FANUC I/O Unit-MODEL A

CONNECTION AND MAINTENANCE MANUAL

B-61813E/04

In this manual we have tried as much as possible to describe all the various matters.
However, we cannot describe all the matters which must not be done, or which cannot be done, because there are so many possibilities.
Therefore, matters which are not especially described as possible in this manual should be regarded as ”impossible”.

DEFINITION OF WARNING, CAUTION, AND NOTE

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

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

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

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

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

PREFACE

Applicable models

This manual describe the following products:

Name of products	Abbreviation
FANUC I/O Unit-MODEL A	I/O Unit-A

Applicable CNCs

Name of products	Abbreviation
FANUC Power Mate	Power Mate
FANUC Series 0 (MODEL C)	Series 0-C
FANUC Series 15	Series 15
FANUC Series 16	Series 16
FANUC Series 18	Series 18
FANUC Series 20	Series 20
FANUC Series 21	Series 21
FANUC SYSTEM F-MODEL D Mate	F-D Mate
FANUC Power Mate *i*	Power Mate *i*
FANUC Series 0*i*	Series 0*i*
FANUC Series 15*i*	Series 15*i*
FANUC Series 16*i*	Series 16*i*
FANUC Series 18*i*	Series 18*i*
FANUC Series 20*i*	Series 20*i*
FANUC Series 21*i*	Series 21*i*
FANUC Series 30*i*	Series 30*i*
FANUC Series 31*i*	Series 31*i*
FANUC Series 32*i*	Series 32*i*

Other related models

Name of products	Abbreviation
FANUC I/O Unit-MODEL B	I/O Unit-B

Abbreviations of manufacturer names used herein

This manual uses the following abbreviations for manufacturers of products such as connectors.

Manufacturer name	Abbreviation
Daito Communication Apparatus Co., Ltd.	Daito
Fujitsu Limited	Fujitsu
HIROSE ELECTRIC CO., LTD.	HIROSE ELECTRIC
HONDA TSUSHIN KOGYO CO., LTD.	HONDA TSUSHIN
Molex Incorporated	Molex
Nihon Weidmüller Co., Ltd.	Weidmüller
SORIAU JAPAN	SORIAU JAPAN
Tyco Electronics AMP K.K.	Tyco Electronics

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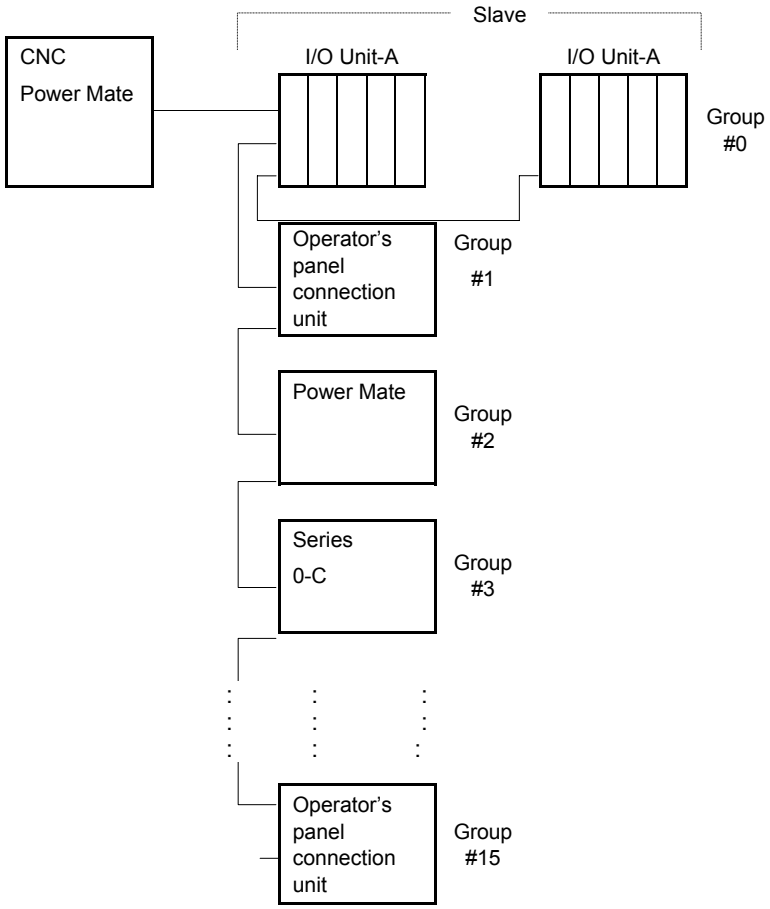
II. MAINTENANCE

I. CONNECTION

1 FANUC I/O Link

I/O Link is a serial interface with a purpose to transfer I/O signals (bit data) between CNC, cell controller, the I/O Unit-MODEL A, the Power Mate and so on at high-speed.

1.1 CONFIGURATION



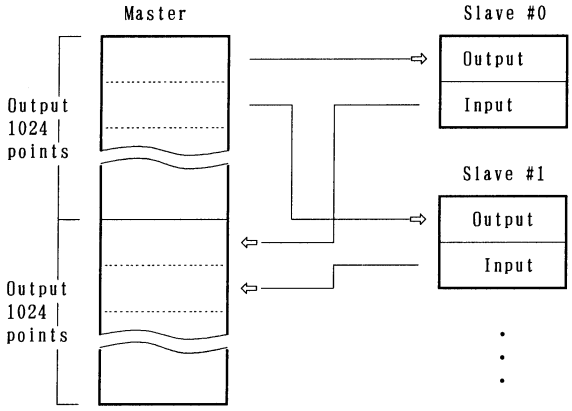
(1) The FANUC I/O Link is made up of one master and a number of slaves.
Master: Series0-C, Series15/16/18/20/21,
Series15*i*/16*i*/18*i*/20*i*/21*i*/30*i*/31*i*/32*i*/0*i*,
Power Mate-D/H, Power Mate *i*-D/H, F-D Mate
Slave: I/O Unit-A, I/O Unit-B, Operator's panel connection unit, Connector panel I/O module, Power Mate, Series0-C, Servo unit β series (I/O Link option), and so on

(2) Up to 16 groups of slaves can be connected with a single I/O Link. Number of slaves per one group is as follows.
I/O Unit-A.....Up to 2 units (i.e.2 bases)
I/O Unit-B.....Up to 30 units (Basic unit, basic and extension units).
Operator's panel I/O module ..... 1 unit (1 basic module and extension modules (up to three)
Operator's panel connection unit, connector panel I/O module, Power Mate, Series0-C, Servo unit β series (I/O Link option) ..... 1 unit

(3) Any slave can be connected with any group. However, different types of slaves cannot be connected with a single group.

1.2 ALLOCATION OF I/O POINTS

I/O Link has 1024 input points per 1 channel and 1024 output points per 1 channel as viewed from the master.
I/O data is periodically transferred between the master and slaves by allotting these I/O points to each slave.



Each slave can occupy as many I/O points as determined for it. For the I/O Link, the total number of I/O points occupied by all slaves per channel must meet:

Number of input points ≤ 1024
Number of output points ≤ 1024

Number of actual I/O points may differ from that of the occupied ones. How to determine the number of I/O points to be allotted to each slave and restrictions for allocation are shown in the followings.
(For the allocation method for I/O points, refer to the PMC PROGRAMMING MANUAL.)

(1) Sum the numbers of the I/O points for all slaves connected with a single I/O Link. The sum must satisfy the following restriction :
Number of input points ≤ 1024 (per one I/O Link)
Number of output points ≤ 1024 (per one I/O Link)

(2) Number of the occupied I/O points per one group must satisfy the following restriction :
Number of input points ≤ 256 (per one group)
Number of output points ≤ 256 (per one group)

(3) Determine the number of I/O points for the I/O Unit-A using the following.
[Output points]

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

NOTE
Count AOA05E as 8 points AOA12F as 16 points.

[Input points]

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

However, as result of the calculation above, when the number of input points is not larger 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 AID32A 5
AOA12F 2 AIA16G 3

[Output points]
$32 \times 3 + 16 \times 2 = 128 \Rightarrow$ 128 points
[Input points]
$32 \times 5 + 16 \times 3 = 208 \Rightarrow$ 256 points

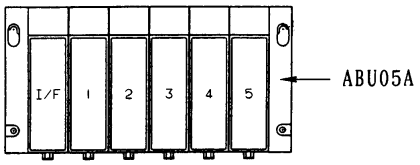
Example 2: When the following modules are used in the group No.2

AOD16C 7 AID16C 4
AOA05E 9 AIA16G 3

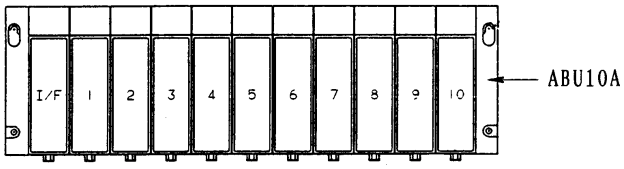
[Output points]
$16 \times 7 + 8 \times 9 = 184 \Rightarrow$ 256 points
[Input points]
$16 \times 4 + 16 \times 3 = 112 \Rightarrow$ 128 points
In this case, as the number of input points is not larger than that of the output points, the number of input points is assumed to be equal to that of the output points, in other words, 256 points.

2 I/O Unit CONFIGURATION

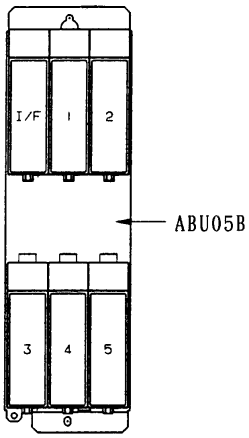
5-slot horizontal base unit (ABU05A)



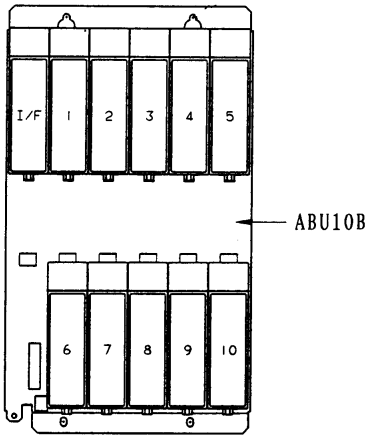
10-slot horizontal base unit (ABU10A)



5-slot vertical base unit (ABU05B)



10-slot vertical base unit (ABU10B)



NOTE
I/F : Interface module (AIF01A, AIF01A2, AIF01B, or AIF02C)
1 to 10 : I/O modules

3 INSTALLATION

3.1 ENVIRONMENT FOR INSTALLATION

3.1.1 Environmental Conditions outside 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 LCD/MDI unit or operator's panel.
- Equivalent to the above.

The environmental conditions when installing these cabinets shall conform to the following table. Section 3.2 describes the installation and design conditions of a cabinet satisfying these conditions.

Ambient temperature of the cabinet	**Operating**	0°C to 45°C
	Storage, Transport	-20°C to 60°C
	Temperature change	0.3°C/minute or less
Humidity	**Normal**	75%RH or less, no condensation
	Short period (less than 1 month)	95%RH or less, no condensation
Vibration	**Operating**	0.5G or less
	Non-operating	1.0G or less
Meters above sea level	**Operating**	Up to 1000 m (Note)
	Non-operating	Up to 12000 m
Environment		Normal machine shop environment (The environment must be considered if the cabinets are in a location where the density of dust, coolant, organic solvent, and/or corrosive gas is relatively high.)

NOTE

If the CNC is installed 1000 m or higher above sea level, the allowable upper ambient temperature of the CNC in the cabinet is changed as follows.

Assume that the allowable upper ambient temperature of the CNC in the cabinet installed 1000 m or higher above sea level decreases by 1.0°C for every 100 m rise in altitude.

Example)

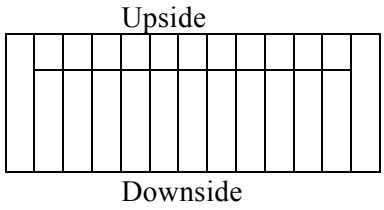
The upper allowable ambient temperature of the CNC in the cabinet installed 1750 m above sea level is:
55°C - 1750/100 × 1.0°C = 47.5°C

Therefore, the allowable ambient temperature range is from 0°C to 47.5°C.

3.2 DESIGNING CONDITION FOR A CABINET

When designing a cabinet to contain the I/O Unit-A, take the same care as taken for the cabinet containing the CNC control unit and other units. For details, refer to the CNC CONNECTION MANUAL.
In addition, when mounting the I/O Unit, conform to the followings in view of maintenance, environmental durability, noise resistance and the like.

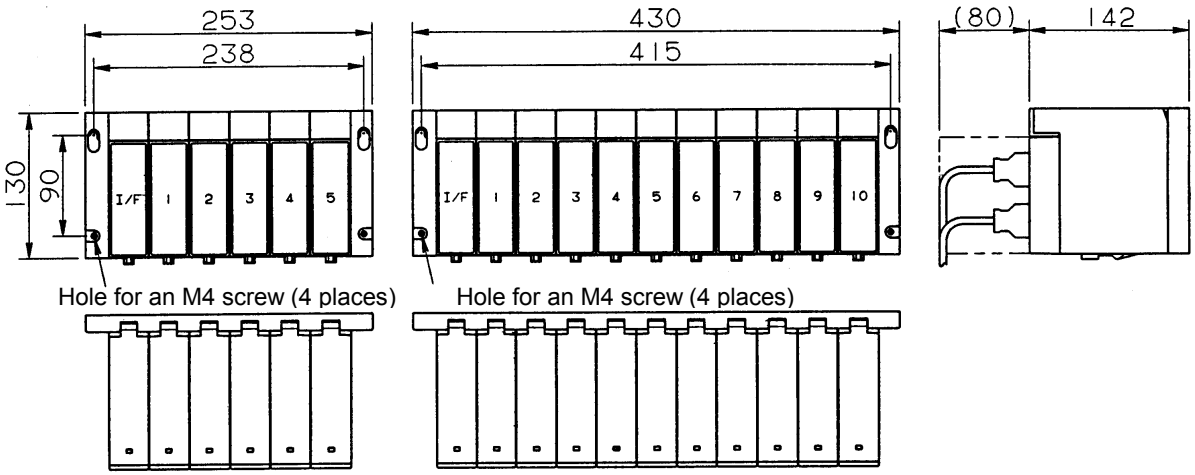
(1) In order to ventilate inside the module well, mount the I/O Unit in the direction shown in the figure below.



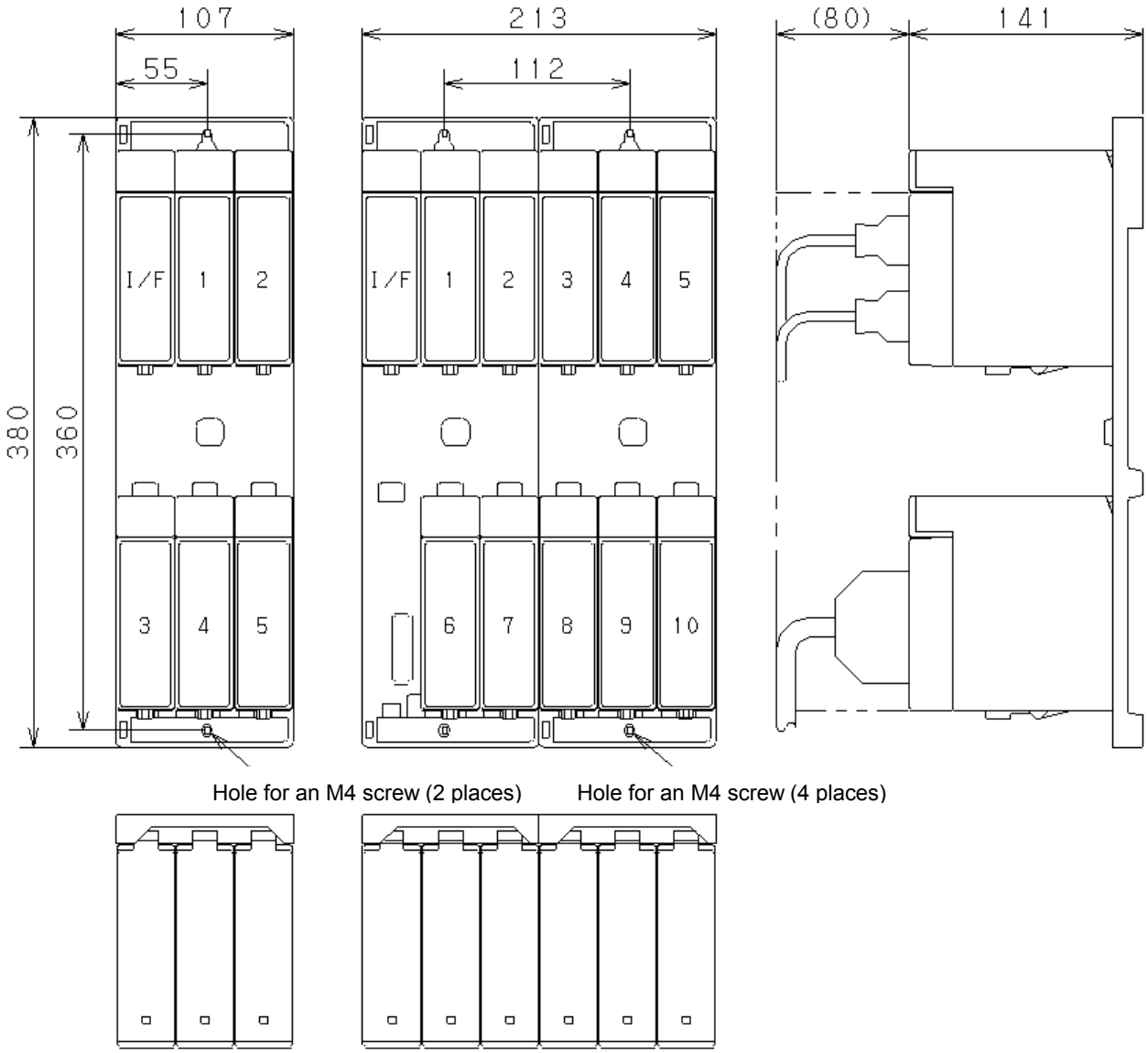
(2) Separate each I/O Unit at least 100 mm vertically from the other units so as to ensure effective ventilation and make it easy to attach/detach wires and modules.
(3) Do not put equipments which generate a large amount of heat under the I/O Unit.
(4) Low-level signals are transferred through the signal cables K1X and K2X. (For these cables, see the general connection diagram.) Lay out these cables apart from the wires for AC power source and the I/O wires of the I/O module by 100 mm or more.
(5) Make sure that there is no protruding portion such as a screw on the mounting surface of the I/O Unit.
(6) Heat values of I/O Unit are listed in Table 3.3

3.3 OUTER DIMENSION OF I/O Unit

Horizontal base units (ABU05A and ABU10A)



Vertical base units (ABU05B and ABU10B)



* The ABU05B and ABU10B units that were shipped early on are housed in a metal case.
The distances between mounting holes for the metal case and their size are the same as for the plastic case used for the current units. However, the width of the metal case differs from that of the plastic case as listed below.

	ABU05B		ABU10B	
	Plastic case	Metal case	Plastic case	Metal case
Width	107mm	110mm	213mm	217mm

Table 3.3 Heat value and weight of each module

	Module name		Basic heat value (W)	Heat value per one I/O point (W)	Weight (g)
	ABU10A		-	-	600
	ABU10B		-	-	740
	ABU05A		-	-	350
	ABU05B		-	-	380
	AIF01A		1.2	-	300
	AIF01A2		1.2	-	300
	AIF01B		1.2	-	270
	AIF02C		1.2	-	300
*1	AID32A1		1.2	0.23	250
*2	AID32B1		1.2	0.23	250
	AID32H1		1.2	0.23	250
	AID16C		0.1	0.21	300
	AID16K		0.1	0.21	300
	AID16D		0.1	0.21	300
	AID16L		0.1	0.21	300
*3	AID32E1		0.1	0.23	220
	AID32E2		0.1	0.23	220
*4	AID32F1		0.1	0.23	220
	AID32F2		0.1	0.23	220
	AIA16G		0.1	0.21	300
*5	AOD32A1		0.3	-	220
	AOD08C		0.1	$0.04+0.4\times IL^2$	380
	AOD08D		0.1	$0.04+0.6\times IL^2$	380
	AOD08DP		0.1	$0.04+0.1\times IL^2$	310
	AOD16C		0.1	$0.04+1.4\times IL^2$	300
	AOD16D		0.1	$0.04+1.4\times IL^2$	320
	AOD16D2		0.1	$0.04+0.1\times IL^2$	320
	AOD16D3		0.1	$0.04+0.1\times IL^2$	320
	AOD16DP		0.1	$0.04+1.8\times IL^2$	310
*6	AOD32C1		0.1	$0.01+0.8\times IL^2$	220
	AOD32C2		0.1	$0.01+0.8\times IL^2$	220
*7	AOD32D1		0.1	$0.01+0.8\times IL^2$	200
	AOD32D2		0.1	$0.01+0.8\times IL^2$	200
	AOA05E		0.1	$0.13+1.5\times IL$	370
	AOA08E		0.1	$0.13+1.5\times IL$	370
	AOA12F		0.1	$0.11+1.5\times IL$	320
	AOR08G		0.1	$0.3+0.1\times IL^2$	300
	AOR16G		0.1	$0.3+0.1\times IL^2$	350
	AOR16H2		0.1	$0.3+0.1\times IL^2$	250
	AIO40A	Input	0.2	0.23	350
		Output		$0.01+1.3\times IL$	
	AAD04A		3.1	-	350
	AAD04B		3.1	-	370
	ADA02A		3.1	-	350
	ADA02B		3.1	-	350
	ACT01A		4.1	-	220
	ATI04A		4.0	-	260
	ATI04B		4.0	-	260
	ATB01A		-	-	100
	ATB01B		-	-	120

Module name	Basic heat value (W)	Heat value per one I/O point (W)	Weight (g)
Optical I/O Link adapter	-	-	100
I/O Link dummy unit	-	-	120

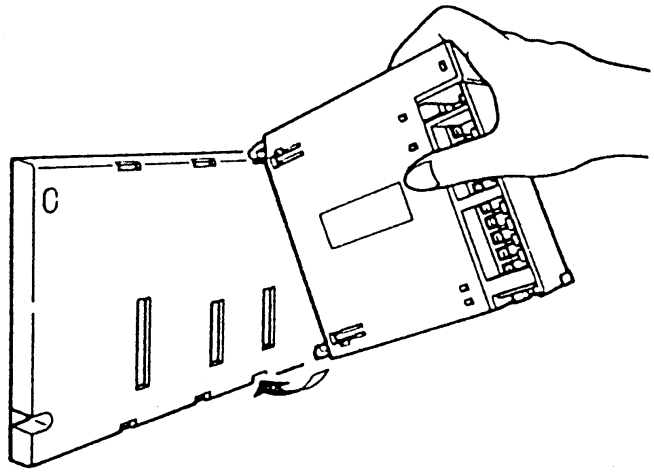
- Total ‘Heat value per 1 I/O point’ for simultaneous ON points plus ‘Basic heat value’ is the heat value of the module.
- IL : Load current of output
- *1 to *7 : "AxD32x" produced to the old specification is equivalent to "AxD32x1" (with additional "1" at the end) produced to the current specification. (Example: Old specification AID32E → AID32E1)

3.4 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.

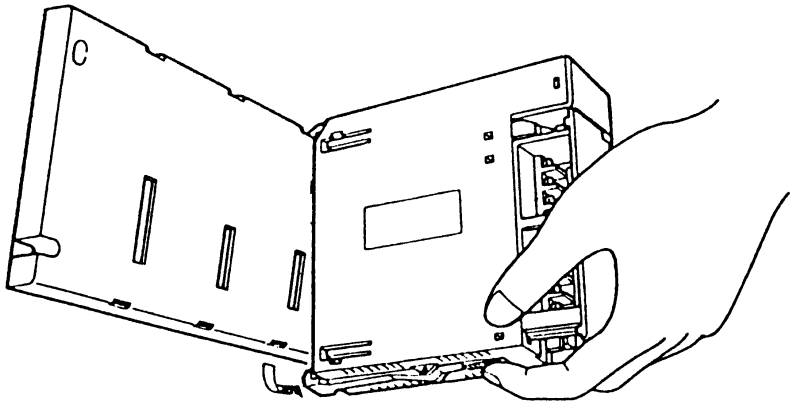
Mounting

Hang the hook at the top of the module on the groove in the upper side of the base unit, and make the connector of the module engage with that of the base unit. Push the module in the lower groove of the base unit till the stopper in the lower side of the module stops.



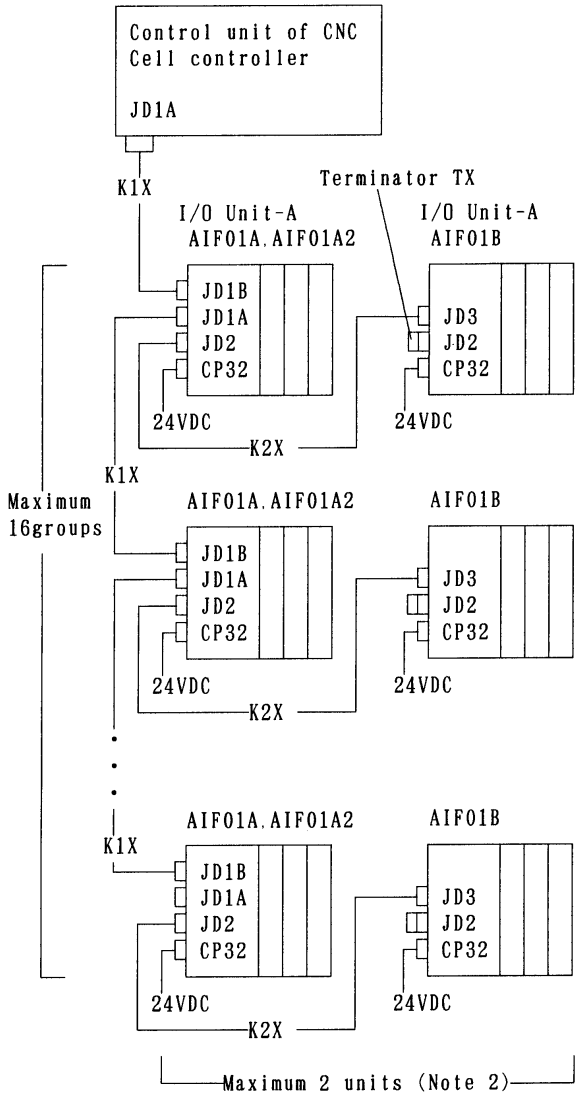
Dismounting

Release the stopper by pushing the lever at the bottom of the module, and then push the module upwards.



4 CONNECTION

4.1 GENERAL CONNECTION DIAGRAM



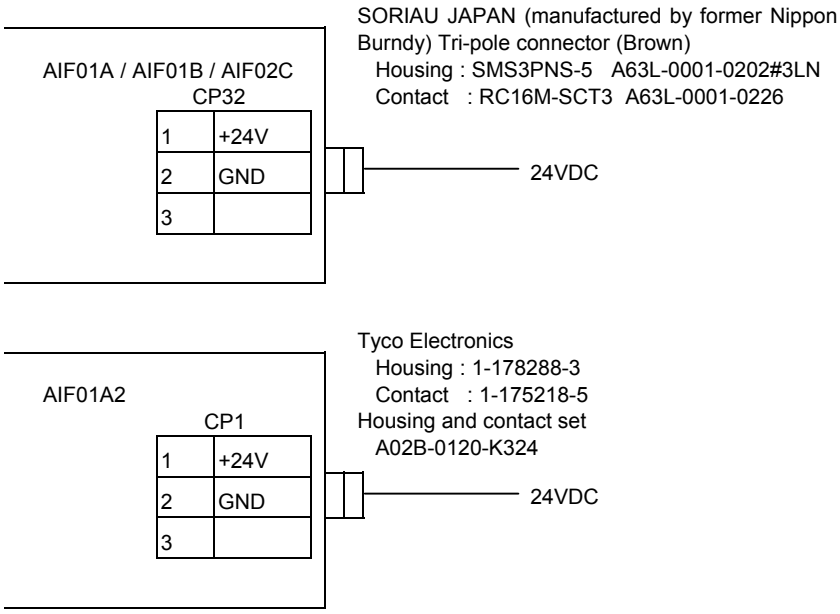
NOTE

1 Number of I/O Units and connecting method are restricted depending on the allocation of the I/O points. Refer to the section 1.2,"Allocation of I/O points."
2 If the master unit is the F-D Mate, one group can consist of up to four I/O Units.
3 Cable K1X can be an optical fiber cable by using the optical I/O link adapter. See chapter 10.
4 Terminator TX is required for connector JD2 of the AIF01B that is the last unit to be connected in the group. If no AIF01B is in use, no terminator has to be attached to the JD2 connector of the AIF01A or AIF01A2.

4.2 CONNECTING INPUT POWER SOURCE

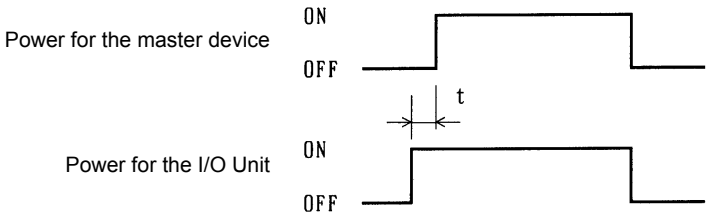
Connect the following power source with the connector CP32 or CP1 of the interface module (AIF01A, AIF01A2, AIF01B, or AIF02C).

- Voltage: 24VDC ±10%
- Current: Determine from Table 4.4



NOTE

Turn ON the power for the I/O Unit just when or before the power for the CNC or the cell controller is turned ON. When the CNC or cell controller power is turned OFF, make sure to turn the power to the I/O Unit OFF as well. If the power is not turned on and off according to the above procedure, an error occurs in the CNC or the controller, or the I/O Unit is not normally connected to the power.

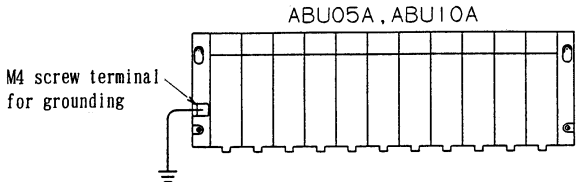


t ≥ 500 ms (Turn ON of the power for I/O Unit can be late 500 ms or less.)

4.3 GROUNDING

Connect the grounding terminal of the base unit (ABU05A, ABU05B, ABU10A, or ABU10B) to ground.

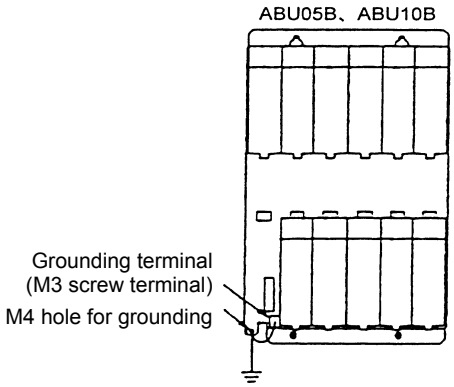
(1) Horizontal type base unit



Use a wire of 2 mm^2 or more for grounding.

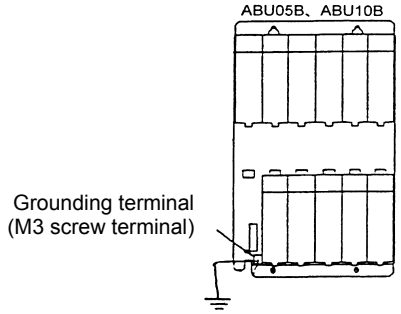
(2) Vertical type base unit

(a) For metal case (early shipment)



NOTE
Connect the grounding terminal to the grounding hole portion.

(b) For plastic case



(2) When the cable K1X (See overall connection figure in section 4.1) runs between different cabinets, make sure to connect the cabinets with a wire more than 5.5 mm^2.

4.4 REQUIRED CURRENT

Table 4.4 Required current of each module

Module name		Required current (mA) of+24V	
		A	B
AIF01A		50	
AIF01A2		50	
AIF01B		50	
AIF02C		50	
AID32A1		20+0.5×n	30+7.5×n
AID32B1		20+0.5×n	30+7.5×n
AID32H1		20+0.5×n	30+7.5×n
AID16C		5	
AID16K		5	
AID16D		5	
AID16L		5	
AID32E1		5	
AID32E2		5	
AID32F1		5	
AID32F2		5	
AIA16G		5+1.5×n	
AOD32A1		14	
AOD08C		5+2×n	
AOD08D		5+2×n	
AOD08DP		5+2×n	
AOD16C		5+2×n	
AOD16D		5+2×n	
AOD16D2		5+2×n	
AOD16D3		5+2×n	
AOD16DP		5+2×n	
AOD32C1		5+0.5×n	
AOD32C2		5+0.5×n	
AOD32D1		5+0.5×n	
AOD32D2		5+0.5×n	
AOA05E		5+5.5×n	
AOA08E		5+5.5×n	
AOA12F		5+4.5×n	
AOR08G		5	10×n
AOR16G		5	10×n
AOR16H2		5	10×n
AIO40A	Input	20+0.5×n	30+7.5×n
	Output	5+0.5×n	
AAD04A		5	130
AAD04B		5	130
ADA02A		6	120
ADA02B		6	130
ACT01A		170+0.3×α	
ATI04A		62.5	100
ATI04B		62.5	100

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

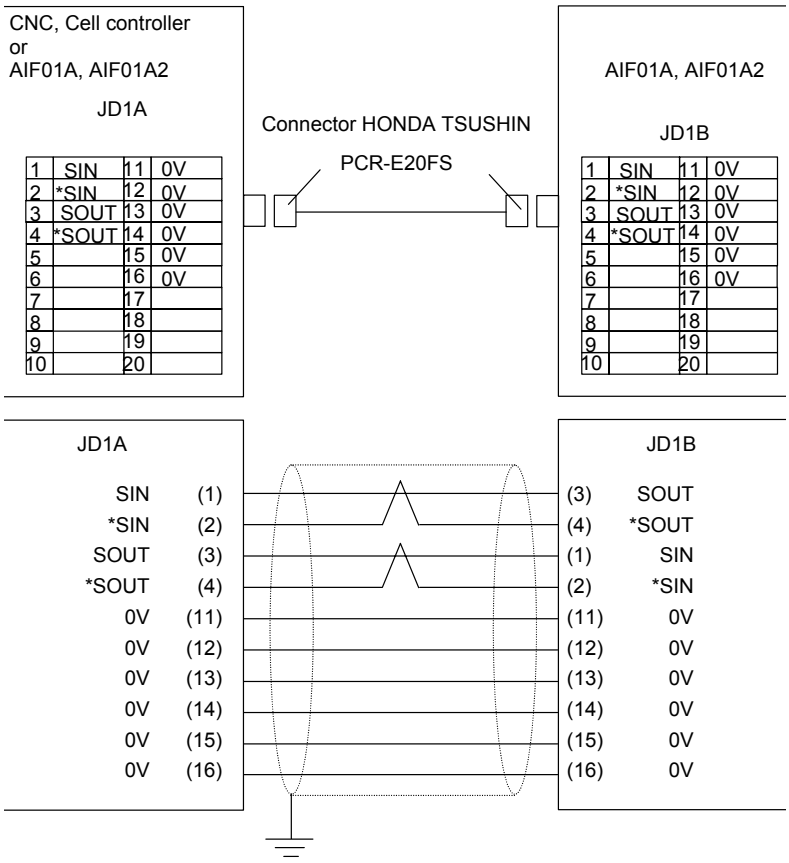
α: +5-V current (mA) output to the outside

- Add the sums of the columns A and B for the modules to be used. The sum is the required current.(Unit: mA)
- For each base unit, keep the sum of column A and the sum of column B to within 500 mA and 1,500 mA, respectively.

4.5 INTERFACE MODULE (AIF01A, AIF01A2, AIF01B)

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

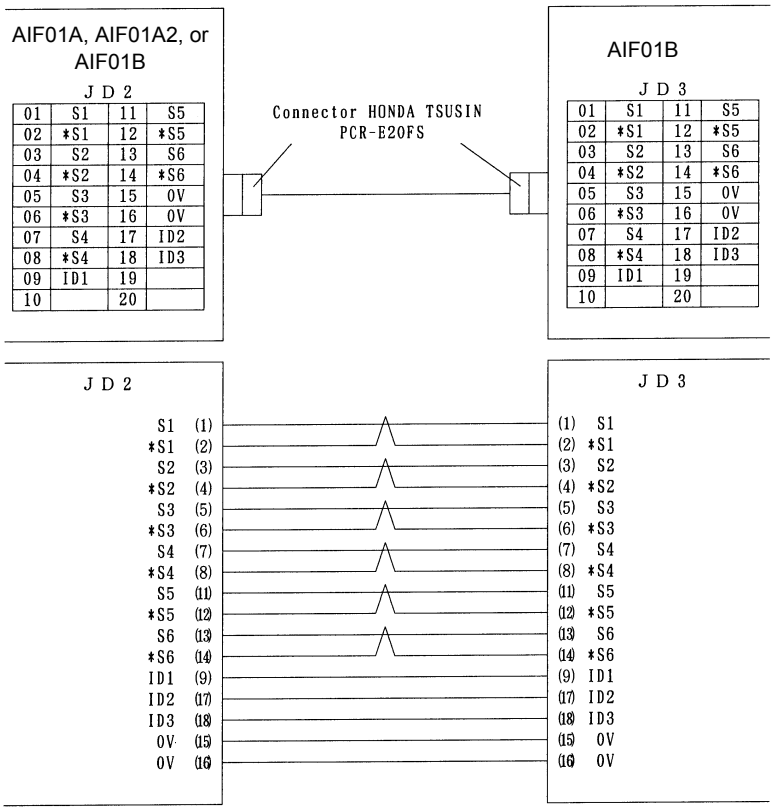
(1) Cable K1X



(a) Make sure to use twisted pair wires for signal SIN and *SIN, and signals SOUT and *SOUT.
   (i) Recommended cable material: A66L-0001-0284#10P (twisted pair/shielded)
   (ii) Shielding wires should be connected with the grounding plate of the cabinet at the JD1A side using a cable clamp. (Refer to the CONNECTION MANUAL for the CNC and the cell controller.)
   (iii) Maximum cable length: 10 m (15 m if used to connect I/O devices within the same cabinet)
   (iv) Make sure not to connect to the connector spare pins.
   (v) In the following cases, make sure to use an optical I/O link adapter and an optical fiber cable.(See Chapter 10)
      - When the cable is more than 10 meters long.
      - When the cable runs between different cabinets and there is no appropriate ground wire between the cabinets.
      - When there is concern that the cable is influenced by strong noise.

(vi) When an optical I/O link adapter is used: Cable to be used between the interface module (AIF01A) and the optical I/O link adapter is dissimilar to this cable. (See Chapter 10.)

(2) Cable K2X



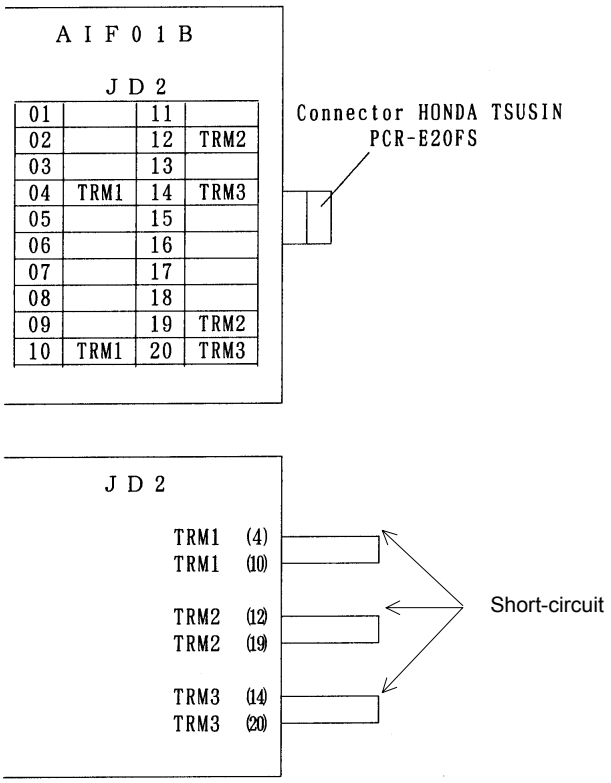
01	S1	11	S5
02	*S1	12	*S5
03	S2	13	S6
04	*S2	14	*S6
05	S3	15	0V
06	*S3	16	0V
07	S4	17	ID2
08	*S4	18	ID3
09	ID1	19	
10		20	

01	S1	11	S5
02	*S1	12	*S5
03	S2	13	S6
04	*S2	14	*S6
05	S3	15	0V
06	*S3	16	0V
07	S4	17	ID2
08	*S4	18	ID3
09	ID1	19	
10		20	

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

- Connect the signals with a 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: 2m

(3) Terminator TX
Ordering information : A03B-0807-K806



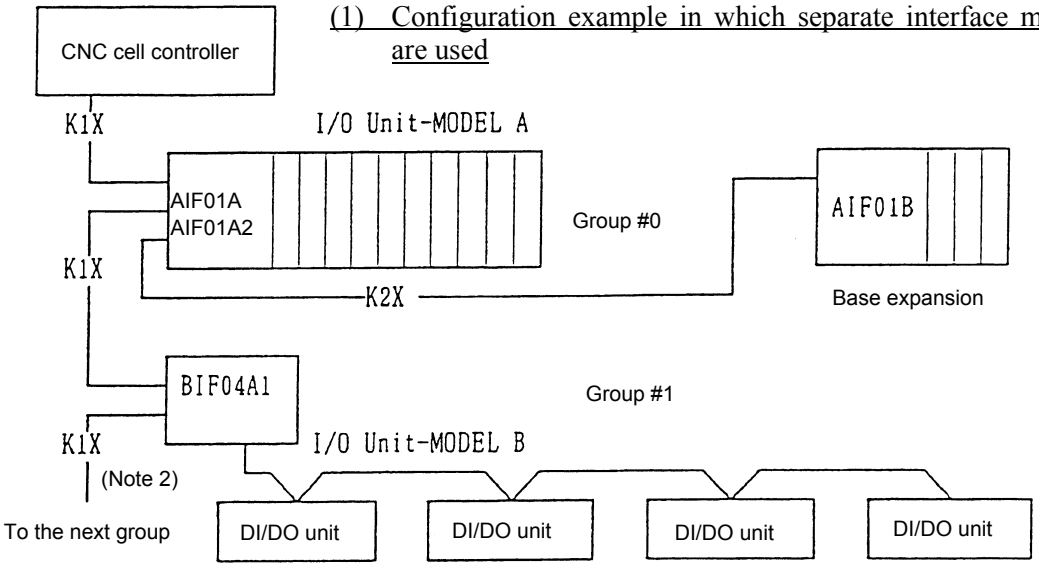
- If no AIF01B is in use, the TX terminator does not have to be attached to the JD2 connector of the AIF01A or AIF01A2.
- If at least one AIF01B is in use, attach the terminator to the JD2 connector of the last AIF01B in the same group.
- Short-circuit the TRM1s, the TRM2s and the TRM3s one another respectively in a manner that a TRM1 is with another TRM1 and so on.

4.6 INTERFACE MODULE (AIF02C) CONNECTION

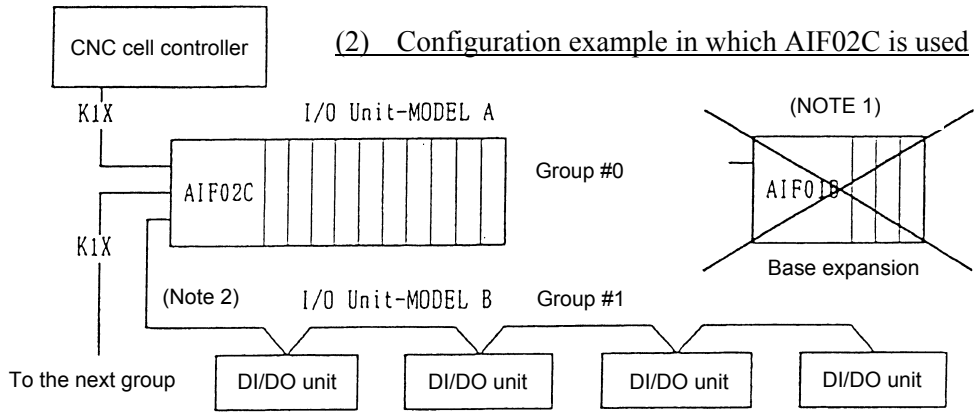
4.6.1 Overview

One interface module (AIF02C) can control communication with both I/O Unit-A and Unit-B, when it is connected to the FANUC I/O Link. The following examples show a configuration in which two conventional separate interface modules, I/O Unit-A and I/O Unit-B, are used and a configuration in which the AIF02C is used.

(1) Configuration example in which separate interface modules are used



(2) Configuration example in which AIF02C is used



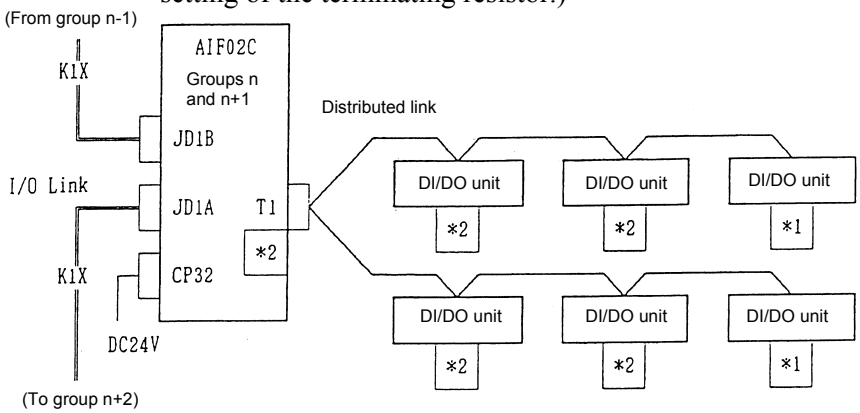
In this way, using the AIF02C eliminates the necessity for the interface unit (BIF04A1) for I/O Unit-B, which has conventionally been used separately; this configuration is suitable for a small I/O Unit-B system. Note the following points.

NOTE
1 The AIF02C cannot be used for base expansion.
2 The BIF04A1 can branch to a maximum of eight communication lines.
The AIF02C can branch only to a maximum of two distributed link cables.

4.6.2 Connection

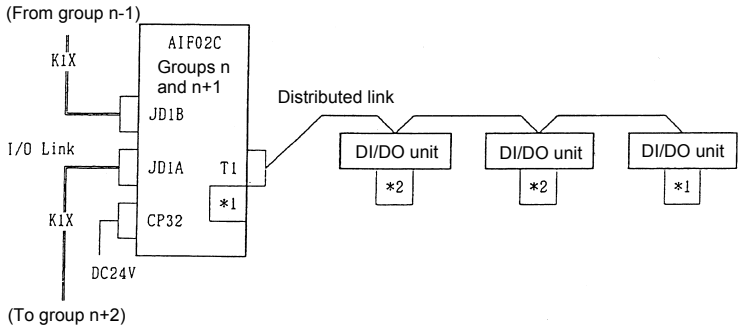
(1) Connection diagram

[a] Configuration with two distributed link cables (note the setting of the terminating resistor.)



NOTE
*1 Set the terminating resistor DIP switch to ON.
*2 Set the terminating resistor DIP switch to OFF.

[b] Connection with one distributed link cable (note the setting of the terminating resistor.)



NOTE
*1 Set the terminating resistor DIP switch to ON.
*2 Set the terminating resistor DIP switch to OFF.

(2) Connection with the I/O Link

The AIF02C occupies two groups on the I/O Link.

When groups #n and #n+1 are used, for example, the smaller-numbered group, #n, is assigned to the I/O Unit-A, and the larger-numbered group, #n+1, is assigned to the I/O Unit-B.

[a] Connection of the I/O link cable

Connect the I/O link cable from the previous group to JD1B.

Connect JD1A to the I/O link cable leading to the next group.

Use the K1X I/O link signal cable, the same I/O link signal cable type as that for the AIF01A.

[b] Number of occupied I/O points on the I/O link

The nominal number of occupied I/O points may differ from the actual number of I/O points.

For the details of the number of I/O points occupied by the I/O Unit-B, refer to Section 4.3.1, "Number of points occupied on the interface unit I/O link," of the FANUC I/O Unit-B MODEL Connection Manual (B-62163E).

(3) Connection with the distributed link (I/O Unit-B)

[a] Number of distributed communication lines

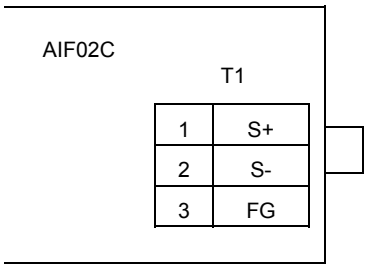
"T1" can connect to two communication lines (twisted-pair wires).

So, it is possible to branch to up to two lines.

To branch to more lines, you should use the I/O Unit-B interface unit (BIF04A1), which enables branching to up to eight communication lines.

[b] Terminal board "T1," used for connection with the distributed link cable

The distributed link cable is connected to "T1."



<1> Use twisted-pair wires as the distributed link cable.

<2> The distributed link cable is polarity-sensitive. Match the signal polarity of the AIF02C with that of the basic unit.

<3> The terminal board has M3 screws with a terminal cover.

Refer to Section 4.4, "Connecting a Distributed Link," and Section 4.6.2.2, "Connecting the communications cable," of the FANUC I/O Unit-MODEL B Connection Manual (B-62163E) for details.

4.6.3 Setting with the DIP Switch

In the AIF02C, distributed link settings can be made with the DIP switch on the back of the module.
The settings and corresponding signals are shown below.

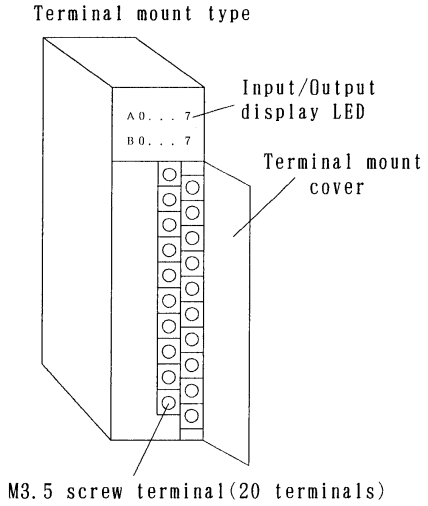
1	Unused
2	
3	
4	EDSP
5	Q
6	H
7	URDY
8	R

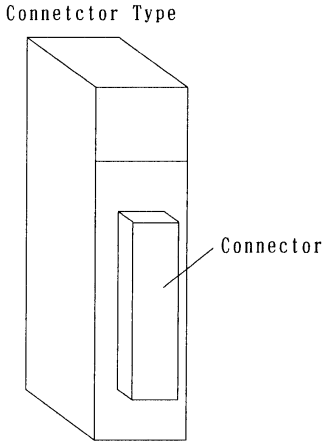
(1) EDSP (error display method selection)
Normally, set EDSP to the ON position.
(2) Q and H (communication speed setting)
Normally, set both Q and H to the OFF positions.
(3) URDY (setting of the power on/off information for the unit)
Normally, set URDY to the OFF position.
(4) R (terminating resistor setting)
The ON position means that a terminating resistor must be installed. The OFF position means that no terminating resistor need be installed.
When only one communication cable is connected to the AIF02C, terminate it and the basic unit at the end of the communication cable with a resistor.
When two communication cables are connected to the AIF02C, terminate the basic unit connected to the end of each communication cable with a resistor. Do not connect a terminating resistor to the AIF02C. (Refer to Section 4.6.2, "Connection.")

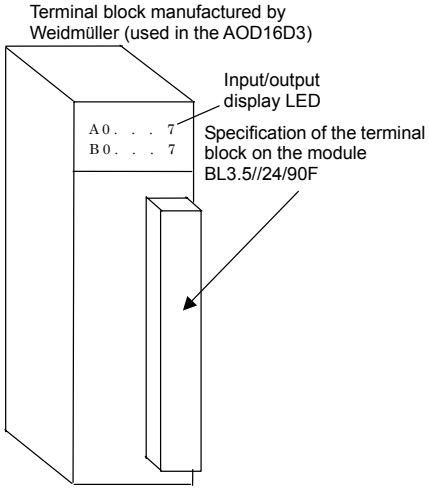
Refer to Section 5.1.1, "DIP switch setting," of the FANUC I/O Unit-MODEL B CONNECTION MANUAL (B-62163E).

4.7 CONNECTING WITH I/O MODULES

From the point of view of an external connecting method, there are two types of I/O modules such as one with a terminal block and one with a connector.





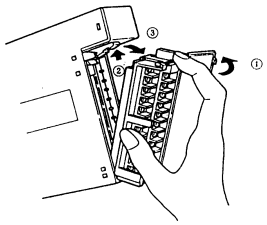


The following three different connectors can be used on the connector-type module.

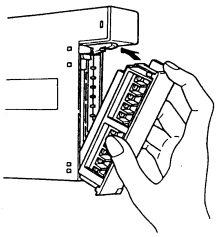
Specification of the connector on the module	Module name
Manufactured by HONDA TSUSHIN MR-50RMA	AID32A1
	AID32B1
	AID32H1
	AID32E1
	AID32F1
	AOD32A1
	AOD32C1
	AOD32D1
	AIO40A
Manufactured by HIROSE ELECTRIC HIF3BB-50PA-2.54DS	AID32E2
	AID32F2
	AOD32C2
	AOD32D2
	AOR16H2
Manufactured by HIROSE ELECTRIC HIF4-40P-3.18DS	AOD16D2

(1) Connect with each module following the connection diagrams of Sections 4.2 and 5.3.
(2) The terminal block is a removable type.

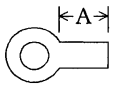
[Dismounting the terminal block]
<1> Open the cover of the terminal block.
<2> Push up the latch at the top of the terminal block.
<3> Drag out the tab at the top of the terminal block and pull it out. The terminal block will be removed from the module.



