# GE Fanuc Automation 

## Computer Numerical Control Products

# Series 15i-Model B <br> Series 150i-Model B 

Connection Manual (Hardware)

## Warnings, Cautions, and Notes as Used in this Publication

## Warning

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

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

## Caution

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

## Note

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

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

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## DEFINITION OF WARNING, CAUTION, AND NOTE

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

## WARNING

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

## CAUTION

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

## NOTE

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

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

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## Contents of this manual

How this manual is organized

This manual describes the electrical and structural specifications required for connecting the CNC control units, FANUC Series $15 i / 150 i$, with a machine tool, and covers the equipment shown in the configuration diagram in Chapter 2. When using the CNC control units, be sure to connect and install them following the instructions in this manual. The manual outlines the units commonly used for Fanuc CNC control units, that is, the I/O unit, servo motor, spindle motor, and so on, and describes additional information on using these units for the Series $15 i / 150 i$. Refer to individual manuals for the detailed specifications of each unit.

This manual comprises the following chapters and appendix.

## 1. GENERAL

This chapter. It describes the outline and organization of this manual, names of models applied and other related manuals.

## 2. CONFIGURATION

This chapter describes the configuration of the electrical system of the machine tool with which the CNC is used.

## 3. INSTALLATION

This chapter describes how to install the CNC.

## 4. TOTAL CONNECTION

This chapter shows the connection diagrams for the CNC and each device.

## 5. POWER SUPPLY UNIT CONNECTION

This chapter describes the connection of the CNC to the power supply unit and input unit.

## 6. CONNECTION OF I/O UNITS TO MACHINE INTERFACE

This chapter describes the connection of the CNC to the I/O unit to machine interface.

## 7. CONNECTION TO CNC PERIPHERALS

This chapter describes the connection of the CNC to peripherals.

## 8. CONNECTION TO OTHER NET-WORKS

This chapter describes how to connect the Series $15 i / 150 i$ to networks.

## 9. HIGH-SPEED SERIAL BUS (HSSB)

This chapter describes the high-speed serial bus (HSSB), which enables transfer of data between the CNC and the personal computer.

## 10.CNC DISPLAY UNIT WITH PC FUNCTIONS

This chapter describes how to connect the CNC to the CNC display unit with PC functions.

## 11.EMERGENCY STOP SIGNAL

This chapter describes the handling of emergency stop signals.

## APPENDIX

A. UNIT EXTERNAL DIMENSION DIAGRAMS
B. EXTERNAL DIMENSIONS OF CONNECTORS
C. 20-PIN INTERFACE CONNECTORS AND CABLES
D. OPTICAL FIBER CABLE
E. LIQUID CRYSTAL DISPLAY (LCD)
F. MEMORY CARD INTERFACE
G. TERMINAL MODULE
H. TERMINAL MODULE A
I. RELAY MODULE A

## Applicable models

This manual can be used with the following models. The abbreviated names may be used.

| Product Name | Abbreviations |  |
| :--- | :--- | :--- |
| FANUC Series $15 i-\mathrm{MB}$ | $15 i-\mathrm{MB}$ | Series $15 i$ |
| FANUC Series $150 i-\mathrm{MB}$ | $150 i-\mathrm{MB}$ | Series $150 i$ |

Related manuals
The table below lists manuals related to FANUC Series $15 i / 150 i-M O D E L B$.
In the table, this manual is marked with an asterisk(*).
Table 1 Related manuals

| Manual name | Specification <br> number |  |
| :--- | :--- | :--- |
| DESCRIPTIONS | B-63782EN |  |
| CONNECTION MANUAL (Hardware) | B-63783EN | $*$ |
| CONNECTION MANUAL (Function) | B-63783EN-1 |  |
| OPERATOR'S MANUAL (PROGRAMMING) | B-63784EN |  |
| OPERATOR'S MANUAL (OPERATION) | B-63784EN-1 |  |
| MAINTENANCE MANUAL | B-63785EN |  |
| PARAMETERMANUAL | B-63790EN |  |

## 2

## CONFIGURATION

The following figure shows the configuration of the electrical system of the machine tool with which this control 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.


## 3 "smulumon

## 3.1 <br> ENVIRONMENTAL REQUIREMENTS OUTSIDE THE CABINET

### 3.1.1

Environmental Conditions Around the Cabinet

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

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

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

|  | Condition | Case of not using hard disk | Case of using hard disk |
| :---: | :---: | :---: | :---: |
| Ambient Temperature | Operating | $0^{\circ} \mathrm{C}$ to $45^{\circ} \mathrm{C}$ | $5^{\circ} \mathrm{C}$ to $40^{\circ} \mathrm{C}$ |
|  | Storage, Transport | $-20^{\circ} \mathrm{C}$ to $60^{\circ} \mathrm{C}$ |  |
| Temperature Change |  | Max. $0.3^{\circ} \mathrm{C} / \mathrm{min}$. | Max. $0.3{ }^{\circ} \mathrm{C} / \mathrm{min}$. |
| Humidity | Normal | $75 \%$ RH or less, no condensation | $10 \%$ to $75 \%$ RH, no condensation |
|  | Short period (less than 1 month) | $95 \%$ RH or less, no condensation | $10 \%$ to $90 \%$ RH, no condensation |
| Vibration | Operating | 0.5 G or less |  |
| Vibration | Non-operating | 1.0 G or less |  |
| Altitude | 1000 m or less |  |  |
| Environment | Normal machine shop environment (The environment must be considered if the cabinets are in a location where the density of dust, coolant, and/or organic solvent is relatively high.) |  |  |

### 3.1.2 <br> Installation Conditions for the CNC and Servo Unit Inside the Cabinet

| Ambient temperature | Operating: $0^{\circ} \mathrm{C}$ to $55^{\circ} \mathrm{C}$ <br> (no hard disk drive used) <br> Operating: $5^{\circ} \mathrm{C}$ to $50^{\circ} \mathrm{C}$ <br> (hard disk drive used) <br> Storage and transportation: $-20^{\circ} \mathrm{C}$ to $60^{\circ} \mathrm{C}$ |
| :--- | :--- |
| Humidity | $95 \%$ or less (relative) with no condensation <br> (no hard disk drive used) <br> $75 \%$ or less (relative) with no condensation <br> (hard disk drive used) |
| Vibration | 0.5 G or less |
| Environment | The unit shall not be exposed direct to cutting oil, <br> lubricant or cutting chips. |

## NOTE

When using the CNC display unit with PC functions, also see Subsection 10.5.1.

## 3.2 POWER REQUIREMENTS

The power requirement of the CNC control unit is calculated as the sum of the power required by the control and servo sections.

The control section power requirement includes the power required for control, the LCD, I/O units, the operator panel interface, and the on/off-controlled 200 VAC service outlet (2.5 A maximum) for the power supply unit.

| Control section power <br> requirement | 1.2 KVA |
| :--- | :--- |
| Servo section power requirement | Varies with the type of related servo motor |

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

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

- The cabinet must be fully closed.

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

- The cabinet to hold the control unit must be designed to maintain a difference in temperature of up to $10^{\circ} \mathrm{C}$ between the air in the cabinet and the outside air when the temperature in the cabinet rises.
For details of the thermal design, see 3.4.
- A closed cabinet must be equipped with a fan to circulate the air within. (This is not necessary for a unit with fan.)
The fan must be adjusted so that the air moves at $0.5 \mathrm{~m} / \mathrm{sec}$ along the surface of each installed unit.
CAUTION : If the air blows directly from the fan to the unit, dust easily adheres to the unit. This may cause the unit to fail.
- For the air to move easily, a clearance of 100 mm is required between each unit and the wall of the cabinet. (This is not necessary for a unit with fan.)
- Packing materials must be used for the cable port and the door in order to seal the cabinet.
- The LCD unit and MDI unit must not be installed in such a place that coolant would directly fall onto the unit.
The front panels of the LCD unit and the MDI unit are dustproof. However, avoid installing the units in locations where their front panels directly receive coolant. For an explanation of the dust protection measures for the power magnetics cabinets and pendant boxes of machine tools, see Section 3.4.
- 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 3.6 for details of noise elimination/management.

- When determining the layout of units in the cabinet, consider maintainability; arrange the units in such a way that they can be easily replaced during maintenance and inspection.
- The hard disk drive and floppy disk drive must not be installed near the source of a strong magnetic field.
- The installation conditions of the I/O unit and connector panel I/O module must be satisfied.
To obtain good ventilation in the module, the I/O unit and connector panel I/O module must be installed in the direction shown in the following figure. Clearances of 100 mm or more both above and below the I/O unit are required for wiring and ventilation.
Equipment radiating too much heat must not be put below the I/O unit and connector panel I/O module.


Connector panel I/O module or I/O base unit (No screws or protrusions shall extend from the bottom of this unit.)

- If the CNC unit is installed at an altitude of over $1,000 \mathrm{~m}$, an upper limit is placed on the ambient temperature (one of the environmental conditions described in Section 3.1) for the CNC within the cabinet. Each increment of 100 m over $1,000 \mathrm{~m}$ requires that $1.0^{\circ} \mathrm{C}$ be subtracted from the maximum allowable ambient temperature for the CNC in the cabinet.
Example) If a cabinet containing the CNC is installed at an altitude of $1,750 \mathrm{~m}$, the maximum allowable ambient temperature for the CNC is: $55^{\circ} \mathrm{C}-750 / 100 \times 1.0^{\circ} \mathrm{C}=47.5^{\circ} \mathrm{C}$
The allowable ambient temperature range for the CNC is therefore from $0^{\circ} \mathrm{C}$ to $47.5^{\circ} \mathrm{C}$.
If the hard disk drive in the CNC is used, the CNC can be installed only at an altitude ranging from:
-60 to $3,000 \mathrm{~m}$ when in operation
-60 to 12,000 when not in operation
- Unspecified frequencies may cause the CNC control unit and hard disk drive to vibrate at their resonance frequency, possibly subjecting unit components to an acceleration higher than allowable. After mounting the CNC control unit on your machine, carefully check for any abnormal conditions.


## CAUTION

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

## 3.4 <br> PROTECTION OF <br> PARTS INSIDE A <br> CABINET OR A PENDANT BOX FROM DUST

When a cabinet or a pendant box, which houses a display and an operator's panel, is designed, it must satisfy following conditions to prevent from the entry of airborne dust, coolant, and organic solvent.
(1) A cabinet or a pendant box must be fully closed.
(2) Packing materials must be used for the fixed side of a display and an operator's panel in order to seal a cabinet or a pendant box.
(3) Packing materials must be used for the door of a cabinet or a pendant box in order to seal a cabinet or a pendant box.
(4) Packing materials must be used for a back panel in order to seal a cabinet or a pendant box.
(5) Packing materials and conduit connector and so on must be used for the cable port in order to seal a cabinet or a pendant box.
(6) ALL holes must be filled.
(7) A display and an operator's panel must not be placed in a location where coolant and cutting chips would directly fall onto them.
(8) Don't let oil drip from the top of a cabinet or a pendant to panel sides.


## 3.5 <br> 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 $10^{\circ} \mathrm{C}$ 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 <br> Temperature Rise within the Cabinet

The cooling capacity of a cabinet made of sheet metal is generally $6 \mathrm{~W} /{ }^{\circ} \mathrm{C}$ per $1 \mathrm{~m}^{2}$ surface area, that is, when the 6 W heat source is contained in a cabinet having a surface area of $1 \mathrm{~m}^{2}$, the temperature of the air in the cabinet rises by $1^{\circ} \mathrm{C}$. 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 $10^{\circ} \mathrm{C}$ or less when the temperature in the cabinet rises:
Internal heat loss $\mathbf{P}[\mathbf{W}] \leqq$
$6\left[\mathrm{~W} / \mathrm{m}^{2} \cdot{ }^{\circ} \mathrm{C}\right] \times$ surface area $\mathrm{S}\left[\mathrm{m}^{2}\right] \times 10\left[{ }^{\circ} \mathrm{C}\right]$ of rise in temperature For example, a cabinet having a surface area of $4 \mathrm{~m}^{2}$ has a cooling capacity of $24 \mathrm{~W} /{ }^{\circ} \mathrm{C}$. To limit the internal temperature increase to $10^{\circ} \mathrm{C}$ under these conditions, the internal heat must not exceed 240 W . If the actual internal heat is 320 W , however, the temperature in the cabinet rises by $13^{\circ} \mathrm{C}$ or more. When this happens, the cooling capacity of the cabinet must be improved using the heat exchanger described next.

### 3.5.2 <br> Cooling by Heat Exchanger

If the temperature rise cannot be limited to $10^{\circ} \mathrm{C}$ 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.

## Example

For a cabinet with a surface area of $4 \mathrm{~m}^{2}$, if a heat exchanger with a heat radiation capacity of $9 \mathrm{~W} /{ }^{\circ} \mathrm{C}$ is used, the total heat radiation capacity increases to
$6 \mathrm{~W} / \mathrm{m}^{2}{ }^{\circ} \mathrm{C} \times 4 \mathrm{~m}^{2} \cdot+.9 \mathrm{~W} /{ }^{\circ} \mathrm{C}=33 \mathrm{~W} /{ }^{\circ} \mathrm{C}$
This means that even if the internal heat generation is 320 W , the temperature rise is held below $10^{\circ} \mathrm{C}$.

### 3.5.3 <br> Calorific Value of Each Unit

| Product name |  | Calorific value | Remarks |
| :---: | :---: | :---: | :---: |
| Control unit | Basic unit (2 slots) | 64W |  |
|  | Basic unit (4 slots) | 68W |  |
|  | Main CPU board | 38W |  |
|  | Additional axis board | 10W |  |
|  | HSSB board | 4W |  |
|  | Data server board A1 | 6W |  |
|  | Data server board A2 | 6.3W | Including the 0.3 W of the ATA card(*1) |
|  | Fast data server | 6.3W | Including the 0.3 W of the ATA card(*1) |
|  | PMC C-language board | 7W |  |
|  | Serial communication board | 7W |  |
|  | DeviceNet board B | 5W |  |
|  | DeviceNet board C | 4W |  |
|  | Profibus board (master) | 4W |  |
|  | Profibus board (slave) | 6W |  |
|  | Etehrnet board | 6W |  |
|  | Fast Ethernet board | 6W |  |
| LCD unit | 10.4" color LCD unit | 20W |  |
|  | 9.5" monochrome LCD unit | 18W |  |
| Hard disk unit for data server |  | 13W |  |
| Separate detector interface unit | Basic unit | 9W | (*2) |
|  | Basic unit + Additional unit | 14W | (*2) |
| Connection unit | Connection unit 1 | $16 \mathrm{~W}+0.18 \mathrm{~W} \times$ Number of ON inputs |  |
|  | Connection units 1 and 2 | $25 \mathrm{~W}+0.18 \mathrm{~W} \times$ Number of ON inputs |  |
| Operator's panel connection unit |  | $3.6 \mathrm{~W}+0.18 \mathrm{~W} \times$ Number of ONs |  |
| I/O unit model A | AIF01A, AIF01B | 1.2W |  |
|  | AID32A, AID32B | $1.2 \mathrm{~W}+0.23 \mathrm{~W} \times$ Number of ON inputs |  |
|  | AID16A, AID16B | $0.1 \mathrm{~W}+0.21 \mathrm{~W} \times$ Number of ON inputs |  |
|  | AID32E, AID32F | $0.1 \mathrm{~W}+0.23 \mathrm{~W} \times$ Number of ON inputs |  |


| Product name |  | Calorific value | Remarks |
| :---: | :---: | :---: | :---: |
| I/O unit model B | BIF04A1 | 1.6W |  |
|  | AIF02C | 1.2W |  |
|  | BID16A1, BID16B1 | $1.5 \mathrm{~W}+0.23 \times$ Number of ON inputs |  |
|  | BID16P1, BID16Q1 | $0.6 \mathrm{~W}+0.23 \times$ Number of ON inputs |  |
|  | BOA12A1 | $0.9 \mathrm{~W}+\left(0.09+1.1 \times \mathrm{IL}^{2}\right) \times$ Number of ON outputs |  |
|  | BOD16A1 | $1.0 \mathrm{~W}+\left(0.13+0.3 \times \mathrm{IL}^{2}\right)$ Number of ON outputs |  |
|  | BOD16P1 | $0.3 \mathrm{~W}+\left(0.13+0.3 \times \mathrm{IL}^{2}\right) \times$ Number of ON outputs |  |
|  | BIA16P1 | $0.1 \mathrm{~W}+0.21 \times$ Number of ON inputs |  |
|  | BMD88A1, BMD88B1 | $1.3 W+0.23 \times$ Number of ON input points + $\left(0.13+0.3 \times \mathrm{IL}^{2}\right) \times$ Number of ON output points |  |
|  | BMD88P1, BMD88Q1 | $0.4 \mathrm{~W}+0.23 \times$ Number of ON input points + $\left(0.13+0.3 \times \mathrm{IL}^{2}\right) \times$ Number of ON output points |  |
| I/O module for operator's panel |  | $3.6 \mathrm{~W}+0.18 \mathrm{~W} \times$ Number of ON inputs |  |
| I/O module for connector panel | Basic unit | $3.6 \mathrm{~W}+0.18 \mathrm{~W} \times$ Number of ON inputs |  |
|  | Extension unit | $3.6 \mathrm{~W}+0.18 \mathrm{~W} \times$ Number of ON inputs |  |
| Exported transformer for control unit |  | 51W |  |
| CNC display unit with PC functions 10.4" (A13B-0193-B031 to -B038) |  | 40W | During normal operation (*3) |
| CNC display unit with PC functions 12.1 " (A13B-0193-B041 to -B048) |  | 52W | During normal operation (*3) |
| CNC display unit with PC functions 15.0 " (A13B-0193-B051 to -B057) |  | 52W | During normal operation (*3) |

## NOTE

1 The calorific value of the ATA flash card is subject to change because of the adoption of a large-capacity card, changes in the card specifications, and so on.
2 Does not include the calorific value of the heat generated inside the separate detector.
3 Units assumed to be active during normal operation: CNC display unit with PC functions, HDD unit, HDD fan, FDD unit, full keyboard, and mouse. Units assumed to be inactive during normal operation: PCMCIA card, serial interface expansion device, parallel-interface-connected device. Note that the generated heat will increase if peripheral devices and PCI expansion boards are connected.

## 3.6 <br> ACTION AGAINST NOISE

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

### 3.6.1 <br> 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). <br> See Section 3.6.4 and connect spark killers or diodes with the solenoid and relay. |
|  | Secondary AC power line |  |
|  | AC/DC power lines (containing the power lines for the servo and spindle motors) |  |
|  | AC/DC solenoid |  |
|  | AC/DC relay |  |
| B | DC solenoid (24VDC) | Connect diodes with DC solenoid and relay. <br> Bind the cables in group $B$ separately from group $A$, or cover group B with an electromagnetic shield. <br> Separate group B as far from Group $C$ as possible. <br> It is more desirable to cover group B with the shield. |
|  | DC relay (24VDC) |  |
|  | DI/DO cable between the I/O unit and power magnetics cabinet |  |
|  |  |  |
|  | and machine |  |
| C | Cable between the CNC and I/O unit | Bind the cables in group C separately from group A , or cover group C with an electromagnetic shield. <br> Separate group C as far from Group B as possible. <br> Be sure to perform shield processing in Section 3.6.5. |
|  | Cable for position and velocity feedback |  |
|  | Cable between the CNC and spindle amplifier |  |
|  | Cable for the position coder |  |
|  | Cable for the manual pulse generator |  |
|  | Cable between the LCD and the MDI |  |
|  | RS-232C and RS-422 interface cable |  |
|  | Cable for the battery |  |
|  | Other cables to be covered with the shield |  |

## NOTE

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

### 3.6.2 Grounding

The CNC machine tool has three grounding systems:

- Grounding system for signals

The grounding system for signals provides the reference potential ( 0 V) for the electric signal system.

- Protective grounding system

The protective grounding system is intended to ensure safety and shield any external noise and internally-generated noise. It consists of device frames, unit cases, panels, as well as the shields of the interface cables connecting devices.

- Protective earth (PE) system

The protective earth (PE) system connects the protective grounding system, which is provided for devices and units, to ground at a single location.


Notes on wiring for the grounding systems

### 3.6.3 <br> Grounding Units

- The ground resistance of the protective earth (PE) system must be $100 \Omega$ or less (as per class-D grounding).
- The connection cable for the protective earth (PE) system must be so large in cross section that the accidental current can flow through the protective earth (PE) system safely in the event of an accident such as a short-circuit.
(In general, the cross section must be equal to or greater than that of the AC power line.)
- The connection cable for the protective earth (PE) system must be integral with the AC power line so that the power is not supplied when the grounding line is disconnected.
(a) Control unit

Connect the 0 V line of the electronic circuits inside the control unit to the earth plate on the cabinet via the signal ground (SG) terminal (bottom front of main board).


## NOTE

Connect an twisted wire earth cable lead $2 \mathrm{~mm}^{2}$ or more to the earth plate on the cabinet keeping the lead as short as possible.
(b) Display unit

(c) MDI unit

(d) Connection units 1, 2

(e) Operator's panel connection unit

(f) I/O unit model A

Connect the grounding terminals of $A B U 05 A, A B U 05 B, A B U 10 A$ and $A B U 10 B$.


Note) Connect the SG terminal to the earth mounting hole.

## NOTE

Connect the SG terminal to the grounding mounting hole.
(g) Hard disk unit


## NOTE

Connect the grounding cable of the hard disk unit via the grounding terminal for signals that is located on the control unit. (Do not connect the cable directly to the grounding plate of the cabinet.)
(h) External power supply

When using an external DC power supply for the units, be sure to ground the 0 V terminal of the power supply.

### 3.6.4 <br> Noise Suppresser

AC/DC solenoids and relays 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.
Generally, to reduce this pulse voltage, use a spark killer when an AC power source is used, and a diode when a DC power source is used.

Notes on selecting the spark killer

- Use a CR spark killer.
(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): $\mathrm{I}^{2} / 10$ to $\mathrm{I}^{2} / 20(\mu \mathrm{~F})$

Equivalent circuit of the spark killer

3.6 .5

Cable Clamp and Shield Processing

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


Fig. 3.6.5 (a) Cable clamp (1)


Fig. 3.6.5 (b) Cable clamp (2)

Prepare ground plate like the following figure.


Fig. 3.6.5 (c) Ground plate

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


Fig. 3.6.5 (d) Ground plate holes
(Reference) Outer drawings of metal fittings for clamp.


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

Ordering specification for metal fittings for clamp
A02B-0118-K001 (5 pieces)

## NOTE

Select cables of appropriate length.
Cables longer than necessary are not recommended. If cables longer than necessary are used, their resistance to noise may be reduced or noise may be induced on other cables. If surplus cable is wound up, inductance increases and an extremely high voltage may be induced during ON/OFF switching. This may result in malfunction or erroneous operation caused by noise.

## 3.7 <br> MEASURES <br> AGAINST SURGES DUE TO LIGHTNING

### 3.7.1 <br> Installation Procedure of Surge Protector

To protect the devices from surge voltages due to lightening, it is recommended to install surge-absorbing elements between the lines of the input power and between one line and ground. This does not, however, assures protection from all surges due to lightening.

## NOTE

The device might break by lightning even when the surge-absorbing elements is installed.

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


### 3.7.2 Notes

(1) For better surge absorbing effect, the wiring shown by heavy line in Fig. 3.7.1 (a) must be as short as possible.
Wire: The wire size must be $2 \mathrm{~mm}^{2}$ or greater.
Wire length: The sum of the wire for the connection of surge protector $\langle 1\rangle \mathrm{a}$ and that of surge protector $\langle 2\rangle \mathrm{b}$ must be 2 m or less.
(2) If conducting dielectric strength tests by applying overvoltages (1000 VAC and 1500 VAC ) to the power line, remove surge protector <2>. Otherwise, the overvoltages will activate the protector.
(3) The nonfuse breaker (5A) is required for line protection if a surge exceeding the capacity of the surge protectors is applied, causing the surge protectors to be short-circuited.
(4) Because no current flows through surge protectors $\langle 1\rangle$ and $\langle 2\rangle$ during normal operation, the nonfuse breaker (5A) can be shared by other devices. It can be connected to the control power for the power supply module and to the power for the fan motor of the spindle motor.

### 3.7.3 <br> Examples of Surge Protectors

For the surge absorbers made by Okaya Denki Sangyo Co.
For the $200-$ V system

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

For the $400-\mathrm{V}$ system

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

## 3.8 <br> CONTROL UNIT

3.8.1

Configuration and Installation of the Control Unit

The Series $15 i / 150 i$ control boards are mounted on the rack having two or more slots.


Fig. 3.8.1 (a) Configuration of Series $15 i / 150 i$ control unit

| Mounting position | Name of board |
| :--- | :--- |
| Slot PSU | Power supply unit |
| Slot 1 | Main CPU board |
| Slot 2 | Fast data server |
| Slot 3 | Additional axis board |

The rack is made of plastic, and comprises a fan motor and backplane board.
The fan motor is mounted on the rack. Air enters the rack from the bottom, and exits from the fan motor mounted at the top.
Make sure that the space shown in Fig. 3.8.1(b) ((1) and (2)) is maintained to ensure air flow. (1) is necessary for replacing the fan.
When a hard disk is used as the data server, hard disk installation area (4) is required. (The external dimensions of the hard disk are subject to change without notice in the interest of product improvement. Before you design a rack using the hard disk contact FANUC regarding the outside dimensions of the hard disk.)


Fig. 3.8.1 (b) Installation of the control unit

### 3.8.2 <br> Replacing the Battery for Memory Backup

## Replacing the lithium battery

Part programs, offset data, and system parameters are stored in CMOS memory in the control unit. The power to the CMOS memory is baked up by a lithium battery mounted on the front panel of the control unit. The above data is not lost even when the main battery goes dead. The backup battery is mounted on the control unit at shipping.
When the voltage of the battery becomes low, alarm message "BAT" blinks on the LCD display and the battery alarm signal is output to the PMC.
If an alarm is issued, replace the battery within one week. Otherwise, the contents of the memory will be lost.
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 [screen display: RAM parity error (low battery voltage)] to occur as the contents of memory are lost. Clear the entire memory and reenter data after replacing the battery.
Before replacing the memory backup battery, the control unit power off. The following two kinds of batteries can be used.

- Lithium battery built into the main board of the Series $15 i / 150 i$.
- Two alkaline dry cells (size D) in the external battery case.

Procedure
(1) Prepare a new lithium battery (A02B-0200-K102).
(2) Turn the control unit on for about 30 seconds.
(3) Turn the control unit off.
(4) Remove the old battery from the top of the main board. First, remove the claws holding the battery, and then remove the battery from the battery holder and disconnect the connector.
(5) Replace the battery, insert the battery into the battery holder, and connect the connectors. Make sure that the battery holder claws are firmly holding the battery in place.


Fig. 3.8.2 Replacing the lithium battery

## WARNING

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

## NOTE

Steps (3) to (5) should be completed within 30 minutes. Do not leave the control unit without a battery for any longer than the period, as this will result in the contents of memory being lost.
If battery replacement may take longer than 30 minutes, download all the data in CMOS memory to a memory card so that CMOS memory can be restored if the contents of memory are lost.

Dispose of used batteries as follows.
(1) Small quantities (less than 10)

Discharge the batteries and dispose of them as ordinary unburnable waste.
(2) Large quantities

Please consult FANUC.

Replacing the alkaline dry cells (size D)
(1) Prepare two new alkaline dry cells (size D).
(2) Turn the Series $15 i / 150 i$ on.
(3) Remove the battery case cover.
(4) Replace the batteries, paying careful attention to their orientation.
(5) Replace the battery case cover.

## NOTE

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


## Use of alkaline dry cells (size D)

## Connection

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


## NOTE

Install the battery case (A02B-0236-C281: 14-m cable) in a location where the batteries can be replaced even when the control unit power is on.
The battery cable connector is attached to the control unit by means of a simple lock system. To prevent the connector from being disconnected due to the weight of the cable or tension within the cable, fix the cable section within 50 cm of the connector.

## 3.9 <br> CABLE-LEAD-IN DIAGRAM

3.9.1

Control Unit Periphery
Connector Layouts


Fig. 3.9.1 (a) Control unit connector installation pitch

Fig. 3.9.1 (b) Power supply unit connector layout


Fig. 3.9.1 (c) Main CPU board connector layout

## NOTE

This connector is provided when the TYPE B axis control card is used.
TYPE A: One optical connector (FSSB line) is attached.
TYPE B: Two optical connectors (FSSB line) are attached.


Fig. 3.9.1 (d) Additional axis board connector layout

## NOTE

This connector is provided when the TYPE B axis control card is used. TYPE A: One optical connector (FSSB line) is attached. TYPE B: Two optical connectors (FSSB line) are attached.


Fig. 3.9.1 (e) Fast data server board connector layout


Fig. 3.9.1 (f) HSSB board connector layout


Fig. 3.9.1 (g) Data servo board A1 connector layout

Connector name, etc. Functions


Fig. 3.9.1 (h) Locations of the Connectors of Data Server Board A2


Fig. 3.9.1 (i) Locations of the Connectors of Serial Communication Boards A1 and A2


Fig. 3.9.1 (j) Locations of the Connectors of Ethernet board


Fig. 3.9.1 (k) Locations of the Connectors of Fast Ethernet board


Fig. 3.9.1 (I) Locations of the Connectors of PROFIBUS-DP board


Fig. 3.9.1 (m) Locations of the Connectors of DeviceNet board

### 3.9.2

LCD Unit Periphery
Connector Layout


Fig 3.9.2 (a) LCD unit connector mounting pitch (when one LCD unit is connected) (rear view)


Fig 3.9.2 (b) LCD unit connector mounting pitch (when two LCD units are connected) (rear view)


Fig. 3.9.2 (c) LCD unit connector layout (when one LCD unit is connected)


Fig. 3.9.2 (d) LCD unit connector layout (when the two LCD units are connected)

## 4 <br> TOTAL CONNECTION

## 4.1 <br> CONNECTIONS BETWEEN CONTROL UNITS



Fig. 4.1 (a) Connections between control units (1/3)


Fig. 4.1 (a) Connections between control units (2/3)


Fig. 4.1 (a) Connections between control units (3/3)

## NOTE

The equipment connected to the controller and units must not generate dangerous voltages even when a failure or another abnormal condition occurs.

## 4.2 <br> CONNECTIONS <br> BETWEEN SERVO <br> CARD



Fig. 4.2 (a) Connections between TYPE A servo card


Fig. 4.2 (b) Connections between TYPE B servo card

## 4.3 CONNECTIONS BETWEEN LCD UNIT



Fig. 4.3 (a) Connection between one LCD unit


Fig. 4.3 (b) Connection between two LCD units

## POWER SUPPLY UNIT CONNECTION

5

## 5.1

POWER SOURCE
UNIT PANEL
CONNECTOR
LAYOUT


## NOTE

Connector compatibility


Non-compatible (The connector has a key groove to prevent the cable being inserted by mistake.)

## 5.2 <br> POWER SUPPLY CONNECTION

5.2.1

Connection when an Input Unit is Used

Like the Series 15 B , the power source unit of the Series $15 i / 150 i$ is provided with a power ON/OFF control function. Therefore, basically, the input unit need not be prepared for the power source unit on the Series $15 i / 150 i$ for power ON/OFF control.

## NOTE

When the input unit is used, the capacitance of the ON/OFF-controlled AC output and the number of connectors are as shown in the figure below.

(1) CP1

This is the AC input connector for the control unit. The AC specifications are as follows:
R, S 200 to $240 \mathrm{VAC}+10 \%-15 \%, 1-$ phase, $50 \mathrm{~Hz} / 60 \mathrm{~Hz} \pm 3 \mathrm{~Hz}$
G Ground (class 3 grounding)

## NOTE

The above AC input specifications may partially be limited depending on the equipment that is powered from CP2 and CP3.
(2) CP2, CP3

These AC outputs are ON/OFF-controlled synchronized with power ON/OFF of the control unit.
The AC output specifications are the same as those for AC input to CP1.
The AC input specifications of CP1 may be limited depending on the AC input specifications of the equipment connected to CP2 and CP3.
Example) When the equipment connected to CP2 is 200/220VAC equipment (not 240 VAC equipment), the AC input specifications of CPS becomes 200/220VAC.
The maximum AC output supplied from CP2 and CP3 combined is 2.5 A . If capacitance is insufficient, refer to 5.2 .3 .
To prevent deterioration of the control unit due to rush current when the power is turned on, the capacitance of the load connected to CP 2 and CP 3 must be kept to $440 \mu \mathrm{~F}$ for CP 2 and CP 3 combined. When an inductive load is connected, insert a spark killer parallel to the load.
(3) CP4

This connector is for control the power source of ON/OFF button connections, for example.
(a) Power source ON/OFF (ON, OFF, COM)

The power of control units is turned ON and OFF.
(Power timing)

(Contact Specifications)
Withstand voltage 50 VDC min. (across contacts) Current $\quad 100 \mathrm{~mA}$ min. (min. load 2 mA )
(b) Alarm inputs (AL, OFF)

The alarm inputs are for turning the system power off when an alarm signal from outside the control unit is received. Input the signal of the input to close when an alarm state is generated.
(Contact Specifications)
Withstand voltage 30 VDC min. (across contacts)
Current $\quad 100 \mathrm{~mA}$ min. (min. load 1 mA )
(c) Alarm outputs (FA, FB)

FA and FB are short-circuited when the DC output fuse used for the power source unit of the control unit blows, or when overvoltage, overcurrent or other abnormality occurs in the DC output of the power source unit. FA and FB are also short-circuited in the same way by the alarm inputs (AL, OFF) closing. This signals are held until the OFF button is pressed, or the input power source (AC input of power source unit) is cut. When these signals are output, the power source of the control unit is cut, and the function of the power ON button is disabled.

$$
\begin{aligned}
& \text { (Contact Rating) } \\
& \text { 50VDC max. } \\
& 0.5 \mathrm{~A} \text { max. } \\
& \text { 50VAC max. } \\
& \text { 5VA max. }
\end{aligned}
$$

(4) CP5

This is the +24 VDC output.
CP5 is used as the power sources for the LCD unit and hard disk unit.
(5) CP6

This is the power source (+24VDC) for the machine interface I/O (e.g. connection unit, operator's panel connection unit).
2 A is the maximum DC output that is supplied from CP6.

### 5.2.2 <br> Power ON/OFF Sequence

Power on units in the following sequence or simultaneously:

1. (200VAC) of overall machine tool, separate detector (scale)
2. Slave I/O unit connected by I/O Link, separate detector I/F unit and LCD unit (24VDC), servo amplifier control
3. CNC control unit (200VAC)
"Simultaneously" here means that 1 and 2 above must be turned on within 500 ms at the most of turning 3 on .
When the separate detector (scale) is used, the output signal of the separate detector must be allowed to stabilize within 500 ms at the most of turning the separate detector I/F unit on.
Be sure to turn the separate detector (scale) on before the separate detector I/F unit sometimes according to the specifications of the separate detector (scale).
The battery for separate absolute pulse coder must remain connected regardless of whether the control unit is on or off. If the battery is removed with the control unit on, the position data of the pulse coder is lost.
The CNC display unit with PC functions is not subject to any power on sequence limitations.
Either the CNC display unit with PC functions or the CNC control unit starts fast, whichever is powered on later.

Power off units in the following sequence or simultaneously:

1. CNC control unit (200VAC)
2. Slave I/O unit connected by I/O Link, separate detector I/F unit and LCD unit (24VDC), servo amplifier control 3. (200VAC) of overall machine tool, separate detector (scale)
"Simultaneously" here means 2 and 3 may be turned off within 500 ms before 1 is turned off. If 2 and 3 are turned off earlier, alarm information remains in the CNC.
Though the CNC display unit with PC functions is not subject to any power off sequence limitations, exit the application and OS according to the regular shutdown procedure before it is powered off.
Motor control is not possible when the power is turned off or a momentary power interruption occurs. Take the required action on the machine tool side for any irregularities that may occur as a result of not being to control the motor.
For example, apply the brake to prevent the shaft from falling when controlling axes that move in the gravity axis direction. If servos do not start normally, or if the motor does not operate, clamp the motor, and unclamp only the currently operating motor. Normally clamp the servo motor, if the servo axis cannot be controlled when the power is turned off or a momentary power interruption occurs. When you clamp the servo motor, the axes that are currently being controlled may fall within the time until the relays for clamping the servo motor. So, whether or not problems will occur in the axis travel distance must be carefully evaluated.

## CONNECTION OF I/O UNITS TO MACHINE INTERFACE

## CAUTION

A signal or the power supply may possibly be assigned to a pin currently indicated as unused in the connector signal assignment table without prior notice. Do not use any pins indicated as being unused.

## 6.1 GENERAL

Combinations of the units listed in Table 6.1 can be used as the machine interface I/O.
The I/O unit for the FANUC I/O Link is installed separately from the control unit, and the two units are mutually connected by a specialized serial link (FANUC I/O Link). Multiple units can be placed in separate locations as shown below. The machine operator's panel that uses many input/output signals can be easily interfaced especially by placing the interface unit for machine operator's panel and the operator's panel connection unit in the immediate vicinity of the machine operator's panel. The FANUC I/O Link enables high-speed data transfer between the control unit and an external unit. The statuses of signals input from the machine are transferred to the control unit at constant intervals. The output signals from the control unit are sent to the external unit at constant intervals. The FANUC I/O Link has more applications. For example, the FANUC I/O Link is used to connect the FANUC Power Mate, which is single-axis CNC, or the FANUC System F-Model D Mate (F-D Mate), which is a cell controller. For details, see the subsequent description. For details of the units which are not listed in Table 6.1, see the corresponding operating manual.

Table 6.1 Types of machine interface I/O (for FANUC I/O Link)

| Unit | Description | Reference |
| :--- | :--- | :--- |
| Connector panel <br> I/O module | Distribution type I/O unit that handles the <br> input/output signals required by the pow- <br> er magnetics circuit; it has an interface <br> with a manual pulse generator. | Sec. 6.3 |
| Operator's panel <br> I/O module (for ma- <br> trix input) | Unit having an interface with a machine <br> operator's panel; it has an interface with <br> a manual pulse generator. | Sec. 6.4 |
| Operator's panel <br> I/O module | Unit having an interface with a machine <br> operator's panel that handles the input/ <br> output signals required by the power <br> magnetics circuit; it has an interface with <br> a manual pulse generator. | Sec. 6.5 |
| FANUC I/O Unit- <br> MODEL A | Modular I/O unit that supports a com- <br> bination of the input/output signals re- <br> quired by a power magnetics circuit. | Sec. 6.6 <br> (B-61813E) |
| FANUC I/O Unit- <br> MODEL B | Distribution type I/O unit that supports a <br> combination of input/output signals re- <br> quired by a power magnetics circuit. | B-62163E |
| Machine operator's <br> panel interface unit | Unit having an interface with a matrix of <br> key switches and LEDs on the machine <br> operator's panel as well as an interface <br> with a manual pulse generator. | Sec. 6.7 |
| Connection unit | Unit having an interface with a machine. | Sec. 6.8 |

Table 6.1 Types of machine interface I/O (for FANUC I/O Link)

| Unit | Description | Reference |
| :--- | :--- | :--- |
| Sink-type output <br> operator's panel <br> connection unit | Unit having an interface with a machine <br> operator's panel. | Sec. 6.9 |
| Source type output <br> operator's panel <br> connection unit | Unit having an interface with a machine <br> operator's panel; a source type output <br> circuit is used in the DO signal output <br> driver. | Sec. 6.10 |

## CAUTION

1 The emergency stop signal should be simultaneously input to the CNC control unit and servo unit so that the power supply to the motor is interrupted. For detailed connection of the servo emergency stop signal, refer to "FANUC Servo Amplifier $\alpha$ series (B-65162E)."
2 The input signals X006.0 to X006.7 include an emergency stop signal. These signals require a sink-type connection.

| Unit | Description | Reference |
| :--- | :--- | :---: |
| Machine operator's <br> panel | Machine operator's panel having remov- <br> able, customizable keytops on the opera- <br> tor's panel and keyboard | Section 6.12 |

## 6.2 <br> CONNECTION OF THE FANUC I/O LINK

In the I/O there are the master station and its slave stations. The master is the control unit of the CNC, and the slave is the interface for I/O units. The slaves are divided into groups, and up to 16 groups can be connected to one I/O Link. A maximum of two base I/O units can be connected as a group using I/O Unit-MODEL A. The operator's panel connection unit and connection unit are each counted as one group.
The I/O Link is connected in different ways depending on the types of units actually used and the number of I/O points. To connect the I/O Link, the assignment and addresses of the I/O signals have been made programmable with the PMC program. The maximum number of I/O points is 1024 .
The two connectors of the I/O Link are named JD1A and JD1B, and are common to all units.
A cable is always connected from JD1A of a unit to JD1B of the next unit. Although JD1B of the last unit is not used and left open, it need not be connected with a terminator. (The terminator is needed on the last interface module in the same group containing an I/O Unit-MODEL A.) The pin assignments of connectors JD1A and JD1B are common to all units on the I/O Link, and are shown on the following page. Use the figures when connecting the I/O Link irrespective of the type of unit.


Fig.6.2 I/O Link connection diagram

## 6.2 .1 <br> Connection of FANUC I/O Link by Electric Cable

Control unit or preceding
slave unit
JD1A
(PCR-EV20MDT)

|  |  |  |  |
| :--- | :--- | :--- | :--- |
| 2 | SIN | 11 | 0 V |
| 2 | $*$ SIN | 12 | 0 V |
| 3 | SOUT | 13 | 0 V |
| 4 | $*$ SOUT | 14 | 0 V |
| 5 |  | 15 |  |
| 6 |  | 16 |  |
| 7 |  | 17 |  |
| 8 |  | 18 | $(+5 \mathrm{~V})$ |
| 9 | $(+5 \mathrm{~V})$ | 19 |  |
| 10 |  | 20 | $(+5 \mathrm{~V})$ |


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


Recommended Cable Material
A66L-0001-0284\#10P(\#28AWG×10pair)

### 6.2.2 <br> Connection of FANUC I/O Link Optical Fiber Cable

## External dimension of optical I/O link adapter

## Weight of optical link adapter

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

## NOTE

In the following cases, use an optical fiber cable.

- When the cable is more than 15 meters long.
- When the cable runs between different cabinets and it is impossible to connect the cabinets with a grounding wire of 5.5 $\mathrm{mm}^{2}$ or thicker.
- When there is concern that the cable is influenced by strong noise; for example :
When there is a strong electromagnetic noise source beside the cable such as a welding machine.
When a noise generating cable such as a power cable runs for a long distance in parallel with the cable.

The external dimensions are the same for a standard type (A13B-0154-B001) and a high-speed type (A13B-0154-B002).


Main body: Approx. 100 g.
The weight is the same for a standard type (A13B-0154-B001) and a high-speed type (A13B-0154-B002).

## Connection

## - Connection diagram



- Interunit connecting cables

- Recommended connector for cable side :

PCR-E20FS (made by HONDA TSUSHIN KOGYO CO., LTD.)

- Recommended cable (wire material) : A66L-0001-0284\#10P
- Cable length : Max. 2 m (when the recommended cable is used)
- Specification:

For internal cable A66L - 6001 - 0008\# L2R003 •• Length 2 m
For external cable A66L - 6001 - 0026\# L1R003 •• Length 1 m
A66L - 6001 - 0026\# L3R003 •• Length 3 m
A66L - 6001 - 0026\# L5R003 •• Length 5 m
A66L - 6001 - 0026\# L7R003 •••Length 7 m
A66L - 6001 - 0026\# L10R003 • • • Length 10 m
A66L - 6001 - 0026\# L15R003 • • • Length 15 m
A66L - 6001 - 0026\# L20R003 • • Length 20 m
A66L - 6001 - 0026\# L30R003 • • • Length 30 m
A66L - 6001 - 0026\# L50R003 •••Length 50 m

- Cable length:

Max. 200 m (standard type)
Max. 100 m (high-speed type)

## NOTE

Do not bend optical cable beyond its bending radius of 25 mm . Do not unnecessarily twist optical cable.

## Maximum number of stages

On the I/O Link, the conventional optical I/O Link adapter can be connected up to five stages using a standard type (A13B-0154-B001) and up to 16 stages using a high-speed type (A13B-0154-B002).

1) Standard type (A13B-0154-B001)

Number of connectable stages: 5
2) High-speed type (A13B-0154-B002)

Number of connectable stages: 6


## Power source

## Installation conditions

## NOTE

The high-speed type and the standard-type cannot be mixed on a single line.

The power source is the same for a standard type (A13B-0154-B001) and a high-speed type (A13B-0154-B002).
(a) Power voltage:
4.75 V to 5.25 V (at the receiving end)
(b) Consumption current:
200 mA

- The optical I/O link adapter enclosure is not fully sealed ; install it with the CNC control unit in the fully enclosed cabinet.
- Ground the case using the case fixing screw of the optical I/O link adapter.
- The optical I/O link adapter is light, and it may not be necessary to mount it with screws. However, keep it from coming in contact with other circuits to prevent possible short-circuits. When mounting the optical I/O link adapter in a cabinet, attach it with an L-type fitting using the case fixing screws (M3) of the optical link adapter.


Required parts

Relay by optical fiber link adapter

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

- Optical I/O link adapter
2
- Interunit connecting cable 2
- Optical cable 1
- External dimensions of optical fiber link adapter

- Application example of optical fiber link adapter



## NOTE

A relay is possible at only one location.
When the high-speed type optical I/O link adapter is used, the optical fiber connection adapter cannot be used.

- Maximum transfer distances using optical fiber cable The following table shows the maximum transfer distances using optical fiber cable. This distance varies according to the number of relays made using the connection adapter.

|  | Number of Relays | Maximum Transfer Distance |
| :--- | :---: | :---: |
| Standard type | 0 | 200 m |
|  | 1 | 100 m (total) |
|  | 0 | 100 m |
|  | 1 | Not allowed |

## 6.3 <br> CONNECTION OF <br> CONNECTOR PANEL <br> I/O MODULE

### 6.3.1 <br> Configuration



## NOTE

When mounting an expansion module directly on the branch-connection PC board, place it on the right side of the basic module as you face the mounting surface. When mounting an expansion module using a DIN rail or screws, place it on the left side of the basic module.
6. CONNECTION OF I/O UNITS TO

### 6.3.2

Connection Diagram


## NOTE

In the above example connection diagram, the expansion module section contains a DI/DO module, a 2A-output module, and an analog input module. These expansion modules can be used in any combination.

