GFZ-62543EN B-62543EN

GE Fanuc CNC

Series 0-TD/0-MD/0-GCD/0-GSD Connection Manual (Hardware)

FANUC

GE Fanuc Automation

Computer Numerical Control Products

Series 0-TD / 0-GCD
Series 0-MD / 0-GSD

Connection Manual (Hardware)

GFZ-62543EN/02 *April 1997*

DEFINITION OF WARNING, CAUTION, AND NOTE

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

WARNING

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

CAUTION

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

NOTE

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

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

Table of Contents

1 PREFACE

This manual describes the electrical and structural specifications required for connecting the FANUC Series 0–D to a machine tool. The manual outlines the components commonly used for FANUC CNC control units, as shown in the configuration diagram in Chapter 2, and supplies additional information on using these components with the Series 0–D. Refer to individual manuals for the detailed specifications of each model. There are different models of the Series 0–D appropriate for different types of machine tools (lathe, machining center, etc.). This manual describes those specifications in common among all Series 0–D models. Whenever one or more models have different specifications, they are noted.

Applicable models

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

Product name	Abbreviations		Series
FANUC Series 0–TD	0–TC	Series 0–D	T series
FANUC Series 0–GCD	0–GCD		
FANUC Series 0–MD	0–MD		M series
FANUC Series 0–GSD	0–GSD		

Manuals related to Series 0–D

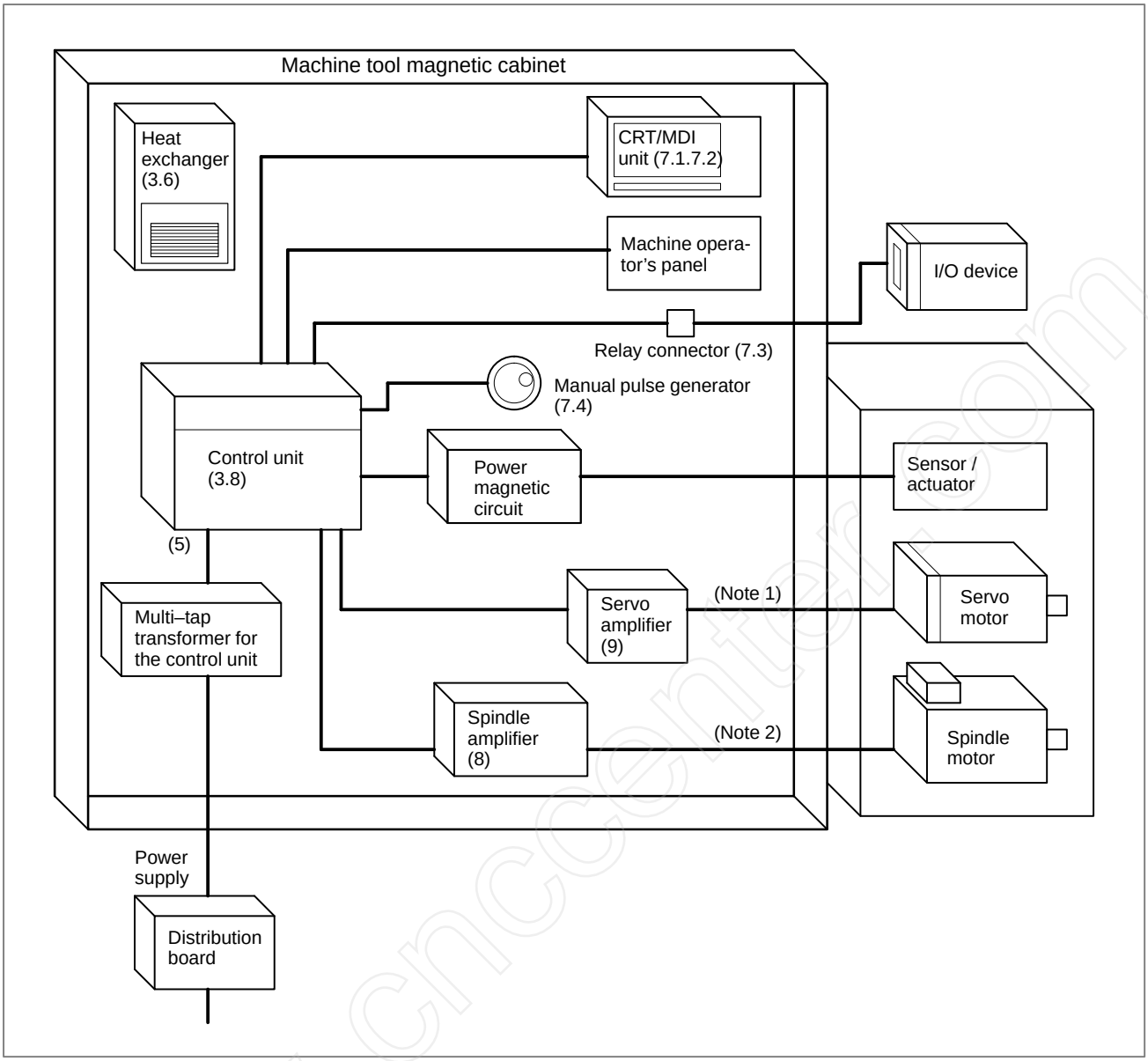
The table below lists manuals related to the FANUC Series 0–D.
In the table, this manual is marked with an asterisk(*).

Table 1 Manuals related to the FANUC Series 0–D

Manuals name	Specification number	
FANUC Series 0–TD/MD/GCD/GSD CONNECTION MANUAL (HARDWARE)	B–62543EN	*
FANUC Series 0–TD/MD/GCD/GSD CONNECTION MANUAL (FUNCTION)	B–62543EN–1	
FANUC Series 0–TD/GCD OPERATOR'S MANUAL	B–62544EN	
FANUC Series 0–MD/GSD OPERATOR'S MANUAL	B–62574EN	
FANUC Series 0–TD/MD/GCD/GSD MAINTENANCE MANUAL	B–62545EN	
FANUC Series 0–TD/GCD PARAMETER MANUAL	B–62550EN	
FANUC Series 0–MD/GSD PARAMETER MANUAL	B–62580EN	

2 CONFIGURATION

The following figure shows the configuration of the electrical system of the machine tool with which the Series 0–D is used.
This manual describes how to connect the units illustrated in this diagram. The machine tool body, machine operator's panel, power magnetic circuit, and sensor/actuator are specific to the machine tool 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.



NOTE

1 Refer to the "FANUC AC Servo Motor Series Descriptions (B-65002E)" or "FANUC CONTROL MOTOR AMPLIFIER α series DESCRIPTION (B–65162E)".

2 Refer to the "FANUC AC Spindle Motor Series (Serial interface) Descriptions (B-65042E)".

3 INSTALLATION

3.1 EXTERNAL ENVIRONMENTAL REQUIREMENTS OF CABINET

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

- Cabinet manufactured by the machine tool builder for housing the control unit or peripheral units;
- Cabinet for housing the flexible turnkey system provided by FANUC;
- Operation pendant, manufactured by the machine tool builder, for housing the CRT/MDI unit or operator’s panel.
- Equivalent to the above.

The environmental conditions when installing these cabinets shall conform to the following table. Section 3.4 describes the installation and design conditions of a cabinet satisfying these conditions.

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

3.2 INSTALLATION CONDITION OF CNC AND SERVO UNIT

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

3.3 POWER CAPACITY

The power capacity of the CNC control unit, which in this section means the specification required for the power supply, is obtained by adding the power capacity of the control section and the power capacity of the servo section.
The power capacity of the control section includes the power capacity of the control unit, CRT/MDI.

Power capacity of the control section	0.4 kVA
Power capacity of the servo section	Depends on servo motor type. Refer to each DESCRIPTIONS.

3.4 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 :

  ❑ 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
- The cabinet must be designed to maintain a difference in temperature of 10°C or less between the air in the cabinet and the outside air when the temperature in the cabinet increases.
  See Section 3.5 for the details on thermal design of the cabinet.
- 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.
- Packing materials must be used for the cable port and the door in order to seal the cabinet.
  Because the CRT unit uses a voltage of approximately 11 kV, airborne dust gathers easily. If the cabinet is insufficiently sealed, dust passes through the gap and adheres to the unit. This may cause the insulation of the unit to deteriorate.
  Acceptable packing materials :

  ❑ Epton sealer No. 686, NITTO INDUSTRY CO., LTD.

  ❑ Polyurethane foam (ester) covered with vinyl chloride, FUJI POLYMERTECH., LTD.
- The CRT/MDI unit must be installed in a location where coolant cannot be poured directly on it. The unit does have a dust–proof front panel.
- 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.
- 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.

3.5 THERMAL DESIGN OF THE CABINET

The purpose of the thermal design of the cabinet is to limit the difference in temperature between the air in the cabinet and the outside air to 10°C or less when the temperature in the cabinet increases.
The internal air temperature of the cabinet increases when the units and parts installed in the cabinet generate heat. Since the generated heat is radiated from the surface of the cabinet, the temperature of the air in the cabinet and the outside air balance at certain heat levels. If the amount of heat generated is constant, the larger the surface area of the cabinet, the less the internal temperature rises. The thermal design of the cabinet refers to calculating the heat generated in the cabinet, evaluating the surface area of the cabinet, and enlarging that surface area by installing heat exchangers in the cabinet, if necessary. Such a design method is described in the following subsections.

3.5.1 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 following expression must then be satisfied to limit the difference in temperature between the air in the cabinet and the outside air to 10°C or less when the temperature in the cabinet rises:

Internal heat loss P [W] ≦
6[W/m^2 • °C] surface area S[m^2] 10[°C] of rise in temperature

For example, a cabinet having a surface area of 4m^2 has a cooling capacity of 24W/°C. To limit the internal temperature increase to 10°C under these conditions, the internal heat must not exceed 240W. If the actual internal heat is 320W, however, the temperature in the cabinet rises by 13°C or more. When this happens, the cooling capacity of the cabinet must be improved using the heat exchanger described next.

3.5.2 Cooling by Heat Exchanger

If the temperature rise cannot be limited to 10°C by the cooling capacity of the cabinet, a heat exchanger must be added. The heat exchanger forcibly applies the air from both the inside and outside of the cabinet to the cooling fin to obtain effective cooling. The heat exchanger enlarges the surface area. Section 3.7 explains five heat exchangers supplied by FANUC. Select one of these according to the application.
If cooling fin A is used for the cabinet, the total cooling capacity of a cabinet having a surface area of 4 m^2 in the example above is improved as follows :

6W/m^2 • °C × 4m^2 + 9.1W/°C= 33.1W/°C

The calculated value verifies that even if the internal heat is 320 W, the temperature rise can be limited to less than 10°C.
See Section 3.6 for installing the heat exchanger.

3.5.3 Heat Loss of Each Unit

Name		Heat loss	Remarks
Control unit	Basic unit	80W	Included each printed board of master, memory, I/O, axis control and Power supply unit
	PMC–M	14W	
Display	9″ monochrome CRT/MDI	14W	These are not relative to the variation of MDI keys

3.6 INSTALLING THE HEAT EXCHANGER

Table 3.6 lists the heat exchangers. Cooling fins A, B and C are not provided with a fan. Note that a fan motor is required for any of these cooling fins when it is used as a heat exchanger.

Table 3.6 List of Heat Exchangers

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

3.6.1 Cooling Fin A/B/C

The cooling fin is shown in Fig. 3.6.1(a).

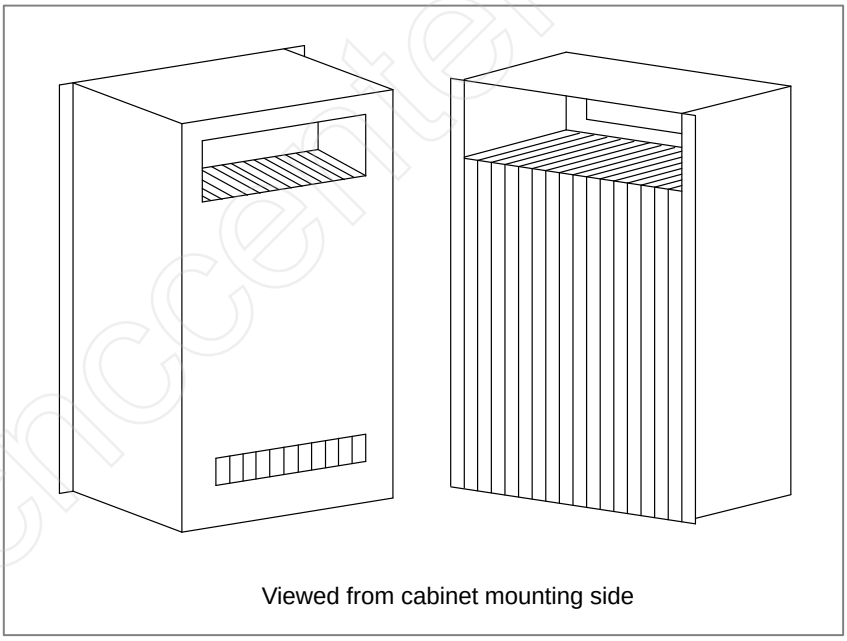


Fig. 3.6.1(a) External view of cooling fin

It is installed in a cabinet made by the machine tool builder.

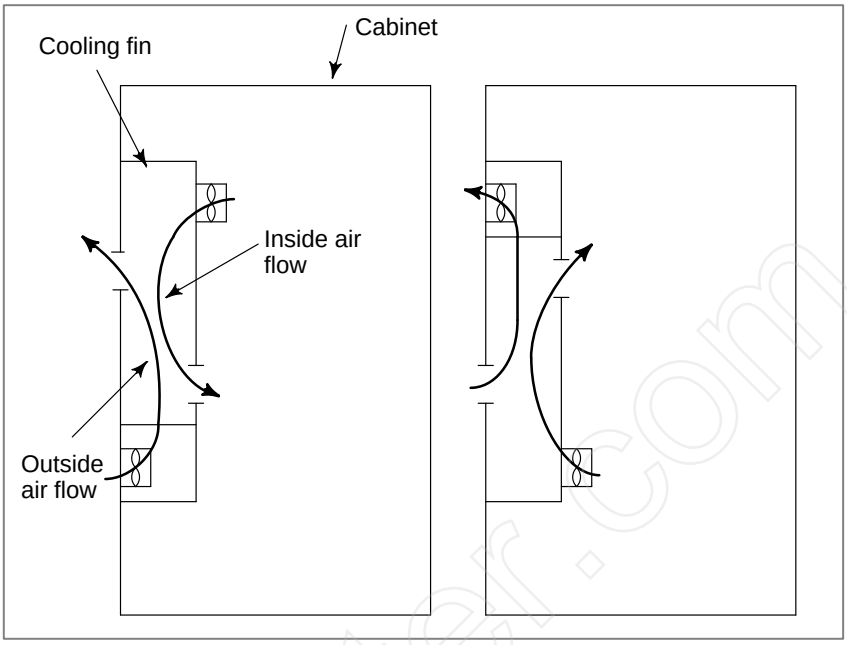
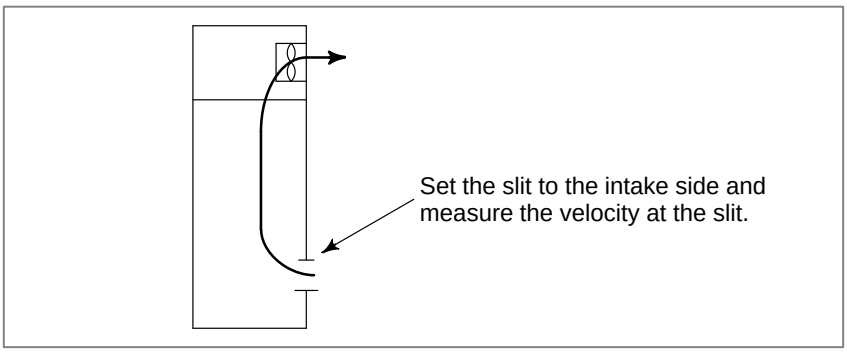


Fig. 3.6.1(b) Internal view of cooling fin

The cooling fin can be installed in two ways, as shown in Fig.3.6.1(b). The following lists the general precautions to be observed when using the cooling fins :

- The fans are not included with the cooling fin. They should be provided by the machine tool builder.
- Bring in the outside air from the bottom and exhaust the hot air from the top.
- The inside air may flow from top to bottom or bottom to top. However, generally decide the direction as follows :
  - ❑ Bring in the air near high heat loss components.
  - ❑ Exhaust the air toward the most important components to be cooled.
- For the cooling fin to display the specified cooling capacity, the air inside the cooling fins must flow at a velocity of 2.5 m/sec or greater.

(velocity of air flow measurement)



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

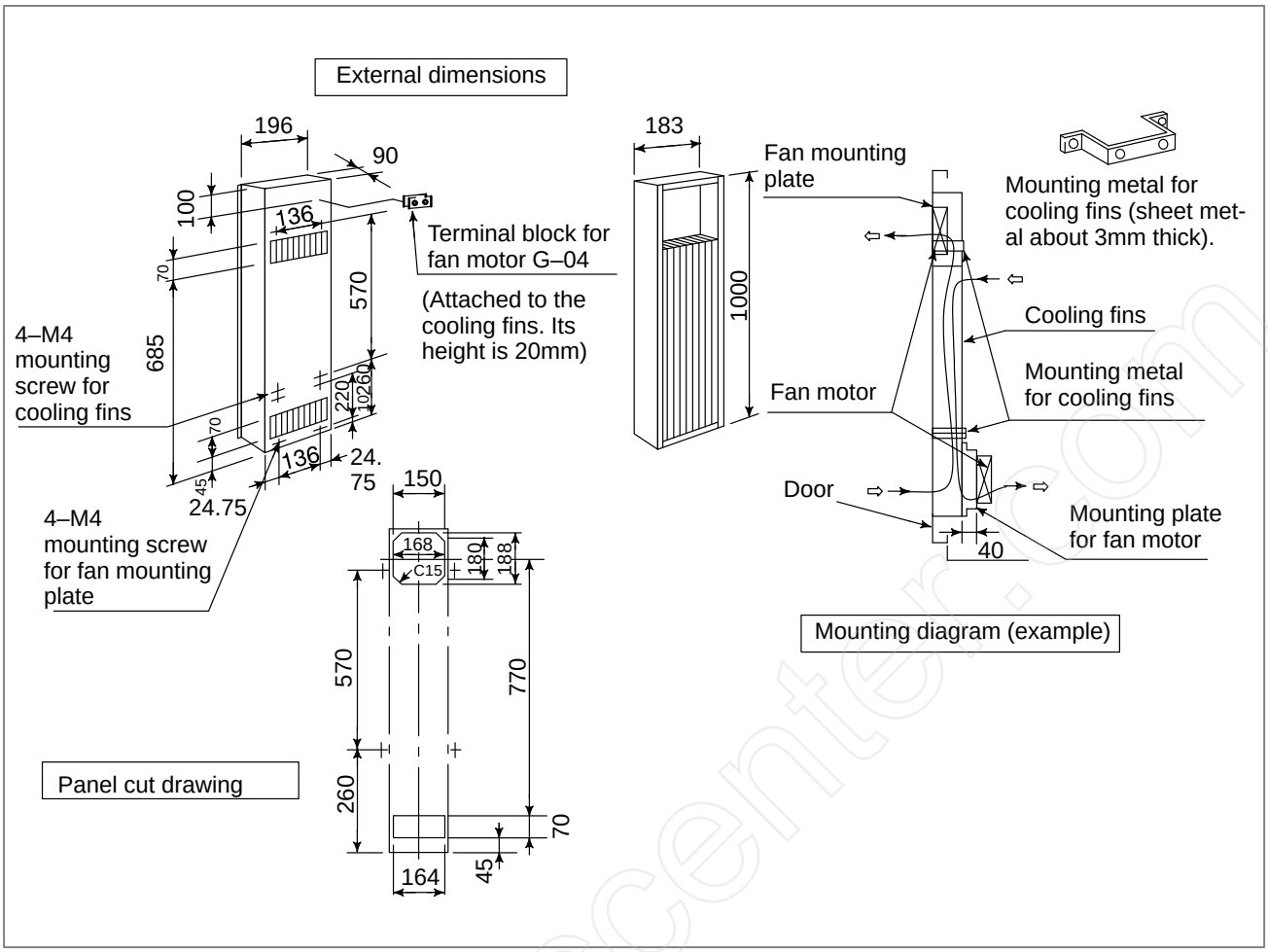


Fig. 3.6.1(c) External dimension and mounting method of cooling fin (A02B–0053–K303)

NOTE

1 Fan motor, mounting plate for fan motor and mounting metal for cooling fins are not attached to the cooling fins.
  So, prepare them at the machine tool builder.
2 Use two fan motors with about 50W power.
3 Weight : 6.5kg

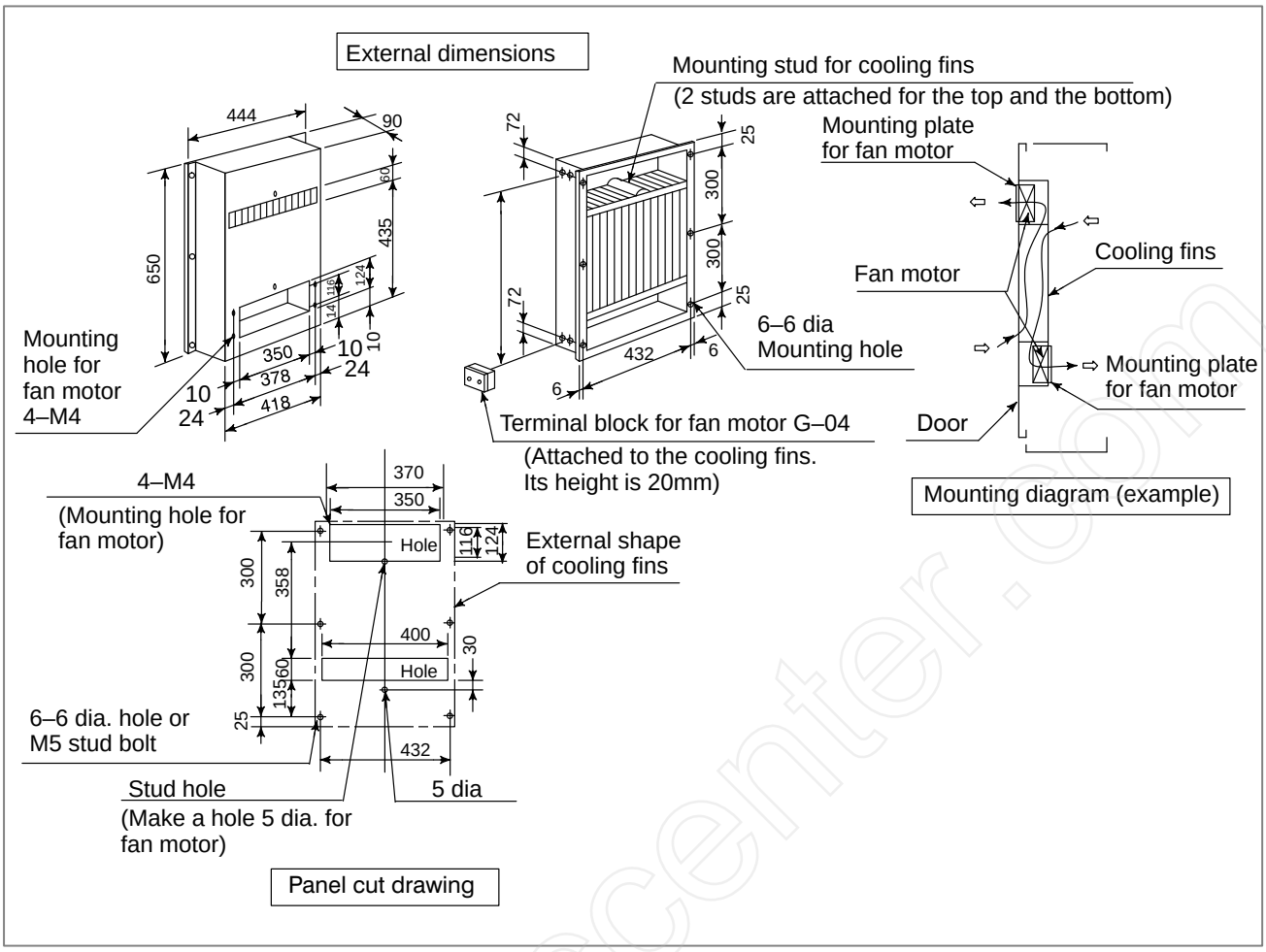


Fig. 3.6.1(d) External dimension and mounting method of cooling fin B (A02B–0053–K304)

NOTE

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

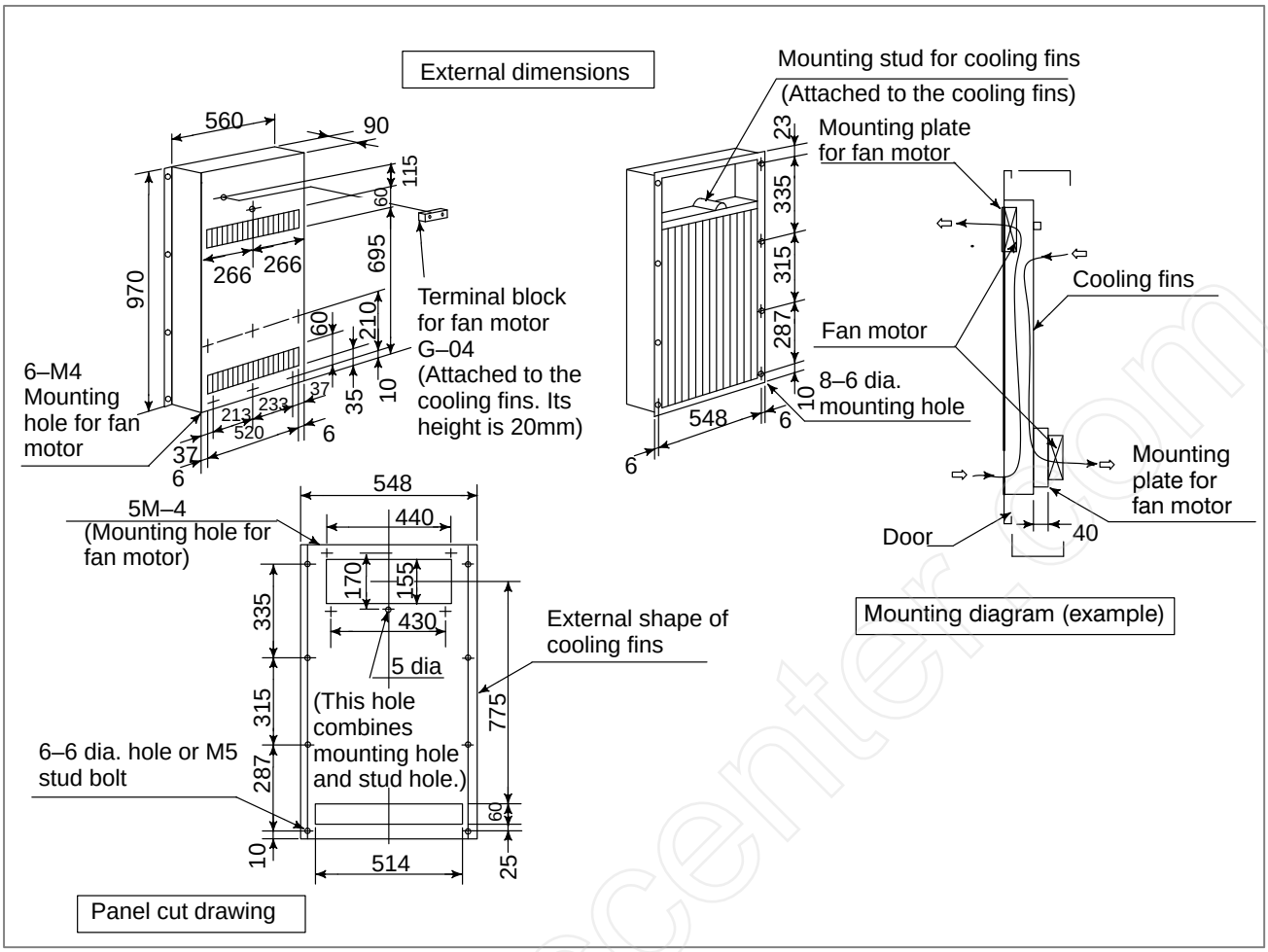


Fig. 3.6.1(e) External dimension and mounting method of cooling fin C (A02B–0053–K305)

NOTE

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

3.6.2 The Heat Pipe Type Heat Exchanger

3.6.2.1 Installation

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

Specifications

Installation format		Installation type in board	
Fan specifications	Cooling ability (W/°C)	9 (50Hz when operating)	
	Voltage (V)	200VAC	
	Frequency (Hz)	50	60
	Rating current (A)	0.28	0.24
	Rating input (W)	28	26
Weight (kg)		4	
Color		Munsell signal N 1.5	

Order specifications | Heat exchanger A02B–0094–C901 |

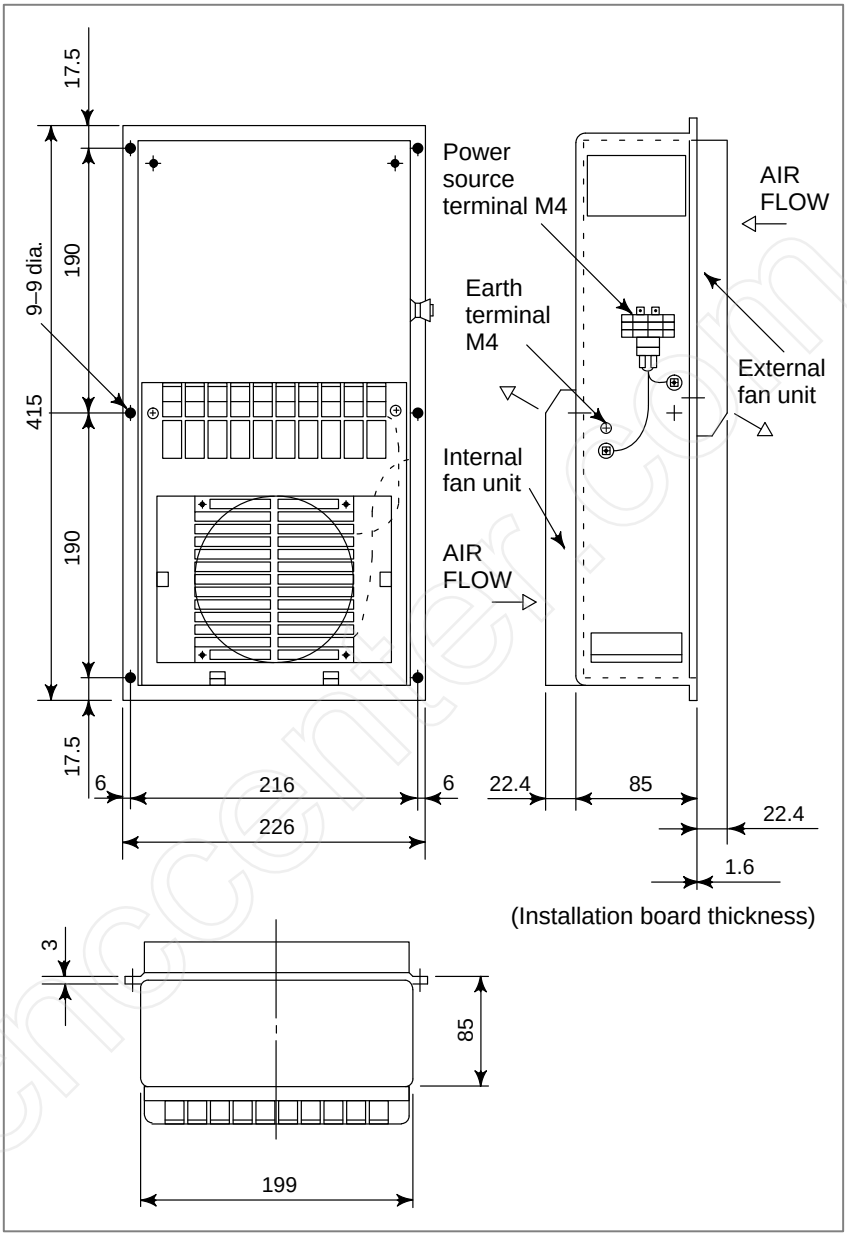
Remarks

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

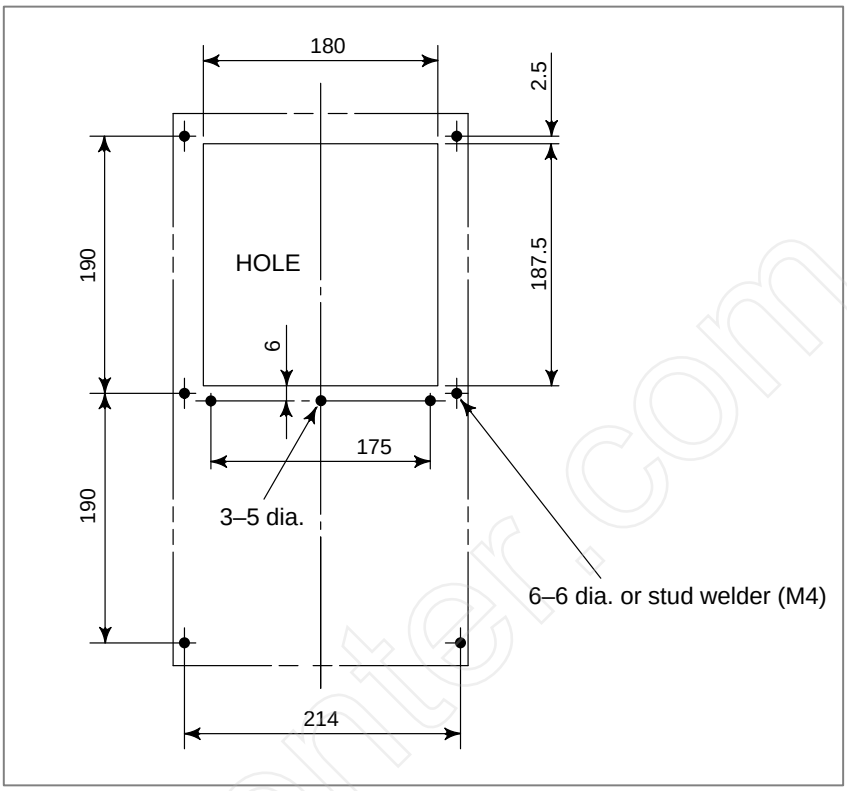
  Fan motor specifications
  A90L–0001–0219#A

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

External dimensions



Panel cut dimensions



Installation method

Please install the heat exchanger by the following sequence:

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

2 Install the heat exchanger main unit in the installation section which has been panel cut. (Fig. 2)
When fastening down the heat exchanger main unit with the screws, first, temporarily secure the panel and the heat exchanger main unit with the installation screw B, which was taken out in **1**). After that, secure the main unit by the installation screws. In this case, the external fan unit installation screw holes should be aligned with the main unit screw holes. (Please provide the installation screws for the heat exchanger main unit.)
Because this product is composed of plastic, set the value shown below for the screw tightening torque.

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

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

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

The installation is now complete.

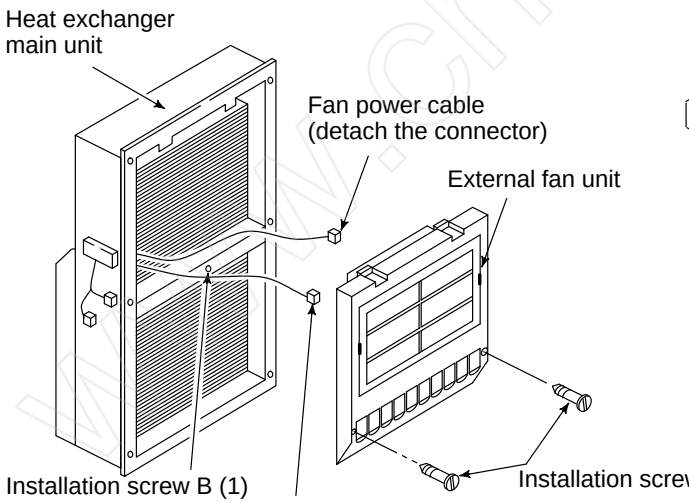


Fig. 1 Take out the external fan unit from the heat exchanger main unit

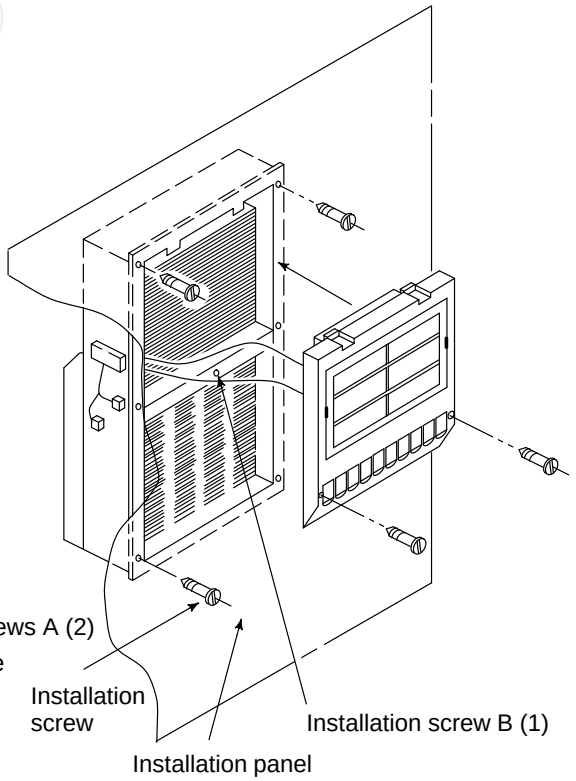


Fig. 2 Install the heat exchanger main unit and the external fan unit

3.7 ACTION AGAINST NOISE

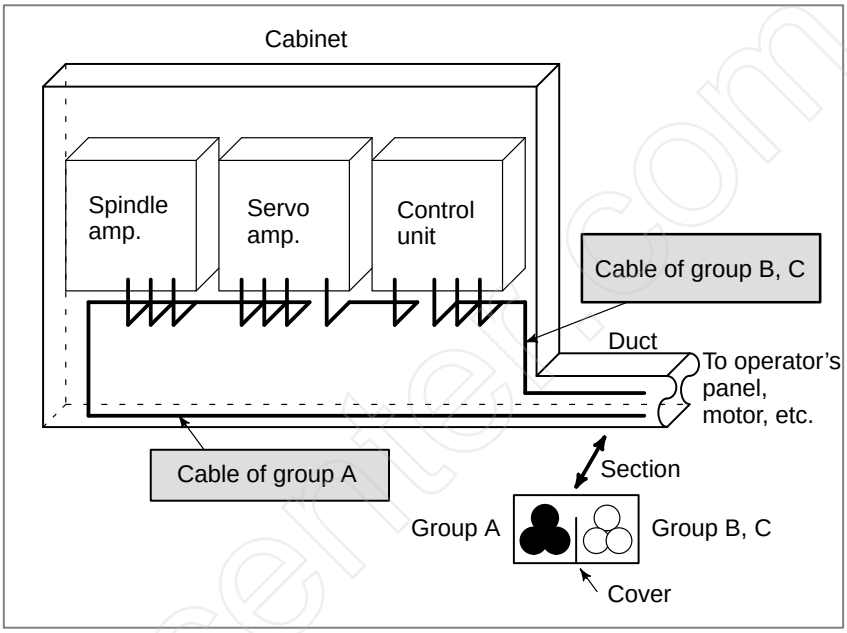
The CNC has been steadily reduced in size using surface–mount and custom LSI technologies for electronic components. The CNC also is designed to be protected from external noise. However, it is difficult to measure the level and frequency of noise quantitatively, and noise has many uncertain factors.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

3.7.1 Separating Signal Lines

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

Group	Signal line	Action
A	Primary AC power line	Bind the cables in group A separately (Note 1) from groups B and C, or cover group A with an electromagnetic shield (Note 2). See Section 3.7.4 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. Bind the cables in group B separately from group A, or cover group B with an electromagnetic shield. Separate group B as far from Group C as possible. It is more desirable to cover group B with the shield.
	DC relay (24VDC)	
	DI/DO cable between the CNC and power magnetics cabinet	
	DI/DO cable between the CNC and machine	
C	Cable between the CNC and servo amplifier	Bind the cables in group C separately from group A, or cover group C with an electromagnetic shield. Separate group C as far from Group B as possible. Be sure to perform shield processing in Section 3.7.5.
	Cable for position and velocity feedback	
	Cable between the CNC and spindle amplifier	
	Cable for the position coder	
	Cable for the manual pulse generator	
	Cable between the CNC and the CRT/MDI	
	RS–232–C interface cable	
	Cable for the battery	
	Other cables to be covered with the shield	

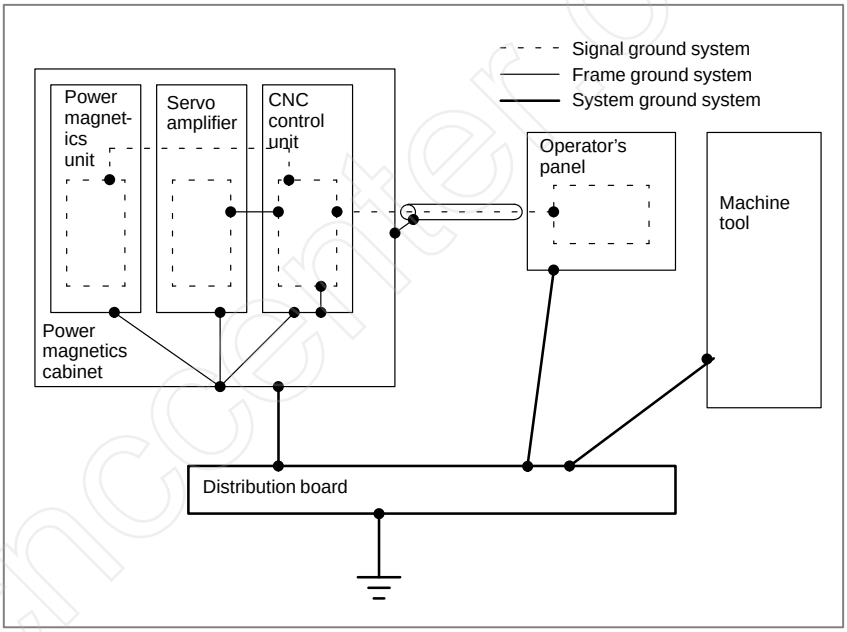
NOTE
1 The groups must be 10 cm or more apart from one another when binding the cables in each group.
2 The electromagnetic shield refers to shielding between groups with grounded steel plates.



3.7.2 Ground

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

- **Signal ground system (SG)**
  The signal ground (SG) supplies the reference voltage (0V) of the electrical signal system.
- **Frame ground system (FG)**
  The frame ground system (FG) is used for safety, and suppressing external and internal noises. In the frame ground system, the frames, cases of the units, panels, and shields for the interface cables between the units are connected.
- **System ground system**
  The system ground system is used to connect the frame ground systems connected between devices or units with the ground.

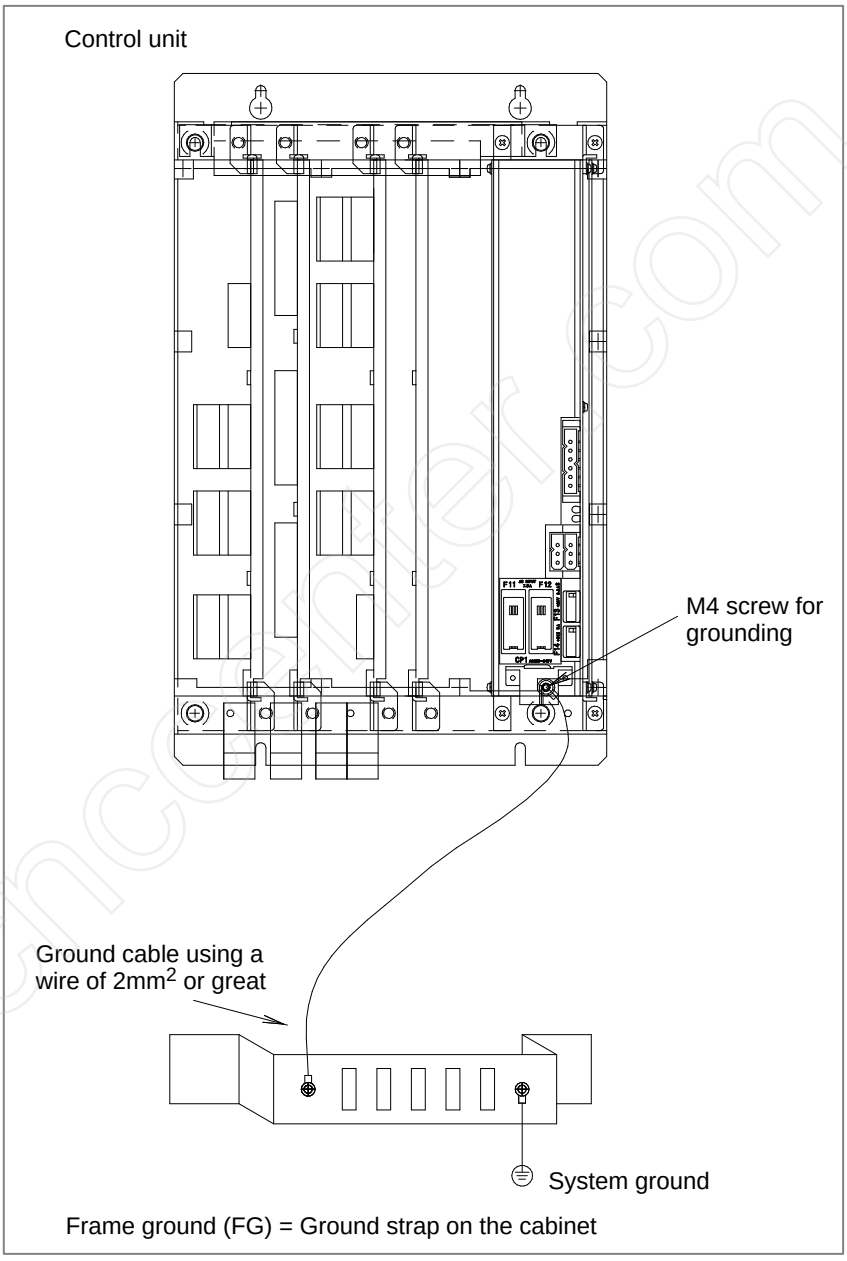


Notes on connecting the ground systems

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

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

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



NOTE
The construction of the printed board is an example and that may be changed by machine type.

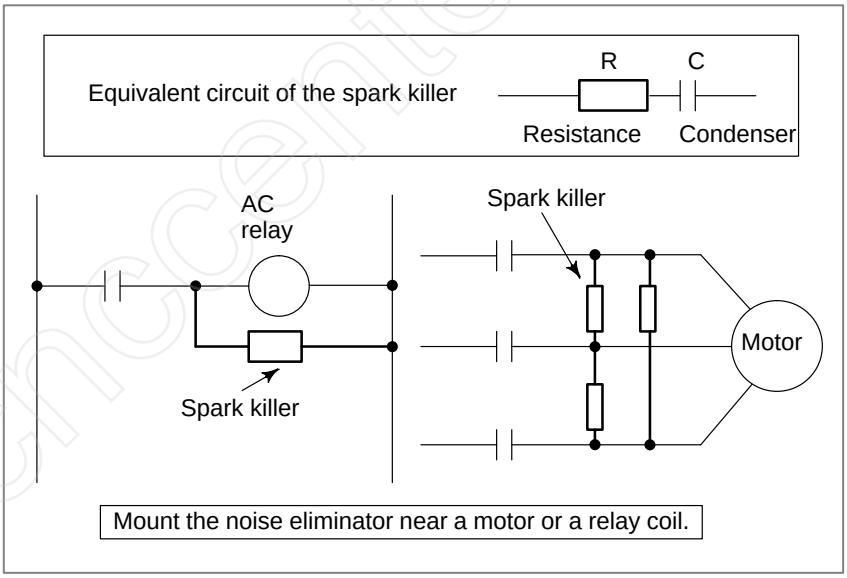
3.7.4 Noise Suppressor

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

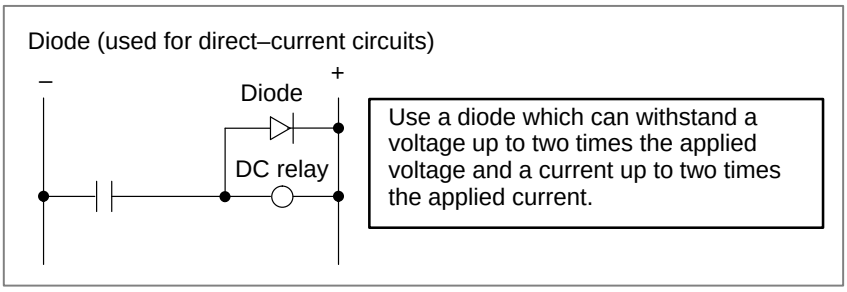
Notes on selecting the spark killer

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

     I : Current at stationary state of the coil



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



3.7.5 Cable Clamp and Shield Processing

The CNC cables that require shielding should be clamped by the method shown below. This cable clamp treatment is for both cable support and proper grounding of the shield. To insure stable CNC system operation, follow this cable clamp method.
Partially peel out the sheath and expose the shield. Push and clamp by the plate metal fittings for clamp at the part. The ground plate must be made by the machine tool builder, and set as follows :

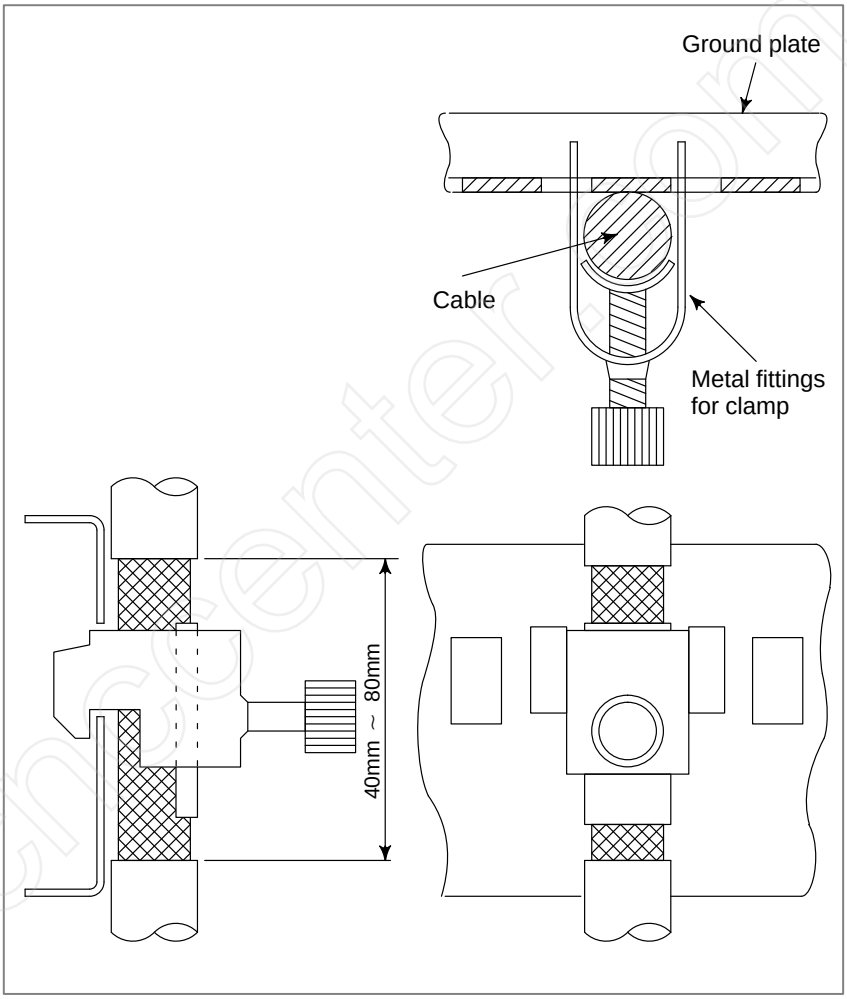


Fig. 3.7.5(a) Cable clamp (1)

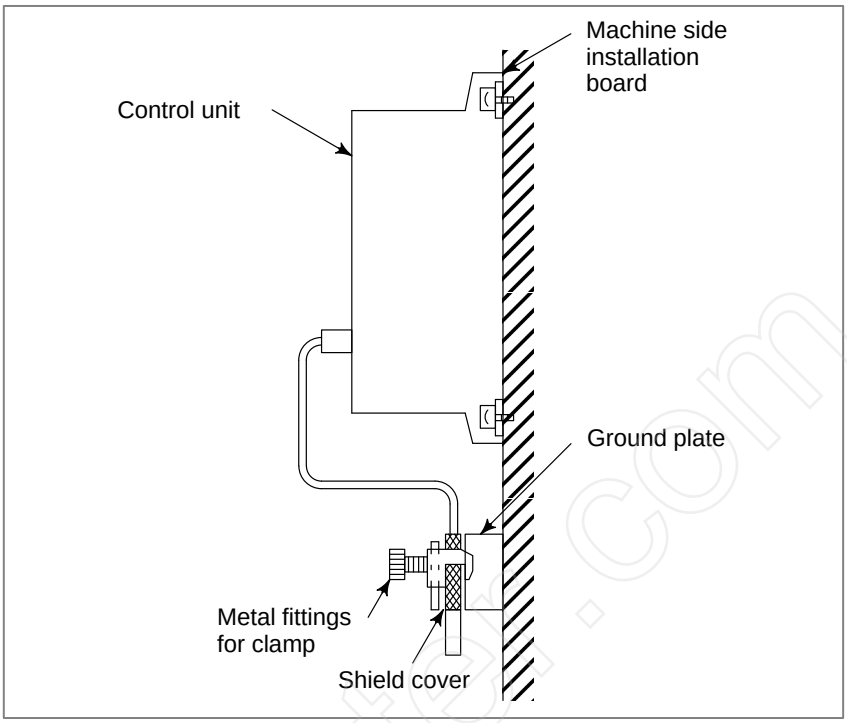


Fig. 3.7.5(b) Cable clamp (2)

Prepare ground plate like the following figure.

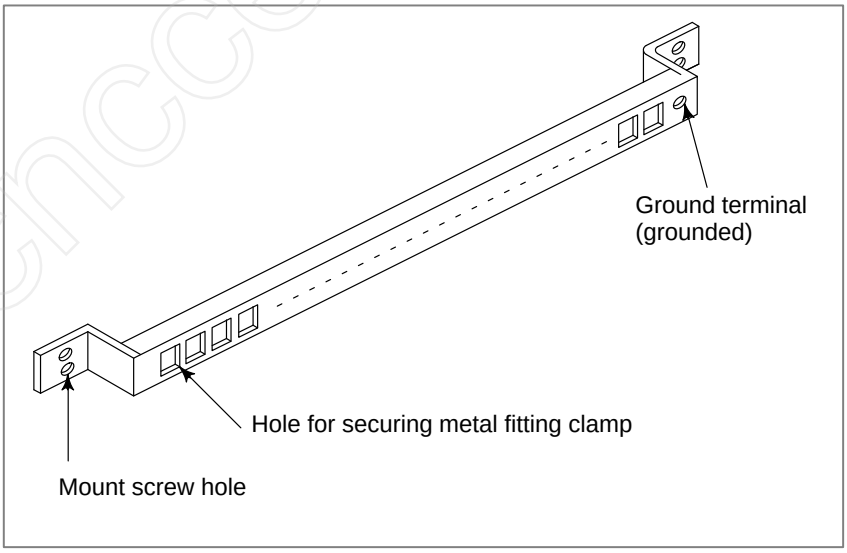


Fig. 3.7.5(c) Ground plate

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

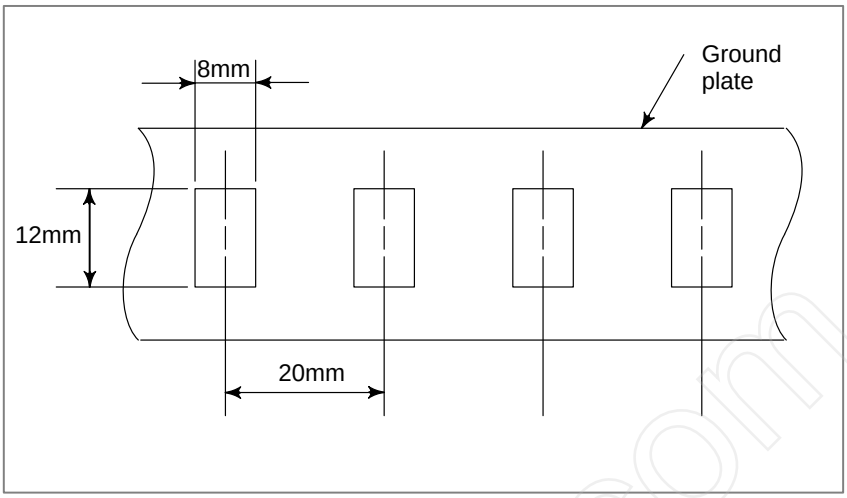


Fig. 3.7.5(d) Ground plate holes

(Reference) Outer drawings of metal fittings for clamp.

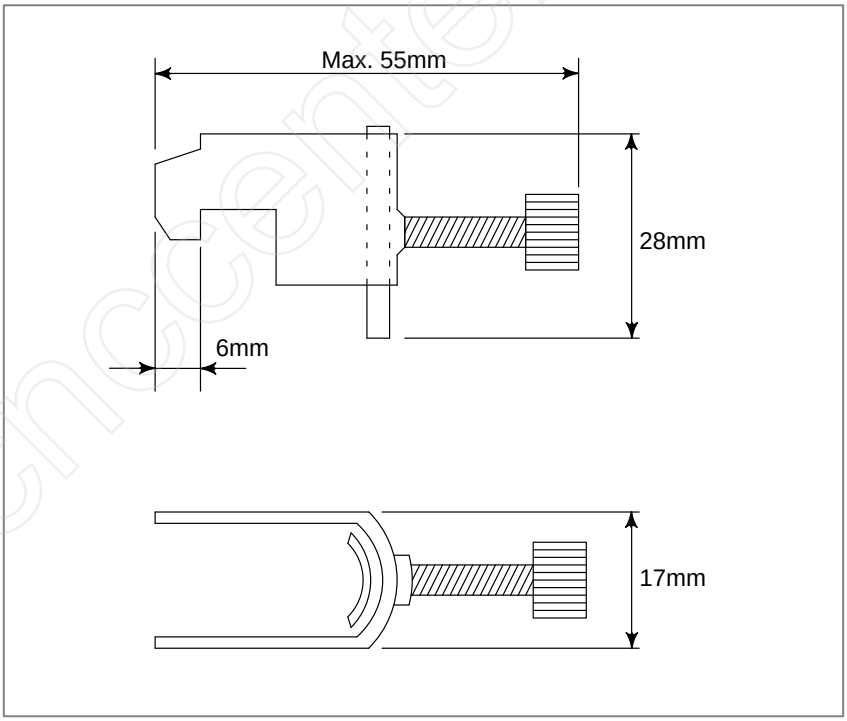


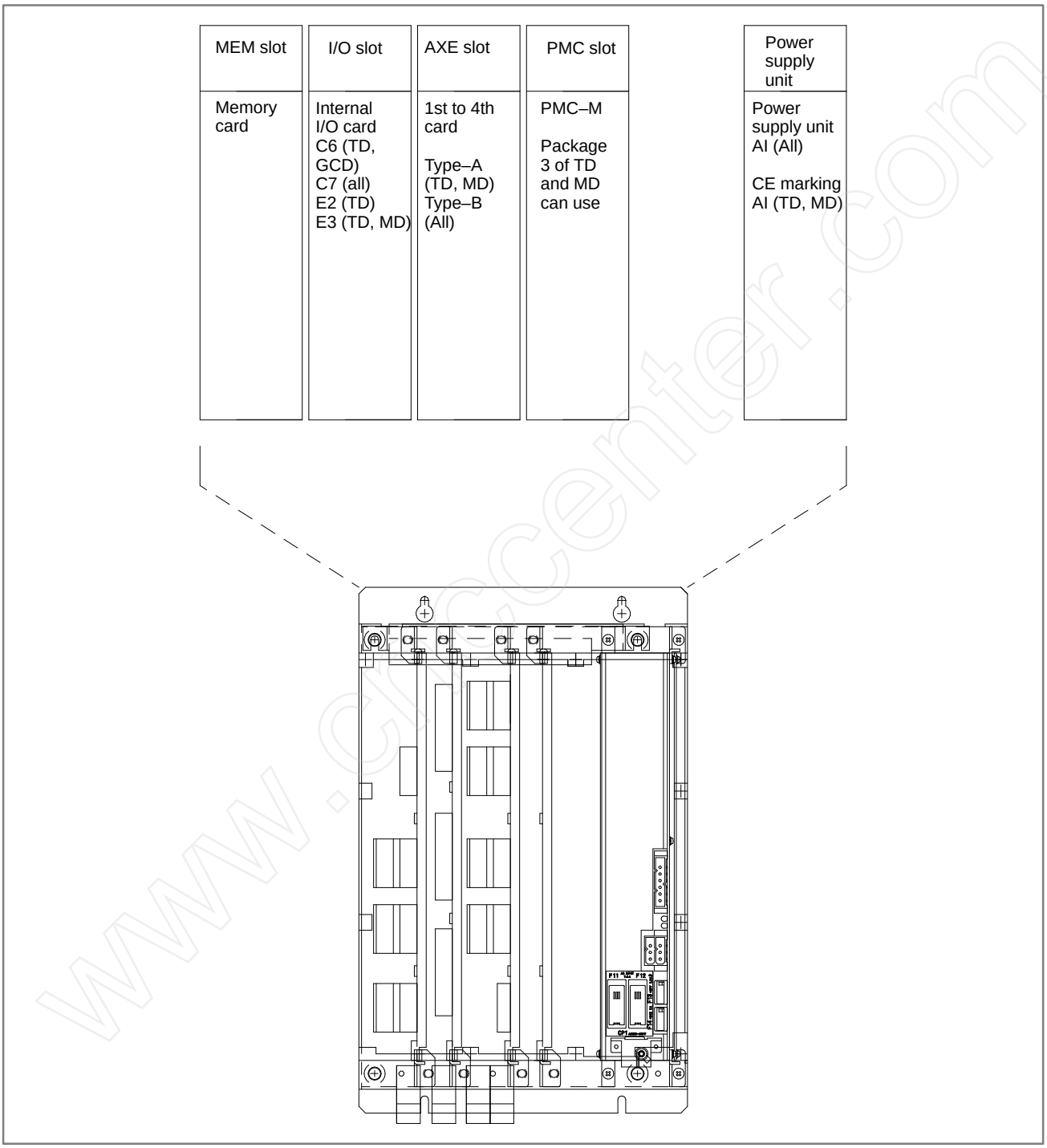
Fig. 3.7.5(e) Outer drawings of metal fittings for clamp

Ordering specification for metal fittings for clamp
A02B–0083–K301 (5 pieces)

3.8 CONTROL UNIT

3.8.1 Configuration of the Control Unit

Each control P.C.B. of Series 0–D is mounted in the slot as follows. Available series is in parenthesis.



NOTE
Connection position of this figure are depended on each printed board.

3.8.2 Battery for Memory Backup

Part programs, offset data, and system parameters are stored in CMOS memory in the control unit.

The program stored in the memory of the control unit is kept after power is cut off. Alcalic electric cells (single × 3 cells) are used for this function. The unit accommodating the dry cells is the battery unit. The cells must be periodically exchanged to new cells once a year at the user's. When exchanging the cells, the power must be always on. (If the cells are removed when the power is off, the parameters and programs stored in the memory goes out.)

The NC is delivered to the machine tool builder with the battery unit set temporarily, so that it should be reset in the cabinet designed at the machine tools builder. Take notes on the following, and reset the battery unit at the cabinet surface. If the machine is delivered to the users with the battery unit still temporarily set, the battery will not be able to be exchanged at the user's, resulting in a fatal maintenance problem.

1) The battery must be able to changed easily with the power on, at the user's side.
2) The battery unit must be away from coolant and chips.

When the voltage of the battery becomes low, alarm message "BAT" blinks on the CRT display and the battery alarm signal is output to the PMC. When this alarm is displayed, replace the battery as soon as possible. In general, the battery can be replaced within one or two weeks, however, this depends on the system configuration.
If the voltage of the battery becomes any lower, memory can no longer be backed up. Turning on the power to the control unit in this state causes system alarm 910 (SRAM parity alarm) to occur because the contents of memory are lost. Clear the entire memory and reenter data after replacing the battery.

The power to the control unit must be turned on when the battery is replaced. If the battery is disconnected when the power is turned off, the contents of memory are lost.