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



(3) Cautionary points when wiring terminal block type
- Wiring material : AWG22 to 18 (0.3 to 0.75 mm^2)
  A wire as this 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.



DAIDO SOLDERLESS TERMINAL	1.25-S3.5
NICHIFU	1.25-3.5S etc.

- Mark tube : Use a short mark tube as possible and cover crimped part with the mark tube.
- Recommended tightening torque : 1 to 1.4 N·m

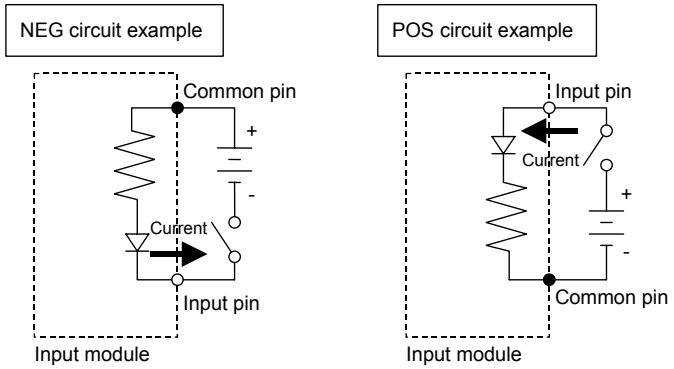
(4) Wiring to the terminal block manufactured by Weidmüller
- Wire with a cross section of 0.08 to 1.5 mm^2 (VDE)/AWG28 to AWG14 (UL/CSA)
- Recommended tightening torque: 0.8 N·m
- Size conformable when a ferrule (rod terminal) is used: 0.5 to 1.5 mm^2
  Peeling length: 6 mm

5 DIGITAL INPUT/OUTPUT MODULES

5.1 LIST OF MODULES

(1) Digital input modules

Input type	Module name	Rated voltage	Rated current	Polarity *1	Response time	Points	External connection *2	LED display
Non-insulation type DC input	AID32A1	24VDC	7.5mA	Both	Maximum 20msec	32	Connector A	Not provided
	AID32B1	24VDC	7.5mA	Both	Maximum 2msec	32	Connector A	Not provided
	AID32H1	24VDC	7.5mA	Both	Maximum 2msec Maximum 20msec	8 24	Connector A	Not provided
Insulation type DC input	AID16C	24VDC	7.5mA	NEG	Maximum 20msec	16	Terminal block	Provided
	AID16K	24VDC	7.5mA	NEG	Maximum 2msec	16	Terminal block	Provided
	AID16D	24VDC	7.5mA	POS	Maximum 20msec	16	Terminal block	Provided
	AID16L	24VDC	7.5mA	POS	Maximum 2msec	16	Terminal block	Provided
	AID32E1	24VDC	7.5mA	Both	Maximum 20msec	32	Connector A	Not provided
	AID32E2	24VDC	7.5mA	Both	Maximum 20msec	32	Connector B	Not provided
	AID32F1	24VDC	7.5mA	Both	Maximum 2msec	32	Connector A	Not provided
	AID32F2	24VDC	7.5mA	Both	Maximum 2msec	32	Connector B	Not provided
AC input	AIA16G	100 to 120VAC	10.5mA (120VAC)	-	ON: Maximum 35msec OFF: Maximum 45msec	16	Terminal block	Provided



NOTE

1 Polarity
NEGative : (Current source type, source type, or Nch)
Regard to be ON when input is at Low level.
POSitive : (Current sink type, sink type, or Pch)
Regard to be ON when input is High level.

2 Connectors (Section 5.4 shows a connector signal arrangement diagram as viewed from the front of the module.)
Connector A : HONDA TSUSHIN MR-50RMA connector
It is recommended that the MR-50LW (housing) and MR50-FH (soldering-type connector) or MRP-50F01 (crimp connector) + MRP-F112 (contact) be used on the cable.
Connector B : HIROSE ELECTRIC HIF3BB-50PA-2.54DS
It is recommended that the HIF3BB-50D-2.54R (press-mount connector) be used on the cable.

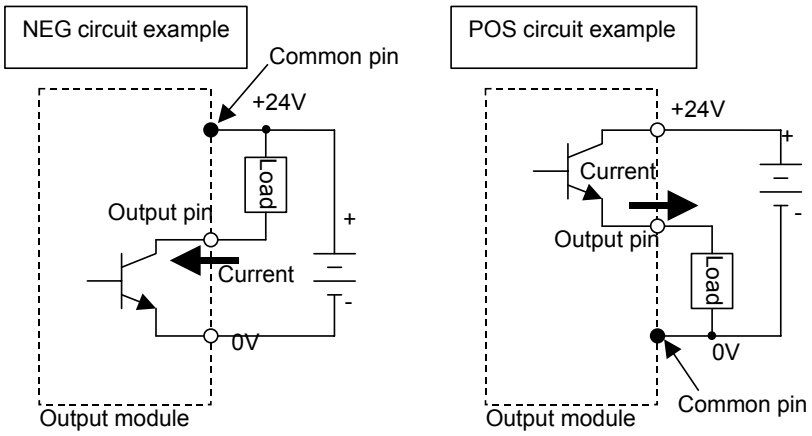
3 For the details of the specifications for each module, refer to the section 5.3.

(2) Digital output modules

Output type	Module name	Rated voltage	Maximum current	Polarity *1	Points	Points/ common	External connection *2	LED display	Output protection
Non-insulation type DC output	AOD32A1	5 to 24VDC	0.3A	NEG	32	8	Connector A	Not provided	Not provided
Insulation type DC output	AOD08C	12 to 4VDC	2A	NEG	8	8	Terminal block	Provided	Fuse
	AOD08D		2A	POS	8	8	Terminal block	Provided	Fuse
	AOD08DP		2A	POS	8	8	Terminal block	Provided	Output protection device
	AOD16C		0.5A	NEG	16	8	Terminal block	Provided	Not provided
	AOD16D		0.5A	POS	16	8	Terminal block	Provided	Not provided
	AOD16D2		2A	POS	16	4	Connector C	Provided	Not provided
	AOD16D3		2A	POS	16	4	Terminal block B	Provided	Fuse
	AOD16DP		0.3A	POS	16	8	Terminal block	Provided	Output protection device
	AOD32C1		0.3A	NEG	32	8	Connector A	Not provided	Not provided
	AOD32C2		0.3A	NEG	32	8	Connector B	Not provided	Not provided
	AOD32D1		0.3A	POS	32	8	Connector A	Not provided	Not provided
	AOD32D2		0.3A	POS	32	8	Connector B	Not provided	Not provided
AC output	AOA05 E	100 to 240VAC	2A	-	5	1	Terminal block	Provided	Fuse
	AOA08E		1A	-	8	4	Terminal block	Provided	Fuse
	AOA12F	100 to 120VAC	0.5A	-	12	6	Terminal block	Provided	Fuse
RELAY output	AOR08G	Maximum 250VAC / 30VDC	4A	-	8	1	Terminal block	Provided	Not provided
	AOR16G		2A	-	16	4	Terminal block	Provided	Not provided
	AOR16H2	30VDC	2A	-	16	4	Connector B	Provided	Not provided

(3) Digital input/output hybrid module

Input/output type	Module name	Rated voltage	Specification	Polarity *1	Points	Points/ common	External connection *2	LED display	Output protection
Non-insulation type DC input	AIO40A	24VDC	Current rating: 7.5 mA Response time: 20 ms (maximum)	Both	24	24	Connector A (shared by input and output signals)	Not provided	Not provided
Non-insulation type DC output		24VDC	Maximum current: 0.2 A/point and 2A for common	NEG	16	16			



NOTE

1 Polarity
NEGative : (Current sink type) Output is at Low level when ON.
POSitive : (Current source type) Output is at High level when ON.

2 Connector and terminal block B
(Section 5.4 shows a connector signal arrangement diagram as viewed from the front of the module.)
Connector A : HONDA TSUSHIN MR-50RMA connector
It is recommended that the MR-50LW (housing) and MR50-FH (soldering-type connector) or MRP-50F01 (crimp connector) + MRP-F112 (contact) be used on the cable.
Connector B : HIROSE ELECTRIC HIF3BB-50PA-2.54DS
It is recommended that the HIF3BB-50D-2.54R (press-mount connector) be used on the cable.
Connector C : HIROSE ELECTRIC HIF4-40P-3.18DS
It is recommended that the HIF4-40D-3.18R (press-mount connector) be used on the cable.
Terminal block B : Weidmüller BL3.5/24/90F
The terminal block for the cable comes with the module.

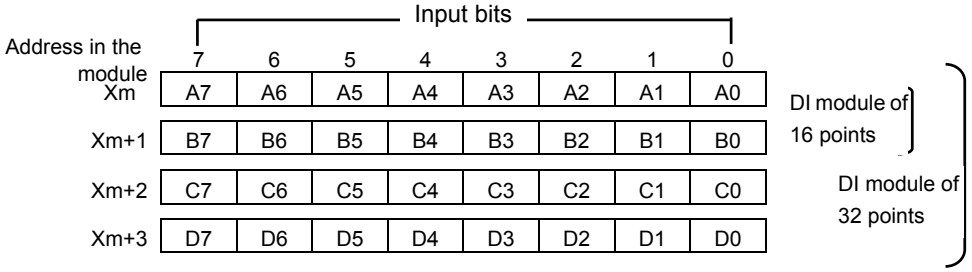
3 For the details of the specifications for each module, refer to the section 5.3.

4 The maximum current of the DC output module includes the permissible rush current.

5.2 CORRESPONDENCE BETWEEN I/O SIGNALS AND ADDRESSES IN A MODULE

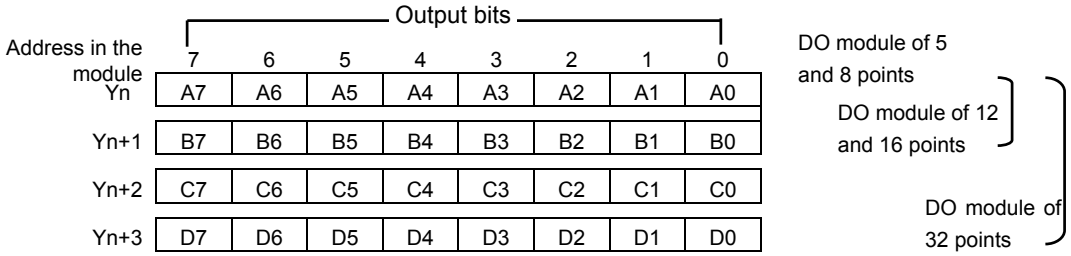
The term "address in a module" refers to an address allocated within each DI/DO module and relative to the start address (Xm, Yn) of the module.

5.2.1 Module with 16/32 Digital Inputs (DI)



When a contact connected to an input of an input module is closed, the corresponding input signal becomes "1".

5.2.2 Module with 5/8/12/16/32 Digital Outputs (DO)



When the output signal from an output module is "1", the corresponding output contact (or transistor) is closed.

5.2.3 AIO40A Module (Hybrid Module with 24 Input and 16 Output Points)

The allotment of this module requires 4 input and 2 output bytes. Input byte 4 (Xm + 3) is invalid.

Input section

Address in the module	Input bits							
	7	6	5	4	3	2	1	0
Xm	A7	A6	A5	A4	A3	A2	A1	A0
Xm+1	B7	B6	B5	B4	B3	B2	B1	B0
Xm+2	C7	C6	C5	C4	C3	C2	C1	C0
Xm+3	–	–	–	–	–	–	–	–

Output section

Address in the module	Output bits							
	7	6	5	4	3	2	1	0
Yn	D7	D6	D5	D4	D3	D2	D1	D0
Yn+1	E7	E6	E5	E4	E3	E2	E1	E0

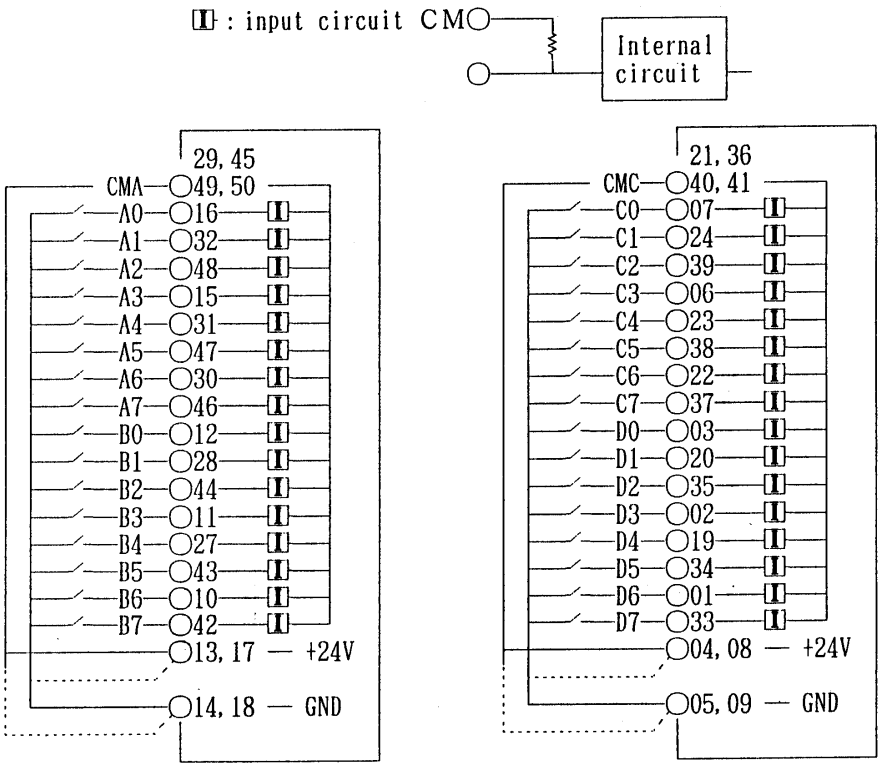
5.3 SPECIFICATION FOR EACH MODULE

Specifications for the module are shown in the following pages.

(1)	Input module	AID32A1
(2)	Input module	AID32B1
(3)	Input module	AID32H1
(4)	Input module	AID16C
(5)	Input module	AID16K
(6)	Input module	AID16D
(7)	Input module	AID16L
(8)	Input module	AID32E1
(9)	Input module	AID32E2
(10)	Input module	AID32F1
(11)	Input module	AID32F2
(12)	Input module	AIA16G
(13)	Output module	AOD32A1
(14)	Output module	AOD08C
(15)	Output module	AOD08D
(16)	Output module	AOD08DP
(17)	Output module	AOD16C
(18)	Output module	AOD16D
(19)	Output module	AOD16D2
(20)	Output module	AOD16D3
(21)	Output module	AOD16DP
(22)	Output module	AOD32C1
(23)	Output module	AOD32C2
(24)	Output module	AOD32D1
(25)	Output module	AOD32D2
(26)	Output module	AOA05E
(27)	Output module	AOA08E
(28)	Output module	AOA12F
(29)	Output module	AOR08G
(30)	Output module	AOR16G
(31)	Output module	AOR16H2
(32)	Input/output module	AIO40A

(1) Input module AID32A1 (Non-insulation type)

Item		Specifications	
Points/module		32 points	
Points/common		16 points/common	
Sink/source current		Both directions	
Input voltage		24VDC +10%, −20%	
Input current		7.5mA (average)	
ON voltage, current		Min. 18VDC, min. 6mA	
OFF voltage, current		Max. 6VDC, max. 1.5mA	
Response time	OFF→ON	Max.20ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.20ms	
Input display		Not provided	
External connection		Connector (HONDA TSUSHIN MR-50RMA)	
Terminal connection and circuitry			

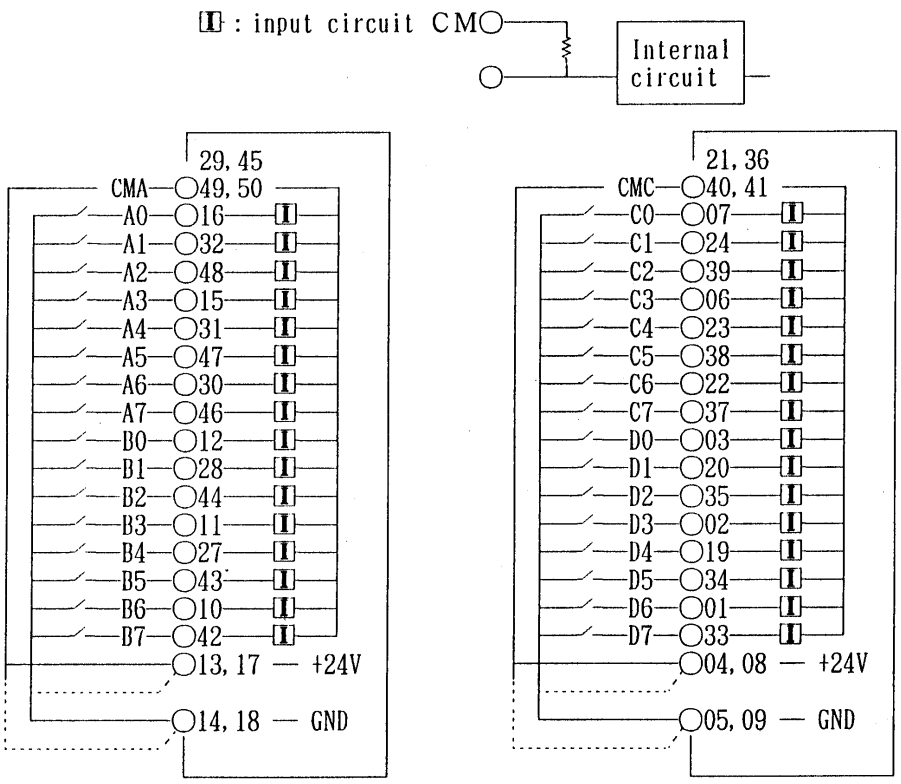


+24V or GND can be selected for input common as above fig.

NOTE
1 Make sure to connect all common (CMA, CMC) pins.
2 This module outputs +24 V on pins 13, 17, 04, and 08.

(2) Input module AID32B1 (Non-insulation type)

Item		Specifications	
Points/module		32 points	
Points/common		16 points/common	
Sink/source current		Both directions	
Input voltage		24VDC +10%, −20%	
Input current		7.5mA (average)	
ON voltage, current		Min. 18VDC, min. 6mA	
OFF voltage, current		Max. 6VDC, max. 1.5mA	
Response time	OFF→ON	Max.2ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.2ms	
Input display		Not provided	
External connection		Connector (HONDA TSUSHIN MR-50RMA)	
Terminal connection and circuitry			

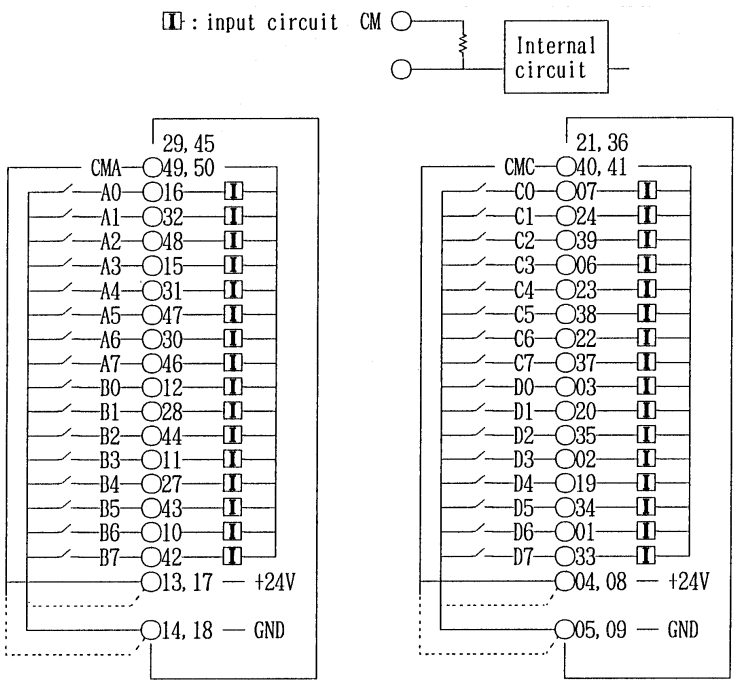


+24V or GND can be selected for input common as above fig.

NOTE
1 Make sure to connect all common (CMA, CMC) pins.
2 This module outputs +24 V on pins 13, 17, 04, and 08.

(3) Input module AID32H1

Item		Specifications	
Points/module		32 points	
Points/common		16 points/common	
Sink/source current		Both directions	
Input voltage		24VDC +10%, −20%	
Input current		7.5mA (average)	
ON voltage, current		Min. 18VDC, min. 6mA	
OFF voltage, current		Max. 6VDC, max. 1.5mA	
Response time	OFF→ON	Max.2ms (A0 to A7) Max.20ms (B0 to D7)	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.2ms (A0 to A7) Max.20ms (B0 to D7)	
Input display		Not provided	
External connection		Connector (HONDA TSUSHIN MR-50RMA)	
Terminal connection and circuitry			

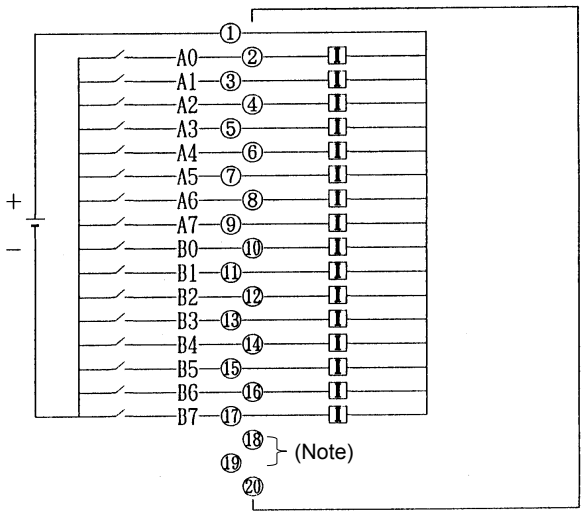


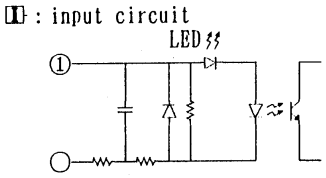
+24V or GND can be selected for input common as above fig.

NOTE
1 Make sure to connect all common (CMA, CMC) pins.
2 This module outputs +24 V on pins 13, 17, 04, and 08.

(4) Input module AID16C

Item		Specifications	
Points/module		16 points	
Points/common		16 points/common	
Sink/source current		Source current type	
Input voltage		24VDC +10%, −20%	
Input current		7.5mA (average)	
ON voltage, current		Min. 15VDC, min. 4mA	
OFF voltage, current		Max. 5VDC, max. 1.5mA	
Response time	OFF→ON	Max.20ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.20ms	
Input display		LED display	
External connection		Terminal block connector (20 terminals, M3.5 screw terminal)	
Terminal connection and circuitry			

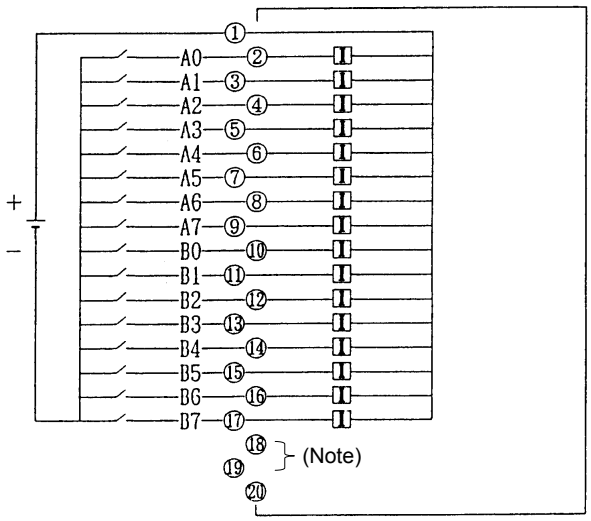


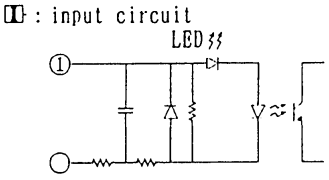


NOTE
Pins 18 and 19 are for factory use only.
Do not connect any wire to them

(5) Input module AID16K

Item		Specifications	
Points/module		16 points	
Points/common		16 points/common	
Sink/source current		Source current type	
Input voltage		24VDC +10%, −20%	
Input current		7.5mA (average)	
ON voltage, current		Min. 15VDC, min. 4mA	
OFF voltage, current		Max. 5VDC, max. 1.5mA	
Response time	OFF→ON	Max.2ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.2ms	
Input display		LED display	
External connection		Terminal block connector (20 terminals, M3.5 screw terminal)	
Terminal connection and circuitry			

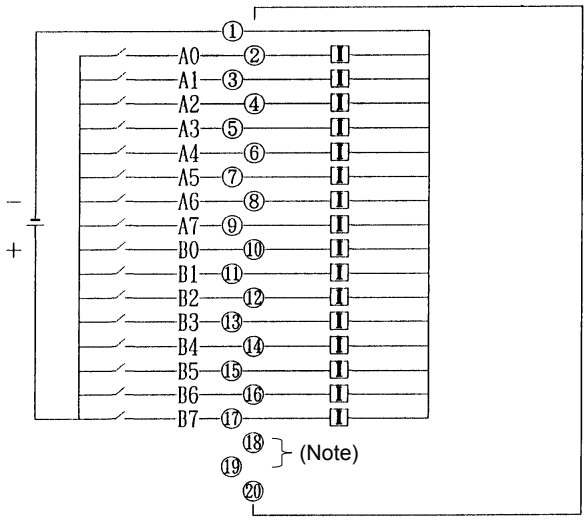


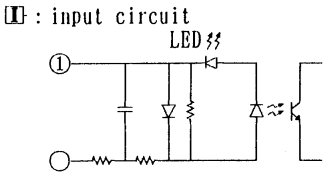


NOTE
Pins 18 and 19 are for factory use only.
Do not connect any wire to them

(6) Input module AID16D

Item		Specifications	
Points/module		16 points	
Points/common		16 points/common	
Sink/source current		Sink current type	
Input voltage		24VDC +10%, −20%	
Input current		7.5mA (average)	
ON voltage, current		Min. 15VDC, min. 4mA	
OFF voltage, current		Max. 5VDC, max. 1.5mA	
Response time	OFF→ON	Max.20ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.20ms	
Input display		LED display	
External connection		Terminal block connector (20 terminals, M3.5 screw terminal)	
Terminal connection and circuitry			

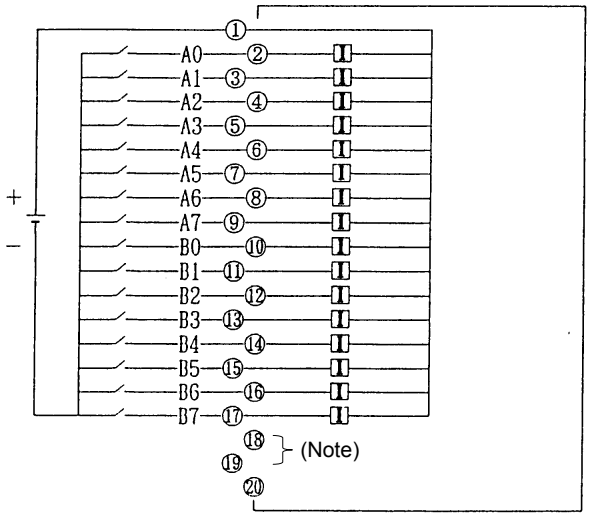


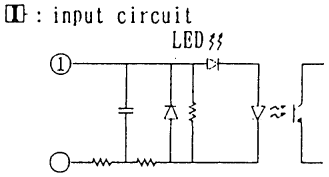


NOTE
Pins 18 and 19 are for factory use only.
Do not connect any wire to them

(7) Input module AID16L

Item		Specifications	
Points/module		16 points	
Points/common		16 points/common	
Sink/source current		Sink current type	
Input voltage		24VDC +10%, −20%	
Input current		7.5mA (average)	
ON voltage, current		Min. 15VDC, min. 4mA	
OFF voltage, current		Max. 5VDC, max. 1.5mA	
Response time	OFF→ON	Max.2ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.2ms	
Input display		LED display	
External connection		Terminal block connector (20 terminals, M3.5 screw terminal)	
Terminal connection and circuitry			

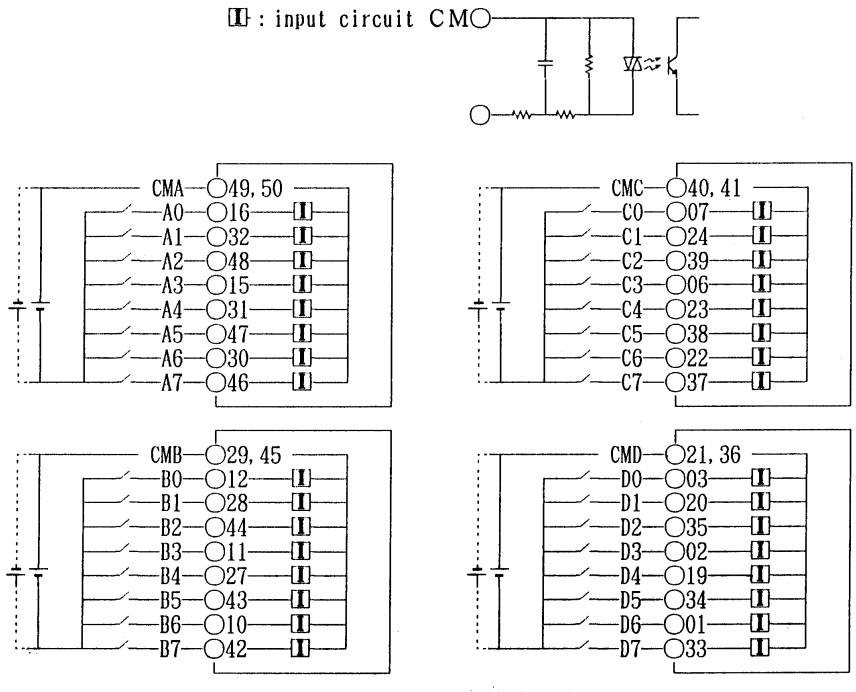




NOTE
Pins 18 and 19 are for factory use only.
Do not connect any wire to them

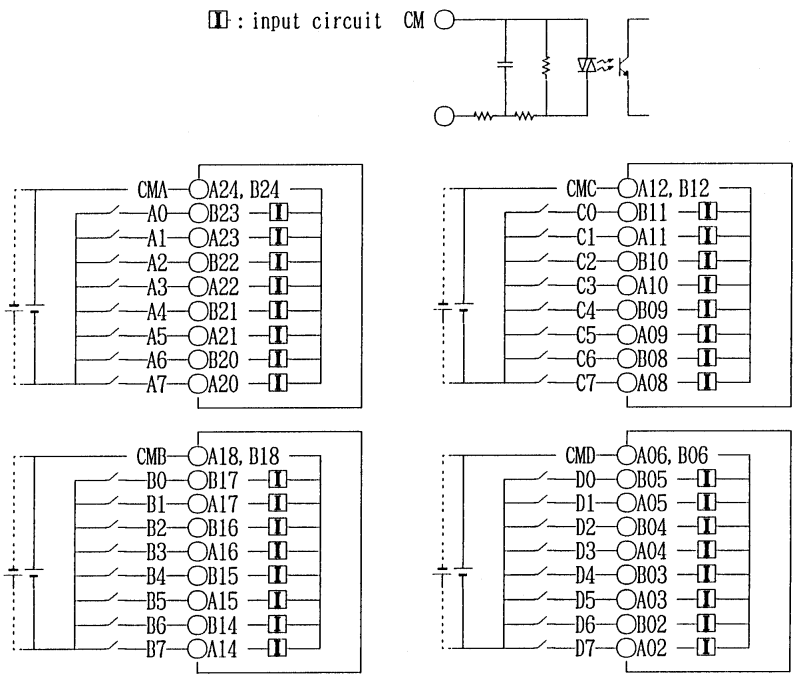
(8) Input module AID32E1

Item		Specifications	
Points/module		32 points	
Points/common		8 points/common	
Sink/source current		Both directions	
Input voltage		24VDC +10%, −20%	
Input current		7.5mA (average)	
ON voltage, current		Min. 15VDC, min. 4.5mA	
OFF voltage, current		Max. 6VDC, max. 2mA	
Response time	OFF→ON	Max.20ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.20ms	
Input display		Not provided	
External connection		Connector (HONDA TSUSHIN MR-50RMA)	
Terminal connection and circuitry			



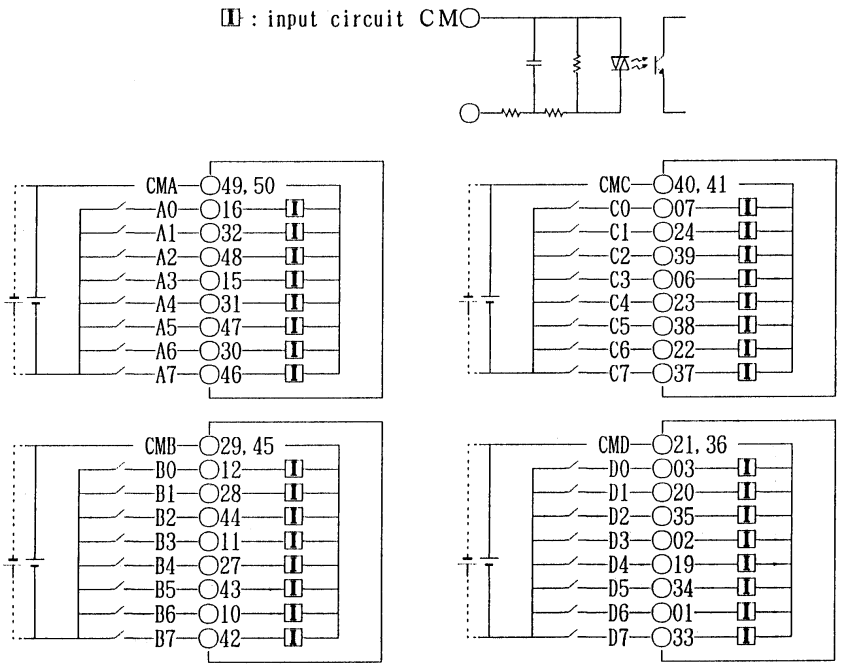
(9) Input module AID32E2

Item		Specifications	
Points/module		32 points	
Points/common		8 points/common	
Sink/source current		Both directions	
Input voltage		24VDC +10%, −20%	
Input current		7.5mA (average)	
ON voltage, current		Min. 15VDC, min. 4.5mA	
OFF voltage, current		Max. 6VDC, max. 2mA	
Response time	OFF→ON	Max.20ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.20ms	
Input display		Not provided	
External connection		Connector (HIROSE ELECTRIC HIF3BB-50PA-2.54DS in accordance with MIL standard)	
Terminal connection and circuitry			



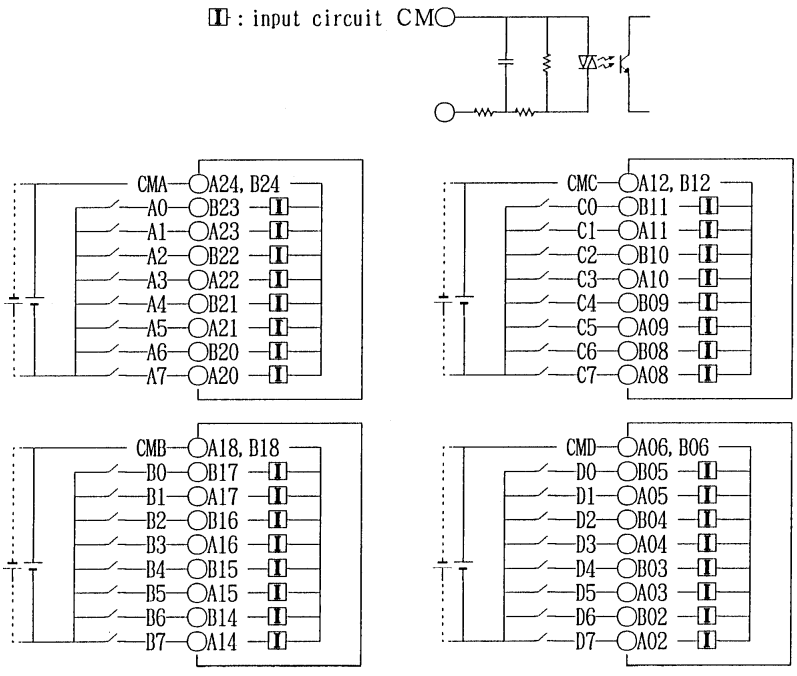
(10) Input module AID32F1

Item		Specifications	
Points/module		32 points	
Points/common		8 points/common	
Sink/source current		Both directions	
Input voltage		24VDC +10%, −20%	
Input current		7.5mA (average)	
ON voltage, current		Min. 15VDC, min. 4.5mA	
OFF voltage, current		Max. 6VDC, max. 2mA	
Response time	OFF→ON	Max.2ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.2ms	
Input display		Not provided	
External connection		Connector (HONDA TSUSHIN MR-50RMA)	
Terminal connection and circuitry			



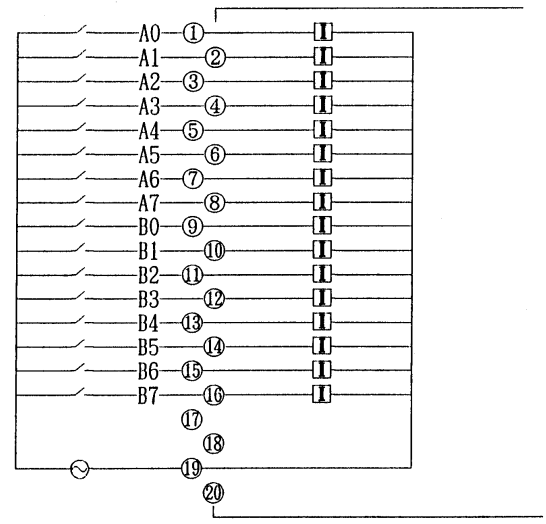
(11) Input module AID32F2

Item		Specifications	
Points/module		32 points	
Points/common		8 points/common	
Sink/source current		Both directions	
Input voltage		24VDC +10%, −20%	
Input current		7.5mA (average)	
ON voltage, current		Min. 15VDC, min. 4.5mA	
OFF voltage, current		Max. 6VDC, max. 2mA	
Response time	OFF→ON	Max.2ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.2ms	
Input display		Not provided	
External connection		Connector (HIROSE ELECTRIC HIF3BB-50PA-2.54DS in accordance with MIL standard)	
Terminal connection and circuitry			

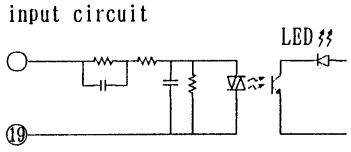


(12) Input module AIA16G

Item		Specifications	
Points/module		16 points	
Points/common		16 points/common	
Sink/source current		100 to 115VAC ±15%	
Input voltage		132Vrms, 50/60 Hz	
Input current		10.55mArms (120VAC, 50Hz)	
ON voltage, current		Min. 74Vrms, min. 6mArms	
OFF voltage, current		Max. 20Vrms, max. 2.2mArms	
Response time	OFF→ON	Max.35ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.45ms	
Input display		LED display	
External connection		Terminal block connector (20 terminals, M3.5 screw terminal)	
Common		16 points/common	
Terminal connection and circuitry			

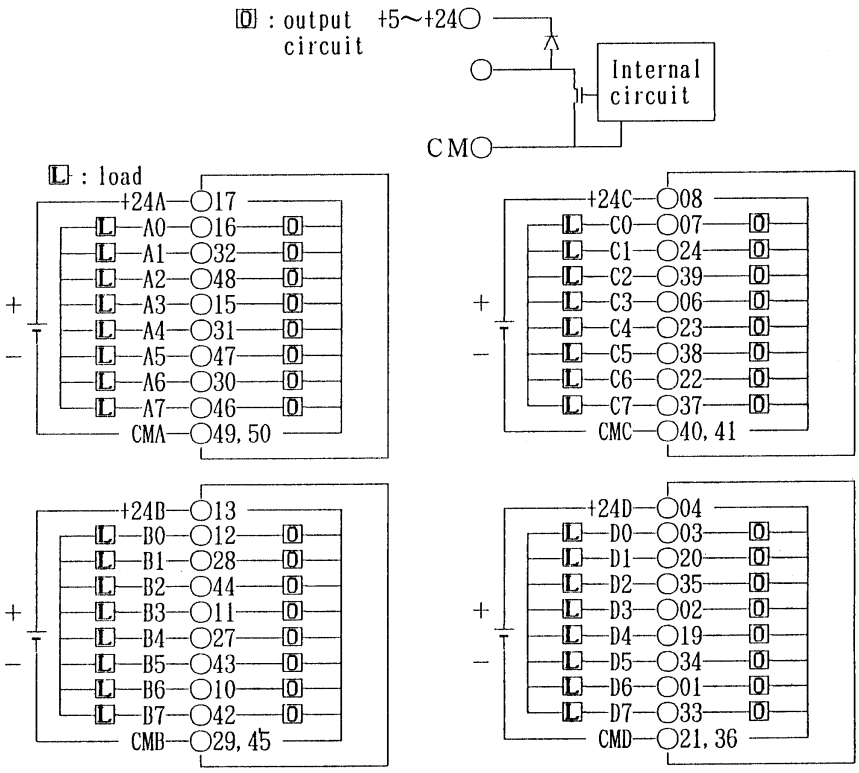


: input circuit



(13) Output module AOD32A1 (Non-insulation type)

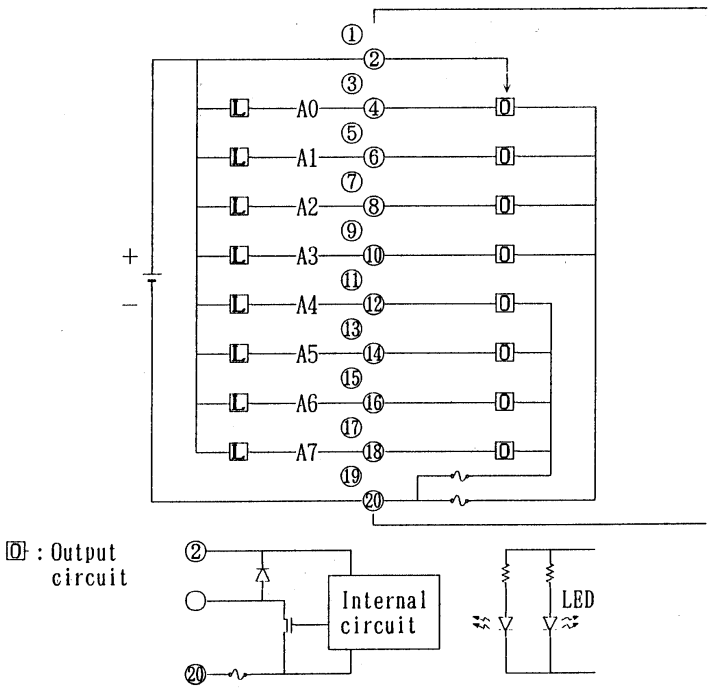
Item		Specifications
Points/module		32 points
Points/common		8 points/common
Sink/source current		Sink current type
Rated load voltage		5 to 24VDC +20%, −15%
Maximum load current		0.3A (however 2A/common)
Maximum voltage drop when ON		0.24V (load current ×0.8Ω)
Maximum leak current when OFF		0.1mA
Response time	OFF→ON	Max.1ms
	ON→OFF	Max.1ms
Input display		Not provided
External connection		Connector (HONDA TSUSHIN MR-50RMA)
Terminal connection and circuitry		



NOTE
For the common (CMA, CMB, CMC, CMD) , make sure to use both of them.

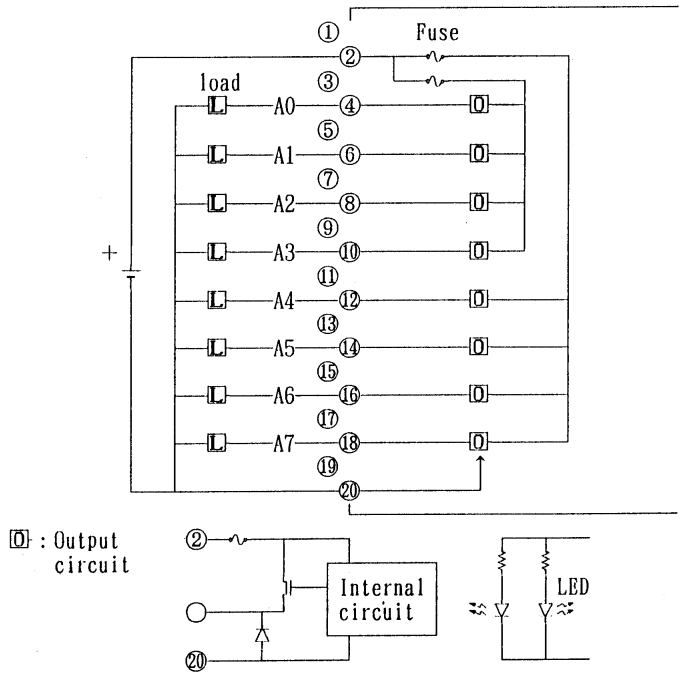
(14) Output module AOD08C

Item		Specifications	
Points/module		8 points	
Points/common		8 points/common	
Sink/source current		Sink current type	
Rated load voltage		12 to 24VDC +20%, −15%	
Maximum load current		2A (however 4A/fuse)	
Maximum voltage drop when ON		0.8V (load current ×0.4Ω)	
Maximum leak current when OFF		0.1mA	
Response time	OFF→ON	Max.2ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.2ms	
Input display		LED display	
External connection		Terminal block connector (20 terminals, M3.5 screw terminal)	
Fuse		5A, 1 piece for each output A0-A3 and A4-A7.	
Terminal connection and circuitry			



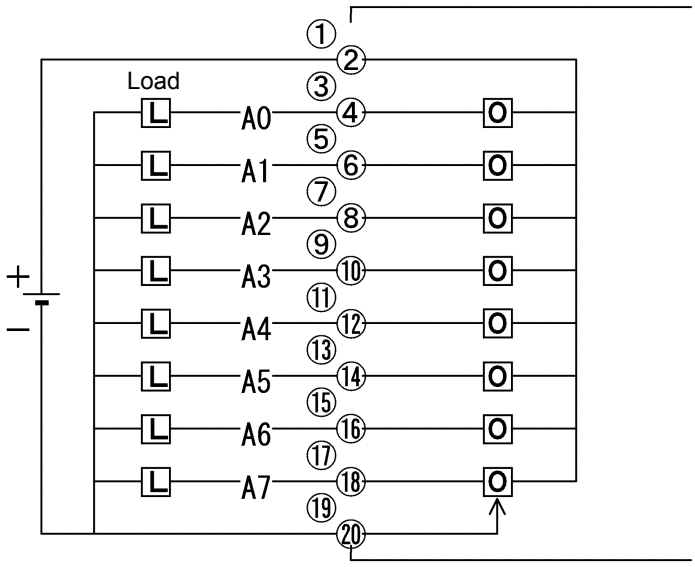
(15) Output module AOD08D

Item		Specifications	
Points/module		8 points	
Points/common		8 points/common	
Sink/source current		Source current type	
Rated load voltage		12 to 24VDC +20%, −15%	
Maximum load current		2A (however 4A/fuse)	
Limit of load		Refer to load derating curve (Fig. 5.3(a))	
Maximum voltage drop when ON		1.2V (load current ×0.6Ω)	
Maximum leak current when OFF		0.1mA	
Response Time	OFF→ON	Max.2ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.2ms	
Output display		LED display	
External connection		Terminal block connector (20 terminals, M3.5 screw terminal)	
Fuse		5A, 1 piece for each output A0-A3 and A4-A7.	
Terminal connection and circuitry			

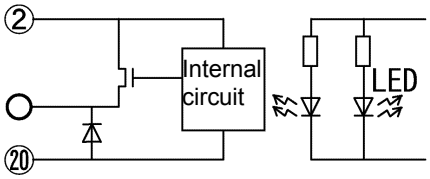


(16) Output module AOD08DP

Item		Specifications	
Points/module		8 points	
Points/common		8 points/common	
Sink/source current		Source current type	
Rated load voltage		12 to 24VDC +20%, −15%	
Maximum load current		2A (however 8A/common)	
Output current limit		2.8A (Min.)	
Maximum voltage drop when ON		0.18V (load current ×0.09Ω)	
Maximum leak current when OFF		0.1mA	
Response Time	OFF→ON	Max.2ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.2ms	
Output display		LED display	
External connection		Terminal block connector (20 terminals, M3.5 screw terminal)	
Terminal connection and circuitry			



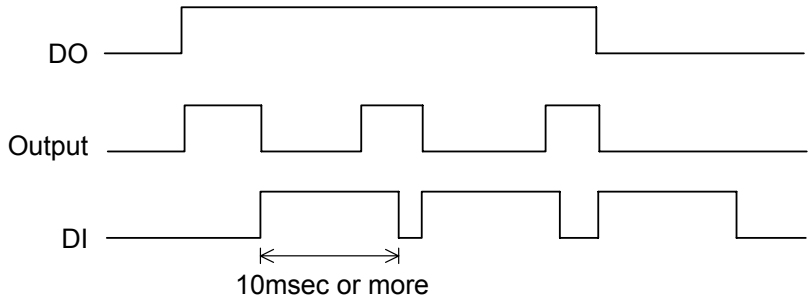
O : Output circuit



- AOD08DP output protection

  The internal circuit of this output module can detect a load overcurrent and driver temperature. To be specific, if the load current increases abnormally, for example, because of a wiring ground fault, the internal limiter of the driver suppresses the output current. If this condition lasts long, the driver can get abnormally hot, thus causing the protection circuit to turn off the output. After the output is turned off and the driver temperature becomes lower, the protection function is automatically reset to turn on the output; this OFF/ON operations are repeated.
  When the overheat protection circuit works to turn off the output, the LED "F" on the front of the module lights red.
  If the protection circuit turns off the output, the output module can detect which DO has encountered the abnormality, using a DI. This function can be allocated to any DI address (1 byte). If an abnormality is detected, the DI bit corresponding to the DO of interest switches between "1" and "0". The DI bit stays "1" for at least 10 ms.
  If the protection function worked, turn off the power for both the DO and system, and remove the cause of the overload.

  The following timing chart shows how the output and DI behave when the output protection function works.



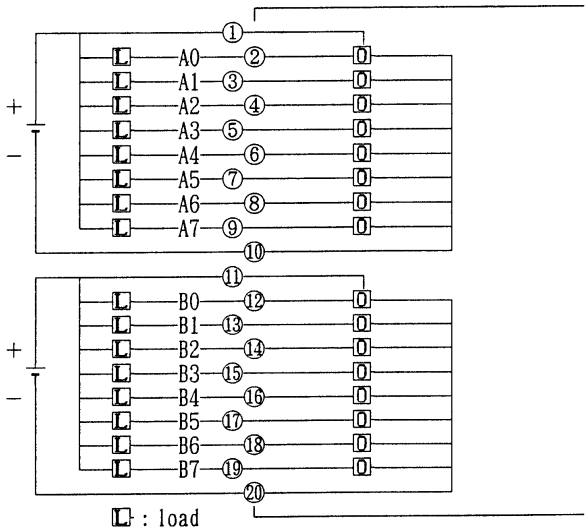
	7	6	5	4	3	2	1	0	← Bit number
DI(Xm)	A7	A6	A5	A4	A3	A2	A1	A0	

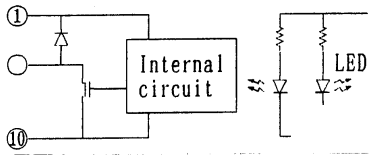
  The DI bit having the same bit number as the DO (A0 to A7) bit where an abnormality was detected becomes "1".

NOTE
An overcurrent prolonged, for example, because of a wiring ground fault may lead to the break-down of a module. To avoid this failure, build a sequence program that can turn off the DO corresponding to the bit number of the DI bit which has been set to "1" because of a failure detected on the driver.

