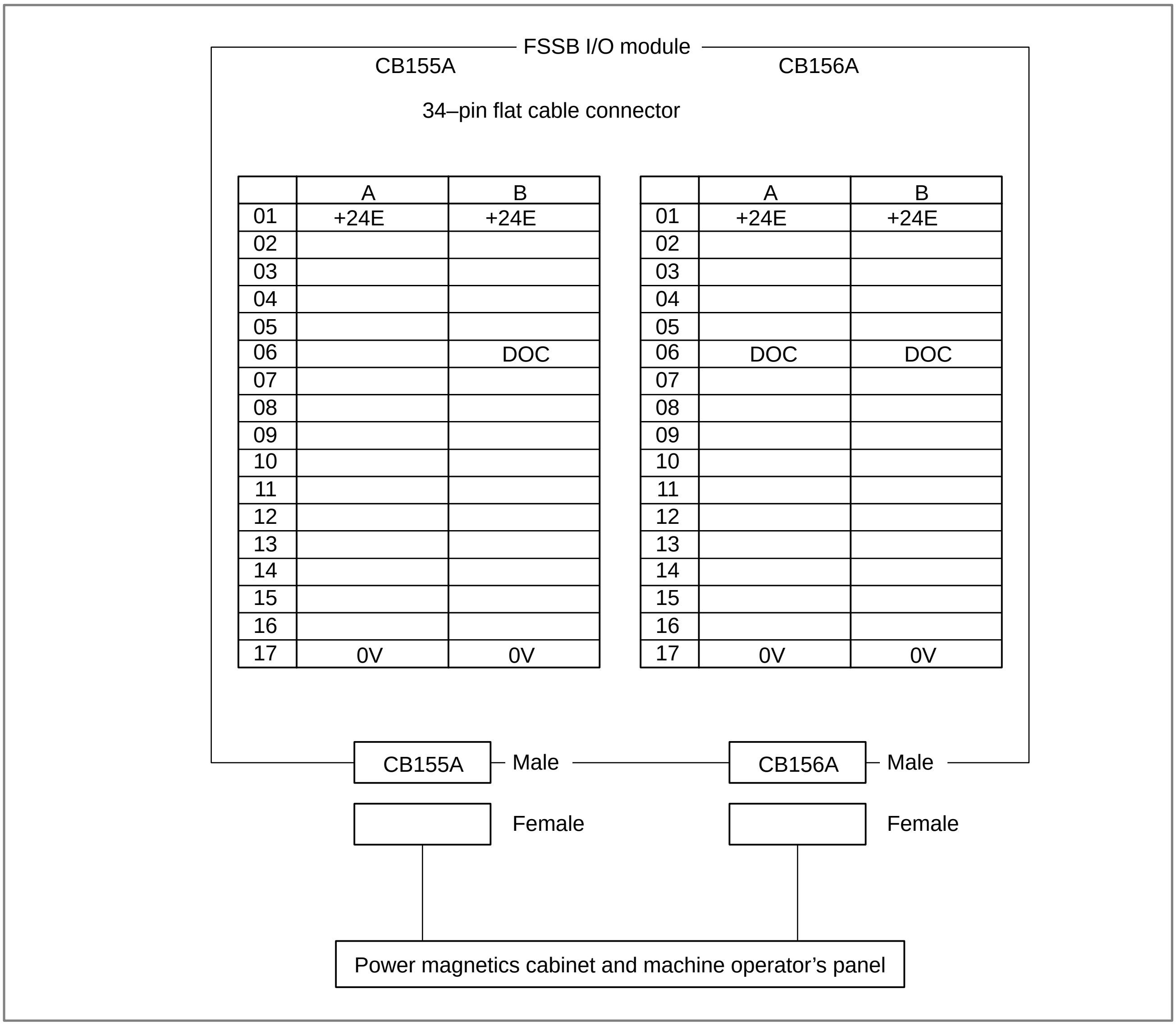
| | #7 | #6 | #5 | #4 | #3 | #2 | #1 | #0 |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| | 156A–B16 | 156A–A16 | 156A–B15 | 156A–A15 | 155A–B16 | 155A–A16 | 155A–B15 | 155A–A15 |

| | #7 | #6 | #5 | #4 | #3 | #2 | #1 | #0 |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| | 156A–B14 | 156A–A14 | 156A–B13 | 156A–A13 | 156A–B12 | 156A–A12 | 156A–B11 | 156A–A11 |

**NOTE**

1. For PMC addresses, the R area of the PMC is used. The DIs and DOs of the FSSB I/O module, the start address of the R area, and its size are specified with parameters.
2. The above figures show the signals of the basic unit. For the extended unit, 155A is replaced by 155B, and 156A by 156B.

## 6.12.8
## Machine Interface



CB155A

| | A | B |
|---|---|---|
| 01 | +24E | +24E |
| 02 | | |
| 03 | | |
| 04 | | |
| 05 | | |
| 06 | | DOC |
| 07 | | |
| 08 | | |
| 09 | | |
| 10 | | |
| 11 | | |
| 12 | | |
| 13 | | |
| 14 | | |
| 15 | | |
| 16 | | |
| 17 | 0V | 0V |

CB156A

| | A | B |
|---|---|---|
| 01 | +24E | +24E |
| 02 | | |
| 03 | | |
| 04 | | |
| 05 | | |
| 06 | DOC | DOC |
| 07 | | |
| 08 | | |
| 09 | | |
| 10 | | |
| 11 | | |
| 12 | | |
| 13 | | |
| 14 | | |
| 15 | | |
| 16 | | |
| 17 | 0V | 0V |

**NOTE**

1 +24E (output)
A voltage of 24 VDC supplied to the Power Mate main unit is connected through a fuse an used for DI signals. Do not connect an external 24 VDC output to this pin. Do not connect is to DOC either.

2 DOC (external 24 VDC input)
An external voltage of 24 VDC should be supplied for DO signals.

## 6.12.9
## Details of DI/DO Connections

See detailed descriptions about DI and DO points of the built–in I/O module in Sections 6.4.4 and 6.4.5. In this case, read CB155 and CB156 as CB155A and CB156A, respectively. Also note that the X and Y addresses differ.

## 6.12.10
## Address Assignment

1) Parameters related to FSSB I/O module setup
   Because the FSSB setup mode does not support automatic setup mode (1902#0 = 0), perform setup in manual setup mode (1902#0 = 1).

| | #7 | #6 | #5 | #4 | #3 | #2 | #1 | #0 |
|---|---|---|---|---|---|---|---|---|
| 1905 | | | IO2 | IO1 | | | | |

**[Data type]** Bit axis

First axis

**IO1 :** Specifies whether the FSSB I/O module basic unit in the first group is to be used.

0 : Not used
1 : Used

**IO2 :** Specifies whether the FSSB I/O module basic unit in the second group is to be used.

0 : Not used
1 : Used

Second axis

**IO1 :** Specifies whether the FSSB I/O module extended unit in the first group is to be used.

0 : Not used
1 : Used

**IO2 :** Specifies whether the FSSB I/O module extended unit in the second group is to be used.

0 : Not used
1 : Used

**NOTE**
1 For the FSSB I/O module only, both I01 and IO2 can be set in the same axis.
2 In each group, do not set up the FSSB I/O module so that only the extended unit is used.

| | |
|---|---|
| 1910 to 1919 | Address translation table value (ATR) for slave X |

If the slave is an FSSB I/O module, set the following:

"16" for the first group (group nearer the Power Mate)
"48" for the second group (group farther from the Power Mate)

2) Parameters related to address setting
The addresses for an FSSB I/O module exist in the R area. Specify the start address of the R area and its size with parameters.

| 1960 | Start address of the R area for the DIs of the FSSB I/O module in the first group |
|---|---|
| 1964 | Start address of the R area for the DIs of the FSSB I/O module in the second group |

**[Data type]** Word

**[Valid data range]** See below. The range differs depending on the PMC type.

| PMC type | Allowable R range |
|---|---|
| PMC–SB5 | 0 to 1499, 9100 to 9117 |
| PMC–SB6 | 0 to 2999, 9100 to 9117 |

| 1961 | Size of the R area for the DIs of the FSSB I/O module in the first group |
|---|---|
| 1965 | Size of the R area for the DIs of the FSSB I/O module in the second group |

**[Data type]** Byte

**[Unit of data]** Byte

**[Valid data range]** 0 to 4 (for a basic unit only)
0 to 8 (for a basic unit plus an extended unit)

**[Explanation]** Only the DI data for the FSSB I/O module in the R area with the start address specified with parameter No. 1960 or 1964 and the size specified with parameter No. 1961 or 1965 is valid.
The data for the first group is valid when bit 4 (IO1) of parameter No. 1905 is 1. The data for the second group is valid when bit 5 (IO2) of parameter No. 1905 is 1.

> **NOTE**
> The end address resulting from adding the size specified with parameter No. 1961 or 1965 to the start address specified with parameter No. 1960 or 1964 must not exceed the data range for parameter No. 1960 or 1964. Otherwise, no data can be transferred.

| 1962 | Start address of the R area for the DOs of the FSSB I/O module in the first group |
|---|---|
| 1966 | Start address of the R area for the DOs of the FSSB I/O module in the second group |

**[Data type]** Word

**[Valid data range]** See below. The range differs depending on the PMC type.

| PMC type | Allowable R range |
|---|---|
| PMC–SB5 | 0 to 1499, 9100 to 9117 |
| PMC–SB6 | 0 to 2999, 9100 to 9117 |

| 1963 | Size of the R area for the DOs of the FSSB I/O module in the first group |
|---|---|
| 1967 | Size of the R area for the DOs of the FSSB I/O module in the second group |

**[Data type]** Byte

**[Unit of data]** Byte

**[Valid data range]** 0 to 3 (for a basic unit only)
0 to 6 (for a basic unit plus an extended unit)

**[Explanation]** Only the DO data for the FSSB I/O module in the R area having the start address specified with parameter No. 1962 or 1966 and the size specified with parameter No. 1963 or 1967 is valid.
The data for the first group is valid when bit 4 (IO1) of parameter No. 1905 is set to 1. The data for the second group is valid when bit 5 (IO2) of parameter No. 1905 is set to 1.

**NOTE**

The end address resulting from adding the size specified with parameter No. 1963 or 1967 to the start address specified with parameter No. 1962 or 1966 must not exceed the data range for parameter No. 1962 or 1966. Otherwise, no data can be transferred.

| 1968 | Address of the R area for DO alarm detection |
|---|---|

**[Data type]** Byte

**[Valid data range]** See below. The range differs depending on the PMC type.

| PMC type | Allowable R range |
|---|---|
| PMC–SB5 | 0 to 1499, 9100 to 9117 |
| PMC–SB6 | 0 to 2999, 9100 to 9117 |

**[Explanation]** This parameter specifies the address indicating which unit has detected a DO alarm.

**Information in the R address specified with parameter No. 1968**

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Undefined | Undefined | Undefined | Undefined | EXDVAL2 | DVAL2 | EXDVAL1 | DVAL1 |

The bits indicates the following when equal to “1”:

DVAL1: A DO alarm has been detected in the basic unit of group 1.

EXDVAL1: A DO alarm has been detected in the extended unit of group 1.

DVAL2: A DO alarm has been detected in the basic unit of group 2.

EXDVAL2: A DO alarm has been detected in the extended unit of group 2.

3) DO (output signal) alarm detection
The DO driver of the FSSB I/O module is capable of detecting an excess load current and measuring its own temperature. If an accident, such as connecting the cable to ground, causes an abnormal increase in the load current, or if the DO driver becomes abnormally hot for some reason, a protection circuit, which is provided for each DO driver (1 byte), is activated, which keeps the DO signal for the relevant 1 byte in the OFF state until the cause of the problem is eliminated. Even if this occurs, the Power Mate *i* and the unit do not generate an alarm but instead continue operating. The above R area identifies which unit has detected an alarm. Bit value “1” indicates that the corresponding unit has detected an alarm. Thus, which unit has detected a DO error can be checked on the DGN screen of the Power Mate. Performing DO alarm processing in advance by using Ladder ensures safety and assists in fault investigation and recovery.

**NOTE**
If the ladder program does not perform DO alarm processing in advance, the Power Mate cannot detect an error in the DO driver.

4) Timing at which the FSSB I/O module data becomes valid
The I/O unit connected to an FSSB I/O module does not start data transfer unless both the PMC and the servo are started. (There is a time delay before the data becomes valid.) It is necessary to determine whether the data from the FSSB I/O module is valid using the FSSB I/O module data enable (FSSB) parameter, shown below, before using the data.

| | #7 | #6 | #5 | #4 | #3 | #2 | #1 | #0 |
|---|---|---|---|---|---|---|---|---|
| F082 | | | | | | | | FSSB |

**FSSB** 0 : The data from the FSSB I/O module is invalid.
1 : The data from the FSSB I/O module is valid.

5) Additional explanation

1 The addresses in the R area for each group, DIs, and DOs must be unique.

2 The R area may be used for other units. The addresses for the units must also be unique.

3 Data simultaneity is assured in units of one byte, starting with the start address.

# 7 CONNECTION TO FA NETWORKS

## 7.1 OVERVIEW

The Power Mate *i* has two FA network expansion slots for connection to an upper controller/personal computer and to a lower I/O device.
Up to two of the following boards can be selected. The two must be different boards.

**Table 7.1**

| Board name | Board specification | Relevant section |
|---|---|---|
| High–speed serial bus (HSSB) board | A20–B0259–J200 | Section 7.2 |
| FANUC I/O Link–II slave board | A20–B0259–J210 | Section 7.3 |
| FANUC I/O Link–II slave board B | A20–B0259–J282 | |
| Ethernet board | A20–B0259–J230 | Section 7.4 |
| FANUC FL–net board | A20–B0259–J272 | Section 7.5 |
| PROFIBUS–DP slave board | A20–B0259–J220 | Section 7.6 |
| PROFIBUS–DP master board | A20–B0259–J221 | |
| DeviceNet slave board | A20–B0259–J240 | Section 7.7 |
| DeviceNet slave board B | A20–B0259–J242 | |
| DeviceNet master board | A20–B0259–J241 | |
| DeviceNet master board B | A20–B0259–J243 | |

**NOTE**

1. The PROFIBUS–DP board cannot be used together with the DeviceNet board at the same time.
2. The DeviceNet slave board and DeviceNet master board must be inserted and removed by following special procedures. There is no special procedure for inserting and removing the DeviceNet slave board B/C and DeviceNet master board B.
3. When the PROFIBUS–DP slave board and PROFIBUS–DP master board are used at the same time, some restrictions may be imposed on the cable–side connector depending on the axis control card specified.

**CAUTION**

This chapter extracts a brief description of each FA network and an explanation of how to connect each FA network from related manuals. In actual connection, follow the instructions described in the relevant manual. If there is a discrepancy in description between this connection manual and the relevant manual, the description in the relevant manual takes priority.

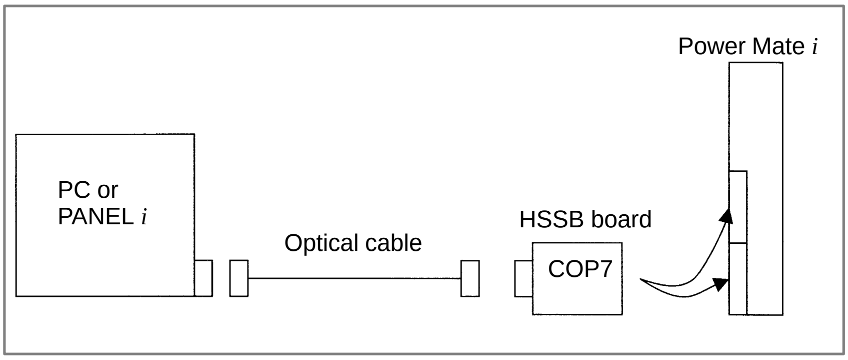
# 7.2 HIGH SPEED SERIAL BUS (HSSB)

## 7.2.1 Overview

The high speed serial bus (referred to as HSSB in the remainder of this manual) enables the Power Mate *i* to be connected to an IBM personal computer or compatible (referred to as the PC) or PANEL *i* via a optical cable, allowing the transfer of large–volume data at high speed.

On the Power Mate *i*, the HSSB board must be mounted in an FA network expansion slot. On the PC, the HSSB PC interface board must be mounted.

## 7.2.2 Connection



1 The HSSB board for the Power Mate *i* is inserted into an FA network expansion slot of the Power Mate *i*. The HSSB board is connected to the PC or PANEL *i* via optical connector COP7 on the board.

2 For information on the optical cable, see Appendix D. The cable used for HSSB is for external lines. The maximum cable length is 100 m.

## 7.2.3 HSSB Board for the Power Mate *i*

HSSB board for the Power Mate *i* supports a 100–m cable.

The PANEL *i* or the HSSB PC interface board must support the use of a 100–m cable.

## 7.2.4 HSSB DC Interface Boards

Which of the following four HSSB PC interface boards can be used with the Power Mate *i*.

| Drawing number | Bus | Remarks |
|---|---|---|
| A20B–8001–0583 | ISA | 1 HSSB channel |
| A20B–8001–0582 | ISA | 2 HSSB channels |
| A20B–8001–0961 | PCI | 1 HSSB channel |
| A20B–8001–0960 | PCI | 2 HSSB channels |

Other HSSB interface boards cannot be used.

**NOTE**

For information on interface boards for PCs, refer to the “FANUC Open CNC High Speed Serial Bus Type 2 Specifications” (A–59770E or ”FANUC High Speed Serial Bus Type 2 Connection and Maintenance Manual” (A–73527E)).

### 7.2.5
### PANEL *i*

PANEL *i* can be connected with the Power Mate *i*.

**NOTE**

For information on intelligent terminals, refer to the “FANUC PANEL *i* Connection and Maintenance Manual” (A–81000E).

## 7.3 FANUC I/O Link–II BOARD

### 7.3.1 Overview

The FANUC I/O Link–II board provides an I/O network conforming to OPCN–1, as laid down by the Japan Electric Manufacturers' Association (JEMA). In the Power Mate *i*, the FANUC I/O Link–II board can be selected as an FA network option board.

The I/O Link–II function has the features listed below.

(1) A connection can be made with devices (including devices produced by other manufacturers) that conform to OPCN–1.

(2) The power to a slave station on the network can be turned on and off at any time without affecting communications performed by other devices.

(3) Up to thirty–one slave stations can be connected to one master station.

(4) The slave function includes a global I/O transfer function (allowing a slave station to receive DO data from other slave stations).

**NOTE**
For the I/O Link–II, refer to the "FANUC I/O Link–II Connection Manual" (B–62714EN).

With the Power Mate *i*, the I/O Link–II slave board and I/O Link–II slave board B are used. These two types of slave boards differ in the interface connector.

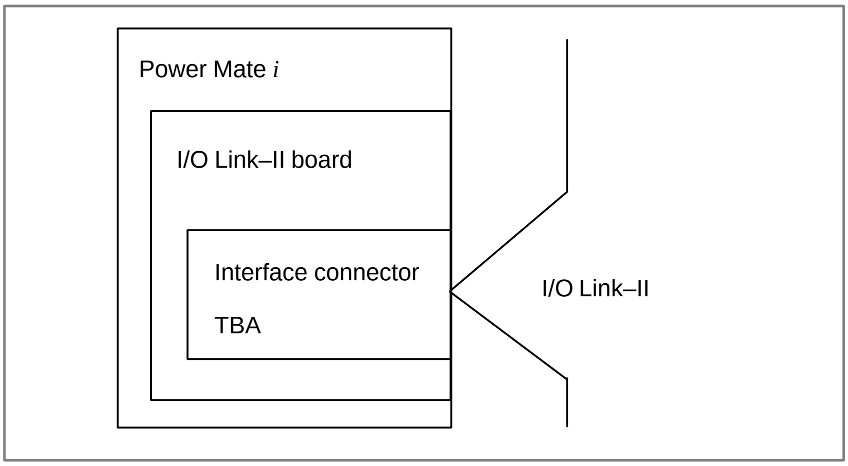
The specifications of the I/O Link–II slave board are as follows:

| Name | I/O Link–II slave board |
|---|---|
| **Ordering code** | A02B–0259–J210 |
| **Board drawing number** | A20B–8100–0310 |
| **Interface connector** | Connector manufactured by Phoenix Contact |
| **Power supply capacity** | 24 VDC ±10%, 0.3 A (to be supplied from the main unit) |
| **Heat dissipation** | 6 (W) |

The specifications of I/O Link–II slave board B are as follows:

| Name | I/O Link–II slave board B |
|---|---|
| **Ordering code** | A02B–0259–J282 |
| **Board drawing number** | A20B–8100–0381 |
| **Interface connector** | Connector manufactured by Hirose Electric |
| **Power supply capacity** | 24 VDC ±10%, 0.3 A (to be supplied from the main unit) |
| **Heat dissipation** | 7 (W) |

## 7.3.2 Connection



The interface connector for the I/O Link–II board of the Power Mate *i* is a 5–pin connector, and two I/O Link–II cable wires are installed. Terminating resistors are built into the I/O Link–II board. So, connect T1 with T2 by using a wire.

**NOTE**

1 This interface is based on the three–wire system, with two FGs omitted from the 7–pin terminal block. Perform cable clamping and shielding with clamp fixtures.

2 When the I/O Link–II slave board is used, the interface connector must be detached (with the communication cable connected) before the base printed circuit board can be installed or removed. When I/O Link–II slave board B is used, the base printed circuit board can be installed or removed without detaching the interface connector if the communication cable is not disturbing.

3 On the communication cable, attach a ferrite core as close as possible to the connector TBA (to improve noise protection).

## 7.3.3 Differences between the Slave Board and Slave Board B

Compared with the I/O Link–II slave board, I/O Link–II slave board B has improved functions. However, I/O Link–II slave board B is not compatible with the I/O Link–II slave board. I/O Link–II slave board B differs from the I/O Link–II slave board as described below.

(1) When the DI/DO data transfer function is used, the DI/DO size is extended from 32 bytes/32 bytes to 128 bytes/128 bytes. (48 bytes/48 bytes when the global I/O transfer function is used) Moreover, the allocation area is changed from X/Y addresses to R addresses.

(2) The communication connector and the method of communication cable connection are changed. Wires, after crimped to a special crimp terminal with a crimping tool compliant with JIS C9711, are inserted into a plug. When a wrong wiring is made, a rod of F1 mm can be used for extraction. A plug (cable–side connector) is delivered with I/O Link–II slave board B. However, <u>a crimp terminal (A02B–0259–K211) must be ordered separately.</u> For line expansion, an additional crimp terminal is required.

(3) The I/O Link–II slave board imposes a restriction on the installation and removal of the base printed circuit board of the Power Mate *i*. On the other hand, I/O Link–II slave board B does not impose such a restriction.

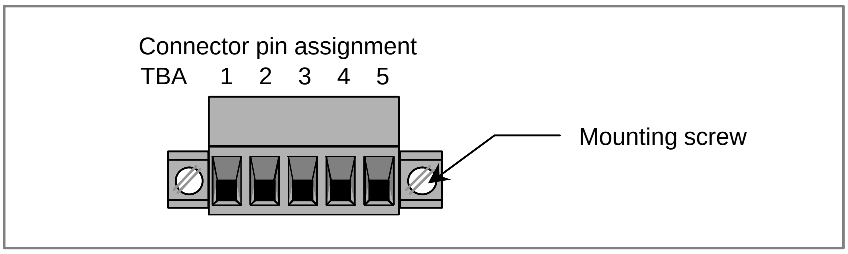
**NOTE**

1 If I/O Link–II slave board B and I/O Link–II board B of the CNC are placed on the same line, the global I/O transfer function does not operate normally on the I/O Link–II board of the Power Mate *i*. (The DI/DO data transfer function can operate normally.)

2 If I/O Link–II slave board B and I/O Link–II board B1/B2 of the CNC are on the same line, the global I/O transfer function does not operate normally on the I/O Link–II board of the Power Mate–D/F/H. (The DI/DO data transfer function can operate normally.)

## 7.3.4 Connection to Connector (Slave Board)

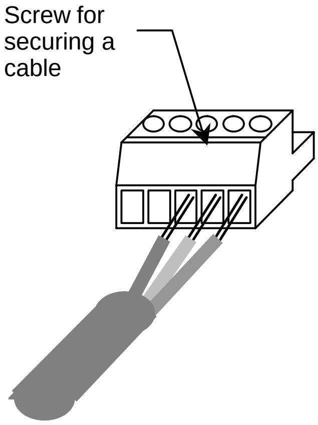
### Connector



| Terminal No. | Signal name | Signal type |
|---|---|---|
| 1 | T1 | A terminating resistor is connected.<br>(T1/T2 connected)<br>No terminating resistor is connected.<br>(T1/T2 open) |
| 2 | T2 | |
| 3 | A | Data signal A |
| 4 | B | Data signal B |
| 5 | SG | Signal ground |

Cable connector:
Manufactured by phoenix Contact
MSTB2.5/5–STF–5.08 (delivered with the product)

### Communication cable connection



Detach the cable connector from the board by removing the mounting screws. Connect the communication cable to the connector according to the procedure below.

(1) Peel off the cable cover, then cut off an excess shield.

(2) Peel off the cover of each wire to match the length of the crimp terminal(Note).

(3) Loosen the cable securing screws of the connector so that the wires can be inserted easily.

(4) Insert the signal wires into the corresponding holes of the terminal block of the connector.

(5) Secure the wires by tightening the cable securing screws of the connector.

(6) Insert the connector with the cable attached into the connector on the board side.

(7) Install the connector by tightening the mounting screws of the connector.

**NOTE**

A crimp terminal can also be used.

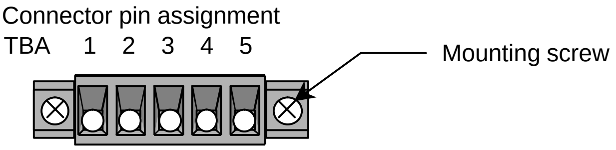
Twist the wires from which the cover is peel off, then install a crimp terminal.

The following crimp terminal is recommended:

– AI series manufactured by Phoenix Contact (Special tool ZA3)

## 7.3.5 Connection to Connector (Slave Board B)

### Connector



| Terminal No. | Signal name | Signal type |
|---|---|---|
| 1 | T1 | A terminating resistor is connected.<br>(T1/T2 connected)<br>No terminating resistor is connected.<br>(T1/T2 open) |
| 2 | T2 | |
| 3 | A | Data signal A |
| 4 | B | Data signal B |
| 5 | SG | Signal ground |

Cable connector:

Manufactured by Hirose Electric
HR31–5.08P–5SC (plug)
HR31–SC–121 x 5 (crimp terminal)
Applicable wire material 0.25 to 1.65 $mm^2$

The plug is delivered with the board.
Place an order on the crimp terminal (A02B–0259–K211) separately.

**NOTE**

The crimp terminal is not delivered with the board.

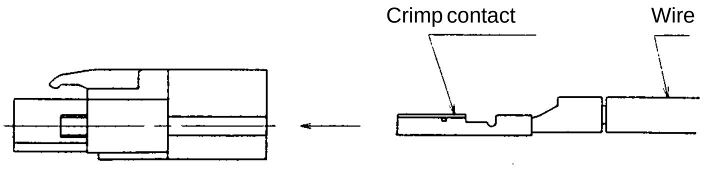
## Communication cable connection

(1) Peel off the cable cover by about 30 mm, then cut off an excess shield.

(2) Peel off the cover of each signal wire by about 5 mm.

(3) Twist the signal wires from which the cover is peel off, then install a crimp terminal.
Use a crimping tool compliant with JIS C9711, and perform crimping at the 1.25 indication location.
Recommended crimping tool: HR31–TC–01 manufactured by Hirose Electric

(4) Insert each signal wire into a plug.
When inserting a crimp terminal into a plug, observe the following orientation:



(5) Insert the plug into the board, then tighten the machine screw of the plug. The machine screw of the plug has a tip of + bit and number 0.

This crimp terminal can connect and crimp two cables with the multi–drop method.

## Crimp terminal extraction

If wires are connected incorrectly, the crimp terminal can be extracted as described below.
A rod of ϕ1 mm can be used for extraction.
Recommended tool: HR31–SC–TP manufactured by Hirose Electric

(1) Press the extraction tool against the mold transformer. (See Fig. 1.)

(2) While pressing the extracting tool against the mold transformer, tilt the extracting tool to release the extraction protection of the crimp terminal. (See Fig. 2.)

(3) Pull out the extraction tool.

(4) Pull the wire to extract the crimp terminal.

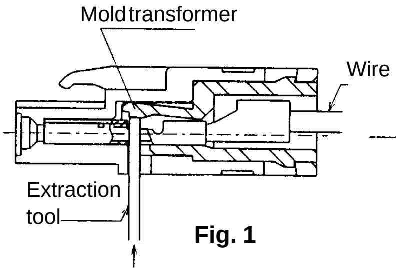


**Fig. 1**

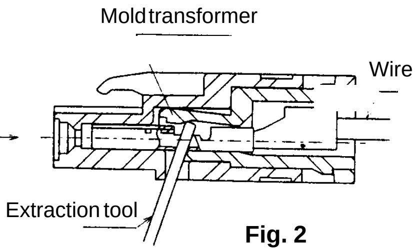


**Fig. 2**

## Line expansion

When a CNC is to be added to an existing line, another crimp terminal (A02B–0259–K211) is required.

(1) Extract the crimp terminal from the plug on the CNC at the last stage of the line.

(2) Remove the existing communication cable from the crimp terminal.

(3) Crimp the communication cable and the additional communication cable onto a new crimp terminal, then insert the new crimp terminal into the plug.

## 7.4
## ETHERNET BOARD

### 7.4.1
### Overview

The Ethernet board for the Power Mate *i* can be inserted into an FA network of the Power Mate *i*. This board enables the DNC1/Ethernet function and FOCAS1/Ethernet function.

### DNC1/Ethernet Function

The DNC1/Ethernet function enables the remote control and monitoring of the CNC from a personal computer.
For details, refer to ”FANUC FA SYSTEM for PC WindowsNT Version, OPERATOR’S MANUAL (B–75044EN).”

### NC data transfer

The following data can be transferred using a personal computer:

- NC program
- Directory information of tape memory
- NC file data
  - Parameter
  - Tool offset value
  - Custom macro variable
- Alarm information
- NC system identifying information
- PMC data
  - Address G, F, Y, X, A, R, T, K, C, D

### Remote control

The following operations can be controlled remotely using a personal computer:

- Selection of NC program
- Deletion of NC program

### Operation

The following operation can be controlled remotely using a personal computer:

- DNC operation

### FOCAS1/Ethernet Function

The FOCAS1/Ethernet function enables the remote control and monitoring of the CNC from a personal computer.
In addition to the DNC1/Ethernet function, the FOCAS1/Ethernet function allows transfer of the following NC data:
For details, refer to ”FANUC Open CNC FOCAS1/Ethernet CNC/PMC Data Window Library.”

- Data related to the controlled axis and spindle
  - Absolute position
  - Relative position
  - Machine position
  - Distance to go
  - Actual feedrate

- NC file data
    - Setting data
    - P–code macro variable
    - Pitch error compensation data
- History data
    - Operation history data
    - Alarm history data
- Data related to servo and spindle
- Modal data
- Diagnosis data
- A/D conversion parameter
- PMC data
    - Extended maintenance type data

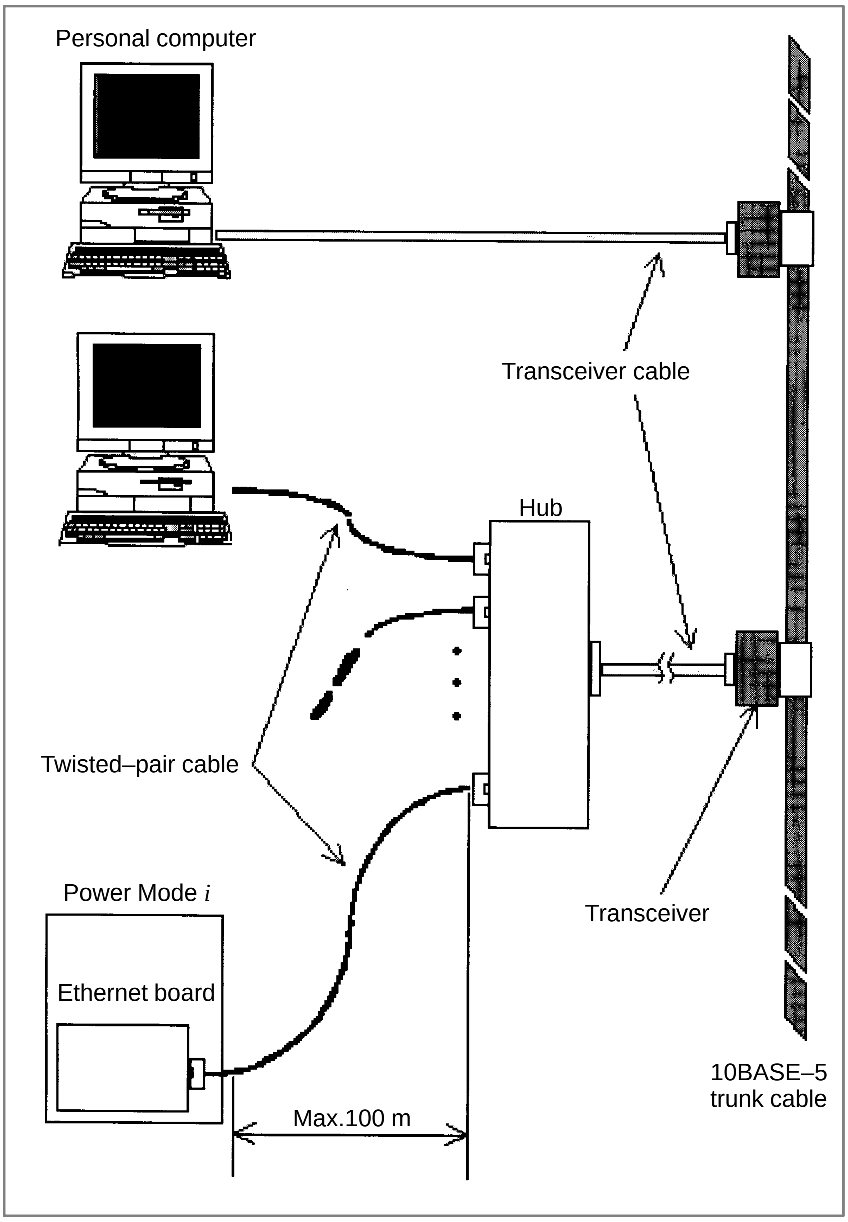
**NOTE**

For information about the Ethernet board, refer to ”FANUC Ethernet Board FANUC Data Server Operator’s Manual B–63354EN”.

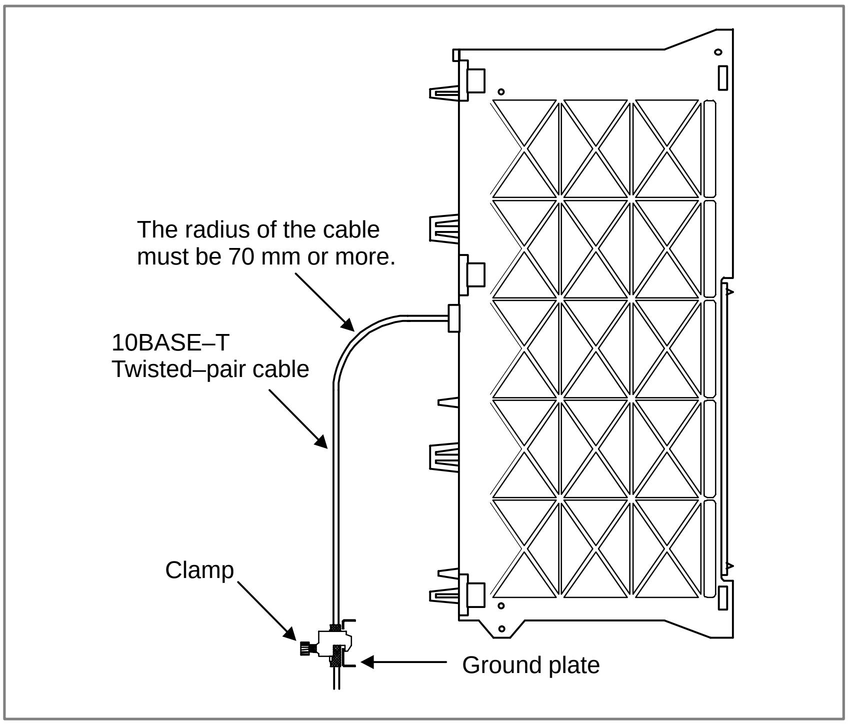
## 7.4.2 Connection

The Ethernet board is provided with a 10BASE–T interface.

Prepare a hub for connecting the Ethernet board to the Ethernet trunk. The following shows an example of a general connection.



Some devices (hub, transceiver, etc.) that are needed for building a network do not come in a dust–proof construction. Using such devices in an atmosphere where they are subjected to dust or oil mist will interfere with communications or damage the Ethernet board. Be sure to install such devices in a dust–proof cabinet.



The Ethernet cable must be fastened by a cable clamp to prevent tension being applied to the connector that connects the cable to the control unit (RJ–45) even if the Ethernet cable is pulled directly. This clamp is also used to ground the cable shield.

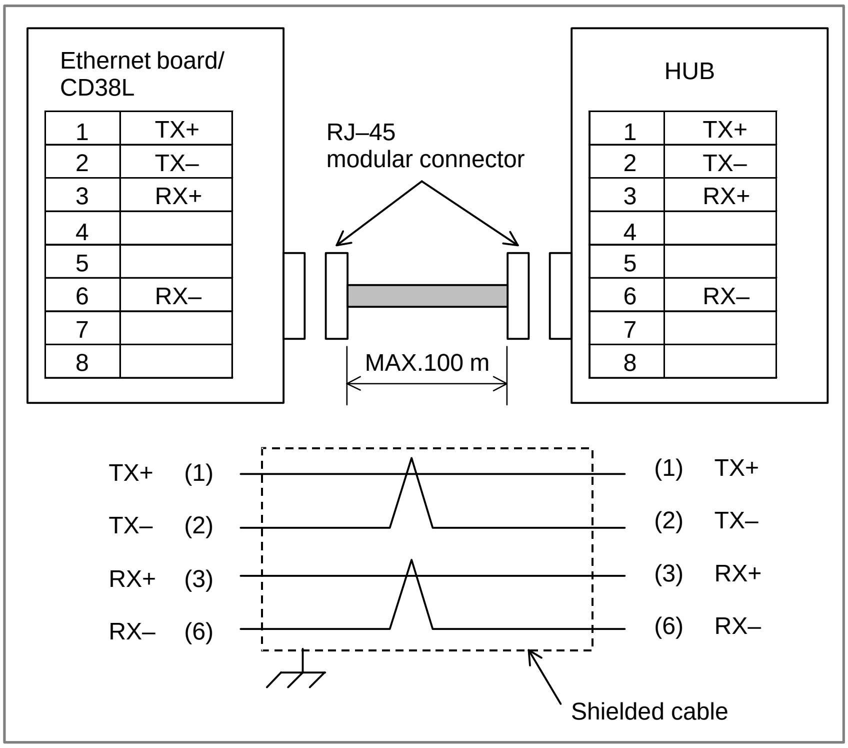
## 7.4.3 10 Base–T Connector Pin Assignments

CD38L

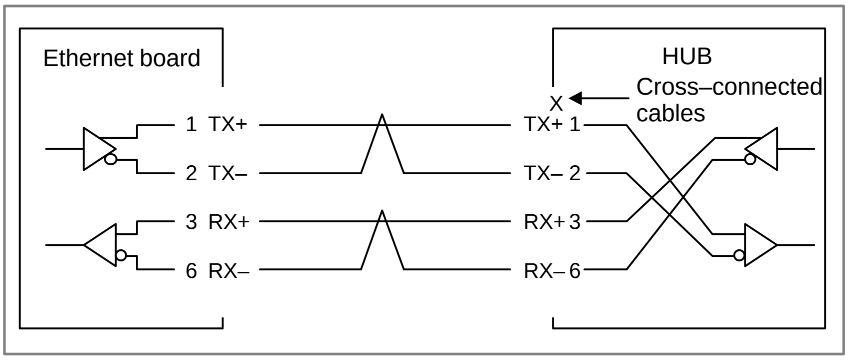
| Pin No. | Signal name | Description |
|---|---|---|
| 1 | TX+ | Send + |
| 2 | TX– | Send – |
| 3 | RX+ | Receive + |
| 4 | | Not used |
| 5 | | Not used |
| 6 | RX– | Receive – |
| 7 | | Not used |
| 8 | | Not used |

### 7.4.4
### Cable Connection

The figure below shows the cable connection between the 10BASE–T interface (CD38L) on the Ethernet board or data server board and hub.



- Keep the total cable length within 100 m.
  Do not extend the cable more than is necessary.
- The figure above shows the cable connection when cables are crossed in the hub.
  ”X” is usually indicated at the port of the hub to signify that cables are crossed in the hub.



Be sure to use a Category 5 shielded twisted pair (STP) cable for improvement of noise immunity in FA environments, although various types of unshielded twisted pair (UTP) cables for 10BASE–T are currently on the market.

Use an 8–pin RJ–45 modular connector as a twisted pair cable connector for the Ethernet.

## 7.5 FANUC FL–net BOARD

### 7.5.1 Overview

FL–net is the open FA network standardized by the FA open promotion conference (JOP) in Manufacturing Science and Technology Center, which is an outside organization of the Ministry of International Trade and Industry. As shown below, many personal computers and FA controllers of different manufacturers such as programmable controllers (PLC) and CNCs are interconnected, controlled, and monitored.

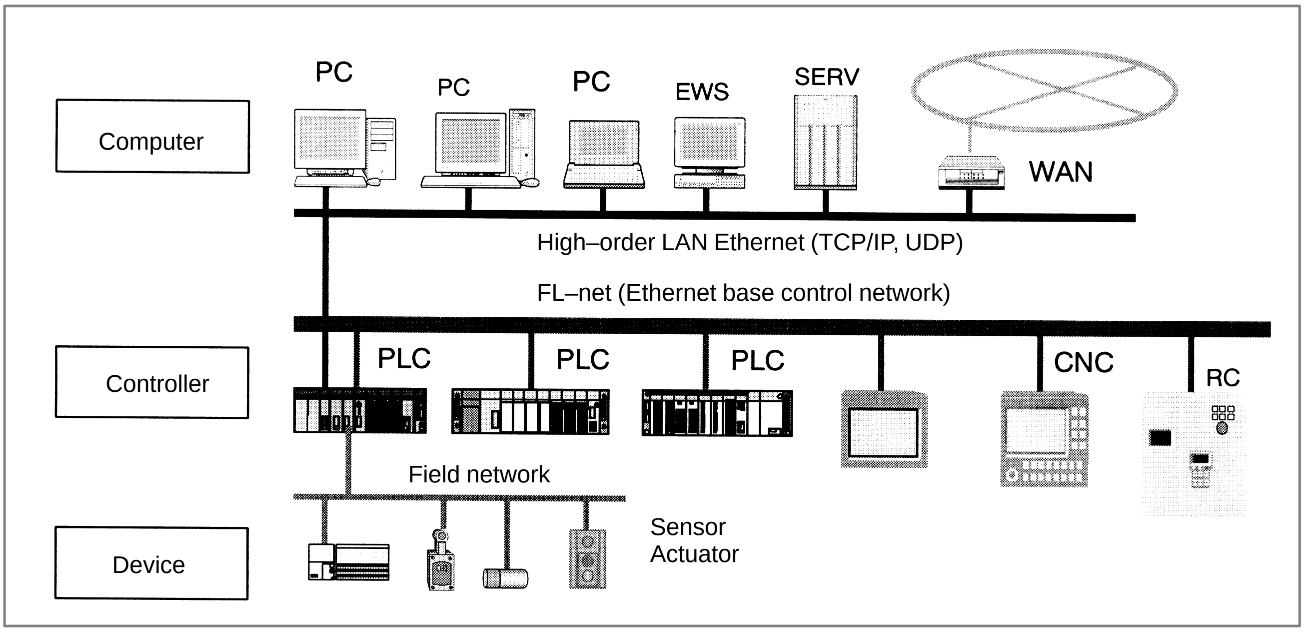


Fig. 7.5.1 Example of FA control network

FL–net has various features required for FA.

1) Large–scale network
   Up to 254 units (nodes) can be connected.
2) Two types of communication functions suitable for applications
   FL–net supports a common memory function that allows each node to share the same data at all times through cyclic communication, and a message communication function that exchanges only necessary information only when required.
3) Large–capacity common memory
   The common memory is as large as 8K bits + 8K words.
4) High–speed response
   Response as fast as 50 ms/32 nodes (with 2K bits + 2K words) can be achieved.
5) High reliability based on masterless method
   No master is present, so that nodes can be connected to and disconnected from the network without affecting the communication of other nodes. So, each node allows free power–on/off operation and maintenance.

**NOTE**

For information about the FANUC FL–net board, refer to ”FANUC FL–net Board Operator’s Manual B–63434EN”.

### 7.5.2
### Connection

The FANUC FL–net board is connected in the same way as the Ethernet board.

## 7.6 PROFIBUS–DP BOARD

### 7.6.1 Overview

The PROFIBUS–DP board provides a field network conforming to DIN19245. The Power Mate *i* provides slave and master functions for this.

In PROFIBUS–DP communication, two types of nodes are involved: a master station (also referred to as a DP–Master) and a slave station (also referred to as a DP–Slave). DI/DO data is exchanged between a DP–Master and DP–Slave according to a data exchange request from the DP–Master.

The DP–Master function is referred to as the PROFIBUS–DP Master (class1) function (simply referred to as the master function). The DP–Slave function is referred to as the PROFIBUS–DP Slave function (simply referred to as the slave function).

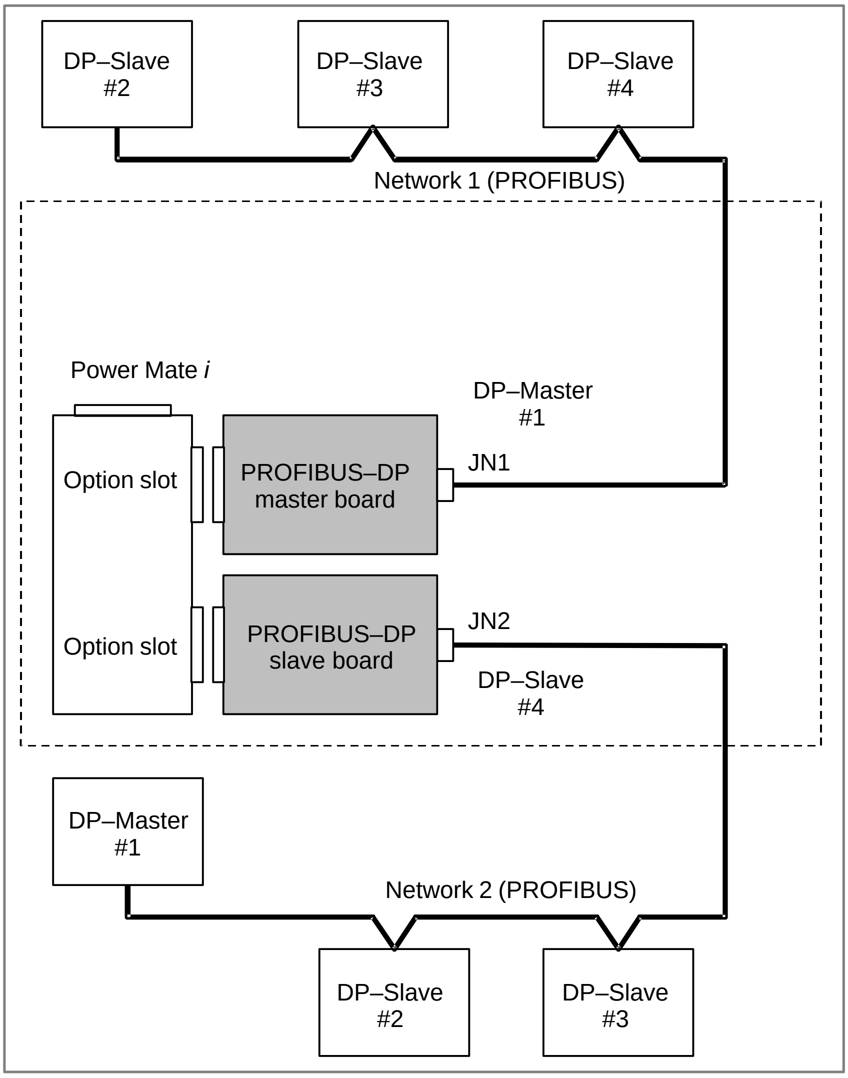
The PROFIBUS–DP board can be inserted into an FA network expansion slot of the Power Mate *i*.

**NOTE**

1. For details of the PROFIBUS–DP, refer to the “PROFIBUS–DP Operator’s Manual” (B–62924EN).
2. The PROFIBUS–DP board cannot be used with the DeviceNet board at the same time.
3. When the PROFIBUS–DP slave board and PROFIBUS–DP master board are used at the same time, the bus connector manufactured by Siemens described later cannot sometimes be used as the cable–side connector to be connected, depending on the axis control card specified. (Interference between the optical connector on the axis control card and the bus connector occurs.)

## 7.6.2
## Connection

An overview of the complete connection is shown below.



Networks 1 and 2 are independent of each other.

Connectors JN1 and JN2

Nine–pin D–Sub female connector

| | | | |
|---|---|---|---|
| 1 | PE | 6 | VP |
| 2 | | 7 | |
| 3 | RxD/TxD(+) | 8 | RxD/TxD(–) |
| 4 | | 9 | |
| 5 | CNTR–P | | |

PE : Shielding
RxD/TxD (+) : Transmission/reception data (+)
CNTR–P : Not used (repeater control)
DGND : Signal ground
VP : Not used (+5 V output)
RxD/TxD (–) : Transmission/reception data (–)

**CAUTION**

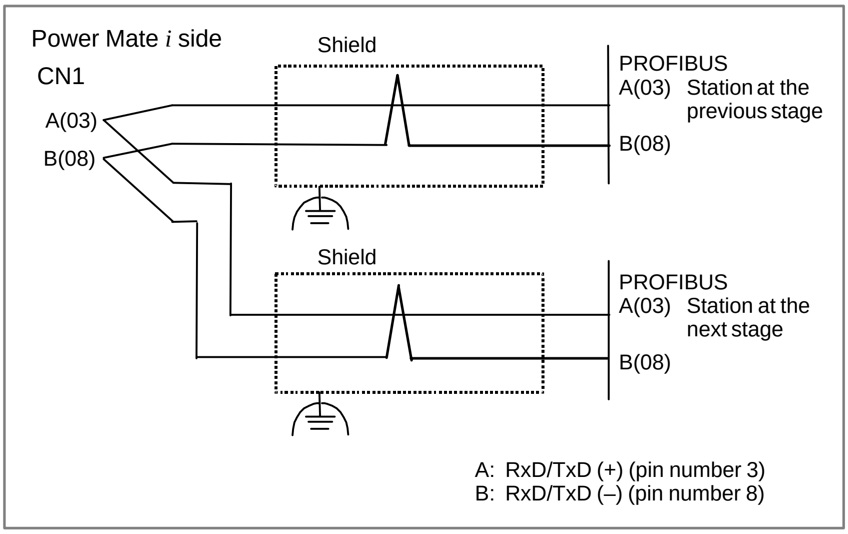
The VP and CNTR–P pins are used for controlling a repeater. Do not connect these pins to anything unless a repeater is used. Otherwise, damage to the device is likely. If you want to use these pins, consult with FANUC beforehand.

1) D–SUB 9–pin male connector (with a height of up to 13.1 mm)
2) Cable–end connector: S7 SINEC L2 bus connector 6ES7 972–0BA11–0XA0, manufactured by Siemens, or equivalent

**NOTE**

Depending on the axis control card used in the Power Mate *i*, the bus connector manufactured by Siemens is sometimes not usable.

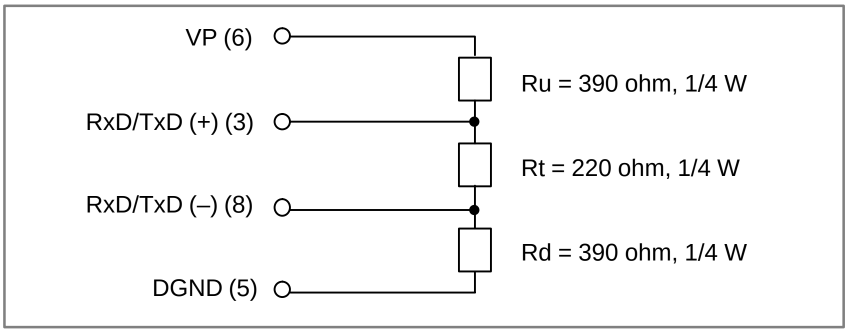
Connect the PROFIBUS cable as shown in the following diagram.



Shielding treatment:

Clamp both the cable drawn from the station at the previous stage and that leading to the station at the next stage on the Power Mate *i* side. For an explanation of how to treat the cable at each station, refer to the respective manuals for the stations.

Each end of the bus cable must be terminated with a resistor as shown below.



**NOTE**

The numbers in parentheses are the connector pin numbers.

# 7.7
# DeviceNet

## 7.7.1
## Overview

There are two types of DeviceNet boards: a master board and slave board.

1) Slave board
   - DeviceNet function: One slave station
   - DI/DO transfer size: 64/64 bytes
   - DI/DO transfer address: Allocated to the R area of the PMC (parameter setting)

2) Master board
   - DeviceNet function: One master station
   - Number of connected nodes: 32 nodes
   - DI/DO transfer size: 32/32 bytes per node
     Maximum DI/DO transfer size 1024/1024 bytes
   - DI/DO transfer address: Allocated to the R area of the PMC (parameter setting)

DeviceNet boards can also be classified by connector in the communication connector section into the two board types as shown below. These types are different in communication cable connection method.

| | **Connector in the communication connector section** |
|---|---|
| DeviceNet master board<br>DeviceNet slave board | MSTB2.5/5–ST–5.08AU<br>Manufactured by Phoenix Contacts Inc. |
| DeviceNet master board B<br>DeviceNet slave board B | HR31–5.08P–5SC<br>Manufactured by Hirose Electric Co., Ltd. |

**NOTE**

1 For DeviceNet, refer to ”FANUC DeviceNet Board Operator’s Manual B–63404EN”.

2 The DeviceNet board cannot be used with the PROFIBUS–DP board at the same time.

3 The DeviceNet master board and DeviceNet slave board uses the same printed circuit board specifications, and only the difference between these boards is the jumper position of the setting pin TM1 on the boards. (The unit specification of the master board is different from that of the slave board.) TM1 is factory–set by FANUC. The relationship between the DeviceNet master board B and DeviceNet slave board B is the same as the relationship between the DeviceNet master board and DeviceNet slave board.

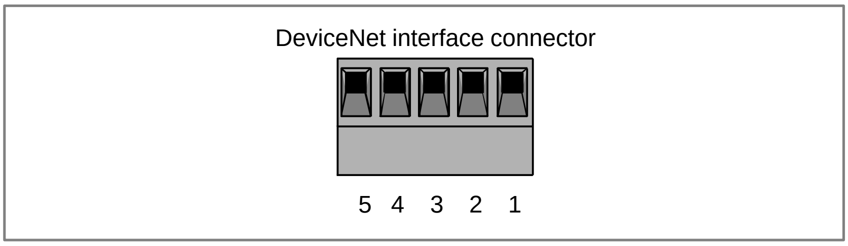
4 The DeviceNet board and DeviceNet board B must be inserted and removed according to the predetermined procedure.

5 When the DeviceNet master board and DeviceNet slave board are used, depending on the axis control card specified, the communication connectors of the DeviceNet boards may interfere with the connector of the axis control card. When such interference occurs, and when there is no special reason for using the DeviceNet master board and DeviceNet slave board, use the DeviceNet master board B and DeviceNet slave board B.

6 The ambient temperature for operating the control unit including DeviceNet boards must be within the range from 0°C to 50°C.

## 7.7.2
## Connection

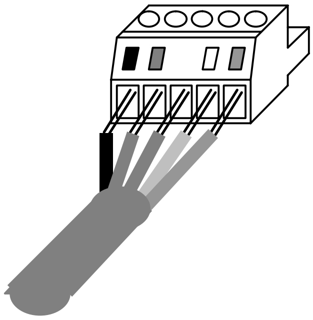
### DeviceNet board



| Terminal No | Signal Name | Color Code | Signal Type |
|---|---|---|---|
| 1 | V– | Black | Signal cable – side |
| 2 | CANL | Blue | Communications data Low side |
| 3 | SHIELD | Bare | Shield |
| 4 | CANH | White | Communications data High side |
| 5 | V+ | Red | Signal cable + side |

Cable connector:
Made by Phoenix Contacts Inc.
MSTB2.5/5–ST–5.08AU (provided with the produc

## Connecting the communications cable



Connect the communications cable to the DeviceNet interface connector according to the following procedure.

(1) Strip about 30 mm of the cable sheath and remove unwanted sheath.

(2) Peel off the aluminum tape covers the signal leads and the power leads, and strip the sheath of the signal leads and power leads matched to the length of the crimped terminals.

(3) Twist the stripped signal leads and power leads and attach the crimped terminals.
We recommend the following crimped terminal:

- Phoenix Contacts Inc. AI series (special tool ZA3)

(4) Loosen the cable fastening screws on the connector so that the line materials can be easily inserted.

(5) Insert each of the signal leads into the holes on the connector terminal plate so that the sheath colors of the shielded lead, signal leads and power leads match the colors indicated on the connector.

(6) Tighten the power leads in place with the cable fastening screws on the connector.

Two thin cables can be connected to this connector in a multi–drop configuration. In this case, insert two leads into a single hole on the terminal plate.

## DeviceNet board B

### • Connector

Cable–end connector for DeviceNet board B:
HR31–5.08p–5SC (plug) and
HR31–SC–121 × 5 pieces (crimp terminals)
manufactured by Hirose Electric Co., Ltd.

The plug is shipped along with DeviceNet board B. The plug has a label indicating a color code. No crimp terminal is shipped unless separately ordered. (A02B–0259–K211).

**NOTE**
No crimp terminal is shipped along with DeviceNet board B or C.

## • Connecting the communication cable

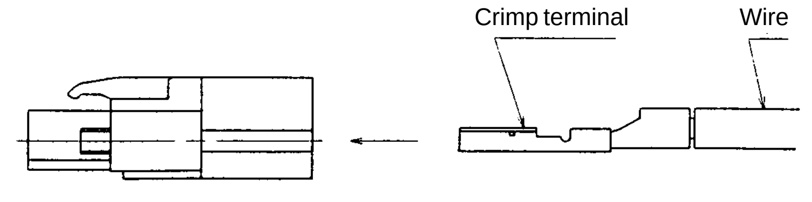
To attach a communication cable to the DeviceNet interface connector, follow this procedure.

(1) Remove the sheath of the cable to a length of about 30 mm, and cut off the excess shielding.

(2) Remove the aluminum tape from around the signal and power supply wires. Also remove the insulator from each wire to a length of about 5 mm.

(3) Twine the stripped signal wire strands. Also twine the stripped power supply wire strands. Attach a crimp terminal to each bundle of wire strands.
To crimp the terminal, use a crimp tool complying with JIS C9711 by setting its indication to 1.25.
Recommended crimp tool:
HR31–TC–01 manufactured by Hirose Electric Co., Ltd.

(4) Insert the shielding wire, signal wire, and power supply wire into the plug by matching their insulator colors to the color codes indicated on the connector.
When attaching each crimp terminal to the plug, keep them in the orientation shown below.



(5) Insert the plug into the DeviceNet board, and fasten it with its bolts using a No. 0 cross–head bit.

These crimp terminals are of a multidrop type. Each terminal can be used to crimp two thin cable wires together. They are not for thick cables.

## • Pulling out crimp terminals

If you made a misconnection, correct it by pulling out the crimp terminal according to this procedure.
A rod 1 mm in diameter can be used to pull out a crimp terminals.
Recommended tool: HR31–SC–TP manufactured by Hirose Electric Co., Ltd.

(1) Push a pull–out tool against the molded lance. (See Fig. 1.)

(2) While pushing the molded lance, tilt the pull–out tool to release the crimp terminal lock. (See Fig. 2.)

(3) Pull out the pull–out tool.

(4) Pull the wire to take out the crimp terminal.

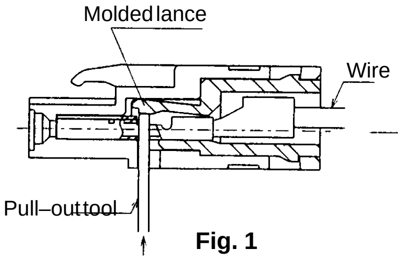


**Fig. 1**

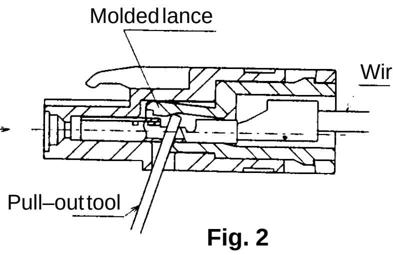


**Fig. 2**

- **Extending the line**

Adding a CNC to the existing line requires another crimp terminal A02B–0259–K211.

(1) Pull out the crimp terminal from the plug of the CNC at the last stage of the line.

(2) Detach the existing communication cable from the crimp terminal.

(3) Attach the detached communication cable and an additional communication cable to a new crimp terminal, and insert it to the plug.

## 7.7.3
## How to Attach and Remove the DeviceNet Board

### Outline

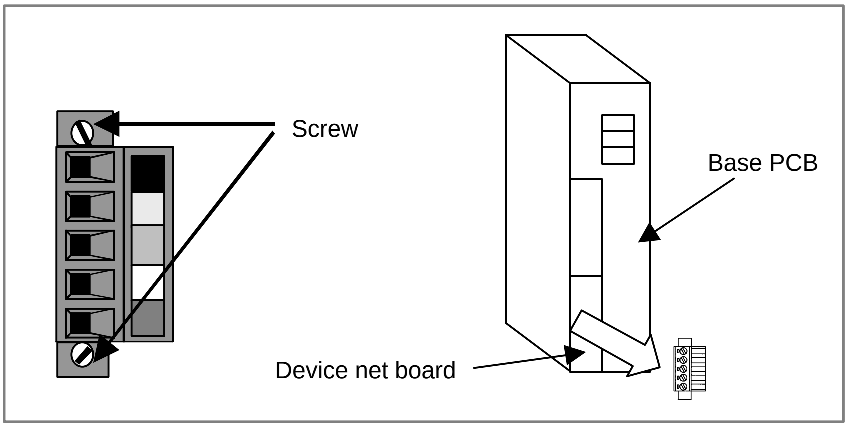
The sequence in which this DeviceNet board is attached and removed from the control unit is fixed.
The attachment and removal of the DeviceNet board B must also follow this sequence.

**NOTICE**

To prevent the inadvertent loss of data in SRAM during this operation, back up the data in the CNC's SRAM to built–in FROM (Power Mate *i* only) or to memory card before you attach and remove the DeviceNet board.

### Removing the DeviceNet Board

1) Removing the DeviceNet connector terminal plate
The terminal plate can be removed from the DeviceNet board interface connector with the cable still connected. Loosen the two screws shown in the figure below, and then remove the terminal plate by pulling it towards you.



**NOTE**

The base PCB cannot be removed unless the connector's terminal plate has been removed first.

2) Removing the base PCB
Remove the base PCB before you remove the DeviceNet board. For details on how to remove the base PCB, refer to the respective Maintenance Manual.

**NOTICE**
The DeviceNet board cannot be removed unless the base PCB has been removed first. If the DeviceNet board is removed without removing the base PCB, the DeviceNet board may interfere and break the base PCB.

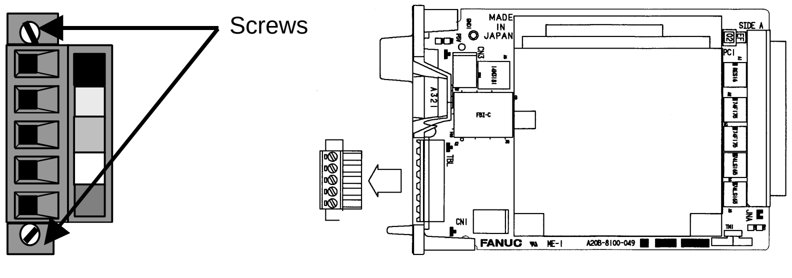
3) Removing the DeviceNet board
Remove the DeviceNet board without the base PCB attached.
For details on how to remove the DeviceNet board, refer to ”How to Remove and Attach Optional Boards” in the respective Maintenance Manual.

### Attaching the DeviceNet board

1) Removing the base PCB
Remove the base PCB before you remove the DeviceNet board. For details on how to remove the base PCB, refer to the respective Maintenance Manual.

**CAUTION**
The DeviceNet board cannot be attached unless the base PCB has been removed first. If you attempt to attach the DeviceNet board without removing the base PCB, the DeviceNet board may interfere and break the base PCB.

2) Removing the DeviceNet connector terminal plate
Remove the interface connector terminal plate from the DeviceNet board. Loosen the two screws shown in the figure below to remove.



3) Attaching the DeviceNet board
Attach the DeviceNet board without the base PCB attached.
For details on how to attach the DeviceNet board, refer to ”How to Remove and Attach Optional Boards” in the respective Maintenance Manual.

4) Attaching the base PCB
After you have attached the DeviceNet board, attach the base PCB. For details on how to attach the base PCB, refer to the respective Maintenance Manual.

5) Attaching the DeviceNet connector terminal plate
Attach the interface connector terminal plate to the DeviceNet board. After attaching the terminal plate, firmly tighten the two screws on the terminal plate.

**NOTE**
The base PCB cannot be attached unless the connector's terminal plate has been removed first.

# 8

# CONNECTION TO SETTING AND DISPLAY UNIT

## 8.1 CRT/MDI UNIT INTERFACE

### 8.1.1 General

This connection is conformed to CRT/MDI and picture display CRT/MDI.

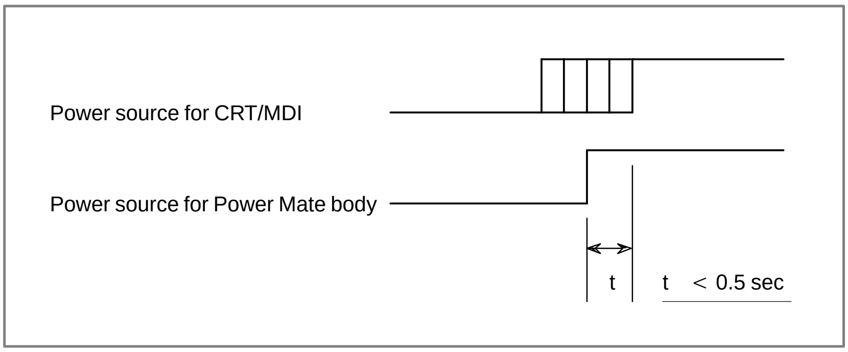
a) The disply link interface for Power Mate has the following features:
   1 One CRT/MDI can be used simultaneously by multiple number of Power Mate units. (Max. 16 Power Mate units)
   2 Only one connecting cable is needed between Power Mate and CRT/MDI.
   3 Maximum displayed axes on the common use screen are 18 axes.

b) Device numbers for each Power Mate are set using the 7–segment LCD and push switch on the front face of the control unit.

c) Maximum total length of the communication cable is 100m.
   When the cable length is 50m to 100m, see Subsec. 8.1.4.

d) Normally turn on the power for the CRT/MDI unit before or, at latest, simultaneously when the power for Power Mate control is turned on.

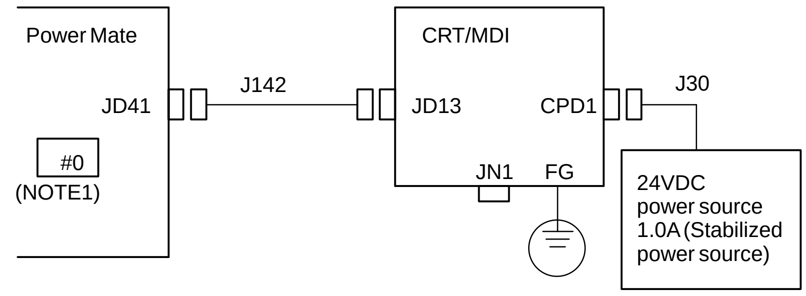
(e) In other Power Mate models, the display link is referred to as the CRT link.



If the power for the CRT/MDI is turned on after the power for Power Mate body is turned on, it becomes impossible to execute special operations while the power for Power Mate is on such as memory all clear (See Subsec. 8.1.6).

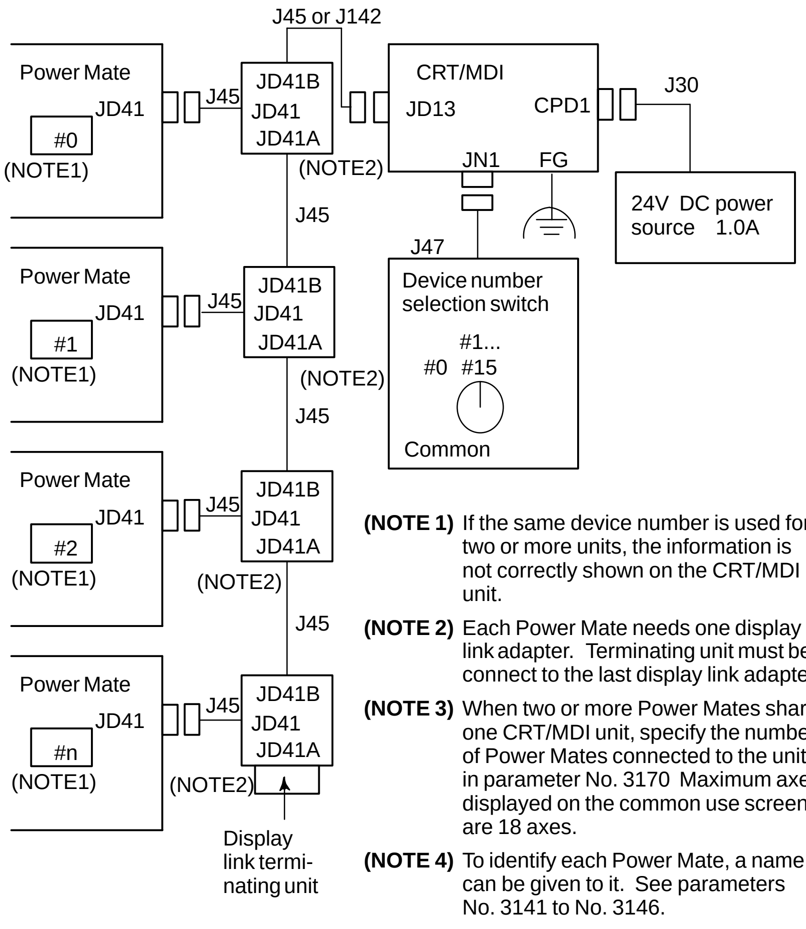
> **WARNING**
> To have the CRT/MDI approved for the CE marking, it is necessary to provide a shock hazard prevention cover (A02B–0200–K820). Attaching the cover to the CRT/MDI is the machine tool builder’s responsibility.

(1) When there is only one unit of Power Mate



**(NOTE 1)** Device number 0 is set.

(2) When multiple power Mates share one CRT/MDI Max.16 Power Mates



**(NOTE 1)** If the same device number is used for two or more units, the information is not correctly shown on the CRT/MDI unit.

**(NOTE 2)** Each Power Mate needs one display link adapter. Terminating unit must be connect to the last display link adapter.

**(NOTE 3)** When two or more Power Mates share one CRT/MDI unit, specify the number of Power Mates connected to the unit in parameter No. 3170 Maximum axes displayed on the common use screen are 18 axes.

**(NOTE 4)** To identify each Power Mate, a name can be given to it. See parameters No. 3141 to No. 3146.

**NOTE**

When a CRT link is used, all the Power Mates must be turned on. If any one Power Mate is not turned on, disconnect it from the display link using JD41 of the Power Mate or the display link adaptor.

## 8.1.2

## Display Link Interface (Connection between the Power Mate Units and CRTs on a One–to–one Basis)

Display link terminal adapter
Power Mate

JD41
(PCR–EV20MDT)

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

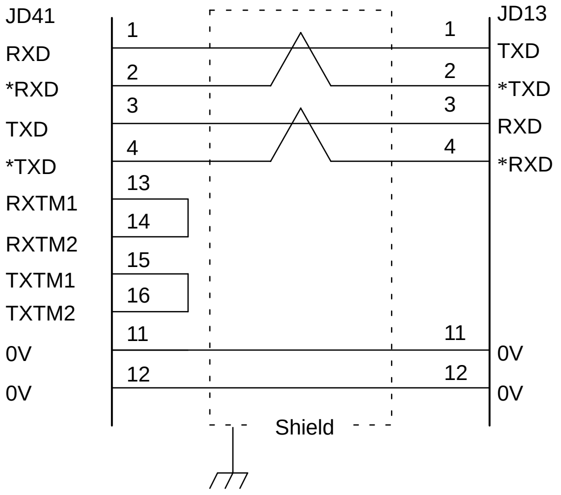
J142

Separate type MDI
CRT/MDI

JD13
(PCR–EV20MDT)

| | | | |
|---|---|---|---|
| 1 | TXD | 11 | 0V |
| 2 | *TXD | 12 | 0V |
| 3 | RXD | 13 | (SI1) |
| 4 | *RXD | 14 | (*SI1) |
| 5 | (ITPGA) | 15 | (SI2) |
| 6 | (*ITPGA) | 16 | (*SI2) |
| 7 | (ITPGB | 17 | (SI3) |
| 8 | (*ITPGB) | 18 | (*SI3) |
| 9 | (SIO) | 19 | |
| 10 | | 20 | (*SI0) |

Cable connection (J142)



Recommended cable:
A66L–0001–0284#10P (#28AWG10 ten pairs)
Recommended connector
PCR–E20FS or PCR–E20FA
Housing PCR–V20LA

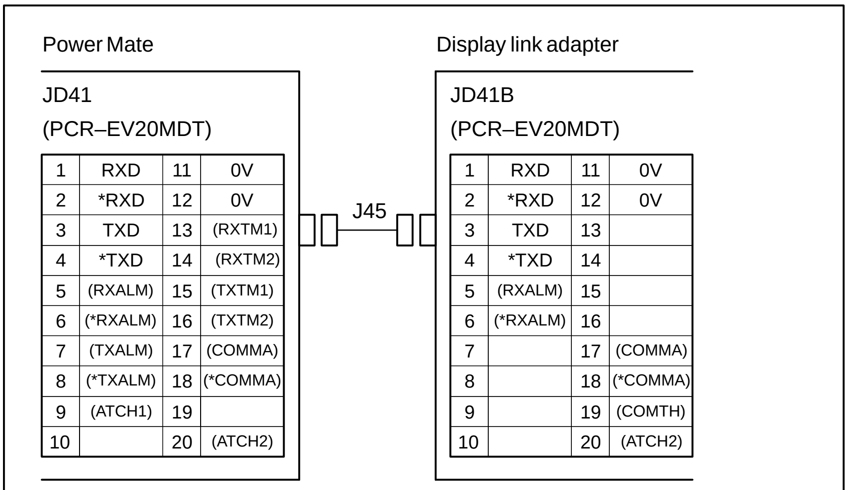
**NOTE**

1 Strapping between pins 13 and 14 and between pins 15 and 16 on the JD41 causes the CRT link to be connected to a terminating resistor on the Power Mate–side. The CRT/MDI and stand alone MDI are connected to a terminating resistor within themselves.

2 In the display link terminal adapter, no signals are assigned to pins 13 to 16, so these pins need not be connected for termination.

3 Do not make any connection other than the above.

## 8.1.3
## Interface between CRT and Power Mate (Connection between a Single CRT and Multiple Power Mate Units)



Power Mate

JD41
(PCR–EV20MDT)

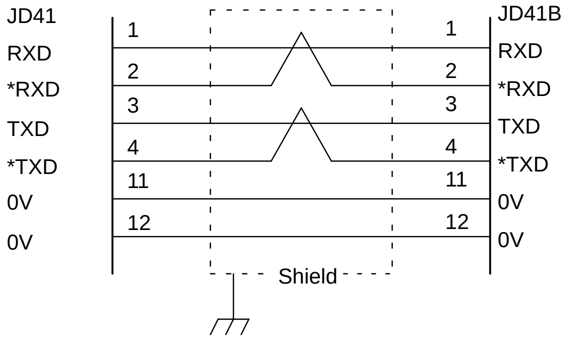
| | | | |
|---|---|---|---|
| 1 | RXD | 11 | 0V |
| 2 | *RXD | 12 | 0V |
| 3 | TXD | 13 | (RXTM1) |
| 4 | *TXD | 14 | (RXTM2) |
| 5 | (RXALM) | 15 | (TXTM1) |
| 6 | (*RXALM) | 16 | (TXTM2) |
| 7 | (TXALM) | 17 | (COMMA) |
| 8 | (*TXALM) | 18 | (*COMMA) |
| 9 | (ATCH1) | 19 | |
| 10 | | 20 | (ATCH2) |

Display link adapter

JD41B
(PCR–EV20MDT)

| | | | |
|---|---|---|---|
| 1 | RXD | 11 | 0V |
| 2 | *RXD | 12 | 0V |
| 3 | TXD | 13 | |
| 4 | *TXD | 14 | |
| 5 | (RXALM) | 15 | |
| 6 | (*RXALM) | 16 | |
| 7 | | 17 | (COMMA) |
| 8 | | 18 | (*COMMA) |
| 9 | | 19 | (COMTH) |
| 10 | | 20 | (ATCH2) |

Cable connection (J45)

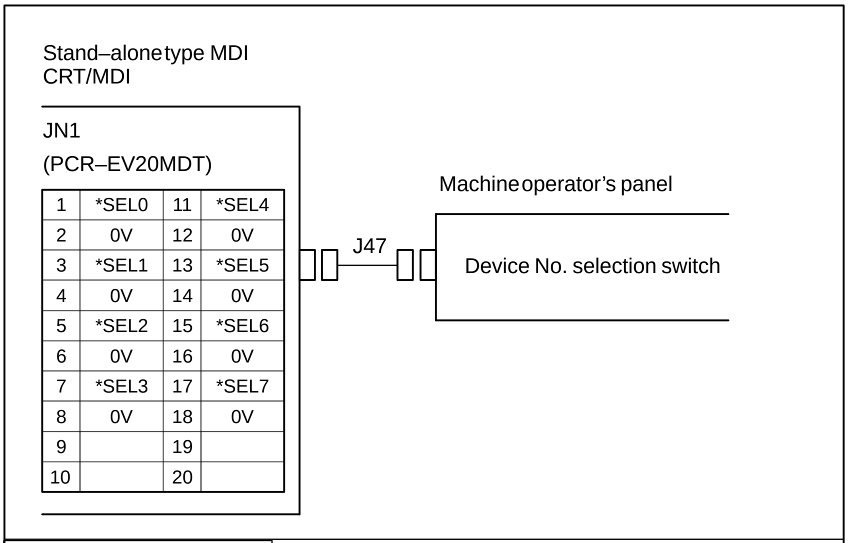


Recommended cable:
A66L–0001–0284#10P (#28AWG10 ten pairs)
Recommended connector
PCR–E20FS or PCR–E20FA
Housing PCR–V20LA

**NOTE**

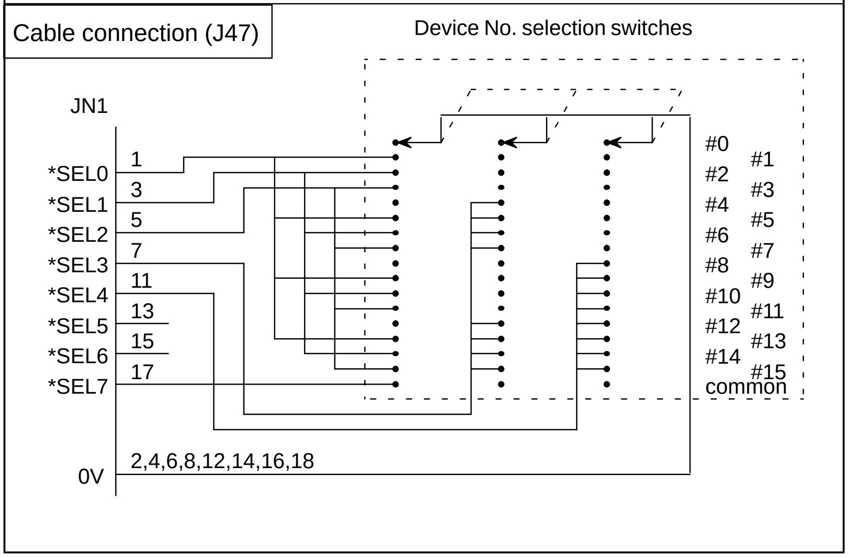
1. Place the display link adaptor as closely to the Power Mate units as possible so that the length of cable between them can be minimized (Up to 500mm).
2. The cable connection between the CRT/MDI unit (JD13) and display link adapter (JD41B) is the same as the above.
3. The cable connection between the display link adapter (JD41A) and display link adapter (JD41B) is the same as the above.
4. Do not make any connection other than the above.

## 8.1.4 Device Number Selection Switch



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

Cable connection (J47)



If the total length of the display link cables is 50 to 100 m, connect *SEL5 to a potential of 0 V. This total length should include all display interface cables. If the total length exceeds 50 m, the Power Mate cannot be made detachable.

**NOTE**

The 0–V signals on pins 2, 4, 6, 8, 12, 14, 16, and 18 of JN1 are connected internally on the printed circuit board. Therefore, connection to any 0–V pin is allowed.

**Relationship between selection switches and device numbers**

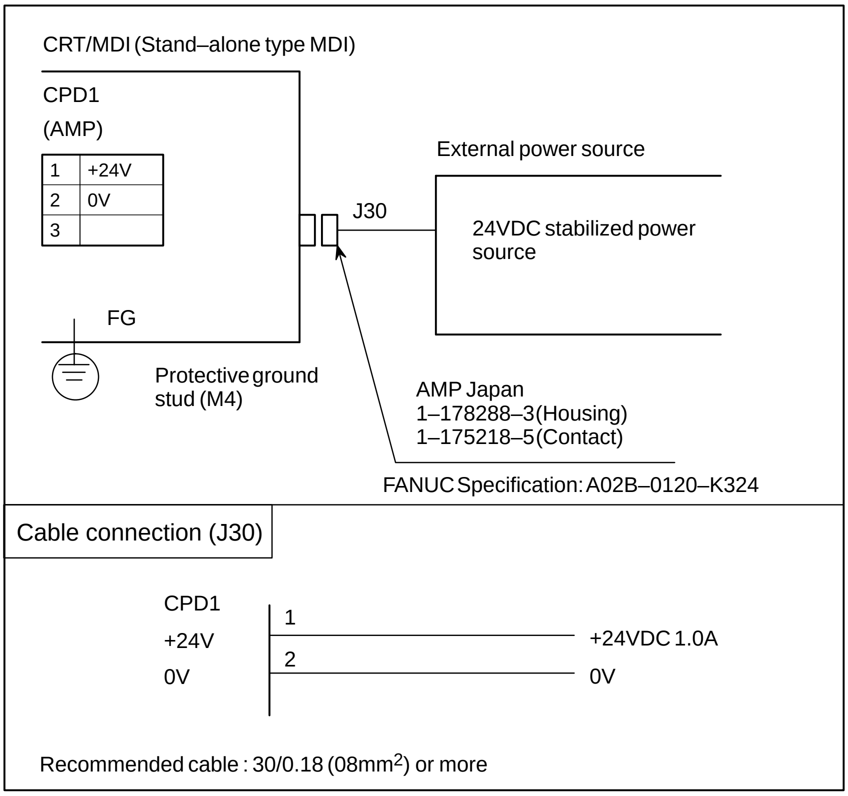
| Device No. | *SEL7 | *SEL4 | *SEL3 | *SEL2 | *SEL1 | *SEL0 |
|---|---|---|---|---|---|---|
| #0 | × | × | × | × | × | × |
| #1 | × | × | × | × | × | ○ |
| #2 | × | × | × | × | ○ | × |
| #3 | × | × | × | ○ | × | × |
| #4 | × | × | ○ | × | × | × |
| #5 | × | × | ○ | × | × | ○ |
| #6 | × | × | ○ | × |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

× : Switch open
○ : Switch closed
– : Either will do

Recommended cable:
A66L–0001–0284#10P (#28AWG10 ten pairs)
Recommended connector
PCR–E20FS or PCR–E20FA
Housing PCR–V20LA
Maximum cable length : 10m

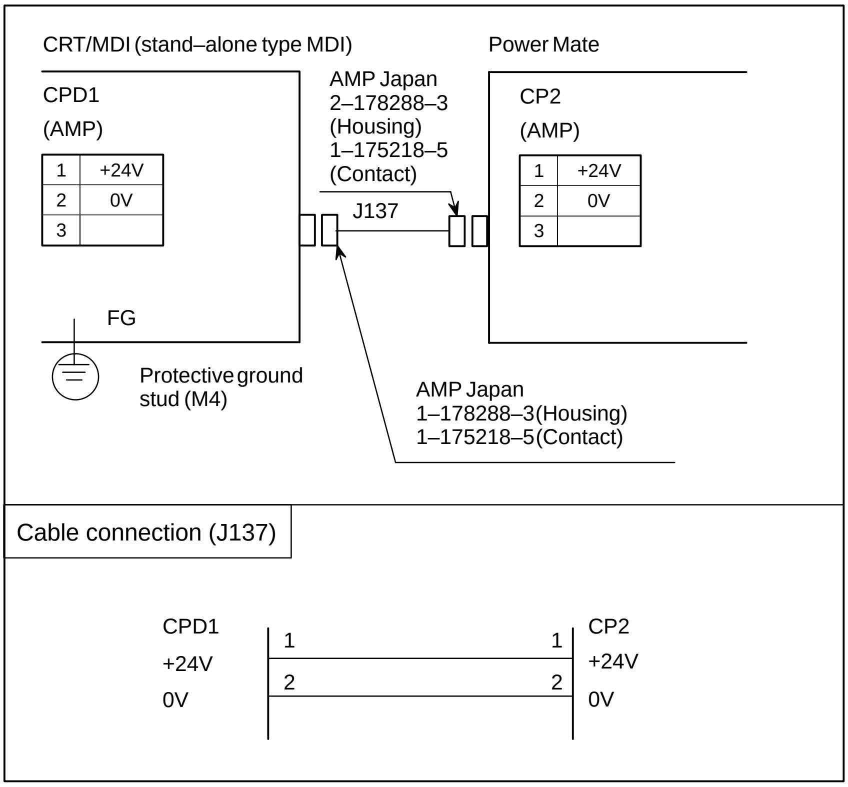
## 8.1.5
## Power Supply Interface

1) From external power supply



Recommended cable : 30/0.18 (08mm$^2$) or more

2) From Power Mate



CRT/MDI unit–side cable connector A02B–0120–K324
Power Mate–side cable connector A02B–0120–K323

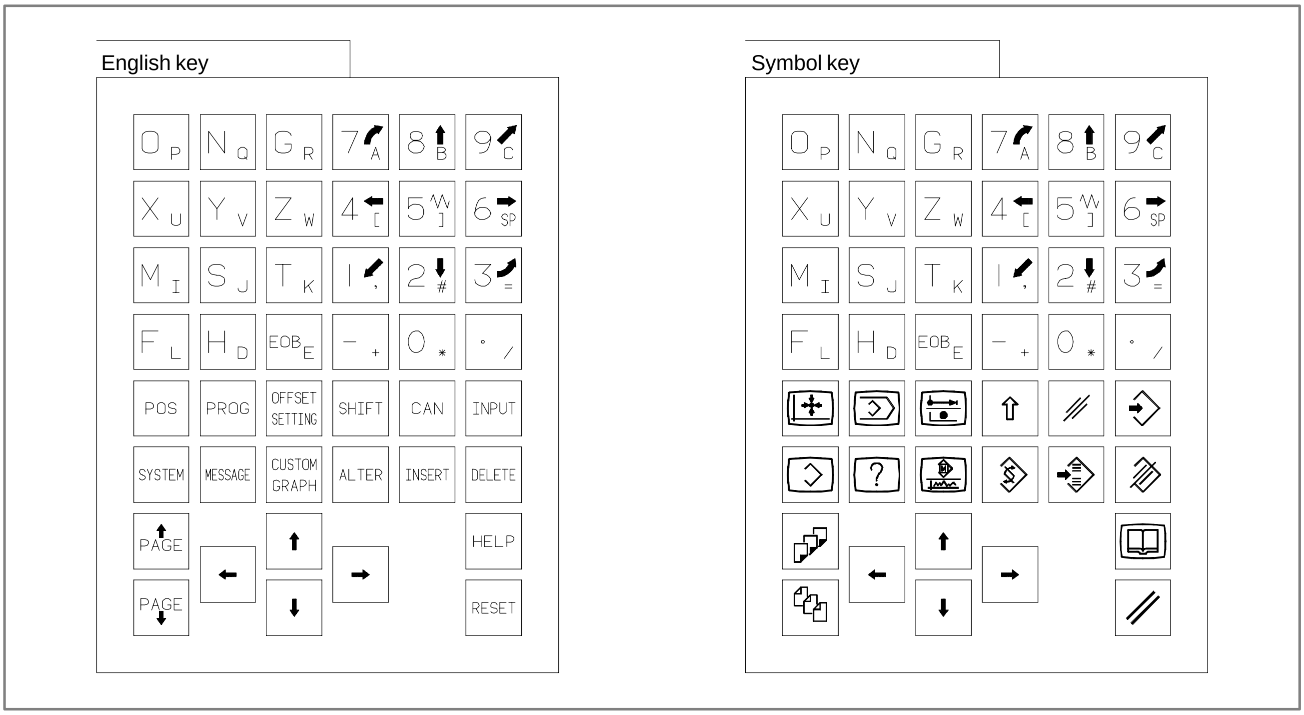
Be sure to perform protective grounding. (See Section 5.8.)

### 8.1.6
### Detachable CRT/MDI Unit

1) The Power Mate can be operated without connecting a CRT/MDI.
2) To attach or detach a CRT/MDI while the Power Mate is turned on, 0V of the Power Mate must be connected to 0V of the CRT/MDI before any other lines.

   The shell of connector JD41 on the Power Mate controller side is connected to 0V of the Power Mate controller. The shell of connector JD13 on the CRT/MDI side is connected to 0V of the CRT/MDI. Connect the connector shells at both ends of the cable to each other, using the free wires of cables J142. By means of this arrangement, when the cable is connected to the Power Mate controller, the shell of connector JD14 on the controller first makes contact with the connector shell of the cable. Thus, the state described above can be achieved.
3) When a CRT/MDI is connected after the Power Mate has been turned on, maintenance operations such as memory all–clear cannot be performed. (See 8.1.1 (d).) To perform maintenance operations, turn the Power Mate off then on again, after connecting the CRT/MDI.
4) When the Power Mate is made detachable, the maximum cable length is 50 m.
5) When the Power Mate is used by switching display links, the same notes apply as those that apply when the Power Mate is made detachable.

## 8.1.7 Keyboard



## 8.1.8 Terminating the Display Link

1) A terminating resistor connected to the display link is intended to shape the waveform on the display link (RS485). When a display link is short or used in a noise–free environment, it may be able to operate normally even if no terminating resistor is connected to it. However, a terminating resistor must always be factory–connected to the display link, because otherwise qualitative evaluation is impossible. If a terminating resistor is not connected to a display link, it may be impossible to update the screen and use the keyboard.

2) A terminating resistor must be connected to both ends of the display link. The CRT/MDI has a built–in terminating resistor. If the CRT/MDI and Power Mate are connected on a one–to–one basis, a terminating resistor is connected using the cable (Section 8.1.2). If there are n Power Mates in one display link, connect a CRT link terminating unit to the display link adaptor to terminate the link.

3) The display link connector JD41 accommodates coaxial sync interface function signals (RS485). The display link adapter connects a terminating resistor to both types of signals. If the coaxial sync interface function is not used, it is unnecessary to connect a terminating resistor to the coaxial sync interface function signals.

## 8.1.9 Display Link Terminating Unit

The display link terminating unit terminates the following signals in the display link adapters JD41A and JD41B:

RXD ←→ *RXD (Display link interface signal)
TXD ←→ *TXD (Display link interface signal)
COMMA ←→ *COMMA (Multiaxis synchronization signal)

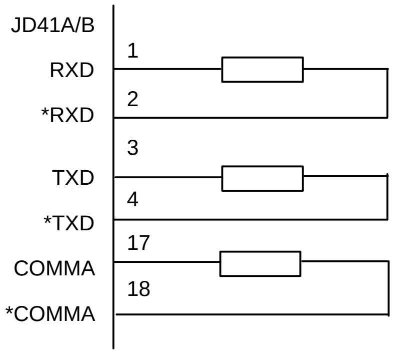
The customer may create the display link terminating unit or may purchase it from FANUC.

Display link adapter JD41A
(PCR–EV20MDT)

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

Display link adapter JD41B
(PCR–EV20MDT)

| | | | |
|---|---|---|---|
| 1 | RXD | 11 | 0V |
| 2 | *RXD | 12 | 0V |
| 3 | TXD | 13 | |
| 4 | *TXD | 14 | |
| 5 | TXALM | 15 | |
| 6 | *TXALM | 16 | |
| 7 | | 17 | COMMA |
| 8 | | 18 | *COMMA |
| 9 | | 19 | (COMTM) |
| 10 | | 20 | |



The terminating resistance is 200Ω with resistor wattage rating of 1/4 W.

Recommended connector on the unit side (JD41)
: PCR–E20FS or PCRE20FA, housing
: PCR–V20LA <Honda Tsushin>

**NOTE**
1 Make no connection to a pin with no name indicated.
2 The display link terminating unit may be connected as shown in the figure above even when only the display link interface is used or when only the multiaxis synchronization function is used.
3 The display link terminating unit of the Power Mate–D/H cannot be used. Also, the display link terminating unit described here cannot be used for the Power Mate–D/H.

FANUC purchase specification: A02B–0259–D001

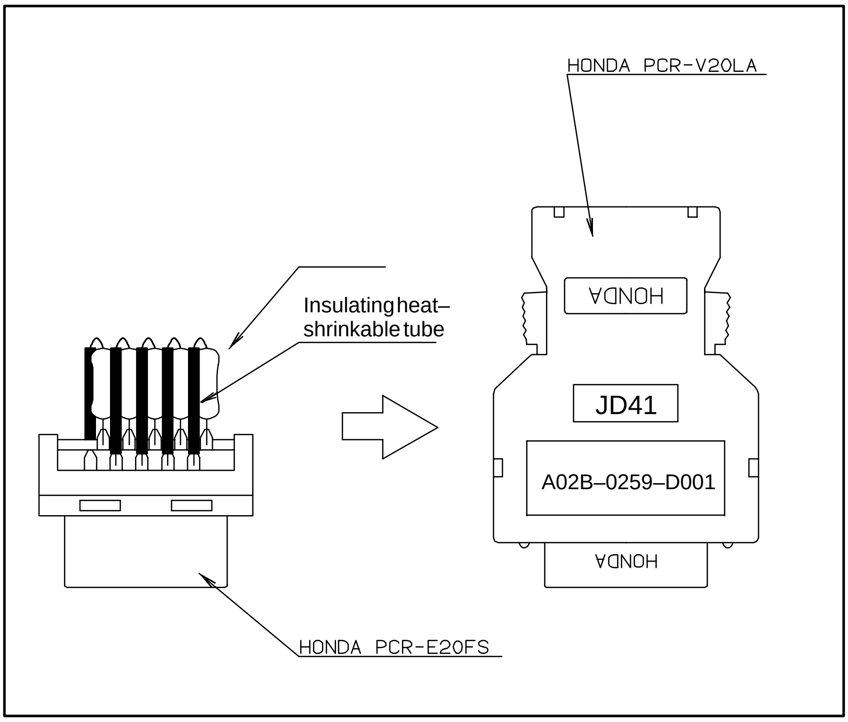


Fig. 8.1.9 Display link terminal unit manufactured by FANUC

## 8.1.10
## CRT Link Adapter

The display link adapter is used to form a T–junction of a display link and to separate multiaxis synchronization signals. The customer may create the display link adapter or may purchase it from FANUC.

When the customer creates the display link adapter, the unit–side connector may not necessarily be the PCR–EV20MDT.

Display link adapter JD41A
(PCR–EV20MDT)

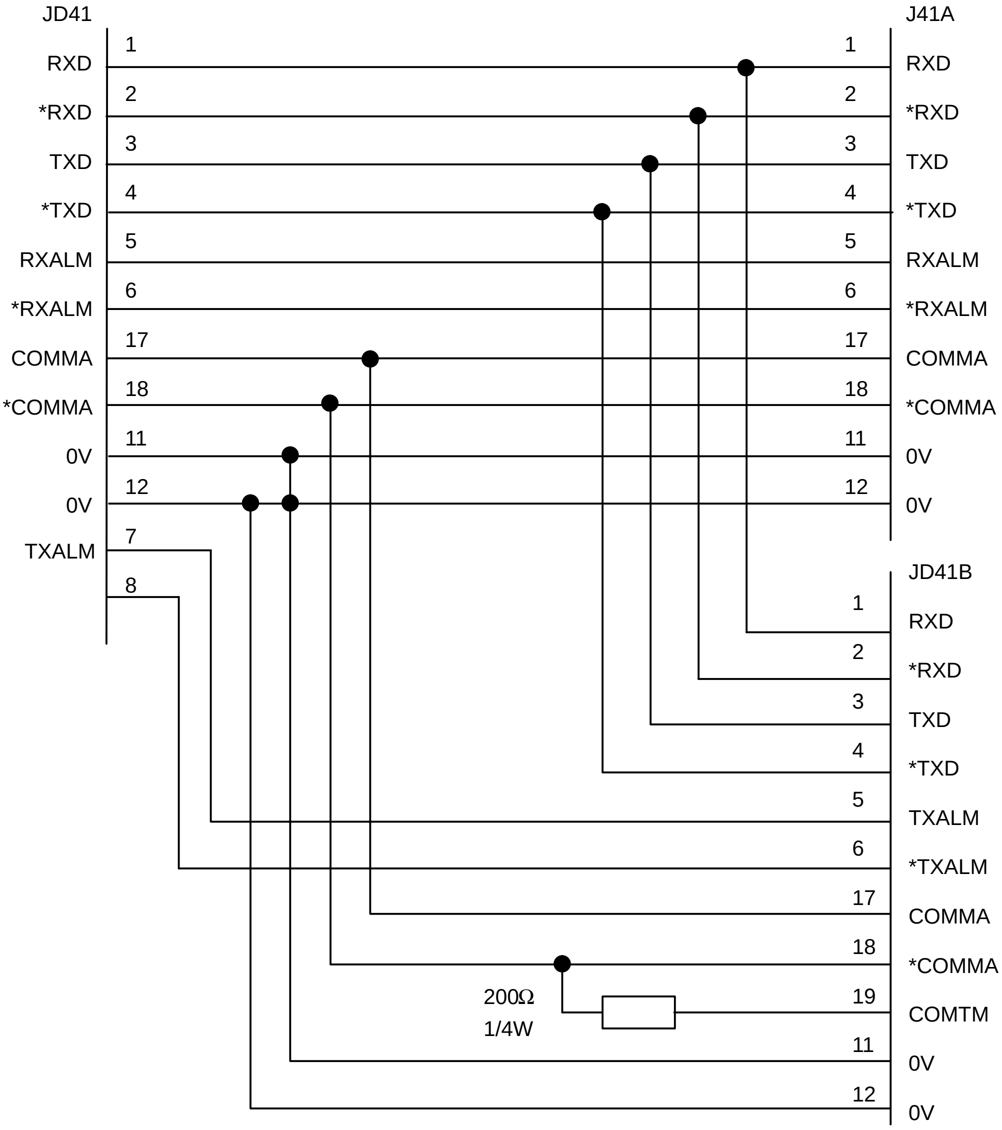
| | | | |
|---|---|---|---|
| 1 | RXD | 11 | 0V |
| 2 | *RXD | 12 | 0V |
| 3 | TXD | 13 | |
| 4 | *TXD | 14 | |
| 5 | RXALM | 15 | |
| 6 | *RXALM | 16 | |
| 7 | | 17 | COMMA |
| 8 | | 18 | *COMMA |
| 9 | | 19 | |
| 10 | | 20 | |

Display link adapter JD41
(PCR–EV20MDT)

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

Display link adapter JD41B
(PCR–EV20MDT)

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



FANUC purchase specification: (A02B–0259–C301)

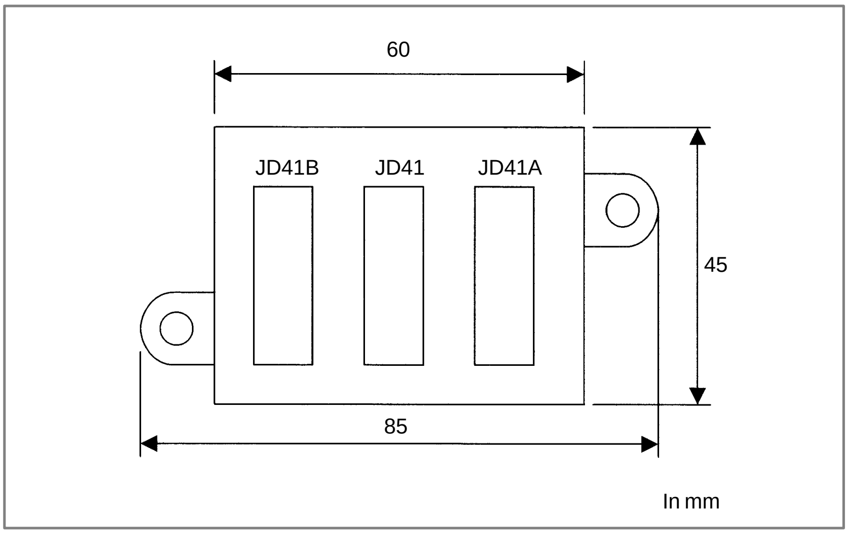


Fig. 8.1.10 (a) Display link adaptor manufactured by FANUC

1) Mounting to the DIN rail

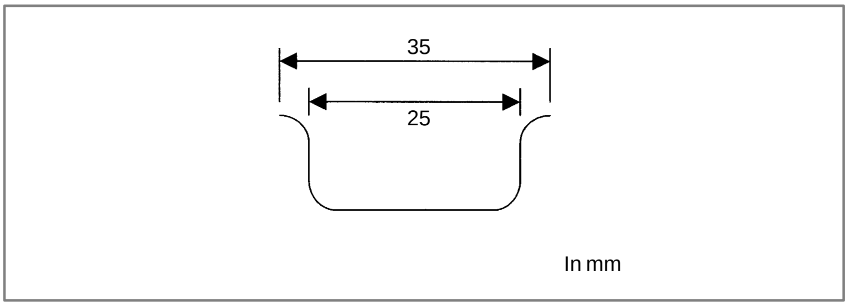


Fig. 8.1.10 (b) Recommended DIN rail

2) Mounting with screws

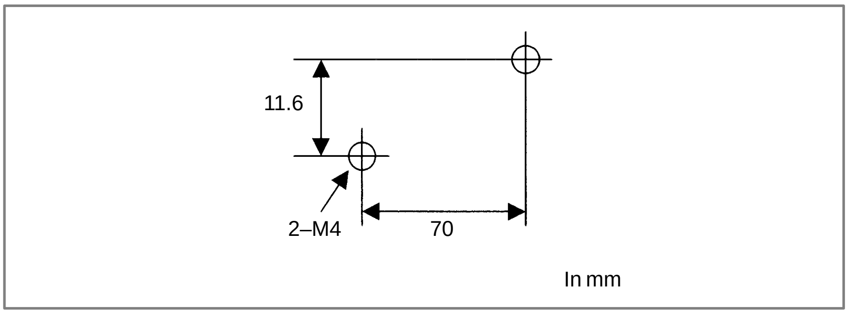
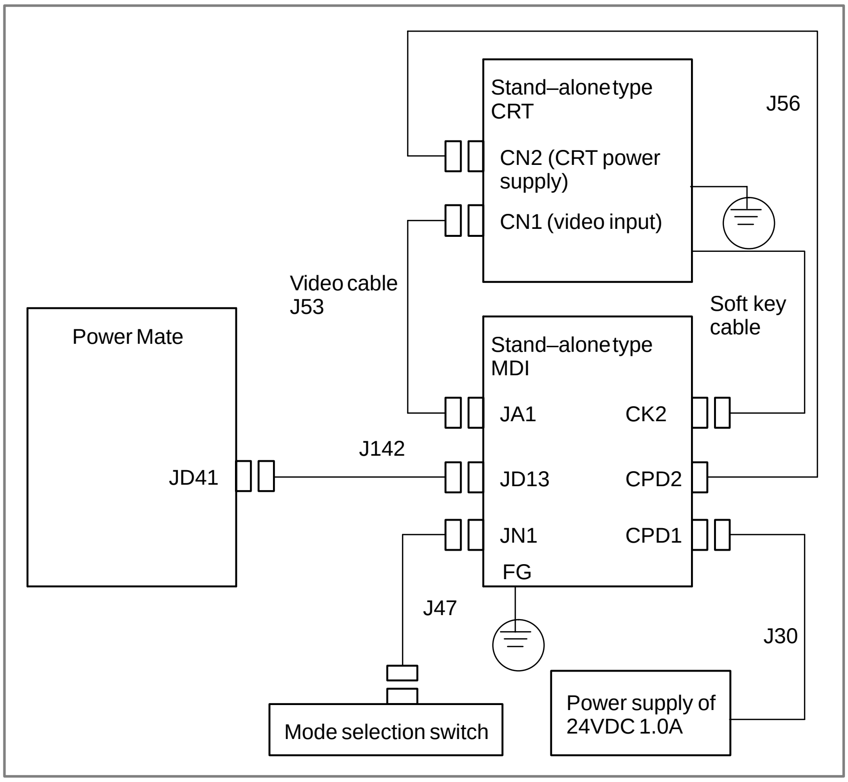


Fig. 8.1.10 (c) Sheet metal hole drilling diagram

## 8.2 INTERFACE BETWEEN STAND–ALONE TYPE CRT, STAND–ALONE TYPE MDI, AND Power Mate

### 8.2.1 Outline

The Power Mate can be used in conjunction with a stand–alone type CRT and a stand–alone type MDI and a picuture display stand–alone type MDI.



**1** Up to 16 Power Mates can be connected to one stand–alone type CRT and one stand–alone type MDI.
Connection is the same as for the CRT/MDI.

**2** Terminating method is the same as for the CRT/MDI.

**3** The stand–alone type CRT is supplied with a soft key cable. Connect this cable to the stand–alone type MDI. Keep in mind that the length of this cable is 500 mm when positioning these units. See Appendix A for the connector position of the soft key cable in stand–alone type CRT.

**4** The screen can be shared in the same way as for the CRT/MDI.

**5** For details concerning cable J142 used to connect a Power Mate and the stand–alone type MDI, see Subsection 8.1.2. See Section 8.1.3 for how to attach the J45 cable for connection with multiple Power Mate units.

**6** For details concerning cable J30 used to connect the power supply to the stand–alone type MDI, see Subsection 8.1.5.

**7** For details concerning cable J47 used to connect the stand–alone type MDI to the mode selection switch, see Subsection 8.1.4.

**8** Video cable J53 and stand–alone type CRT power cable J56 are not supplied with the unit.

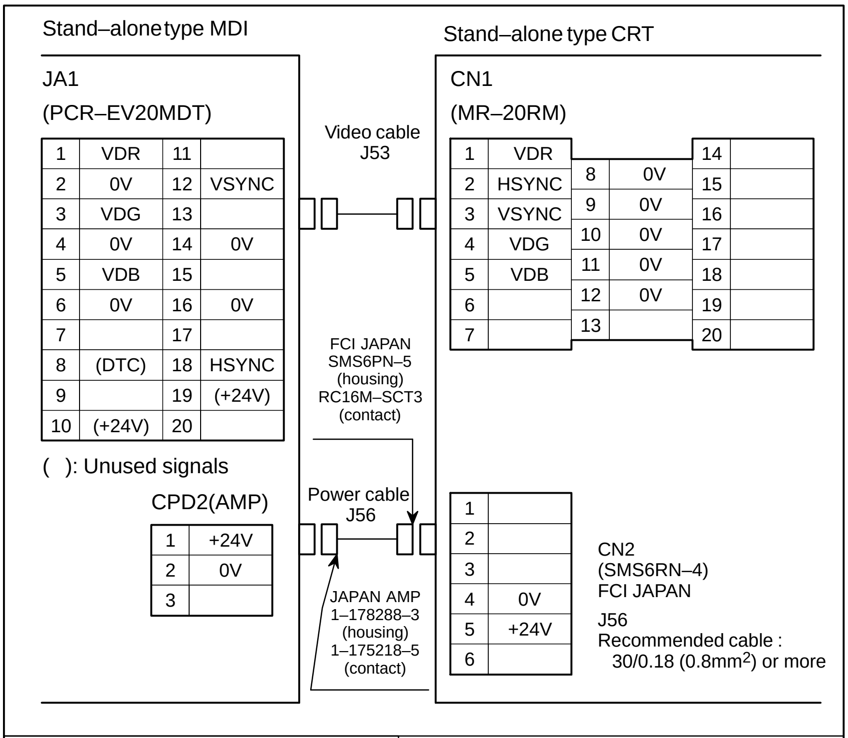
**9** Always connect the protective ground plates of the stand–alone type CRT and stand–alone type MDI to ground, see Section 5.8

**10** All interfaces not described here are the same as those of the CRT/MDI.

**WARNING**

To have the stand–alone type CRT approved for the CE marking, it is necessary to provide a shock hazard prevention cover (A02B–0200–K820). Attaching the cover to the CRT is the machine tool builder's responsibility.

## 8.2.2
## Video and Power Supply Interface



JA1 (PCR–EV20MDT)

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

(  ): Unused signals

CN1 (MR–20RM)

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

CPD2(AMP)

| | |
|---|---|
| 1 | +24V |
| 2 | 0V |
| 3 | |

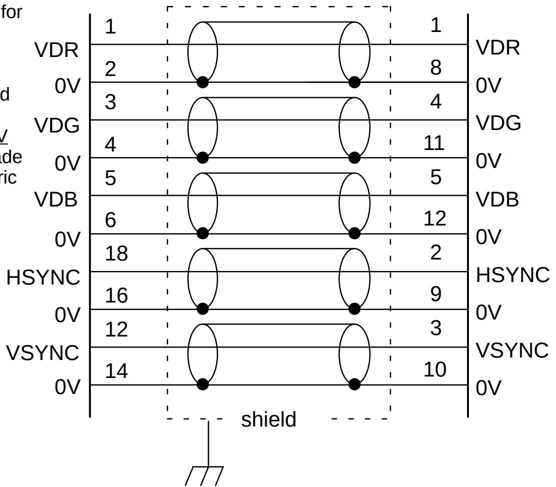
CN2 (SMS6RN–4) FCI JAPAN

| | |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | 0V |
| 5 | +24V |
| 6 | |

J56
Recommended cable :
30/0.18 (0.8mm$^2$) or more

Connection of video cable J53

Cable connector for CN1
- Covered connector MR–20LFH (made by Honda Tsushin)



| | | | |
|---|---|---|---|
| VDR | 1 | 1 | VDR |
| 0V | 2 | 8 | 0V |
| VDG | 3 | 4 | VDG |
| 0V | 4 | 11 | 0V |
| VDB | 5 | 5 | VDB |
| 0V | 6 | 12 | 0V |
| HSYNC | 18 | 2 | HSYNC |
| 0V | 16 | 9 | 0V |
| VSYNC | 12 | 3 | VSYNC |
| 0V | 14 | 10 | 0V |

Cable connector for JA1
- Connector FI40B–20S (15–pin soldered type)
- Case FI–20–CV
  Above parts made by Hirose Electric Co., Ltd.