Mounting the battery case

Each control unit is factory–equipped with a battery so that the unit can retain the factory–set parameters. Never disconnect the battery while the unit is turned off, therefore. Mount the battery case containing the battery on the cabinet, by means of the following procedure:

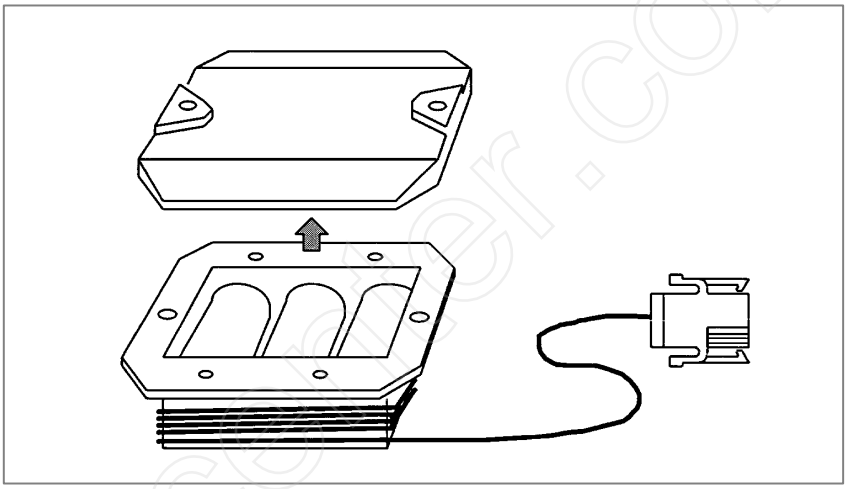
(1) Turn on the control unit.

(2) Leaving the control unit turned on, perform steps 1 to 5:

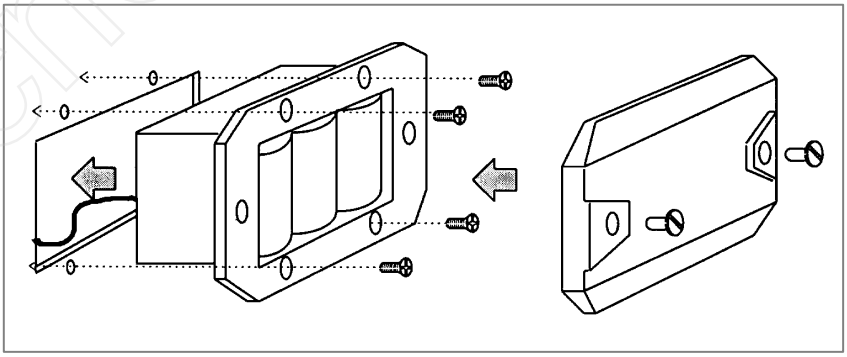
1 Remove the battery connector from the memory PC board.

2 Remove the battery case and cable from the yellow carton. (Discard the carton.)

3 Remove the lid from the battery case, being careful to keep it horizontal so that the screws do not full out.



4 Screw the battery case onto the cabinet at the predetermined mounting position. Replace the lid removed in step 3 and tighten the screws.



5 Reconnect the connector removed in step 1.

Replacing the battery

Procedure for replacing the battery

1 Have commercially available D–size alkaline cells ready for replacement.

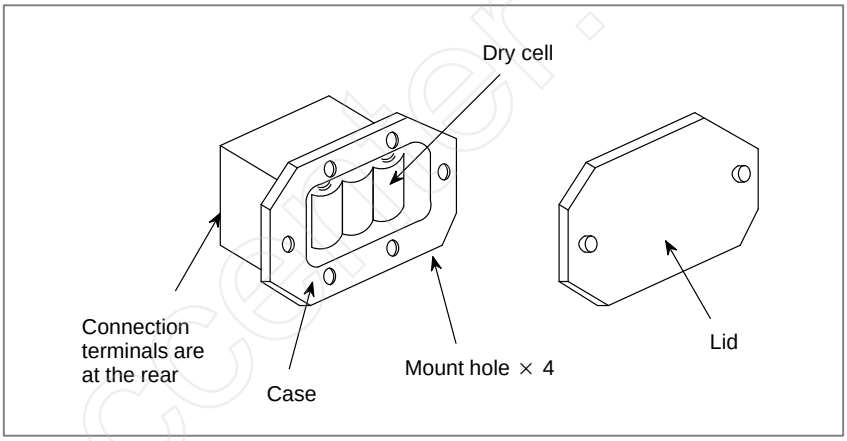
2 Turn on the control unit. Leave the control unit turned on until step 5 is completed.

3 Remove the lid from the battery case.

4 Replace the cells, observing the correct orientation.

5 Replace the lid on the battery case.

6 Turn off the control unit.



3.8.3 Cable Lead–in Diagram

Following diagram shows the grid of connector location.
Control board may not have all connectors as shown above.
For actual connector layout of each board, please see the connector layout diagrams next page or later.

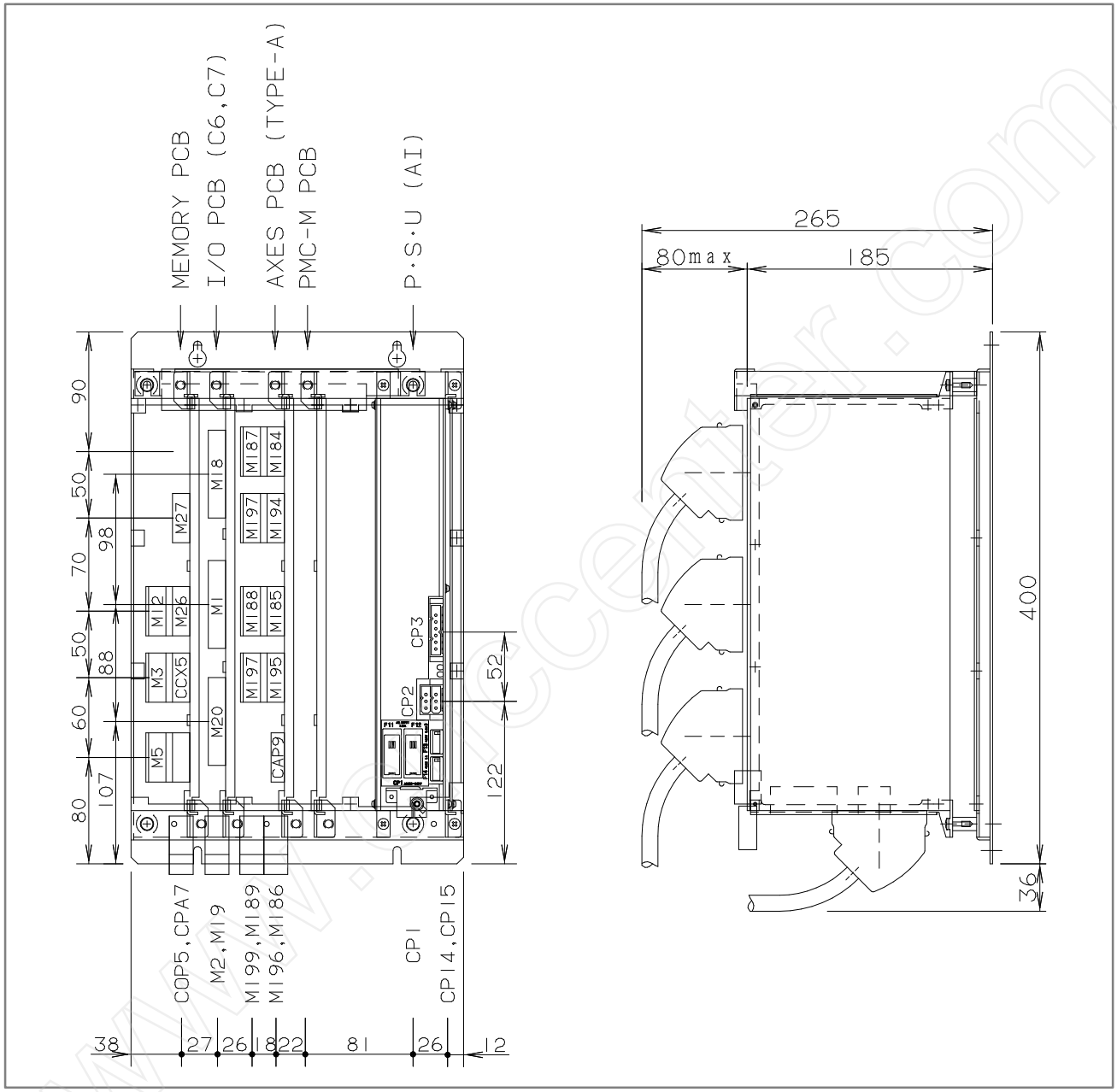


Fig. 3.8.3 (a) Cable lead–in diagram (Type–A axis card, power supply unit AI is mounting)

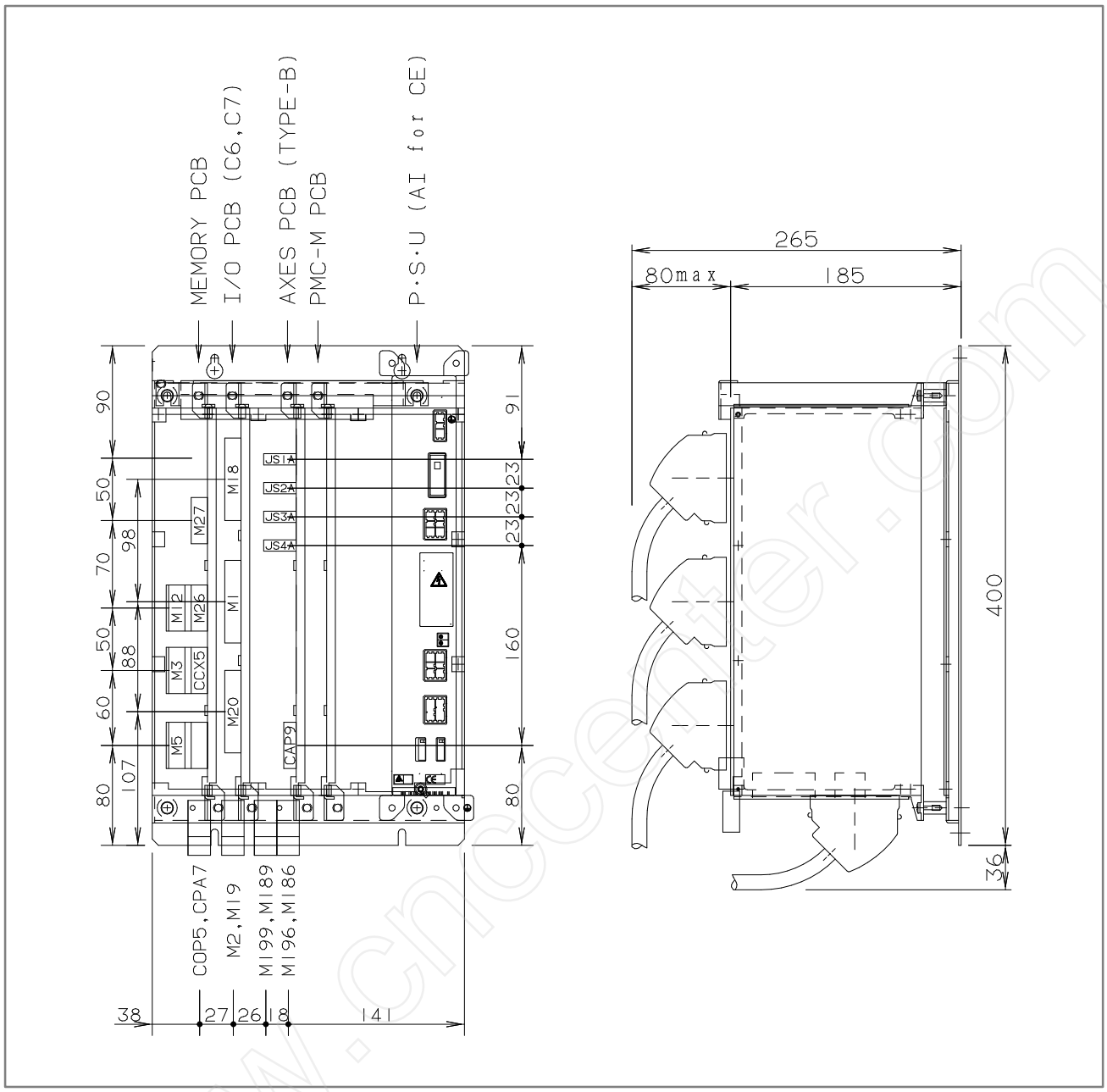
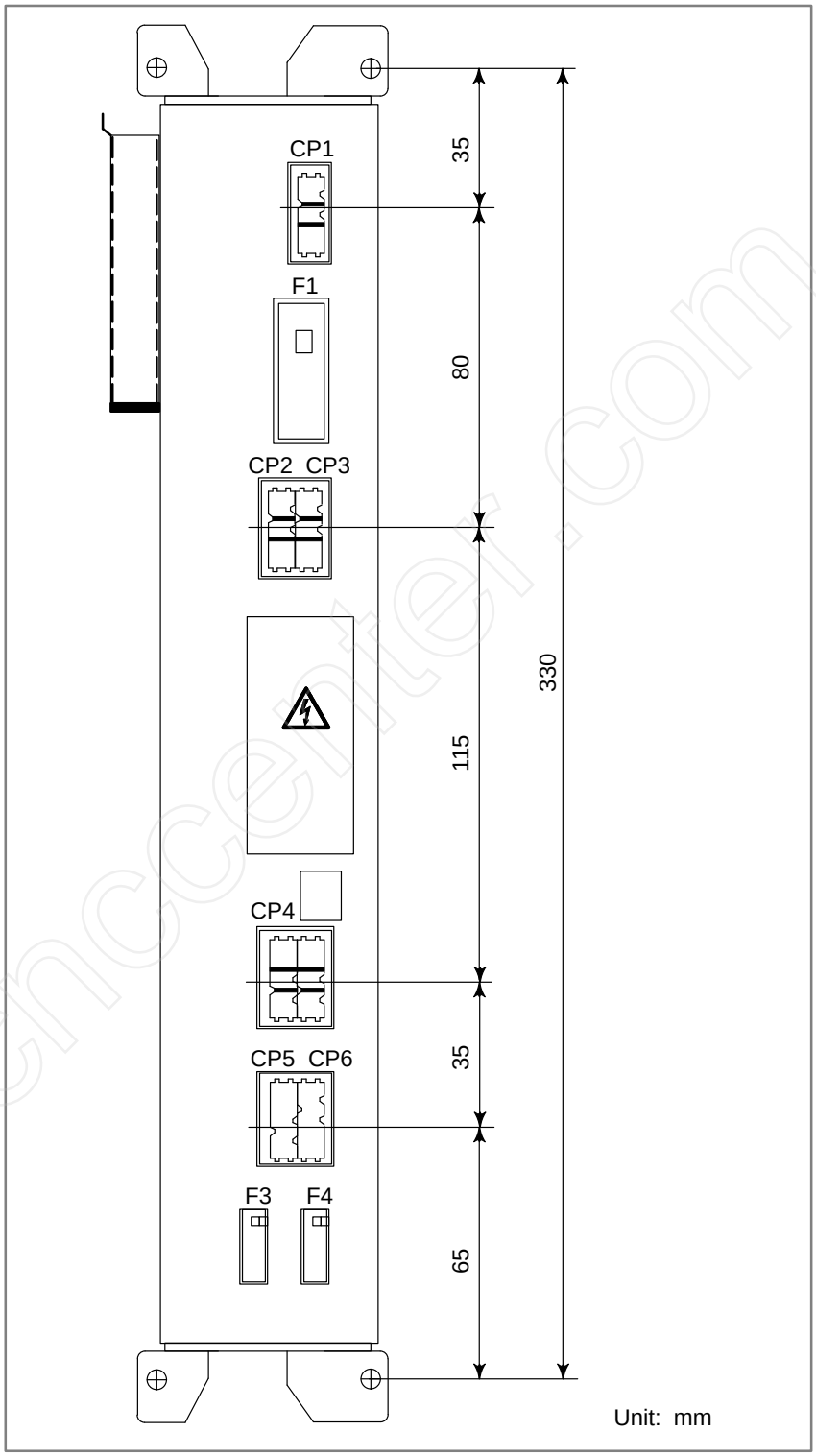


Fig. 3.8.3 (b) Cable lead–in diagram (Type–B axis card, power supply unit AI for CE marking is mounting)

Connector layout of power supply unit for CE marking



4 COMPLETE CONNECTION DIAGRAM

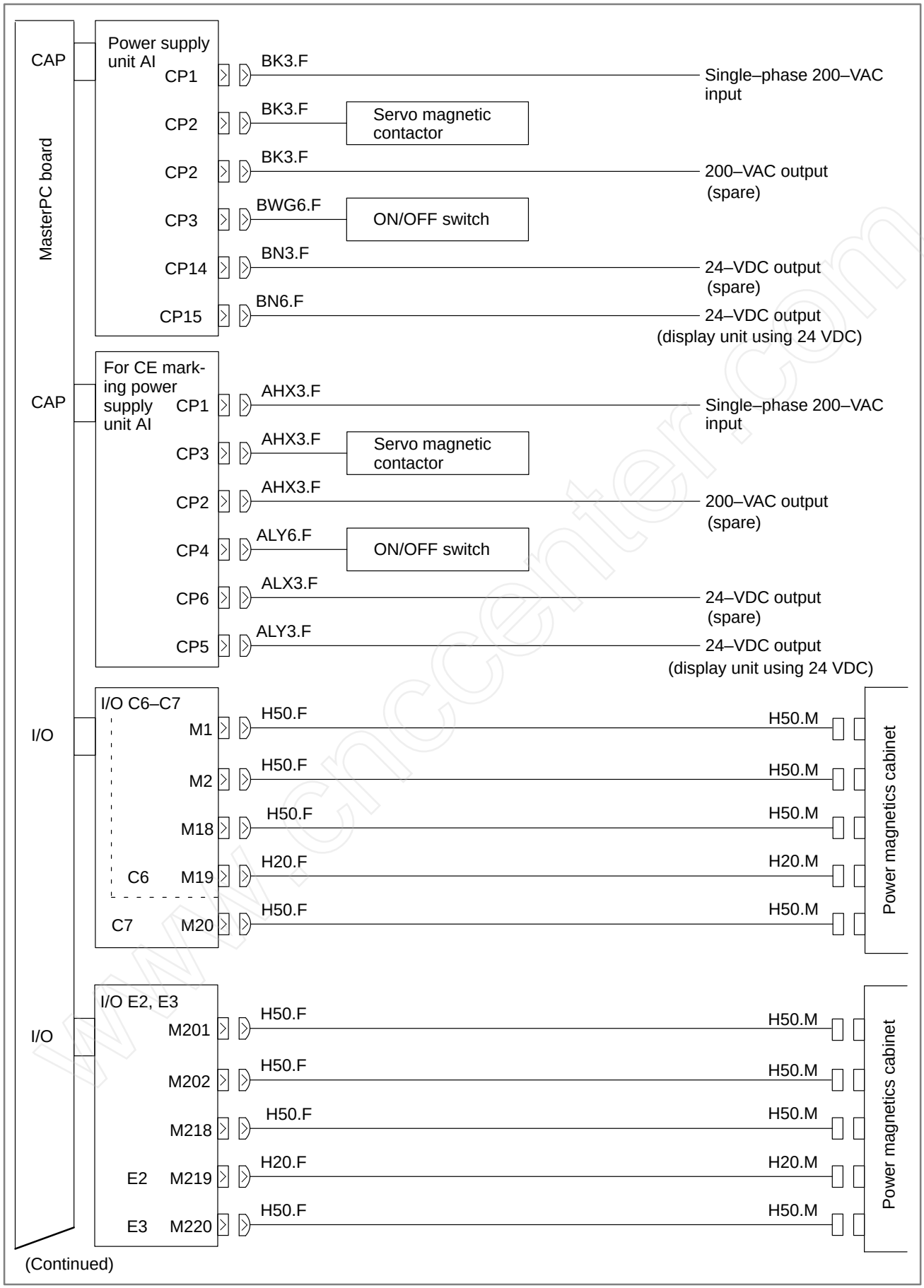
4.1 PRECAUTIONS

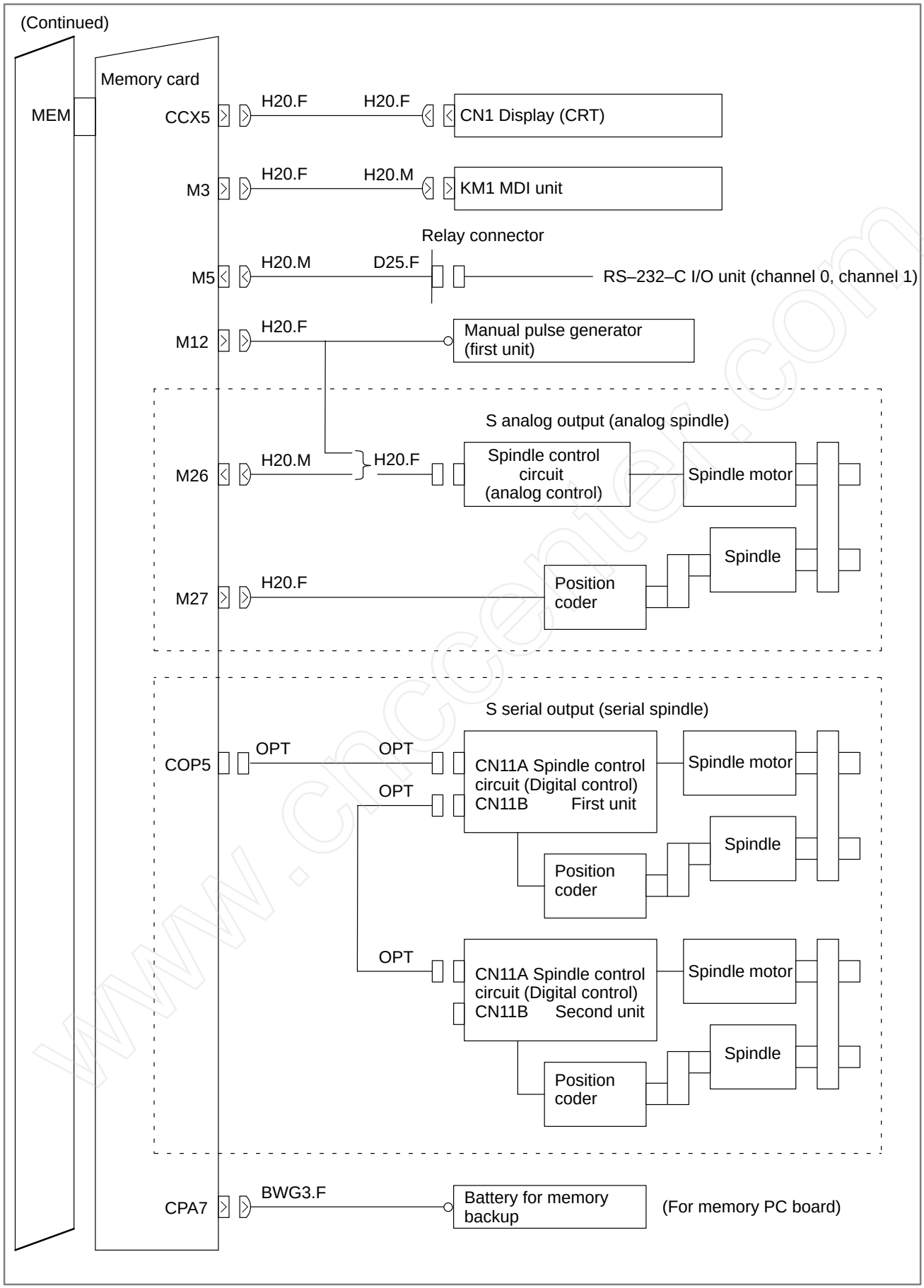
The complete connection diagram shows examples of connecting all PC boards that can fit into the slots of the master PC board. Some slots can accept two or more PC boards which are connected to different devices. This drawing shows two or more identical slot names, but actual individual slots on the master PC board have different names. See the connection of each slot according to the PC board to be fitted into the slot.

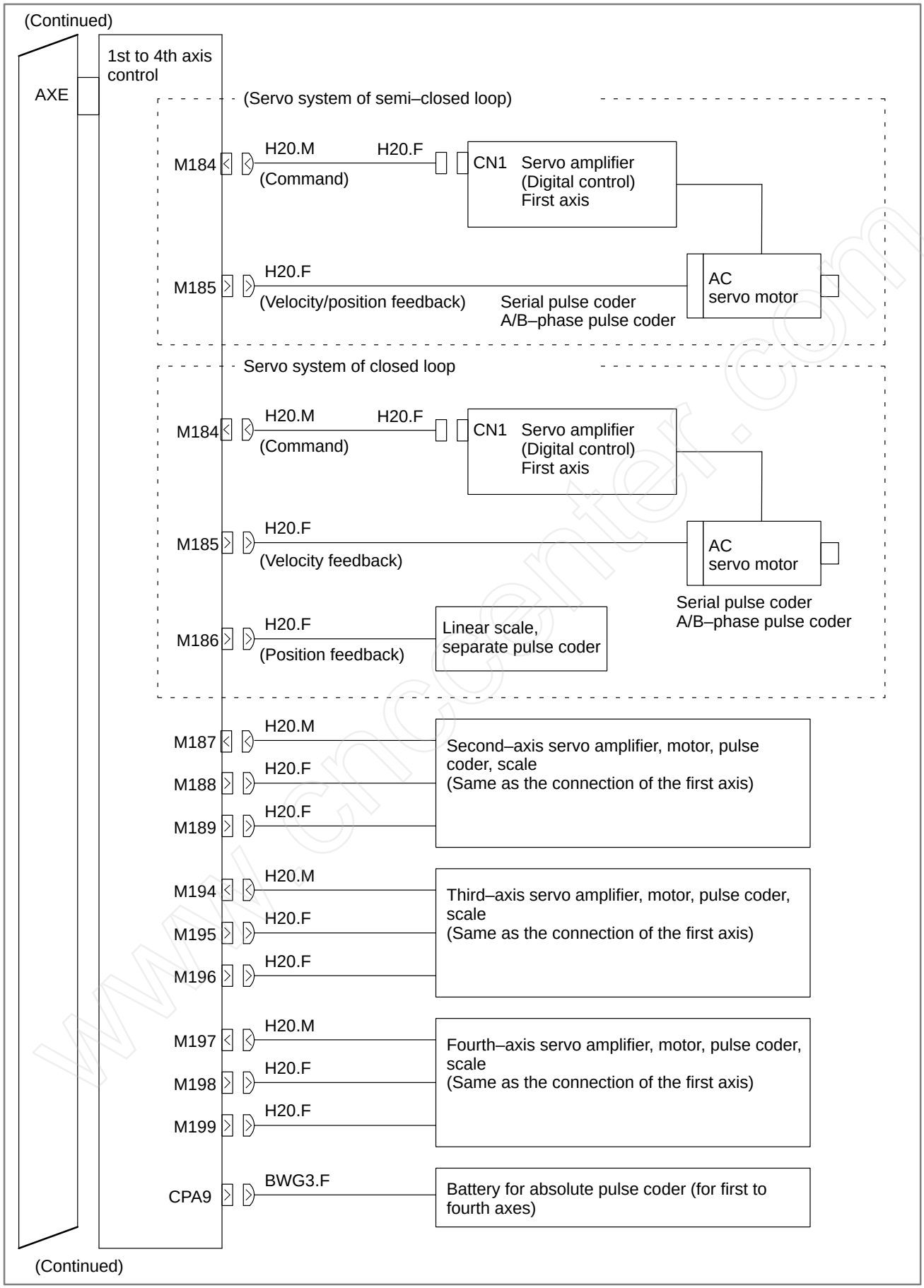
The diagram shows the connection of all PC boards that can be fitted into the slots. In the actual unit, the PC boards to be mounted are determined by the model and optional functions. Note that all the PC boards shown in the diagram are not always mounted.

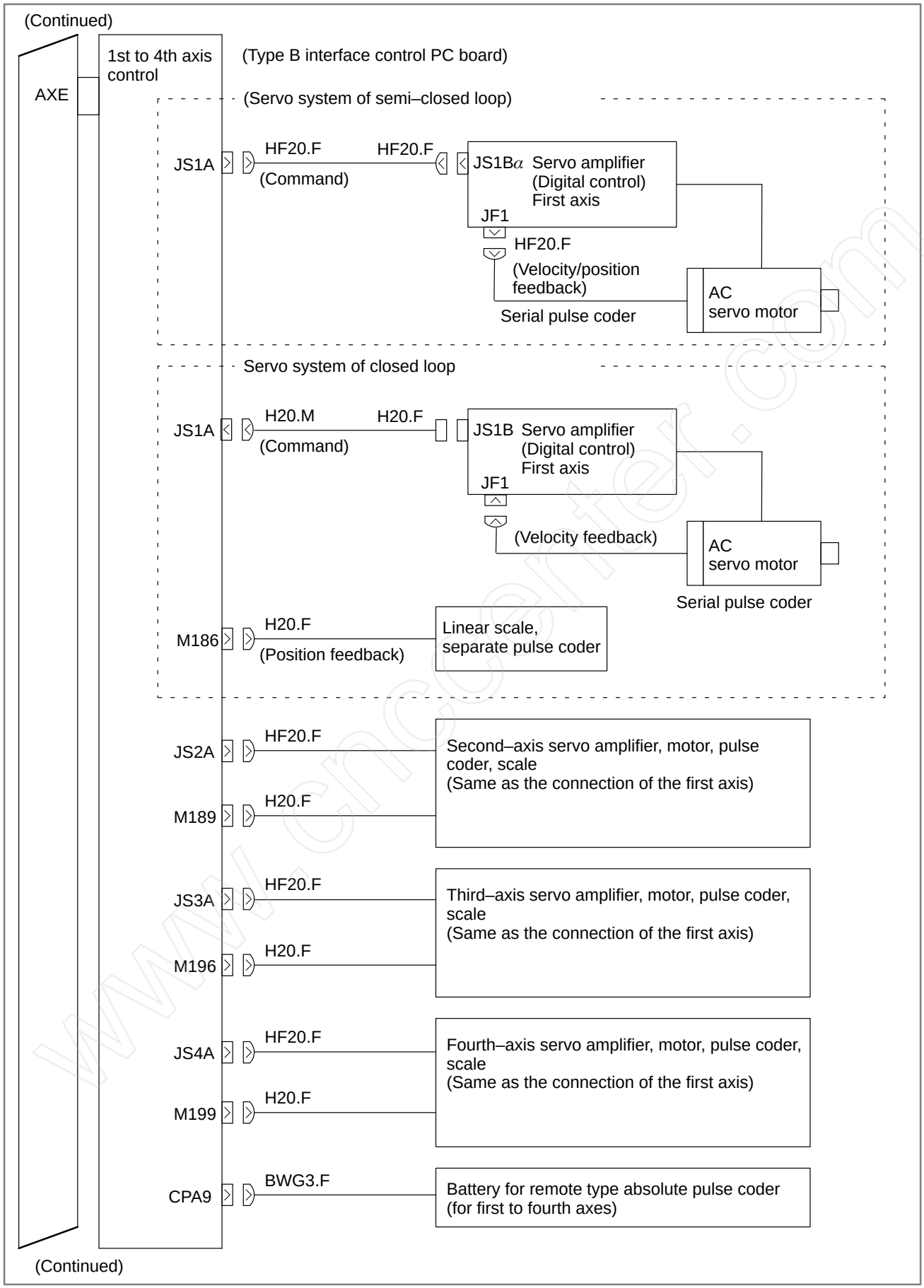
Table of connector marks

Mark	Machine maker	Specifications
BK3. F	NIPPON FCI (old name is Nippon Burndy)	3 Pins, Black, Female
BWG3. F	NIPPON FCI (old name is Nippon Burndy)	3 Pins, White (metalic), Female
BWG6. F	NIPPON FCI (old name is Nippon Burndy)	6 Pins, White (metalic), Female
BN3. F	NIPPON FCI (old name is Nippon Burndy)	3 Pins, Brown, Female
BN6. F	NIPPON FCI (old name is Nippon Burndy)	6 Pins, Brown, Female
BK6. F	NIPPON FCI (old name is Nippon Burndy)	6 Pins, Black, Female
AHX3. F	AMP	3 Pins, Black, For high voltage, X type, Female
ALY6. F	AMP	6 Pins, Black, For low voltage, Y type, Female
ALX3. F	AMP	3 Pins, Black, For low voltage, X type, Female
ALY3. F	AMP	3 Pins, Black, For low voltage, Y type, Female
H20. M	HONDA TSUSHIN	20 Pins, MR connector 20 pins, Male
H20. F	HONDA TSUSHIN	20 Pins, MR connector 20 pins, Female
H50. M	HONDA TSUSHIN	50 Pins, MR connector 50 pins, Male
H50. F	HONDA TSUSHIN	50 Pins, MR connector 50 pins, Female
HF20. F	HONDA TSUSHIN etc.	20 Pins, Half pitch connector 20 pins, Female
D25. F		Connector, Female
OPT		Optical connector

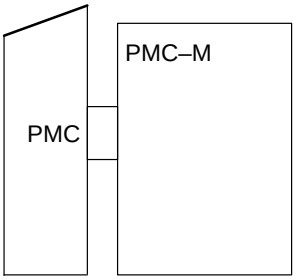








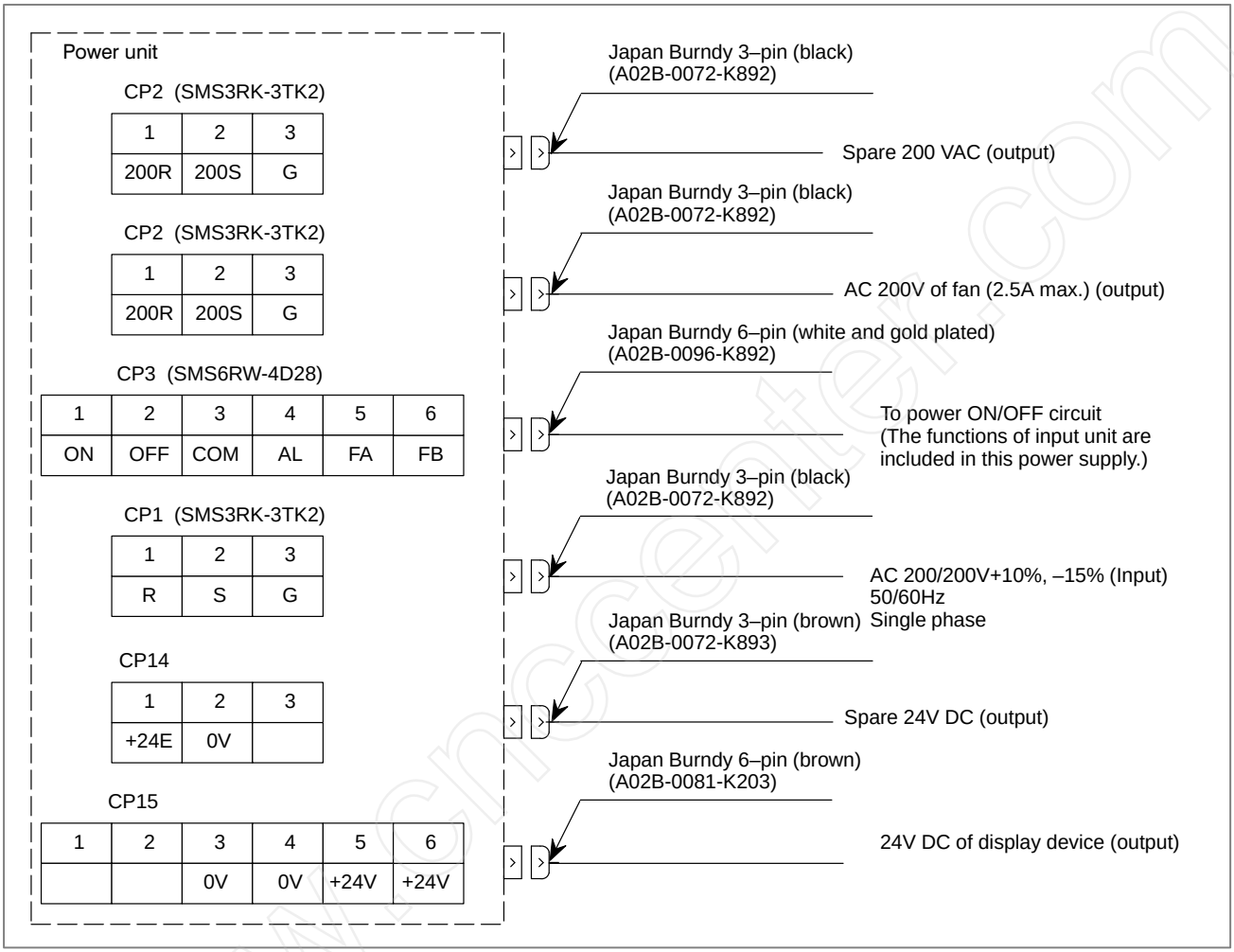
(Continued)



*Both Package 3 of 0–TD and 0–MD can use only.

5 POWER SUPPLY UNIT

5.1 CONNECTION OF INPUT UNIT BUILT–IN TYPE POWER UNIT (POWER SUPPLY UNIT AI)



1) Interface

CP3 : SMS6RW-4D28

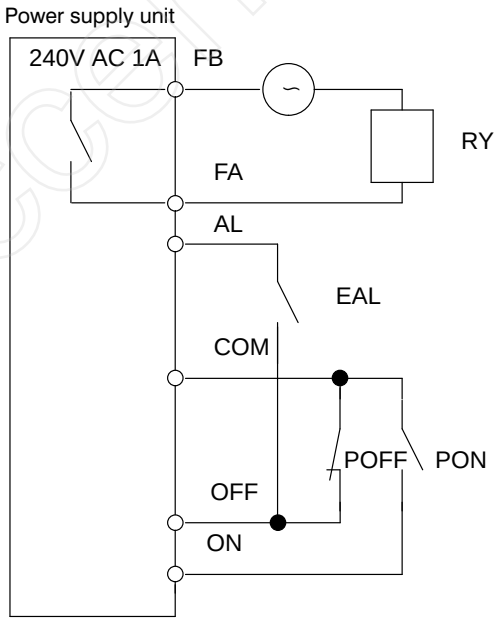
1	2	3	4	5	6
ON	OFF	COM	AL	FA	FB

ON
OFF
COM
— Power ON/OFF contact signal input

AL — External alarm contact signal input
When an alarm occurs in any place other than this power supply unit, the contact signal from outside allows this power supply to be turned off.
When the contact EAL is closed in the circuit described in 2) the power output is turned off and the red ALM lamp located at the front panel of power supply unit lights up.
In this status, no power supply can be turned on by closing the contact PON .Open the contact POFF and cancel the alarm.
The external alarm contact signal input should be open in normal status.

FA
FB
— Power supply alarm contact signal output
When a fuse is blown and an alarm occurs, these contact signal outputs are closed. On the other hand, they are open in normal status. The alarm display and cancel method are the same as those of external alarm contact signal input above.

2) Connection example



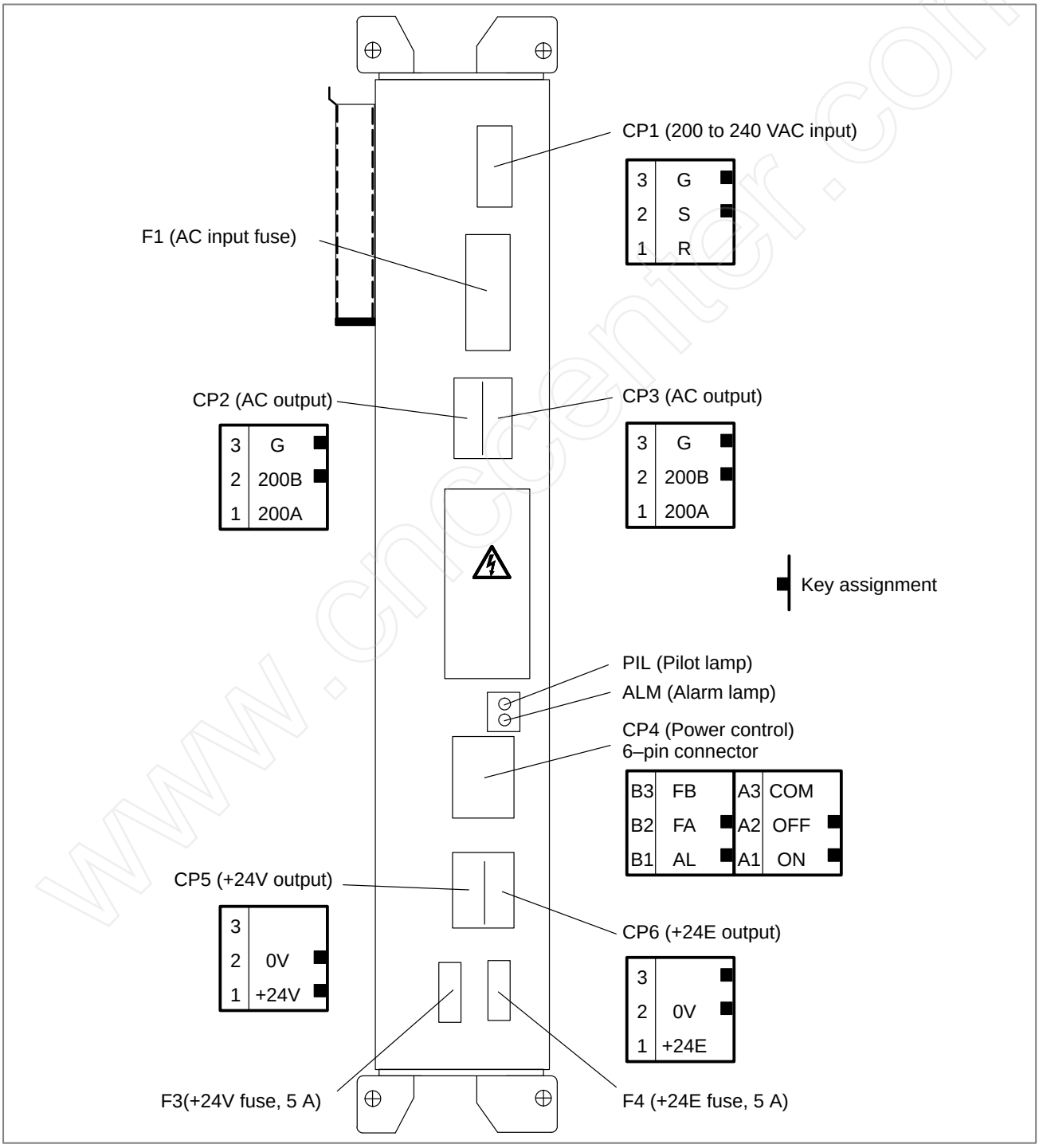
PON : Power–on switch.
POFF: Power–off switch.
EAL : External alarm contact thermostat, power alarm of external unit
RY : It is operated by the NC power alarm.

NOTE
1 Neither EAL nor RY is used in general system.
2 The contact capacity of PON, POFF, and EAL is as shown below:
50V DC 0.1A

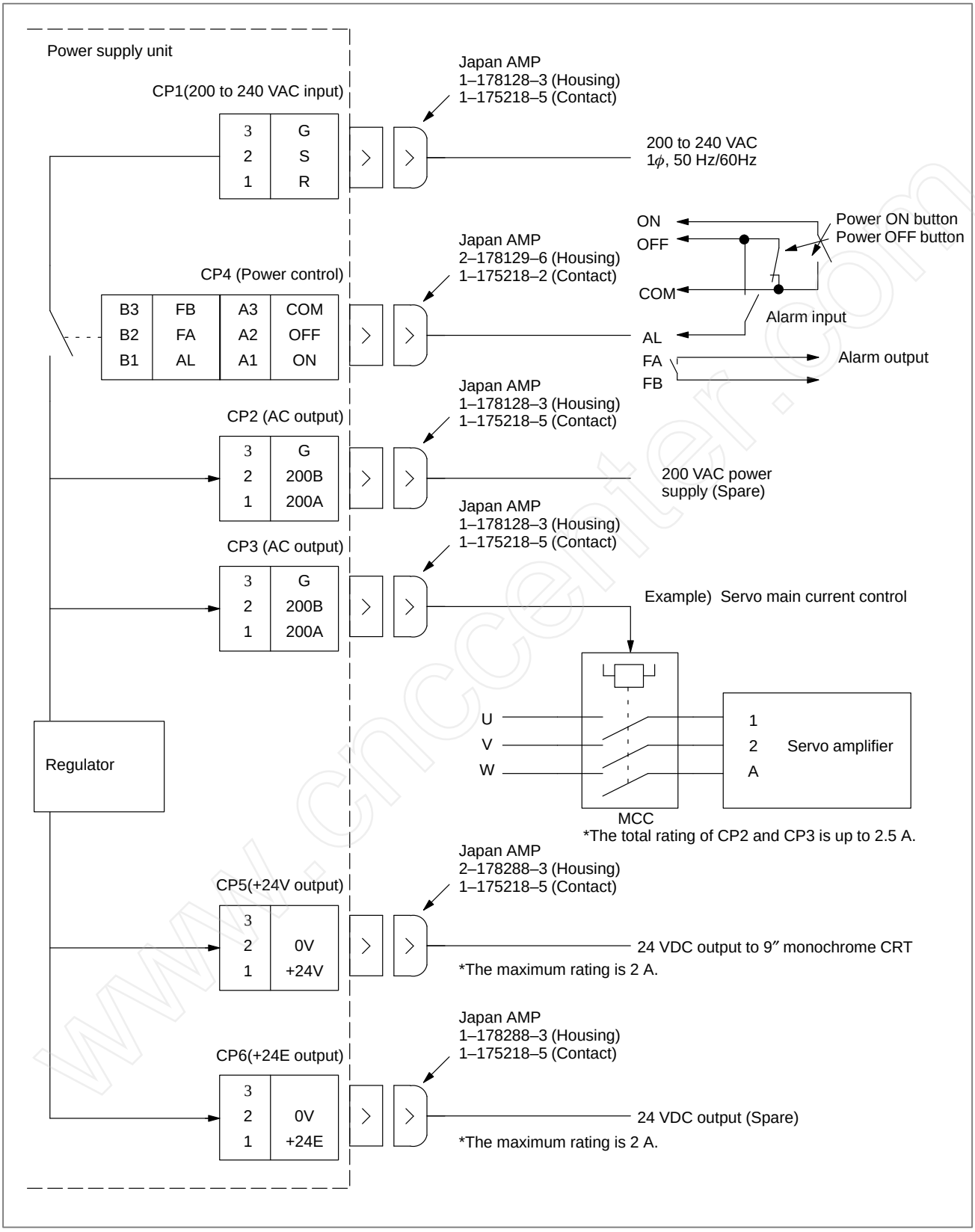
5.2 CONNECTION OF THE INPUT UNIT BUILT–IN POWER SUPPLY UNIT AI (QUALIFYING FOR CE MARKING)

This unit can be used in Series 0–TD and 0–MD.

- **Signal assignment**



● Connection diagram



- **Notes on using a power supply unit certified as conforming to safety standards**

The power supply unit indicated below is certified as conforming to DIN VDE 0160 (German safety standard for power supplies) by TÜV Rhineland.

- Certified power supply unit

  A16B–1212–0950

- Operating requirements

  1) The cabinet to house the power supply unit must be of protection class IP54 or higher.
  2) An isolating transformer or surge absorber must be configured in the previous stage of the input power of the power supply unit. Without the isolating transformer or surge absorber, the power supply unit must not be connected to a factory power line.
  3) The power supply unit must be housed in a metal cabinet. A power supply unit or CNC control unit which is not sufficiently shielded by a metal cabinet may cause electromagnetic interference (EMI).

     This certification does not include certification of conformity to EMI standards.

6 CONNECTION OF MACHINE INTERFACE I/O

6.1 OVERVIEW

The Series 0 is provided with an I/O card as the standard machine interface I/O. The internal I/O card is available in four types, which provide different types of output signals and different numbers of I/O signals.

6.2 CONNECTION OF THE INTERNAL I/O CARD

The internal I/O card is available in max. four types, which have different output signals and different numbers of I/O signals.

The I/O card is decided by the type of series 0.

Table 6.2 Internal I/O cards

	Series 0					Output signal	Number of input signals	Number of output signals	Connector that can be used
	T	M	GS	GC	P				
I/O C6	○	×	×	○	×	Sink output	80	56	M1, M2, M18, M19
I/O C7	○	○	○	×	○		104	72	M1, M2, M18, M19, M20
I/O E2	○	×	×	×	×	DO common output	80	56	M201, M202, M218, M219
I/O E3	○	○	×	×	×		104	72	M201, M202, M218, M219, M220

○: Usable
×: No use

6.2.1 Machine Interface Signal Standard

- **Input signal standard**

(1) Direct current input signal A

The direct current input signal A is the signals transmitted form the machine tool to the CNC; the signals from the buttons, limit switches, relay contracts, or the proximity switches.

(a) The contracts of the machine tools side must satisfy the following conditions.

Capacity of the contracts:
30 VDC, 16mA or more
Leak current between contacts when circuit is open:
1 mA or less (26.4 V voltage)
Voltage fall between contacts when circuit is closed:
2 V or less (8.5 mA current) (including voltage fall of cables)

If the contact cannot obtain a sufficient voltage drop of less than 2V between contacts when closed by such as a 2–line type adjacent switch, if the delay time of the input signal stipulated in Fig. 6.2.1(b) is allowed to extend to a maximum of 30 ms, a voltage drop of less than 3.5V between contacts when closed (current less than 8.5 mA, 1 including voltage drop of cable) can also be used. However, a unit in which operation is guaranteed at a current of 4 mA must be used.

(b) The receiver circuit of this signal is as Fig. 6.2.1 (a).
The time standard of this signal is of Fig. 6.2.1 (b).

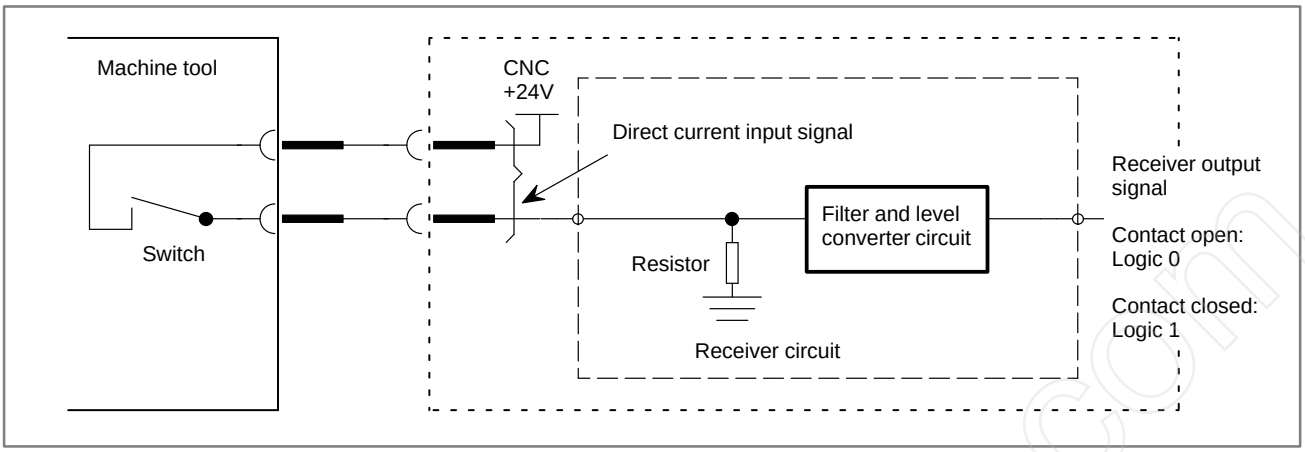


Fig. 6.2.1 (a) Receiver circuit

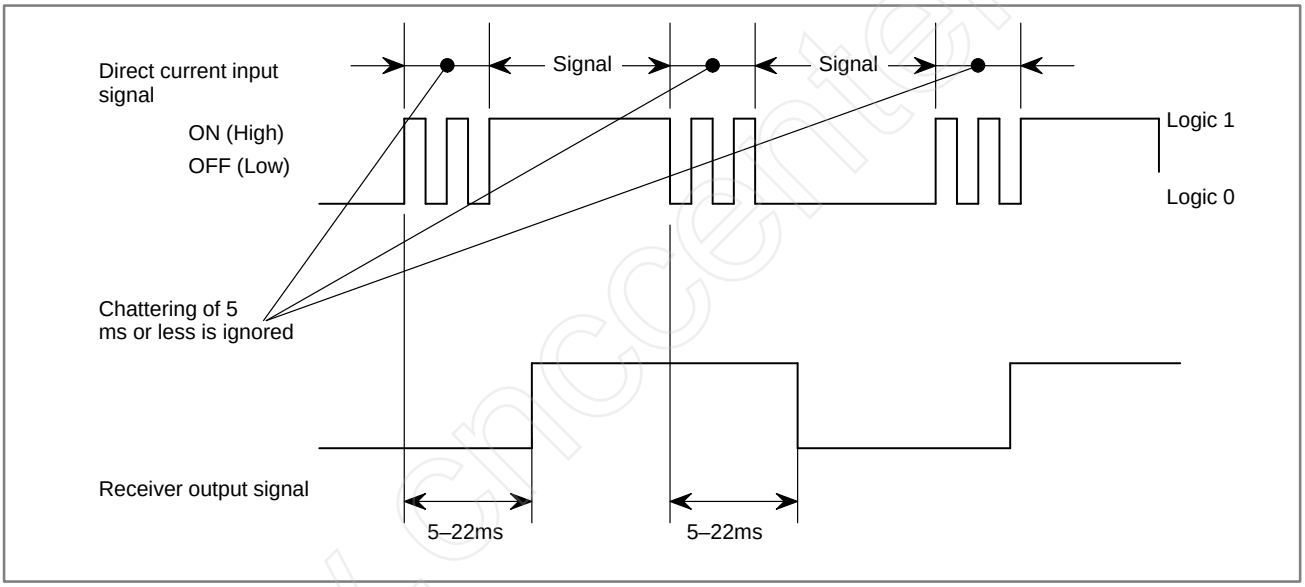


Fig. 6.2.1 (b) Width of input signals and delay time

(2) Direct current input signal B

The direct current input signal B is the signals transmitted from the machine tool to the NC in high speed.

(a) The contracts of the machine tool side must satisfy the following conditions.

Capacity of the contracts:
30VDC, 16mA or more
Leak current between contacts when circuit is open:
1 mA or less (26.4 V voltage)
Voltage fall between contacts when circuit is closed:
2 V or less (8.5 mA current)
(including voltage fall of cables)

(b) The receiver circuit of this signal is as Fig. 6.2.1 (c).

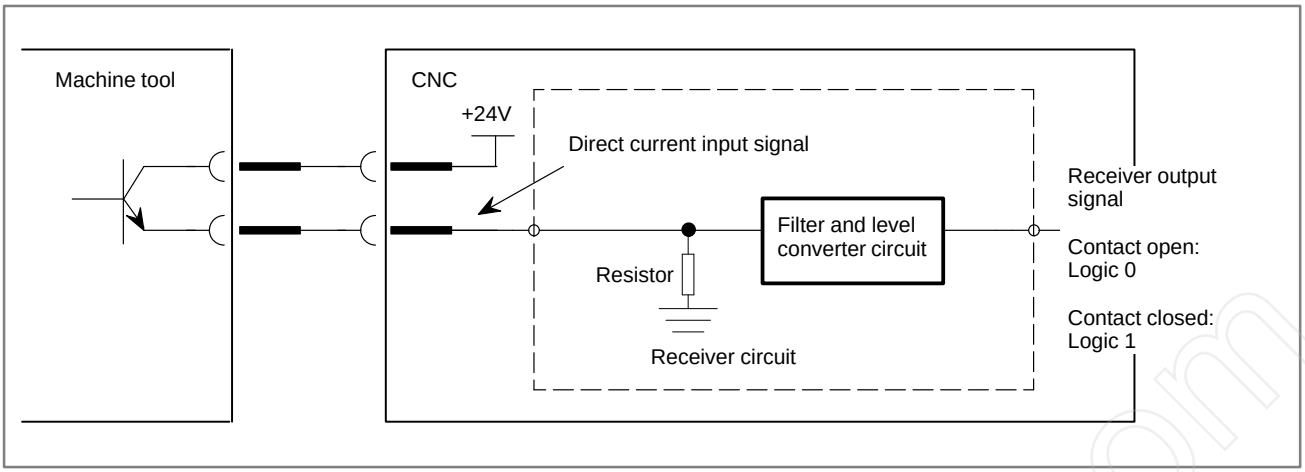


Fig. 6.2.1 (c) Receiver circuit

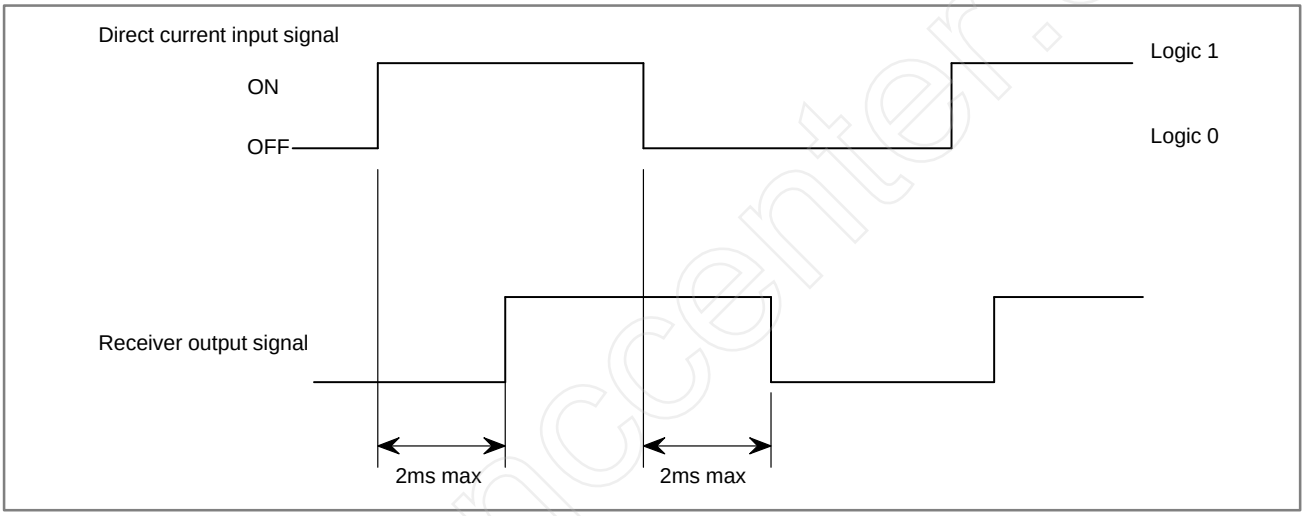


Fig. 6.2.1 (d) Width of input signals and delay time

(3) Selection of common line

There are two types of direct current input signal. Fig. 6.2.1 (c) shows a sample connection for the first type: an input signal fixed to the sink input. Fig. 6.2.1 (e) or Fig. 6.2.1 (f) shows a sample connection for the second type: an input signal which can be set to either sink input or source input according to the wiring in the machine.

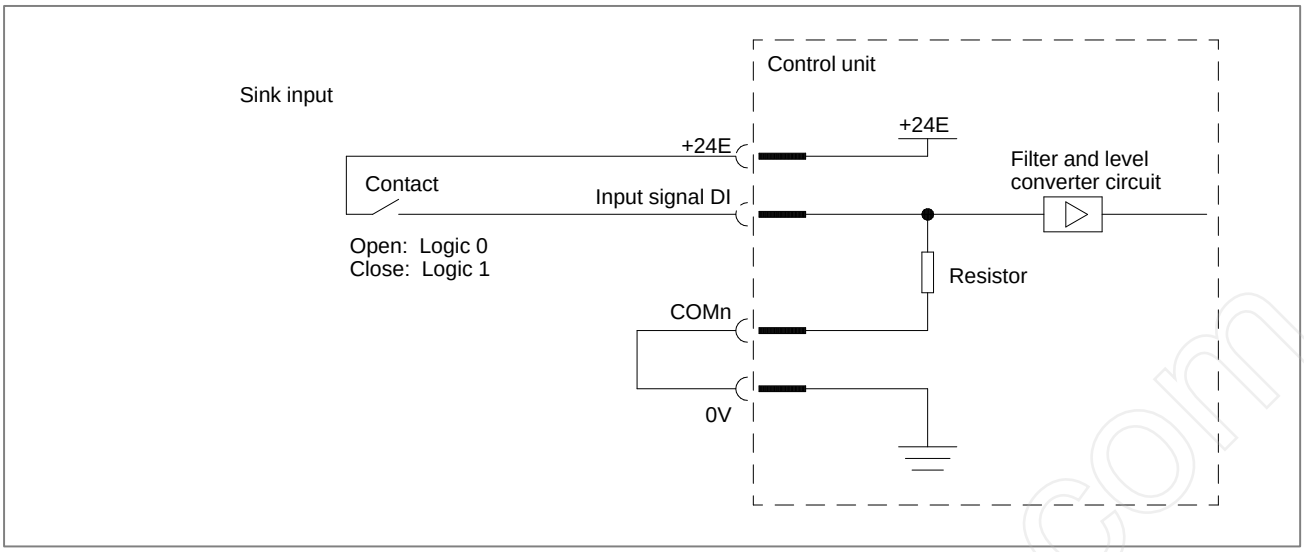


Fig. 6.2.1 (e)

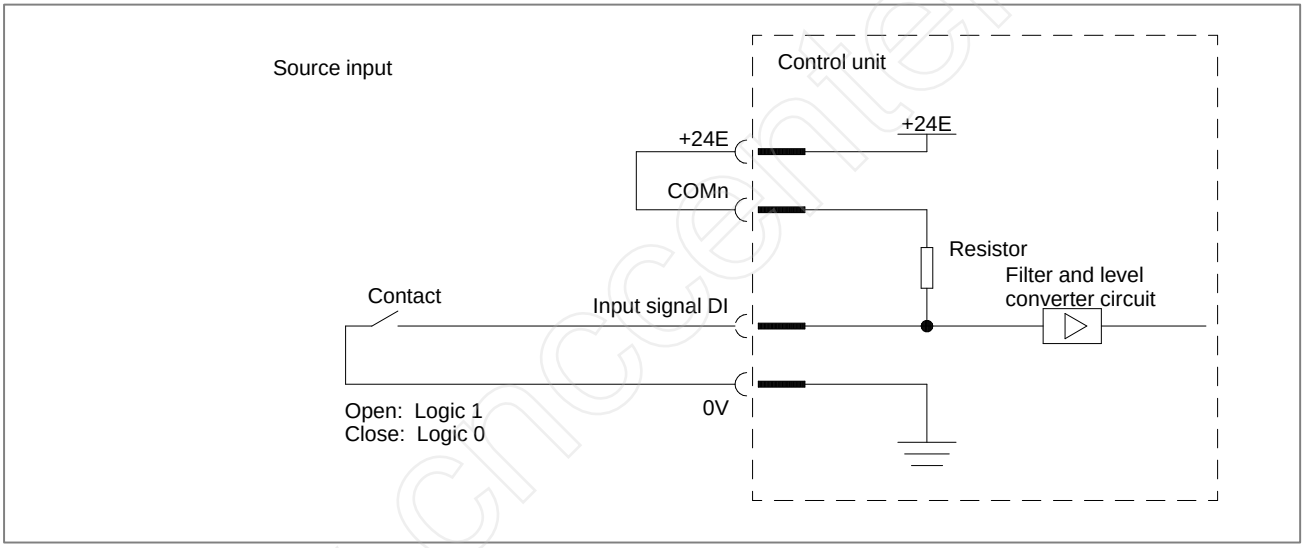


Fig. 6.2.1 (f)

- **Output signal standard**

A direct current output signal is used to drive a light emitting diode (LED) indicator or a relay of a machine. For the direct current output signal, a non–insulation interface (direct current output signal A) and a DO common output interface (direct current output signal B) are supported. The non–insulation interface uses an NPN transistor as a driver, while the DO common output interface uses a semiconductor contact.