(17) Output module AOD16C

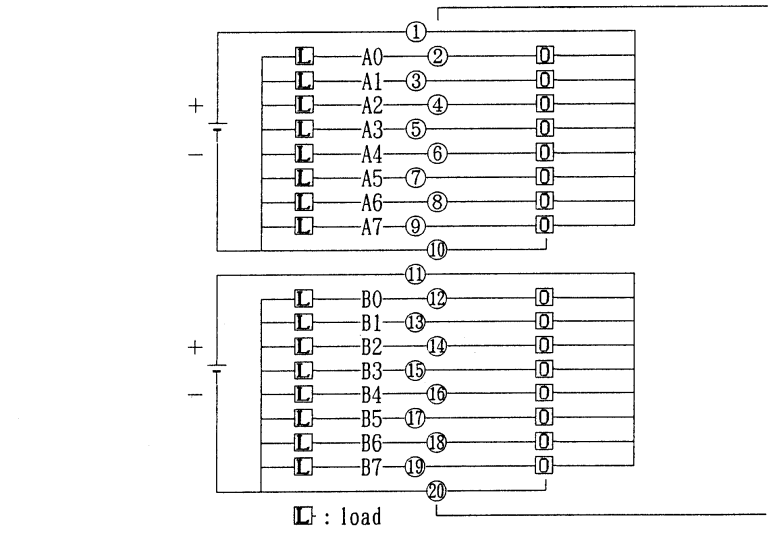
Item		Specifications	
Points/module		16 points	
Points/common		8 points/common	
Sink/source current		Sink current type	
Rated load voltage		12 to 24VDC +20%, −15%	
Maximum load current		0.5A (however 2A/common)	
Maximum voltage drop when ON		0.7V (load current ×1.4Ω)	
Maximum leak current when OFF		0.1mA	
Response time	OFF→ON	Max.2ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.2ms	
Output display		LED display	
External connection		Terminal block connector (20 terminals, M3.5 screw terminal)	
Terminal connection and circuitry			





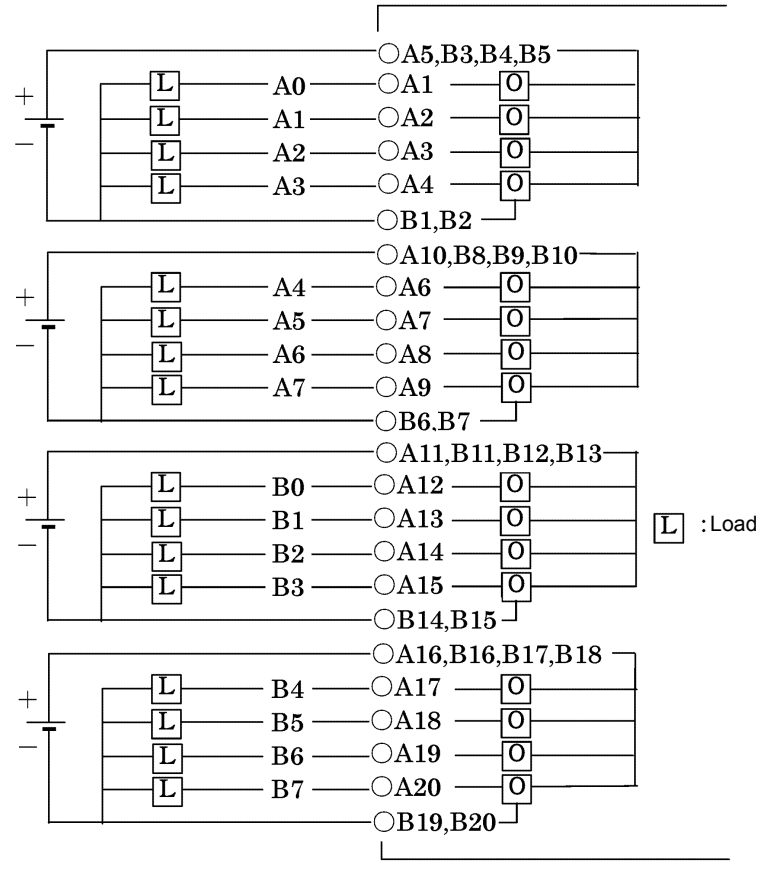
(18) Output module AOD16D

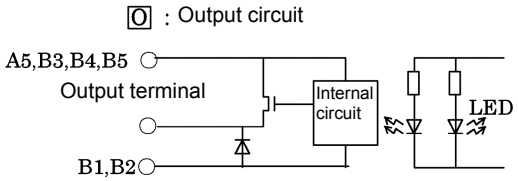
Item		Specifications	
Points/module		16 points	
Points/common		8 points/common	
Sink/source current		Source current type	
Rated load voltage		12 to 24VDC +20%, −15%	
Maximum load current		0.5A (however 2A/common)	
Maximum voltage drop when ON		0.7V (load current ×1.4Ω)	
Maximum leak current when OFF		0.1mA	
Response time	OFF→ON	Max.2ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.2ms	
Output display		LED display	
External connection		Terminal block connector (20 terminals, M3.5 screw terminal)	
Terminal connection and circuitry			



(19) Output module AOD16D2

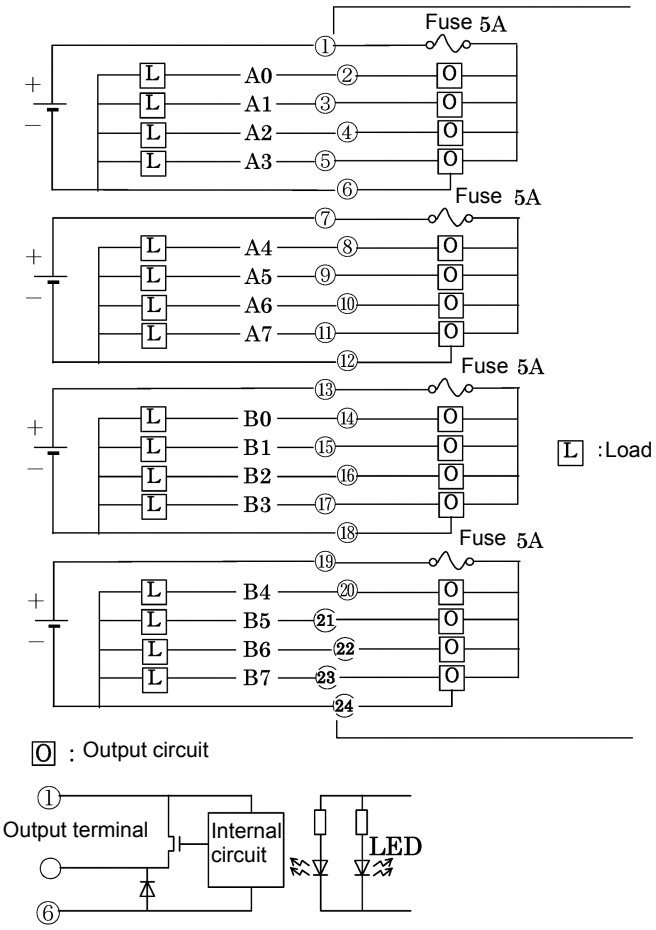
Item		Specifications	
Points/module		16 points	
Points/common		4 points/common	
Sink/source current		Source current type	
Rated load voltage		12 to 24VDC +20%, −15%	
Maximum load current		2A (4A/common)	
Maximum voltage drop when ON		0.4V (load current ×0.2Ω)	
Maximum leak current when OFF		0.1mA	
Response time	OFF→ON	Max.2ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.2ms	
Output display		LED display	
External connection		Connector (HIROSE ELECTRIC HIF4-40P-3.18DS)	
Terminal connection and circuitry			





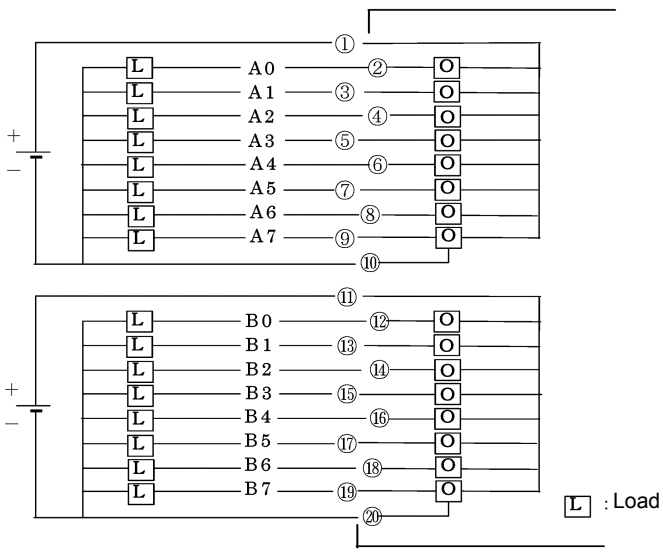
(20) Output module AOD16D3

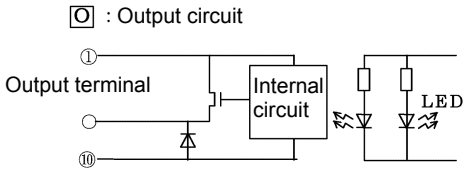
Item		Specifications	
Points/module		16 points	
Points/common		4 points/common	
Sink/source current		Source current type	
Rated load voltage		12 to 24VDC +20%, −15%	
Maximum load current		2A (4A/common)	
Maximum voltage drop when ON		0.4V (load current ×0.2Ω)	
Maximum leak current when OFF		0.1mA	
Response time	OFF→ON	Max.2ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.2ms	
Output display		LED display	
External connection		24-pin terminal block (BL3.5/24/90F) manufactured by Weidmüler Conformable wire (maximum): 1.5 mm^2 (VDE)/AWG 14 (UL/CSA) Note: The terminal block for the cable comes with this module.	
Fuse		One 5A fuse for each of output sets A0 to A3, A4 to A7, B0 to B3, and B4 to B7 MP50 (A60L-0001-0046#5.0) manufactured by Daito. Ordering information for a 4-fuse set: A03B-0819-K104	
Terminal connection and circuitry			



(21) Output module AOD16DP

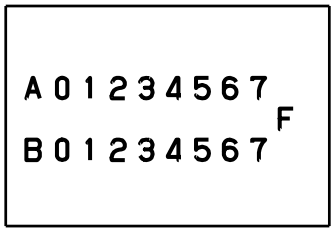
Item		Specifications	
Points/module		16 points	
Points/common		8 points/common	
Sink/source current		Source current type	
Rated load voltage		12 to 24VDC +20%, −15%	
Maximum load current		0.3A (2.4A/common) 0.5A (2A/common) See the "Load reduction curve" shown in Fig. 5.3 (f).	
Maximum voltage drop when ON		0.63V (load current ×1.25Ω)	
Maximum leak current when OFF		40μA	
Response time	OFF→ON	Max.2ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.2ms	
Output display		LED display	
External connection		Connector (20 terminals, M3.5 screw terminal)	
Terminal connection and circuitry			





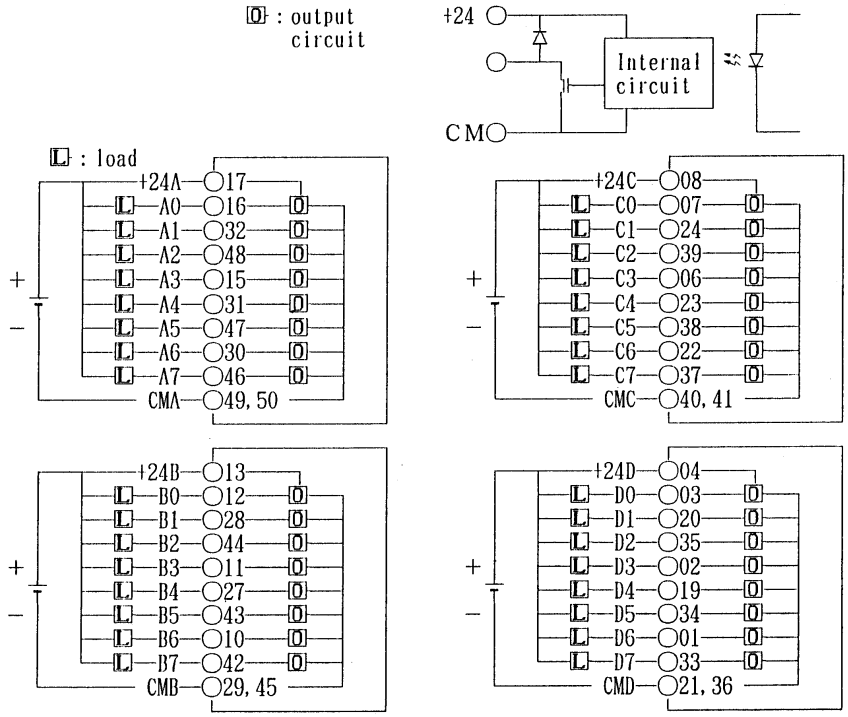
• Output protection

The internal circuit of this output module can detect a load overcurrent. To be specific, if the load current increases abnormally, for example, because of a cable ground fault or an internal DO driver is abnormally heated for some reason, the protection circuit for the DO driver (4-point unit) works to keep the output of the DO driver turned off until the cause is removed. When the overheat protection function works, the LED "F" on the module lights.



(22) Output module AOD32C1

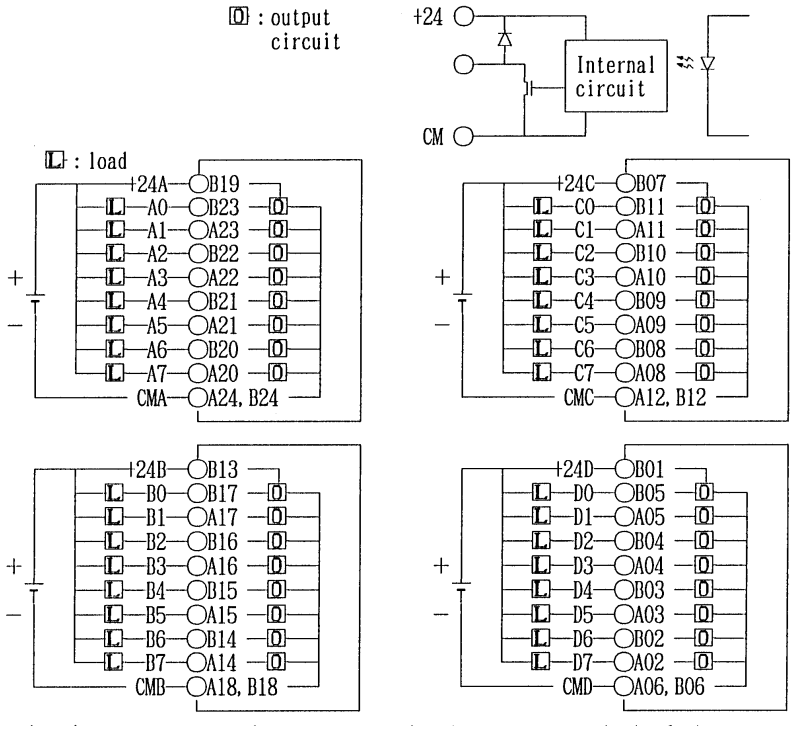
Item		Specifications
Points/module		32 points
Points/common		8 points/common
Sink/source current		Sink current type
Rated load voltage		12 to 24VDC +20%, −15%
Maximum load current		0.3A (however 2A/common)
Maximum voltage drop when ON		0.24V (load current ×0.8Ω)
Maximum leak current when OFF		0.1mA
Response time	OFF→ON	Max.2ms
	ON→OFF	Max.2ms
Output display		Not provided
External connection		Connector (HONDA TSUSHIN MR-50RMA)
Terminal connection and circuitry		



NOTE
For the common (CMA, CMB, CMC, CMD), make sure to use both of them.

(23) Output module AOD32C2

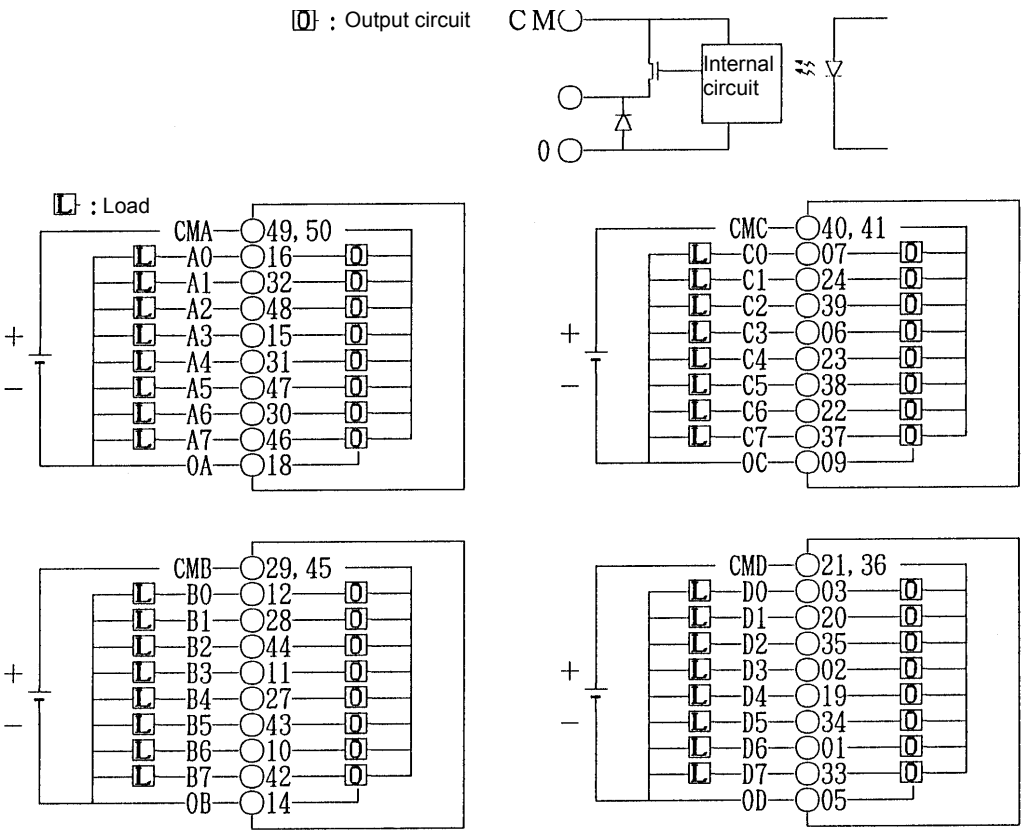
Item		Specifications
Points/module		32 points
Points/common		8 points/common
Sink/source current		Sink current type
Rated load voltage		12 to 24VDC +20%, −15%
Maximum load current		0.3A (however 2A/common)
Maximum voltage drop when ON		0.24V (load current ×0.8Ω)
Maximum leak current when OFF		0.1mA
Response time	OFF→ON	Max.2ms
	ON→OFF	Max.2ms
Output display		Not provided
External connection		Connector (HIROSE ELECTRIC HIF3BB-50PA-2.54DS in accordance with MIL standard)
Terminal connection and circuitry		



NOTE
For the common (CMA, CMB, CMC, CMD), make sure to use both of them.

(24) Output module AOD32D1

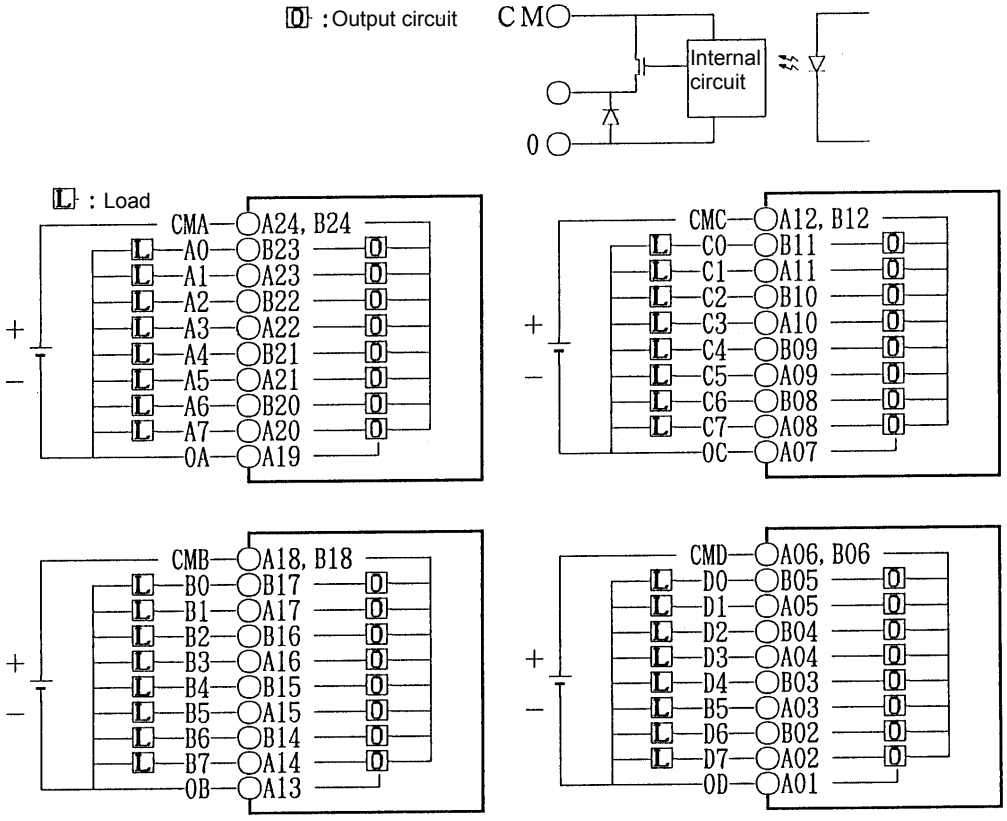
Item		Specifications
Points/module		32 points
Points/common		8 points/common
Sink/source current		Source current type
Rated load voltage		12 to 24VDC +20%, −15%
Maximum load current		0.3A (however 2A/common)
Maximum voltage drop when ON		0.24V (load current ×0.8Ω)
Maximum leak current when OFF		0.1mA
Response Time	OFF→ON	Max.2ms
	ON→OFF	Max.2ms
Output display		Not provided
External connection		Connector (HONDA TSUSHIN MR-50RMA)
Terminal connection and circuitry		



NOTE
For the common (CMA, CMB, CMC, CMD), make sure to use both of them.

(25) Output module AOD32D2

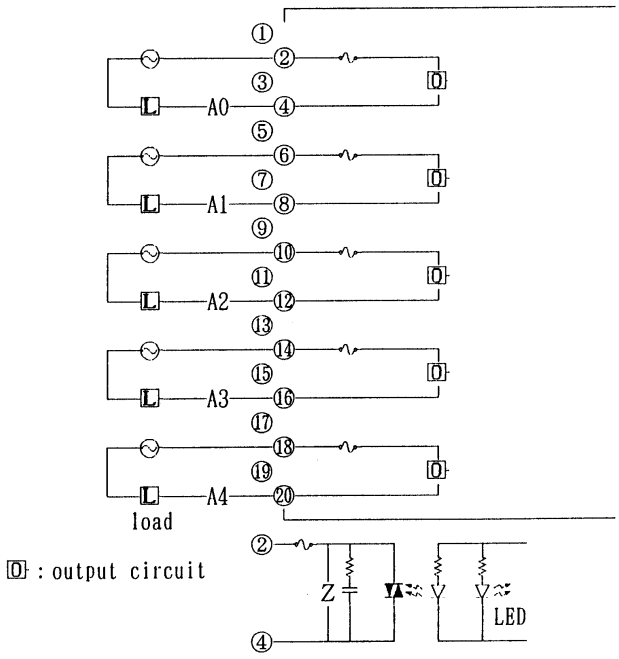
Item		Specifications
Points/module		32 points
Points/common		8 points/common
Sink/source current		Source current type
Rated load voltage		12 to 24VDC +20%, −15%
Maximum load current		0.3A (however 2A/common)
Maximum voltage drop when ON		0.24V (load current ×0.8Ω)
Maximum leak current when OFF		0.1mA
Response time	OFF→ON	Max.2ms
	ON→OFF	Max.2ms
Output display		Not provided
External connection		Connector (HIROSE ELECTRIC HIF3BB-50PA-2.54DS in accordance with MIL standard)
Terminal connection and circuitry		



NOTE
For the common (CMA, CMB, CMC, CMD), make sure to use both of them.

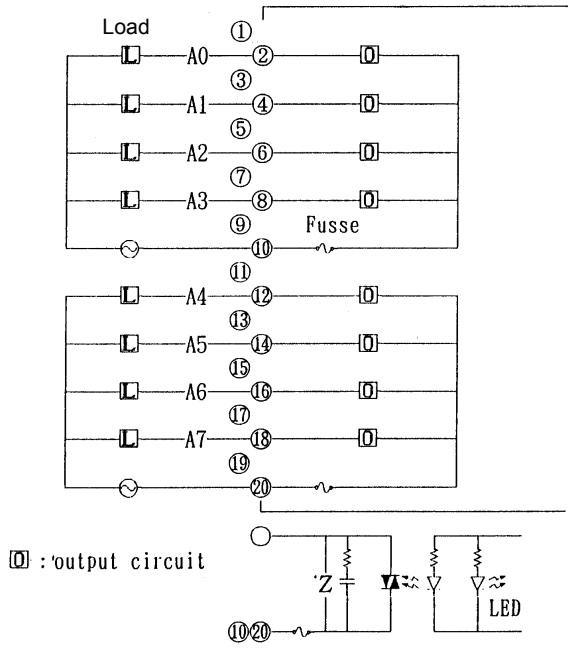
(26) Output module AOA05E

Item		Specifications	
Points/module		5 points	
Points/common		1 points/common	
Rated load voltage		100 to 230VAC ±15%, 47 to 63Hz	
Maximum load current		2A/point (however 5A/module)	
Maximum rush current		25A (1 period)	
Limit of load		Refer to load derating curve (Fig. 5.3 (b))	
Maximum voltage drop when ON		1.5Vrms	
Maximum leak current when OFF		3.0mA (115VAC), 6.0mA (230VAC)	
Response time	OFF→ON	Max.1ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Half of the load frequency or less	
Output display		LED display	
External connection		Terminal block connector (20 terminals, M3.5 screw terminal)	
Fuse		3.2A, 1 piece for each output A0 to A4	
Terminal connection and circuitry			



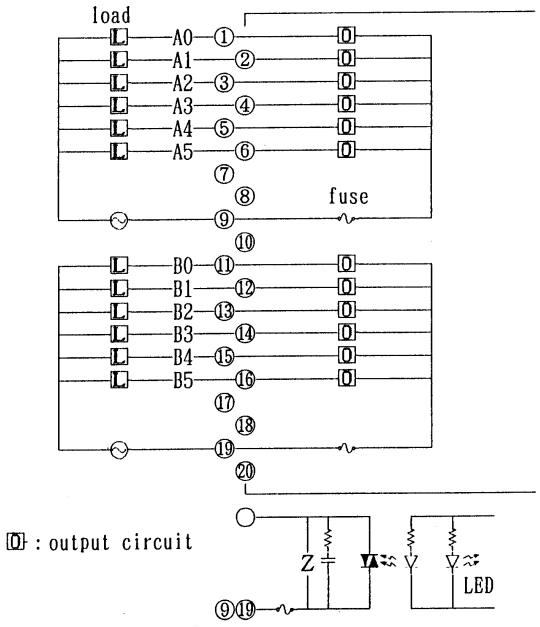
(27) Output module AOA08E

Item		Specifications	
Points/module		8 points	
Points/common		4 points/common	
Rated load voltage		100 to 230VAC ±15%, 47 to 63Hz	
Maximum load current		1A/point (however 2A/common)	
Maximum in rush current		10A (1 period)	
Maximum voltage drop when ON		1.5Vrms	
Maximum leak current when OFF		3.0mA (115VAC), 6.0mA (230VAC)	
Response time	OFF→ON	Max.1ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Half of the load frequency or less	
Output display		LED display	
External connection		Terminal block connector (20 terminals, M3.5 screw terminal)	
Fuse		3.2A, 1 piece for each output A0 to A3 and A4 to A7	
Terminal connection and circuitry			



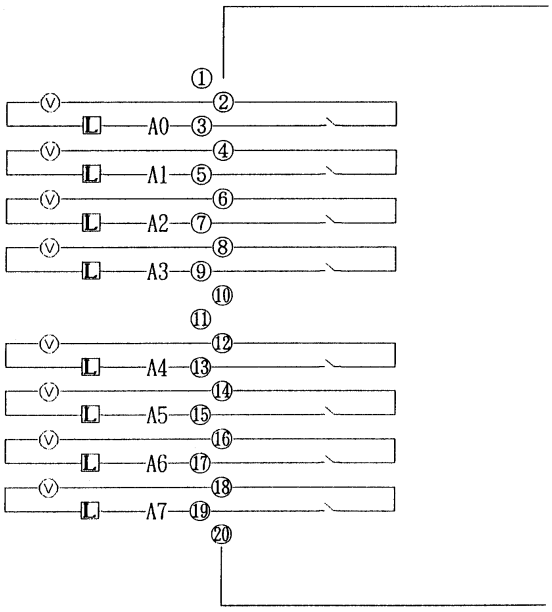
(28) Output module AOA12F

Item		Specifications	
Points/module		12 points	
Points/common		6 points/common	
Rated load voltage		100 to 115VAC ±15%, 47 to 63Hz	
Maximum load current		0.5A/point (however, 2A/common)	
Maximum in rush current		5A (1 period)	
Limit of load		Refer to load derating curve (Fig. 5.3 (c))	
Maximum voltage drop when ON		1.5Vrms	
Maximum leak current when OFF		1.5mA (115VAC)	
Response time	OFF→ON	Max.1ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Half of the load frequency or less	
Output display		LED display	
External connection		Terminal block connector (20 terminals, M3.5 screw terminal)	
Fuse		3.2A, 1 piece for each output A0 to A5 and B0 to B5	
Terminal connection and circuitry			



(29) Output module AOR08G

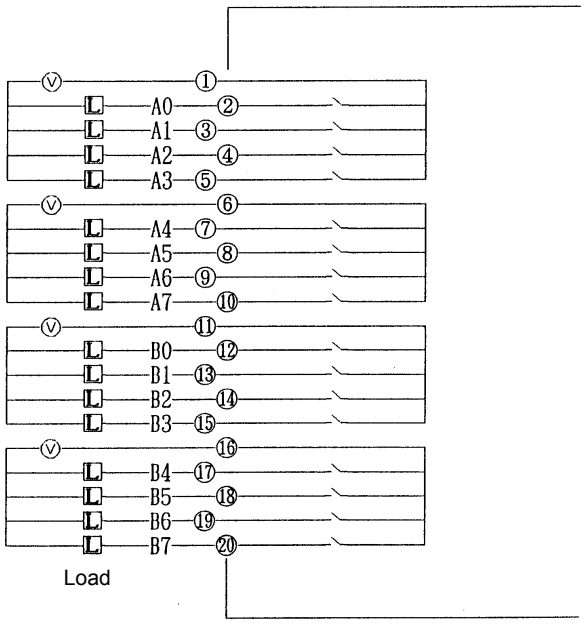
Item		Specifications	
Points/module		8 points	
Points/common		1 points/common	
Maximum load		30VDC/250VAC, 4A (resistance load)	
Minimum load		5VDC, 10mA	
Limit of load		Refer to load derating curve (Fig. 5.3 (d))	
Maximum voltage drop when ON		1.5Vrms	
Maximum leak current when OFF		1.5mA (115VAC)	
Response time	OFF→ON	Max.15ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.15ms	
Output display		LED display	
External connection		Terminal block connector (20 terminals, M3.5 screw terminal)	
Relay life	Mechanical	Min. 20,000,000 times	
	Electrical	Min. 100,000 times (resistance load)	
Terminal connection and circuitry			



Ⓥ : Direct current power or alternating current power

(30) Output module AOR16G

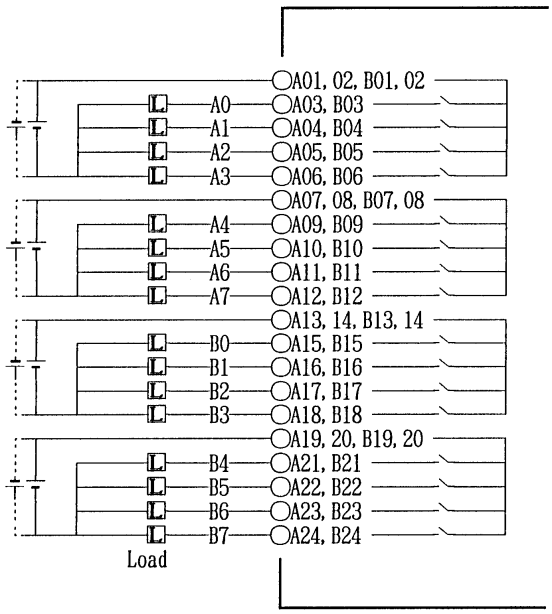
Item		Specifications	
Points/module		16 points	
Points/common		4 points/common	
Maximum load		30VDC/250VAC, 2A (resistance load)	
Minimum load		5VDC, 10mA	
Maximum current		4A/common	
Limit of load		Refer to load derating curve (Fig. 5.3 (e))	
Response time	OFF→ON	Max.15ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.15ms	
Output display		LED display	
External connection		Terminal block connector (20 terminals, M3.5 screw terminal)	
Relay life	Mechanical	Min. 20,000,000 times	
	Electrical	Min. 100,000 times (resistance load)	
Terminal connection and circuitry			



Ⓥ: Direct current power or alternating current power

(31) Output module AOR16H2

Item		Specifications	
Points/module		16 points	
Points/common		4 points/common	
Maximum load		30VDC, 2A (resistance load)	
Minimum load		5VDC, 10mA	
Maximum current		4A/common	
Limit of load		Refer to load derating curve (Fig. 5.3 (e))	
Response time	OFF→ON	Max.15ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.15ms	
Output display		LED display	
External connection		Connector (HIROSE ELECTRIC HIF3BB-50PA-2.54DS in accordance with MIL standard)	
Relay life	Mechanical	Min. 20,000,000 times	
	Electrical	Min. 100,000 times (resistance load)	
Terminal connection and circuitry			



⏚ : Direct current power

(32) Input/output module AIO40A

- Input specifications

Item		Specifications	
Points/module		24 points	
Points/common		24 points/common	
Sink/source current		Both directions	
Input voltage		24VDC +10%, −20%	
Input current		7.5mA (average)	
ON voltage, current		Min. 18VDC, min. 6mA	
OFF voltage, current		Max. 6VDC, max. 1.5mA	
Response time	OFF→ON	Max.20ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.20ms	
Input display		Not provided	
External connection		Connector (HONDA TSUSHIN MR-50RMA, shared by output signals)	

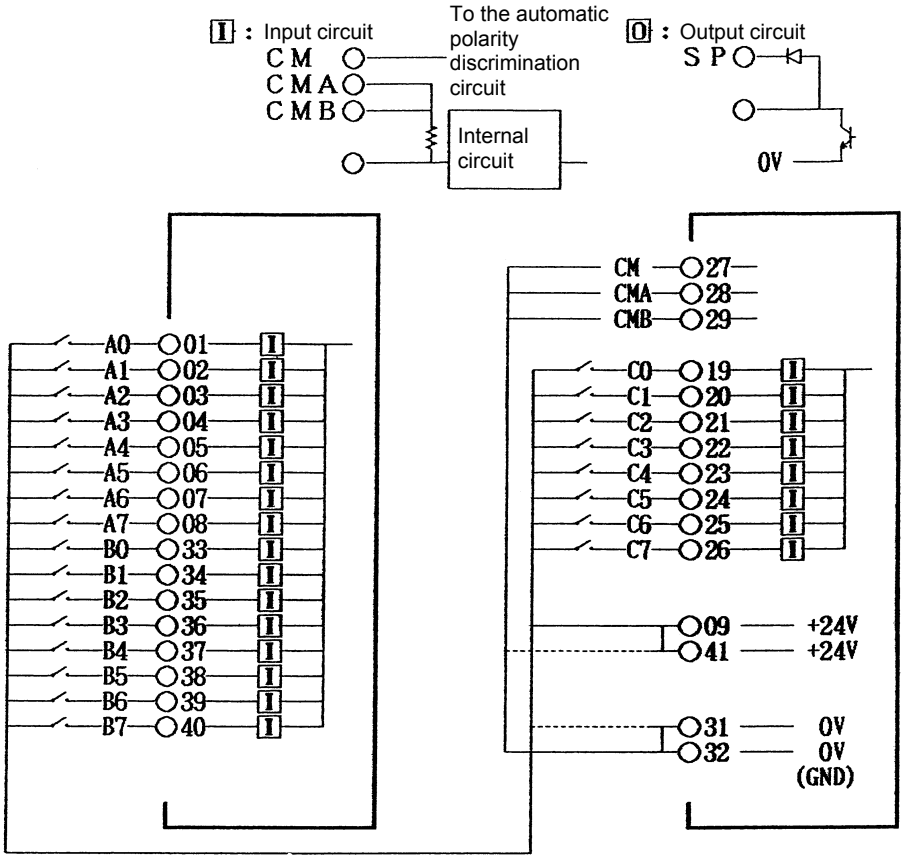
- Output specifications

Item		Specifications	
Points/module		16 points	
Points/common		16 points/common	
Sink/source current		Sink current type	
Rated load voltage		24VDC +20%, −15%	
Maximum load current		0.2A (however 2A/common)	
Maximum in rush current		0.2A	
Limit of load		• If the output current per point is 0.1 A or lower, all of the 16 points E0 to E7 and F0 to F7 can be turned on at a time. • If the output current per point is higher than 0.1 A but not higher than 0.2 A, do not turn on more than 3 points at a time.	
Maximum voltage drop when ON		1.5V	
Maximum leak current when OFF		1.0mA (30VDC)	
Response time	OFF→ON	Max.1ms	This is the value from input to output in the module. The actual value is determined by adding it to the scanning time depending on each system.
	ON→OFF	Max.1ms	
Output display		Not provided	
External connection		Connector (HONDA TSUSHIN MR-50RMA, shared by input signals)	

•Input/output module

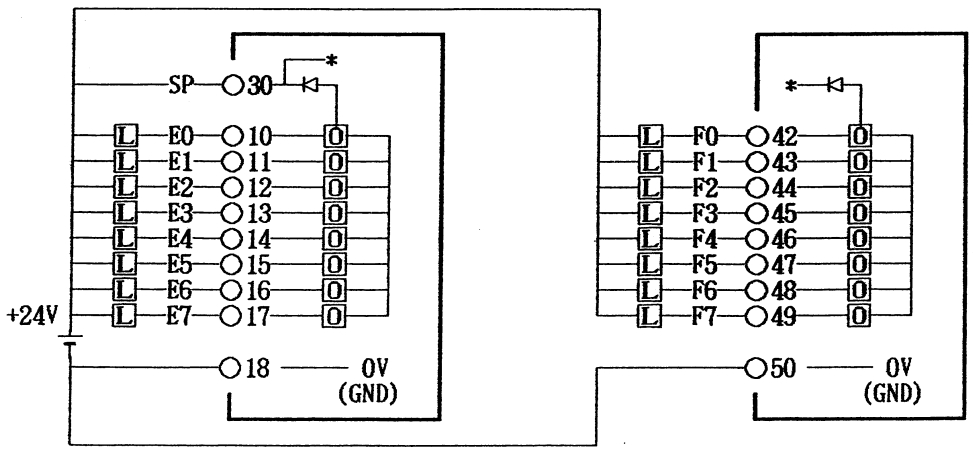
Terminal connection and circuitry

Input section



Either 24 V or 0 V can be selected as an input common potential as shown above.
(Solid line: 24-V common. Dotted line: 0-V common.)

Output section



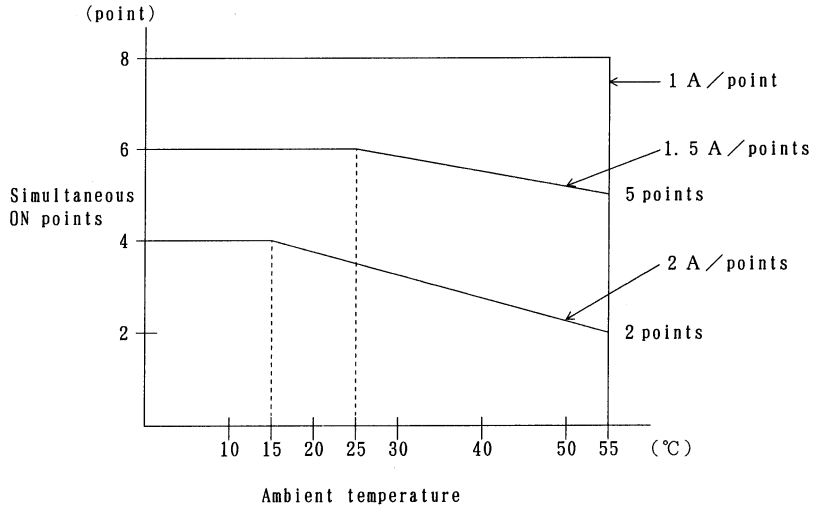


Fig.5.3 (a) AOD08D Load reduction curve

NOTE
Ambient temperature means the temperature surrounding the I/O Unit and not that surrounding the cabinet containing the I/O Unit.

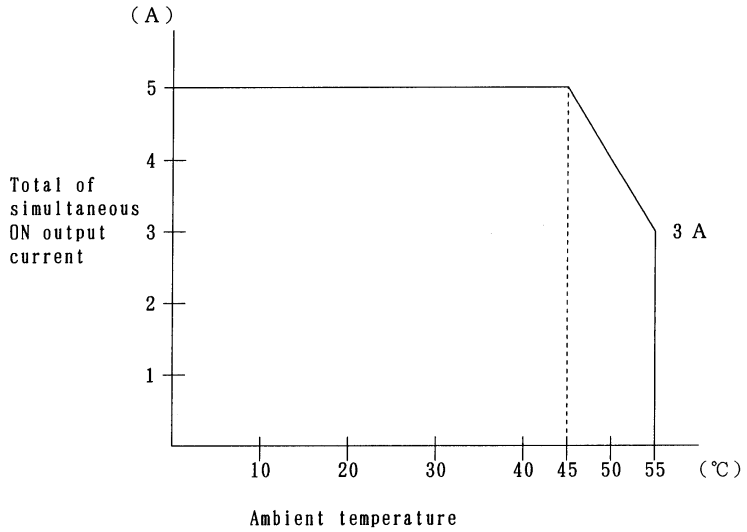


Fig.5.3 (b) AOA05E Load reduction curve

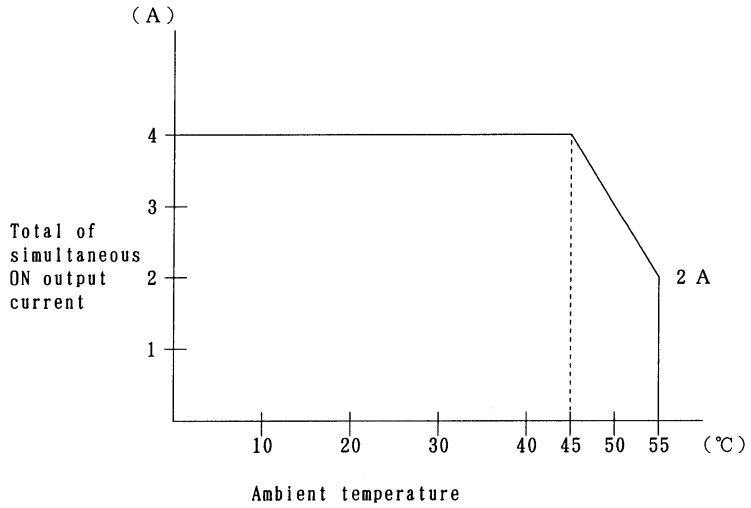


Fig.5.3 (c) AOA12F Load reduction curve

NOTE
Ambient temperature means the temperature surrounding the I/O Unit and not that surrounding the cabinet containing the I/O Unit.

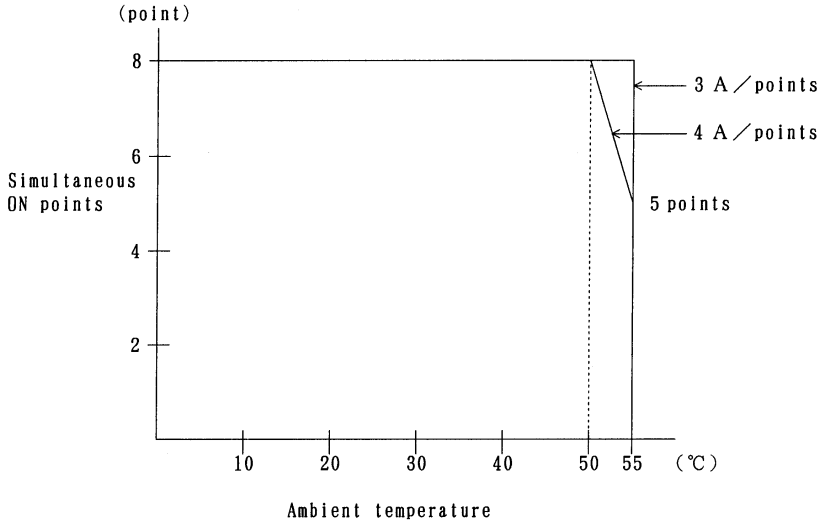


Fig.5.3 (d) AOR08G Load reduction curve

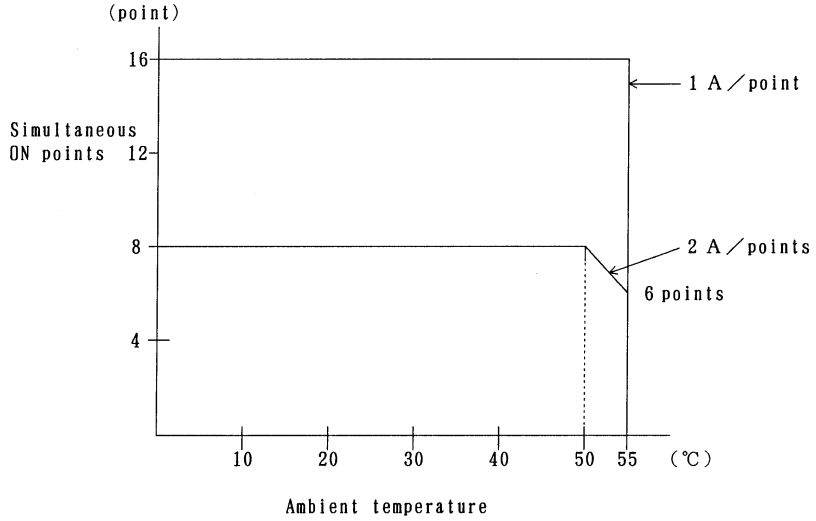


Fig.5.3 (e) AOR16G, AOR16H2 Load reduction curve

NOTE
Ambient temperature means the temperature surrounding the I/O Unit and not that surrounding the cabinet containing the I/O Unit.

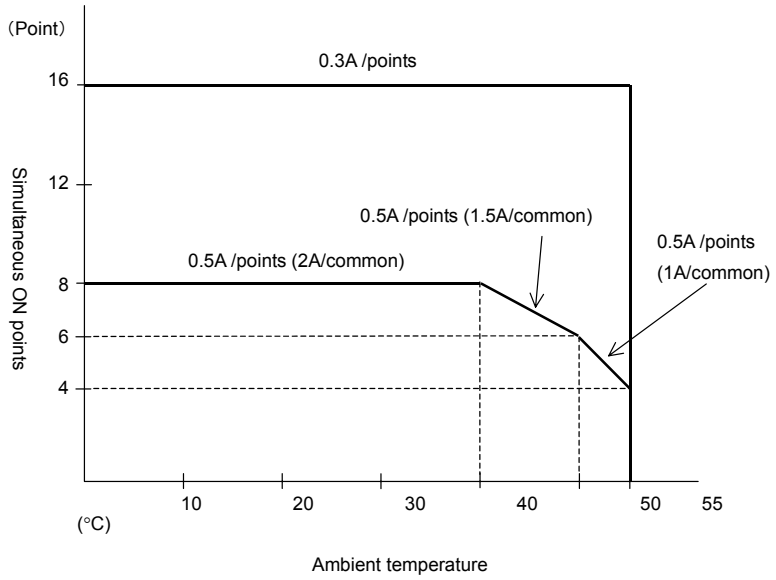


Fig.5.3 (f) AOD16DP Load reduction curve

5.4 DETAILS OF I/O Unit CONNECTORS (HONDA TSUSHIN/HIROSE ELECTRIC) AND TERMINAL BLOCK (WEIDMÜLLER)

Given below are the details (signal arrangement diagrams as viewed from the front of the module) of the connector pins and AOD16D3 terminal block for the I/O Units (32-point input module, 32-point output module, and 24-point input/16-point output hybrid module) explained in Section 5.3.

5.4.1 Modules Using the MR-50RMA Connector Manufactured by Honda Tsushin

- AID32A1/AID32B1/AID32H1 (32-point DC input module)

33	D7			01	D6
34	D5			02	D3
35	D2	19	D4	03	D0
36	CMC	20	D1	04	+24V
37	C7	21	CMC	05	GND
38	C5	22	C6	06	C3
39	C2	23	C4	07	C0
40	CMC	24	C1	08	+24V
41	CMC	25		09	GND
42	B7	26		10	B6
43	B5	27	B4	11	B3
44	B2	28	B1	12	B0
45	CMA	29	CMA	13	+24V
46	A7	30	A6	14	GND
47	A5	31	A4	15	A3
48	A2	32	A1	16	A0
49	CMA			17	+24V
50	CMA			18	GND

- AID32E1/AID32F1 (32-point DC input module)

33	D7			01	D6
34	D5			02	D3
35	D2	19	D4	03	D0
36	CMD	20	D1	04	
37	C7	21	CMD	05	
38	C5	22	C6	06	C3
39	C2	23	C4	07	C0
40	CMC	24	C1	08	
41	CMC	25		09	
42	B7	26		10	B6
43	B5	27	B4	11	B3
44	B2	28	B1	12	B0
45	CMB	29	CMB	13	
46	A7	30	A6	14	
47	A5	31	A4	15	A3
48	A2	32	A1	16	A0
49	CMA			17	
50	CMA			18	

- AOD32A1/AOD32C1 (32-point DC output module)

33	D7			01	D6
34	D5			02	D3
35	D2	19	D4	03	D0
36	CMD	20	D1	04	+24V-D
37	C7	21	CMD	05	
38	C5	22	C6	06	C3
39	C2	23	C4	07	C0
40	CMC	24	C1	08	+24V-C
41	CMC	25		09	
42	B7	26		10	B6
43	B5	27	B4	11	B3
44	B2	28	B1	12	B0
45	CMB	29	CMB	13	+24V-B
46	A7	30	A6	14	
47	A5	31	A4	15	A3
48	A2	32	A1	16	A0
49	CMA			17	+24V-A
50	CMA			18	

- AOD32D1 (32-point DC output module)

33	D7			01	D6
34	D5			02	D3
35	D2	19	D4	03	D0
36	CMD	20	D1	04	
37	C7	21	CMD	05	0V-D
38	C5	22	C6	06	C3
39	C2	23	C4	07	C0
40	CMC	24	C1	08	
41	CMC	25		09	0V-C
42	B7	26		10	B6
43	B5	27	B4	11	B3
44	B2	28	B1	12	B0
45	CMB	29	CMB	13	
46	A7	30	A6	14	0V-B
47	A5	31	A4	15	A3
48	A2	32	A1	16	A0
49	CMA			17	
50	CMA			18	0V-A

- AIO40A (24-point DC input/16-point DC output hybrid module)

33	B0			01	A0
34	B1	19	C0	02	A1
35	B2	20	C1	03	A2
36	B3	21	C2	04	A3
37	B4	22	C3	05	A4
38	B5	23	C4	06	A5
39	B6	24	C5	07	A6
40	B7	25	C6	08	A7
41	+24V	26	C7	09	+24V
42	F0	27	CM	10	E0
43	F1	28	CMA	11	E1
44	F2	29	CMA	12	E2
45	F3	30	SP	13	E3
46	F4	31	0V	14	E4
47	F5	32	0V	15	E5
48	F6			16	E6
49	F7			17	E7
50	0V			18	0V

5.4.2 Modules Using the HIF3BB-50PA-2.54DS Connector Manufactured by Hirose Electric

- AID32E2/AID32F2 (32-point DC input module)

A01		B01	
A02	D7	B02	D6
A03	D5	B03	D4
A04	D3	B04	D2
A05	D1	B05	D0
A06	CMD	B06	CMD
A07		B07	
A08	C7	B08	C6
A09	C5	B09	C4
A10	C3	B10	C2
A11	C1	B11	C0
A12	CMC	B12	CMC
A13		B13	
A14	B7	B14	B6
A15	B5	B15	B4
A16	B3	B16	B2
A17	B1	B17	B0
A18	CMB	B18	CMB
A19		B19	
A20	A7	B20	A6
A21	A5	B21	A4
A22	A3	B22	A2
A23	A1	B23	A0
A24	CMA	B24	CMA
A25		B25	

- AOD32C2 (32-point DC output module)

A01		B01	+24V-D
A02	D7	B02	D6
A03	D5	B03	D4
A04	D3	B04	D2
A05	D1	B05	D0
A06	CMD	B06	CMD
A07		B07	+24V-C
A08	C7	B08	C6
A09	C5	B09	C4
A10	C3	B10	C2
A11	C1	B11	C0
A12	CMC	B12	CMC
A13		B13	+24V-B
A14	B7	B14	B6
A15	B5	B15	B4
A16	B3	B16	B2
A17	B1	B17	B0
A18	CMB	B18	CMB
A19		B19	+24V-A
A20	A7	B20	A6
A21	A5	B21	A4
A22	A3	B22	A2
A23	A1	B23	A0
A24	CMA	B24	CMA
A25		B25	

- AOD32D2 (32-point DC output module)

A01	0V-D	B01	
A02	D7	B02	D6
A03	D5	B03	D4
A04	D3	B04	D2
A05	D1	B05	D0
A06	CMD	B06	CMD
A07	0V-C	B07	
A08	C7	B08	C6
A09	C5	B09	C4
A10	C3	B10	C2
A11	C1	B11	C0
A12	CMC	B12	CMC
A13	0V-B	B13	
A14	B7	B14	B6
A15	B5	B15	B4
A16	B3	B16	B2
A17	B1	B17	B0
A18	CMB	B18	CMB
A19	0V-A	B19	
A20	A7	B20	A6
A21	A5	B21	A4
A22	A3	B22	A2
A23	A1	B23	A0
A24	CMA	B24	CMA
A25		B25	

- AOR16H2 (16-point relay output module)

A01	CMA	B01	CMA
A02	CMA	B02	CMA
A03	A0	B03	A0
A04	A1	B04	A1
A05	A2	B05	A2
A06	A3	B06	A3
A07	CMB	B07	CMB
A08	CMB	B08	CMB
A09	A4	B09	A4
A10	A5	B10	A5
A11	A6	B11	A6
A12	A7	B12	A7
A13	CMC	B13	CMC
A14	CMC	B14	CMC
A15	B0	B15	B0
A16	B1	B16	B1
A17	B2	B17	B2
A18	B3	B18	B3
A19	CMD	B19	CMD
A20	CMD	B20	CMD
A21	B4	B21	B4
A22	B5	B22	B5
A23	B6	B23	B6
A24	B7	B24	B7
A25		B25	

5.4.3 Modules Using the HIF4-40P-3.18DS Connector Manufactured by Hirose Electric

- AOD16D2 (16-point DC output module)

A01	A0	B01	0V-A
A02	A1	B02	0V-A
A03	A2	B03	CMA
A04	A3	B04	CMA
A05	CMA	B05	CMA
A06	A4	B06	0V-B
A07	A5	B07	0V-B
A08	A6	B08	CMB
A09	A7	B09	CMB
A10	CMB	B10	CMB
A11	CMC	B11	CMC
A12	B0	B12	CMC
A13	B1	B13	CMC
A14	B2	B14	0V-C
A15	B3	B15	0V-C
A16	CMD	B16	CMD
A17	B4	B17	CMD
A18	B5	B18	CMD
A19	B6	B19	0V-D
A20	B7	B20	0V-D

5.4.4 Modules Using the Terminal Block BL3.5/24/90F Manufactured by Weidmüller

- AOD16D3 (16-point DC output module)

01	CMA
02	A0
03	A1
04	A2
05	A3
06	0V-A
07	CMB
08	A4
09	A5
10	A6
11	A7
12	0V-B
13	CMC
14	B0
15	B1
16	B2
17	B3
18	0V-C
19	CMD
20	B4
21	B5
22	B6
23	B7
24	0V-D

6 ANALOG INPUT MODULE

6.1 12-BIT ANALOG INPUT MODULE (AAD04A)

6.1.1 Specifications

Item	Specifications
Number of input channel	4 channel/module
Analog input	• Voltage input -10VDC to+10VDC(input resistance 4.7MΩ) • Current input -20mADC to+20mADC(input resistance 250Ω) Caution) Which method to use, voltage input or current input, can be selected by connecting the corresponding input to the terminal block.
Digital output	12 bit binary (complementary representation of "2".)
Input/output correspondence	<table><tr><th>Analog input</th><th>Digital output</th></tr><tr><td>+10V</td><td>+2000</td></tr><tr><td>+5V or + 20mA</td><td>+1000</td></tr><tr><td>0V or 0mA</td><td>0</td></tr><tr><td>-5V or -20mA</td><td>-1000</td></tr><tr><td>-10V</td><td>-2000</td></tr></table>
Resolution	5mV or 20μA
Total precision	Voltage input ±0.5%(For full scale) Current input ±1%(For full scale)
Conversionary time	Max.2ms (Note)
Maximum input voltage/current	±15V, ±30mA
Isolation	Photocoupler isolated (between the input signal and the base) However, not isolated between input channels
Output connecting	Removable terminal block (20 terminals, M3.5 screw terminal)
Required input points	64 points

NOTE
Conversion time means that only in a module. Actual response speed is determined by adding the scanning time depending on each system to this conversion time.