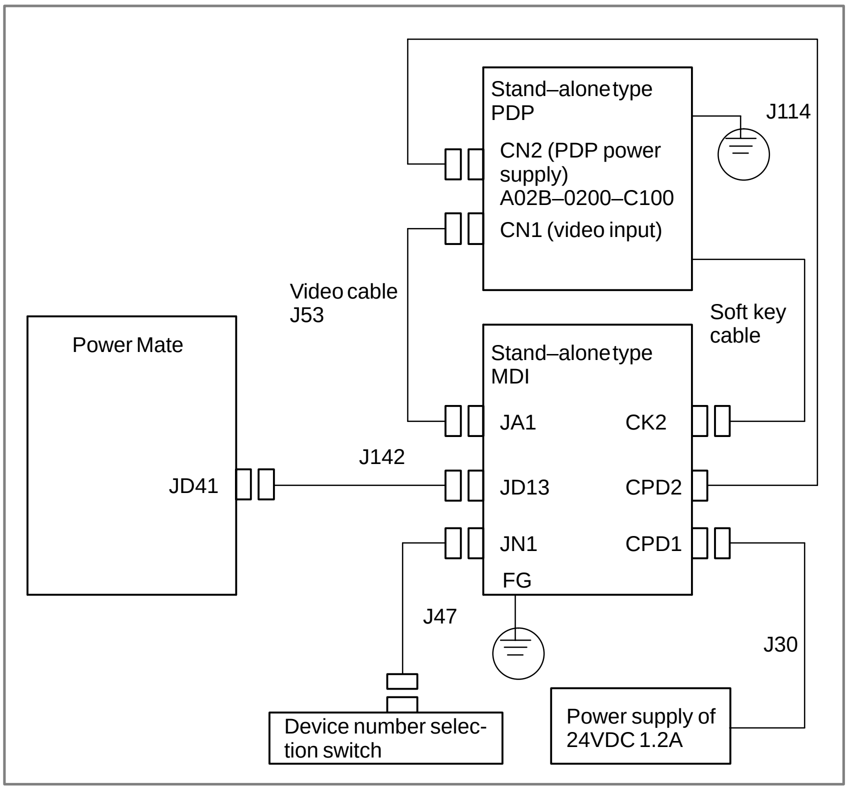
Recommended cables
A66L–0001–0371 : 5–core coaxial cable

**NOTE**
Do not make any connection other than the above.

## 8.3 INTERFACE BETWEEN STAND–ALONE TYPE PDP, STAND–ALONE TYPE MDI, AND Power Mate

### 8.3.1 Outline

The Power Mate is used in conjunction with a stand–alone type PDP, a stand–alone type MDI, and a picture display type stand–alone type MDI.



1 Up to 16 Power Mates can be connected to one stand–alone type PDP and one stand–alone type MDI.
Connection is the same as for the CRT/MDI.

2 Terminating method is the same as for the CRT/MDI.

3 The stand–alone type PDP is supplied with a soft key cable. Connect this cable to the stand–alone type MDI. Keep in mind that the length of this cable is 450 mm when positioning these units. See Appendix A for the comector position of the soft key cable in stand–alone type CRT.

4 The screen can be shared in the same way as for the CRT/MDI.

5 For details concerning cable J142 used to connect a Power Mate and the stand–alone type MDI, see Subsection 8.1.2. See Section 8.1.3 for how to attach the J45 cable for connection with multiple Power Mate units.

6 For details concerning cable J30 used to connect the power supply to the stand–alone type MDI, see Subsection 8.1.5.

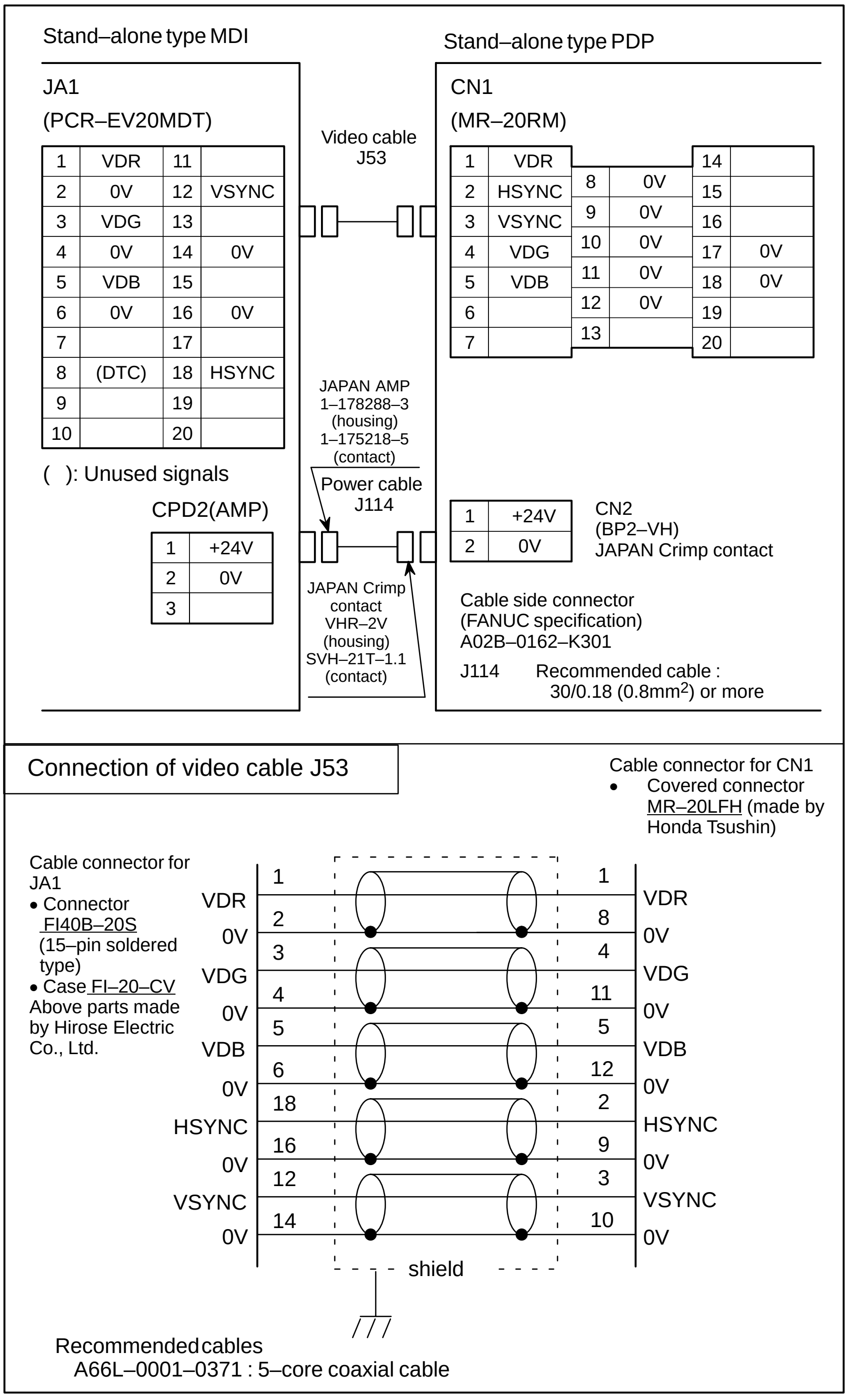
7 For details concerning cable J47 used to connect the stand–alone type MDI to the device number selection switch, see Subsection 8.1.4.

**8** Video cable J53 are stand–alone type PDP power cable J114 are not suppled with unit.

**9** Always connect the protective ground plates of the stand–alone type CRT and stand–alone type MDI to ground, see Section 5.8.

**10** All interfaces not described here are the same as those of the CRT/MDI.

## 8.3.2 Video and Power Supply Interface



JA1 (PCR–EV20MDT)

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

CN1 (MR–20RM)

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

CPD2(AMP)

| | |
|---|---|
| 1 | +24V |
| 2 | 0V |
| 3 | |

CN2 (BP2–VH)

| | |
|---|---|
| 1 | +24V |
| 2 | 0V |

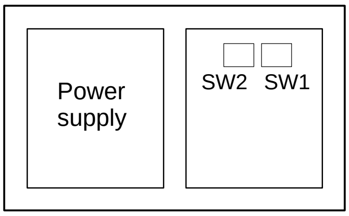
**NOTE**

Do not make any connection other than the above.

## 8.3.3 Adjusting the Stand–Alone Type PDP

Fine adjustment of the video signal is supported to enable its use with stand–alone type PDP. This adjustment is necessary to compensate for errors resulting from the combination of CNCs 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 CNC, either as part of regular field maintenance or to correct a failure.

### Locations of switches and jumper pins



Plasma display (rear view)

### Adjustment

- **Eliminating flicker**

- Stand–alone type PDP : Switch SW1

**1** Change the jumper pin or switch setting 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**

- Stand–alone type PDP : 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.

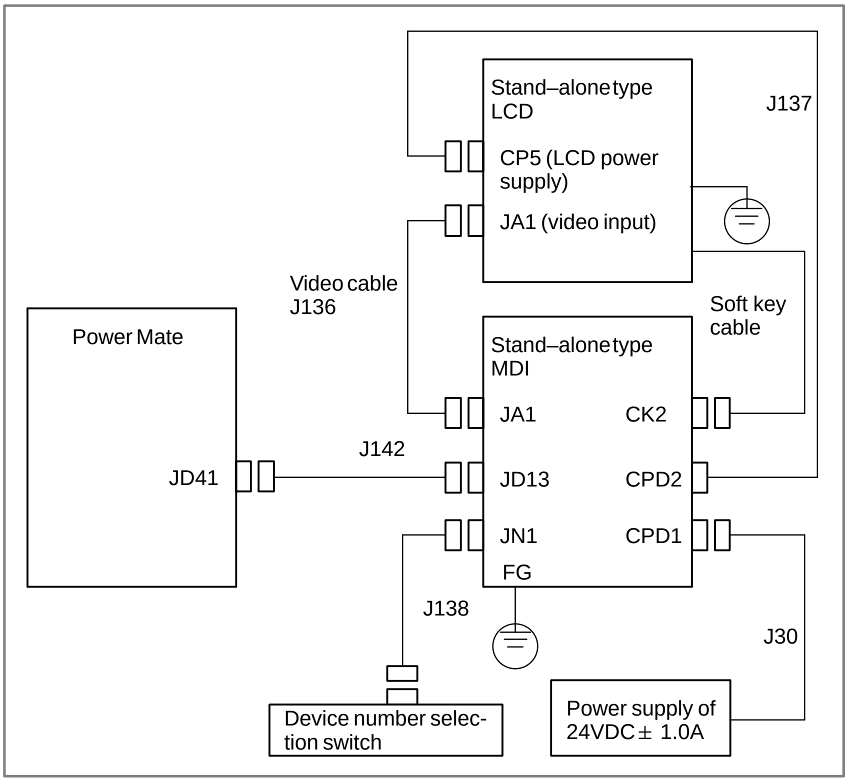
**CAUTION**
Do not attempt to change any controls or settings other than those described above.

**NOTE**
If a PDP is used with two CNCs by selecting one at a time, the adjustment described above must be made each time switching between the CNCs occurs. So, this configuration should be avoided.

## 8.4 LCD/MDI, STAND–ALONE TYPE LCD, AND STAND–ALONE TYPE MDI INTERFACE

### 8.4.1 Outline

The Power Mate can be used in combination with the LCD/MDI, stand–alone type LCD, stand–alone type MDI, or picture display stand–alone type MDI.



1 Up to 16 Power Mates can be connected to LCD/MDI or one stand–alone type LCD and one stand–alone type MDI. Connection is the same as for the CRT/MDI.

2 Terminating method is the same as for the CRT/MDI.

3 The stand–alone type LCD is supplied with a soft key cable. Connect this cable to the stand–alone type MDI. Keep in mind that the length of this cable is 500 mm when positioning these units. See Appendix A for the connector position of the soft key cable in stand–alone type LCD.

4 The screen can be shared in the same way as for the CRT/MDI.

5 For details concerning cable J142 used to connect a Power Mate and the LCD/MDI or stand–alone type MDI, see Subsection 8.1.2. See Section 8.1.3 for how to use the J45 cable for connection with multiple Power Mate units.

6 For details concerning cable J30 used to connect the power supply to the LCD/MDI or stand–alone type MDI, see Subsection 8.1.5.

**7** For stand–alone type LCD or stand–alone type MDI, video cable J136 or stand–alone type LCD power cable J137 are not supplied with the unit.

**8** Always connect the protective ground plates of the LCD/MDI, stand–alone type LCD, and stand–alone type MDI to ground, see Section 5.8.

**9** External dimension of LCD/MDI is same as it of CRT/MDI.

**10** If the ambient temperature is low, the brightness of the LCD decreases (immediately after the power is turned on, in particular). This is due to the characteristics of the LCD, and does not indicate a fault. As the ambient temperature rises, the LCD becomes brighter.

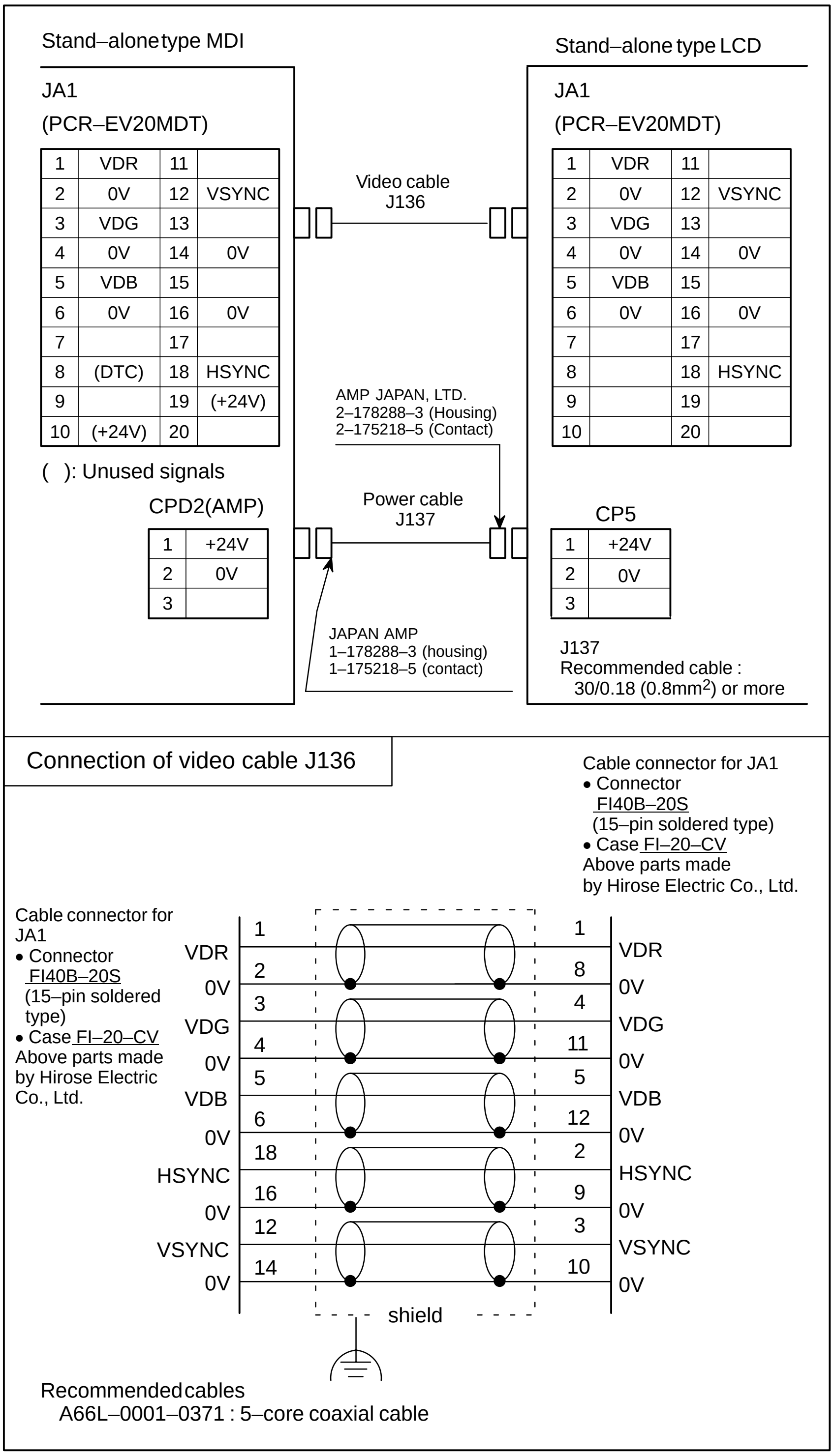
**11** All interfaces not described here are the same as those of the CRT/MDI.

**NOTE**

Even if only one Power Mate unit is connected, connection must be made through the device number selection switch interface.

## 8.4.2

## Video and Power Supply Interface (for Stand–Alone Type)



Stand–alone type MDI

JA1
(PCR–EV20MDT)

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

( ): Unused signals

CPD2(AMP)

| | |
|---|---|
| 1 | +24V |
| 2 | 0V |
| 3 | |

Stand–alone type LCD

JA1
(PCR–EV20MDT)

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

CP5

| | |
|---|---|
| 1 | +24V |
| 2 | 0V |
| 3 | |

J137
Recommended cable :
30/0.18 (0.8mm$^2$) or more

Connection of video cable J136

Cable connector for JA1
- Connector FI40B–20S (15–pin soldered type)
- Case FI–20–CV

Above parts made by Hirose Electric Co., Ltd.

Cable connector for JA1
- Connector FI40B–20S (15–pin soldered type)
- Case FI–20–CV

Above parts made by Hirose Electric Co., Ltd.

| | | | |
|---|---|---|---|
| VDR | 1 | 1 | VDR |
| 0V | 2 | 8 | 0V |
| VDG | 3 | 4 | VDG |
| 0V | 4 | 11 | 0V |
| VDB | 5 | 5 | VDB |
| 0V | 6 | 12 | 0V |
| HSYNC | 18 | 2 | HSYNC |
| 0V | 16 | 9 | 0V |
| VSYNC | 12 | 3 | VSYNC |
| 0V | 14 | 10 | 0V |

Recommended cables
A66L–0001–0371 : 5–core coaxial cable

**NOTE**

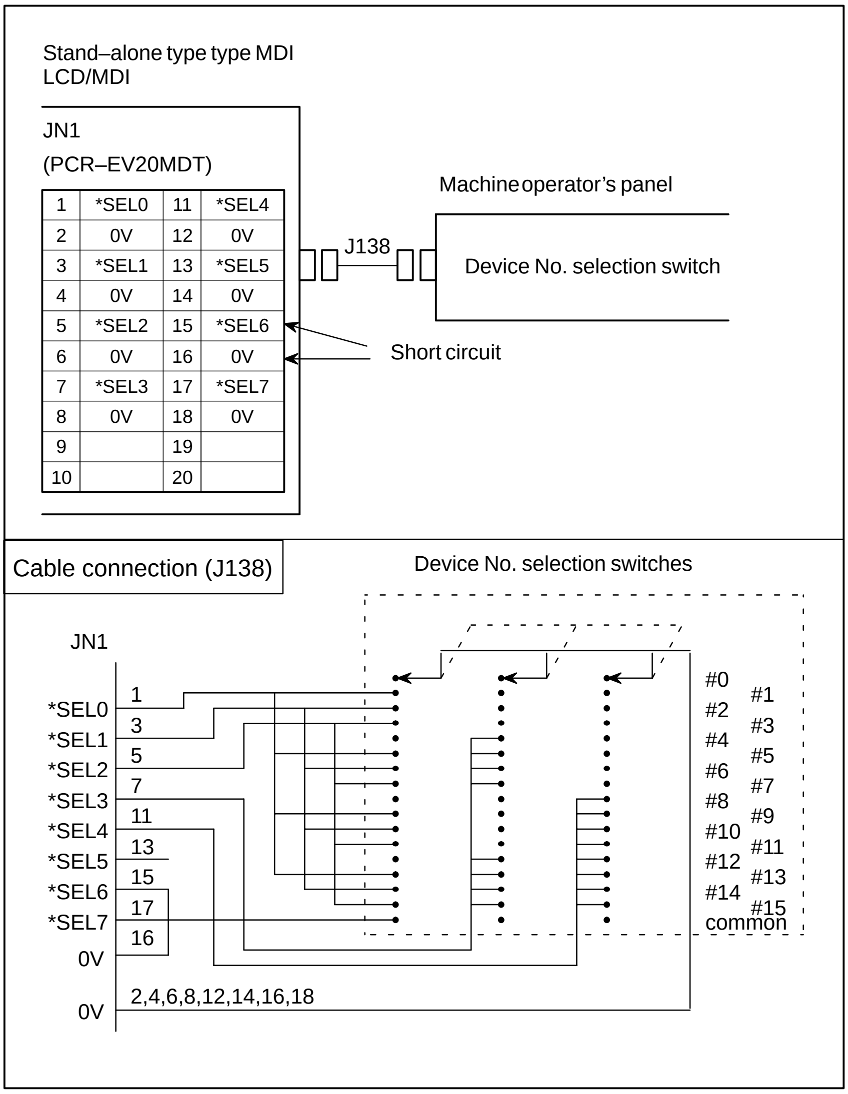
1 The LCD/MDI is factory–attached with a video cable and a power cord.

2 Do not make any connection other than the above.

## 8.4.3
## Device Number Selection Switch Interface

When a LCD/MDI or stand–alone type LCD is used, connection must be made through the device selection switch interface even if only one Power Mate unit is connected.

Connect JN1 (15) and JN1 (16). Otherwise, the screen will shift up when displayed.



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

Relationship between selection switches and device numbers

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

× : Switch open
○ : Switch closed
– : Either will do

Recommended cable:
A66L–0001–0284#10P (#28AWG10 ten pairs)
Recommended connector
PCR–E20FS or PCR–E20FA
Housing PCR–V20LA
Maximum cable length : 10m

## 8.4.4 Adjusting the Stand–Alone Type LCD

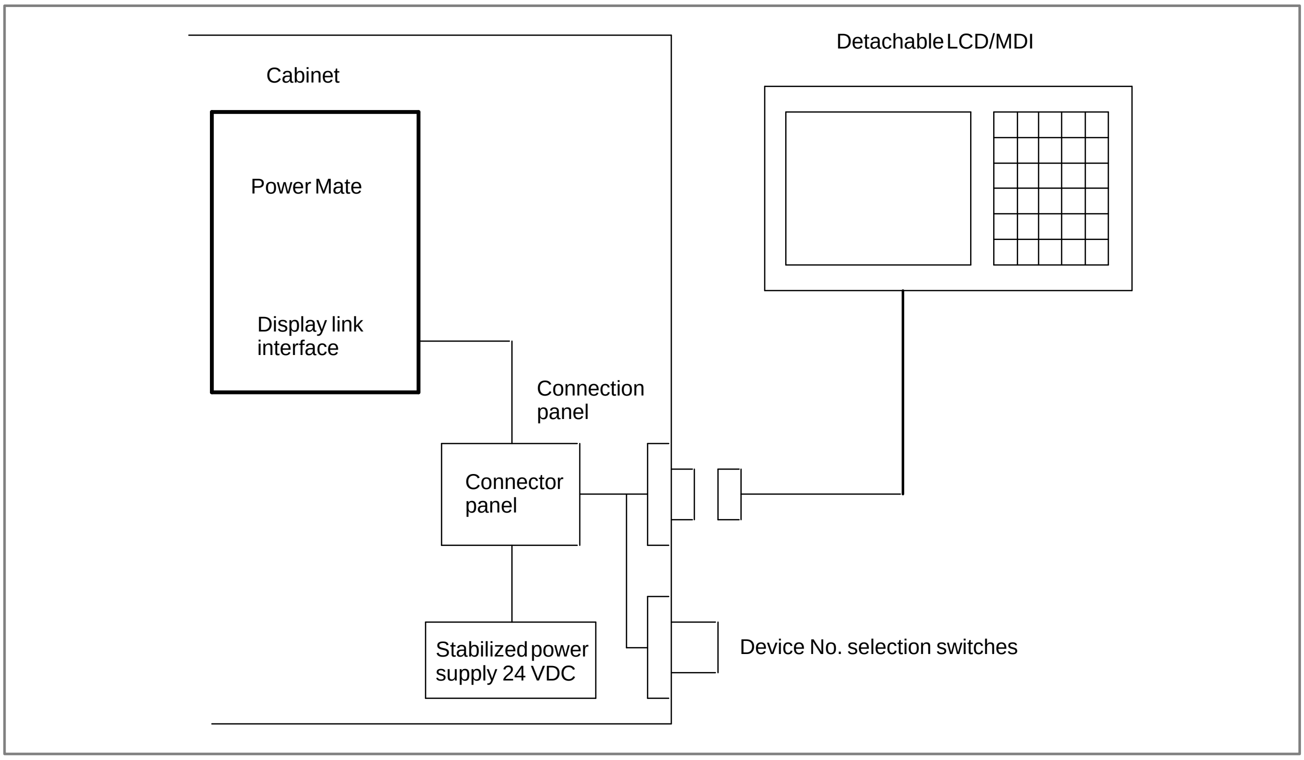
The stand–alone type LCD is provided with the following adjustment switch and potentiometers, the factory settings of which must not be changed. (Adjustment is necessary only when the unit has been disassembled to replace the adapter or LCD panel.)

VR1 : Flicker adjustment potentiometer
VRP1 : Contrast adjustment potentiometer
SW1 : Horizontal position adjustment switch

## 8.5
## CONNECTION TO A DETACHABLE LCD/MDI UNIT

### 8.5.1
### Outline

The Power Mate supports the use of a detachable LCD/MDI, which consists of a 7.2″ LCD/MDI housed in a portable dustproof case.



(1) No cable is provided with the detachable LCD/MDI.

(2) The customer is responsible for preparing the connector panel, external power supply, connection panel, and device No. selection switches.

(3) The customer is responsible for preparing all inter–unit connection cables.

(4) If the ambient temperature is low, the brightness of the LCD decreases (immediately after the power is turned on, in particular). This is due to the characteristics of the LCD, and does not indicate a fault. As the ambient temperature rises, the LCD becomes brighter.

## 8.5.2 Specifications

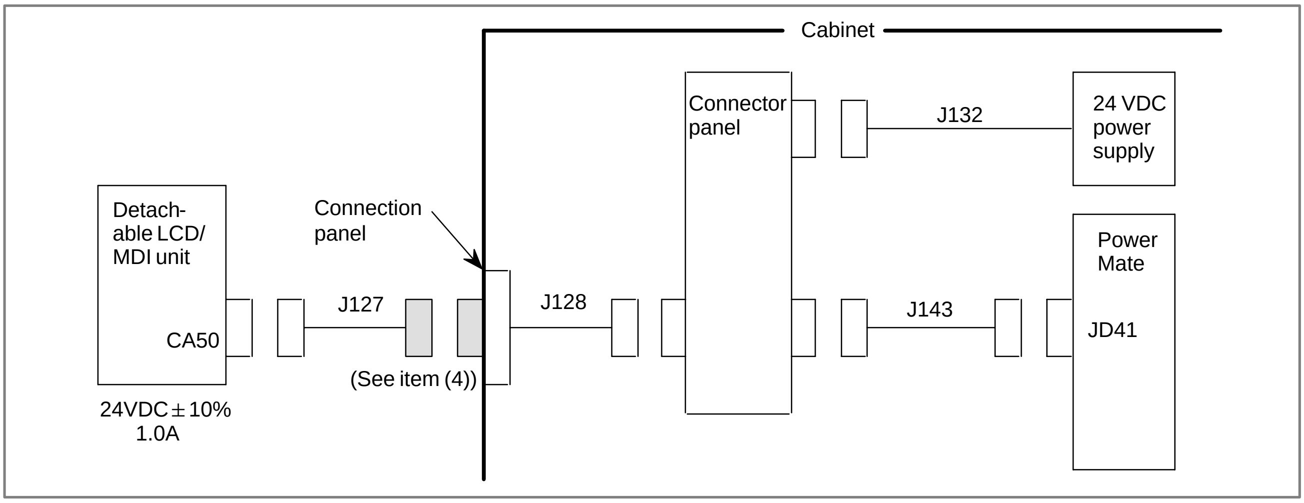
| | |
|---|---|
| Indicator | 7.2″ LCD, 40 characters by 16 lines |
| Power supply | 24 VDC ±10%, 1.0 A<br>(including an instantaneous value and ripple) |
| External dimensions | 410 (W) x 235 (H) x 235 (D) mm<br>(including the cable winding section) |
| Weight | 7.0 kg (excluding connection cables) |
| Drawing number | A02B–0166–C271#R (English keys)<br>A02B–0166–C271#S (Symbolic keys) |

**NOTE**

This detachable LCD/MDI does not support the picture display function.

## 8.5.3 Detachable LCD/MDI Unit Connected to One Power Mate Unit

1) Inter–unit connection diagram

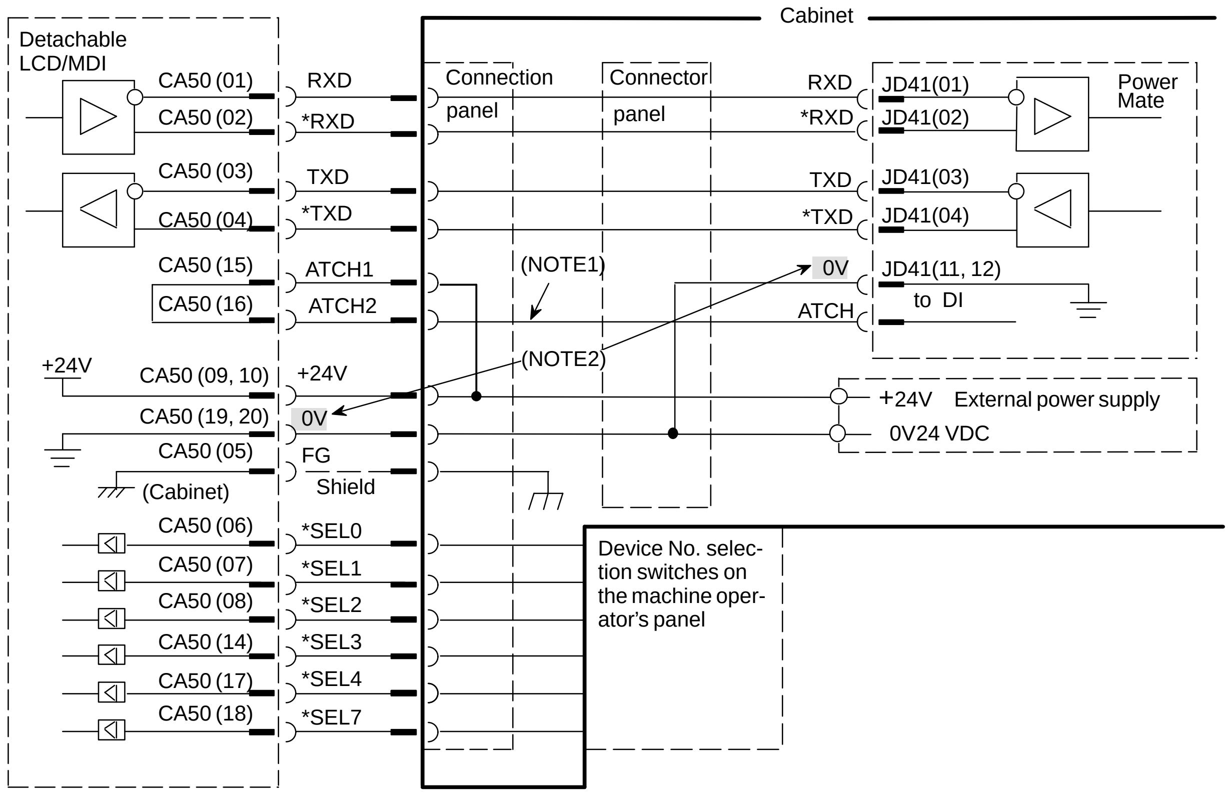


(1) The total length of the cables (J127, J128, and J143) between the detachable LCD/MDI unit and Power Mate must not exceed 50 m.

(2) Cables J127, J128, and J132 also serve as a 24 VDC power supply line for the detachable LCD/MDI unit. The 24 VDC power is subject to a voltage drop corresponding to the total resistance of the 24V line and 0V line. Taking this voltage drop into consideration, determine the cable length so that 24 VDC ± 10% is available at connector CA50 of the detachable LCD/MDI unit.

(3) Use cable J143 for termination on the Power Mate side.

(4) While the power is on, cables can be attached/detached to/from those connectors on the connection panel that are shaded (▨) in the above figure. For the other connectors (such as CA50 and JD14), cables can neither be attached nor detached while the power is on.

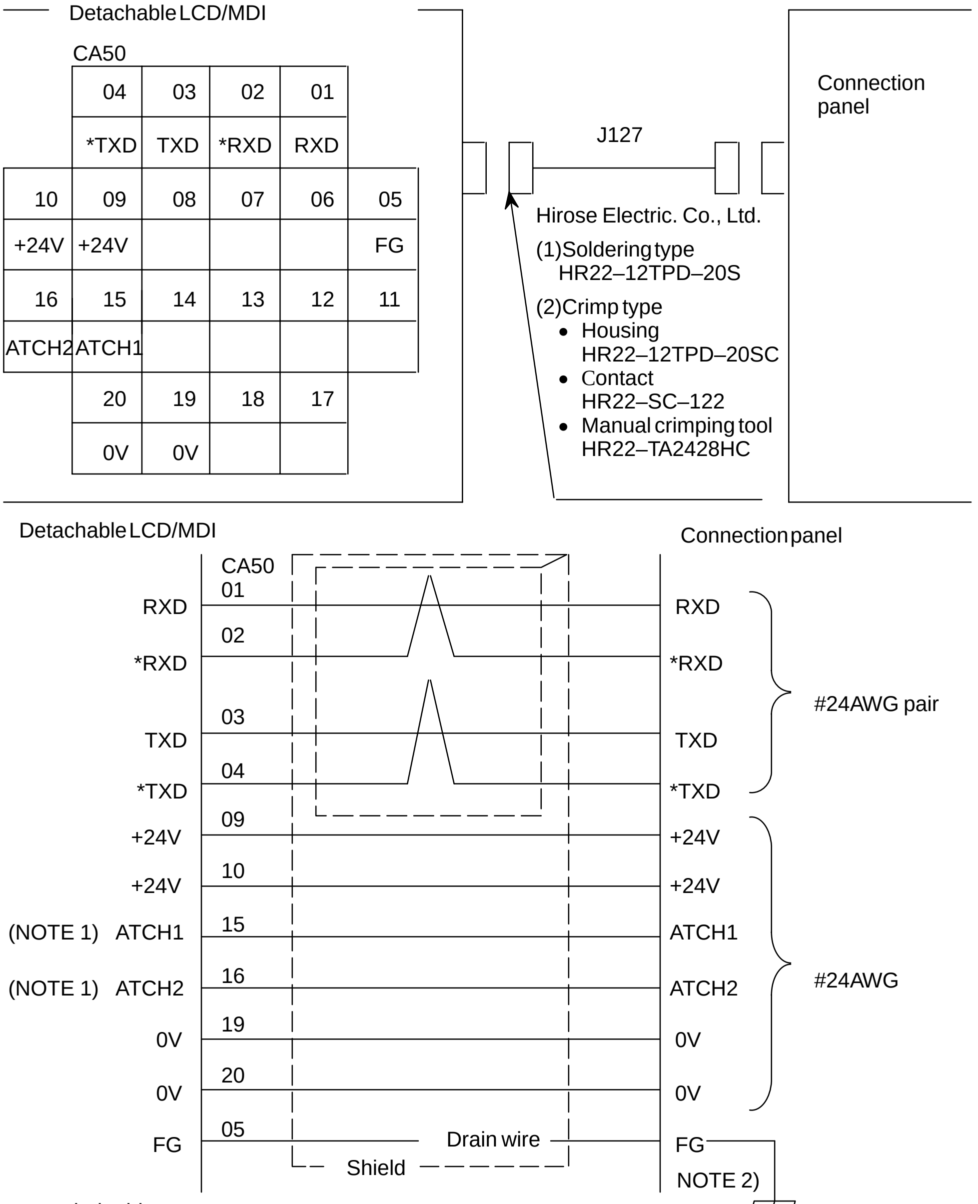


**NOTE**

1 ATCH1 and ATCH2 can be used as DI signals for detecting whether a detachable LCD/MDI is attached to the connection panel (See Subsec. 8.5.5). ATCH1 and ATCH2, when unused, need not be connected.

2 To attach or detach a detachable LCD/MDI while the Power Mate is turned on, 0V of the Power Mate must be connected to 0V of the detachable LCD/MDI before any other line.

2) Details of cable J127



Recommended cable
A66L–0001–0298: Oki Electric Cable Co., Ltd.
(#24AWG pair x 2, #24AWG x 10, external cable diameter: 8.5 mm, Conductor registance: 88.9Ω/km)

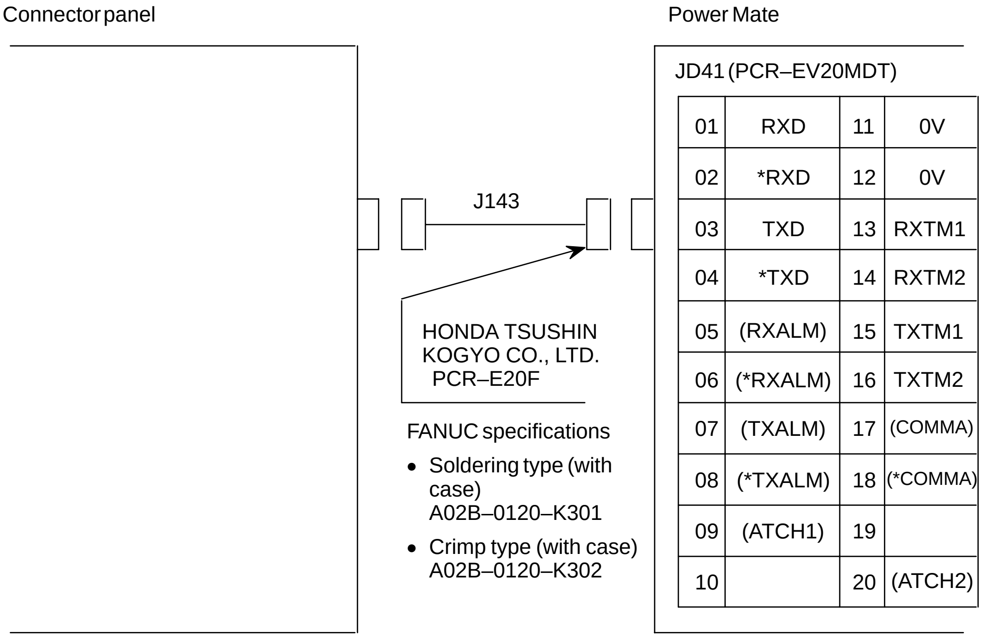
**NOTE**

1 ATCH1, ATCH2
ATCH1 and ATCH2 can be used as DI signals for detecting whether a detachable LCD/MDI is attached to the connection panel (See Subsec. 8.5.5). ATCH1 and ATCH2, when unused, need not be connected.

2 FG
Using a drain wire, connect CA50 (05) to the FG terminal of the connection panel.
Connect the FG terminal of the connection panel to the frame ground by using a twisted–pair cable that is 100 to 300 mm long with a cross–sectional area of at least 2 mm$^2$.

3 The external diameter of the cable used with connector CA50 is 8.5 mm. If the external diameter of the cable is less than 8.5 mm, increase the diameter to 8.5 mm by using heat–shrinkable tube or taping at the connector joint to ensure a dustproof connection.

### 3) Details of cable J126



HONDA TSUSHIN
KOGYO CO., LTD.
PCR–E20F

FANUC specifications

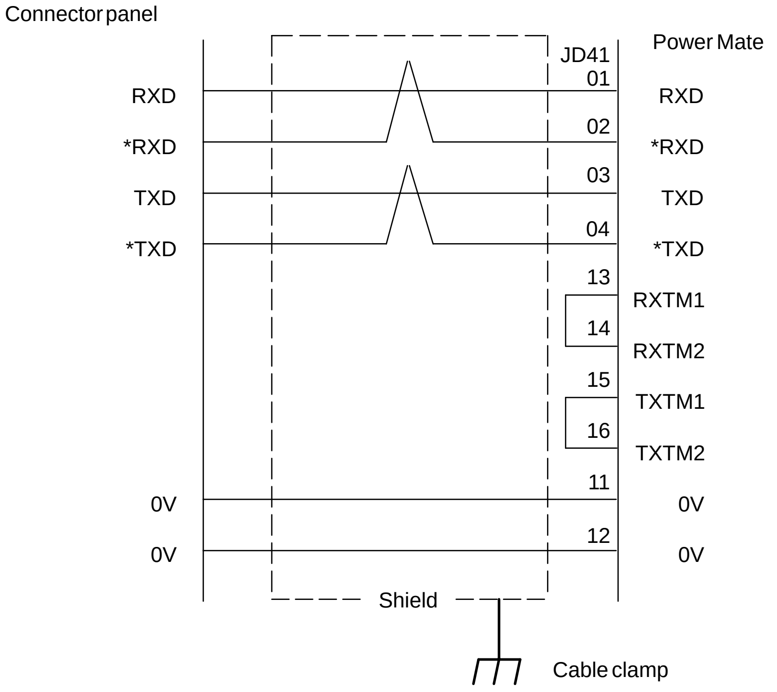
- Soldering type (with case)
  A02B–0120–K301
- Crimp type (with case)
  A02B–0120–K302

JD41 (PCR–EV20MDT)

| | | | |
|---|---|---|---|
| 01 | RXD | 11 | 0V |
| 02 | *RXD | 12 | 0V |
| 03 | TXD | 13 | RXTM1 |
| 04 | *TXD | 14 | RXTM2 |
| 05 | (RXALM) | 15 | TXTM1 |
| 06 | (*RXALM) | 16 | TXTM2 |
| 07 | (TXALM) | 17 | (COMMA) |
| 08 | (*TXALM) | 18 | (*COMMA) |
| 09 | (ATCH1) | 19 | |
| 10 | | 20 | (ATCH2) |

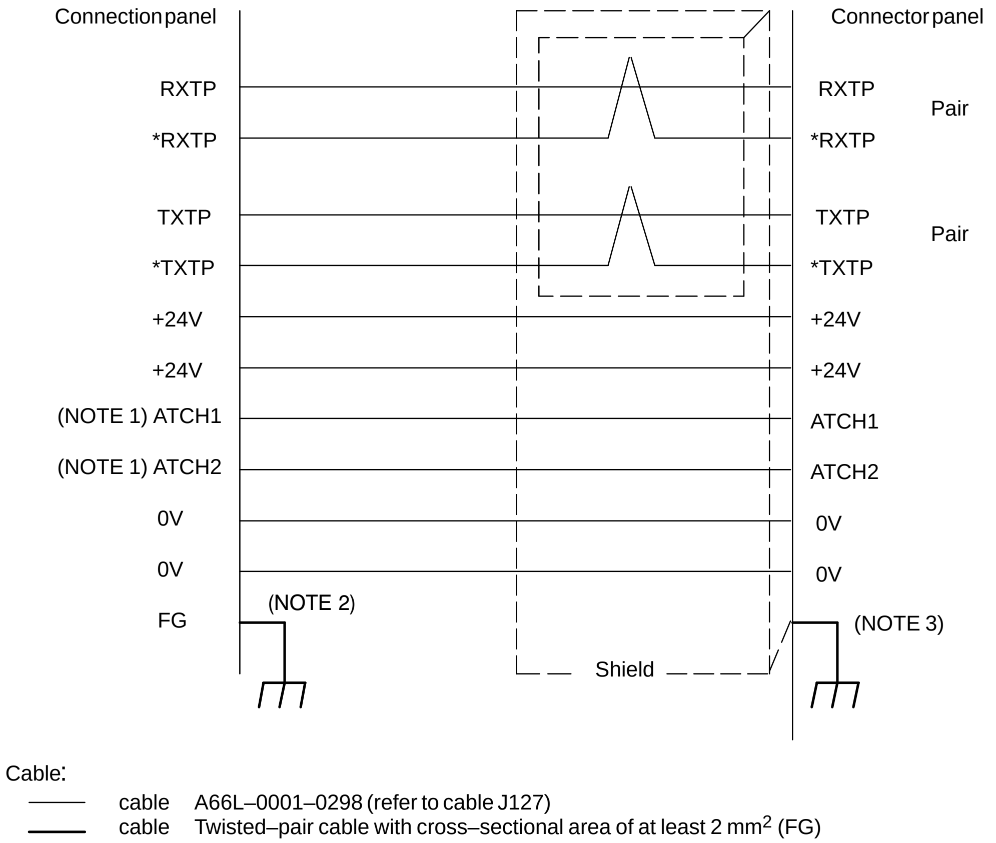
Pins 09 and 20 accommodate signals for checking connection to the Handy operator's panel.

Cable connection (J143)



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

4) Details of cable J128



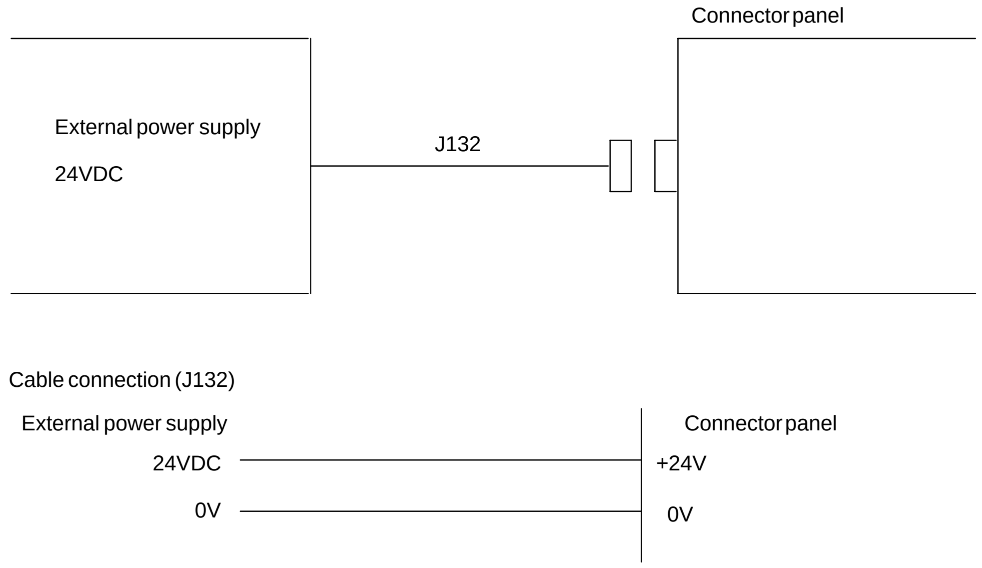
**NOTE**

1 ATCH1 and ATCH2, when unused, need not be connected.

2 FG on the connection panel:
Connect the FG terminal on the connection panel to the frame ground. For this connection, use a twisted–pair cable, 100 to 300 mm long, with a cross–sectional area of at least 2 $mm^2$.
Use this FG terminal to connect the shield of cable J127 to ground.

3 FG on the connector panel:
On the connector panel, connect the shield of cable J128 to the frame ground. For this connection, use a twisted–pair cable, 100 to 300 mm long and with a cross–sectional area of at least 2 $mm^2$.

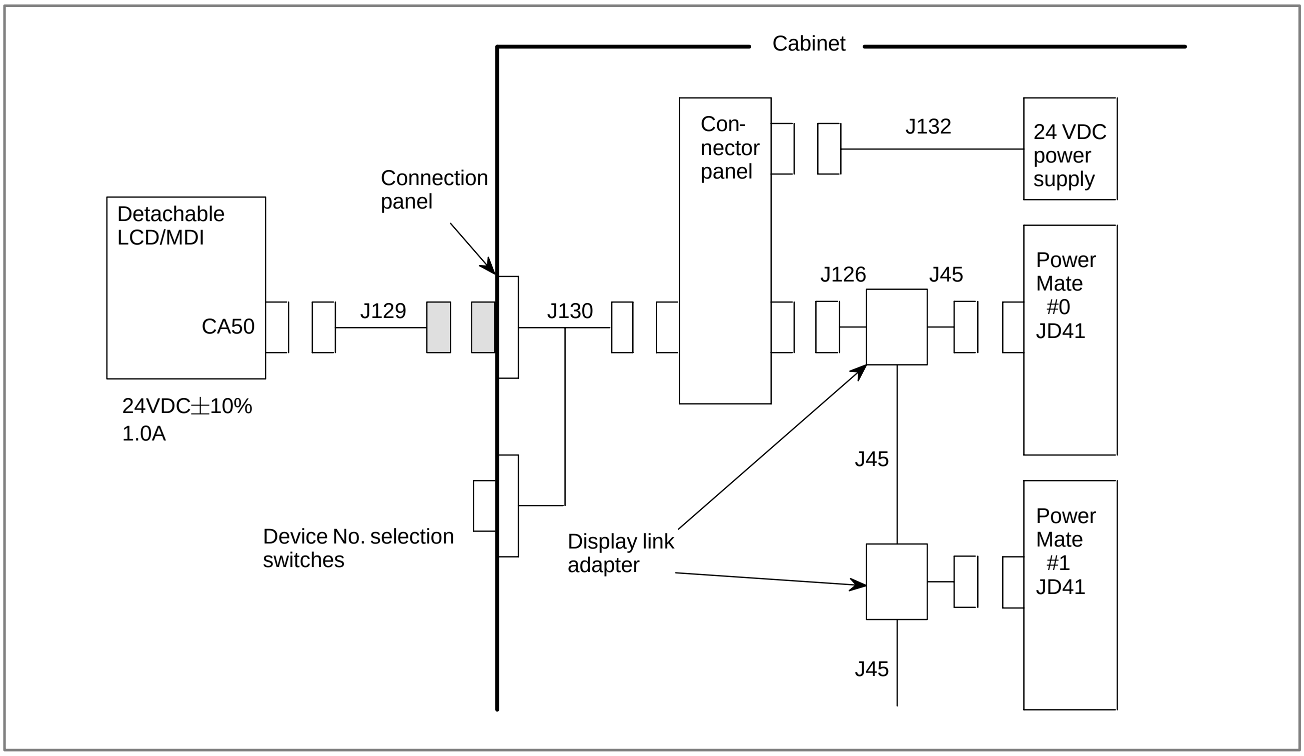
5) Details of cable J132



### 8.5.4

### When One Detachable LCD/MDI Unit is Shared by Multiple Power Mate Units

1) Inter–unit connection diagram



(1) When using the CRT sharing function, mount the device No. selection switches on the cabinet.

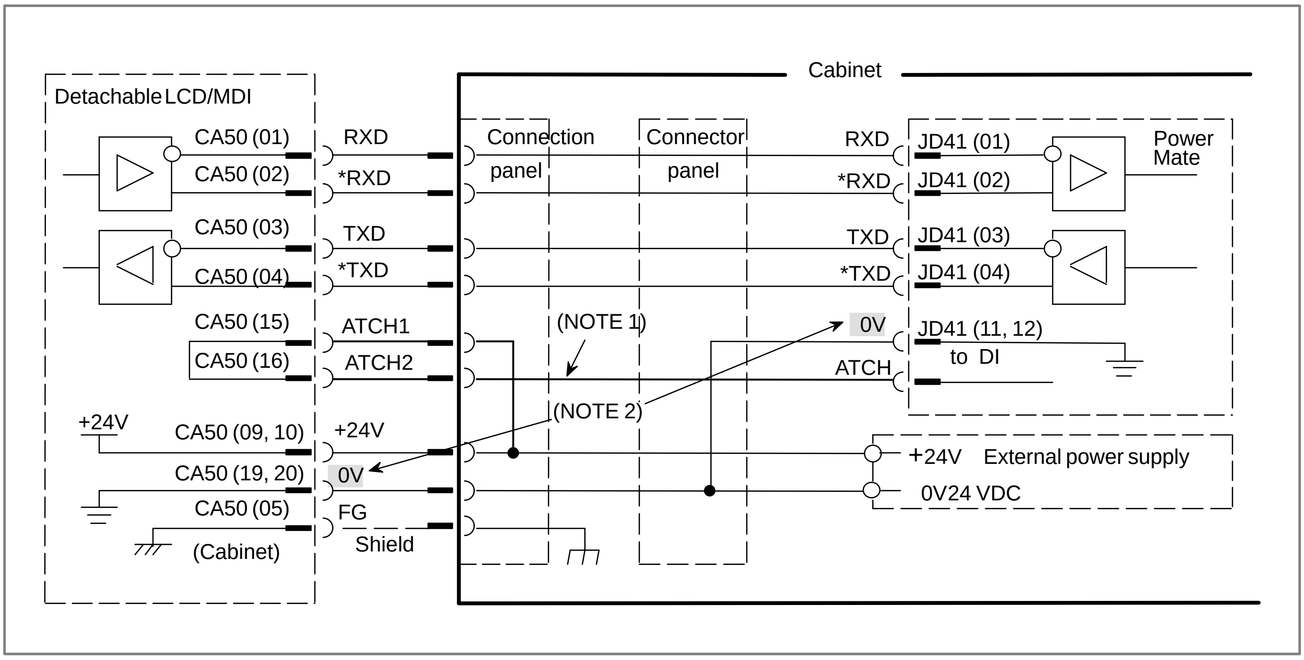
(2) The total length of the cables (J129, J130, J126, J45 x n) between the detachable LCD/MDI and Power Mate units must not exceed 50 m.

(3) Cables J129, J130, and J132 also serve as a 24 VDC power supply line for the detachable LCD/MDI. The 24 VDC power is subject to a voltage drop corresponding to the total resistance of the 24V and 0V lines. Taking this voltage drop into consideration, determine the cable length so that 24 VDC ±10% is available at connector CA50 of the detachable LCD/MDI.

(4) Connect the display link to a terminating resistor in the last display link adapter (see Section 8.1.9).

(5) The connections from Power Mate #0 to Power Mate #15 are the same as those for the CRT/MDI unit.

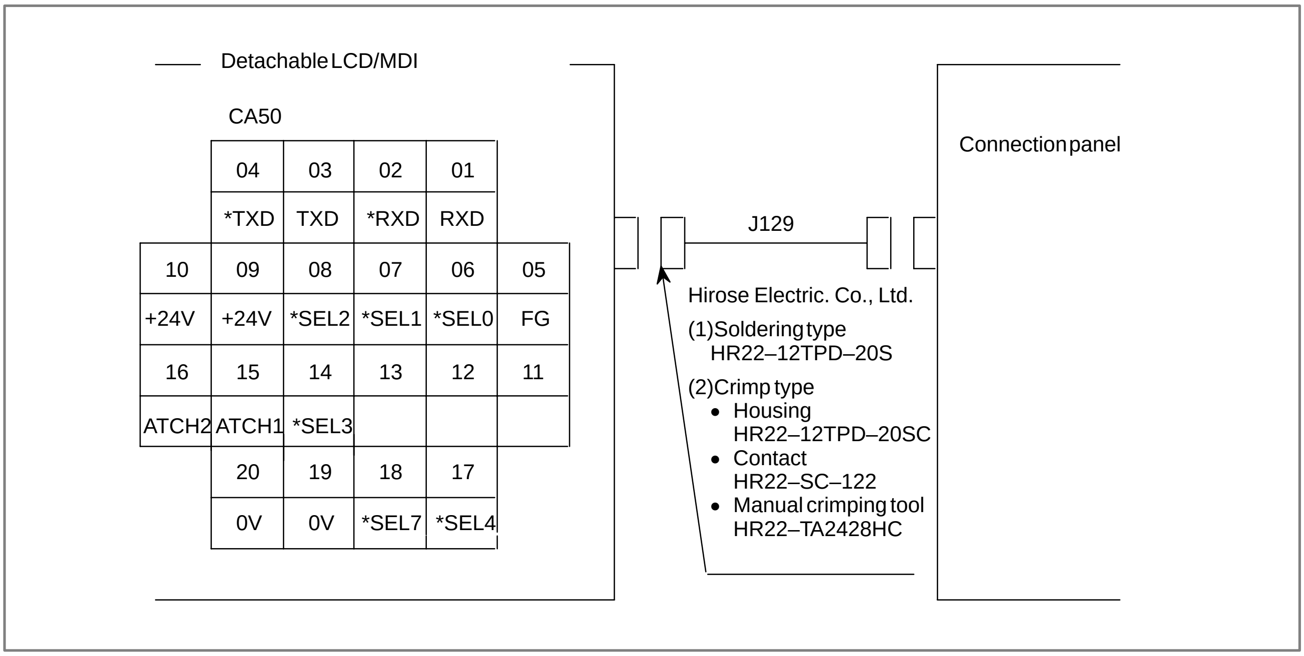
(6) While the power is on, cables can be attached/detached to/from those connectors on the connector panel that are shaded (▨) in the above figure. For the other connectors (such as CA50 and JD41), cables can neither be attached nor detached while the power is on.



**NOTE**

1. ATCH1 and ATCH2 can be used as DI signals for detecting whether a detachable LCD/MDI is attached to the connection panel (See Subsec. 8.5.5). ATCH1 and ATCH2, when unused, need not be connected.
2. To attach or detach a detachable LCD/MDI while the Power Mate is turned on, 0V of the Power Mate must be connected to 0V of the detachable LCD/MDI before any other line.

2) Details of cable J129



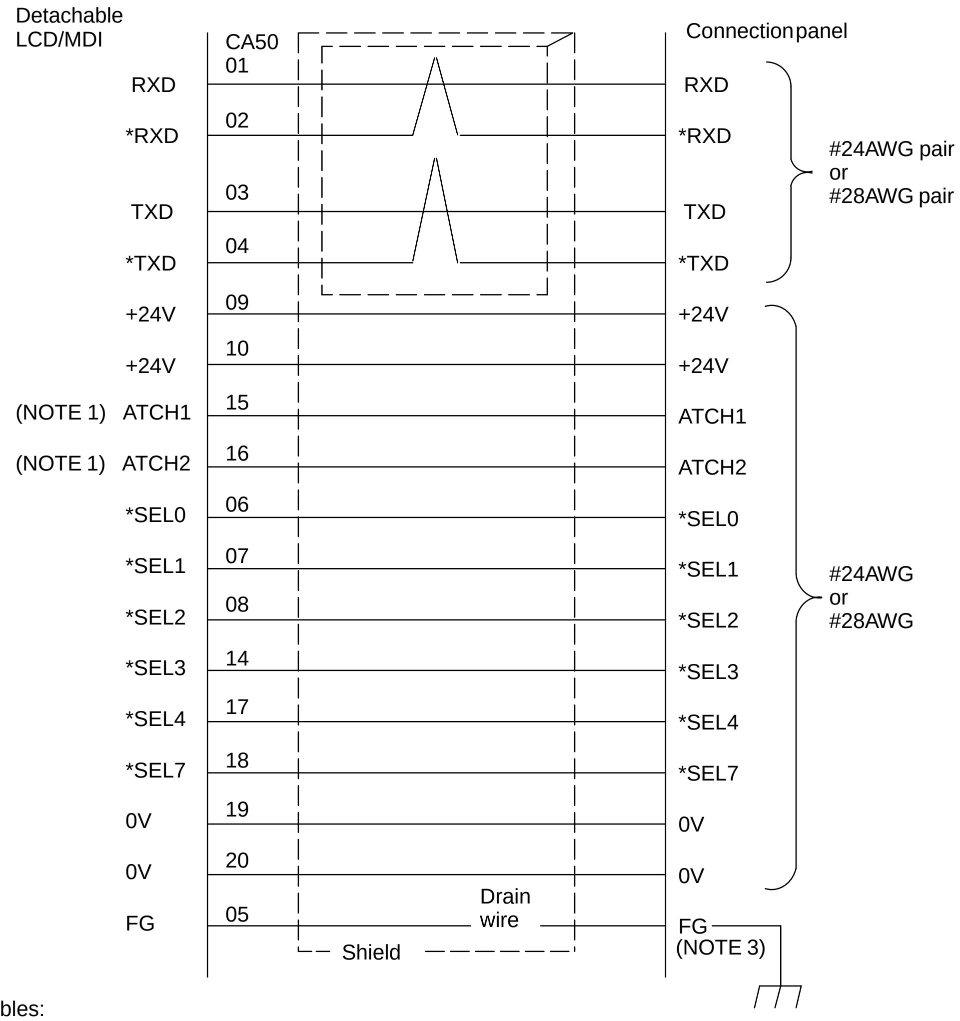
| | | | | | |
|---|---|---|---|---|---|
| | 04 | 03 | 02 | 01 | |
| | *TXD | TXD | *RXD | RXD | |
| 10 | 09 | 08 | 07 | 06 | 05 |
| +24V | +24V | *SEL2 | *SEL1 | *SEL0 | FG |
| 16 | 15 | 14 | 13 | 12 | 11 |
| ATCH2 | ATCH1 | *SEL3 | | | |
| | 20 | 19 | 18 | 17 | |
| | 0V | 0V | *SEL7 | *SEL4 | |

Hirose Electric. Co., Ltd.

(1)Soldering type
HR22–12TPD–20S

(2)Crimp type
- Housing
  HR22–12TPD–20SC
- Contact
  HR22–SC–122
- Manual crimping tool
  HR22–TA2428HC

Cable connection (J129)



Recommended cables:
A66L–0001–0298: Oki Electric Cable Co., Ltd. (#24AWG pair x 2, #24AWG x 10, external cable diameter: 8.5 mm), or
A66L–0001–0284#10P: Oki Electric Cable Co., Ltd., Hitachi Cable, Ltd. (#28AWG pair, external cable diameter: 6.2 mm, Conductor registance: 88.9Ω/km)

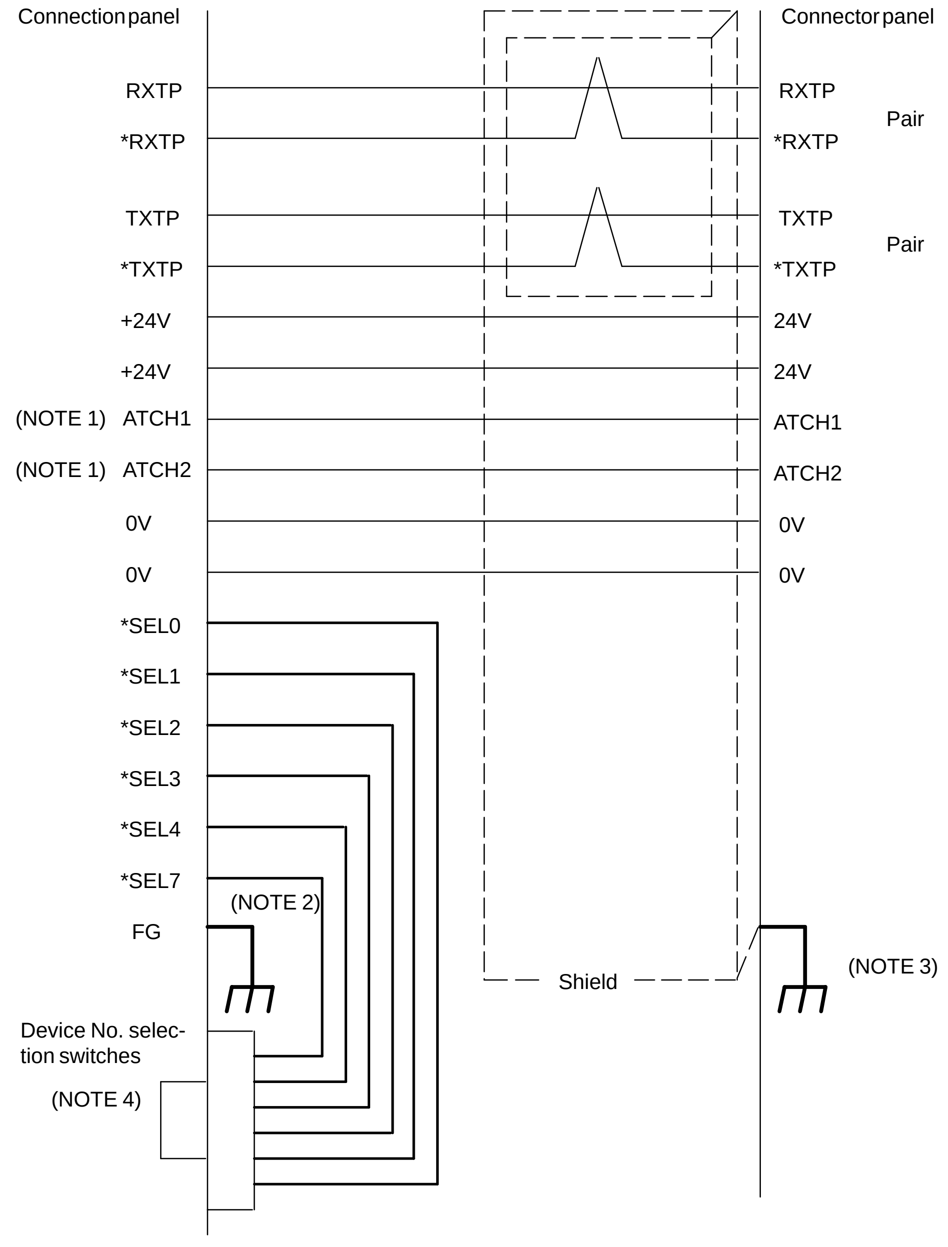
**NOTE**

1 ATCH1, ATCH2, *SELn
ATCH1 and ATCH2 can be used as DI signals for detecting whether a detachable LCD/MDI is attached to the connection panel (See Subsec. 8.5.5). ATCH1 and ATCH2, when unused, need not be connected.
Connect only necessary signals out of *SEL0 to *SEL7 according to the number of devices. The A66L–0001–0298 cable cannot be used if seven or more signals are being input from ATCH1, ATCH2, and *SEL0 to *SEL7. In such a case, use cable A66L–0001–0284#10P.

2 The external diameter of the cable used with connector CA50 is 8.5 mm. If the external diameter of the cable is less than 8.5 mm, increase the diameter to 8.5 mm by using heat–shrinkable tube or taping at the connector joint to ensure a dustproof connection.

3 FG
Using a drain wire, connect CA50 (05) to the FG terminal of the connection panel.
Connect the FG terminal of the connector panel to the frame ground by using a twisted–pair cable, 100 to 300 mm long and with a cross–sectional area of at least 2 mm$^2$.

3) Details of cable J130



Cable:

| | | |
|---|---|---|
| —— | cable | A66L–0001–J298 (refer to cable J129) |
| ━━ | cable | #28AWG × 6 |
| ━━ | cable | Twisted–pair cable with a cross–sectional area of at least 2 mm$^2$ (FG) |

**NOTE**

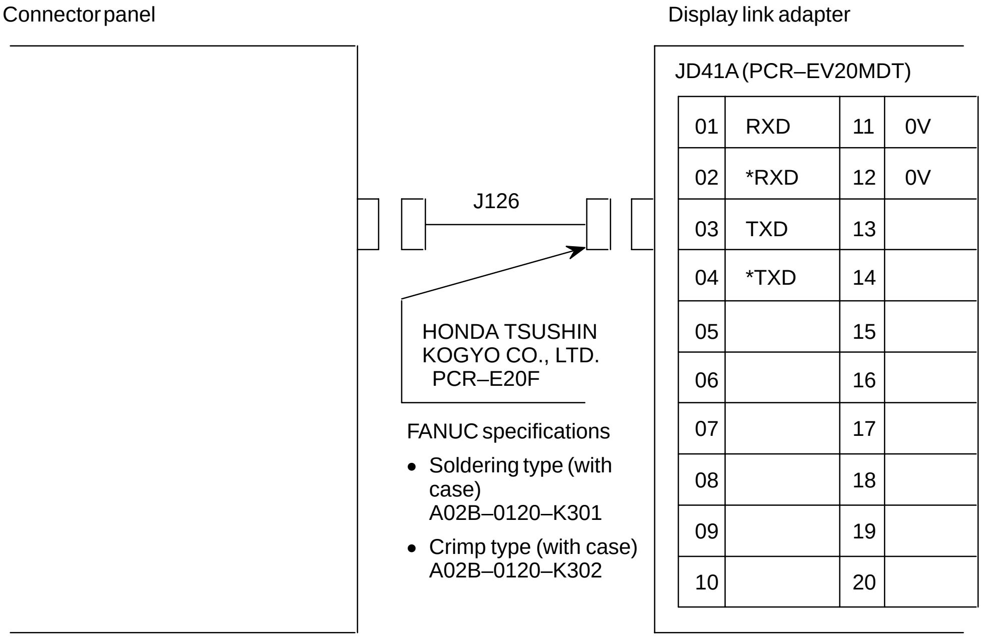
1 ATCH1 and ATCH2, when unused, need not be connected.

2 FG on the connection panel
Connect the FG terminal on the connection panel to the frame ground. For this connection, use a twisted–pair cable, 100 to 300 mm long and with a cross–sectional area of at least 2 $mm^2$.
At this FG terminal, connect the shield of cable J129 to ground.

3 FG on the connector panel
On the connector panel, connect the shield of cable J130 to the frame ground. For this connection, use a twisted–pair cable, 100 to 300 mm long and with a cross–sectional area of at least 2 $mm^2$.

4 Device No. selection switch connection
For details of device No. selection switch connection, see Section 8.1.4.

4) Details of cable J126



HONDA TSUSHIN
KOGYO CO., LTD.
PCR–E20F

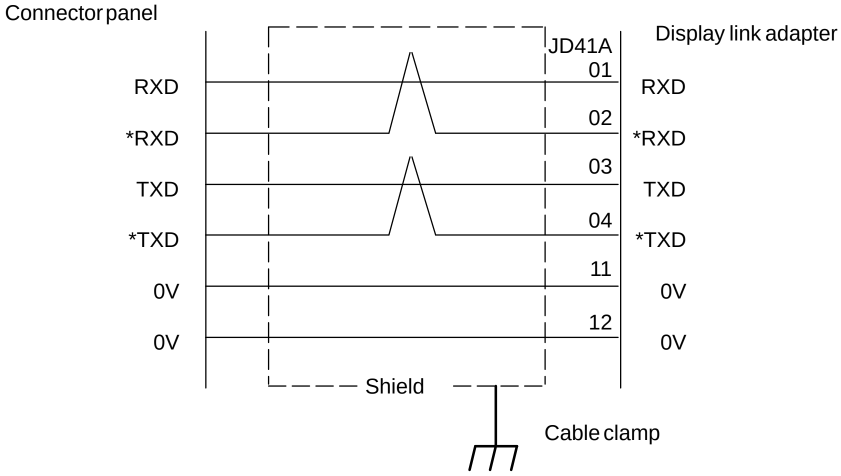
FANUC specifications

- Soldering type (with case)
  A02B–0120–K301
- Crimp type (with case)
  A02B–0120–K302

JD41A (PCR–EV20MDT)

| | | | |
|---|---|---|---|
| 01 | RXD | 11 | 0V |
| 02 | *RXD | 12 | 0V |
| 03 | TXD | 13 | |
| 04 | *TXD | 14 | |
| 05 | | 15 | |
| 06 | | 16 | |
| 07 | | 17 | |
| 08 | | 18 | |
| 09 | | 19 | |
| 10 | | 20 | |

Cable connection (J126)



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

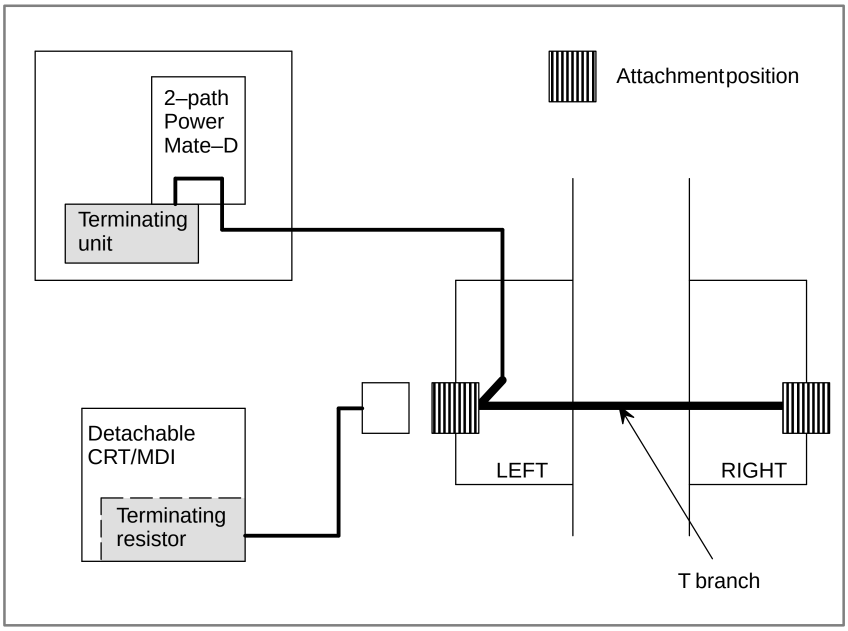
5) Details of cable J132
See Item 8.5.3.5).

6) Details of cable J45
See Subsec. 8.1.3.

## 8.5.5
## Example of Connecting a Detachable LCD/MDI Unit to the Two–path Power Mate *i*–D

When the two–path Power Mate *i*–D is provided with two detachable LCD/MDI attachment positions, the display link (RS–485) will have a T branch. Minimize the length of this branch. No more than one detachable LCD/MDI can be connected to a display link at any one time. Further details are given in Subsec. 8.5.3.

The ATCH signal shown in the figure in Subsec. 8.5.3 can be used to automatically change the path to be displayed according to the attachment position. The displayed path can be selected by the PMC. When a detachable LCD/MDI is attached to each attachment position, the displayed path can be changed automatically by using the ATCH signal to turn on the corresponding DI signal.



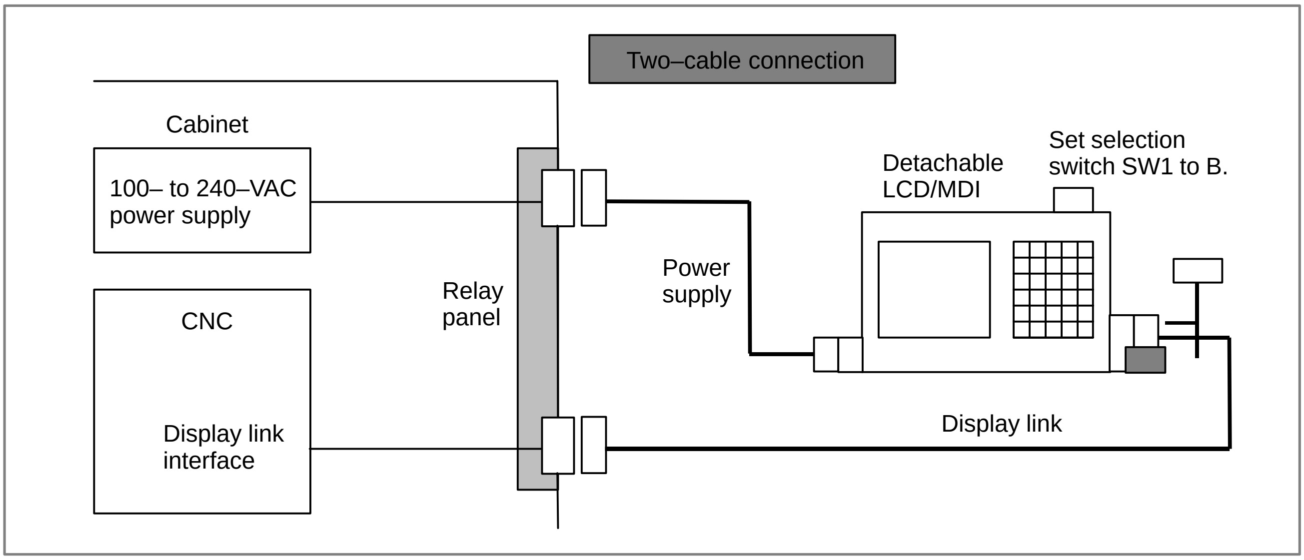
## 8.6 DETACHABLE LCD/MDI TYPE B

The detachable LCD/MDI Type B is an LCD/MDI unit with an 8.4–inch LCD/MDI housed in a portable case. The unit has the following features:

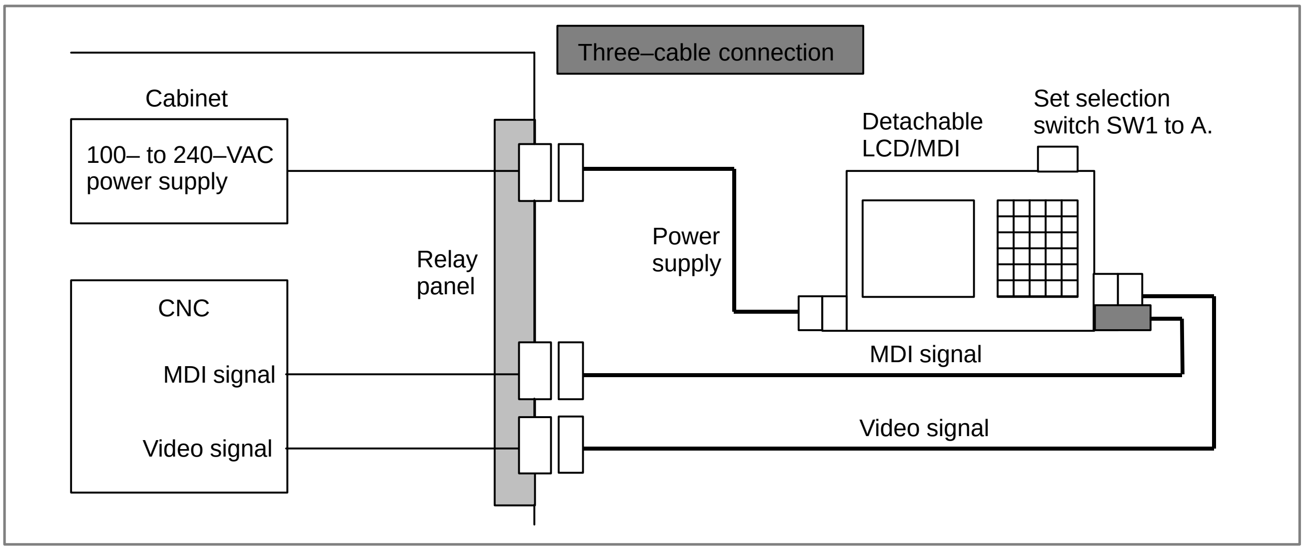
- The detachable LCD/MDI Type B is much thinner than the conventional detachable LCD/MDI and weighs about a half of the conventional one.
- The detachable LCD/MDI Type B allows both display link (CRT link) connection and video signal/MDI signal connection.
- While the CNC is on, the detachable LCD/MDI Type B can be connected (detachable).
- The input power supply voltage is 100 to 240 VAC.

Before connecting this detachable LCD/MDI Type B (called the detachable LCD/MDI hereinafter), check the CNC interface. The cabling method differs depending on the interface. In addition, the selection switch SW1 located on the top of the detachable LCD/MDI needs to be set. The detachable LCD/MDI is connected to the Power Mate i via the display link.

1) Connection via the display link



2) Connection via video and MDI signals



**NOTE**

1 The customer needs to prepare the cable between the detachable LCD/MDI and relay panel, the cable between the power supply and relay panel, the cable between the CNC and relay panel, and the relay panel.

2 Selection switch SW1 specifies whether the display link or video and MDI signals are used for connection.

## 8.6.1 Specifications

| | |
|---|---|
| Display | 8.4” TFT, 40 characters x 16 lines |
| Outside dimensions | 445 (W) × 229 (H) × 122 (D)<br>(not including inter–unit connection cables) |
| Weight | 3.5 kg (not including inter–unit connection cables) |
| Power supply | AC100V to 240V |
| Current capacity | 0.5 A (on 100 VAC), 0.25 A (on 200 VAC) |
| Interface | One channel for the display link (CRT link) or one channel for the video/MDI signals, selected by the switch on the unit |
| Keyboard | Small type M–series English keys |
| Specification drawing number | Unit: A02B–0166–C291#R (not including inter–unit connection cables)<br>Nameplate: A02B–0166–J103 (FANUC) |

**NOTE**

1 The display link cannot be used for connection to more than one CNC (the CRT sharing function).

2 Protruding portions on the top and side planes are not included in the outside dimensions.

3 This unit is not approved for the CE marking.

## 8.6.2 Environmental Conditions

| | |
|---|---|
| Ambient temperature | Operating: 0°C to 45°C, transportation and storage: –20°C to 60°C |
| Relative humidity | 30% to 95% (no condensation) |
| Vibration | Operating: 0.5 G or less, transportation and storage: 1.0 G or less |
| Contaminant | Avoid direct exposure to contaminants (such as dust, coolant, organic solvent, acid, corrosive gas, and salt). See NOTE. |
| (Non–)ionized radiation | Avoid direct exposure to radiation (such as microwave, ultraviolet ray, laser beam, and X–ray). |
| Elevation | Operating: 1000 m or less, transportation and storage: 1200 m or less |

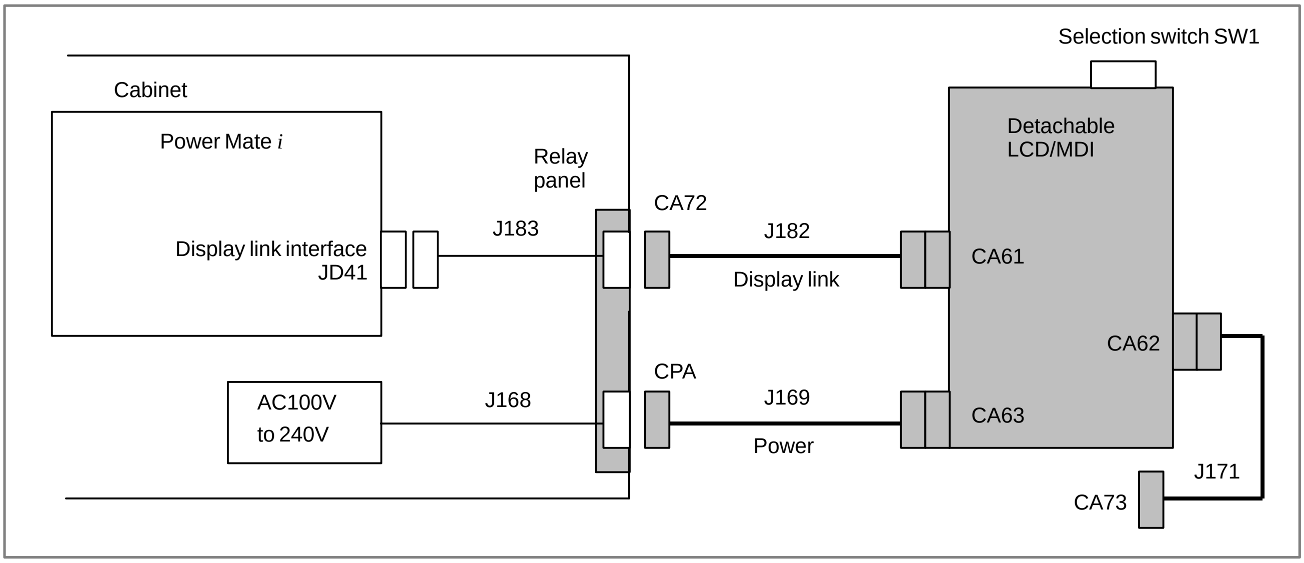
**NOTE**

1 The detachable LCD/MDI itself and the cable connection portions of the detachable LCD/MDI are not water proof. Therefore be careful not to expose these parts directly to contaminants.
2 Be careful not to expose the cable connection portions of the relay panel directly to contaminants regardless of whether cables are connected to the relay panel or not.
3 When using the detachable LCD/MDI, keep it away from noise or electromagnetic sources.
4 Bumping the detachable LCD/MDI against something can deform the detachable LCD/MDI. So, handle the detachable LCD/MDI carefully.

## 8.6.3 Connection Using the Display Link

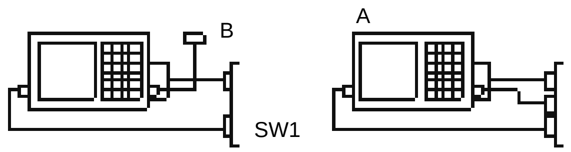
The detachable LCD/MDI is connected to the Power Mate *i* as explained below. (This method is also used to connect the detachable LCD/MDI to an *i* series CNC that supports the display link.)

- Attach cables J182 and J169 to the detachable LCD/MDI in advance.
- In the cabinet, CNC connection cable J183 and power cable J168 are assumed to have been run to the relay panel. The relay panel has connectors CA72 and CPA.



### Connection method

(1) Set selection switch SW1 on the detachable LCD/MDI to B. The following label is stuck to selection switch SW1:



(2) Connect display link cable J182 to connector CA72 on the relay panel.

(3) Connect power cable J169 to connector CPA on the relay panel.

### Disconnection method

(1) Detach power cable J169 from connector CPA on the relay panel.

(2) Detach display link cable J182 from connector CA72 on the relay panel.

**NOTE**

1 Put the FANUC–specified label near connector CA72 on the relay panel to indicate that the selection switch SW1 is to be set to B. (See Subsection 8.6.9.)

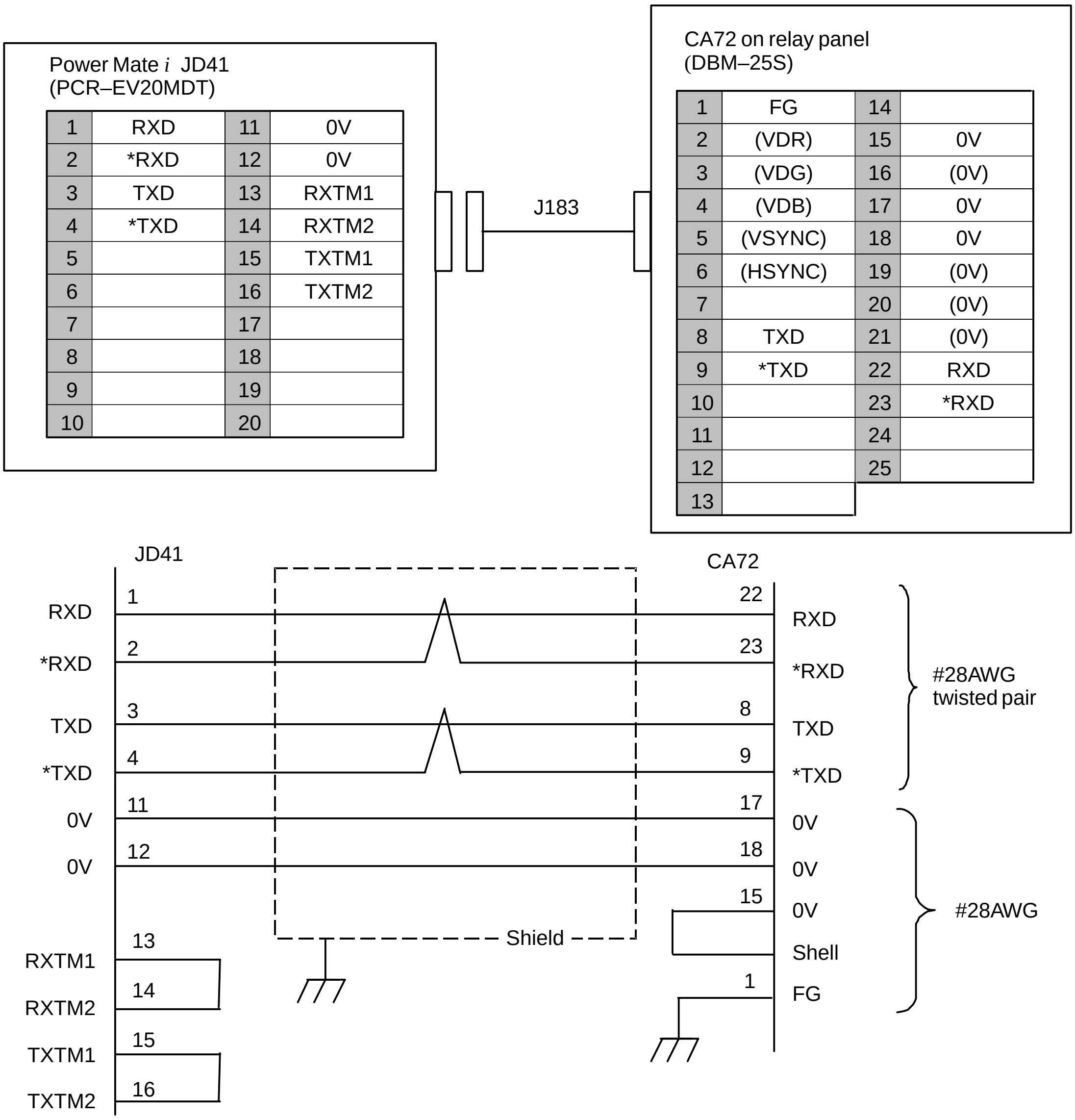
2 Cable J171 is not connected to the relay panel. Detach the cable from connector CA62 of the detachable LCD/MDI beforehand, or take appropriate measures not to expose the connector CA73 directly to contaminants. (In an environment where strong noise is generated, the cable J171 can function as an antenna receiving noise.)

3 After cabling, you may set selection switch SW1.

4 When you want to perform a special operation at power–on such as a memory all clear operation, connect the detachable LCD/MDI, turn on the power to the CNC, then perform the special operation.

5 When the cable is detached and attached directly from/to connector JD41 of the Power Mate *i*, enough working space is required.

Details of display link cable J183



Power Mate *i* JD41
(PCR–EV20MDT)

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

CA72 on relay panel
(DBM–25S)

| | | | |
|---|---|---|---|
| 1 | FG | 14 | |
| 2 | (VDR) | 15 | 0V |
| 3 | (VDG) | 16 | (0V) |
| 4 | (VDB) | 17 | 0V |
| 5 | (VSYNC) | 18 | 0V |
| 6 | (HSYNC) | 19 | (0V) |
| 7 | | 20 | (0V) |
| 8 | TXD | 21 | (0V) |
| 9 | *TXD | 22 | RXD |
| 10 | | 23 | *RXD |
| 11 | | 24 | |
| 12 | | 25 | |
| 13 | | | |

Recommended cable: A66L–0001–0284#10P (#28AWG 10 pairs, common shield) <Hitachi Cable, Ltd., Oki Electric Cable Co., Ltd.>
Recommended connector JD41/JD45/JD14 Connector: PCR–E20FS or PCR–E20FA
Housing: PCR–V20LA <Honda Tsushin>
Recommended connector CA72 Connector: DBM–25S Metal lock: D20418–J9 <Japan Aviation Electronics>
The total length of cables J182 and J183 is 50 m maximum.

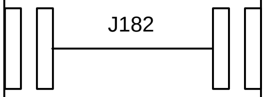
**NOTE**

1. Connect pin 1, labeled FG, of the relay connector CA72 to the cabinet.
2. In interface JD41 of the Power Mate i, termination on the CNC side is done by connecting (13) and (14), and (15) and (16). When one detachable LCD/MDI and one Power Mate *i* are connected, connecting (13) and (14), and (15) and (16) leads to no problem.
3. Connecting the shell of connector CA72 to 0 V is to make the unit detachable. This connects 0 V of the CNC and 0 V of the detachable LCD/MDI first.

## Details of display link cable J182

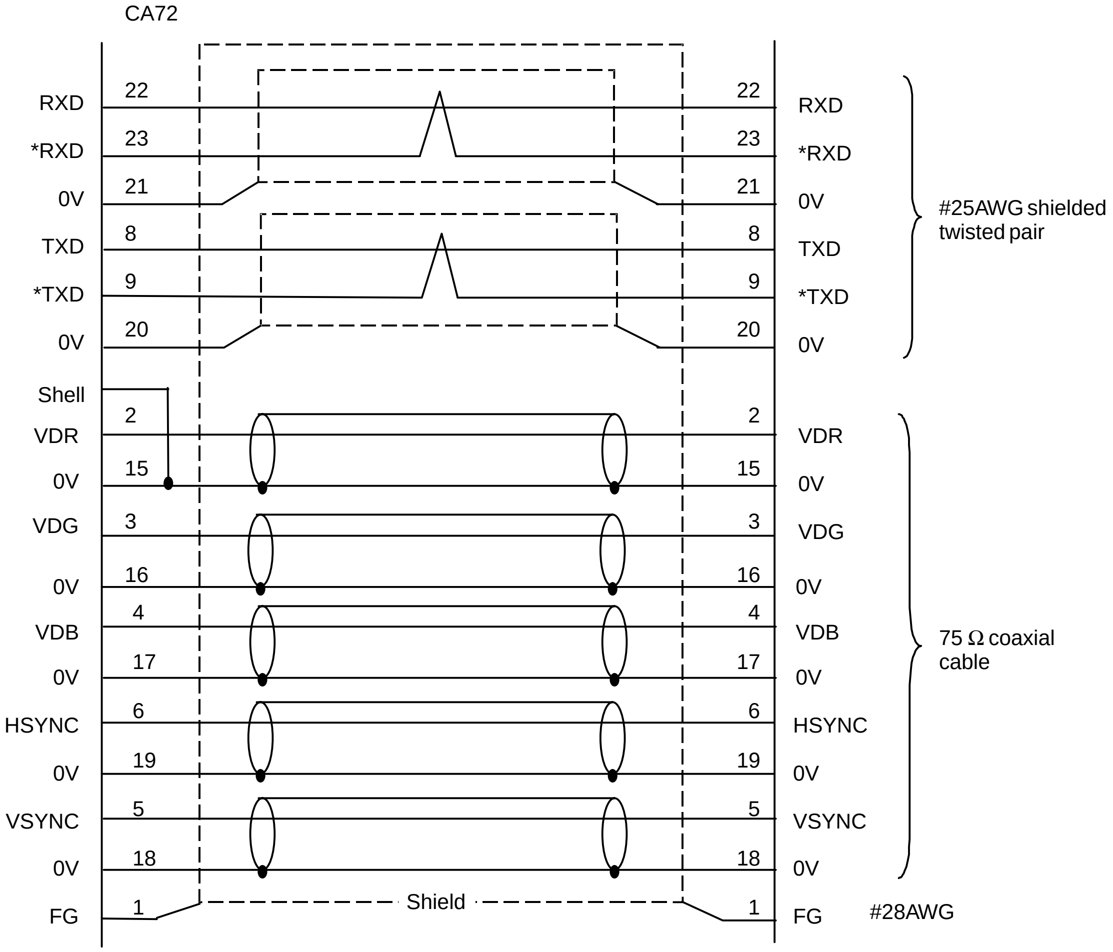
CA72 on relay panel
(DBM–25S)

| | | | |
|---|---|---|---|
| 1 | FG | 14 | |
| 2 | VDR | 15 | 0V |
| 3 | VDG | 16 | 0V |
| 4 | VDB | 17 | 0V |
| 5 | VSYNC | 18 | 0V |
| 6 | HSYNC | 19 | 0V |
| 7 | | 20 | 0V |
| 8 | TXD | 21 | 0V |
| 9 | *TXD | 22 | RXD |
| 10 | | 23 | *RXD |
| 11 | | 24 | |
| 12 | | 25 | |
| 13 | | | |



CA61 on detachable LCD/MDI
(DBM–25S–0001)

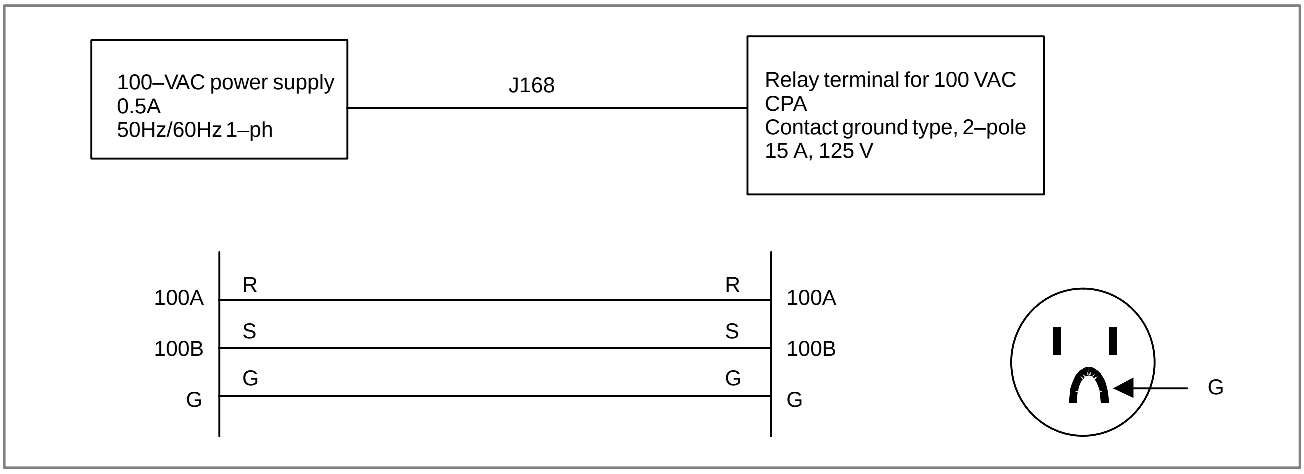
| | | | |
|---|---|---|---|
| 1 | FG | 14 | |
| 2 | VDR | 15 | 0V |
| 3 | VDG | 16 | 0V |
| 4 | VDB | 17 | 0V |
| 5 | VSYNC | 18 | 0V |
| 6 | HSYNC | 19 | 0V |
| 7 | | 20 | 0V |
| 8 | TXD | 21 | 0V |
| 9 | *TXD | 22 | RXD |
| 10 | | 23 | *RXD |
| 11 | | 24 | |
| 12 | | 25 | |
| 13 | | | |



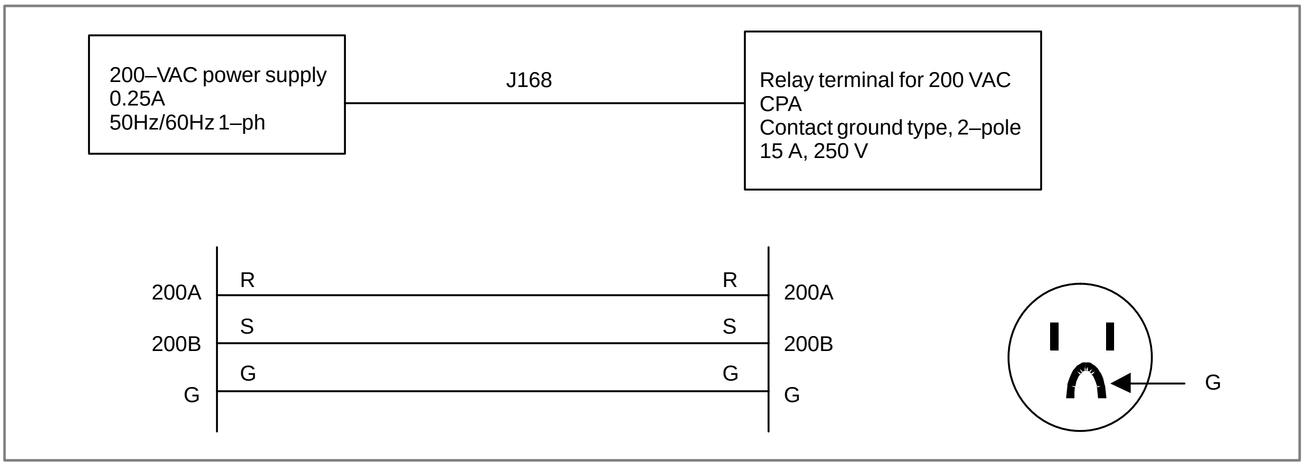
Recommended cable: A66L–0001–0450 (#25AWG shielded twisted pair × 2, 75 Ω coaxial cable × 5, common shield)
Standard outside diameter 11.4 mm (12 mm maximum) <Hitachi Cable, Ltd.>
Recommended connectors CA61 and CA72: D–SUB 25–pin (DBM–25P) <Japan Aviation Electronics>
An appropriate case for the outside diameter of the cable used is required.
Recommended case: DB–C4–J11–S2 <Japan Aviation Electronics>
The total length of cables J182 and J183 is 50 m maximum.

Details of power cable J168

1) For 100 VAC



2) For 200 VAC

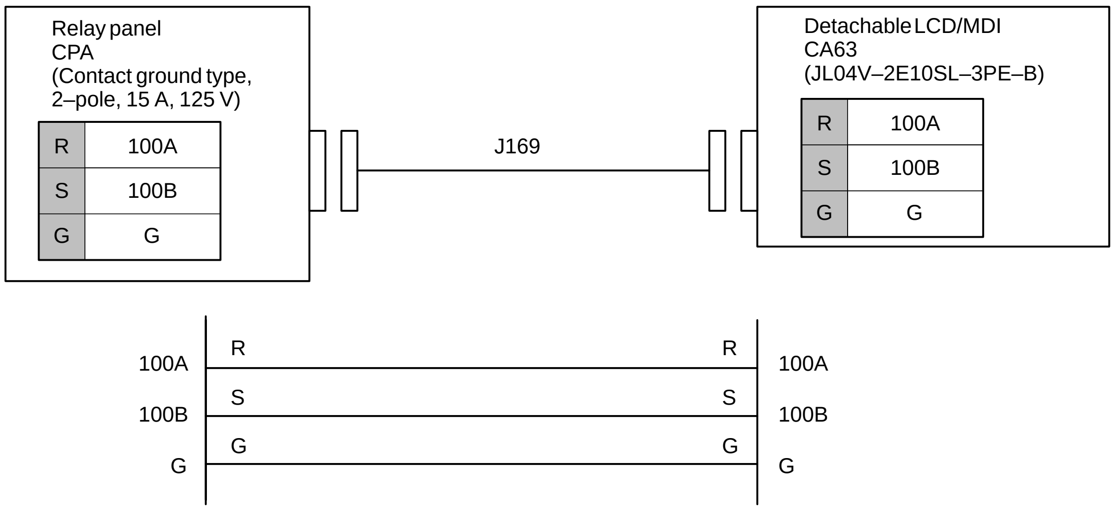


**NOTE**

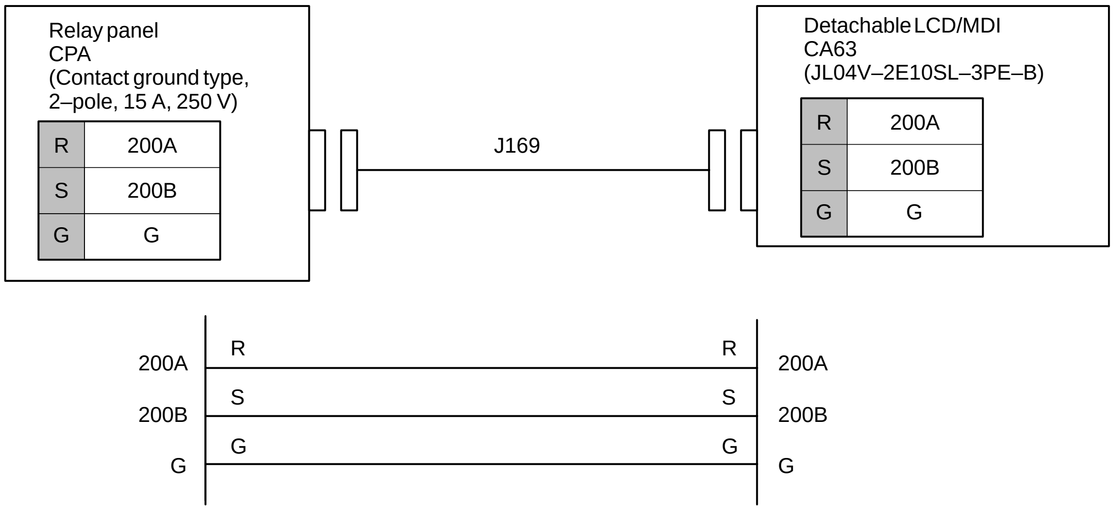
1. The relay connector of this cable is not necessarily located on the same relay panel as for CA72.
2. At least class D grounding is required.

Details of power cable J169

1) For 100 VAC



2) For 200 VAC



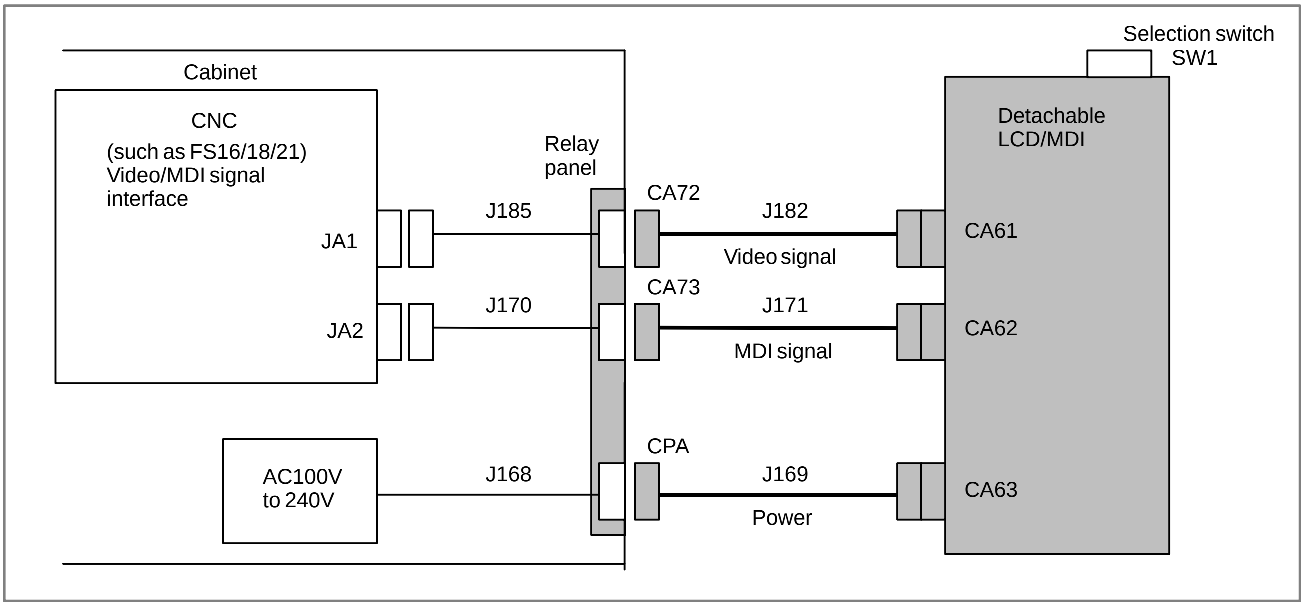
Recommended cable: A66L–0001–0411#3 × 0.5 (#25AWG × 3)
Recommended connector CPA: 2–pole grounding attachment plug 15 A, 125 V
<Matsushita Electric Works, Ltd., WF7004> (For 100 VAC)
2–pole grounding attachment plug 15 A, 250 V <Matsushita Electric Works, Ltd., WF7013> (For 200 VAC)
Recommended connector CA63: JL04V–6A10SL–3SE–EB straight plug <Japan Aviation Electronics>
JL04–1012CK (06) cable clamp <Japan Aviation Electronics>

## 8.6.4

## Connection Using the Video and MDI Signals

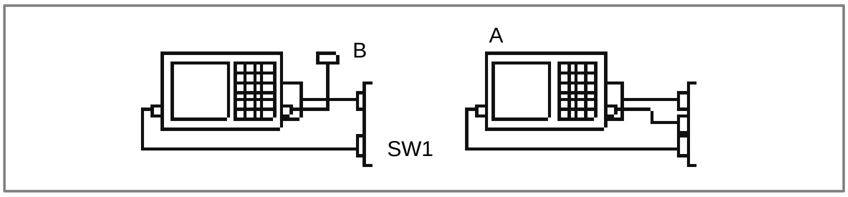
The detachable LCD/MDI is connected to a CNC such as the FS16, FS18, and FS21 through the video signal/MDI signal interface as explained below.

- Attach cables J182, J171, and J169 to the detachable LCD/MDI in advance.
- <u>The cables J185 and J170 must be attached to the CNC in advance.</u> On the relay panel, prepare connectors CA72, CA73, and CPA in advance.



### Connection method

(1) Set selection switch SW1 on the detachable LCD/MDI to A. The following label is stuck to selection switch SW1:



(2) Connect video signal cable J182 to connector CA72 on the relay panel. Connect MDI signal cable J171 to connector CA73 on the relay panel.

(3) Connect power cable J169 to connector CPA on the relay panel.

### Disconnection method

(1) Detach Power cable J169 from connector CPA on the relay panel.

(2) Detach video signal cable J182 from connector CA72 on the relay panel. Detach MDI signal cable J171 from connector CA73 on the relay panel.

**NOTE**

1. Put the FANUC–specified labels near connectors CA72 and CA73 on the relay panel to indicate that the selection switch SW1 is to be set to A. (See Subsection 8.6.9.)
2. After cabling, you may set the selection switch SW1.
3. When you want to perform a special operation at power–on such as a memory all clear operation, connect the detachable LCD/MDI, turn on the power to the CNC, then perform the special operation.

**CAUTION**

Detaching cables directly from connectors JA1 and JA2 of the CNC is not permitted. This is because if incorrect cables are connected to JA1 and JA2 by mistake, CNC data can be cleared.

Details of video signal cable J185

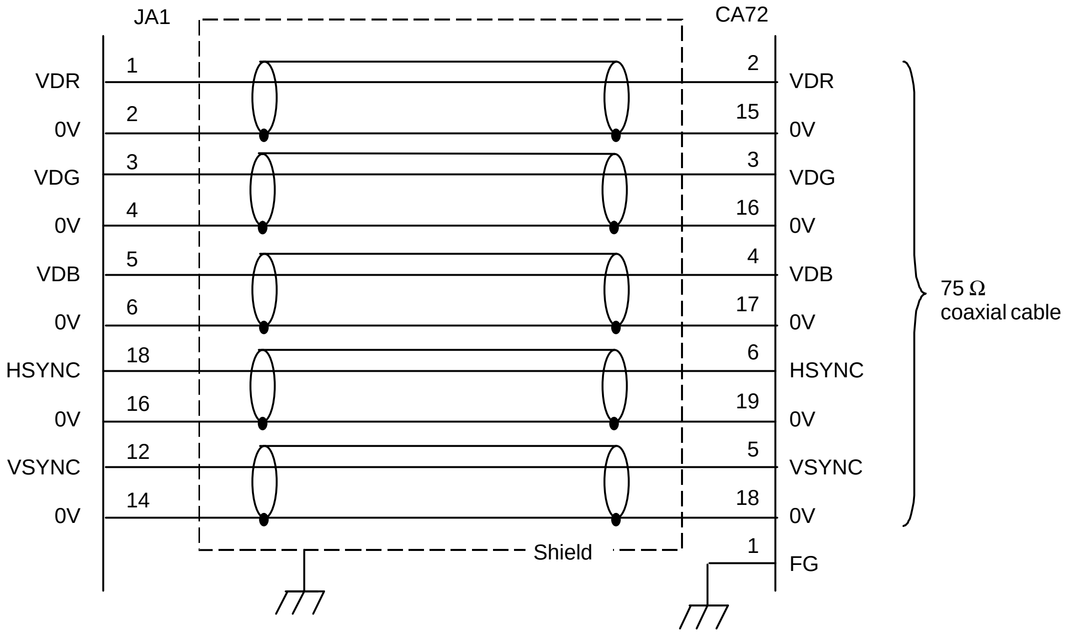
CNC JA1
(PCR–EV20MDT)

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

J185

CA72 on relay panel72
(DBM–25S)

| | | | |
|---|---|---|---|
| 1 | FG | 14 | |
| 2 | VDR | 15 | 0V |
| 3 | VDG | 16 | 0V |
| 4 | VDB | 17 | 0V |
| 5 | VSYNC | 18 | 0V |
| 6 | HSYNC | 19 | 0V |
| 7 | | 20 | (0V) |
| 8 | (TXD) | 21 | (0V) |
| 9 | (*TXD) | 22 | (RXD) |
| 10 | | 23 | (*RXD) |
| 11 | | 24 | |
| 12 | | 25 | |
| 13 | | | |



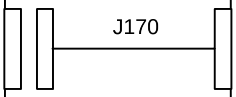
Recommended cable: A66L–0001–0371 (5–conductor coaxial cable, common shield) <Hitachi Cable, Ltd.>
Recommended connector JA1: FI40B–20S (solder type, 15 pins), case: FI–20–CV5 <Hirose Electric Co., Ltd.>
Recommended connector CA72: DBM–25S, metal lock: D20418–J9 <Japan Aviation Electronics>
The total length of cables J185 and J182 is 50 m maximum.