### 6.3.3 <br> Module Specification

Module types

| Name | Drawing number | Specification | Reference |
| :--- | :--- | :--- | :--- |
| Branch-connection <br> I/O module <br> (basic module) | A03B-0815-C001 | DI/DO: 24/16 |  |
| Branch-connection <br> I/O module <br> (expansion module A) | A03B-0815-C002 | DI/DO: 24/16 <br> With MPG interface |  |
| Branch-connection <br> I/O module <br> (expansion module B) | A03B-0815-C003 | DI/DO: 24/16 <br> Without MPG inter- <br> face |  |
| Branch-connection <br> I/O module <br> (expansion module <br> C) | A03B-0815-C004 | DO: 16 <br> 2A-output module |  |
| Branch-connection <br> I/O module <br> (expansion module <br> D) | A03B-0815-C005 | Analog input mod- <br> ule |  |
| Fuse (spare) | A03B-0815-K002 | 1A <br> (for the basic mod- <br> ule) |  |
| Module-to-module <br> flat cable | A03B-0815-K100 | 20 mm long <br> Usable when the in- <br> terval between two <br> adjacent modules is <br> $32 ~ m m . ~$ |  |

Module specification (common items)

| Item | Specification | Remarks |
| :--- | :--- | :--- |
| Interface with the CNC | FANUC I/O Link con- <br> nection | Enables expansion as <br> slaves of the CNC to up to <br> 16 units or 1024/1024 <br> points. |
| Interface between the <br> basic and expansion <br> modules | Bus connection via flat <br> cable | Up to three expansion mod- <br> ules can be connected for <br> each basic module. |

For the specification (such as signal input/output rating) for specific modules, see the descriptions on the respective pages.
6. CONNECTION OF I/O UNITS TO

## Installation conditions

\(\left.$$
\begin{array}{|l|l|}\hline \begin{array}{l}\text { Unit ambient } \\
\text { temperature }\end{array} & \begin{array}{l}\text { Operating: } 0^{\circ} \mathrm{C} \text { to } 55^{\circ} \mathrm{C} \\
\text { Storage and transportation: }-20^{\circ} \mathrm{C} \text { to } 60^{\circ} \mathrm{C}\end{array} \\
\hline \text { Temperature drift } & 0.3^{\circ} \mathrm{C} / \text { min (maximum) } \\
\hline \text { Humidity } & \begin{array}{l}\text { Ordinary operation: } 75 \% \text { or less (relative) } \\
\text { Short-period operation (within one month): } 95 \% \text { or } \\
\text { less (relative) }\end{array} \\
\hline \text { Vibration } & \text { Operation: } 0.5 \mathrm{G} \text { or lower } \\
\hline \text { Atmosphere } & \begin{array}{l}\text { Ordinary factory environment (extra consideration } \\
\text { is required if the unit is to be used in an } \\
\text { environment where the concentration of dust, } \\
\text { cutting fluid, or organic solvent is high.) }\end{array} \\
\hline \text { Other conditions } & \begin{array}{l}\text { (1) This I/O module must be used in a cabinet that } \\
\text { has a completely sealed structure. }\end{array}
$$ <br>
(2) To keep I/O modules well-ventilated, mount <br>
them in the orientation shown below, and allow <br>
a space of at least 100 mm above and below <br>
for cabling and ventilation. In addition, do not <br>
place any unit generating a large amount of <br>

heat under the I/O modules.\end{array}\right]\)| (3) Be careful not to block the vents of the basic |
| :--- |
| module with the flat cable; see the relevant |
| description in Section 6.3 .17 (for connection |
| between the basic and expansion modules). |

## Power requirements

| Module | Supply voltage | Power <br> requirement | Remarks |
| :--- | :--- | :--- | :--- |
| Basic module | 24 VDC $10 \%$ <br> shall be supplied <br> via the I/O <br> connector CB150 <br> of the basic <br> module; $\pm 10 \%$ <br> contains <br> instantaneous <br> changes and | $0.2 \mathrm{~A}+7.3 \mathrm{~mA} \times \mathrm{DI}$ | Number of DI <br> points for which <br> $\mathrm{DI}=\mathrm{ON}$ |
| ripple. |  |  |  |

Estimate the amount of heat generated by each module as its power requirement $\times 24(\mathrm{~W})$.

### 6.3.4 <br> DI/DO Connector Pin Assignment

Pin-outs of DI/DO connectors on the basic module and expansion modules A and B are shown below.

| CB150 (HONDA MR-50RMA) |  |  |  |  |  | 50 male pins with fittings for fixing the connector covers |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 33 | DOCOM |  |  | 01 | DOCOM |  |
| 34 | Yn+0.0 | 19 | 0 V | 02 | $Y \mathrm{n}+1.0$ |  |
| 35 | Yn+0.1 | 19 | OV | 03 | $Y \mathrm{Y}+1.1$ |  |
| 36 | $\mathrm{Yn}+0.2$ | 20 | OV | 04 | $Y \mathrm{Y}+1.2$ |  |
| 37 | $\mathrm{Yn}+0.3$ | 21 | OV | 05 | $Y \mathrm{n}+1.3$ |  |
| 38 | $Y \mathrm{Y}+0.4$ | 22 | OV | 06 | $Y \mathrm{Y}+1.4$ |  |
| 39 | $Y \mathrm{Y}+0.5$ | 33 | OV | 07 | $Y \mathrm{n}+1.5$ |  |
| 40 | Yn+0.6 | 24 | DICOMO | 08 | $Y \mathrm{n}+1.6$ |  |
| 41 | Yn+0.7 | 25 | Xm+1.0 | 09 | $Y \mathrm{Y}+1.7$ |  |
| 42 | Xm+0.0 | 26 | Xm+1.1 | 10 | Xm+2.0 |  |
| 43 | Xm+0.1 | 27 | Xm+1.2 | 11 | Xm+2.1 |  |
| 44 | Xm+0.2 | 8 | Xm+1.3 | 12 | Xm+2.2 |  |
| 45 | Xm+0.3 | 29 | Xm+1.4 | 13 | Xm+2.3 |  |
| 46 | Xm+0.4 | 30 | Xm+1.5 | 14 | Xm+2.4 |  |
| 47 | Xm+0.5 | 31 | Xm+1.6 | 15 | Xm+2.5 |  |
| 48 | Xm+0.6 | 32 | Xm+1.7 | 16 | Xm+2.6 |  |
| 49 | Xm+0.7 |  |  | 17 | Xm+2.7 |  |
| 50 | +24V |  |  | 18 | +24V |  |

## NOTE

1 The DI and DO addresses for the basic and extension modules run contiguously. These basic and extension module DI and DO addresses are allocated to the I/O Link as a group. For example, when the DI and DO top addresses are X0004 and Y0000 ( $\mathrm{m}=4$ and $\mathrm{n}=0$ ), respectively, then the addresses are allocated as shown in the following table.
2 Pins 18 and $50(+24 \mathrm{~V})$ of connector CB150 are used to supply 24 V to the module from an external source. This voltage must always be supplied because it is used in the module.

|  | DI | DO |
| :--- | :---: | :---: |
| Basic module | X 4 to X6 | Y 0 to Y 1 |
| Extension module 1 | X 7 to X9 | Y 2 to Y3 |
| Extension module 2 | X 10 to X 12 | Y 4 to Y5 |
| Extension module 3 | X 13 to X15 | Y 6 to Y7 |

### 6.3.5 <br> DI (Input Signal) <br> Connection

This section explains how DI points (input signals) are connected to the basic module and expansion modules A and B.

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


6. CONNECTION OF I/O UNITS TO


## NOTE

$1 \mathrm{Xm}+0.0$ through $\mathrm{Xm}+0.7$ are DI pins for which a common voltage can be selected. That is, by connecting the DICOM0 CB150(24) pin to the +24 V power supply, a DI signal can be input with its logical state reversed. If, however, a cable is connected to ground, it has the same effect as inputting an ON state DI signal. To prevent such accidents, the connection of the DICOM0 CB150(24) pin to the 0 V power supply is recommended wherever possible.
2 For safety reasons, the emergency stop signal needs to be allocated to an appropriate bit of the addresses for which the common voltage is fixed, ranging from $\mathrm{Xm}+1.0$ to $\mathrm{Xm}+1.7$ or from $\mathrm{Xm}+2.0$ to $\mathrm{Xm}+2.7$. See 6.2 for information about how to allocate the emergency stop signal.
3 For unused DI pins allocated to the addresses for which the common voltage is fixed (from $X m+1.0$ to $X m+1.7$ and from $X m+2.0$ to $X m+2.7$ ), the logic is fixed to " 0 ". For unused pins allocated to $X m+0.0$ to $X m+0.7$ for which the common voltage can be selected, the logic is fixed to " 0 " when the DICOMO CB150(24) pin is connected to the 0 V power supply. When the DICOM0 CB150(24) pin is connected to the +24 V power supply, the logic is fixed to " 1 ". The logic of the unused pins allocated to $\mathrm{Xm}+0.0$ to $\mathrm{Xm}+0.7$ is variable when the contact of the DICOMO CB150(24) pin is open.

### 6.3.6 <br> DO (Output Signal) Connection

This section explains how DO points (output signals) are connected to the basic module and expansion modules A and B.

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


### 6.3.7 DI/DO Signal Ratings

This section describes the DI/DO signal ratings for the basic module and expansion modules A and B.

DI (input signal ratings)

| Number of points | $\mathbf{2 4}$ (per module) |
| :--- | :--- |
| Contact capacity | $30 \mathrm{VDC}, 16 \mathrm{~mA}$ or higher |
| Open-circuit <br> contact-to-contact <br> leakage current | 1 mA or lower (at 26.4 V ) |
| Closed-circuit <br> contact-to-contact <br> voltage drop | 2 V or lower (including drop across the cable) |
| Delay time | 2 ms (maximum) across the receiver <br> In addition, it is necessary to consider the sum of <br> the I/O Link transfer time (up to 2 ms ) between the <br> CNC and I/O module and the ladder scan cycle <br> time (in the CNC). |

DO (output signal ratings)

| Number of points | 16 (per module) |
| :--- | :--- |
| On-state maximum <br> load current | 200 mA or lower, including instantaneous changes |
| On-state saturation <br> voltage | 1 V (maximum) measured when the load current is <br> 200 mA |
| Withstand voltage | $24 \mathrm{~V}+20 \%$ or lower, including instantaneous <br> changes |
| Off-state outflow leak- <br> age current | 20 A or lower |
| Delay time | $50 \mu \mathrm{~s}$ (maximum) across the driver <br> In addition, it is necessary to consider the sum of <br> the I/O Link transfer time (up to 2 ms ) between the <br> CNC and I/O module and the ladder scan cycle <br> time (in the CNC). |

Turning on and off power (common to DO points) for the DO points (output signals)

Turning off (opening) power supply pin DOCOM for the DO points (output signals) turns off all DO points of each module at one time. The state of the DO points is as shown below.
DOCOM ON OFF

| DO when the corre- |
| :--- |
| sponding DO is on ON |
| in the sequence | OFF


| DO when the cor- |
| :--- |
| responding DO is |
| off in the sequence |

## NOTE

If a DO is on in the sequence, the on/off state of the DOCOM is reflected on that DO as shown in the dotted area. Do not turn off +24 V supplied to the I/O module during operation. If it is turned off, an alarm is issued for communication with the CNC. This +24 V must be turned on at the same time or before the power to the CNC is turned on. It must be turned off at the same time or after the power to the CNC is turned off.

Parallel connection of DO points (output signals)
Connecting two DO points in parallel for simultaneous on/off control in the sequence can double the maximum allowable DO load current, allowing up to 400 mA to be obtained, since the maximum allowable load current of one DO point is 200 mA . Note, however, that when the DO points are off, their leakage current is also doubled (to up to 40 A ).


### 6.3.8

2A-Output Connector Pin Assignment Diagram

This section describes the pin assignments of the 2 A -output connector used for expansion module C.

CB154 (HONDA MR-50RMA)


50-pin male connector with metal fixture for connector housing

## NOTE

1 The DI/DO addresses of the basic and expansion modules are sequential. These addresses are assumed to be in one group when they are assigned to the I/O Link. That is, if the first address in the assignment is X0004 and Y0000 ( $\mathrm{m}=4$, $\mathrm{n}=0$ ), the DI/DO addresses are as listed below.
2 If the 2A-output module is used, its DI addresses cannot be used. (If the 2 A -output module is used as expansion module 3, X13 to X15 cannot be used.)

|  | DI | DO |
| :--- | :---: | :---: |
| Basic module | X 4 to X 6 | Y 0 to Y 1 |
| Basic module 1 | X 7 to X 9 | Y 2 to Y 3 |
| Basic module 2 | X 10 to X 12 | Y 4 to Y 5 |
| Basic module 3 | X 13 to X 15 | Y 6 to Y 7 |

### 6.3.9 <br> 2A DO (Output Signal) Connection

This section describes how the 2 A -output connector pins are connected for expansion module C .


### 6.3.10 2A-Output DO Signal Ratings

This section describes the 2 A -output DO signal ratings for expansion module C .

DO (output signal ratings)

| Number of points | $\mathbf{3 2}$ (per module) |
| :--- | :--- |
| On-state maximum <br> load current | 2 A per point <br> Up to 12 A for the entire module (16 DO points), <br> including instantaneous changes |
| Withstand voltage | $24 \mathrm{~V}+20 \%$ or lower, including instantaneous <br> changes |
| Off-state outflow <br> leakage current | $100 \mu \mathrm{~A}$ or lower |
| Delay time | It is necessary to consider the sum of the I/O Link <br> transfer time (up to 2 ms) and ladder scan cycle <br> time (in the CNC). |

Turning the on and off power (common to DO points) for the DO points (output signals)
Turning off (opening) power supply pin DOCOM for the DO points (output signals) turns off all DO points of each module at one time. The state of the DO points is as shown below.
DOCOM ON
DO when the corre-
sponding DO is on ON
in the sequence OF

| DO when the cor- |
| :--- |
| responding DO is ON |
| off in the sequence OFF |

## NOTE

If a DO is on in the sequence, the on/off state of the DOCOM is reflected on that DO as shown in the dotted area. Do not turn off +24 V supplied to the I/O module during operation. If it is turned off, an alarm is issued for communication with the CNC. This +24 V must be turned on at the same time or before the power to the CNC is turned on. It must be turned off at the same time or after the power to the CNC is turned off.

Parallel connection of DO points (output signals)
For the 2 A -output module, it is impossible to connect DO points in parallel. In addition, its DO points cannot be connected in parallel with those of any other module.
6.3.11

Analog Input Connector Pin Assignment Diagram

This section describes the pin assignments of the analog input connector used for expansion module D.



50-pin male connector with metal fixture for connector housing

## NOTE

1 The DI/DO addresses of the basic and expansion modules are sequential. These addresses are assumed to be in one group when they are assigned to the I/O Link. That is, if the first address in the assignment is X0004 and Y0000 ( $\mathrm{m}=4$, $\mathrm{n}=0$ ), the $\mathrm{DI} / \mathrm{DO}$ addresses are as listed below.
2 Also the DO space can be used as an input channel selection area for the analog input module.

|  | DI | DO |
| :--- | :---: | :---: |
| Basic module | X 4 to X 6 | Y 0 to Y 1 |
| Basic module 1 | X 7 to X 9 | Y 2 to Y 3 |
| Basic module 2 | X 10 to X 12 | Y 4 to Y 5 |
| Basic module 3 | X 13 to X 15 | Y 6 to Y 7 |

6. CONNECTION OF I/O UNITS TO

### 6.3.12

Analog Input Signal Connection

This section shows the connection diagram for the analog input connector of expansion module D


## NOTE

1 In the above diagram, letter n stands for a channel number (where $\mathrm{n}=1,2,3$, or 4 ).
2 Either voltage input or current input can be selected for each channel. If current input is selected, be sure to strap JMPn and INPn.
3 The conductors of the connector cable should be shielded twisted pairs.
4 In the above diagram, the shielding for each channel is separately connected to FGNDn, all of which are connected to FGND. However, as the frame ground, you may connect each shielding directly to a cable clamp without using FGNDn.
When the voltage supply (current supply) has a GND pin as shown in the figure, connect the COMn pin to the GND pin. When not, connect INMn to COMn on the analog input module.

### 6.3.13 <br> Analog Input Signal Ratings

This section describes the analog input signal ratings for expansion module D.

| Item | Specification |  | Remarks |
| :---: | :---: | :---: | :---: |
| Number of input channels (NOTE) | 4 |  |  |
| Analog input | -10 to +10 VDC (with input resistance of $4.7 \mathrm{M} \Omega$ ) -20 to +20 mADC (with input resistance of $250 \Omega$ ) |  | Either voltage input or current input is selectable separately for each channel. |
| Digital output (NOTE) | 12-bit binary |  | Twos complement representation |
| Supported input/ output |  |  |  |
|  | Analog input | Digital output |  |
|  | +10V | +2000 |  |
|  | +5 V or +20 mV | +1000 |  |
|  | OV or OmA | 0 |  |
|  | -5 V or -20 mA | -1000 |  |
|  | -10V | -2000 |  |
| Resolution | 5 mV or $20 \mu \mathrm{~A}$ |  |  |
| Overall precision | Voltage input: $\pm 0.5 \%$ <br> Current input: $\pm 1 \%$ |  | In reference to the full-scale reading |
| Maximum input voltage/current | $\pm 15 \mathrm{~V} / \pm 30 \mathrm{~mA}$ |  |  |
| Minimum conversion time (NOTE) | Ladder scan cycle by the connected CNC |  |  |
| Number of occupied input/output points (NOTE) | $\mathrm{DI}=3$ bytes, $\mathrm{DO}=2$ bytes |  |  |

## NOTE

This analog input module has four input channels, but its digital output section uses one 12-bit output in the 3 bytes for the number of occupied input points. That is, the ladder dynamically selects which channel to use. A channel switching DO for channel selection is in the 2 bytes for the number of occupied output points.

### 6.3.14 <br> Analog Input Specification

(About digital output)
This analog input module has four input channels, but its digital output section uses one 12 -bit output in the 3 bytes for the number of occupied input points. The format of the output is as listed below.

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

D00 to D11 form 12-bit digital output data. D00 and D11 correspond to weights of $2^{0}$ and $2^{11}$, respectively.
D11 corresponds also to the sign bit of a twos complement representation.
CHA and CHB represent analog input channels. That is, if the 2 bytes mentioned above are read by the PMC program, D11 to D00 reflect the A-D conversion result for input channels represented by CHA and CHB. See the following description about channel selection for details of CHA and CHB. There are some items to be considered when data is read from the PMC program. See the relevant description on assignment in Section 6.3.
(About channel selection)
For this analog input module, you must use the PMC program to select from the four channels a channel to be used for output to the digital output section. CHA and CHB in the 2 bytes for the number of occupied output points are used as DO points for channel selection. They are mapped as shown below.

## Moduleinternal address

$Y n$
$Y n+1$

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $X$ | $X$ | $X$ | $X$ | $X$ | $X$ | $X$ | $X$ |
| $X$ | $X$ | $X$ | $X$ | $X$ | $X$ | CHB | CHA |

Specifying a pair of values listed below for CHA and CHB causes the corresponding channel to be selected, thus enabling the A-D conversion and selection data for the channel to be read as DI data. Letter X in the above table indicates a bit not in use. It can be either 0 or 1.

| CHB | CHA | Channel to be selected |
| :---: | :---: | :---: |
| 0 | 0 | Channel 1 |
| 0 | 1 | Channel 2 |
| 1 | 0 | Channel 3 |
| 1 | 1 | Channel 4 |

(About the addresses)
The first address for X (DI) of the basic modules containing an analog input module must be even-numbered. With this assignment, the digital output address of the analog input module is determined based on the space where it is mounted, as listed below.

- If the analog input module is mounted in the space for expansion module 1 ( m is the top address assigned)

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

- If the analog input module is mounted in the space for expansion module 2 ( m is the first assigned address)

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

- If the analog input module is mounted in the space for expansion module 3 ( m is the first assigned address)

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

NOTE
When the 2-byte digital output address is referenced by the PMC program, its data should be read in word (16-bit) units.
6.3.15

Manual Pulse Generator Connection

An example in which three manual pulse generators are connected is shown below.


Recommended material: A66L-0001-0286
(\#20AWG $\times 6+\# 24 \mathrm{AWG} \times 3$ pairs)

## NOTE

Since some pins of this connector, unlike other 20-pin connectors, have been removed, resulting in a unique pin arrangement, be careful when identifying pin numbers. See Figure 2 in Appendix B and Table C (a) in Appendix C.

Recommended connector: A02B-0120-K303 (includes the following body and housing)
(Body: FI40-2015S, soldering type, from Hirose Electric Co., Ltd.) (Housing: FI40-20-CV5, from Hirose Electric Co., Ltd.)
Recommended cables:
A02B-0120-K841 ( 7 m ) (for connecting three manual pulse
generators)
A02B-0120-K848 $(7 \mathrm{~m})$ (for connecting two manual pulse
generators)
A02B-0120-K847 ( 7 m ) (for connecting one manual pulse
generator)
(These cables do not include the wire shown in the above figure.)

## NOTE

The number of manual pulse generators that can be connected varies with the model and the configuration of options.

### 6.3.16 <br> Cable Length for <br> Manual Pulse Generator

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

$$
\begin{array}{cl}
0.2 \geqq \frac{0.1 \times \mathrm{R} \times 2 \mathrm{~L}}{\mathrm{~m}} \quad \begin{array}{l}
\text { Wher } \\
0.1=\text { manual pulse generator supply } \\
\text { current }(0.1 \mathrm{~A})
\end{array} \\
& \mathrm{R}=\text { resistance per unit cable length } \\
(\Omega / \mathrm{m}) \\
& \mathrm{m}=\text { number of } 0 \text {-volt and } 5 \text {-volt wires } \\
& \mathrm{L}=\text { cable length }(\mathrm{m}) .
\end{array}
$$

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

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

In the case of the A66L-0001-0286 cable, for example, when three pairs of signal wires and six power supply wires ( $20 / 0.18,0.0394 \Omega / \mathrm{m}$ ) are used (three power supply wires connected to 5 V and the other three to 0 V ), the cable length is:
$\mathrm{L} \leqq \frac{3}{0.0394}=76.75[\mathrm{~m}]$

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

### 6.3.17 <br> Connection of Basic and Extension Modules

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


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

## NOTE

1 Modules need to be spaced at least 32 mm apart, in which case a flat cable of about 20 mm in length is required. To install modules further away from each other, the cable length will be 20 mm plus the extra distance. Note that the maximum length of a flat cable is 100 mm .
2 To ensure adequate ventilation, install the modules in such a way that the flat cables lie on top of them. The basic module has a vent at the top (as indicated by the dotted lines in the above figure). When connecting modules, install extension modules so that the flat cables do not cover the vent, as shown in the above figure.
When mounting an expansion module directly on the branch-connection PC board, place it on the right side of the basic module as you face the mounting surface. When mounting an expansion module using a DIN rail or screws, place it on the left side of the basic module.

### 6.3.18 <br> Module Installation

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


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

## NOTE

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

Prohibited area on soldered side
Prohibited area on component side

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


Mounting the module

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

## NOTE

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

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


## NOTE

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

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


Mounting the module

1. Hook the module at the upper end of the DIN rail.
2. Push the stopper into the slit located at the lower end of the rail until it clicks into place.
Dismounting the module
Insert the tip of the slotted screwdriver and push out the stopper in the direction indicated by the arrow.

## NOTE

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

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


## NOTE

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

### 6.3.19 Other Notes

## DO signal reaction to a system alarm

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


The basic connector panel I/O module is allocated a group of DI addresses ( 16 bytes) and a group of DO addresses ( 8 bytes). Up to three hardware extension modules can be added or removed as required. The reason for this address allocation is explained below.
The MPG interface (MPG counter) occupies a DI space from Xm +12 through $\mathrm{Xm}+14$. These addresses are fixed regardless of whether extension module 2 or 3 is used, and $\mathrm{Xm}+12$ through $\mathrm{Xm}+14$ must be allocated as a DI work area to enable the use of the MPG. Therefore, when using an MPG for the i series CNC, allocate DI addresses in units of 16 bytes. Do not use the DI space from $\mathrm{Xm}+12$ through $\mathrm{Xm}+14$ for Ladder; the CNC processes the MPG counter value directly.
DI address $\mathrm{Xm}+15$ is used for detecting overcurrent and overheating alarms that occur in the IC used in the DO driver. [For details, see the section describing the detection of DO (output signal) alarms.] This address is fixed regardless of whether extension module 2 or 3 is used, and it must be allocated as a work area before it can be used. When using this area, therefore, allocate DI addresses in units of 16 bytes.
Basically, I/O addresses can be allocated to the connector panel I/O modules freely. When allocating DI addresses, however, consider also the addresses that are directly supervised by the CNC, and keep the following in mind.

Fixed addresses directly supervised by the CNC (for FS15i/150i)

| ADDRESS | $\mathbf{7}$ | $\mathbf{6}$ | $\mathbf{5}$ | $\mathbf{4}$ | $\mathbf{3}$ | $\mathbf{2}$ | $\mathbf{1}$ | $\mathbf{0}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| X0006 |  |  |  | ${ }^{*}$ ESP |  |  |  |  |
| X0008 |  |  |  | AE2 | AE1 |  |  |  |
| X0011 |  | SKIP1 |  |  |  |  |  |  |

When DI addresses are allocated in units of 16 bytes, starting at X0005


## DO (output signal) alarm detection

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

| Alarm detection <br> address and bit | DO address | Location |
| :---: | :---: | :---: |
| $\mathrm{Xm}+15.0$ | $\mathrm{Yn+0}$ | Basic module |
| $\mathrm{Xm}+15.1$ | $\mathrm{Yn}+1$ | Basic module |
| $\mathrm{Xm}+15.2$ | $\mathrm{Yn}+2$ | Extension module 1 |
| $\mathrm{Xm}+15.3$ | $\mathrm{Yn+3}$ | Extension module 1 |
| $\mathrm{Xm}+15.4$ | $\mathrm{Yn+4}$ | Extension module 2 |
| $\mathrm{Xm}+15.5$ | $\mathrm{Yn}+5$ | Extension module 2 |
| $\mathrm{Xm}+15.6$ | $\mathrm{Yn}+6$ | Extension module 3 |
| $\mathrm{Xm}+15.7$ | $Y n+7$ | Extension module 3 |

## NOTE

This function is supported by neither the 2A-output module nor the analog input module.

2A-output and analog input module assignment The 2A-output and analog input modules can be allocated in any of the spaces for expansion modules 1,2 , and 3 . It is also possible to allocate up to three 2 A -output or analog input modules in all these module spaces. If the MPG interface is required, however, it occupies expansion module 1 , and therefore, neither a 2 A -output nor analog input module can be allocated in this module space.

Because no DI is available in the 2 A -output module, the DI space corresponding to the 2 A -output module cannot be used. For example, if the 2 A -output module is allocated in the space for expansion module 2 , it is impossible to use a space between $\mathrm{Xm}+6$ and $\mathrm{Xm}+8$. (This will not shift the space for other modules; the DI space for expansion module 3 remains between $\mathrm{Xm}+9$ and $\mathrm{Xm}+11$.)

### 6.3.20 <br> Distribution I/O Setting

By changing the setting (rotary switch) for the expansion modules, connections can be made by omitting some expansion modules as shown below.


Method of setting (control and method of setting the control)
As shown below, the control (rotary switch) is located on an expansion module. To change the setting, turn the switch with a flat-bladed screwdriver with a tip width of about 2.5 mm .


The function of the rotary switch is as follows:

| Setting position | Actual indication | Meaning of setting |
| :---: | :---: | :---: |
| 0 | 0 | This is the standard setting. The rotary switch is factory-set to this position. This setting is used when no expansion module is omitted. |
| 1 | - | Set the rotary switch on an expansion module to this position when the preceding expansion module is omitted. |
| 2 | 2 | Set the rotary switch on an expansion module to this position when the preceding two expansion modules are omitted. |
| 3 | - | This setting is prohibited. |
| 4 to F | $\begin{aligned} & 4,-, 6,-- \\ & 8,-, \text { A, } \\ & \text { C, -, E, -, } \end{aligned}$ | 4,8 , or $C$ has the same effect as 0 . <br> 5,9 , or $D$ has the same effect as 1 . <br> $6, A$, or $E$ has the same effect as 2. <br> 7 , $B$, or $F$ has the same effect as 3 . (This setting, however, is prohibited.) |

Examples of setting

(When expansion module 2 is omitted) On expansion module 3, set the rotary switch to setting position 1 . On expansion module 1, keep the rotary switch set to setting position 0 .


This setting capability is a newly added function. Depending on the type of the module, this function is available as indicated below.

| Expansion module B <br> (DO/DO $=24 / 16$, without <br> manual pulse interface) | A03B-0815-C003 | Starting from June, 1998 |
| :--- | :--- | :--- |
| Expansion module C <br> (DO $=16,2 A$ output) | A03B-0815-C004 | Starting from August, 1998 |
| Expansion module D <br> (analog input) | A03B-0815-C005 | Starting from August, 1998 |

## NOTE

Expansion module A (DI/DO = 24/16, with manual pulse interface) (A03B-0815-C002) is fitted with an additional rotary switch as other types of modules are modified. However, expansion module A is always mounted at the location of expansion module 1 , so that its factory setting need not be changed.

## 6.4 <br> CONNECTION OF OPERATOR'S PANEL <br> I/O MODULE (FOR MATRIX INPUT)

### 6.4.1

## Overall Connection

Diagram


Connectors that cannot be used on the cable side

|  | Specification | Manufacturer |
| :--- | :--- | :--- |
| Connector | FI-20-CV7 | Hirose Electric Co., Ltd. |
| Connector case and <br> connector | FI30-20S-CV7 | Hirose Electric Co., Ltd. |

### 6.4.2 Power Connection

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


## NOTE

The specification of the power supply connector CPD1 (IN) is the same as that for CPD1 (OUT). There are no indications on the printed circuit board to distinguish between the IN and OUT connectors. Do not turn off the +24 V supply to the connector during operation. Turning off the +24 V supply will cause a CNC communication alarm. When turning on the power, the +24 V supply to the I/O module must be turned on before or at the same time as the power supply to the CNC.
6.4.3

DI/DO Connector Pin Arrangement

| CE53 |  |  | CE54 |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | A | B |  | A | B |
| 01 | OV | OV | 01 | OV | OV |
| 02 | N.C. | +24V | 02 | COM1 | +24V |
| 03 | Xm+0.0 | Xm+0.1 | 03 | Xm+1.0 | Xm+1.1 |
| 04 | Xm+0.2 | Xm+0.3 | 04 | Xm+1.2 | Xm+1.3 |
| 05 | Xm+0.4 | Xm+0.5 | 05 | Xm+1.4 | Xm+1.5 |
| 06 | Xm+0.6 | Xm+0.7 | 06 | Xm+1.6 | Xm+1.7 |
| 07 | $\mathrm{Yn}+0.0$ | Yn+0.1 | 07 | Yn+3.0 | $\mathrm{Yn}+3.1$ |
| 08 | Yn+0.2 | Yn+0.3 | 08 | Yn+3.2 | Yn+3.3 |
| 09 | Yn+0.4 | Yn+0.5 | 09 | Yn+3.4 | $\mathrm{Yn}+3.5$ |
| 10 | Yn+0.6 | Yn+0.7 | 10 | Yn+3.6 | Yn+3.7 |
| 11 | Yn+1.0 | $\mathrm{Yn}+1.1$ | 11 | Yn+4.0 | $\mathrm{Yn}+4.1$ |
| 12 | $\mathrm{Yn}+1.2$ | $\mathrm{Yn}+1.3$ | 12 | Yn+4.2 | Yn+4.3 |
| 13 | $\mathrm{Yn}+1.4$ | $\mathrm{Yn}+1.5$ | 13 | $\mathrm{Yn}+4.4$ | Yn+4.5 |
| 14 | $\mathrm{Yn}+1.6$ | $\mathrm{Yn}+1.7$ | 14 | Yn+4.6 | Yn+4.7 |
| 15 | $\mathrm{Yn}+2.0$ | Yn+2.1 | 15 | Yn+5.0 | $\mathrm{Yn}+5.1$ |
| 16 | Yn+2.2 | Yn+2.3 | 16 | Yn+5.2 | Yn+5.3 |
| 17 | Yn+2.4 | Yn+2.5 | 17 | Yn+5.4 | $Y \mathrm{n}+5.5$ |
| 18 | Yn+2.6 | Yn+2.7 | 18 | Yn+5.6 | Yn+5.7 |
| 19 | KYD0 | KYD1 | 19 | Yn+6.0 | $\mathrm{Yn}+6.1$ |
| 20 | KYD2 | KYD3 | 20 | Yn+6.2 | Yn+6.3 |
| 21 | KYD4 | KYD5 | 21 | Yn+6.4 | Yn+6.5 |
| 22 | KYD6 | KYD7 | 22 | Yn+6.6 | Yn+6.7 |
| 23 | KCM1 | KCM2 | 23 | KCM5 | KCM6 |
| 24 | KCM3 | KCM4 | 24 | KCM7 | DOCOM |
| 25 | DOCOM | DOCOM | 25 | DOCOM | DOCOM |
| Flat cable-side connector specification: <br> A02B-0120-K342 <br> (HIFBB-50D-2.54R (Hirose Electric Co., Ltd.)) <br> 50 contacts <br> Cable material specification: <br> A02B-0120-K886 <br> (61-meter, $50-$ pin cable <br> (Hitachi Cable, Ltd. or Oki Electric Cable Co., Ltd.)) |  |  |  |  |  |

### 6.4.4 <br> DI (General-purpose Input Signal) Connection

## NOTE

Xm +1.0 through $\mathrm{Xm}+1.7$ are DI pins for which a common voltage can be selected. That is, by connecting the COM1 CE54(A02) pin to the +24 V power supply, a DI signal can be input with its logical state reversed. If, however, a cable is connected to ground, it has the same effect as inputting an ON state DI signal. To prevent this from occurring, the connection of the COM1 CE54(A02) pin to the 0 V power supply is recommended whereever possible.
For safety reasons, the emergency stop signal needs to be allocated to an appropriate bit of the addresses for which the common voltage is fixed, ranging from $\mathrm{Xm}+0.0$ to $X m+0.7$. See "Address allocation" in Section 9.5.10 for details of how to allocate the emergency stop signal.
For unused DI pins allocated to the addresses for which the common voltage is fixed (from $\mathrm{Xm}+1.0$ to $\mathrm{Xm}+1.7$ ), the logic is fixed to " 0 ". For unused pins allocated to $\mathrm{Xm}+1.0$ to $X m+1.7$ for which the common voltage can be selected, the logic is fixed to " 0 " when the COM1 CE54(A02) pin is connected to the 0 V power supply. When the COM1 CE54(A02) pin is connected to the +24 V power supply, the logic is fixed to " 1 ". The logic of the unused pins allocated to $\mathrm{Xm}+1.0$ to $\mathrm{Xm}+1.7$ is variable when the contact of the COM1 CE54(A02) pin is open.

### 6.4.5 $\circ$ A maximum of 56 points are provided. <br> DI (Matrix Input Signal) Connection



## NOTE

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


### 6.4.6 <br> - A maximum of 56 points are provided. <br> DO (Output Signal) <br> Connection



6. CONNECTION OF I/O UNITS TO


6.4 .7

Manual Pulse
Generator Connection

For details of the connection of the manual pulse generator, see Section 6.3.15.
6. CONNECTION OF I/O UNITS TO

### 6.4.8

## External View



Machine operator's panel DI/DO interface
| : Polarity guide
: A1 pin mark


## 6.4 .9 Specifications

Installation specifications

| Ambient temperature | During operation <br> During storage and transportation $\quad 0^{\circ} \mathrm{C}$ to $58^{\circ} \mathrm{C}$ <br> $-20^{\circ} \mathrm{C}$ to $60^{\circ} \mathrm{C}$ |
| :--- | :--- |
| Temperature change | Max. $0.3^{\circ} \mathrm{C} / \mathrm{min}$. |
| Relative humidity | Normal <br> Short term (1 month or less) $: \quad 75 \%$ or less <br> $95 \%$ or less |
| Vibration | During operation: 0.5 G or less |
| Environment | Ordinary machining factory environment <br> (Special consideration is required when installing the <br> module in a dusty location or where highly concen- <br> trated cutting lubricant or organic solvent is used.) |
| Other requirements | (1) Install the I/O module in a fully enclosed cabinet. |

Ordering specifications

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

Module specifications

| Item | Specification | Remarks |
| :--- | :--- | :--- |
| General-purpose DI | 16 points | $24-\mathrm{V}$ input |
| Matrix DI | 56 points $(8 \times 7)$ | $5-\mathrm{V}$ input |
| DO points | 56 points | 24 V source type output |
| CNC interface | FANUC I/O Link <br> connectionUp to 16 modules can be <br> connected as CNC slaves. Or, a <br> maximum of 1024 points can be <br> supported on both the input and <br> output sides. |  |
| MPG interface | Max. 3 units | MPG interface can be used only <br> for the $i$ series CNC. |

Power supply rating

| Module | Supply voltage | Current rating | Remarks |
| :--- | :--- | :--- | :--- |
| $\begin{array}{l}\text { Operator's panel } \\ \text { I/O module }\end{array}$ | $\begin{array}{l}\text { 24 VDC } \pm 10 \% \text { supplied } \\ \text { from the power supply } \\ \text { connector CPD1. The }\end{array}$ | 0.35 A | $\begin{array}{l}\text { The total power } \\ \text { consumption of } \\ \text { allowance ofr } \pm 10 \% \\ \text { should } \\ \text { instantaneous voltage } \\ \text { and ripple voltage. }\end{array}$ |
| DI points is |  |  |  |$]$| included. |
| :--- |
| The power |
| consumption of |
| DO points is not |
| included. |

DI (input signal) specifications
(General-purpose input signal)

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

(Matrix input signal)

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

## NOTE

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

DO (output signal) specifications

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

## NOTE

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

### 6.4.10

Other Notes

DO signal reaction to a system alarm

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

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

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


| DO space map |  |
| :---: | :---: |
| Yn |  |
| $\mathrm{Yn}+1$ | Output signal |
| $\mathrm{Yn}+2$ |  |
| $\mathrm{Yn}+3$ |  |
|  |  |
| $\mathrm{Yn}+5$ | Reserved |
| $\mathrm{Yn}+6$ |  |
| $\mathrm{Yn}+7$ |  |

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

The MPG interface (MPG counter) occupies DI space from Xm+12 through $\mathrm{Xm}+14$. These addresses are fixed, and $\mathrm{Xm}+12$ through $\mathrm{Xm}+14$ must be allocated as a DI work area to enable the use of the MPG. Therefore, when using an MPG for the I series CNC, allocate DI addresses in units of 16 bytes. Do not use the DI space from Xm+12 through Xm+14 for Ladder; the CNC processes the MPG counter value directly.
DI address $\mathrm{Xm}+15$ is used for detecting overcurrent and overheating alarms that may occur in the IC used in the DO driver. [For details, see the section describing the detection of DO (output signal) alarms.] This address is fixed, and must be allocated as a work area before it can be used. Therefore, when using this area, allocate DI addresses in units of 16 bytes. Arbitrary addresses can be allocated as the I/O addresses of the operator's panel I/O module. In DI allocation, however, when *ESP (emergency stop signal) is allocated to this I/O module, the other fixed addresses (AE1, AE2, and SKIP1) become unavailable because of the relation with the fixed addresses directly supervised by the CNC.
6. CONNECTION OF I/O UNITS TO

Fixed addresses directly supervised by the CNC (for FS15i/150i)

|  | $\mathbf{7}$ | $\mathbf{6}$ | $\mathbf{5}$ | $\mathbf{4}$ | $\mathbf{3}$ | $\mathbf{2}$ | $\mathbf{1}$ | $\mathbf{0}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| X0006 |  |  |  | *ESP |  |  |  |  |
| X0008 |  |  |  | AE2 | AE1 |  |  |  |
| X0011 |  | SKIP1 |  |  |  |  |  |  |

When DI addresses are allocated in units of 16 bytes, starting at X0006

| X0006 | General-purpose input signal | $\longleftarrow$ *ESP fixed signal |
| :---: | :---: | :---: |
| X0007 |  |  |
| X0008 | Reserved |  |
| X0009 |  |  |
| X0010 |  |  |
| X0011 | Matrix input signals |  |
| X0012 |  |  |
| X0013 |  |  |
| X0014 |  |  |
| X0015 |  |  |
| X0016 |  |  |
| X0017 | Reserved |  |
| X0018(for 1st MPG) | MPG | ' Allocating DI addresses starting from X0005 allows the AEn |
| X0019(for 2nd MPG) |  | , signal to be used and the *ESP fixed signal to be allocated |
| X0020(for 3rd MPG) |  | : to an address for which the common voltage is fixed to 24 V . |
| X0021(DO alarm detection) | DO alarm detection | ' |

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

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


## NOTE

When the DO signal is in the ON state in the sequence, the ON or OFF state of the DOCOM pin determines the state of the signal, as indicated by the dotted lines in the above figure. Do not turn off the +24 V supply, provided by the CPD1 to the I/O module, during the operation. Turning off the +24 V supply would cause a CNC communication alarm. When turning on the power, the +24 V supply to the $\mathrm{I} / \mathrm{O}$ module must be turned on before or at the same time as the power supply to the CNC. When turning off the power, the +24 V supply to the I/O module must be turned off after or at the same time as the power supply to the CNC.