(1) Direct current output signal A

(a) Rating of the output transistor

(i) Maximum load current when the output is on

Up to 200 mA, including an instantaneous value

(ii) Saturation voltage when the output is on

1.6 Vmax, 1.0 Vtyp at a load current of 200 mA

(iii) Withstand voltage when the output is off

Up to 24 V +20%, including an instantaneous value

(iv)Leakage current when the output is off

Up to 100 μA

(b) Output circuit

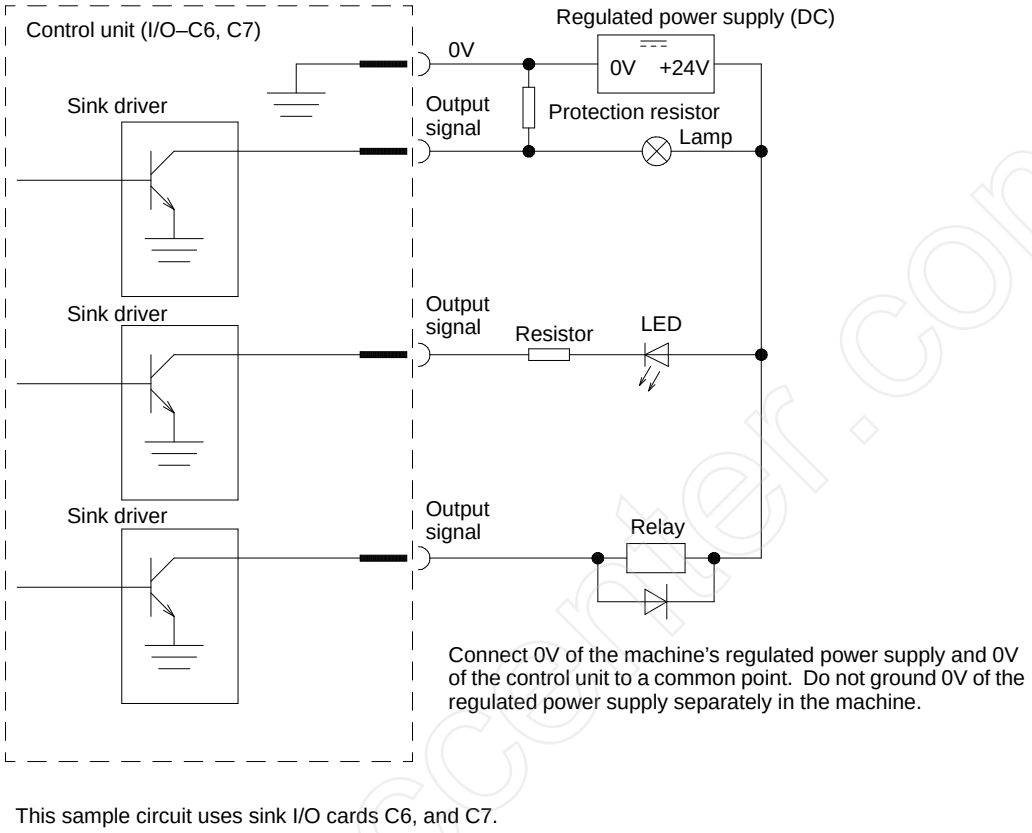


Fig. 6.2.1 (g)

NOTE

1 When connecting inductive loads like relays in the machine tool side, a spark killer must be inserted. The spark killer must also be inserted as near as possible (within 20 cm) to the load. When connecting capacitance load in the machine tool side, a resistance for current limit must be inserted in series, and it must be used within the rated current and voltage, including instantaneous current and voltage.

2 When lighting a lamp directly with a solid state relay output, a rush current may flow to damage the driver. A protection circuit as below must be inserted and it must be used within the rated voltage and current, including instantaneous current and voltage.

(2) Direct current output signal B

(a)Driver ratings

(i) Maximum load current when the output is on

Up to 250 mA, including an instantaneous value

(ii)Maximum voltage drop when the output is on

6 I_L (volt)

where I_L is a load current

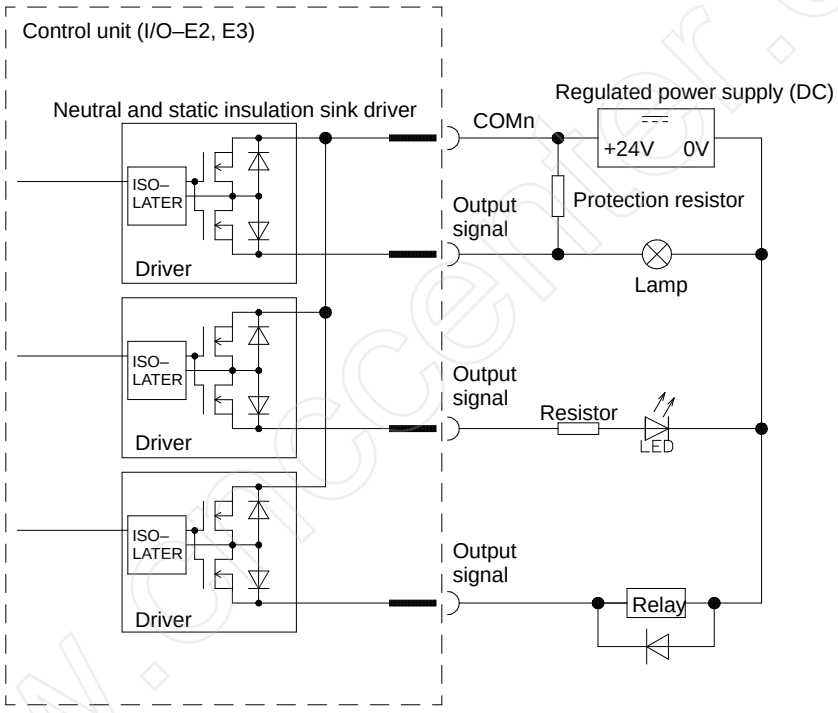
(Example) When I_L is 250 mA, 6 I_L = 6 × 0.25 = 1.5 (V)

(iii)Withstand voltage when the output is off

Up to 50 V, including an instantaneous value

(iv)Leakage current when the output is off

Up to 100 μA



This sample circuit uses I/O cards E2, and E3 as a source DO. The voltage of the regulated power supply can be adjusted from 24 to 48 VDC. The polarity of the regulated power supply is inverted when the I/O card is used as a sink DO. In this case, the orientation of the LED and surge suppression diode must be inverted.

Fig. 6.2.1 (h)

NOTE

1 When connecting inductive loads like relays in the machine tool side, a spark killer must be inserted. The spark killer must also be inserted as near as possible (within 20 cm) to the load. When connecting capacitance load in the machine tool side, a resistance for current limit must be inserted in series, and it must be used within the rated current and voltage, including instantaneous current and voltage.

2 When lighting a lamp directly with a solid state relay output, a rush current may flow to damage the driver. A protection circuit as below must be inserted and it must be used within the rated voltage and current, including instantaneous current and voltage.

6.2.2 System without PMC

- **Signal assignment of the internal I/O card**

The figure below shows the signal assignment of the internal I/O card. The CNC for 0–MD, 0–GSD (M series) systems and that for 0–TD, 0–GCD (T series) systems use different signals.

NOTE
The Series 0–PD always requires a PMC. See Subsection 6.2.5 for an explanation of the machine interface I/O connection for the Series 0–PD.

(1) M–series signals

(a) Signals input from the machine to the CNC (system without PMC)

PMC ADDRESS	DGN NO.	BIT NUMBER #7	#6	#5	#4	#3	#2	#1	#0	M Series
X000	000									
		M18–36	M18–21	M18–5	M18–35	M18–20	M18–34	M18–19	M18–33	
X002	002									
		M18–24	M18–8	M18–38	M18–23	M18–7	M18–37	M18–22	M18–6	
X004	004	4NG								
		M18–11	M18–41	M18–26	M18–10	M18–40	M18–25	M18–9	M18–39	
X006	006									
		M18–45	M18–14	M18–44	M18–13	M18–43	M18–12	M18–42	M18–27	
X008	008	SKIP		*RILK			ZAE	YAE	XAE	
		M18–49	M18–18	M18–48	M18–17	M18–47	M18–16	M18–46	M18–15	
X010	010									
		M20–11	M20–41	M20–26	M20–10					
X012	012									
		M20–45	M20–14	M20–44	M20–13	M20–43	M20–12	M20–42	M20–27	
X014	014									
		M20–49	M20–18	M20–48	M20–17	M20–47	M20–16	M20–46	M20–15	
X016	016	HX/ROV1		*DECX		–X	+X	SBK	BDT	
		M1–6		M1–38		M1–20	M1–21	M1–11	M1–12	
X017	017	HY/ROV2		*DECY		–Y	+Y	MLK	*ILK	
		M1–7		M1–39		M1–22	M1–23	M1–9	M1–10	
X018	018	HZ/DRN		*DECZ		–Z	+Z			
		M1–8		M1–40		M1–24	M1–25			
X019	019	H4		*DEC4		–4	+4			
		M20–40		M20–25		M20–9	M20–39			
X020	020	ZRN	*SSTP	SOR	SAR	FIN	ST	MP2	MP1/MINP	
		M1–13	M1–37	M1–5	M1–14	M1–15	M1–16	M1–17	M1–18	
X021	021	ERS	RT	*SP	*ESP	*OV8	*OV4	*OV2	*OV1	
		M1–41	M1–26	M1–27	M1–19	M1–33	M1–34	M1–35	M1–36	
X022	0022	PN8	PN4	PN2	PN1	KEY	MD4	MD2	MD1	
		M1–42	M1–43	M1–44	M1–45	M1–46	M1–47	M1–48	M1–49	

(b) Signals output from the CNC to the machine (system without PMC)

PMC ADDRESS	DGN NO.	BIT NUMBER #7	#6	#5	#4	#3	#2	#1	#0	M Series
Y048	048	OP	SA	STL	SPL		ZPZ/EF	ZPY	ZPX	
		M2–5	M2–6	M2–7	M2–8		M2–27	M2–26	M2–25	
Y049	049	MA			ENB	DEN		RST	AL	
		M2–9			M2–41	M2–22		M2–23	M2–24	
Y050	050			DST		TF	SF		MF	
				M2–10		M2–20	M2–19		M2–21	
Y051	051	M28	M24	M22	M21	M18	M14	M12	M11	
		M2–33	M2–34	M2–35	M2–36	M2–37	M2–38	M2–39	M2–40	
Y052	052	S28	S24	S22	S21	S18	S14/GR30	S12/GR20	S11/GR10	
		M2–11	M2–12	M2–13	M2–14	M2–15	M2–16	M2–17	M2–18	
Y053	053	T28	T24	T22	T21	T18	T14	T12	T11	
		M2–42	M2–43	M2–44	M2–45	M2–46	M2–47	M2–48	M2–49	
Y080	080									
		M19–8	M19–7	M19–6	M19–5	M19–4	M19–3	M19–2	M19–1	
Y082	082									
		M19–16	M19–15	M19–14	M19–13	M19–12	M19–11	M19–10	M19–9	
Y084	084					ZP4				
		M20–36	M20–21	M20–5	M20–35	M20–20	M20–34	M20–19	M20–33	
Y086	086									
		M20–24	M20–8	M20–38	M20–23	M20–7	M20–37	M20–22	M20–6	

(2) T–series signals

(a) Signals input from the machine to the CNC (system without PMC)

PMC ADDRESS	DGN NO.	BIT NUMBER #7	#6	#5	#4	#3	#2	#1	#0	T Series
X000	000									
		M18–36	M18–21	M18–5	M18–35	M18–20	M18–34	M18–19	M18–33	
X002	002									
		M18–24	M18–8	M18–38	M18–23	M18–7	M18–37	M18–22	M18–6	
X004	004									
		M18–11	M18–41	M18–26	M18–10	M18–40	M18–25	M18–9	M18–39	
X006	006									
		M18–45	M18–14	M18–44	M18–13	M18–43	M18–12	M18–42	M18–27	
		SKIP						ZAE	XAE	
X008	008	SKIP			SKIP4	SKIP3	SKIP2	ZAE	XAE	← 0–GCD
		M18–49	M18–18	M18–48	M18–17	M18–47	M18–16	M18–46	M18–15	
X010	010									
		M20–11	M20–41	M20–26	M20–10					

X012	012								
		M20–45	M20–14	M20–44	M20–13	M20–43	M20–12	M20–42	M20–27
X014	014								
		M20–49	M20–18	M20–48	M20–17	M20–47	M20–16	M20–42	M20–15
X016	016	HX/ROV1		*DECX		–X	+X	SBK	BDT
		M1–6		M1–38		M1–20	M1–21	M1–11	M1–12
X017	017	HZ/ROV2		*DECZ		–Z	+Z	MLK	MPI/MINP
		M1–7		M1–39		M1–22	M1–23	M1–9	M1–10
X018	018	DRN		*+LZ		GR2	GR1		
		M1–8		M1–40		M1–24	M1–25		
X019	019	*DEC3		*DEC4					
		M20–40		M20–25		M20–9	M20–39		
X020	020	ZRN	*SSTP	SOR	SAR	FIN	ST	STLK	MIX
		M1–13	M1–37	M1–5	M1–14	M1–15	M1–16	M1–17	M1–18
X021	021	ERS	RT	*SP	*ESP	*OV8	*OV4	*OV2	*OV1
		M1–41	M1–26	M1–27	M1–19	M1–33	M1–34	M1–35	M1–36
X022	022	PN8	PN4	PN2	PN1	KEY	MD4	MD2	MD1
		M1–42	M1–43	M1–44	M1–45	M1–46	M1–47	M1–48	M1–49

(b) Signals output from the CNC to the machine (system without PMC)

PMC ADDRESS	DGN NO.	BIT NUMBER #7	#6	#5	#4	#3	#2	#1	#0 (T Series)
Y048	048	OP	SA	STL	SPL			ZPZ	ZPX
		M2–5	M2–6	M2–7	M2–8		M2–27	M2–26	M2–25
Y049	049	MA			ENB	DEN		RST	AL
		M2–9			M2–41	M2–22		M2–23	M2–24
Y050	050			DST		TF	SF		MF
				M2–10		M2–20	M2–19		M2–21
Y051	051	M28	M24	M22	M21	M18	M14	M12	M11
		M2–33	M2–34	M2–35	M2–36	M2–37	M2–38	M2–39	M2–40
Y052	052	S28	S24	S22	S21	S18	S14	S12	S11
		M2–11	M2–12	M2–13	M2–14	M2–15	M2–16	M2–17	M2–18
Y053	053	T28	T24	T22	T21	T18	T14	T12	T11
		M2–42	M2–43	M2–44	M2–45	M2–46	M2–47	M2–48	M2–49
Y080	080								
		M19–8	M19–7	M19–6	M19–5	M19–4	M19–3	M19–2	M19–1
Y082	082								
		M19–16	M19–15	M19–14	M19–13	M19–12	M19–11	M19–10	M19–9
Y084	084					AP4			
		M20–36	M20–21	M20–5	M20–35	M20–20	M20–34	M20–19	M20–33
Y086	086								
		M20–24	M20–8	M20–38	M20–23	M20–7	M20–37	M20–22	M20–6

6.2.3 Descriptions on Signals

Refer to another function version for the descriptions on signals.

6.2.4 Signal Connection with Power Magnetic Cabinet

Following are signal connection with power magnetic cabinet.

M series power magnetic interface

Control unit

M1(MR–50RMD)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
0V	0V	0V	0V	SOR	HX ROV1	HY ROV2	HZ DRN	MLK	*ILK	SBK	BDT	ZRN	SAR	FIN	ST	MP2	MP1 MINP
	19	20	21	22	23	24	25	26	27	28	29	30	31	32			
	*ESP	–X	+X	–Y	+Y	–Z	+Z	RZ	*SP		+24E	+24E	+24E	+24E			
33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
*OV8	*OV4	*OV2	*OV1	*SSTP	*DECX	*DECY	*DECZ	ERS	PN8	PN4	PN2	PN1	KEY	MD4	MD2	MD1	

M2(MR–50RMD)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
0V	0V	0V	0V	OP	SA	STL	SPL	MA	DST	S28	S24	S22	S21	S18	S14 GR30	S12 GR20	S11 GR10
	19	20	21	22	23	24	25	26	27	28	29	30	31	32			
	SF	TF	MF	DEN	RST	AL	ZPX	ZPY	ZPZ EF								
33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
M28	M24	M22	M21	M18	M14	M12	M11	ENB	T28	T24	T22	T21	T18	T14	T12	T11	

M18(MR–50RMD)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
										4NG				XAE	ZAE		
	19	20	21	22	23	24	25	26	27	28	29	30	31	32			
33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
													YAE		*RILK	SKIP	

M20(MR–50RMD)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
								–4									
	19	20	21	22	23	24	25	26	27	28	29	30	31	32			
		ZP4					*DEC4				CONG						
33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
						+4	H4									SKIP	

J1 J2 J30 J32

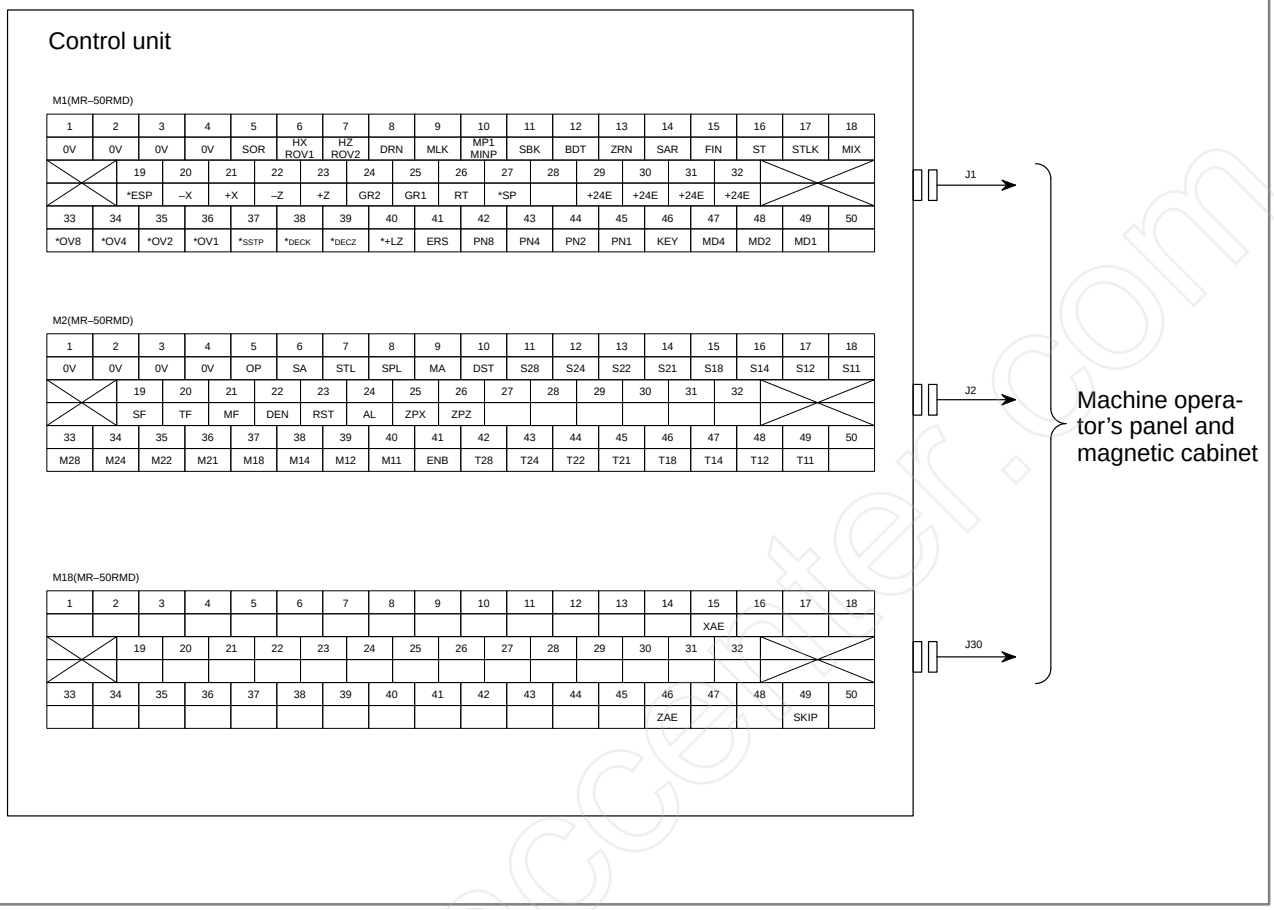
Machine operator's panel and magnetic cabinet

NOTE

Use unified shield cable for signal connection of J1 and J2.

Recommended cable specification A66L–0001–0042 (7/0.18 50 cores)

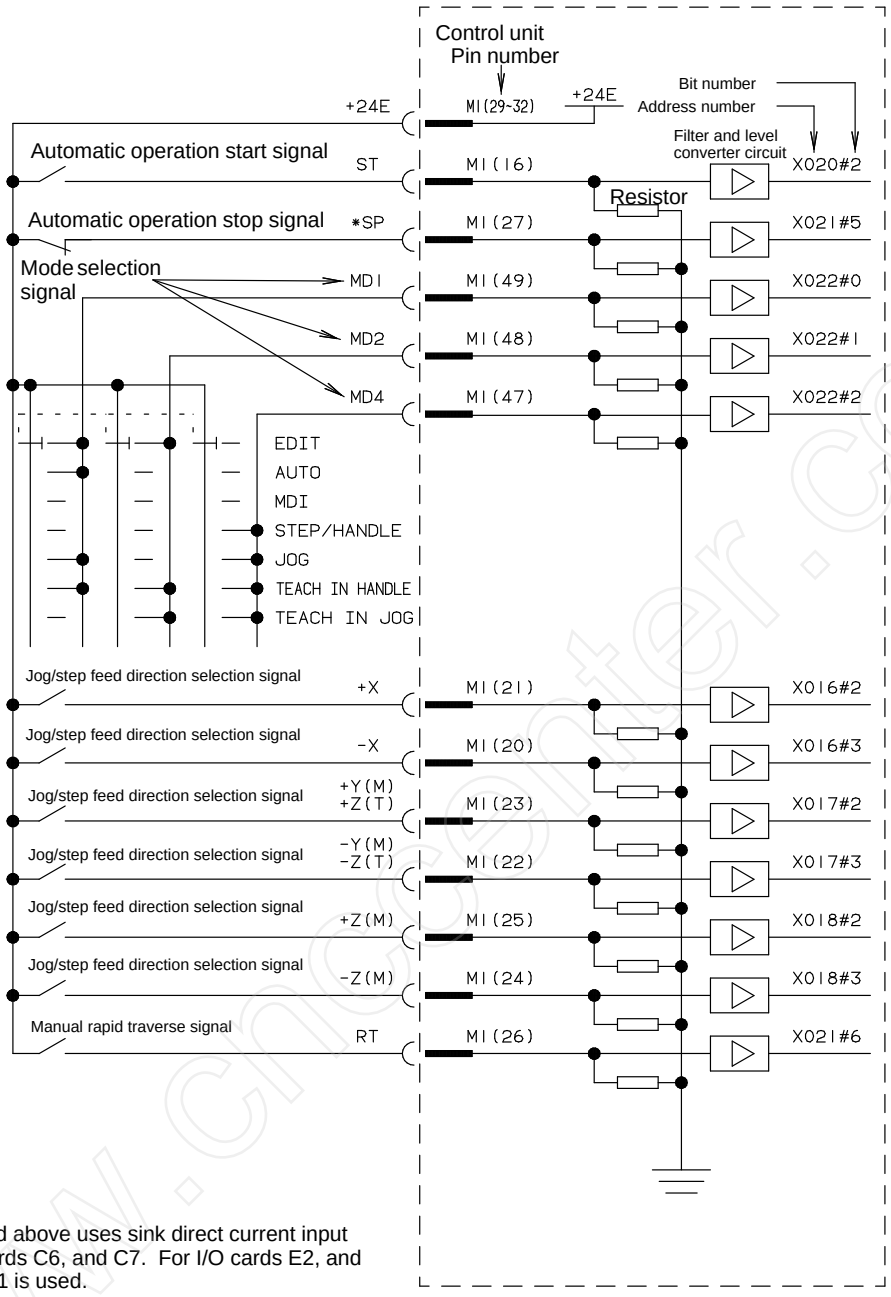
T series power magnetic interface



NOTE

Use unified shield cable for signal connection of J1 and J2.

Recommended cable specification A66L–0001–0042 (7/0.18 50 cores)



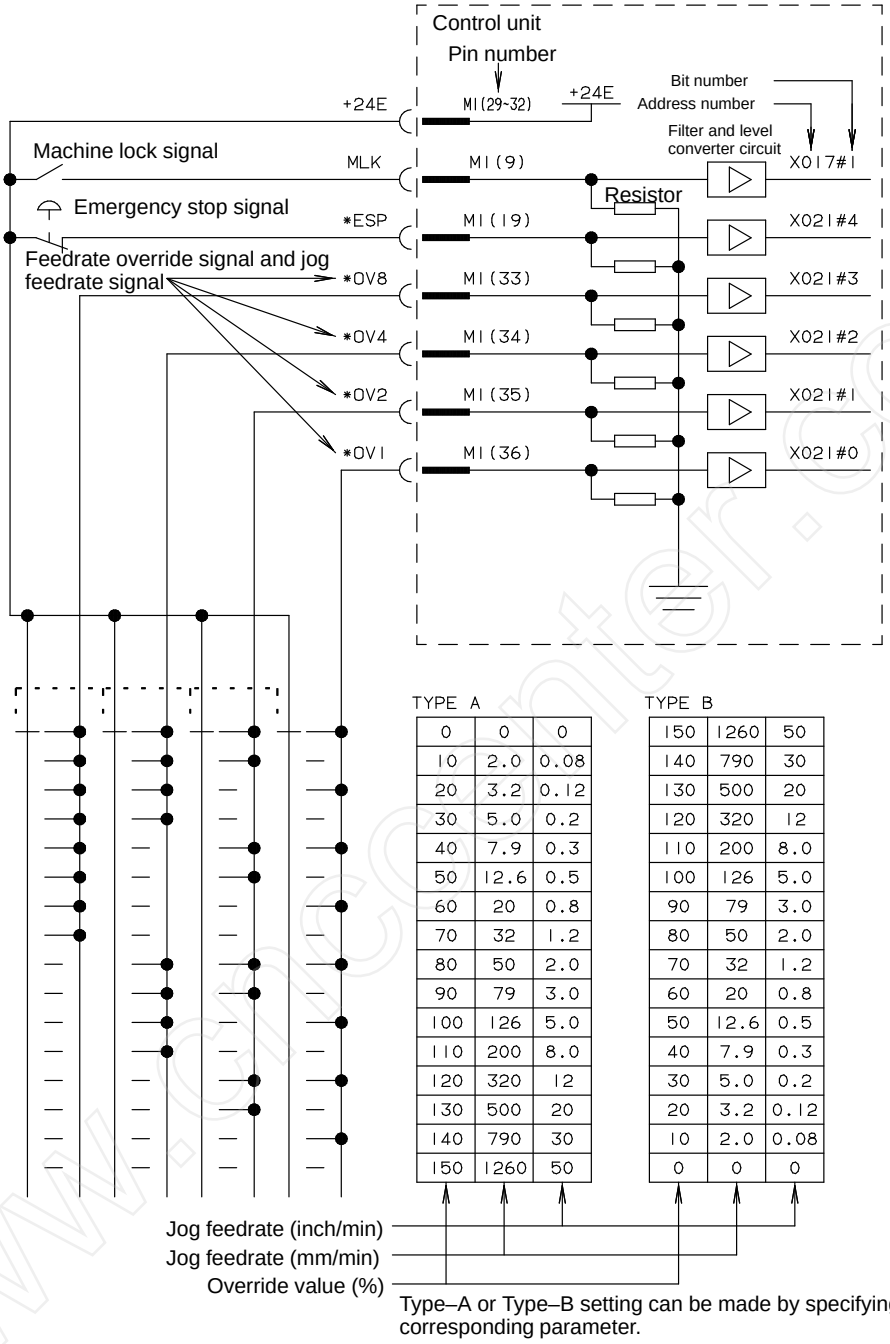
The circuit indicated above uses sink direct current input signal A and I/O cards C6, and C7. For I/O cards E2, and E3, connector M201 is used.

CAUTION

The mode selection signal uses a gray code. To ensure the correct operation of the NC at mode switching, use a rotary switch with make–before–break contacts.

NOTE

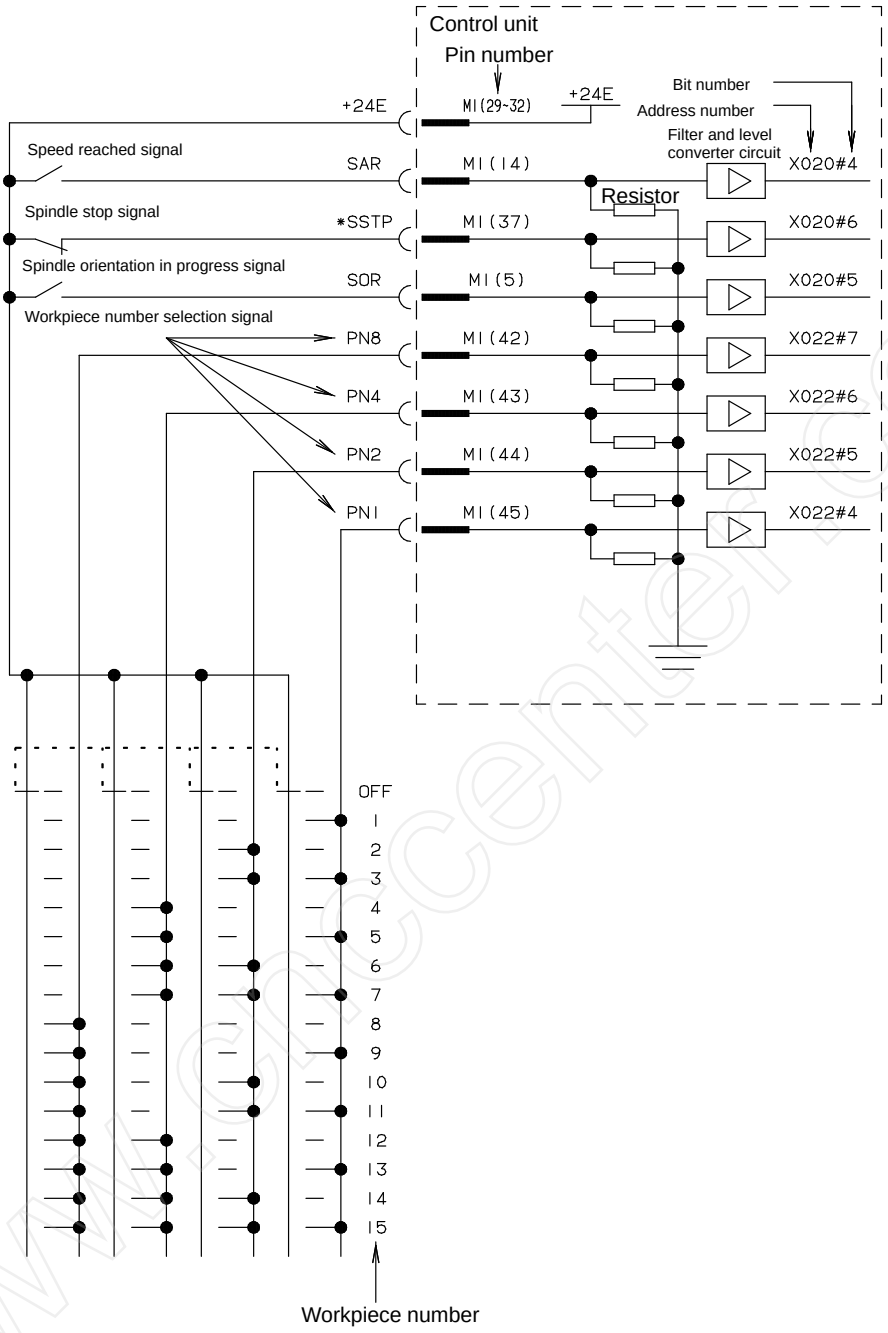
(M) . . . . . 0–MD and 0–GSD
(T) . . . . . 0–TD and 0–GCD



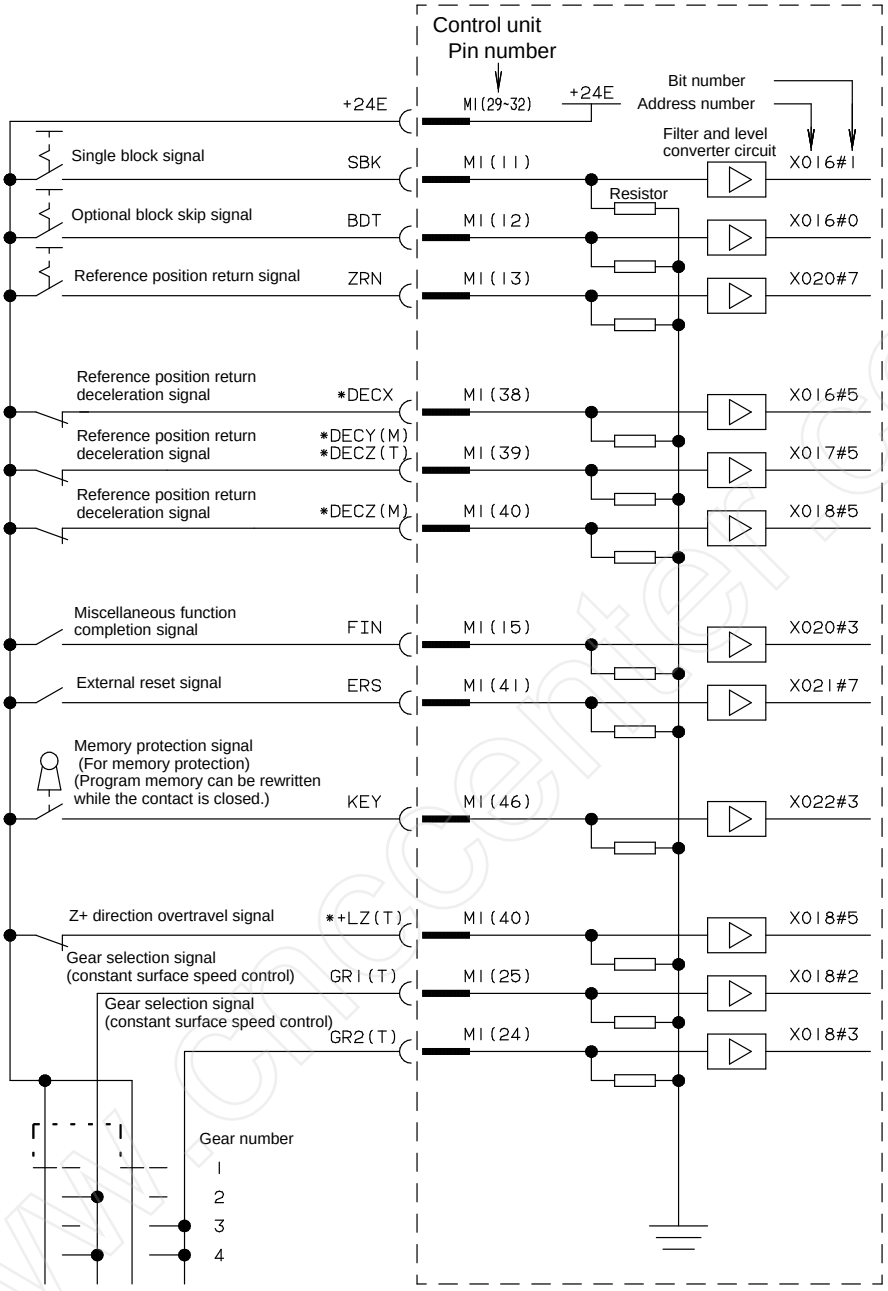
TYPE A		
0	0	0
10	2.0	0.08
20	3.2	0.12
30	5.0	0.2
40	7.9	0.3
50	12.6	0.5
60	20	0.8
70	32	1.2
80	50	2.0
90	79	3.0
100	126	5.0
110	200	8.0
120	320	12
130	500	20
140	790	30
150	1260	50

TYPE B		
150	1260	50
140	790	30
130	500	20
120	320	12
110	200	8.0
100	126	5.0
90	79	3.0
80	50	2.0
70	32	1.2
60	20	0.8
50	12.6	0.5
40	7.9	0.3
30	5.0	0.2
20	3.2	0.12
10	2.0	0.08
0	0	0

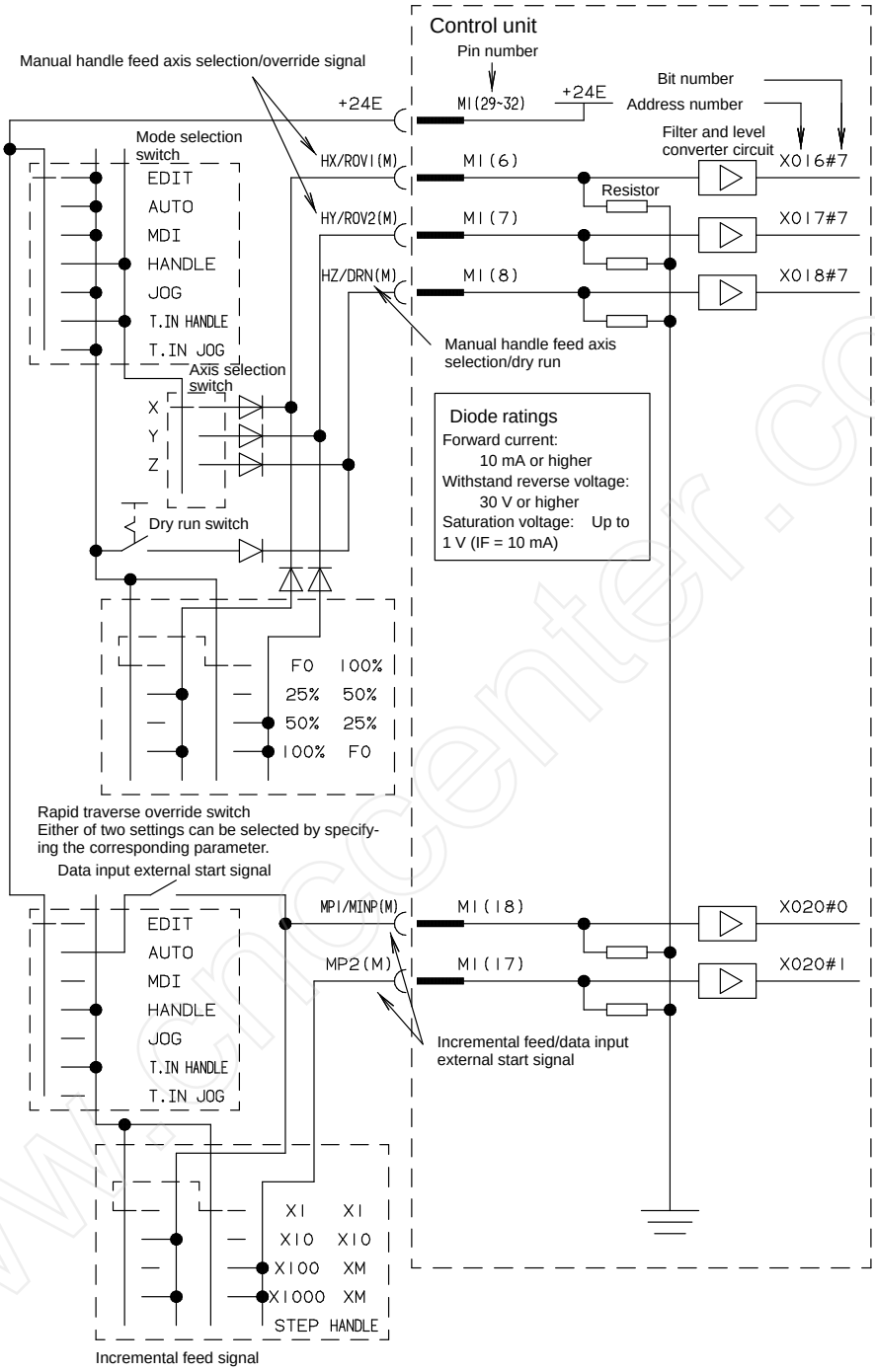
The circuit indicated above uses sink direct current input signal A and I/O cards C6, and C7.
For I/O cards E2, and E3, connector M201 is used.



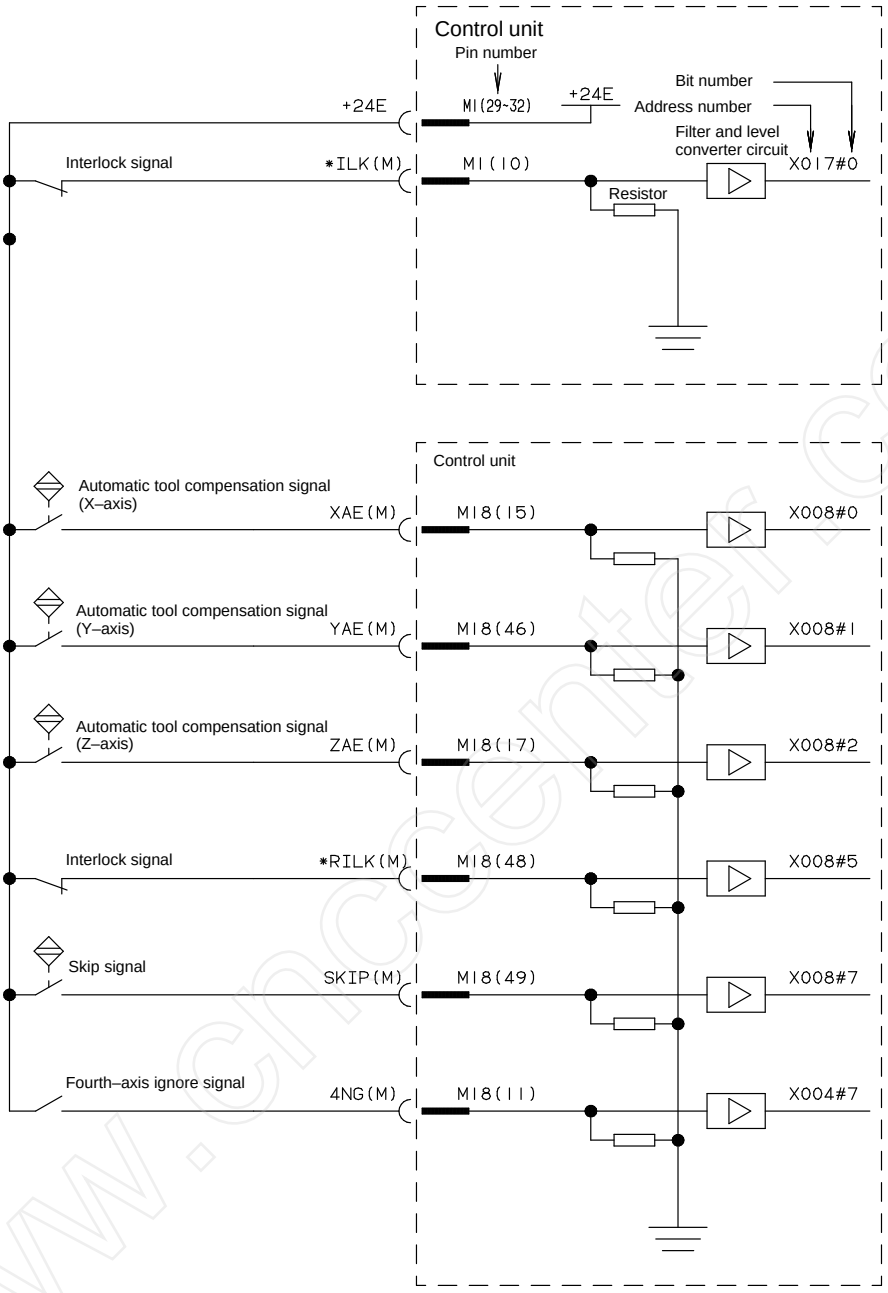
The circuit indicated above uses sink direct current input signal A and I/O cards C6, and C7.
For I/O cards E2, and E3, connector M201 is used.



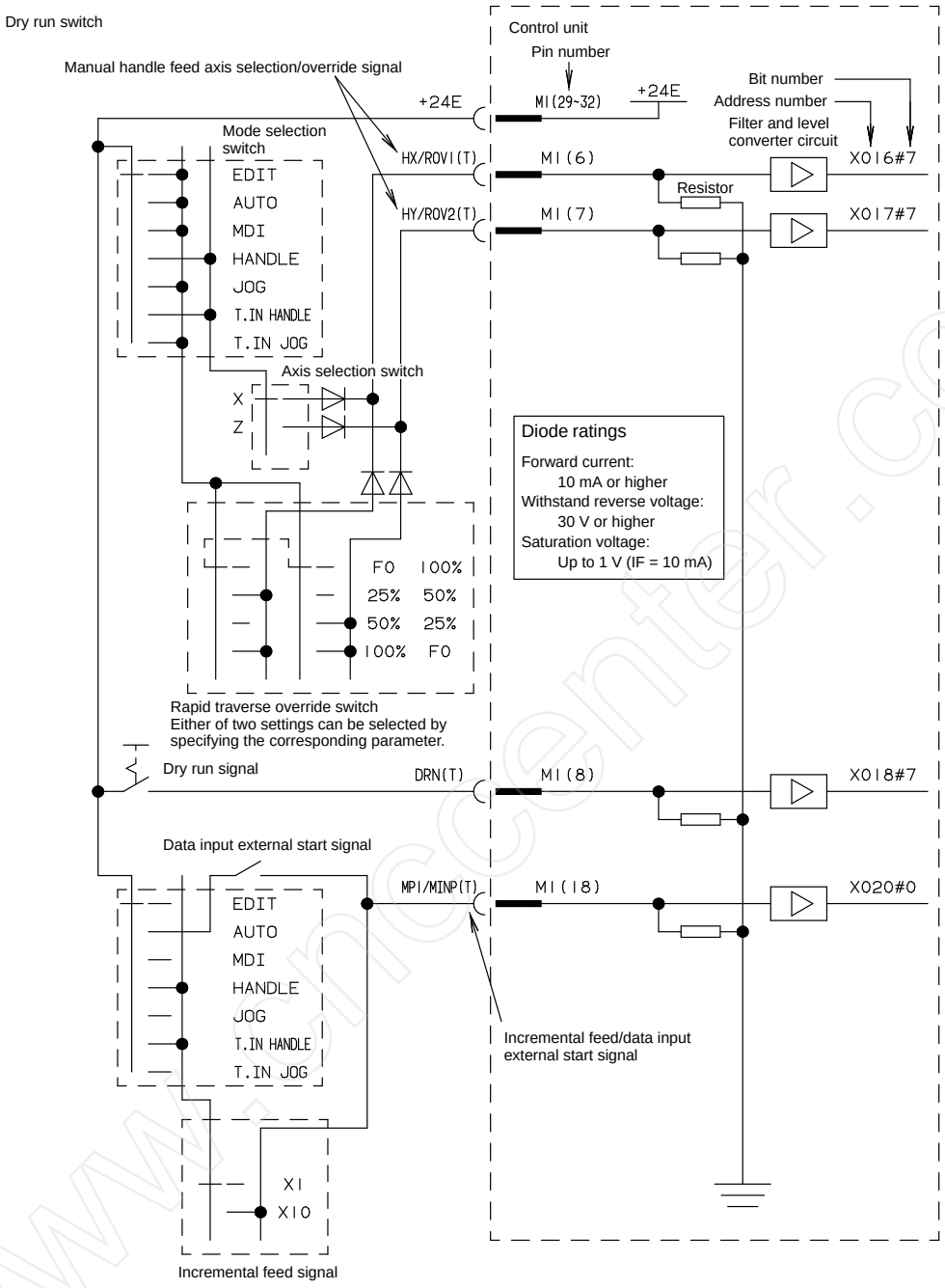
The circuit indicated above uses sink direct current input signal A and I/O cards C6, and C7.
For I/O cards E2, and E3, connector M201 is used.



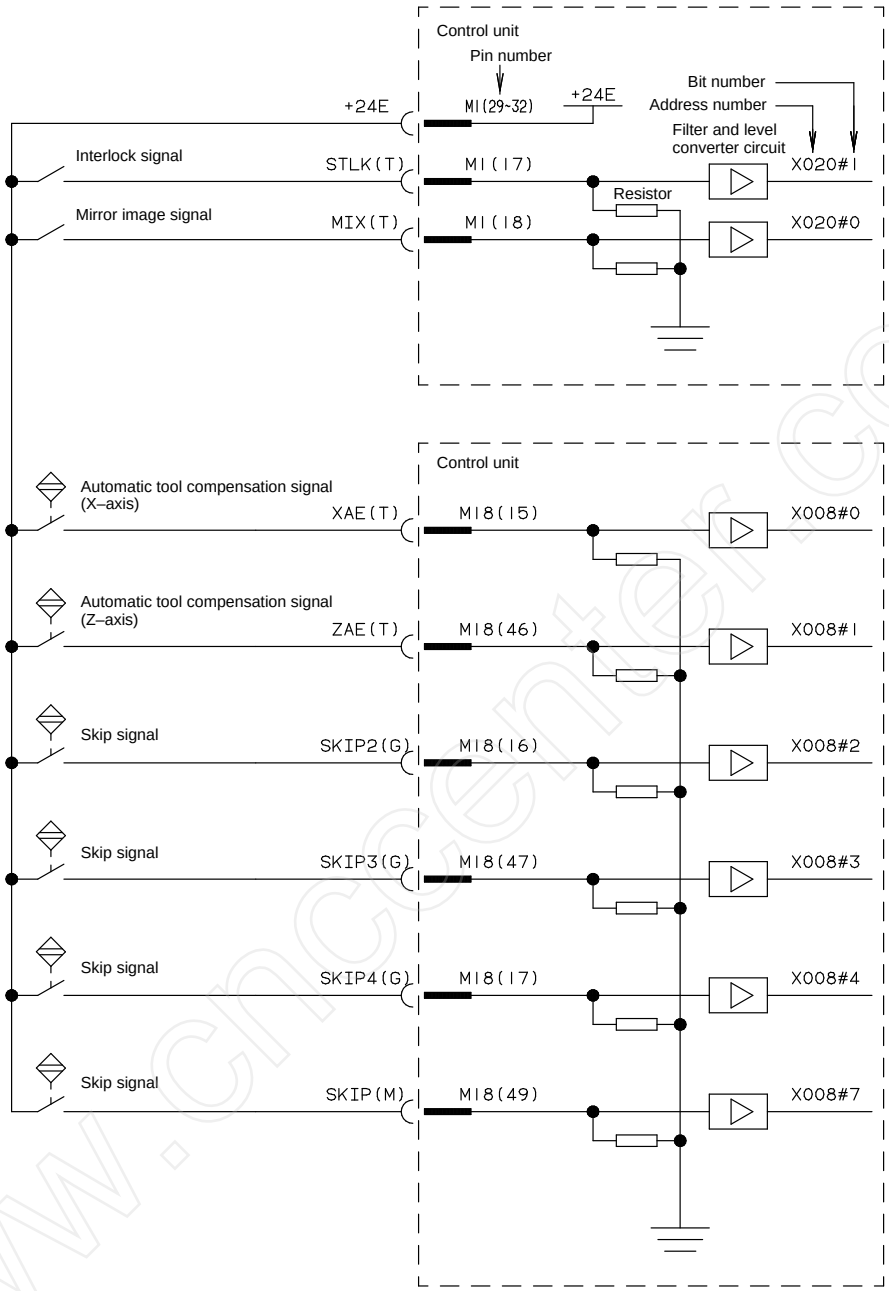
All the signals indicated above are M–series signals. The circuit indicated above uses sink direct current input signal A and I/O cards C6, and C7. For I/O cards E2, and E3, connector M201 is used.



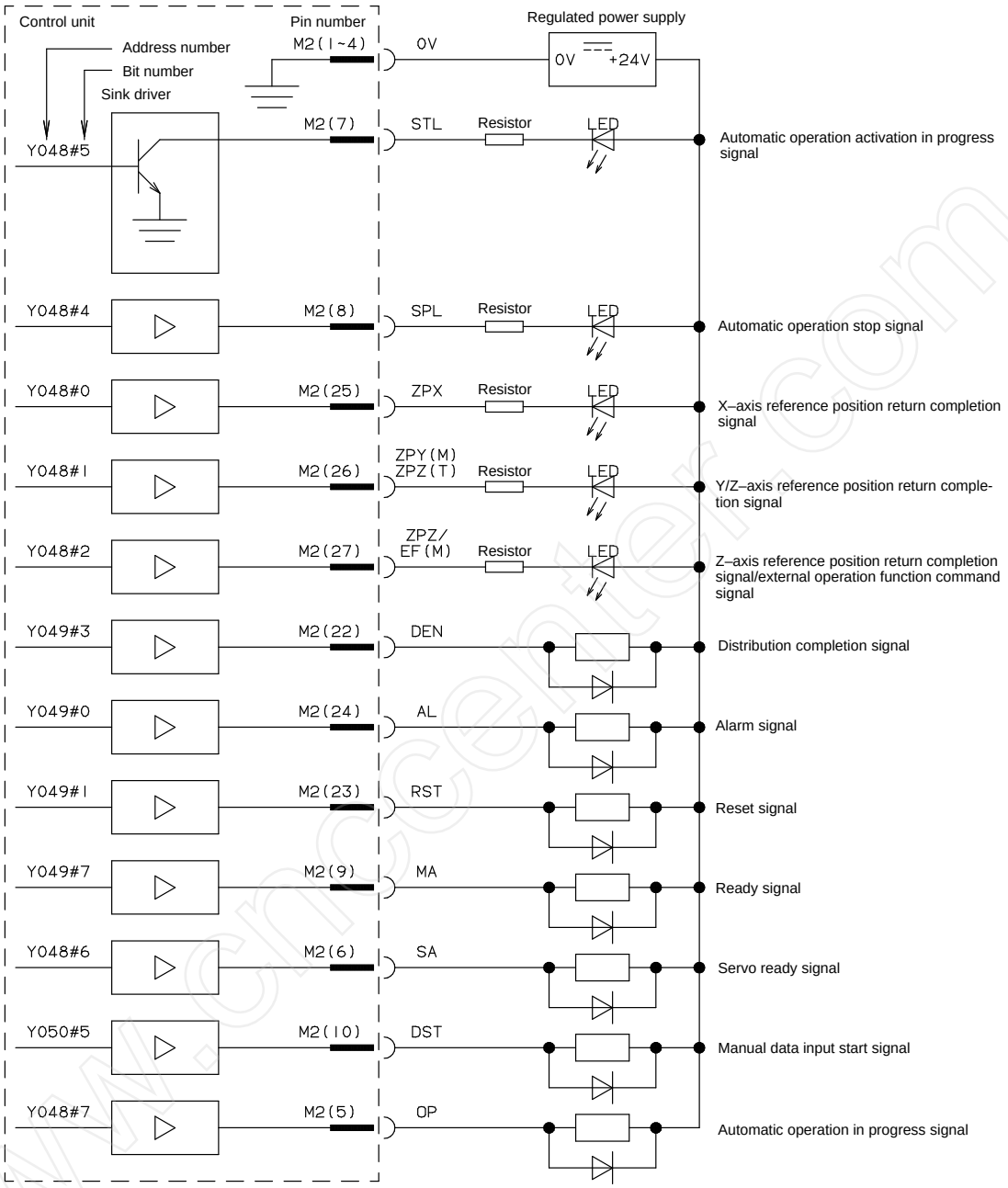
All the signals indicated above are M–series signals. *ILK and 4NG are sink direct current input signals A, and XAE, YAE, ZAE, *RILK, and SKIP are sink direct current input signals B. The circuit indicated above uses I/O cards C6, and C7. For I/O cards E2, and E3, connectors M1 and M18 should be replaced with M201 and M218, respectively.



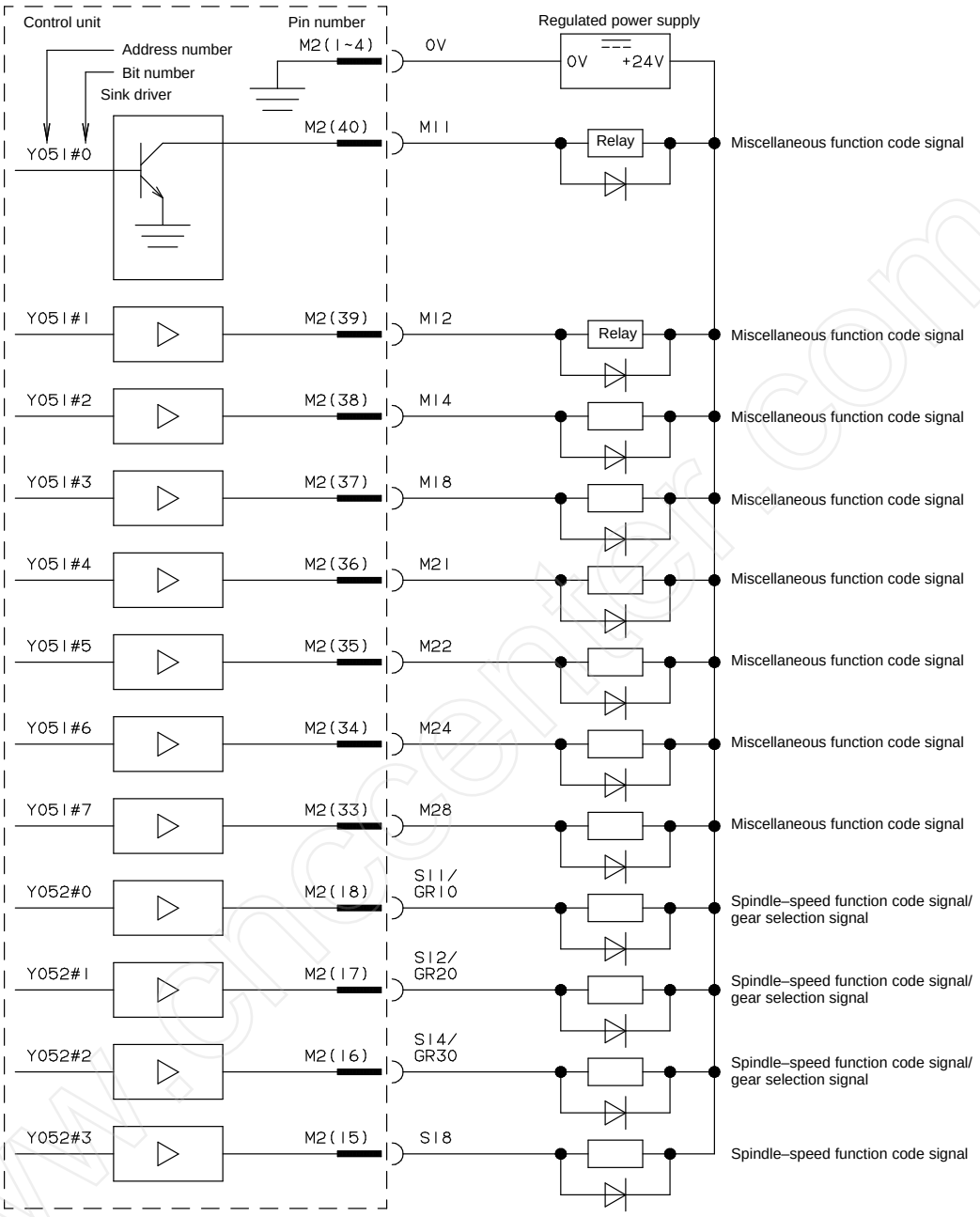
All the signals indicated above are T–series signals. The circuit indicated above uses sink direct current input signal A and I/O cards C6, and C7. For I/O cards E2, and E3, connector M201 is used.



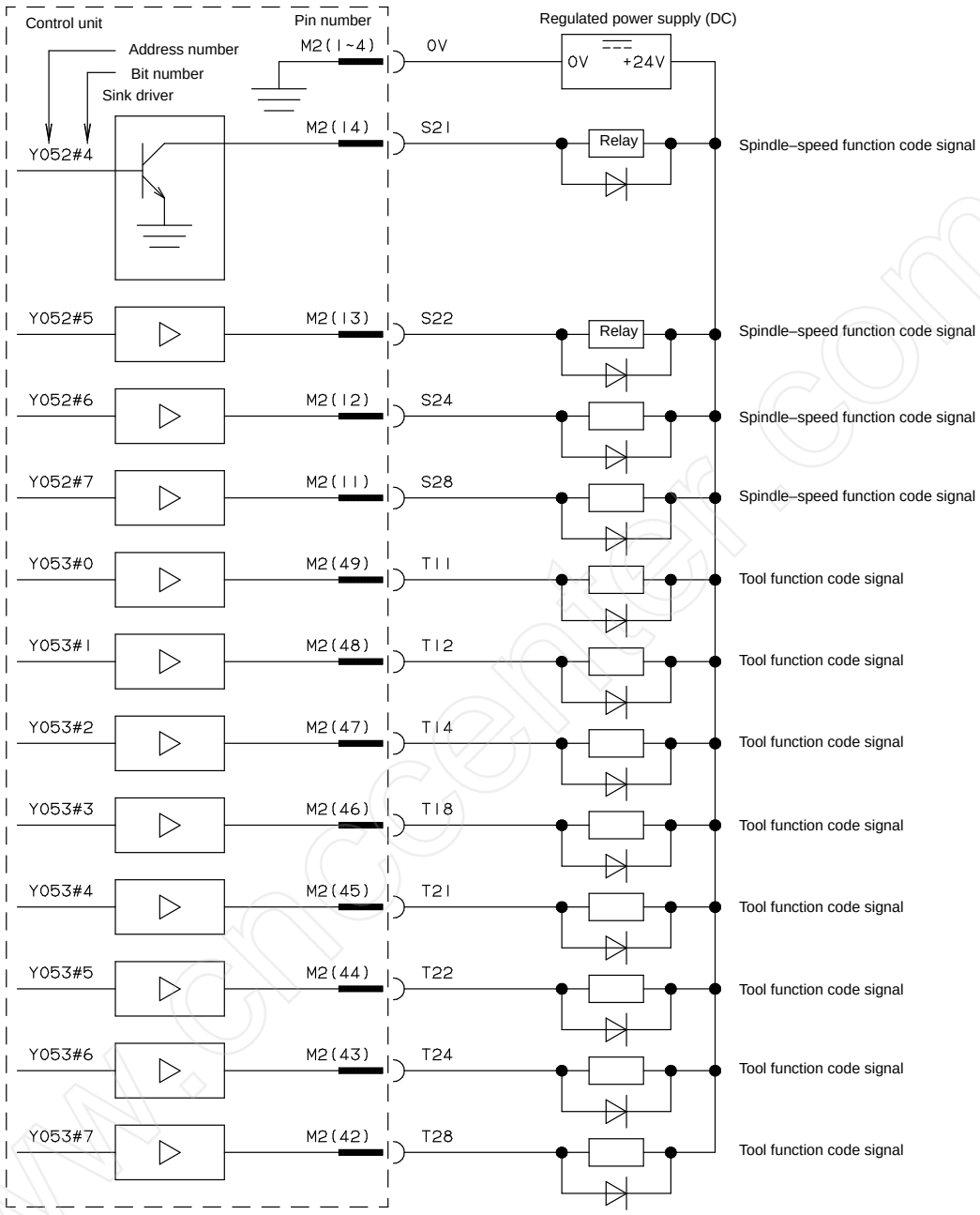
All the signals indicated above are T–series signals. STLK and MIX are sink direct current input signals A, and XAE, ZAE, SKIP2, SKIP3, SKIP4, and SKIP are sink direct current input signals B. The circuit indicated above uses I/O cards C6, and C7. For I/O cards E2, and E3, connectors M1 and M18 should be replaced with M201 and M218, respectively.



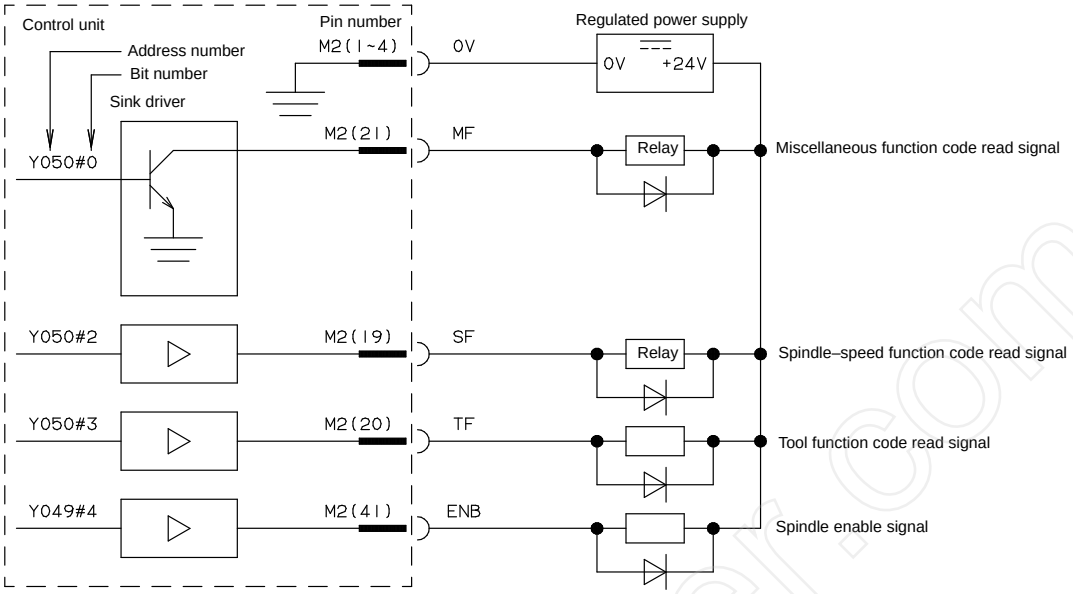
The circuit indicated above uses sink I/O cards C6, and C7.