**NOTE**
Connect pin 1 (FG) of relay connector CA72 to the cabinet.

### Details of MDI signal cable J170

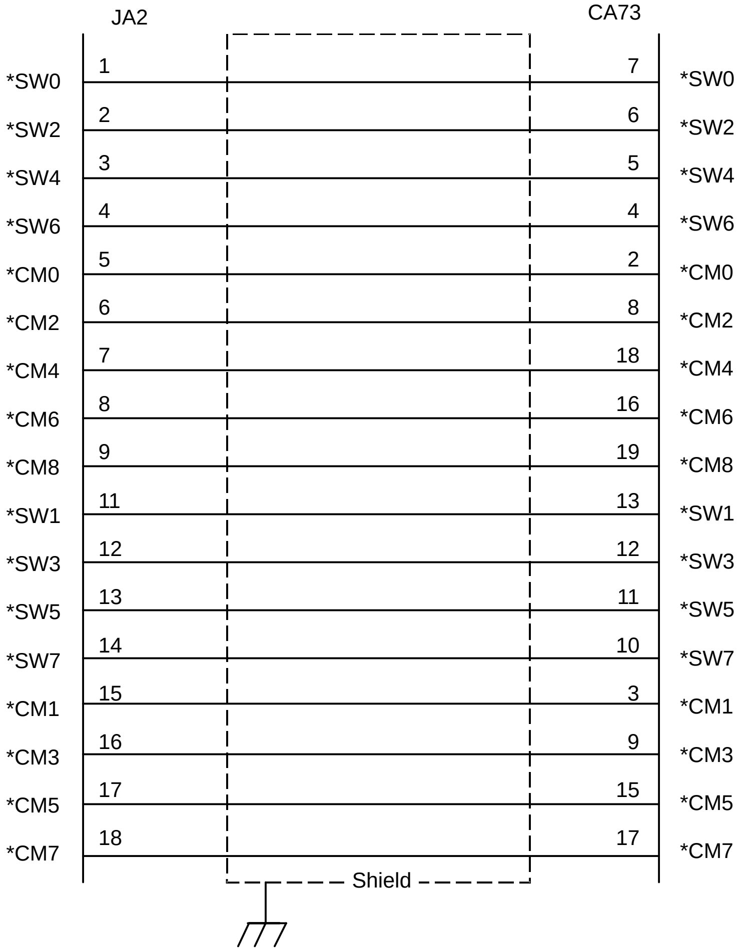
CNC JA2
(PCR–EV20MDT)

| | | | |
|---|---|---|---|
| 1 | *SW0 | 11 | *SW1 |
| 2 | *SW2 | 12 | *SW3 |
| 3 | *SW4 | 13 | *SW5 |
| 4 | *SW6 | 14 | *SW7 |
| 5 | *CM0 | 15 | *CM1 |
| 6 | *CM2 | 16 | *CM3 |
| 7 | *CM4 | 17 | *CM5 |
| 8 | *CM6 | 18 | *CM7 |
| 9 | *CM8 | 19 | (*CM9) |
| 10 | (*CM10) | 20 | (*CM11) |



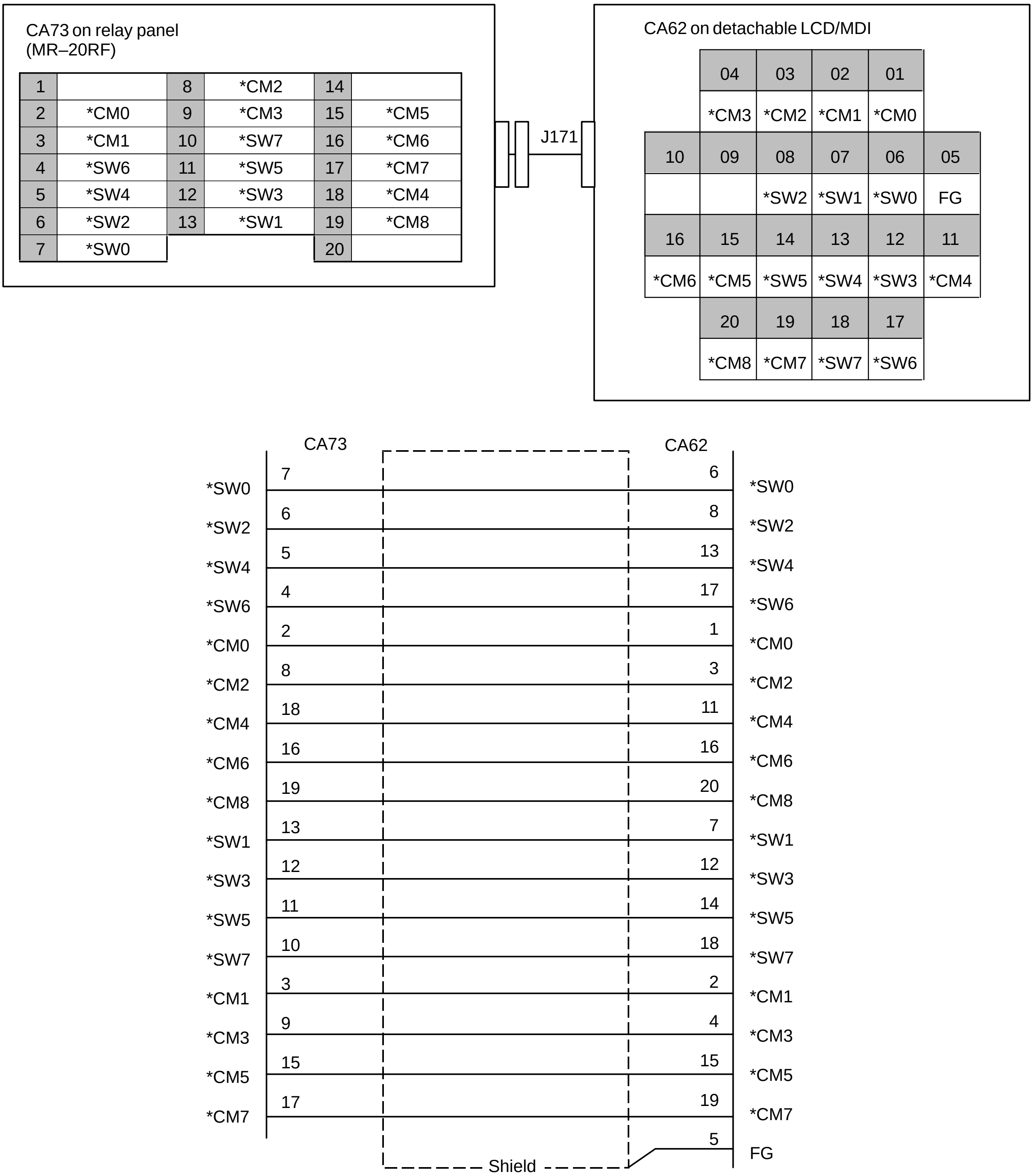
CA73 on relay panel
(MR–20RF)

| | | | | | |
|---|---|---|---|---|---|
| 1 | | 8 | *CM2 | 14 | |
| 2 | *CM0 | 9 | *CM3 | 15 | *CM5 |
| 3 | *CM1 | 10 | *SW7 | 16 | *CM6 |
| 4 | *SW6 | 11 | *SW5 | 17 | *CM7 |
| 5 | *SW4 | 12 | *SW3 | 18 | *CM4 |
| 6 | *SW2 | 13 | *SW1 | 19 | *CM8 |
| 7 | *SW0 | | | 20 | |



Recommended cable: A66L–0001–0284#10P (#28AWG 10 pairs, common shield)
<Hitachi Cable, Ltd., Oki Electric Cable Co., Ltd.>
Recommended connector JA2: PCR–E20FS or PCR–E20FA, housing: PCR–V20LA <Honda Tsushin>
Recommended connector CA73: MR–20RF (with no case) <Honda Tsushin>
The total length of cables J170 and J171 is 50 m maximum.

Details of MDI signal cable J171



CA73 on relay panel
(MR–20RF)

| | | | | | |
|---|---|---|---|---|---|
| 1 | | 8 | *CM2 | 14 | |
| 2 | *CM0 | 9 | *CM3 | 15 | *CM5 |
| 3 | *CM1 | 10 | *SW7 | 16 | *CM6 |
| 4 | *SW6 | 11 | *SW5 | 17 | *CM7 |
| 5 | *SW4 | 12 | *SW3 | 18 | *CM4 |
| 6 | *SW2 | 13 | *SW1 | 19 | *CM8 |
| 7 | *SW0 | | | 20 | |

CA62 on detachable LCD/MDI

| | | | | | |
|---|---|---|---|---|---|
| | 04 | 03 | 02 | 01 | |
| | *CM3 | *CM2 | *CM1 | *CM0 | |
| 10 | 09 | 08 | 07 | 06 | 05 |
| | | *SW2 | *SW1 | *SW0 | FG |
| 16 | 15 | 14 | 13 | 12 | 11 |
| *CM6 | *CM5 | *SW5 | *SW4 | *SW3 | *CM4 |
| | 20 | 19 | 18 | 17 | |
| | *CM8 | *CM7 | *SW7 | *SW6 | |

| | CA73 | CA62 | |
|---|---|---|---|
| *SW0 | 7 | 6 | *SW0 |
| *SW2 | 6 | 8 | *SW2 |
| *SW4 | 5 | 13 | *SW4 |
| *SW6 | 4 | 17 | *SW6 |
| *CM0 | 2 | 1 | *CM0 |
| *CM2 | 8 | 3 | *CM2 |
| *CM4 | 18 | 11 | *CM4 |
| *CM6 | 16 | 16 | *CM6 |
| *CM8 | 19 | 20 | *CM8 |
| *SW1 | 13 | 7 | *SW1 |
| *SW3 | 12 | 12 | *SW3 |
| *SW5 | 11 | 14 | *SW5 |
| *SW7 | 10 | 18 | *SW7 |
| *CM1 | 3 | 2 | *CM1 |
| *CM3 | 9 | 4 | *CM3 |
| *CM5 | 15 | 15 | *CM5 |
| *CM7 | 17 | 19 | *CM7 |
| | | 5 | FG |

Recommended cable: A66L–0001–0284#10P (#28AWG 10 pairs, common shield)
<Hitachi Cable, Ltd., Oki Electric Cable Co., Ltd.>
Recommended connector CA73: MR–20LF (with a case) <Honda Tsushin>
Recommended connector CA62: HR22–12TPD–20S (housing and contact) <Hirose Electric Co., Ltd.>
FANUC purchase drawing number: A02B–0211–K382
The total length of cables J170 and J171 is 50 m maximum.

Details of video signal cable J182

See Subsection 8.6.4.

Details of power cable J168
See Subsection 8.6.4.
Details of power cable J169
See Subsection 8.6.4.

## 8.6.5 Notes on Cables

1) Make no connection to an unused pin or a pin with its name parenthesized in connectors.
2) Do not change the combination of the wires of twisted pairs of cables and the combination of signal and 0–V wire pairs of coaxial cables.
3) When the internal cables of the cabinet are placed inside the cabinet without attaching them to the relay panel:
   - Put the FANUC–specified label to the connector cases to indicate whether selection switch SW1 is set to A or B. (See Appendix B.)
   - Mount a cover on each connector to prevent connector pins from touching a metal plate in the cabinet.
   - Be careful not to expose the mating part of each connector directly to contaminants when the connector is covered or when the connector is connected to a detachable LCD/MDI cable. In addition, carefully determine the internal cable length so that the mating part does not protrude from the cabinet.
   - Also clamp the shield of internal cables.

## 8.6.6 Supplementary

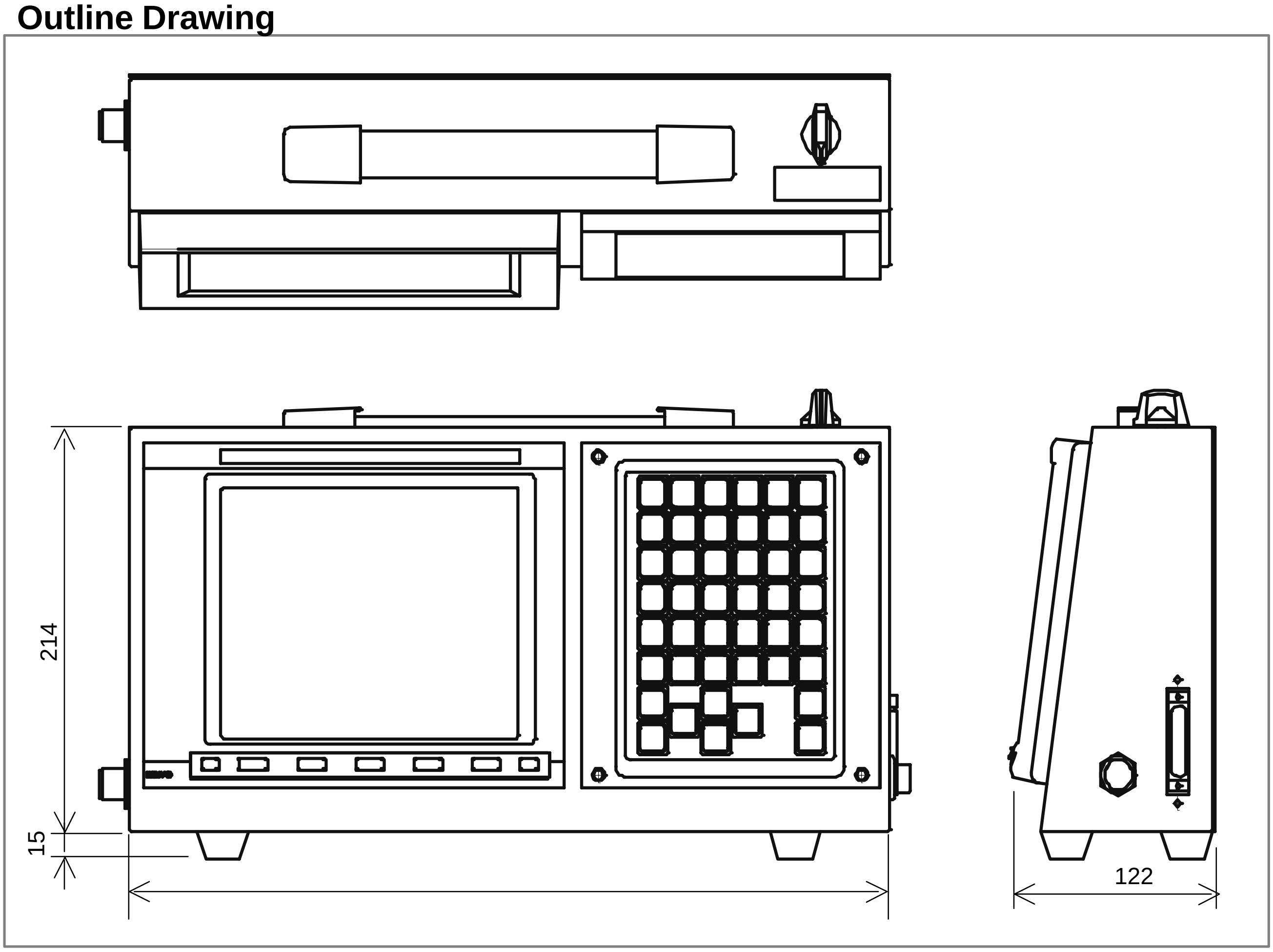
1) The coil ON/OFF state is indicated in ladder indication as follows:

| | |
|---|---|
| Coil ON | White |
| Coil OFF | Colored |

   The color varies depending on the CNC model and parameter setting (color or monochrome).

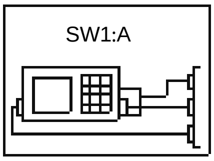
2) A CNC and the detachable LCD/MDI Type B are connected on a one–to–one basis. The detachable LCD/MDI Type B cannot be connected to more than one CNC via the display link.
3) The connectors used on the relay panel are not necessarily the connectors indicated in this manual. To make detachable connection possible, as connector CA72, use such a connector that allows 0 V to be connected first.
4) The cables of the detachable LCD/MDI are consumables.
5) The detachable LCD/MDI Type B does not have a picture display function.
6) If a system alarm is issued in the Power Mate when the detachable LCD/MDI is used with the Power Mate, the screen most recently displayed on the detachable LCD/MDI is left displayed.
7) If the ambient temperature is low, the LCD luminance lowers. (In particular, immediately after power–on, the LCD screen is dim.) This is a characteristic of the LCD, and this does not mean that the LCD fails. As the ambient temperature rises, the LCD luminance increases.

## 8.6.7
## Outline Drawing



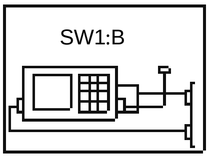
## 8.6.8
## Labels

1) When using the video/MDI signals for connection, put the following label on the relay unit and the cable connectors in the cabinet. This label indicates that switch SW1 on the detachable LCD/MDI unit is set to A.



A02B–0166–K030
(The number of labels shown to the left: 50)

2) When using the display link for connection, put the following label on the relay unit and the cable connectors in the cabinet. This label indicates that switch SW1 on the detachable LCD/MDI unit is set to B.

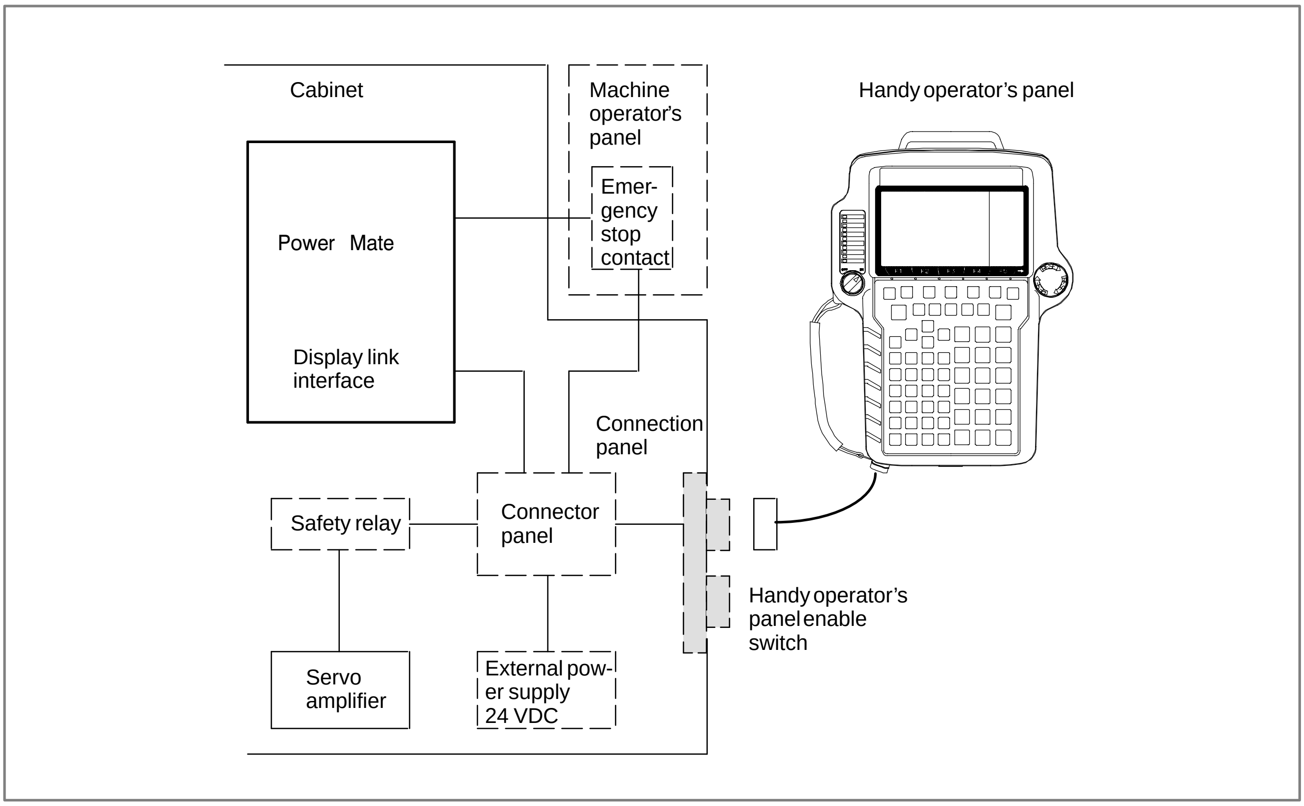


A02B–0166–K031
(The number of labels shown to the left: 50)

# 8.7 CONNECTION TO THE HANDY OPERATOR'S PANEL

## 8.7.1 Outline

The handy operator's panel has machine operator's panel functions for teaching operations, as well as CRT/MDI functions for displaying and setting the Power Mate parameters and programs. (The Handy Operator's Panel function has a restriction, unlike the CRT/MDI unit.)



(1) The machine operator's panel functions are implemented by Power Mate ladder programs.

(2) FANUC designs a machine builder–defined key sheet on request. So, it is easy for the machine builder to produce a unique machine operator's panel.

(3) No cables are provided with the handy operator's panel.

(4) The customer is responsible for preparing a connector panel, external stabilized power supply, safety relay, emergency stop contact, and connection panel.

(5) The customer is responsible for preparing all inter–unit connection cables.

(6) It is possible that the CE standard does not allow the mounting of the connection panel on the cabinet so that the handy operator's panel can be connected and disconnected. (The reason for this is that the emergency stop signal must be bypassed.) In this case, keep the handy operator's panel connected at all times.

(7) One handy operator's panel cannot be shared among more than one Power Mate.

## 8.7.2 Emergency Stop

The handy operator's panel has an emergency stop button and deadman's switches (right side and left side). In any of the following cases, the emergency stop state is assumed, and the Power Mate and servo amplifier are so notified:

1) When the emergency stop button is pressed
2) When the deadman's switch enable switch is on, and both of the deadman's switches are released
3) When a handy operator's panel error occurs, disabling normal communications, while the handy operator's panel is being used

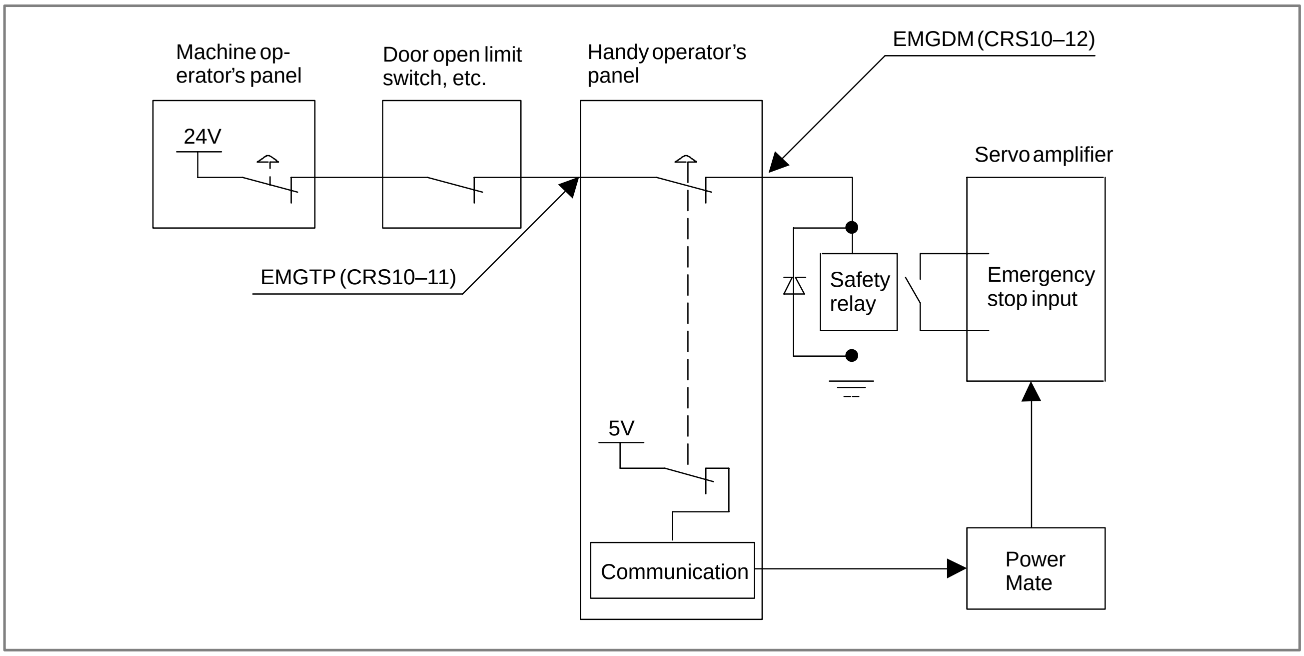
### Notifying the Power Mate of an emergency stop

The Power Mate is notified of an emergency stop by means of communication from the handy operator's panel when the emergency stop state is set with the handy operator's panel.

If the handy operator's panel is connected as shown in the figure below, the handy operator's panel notifies the Power Mate of the emergency stop state when the DOOR OPEN LIMIT switch or the emergency stop switch on the machine operator's panel is pressed and when 24 V is not supplied to the emergency stop line.

### Notifying the servo amplifier of an emergency stop

To notify the servo amplifier of an emergency stop, the emergency stop contact of the handy operator's panel is connected in series with a separate emergency stop contact such as that of the machine operator's panel or the door open limit switch. If any of these contacts is closed, the relay for emergency stop input to the servo amplifier is activated.

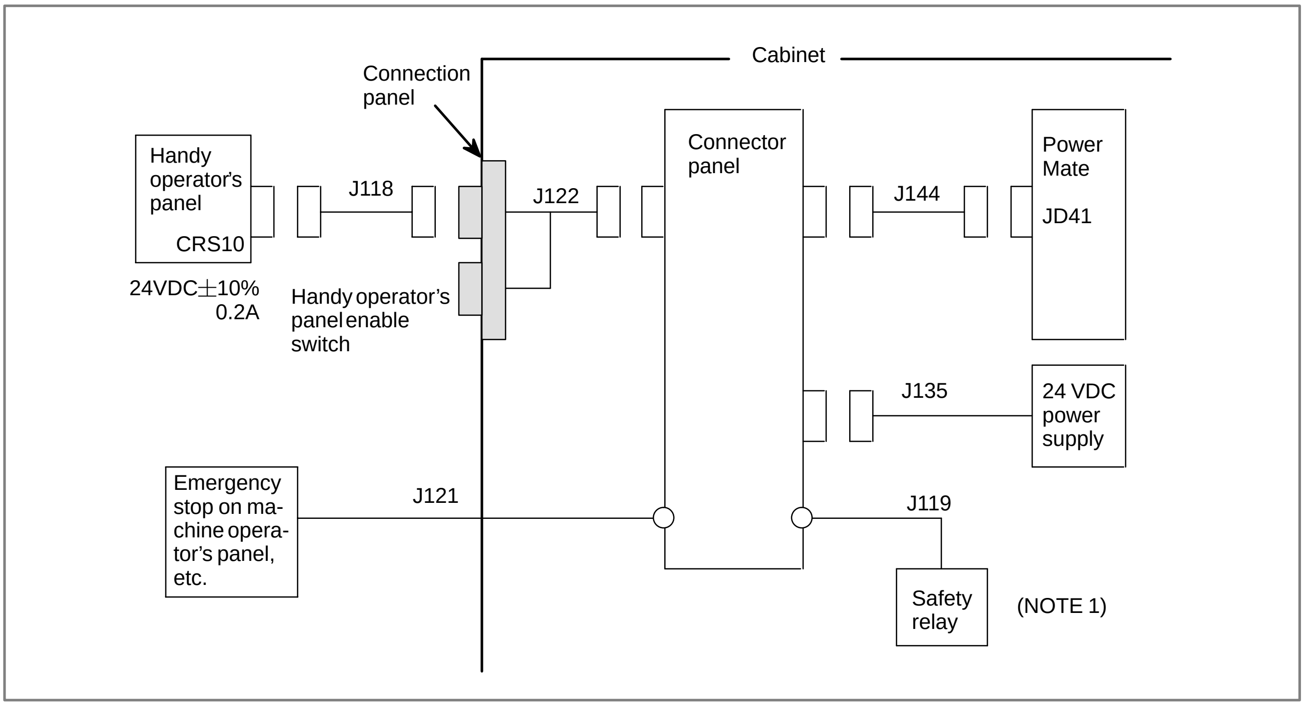


The allowable current of the emergency stop line of the handy operator's panel is as follows:
24 VDC ±10%, 75 mA

## 8.7.3
## Connection Allowing the Handy Operator's Panel to be Detached

It is possible that the CE standard does not allow the mounting of the connection panel on the cabinet so that the handy operator's panel can be connected and disconnected. (The reason for this is that the emergency stop signal must be bypassed.) In this case, keep the handy operator's panel connected at all times.

1) Inter–unit connection



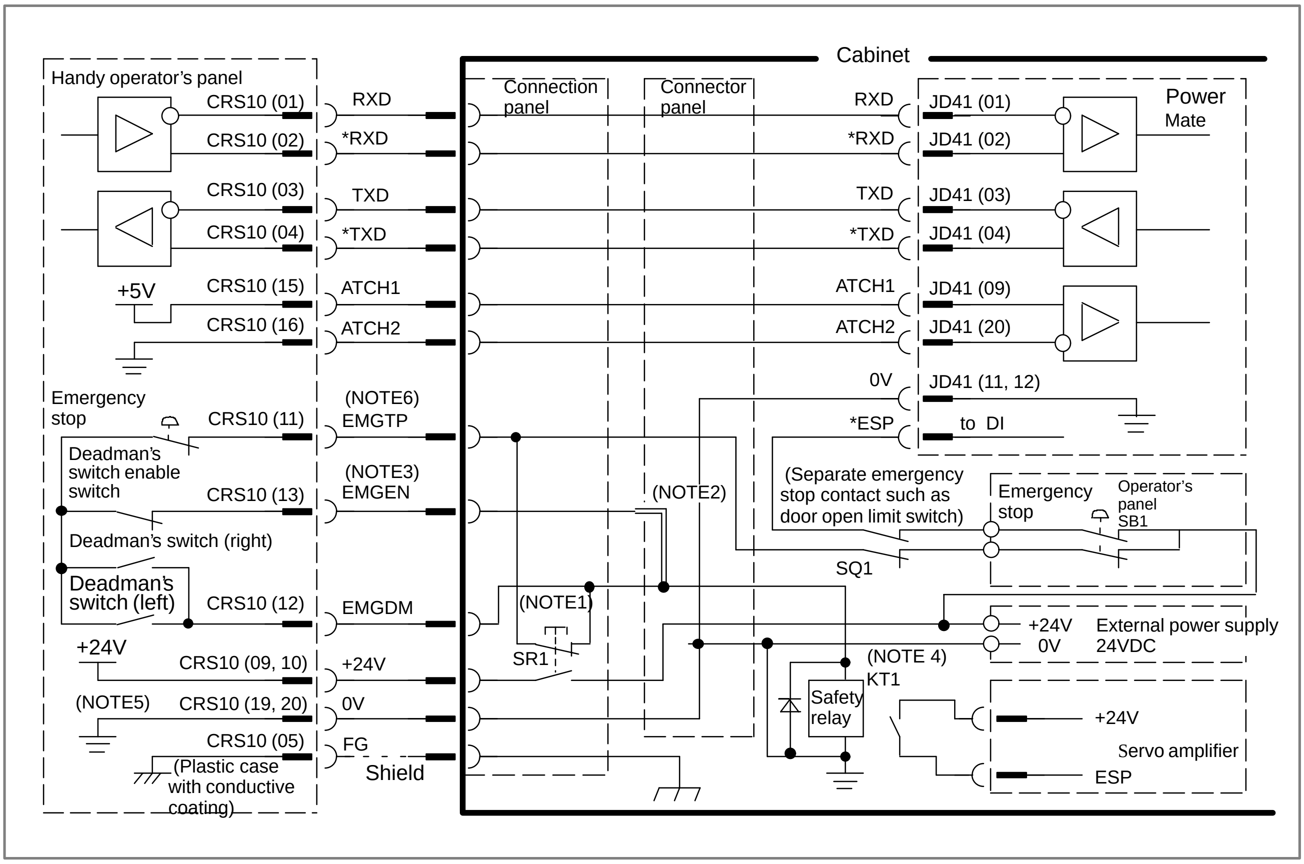
**NOTE**

1 This safety relay acts as a contact for emergency stop input to the servo amplifier, and a contact for the MCC contactor. For details, refer to the "FANUC Control Motor Amplifier Series Safe Circuit Conditions and Sample Configurations (A–71429–S13J)."

2 The total length of the cables (J118, J122, and J144) between the handy operator's panel and the Power Mate must not exceed 50 m.

3 Cables J118, J122, and J135 also serve as a 24 VDC power supply line for the handy operator's panel. The 24 VDC power is subject to a voltage drop corresponding to the total resistance of the 0V and 24V lines. Taking this voltage drop into consideration, determine the cable length so that 24 VDC +10% is available at connector CRS10 of the handy operator's panel.

4 The J144 cable is used to attach a terminating unit to the Power Mate.



**NOTE**

1 While the switch is off, the handy operator’s panel emergency stop operation is bypassed. While the switch is on, power is fed to the handy operator’s panel, such that emergency stop operation is enabled.

2 When the deadman’s switch enable switch is not being used, never make this connection. Thus, the deadman’s switches are enabled at all times.

3 By inserting a contact to the EMGEN line, the deadman’s switch can be enabled regardless of the deadman’s switch enable switch status when, for example, the door is opened.

4 A separate safety relay is required to act as a contact for emergency stop input to the servo amplifier, and also as a contact for the MCC contactor. For details, refer to the “FANUC Control Motor Amplifier $\alpha$ Series Safe Circuit Conditions and Sample Configurations (A–71429–S13J).”

5 To attach or detach a handy operator’s panel while the Power Mate is turned on, 0V of the Power Mate must be connected to 0V of the handy operator’s panel before any other line.

6 Unless +24 V is supplied to EMGTP (CRS10–11), the handy operator’s panel is placed in the emergency stop state.

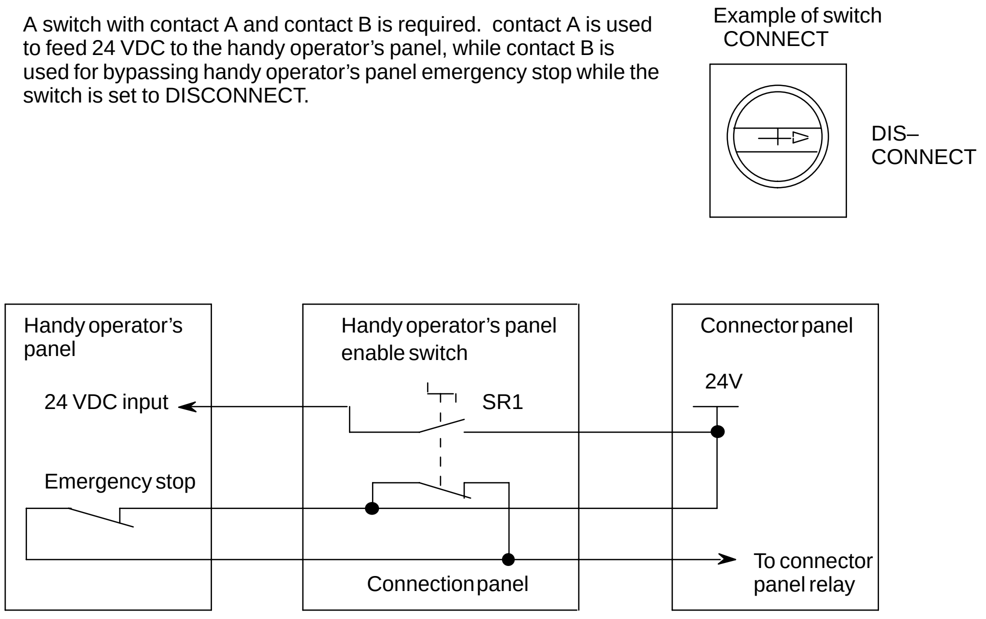
2) Connection panel

The connection panel can be used to make the handy operator's panel detachable from the cabinet.

On the connection panel, install a connector to which the handy operator's panel cable can be attached, and also install a switch to enable/disable the handy operator's panel.

Handy operator's panel enable switch

A switch with contact A and contact B is required. contact A is used to feed 24 VDC to the handy operator's panel, while contact B is used for bypassing handy operator's panel emergency stop while the switch is set to DISCONNECT.



(1) While the enable switch is set to DISCONNECT (while the switch is off)

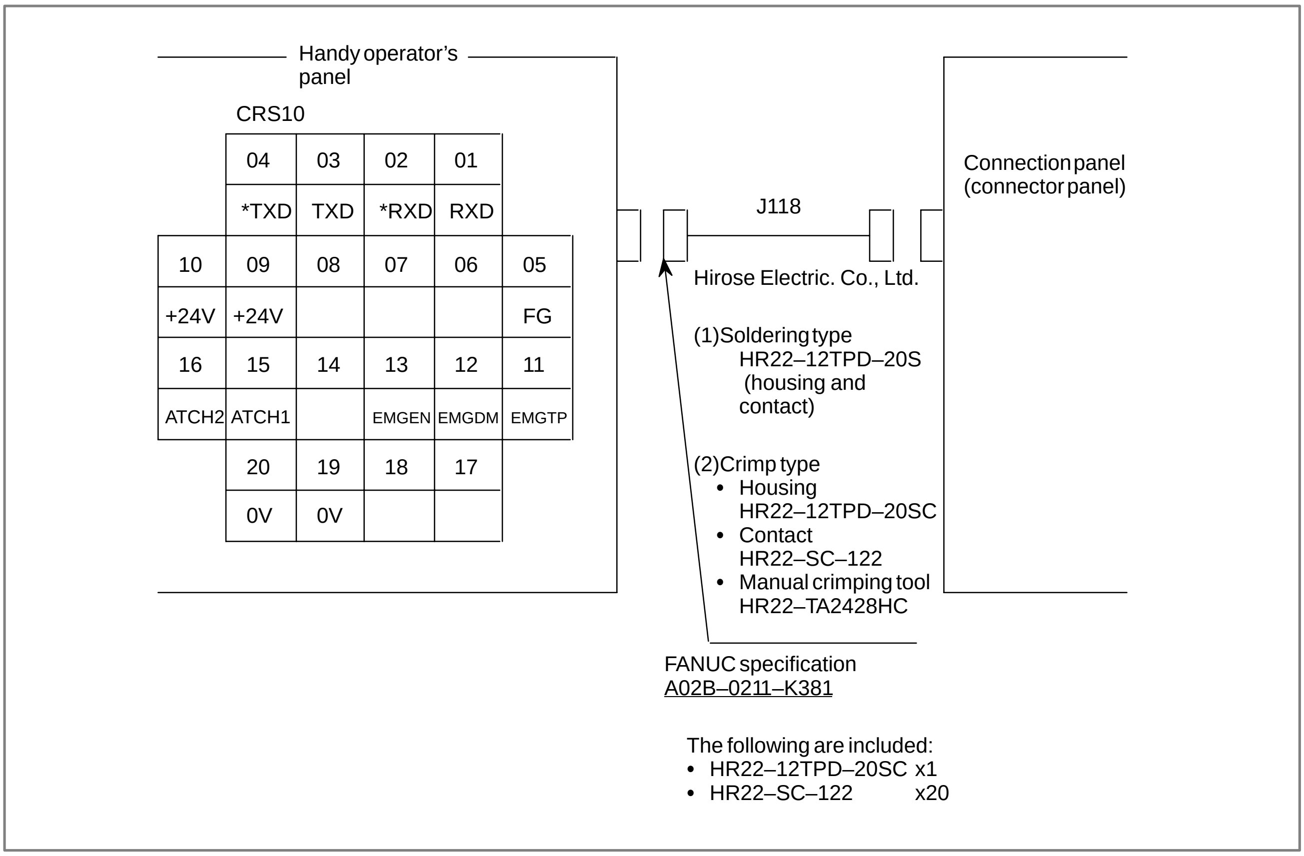
- The handy operator's panel does not receive 24 VDC, hence cannot be used.
- Emergency stop cannot be performed from the handy operator's panel.

(2) While the enable switch is set to CONNECT (while the switch is on)

- The handy operator's panel receives 24 VDC, hence can be used.
- Emergency stop can be performed from the handy operator's panel.

The emergency stop described above occurs when the emergency stop button on the handy operator's panel is pressed, or when the deadman's switch enable switch is on and both of the deadman's switches are released.

3) Details of cable J118



|  |  |  |  |  |  |
|---|---|---|---|---|---|
|  | 04 | 03 | 02 | 01 |  |
|  | *TXD | TXD | *RXD | RXD |  |
| 10 | 09 | 08 | 07 | 06 | 05 |
| +24V | +24V |  |  |  | FG |
| 16 | 15 | 14 | 13 | 12 | 11 |
| ATCH2 | ATCH1 |  | EMGEN | EMGDM | EMGTP |
|  | 20 | 19 | 18 | 17 |  |
|  | 0V | 0V |  |  |  |

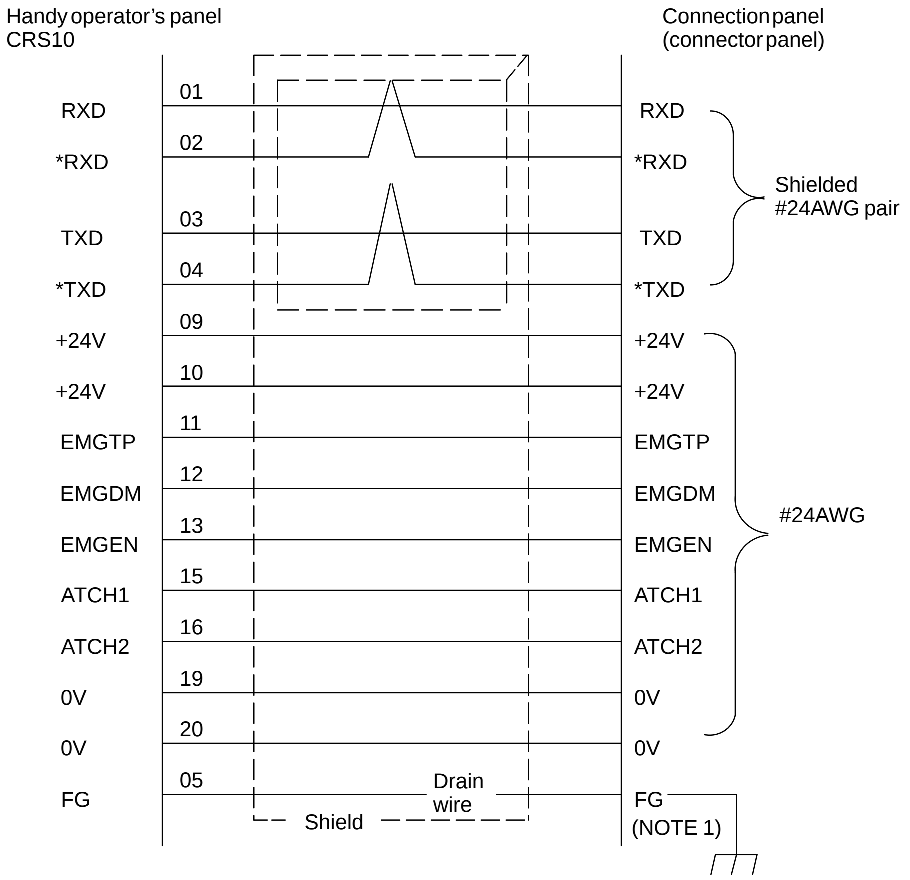
Hirose Electric. Co., Ltd.

(1)Soldering type
HR22–12TPD–20S
(housing and
contact)

(2)Crimp type
- Housing
  HR22–12TPD–20SC
- Contact
  HR22–SC–122
- Manual crimping tool
  HR22–TA2428HC

FANUC specification
A02B–0211–K381

The following are included:
- HR22–12TPD–20SC x1
- HR22–SC–122 x20



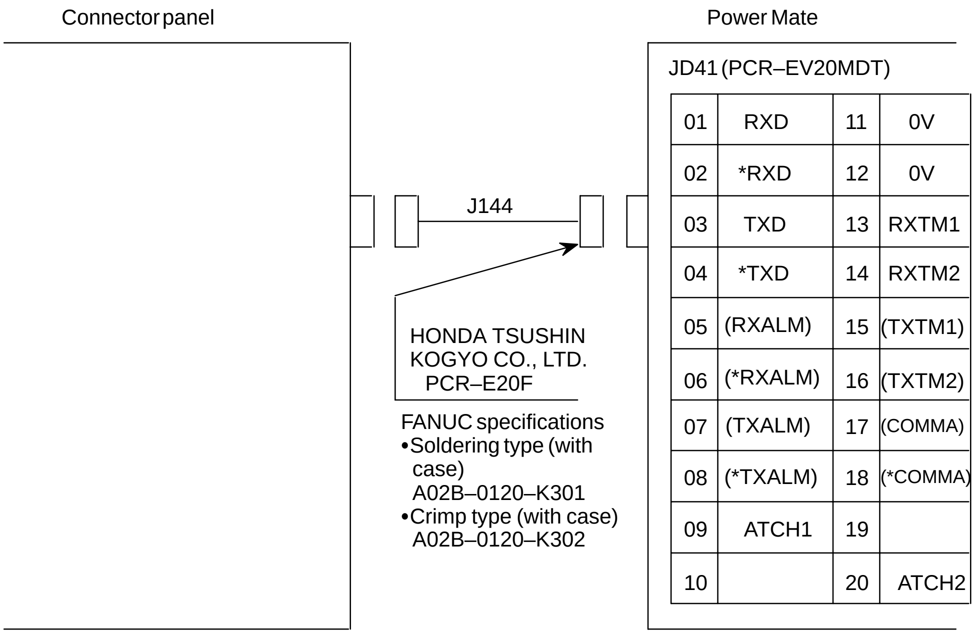
Recommended cable:
A66L–0001–0298: Oki Electric Cable Co., Ltd.
(Shielded #24AWG pair x 2, #24AWG x 10, external cable diameter: 8.5 mm, conductor registance: 88.9 Ω/km)

**NOTE**

1 FG
   - Using a drain wire, connect CRS10(05) to the FG terminal of the connector panel.
   - Connect the FG terminal on the connector panel to the frame ground. For this connection, use a twisted–pair cable, 100 to 300 mm long and a cross–sectional area of at least 2 mm$^2$.

2 The external diameter of the cable used with connector CRS10 is 8.5 mm. If the external diameter of the cable is less than 8.5 mm, increase the diameter to 8.5 mm by using heat–shrinkable tube or taping at the connector joint to ensure a dustproof connection.

4) Details of cable J144

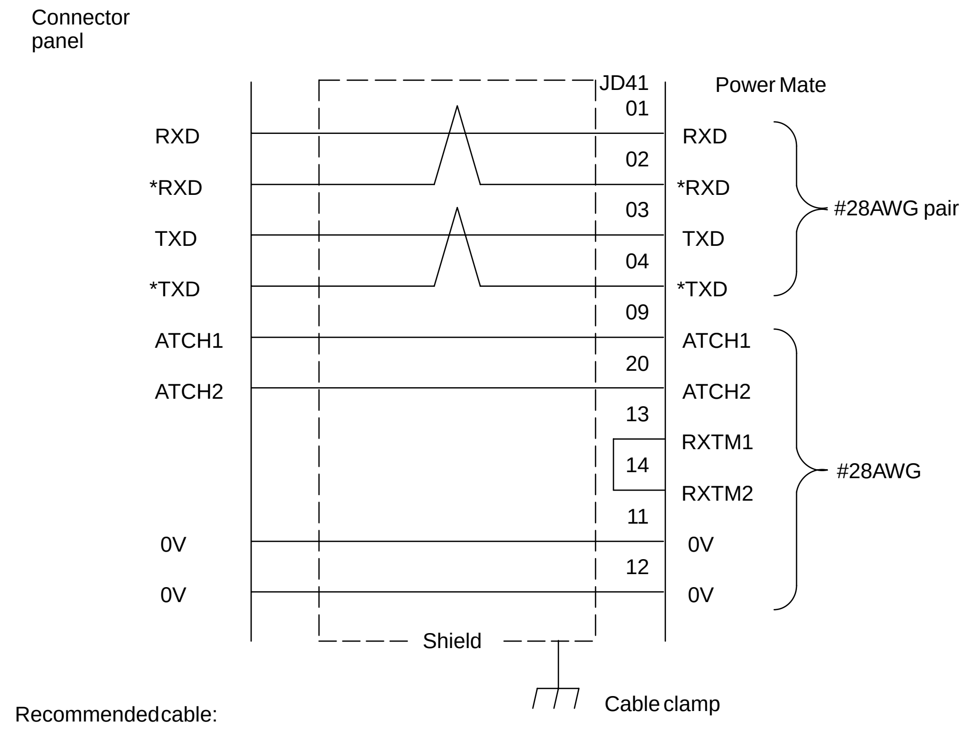


FANUC specifications
- Soldering type (with case) A02B–0120–K301
- Crimp type (with case) A02B–0120–K302

JD41 (PCR–EV20MDT)

| | | | |
|---|---|---|---|
| 01 | RXD | 11 | 0V |
| 02 | *RXD | 12 | 0V |
| 03 | TXD | 13 | RXTM1 |
| 04 | *TXD | 14 | RXTM2 |
| 05 | (RXALM) | 15 | (TXTM1) |
| 06 | (*RXALM) | 16 | (TXTM2) |
| 07 | (TXALM) | 17 | (COMMA) |
| 08 | (*TXALM) | 18 | (*COMMA) |
| 09 | ATCH1 | 19 | |
| 10 | | 20 | ATCH2 |

Cable connection (J144)

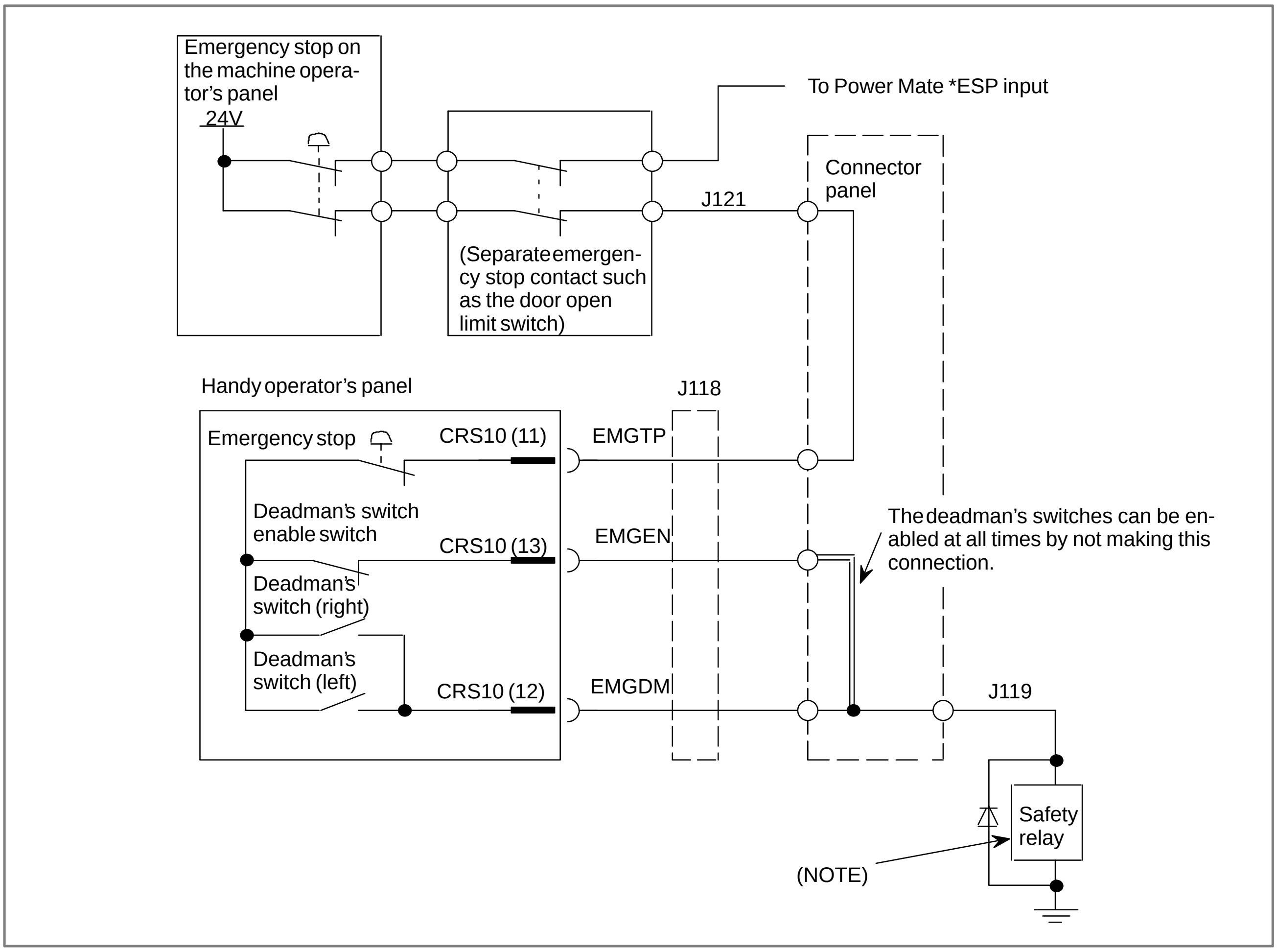


Recommended cable:
A66L–0001–0284#10P (#28AWG 10 pairs):
Oki Electric Cable Co., Ltd.

**NOTE**

Termination is accomplished by short–circuiting JD41 (13) and JD41 (14).

5) Details of cables J119 and J121



**NOTE**

Safety relay:

This safety relay acts both as a contact for emergency stop input to the servo amplifier, and as a contact for the MCC contactor. For details, refer to the "FANUC Control Motor Amplifier $\alpha$ Series Safe Circuit Conditions and Sample Configurations (A–71429–S13J)."

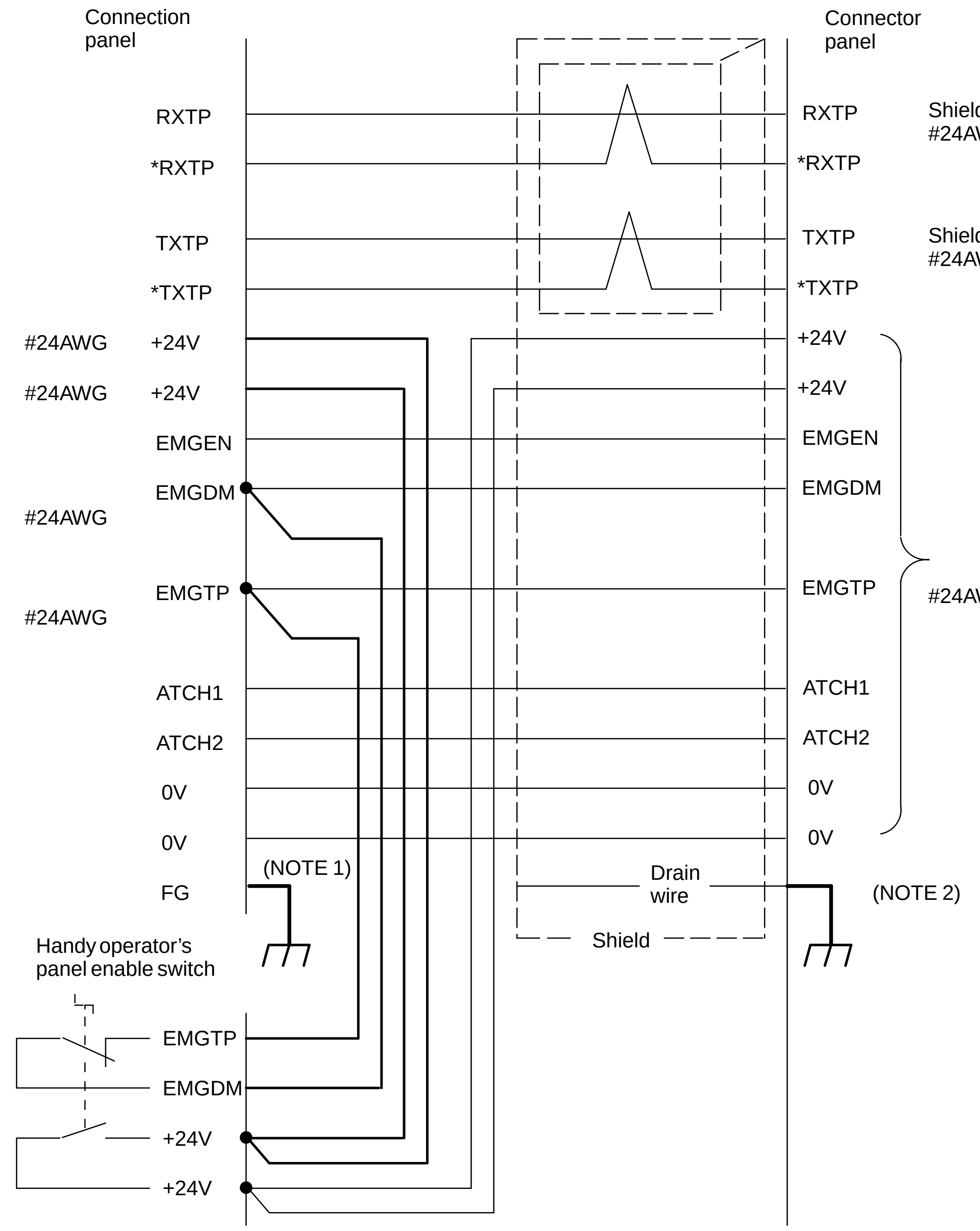
Enable the safety relay on the handy operator's panel by connecting the emergency stop contact of the handy operator's panel in series with a separate emergency stop contact such as the emergency stop contact of the machine operator's panel or the door open limit switch.

With the connection shown above, the safety relay is switched off when:

1) The emergency stop button is pressed, or
2) The deadman's switch enable switch is on (with the contact open), and both of the deadman's switches are released.

So, the contact for emergency stop input to the servo amplifier and the MCC contact are opened to turn off the power.

6) Details of cable J122



Recommended cables:

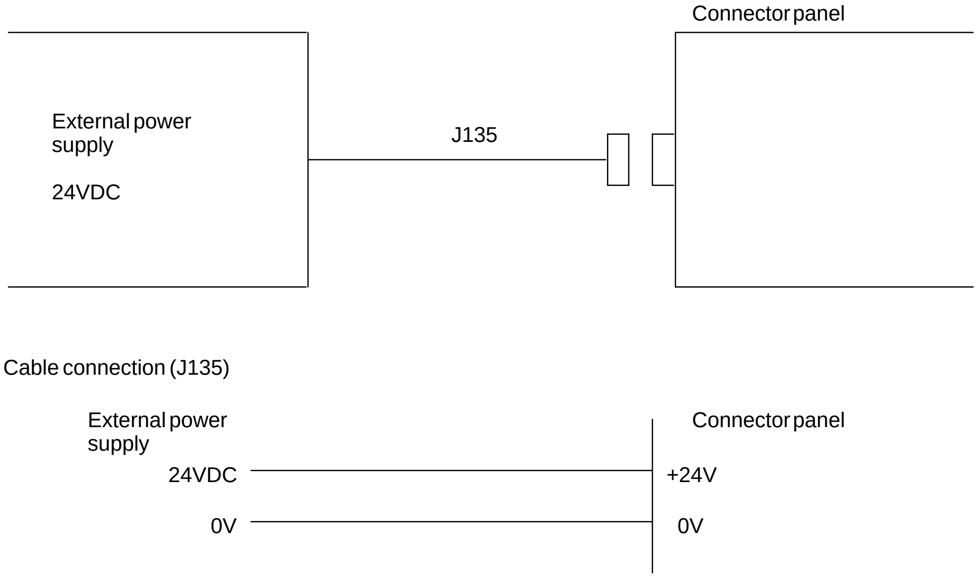
| | | |
|---|---|---|
| ── | cable | A66L–0001–0298 (refer to Cable J118) |
| ━━ | cable | #24AWG × 5 |
| ▬▬ | cable | Twisted–pair cable with a cross–sectional area of at least 2 mm$^2$ (FG) |

**NOTE**

1 FG on the connection panel:
Connect the FG terminal on the connection panel to the frame ground. For this connection, use a twisted–pair cable, 100 to 300 mm long and with a cross–sectional area of at least 2 mm$^2$. At this FG terminal, connect the shield of cable J118 to ground.

2 FG on the connector panel:
On the connector panel, connect this FG terminal to the frame ground. For this connection, use twisted–pair cable, 100 to 300 mm long and with a cross–sectional area of at least 2 mm$^2$. At this FG terminal, connect the shield of cable J122 to ground.

## 7) Details of cable J135



8) Safety precautions

To make the handy operator's panel disconnectable, the handy operator's panel enable switch must be mounted on the connection panel. When the handy operator's panel is connected, but the handy operator's panel enable switch is set to "DISCONNECT," the emergency stop and deadman switches on the handy operator's panel are disabled. Therefore, when the handy operator's panel is connected, do not set the handy operator's panel enable switch to "DISCONNECT." Put up a notice indicating this near the handy operator's panel enable switch.

**CAUTION**

1 While the handy operator's panel is in use, do not set the handy operator's panel enable switch to "DISCONNECT." Otherwise, the emergency stop and deadman switches on the handy operator's panel will be disabled.

2 While the handy operator's panel is in use, do not let anyone else set the handy operator's panel enable switch to "DISCONNECT." One way to accomplish this is to use a handy operator's panel with a key attached so that the user of the handy operator's panel can keep the key.

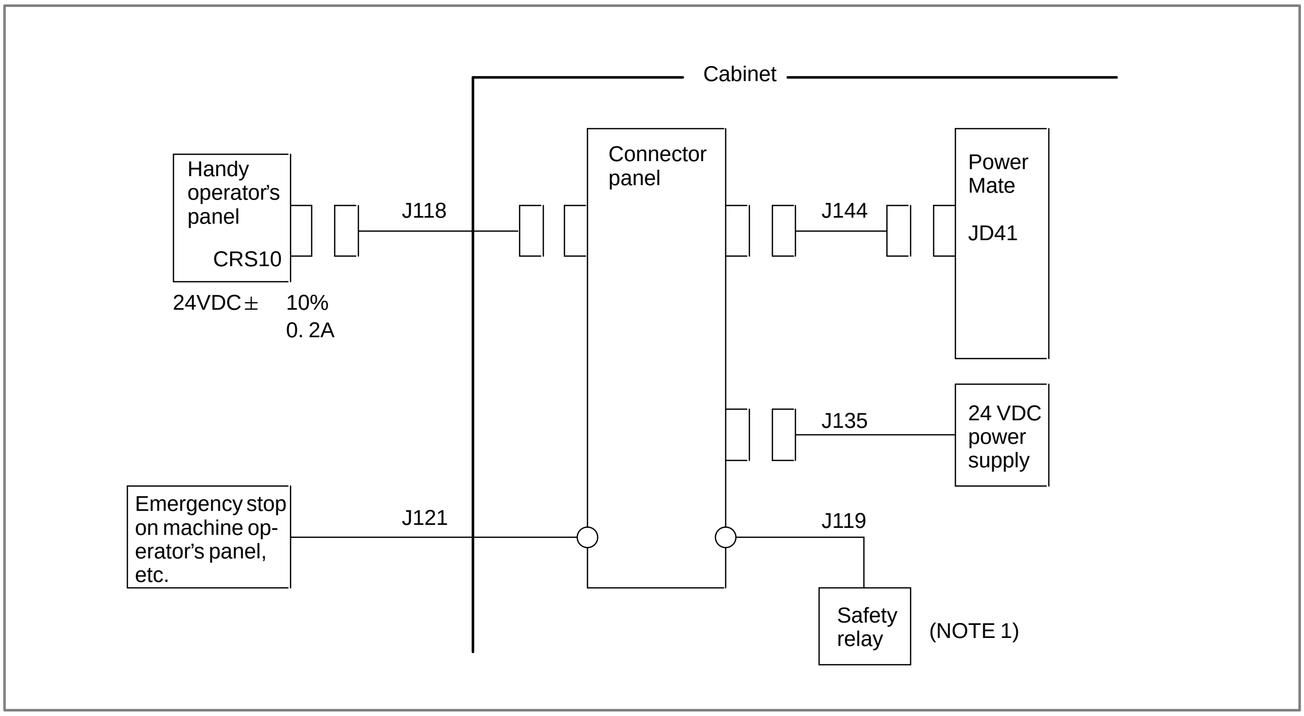
3 After the emergency stop switch on the handy operator's panel has been pressed, do not reset the emergency stop by setting the handy operator's panel enable switch to "DISCONNECT."

4 When the handy operator's panel is not being used (the handy operator's panel enable switch is set to ”DISCONNECT”), remove the handy operator's panel and put it away so that no one may think that the emergency stop and deadman switches on the handy operator's panel are effective.

Setting the handy operator's panel enable switch to ”DISCONNECT” when the handy operator's panel is connected causes the power to the handy operator's panel to be turned off, turning off the display on the handy operator's panel.

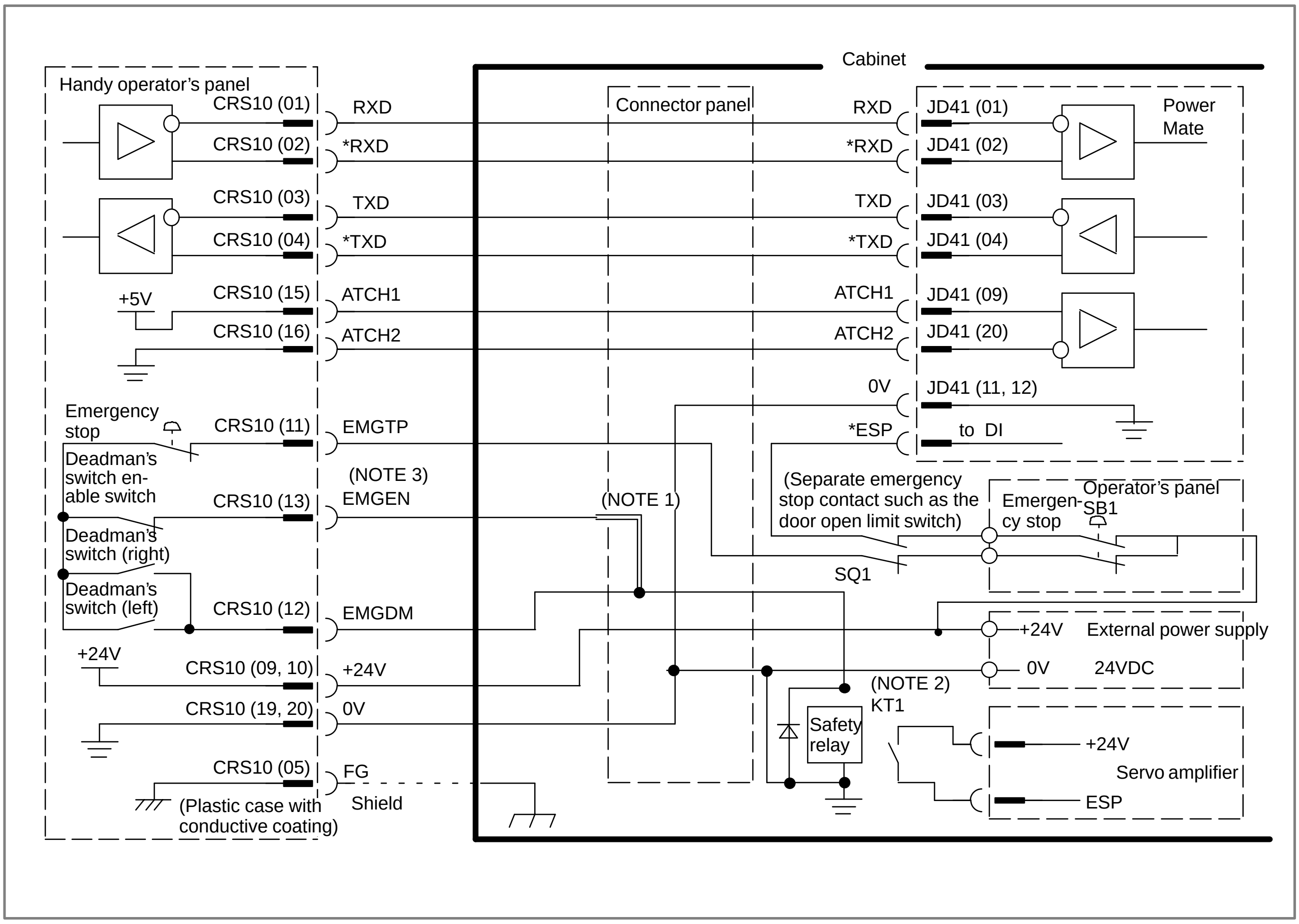
### 8.7.4
### Keeping the Handy Operator's Panel Connected at All Times

1) Inter–unit connection diagram



**NOTE**

1 The safety relay acts both as a contact for emergency stop input to the servo amplifier, and as a contact for the MCC contactor. For details, refer to "FANUC Control Motor Amplifier α Series Safe Circuit Conditions and Sample Configurations (A–71429–S13J)."
2 The total length of the cables (J118 and J144) between the handy operator's panel and the Power Mate must not exceed 50 m.
3 Cables J118 and J135 also serve as a 24 VDC power supply line to the handy operator's panel. The 24 VDC power is subject to a voltage drop corresponding to the total resistance of the 0V and 24V lines. Taking this voltage drop into consideration, determine the cable length so that 24 VDC ±10% is available at connector CRS10 of the handy operator's panel.
4 The J144 cable is used to attach a terminating unit to the Power Mate.
5 For details of connecting cables J118, J119, J121, J135, and J144, see Subsec. 8.7.3.



**NOTE**

1 When the deadman's switch enable switch is not used, do not make this connection. Thus, the deadman's switches are enabled at all times.

2 A separate safety relay is required to act as a contact for emergency stop input to the servo amplifier, and as a contact for the MCC contactor. For details, refer to "FANUC Control Motor Amplifier α Series Safe Circuit Conditions and Sample Configurations (A–71429–S13J)."

3 By inserting a contact to the EMGEN line, the deadman's switch can be enabled regardless of the deadman's switch enable switch status when, for example, the door is opened.

4 When the +24 V power is not supplied to EMGTP (CRS10 (11)), the Handy operator's panel enters the emergency stop status.

## 8.7.5
## Power Mate Setting

To use the Handy Operator's Panel, it is necessary to specify so using the 7–segment LED and pushbutton switch on the Power Mate. Refer to the applicable Operator's Manual for details.

## 8.8 CONNECTION TO THE HANDY OPERATOR’S PANEL TYPE B

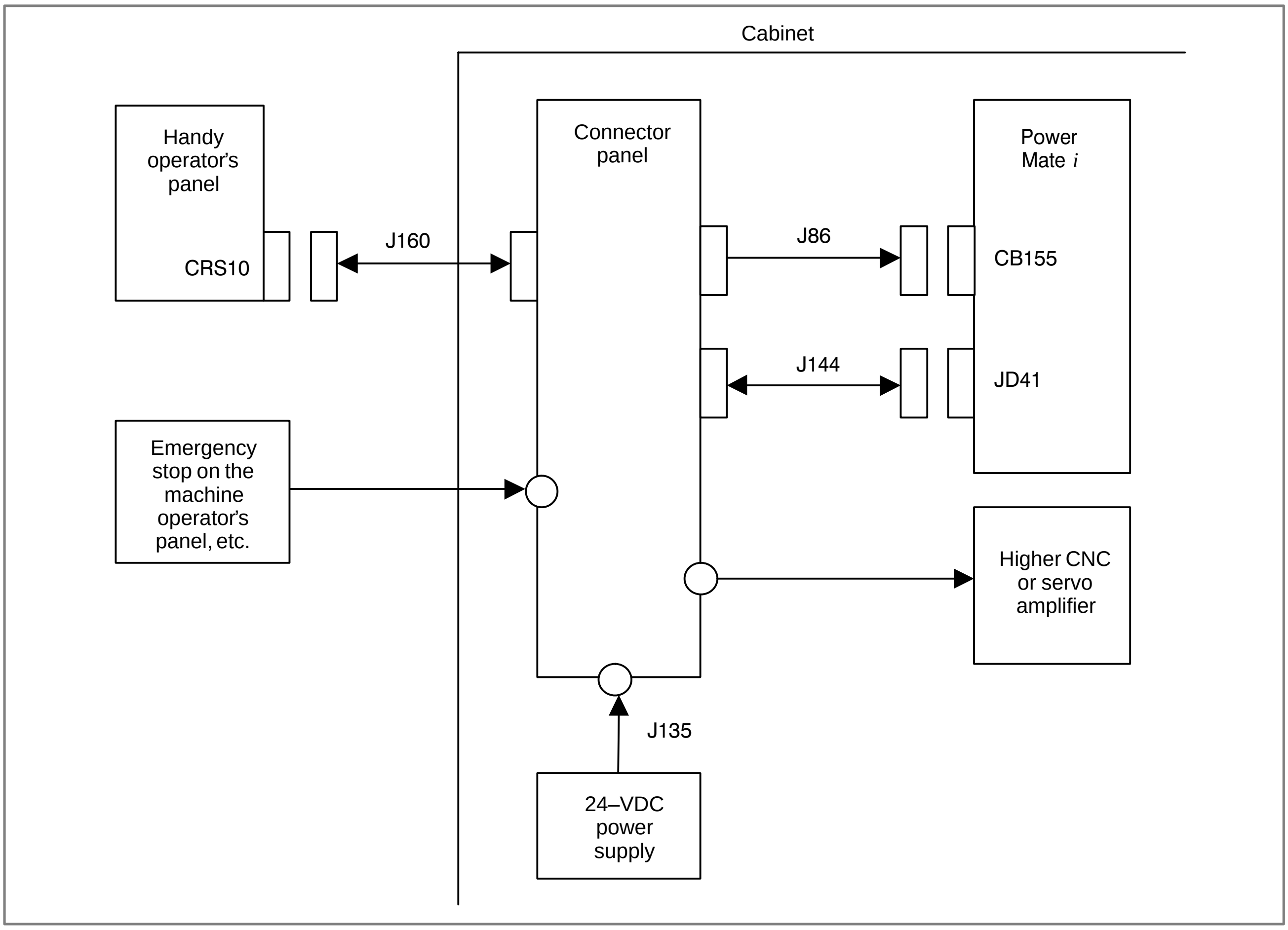
### 8.8.1 Overview

The handy operator’s panel type B allows the Power Mate *i* to use the emergency stop feature on the handy operator’s panel as a part of emergency stop features implemented on a machine tool used with the CNC.

The specifications of this handy operator’s panel for a machine tool are the same as the conventional handy operator’s panel (see Section 8.7) except the following:

- The emergency stop button has two contact outputs.
- Switch A (the conventional deadman’s switch enable switch) can be used as a modal switch.
- While one of switches B (the conventional deadman’s switches) is pressed, operations with the handy operator’s panel can be enabled.
- With the conventional handy operator’s panel, when the emergency stop button is pressed, or the deadman’s switch enable switch is ON, releasing both the deadman’s switches notifies the Power Mate of the emergency stop state through communication. With this handy operator’s panel, the notification of the emergency stop state is not performed through communication.
- The handy operator’s panel is assumed to be always connected to the machine.

## 8.8.2
## Connection Diagram

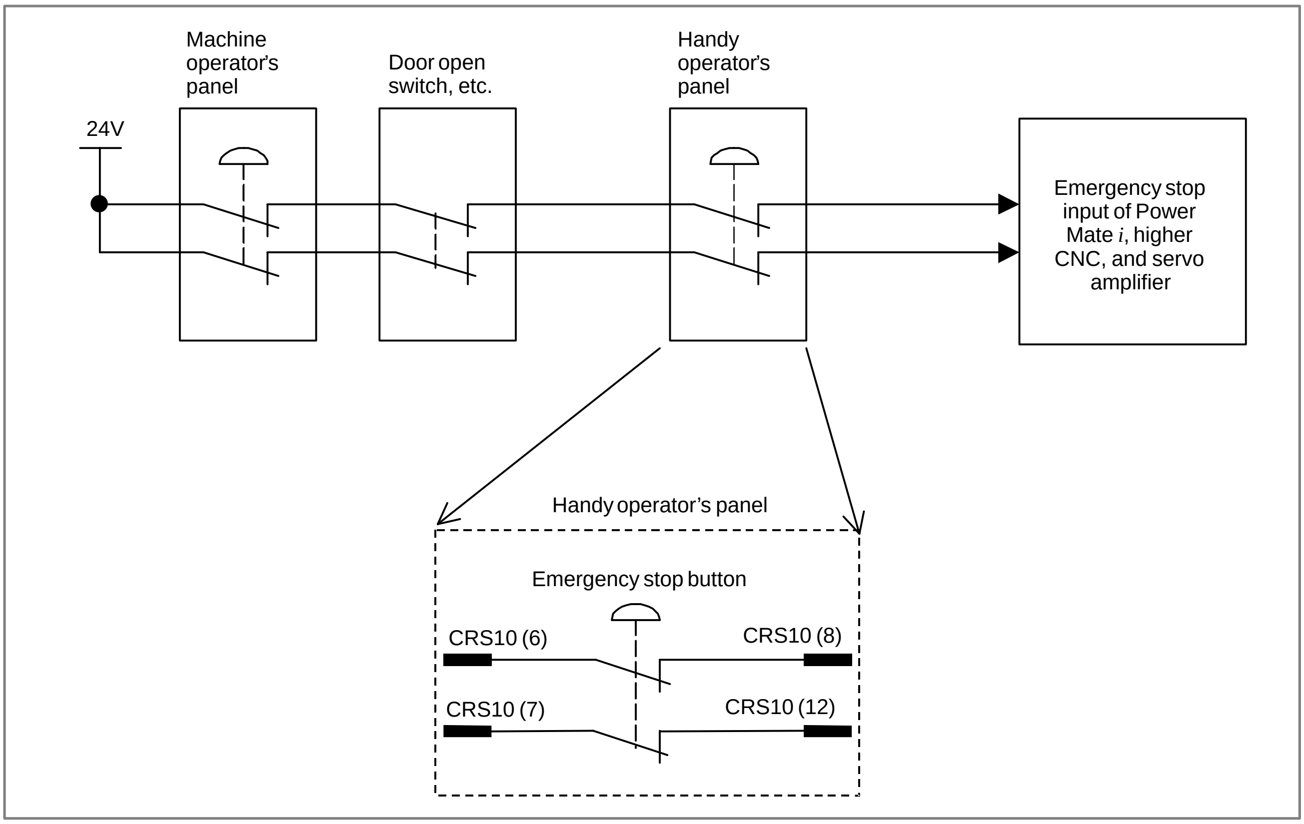


**NOTE**

For the connection diagram, see also Subsection 8.7.4. The same notes as that on cable J118 apply to cable J160.

## 8.8.3 Emergency Stop

The handy operator's panel has two emergency stop contact points. Assign one contact to the emergency stop input to the servo amplifier, and assign the other contact to the emergency stop input to the Power Mate or higher CNC. With the conventional handy operator's panel, the emergency stop state is posted to the Power Mate through communication; with this handy operator's panel, connection to the emergency stop input of the Power Mate (the built–in I/O card or I/O supporting FANUC I/O Link) is required.



**WARNING**

Be sure to connect the emergency stop signal of this handy operator's panel to the emergency stop input of the Power Mate *i* or higher CNC, and to the emergency stop input of the servo amplifier.

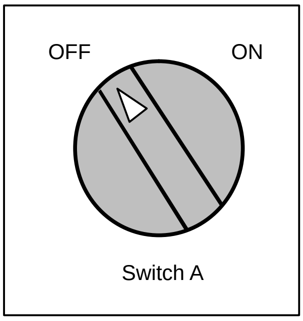
**NOTE**

1 The emergency stop state of the handy operator's panel is not posted to the Power Mate *i* through communication.

2 If the handy operator's panel becomes faulty, disabling communication with the Power Mate *i*, the Power Mate *i* enters the emergency stop state.

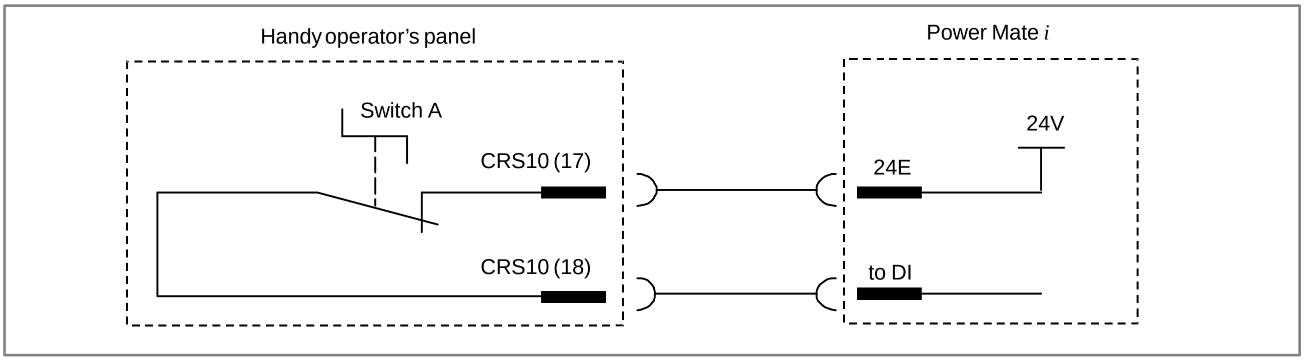
## 8.8.4
## Switch A

The handy operator's panel has one contact for a modal switch. This switch can be used as a switch for maintaining a state.



| Setting of switch A | Between CRS10 (17) and (18) |
|---|---|
| OFF | Closed |
| ON | Open |

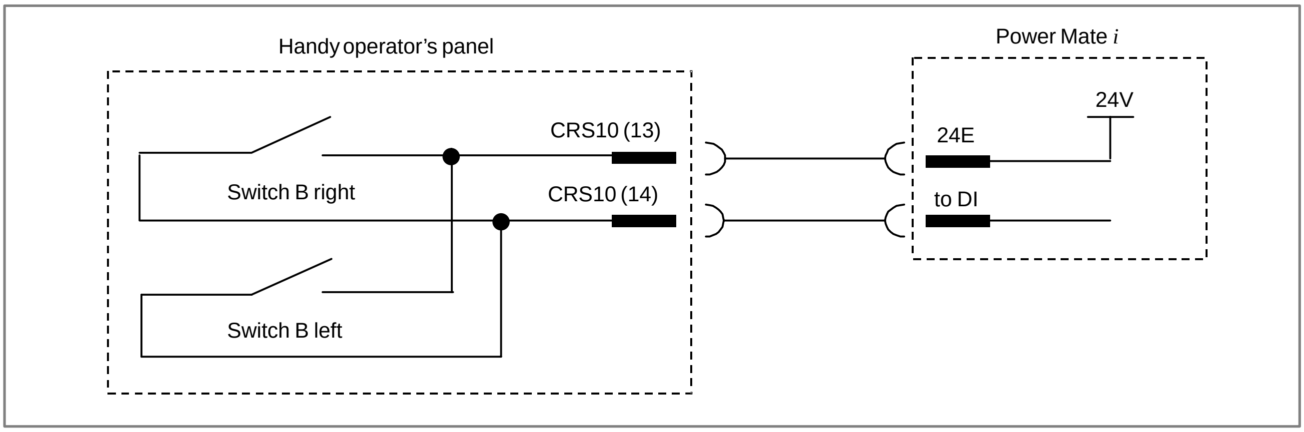
### Connection details



## 8.8.5
## Switch B

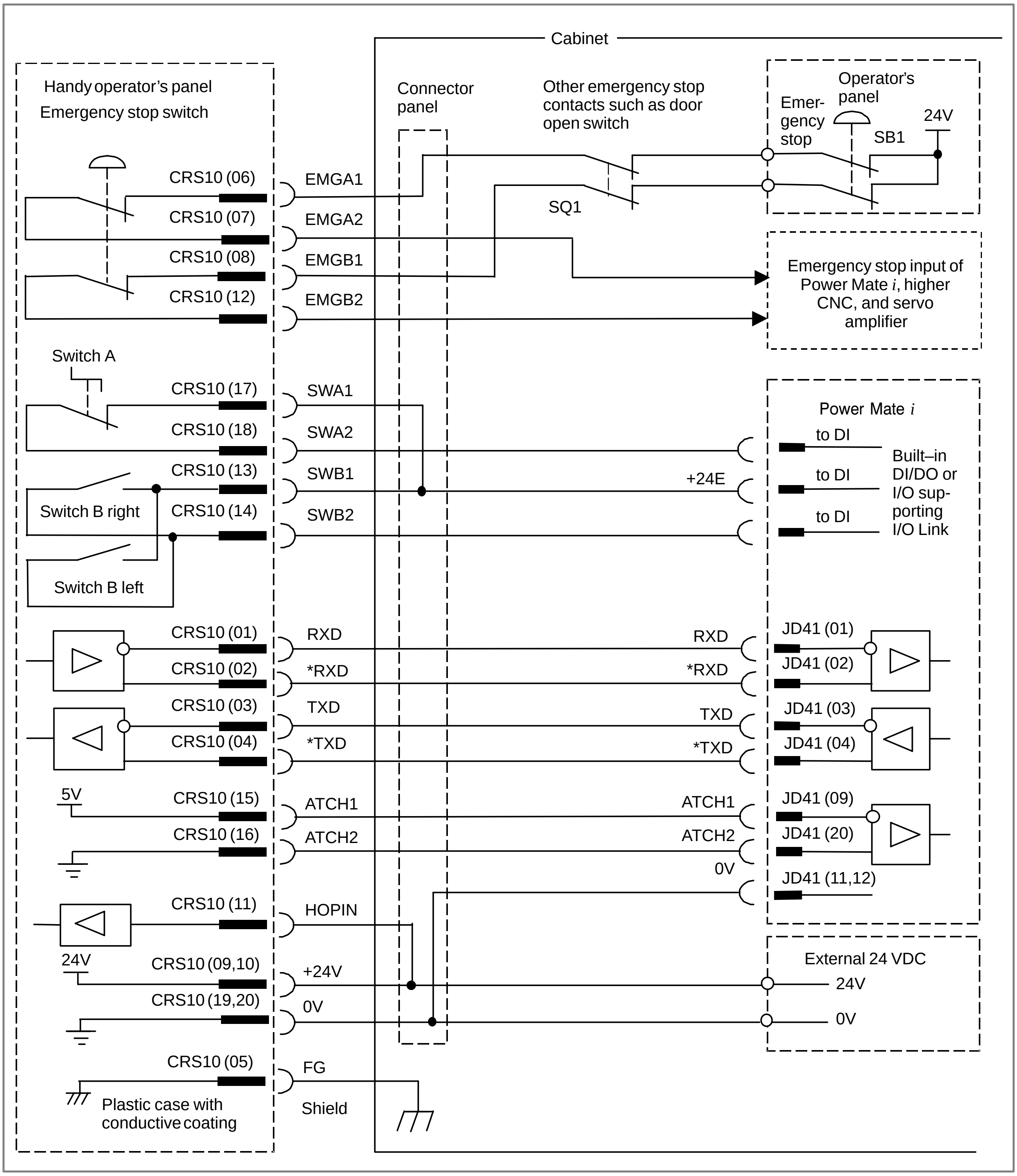
The handy operator's panel has a switch on the right and left of the portion where the user holds the operator's panel. The handy operator's panel can recognize the switch condition when both or one of the right and left switches is pressed and when both switches are released. This switch can be assigned to a signal for indicating, for example, that the handy operator's panel is used for operation.

### Connection details



| Switch B right | Switch B left | Between CRS10 (13) and (14) |
|---|---|---|
| Pressed | Pressed | Closed |
| Pressed | Released | Closed |
| Released | Pressed | Closed |
| Released | Released | Open |

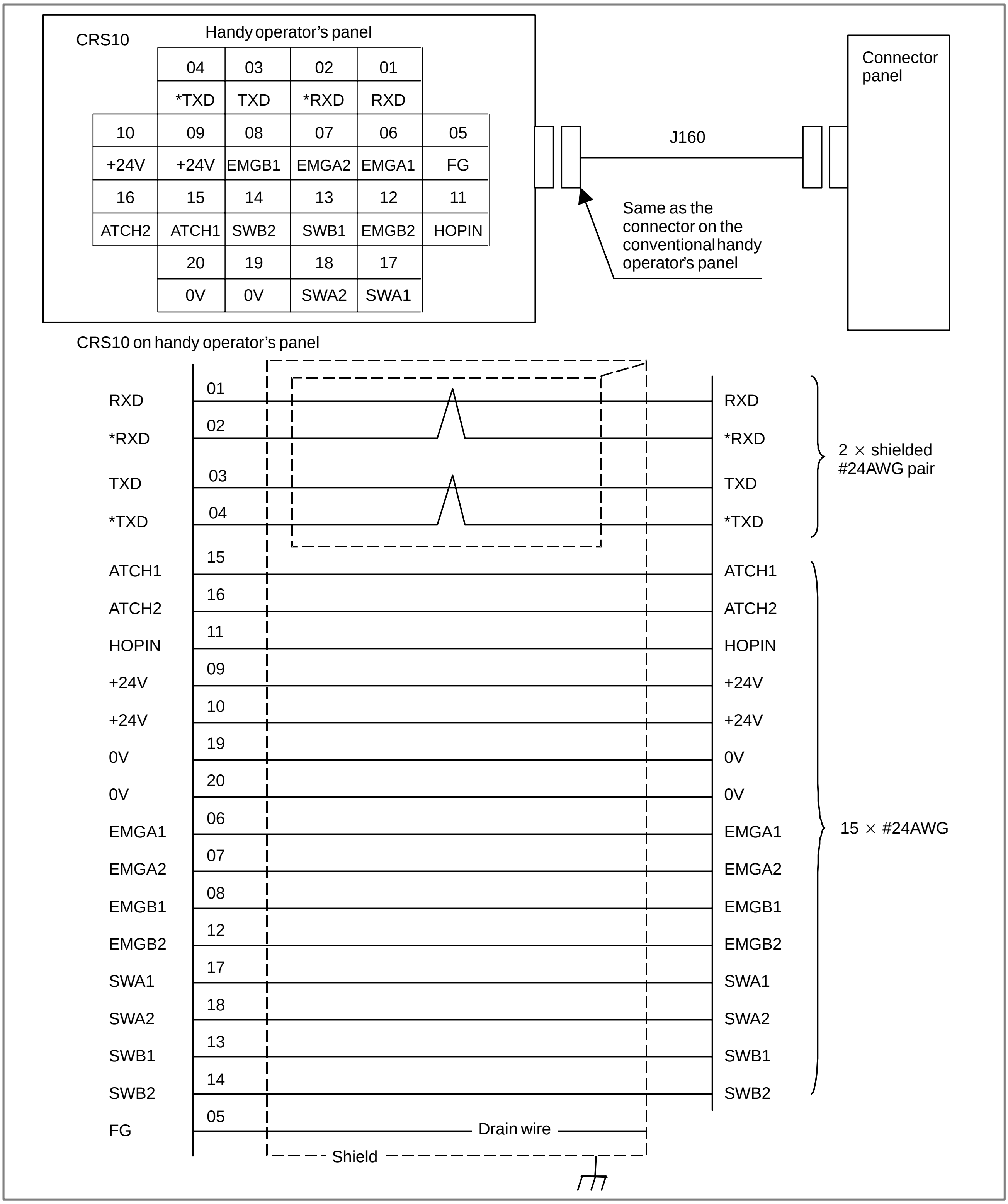
## 8.8.6 Detailed Connection Diagram



## 8.8.7
## Details of Cables J86, J135, and J144

For details of cables J86, J135, and J144, see Section 6.4 and Subsection 8.7.3.

## 8.8.8
## Details of Cable J160



| | | | | | |
|---|---|---|---|---|---|
| | 04 | 03 | 02 | 01 | |
| | *TXD | TXD | *RXD | RXD | |
| 10 | 09 | 08 | 07 | 06 | 05 |
| +24V | +24V | EMGB1 | EMGA2 | EMGA1 | FG |
| 16 | 15 | 14 | 13 | 12 | 11 |
| ATCH2 | ATCH1 | SWB2 | SWB1 | EMGB2 | HOPIN |
| | 20 | 19 | 18 | 17 | |
| | 0V | 0V | SWA2 | SWA1 | |

**NOTE**

The outside diameter of the cable used with connector CRS10 is 8.5 mm. If the outside diameter of the cable is larger than 8.5 mm, the outside diameter of the cable must be decreased by, for example, peeling off the sheath of only the connector attachment portion of the cable and use a heat–shrinkable tube.

## 8.9 CONNECTION TO AN LCD WITH A TOUCH PANEL

### 8.9.1 Overview

This section explains how to connect an LCD with a touch panel to the Power Mate *i*–D/H. The LCD with a touch panel is connected to the Power Mate *i*–D/H via the display link. Another supplier's touch panel can also be connected to the Power Mate *i*–D/H. In this case, a separate setup/display device is required for CNC maintenance. The LCD with a touch panel can be used as a machine operator's panel and also as a CNC setup/display device.

The LCD with a touch panel has the following features:

(1) Two types of LCDs are available: a monochrome LCD with a 9.5" touch panel and a color LCD with a 10.4" touch panel.

(2) One LCD with a touch panel can be shared among multiple Power Mate *i* units and *i* series CNCs (that support the display link). (Up to 16 CNCs can be connected.)

(3) A virtual keyboard appears on the touch panel as required, so an MDI unit is normally unnecessary.
For the cards and functions available with the memory card interface of the LCD with a touch panel, see Appendix F.

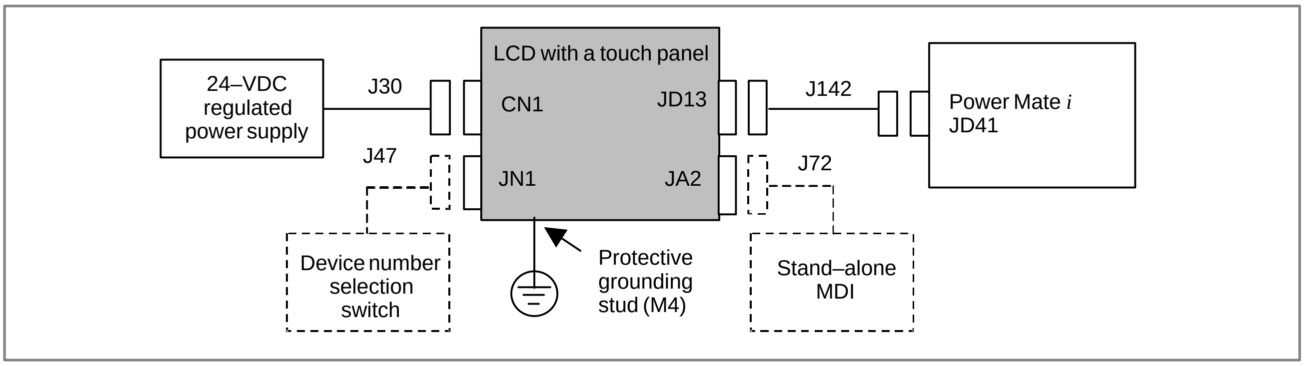
### 8.9.2 Specifications

| Name | Specification | Remarks |
|---|---|---|
| Color LCD with a touch panel | A02B–0259–C212 | 10.4" display |
| Monochrome LCD with a touch panel | A02B–0259–C211 | 9.5" display |
| Stand–alone type MDI for the touch panel (English keys) | A02B–0236–C120#MBR | M–series/small type keys 200 × 140 mm |
| Stand–alone type MDI for the touch panel (symbol keys) | A02B–0236–C120#MBS | |

| Item | | Specification |
|---|---|---|
| Resolution | | 680 × 480 dots |
| Number of colors | | 256 colors when touch panel application screens are used<br>16 colors when CNC and PMC screens are used |
| Power supply capacity | LCD with a touch panel | DC24V ± 10% 0.2A (including an instantaneous value and ripple) |
| Heat loss | Stand–alone MDI for the touch panel | — |
| | LCD with a touch panel | 15W |
| | Stand–alone MDI for the touch panel | — |

| Item | | Specification |
|---|---|---|
| Weight | LCD with a touch panel | 2.4 kg |
| | Stand–alone MDI for the touch panel | 1.3 kg |
| Environmental requirements | See Section 3.1. | |

## 8.9.3
## Total Connection



(1) The display link is used for connection to the LCD with a touch panel. The specifications of the display link are the same as described in Section 8.1 except the maximum length.

(2) The maximum length of cable J142 is 50 mm. (100 m is not permitted.)

(3) For display link cable J142, see Subsection 8.1.2.

(4) For device number selection switch interface cable J47, see Subsection 8.1.4.
With the conventional LCD/MDI, even when it is connected to just one CNC, the device number selection switch interface must be connected. With the new LCD with a touch panel, such connection is unnecessary. (Do not connect JN1 (15) and JN1 (16).)

(5) For power interface cable J30, see Subsection 8.1.5. The cable can also be drawn from power connector CP2 of the Power Mate *i*. (J137)

(6) A protective grounding stud is located on the rear of the LCD. Be sure to connect the grounding stud to a good ground with a twisted wire that is about 100 mm long and has a cross–sectional area of at least 2 mm$^2$.

(7) In the conventional way, the LCD can be connected to multiple CNCs that support the display link. See (2) in Subsection 8.1.1 and Subsection 8.1.3. The cable between the LCD with a touch panel and the display link adapter may be J142 instead of J45.

(8) The LCD with a touch panel can be used in a detachable manner.

(9) When operating the touch panel, be sure to use the touch panel pen (A02B–0236–K111).

(10) The stand–alone type MDI is designed for those who are familiar with conventional MDI operation. The LCD with a touch panel has a virtual keyboard, so operation can be performed without using the stand–alone type MDI. The stand–alone type MDI is different from the conventional stand–alone MDI used with the Power Mate though the MDI key layout is the same as that of the conventional stand–alone MDI unit. (See Subsection 8.1.7.)

(11) The LCD with a touch panel is provided with rotary switch JA2. This switch is designed for future functional expansion. Leave the switch as factory–set. (Normally, the switch is set to 0.)

(12) Jumper terminals STM1 and STM2 are used to terminate the display link. Normally, leave these terminals connected. (Disconnect these terminals if the display link does not terminate. When the LCD with a touch panel is not connected at an end of the display link, termination of the display link is unnecessary in the LCD.)

(13) If the ambient temperature is low, the LCD luminance lowers. See (10) in Subsection 8.4.1.

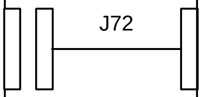
(14) The method of a special operation at power–on such as a memory all clear operation differs from that with the conventional CRT/MDI.

## 8.9.4

## Connection to the Stand–Alone Type MDI

Stand–alone type MDI: Ck1
(PCR–E20MD)

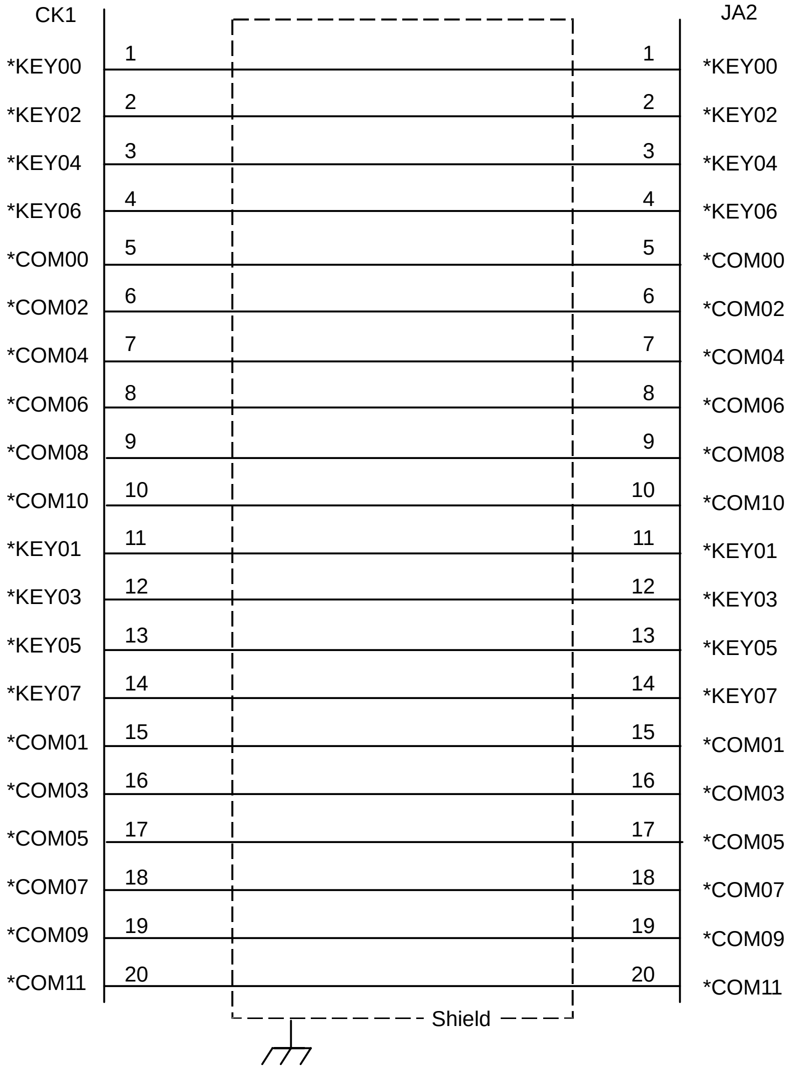
| | | | |
|---|---|---|---|
| 1 | *KEY00 | 11 | *KEY01 |
| 2 | *KEY02 | 12 | *KEY03 |
| 3 | *KEY04 | 13 | *KEY05 |
| 4 | *KEY06 | 14 | *KEY07 |
| 5 | *COM00 | 15 | *COM01 |
| 6 | *COM02 | 16 | *COM03 |
| 7 | *COM04 | 17 | *COM05 |
| 8 | *COM06 | 18 | *COM07 |
| 9 | *COM08 | 19 | *COM09 |
| 10 | *COM10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



LCD with a touch panel: JA2
(PCR–EV20MDT)

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

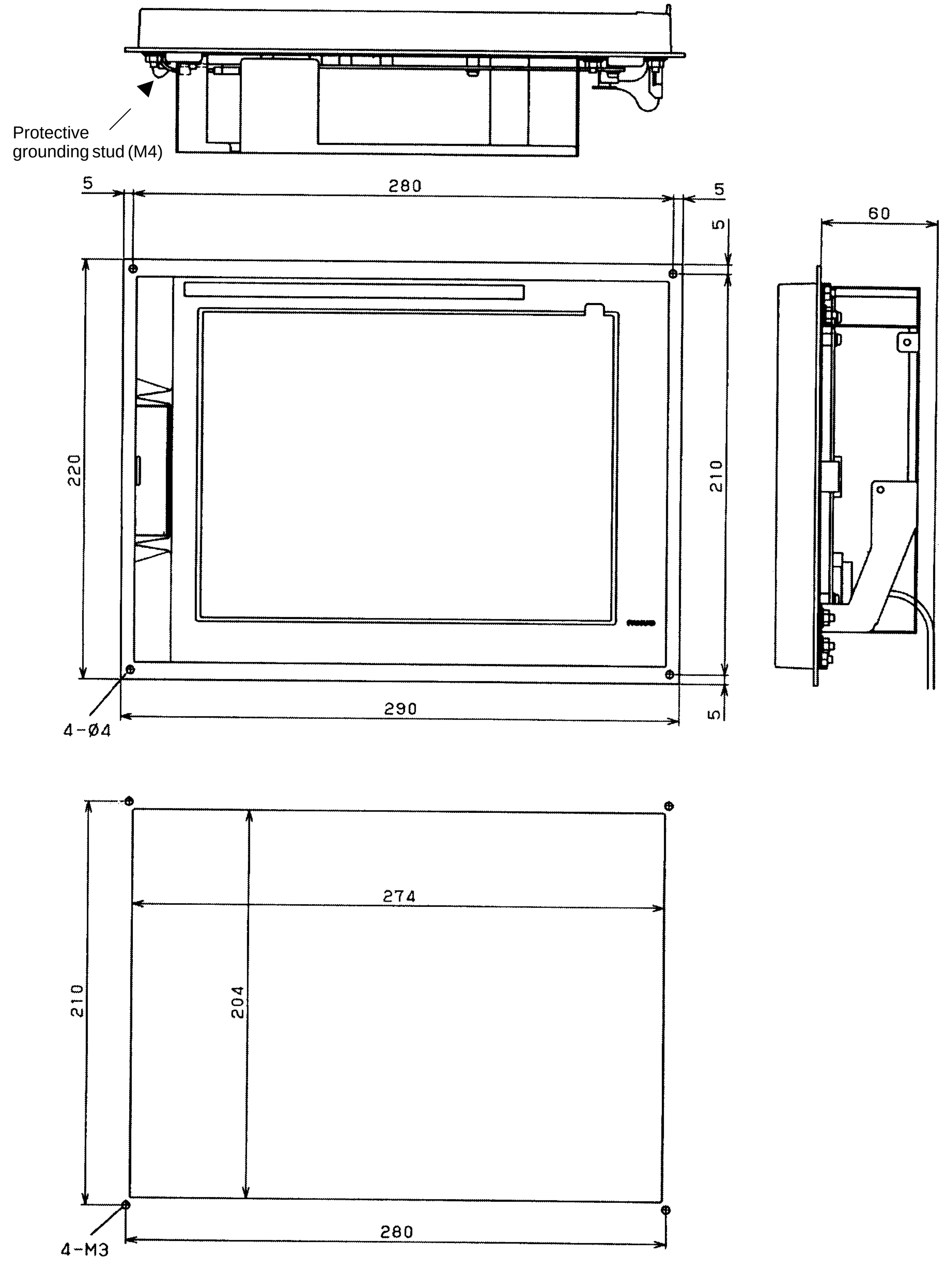
Cable connection (J72)



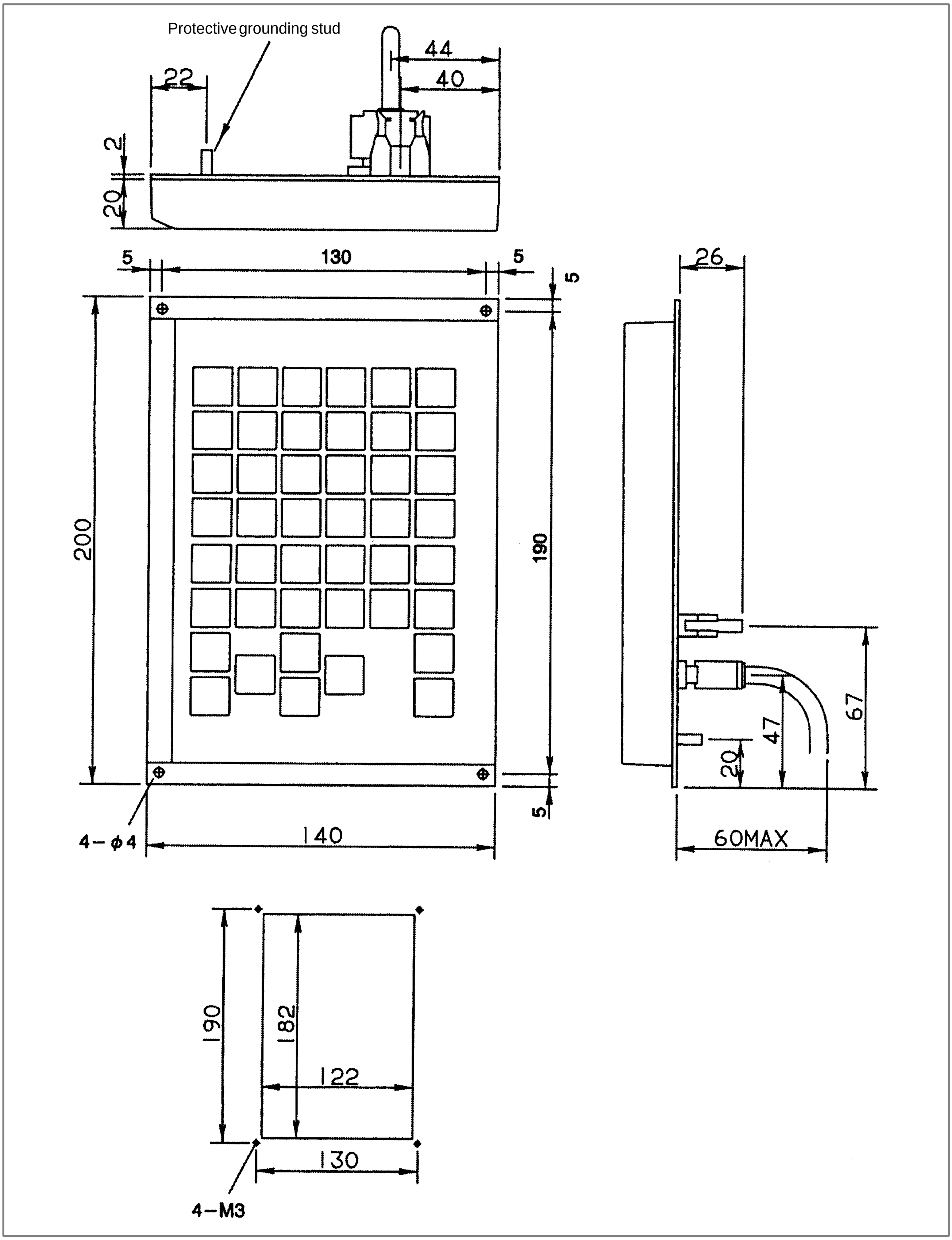
Recommended cable: A66L–0001–0284#10P (#28AWG × 20)
Recommended connector: PCR–E20FS or PCR–E20FA, housing: PCR–V20LA
FANUC purchase specification: A02B–0120–K810 (cable length: 5 m)

## 8.9.5 Outline Drawing

1) LCD with a touch panel



2) Stand–alone type MDI for the touch panel



## 8.9.6
## Touch Panel

The touch panel is operated by directly touching the LCD screen. For touch panel operation, be sure to use the FANUC–supplied pen (A02B–0236–K111) provided with the touch panel. If the LCD screen is touched using a sharp–tipped pen, the surface of the LCD screen may be damaged. Moreover, the LCD screen must not be touched by with your fingers. Otherwise, the operability may be degraded, and the screen is likely to become dirty.

## 8.9.7
## Protection Sheet for the Touch Panel

A protection sheet is attached the face of an LCD with a touch panel to protect the thin film of the touch panel and LCD. If the protection sheet is damaged, it can be replaced. (The protection sheet is a consumable part.)

### Replacing the protection sheet

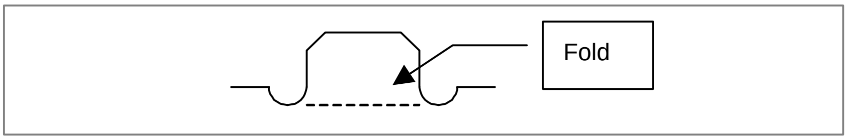
- **Materials used**

| | |
|---|---|
| 1) Protection sheet | A02B–0236–K110 |
| 2) Neutral detergent | (detergent that can clean oily dirt off = detergent for kitchen can be used) |
| 3) Soft cloth | (such as towel) |

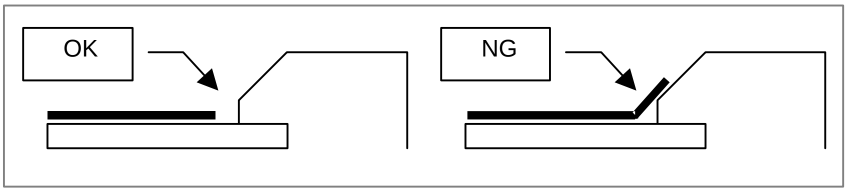
- **Replacement procedure**

1) Before replacement
   <1> Turn off the power to the machine.
   <2> Peel off the old protection sheet from the surface of the touch panel.
   <3> Wipe off adhesive residue if any on the screen surface with alcohol.
   <4> Use the detergent to remove oil or dirt stuck to the surface of the touch panel.
   <5> With a soft, damp cloth, wipe off detergent completely.
      - If the touch panel surface becomes cloudy, oil is still left on the surface. Remove oil completely.
      - If oil or detergent is left on the surface of the touch panel, the protection sheet cannot adhere to the panel completely and will sometimes peel off easily.
   <6> With a dry soft cloth, wipe off moisture completely.

2) Applying the protection sheet
   <1> Fold the tab over the front side (the side opposite to the backing sheet).



   <2> Peel off the backing sheet.
   <3> Position the sheet, then attach the upper and lower sides of the sheet first. Check that the sides of the protection sheet do not touch the escutcheon.



<4> Attach the right and left sides of the protection sheet while pushing out air between the touch panel and protection sheet.

- With part of the protection sheet kept stuck to the touch panel, do not attempt to correct the position of the protection sheet by pulling the sheet.

<5> Press the adhesive parts of the four sides, and attach the entire sheet completely.

- Check that the four corners and four sides of the protection sheet do not float.

3) Checks after replacement

<1> Check that there is no wrinkle on the surface of the protection sheet.

<2> After power–on, check that there is no touch panel portion kept pressed.