6.1.2 Correspondence between Input Signals and Addresses in a Module

In the analog input module AAD04A, the 4-channel analog input signals are cyclically A-D converted in order, and the converted digital data are written in the following addresses. Therefore, in the PMC program, it is possible at any time to know the values for the analog input signals by referring to the following addresses.

Address in module	Bits 7	6	5	4	3	2	1	0	
0	D07-0	D06-0	D05-0	D04-0	D03-0	D02-0	D01-0	D00-0	Channel 0
1	X-0	X-0	X-0	X-0	D11-0	D10-0	D09-0	D08-0	
2	D07-1	D06-1	D05-1	D04-1	D03-1	D02-1	D01-1	D00-1	Channel 1
3	X-1	X-1	X-1	X-1	D11-1	D10-1	D09-1	D08-1	
4	D07-2	D06-2	D05-2	D04-2	D03-2	D02-2	D01-2	D00-2	Channel 2
5	X-2	X-2	X-2	X-2	D11-2	D10-2	D09-2	D08-2	
6	D07-3	D06-3	D05-3	D04-3	D03-3	D02-3	D01-3	D00-3	Channel 3
7	X-3	X-3	X-3	X-3	D11-3	D10-3	D09-3	D08-3	

D00-n and D11-n correspond to the weights of 2^0 and 2^{11} respectively. Here, D11-n corresponds to the sign bit in the complementary representation of "2."
In addition, in X-n is written the same value as that in D11-n.

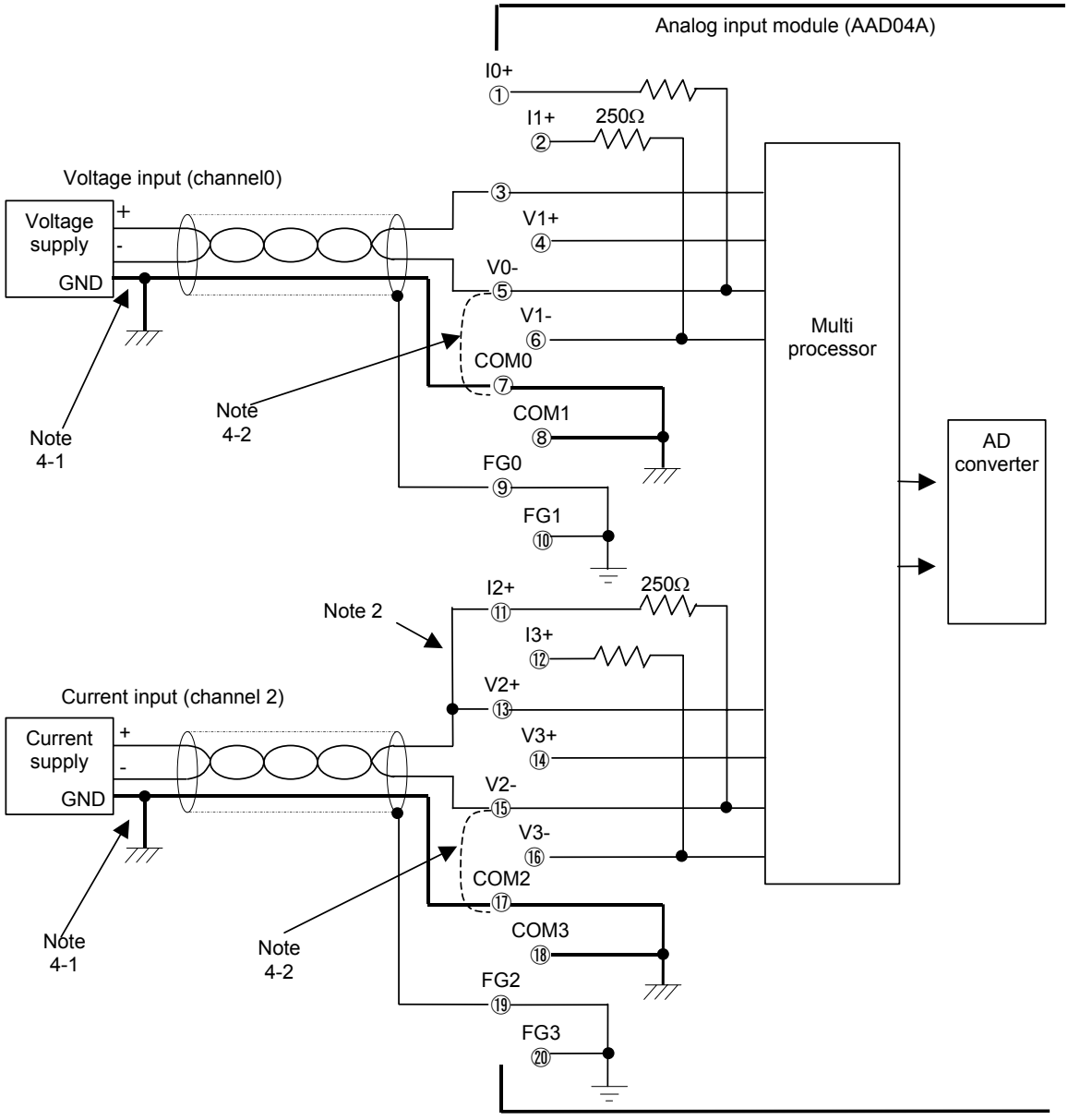
NOTE
1 When addressing I/O modules, the beginning address for this module should be assigned to an even one. Moreover, when an A-D converted value is referred to in a PMC program, make sure to read the data in unit of a word (16 bits).
2 Note that on the PMC-N, -NA, and -QA (PMC for the Series 15 and F-D Mate), the high-order one byte and low-order one byte of a word (16 bits) are interchanged with each other as described below.

Addresses for word-unit operation in the PMC-N, NA, and QA

Analog input module → PMC

	Address in the module	High-order byte	Low-order byte
Channel 0	0	D07-0 to D00-0	X-0,D11-0 to D08-0
Channel 1	+2	D07-1 to D00-1	X-1,D11-1 to D08-1
Channel 2	+4	D07-2 to D00-2	X-2,D11-2 to D08-2
Channel 3	+6	D07-3 to D00-3	X-3,D11-3 to D08-3

6.1.3 Connecting with Analog Input Module



NOTE

1 Though the example above shows the connection of channels 0 and 2, it is just the same with the channel 1 (I1+, V1+, V1-, COM1 and FG1) and the channel 3 (I3+, V3+, V3-, COM3 and FG3).
2 Either voltage input or current input can be specified for each channel. When current input is specified, make sure to short-circuit in + and Vn+ (n: 0 to 3).
3 Use shielded cables of twisted pair for connecting.
4 Fix a reference voltage by connecting the COMn (where n is 0, 1, 2, or 3) terminal of this module to the common line (GND) of the voltage or current source to be used as shown above (Note 4-1). If the voltage or current source has a terminal shared by the external output (terminal OUT-) and ground (GND), the Vn- and COMn (where n is 0, 1, 2, or 3) of this module can be connected to each other as shown above (Note 4-2).

6.2 16-BIT ANALOG INPUT MODULE (AAD04B)

6.2.1 Specifications

Item	Specifications
Number of input channel	4 channel/module
Analog input	• Voltage input -10VDC to+10VDC(input resistance 4.7MΩ) • Current input -20mADC to+20mADC(input resistance 250Ω) Caution) Which method to use, voltage input or current input, can be selected by connecting the corresponding input to the terminal block.
Digital output	16 bit binary (complementary representation of "2".)
Input/output correspondence	<table><tr><th colspan="2">Analog input</th><th rowspan="2">Digital output</th></tr><tr><th>Voltage input</th><th>Current input</th></tr><tr><td>+10V</td><td>-</td><td>+32000</td></tr><tr><td>+5V</td><td>+20mA</td><td>+16000</td></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>-5V</td><td>-20mA</td><td>-16000</td></tr><tr><td>-10V</td><td>-</td><td>-32000</td></tr></table>
Resolution	Voltage input: 0.3125mV Current input: 1.25μA
Total precision	Voltage input: ±0.5%(For full scale) Current input: ±1%(For full scale)
Conversionary time	Max.2ms (Note)
Maximum input voltage/current	±15V, ±30mA
Isolation	Photocoupler isolated (between the input signal and the base) However, not isolated between input channels
Output connecting	Removable terminal block(20 terminals, M3.5 screw terminal)
Required input points	64 points
Name assigned to module	“AD04A” or “/8”

NOTE
Conversion time means that only in a module. Actual response speed is determined by adding the scanning time depending on each system to this conversion time.

6.2.2 Correspondence between Input Signals and Addresses in a Module

In the analog input module AAD04B, the 4-channel analog input signals are cyclically A-D converted in order, and the converted digital data are written in the following addresses. Therefore, in the PMC program, it is possible at any time to know the values for the analog input signals by referring to the following addresses.

Address in module	Bits 7	6	5	4	3	2	1	0	
0	D07-0	D06-0	D05-0	D04-0	D03-0	D02-0	D01-0	D00-0	Channel 0
1	D15-0	D14-0	D13-0	D12-0	D11-0	D10-0	D09-0	D08-0	
2	D07-1	D06-1	D05-1	D04-1	D03-1	D02-1	D01-1	D00-1	Channel 1
3	D15-1	D14-1	D13-1	D12-1	D11-1	D10-1	D09-1	D08-1	
4	D07-2	D06-2	D05-2	D04-2	D03-2	D02-2	D01-2	D00-2	Channel 2
5	D15-2	D14-2	D13-2	D12-2	D11-2	D10-2	D09-2	D08-2	
6	D07-3	D06-3	D05-3	D04-3	D03-3	D02-3	D01-3	D00-3	Channel 3
7	D15-3	D14-3	D13-3	D12-3	D11-3	D10-3	D09-3	D08-3	

D00-n and D15-n correspond to the weights of 2^0 and 2^{15} respectively. Here, D15-n corresponds to the sign bit in the complementary representation of "2." (where n represents one of the channel numbers 0 to 3)

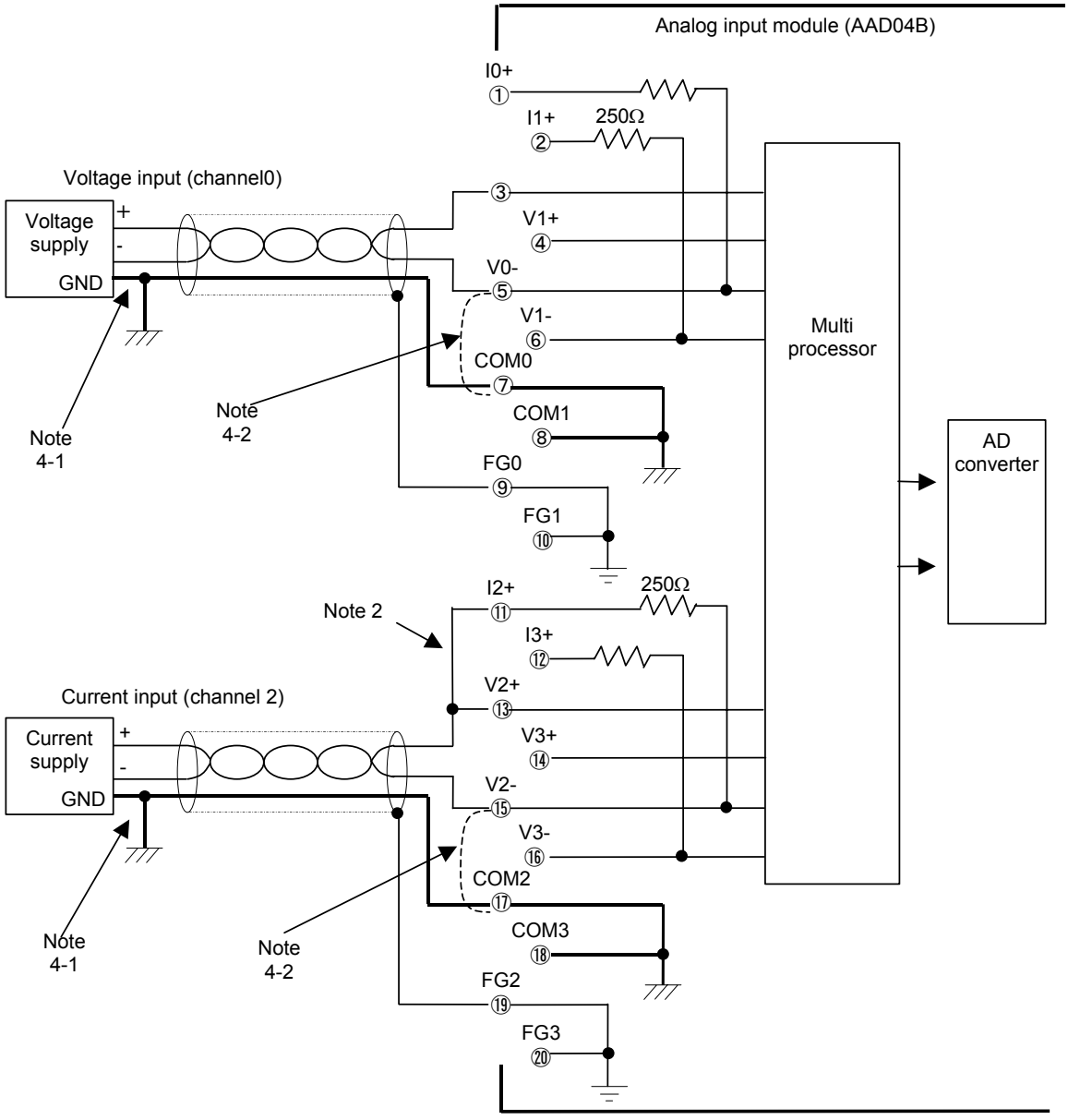
NOTE
1 When addressing I/O modules, the beginning address for this module should be assigned to an even one. Moreover, when an A-D converted value is referred to in a PMC program, make sure to read the data in unit of a word (16 bits).
2 This module has a very high resolution. When A/D-converted values are input to a system for reference by the PMC program, they may disperse largely depending on the system. If this is the case, the dispersion of input values can be suppressed by obtaining their moving average in the PMC program or lowering the resolution by masking the lowest-order bit if possible.
3 Note that on the PMC-N, -NA, and -QA (PMC for the Series 15 and F-D Mate), the high-order one byte and low-order one byte of a word (16 bits) are interchanged with each other as described below.

Addresses for word-unit operation in the PMC-N, NA, and QA

Analog input module → PMC

	Address in the module	High-order byte	Low-order byte
Channel 0	0	D07-0 to D00-0	D15-0 to D08-0
Channel 1	+2	D07-1 to D00-1	D15-1 to D08-1
Channel 2	+4	D07-2 to D00-2	,D15-2 to D08-2
Channel 3	+6	D07-3 to D00-3	D15-3 to D08-3

6.2.3 Connecting with Analog Input Module



NOTE

1 Though the example above shows the connection of channels 0 and 2, it is just the same with the channel 1 (I1+, V1+, V1-, COM1 and FG1) and the channel 3 (I3+, V3+, V3-, COM3 and FG3).
2 Either voltage input or current input can be specified for each channel. When current input is specified, make sure to short-circuit in + and Vn+ (n: 0 to 3).
3 Use shielded cables of twisted pair for connecting.
4 Fix a reference voltage by connecting the COMn (where n is 0, 1, 2, or 3) terminal of this module to the common line (GND) of the voltage or current source to be used as shown above (Note 4-1). If the voltage or current source has a terminal shared by the external output (terminal OUT-) and ground (GND), the Vn- and COMn (where n is 0, 1, 2, or 3) of this module can be connected to each other as shown above (Note 4-2).

7 ANALOG OUTPUT MODULE

7.1 12-BIT ANALOG OUTPUT MODULE (ADA02A)

7.1.1 Specification

Item	Specification
Number of output channels	2 channels/module
Digital input	12-bit binary (2's complement representation)
Analog output	-10VDC to +10VDC(external load resistance: 10KΩ or more) (Note 1) 0mADC to +20mADC(external load resistance: 400Ω or less)
Input/output correspondence	<table><tr><th>Digital input</th><th>Analog output</th></tr><tr><td>+2000</td><td>+10V</td></tr><tr><td>+1000</td><td>+5V or +20mA</td></tr><tr><td>0</td><td>0V or 0mA</td></tr><tr><td>-1000</td><td>-5V</td></tr><tr><td>-2000</td><td>-10V</td></tr></table>
Resolution	5mV or 20μA
Comprehensive accuracy	Voltage output: ±0.5% (For the full scale) Current output: ±1% (For the full scale)
Converting time	1msec or less (Note 2)
Insulation	Photocoupler insulation (between output signal and base). However, non-insulation between output channels.
External connection	At removable terminal block (20 terminals, M3.5 screw terminals)
Number of occupied output points	32 points

NOTE
1 Which method to use, voltage input or current input, can be selected by connecting the corresponding input to the terminal block.
2 The converting time is the one only inside the module. The actual response time is added a scan time that is determined by the system.

7.1.2 Correspondence between Output Signals and Addresses in a Module

In the analog output module ADA02A, a 12-bit digital value is written into each of the following addresses to output the desired voltage/current to its corresponding analog output.

Address in module	Bits 7	6	5	4	3	2	1	0	
0	D07-0	D06-0	D05-0	D04-0	D03-0	D02-0	D01-0	D00-0	Channel 0
1	-	-	-	-	D11-0	D10-0	D09-0	D08-0	
2	D07-1	D06-1	D05-1	D04-1	D03-1	D02-1	D01-1	D00-1	Channel 1
3	-	-	-	-	D11-1	D10-1	D09-1	D08-1	

D00-n corresponds to the 2^0 weight, while D11-n corresponds to the 2^{11} weight.
However, D11-n corresponds to the code bit 2's complement representation.

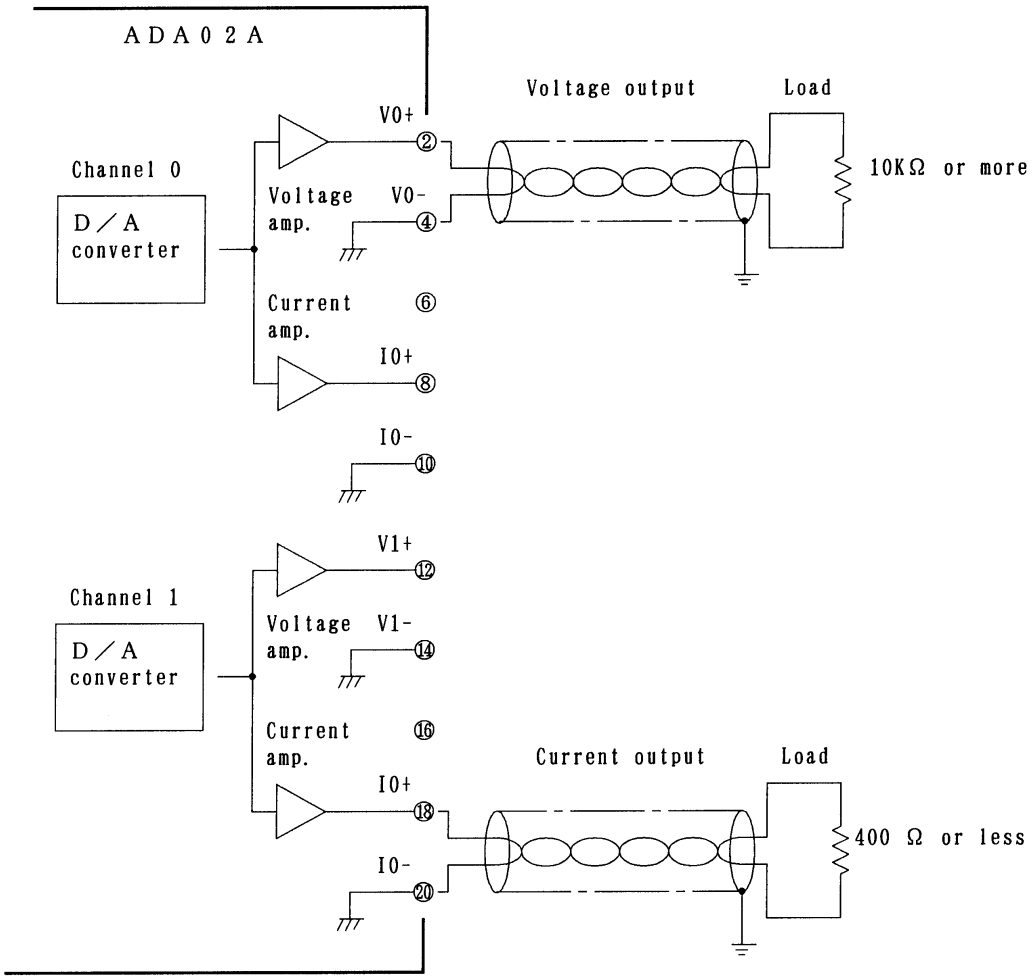
NOTE
1 When setting an I/O module address, this module initial address must be assigned to an even address. To write a value that is to be converted from digital to analog into a PMC program, be sure to write it in words (16 bits).
2 Note that on the PMC-N, -NA, and -QA (PMC for the Series 15 and F-D Mate), the high-order one byte and low-order one byte of a word (16 bits) are interchanged with each other as described below.

Addresses for word-unit operation in the PMC-N, NA, and QA

PMC → 12-bit analog output module

	Module in address	High-order byte	Low-order byte
Channel 0	0	D07-0 to D00-0	D11-0 to D08-0
Channel 1	+2	D07-1 to D00-1	D11-1 to D08-1

7.1.3 Connection to Analog Output Module



NOTE
1 Use a 2-core twisted shielded cable as the connection cable
2 Ground the cable shield on the load side.

7.2 14-BIT ANALOG OUTPUT MODULE (ADA02B)

7.2.1 Specification

Item	Specification
Number of output channels	2 channels/module
Digital input	14-bit binary (2's complement representation)
Analog output	•Voltage output -10 VDC to +10 VDC (external load resistance of 10 kΩ or higher) (Note 1) •Current output 0 mADC to +20 mADC (external load resistance of 400Ω or lower)
Input/output correspondence	
Resolution	Voltage output: 1.25 mV Current output: 2.5 μA
Overall precision	Voltage output: ±0.5% (of the full scale) Current output: ±1% (of the full scale)
Converting time	1 msec or shorter (Note 2)
Insulation	Photocoupler-based insulation between output signal and base, but no insulation between output channels
External connection	Removable terminal block (20 terminals, M3.5 screw terminal)
Number of occupied output points	32 points

Digital input	Analog output	
	Voltage output	Current output
+8000	+10V	+20mA
+4000	+5V	+10mA
0	0	0
-4000	-5V	-
-8000	-10V	-

NOTE
1 Which method to use, voltage input or current input, can be selected by connecting the corresponding input to the terminal block.
2 The converting time is that inside the module. The actual response time is added the scan time that is determined by the system.

7.2.2 Correspondence between Output Signals and Addresses in the Module

In the ADA02B analog output module, a 14-bit digital value is written to each of the following address to output the desired voltage/current from its corresponding analog output.

Address in module	Bits 7	6	5	4	3	2	1	0	
0	D07-0	D06-0	D05-0	D04-0	D03-0	D02-0	D01-0	D00-0	Channel 0
1	-	-	D13-0	D12-0	D11-0	D10-0	D9-0	D8-0	
2	D07-1	D06-1	D05-1	D04-1	D03-1	D02-1	D01-1	D00-1	Channel 1
3	-	-	D13-1	D12-1	D11-1	D10-1	D9-1	D8-1	

D00-n (where n is 0 or 1) corresponds to a weight of 2^0, and D13-n to a weight of 2^{13}. However, D13-n corresponds to the sign bit of a two's complement representation.

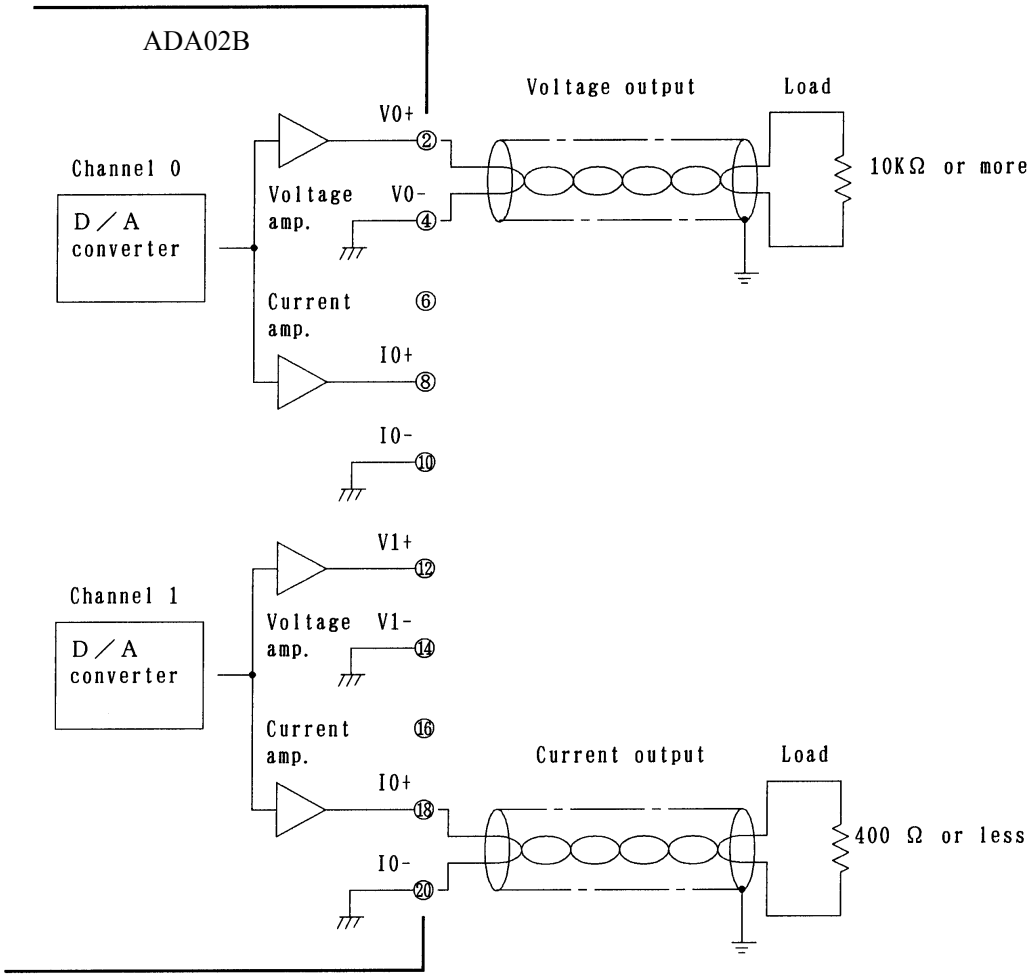
NOTE
1 When setting an I/O module address, this module initial address must be assigned to an even address. To write a value that is to be converted from digital to analog into a PMC program, be sure to write it in words (16 bits).
2 Note that on the PMC-N, -NA, and -QA (PMC for the Series 15 and F-D Mate), the high-order one byte and low-order one byte of a word (16 bits) are interchanged with each other as described below.

Addresses for word-unit operation in the PMC-N, NA, and QA

PMC → 14-bit analog putput module

	Module inaddress	High-order byte	Low-order byte
Channel 0	0	D07-0 to D00-0	D13-0 to D08-0
Channel 1	+2	D07-1 to D00-1	D13-1 to D08-1

7.2.3 Connection between the Analog Output Module and Load



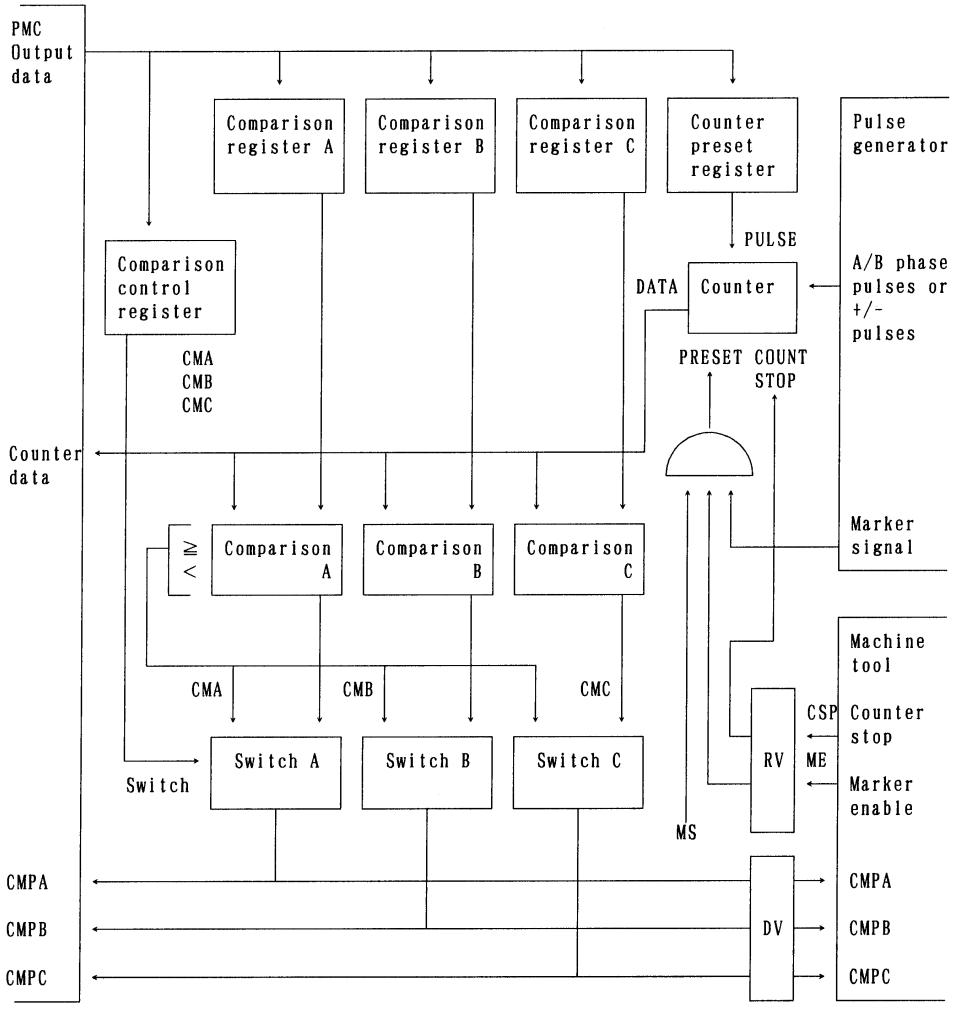
NOTE
1 Use a shielded 2-conductor twisted pair cable for the connection between the analog output module and load.
2 Ground the cable shielding on the load side.

8 HIGH-SPEED COUNTER MODULE

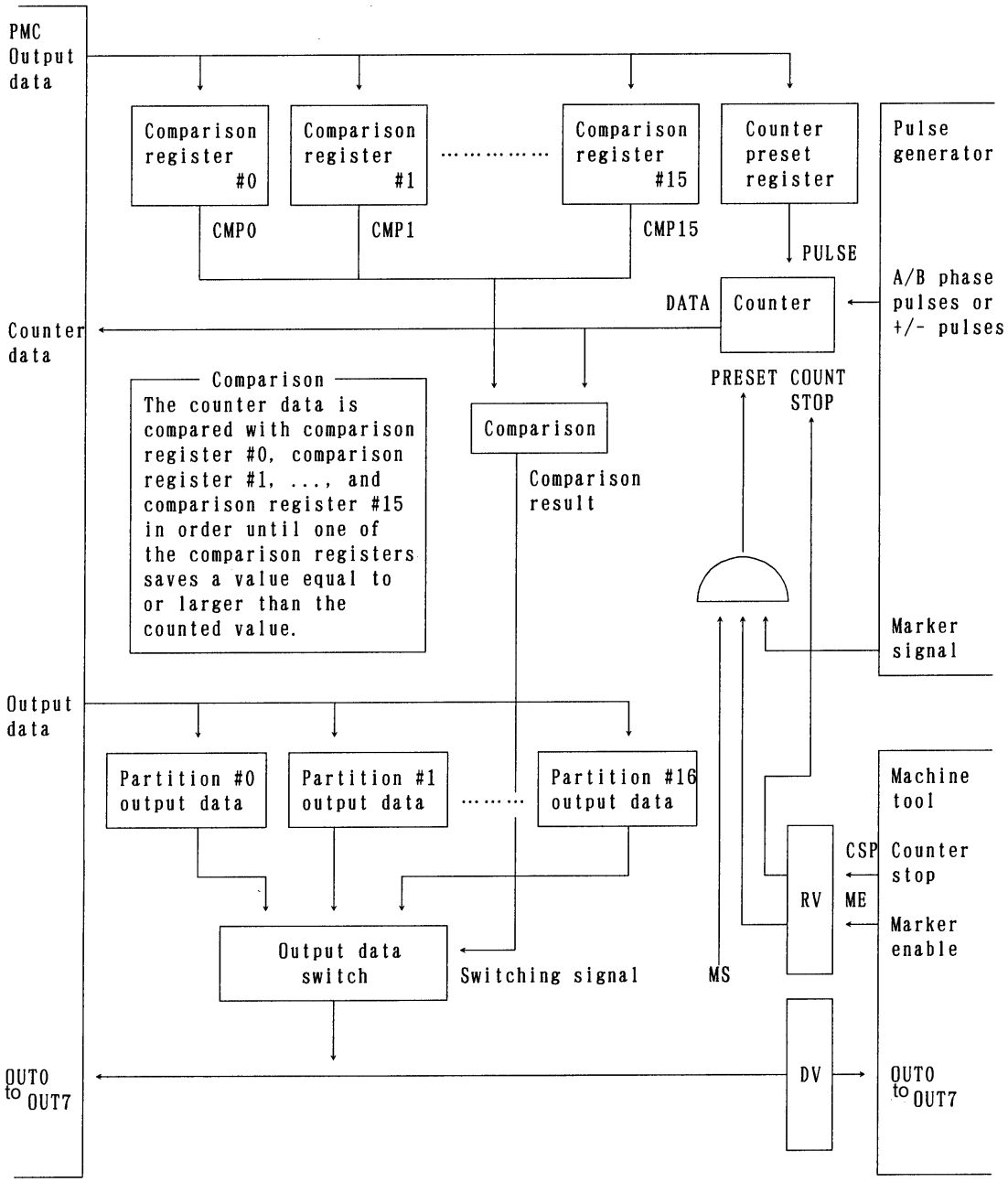
8.1 OUTLINE OF HIGH-SPEED COUNTER MODULE

The high-speed counter module consists of a counter which counts the pulses sent from a pulse generator such as a position detector in the machine tool and comparison registers for comparing preset values with counter data. The module can read the counter data and output the results of comparison to the machine.
The high-speed counter module can run in two different modes, mode A and mode B. These two modes differ in the way data is compared. Shown below are configuration diagrams, briefing either mode.

A. Mode A



B. Mode B


PMC Output data
Comparison register #0
Comparison register #1
Comparison register #15
Counter preset register
Pulse generator
CMP0
CMP1
CMP15
PULSE
DATA
Counter
A/B phase pulses or +/- pulses
Counter data
Comparison
The counter data is compared with comparison register #0, comparison register #1, ..., and comparison register #15 in order until one of the comparison registers saves a value equal to or larger than the counted value.
Comparison
Comparison result
PRESET
COUNT
STOP
Marker signal
Output data
Partition #0 output data
Partition #1 output data
Partition #16 output data
Machine tool
CSP
Counter stop
RV
ME
Marker enable
Output data switch
Switching signal
MS
DV
OUT0 to OUT7
OUT0 to OUT7

8.2 SPECIFICATIONS OF HIGH-SPEED COUNTER MODULE

8.2.1 Pulse Counter

(1) Binary up/down counter (1)
(2) Counter capacity
0 to 8,388,607
(3) Counter data
The pulse counter can preset data and read count data.

8.2.2 Comparison Function

(1) Mode A

A. Comparison register (23 bits)
Comparison registers A, B, and C are provided. The values to be compared are preset in the comparison registers.
B. Comparison output
The results (CMPA, CMPB, and CMPC) of comparing the count data in the pulse counter with the data set in the comparison registers are output.
C. Comparison output values
The comparison output values are set as listed in the table below. The values depend on the states of CMA, CMB, and CMC, the comparison mode signals from the PMC.

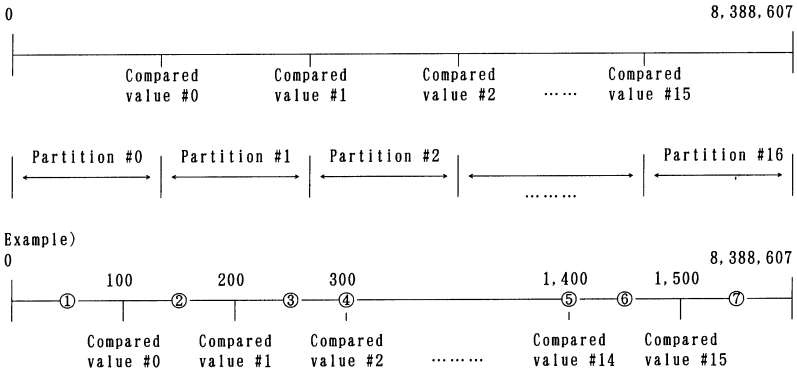
	Counter value ≤ comparison register value	**Counter value > comparison register value**
CMA=0 CMB=0 CMC=0	CMPA=0 CMPB=0 CMPC=0	CMPA=1 CMPB=1 CMPC=1
CMA=1 CMB=1 CMC=1	CMPA=1 CMPB=1 CMPC=1	CMPA=0 CMPB=0 CMPC=0

(2) Mode B
A. Comparison register (23 bits)
There are 16 comparison registers #0,#1, ...,#15. The values to be compared are preset in the comparison registers. The preset value in a comparison register having a larger register number should be larger than that in a comparison register having a smaller register number, as follows:
Value in register #0 < value in register #1< ... < value in register #14 < value in register 15
B. Comparison output
The results (OUT0 to OUT7) of comparing the count data in the pulse counter with the data set in the comparison registers are output.

C. Comparison output values

The count data in the pulse counter is compared with the values in the comparison registers in sequential order from register 0 until the count data is equal to or less than the value in a comparison register. This enables a partition to be made which includes the count data. Then the output data for the partition (which is previously preset) is output. Eight output points (OUT0 to OUT7) are provided.

If the count data is equal to the value in a comparison register, the data in the partition having the same number as the register number is output.



Assume that, when count data is in partition #n, the data to be output is set to respective values in hexadecimal as listed below.

Output data from partition #0 = 0H
Output data from partition #1 = 1H
Output data from partition #2 = 2H
Output data from partition #3 = 3H
Output data from partition #4 = 4H
Output data from partition #5 = 5H
Output data from partition #6 = 6H
Output data from partition #7 = 7H
Output data from partition #8 = 8H
Output data from partition #9 = 9H
Output data from partition #10 = 10H
Output data from partition #11 = 11H
Output data from partition #12 = 12H
Output data from partition #13 = 13H
Output data from partition #14 = 20H
Output data from partition #15 = 21H
Output data from partition #16 = FFH

The output data is set as listed in the table below, depending on the counter values in ① to ⑦ above.

	Partition	OUT								
		7	6	5	4	3	2	1	0	HEX value
①	0≤Counter value≤100	0	0	0	0	0	0	0	0	0h
②	100<Counter value≤200	0	0	0	0	0	0	0	1	1h
③	200<Counter value≤300	0	0	0	0	0	0	1	0	2h
④		0	0	0	0	0	0	1	0	2h
⑤	Comparison value in partition 14<Counter value≤1400	0	0	1	0	0	0	0	0	20h
⑥	1400<Counter value≤1500	0	0	1	0	0	0	0	1	21h
⑦	1500<Counter value≤8,388,607	1	1	1	1	1	1	1	1	FFh

NOTE
Preset an increasingly larger value in each of the compare registers (#0, #1, ..., #15) as the register number becomes larger.
Unless this condition is satisfied, it is likely that no normal compensation may take place, leading to an abnormal compare output.

8.2.3 Pulse Interface

The following three types of pulses are entered in the high-speed counter module.

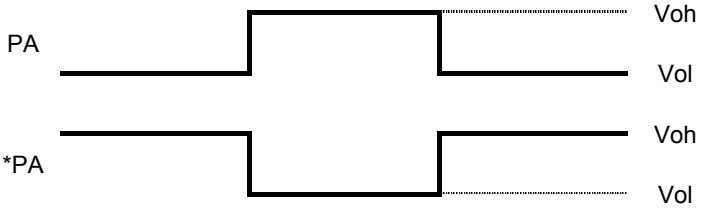
A. Phase A/B pulses: The phase difference between these detection pulses is 90°
B. +/- pulses: These detection pulses are separated in the positive and negative directions.

Select either type of the detection pulse.

C. Marker signal: Used to preset data in the pulse counter.

(1) Phase A/B pulse interface
The phase A/B pulses are selected when the PSEL signal is open.

A. Interface IC
The signal of the pulse generator connected to the high-speed counter module is equivalent to that of the line driver SN75113. It also equivalent to that of the AM26LS31. The signals involved are the equilibrium transmission signals shown below.

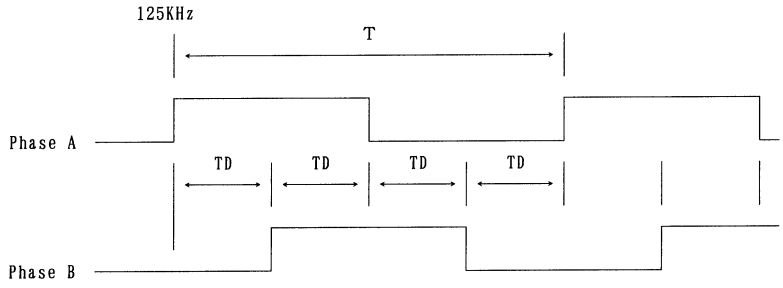


(The PB and MKS signals are the same, respectively, as PA and *PB. The *MKS signal is the same as *PA.)

The voltage ratings of the receiver in this module are: Voh = 2.4 V or higher and Vol = 0.45 V or lower. Be sure to use a pulse generator having a driver that satisfies these voltage requirements.

If you want to use a commercial rotary encoder as the pulse generator, select "line driver type output" that meets the above voltage requirements. It is impossible to use any output type (such as open-collector output or voltage output type) having a higher output rating.

B. Maximum frequency

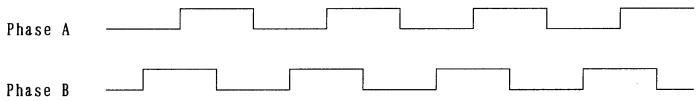


Tmin. =8μS (minimum period)
TDmin. =1.2μS (minimum time between edges)

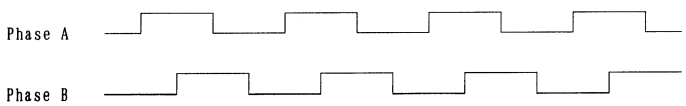
C. Count and direction

A counter multiplied by four compared to phase A and B pulses is provided. It counts positive when phase A advances before phase B and it counts negative when phase B advances before phase A.

Positive count
Advance of phase A before phase B



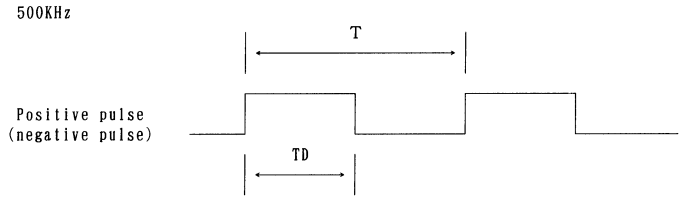
Negative count
Advance of phase B before phase A



(2) Positive/negative pulse interface
Positive and negative pulses are selected when the PSEL signal is connected to 0 VDC.

A. Interface IC
See Paragraph A, "Interface IC", in Item (1), "Phase A/B pulse interface".

B. Maximum frequency

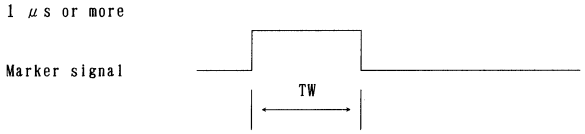


Tmin. = 2μS (minimum period)
TDmin. = 0.5μS (minimum pulse width)

(3) Marker signal

A. Interface IC
Use differential drivers (SN75113 or equivalent) at the output ports of the pulse generator.

B. Minimum pulse width



TWmin. = 1μS

8.2.4 External Contact Input

The pulse counter module uses insulating receivers (having a voltage rating of 24 VDC) at the input ports. The following two types of signal inputs are provided.

(1) Marker enable signal input (ME)
The contact of the marker enable signal is closed to make the marker signal valid.
This enables data to be preset in the counter.

(2) Count stop signal input (CSP)
The contact of the count stop signal is closed to stop the count operation.

8.2.5 External Contact Output

Solid state relays (SSR) are used for the contacts.

(1) Mode A
The comparison mode signal outputs A, B, C (CMPA, CMPB, and CMPC) are provided in mode A. These outputs indicate the results of comparing the comparison registers A, B, and C with the pulse counter. The comparison output values are determined depending on whether the control mode signals (CMA, CMB, and CMC) from the PMC are set to 1 or 0.

(2) Mode B
The results of comparing comparison register #0, comparison register #1, ..., comparison register #15 with the pulse counter are provided in mode B. The comparison output indicates the values in the output data registers for the partitions in which the count data is located. Eight output points are provided. (See Section 8.2.2 (2))

8.2.6 Marker Processing

(1) Mode A

A. Synchronization with marker
The counter value is set to the data in the counter preset register at the rising edge of the first marker signal with the MS signal output from the PMC set to 1 and the contact of the marker enable signal input (ME) from the machine closed.

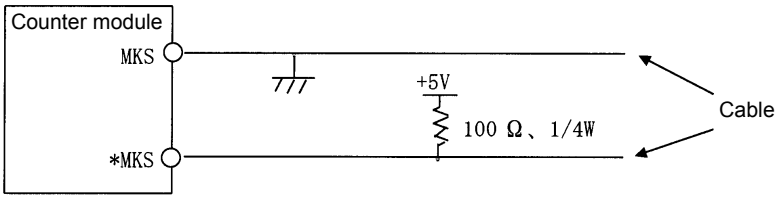
B. Marker hold
The MH signal is set to 1 at the rising edge of the first marker signal with the MS signal output from the PMC set to 1 and the contact of the marker enable signal input (ME) from the machine closed. The MH signal is reset when the marker hold reset (MHR), an output signal from the PMC, is set to 1 or the MS signal output from the PMC is set to 0.

(2) Mode B

A. Synchronization with marker
When the MS signal output from the PMC is 1 and the contact of the marker enable (ME) signal input from the machine is closed, the counter is set to the data in the counter preset register at the rising edge of the first marker signal.

B. Maker hold
When the MS signal output from the PMC is 1 and the contact of the marker enable (ME) signal input from the machine is closed, the MH signal is set to 1 at the rising edge of the marker signal. The MH signal is reset when the MS signal output from the PMC is set to 0.

(3) Pin treatment when no marker signal is used
If you use (that is, preset) no marker signal, treat the corresponding pin as shown below. Otherwise, a broken-wire alarm will be raised. The counter keeps running even after a broken-wire alarm is raised, though.



If the treatment shown above cannot prevent a broken-wire alarm from being raised, make sure that the GND terminal of the pulse generator is connected to the LGND (0V) pin of the JA9 connector.

8.2.7 LED indicators

The high-speed counter module has the following indicators.

(1) OK indicator
See below Table.

(2) ALM0 and ALM1 indicators
See below Table.

(3) Phase A and B pulses (positive and negative pulses) input signal indicators (A and B)
The phase A pulse input signal indicator is on when the phase A pulse input is active.
The phase B pulse input signal indicator is on when the phase B pulse input is active.
If the pulse remains "1" (high) only for a short time and has a long period, it is difficult to recognize a blinking LED.

(4) Marker signal indicator (M)
The marker signal indicator is on while the marker signal (MP) from the pulse generator is active.

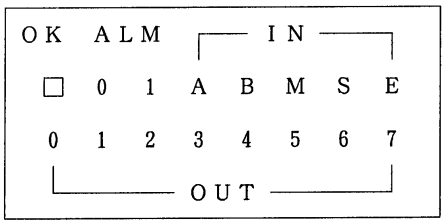
(5) Count stop signal indicator (S)
The count stop signal indicator is on when the contact of the count stop signal input sent from the machine is closed.

(6) Marker enable signal indicator (E)
The marker enable signal indicator is on when the contact of the marker enable signal input sent from the machine is closed.

(7) Comparison result output indicators (OUT0, OUT1, OUT2, OUT3, OUT4, OUT5, OUT6, and OUT7)

A. Mode A
The indicators OUT0, OUT1, and OUT2 correspond to the signals CMPA, CMPB, and CMPC. OUT1 goes on when CMPA goes on, OUT2 goes on when CMPB goes on, and OUT3 goes on when CMPC goes on.

B. Mode B
The indicators OUT0 - OUT7 go on corresponding to when the output data OUT0 - OUT7resulting from the comparisons between the count data and comparison resisters are set to 1.



LED indicator panel

OK	ALM0	ALM1	Explanation of alarm
●	●	○	Disconnection alarm
○	●	○	Self-diagnosis alarm, RAM error
○	○	●	Self-diagnosis alarm, ROM error
○	●	●	Watch dog alarm
●	○	○	Normal operation

● : On
○ : Off

The state of the OK, ALM0, or ALM1 is not held.

8.3 PMC INTERFACE

8.3.1 Mode A

(1) PMC I/O area
In mode A, four input bytes and four output bytes are used as the I/O area. The bytes in the I/O area have the following names. The input and output directions are specified on the basis of the PMC. The operation mode is set to mode A at power-on.

(a) Output data (sent from PMC to high-speed counter module)

0	CTRL (control)
+1	DTOH (higher 8-bit data)
+2	DTOM (middle 8-bit data)
+3	DTOL (lower 8-bit data)

(b) Input data (entered from high-speed counter module to PMC)

0	CNTS (counter H and status)
+1	CNTM (middle 8 bits of counter)
+2	CNTL (lower 8 bits of counter)
+3	STTS (status)

(2) PMC outputs (entered from PMC to high-speed counter module)
The PMC outputs are separated into control output CTRL and data outputs DTOH, DTOM, and DTOL. As with normal DOs, the control outputs of bit 3 to bit 7 are controlled independently. The control outputs of bit0 to bit2 constitute the SELECT indicating the target data specified by DTOH, DTOM, and DTOL.

(a) Control output

CTRL

7	6	5	4	3	2	1	0
MHR	MS		CE	PRS	SELECT		

PRS : Preset
CE : Count enable
MS : Marker synchronization
MHR : Marker hold reset

(b) Details of DTOH, DTOM, and DTOL
The SELECT bits indicate the target data.

SELECT	
0	CCTR (comparison control)
1	Counter preset data
2	Comparison register A
3	Comparison register B
4	Comparison register C
7	Change to mode B

NOTE
1 Change to mode B: See Section 8.3.2, "Mode B".
2 Detail of CCTR

DTOH

7	6	5	4	3	2	1	0
					CMC	CMB	CMA

The DTOM and DTOL are ignored.

(3) PMC inputs (entered from high-speed counter module to PMC)

The inputs to the PMC include the status and counter data. The data is shown below.

0	CNTS (counter H and status)
+1	CNTM (middle 8 bits of counter)
+2	CNTL (lower 8 bits of counter)
+3	STTS (status)

NOTE
1 Details of CNTS

7	6	5	4	3	2	1	0
TRA	Counter H (most significant 7 bits)						

TRA : Transfer A

NOTE
2 Details of STTS

7	6	5	4	3	2	1	0
TRB	ALM	CSP	ME	MH	CMPC	CMPB	CMPA

CMPA : Comparison output A
CMPB : Comparison output B
CMPC : Comparison output C
MH : Marker hold
ME : Marker enable
CSP : Count stop
ALM : Alarm (disconnection or watch dog alarm)
TRB : Transfer B

8.3.2 Mode B

Change to mode B
The operation mode is set to mode A at power-on. The following data is output to the counter module and the mode changes from A to B. The mode cannot change from B to A.

0	CTRL : 0FH (SELECT = 7, PRS = 1)
+1	DTOH : 01H
+2	DTOM : 00H
+3	DTOL : 00H

(1) PMC I/O area
In mode B, eight input bytes and four output bytes are used as the I/O area. The bytes in the I/O area have the following names. The input and output directions are specified on the basis of the PMC.