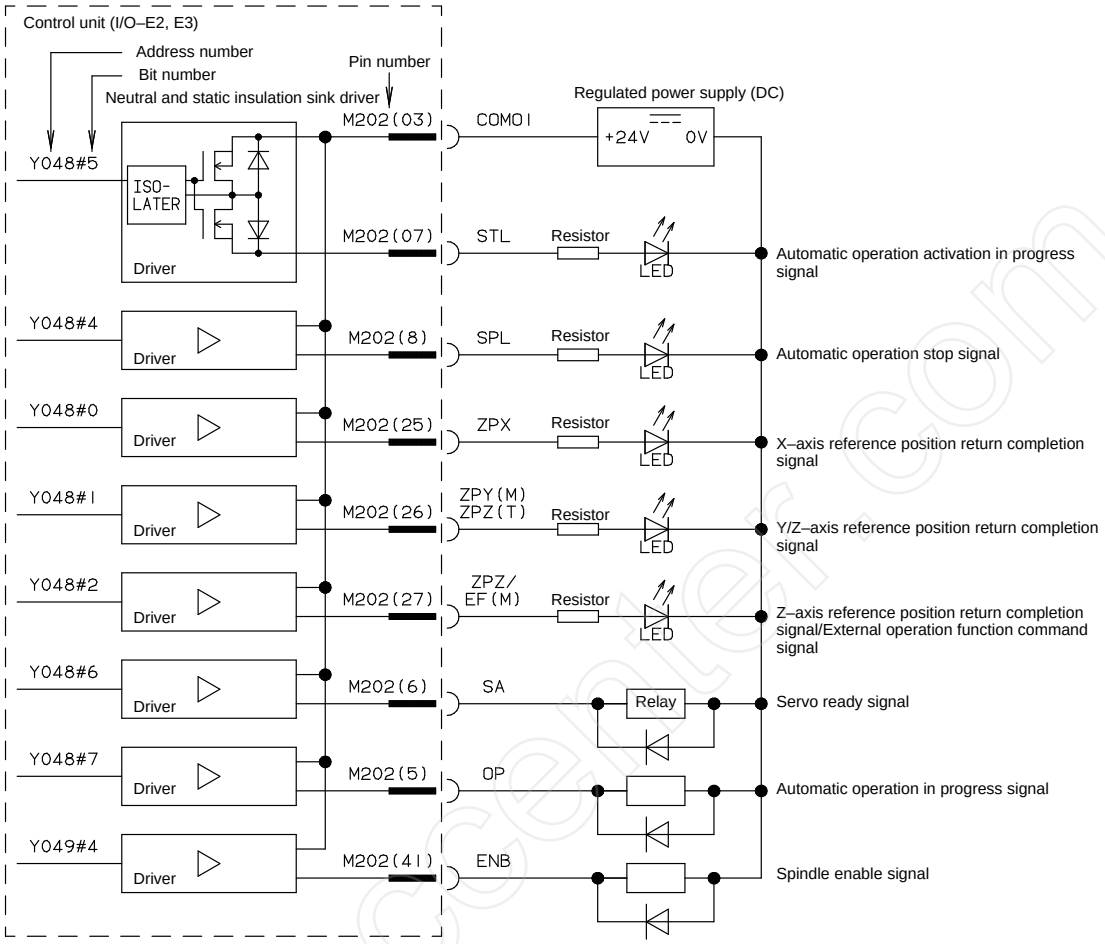
The circuit indicated above uses sink I/O cards C6, and C7.



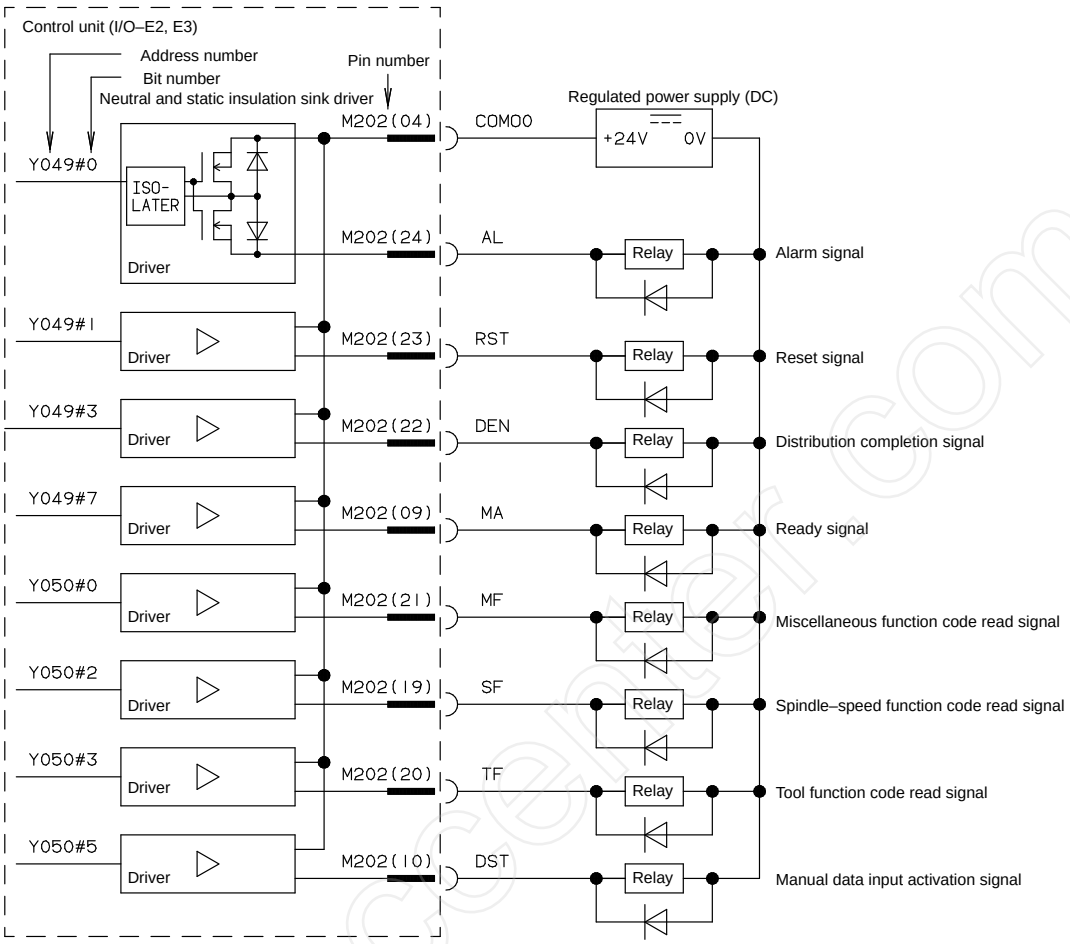
The circuit indicated above uses sink I/O cards C6, and C7.



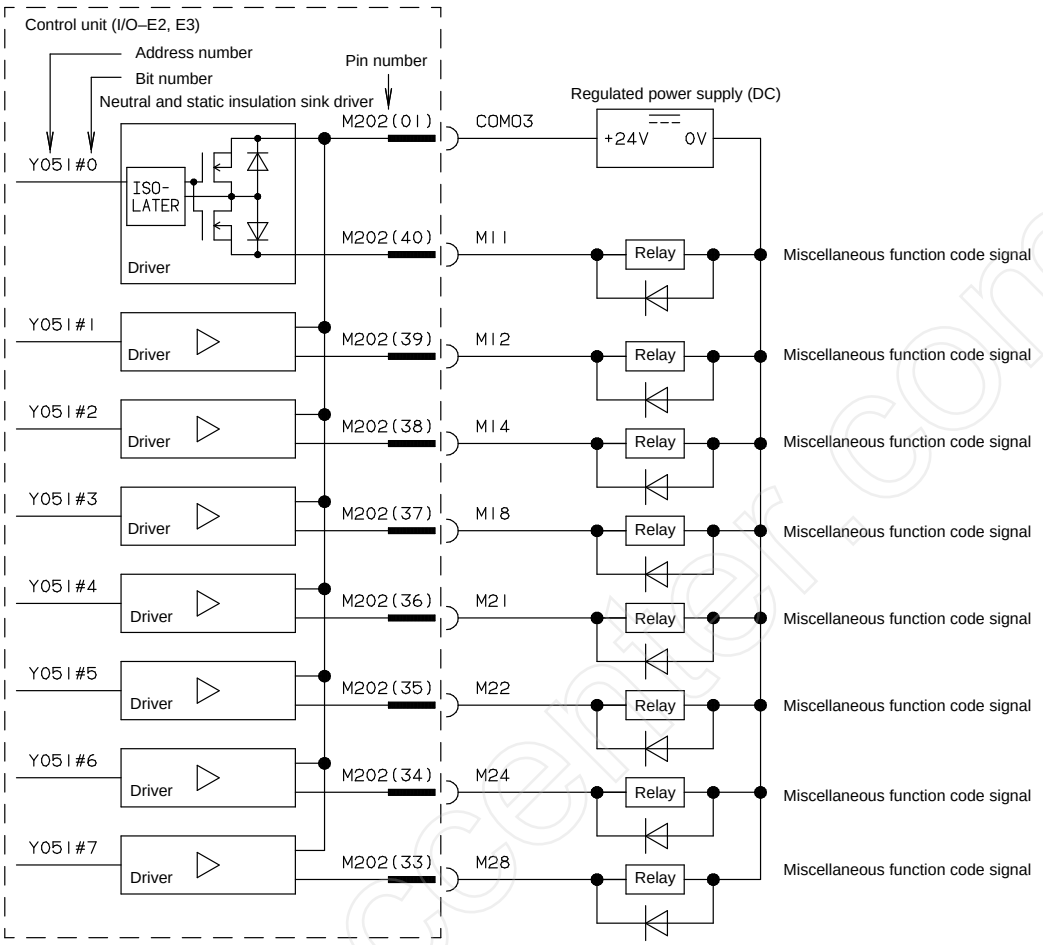
The circuit indicated above uses sink I/O cards C6, and C7.



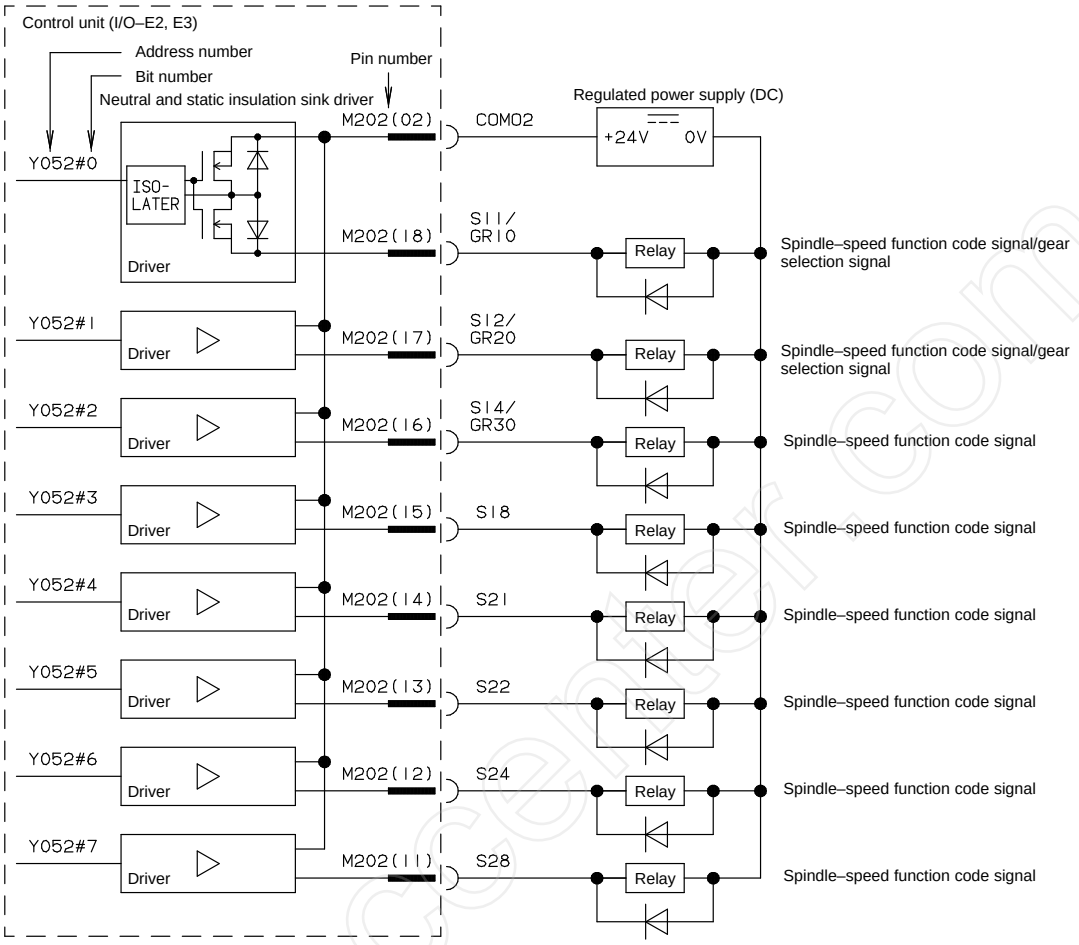
The circuit indicated above uses I/O cards E2, and E3 as a source DO. The voltage of the regulated power supply can be adjusted from 24 to 48 VDC. The polarity of the regulated power supply is inverted when the I/O card is used as a sink DO. In this case, the orientation of the LEDs and surge suppression diodes must be inverted.



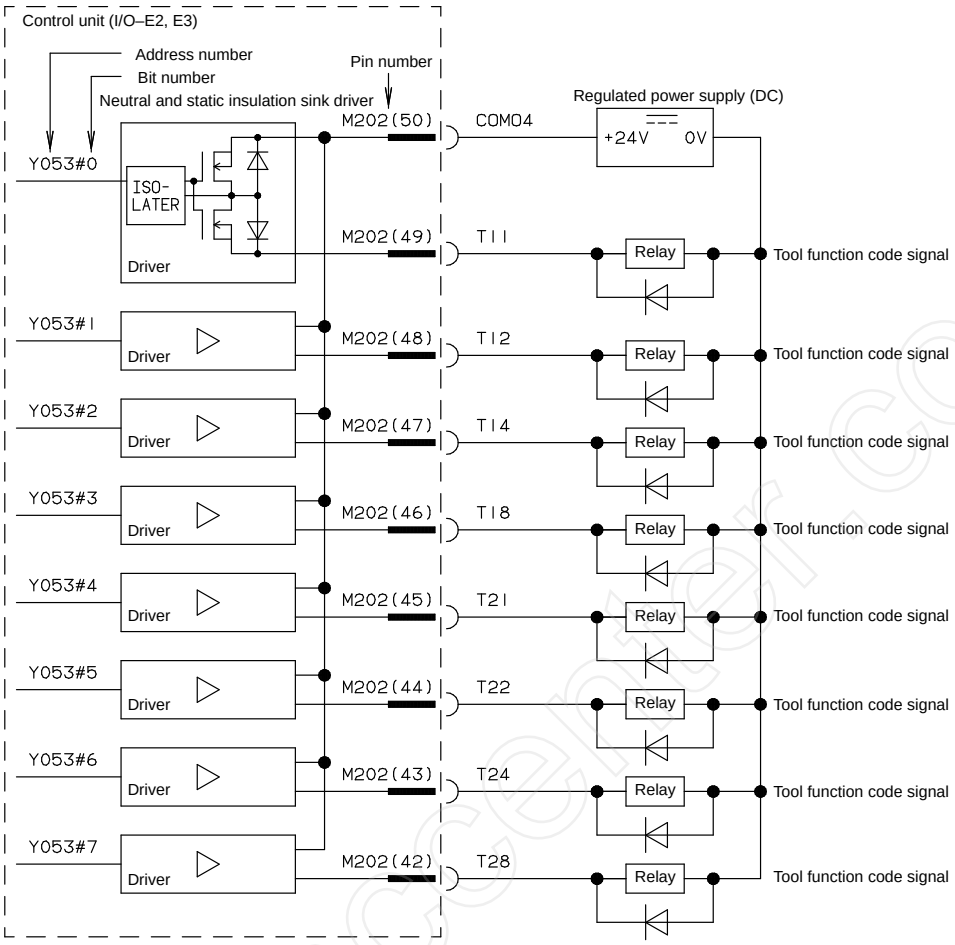
The circuit indicated above uses I/O cards E2, and E3 as a source DO. The voltage of the regulated power supply can be adjusted from 24 to 48 VDC. The polarity of the regulated power supply is inverted when the I/O card is used as a sink DO. In this case, the orientation of the LEDs and surge suppression diodes must be inverted.



The circuit indicated above uses I/O cards E2, and E3 as a source DO. The voltage of the regulated power supply can be adjusted from 24 to 48 VDC. The polarity of the regulated power supply is inverted when the I/O card is used as a sink DO. In this case, the orientation of the LEDs and surge suppression diodes must be inverted.



The circuit indicated above uses I/O cards E2, and E3 as a source DO. The voltage of the regulated power supply can be adjusted from 24 to 48 VDC. The polarity of the regulated power supply is inverted when the I/O card is used as a sink DO. In this case, the orientation of the LEDs and surge suppression diodes must be inverted.



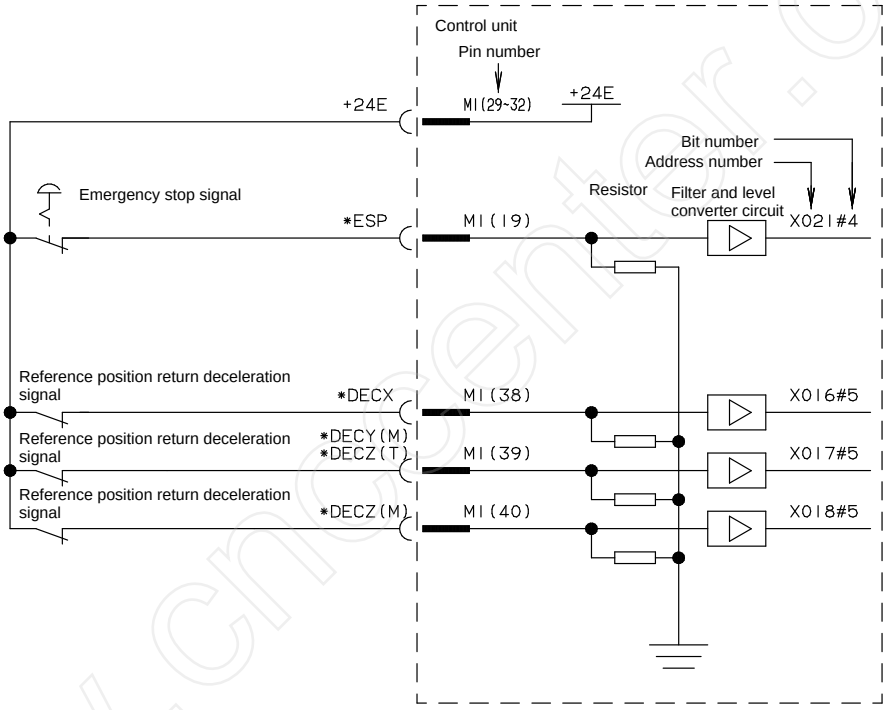
The circuit indicated above uses I/O cards E2, and E3 as a source DO. The voltage of the regulated power supply can be adjusted from 24 to 48 VDC. The polarity of the regulated power supply is inverted when the I/O card is used as a sink DO. In this case, the orientation of the LEDs and surge suppression diodes must be inverted.

6.2.5 System Using the PMC

When a PMC is used, a signal input from the machine is input to the PMC, which outputs a signal to the CNC according to the input signal and sequence program. A signal output from the CNC is sent through the PMC to the machine.

The pins of the internal I/O card can be more flexibly assigned to I/O signals than those of a system without a PMC. The CNC, however, monitors some signals directly, that is, not through the PMC.

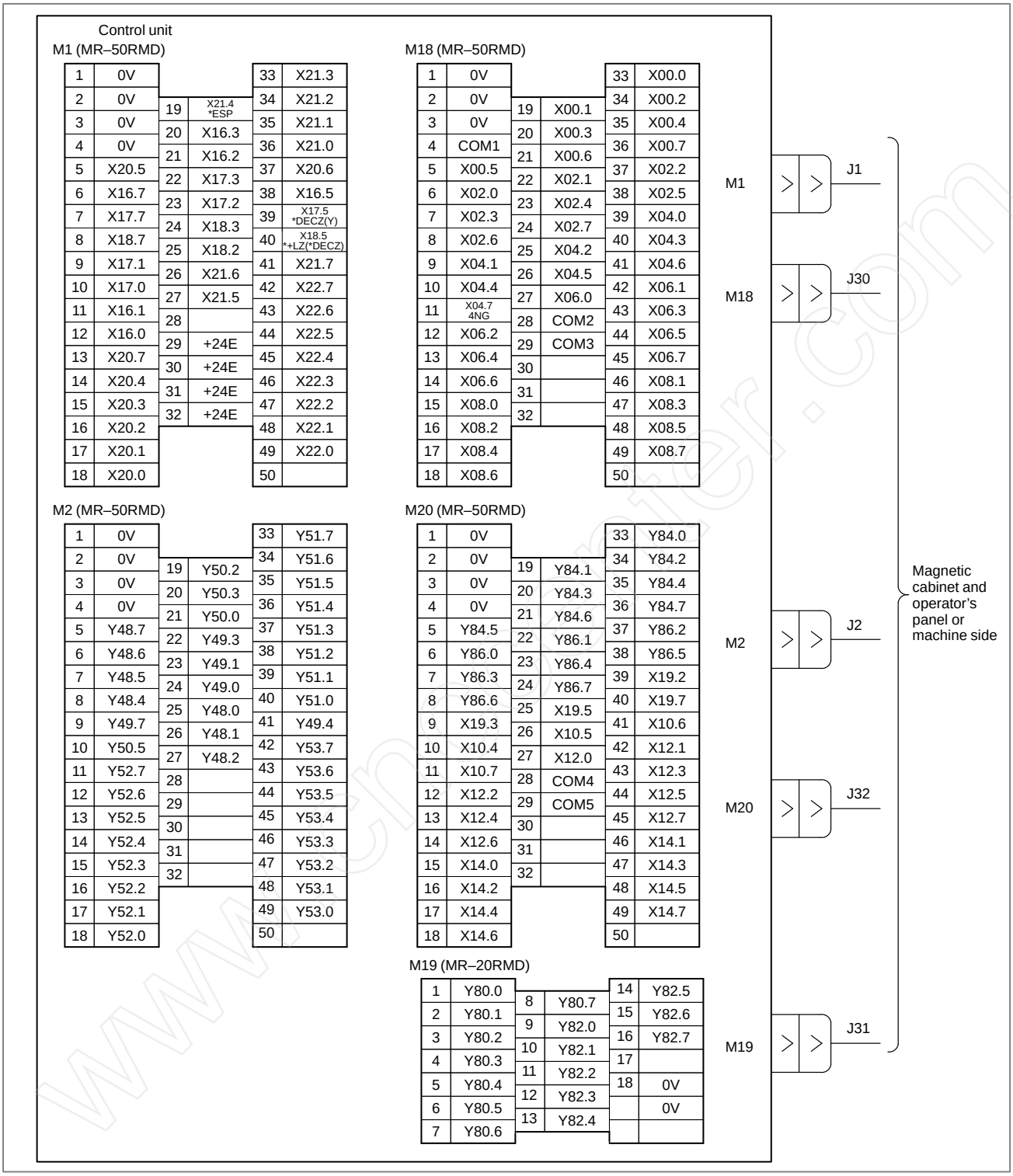
- **Signals that are directly monitored by the CNC**



The circuit indicated above uses sink direct current input signal A and I/O cards C6, and C7.
For I/O cards E2, and E3, connector M201 is used.

- **Connector table of built–in I/O C6 to C7**

Internal I/O C6: It can be used by 0–TD and 0–GCD.
Internal I/O C7: It can be used by all 0–D.

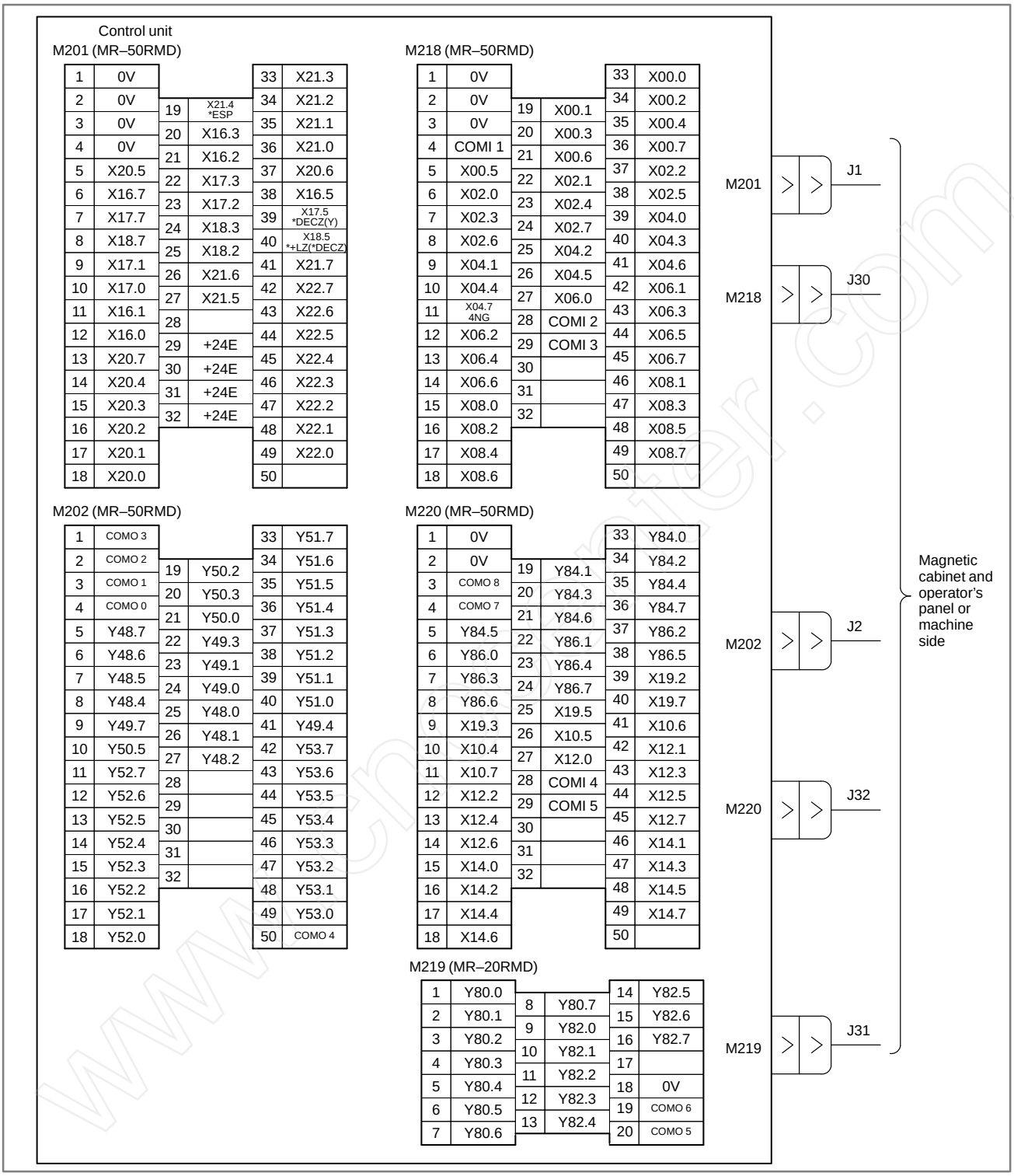


NOTE

Use unified shielded cable forJ1, J2, J30, J31 and J32.
Recommended cable : A66L–0001–0042 (7/0.18 50 cores)
A66L–0001–0041 (7/0.18 20 cores)

- **Connector table of built–in I/O E2 to E3**

Internal I/O E2: It can be used by 0–TD.
Internal I/O E3: It can be used by 0–TD and 0–MD.



NOTE

Use unified shielded cable forJ1, J2, J30, J31 and J32.
Recommended cable : A66L–0001–0042 (7/0.18 50 cores)
A66L–0001–0041 (7/0.18 20 cores)

- **Signal pin assignment of internal I/O**

Table 6.2.5 (a) Signal pin assignment and common signal pin assignment for input signals

Signal address	Signal pin assignment			Common signal pin assignment			Signal that is directly monitored by the CNC
	I/O–C	I/O–E	No.	I/O–C	I/O–E	No.	
X00#0	M18	M218	33	M18	M218	04	*+LX (P)
X00#1	M18	M218	19				*–LX (P)
X00#2	M18	M218	34				
X00#3	M18	M218	20				
X00#4	M18	M218	35				
X00#5	M18	M218	05				*DECX (P)
X00#6	M18	M218	21				
X00#7	M18	M218	36				
X02#0	M18	M218	06				*+LY (P)
X02#1	M18	M218	22				*–LY (P)
X02#2	M18	M218	37				
X02#3	M18	M218	07				
X02#4	M18	M218	23				
X02#5	M18	M218	38				*DECY (P)
X02#6	M18	M218	08				
X02#7	M18	M218	24				
X04#0	M18	M218	39	M18	M218	28	*+L3 (P)
X04#1	M18	M218	09				*–L3 (P)
X04#2	M18	M218	25				
X04#3	M18	M218	40				
X04#4	M18	M218	10				
X04#5	M18	M218	26				*DEC3 (P)
X04#6	M18	M218	41				
X04#7	M18	M218	11				(4NG M series)
X06#0	M18	M218	27				*+L4 (P)
X06#1	M18	M218	42				*–L4 (P)
X06#2	M18	M218	12				

+24E: Pins 29, 30, 31, and 32 of M1/M201
0V: Pins 01, 02, and 03 of M18/M218

Signal address	Signal pin assignment			Common signal pin assignment			Signal that is directly monitored by the CNC
	I/O–C	I/O–E	No.	I/O–C	I/O–E	No.	
X06#3	M18	M218	43	M18	M218	28	
X06#4	M18	M218	13	+24E: Pins 29, 30, 31, and 32 of M1/M201 0V: Pins 01, 02, and 03 of M18/M218			
X06#5	M18	M218	44				*DEC4 (P)
X06#6	M18	M218	14				4NG (P)
X06#7	M18	M218	45				
X08#0	M18	M218	15	M18	M218	29	XAE (M, T), *RILK (P)
X08#1	M18	M218	46				YAE (M), ZAE (T)
X08#2	M18	M218	16				ZAE (M)
X08#3	M18	M218	47	+24E: Pins 29, 30, 31, and 32 of M1/M201 0V: Pins 01, 02, and 03 of M18/M218			
X08#4	M18	M218	17				PFWB (P)
X08#5	M18	M218	48				*RILK (M), *PFIN (P)
X08#6	M18	M218	18				*NFIN (P)
X08#7	M18	M218	49				SKIP (M, T), PE (P)
X10#4	M20	M220	10	M20	M220	28	
X10#5	M20	M220	26				
X10#6	M20	M220	41				
X10#7	M20	M220	11				
X12#0	M20	M220	27				
X12#1	M20	M220	42	+24E: Pins 29, 30, 31, and 32 of M1/M201 0V: Pins 01, 02, 03, and 04 of M20/M220			
X12#2	M20	M220	12				
X12#3	M20	M220	43				
X12#4	M20	M220	13				
X12#5	M20	M220	44				
X12#6	M20	M220	14				
X12#7	M20	M220	45				

X08#0 to X08#7 are direct current input signals B (for fast signal input).

Signal address	Signal pin assignment			Common signal pin assignment			Signal that is directly monitored by the CNC
	I/O–C	I/O–E	No.	I/O–C	I/O–E	No.	
X14#0	M20	M220	15	M20	M220	29	
X14#1	M20	M220	46				
X14#2	M20	M220	16				
X14#3	M20	M220	47				
X14#4	M20	M220	17	+24E: Pins 29, 30, 31, and 32 of M1/M201 0V: Pins 01, 02, 03, and 04 of M20/M220			*ESP (P)
X14#5	M20	M220	48				
X14#6	M20	M220	18				
X14#7	M20	M220	49				
X19#2	M20	M220	39				
X19#3	M20	M220	09				
X19#5	M20	M220	25				
X19#7	M20	M220	40				
X16#0	M1	M201	12	Always sink input +24E: Pins 29, 30, 31, and 32 of M1/M201			*+EDCX (P)
X16#1	M1	M201	11				*+EDCY (P)
X16#2	M1	M201	21				*+EDC3 (P)
X16#3	M1	M201	20				*+EDC4 (P)
X16#5	M1	M201	38				*DECX (M, T)
X16#7	M1	M201	06				
X17#0	M1	M201	10				*–EDCX (P)
X17#1	M1	M201	09				*–EDCY (P)
X17#2	M20	M220	23				*–EDC3 (P)
X17#3	M20	M220	22				*–EDC4 (P)
X17#5	M20	M220	39				*DECY (M), *DECZ (T)
X17#7	M20	M220	07				
X18#2	M20	M220	25				
X18#3	M20	M220	24				
X18#5	M20	M220	40				*DECZ (M), +LZ (T)
X18#7	M20	M220	08				
X20#0	M1	M201	18				

Signal address	Signal pin assignment			Common signal pin assignment			Signal that is directly monitored by the CNC
	I/O–C	I/O–E	No.	I/O–C	I/O–E	No.	
X20#1	M1	M201	17	Always sink input			
X20#2	M1	M201	16				
X20#3	M1	M201	15	+24E: Pins 29, 30, 31, and 32 of M1/M201			
X20#4	M1	M201	14				
X20#5	M1	M201	05				
X20#6	M1	M201	37				
X20#7	M1	M201	13				
X21#0	M1	M201	36				
X21#1	M1	M201	35				
X21#2	M1	M201	34				
X21#3	M1	M201	33				
X21#4	M1	M201	19				*ESP (M, T)
X21#5	M1	M201	27				
X21#6	M1	M201	26				
X21#7	M1	M201	41				
X22#0	M1	M201	49				
X22#1	M1	M201	48				
X22#2	M1	M201	47				
X22#3	M1	M201	46				
X22#4	M1	M201	45				
X22#5	M1	M201	44				
X22#6	M1	M201	43				
X22#7	M1	M201	42				

Table 6.2.5 (b) Signal pin assignment and common signal pin assignment for output signals Expansion I/O cards C6 and C7 are fixed to sink output. Expansion I/O cards E2, and E3 can be set to sink output or source output, by setting the common signal accordingly.

Signal address	Signal pin		Signal pin		Common signal pin		
	I/O–C	No.	I/O–E	No.	Common	I/O–E	No.
Y48#0	M2	25	M202	25	COMO1	M202	03
Y48#1	M2	26	M202	26			
Y48#2	M2	27	M202	27			
Y48#3	M2	08	M202	08			
Y48#4	M2	07	M202	07			
Y48#5	M2	06	M202	06			
Y48#6	M2	05	M202	05			
Y48#7	M2	41	M202	41			
Y49#0	M2	24	M202	24	COMO0	M202	04
Y49#1	M2	23	M202	23			
Y49#2	M2	22	M202	22			
Y49#3	M2	09	M202	09			
Y49#4	M2	21	M202	21			
Y49#5	M2	19	M202	19			
Y49#6	M2	20	M202	20			
Y51#7	M2	10	M202	10			
Y51#0	M2	40	M202	40	COMO3	M202	01
Y51#1	M2	39	M202	39			
Y51#2	M2	38	M202	38			
Y51#3	M2	37	M202	37			
Y51#4	M2	36	M202	36			
Y51#5	M2	35	M202	35			
Y51#6	M2	34	M202	34			
Y51#7	M2	33	M202	33			

Signal address	Signal pin		Signal pin		Common signal pin		
	I/O–C	No.	I/O–E	No.	Common	I/O–E	No.
Y52#0	M2	18	M202	18	COMO2	M202	02
Y52#1	M2	17	M202	17			
Y52#2	M2	16	M202	16			
Y52#3	M2	15	M202	15			
Y52#4	M2	14	M202	14			
Y52#5	M2	13	M202	13			
Y52#6	M2	12	M202	12			
Y52#7	M2	11	M202	11			
Y53#0	M2	49	M202	49	COMO4	M202	50
Y53#1 (NBL (P))	M2	45	M202	45			
Y53#2 (PF (P))	M2	47	M202	47			
Y53#3 (PFB (P))	M2	46	M202	46			
Y53#4	M2	45	M202	45			
Y53#5	M2	44	M202	44			
Y53#6	M2	43	M202	43			
Y53#7	M2	42	M202	42			
Y80#0	M19	01	M219	01	COMO5	M219	20
Y80#1	M19	02	M219	02			
Y80#2	M19	03	M219	03			
Y80#3	M19	04	M219	04			
Y80#4	M19	05	M219	05			
Y80#5	M19	06	M219	06			
Y80#6	M19	07	M219	07			
Y80#7	M19	08	M219	08			

Signal address	Signal pin		Signal pin		Common signal pin		
	I/O–C	No.	I/O–E	No.	Common	I/O–E	No.
Y82#0	M19	09	M219	09	COMO6	M219	19
Y82#1	M19	10	M219	10			
Y82#2	M19	11	M219	11			
Y82#3	M19	12	M219	12			
Y82#4	M19	13	M219	13			
Y82#5	M19	14	M219	14			
Y82#6	M19	15	M219	15			
Y82#7	M19	16	M219	16			
Y84#0	M20	33	M220	33	COMO7	M220	04
Y84#1	M20	19	M220	19			
Y84#2	M20	34	M220	34			
Y84#3	M20	20	M220	20			
Y84#4	M20	35	M220	35			
Y84#5	M20	05	M220	05			
Y84#6	M20	21	M220	21			
Y84#7	M20	36	M220	36			
Y86#0	M20	06	M220	06	COMO8	M220	03
Y86#1	M20	22	M220	22			
Y86#2	M20	37	M220	37			
Y86#3	M20	07	M220	07			
Y86#4	M20	23	M220	23			
Y86#5	M20	38	M220	38			
Y86#6	M20	08	M220	08			
Y86#7	M20	24	M220	24			

7 CONNECTION OF PERIPHERAL EQUIPMENT

7.1 CONNECTING THE DISPLAY UNIT

7.1.1 Outline

The display unit of the CNC is used to display information such as CNC programs and parameters to the operator and to assist the operator in the operation of the machine.

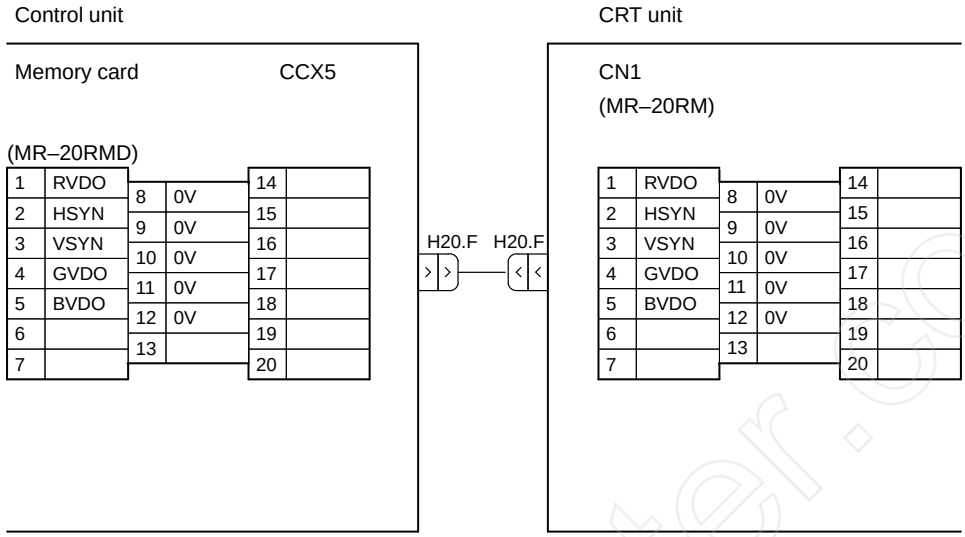
For the Series 0–D, CRT display unit is available. This section describes how to connect these display units to the control unit. Outline drawings are given in the appendix.

Each display unit can be provided as a unit incorporating an MDI keyboard, for example a CRT/MDI unit. The MDI section can be connected in the same way as a separate MDI unit. For an explanation of making this connection, see the subsequent chapter.

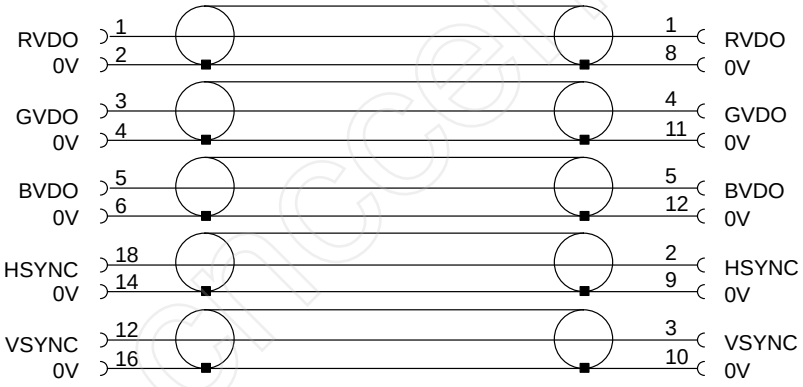
Some display units are available either as a standard type or as a type conforming to European safety standards (qualifying for CE marking). Since the type qualifying for CE marking uses a different power supply unit, the connection of the CE marking type differs from that of the standard type in some respects. The unit qualifying for CE marking with the MDI keyboard has keys of different colors, and may use symbolic keys.

The unit of CRT/MDI has a stud or hole for grounding. Ground the unit to a housing in the vicinity, using a line containing conductors of 2 mm^2 or greater.

7.1.2
Video Signal Interface



Cable wiring



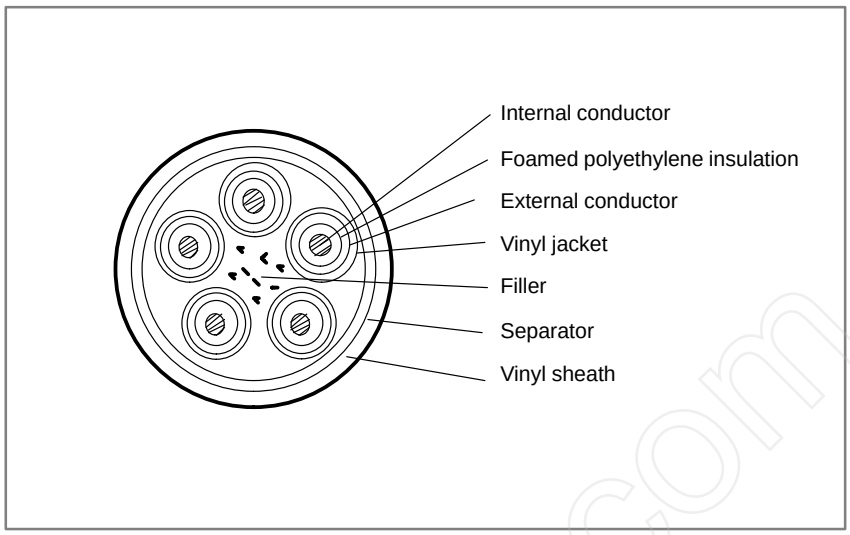
Maximum cable length: 50 m

Recommended cable material : A66L–0001–0219 coaxial cable

Recommended cable order number: A02B–0098–K825 (7 m)

Cable specifications (A66L–0001–0219)

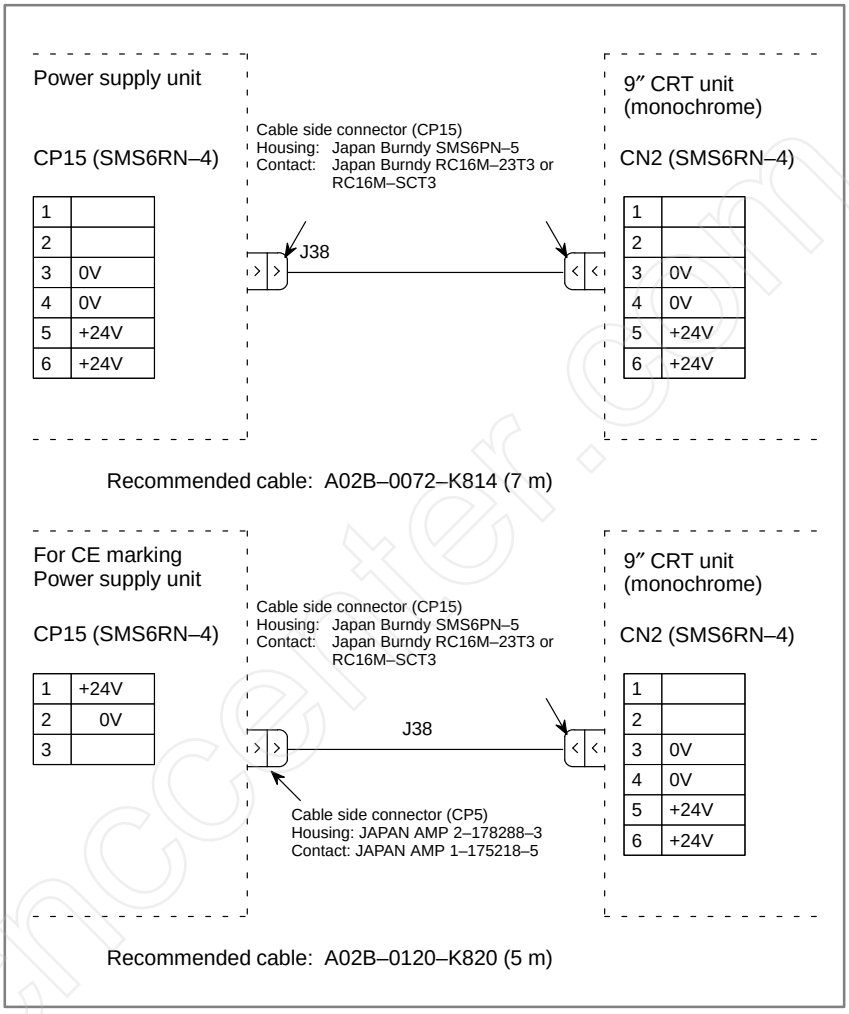
Item		Unit	Material, specifications
Code		–	A66L–0001–0219
Manufacturer		–	Hitachi Cable, Ltd.
Cable type		–	C0–CX–75–5C
Number of coaxial cables		Cables	5
Conductor	Size	mm^2	0.18
	Configuration	Conductors/mm	7/0.18 (Tinned soft copper wire)
	Approximate outside diameter	mm	0.54
Insulation	Material	–	Foamed polyethylene (white)
	Thickness	mm	0.93
	Approximate outside diameter	mm	2.40
Braided shield	Wire diameter	mm	0.1 (Tinned soft copper wire)
	Density	%	90
	Thickness	mm	0.25
	Approximate outside diameter	mm	2.90
Jacket	Material	–	Vinyl
	Color	–	Black, white, red, green, blue
	Thickness	mm	0.25
	Approximate outside diameter	mm	3.40
Outside diameter of bundled coaxial cables		mm	9.2
Tying tape thickness		mm	0.05
Sheath	Material	–	Vinyl
	Color	–	Black
	Thickness	mm	0.5
Finished outside diameter		mm	10.3
Maximum finished outside diameter		mm	11.0
Conductor resistance at 20°C		Ω/km	110
Withstand voltage (across internal conductor and external conductor)		–	Capable of withstanding 1000 VAC for one minute
Insulation resistance at 20°C		MΩ–km	1000
Characteristic impedance (10 MHz)		Ω	75 ± 3
Capacitance (1 kHz)		nF/km	56
Standard attenuation (10 MHz)		dB/km	46



7.1.3 Connecting the Display Unit Power Supply

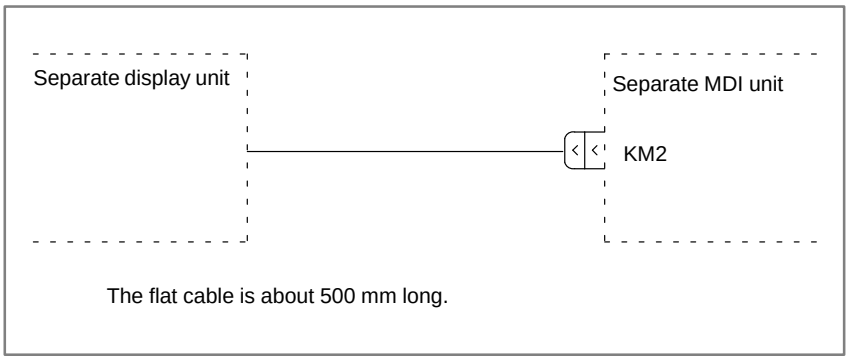
Use a power cable containing conductors of 30/0.18 (0.8 mm^2) or greater.

(1) 9″ monochrome CRT



7.1.4 Connecting the Soft Key Cable of a Separate Display Unit

Some separate display units have soft keys. These units have flat cables for the soft keys. Connect the soft key cable to connector KM2 of a separate MDI unit.

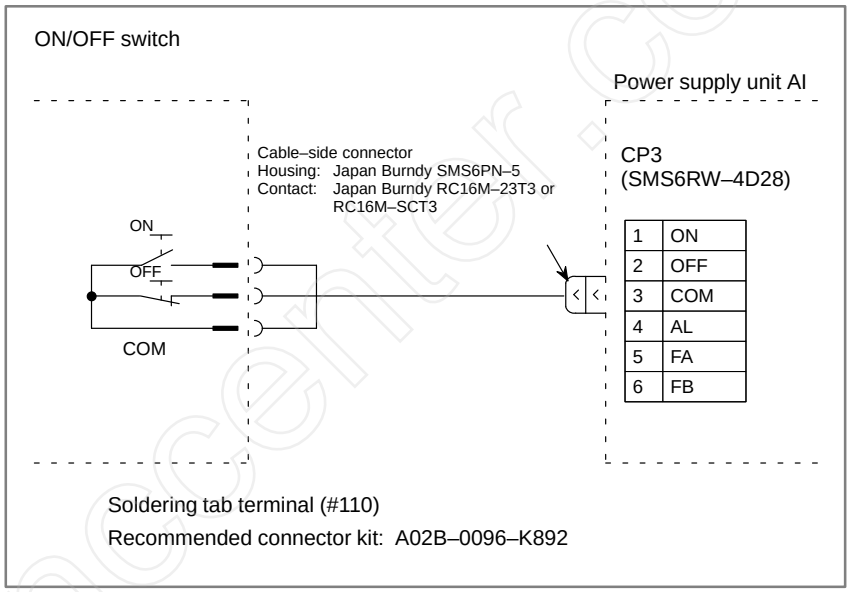


7.1.5 ON/OFF Switch on the Display Unit

The 9″ CRT/MDI unit of Series 0–PD have an ON/OFF switch for turning the control unit on and off. The control unit can be turned on or off by pressing the ON/OFF switch when the switch is connected to the power supply unit AI (input unit built–in type).

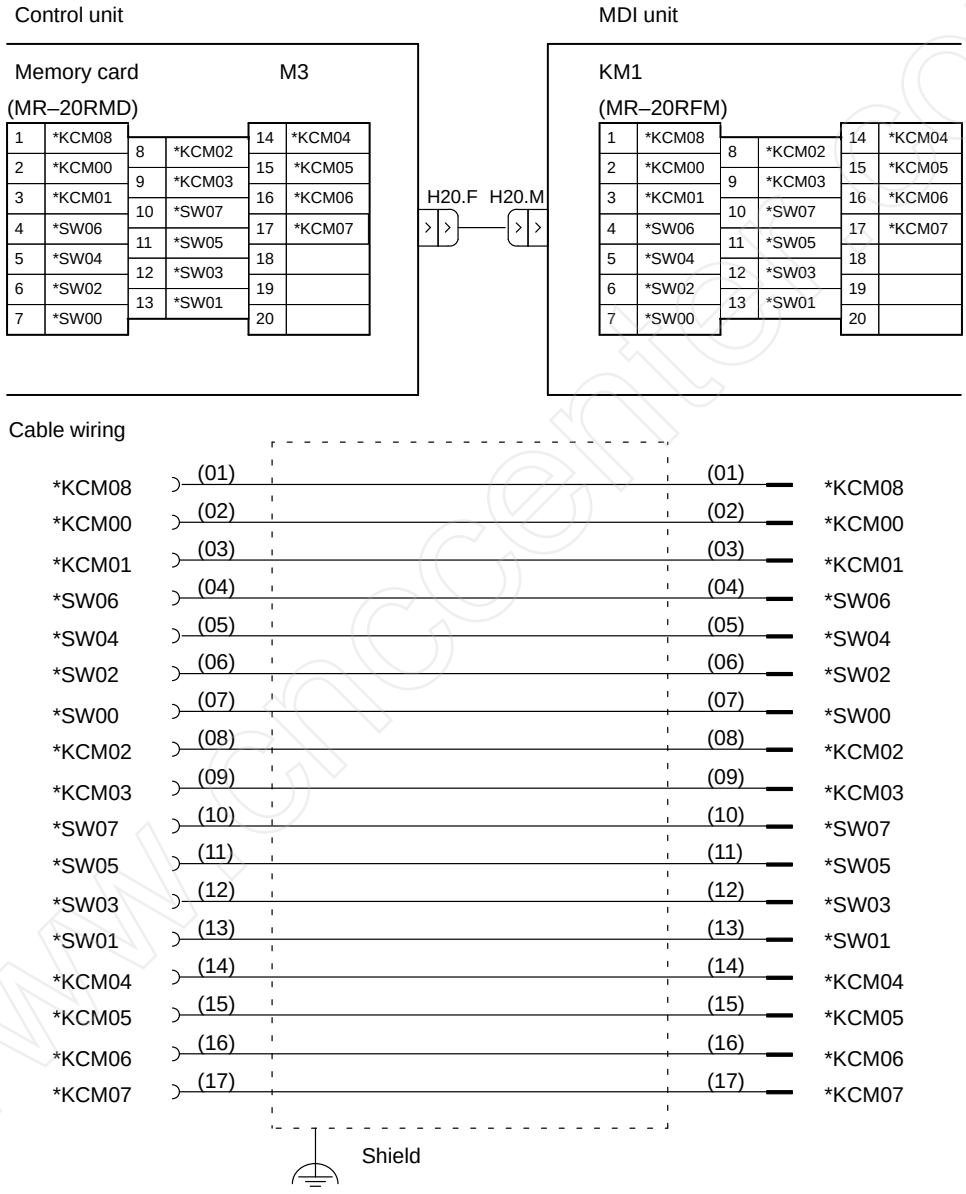
NOTE
Only Series 0–PD has the ON/OFF switch in the 9″ CRT/MDI unit.

- Connecting to the power supply unit AI
  9″ CRT/MDI unit of 0–PD full–key type



7.2 CONNECTING THE MDI UNIT

7.2.1 MDI Unit Interface

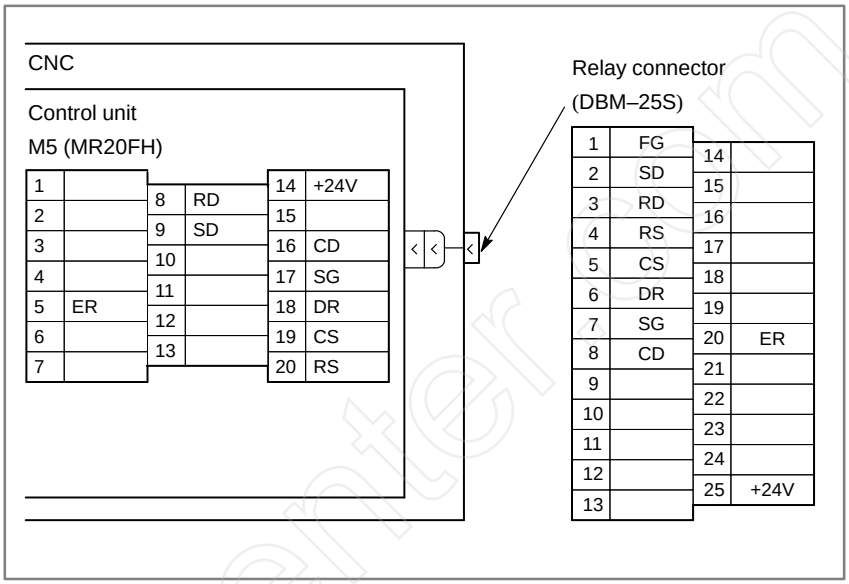


Use a unified shield cable of up to 50 m long.
Recommended cable : A02B–0050–K803 (7 m) or A02B–0098–K803 (7 m)
Recommended cable material : A66L–0001–0041 (7/0.18, 20 cores)

7.3 CONNECTING AN I/O DEVICE

7.3.1 Reader/Punch Interface

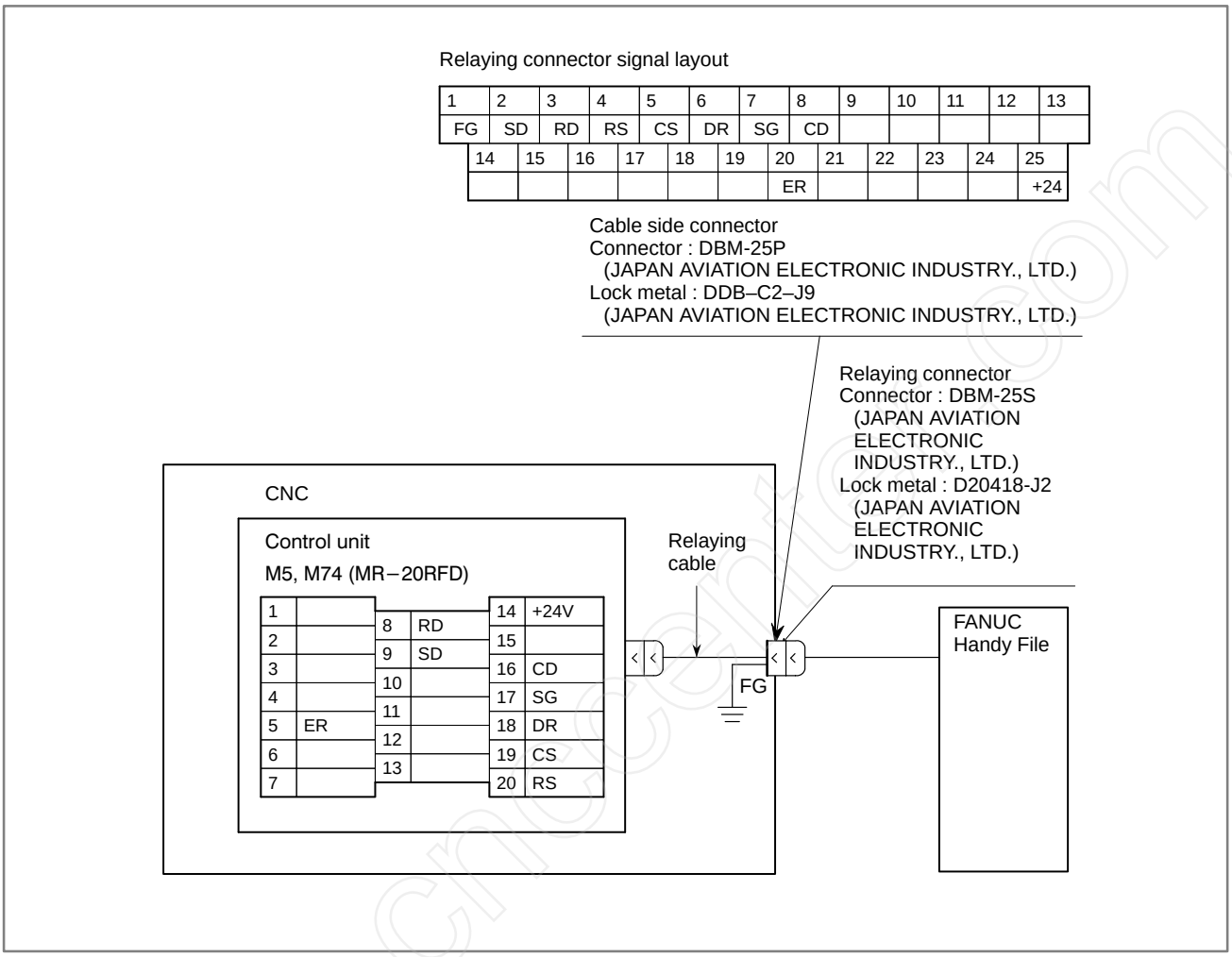
A program input/output unit, such as tape reader or FANUC FLOPPY CASSETTE, can be connected to the M5 connector of the control unit.



NOTE

The machine tool builder should provide the reader/punch relay board and cable, or use a punch panel. A unified shield cable must be used.

7.3.2 FANUC Handy File Connection



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-0001-0041
3 Open all terminals other than illustrated.

7.3.3 RS–232–C Interface Specification

RS–232–C Interface signals

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

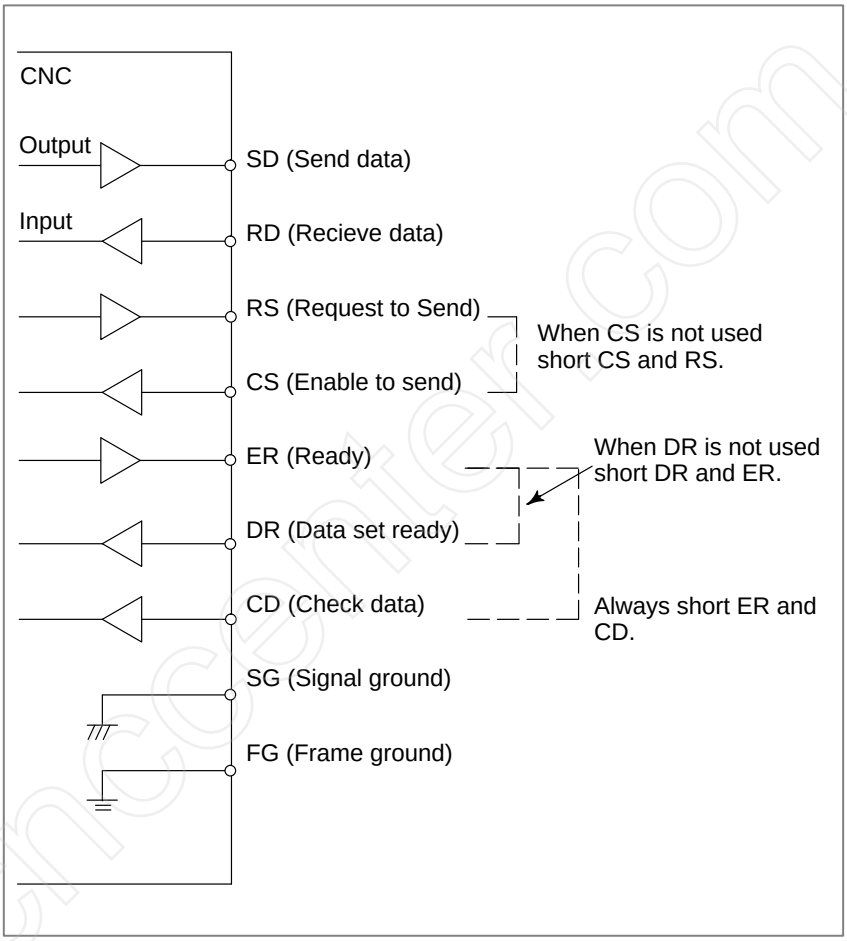
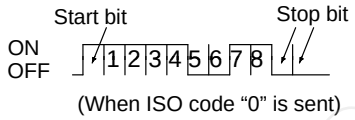


Fig. 7.3.3 RS–232–C interface

Signal description of RS–232–C interface

Signal name	RS–232–C circuit number	I/O	Description	
SD	103	Output	Sending data	 (When ISO code “0” is sent)
RD	104	Input	Receiving data	
RS	105	Output	Sending request	This signal is set to on when NC starts sending data and is turned off when transmission ends.
CS	106	Input	Sending permitted	When both this signal and the DR signal are set, the NC can send data. If external device processing is delayed by a punching operation, etc., NC data sending can be stopped by turning off this signal after sending two characters, including the data being sent currently. If this signal will not be used, make sure to strap this signal circuit to the RS signal circuit.
DR	107	Input	Data set ready	When external device is ready to operate, this signal is set. This signal should usually be connected to the signal indicating external device power supply being on. (ER signal of external device). See Note below. The NC transfers data when this signal is set. If the signals turned off during data transfer, alarm 086 is issued. If the DR signal will not be used, make sure to strap this signal circuit to the ER signal circuit.
ER	108.2	Output	NC ready to operation	This signal is set when the NC is ready to operate. External device should regard the SD signal as being significant when the ER signal is set.
CD	109	Input	Signal quality signal	Since this signal is not used in connections with external device, the signal circuit must be strapped, inside the connecting cable, to the ER signal circuit.
SG	102		Signal grounding	
FG	101		Frame grounding	

NOTE

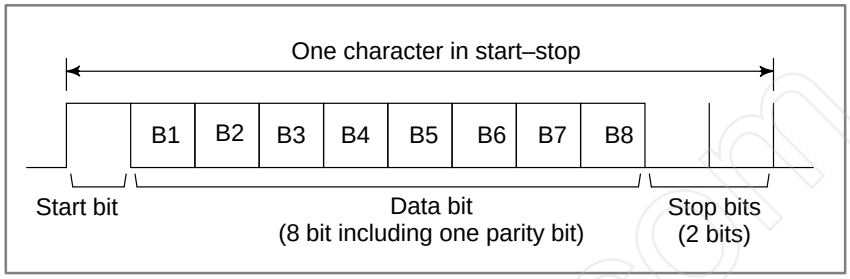
Signal on/off state is defined as follows;

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

Transmission Method of RS–232–C interface

Start–stop

Generally, two transmission methods are available at the serial interface. Series 0 use the start–stop method. With this method, start and stop signals are output before and after each data bit.