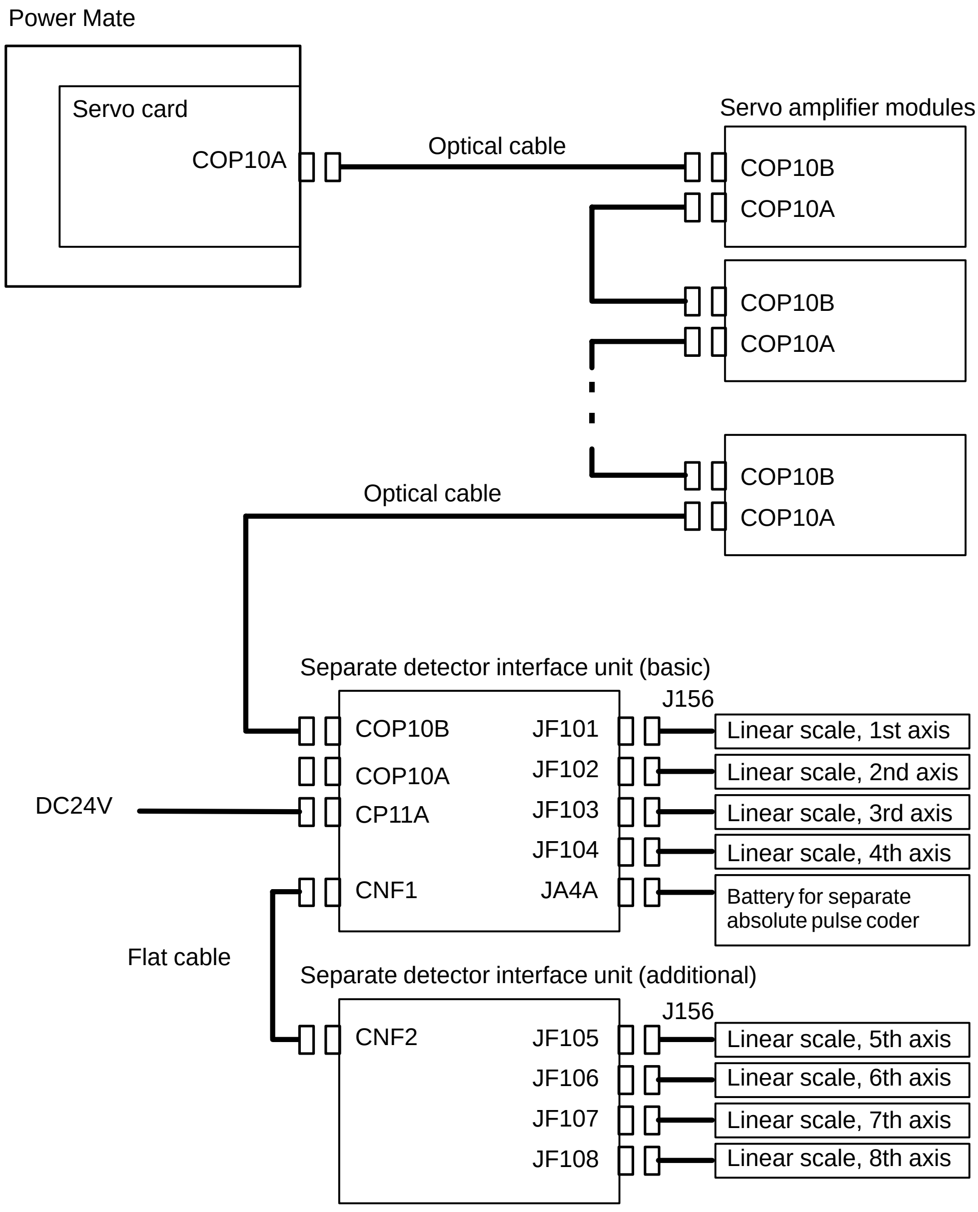
<3> Press the touch panel, and check that correct operation takes place.

# 9 CONNECTION TO SERVO OR SPINDLE

# 9.1
# SERVO INTERFACE (FSSB)

## 9.1.1
## Connection by FSSB

The connection between the Power Mate *i* and the servo amplifiers should use only one optical cable, regardless of the number of controlled axes.
For Power Mate *i*–D, up to 2 axes can be connected.
For Power Mate *i*–H, up to 8 axes can be connected.
For the connection of the $\alpha$ series or β series servo amplifier, refer to Descriptions (B–65162E/B–65232EN).

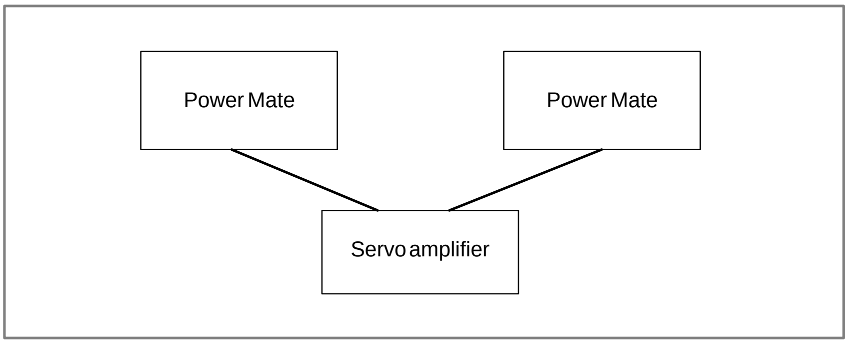


For the optical fiber cable, see Appendix D.

## 9.1.2
## Sharing a Servo Amplifier

When a single servo amplifier is shared by multiple Power Mates, servo alarm 401 (servo amplifier ready signal OFF) may occur in the cases explained below.

1) When multiple Power Mates share a single servo amplifier



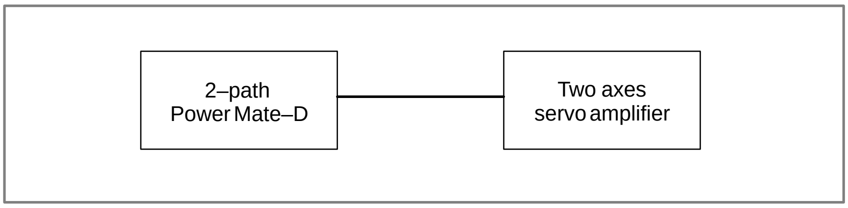
The servo amplifier does not turn on the servo amplifier ready signal until all the Power Mates have started.

When one Power Mate enters one of the following states, the servo amplifier turns off the ready signal, causing servo alarm 401 to occur in the other Power Mates:

- The power is turned off.
- A servo alarm occurs.
- The system enters the emergency stop state.
- The controlled axis detach signal is turned on.

If power–up for one Power Mate is delayed when the Power Mates are turned on, or if a follow–up operation, performed after power–up, requires too much time when an absolute pulse coder is being used, servo alarm 401 also occurs in the other Power Mates.

2) When a two axes servo amplifier is used by a two–path Power Mate *i*–D



The servo amplifier does not turn on the servo amplifier ready signal until both paths of the two–path Power Mate *i*–D have been started.

If one path of the Power Mate *i*–D enters one of the following states, the two–axis servo amplifier turns off the ready signal, causing servo alarm 401 to occur in the other path.

- A servo alarm occurs for one path.
- One path enters the emergency stop state.
- The controlled axis detach signal is turned on for one path.

If a follow–up operation, performed after power–up, requires too much time when an absolute pulse coder is being used, servo alarm 401 also occurs in the other path.

### Measures

Setting bit 2 (NOFVY) of parameter No. 1803 makes the servo amplifier to wait for the VRDY to be turned on with no servo alarm issued.

With this setting, if the system waits for VRDY to be set to on, “WAIT” appears on the CRT or DPL unit. In addition, VRDY wait signal [F209#4] is output.

To use the controlled–axis removal function for an axis, a servo amplifier must be provided for the axis.

## 9.2 SEPARATE DETECTOR INTERFACE UNIT

### 9.2.1 General

When a separate pulse coder or linear scale is used, a separate detector interface unit is required. The separate detector interface unit should be connected to the Power Mate control unit through an optical cable, as one of the units on the servo interface (FSSB). See Figures in Sec. 9.1. The separate detector interface connected in the final stage of the FSSB line, it can also be connected, at the nearest location, to the Power Mate control unit. Or, it can be installed between two servo amplifier modules.

Usually, the separate detectors corresponding to the servo motors for the first to eighth axes are connected to JF101 to JF108 of the separate detector interface. If required, the controlled axis numbers corresponding to JF101 to JF108 may be changed. For example, in the figure above, if separate detectors are used for the second, fourth, sixth, and eighth controlled axes only, the second, fourth, sixth, and eighth axes can be made to correspond to JF101 to JF104 of the basic unit, eliminating the need for an additional unit. The power that the unit can supply to separate detectors is 0.35 A (5V) per detector.

**NOTE**

1 When the separate detector interface unit is used with the serial interface in the Power Mate *i*, a high–speed axis control card is required.

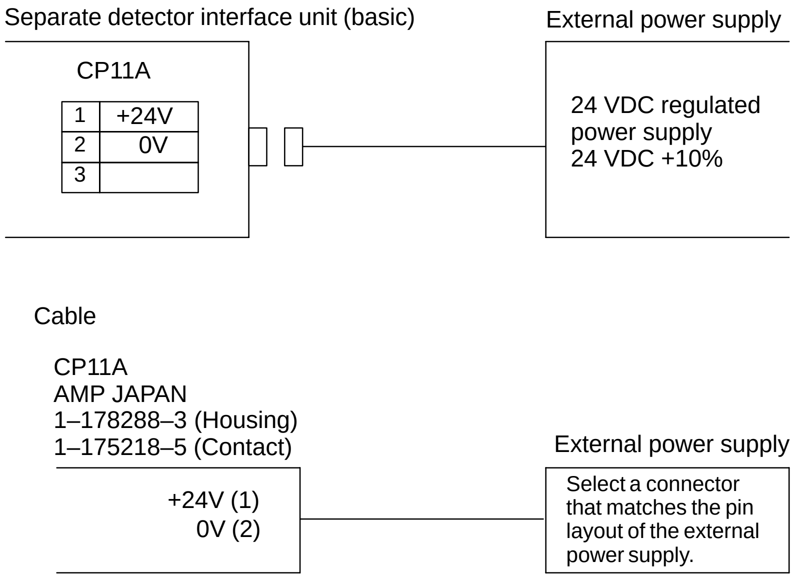
2 The +5–V output in the interface can be used as the power supply of a separate detector or linear scale. The supply current per separate detector is 0.35 A maximum. The voltage of the basic unit is 4.95 V (min), and that of the additional unit is 4.90 V (min).

3 Do not make any connection other than the connection shown in the diagram.

| Item | Specifications |
|---|---|
| Power supply | Stabilized power supply: 24 VDC ±10%<br>(including an instantaneous value and ripple)<br>Current: 0.9 A (for basic only), 1.5 A (for additional) |
| Ordering specification | A02B–0230–C203 (basic)<br>A02B–0236–C204 (additional) |
| Installation | The unit can be secured with screws or DIN rail. |

## 9.2.2 Connection of Power Supply

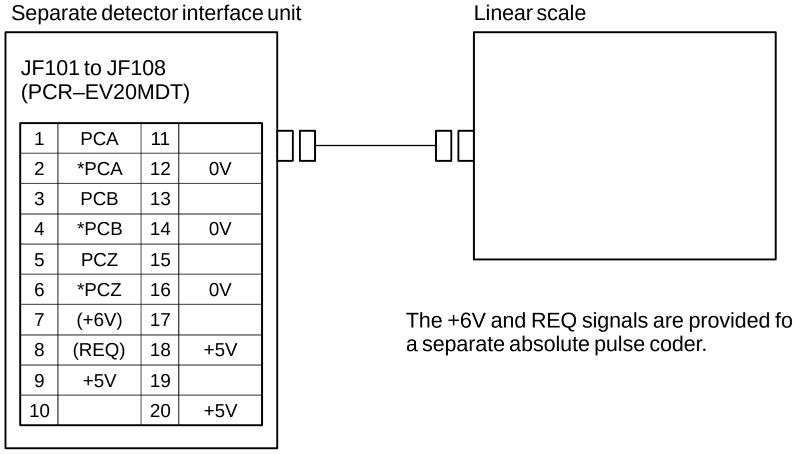
Power to the separate detector interface unit should be supplied from an external 24 VDC power supply. To the extended unit, if it exists, power is supplied from the basic unit.



Recommended cable specification:
A02B–0124–K830 (5 m)
(The external power supply end of the cable is provided with M3 crimp terminals.)

The 24 VDC input to CP11A can be output at CP11B for use in branching. The connection of CP11B is identical to that of CP11A.

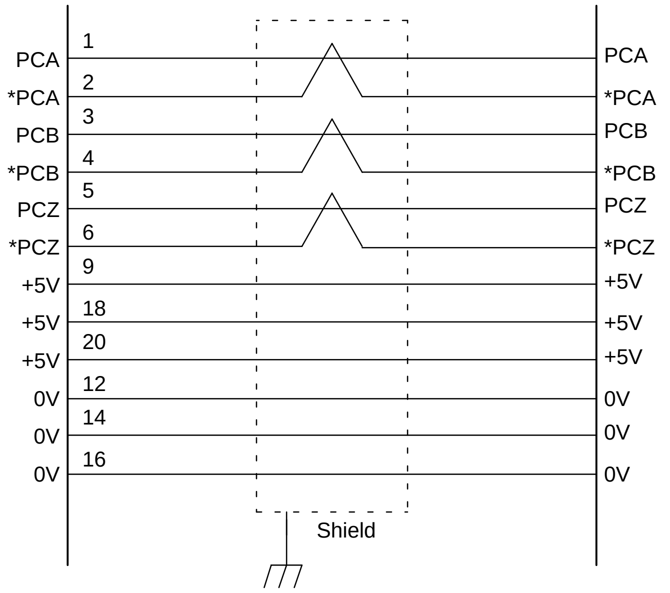
## 9.2.3 Connection to Linear Scale (Parallel Interface)



| | | | |
|---|---|---|---|
| 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 |

The +6V and REQ signals are provided for a separate absolute pulse coder.

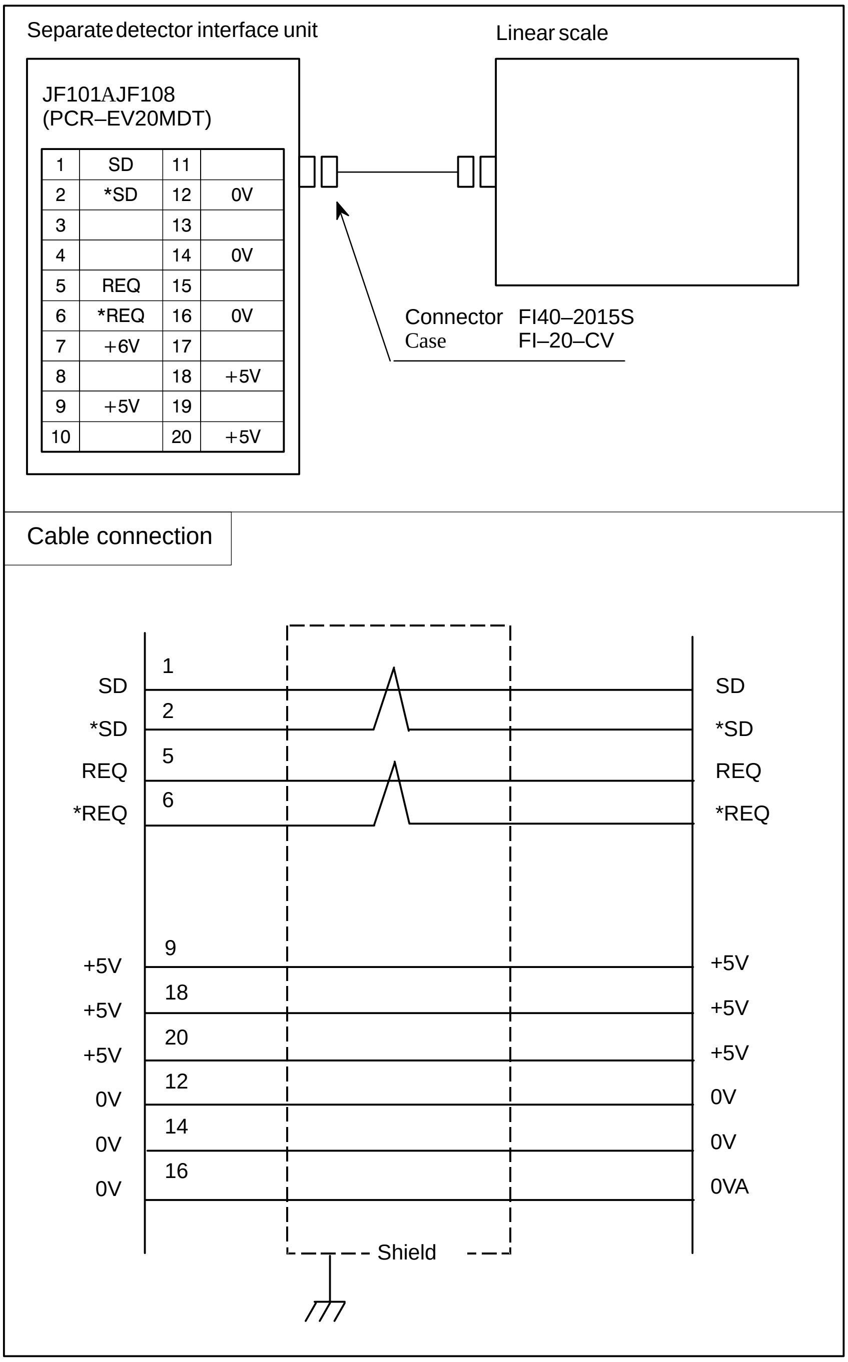
Cable connection



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

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

## (Serial interface)



JF101AJF108
(PCR–EV20MDT)

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

The recommended cable and connectors (JF101 to JF108) are the same as for the parallel interface.

## 9.2.4
## Connection to Separate Pulse Coder (Parallel Interface)

- **Absolute detection**

Separate detector interface unit

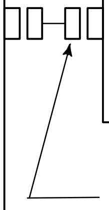
JF101 to JF108
(PCR–EV20MDT)

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

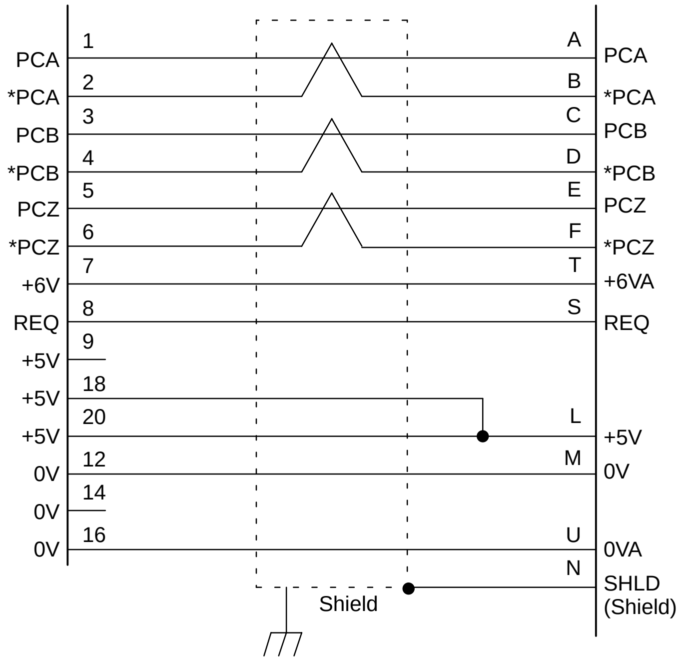
Separate absolute pulse coder

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 | | | |



Cable connection



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

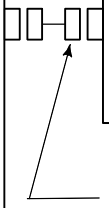
Recommended connectors:
PCR–E20FA (Honda Tsushin)
FI30–20S (Hirose Denki)
FCN–247J020–G/E (Fujitsu)
52622–2011 (Molex)
FI40B–2015S (Hirose Denki)

## ● For incremental detector

Separate detector interface unit

JF101 to JF108
(PCR–EV20MDT)

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

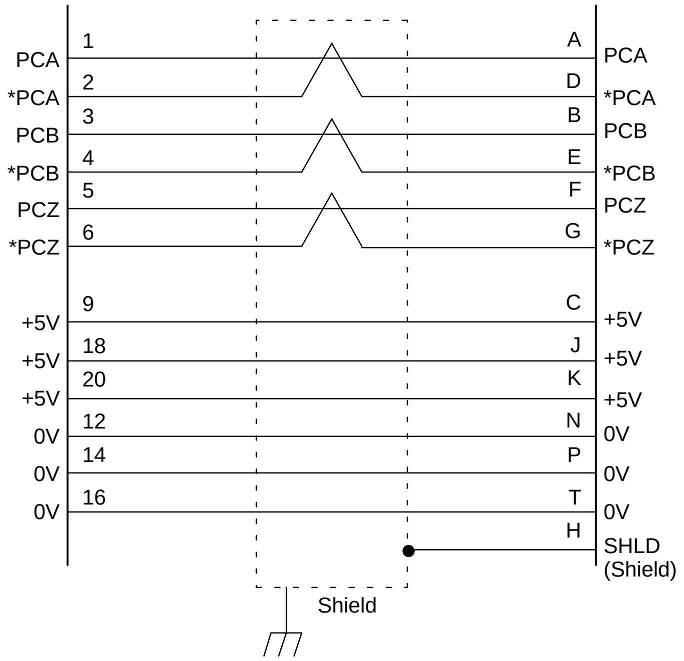


Separate pulse coder

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 | | | | | | |

Cable connection



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

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

## (Serial interface)

Separate detector interface unit

JF101AJF108
(PCR–EV20MDT)

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

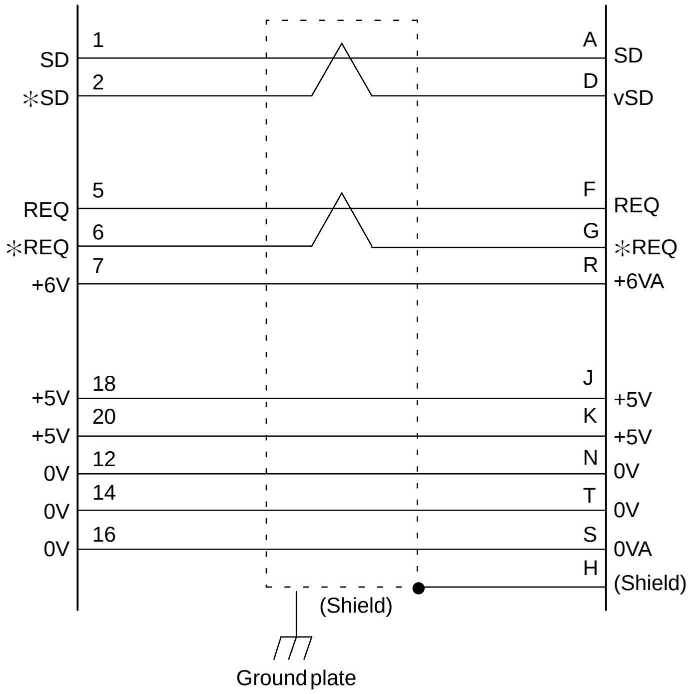
Separate pulse coder

Pulse coder

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

MS3106B20–29SW

Cable connection



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

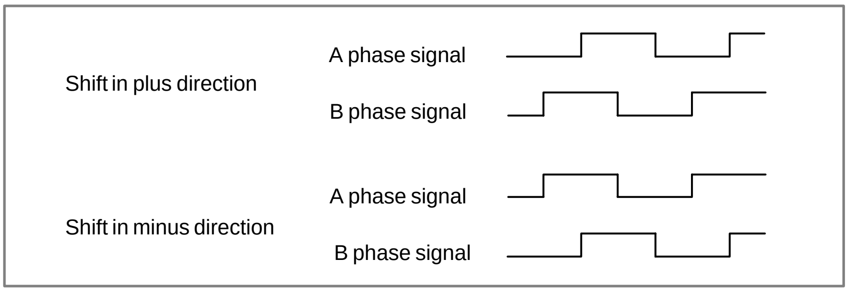
Recommended connector:
PCR–E20FA (Honda Tsushin Kogyo)
FI30–20S (Hirose Electric)
FCN–247J020–G/E (Fujitsu)
52622–2011 (Molex Japan)
FI40B–2015S (Hirose Electric)

## 9.2.5 Input Signal Requirements

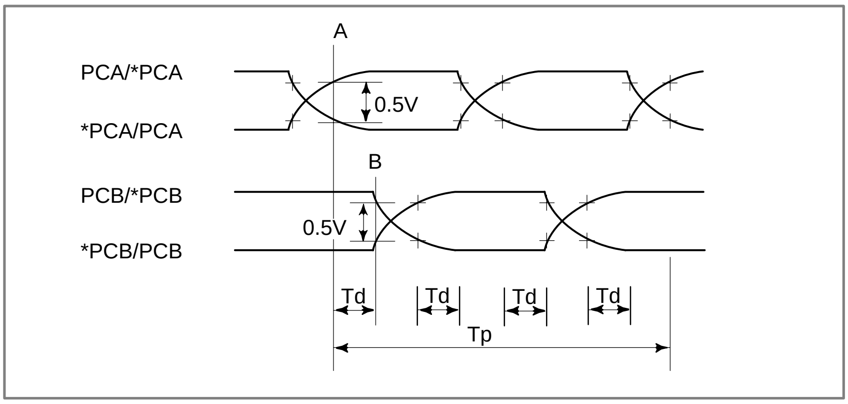
The standard of the feedback signal from the separate detector is as shown below.

(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



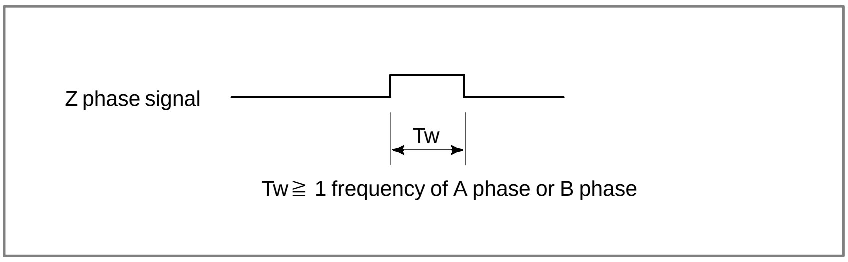
Requirements for the signals at the input pins of input connectors JF101 to JF108

TD ≧ 0.15 μsec

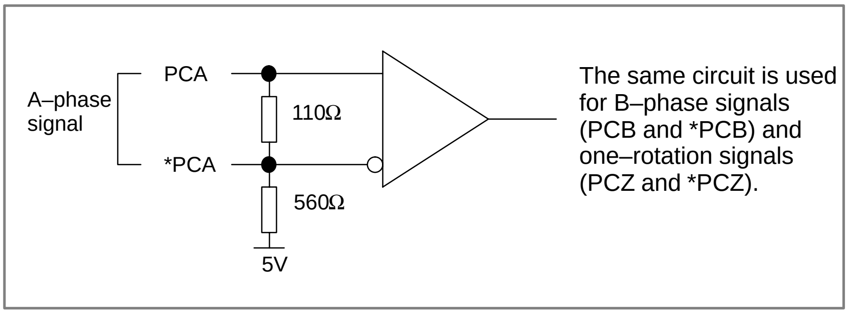
The signals for these connectors are differential input signals with A and B phases. An important factor is time TD from point A, when the potential difference between PCA and *PCA exceeds 0.5V, to point B, when the potential difference between PCB and *PCB becomes lower than 0.5V. The minimum value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

(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.



## Receiver circuit



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

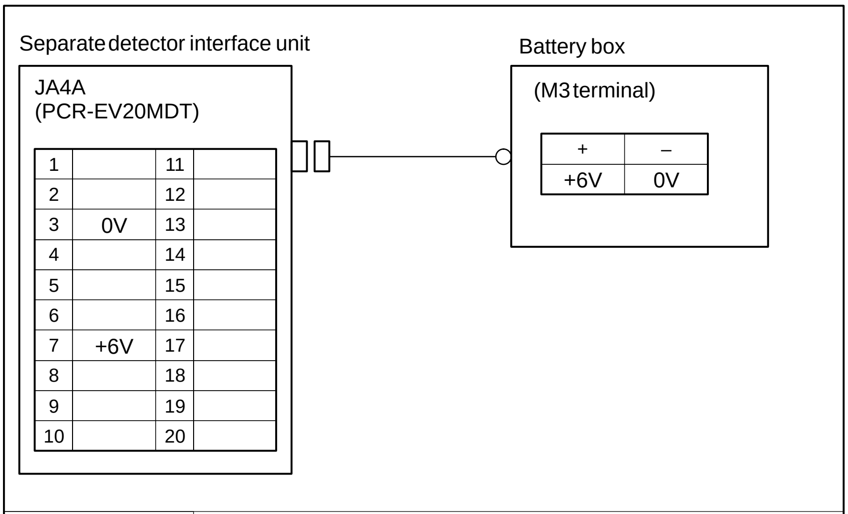
If the separate pulse coder rotates in the opposite direction to that of the servo motor, reconnect the interface cable of the separate pulse coder as described below.

(1) Exchange signal PCA with signal PCB.

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

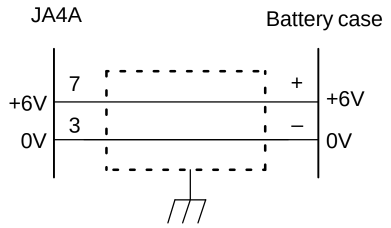
## 9.2.6

## Connection of Battery for Separate Absolute Pulse Coder



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

Cable wiring



Recommended cable material ≧ 0.2mm$^2$ (7/0.18)

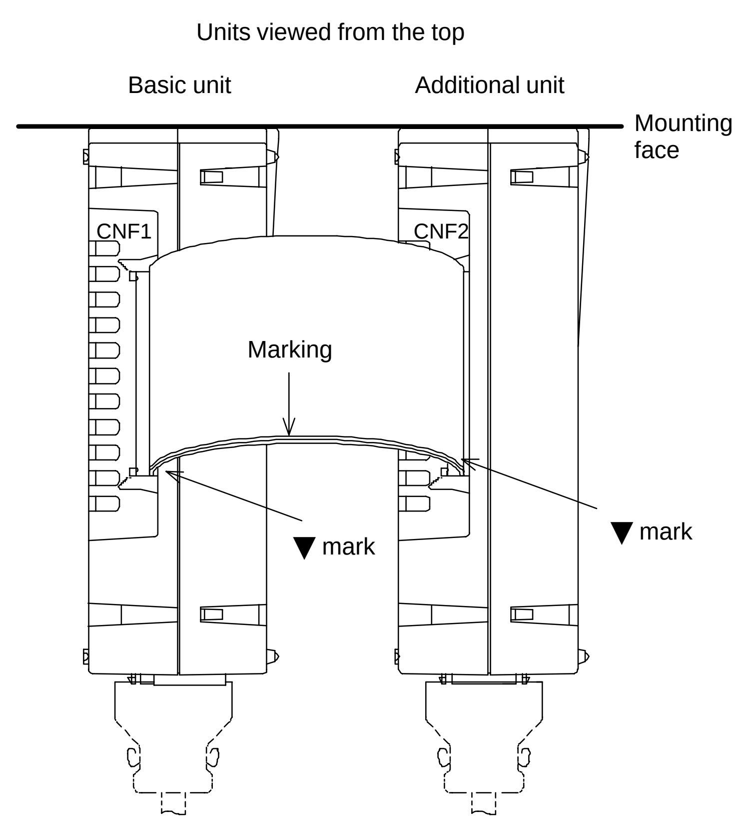
Recommended connectors:
PCR–E20FA (Honda Tsushin)
FI30–20S (Hirose Denki)
FCN–247J020–G/E (Fujitsu)
52622–2011 (Molex)
FI40B–2015S (Hirose Denki)

**NOTE**

The battery for a separate absolute pulse coder is required only when that pulse coder is used.
When an absolute pulse coder with a built–in motor is used, a separate battery must be installed on the α Series amplifier side.

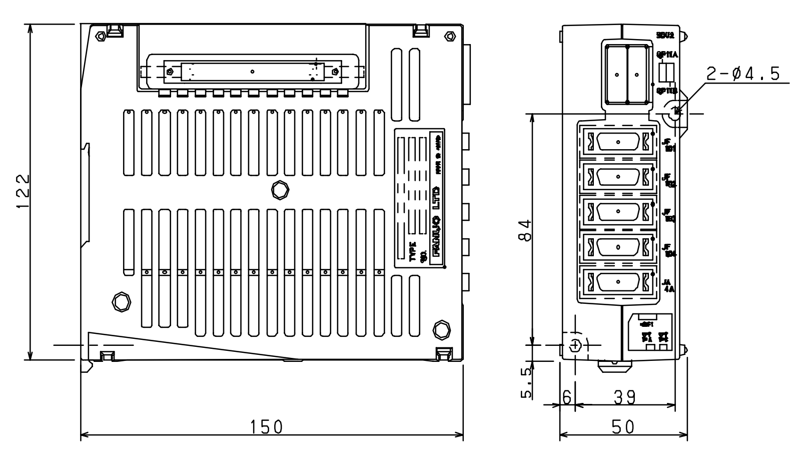
## 9.2.7
## Connection between Basic and Additional Units

An additional unit must be connected to a basic unit with a flat cable, as shown below. The flat cable is 100 mm in length.



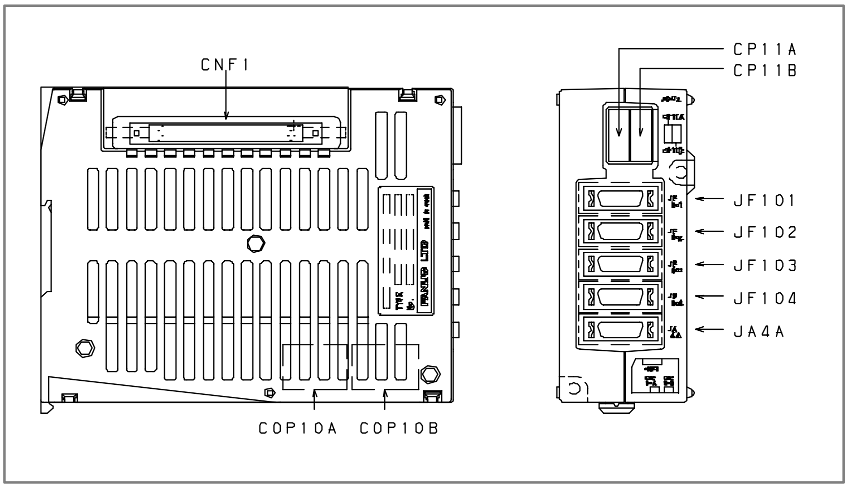
Order a flat cable together with a separate detector interface unit.

## 9.2.8
## Outside Dimensions

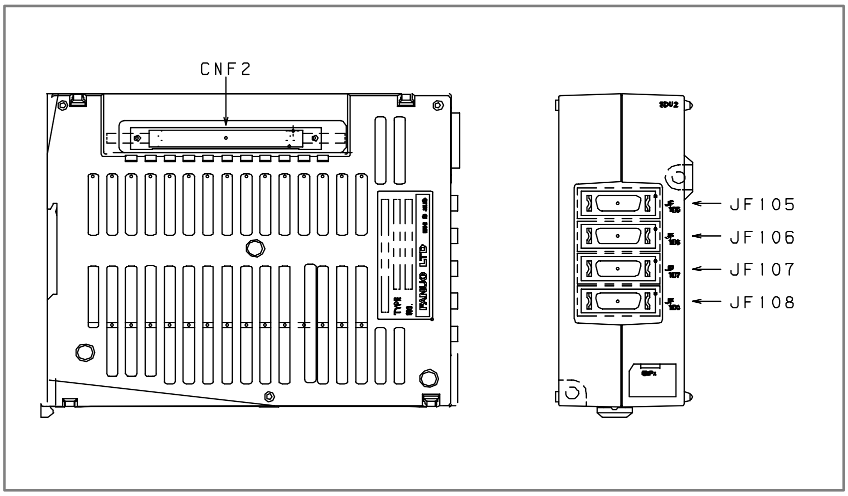


## 9.2.9
## Connector Positions

Positions of the connectors of a basic unit



Positions of the connectors of an additional unit



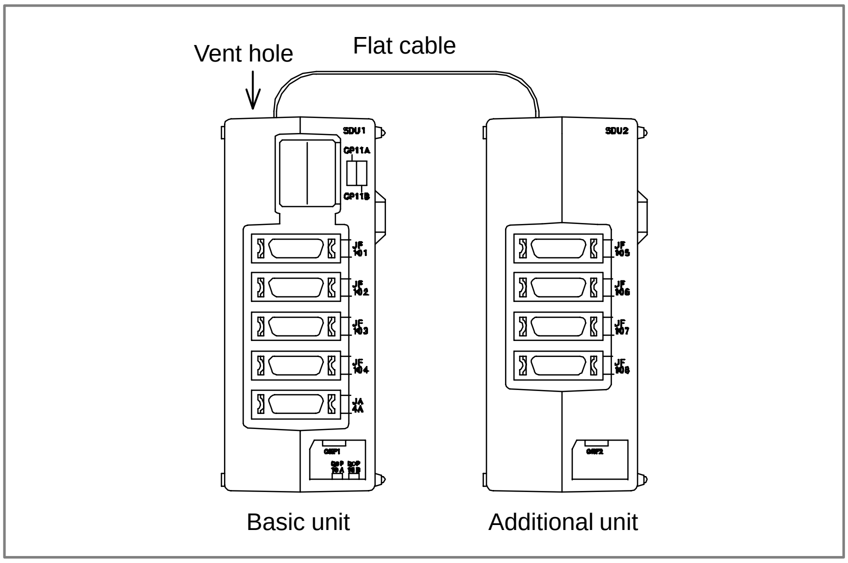
## 9.2.10 Mounting

1) Notes on mounting

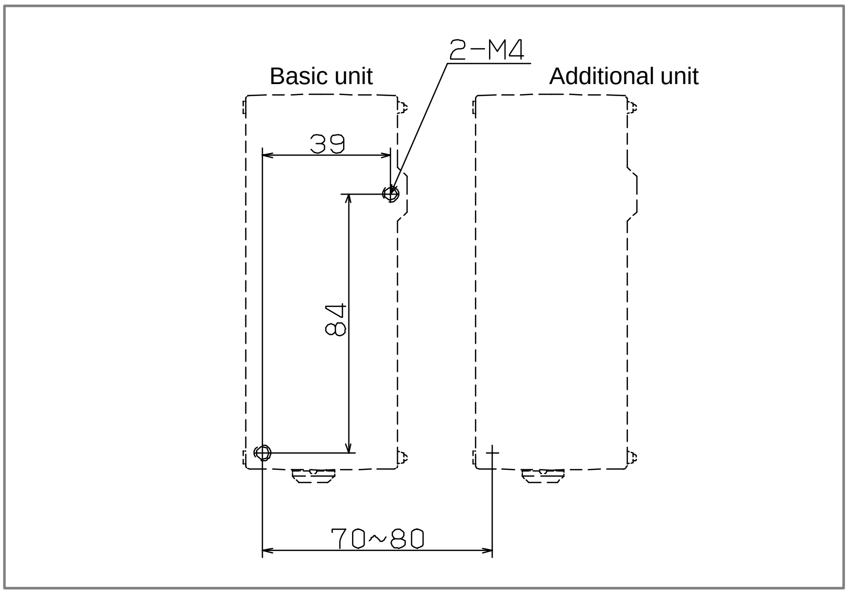
   (1) Use the unit inside a hermetically sealed cabinet.

   (2) Mount the unit on a vertical face. Leave a space of 100 mm or greater both above and below the unit. Do not place a device that generates large amounts of heat below the unit.

   (3) When using basic and additional units, mount them as shown in the figure below, so that the flat cable connecting the units does not block the vent hole of the basic unit.
   The maximum length of the flat cable is 100 mm.



2) If mounting with screws



**Mounting hole drilling diagram**

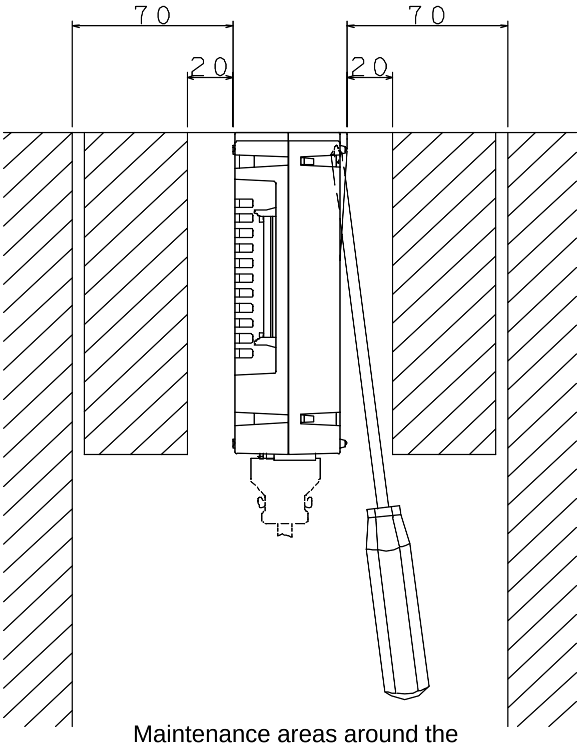
When using both basic and additional units, the spacing between the mounting holes must be 70 to 80 mm, as shown in the figure above.

**CAUTION**

To mount and remove the unit, the screwdriver must be inserted obliquely. An adequate maintenance area is, therefore, required on both sides of the unit.

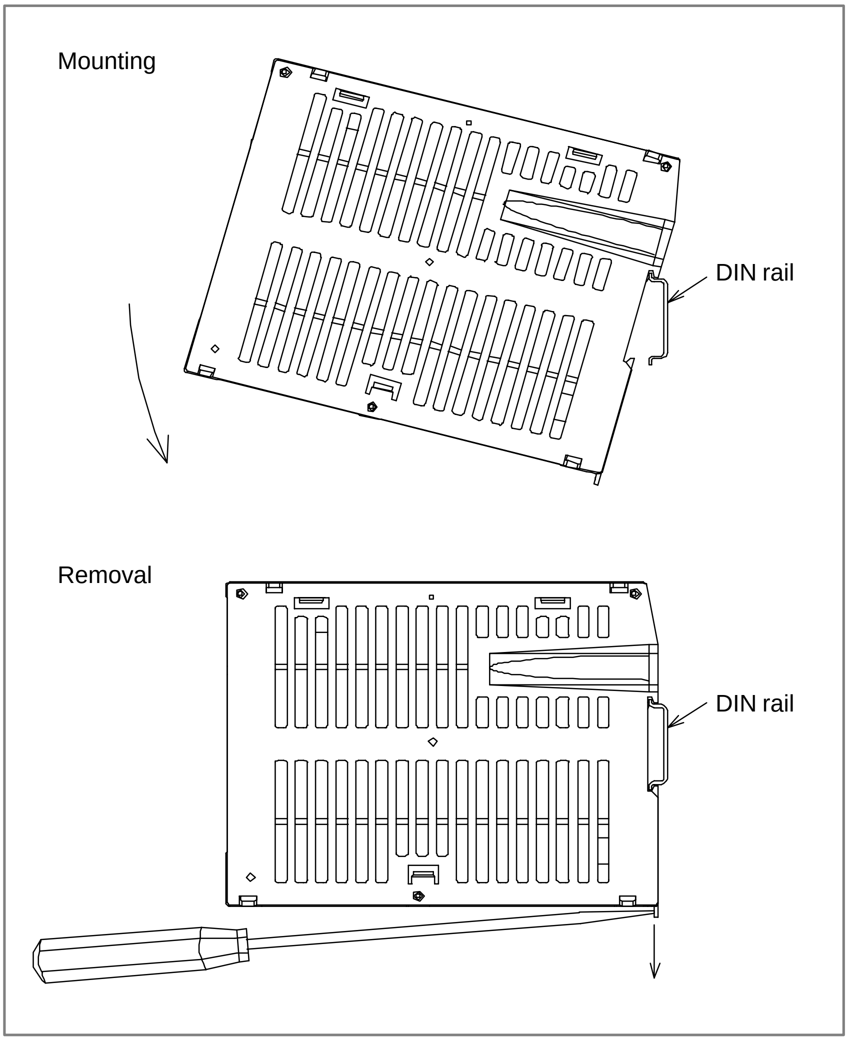
As a rough guide, if the depth of the adjacent unit is equal to or less than that of the unit to be mounted, leave a space of about 20 mm between the units. If the depth of the adjacent unit is greater than the unit to be mounted, leave a space of about 70 mm between the units.

When mounting the unit near the side of the cabinet, leave a space of about 70 mm between the unit and the side of the cabinet.



Maintenance areas around the separate detector interface unit

3) Mounting the unit on the DIN rail



Installing the unit:

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

Removing the unit:

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

**CAUTION**

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

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

### 9.3.1 Overview

The FANUC servo unit β series with I/O Link (called the β amplifier with I/O Link in this chapter) is a servo unit that can be easily connected to a Power Mate via the FANUC I/O Link.

> **NOTE**
> Using the β amplifier requires that the Power Mate CNC manager software function be installed in the Power Mate. This function is included as one of the option functions.

### 9.3.2 Connection

The β amplifier with I/O Link is connected to the Power Mate using the usual FANUC I/O Link connection. See Sec. 6.2.

### 9.3.3 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 Power Mate, 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.

### 9.3.4 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 Power Mate. 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 PM16I (input) and PM16O (output).
The BASE is always 0, and the SLOT is 1.

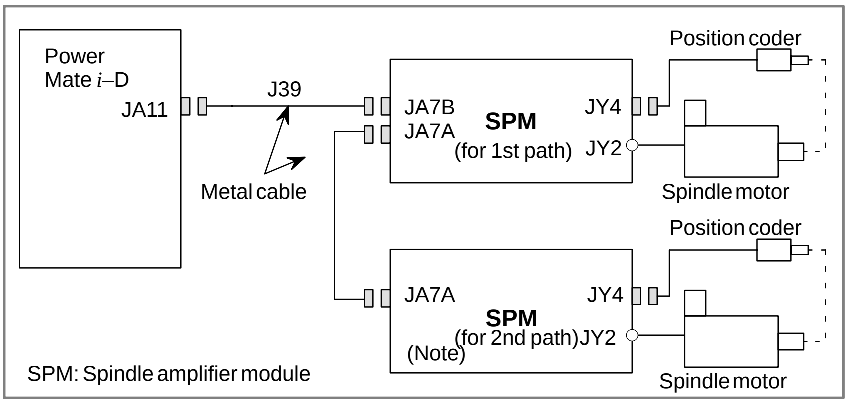
## 9.4 SPINDLE INTERFACE

The following two configurations of the spindle interface are available. The Power Mate *i*–D supports the selection of either a serial or analog spindle.

To use an analog spindle, option card 1 or 2 is needed.

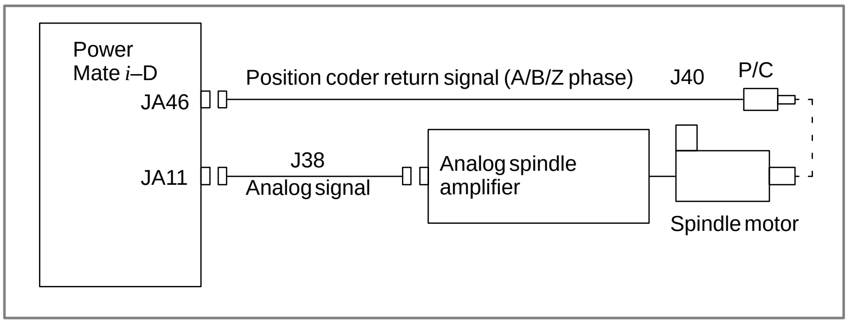
**NOTE**
No spindle interface can be used in the Power Mate *i*–H.

### α series spindle amplifier (Serial spindle)



**NOTE**
1 In a 1–path Power Mate *i*–D, the second SPM cannot be used.
2 On a 2–path Power Mate *i*–D, the first SPM is for the first path, while the second SPM is for the second.
3 In a 2–path Power Mate *i*–D, the first SPM must always be used if the second SPM is used.

### Analog spindle



**NOTE**
1 For the second path of the two–path Power Mate *i*–D, analog signal output is enabled, but the position coder feedback signal cannot be input.
2 The position coder feedback signal of an analog spindle cannot be used together with the external pulse input function.

## 9.4.1

## α Series Spindle Amplifier Interface (Serial Spindle)

Power Mate

JA11

(PCR-EV20MDT)

| | | | |
|---|---|---|---|
| 1 | SIN | 11 | 0V |
| 2 | *SIN | 12 | 0V |
| 3 | SOUT | 13 | 0V |
| 4 | *SOUT | 14 | 0V |
| 5 | (ES2) | 15 | 0V |
| 6 | (SVC2) | 16 | 0V |
| 7 | (SVC1) | 17 | |
| 8 | (ES1) | 18 | (+5V) |
| 9 | (+5V) | 19 | |
| 10 | | 20 | (+5V) |

J39

α series Spindle Amplifier Module

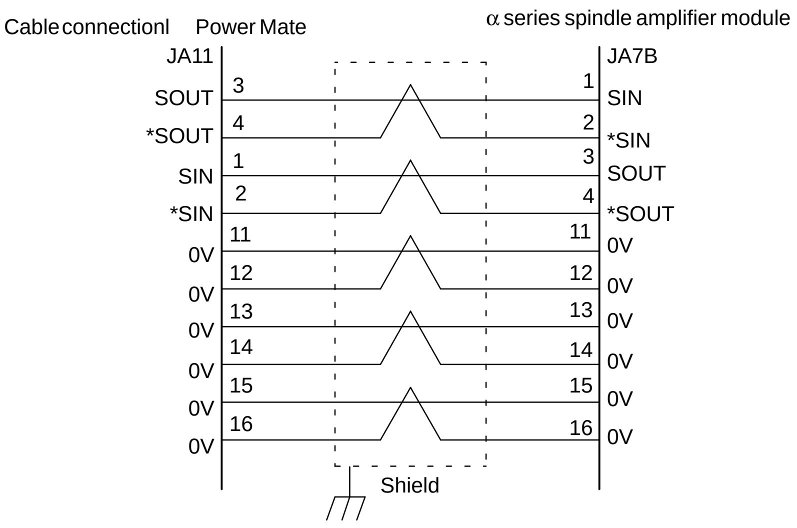
JA7B

(PCR–EV20MDT)

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

Connector PCR–E20FA or PCR–E20FS
Case PCR–V20LA

Cable connection J39



**CAUTION**

The +5V terminal is used for optical link transmission via an optical I/O link adapter. When using this cable or other metallic cables, leave the +5V terminal open. If +5V is supplied to this terminal when a metallic cable is used, +5 V for the Power Mate and that for the spindle module are short–circuited, then the unit is damaged.

**NOTE**

1 Recommended cable specification:
A66L–0001–0284#10P (#28AWG x 10 pairs)

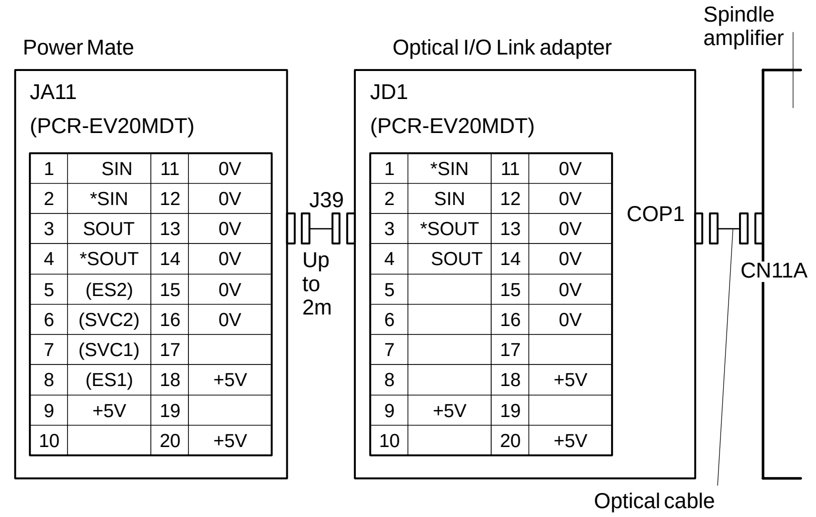
2 When this cable is routed near other cables, such as power cables, connect the shield line to the grounding plate. This connection is not, however, necessary when the Power Mate and spindle amplifier module are mounted in close proximity.

3 This cable can be used to connect the Power Mate and spindle amplifier module electrically, when the Power Mate and spindle amplifier module are mounted in the same power magnetics cabinet or in power magnetics cabinets which have been connected by welding or other means. When mounted in separate power magnetics cabinets, the Power Mate and spindle amplifier module must be connected by an optical cable, via an optical I/O link adapter.

4 Leave ES1, ES2, SVC1, and SVC2 unconnected; they are used for the analog spindle.

5 Do not make any connection other than the above.

In the case of connecting to the spindle amplifier, using optical cable equipped with an optical I/O link adaptor.



JA11
(PCR-EV20MDT)

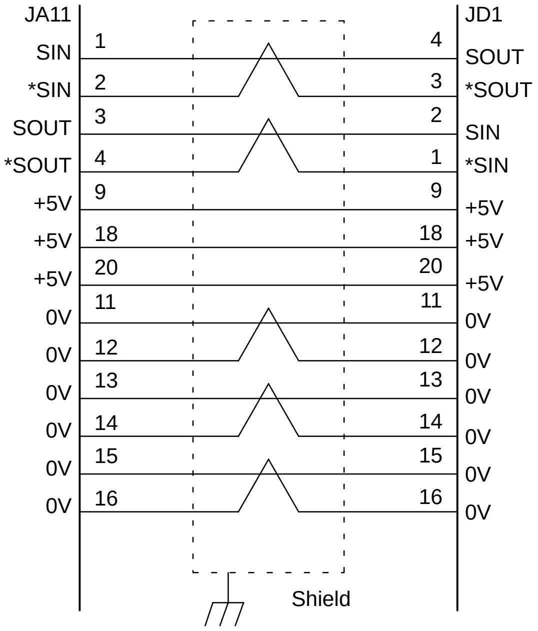
| | | | |
|---|---|---|---|
| 1 | SIN | 11 | 0V |
| 2 | *SIN | 12 | 0V |
| 3 | SOUT | 13 | 0V |
| 4 | *SOUT | 14 | 0V |
| 5 | (ES2) | 15 | 0V |
| 6 | (SVC2) | 16 | 0V |
| 7 | (SVC1) | 17 | |
| 8 | (ES1) | 18 | +5V |
| 9 | +5V | 19 | |
| 10 | | 20 | +5V |

JD1
(PCR-EV20MDT)

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

See Subsec. 6.2.3 for optical I/O Link adaptor specifications.

Cable wiring



Recommended cable
A66L-0001-0284#10P (#28AWG × 10–pair)

**NOTE**
Do not make any connection other than the above.

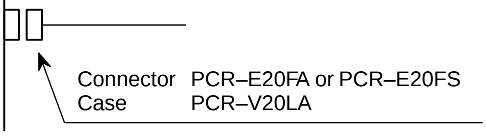
## 9.4.2
## Analog Spindle Interface

Power Mate

JA11

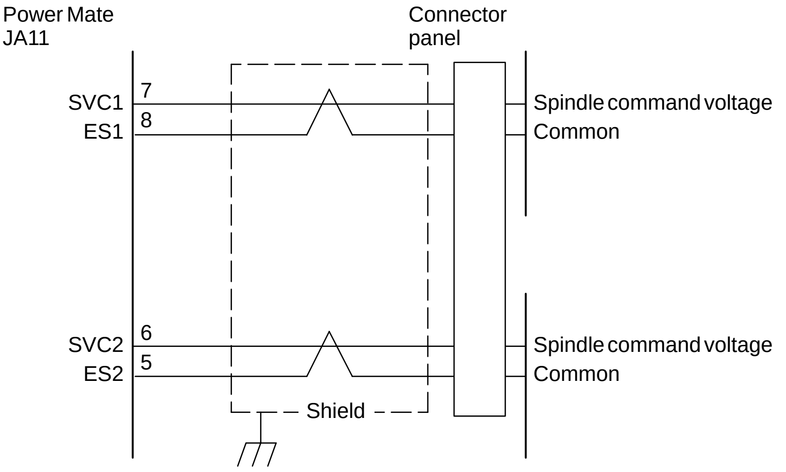
| | | | |
|---|---|---|---|
| 1 | (SIN) | 11 | (0V) |
| 2 | (*SIN) | 12 | (0V) |
| 3 | (SOUT) | 13 | (0V) |
| 4 | (*SOUT) | 14 | (0V) |
| 5 | ES2 | 15 | (0V) |
| 6 | SVC2 | 16 | (0V) |
| 7 | SVC1 | 17 | |
| 8 | ES1 | 18 | (+5V) |
| 9 | (+5V) | 19 | |
| 10 | | 20 | (+5V) |

| Signal name | Description |
|---|---|
| SVC1 | Spindle command voltage (for 1st path) |
| ES1 | Common line (for 1st path) |
| SVC2 | Spindle command voltage (for 2nd path) |
| ES2 | Common line (for 2nd path) |



Connector PCR–E20FA or PCR–E20FS
Case PCR–V20LA

Cable wiring J38



**NOTE**

1. Recommended cable specification : A66L–0001–0284#10P (#28 AWG x 10 pairs)
2. SVC2 and ES2 are used only for the second path of the two–path Power Mate *i*–D.
3. Leave SIN, *SIN, SOUT, *SOUT, and +5V unconnected; they are used for the serial spindle.
4. For a spindle motor that rotates at low speed even if the analog voltage output is 0V, the spindle enable signal ENB<F001#4> can be used to forcibly stop the motor.
5. Do not make any connection other than the above.

SVC rating

Output voltage: ± 10 V
Output current: 2 mA (maximum)
Output impedance: 100 Ω
The external impedance must be kept at 2 kΩ or higher.

## 9.4.3
## Position Coder Interface

Power Mate

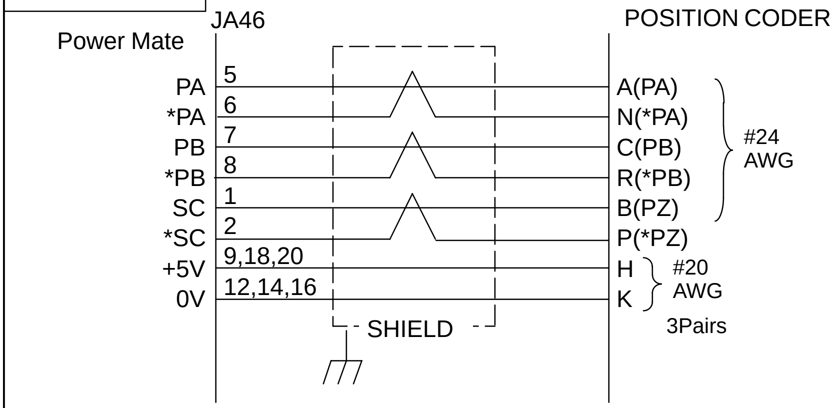
JA46

| | | | |
|---|---|---|---|
| 1 | SC | 11 | |
| 2 | *SC | 12 | 0V |
| 3 | (PB2) | 13 | |
| 4 | (*PB2) | 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 Z–phase signal |
| PA, *PA | Position coder A–phase signal |
| PB, *PB | Position coder B–phase signal |

Connector FI40–2015S
Case FI–20–CV

Cable wiring J40



Recommended cable material

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

**NOTE**

1 The two–path Power Mate *i*–D is not provided with a position coder interface for the second path.

2 The position coder interface for an analog spindle shares the circuit resource with an external input pulse interface. The two functions cannot be used simultaneously.

3 Do not make any connection other than the above.

Input pulse requirements
At connector JA46, the following must be satisfied:

- The minimum A/B phase difference is 650 ns.
- The minimum A/B phase cycle is 4 μs. (When spindle position control is performed, the minimum cycle is 8 μs.)
- The Z phase pulse width equals one A/B phase cycle period.

# 9.5
# ANALOG SERVO INTERFACE UNIT

## 9.5.1
## Overview

The analog servo interface unit is designed to support analog servo interfaces in the Power Mate *i*–Model D/H (called the CNC hereinafter). Use of the analog servo interface unit allows analog servo amplifiers for up to eight axes to be connected to the CNC.

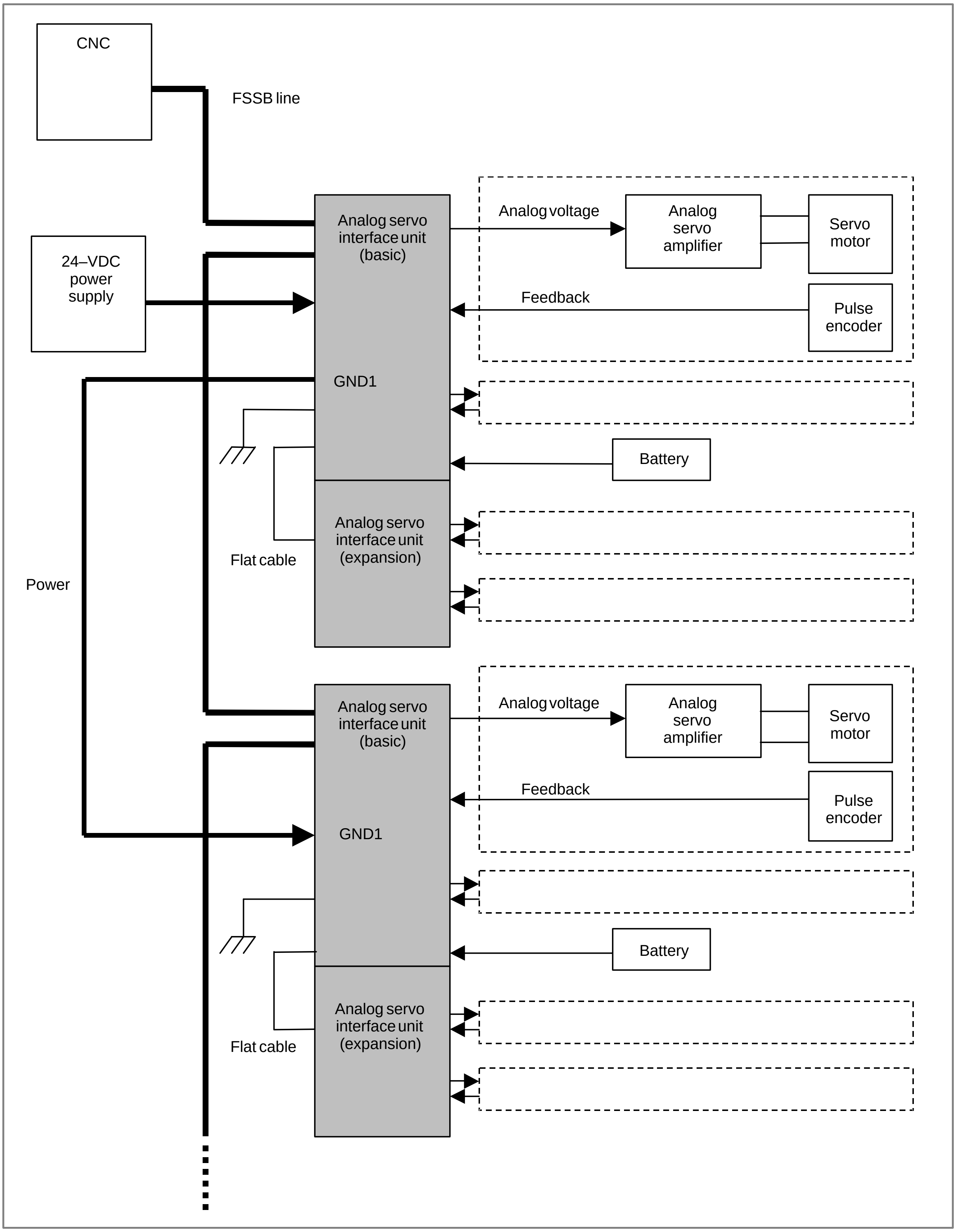
## 9.5.2
## Main Specifications

1) Two types of analog servo interfaces are supported.
   - Analog servo interface type F
     (The ready signal input and alarm signal input from the servo amplifier are 5–VDC signals.)
   - Analog servo interface type M
     (The ready signal input and alarm signal input from the servo amplifier are 24–VDC signals.)
2) The analog servo interface unit includes a basic unit and expansion unit.
3) The basic unit has analog servo interfaces for two axes and a feedback interface for each axis.
4) The expansion unit has analog servo interfaces for two axes and a feedback interface for each axis.
5) When two groups of analog servo interface units, each of which consists of one basic unit and one expansion unit, are connected to an FSSB line, the FSSB line has up to eight analog servo interfaces.
6) The analog servo interface unit also supports a separate pulse coder.
7) The feedback interface of a separate detector may be parallel or serial. (See Section 17.9.)
8) The ambient temperature of the unit is 0°C to 55°C during operation and –20°C to 60°C during storage and transportation.
9) When the servo HRV3 function is used (the support of this function by the Power Mate *i* is not yet determined), this unit cannot be used at present. FANUC plans to make this unit usable with the servo HRV3 function by software version upgrading on the CNC side (for the time to release the new software version, contact FANUC). Even after this improvement, however, high–speed HRV current control cannot be used. High–speed HRV current control cannot be performed not only for analog controlled axes but also for digital servo axes connected to the same servo card.

## Ordering specification

| Name | Specification | Remarks |
|---|---|---|
| Basic unit of analog servo interface unit | A02B–0259–C180 | |
| Expansion unit of analog servo interface unit | A02B–0259–C181 | |
| Flat cable for analog servo interface unit | A02B–0259–K850 | |
| Spare fuse | A03B–0815–K001 | 1.0A, for 24 VDC |

## 9.5.3 Configuration

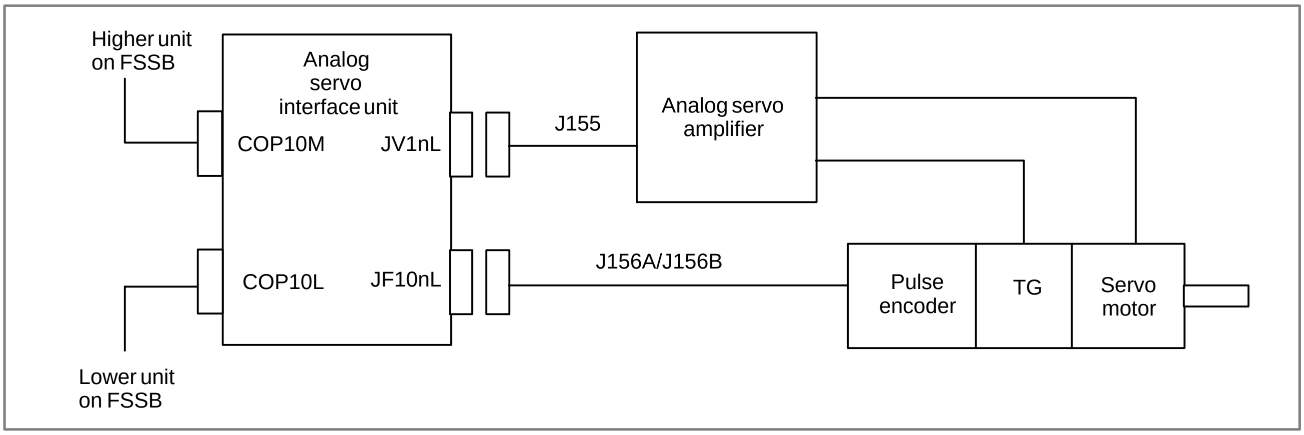


## 9.5.4
## Connection of Analog Servo Interface Type F

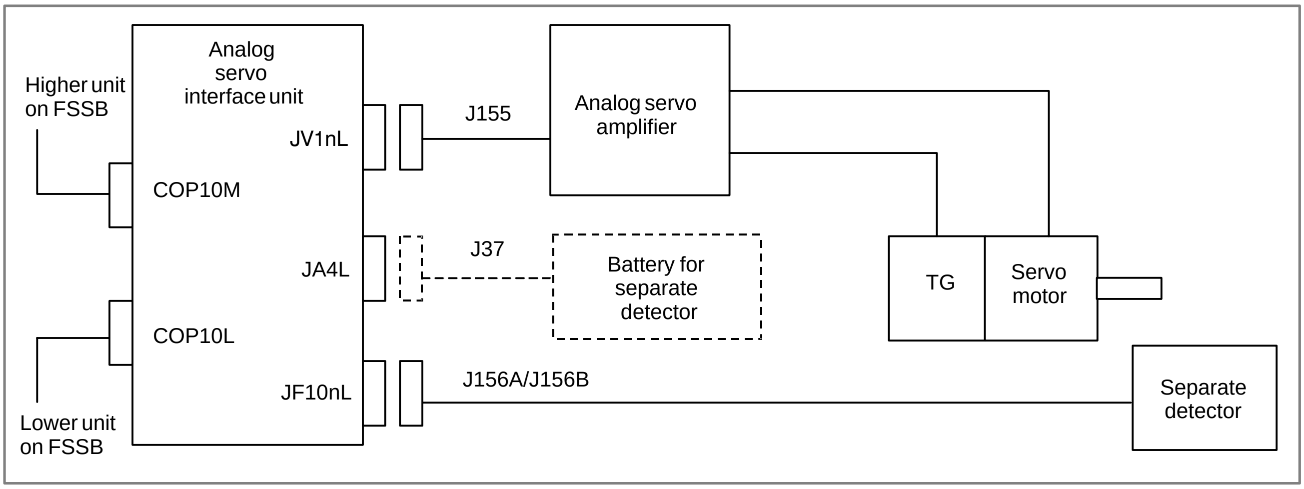
The ready signal input and alarm signal input from the analog servo interface are 5–VDC signals.

### 9.5.4.1
### System configuration

1) Configuration when a pulse coder built into a motor is used



2) Configuration when a separate detector is used



### 9.5.4.2
### Connection details

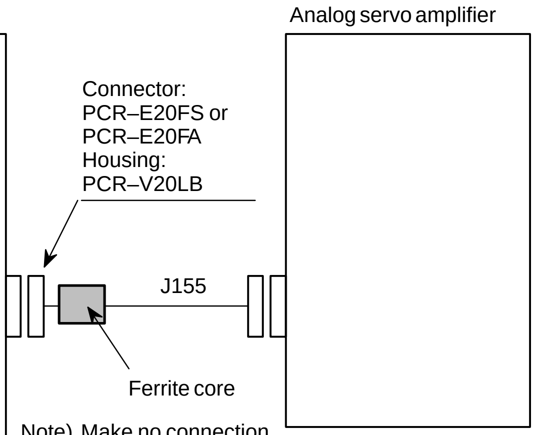
1) Cable J155

Cable J155 is used to connect an analog servo interface unit (JV1nL) and an analog servo amplifier.

Analog servo interface unit

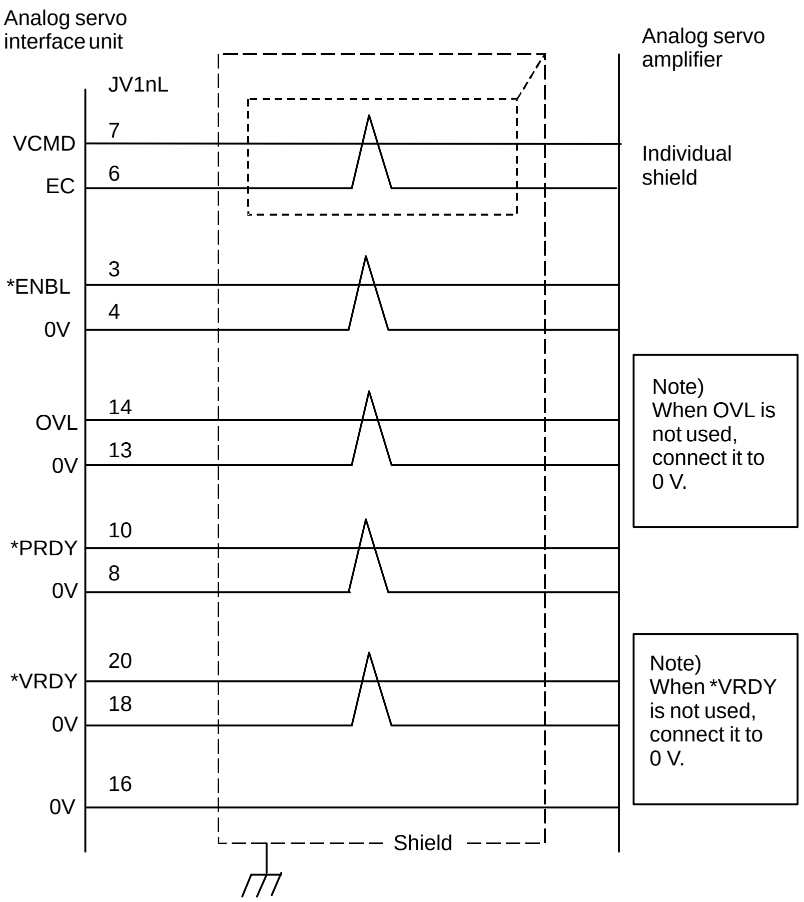
JV1nL
(PCR–EV20MDT)

| | | | |
|---|---|---|---|
| 1 | (A) | 11 | (*B) |
| 2 | (*A) | 12 | (*B) |
| 3 | *ENBL | 13 | OVL |
| 4 | 0V | 14 | 0V |
| 5 | (Z) | 15 | (ALM) |
| 6 | EC | 16 | 0V |
| 7 | VCMD | 17 | (*SRDY) |
| 8 | 0V | 18 | 0V |
| 9 | (*Z) | 19 | (24VOUT) |
| 10 | *PRDY | 20 | *VRDY |



Note) Make no connection to a pin with its signal name parenthesized.

Cable connection (J155)



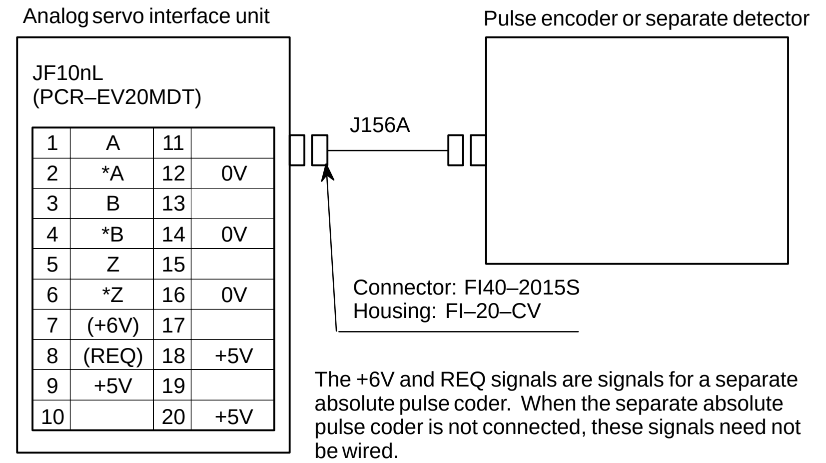
Note)
When OVL is not used, connect it to 0 V.

Note)
When *VRDY is not used, connect it to 0 V.

Maximum cable length: 50 m
Recommended cable: A66L–0001–0206 (Individually shielded twisted pair #24AWG × 3 + twisted pair #24AWG × 7)
The outside diameter of the cable is 11, so decrease the outside diameter by peeling off the sheath to insert the cable into the connector case (8 in diameter).
Recommended ferrite core: ZCAT2032–0930 manufactured by TDK
Install the ferrite core as close to the analog servo interface unit as possible. The ferrite core must be of the split type.

2) Cable J156A (parallel interface)

Cable J156A is used to connect an analog servo interface unit (JF10nL) and a pulse encoder or separate detector.

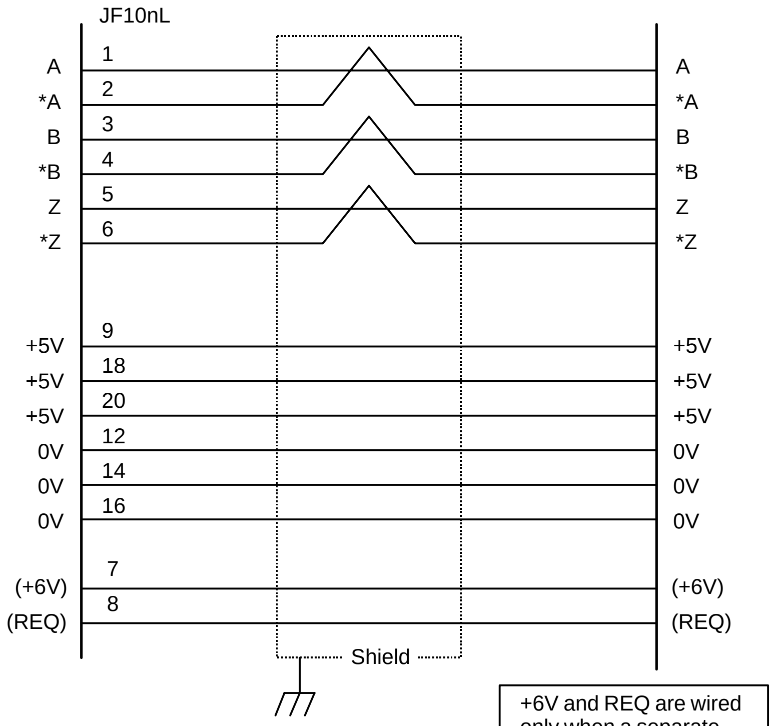


| | | | |
|---|---|---|---|
| 1 | A | 11 | |
| 2 | *A | 12 | 0V |
| 3 | B | 13 | |
| 4 | *B | 14 | 0V |
| 5 | Z | 15 | |
| 6 | *Z | 16 | 0V |
| 7 | (+6V) | 17 | |
| 8 | (REQ) | 18 | +5V |
| 9 | +5V | 19 | |
| 10 | | 20 | +5V |

Connector: FI40–2015S
Housing: FI–20–CV

The +6V and REQ signals are signals for a separate absolute pulse coder. When the separate absolute pulse coder is not connected, these signals need not be wired.

Cable connection (J156A)

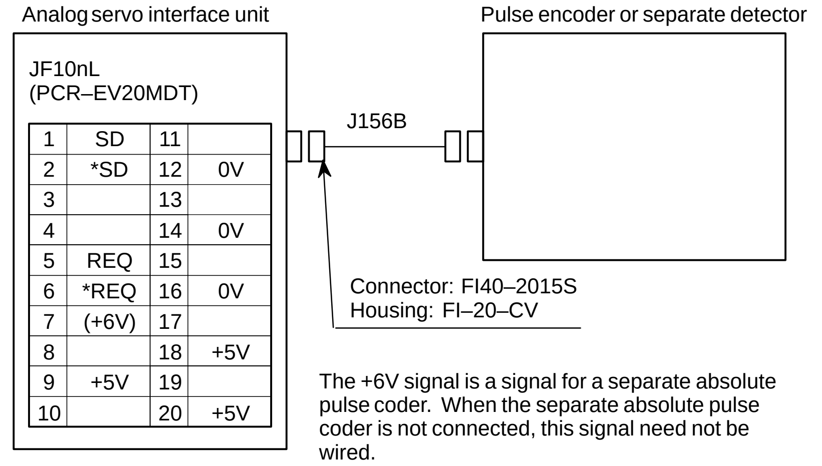


+6V and REQ are wired only when a separate absolute pulse coder is used.

Maximum cable length: 50 m
Recommended cable: A66L–0001–0286 (#20AWG × 6 + #24AWG × 3 pairs)

3) Cable J156B (serial interface)

Cable J156B is used to connect an analog servo interface unit (JF10nL) and a pulse encoder or separate detector.

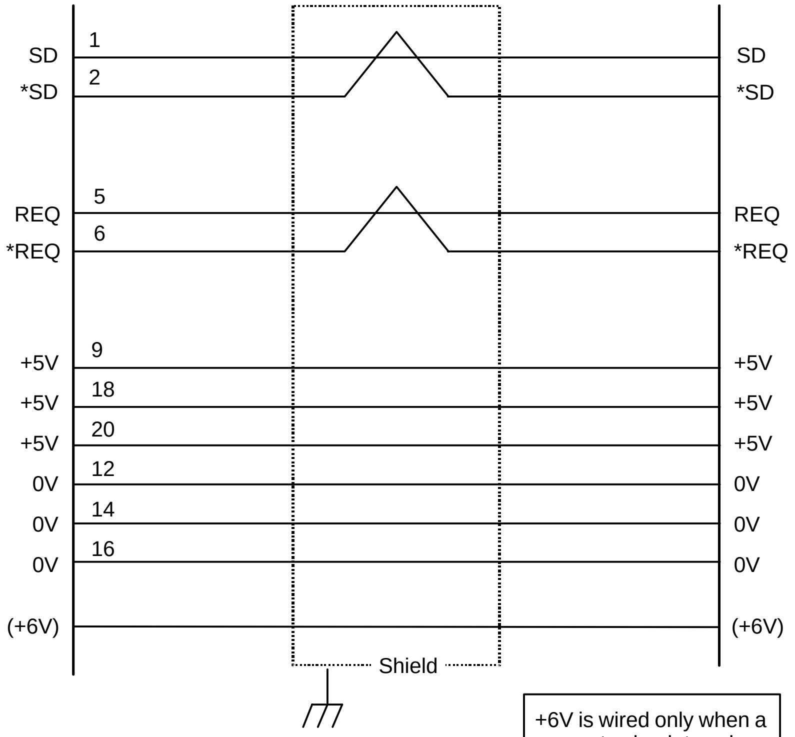


| | | | |
|---|---|---|---|
| 1 | SD | 11 | |
| 2 | *SD | 12 | 0V |
| 3 | | 13 | |
| 4 | | 14 | 0V |
| 5 | REQ | 15 | |
| 6 | *REQ | 16 | 0V |
| 7 | (+6V) | 17 | |
| 8 | | 18 | +5V |
| 9 | +5V | 19 | |
| 10 | | 20 | +5V |

Connector: FI40–2015S
Housing: FI–20–CV

The +6V signal is a signal for a separate absolute pulse coder. When the separate absolute pulse coder is not connected, this signal need not be wired.

Cable connection (J156B)

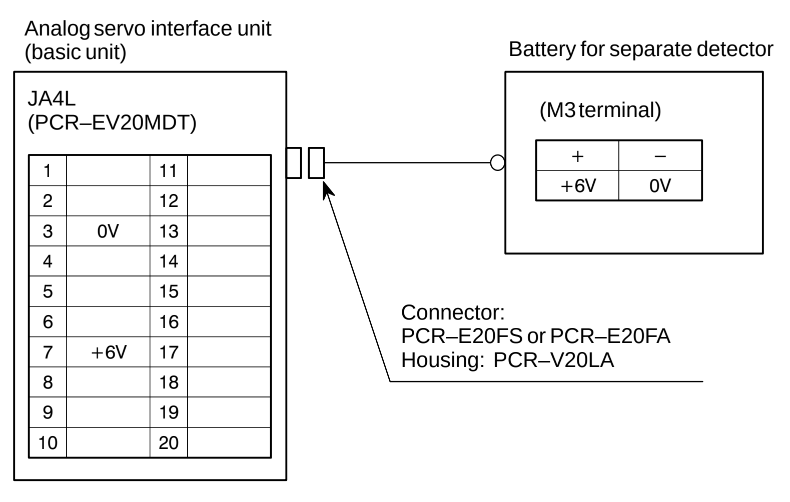


+6V is wired only when a separate absolute pulse coder is used.

Maximum cable length: 50 m
Recommended cable: A66L–0001–0286 (#20AWG × 6 + #24AWG × 3 pairs)

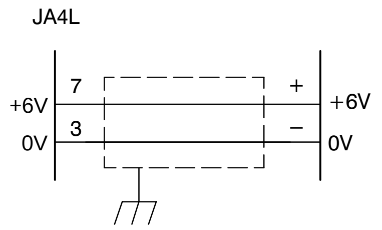
4) Cable J37

Cable J37 is used to connect an analog servo interface unit (JA4L) and the battery for a separate detector.



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

Cable connection (J37)



**NOTE**

Although the expansion unit also has connector JA4M for connecting the battery for a separate detector, this connector is normally not used. When the basic unit is replaced, a battery for the separate detector can also be connected to JA4M to continuously supply the battery voltage to the absolute pulse coder connected to the expansion unit.

---

## 9.5.4.3
## Details of signals

1. VCMD, EC (output)

VCMD and EC are the speed command signals for the servo amplifier. The voltage of VCMD with respect to EC represents the speed command voltage. (The speed command voltage is enabled only while the *ENBL signal is on.)

Electrical characteristics

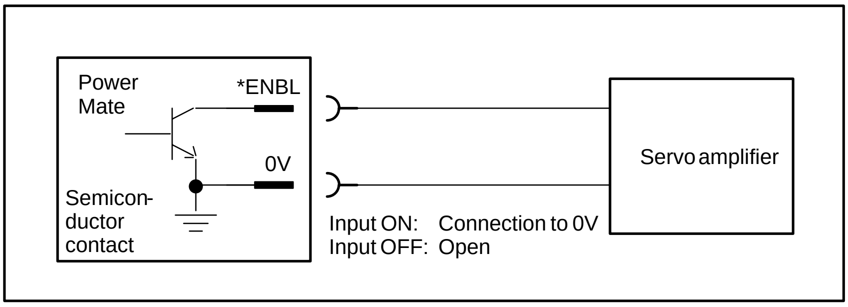
Output voltage : –10 V to +10 V

Output current : 2 mA

Output impedance : 100 ohms

2 *ENBL (output)

*ENBL is the enable signal for the servo amplifier. While this signal is on (connected to 0V), the VCMD signal is enabled.
Open collector output.



Electrical characteristics

Maximum load current when output is on:
No more than 200 mA, including momentary values

Maximum output voltage when output is on:
$6I_L$ (volt), where $I_L$: Load current

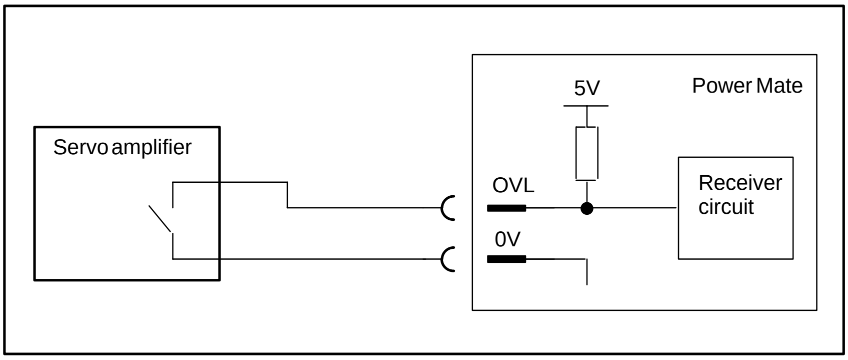
Withstand voltage when output is off:
No more than 24 V, including momentary values

Leakage current when output is off:
No more than 100 μA

3 OVL (input)

OVL is the overload alarm signal issued by the servo amplifier. When this signal enters the release state (high level), the Power Mate assumes that the servo system has entered the overload state, and turns off the *PRDY and *ENBL signals for the axis. If this signal is not used, connect OVL and 0V to each other (low level).

When an overload alarm is issued, the servo amplifier must stop the motor regardless of the state of the VCMD signal.



Electrical characteristics

Absolute maximum rating

| Item | Sym- bol | Specification | Unit | Supplement |
|---|---|---|---|---|
| Input voltage range | Vin | –3.6 to +13.6 | V | |

Input characteristics

| **Item** | **Sym-bol** | **Specification** | **Unit** | **Supplement** |
|---|---|---|---|---|
| High level input voltage | VH | 3.6 to 10.5 | V | (NOTE) |
| Low level input voltage | VL | 0 to 1.0 | V | |
| High level input current | Iih | +1.5 max | mA | Vin= 5V |
| | | +8.8 max | mA | Vin=10V |
| Low level input current | Iil | –8.0 max | mA | Vib= 0V |

The plus sign (+) of Iih and Iil represents the direction of flow into the receiver, while the minus sign (–) represents the direction of flow from the receiver.

**NOTE**
The input release state is also assumed to be the high level.

4 *PRDY (output)

*PRDY is the ready signal, issued by the Power Mate to the servo amplifier. The electrical characteristics of this signal are the same as those of *ENBL.

5 *VRDY (input)

*VRDY is the ready signal issued by the servo amplifier. When the power to the servo amplifier is turned on to set the normal startup state, and the *PRDY signal from the Power Mate is subsequently turned on, the servo amplifier must immediately turn on (short–circuit) the *VRDY signal. If the servo amplifier encounters an error, the *VRDY signal must be turned off (released) to report the error to the Power Mate. If this signal is not used, connect *VRDY and 0V to each other (low level), and set bit 1 (CVR) of parameter No. 1800 to 1.

If the servo amplifier encounters an error, stop the motor regardless of the state of the VCMD signal.

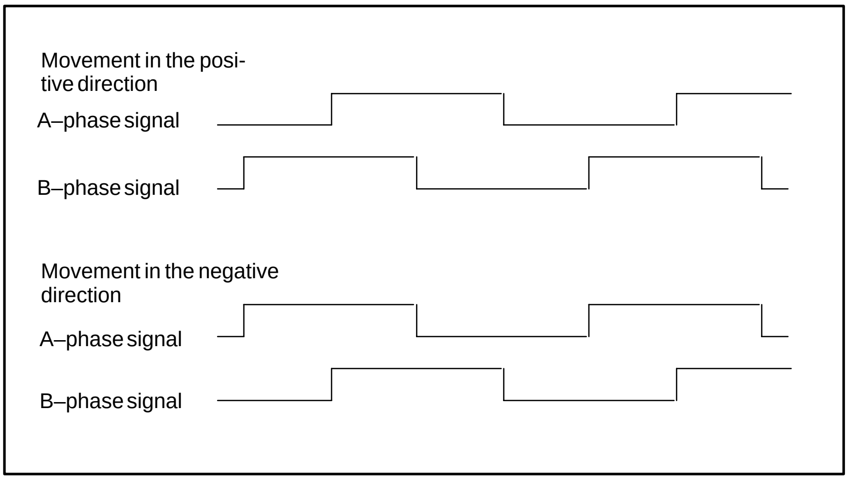
The electrical characteristics of this signal are the same as those of OVL.

7 A, *A, B, *B, Z, *Z

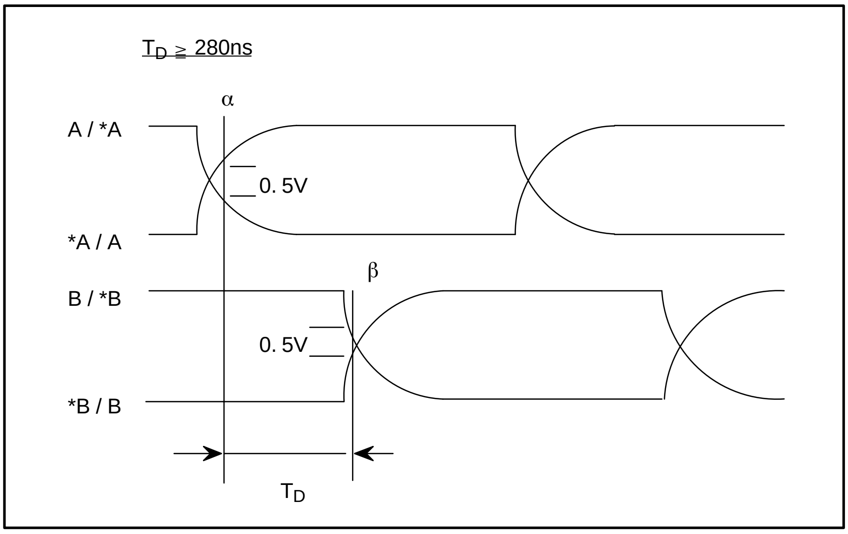
These signals are received from the pulse coder.

- A–phase and B–phase signals (A, *A, B, *B)

  The A–phase and B–phase signals are shifted by 90 degrees relative to each other, and are used to transfer incremental position information. A position is detected, assuming that the direction of movement is positive while the B–phase signal is advanced, or that the direction of movement is negative while the A–phase signal is advanced.



The differential input signals shown below are applied to the connectors. The time duration, TD, from point α where the relative potential difference between A and *A becomes 0.5 V or more, to point β where the relative potential difference between B and *B becomes 0.5 V or less, must satisfy the condition indicated below. (This condition may restrict the maximum speed of movement.)



- Z–phase signal (Z, *Z)

  The Z–phase signal (one–rotation signal) requires a signal width of no less than one period of the A–phase or B–phase signal.

  If the motor does not have this signal, ensure that the machine supplies this signal.

  An absolute pulse coder supports the following reference position setting modes, which do not use the Z–phase signal:

  **1** External reference position setting

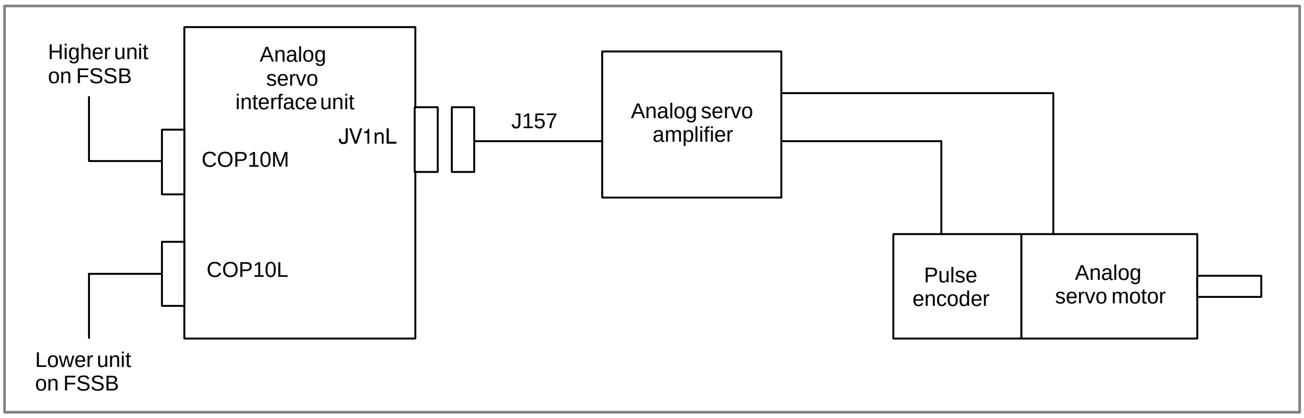
  **2** Butt–type reference position setting

## 9.5.5 Connection of Analog Servo Interface Type M

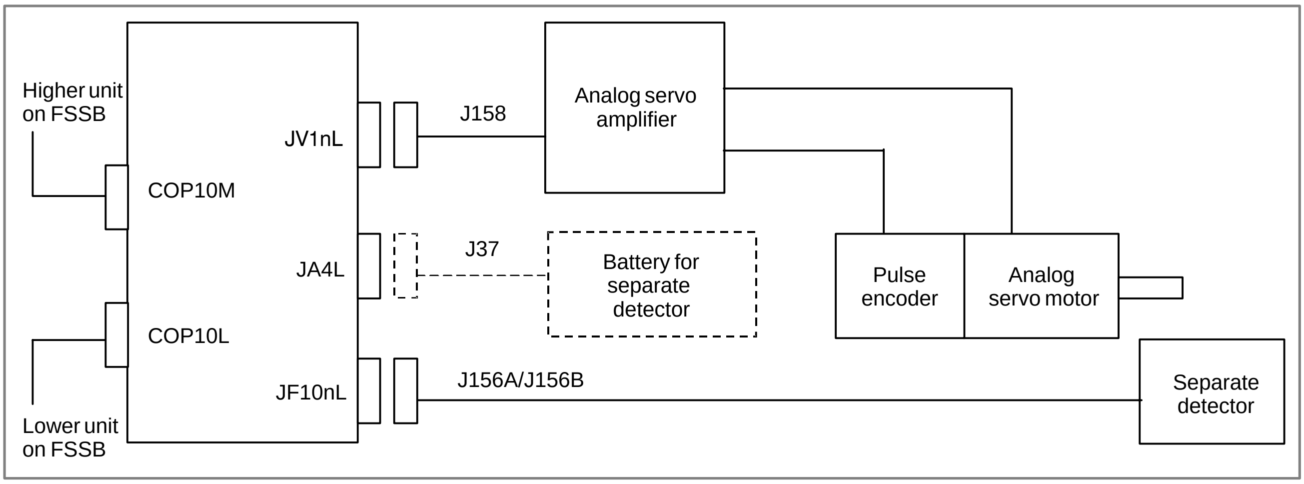
The ready signal input and alarm signal input from the analog servo interface are 24–VDC signals.

### 9.5.5.1 System configuration

1) Configuration when a built–in pulse encoder is used



2) Configuration when a separate detector is used



### 9.5.5.2 Connection details

1) Cable J156A/J156B

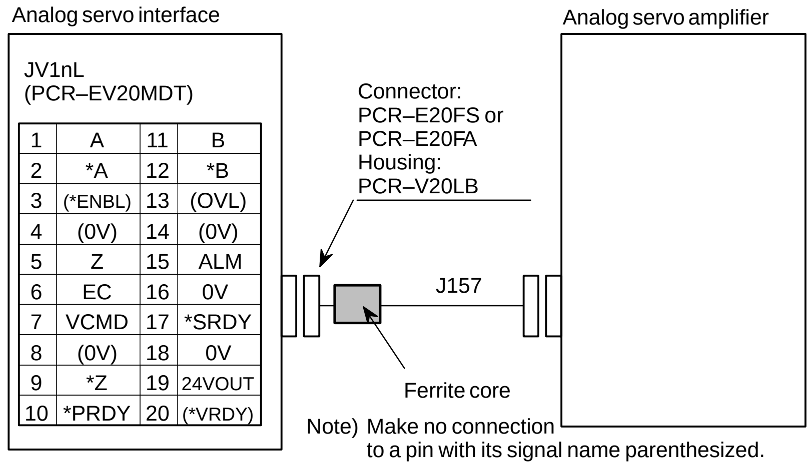
See 2) and 3) of Subsection 17.4.2.

2) Cable J37

See 4) in Subsection 17.4.2.

3) Cable J157

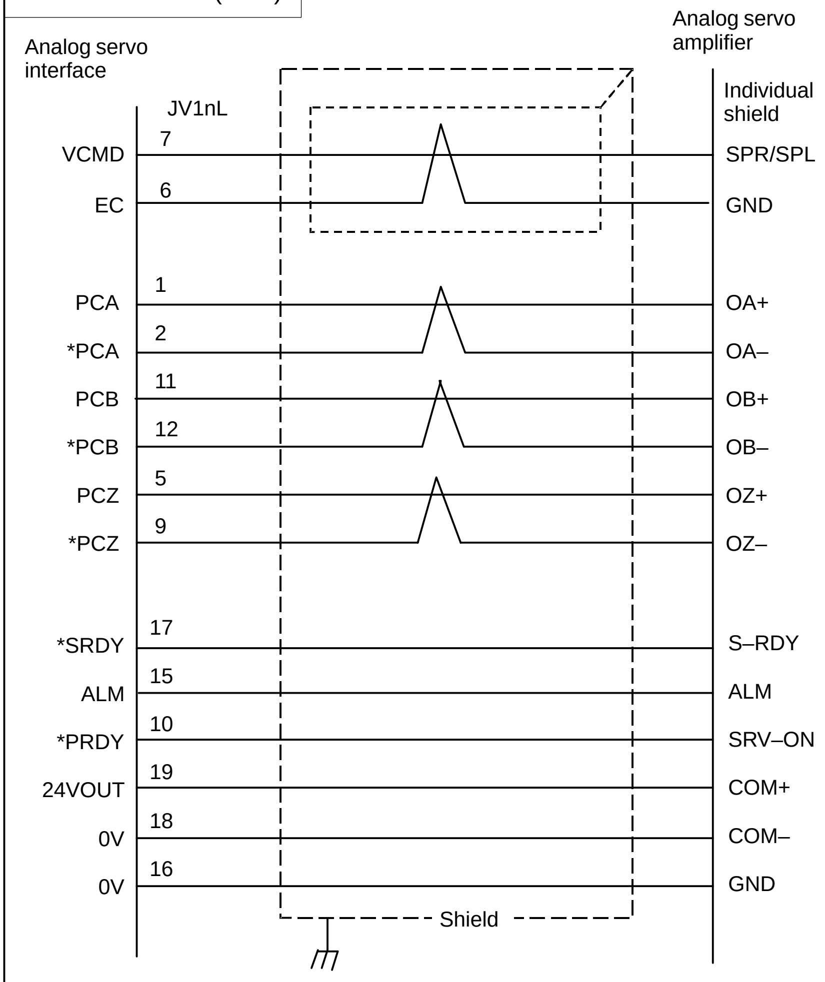
Cable J157 is used to connect an analog servo interface unit (JV1nL) and analog servo amplifier.



| | | | |
|---|---|---|---|
| 1 | A | 11 | B |
| 2 | *A | 12 | *B |
| 3 | (*ENBL) | 13 | (OVL) |
| 4 | (0V) | 14 | (0V) |
| 5 | Z | 15 | ALM |
| 6 | EC | 16 | 0V |
| 7 | VCMD | 17 | *SRDY |
| 8 | (0V) | 18 | 0V |
| 9 | *Z | 19 | 24VOUT |
| 10 | *PRDY | 20 | (*VRDY) |

Note) Make no connection to a pin with its signal name parenthesized.

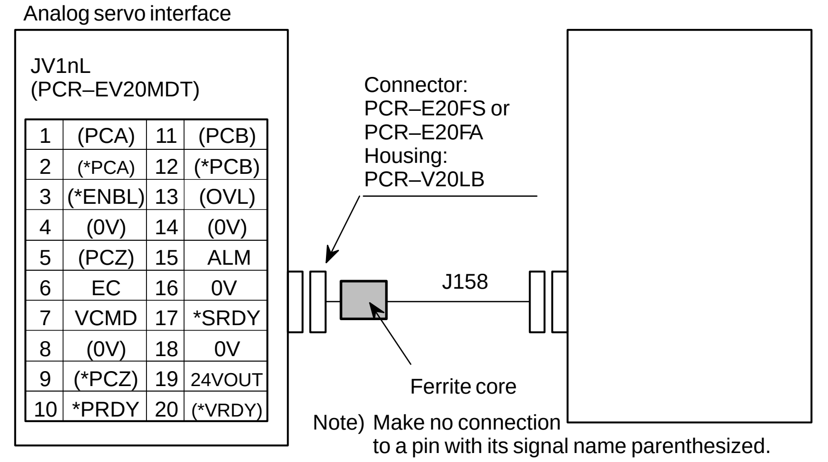
## Cable connection (J157)



Maximum cable length: 50 m (additionally restricted by voltage drop)
Recommended cable: A66L–0001–0206 (Individually shielded twisted pair #24AWG × 3 + twisted pair #24AWG × 7)
The outside diameter of the cable is 11, so decrease the outside diameter by peeling off the sheath to insert the cable into the connector case (8 in diameter).
Recommended ferrite core: ZCAT2032–0930 manufactured by TDK
Install the ferrite core as close to the analog servo interface unit as possible. The ferrite core must be of the split type.

4) Cable J158

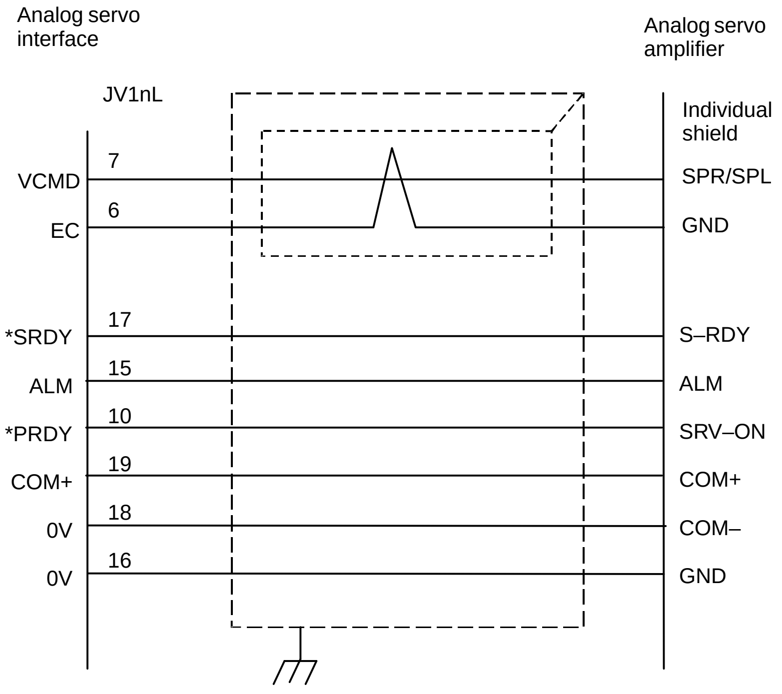
Cable J158 is used to connect an analog servo interface unit (JV1nL) and analog servo amplifier.



| | | | |
|---|---|---|---|
| 1 | (PCA) | 11 | (PCB) |
| 2 | (*PCA) | 12 | (*PCB) |
| 3 | (*ENBL) | 13 | (OVL) |
| 4 | (0V) | 14 | (0V) |
| 5 | (PCZ) | 15 | ALM |
| 6 | EC | 16 | 0V |
| 7 | VCMD | 17 | *SRDY |
| 8 | (0V) | 18 | 0V |
| 9 | (*PCZ) | 19 | 24VOUT |
| 10 | *PRDY | 20 | (*VRDY) |

Note) Make no connection to a pin with its signal name parenthesized.

Cable connection (J158)



Maximum cable length: 50 m (additionally restricted by voltage drop)
Recommended cable: A66L–0001–0206 (Individually shielded twisted pair #24AWG × 3 + twisted pair #24AWG × 7)
The outside diameter of the cable is 11, so decrease the outside diameter by peeling off the sheath to insert the cable into the connector case (8 in diameter).
Recommended ferrite core: ZCAT2032–0930 manufactured by TDK
Install the ferrite core as close to the analog servo interface unit as possible.
The ferrite core must be of the split type.

### 9.5.5.3 Details of signals

(1) VCMD, EC (output)

VCMD and EC are the speed command signals for the servo amplifier. For details, see (1) in Section 4.3, ”CONNECTION DETAILS”.

(2) A, *A, B, *B, Z, *Z (input)

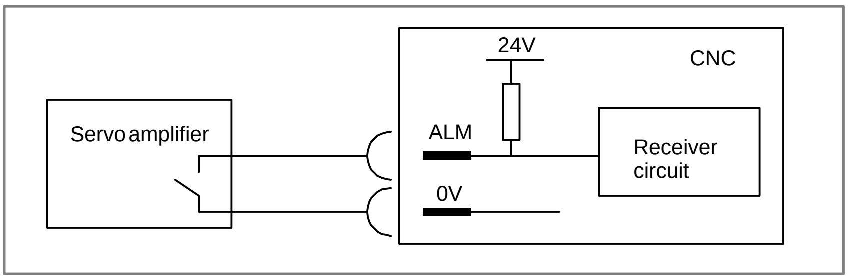
These signals are input from the pulse encoder. For details, see (7) ”A, *A, B, *B, Z, *Z” in Section 4.3, ”CONNECTION DETAILS”.

(3) *PRDY (output)

*PRDY is the ready signal issued from the CNC to servo amplifier. For details, see (4) ”*PRDY” in Section 4.3, ”CONNECTION DETAILS”.

(4) ALM (input)

ALM is the alarm signal issued from the servo amplifier to CNC. If the output from the servo amplifier is turned off (open, high level), the CNC regards the servo system as being in the alarm state. When this signal is not used, connect ALM and 0 V (the on state, low level).



Electrical characteristics
Contact capacitance: 30 VDC, 16 mV or more
Leakage current between contact points when the circuit is open: 1 mA or less (voltage: 26.4 V)
Voltage drop between contact points when the circuit is closed: 2 V or less (current: 8.5 mA, including voltage drop over the cable)

(5) *SRDY (input)

*SRDY is the ready signal issued from the servo amplifier to CNC. When the output from the servo amplifier is on (connected, low level), the CNC regards the servo system as being ready. The electrical characteristics are the same as those of ALM.

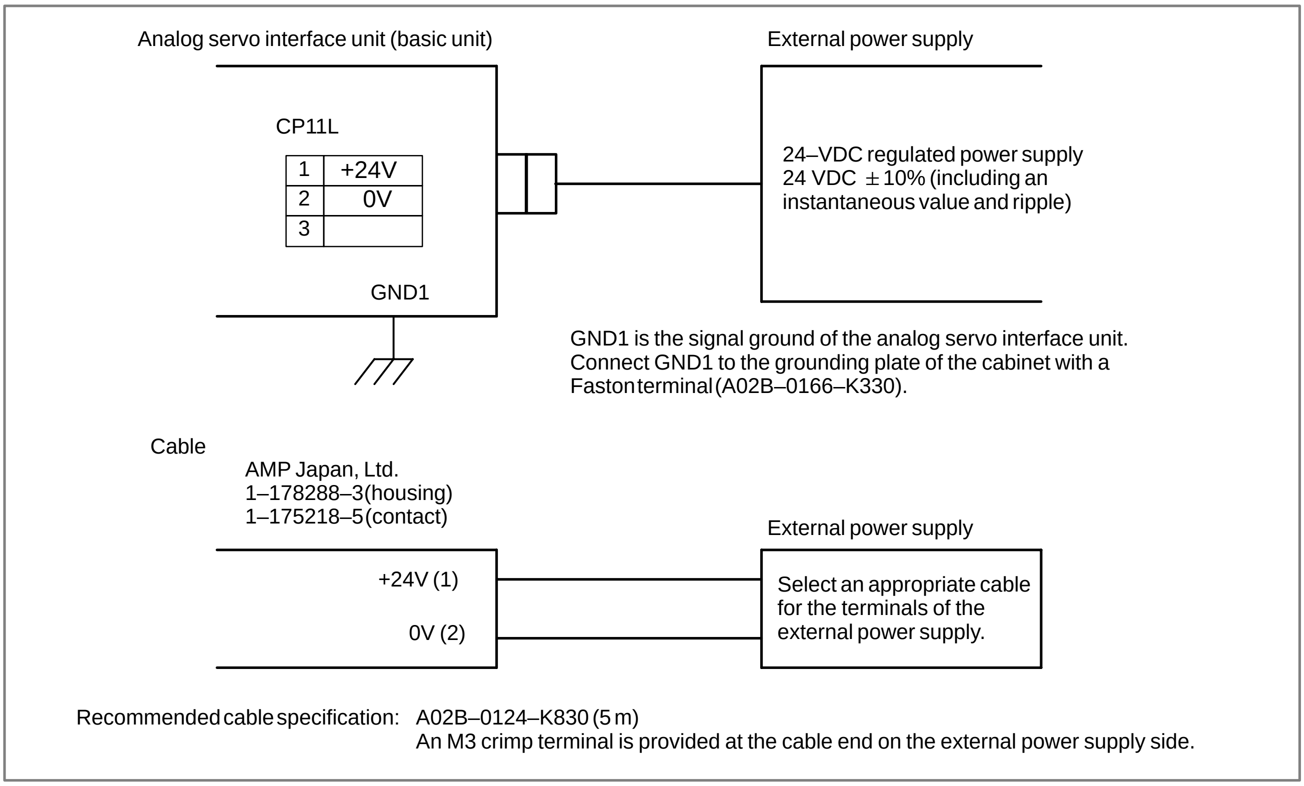
(6) 24VOUT (output)

24VOUT is the 24–V power output from the CNC to servo amplifier. 24 V ±10%. Output of up to 250 mA is possible from one JV1n connector (up to 500 mA per unit).
When this power supply is used for the servo amplifier, the specifications for the servo amplifier must be satisfied with the voltage drop due to cable resistance taken into consideration.

## 9.5.6
## Power Supply and Heat Loss

### 9.5.6.1
### Connection of the power supply

Supply power to the analog servo interface unit from an external 24–VDC power supply.



The 24–VDC signal input to CP11L can be taken out from CP11M for the purpose of branching. CP11M connection is the same as for CP11L.

### 9.5.6.2
### Power supply capacity

Power supply: 24 VDC ±10% (including an instantaneous value and ripple)

| | **One basic unit** | **One basic unit + one expansion unit** |
|---|---|---|
| Type F | 0.7 A | 1.0 A |
| Type M | 1.2 A (Note) | 2.0 A (Note) |

**NOTE**

For type M, 0.25 A of the 24–V power for analog servo amplifiers is included per axis.

## 9.5.6.3
## Heat loss

Heat loss

| | **One basic unit** | **One basic unit + one expansion unit** |
|---|---|---|
| Type F | 10 W | 14 W |
| Type M | 17 W | 28 W |

## 9.5.7
## Selection Switch SW1

Analog servo interface type F and analog servo interface type M are different in input level of the ready signal (input) and alarm signal (input) from the servo amplifier. Which type is to be used is set with selection switch SW1.