Parallel DO (output signal) connection

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


DO (output signal) alarm detection

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

| Alarm detection address <br> and bit | DO address | Remarks |
| :---: | :---: | :---: |
| $\mathrm{Xm}+15.0$ | $\mathrm{Yn}+0$ |  |
| $\mathrm{Xm}+15.1$ | $\mathrm{Yn+1}$ |  |
| $\mathrm{Xm}+15.2$ | $\mathrm{Yn}+2$ |  |
| $\mathrm{Xm}+15.3$ | $\mathrm{Yn}+3$ |  |
| $\mathrm{Xm}+15.4$ | $\mathrm{Yn}+4$ |  |
| $\mathrm{Xm}+15.5$ | $\mathrm{Yn}+5$ |  |
| $\mathrm{Xm}+15.6$ | $\mathrm{Yn}+6$ |  |
| $\mathrm{Xm}+15.7$ | $\mathrm{Yn}+7$ | Reserved |

## 6.5 <br> CONNECTION OF <br> OPERATOR'S PANEL <br> I/O MODULE (NOT <br> FOR MATRIX INPUT)

### 6.5.1 <br> Overall Connection <br> Diagram



Connectors that cannot be used on the cable side

|  | Specification | Manufacturer |
| :--- | :--- | :--- |
| Connector case | FI-20-CV7 | Hirose Electric Co., Ltd. |
| Connector case and <br> connector | FI30-20S-CV7 | Hirose Electric Co., Ltd. |

### 6.5.2 Power Connection

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


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

## NOTE

1 The specification of the power supply connector CPD1 (IN) is the same as that for CPD1 (OUT). There are no indications on the printed circuit board to distinguish between the $\mathbb{N}$ and OUT connectors.
2 Do not turn off the +24 V supply to the connector during operation. Turning off the +24 V supply will cause a CNC communication alarm. When turning on the power, the +24 V supply to the I/O module must be turned on before or at the same time as the power supply to the CNC. When turning off the power, the +24 V supply to the I/O module must be turned off after or at the same time as the power supply to the CNC.
6.5.3

DI/DO Connector Pin Arrangement

| CE56 |  |  | CE57 |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | A | B |  | A | B |
| 01 | OV | +24V | 01 | OV | +24V |
| 02 | Xm+0.0 | Xm+0.1 | 02 | Xm+3.0 | Xm+3.1 |
| 03 | Xm+0.2 | Xm+0.3 | 03 | Xm+3.2 | Xm+3.3 |
| 04 | Xm+0.4 | Xm+0.5 | 04 | Xm+3.4 | Xm+3.5 |
| 05 | Xm+0.6 | Xm+0.7 | 05 | Xm+3.6 | Xm+3.7 |
| 06 | Xm+1.0 | Xm+1.1 | 06 | Xm+4.0 | Xm+4.1 |
| 07 | Xm+1.2 | Xm+1.3 | 07 | Xm+4.2 | Xm+4.3 |
| 08 | Xm+1.4 | Xm+1.5 | 08 | Xm+4.4 | Xm+4.5 |
| 09 | Xm+1.6 | Xm+1.7 | 09 | Xm+4.6 | Xm+4.7 |
| 10 | Xm+2.0 | Xm+2.1 | 10 | Xm+5.0 | Xm+5.1 |
| 11 | Xm+2.2 | Xm+2.3 | 11 | Xm+5.2 | Xm+5.3 |
| 12 | Xm+2.4 | Xm+2.5 | 12 | Xm+5.4 | Xm+5.5 |
| 13 | Xm+2.6 | Xm+2.7 | 13 | Xm+5.6 | Xm+5.7 |
| 14 | DICOM0 |  | 14 |  | DICOM5 |
| 15 |  |  | 15 |  |  |
| 16 | Yn+0.0 | Yn+0.1 | 16 | Yn+2.0 | Yn+2.1 |
| 17 | $\mathrm{Yn}+0.2$ | $\mathrm{Yn}+0.3$ | 17 | Yn+2.2 | Yn+2.3 |
| 18 | $\mathrm{Yn}+0.4$ | $\mathrm{Yn}+0.5$ | 18 | $\mathrm{Yn}+2.4$ | $\mathrm{Yn}+2.5$ |
| 19 | Yn+0.6 | $\mathrm{Yn}+0.7$ | 19 | Yn+2.6 | Yn+2.7 |
| 20 | $\mathrm{Yn}+1.0$ | $\mathrm{Yn}+1.1$ | 20 | $\mathrm{Yn}+3.0$ | $\mathrm{Yn}+3.1$ |
| 21 | $\mathrm{Yn}+1.2$ | $\mathrm{Yn}+1.3$ | 21 | $\mathrm{Yn}+3.2$ | $\mathrm{Yn}+3.3$ |
| 22 | $\mathrm{Yn}+1.4$ | $\mathrm{Yn}+1.5$ | 22 | $\mathrm{Yn}+3.4$ | $\mathrm{Yn}+3.5$ |
| 23 | $\mathrm{Yn}+1.6$ | $\mathrm{Yn}+1.7$ | 23 | Yn+3.6 | Yn+3.7 |
| 24 | DOCOM | DOCOM | 24 | DOCOM | DOCOM |
| 25 | DOCOM | DOCOM | 25 | DOCOM | DOCOM |

Flat cable-side connector specification:
A02B-0120-K342
(HIFBB-50D-2.54R (Hirose Electric Co., Ltd.))
50 contacts
Cable material specification
A02B-0120-K886
(61-meter, $50-$ pin cable
(Hitachi Cable, Ltd. or Oki Electric Cable Co., Ltd.))
6. CONNECTION OF I/O UNITS TO

### 6.5.4 <br> DI (General-Purpose <br> Input Signal) <br> Connection



6. CONNECTION OF I/O UNITS TO


## NOTE

$1 \mathrm{Xm}+0.0$ through $\mathrm{Xm}+0.7$ and $\mathrm{Xm}+5.0$ to $\mathrm{Xm}+5.7$ are DI pins for which a common voltage can be selected. That is, by connecting the DICOM0 CE56(A14) or DICOM5 CE57 (B14) pin to the +24 V power supply, a DI signal can be input with its logical state reversed. If, however, a cable is connected to ground, it has the same effect as inputting an ON state DI signal. To prevent this from occurring, the connection of the DICOM0 and DICOM5 pins to the 0 V power supply is recommended wherever possible.
2 For safety reasons, the emergency stop signal needs to be allocated to an appropriate bit of the addresses for which the common voltage is fixed. See "Address allocation" in 6.5.9 for details of how to allocate the emergency stop signal.
3 For unused DI pins allocated to the addresses for which the common voltage is fixed (DICOM0 or DICOM5), the logic is fixed to " 0 ". When the DICOM0 or DICOM5 pins are connected to the +24 V power supply, the logic is fixed to " 1 ". The logic of the unused pins is variable when the contact of the DICOM0 or DICOM5 pin is open.
6. CONNECTION OF I/O UNITS TO

### 6.5.5 <br> DO (Output Signal) <br> Connection



6. CONNECTION OF I/O UNITS TO
6.5.6

Manual Pulse

## Generator Connection

### 6.5.7

## External View



Machine operator's panel DI/DO interface
: Polarity guide
: A1 pin mark


### 6.5.8 Specifications

## Installation

 specifications| Ambient temperature | During operation <br> During storage and transportation$0^{\circ}$ to $58^{\circ} \mathrm{C}$ <br> $-20^{\circ} \mathrm{C}$ to $60^{\circ} \mathrm{C}$ <br> Temperature change <br> Relative humidity <br> Max. $0.3^{\circ} \mathrm{C} / \mathrm{min}$. <br> Vibration <br> Normal <br> Short term (1 month or less) : $75 \%$ or less <br> $95 \%$ or less <br> Environment <br> During operation: 0.5 G or less <br> Other requirements <br> Ordinary machining factory environment (Special <br> consideration is required when installing the module <br> in a dusty location or where highly concentrated cut- <br> ting lubricant or organic solvent is used.) <br> (1) Install the I/O module in a fully enclosed cabinet. |
| :--- | :--- |

## Ordering specifications

| Item | Specification | Remarks |
| :--- | :--- | :--- |
| Operator's panel I/O <br> module <br> (with MPG interface) | A20B-2002-0520 | General-purpose DI: 48 <br> points <br> DO: 32 points <br> MPG interface is <br> supported. |
| Operator's panel I/O <br> module <br> (without MPG interface) | A20B-2002-0521 | DI: 48 points <br> DO: 32 points <br> MPG interface is not <br> supported. |
| Fuse (replacement part) | A03B-0815-K001 | 1A |

## Module specifications

| Item | Specification | Remarks |
| :--- | :--- | :--- |
| DI points | 48 points | $24-\mathrm{V}$ input |
| DO points | 32 points | 24 V source type output |
| CNC interface | FANUC I/O Link <br> connection | Up to 16 modules can be <br> connected as CNC slaves. <br> Or, a maximum of 1024 <br> points can be supported on <br> both the input and output <br> sides. |
| MPG interface | Max. 3 units | MPG interface can be <br> used. |

6. CONNECTION OF I/O UNITS TO

## Power supply rating

| Module | Supply voltage | Current <br> rating | Remarks |
| :--- | :--- | :--- | :--- |
| Operator's <br> panel I/O <br> module | 24 VDC $\pm 10 \%$ supplied <br> from the power supply <br> connector CPD1. The al- <br> lowance of $\pm 10 \%$ should <br> include instantaneous <br> voltage and ripple voltage. | 0.3 A <br> +7.3 mAXDI | The total power <br> consumption of DI <br> points is included. <br> The power con- <br> sumption of DO <br> points is not in- <br> cluded. |

## DI (input signal) specifications

(General-purpose input signal)

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

## DO (output signal)

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

## NOTE

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

## DO signal reaction to a system alarm

If a system alarm occurs in the CNC using the operator's panel 48/32 I/O module, or if I/O Link communication between the CNC and operator's panel I/O module fails, all the DO signals of the I/O module are turned off. Therefore, sufficient care is necessary when setting up the machine sequence. Also, the same phenomenon occurs if the power to the CNC or the I/O module is turned off.

## Address allocation

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

| DI space map |  |
| :---: | :---: |
| Xm | Input signal |
| Xm+1 |  |
| Xm+2 |  |
| Xm+3 |  |
| Xm+4 |  |
| Xm+5 |  |
| Xm+6 |  |
| Xm+7 | Reserved |
| Xm+8 |  |
| Xm+9 |  |
| Xm+10 |  |
| Xm+11 |  |
| Xm+12(for 1st MPG) | MPG |
| Xm+13(for 2nd MPG) |  |
| Xm+14(for 3rd MPG) |  |
| Xm+15(DO alarm detection) | DO alarm detection |


| DO space map |  |
| :--- | :--- |
| Yn | Outputsignal |
| $\mathrm{Yn}+1$ |  |
| $\mathrm{Yn}+2$ |  |
| $\mathrm{Yn}+3$ |  |

The operator's panel 48/32 I/O module is allocated a group of DI addresses ( 16 bytes) and a group of DO addresses ( 4 bytes). This address allocation is explained below.

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

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

Basically, 48/32 I/O addresses can be allocated to the operator's panel I/O module freely. When allocating DI addresses, however, consider also the fixed addresses that are directly supervised by the CNC, and keep the following in mind.

Fixed addresses directly supervised by the CNC (for $15 i / 150 i$ )

| ADDRESS | $\mathbf{7}$ | $\mathbf{6}$ | $\mathbf{5}$ | $\mathbf{4}$ | $\mathbf{3}$ | $\mathbf{2}$ | $\mathbf{1}$ | $\mathbf{0}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| X0006 |  |  |  | *ESP |  |  |  |  |
| X0007 |  |  |  | AE2 | AE1 |  |  |  |
| X0008 |  | SKIP1 |  |  |  |  |  |  |

When DI addresses are allocated in units of 16 bytes, starting at X0005

| X0005 | Input signal | «AESP fixed signal |
| :---: | :---: | :---: |
| X0006 |  |  |
| X0007 |  |  |
| X0008 |  |  |
| X0009 |  |  |
| X0010 |  |  |
| X0011 | Reserved |  |
| X0012 |  |  |
| X0013 |  |  |
| X0014 |  |  |
| X0015 |  |  |
| X0016 |  |  |
| X0017(for 1st MPG) | MPG |  |
| X0018(for 2nd MPG) |  |  |
| X0019(for 3rd MPG) |  |  |
| X0020(DOalarmdetection) | DO alarm detection |  |

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

All the DO signals can be turned off simultaneously by turning off (opening) the DO (output signal) power supply pin "DOCOM". Doing so causes the DO signal status to change as shown below.
When DO is ON in the ON
Sequence
When DO is OFF in the ON OF
Wequence

## NOTE

1 When the DO signal is in the ON state in the sequence, the ON or OFF state of the DOCOM pin determines the state of the signal, as indicated by the dotted lines in the above figure.
2 Do not turn off the +24 V supply, provided by the CPD1 to the I/O module, during the operation. Turning off the +24 V supply would cause a CNC communication alarm. When turning on the power, the +24 V supply to the I/O module must be turned on before or at the same time as the power supply to the CNC. When turning off the power, the +24 V supply to the $\mathrm{I} / \mathrm{O}$ module must be turned off after or at the same time as the power supply to the CNC.

## Parallel DO (output signal) connection

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


## DO (output signal) alarm detection

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

| Alarm detection <br> address and bit | DO address | Remarks |
| :---: | :---: | :---: |
| $\mathrm{Xm}+15.0$ | $\mathrm{Yn+0}$ |  |
| $\mathrm{Xm}+15.1$ | $\mathrm{Yn+1}$ |  |
| $\mathrm{Xm}+15.2$ | $\mathrm{Yn}+2$ |  |
| $\mathrm{Xm}+15.3$ | $\mathrm{Yn+3}$ | Reserved |
| $\mathrm{Xm}+15.4$ | $\mathrm{Yn+4}$ | Reserved |
| $\mathrm{Xm}+15.5$ | $\mathrm{Yn}+5$ | Reserved |
| $\mathrm{Xm}+15.6$ | $Y n+6$ | Reserved |
| $\mathrm{Xm}+15.7$ | $Y n+7$ |  |

## 6.6 CONNECTION OF THE FANUC I/O UNIT-MODEL A

The FANUC I/O Unit-MODEL A ("I/O Unit") is a modular-type I/O unit. It interfaces with the machine when connected to the control unit (Series $15 i / 150 i$ ) via the I/O Link. One I/O unit can be configured by mounting the I/O modules required for either the $5-$ or $10-$ slot base unit. A variety of I/O modules are provided so appropriate modules can be selected according to the use, points, voltage level, current capacity, and signal specifications.

### 6.6.1

Structure of FANUC I/O Unit-MODEL A


Interface module AIF01A or AIF01B

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

### 6.6.2

## Outer Dimensions



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

### 6.6.3 <br> Mounting and Dismounting Modules

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

## Mounting



1 Hang the hook at the top of the module on the groove in the upper side of the base unit.
2 Make the connector of the module engage with that of the base unit.
3 Push the module in the lower groove of the base unit till the stopper in the lower side of the module stops.

## Dismounting



1 Release the stopper by pushing the lever at the bottom of the module.
2 Push the module upwards.

### 6.6.4 <br> Connection Diagram



## CAUTION

1 Number of I/O Units and connecting method are restricted depending on the allocation of the I/O points.
See 6.2 "Connection of FANUC I/O Link" and 6.6.11 "Number of I/O points for the I/O Unit-A".
2 Cable K1X can be an optical fiber cable by using the optical I/O link adapter.
Refer to item 6.2.2.
3 Attach a terminator to connector JD2 on the last AIF01B in the group. See (3) in Section 6.6.7.
6. CONNECTION OF I/O UNITS TO

## 6.6 .5 <br> Connecting Input Power Source

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

- Voltage : 24VDC $\pm 10 \%$
- Current : Determine from Table 6.6.5.



## CAUTION

Turn ON the power for the I/O unit just before or when the power for the CNC is turned ON. When the CNC power is turned OFF, make sure to turn the power to the I/O unit OFF as well.

Table 6.6.5 Required current of each module

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

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

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


### 6.6.6 Grounding

$\bullet$ Ground the base unit (ABU05A, ABU10A) by its grounding terminal


- When the cable K1X (see connection diagram in section 6.6.4) runs between different cabinets, make sure to connect the cabinets with a grounding wire more than $5.5 \mathrm{~mm}^{2}$.


### 6.6.7 <br> Connecting Signal Cables

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

- Use twisted pair wires for signal SIN and *SIN, and signals SOUT and *SOUT.
- Recommended cable material : A66L-0001-0284\#10P (twisted pair/shielded)
- Shielding wires should be connected with the grounding plate of the cabinet at the JD1A side using a cable clamp.
- Maximum cable length: 15 m
- Do not make any wire connections to the connector spare pins.
- Use an optical I/O link adapter and an optical fiber cable, [in the following cases] :
$\square$ When the cable is more than 15 meters long.
$\square$ When the cable runs between different cabinets and there is no appropriate ground wire between the cabinets.
$\square$ When there is concern that the cable is influenced by strong noise.


## Cable K2X



- Connect the signals with the same name.
- Make sure to use twisted pair wires for the following signals:

S1 and *S1, S2 and *S2, S3 and *S3
S4 and *S4, S5 and *S5, S6 and *S6

- Do not connect the pins No. 10, No. 19 and No. 20, as they are used internally.
- Recommended cable material: A66L - 0001 - 0284\#10P
(twisted pair/shielded)
- Maximum cable length : 2 m

6. CONNECTION OF I/O UNITS TO

## Terminator TX


6.6.8

Connecting with I/O Modules

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


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

## Dismounting the

 terminal block1 Open the cover of the terminal block.
2 Push up the latch at the top of the terminal block.
3 Drag out the tab at the top of the terminal block and pull it out. The terminal block will be removed from the module.

Cautionary points when wiring terminal block type

- Wiring material :AWG22-18 (0.3-0.75mm²)

A wire as thin as possible is recommended.

- Crimp style terminal : M3.5

Crimp style terminal with no insulation sleeve and a short distance "A", as illustrated in the drawing below, is recommended.


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


### 6.6.9 <br> Digital Input/Output Module

## Digital input modules

| Input type | Module name | Rated voltage | Rated current | Polar ity | Response time | Points | External connection | LED display |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Non-insulation DC input | $\begin{aligned} & \text { AID } \\ & 32 \mathrm{~A} \end{aligned}$ | 24VDC | 7.5 mA | Both | $\begin{aligned} & \hline \text { Maximum } \\ & 20 \mathrm{~ms} \end{aligned}$ | 32 | Connector | not <br> provided |
|  | $\begin{aligned} & \text { AID } \\ & 32 \mathrm{~B} \end{aligned}$ | 24VDC | 7.5 mA | Both | $\begin{aligned} & \hline \text { Maximum } \\ & 2 \mathrm{~ms} \end{aligned}$ | 32 | Connector | not <br> provided |
| Insulation type DC input | $\begin{aligned} & \text { AID } \\ & 16 \mathrm{C} \end{aligned}$ | 24VDC | 7.5 mA | NEG | $\begin{gathered} \hline \text { Maximum } \\ 20 \mathrm{~ms} \end{gathered}$ | 16 | Terminal block | provided |
|  | $\begin{aligned} & \text { AID } \\ & \text { 16D } \end{aligned}$ | 24VDC | 7.5 mA | POS | $\begin{aligned} & \hline \text { Maximum } \\ & 20 \mathrm{~ms} \end{aligned}$ | 16 | Terminal block | provided |
|  | $\begin{aligned} & \text { AID } \\ & 32 E \end{aligned}$ | 24VDC | 7.5 mA | Both | $\begin{aligned} & \hline \text { Maximum } \\ & 20 \mathrm{~ms} \end{aligned}$ | 32 | Connector | not <br> provided |
|  | $\begin{aligned} & \text { AID } \\ & 32 F \end{aligned}$ | 24VDC | 7.5 mA | Both | $\begin{aligned} & \hline \text { Maximum } \\ & 2 \mathrm{~ms} \end{aligned}$ | 32 | Connector | not <br> provided |
| AC input | $\begin{aligned} & \text { AIA } \\ & 16 \mathrm{G} \end{aligned}$ | $\begin{gathered} 100- \\ 120 \mathrm{VAC} \end{gathered}$ | $\begin{gathered} 10.5 \mathrm{~mA} \\ (120 \mathrm{~V} \\ \mathrm{AC}) \end{gathered}$ | ON Max 35ms OFF Max 45 ms |  | 16 | Terminal block | provided |

## CAUTION

1 Polarity
Negative : 0 V common (current source type)

- The input is defined as ON when at a low level

Positive : 24 V common (current sink type)

- The input is defined as ON when at a high level

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

## Digital output modules

| Output type | Module name | Rated voltage | Rated current | Polarity | Points | Points /common | External connection | LED display | Fuse |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Insula- <br> tion <br> type <br> DC <br> output | $\begin{aligned} & \hline \text { AOD } \\ & \text { 08C } \end{aligned}$ | $\begin{aligned} & \hline 12-24 \\ & \text { VDC } \end{aligned}$ | 2A | NEG | 8 | 8 | Terminal block | provided | $\begin{gathered} \text { pro- } \\ \text { vided } \end{gathered}$ |
|  | $\begin{aligned} & \hline \text { AOD } \\ & \text { 08D } \end{aligned}$ |  | 2 A | POS | 8 | 8 | Terminal block | provided | $\begin{gathered} \text { pro- } \\ \text { vided } \end{gathered}$ |
|  | $\begin{aligned} & \text { AOD } \\ & 16 \mathrm{C} \end{aligned}$ |  | 0.5A | NEG | 16 | 8 | Terminal block | provided | $\begin{aligned} & \text { not } \\ & \text { pro- } \end{aligned}$ vided |
|  | $\begin{aligned} & \text { AOD } \\ & 16 D \end{aligned}$ |  | 0.5A | POS | 16 | 8 | Terminal block | provided | $\begin{gathered} \text { not } \\ \text { pro- } \end{gathered}$ vided |
|  | $\begin{aligned} & \text { AOD } \\ & 32 \mathrm{C} \end{aligned}$ |  | 0.3A | NEG | 32 | 8 | Connector | $\begin{array}{\|c\|} \text { not } \\ \text { provided } \end{array}$ | not provided |
|  | $\begin{aligned} & \text { AOD } \\ & \text { 32D } \end{aligned}$ |  | 0.3A | POS | 32 | 8 | Connector | not provided | not provided |
| AC output | $\begin{gathered} \hline \text { AOD } \\ 05 \mathrm{E} \end{gathered}$ | $\begin{aligned} & 100- \\ & 240 \\ & \text { VAC } \end{aligned}$ | 2A | - | 5 | 1 | Terminal block block | provided | $\begin{gathered} \text { pro- } \\ \text { vided } \end{gathered}$ |
|  | $\begin{gathered} \hline \text { AOD } \\ \text { 08E } \end{gathered}$ |  | 1A | - | 8 | 4 | Terminal block | provided | $\begin{gathered} \text { pro- } \\ \text { vided } \end{gathered}$ |
|  | $\begin{gathered} \text { AOD } \\ 12 \mathrm{~F} \end{gathered}$ | $\begin{gathered} \hline 100- \\ 120 \\ \text { VAC } \end{gathered}$ | 0.5A | - | 12 | 6 | Terminal block | provided | provided |
| Relay output | $\begin{aligned} & \text { AOR } \\ & \text { 08G } \end{aligned}$ | $\begin{gathered} \hline \text { Maxi- } \\ \text { mum } \\ 250 \\ \text { VAC/ } \\ \text { 30VDC } \end{gathered}$ | 4A | - | 8 | 1 | Terminal block | provided | $\begin{gathered} \text { not } \\ \text { pro- } \\ \text { vided } \end{gathered}$ |
|  | $\begin{aligned} & \text { AOR } \\ & \text { 16G } \end{aligned}$ |  | 2 A | - | 16 | 4 | Terminal block | provided | $\begin{gathered} \text { not } \\ \text { pro- } \\ \text { vided } \end{gathered}$ |

## CAUTION

1 Polarity
Negative : 0 V common (current sink type)

- Output is at low level when ON.

Positive : 24 V common (current source type)

- Output is at high level when ON.

2 For the details of the specifications for each module, refer to FANUC I/O Unit-MODEL A Connection•Maintenance Manual (B-61813E).
6. CONNECTION OF I/O UNITS TO

### 6.6.10

Correspondence between I/O Signals and Addresses in a Module


Addresses in a module are defined relatively, with the beginning address as 0 . Real addresses viewed by the sequence program of the PMC are set by the programmer.
For input modules, an input signal becomes " 1 " when the contact point connected with the input is turned ON. For output modules, an output contact point (or transistor) is turned ON when the output signal is " 1 ".

### 6.6.11 Number of Points for I/O Unit-MODEL A

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

## - Output points

Sum of the actual output points in a group

| 0 to 32 |  | 32 points |
| :--- | :--- | :--- |
| 40 to 64 | $\rightarrow$ | 64 points |
| 72 to 128 | $\rightarrow$ | 128 points |
| 136 to 256 |  | 256 points |

## NOTE

Count AOA05E as 8 points and AOA12F as 16 points.

## - Input points

Sum of the actual input points in a group
0 to $32 \quad \rightarrow \quad 32$ points
40 to $64 \quad \rightarrow \quad 64$ points
72 to $128 \quad \rightarrow \quad 128$ points
136 to $256 \quad \rightarrow \quad 256$ points

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

## Example 1:

When the following modules are used in the group No. 0
AOD32C . . . . . . . . . . . . . . . . . . . . . . 3
AOA12F ............................ . 2
AID32A ............................ 5
AIA16G ............................ . . 3
[Input points]
$32 \times 5+16 \times 3=208 \rightarrow 256$ points
[Output points]
$32 \times 3+16 \times 2=128 \rightarrow 128$ points

## Example 2:

When the following modules are used in the group No. 2.
AOD16C 7
AOA05F . . . . . . . . . . . . . . . . . . . . . . . 9
AID16A ............................. 4
AIA16G 3
[Input points]
$16 \times 4+16 \times 3=112 \rightarrow 128$ points
[Output points]
$16 \times 7+8 \times 9=184 \rightarrow 256$ points
In this case, as the number of input points is smaller than that of the output points, the number of input points is assumedl to be equal to that of the output points, in other words, 256 points.

## 6.7 <br> CONNECTION OF MACHINE OPERATOR'S PANEL INTERFACE UNIT

The machine operator's panel interface unit (A16B-2201-0110) is connected to the control unit through the I/O Link and is used for interfacing with the machine operator's panel.
It features interfaces with matrix key switches, LEDs and manual pulse generators.


### 6.7.1

## Function Overview

## Number of DI/DO points

|  | DI/DO = 128/128 |  | DI/DO $=256 / 256$ |  |
| :---: | :---: | :---: | :---: | :---: |
|  | $\begin{gathered} \text { DI } \\ \text { (OCO2I) } \end{gathered}$ | $\begin{gathered} \text { DO } \\ \text { (OCO2O) } \end{gathered}$ | $\begin{gathered} \text { DI } \\ (\mathrm{OCO3I}) \end{gathered}$ | $\begin{gathered} \text { DO } \\ (\mathrm{OCO3O}) \end{gathered}$ |
| Number of matrix key switch inputs | 64 |  | 96 |  |
| Number of matrix LED data outputs |  | 64 |  | 64 |
| Number of general-purpose switch inputs | 32 |  | 32 |  |
| Number of general-purpose LED data outputs |  | 32 |  | 32 |
| Number of total DI/DO points | 96 | 96 | 128 | 96 |

- Matrix key switch inputs (matrix DI)

Ninety-six DI points are provided by a matrix of twelve common signals times eight data signals. Note that I/O Link allocation may limit the number of usable key switch inputs.

- Matrix LED data outputs (matrix DO)

Sixty-four DO points are provided by a matrix of eight common signals times eight data signals.

- General-purpose switch inputs (general-purpose DI) Each general-purpose DI point has an individual interface.
- General-purpose LED data outputs (general-purpose DO) Each general-purpose DO point has an individual interface.


## Analog signal inputs

## Terminal for signal forwarding

First manual pulse generator

- Two inputs (input voltage: 0 to +10 V )
- Input voltages are converted from analog to digital. The resulting five bits of data are sent to the CNC through the FANUC I/O Link.
- The analog signal input function can be used regardless of whether I/O Link allocation is 128/128 or 256/256.
- Emergency stop and OT release signals are forwarded without change to the power magnetics cabinet.
- Power ON/OFF control signals are forwarded without change to an input unit.
- Analog signal inputs described in item "Analog signal inputs" can be sent out without being changed.

Pulse information from the manual pulse generator is transferred via an I/O Link.
When this unit is used together with a unit (connector panel I/O module) connected to the I/O Link supporting another MPG interface, only the MPG interface of the unit (module) closest to the CNC connected to the I/O Link is valid.
6. CONNECTION OF I/O UNITS TO

## 6.7 .2 <br> System Configuration



## NOTE

1 Power requirements
When $60 \%$ of the DI/DO points are on, this interface unit requires "1.0 A"
2 The cable connected to CM26 must not be longer than 30 cm .

## 6.7 .3 <br> Signal Assignment

## Connector pin signal assignment

| CM15 (General DI/DO) |  |  | CM16 (General DI/DO) |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | A | B |  | A | B |
| 01 | +5E | D106 | 01 | DI20 | DI22 |
| 02 | OV | DO06 | 02 | DI24 | +5E |
| 03 | +5E | DI07 | 03 | DI23 | DI21 |
| 04 | OV | DO07 | 04 | DI25 | DI26 |
| 05 | +5E | D116 | 05 | DI27 | +5E |
| 06 | OV | DO16 | 06 | DO00 | OV |
| 07 | +5E | D117 | 07 | DI05 | +5E |
| 08 | OV | DO17 | 08 | D001 | OV |
| 09 | *ESP | ECM1 | 09 | DI15 | +5E |
| 10 | OTR | ECM2 | 10 | DO02 | OV |
| 11 | DI00 | D102 | 11 | DO03 | DO04 |
| 12 | DI04 | +5E | 12 | DO05 | OV |
| 13 | DI03 | D101 | 13 | OV | OV |
| 14 | D105 | DI10 | 14 | DO10 | DO11 |
| 15 | DI12 | DI14 | 15 | DO12 | DO13 |
| 16 | +5E | DI13 | 16 | DO14 | DO15 |
| 17 | DI11 | DI15 | 17 | +5E | +5E |

CM17 (General DI/DO)

|  | A | B |
| :---: | :---: | :---: |
| 01 | 0 V | OV |
| 02 | DO20 | DO21 |
| 03 | DO22 | DO23 |
| 04 | DO24 | DO25 |
| 05 | DO26 | DO27 |
| 06 | 0 V | 0 V |
| 07 | DO30 | DO31 |
| 08 | DO32 | DO33 |
| 09 | DO34 | DO35 |
| 10 | DO36 | DO37 |
| 11 | 0 V | 0 V |
| 12 | +5 E | +5 E |
| 13 | DI30 | DI31 |
| 14 | DI32 | DI33 |
| 15 | DI34 | DI35 |
| 16 | DI36 | DI37 |
| 17 | +5 E | +5 E |

CA40 (Connector on the manual pulse generator)

| 14 | DI37 |  |  | 01 | +5V |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 15 | OV | 08 | Di3 | 02 | +5V |
| 16 | DO37 | 09 | Di32 | 03 | HA1 |
| 17 | OV | 11 | Di33 | 04 | HB1 |
| 18 |  | 12 | D135 | 05 |  |
| 19 | +5E | 12 | D135 | 06 |  |
| 20 | +5E | 13 | Di36 | 07 | DI30 |

CNA1 (Connector on the machine side)

| 9 | OM | 10 | ECM2 |  |  | 20 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 9 | OM | 8 | ECM1 | 19 |  | 18 |  |
| 7 | DO36 | 6 | SM | 17 | *ESP | 16 |  |
| 5 | SM | 4 | OM | 15 | COM | 14 |  |
| 3 | OM | 2 | LM | 13 | EOF | 12 |  |
| 1 | LM | 2 |  | 11 | EON |  |  |

CNB1 (Connector on the operator's panel side)
CPD1 (Power supply)

| 01 | LM | 05 | EON | 09 | HA1 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 02 | SM | 06 | EOF | 10 | HB1 |
| 03 | 0 M | 07 | COM | 11 | +5 V |
| 04 | 0 M | 08 | 0 V | 12 | 0 V |


| 3 | 2 | 1 |
| :---: | :---: | :---: |
|  | 0 V | +24 V |
| 6 | 5 | 4 |
|  | 0 V | +24 V |

Pins shaded by $\square$ are those for forwarding signals. Pins with the same name are connected directly to one another.

## NOTE

1 LM and SM also function as input terminals to the A/D converter.
2 OM is connected to 0 V on the PCB. Input/output pins shaded by $\qquad$ are in pairs. Only one in each pair is usable.

| 9 | +5 V | 10 |  | 19 |  | 20 | +5 V |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 7 |  | 8 |  | 17 |  | 18 | +5 V |
| 5 |  | 6 |  | 15 | 0 V | 16 | 0 V |
| 3 | TXB | 4 | ${ }^{*}$ TXB | 14 | 0 V |  |  |
| 1 | RXB | 2 | ${ }^{*}$ RXB | 13 | 0 V | 12 | 0 V |

JD1B (FANUC I/O Link : BEFORE SLAVE)

CM26 (Matrix DI/DO)

|  | A | B |
| :---: | :---: | :---: |
| 01 | OV | *MND1 |
| 02 | *KYD0 | *KYD1 |
| 03 | *KYD2 | *KYD3 |
| 04 | *KYD4 | *KYD5 |
| 05 | *KYD6 | *KYD7 |
| 06 | *KYC0 | *KYC1 |
| 07 | *KYC2 | *KYC3 |
| 08 | *KYC4 | *KYC5 |
| 09 | *KYC6 | *KYC7 |
| 10 | *KYC8 | *KYC9 |
| 11 | *KYCA | *KYCB |
| 12 | *BZMD | 0V |
| 13 | *LD0 | *LD8 |
| 14 | *LD1 | *LD9 |
| 15 | *LD2 | *LD10 |
| 16 | *LD3 | *LD11 |
| 17 | *LD4 | *LD12 |
| 18 | *LD5 | *LD13 |
| 19 | *LD6 | *LD14 |
| 20 | *LD7 | *LD15 |
| 21 | LC1L | LC1H |
| 22 | LC2L | LC2H |
| 23 | LC3L | LC3H |
| 24 | LC4L | LC4H |
| 25 | 0V | 0V |


| DInx | General-purposeDI | LM | Load meter voltage |
| :--- | :--- | :--- | :--- |
| DOnx | General-purposeDO | SM | Speed meter voltage |
| *ESP | Emergency stop | OM | LM/SM reference voltage (OV) |
| ECM1 | *ESP common signal | ${ }^{\text {KKYDx }}$ | Matrix DI data signal |
| OTR | OT release | ${ }^{\text {KYYCx }}$ | Matrix DI common signal |
| ECM2 | OTR common signal | *LDx | Matrix DO data signal |
| EON/OF | Power ON/OFF control signal | LCnL/H | Matrix DO common signal |
| COM | EON/EOF common signal | ${ }^{* M N D I ~}$ | Three DI points acceptable |
| HAI | Input from manual pulse generator | *BZMD | Buzzer off |
| HBI | Input from manual pulse generator |  |  |

See Subsec. 6.7.4 for details of connection and signal meanings.

### 6.7.4 <br> Interface

## General-purpose DI



Input signal specifications

| Contact rating | $5 \mathrm{VDC}, 3.2 \mathrm{~mA}$ or higher |
| :--- | :--- |
| Leakage current between open contacts | 0.2 mA or lower (5 VDC) |
| Voltage drop across closed contacts | 0.75 V or lower |

## General-purpose DO



Output signal specifications

| Maximum load current | 0.03 A |
| :--- | :--- |
| Maximum open-circuit leakage current | 0.1 mA |
| Maximum closed-circuit voltage drop | 0.1 V |

## NOTE

When using an LED at the DO point, connect an external resistor that meets the requirements of the LED.
6. CONNECTION OF I/O UNITS TO

## Matrix DI

- Key switch addresses

See Subsec. 6.7.5 for the corresponding PMC addresses.


## - Mode selection

$\square$ Preventing malfunctions that may be caused by detouring current When there are three or more matrix DI points, detouring current can cause a nonexistent DI input to be falsely detected as existing.
As shown below, if KY01, KY03, and KY21 are closed simultaneously, current detours through the path indicated with arrows, thus causing a false input of *KY23 to be detected because of a current path formed by a combination of common signal *KYC2 and data signal *KYD3.


Two modes are available to prevent this malfunction. One should be selected according to the user applications.
[Method 1]

- Ignoring all occurrences of three or more simultaneous inputs

Action : Make the *MNDI signal open (see item "• Key switch addresses")

## NOTE

If there are two inputs and a third is added, all three are ignored. When one of the three inputs is removed, two are accepted.
[Method 2]

- Attaching detour prevention diodes to enable three simultaneous inputs
Action : Connect the *MNDI signal (see item " $\bullet$ Key switch addresses") to 0V.

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

Detour prevention diode


This PCB can raise a confirmation sound when a key is pressed. The condition to raise an audible alarm is set in 8 -bit units, or in $* \mathrm{KYCn}$ units. If *BZMD and common $* \mathrm{KYCn}$ are disconnected, a KYnx input causes a sound to generate. If they are connected, a KYnx input does not generate the sound.
To generate a confirmation sound for key input, the DO (PMC address DO + 00.7) "MD07" must have been turned to " 1 " (see Subsec. 6.7.5).

1 A diode is necessary to connect *BZMD and *KYCn, as shown below.
2 This setting cannot be changed when power is supplied.
3 The sound is generated when the circuit closes between common signal *KYCn and data signal *KYDx. It does not sound when the circuit is disconnected. If key switches are used, the sound is heard at the moment a key is pressed. It does not sound when a key is released or when a key is held pressed.


## (Example)

If *BZMD is connected to *KYC0 and *KYC2, but disconnected from *KYC1 and *KYC3, as shown below, closing a switch at key addresses KY10 to KY17 and KY30 to KY37 causes a confirmation sound for key input to be heard, but closing a switch at key addresses KY00 to KY07 and KY20 to KY27 does not.
See item " Key switch addresses".


- Signal specification

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

NOTE
This voltage must be maintained even when detour prevention diodes are used.
6. CONNECTION OF I/O UNITS TO

## Matrix DO

- LED addresses

See Subsec. 6.7.5 for the corresponding PMC addresses.


## NOTE

The timing for the common signals are shown below. Their duty cycle is 2 ms for LEDs being on and 6 ms for LEDs being off.
LC4L (H)
LC3L (H)
$\qquad$ $\square$ $\square \longrightarrow \square \square \square \square \square \square$ $\square \longrightarrow$
LC2L (H)
LC1L (H)
$\qquad$ $\square$ $\square$ $\square$ $\square$ $\square$ $\square$ $\square$
 $\square$ $\square$ $1<\overline{8 \mathrm{~ms}} \rightarrow$


- Internal circuit

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

6. CONNECTION OF I/O UNITS TO

- Signal specifications

Interface for manual pulse generator

- Connection of connector CNB1
- Connection of connector CA40

The LEDs must have the following rating

| Forward voltage | $2.4 \mathrm{~V} \max \left(\mathrm{l}_{\mathrm{f}}=5 \mathrm{~mA}\right)$ (Typical value) |
| :--- | :--- |
| Forward current | $30 \mathrm{~mA} \max$ |
| Reverse voltage | $3 \mathrm{~V} \max$ |

One interface is provided on connector CNB1.

| When only the manual pulse generator is directly connected | HA1 | $\begin{aligned} & \text { HA1 } \\ & \text { HB1 } \end{aligned}$ | Manual pulse generator |
| :---: | :---: | :---: | :---: |
|  |  |  |  |
|  | HB1 10 |  | 0 |
|  | HBI 10 |  | (0) |
|  | +5V 11 | +5V | ( $($ |
|  | 0 V 12 |  |  |
|  |  |  |  |
|  | CNB1 |  |  |
|  | Control PCB |  |  |

Pendant-type manual pulse generator with axis selection and multiplier setting functions can be connected to connector CA40.


## NOTE

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

## Analog signal inputs

- Connection diagram (example)

Analog inputs received from the outside are forwarded without change to output terminals.

Analog inputs from the spindle amp being output for load meter and speed meter indications.


Analog inputs received on the Machine operator's panel interface unit are converted to five-bit digital values, which are sent to the CNC though the I/O Link.
See Subsec. 6.7.5 for PMC addresses.
LM conversion data : "LM03 to LM07"
SM conversion data : "SM03 to SM07"

| Acceptable input voltage | 0 V to +15 V |  |
| :--- | :--- | :--- |
| Voltage that can be converted to digital | 0 V to +10 V | Note) |

## NOTE

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

- A/D conversion specifications

| Conversion error | $5 \%$ | $(\max )$ |
| :--- | :--- | :--- |
| Resolution | 5 bit | $(\min )$ |

## - Emergency stop

## - OT release

- Power ON/OFF control signal

A signal generated by the emergency stop switch on the machine operator's panel can be sent to the power magnetics cabinet. (This signal cannot be sent to the CNC through the FANUC I/O Link.)


A signal generated by the OT release switch on the machine operator's panel can be sent to the power magnetics cabinet.
(This signal cannot be sent to the CNC through the FANUC I/O Link.)


Signals generated by the power ON/OFF control switches on the machine operator's panel can be sent to an input unit. (These signals cannot be sent to the CNC through the FANUC I/O Link.)


## NOTE

The LM, OM, SM, D036, ECM, EON, EOF, COM, ESP, and OTR signals are all assigned to the pins of one connector (CNA1).
They can be connected to the machine using only one cable.

### 6.7.5 <br> PMC Addresses


6.7.6

Major Connection Precautions

- Use flat cables for connectors CM15, CM16, CM17, and CM26. When splitting and connecting flat cables to the machine operator's panel or other equipment, be careful not to break or short the conductors.
- All signals with the same name described in Subsec. 6.7.3 are connected to one another.
- One of the holes for mounting the PCB is also used for grounding. Before mounting the PCB, check the location of that hole with the diagram in Subsec. 6.7.10.


### 6.7.7 <br> State of the LEDs on the Machine Operator's Panel Interface Unit

## L1 (green) :

Monitors +5 E . When on, it indicates that the fuse is intact ( $+5 \mathrm{E}: 5 \mathrm{~V}$ for connector output).
When off, it indicates that the fuse has blown.
L2 (green) :
Monitors key scanning. When blinking, it indicates that the keys are being scanned normally. When on or off, it indicates key scanning is at halt.
L3 (red) :
When on, it indicates that an alarm condition has occurred. When off, it indicates that there is no alarm condition.

### 6.7.8 <br> Connector (on the Cable Side) Specifications

| Connector | Major use | Specification |
| :--- | :--- | :--- |
| CM15, <br> CM16, <br> CM17 | General-purpose <br> DI/DO | HIF3BA-34D-2.54R : <br> Manufactured by HIROSE ELECTRIC <br> CO., LTD. |
| CNA1 | Relay terminal <br> (to the machine) | PCR-E20FS : <br> Manufactured by HONDA TSUSHIN KO- <br> GYO CO., LTD. |
| CNB1 | Relay terminal <br> (to the machine <br> operator's panel) | MVSTBR2.5/12-ST-5.08 : <br> Manufactured by PHOENIX CONTACT <br> GmbH \& Co. |
| JD1A, <br> JD1B | FANUC I/O Link | PCR-E20FS : <br> Manufactured by HONDA TSUSHIN KO- <br> GYO CO., LTD. |
| CPD1 | Power supply | Dynamic D3100 (three pins) : <br> Manufactured by AMP JAPAN, LTD. <br> 1-178288-3 : Connector <br> 1-175218-5 : Contact |
| CM26 | Matrix DI/DO | HIF3BB-50D-2.54R : <br> Manufactured by HIROSE ELECTRIC <br> CO., LTD. |
| CA40 | Manual <br> generator | MR-20LFH (solder type) : <br> Manufactured by HONDA TSUSHIN KO- <br> GYO CO., LTD. |

## NOTE

1 Several types of connectors are available for use at the other end of the cable leading to connector CNB1. Refer to brochures of PHOENIX CONTACT GmbH \& Co..
The connector used on the machine operator's panel interface unit side is MSTBVA2.5/12-G-5.08.
2 Crimped type cable connector is available for CA40. For purchase from FANUC, please specify as below.
A02B-0029-K890 : Solder type
A02B-0029-K892 : Crimped type
6. CONNECTION OF I/O UNITS TO MACHINE INTERFACE

## 6.7 .9

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


### 6.7.10

Machine Operator's Panel Interface Unit Mounting Dimension

## Diagram

## Mounting hole position


6. CONNECTION OF I/O UNITS TO

Sheet fixing area (mounting face side)

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


## NOTE

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

Sheet fixing area (Soldering face side)

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


## NOTE

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

### 6.7.11 <br> Fuse Mounting <br> Position



FU1 : +24V fuse (general-purpose DO, this supplies printed board power protection)
FU2 : +5V fuse (IC power, manual pulse generator protection)
FU3 : +5E fuse (general-purpose DI protection)

## NOTE

FU2 is not mounted on Revision 05A or later.

## 6.8 <br> CONNECTING THE CONNECTION UNIT

A connection unit (A20B-1005-0310 or A20B-1003-0200) is connected to the control unit of the Series $15 i / 150 i$ via FANUC I/O Link and used for interfacing with the machine.
Electrical interfaces and pin assignment for connectors C01 to C05 and C09 to C13 used for interfacing with the machine are fully compatible with the connection unit of the Series $15-\mathrm{A} / \mathrm{B}$. The numbers of input and output points for each configuration are listed below.

| Name | Ordering code | Input | Output |
| :---: | :---: | :---: | :---: |
| Connection unit 1 | A02B-1005-0310 | 96 | 64 |
| Connection unit 1 <br> + <br> Connection unit 2 | A20B-1005-0310 <br> + <br> A20B-1003-0200 | 192 | 128 |

Ground the connection unit $1 / 2$.



Power input specifications
Voltage: $\quad 24 \mathrm{VDC} \pm 10 \%$
Capacity: $\quad 670+7.3 \times \mathrm{n}(\mathrm{mA})$ : When only connection unit 1 is used
$1150+7.3 \times \mathrm{n}(\mathrm{mA}):$ When connection unit 1 and connection unit 2 are used
n : Number of input points which are simultaneously turned on
Use a $30 / 0.18\left(0.75 \mathrm{~mm}^{2}\right)$ wire or thicker for the power cable.
6. CONNECTION OF I/O UNITS TO MACHINE INTERFACE

### 6.8.1

(a) Between CP52 and CP55

Connecting

## Connection Unit 1 and

## Connection Unit 2

CP52

| 1 | 2 | 3 | 4 | 5 | 6 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| +5 V | +5 V | 0 V | 0 V | +24 V | +24 N |

CP55

| 1 | 2 | 3 | 4 | 5 | 6 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| +5 V | +5 V | 0 V | 0 V | +24 V | +24 N |



Use a $30 / 0.18\left(0.75 \mathrm{~mm}^{2}\right)$ wire or thicker for the power cable.
(b) Between CDD1 and CDD2

| Connection Unit 1 |  |  |  |  | Connection Unit 2 |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { CDD1 } \\ & \text { FAP-50-1 } \end{aligned}$ |  |  |  |  | $\begin{aligned} & \text { CDD2 } \\ & \text { FAP-50-1 } \end{aligned}$ |  |  |  |
| A01 | OV | B01 | OV |  | A01 | OV | B01 | OV |
| A02 |  | B02 |  |  | A02 |  | B02 |  |
| A03 |  | B03 |  |  | A03 |  | B03 |  |
|  | OV |  |  |  |  |  |  |  |
| A04 | OV | B04 |  | $-$ | A04 | OV | B04 |  |
| A05 |  | B05 |  |  | A05 |  | B05 |  |
| A06 |  | B06 | OV | Cable | A06 |  | B06 | OV |
| A07 | *D7 | B07 | *D6 |  | A07 | *D7 | B07 | *D6 |
| A08 | *D5 | B08 | *D5 |  | A08 | *D5 | B08 | *D5 |
| A09 | 0V | B09 | *D3 |  | A09 | OV | B09 | *D3 |
| A10 | *D2 | B10 | *D1 |  | A10 | *D2 | B10 | *D1 |
| A11 | *D0 | B11 | OV |  | A11 | *D0 | B11 | OV |
| A12 | OV | B12 | OV |  | A12 | OV | B12 | OV |
| A13 | AU | B13 | A4 |  | A13 | AU | B13 | A4 |
| A14 | A3 | B14 | OV |  | A14 | A3 | B14 | OV |
| A15 | A2 | B15 | A1 |  | A15 | A2 | B15 | A1 |
| A16 | A0 | B16 | OV |  | A16 | A0 | B16 | OV |
| A17 | *OE | B17 | OV |  | A17 | *OE | B17 | OV |
| A18 | OV | B18 | OV |  | A18 | OV | B18 | OV |
| A19 | *DVWE | B19 | OV |  | A19 | *DVWE | B19 | OV |
| A20 | OV | B20 |  |  | A20 | OV | B20 |  |
| A21 | OV | B21 | OV |  | A21 | OV | B21 | OV |
| A22 | *ALRO | B22 | OV |  | A22 | *ALRO | B22 | OV |
| A23 | *CLR | B23 | EN |  | A23 | *CLR | B23 | EN |
| A24 |  | B24 | OV |  | A24 |  | B24 | OV |
| A25 | *ASIO | B25 |  |  | A25 | *ASIO | B25 |  |

The following cable is available.

| Name | Ordering code | Length |
| :---: | :---: | :---: |
| Cable | A02B-0072-K818 | 150 mm |

Maximum wire length: 1 m
Connectors at the ends of the cable:
FAS-50-17 (A63L-0001-0209\#50)

### 6.8.2 <br> Input Signal Regulations for the Connection Unit

Input signals for the connection unit conform to a non-insulation type interface. There are two input types: Direct current input signal A and direct current input signal B.
(1) Direct current input signal A

Direct current input signal A is a signal sent to the CNC from the machine, e.g., from a button, limit switch, relay contact, or proximity switch.
(a) The contacts on the machine must meet the following requirements:
Contact capacity: 30 VDC, 16 mA or more
Leakage current between contacts when the circuit is open: 1 mA or less (Voltage: 26.4 V )
Voltage drop between contacts when the circuit is closed: 2 V or less (Current: 8.5 mA )
(Including the voltage drop through the cable)
(b) Fig. 6.8.2 (a) shows the receiver circuit for the signal.


Fig. 6.8.2 (a) Receiver circuit

Fig. 6.8.2 (b) shows the time specifications for the signal.