Codes

Transmission codes are as follows:

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

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

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

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

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

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

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

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

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

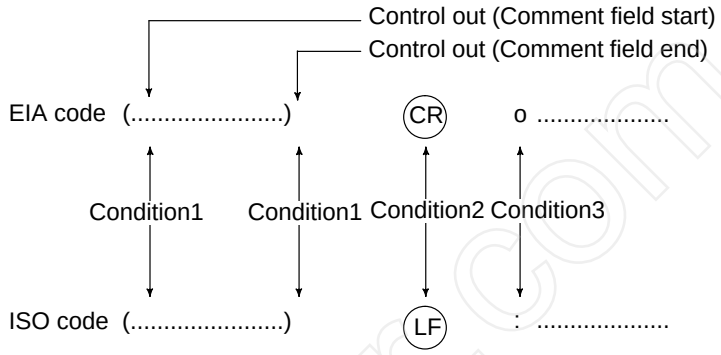
(ii) If control code DC3 is input to NC, NC stops data output within ten characters. When control code DC1 is input to NC, NC starts sending data again.

(c) When the external device is equipped with an ISO/EIA converter, the external device must satisfy the specification shown in Table 7.3.3 (a).

Table7.3.3

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		○				•	○	○			Address O
P		○		○		•				p		○		○		•	○	○	○		Address P
Q	○	○		○		•			○	q		○		○	○	•					Address Q
R	○	○		○		•		○		r		○			○	•			○		Address R
S		○		○		•		○	○	s			○	○		•		○			Address S
T	○	○		○		•	○			t			○			•		○	○		Address T
U		○		○		•	○		○	u			○	○		•	○				Address U
V		○		○		•	○	○		v			○			•	○		○	?	Address V
W	○	○		○		•	○	○	○	w			○			•	○	○			Address W
X	○	○		○	○	•				x			○	○		•	○	○	○		Address X
Y		○		○	○	•			○	y			○	○	○	•				?	Address Y
Z		○		○	○	•		○		z			○		○	•			○		Address Z
DEL	○	○	○	○	○	•	○	○	○	Del		○	○	○	○	•	○	○	○	*	Delete (cancel erroneous hole)
NUL						•				Blank						•				*	No holes. Not used at significant data zone is EIA code.
BS	○				○	•				BS			○		○	•		○		*	Back space
HT					○	•			○	Tab			○	○	○	•	○	○		*	Tabulator
LF or NL					○	•		○		CR or EOB	○					•					End of block
CR	○				○	•	○		○							•				*	Carriage return
SP	○		○			•				SP				○		•				*	Space
%	○		○			•	○		○	ER					○	•		○	○		Absolute rewind stop
(			○		○	•				(2–4–5)				○	○	•		○			Control out (start of comment)
)	○		○		○	•			○	(2–4–7)		○			○	•		○			Control in (end of comment)
+			○		○	•		○	○	+		○	○	○		•				*	Plus sign
–			○		○	•	○		○	–		○	○		○	•				–	Minus sign
:			○	○	○	•		○													Assumed as program number in ISO code.
/	○		○		○	•	○	○	○	/			○	○		•			○		Optional block skip
.			○		○	•	○	○		.		○	○		○	•		○	○		Decimal point
#	○		○			•		○	○											*	Sharp
$			○			•	○													*	Dollar symbol
&	○		○			•	○	○		&					○	•	○	○		*	Ampersand
’			○			•	○	○	○											*	Apostrophe
*	○		○		○	•		○												*	Asterisk
,	○		○		○	•	○			,			○	○	○	•		○	○	*	Comma
;	○		○	○	○	•		○	○											*	Semicolon
<			○	○	○	•	○													*	Left angle bracket
=	○		○	○	○	•	○		○											*	Equal mark
>	○		○	○	○	•	○	○												*	Right angle bracket
?			○	○	○	•	○	○	○											*	Question mark
@	○	○				•														*	Commerical at mark
”			○			•		○												*	Quotation mark

NOTE
1 When the external device is equipped with an ISO/EIA converter, the following items must be noted in Table 7.3.3.



Condition1

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

Condition2

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

Condition3

EIA code O is : in ISO code.

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

(iii) Transmission rate (Baud rate)

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

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

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

(Example)

Baud rate : 110

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

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

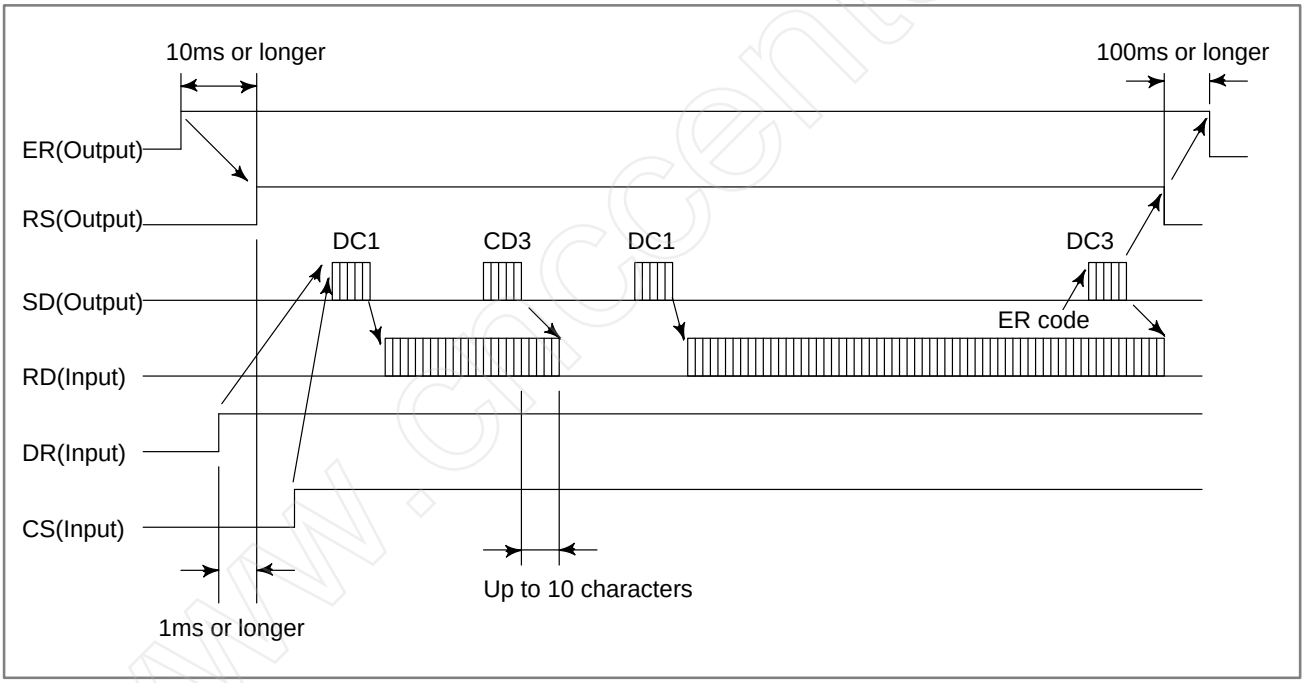
(Max.)

(iv) Cable length
The cable length depends on the external device type. Consult with the device manufacturers for actual connecting cable lengths.
When cable A (A66L–0001–0041) is used, cable length is as follows by the specification of NC.

for RS–232–C 100m or less ... 4800 bauds or less
60m or less ... 9600 bauds or less

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

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



Time chart when the NC send data (Punch out)

(1) NC output DC2.

(2) NC outputs punch data in succession.

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

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

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

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

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

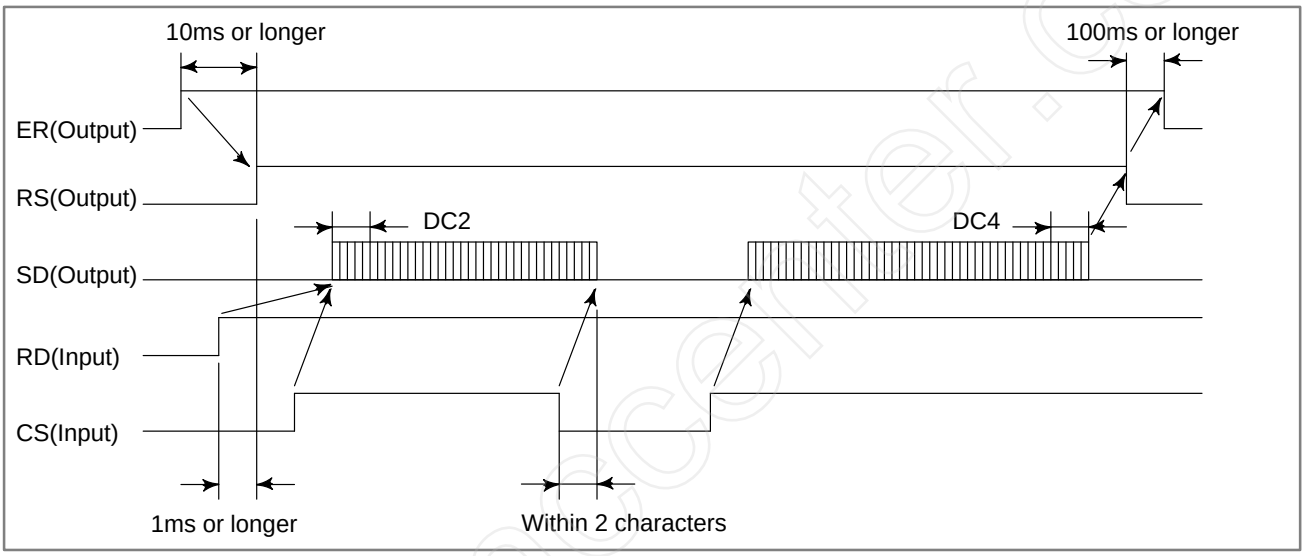


Fig. A

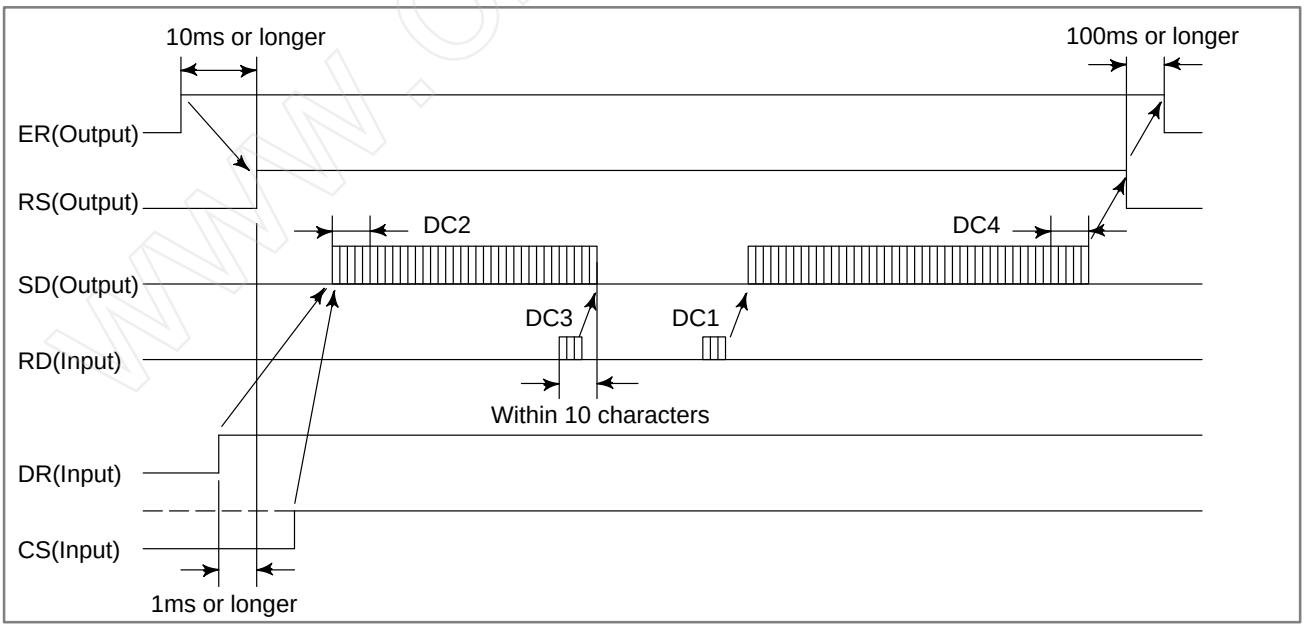
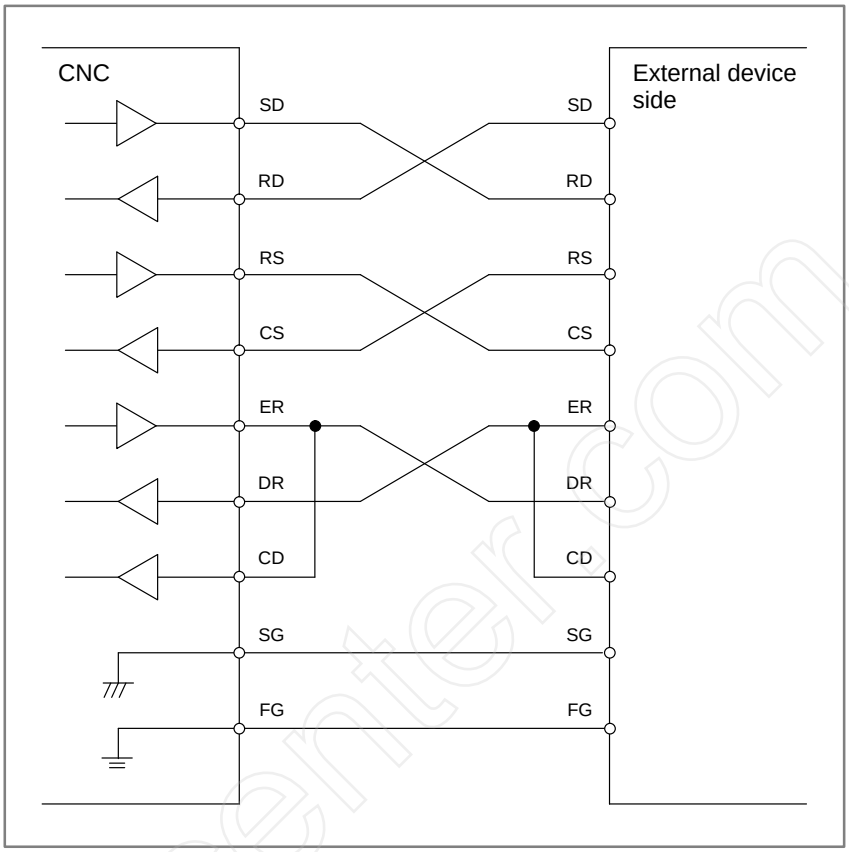
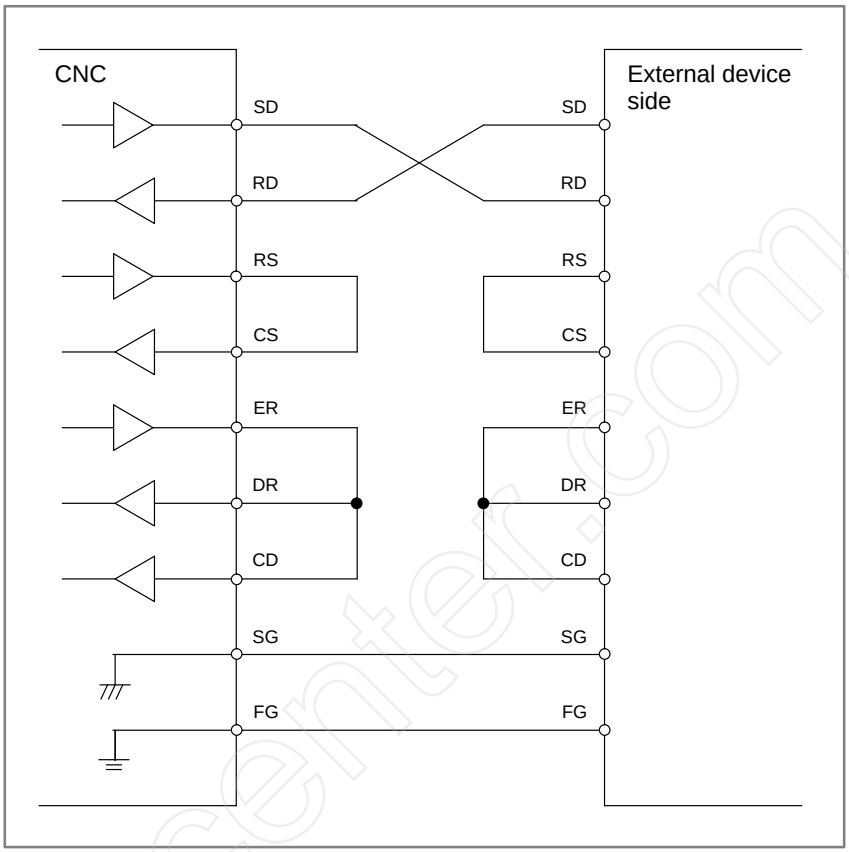


Fig. B

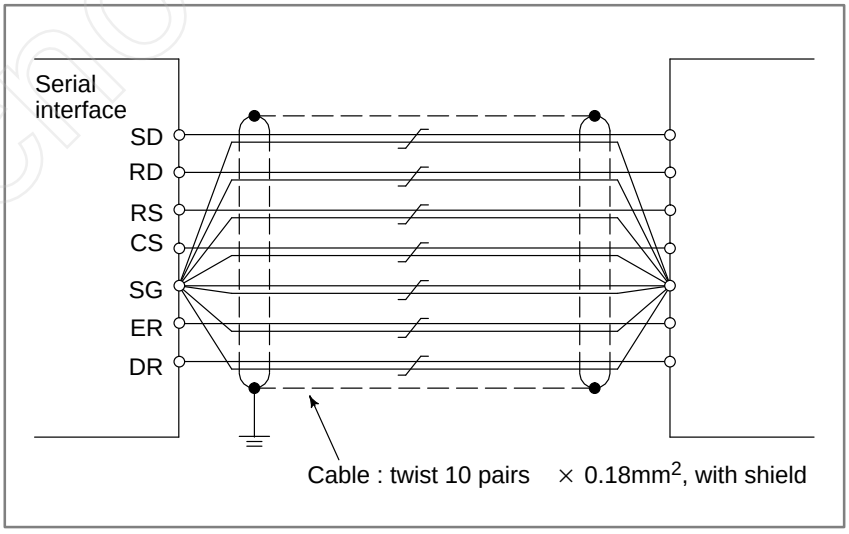
Connection between RS–232–C interface and external device



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



Prepare the cable with I/O device as follows :



7.3.4 Parameters Related to the Reader/Punch Interface

SETTING	I/O : Select the I/O unit

Select an I/O unit to or from which a program is input or output through the reader/punch interface.

0 : Uses the unit whose parameters are specified in No.0002 (NFED, ASR33, STP2), No.0552 (BRATE0), and No.0038 (RSCMD1, DEVFL1). (Memory card M5)

1 : Uses the unit whose parameters are specified in No.0012 (NFED, ASR33, STP2), No.0553 (BRATE1), and No.0038 (RSCMD1, DEVFL1). (Memory card M5)

	#7	#6	#5	#4	#3	#2	#1	#0	
0002	NFED					ASR33		STP2	(I/O=0)
	#7	#6	#5	#4	#3	#2	#1	#0	
0012	NFED					ASR33		STP2	(I/O=1)

NFED 1 : When a program is output, a feed command is not output before or after the program. (Set this to 1 when a FANUC Handy File is used.)

0 : When a program is output, a feed command is output before and after the program.

ASR33 1 : Uses the 20–mA interface.

0 : Uses the Fanuc Handy File.

STP2 1 : Uses two bits as the stop bits.

0 : Uses one bit as the stop bit.

0552	BRATE0	(I/O=0)
0553	BRATE1	(I/O=1)

BRATE0, BRATE1: Baud rate when reader/punch interface is used.

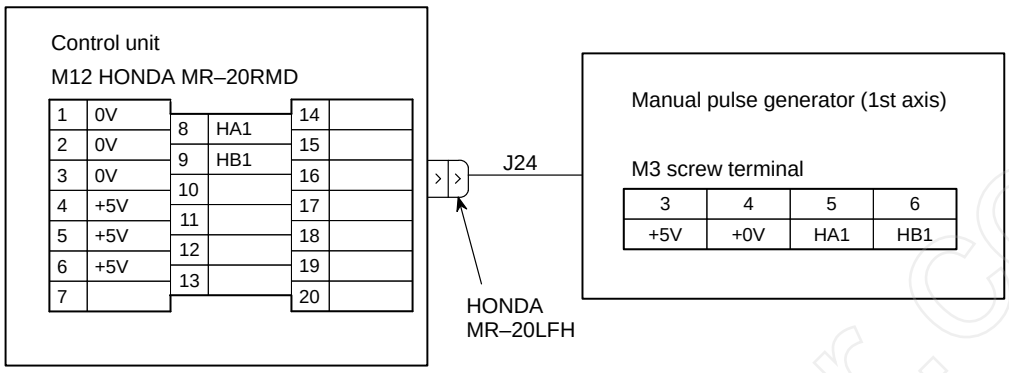
Set value	Baud rate
1	50
2	100
3	110
4	150
5	200
6	300
7	600
8	1200
9	2400
10	4800
11	9600

	#7	#6	#5	#4	#3	#2	#1	#0	
0038	RSCMD1	DEVFL1							(I/O=0)

RSCMD1, DEVFL1 I/O unit on channel 1 of reader/punch interface

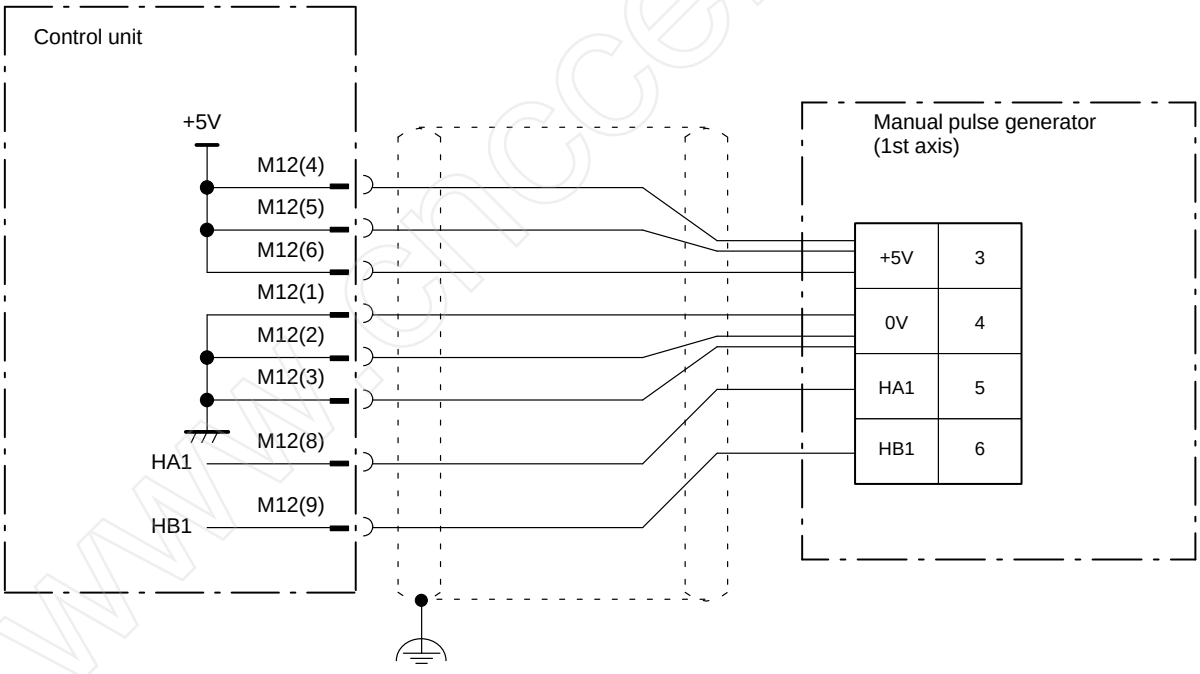
RSCMD1	DEVFL1	I/O unit to be used
0	0	“Bubble Cassette”
0	1	“Floppy Cassete”
1	0	FANUC PPR, RS232C
1	1	New interface

7.4 MANUAL PULSE GENERATOR INTERFACE



Cable spec. : 7/0.18 (0.2mm^2) or more unified shielded cable
Recommended cable spec : A66L–0001–0041

A02B–0050–K802 (7m) can be used for J24.



Cable connection for the manual pulse generator

The power supply to the manual pulse generator is 5 VDC, same as for the pulse coder. It is therefore necessary to prevent cable resistance from causing the supply voltage to drop more than 0.2V (total for both the 0 V and 5 V lines).
This is written as:

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

0.1 : 0.1 A power supply current of the manual pulse generator
R : Resistance per unit length of the wire (Ω/m)
m : Number of wires connected in each 0 V and 5 V line
L : Wire length (m)

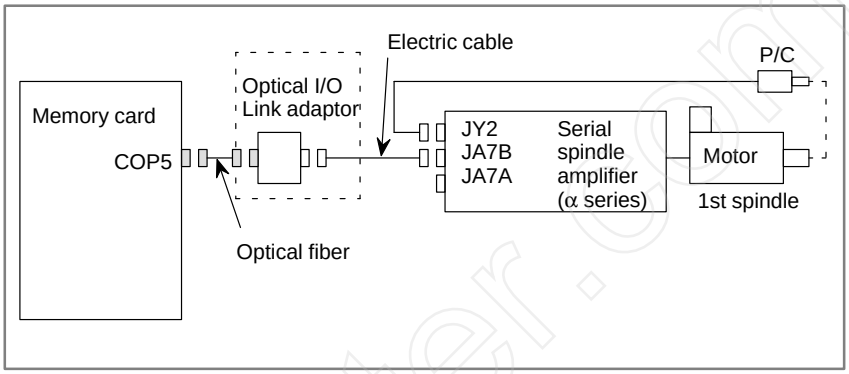
This can be converted to the following equation:

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

8 CONNECTIONS FOR SPINDLE

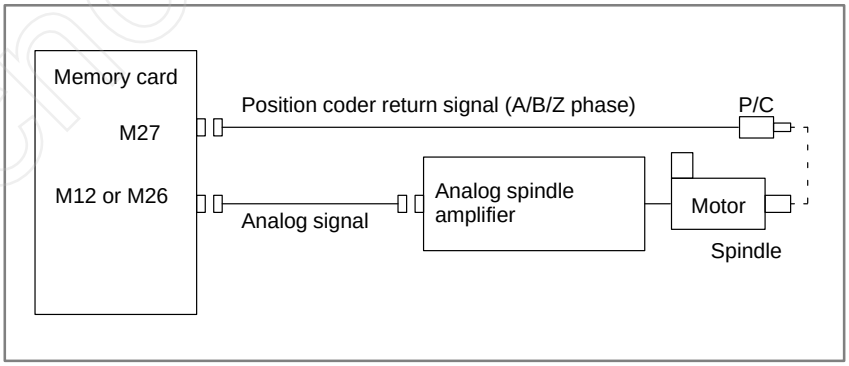
Serial spindle

The following three configurations of the spindle interface are available

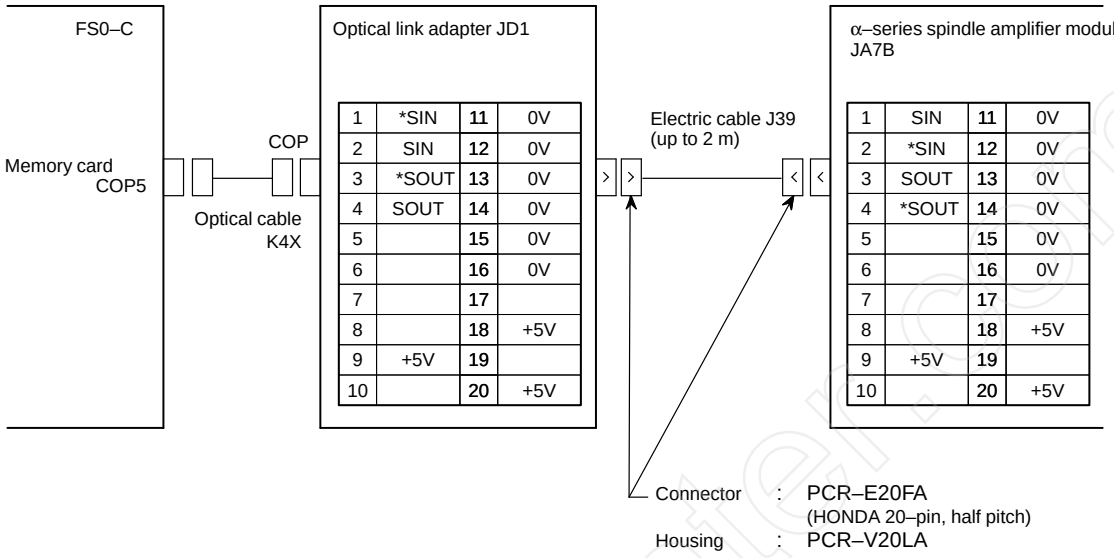


NOTE
Optical I/O Link adapter in ⬚ is required when serial spindle amplifier is α series.

Analog spindle



8.1 SERIAL SPINDLE INTERFACE



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

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

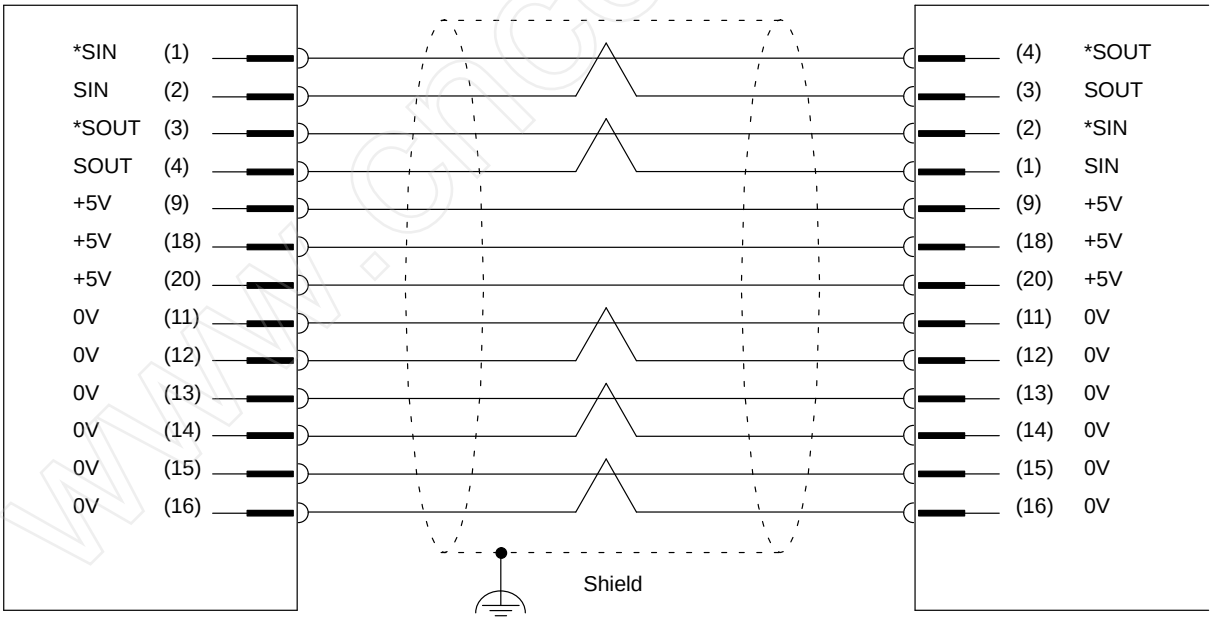
Code of optical cable (K4X)

A66L–6001–0009#L□□□□□ (with reinforced jacket)

Length designation

or A66L–6001–0008#L2R003 (2m) (Without reinforced jacket)

Electric cable connection

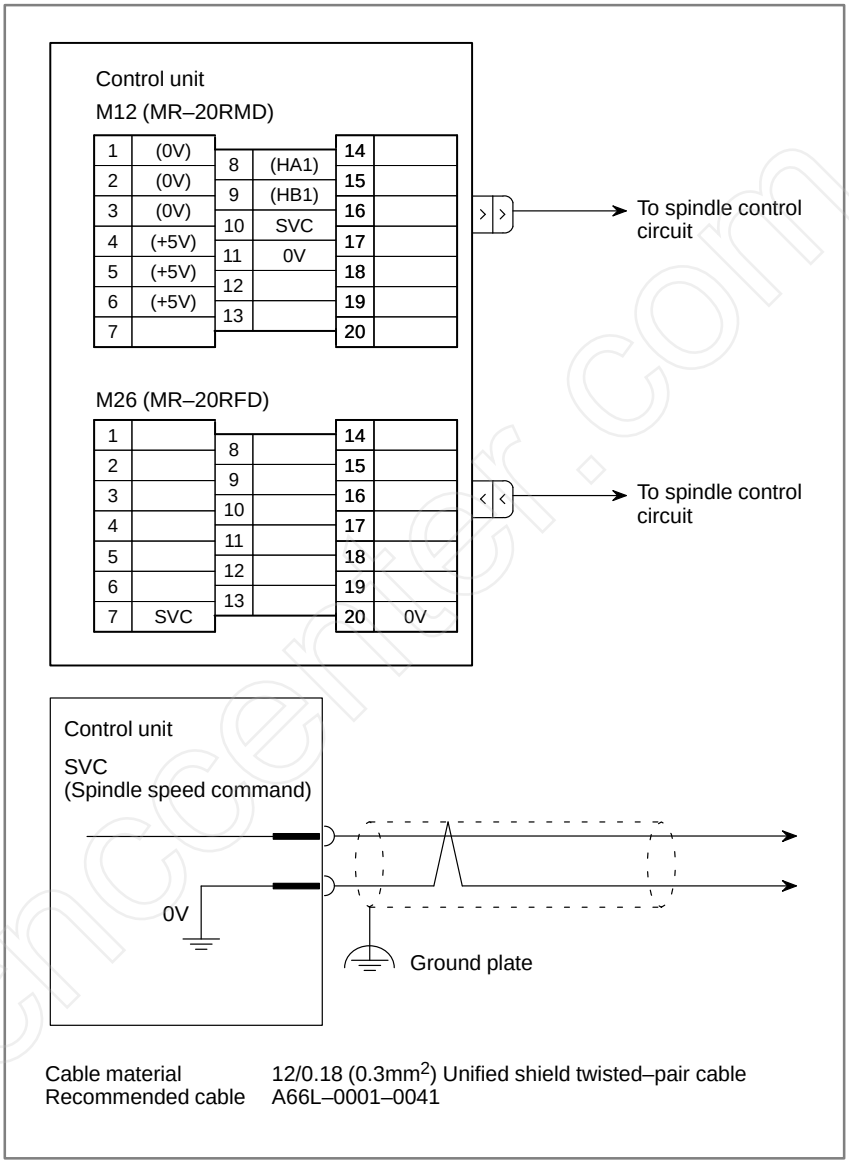


Recommended cable material A66L–0001–0284#10P (#28AWG × 10)

Recommended cable specification A02B–0120–K844 (1m)

8.2 ANALOG SPINDLE INTERFACE

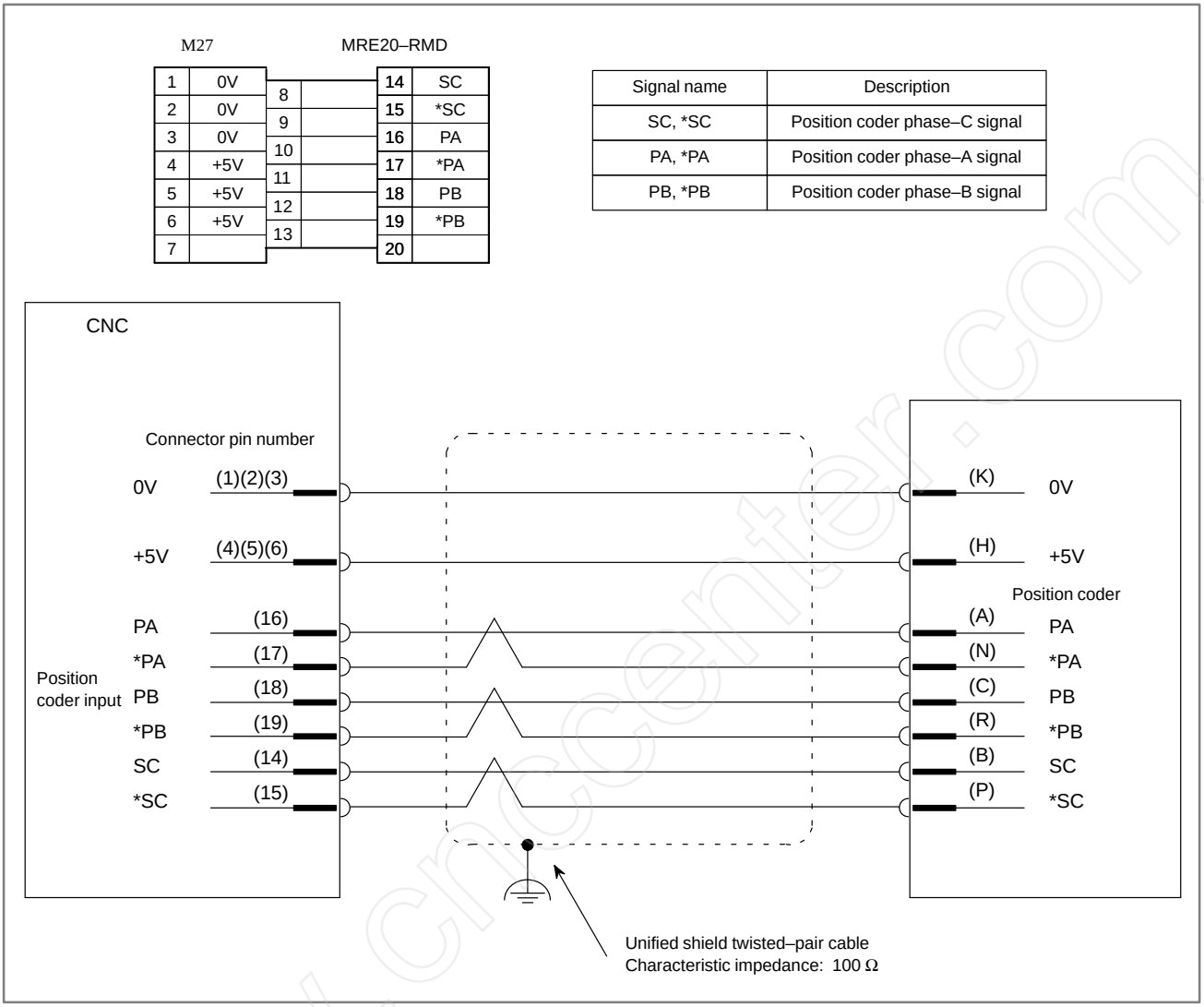
The speed of the analog spindle is specified by analog voltage output. The analog output for the first spindle can be output from pin 10 of M12 or pin 7 of M26. Choose either pin.



Cable material 12/0.18 (0.3mm^2) Unified shield twisted–pair cable
Recommended cable A66L–0001–0041

NOTE
1 M12 is also used as the connector for the first manual pulse generator.
2 In addition to the spindle speed analog voltage signal (SVC), use the spindle enable signal (ENB). Use the same cable as that indicted above.

8.3 POSITION CODER INTERFACE



Signal name	Description
SC, *SC	Position coder phase–C signal
PA, *PA	Position coder phase–A signal
PB, *PB	Position coder phase–B signal

NOTE

1 The current drain of the position coder is 0.35 A. Determine the number of 0V and +5V lines to be connected so that the total voltage drop between the NC and position coder does not exceed 0.2 V, total for both ways.

2 With the 0–TTC, a second position coder can be used. Use the M29 connector of the 5th/6th axis card. The M29 connector has the same pin assignment as the M27 connector.
When the second position coder is not used, connect the first position coder to M27 and M29 in parallel.

9 SERVO CONNECTIONS

9.1 OUTLINE

This section describes the servo interface between the Series 0–D and the α and β series servo amplifier and servo motor.

The Series 0–D supports two types of axis control cards according to the type of servo interface.

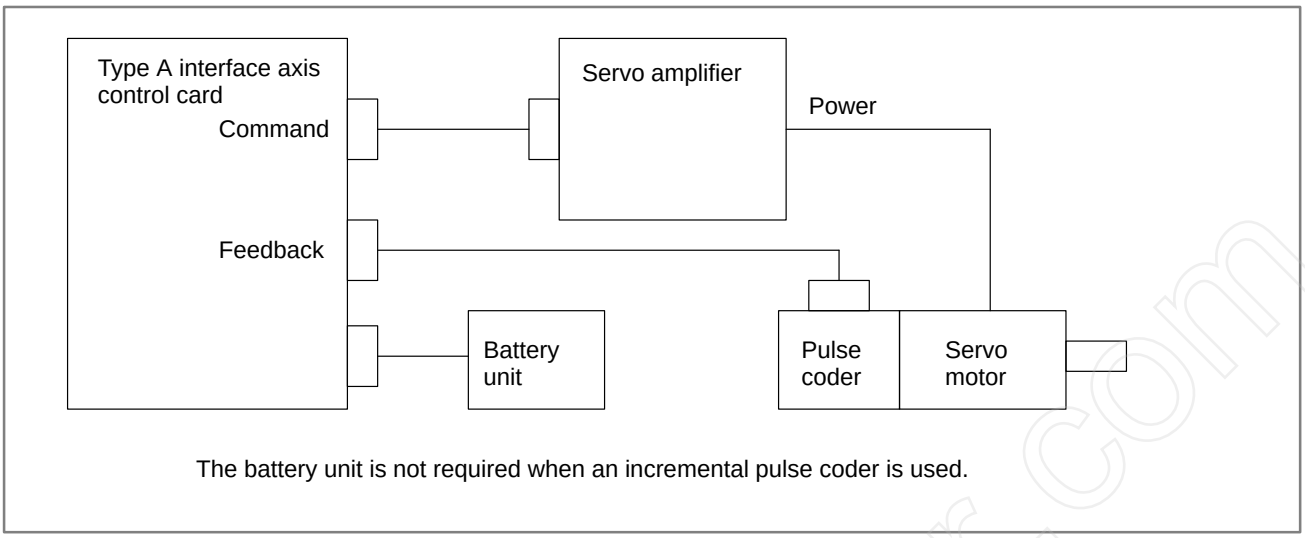
- Axis control card of type A interface
  (It can be used by 0–TD and 0–MD)
- Axis control card of type B interface

• Connector names

	Axis control card of type A interface				Axis control card of type B interface			
Axis name	Command	Semi–closed loop	Closed loop		Command	Semi–closed loop	Closed loop	
		Feedback	Position feedback	Velocity feedback		Feedback	Position feedback	Velocity feedback
1st axis	M184	M185	M186	M185	JS1A	JFn	M186	JFn
2nd axis	M187	M188	M189	M188	JS2A	JFn	M189	JFn
3rd axis	M194	M195	M196	M195	JS3A	JFn	M196	JFn
4th axis	M197	M198	M199	M198	JS4A	JFn	M199	JFn

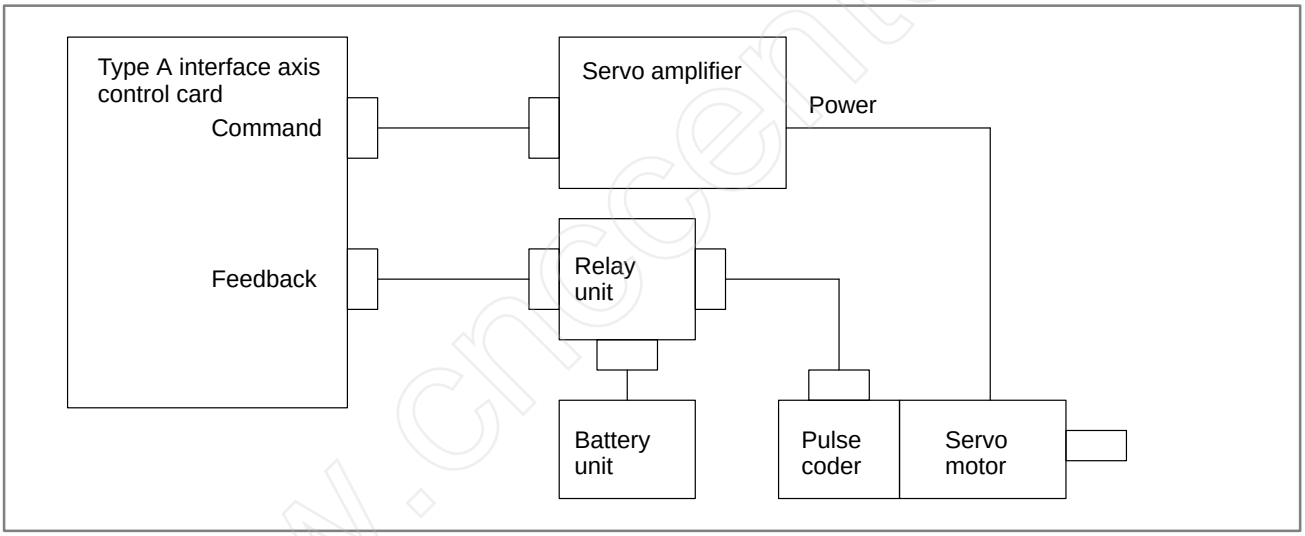
For a type B interface axis control card, the feedback or velocity feedback cable is connected to the JFn connector on the servo amplifier, where n varies with the servo amplifier being used.

- **Semi–closed loop system**

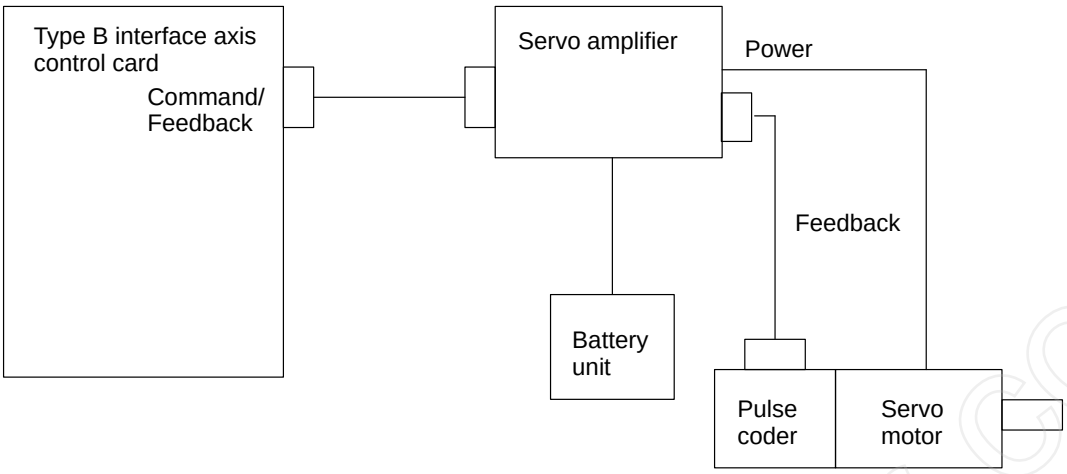


The battery unit is not required when an incremental pulse coder is used.

- **Semi–closed loop system** (when an absolute pulse coder and relay unit are used)

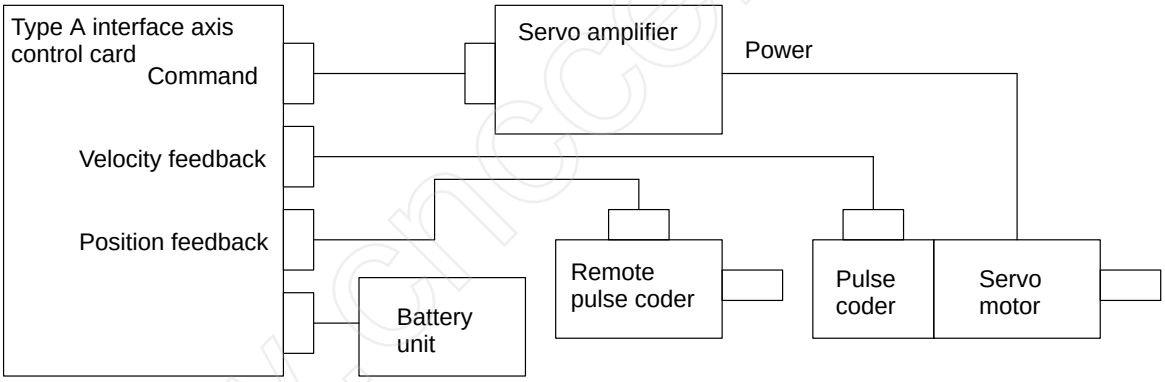


- **Semi–closed loop system**



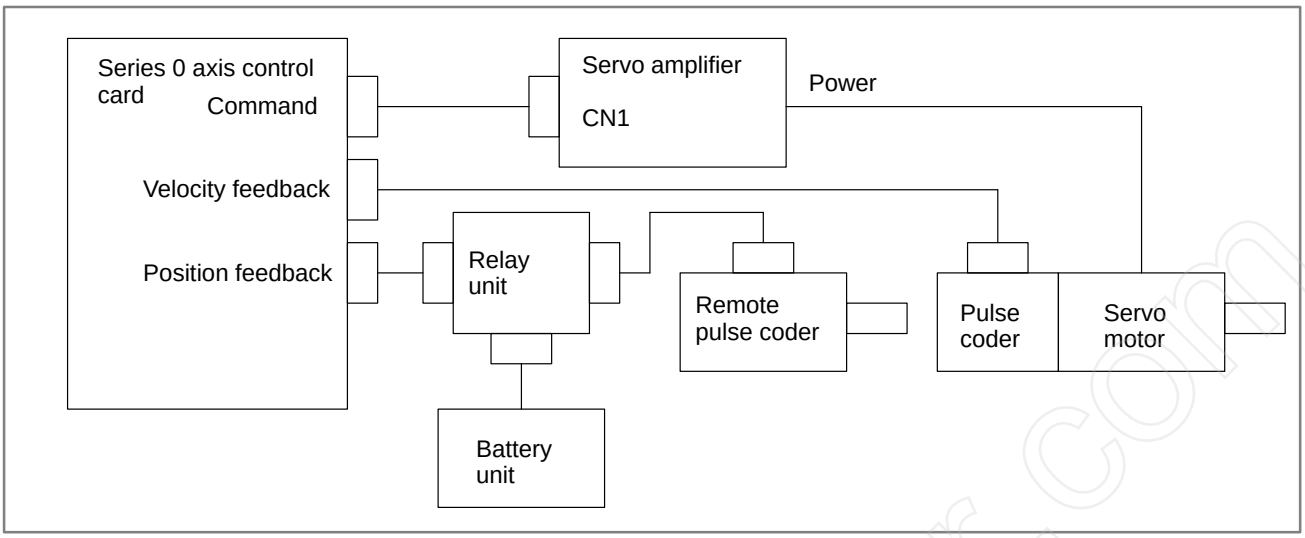
The battery unit is not required when an incremental pulse coder is used.
Use the servo amp. for type B interface or set common amp. to the B type.

- **Closed loop system**

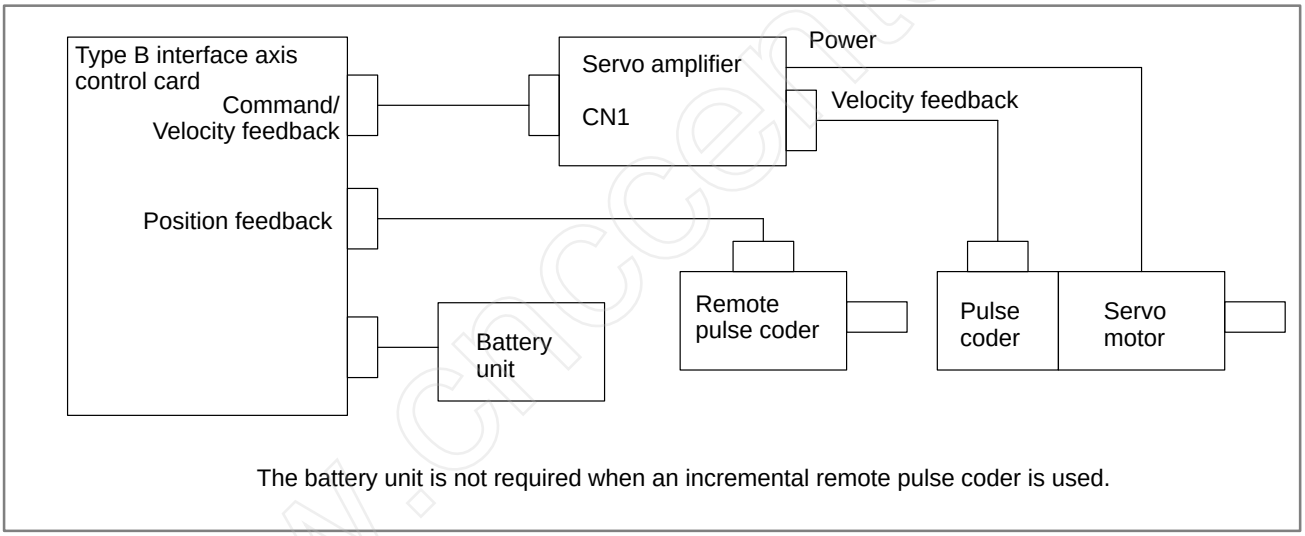


The battery unit is not required when an incremental pulse coder is used.

- **Closed loop system** (when an absolute pulse coder and relay unit are used)



- **Closed loop system**



The battery unit is not required when an incremental remote pulse coder is used.

9.2 SERVO AMPLIFIER INTERFACE

This section describes each servo amplifier interface, taking that for the first axis as an example.

9.2.1 In case of Type A Interface

Type A interface axis control card M184 (MR–20RF)

01	*PWMAn	08	IRn	14	*PWMDn
02	COMAn	09	GDRn	15	COMDn
03	*PWMBn	10	ISn	16	*PWMEn
04	COMBn	11	GDSn	17	COMEn
05	*PWMCn	12	*MCONn	18	*PWMFn
06	COMCn	13	GNDn	19	COMFn
07	*DRDYn			20	

n: axis number

Servo amplifier JV1B (L–axis), JV2B (M–axis)

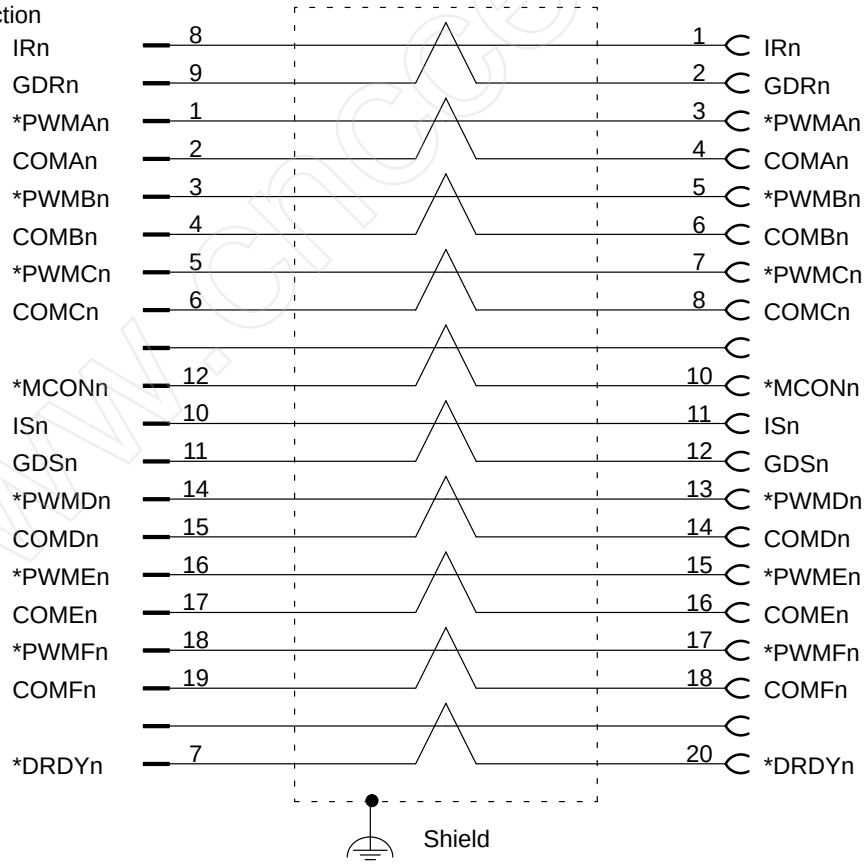
CN1

01	IRn	11	ISn
02	GDRn	12	GDSn
03	*PWMAn	13	*PWMDn
04	COMAn	14	COMDn
05	*PWMBn	15	*PWMEn
06	COMBn	16	COMEn
07	*PWMCn	17	*PWMFn
08	COMCn	18	COMFn
09		19	
10	*MCONn	20	*DRDYn

Connector: MR–20LMH (HONDA, 20–pin, male)

Connector: PCR–E20FA (HONDA, 20–pin, half–pitch) or equivalent

Cable connection



Recommended cable material A66L–0001–0284#10P (#28AWG × 10pairs)

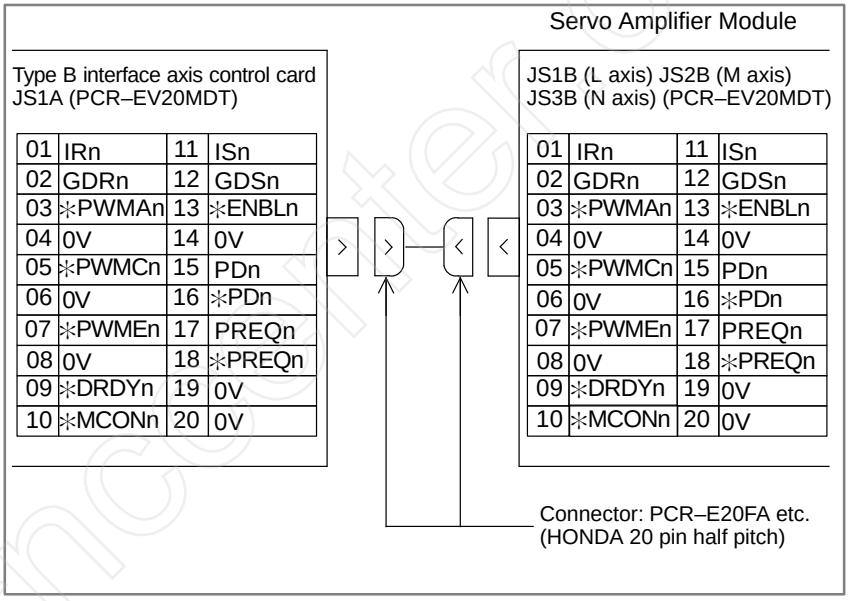
Recommended cable specification A02B–0098–K841 (5m)

CAUTION

To protect the signals from external noise, assign the cable's central pairs to each pair of current feedback signal and ground signal (i.e., IRn and GDRn, and ISn and GDSn). Otherwise, external noise may result in uneven feed or abnormal sound.

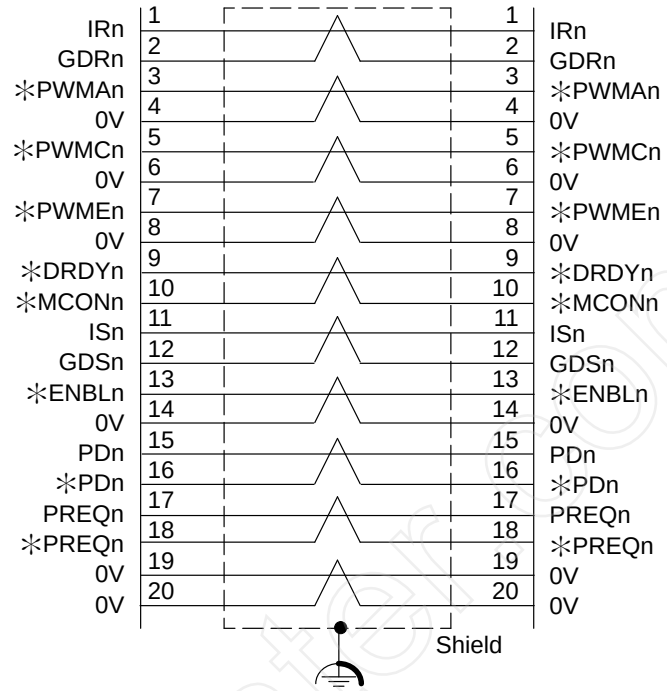
For connection on control motor amplifier α series or β series, refer to the Descriptions manual.

9.2.2 Interface to the Servo Amplifier



01	IRn	11	ISn
02	GDRn	12	GDSn
03	⁎PWMAn	13	⁎ENBLn
04	0V	14	0V
05	⁎PWMCn	15	PDn
06	0V	16	⁎PDn
07	⁎PWMEn	17	PREQn
08	0V	18	⁎PREQn
09	⁎DRDYn	19	0V
10	⁎MCONn	20	0V

CABLE WIRING



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

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

NOTE

1 The total length of the cable between the CNC and amplifier and that between the amplifier and motor shall not exceed 50m.
2 As the current feedback lines (IRn and ISn), use the middle twisted pair of the recommended cable. If any other pair is used, abnormal noise or oscillation may occur.
3 Use a servo unit which supports the type–B interface. When using a servo unit which supports both the type–A and type–B interfaces, select the type–B interface. For details, refer to the manual supplied with the servo unit. If the interface setting is incorrect, a servo alarm (AL401 V READY OFF) will be issued.

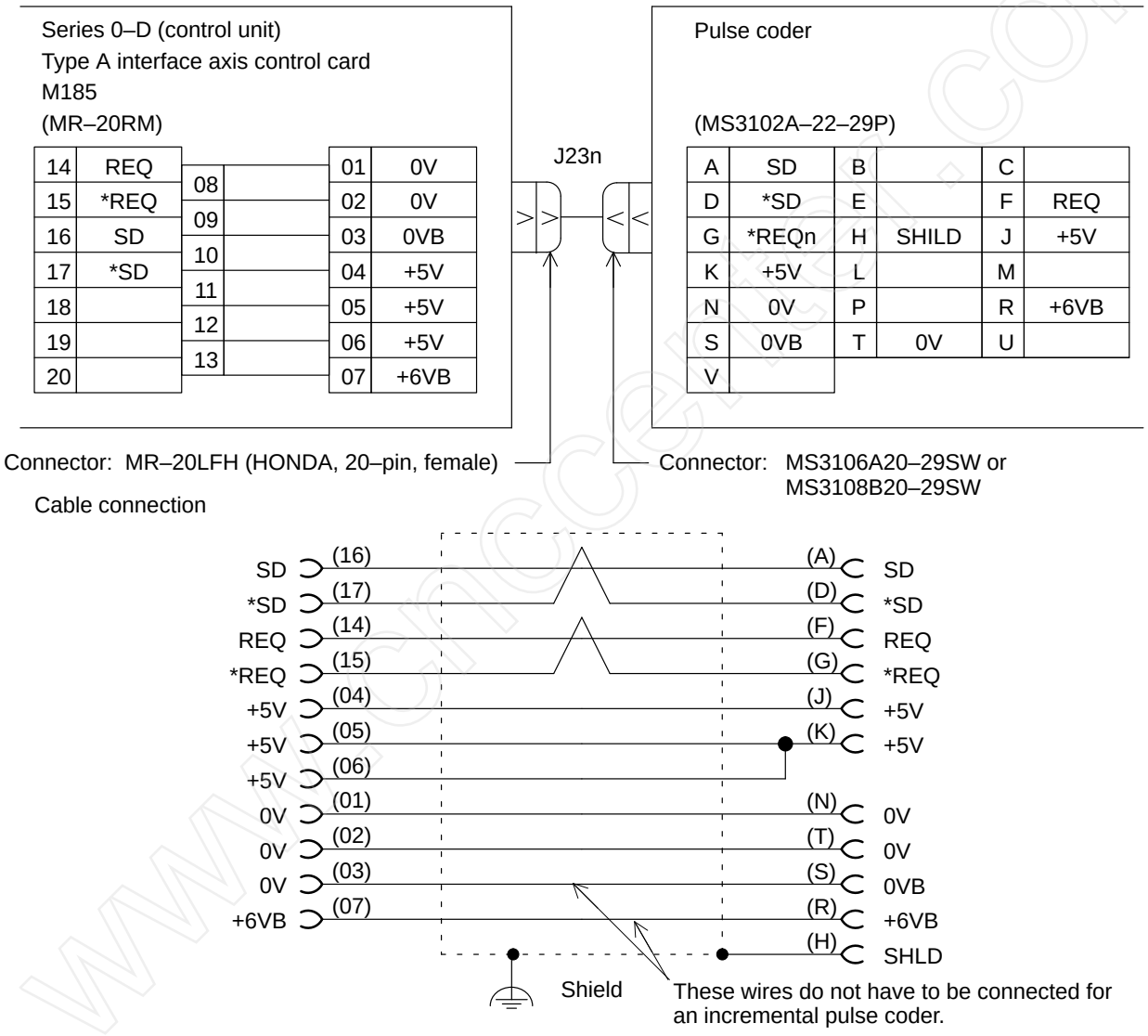
9.3 INTERNAL TYPE PULSE CODER (SERIAL PULSE CODER INTERFACE)

The connector to which the feedback cable from the built–in pulse coder is connected varies with the servo interface type.