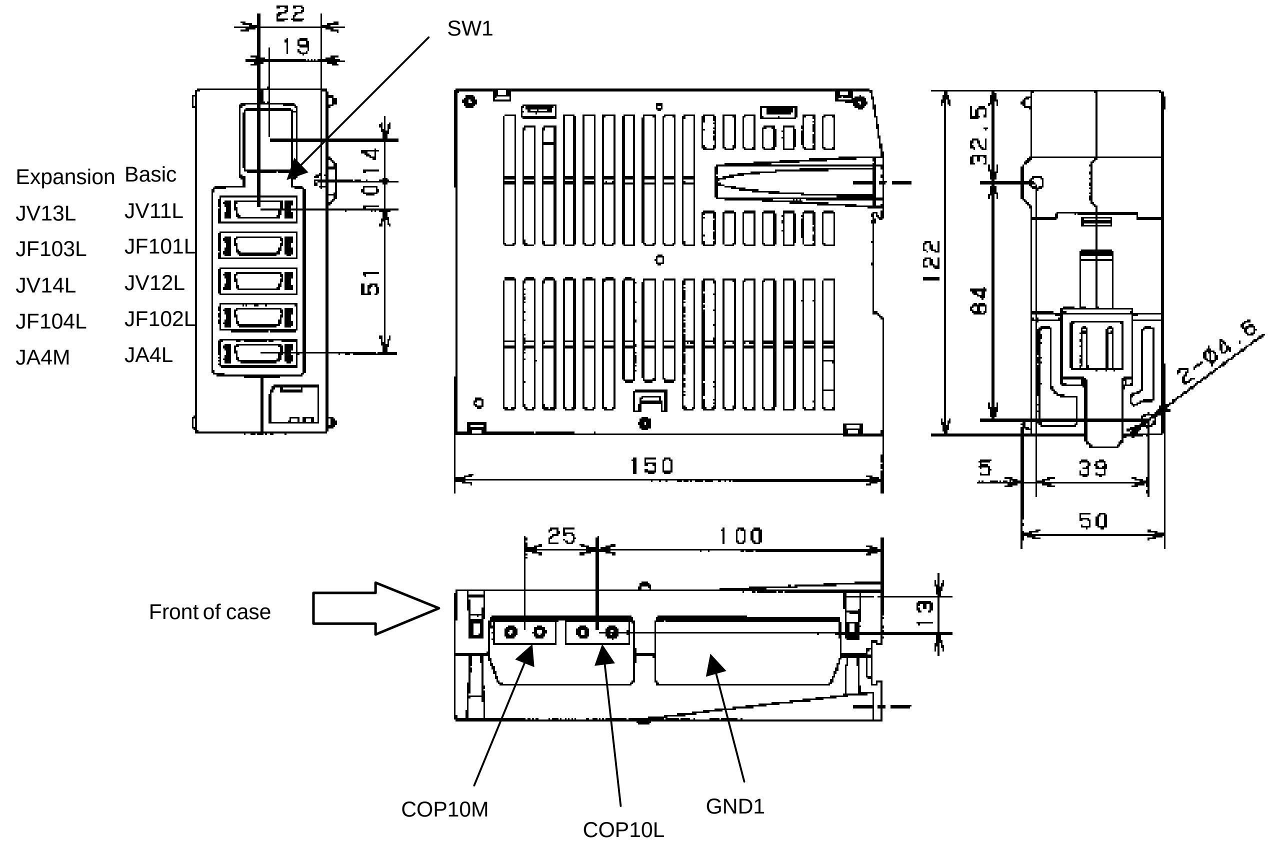
Selection switch SW1 has two positions F and M (see NOTE).

| **SW1** | **Ready signal** | **Alarm signal** | **Remarks** |
|---|---|---|---|
| F | *VRDY selected | OVL selected | Analog servo interface type F (5–V signals) |
| M | *SRDY selected | ALM selected | Analog servo interface type M (24–V signals) |

**NOTE**

Actually, the switch has three positions. When the switch is viewed from the front of the unit, tilting the switch to the left sets M, and setting the switch to the middle position or right position sets F.

## 9.5.8 Outline Drawing



## 9.5.9 Notes

1) The Power Mate *i*–D can be connected to digital servo amplifier interfaces and analog servo interfaces for up to 2 axes in total. The Power Mate i–H can be connected to these interfaces for up to eight axes in total.
2) An analog servo interface unit group may consist of either one basic unit (two axes) or one basic unit plus expansion unit (four axes). When five or more axes are used, two groups are needed.
3) When two analog servo interface unit groups are used, neither separate pulse coder interface unit nor FSSB I/O module can be used.
4) When analog servo interface units are used, two FSSB I/O module groups cannot be used.
5) Groups connected to the CNC via the FSSB line are referred to group 1 and group 2 in order from the group nearer to the CNC. When there is only one group, the group is referred to as group 1.
6) The analog servo interface unit is not approved for the CE marking.

7) To use of the analog servo interface unit, an axis control card (high–speed type) and the digital servo function A02B–0259–H591#90A0 (the 05th edition or later) are required. Select an appropriate axis control card that can match the sum of the digital servo axes and analog servo axes used.
When a separate detector for serial feedback is used, the digital servo function A02B–0259–H591#90A0 (the 24th edition or later) is required.

8) If the CNC issues a system alarm, or a communication alarm between the CNC and the analog servo interface unit is issued, the *ENBL and *PRDY signals from the unit are turned off. Also when the power to the CNC or the power to this unit is turned off, the same condition results.

9) The basic unit and expansion unit are connected in the same way as separate detector interface unit connection. Refer to the connection manual. (The flat cable used is different from that of the separate pulse coder interface unit.)

10) This unit is installed in the same way as the separate detector interface unit. See Section 9.2.

11) Select an FSSB cable (optical fiber cable) from the ordering list.

12) The power–on/off sequence is the same as that for the separate detector interface unit. See Section 9.2. When a separate detector with a parallel interface is used, and its power is supplied from other than the analog servo interface unit, turn on the power to the separate detector before turning on the analog servo interface unit. In this case, the A–/B–phase signals of the separate detector must have been stabilized until the power to the analog servo interface unit is turned on.

13) To use the servo HRV3 function (not supported by the Power Mate *i* at present), set parameter No. 2009 to enable the analog servo interface function, then turn the power to the CNC and the units on the FSSB line including this unit off then back on.

### 9.5.10
### Parameter Setting

1) In the emergency stop state, turn on the power to the CNC.

2) Set FSSB–related parameters as explained below.
When the analog servo interface unit is used, the FSSB automatic setting function cannot be used, so parameter Nos. 1023, 1905, 1910 to 1919, 1936, and 1937 must be set through manual setting 2. For details on setting, refer to the description of FSSB setting in the connection manual (functions). When these parameters are set, the analog servo interface unit is basically treated like the separate detector interface unit. (The analog servo interface unit and separate detector interface unit are collectively called the interface unit hereinafter.)

Set parameters appropriately according to the description given below and the relevant CNC parameter manual.

[Parameters to be set]

| Parameter No. | Setting | Meaning |
|---|---|---|
| No. 1023 | See <1>. | Servo axis number for each axis |
| No. 1815 | See <2>. | Settings for separate pulse coder |
| No. 1902, B0 | See <3>. | FSSB manual setting enabled |
| No. 1905 | See <4>. | (Bit type parameter) |
| No. 1910 to 1919 | See <5>. | Conversion table value for slave number |
| No. 1936 | See <6>. | Connector number of fist interface unit |
| No. 1937 | | Connector number of second interface unit |

<1> Servo axis number setting

| | |
|---|---|
| 1023 | Setting of servo axis number for each axis |

**[Data type]** Byte axis

**[Valid data range]** 1, 2, 3, ..., the number of controlled axes

Set the number of the servo axis to which each controlled axis corresponds. Refer to the description of FSSB setting in the connection manual (functions).

<2> Settings for separate pulse coder

| | #7 | #6 | #5 | #4 | #3 | #2 | #1 | #0 |
|---|---|---|---|---|---|---|---|---|
| 1815 | | | APC | APZ | | | OPT | |

**APC** 0 : The position detector is not an absolute pulse coder.
1 : An absolute pulse coder is used as the position detector.

**APZ** The reference position of the absolute pulse coder is:

0 : Not established.
1 : Established.
(This bit is set to 1 automatically after the reference position has been established.)
When using the serial α/β pulse coder, to rewrite APZ manually from 0 to 1 without performing reference position return, in the battery–backed–up condition rotate the motor at least one turn, turn the power off then back on, then change the APZ setting from 0 to 1.

**OPT** 0 : The pulse coder built into the motor is used for position detection.
1 : A separate pulse coder and linear scale are used.

<3> FSSB manual setting

| | #7 | #6 | #5 | #4 | #3 | #2 | #1 | #0 |
|---|---|---|---|---|---|---|---|---|
| 1902 | | | | | | | | FMD |

**[Data type]** Bit

**FMD** The FSSB setting mode is set to:

0 : Automatic setting mode.
1 : Manual setting 2 mode.

**NOTE**

When using the analog servo interface unit, set this bit to 1.

<4> Bit parameter setting

|  | #7 | #6 | #5 | #4 | #3 | #2 | #1 | #0 |
|---|---|---|---|---|---|---|---|---|
| 1905 | PM2 | PM1 |  |  |  |  |  | FSL |

**[Data type]** Bit

**FSL** The type of the interface between the servo amplifier and servo software for this axis is:

0 : Fast type.
1 : Slow type.

**NOTE**

For axes connected to analog servo amplifiers, set 0. (For axes connected to digital servo amplifiers, set an appropriate value according to the parameter manual.)

**PM1** For this axis, the first interface unit is:

0 : Not used.
1 : Used.

**PM2** For this axis, the second interface unit is:

0 : Not used.
1 : Used.

Up to two interface units in total can be connected to the CNC through the FSSB. The interface units are counted as the first unit and second unit in order from the unit nearer to the CNC. (When an expansion unit is used, the basic unit and expansion unit are counted together as one unit.)

For each axis that uses an interface unit, set the PM1 or PM2 bit to 1 according to whether the axis is to be connected to the first interface unit or the second interface unit. (Accordingly, for the axes connected to analog servo amplifiers, PM1 or PM2 is always 1.)

**NOTE**

When interface units are used, connector numbers (parameter Nos. 1936 and 1937) must also be set.

<5> Setting of address conversion tables for slave numbers

| | |
|---|---|
| 1910 | Address conversion table value for slave number 1 (ATR) |
| 1911 | Address conversion table value for slave number 2 (ATR) |
| 1912 | Address conversion table value for slave number 3 (ATR) |
| 1913 | Address conversion table value for slave number 4 (ATR) |
| 1914 | Address conversion table value for slave number 5 (ATR) |
| 1915 | Address conversion table value for slave number 6 (ATR) |
| 1916 | Address conversion table value for slave number 7 (ATR) |
| 1917 | Address conversion table value for slave number 8 (ATR) |
| 1918 | Address conversion table value for slave number 9 (ATR) |
| 1919 | Address conversion table value for slave number 10 (ATR) |

**[Data type]** Byte

**[Valid data range]** 0 to 7, 16, 40, 48

Set the address conversion table values for slave numbers 1 to 10. Slaves refer to servo amplifiers and interface units connected to the CNC through the FSSB optical cable. Slave numbers 1 to 10 are assigned sequentially to slaves from the slave nearest to the CNC.

Single–axis amplifiers and interface units are each assigned one slave number (an interface unit with an expansion unit is also assumed to be one interface unit). A two–axis amplifier, regarded as two single–axis amplifiers, is assigned two slave numbers. A three–axis amplifier, regarded as three single–axis amplifiers, is assigned three slave numbers.

Analog amplifiers are assigned slave numbers independently of interface units. On the assumption that analog amplifiers are connected sequentially following the end of the slaves connected to the FSSB (the position farthest from the CNC), each single–axis amplifier is assigned a slave number. For example, when the unit connected at the end of the FSSB is slave 5, the axes connected to analog amplifiers are assigned slave numbers sequentially starting with slave number 6. (See the setting example given later.)

As the address conversion table value for each slave number, set the following value depending on whether the slave is an amplifier or an interface unit, or whether the slave is present or not:

○ When the slave is an amplifier: (including an analog amplifier)
Set the value obtained by subtracting 1 from the setting in parameter No. 1023 for the axis assigned to the amplifier.

○ When the slave is an interface unit:
For the first unit (the unit connected nearer to the CNC), set 16; for the second unit (the unit connected farther from the CNC), set 48.

○ When the slave is not present:
Set 40.

<6> Connector number setting

| | |
|---|---|
| 1936 | Connector number of the first interface unit |
| 1937 | Connector number of the second interface unit |

**[Data type]** Byte axis

**[Valid data range]** 0 to 3 (when the interface unit is an analog servo interface unit)
0 to 7 (when the interface unit is a separate detector interface unit)

When using an interface unit, set the value obtained by subtracting 1 from the connector number of the unit to which the axis is connected. (When using an analog servo interface unit, set a value 0 to 3 for each axis that is connected to a connector JV1nL to JV4nL.)
For axes that do not use any unit, set 0.
Any axis can use any connector. However, use connector numbers in ascending order. This means that, for example, you cannot use connector 4 without using connector 3.

3) Turn the power off then back on.

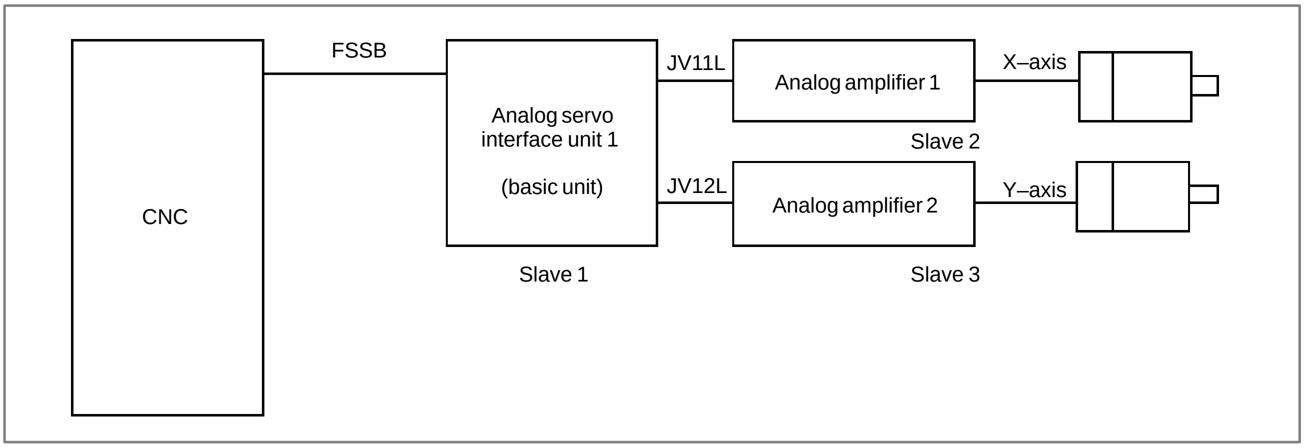
Setting continues to step 4) for initial servo parameter setting.

(Reference) Examples of FSSB setting when an analog servo interface unit is used

[Setting example 1: When two analog servo axes are used]

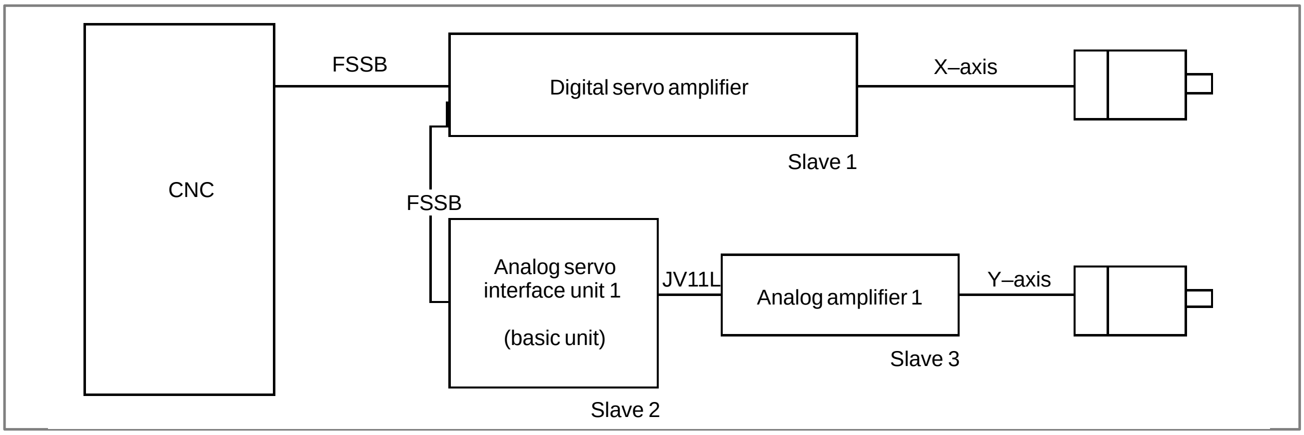
The analog servo interface unit is assigned slave 1, and the analog amplifiers are assigned slaves 2 and 3 sequentially on the assumption that the analog amplifiers are connected next to the analog servo interface unit.

| No. | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 |
|---|---|---|---|---|---|---|---|---|---|---|
| Value | 16 | 0 | 1 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |



| Axis | No. 1023 | No. 1905 | No. 1936 | No. 1937 |
|---|---|---|---|---|
| X | 1 | 01000000 | 0 | 0 |
| Y | 2 | 01000000 | 1 | 0 |

[Setting example 2: When one digital servo axis and one analog servo axis are used]

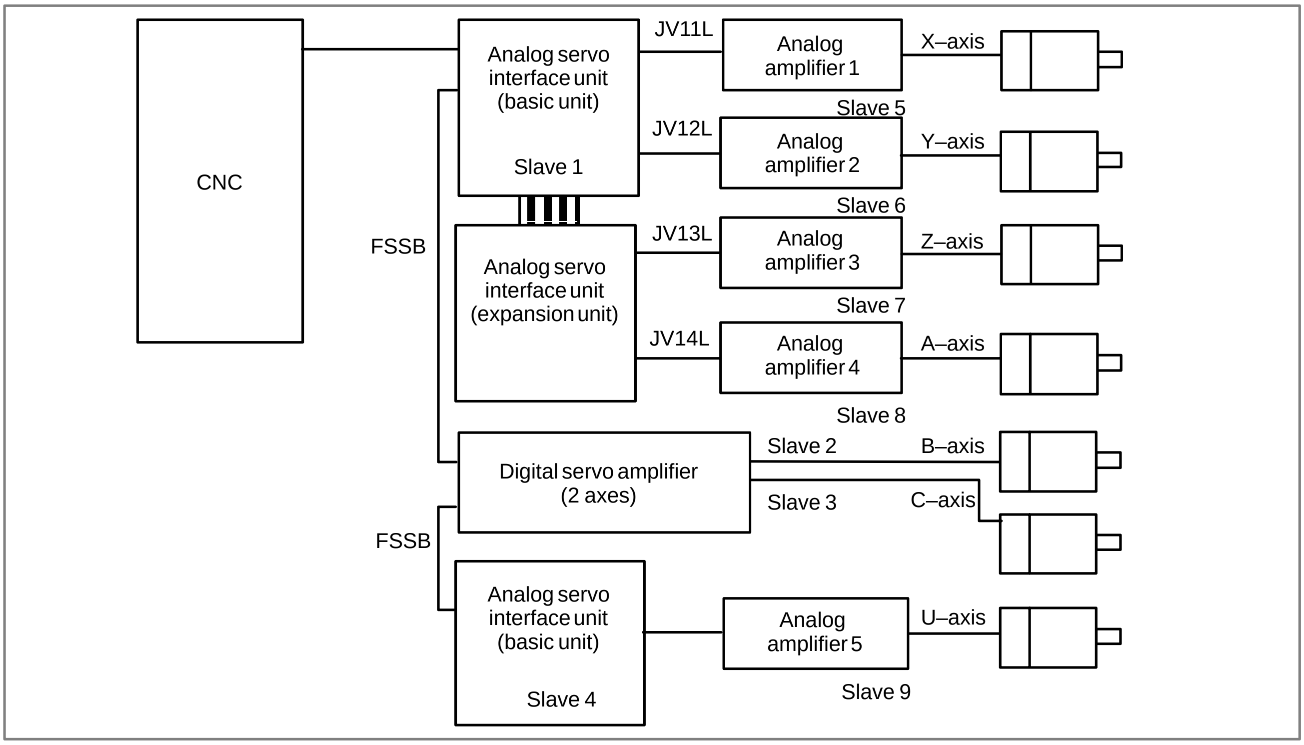


In the order of connection to the FSSB, the digital servo amplifier is assigned slave 1, and the analog servo interface unit is assigned slave 2. The axis connected to the analog amplifier is assumed to be connected next to the analog servo interface unit, and the analog amplifier is assigned slave 3.

| No. | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 |
|---|---|---|---|---|---|---|---|---|---|---|
| Value | 0 | 16 | 1 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |

| Axis | No. 1023 | No. 1905 | No. 1936 | No. 1937 |
|---|---|---|---|---|
| X | 1 | 00000000 | 0 | 0 |
| Y | 2 | 01000000 | 1 | 0 |

[Setting example 3: When five analog servo axes and two digital servo axes are used]



In the order of connection to the FSSB, the first analog servo interface unit (including the expansion unit) is assigned slave 1, the digital servo amplifier (two axes) is assigned slaves 2 and 3, and the second analog servo interface unit is assigned slave 4. The analog amplifiers are assigned slaves 5 to 9 on the assumption that they are connected after the analog servo interface unit.

| No. | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 |
|---|---|---|---|---|---|---|---|---|---|---|
| Value | 16 | 4 | 5 | 48 | 0 | 1 | 2 | 3 | 6 | 40 |

| Axis | No. 1023 | No. 1905 | No. 1936 | No. 1937 |
|---|---|---|---|---|
| X | 1 | 01000000 | 0 | 0 |
| Y | 2 | 01000000 | 1 | 0 |
| Z | 3 | 01000000 | 2 | 0 |
| A | 4 | 01000000 | 3 | 0 |
| B | 5 | 00000000 | 0 | 0 |
| C | 6 | 00000000* | 0 | 0 |
| D | 7 | 10000000 | 0 | 0 |

* When an even–numbered value is set in parameter No. 1023 for a digital servo axis, the slow type must be set for that axis as the type of the interface between the servo amplifier and servo software (bit 0 of parameter No. 1905 = 1). (Refer to the parameter manual of the CNC.)

4) Perform initial servo parameter setting.

For axes to which an analog servo amplifier are connected, perform initial servo parameter setting as follows:

| Parameter No. | Name | Setting |
|---|---|---|
| No. 2000 | Initial setting bit | 00000000 |
| No. 2020 | Motor number | 50 |
| No. 2001 | AMR | 00000000 |
| No. 1820 | CMR | Make settings similar to the settings for digital servo amplifiers according to the machine system. |
| No. 2084 | F•FG (numerator) | |
| No. 2085 | F•FG (denominator) | |
| No. 2022 | Direction of movement | 111 (CCW) or –111 (CW) |
| No. 1821 | Reference counter | Set the number of pulses per motor rotation (after F.FG) in the same way as for digital servo amplifiers. |

| Parameter No. | Name | Setting |
|---|---|---|
| No. 2023 | Number of speed pulses | Setting = 1536.797 × E, where E is the voltage value (V) equivalent to the speed command for 1000 rpm |
| No. 2024 | Number of position pulses | Set the number of pulses per motor rotation (before F•FG) in the same way as for digital servo amplifiers. |

5) Turn the power off then back on.

6) Set parameters to enable the analog servo interface function. For axes to which an analog servo amplifier is connected, set the following parameters:

| | #7 | #6 | #5 | #4 | #3 | #2 | #1 | #0 |
|---|---|---|---|---|---|---|---|---|
| 2009 | | | | ANALOG | | | | SERDMY |

**[Data type]** Bit axis

**SERDMY** The serial feedback dummy function is:

0 : Disabled.
1 : Enabled.

**NOTE**
For axes to which an analog servo amplifier is connected, set 1.

**ANALOG** The analog servo interface function is:

0 : Disabled.
1 : Enabled.

**NOTE**
For axes to which an analog servo amplifier is connected, set 1. After enabling this bit, be sure to turn off the power to this unit at least once.

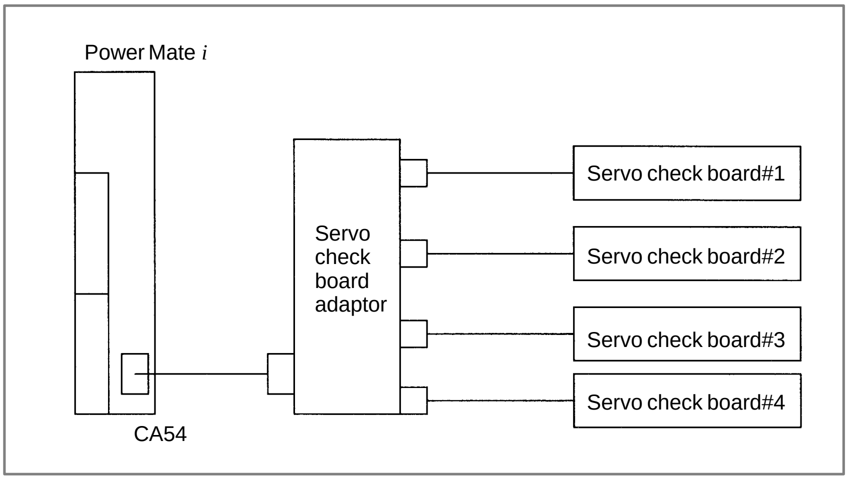
| | |
|---|---|
| 2165 | Amplifier ID |

**[Data type]** Byte axis

**NOTE**
For axes to which an analog servo amplifier is connected, set 0.

Initial servo parameter setting described before automatically sets value 45 in this parameter. Clear this setting, and set 0. (If a non–zero value is set in this parameter for an axis to which an analog amplifier is connected, an alarm indicating illegal motor amplifier combination is issued.)

## 9.6 CONNECTING SERVO CHECK BOARDS



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### 9.6.1 Connection Procedure

Connect the cable of the servo check board adaptor to connector CA54 of the Power Mate *i*. CA54 is located in the basic unit.

1 Turn off the power to the Power Mate *i*.

2 Remove the fan unit, referring to Section 2.5.1, “Removing the fan unit” in the “Power Mate *i* Maintenance Manual.”

3 Pull the base printed circuit board by about 1/3 of its depth (until connector CA54 is visible), referring to Section 2.6.1, “Inserting and removing the base printed circuit board” in the “Power Mate *i* Maintenance Manual.”

4 Pass the cable of the servo check board adaptor through the hole located in the lower part of the basic unit (above the faston pin) and connect it to connector CA54.

5 Return the base printed circuit board to its original position.

6 Mount the fan unit, referring to Section 2.5.2, “Mounting the fan unit” in the “Power Mate *i* Maintenance Manual.”

7 Connect a servo check board to the servo check board adaptor. Support the servo check board so that its weight does not pull it out its the connector.

**NOTE**

On the base printed circuit board, SRAM with battery backup is mounted. When connecting the cable, do not pull the base printed circuit board outward more than necessary so that other objects do not come into contact with the portions of the base printed circuit board other than the face plate. Back up the SRAM contents to the built–in FROM of the Power Mate *i* before cable connection so that if the SRAM contents should be damaged, they can be restored soon.

When the use of the servo check board is completed, disconnect the cable of the servo check board adaptor from the Power Mate *i*, by reversing the above procedure.

## 9.6.2 Servo Check Boards

To use servo check boards with the Power Mate *i*, servo check board adaptor A02B–0236–K822 is required. This adaptor is provided with a cable for connection to the Power Mate *i*.

For a detailed explanation of how to connect and use the servo check boards, refer to the “FANUC AC SERVO MOTOR α series Parameter Manual” or other relevant manuals.

## 9.6.3 Notes on Use

1 A servo check board must be connected only when it is to be used. As soon s the board is no longer needed, remove it.

2 Up to two digital servo check boards can be used at one time. If three or more boards are to be used at one time, contact FANUC.

3 Only one analog servo check board can be used at a time. If two or more boards are to be used at a time, contact FANUC.

4 Use the attached cable. The cable length cannot be extended.

# 10 CONNECTION TO PERIPHERALS

## 10.1
## I/O DEVICE INTERFACE

### 10.1.1
### RS–232–C Interface Specification

(1) RS–232–C interface signal names

Generally, the RS–232–C interface uses the following signals:

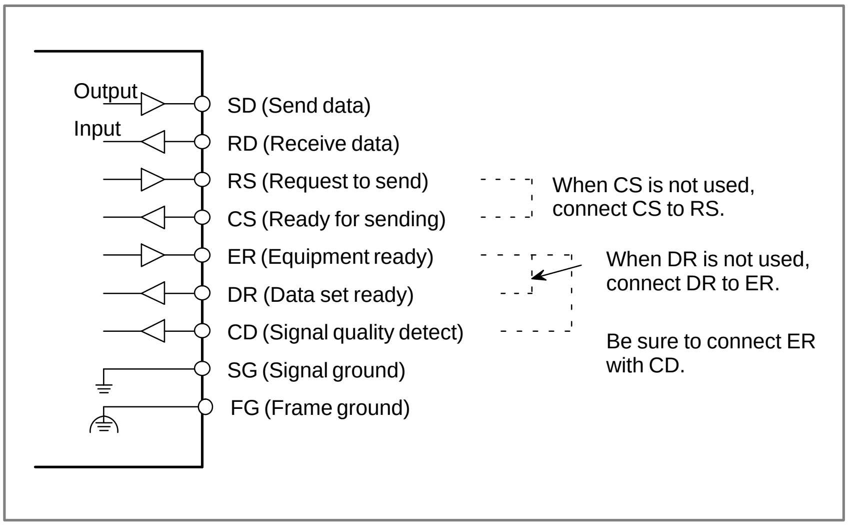
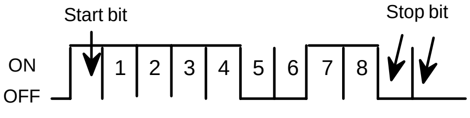
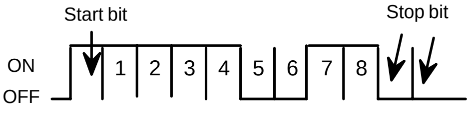


**Fig. 10.1.1 (a) RS–232–C interface**

(2) RS–232–C interface signals

| **Signal name** | **RS–232–C circuit number** | **Input/output** | **Description** |
|---|---|---|---|
| SD | 103 | Output | Send data<br><br> <br>(The ISO code for 0 is sent) |
| RD | 104 | Input | Receive data<br><br> <br>(The ISO code for 0 is sent) |
| RS | 105 | Output | Request to send<br>This signal is turned on when data output from the NC machine is started; it is turned off when data output from the NC machine is terminated. |
| CS | 106 | Input | Ready for sending<br>When this signal and the DR signal are on, data can be output from the NC machine. If the I/O device is not ready in time, for example, for punch–out operation, this signal, when turned off, causes the NC machine to stop data transmission after sending a maximum of two characters including characters currently being transmitted. When this signal is not used, be sure to connect this signal to the RS signal on the NC. |
| DR | 107 | Input | Data set ready<br>When this signal is no, the I/O device is ready. Generally, this signal is connected with a signal for indicating the power–on state(*1) of the I/O device (ER signal on the I/O device side). The NC sends data when this signal is on. If this signal is turned off during data transmission, alarm No.086 occurs. When this signal is not used, be sure to connect this signal to the ER signal on the NC. |
| ER | 108.2 | Output | NC equipment ready<br>When this signal is on, the NC machine is ready for operation. An I/O device regards the SD signal sent while the ER signal is on, as valid information. |
| CD | 109 | Input | Signal quality detect<br>This signal is not used for connection with an I/O device. Be sure to connect this signal with the ER signal on the NC in the cable. |
| SG | 102 | | Signal ground |
| FG | 101 | | Frame ground |

**NOTE**
(*1) The signal is turned on and off as follows:

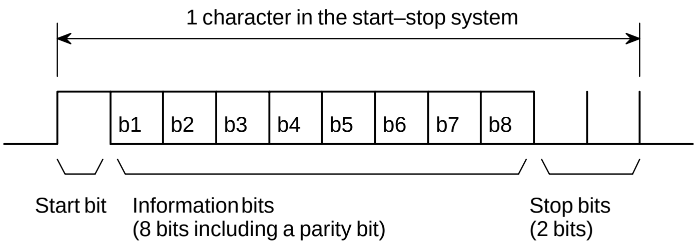
| | **–3V or lower** | **+3V or higher** |
|---|---|---|
| Function | OFF | ON |
| Signal Condition | Marking | Spacing |

(3) RS–232–C interface transmission system

(a) Start–stop system

In general, two systems can be used for serial interface transmission: the start–stop system and synchronous system. With Power Mate the start–stop system is used.

Start–stop system: Information bits are transmitted preceded by a start signal and followed by a stop signal.



(For bit correspondence information, see the description of the SD and RD signals in Item 2).

(b) Codes

The following codes are used:

i) EIA code + control codes DC1 to DC4

ii) ISO code + control codes DC1 to DC4

An I/O device must be able to identify the following control codes output from the NC system:

| **Character** | | **8** | **7** | **6** | **5** | **4** | | **3** | **2** | **1** |
|---|---|---|---|---|---|---|---|---|---|---|
| DC1 | Start tape reader | | | | ○ | | ° | | | ○ |
| DC2 | Specify tape punch | | | | ○ | | ° | | ○ | |
| DC3 | Stop tape reader | ○ | | | ○ | | ° | | ○ | ○ |
| DC4 | Release tape punch | | | | ○ | | ° | ○ | | |

**NOTE**
The control codes above are commonly used regardless of whether the EIA code or ISO code is used.

With this interface, control codes DC1 to DC4 are used. Note the following:

(a) The NC machine can control an I/O device by sending DC1 to DC4.

(b) An I/O device can perform the operations below if it is not ready to receive data from the NC machine.

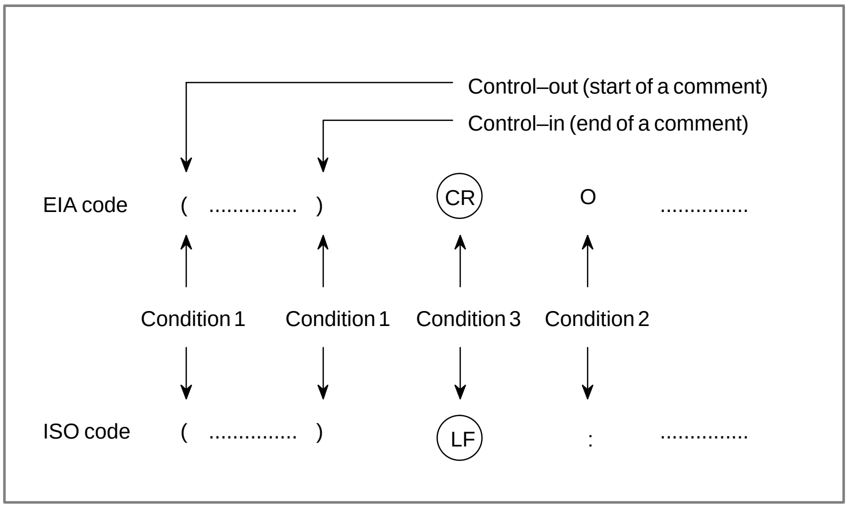
(i) The I/O device can temporarily stop data transmission from the NC machine by using the CS signal on the NC.
The CS signal, when turned off and sent to the NC machine, causes the NC machine to stop data transmission after sending a maximum of two characters including characters currently being transmitted. When the CS signal is turned on again, data transmission resumes.

(ii) When control code DC3 is sent to the NC machine, the NC machine stops data transmission after sending 10 or less characters. Then, when control code DC1 is sent to the NC machine, the NC machine resumes data transmission. When an I/O device containing an ISO/EIA converter is used, the device needs to satisfy the specifications of Table 10.1.1.

## Table 10.1.1

| 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 information section in ISO code.<br>Assumed as program No. in 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 an error punch). |
| NUL | | | | | | ° | | | | Blank | | | | | | ° | | | | Not punched. Can not be used in significant section in 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 (a comment is started) |
| ) | ○ | | ○ | | ○ | | | | ○ | ( 2–4–7 ) | | ○ | | | ○ | | | ○ | | Control in (the end of a comment) |
| + | | | ○ | | ○ | ° | | ○ | ○ | + | | ○ | ○ | ○ | | ° | | | | Positive sign |
| – | | | ○ | | ○ | ° | ○ | | ○ | – | | ○ | | | | ° | | | | Negative sign |
| : | | | ○ | ○ | ○ | ° | | ○ | | | | | | | | | | | | Colon |
| / | ○ | | ○ | | ○ | ° | ○ | ○ | ○ | / | | | ○ | ○ | | ° | | | ○ | Optional block skip |
| . | | | ○ | | ○ | ° | ○ | ○ | | . | | ○ | ○ | | ○ | ° | | ○ | ○ | Period (A decimal point) |
| # | ○ | | ○ | | | ° | | ○ | ○ | | | | | | | | | | | Sharp |
| $ | | | ○ | | | ° | ○ | | | | | | | | | | | | | Dollar sign |
| & | ○ | | ○ | | | ° | ○ | ○ | | & | | | | | ○ | ° | ○ | ○ | | Ampersand |
| ' | | | ○ | | | ° | ○ | ○ | ○ | | | | | | | | | | | Apostrophe |
| * | ○ | | ○ | | ○ | ° | | ○ | | | | | | | | | | | | Asterisk |
| , | ○ | | ○ | | ○ | ° | ○ | | | , | | | ○ | ○ | ○ | | | ○ | ○ | Comma |
| ; | ○ | | ○ | ○ | ○ | ° | | ○ | ○ | | | | | | | | | | | Semicolon |
| < | | | ○ | ○ | ○ | ° | ○ | | | | | | | | | | | | | Left angle bracket |
| = | ○ | | ○ | ○ | ○ | ° | ○ | | ○ | | | | | | | | | | | Equal |
| > | ○ | | ○ | ○ | ○ | ° | ○ | ○ | | | | | | | | | | | | Right angle bracket |
| ? | | | ○ | ○ | ○ | ° | ○ | ○ | ○ | | | | | | | | | | | Question mark |
| @ | ○ | ○ | | | | ° | | | | | | | | | | | | | | Commercial at mark |
| ” | | | ○ | | | | | ○ | | | | | | | | | | | | Quotation |

**NOTE**
When an I/O device containing an ISO/EIA converter is used, pay special attention to the following in Table 10.1.1.



| | |
|---|---|
| Condition 1 | In the EIA code, a card punched at bits 2, 4, and 5 corresponds to the ISO code for the left parenthesis “(.” A card punched at bits 2, 4, and 7 corresponds to the ISO code for the right parenthesis “).” |
| Condition 2 | The EIA code for O is converted to the ISO code for the colon (:). |
| Condition 3 | The EIA code for (CR) is converted to the ISO code for (LF) . |

**NOTE**
Control codes DC1 to DC4 are transmission codes output from the NC machine, and need not be fed as paper tape information.

(iii) Transmission rate (baud rate)

The transmission rate (baud rate) indicates the number of bits sent per second. One of the following baud rates can be selected by parameter setting:

600, 1200, 2400, 4800, 9600

Example: When 4800 baud is used
Assuming that 1 start bit and 2 stop bits are used (11 bits/character).
Then,
Number of transmission characters per second=
4800/11 characters per second (maximum)

(iv) Cable length

The cable length varies from one I/O device to another. For the required cable length, consult with each I/O device supplier.

### When the NC receives data (for reading into memory)

(1) The NC machine sends a DC1 code.

(2) Upon receipt of the DC1 code, the I/O device starts data transmission to the NC machine.

(3) While the NC machine is processing, it sends a DC3 code.

(4) Upon receipt of the DC3 code, the I/O device stops data transmission to the NC machine.
When the DC3 code is sent, the I/O device is to stop data transmission after sending 10 or less characters. If more than 10 characters are sent, alarm no.087 occurs.

(5) The NC machine sends another DC1 code when its processing is completed.

(6) Upon receipt of the DC1 code, the I/O device resumes data transmission to the NC machine in order to send the remaining data.

(7) Upon completion of data read operation, the NC machine sends another DC3 code.

(8) The I/O device stops data transmission.

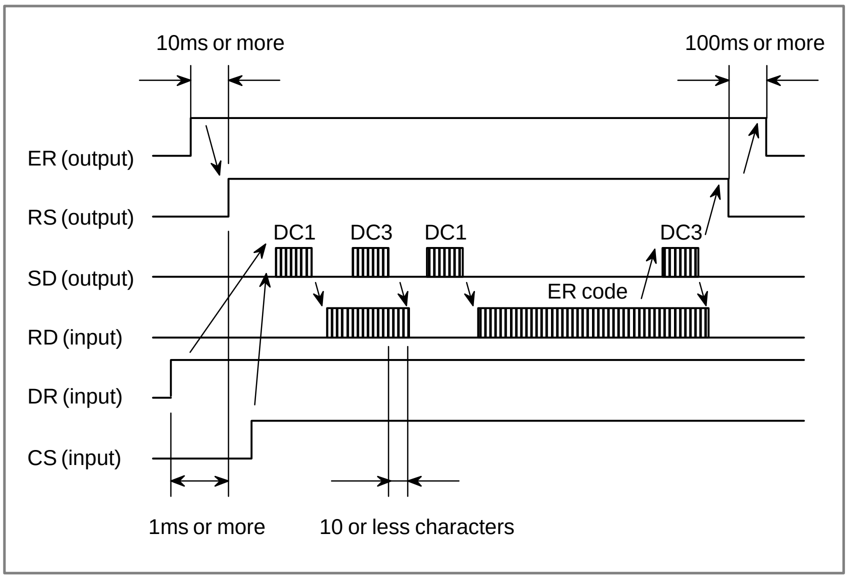


Fig. 10.1.1 (b)

### When the NC sends data (punch–out)

(1) The NC machine sends a DC2 code.

(2) The NC machine sends punch–out information.

(3) While the I/O device is processing data:

  (a) The CS signal on the NC can be turned off to cause the NC machine to stop data transmission after sending a maximum of two characters including characters currently being transmitted. When the CS signal is turned on again, data transmission resumes. (See Fig. 10.1.1 (c).)

  (b) When a DC3 control code is sent to the NC machine, the NC machine stops data transmission after sending 10 or less characters, which are counted starting at the time of DC3 code transmission. Then, when a DC1 control code is sent to the NC, the NC machine resumes data transmission. (See Fig. 10.1.1 (d).)

(4) Upon completion of data transmission, the NC machine sends a DC4 code.

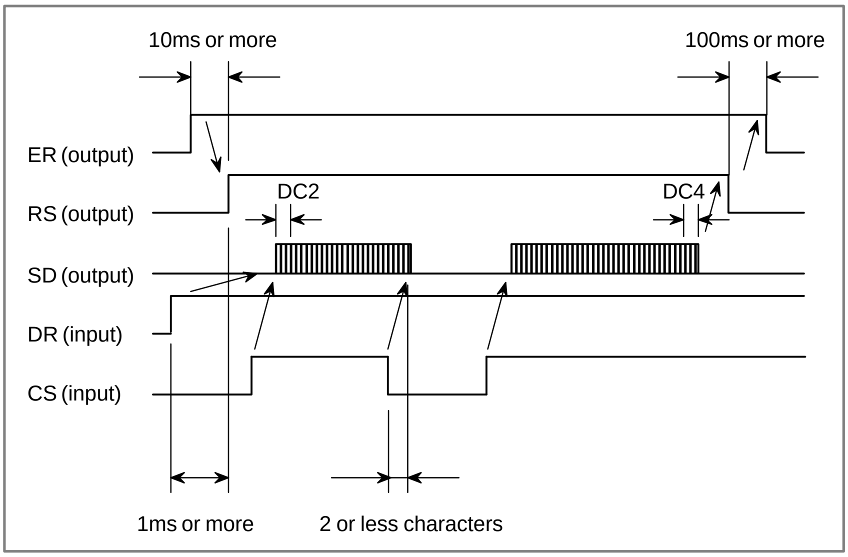


Fig. 10.1.1 (c)

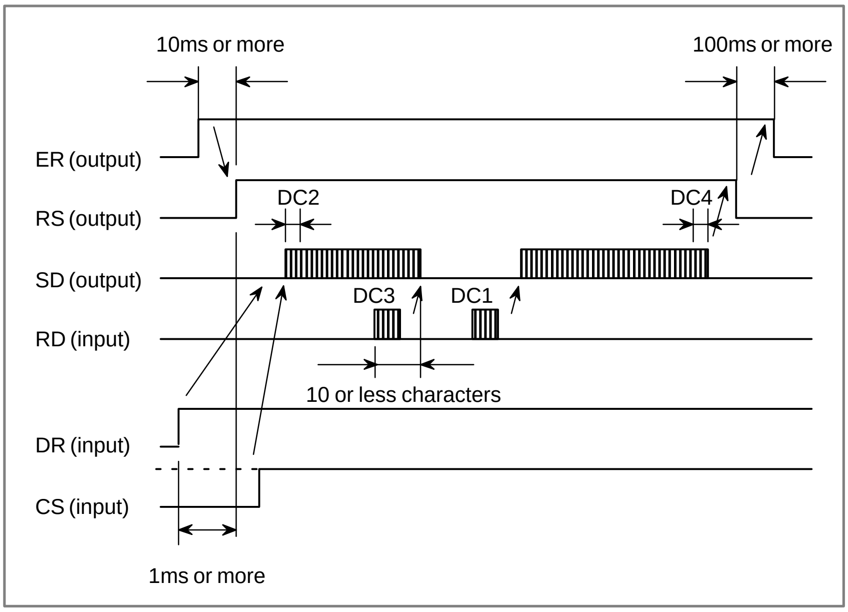
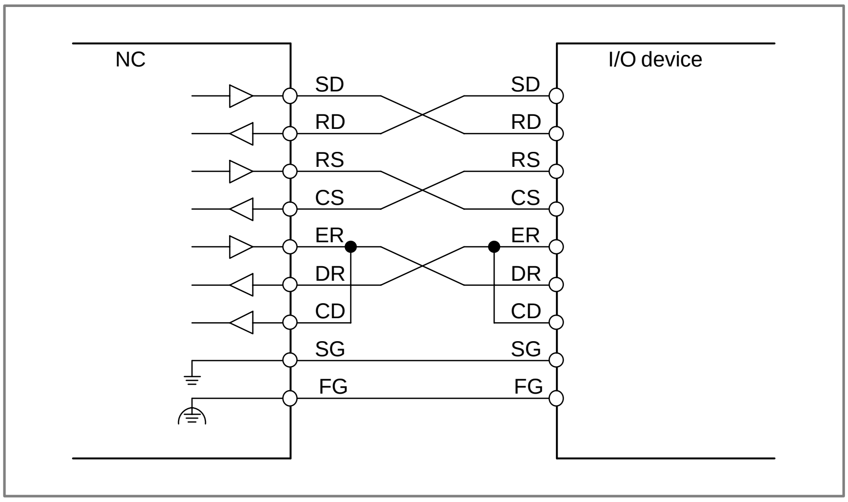


Fig. 10.1.1 (d)

(5) Connecting the RS–232–C interface with an I/O device



## 10.1.2 RS–232–C Serial Port Specifications

1) Two RS–232C channels can be connected to serial port JD42 of the Power Mate *i*. Normally, two channels are used so that the second channel can be used for purposes of maintenance with a notebook personal computer. When only one channel is used, a separate setup/display device for maintaining the Power Mate *i* is required.

2) When two channels are connected to the serial port, the following devices may be connected to channel 1:

- I/O device such as the Handy File
- RS–232C device controlled by a macro executor or C executor user program
  When a user–program–controlled RS–232C device is connected, I/O devices such as the Handy File cannot be used. In this case, data must be saved and restored using a memory card or a notebook personal computer connected to channel 2.

3) When two channels are connected to the serial port, the following is connected to channel 2:

- Notebook personal computer (FAPT LADDER–II, DPL/MDI operation package)
  Basically, channel 2 should be kept connectable to a notebook personal computer. (FANUC service uses the notebook personal computer for maintenance purposes.)

**NOTE**
No control line is provided for channel 2. Therefore, only a device that can be controlled using DC codes rather than a control line can be connected to channel 2.

4) When one channel is connected to the serial port, the following devices may be connected:

- I/O device such as the Handy File

- RS–232C device controlled by a macro executor or C executor user program
  When a user–program–controlled RS–232C device is connected, I/O devices such as the Handy File cannot be used. In this case, data must be saved and restored using a memory card.
  For single–channel connection, the device shown below cannot be used. To use the following, connect two channels to the serial port:
- Notebook personal computer (FAPTLADDER–II, DPL/MDI operation package)

5) For FANUC's 24–V type I/O devices, 24–VDC power must be output to the relay connector. Also for channel 2, output 24–VDC power for use in the future.

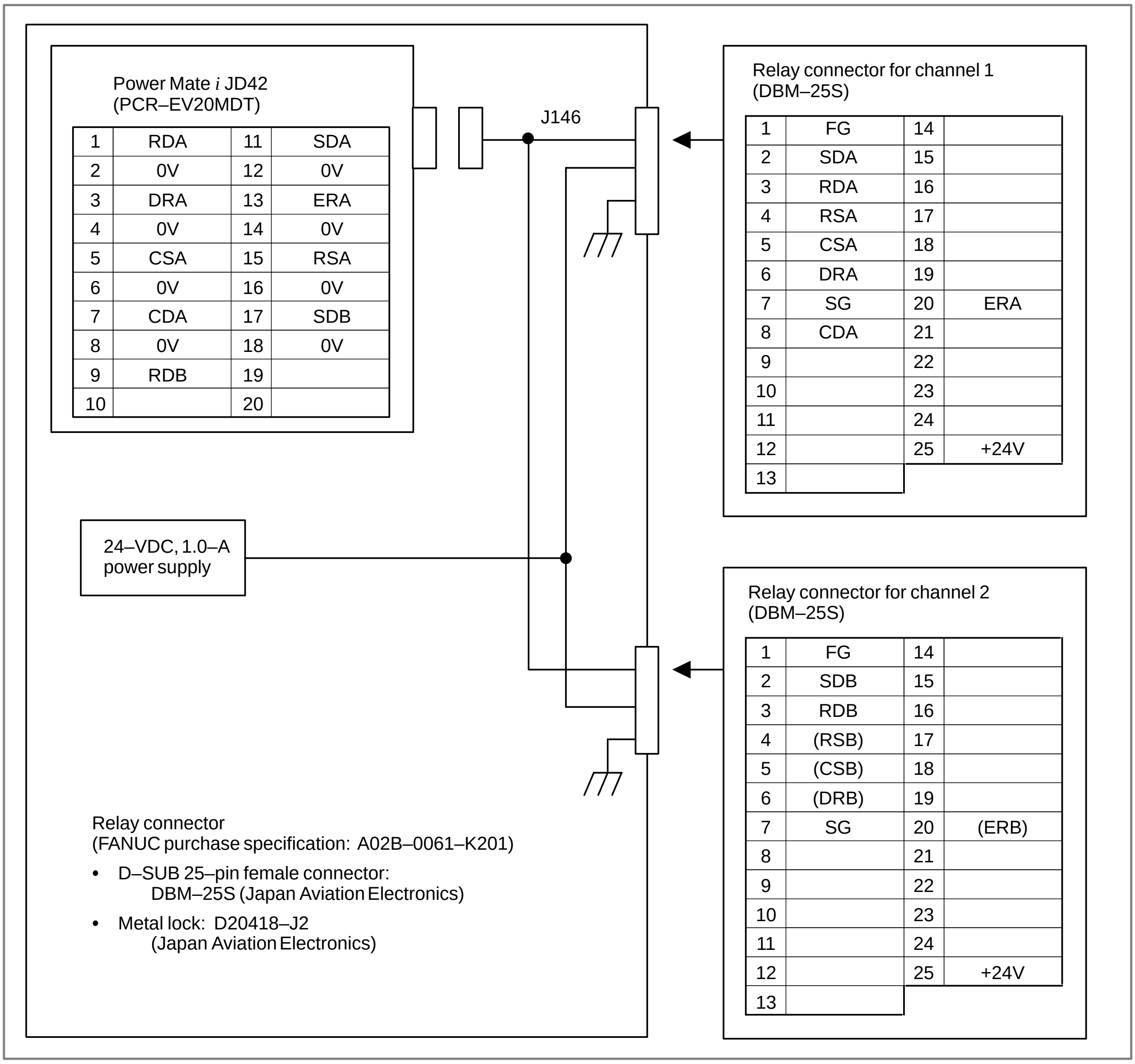
6) A notebook personal computer (FAPTLADDER–II, DPL/MDI operation package) is connected with the power to the Power Mate *i* on (detachable). For this reason, the 0–V line of the Power Mate *i* and the 0–V line of the notebook personal computer must be connected first. For details, see Subsection 10.1.3. Make channel 1, which is not connected to a notebook personal computer, also detachable for future use.

**NOTE**

When the notebook personal computer is connected to the Power Mate *i* in detachable mode, the power to the notebook personal computer must have been turned off.

## 10.1.3

## Details of Two–Channel Connection



Power Mate *i* JD42
(PCR–EV20MDT)

| | | | |
|---|---|---|---|
| 1 | RDA | 11 | SDA |
| 2 | 0V | 12 | 0V |
| 3 | DRA | 13 | ERA |
| 4 | 0V | 14 | 0V |
| 5 | CSA | 15 | RSA |
| 6 | 0V | 16 | 0V |
| 7 | CDA | 17 | SDB |
| 8 | 0V | 18 | 0V |
| 9 | RDB | 19 | |
| 10 | | 20 | |

24–VDC, 1.0–A power supply

Relay connector for channel 1
(DBM–25S)

| | | | |
|---|---|---|---|
| 1 | FG | 14 | |
| 2 | SDA | 15 | |
| 3 | RDA | 16 | |
| 4 | RSA | 17 | |
| 5 | CSA | 18 | |
| 6 | DRA | 19 | |
| 7 | SG | 20 | ERA |
| 8 | CDA | 21 | |
| 9 | | 22 | |
| 10 | | 23 | |
| 11 | | 24 | |
| 12 | | 25 | +24V |
| 13 | | | |

Relay connector for channel 2
(DBM–25S)

| | | | |
|---|---|---|---|
| 1 | FG | 14 | |
| 2 | SDB | 15 | |
| 3 | RDB | 16 | |
| 4 | (RSB) | 17 | |
| 5 | (CSB) | 18 | |
| 6 | (DRB) | 19 | |
| 7 | SG | 20 | (ERB) |
| 8 | | 21 | |
| 9 | | 22 | |
| 10 | | 23 | |
| 11 | | 24 | |
| 12 | | 25 | +24V |
| 13 | | | |

Relay connector
(FANUC purchase specification: A02B–0061–K201)

- D–SUB 25–pin female connector:
  DBM–25S (Japan Aviation Electronics)
- Metal lock: D20418–J2
  (Japan Aviation Electronics)

Cable–side connector (FANUC purchase specification: A02B–0118–K895)

- D–SUB 25–pin male connector with a cover: DBM–25P (Japan Aviation Electronics)
- Metal lock: DB–C2–J9 (Japan Aviation Electronics)

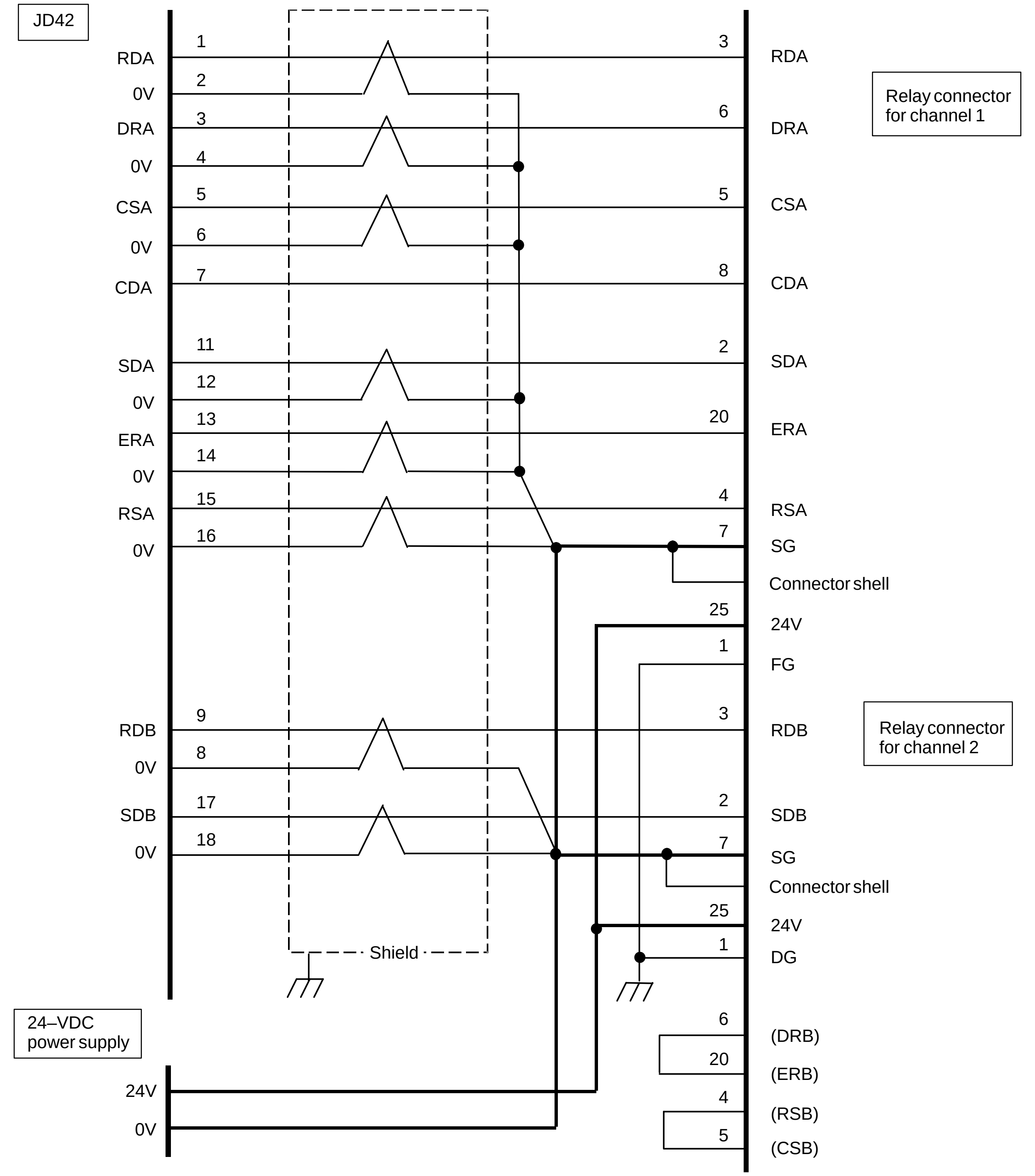
24–VDC power supply

Used for FANUC's 24–V type I/O devices such as the Handy File
24 VDC ±10% (including an instantaneous value and ripple)
This power can be supplied also via the power supply connector CP2 of the Power Mate.

The above cable is available from FANUC in a form of a punch panel (for two channels).
The punch panel has a terminal block for connection to the 24–VDC power supply. A 24–VDC cable is required separately.

- Punch panel (for two channels), 1 m long: A02B–0259–C051
- Punch panel (for two channels), 2 m long: A02B–0259–C052
- Punch panel (for two channels), 5 m long: A02B–0259–C053

Cable connection (J146)

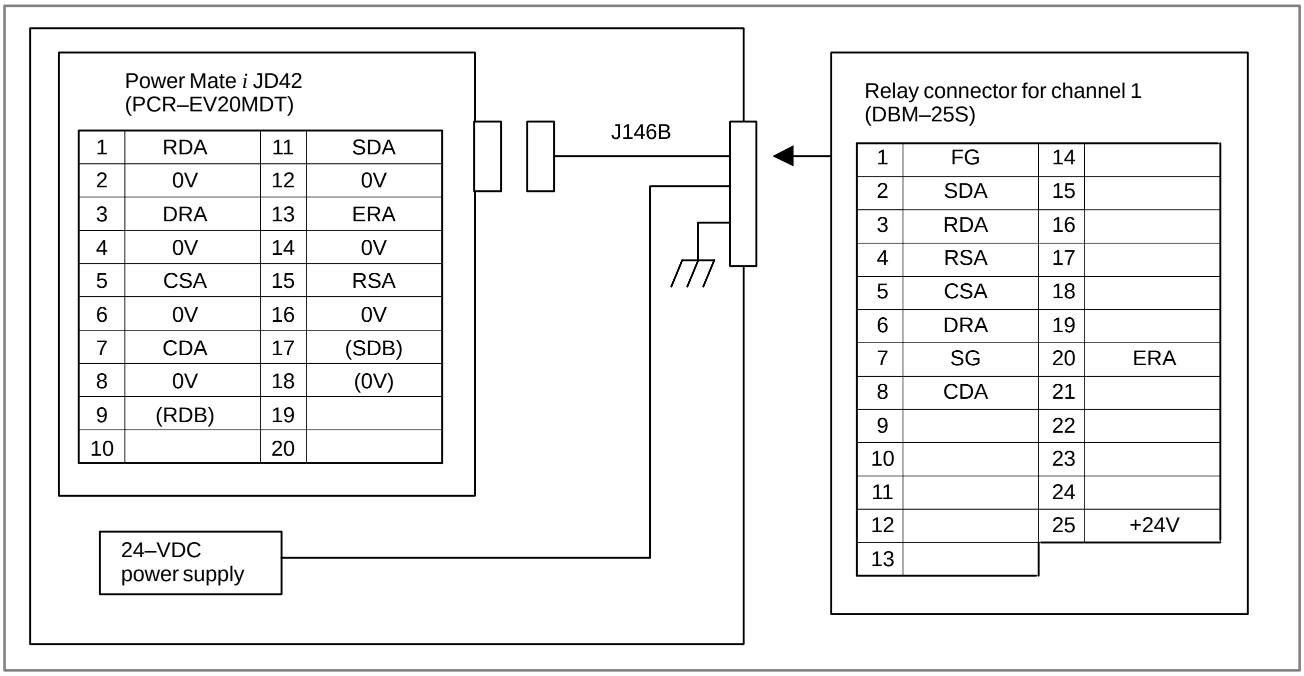


Recommended cable: A66L–0001–0284#10P (#28AWG, 10 pairs), #28AWG except the following power supply part.
The 24–V and 0–V wires from the 24–V power supply must have the thickness that satisfies the input power specification of the connected device.

**NOTE**

1. Connecting the 0–V wire to the connector shell is to make the connected device detachable. See also Subsection 10.1.5.
2. Do not make any connection other than the above.

## 10.1.4
## Details of Single–Channel Connection



Power Mate *i* JD42
(PCR–EV20MDT)

| | | | |
|---|---|---|---|
| 1 | RDA | 11 | SDA |
| 2 | 0V | 12 | 0V |
| 3 | DRA | 13 | ERA |
| 4 | 0V | 14 | 0V |
| 5 | CSA | 15 | RSA |
| 6 | 0V | 16 | 0V |
| 7 | CDA | 17 | (SDB) |
| 8 | 0V | 18 | (0V) |
| 9 | (RDB) | 19 | |
| 10 | | 20 | |

Relay connector for channel 1
(DBM–25S)

| | | | |
|---|---|---|---|
| 1 | FG | 14 | |
| 2 | SDA | 15 | |
| 3 | RDA | 16 | |
| 4 | RSA | 17 | |
| 5 | CSA | 18 | |
| 6 | DRA | 19 | |
| 7 | SG | 20 | ERA |
| 8 | CDA | 21 | |
| 9 | | 22 | |
| 10 | | 23 | |
| 11 | | 24 | |
| 12 | | 25 | +24V |
| 13 | | | |

Relay connector (FANUC purchase specification: A02B–0061–K201)

- D–SUB 25–pin female connector: DBM–25S (Japan Aviation Electronics)
- Metal lock: D20418–J2 (Japan Aviation Electronics)

Cable–side connector (FANUC purchase specification: A02B–0118–K895)

- D–SUB 25–pin male connector with a cover: DBM–25P (Japan Aviation Electronics)
- Metal lock: DB–C2–J9 (Japan Aviation Electronics)

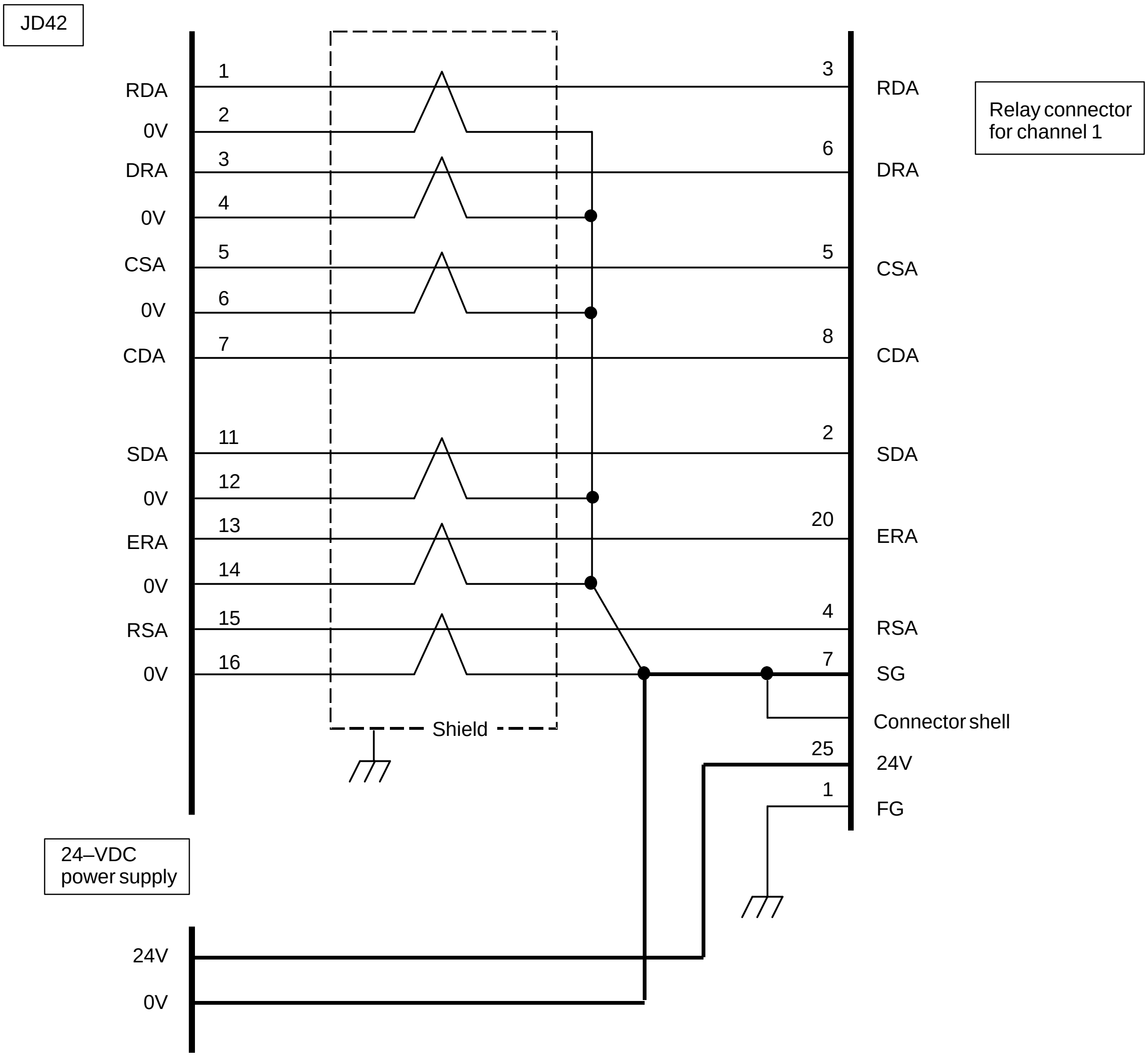
24–VDC power supply

Used for FANUC's 24–V type I/O devices such as the Handy File
24 VDC ±10% (including an instantaneous value and ripple)
This power can be supplied also via the power supply connector CP2 of the Power Mate.

The above cable is available from FANUC in a form of a punch panel (for one channel).
The punch panel has a terminal block for connection to 24–VDC power supply. A 24–VDC cable is required separately.

- Punch panel (for one channel), 1 m long: A02B–0259–C191
- Punch panel (for one channel), 2 m long: A02B–0259–C192
- Punch panel (for one channel), 5 m long: A02B–0259–C193

Cable connection (J146)



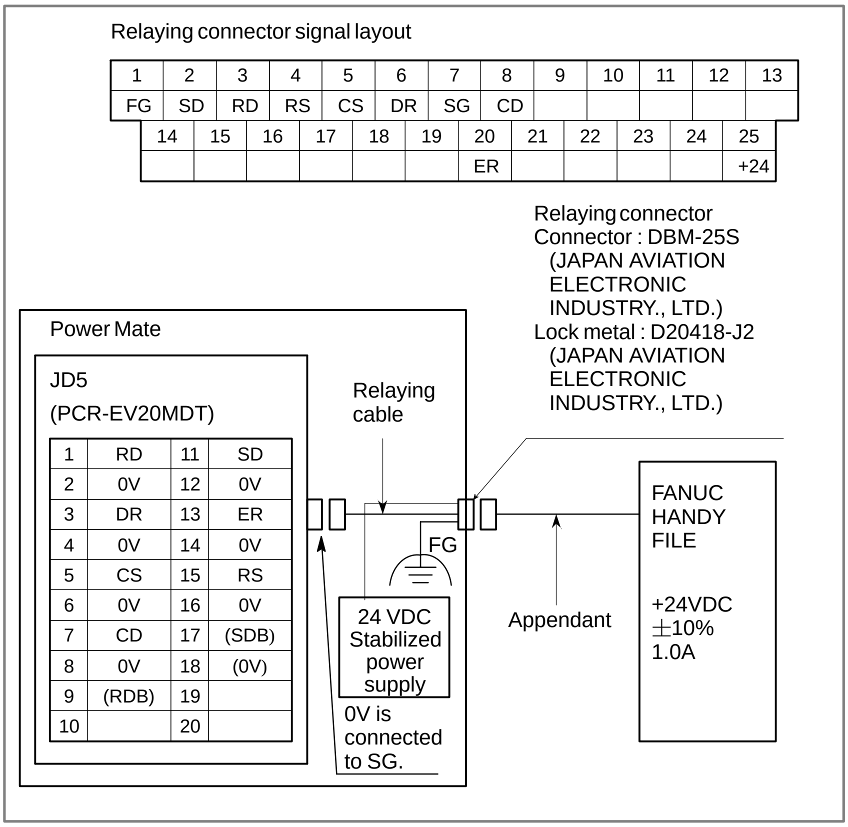
Recommended cable: A66L–0001–0284#10P (#28AWG, 10 pairs), #28AWG except the following power supply part:
The 24–V and 0–V wires from the 24–V power supply must have the thickness that satisfies the input power specification of the connected device.

**NOTE**

1 Connecting the 0–V wire to the connector shell is to make the connected device detachable.

2 Do not make any connection other than the above.

## 10.1.5
## Connection to the Handy File (Channel 1)



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 |

Relaying connector
Connector : DBM-25S
(JAPAN AVIATION ELECTRONIC INDUSTRY., LTD.)
Lock metal : D20418-J2
(JAPAN AVIATION ELECTRONIC INDUSTRY., LTD.)

Power Mate

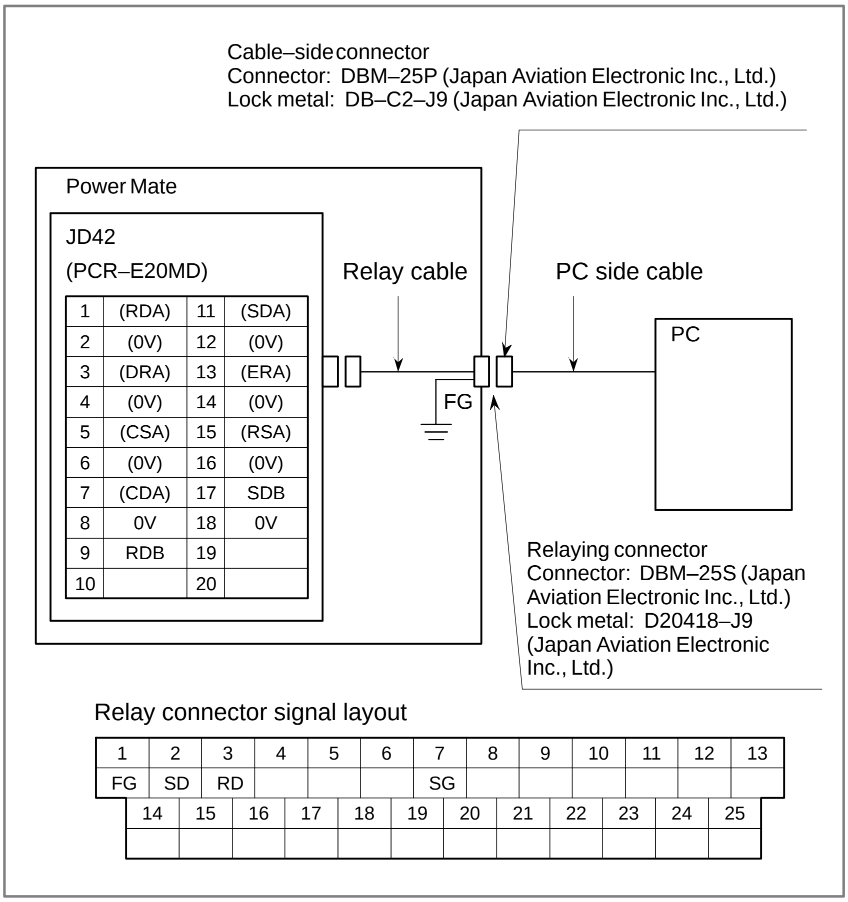
JD5
(PCR-EV20MDT)

| | | | |
|---|---|---|---|
| 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 | (SDB) |
| 8 | 0V | 18 | (0V) |
| 9 | (RDB) | 19 | |
| 10 | | 20 | |

**NOTE**

1. Machine tool builder shall furnish relay connector, relay cable and 24VDC.
2. Use a totally shielded cable for the signal cable.
   Recommended cable specification : A66L-0001-0284#10P
   (Line length : 15m or less)
3. Open all terminals other than illustrated.
4. Set a parameter to be able to use reader puncher interface when connecting Handy File.
   The baud rate is 4800 baud.
5. 24 VDC power for the FANUC Handy File must be supplied from an external 24 VDC power supply or the CP2 power output of the Power Mate (see Section 5.7).

## 10.1.6
## Connection by the Notebook Personal Computer (Channel 2)



JD42 (PCR–E20MD)

| | | | |
|---|---|---|---|
| 1 | (RDA) | 11 | (SDA) |
| 2 | (0V) | 12 | (0V) |
| 3 | (DRA) | 13 | (ERA) |
| 4 | (0V) | 14 | (0V) |
| 5 | (CSA) | 15 | (RSA) |
| 6 | (0V) | 16 | (0V) |
| 7 | (CDA) | 17 | SDB |
| 8 | 0V | 18 | 0V |
| 9 | RDB | 19 | |
| 10 | | 20 | |

Relay connector signal layout

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| FG | SD | RD | | | | SG | | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| | | | | | | | | | | | |

**NOTE**

1 Machine tool builder shall furnish relay connector and relay cable.

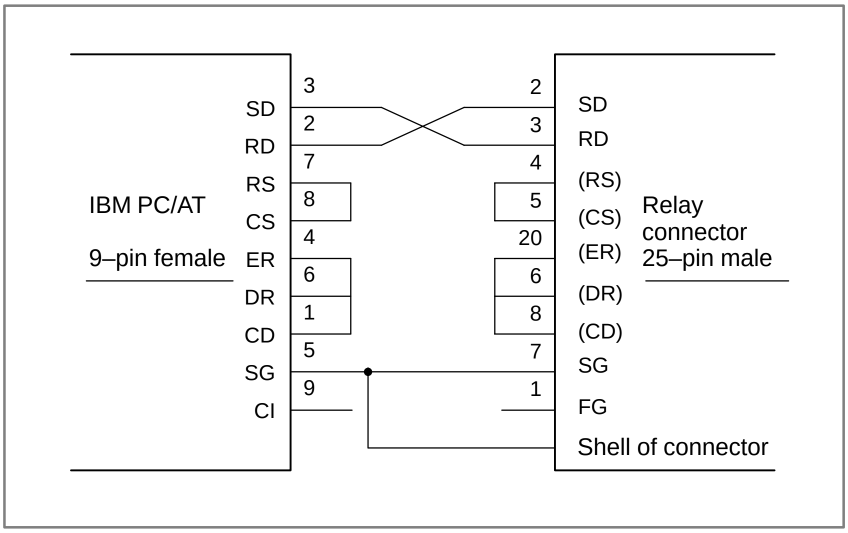
2 Use a totally shielded cable for the signal cable.
Recommended cable specification:
A66L–0001–0284#10P (#28AWG × 10 pairs)

3 Open all terminals other than illustrated.

4 Connect the Power Mate to 0V of the notebook personal computer first so that the Power Mate can be connected to and disconnected (detached) from the notebook personal computer while the Power Mate is turned on.

### Personal computer side cable

IBM PC/AT (Cable specification: A02B–0259–K830)



**NOTE**

1 It is unnecessary to connect pins 4, 5, 6, 8, and 20 of the relay connector for this Power Mate model. However, they should be connected for compatibility with other Power Mate models.

2 SG of the IBM PC/AT is connected to the shell of the relay connector to make the Power Mate detachable.

# 10.2 EXTERNAL PULSE INPUT INTERFACE

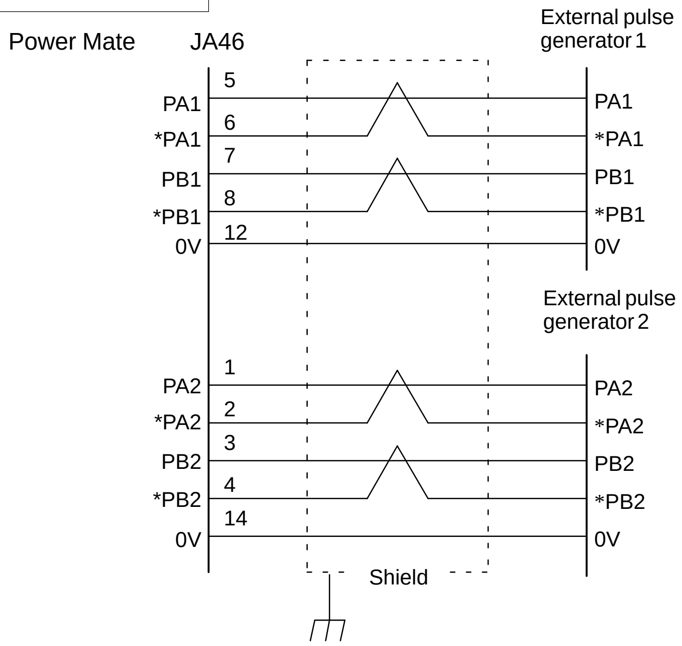
Power Mate

JA46
(PCR–EV20MDT)

| | | | |
|---|---|---|---|
| 1 | PA2 | 11 | |
| 2 | *PA2 | 12 | 0V |
| 3 | PB2 | 13 | |
| 4 | *PB2 | 14 | 0V |
| 5 | PA1 | 15 | |
| 6 | *PA1 | 16 | 0V |
| 7 | PB1 | 17 | |
| 8 | *PB1 | 18 | (+5V) |
| 9 | (+5V) | 19 | |
| 10 | | 20 | (+5V) |

| Name | Description |
|---|---|
| PA1, *PA1 | 1st channel of A–phase signal |
| PB1, *PB1 | 1st channel of B–phase signal |
| PA2, *PA2 | 2nd channel of A–phase signal |
| PB2, *PB2 | 2nd channel of B–phase signal |

Cable wiring (J147)



Recommended cable material

A66L–0001–0284#10P (#28AWG × 10)

#28AWG = 0.233Ω/m

**NOTE**

1. To use this function, option card 1 or 2 is needed.
2. This interface cannot be used together with an position coder interface.
3. The Power Mate can supply power to a unit requiring not more than 0.35 A at 5 V (the total for two external pulse generators if used). In this case, pay careful attention to the voltage drop caused by the cable resistance. Assume 4.95 V for the 5 V power of the Power Mate.
4. Line length is 50m or less.
5. Do not make any connection other than the above.

(a) Operating conditions

The maximum allowable frequency for the input signal is 100 kHz (the frequency is, however, multiplied by four in the CNC).

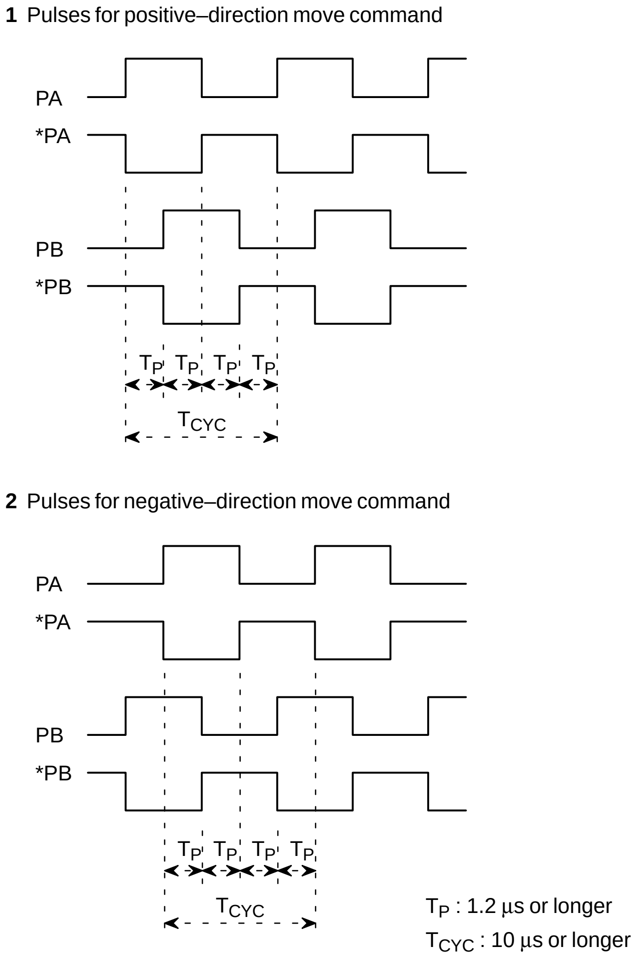


Fig. 10.2 (a) Input pulse waveforms

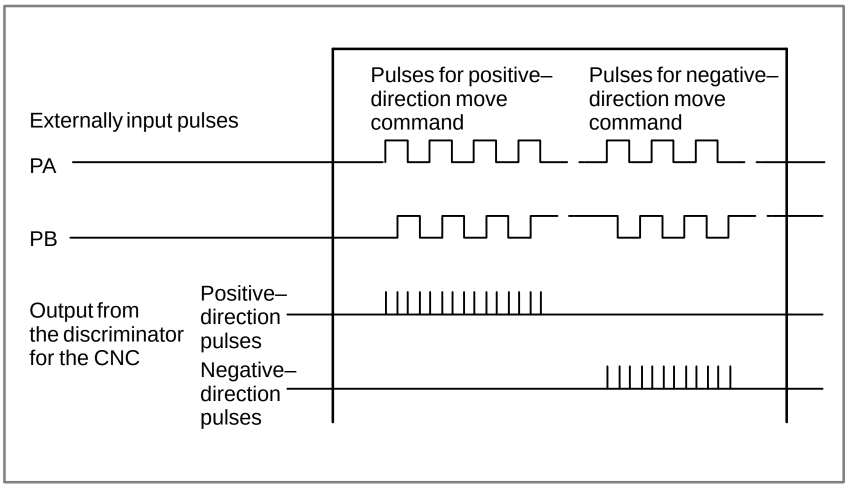


**Fig. 10.2 (b)  Sequence**

(b) Recommend circuit

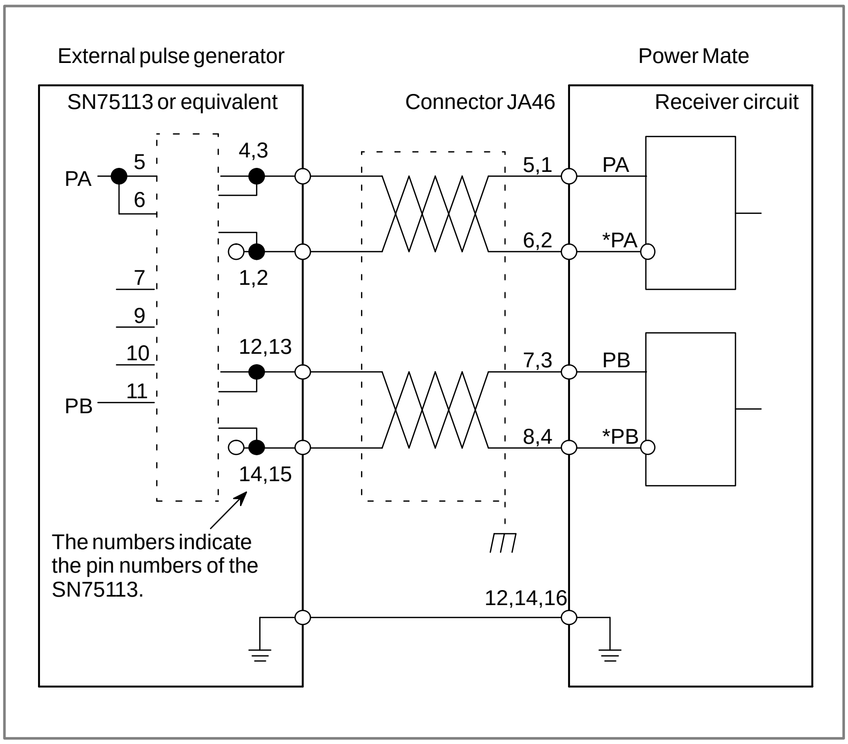


**Fig. 10.2 (c)  Recommended circuit**

# 10.3 MANUAL PULSE GENERATOR INTERFACE

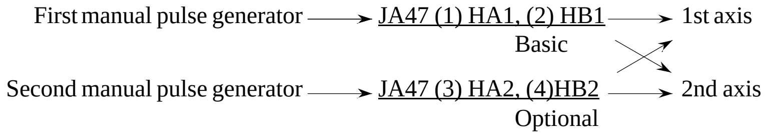
## 10.3.1 Overview

1) One–path Power Mate *i*–D

In basic mode, a manual pulse generator interface for one axis is provided. Whether this manual pulse generator interface is used for the first or second axis can be selected by the PMC.

An optional manual pulse generator interface for another axis can be added.

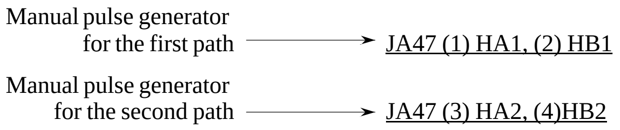
This manual pulse generator interface can be used for either the first or second axis, this being selected by the PMC.



2) Two–path Power Mate *i*–D

In basic mode, a manual pulse generator interface for one axis is provided for each path.

One manual pulse generator is connected to each path. The connecting positions are fixed. The use of the manual pulse generator interface can be specified separately for each path by the PMC.

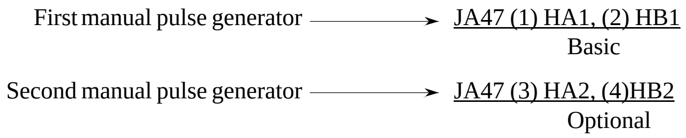


3) Power Mate *i*–H

In basic mode, a manual pulse generator interface for one axis is provided. The axis for which this manual pulse generator interface is used is selected using the PMC.

An optional manual pulse generator interface for another axis can be added.

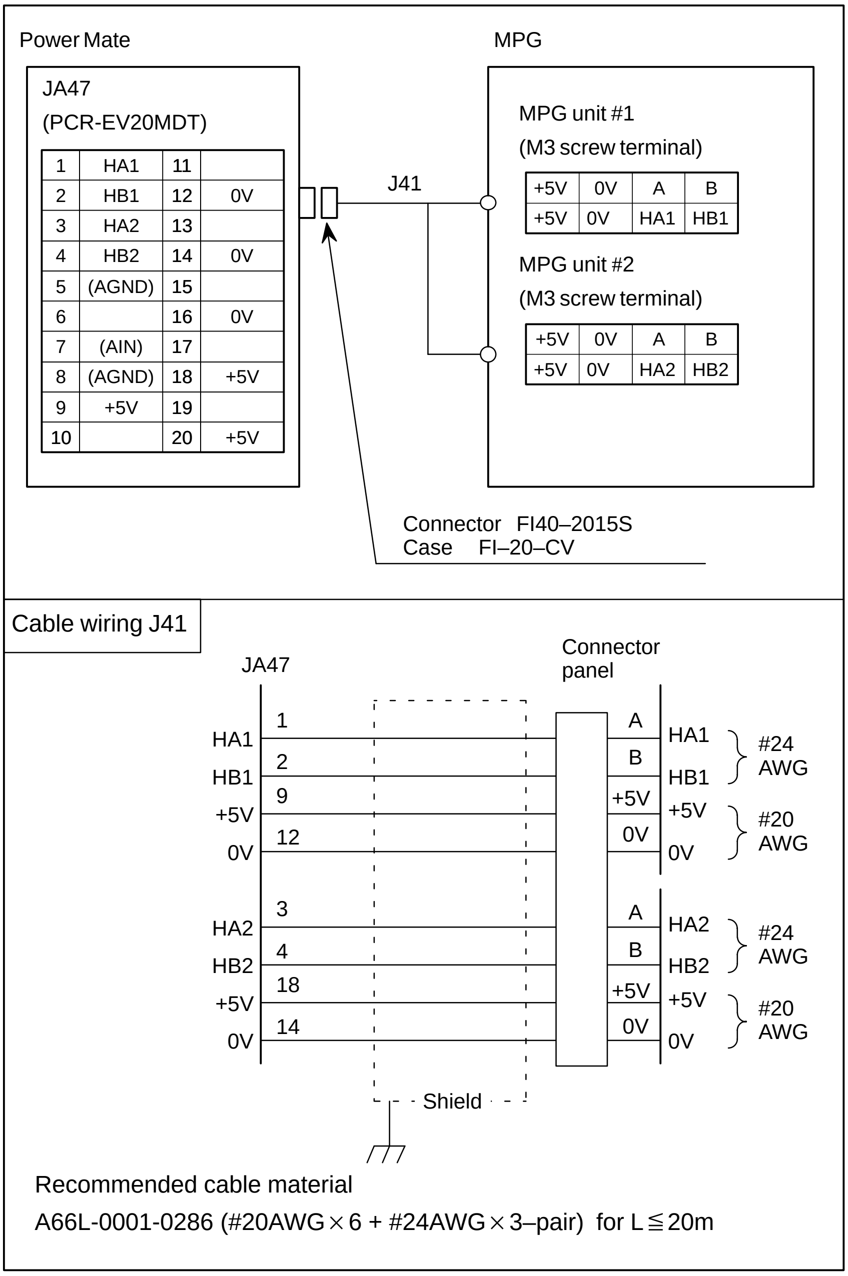
The axis for which this manual pulse generator interface is used is selected using the PMC.



**NOTE**

Some units for FANUC I/O Link have a manual pulse generator interface. This interface cannot be used together with the above interface.

## 10.3.2 Connection



Recommended cable:

A66L–0001–0286 (6 pairs of #20AWG wires and 3 pairs of #24AWG wires)

Recommended connector:

A02B–0120–K303 (such as the following connector and its housing)
(Connector:Soldering–type FI40–2015S, manufactured by Hirose Electric Co., Ltd.)
(Housing:FI–20–CV, manufactured by Hirose Electric Co., Ltd.)

Recommended cables:

A02B–0259–K822 (7m) (for connecting two manual pulse generators)

A02B–0259–K821 (7m) (for connecting one manual pulse generator)

(These cables are those used between the JA47 connector and the connector panel.)

Do not make any connection other than the above.

**NOTE**

Do not make any connection other than the above.

### 10.3.3
### Cable Length for Manual Pulse Generator

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

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

Wher

0.1 = manual pulse generator supply current (0.1 A)/unit

R = resistance per unit cable length (Ω/m)

m = number of 0–volt and 5–volt wires

L = cable length (m).

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

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

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

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

However, the maximum pulse transmission distance for the manual pulse generator is 50 m. Taking this into consideration, the cable length may be extended to:

38.37 m (when two manual pulse generators are used).

## 10.3.4 Interface of the External Pulse Generator (for Power Mate *i*–H)

In the Power Mate *i*–H, an external pulse generator with a single–phase input can be connected instead of the manual pulse generator manufactured by FANUC.

- **Pulse width**

The relationship between the HAn and HBn signals and the Power Mate pulses shall be as shown in Fig. 10.3.4 (a).
Pulse cycle $T_1$ shall be 200$\mu$sec or more. Pulse cycle $T_1/4$ shall be 50$\mu$sec or more.

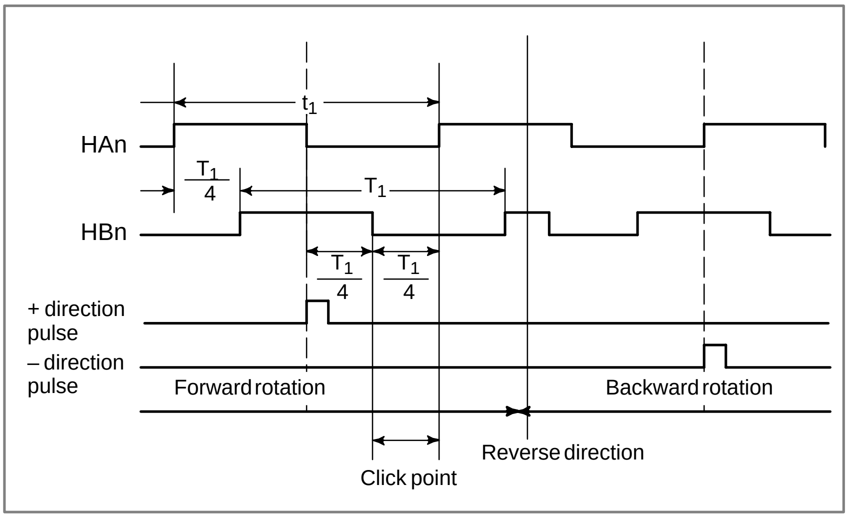


Fig. 10.3.4 (a)

- **Recommended output signal circuit**

A circuit configuration shown in Fig. 10.3.4 (b) is recommended for the output signals of the external pulse generator.

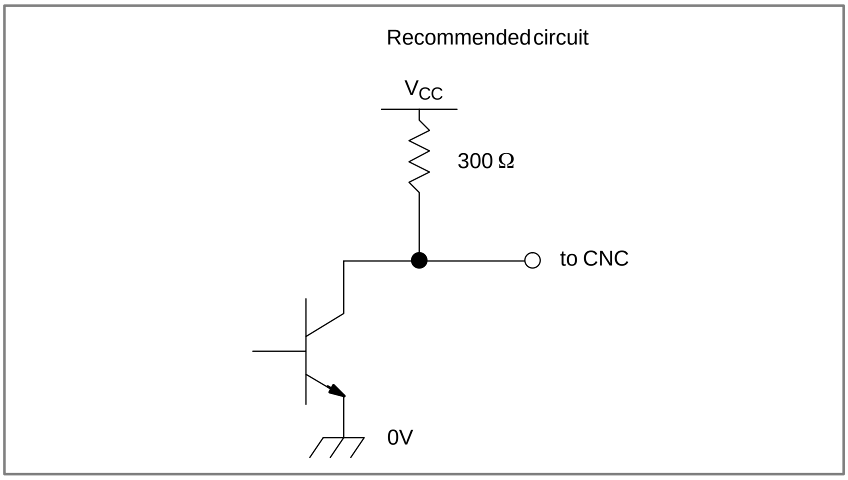


Fig. 10.3.4 (b)

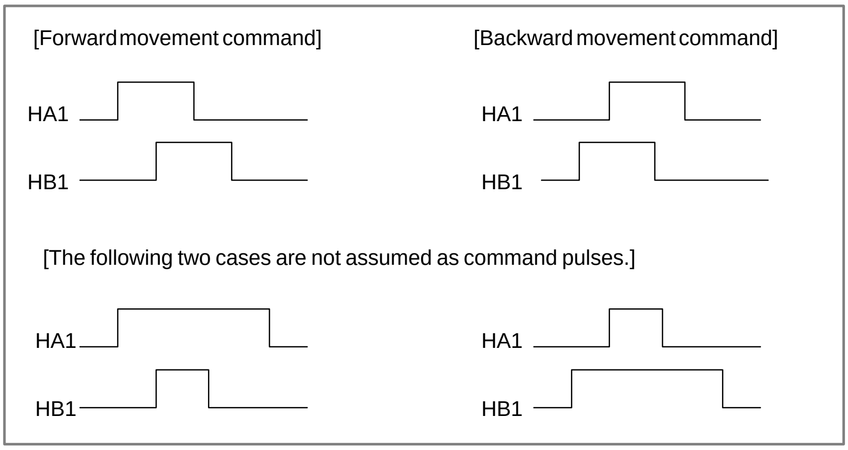
- **Threshold voltage of the Power Mate receiver**

Input signal level change point (threshold)

When the voltage is 3.7 V or higher, the input signal level changes from low to high.

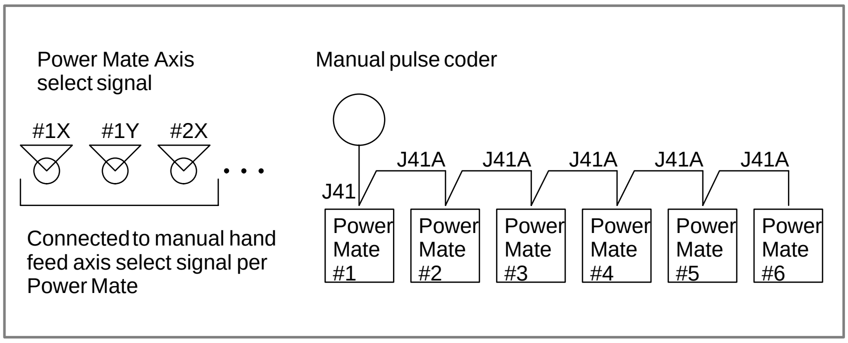
When the voltage is 1.5 V or lower, the input signal level changes from high to low.

- **Signal logics**



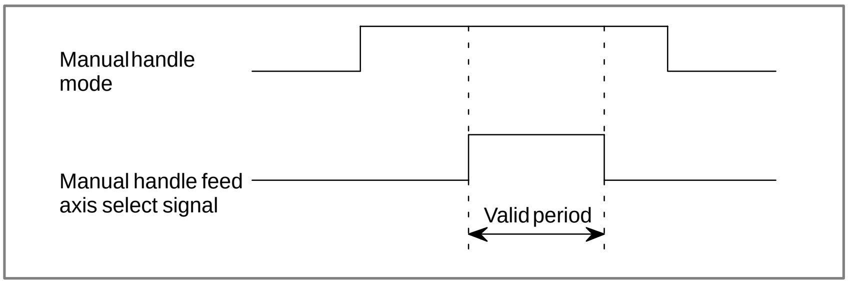
## 10.3.5 Connecting a Manual Pulse Coder to Multiple Power Mates

One manual pulse coder can be connected to up to six Power Mates, such that each Power Mate can control the manual pulse coder.



(1) Manual pulse control

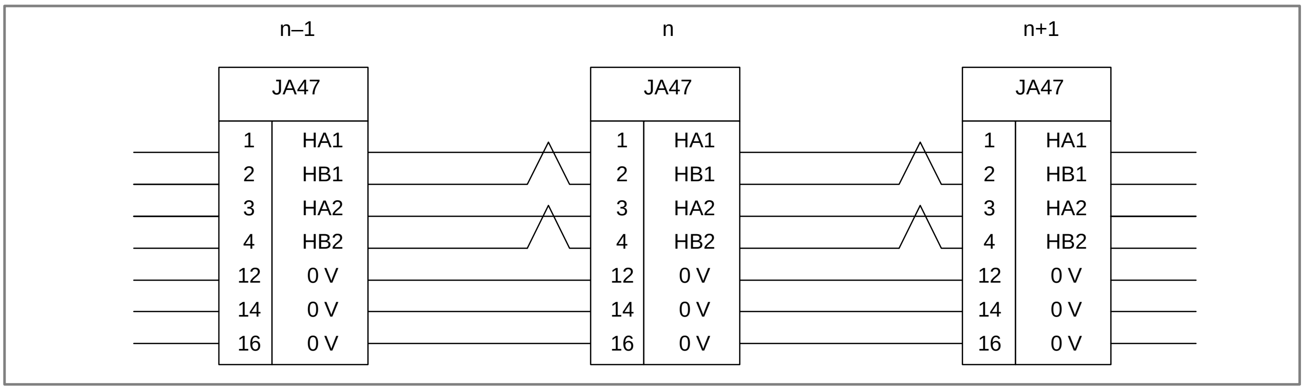
For each Power Mate, manual pulse mode is enabled when the following condition is satisfied:



**NOTE**

Any manual pulse signal that is applied outside the valid period, shown above, is ignored. (At the start of the valid period for the manual pulse mode, a manual pulse signal being applied at that time is discarded.)

(2) Details of J41A connection



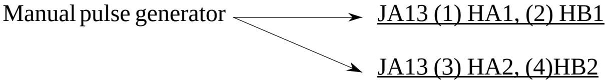
**NOTE**
Do not connect any pins other than those shown above.

**CAUTION**
Connecting the 5–V signals on pins 9, 18, and 20 can damage the Power Mate.

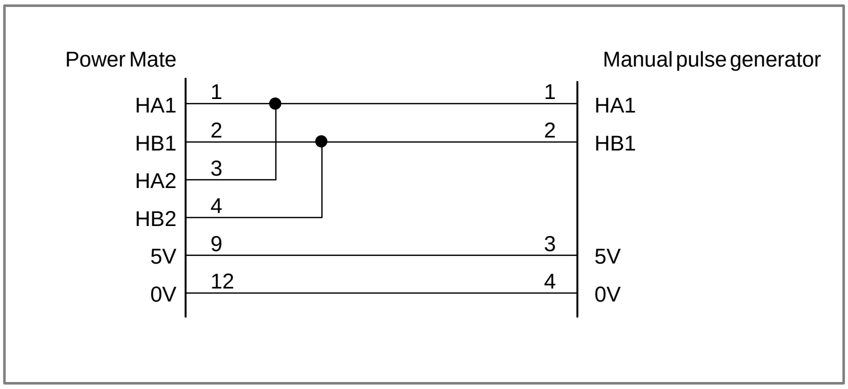
---

## 10.3.6
## Sharing of a Manual Pulse Generator by the Two–path Power Mate *i*–D

Generally, one manual pulse generator is required for each path. However, a single manual pulse generator can be shared by two paths. The PMC selects the path that will use the manual pulse generator.



When sharing a manual pulse generator, connect the signals of the manual pulse generator to both interfaces. In this case, the signals are connected in the same way as when two Power Mates are connected to a single manual pulse generator, as explained in Subsec. 10.3.5.



# 10.4 ANALOG INPUT FUNCTION

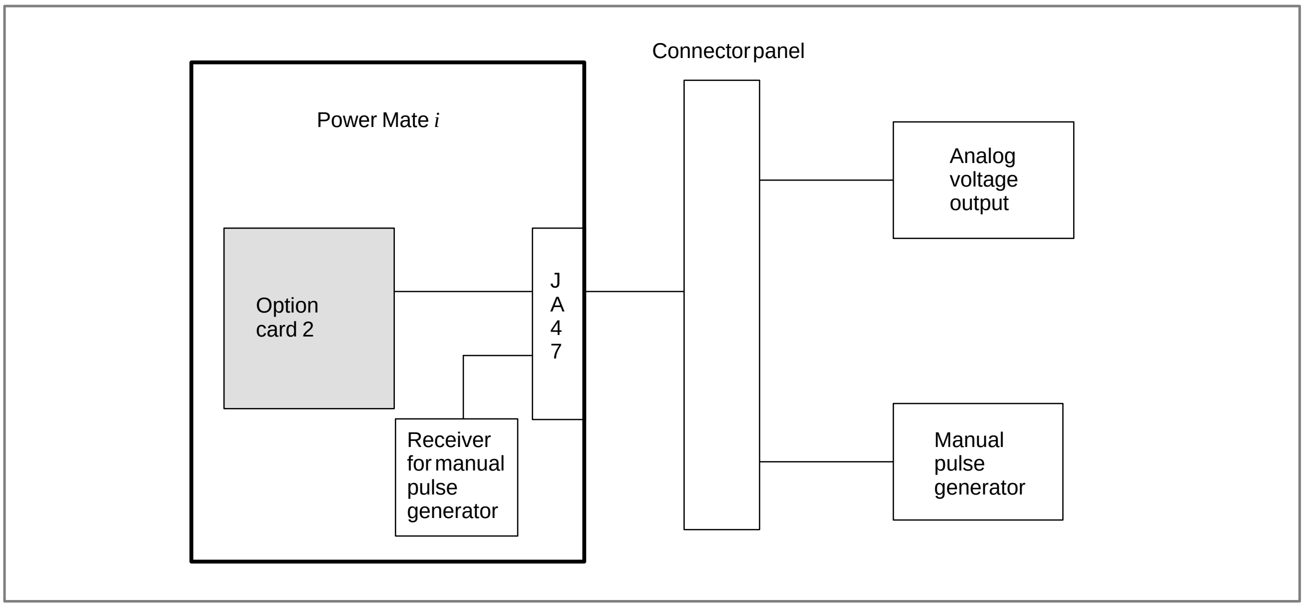
## 10.4.1 Overview

The one–path Power Mate *i*–D and Power Mate *i*–H are provided with one analog voltage input channel.

**NOTE**
The analog input function is not supported by the 2–path Power Mate *i*–D.

Option card 2 (A02B–0259–J021) is required to enable the use of the analog input function.

## 10.4.2 System Configuration



## 10.4.3
## Analog Input Function Specifications

| Item | Specification |
|---|---|
| Number of input channels | 1 |
| Analog input range | –10 to +10VDC |
| Maximum input voltage | ±12VDC |
| Digital output | Signed 8–bit binary data |
| Resolution | 78 mV |
| Overall accuracy | ±0.5% (of the full scale) |
| Conversion time | 8 ms or less(NOTE) |
| Insulation | Non–insulated |

**NOTE**

The conversion time represents the time required for conversion in the Power Mate, until resultant data is output to the F area of the PMC. The actual response speed can be obtained by adding the PMC ladder scan time.

## 10.4.4
## Connection Details

Analog input interface

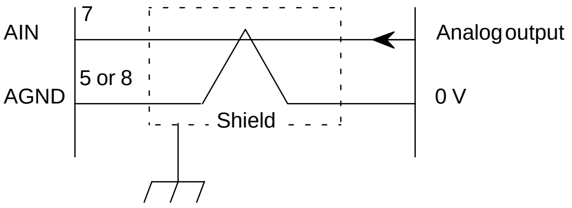
Power Mate

JA47
(RCR-EV20MDT)

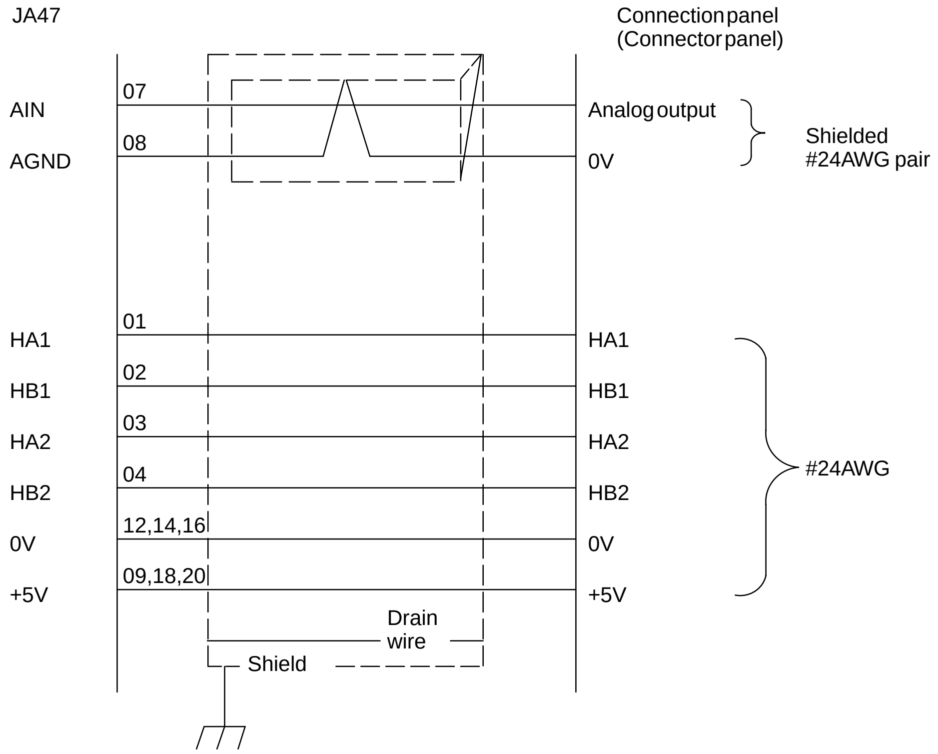
| | | | |
|---|---|---|---|
| 1 | (HA1) | 11 | |
| 2 | (HB1) | 12 | (0V) |
| 3 | (HA2) | 13 | |
| 4 | (HB2) | 14 | (0V) |
| 5 | AGND | 15 | |
| 6 | | 16 | (0V) |
| 7 | AIN | 17 | |
| 8 | AGND | 18 | (+5V) |
| 9 | (+5V) | 19 | |
| 10 | | 20 | (+5V) |

| Signal mame | Description |
|---|---|
| AIN | Analog input voltage |
| AGND | Reference voltage |

Cable connection



When the analog input interface is used together with the manual pulse generator, their cables must be separated on the connector panel. Use a double–shielded cable between the JD47 connector and the connector panel to separate the analog input voltage from the manual pulse generator signal.



Recommended cable:
A66L–0001–0298: Oki Electric Cable Co., LTD.
(Shield #24AWG pair x 2, #24AWG x 10, drain wire, external cable diameter: 8.5mm)

**NOTE**

Do not make any connection other than the above.

# 10.5 CONNECTION TO A COMMERCIALLY AVAILABLE TOUCH PANEL

## 10.5.1 Overview

The Power Mate *i*–D/H can be connected to a commercially available touch panel that supports FANUC's interface designed for other suppliers' touch panels. With programs on the touch panel, input relay (x), output relay (Y), internal relay (R), keep relay (K), data table (D), timer (T), and counter (C) information of the Power Mate *i* can be read, and touch panel screens can be created based on the read information. In addition, data can be written to the relay (R), keep relay (K), data table (D), timer (T), and counter (C) areas in the Power Mate i.

## 10.5.2 Connectable Commercially Available Touch Panels

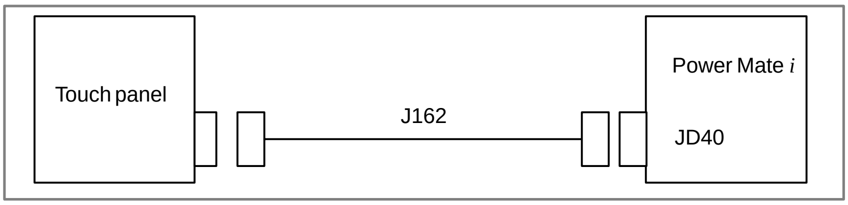
Commercially available touch panels that support FANUC's interface designed for other suppliers' touch panels can be connected to the Power Mate *i*. For information about whether a touch panel supports FANUC's interface for other supplier's touch panels, contact the manufacturer of the touch panel.

FANUC has confirmed the operation of the following touch panels:

- GP–450E, GP–550T, and GP–550S manufactured by Digital Co.
- Handy terminal UT6–AY114 FNC8–A manufactured by Japan Aviation Electronics Industry, Ltd.

FANUC has not confirmed the operation of products other than the above.

## 10.5.3 Connection



(1) The touch panel interface of the Power Mate *i* is RS–422 (JD40).

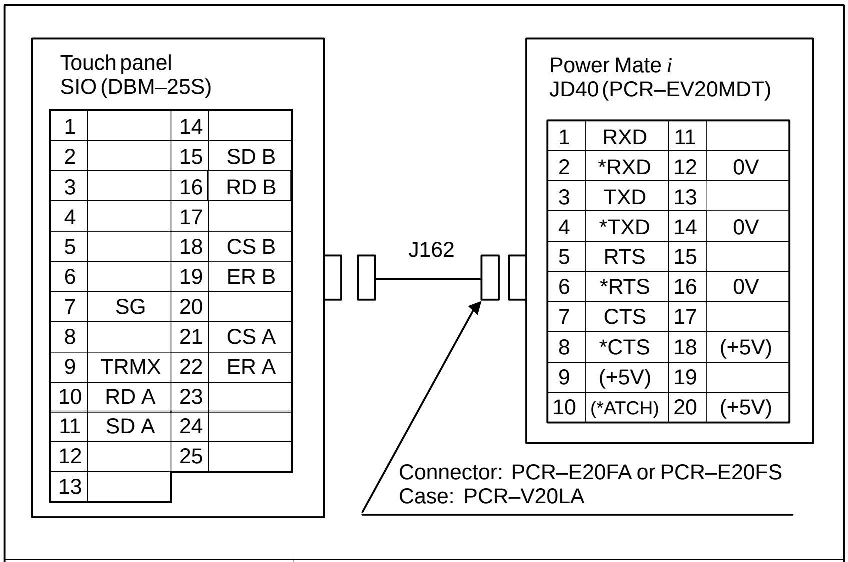
(2) The Power Mate *i* cannot be maintained using commercially available touch panels. So, a notebook personal computer (FAPTLADDER–II, DPL/MDI operation package) should be made connectable to the Power Mate i over RS–232C channel 2 for maintenance purposes. Instead of the notebook personal computer, a setup/display device such as a detachable LCD/MDI can also be used for maintenance.