Fig. 6.8.2 (b) Width and delay time of the input signal
(2) Direct current input signal B

Direct current input signal B is a signal sent from the machine to the CNC and used at high speed.
(a) The contacts on the machine must meet the following requirements:
Contact capacity: 30 VDC, 16 mA or more
Leakage current between contacts when the circuit is open: 1 mA or less (Voltage: 26.4 V )
Voltage drop between contacts when the circuit is closed: 2 V or less (Current: 8.5 mA )
(Including the voltage drop through the cable)
(b)Fig. 6.8 .2 (c) shows the receiver circuit for the signal.


Fig. 6.8.2 (c) Receiver circuit

As shown in Fig. 6.4.2 (c), the common voltage for the connection unit can be selected from +24 V and 0 V by the wiring on the machine.
(a) To use the connection unit with the +24 V common voltage

Connect (A) with (B) and (C) with (D). Logical 0 when the transistor is off. Logical 1 when the transistor is on.
(b) To use with the 0 V common voltage

Connect (A) with (D) and (B) with (C). Logical 1 when the transistor is off. Logical 0 when the transistor is on.
Fig. 6.8.2. (d) shows the time specifications for the signal.


Fig. 6.8.2 (d) Width and delay time of the input signal
6. CONNECTION OF I/O UNITS TO

## 6.8 .3 <br> (1) Connection unit 1 <br> Connector Pin <br> Assignment for the Connection Unit

C01
MR-50RMA

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | DIB5 | DIB1 | DIB6 |  |  |  |  |  |  |  |  |  | DI44 | DI40 | DI45 | DI16 | DI60 |
|  | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 |  |  |  |
|  | OV | DIB7 | DIB4 |  |  |  |  | DI26 | DI37 | DI06 | DI33 | DI50 | DI62 | 51 |  |  |  |
| 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 |
| +24 | DIB2 | DIB0 | DIB3 | COMI1 |  |  |  | DI32 | DI36 | DI31 | DI35 | DI30 | DI34 | DI63 | DI61 |  | DI56 |

C02
MR-50RMA

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| DI52 | DI65 | DI64 | DI91 | DI92 | DI95 | DI41 | DI77 | DI47 | DI46 | DI73 | DI74 | DI53 | DI67 |  | DI05 | DI15 | DI25 |
| $\checkmark$ | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 |  |  |  |
|  | D193 | D194 | DI90 | DI22 | DI12 | DI02 | DI97 | DI55 | DI43 | DI42 |  | DI82 | DI81 | DI80 |  |  |  |
| 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 |
| +24 | DI07 | D117 | DI27 | DI23 | DI13 | DI03 | DI96 | DI57 | DI70 | DI71 | DI72 | DI00 | DI01 | DI10 | DI11 | DI20 | DI21 |

C03
MR-50RMA

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| DIAO | DIA1 | DIA2 | DI80 | DI81 | DI82 | DI85 | DI86 | DI66 | DI87 |  |  | DIA7 | DIA6 | DO26 | COM12 | DO27 | COM13 |
| $\checkmark$ | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 |  |  |  |
|  | DIA3 | DIA4 | DIA5 | DI83 | DO67 | DO66 | DO65 | DO64 | DO63 | DO62 | DO61 | DO60 | DO22 | COM17 |  |  |  |
| 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 |
| +24V | DI04 | DI14 | DI24 | DI84 | DI54 | DI75 | DI76 | DO77 | DO76 | DO75 | DO74 | DO73 | DO72 | D071 | DO70 | DO23 | COM18 |

C04
MR-50RMA

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| DO04 | OV | OV | OV | DO03 | COM1 | COM16 | DO57 | DO55 | DO54 | DO56 | DO12 | MOM6 |  |  | COM10 | DO24 | COM3 |
|  | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 |  |  |  |
|  | COM4 | DO01 | DO30 | DO31 | DO32 | DO33 | COM14 | DO13 | DO21 | COM9 | COM5 | COM2 | COM11 | DO07 |  |  |  |
| 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 |
| DO05 | DO10 | DO00 | DO02 | DO34 | DO35 | DO36 | DO37 | DO20 | COM7 | DO17 | DO11 | DO06 | DO25 | COM8 | DO14 | DO15 | DO16 |

C05
MR-20RMA

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| COM15 | COM15 |  |  |  |  |  |
|  | 8 | 9 | 10 | 11 | 12 | 13 |
|  | DO40 | DO41 | DO42 | DO43 | DO44 | DO45 |
| 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| DO46 | DO47 | DO50 | DO51 | DO52 | DO53 |  |

## (2) Connection unit 2

C09 MR-50RMA

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | D175 | DI71 | D176 |  |  |  |  |  |  |  |  |  | DI104 | DI100 | DI105 | DID6 | DI102 |
| - | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 |  |  |  |
| $\bigcirc$ | OV | D1177 | DI174 |  |  |  |  | DIE6 | DIF7 | DIC6 | DIF3 | D1110 | DI122 | D1111 |  |  |  |
| 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 |
| +24 | DI172 | DI170 | DI173 | COM12 |  |  |  | DIF2 | DIF6 | DIF1 | DIF5 | DIF0 | DIF4 | DI123 | DI121 |  | DI116 |

C10
MR-50RMA

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| DI112 | DI125 | DI124 | DI151 | DI152 | DI155 | DI101 | D1137 | DI107 | DI106 | DI133 | DI134 | D1113 | DI127 |  | DIC5 | DID5 | DIE5 |
|  | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 |  |  |  |
|  | DI153 | DI154 | DI150 | DIE2 | DID2 | DIC2 | DI157 | DI115 | DI103 | DI102 |  | DI142 | DI141 | DI140 |  |  |  |
| 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 |
| +24 | DIC7 | DID7 | DIE7 | DIE3 | DID3 | DIC3 | DI156 | D1117 | D1130 | DI131 | DI132 | DIC0 | DIC1 | DIDO | DID1 | DIE0 | DIE1 |

C11
MR-50RMA

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| DI160 | DI161 | DI162 | DI140 | DI141 | DI142 | DI145 | DI146 | DI126 | DI147 |  |  | DI167 | DI166 | DOA6 | COM30 | DOA7 | COM31 |
| $\square$ | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 |  |  |  |
|  | DI163 | DI164 | DI165 | DI143 | DOE7 | DOE6 | DOE5 | DOE4 | DOE3 | DOE2 | DOE1 | DOE0 | DOA2 | COM35 |  |  |  |
| 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 |
| +24 | DIC4 | DID4 | DIE4 | DI144 | DI114 | DI135 | DI136 | DOF7 | DOF6 | DOF5 | DOF4 | DOF3 | DOF2 | DOF1 | DOF1 | DOA3 | COM36 |

C12
MR-50RMA

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| DO84 | OV | OV | OV | D083 | COM19 | COM34 | DOD7 | DOD5 | DOD4 | DOD6 | DO92 | COM24 |  |  | COM28 | DOA4 | COM21 |
|  | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 |  |  |  |
|  | COM22 | DO81 | DOB0 | DOB1 | DOB2 | DOB3 | COM32 | D093 | DOA1 | COM27 | COM27 | COM20 | COM29 | DO87 |  |  |  |
| 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 |  |  |  |
| DO85 | DO90 | DO80 | D082 | DOB4 | DOB5 | DOB6 | DOB7 | DOAO | COM25 | D097 | D091 | DO86 | DOA5 | COM26 | D094 | DO95 | D096 |

## C13

MR-20RMA

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| COM33 | COM33 |  |  |  |  |  |
|  | 19 | 20 | 21 | 22 | 23 | 24 |
|  | DOC0 | DOC1 | DOC2 | DOC3 | DOC4 | DOC5 |
| 33 | 34 | 35 | 36 | 37 | 38 | 39 |
| DOC6 | DOC7 | DOD0 | DOD1 | DOD2 | DOD3 |  |

6. CONNECTION OF I/O UNITS TO

### 6.8.4

Details of the Connection between the Connection Unit and the Machine


## NOTE

The machine tool builder can determine address number n .


## NOTE

The machine tool builder can determine address number n .
6. CONNECTION OF I/O UNITS TO


## NOTE

The machine tool builder can determine address number n .
DI82 to DI80 are assigned to two connector pins each.


## NOTE

The machine tool builder can determine address number $n$.
The common voltage for DIB7 to DIB0 can be selected from +24 V and 0 V by the wiring on the machine. The above figure shows the connection when the +24 V common voltage is used. The common voltage is common to DIB7 to DIB0. It is therefore not possible to use a signal with the +24 V common voltage and another signal with the 0 V common voltage.
6. CONNECTION OF I/O UNITS TO


## NOTE

The machine tool builder can determine address number $m$.
The common voltages for DO05 to DO00 are connected in connection unit 1 (COM1).
The common voltages for DO16 to DO14 are connected in connection unit 1 (COM8).


## NOTE

The machine tool builder can determine address number m .
6. CONNECTION OF I/O UNITS TO


## NOTE

The machine tool builder can determine address number m .
The common voltages for DO21, DO20, and DO37 to DO30 are connected in connection unit 1 (COM14).
The common voltages for DO57 to DO54 are connected in connection unit 1 (COM16).


## NOTE

The machine tool builder can determine address number m .
The common voltages for DO22 and DO67 to DO60 are connected in connection unit 1 (COM17).
The common voltages for DO23 and DO77 to DO70 are connected in connection unit 1 (COM18).
6. CONNECTION OF I/O UNITS TO


## NOTE

The machine tool builder can determine address number m .
The common voltages for DO47 to DO40 and DO53 to DO50 are connected in connection unit 1 (COM15).


## NOTE

The machine tool builder can determine address number n .
6. CONNECTION OF I/O UNITS TO


## NOTE

The machine tool builder can determine address number n .


## NOTE

The machine tool builder can determine address number n .
DI142 to DI140 are assigned to two connector pins each.
6. CONNECTION OF I/O UNITS TO


## NOTE

The machine tool builder can determine address number n .
The common voltage for DI177 to DI170 can be selected from +24 V and 0 V by the wiring on the machine. The above figure shows the connection when the +24 V common voltage is used. The common voltage is common to DI177 to DI170. It is therefore not possible to use a signal with the +24 V common voltage and another signal with the 0 V common voltage.


## NOTE

The machine tool builder can determine address number $m$.
The common voltages for DO85 to DO80 are connected in connection unit 2 (COM19).
The common voltages for DO96 to DO94 are connected in connection unit 2 (COM26).
6. CONNECTION OF I/O UNITS TO


## NOTE

The machine tool builder can determine address number m .


## NOTE

The machine tool builder can determine address number m .
The common voltages for DOA1, DOA0, and DOB7 to DOB0 are connected in connection unit 2 (COM32).
The common voltages for DOD7 to DOD4 are connected in connection unit 2 (COM34).
6. CONNECTION OF I/O UNITS TO


## NOTE

The machine tool builder can determine address number m .
The common voltages for DOA2 and DOE7 to DOEO are connected in connection unit 2 (COM35).
The common voltages for DOA3 and DOF7 to DOF0 are connected in connection unit 2 (COM36).


## NOTE

The machine tool builder can determine address number m .
The common voltages for DOC7 to DOC0 and DOD3 to DODO are connected in connection unit 2 (COM33).
6. CONNECTION OF I/O UNITS TO

## 6.8 .5

External View of the
Connection Unit


## 6.9 <br> CONNECTION OF OPERATOR'S PANEL CONNECTION UNIT

The operator's panel connection unit (A16B-2200-0660, 0661) is connected to the Series $15 i / 150 i$ control unit through the FANUC I/O Link and is used for interfacing with the machine operator's panel.
The electric interface and pin layout of the connectors CM1 to CM4 are fully compatible with those for Series $15-\mathrm{A} / \mathrm{B}$. There are two units available depending on the number of I/O points.

| Specification | Input | Output |
| :---: | :---: | :---: |
| A16B-2200-0660 | 96 | 64 |
| A16B-2200-0661 | 64 | 32 |



Power supply input specification
Voltage: $24 \mathrm{VDC} \pm 10 \%$
Capacity: $500+7.3 \times \mathrm{nmA}$
n : number of inputs ON simultaneously
Use a $30 / 0.18\left(0.75 \mathrm{~mm}^{2}\right)$ wire or thicker for the power cable.
Grounding of the operator's panel connection unit


### 6.9.1 <br> Input Signal Regulations for the Operator's Panel Connection Unit

Input signals for the operator's panel connection unit conform to a non-insulation type interface. The input type is direct current input signal A.
(1) Direct current input signal A

Direct current input signal A is a signal sent to the CNC from the machine, e.g., from a button, limit switch, relay contact, or proximity switch.
(a) The contacts on the machine must meet the following requirements:
Contact capacity: 30 VDC, 16 mA or more
Leakage current between contacts when the circuit is open: 1 mA or less (Voltage: 26.4 V )
Voltage drop between contacts when the circuit is closed: 2 V or
less (Current: 8.5 mA )
(Including the voltage drop through the cable)
(b) Fig. 6.9.1 (a) shows the receiver circuit for the signal.


Fig. 6.9.1 (a) Receiver circuit

Fig. 6.9.1 (b) shows the time specifications for the signal.


Fig. 6.9.1 (b) Width and delay time of the input signal

### 6.9.2 Output Signal Regulations for the Operator's Panel Connection Unit

The output signals from the operator's panel connection unit are used for driving lamps and light emitting diodes on the machine operator's panel. An NPN transistor is used as a driver. The output type is direct current output signal B.
(1) Direct current output signal B

The direct current output signal B is used for driving relays and light emitting diodes for indication on the machine. A transistor is used as a driver.
(a) Ratings of the output transistor
(i) Maximum load current when output is ON: 200 mA (including $\underline{\text { momentary load) }}$
(ii) Saturation voltage when output is $\mathrm{ON}: 1.6 \mathrm{~V}$ (maximum)/1.0 V (normal) (when load current is 200 mA )
The maximum load current is limited to 1.3 A per common wire (Note).

## NOTE

Although a maximum load current of 200 mA is permitted when the output is ON, the load current allowed to flow through a common wire is limited to 1.3 A . Therefore, the load current of the output transistor must satisfy the following condition:
$(\mathrm{N} \times \mathrm{I}) / \mathrm{M}<1.3 \mathrm{~A}$
Where $\mathrm{N}=$ Number of DO points that can be turned on simultaneously
$\mathrm{I}=$ Load current that flows when output is ON
$\mathrm{M}=$ Number of common wires (one or two)
Example: When there are 64 DO points that can be turned on simultaneously and two common wires are used, the rated load current is 40 mA , calculated as shown below:
$(64 \times \mathrm{I}) / 2<1.3 \mathrm{~A}$
I $<40 \mathrm{~mA}$
(iii) Withstand voltage when the output is off: $24 \mathrm{~V}+20 \%$ or less including an instantaneous value
(iv) Leakage current when the output is off: $100 \mu \mathrm{~A}$ or less
6. CONNECTION OF I/O UNITS TO
(b) Output circuit

(c) When an inductive load such as a relay is connected to the machine, mount a spark killer as near the load as possible (20 cm or less). When a capacitive load is connected to the machine, insert a serial resistor for limiting the current so that the rated current and voltage are ensured even for an instantaneous value.
(d) When the lamp is turned OFF, its resistance becomes extremely low. So, when the lamp is turned on directly by transistor output, surge current may flow and damage the transistor. For this reason, add a protective circuit as shown below.


### 6.9.3 <br> Connector Layout for Sink Output Operator's Panel Connection Unit



## NOTE

Address No. n can be decided by machine tool builders.
6. CONNECTION OF I/O UNITS TO


## NOTE

Address No. n can be decided by machine tool builders.
6.9.4

Details of the
Connection between the Sink Output
Operator's Panel
Connection Unit and the Machine


## NOTE

The machine tool builder can determine address number p .
6. CONNECTION OF I/O UNITS TO


## NOTE

The machine tool builder can determine address number $p$.


## NOTE

The machine tool builder can determine address number p .
6. CONNECTION OF I/O UNITS TO


## NOTE

The machine tool builder can determine address number p .


## NOTE (*)

The machine tool builder can determine address number q .
The common voltages for DO57 to DO00 are connected in the operator's panel connection unit (COM3).
+5 V output for supplying the power to the light emitting diode on the operator's panel. The output voltage is +5 VDC and the current is 300 mA . The power capacity is not enough to drive the lamp. A separate regulated power supply is necessary for the lamp. The load capacity of the output driver refer to 6.9.2.
6. CONNECTION OF I/O UNITS TO


NOTE
The machine tool builder can determine address number q . The common voltages for DO57 to DO00 are connected in the operator's panel connection unit (COM3).


## NOTE

The machine tool builder can determine address number q . The common voltages for DO67 to DO70 are connected in the operator's panel connection unit (COM4).
6. CONNECTION OF I/O UNITS TO

### 6.9.5

External View of Sink Output Operator's Panel Connection Unit


Fig. 6.9.5 External view of operator's panel connection unit

The following LEDs and fuses are mounted on this printed circuit board.
[LEDs]
DB1 (GREEN PILOT): Lights when this PCB is ON.
DB2 (RED ALARM) : Lights when an error occurs on this PCB or CNC.
[Fuses]
FU1 (3.2 A): For external 24 V input
FU2 ( 5.0 A ): For +5 V power supply used on this PCB
Ordering specification A02B-0163-K111 (FU1/FU2 2-fuse set)

### 6.10 CONNECTION OF SOURCE OUTPUT OPERATOR'S PANEL CONNECTION UNIT

The source output operator's panel connection unit (A16B-2202-0730, or -0731 ) is connected to Series $15 i / 150 i$ control units by the FANUC I/O Link, and functions as the interface with the machine tool operator's panel.
Output from this connection unit is source-type. Input is sink-type ( 24 V common). However, some connection units have DI that can be switched to source-type input ( 0 V common).
Two connection units are available according to the number of I/Os.

| Specification | Input | Output |
| :---: | :---: | :---: |
| A16B-2202-0730 | 96 | 64 |
| A16B-2202-0731 | 64 | 32 |

Source output operator's panel connection unit
A16B-2202-0730,0731


Power supply input specification
Voltage: 24 VDC $\pm 10 \%$
Capacity: $500+7.3 \times \mathrm{n}(\mathrm{mA})$
n : number of inputs ON simultaneously
Use a $30 / 0.18\left(0.75 \mathrm{~mm}^{2}\right)$ wire or thicker for the power cable.
Grounding of the operator's panel connection unit

6.10 .1

Source Output Operator's Panel Connection Unit Input Signal Standard

The input signal to the source output operator's panel connection unit is input over a non-insulated interface, and is called "DC input signal A."
(1) DC input signal A

DC input signal $A$ is sent to the NC from the machine tool by pushbuttons, limit switches, relay contacts and proximity switches. Most receivers are sink types. However, some inputs can be switched to source type. (Use of sink-type receivers is required in safety standards.)
(a) Satisfy the machine-side contact conditions:

Contact capacitance: $30 \mathrm{VDC}, 16 \mathrm{~mA}$ min.
Leak current between contacts in open circuit:
1 mA min. (voltage 26.4 V )
Voltage drop between contacts in closed circuit:
2 V max. (including cable voltage drop)
(b) Input receiver circuit


Fig. 6.10.1 (a) Sink-type receiver circuit
(c) Circuit of common switchable input receiver


Fig. 6.10.1 (b) Common switchable receiver circuit

Figure 6.10.1 (c) below shows the signal timing standard.


Fig. 6.10.1 (c) Width and delay time of input signal

Source-type input signals are logic " 1 " when the contact is open, and logic " 0 " when closed.

## CAUTION

If the output signal line falls to ground when the input signal is source-type ( 0 V common), the state is the same when the contact is closed. For this reason, source-type input signals are not recommended for ensuring safety.
By CE-marking compliancy, sink-type (+24 V common) input signals are required.

### 6.10 .2 Output Signal Standard for Source Output Operator's Panel Connection Unit

The output signal of the source output operator's panel connection unit is for driving lamps and LEDs on the machine tool operator's panel. A MOS FET is used as the driver.
(1) Direct current output signal

The DC output signal is used for driving relays and light emitting diodes for indication on the machine. A transistor is used as the driver.
(a) Output signal standard is as follows:

Maximum load current when output is ON :
200 mA (including momentary load)
Saturation voltage when output is $\mathrm{ON}: 1.0 \mathrm{~V}$ max.
Withstand voltage: $24 \mathrm{~V}+20 \%$ (including momentary load)
Leaking current when the output is OFF: $100 \mu \mathrm{~A}$
Use the following power supply as the external power supply of the output signal:

Power voltage: $\quad+24 \mathrm{~V} \pm 10 \%$
Power current: Sum of maximum load current including momentary current per board +100 mA min.
Power ON timing: Same time as or before control unit
Power OFF timing: Same time as or after control unit

## CAUTION

Connect the power supply that meets these specifications to power terminals DOCOM and 0 V for the output signals. The maximum current that is allowed to pass to each DOCOM terminal pin is 2.0 A, and care must be paid to prevent the sum of the load current from exceeding the current that is allowed to pass via the DOCOM terminal.
(b) Output signal driver

Eight signals are output from each of the output signal driver elements used on this operator's panel connection unit.
The current of each output signal is monitored in the driver element. When overcurrent is detected, output of that signal is turned OFF. Once signal output is turned OFF due to overcurrent, signal output is restored to ON as turning signal output OFF eliminates the overcurrent state. For this reason, output is repeatedly switched ON and OFF when the output signal falls to ground or when it is in an overcurrent state. This also happens when a large surge current load is connected.
The driver element also has an overheat detection circuit. When the overcurrent state is continuous due to outputs having fallen to ground and the temperature inside the element rises, output of all eight signals is turned OFF and this OFF state is held. Output is restored for each individual signal by temporarily setting output logically OFF after the temperature inside the element has dropped. Signal output can also be restored by powering OFF the system. When the overheat detection circuit is activated on this printed circuit board, the red LEDs mounted next to the driver element light so that you can confirm activation of the overheat detection circuit. (See Note.) When the overheat detection circuit is activated, the CNC is notified of an alarm as a system alarm. (You can also disable notification to the CNC system of this alarm by closing (shorting) the short bar of setting pin CP1 mounted on this printed circuit board. When notification is disabled, this alarm is not treated as a system alarm.)
Correspondence between red LED and DO output signal

| Red LED Name | DO Output Signal | Remarks |
| :---: | :---: | :---: |
| DAL1 | $\mathrm{Y} \mathrm{q}+0.0$ to $\mathrm{Y} \mathrm{q}+0.7$ |  |
| DAL2 | $\mathrm{Y} \mathrm{q}+1.0$ to $\mathrm{Y} \mathrm{q}+1.7$ |  |
| DAL3 | $\mathrm{Y} \mathrm{q}+2.0$ to $\mathrm{Y} \mathrm{q}+2.7$ |  |
| DAL4 | $\mathrm{Y} \mathrm{q}+3.0$ to $\mathrm{Y} \mathrm{q}+3.7$ |  |
| DAL5 | $\mathrm{Y} \mathrm{q}+4.0$ to $\mathrm{Y} \mathrm{q}+4.7$ |  |
| DAL6 | $\mathrm{Y} \mathrm{q}+5.0$ to $\mathrm{Y} \mathrm{q}+5.7$ |  |
| DAL7 | $\mathrm{Y} \mathrm{q}+6.0$ to $\mathrm{Y} \mathrm{q}+6.7$ |  |
| DAL8 | $\mathrm{Y} \mathrm{q}+7.0$ to $\mathrm{Y} \mathrm{q}+7.7$ |  |

## NOTE

Lighting of the red LEDs and transfer alarm to CNC function are supported on printed circuit board 03B onwards.

If the CNC diagnoses that output does not turn ON even though it is ON, a probable cause is that overloading of that output or other output in the same element is causing the eight outputs of that element to stay OFF. If this is the case, power the system OFF, and remove the cause of the overload.

Driver device internal block diagram

(c) Output signal precautions

The figure below shows the precautions when connecting output signals. Parallel connection of output terminals shown like that shown in this figure is prohibited.


## CAUTION

If the output signal falls to ground when the output signal is sink-type ( 0 V common), the output signal stays ON. For this reason, sink-type output signals are not recommended for ensuring safety.
By CE-marking compliancy, source-type (+24 V common) output signals are required.

### 6.10.3 <br> ALARM LEDs on Source Output Operator's Panel Connection Unit



ALARM out: Normal state
ALARM lit: Alarm state (communications with CNC suspended)
The source output operator's manual connection unit is provided with a function for detecting and outputting an alarm for excessive current flowing to the output driver device caused by DO falling to ground. When the above alarm is detected, the CNC outputs a system alarm, and the LED corresponding to the DO where the alarm occurred lights. See the following table for details on which LED lights.
You can also disable output of the output driver alarm as a CNC system alarm by the on-board setting pin "CP1".

DAL1 out: Normal state lit: Error occurred on DO outputs $\mathrm{Yq}+0.0$ to $\mathrm{Yq}+0.7$
DAL2 out: Normal state
lit: Error occurred on DO outputs $\mathrm{Yq}+1.0$ to $\mathrm{Yq}+1.7$
DAL3 out: Normal state
lit: Error occurred on DO outputs Yq+2.0 to Yq+2.7
DAL4 out: Normal state
lit: Error occurred on DO outputs $\mathrm{Yq}+3.0$ to $\mathrm{Yq}+3.7$
DAL5 out: Normal state
lit: Error occurred on DO outputs Yq+4.0 to Yq+4.7
DAL6 out: Normal state
lit: Error occurred on DO outputs Yq+5.0 to Yq+5.7
DAL7 out: Normal state
lit: Error occurred on DO outputs Yq+6.0 to Yq+6.7
DAL8 out: Normal state
lit: Error occurred on DO outputs Yq+7.0 to Yq+7.7

System alarms generated by the above alarms are as follows.
For details, refer to "FANUC Series 15i/150i-MODEL A Maintenance Manual (B-63325EN)."
"NMI SLC aa(bb)" Example "NMI SLC 03(41)" (aa: XXXXXX11

Binary bits 0 and 1 are " 1 ". Other bits are not fixed.) (bb: X1XXXXX1

Binary bit 6 is " 1 ". Bits other than bit 0 to 4 , and 6 are not fixed.)
The value obtained by subtracting " 1 " from the value indicated by bits 0 to 4 is the I/O group number where the error occurred.
The above example shows I/O alarms that have occurred in group O .
Setting pin "CP1" settings are as follows:
Open: CNC is not notified of alarm.
Short: CNC is notified of alarm.

### 6.10.4 <br> Connector Pin <br> Assignment Addresses of Source Output <br> Operator's Panel Connection Unit

CM51


CM52

| 1 | DI60 |  |  | 33 | 0 V |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 2 | DI63 | 19 |  | 34 | DI62 |
| 3 | DI66 |  | D164 | 35 | DI65 |
| 4 | DI71 | 20 |  | 36 | DI70 |
| 5 | DI74 | 21 | DI67 | 37 | DI73 |
| 6 | DI77 | 22 | DI72 | 38 | DI76 |
| 7 | DI82 | 23 | DI75 | 39 | DI81 |
| 8 | DI85 | 24 | DI80 | 40 | DI84 |
| 9 | DI87 | 25 | DI83 | 41 | DI86 |
| 10 | DI92 | 26 | DI90 | 42 | D191 |
| 11 | D195 | 27 | D193 | 43 | D194 |
| 12 | DIA0 | 28 | DI96 | 44 | DI97 |
| 13 | DIA3 | 29 | DIA1 | 45 | DIA2 |
| 14 | DIA6 | 30 | DIA4 | 46 | DIA5 |
| 15 | DIB1 | 31 | DIA7 | 47 | DIB0 |
| 16 | DIB4 | 32 | DIB2 | 48 | DIB3 |
| 17 | DIB6 |  |  | 49 | DIB5 |
| 18 | +24V |  |  | 50 | DIB7 |

CMB3

| 1 | DO00 |  |  | 33 | 0 V |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 2 | DO03 |  |  | 34 | DO02 |
| 3 | DO06 | 19 | DO01 | 35 | DO05 |
| 4 | DO11 | 20 | DO04 | 36 | DO10 |
| 5 | DO14 | 21 | DO07 | 37 | D013 |
| 6 | DO17 | 22 | DO12 | 38 | DO16 |
| 7 | DO22 | 23 | DO15 | 39 | DO21 |
| 8 | DO25 | 24 | DO20 | 40 | DO24 |
| 9 | DO27 | 25 | DO23 | 41 | DO26 |
| 10 | DO32 | 26 | DO30 | 42 | DO31 |
| 11 | DO35 | 27 | DO33 | 43 | DO34 |
| 12 | DO40 | 28 | DO36 | 44 | DO37 |
| 13 | DO43 | 29 | DO41 | 45 | DO42 |
| 14 | DO46 | 30 | DO44 | 46 | DO45 |
| 15 | DO51 | 31 | DO47 | 47 | D050 |
| 16 | DO54 | 32 | DO52 | 48 | DO53 |
| 17 | DOCOM |  |  | 49 | DO55 |
| 18 | DICMN2 |  |  | 50 | DOCOM |

CMB4

| 1 | DO61 | 8 | D062 | 14 | DO60 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 2 | DO64 |  |  | 15 | DO63 |
| 3 | DO67 | 9 | DO65 | 16 | D066 |
| 4 | DO72 | 10 | DO70 | 17 | D071 |
| 5 | DO75 | 11 | D073 | 18 | D074 |
| 6 | DO56 | 12 | D076 | 19 | D077 |
| 7 | 0 V | 13 | DO57 | 20 | DOCOM |

## NOTE

Connector CNB4 is not mounted on this PCB when operator's panel connection unit (DI/DO $64 / 32$ ) is selected.

DICMN1, DICMN2 : DI (input) common switching terminals. Normally, short with 0 V before use.
$+24 \mathrm{~V}$

## DOCOM

: +24 VDC (output) terminal. Do not connect to inputs other than DI signal inputs on the operator's panel connection unit.
(b) About I/O addresses

The following table shows the PMC addresses assigned to the source output operator's panel connection unit according to the number of I/Os (DI/DO 96/64, 64/32).
[DI addresses]


- The machine tool builder can determine address number p .
- The following 20 address points are common switchable DIs.

$$
\begin{aligned}
& X p+0.0, X p+0.1, X p+0.2, X p+0.7 \\
& X p+1.0, X p+1.1, X p+1.2, X p+1.7 \\
& X p+4.0 \text { to } X p+4.7 \\
& X p+11.4, X p+11.5, X p+11.7
\end{aligned}
$$

[DO addresses]

| DO 64 points | $\left.\begin{array}{\|lll}\text { DO 32 } \\ \text { points }\end{array} \mathrm{Y}\right) \mathrm{q}+1$ | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | D007 | D006 | D005 | D004 | D003 | D002 | D001 | D000 |
|  |  | D017 | D016 | D015 | D014 | D013 | D012 | D011 | D010 |
|  |  | D027 | D026 | D025 | D024 | D023 | D022 | D021 | D020 |
|  |  | D037 | D036 | D035 | D034 | D033 | D032 | D031 | D030 |
|  |  | D047 | D046 | D045 | D044 | D043 | D042 | D041 | D040 |
|  |  | D057 | D056 | D055 | D054 | D053 | D052 | D051 | D050 |
|  |  | D067 | D066 | D065 | D064 | D063 | D062 | D061 | D060 |
|  |  | D077 | D076 | D075 | D074 | D073 | D072 | D071 | D070 |

The machine tool builder can determine address number p .

For details on address assignment, refer to the "FANUC PMC-MODEL N/NA PROGRAMMING MANUAL (Ladder Language) (B-61013E)" or "FANUC PMC-MODEL NB PROGRAMMING MANUAL (Ladder Language) (B-61863E)."

### 6.10 .5

Details of Machine Side
Connections of Source
Output Operator's
Panel Connection Unit


## NOTE

The machine tool builder can determine address number p .
6. CONNECTION OF I/O UNITS TO


## NOTE

The machine tool builder can determine address number $p$.


## NOTE

The machine tool builder can determine address number p .
6. CONNECTION OF I/O UNITS TO


6. CONNECTION OF I/O UNITS TO


## NOTE

The machine tool builder can determine address number q .

Details of machine side connections of source output operator's panel connection unit (DI common switchable DI)


## NOTE

In this connection example, common is 24 V and input is sink-type input.
The machine tool builder can determine address number $p$.
6. CONNECTION OF I/O UNITS TO

### 6.10.6

## External Dimensions of

Source Output
Operator's Panel
Connection Unit


Fig. 6.10.6 External dimensions of source output operator's panel connection unit

The following LEDs, fuses and dials are mounted on this printed circuit board.
[LEDs]
DB1 (GREEN PILOT): Lights when this PCB is ON.
DB2 (RED ALARM): Lights when an error occurs on this PCB or CNC.
DAL1 to DAL8: See Subsec. 6.10.3.
[Fuses]
FU1 (3.2 A): For external 24 V input
FU2 (5.0 A): For +5 V power supply used on this PCB
Ordering specification A02B-0163-K111 (FU1/FU2 2-fuse set)
[Setup pin]
CP1: Selects whether or not to output DO output errors to the NC as a system error. (See Subsec. 6.10.3.)

### 6.11 <br> ADDRESS-FIXED SIGNALS

The addresses of the emergency stop signal (*ESP), skip signal (SKIP1), and measured position reached signals (AE1 and AE2), which are input from the machine, are fixed.

| Signal |  | Address |
| :--- | :---: | :---: |
| Emergency stop signal | *ESP | $\times 6.4$ |
| Skip signal | SKIP 1 | $\times 11.6$ |
| Measured position reached <br> signal | AE1 | $\times 8.3$ |
|  | AE2 | $\times 8.4$ |

## NOTE

1 If the skip signal or measured position reached signal is not provided as an option, another signal can be assigned.
2 When a connection unit is used, connect the connection unit by assigning signals starting from address X 0.0 . The skip signal is thereby received at high speed because the delay time for the receiver becomes short (the input type becomes direct current input signal B).

### 6.12 CONNECTION TO THE MACHINE OPERATOR'S PANEL

6.12 .1 Overview

Machine operator's panel is connected with $i$ series CNC by I/O Link, which is composed by some following operator's panels.

Main panel A/A1
This operator's panel incorporated with MDI with full alphabet keys. And that has 55 keys. All key tops are detachable. MTB can customize keys and make his original key layout easily.
Main panel B/B1
The part of keyboard of machine operation in Main panel A.
Sub panel A
This operator's panel has power ON/OFF, emergency stop, program protect, and two rotary switches.
Sub panel B
This operator's panel has emergency stop, program protect, and rotary switch.
Sub panel C
This operator's panel has power ON/OFF, emergency stop, program protect, rotary switch, and MPG.
Sub panel B1
This operator's panel has emergency stop, program protect, two rotary switches.
Sub panel C1
This operator's panel has emergency stop, program protect, two rotary switches, and MPG.


Unit=mm

6. CONNECTION OF I/O UNITS TO

### 6.12 .2

## Total Connection

## Diagram



## NOTE

1 CNC is only possible to use the MPG interface on this operators panel. If CNC uses some I/O unit having MPG interface (ex. Dispersion type I/O module for panel) and this operator's panel, the MPG interface nearest the CNC is only available on the I/O Link connection.
2 MPG cannot be connected with either of JA3 and JA58.
3 Connect FANUC standard MDI unit in case of Main panel B/B1.
4 When using a CNC-dedicated LCD unit, connect the MDI unit to the LCD unit. When not using the CNC-dedicated LCD unit, connect the MDI unit to the main CPU board.

### 6.12.3 <br> Each Connections

### 6.12.3.1 <br> Pin assignment

CA64 (Power source)

| 3 |  | 2 | 0 V | 1 | +24 V |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 6 |  | 5 | 0 V | 4 | +24 V |

Recommended connector for cable:
Housing : AMP 1-178288-3 (3 pins type)
Contact : AMP 1-175218-5
CM67(ON/OFF,Program protect,ESP)

| A01 | EON | B01 | EOFF |
| :---: | :---: | :---: | :---: |
| A02 | COM1 | B02 | COM2 |
| A03 | Xm+1.4 | B03 | KEYCOM |
| A04 | *ESP | B04 | ESPCM1 |
| A05 | TR1 | B05 | TR2 |

Recommended connector for cable:
Housing : AMP 178289-5
Contact : AMP 1-175218-5
CM65 (General-purpose DI)

| A01 |  | B01 |  |
| :---: | :---: | :---: | :---: |
| A02 |  | B02 | Xm +0.5 |
| A03 | Xm+0.1 | B03 | Xm+0.3 |
| A04 | $+24 V$ | B04 | Xm+0.4 |
| A05 | Xm+0.2 | B05 | Xm+0.0 |

Recommended connector for cable:
Hirose electric : HIF3BA-10D-2.54R
CM68 (General-purpose DI/DO

| A01 | +24 V | B01 | Xm+1.5 |
| :---: | :---: | :---: | :---: |
| A02 | $\mathrm{Xm}+1.6$ | B02 | Xm+1.7 |
| A03 | Xm+2.0 | B03 | Xm+2.1 |
| A04 | Xm+2.2 | B04 | Xm+2.3 |
| A05 | Xm+2.4 | B05 | Xm+2.5 |
| A06 | TR3 | B06 | TR4 |
| A07 | TR5 | B07 | TR6 |
| A08 | Yn+5.3 | B08 | Yn+5.7 |
| A09 | Yn+6.3 | B09 | Yn+6.7 |
| A10 | DOCOM | B10 | $0 V$ |

Recommended connector for cable:
Housing : AMP 178289-8
Contact : AMP 1-175218-5

CA65 (Power magnetic cabinet)

| A01 | EON | B01 | EOFF |
| :---: | :---: | :---: | :---: |
| A02 | COM1 | B02 | COM2 |
| A03 | *ESP | B03 | ESPCM1 |
| A04 | TR1 | B04 | TR2 |
| A05 | TR3 | B05 | TR4 |
| A06 | TR5 | B06 | TR6 |
| A07 | TR7 | B07 | TR8 |
| A08 |  | B08 |  |
| A09 |  | B09 |  |
| A10 |  | B10 |  |

Recommended connector for cable: Hirose electric : HIF3BA-20D-2.54R

CM66 (General-purpose DI)

| A01 |  | B01 |  |
| :---: | :---: | :---: | :---: |
| A02 |  | B02 | Xm+1.3 |
| A03 | Xm+0.7 | B03 | Xm+1.1 |
| A04 | $+24 V$ | B04 | Xm+1.2 |
| A05 | Xm+1.0 | B05 | Xm+0.6 |

Recommended connector for cable:
Hirose electric : HIF3BA-10D-2.54R
CM69 (General-purpose DI/DO)

| A01 | +24V | B01 | Xm+2.6 |
| :---: | :---: | :---: | :---: |
| A02 | Xm+2.7 | B02 | Xm+3.0 |
| A03 | Xm+3.1 | B03 | Xm+3.2 |
| A04 | Xm+3.3 | B04 | Xm+3.4 |
| A05 | Xm+3.5 | B05 | Xm+3.6 |
| A06 | Xm+3.7 | B06 | DICOM |
| A07 | TR7 | B07 | TR8 |
| A08 | Yn+7.3 | B08 | $Y \mathrm{n}+7.4$ |
| A09 | Yn+7.5 | B09 | Yn+7.6 |
| A10 | DOCOM | B10 | OV |

Recommended connector for cable:
Housing : AMP 178289-8
Contact : AMP 1-175218-5
6. CONNECTION OF I/O UNITS TO

## NOTE

1 Input/output Pins shaded by $\square$ are in pairs. Only one in each pair is usable.
2 Pins shaded by are those for forwarding signals. Pins with the same name are connected directly to one another.

JA3 (Manual pulse generator)

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

JA58 (Pendant type manual pulse generator)

| 1 | HA1 | 11 | Xm+1.5 |
| :---: | :---: | :---: | :---: |
| 2 | HB1 | 12 | 0 V |
| 3 | $\mathrm{Xm}+2.2$ | 13 | $\mathrm{Xm}+1.6$ |
| 4 | $\mathrm{Xm}+2.3$ | 14 | 0 V |
| 5 | $\mathrm{Xm}+2.4$ | 15 | $\mathrm{Xm}+1.7$ |
| 6 | $\mathrm{Xm}+2.5$ | 16 | 0 V |
| 7 | $\mathrm{Yn}+5.3$ | 17 | $\mathrm{Xm}+2.0$ |
| 8 | $\mathrm{Xm}+2.1$ | 18 | +5 V |
| 9 | +5 V | 19 | +24 V |
| 10 | +24 V | 20 | +5 V |

Recommended connector for cable of JA3 and JA58
When the depth of the operator's panel is 60 mm min.
Recommended connector for cable:
Hirose electric: FI30-20S (Connector) FI-20-CV7 (Case)
When the depth of the operator's panel is 80 mm min.
Recommended connector for cable of JA3:
Hirose electric: FI40B-2015S (Connector)
FI-20-CV (Case)

Recommended connector for cable of JA58:
Honda: PCR-E20FA (Connector) PCR-V20LA (Case)
Hirose electric: FI30-20S (Connector)
FI-20-CV2 (Case)

Fujitsu: FCN-247JO20-G/E (Connector) FCN-240C020-Y/S (Case)
Molex: 52622-2011 (Connector) 52624-2015 (Case)

### 6.12.3.2 Power supply connection

To the connector CA64 (IN) shown in the figure below, connect the required power for operating the operator's panel and the power for general-purpose DI. For easier power supply branching, the power supplied from CA64 (IN) is directly output to CA64 (OUT). When power supply branching is required, use CA64 (OUT).


## NOTE

1 Both connectors CA64(IN) and CA64(OUT) are same specification. And there is not indication of (IN) and (OUT) on the PCB.
2 Power supply for the operator's panel must not turn off at operation. If +24 V is turned off at operation, CNC happen to get system alarm(Communication alarm between CNC and operator's panel). +24 V for operator's panel must be supplied before or same time CNC power on.
6. CONNECTION OF I/O UNITS TO

### 6.12.3.3 <br> MDI connection



See Subsections 7.1.2 and 7.1.3.
Recommended connector for cable
Main CPU
JA2 : HIROSE Electric
FI30-20S(Connector)
FI-20-CV2(Case)

```
LCD unit
CA55 : Japan Aviation Electronics
LY10-DC20 (Housing) LY10-C2-3 (Contact)
```

Recommended connector for cable of CNK1: HIROSE Electric FI30-20S (Connector) FI-20-CV7 (Case)


Recommended cable specification: A02B-0236-K812 ( 25 cm )
A02B-0236-K813 ( 45 cm )
Recommended wire specification: A66L-0001-0284\#10P (\#AWG28 $\times 10$ pairs)

## NOTE

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

### 6.12.3.4 I/O Link connection

```
Control unit preceding slave unit Main panel A/B/A1/B1
```



```
Recommended connector for cable of JD1A and JD1B on Main panel A/B/A1/B1
When the depth of the operator's panel is 60 mm min.
Recommended connector for cable:
Hirose electric: FI30-20S (Connector)
FI-20-CV7 (Case)
When the depth of the operator's panel is 80 mm min.
Recommended connector for cable:
Honda: PCR-E20FA (Connector) PCR-V20LA (Case)
Hirose electric: FI30-20S (Connector)
FI-20-CV2 (Case)
Fujitsu: FCN-247J020-G/E (Connector)
FCN-240C020-Y/S (Case)
Molex: 52622-2011 (Connector) 52624-2015 (Case)
```

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


Recommended wire material:
A66L-0001-0284\#10P(AWG28 $\times 10$ pairs)
6. CONNECTION OF I/O UNITS TO

### 6.12.3.5 <br> Emergency stop signal connection

A signal generated by the emergency stop switch on the machine operators panel can be sent to the power magnetic cabinet. (This signal cannot be sent to the FANUC I/O Link.)
When MTB uses the Sub panel A/B/B1/C/C1, wiring to the emergency stop switch is contained in the Sub panel $\mathrm{A} / \mathrm{B} / \mathrm{B} 1 / \mathrm{C} / \mathrm{C} 1$.


### 6.12.3.6 <br> Power ON/OFF control signal connection

Signal generated by the power ON/OFF control switches on the machine operators panel can be sent to the power magnetic cabinet. (This signal cannot be sent to the FANUC I/O Link.)
When MTB uses the Sub panel A/C/C1, wiring to the ON/OFF control switches are contained in the Sub panel A/C/C1.


### 6.12.3.7 <br> DI (input signal) connection


6. CONNECTION OF I/O UNITS TO

## NOTE

Connection of $X m+0.0$ to $X m+0.7, X m+1.0$ to $X m+1.4$ shows when the Sub panel $A$ is used.


## NOTE

$1 \mathrm{Xm}+3.0-3.7$ have a common line that is possible to select the source/sink type. If DICOM (CM69-B06pin) is connected to +24 V , the DI signal logic is negative. But in this connection, if the DI signal wires happen to drop the ground level, the status of the DI signal is same as the DI signal is "ON". From the safety viewpoint, DICOM should be connected OV.
2 From the safety viewpoint, Emergency Stop signal must be assigned on the address $\mathrm{Xm}+0.0-0.7$ or $\mathrm{Xm}+1.0-1.7$ or $\mathrm{Xm}+2.0-2.7$. As refer to the 6.12.5 DI/DO mapping, assign the Emergency stop DI.
$3 X m+0.0-0.7, X m+1.0-1.7$ and $X m+2.0-0.7$ common lines are fixed. So, if these DI pins in this address open, the status of these one stay " 0 ". And in case of $X m+3.0-3.7$ which have a selectable common line, if the DICOM(CM69-B06pin) is connected to 0 V and these DI pins open, the status of these one stay " 0 ". And if the DICOM are connected to +24 V and these DI pins open, the status of these one stay " 1 ". And if the DICOM is not connected to 0 V or +24 V and these DI pins open, the status of these one don't care.
6. CONNECTION OF I/O UNITS TO

### 6.12.3.8 <br> DO (output signal) connection



### 6.12.3.9

Manual pulse generator connection
(1) When only the manual pulse generator.

Example of the 3 Manual pulse Generator connection is as follows. $i$ series CNC is only possible to use the MPG interface. If $i$ series CNC uses some I/O unit having MPG interface (ex. Dispersion type I/O module for panel) and this operator's panel, the MPG interface nearest the CNC is only available on the I/O Link connection.