For the type A interface, connect the feedback cable to the feedback connector on the axis control card (for example, M185 for the first axis).

For the type B interface, connect the feedback cable to the feedback connector on the servo amplifier (for example, JF1 for the first axis).

9.3.1 α Series Motor (α3/3000 to α150/2000)



Cable material : +5V, 0V ——— Two or more wires each having a cross–sectional area of at least 0.5 mm^2 (when the cable length is 14 m or less)

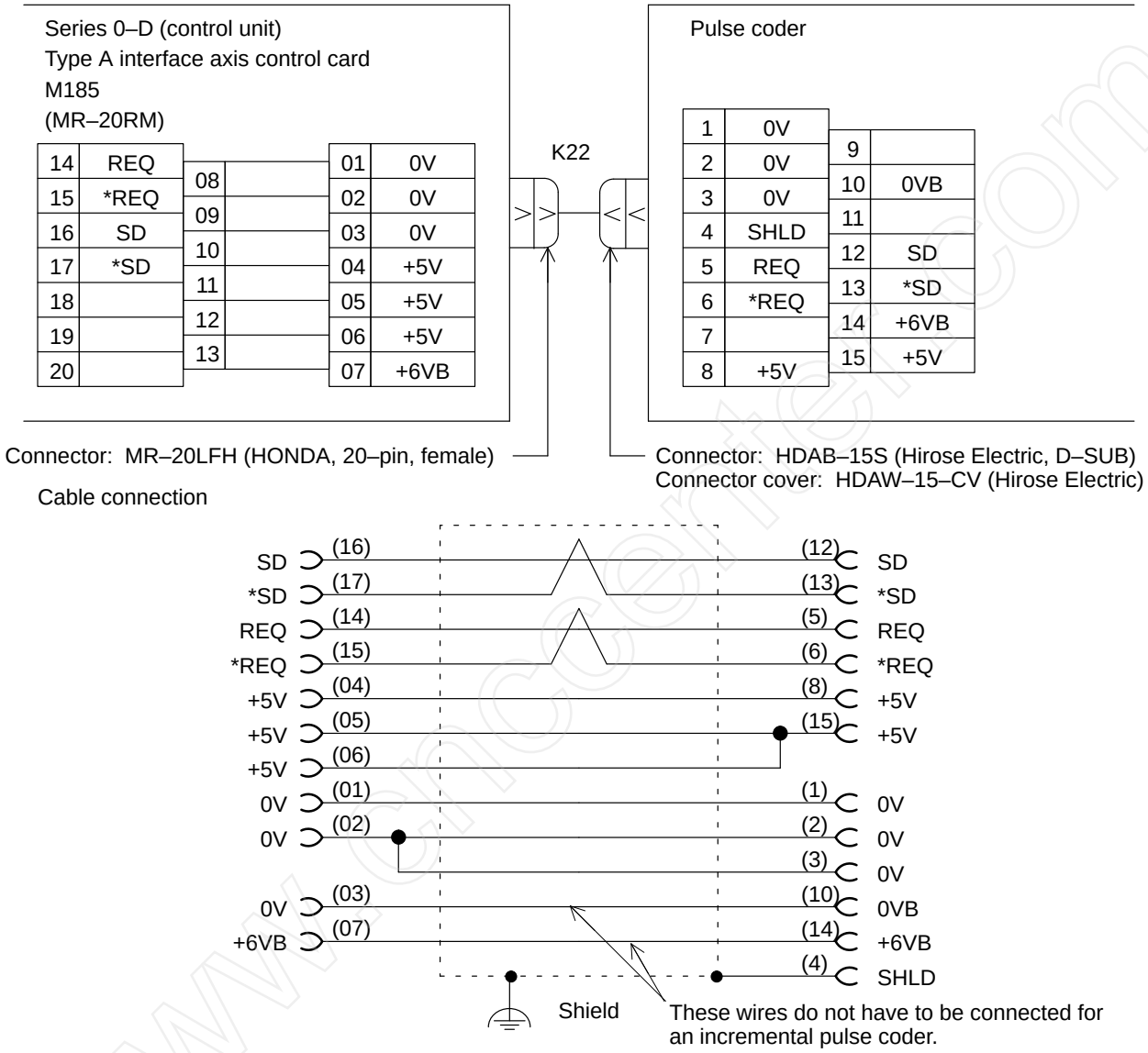
: +6VB, 0VB — One or more wires each having a cross–sectional area of at least 0.5 mm^2

: SD, *SD, REQ, *REQ — Twisted pair wires each having a cross–sectional area of at least 0.18 mm^2

NOTE

The voltage resistance for +5 V must not exceed 0.5Ω, total for both ways.

9.3.2 α Series Motor (α1/3000, α2/2000, or α2/3000)



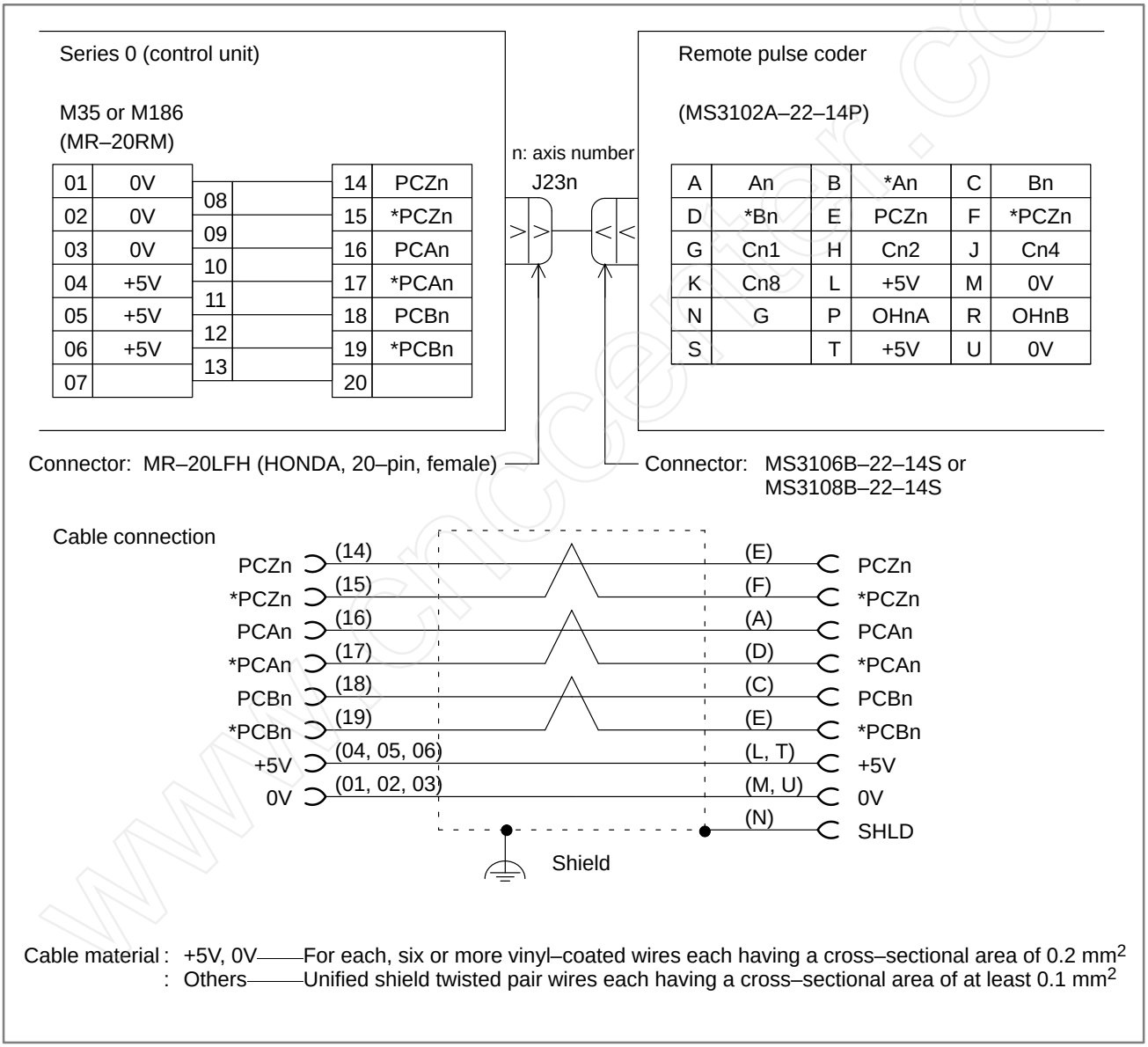
Cable material : +5V, 0V ——— Two or more wires each having a cross–sectional area of at least 0.5 mm^2 (when the cable length is 14 m or less)
: +6VB, 0VB ——— One or more wires each having a cross–sectional area of at least 0.5 mm^2
: SD, *SD, REQ, *REQ ——— Twisted pair wires each having a cross–sectional area of at least 0.18 mm^2

NOTE
The voltage resistance for +5 V must not exceed 0.5Ω, total for both ways.

9.4 REMOTE TYPE PULSE CODER

9.4.1 Low–Resolution A/B Phase Separate Pulse Coder (2000P to 3000P) (Separate Incremental Pulse Coder)

The position feedback cable from the separate pulse coder must be connected to the position feedback connector on the axis control card (for example, M186 for the first axis), regardless of the servo interface type.



Cable material : +5V, 0V——For each, six or more vinyl–coated wires each having a cross–sectional area of 0.2 mm^2
: Others——Unified shield twisted pair wires each having a cross–sectional area of at least 0.1 mm^2

NOTE
The total voltage resistance for +5 V and 0 V must not exceed 0.5Ω, total for both ways.

9.4.2 Remote Pulse Coder (Separate Absolute Pulse Coder)

- **Velocity feedback connection**

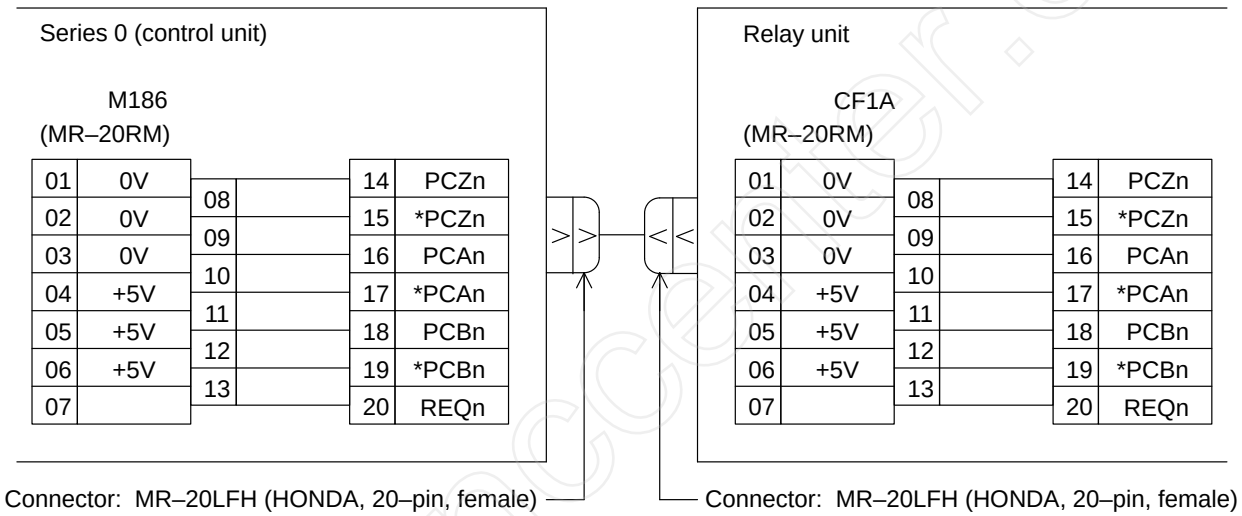
The velocity feedback connection between the motor's built–in pulse coder and the Series 0 is the same as that described in Section 9.3.5.

- **Position feedback connection**

An A/B–phase absolute pulse coder can be connected to the Series 0 in either of two ways: via the relay unit of the absolute pulse coder battery unit, or directly.

- When using the relay unit

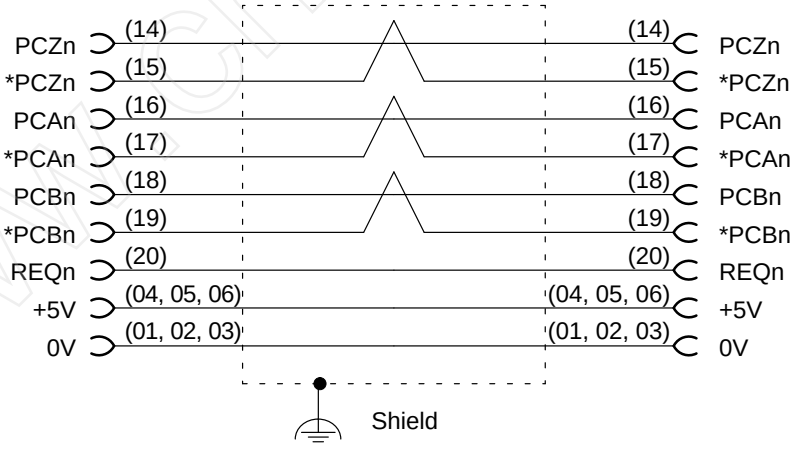
(1) Connection between Series 0 and relay unit



Connector: MR–20LFH (HONDA, 20–pin, female)

Connector: MR–20LFH (HONDA, 20–pin, female)

Cable connection



Cable material : +5V, 0V———Six or more vinyl–coated wires each having a cross–sectional area of 0.5 mm^2
: Cn1 to Cn8——Vinyl–coated wires each having a cross–sectional area of at least 0.18 mm^2
: Others———Unified shield twisted pair wires each having a cross–sectional area of at least 0.18 mm^2

The cable length must not exceed 2 m.

Recommended cable specification A02B–0074–K804 (2m)

(2) Connection between relay unit and A/B–phase pulse coder

Relay unit

CF1B
(MR–20RM)

01	0V	08	14	PCZn
02	0V	09	15	*PCZn
03	0V	10	16	PCAn
04	+5V	11	17	*PCAn
05	+5V	12	18	PCBn
06	+6VA	13	19	*PCBn
07			20	REQn

A/B–phase separate pulse coder
(separate absolute pulse coder)

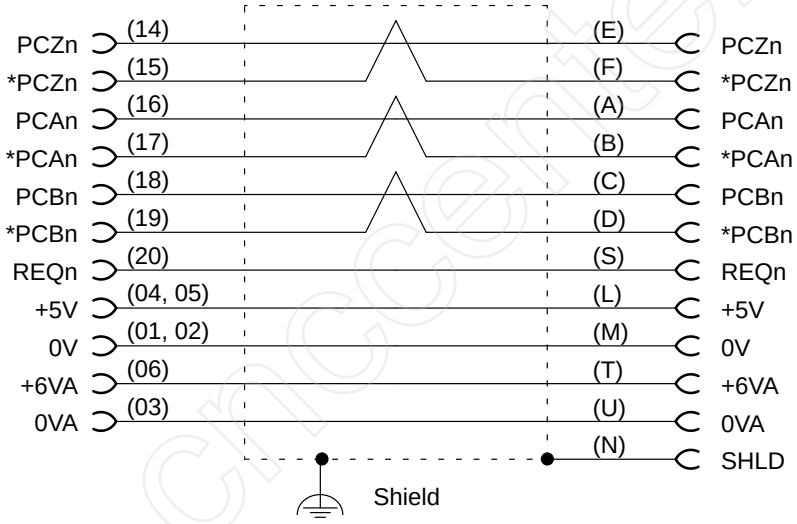
(MS3102A–22–14P)

A	PCAn	B	*PCAn	C	PCBn
D	*PCBn	E	PCZn	F	*PCZn
G		H		J	
K		L	+5V	M	0V
N	SHLD	P		R	
S	REQn	T	+6VA	U	0VA

Connector: MR–20LFH (HONDA, 20–pin, female)

Connector: MS3106B–22–14S (straight)
MS3108B–22–14S (elbow)

Cable connection



Cable material : +5V, 0V———Two 0.5–mm^2 wires
: +6VA, 0VA———One 0.5–mm^2 wire
: Others———Unified shield twisted pair wires each having a cross–sectional area of 0.18 mm^2

NOTE

The total voltage resistance for +5 V and 0 V must not exceed 0.5Ω, total for both ways, including the cable between the axis control card and the relay unit.

- Direct connection

Series 0 (control unit)

M186
(MR–20RM)

01	0V	08	14	PCZn
02	0V	09	15	*PCZn
03	0VB	10	16	PCAn
04	+5V	11	17	*PCAn
05	+5V	12	18	PCBn
06	+5V	13	19	*PCBn
07	+6VB		20	REQn

A/B–phase separate pulse coder
(separate absolute pulse coder)

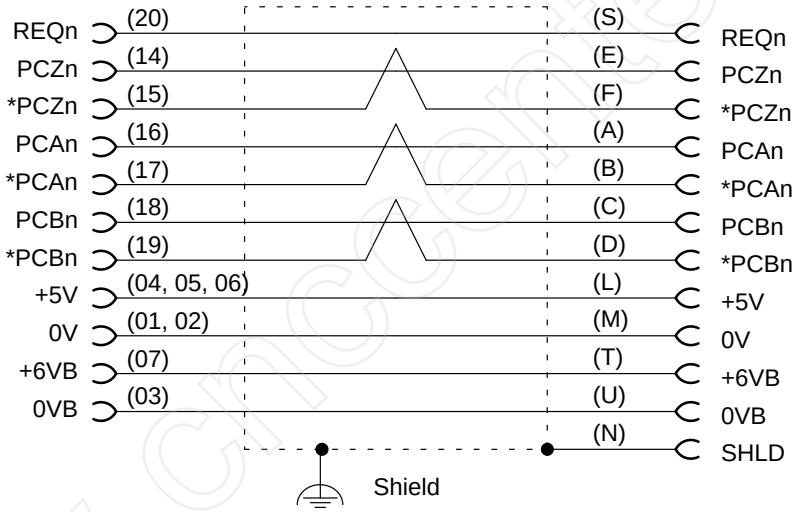
(MS3102A–22–14P)

A	PCAn	B	*PCAn	C	PCBn
D	*PCBn	E	PCZn	F	*PCZn
G		H		J	
K		L	+5V	M	0V
N	SHLD	P		R	
S	REQn	T	+6VB	U	0VB

Connector: MR–20LFH (HONDA, 20–pin, female)

Connector: MS3106B–22–14S (straight)
MS3108B–22–14S (elbow)

Cable connection



Cable material : +6VB, 0VB—0.5 mm^2 or more
: +5V, 0V——0.5 mm^2 or more
: Others———Unified shield twisted pair wires each having a cross–sectional area of at least 0.1 mm^2
: REQn———0.18 mm^2 or more

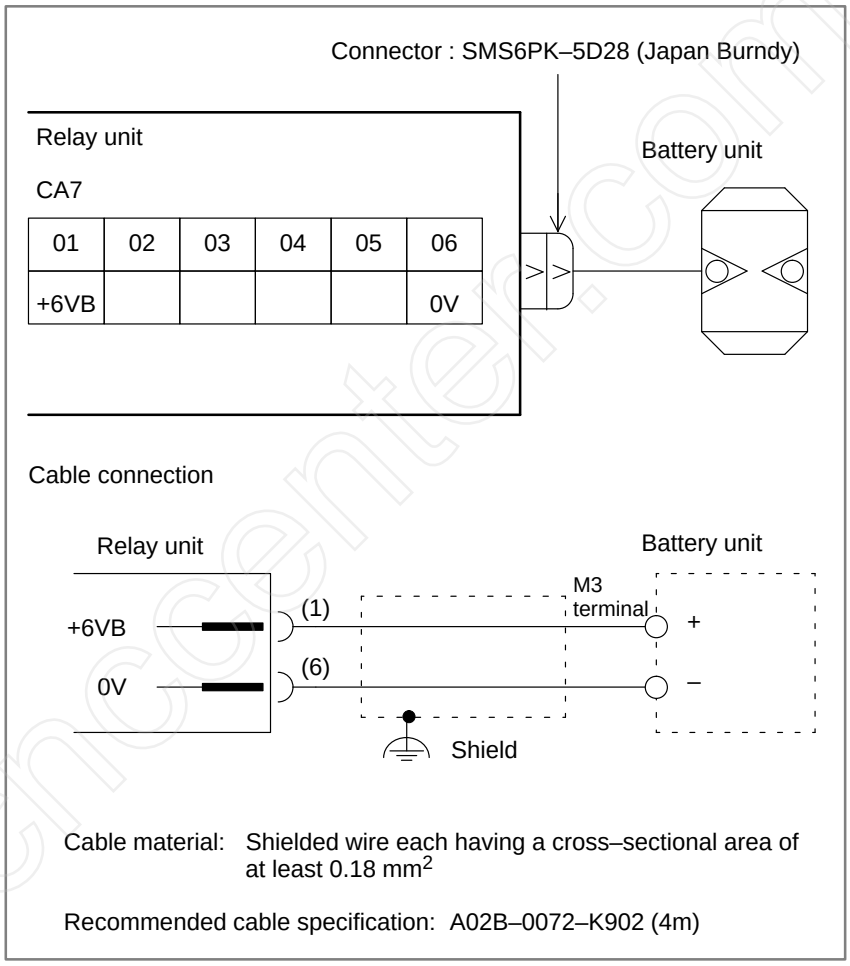
Recommended cable specification A02B–0096–K801 (14m) (straight)
A02B–0096–K802 (14m) (elbow)

NOTE
The voltage resistance for +5 V must not exceed 0.5Ω, total for both ways.

9.5 CONNECTION OF THE BATTERY UNIT FOR AN ABSOLUTE PULSE CODER

The battery unit for an absolute pulse coder can be connected to the Series 0 in either of two ways: via a relay unit or directly.

9.5.1 Connection Using the Relay Unit



Cable material: Shielded wire each having a cross–sectional area of at least 0.18 mm^2

Recommended cable specification: A02B–0072–K902 (4m)

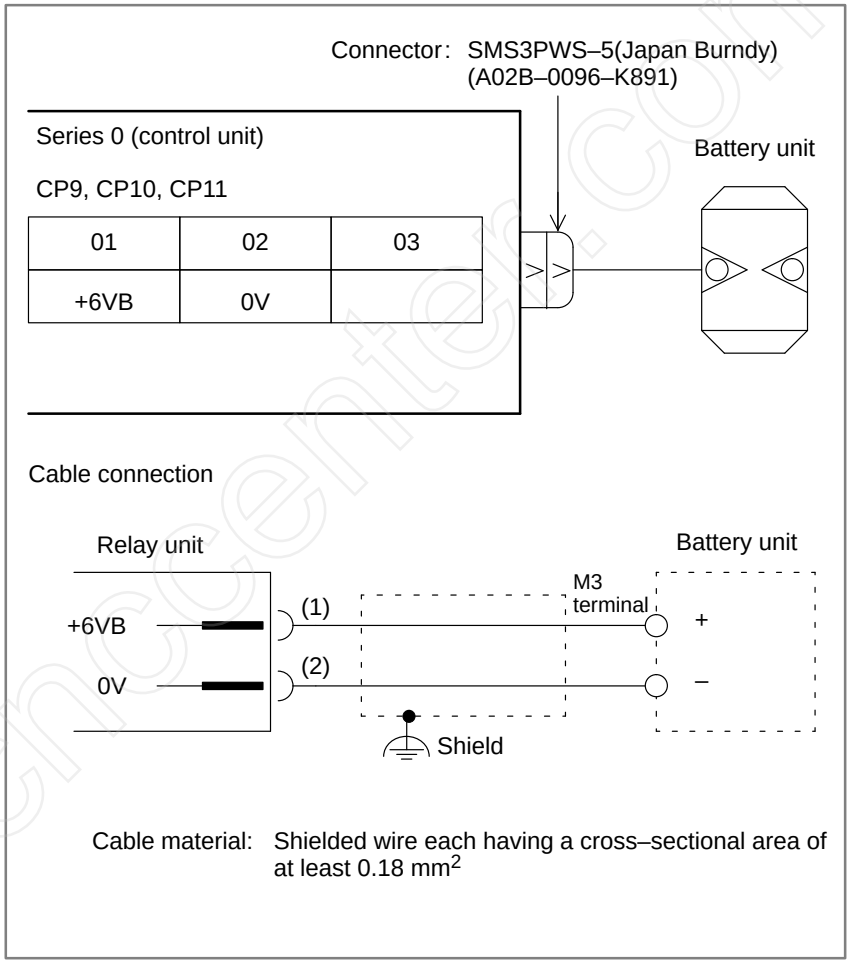
NOTE
1 A single relay unit can distribute power from the battery to up to four pulse coders.
2 A single battery unit can supply power to up to six pulse coders.
3 Replace the battery with a new one once a year.

9.5.2 Connection without a Relay Unit

The battery unit can be connected directly to each axis control card, from which the battery power is distributed to each pulse coder.

Battery connector name

	1st–4th axis control card			
	1st axis	2nd axis	3rd axis	4th axis
Connector name	CPA9			



NOTE
1 A single battery unit can supply power to up to six pulse coders.
2 Replace the battery with a new one once a year.

9.6 HANDLING OF UNUSED AXES (CLAMPING)

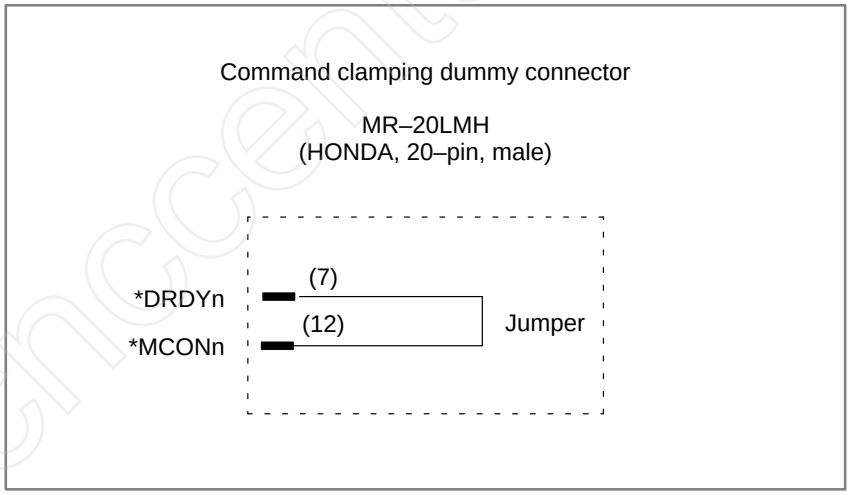
The user can select any of the supported axes as the axes to be controlled. A cable for a servo amplifier or motor need not be connected to those axes that are not to be used. Leaving the connector for an unused axis open, however, causes the CNC to enter a servo alarm state. This section describes how to handle (clamp) unused axes.

NOTE
Servo parameters must also be set for clamped axes. Set the same servo parameters as those for any axis to be used.

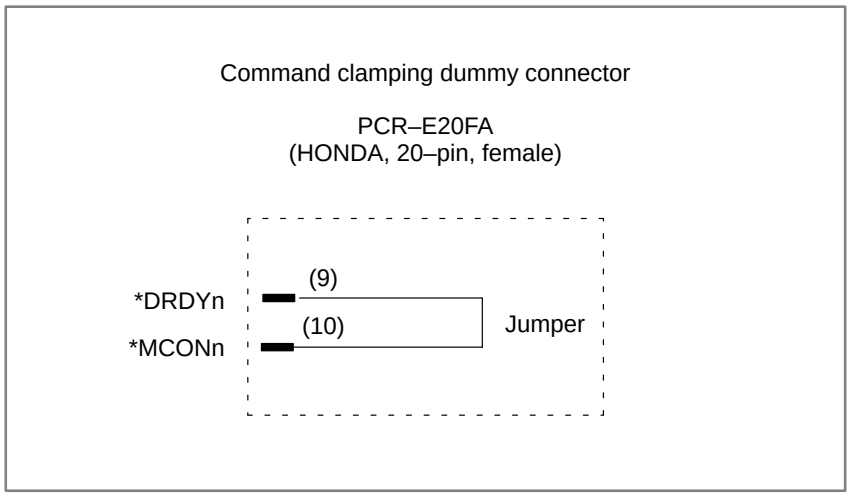
9.6.1 Handling of the Command Connectors of Unused Axes

Connect a command clamping dummy connector to the command connector of each unused axis.

- **Type A interface**



- **Type B interface**



9.6.2 Handling of the Feedback Connectors of Unused Axes

A dummy connector is not necessary. Set the relevant servo parameters as follows and leave the feedback connectors open.

Set the axis ignore parameter (bit 0 of No. 8n09: n is the axis number) for each unused axis to 1. Set flexible feed gear parameters 8n84 and 8n85 to 1.

APPENDIX

A EXTERNAL DIMENSIONS OF VARIOUS UNITS

A.1 UNITS OF CNC

	Name of dimensions					Specifications
Fig. U1	Control unit (Control unit A)					
		Color	MDI	Key	Series	
Fig. U2 (a)	9″CRT/MDI unit	Monochrome Monochrome	Small Small	English English	T, GCD M, GSD	A02B–0098–C045#TBR A02B–0098–C045#MBR
Fig. U2 (b)	9″CRT/MDI unit	Monochrome	Full key	English	PD	A02B–0099–C094#PR
Fig. U3	Separate type 9″CRT unit	Monochrome	—	—	T, M	A02B–0098–C132
Fig. U4	Separate type MDI unit	— — —	Small Small	English English	T M	A02B–0098–C145#TAR A02B–0098–C145#MAR
Fig. U5	Manual pulse generator (Thin type)					A860–0202–T001
Fig. U6	Punch panel					A02B–0098–C221 to C223
Fig. U7	Position coder (Max.4000 rpm) (Max.6000 rpm)					A86L–0027–0001#102 A86L–0027–0001#002
Fig. U8 (a)	Battery unit for NC					
Fig. U8 (b)	Power supply battery case for absolute pulse coder					A06B–6050–K060

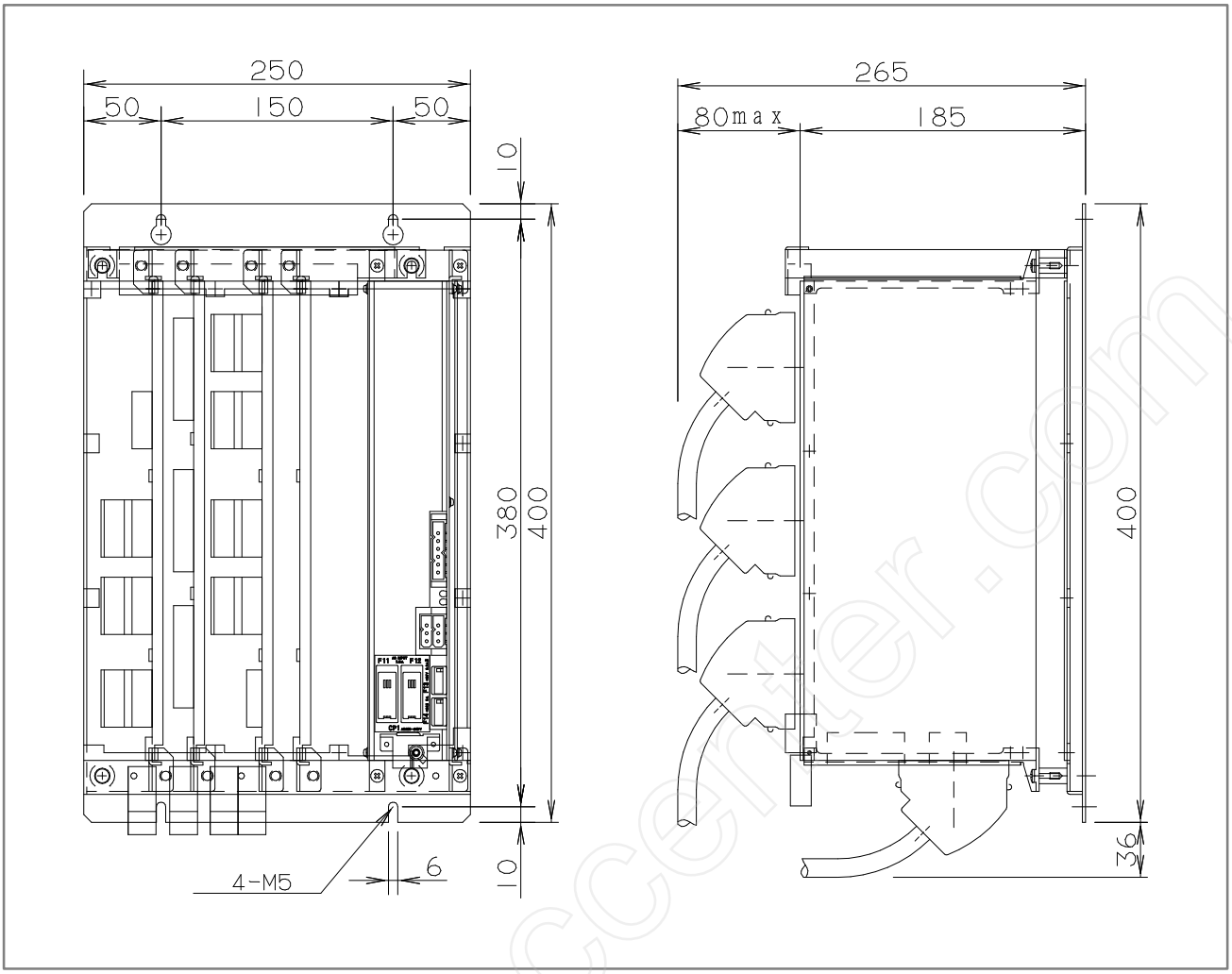


Fig. U1 External dimension of control unit

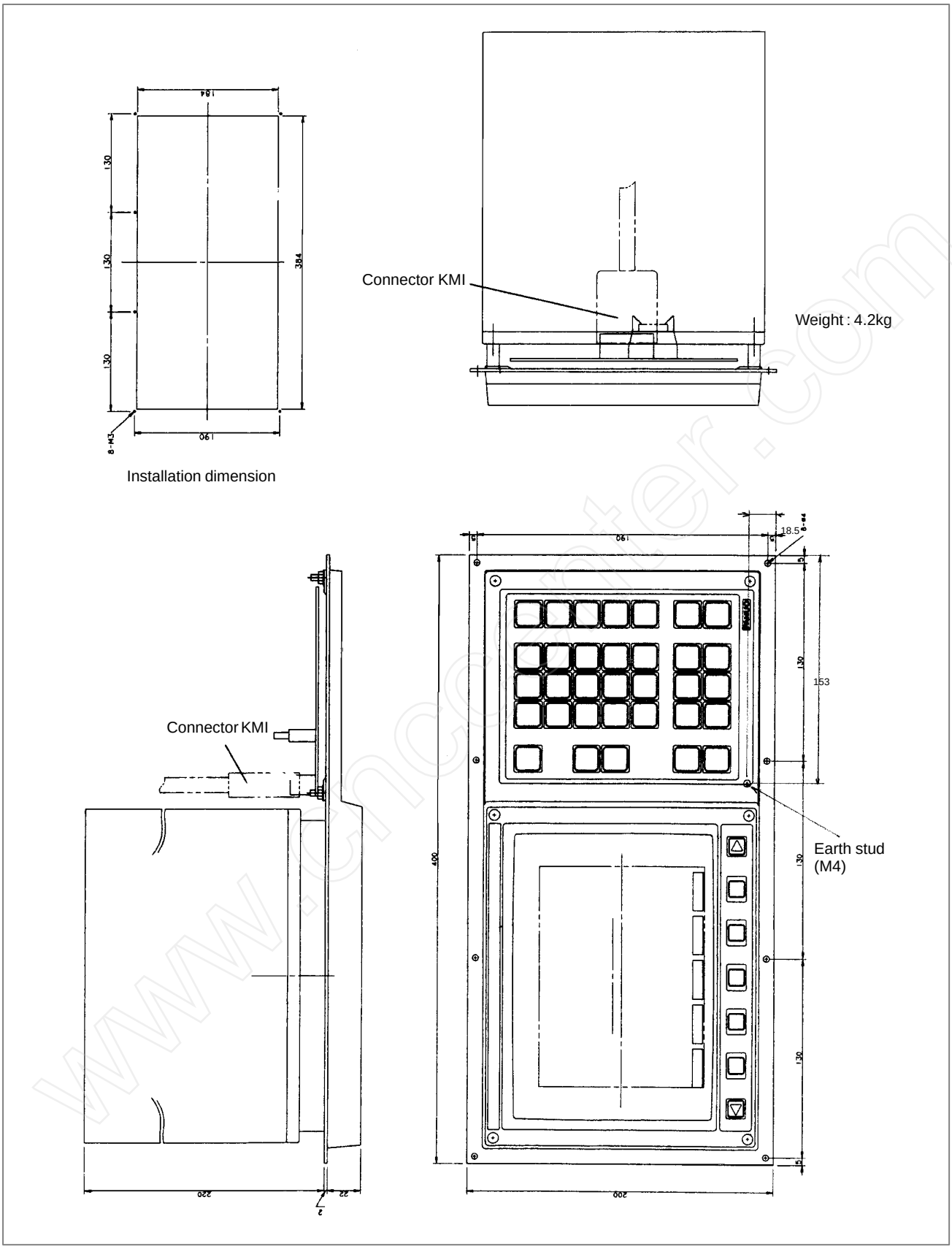


Fig. U2 (a) 9″ CRT/MDI unit (Monochrome, small key type)

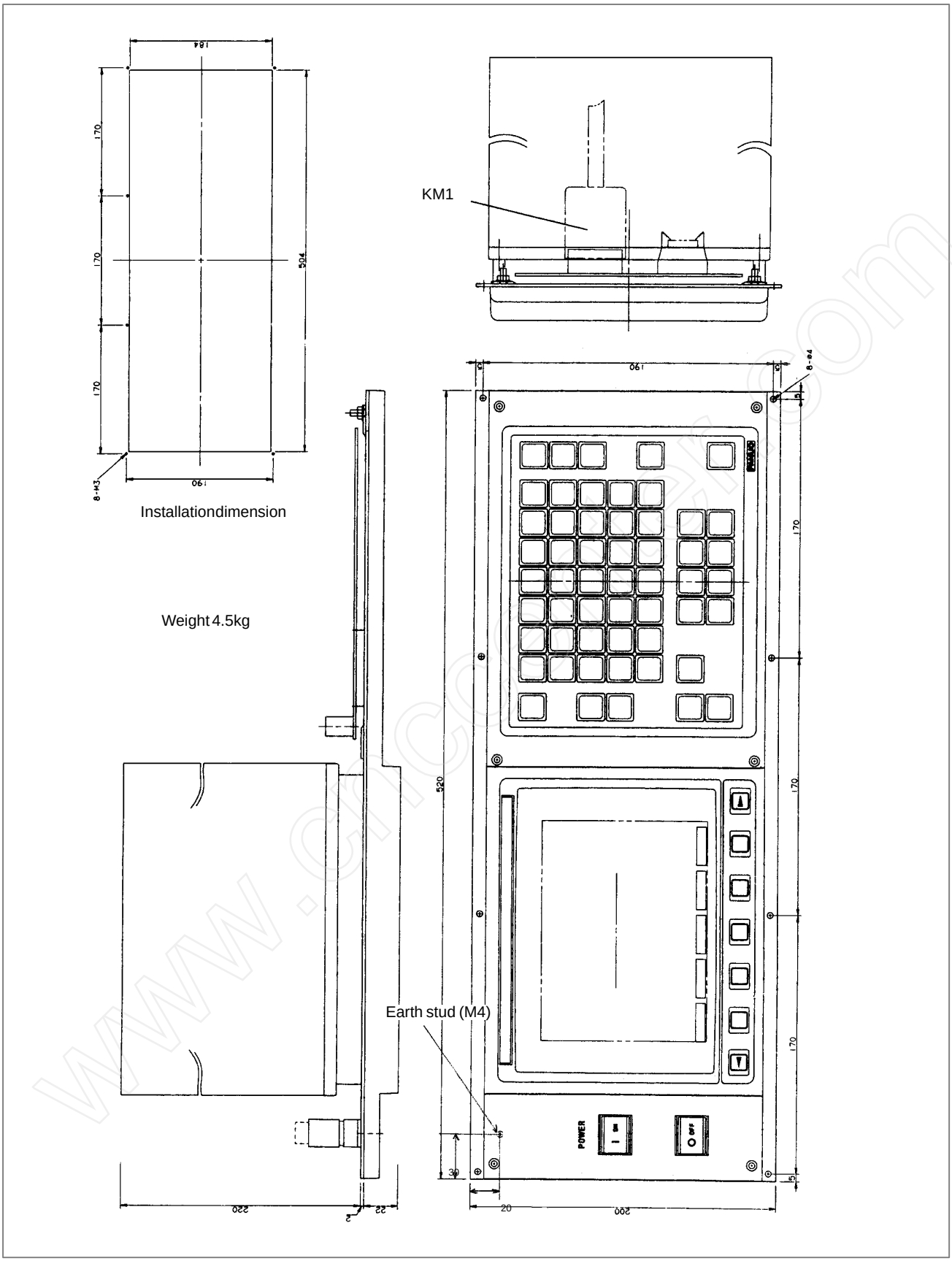


Fig. U2 (b) For 0–PD 9″CRT/MDI unit (Monochrome, full key type) dimension

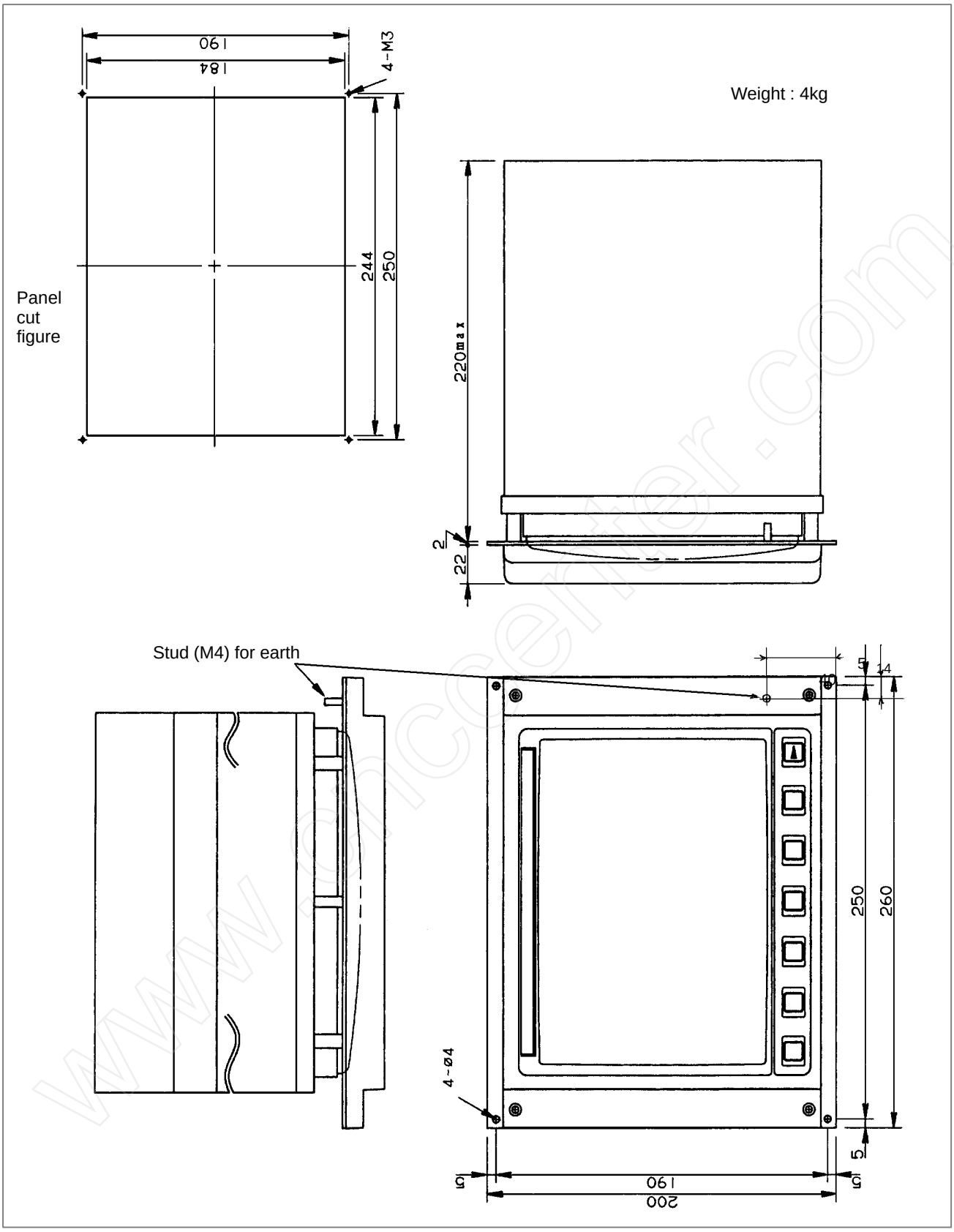


Fig. U3 Remote type 9″CRT unit (Monochrome)

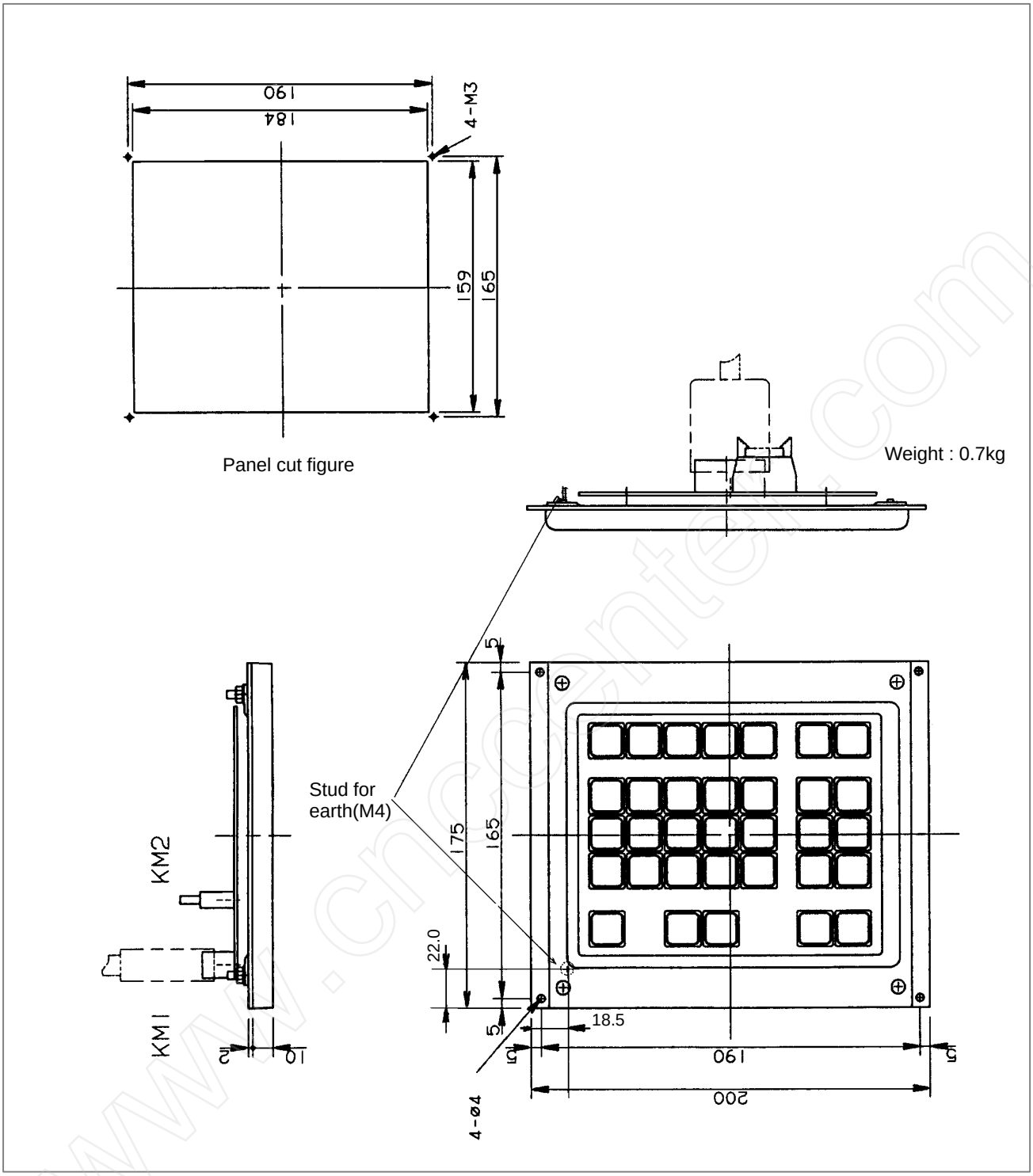


Fig. U4 MDI unit (Small type)

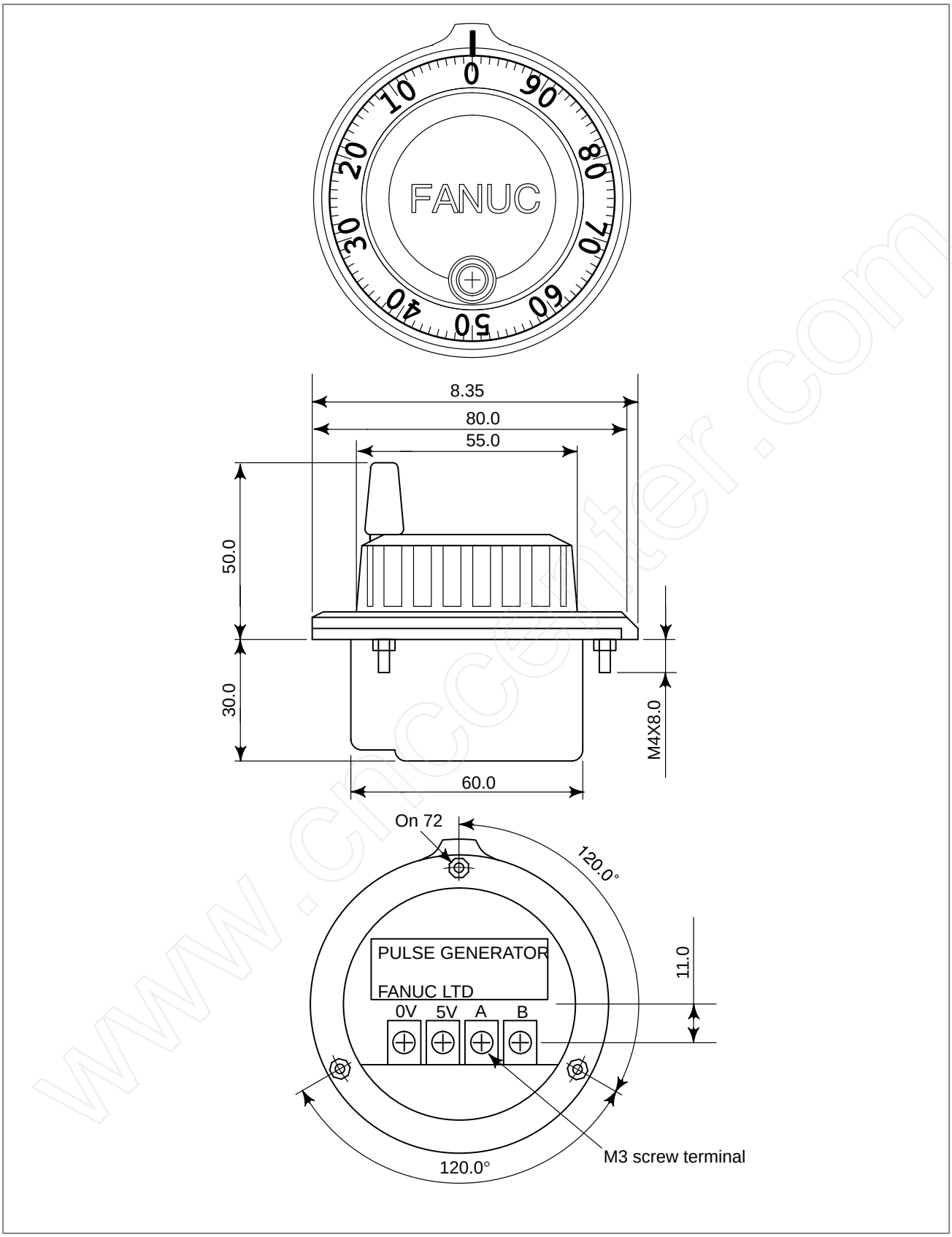


Fig. U5 Manual pulse generator (A860–0202–T001)

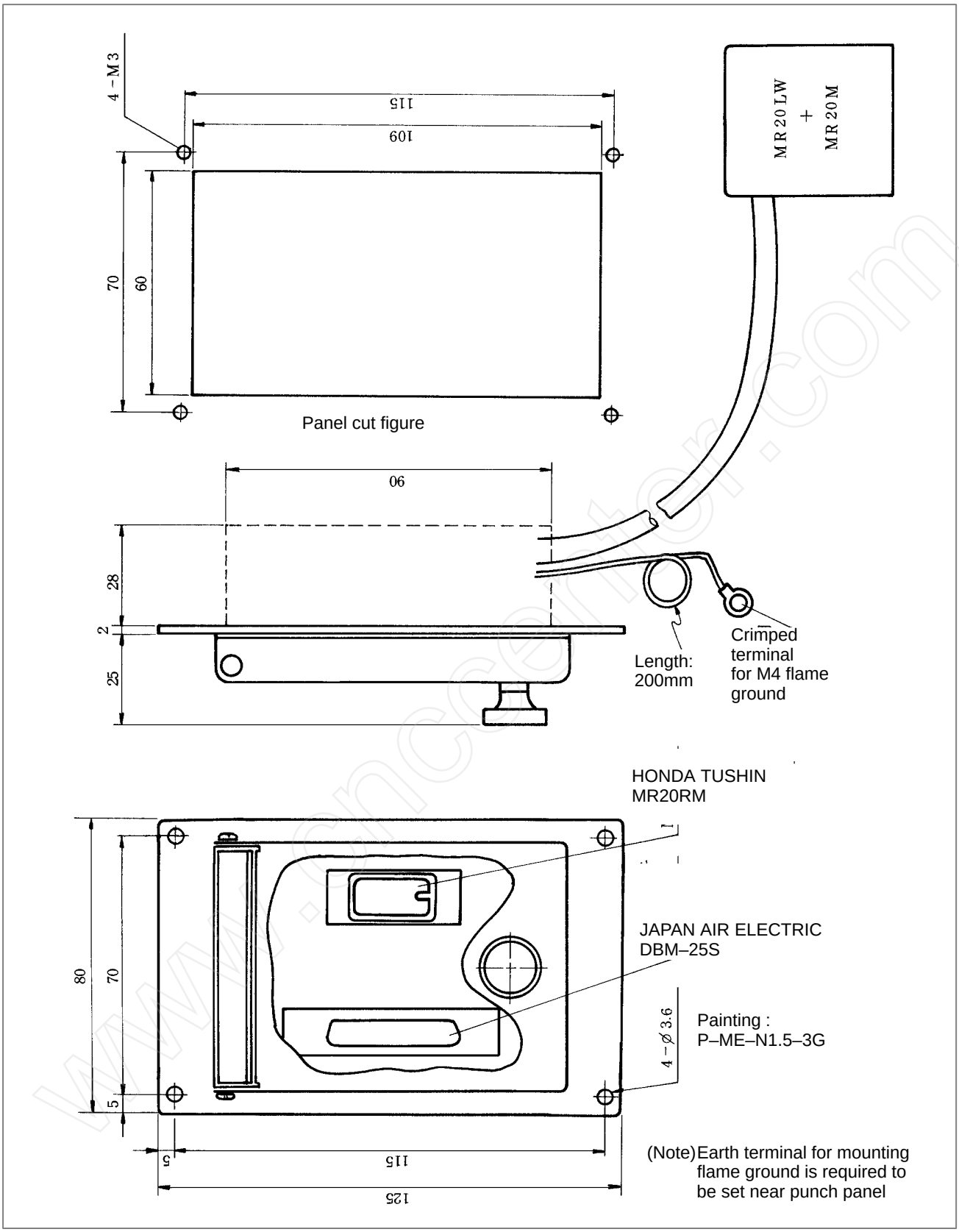


Fig. U6 Punch panel

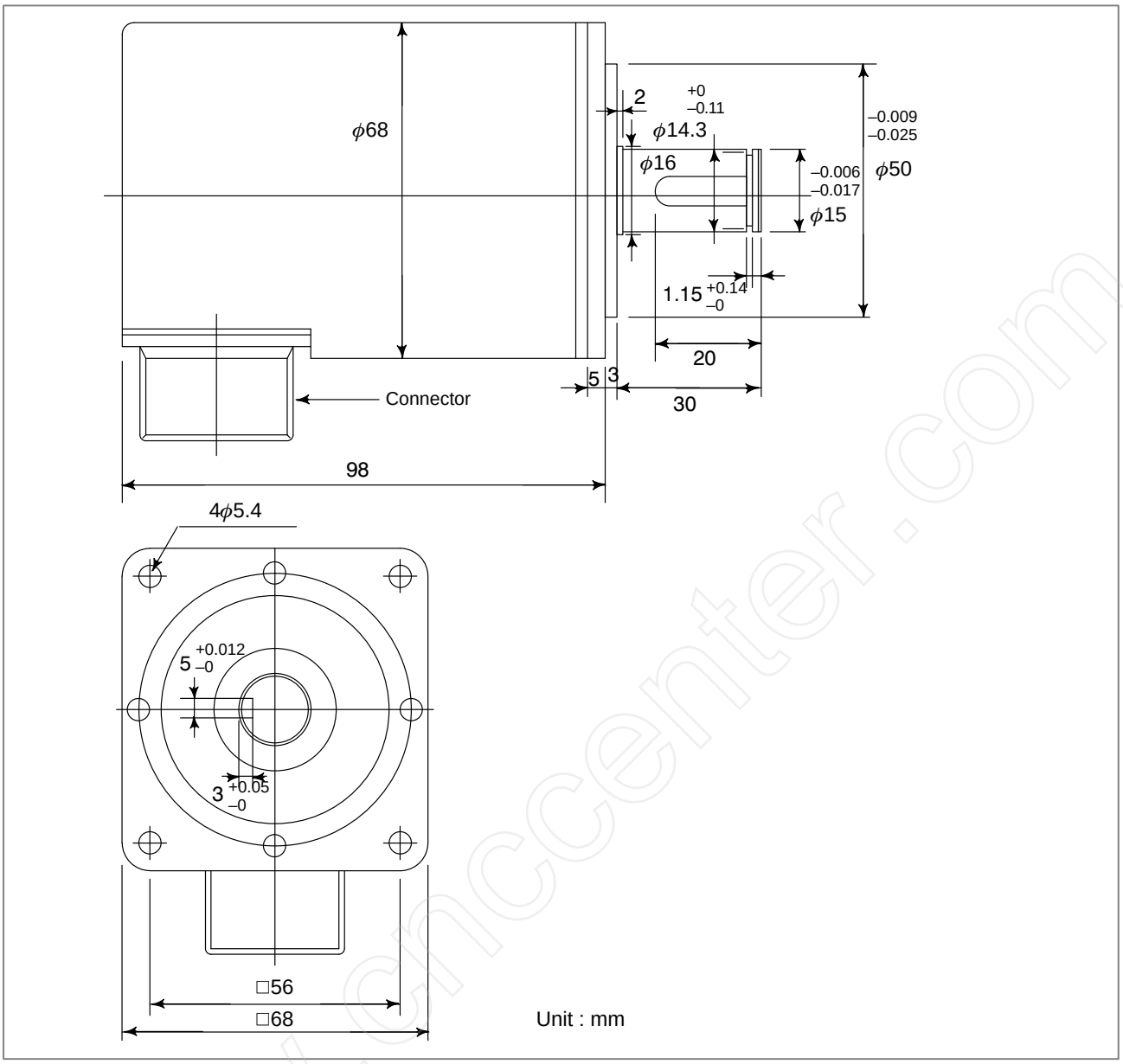


Fig. U7 Diagram of position coder A86L–0027–0001#102 : Max. 4000rpm
A86L–0027–0001#002 : Max. 6000rpm

NOTE

Mechanical specifications of the position coder are as follows :