(3) The customer should prepare cable J162.

(4) Turn on the power to the Power Mate before turning on the touch panel. Some touch panels allow setting of the time from power–on until the touch panel starts operation. When such a touch panel is used, the touch panel may be turned on before the power–on of the Power Mate if the Power Mate is turned on before the touch panel actually starts operation.

## 10.5.4

## Details of Connection via RS–422



Touch panel
SIO (DBM–25S)

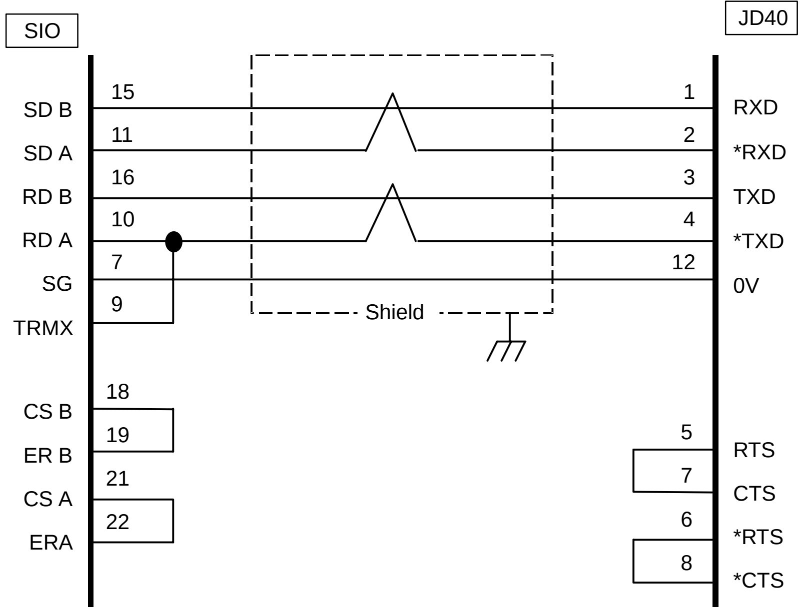
| | | | |
|---|---|---|---|
| 1 | | 14 | |
| 2 | | 15 | SD B |
| 3 | | 16 | RD B |
| 4 | | 17 | |
| 5 | | 18 | CS B |
| 6 | | 19 | ER B |
| 7 | SG | 20 | |
| 8 | | 21 | CS A |
| 9 | TRMX | 22 | ER A |
| 10 | RD A | 23 | |
| 11 | SD A | 24 | |
| 12 | | 25 | |
| 13 | | | |

Power Mate *i*
JD40 (PCR–EV20MDT)

| | | | |
|---|---|---|---|
| 1 | RXD | 11 | |
| 2 | *RXD | 12 | 0V |
| 3 | TXD | 13 | |
| 4 | *TXD | 14 | 0V |
| 5 | RTS | 15 | |
| 6 | *RTS | 16 | 0V |
| 7 | CTS | 17 | |
| 8 | *CTS | 18 | (+5V) |
| 9 | (+5V) | 19 | |
| 10 | (*ATCH) | 20 | (+5V) |

Connector: PCR–E20FA or PCR–E20FS
Case: PCR–V20LA

Cable connection (J162)



Recommended cable
Communication line: A66L–0001–0284#10P (#28AWG × 10 pairs, shielded)
Others: #24AWG

**NOTE**
The above shows a sample connection. For connection on the touch panel side, refer to the specifications on the touch panel used.

## 10.6 CONNECTION BY MULTIAXIS SYNCHRONIZATION FUNCTION (Power Mate *i*–H ONLY)

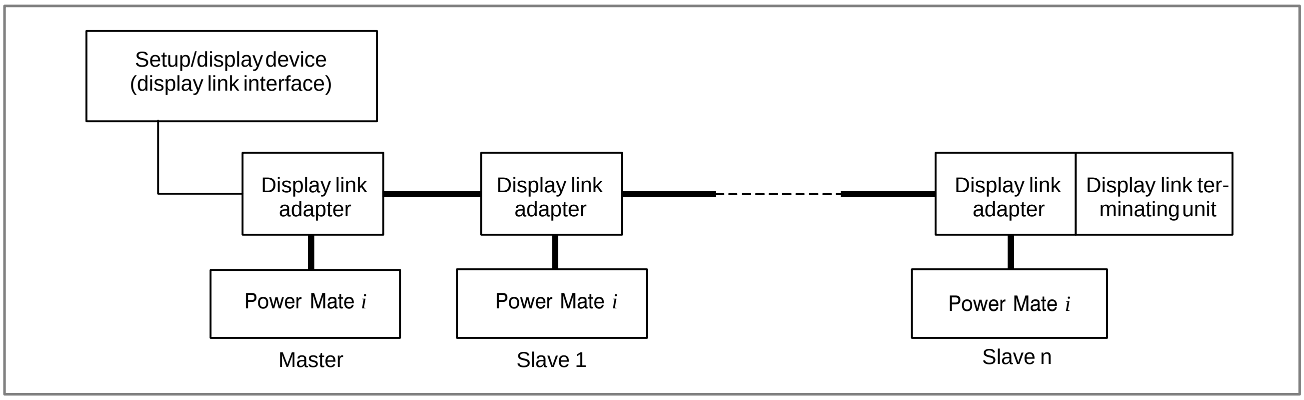
### 10.6.1 Overview

With the multiaxis synchronization function, up to 16 FANUC Power Mate *i*–MODEL H units can be interconnected, enabling synchronization control for up to 128 axes. Use of a special communication line for multiaxis synchronization allows precise synchronization. This function is free from synchronous error accumulation even after long–time operation.

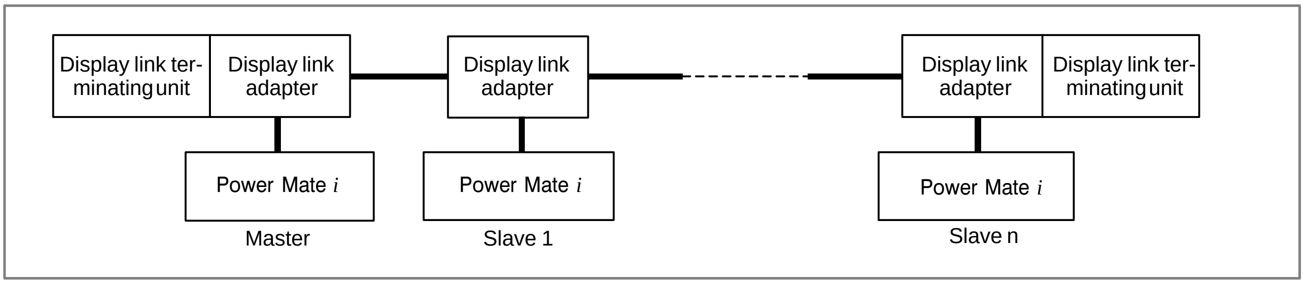
The multiaxis synchronization function uses one master connected to multiple slaves. The master must be placed at the beginning of the multiaxis synchronization line. The device number of each Power Mate *i*–H unit is assigned in the same way as on the display link.

The multiaxis synchronization line interface is within the connector that contains the display link interface. The method for connecting the multiaxis synchronization line interface varies depending on how the display link interface is used.

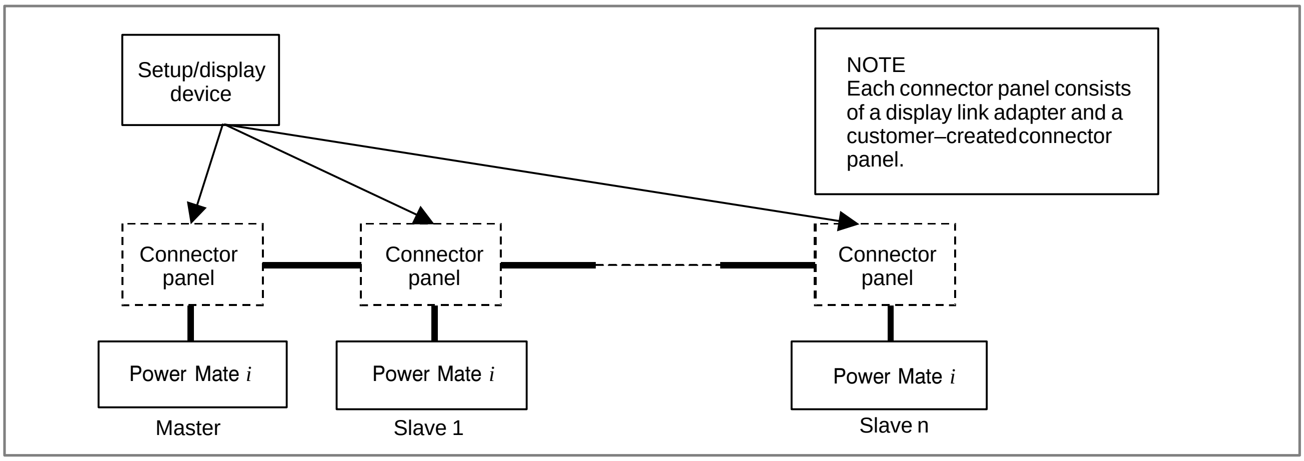
1) When a setup/display unit using the display link interface is always connected for use



2) When a setup/display device using the display link interface is not used

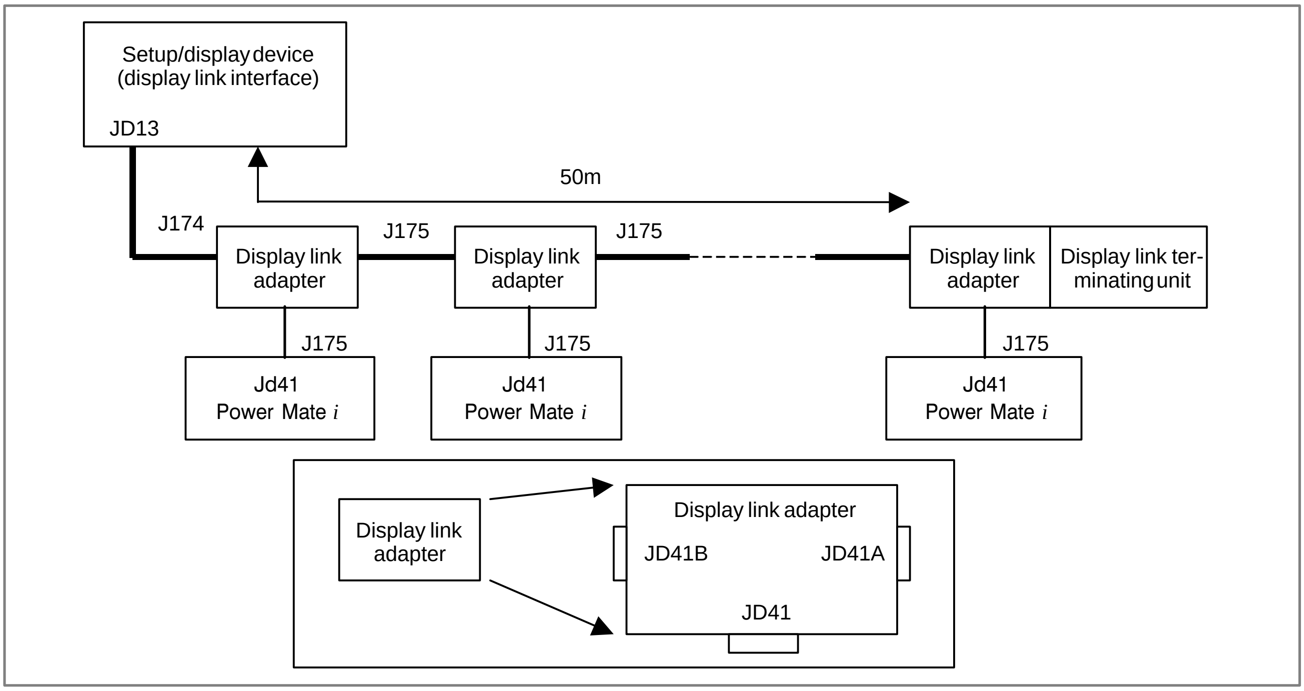


3) When a setup/display device using the display link interface is used among the Power Mate *i*–H units in a detachable manner (also when the handy operator’s panel is used in a detachable manner)



**NOTE**
For the display link adapter and display link terminating unit, see Subsections 8.1.9 and 8.1.10.

## 10.6.2
## Connection When a Setup/Display Device using the Display Link Interface is Always Connected



(1) The same restrictions as on J45 of the CRT/MDI interface in Section 8.1 are imposed on cables J174 and J175.

(2) The maximum cable length is 50 m (the total length of cable J174 and cables J175 that interconnect the display link adapters). The cable length between the Power Mate *i*–H and display link adapter should be as short as possible (500 mm maximum).

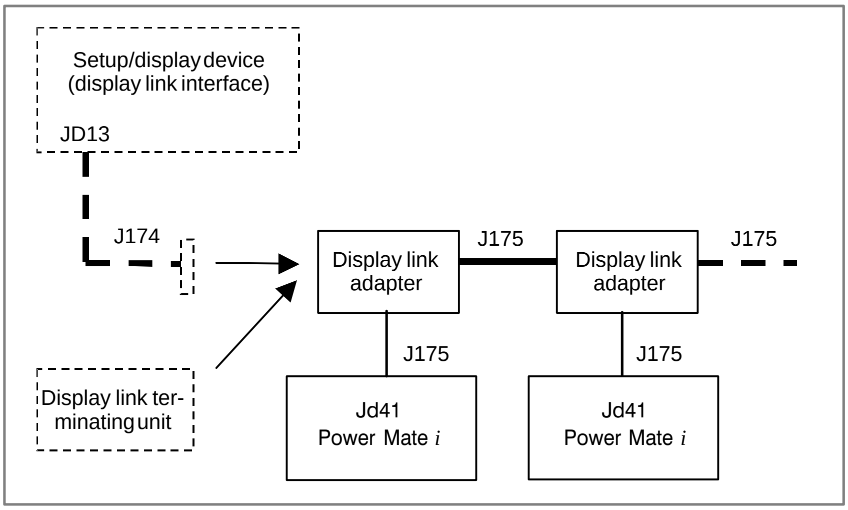
(3) The restrictions on the display link interface are the same as those described in Section 8.1. Note that, however, the maximum cable length, 50 m, cannot be exceeded.

(4) The display link interface signals are terminated by the setup/display device (including a terminating resistor) and the display link terminating unit at the right end.

(5) The multiaxis synchronization signal is terminated by cable J174 and the display link terminating unit at the right end.

(6) Cable J174 has upper compatibility with display link interface cable J142 (see Subsection 8.1.2). Even when the multiaxis synchronization function is not needed, cable J174 may be used.

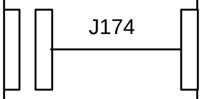
(7) When the setup/display device is used in a detachable manner, the multiaxis synchronization signal must be terminated by a display link terminating unit while the setup/display device is detached.



Details of cable J174

JD13 on setup/display device
(PCR–EV20MDT)

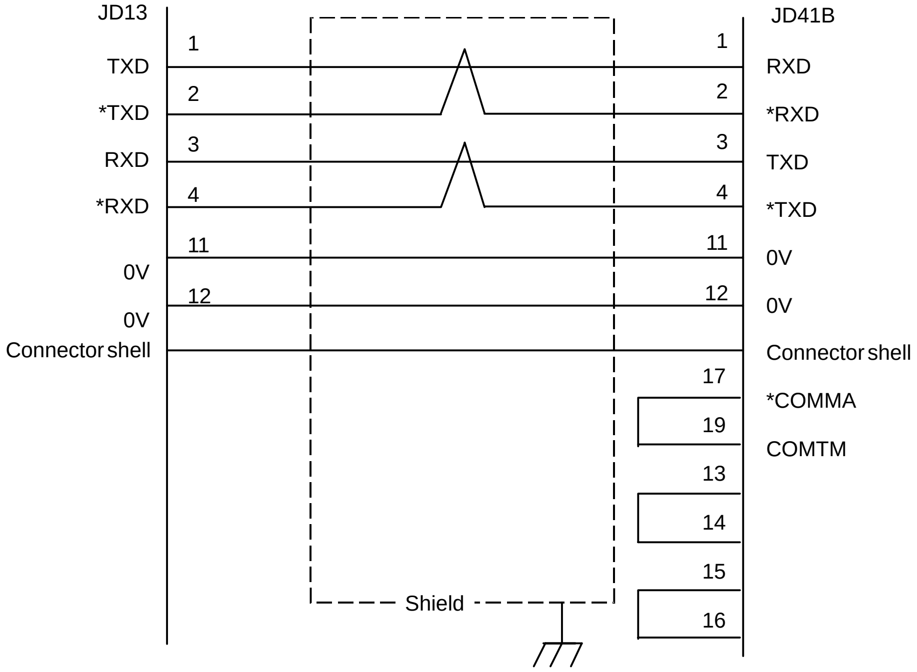
| | | | |
|---|---|---|---|
| 1 | TXD | 11 | 0V |
| 2 | *TXD | 12 | 0V |
| 3 | RXD | 13 | (SI1) |
| 4 | *RXD | 14 | (*SI1) |
| 5 | (ITPGA) | 15 | (SI2) |
| 6 | (*ITPGA) | 16 | (*SI2) |
| 7 | (ITPGB) | 17 | (SI3) |
| 8 | (*ITPGB) | 18 | (*SI3) |
| 9 | (SIO) | 19 | |
| 10 | | 20 | (*SIO) |



JD41B on display link adapter
(PCR–EV20MDT)

| | | | |
|---|---|---|---|
| 1 | RXD | 11 | 0V |
| 2 | *RXD | 12 | 0V |
| 3 | TXD | 13 | |
| 4 | *TXD | 14 | |
| 5 | (TXALM) | 15 | |
| 6 | (*TXALM) | 16 | |
| 7 | | 17 | COMMA |
| 8 | | 18 | (*COMMA) |
| 9 | | 19 | COMTM |
| 10 | | 20 | |

Cable connection (J174)



Recommended cable: A66L–0001–0284#10P (#28AWG 10 pairs, common shield)
<Hitachi Cable, Ltd., Oki Electric Cable Co., Ltd.>
Recommended connector on the cable side: PCR–E20FS or PCRE20FA, housing: PCR–V20LA <Honda Tsushin>
FANUC purchase drawing number: A02B–0259–K861 (cable length: 5 m)
A02B–0259–K862 (cable length: 10 m)

**NOTE**

1 The multiaxis synchronization signal is terminated by connecting pins 17 and 19 on connector JD41B.

2 Connecting pins 13 and 14, and pins 15 and 16 on connector JD41B is to make cable J174 upper compatible with cable J142 (Subsection 8.1.2).

3 Do not change the combination of the wires of twisted pairs.

4 Connecting the connector shells to each other is to use the setup/display device in a detachable manner.

5 Do not make any connection other than the above.

## Details of cable J175

JD41 on display link adapter
(PCR–EV20MDT)

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

J175

Power Mate *i*–H JD41
(PCR–EV20MDT)

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

JD41A on display link adapter
(PCR–EV20MDT)

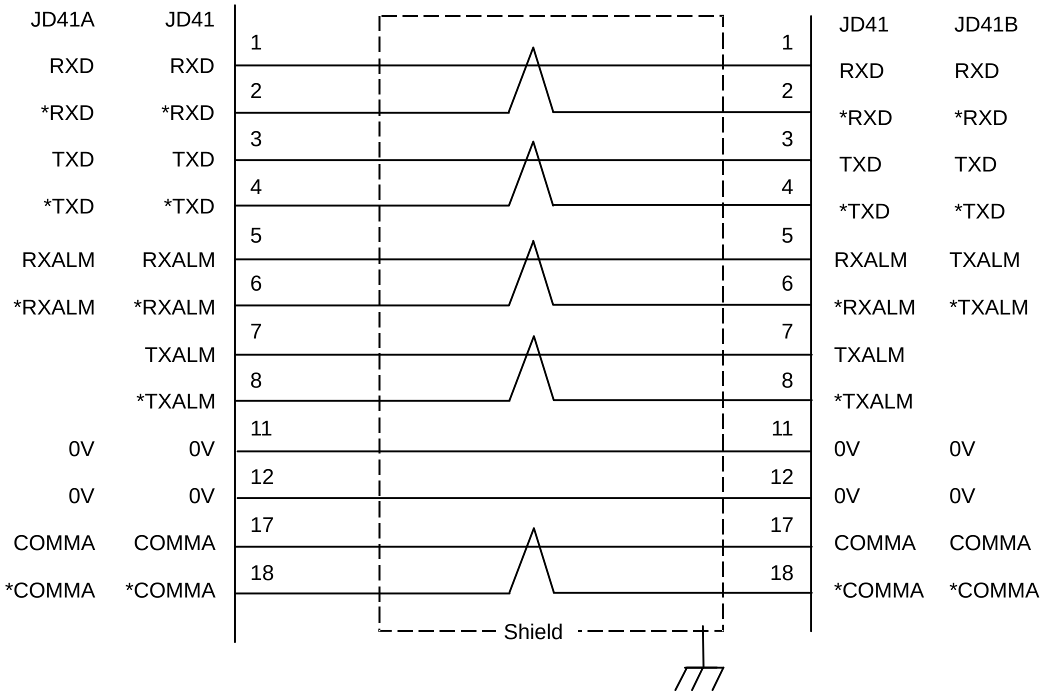
| | | | |
|---|---|---|---|
| 1 | RXD | 11 | 0V |
| 2 | *RXD | 12 | 0V |
| 3 | TXD | 13 | |
| 4 | *TXD | 14 | |
| 5 | RXALM | 15 | |
| 6 | *RXALM | 16 | |
| 7 | | 17 | COMMA |
| 8 | | 18 | *COMMA |
| 9 | | 19 | |
| 10 | | 20 | |

J175

JD41B on display link adapter
(PCR–EV20MDT)

| | | | |
|---|---|---|---|
| 1 | RXD | 11 | 0V |
| 2 | *RXD | 12 | 0V |
| 3 | TXD | 13 | |
| 4 | *TXD | 14 | |
| 5 | TXALM | 15 | |
| 6 | *TXALM | 16 | |
| 7 | | 17 | COMMA |
| 8 | | 18 | *COMMA |
| 9 | | 19 | (COMTM) |
| 10 | | 20 | |

Cable connection (J175)



Recommended cable: A66L–0001–0284#10P (#28AWG 10 pairs, common shield)
<Hitachi Cable, Ltd., Oki Electric Cable Co., Ltd.>

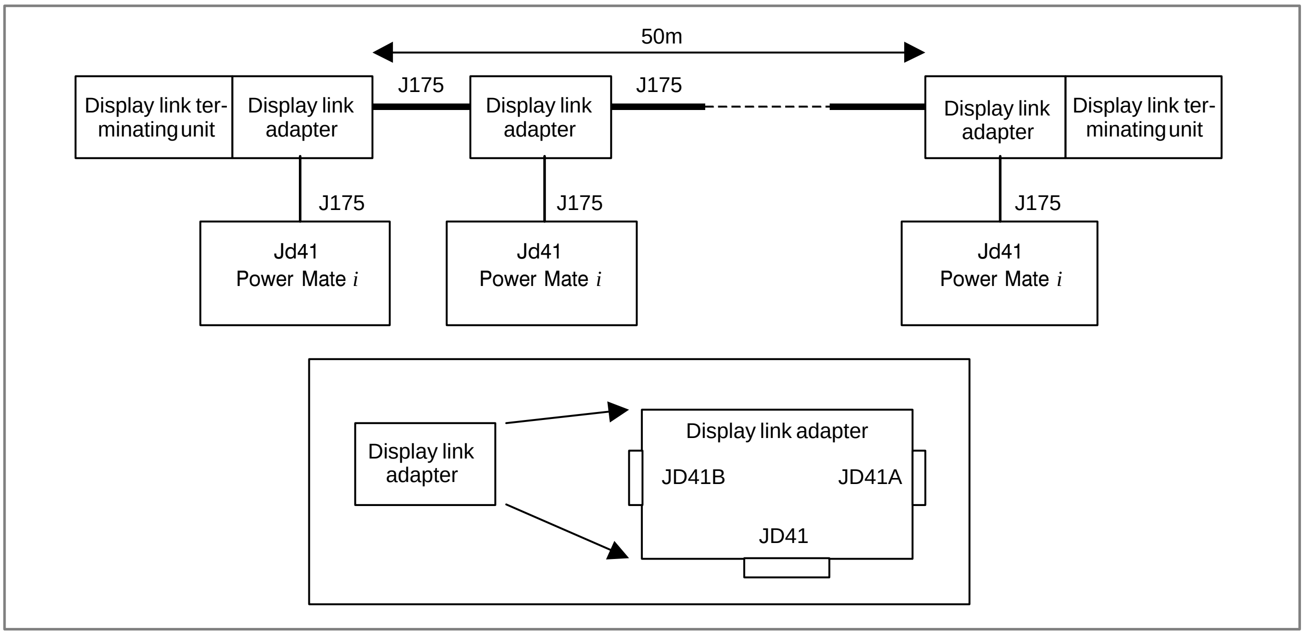
Recommended connector on the cable side:
PCR–E20FS or PCRE20FA, housing:
PCR–V20LA <Honda Tsushin>

FANUC purchase drawing number:
A20B–0259–K863 (cable length: 500 mm)
A02B–0259–K864 (cable length: 5 m)
A02B–0259–K865 (cable length: 10 m)

**NOTE**
1 Do not change the combination of the wires of twisted pairs.
2 Do not make any connection other than the above.
3 The maximum cable length between the Power Mate *i*–H and display link adapter is 500 mm.

---

## 10.6.3
## Connection When a Setup/Display Device Using the Display Link Interface is Not Used



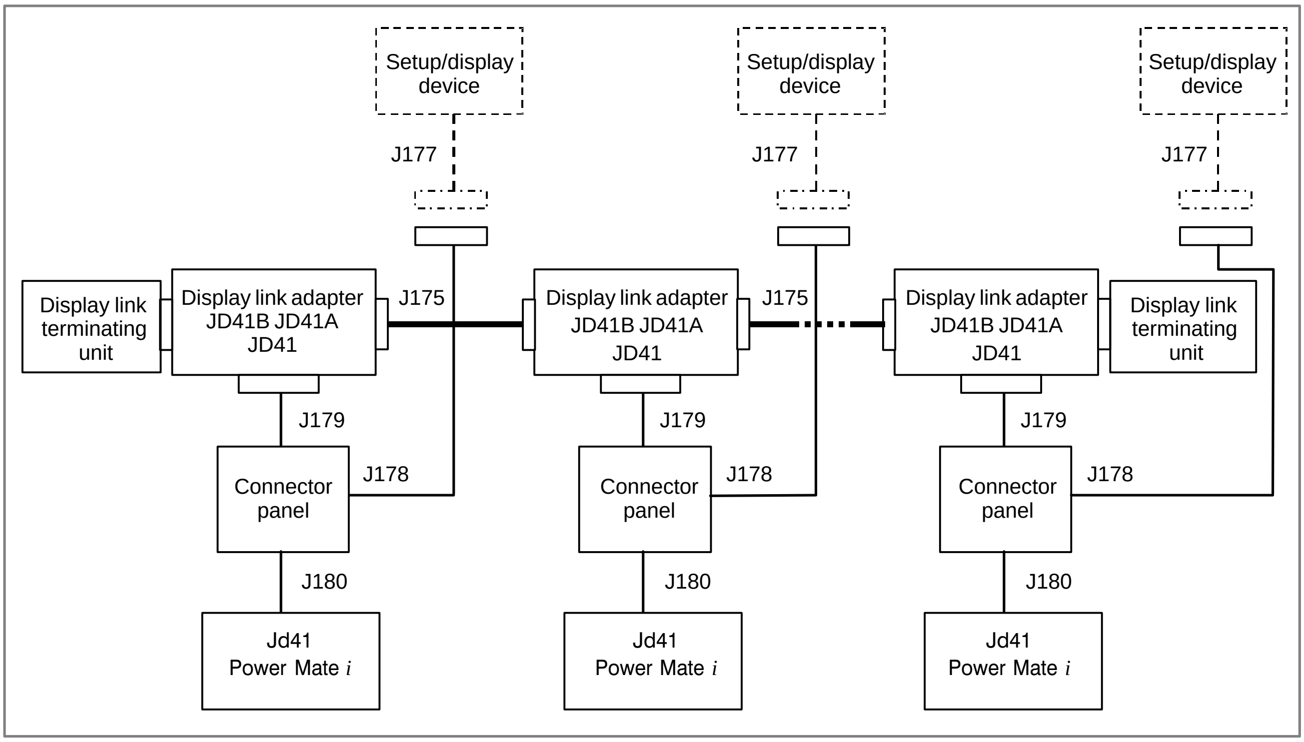
(1) The same restrictions as on J45 of the CRT/MDI interface described in Section 8.1 are imposed on cable J175. In particular, pay attention to the cable length between the Power Mate *i*–H and display link adapter. For cable connection, see Subsection 10.6.2.

(2) The maximum cable length is 50 m (the total length of cables J175 that interconnect the display link adapters).

(3) The multiaxis synchronization signal is terminated by the display link terminating units at both ends.

## 10.6.4
## When a Setup/Display Device Using the Display Link Interface is Used among the Power Mate *i*–H Units in a Detachable Manner

1) Connection diagram



(1) The connector panels are to be created by the customer.

(2) The same restrictions as on J45 of the CRT/MDI interface described in Section 8.1 are imposed on cable J175.
The maximum cable length is 50 m (the total length of cables J175 that interconnect the display link adapters).
For cable connection, see Subsection 10.6.2.

(3) Cables J178 to J180 are not available from FANUC.

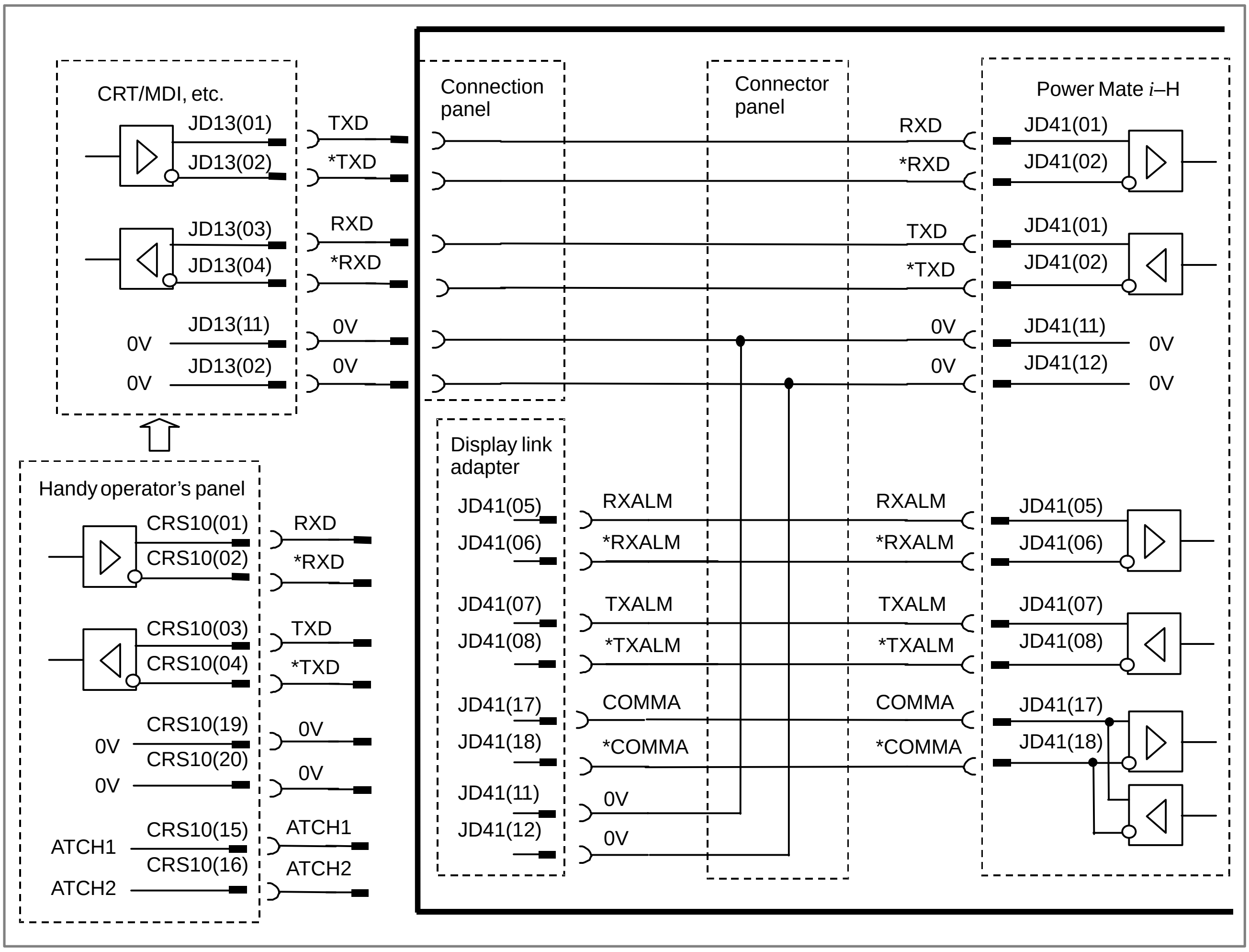
(4) The cable length from the Power Mate *i*–H to connector panel to display link adapter should be as short as possible (500 mm maximum).

(5) The restrictions on the display link interface are the same as those described in Section 8.1. Note that, however, the maximum cable length, 50 m, cannot be exceeded. (J177 + J178 + J180)

(6) The display link interface signal is terminated by the setup/display device (including a terminating resistor) and each Power Mate *i*–H. When the setup/display device is detached, the display link interface signal need not be terminated.

(7) The multiaxis synchronization signal is terminated by the display link terminating units at both ends.

(8) The handy operator’s panel is connected in the same way as the above though the handy operator’s panel does not use the display link interface.



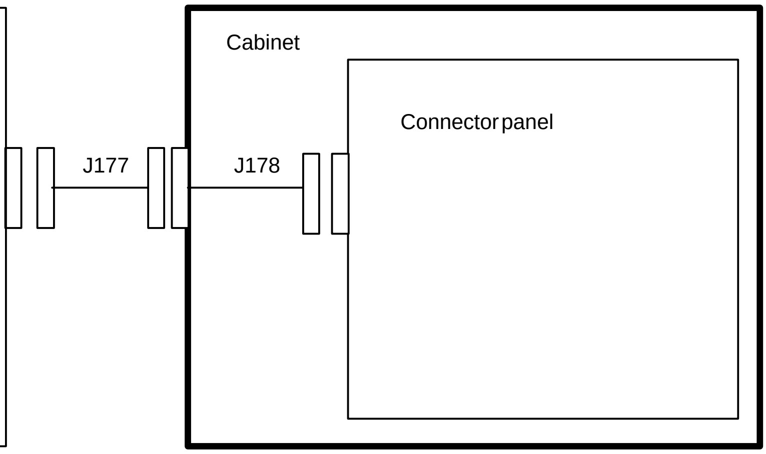
**NOTE**

1. The connector panel is to be prepared by the customer.
2. In the above diagram, cabling of JD41A and JD41B among the display link adapters is omitted.
3. In the above diagram, the terminating wiring at JD41 of the Power Mate *i*–H is omitted.
4. When the handy operator’s panel is used, the ATCH1 and ATCH2 signals must be connected to the Power Mate i–H via the connection panel and connector panel. In addition, signals (EMGTP, EMGEN, EMGDM, +24 V, and FG) input to the handy operator’s panel for purposes of other than communication must be wired. See Subsection 8.7.3 and the above connection diagram.

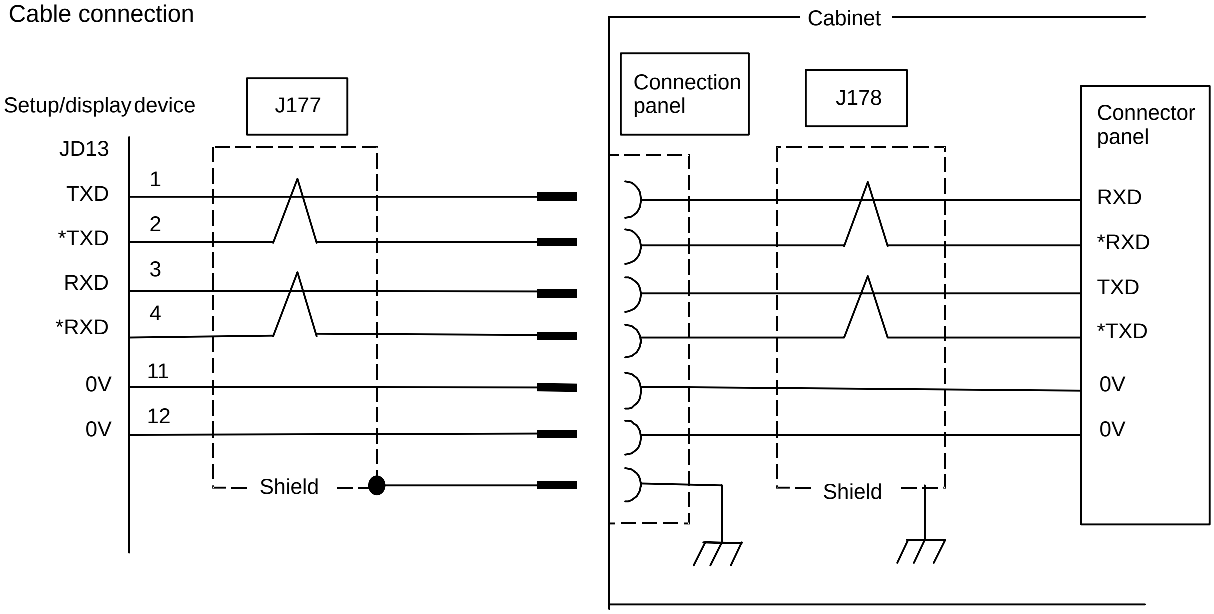
## 2) Details of cables J177 and J178

JD13 in setup/display device
(PCR–EV20MDT)

| | | | |
|---|---|---|---|
| 1 | TXD | 11 | 0V |
| 2 | *TXD | 12 | 0V |
| 3 | RXD | 13 | (SI1) |
| 4 | *RXD | 14 | (*SI1) |
| 5 | (ITPGA) | 15 | (SI2) |
| 6 | (*ITPGA) | 16 | (*SI2) |
| 7 | (ITPGB) | 17 | (SI3) |
| 8 | (*ITPGB) | 18 | (*SI3) |
| 9 | (SIO) | 19 | |
| 10 | | 20 | (*SIO) |



Cable connection



Recommended cable: A66L–0001–0284#10P (#28AWG 10 pairs, common shield) <Hitachi Cable, Ltd., Oki Electric Cable Co., Ltd.>
Recommended connector on the cable side (JD13): PCR–E20FS or PCRE20FA, housing: PCR–V20LA <Honda Tsushin>

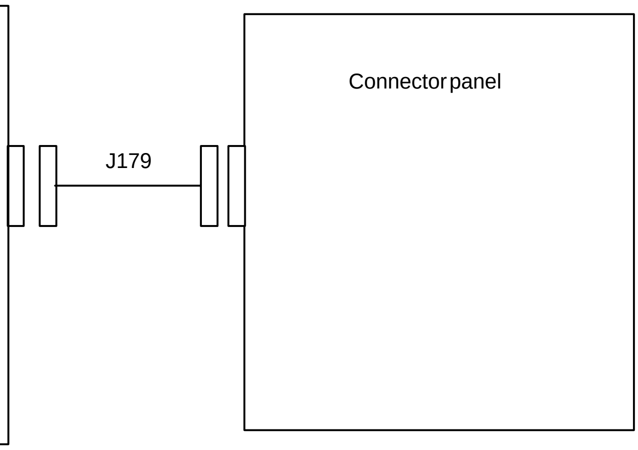
**NOTE**

1. Make no connection to a pin with no name indicated or its name parenthesized in connector JD13.
2. The shield of cable J177 must be grounded when connected to the cabinet.
3. Do not change the combination of the wires of twisted pairs.

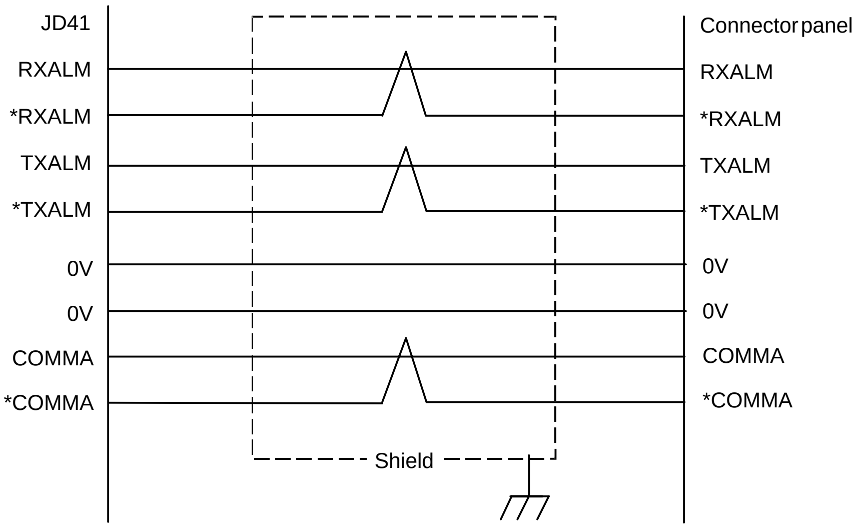
### 3) Details of cable J179

JD41 on display link adapter
(PCR–EV20MDT)

| | | | |
|---|---|---|---|
| 1 | (RXD) | 11 | 0V |
| 2 | (*RXD) | 12 | 0V |
| 3 | (TXD) | 13 | |
| 4 | (*TXD) | 14 | |
| 5 | RXALM | 15 | |
| 6 | *RXALM | 16 | |
| 7 | TXALM | 17 | COMMA |
| 8 | *TXALM | 18 | *COMMA |
| 9 | | 19 | |
| 10 | | 20 | |



Cable connection (J179)

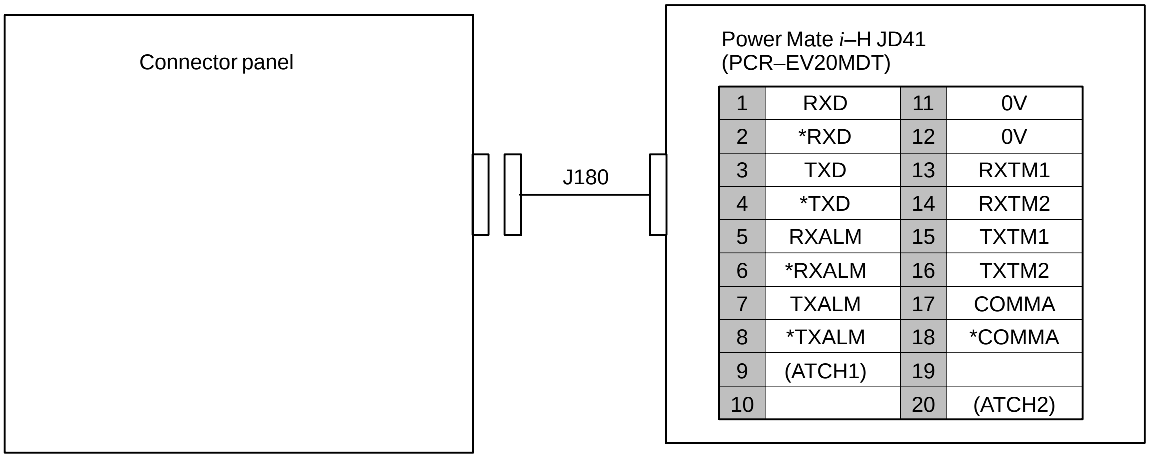


Recommended cable: A66L–0001–0284#10P (#28AWG 10 pairs, common shield) <Hitachi Cable, Ltd., Oki Electric Cable Co., Ltd.>
Recommended connector on the cable side: PCR–E20FS or PCRE20FA, housing: PCR–V20LA <Honda Tsushin>

**NOTE**

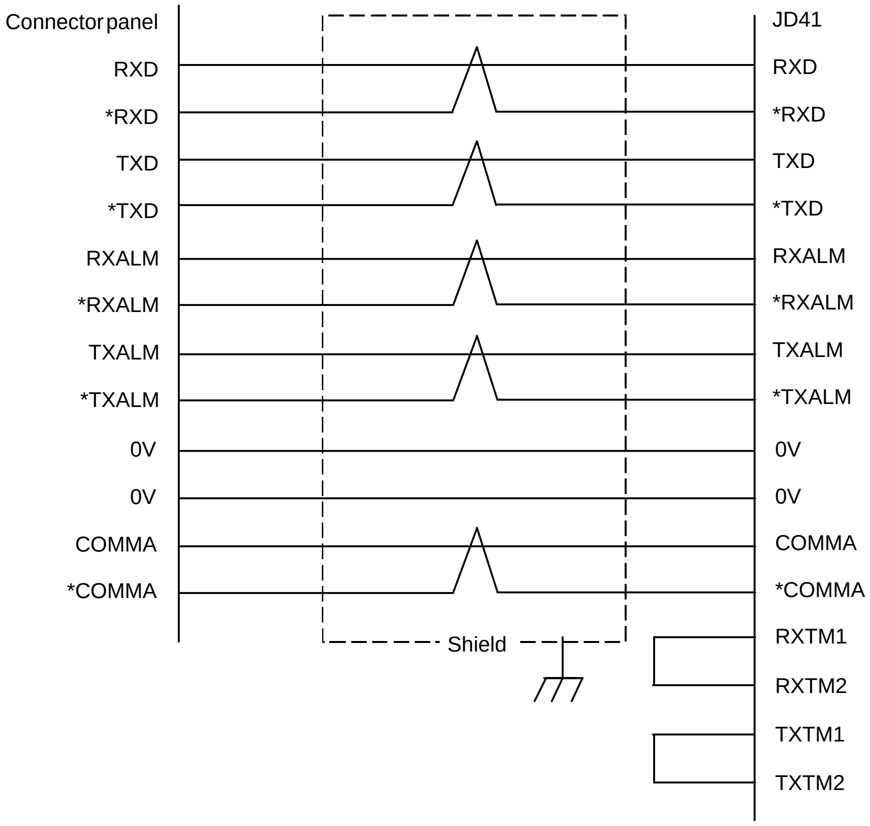
1. Make no connection to a pin with no name indicated or its name parenthesized in connector JD41.
2. Do not change the combination of the wires of twisted pairs.
3. When the connector panel and display link adapter are installed very close to each other, and there is no noise around these units, the shield of the cable need not be clamped. (The cable is not necessarily a shielded cable.)
4. The cable length of cable J179 should be as short as possible. The total length of cables J179 and J180 is 500 mm maximum.

### 4) Details of cable J180



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

Cable connection (J180)



Recommended cable: A66L–0001–0284#10P (#28AWG 10 pairs, common shield) <Hitachi Cable, Ltd., Oki Electric Cable Co., Ltd.>
Recommended connector on the cable side (JD41): PCR–E20FS or PCRE20FA, housing: PCR–V20LA <Honda Tsushin>

**NOTE**

1. Make no connection to a pin with no name indicated or its name parenthesized in connector JD41.
2. Do not change the combination of the wires of twisted pairs.
3. When the handy operator's panel is connected to the Power Mate, connection to JD41(9), labeled ATCH1, and JD41(20), labeled ATCH2, must be made. Make no connection to JD41(15), labeled TXTM1, and JD41(16), labeled TXTM2.

# 10.7
# HANDY MACHINE OPERATOR’S PANEL

## 10.7.1
## Overview

The handy machine operator’s panel is a compact, hand–held operator’s panel to allow the operator to perform operation beside the machine. It consists of a manual pulse generator equipped with a small display device, input keys, emergency stop switch, and enable switch (deadman’s switch).

The handy machine operator’s panel uses a special interface unit to be connected to the Power Mate *i* via FANUC I/O Link. The handy machine operator’s panel can be made detachable by using a connection panel of the cabinet.

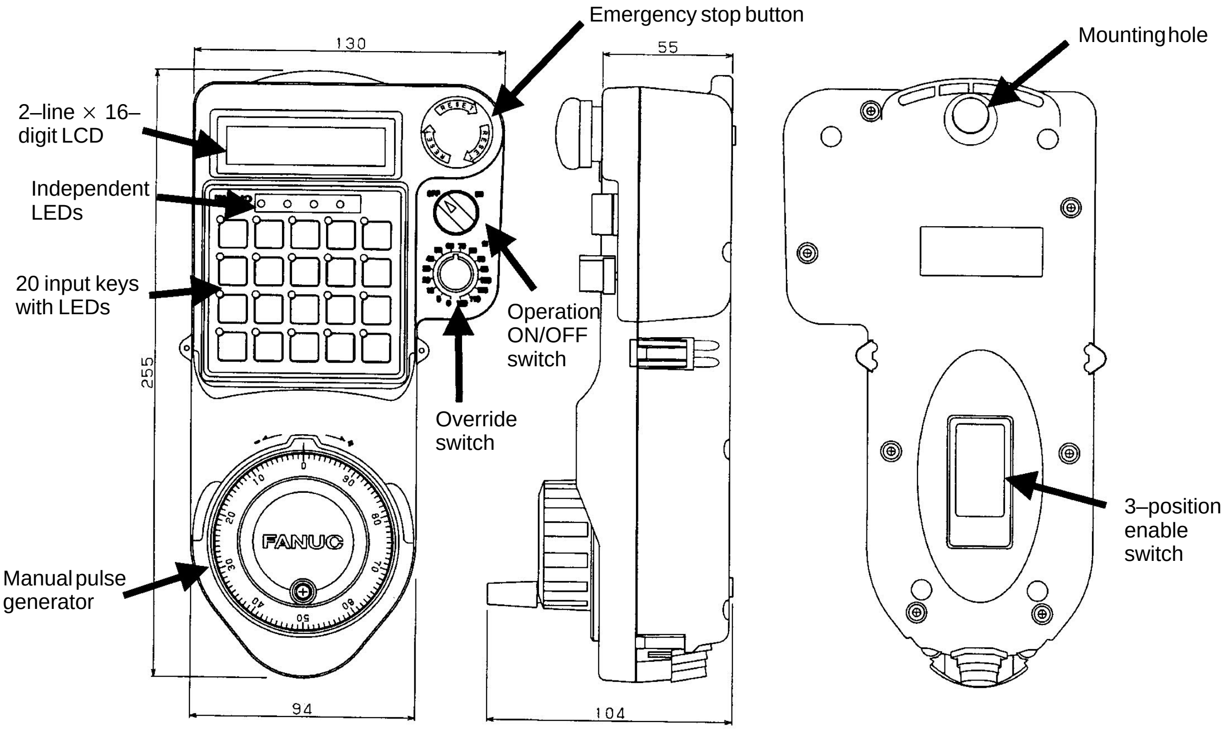
The handy machine operator’s panel is designed to operate the machine; it cannot be used to maintain the Power Mate *i*. For the maintenance of the Power Mate *i*, a setup/display device is required separately.

For details on the handy machine operator’s panel, refer to a separately issued technical report A–80050. (If there is a discrepancy in description, the manual on the handy machine operator’s panel takes priority.)

## 10.7.2
## Main Functions

- The input key, operation ON/OFF switch, and override switch states on the handy machine operator’s panel can be read using PMC ladder programs.
- Positions and messages consisting of alphanumerical and kana characters can be displayed on the LCD of the handy machine operator’s panel by using PMC ladder programs.
- The LEDs attaching to the input keys and the independent LEDs can be turned on and off using PMC ladder programs.
- Operation with the manual pulse generator is possible.
- An emergency stop button is provided to disconnect the system emergency stop circuit line and place the system in the emergency stop state.
- A three–position enable switch is provided to disconnect the system emergency stop circuit line and place the system in the emergency stop state. A circuit can be configured so that when the enable switch is enabled, releasing the switch or strongly grasping the switch places the system in the emergency stop state.
- The enable switch must be enabled automatically when the operator can be exposed to danger, for example, when a door or fence is opened.
- For ensure safety, the emergency stop button and enable switch have two contact outputs.
- The emergency stop button and enable switch on this unit are part of the system emergency stop circuit. The emergency stop circuit must be connected last to the emergency stop inputs of the CNC and servo amplifiers.
- Detachable connection is possible by providing the cabinet with a connection panel.

## 10.7.3
## External View of the Handy Machine Operator's Panel



# 11 EMERGENCY STOP SIGNAL

## 11.1 GENERAL

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 must be input to the Power Mate *i*, servo amplifier, and spindle amplifier. An emergency stop signal is usually generated by closing the B contact of a pushbutton switch.

## 11.2 Power Mate *i*

When the emergency stop signal (*ESP) contact is closed, the Power Mate *i* 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 Power Mate *i* is reset and enters the emergency stop state, and the servo and spindle motors are stopped.

The Power Mate *i* must be supplied with an emergency stop signal from either the built–in I/O module or the I/O module supporting the FANUC I/O Link. Which I/O module to use is selected using bit 3 (BIO) of parameter 3008.

BIO : 0 An emergency stop signal is input from the I/O module supporting the FANUC I/O Link (default)
1 An emergency stop signal is input from the built–in I/O module.

**CAUTION**
Make a provision that prevents the emergency stop condition from being released by mistake if the setting of the BIO parameter is incorrect. In the Power Mate *i*, G008.4 input from the ladder program to the CNC is also an emergency stop signal. If an emergency stop signal is input from the built–in I/O module, add X1000.4 as a condition for G008.4 to cause G008.4 to become 0 when an emergency stop signal is input. If an emergency stop signal is input from the I/O module supporting the FANUC I/O Link, add X000.4 as a condition for G008.4 to cause G008.4 to become 0 when an emergency stop signal is input. Do not stop the ladder program or re–set the BIO parameter with the emergency stop condition reset. (For the second path in a 2–path Power Mate *i*–D, read X1000.4, X000.4, and G008.4 as X1001.4, X001.4, and G1008.4, respectively.)

If an emergency stop signal is input from the I/O module supporting the FANUC I/O Link, use a DI point for which the common voltage line is at 24 V for the emergency stop signal. Do not use a DI point where the common voltage can be switched.

## 11.3 SERVO/SPINDLE

Shutting off the servo amplifier power causes a dynamic brake to be applied to the servo motor. Even when a dynamic brake is applied, however, a servo motor attached to a vertical axis can move under the force of gravity. To overcome this problem, use a servo motor with a brake.

While the spindle motor is running, shutting off the motor–driving power to the spindle amplifier allows the spindle motor to continue running under its own inertia, which is quite dangerous. When the emergency stop signal (*ESP) contact opens, it is necessary to confirm that the spindle motor has been decelerated to a stop, before the spindle motor power is shut off.

The FANUC servo amplifier α/β series products are designed to satisfy the above requirements. The emergency stop signal should be input to the power supply module (called the PSM) for α series. 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.

For the servo amplifier β series, input an emergency stop signal to the servo amplifier, and control the turn–on/off of the motor power using an external circuit.

The Power Mate *i* is designed to detect overtravel by using a software limit function. Normally, no hardware limit switch is required to detect overtravel. If the machine goes beyond a software limit because of a servo feedback failure, however, it is necessary to provide a stroke end limit switch, connected so that the emergency stop signal can be used to stop the machine.

Fig. 11.3 shows an example showing how to use the emergency stop signal with this Power Mate *i* and α series servo amplifier.

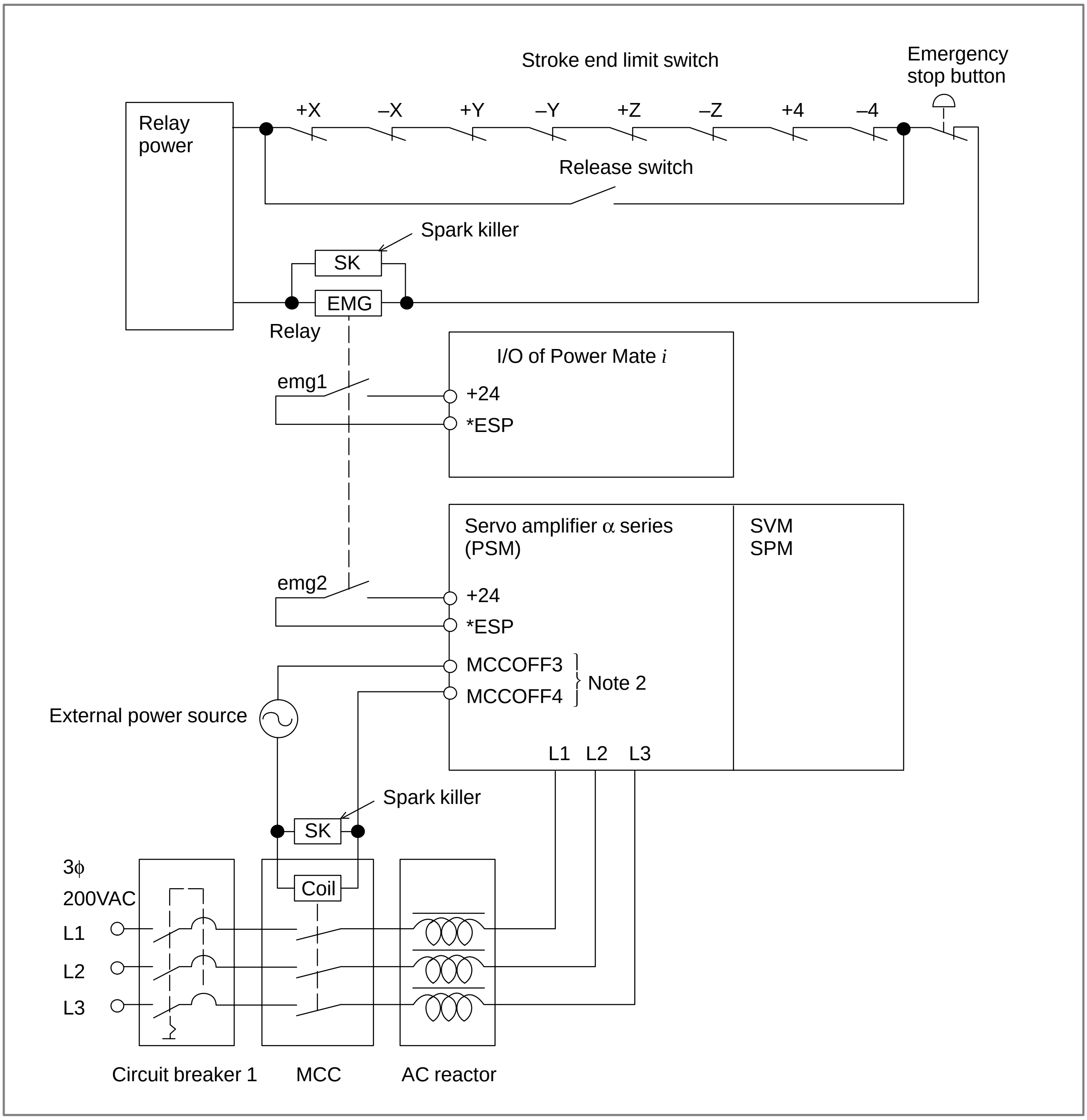


**Fig. 11.3**

**NOTE**

1 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.

2 The servo amplifier β series has no motor power MCC control signal. To turn on and off the MCC, use an emergency stop signal from an external circuit.

## Brake control at emergency stop

- **Emergency stop signal**

The emergency stop signal is controlled as an input signal for the CNC (X8.4) and as an input to the power supply module (PSM) that directly shut off the motor driving power.

- **Brake control**

When an emergency stop is performed, brake control is performed not to cause the servo motor to fall. To do this, the servo–motor driving power must be shut off with the brake applied. In actual operation, the following two controls are required:

1) Processing of emergency stop for the CNC (X8.4)

When an emergency stop is input to the CNC, the motor is decelerated, then excitation is turned off. If the brake control function shown below is enabled, servo excitation is turned off after a time preset in the timer elapses.

The axis that controls the brake prevents the motor from falling if the brake control function is enabled, and a timer value is set. As the timer value, set a time required until the brake is applied, which is about 100 ms to 200 ms.

Parameter setting

|  | #7 | #6 | #5 | #4 | #3 | #2 | #1 | #0 |
|---|---|---|---|---|---|---|---|---|
| 2005 |  | BRKC |  |  |  |  |  |  |

**[Data type]** Bit axis

**BRKC** The brake control function is:

0 : Disabled.
1 : Enabled.

|  |  |
|---|---|
| 2083 | Brake control timer |

Increment system : msec
Setting range : 0 to 16000

2) Direct shut–off of the motor driving power

To shut off the motor driving power directly, an emergency stop signal is input to the PSM, and the AC power supplied to the servo motor through the PSM contact output is turned off. In this case, when brake control is to be performed not to cause the servo motor to fall, the servo motor driving power must be shut off with the brake applied.

Therefore, it is necessary to delay the emergency stop signal input to the PSM for the timer value set in 1) above. For this reason, an off–delay timer needs to be provided outside the PSM.

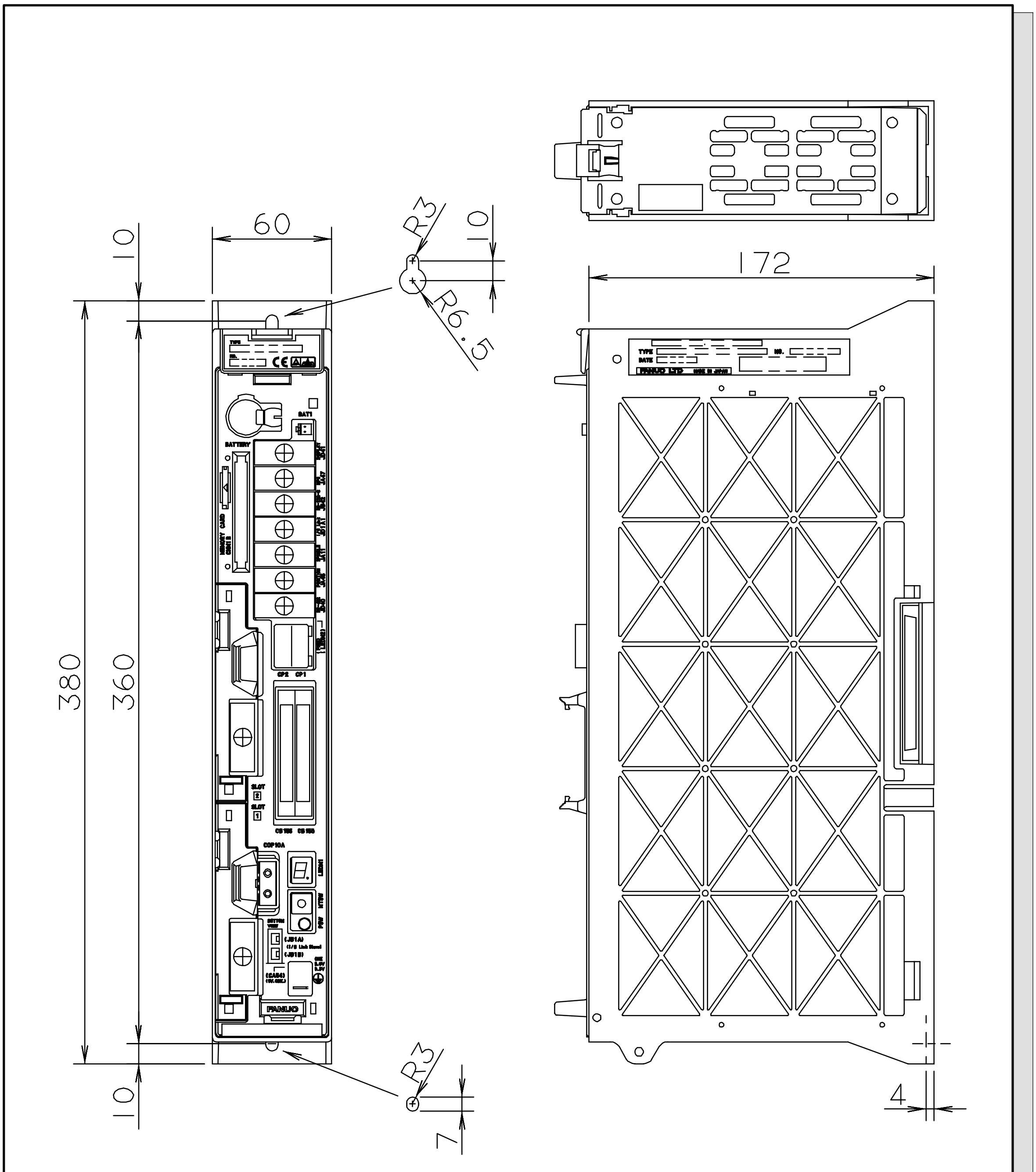
# APPENDIX

# A EXTERNAL DIMENSIONS OF EACH UNIT

| **Classification** | **Name** | **Number of Figure** |
|---|---|---|
| Control unit | Control unit | Fig. 1 |
| I/O | I/O Card D, E | Fig. 2 |
| | FSSB I/O Module | Fig. 3 |
| Setting and display unit | CRT/MDI, CRT/MDI with picture display | Fig. 4 |
| | LCD/MDI | Fig. 5 |
| | Separate CRT | Fig. 6 |
| | Separate MDI, separate MDI with picture display | Fig. 7 |
| | Separate PDP | Fig. 8 |
| | Separate LCD | Fig. 9 |
| | Detachable LCD/MDI | Fig. 10 |
| | Handy operator’s panel | Fig. 11 |
| External device | $\alpha$ position coder | Fig. 12 |
| | Manual pulse generator | Fig. 13 |
| | Manual pulse generator (Pendant type) | Fig. 14 |
| | Separate detector interface unit | Fig. 15 |
| | Battery case for separate absolute pulse coder | Fig. 16 |
| | Battery case for external control unit | Fig. 17 |
| | Punch panel (for 1 channel) | Fig. 18 |
| | Punch panel (for 2 channels) | Fig. 19 |
| | FANUC Handy File | Fig. 20 |
| | I/O Link connection unit | Fig. 21 |

## *Fig. 1* Control unit

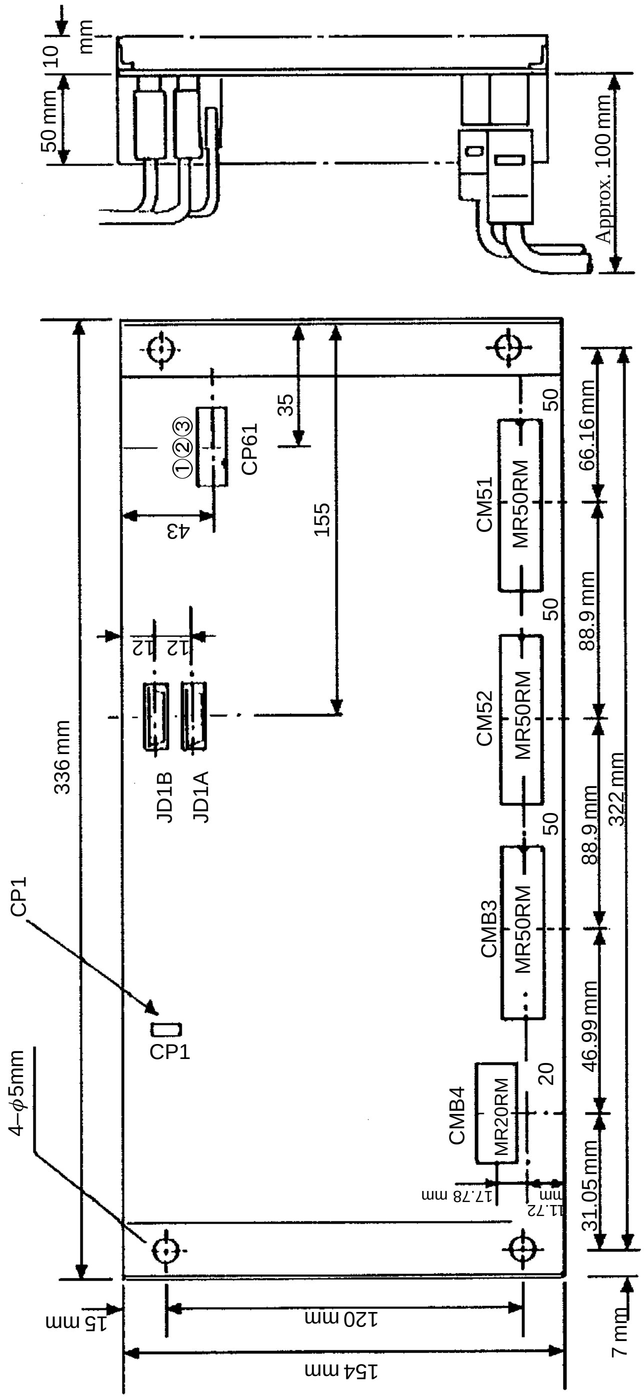
Specification : A02B–0259–B501



Weight : 1.8kg

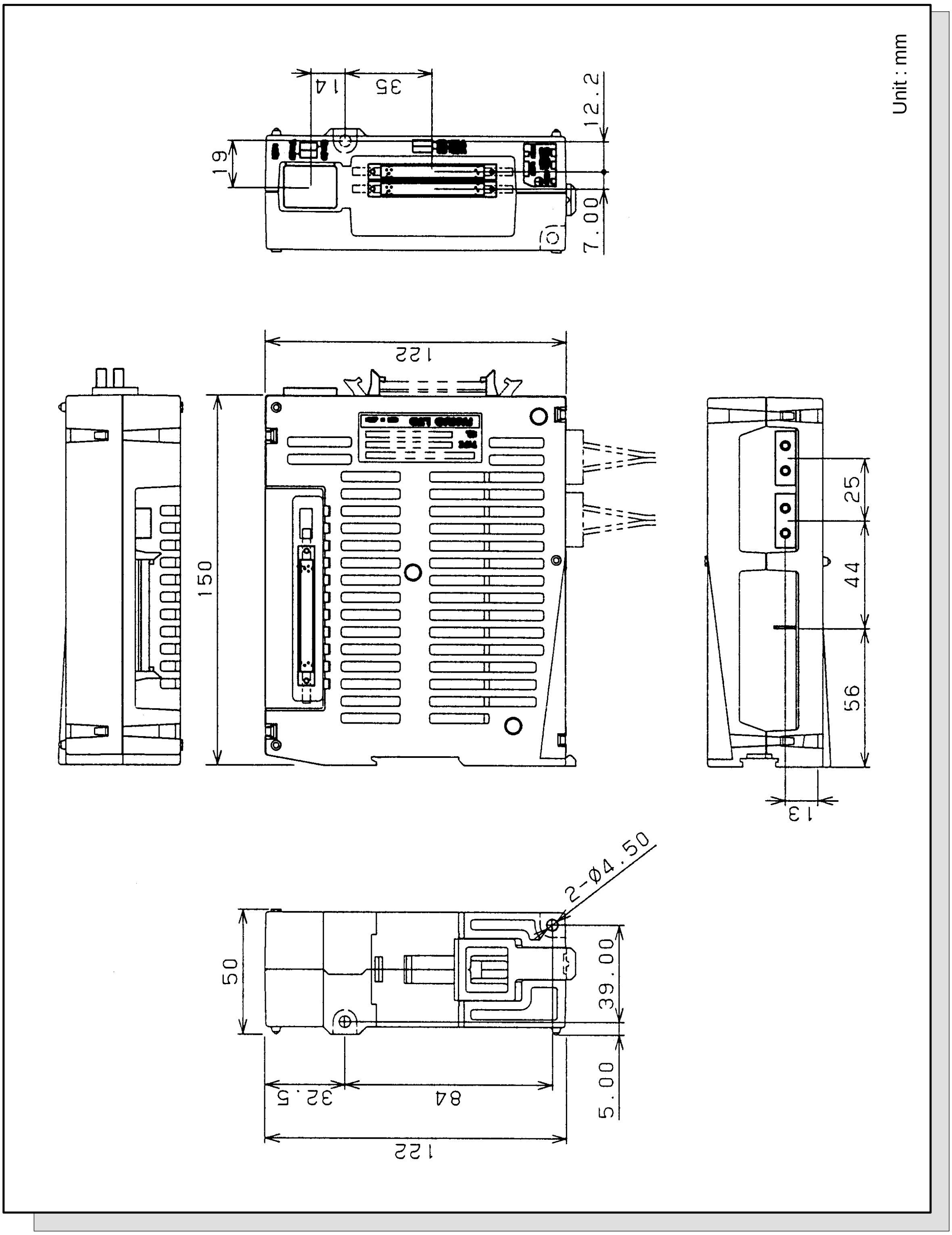
## *Fig. 2* I/O Card D, E

Specification : A16B–2202–0733 (DI/DO=48/32)
A16B–2202–0732 (DI/DO=96/64)



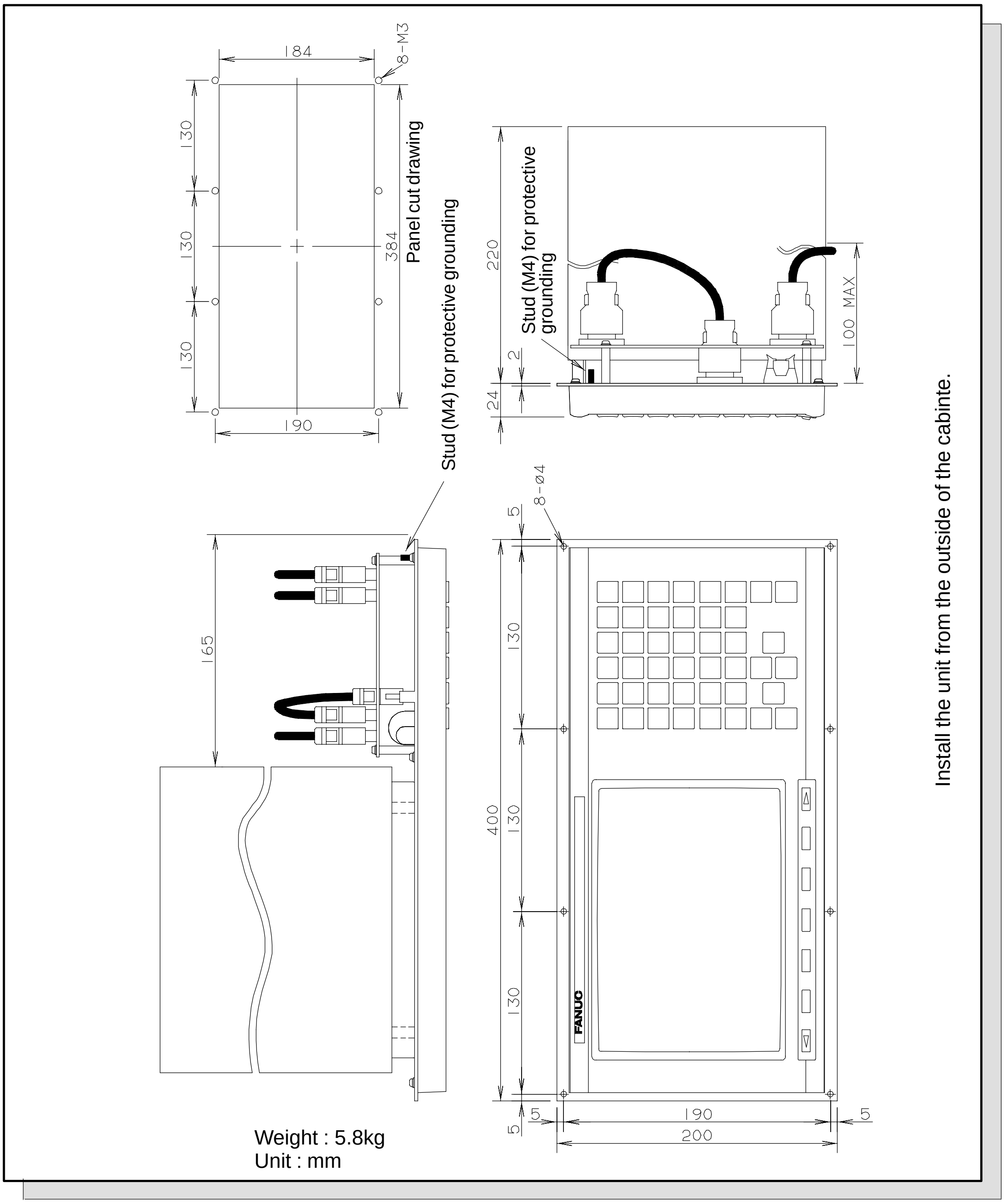
## *Fig. 3* FSSB I/O Module

Specification : A02B–0236–C211, C212



## *Fig. 4* CRT/MDI, CRT/MDI with picture display

Specification : A02B–0166–C201#R (English key)
A02B–0166–C201#S (Symbolic key)
A02B–0166–C221#R (English key, with picture display for 32 screen)
A02B–0166–C221#S (Symbolic key, with picture display for 32 screen)
A02B–0166–C222#R (English key, with picture display for 64 screen)
A02B–0166–C222#S (Symbolic key, with picture display for 64 screen)

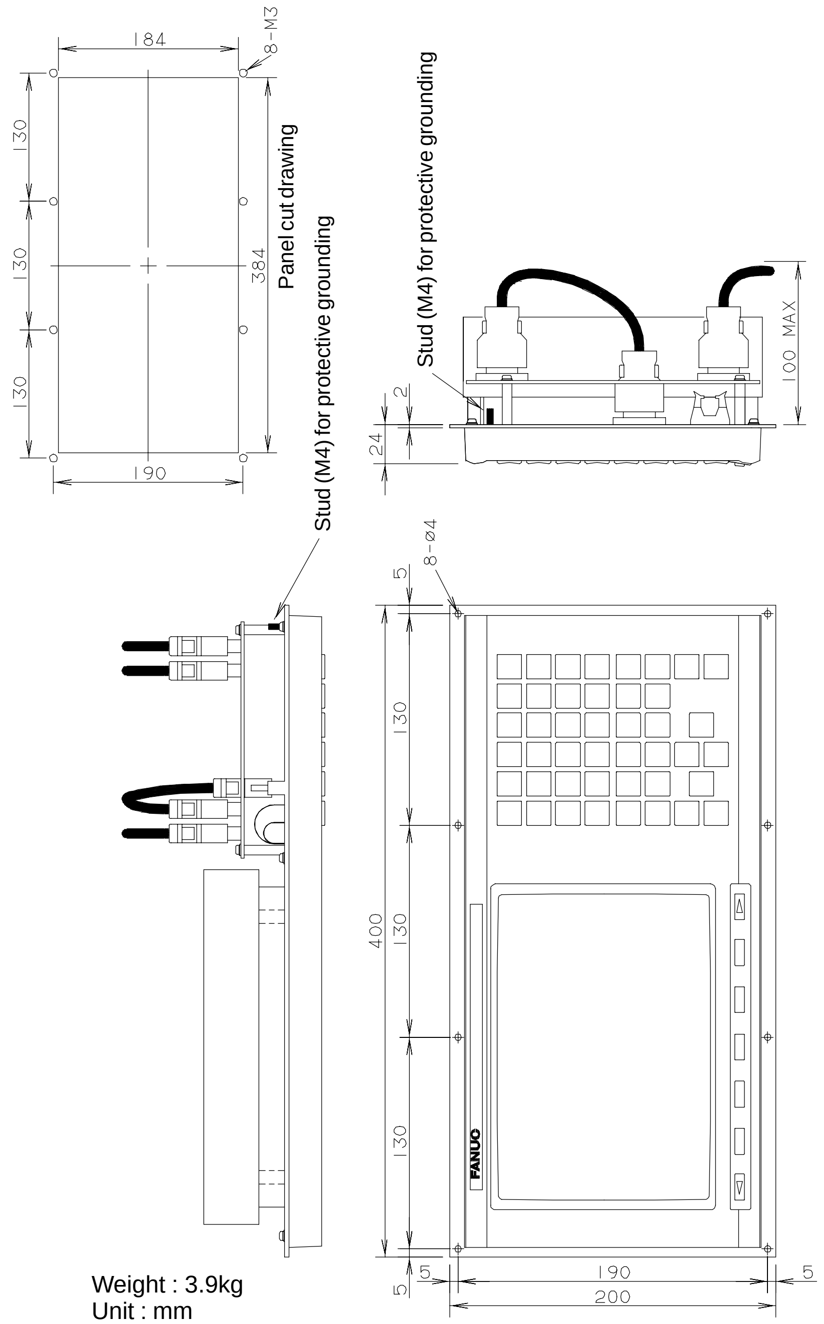


Install the unit from the outside of the cabinte.

Weight : 5.8kg
Unit : mm

## *Fig. 5* LCD/MDI

Specification : A02B–0166–C261#R (English key)
A02B–0166–C261#S (Symbolic key)

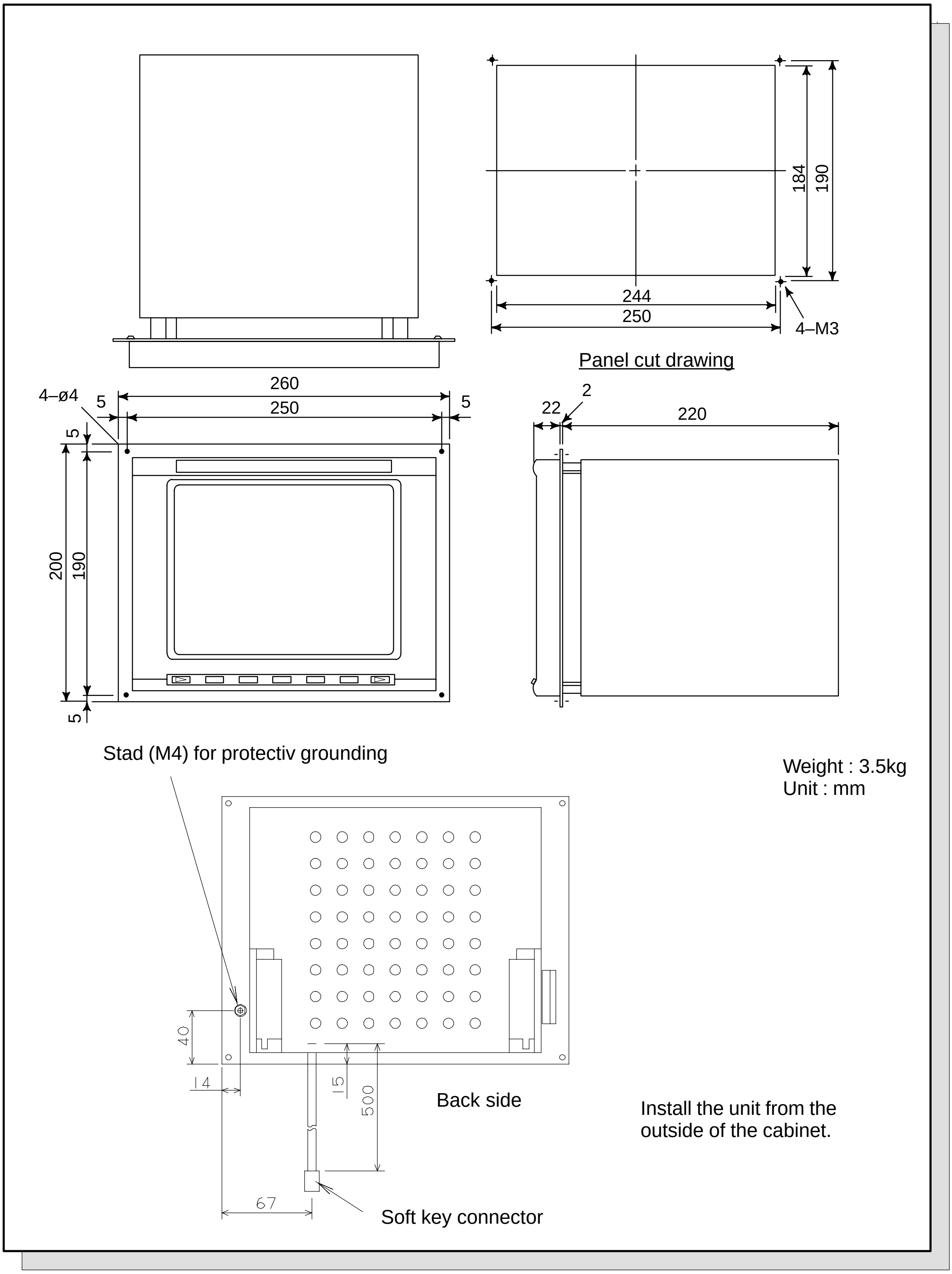


Install the unit from the outside of the cabinte.

Weight : 3.9kg
Unit : mm

## *Fig. 6* Separate CRT

Specification : A02B–0120–C111

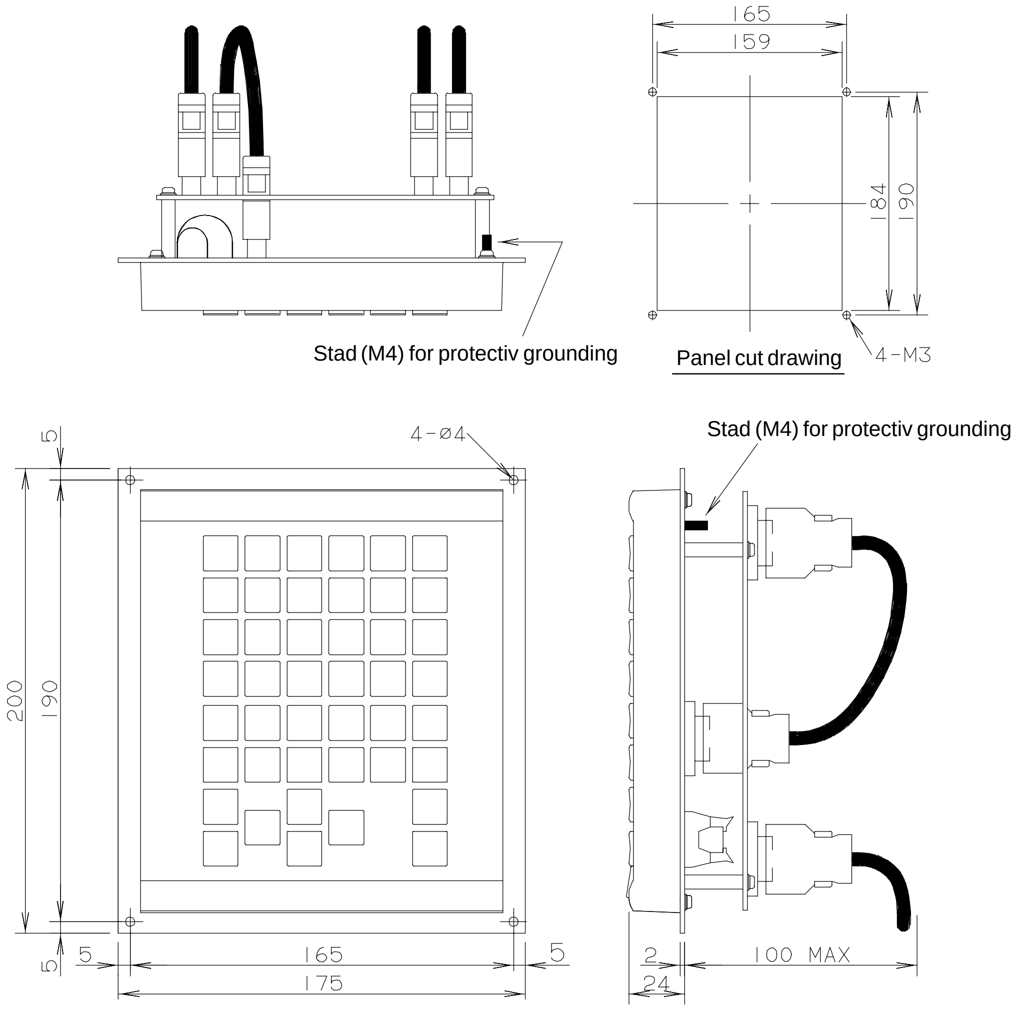


Weight : 3.5kg
Unit : mm

Install the unit from the outside of the cabinet.

## Fig. 7 Separate MDI, separate MDI with picture display

Specification : A02B–0166–C210#R (English key)
A02B–0166–C210#S (Symbolic key)
A02B–0166–C231#R (English key, with picture display for 32 screen)
A02B–0166–C231#S (Symbolic key, with picture display for 32 screen)
A02B–0166–C232#R (English key, with picture display for 64 screen)
A02B–0166–C232#S (Symbolic key, with picture display for 64 screen)

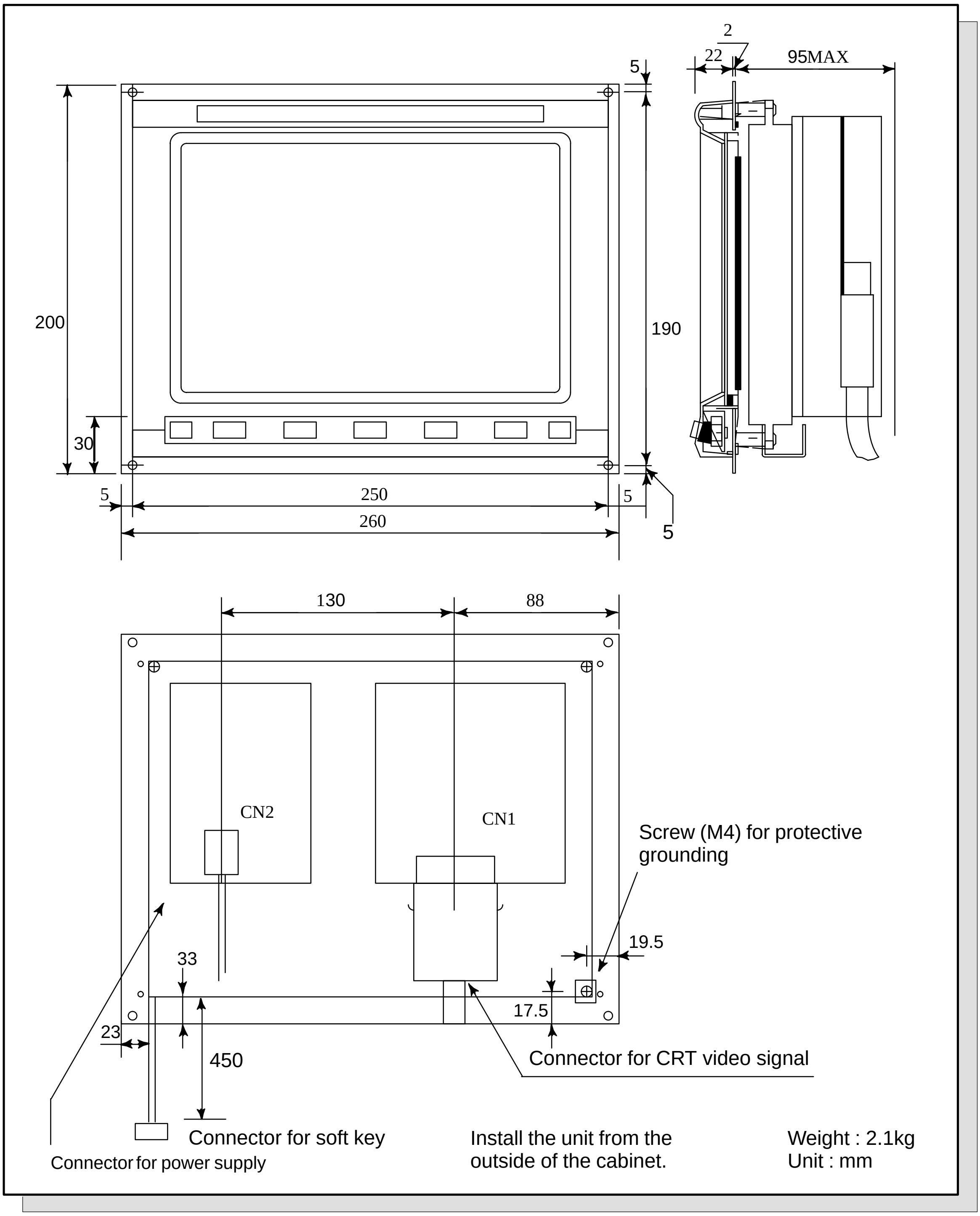


Install the unit from the outside of the cabinet.

Weight : 1.3kg
Unit : mm

## Fig. 8 Separate PDP

Specification : A02B–0200–C100

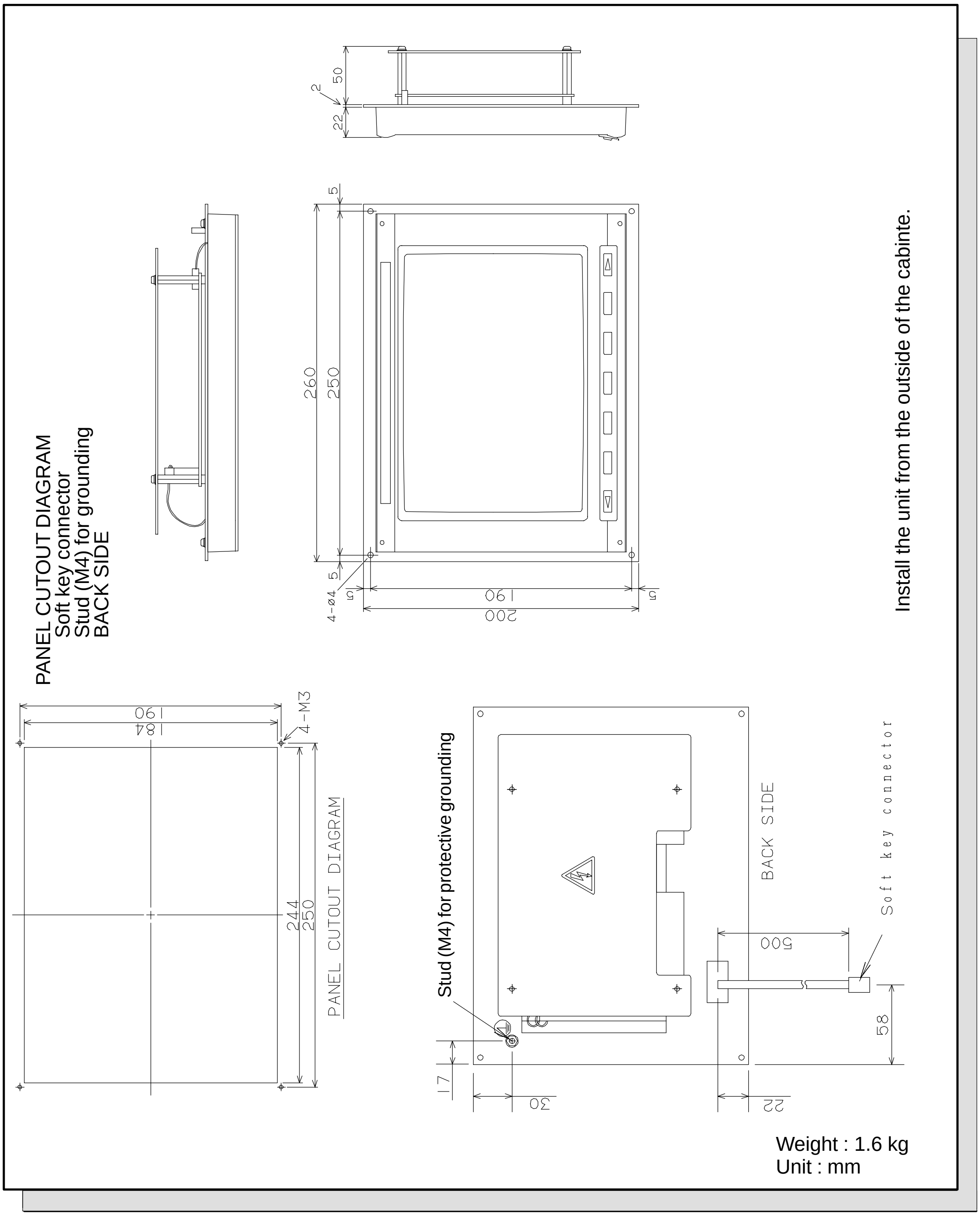


Install the unit from the outside of the cabinet.

Weight : 2.1kg
Unit : mm

## *Fig. 9* Separate LCD

Specification : A02B–0166–C251

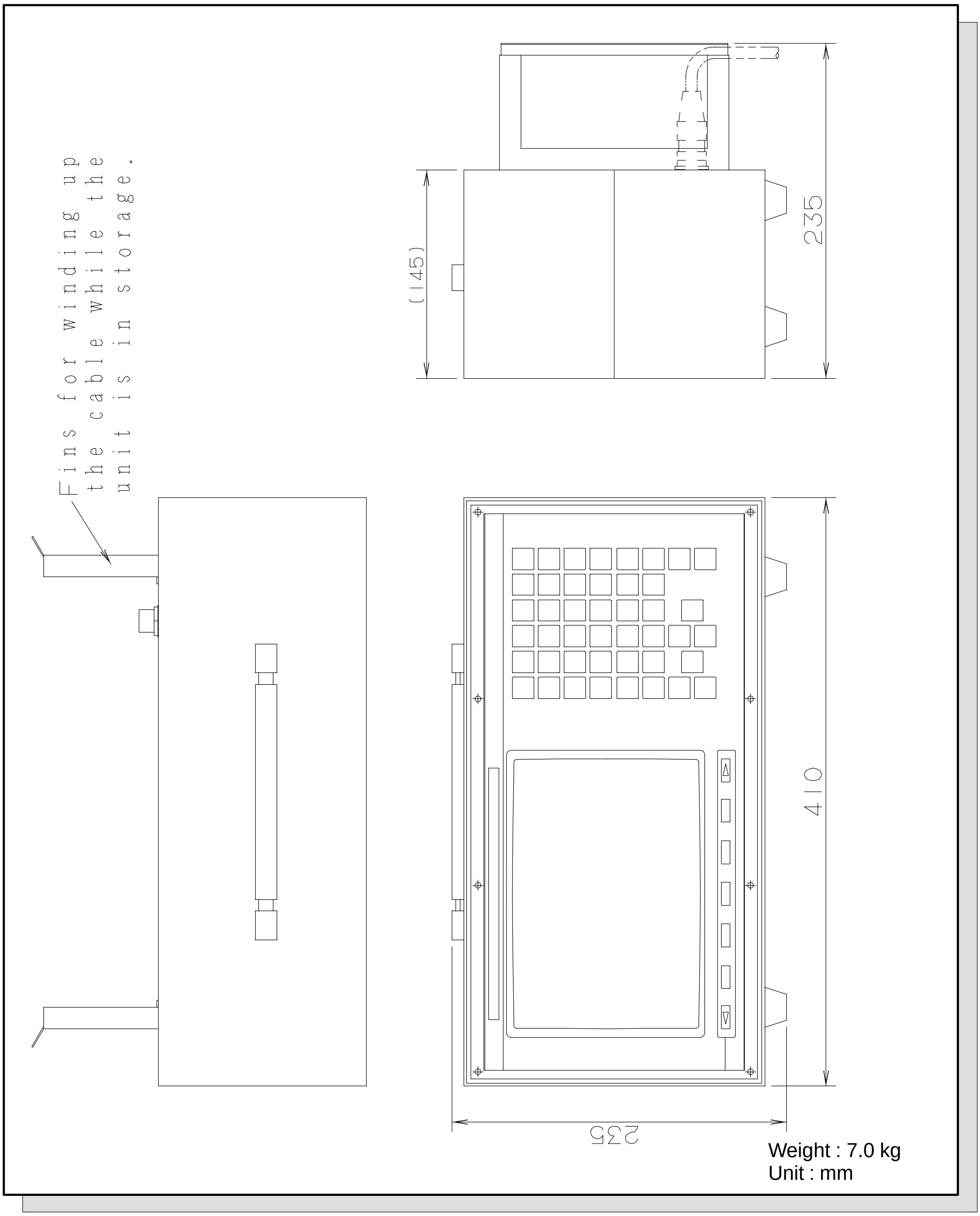


Install the unit from the outside of the cabinte.