(a) Output data (sent from PMC to high-speed counter module)

0	CTRL (control)
+1	DTOH (higher 8-bit data)
+2	DTOM (middle 8-bit data)
+3	DTOL (lower 8-bit data)

(b) Input data (entered from high-speed counter module to PMC)

0	CNTS (counter H and status)
+1	CNTM (middle 8 bits of counter)
+2	CNTL (lower 8 bits of counter)
+3	STTS (status)
+4	OUTD
+5	MODD
+6	Unused
+7	Unused

(2) PMC outputs (outputs from PMC)
The PMC outputs are separated into control output CTRL and data outputs DTOH, DTOM, and DTOL. As with normal DOs, the control outputs of bit 5 to bit 7 are controlled independently. The control outputs of bit 0 to bit 4 constitute SELECT indicating the target data specified by DTOH, DTOM, and DTOL.

(a) Control outputs

CTRL

7	6	5	4	3	2	1	0
MS	CE	PRS	SELECT				

PRS : Preset
CE : Count enable
MS : Marker synchronization

(b) Details of DTOH, DTOM, and DTOL
Enter the comparison value and preset value (24 bits) to the DTOH, DTOM, and DTOL.
Enter a comparison result (8 bits) output for each partition, respectively, to the DTOH, DTOM, and DTOL.

SELECT	Target data	
0	Comparison data : Specify a comparison value (24 bits) for partition #0.	
1	Comparison data : Specify a comparison value (24 bits) for partition #1.	
2	Comparison data : Specify a comparison value (24 bits) for partition #2.	
3	Comparison data : Specify a comparison value (24 bits) for partition #3.	
4	Comparison data : Specify a comparison value (24 bits) for partition #4.	
5	Comparison data : Specify a comparison value (24 bits) for partition #5.	
6	Comparison data : Specify a comparison value (24 bits) for partition #6.	
7	Comparison data : Specify a comparison value (24 bits) for partition #7.	
8	Comparison data : Specify a comparison value (24 bits) for partition #8.	
9	Comparison data : Specify a comparison value (24 bits) for partition #9.	
10	Comparison data : Specify a comparison value (24 bits) for partition #10.	
11	Comparison data : Specify a comparison value (24 bits) for partition #11.	
12	Comparison data : Specify a comparison value (24 bits) for partition #12.	
13	Comparison data : Specify a comparison value (24 bits) for partition #13.	
14	Comparison data : Specify a comparison value (24 bits) for partition #14.	
15	Comparison data : Specify a comparison value (24 bits) for partition #15.	
16	Comparison output data (8 bits) for partition #0 to #2	Partition #0: DTOH
		Partition #1: DTOM
		Partition #2: DTOL
17	Comparison output data (8 bits) for partition #3 to #5	Partition #3: DTOH
		Partition #4: DTOM
		Partition #5: DTOL
18	Comparison output data (8 bits) for partition #6 to #8	Partition #6: DTOH
		Partition #7: DTOM
		Partition #8: DTOL
19	Comparison output data (8 bits) for partition #9 to #11	Partition #9: DTOH
		Partition #10: DTOM
		Partition #11: DTOL
20	Comparison output data (8 bits) for partition #12 to #14	Partition #12: DTOH
		Partition #13: DTOM
		Partition #14: DTOL
21	Comparison output data (8 bits) for partition #15 and #16	Partition #15: DTOH
		Partition #16: DTOM
22	Counter preset data (24 bits)	

(The numbers of DTOH, DTOM, and DTOL indicate the output data for the partitions specified by the numbers.)

(c) PMC inputs (inputs to PMC)
The inputs to the PMC include the status and counter data. The data is shown below.

0	CNTS (counter H and status)
+1	CNTM (middle 8 bits of counter)
+2	CNTL (lower 8 bits of counter)
+3	STTS (status)
+4	OUTD
+5	MODD
+6	Not used
+7	Not used

NOTE
1 Detail of CNTS

7	6	5	4	3	2	1	0
TRA	Counter H (most significant 7 bits)						

TRA : Transfer A

NOTE
2 Details of STTS

7	6	5	4	3	2	1	0
TRB	ALM	CSP	ME	MH			

MH : Marker hold
ME : Marker enable
CSP : Count stop
ALM : Alarm (disconnection or watch dog alarm)
TRB : Transfer B

NOTE
3 Detail of OUTD

7	6	5	4	3	2	1	0
OUT7	OUT6	OUT5	OUT4	OUT3	OUT2	OUT1	OUT0

OUT0 : Bit 0 of comparison output
OUT1 : Bit 1 of comparison output
OUT2 : Bit 2 of comparison output
OUT3 : Bit 3 of comparison output
OUT4 : Bit 4 of comparison output
OUT5 : Bit 5 of comparison output
OUT6 : Bit 6 of comparison output
OUT7 : Bit 7 of comparison output

NOTE
4 Detail of MODD

7	6	5	4	3	2	1	0
							MOD0

MOD0 : Set to 1 after the mode changes to B.

8.3.3 Details of PMC Interface Signals

(1) PMC inputs (inputs from PMC)

(a) TRA and TRB
The counter data is valid when TRA is equal to TRB and invalid when TRA is not equal to TRB.

(b) CMPA, CMPB, and CMPC (comparison output signals A, B, and C, only in mode A)
The CMPA, CMPB, and CMPC signals are output signals resulting from the comparison between the comparison registers A, B, and C and the counter data, respectively. The output levels of CMPA, CMPB, and CMPC are determined by the comparison mode signals CMA, CMB, and CMC.
When CMA, CMB, and CMC are 0, and the counter data is larger than the values in comparison registers A, B, and C, CMPA, CMPB, and CMPC are set to 1.
When CMA, CMB, and CMC are 1, and the counter data is equal to or less than the values in comparison registers A, B, and C, CMPA, CMPB, and CMPC are set to 1.

(c) OUT0 to OUT 7 (comparison output signal 0 to comparison output signal 7, only in mode B)
OUT0 - OUT7 correspond to bit 0 to bit 7 in the comparison result output of a single byte.

(d) MH (marker hold signal)
The marker hold signal MH is set to 1 at the rising edge of the marker signal when the marker enable signal is 1. The marker hold signal is reset when MHR=1 or MS=0. (In mode B, the marker hold signal MH is reset only when MS=0.)

(e) ME (marker enable signal)
The marker enable signal ME enables the marker signal as follows:
ME=1: Marker signal enabled
ME=0: Marker signal disabled

(f) CSP (count stop signal)
The counter stops counting when the contact for the external input signal CSP is closed.

(g) ALM (alarm signal)
The alarm signal ALM is set to 1 if the signal line for the count pulse or the marker signal is disconnected or short-circuited.
ALM is also set to 1 when the watch dog alarm is activated.

(2) PMC outputs (outputs from PMC)

(a) SELECT (selection signal)
The SELECT signal selects the register in which data will be set. That is, the signal specifies the register for presetting data. The SELECT signal should be set when or before the PRS signal is reversed.

(b) PRS (preset signal)
The PRS signal presets data in registers. If data is set in DTOH, DTOM, and DTOL and then PRS is reversed, the data is set in the register specified by SELECT. Reversing the PRS signal means that PRS changes from level 0 to level 1 or vise versa.
DTOH, DTOM, DTOL, and SELECT should not be changed within two scans after the PRS is reversed. Also, the PRS must not reversed again within this period.
When SELECT=1, data is set in both the counter preset register and the counter.
Data is set by setting the first PRS to 1 after power-on or after the mode changes to B.

(c) CE (count enable signal)
The CE signal determines whether the counter counts. When the CE is set to 1 and the external input signal CSP closes the contact, the counter retains its value, instead of counting. When CE = 1 and the CSP external input contact is open, the counter counts input pulses. Presetting the counter requires maintaining CE = 0.

(d) MS (marker synchronization signal)
The MS signal determines whether marker synchronization is provided. When the MS is 1 and the contact of external input signal ME is closed, the counter is preset to the value in the counter preset register at the rising edge of the first marker signal.
For mode A, after presetting:
<1> Set MS bit (0 → 1) again, or
<2> Reset MHR bit (1 → 0).
When either of the above conditions is satisfied, marker synchronization is established again.
(Note that item <2> is unusable for mode B.)

(e) MHR (marker hold reset signal, only in mode A)
The MHR signal resets the marker hold (MH) signal which is output to the PMC. The MHR is set to 1 to reset the marker hold signal.

(f) CMA, CMB, and CMC (comparison mode signals A, B, and C, only in mode A)

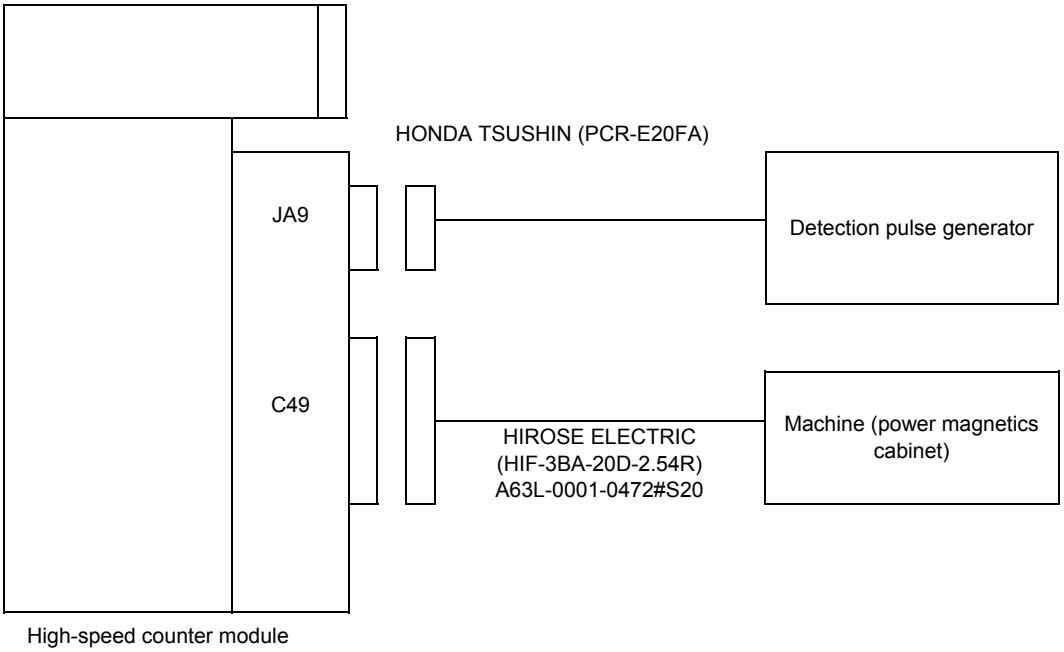
The CMA, CMB, and CMC signals specify the levels of the comparison outputs A, B, and C (CMPA, CMPB, and CMPC), respectively.

When CMA, CMB, and CMC are 0, and the value of the counter is larger than the values in comparison registers A, B, and C, CMPA, CMPB, and CMPC are set to 0.

When CMA, CMB, and CMC are 1, and the value of the counter is equal to or less than the values in comparison registers A, B, and C, CMPA, CMPB, and CMPC are set to 1.

8.4 TOTAL CONNECTION OF HIGH-SPEED COUNTER MODULE

8.4.1 Connection Diagram



8.4.2 Connector Signal List

JA9

		10				20	+5V
9	+5V	8	PSEL	19		18	+5V
7	LGND	6	*MKS	17		16	LGND
5	MKS	4	*PBS	18		14	LGND
3	PBS	2	*PAS	13		12	LGND
1	PAS			11			

PAS : Phase A pulse input signal (Negative pulse input signal) (positive)
*PAS : Phase A pulse input signal (Negative pulse input signal) (negative)
PBS : Phase B pulse input signal (Positive pulse input signal) (positive)
*PBS : Phase B pulse input signal (Positive pulse input signal) (negative)
MKS : Marker signal (positive)
*MKS : Marker signal (negative)
PSEL : Pulse select signal
+5V : 5V (output from this module)
LGND : 0V

8.4.2.1 C49 signal (for mode A)

C49

	A	B
01	ME	
02	CSP	
03	COM1	
04		
05		
06	CMP A	
07	CMP B	
08	CMP C	
09		
10	COM2	

ME : Marker enable signal input
CSP : Counter stop signal input
CMP A : Comparison result output
CMP B : Comparison result output
CMP C : Comparison result output
COM1 : Common signal for ME and CSP
COM2 : Common signal for comparison result output CMP A to comparison result output CMP C

8.4.2.2 C49 signal (for mode B)

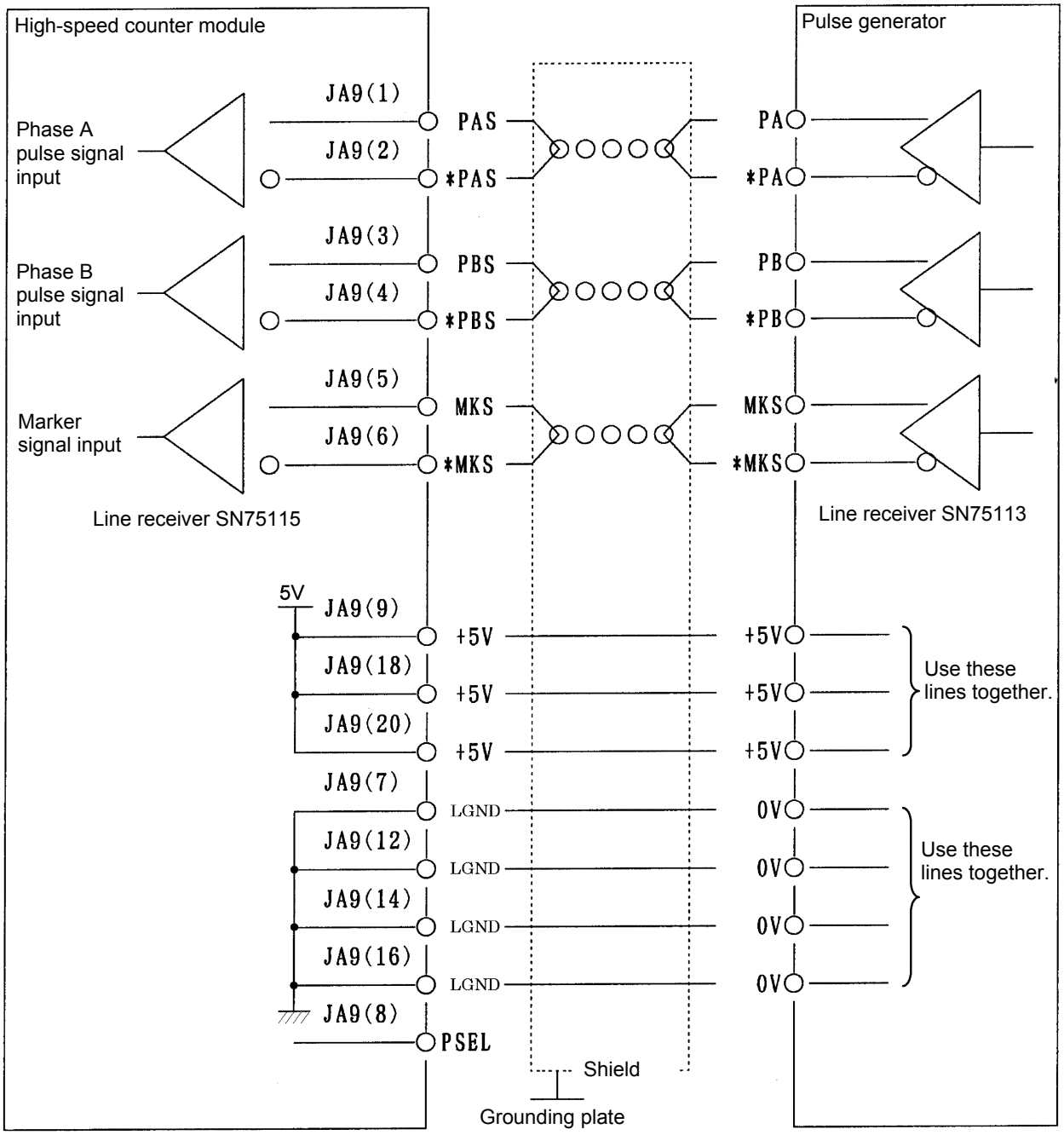
C49

	A	B
01	ME	
02	CSP	
03	COM1	
04		
05		
06	OUT0	OUT4
07	OUT1	OUT5
08	OUT2	OUT6
09	OUT3	OUT7
10	COM2	COM3

ME : Marker enable signal input
CSP : Counter stop signal input
OUT0 : Comparison result output
OUT1 : Comparison result output
OUT2 : Comparison result output
OUT3 : Comparison result output
OUT4 : Comparison result output
OUT5 : Comparison result output
OUT6 : Comparison result output
OUT7 : Comparison result output
COM1 : Common signal for ME and CSP
COM2 : Common signal for comparison result output 0 to comparison result output 3
COM3 : Common signal for comparison result output 4 to comparison result output 7

8.5 CONNECTION WITH PULSE GENERATOR

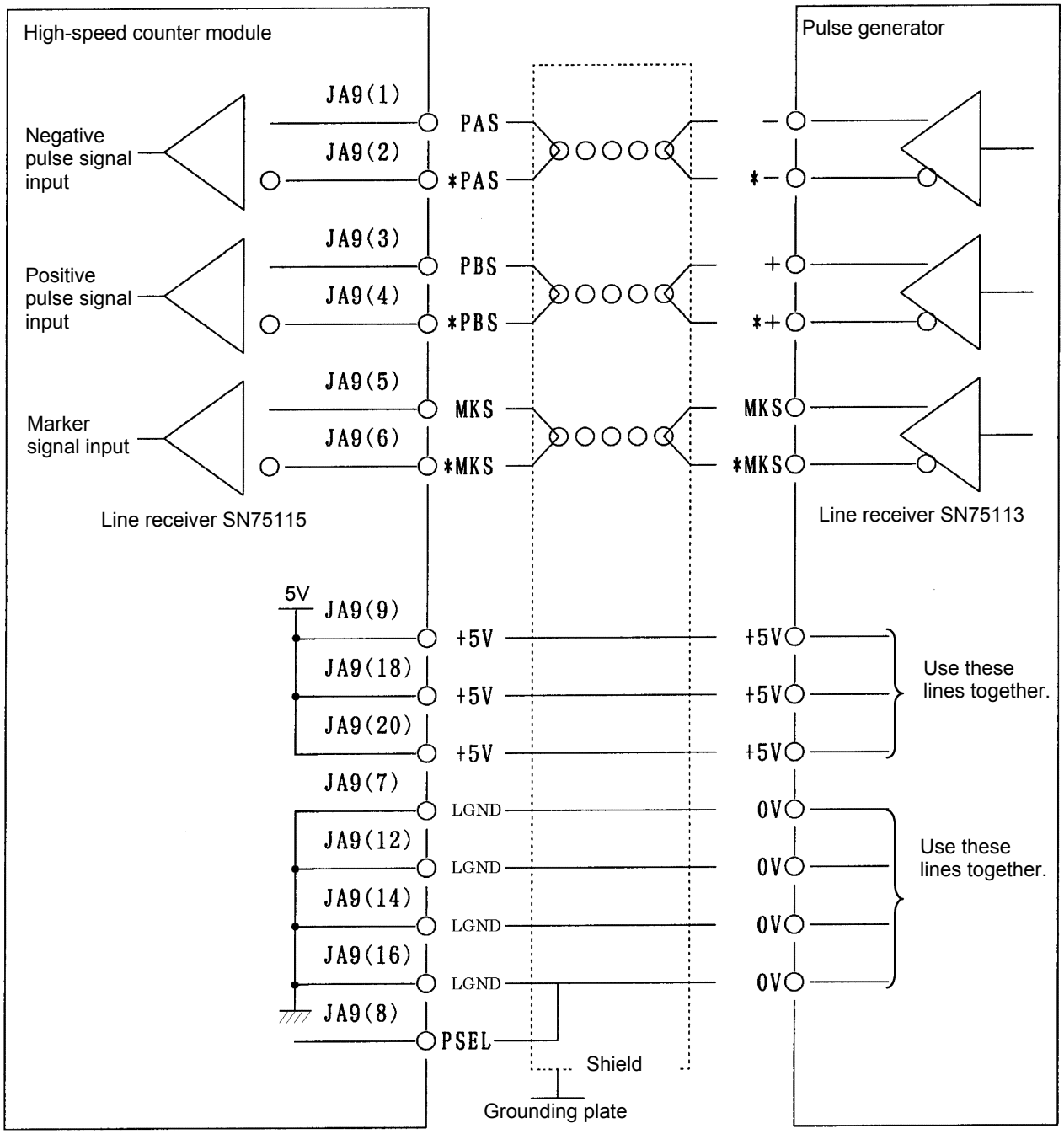
8.5.1 Use of Phase A and B Pulses



(*) The maximum current rating for each 5-V output is 300 mA.

Recommended cable
A66L-0001-0286 (#20AWG×7, #24AWG×3 Pairs)

8.5.2 Use of Positive/Negative Pulses

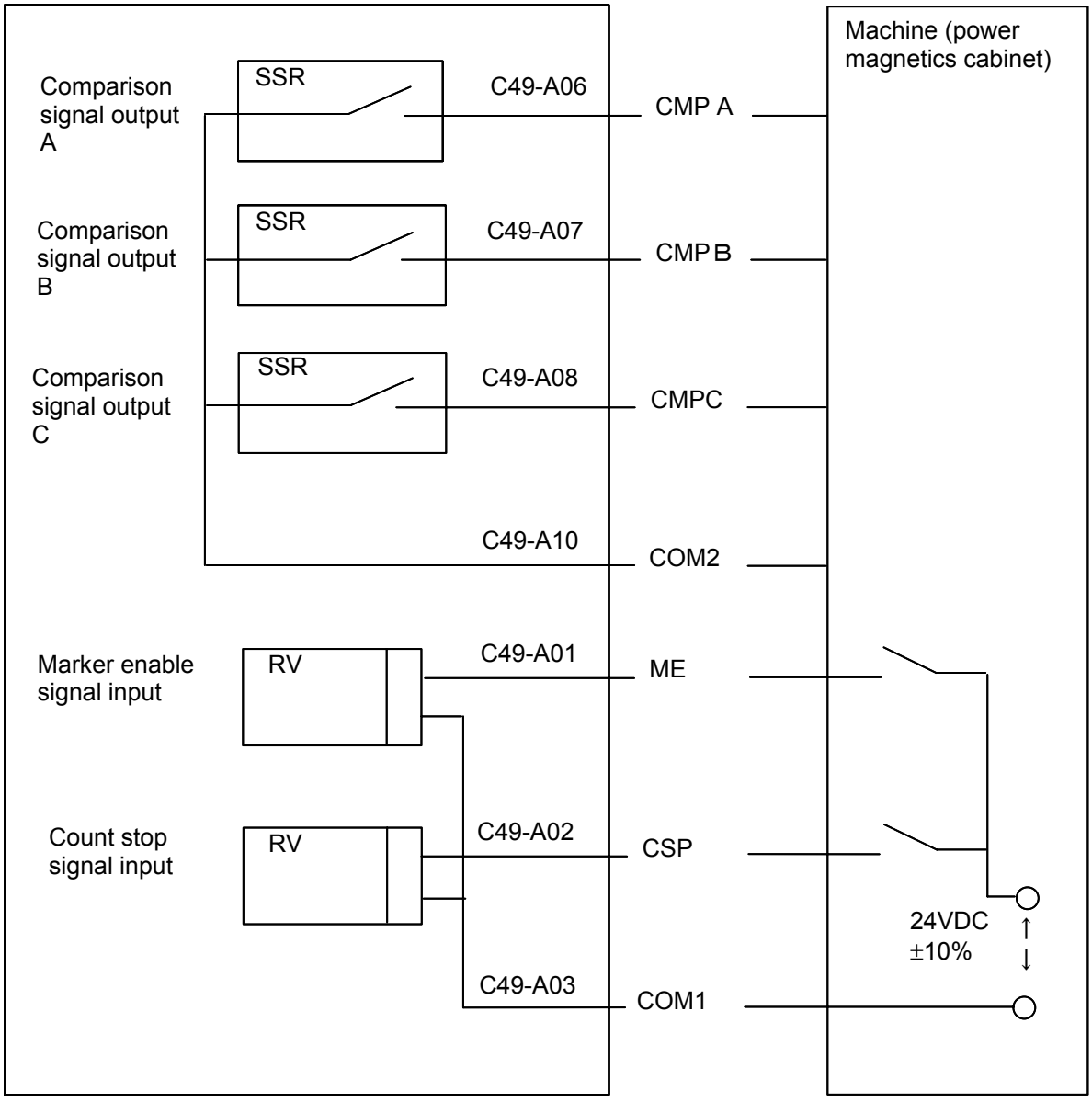


(*) The maximum current rating for each 5-V output is 300 mA.

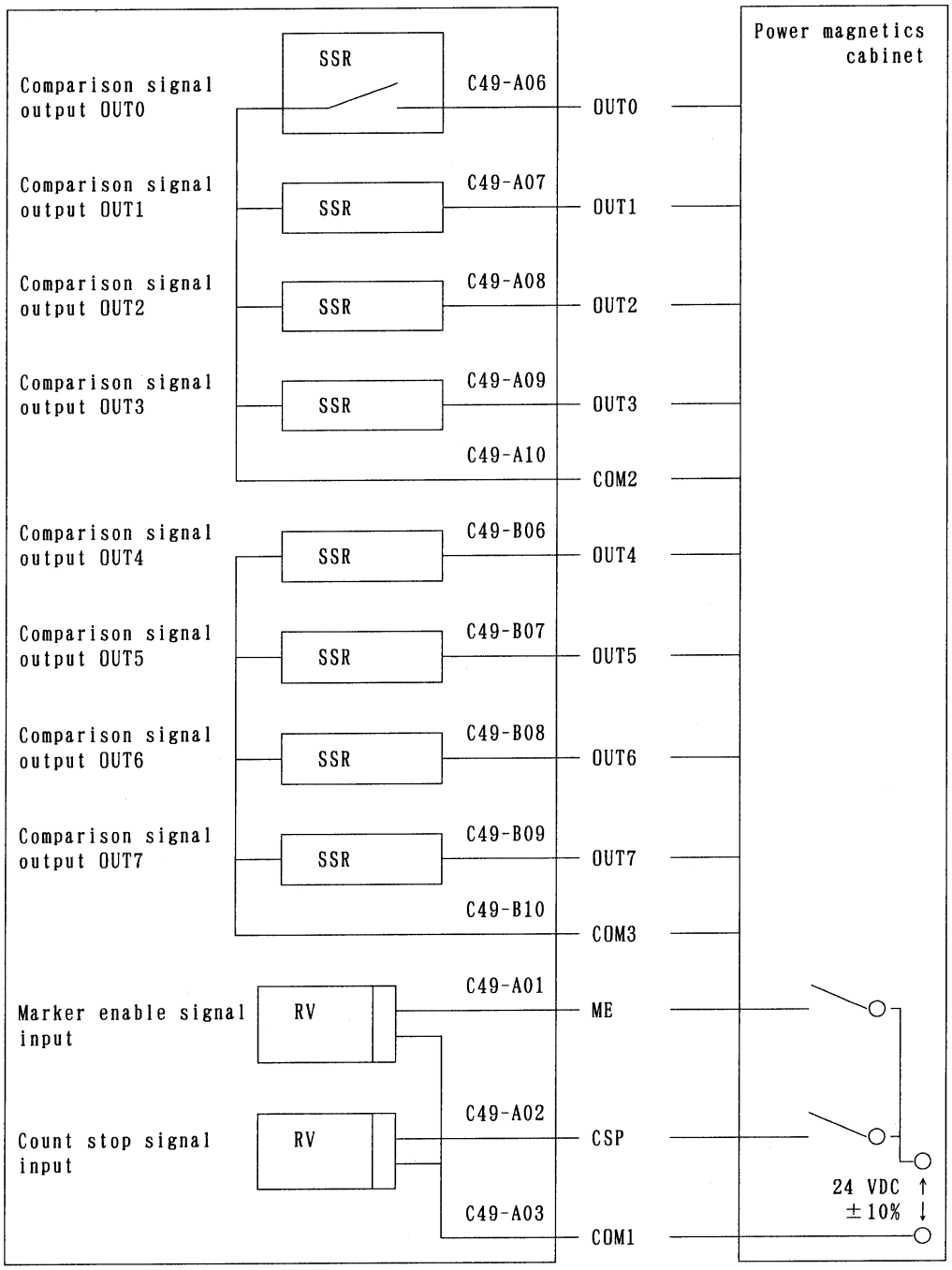
Recommended cable
A66L-0001-0286 (#20AWG×8, #24AWG×3 Pairs)

8.6 CONNECTION WITH MACHINE (POWER MAGNETICS CABINET)

8.6.1 Use in Mode A



8.6.2 Use in Mode B



8.7 I/O SIGNALS CONVENTIONS

8.7.1 Solid State Relay Output Signals (OUT0 to OUT7)

The solid state relay output signals drive relays in the machine (power magnetics cabinet) side and indicator LEDs.

(1) Solid state relays

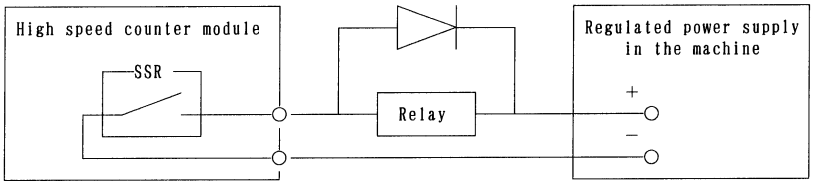
(a) Maximum load current at output-on
250 mA: Up to three outputs set to on
125 mA: Eight outputs set to on

(b) Saturation voltage at output-on
Not more than 6 × IL [V] (IL: load current)

(c) Withstand voltage at output-off
30 VDC max. even for instantaneous voltage

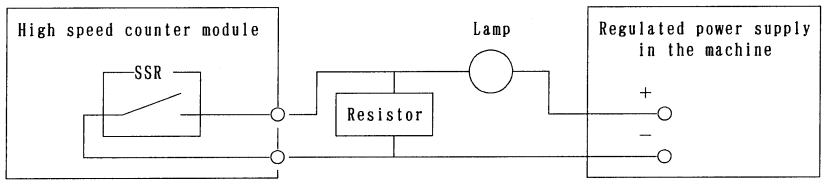
(d) Leak current at output-off
Not more than 100μA

(2) Output circuit



(3) Always install spark arresters when inductive loads such as relays are connected in the machine. Insert the spark arresters as near the load as possible (less than 20 cm). When capacitive loads are used in the machine, insert current limiting resistors in series with the loads to prevent the instantaneous current and voltage from exceeding the rated values.

(4) If a lamp is turned on by a solid state relay output, the resulting surge current may damage the solid state relay. Thus, as shown in the figure below, provide a protective resistor to prevent the instantaneous current and voltage from exceeding the rated values.



8.7.2 DC Input Signals (ME and CSP)

The DC input signals (such as relay contact signal) are sent from the machine (control circuit) to the pulse counter module.

(1) Input conditions
On voltage and current: 15 VDC or more, 4.5 mA or more
Off voltage and current: 6 VDC or less, 2 mA or less
Response time: 20 ms or less

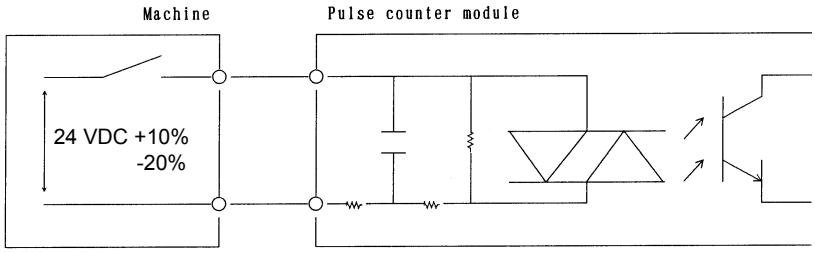
(2) Voltage and polarity
Voltage : 24 VDC +10%, -20%
Polarity : Positive or negative polarity available (The power is not supplied from the pulse counter module.)

(3) Logical correspondence

Contact	Logic
Open	0
Closed	1

(4) Receiver circuit of DC input signal

Machine Pulse counter module



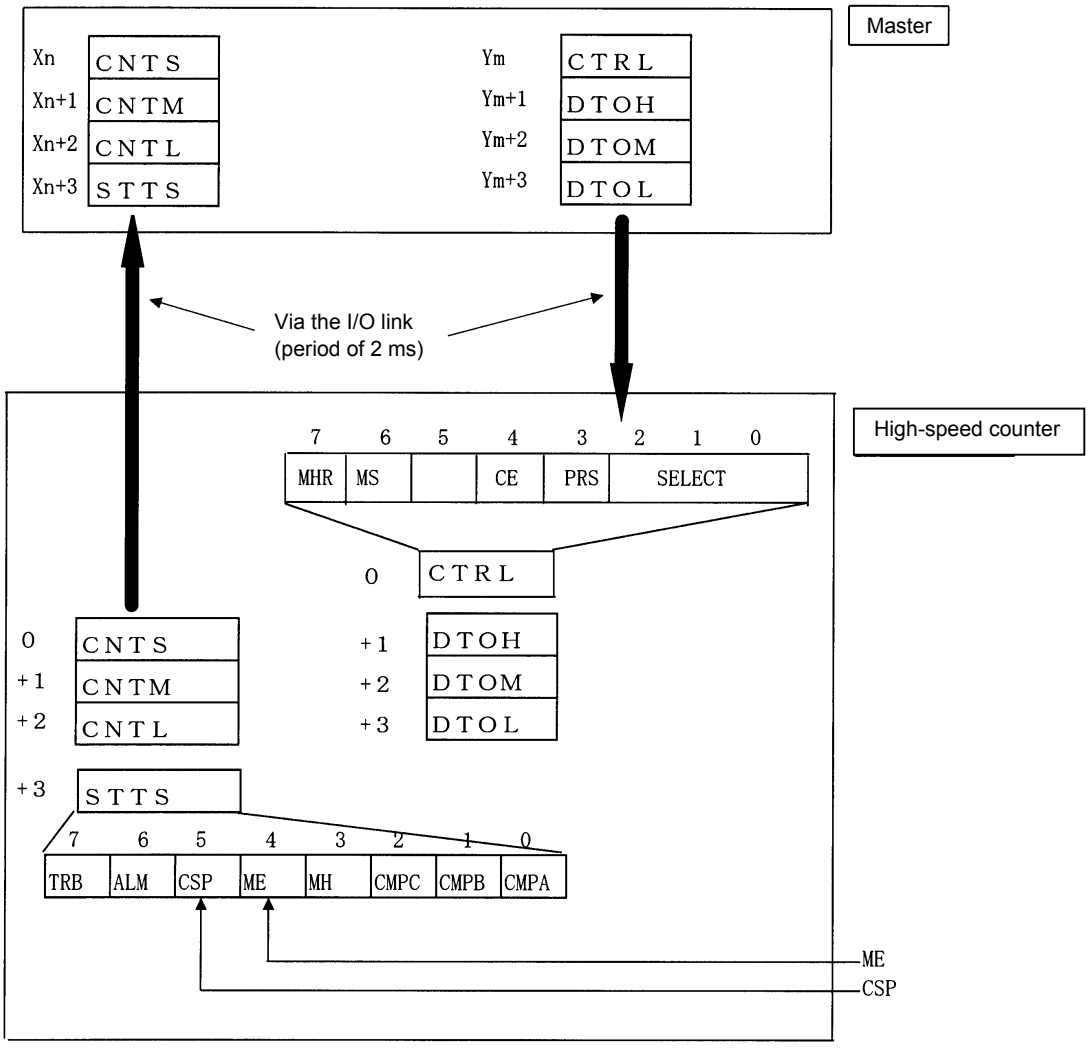
8.7.3 +5-V Output from JA9 Connector

- A voltage of +5 V on the JA9 connector of this module is the output of the counter module (300 mA maximum).
  It is necessary to satisfy Table 4.4 in Section 4.4, "Required Current", though.
  Example: Assuming that 100 mA is supplied from the +5-V pin of the JA9 connector:
  $170 + 0.3 \times 100 = 200$
  Thus, the required current is 200 mA.

8.8 SUPPLEMENT

8.8.1 Configuration of Mode A

How mode A is configured is shown below. The contents of the CNTS, CNTM, CNTL, and STTS on a high-speed counter module are sent to the X area assigned on the master via the I/O link. The contents of the Y area assigned on the master are sent to CTRL, DTOH, DTOM, and DTOL on the high-speed counter module, via the I/O link.



8.8.2 Counter Presetting and Counting

(1) Presetting a counter value (using the external signal MKS)
To preset a counter value, using the MKS signal, follow this procedure:
(a) Reset the MH (marker hold) signal.
(b) Preset a value in the counter at the rising edge of the MKS signal.
The MH signal is set at the same time the counter is preset with data.

(a) Resetting the MH signal
For mode A, both methods, (i) and (ii), are usable. For mode B, method (ii) is usable.
(i) Resetting the MS bit (bit 6) of the CTRL (control) register to 0..... Control example 1
(ii) Setting the MHR bit (bit 7) of the CTRL register to 1 ..... Control example 2

	Condition				Status	
	MHR of CTRL	**MS of CTRL**	**ME of external signal**	**MKS of external signal**	**ME of STTS**	**MH of STTS**
(i)	×	0	×	×	×	Changes to 0.
(ii)	1	×	×	×	×	Changes to 0.

- The cross × in the above table means that the corresponding bit can be either 0 or 1. (The ME bit of the STTS register corresponds to the state of the external signal ME.)

(b) Presetting a counter value
For both methods, (i) and (ii), the presetting is completed within 100 μs after the MKS has arisen.

	Condition				Status	
	MHR of CTRL	**MS of CTRL**	**ME of external signal**	**MKS of external signal**	**ME of STTS**	**MH of STTS**
(i), (ii)	0	1	Contact "Closed"	First ↑ state	1	1

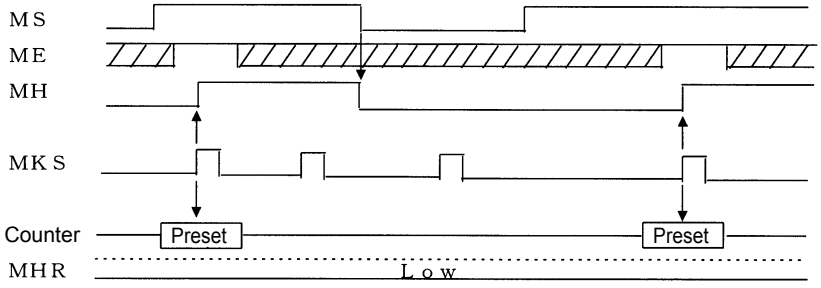
- Contact "Closed" in the above table means that 24 V is applied to the ME pin.

(2) Presetting a counter value (operating the PRS bit by ladder)
<1> Load the 3 low-order CTRL bits (SELECT) with 001 by ladder.
<2> Preset the DTOH, DTOM, and DTOL by ladder.
<3> Invert the PRS bit by ladder.
(If the PRS is 0, set it to 1. If it is 1, reset it to 0.)

NOTE
1 Once the PRS bit has been inverted, do not change the content of the DTOH, DTOM, DTOL, or CTRL within the period of two ladder cycle scans.
Also do not invert the PRS bit again within the same period.
2 It takes about 5 ms for the counter to be preset since the inversion of the PRS bit.

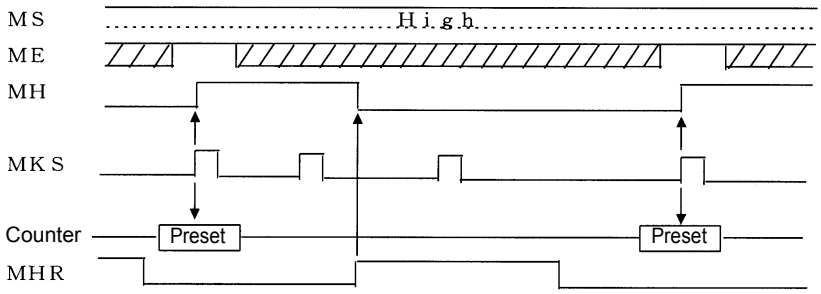
Control example 1:

(Hatching ▨ means that the bit can be either 0 or 1.)



Control example 2:

(Hatching ▨ means that the bit can be either 0 or 1.)



(3) Count

The following table lists the conditions for counting by this module.

	Condition			Status
	CE of CTRL	CSP of external signal	PSEL of external signal	CSP of STTS
Count (A/B phase pulse)	1	Contact "Open"	Open	Reset to 0.
Count (+/- pulse)	1	Contact "Open"	Connected to 0 V	Reset to 0.

- Contact "Open" in the above table means that the CSP pin is open (0 or NEG).

NOTE
The count value does not become negative. The highest-order bit of the CNTS register is the TRA bit (see Subsection 8.8.4).
Count-down: +1(00 0001H)→0(00 0000H)→+8,388,607(7F FFFFH)→+8,388,606(7F FFFEH)

(4) Stopping counting
The following table lists the condition for this module to stop counting.

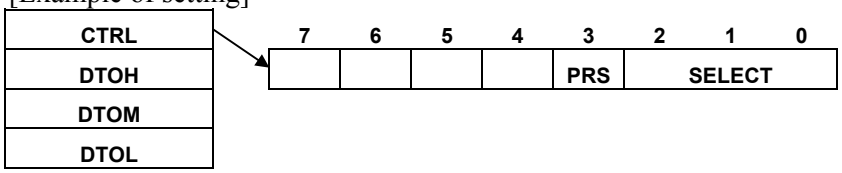
	Condition			Status
	CE of CTRL	**CSP of external signal**	**PSEL of external signal**	**CSP of STTS**
Count stop method 1	0	×	×	×
Count stop method 2	×	Contact "Closed"	×	Reset to 1.

- Contact "Closed" in the above table means that 24 V is applied to the CSP pin (1 or POS).
- The cross × in the above table means that the corresponding bit can be either 0 or 1.
  (The × state of the CSP pin of the STTS register corresponds to the state of the external signal CSP.)

8.8.3 Setting Data

Data for some models (such as the FS15 and FS18) is in the opposite order to that of the NC data. In this case, convert (rearrange) the data in byte units.

[Example of setting]



Example 1 :

To preset the counter preset register with a specific value (the counter is also set to preset value), follow the steps below.

(1) Preset the DTOH, DTOM, and DTOL with a desired value.
(2) Set SELECT to 001.
(3) Reverse the setting of the PRS (from 0 to 1 or from 1 to 0).
(4) Wait for two scanning periods.

- Another method for presetting the counter is to use the MKS external signal (see Subsection 8.8.2). It takes a maximum of 5 ms to preset using the first method, while it takes only a maximum of 100 μs to preset using the MKS external signal.

Example 2 :

To set the comparison control register with the setting (0 or 1) of CMA, CMB, and CMC, follow the steps below.

(1) Set DTOH bits 0, 1, and 2 to the desired data.
(2) Set SELECT to 000.
(3) Reverse the setting of the PRS (from 0 to 1 or from 1 to 0).
(4) Wait for two scanning periods.

Example 3 :

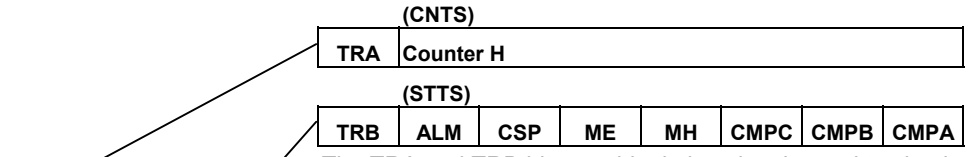
To set comparison register B to a desired comparison value, follow the steps below.

(1) Set DTOH, DTOM, and DTOL to the desired comparison value.
(2) Set SELECT to 011.
(3) Reverse the setting of the PRS (from 0 to 1 or from 1 to 0).
(4) Wait for two scanning periods.

The result of comparing comparison registers A, B, and C with the pulse counter is output via OUT0 to OUT2 of connector C49 of this counter module (A → OUT0, B → OUT1, and C → OUT2).
Their output status is output via OUT0 to OUT2 of the LED indication panel (A → OUT0, B → OUT1, and C → OUT2).
The result of comparison can be confirmed by checking STTS bits 0, 1, and 2 (CMPA, CMPB, and CMPC) with the PMC.

8.8.4 Reading Data

The CNTS and STTS are two of the four input bytes. The most significant bit, TRA, of the CNTS and the most significant bit, TRB, of the STTS can be used to determine whether the count data is correct. **If both TRA and TRB are 0 or 1, the count data is correct.** The time during which the TRA and TRB bits have a different value from each other is abut 2 msec.
In almost all cases, both TRA and TRB will be 0 or 1 when you view the diagnostic display. (Do not determine that the data has not changed because of the fact that the TRA and TRB do not become 0 or 1 alternately.) **Note that the count data does not take a negative value**.



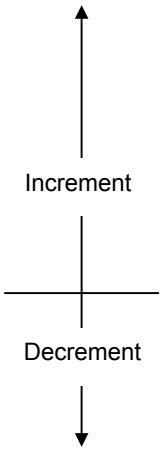
TRA	TRB	Validity
0	0	Correct
0	1	Incorrect
1	0	Incorrect
1	1	Correct

The TRA and TRB bits provide timing signals used to check count data. The count data is 3 bytes. After sent to the host via the I/O Link, its 2 bytes (CNTS and CNTM bytes) are first written to memory. If the count data is accessed at this moment, it does not represent a true value because the CNTL remains in the previous state. Both the TRA and TRB bits become 0 or 1 only after all 4 bytes (3 count data bytes + 1 STTS byte) are written to memory.

The counter assumes the following data when it is incremented or decremented.

Contents of [CNTS CNTM CNTL]

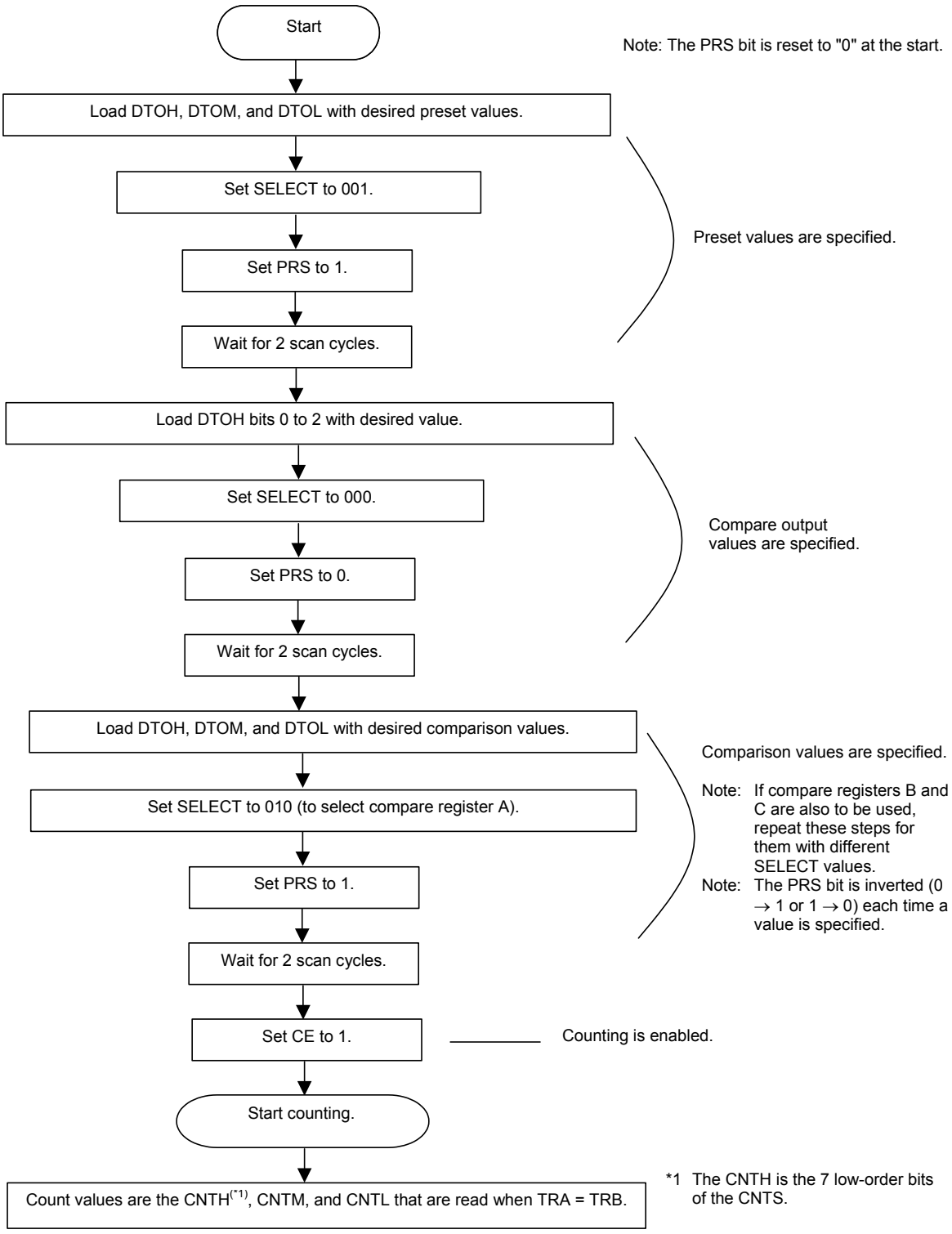
□ 0000000 00000000 00000010
□ 0000000 00000000 00000001
□ 0000000 00000000 00000000
□ 1111111 11111111 11111111
to
□ 0000000 00000000 00000011
□ 0000000 00000000 00000010
□ 0000000 00000000 00000001
□ 0000000 00000000 00000000
□ 1111111 11111111 11111111
□ 1111111 11111111 11111110
□ 1111111 11111111 11111101
□ 1111111 11111111 11111100



The square □represents the TRA. (The most significant bit is the TRA. It is not a sign bit.)

8.9 EXAMPLE OF STARTING UP ACT01A

8.9.1 Mode A Startup Flowchart



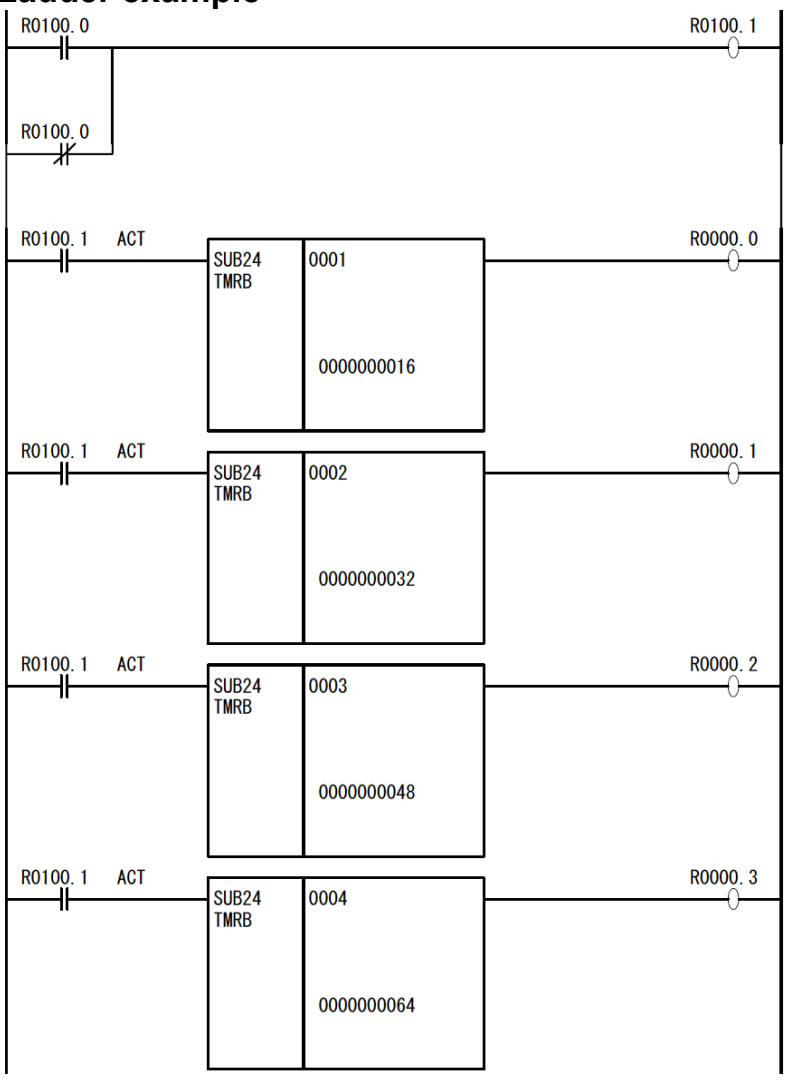
8.9.2 Example of Mode A Ladder

Allotment

Address	Group	Base	Slot	Module name	Address	Group	Base	Slot	Module name
X0000					Y0000	0	0	01	/2
X0001					Y0001	0	0	01	/2
X0002					Y0002	0	0	02	/2
X0003					Y0003	0	0	02	/2
X0004					Y0004				
X0005					Y0005				
X0006					Y0006				
X0007					Y0007				
X0008					Y0008				
X0009					Y0009				
X0010	0	0	05	/4	Y0010	0	0	05	/4
X0011	0	0	05	/4	Y0011	0	0	05	/4
X0012	0	0	05	/4	Y0012	0	0	05	/4
X0013	0	0	05	/4	Y0013	0	0	05	/4
X0014					Y0014				
X0015					Y0015				

The ACT01A is allocated to X0010 to X0013 and Y0010 to Y0013. Y0000 to Y0003 are the addresses used to confirm count values.

Ladder example



R0100.1 is used as a normally ON coil.