(1) Input axis inertia 1.0×10^{-3} kg,cm,sec^2 or less

(2) Input axis starting torque 1000g,cm or less

(3) Input axis permissible loads

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

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

(4) Weight 1kg or less

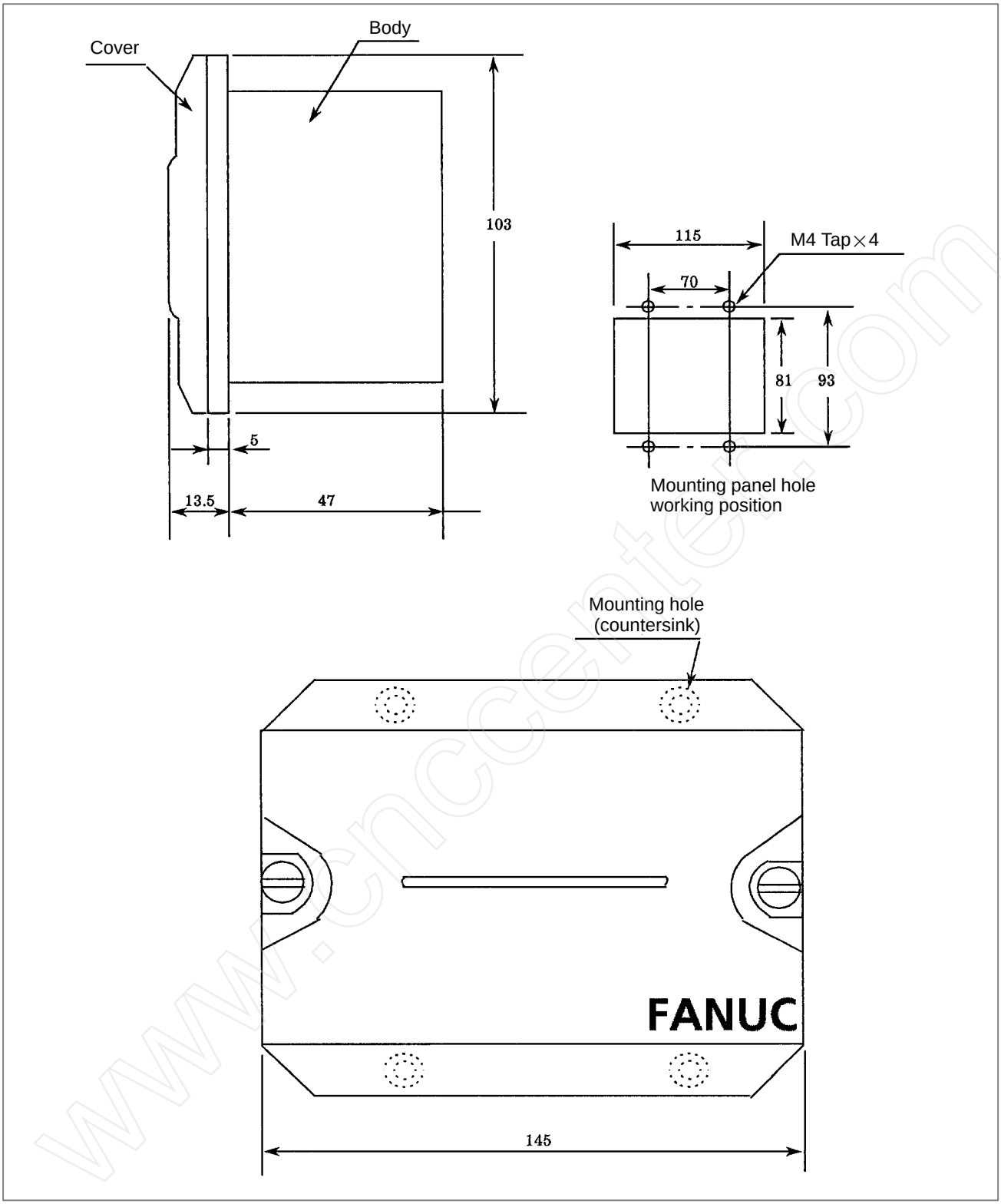


Fig. U8 (a) Battery unit for CNC

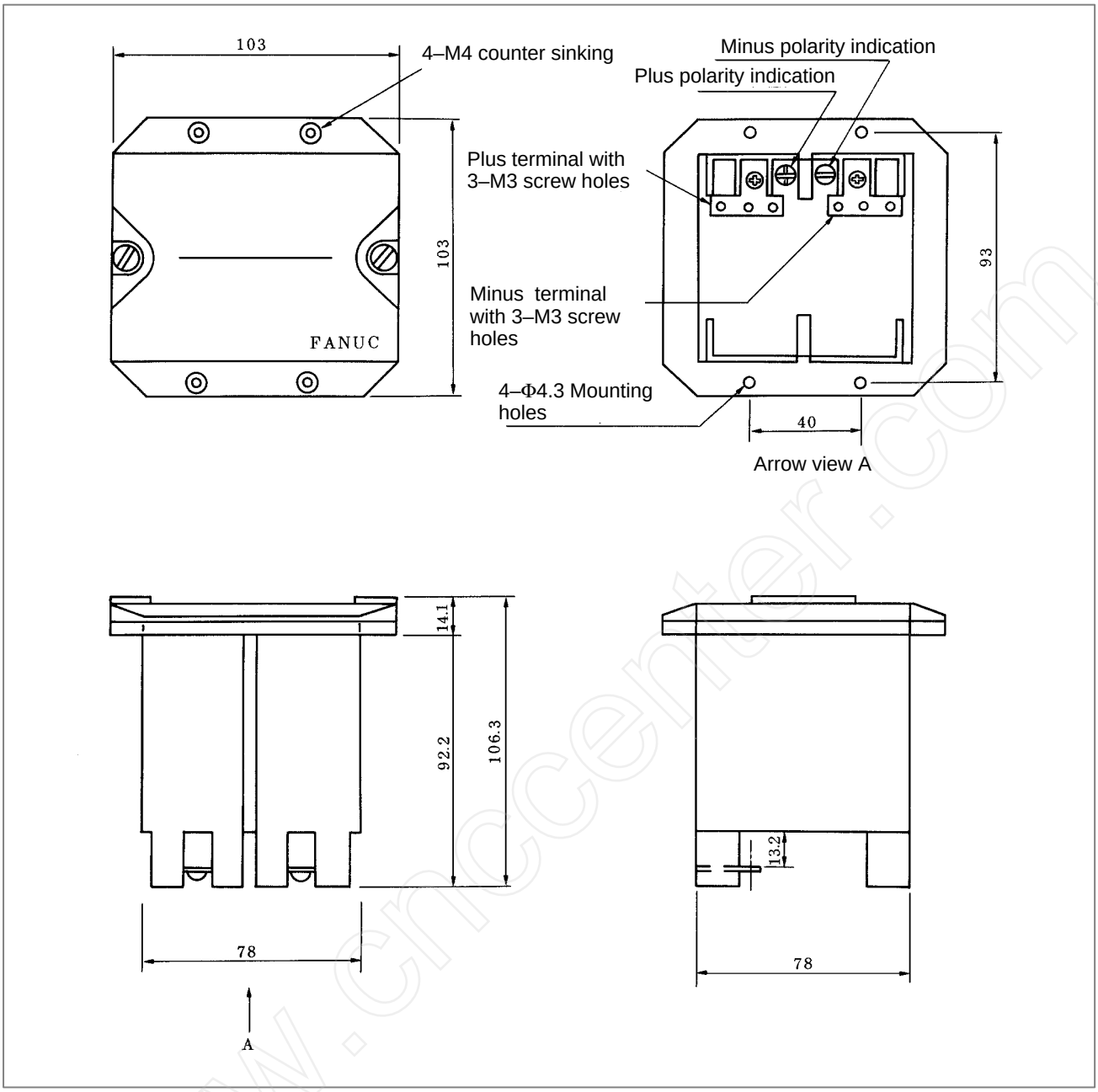
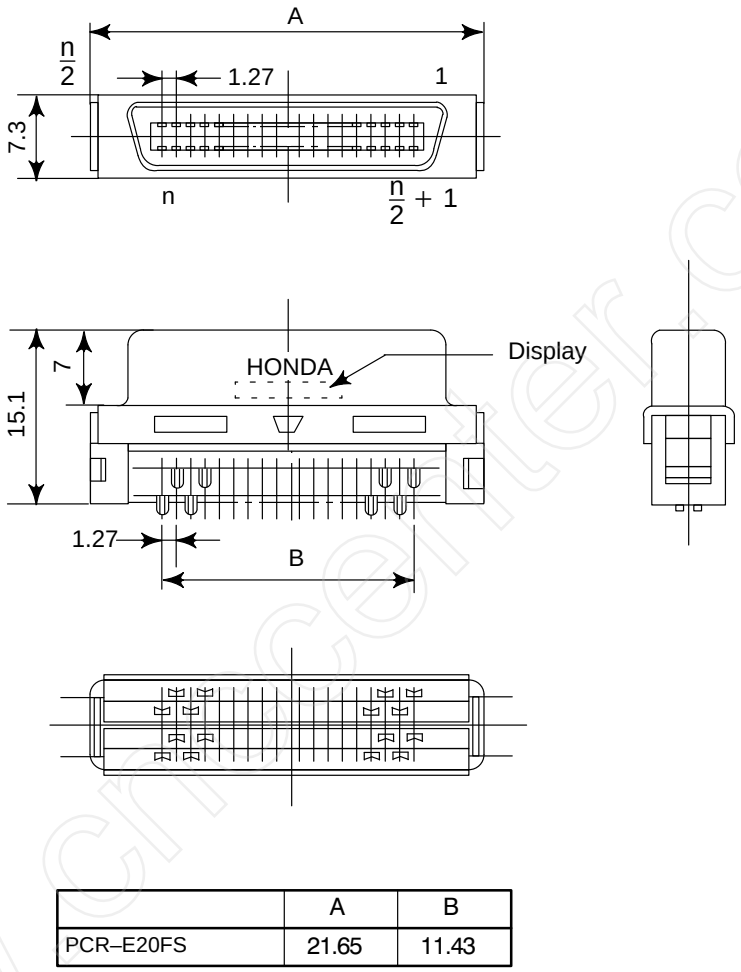


Fig. U8 (b) Battery case for absolute pulse coder

A.2 CONNECTOR

	Name of external dimension	
Fig. C1 (a)	PCR-connector (Soldering type)	PCR–E20FS
Fig. C1 (b)	FI40 connector	FI40–2015S
Fig. C2 (a)	Dimension of connector case (HONDA TUSHIN PCR TYPE)	PCR–V20LA/PCR–V20LB
Fig. C2 (b)	Dimension of connector case (HIROSE FI TYPE)	FI–20–CV
Fig. C2 (c)	Dimension of connector case (FUJITSU FCN)	FCN–240C20–Y/S
Fig. C3 (a)	AMP connector(1)	AMP1–178128–3
Fig. C3 (b)	AMP connector(2)	AMP2–178128–3
Fig. C3 (c)	AMP connector(3)	AMP1–178288–3
Fig. C3 (d)	AMP connector(4)	AMP2–178288–3
Fig. C3 (e)	AMP connector(5)	AMP2–178129–6
Fig. C3 (f)	Contact for AMP connector	AMP1–175218–2/5 AMP1–175196–2/5
Fig. C4 (a)	HONDA connector (Case)	
Fig. C4 (b)	HONDA connector (Beveled case)	
Fig. C4 (c)	HONDA connector (Male)	
Fig. C4 (d)	HONDA connector (Female)	
Fig. C4 (e)	HONDA connector terminal layout	
Fig. C5 (a)	NIPPON FCI (Old name is Nippon Burndy) connector (3–pins, black)	SMS3PK–5
Fig. C5 (b)	NIPPON FCI (Old name is Nippon Burndy) connector (3–pins,brown)	SMS3PN–5
Fig. C5 (c)	NIPPON FCI (Old name is Nippon Burndy) connector (3–pins,white)	SMS3PW–5
Fig. C5 (d)	NIPPON FCI (Old name is Nippon Burndy) connector (6–pins,brown)	SMS6PN–5
Fig. C5 (e)	NIPPON FCI (Old name is Nippon Burndy) connector (6–pins,white)	SMS6PW–5
Fig. C5 (f)	NIPPON FCI (Old name is Nippon Burndy) connector (6–pins,black rectangle)	SMS6P–1

Connector body		
HONDA TSUSHIN	PCR–E20FS (Soldering type)	
Usage	General	
Connector cover	HONDA TSUSHIN	PCS–E20LA (Metal)
	HONDA TSUSHIN	PCR–V20L (Plastic)



	A	B
PCR–E20FS	21.65	11.43

Fig. C1 (a) PCR connector (Soldering type)

Connector body	HIROSE FI40–2015S
Usage	For simultaneous axis
Housing	HIROSE FI–20–CV
Dimension	

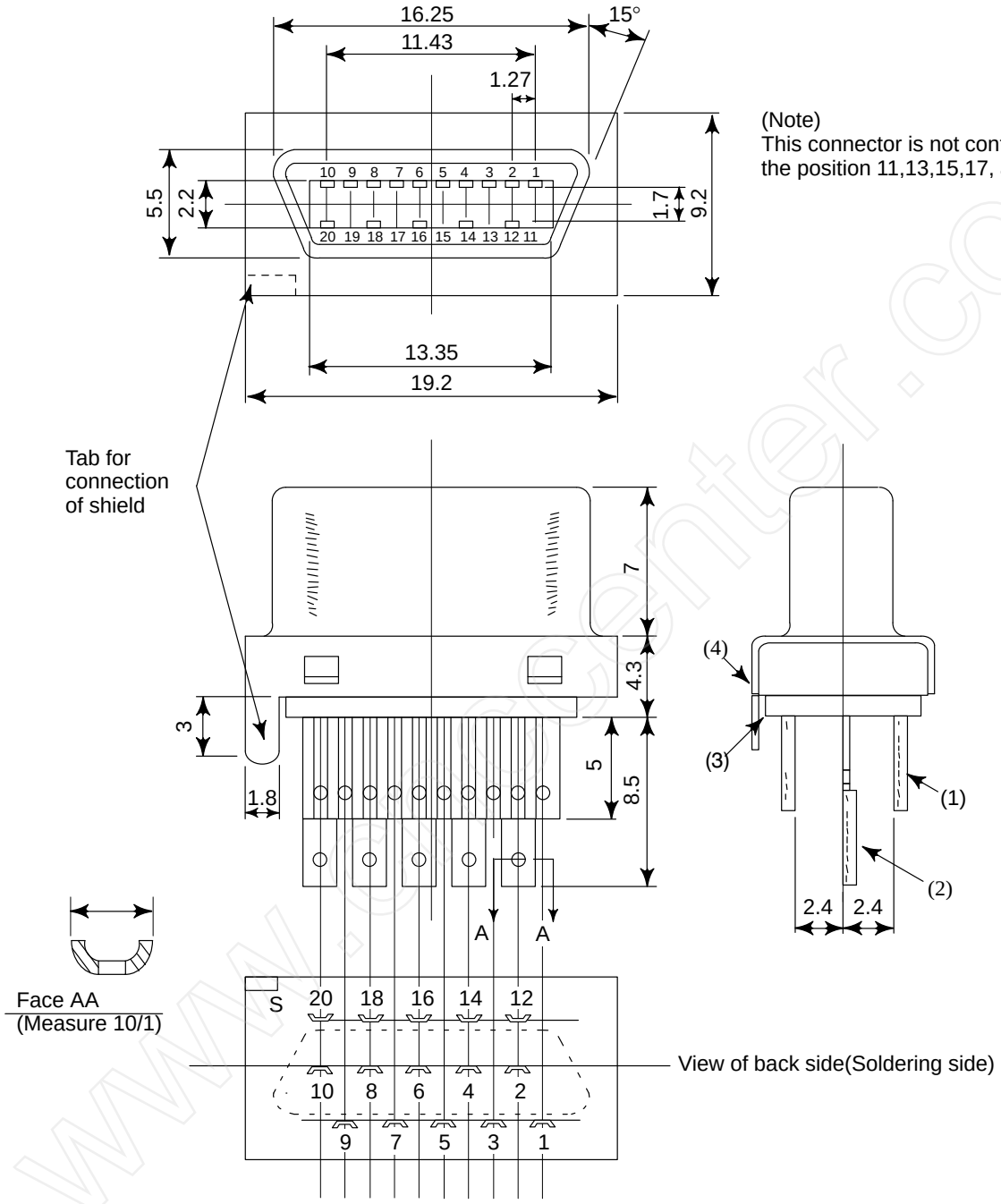
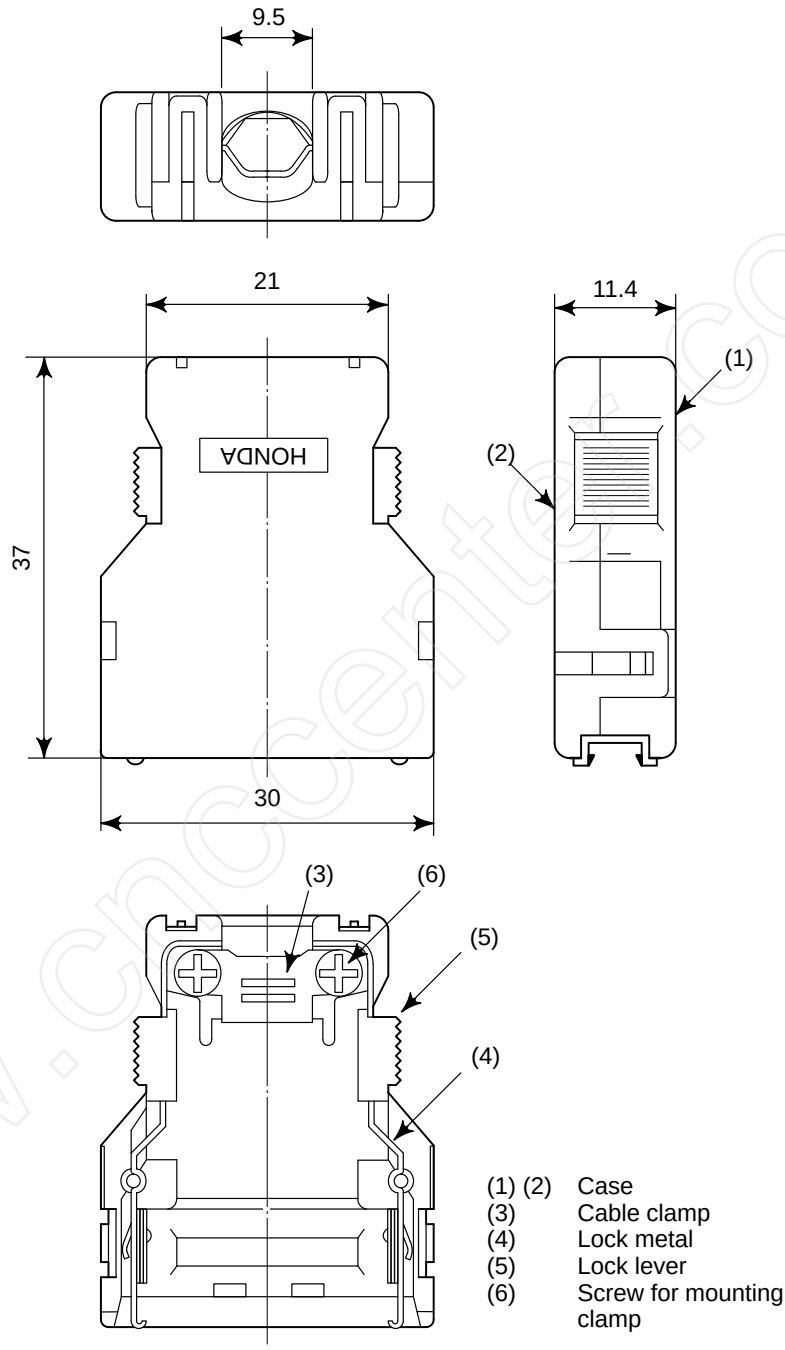


Fig. C1 (b) F140 connector

Connector body HONDA TSUSHIN PCR–V20LA (External cable diameter F6)
PCR–V20LB (External cable diameter F8)

Usage General

Dimension



(1) (2) Case
(3) Cable clamp
(4) Lock metal
(5) Lock lever
(6) Screw for mounting cable clamp

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

Connector body HIROSE F1–20–CV
Usage For simultaneous axes cable
Dimension

(1), (2) Case
(3) Lock metal
(4) Lock lever
(5) Cable clamp
(6) Screw for mounting cable clamp

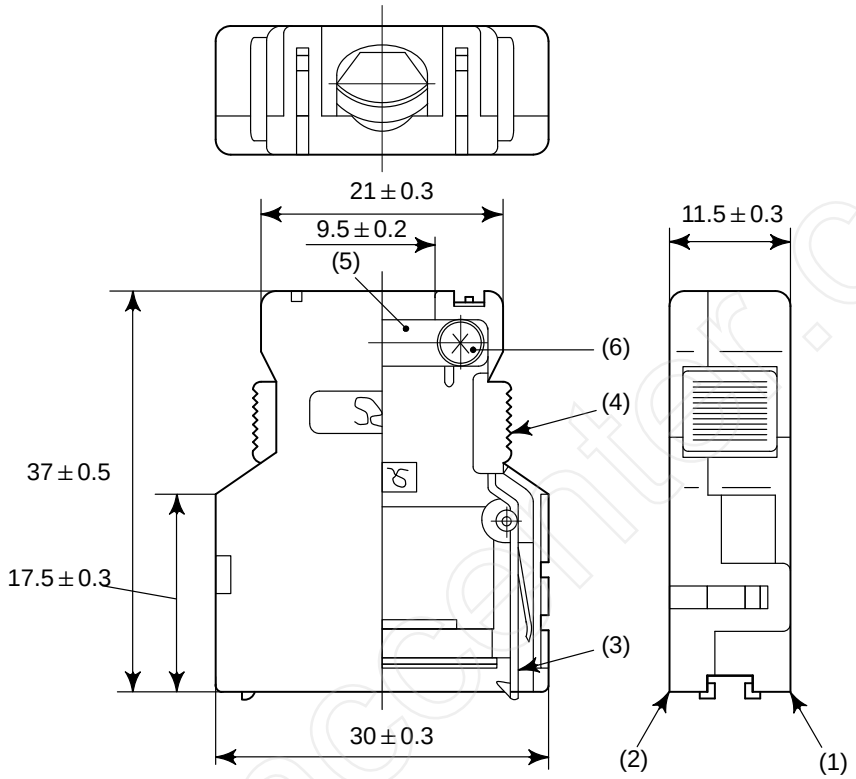


Fig. C2 (b) Connector case (HIROSE F1 type)

Connector body Fujitsu FCN–240C20–Y/S(For External cable diameter Φ5.8)
Usage General
Dimension

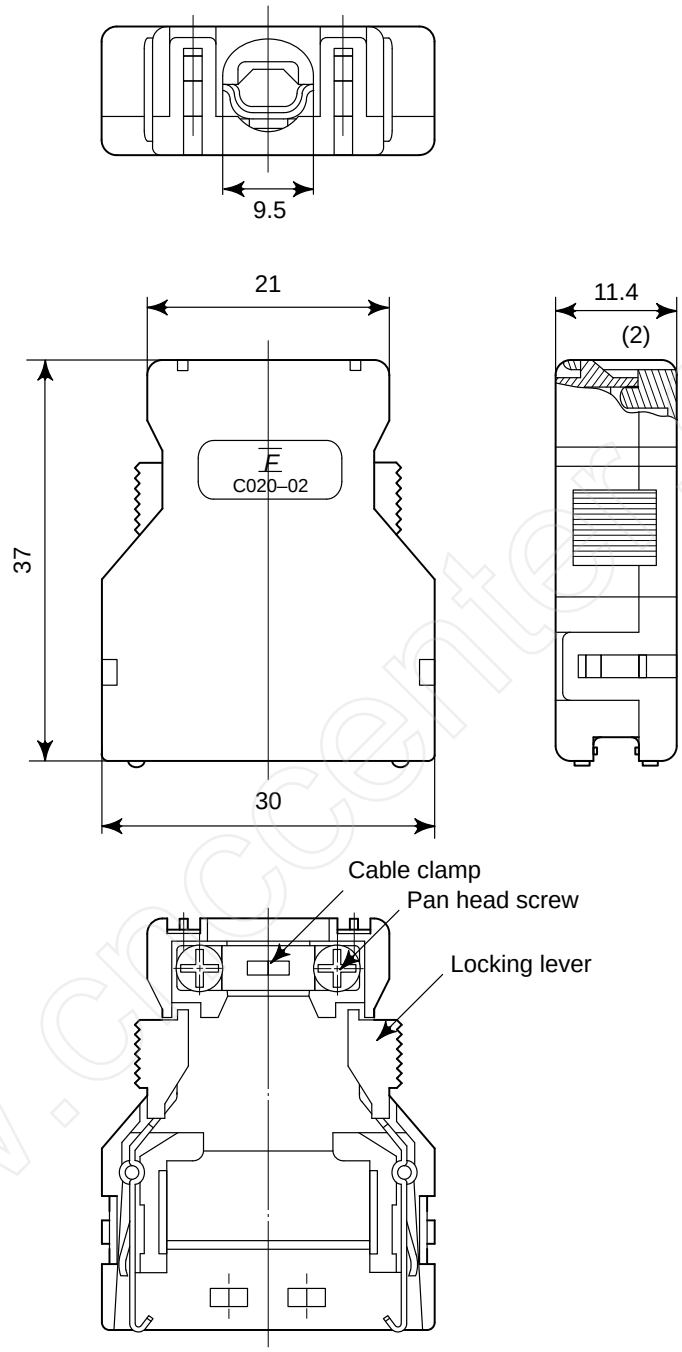


Fig. C2 (c) Connector case (Fujitsu FCN type)

Style AMP1–178128–3

Usage For CE marking
Power supply unit
200VAC input

3	G
2	S
1	R

Location of key

For CE marking
Power supply unit
200VAC output

3	G
2	200B
1	200A

Dimension

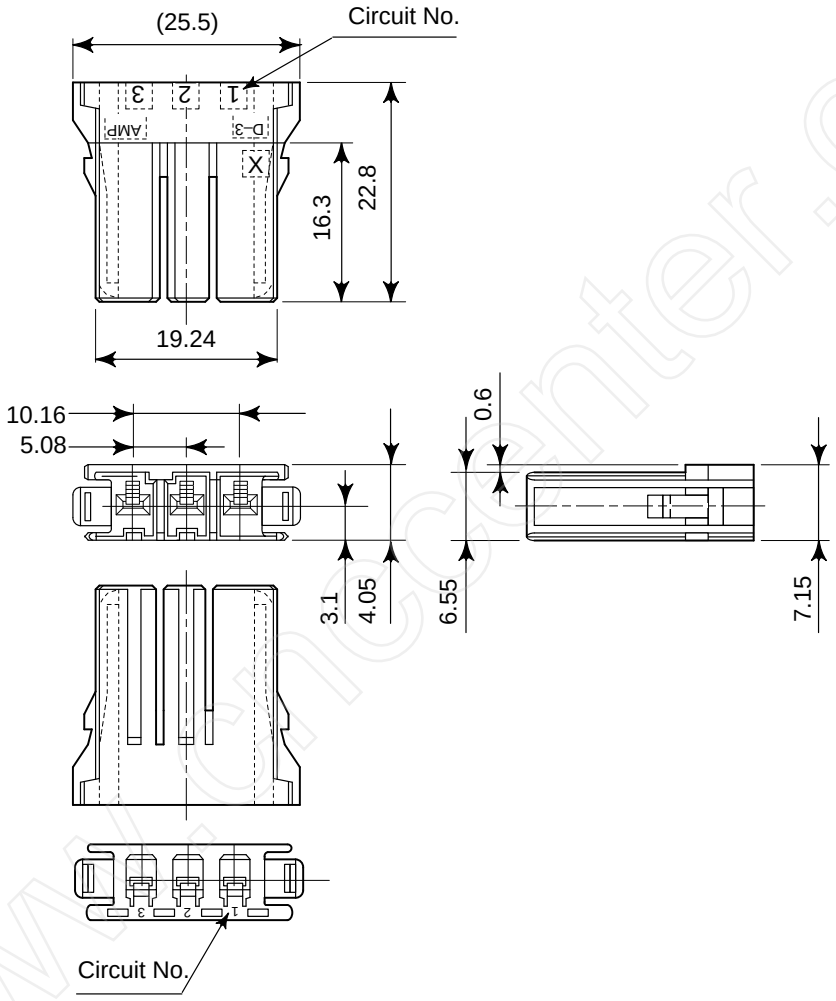


Fig. C3 (a) AMP connector (1)

Style AMP2–178128–3

Dimension

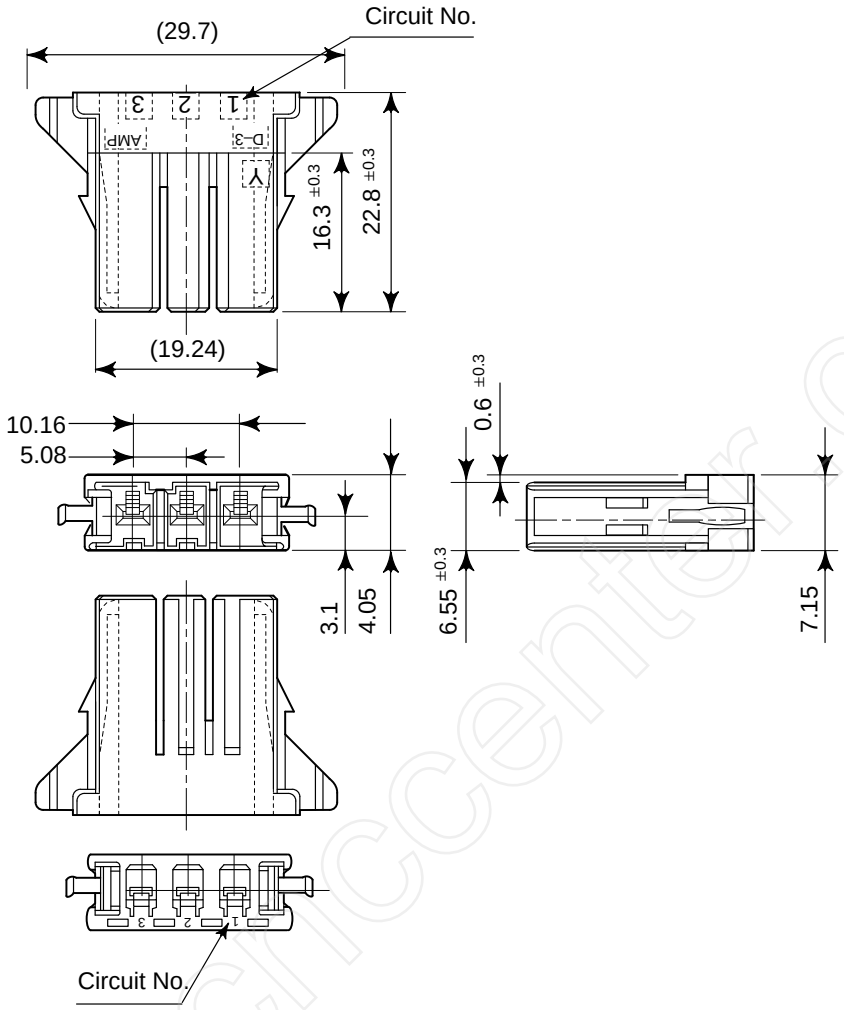


Fig. C3 (b) AMP connector(2)

Style AMP1–178288–3
Usage For CE marking
Power supply unit
+24E Output

Dimension

3	
2	0V
1	+24E

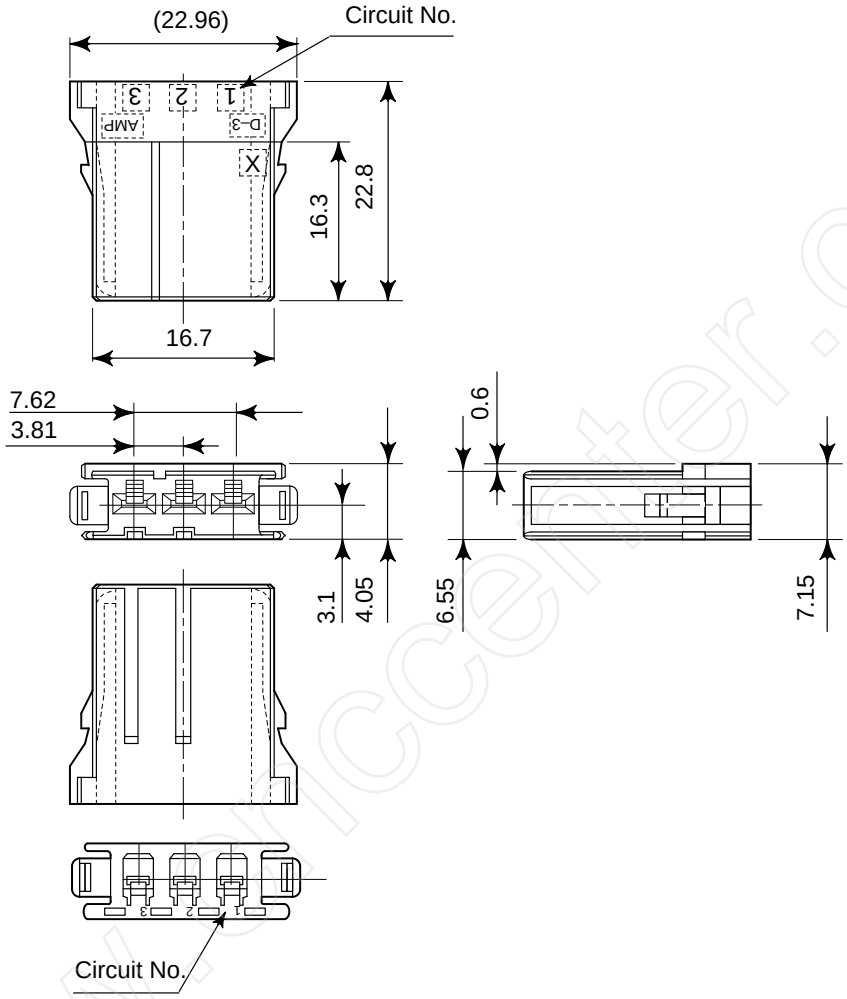


Fig. C3 (c) AMP connector(3)

Style AMP2–178288–3

Usage For CE marking
Power supply unit
+24V output

Dimension

3	
2	0V
1	+24V

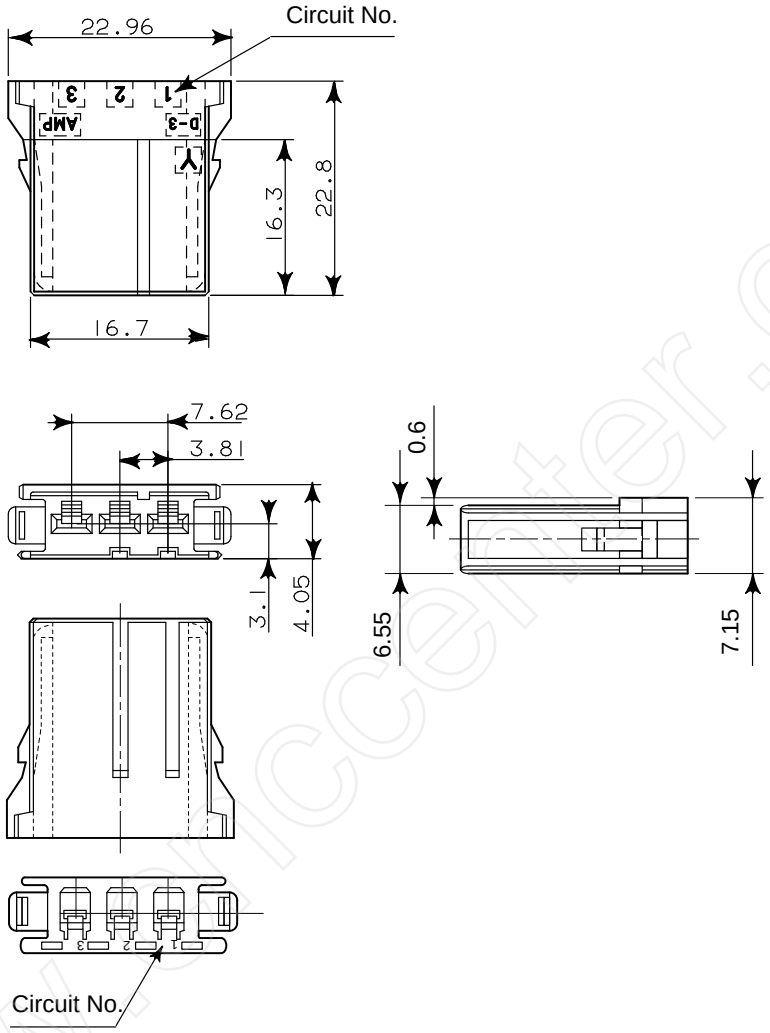


Fig. C3 (d) AMP connector(4)

Style AMP2–178129–6

Usage For CE marking
Power supply unit
ON/OFF control

B3	FB	A3	COM
B2	FA	A2	OFF
B1	AL	A1	ON

Dimension

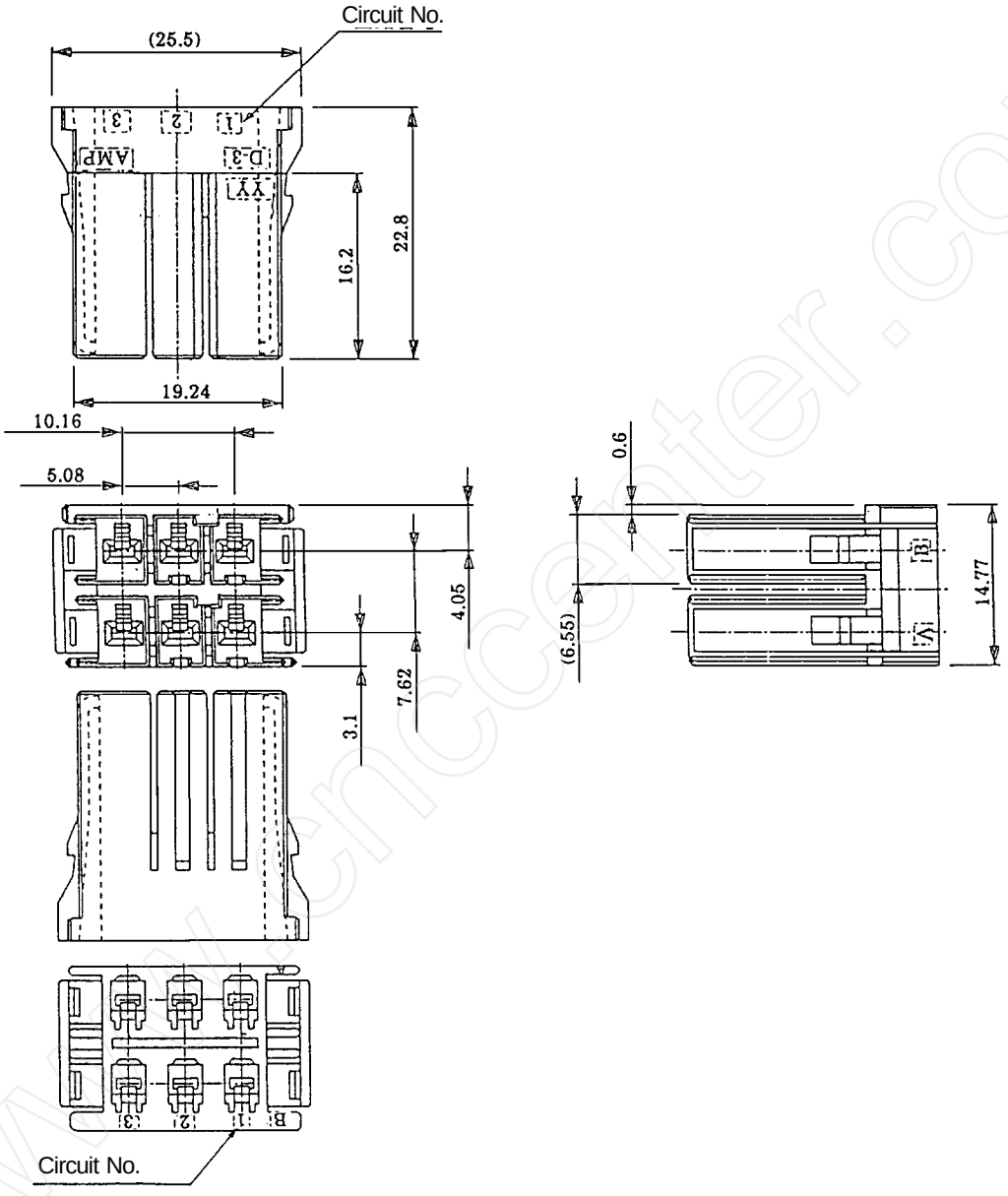


Fig. C3 (e) AMP connector (5)

Style Piece : AMP1–175218–2 (Metal plating) AMP1–175218–5 (Tin plating)
Reel : AMP1–175196–2 (Metal plating) AMP1–175196–5
Connector cable AWG 16, 18, 20
Dimension

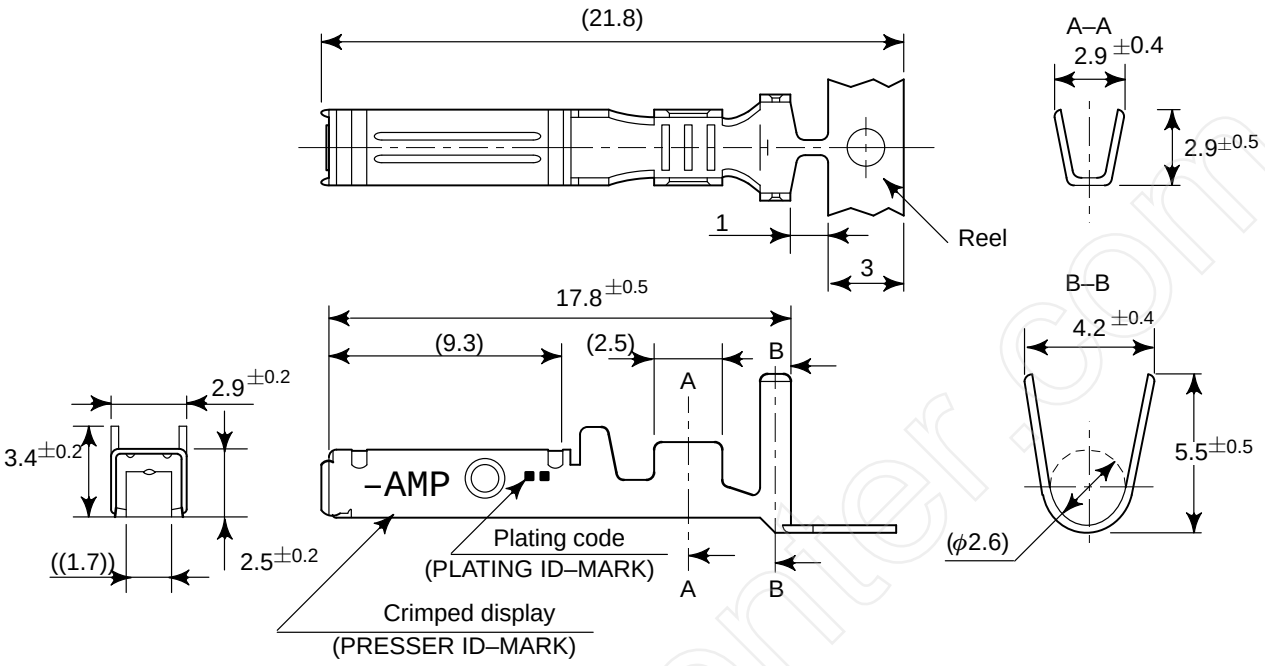
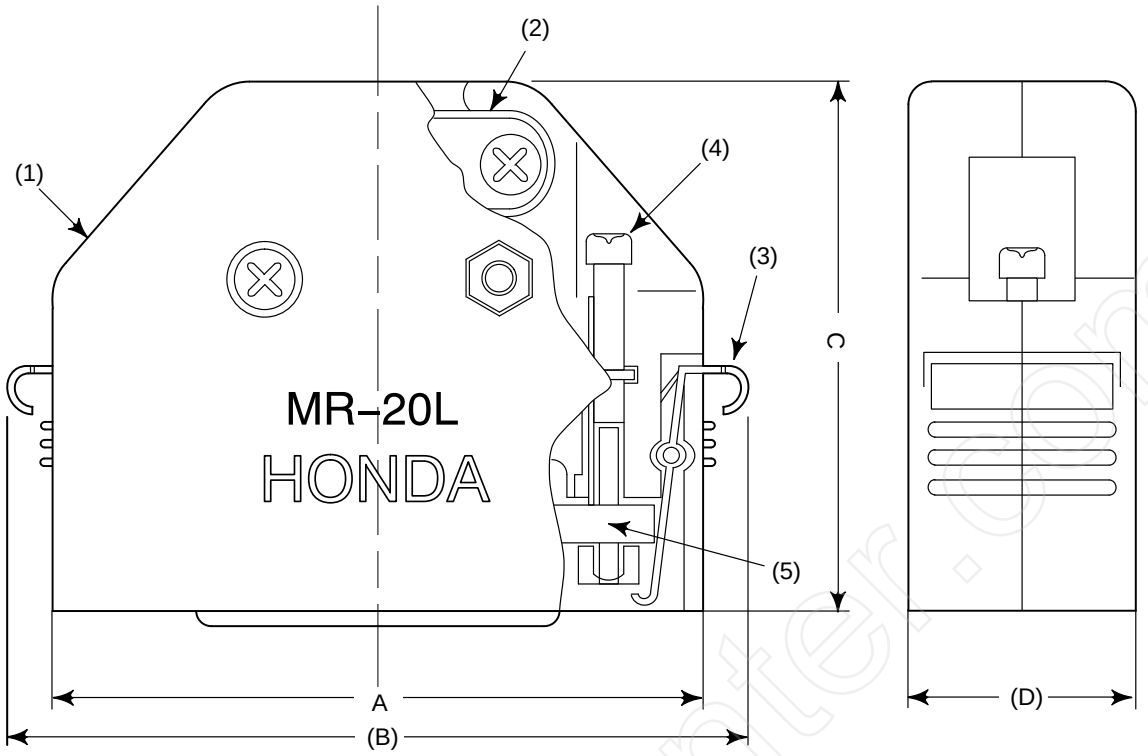


Fig. C3 (f) Contact for AMP connector

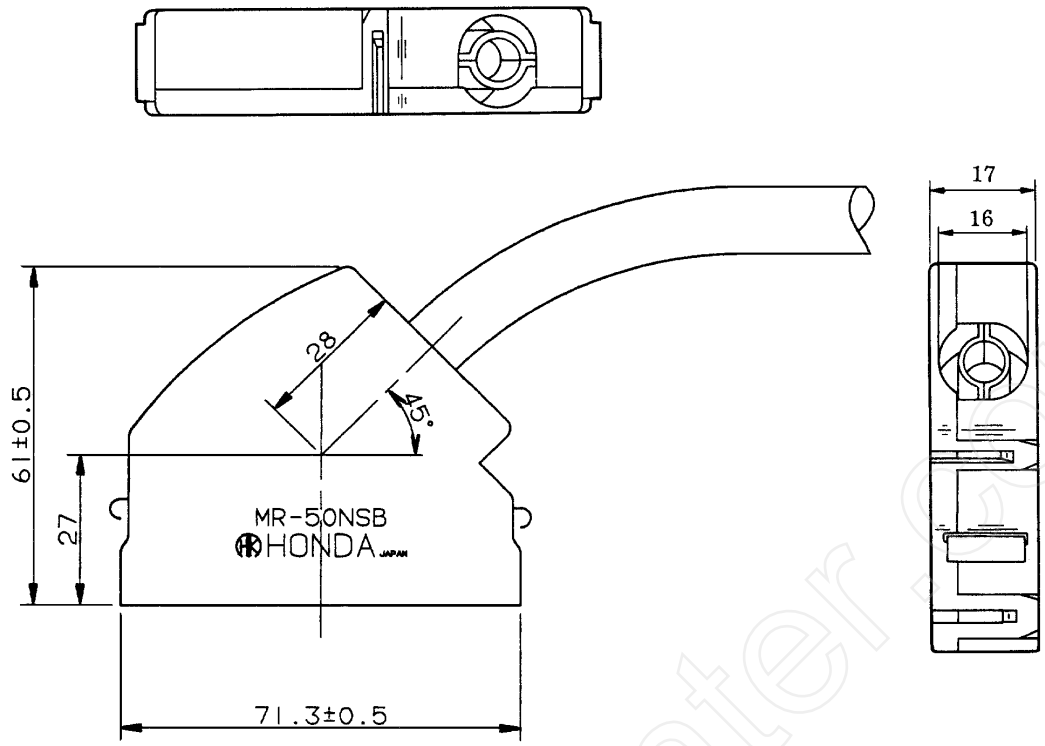


Specification \ Symbol	A	(B)	C	(D)	No. of terminals
MR–20LMH (Plug)	39.3	44.9	39.8	17	20
MR–20LFH (Jack)					
MR–50LMH (Plug)	67.9	73.5	44.8	18	50
MR–50LFH (Jack)					

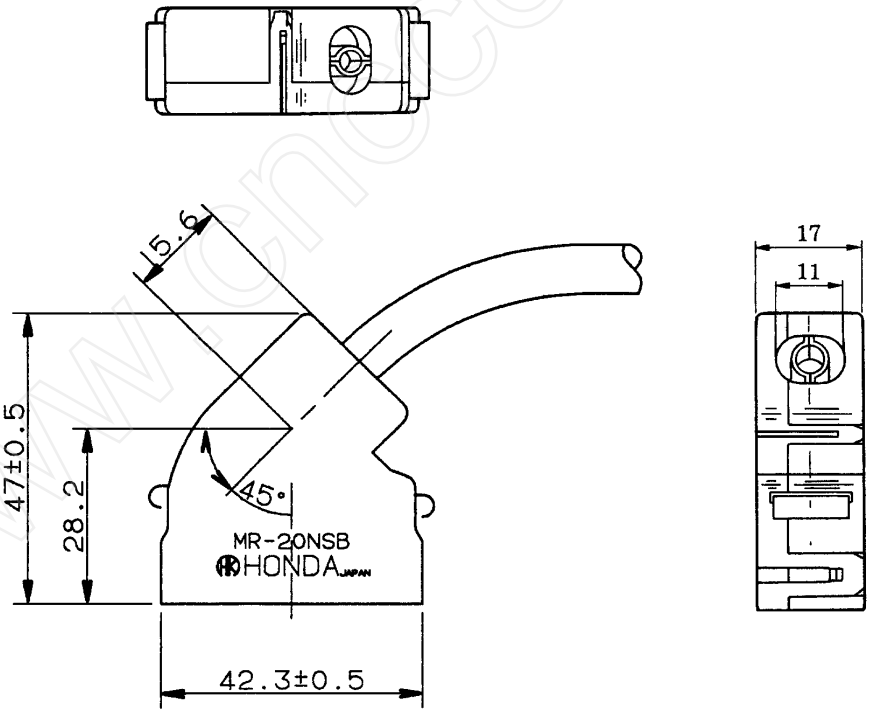
Symbol	Name
(1)	Connector cover
(2)	Cable clamp
(3)	Stopper
(4)	Screw for cable clamp
(5)	Plug connector(MR–20,50MH)
	Jack connector(MR–20,50FH)

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

Fig. C4 (a) HONDA connector (case)

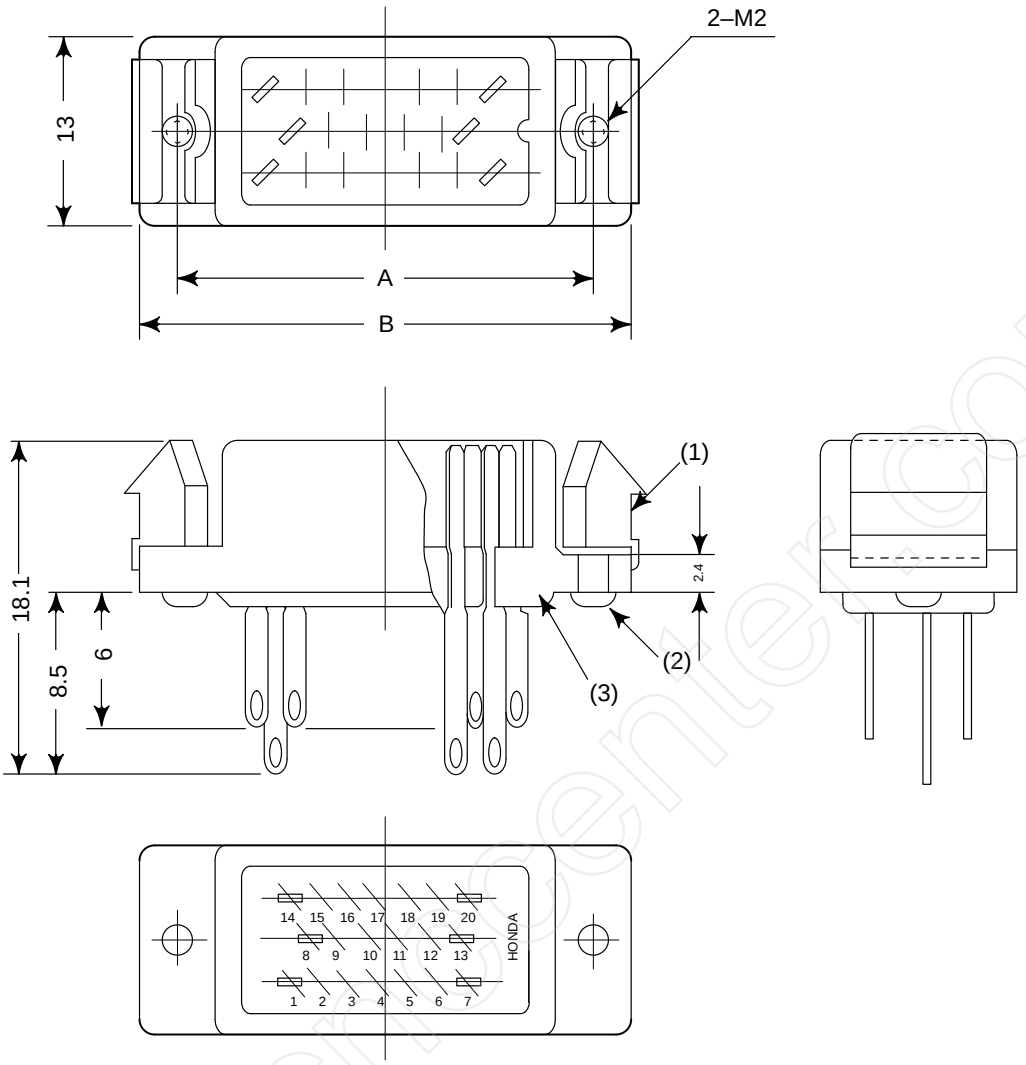


External view of the 50–pin connector housing



External view of the 20–pin connector housing

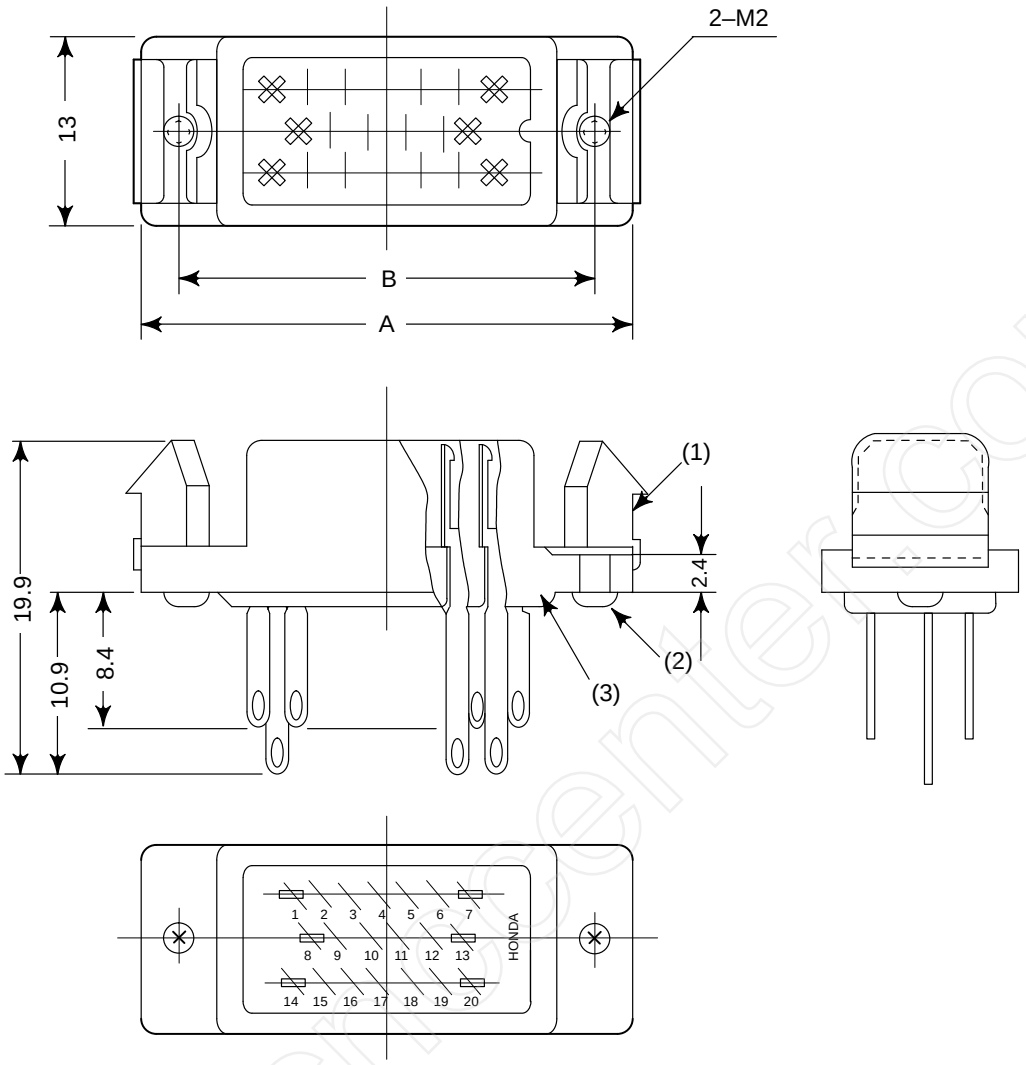
Fig. C4 (b) HONDA connector (Beveled case)



	A	B	No. of terminals
MR–20RMH	32.8	27.8	20
MR–50RMH	61.4	56.4	50

Symbol	Name
(1)	Metal clamp of connector
(2)	Clamp screw Φ2.6×8
(3)	Connector(MR–20, 50MH)

Fig. C4 (c) HONDA connector (Plug connector)



	A	B
MR–20RFH	32.8	27.8
MR–50RFH	61.4	56.4

No.of terminals
20
50

Symbol	Name
1	Metal clamp of connector
2	Screw for mounting $\phi 2.6 \times 8$
3	Connector(MR–20, 50FH)

Fig. C4 (d) HONDA connector (Jack connector)

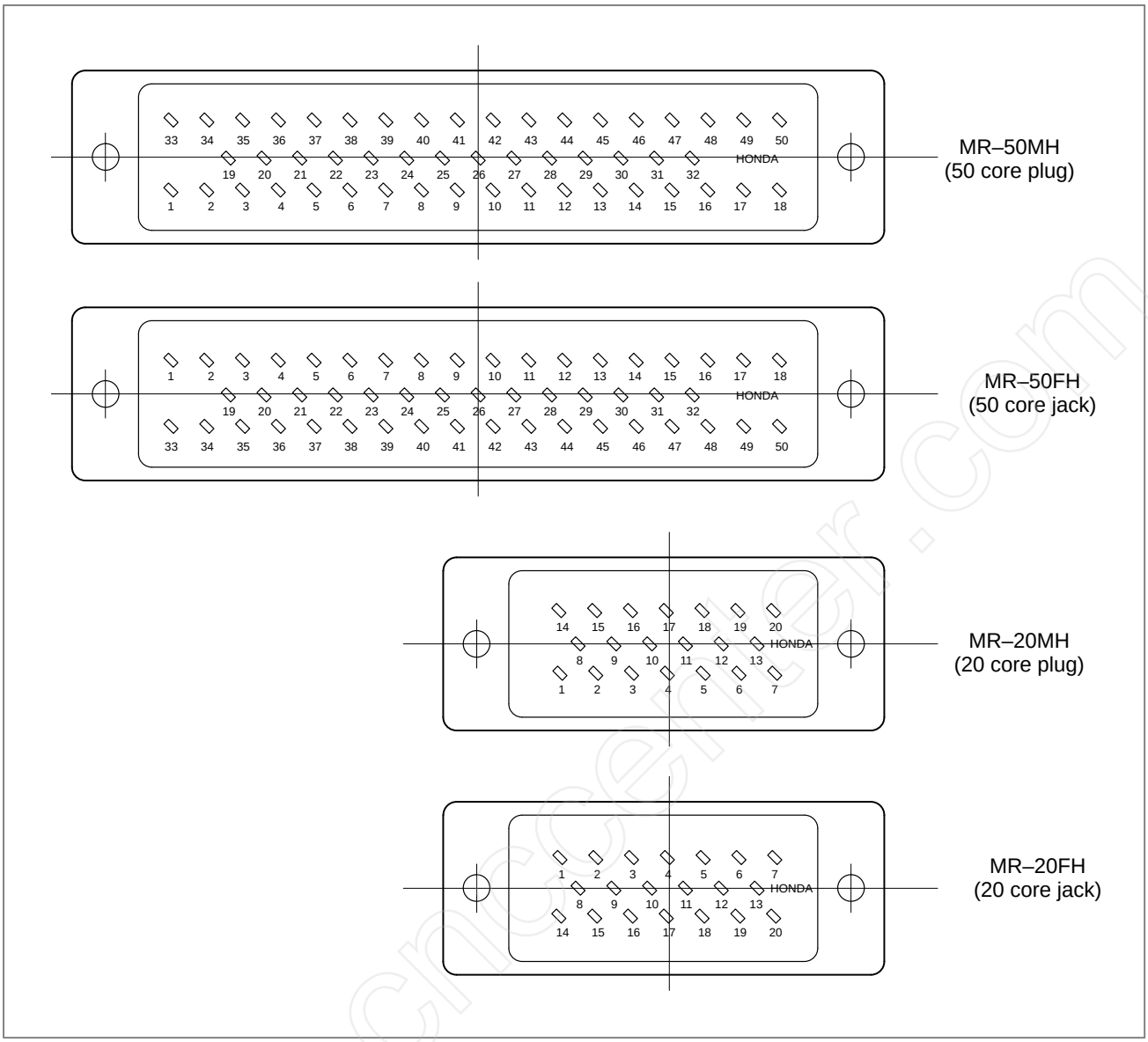
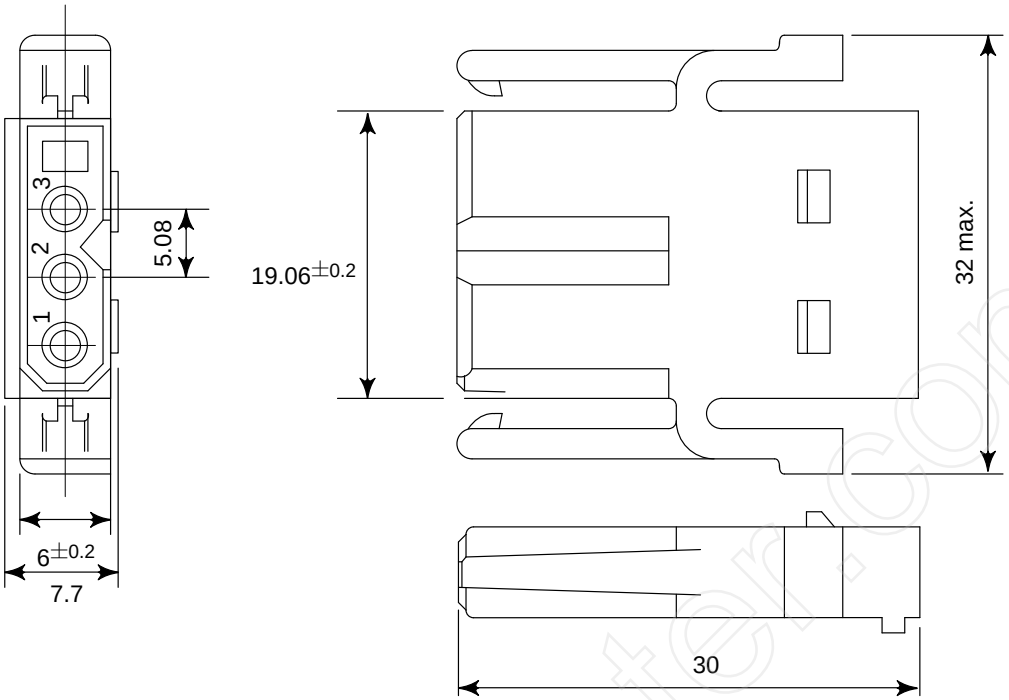


Fig. C4 (e) Terminal layout of HONDA connector



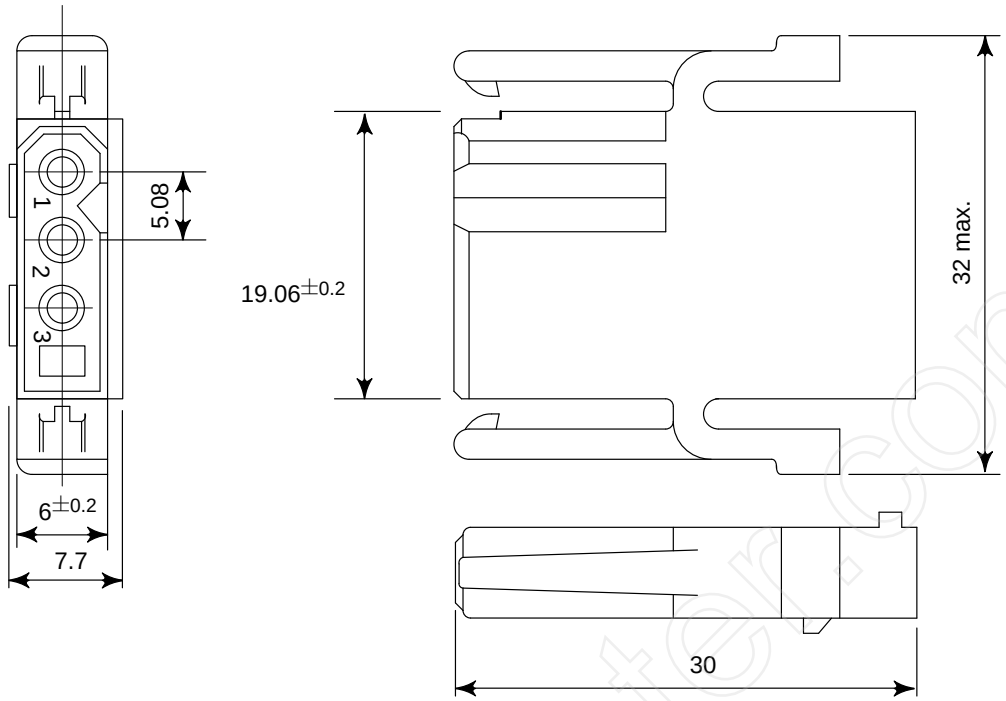
Manufacturer : NIPPON FCI

Name		Specification (Connector maker number)	Remarks
Connector housing for cable		SMS3PK–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. C5 (a) NIPPON FCI connector (3–pins,black)



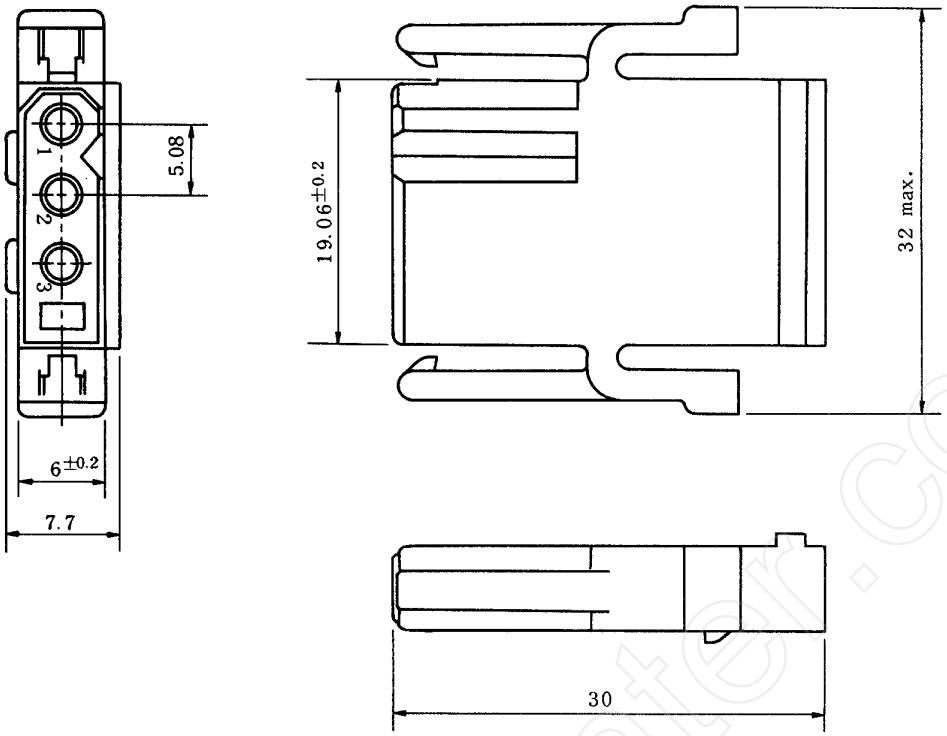
Manufacturer : NIPPON FCI

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

Cables

Cross sectional area : 0.75mm^2(30/0.18)
Insulation diameter : 2.8mm max
Peeling length : 7.2mm

Fig. C5(b) NIPPON FCI connector (3–pins,Brown)



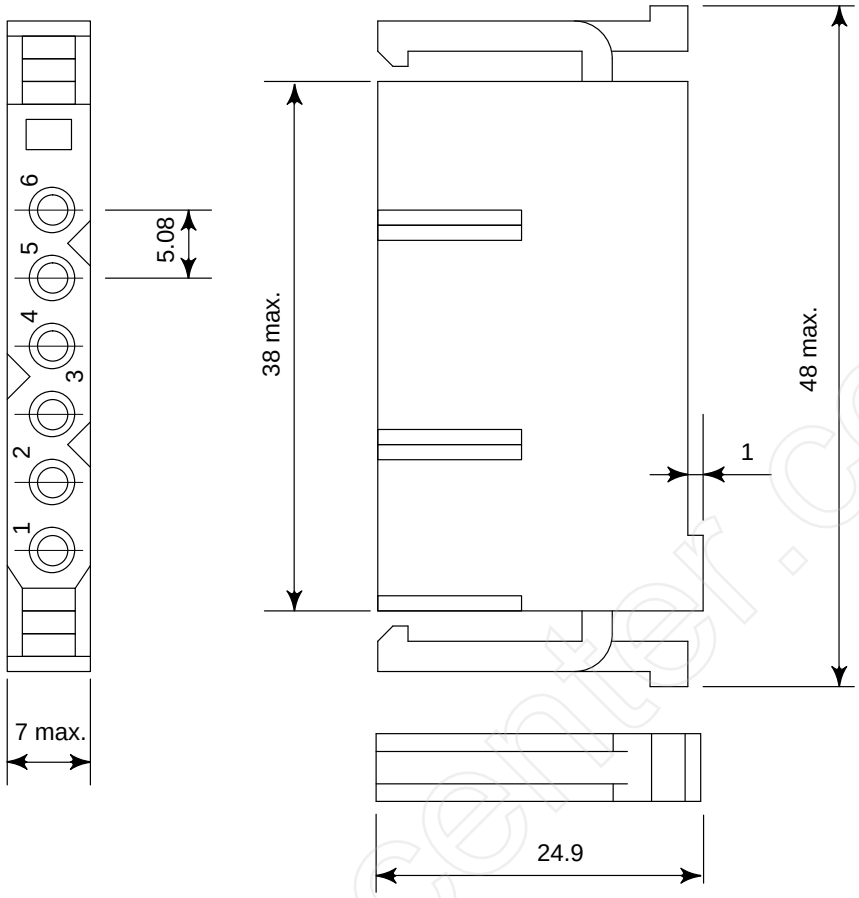
Manufacturer : NIPPON FCI

Name		Specification (Connector maker number)	Remarks
Connector housing for cable		SMS3PWS–5	White
Contact	(Crimp type)	RC16M–23D28	For details on tools for crimp terminals, contact the manufacturer.