Weight : 1.6 kg
Unit : mm

## *Fig. 10* Detachable LCD/MDI

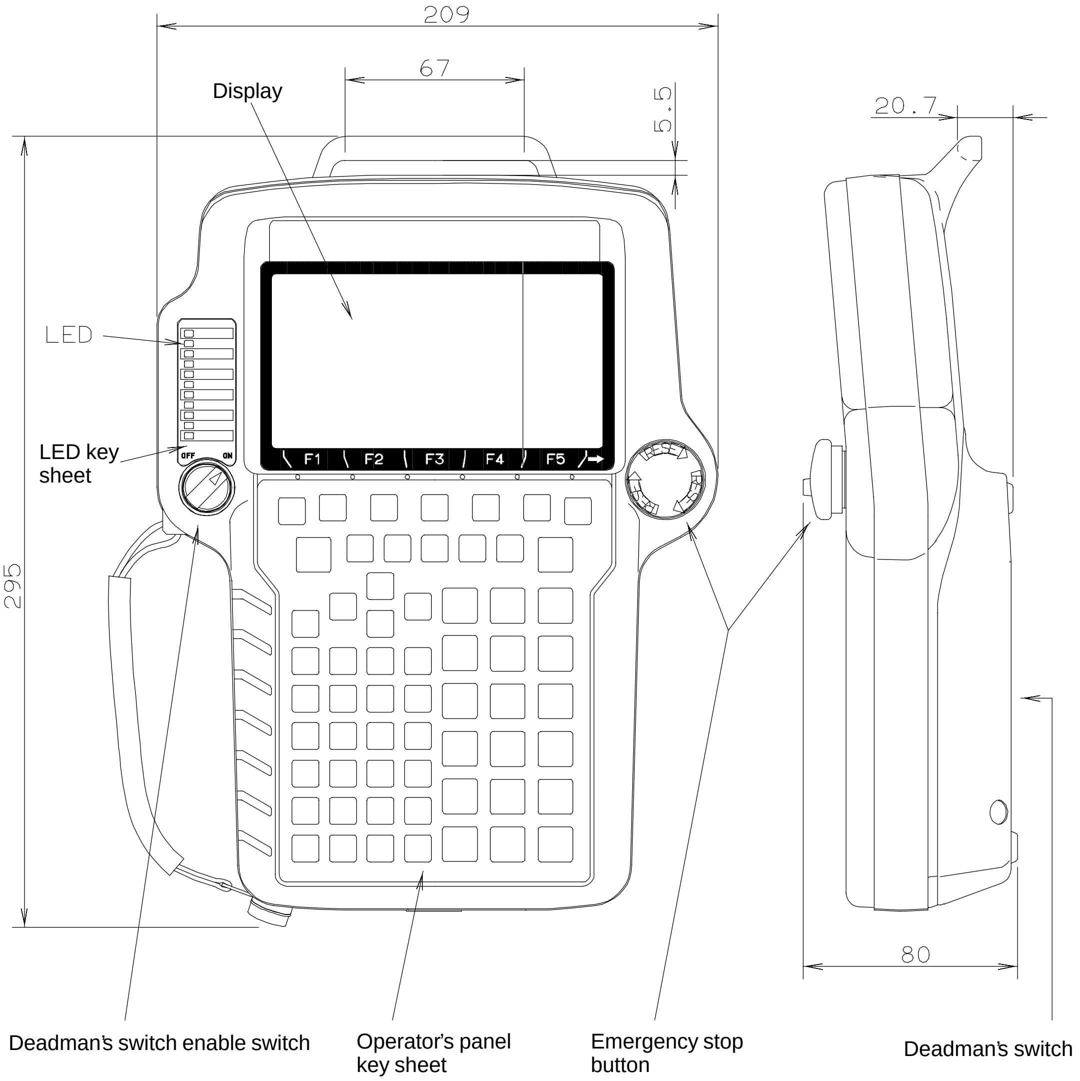
Specification : A02B–0166–C271#R (English key)
A02B–0166–C271#S (Symbolic key)



Weight : 7.0 kg
Unit : mm

## Fig. 11 Handy operator's panel

Specification : A02B–0211–C020#R (English key)
A02B–0211–C020#S (Symbolic key)

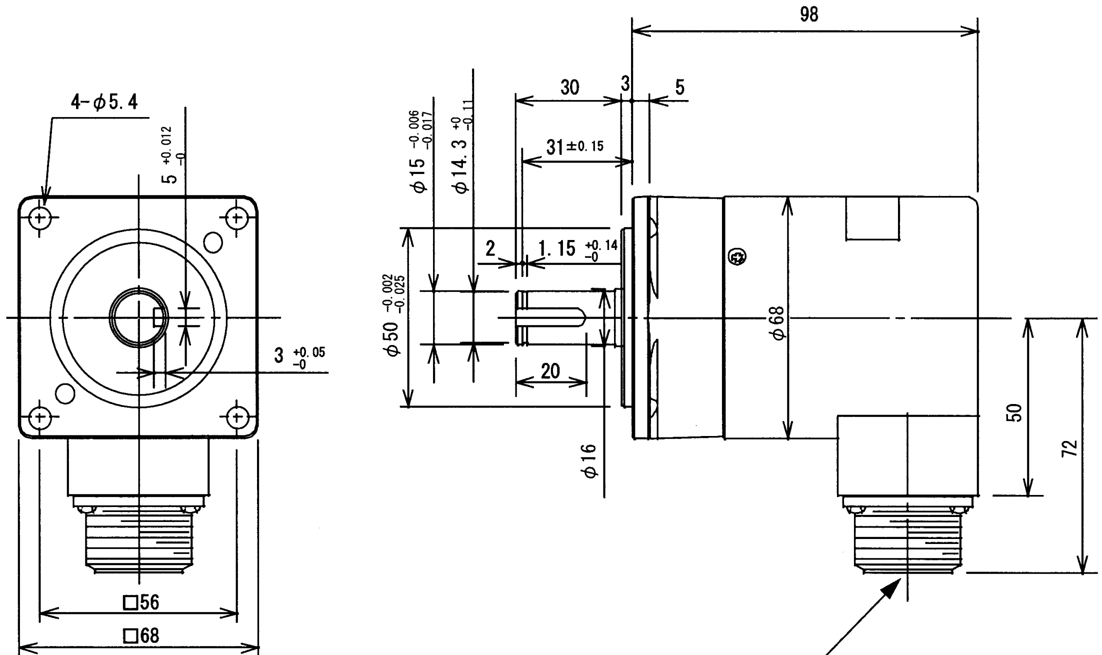


Tolerance: ± 1 mm

Weight : 1.3 kg
Unit : mm

## *Fig. 12* α position coder

Specification : A860–0309–T302 (Max. 10000 min$^{-1}$)

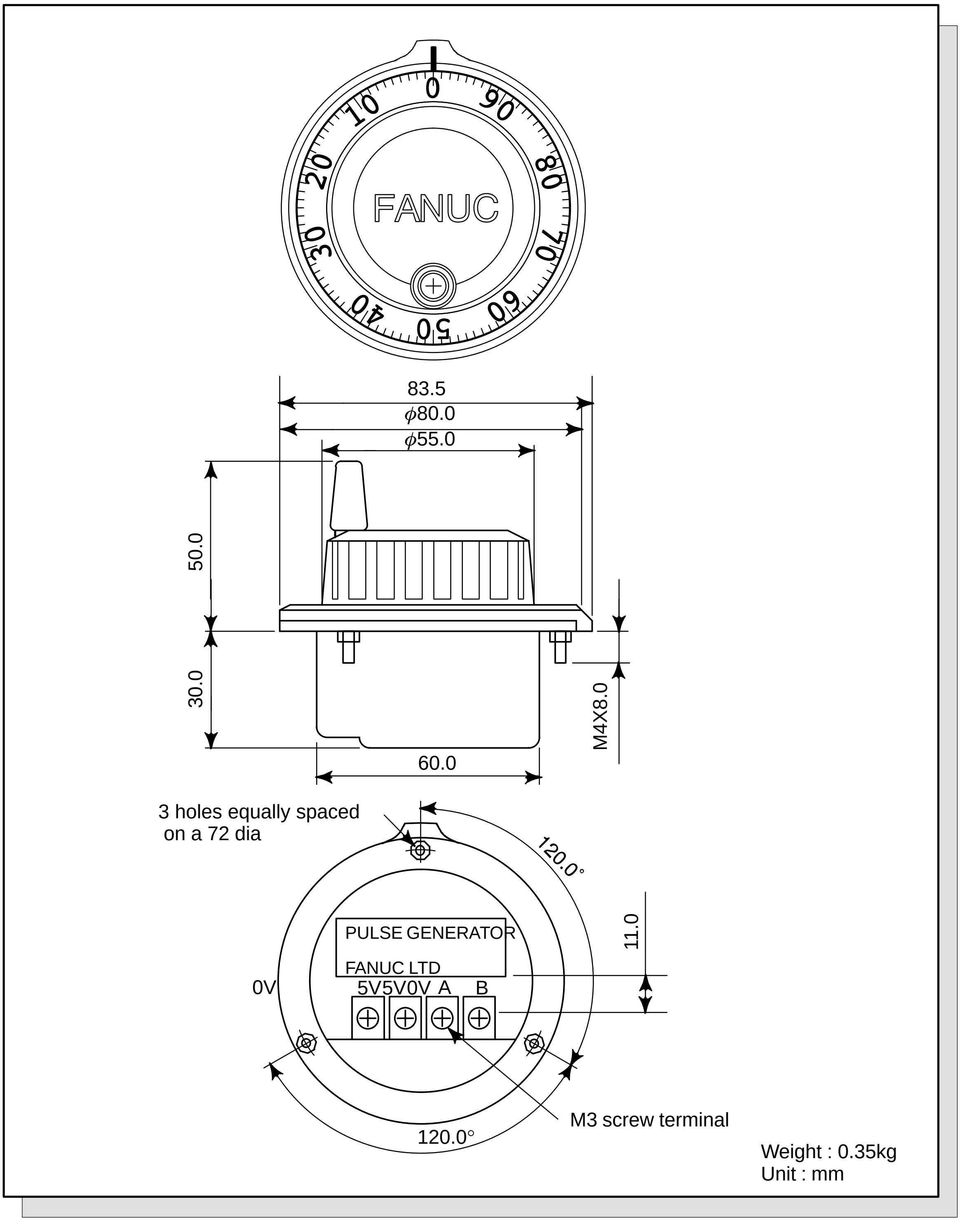


MS connector : MS3102A–20–29P

Weitht : 1 kg or less
Unit : mm

## *Fig. 13* Manual pulse generator

Specification : A860–0202–T001

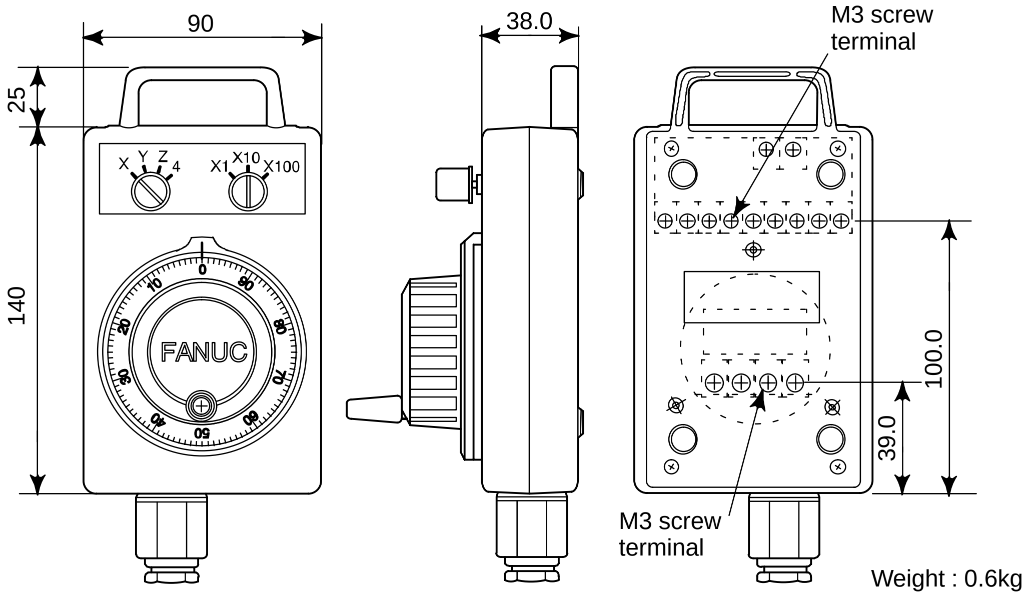


Weight : 0.35kg
Unit : mm

**Fig. 14** Manual pulse generator (Pendant type)

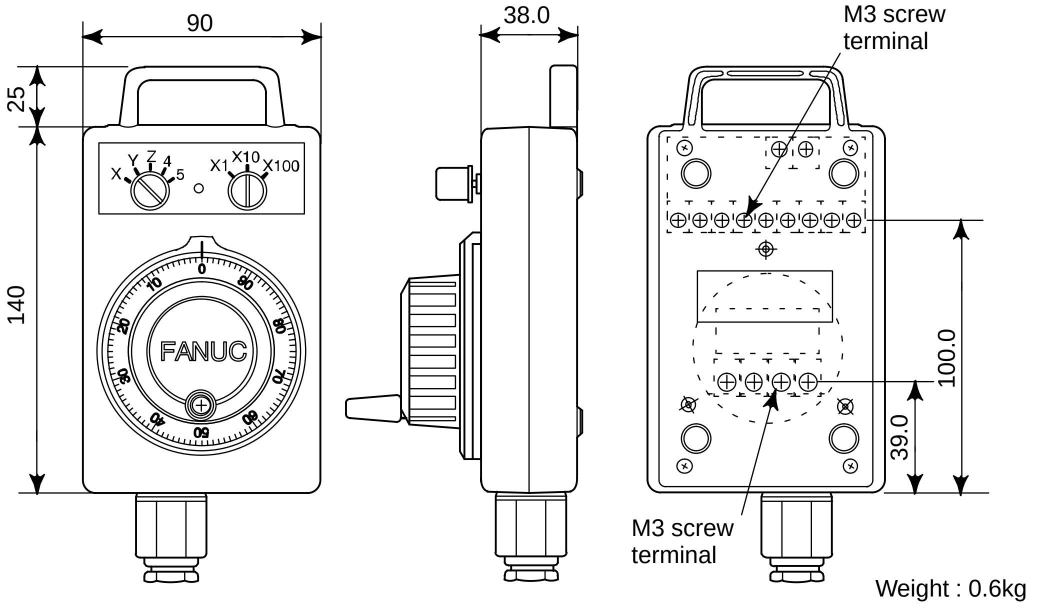
Specification : A860–0202–T004 to T015, T020

**A860–0202–T004 to T009**



Weight : 0.6kg
Unit : mm

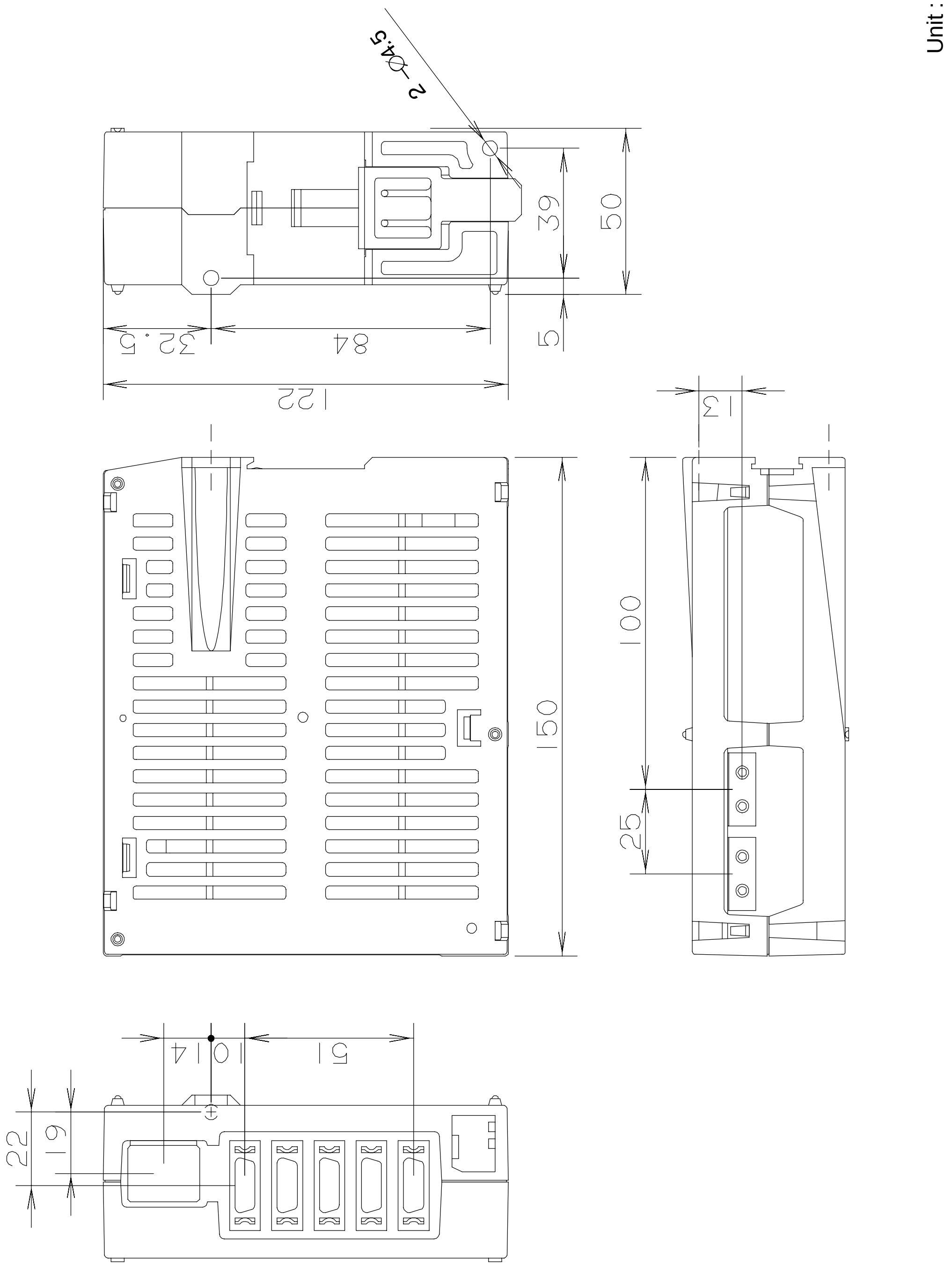
**A860–0202–T010 to T015, T020**



Weight : 0.6kg
Unit : mm

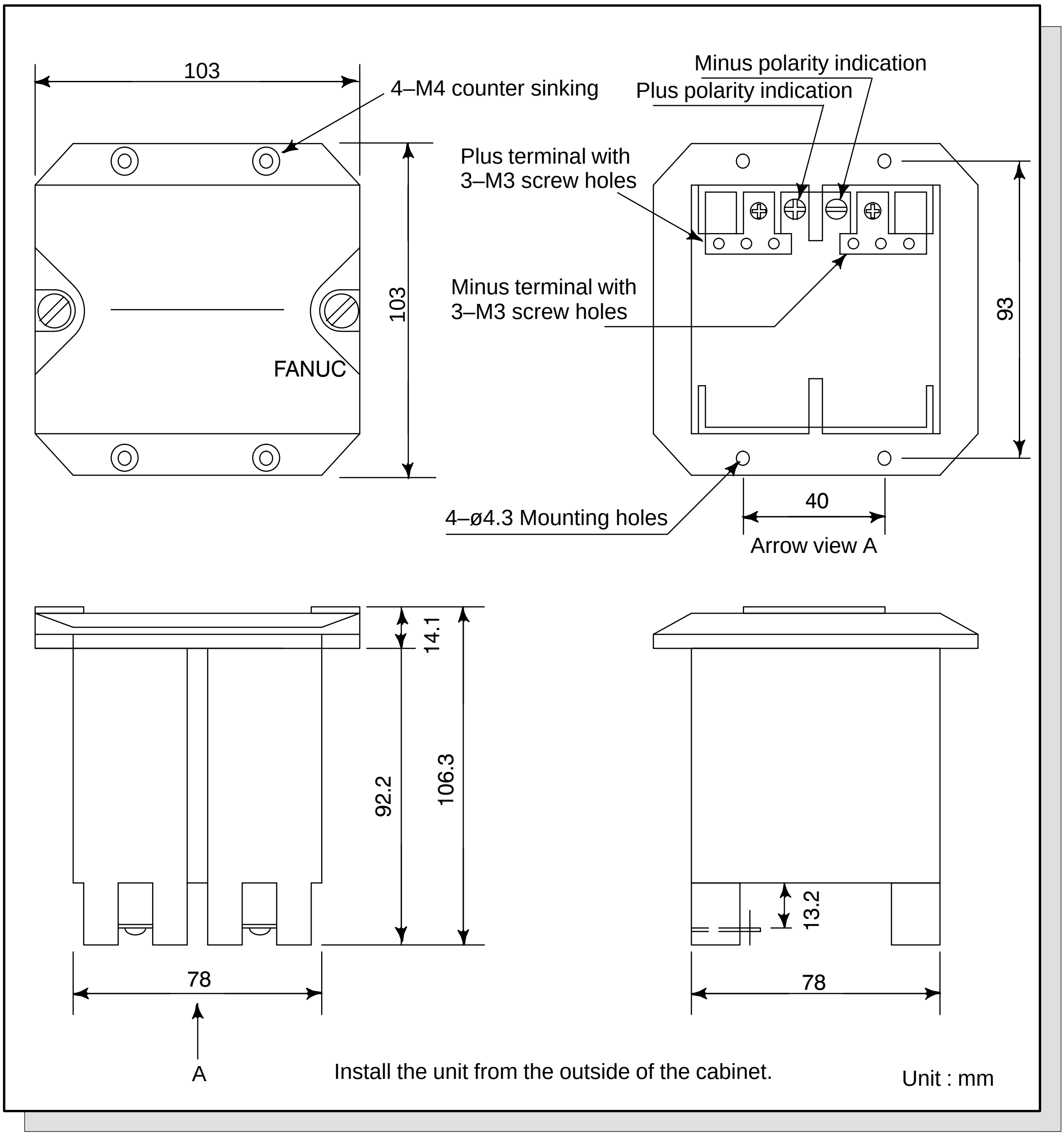
## *Fig. 15* Separate detector interface unit

Specification : A02B–0236–C203, –C204



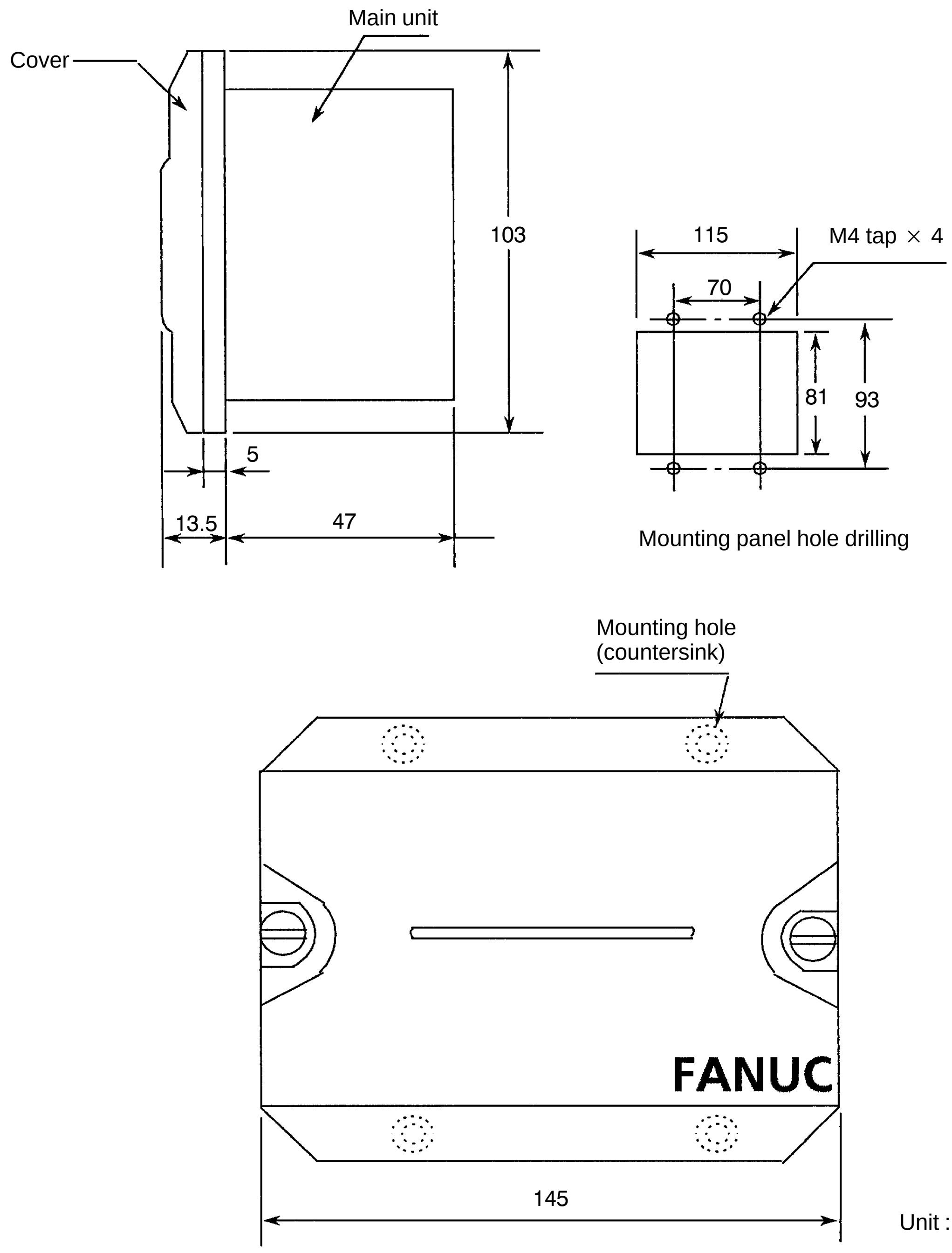
## *Fig. 16* Battery case for separate absolute pulse coder

Specification : A06B–6050–K060



## *Fig. 17* Battery case for external control unit

Specification : A02B–0236–C281



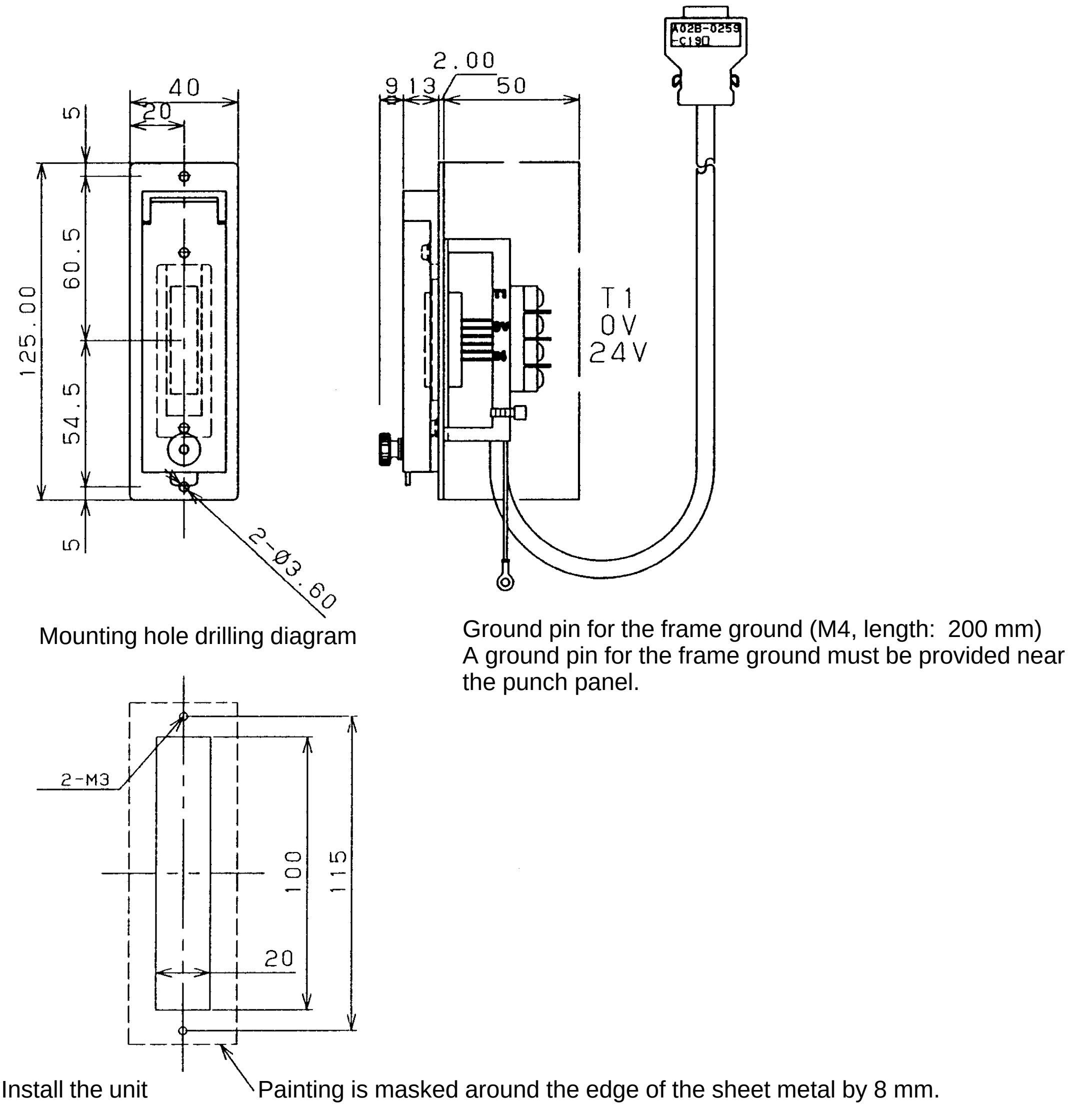
Unit : mm

Install the unit from the outside of the cabinet.

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

## *Fig. 18* Punch panel (for 1 channel)

Specification : A02B–0259–C191 (Cable length: 1 m)
A02B–0259–C192 (Cable length: 2 m)
A02B–0259–C193 (Cable length: 5 m)



Mounting hole drilling diagram

Ground pin for the frame ground (M4, length: 200 mm)
A ground pin for the frame ground must be provided near the punch panel.

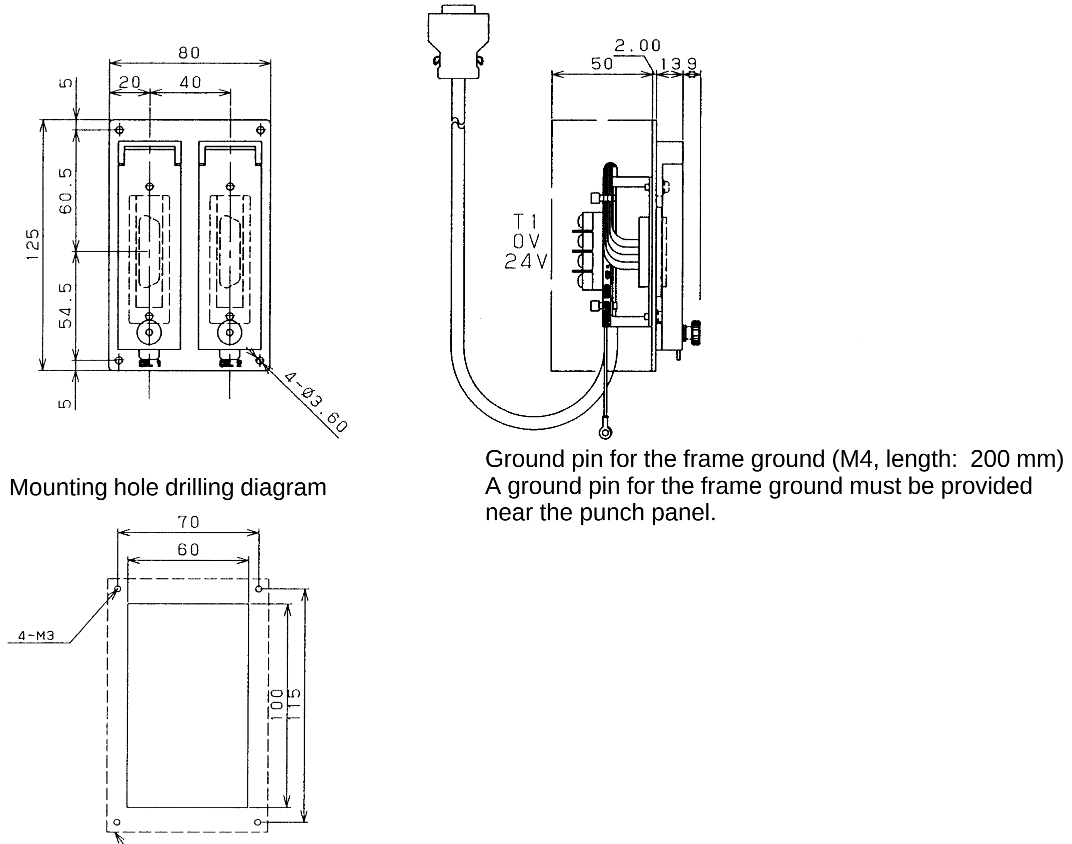
Install the unit from the outside of the cabinet.

Painting is masked around the edge of the sheet metal by 8 mm.
As an EMC measure, when connecting the sheet metal to the cabinet electrically, painting must also be masked on the cabinet.

Unit : mm

## Fig. 19 Punch panel (for 2 channels)

Specification : A02B–0259–C051 (Cable length : 1m)
A02B–0259–C052 (Cable length : 2m)
A02B–0259–C053 (Cable length : 3m)



Ground pin for the frame ground (M4, length: 200 mm)
A ground pin for the frame ground must be provided near the punch panel.

Mounting hole drilling diagram

Painting is masked around the edge of the sheet metal by 8 mm.
As an EMC measure, when connecting the sheet metal to the cabinet electrically, painting must also be masked on the cabinet.

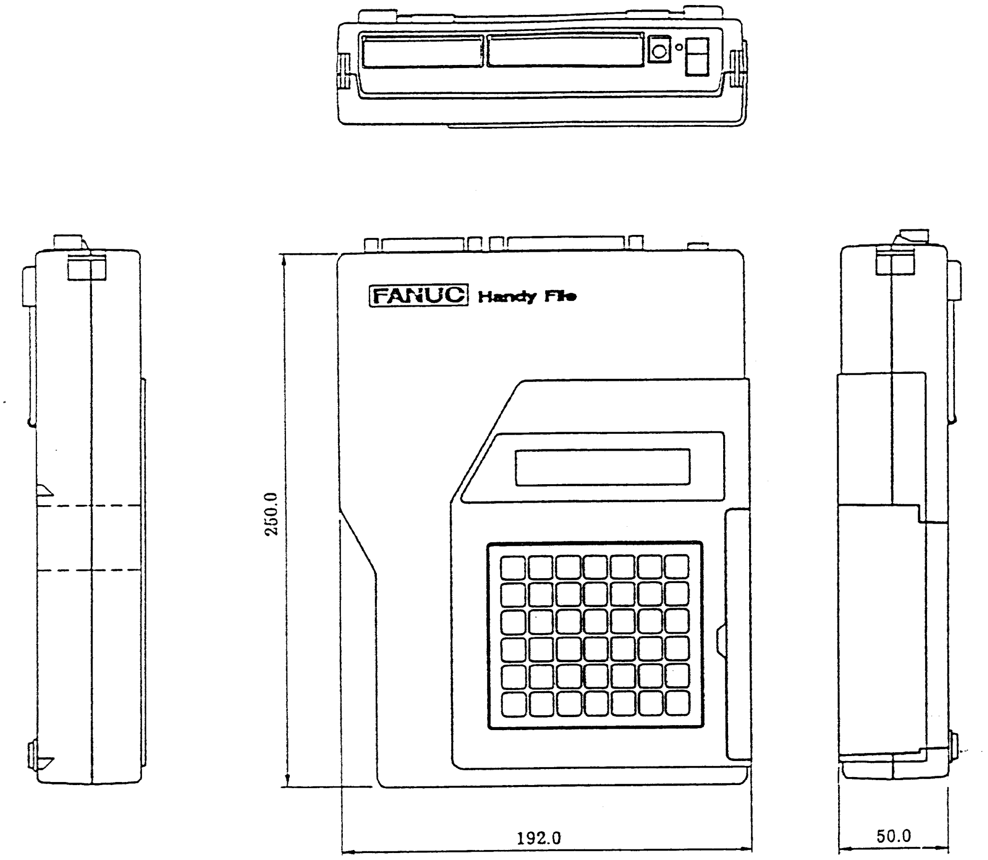
Install the unit from the outside of the cabinet.

Unit : mm

## *Fig. 20* FANUC Handy File

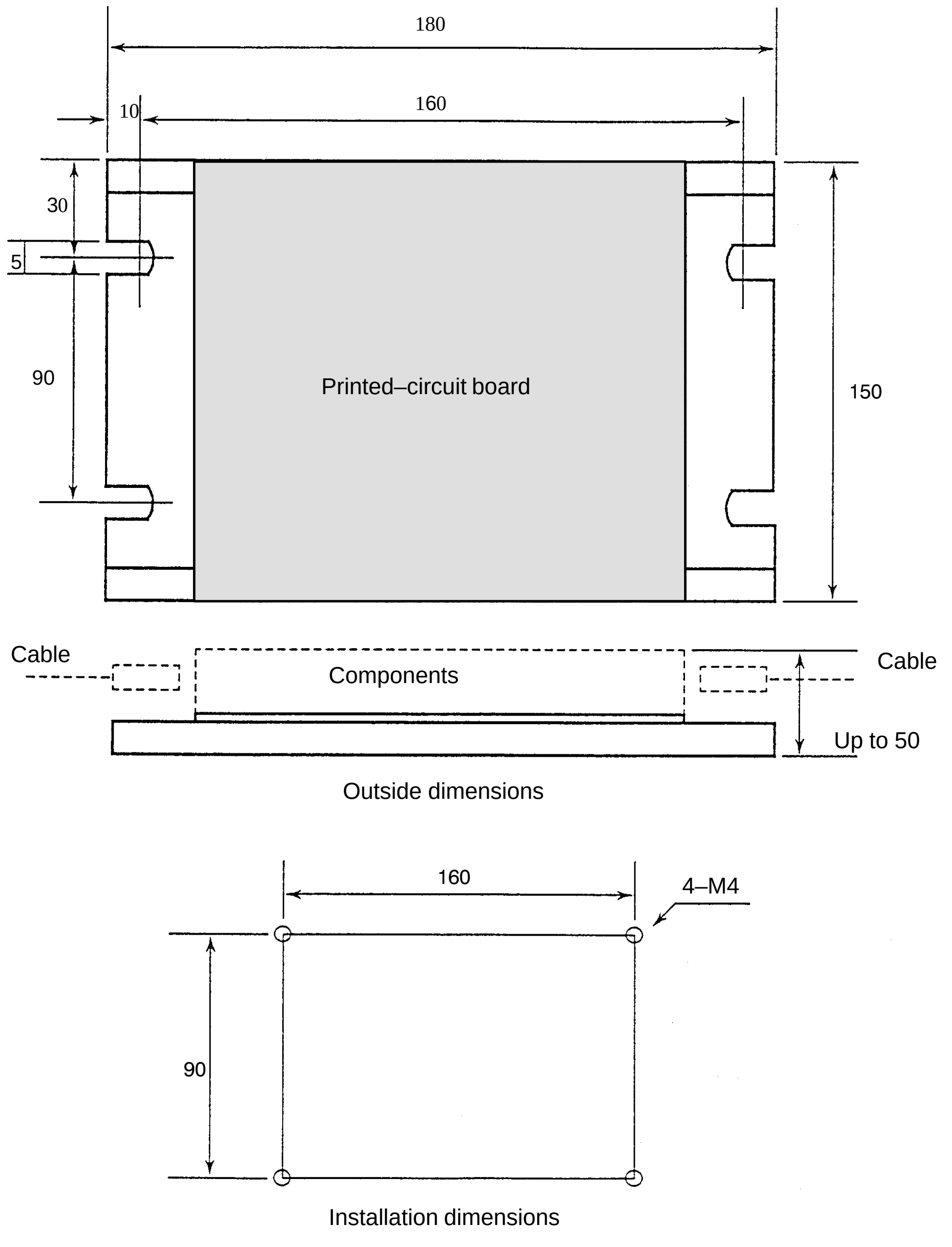
Specification : A13B–0159–B001 (English key)
A13B–0159–B002 (Japanese key)

Weight : 1.4kg
Unit : mm



## *Fig. 21* I/O Link connection unit

Specification : A20B–2000–0410 (electric – optical)
A20B–2000–0411 (electric – electric)
A20B–2000–0412 (optical – optical)



Weight : 600g
Unit : mm

# B EXTERNAL DIMENSIONS OF CONNECTORS

| Fig. title | Specification No. | Fig. No. |
|---|---|---|
| PCR connector (soldering type) | PCR–E20FS | Fig. 1 |
| FI40 connector | FI40–2015S | Fig.2 |
| Connector case (HONDA PCR type) | PCR–V20LA,<br>PCR–V20LB | Fig.3 |
| Connector case (HIROSE FI type) | FI–20–CV | Fig.4 |
| Connector case (FUJITSU FCN type) | FCN–240C20–Y/S | Fig.5 |
| Connector case (HIROSE PCR type) | FI–20–CV7 | Fig.6 |
| AMP connector (1) X type | AMP1–178288–3 | Fig.7 |
| AMP connector (2) Y type | AMP2–178288–3 | Fig.8 |
| Contact for AMP connector | AMP1–175218–2/5<br>AMP1–175196–2/5 | Fig.9 |
| HONDA connector (case) |  | Fig.10 |
| HONDA connector (angled case) |  | Fig.11 |
| HONDA connector (male) |  | Fig.12 |
| HONDA connector (female) |  | Fig.13 |
| HONDA connector (terminal layout) |  | Fig.14 |
| Connector (FCI Japan)(3 pins/brown) | SMS3PN–5 | Fig.15 |
| Connector (FCI Japan)(6 pins/brown) | SMS6PN–5 | Fig.16 |
| Punch panel connector for RS–232–C serial port |  | Fig.17 |
| Locking plate for RS–232–C serial port |  | Fig.18 |
| Faston terminal |  | Fig. 19 |
| Connector for HIROSE flat cable | HIF3BA–34D–2.54R | Fig. 20 |

## *Fig. 1* PCR Connector (Soldering type)

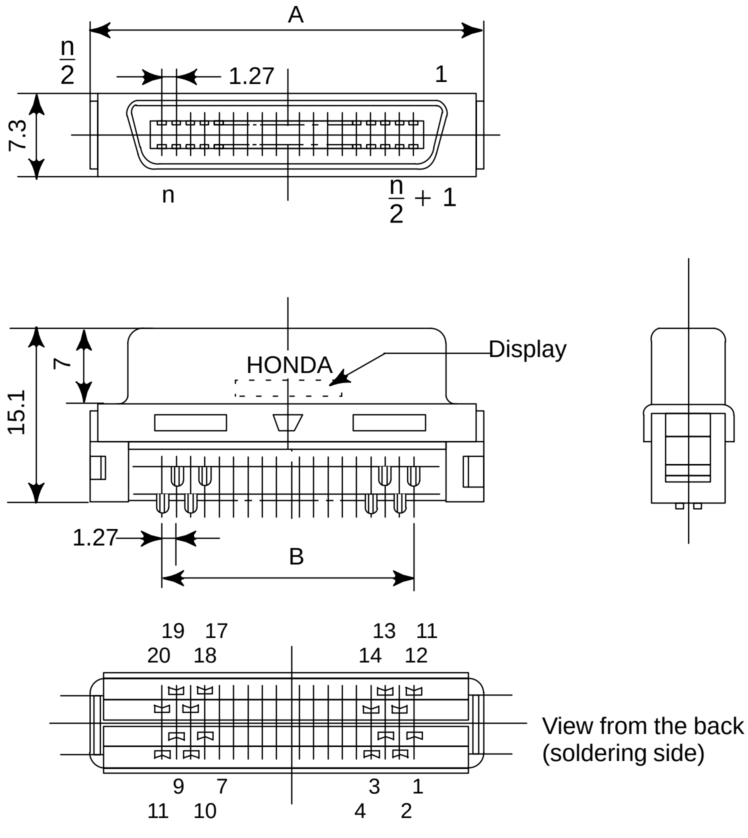
Specification : A02B–0120–K301 (PCR–E20FS+PCR–V20LA)
A02B–0120–K302 (PCR–E20FA+PCR–V20LA)

TYPE : HONDA PCR–E20FS(SOLDERING TYPE)
PCR–E20FA(CRIMP TYPE)

USAGE : GENERAL INTERFACE

MATING HOUSING : HONDA PCR–V20LA(PLASTIC)
HONDA PCR–V20LB(PLASTIC)

DIMENSION



| | A | B |
|---|---|---|
| PCR–E20FS | 21.65 | 11.43 |

Unit : mm

## *Fig. 2* FI40 Connector

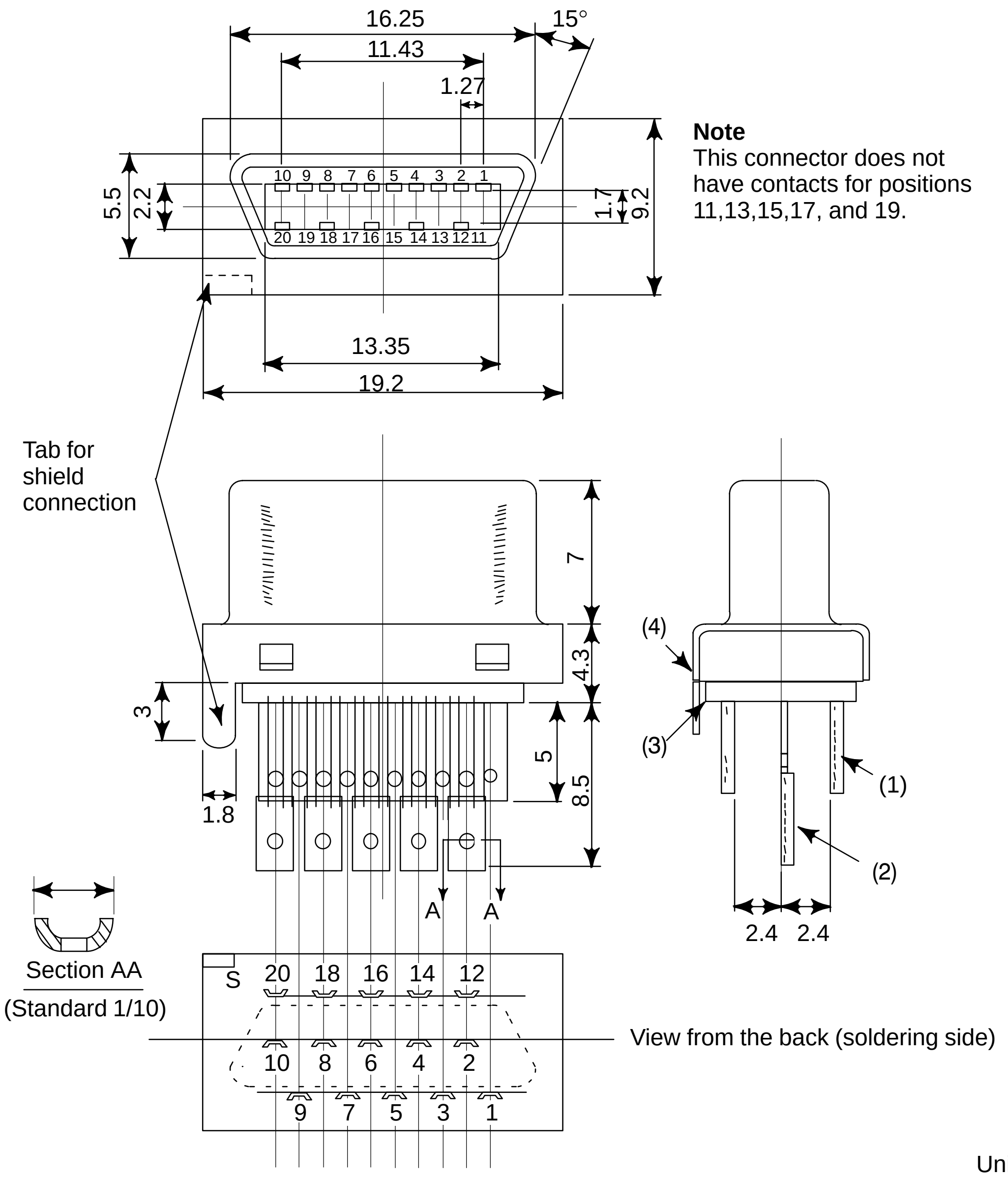
Specification : A02B–0120–K303 (F140–2015S+F1–20–CV)

TYPE : HIROSE FI40–2015S

USAGE : PULSE CODER INTERFACE
LINEAR SCALE INTERFACE
MPG INTERFACE

MATING HOUSING : HIROSE FI–20–CV

DIMENSION



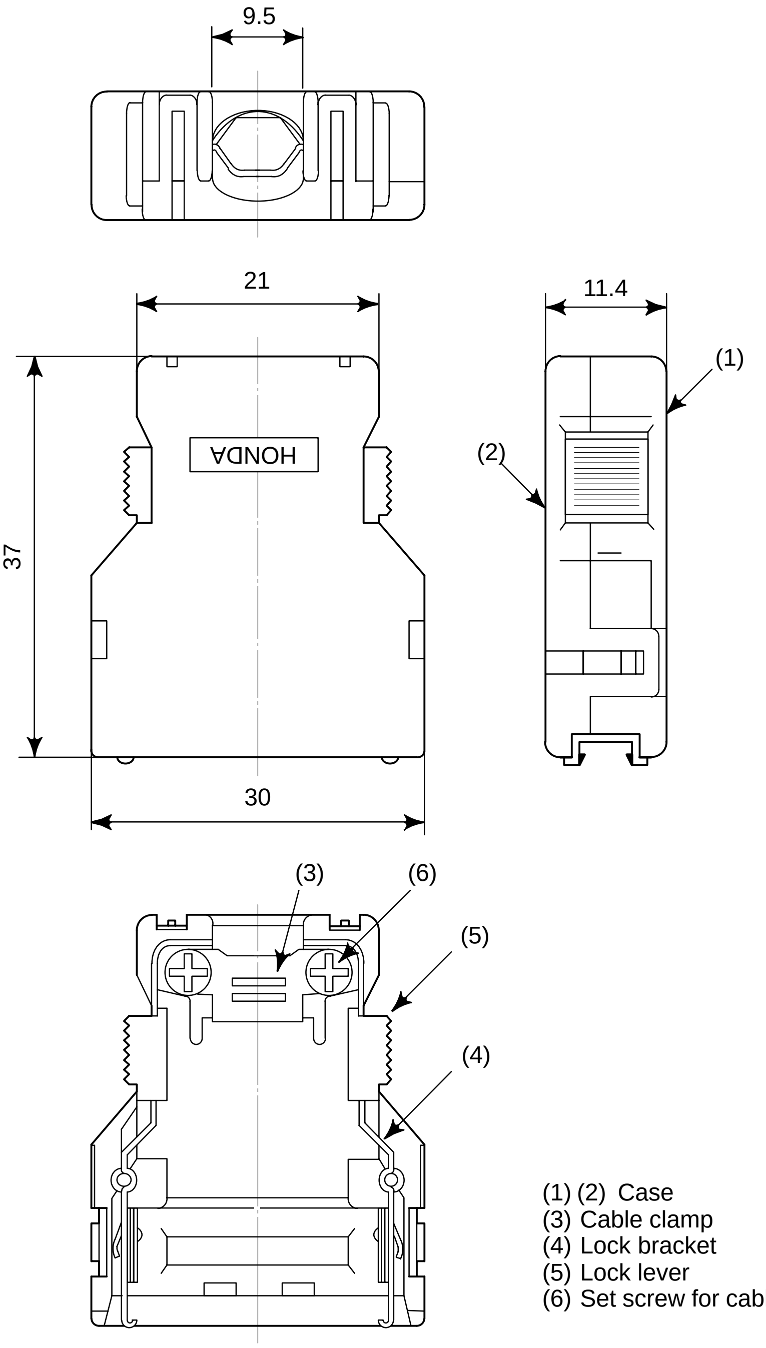
**Note**
This connector does not have contacts for positions 11,13,15,17, and 19.

Unit : mm

## *Fig. 3* Connector case (Honda PCR type)

| | | |
|---|---|---|
| TYPE | : | HONDA PCR–V20LA (for 6 dia. cable) |
| USAGE | : | GENERAL |

DIMENSION

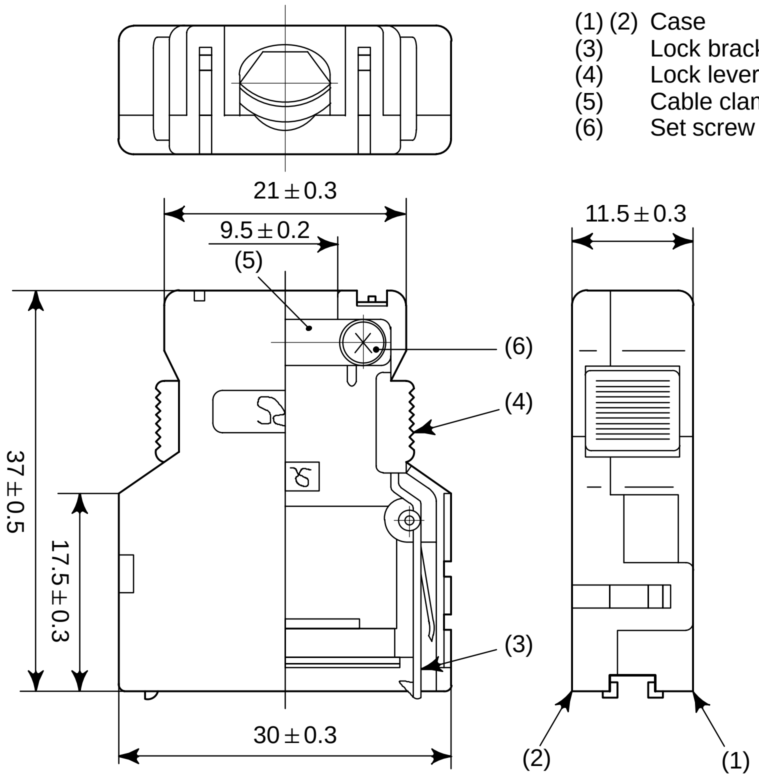


(1) (2) Case
(3) Cable clamp
(4) Lock bracket
(5) Lock lever
(6) Set screw for cable clamp

Unit : mm

## ***Fig. 4*** Connector case (Hirose FI type)

TYPE : HIROSE FI–20–CV (for 8 dia. cable)
USAGE : PULSE CODER INTERFACE
LINEAR SCALE INTERFACE
MPG INTERFACE
DIMENSION

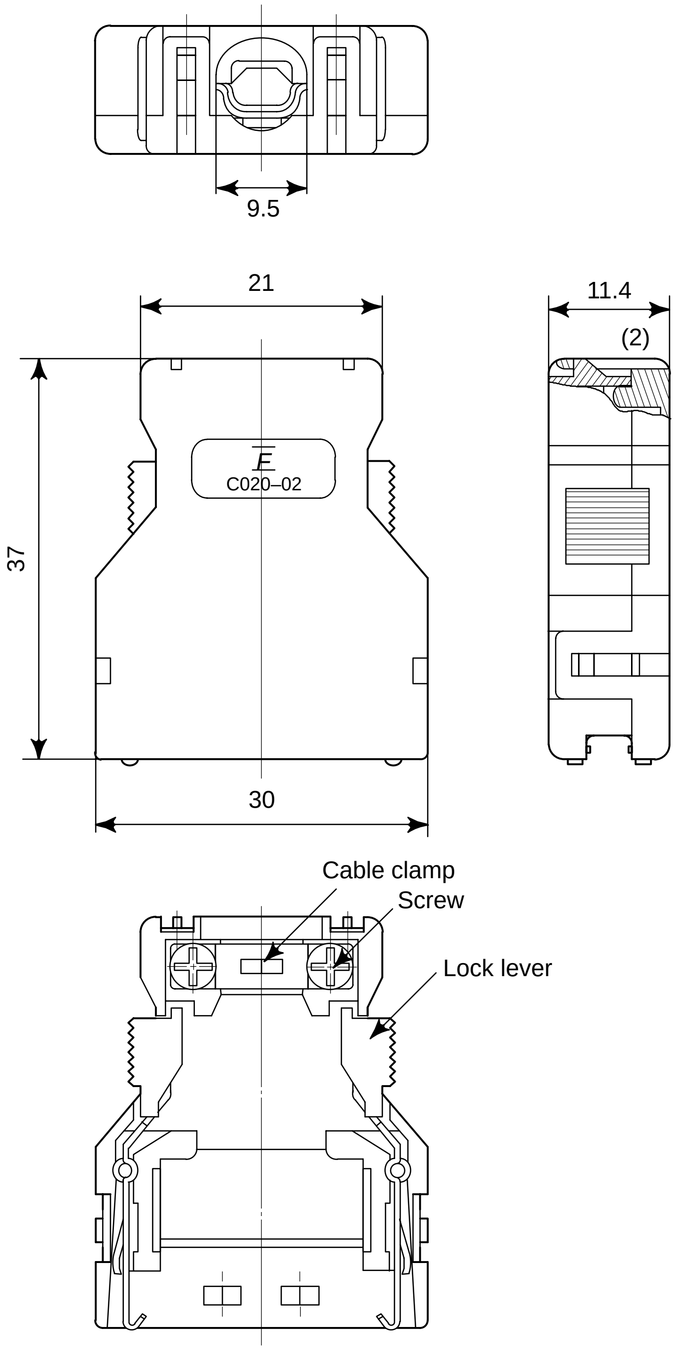


(1) (2) Case
(3) Lock bracket
(4) Lock lever
(5) Cable clamp
(6) Set screw for cable clamp

Unit : mm

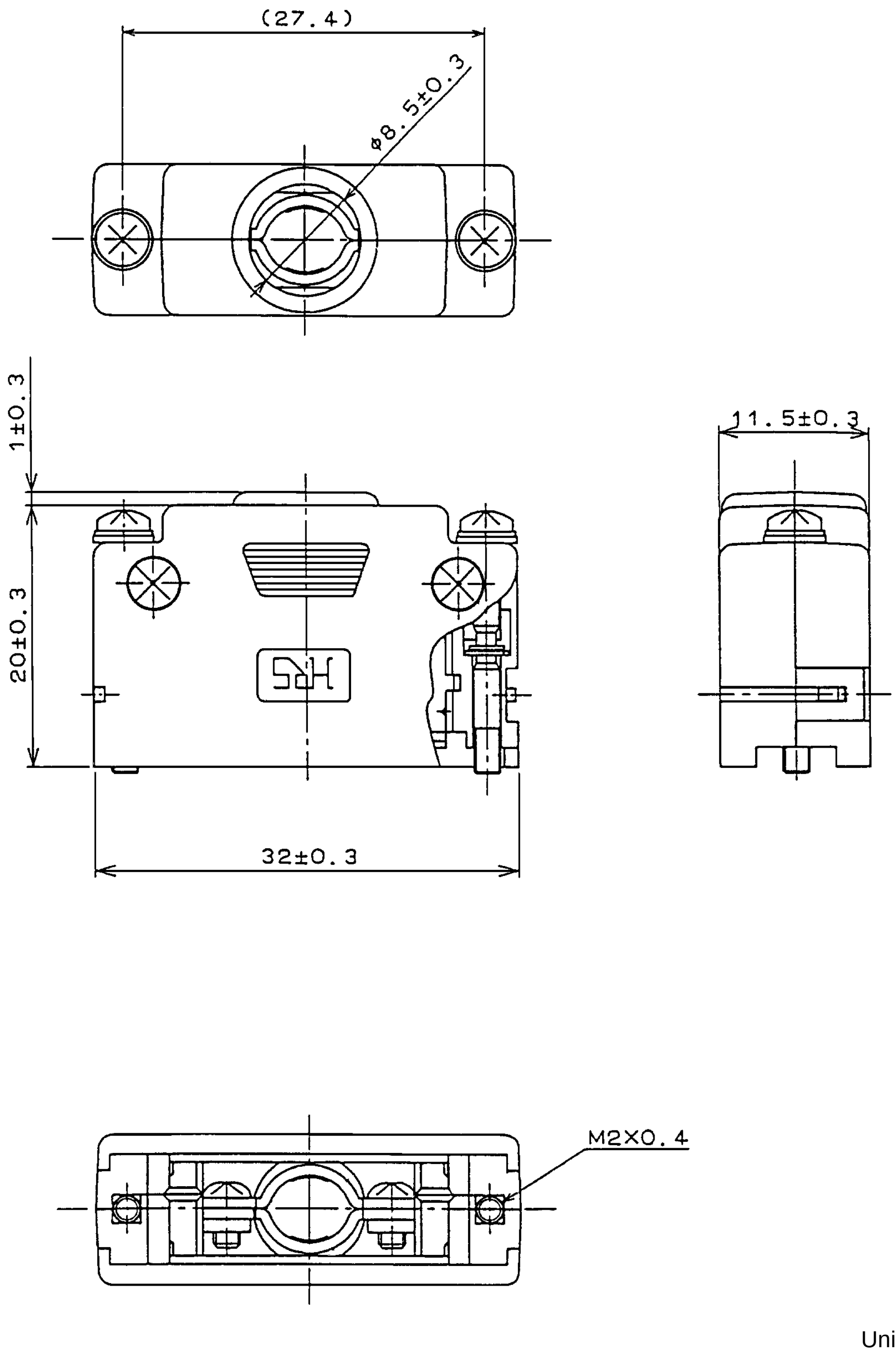
## *Fig. 5* Connector case (Fujitsu FCN type)

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



Unit : mm

## *Fig. 6* Connector case (PCR type (Hirose Electric))



Unit : mm

## *Fig. 7* AMP Connector (1) type X

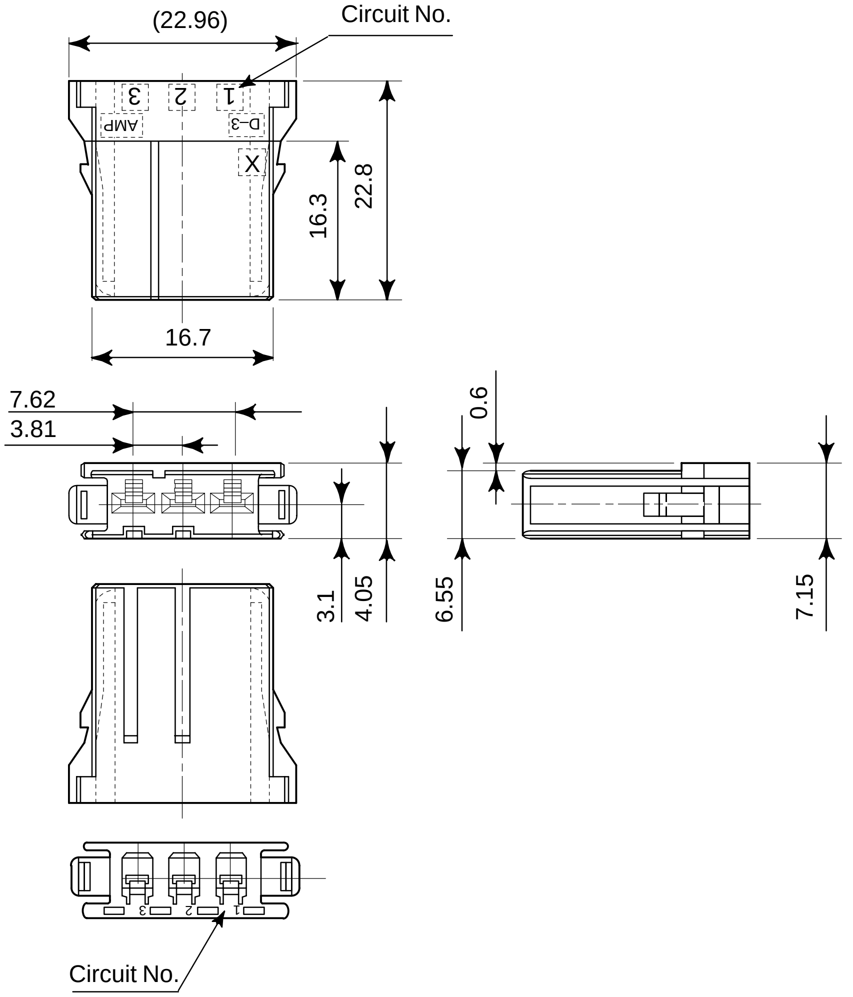
Specification : A02B–0120–K324 (with contact AMP1–175218–5)

TYPE : AMP1–178288–3 (HOUSING)

USAGE : CONTROL UNIT POWER SUPPLY INPUT
CRT/MDI POWER SUPPLY INPUT

DIMENSION

| | | |
|---|---|---|
| CP1 | 3 | |
| | 2 | 0V |
| CPD1 | 1 | +24E |



Unit : mm

## *Fig. 8* AMP Connector (2) type Y

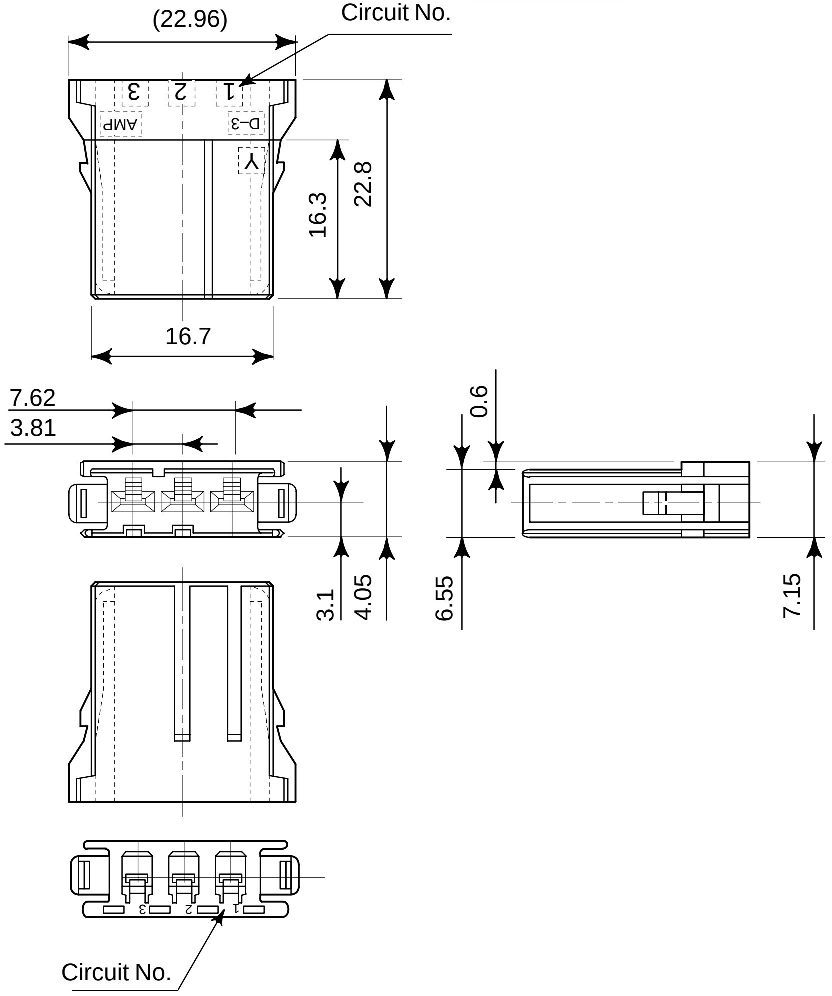
Specification : A02B–0120–K323 (with contact AMP1–175218–5)

TYPE : AMP2–178288–3 (HOUSING)

USAGE : LCD UNIT POWER SUPPLY INPUT CP5
CONTROL UNIT POWER SUPPLY OUTPUT CP2

DIMENSION

| | |
|---|---|
| 3 | |
| 2 | 0V |
| 1 | +24V |



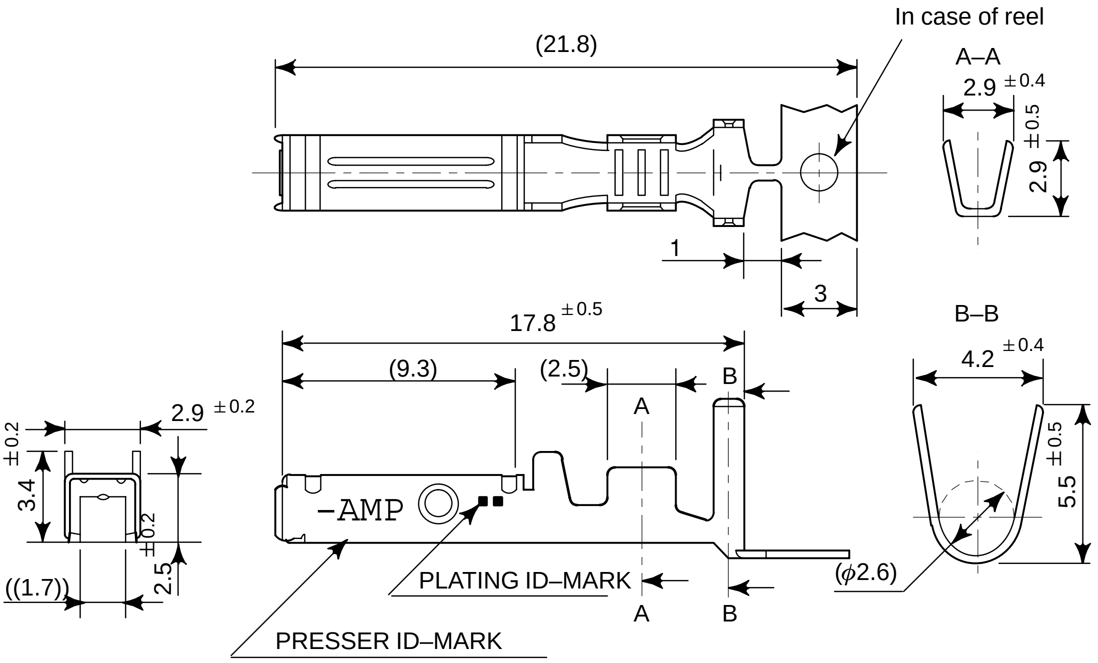
Unit : mm

## *Fig. 9* Contact for AMP Connector

SEPARATE : AMP1–175218–2(Gold coated)
AMP1–175218–5(Tin coated)

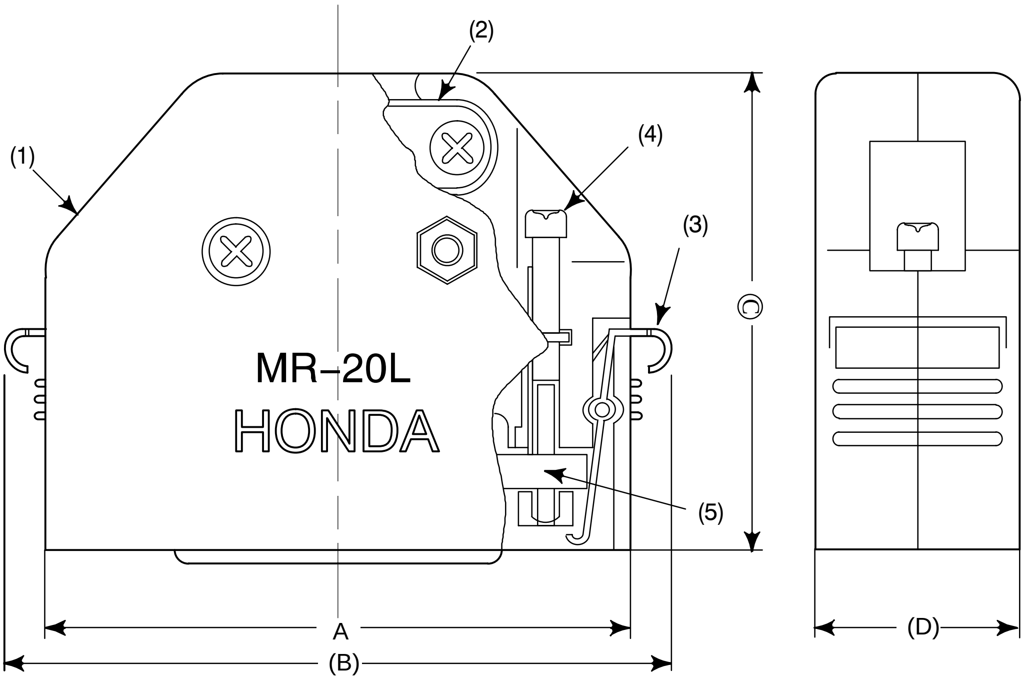
REEL : AMP1–175196–2(Gold coated)
AMP1–175196–5(Tin coated)

WIRE : AWG 16, 18, 20



Unit : mm

***Fig. 10*** Honda connector (Case)



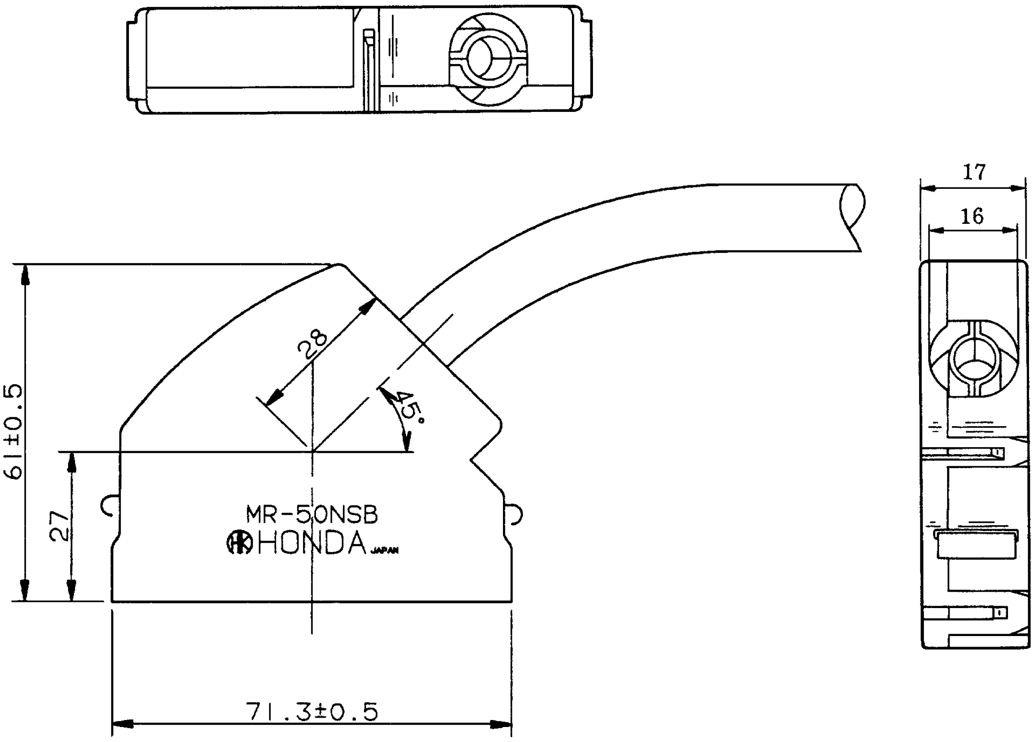
| Symbol / Specification | A | (B) | C | (D) | Number of terminals |
|---|---|---|---|---|---|
| MR–20LMH (Plug) | 39.3 | 44.9 | 39.8 | 17 | 20 |
| MR–20LFH (Jack) | | | | | |
| MR–50LMH (Plug) | 67.9 | 73.5 | 44.8 | 18 | 50 |
| MR–50LFH (Jack) | | | | | |

| 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

Unit : mm

## *Fig. 11* Honda connector (angled–type case)

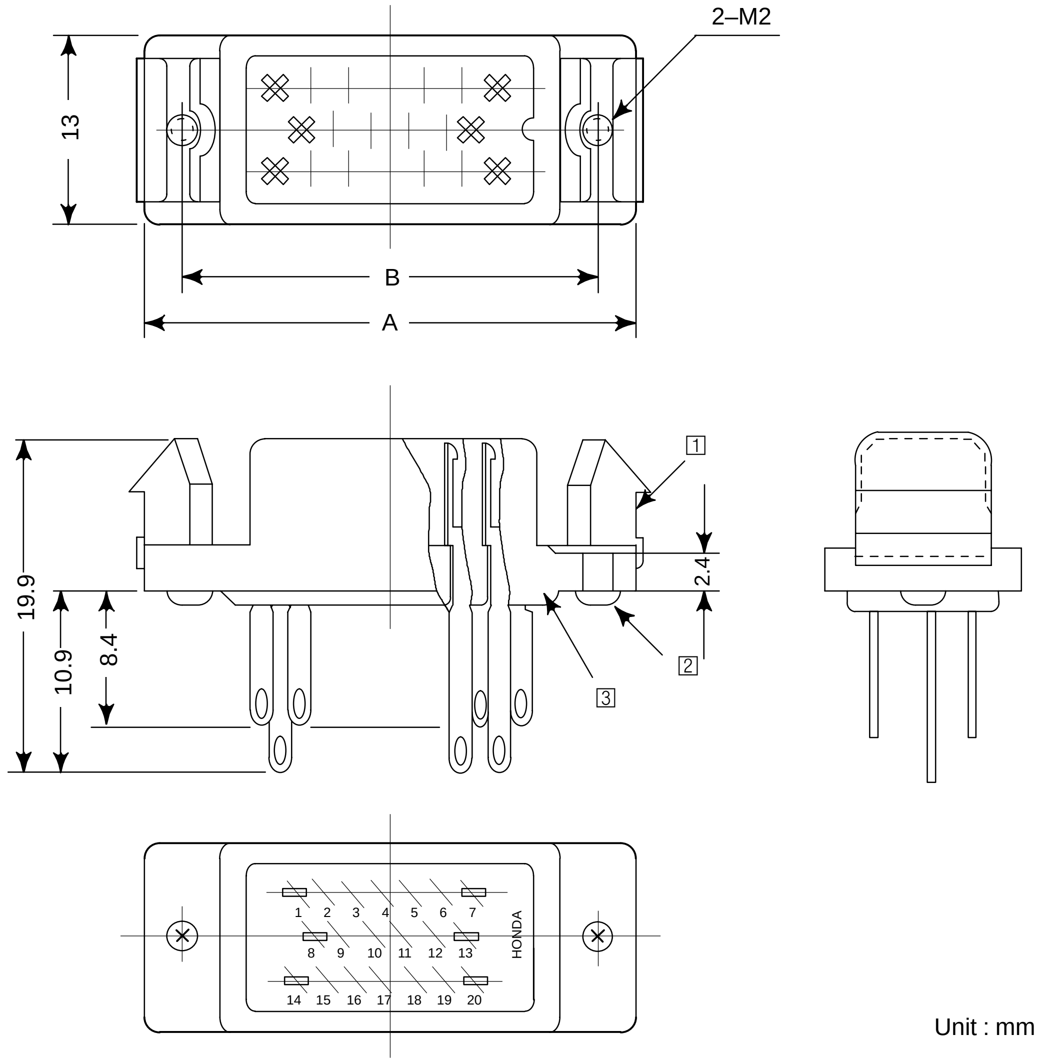


External dimensions of 50–pin connector

Unit : mm

## *Fig. 12* Honda connector (Male)

Specification : A02B–0029–K898 (20 pins, soldering type, with cover)
A02B–0029–K900 (20 pins, crimp type, with cover and contact)
A02B–0029–K899 (50 pins, soldering type, with cover and contact)
A02B–0029–K901 (50 pins, crimp type, with cover and contact)



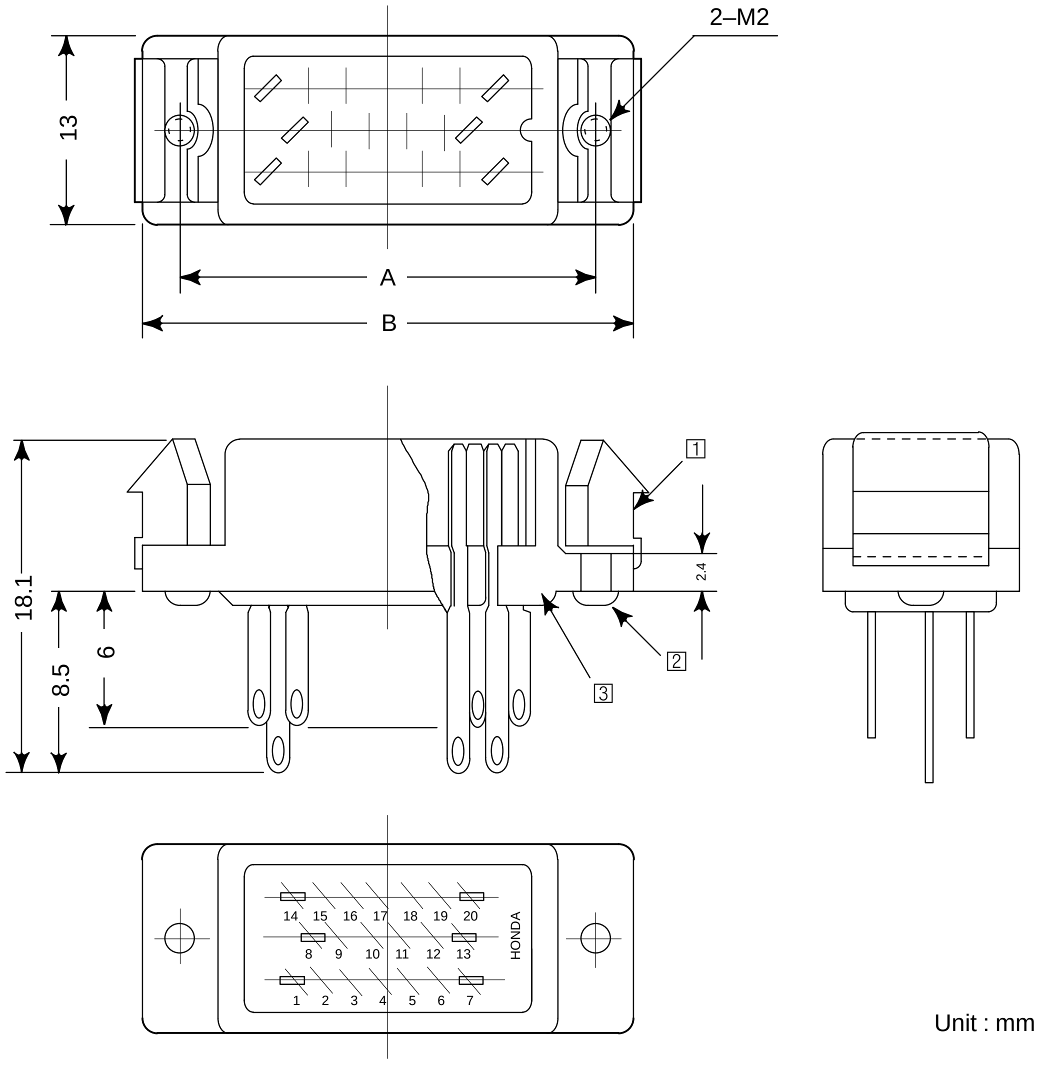
Unit : mm

| | A | B |
|---|---|---|
| 20 Pins | 32.8 | 27.8 |
| 50 Pins | 61.4 | 56.4 |

| Symbol | Name |
|---|---|
| 1 | Cable clamp |
| 2 | Screw 2.6dia.×8 |
| 3 | Connector |

## *Fig. 13* Honda connector (Female)

Specification : A02B–0029–K890 (20 pins, soldering type, with cover)
A02B–0029–K892 (20 pins, crimp type, with cover and contact)
A02B–0029–K891 (50 pins, soldering type, with cover)
A02B–0029–K893 (50 pins, crimp type, with cover and contact)



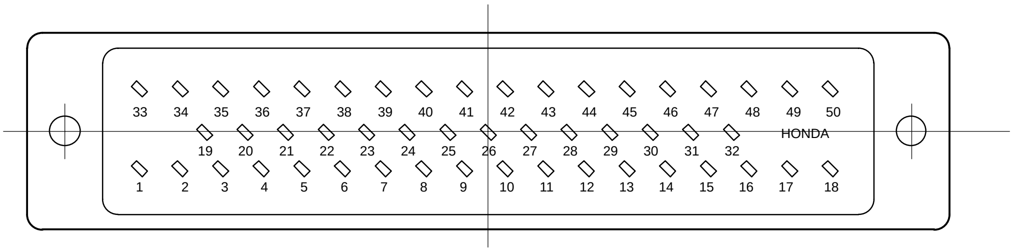
Unit : mm

| | A | B |
|---|---|---|
| 20 Pins | 32.8 | 27.8 |
| 50 Pins | 61.4 | 56.4 |

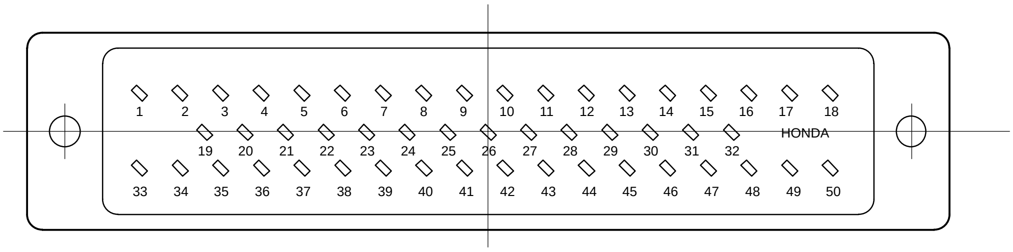
| Symbol | Name |
|---|---|
| 1 | Cable clamp |
| 2 | Screw 2.6dia.×8 |
| 3 | Connector |

## *Fig. 14* Honda connector (Terminal layput)

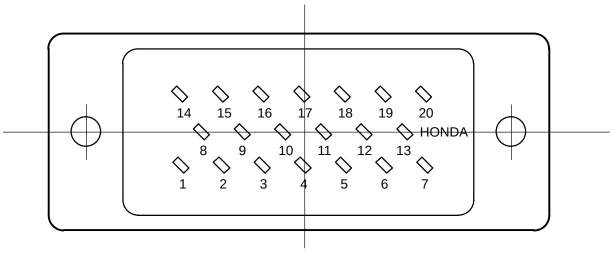
- **MR–50MH, MRP–50M01(50–core, plug)**



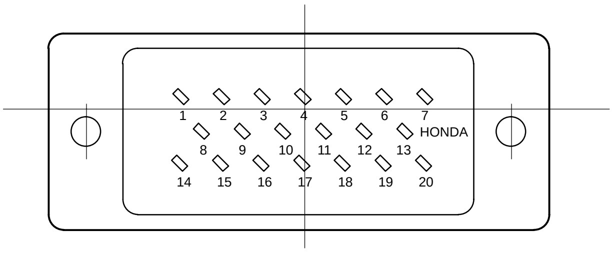
- **MR–50FH, MRP–50F01(50–core, jack)**



- **MR–20MH, MRP–20M01(20–core, plug)**

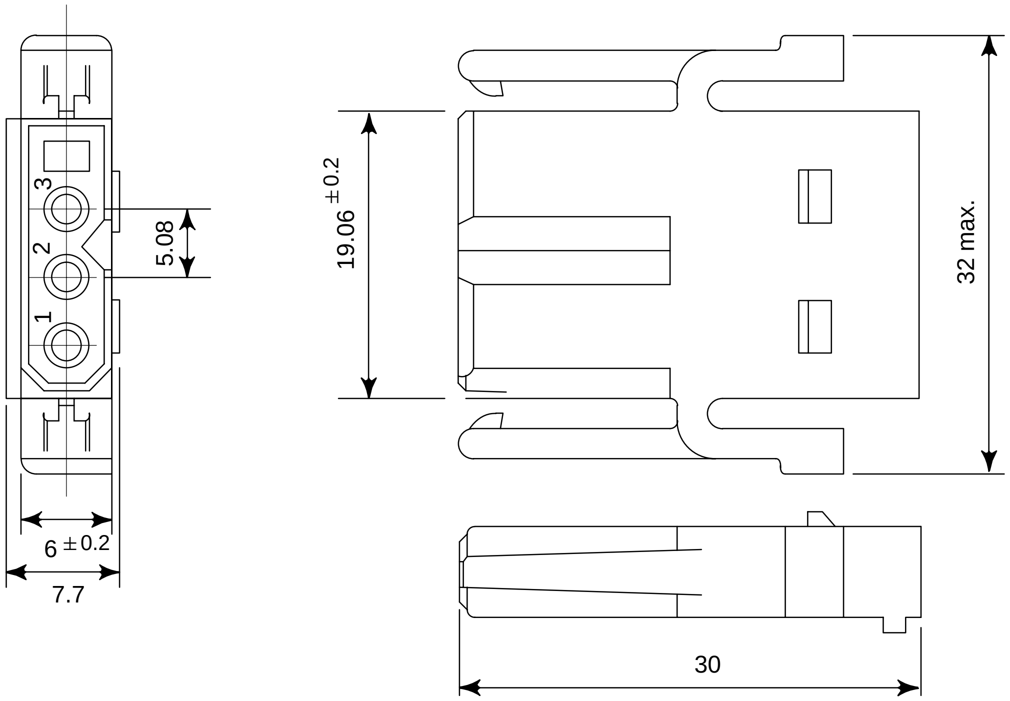


- **MR–20FH, MRP–20F01(20–core, jack)**



## *Fig. 15* Connector made by FCI (3 pins, brown)

Specification : A02B–0072–K893 (Housing, Soldering contact)



Unit : mm

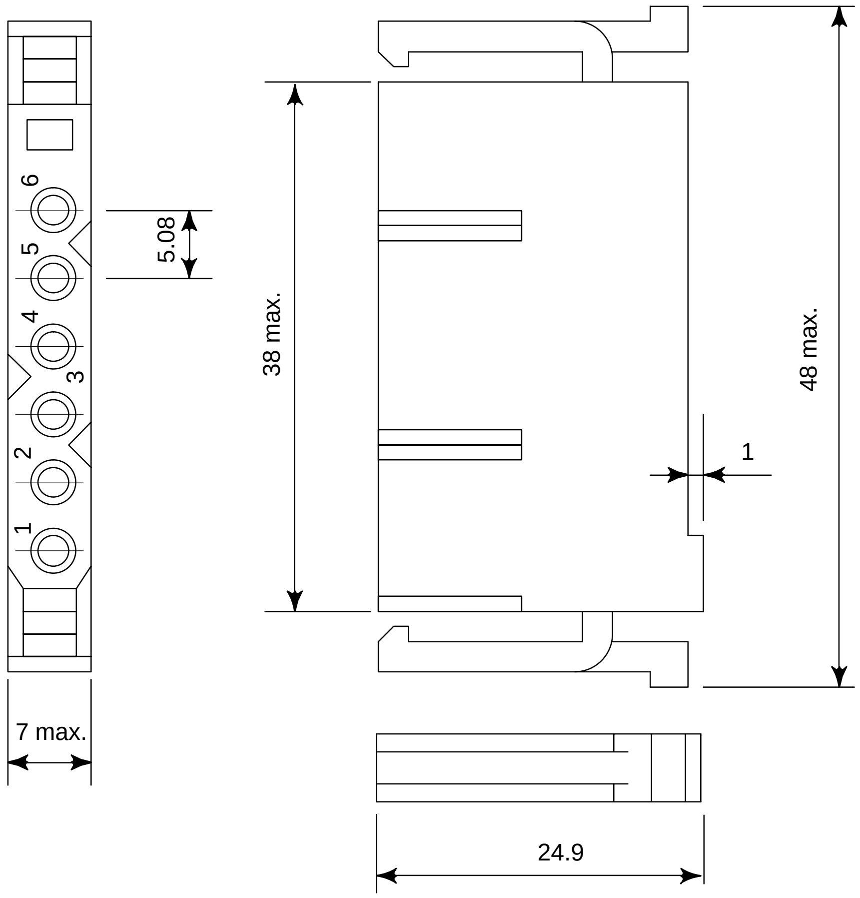
Manufacturer : FCI JAPAN, LTD.

| Name | | Specification (Connector maker number) | Remarks |
|---|---|---|---|
| Connector housing for cable | | SMS3PN–5 | Black |
| 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. 16* Connector made by FCI (6 pins, brown)

Specification : A02B–0061–K203 (Housing, Soldering contact)



Unit : mm

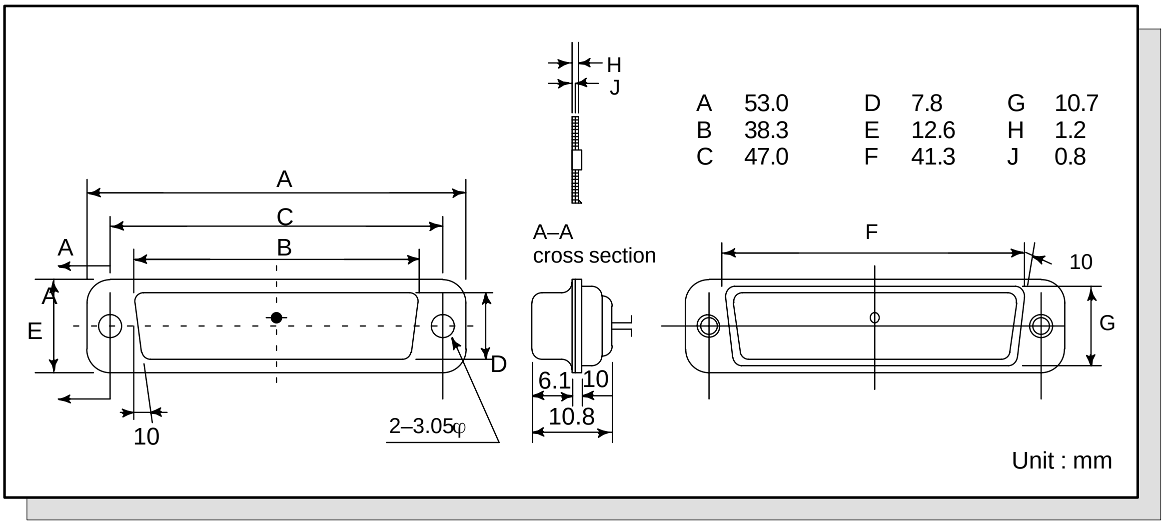
Manufacturer : FCI JAPAN, LTD.

| 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. 17 Punch panel connector for RS–232–C serial port

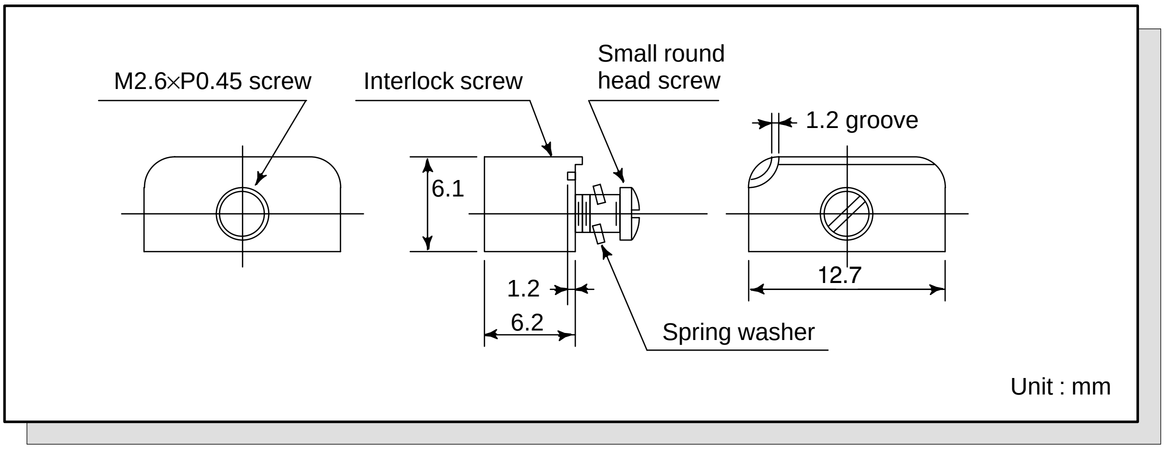
Specification : A02B–0118–K895 (male, with cover)
A02B–0061–K201 (female, with metal fitting for lock)



| | | | | | |
|---|---|---|---|---|---|
| A | 53.0 | D | 7.8 | G | 10.7 |
| B | 38.3 | E | 12.6 | H | 1.2 |
| C | 47.0 | F | 41.3 | J | 0.8 |

Unit : mm

## Fig. 18 RS–232–C serial port connector metal fitting for lock



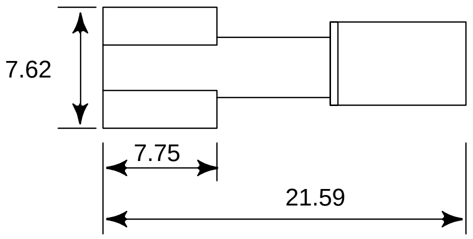
Unit : mm

## *Fig. 19* Faston terminal

Specification : A02B–0166–K330

| | | |
|---|---|---|
| Model | : | Faston terminal |
| Purpose | : | For grounding for signals |
| Applicable housing | : | 170604–1 manufactured by AMP (Japan), Ltd. or<br>FVDDF2–250, type I, blue manufactured by Japan Crimp Terminal Corporation |

DIMENSION

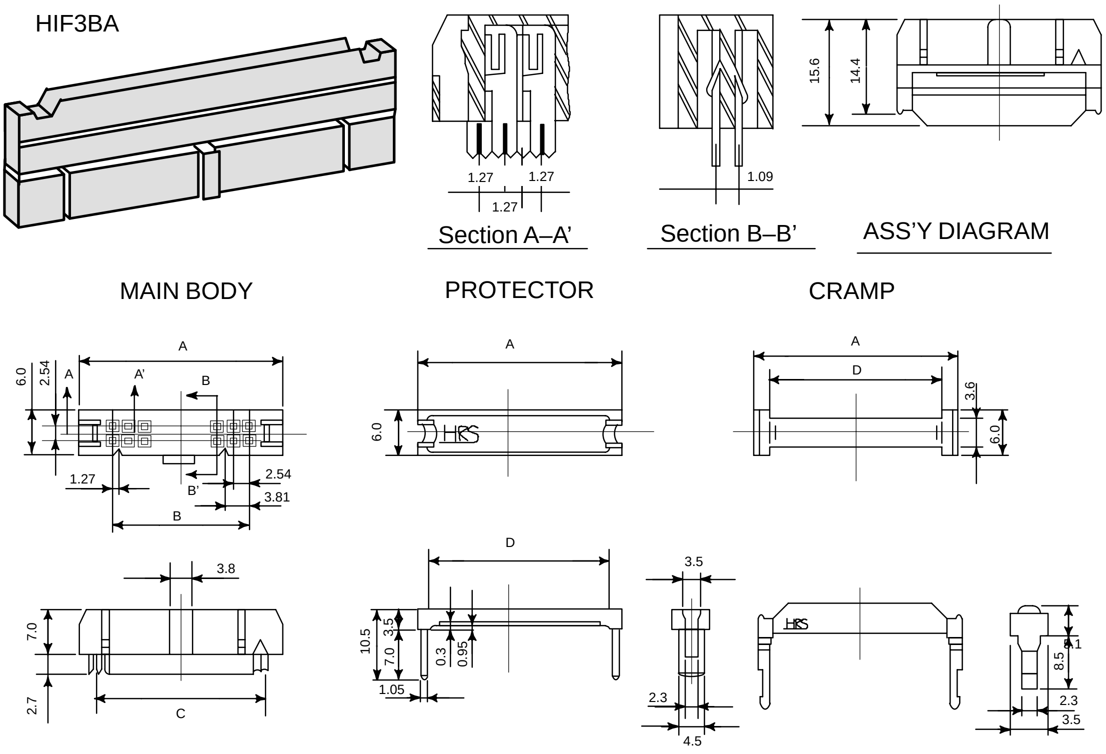


Applicable wire :
A cross–section of 1.25 to 2.27 $mm^2$

Unit : mm

## *Fig. 20* Connector for hirose flat cable

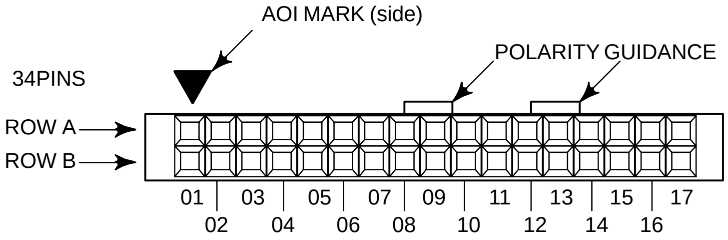
Specification HIROSE ELEC. CO.
HIF3BA–34D–2.54R (34contacts)



Dimensions

| Description | No.of contact | A | B | C | D |
|---|---|---|---|---|---|
| HIF3BA–34D–2.54R | 34 | 47.75 | 40.64 | 41.91 | 43.28 |

FLAT CABLE CONNECTOR CONTACT NUMBER (HIROSE)



OUTVIEW FROM CONNECTOR SIDE

Unit : mm

# C 20–PIN INTERFACE CONNECTORS AND CABLES

# C.1
# BOARD–MOUNTED CONNECTORS

## C.1.1
## Vertical–type Connectors

Models: PCR–EV20MDT (Honda Tsushin)
52618–2011 (Molex Japan)

These board–mounted connectors have been specially developed to achieve the high packing density required for FANUC products. As explained in the following subsection, Honda PCR series connectors can be used as cable connectors because the mating mechanism of the newly developed connectors is compatible with that of the Honda PCR series connectors. To support this specification extensively, many connector manufacturers are now developing custom–tailored cable connectors. (Note that these cables cannot be used with screw–fixing cable connector housings.)

## C.2 CABLE–SIDE CONNECTORS

Cable–side 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.

**Table C.2 Cable–side connectors**

| | Use | Type | Manufac-turer | Connector model | Housing model | Applicable cable outside diameter |
|---|---|---|---|---|---|---|
| Cable–side connector | General use | Strand wire press–mount type | Honda | PCR–E20FA | PCR–V20LA* | $\phi$6 mm<br>($\phi$5.7 to 6.5) |
| | | | Hirose | FI30–20S* | FI–20–CV2* | $\phi$6.2 mm<br>($\phi$5.5 to 6.5) |
| | | | | FI30–20S* | FI–20–CV7* (Note) | $\phi$6.2 mm<br>($\phi$5.5 to 6.5) |
| | | | Fujitsu | FCN–247J020–G/E | FCN–240C020–Y/S* | $\phi$5.8 mm<br>($\phi$5.5 to 6.5) |
| | | | Molex | 52622–2011* | 52624–2015* | $\phi$6.2 mm<br>($\phi$5.9 to 6.5) |
| | | Soldering type | Honda | PCR–E20FS | PCR–V20LA* | $\phi$6 mm<br>($\phi$5.7 to 6.5) |
| | | | Hirose | FI40–20S* | FI–20–CV2* | $\phi$6.2 mm<br>($\phi$5.5 to 6.5) |
| | | | | FI40B–20S*<br>(FI40A–20S*) | FI–20–CV5* | $\phi$9.2 mm<br>($\phi$8.9 to 9.5) |
| | | | | FI40B–20S* | FI–20–CV6* | $\phi$10.25 mm<br>($\phi$9.5 to 11.0) |
| | For pulse coder, coaxial cable, linear scale, manual pulse generator, etc. | Soldering type | Honda | PCR–E20FS | PCR–V20LA* | $\phi$6 mm<br>($\phi$5.7 to 6.5) |
| | | | Hirose | FI40B–2015S*<br>(FI40–2015S*) | FI–20–CV* | $\phi$8.5 mm<br>($\phi$8.0 to 9.0) |
| | | | | FI40B–20S*<br>(FI40A–20S*) | FI–20–CV5* | $\phi$9.2 mm<br>($\phi$8.9 to 9.5) |
| | | | | FI40B–20S* | FI–20–CV6* | $\phi$10.25 mm<br>($\phi$9.5 to 11.0) |

**NOTE**

Low screw–lock housing (Can not used in Power Mate *i*.)

## Supplementary description of cable–side 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.
- Solder type connectors
  The table below gives further details of solder type connectors and the housings.

| Connector model (manufacturer) | Description |
|---|---|
| PCR–E20FS (Honda) | For general signal applications. Suitable for assembly of a small number of cables or for on–site cable assembly |
| FI40–20S (Hirose) | Equivalent to the Honda PCR–E20FS |
| FI40B–20S (Hirose)<br>(former FI40A–20S) | This connector has as many pins as the FI40–20S and a wider space between soldering portions. This results in increased work efficiency in soldering. A thick wire can be soldered. In comparison with the conventional FI40A–20S, with which a wire of up to about #20AWG can be soldered, this connector has higher pin strength and allows wires of up to about #17AWG to be soldered. When a thick wire such as #17AWG is used, it is recommended that a strong housing such as FI–20–CV6 be used. |
| FI40B–2015S (Hirose)<br>(former FI40–2015S) | The number of pins has been thinned out to expand a space between soldering portions. This connector has higher pin strength than the conventional FI40–2015S. If the outside diameter of a cable does not exceed 8.5 mm, thick wires of up to about #17AWG can be soldered. This connector cannot be used with the position coder interface of the *i* series. |

| Housing (manufacturer) | Description |
|---|---|
| FI–20–CV5 (Hirose) | Plastic housing recommended for the FI40B–20S<br>Applicable cable outside diameter: 9.2 mm |
| FI–20–CV6 (Hirose) | Diecast metal housing developed for the FI40B–20S<br>Applicable cable outside diameter: 10.25 mm<br>(FI–20–CV6 is a die–cast metal case.) |

For the solder type connectors of Hirose Electric and the housings, the combinations indicated below are possible as well as the combinations indicated in Table C.2. Use a cable of which outside diameter matches the limitation of the housing.

| Connector model | | Housing model (applicable cable outside diameter) | |
|---|---|---|---|
| FI40B–2015S<br>(formerly FI40–2015S) | ⟷ | FI–20–CV (8.5 mm) No other diameters | |
| FI40–20S<br>FI40B–20S<br>(formerly FI40A–20S) | ⟷ | FI–20–CV2 ($\phi$6.2mm)<br>FI–20–CV5 ($\phi$9.2mm)<br>FI–20–CV6 ($\phi$10.25mm) | Mutually applicable |

# C.3 RECOMMENDED CONNECTORS, APPLICABLE HOUSING, AND CABLES

**Table C.3 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<br>Strand press–mount type | PCR–E20FA<br>(Honda Tsushin) | PCR–V20LA<br>(Honda Tsushin) | A66L–0001–0284#10P<br>(6.2 mm in diameter) | Plastic housing |
| | FI30–20S<br>(Hirose Electric) | FI–20–CV2<br>(Hirose Electric) | | Plastic housing |
| | | FI–20–CV7<br>(Hirose Electric) | | Plastic housing |
| | FCN–247J020–G/E<br>(Fujitsu Takamizawa) | FCN–240C020–Y/S<br>(Fujitsu Takamizawa) | | Plastic housing |
| | 52622–2011<br>(Molex) | 52624–2015<br>(Molex) | | Plastic housing |
| PCR–E20FS<br>Soldering type | PCR–E20FS<br>(Honda Tsushin) | PCR–V20LA<br>(Honda Tsushin) | | Plastic housing |
| | FI40–20S<br>(Hirose Electric) | FI–20–CV2<br>(Hirose Electric) | | Plastic housing |
| FI40B–2015S (formerly FI40–2015S) 15–pin soldering type | F140B–2015S (formerly FI40–2015S) (Hirose Electric) | FI–20–CV<br>(Hirose Electric) | A66L–0001–0286 (Note)<br>A66L–0001–0402 (Note)<br>(8.5 mm in diameter) | Plastic housing |
| FI40B–20S<br>(formerly FI40A–20S)<br>Soldering type | FI40B–20S<br>(formerly FI40A–20S)<br>(Hirose Electric) | FI–20–CV5<br>(Hirose Electric) | A66L–0001–0367<br>A66L–0001–0368<br>(9.2 mm in diameter) | Plastic housing |
| | FI40B–20S<br>(Hirose Electric) | FI–20–CV6<br>(Hirose Electric) | A66L–0001–0403 (Note)<br>(9.8 mm in diameter) | Metal housing |

**NOTE**

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 the Section on the cable materials 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.

## C.4
## 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<br>JGPS–014 | MFC–K1<br>PCS–K1 | |
| | | FHAT–918A | | |
| | FI30–20S (Hirose Electric) | FI30–20CAT | FI30–20/ID | Low cost |
| | | FI30–20CAT1 | HHP–502<br>FI30–20GP | |
| | FCN–247J020–G/S (Fujitsu) | FCN–237T–T043/H | FCN–237T–T109/H<br>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.

## C.5 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.

**Table C.5 Recommended materials for cable assemblies**

| Material | Use | Constitution | FANUC specification number | Manufacturer | Remark |
|---|---|---|---|---|---|
| 10–pair cable | General use | 0.08 $mm^2$ 10 pairs | A66L–0001–0284#10P | Hitachi Cable, Ltd.<br>Oki Electric Cable Co., Ltd. | |
| 5–conductor coaxial cable | CRT interface (long–distance) | 5–conductor coaxial | A66L–0001–0371 | Hitachi Cable, Ltd. | 50 m or less |
| 12–conductor composite cable (Note) | Pulse coder | 0.5 $mm^2$ 6 conductors<br>0.18 $mm^2$ 3 pairs | A66L–0001–0286 | Hitachi Cable, Ltd.<br>Oki Electric Cable Co., Ltd. | 20 m or less |
| | Linear scale | 0.75 $mm^2$ 6 conductors<br>0.18 $mm^2$ 3 pairs | A66L–0001–0402 | Oki Electric Cable Co., Ltd. | 30 m or less<br>Usable on movable parts |
| | Manual pulse generator | 1.25 $mm^2$ 6 conductors<br>0.18 $mm^2$ 3 pairs | A66L–0001–0403 | Oki Electric Cable Co., Ltd. | 50 m or less<br>Usable on movable parts |

**NOTE**

For a pulse coder, scale, manual pulse generator, or other unit using +5 V power, select cable wires considering the voltage drop due to the cable resistance.

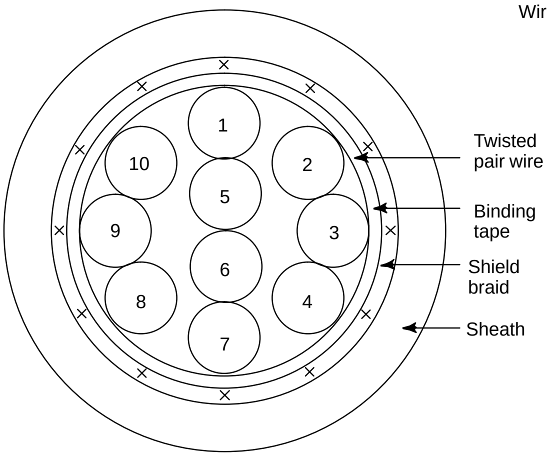
## 10–pair cable

- **Specifications**

| Item | | Unit | Specifications |
|---|---|---|---|
| Product No. | | – | A66L–0001–0284#10P |
| Manufacturer | | | HITACHI CABLE, LTD.<br>OKI ELECTRIC CABLE., LTD. |
| Rating | | – | 60°C 30V:UL2789<br>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<br>Thinnest portion : 0.08 (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<br>Oki Electric Cable : Available,10/0.12 |
| Shield braid | Element wire diameter | mm | 0.12 |
| | Braid density | % | 85 or more |
| Sheath | Color | – | Black |
| | Thickness | mm | 1.0 |
| | Outside diameter (approx.) | mm | 6.2 |
| Standard length | | m | 200 |
| Packing method | | – | Bundle |
| Electrical performance | Electric resistance(at 20°C) | Ω/km | 233 or less |
| | Insulation resistance (at 20°C) | MΩ–km | 10 or less |
| | Dielectric strength (AC) | V/min. | 300 |
| Flame resistance | | – | Shall pass flame resistance test VW–1SC of UL standards. |

- **Cable structure**

The cable structure is shown below.

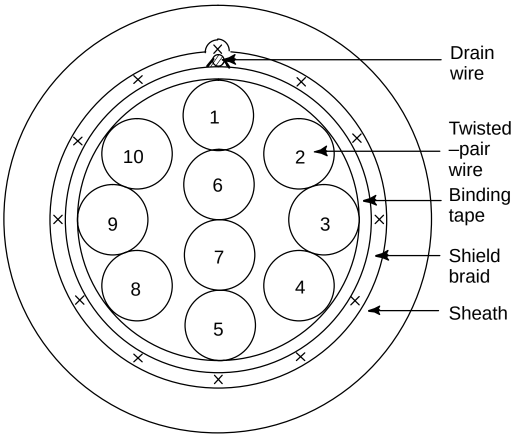


Wire identification table (HITACHI)

| 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. C.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. C.5 (b) Cable made by Oki Electric Cable

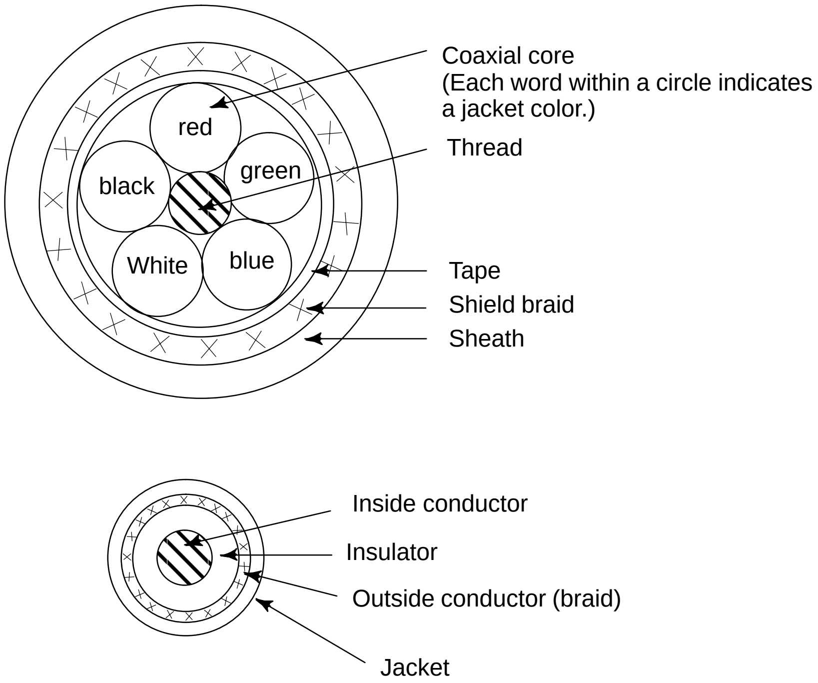
## 5–core coaxial cable

- **Specifications**

| Item | | Unit | Description |
|---|---|---|---|
| Specification | | – | A66L–0001–0371 |
| Manufacture | | – | HITACHI CABLE CO., LTD. |
| Manufacture's specification | | – | CO–IREFV(0)–CX–75–SB5X0.14SQ |
| Number of Conductors | | Core | 5 |
| Inside Conductor | Size | $mm^2$ | 0.14 |
| | Components | Conductors (PCS)/mm | 7/0.16 |
| | Material | – | Tin–coated Soft Copper Wire |
| | Diameter | mm | 0.48 |
| Insulator | Material (Color) | – | Polyethylene (White) |
| | Thickness | mm | 0.71 |
| | Diameter | mm | 1.90 |
| Outside Conductor | Material | – | Tin–coated Soft Copper Wire (Rolled) |
| | Diameter of Component–Wire | mm | 0.08 |
| | Density | % | 95 or more |
| | Diameter | mm | 0.2 |
| Jacket | Material | – | Vinyl |
| | Color | – | Black. White. Red. Green. Blue |
| | Thickness | mm | 0.15 |
| | Diameter | mm | 2.6 |
| Twisted Assembly Diameter | | mm | 7.1 |
| Thickness of Paper Tape | | mm | 0.05 |
| Shield braid | Wire dia. Material | mm | 0.12<br>Tin–coaded soft copper wire |
| | Density | % | 80 or more |
| | Thickness | mm | 0.3 |
| | Diameter | mm | 7.8 |
| Sheath | Material, Color | – | Oil Tight Vinyl Black |
| | Thickness | mm | 0.7 (Min. thickness: 0.56) |
| Finish Diameter | | mm | 9.2 ±0.3 |
| Conductor Resistance (20°C) | | Ω/km | 143 or less |
| Withstand Voltage (A.C.) | | V/min. | 1000 |
| Insulation Resistance (20°C) | | MΩ–km | 1000 or more |
| Impedance (10MHz) | | Ω | 75±5 |
| Standard Capacitance (1MHz) | | nF/km | 56 |
| Standard Attention (10MHz) | | dB/km | 53 |
| Weight | | kg/km | 105 |
| Standard Length | | m | 200 |
| Package form | | – | Bundle |

- **Cable structure**

The cable structure is shown below.



## 12–core cable

- **Specifications**

| Item | | Unit | Specifications | |
|---|---|---|---|---|
| Product No. | | – | A66L–0001–0286 | |
| Manufacturer | | – | HITACHI CABLE, LTD.<br>OKI ELECTRIC CABLE., 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.<br>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 | |
| 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, | |

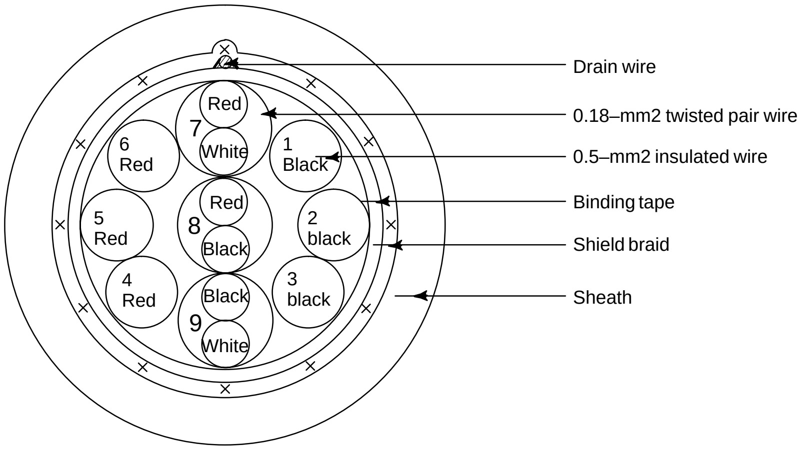
**NOTE**

The maximum outside diameter applies to portions other than the drain wire.

- **Markings on cable**
  - Name or symbol of the manufacturer
  - Manufacturing year

- **Cable structure**

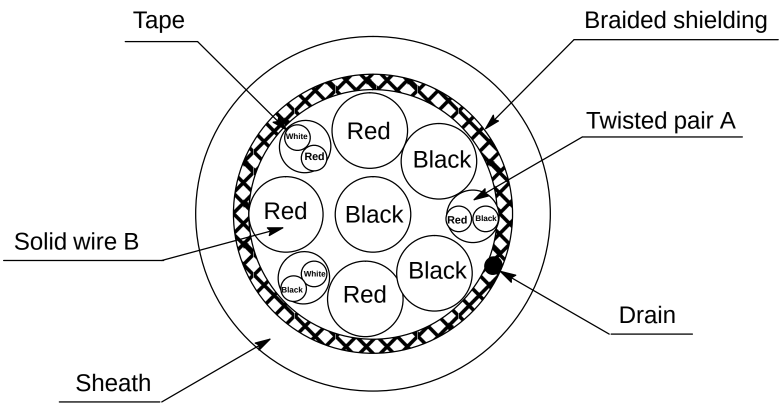
The cable structure is shown below.



The colors in the figure indicate the colors of insulators.

## • 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<br>Typical pitch:<br>20 mm | | Left<br>Typical pitch:<br>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 Japanese paper tape 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 |  | | | | |

# D OPTICAL FIBER CABLE

This section describes the specifications and notes of the optical fiber cables for the following interfaces.

(1) Serial spindle interface (for internal lines)
(2) I/O Link interface (for exchange lines)
(3) High–speed serial bus (HSSB) interface (for exchange lines)
(4) Serial servo bus (FSSB) interface (for internal or exchange lines)

## Notes on the specifications of optical cable C

(1) Supported optical cables

(a) Internal cord type cable: A66L–6001–0023#L□R□□□
Cable length: 0.15 to 10 m
Code diameter: 2.2 mm × 2 cords
Tensile strength:
Fiber cord 7 kg per cord
Between optical fiber cord and optical connector 2 kg
Minimum bending radius of fiber cord: 25 mm
Operating temperature: –20 to 70°C

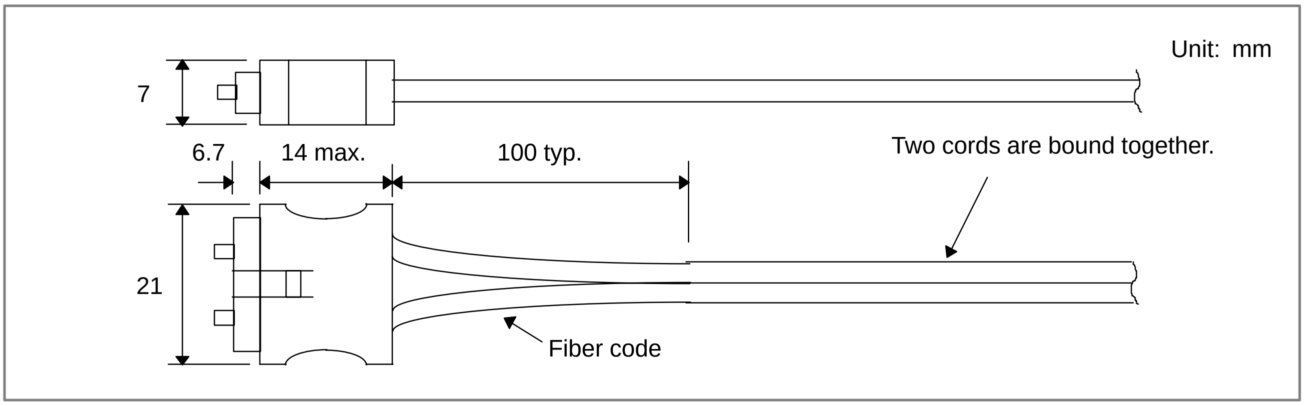


**Fig. D (a) External dimensions of internal cord type cable**

(b) External type cable: A66L–6001–0026#L□R□□□
A66L–6001–0029#L□R□□□
Cable length: 1 to 200 m
Fiber cord diameter: 2.2 mm × 2 cords
Diameter of cable with reinforced cover: 7.6 mm
Tensile strength: Cable with reinforced cover: 75 kg
Optical fiber cord: 7 kg per cord
Between fiber cord and optical connector: 2 kg
Minimum bending radius of optical fiber cord: 25 mm
Minimum bending radius of cable with reinforced cover: 50 mm
Bending resistance (cable with reinforced cover):
10 million bending cycles at room temperature
(when the bending radius is 100 mm)

Flame resistance: Equivalent to UL VW–1
Operating temperature: –20 to 70°C

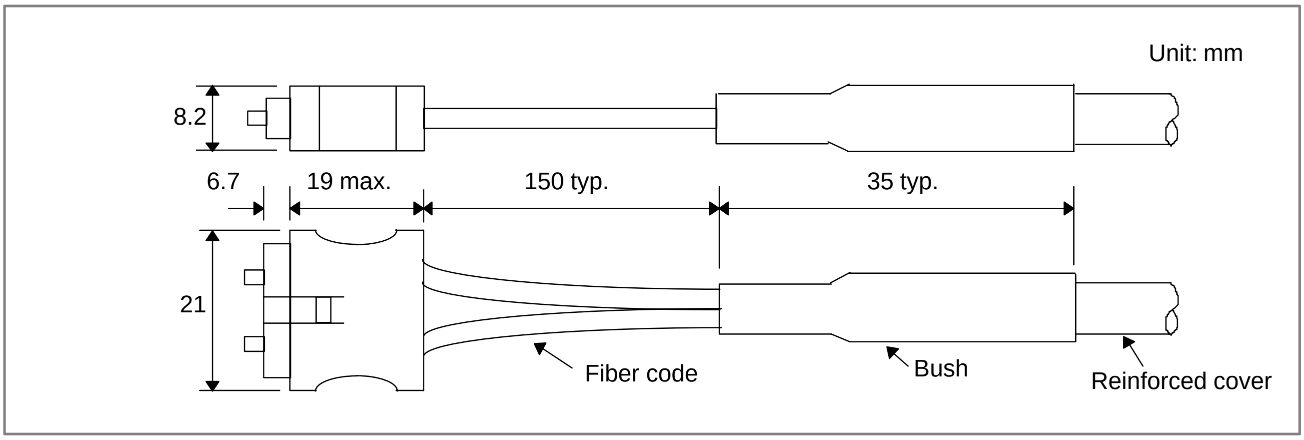


**Fig. D (b) External dimensions of external cable**

**Table D (a) Standard cable length**

| **Internal cord type cable** | | **External cable** | |
|---|---|---|---|
| **A66L–6001–0023#** | | **A66L–6001–0026#** | |
| **Specification** | **Length** | **Specification** | **Length** |
| L150R0 | 0.15 m | L1R003 | 1.0 m |
| L300R0 | 0.3 m | L3R003 | 3.0 m |
| L1R003 | 1.0 m | L5R003 | 5.0 m |
| L2R003 | 2.0 m | L7R003 | 7.0 m |
| L5R003 | 5.0 m | L10R03 | 10.0 m |
| L10R03 | 10.0 m | L15R03 | 15.0 m |
| | | L20R03 | 20.0 m |
| | | L30R03 | 30.0 m |
| | | L50R03 | 50.0 m |

2. Cable selection

- Always use an external cable (A66L–6001–0026#~) when the cable is to be laid outside the power magnetics cabinet or main unit cabinet, where it may be pulled, rubbed, or stepped on.
- Use an external cable when part of the cabling is to be subject to movement. For example, when connecting a portable operation pendant box to the power magnetics cabinet, the use of an external cable is desirable because the cable is likely to be bent, pulled, or twisted repeatedly even though frequent system operation is not expected. However, the force likely to be applied when the cable is installed or moved for maintenance purposes does not need to be taken into consideration.