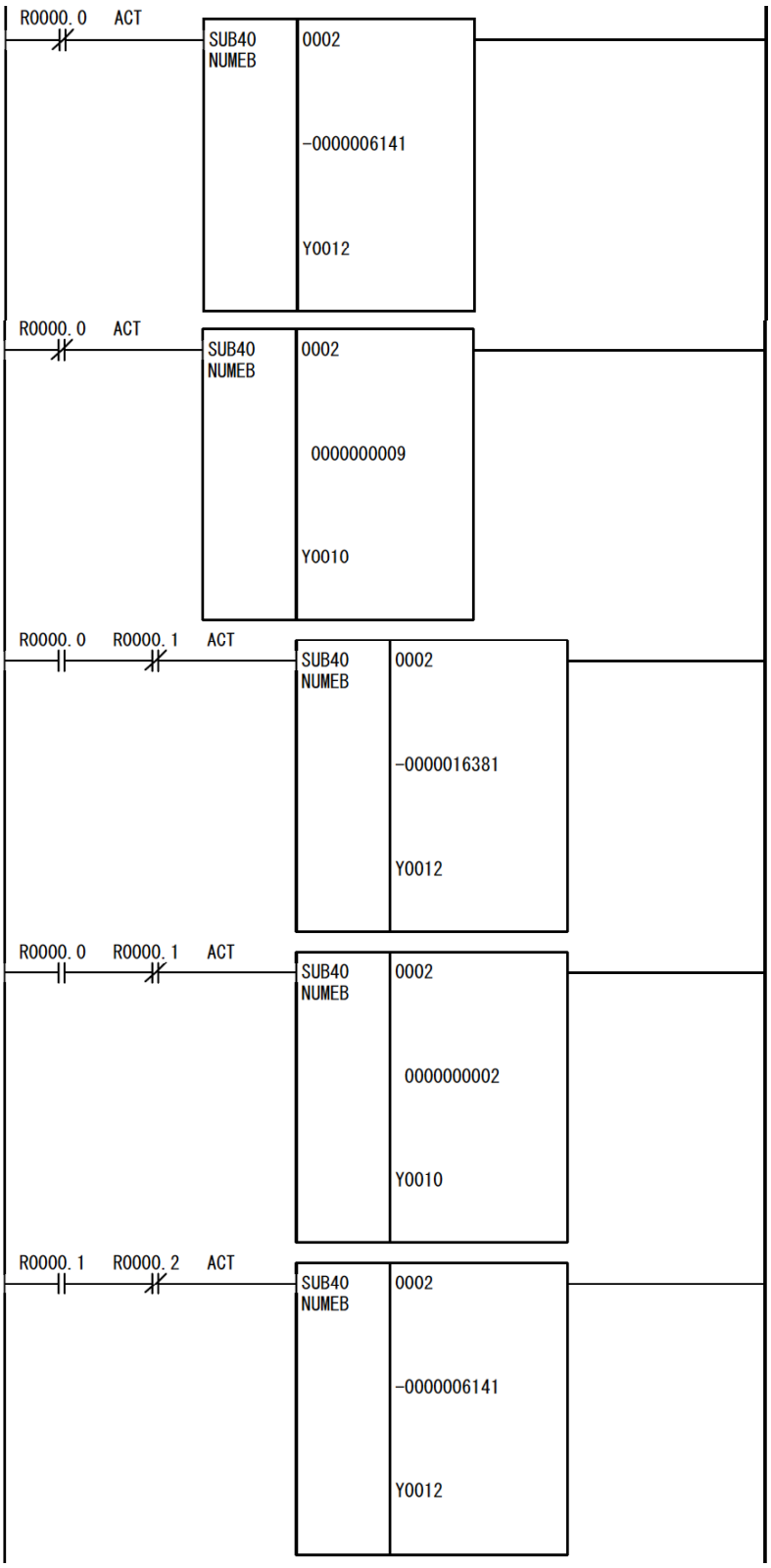
The timer is used to generate a timing signal at intervals of 16 ms (2 scan cycles).

R0000.0 is turned on 16 ms (2 scan cycles) after RUN.

R0000.1 is turned on 32 ms (4 scan cycles) after RUN.

R0000.2 is turned on 48 ms (6 scan cycles) after RUN.

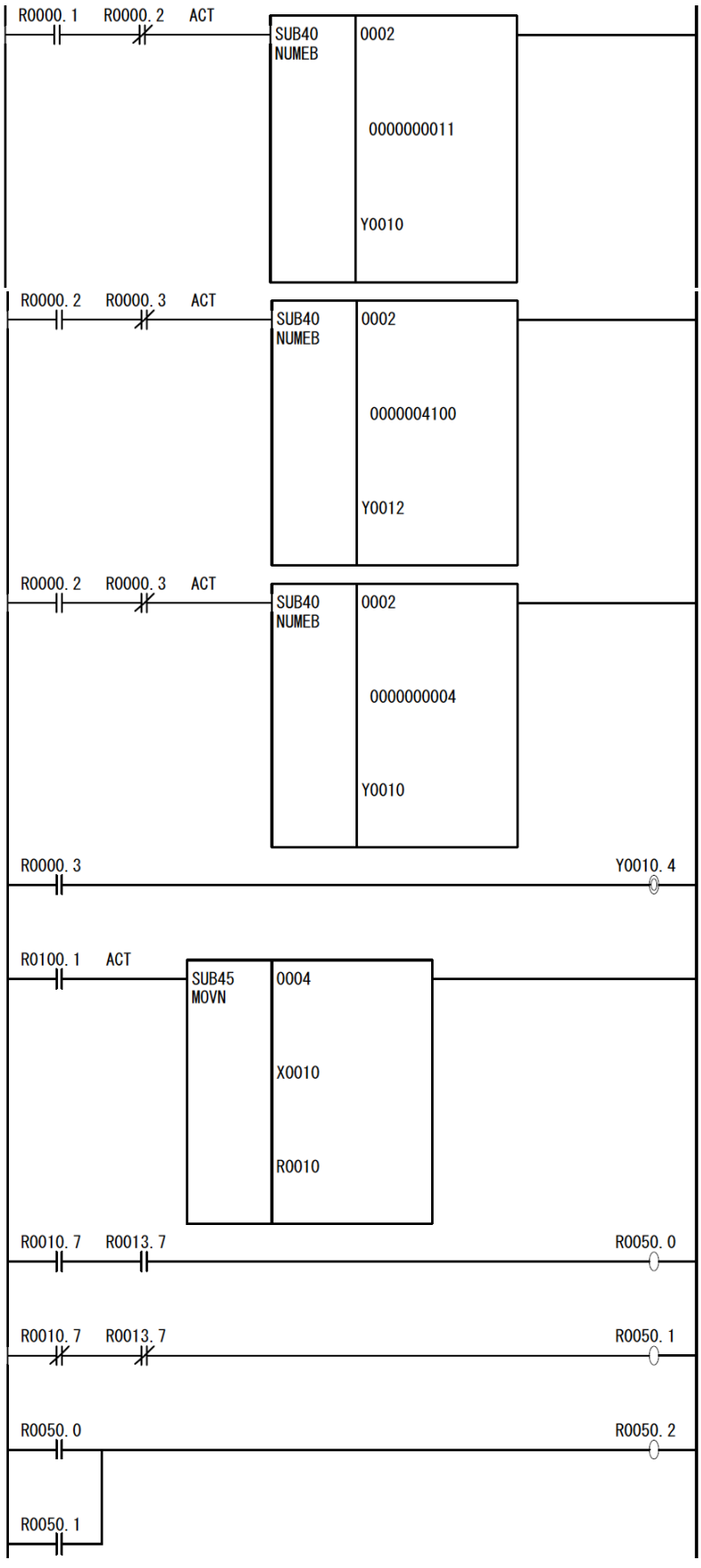
R0000.3 is turned on 64 ms (8 scan cycles) after RUN.



A preset value is specified right after RUN.
A preset value of +1000 is used here.
If +1000 → 0003E8h, the following are written:
Y0011: DTOH ← 00h
Y0012: DTOM ← 03h
Y0013: DTOL ← E8h
If Y0012 to Y0013 have 1-word data, E803h → -6141 is written.
In addition, if SELECT = 001 and PRS = 1, Y0010:00001001 is set to 9 (Y0011 is 0).

Compare register A is loaded with a comparison value 2 scan cycles after RUN.
A preset value of +960 is used here.
If +960 → 0003C0h, the following are written:
Y0011: DTOH ← 00h
Y0012: DTOM ← 03h
Y0013: DTOL ← C0h
If Y0012 to Y0013 have 1-word data, C003h → -16381 is written.
In addition, if SELECT = 010 and PRS = 0, Y0010:00000010 is set to 2 (Y0011 is 0).

Compare register B is loaded with a comparison value 4 scan cycles after RUN.
A preset value of +1000 is used here.
If +1000 → 0003E8h, the following are written:
Y0011: DTOH ← 00h
Y0012: DTOM ← 03h
Y0013: DTOL ← E8h
If Y0012 to Y0013 have 1-word data, E803h → -6141 is written.



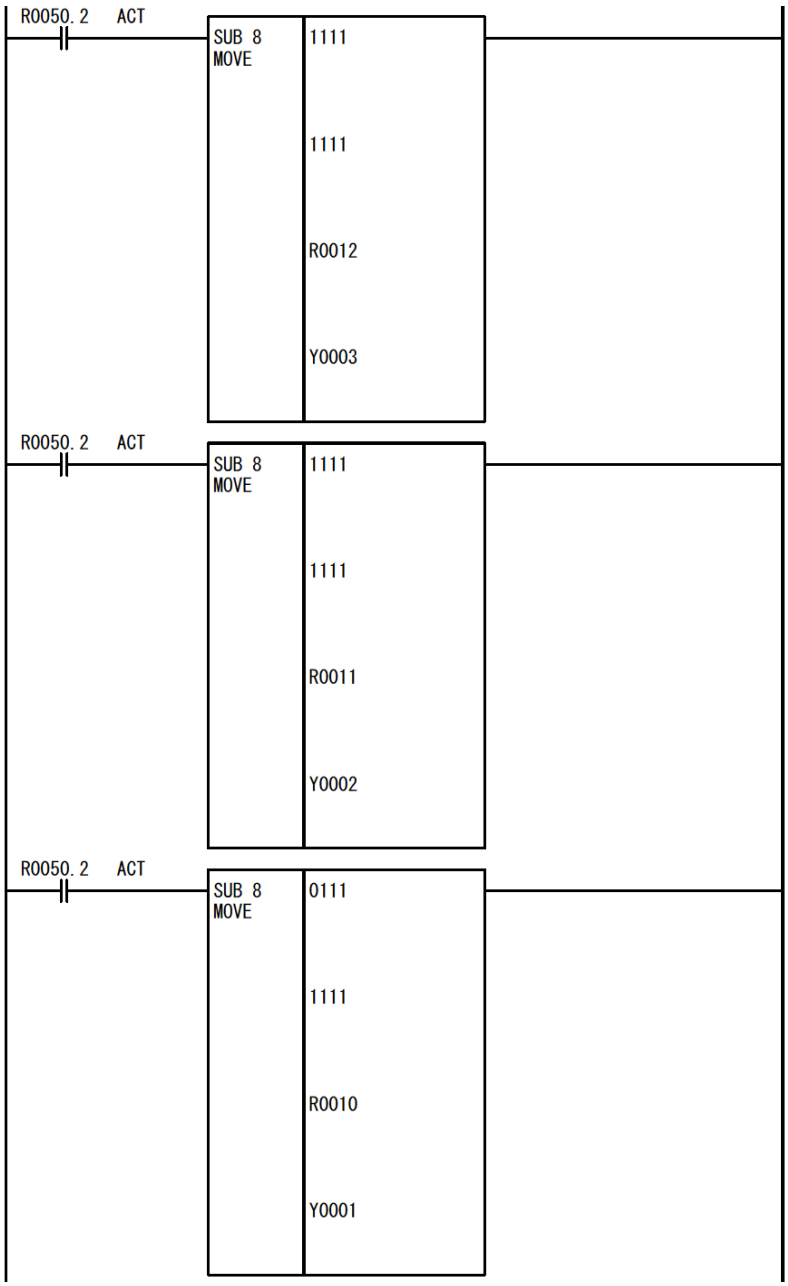
In addition, if SELECT = 011 and PRS = 1, Y0010:00001011 is set to 11 (Y0011 is 0).

Compare register C is loaded with a comparison value 6 scan cycles after RUN.
A preset value of +1040 is used here.
If +1040 → 000410h, the following are written:
Y0011: DTOH ← 00h
Y0012: DTOM ← 04h
Y0013: DTOL ← 10h
If Y0012 to Y0013 have 1-word data, 1004h → +4100 is written.
In addition, if SELECT = 100 and PRS = 0, Y0010:00000100 is set to 4 (Y0011 is 0).

The counter is enabled 8 scan cycles after RUN.

X0010 to X0013 are sent to R0010 to R0013 to maintain data consistency.

A timing signal indicating TRA = TRB is generated.
If TRA = TRB = 1 or TRA = TRB = 0, R50.2 becomes 1.

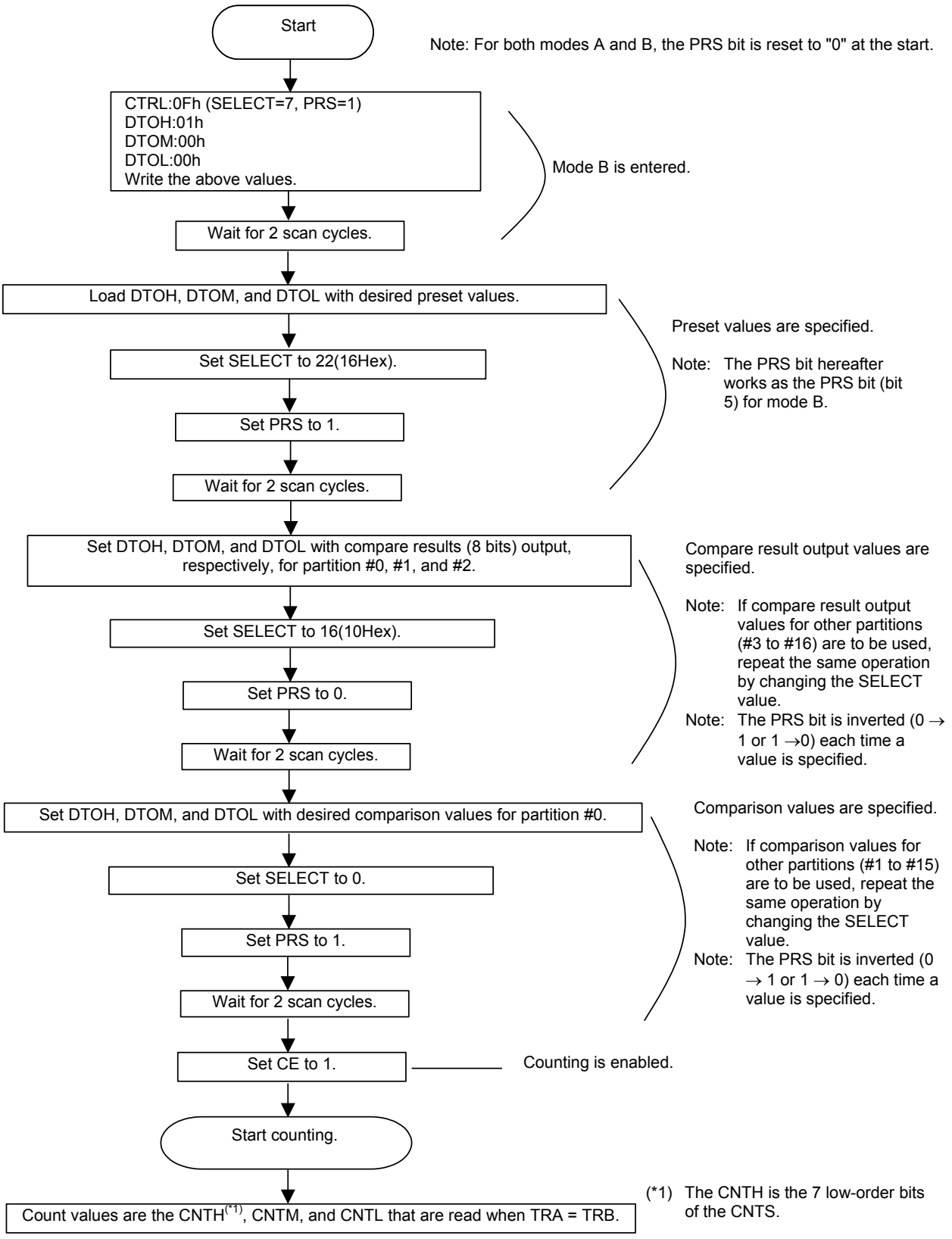


The counter value is output to Y0001 to Y0003 when TRA = TRB.
CNTH→Y0001
CNTM→Y0002
CNTL→Y0003
The highest-order bit (TRA) is masked because CNTH is 7-bit data.

NOTE

1 This sample ladder does not specify what the compare output is. To have it specify, perform the same operation as for setting the compare register by changing the SELECT value. Note that it is necessary to invert the PRS bit (0 → 1 or 1 → 0) each time a value is specified.
2 The compare output value and comparison value can be specified in any order until CE = 1 (counter enable).

8.9.3 Mode B Startup Flowchart



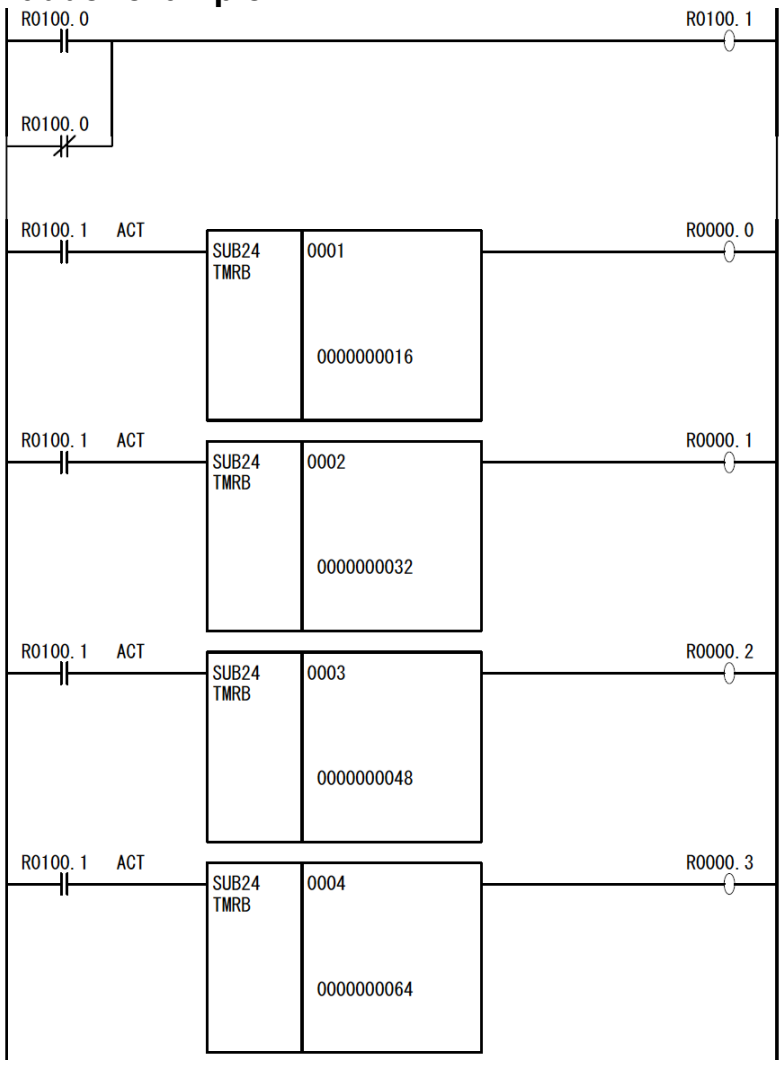
8.9.4 Example of Mode B Ladder

Allotment

Address	Group	Base	Slot	Module name	Address	Group	Base	Slot	Module name
X0000					Y0000	0	0	01	/2
X0001					Y0001	0	0	01	/2
X0002					Y0002	0	0	02	/2
X0003					Y0003	0	0	02	/2
X0004					Y0004				
X0005					Y0005				
X0006					Y0006				
X0007					Y0007				
X0008					Y0008				
X0009					Y0009				
X0010	0	0	05	/8	Y0010	0	0	05	/4
X0011	0	0	05	/8	Y0011	0	0	05	/4
X0012	0	0	05	/8	Y0012	0	0	05	/4
X0013	0	0	05	/8	Y0013	0	0	05	/4
X0014	0	0	05	/8	Y0014				
X0015	0	0	05	/8	Y0015				
X0016	0	0	05	/8	Y0016				
X0017	0	0	05	/8	Y0017				
X0018					Y0018				

The ACT01A is allocated to X0010 to X0017 and Y0010 to Y0013. Y0000 to Y0003 are the addresses used to confirm count values.

Ladder example



R0100.1 is used as a normally ON coil.

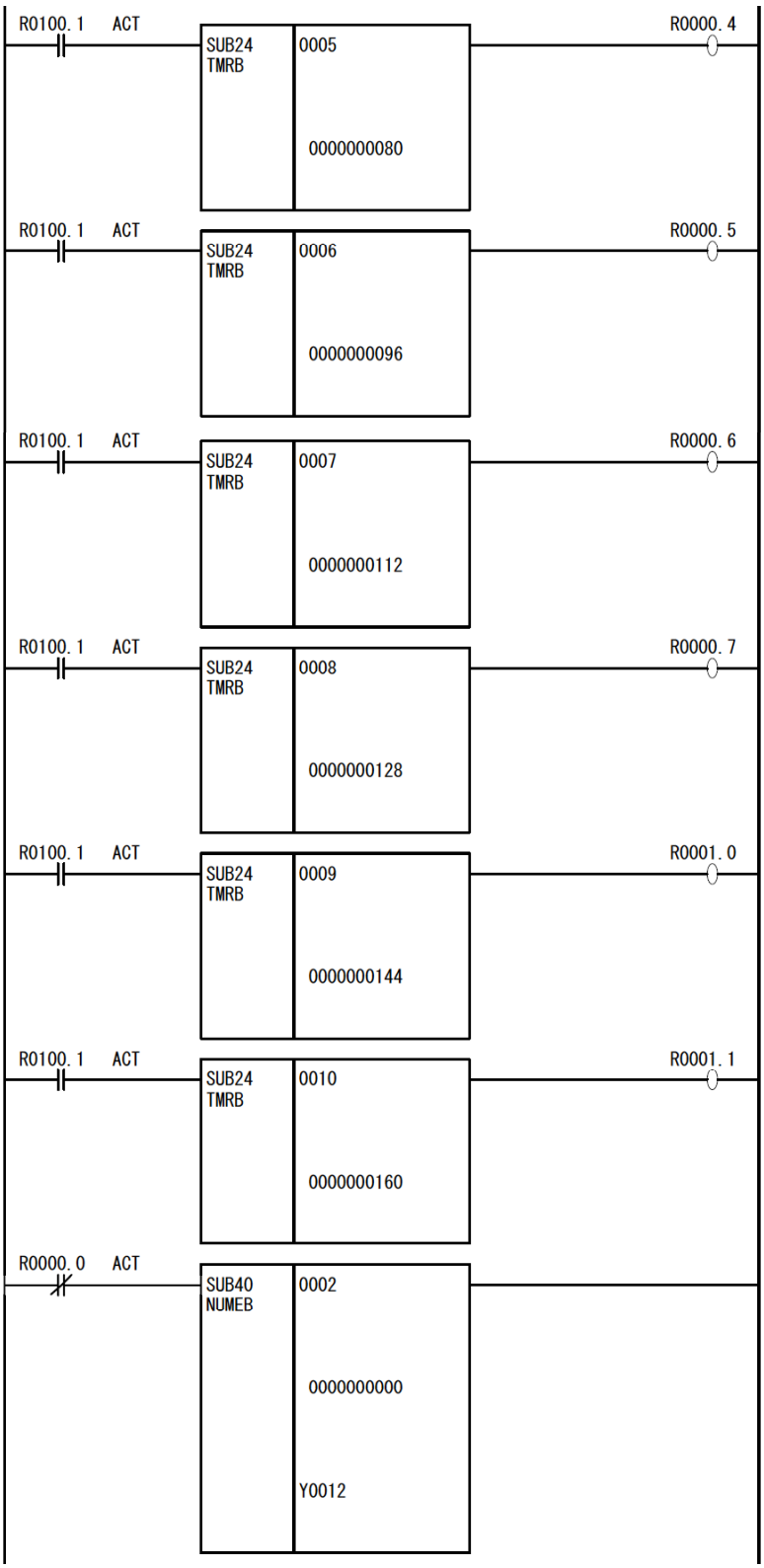
The timer is used to generate a timing signal at intervals of 16 ms (2 scan cycles).

R0000.0 is turned on 16 ms (2 scan cycles) after RUN.

R0000.1 is turned on 32 ms (4 scan cycles) after RUN.

R0000.2 is turned on 48 ms (6 scan cycles) after RUN.

R0000.3 is turned on 64 ms (8 scan cycles) after RUN.



R0000.4 is turned on 80 ms (10 scan cycles) after RUN.

R0000.5 is turned on 96 ms (12 scan cycles) after RUN.

R0000.6 is turned on 112 ms (14 scan cycles) after RUN.

R0000.7 is turned on 128 ms (16 scan cycles) after RUN.

R0001.0 is turned on 144 ms (18 scan cycles) after RUN.

R0001.1 is turned on 160 ms (20 scan cycles) after RUN.

Mode B is entered right after RUN.
The following are written:
CTRL: 0Fh (SELECT = 7 and PRS = 1)
DTOH: 01h
DTOM: 00h
DTOL: 00h

Continued from mode B writing

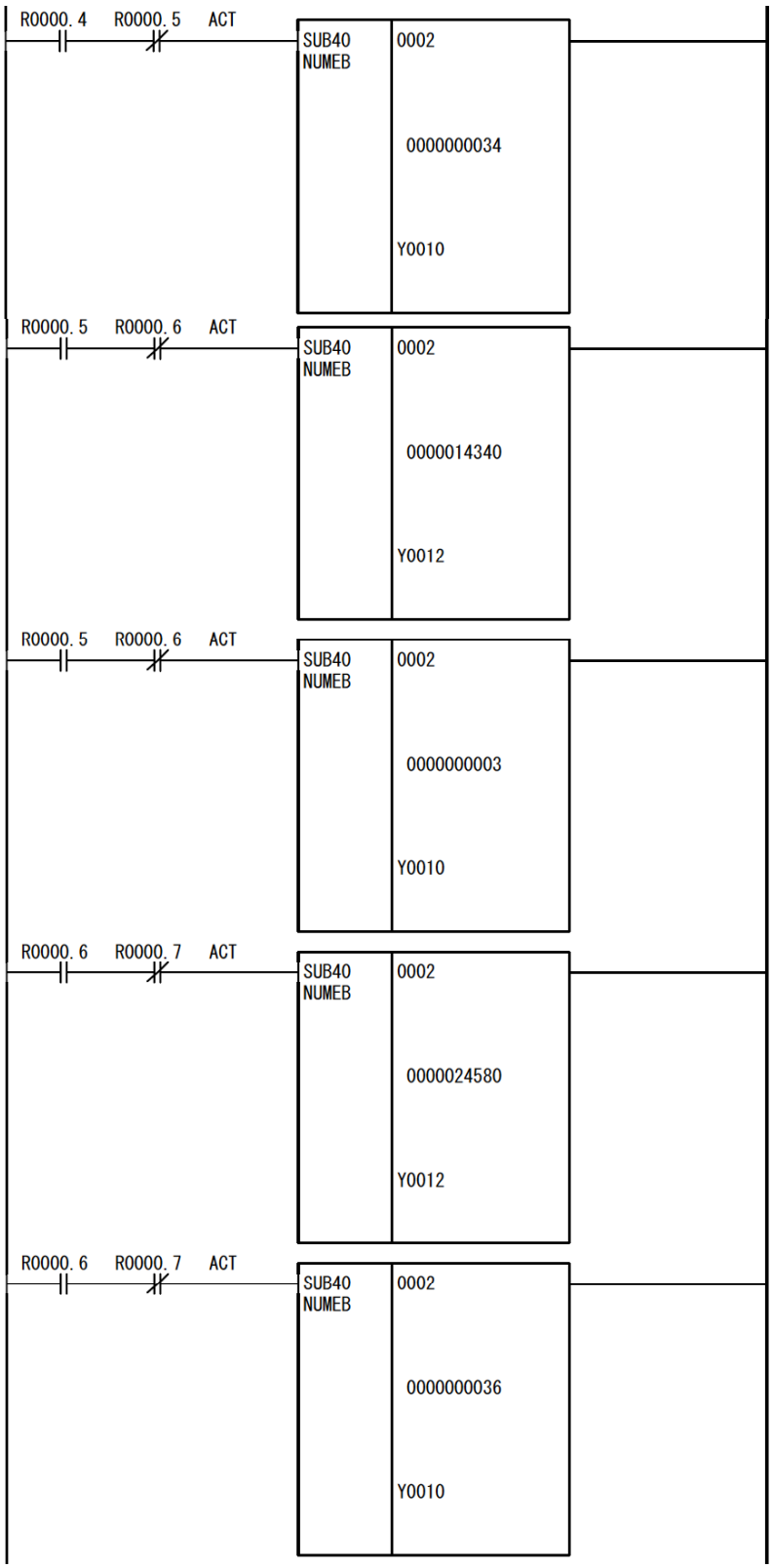
A preset value is specified 2 scan cycles after RUN.
A preset value of +1000 is used here.
If +1000 → 0003E8h, the following are written:
Y0011: DTOH ← 00h
Y0012: DTOM ← 03h
Y0013: DTOL ← E8h
If Y0012 to Y0013 have 1-word data, E803h → -6141 is written.
In addition, if SELECT = 22(16h) and PRS = 1, Y0010:00110110 is set to 36h → +54 (Y0011 is 0).

A comparison value for partition #0 is specified 4 scan cycles after RUN.
A comparison value of +960 is used here. (A range from 0 to +960 becomes partition #0.)
If +960 → 0003C0h, the following are written:
Y0011: DTOH ← 00h
Y0012: DTOM ← 03h
Y0013: DTOL ← C0h
If Y0012 to Y0013 have 1-word data, C003h → -16381 is written.
In addition, if SELECT = 0 and PRS = 0, Y0010 is set to 0 (Y0011 is 0).

An output value for partition #0 to #2 is specified 6 scan cycles after RUN.
To be specific, the following are output.
Partition #0: Y0011 ← 00h
Partition #1: Y0012 ← FFh
Partition #2: Y0013 ← 55h
If Y0012 to Y0013 have 1-word data, 55FFh → +22015 is written.
In addition, if SELECT = 16(10h) and PRS = 1, Y0010=0011000 is set to 30h → +48 (Y0011 is 0).

A comparison value for partition #1 is specified 8 scan cycles after RUN.
A comparison value of +1000 is used here. (A range from +960 to +1000 becomes partition #1.)
If +1000 → 0003E8h, the following are written:
Y0011: DTOH ← 00h
Y0012: DTOM ← 03h
Y0013: DTOL ← E8h
If Y0012 to Y0013 have 1-word data, E803h → -6141 is written.
In addition, if SELECT = 1 and PRS = 0, Y0010 is set to 00000001 (Y0011 is 0).

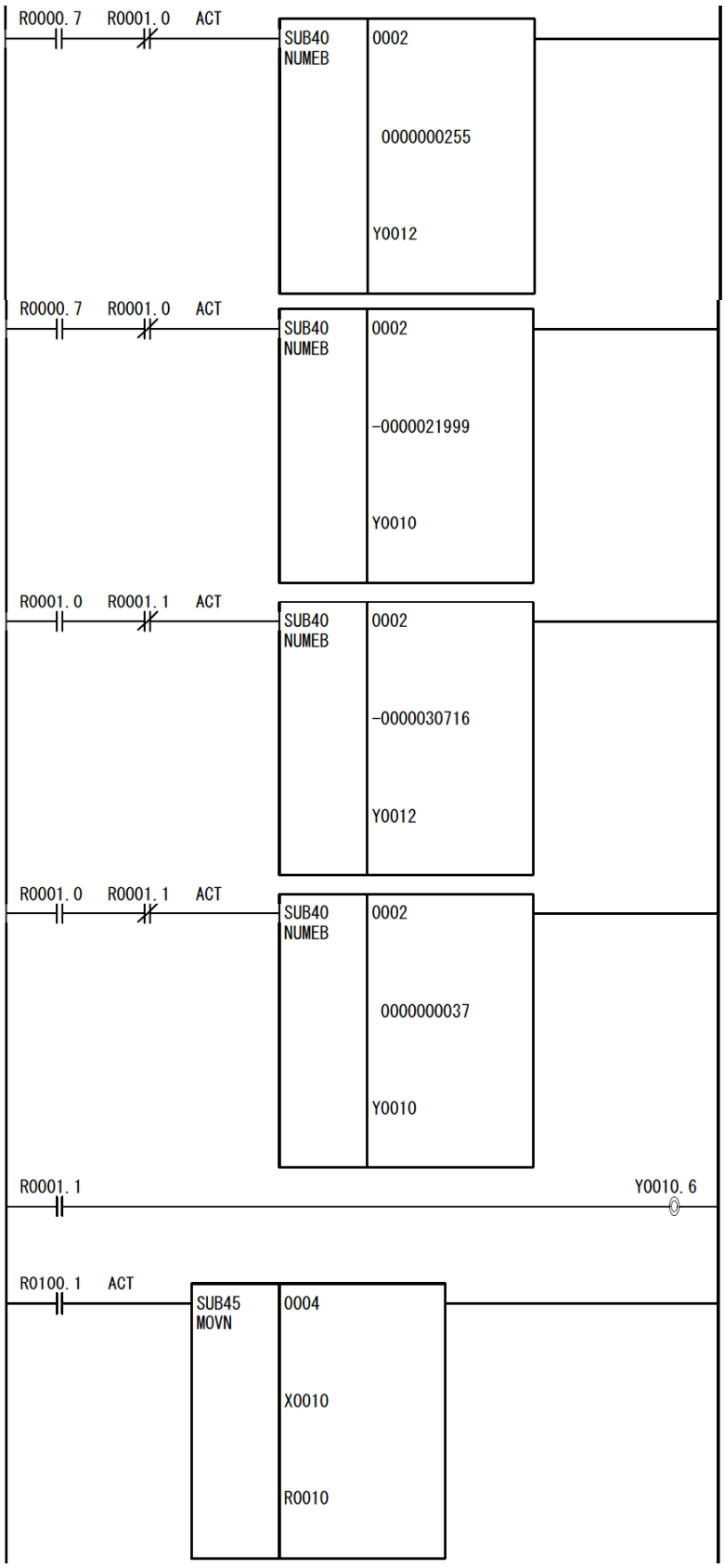
A comparison value for partition #2 is specified 10 scan cycles after RUN.
A comparison value of +1040 is used here. (A range from +1000 to +1040 becomes partition #2.)
If +1040 → 000410h, the following are written:
Y0011: DTOH ← 00h
Y0012: DTOM ← 04h
Y0013: DTOL ← 10h
If Y0012 to Y0013 have 1-word data, 1004h → +4100 is written.



In addition, if SELECT = 2 and PRS = 1, Y0010=00100010 is set to 22h → +34 (Y0011 is 0).

A comparison value for partition #3 is specified 12 scan cycles after RUN.
A comparison value of +1080 is used here. (A range from +1040 to +1080 becomes partition #3.)
If +1080 → 000438h, the following are written:
Y0011: DTOH ← 00h
Y0012: DTOM ← 04h
Y0013: DTOL ← 38h
If Y0012 to Y0013 have 1-word data, 3804h → +14340 is written.
In addition, if SELECT = 3 and PRS = 0, Y0010=00000011 is set to +3 (Y0011 is 0).

A comparison value for partition #4 is specified 14 scan cycles after RUN.
A comparison value of +1120 is used here. (A range from +1080 to +1120 becomes partition #4.)
If +1120 → 000460h, the following are written:
Y0011: DTOH ← 00h
Y0012: DTOM ← 04h
Y0013: DTOL ← 60h
If Y0012 to Y0013 have 1-word data, 6004h → +24580 is written.
In addition, if SELECT = 4 and PRS = 1, Y0010=00100100 is set to 24h → +36 (Y0011 is 0).

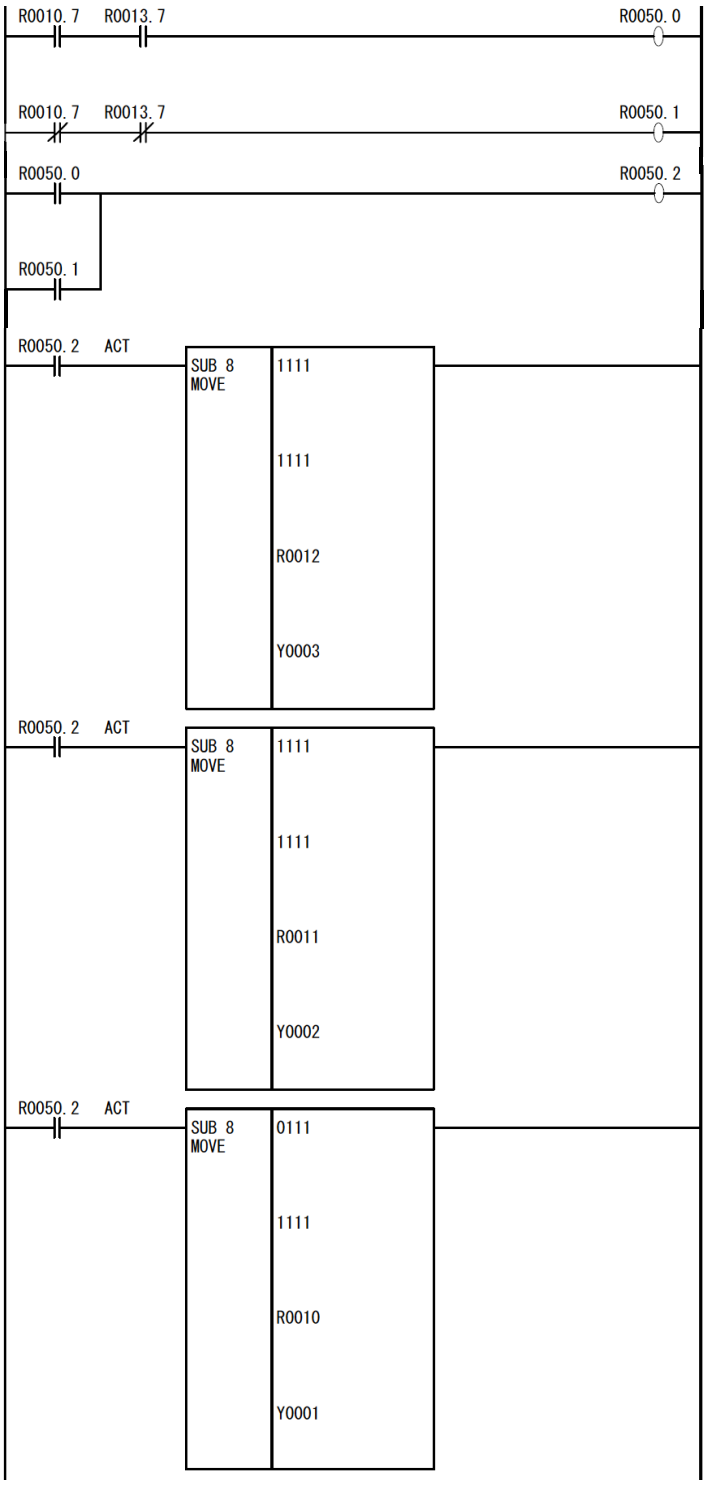


An output value for partition #3 to #5 is specified 16 scan cycles after RUN.
To be specific, the following are output.
Partition #3: Y0011 ← AAh
Partition #4: Y0012 ← FFh
Partition #5: Y0013 ← 00h
If Y0012 to Y0013 have 1-word data, 00FFh → +255 is written.
In addition, if SELECT = 17(11h) and PRS = 0, 1-word data AA11h → -21999 is written to Y0010 to Y0011 because Y0010 = 0001001 = 11h and Y0011 = AAh.

A comparison value for partition #5 is specified 18 scan cycles after RUN.
A comparison value of +1160 is used here. (A range from +1120 to +1160 becomes partition #5.)
If +1160 → 000488h, the following are written:
Y0011: DTOH ← 00h
Y0012: DTOM ← 04h
Y0013: DTOL ← 88h
If Y0012 to Y0013 have 1-word data, 8804h → -30716 is written.
In addition, if SELECT = 5 and PRS = 1, Y0010=00100101 is set to 25h → +37 (Y0011 is 0).

The counter is enabled 20 scan cycles after RUN.

X0010 to X0013 are sent to R0010 to R0013 to maintain data consistency.



A timing signal indicating TRA = TRB is generated. If TRA = TRB = 1 or TRA = TRB = 0, R50.2 becomes 1.

The counter value is output to Y0001 to Y0003 when TRA = TRB.
CNTH → Y0001
CNTM → Y0002
CNTL → Y0003
The highest-order bit (TRA) is masked because CNTH is 7-bit data.

NOTE

1 This sample ladder does not set a comparison value or output value for partition #6 and above. If comparison and output values for these partitions are to be used, repeat the same operation as for partition #6 and below by changing the SELECT value.
Be sure to invert the PRS bit (0 → 1 or 1 → 0) each time a value is specified.

2 The comparison and compare output values for each partition can be specified in any order until CE = 1 (counter enable).

9 TEMPERATURE INPUT MODULE

9.1 OVERVIEW

A temperature input module is used to measure the temperature of machine tools and similar equipment. The temperature input module can be either of the following, depending on the type of the sensor used.

- Thermoresistance-type temperature input module: ATI04A
- Thermocouple-type temperature input module: ATI04B

These modules can measure temperature on up to four channels. For the thermoresistance-type temperature input module, either JPt100Ω or Pt100Ω can be selected. For the thermocouple-type temperature input module, either K or J thermocouple input can be selected. This selection is made using the PMC user program (ladder).

9.2 TEMPERATURE INPUT MODULE SPECIFICATION

Input signal types and number of input channels	• Types ATI04A Three-wire thermoresistance (JPt100Ω) Three-wire thermoresistance (Pt100Ω) ATI04B J thermocouple (can also be used with the tip grounded) K thermocouple (can also be used with the tip grounded) • Number of input channels 2/4, for all for which the input is the same
Input signal switching method	• User program (ladder)
Temperature measurement range and precision	• Thermoresistance type (ATI04A) -50 to 300.0°C Resolution 0.1°C Overall precision ±1%FS • Thermocouple type (ATI04B) 0 to 600.0°C Resolution 0.1°C Overall precision ±1%FS
Data sampling period setting (Note)	• 0.3 s per two channels • 0.5 s per four channels to 10 s per four channels (4 s per four channels is assumed if no specification is made)
System failure check	• Self-diagnosis A watchdog timer is used. • Abnormal temperature (including sensor input disconnection) Failure information about each abnormal channel is sent to the PMC.
Interface with the PMC	• PMC → temperature module Information format: Binary or bit Signals: 32 points • Temperature module → PMC Information format: Binary or bit Signals: 32 points
External connection	Connector (Hirose Electric : HIF3BA-34PA-2.54DS)

NOTE
The actual response time is the sum of the time required for the signal to pass the filter and the scan time that is determined depending on the system1

9.3 PMC INTERFACE

9.3.1 PMC I/O Area

This temperature module uses an input/output area consisting of four bytes for input and the same number of bytes for output. Each byte of the input/output area has the following meanings. The terms "input" and "output" are used in reference to the PMC. When input/output addresses are assigned to the module, "/4" is used as the module name.

(1) Output (PMC → temperature module)

Addresses in the module		
0	DO07 to DO00	Period for 4-channel automatic measurement mode (lower 8 bits)
+1	DO15 to DO08	Period for 4-channel automatic measurement mode (higher 8 bits)
+2	DO23 to DO16	Module setting data and timing data
+3	DO31 to DO24	Module setting data and timing data

(2) Input (temperature module → PMC)

Addresses in the module		
0	DI07 to DI00	CH1 temperature data, CH3 temperature data, or abnormality data (lower 8 bits)
+1	DI12 to DI08	CH1 temperature data, CH3 temperature data, or abnormality data (higher 5 bits)
	DI15 to DI13	Status signal
+2	DI23 to DI16	CH2 temperature data, CH4 temperature data, or abnormality data (lower 8 bits)
+3	DI28 to DI24	CH2 temperature data, CH4 temperature data, or abnormality data (higher 5 bits)
	DI31 to DI29	Status signal

NOTE

If you are using the PMC-N, NA, or QA (the PMC for Series 15 or F-D Mate), all addresses up to those listed above can be used without modifying them if the data is manipulated in byte (8-bit) units. When manipulating data in word (16-bit) units, note that the byte addresses are transposed as shown below.

Addresses for word-unit operation in the PMC-N, NA, and QA

PMC → Temperature module

High-order bits	Low-order bits	Addresses in the module
DO07 to DO00	DO15 to DO08	0
DO23 to DO16	DO31 to DO24	+2

Temperature module → PMC

High-order bits	Low-order bits	Addresses in the module
DI07 to DI00	DI15 to DI08	0
DI23 to DI16	DI31 to DI24	+2

9.3.2 Measurement Mode

This temperature module can operate in any of the following three measurement modes. The mode to use can be selected using a user program (ladder).

(1) 2-channel measurement mode
This mode uses two channels, CH1 and CH2, for measurement. Data on each channel is updated every 0.3 s.

(2) 4-channel automatic measurement mode
This mode uses four channels, CH1 to CH4, for measurement. Input switching from CH1 and CH2 data to CH3 and CH4 data and vice versa is performed automatically. Data on each channel is updated at a specified interval, say, every 0.5 to 10 s.

(3) 4-channel manual measurement mode
This mode uses four channels, CH1 to CH4, for measurement. The PMC can reference CH1 and CH2 data or CH3 and CH4 data at the desired timing.

9.3.3 Details of Output Signals (PMC → Temperature Module)

DO07	DO06	DO05	DO04	DO03	DO02	DO01	DO00
DO15	DO14	DO13	DO12	DO11	DO10	DO09	DO08
	DO22			DO19	DO18	DO17	DO16
					DO26	DO25	DO24

(1) Before setting the module setting data bit (NC READY (DO16)) to "1", set the following bits.

DO00 (LSB) to DO15 (MSB):
Channel switching period for 4-channel automatic measurement mode
These bits are set with a binary number representing the channel switching period for the 4-channel automatic measurement mode. They need not be set for the 2-channel mode.
The period can be varied in a range between 0.5 s and 10 s. When setting the bits, use a value ten times the desired period.
(Example) 2 s → 20 (14h)
The valid data range is between 5 and 100 (64h). Any value out of this range is regarded as being 40 (28h), that is, 4 s. If nothing is specified, a period of 4 s is again assumed.

DO17 : Module type
This bit is set according to the type of the temperature module being used.
0 : Thermocouple-type module (ATI04B)
1 : Thermoresistance-type module (ATI04A)

DO18 : Sensor type
This bit is set according to the type of the temperature sensor being used.

- ATI04A
  0 : Pt
  1 : JPt

- ATI04B
  0 : K
  1 : J

DO19 : Reserved for future use
This bit must always be set to "0".

DO24 : Number of channels
This bit is used to specify the number of channels to be measured.
0 : 2 channels
1 : 4 channels (if 1 is selected, DO25 must also be used.)

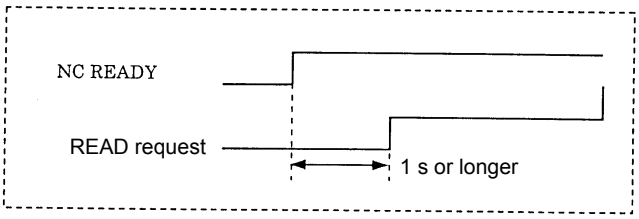
DO25 : 4-channel mode specification
This bit is used to select the 4-channel mode to be used.
0 : Automatic measurement (the period is specified using DO00 to DO15.)
1 : Manual measurement (a request is issued using DO22 and DO26 at every data read.)

2) Timing data
DO16 : NC READY
When the power is switched on, this bit is set to "1" to cause the module setting data to be set in the temperature module.
The NC READY bit is enabled only once after the power is switched on. To rewrite the module setting data, switch the power off and then on again.

DO22 : READ request

This bit serves as the timing signal used in 4-channel manual measurement mode. Setting the bit to "1" issues a request for temperature data. When the input signal data READY signal becomes "1", read the temperature data.

This bit need not be set for 2-channel mode.



NOTE

After setting the NC READY bit to "1", wait for one second, and then set the READ request to "1".

DO26 : Channel select

This bit is used to specify channel switching for 4-channel manual measurement mode.

0: Channels 1 and 2

1: Channels 3 and 4

NOTE

See Section 9.5, "Timing Charts," for concrete explanations about how to handle the timing data.

9.3.4 Details of Input Signals (Temperature Module → PMC)

(1) Status signals and CH1 temperature data, CH3 temperature data, or abnormality data

DI07	DI06	DI05	DI04	DI03	DI02	DI01	DI00

DI15	DI14	DI13	DI12	DI11	DI10	DI09	DI08

- Status signals

  DI13 : Abnormality sign bit
  1 : This bit is set to "1" when the temperature input is abnormal. DI00 to DI12 are used to describe the abnormality.
  0 : DI00 to DI12 are used to indicate the temperature data.

  DI14 : CH1 data READY
  1 : Read the CH1 temperature data from DI00 to DI12 when this bit is set to "1".

  DI15 : CH3 data READY
  1 : Read the CH3 temperature data from DI00 to DI12 when this bit is set to "1".

- CH1 temperature data, CH3 temperature data, or abnormality data

  DI00 (LSB) to DI12 (MSB):
  These bits indicate temperature input data (CH1/CH3) or abnormality data.

Temperature input data

The temperature input data is in binary. It is ten times the actual temperature.

Example

(83EDh → 1005 → 100.5°C)
↑— The highest three bits are status signals.

For the thermoresistance-type module (ATI04A), the DI12 bit is a sign bit. (Negative data is represented in two's complement.)

Example

(9F9Ch → -10.0°C)
↑— The highest three bits are status signals.

Abnormality data

If an abnormality occurs in the input data or in the module, the DI13 bit (status signal) becomes "1", resulting in the display changing from temperature input data to abnormality data. Abnormality data is assigned to these bits as listed below:

DI00 : CH1 input out of scale--the current temperature falls outside the measurable range.
DI01 : CH1 input burn-out--the cable or connector has been detached.
DI02 : CH3 input out of scale--the current temperature falls outside the measurable range.
DI03 : CH3 input burn-out--the cable or connector has been detached.
DI04 : Cold-junction abnormality (only for thermocouple-type input module)--the temperature of the terminal board unit falls outside the measurable range.
DI05 : System error--the internal circuit is abnormal.
DI06 : Wrong module--other than the correct module has been installed.

(2) Status signals, CH2 temperature data, CH4 temperature data, or abnormality data

DI23	DI22	DI21	DI20	DI19	DI18	DI17	DI16

DI31	DI30	DI29	DI28	DI27	DI26	DI25	DI24

- Status signals
  DI129 : Abnormality sign bit
  1 : This bit becomes "1" when the temperature input becomes abnormal. DI16 to DI28 are used to describe the abnormality.
  0 : DI16 to DI28 are used to indicate the temperature data.

  DI30 : CH2 data READY
  1 : Read the CH2 temperature data from DI16 to DI28 when this bit is set to "1".

  DI31 : CH4 data READY
  1 : Read the CH4 temperature data from DI16 to DI28 when this bit is set to "1".
- CH2 temperature data, CH4 temperature data, or abnormality data
  DI16 (LSB) to DI28 (MSB):
  These bits indicate temperature input data (CH2/CH4) or abnormality data.

Temperature input data

The temperature input data is in binary. It is ten times the actual temperature.

Example

(41F3h → 0499 → 49.9°C)

└ The highest three bits are status signals.

For a thermoresistance-type module (ATI04A), the DI28 bit is a sign bit. (Negative data is represented in two's complement.)

Example

(5FFBh → -0.5°C)

└ The highest three bits are status signals.

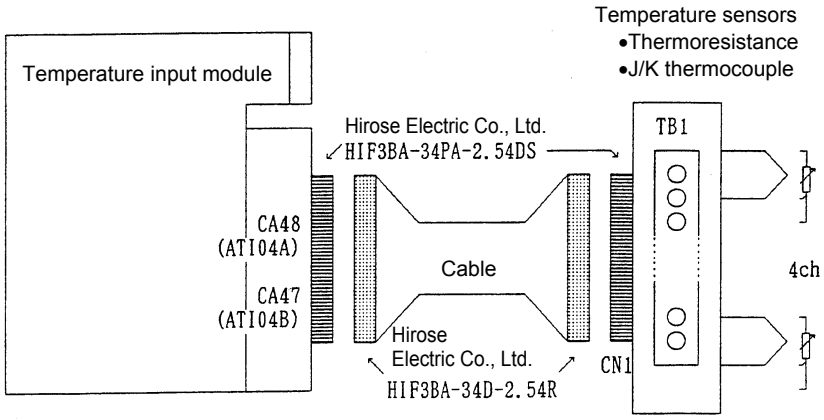
Abnormality data

If an abnormality occurs in the input data or the module, the DI29 bit (status signal) is set to "1", resulting in the display changing from temperature input data to abnormality data. Abnormality data is assigned to these bits as listed below:

- DI16 : CH2 input out of scale--the current temperature falls outside the measurable range.
- DI17 : CH2 input burn-out--the cable or connector has been detached.
- DI18 : CH4 input out of scale--the current temperature falls outside the measurable range.
- DI19 : CH4 input burn-out--the cable or connector has been detached.
- DI20 : Cold-junction abnormality (only for thermocouple-type input module)--the temperature of the terminal board unit falls outside the measurable range.
- DI21 : System error--the internal circuit is abnormal.
- DI22 : Wrong module--other than the correct module has been installed.

9.4 COMPLETE CONNECTION OF TEMPERATURE INPUT MODULE

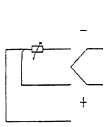
9.4.1 Temperature Input Module Connection Diagram



Terminal board unit
(There are two types of terminal board units, the first for a thermoresistance-type module and the second for a thermocouple-type module.)
See Section 9.7 for explanations about the dimensions of the terminal board.