Cables

Cross sectional area : 0.75mm^2(30/0.18)
Insulationdiameter : 2.8mm max
Peeling length : 7.2mm

Fig. C5 (c) NIPPON FCI connector (3–pins,white)



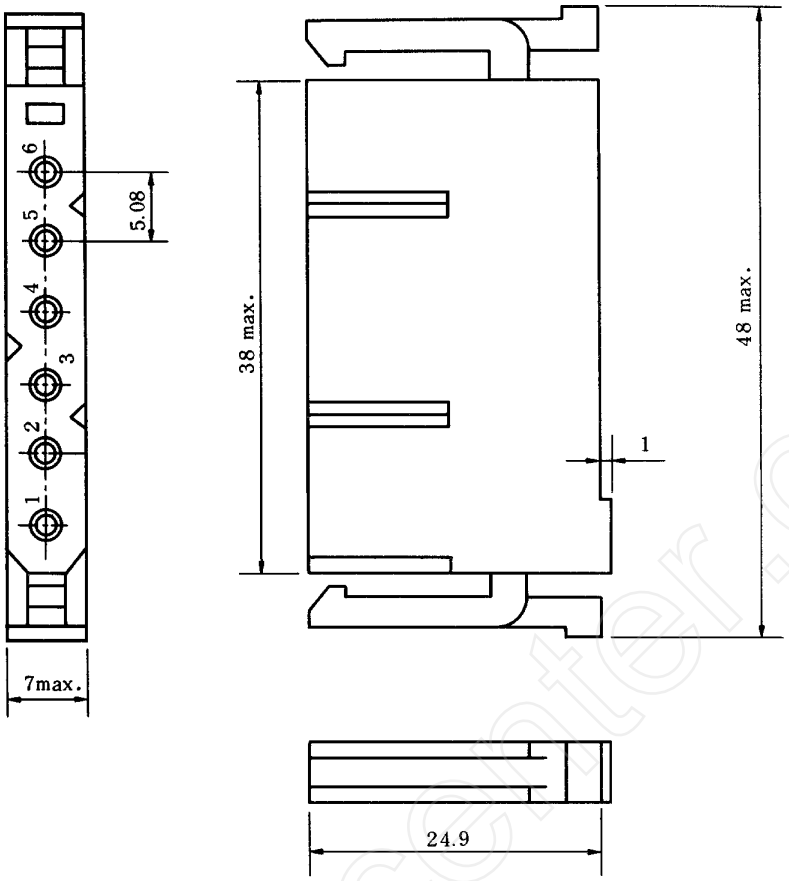
Manufacturer : NIPPON FCI

Name		Specification (Connector maker number)	Remarks
Connector housing for cable		SMS3PN–5	Brown
Contact	(Crimp type)	RC16M–23T3	For details on tools for crimp terminals, contact the manufacturer.
	(Soldering type)	RC16M–SCT3	

Cables

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

Fig. C5 (d) NIPPON FCI connector (6–pins,brown)



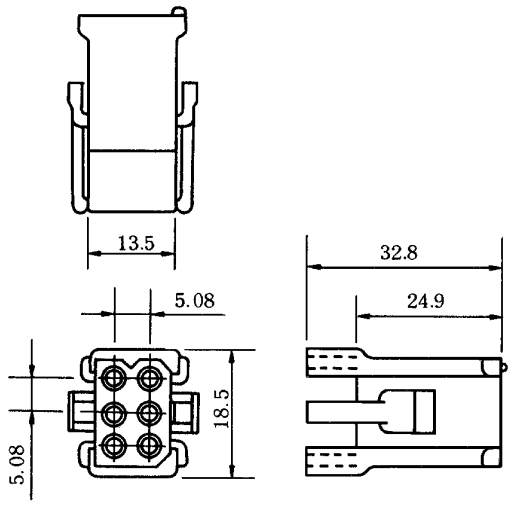
Manufacturer : NIPPON FCI

Name		Specification (Connector maker number)	Remarks
Connector housing for cable		SMS6PW–5	White
Contact	(Crimp type)	RC16M–23D28	For details on tools for crimp terminals, contact the manufacturer.
	(Soldering type)	RC16M–SCD28	

Cables

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

Fig. C5(e) NIPPON FCI connector (6–pinds,white)



Manufacturer : NIPPON FCI

Name		Specification (Connector maker number)	Remarks
Connector housing for cable		SMS6P–1	Black
Contact	(Crimp type)	RC16M–23T3	For details on tools for crimp terminals, contact the manufacturer.
	(Soldering type)	RC16M–SCT3	

Cables

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

Fig. C5 (f) NIPPON FCI connector (6–pins, Black, Rectangle)

B CONNECTING CABLES AND CONNECTORS

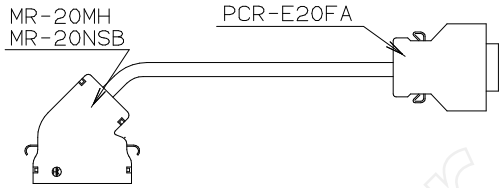
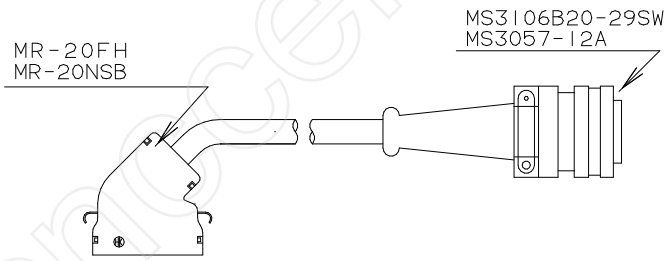
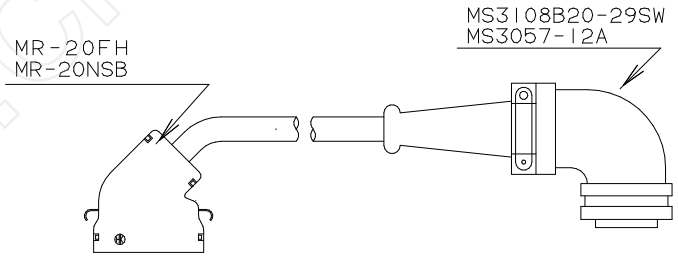
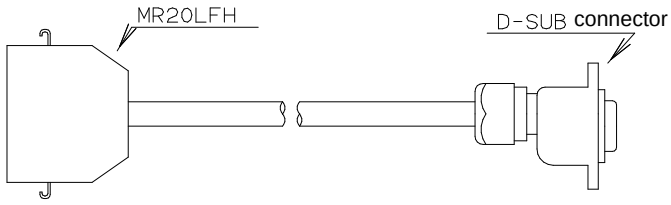
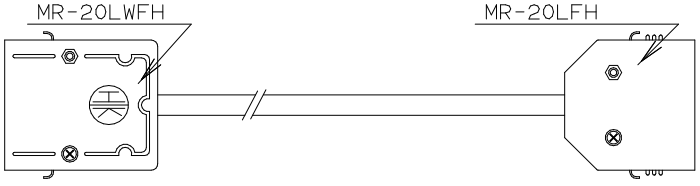
B.1
TABLE OF CABLE

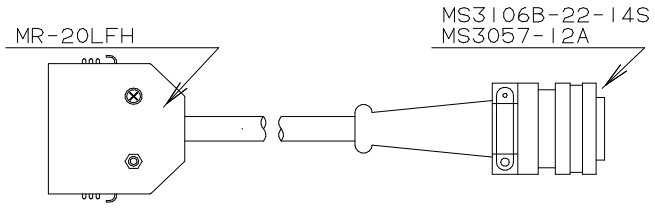
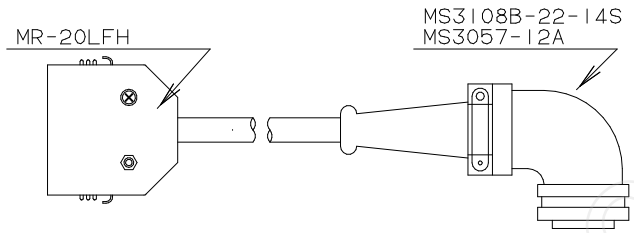
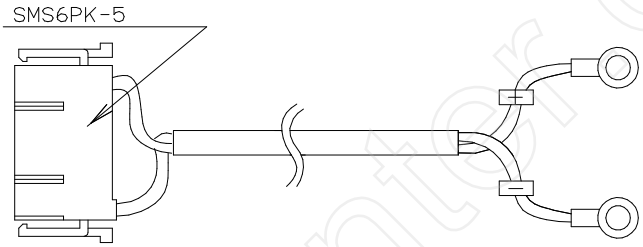
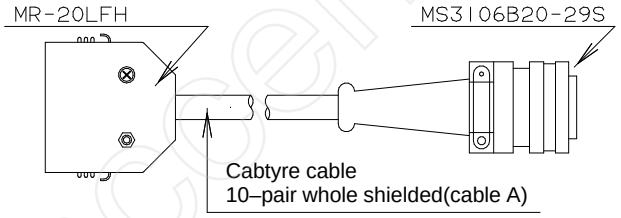
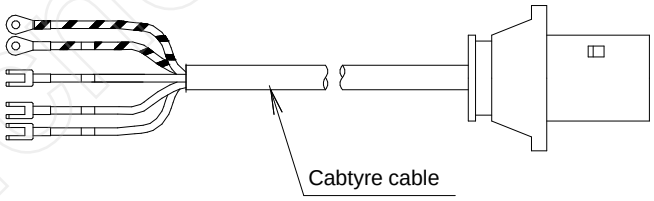
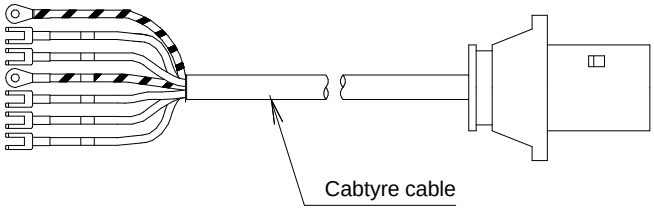
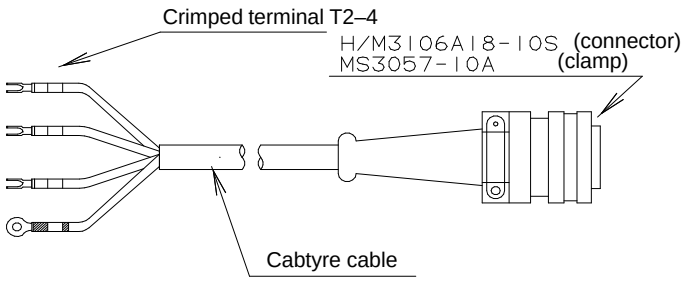
Cable	Usage	Max–length (m)
J1	Machine interface: CNC M1–Magnetic cabinet	50
J2	Machine interface: CNC M2–Magnetic cabinet	50
J15	1st axis motor power line: Velocity control unit motor	50
J16	2nd axis motor power line: Velocity control unit motor	50
J17	3rd axis motor power line: Velocity control unit motor	50
J18	4th axis motor power line: Velocity control unit motor	50
J20*	AC input unit CP2–power source CP11	
J23	Position coder CNC, M27–Position coder	50
J24	Manual pulse generator : CNC M12 or M21–manual pulse generator (For 1st unit)	50
J26	Analog output : CNC, M26–spindle control circuit	50
J27	MDI key signal : CNC, M3–CRT/MDI, KM1	50
J28	Reader puncher interface : CNC M5–connecting pin	50 to I/O device
J30	Machine interface CNC: M18–magnetic cabinet	50
J31	Machine interface CNC: M19–magnetic cabinet	50
J32	Machine interface CNC:M20–magnetic cabinet	50
J37	CRT signal : CNC, CCX (CCX2)–CRT/MDI unit, CN1	50
J38	CRT power supply : Power supply unit, CP15–CRT/MDI unit, CN2	50
J51	Servo power : Servo transformer–Velocity control unit	
J52	Power supply for MCC : 100VAC velocity control unit	
J61	Servo transformer input power supply : AC input 3 phases–servo transformer	
J81	Absolute pulse coder relay 1st axis : Integrated relay unit to pulse coder	
J82	Absolute pulse coder relay 2nd axis : Integrated relay unit to pulse coder	
J83	Absolute pulse coder relay 3rd axis : Integrated relay unit to pulse coder	
J84	Absolute pulse coder relay 4th axis : Integrated relay unit to pulse coder	
J85 to J88	Absolute pulse coder relay from 1st to 4th axis : Relay unit to Battery unit	
J89	Absolute pulse coder battery cable : Relay unit to Battery unit	
J210 to J213	Servo command 1 axis to 4 axis : CNC to Integrated pulse coder	50
J220 to J223	Position feedback cable 1 axis to 4 axis : CNC to integrated pulse coder	50
J230 to J233	Position feedback cable 1 axis to 4 axis : CNC to remote pulse coder	50
J240 to J243	Velocity feedback cable 1 axis to 4 axis : CNC to servo motor	50

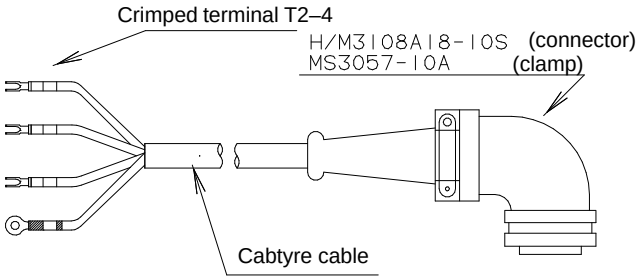
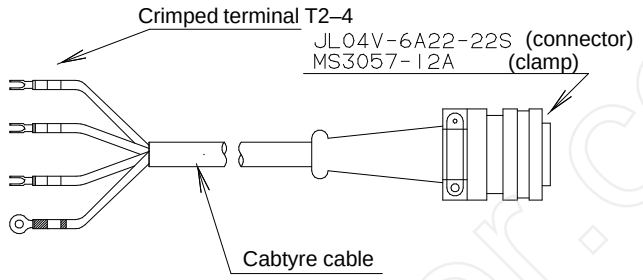
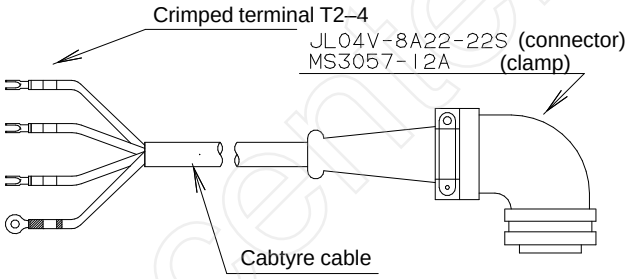
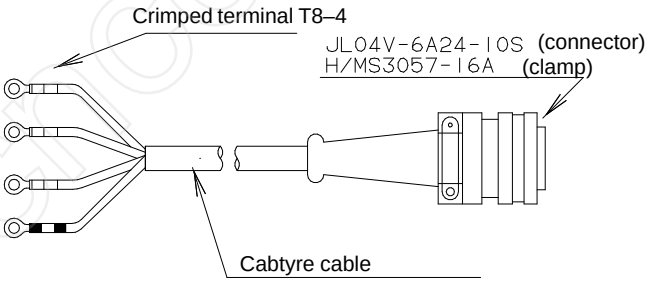
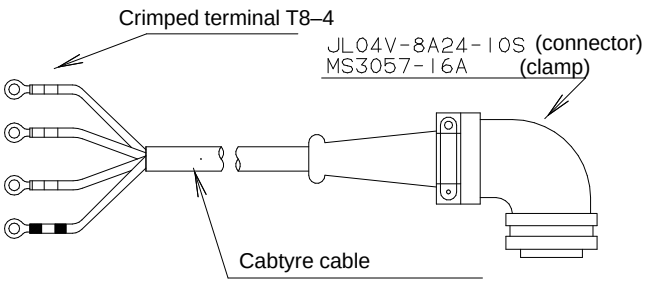
B.2 INTERFACE CABLE (OUR SUPPLY)

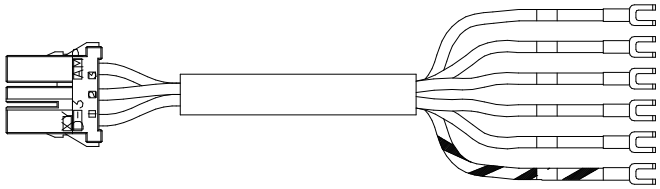
The following interface cables are provided.

Connection cable for SERVO

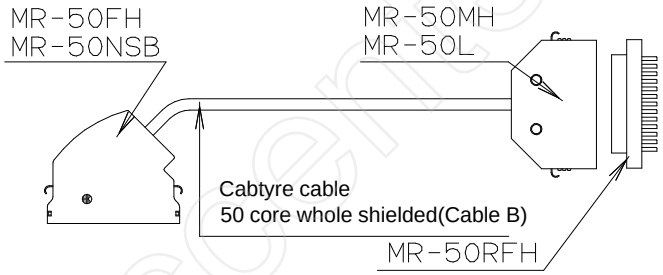
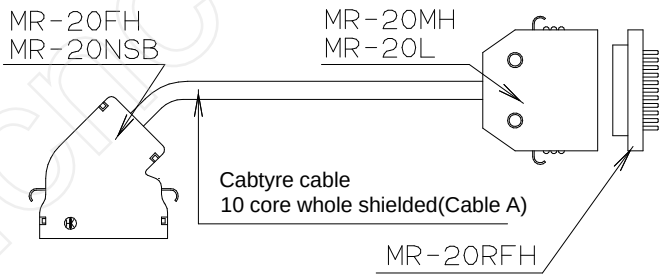
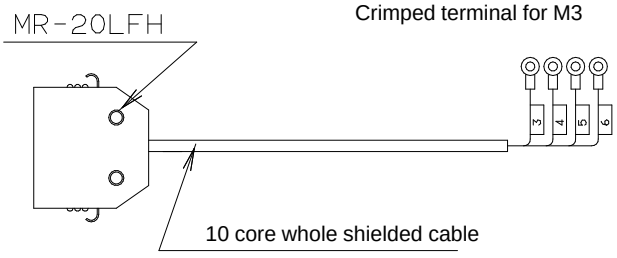
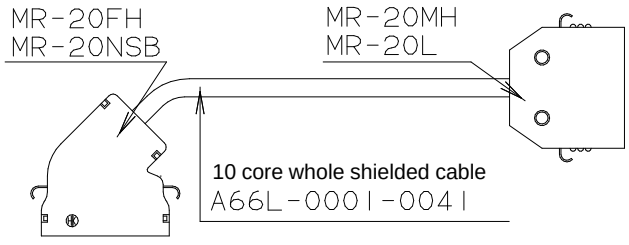
Usage	Name	Specifications	Code	Length
For current command Control unit ↕ Servo amplifier (α series)	J210 to J217		A02B– 0098– K841	5 m
Serial spindle signal cable α series amplifier (JA7B) ↕ Electric/optical transducer			A02B– 0120– K844	1 m
Incremental A/B phase pulse coder Servo motor α3–α150 ↕ Control unit	J220 to J227		A02B– 0098– K860	14 m
Incremental A/B phase pulse coder Servo motor α3–α150 ↕ Control unit	J220 to J227		A02B– 0098– K861	14 m
Incremental A/B phase pulse coder Servo motor α1,α2 ↕ Control unit	J220 to J227		A06B– 6050– K854	14 m
Absolute A/B phase feedback Relay unit ↕ Control unit	J220 to J227A		A02B– 0074– K804	2 m

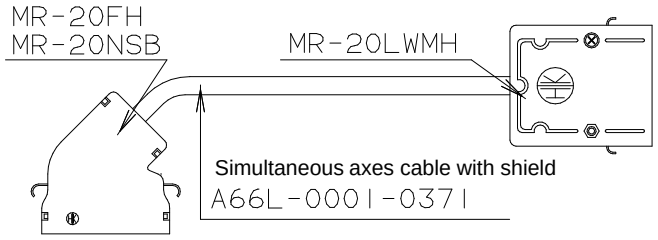
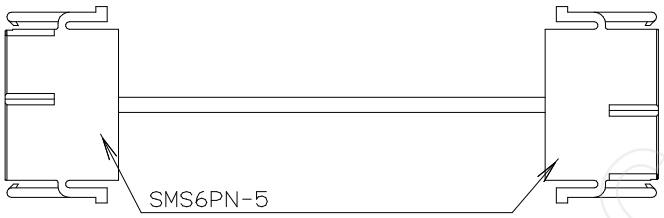
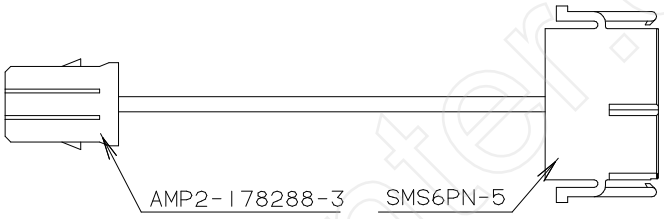
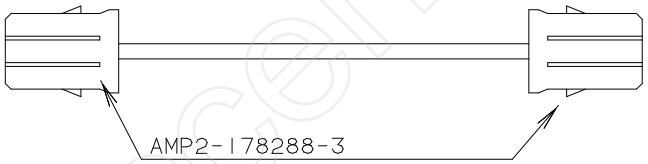
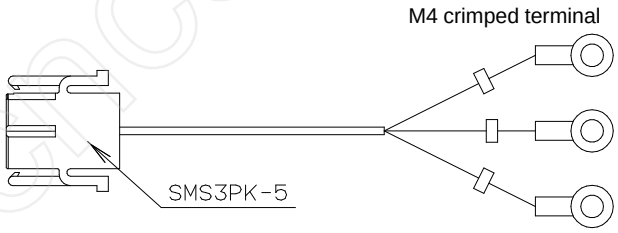
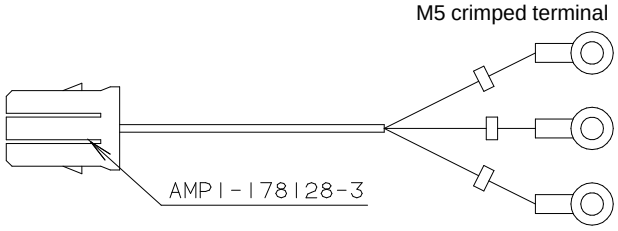
Usage	Name	Specifications	Code	Length
Absolute A/B phase feedback AC servo motor ↕ Relay unit	J81 to J84		A06B–6050–K055	14 m
Absolute A/B phase feedback AC servo motor ↕ Relay unit	J81 to J84		A06B–6050–K056	14 m
Battery unit for absolute pulse coder ↕ Relay unit	J89		A02B–0072–K902	4 m
Cable for position coder Position coder ↕ Controller	J23		A02B–0050–K801	7 m
For servo motor drive Servo amplifier ↕ Servo motor α1,α2 (Without brake)	J15 to J18		A06B–6050–K824	14 m
For servo motor drive Servo amplifier ↕ Servo motor α1,α2 (With brake)	J15 to J18		A06B–6050–K825	14 m
For servo motor drive Servo amplifier ↕ Servo motor α3,α6,α9 (Straight)	J15 to J18		A06B–6079–K800	14 m

Usage	Name	Specifications	Code	Length
For servo motor drive Servo amplifier ⇕ Servo motor α3,α6,α9 (Elbow)	J15 to J18		A06B– 6079– K801	14 m
For servo motor drive Servo amplifier ⇕ Servo motor α12,α22,α30 (Straight)	J15 to J18		A06B– 6079– K802	14 m
For servo motor drive Servo amplifier ⇕ Servo motor α12,α22,α30 (Elbow)	J15 to J18		A06B– 6079– K803	14 m
For servo motor drive Servo amplifier ⇕ Servo motor α22,α30,α40 (Straight)	J15 to J18		A06B– 6079– K804	14 m
For servo motor drive Servo amplifier ⇕ Servo motor α22,α30,α40 (Elbow)	J15 to J18		A06B– 6079– K805	14 m

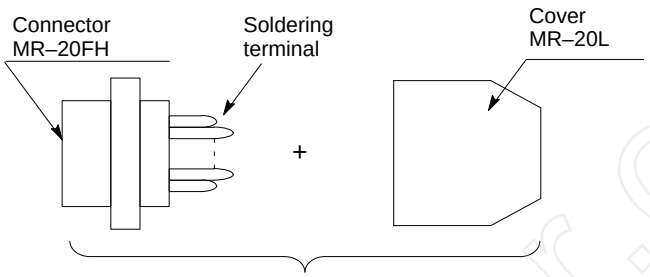
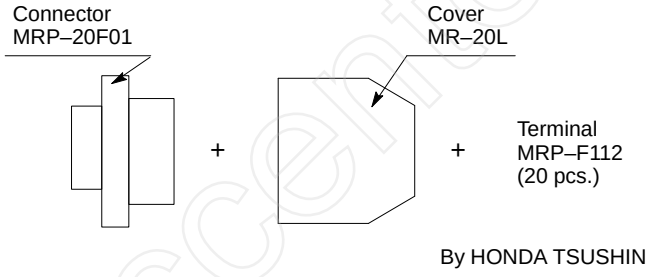
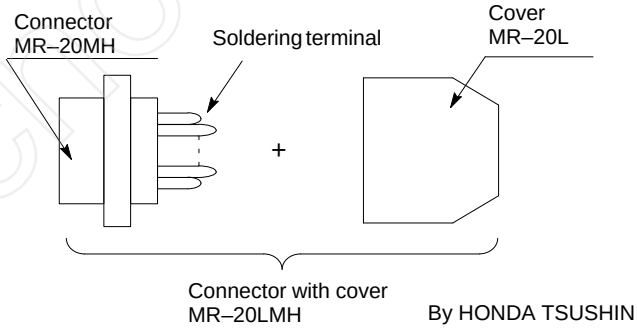
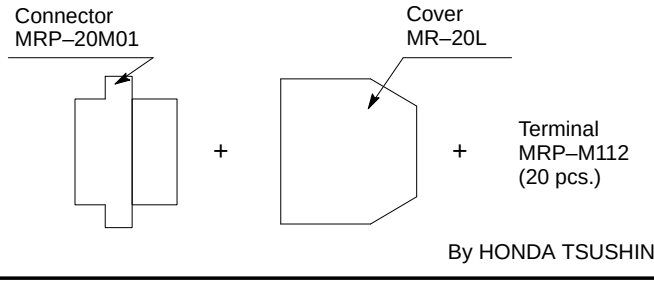
Usage	Name	Specifications	Code	Length
For servo motor drive Servo amplifier ⇕ Servo motor α0.5 (Without brake)	J15 to J18		A06B– 6050– K822	14 m
For servo motor drive Servo amplifier ⇕ Servo motor α0.5 (With brake)	J15 to J18		A06B– 6050– K823	14 m

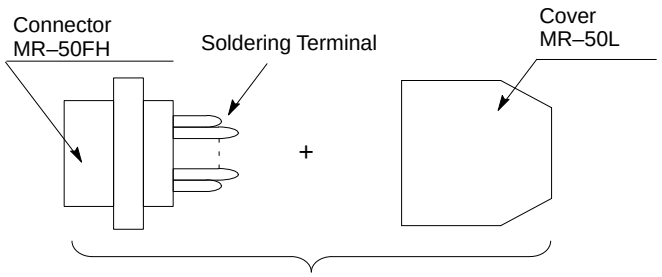
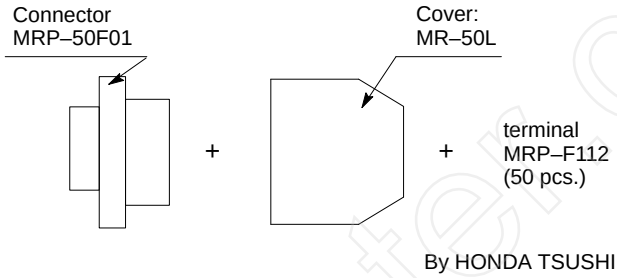
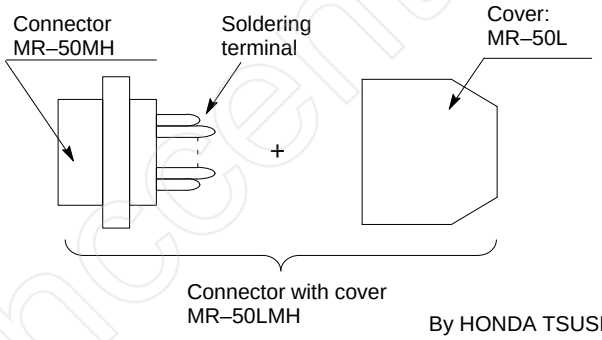
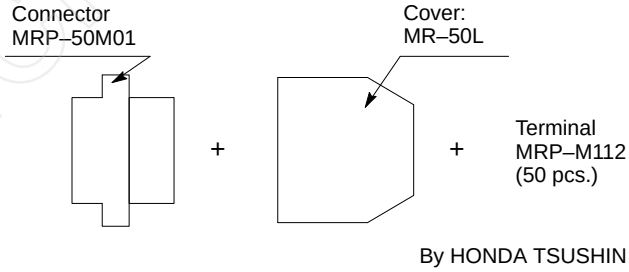
Connection cable for CNC

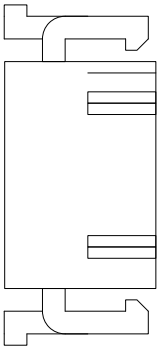
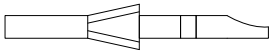
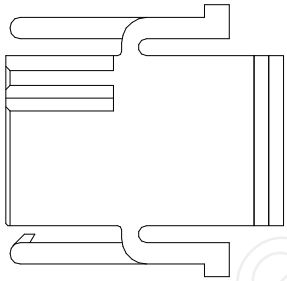
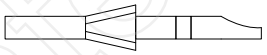
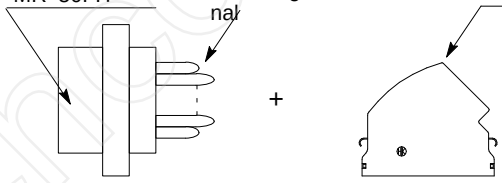
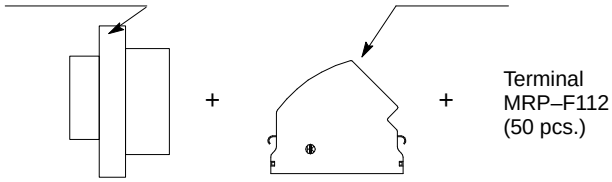
Usage	Name	Specifications	Code	Length
Signal cable for DI/DO Control unit ⇕ Operator's panel or control panel	J1 J2 J30 J32		A02B– 0098– K801	7 m
Signal cable for DI/DO Control unit ⇕ Operator's panel or control panel	J31 J39		A02B– 0098– K802	7 m
Signal cable (For 1 axis) for manual pulse generator Control unit ⇕ Manual pulse generator	J24		A02B– 0050– K802	7 m
Signal cable for MDI Control unit ⇕ MDI unit (Common to both small type and full key type)	J27		A02B– 0098– K803	10 m

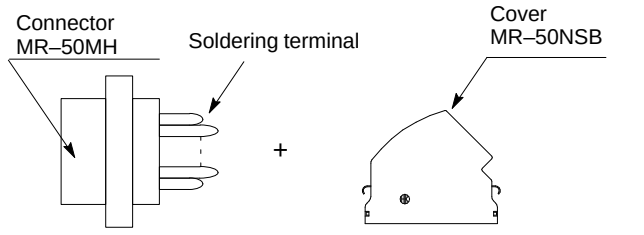
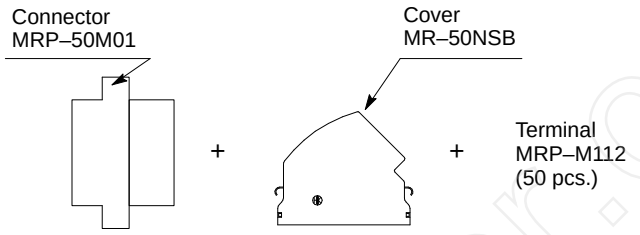
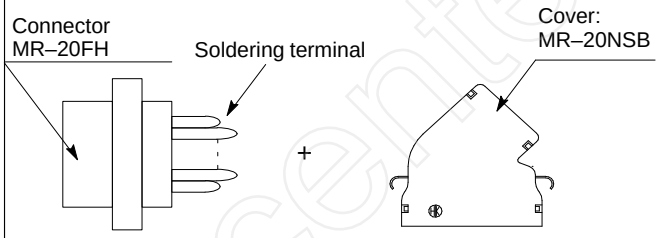
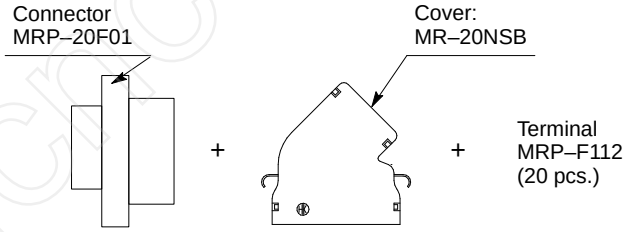
Usage	Name	Specifications	Code	Length
Signal cable for VIDEO Control unit ↕ Display (For EMC)	J37A		A02B– 0098– K871	7 m
Monochrome CRT Power supply cable Power supply unit ↕ CRT unit	J38		A02B– 0072– K817	7 m
Monochrome CRT Power supply cable Power supply unit (For CE) ↕ CRT unit	J38		A02B– 0120– K820	5 m
LCD unit Power supply cable Power supply unit (For CE) ↕ LCD unit	J38		A02B– 0120– K823	5 m
Control unit power supply cable Power supply unit (AI) ↕ Input power supply (200VAC)			A02B– 0072– K823	7 m
Control unit power supply cable Power supply unit (For CE) ↕ Input power supply (200VAC)			A02B– 0120– K845	7 m

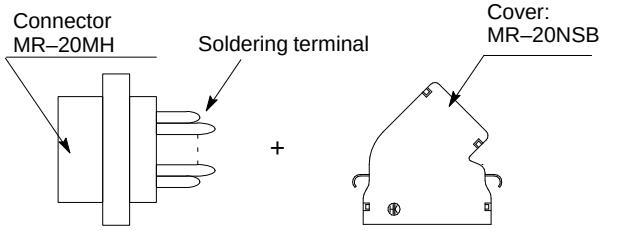
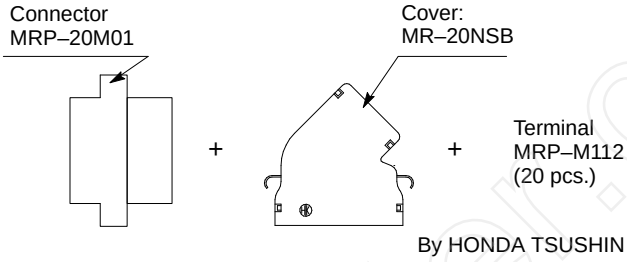
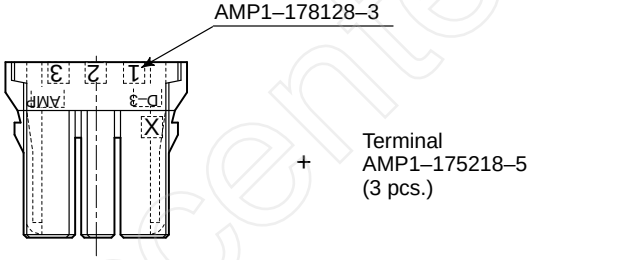
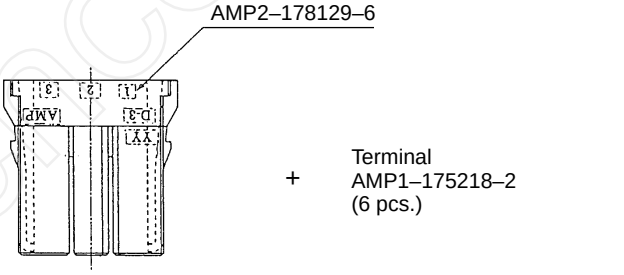
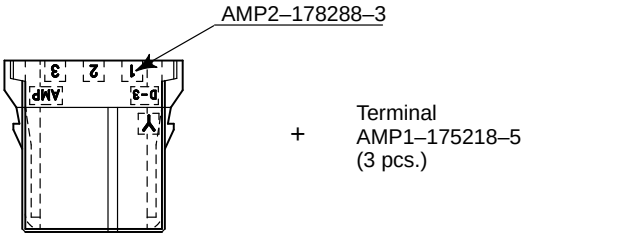
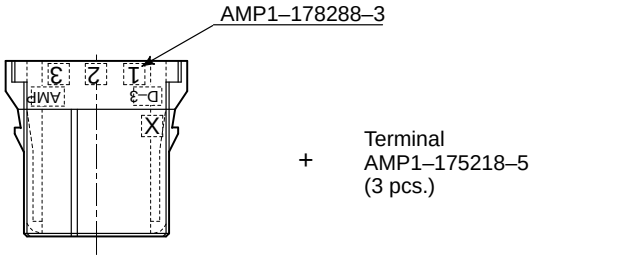
B.3 CONNECTOR FOR INTERFACE (ATTACHED TO CABLES)

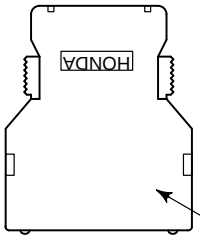
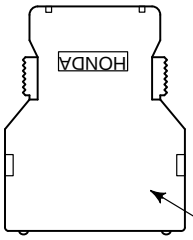
Usage (Connector No.)	Name	Specifications	Code	Number
M3 M12 M19 M21 M27 M185 M186 M188 M189 M195 M196 M198 M199 M219 CCX5	Connector with cover (20–pin female soldering type)		A02B–0029–K890	
	Connector with cover (20–pin female crimp type)		A02B–0029–K892	
M5 M26 M184 M187 M194 M197 KM1	Connector with cover (20–pin male soldering type)		A02B–0029–K898	
	Connector with cover (20–pin male crimp type)		A02B–0029–K900	

Usage (Connector No.)	Name	Specifications	Code	Number
M1 M2 M18 M20 M201 M202 M218 M220	Connector with cover (50 pin female soldering type)		A02B–0029–K891	
	Connector with cover (50 pin female crimp type)		A02B–0029–K893	
	Connector with cover (50 pin male soldering type)		A02B–0029–K899	
	Connector with cover (50 pin male crimp type)		A02B–0029–K901	

Usage (Connector No.)	Name	Specifications	Code	Number
CP15 CN2 (CRT/MDI)	Connector 6 pin female soldering type brown	Housing SMS6PN–5  + Contact RC16M–SCT3 (6 pcs.)  By NIPPON FCI	A02B–0061–K203	
CP14 CP51	Connector 3 pin female soldering type brown	Housing SMS3PN–5  Contact RC16M–SCT3 (3 pcs.)  By NIPPON FCI	A02B–0072–K893	
M1 M2 M18 M20 M201 M202 M218 M220	Connector with cover (50 pin female soldering type)	Connector MR–50FH Soldering terminal + Cover MR–50NSB  By HONDA TSUSHIN	A02B–0098–K891	
	Connector with cover (50 pin female crimp type)	Connector MRP–50F01 + Cover: MR–50NSB + Terminal MRP–F112 (50 pcs.)  By HONDA TSUSHIN	A02B–0098–K893	

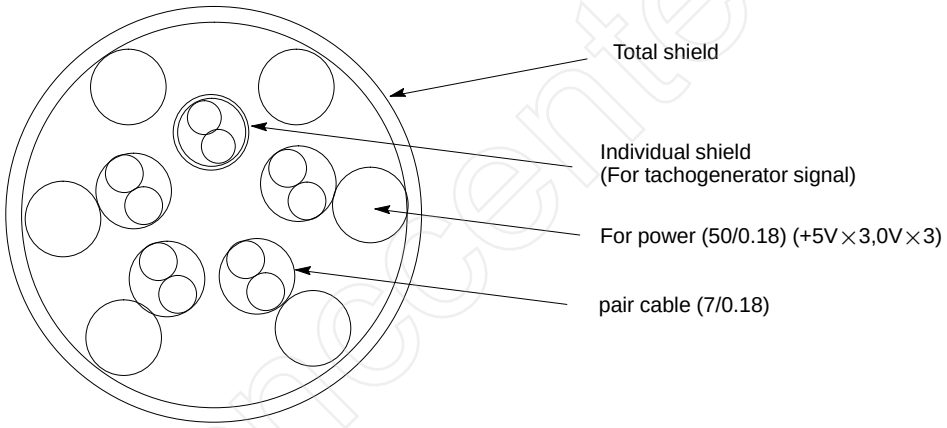
Usage (Connector No.)	Name	Specifications	Code	Number
M1 M2 M18 M20 M201 M202 M218 M220	Connector with cover (50 pin male soldering type)	 By HONDA TSUSHIN	A02B–0098–K899	
	Connector with cover (50 pin male crimp type)	 By HONDA TSUSHIN	A02B–0098–K901	
M3 M12 M19 M21 M27 M185 M186 M188 M189 M195 M196 M198 M199 M219 CCX5	Connector with cover (20 pin female soldering type)	 By HONDA TSUSHIN	A02B–0098–K890	
	Connector with cover (20 pin female crimp type)	 By HONDA TSUSHIN	A02B–0098–K892	

Usage (Connector No.)	Name	Specifications	Code	Number
M5 M26 M184 M187 M194 M197 KM1	Connector with cover (20 pin male soldering type)		A02B–0098–K898	
	Connector with cover (20 pin male crimp type)		A02B–0098–K900	
Qualifying for CE marking Power supply unit AI 200 V AC input/output (CP1, CP2, CP3)	AMP 3 pins Black X type		A02B–0120–K321	
Qualifying for CE marking Power supply unit AI ON/OFF Control (CP4)	AMP 6 pins Black YY type		A02B–0120–K322	
Qualifying for CE marking Power supply unit AI 24 V DC Output (CP5)	AMP 3 pins Black Y type		A02B–0120–K323	
Qualifying for CE marking Power supply unit AI 24 V DC Output (CP6)	AMP 3 pins Black X type		A02B–0120–K324	

Usage (Connector No.)	Name	Specifications	Code	Number
I/O Link (JD1A, JD1B) Type B interface Servo cable (JS1A)	Connector with cover (20 pins Half pitch ·Female ·Soldering type)	 + Connector PCR–E20FS Cover PCR–V20LA By HONDA TSUSHIN	A02B–0120–K301	
	Connector with cover (20 pins Half pitch ·Female· Crimped type)	 + Connector PCR–E20FA Cover PCR–V20LA By HONDA TSUSHIN	A02B–0120–K302	

B.4 CABLE FOR STANDARD INTERFACE

Name	Conductor		Sheath thickness	Total outer dia.	Electric characteristic		Code*
	Diameter	Composition			Conductor resistance	Allowable current	
Cable A (10–pair)	ϕ0.55 mm	7/0.18	1.5 mm	ϕ10.0 mm	110Ω/km	1.6 A	A66L–0001–0041
Cable B (50 core)	ϕ0.55 mm	7/0.18	1.7 mm	ϕ12.5 mm	106Ω/km	1.6 A	A66L–0001–0042
Cable C (5–pair, 6 core)	ϕ0.55 mm	7/0.18	1.0 mm	ϕ11.0 mm	116Ω/km	1.6 A	A66L–0001–0157
	ϕ1.5 mm	50/0.18			16Ω/km	10 A	



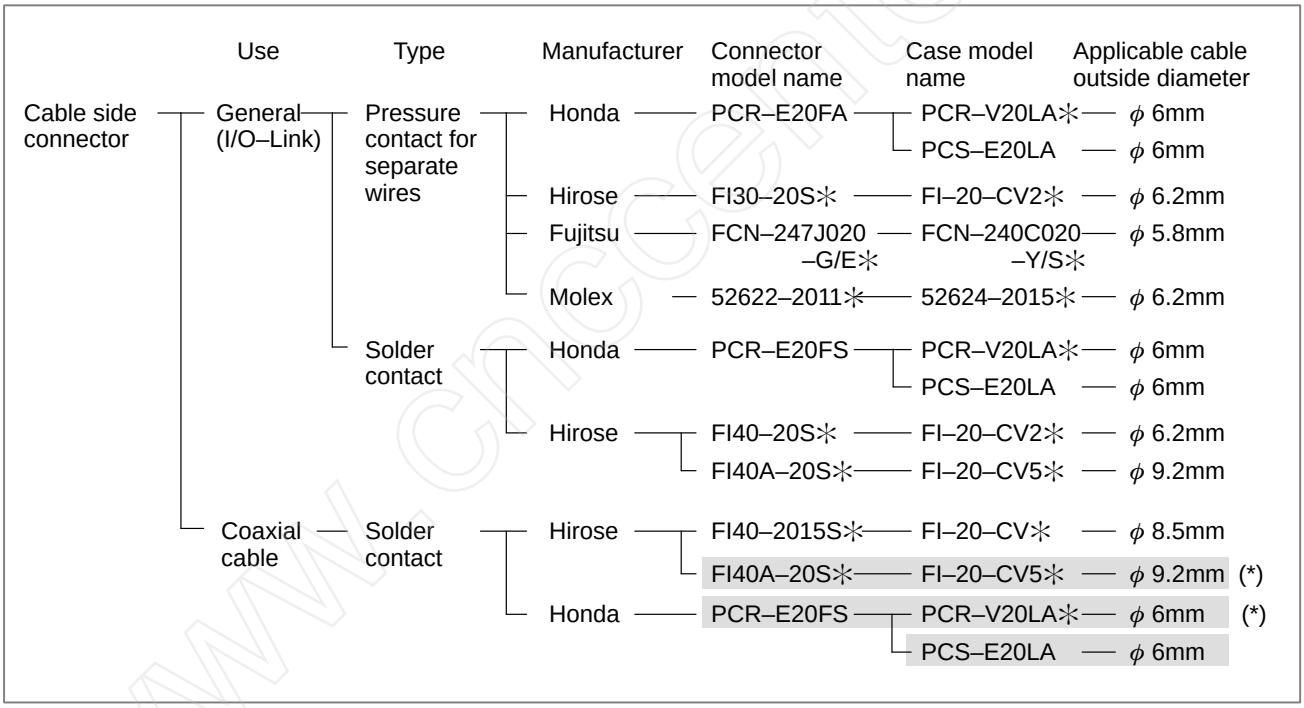
C HALF PITCH 20–PIN INTERFACE CONNECTORS AND CABLES

Connector for the PC board

Model: PCR–EV20MDT manufactured by Honda Tsushin
The connector for the PC board has been specially developed support FANUC's high–mounting density. PCR connectors made by Honda Tsushin are compatible with the mating part of the connector and can be selected for the cable connection.

Cable connector

Several connector manufacturers have developed custom cable side connectors for this purpose.
The cable connector is separated into a body and a housing. The connectors available are shown below. Models marked with (⁎) have been customized for FANUC; those not so marked are mass produced as standard products.



Pressure contact for separate wires

This connector assembles multiple #28AWG wires into a single connection. In comparison with solder contact and crimp contact connectors, this connector enables a cable to be assembled at a much lower cost.

Solder contact

The Honda Tsushin PCR–E20FS is a solder contact type connector used for assembling a small number of cables or for cable assembly on site. The Hirose Electric FI40–20S is equivalent to the PCR–E20FS but has large solder terminals to facilitate soldering.

Hirose Electric has also developed the FI40A–20S, which has the same number of pins as the FI40–20S but a larger solder row pitch to enable easier soldering. Since the applicable cable diameter of the case has been increased, the FI40A–20S can also be used with thick wires (diameter: 9.2 mm).

These connectors enable the soldering of wires of up to around #20AWG. When a large number of #20AWG wires are used, however, the pitch of the solder contacts may be too small to achieve satisfactory workability. To overcome this problem, the Hirose Electric FI40–2015S has been developed. The number of pins has been reduced so that the pitch of the solder contacts is as large as a conventional MR connector.

NOTE

The connectors can also be used for pulse coders and other equipment. In this case, the supported cable outside diameters are 9.2 mm and 6.0 mm, respectively. Either connector can be used, depending on the outside diameter of the cable to be used.

The FANUC–developed cable (A66L–0001–0286) has an outside diameter of 8.5 mm and cannot be used with these connectors.

Recommended connectors and applicable housings

Connector name in Connection Manual	FANUC–authorized connector (manufacturer)	FANUC–authorized housing or case (manufacturer)	FANUC order number of applicable cable (FANUC–developed cable)	Remarks
PCR–E20FA Pressure contact for separate wires	PCR–E20FA (Honda Tsushin)	PCR–V20LA (Honda Tsushin)	A66L–0001–0284#10P (Outside diameter: 6.2 mm)	Plastic housing
		PCS–E20LA (Honda Tsushin)		Metal housing
	FI30–20S (Hirose Electric)	FI–20–CV2 (Hirose Electric)		Plastic housing
	FCN–247J020–G/E (Fujitsu)	FCN–240C020–Y/S (Fujitsu)		Plastic housing
	52622–2011 (Molex)	52624–2015 (Molex)		Plastic housing
PCR–E20FS Solder contact	PCR–E20FS (Honda Tsushin)	PCR–V20LA (Honda Tsushin)	A66L–0001–0284#10P (Outside diameter: 6.2 mm)	Plastic housing
		PCS–E20LA (Honda Tsushin)		Metal housing
	FI40–20S (Hirose Electric)	FI–20–CV2 (Hirose Electric)		Plastic housing
FI40–2015S 15–pin solder contact	FI40–2015S (Hirose Electric)	FI–20–CV (Hirose Electric)	A66L–0001–0286 (Outside diameter: 8.5 mm)	Plastic housing
FI40A–20S Solder contact	FI40A–20S (Hirose Electric)	FI–20–CV5 (Hirose Electric)	A66L–0001–0367 A66L–0001–0368 (Outside diameter: 9.2 mm)	Plastic housing

Specialized tools for assembling pressure contact connector

Connector name in Connection Manual	FANUC–authorized connector (manufacturer)	Wire preparation tool	Pressure tool	Remarks
PCR–E20FA	PCR–E20FA (Honda Tsushin)	PCS–K2A	FHPT–918A	Low price
		JGPS–015–1/1–20 JGPS–014	MFC–K1 PCS–K1	(Note)
		FHAT–918A		
	FI30–20S (Hirose Electric)	FI30–20CAT	FI30–20/ID	Low price
		FI30–20CAT1	HHP–502 FI30–20GP	
	FCN–247J020–G/S (Fujitsu)	FCN–237T–T043/H	FCN–237T–T109/H FCN–247T–T066/H	
		FCN–237T–T044/H		
		FCN–237T–T062/H		
	52622–2011 (Molex)	57829–5000	57830–5000	Low price
		57823–5000	57824–5000	

NOTE
1 The tools in the shaded boxes are available from FANUC (order number: A02B–0120–K391).
2 The tools are designed for use with the connectors of the corresponding manufacturers.

Cable wires

Cable wires generally need to be developed or ordered by the machine tool builder.
FANUC has developed wires that specifically suit the interface connector of the Series 0/00/0–Mate. They are listed in the table below, for your convenience when ordering from the manufacturer.
(In addition to these, a cable for moving parts is under development.)

Cable type	Use	Structure	FANUC specification No.	Manufacturer	Remarks
10–pair-cable	General purpose	Ten 0.08mm^2 pairs	A66L–0001–0284 #10P	Hitachi cable, Oki Electric Cable	
6–pair cable	CRT interface (for press–mount connector)	Six 0.08mm^2 pairs	A66L–0001–0295	Hitachi Cable	20m maximum
6–core coaxial cable	CRT interface (for long distances)	Coaxial six cores	A66L–0001–0296	Hitachi Cable	50m maximum
Composite 12–core cable (Note)	Pulse coders, linear scales, and manual pulse generators	Six 0.05mm^2 wires and three 0.18mm^2 pairs	A66L–0001–0286	Hitachi Cable, Oki Electric Cable	20m maximum (Note)

NOTE

For the pulse coder, scale, and manual pulse generator, each of which has a +5–V power supply, wires need to be selected taking into consideration the supply voltage drop caused by the resistance of the cable.
A66L–0001–0286 has been designed for use with a cable length of 20 mm or less. If the cable length exceeds 20 m, relay a cable with a lower resistance, such as A66L–0001–0157.
The number of manual pulse generators to be connected is assumed to be three. If only one generator is connected, the cable can be extended to a maximum of 50 m by connecting wires with in parallel a cross–sectional area of 0.5 mm^2 for the power supply.

D EMERGENCY STOP SIGNAL

WARNING

Using the emergency stop signal effectively enables the design of safe machine tools.

The emergency stop signal is provided to bring a machine tool to an emergency stop. It is input to the CNC controller, servo amplifier, and spindle amplifier. An emergency stop signal is usually generated by closing the B contact of a pushbutton switch.

When the emergency stop signal (*ESP) contact is closed, the CNC controller enters the emergency stop released state, such that the servo and spindle motors can be controlled and operated.

When the emergency stop signal (*ESP) contact opens, the CNC controller is reset and enters the emergency stop state, and the servo and spindle motors are decelerated to a stop.

Shutting off the servo amplifier power causes a dynamic brake to be applied to the servo motor. Even when a dynamic brake is applied, however, a servo motor attached to a vertical axis can move under the force of gravity. To overcome this problem, use a servo motor with a brake.

While the spindle motor is running, shutting off the motor–driving power to the spindle amplifier allows the spindle motor to continue running under its own inertia, which is quite dangerous. When the emergency stop signal (*ESP) contact opens, it is necessary to confirm that the spindle motor has been decelerated to a stop, before the spindle motor power is shut off.

The FANUC control amplifier α series products are designed to satisfy the above requirements. The emergency stop signal should be input to the power supply module (called the PSM). The PSM outputs a motor power MCC control signal, which can be used to switch the power applied to the power supply module on and off.

The CNC controller is designed to detect overtravel by using a software limit function. Normally, no hardware limit switch is required to detect overtravel. If the machine goes beyond a software limit because of a servo feedback failure, however, it is necessary to provide a stroke end limit switch, connected so that the emergency stop signal can be used to stop the machine.

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

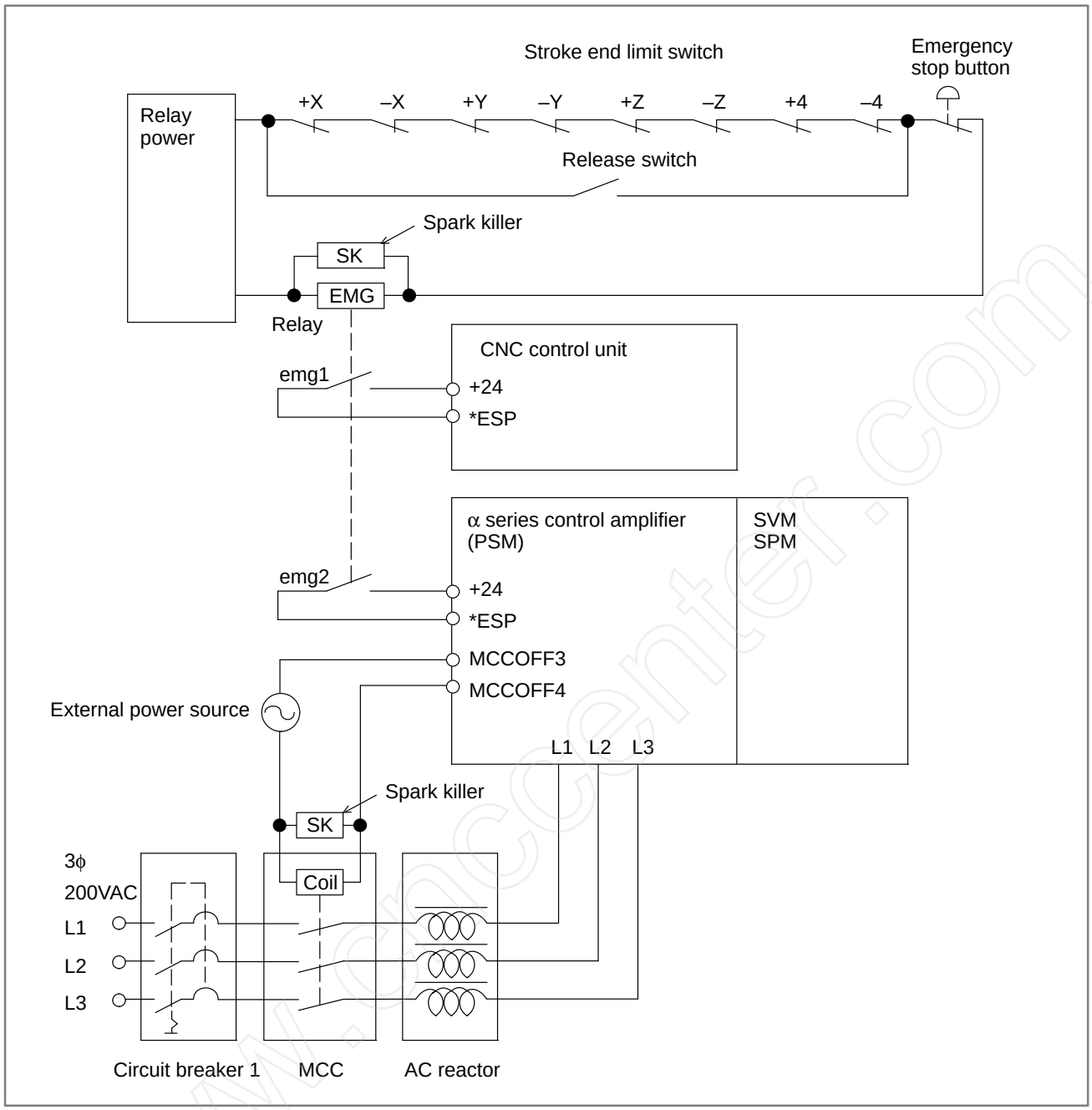


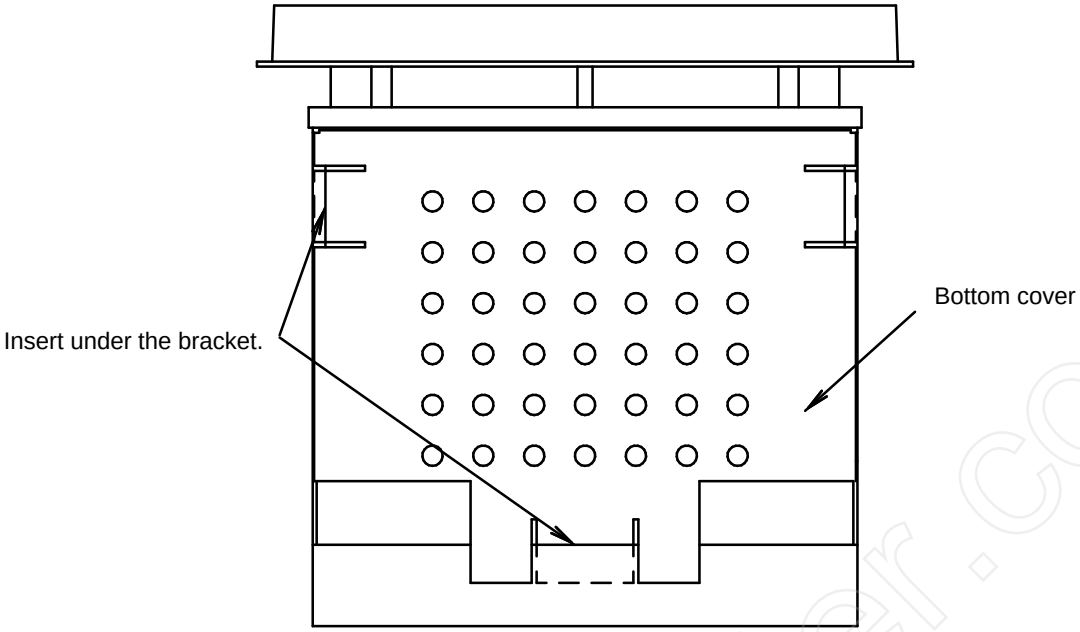
Fig. D

WARNING

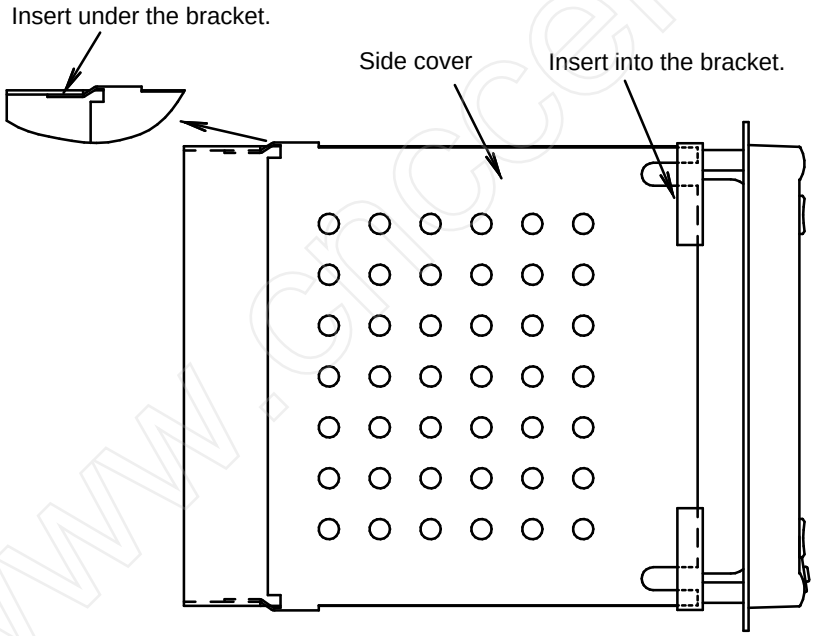
To use a spindle motor and amplifier produced by a manufacturer other than FANUC, refer to the corresponding documentation as well as this manual. Design the emergency stop sequence such that, if the emergency stop signal contact opens while the spindle motor is rotating, the spindle motor is decelerated until it stops.

E INSTALLING CRT PROTECTION COVERS

Qualification for CE marking (machine directive) requires the installation of CRT protection covers for the 9″ monochrome CRT. The top and rear covers are installed at the factory. This section shows how to install the bottom and side covers.



Installing the bottom cover (bottom view)



Installing the side cover (side view)

CRT protection covers

≪O≫

≪P≫

≪R≫

≪S≫

≪T≫

≪U≫

≪V≫

Revision Record

FANUC Series 0–TD/MD/GCD/GSD CONNECTION MANUAL (HARDWARE) (B–62543EN)

Edition	Date	Contents	Edition	Date	Contents
02	Apr., ’97	All pages are changed.			
01					