- Use an external cable in locations where sparks or flame are a danger. Although the internal cord type cable (A66L–6001–0023#~) is covered by nonflammable resin, the cover, if exposed to frame for a long time, may melt, allowing the fiber cable inside to burn.
- Use an external cable when the cable is expected to be pulled with considerable force during installation (the force applied to the cable must be within the specified tensile strength limit at all times). For example, even though installing a cable in a cable duct can be regarded as internal cabling, a cable of the appropriate type must be selected according to the tensile force to be applied to the cable during installation.
- Both the internal cord type and external cables have the same oil and heat resistance properties.

3. Procuring the cable
All the optical fiber cables mentioned above are special cable products with optical connectors, which are designed, produced, and tested to ensure the required system performance and reliability. It is technically impossible for users to produce these cables or process (cut and reconnect) them after purchase. Users are requested to purchase cables of the necessary length from an appropriate supplier. Cables are available from either FANUC or any of the FANUC–approved manufacturers listed in Table D (b).

**Table D (b) FANUC–approved cable manufacturers and cable model numbers (retail)**

(1) Internal cord type cable A66L–6001–0023#L□R□□□

| Manufacturer | Model number | Remarks |
|---|---|---|
| Japan AMP, Co., Ltd. | ✻–353373–✻ | |
| Japan Aviation Electronics Industry, Ltd. | PF–2HB209–✻✻M–F–1 | ✻✻ indicates the cable length (m). |
| Hirose Electric Co., Ltd. | H07–P22–F2VCFA–✻✻ | ✻✻ indicates the cable length (m). |

(2) External Cable A66L–6001–0026#L□R□□□

| Manufacturer | Model number | Remarks |
|---|---|---|
| Japan AMP, Co., Ltd. | ✻–353199–✻ | |
| Japan Aviation Electronics Industry, Ltd. | CF–2HB208–✻✻M–F–1 | ✻✻ indicates the cable length (m). |
| Hirose Electric Co., Ltd. | H07–P22–F2NCFA–✻✻ | ✻✻ indicates the cable length (m). |
| Oki Electric Cable Co., Ltd. | OPC201HPXF–✻✻MB | ✻✻ indicates the cable length (m). |

**NOTE**
Cables other than those of standard lengths cannot be purchased from FANUC.

4. Handling precautions

(1) Protection during storage

When the electrical/optical conversion module mounted on the printed circuit board and the optical cable are not in use, their mating surfaces must be protected with the lid and caps with which they are supplied. If left uncovered, the mating surfaces are likely to become dirty, possibly resulting in a poor cable connection.

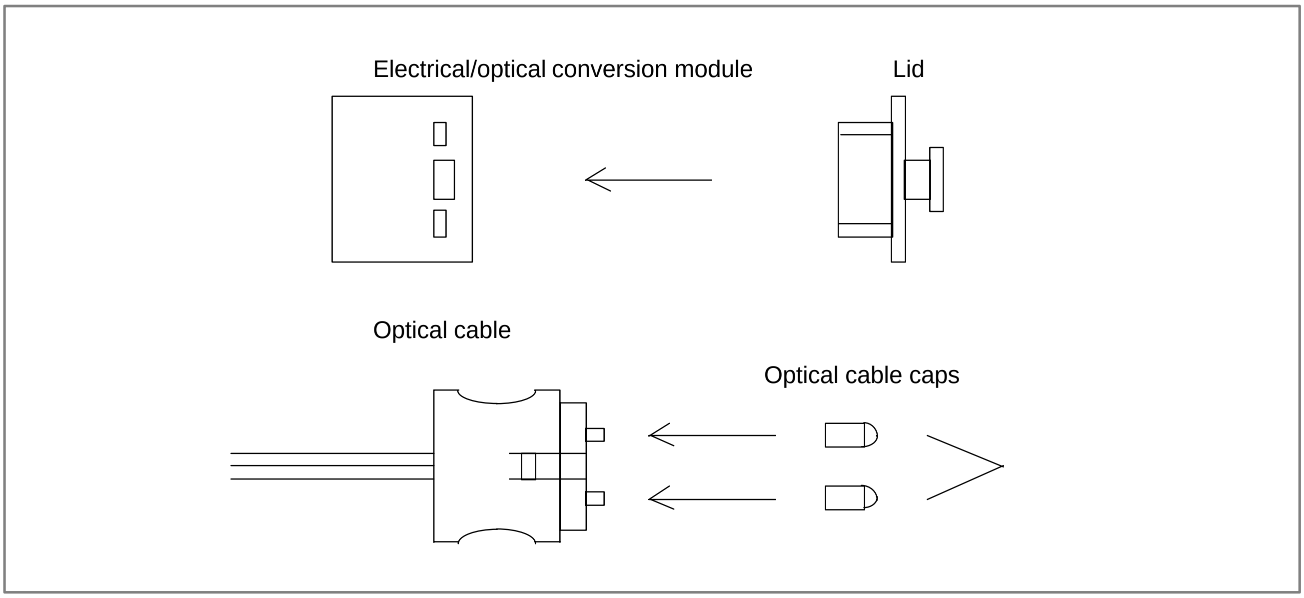


**Fig. D (c) Protection of electrical/optical conversion module and optical fiber cable (when not in use)**

(2) Optical cable

- Make sure that the bending radius and tensile strength of the cable are always within their ranges described in the specifications (see the first item), regardless of whether the cable is stored or routed and whether operation is in progress or not.
- Although the reinforcing cover of the external cable has sufficient mechanical strength, be careful not to drop heavy objects on the cable.
- Grasp the optical connector firmly when connecting or disconnecting the cable. Do not pull on the fiber cord itself. (The maximum tensile strength between the fiber cord and optical connector is 2 kg. Applying greater force to the cord is likely to cause the optical connector to come off, making the cable unusable.)
- Once connected, the optical connector is automatically locked by the lock levers on its top. To remove the optical connector, release the lock levers and pull the optical connector.
- Although optical connectors cannot be connected in other than the correct orientation, always take note of the optical connector's orientation before making the connection.
- Before installing an external cable, fix either a wire with a hook or a tension member to the reinforcing cover of the optical connector and pull the wire or tension member, as shown in Fig. D (d). This is done to prevent a tensile force from being applied between the fiber cord and optical connector. If no tensile force is applied

between the fiber cord and optical connector when installing the cable, you can hold the reinforcing cover of the connector directly and pull it. In the case of an internal cord, which does not have a reinforcing cover, apply the same protective measures, as instructed in Fig. D (d), for that portion of the cable where the two cords are bound together, in order to prevent a tensile force from being applied between the fiber cord and optical connector. In the same way as for an external cable, if no tensile force is applied between the fiber cord and optical connector during installation, you can hold the shielded part of the cable directly and pull it. Because the combined tensile strength of the two cords is only 14 kg, however, avoid applying too great a force to the cable during installation, regardless of whether you have taken the protective measures.

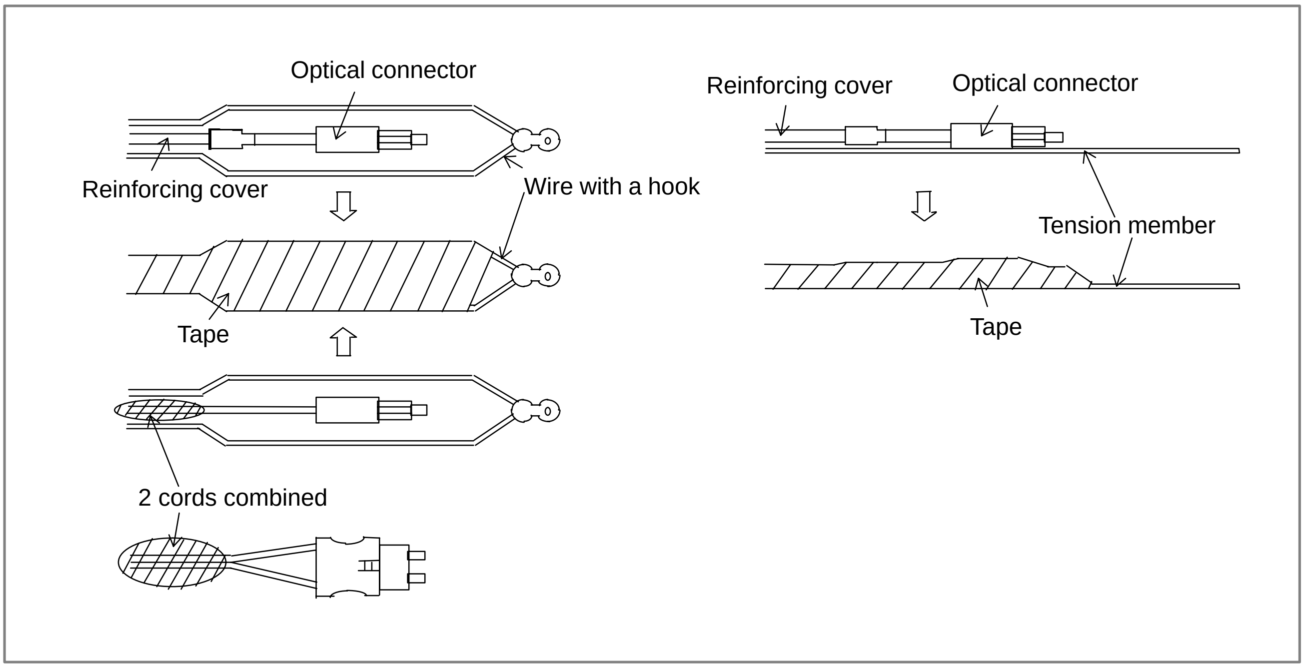


**Fig. D (d) Prior to installing a cable**

- Take care to keep both parts of the optical connector (cable side and PCB side) clean. If they become dirty, wipe them with tissue paper or absorbent cotton to remove dirt. The tissue paper or absorbent cotton may be moistened with ethyl alcohol. Do not use any organic solvent other than ethyl alcohol.
  - Fix the reinforcing cover of the external cable or the cord binding portion of the internal cord type cable by using a cable clamp, as shown in Fig. D (e), to prevent the weight of the fiber cable from being applied directly to the connecting part of the optical connector.

    (Recommended cable clamp):

    Recommended cable clamps are listed below. Use a clamp that grasps the optical cable lightly; the clamp should not apply excessive pressure to the cable.

    For an external cable:

    CKN–13SP (with sponge)(Kitagawa Industry Co., Ltd.)

For an internal cord type cable:
MN–1 (Kitagawa Industry Co., Ltd.)

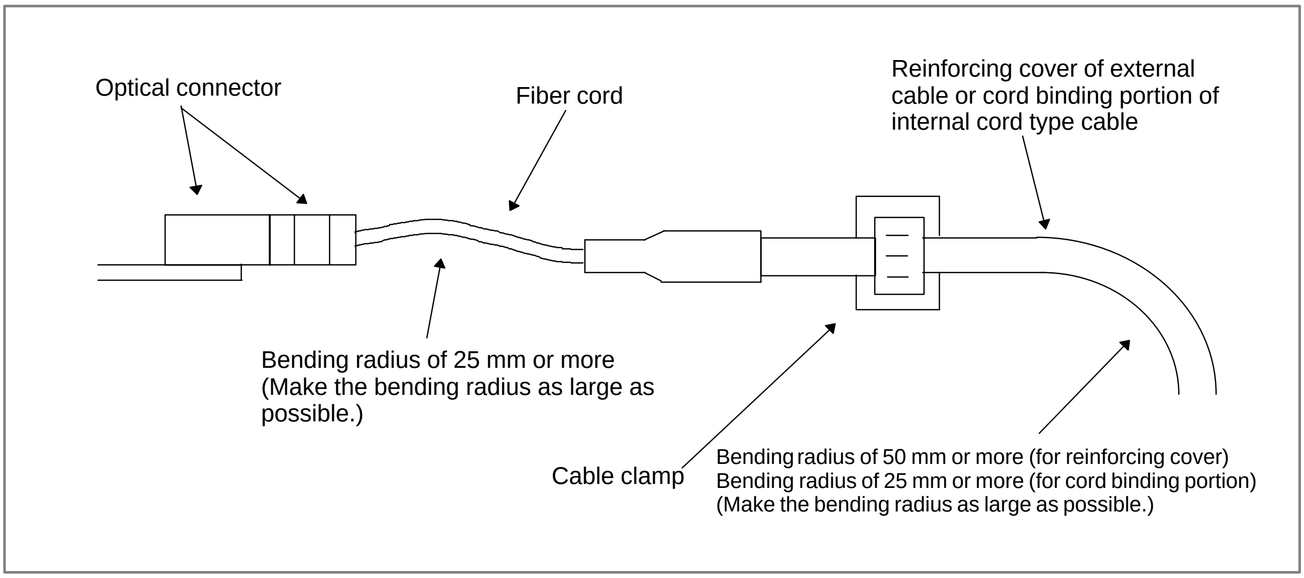


**Fig. D (e) Fixing the cable with a clamp**

- Any superfluous portion of the optical cable may be wound into a loops. Should this prove necessary, make sure the diameter of each loop is at least 150 mm (for an external cable) or at least 100 mm (for an internal cord type cable). Winding the cable into smaller loops may produce sharp curves that exceed the specified bending radius limit without the user being aware. Such bending can result in a greater transmission loss, ultimately leading to a communication failure.
- When using a nylon band (cable tie) as a cable clamp, follow the instructions given below. Also, take care not to apply a bending force to one particular part of the cable when fixing it with a clamp. Failing to clamp the cable correctly may cut or damage it.

  External cable:

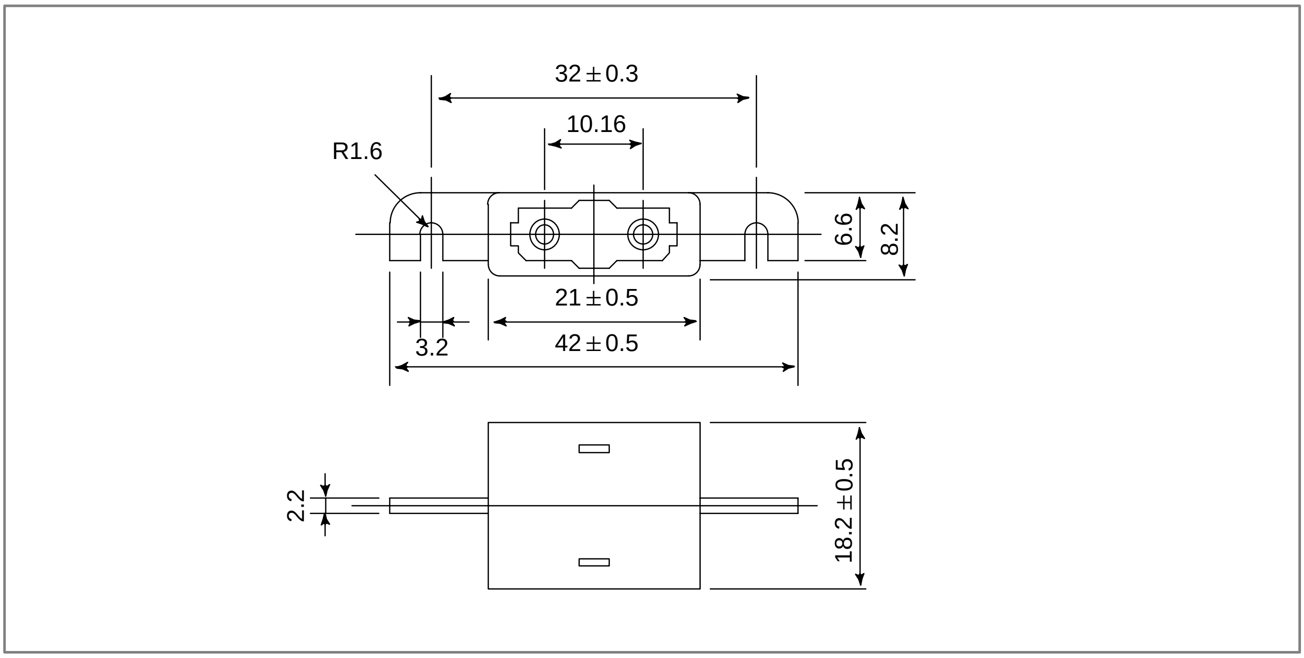
  Do not clamp the uncovered portion of the cable with a nylon band. When clamping the cable by the reinforcing cover, the clamping force is not an important factor to consider. However, ensure that the clamping force is as small as possible to ensure that the reinforcing cover is not deformed by the clamping. If possible, the clamping force should be 5 kg or less.

  Internal cord type cable:

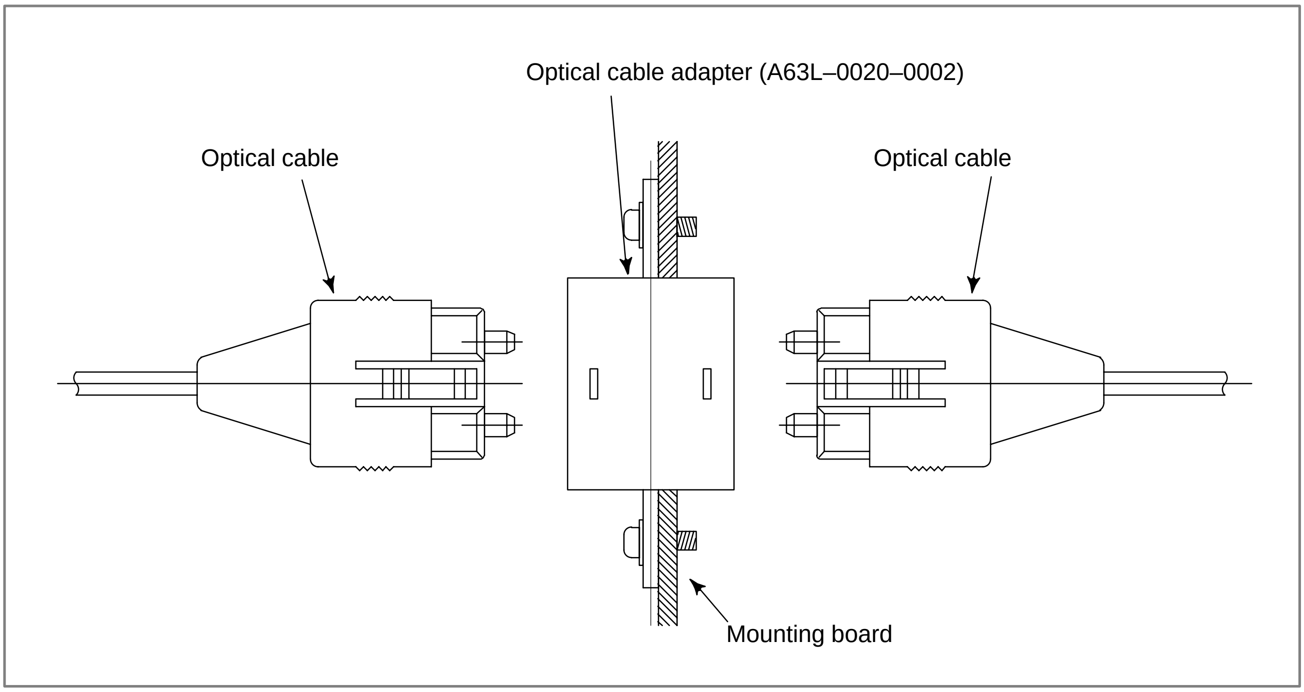
  Lightly clamp the optical cable with a nylon band so that the cable shield is not deformed. If possible, the clamping force should be 1 or 2 kg (make sure that no force is applied to the cable). Due care is required when clamping the internal cord type cable because its cable shield is weaker than the reinforcing cover of the external cable.

5. Optical cable relay of FANUC I/O Link
   When used for the FANUC I/O Link application, optical fiber cables can be connected by using an optical cable adapter, as follows.

(a) External view of an optical cable adapter



(b) Example of the use of an optical cable adapter

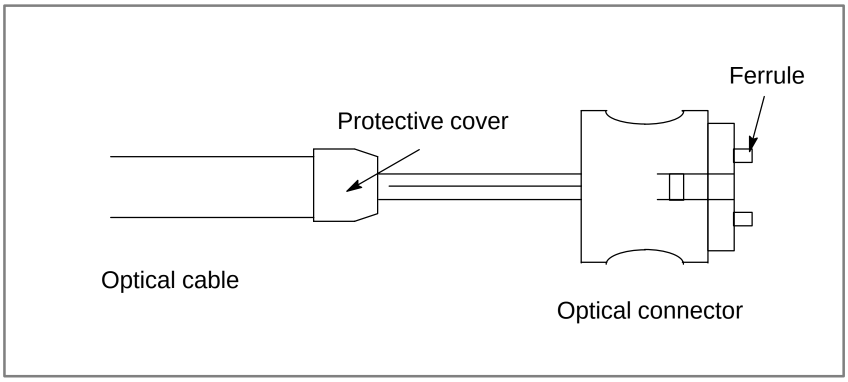


**NOTE**
Up to one relay points are permitte.

6. Precautions for connection with low–loss optical junction adapter

- Features of and handling precautions for low–loss optical junction adapter (A63L–0020–0004)
  When optical connectors for a conventional optical junction adapter (A63L–0020–0002) are jointed, the facing ferrules(Note 1) are located about 60 um from each other. This is because the optical fiber of conventional PCF (plastic clad silica fiber) cables (A66L–6001–0008, –0009, –0026) may protrude from the tip of the ferrules (by up to about several um), resulting in the fiber protrusion being damaged when the ferrules are butted against each other.
  In the low–loss optical junction adapter, the ferrules are butted against each other, thus greatly reducing the reduction in repeater loss. Therefore, the two optical cables used with the low–loss optical junction adapters must be dedicated to the adapters.
  If a conventional PCF (plastic clad silica fiber) cable (A66L–6001–0008, –0009, –0026) is used as even one of the two optical fiber cables for joining the low–loss optical junction adapter, both cables may be damaged, resulting in deteriorated characteristics.

**NOTE**
Ferrule: Movable metal at the tip of an optical connector; the fiber is bonded to the ferrule.



- Features of low–loss optical cable (A66L–6001–0029)
  A low–loss optical cable is selected from conventional PCF optical cables (A66L–6601–0026). The selected cable offers low loss, and its connector section is given special treatment; the fiber ends are provided with a depression so that the ferrules can be butted against each other. The two optical cables used with the low-loss optical junction adapter must be of low–loss type.
- Appearance of the low–loss optical junction adapter and cable (how to distinguish them from conventional types)
  The body of the conventional optical junction adapter is black, but that of the low–loss optical junction adapter is blue. In addition, the protective cover(Note 1) of the conventional PCF optical cable is black, but that of the low–loss optical cable is blue.

7. Installing the optical cable junction adapter
   The optical cable junction adapter should be installed within a cabinet, as a rule. If it is impossible to avoid installing it within a cabinet, protect the adapter and the optical cable portions (such as connectors and cords) not covered with reinforcement coating from the outside air by, for example, covering them with packing.

8. Environmental resistance of the optical cable junction adapter
   - The optical cable junction adapter is not waterproof. Even when optical cables are attached to both ends of the adapter, there are very small gaps in the linked portions, so water resistance can not be expected.
   - When optical cables are attached to both ends of the junction adapter installed in a normal environment (such as within a cabinet), it is unlikely that dust will penetrate between the adapter and optical fiber to the degree that it may hamper normal optical linkage. If one or both ends of the adapter are left open, dust and dirt may accumulate even when the adapter is in a normal environment (such as within a cabinet). The dust and dirt on the adapter ends is likely to hamper normal optical linkage when the optical cables are attached. In such a case, clean the junction adapter and the optical connector using the optical cable junction adapter cleaning method described below.
   - Do not allow cutting fluid to splash over the adapter or those optical cable portions (such as connectors and cords) that are not covered with reinforcement coating. If the inside of the adapter and cable end surfaces are contaminated with cutting fluid, a malfunction may occur.

9. Cleaning
   If the optical cable junction adapter, optical–to–electrical conversion module, or optical cable are soiled, clean them according to the following procedures.
   - Cleaning the optical cable junction adapter and optical-to-electrical conversion module
     First, clean the entire housing by wiping it with a cloth moistened with, or by washing it in, ethyl alcohol or HCFC141B (alternative CFC; High Shower spray can DS–2168, manufactured by Sun Hayato). Similarly, wash the two sleeves in the adapter or wipe them with a cotton swab or the like.

- Cleaning optical cables
  For the optical cables, it is important to clean the connectors at their ends. Any soiling on the optical fiber end surfaces will hamper optical transmission, resulting in a malfunction. Wipe the optical fiber end surfaces (that is, the ferrule end surfaces) thoroughly with a soft, clean cloth (like gauze) moistened with ethyl alcohol or HCFC141B, in the same way as described above. The use of cotton swabs may prove convenient. The fiber end surfaces of low–loss optical cables are lower than the ferrules. To remove any soiling from the fiber end surfaces completely, push the cotton swab or gauze into the depressions all the way through while rotating the ferrule. If the ferrules and optical connectors are contaminated with oily substances, and they may extend over a cleaned fiber end surface when it is attached to the optical-to-electrical conversion module, it is a good idea to wash them before wiping the optical fiber end surfaces, using the procedure stated above.

# E INTERFACE CABLE

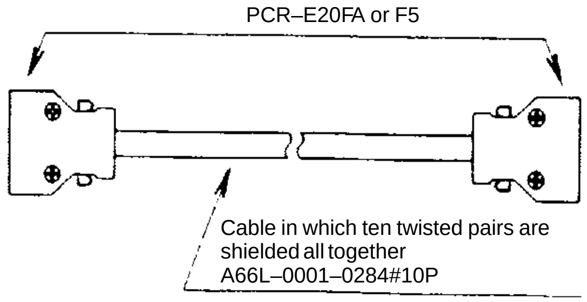
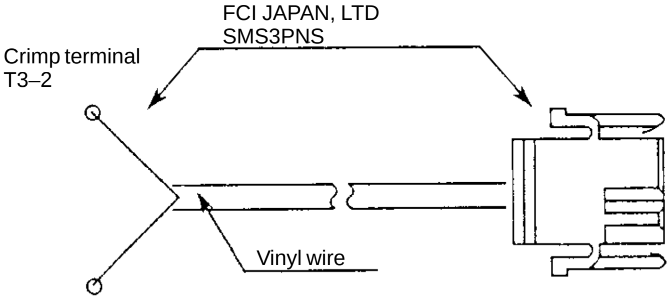
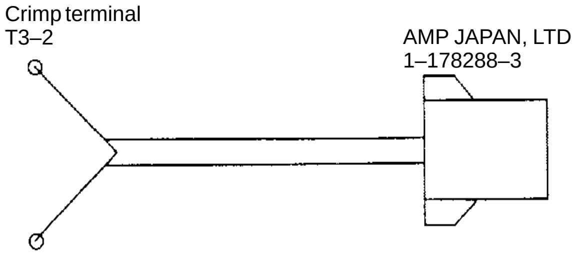
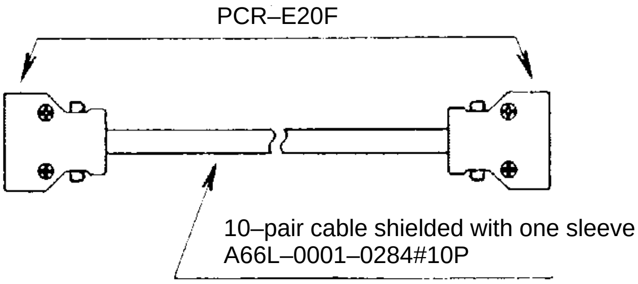
**Cables**

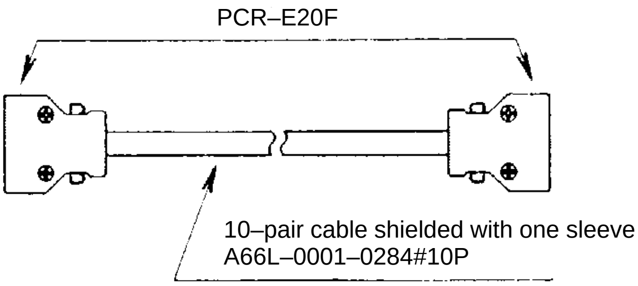
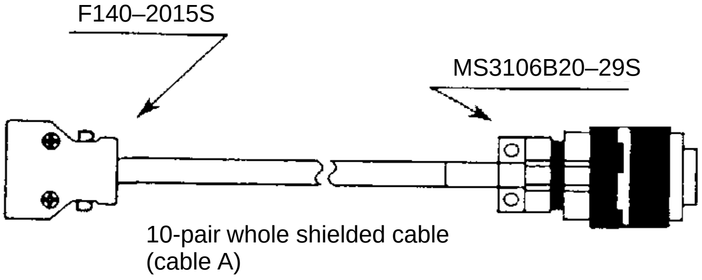
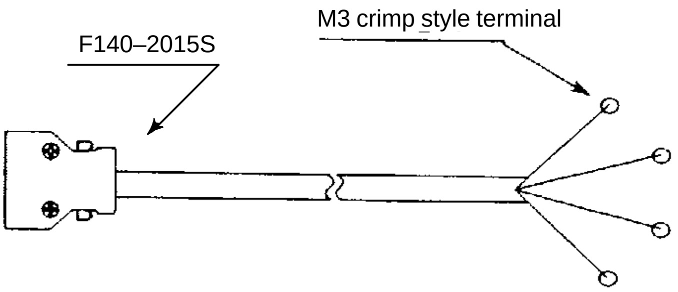
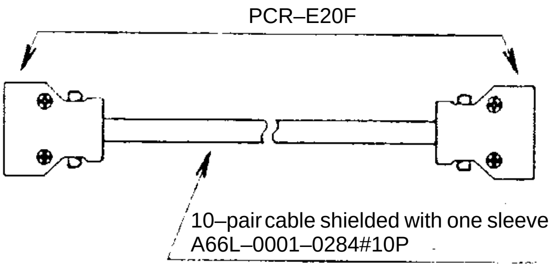
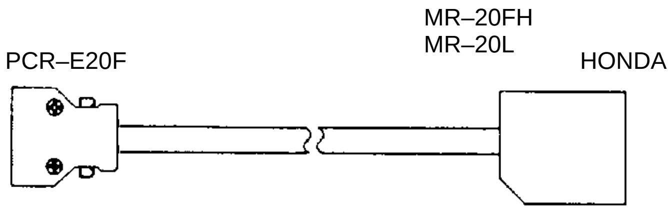
| Cable No. | Name and connection | Maximum length (m) |
|---|---|---|
| J22 | I/O Link cable between the JD1A1 and JD1B | Electric: 10m<br>Optical: 200m |
| J24 | Power cable between the 24 V power supply and I/O card or the I/O unit–A | — |
| J30 | Power cable between the 24 V power supply and Power Mate or CRT/MDI unit | — |
| J38 | S-analog output cable between the JA11 and analog spindle | 50 |
| J39 | Serial spindle cable between the JA11 and optical I/O Link adaptor | 2 |
| J39 | Serial spindle cable between the JA11 and spindle amplifier | 50 |
| J40 | Position coder cable between the JA46 and position coder | 50 |
| J41 | Manual pulse cable between the JA47 and manual pulse generator | 50 |
| J86 | Built–in I/O cable (34pins) between CB155 and power magnetics cabinet | 50 |
| J87 | Built–in I/O cable (50pins) between CB156 and power magnetics cabinet | 50 |
| J88 | DI/DO cable between the CM51 and power magnetics cabinet | 50 |
| J89 | DI/DO cable between the CM52 and power magnetics cabinet | 50 |
| J90 | DI/DO cable between the CMB3 and power magnetics cabinet | 50 |
| J91 | DI/DO cable between the CMB4 and power magnetics cabinet | 50 |
| J142 | CRT/MDI cable between the JD41 and JD13 | 50 |
| J146 | Punch panel cable between the JD42 and an I/O unit relay connector | 50 |
| J147 | External pulse generator cable between JA46 and external pulse generator | 50 |

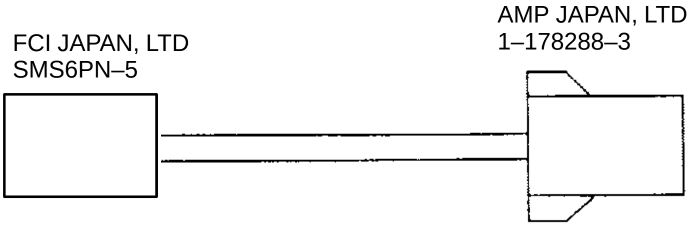
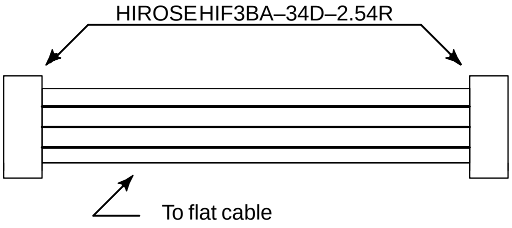
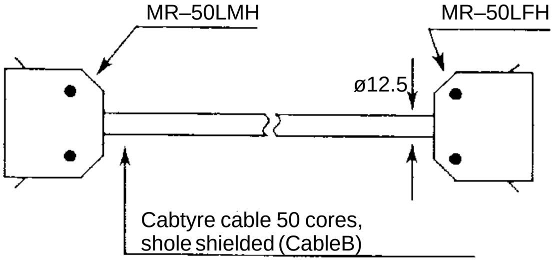
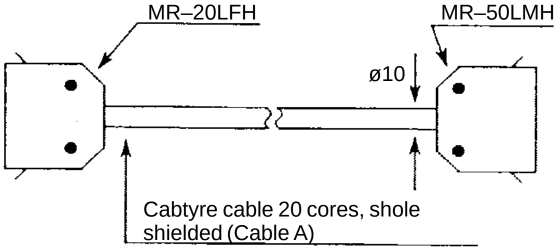
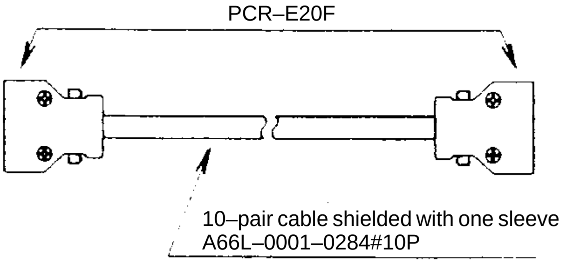
**NOTE**

Each maximum allowable cable length relates to the use of the cable for an interface signal. For some cables (such as that for a pulse coder) that contain a power cable, however, an additional limit, based on a drop in the supply voltage, is imposed.

The following interface cables are provided.

| Name | Application | Specifications | Code | Length |
|---|---|---|---|---|
| J22 | Signal cable for the I/O card or I/O Link |  | A02B–<br>0124–<br>K820 | 1m |
| | | | A03B–<br>0807–<br>K801 | 5m |
| | | | A03B–<br>0807–<br>K802 | 10m |
| J24 | +24V power cable for I/O cards or I/O units |  | A02B–<br>0124–<br>K831 | 5m |
| J30 | +24V power cable for the CRT/MDI or the CNC |  | A02B–<br>0124–<br>K830 | 5m |
| J39 | Serial spindle cable (electrical – optical conversion) |  | A02B–<br>0124–<br>K822 | 1m |

| Name | Application | Specifications | Code | Length |
|---|---|---|---|---|
| J39 | Serial spindle cable (electrical – electrical) |  | A02B–0166–K840 | 5m |
| J40 | Position coder cable |  | A02B–0259–K800 (Straight),<br>A02B–0259–K801 (elbow) | 7m |
| J41 | Manual pulse generator cable |  | A02B–0259–K821 (for 1unit)<br>A02B–0259–K822 (for 2units) | 7m |
| J45 | CRT link cable (Connection to multiple Power Mate) |  | A02B–0259–K813 | 0.5m |
| | | | A02B–0259–K814 | 5m |
| | | | A02B–0259–K815 | 10m |
| J53 | Video cable (for CRT, PDP) |  | A02B–0124–K871 | 0.5m |

| Name | Application | Specifications | Code | Length |
|---|---|---|---|---|
| J56 | +24V power cable between separate type MDI and separate type CRT |  | A02B–0124–K861 | 0.5m |
| J86,<br>J87 | Built–in I/O cable |  | A02B–0124–K840 | 0.3m |
| | | | A02B–0124–K841 | 0.5m |
| | | | A02B–0124–K842 | 1m |
| J88<br>J89<br>J90 | Magnetic cabinet Operator's panel |  | A02B–0029–K801 | 7m |
| J91 | Magnetic cabinet Operator's panel |  | A02B–0029–K802 | 7m |
| J142 | CRT link cable (One–to–one connection) |  | A02B–0259–K811 | 5m |
| | | | A02B–0259–K812 | 10m |

# F MEMORY CARD INTERFACE

# F.1
# Power Mate *i* MAIN BODY

## Overview

The memory card interface at the front of the main unit can be used for data input/output to and from the Power Mate. This appendix describes the specifications of the usable memory cards and provides notes on their use.

## SRAM cards

SRAM cards that conform to any of the following standards can be used:

- TYPE 1 or TYPE2 4.0 or later, as defined by the Japan Electronic Industry Development Association (JEIDA)
- TYPE1 or TYPE2 2.0 or later, as defined by the Personal Computer Memory Card International Association (PCMCIA)
- PC Card Standard

SRAM cards operable only on 3.3 V cannot be used because they cannot be physically inserted.
FANUC has checked the operation of the following FANUC–designated SRAM cards:

| | | |
|---|---|---|
| 1MB SRAM card | Fujitsu Media Device | MB98A91023–20 |
| 2MB SRAM card | Fujitsu Media Device | MB98A91123–20 |

**NOTE**
Since the SRAM memory card holds a backup copy of battery data, the memory card cannot be used for backing up the SRAM data of the Power Mate *i*.

## Flash memory cards

Series 2 flash memory cards from Intel Corp. (or equivalents) can be used. As with SRAM cards, however, flash memory cards operable only on 3.3 V cannot be used because they cannot be physically inserted. Flash memory cards using non–Intel flash memory as a built–in chip cannot be used. When the flash memory card is formatted and written on a personal computer, however, it may prove possible to read the card.
FANUC has checked the operation of the following FANUC–designated flash memory card:

| | | |
|---|---|---|
| 4MB flash memory card | Intel | IMC004FLSA |

**NOTE**
1 The 265KB, 512KB, and 1MB flash memory cards usable with the Power Mate D do not work with the Power Mate *i*.
2 The 4MB flash memory card that is compatible with the Power Mate H can also be used with the Power Mate *i*.

## Memory card capacity

The capacity of a memory card is usually represented as that when the card is unformatted. After the card is formatted, the actually usable capacity will be slightly less. Thus, the capacity of the memory card to be used must be greater than the size of the data or programs to be stored.

(Example) When storing 512K bytes of data
A memory card having a capacity of at least 1M byte is required.

On flash memory cards, the last 128–KB area is used as the buffer area, further reducing the usable capacity by 128K bytes.

## Memory card formatting

The BOOT SYSTEM formats a memory card using method called the FAT file system. The formatting method called the flash file system is also supported. However, the FAT file system and flash file system are not compatible with each other, and the read and list functions cannot be used.

## File operation with a flash memory card

Flash memory cards do not allow individual files to be deleted; all the files on a flash memory card need to be deleted at the same time. Accordingly, the following operations cannot be performed:

- Deletion of an existing file
- Renaming of a file
- Overwriting of a file

## Notes on formatting a flash memory card with CardPro

CardPro uses the flash file system as standard to format a flash memory card. When using CardPro to format a flash memory card used with the boot system, use the following command to format the card.

```
A:CPFORMAT drive–name:/F:FLASHFAT/NOCIS
```

## Using a flash memory card formatted with the BOOT SYSTEM on other systems

| | **Ramzo** | **CardPro** |
|---|---|---|
| Reading of files | ○ | ○ |
| Addition of files | No file addition function is available. | × |
| Listing of files | ○ | ○ |

## Using a flash memory card formatted with other systems on the BOOT SYSTEM

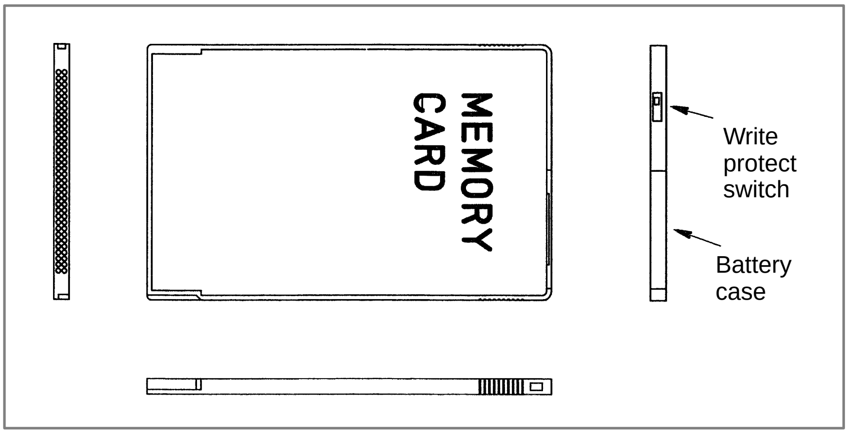
| | **Ramzo** | **CardPro** |
|---|---|---|
| Reading of files | ○ | ○ |
| Addition of files | ○ | × |
| Listing of files | ○ | ○ |

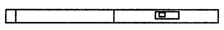
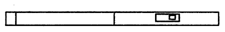
**NOTE**

1 Ramzo is a memory card reader/writer manufactured by Adtech System Science.

2 CardPro is a memory card reader/writer manufactured by Data IO.

## Names and functions of components



| | Name | Function |
|---|---|---|
| 1 | Write protect switch | Writing to the memory card can be disabled by setting the write protect switch.<br>Writing is enabled. <br>Writing is disabled.  |
| 2 | Battery case | A battery for data backup is housed within an SRAM memory card.<br>Flash memory cards do not have a battery case. |

## Inserting a memory card

A memory card has an insertion guide to protect against reverse insertion. Pay attention to the orientation of the memory card.

## Battery

The batteries used with FANUC–supplied SRAM memory cards were of the CR2325 and BR2325 types.

These batteries were difficult to obtain, so the CR2025 battery was introduced to replace these batteries in May, 1997.

By replacing the battery holder, the user can use SRAM memory cards that used the previous batteries (CR2325 and BR2325) with the new battery (CR2025).

**SRAM memory cards**

1) A87L–0001–0150#□□□
   Manufacturer’s model: MB98A9□□33–20

**Battery type**

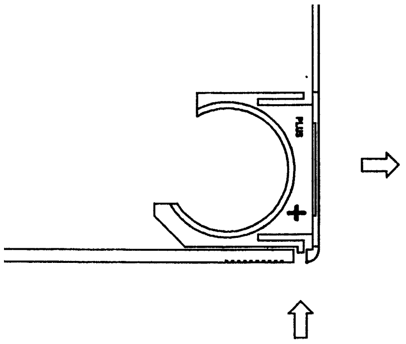
1) Before the change: CR2325 or BR2325
   - Indication on the side of the memory card:
     9□□33–20 S000 □□□ □□□
2) After the change: CR2025 or equivalent
   (common battery intended for use in electronic calculators)
   - Indication on the side of the memory card:
     9□□33–20 9157 □□□ □□□

### Battery holder replacement

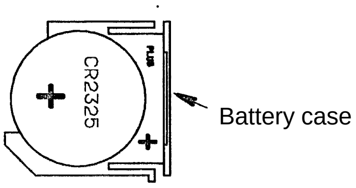
1) By replacing the battery holder, the user can use SRAM memory cards that used the previous batteries (CR2325 and BR2325) with the new battery (CR2025).
2) The battery holder set for CR2025 is available from shops handling Fujitsu electronic devices.
   - Ordering code: MB98XXX–holder set–09146
   - Contents of the set: Battery holder (1), battery (CR2025) (1), manual (1)

## Battery replacement

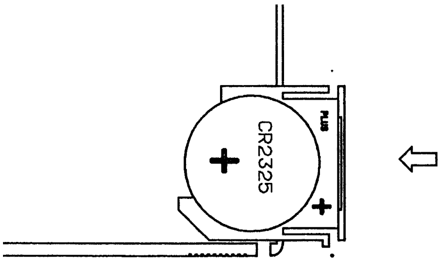
(1) While pressing down the fixing claw, pull out the battery case.



(2) Replace the battery with a new one.
Match the + mark of the battery with the + mark on the battery case.



(3) Return the battery case to its original position, then check that the battery operates normally.



## ATA card

1. Overview

   The PCMCIA card interface of FANUC Power Mate *i*–D/H allows data input/output via a flash ATA card (operating on 5 V).

   The flash ATA card has the advantage that data can be input and output with a personal computer including the PCMCIA interface without a special PC card writer.

2. Supported software editions

   The supported software editions are as follows:

|  | **Model** | **Series** | **Edition** |
|---|---|---|---|
| System software | Power Mate *i*–D | 88E0 | 09 or later |
|  | Power Mate *i*–H | 88F0 | 08 or later |
|  |  | 88F1 | 01 or later |
| Boot software | Power Mate *i*–D/H | 881I | 05 or later |

3 Flash ATA card specifications

A flash ATA card to be used must meet the following standards and types.

Note that all flash ATA cards that conform to the indicated standards do not always ensure operation.

For the cards FANUC has checked the card operation, see Item 4.

3–1 Card standards

PCMCIA (Personal Computer Memory Card International Association)
PC Card standard Release 2.1, PCMCIA PC Card ATA Release 1.02

3–2 Card type

PCMCIA TYPE I and TYPE II

3–3 Card operation mode

PC–ATA specification

3–4 Operating voltage of cards

Cards operable only on 5 V and cards operable on 5 V and 3.3 V (automatic switching)

4 Flash ATA cards of which operation has been checked

As of April in 1999, FANUC had confirmed the operation of the following cards on the Power Mate *i*. (These cards support automatically switching between 5 V and 3.3 V.)

1) When a flash ATA card is used for data input/output (for data saving and restoration)

| Manufacturer | Model number | Capacity | Remarks |
|---|---|---|---|
| Hitachi, Ltd. | HB286008A3 | 8MB | Production discontinued |
| | HB286015A3 | 15MB | |
| | HB286030A3 | 30MB | |
| | HB286045A3 | 45MB | |
| | HB289016A4 | 16MB | Under volume production |
| | HB289032A4 | 32MB | |
| | HB289048A4 | 48MB | |
| Matsushita Electric Industrial Co., Ltd. | BN–012AB | 12MB | |
| | BN–020AB | 20MB | |
| | BN–040AB | 40MB | |
| SanDisk Co. | SDP3B–20 | 20MB | Production discontinued |
| | SDP3B–40 | 40MB | |

**NOTE**

1 For other than the above cards, FANUC has not checked operation.

2 The above flash ATA cards support automatic switching between 5 V and 3.3 V.

3 Cards operable only on 3.3 V cannot be used.

4 When a manufacturer changes the specification of a card listed above, the operation of the card can be disabled.

**CAUTION**

When an ATA flash card is used with a Power Mate CNC other than the Power Mate *i*–D/H, the CNC itself or the card may be damaged electrically. Therefore, although an ATA flash card can be physically inserted into the PCMCIA card interface of Power Mate CNCs other than the Power Mate *i*–D/H, be very careful not to insert the ATA flash card by mistake.

5 Support of operations in each function

5–1 Support in the boot system function

| System monitor menu function | | Operation | SRAM memory card | Flash memory card | Flash ATA card |
|---|---|---|---|---|---|
| 1. SYSTEM DATA LOADING Note 2) | | File listing | ○ | ○ | ○ |
| | | File read | ○ | ○ | ○ |
| 4. SYSTEM DATA SAVE | | File write | ○ | ○ Note 3) | ○ |
| 5. SRAM DATA BACKUP | SRAM BACKUP | File write | ○ | ○ Note 3) | ○ |
| | RESTORE SRAM | File read | ○ | ○ | ○ |
| 6. MEMORRY CARD FILE DELETE Note 2) | | File listing | ○ | × | ○ |
| | | File deletion | ○ | × Note 3) | ○ |
| 7. MEMORY CARD FORMAT | | Card formatting | ○ | ○ | Δ Note 1) |

For details on the specifications of the boot system, also refer to the following maintenance manual (the description of the boot system in an appendix):

- FANUC Power Mate *i*–D/H Maintenance Manual B–63175EN

5–2 Support of operations in the data I/O function using a memory card (I/O channel: 4 is set in parameter No. 20)

| Function | Operation | SRAM memory card | Flash memory card | Flash ATA card |
|---|---|---|---|---|
| File directory display | File listing | ○ | ○ | ○ |
| File search | File listing | ○ | ○ | ○ |
| File read | File listing | ○ | ○ | ○ |
| | File read | ○ | ○ | ○ |
| File write | File listing | ○ | ○ | ○ |
| | File write | ○ | × Note 3) | ○ |
| File deletion | File listing | ○ | ○ | ○ |
| | File deletion | ○ | × Note 3) | ○ |

For details on the specifications of the data input/output function using a memory card, also refer to the following maintenance manual:

- FANUC Power Mate *i*–D/H Maintenance Manual B–63175EN

**NOTE**

1 Flash ATA cards are formatted in the quick format mode (the file allocation table and directory information in the root directory are cleared). For an unformatted flash ATA card, format it with a personal computer.

2 Files on a memory card that can be displayed and selected are the first 64 files registered in the root directory area.

3 On a flash memory card, a particular file cannot be erased. File erasure must be performed for the entire card at a time. Therefore, the following operations cannot be performed:
   - Deletion of already existing files
   - Overwrite of a file having the same name

4 When data is written to a flash memory card, the last 128KB area of the flash memory card itself is used as a buffer area. This reduces the usable capacity of the flash memory card by 128KB.

5 Only the root directory area can be used to display, read, and write files on a memory card. The subdirectory area cannot be used. File names on the memory card must each consist of up to eight uppercase alphanumeric characters, and extensions must each consist of up to three uppercase alphanumeric characters.

6 The time required to read or write data varies depending on the type and use status of the memory card.

7 When a memory card is used, files on the memory card may be erased by mistake. So, necessary data should be backed up on the personal computer.

### 5–3 Other supported functions

For functions that supported the use of SRAM memory cards and flash memory cards, a flash ATA card can be used.

- Input/output from the PMC I/O screen
- Input/output of maintenance information and periodic maintenance information
- Input/output of parameters by the Power Mate CNC manager

For details about the specifications of the I/O functions, refer to the operator’s manual.

**NOTE**

Flash ATA cards cannot be used in the memory card access function by C executor applications.

# F.2
# LCD WITH A TOUCH PANEL

1. Overview

   With the PCMCIA card interface of the LCD with a touch panel that supports the display link, some types of SRAM memory cards and flash ATA cards can be used.

   Files such as CNC parameter files, offset data files, and part program files can be transferred from a card by using the PCMCIA card interface of the LCD with a touch panel that supports the display link.

**NOTE**

1 Functions available with the PCMCIA card interface of the LCD with a touch panel differ from the functions available with the PCMCIA card interface of the CNC.

2 Cards that can be used with the PCMCIA card interface of the LCD with a touch panel are not necessarily the same as the cards usable with the PCMCIA card interface of the CNC.

3 Some files such as a file of touch panel screen data cannot be transferred using this interface.

2. Supported software editions

   The supported software editions are as follows:

| | Series | Edition |
|---|---|---|
| System software | 88E0 | 13 or later |
| | 88F1 | 05 or later |
| Boot software | 881I | 09 or later |

3 Flash ATA card specifications

A flash ATA card to be used must meet the following standards, types, and conditions.

Note that all flash ATA cards that satisfy the following requirements do not always ensure operation.

For the cards FANUC has checked the card operation, see Item 4.

3–1 Card standards

PCMCIA (Personal Computer Memory Card International Association)
PC Card standard Release 2.1, PCMCIA PC Card ATA Release 1.02

3–2 Card type

PCMCIA TYPE I and TYPE II

3–3 Card operation mode

PC–ATA specification

3–4 Operating voltage of cards

Cards operable only on 5 V and cards operable on 5 V and 3.3 V (automatic switching)

3–5 Conditions of cards usable with the LCD with a touch panel that supports the display link

- The memory map mode must be supported.
- Variable waits must not occur.
- The address access time must be 250 ns or less.

4 Cards of which operation has been checked

As of December in 2000, FANUC had confirmed the operation of the following cards with the LCD with a touch panel:

1) SRAM memory cards

| Manufacturer | Model number | Capacity | Remarks |
|---|---|---|---|
| Fujitsu Media Device Co., Ltd. | MB98A91023–20 | 1MB | Not suitable for data backup |
| | MB98A91123–20 | 2MB | |

2) Flash ATA cards

| Manufacturer | Model number | Capacity | Remarks |
|---|---|---|---|
| Hitachi, Ltd. | HB286008A3 | 8MB | Production discontinued |
| | HB286015A3 | 15MB | |
| | HB286030A3 | 30MB | |
| | HB286045A3 | 45MB | |
| | HB289016A4 | 16MB | Under volume production |
| | HB289032A4 | 32MB | |
| | HB289048A4 | 48MB | |
| Matsushita Electric Industrial Co., Ltd. | BN–012AB | 12MB | |
| | BN–020AB | 20MB | |
| | BN–040AB | 40MB | |
| SanDisk Co. | SDP3B–20 | 20MB | Production discontinued |
| | SDP3B–40 | 40MB | |

**NOTE**

1 For other than the above cards, FANUC has not checked operation.

2 The above flash ATA cards support automatic switching between 5 V and 3.3 V.

3 Cards operable only on 3.3 V cannot be used.

4 When a manufacturer changes the specification of a card listed above, the operation of the card can be disabled.

5 Flash memory cards cannot be used.

5 Support of each function

When 7 is set in parameter No. 20, and [Punch] or [Read] operation is performed on each screen, the following data can be input or output via the PCMCIA card interface of the LCD with a touch panel:

| **Data to be input/output** | **Screen for I/O operation** |
|---|---|
| Programs | Program screen or ALL I/O screen |
| Parameters | Parameter screen or ALL I/O screen |
| Tool offset data | Tool compensation screen or ALL I/O screen |
| Custom macro variables | Macro variable display screen or ALL I/O screen |
| Pitch error compensation data | Pitch error compensation screen or ALL I/O screen |
| Periodic maintenance data | Periodic maintenance screen |
| Maintenance information | Maintenance information screen |
| Operation history | Operation history screen |
| PMC parameters | PMC I/O screen |
| Ladder programs | PMC I/O screen |
| Parameters of the b amplifier of a slave of I/O Link | Parameter screen of Power Mate CNC manager |

In addition to data input/output, operations such as display of a file directory, search, and deletion can be performed on the ALL I/O screen, PMC I/O screen, and in the memory card list display on the program screen.

For details on data input/output and other operations, refer to the following connection manual (functions), operator's manual, and maintenance manual:

- FANUC Power Mate *i*–D/H Connection Manual (Functions) B–63173EN–1
- FANUC Power Mate *i*–D/H Operator's Manual B–63174EN
- FANUC Power Mate *i*–D/H Maintenance Manual B–63175EN

In the following functions, data input/output cannot be performed via the PCMCIA card interface of the LCD with a touch panel:

- Boot system function
  (Therefore, data that can be input/output only by the boot system function such as image data created by the system or FAPT PICTURE and image data of the C executor or macro executor cannot be input/output.)
- External control of I/O devices
- Memory card access function by C executor applications

**NOTE**

1 Flash ATA cards are formatted in the quick format mode (the file allocation table and directory information in the root directory are cleared). For an unformatted flash ATA card, format it with a personal computer.

2 Files on a memory card that can be displayed and selected are the first 64 files registered in the root directory area.

3 Only the root directory area can be used to display, read, and write files on a memory card. The subdirectory area cannot be used. File names on the memory card must each consist of up to eight uppercase alphanumeric characters, and extensions must each consist of up to three uppercase alphanumeric characters.

4 The time required to read or write data varies depending on the type and use status of the memory card.

5 When a memory card is used, files on the memory card may be erased by mistake. So, necessary data should be backed up on the personal computer.

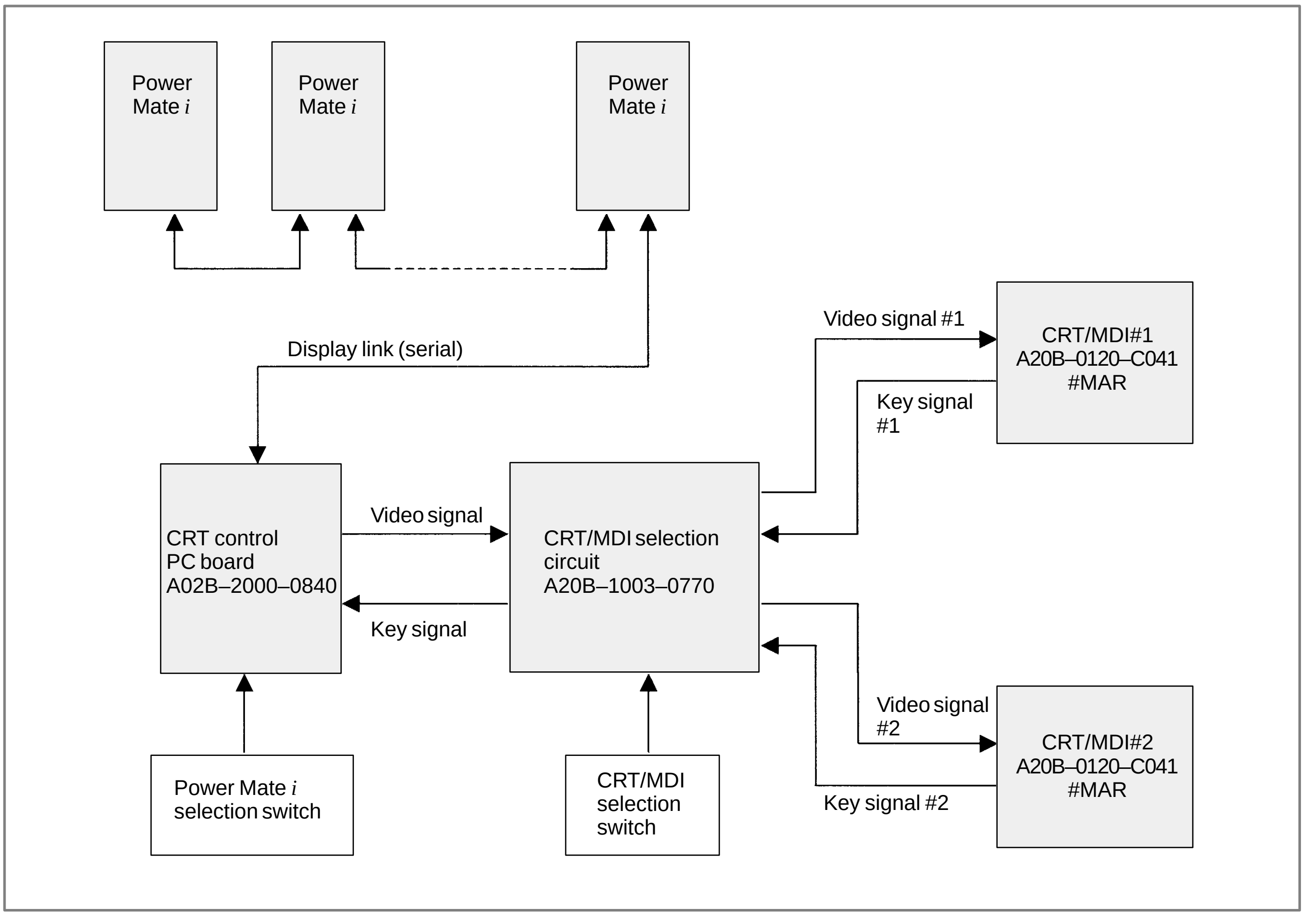
6 Unless support of functions and I/O operations by this interface is explicitly described in this manual, these functions and I/O operations should be considered to be unsupported by this interface.

# G CONNECTING TWO CRT/MDI UNITS

## G.1 OVERVIEW

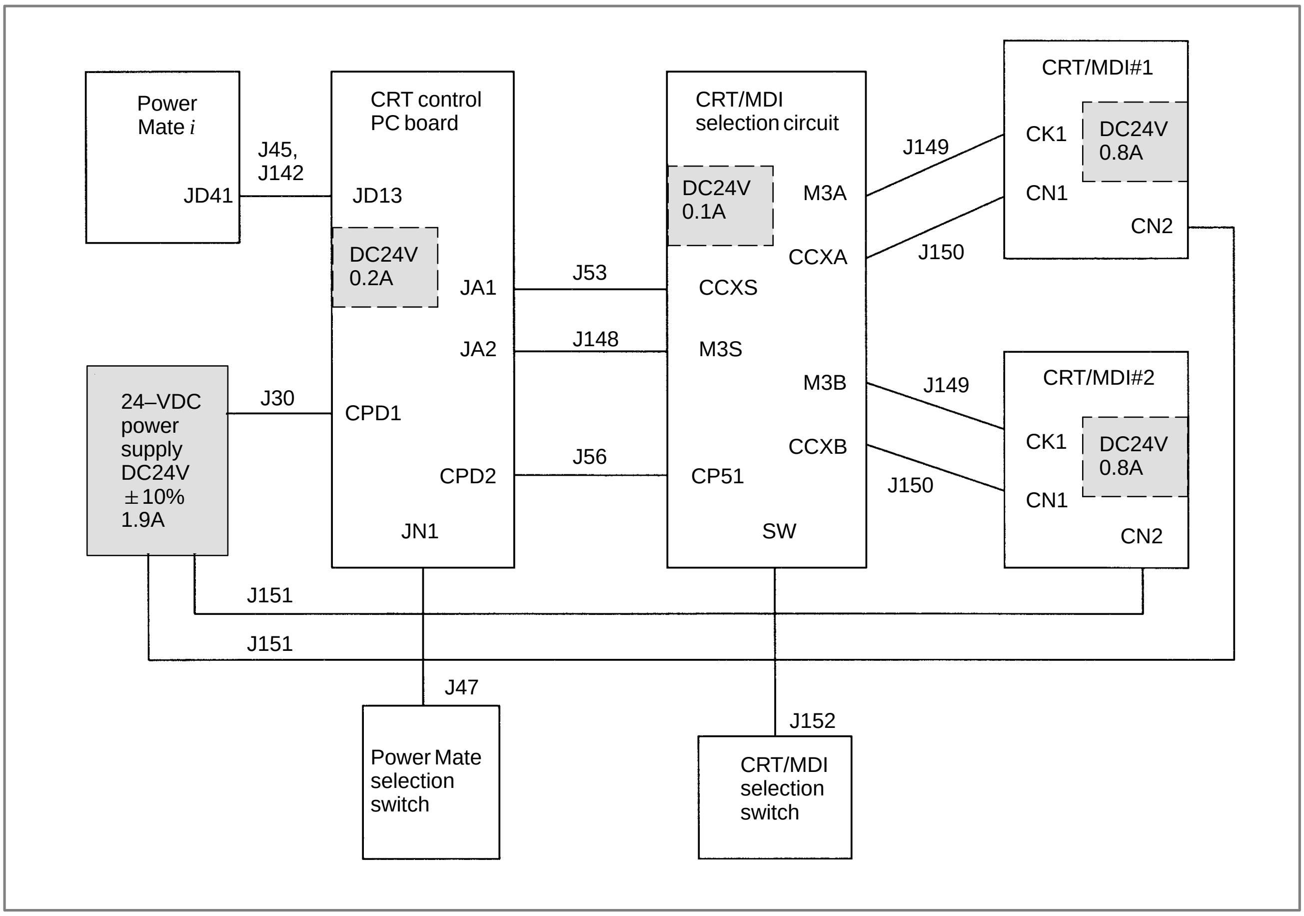
A single Power Mate *i* product can be used to switch between and control two CRT/MDI units.

It is also possible to use multiple Power Mate *i* products to switch between and control two CRT/MDI units over a display link. The user can also use the LCD/MDI instead of the CRT/MDI.



1) The CRT/MDI selection switch switches between CRT/MDI#1 and CRT/MDI#2 to send and receive interface signals.
2) A display link enables multiple Power Mate *i* products to switch between and control two CRT/MDI units.
3) The user is responsible for preparing the cables and selection switches.
4) Each unit requires a 24–VDC power supply.
5) Specify two nameplates (A02B–0122–J101) for the CRT/MDI.

## G.2 CONNECTION



1) Cables J45 and J142
Display link cables connected between the Power Mate *i* and CRT control PC board. For details, see Subsections 8.1.2 and 8.1.3.

2) Cable J47
Signal selection cable connected between the CRT control PC board and Power Mate selection switch. For details, see Subsection 8.1.4.

3) Cable J30
Power cord connected between the 24–VDC power supply and CRT control PC board. For details, see Subsection 8.1.5. (CRT control PC board: 24 VDC ±10%, 0.2 A)

4) Cable J53
Video signal cable connected between the CRT control PC board and CRT/MDI selection circuit. For details, see Subsection 8.2.2. The maximum allowed total length of J53 and J150 is 50 m.

5) Cable J56
Power cord connected between the CRT control PC board and CRT/MDI selection circuit. For details, see Subsection 8.2.2. (CRT/MDI selection circuit: 24 VDC ±10%, 0.1 A)

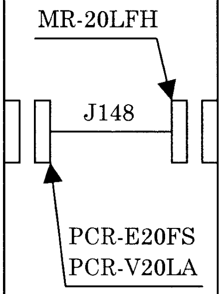
6) Cable J148
Key signal cable connected between JA2 on the CRT control PC board and M3S on the CRT/MDI selection circuit.

CRT control PC board

JA2

(PCR-EV20MDT)

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



CRT/MDI selection circuit

M3S

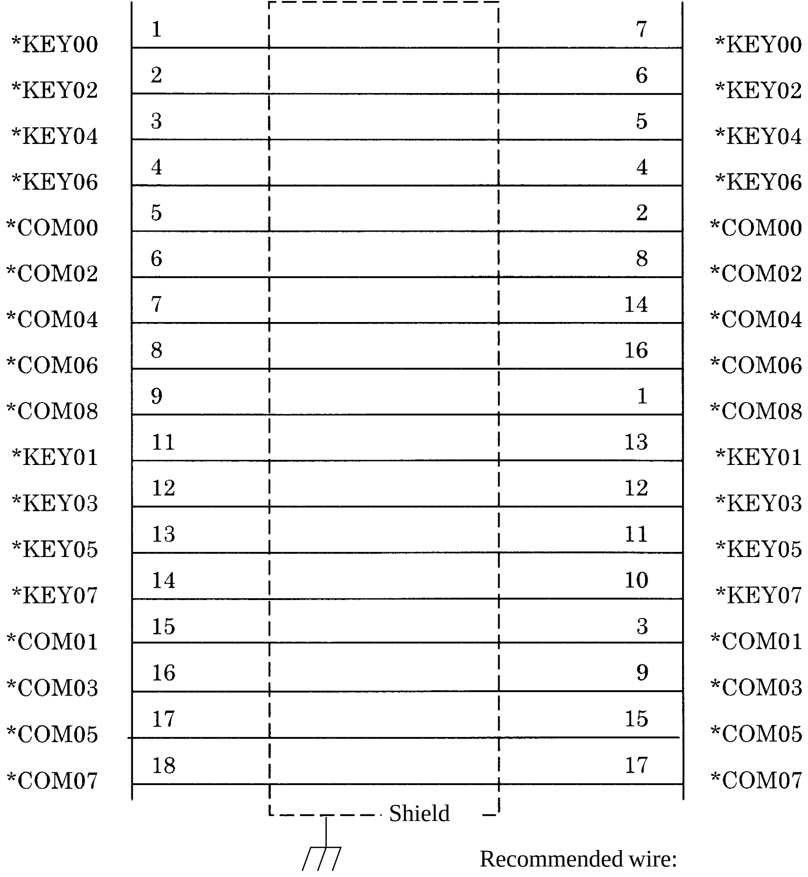
(MR-20RMD)

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

NOTE) Pins 18 to 20 are not switchable.

Cable connection (J148)

The maximum allowed total length of J148 and J149 is 50 m.



Recommended wire:
A66L–0001–0284#10P (#28AWG10 paired)

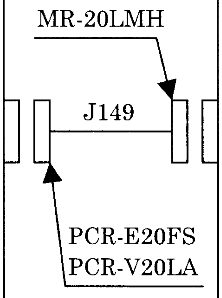
7) Cable J149
Key signal cable connected between CK1 on the CRT/MDI and M3A or M3B on the CRT/MDI selection circuit.

CRT/MDI

CK1

(PCR-EV20MDT)

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



CRT/MDI selection circuit

M3A/B

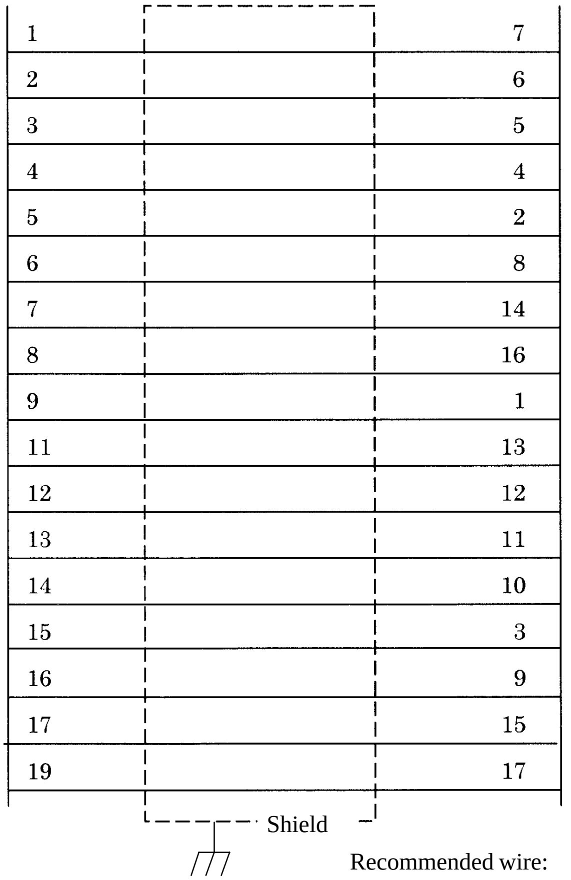
(MR-20RFD)

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

NOTE) Pins 18 to 20 are not switchable.

Cable connection (J149)

The maximum allowed total length of J148 and J149 is 50 m.



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

Recommended wire:
A66L–0001–0284#10P (#28AWG10 paired)

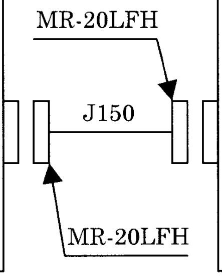
8) Cable J150
Video signal cable connected between CCXA or CCXB on the CRT/MDI selection circuit and CN1 on the CRT/MDI.

CRT/MDI selection circuit

CCXA/B

(MR-20RMD)

| | | | | | |
|---|---|---|---|---|---|
| 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 | |



CRT/MDI

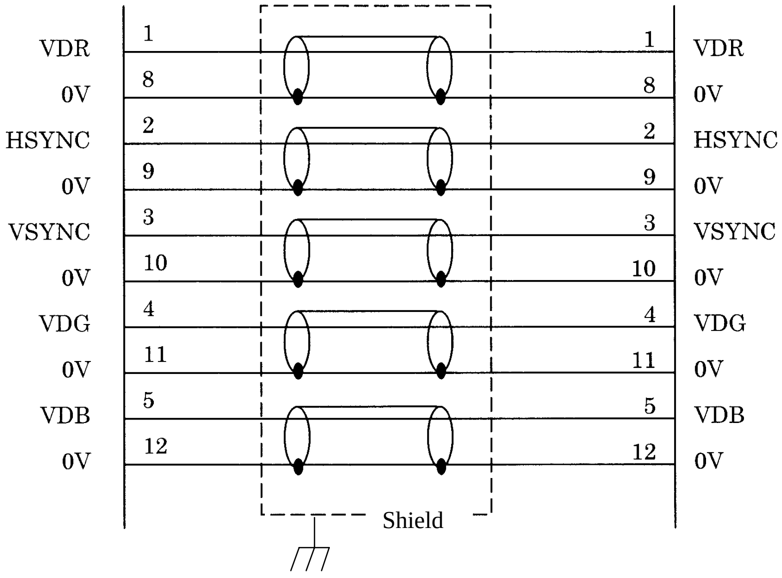
CN1

(MR-20RMD)

| | | | | | |
|---|---|---|---|---|---|
| 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 | |

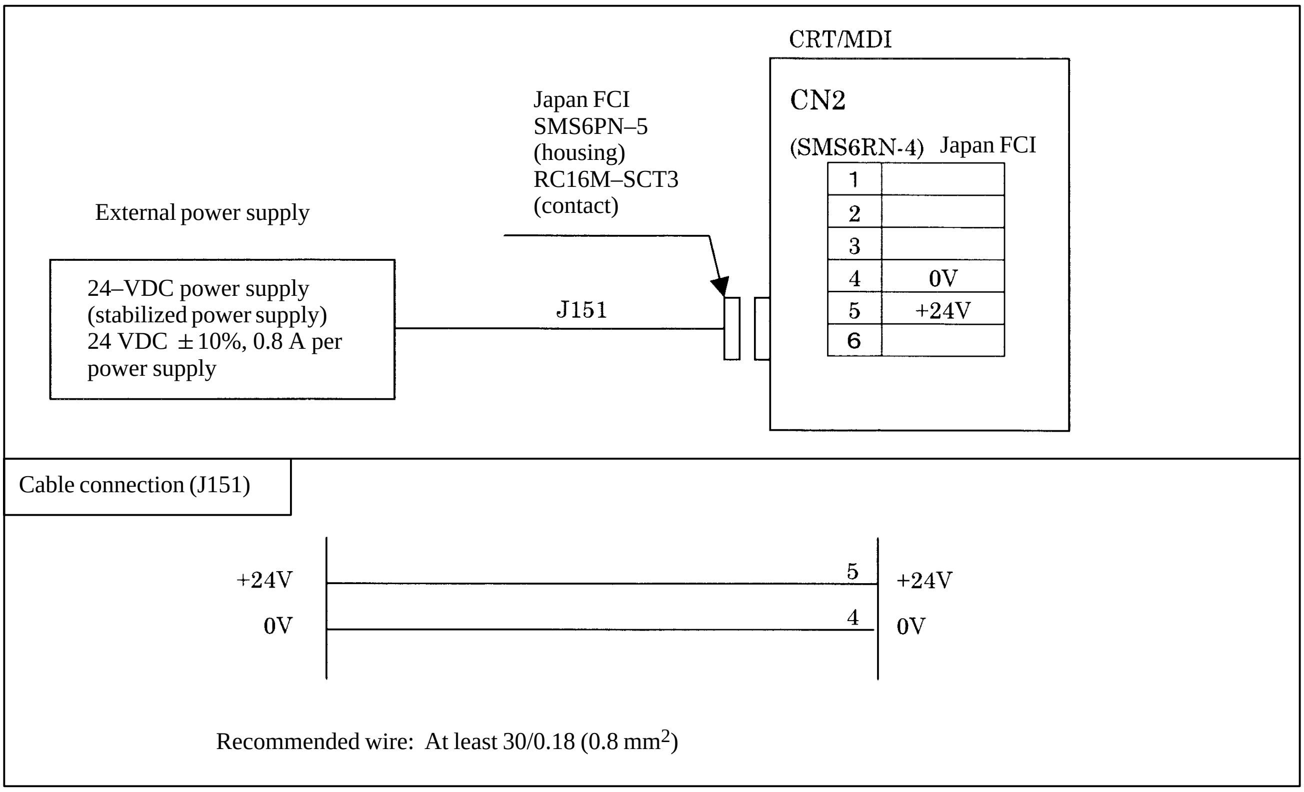
Cable connection (J150)

The maximum allowed total length of J150 and J53 is 50 m.



Recommended wire: A66L–0001–0371 . . . . Coaxial cable (five conductors, common shield)

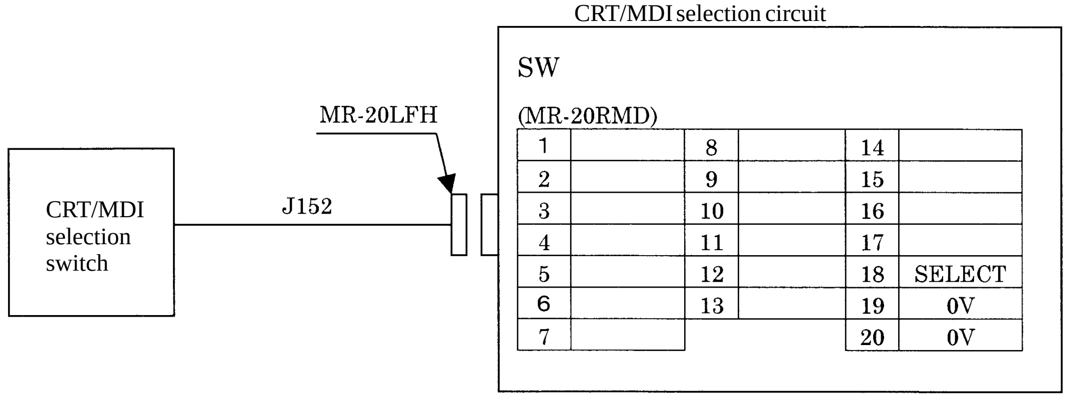
9) Cable J151
Power cord connected to CN2 on the CRT/MDI



Recommended wire: At least 30/0.18 (0.8 mm$^2$)

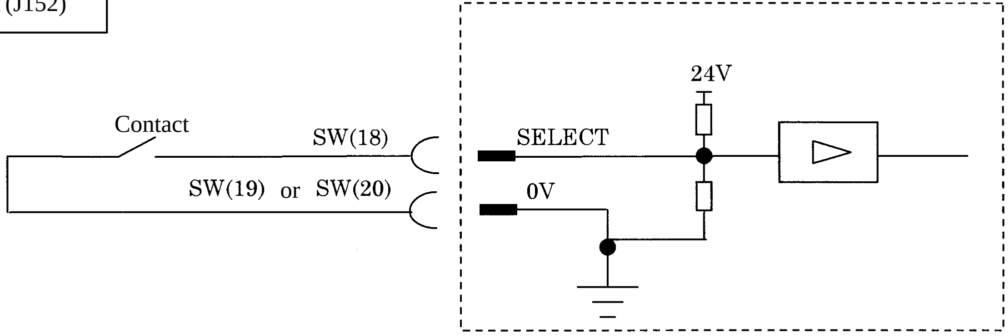
10) Cable J152

Signal selection cable connected between the CRT/MDI selection switch and SW on the CRT/MDI selection circuit.



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

Cable connection (J152)



Recommended wire: At least 30/0.18 (0.8 mm$^2$). The cable length must be 10 m or less.

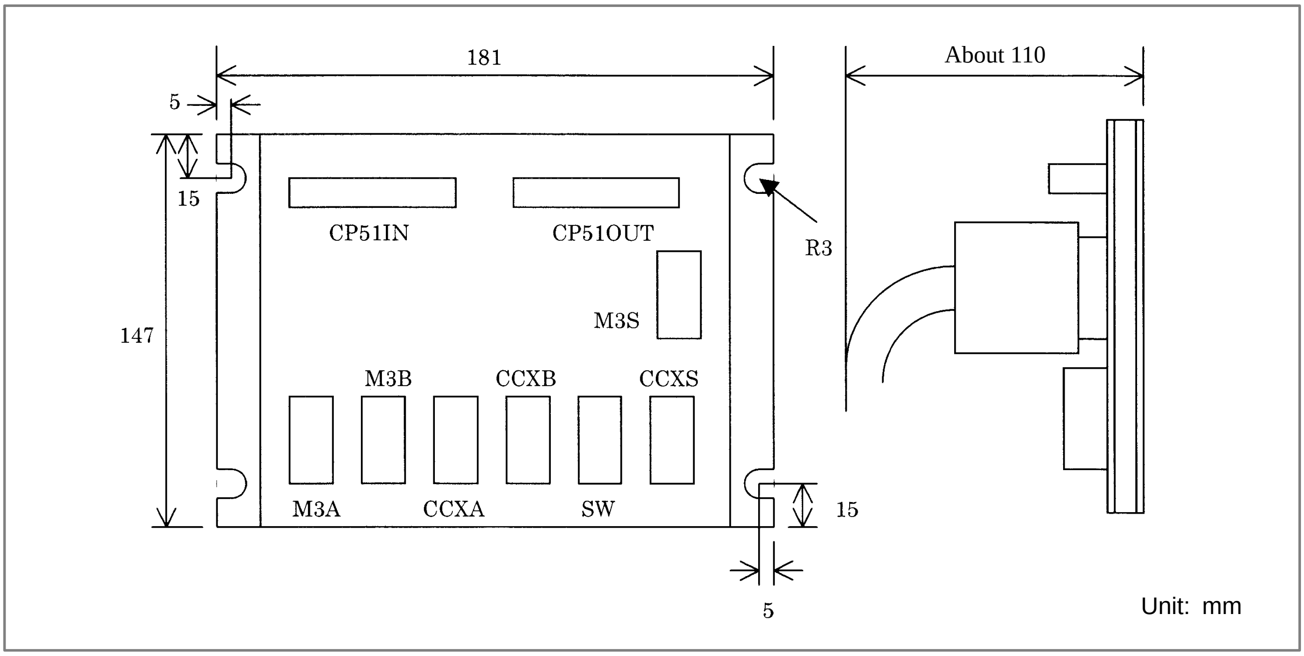
Relationships between selection switch settings and selected CRT/MDI units

| Contact | CRT/MDI selected |
|---|---|
| Open | CRT/MDI#1 |
| Closed | CRT/MDI#2 |

## G.3 SPECIFICATIONS OF THE CRT/MDI SELECTION CIRCUIT

Part No.: A20B–1003–0770

External view



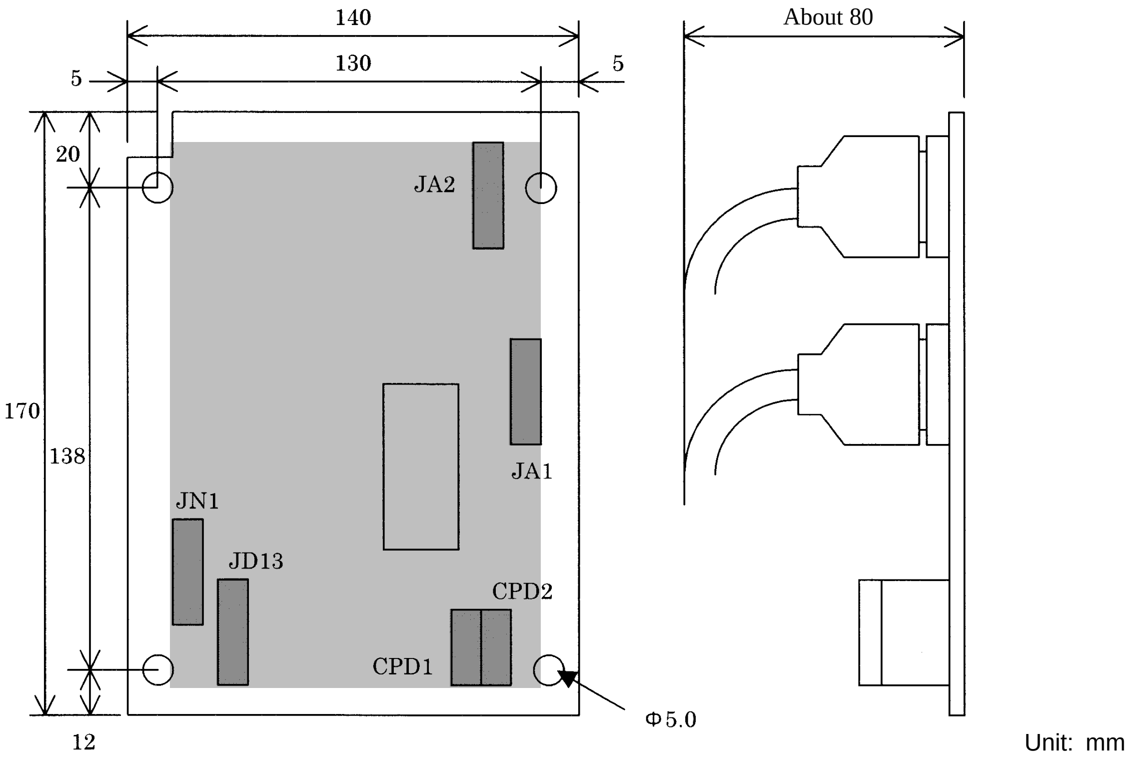
> **NOTE**
> Make sure that the CRT/MDI selection circuit is not inclined by 30° or more from the vertical line.

## G.4 SPECIFICATIONS OF THE CRT CONTROL PC BOARD

Part No.: A20B–2000–0840

This PC board is usually mounted at the back of the CRT/MDI, LCD/MDI, or separate MDI.
Brackets are not provided. When installing this PC board in the cabinet, insert studs (about 10 mm long) into the clearance holes (see the figure below).

External view



**NOTE**
The interface specifications of JA1, JA2, JD13, JN1, CPD1, and CPD2 on this PC board are the same as those for the CRT/MDI, separate CRT, and separate MDI.

## G.5 SUPPLEMENT

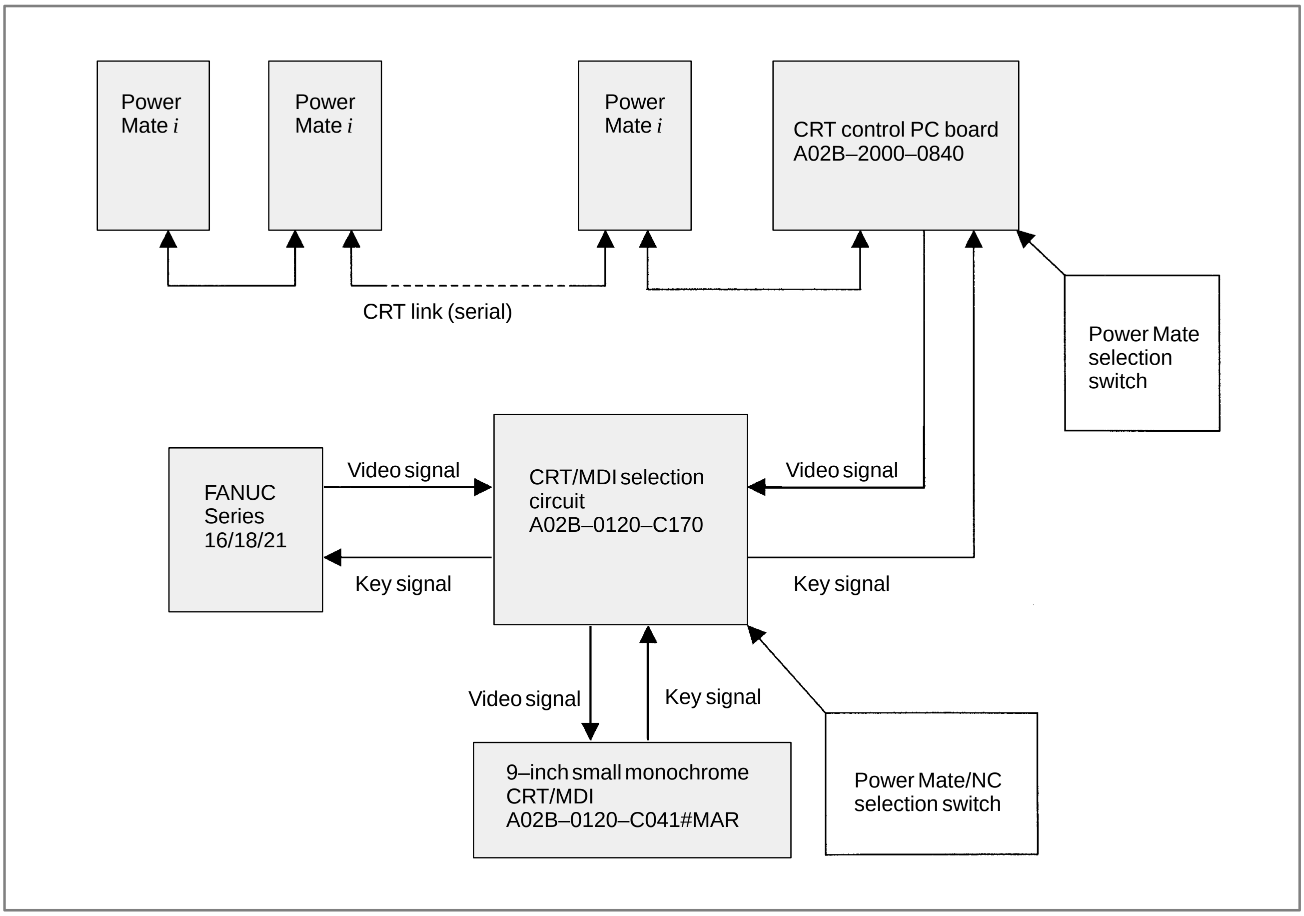
1) Only the CRT/MDI selected by the selection switch can be used. The other non–selected CRT/MDI does not display anything, nor does it accept anything from the MDI.
2) For the CRT/MDI, see Section 8.1.
3) For the separate CRT and separate MDI, see Section 8.2.
4) Take the voltage drop into consideration, and ensure that 24–VDC power supply provides 24 VDC ± 10% at the connector port on each unit.
5) Switching between two PDP/MDI units is not allowed.
6) When switching between two LCD/MDI units, combine a CRT/MDI selection circuit and CRT control PC board with the separate LCD (A02B–0166–C251) and separate MDI (A02B–0120–C121#MAR). Change the video interface connector on the LCD/MDI from CN1 to JA1 (15–pin PCR connector (Hirose)). Also change the power supply connector on the LCD/MDI from CN2 to CP5 (3–pin connector (Japan AMP)). Read CN1 as JA1 and CN2 as CP5, while referring to Section 8.4.

# H

# SHARING THE CRT/MDI WITH ANOTHER CNC

## H.1 OVERVIEW

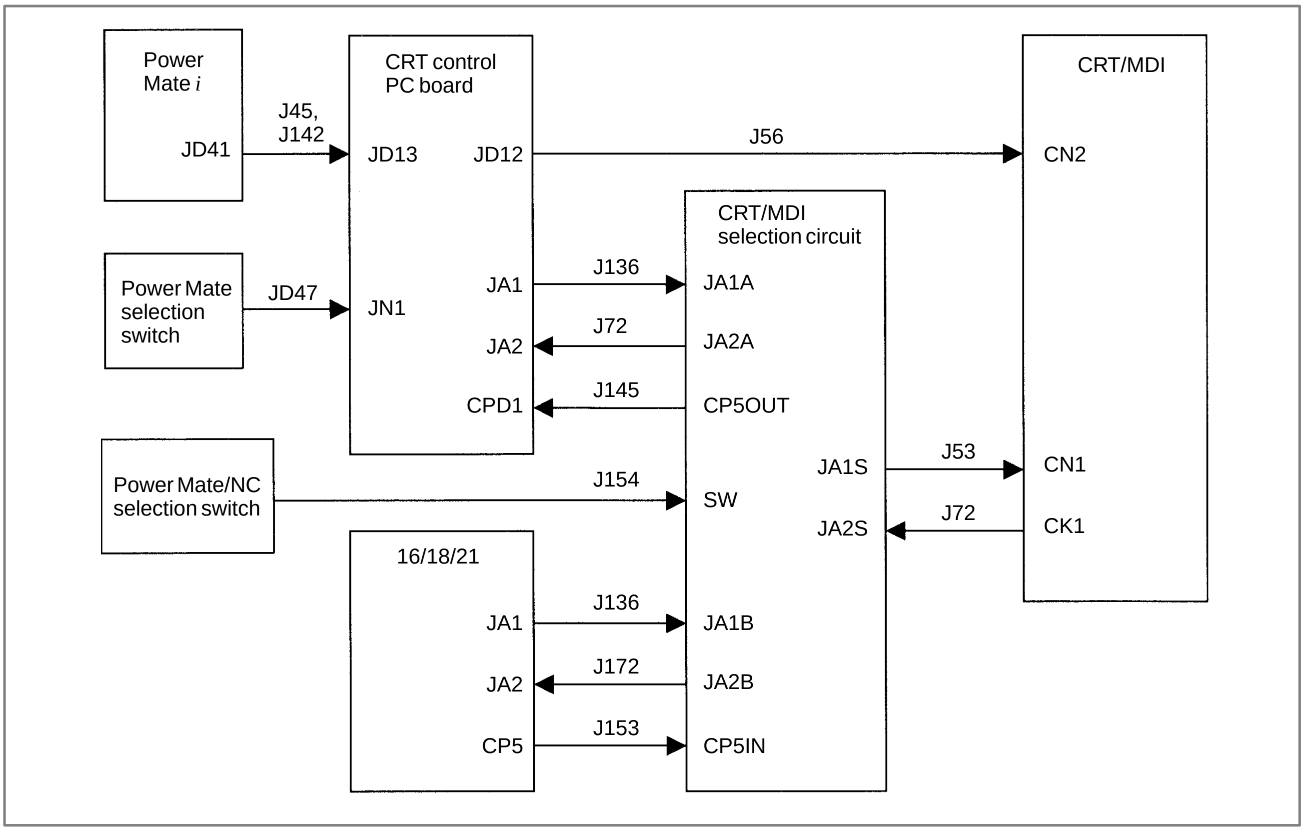
A single 9–inch small monochrome CRT/MDI can be shared by the Power Mate *i* and FANUC series 16, 18, or 21. It is also possible to use a display link to switch a single CRT/MDI between multiple Power Mate *i* products and the FANUC series 16, 18, or 21.
The LCD/MDI can also be switched in the same way as the CRT/MDI.



1) The Power Mate/NC selection switch shown above can be used to select either the Power Mate *i* or FANUC series 16, 18, or 21 as the unit used to send and receive interface signals from the CRT/MDI.
2) A display link enables multiple Power Mate *i* products to switch between and control two CRT/MDI units.
3) The CRT/MDI must be the 9–inch monochrome unit.
4) The user is responsible for preparing the cables and selection switches.
5) Each unit requires a power supply

**NOTE**
If the FANUC Series 16*i*/18*i*/21*i* has the display link function, the 16*i*/18*i*/21*i* can share a setup/display device with the Power Mate *i* through the display link.

## H.2 CONNECTION



1) Cables J45 and J142
Display link cables connected between the Power Mate and CRT control PC board. For details, see Subsections 8.1.2 and 8.1.3.

2) Cable J47
Device selection switch interface cable connected between the power mate selection switch and CRT control PC board. For details, see Subsection 8.1.4.

3) Cable J53
Video signal cable connected between the CRT/MDI selection circuit and CRT/MDI. For details, see Subsection 8.2.2. The maximum allowed total length of J53 and J136 is 50 m.

4) Cable J56
Power cord connected between the CRT control PC board and CRT/MDI. For details, see Subsection 8.2.2.

5) Cable J136
Video signal cable connected between the CRT control PC board or FANUC series 16, 18, or 21 and the CRT/MDI selection circuit. For details, see Subsection 8.4.2.

6) Cable J145
Power cord connected between the CRT/MDI selection circuit and CRT control PC board. For details, see Subsection 8.1.5. (Read the Power Mate as the CRT/MDI selection circuit. Also read the CRT/MDI unit as the CRT control PC board.)

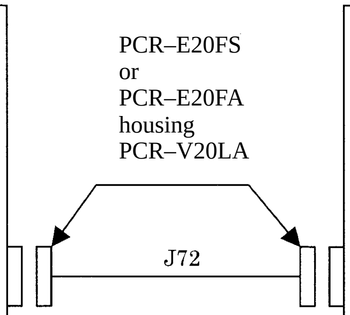
7) Cable J72
Key signal cable connected between JA2A on the CRT/MDI selection circuit and JA2 on the CRT control PC board, between JA2B on the CRT/MDI selection circuit and JA2 on the FANUC series 16, 18, 21, or between the JA2S on the CRT MDI selection circuit and CK1 on the CRT/MDI.

CRT/MDI selection circuit

JA2A/JA2B/JA2S

(PCR-EV20MDT)

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



CRT control PC board, 16/18/21, CRT/MDI

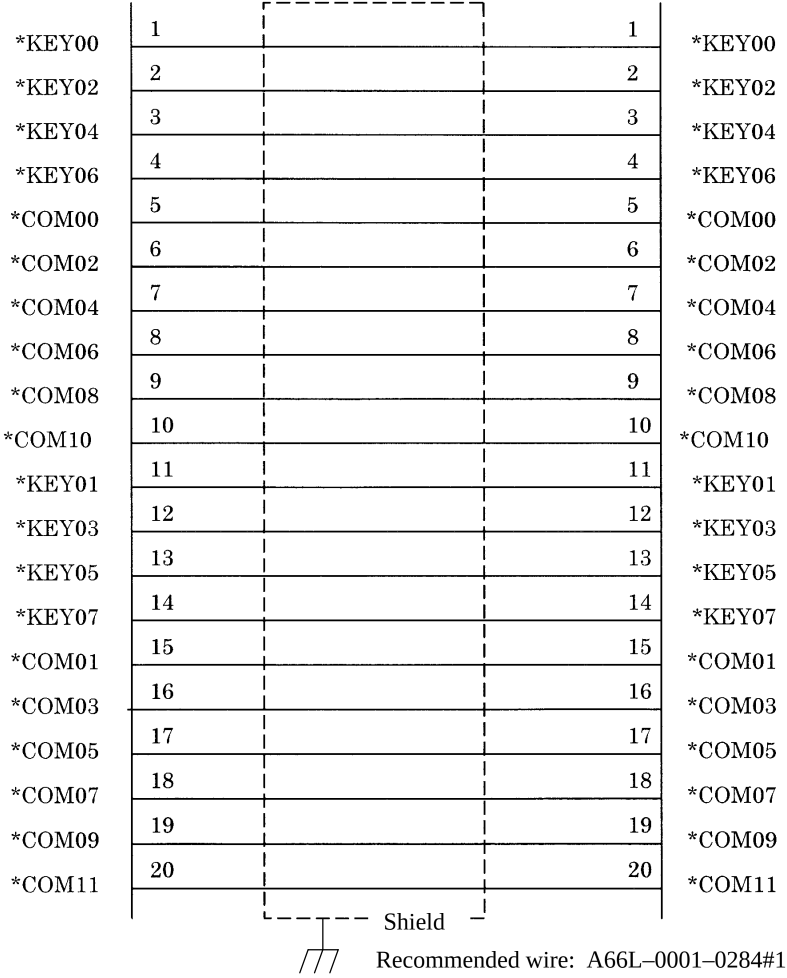
JA2A/JA2B/JA2S

(PCR-EV20MDT)

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

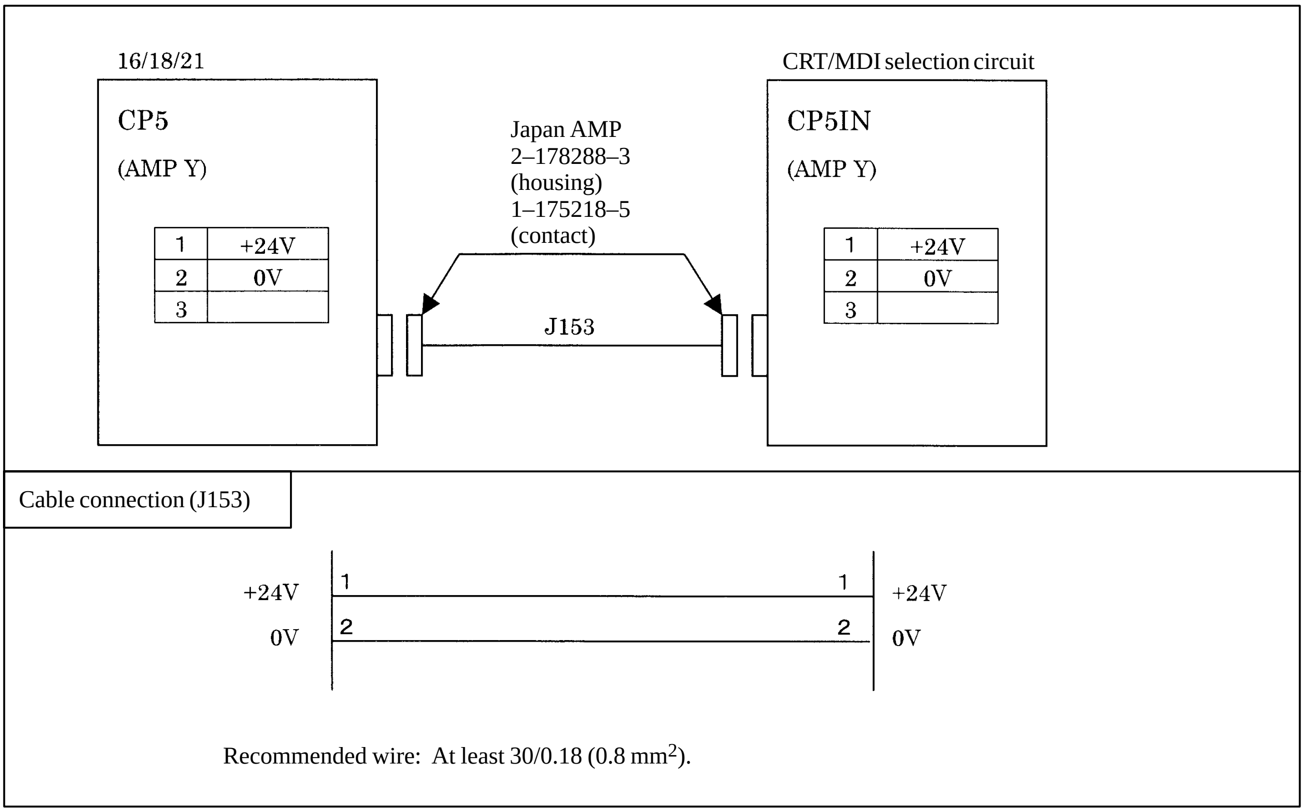
Cable connection (J72)

The maximum allowed total length of two J72 cables is 50 m.



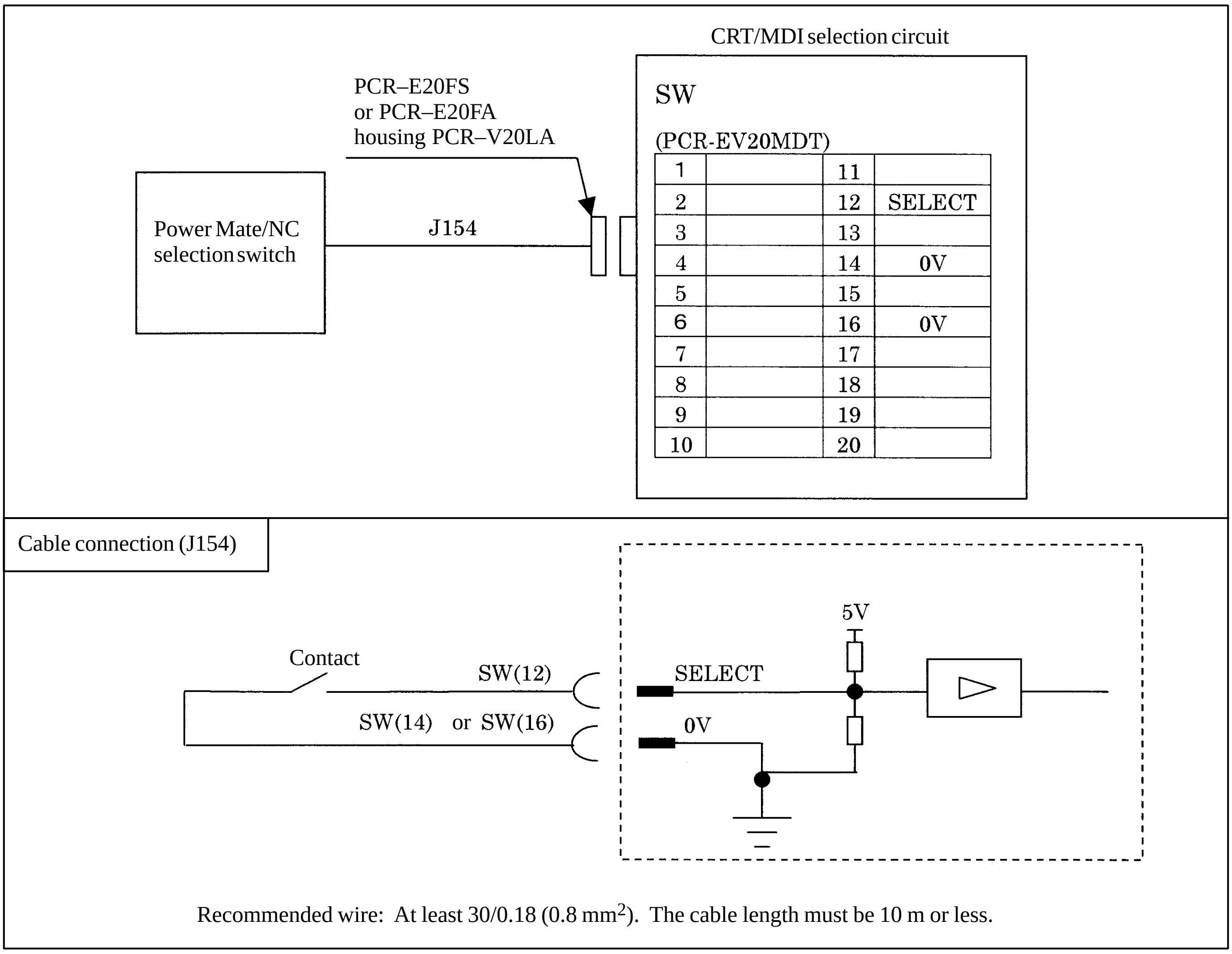
Recommended wire: A66L–0001–0284#10P (#28AWG10 paired)

8) Cable J153
Power cord connected between CP5 on the FANUC series 16, 18, or 21 and CP5IN on the CRT/MDI selection circuit.



Recommended wire: At least 30/0.18 (0.8 mm$^2$).

9) Cable J154
Selection signal cable connected between the Power Mate/NC selection switch and SW on the CRT/MDI selection circuit.



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

Recommended wire: At least 30/0.18 (0.8 mm$^2$). The cable length must be 10 m or less.

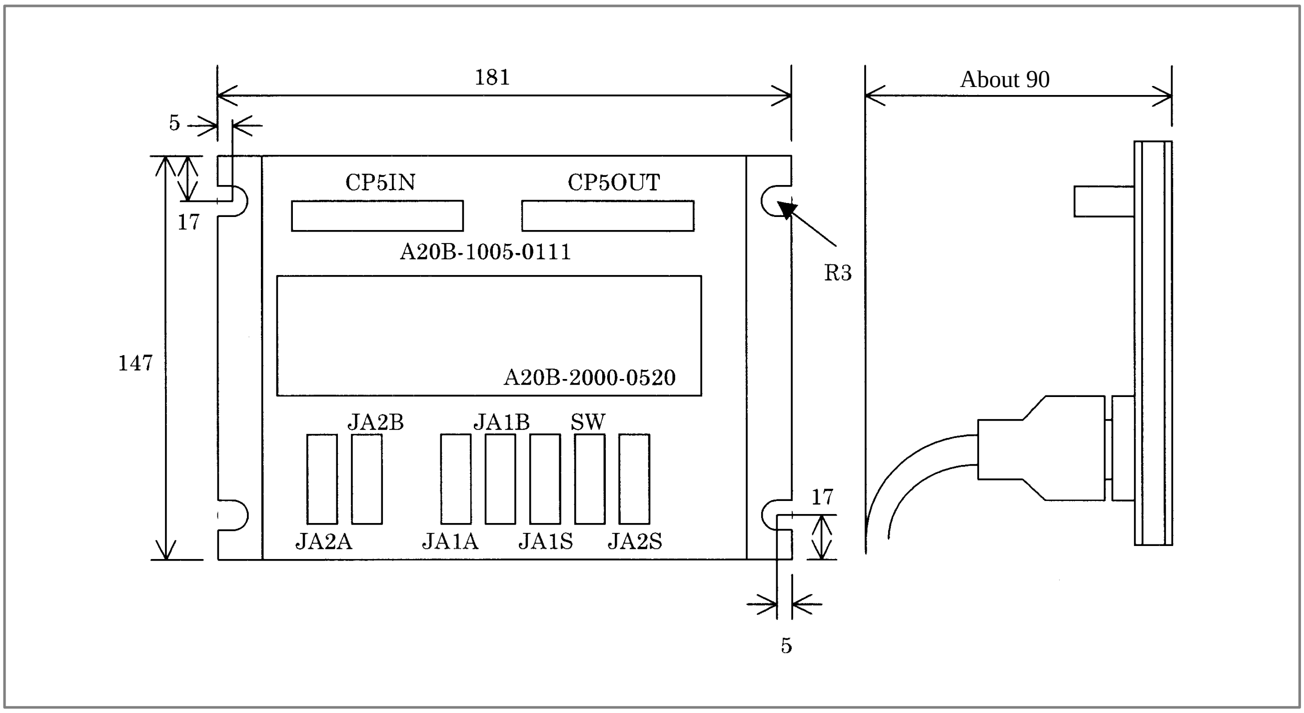
Relationships between selection switch settings and selected connectors

| Contact | Connector selected |
|---|---|
| Open | Side A (JA1A or JA2A) |
| Closed | Side B (JA1B or JA2B) |

## H.3 SPECIFICATIONS OF THE CRT/MDI SELECTION CIRCUIT

Part No.: A02B–0120–C170

External view



## H.4 SPECIFICATIONS OF THE CRT CONTROL PC BOARD

See Section G.4.

## H.5 WHEN USING THE LCD/MDI

1) Combine the separate LCD (A02B–0166–C251) and separate MDI (A02B–0120–C121#MAR).
2) The CRT control PC board used together with the LCD/MDI is that having part number A20B–2000–0843. Its external dimensions and installation are the same as those for the A20B–2000–0840. The same CRT/MDI selection circuit as that for the CRT/MDI is used.
3) The CRT/MDI and LCD/MDI use different connectors as indicated below.

| | CRT/MDI | LCD/MDI |
|---|---|---|
| Video Input | CN1<br>(Honda 20–pin MR connector) | JA1<br>(Honda 20–pin PCR connector) |
| Power input | CN2<br>(Japan FCI 16–pin connector) | CP5<br>(Japan AMP 3–pin Y connector) |

   Video input cable J72 rather than J53 is used. Power cord J145 rather than J56 is used. See Subsection 8.4.2.

4) The device selection switch interface for the LCD/MDI differs from that for the CRT/MDI. See Subsection 8.4.3.

## H.6 SUPPLEMENT

1) The +24–V power to the CRT/MDI, CRT/MDI selection circuit, and CRT control PC board is supplied from the FANUC series 16, 18, or 21. Even when only the Power Mate uses the CRT/MDI, the 16, 18, or 21 must have been turned on.
2) For the CRT/MDI, see Section 8.1
3) For the separate CRT and separate MDI, see Section 8.2.
4) For the LCD/MDI, see Section 8.4.
5) Take the voltage drop into consideration, and ensure that the 24–VDC power supply provides 24 VDC ± 10% at the connector port on each unit.
6) The Power Mate can be connected only to the small–key CRT/MDI or LCD/MDI.
7) In general, the CRT/MDI uses M keys. To use T keys, parameter setting is necessary.
8) In reference to the CRT/MDI, up to two CRT/MDI selection circuits can be stacked (so that switching between up to four NCs is possible). By comparison, the LCD/MDI supports the use of only one CRT/MDI selection circuit.
9) On the CRT–shared screen on the Power Mate, information on the FANUC series 16, 18, or 21 cannot be displayed.

# Index

## Revision Record

## FANUC Power Mate *i*–MODEL D/H CONNECTION MANUAL (HARDWARE) (B–63173EN)

| Edition | Date | Contents | Edition | Date | Contents |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| 03 | Jan., 2002 | ● Addition of following items<br>❑ 8.6 Detachable LCD/MDI type B<br>❑ 8.8 Connection to the handy operator's panel type B<br>❑ 9.5 Analog servo interface unit<br>❑ 10.5 Connection to a commercially available touch panel<br>❑ 10.6 Connection by multiaxis synchronization function<br>● Correction of errors | | | |
| 02 | Aug., 1998 | ● Addition of following items<br>❑ 6.7 Connection of connector panel I/O module<br>❑ 6.12 FSSB I/O module<br>❑ Appendix G connecting to CRT/MDI units<br>❑ Appendix H Sharing the CRT/MDI with another CNC<br>● Correction of errors | | | |
| 01 | Feb., 1998 | | | | |