Main panel A, B, A1, B1



When the depth of the operator's panel is 80 mm min.
Recommended wire material : A66L-0001-0286(\#20AWG $\times 6+\# 24 A W G \times 3$ pairs)
Recommended connector: A02B-0120-K303(Including below connector and case)
(Connector : HIROSE FI30-20S Soldering type)
(Case : HIROSE FI-20-CV7)
Recommended cable : A02B-0120-K841(7m) (MPG 3 units)
A02B-0120-K848(7m) (MPG 2 units)
A02B-0120-K847(7m) (MPG 1 unit)
(These cables don't include the wiring part in the figure.)
When the depth of the operators panel is 60 mm min.
Recommended wire material : A66L-0001-0284\#10P(\#28AWG $\times$ 10pairs)
Recommended connector : A02B-0236-K302(Including below connector and case)
(Connector: HIROSE FI30-20S Stand wire press-mount type)
(Case : HIROSE FI-20-CV2)

## NOTE

Calculate the MPG cable max. Length as refer to the following calculation.

MPG needs a 5VDC power supply and the voltage must be less than 0.2 V dropping.
(the 0.2 V dropping includes the resistance in the cable.)
$0.2 \geq \frac{0.1 \times R \times 2 L}{m}$

Because
$L \leq \frac{m}{R}$
Example: In case of cable A66L-0001-0286
It has 3 pairs signal wires and 6 power line wires (20/0.18, $0.0394 \Omega / \mathrm{m}$ ).
If the cable is used and each 3 wires are used for 0 V and 5 V power line, then
max. cable length is as follows.
$L \leq \frac{3}{0.0394}=76.75(\mathrm{~m})$
The answer is 76.75 m , if MPG unit is 1 .
(But FANUC decide any cable must be less than 50m.)
The answer is 38.37 m , if MPG units are 2 .
The answer is 25.58 m , if MPG units are 3 .

And In case of cable A66L-0001-0284\#10P
The answer is 12.88 m , if MPG units are 1 .
The answer is 6.44 m , if MPG units are 2.
The answer is 4.29 m , if MPG units are 3 .

If the customer will use a some other vender's MPG ,not FANUC's MPG, the electrical condition must be as follows.

HAn, HBn signals form MPG and CNC internal pulse are as follows. A cycle of the HA/HB pulse $T_{1}$ must be more than $200 \mu \mathrm{sec}$ and $\mathrm{T}_{1} / 4$ must be more than $50 \mu \mathrm{sec}$.


And the receiver circuit is as follows.

$\mathrm{V}_{\mathrm{IH}}, \mathrm{V}_{\mathrm{IL}}$ level at Connector pin
If Vin low to high, $\mathrm{V}_{\text {IH }}$ must be higher than 3.7 V .
If Vin high to low, $\mathrm{V}_{\text {IL }}$ must be lower than 1.5 V .
(2) When a pendant-type manual pulse generator

When a pendant-type manual pulse generator with including axis selection and multiplier setting functions is connected.


## NOTE

1 When Xm+1.5-Xm+2.5 of connector JA58 are allocated as the Dls used for the axis selection and multiplier setting, $\mathrm{Xm}+1.5-\mathrm{Xm}+2.5$ of connector CM68 cannot be used.
2 One DO is available for the manual pulse generator side at the user's direction. When this is used, $\mathrm{Yn}+5.3$ of CM68 cannot be used, as in the case for Dls above.
6. CONNECTION OF I/O UNITS TO

### 6.12.3.10

Connector (on the cable side) specifications.

| Connector | Maker Specification |  | Order specification |
| :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { JD1A, JD1B, } \\ & \text { JA3, JA58 } \\ & \text { (Operator's panel depth }=60 \mathrm{~mm} \text { min.) } \end{aligned}$ | Stand wire pressmount type | Hirose <br> FI30-20S (Connector) <br> FI-20-CV7 (Case) | A02B-0236-K302 |
| $\begin{aligned} & \text { JD1A, JD1B, } \\ & \text { JA58 } \\ & \text { (Operator's panel depth }=80 \mathrm{~mm} \text { min.) } \end{aligned}$ | Soldering type | Honda <br> PCR-E20FS (Connector) <br> PCR-V20LA (Case) <br> Hirose <br> FI40B-20S (Connector) <br> FI-20-CV2 (Case) | A02B-0120-K301 |
|  | Stand wire pressmount type | Honda <br> PCR-E20FA (Connector) <br> PCR-V20LA (Case) <br> Hirose <br> FI30-20S (Connector) <br> FI-20-CV2 (Case) | A02B-0120-K302 |
| JA3 <br> (Operator's panel depth $=80 \mathrm{~mm}$ min.) | Soldering type | Hirose <br> FI40B-2015S (Connector) <br> FI-20-CV (Case) | A02B-0120-K303 |
| CNK1 | Stand wire pressmount type | Hirose <br> FI30-20S (Connector) <br> FI-20-CV7 (Case) | A02B-0236-K302 |
| $\begin{aligned} & \hline \text { CA64 (IN), } \\ & \text { CA64 (OUT) } \end{aligned}$ | AMP$1-178288-3$ (Housing)$1-175218-5$ (Contact) |  | A02B-0120-K324 |
| CM67 | AMP <br> $178289-5$ (Housing) <br> $1-175218-5$ (Contact) |  | A02B-0236-K312 |
| CM68, CM69 | AMP$178289-8$ (Housing)$1-175218-5$ (Contact) |  | A02B-0236-K313 |
| $\begin{aligned} & \text { CM65, } \\ & \text { CM66 } \end{aligned}$ | HiroseHIF3BA-10D-2.54R |  | A02B-0236-K314 |
| CA65 | HiroseHIF3BA-20D-2.54R |  | A02B-0120-K343 |

### 6.12.4

## DI/DO Address

6.12.4.1

Keyboard of main panel

DI/DO address of Keyswitches and LED on the keyboard of Main panel $A / B / A 1 / B 1$ are as follows.

| Key/LED | BIT | $\mathbf{7}$ | $\mathbf{6}$ | $\mathbf{5}$ | $\mathbf{4}$ | $\mathbf{3}$ | $\mathbf{2}$ | $\mathbf{1}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\mathrm{Xm}+4 / \mathrm{Yn}+0$ | B 4 | B 3 | B 2 | B 1 | A 4 | A 3 | A 2 | A 1 |
| $\mathrm{Xm}+5 / \mathrm{Yn}+1$ | D 4 | D 3 | D 2 | D 1 | D 4 | C 3 | C 2 | C 1 |
| $\mathrm{Xm}+6 / \mathrm{Yn}+2$ | A 8 | A 7 | A 6 | A 5 | E 4 | E 3 | E 2 | E 1 |
| $\mathrm{Xm}+7 / \mathrm{Yn}+3$ | C 8 | C 7 | C 6 | C 5 | B 8 | B 7 | B 6 | B 5 |
| $\mathrm{Xm}+8 / \mathrm{Yn}+4$ | E 8 | E 7 | E 6 | E 5 | D 8 | D 7 | D 6 | D 5 |
| $\mathrm{Xm}+9 / \mathrm{Yn}+5$ |  | B 11 | B 10 | B 9 |  | A 11 | A 10 | A 9 |
| $\mathrm{Xm}+10 / \mathrm{Yn}+6$ |  | D 11 | D 10 | D 9 |  | C 11 | C 10 | C 9 |
| $\mathrm{Xm}+11 / \mathrm{Yn}+7$ |  |  |  |  |  | E 11 | E 10 | E 9 |



### 6.12.4.2 <br> Override signals

Table of gray code output is as follows when the Sub panel A/B/B1/C/C1 is used

Rotary switch (SA1)

| $\%$ | $\mathbf{0}$ | $\mathbf{1}$ | $\mathbf{2}$ | $\mathbf{4}$ | $\mathbf{6}$ | $\mathbf{8}$ | $\mathbf{1 0}$ | $\mathbf{1 5}$ | $\mathbf{2 0}$ | $\mathbf{3 0}$ | $\mathbf{4 0}$ | $\mathbf{5 0}$ | $\mathbf{6 0}$ | $\mathbf{7 0}$ | $\mathbf{8 0}$ | $\mathbf{9 0}$ | $\mathbf{9 5}$ | $\mathbf{1 0 0}$ | $\mathbf{1 0 5}$ | $\mathbf{1 1 0}$ | $\mathbf{1 2 0}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\mathrm{Xm}+0.0$ | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| $\mathrm{Xm}+0.1$ | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| $\mathrm{Xm}+0.2$ | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| $\mathrm{Xm}+0.3$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| $\mathrm{Xm}+0.4$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| $\mathrm{Xm}+0.5$ | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 |

## NOTE

$\mathrm{Xm}+0.5$ is a parity bit.

Rotary switch (SA2)

| $\%$ | $\mathbf{5 0}$ | $\mathbf{6 0}$ | $\mathbf{7 0}$ | $\mathbf{8 0}$ | $\mathbf{9 0}$ | $\mathbf{1 0 0}$ | $\mathbf{1 1 0}$ | $\mathbf{1 2 0}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\mathrm{Xm}+0.6$ | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 |
| $\mathrm{Xm}+0.7$ | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 |
| $\mathrm{Xm}+1.0$ | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| $X m+1.1$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| $X m+1.2$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

## NOTE

$1 \mathrm{Xm}+1.2$ is a parity bit.
2 There is no Rotary switch(SA2) of Sub panel B/C.

### 6.12.5 <br> I/O address map is as follows. DI/DO Mapping

| DI map |  | DO map |  |
| :---: | :---: | :---: | :---: |
| Xm+0 |  | Yn+0 |  |
| Xm+1 | General-purpose | Yn+1 |  |
| Xm+2 |  | Yn+2 | Keyboard |
| Xm+3 |  | Yn+3 | (LED) |
| Xm+4 | Keyboard of Main panel (Keyswitches) | Yn+4 | Purpose DO |
| Xm+5 |  | Yn+5 |  |
| Xm+6 |  | Yn+6 |  |
| Xm+7 |  | Yn+7 |  |
| Xm+8 |  |  |  |
| Xm+9 |  |  |  |
| Xm+10 |  |  |  |
| Xm+11 |  |  |  |
| Xm+12 (1st MPG) | MPG |  |  |
| Xm+13 (2nd MPG) |  |  |  |
| Xm+14 (3rd MPG) |  |  |  |
| Xm+15 | Reserve |  |  |

DI mapping should be assigned 1 group $=16$ byte mapping and DO mapping should be assigned 1 group $=8$ byte mapping. The reason is as follows.
MPG interface(the counter for MPG) uses $\mathrm{Xm}+12$ to $\mathrm{Xm}+14$ area and it is fixed. And if MPG interface will be used, $\mathrm{Xm}+12$ to $\mathrm{Xm}+14$ area must be assigned. therefore, in case of i series and using MPG interface, DI mapping must be assigned 16 byte mapping. MPG counter area are directly processed by CNC software. So you must not use this area by customer ladder.
It is possible to assign any address for this operator's panel. But in DI address, each CNC have some fixed address that is directly processed by CNC software. So, as refer to the following mention,assign the DI mapping.
6. CONNECTION OF I/O UNITS TO

Directly processed address by CNC

|  | $\mathbf{7}$ | $\mathbf{6}$ | $\mathbf{5}$ | $\mathbf{4}$ | $\mathbf{3}$ | $\mathbf{2}$ | $\mathbf{1}$ | $\mathbf{0}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| X 0006 |  |  |  | ${ }^{*}$ ESP |  |  |  |  |
| X 0008 |  |  |  | AE2 | AE1 |  |  |  |
| X0011 |  | SKIP1 |  |  |  |  |  |  |

Ex. In case of 16 byte mapping start from X0006 for DI area.

Ex. In case of 16 byte mapping start from X0006 for DI area.

| X0006 | General-purpose DI | SSP Fixed signal |
| :---: | :---: | :---: |
| X0007 |  | AEn Fixed signals |
| X0008 |  |  |
| X0009 |  |  |
| X0010 | Keyboard of Main panel (Keyswitches) |  |
| $\times 0011$ |  |  |
| X0012 |  |  |
| X0013 |  |  |
| X0014 |  | In case of mapping start from X0006, AEn1 singal which is address fixed signal can be used any time. And *ESP signal can be placed at +24 V common fixed address. |
| X0015 |  |  |
| X0016 |  |  |
| X0017 |  |  |
| X0018 (1st MPG) | MPG |  |
| X 0019 (2nd MPG) <br> $\mathrm{X0020}$ (3rd MPG) |  | (No fixed signal can be assigned to the key- |
|  |  | switch input part.) |

### 6.12.6

## Specifications

### 6.12.6.1

## Environmental

 requirement| Temperature around a unit | At operation0 to $55^{\circ} \mathrm{C}$ <br> Storing or transporting -20 to $60^{\circ} \mathrm{C}$ <br> Temperature variance <br> Humidity <br>  <br> Max. $0.3^{\circ} \mathrm{C} / \mathrm{min}$ <br> Vibration <br> Normally $\quad 75 \%$ or less (Relative humidity) <br> Short time(Within one month) $\quad 95 \%$ or less (Relative humidity) |
| :--- | :--- |
| Operating $\quad 0.5 \mathrm{G}$ or less |  |

### 6.12.6.2

## Main panel A/B/A1/B1

 specification| Item | Specification | Remarks |
| :--- | :--- | :--- |
| General-purpose DI points | 32 points | 24VDC input signals |
| General-purpose DO points | 8 points | 24VDC output signals |
| Keyswitches of MDI | 65 keys | Full alphabet key (Main panel A/A1) |
| Keyswitches of Machine op- <br> erator's panel | 55 keys | Matrix DI |
| LED | Color : Green | Attached to all keyswitches, Matrix DO |
| MPG interface | Max. 3 units | Only available for $i$ series. |
| Interface to CNC | FANUC I/O Link <br> connection | Max. 16 modules or total points max. 1024/1024 will be available. |

### 6.12.6.3

## Sub panel A/B/B1/C/C1

specification

| Item | Specification of Sub panel |  |  |  |  | Note |
| :--- | :---: | :---: | :---: | :---: | :---: | :--- |
|  | A | B | B1 | C | $\mathbf{C 1}$ |  |
| Override rotary switch | 2 | 1 | 2 | 1 | 2 | 5 bit Gray code output (with a parity bit) |
| Emergency stop switch | 1 | 1 | 1 | 1 | 1 | Number of Contact : 4 (Contact a x 2, <br> Contact b x 2) <br> M3.5 Screw |
| Program protect key | 1 | 1 | 1 | 1 | 1 |  |
| ON/OFF switch | ON/OFF | - | - | ON/OFF | ON/OFF |  |
| MPG | - | - | - | 1 | 1 |  |

### 6.12.6.4

## Power supply

 specification| Voltage | Capacity | Note |
| :--- | :---: | :--- |
| 24 VDC <br> including momentary values) | 0.4 A | Including all DI consumption |

### 6.12.6.5 <br> General-purpose DI signal definition

| Capacity | 30VDC, 16 mA or more |
| :--- | :--- |
| Interconnect leakage current in closed circuit | 1 mA or less(at 26.4 V ) |
| Interconnect voltage drop in closed circuit | 2V or less(including the voltage drop in the cables) |
| Delay time | Receiver delay : Max. 2 ms <br>  <br>  <br>  <br>  <br>  <br>  <br>  <br> Need to consider about the serial communication (I/O Link) delay <br> between CNC and operator's panel $2 \mathrm{~ms}(\mathrm{MAX})+$ Scan cycle of <br> ladder (Scan cycle is different each CNCs). |

6. CONNECTION OF I/O UNITS TO

### 6.12.6.6

General-purpose DO signal definition

| Maximum load current in ON state | 200 mA or less |
| :--- | :--- |
| Saturation voltage in ON state | Max. 1V (When load current is 200mA) |
| Withstand voltage | $24 \mathrm{~V} \pm 20 \%$ or less <br> (including momentary values) |
| Leakage current in OFF state | $20 \mu \mathrm{~A}$ or less |
| Delay time | Driver delay : Max. $50 \mu \mathrm{~s}$ <br> Need to consider about the serial communication (I/O Link) delay <br> between CNC and operator's panel $2 \mathrm{~ms}(\mathrm{MAX})+$ Scan cycle of <br> ladder (Scan cycle is different each CNCs). |

### 6.12.7 <br> Key Symbol Indication <br> on Machine Operator's <br> Panel

### 6.12.7.1

## Meaning of key symbols

| Symbol | English | Meaning of key |
| :---: | :---: | :---: |
| $\vec{\square}$ | AUTO | AUTO mode selection signal; Sets automatic operation mode. |
| ¢ | EDIT | EDIT mode selection signal; Sets program edit operation mode. |
| \| $\overline{\text { /Tr }}$ | MDI | MDI mode selection; Sets MDI mode. |
| + | REMOTE | DNC operation mode; Sets DNC operation mode. |
| $\cdots$ | REF RETURN | Reference position return mode selection; Sets reference position return mode. |
| WM | JOG | JOG feed mode selection; Sets jog feed mode. |
| $\vec{W}$ | $\begin{aligned} & \text { INC } \\ & \text { JOG } \end{aligned}$ | Step feed mode selection; Sets step feed mode. |
| -8) | HANDLE | Manual handle feed mode selection; Sets manual handle feed mode. |
| W (6) | TEACH | Teach-in jog (reach-in handle) mode selection signal; Sets teach-in jog (teach-in handle) mode. |
|  | SINGLE <br> BLOCK | Single block signal; Executes program one by one. This key is used to check a program. |



### 6.12.7.2 <br> Detachable key top

Keyboard of machine operator's panel has 55 keys. All key tops are detachable. MTB can customize keys and make his original key layout easily. And using transparent key top (optional), a film sheet with marking is inserted into the key.


## NOTE

Use the oil-proof sheet in the environment which oil is used for.

### 6.12 .8 Others

The keyboard of this operator's panel is a matrix composition. When three or more keys are pushed, the bypass current cause unrelated key to be available. This malfunction can be prevented with ladder program. One example is shown as follows.
(Elimination rule of malfunction)
When three keyinputs or more is input, all the keyinput since the third is made invalid.

However, when the number of all keyinput becomes two or less because keyinput was lost, all keyinputs are made effective.


## (Operation of ladder program)

The example of the operation of ladder program is shown about matrix DI composed of 8 bits x 8 commons as follows.
(1) The number of datalines where the keyinput exists is examined. Logical add R1 of the data of all addresses is calculated. The number of bits which are " 1 " in the 8 bits data of R1 corresponds to the number of datalines where the keyinput exists.

1) When the data of $R 1$ is corresponding to 00 h , there is no bit which is " 1 " in the data of R1.

Ex. State (a) : R1=(00000000) $\rightarrow$ There is no dataline where input exists.
2) When the data of $R 1$ is corresponding to the data in undermentioned datatable1., the number of bits which are " 1 " in the data of R1 is one. Similarly, when the data of R1 is corresponding to the data in datatable2., the number of bits which are " 1 " in the data of R1 is two.

Ex. State (b) or (c) : R1 $=(00000100) \rightarrow$ There is one dataline where input exists.
Ex. State (d) or (e) : R1 $=(00010100) \rightarrow$ There are two datalines where input exists.
3) If the data of R1 is not corresponding to 00 h and the both datatables, the number of bits which are " 1 " in the data of R1 is three or more.

Ex. State $(\mathrm{f}): \mathrm{R} 1=(00110100)$ ? There are three datalines where input exists.

| Data table 1. |
| :---: |
| 00000001 00000010 <br> 00000100 00001000 <br> 00010000 00100000 <br> 01000000 10000000 |
| 00000011 00000110 00001100 00011000 <br> 00110000 01100000 11000000 10000001 <br> 00000101 00001010 00010100 00101000 <br> 01010000 10100000 01000001 10000010 <br> 00001001 00010010 00100100 01001000 <br> 10010000 00100001 01000010 10000100 <br> 00010001 00100010 01000100 10001000 |

(2) Judgment 1

1) If there is no dataline where the keyinput exists.

$$
\rightarrow \text { Any key switch is not pushed. : Ex. State (a) }
$$

2) When the keyinput exists in two datalines or less.

$$
\rightarrow \text { To [3] }
$$

3) When the keyinput exists in three datalines or more.
$\rightarrow$ There are three keyinputs or more. It is invalid keyinput.
: Ex. State (f)
(3) When the keyinput exists in two datalines or less, it is examined whether two or more keyinput exists on the same dataline.
The data of all addresses is subtracted from logical add R1 and subtraction result R2 is obtained. There are no two or more keyinput on the same dataline if it is $\mathrm{R} 2=00 \mathrm{~h}$.

Ex. When there is one dataline where input exists.
State (b) : R2 = FCh State (c) : R2 = F8h
When there are two datalines where input exists.
State (d) : R2 = 00h
State (e) : R2 = FCh
(4) Judgment 2

1) In case of $\mathrm{R} 2=00 \mathrm{~h} \rightarrow$ There are two or less datalines where input exists, and there are no two or more keyinputs on the same dataline. In this case, the numbers of all keyinputs are one or two. It is effective keyinput. : Ex. State (d)
2) In case of $R 2 \neq 00 \mathrm{~h} \rightarrow$ There are two or less datalines where input exists, and two or more keyinputs exists on the same dataline. To [5].
(5) Judgment 3

When there is one dataline where input exists $\rightarrow$ To [6].
When there are two datalines where input exists $\rightarrow$ There are three keyinputs or more It is invalid keyinput. : Ex. State (e)
(6) Subtraction result R 2 is added to logical add R 1 . If this addition result is 00 h , the number of all keyinputs is two.

$$
\begin{aligned}
& \text { Ex. State }(b): R 1+R 2=04 h+F C h=00 h \\
& \text { State }(c): R 1+R 2=04 h+F 8 h=F C h
\end{aligned}
$$

(7) Judgment 4

In case of $\mathrm{R} 1+\mathrm{R} 2=00 \mathrm{~h} \rightarrow$ There is one dataline where input exists, and there are two keyinputs on this dataline.That is, because the numbers of all input are two keys, it is effective input. : Ex. State (b)
In case of $\mathrm{R} 1+\mathrm{R} 2 \neq 00 \mathrm{~h} \rightarrow$ There are three keyinputs or more on the same dataline. It is invalid keyinput. : Ex. State (c)
(8) Only when the keyinput becomes effective because of judgment 1-4, all DI data $(\mathrm{Xm}+4-\mathrm{Xm}+11)$ is used by the ladder program.
6. CONNECTION OF I/O UNITS TO MACHINE INTERFACE

### 6.12 .9

Connector Locations

### 6.12.9.1

Connector locations of main panel A/A1


### 6.12.9.2

Connector locations of main panel B/B1


## 7

## CONNECTION TO CNC PERIPHERALS

## CAUTION

A signal or power supply may possibly be assigned to a pin currently indicated as unused in the connector signal assignment table without prior notice. Do not use any of the pins indicated as being unused.

# 7.1 LCD UNIT (DISPLAYUNIT FOR CNC EXCLUSIVE USE) INTERFACE 

The following two LCD units are available. The each have the same interface.

- 9.5" STN monochrome LCD
- 10.4" TFT color LCD (for 1LCD connection)
- 10.4" TFT color LCD (for 2LCD connection)


### 7.1.1 <br> Connection of 1LCD Unit

### 7.1.1.1

Connection of LCD unit (for 1LCD connection)

7.1.2

Connection of MDI Unit (with CNC-Only Display Used)

The following four MDI units are available. The each have the same interface.

- 56 key vertical type
- 56 key horizontal type
- 61 key (Full Key) vertical type
- 61 key (Full Key) horizontal type



## NOTE

When two LCD units (for two-LCD connection) are used, both the first and second LCD units can be connected to MDI units, but only the MDI unit selected by the MDI switch can be used. For the MDI switch interface, see Subsection 7.1.3.

Cable connection


| Recommended cable: | A02B-0236-K813 | $(450 \mathrm{~mm})$ |
| :--- | :--- | :--- |
| Recommended cable material: | A66L-0001-0284\#10P | $(\# 28 A W G \times 10$ pairs $)$ |

## NOTE

As the connector on the CA55 side of the MDI cable is attached by means of a simple lock system, it should not be subjected to a force of more than 1 kg . Also, clamp the connector to prevent vibration from possibly loosening the connection. Note, however, that shielding and clamping are not required if the cable length is less than 500 mm .

### 7.1.3 <br> MDI Unit Switch <br> Connection (when LCD <br> Units for Two-LCD <br> Connection are Used)



### 7.1.4 <br> MDI Unit Connection (with No CNC-Only Display Used)

## NOTE

If the CNC-dedicated display is used, this interface cannot be used.

7.1.5

Mounting the PCMCIA Blind Cover on an LCD
Unit for Two-LCD
Connection

The memory card interface of the second LCD unit cannot be used. The machine tool builder should mount a PCMCIA blind cover as shown below.


Outline drawing of the PCMCIA blind cover


Specification number A02B-0265-K500

## 7.2 <br> I/O UNIT INTERFACE

### 7.2.1

RS-232C Serial Port
(JD5A, JD5B, JD5C)


### 7.2.2

RS-232C Serial Port

## (JD36A)



## NOTE

This connector cannot be used on LCD units having a touch panel
Pins 18 and $20(+5 \mathrm{~V})$ are provided for touch panel connection. Never use these pins for making any other connection.
+24 V can be used as the power source for FANUC RS-232C equipment.

## Cable connection



Recommended cable: A66L-0001-0284\#10P (\#28WAG $\times 10$ pairs)

## NOTE

- The machine tool builder shall furnish relay connectors and relay cables.
- Use a totally shielded cable for the signal cable.
- Recommended cable material: A66L-0001-0284\#10P (\#28AWG $\times 10$ pairs)
- Open all terminals other than illustrated.
- Set suitable parameters on reader/puncher interface for FANUC Handy File. The baud rate is 4800 baud.
- FANUC Handy File should be connected to one of JD5A, JD5B or JD36A. When FANUC Handy File are connected to two or more connectors, the +24 V power capacity may be exceeded.
7.2.3

RS422 Serial Port
(JD6A, JD6B)

| CNC |  |  |  | $\square \square-\square[$ | External unit (RS-422) |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| 1 | RD | 11 | SD |  | 1 | FG | 20 |  |
| 2 | *RD | 12 | *SD |  | 2 |  | 21 |  |
| 3 |  | 13 |  |  | 3 |  | 22 | *SD |
| 4 |  | 14 |  |  | 4 | SD | 23 |  |
| 5 | CS | 15 | RS |  | 5 |  | 24 | *RD |
| 6 | *CS | 16 | *RS |  | 6 | RD | 25 | ${ }^{*} \mathrm{RS}$ |
| 7 | DR | 17 | ER |  | 7 | RS | 26 |  |
| 8 | 0V | 18 | *ER |  | 8 |  | 27 | ${ }^{*} \mathrm{CS}$ |
| 9 | ${ }^{*}$ DR | 19 | (+24V) |  | 9 | CS | 28 |  |
| 10 | (+24V) | 20 |  |  | 10 |  | 29 | ${ }^{*} \mathrm{DR}$ |
|  |  |  |  |  | 11 | DR | 30 | *ER |
|  |  |  |  |  | 12 | ER | 31 |  |
|  |  |  |  |  | 13 |  | 32 |  |
|  |  |  |  |  | 14 |  | 33 |  |
|  |  |  |  |  | 15 |  | 34 |  |
|  |  |  |  |  | 16 |  | 35 |  |
|  |  |  |  |  | 17 |  | 36 |  |
|  |  |  |  |  | 18 |  | 37 |  |
|  |  |  |  |  | 19 | SG |  |  |

## NOTE

1 In the above diagram, the interface on the external unit side is simply an example. When developing a cable, design it according to the actual external unit interface that will be used.
2 Do not connect anything to the +24 V pin.


## NOTE

Use a twisted pair common-shield cable with a wire size of $7 / 0.127\left(0.09 \mathrm{~mm}^{2}\right)$ or larger. Observe the pin arrangement shown above. Ground the shielding to a cable clamp.

Recommended wire: A66L-0001-0284\#10P
7.2.4

Connection with FANUC Handy File

FANUC Handy File can be connected to the CNC via the ES-232C serial port.


## 7.3

MANUAL PULSE
GENERATOR
INTERFACE


Recommended cable
A66L-0001-0286 (\#20AWG $\times 6+\# 24 A W G \times 3$ pairs) length 20 max.

Recommended connector:
A02B-0120-K303 (includes the following body and housing)
(Body: FI40-2015S, soldering type, from Hirose Electric Co., Ltd.)
(Housing: FI40-20-CV5, from Hirose Electric Co., Ltd.)

## NOTE

Since some pins of this connector, unlike other 20-pin connectors, have been removed, resulting in a unique pin arrangement, be careful when identifying pin numbers. See Figure 2 in Appendix B and Table C (a) in Appendix C.

- Manual pulse generator cable

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

$$
0.2 \geqq(0.1 \times \mathrm{R} \times 2 \mathrm{~L}) / \mathrm{m}
$$

Where
0.1: manual pulse generator supply current 0.1 A

R: resistance per unit cable length $(\Omega / \mathrm{m})$
m : number of 0 V and 5 V wires
L: cable length (m).
Therefore, the cable length can be determined using the following expression:

$$
L \leqq m / R
$$

In the case of the A66L-0001-0286 cable developed for the FS15/16/18 pulse coder interface, when three pairs of signal wires and six power source wires $(20 / 0.18,0.0394 \Omega / \mathrm{m})$ are used (three power source wires connected to 5 V and the other three to 0 V ), the cable length is:

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

However, the maximum pulse transmission distance for the manual pulse generator is 50 m . So, the cable length may be extended to 50 m .

## 7.4 <br> HIGH-SPEED SKIP <br> (HDI) SIGNAL <br> INTERFACE

CNC

| $\begin{aligned} & \text { JA40 } \\ & \text { PCR-EV20MDT } \end{aligned}$ |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | HDIO | 11 | HDI1 |  |  |
| 2 | OV | 12 | 0 V |  |  |
| 3 | HDI2 | 13 | HDI3 |  |  |
| 4 | 0V | 14 | 0 V |  |  |
| 5 | (ES)0V | 15 | HDI5 |  |  |
| 6 | HDI4 | 16 | OV |  |  |
| 7 | (SVC) | 17 | HDI6 |  |  |
| 8 | (ENB1) | 18 | 0 V |  |  |
| 9 | (ENB2) | 19 | HDI7 |  |  |
| 10 | 0V | 20 | 0 V |  | Signals in parentheses ( ) are used by the analog spindle I/F. |

## Cable connection



Pin $5(0 \mathrm{~V})$ signal is the common signal when analog output SVC is used. Pin $10(0 \mathrm{~V})$ signal should be used as the OV signal paired with HDI4 when OV is used both for analog spindle output SVC and high-speed skip (HDI).

Input signal rules for the high-speed skip (HDI)
Circuit configuration


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

| Item | Symbol | Standard | Units | Remarks |
| :--- | :---: | :---: | :---: | :---: |
| High-level input voltage | VH | 3.6 to 11.6 | V |  |
| Low-level input voltage | VL | 0 to 1.0 | V |  |
| High-level input current | liH | 2 (max) | mA | $\mathrm{V}_{\text {in }}=5 \mathrm{~V}$ |
|  |  | 11 (max) | mA | $\mathrm{V}_{\text {in }}=10 \mathrm{~V}$ |
| Low-level input current | liL | -8.0 max | mA | $\mathrm{V}_{\text {in }}=0 \mathrm{~V}$ |
| Input signal pulse width |  | 20 min | $\mu \mathrm{s}$ |  |
| Delay or variance of the <br> input signal |  | $0.02(\max )$ | ms |  |

## NOTE

1 The symbols (+ or - ) of lih and lil indicate the direction of current flowing to (+) and out of ( - ) the receiver.
2 The high-speed skip (HDI) signal is regarded as "1" at a low input voltage level and as " 0 " at a high input voltage level.

## 7.5 SPINDLE INTERFACE

The spindle interface can be configured in one of three ways on the Series 15i/150i.
(1) Serial spindle

(2) Serial spindle + rotary tool

(3) Analog spindle


## NOTE

For details of the connections between the spindle amplifiers and spindle motors, and between the spindle amplifiers and position codes, refer to the SPINDLE MOTOR $\alpha i$ series Descriptions manual.

### 7.5.1

## $\alpha$ Spindle Interface



## NOTE

1 The +5 V signals inside parentheses ( ) are power source signals to the optical I/O Link adapter to be used when an optical I/O Link adapter is used for the connection between NC and the spindle amplifier. Do not connect this signal when the optical cable is not used. It cannot be used jointly with the No. 2 serial spindle.
The signals inside < > are used for the No. 2 serial spindle interface. The 3rd and 4th spindles can be used by using a serial spindle connection adapter.
2 For an $\alpha i$ spindle, a connection with the conventional optical I/O link adapter is not allowed. The optical adapter (A13B-0154-B003) must be used.



Recommended wire specification: A66L-0001-0284\#10P (\#28AWG $\times 10$ pairs)
When this cable is laid nearby power lines and other cables, the shielded lead must be connected to the earth plate. However, note that this connection is not required when the CNC and spindle amplifier module are mounted nearby. In the following cases, use optical fiber cable connection through an optical I/O Link adapter:

- When the cable length exceeds 20 m
- When the cabinet where the spindle amplifier is installed and the operator's panel cabinet where the control unit is installed cannot be connected through a grounding wire of $5.5 \mathrm{~mm}^{2}$ or more
- When the cable may be affected by noise

For example, this applies when there is a source of strong magnetic noise, such as a welder, near the cable.
7.5.2

## Analog Spindle

 InterfaceCNC


Signals in parentheses ( ) are high-speed skip (HDI) input signals.
SVC, ES: $\quad$ Spindle command voltage and common signal
ENB1, ENB2: These spindle enable signals turn on when the spindle command voltage is valid. These signals are not used when a FANUC spindle servo unit is used. Use these signals at an applied voltage of 30 or less when OFF and at a current of 200 ma or less when ON.

Cable connection


```
SVC rating
    Output voltage }\pm10\textrm{V
    Output current Max. 2 mA
    Output impedance 100 \Omega
```


### 7.5.3

Position Coder Interface

CNC


## Position coder

Signals in parentheses ( ) are for the serial spindle motor interface, and are not used when the position code is used.

## Cable connection



Recommended wire specification: A66L-0001-0286 (\#20AWG $\times 6+$ \#24AWG $\times 3$ ) max. 20 m
The solder-type 15-pin connector (FI40B-2015S, or conventional FI40-2015S) manufactured by Hirose Electric cannot be used as the connector on the cable side.

The position coder generates rectangular wave voltage signals in proportion to the angle of rotation of the spindle, and is used in feed per revolution and thread cutting.
(1) 1 rotation of position coder with respect to 1 rotation of spindle
(2) 1 rotation of position coder with respect to 2 rotations of spindle
(3) 1 rotation of position coder with respect to 4 rotations of spindle
(4) 1 rotation of position coder with respect to 8 rotations of spindle

Fig. 7.5.3 shows the timing of the signals generated by the pulse coder.


Fig. 7.5.3 Rectangular wave of position coder

## NOTE

The differential signal is used as the feedback signal from the position coder. *PCA, *PCB and *PCZ refer to each of their inverted signals.

## Time rules

These are the signal rules that apply to the input pin of the input connector of the NC in the figure above.
Because the signal of this connector is in phases A and B and is a differential input, Td is of interest, which is the duration from point A when the relative potential difference between PCA and *PCA becomes 0.5 V or higher to point B when the relative potential difference between PCB and $*$ PCB reduces below 0.5 V . Its minimum is:

$$
\mathrm{Td} \geqq 0.65 \mu \mathrm{~s}
$$

Tp , which is the minimum of one period in each of phases A and B , is:
$\mathrm{Td} \geqq 4 \mu \mathrm{~s}$
Phase $Z$ signal input
The phase Z signal (one-rotation signal) requires a signal width equal to or greater than one period of the phase A or B signal.
7.5.4

Connection of 1 to 4 Serial Spindles

3 or 4 serial spindle can be connected on the Series 15i/15i (only on M type models) by using the serial spindle connector panel.

Serial spindle connector panel specifications: A13B-0180-B001
External dimensions of serial spindle connector panel
The external dimensions of the serial spindle connector panel are the same as those for the optical I/O Link adapter (A13B-0154-B001).


Serial spindle connector panel installation conditions

- The serial spindle connector panel is not fully sealed; install it with the CNC control unit in the fully enclosed cabinet.
- Ground the case using the case installation of the serial spindle connector panel.
- The serial spindle connector panel is light, and it may not be necessary to mount it with screws. However, keep it from coming in contact with other circuits to prevent possible short-circuits. When mounting the serial spindle connector panel in a cabinet, attach it with an L-type fitting using the case fixing screws (M3) of the optical link adapter.


Connection examples
(When only the electrical cable is used for connection)

(When the optical cable is used for connection)

(When only the electrical cable is used for connection)
Cable connections between CNC and serial spindle connector panel (interunit connection cable (1))


## NOTE

1 The +5 V signals inside $<>$ are power source signals to the optical link adapter to be used when an optical adapter is used for the connection between CNC and the spindle. Do not connect this signal when the optical cable is not used. The signals inside [ ] are for use when the position coder is used. These signals cannot be used jointly with the serial spindle interface on the 2nd channel.
2 Make a branch connection from the spindle amplifier module to connect the 2nd and 4th serial spindles.


## NOTE

When this cable is laid nearby power lines and other cables, the shielded lead must be connected to the earth plate. However, note that this connection is not required when the CNC and spindle amplifier module are mounted nearby.

Cable connections between the serial spindle connector panel and the spindle amplifier
(interunit connection cable (2))


## NOTE

1 The +5 V signals inside $<>$ are power source signals to the optical link adapter to be used when an optical adapter is used for the connection between the CNC and the spindle. Do not connect this signal when the optical cable is not used.
2 Make a branch connection from the spindle amplifier module to connect the 2nd serial spindle.

## Cable connection

$$
\text { JA7A-1, } 2
$$

JA7B


Recommended material specification:
A66L-0001-0284\#10P (\#28AWG $\times 10$ pairs)

## NOTE

When this cable is laid nearby power lines and other cables, the shielded lead must be connected to the earth plate. However, note that this connection is not required when the serial spindle connector panel and spindle amplifier module are mounted nearby.
(Cable connection when the optical cable is used for connection) Cable connections between CNC and serial spindle connector panel (interunit connection cable (3))


## NOTE

1 The signals inside [ ] are for use when position coders are used. They cannot be used jointly with the No. 2 serial spindle interface.
2 Make a branch connection from the spindle amplifier module to connect the 2nd and 4th serial spindles.

## Cable connection

JA41


Recommended cable-side connector
PCR-E20FA (Honda Tsushin Kogyo Co., Ltd.)
CN-247J020-G/E (Fujitsu, Ltd.)
52622-2011 (Molex Japan Co., Ltd.)
Recommended cable specification: A02B-0236-K847
Recommended cable material:
A66L-0001-0284\#10P (\#28AWG $\times 10$ pairs)

## NOTE

When this cable is laid nearby power lines and other cables, the shielded lead must be connected to the earth plate. However, note that this connection is not required when the CNC and spindle amplifier module are mounted nearby.
(Cable connection between the serial spindle connector panel and optical adapter)
(interunit connection cable (4))

Serial spindle connector panel


Optical adapter


## NOTE

Make a branch connection from the spindle amplifier module to connect the 2 nd and 4 th serial spindles.

## Cable connection

JA7A-1, 2


Recommended cable-side connector
PCR-E20FA (Honda Tsushin Kogyo Co., Ltd.)
FCN-247J020-G/E (Fujitsu, Ltd.)
52622-2011 (Molex Japan Co., Ltd.)
Recommended cable material:
A66L-0001-0284\#10P (\#28AWG $\times 10$ pairs)
7.6
SERVO INTERFACE (FSSB)

Serial communications using optical fiber cable is used as the servo interface.
For details on connections relating to the servo amplifier series, refer to the FANUC SERVO AMPLIFIER $\alpha i$ series Specifications (B-65282E).

### 7.6.1

Connection Example
When High-Speed HRV
Current Control is not
Used


Servo amplifier: All servo amplifiers in this example are single-axis amplifiers. The numbers in the branckets indicate the axis numbers of the axes.

Separate detector interface module: A unit supporting servo HRV3 is required.


- When servo HRV3 is used, an axis control card supporting servo HRV is required. In addition, when servo HRV3 is used, the servo amplifiers used must be amplifiers for high-speed HRV current control or servo HRV3 amplifiers.
- Up to eight axes in total can be connected to the FSSB line.
- The total number of axes and separate detectors connected to one servo card must be 10 or less. (Nine in total in this example)
- Cards used for two to eight axes are all classified as TYPE A.

Recommended cable (optical fiber cable)
For detailed specifications, see Appendix. When a separate pulse coder or linear scale is used, a separate detector interface unit is required as shown in the above. The separate detector interface unit is connected as a servo interface (FSSB) unit to the control unit with an optical fiber cable. The signals input from the linear scale to the separate detector interface unit must be asserted within 500 ms after power-up.

### 7.6.2

Connection Example when High-Speed HRV Current Control is Used


- An axis control card supporting servo HRV is required. As the servo amplifiers, use amplifiers for high-speed HRV current control or servo HRV3 amplifiers.
- Up to four axes in total can be connected to a single FSSB line. (In this example, four axes are connected.)
- The total number of axes and a separate detector attached to one FSSB line must be five or less.
- When the total number of axes and a separate detector attached to one FSSB line is five, the separate detector must be attached at the far end. (In this example, the total number is five, so the separate detector is attached at the far end.)
- Up to eight axes can be controlled with a single servo card. (There are eight axes in this example. A TYPE B 8 -axis card is used.)
- The total number of axes and separate detectors connected to one servo card must be 10 or less. (Nine in total in this example)
- Use of a 2-axis card allows connection of amplifiers <1> and <2>, use of a 4-axis card allows connection of amplifiers <1> to <4>, and use of a 6 -axis card allows connection of amplifiers $<1>$ to $<6>$.
- The 2-axis and 4 -axis cards are TYPE A cards, and the 6 -axis and 8 -axis cards are TYPE B cards.
7.6.3

Requirements for the FSSB Line

- When high-speed HRV current control is to be used, amplifiers for high-speed HRV current control are required. As the separate detector interface unit, a separate detector interface unit supporting servo HRV3 must be used.

- When an FSSB line uses high-speed HRV current control, servo amplifiers for up to four axes can be connected to the FSSB line, and up to five slaves including a separate detector interface unit are allowed. When high-speed HRV current control is used in a system with five or more axes, two FSSB lines are required, so a TYPE B axis control card is required. With two FSSB lines, up to eight axes can be controlled. When an axis control card supporting servo HRV3 is used, a separate detector interface unit supporting servo HRV3 is required as the separate detector interface unit even if it is attached to an FSSB line that does not use high-speed HRV current control.

- When four controlled axes are connected to an FSSB line that uses high-speed HRV current control, a separate detector interface unit must be connected at the far end of the FSSB line. When there are three controlled axes or less, however, the separate detector interface unit may be connected at any position on the line.

- In axis assignment, pairs of the first and second axes, the third and fourth axes, the fifth and sixth axes, and the seventh and eighth axes must each be connected to the same FSSB line. For example, you cannot connect the third axis to the first FSSB line, and the fourth axis to the second FSSB line. Axes to be paired must be connected to the same FSSB line.



### 7.6.4

## Separate Detector

## Interface Unit

### 7.6.4.1

Separate detector interface unit

| Item | Specification |
| :--- | :--- |
| Power supply | +24VDC( $\pm 10 \%)$ <br> $0.9 \mathrm{~A}:$ Only use Basic 4 axes unit <br> $1.5 \mathrm{~A}:$ Use Basic 4 axes unit and additional 4 axes unit |
| Ordering information | Basic 4 axes unit : A02B-0236-C205 <br> Additional 4 axes unit : A02B-0236-C204 |
| External dimensions | Refer to fig. 12 in Appendix A. |

## NOTE

The power supply which this unit can supply to the separate detector unit is $0.35 \mathrm{~A}(5 \mathrm{~V})$ per one.
Minimum voltage for 5 V
4.95 V (min.) for the basic 4-axis unit
4.90 V (min.) for the additional 4-axis unit

### 7.6.4.2

Power source connection

Supply the power source for this unit from the servo amplifier or from an external 24VDC power source.


Recommended cable length (including external power source): A02B-0124-K830 (length: 5 m , with M3 terminal on 24 V power source side)
7.6.4.3

Battery connection for separate absolute detector

This is required only when the separate absolute detector is used.


Recommend lead: $\geqq 0.2 \mathrm{~mm}^{2}(7 / 0.18)$
Recommended connectors:
PCR-E20FA (Honda)
F130-20S (Hirose Denki)
FCN-247J020-G/E (Fujitsu)
52622-2011 (Molex)

## NOTE

This battery for the separate absolute detector is required only when the separate absolute detector is used. If the built-in absolute pulse coder of the motor is used, the battery for the separate absolute detector is not required because the built-in battery of the amplifier is used.

### 7.6.4.4

## Linear scale interface

 (parallel interface)Separate detector interface unit


Recommended connector:
A02B-0120-K303 (includes the following body and housing)
(Body: FI40-2015S, soldering type, from Hirose Electric Co., Ltd.)
(Housing: Fl40-20-CV5, from Hirose Electric Co., Ltd.)

## NOTE

Since some pins of this connector, unlike other 20-pin connectors,
Signals in parentheses ( ) are for when the separate absolute pulse coder is used. have been removed, resulting in a unique pin arrangement, be careful when identifying pin numbers. See Figure 2 in Appendix B and Table C (a) in Appendix C.

Cable connection


Recommended cable: A66L-0001-0286 (\#20AWG $\times 6+$ \#24AWG $\times 3$ )

### 7.6.4.5

Linear scale interface (serial interface)

7.6.4.6

Separate pulse coder interface

When absolute detection is used:

Separate detector interface unit

| JF101 to JF108 |  |  |  |
| :--- | :--- | :--- | :--- |
| PCR-EV20MDT |  |  |  |
| 1 PCA 11  <br> 2 *PCA 12 0 V <br> 3 PCB 13  <br> 4  14 0 V <br> 5 PCZ 15  <br> 6 ${ }^{*} \mathrm{PCZ}$ 16 0 V <br> 7 +6 V 17  <br> 8 REQ 18 +5 V <br> 9 +5 V 19  <br> 10  20 +5 V |  |  |  | body and housing)

Recommended connector: A02B-0120-K303 (includes the following
(Body: FI40-2015S, soldering type, from Hirose Electric Co., Ltd.)
(Housing: FI40-20-CV5, from Hirose Electric Co., Ltd.)