9.4.2 Connector Signal Lists

(1) Thermoresistance input module
ATI04A

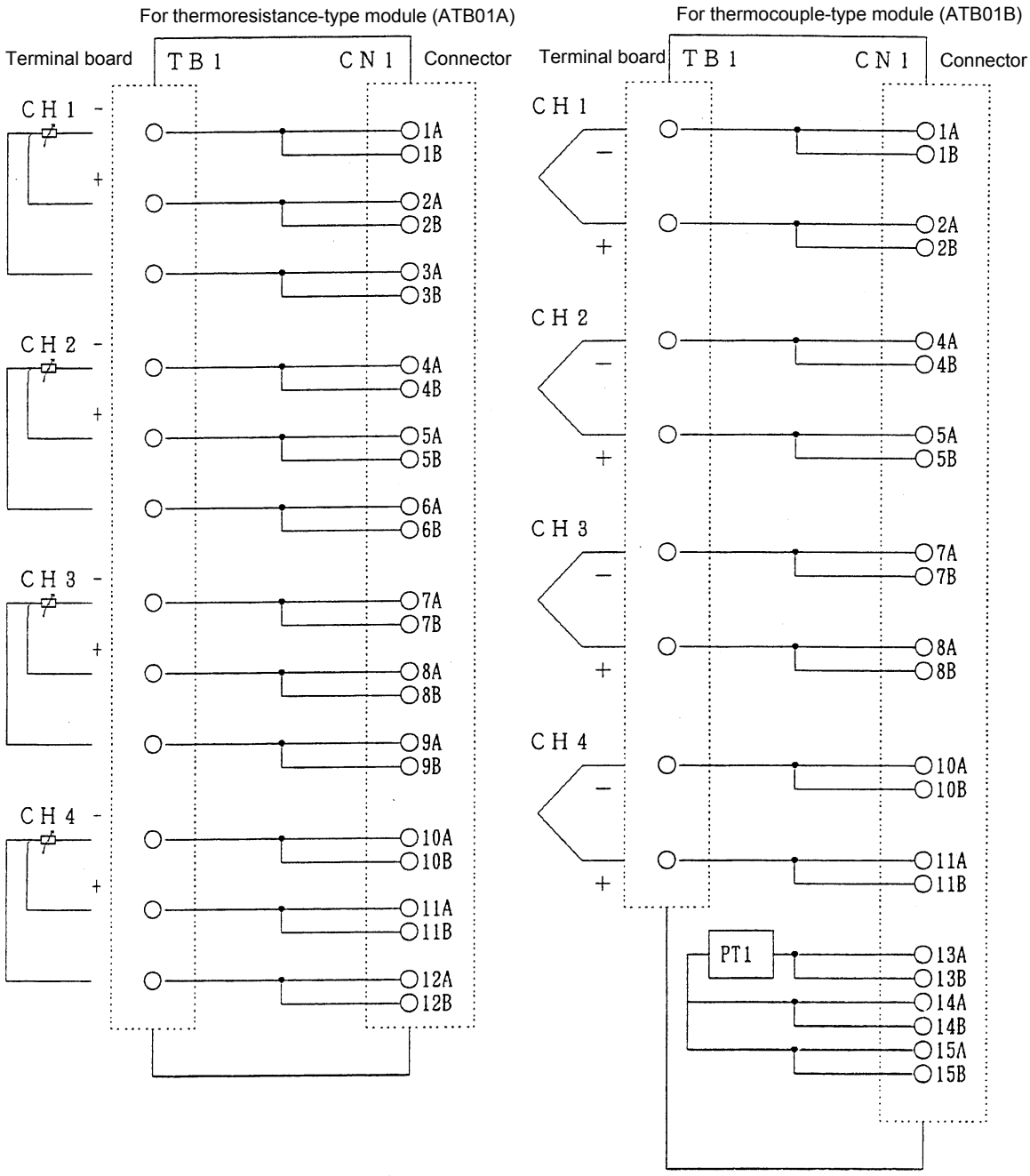


Channel	Pin No.	Pin No.
Channel 1 -	1A	1B
Channel 1 +	2A	2B
Channel 1 +	3A	3B
Channel 2 -	4A	4B
Channel 2 +	5A	5B
Channel 2 +	6A	6B
Channel 3 -	7A	7B
Channel 3 +	8A	8B
Channel 3 +	9A	9B
Channel 4 -	10A	10B
Channel 4 +	11A	11B
Channel 4 +	12A	12B
Unusable	13A	13B
Unusable	14A	14B
Unusable	15A	15B
Unusable	16A	16B
Unusable	17A	17B

(2) Thermocouple input module
ATI04B

Channel	Pin No.	Pin No.
Channel 1 -	1A	1B
Channel 1 +	2A	2B
Unusable	3A	3B
Channel 2 -	4A	4B
Channel 2 +	5A	5B
Unusable	6A	6B
Channel 3 -	7A	7B
Channel 3 +	8A	8B
Unusable	9A	9B
Channel 4 -	10A	10B
Channel 4 +	11A	11B
Unusable	12A	12B
Cold-junction compensation element A	13A	13B
Cold-junction compensation element B1	14A	14B
Cold-junction compensation element B2	15A	15B
Unusable	16A	16B
Unusable	17A	17B

9.4.3 Terminal Board Unit Connection Diagram

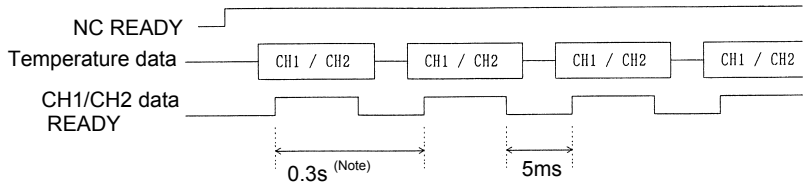


NOTE

The thermocouple module ATB01B incorporates a cold-junction compensation device (PT1). It is essential to temperature measurement with a thermocouple. Use the ATB01B whenever the ATI04B is used.

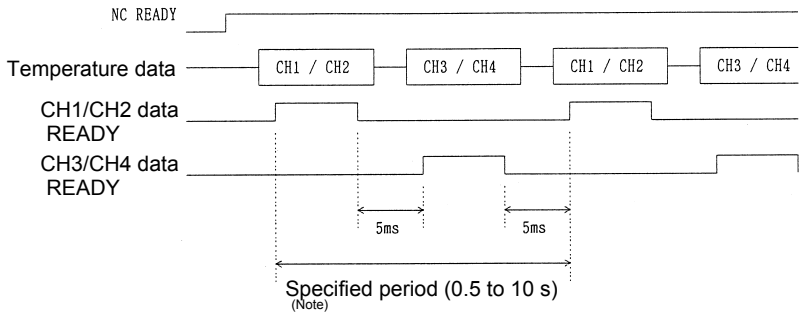
9.5 TIMING CHARTS

(1) 2-channel mode



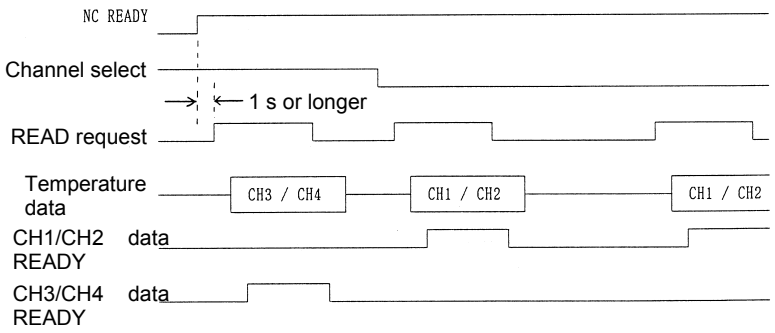
NOTE
The actual response time is the sum of the time required to pass the filter and the scan time that is determined depending on the system.

(2) 4-channel automatic measurement mode



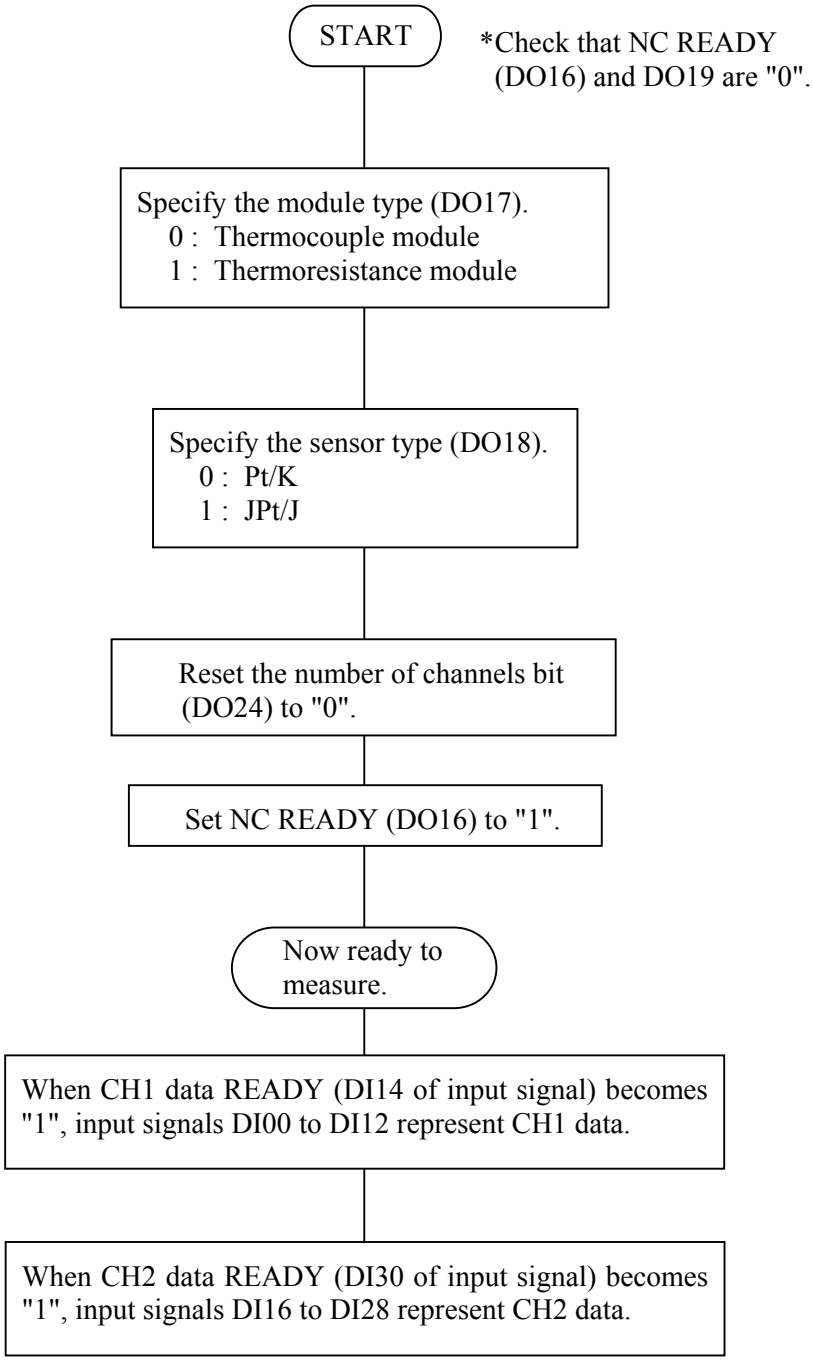
NOTE
The actual response time is the sum of the time required to pass the filter and the scan time that is determined depending on the system.

(3) 4-channel manual measurement mode



9.6 MEASUREMENT EXAMPLES

(1) 2-channel mode
(a) Flowchart



(b) Ladder example

The following measurement and ladder examples apply when a thermoresistance module with Pt is used for measurement.

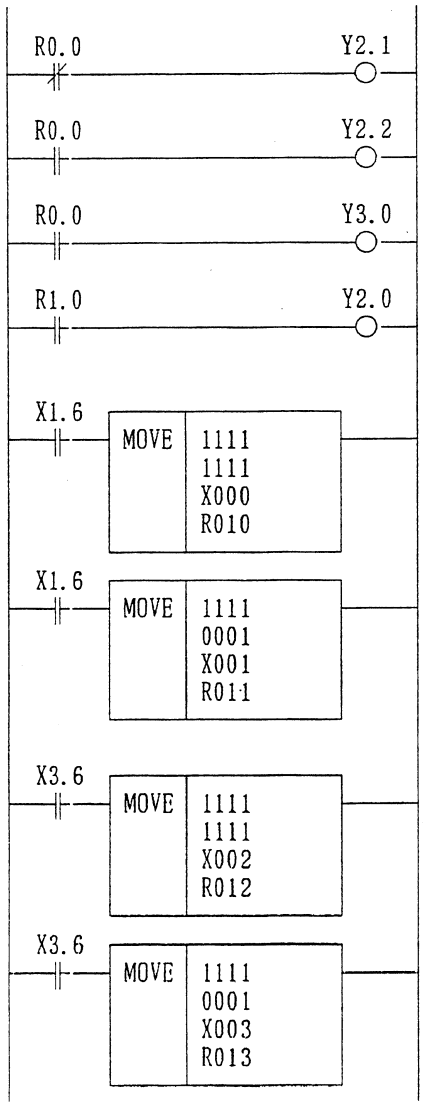
PMC measurement

	GROUP	BASE	SLOT	NAME		GROUP	BASE	SLOT	NAME
X000	0	0	1	/4	Y000	0	0	1	/4
X001	0	0	1	/4	Y001	0	0	1	/4
X002	0	0	1	/4	Y002	0	0	1	/4
X003	0	0	1	/4	Y003	0	0	1	/4

NOTE

Set the ladder scan time to 0.25 s or less.
This example of ladder use is for the second level.
R0.0 is used as a normally open relay.

Ladder



Specify the module.

(thermoresistance-type module)
Specify the sensor (Pt).

Specify the number of channels (two channels).

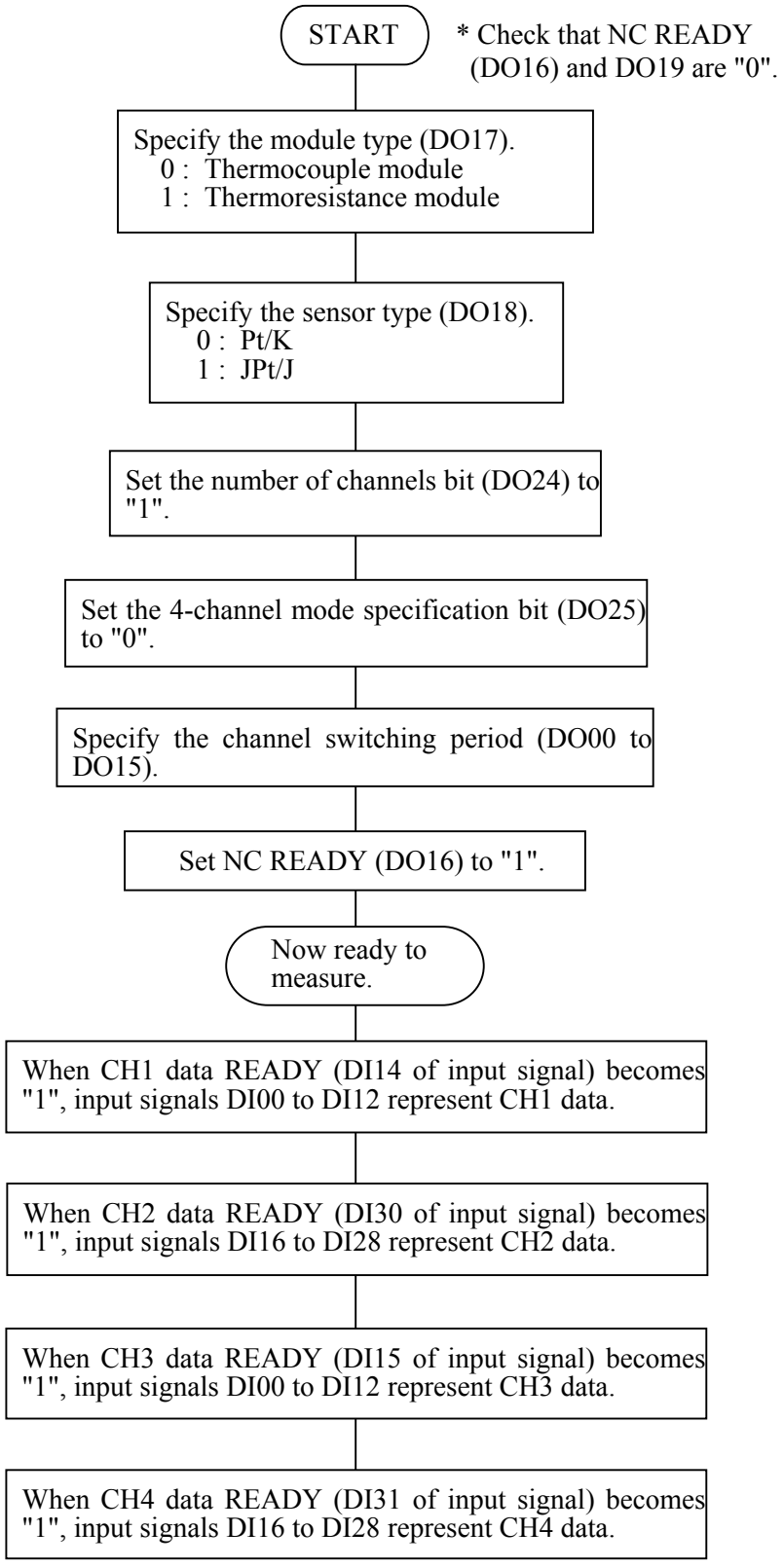
NC READY (When R1.0 becomes "1", NC READY becomes "1" to start measurement.)

When CH1 data READY is "1", CH1 temperature data is sent to R010 to R011.

When CH2 data READY is "1", CH2 temperature data is sent to R012 to R013.

(2) 4-channel automatic measurement mode

(a) Flowchart



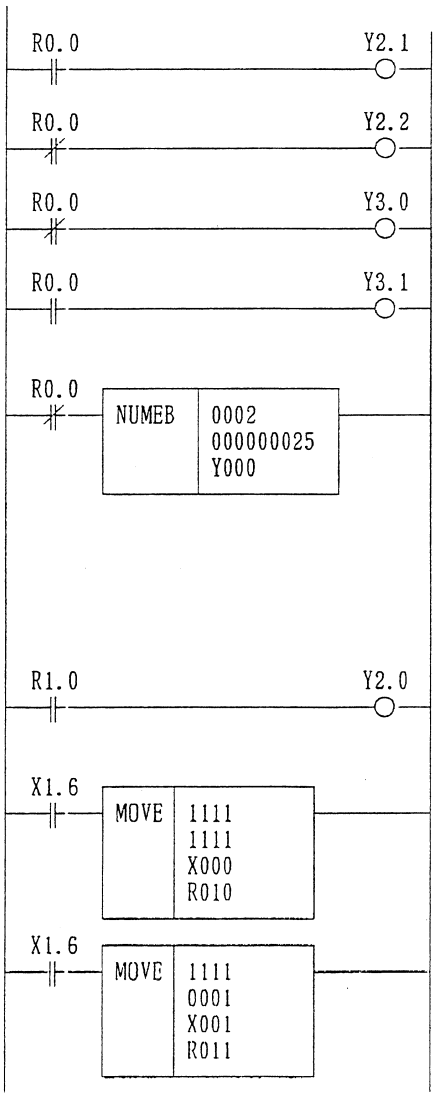
(b) Ladder example

The following measurement and ladder examples apply when a J thermocouple module is used for measurement.
PMC assignment

	GROUP	BASE	SLOT	NAME		GROUP	BASE	SLOT	NAME
X000	0	0	1	/4	Y000	0	0	1	/4
X001	0	0	1	/4	Y001	0	0	1	/4
X002	0	0	1	/4	Y002	0	0	1	/4
X003	0	0	1	/4	Y003	0	0	1	/4

NOTE
This example of ladder use is for the second level. R0.0 is used as a normally open relay.

Ladder



Specify the module.

(thermocouple-type module)
Specify the sensor
(J thermocouple).

Specify the number of channels (four channels).

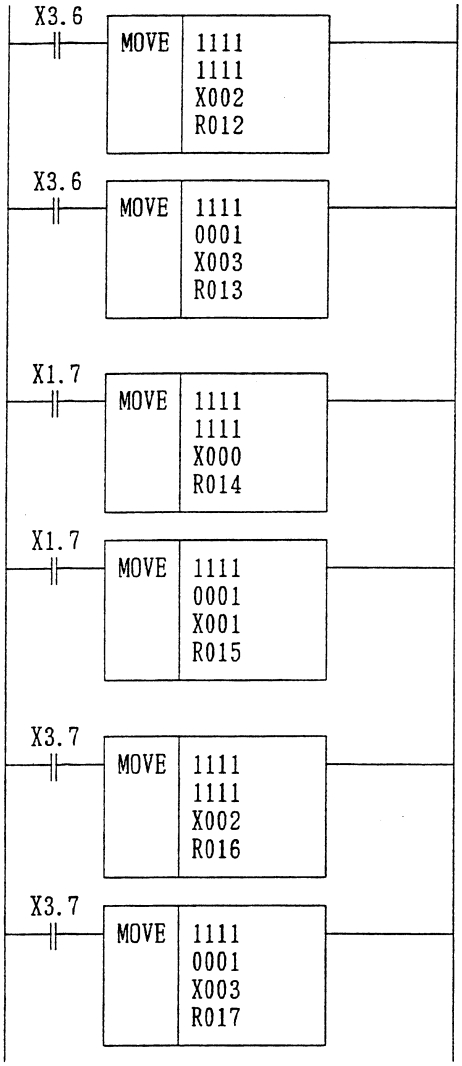
Specify a 4-channel mode (automatic measurement).

Specify the channel switching period for 4-channel automatic measurement.
Specify 0025 to provide a period of 2.5 s.(Note)

NC READY (When R1.0 is set to "1", NC READY becomes "1" to start measurement.)

When CH1 data READY is set to "1", CH1 temperature data is sent to R010 to R011.

NOTE
If your machine is the PMC-N, NA, or QA, specify 6400.
0025 ⇒ 0019h. Because the upper byte is exchanged with the lower byte, 1900h ⇒ 6400.



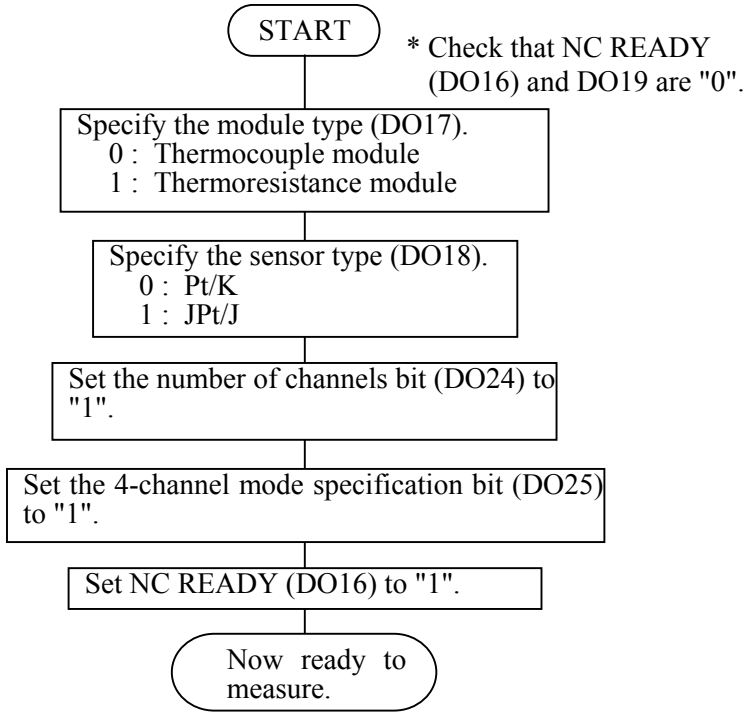
When CH2 data READY is "1", CH2 temperature data is sent to R012 to R013.

When CH3 data READY is "1", CH3 temperature data is sent to R014 to R015.

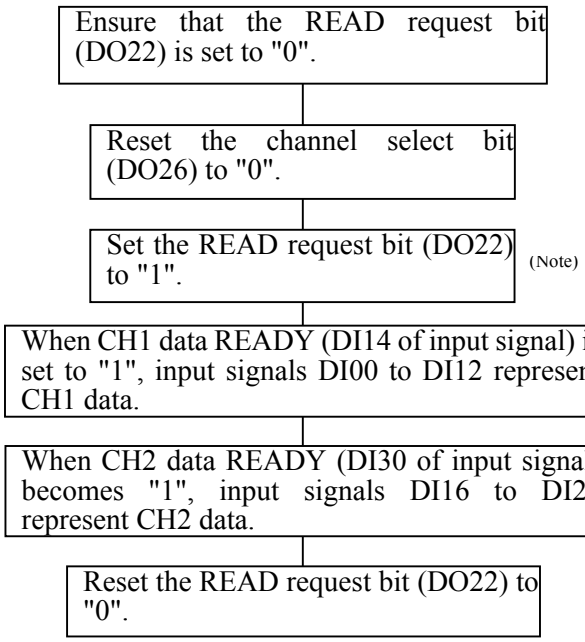
When CH4 data READY is "1", CH4 temperature data is sent to R016 to R017.

(3) 4-channel manual measurement mode

(a) Flowchart

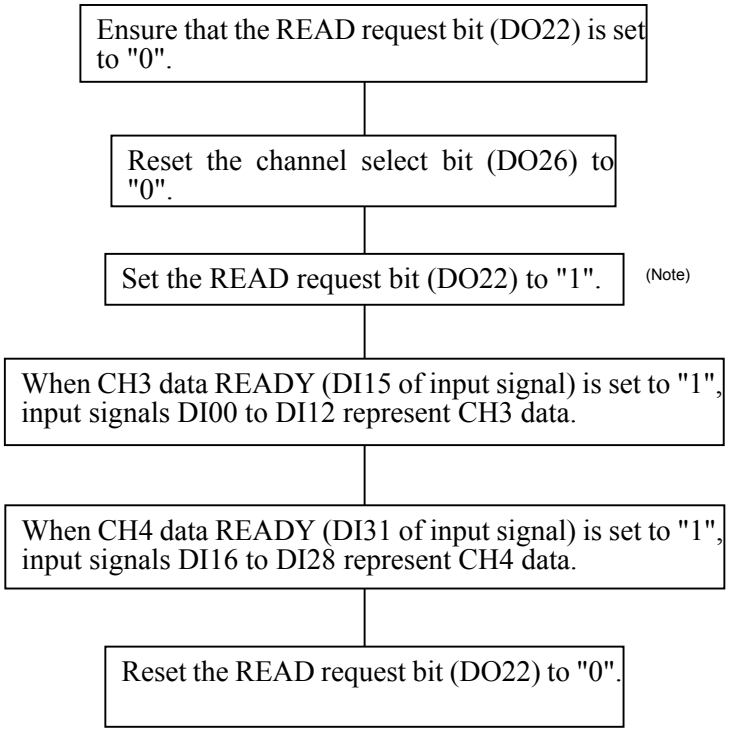


* Reading CH1 and CH2 data



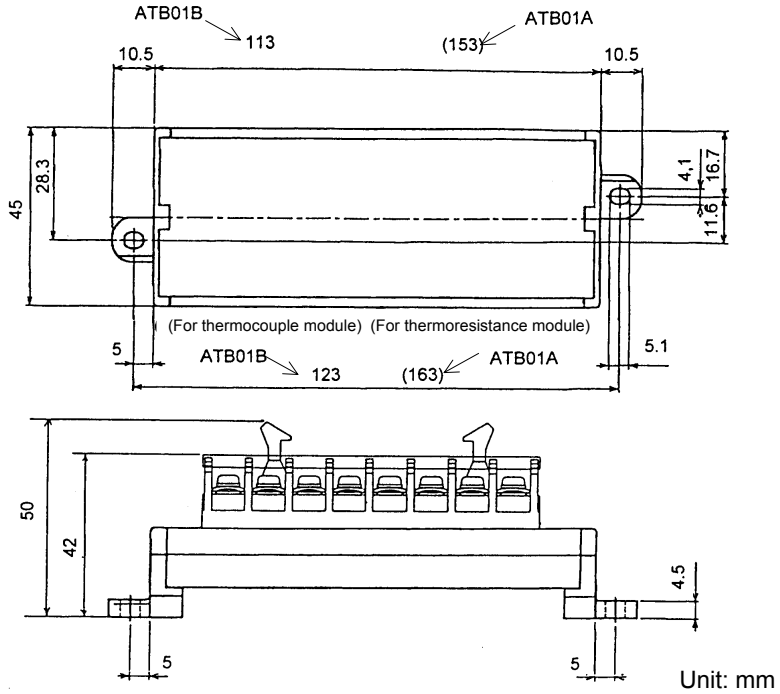
NOTE
After setting NC READY to "1", wait for one second, and then set the READ request to "1".

* Reading CH3 and CH4 data



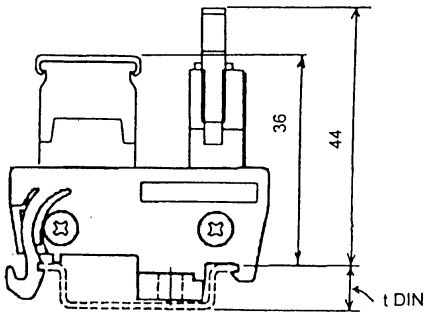
NOTE
1 After setting the NC READY bit to "1", wait for one second, and then set the READ request bit to "1".
2 To create the ladder for 4-channel manual measurement, refer to the above flowchart or timing chart.

9.7 TERMINAL BOARD UNIT DIMENSIONS



Unit: mm

To use a DIN rail, add its height (tDIN) to the dimension shown below.



Unit: mm

10 OPTICAL I/O Link ADAPTER

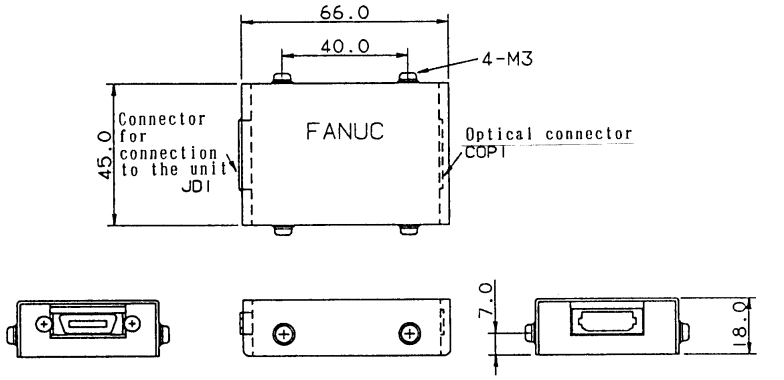
The signal cable K1X shown in the general connection diagram (in section 4.1) can be extended to the maximum length of 200 m with optical fiber cables using an optical I/O link adapter.
Two optical I/O Link adapters, A13B-0154-B001 and A13B-0154-B002 (high-speed response type).

NOTE

1 For the cable K2X, the optical I/O link adapter cannot be applied to.

2 In the following cases, make sure to use an optical fiber cable for K1X. For cabling within the same cabinet, however, this applies only when the cable is 15 m or longer.
- When the cable is more than 10 meters long.
- When the cable K1X runs between different cabinets and it is impossible to connect the cabinets with a wire of 5.5 mm^2 or thicker.
- When there is concern that the cable K1X is influenced by strong noise.
  For example;
  When there is a strong electromagnetic noise source beside the cable K1X such as a welding machine and the like.
  When a noise generating cable such as a power cable and the like runs for a long distance in parallel with the cable K1X.

10.1 EXTERNAL DIMENSION OF OPTICAL I/O Link



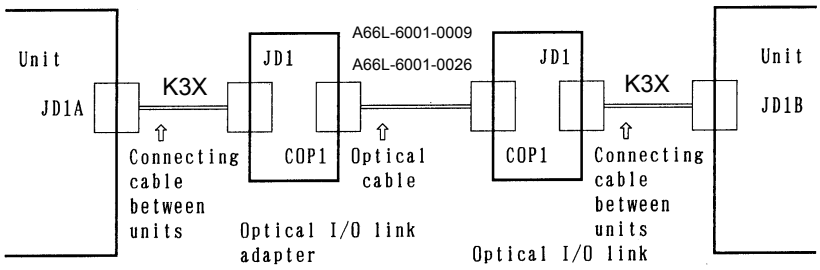
Unit: mm

10.2 WEIGHT OF OPTICAL I/O Link

Main body: Approx. 100g

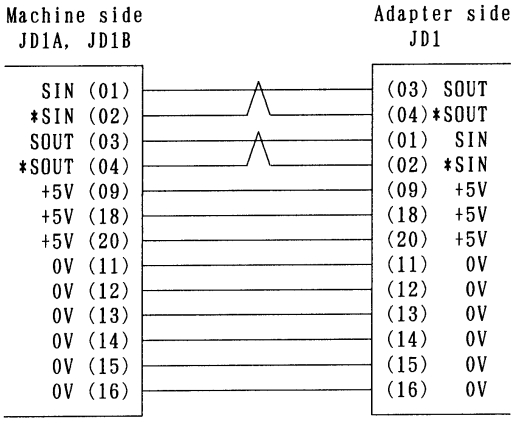
10.3 CONNECTION OF OPTICAL I/O Link

(1) Connection diagram



(2) Interunit connecting cables K3X

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



(a) Recommended connector for cable side:
PCR-E20FA (manufactured by HONDA TSUSHIN)
FI30-20S (manufactured by HIROSE ELECTRIC)
FCN-247J020-G/E (manufactured by Fujitsu)
52622-2011 (manufactured by Molex)

(b) Recommended cable (with material): A66L-0001-0284#10P

(c) Cable length: Max.2m (when the recommended cable is used)

(3) Optical cable

<1> Specification (Be sure to use the optical cable conforming to this specification.):

- A66L-6001-0009 (usable only with the standard type optical I/O Link adapter)
- A66L-6001-0026

<2> Cable length:
Max.200m (when the standard type optical I/O Link adapter A13B-0154-B001 is used)
Max.100m (when the high-speed response type optical I/O Link adapter A13B-0154-B002 is used)

NOTE
The cable length stated above applies when the optical fiber junction adapter A02B-0094-K841 is not in use. See Subsection 10.7.5 for details.

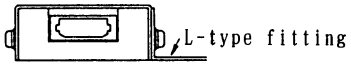
10.4 POWER SOURCE OF OPTICAL I/O Link ADAPTER

The power source is common to the standard type (A13B-0514-B001) and the high-speed response type (A13B-0154-B002).

(1) Power voltage: 4.75 V to 5.25 V (at the receiving end)
(2) Consumption current: 200mA
(3) Power is supplied via the I/O Link cable K3X.

10.5 INSTALLATION CONDITIONS OF OPTICAL I/O Link ADAPTER

(1) As this adapter is not a closed type, install it in the same closed type cabinet as used for the NC control unit.
(2) Make sure to ground the case using the case fixing screw of the adapter.
(3) As the adapter is light, it is not necessary to fix it with screws. However, keep it from getting contact with other circuits lest it should be short-circuited. In addition, when fixing the adapter in a cabinet and the like, fix it with a L-type fitting using the case fixing screws (M3) of the adapter.



10.6 CAUTIONS FOR USING OPTICAL I/O Link ADAPTERS

10.6.1 Configuring I/O Links Using Optical I/O Link Adapters

The following restriction applies when I/O Links are configured using optical I/O Link adapters.
Restriction on the number of optical I/O Link adapters used per I/O Link channel

Master - Group#0 - - - - - - - - Group#1 - - - - ● ● ● ● ● ● - - - Group#15
(CNC) ↑ (I/O-A or the like) ↑ (I/O-A or the like) ↑ ↑ (I/O-A or the like)
Partition #1 Partition #2 Partition #3 Partition #4

When using the standard-type optical I/O Link adapter (A13B-0154-B001):

Up to 5 partitions (I/O Link master -- group #0 -- group #1 -- ... -- group #15) can be configured with optical fibers.
Use electrical cables for the K1X in the other partitions.

When using the high-speed response type optical I/O Link adapter (A13B-0154-B002):

The A13B-0154-B002 performs optical-electrical conversion faster than the A13B-0154-B001.
All (16) partitions (master -- group #0 -- group #1 -- ... -- group #15) can be configured with optical fiber.

NOTE

1 When using an optical fiber for I/O Links, use optical I/O Link adapters conforming to the same specification on both ends of the optical fiber.
2 When using the high-speed response type optical I/O Link adapter (A13B-0154-B002), do not use any optical fiber cable other than the A66L-0001-0026.
When using the standard-type optical I/O Link adapter (A13B-0154-B001), either of the optical fiber cables A66L-0001-0009 and A66L-0001-0026 can be used.
3 If 6 or more partitions of an I/O Link are configured with optical fibers, using the standard-type optical I/O Link adapter even in one of these partitions disables the I/O Link from operating normally.
When using optical fibers in 6 or more partitions, do not use the standard-type optical I/O Link adapter; use only the high-speed response type optical I/O Link adapter.

Parts required per optical I/O Link partition

(1) When configuring 5 or fewer partitions with optical fibers
Two standard-type optical I/O Link adapters (A13B-0154-B001)
Two unit-to-unit connecting cables (K3X)
One optical cable (A66L-6001-0026 or A66L-6001-0009)

(2) When configuring six or more partitions with optical fibers
Two high-speed response type optical I/O Link adapters (A13B-0154-B002)
Two unit-to-unit connecting cables (K3X)
One optical cable (A66L-6001-0026)

10.6.2 When Using Series 16*i*/18*i*/21*i*-MODEL B as Master

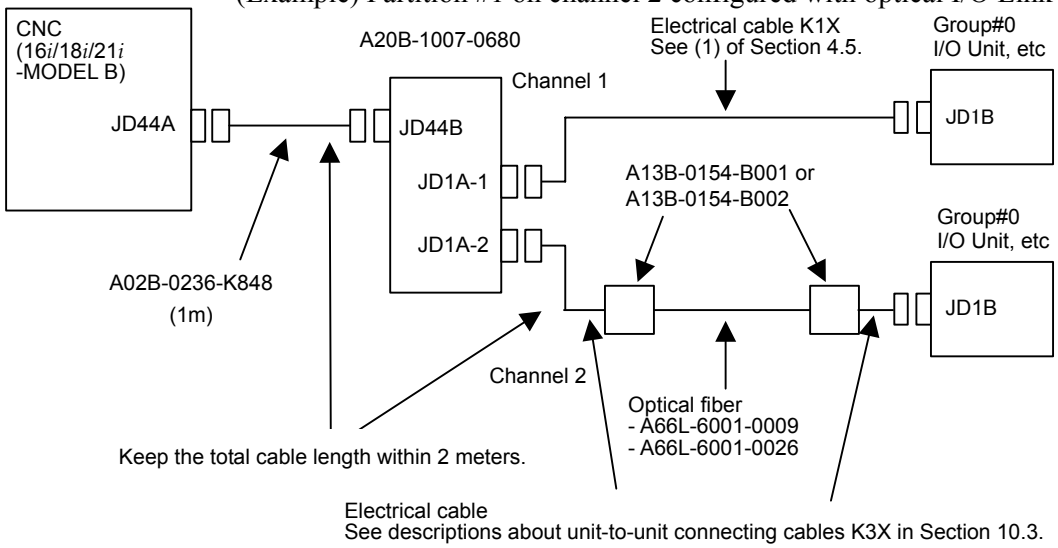
Two channels' worth of I/O Link signals are allocated to the I/O Link connector (JD44A) of the Series 16*i*/18*i*/21*i*-MODEL B.

(1) When using only one I/O Link channel
No I/O Link connector adapter (A20B-1007-0680) is required.
Either an electrical cable or optical I/O Link can be used as the K1X. When using the optical I/O Link, make a connection as described in (1) of Section 10.3.
In this connection, the DI/DO data of channel 2 is invalid.

(2) When using two I/O Link channels
Using two I/O Link channels requires using the I/O Link connector adapter (A20B-1007-0680).
When configuring an optical I/O Link, you can use optical fibers between the I/O Link connector adapter and group #15 (all partitions on channels 1 and 2). No optical fiber can be used between the CNC (JD44A) and I/O Link connector adapter (JD44B). Use a 1-meter electrical cable (A02B-0236-K848).

NOTE
Do not have the cable length from the CNC (JD44A) to the I/O Link connector adapter and then to the optical I/O Link adapter exceed 2 meters in total.

(Example) Partition #1 on channel 2 configured with optical I/O Link



10.6.3 When Using Series 30*i*/31*i*/32*i*-MODEL B as Master

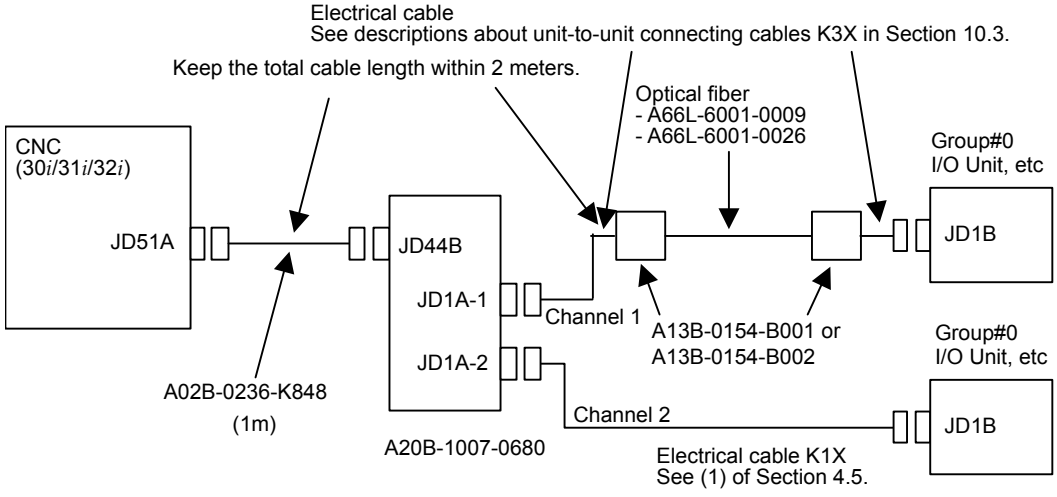
Three channels' worth of I/O Link signals are allocated to the I/O Link connector (JD51A) of the Series 30*i*/31*i*/32*i*-MODEL B.

(1) When using only one I/O Link channel
You do not need to use the I/O Link connector adapter (A20B-1007-0680) or 3-channel I/O Link connector adapter (A20B-1008-0360).
Either an electrical cable or optical I/O Link can be used as the K1X. When using the optical I/O Link, make a connection as described in (1) of Section 10.3.
In this connection, the DI/DO data for channels 2 and 3 is invalid.

(2) When using two I/O Link channels
Using two I/O Link channels requires using the I/O Link connector adapter (A20B-1007-0680).
When configuring an optical I/O Link, you can use optical fibers between the I/O Link connector adapter and group #15 (all partitions on channels 1 and 2). No optical fiber can be used between the CNC (JD51A) and I/O Link connector adapter (JD44B). Use a 1-meter electrical cable (A02B-0236-K848).

NOTE
Do not have the cable length from the CNC (JD51A) to the I/O Link connector adapter and then to the optical I/O Link adapter exceed 2 meters in total.

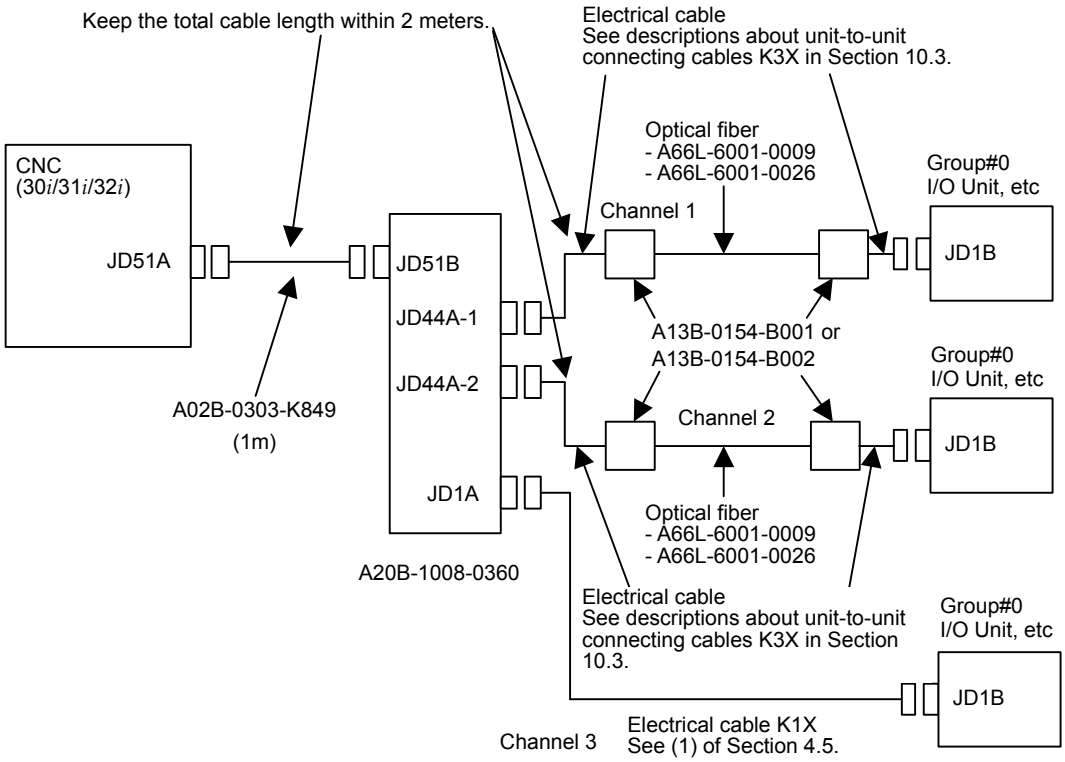
(Example) Partition #1 on channel 1 configured with optical I/O Link



(3) When using three I/O Link channels
Using three I/O Link channels requires using the 3-channel I/O Link connector adapter (A20B-1008-0360).
When configuring an optical I/O Link, you can use optical fibers between the I/O Link connector adapter and group #15 (all partitions on channels 1, 2, and 3). No optical fiber can be used between the CNC (JD51A) and I/O Link connector adapter (JD51B). Use a 1-meter electrical cable (A02B-0303-K849).

NOTE
Do not have the cable length from the CNC (JD51A) to the I/O Link connector adapter and then to the optical I/O Link adapter exceed 2 meters in total.

(Example) When configuring partition #1 on channels 1 and 2 with the optical I/O Link

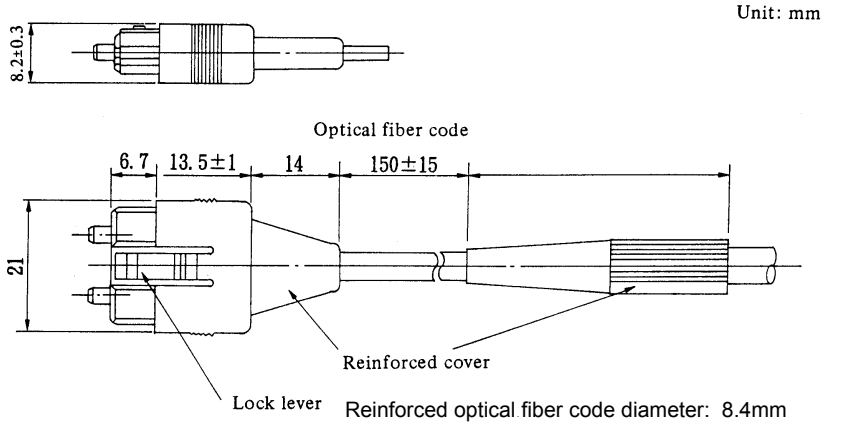


10.7 OPTICAL FIBER CABLE

This CNC uses optical cables for connections between the control unit and the I/O Unit. Unlike the conventional power cables, optical fiber cables need special care in installation and handling. No optical fiber cable can be used on movable parts.

10.7.1 External View of Optical Fiber Cable

Unit: mm



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

(1) Standard length of an optical fiber cable is 10, 15, 20, 30, 50, 100, and 200 meters.
(2) No machine tool builder is allowed to cut or joint optical fiber cables.
(3) If it needs to relay on cabling, use optical fiber junction adapter. Up to the relay points are allowed on a transmission line.

10.7.2 Notice of Optical Fiber Cable Handling

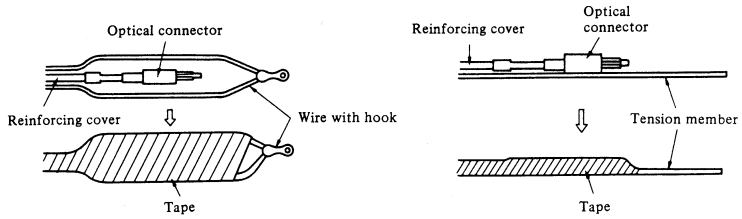
(1) Even though reinforcing cover used on the optical fiber code has enough mechanical strength, be sure not to be damaged by heavy materials drop.

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

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

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

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

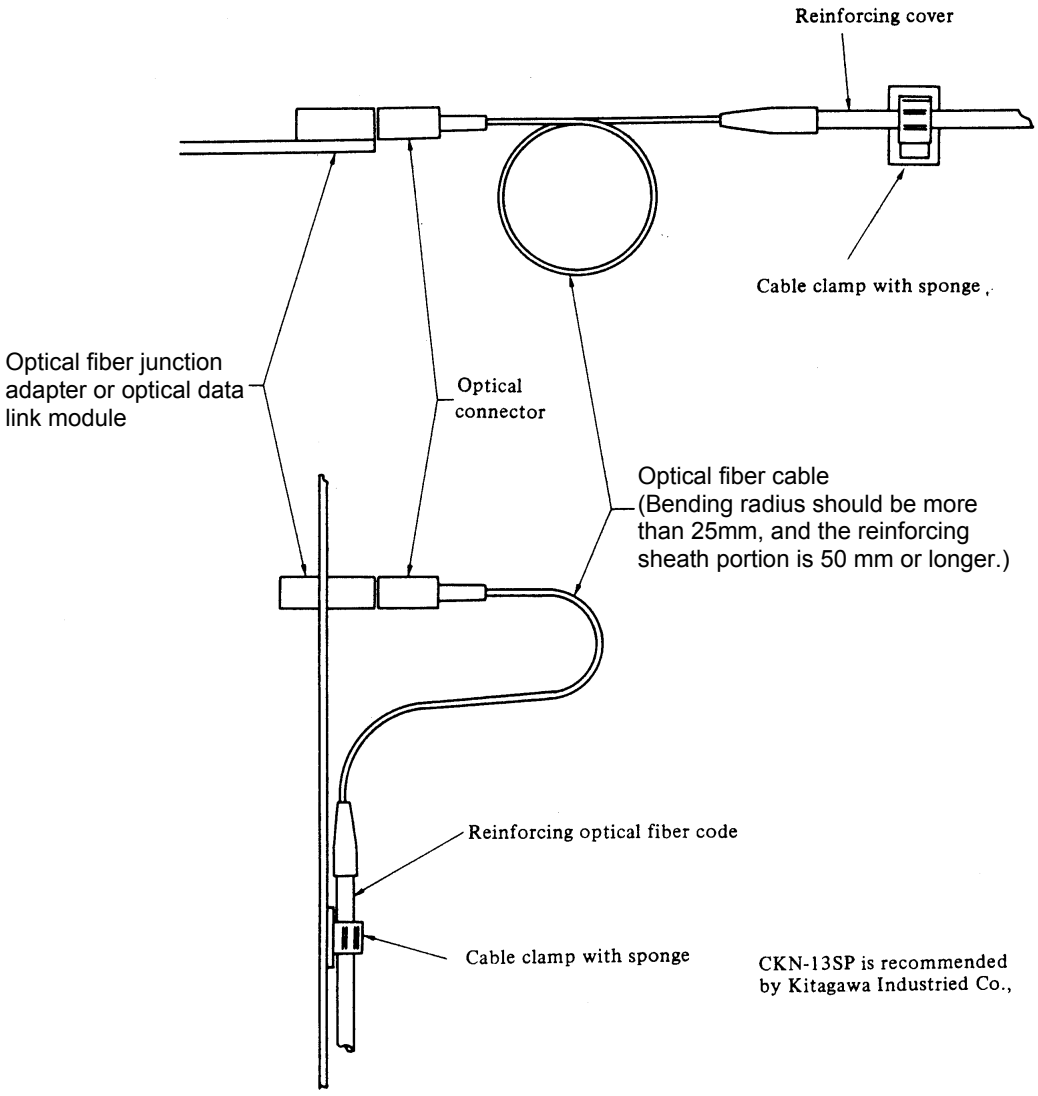


(6) Reinforcing cover is fixed to cable lamp so that optical fiber cable could not weigh directly the connecting part of connector.

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

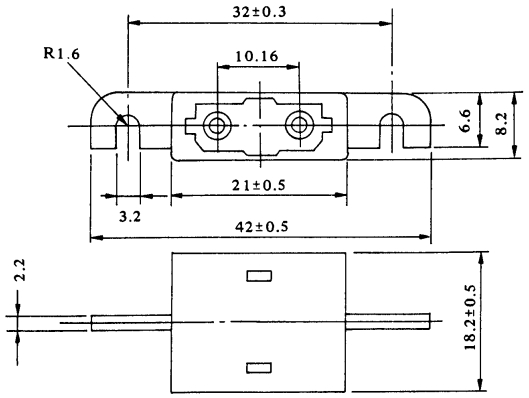
10.7.3 Optical Fiber Cable Clamping Method

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

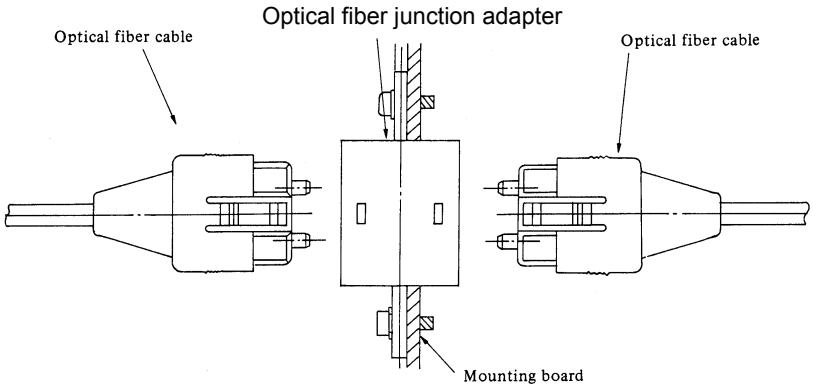


10.7.4 Relay Using an Optical Fiber Junction Adapter

(1) External view of an optical fiber junction adapter



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



Specification: A02B-0094-K841

NOTE
Up to one relay points are permitted.
When the high-speed response type optical I/O Link adapter is used, however, it is impossible to use the optical fiber junction adapter.