## NOTE

Since some pins of this connector, unlike other 20-pin connectors, have been removed, resulting in a unique pin arrangement, be careful when identifying pin numbers. See Figure 2 in Appendix B and Table C (a) in Appendix C.

## Cableconnection



Recommended cable: A66L-0001-0286 (\#20AWG $\times 6$ + \#24AWG $\times 3$ )

When incremental detection is used:


### 7.6.4.7 Input signal rules

(1) A, B phase signal input

When positional information is input by A and B phase signals which have a phase deviation of $90^{\circ}$ to each other, the direction in which the B phase advances is taken as the plus direction, and the direction in which the A phase advances is taken as the minus direction. The phase is detected by these two signals.

(2) Phase difference and minimum repeat cycle


In the above figure, the minimum time of (TD) is calculated as follows:

$$
\mathrm{TD} \geqq 0.15 \mu \mathrm{sec}
$$

The cycle and pulse width that satisfies the above phase difference becomes the lower limit value.
(3) Z phase signal input

A signal width more than a $1 / 4$ cycle of the $A$ or $B$ phase signal is required for the Z phase signal ( 1 rotation signal).

$T w \geqq 1 / 4$ cycle of $A$ or $B$ phase signal

Relationship between servo motor and separate pulse coder with regard to direction of rotation

If the separate pulse coder rotates in the direction opposite to that in which the servo motor rotates, change the connection of the interface cable for the separate pulse coder as stated below:
(1) Exchange signal PCA with signal PCB.
(2) Exchange signal $* \mathrm{PCA}$ with $* \mathrm{PCB}$.
7.6.4.8

Basic-unit connector layout
Connector layout


Additional-unit connector layout


### 7.6.4.9 <br> Cautions for mounting separate detector interface unit

(1) Use the unit in a completely sealed cabinet.
(2) Mount the unit on a vertical surface, and allow a space of at least 100 mm above and below the unit. Do not place any unit generating a large amount of heat under the detector interface unit.
(3)For the dimensions of the unit, see the corresponding outline drawing in Appendix A.

## CAUTION

This unit requires a clearance on both sides for maintenance purposes to accommodate a screwdriver inserted obliquely when the detector interface unit is mounted or removed.
As a guideline, allow a gap of at least about 20 mm between this unit and each adjacent unit if the detector interface unit is not shorter than adjacent units, and about 70 mm if it is shorter.
If this unit is mounted next to the side of the cabinet, allow a gap of at least about 70 mm between the unit and the cabinet side.


Connection between basic and additional units

A flat cable is used to connect an additional unit to the basic unit as shown below. The flat cable is 100 mm long.


The flat cable should be ordered together with the separate detector interface unit.

When using an additional unit together with the basic unit, run the flat cable connecting the units so that it does not block the vents of the basic unit.

## Details of mounting

 holes

Mounting hole layout and dimensions

If both basic and additional units are to be used, separate the mounting holes by 70 to 80 mm , as shown above.

Using DIN rail for mounting


How to mount

1. Place the hook of the unit on the top end of the DIN rail.
2. Push in the unit firmly until it clicks.

How to remove

1. Pull down the lock on the unit using a flat-blade screwdriver or similar object.
2. Remove the unit by pulling bottom toward you.

## CAUTION

To prevent damage to the lock when removing the unit, be careful not to apply excessive force to the lock. When mounting and removing the unit, whenever possible, hold the top and bottom edges. Do not apply force to the sides (where the are slits are located).

## 7.7

GENERAL-PURPOSE VOLTAGE INPUT INTERFACE


## NOTE

Signals enclosed in parentheses cannot be used at present. Do not connect anything to pins not available for use.

Follow the signal cable connection diagram shown below.


Recommended wire: A66L-0001-0284\#10P (\#28AWG $\times 10$ pairs)

## 7.8

REMOTE BUFFER
INTERFACE

### 7.8.1 <br> Serial Communication <br> Board A1 (RS-232-C)

Serial communication board A1
JD5L
PCR-E20LMDET-SL

| 1 | RD | 11 | SD |
| :---: | :---: | :---: | :---: |
| 2 | OV | 12 | OV |
| 3 | DR | 13 | ER |
| 4 | OV | 14 | OV |
| 5 | CS | 15 | RS |
| 6 | OV | 16 | OV |
| 7 | CD | 17 |  |
| 8 | OV | 18 |  |
| 9 |  | 19 | $(+24 \mathrm{~V})$ |
| 10 | $(+24 \mathrm{~V})$ | 20 |  |



Conceptual diagram of the signal connection relationships

| CNC side | $\mathrm{SD} \xrightarrow{\text { Host side }}$ |
| :---: | :---: |
| Output $\longrightarrow$ SD |  |
| Input $\longrightarrow \rightarrow$ RD | $\mathrm{RD} \longrightarrow$ |
| $\bigcirc$ RS | $\mathrm{RS} \longrightarrow$ |
| $\rightarrow$ CS | $\mathrm{CS} \longrightarrow-$ |
| - ER | ER $\longrightarrow$ |
| - DR | $\mathrm{DR} \longrightarrow$ |
| $\rightarrow$ CD | $\mathrm{CD} \longrightarrow$ |
| OV $\square$ | SG |
| FRAME _ FG | FG |

Cable connection example


If not using CS, connect it to RS. For protocol A and extended protocol A, however, it is used for busy control, and must be connected as shown in the figure above.

If not using DR, connect it to ER.
Be sure to connect CD to ER.

### 7.8.2

Serial Communication
Board A2 (RS-422)

| Serial communication board A2 |  |  |  | Host computer (example) |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| JD6L <br> PCR-E20LMDET-SL |  |  |  | 1 | FG | 20 |  |
| 1 | RD | 11 | SD | 2 |  | 21 |  |
| 2 | *RD | 12 | *SD | 3 |  | 22 | *SD |
| 3 | RT | 13 | TT | 4 | SD | 23 |  |
| 4 | *RT | 14 | *TT | 5 |  | 24 | *RD |
| 5 | CS | 15 | RS | 6 | RD | 25 | *RS |
| 6 | *CS | 16 | *RS | 7 | RS | 26 | *RT |
| 7 | DM | 17 | TR | 8 | RT | 27 | ${ }^{*} \mathrm{CS}$ |
| 8 | OV | 18 | *TR | 9 | CS | 28 |  |
| 9 | *DM | 19 | ( +24 V ) | 10 |  | 29 | *DM |
| 10 | (+24V) | 20 |  | 11 | DM | 30 | *TR |
|  |  |  |  | 12 | TR | 31 |  |
| $(+24 \mathrm{~V})$ is not used. |  |  |  | 13 |  | 32 |  |
|  |  |  |  | 14 |  | 33 |  |
|  |  |  |  | 15 |  | 34 |  |
|  |  |  |  | 16 |  | 35 | *TT |
|  |  |  |  | 17 | TT | 36 |  |
|  |  |  |  | 18 |  | 37 |  |
|  |  |  |  | 19 | SG |  |  |

(1) Conceptual diagram of the signal connection relationships

The figure below is a conceptual diagram showing the connection relationships between the signals of the CNC and the host.
The signals except FG and SG are subject to differential signal transmission in accordance with the RS-422 standard and, therefore, use two signal lines each.
CNC side
Output
Input
(2) RS-422 cable connection example


## NOTE

1 Be sure to use a twisted pair cable.
2 The pin position of the *DM signal on the CNC is not regular, unlike those of the other signals. (The reason for this is to reduce the possibility of destruction when the cable is erroneously connected to another connector.)

## CONNECTION TO OTHER NETWORKS

8

The $i$ Series CNC can be connected to the following networks. For an explanation of how to make the connection, refer to the manuals listed below:

| Manual title | Manual code |
| :--- | :---: |
| FANUC I/O Link-II Connection Manual | B-62714EN |
| FANUC Data Server Operator's Manual | B-62694EN |
| FANUC Ethernet Board/Data Server Operator's <br> Manual | B-63354EN |
| FANUC Fast Ethernet Board/Fast Data Server <br> Operator's Manual | B-63644EN |
| FANUC Profibus-DP Board Operator's Manual | B-62924EN |
| FANUC DeviceNet Board Operator's Manual | B-63404EN |

HIGH-SPEED SERIAL BUS (HSSB)

## 9.1 OVERVIEW

## 9.2 <br> CAUTIONS

The high-speed serial bus (HSSB) enables the high-speed transfer of large amounts of data between a commercially available IBM PC or compatible personal computer or CNC display unit with PC functions and a CNC, by connecting them via a high-speed optical fiber.
On the CNC, the HSSB interface board is installed in a minislot. On the personal computer, an appropriate interface board is installed.
The HSSB can be used with a Series $15 i$ system, but not with a Series $15 i$ system.

The use of the HSSB requires an IBM PC/AT compatible computer or FANUC intelligent terminal. The machine tool builder or end user is required to procure and maintain the personal computer.
To enable the use of the HSSB, Windows 95 or Windows NT must have been installed on the personal computer.
FANUC owns the copyright for the HSSB device driver.
The software mentioned above and the contents of the related manuals may not be used or reproduced in part or whole without the prior written permission of FANUC.

## NOTE

1 IBM is a registered trademark of IBM Corp. of the US.
2 Windows 95/Windows NT are registered trademarks of Microsoft Corp. of the US.
3 The company and product names mentioned in this manual are trademarks or registered trademarks of the respective companies.

## 9.3 <br> CONNECTION DIAGRAM



## 9.4 <br> SETTING UP THE HSSB INTERFACE BOARD ON THE CNC



## - Setting/adjustment

 location: Rotary switch SW1 (when a PC is connected)With the rotary switch SW1 on the board, the start sequence at power-up can be changed.

| Setting of rotary switch SW1 | 2. Description |
| :---: | :---: |
| 0 | Setting for maintenance. <br> The start menu appears, allowing you to perform boot and IPL operations from the PC. |
| 1 | Normal setting. <br> The start menu is not displayed. <br> You cannot perform boot and IPL operations from the PC. |
| 2 | The CNC and PC start separately without handshaking. <br> - CNC <br> - Even when the PC is not connected to the CNC or is off, just the CNC can be started and operated. (For CNC operation, a CNC-dedicated display, an MDI unit, an operator's panel, and so on are required.) <br> - Even when the PC is connected and is on, the start menu is not displayed. <br> - PC <br> - Even when the CNC is connected to the PC and is on, the start menu is not displayed. You cannot perform boot and IPL operations from the PC. <br> When an HSSB device driver supporting Windows 95/98, Windows NT 4.0, or Windows 2000 is installed in the PC, setting the rotary switch to this position allows you to turn on and off the power just to the PC or CNC. When more than one CNC is connected to a single PC, usually set the switch to this setting position. |

- Setting/adjustment location: Rotary switch SW1 (when an CNC display unit with PC functions is connected)

With the rotary switch SW1 on the board and the jumper plug SW5 on the CNC display unit with PC functions, the start sequence at power-up can be changed.

| Setting of rotary switch SW1 | Jumper plug (SW5) | Description |
| :---: | :---: | :---: |
| 0 | Open | Setting for maintenance. <br> The start menu appears, allowing you to perform boot and IPL operations from the CNC display unit with PC functions. |
| 1 | Open | Normal setting. <br> The start menu is not displayed. You cannot perform boot and IPL operations from the CNC display unit with PC functions. |
| 2 | Connected | The CNC and the CNC display unit with PC functions start separately without handshaking. <br> - CNC <br> - Even when the CNC display unit with PC functions is not connected to the CNC or is off, just the CNC can be started and operated. (For CNC operation, a CNC-dedicated display, an MDI unit, an operator's panel, and so on are required.) <br> - Even when the CNC display unit with PC functions is connected and is on, the start menu is not displayed. <br> - CNC display unit with PC functions <br> - Even when the CNC is not connected or is off, just the CNC display unit with PC functions can be started and operated. <br> - The temperature management function of the CNC display unit with PC functions does not work. Before using the CNC display unit with PC functions, check that its temperature is within the recommended temperature range. <br> - Even when the CNC is connected to the CNC display unit with PC functions is on, the start menu is not displayed. You cannot perform boot and IPL operations from the CNC display unit with PC functions. <br> For normal operation, this setting is prohibited. Use this setting only for maintenance. |

## NOTE

For the jumper plug (SW5) position on the CNC display unit with PC functions, see Section 10.7.

# 9.5 <br> PERSONAL COMPUTER SPECIFICATION 

## CAUTION

1 The personal computer must be purchased and maintained by the machine tool builder or end user.
2 FANUC is not liable for any problems resulting from the operation of users' personal computers, regardless of whether the operations are normal or abnormal.
(1) The ISA personal computer interface board conforms to the ISA and can be used with IBM PC/AT machines and fully compatible machines. (The CPU must be the 486 or better.)
(2) The FANUC high-speed serial bus type 2 (for the ISA bus) uses the 16 bytes that are based on the I/O address set by the appropriate switch for each HSSB channel. (For an explanation of how to set the address, see the section on the setting switch in the Maintenance manual.) Other functions or expansion boards that use the same resource cannot be used at the same time.
(3)To use this board, the HSSB driver must be installed in the personal computer. The HSSB driver is contained in the "open CNC driver library disk (ordering information: A02B-0207-K730)."
(4) Conduct a personal computer-to-CNC control unit connection test thoroughly in advance.
(5) The power required for the operation of the personal computer interface board is as follows.

| 1-ch type | $+5 \mathrm{~V}, 1 \mathrm{~A}$ |
| :---: | :---: |
| 2-ch type | $+5 \mathrm{~V}, 1.5 \mathrm{~A}$ |

### 9.5.2

Personal Computer Specifications Required if the PCI Bus Board is Used
(1) The PCI personal computer interface board can be used with the personal computer conforming to the PCI standard rev. 2.1 (5V). It supports the ISA-type slot, but not the MCA-type slot.
(2) To use this board, the HSSB driver must be installed in the personal computer. The HSSB driver is contained in the "open CNC driver library disk (ordering information: A02B-0207-K730)." The HSSB driver supporting the PCI board is contained in the "open CNC driver library disk (ordering information: A02B-0207-K730)," Edition 1.6 or later.
(3) Conduct a personal computer-to-CNC control unit connection test thoroughly in advance.
(4) The power required for the operation of the personal computer interface board is as follows.

| 1-ch type | $+5 \mathrm{~V}, 0.8 \mathrm{~A}$ |
| :---: | :---: |
| 2-ch type | $+5 \mathrm{~V}, 1 \mathrm{~A}$ |

(1) Personal computer interface boards

The same environmental conditions as those for the installation of the personal computer must be satisfied.
(2) CNC interface board

The same environmental conditions as those described earlier for the installation of the CNC control unit must be satisfied.

## 9.7 <br> PROCEDURE FOR INSTALLING PERSONAL COMPUTER INTERFACE BOARDS

## WARNING

Before starting to mount or remove a personal computer interface board, switch off the personal computer and its peripheral devices, and disconnect their power supply cables. Otherwise, there is a serious danger of electric shock.
(1) For the ISA bus interface board, set the I/O address before installing the board. Set I/O base addresses which do not overlap the I/O address areas exclusively used by the personal computer and ISA expansion board. (See the figure below.)
When using multiple personal computer interface boards, set the I/O base addresses so that those addresses do not overlap each other. For the PCI bus board, the address need not be set.
(2)Remove the blank panel from the expansion slot of the personal computer.
(3) Insert the interface board. Ensure that it has been completely inserted into the ISA connector or PCI connector.
(4) Fix the metal brackets with screws.

## CAUTION

Do NOT touch the edge terminals (the contacts that engage with a mating connector) of the interface board.


I/O base address setting
(for personal computer interface board of new type 2 (A20-B-8100-0582, -0583))

## 9.8 <br> HANDLING PRECAUTIONS

(1) Personal computer interface board
(A) Electrostatic interference

The personal computer interface board is shipped in an anti-static bag. To store or transport the interface board, always place it in the anti-static bag. Before removing the interface board from the anti-static bag, ground your body.
(B) Protection of card edge terminals

When handling the personal computer interface board, do NOT touch its card edge terminals (the gold-plated contacts which engage with a mating connector). If you accidentally touch any card edge terminal, wipe it gently with clean or ethyl alcohol-dipped tissue paper or absorbent cotton. Do not use any organic solvent other than ethyl alcohol.
(2) Optical connector and fiber cable

See Appendix D.

## 9.9

RECOMMENDED CABLES


Compatible cables (optical fiber cables, used for interconnections)
A66L-6001-0026\#L
For an explanation of the cable length and other related information, see Appendix D.

# 10 <br> <br> CNC DISPLAY UNIT WITH PC FUNCTIONS 

 <br> <br> CNC DISPLAY UNIT WITH PC FUNCTIONS}

Ordering numbers of related basic units A13B-0193-B031 to -B057
10.1

OVERVIEW

The CNC display unit with PC functions is a panel computer incorporating an IBM PC-compatible personal computer. The CNC display unit with PC functions can be connected to the Series $150 i$ system through a high-speed optical fiber (high-speed serial bus) to build a system having personal computer capabilities.

## 10.2 <br> ATTENTION

- The copyright of Windows 2000, Windows NT, Windows 95/98 and other software provided with the CNC display unit with PC functions is owned by Microsoft Corporation (USA), NeoMagic Inc., Phoenix Technologies Ltd., PFU Co.,Ltd, and FANUC LTD.
- No part of the software described above, or its manuals, may be used or reproduced without permission.
- No part of the software described above, or its manuals, may be sold independently of the CNC display unit with PC functions.
- The software described above, and its manual, must be used under the conditions described in the attached license agreement.
- The use of the CNC incorporating the CNC display unit with PC functions shall imply that the user agrees to the conditions of the license agreement described above.
*Windows2000, Windows NT and Windows 95/98 is a registered trademark of Microsoft corporation, USA
* Company name and product name mentions in this manual are (registered) trademark of each company.


## CAUTION

1 If an operation error or mishap occurs, the data on the hard disk may be lost, even if all the installation conditions are satisfied. Therefore, always maintain a backup copy of the data on the hard disk in case the stored data is lost or damaged.
Especially, the power-off on accessing the hard disk must not be done because that possibility is very high. Please concern for the end-users.
2 Be sure to finish the OS and the applications through the proper operation of shutdown before turning the power off. Without the above-mentioned operation, there is no assurance of the following action. At worst, the command of initializing the HDD will not work.

## 10.3

HARDWARE
SPECIFICATIONS

| Item |  | Specification |  |  |
| :---: | :---: | :---: | :---: | :---: |
| CPU |  | Pentium III 500 MHz <br> Celeron 400 MHz <br> MMX-Pentium 233 MHz |  |  |
| Memory |  | $32 \mathrm{MB}, 64 \mathrm{MB}$ or 128 MB <br> (32MB can be specified only in case of MMX-Pentium) |  |  |
| Display Unit | LCD | 10.4" color LCD ( $640 \times 480$ dots, 65536 colors) or 12.1" color LCD (800x600dots, 65536 colors) or 15.0" color LCD (1024×768 dots, 65536 colors ) |  |  |
|  | Touch-Panel | Option | It is possible to specify both of touch-Panel and soft-key. (SoftKey is not available in case of 15.0 " LCD) |  |
|  | Soft-Key | Option |  |  |
| HDD unit |  | 3.5" Hard Disk Drive10GB Ultra ATA/33 <br> Maximum 2 IDE devices can be connected. (Master/ Slave) <br> (There is limitation of cable length. 2 IDE devices must be mounted under CNC display unit with PC functions) <br> (It is mounted on the backside of the MDI or the FA Full-keyboard.) |  |  |
| $\begin{array}{\|l\|} \hline \text { I/O } \\ \text { Port } \end{array}$ | PCMCIA Card | 1 port (Type I/II, based on PCMCIA 2.1) |  |  |
|  | USB | 2 ports (based on Universal Serial Bus Revision 1.0) |  |  |
|  | Serial Port 1 | 1 port (In case of Touch-Panel type, Serial 1 cannot be used.) |  |  |
|  | Serial Port 2 | 1 port |  |  |
|  | Full Keyboard | 1 port (PS/2 compatible) |  |  |
|  | Mouse | 1 port (PS/2 compatible) |  |  |
|  | Floppy disk | 1 port (PC/AT compatible) |  |  |
|  | Parallel Port | 1 port (Data transfer mode is by-directional mode) |  |  |
| Connection with CNC controller |  | High Speed Serial Bus (HSSB) |  |  |
| PCI Extension (option) |  | 2 slots of the short card based on PCl specification 2.1 $32-\mathrm{bit}, 33 \mathrm{MHz},+5 \mathrm{~V}$ <br> Maximum dimension of card: $176.41 \mathrm{~mm} \times 106.68 \mathrm{~mm}$ |  |  |
| Real time clock |  | Monthly error is within 3 minutes. |  |  |
| Dimension of Basic unit |  | ```290x220mm (10.4" LCD type) \(340 \times 280 \mathrm{~mm}\) (12.1" LCD type) 400x320mm (15.0" LCD type) Depth 60mm(without PCI extension)/125mm(with PCI extension)``` |  |  |
| Dimension of MDI and FA Fullkeyboard |  | $290 \times 220 \mathrm{~mm}$ (for 10.4" LCD type and vertical) <br> 230x220mm (for 10.4" LCD type and horizontal) *Only MDI <br> $340 \times 220 \mathrm{~mm}$ (for 12.1" LCD type and vertical) <br> $230 \times 280 \mathrm{~mm}$ (for $12.1^{\prime \prime}$ LCD type and horizontal) *Only MDI <br> $400 \times 220 \mathrm{~mm}$ (for 15.0 "LCD type and vertical ) *Only FA Full keyboard |  |  |


| Item |  | Specification |
| :--- | :--- | :--- |
| Weight | for 10.4" LCD type | 3.6 kg (Intelligent Terminal) |
|  |  | 3.5 kg (FA Full-keyboard with 3.5"HDD unit for vertical) |
|  |  | 2.9 kg (MDI with 3.5"HDD unit for vertical) |
|  |  | 2.7 kg (MDI with 3.5"HDD unit for horizontal) |
|  |  | for 12.1" LCD type |
|  |  | 4.3 kg (Intelligent Terminal) |
|  |  | 3.7 kg (FA Full-keyboard with 3.5"HDD unit for vertical) |
|  |  | 3.2 kg (MDI with 3.5"HDD unit for vertical) |
|  |  | 3.1 kg (MDI with 3.5"HDD unit for horizontal) |
|  |  | for 15.0" LCD type |
|  |  | 6.0 kg (Intelligent Terminal) |
|  |  | 3.9 kg (FA Full-keyboard with 3.5"HDD unit for vertical) |

* A MDI unit can be used in case of connecting with CNC via High Speed Serial Bus (HSSB).


## 10.4

TOTAL CONNECTION
10.4.1

Without Soft-Key \&
Touch-Panel


[^0]*2 A 3.5 "HDD unit with a FAN unit must be mounted on the backside of a FA Full Keyboard.
10.4.2

With Soft-Key, Without
Touch-Panel

*1 These devices can be used only during application development. These cannot be installed in the control unit.
*2 A 3.5 "HDD unit with a FAN unit must be mounted on the backside of a MDI.
10.4.3

With Touch-Panel, Without Soft-Key

*1 Either Separate MDI or FA Full Keyboard is usable. Both cannot be used simultaneously. A 3.5"HDD unit with a FAN unit must be mounted on the backside of a FA Full Keyboard or a MDI.
*2 These devices can be used only during application development. These cannot be installed in the control unit.
*3 RS232-C channel 1 is not usable because it is used by the Touch-Panel.
10.4.4

With Soft-Key and Touch-Panel

*1 These devices can be used only during application development. These cannot be installed in the control unit.
*2 A 3.5 "HDD unit with a FAN unit must be mounted on the backside of a MDI.
*3 RS232-C channel 1 is not usable because it is used by the Touch-Panel.

## 10.5 <br> SPECIFICATION

### 10.5.1 <br> Environment

When CNC display unit with PC functions is used, the following environmental conditions (as measured top of the CNC display unit with PC functions inside the cabinet) must be ensured for the CNC display unit with PC functions unit installation.

| Ambient temperature | Operating $:+5$ to $+45^{\circ} \mathrm{C}$ <br> Non-operating $:-20$ to $+60^{\circ} \mathrm{C}$ |
| :---: | :---: |
| Change in temperature | Up to $0.3{ }^{\circ} \mathrm{C} / \mathrm{min}$ |
| Ambient relative humidity | Standard $: 10$ to $75 \%$ (non-condensing) Short-term $: 10$ to $90 \%$ (non-condensing) (within one month) |
| Vibration | Operating : up to 0.5 G <br> Non-operating : up to 1.0 G |
| Environment | Installed in a hermetically sealed cabinet |
| Altitude | Operating $:-60 \mathrm{~m}$ to 3000 m <br> Non-operating $:-60 \mathrm{~m}$ to 12000 m |

(*1) Ambient temperature during operation :
The temperature sensor on the CNC display unit with PC functions PCB monitors whether the temperature is within the specified range.

1) If the temperature at power-on is beyond the allowable range only $\mathrm{CNC} / \mathrm{PMC}$ is started. After that if the temperature becomes to within the allowable range, CNC display unit with PC functions automatically starts.
This function is disable when Option for Non-Connecting with CNC is ordered. CNC display unit with PC functions starts up irrespective of the temperature. Therefore, the temperature around CNC display unit with PC functions should be watched by the other method.
2) If the temperature drifts out of the allowable range after normal activation, an error occurs when the hard disk is next accessed.
(*2) Vibration :
The CNC display unit with PC functions unit and built-in hard disk drive may suffer resonance at certain frequencies. Careful checking is required on the CNC display unit with PC functions unit has been mounted on a machine.

## CAUTION

If an operation error or mishap occurs, the data on the hard disk may be lost, even if all the installation conditions are satisfied. Therefore, always maintain a backup copy of the data on the hard disk in case the stored data is lost or damaged.
Especially, the power-off on accessing the hard disk must not be done because that possibility is very high. Please concern for the end-users.

Some development or maintenance options may not satisfy the above specifications.
(*3) Measure for Noise :
Please measure for noise sufficiently referring to CNC's connection manual.

### 10.5.2 <br> Power Specification

1) Power Supply Requirement
a) Specification

When the CNC display unit with PC functions is used, the following power supply is required.

| Input Voltage | $+24 \mathrm{VDC} \pm 10 \%$ |
| :--- | :--- |
| Current capacity | Max. 7A (For 10.4" and 12.1" LCD type unit) <br> Max. 10A (For 15.0" LCD type unit) |

## NOTE

If Handy File or other unit made by FANUC is connected to RS232C port, this value will increase by +1 A .
b) Timing

Input power can be turned on/off without relation to CNC power on/off.
Normal start is not performed when only the CNC controller is turned on without the CNC display unit with PC functions being turned on.

## 2) Power Supply

Following powers are usable for peripherals.
Check the power supply current required for each connected peripheral and then make sure that the following usage range is not exceeded.

| Voltage | Equipment | Max. Current |  |
| :--- | :--- | :--- | :--- |
| +5 V | FDD, <br> Keyboard, Mouse <br> HDD(secondary) or ATAPI device <br> PCI extension board | 4000 mA |  |
|  | USB device |  |  |
|  | PCMCIA card |  | Max. $500 \mathrm{~mA} /$ port |
|  | Max. 500 mA |  |  |
| +3.3 V | PCI extension board <br> PCI extension board <br> PCMCIA card <br> HDD(secondary) or ATAPI device | 1000 mA |  |
| +12 V | PCI extension board | 1700 mA |  |
| -12 V |  | 140 mA |  |

3) Power Consumption
10.4"/12.1" LCD type : about 40W
15.0 LCD type : about 52W

Above operating includes the following devices.

- CNC display unit with PC functions, HDD Unit, FAN for HDD, FDD Unit, Full Keyboard, and Mouse.

Above operating does not include the following devices.

- PCMCIA Card, PCI Extension board, and Devices to connect by Serial or Parallel Interface.


## NOTE

Above power consumption is reference. If peripherals are connected or PCl extended boards are mounted, the power consumption will increase. Also, please consider the cabinet design and the cooling method which is most suitable to the total power consumption.
10.5.3

## CAUTION

Be sure to finish the OS and the applications through the proper operation of shutdown before turning the power off. Without the above-mentioned operation, there is no assurance of the following action. At worst, the command of initializing the HDD will not work.
10.6

MOUNTING SPACE

The following three spaces are required around the CNC display unit with PC functions.
(a) Space for connecting cables.

Also, If you wish to exchange a battery or a fuse without removing Intelligent Terminal 3 from the machine panel, this space A is required and it is necessary to be able to access to the battery or the fuse from the rear side of the CNC display unit with PC functions.
(b) If PCI extension board exists, this space B is required for cable connection. The dimension X depends on cables connected to the PCI Extension board.
(c) This space is required for airflow.

CNC display unit with PC functions consumes the power described at "10.5.2" item 3). Therefore, please install cooling system in the cabinet with keeping space C .
10.6.1

Basic Unit 10.4" LCD
Type


### 10.6.2

Basic Unit 12.1" LCD Type


### 10.6.3

## Basic Unit 15.0" LCD

Type

10.6.4 HDD Unit

The HDD unit is mounted on the backside of the MDI or the FA Full-Keyboard.


Refer to APPENDIX about outline dimensions of the FA full keyboard and the position of the HDD unit.

## 10.7 <br> CONNECTION TO PERIPHERAL

### 10.7.1

## Connector Location



| Connector Number | Connector Name | Function | Reference |  |
| :--- | :--- | :--- | :--- | :--- |
| CP5 | +24V INPUT | Main Power Input | to Section | 10.7 .2. |
| JD33 | $232-1$ | Serial Port 1 | to Section | 10.7 .3. |
| JD46 | $232-2$ | Serial Port 2 +USB | to Section | 10.7 .4. |
| JD9 | CENTRO | Parallel Port | to Section | 10.7 .5. |
| COP7 | HSSB | HSSB | to Section | 10.7 .6. |
| CD32B | MOUSE | Mouse | to Section | 10.7 .7. |
| CD32A | KEY BOARD | Full Keyboard | to Section | 10.7 .8. |
| CNH3 | HDD | HDD Signal | to Section | 10.7 .9. |
| CN2B | HDD POWER | FAN for HDD | to Section | 10.7 .9. |
| CN7 | HDD FAN | FDD Signal | to Section | 10.7 .9. |
| CD34 | FDD | to Section | 10.7 .10. |  |
| CN2 | FDD POWER | PCMCIA Card | to Section | 10.7 .10. |
|  |  | to Section | 10.7 .12. |  |
| CNP1 | PCI SLOT 1 | PCI extension slot 1 | to Section | 10.8 |
| CNP2 | PCI SLOT 2 | PCI extension slot 2 | to Section | 10.8 |

## NOTE

The Soft-Key only exists in the CNC display unit with PC functions with Soft-Key.

### 10.7.2

Main Power Input


1) Cable Wiring

2) Recommended Cable Material

Use wire of AWG16 (1.3 mm ${ }^{2}$ ) or thicker.

## NOTE

Please wire this cable separately from the other cables connected to CNC display unit with PC functions.
10.7.3

Serial Port 1

In case of CNC display unit with PC functions with the TOUCH-PANEL, Serial Port 1 is not available because the TOUCH-PANEL CONTROLLER uses the 1st port of RS-232-C.

CNC display unit with PC functions

| JD33 (PCR-E20MD) |  |  |  |
| :--- | :--- | :--- | :--- |
| 1 RD 11 <br> 2 0 VD 12 <br> 3 DR 13 <br> 4 0 V 14 <br> 5 CS 15 <br> 6 (Reserve) 16 <br> 7 CD 17 <br> 8 (Reserve) 18 <br> 9 RI 19 <br> 10 (Reserverve)  |  |  |  |

* (Reserve) pins are not usable.
ex.) Host Computer
(DBM-25)

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

## NOTE

1 The figure shows a sample host computer interface. Design the cable to suit the interface of the actual device to be connected.
2 The +24 V pins of the interface for CNC display unit with PC functions shown above can be used only with the FANUC I/O unit. Do not use these pins for other purposes. Also, do not attempt to simultaneously connect two or more FANUC I/O units to one CNC display unit with PC functions. Two or more simultaneous connections may cause the $+24-\mathrm{V}$ power supply rating to be exceeded.

1) RECOMMENDED CABLE MATERIAL

A66L-0001-0284\#10P $\cdot \cdot 0.08 \mathrm{~mm}^{2}$ X 10 pairs
2) RECOMMENDED CONNECTOR FOR CABLE and HOUSING(JD33 sideK

| CONNECTOR | HOUSING | MAKER |
| :--- | :--- | :--- |
| PCR-E20FA | PCR-V20LA/PCS-E20LA | (Honda Tsushin Kogyo) |
| FI30-20S | FI-20-CV2/FI-20-CV7 | (Hirose Electric) |
| FCN-247J020-G/E | FCN-240C020-Y/S | (Fujitsu) |
| $52622-2011$ | $52624-2015$ | (Molex Japan) |

3) RECOMMENDED PUNCH PANEL SPECIFICATION A02B-0236-C191 (Wire length : 1m)
A02B-0236-C192 (Wire length : 2m)
A02B-0236-C193 (Wire length : 5m)
When a punch panel other than the above is used, a failure to start or another problem occurs.

### 10.7.4 <br> Serial Port 2+USB

CNC display unit with PC functions

| JD46 (PCR-E20MD) |  |  |  |
| :---: | :---: | :---: | :---: |
| 1 | RD | 11 | SD |
| 2 | OV | 12 | USB1_0V |
| 3 | DR | 13 | ER |
| 4 | OV | 14 | USB2 0V |
| 5 | CS | 15 | RS |
| 6 | USB1+ | 16 | USB2+ |
| 7 | CD | 17 | USB2- |
| 8 | USB1- | 18 | USB2_5V |
| 9 | RI | 19 | (+24V) |
| 10 | (+24V) | 20 | USB1_5V |

( ): Used with FANUC I/O device

* (Reserve) pins are not usable.
ex.) Host Computer

| (DBM-25S) <br> 1 FG 14  <br> 2 SD 15  <br> 3 RD 16  <br> 4 RS 17  <br> 5 CS 18  <br> 6 DR 19  <br> 7 SG 20 ER <br> 8 CD 21  <br> 9  22 RI <br> 10  23  <br> 11  24  <br> 12  25  <br> 13    |
| :--- |

ex.) Punch panel for USB port


USB port 2

| 1 | USB2_5V |
| :--- | :--- |
| 2 | USB2+ |
| 3 | USB2- |
| 4 | USB2_0V |



## NOTE

1 The figure shows a sample host computer interface and USB. Design the cable to suit the interface of the actual device to be connected.
2 The +24 V pins of the interface for CNC display unit with PC functions shown above can be used only with the FANUC I/O unit. Do not use these pins for other purposes. Also, do not attempt to simultaneously connect two or more FANUC I/O units to one CNC display unit with PC functions.
3 Commercial USB devices cannot be guaranteed its proper work with Intelligent Terminal 3. Careful checking by the customer will be required. And please be aware that those devices in the market are not almost considered about waterproof and dustproof.

1) RECOMMENDED CABLE MATERIAL SPEC.

For RS232-C : A66L-0001-0284\#10P $\cdot \cdots 0.08 \mathrm{~mm}^{2} 10$ pairs
For USB : Please use special wire for USB
2) RECOMMENDED CONNECTOR FOR CABLE and HOUSING(JD46 sideK

| CONNECTOR | HOUSING | MAKER |
| :--- | :--- | :--- |
| PCR-E20FA | PCR-V20LA/PCS-E20LA | (Honda Tsushin Kogyo) |
| FI30-20S | FI-20-CV2/FI-20-CV7 | (Hirose Electric) |
| FCN-247J020-G/E | FCN-240C020-Y/S | (Fujitsu) |
| $52622-2011$ | $52624-2015$ | (Molex Japan) |

3) RECOMMENDED PUNCH PANEL SPECIFICATION

A02B-0236-C191 (Wire length : 1m)
A02B-0236-C192 (Wire length : 2m)
A02B-0236-C193 (Wire length : 5m)
When a punch panel other than the above is used, a failure to start or another problem occurs.
The above punch panel does not include the USB signal.
10.7.5

## Parallel Port

CNC display unit with PC functions

| JD9 (PCR-E20MD) |  |  |  |
| :--- | :--- | :--- | :--- |
| 1 STD0 11 <br> *STB   <br> 2 STD1 12 <br> 3 STD2 13 <br> 4 STD3 14 <br> 5 STD4 15 <br> 6 STD5 16 <br> 7 STD6 17 <br> 8 STD7 18 <br> 9 PE 19 <br> 10 SLCT 20 <br>  BLIN  |  |  |  |
|  |  |  |  |

ex.) PRINTER

| 1 | *STB | 19 | OV |
| :---: | :---: | :---: | :---: |
| 2 | STD0 | 20 | OV |
| 3 | STD1 | 21 | OV |
| 4 | STD2 | 22 | OV |
| 5 | STD3 | 23 | OV |
| 7 | STD5 | 25 | OV |
| 6 | STD4 | 24 | OV |
| 8 | STD6 | 26 | OV |
| 9 | STD7 | 27 | OV |
| 10 | *ACK | 28 | OV |
| 11 | BUSY | 29 | OV |
| 12 | PE | 30 | OV |
| 13 | SLCT | 31 | *INIT |
| 14 | *AFD | 32 | *ERROR |
| 15 |  | 33 | OV |
| 16 | OV | 34 |  |
| 17 | FG | 35 |  |
| 18 |  | 36 | *SLIN |

## NOTE

1 The figure shows a sample printer interface. Design the cable to suit the interface of the actual device to be connected.
2 Some kinds of Printers and other devices may not work properly with Intelligent Terminal 3, so careful checking by the customer will be required. And please be aware that I/O devices in the market are not almost considered about waterproof and dustproof.

1) RECOMMENDED CABLE MATERIAL SPEC.

A66L-0001-0284\#10P $\cdot \cdot 0.08 \mathrm{~mm}^{2} 10$ pairs
2) RECOMMENDED CONNECTOR FOR CABLE and HOUSING(JD9 sideK

| CONNECTOR | HOUSING | MAKER |
| :--- | :--- | :--- |
| PCR-E20FA | PCR-V20LA/PCS-E20LA | (Honda Tsushin Kogyo) |
| FI30-20S | FI-20-CV2/FI-20-CV7 | (Hirose Electric) |
| FCN-247J020-G/E | FCN-240C020-Y/S | (Fujitsu) |
| $52622-2011$ | $52624-2015$ | (Molex Japan) |

10.7.6

## High Speed Serial Bus

(HSSB)


1) RECOMMENDED CABLEJOptical Fiber CableK A66L-6001-0026\#L1R003 $\cdot$ Cable Length $=1 \mathrm{~m}$ A66L-6001-0026\#L3R003 $\cdots$ Cable Length $=3 \mathrm{~m}$ A66L-6001-0026\#L5R003 $\cdots$ Cable Length $=5 \mathrm{~m}$ A66L-6001-0026\#L7R003 $\cdots$ Cable Length $=7 \mathrm{~m}$ A66L-6001-0026\#L10R03 • • Cable Length $=10 \mathrm{~m}$ A66L-6001-0026\#L15R03 $\cdot$ • Cable Length $=15 \mathrm{~m}$ A66L-6001-0026\#L20R03 $\cdots$ Cable Length $=20 \mathrm{~m}$ A66L-6001-0026\#L30R03 $\cdots$ Cable Length $=30 \mathrm{~m}$ A66L-6001-0026\#L50R03 $\cdot$. Cable Length $=50 \mathrm{~m}$ A66L-6001-0026\#L100R3 $\cdots$ Cable Length $=100 \mathrm{~m}$
2) Junction-only low-loss optical fiber cables A66L-6001-0029\#L1R003: Cable length $=1 \mathrm{~m}$ A66L-6001-0029\#L3R003: Cable length $=3 \mathrm{~m}$ A66L-6001-0029\#L5R003: Cable length $=5 \mathrm{~m}$ A66L-6001-0029\#L7R003: Cable length $=7 \mathrm{~m}$ A66L-6001-0029\#L10R003: Cable length $=10 \mathrm{~m}$ A66L-6001-0029\#L15R003: Cable length $=15 \mathrm{~m}$ A66L-6001-0029\#L20R003: Cable length $=20 \mathrm{~m}$ A66L-6001-0029\#L30R003: Cable length $=30 \mathrm{~m}$ A66L-6001-0029\#L40R003: Cable length $=40 \mathrm{~m}$ A66L-6001-0029\#L50R003: Cable length $=50 \mathrm{~m}$
3) Low-loss optical junction adapter

A63L-0020-0004

Refer to the following TECHNICAL REPORT that describes the HSSB and Optical Fiber Cable.

| Name | Spec. |
| :--- | :---: |
| FANUC High Speed Serial Bus Type 2 <br> Connecting and Maintenance Manual | A-73527E |

## NOTE

1 Optical fiber cable used for FANUC I/O Link, for FSSB and for Serial Spindle can not be used.

## NOTE

2 Optical fiber cable can not be cut or joined by customer. Use one of above cables.

### 10.7.7

Mouse

CNC display unit with PC functions


## NOTE

1 Some kinds of Mouse may not work properly with CNC display unit with PC functions, so careful checking by the customer will be required. And please be aware that Mouse in the market is not almost considered about waterproof and dustproof.
2 The Mouse and The Touch-Panel can not be used simultaneously.

1) RECOMMENDED MOUSE

A86L-0001-0212 • • Standard PS/2 Mouse (in the market)
(Only for application development or maintenance)

### 10.7.8

## Full Keyboard

## CNC display unit with PC functions



## NOTE

Some kinds of Full Keyboard may not work properly with CNC display unit with PC functions, so careful checking by the customer will be required. And please be aware that Full Keyboard in the market is not almost considered about waterproof and dustproof.

1) RECOMMENDED FULL KEYBOARD

A86L-0001-0210: 101 type (in the market) Only for application development or maintenance
A86L-0001-0211 : 106 type (in the market) Only for application development or maintenance
A02B-0236-C131\#JC : FA Full Keyboard (Japanese) for 10.4" LCD type
A02B-0236-C131\#EC : FA Full Keyboard (English) for 10.4" LCD type
A02B-0236-C132\#JC : FA Full Keyboard (Japanese) for 12.1" LCD type
A02B-0236-C132\#EC :FA Full Keyboard (English) for 12.1" LCD type
A08B-0082-C150\#JC : FA Full Keyboard (Japanese) for 15.0 LCD type
A08B-0082-C150\#EC :FA Full Keyboard (English) for 15.0" LCD type

## NOTE

Refer to the below manual about FA Full Keyboard.

| Name | Drawing No. |
| :--- | :---: |
| FA FULL-KEYBOARD FOR FANUC NC <br> BOARD CONNECTION MANUAL | A-73159E |

10.7.9

Hard Disk Drive

1) Cable Connection

Connect HDD Signal cable to CNH3.
Connect HDD Power cable to CN2B.
Connect FAN cable to CN7.
Each cables are connected to HDD unit at exfactory.
2) Cable Length

HDD Power Cable: 50 cm
HDD Signal Cable: 40 cm
HDD FAN Cable: 65 cm

10.7.10

## Floppy Disk Drive

(Signal \& Power)

CNC display unit with PC functions

| CD34 |  |  |  |
| :---: | :---: | :---: | :---: |
| 1 | OV | 2 | DENSEL |
| 3 | OV | 4 |  |
| 5 | OV | 6 |  |
| 7 | OV | 8 | *INDEX |
| 9 | OV | 10 | *MT0 |
| 11 | OV | 12 | *DS1 |
| 13 | OV | 14 | *DS0 |
| 15 | OV | 16 | *MT1 |
| 17 | OV | 18 | *DIR |
| 19 | OV | 20 | *STEP |
| 21 | OV | 22 | *WDATA |
| 23 | OV | 24 | *WE |
| 25 | OV | 26 | *TRK0 |
| 27 | OV | 28 | *WPRT |
| 29 | OV | 30 | *RDATA |
| 31 | OV | 32 | HDSEL |
| 33 | OV | 34 | *DSKCH |
| CN2 |  |  |  |
| - |  | 1 | (+12V) |
| 123 |  | 2 | OV |
| 1 |  | 3 | 0V |
|  |  | 4 | +5V |

3.5" Floppy Disk Drive A


## NOTE

1 This is standard interface for IBM PC. But, please pay attention to the following points.

1) Only 2 modes J720K/1.44M bytesK are available.
2) DENSEL is fixed "Low" level.
3) The floppy disk drive which needs +12VDC input is not available.

2 Some kinds of floppy disk drive may not work properly with Intelligent Terminal 3, so careful checking by the customer will be required. And please be aware that floppy disk drives in the market are not almost considered about waterproof and dustproof.
3 The figure shows a sample drive interface. Design the cable to suit the interface of the actual drive to be connected.
4 Recommended Cable is as follows. (Cable length is 1.0 m )
A02B-0207-K801

1) Cable Wiring

| CD34 |  |  |  |  | J1 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| CNC display unit with PC functions P.C.B | $\begin{array}{r} 0 \mathrm{~V} \\ \text { DENSEL } \\ 0 \mathrm{~V} \\ \text { (NC) } \\ 0 \mathrm{~V} \\ \text { (NC) } \\ 0 \mathrm{~V} \\ \text { *INDEX } \\ 0 \mathrm{~V} \\ \text { *MTO } \\ 0 \mathrm{~V} \\ \text { *DS1 } \\ 0 \mathrm{~V} \\ \text { *DSO } \\ 0 \mathrm{~V} \\ \text { *MT1 } \\ 0 \mathrm{~V} \\ \text { *DIR } \\ 0 \mathrm{~V} \\ \text { *STEP } \\ 0 \mathrm{~V} \\ \text { *WDATA } \\ 0 \mathrm{~V} \\ \text { *WE } \\ 0 \mathrm{~V} \\ \text { *TRKO } \\ 0 \mathrm{~V} \\ \text { *WPRT } \\ 0 \mathrm{~V} \\ \text { *RDATA } \\ 0 \mathrm{~V} \\ \text { HDSEL } \\ 0 \mathrm{~V} \\ \text { *DSK } \end{array}$ | 1 | 1 | 1 | OV <br> DENSEL <br> OV <br> (NC) <br> OV <br> (NC) <br> OV <br> *INDEX <br> OV <br> *DS0 <br> OV <br> *DS1 <br> OV <br> (Reserve) <br> OV <br> *MTRON <br> OV <br> *DIR <br> OV <br> *STEP <br> OV <br> *WDATA <br> OV <br> *WE <br> OV <br> *TRKO <br> OV <br> *WPRT <br> OV <br> *RDATA <br> OV <br> HDSEL <br> OV | Panel Mount Type 3.5" Floppy Disk Unit <br> (Refer to the figure of previous page about the pin assignments) |
|  |  | 2 | 2 | 2 |  |  |
|  |  | 3 | 3 | 3 |  |  |
|  |  | 4 | 4 | 4 |  |  |
|  |  | 5 | 5 | 5 |  |  |
|  |  | 6 | 6 | 6 |  |  |
|  |  | 7 | 7 | 7 |  |  |
|  |  | 8 | 8 | 8 |  |  |
|  |  | 9 | 9 | 9 |  |  |
|  |  | 10 | 10 | 16 |  |  |
|  |  | 11 | 11 | 15 |  |  |
|  |  | 12 | 12 | 14 |  |  |
|  |  | 13 | 13 | 13 |  |  |
|  |  | 14 | 14 | 12 |  |  |
|  |  | 15 | 15 | 11 |  |  |
|  |  | 16 | 16 | 10 |  |  |
|  |  | 17 | 17 | 17 |  |  |
|  |  | 18 | 18 | 18 |  |  |
|  |  | 19 | 19 | 19 |  |  |
|  |  | 20 | 20 | 20 |  |  |
|  |  | 21 | 21 | 21 |  |  |
|  |  | 22 | 22 | 22 |  |  |
|  |  | 23 | 23 | 23 |  |  |
|  |  | 24 | 24 | 24 |  |  |
|  |  | 25 | 25 | 25 |  |  |
|  |  | 26 | 26 | 26 |  |  |
|  |  | 27 | 27 | 27 |  |  |
|  |  | 28 | 28 | 28 |  |  |
|  |  | 29 | 29 | 29 |  |  |
|  |  | 30 | 30 | 30 |  |  |
|  |  | 31 | 31 | 31 |  |  |
|  |  | 32 | 32 | 32 |  |  |
|  |  | 33 | 33 | 33 |  |  |
|  |  | 34 | 34 | 34 |  |  |
|  |  |  |  |  |  |  |

FDD interface is standard one for IBM PC. The connecting cable which can be gotten in the market is twisted from 10th pin to 16 th pin between the CNC display unit with PC functions (PC) and a Drive A. In this case, the drive number plug of FDD must be set "DRIVE 1" (Secondary Drive).
2) Power Cable Wiring

10.7.11

Soft-Key (CNC Display
Unit with PC Functions with Soft Key)


1) Cable Length: 50 cm
10.7.12

PCMCIA Card


## NOTE

1 Only Type I or Type II PCMCIA card using only +5 V is usable. The following card cannot be used.

- Card-bus card
- Dual mode card (Card-bus mode/ PCMCIA mode) with Card-bus mode
- Type III card
- +3.3V card

2 Care about the direction of the card, and insert certainly.

## CAUTION

If the door is opened, dust or coolant would enter and might cause any troubles. Please pay attention.

## 10.8 <br> METHOD OF <br> MOUNTING PCI <br> EXTENSION BOARD

10.8.1

Usable Board

The size of usable board on the CNC display unit with PC functions is defined as below figure, and one or two boards can be mounting on the CNC display unit with PC functions.


### 10.8.2

Method of Mounting PCI Extension Board

1) Release vibration-proof fittings by loosening the screw at point (B).
2) Push the board fully into the PCI connector.
3) Tighten the screw at point (A).
4) Press down vibration-proof fittings to the PCI extension board and tighten the screw at point (B).

In the case of mounting two boards, the height of board mounted in slot 1 must be lower than the height of the board mounted in slot 2 for holding both board with each vibration-proof fittings.

If the fittings do not fit these extension boards, please change the screw (B) positions.

10.8.3

Method of Mounting PCI Extension Board
(1) Environment Conditions

Refer to the specifications of PCI extension board for the environmental conditions for installation of it. If the PCI extension board specifications impose harder environmental conditions than the conditions described in "I.CONNECTION - 2.2. Environment", these environmental conditions for the PCI extension board are given priority.

## NOTE

Fanuc does not guarantee the proper workings or maintenance of any PCI extension boards. And is not liable to any trouble or damage incurred by use of any PCl extended boards.

## 11

## EMERGENCY STOP SIGNAL

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 $\alpha$ 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 $\alpha$ series control amplifier.


Fig. 11

## WARNING

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

## APPENDIX

 UNIT EXTERNAL DIMENSION DIAGRAMS| Fig. 1 (a) | External dimensions of 2 slot control unit |
| :--- | :--- |
| Fig. 1 (b) | External dimensions of 4 slot control unit |
| Fig. 2 (a) | External dimensions of $10.4^{\prime \prime} / 9.5^{\prime \prime}$ LCD unit |
| Fig. 2 (b) | External dimensions of $10.4^{\prime \prime}$ LCD unit for two LCDs connection |
| Fig. 3 (a) | External dimensions of MID unit, 56 key (horizontal type) |
| Fig. 3 (b) | External dimensions of MDI unit Full Key (61 Key) (horizontal <br> type) |
| Fig. 3 (c) | External dimensions of MID unit, 56 key (vertical type) |
| Fig. 3 (d) | External dimensions of MDI unit Full Key (61 Key) (vertical <br> type) |
| Fig. 4 | External dimensions of CNC display unit with PC functions |
| Fig. 5 | External dimensions of hard disk unit |
| Fig. 6 (a) | Personal computer interface card (ISA standard) |
| Fig. 6 (b) | Personal computer interface card (PCI standard) |
| Fig. 7 (a) | External dimensions of position coders A and B |
| Fig. 7 (b) | External dimensions of ALPHA position coder |
| Fig. 8 (a) | External dimensions of manual pulse generator |
| Fig. 8 (b) | External dimensions of pendant-type manual pulse generator |
| Fig. 9 | External dimensions of separate detector interface unit |
| Fig. 10 | External dimensions of battery case for separate detector abso- <br> lute pulse coder |
| Fig. 11 (a) | External dimensions of punch panel (thin type connector with a <br> screw lock) |
| Fig. 11 (b) | External dimensions of punch panel (thin type connector with a <br> spring lock) |
| Fig. 12 | External dimensions of FANUC Handy File |
| Fig. 13 | External dimensions of Machine operator's Panel |

Fig. 1 (a) External dimensions of 2 slot control unit


Fig. 1 (b) External dimensions of 4 slot control unit


Fig. 2 (a) External dimensions of $10.4^{\prime \prime} 9.5^{\prime \prime}$ LCD unit


Fig. 2 (b) External dimensions of 10.4" LCD unit for two LCDs connection


Fig. 3 (a) External dimensions of MID unit, 56 key (horizontal type)


Fig. 3 (b)


Fig. 3 (c) External dimensions of MID unit, 56 key (vertical type)


Fig. 3 (d) External dimensions of MDI unit Full Key (61 Key) (vertical type)


Fig. 4 External Dimensions of CNC Display Unit with PC Functions
External Dimensions Table (For an explanation of panel cutouts, see Fig. 4.7.)

| Name |  | Specification number |  | Remarks | Reference item |
| :---: | :---: | :---: | :---: | :---: | :---: |
| CNC Display <br> Unit with PC <br> Functions <br> Basic Unit | A1 | A08B-0082-B001 |  | 10.4 color LCD, without Touch Panel, without Softkey | Fig.4.1(a) |
|  | A2 | A08B-0082-B002 |  | 10.4 color LCD, without Touch Panel, with Softkey |  |
|  | A3 | A08B-0082-B003 |  | 10.4 color LCD, without Touch Panel, without Softkey |  |
|  | A4 | A08B-0082-B004 |  | 10.4 color LCD, without Touch Panel, with Softkey |  |
|  | B1 | A08B-0082-B011 |  | 12.1 color LCD, without Touch Panel, without Softkey | Fig.4.1(b) |
|  | B2 | A08B-0082-B012 |  | 12.1 color LCD, without Touch Panel, with Softkey |  |
|  | B3 | A08B-0082-B013 |  | 12.1 color LCD, with Touch Panel, without Softkey |  |
|  | B4 | A08B-0082-B014 |  | 12.1 color LCD, with Touch Panel, with Softkey |  |
|  | C1 | A08B-0082-B021 |  | 15.0 color LCD, without Touch Panel, without Softkey | Fig.4.1(c) |
|  | C3 | A08B-0082-B023 |  | 15.0 color LCD, with Touch Panel, without Softkey |  |
| FA Full Keyboard |  | A02B-0236-C131 | \#EC | 10.4 LCD, English, 220x290 | Fig.4.2(a) |
|  |  | \#JC | 10.4 LCD, Japanese,220x290 |  |
|  |  | A02B-0236-C132 | \#EC | 12.1 LCD, English, 220x340 | Fig.4.2(b) |
|  |  | \#JC | 12.1 LCD, Japanese,220×340 |  |
|  |  | A08B-0082-C150 | \#EC | 15.0 LCD, English,220x400 | Fig.4.2(c) |
|  |  | \#JC | 15.0 LCD, Japanse,220x400 |  |
| Separate type MDI |  |  | A02B-0261-C153 | \#MCR | For 150i, 56 key, English, Vertical, 220x290 | Fig.4.3(a) |
|  |  | \#MCS |  | For 150i, 56 key, Symbol, Vertical, 220x290 |  |  |
|  |  | A02B-0261-C154 | \#MCR | For 150i, 56 key, English, Horizon, 220x230 | Fig.4.3(c) |  |
|  |  | \#MCS | For 150i, 56 key, Symbol, Horizon, 220x230 |  |  |
|  |  | A02B-0261-C155 | \#MCR | For 150i, 56 key, English, Vertical, 220x340 | Fig.4.3(b) |  |
|  |  | \#MCS | For 150i, 56 key, Symbol, Vertical, 220x340 |  |  |
|  |  | A02B-0261-C156 | \#MCR | For 150i, 56 key, English, Horizon, 280x230 | Fig.4.3(d) |  |
|  |  | \#MCS | For 150i, 56 key, Symbol, Horizon, 280x230 |  |  |
|  |  | A02B-0261-C163 | \#MCR | For 150i, 61 key, English, Vertical, 220x290 | Fig.4.3(a) |  |
|  |  | \#MCS | For 150i, 61 key, Symbol, Vertical, 220x290 |  |  |
|  |  | A02B-0261-C164 | \#MCR | For 150i, 61 key, English, Horizon, 220x230 | Fig.4.3(c) |  |
|  |  | \#MCS | For 150i, 61 key, Symbol, Horizon, 220x230 |  |  |
|  |  | A02B-0261-C165 | \#MCR | For 150i, 61key, English, Vertical, 220x340 | Fig.4.3(b) |  |
|  |  | \#MCS | For 150i, 61key, Symbol, Vertical,220x340 |  |  |
|  |  | A02B-0261-C166 | \#MCR | For 150i, 61key, English, Horizon,280x230 | Fig.4.3(d) |  |
|  |  | \#MCS | For 150i, 61key, Symbol, Horizon, 280x230 |  |  |
| Floppy disk drive |  |  | A02B-0207-C008 |  |  | Fig.4.4 |
| Full Keyboard | 101 | A86L-0001-0210 |  | English | Fig.4.5 |  |
|  | 106 | A86L-0001-0211 |  | Japanese |  |  |
| Mouse |  | A86L-0001-0212 |  |  | Fig.4.6 |  |
| Panel Cutouts |  |  |  |  | Fig.4.7 |  |

Fig. 4.1 (a) CNC Display Unit with PC Functions (10.4" LCD Type)

Specification : A13B-0193-B031 to -B038


Fig. 4.1 (b) CNC Display Unit with PC Functions (12.1" LCD Type)

Specification : A13B-0193-B041 to -B048


Fig. 4.1 (c) CNC Display Unit with PC Functions (15.0" LCD Type)

Specification : A13B-0193-B051 to -B057


Fig. 4.2 (a) FA Full Keyboard (for 10.4" LCD Type)


Fig. 4.2 (b) FA Full Keyboard (for 12.1" LCD Type)


Fig. 4.2 (c) FA Full Keyboard (for 15.0" LCD Type)


Fig. 4.3 (a) MDI (for 10.4" LCD Type, Vertically Installed)


Fig. 4.3 (b) MDI (for 12.1" LCD Type, Vertical Installed)


Fig. 4.3 (c) MDI (for 10.4" LCD Type, Horizontally Installed)


Fig. 4.3 (d) MDI (for 12.1" LCD Type, Horizontally Installed)


Fig. 4.4 Floppy Disk Drive (A02B-0207-C008)


Fig. 4.5 Type 101/106 Full Keyboards


## NOTE

Neither type 101 nor 106 keyboard is dustproof. Use them for program development. The ambient temperature must be in the range of 0 to $40^{\circ} \mathrm{C}$.

Fig. 4.6 Mouse (A86L-0001-0212)


## NOTE

1 The mouse is not dustproof. Use it for program development and maintenance only. The ambient temperature must be in the range of 0 to $40^{\circ} \mathrm{C}$.
2 The shape and wire length of the mouse have been changed. The wire length has been shortened from 2700 mm to 1800 mm .

Fig. 4.7 Panel Cutouts


Fig. 5 External dimensions of Hard Disk Unit


Fig. 6 (a) Personal Computer Interface Card (ISA Standard)

Drawing numbers: A20B-8001-0582 (2-ch type)
A20B-8001-0583 (1-ch type)


Fig. 6 (b) Personal Computer Interface Card (PCI Standard)

Drawing numbers: A20B-8001-0960 (2-ch type)
A20B-8001-0961 (1-ch type)


Fig. 7 (a) External dimensions of position coders $A$ and $B$

$$
\begin{array}{ll}
\text { Specification No.: } & \text { A86L-0026-0001\#102 (Max. 4000min } \\
& \text { A86L-0026-0001\#002 (Max. } \left.6000 \mathrm{~min}^{-1}\right)
\end{array}
$$



Fig. 7 (b) External dimensions of $\alpha$ position coder
Specification No.: A860-0309-T302 (Max. 10,000 $\mathrm{min}^{-1}$ )


Fig. 8 (a) External dimensions of manual pulse generator

Specification No.: A860-0203-T001


Fig. 8 (b) External dimensions of pendant-type manual pulse generator

Specification No.: A860-0203-T010 to T015
A860-0203-T010 to T015

Fig. 9 External dimensions of separate detector interface unit


Fig. 10 External dimensions of battery case for separate detector absolute pulse coder

Specification No.: A06B-6050-K060


Fig. 11 (a) External dimensions of punch panel (thin type connector with a screw lock)

Specification No.: A02B-0236-C191 to C193


## NOTE

This punch panel cannot be used for the serial port for control.

Fig. 11 (b) External dimensions of punch panel (thin type connector with a spring lock)

Specification No.: A02B-0210-C191 to C193


Fig. 12 External dimensions of FANUC Handy File


Fig. 13 External dimensions of Machine Operator's panel

External dimensions table

| Name | Specification number | Remarks | Reference item |
| :--- | :--- | :--- | :--- |
| Main panel A1 | A02B-0236-C230 | Symbolic key | Fig. 13.1 |
| Main panel A1 | A02B-0236-C240 | English key | Fig. 13.2 |
| Main panel A <br> Main panel A1 | A02B-0236-C231 <br> A02B-0236-C240 | With 3.5" hard disk unit for CNC display unit with <br> PC functions | Fig. 13.3 |
| Main panel B | A02B-0236-C231 | Symbolic key | Fig. 13.4 |
| Main panel B1 | A02B-0236-C241 | English key | Fig. 13.5 |
| Sub panel A | A02B-0236-C232 |  | Fig. 13.6 |
| Sub panel B | A02B-0236-C233 |  | Fig. 13.7 |
| Sub panel B1 | A02B-0236-C235 |  | Fig. 13.8 |
| Sub panel C | A02B-0236-C234 |  | Fig. 13.9 |
| Sub panel C1 | A02B-0236-C236 |  | Fig. 13.10 |

Fig. 13 (a) Outline of Main panel A


Fig. 13 (b) Outline of Main panel A1


Outline of Main panel A/A1 (with data server HDD unit for CNC display
Fig. 13 (c) unit with PC functions)


Fig. 13 (d) Outline of Main panel B


Fig. 13 (e) Outline of Main panel B1


Unit : mm


Panel cut drawing

Fig. 13 (f) Outline of Sub panel A


Fig. 13 (g) Outline of Sub panel B


Fig. 13 (h) Outline of Sub panel B1


Unit : mm


Fig. 13 (i) Outline of Sub panel C


Fig. 13 (j) Outline of Sub panel C1


EXTERNAL DIMENSIONS OF CONNECTORS

| Fig. title | Specification No. | Fig. No. |
| :---: | :---: | :---: |
| PCR connector (soldering type) | PCR-E20FS | Fig. 1 |
| Fl40 connector | FI40-2015S | Fig. 2 |
| Connector case (HONDA PCR type) | PCR-V20LA/PCRV20LB | Fig. 3 |
| Connector case (HIROSE FI type) | Fl-20-CV | Fig. 4 |
| Connector case (FUJITSU FCN type) | FCN-240C20-Y/S | Fig. 5 |
| Connector case (HIROSE PCR type) | FI-20-CV7 | Fig. 6 |
| AMP connector (1) for servo side | AMP1-178128-3 | Fig. 7 |
| AMP connector (2) for servo side | AMP2-178129-6 | Fig. 8 |
| AMP connector (3) for +24 V power supply | AMP1-178288-3 | Fig. 9 |
| AMP connector (4) for +24 E power supply | AMP2-178288-3 | Fig. 10 |
| Contact for AMP connector | $\begin{aligned} & \text { AMP1-175218-2/5 } \\ & \text { AMP1-175196-2/5 } \end{aligned}$ | Fig. 11 |
| HONDA connector (case) |  | Fig. 12 |
| HONDA connector (angled case) |  | Fig. 13 |
| HONDA connector (male) |  | Fig. 14 |
| HONDA connector (female) |  | Fig. 15 |
| HONDA connector (terminal layout) |  | Fig. 16 |
| Connector (Burndy Japan)(3 pins/brown) | SMS3PN-5 | Fig. 17 |
| Connector (Japan Aviation Electronics) (for MDI) | LY10-DC20 | Fig. 18 |
| Contact (Japan Aviation Electronics) (for MDI) | LY10-C2-3-1000 | Fig. 19 |
| Punch panel connector for reader/punch interface |  | Fig. 20 |
| Locking plate for reader/punch interface connector |  | Fig. 21 |
| Connector for HIROSE flat cable | HIF3BB-50D-2.54R | Fig. 22 |
| Honda connector (for distribution I/O connection printed circuit board) | MRH-50FD | Fig. 23 |
| AMP connector (for loader I/O board) | AMP178214-1 | Fig. 24 |
| Faston terminal | A02B-0166-K330 | Fig. 25 |
| HIROSE connector (for DeviceNet board) | HR31-5.08P-5SC | Fig. 26 |
| Contact to for HIROSE connector (for DeviceNet board) | HR31-SC-121 | Fig. 27 |

Fig. 1 PCR Connector (Soldering type)

```
TYPE : HONDA PCR-E20FS(SOLDERING TYPE)
USAGE : GENERAL
HOUSING : HONDA PCR-V20LA
DIMENSION
```



|  | A | B |
| :--- | :---: | :---: |
| PCR-E20FS | 21.65 | 11.43 |

Fig. 2 Fl40 Connector


Fig. 3 Connector case (HONDA PCR type)


Fig. 4 Connector case (HIROSE FI type)

```
TYPE : HIROSE FI-20-CV
USAGE : PULSE CODER INTERFACE
    LINEAR SCALE INTERFACE
    MANUAL PULSE GENERATOR INTERFACE
```


(2)
(3)
(4)
4)


Fig. 5 Connector case (FUJITSU FCN type)


Fig. 6 Connector case (PCR type (Hirose Electric))


Fig. 7 AMP Connector (1)


Fig. 8 AMP Connector (2)


Fig. 9 AMP Connector (3)


Fig. 10 AMP Connector (4)


Fig. 11 Contact for AMP Connector


Fig. 12 Honda connector (Case)


Fig. 13 Honda connector (angled-type case)


Fig. 14 Honda connector (Male)


$\left.$|  | A | B |
| :--- | :---: | :---: |
| MR-20RMH | 32.8 | 27.8 |
| MR-50RMH | 61.4 | 56.4 | | Number of |
| :---: |
| terminals | \right\rvert\, | 20 |
| :---: |


| Symbol | Name |
| :---: | :--- |
| 1 | Cable clamp |
| 2 | Screw 2.6dia.×8 |
| 3 | Connector (MR-20,-50FH) |

Fig. 15 Honda connector (Female)


|  | A | B |
| :--- | :---: | :---: |
| MR-20RMH | 32.8 | 27.8 |
| MR-50RHF | 61.4 | 56.4 |
|  | Number of <br> terminals |  |
| 20 |  |  |
| 50 |  |  |


| Symbol | Name |
| :---: | :--- |
| 1 | Cable clamp |
| 2 | Screw 2.6dia. $\times 8$ |
| 3 | Connector (MR-20,-50FH) |

Fig. 16 HONDA connector (terminal layout)


Fig. 17 Connector made by FCI (3 pins, brown)
Manufacturer : FCI JAPAN, LTD.

| Name |  | Specification <br> (Connector maker <br> number) | Remarks |
| :---: | :--- | :--- | :--- |
| Connector housing for cable | SMS3PK-5 | Brown |  |
|  | (Crimp type) | RC16M-23T3 | For details on tools <br> required for crimp <br> terminals,contact the <br> manufacturer. |
|  | (Solder type) | RC16M-SCT3 | ROM |

Cables: Cross sectional area : $0.75 \mathrm{~mm}^{2}(30 / 0.18)$
Insulation diameter : 2.8mm max
Peeling length : 7.2mm

Fig. 18 Connector (Japan Aviation Electronics)(for MDI)


Fig. 19 Contact (Japan Aviation Electronics)(for MDI)


Detailed contact diagram (Scale: 10:1)

Excluding the crimp terminal

Fig. 20 Reader puncher panel connector


Fig. 21 Reader puncher connector metal fitting for lock


Fig. 22 Connector for hirose flat cable


Fig. 23 Honda connector

Honda MR type, 50 pins, male, connection printed circuit board soldering type connector
Type No. Honda Tsushin Kogyo Co., Ltd.
MRH-50FD


Pin configuration of Honda MR connector, 50 pins, male


Fig. 24 AMP connector
Type: AMP 178214-1
Application: Used for the loader I/O board
Dimensions:


Fig. 25
Faston Terminal

Type: Faston terminal
Use:
Frame grounding
Applicable housing: 170604-1 manufactured by AMP Japan, Ltd. or FVDDF2-250 TYPE I (blue) manufactured by Japan Solderless terminal MFG. co.Ltd.
Dimensions:


Applicable wire 1.25 to $2.27 \mathrm{~mm}^{2}$

Fig. 26 HIROSE connector (for DeviceNet Board)

```
Type: HR31-5.08P-5SC
```

Application: DeviceNet
Dimensions:


Fig. 27 Contact for HIROSE connector (for DeviceNet Board)

Type: HR31-SC-121
Application: DeviceNet
Dimensions:


## 20-PIN INTERFACE CONNECTORS AND CABLES

This section provides supplementary information about the recommended (FANUC-approved) 20-pin interface connectors used with the following target model.

## C. 1 <br> BOARD-MOUNTED CONNECTORS

(a) Vertical-type Connectors

Models: PCR-EV20MDT (Honda Tsushin)
52618-2011 (Molex Japan)
These board-mounted connectors have been specially developed to achieve the high packing density required for FANUC products. As explained in the following subsection, Honda PCR series connectors can be used as cable connectors because the mating mechanism of the newly developed connectors is compatible with that of the Honda PCR series connectors. To support this specification extensively, many connector manufacturers are now developing custom-tailored cable connectors. (Note that these cables cannot be used with screw-fixing cable connector housings.)
(b) Straight and Right-angled Connectors (for Spring and Screw-fixing Connector Housings)
Models: PCR-E20MDK-SL-A (Honda Tsushin)
(straight connector)
PCR-E20LMDETZ-SL (Honda Tsushin)
(right-angled connector)
These connectors are used for the main and option boards of the $i$ series. As cable connectors, they are compatible with screw-fixing connector housings as well as the spring locking connector housings.
C. 2

CABLE CONNECTOR

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.


Fig. C. 2 Cable connectors

## NOTE

Use the same maker's connector body and housing to combine them.

## C. 3

## CABLE

CONNECTORS

Strand wire press-mount connector :
With this connector, \#28AWG wires are press-connected to each pin at the same time. The cost of producing a cable/connector assembly with this connector model is much lower than with connectors designed for crimping or soldering.
Also, the following connector housing has been newly developed for use with the $i$ series.

| Connector model (manufacturer) | Supplementary description |
| :--- | :--- |
| FI-20-CV7 (Hirose) | Low connector housing, more compact than conventional models. The housing <br> can be fastened to a board-mounted connector by means of a screw lock. It is <br> intended mainly for connecting the board-mounted connectors used on the main <br> and option boards of the LCD-mounted type $i$ series (see Section B.3.2). Note that <br> this connector housing cannot be used for conventional board-mounted <br> connectors. |

Soldering type connector : Details of soldering type connectors and their housings are summarized below.
Table C. 3 Details of soldering type connectors and housings

## - Connectors

| Connector model (manufacturer) | Supplementary description |
| :--- | :--- |
| PCR-E20FS (Honda) | Soldering type connector for general signals. This is suitable for producing cable <br> assemblies in small quantities, as well as on-site. |
| FI40-20S (Hirose) | Equivalent to Honda PCR-E20FS |
| FI40B-20S (Hirose) <br> (formerly, FI40A-20S) | Has the same number of pins as the FI40-20S, but features a wider soldering pitch, <br> facilitating soldering and enabling the use of thicker wires. Its reinforced pins allow <br> wires as thick as \#17AWG to be soldered to the FI40B-20S (wires no thicker than <br> \#20AWG can be used with the FI40A-20S). Note, however, that a thick wire, such <br> as \#17AWG, should be used with a more robust housing like the FI-20-CV6. |
| FI40B-2015S (Hirose) <br> (formerly, FI40-2015S) | Features a wider soldering pitch, attained by using the space provided by thinning <br> out some pins. Also features tougher pins, compared with its predecessor, the <br> FI40-2015S. These pins can be soldered to wires as thick as \#17AWG, provided <br> that the cable diameter does not exceed 8.5 mm. |

## - Housings

| Housing model (manufacturer) | Supplementary description |
| :--- | :--- |
| FI-20-CV5 (Hirose) | Should be used with the FI40B-20S. This is a plastic housing designed for use with <br> a cable that is 9.2 mm in diameter. |
| FI-20-CV6 (Hirose) | Should be used with the FI40B-20S. This housing, however, can be used with a <br> thicker cable (such as 10.25 mm) than is possible with the FI-20-CV5. Its <br> components are die cast. |

In addition to the combinations shown in Fig. B.4, Hirose soldering-type connectors can be combined with the housings listed below. Ensure that the diameter of the cable used with each housing satisfies the requirements of that housing.

Connector model

- FI40B-2015S (formerly FI40-2015S)
- (FI40-20S (FI-20-CV2 $(\phi 6.2 \mathrm{~mm})$ ) Those listed



## C. 4

RECOMMENDED
CONNECTORS,
APPLICABLE
HOUSINGS, AND
CABLES
Table C. 4 Recommended connectors, applicable housings, and cables

| Connector name referenced in the Connection Manual | FANUC-approved connector (manufacturer) | FANUC-approved housing (manufacturer) | Compatible cable (cable diameter) <br> FANUC development <br> FANUC specification number | Remark |
| :---: | :---: | :---: | :---: | :---: |
| PCR-E20FA <br> Strand press-mount type | PCR-E20FA (Honda Tsushin) | PCR-V20LA (Honda Tsushin) | A66L-0001-0284\#10P ( 6.2 mm in diameter) A66L-0001-0284\#10P ( 6.2 mm in diameter) A66L-0001-0284\#10P ( 6.2 mm in diameter) | Plastic housing |
|  | FI30-20S (Hirose Electric) | $\begin{aligned} & \text { FI-20-CV2 } \\ & \text { (Hirose Electric) } \end{aligned}$ |  | Plastic housing |
|  | FCN-247J020-G/E (Fujitsu Takamizawa) | FCN-240C020-Y/S (Fujitsu Takamizawa) |  | Plastic housing |
|  | $\begin{array}{\|l} \text { 52622-2011 } \\ \text { (Molex) } \end{array}$ | $\begin{aligned} & \text { 52624-2015 } \\ & \text { (Molex) } \end{aligned}$ |  | Plastic housing |
| PCR-E20FA <br> Strand wire press-mount type | FI30-20S (Hirose Electric) | $\begin{aligned} & \text { FI-20-CV7 } \\ & \text { (Hirose Electric) } \end{aligned}$ |  | Plastic housing |
| PCR-E20FS <br> Soldering type | PCR-E20FS (Honda Tsushin) | PCR-V20LA (Honda Tsushin) |  | Plastic housing |
|  | FI40-20S (Hirose Electric) | $\begin{aligned} & \text { FI-20-CV2 } \\ & \text { (Hirose Electric) } \end{aligned}$ |  | Plastic housing |
| FI40B-2015S (formerly FI40-2015S) 15-pin soldering type | FI40B-2015S (formerly FI40-2015S) (Hirose Electric) | $\begin{aligned} & \text { FI-20-CV } \\ & \text { (Hirose Electric) } \end{aligned}$ | A66L-0001-0286 (*1) <br> A66L-0001-0402 (*1) <br> (8.5 mm in diameter)  | Plastic housing |
| FI40B-20S (formerly FI40A-2015S) Soldering type | FI40B-2015S (formerly FI40-2015S) (Hirose Electric) | $\begin{aligned} & \text { FI-20-CV5 } \\ & \text { (Hirose Electric) } \end{aligned}$ | A66L-0001-0367 <br> A66L-0001-0368 <br> (9.2 mm in diameter) | Plastic housing |
|  | FI40B-20S (Hirose Electric) | FI-20-CV6 (Hirose Electric) | A66L-0001-0403 (9.8 mm in diameter) | Metal housing |

## NOTE

*1 Cable A66L-0001-0286 has been recommended for use as a pulse coder cable. It can be up to 20 m long. Two cables, A66L-0001-0402 and A66L-0001-0403, have recently been developed. A66L-0001-0402 and A66L-0001-0403 can be as long as 30 m and 50 m , respectively. (See Fig. 4 for detailed specifications.)
Both cables have the same level of oil and bending resistance (cable, 100 mm in diameter, capable of withstanding at least 10 million bending cycles) as conventional cables, and are UL- and CSA-certified.

## C. 5 <br> CABLE WIRES

Cable wires generally need to be developed or ordered by the machine tool builder for the Series $15 i / 150 i$.
FANUC has developed wires that specifically suit the interface connector of the Series $15 i / 150 i$, Series $15-B / 16 / 18$. 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.)

| Material | Use | Constitution | FANUC specification number | Manufacturer | Remark |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 10-pair cable | General use | $\begin{aligned} & 0.08 \mathrm{~mm}^{2} \\ & 10 \text {-pair } \end{aligned}$ | $\begin{aligned} & \text { A66L-0001-0284 } \\ & \text { \#10P } \end{aligned}$ | Hitachi Cable, Ltd. Oki Electric Cable Co., Ltd. |  |
| 12-conductor composite cable | Pulse coder, linear scale, manual pulse generator | $\begin{aligned} & 0.5 \mathrm{~mm}^{2} \\ & \text { 6-conductor } \\ & 0.18 \mathrm{~mm}^{2} \\ & \text { 3-pair } \end{aligned}$ | A66L-0001-0286 | Hitachi Cable, Ltd. Oki Electric Cable Co., Ltd. | 20 m or less |
|  |  | $\begin{array}{\|l} \hline 0.75 \mathrm{~mm}^{2} \\ 6 \text {-conductor } \\ 0.18 \mathrm{~mm}^{2} \\ \text { 3-pair } \end{array}$ | A66L-0001-0402 | Oki Electric Cable Co., Ltd. | 30 m or less Usable on movable parts |
|  |  | $\begin{array}{\|l\|} \hline 1.25 \mathrm{~mm}^{2} \\ \text { 6-conductor } \\ 0.18 \mathrm{~mm}^{2} \\ \text { 3-pair } \end{array}$ | A66L-0001-0403 | Oki Electric Cable Co., Ltd. | 50 m or less Usable on movable parts |

## NOTE

For the pulse coder, scale, and manual pulse generator, each of which has a $+5-\mathrm{V}$ 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 , connect A66L-0001-0286 to 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.
(1) 10-pair cable
(a) Specifications

| Item |  | Unit | Specifications |
| :---: | :---: | :---: | :---: |
| Product No. |  | - | A66L-0001-0284\#10P |
| Manufacturer |  | - | Hitachi Cable, Ltd. <br> Oki Electric Cable Co., Ltd. |
| Rating |  | - | $60^{\circ} \mathrm{C} 30 \mathrm{~V}$ : UL2789 <br> $80^{\circ} \mathrm{C} 30$ V: UL80276 |
| Material | Conductor | - | Stranded wire of tinned annealed copper (ASTM B-286) |
|  | Insulator | - | Cross-linked vinyl |
|  | Shield braid | - | Tinned annealed copper wire |
|  | Sheath | - | Heat-resistant oilproof vinyl |
| Number of pairs |  | Pairs | 10 |
| Conductor | Size | AWG | 28 |
|  | Structure | Conductors/ mm | 7/0.127 |
|  | Outside diameter | mm | 0.38 |
| Insulator | Thickness | mm | 0.1 Thinnest portion: $008(3.1 \mathrm{~mm})$ |
|  | Outside diameter (approx.) | mm | 0.58 |
|  | Core style (rating) | mm | UL1571 ( $80^{\circ} \mathrm{C}, 30 \mathrm{~V}$ ) |
| Twisted pair | Outside diameter (approx.) | mm | 1.16 |
|  | Pitch | mm | 20 or less |
| Lay |  | - | Collect the required number of twisted pairs into a cable, then wrap binding tape around the cable. To make the cable round apply a cable separator as required. |
| Lay diameter (approx.) |  | mm | 3.5 |
| Drain wire |  | Conductors/ mm | $\begin{array}{ll}\text { Hitachi Cable: } & \text { Not available } \\ \text { Oki Electric Cable: } & \text { Available, 10/0.12 }\end{array}$ |
| Shield braid | Element wire diameter | mm | 0.12 |
|  | Braid density | \% | 85 or more |
| Sheath | Color | - | Black |
|  | Thickness | mm | 1.0 |
|  | Outside diameter (approx.) | mm | 6.2 |
| Standard length |  | m | 200 |


| Item |  | Unit | Specifications |
| :--- | :--- | :---: | :---: |
| Packing method <br> Electrical <br> performance | Electric <br> resistance <br> (at $\left.20^{\circ} \mathrm{C}\right)$ | $\Omega / \mathrm{km}$ | Bundle |
|  | Insulation <br> resistance <br> (at $20^{\circ} \mathrm{C}$ ) | $\mathrm{M} \Omega-\mathrm{km}$ | 233 or less |
|  | Dielectric strength <br> (AC) | $\mathrm{V} / \mathrm{min}$. | 10 or more |
| Flame resistance |  | - | Shall pass flame resistance test VW-1SC of UL standards. |

(b) Cable structure


Wire identification table (Hitachi)

| Pair No. | Insulator color |  |
| :---: | :---: | :---: |
|  | First wire | Second wire |
| 1 | Blue | White |
| 2 | Yellow | White |
| 3 | Green | White |
| 4 | Red | White |
| 5 | Purple | White |
| 6 | Blue | Brown |
| 7 | Yellow | Brown |
| 8 | Green | Brown |
| 9 | Red | Brown |
| 10 | Purple | Brown |

The numbers assigned to the wires correspond to the number in the table at right.

Fig. C. 5 (a) Cable made by Hitachi Cable


Fig. C. 5 (b) Cable made by Hitachi Cable
(2) Composite 12-core cable
(a) Specifications (A66L-0001-0286)

| Item |  | Unit | Specifications |  |
| :---: | :---: | :---: | :---: | :---: |
| Product No. |  | - | A66L-0001-0286 |  |
| Manufacturer |  | - | Oki Cable, Ltd. Hitachi Electric Cable Co., Ltd. |  |
| Rating |  | - | $80^{\circ} \mathrm{C}, 30 \mathrm{~V}$ |  |
| Material | Conductor, braid-shielded wire, drain wire | - | Strand wire of tinned annealed copper (JIS C 3152) |  |
|  | Insulator | - | Heat-resistant flame-retardant vinyl |  |
|  | Sheath | - | Oilproof, heat-resistant, flame-retardant vinyl |  |
| Number of wires (wire nos.) |  | Cores | 6 (1 to 6) | 6 (three pairs) (7 to 9) |
| Conductor | Size | $\mathrm{mm}^{2}$ | 0.5 | 0.18 |
|  | Structure | Conductors/ mm | 20/0.18 | 7/0.18 |
|  | Outside diameter | mm | 0.94 | 0.54 |
| Insulator | Standard thickness (Theminimum thickness is at least $80 \%$ of the standard thickness.) | mm | 0.25 | 0.2 |
|  | Outside diameter | mm | 1.50 | 0.94 |



## NOTE

The maximum outside diameter applies to portions other than the drain wire.
(b) Cable structure (A66L-0001-0286)

The cable structure is shown below.

(c) Specifications (A66L-0001-042, 0403)

|  | Item | Specification |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| FANUC specification number |  | A66L-0001-0402 |  | A66L-0001-0403 |  |
| Manufacturer |  | Oki Electric Cable Co., Ltd. |  |  |  |
|  |  | A-conductor | B-conductor | A-conductor | B-conductor |
| Conductor | Constitution <br> Number of conductors/mm | $\begin{gathered} 16 / 0.12 \\ \left(0.18 \mathrm{~mm}^{2}\right) \end{gathered}$ | $\begin{gathered} 3 / 22 / 0.12 \\ \left(0.75 \mathrm{~mm}^{2}\right) \end{gathered}$ | $\begin{gathered} 16 / 0.12 \\ \left(0.18 \mathrm{~mm}^{2}\right) \end{gathered}$ | $\begin{gathered} 7 / 16 / 0.12 \\ \left(1.25 \mathrm{~mm}^{2}\right) \end{gathered}$ |
|  | Typical outside diameter (mm) | 0.55 | 1.20 | 0.55 | 1.70 |
| Insulation (polyester) | Color | White, red, black | Red, black | White, red, black | Red, black |
|  | Typical thickness (mm) | 0.16 | 0.23 | 0.16 | 0.25 |
|  | Typical outside diameter (mm) | 0.87 | 1.66 | 0.87 | 2.20 |
| Pair twisting | Constitution | White-red, white-black, and black-red |  | White-red, white-black, and black-red |  |
|  | Direction of twisting | Left Typical pitch: 20 mm |  | Left Typical pitch: 20 mm |  |
| Assembling by twisting | Number of strands or conductors | 3 | 6 | 3 | 6 |
|  | Direction of twisting | Left |  | Left |  |
|  | Taping | Twisting is wrapped with washi, or Japanese paper, tape. |  | Twisting is wrapped with washi, or Japanese paper, tape. |  |
|  | Typical outside diameter (mm) | 5.7 |  | 6.9 |  |
| Braided shielding | Typical strand diameter (mm) | 0.14 |  |  |  |
|  | Typical density (mm) | 80 |  |  |  |
|  | Drain | A 12/0.18 mm wire is roughly wrapped under braided shielding. |  |  |  |
|  | Typical outside diameter (mm) | 6.4 |  | 7.6 |  |
| Sheath (polyurethane) | Color | Black (matted) |  |  |  |
|  | Typical thickness (mm) | 1.05 |  | 1.1 |  |
|  | Vertical taping | Vertically taped with washi under sheathing. |  |  |  |
|  | Outside diameter (mm) | $8.5 \pm 0.3$ |  | $9.8 \pm 0.3$ |  |
| Finished assembly | Typical length (m) | 100 |  |  |  |
|  | Short size | Basically not approved. |  |  |  |


| Item |  | Specification |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| FANUC specification number |  | A66L-0001-0402 |  | A66L-0001-0403 |  |
| Manufacturer |  | Oki Electric Cable Co., Ltd. |  |  |  |
|  |  | A-conductor | B-conductor | A-conductor | B-conductor |
| Finished assembly performance | Rating | $80^{\circ} \mathrm{C} 30 \mathrm{~V}$ |  |  |  |
|  | Standard | Shall comply with UL STYLE 20236 and CSA LL43109 AWM I/II A $80^{\circ} \mathrm{C} 30 \mathrm{~V}$ FT-1. |  |  |  |
|  | Flame resistance | Shall comply with VW-1 and FT-1. |  |  |  |
| Electrical performance | Conductor resistance $\Omega / \mathrm{km}\left(20^{\circ} \mathrm{C}\right)$ | 103 or lower | 25.5 or lower | 103 or lower | 15.0 or lower |
|  | Insulation resistance $\mathrm{M} \Omega / \mathrm{km}\left(20^{\circ} \mathrm{C}\right)$ | 1 or higher |  |  |  |
|  | Dielectric strength V-min | A. C 500 |  |  |  |
| Insulation performance | Tensile strength $\mathrm{N} / \mathrm{mm}^{2}$ | 9.8 or higher |  |  |  |
|  | Elongation \% | 100 or higher |  |  |  |
|  | Tensile strength after aging \% | At least 70\% of that before aging |  |  |  |
|  | Elongation after aging \% | At least 65\% of that before aging |  |  |  |
|  | Aging condition | For 168 hours at $113^{\circ} \mathrm{C}$ |  |  |  |
| Sheathing performance | Tensile strength $\mathrm{N} / \mathrm{mm}^{2}$ | 9.8 or higher |  |  |  |
|  | Elongation \% | 100 or higher |  |  |  |
|  | Tensile strength after aging \% | At least 70\% of that before aging |  |  |  |
|  | Elongation after aging \% | At least 65\% of that before aging |  |  |  |
|  | Aging condition | For 168 hours at $113^{\circ} \mathrm{C}$ |  |  |  |
| Cable cross section |  |  |  |  |  |

## P OPTICAL FIBER CABLE

The $i$ Series CNC uses optical fiber cables for the following interfaces.
This table lists the usable combinations.

| Interface | Recommended <br> optical cable | Maximum allowable <br> transmission distance | Applicable junc- <br> tion adapter | Remark |
| :--- | :--- | :--- | :--- | :--- |
| Serial spindle interface | A66L-6001-0026\#L~ | 100 m | None |  |
|  | A66L-6001-0029\#L~ | 55 m | A63L-0020-0004 | For junction only |
|  | A66L-6001-0026\#L~ | 200 m | A63L-0020-0002 |  |
| High-speed serial bus <br> (HSSB) interface (Note) | A66L-6001-0026\#L~ | 100 m | None |  |
|  | A66L-6001-0029\#L~ | 55 m | A63L-0020-0002 | For junction only |
| Serial servo bus (FSSB) <br> interface | A66L-6001-0023\#L~ | 10 m | None |  |
|  | A66L-6001-0026\#L~ | 100 m | None |  |
| CNC-Display unit inter- <br> face | A66L-6001-0026\#L~ | 100 m | A66L-0020-0024 | For junction only |
|  | A66L-6001-0029\#L~ | 55 m |  |  |

## Notes on the

 specifications of optical fiber cable C1. Supported optical fiber cables
(1) Internal cord type cable : A66L-6001-0023\#L$\mathrm{R} \square \square \square$ (only for the FSSB interface)
Cable length
: 0.15 to 10 m
: $2.2 \mathrm{~mm} \times 2$ cords
Tensile strength : Optical fiber cord $: 7 \mathrm{~kg}$ per cord
Between optical fiber cord and connector $: 2 \mathrm{~kg}$
Minimum bending radius of optical fiber cord: 25 mm
Operating temperature : -20 to $70^{\circ} \mathrm{C}$


Fig. D (a) External dimensions of internal cord type cable Unit: mm
(2) External type cable

Cable length
: A66L-6001-0026\#L$R \square \square \square$
A66L-6001-0029\#L $\square$$R \square \square \square$

Optical fiber cord diameter : $2.2 \mathrm{~mm} \times 2$ cords
Diameter of cable with reinforced cover : 7.6 mm
Tensile strength : Cable with reinforced cover : 75 kg
Optical fiber cord : 7 kg per cord
Between optical fiber cord and connector: 2 kg
Minimum bending radius of optical fiber cord : 25 mm
Minimum bending radius of cable with reinforced cover : 50 mm Bending resistance (cable with reinforced cover) :

10 million bending cycles at room temperature (when the bending radius is 100 mm )
Flame resistance
: Equivalent to UL VW-1
Operating temperature $:-20$ to $70^{\circ} \mathrm{C}$


Fig. D (b) External dimensions of external cable Unit: mm

Table D(a) Standard cable length

| Internal cord type cable |  | External cable |  |
| :---: | :---: | :---: | :---: |
| A66L-6001-0023\# |  | A66L-6001-0026\# <br> A66L-6001-0029\# |  |
| Specification | Length | Specification | Length |
| L150R0 | 0.15 m | L1R003 | 1.0 m |
| L300R0 | 0.3 m | L2R003 | 2.0 m |
| L500R0 | 0.5 m | L3R003 | 3.0 m |
| L1R003 | 1.0 m | L5R003 | 5.0 m |
| L2R003 | 2.0 m | L7R003 | 7.0 m |
| L3R003 | 3.0 m | L10R03 | 10.0 m |
| L5R003 | 5.0 m | L15R03 | 15.0 m |
| L7R003 | 7.0 m | L20R03 | 20.0 m |
| L10R03 | 10.0 m | L30R03 | 30.0 m |
|  |  | L50R03 | 50.0 m |
|  |  | L00R03 (Note) | 100.0 m |

Note) Only for A66l-6001-0026
2. Cable selection

- Always use an external cable (A66L-6001-0026\#) when the cable is to be laid outside the power magnetics cabinet or main unit cabinet, where it may be pulled, rubbed, or stepped on.
- Use an external cable when part of the cabling is to be subject to movement. For example, when connecting a portable operation pendant box to the power magnetics cabinet, the use of an external cable is desirable because the cable is likely to be bent, pulled, or twisted repeatedly even though frequent system operation is not expected. However, the force likely to be applied when the cable is installed or moved for maintenance purposes does not need to be taken into consideration.
- Use an external cable in locations where sparks or flame are a danger. Although the internal cord type cable (A66L-6001-0023\#) is covered by nonflammable resin, the cover, if exposed to frame for a long time, may melt, allowing the fiber cable inside to burn.
- Use an external cable when the cable is expected to be pulled with considerable force during installation (the force applied to the cable must be within the specified tensile strength limit at all times). For example, even though installing a cable in a cable duct can be regarded as internal cabling, a cable of the appropriate type must be selected according to the tensile force to be applied to the cable during installation.
- Both the internal cord type and external cables have the same oil and heat resistance properties.

3. Procuring the cable

All the optical fiber cables mentioned above are special cable products with optical connectors, which are designed, produced, and tested to ensure the required system performance and reliability. It is technically impossible for users to produce these cables or process (cut and reconnect) them after purchase. Users are requested to purchase cables of the necessary length from an appropriate supplier. Cables are available from either FANUC or any of the FANUC-approved manufacturers listed in Table D(b).

Table D(b) FANUC-approved cable manufacturers and cable model numbers (retail)
(1)Internal cord type cable: AA66L-6001-0023\#L $\square \mathrm{R} \square \square \square$

| Manufacturer | Model number | Remarks |
| :--- | :--- | :--- |
| Japan AMP, Co., Ltd. | *-353373-* |  |
| Japan Aviation Electronics <br> Industry, Ltd. | PF-2HB209-**M-F-1 | $* *$ indicates the <br> cable length (m). |
| Hirose Electric Co., Ltd. | H07-P22-F2VCFA-** | ** indicates the <br> cable length (m). |

(2) External cable: A66L-6001-0026\#L $\square \mathrm{R} \square \square \square$

| Manufacturer | Model number | Remarks |
| :--- | :--- | :--- |
| Japan AMP, Co., Ltd. | *-353199-* |  |
| Japan Aviation Electronics <br> Industry, Ltd. | CF-2HB208-**M-F-1 | ** indicates the <br> cable length (m). |
| Hirose Electric Co., Ltd. | H07-P22-F2NCFA-** | ** indicates the <br> cable length (m). |
| Oki Electric Cable Co., Ltd. | OPC201HPXF-**MB | ** indicates the <br> cable length $(\mathrm{m})$. |

4. Handling precautions
(1) Protection during storage

When the electrical/optical conversion module mounted on the printed circuit board and the optical fiber cable are not in use, their mating surfaces must be protected with the lid and caps with which they are supplied. If left uncovered, the mating surfaces are likely to become dirty, possibly resulting in a poor cable connection.


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

- Although the reinforcing cover of the external cable has sufficient mechanical strength, be careful not to drop heavy objects on the cable.
- Grasp the optical connector firmly when connecting or disconnecting the cable. Do not pull on the optical fiber cord itself. (The maximum tensile strength between the fiber cord and connector is 2 kg . Applying greater force to the cord is likely to cause the connector to come off, making the cable unusable.)
- Once connected, the optical connector is automatically locked by the lock levers on its top. To remove the connector, release the lock levers and pull the connector.
- Although optical connectors cannot be connected in other than the correct orientation, always take note of the connector's orientation before making the connection.
- Before installing an external cable, fix either a wire with a hook or a tension member to the reinforcing cover of the optical connector and pull the wire or tension member, as shown in Fig. $\mathrm{D}(\mathrm{d})$. This is done to prevent a tensile force from being applied between the fiber cord and connector. If no tensile force is applied between the fiber cord and connector when installing the cable, you can hold the reinforcing cover of the connector directly and pull it.
In the case of an internal cord, which does not have a reinforcing cover, apply the same protective measures, as instructed in Fig. $\mathrm{D}(\mathrm{d})$, for that portion of the cable where the two cords are bound together, in order to prevent a tensile force from being applied between the fiber cord and connector.
In the same way as for an external cable, if no tensile force is applied between the fiber cord and connector during installation, you can hold the shielded part of the cable directly and pull it. Because the combined tensile strength of the two cords is only 14 kg , however, avoid applying too great a force to the cable during installation, regardless of whether you have taken the protective measures.


Fig. D (d) Prior to installing a cable

- Take care to keep both parts of the optical connector (cable side and PCB side) clean. If they become dirty, wipe them with tissue paper or absorbent cotton to remove dirt. The tissue paper or absorbent cotton may be moistened with ethyl alcohol. Do not use any organic solvent other than ethyl alcohol.
- Fix the reinforcing cover of the external cable or the cord binding portion of the internal cord type cable by using a cable clamp, as shown in Fig. $\mathrm{D}(\mathrm{e})$, to prevent the weight of the optical fiber cable from being applied directly to the connecting part of the optical connector.
(Recommended cable clamp):
Recommended cable clamps are listed below. Use a clamp that grasps the optical cable lightly; the clamp should not apply excessive pressure to the cable.
For an external cable:
CKN-13SP (with sponge)(Kitagawa Industry Co., Ltd.)
For an internal cord type cable:
MN-1 (Kitagawa Industry Co., Ltd.)


Fig. D (e) Fixing the cable with a clamp

- Any superfluous portion of the cable may be wound into a loops. Should this prove necessary, make sure the diameter of each loop is at least 150 mm (for an external cable) or at least 100 mm (for an internal cord type cable). Winding the cable into smaller loops may produce sharp curves that exceed the specified bending radius limit without the user being aware. Such bending can result in a greater transmission loss, ultimately leading to a communication failure.
- When using a nylon band (cable tie) as a cable clamp, follow the instructions given below. Also, take care not to apply a bending force to one particular part of the cable when fixing it with a clamp. Failing to clamp the cable correctly may cut or damage it.
External cable:
Do not clamp the uncovered portion of the cable with a nylon band. When clamping the cable by the reinforcing cover, the clamping force is not an important factor to consider. However, ensure that the clamping force is as small as possible to ensure that the reinforcing cover is not deformed by the clamping. If possible, the clamping force should be 5 kg or less.


## Internal cord type cable:

Lightly clamp the optical cable with a nylon band so that the cable shield is not deformed. If possible, the clamping force should be 1 or 2 kg (make sure that no force is applied to the cable). Due care is required when clamping the internal cord type cable because its cable shield is weaker than the reinforcing cover of the external cable.
5. Optical fiber cable relay

When used for the FANUC I/O Link application, optical fiber cables can be connected by using an optical fiber adapter, as follows.
(a) External view of an optical fiber adapter

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


## NOTE

Up to one relay points are permitte.
6. Optical fiber cable relay for FANUC High speed serial bus When used for the FANUC High speed serial bus, optical fiber cables can be relayed by using an optical fiber adapter with low-loss optical junction and by connecting an exdusive low-loss optical fibercable, as follows.
(a) External view of an optical fiber adapter with low-loss optical junction

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


## NOTE

Up to one relay points are permitte.
7. Precautions for connection with low-loss optical junction adapter

- Features of and handling precautions for low-loss optical junction adapter (A63L-0020-0004)
When optical connectors for a conventional optical junction adapter (A63L-0020-0002) are jointed, the facing ferrules(Note 1) are located about 60 um from each other. This is because the optical fiber of conventional PCF (plastic clad silica fiber) cables (A66L-6001-0008, -0009, -0026) may protrude from the tip of the ferrules (by up to about several um), resulting in the fiber protrusion being damaged when the ferrules are butted against each other.
In the low-loss optical junction adapter, the ferrules are butted against each other, thus greatly reducing the reduction in repeater loss. Therefore, the two optical cables used with the low-loss optical junction adapters must be dedicated to the adapters.
If a conventional PCF (plastic clad silica fiber) cable (A66L-6001-0008, -0009, -0026) is used as even one of the two optical fiber cables for joining the low-loss optical junction adapter, both cables may be damaged, resulting in deteriorated characteristics.


## NOTE

Ferrule: Movable metal at the tip of an optical connector; the fiber is bonded to the ferrule.


- Features of low-loss optical cable (A66L-6001-0029)

A low-loss optical cable is selected from conventional PCF optical cables (A66L-6601-0026). The selected cable offers low loss, and its connector section is given special treatment; the fiber ends are provided with a depression so that the ferrules can be butted against each other. The two optical cables used with the low-loss optical junction adapter must be of low-loss type.

- Appearance of the low-loss optical junction adapter and cable (how to distinguish them from conventional types)
The body of the conventional optical junction adapter is black, but that of the low-loss optical junction adapter is blue. In addition, the protective cover(Note 1) of the conventional PCF optical cable is black, but that of the low-loss optical cable is blue.

8. Installing the optical fiber junction adapter

The optical fiber junction adapter should be installed within a cabinet, as a rule. If it is impossible to avoid installing it within a cabinet, protect the adapter and the optical cable portions (such as connectors and cords) not covered with reinforcement coating from the outside air by, for example, covering them with packing.
9. Environmental resistance of the optical fiber junction adapter

- The optical fiber junction adapter is not waterproof. Even when optical cables are attached to both ends of the adapter, there are very small gaps in the linked portions, so water resistance can not be expected.
- When optical cables are attached to both ends of the junction adapter installed in a normal environment (such as within a cabinet), it is unlikely that dust will penetrate between the adapter and optical fiber to the degree that it may hamper normal optical linkage. If one or both ends of the adapter are left open, dust and dirt may accumulate even when the adapter is in a normal environment (such as within a cabinet). The dust and dirt on the adapter ends is likely to hamper normal optical linkage when the optical cables are attached. In such a case, clean the junction adapter and the optical connector using the optical fiber junction adapter cleaning method described below.
- Do not allow cutting fluid to splash over the adapter or those optical cable portions (such as connectors and cords) that are not covered with reinforcement coating. If the inside of the adapter and fiber end surfaces are contaminated with cutting fluid, a malfunction may occur.


## 10.Cleaning

If the optical fiber junction adapter, optical-to-electrical conversion module, or optical cable are soiled, clean them according to the following procedures.

- Cleaning the optical fiber junction adapter and optical-to-electrical conversion module
First, clean the entire housing by wiping it with a cloth moistened with, or by washing it in, ethyl alcohol or HCFC141B (alternative CFC; High Shower spray can DS-2168, manufactured by Sun Hayato). Similarly, wash the two sleeves in the adapter or wipe them with a cotton swab or the like.
- Cleaning optical cables

For the optical cables, it is important to clean the connectors at their ends. Any soiling on the optical fiber end surfaces will hamper optical transmission, resulting in a malfunction. Wipe the optical fiber end surfaces (that is, the ferrule end surfaces) thoroughly with a soft, clean cloth (like gauze) moistened with ethyl alcohol or HCFC141B, in the same way as described above. The use of cotton swabs may prove convenient. The fiber end surfaces of low-loss optical cables are lower than the ferrules. To remove any soiling from the fiber end surfaces completely, push the cotton swab or gauze into the depressions all the way through while rotating the ferrule. If the ferrules and optical connectors are contaminated with oily substances, and they may extend over a cleaned fiber end surface when it is attached to the optical-to-electrical conversion module, it is a good idea to wash them before wiping the optical fiber end surfaces, using the procedure stated above.
11. Compatibility with previous models of FANUC optical fiber cables FANUC has offered other types of optical cables for different applications (see Table $\mathrm{D}(\mathrm{c})$ ).
Note that the optical cables for FANUC I/O Link and FANUC high-speed serial bus applications cannot be used for the servo interface application. On the other hand, however, the external optical cable for the servo interface application can be used in place of previous cables types, as shown in Table $\mathrm{D}(\mathrm{d})$. (The external optical cable for the servo interface application is designed to offer a level of performance equivalent to that of the previous cables. This is not the case with the internal cord type cable, so it cannot replace the previous cables.)

Table D(c) FANUC optical fiber cables

|  | System application | FANUC specification No. | Specification |
| :---: | :---: | :---: | :---: |
| Previous optical fiber cables | FANUC I/O <br> Link <br> interface <br> Serial <br> spindle <br> interface | A66L-6001-0008\#L ~ | Internal cable/fixed type |
|  |  | A66L-6001-0009\#L ~ | External cable/fixed type |
|  | FANUC high-speed serial bus interface | A66L-6001-0021\#L ~ | External cable/fixed type |
|  |  | A66L-6001-0022\#L ~ | External cable/fixed type |
| New optical fiber cables | Serial ser- <br> vo-bus <br> interface | A66L-6001-0023\#L ~ | Internal cable/fixed type |
|  |  | A66L-6001-0026\#L ~ | External cable/fixed or portable type |

Table D(d) Previous optical fiber cables that can be replaced by the new external cable (A66L-6001-0026\#L)

| Optical cable | $\longrightarrow$ | Replaceable optical fiber cables |
| :---: | :---: | :---: |
| External cable for serial servo-bus interface A66L-6001-0026\#L ~ | $\longrightarrow$ | FANUC I/O Link: A66L-6001-0009\#L ~ |
|  | $\longrightarrow$ | FANUC high-speed serial bus: A66L-6001-0021\#L ~ |
|  |  | FANUC high-speed serial bus: A66L-6001-0022\#L ~ |

## LIQUID CRYSTAL DISPLAY (LCD)

## Brightness of the monochrome LCD

## LCD with a touch panel

## Protection sheet for the touch panel

## Replacing procedure

When the ambient temperature is low, the brightness of the LCD decreases. (The LCD screen is dark particularly immediately after the power is turned on.) This phenomenon is not a failure but is a property specific to the LCD. When the ambient temperature increases, the LCD screen becomes brighter. The monochrome LCD has a brightness control function.

The touch panel is operated by directly touching the LCD screen. For this operation, be sure to use a FANUC-supplied pen (A02B-0236-K111) dedicated to the touch panel. If a sharp-pointed pen is used, for example, to touch the LCD screen, the LCD surface may be flawed or damaged. Moreover, do not touch the LCD screen directly with a finger. Otherwise, the operability of the LCD may deteriorate, and the LCD screen may get dirty.

A protection sheet is attached the face of an LCD with a touch panel to protect the thin film of the touch panel and LCD.

| Name |  | Ordering number |
| :--- | :--- | :--- |
| Protection sheet for the <br> touch panel | For 10.4" LCD | A02B-0236-K130 |
|  | For 12.1" LCD | A02B-0236-K118 |
|  | For 15" LCD | A02B-0082-K020 |

<1> First, remove the old protection sheet.
<2> Wipe moisture, dust, and grease on the surface of the LCD.
<3> Peel off the white film attached on the back (facing the LCD) of the new protection sheet.
<4> Attach the protection sheet so that it is to the lower-left of the replacement tab. At this time, align the overhang edge at bottom of the escutcheon with the corresponding part of the protection sheet. In addition, prevent dust from entering between the LCD and protection sheet.

<5> Attach the four sides while pushing out air between the touch panel and protection sheet.
Do not pull the protection sheet to correct its position with the part of the sheet kept stuck to the touch panel.
<6> Press the adhesive parts of the four sides, and attach the sheet completely.
Check that the four corners and four sides of the protection sheet do not float.

## MEMORY CARD INTERFACE

## Overview

## Compatible and incompatible cards

Using the memory card interface located on the left side of the LCD, input/output of data inside the CNC and remote diagnosis using a modem card can be performed. This appendix describes the memory card interface for data input/output. For an explanation of remote diagnosis using a modem card, see the related document.

SRAM card

- JEIDA (4.0 or later) Type 1 and Type 2
- PCMCIA (2.0 or later) Type 1 and Type 2
- PC Card Standard

SRAM cards conforming to any of the above standards can be used. However, SRAM cards operating only on a power supply voltage of 3.3 V cannot be inserted physically. Such SRAM cards cannot be used.
The operation of the following FANUC-recommended SRAM cards has been confirmed by FANUC:

| 256KB SRAM card | Fujitsu | MB98A90823-20 |
| :--- | :--- | :--- |
| 512KB SRAM card | Fujitsu | MB98A90923-20 |
| 1MB SRAM card | Fujitsu | MB98A91023-20 |
| 2MB SRAM card | Fujitsu | MB98A91123-20 |

Flash memory card
With the $i$ Series incorporating personal computer functions, no flash memory card can be used. With the $i$ Series, Intel series 2 flash memory cards (or equivalent) can be used. However, flash memory cards operating only on a power supply voltage of 3.3 V cannot be inserted physically. Such flash memory cards cannot be used.
Basically, flash memory cards with non-Intel on-chip flash memories cannot be used. However, such flash memory cards, if formatted or written by a personal computer, may be read with the $i$ Series. The operation of the following FANUC-recommended flash memory card has been confirmed by FANUC:

| 4MB flash memory card | Fujitsu | IMC004FLSA |
| :--- | :--- | :--- |

## Memory card capacity

## Memory card formatting

File operation with a flash memory card

Notes on formatting a flash memory card with CardPro

The capacity of a memory card usually indicates an unformatted capacity. After formatting, the usable capacity decreases slightly. So, a memory card with a capacity larger than the size of data and programs actually stored needs to be prepared.
Example: When the size of data to be stored is 512 KB
A memory card with a capacity of 1 MB or more is required.
When a flash memory card is used, the last 128 KB of the memory card is used as a buffer area, so that the usable space decreases additionally by 128 KB .

The BOOT SYSTEM formats a memory card using method called the FAT file system. The formatting method called the flash file system is also supported. However, the FAT file system and flash file system are not compatible with each other, and the read and list functions cannot be used.

Flash memory cards do not allow individual files to be deleted; all the files on a flash memory card need to be deleted at the same time. Accordingly, the following operations cannot be performed:

- Deletion of an existing file
- Renaming of a file
- Overwriting of a file

CardPro uses the flash file system as standard to format a flash memory card. When using CardPro to format a flash memory card used with the boot system, use the following command to format the card.

A:CPFORMAT drive-name:/F:FLASHFAT/NOCIS

|  | Ramzo | CardPro |
| :--- | :---: | :---: |
| Reading of files | $\bigcirc$ | $\bigcirc$ |
| Addition of files | No file addition function <br> is available. | $\times$ |
| Listing of files | $\bigcirc$ | $\bigcirc$ |

## Using a flash memory card formatted with other systems on the BOOT SYSTEM

|  | Ramzo | CardPro |
| :--- | :---: | :---: |
| Reading of files | $\bigcirc$ | $\bigcirc$ |
| Addition of files | $\bigcirc$ | $\times$ |
| Listing of files | $\bigcirc$ | $\bigcirc$ |

## NOTE

1 Ramzo is a memory card reader/writer manufactured by Adtech System Science.
2 CardPro is a memory card reader/writer manufactured by Data IO.

Names and functions of components


## Inserting a memory card

Battery

A memory card has an insertion guide to protect against reverse insertion. Pay attention to the orientation of the memory card. The front of the memory card must face the LCD of the $i$ Series.

The batteries used with FANUC-supplied SRAM memory cards were of the CR2325 and BR2325 types.
These batteries were difficult to obtain, so the CR2025 battery was introduced to replace these batteries in May, 1997.
By replacing the battery holder, the user can use SRAM memory cards that used the previous batteries (CR2325 and BR2325) with the new battery (CR2025).

## SRAM memory cards

1) A87L-0001-0150\#

Manufacturer's model: MB98A9 $\square \square 33-20$

## Battery type

1) Before the change: CR2325 or BR2325

- Indication on the side of the memory card:
$9 \square \square 33-20 \mathrm{~S} 000$


2) After the change: CR2025 or equivalent (common battery intended for use in electronic calculators)

- Indication on the side of the memory card:

9 $\square \square 33-209157$
$\square$

## Battery holder replacement

1) By replacing the battery holder, the user can use SRAM memory cards that used the previous batteries (CR2325 and BR2325) with the new battery (CR2025).
2) The battery holder set for CR2025 is available from shops handling Fujitsu electronic devices.

- Ordering code: MB98XXX-holder set-09146
- Contents of the set: Battery holder (1), battery (CR2025) (1), manual (1)

Battery replacement
(1) While pressing down the fixing claw, pull out the battery case.

(2) Replace the battery with a new one.

Match the + mark of the battery with the + mark on the battery case.

(3) Return the battery case to its original position, then check that the battery operates normally.


## ATA CARD

1. Overview

Series $15 / 150 i$ enable output and input of data to and from the flash ATA card (which operates on 5 V ).
The flash ATA card has a built-in controller together with a memory device and, therefore, has the advantage that it can output and input data to and from a PCMCIA-interface-installed personal computer without the use of a special PC card writer.
2. Flash ATA card specifications

The flash ATA card must conform to the following standard and must have the following shape.
Not all ATA cards that conform to this standard are guaranteed to operate normally. It is recommended to use those cards that have been verified to operate normally.
2-1 Card standard
PCMCIA (Personal Computer Memory Card International Association)
The card must conform to PC Card standard Release 2.1 and PCMCIA PC Card ATA Release 1.02.

2-2 Card shape PCMCIA TYPE I or Type II
2-3 Card operating mode PC-ATA specifications
2-4 Card operating voltage
The card may operate on a single voltage of 5 V or on $5 \mathrm{~V} / 3.3 \mathrm{~V}$ (automatically switched).
3. Note

- The flash ATA card is in quick format.

A flash ATA card that has not been formatted must be formatted on the personal computer.

TERMINAL MODULE

## G. 1 OVERVIEW

## G. 2 TOTAL CONNECTION

## G. 3 CONNECTION OF EACH PART <br> G.3.1 Pin Assignment

G.3.1.1 Connector Pin Assignment of Connector Panel I/O Module
G.3.1.2 Connector-terminal Block Pin Assignment of Terminal Module G.3.2 Connection of 24VDC Power Supply and Signals
G.3.2.1 24VDC Power Supply Connection
G.3.2.2 DI (Input Signal) Connection
G.3.2.3 DO (Output Signal) Connector
G. 4 MOUNTING TERMINAL MODULE
G. 5 SPECIFICATIONS
G.5.1 Installation Specifications
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G.5.3 Module Specifications
G.5.4 Power Voltage
G.5.5 DI/DO (Input/output Signal Specification)
G. 1

OVERVIEW

The terminal module is connected by connector panel I/O module and a cable. It is the terminal module that a input/output signal (DI 24 points/DO 16 points) from the machine side can be relayed with the terminal block.

## G. 2 <br> TOTAL CONNECTION



## NOTE

The terminal module can't be connected with connector panel I/O output 2A module.

## G. 3

CONNECTION OF
EACH PART

## G.3.1

Pin Assignment

## G.3.1.1

Connector Pin
Assignment of Connector Panel I/O Module

| CB150 (HONDA MR-50RMA) |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 33 | +24E |  |  | 01 | +24E |
| 34 | Yn+0.0 |  |  | 02 | $Y \mathrm{n}+1.0$ |
| 35 | $\mathrm{Yn}+0.1$ | 19 | OV | 03 | $Y n+1.1$ |
| 36 | Yn+0.2 | 20 | OV | 04 | $Y \mathrm{n}+1.2$ |
| 37 | $\mathrm{Yn}+0.3$ | 21 | OV | 05 | Yn+1.3 |
| 38 | Yn+0.4 | 22 | OV | 06 | $Y n+1.4$ |
| 39 | $Y n+0.5$ | 23 | OV | 07 | $Y n+1.5$ |
| 40 | $Y \mathrm{n}+0.6$ | 24 | DICOM0 | 08 | $Y n+1.6$ |
| 41 | Yn+0.7 | 25 | Xm+1.0 | 09 | Yn+1.7 |
| 42 | Xm+0.0 | 26 | Xm+1.1 | 10 | Xm+2.0 |
| 43 | Xm+0.1 | 27 | Xm+1.2 | 11 | Xm+2.1 |
| 44 | Xm+0.2 | 28 | Xm+1.3 | 12 | Xm+2.2 |
| 45 | Xm+0.3 | 29 | Xm+1.4 | 13 | Xm+2.3 |
| 46 | Xm+0.4 | 30 | Xm+1.5 | 14 | Xm+2.4 |
| 47 | Xm+0.5 | 31 | Xm+1.6 | 15 | Xm+2.5 |
| 48 | Xm+0.6 | 32 | Xm+1.7 | 16 | Xm+2.6 |
| 49 | Xm+0.7 |  |  | 17 | Xm+2.7 |
| 50 | +24V |  |  | 18 | +24V |

## NOTE

For detailed allocation of DI/DO address, refer to connection manual of connector panel I/O module.

## G.3.1.2

Connector-terminal Block Pin Assignment of Terminal Module


## G.3.2

## Connection of 24VDC

## Power Supply and

Signals

## G.3.2.1 <br> 24VDC Power Supply Connection

24 VDC power supply into 2 system of control power supply +24 V for connector panel I/O module and +24 E for machine side input/output signal, and it can be supplied.
Of course, one power supply unit can supply to both the +24 V and +24 E .

## G.3.2.2

## DI (Input Signal)

## Connection




## NOTE

Xm +0.0 through $\mathrm{Xm}+0.7$ are DI pins for which a common voltage can be selected.
That is, set up a setting pin XB1 on "0V" side, set up a setting pin XB2 on " +24 " side, by connecting the DICOM0 to the +24 V power supply, a DI signal can be input with its logical state reverse. If, however, a cable is connected to ground, it has the same effect as inputting an ON state DI signal. To prevent this from occurring, set up a setting pin XB1 on " +24 " side, set up a setting pin XB2 on " $0 V$ " side, the connection of the DICOMO to the OV power supply is recommended wherever possible.
It is set up as follows at the time of factory shipping.
Setting pin XB1: "+24" side
Setting pin XB2 : "0V" side

## G.3.2.3 <br> DO (Output Signal) Connector


G. 4

MOUNTING
TERMINAL MODULE

As for the mounting of the terminal module, a screw or DIN rail mounting is possible.

(Unit mm)

## G. 5 <br> SPECIFICATIONS

## G.5. 1

Installation Specifications

| Ambient <br> temperature | At operation <br> Storing or transporting | $0^{\circ} \mathrm{C}$ to $55^{\circ} \mathrm{C}$ <br> $-20^{\circ} \mathrm{C}$ to $60^{\circ} \mathrm{C}$ |
| :--- | :--- | :--- |
| Temperature <br> change | Max. $0.3^{\circ} \mathrm{C} / \mathrm{min}$ | $75 \%$ or less (Relative humidity) <br> $95 \%$ or less (Relative humidity) |
| Relative humidity | Normally <br> Short time (Within one month) |  |
| Vibration | Operating 0.5 G or less |  |
| Environment | Normal FA atmosphere (The examination is necessary when using <br> the system under environments with higher degree of dust, cool- <br> ant, or organic solution.) |  |
| Otherrequirements | Use this module in a cabinet that is always completely closed. |  |

## G.5.2 <br> Ordering <br> Specifications

| Item | Specification | Remarks |
| :--- | :--- | :--- |
| Terminalmodule | A03B-0815-C020 |  |
| Connection cable <br> (Between connector panel I/O module <br> and terminal module.) | A03B-0815-K020 | 0.3 m |
|  | A03B-0815-K021 | 1 m |
|  | A03B-0815-K022 | 2 m |

## G.5. 3 <br> Module Specifications

| Item |  | Specification | Remarks |
| :--- | :--- | :--- | :--- |
| Dl points | 24 points | Terminal block connection |  |
| DO points | 16 points | Terminal block connection |  |
|  | Rated voltage | 250 V | Screw up type |
|  | Rated thermal <br> current | 10 A |  |
|  | Adaptationwire | $1.25 \mathrm{~mm}^{2}$ |  |
|  | Tighteningtorque | 0.5 to $0.75 \mathrm{~N} \cdot \mathrm{~m}$ |  |

## G.5.4 <br> Power Voltage

$24 \mathrm{VDC} \pm 10 \%$ is supplied from terminal block XT150A and XT150B (The $\pm 10 \%$ tolerance includes momentary and ripple currents.) For detailed power supply rating of connector panel I/O module, refer to connection manual of connector panel I/O module.
G.5.5

DI/DO (Input/output Signal Specification)

For detailed input/output signal specifications, refer to connection manual of connector panel I/O module.

## H. 1 OVERVIEW

## H. 2 TOTAL CONNECTION

## H. 3 CONNECTION OF EACH PART

H.3.1 Pin Assignment
H.3.2 Connection of 24VDC Power Supply and Signals H.3.2.1 24VDC Power Supply Connection
H.3.2.2 DI (Input Signal) Connection
H.3.2.3 DO (Output Signal) Connector
H.3.3 Connection of Basic and Extension Modules
H. 4 MOUNTING THE TERMINAL MODULE A

## H. 5 SPECIFICATIONS

H.5.1 Installation Specifications
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H.5.3 Module Specifications
H.5.4 Power Voltage
H.5.5 DI/DO (Input/output Signal Specification)
H. 1 OVERVIEW

The Terminal Module A is connected by the Connector Panel I/O Module directly. It is the Terminal Module A that a input/output signal (DI 24 points/DO 16 points) from the machine side can be relayed with the terminal block. And output signal (DO 16 points) are also relayed by a connector.

## H. 2 <br> TOTAL CONNECTION



## NOTE

1 Terminal Module A cannot be connected with the Connector Panel I/O Output 2A Module.
2 Terminal Module A can be connected with the Relay Module(A20B-1006-0760).

## H. 3 <br> CONNECTION OF EACH PART

H.3.1

Pin Assignment

Terminal and Connector pin assignment of the Terminal Module

| XT150A (YOSHIDA PX7-32A) |  |  |  | XT150B (YOSHIDA PX7-32A) |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | OV | 17 | +24E | 1 | +24E | 17 | +24E |
| , | DICO | 18 | DICOM | 2 | +24 | 18 | Xm+2.4 |
| 2 | DICOM | 19 | Xm+0.0 | 2 | Xm+2.6 | 19 | Xm+2.5 |
| 3 | Xm+0.2 | 20 | Xm+0.1 | 3 | Xm+2.7 | 20 | OV |
| 4 | Xm+0.3 | 21 | DICOM | 4 | OV | 21 | $\mathrm{Yn}+0.0$ |
| 5 | DICOM | 1 | DICOM | 5 | Yn+0.2 | 21 | Yn+0.1 |
| 6 | Xm+0.6 | 22 | Xm+0.4 | 6 | Yn+0.3 | 22 | Yn+0.1 |
| 7 | Xm+0.7 | 23 | Xm+0.5 | 7 | OV | 23 | OV |
| 8 | +24E | 24 | +24E | 8 | Yn+0.6 | 24 | $Y \mathrm{n}+0.4$ |
| 9 | Xm+1.2 | 25 | Xm+1.0 | 9 | Yn+0.7 | 25 | $Y \mathrm{n}+0.5$ |
| 10 | Xm+1.3 | 26 | Xm+1.1 | 10 | OV | 26 | OV |
| 11 | +24E | 27 | +24E | 11 | Yn+1.2 | 27 | $Y n+1.0$ |
| 12 | Xm+1.6 | 28 | Xm+1.4 | 12 | Yn+1.3 | 28 | $Y \mathrm{n}+1.1$ |
| 13 | Xm+1.7 | 29 | Xm+1.5 | 13 | OV | 29 | OV |
| 14 | +24E | 30 | +24E | 14 | Yn+1.6 | 30 | $Y \mathrm{n}+1.4$ |
| 15 | Xm+2.2 | 31 | Xm+2.0 | 15 | Yn+1.7 | 31 | $Y \mathrm{n}+1.5$ |
| 16 | Xm+2.3 | 32 | Xm+2.1 | 16 | OV | 32 | +24V |

X150 (HIROSE HIF3CB-50PA-2.54DSA)

| A1 |  | B1 |  |
| :---: | :---: | :---: | :---: |
| A2 |  | B2 |  |
| A3 |  | B3 | $Y \mathrm{n}+0.2$ |
| A4 | Yn+0.6 | B4 | Yn+0.0 |
| A5 | Yn+1.0 | B5 | $Y \mathrm{n}+0.1$ |
| A6 | $Y \mathrm{n}+1.2$ | B6 | $Y \mathrm{n}+0.3$ |
| A7 | $Y \mathrm{n}+0.5$ | B7 | $Y \mathrm{n}+0.7$ |
| A8 | Yn+1.1 | B8 | $\mathrm{Yn}+1.3$ |
| A9 | Yn+1.4 | B9 | $Y \mathrm{n}+1.4$ |
| A10 | Yn+1.5 | B10 | $Y \mathrm{n}+1.5$ |
| A11 | $Y \mathrm{n}+1.6$ | B11 | $Y \mathrm{n}+1.6$ |
| A12 | Yn+1.7 | B12 | Yn+1.7 |
| A13 |  | B13 |  |
| A14 |  | B14 |  |
| A15 |  | B15 |  |
| A16 |  | B16 |  |
| A17 |  | B17 |  |
| A18 | Yn+0.4 | B18 |  |
| A19 |  | B19 |  |
| A20 |  | B20 |  |
| A21 |  | B21 |  |
| A22 |  | B22 |  |
| A23 |  | B23 |  |
| A24 | OV | B24 | OV |
| A25 | OV | B25 |  |

A connector specification of flat cable side is HIF3BA-20D-2.54R

## NOTE

1 For detailed allocation of DI/DO address, refer to connection manual of Connector Panel I/O Module.
2 Output Pins shaded by $\square$ are in pairs. Only one in each pair is usable.

## H.3.2

Connection of 24VDC

## Power Supply and

Signals
H.3.2.1

24VDC Power Supply Connection

24 VDC power supply into 2 system of control power supply +24 V for the connector panel I/O module and +24 E for machine side input/output signal, and it can be supplied.
Also one power supply unit can supply to both the +24 V and +24 E .

## H.3.2.2

DI (Input Signal)

## Connection




## NOTE

$X m+0.0$ through $\mathrm{Xm}+0.7$ are DI pins for which a common voltage can be selected. That is, set up a setting pin XB1 on " 0 V " side, set up a setting pin XB2 on " +24 " side, by connecting the DICOMO to the +24 V power supply, a DI signal can be input with its logical state reverse. If, however, a cable is connected to ground, it has the same effect as inputting an ON state DI signal. To prevent this from occurring, set up a setting pin XB1 on "+24" side, set up a setting pin XB2 on " 0 V " side, the connection of the DICOM0 to the 0 V power supply is recommended wherever possible.

## H.3.2.3

DO (Output Signal)
Connector


## NOTE

At Connection parts of the Terminal Module, $\longrightarrow$ means the terminal "XT150B", $\longrightarrow$ means the connector "X150".

## H.3.3 <br> Connection of Basic and Extension Modules

Connect I/O modules mounted on the Terminal module A by using 34 -pin flat cable connectors as shown in the figure below. Ensure that all 34 pins at one end of the cable are connected to the corresponding pins at the other end; e.g., connect the A1 pin to the pin having the same designation (A1) at the other end.


NOTE
Make the length of the flat cable more than 100 mm in consideration of wiring to the terminal blocks on the terminal module A. But, the maximum length of the total extension of the flat cable is 300 mm .
To ensure adequate ventilation, install the modules in such a way that the flat cables lie on top of them. The basic module has a vent at the top (as indicated by the dotted lines in the above figure). When connecting modules, install extension modules so that the flat cables do not cover the vent, as shown in the above figure. Therefore, for direct connection to the Terminal module A, expansion modules are installed to the right of the basic module on the installation plane.

## H. 4 <br> MOUNTING THE TERMINAL MODULE

A


## NOTE

When mounting the Terminal Module by screw, remove spacers.


## H. 5 <br> SPECIFICATIONS

## H.5. 1

Installation Specifications

| Ambient <br> temperature | At operation <br> Storing or transporting | $0^{\circ} \mathrm{C}$ to $55^{\circ} \mathrm{C}$ <br> $-20^{\circ} \mathrm{C}$ to $60^{\circ} \mathrm{C}$ |
| :--- | :--- | :--- |
| Temperature <br> change | Max. $0.3^{\circ} \mathrm{C} / \mathrm{min}$ |  |
| Relative humidity | Normally <br> Short time (Within one month) $95 \%$ or less (Relative humidity) |  |
| Vibration | Operating 0.5 G or less |  |
| Environment | Normal FA atmosphere (The examination is necessary when using <br> the system under environments with higher degree of dust, cool- <br> ant, or organic solution.) |  |
| Other Requirements | Use this module in a cabinet that is always completely closed. |  |

## H.5.2

Ordering Specifications

| Item | Specification | Remarks |
| :--- | :--- | :--- |
| Terminal module A | A03B-0815-C021 |  |
| Inter-module flat cable | A03B-0815-K101 | Length100mm |

## H.5.3

Module Specifications

| Item |  | Specification | Remarks |
| :--- | :--- | :--- | :--- |
| Dl points | 24 points | Terminal Block connection |  |
| DO points | 16 points | Terminal Block or Connector <br> Connection |  |
| Terminal <br> Block | Rated Voltage | 250 V | Screw up type |
|  | Rated Thermal <br> Current | 10 A |  |
|  | AdaptationWire | $1.25 \mathrm{~mm}^{2}$ |  |
|  | Tightening Torque | 0.5 to $0.75 \mathrm{~N} \cdot \mathrm{~m}$ |  |

## H.5.4 <br> Power Voltage

$24 \mathrm{VDC} \pm 10 \%$ is supplied from the terminal block XT150A and XT150B
(The $\pm 10 \%$ tolerance includes momentary and ripple currents.)
For detailed power supply rating of Connector Panel I/O Module, refer to connection manual of Connector Panel I/O Module.
H.5.5

DI/DO (Input/output Signal Specification)

For detailed input/output signal specifications, refer to connection manual of Connector Panel I/O Module.

## RELAY MODULE A

## I. 1 OVERVIEW

I. 2 TOTAL CONNECTION
I. 3 CONNECTION OF EACH PART
I.3.1 Pin Assignment
I.3.2 Connection of the Relay Module A
I. 4 OUTLINE OF THE RELAY MODULE A
I. 5 SPECIFICATIONS
I.5.1 Installation Specifications
I.5.2 Ordering Specifications
I.5.3 Module Specifications

## I. 1 OVERVIEW

Relay Module A has 10 relays and is used when driving the load of the exceeding the rated current of the Connector Panel I/O Module's DO. This module is connected to the Terminal module A "A03B-0815-C021" which the Connector Panel I/O Module is mounted on with a flat cable. And connect one more this module when all of the Connector Panel I/O Module's 16 points of DO are used.

## I. 2

## TOTAL CONNECTION



NOTE
1 The first Relay Module A drives 10 relays by 10 points of DO. And the second Relay module A drives 10 relays by 6 points of DO. (In 2 relays, 1 relay is driven by 1 point of DO. In other 8 relays, 2 relays are driven by 1 point of DO.)
2 Don't connect the DO used in the Relay module A to Terminal module A side.

## I. 3 <br> CONNECTION OF <br> EACH PART

## I.3.1 <br> Terminal and Connector pin assignment of the Relay Module A. <br> Pin Assignment

XT1

|  |  | 1 | KA1A |
| :---: | :---: | :---: | :---: |
| 2 | COM1 | 3 | KA1C |
| 4 | COM1 | 5 | KA2A |
| 6 | COM1 | 7 | KA2C |
| 8 | COM2 | 9 | COM2 |
| 10 | COM2 | 11 | KA3A |
| 12 | COM3 | 13 | KA34 |
| 14 | COM3 | 15 | KA4A |
| 16 | COM4 | 17 | KA5A |
| 18 | COM4 | 19 | KA56C |
| 20 | COM4 | 21 | KA6A |
| 22 | COM5 | 23 | COM5 |
| 24 | COM6 | 25 | KA7A |
| 26 | COM6 | 27 | KA7C |
| 28 | COM6 | 29 | KA8A |
| 30 | COM7 | 31 | KA8C |
| 32 | COM7 | 33 | KA9A |
| 26 | COM8 | 35 | KA9C |
| 28 | COM8 | 37 | KA10A |
| 30 | COM8 | 39 | KA10C |
| 32 | +24E |  |  |

XT1 connecting wire
Solid : 0.2-6.0mm ${ }^{2}$
Stranded : $0.2-4.0 \mathrm{~mm}^{2}$
AWG : AWG24-10
Stranded with ferrules : $0.5-4.0 \mathrm{~mm}^{2}$
(without/with plastic collar)
Stripping length : 8mm

XP1

| A01 | +24 E | B 01 | +24 E |
| :---: | :---: | :---: | :---: |
| A02 |  | B 02 |  |
| A03 |  | B 03 | $\mathrm{Yn}+0.2$ |
| A04 | $\mathrm{Yn}+0.6$ | B 04 | $\mathrm{Yn}+0.0$ |
| A05 | $\mathrm{Yn}+1.0$ | B 05 | $\mathrm{Yn}+0.1$ |
| A06 | $\mathrm{Yn}+1.2$ | B 06 | $\mathrm{Yn}+0.3$ |
| A07 | $\mathrm{Yn}+0.5$ | B 07 | $\mathrm{Yn}+0.7$ |
| A08 | $\mathrm{Yn}+1.1$ | B 08 | $\mathrm{Yn}+1.3$ |
| A09 | $\mathrm{Yn}+1.4$ | B 09 | $\mathrm{Yn}+1.4$ |
| A10 | $\mathrm{Yn}+1.5$ | B 10 | $\mathrm{Yn}+1.5$ |
| A11 | $\mathrm{Yn}+1.6$ | B 11 | $\mathrm{Yn}+1.6$ |
| A12 | $\mathrm{Yn}+1.7$ | B 12 | $\mathrm{Yn}+1.7$ |
| A13 |  | B 13 |  |
| A14 |  | B 14 |  |
| A15 |  | B 15 |  |
| A16 |  | B 16 |  |
| A17 |  | B 17 |  |
| A18 | $\mathrm{Yn}+0.4$ | B 18 |  |
| A19 |  | B19 |  |
| A20 |  | B20 |  |
| A21 |  | B21 |  |
| A22 |  | B22 |  |
| A23 |  | B23 |  |
| A24 | $0 V$ | B24 | 0 OV |
| A25 | $0 V$ | B25 |  |

XP2

| A01 | +24E | B01 | +24E |
| :---: | :---: | :---: | :---: |
| A02 |  | B02 |  |
| A03 |  | B03 | Yn+1.4 |
| A04 | Yn+1.6 | B04 | $\mathrm{Yn}+1.2$ |
| A05 | $\mathrm{Yn}+1.7$ | B05 | $\mathrm{Yn}+1.3$ |
| A06 |  | B06 | $\mathrm{Yn}+1.4$ |
| A07 | Yn+1.5 | B07 | Yn+1.6 |
| A08 | $Y \mathrm{n}+1.7$ | B08 |  |
| A09 |  | B09 |  |
| A10 |  | B10 |  |
| A11 |  | B11 |  |
| A12 |  | B12 |  |
| A13 |  | B13 |  |
| A14 |  | B14 |  |
| A15 |  | B15 |  |
| A16 |  | B16 |  |
| A17 |  | B17 |  |
| A18 | $Y n+1.5$ | B18 |  |
| A19 |  | B19 |  |
| A20 |  | B20 |  |
| A21 |  | B21 |  |
| A22 |  | B22 |  |
| A23 |  | B23 |  |
| A24 | OV | B24 | 0V |
| A25 | OV | B25 |  |

XP1, XP2 connector specification of flat cable side is HIF3BA-20D-2.54R

## I.3.2

Connection of the
Relay Module A


## NOTE

1 About Connection of the DI, refer to connection manual of Connector Panel I/O Module.
2 At Connection parts of the Terminal Module A, $\longrightarrow$ means the terminal "XT150B", means the connector "X150".


## NOTE

An above figure shows the connection when two Relay module A are used.

Relay module A


## I. 4 <br> OUTLINE OF THE <br> RELAY MODULE A



Unit=mm

## I. 5 <br> SPECIFICATIONS

I.5.1

Installation Specifications

| Ambient <br> Temperature | Atoperation <br> Storing or transporting | $0^{\circ} \mathrm{C}$ to $55^{\circ} \mathrm{C}$ <br> $-20^{\circ} \mathrm{C}$ to $60^{\circ} \mathrm{C}$ |
| :--- | :--- | :--- |
| Temperature <br> Change | Max. $0.3^{\circ} \mathrm{C} / \mathrm{min}$ |  |
| Relative Humidity | Normally <br> Short time (Within one month) <br> M |  |
| Vibration | Operating or less (Relative humidity) 0.5 G or less |  |
| Environment | Normal FA atmosphere (The examination is necessary when using <br> the system under environments with higher degree of dust, cool- <br> ant, or organic solution.) |  |
| Other Requirements | Use this module in a cabinet that is always completely closed. |  |

## I.5.2 <br> Ordering Specifications

| Item | Specification | Remarks |
| :--- | :---: | :---: |
| Relay Module A | A20B-1006-0760 |  |

## I.5.3

Module Specifications

| Item |  | Specification | Remarks |
| :---: | :---: | :---: | :---: |
| Output Points |  | 10 points |  |
| Relay coil | Coil resistance | $1100 \Omega$ | Rated voltage 24VDC |
|  | On voltage | Less than 70\% of rated voltage |  |
|  | Off voltage | More than 15\% of rated voltage |  |
|  | Max. permissible voltage | 110\% of rated voltage | $23^{\circ} \mathrm{C}$ |
| Relay contact | Number of contact | 1 a contact $\times 10$ |  |
|  | Rated load current | 250VAC 3A,30VDC 3A |  |
|  | Min. load current | 5VDC, 100mA |  |
| Terminal | Connection wire | Solid : 0.2-6.0mm ${ }^{2}$ |  |
|  |  | Stranded : $0.2-4.0 \mathrm{~mm}^{2}$ |  |
|  |  | AWG : AWG24-10 |  |
|  |  | Stranded with ferrules : $0.5-4.0 \mathrm{~mm}^{2}$ | without/with plastic collar |
|  | Strippinglength | 8mm |  |
|  | Tightening Torque | $0.5-0.6 \mathrm{Nm}$ |  |

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[^0]:    *1 These devices can be used only during application development. These cannot be installed in the control unit.