(3) 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.

(4) 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.

(3) Cleaning

If the optical fiber junction adapter, optical-to-electrical conversion module, and 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.

10.7.5 Maximum Transmission Distance by Optical Fiber Junction Cable

Maximum transmission distance by optical fiber junction cable is shown below:
The maximum transmission distance varies depending on the number of relay points supported by optical fiber junction adapters. When the high-speed response type optical I/O Link adapter is in use, no optical fiber junction adapter can be used.

Optical I/O Link adapter	Relay points	Max. trans. distance
Standard type	0	200m
	1	100m (total)
High-speed response type	0	100m
	1	Not applicable

11 I/O Link DUMMY UNIT

11.1 OVERVIEW

If a slave unit (such as the FS0, Power Mate, I/O Unit-MODEL A, or connection unit) is removed from the FANUC I/O Link (Note), the group number for those that followed the removed slave unit changes. So, it becomes necessary to change the PMC assignment. However, connecting a FANUC I/O Link dummy unit in place of the removed slave unit makes it unnecessary to change PMC assignment.

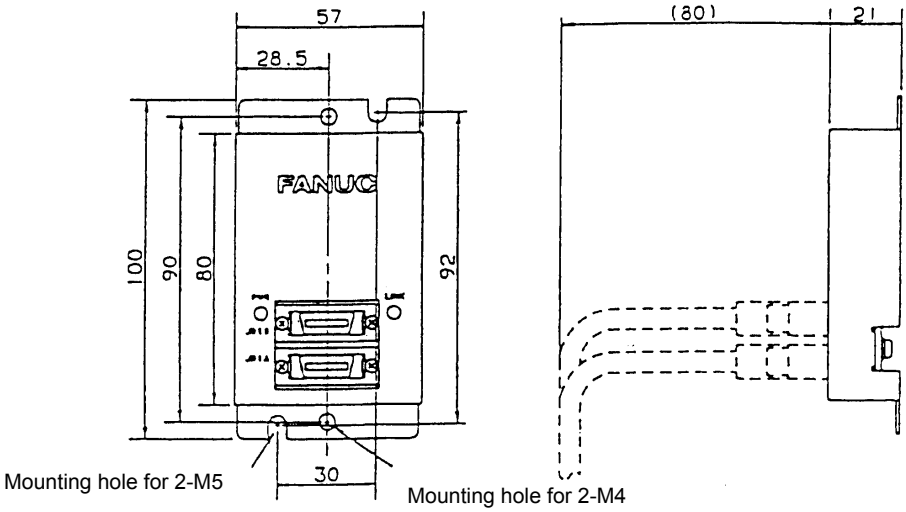
This chapter describes the electrical and structural specifications that apply to the FANUC I/O Link dummy unit when it is connected to the FANUC I/O Link.

Specification: A13B-0167-B001

NOTE
The FANUC I/O Link is a serial interface for connecting the CNC or cell controller to the I/O Unit-MODEL A, Power Mate, or other units for high-speed transfer of I/O signals (bit data).

11.2 EXTERNAL DIMENSIONS

Units: mm



11.3 LED INDICATORS

(1) PWR: Lights when the FANUC I/O Link dummy unit is supplied with power.
(2) LINK: Lights when the FANUC I/O Link is performing communication.

11.4 WEIGHT

(1) Main unit: Approximately 120 g

11.5 POWER REQUIREMENTS

(1) Supply voltage: 4.75 to 5.25 V (at reception terminal)
(2) Required current: 180 mA (maximum)
(3) Power dissipation: 0.9 W
(4) Supply method: Via the I/O link cable

11.6 INSTALLATION CONDITIONS

This unit is not hermetically sealed. So, it must be installed in a cabinet that is hermetically sealed to the same level as that for the NC. The cabinet must be installed in a location where the following environmental requirements are satisfied.

(1) Ambient temperature
Operating: 0 to 45°C
Storage and transportation: -20 to 60°C
(2) Humidity
Normal: 75% or less (relative)
Short-period (within one month): 95% (maximum)
(3) Vibration
Operating: 0.5 G or less

11.7 CONNECTION DIAGRAMS

11.7.1 When not Connecting FANUC I/O Link Dummy Units in Series

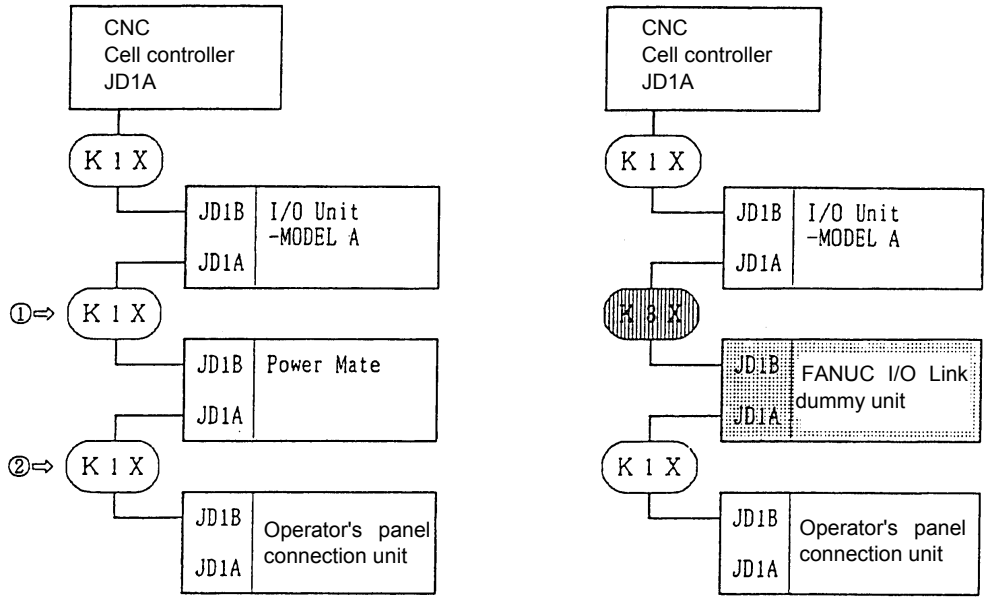


Fig. 11.7.1 Example of Using the FANUC I/O Link Dummy Unit (in Place of the Power Mate)

(1) Replacing a cable
The FANUC I/O Link dummy unit is supplied with power from the preceding or following group via a K3X cable. So, the K1X cable at either JD1A or JD1B of the dummy unit must be replaced with the K3X cable (① or ② in Fig. 11.7.1).

> ⚠ **CAUTION**
> Do not attach a K3X cable to JD1A and JD1B simultaneously.

(2) Cable length
K1X cable: 10 m (maximum) (for cabling within the same cabinet, up to 15 m)
K3X cable: 2 m (maximum)

11.7.2 Connecting FANUC I/O Link Dummy Units in Series

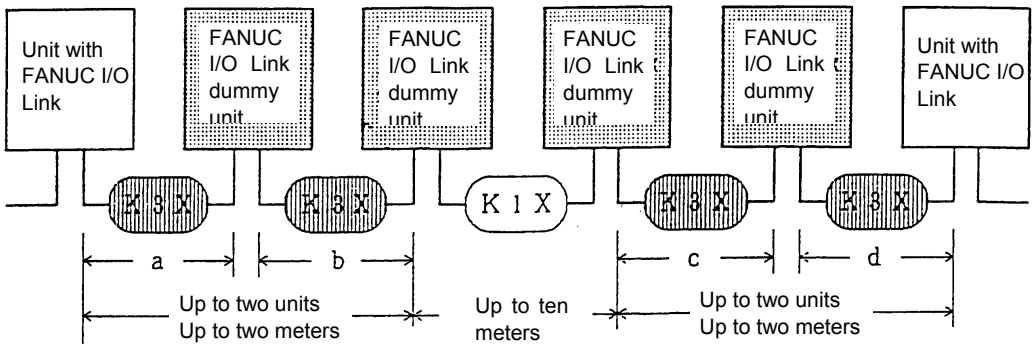


Fig. 11.7.2

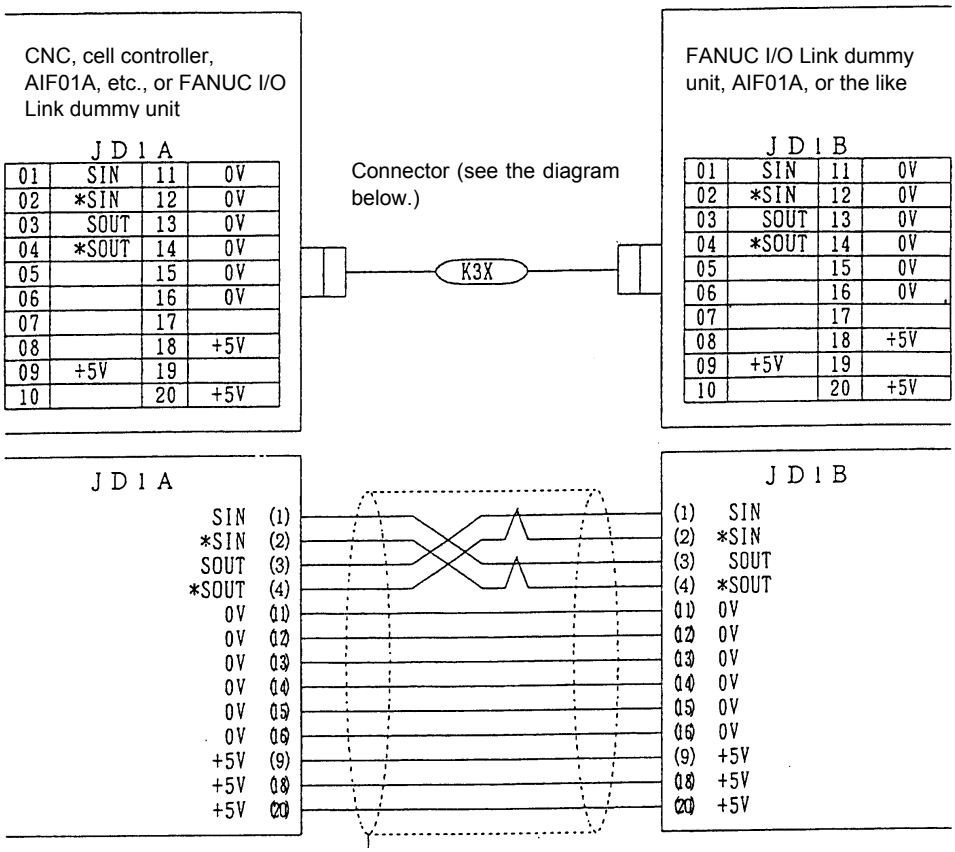
(1) Number of FANUC I/O Link dummy units that can be used in succession
Up to two FANUC I/O Link dummy units can be connected via a K3X cable to a unit that supplies power to them. (See Fig. 11.7.2.)

(2) Cable length
K1X cable: 10 m (maximum) (for cabling within the same cabinet, up to 15 m)
K3X cable: 2 m (maximum) in total ($a + b \leq 2$ m and $c + d \leq 2$ m)

11.7.3 Grounding

Ground the case of the FANUC I/O Link dummy unit.

11.7.4 K3X Cable



- Cable connector

Manufacturer	Pin		Housing
	Soldering type	Crimping type	
Honda Tsushin	PCR-E20FS	PCR-E20FA	PCR-V20LA
Hirose Electric	FI-40-20S	FI-30-20S	FI-20-CV2
Fujitsu	-	FCN-247J020-G/E	FCN-240C020-Y/S

- Use twisted-pair wires for the SIN, *SIN, SOUT, and *SOUT signals.
- Recommended wires : A66L-0001-0284#10P (twisted-pair wires with common shielding)
- Maximum cable length : 2 m (when recommended wires are used)
- Do not connect a wire to an idle pin.
- Connect the cable shielding to the grounding plate of the cabinet via a metal cable clamp at JD1A. (See the applicable CNC or cell controller connection manual.)

12 TWO-CHANNEL I/O Link CONNECTOR ADAPTER

12.1 OVERVIEW

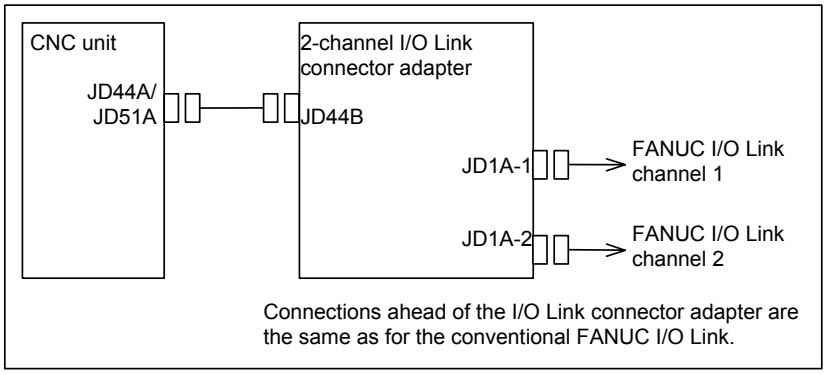
The FANUC Series 16*i*/18*i*/21*i*-MODEL B CNC has two FANUC I/O Link interface channels. These channels make it possible to increase the number of I/O points from 1024/1024 to 2048/2048.
This chapter explains how to connect a 2-channel I/O Link connector adapter required in using the I/O Link 2-channel function.

NOTE
Using this function on the 16*i*/18*i*/21*i*-MODEL B mentioned above requires specifying the PMC-SB6/-SB7.
This function cannot be used with the PMC on the loader control board.

12.2 CONNECTION FOR USE OF TWO FANUC I/O Link CHANNELS

Two channels' worth of I/O Link signals are allocated to the I/O Link connector (JD44A) of the Series 16*i*/18*i*/21*i*-MODEL B CNC.
Three channels' worth of I/O Link signals are allocated to the I/O Link connector (JD51A) of the Series 30*i*/31*i*/32*i* CNC.
To use two I/O Link channels in the above CNC, branch out the I/O Link (JD44A/JD51A connector signals), using an I/O Link connector adapter.
(See Chapter 13 for explanations about how to use the I/O Link 4-channel function with the Series 30*i*/31*i*/32*i*.)

Connection



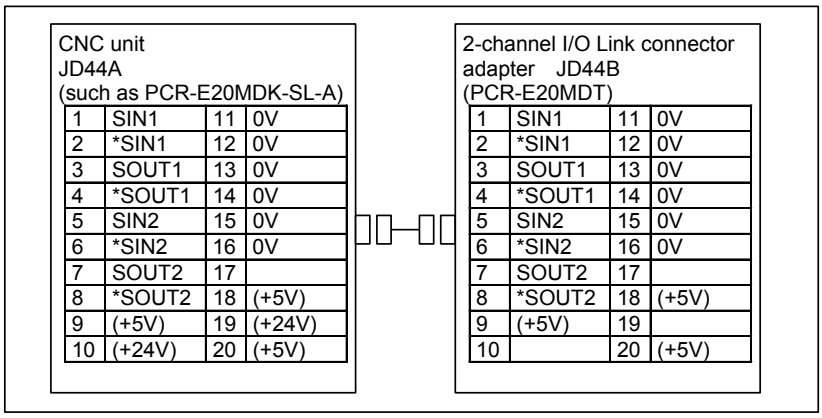
2-channel I/O Link connector adapter: A20B-1007-0680

Restriction

When 2 I/O Link channels are used, the FANUC I/O Unit-MODEL B supports connection of up to 8 groups for the 2 channels.

12.3 CONNECTING THE CNC WITH TWO-CHANNEL I/O Link CONNECTOR ADAPTER

Connecting the Series 16*i*/18*i*/21*i*-MODEL B CNC



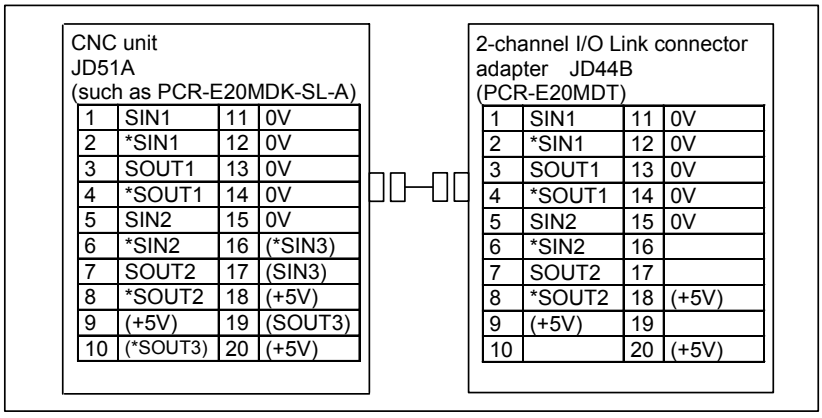
CNC unit
JD44A
(such as PCR-E20MDK-SL-A)

1	SIN1	11	0V
2	*SIN1	12	0V
3	SOUT1	13	0V
4	*SOUT1	14	0V
5	SIN2	15	0V
6	*SIN2	16	0V
7	SOUT2	17	
8	*SOUT2	18	(+5V)
9	(+5V)	19	(+24V)
10	(+24V)	20	(+5V)

2-channel I/O Link connector adapter JD44B
(PCR-E20MDT)

1	SIN1	11	0V
2	*SIN1	12	0V
3	SOUT1	13	0V
4	*SOUT1	14	0V
5	SIN2	15	0V
6	*SIN2	16	0V
7	SOUT2	17	
8	*SOUT2	18	(+5V)
9	(+5V)	19	
10		20	(+5V)

Connecting the Series 30*i*/31*i*/32*i* CNC



CNC unit
JD51A
(such as PCR-E20MDK-SL-A)

1	SIN1	11	0V
2	*SIN1	12	0V
3	SOUT1	13	0V
4	*SOUT1	14	0V
5	SIN2	15	0V
6	*SIN2	16	(*SIN3)
7	SOUT2	17	(SIN3)
8	*SOUT2	18	(+5V)
9	(+5V)	19	(SOUT3)
10	(*SOUT3)	20	(+5V)

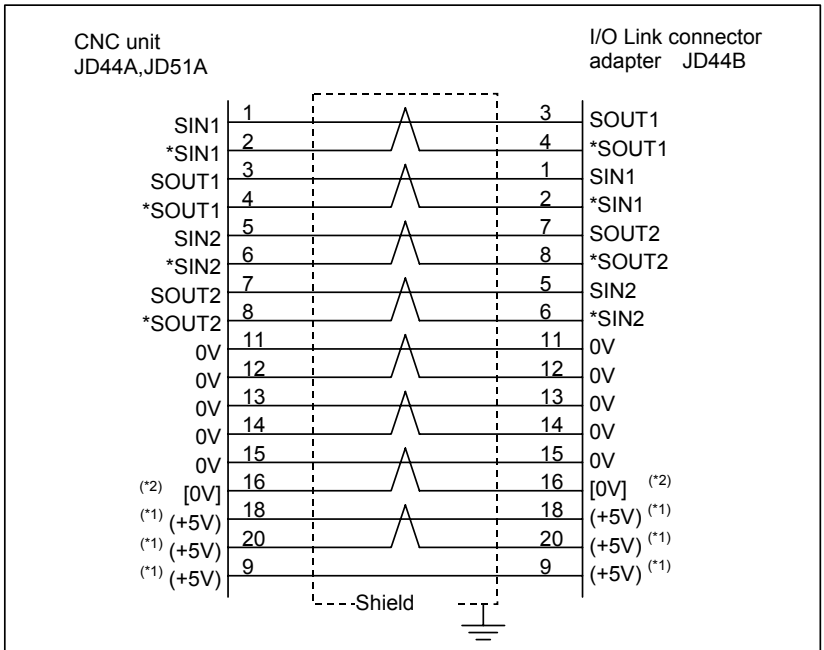
2-channel I/O Link connector adapter JD44B
(PCR-E20MDT)

1	SIN1	11	0V
2	*SIN1	12	0V
3	SOUT1	13	0V
4	*SOUT1	14	0V
5	SIN2	15	0V
6	*SIN2	16	
7	SOUT2	17	
8	*SOUT2	18	(+5V)
9	(+5V)	19	
10		20	(+5V)

The +5-V pin is intended to perform optical fiber transmission using an optical I/O Link adapter. When using no optical I/O Link adapter, keep the +5-V pin unconnected. (See Section 10.6 for details.)
When the Series 30*i*/31*i*/32*i* CNC is used, pins 10, 16, 17, and 19 are reserved for I/O Link channel 3. When connecting these CNC units with a 2-channel I/O Link adapter, do not connect anything to these pins.

Do not connect anything to the +24-V pin.

12.4 CABLING



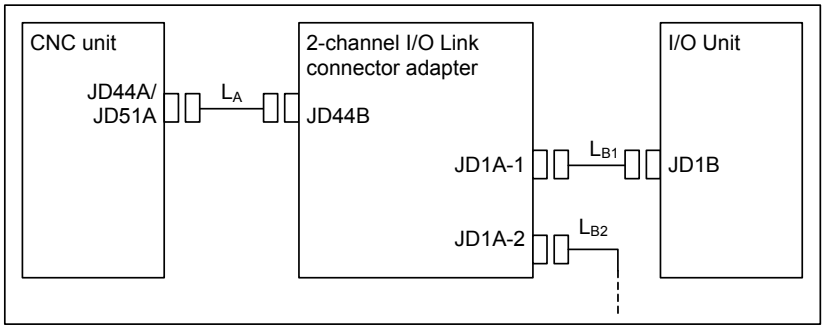
*1 When using no optical I/O Link adapter, do not connect anything to the +5-V pin.
*2 If the CNC of interest is the Series 30i/31i/32i, do not connect anything to pin 16.

Recommended cable-end connector:
PCR-E20FA (manufactured by HONDA TSUSHIN)
FCN-247J020-G/E (manufactured by Fujitsu)
52622-2011 (manufactured by Molex)
Recommended cable (wire): A66L-0001-0284#10P

12.5 CONNECTING TWO-CHANNEL I/O Link CONNECTOR ADAPTER TO I/O Units FOR THE FANUC I/O Link

The 2-channel I/O Link connector adapter can be connected to diverse I/O Units in the same manner as for the conventional FANUC I/O Link.

12.6 CABLE LENGTH

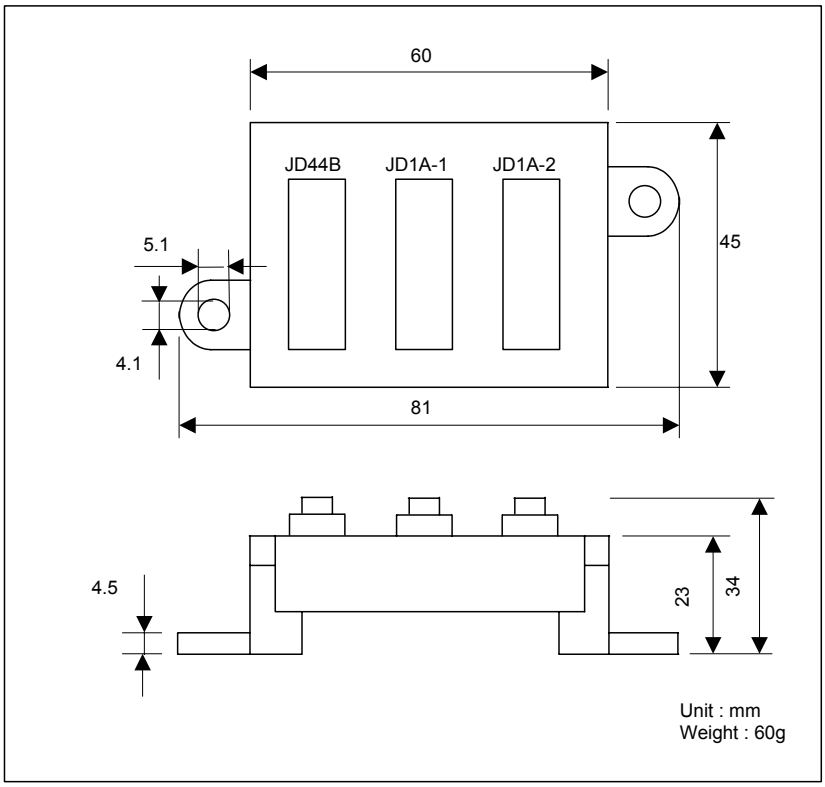


The sum (L_A + L_B) of the cable length L_A between the CNC unit (JD44A) and 2-channel I/O Link connector adapter (JD44B) and the cable length LB (= L_{B1} + L_{B2}) between the I/O Link connector adapter (JD1A-1 or JD1A-2) and I/O Unit (JD1B) shall not be longer than 10 m. For cabling within the same cabinet, the sum can be up to 15 m.

12.7 INSTALLING TWO-CHANNEL I/O Link CONNECTOR ADAPTER

Install the 2-channel I/O Link connector adapter in a cabinet that can be sealed on the same level as for the CNC unit.

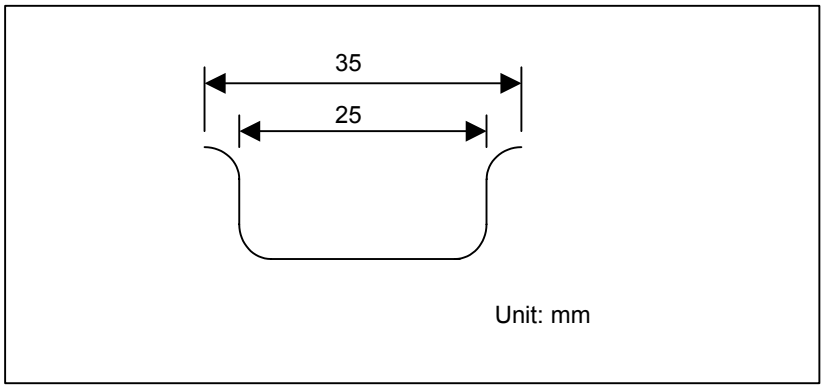
12.8 OUTSIDE DIMENSIONS OF TWO-CHANNEL I/O Link CONNECTOR ADAPTER



Allow a space of about 10 cm above the adapter so that cables can be laid and connected.

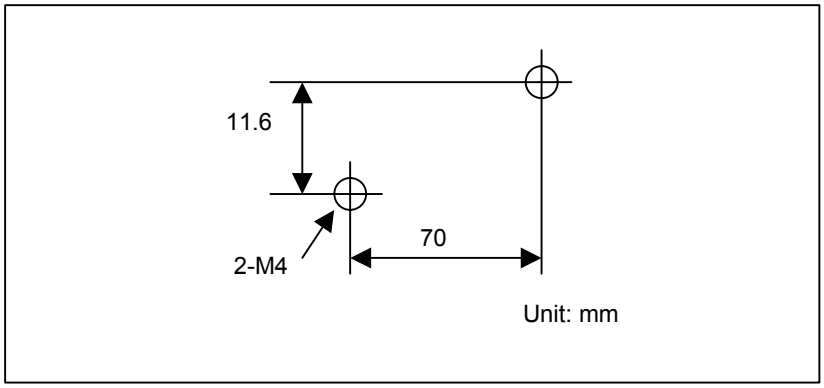
12.9 MOUNTING TWO-CHANNEL I/O Link CONNECTOR ADAPTER

Mounting on the DIN rail



Recommended DIN rail

Using screws



Mounting hole dimension and layout diagram

13 THREE-CHANNEL I/O Link CONNECTOR ADAPTER

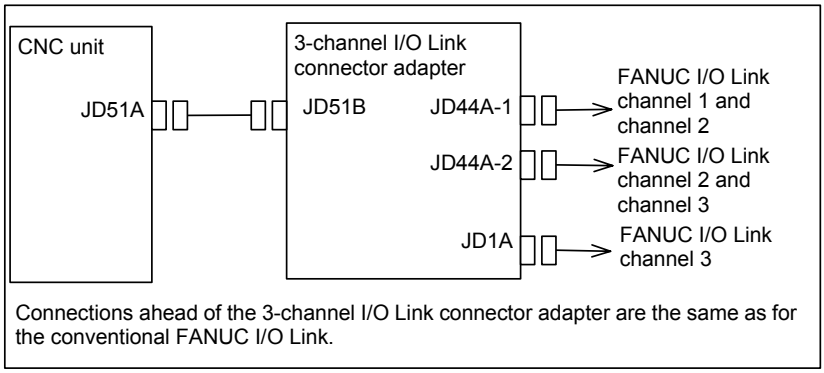
13.1 OVERVIEW

With the FANUC Series 30*i*/31*i*/32*i* CNC, it is possible to use up to 4 FANUC I/O Link interface channels. These channels make it possible to increase the number of I/O points from 1024/1024 to 4096/4096.
This chapter explains how to connect a 3-channel I/O Link connector adapter required in using the FANUC I/O Link 4-channel function.

13.2 CONNECTION FOR USE OF FOUR FANUC I/O Link CHANNELS

Three channels' worth of I/O Link signals are allocated to the I/O Link connector (JD51A) of the Series 30*i*/31*i*/32*i* CNC.
To use the I/O Link 4-channel function, branch out the JD51A connector signals, using a 3-channel I/O Link connector adapter.
(Channel 4 is allocated on the optional board.)

Connection



3-channel I/O Link connector adapter: A20B-1008-0360

Restriction

The FANUC I/O Unit-MODEL B supports connection of up to 8 groups for the 4 channels.

13.3 CONNECTING THE CNC WITH THREE-CHANNEL I/O Link CONNECTOR ADAPTER

CNC unit
JD51A
(such as PCR-E20MDK-SL-A)

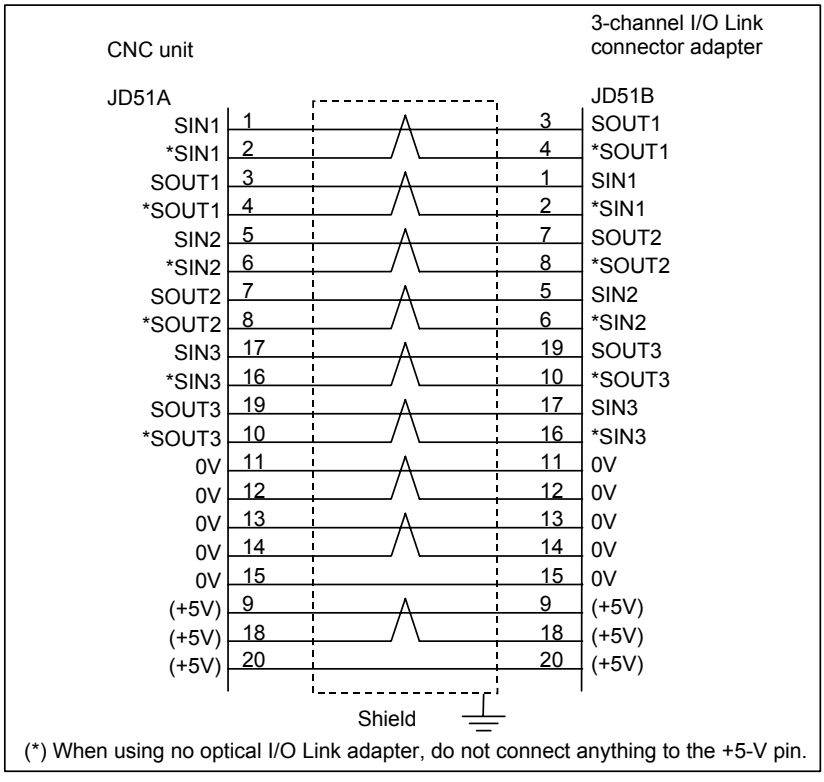
1	SIN1	11	0V
2	*SIN1	12	0V
3	SOUT1	13	0V
4	*SOUT1	14	0V
5	SIN2	15	0V
6	*SIN2	16	*SIN3
7	SOUT2	17	SIN3
8	*SOUT2	18	(+5V)
9	(+5V)	19	SOUT3
10	*SOUT3	20	(+5V)

3-channel I/O Link connector adapter JD51B
(PCR-E20MDT)

1	SIN1	11	0V
2	*SIN1	12	0V
3	SOUT1	13	0V
4	*SOUT1	14	0V
5	SIN2	15	0V
6	*SIN2	16	*SIN3
7	SOUT2	17	SIN3
8	*SOUT2	18	(+5V)
9	(+5V)	19	SOUT3
10	*SOUT3	20	(+5V)

The +5-V pin is intended to perform optical fiber transmission using an optical I/O Link adapter. When using no optical I/O Link adapter, keep the +5-V pin unconnected.

13.4 CABLING



Recommended cable-end connector:
PCR-E20FA (manufactured by HONDA TSUSHIN)
FCN-247J020-G/E (manufactured by Fujitsu)
52622-2011 (manufactured by Molex)
Recommended cable (wire): A66L-0001-0284#10P

13.5 ALLOCATING THREE-CHANNEL I/O Link CONNECTOR ADAPTER SIGNALS

3-channel I/O Link connector adapter JD44A-1
(PCR-E20MDT)

1	SIN1	11	0V
2	*SIN1	12	0V
3	SOUT1	13	0V
4	*SOUT1	14	0V
5	SIN2	15	0V
6	*SIN2	16	0V
7	SOUT2	17	
8	*SOUT2	18	(+5V)
9	(+5V)	19	
10		20	(+5V)

JD44A-2
(PCR-E20MDT)

1	SIN2	11	0V
2	*SIN2	12	0V
3	SOUT2	13	0V
4	*SOUT2	14	0V
5	SIN3	15	0V
6	*SIN3	16	0V
7	SOUT3	17	
8	*SOUT3	18	(+5V)
9	(+5V)	19	
10		20	(+5V)

JD1A
(PCR-E20MDT)

1	SIN3	11	0V
2	*SIN3	12	0V
3	SOUT3	13	0V
4	*SOUT3	14	0V
5		15	0V
6		16	0V
7		17	
8		18	(+5V)
9	(+5V)	19	
10		20	(+5V)

13.6 CONNECTING THREE-CHANNEL I/O Link CONNECTOR ADAPTER SIGNAL TO EACH CHANNEL

The 3-channel I/O Link connector adapter can be connected to each I/O Unit in the same manner as for the conventional I/O Link. However, note the following points:

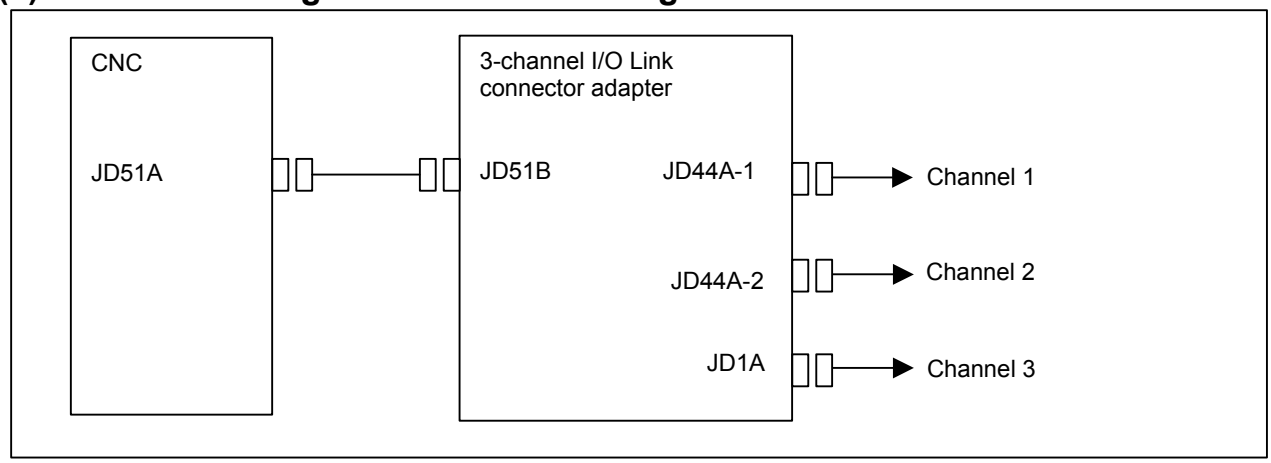
The signals for I/O Link channels 1 and 2 are allocated to the JD44A-1 connector. The signals for I/O Link channels 2 and 3 are allocated to the JD44A-2 connector.
The JD1A connector is dedicated to I/O Link channel 3.

(1) To branch out the 3-channel signals, an ordinary I/O Link cable is connected to each of the JD44A-1, JD44A-2, and JD1A. In this case, the JD44A-1, JD44A-2, and JD1A correspond, respectively, to channels 1, 2, and 3.

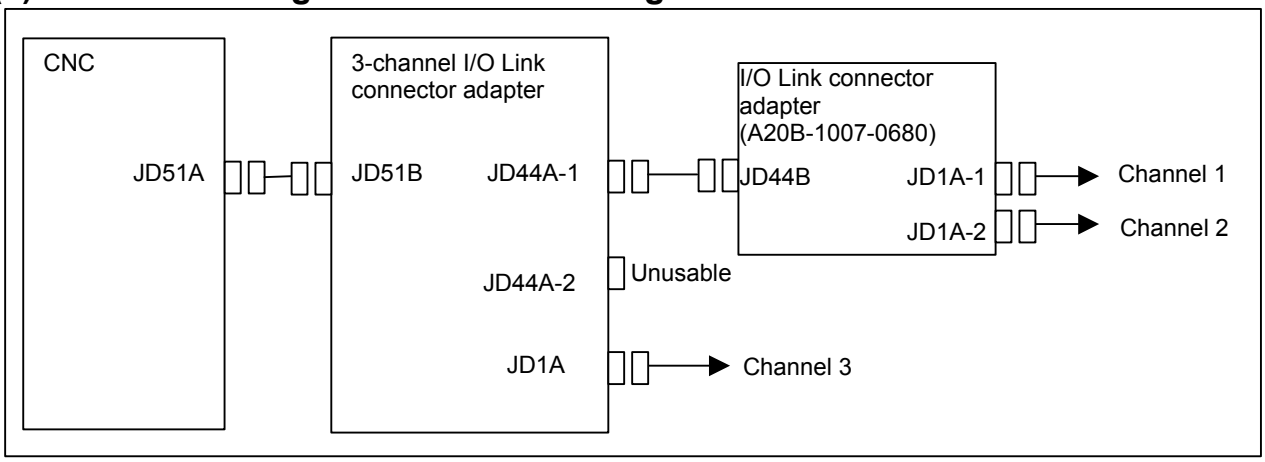
(2) To extend channels 1 and 2 together, the I/O Link connector adapter (A20B-1007-0680) is connected to the JD44A-1 to separate channels 1 and 2 from each other after the adapter.
To use channel 3, connect it to the JD1A; the JD44A-2 cannot be used.

(3) To extend channels 2 and 3 together, the I/O Link connector adapter (A20B-1007-0680) is connected to the JD44A-2 to separate channels 2 and 3 from each other after the adapter.
To use channel 1, connect it to the JD44A-1; the JD1A cannot be used.

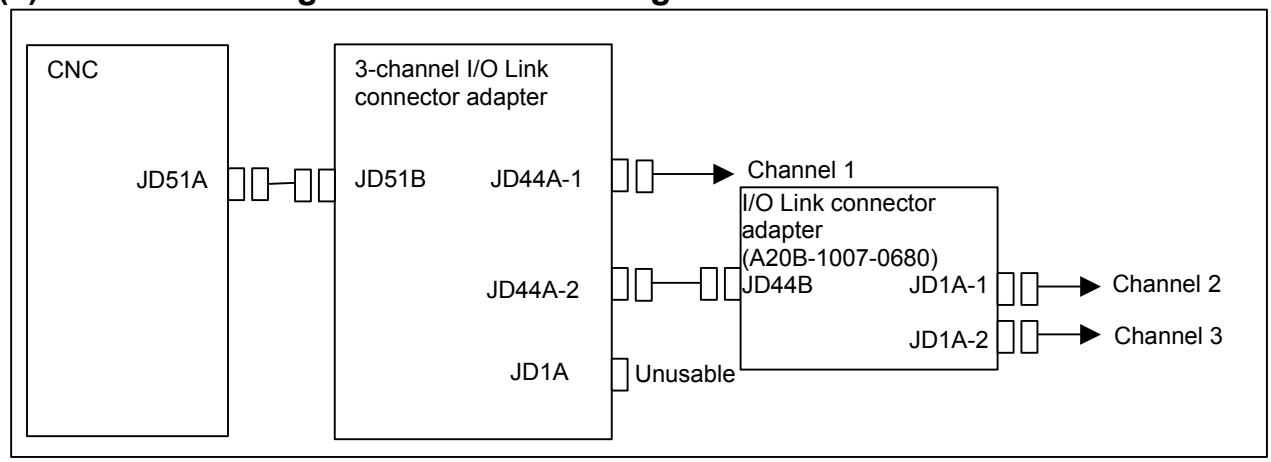
(1) When branching out the 3-channel signals



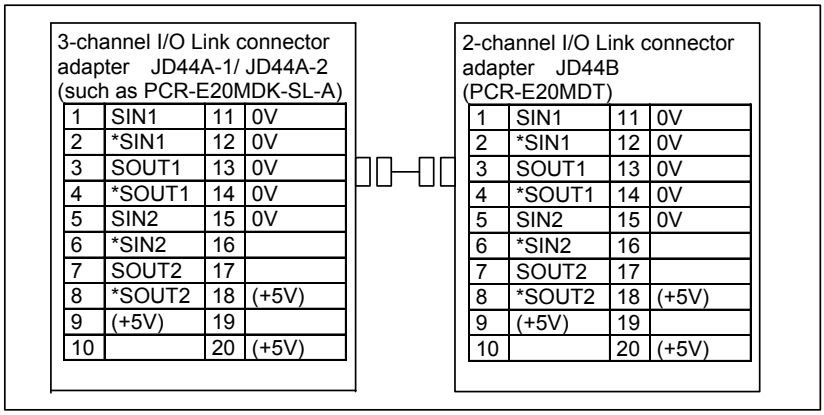
(2) When extending channels 1 and 2 together



(3) When extending channels 2 and 3 together



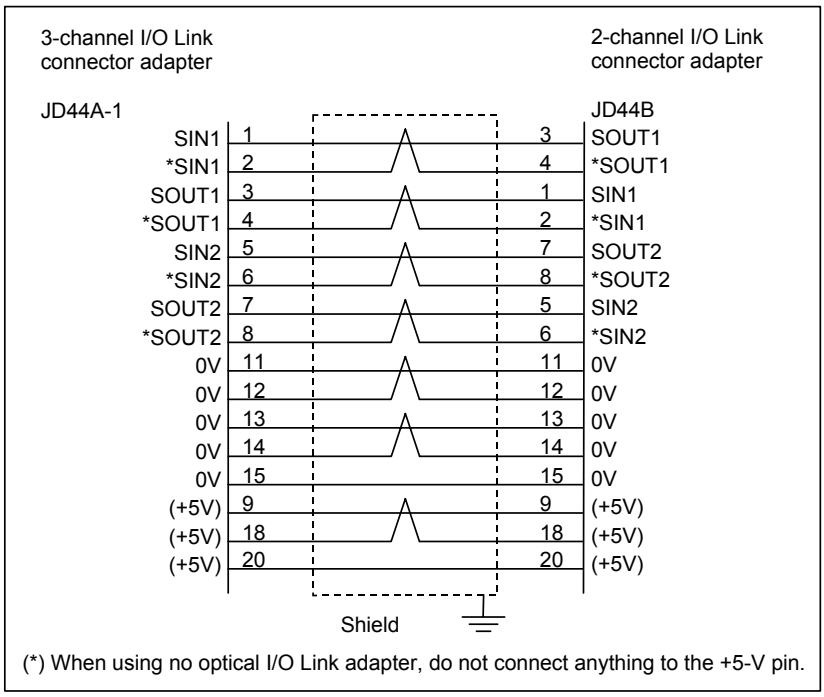
13.7 CONNECTING THREE-CHANNEL I/O Link CONNECTOR ADAPTER TO TWO-CHANNEL I/O Link CONNECTOR ADAPTER



1	SIN1	11	0V
2	*SIN1	12	0V
3	SOUT1	13	0V
4	*SOUT1	14	0V
5	SIN2	15	0V
6	*SIN2	16	
7	SOUT2	17	
8	*SOUT2	18	(+5V)
9	(+5V)	19	
10		20	(+5V)

The +5-V pin is intended to perform optical fiber transmission using an optical I/O Link adapter. When using no optical I/O Link adapter, keep the +5-V pin unconnected.

Cabling



Recommended cable-end connector:

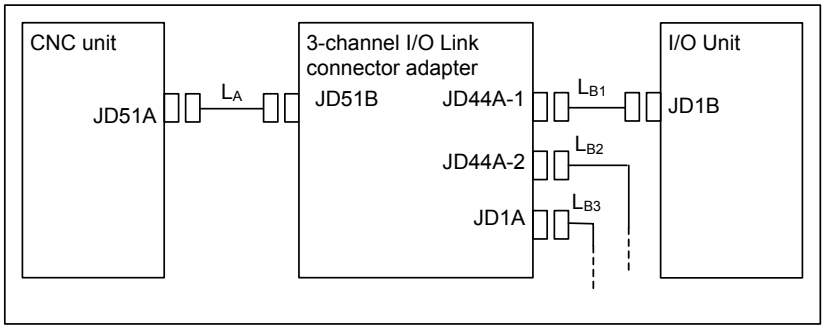
PCR-E20FA (manufactured by HONDA TSUSHIN)
FCN-247J020-G/E (manufactured by Fujitsu)
52622-2011 (manufactured by Molex)

Recommended cable (wire): A66L-0001-0284#10P

13.8 CONNECTING THREE-CHANNEL I/O Link CONNECTOR ADAPTER TO I/O Units FOR THE FANUC I/O Link

The 3-channel I/O Link connector adapter can be connected to diverse I/O Units in the same manner as for the conventional FANUC I/O Link.

13.9 CABLE LENGTH

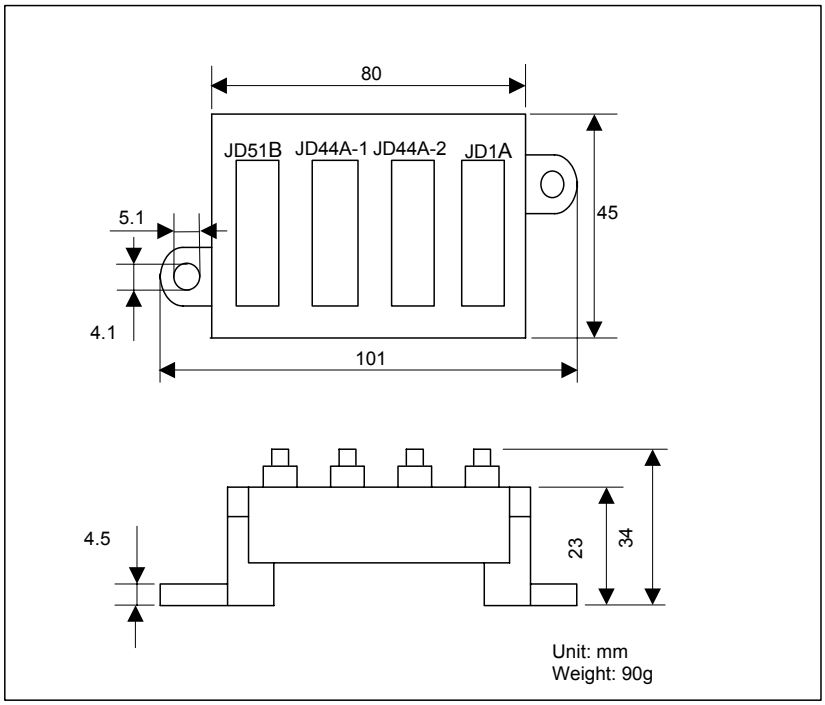


The sum (L_A + L_B) of the cable length L_A between the CNC unit (JD51A) and I/O Link connector adapter (JD51B) and the cable length LB (=L_{B1}+L_{B2}+L_{B3}) between the I/O Link connector adapter (JD44A-1, JD44A-2, or JD1A) and I/O Unit (JD1B) shall not be longer than 10 m. For cabling within the same cabinet, the sum can be up to 15 m.

13.10 INSTALLING THREE-CHANNEL I/O Link CONNECTOR ADAPTER

Install the 3-channel I/O Link connector adapter in a cabinet that can be sealed on the same level as for the CNC unit.

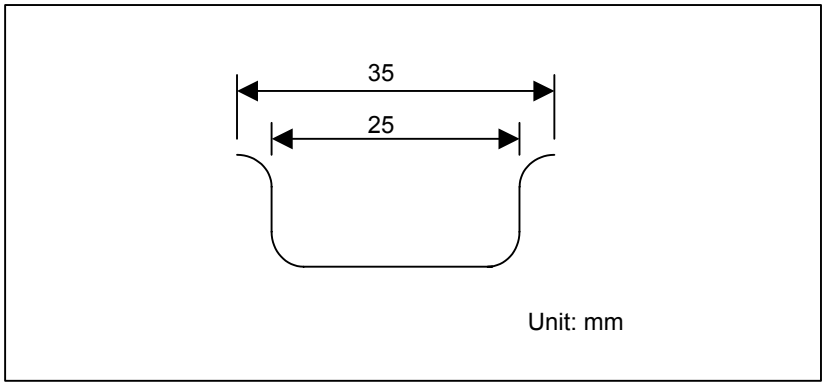
13.11 OUTSIDE DIMENSIONS OF THREE-CHANNEL I/O Link CONNECTOR ADAPTER



Allow a space of about 10 cm above the adapter so that cables can be laid and connected.

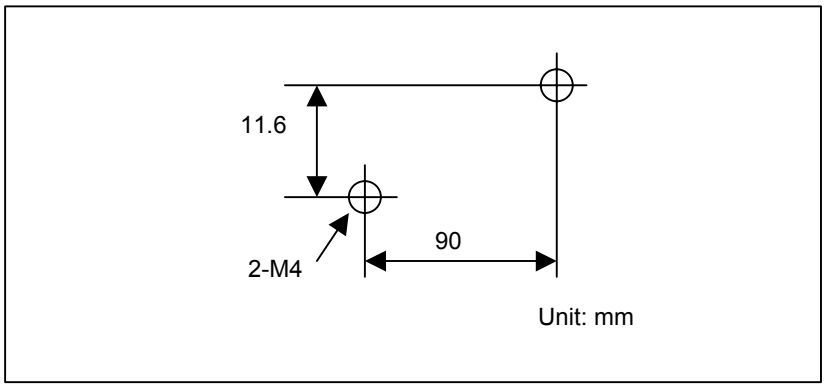
13.12 MOUNTING THREE-CHANNEL I/O Link CONNECTOR ADAPTER

Mounting on the DIN rail



Recommended DIN rail

Using screws



Mounting hole dimension and layout diagram

14 SAFETY FOR USING AC

IF AC output module or AC input module is used, Section 14.1 is recommended for safety. When using it for a machine directed to the European market, carefully observe the descriptions in Section 14.1 [as per EN50178].

14.1 ENVIRONMENT FOR INSTALLATION

14.1.1 Installation Category (Overvoltage Category)

Install the unit in the environment of Installation Category II (Overvoltage Category II) or better. [DIN VDE0110]
The available impulse surge level to the ground that appears in the power source is 2.5kV maximum.
(100VAC system power source is needed in AC input module According to the standard, the available impulse surge level to the ground is 1.5kV for this power source (voltage of which is 150VAC or less). However, for this module, the available impulse surge level to the ground that appears in the power source is 2.5 kV.)
Generally, an isolation transformer used for the main power source is regarded as an effective surge filter.

The class of the 16-point relay output module (AOR16G) is set to installation category (overvoltage category) I.
(Keep any impulse voltage to ground that may appear on the AC power to within 1.5 kV.)

The class for the 8-point relay output module (AOR08G), AC output module, and AC input module is set to installation category (overvoltage category) II.

14.1.2 Pollution Degree

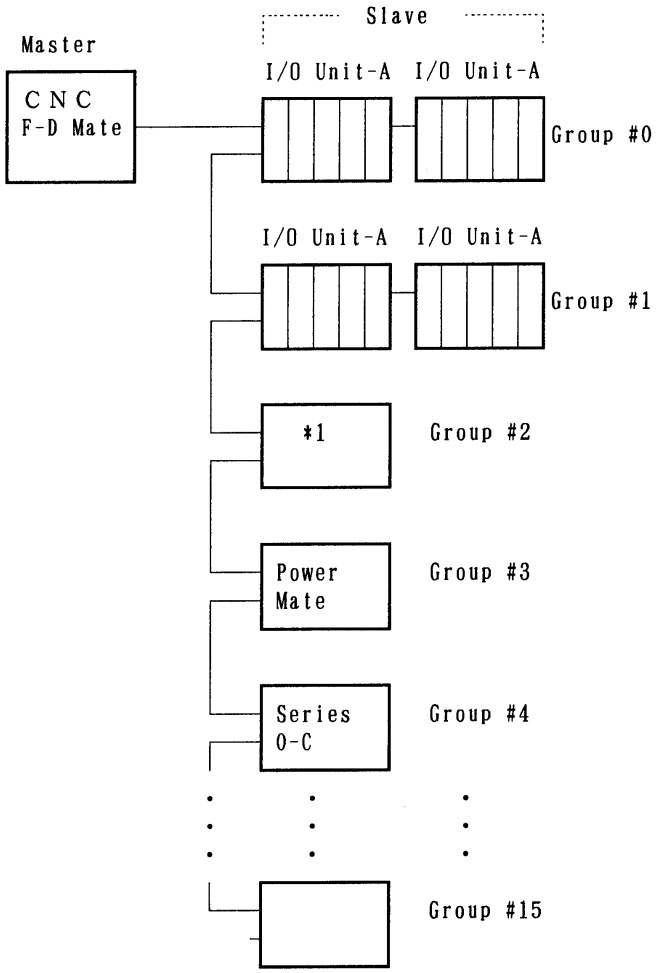
Install the unit in the environment of pollution degree 2 or better. [EN50178]
In cabinet of IP-54 or better (described in Section 3.1), it can be considered as pollution degree 2 or better usually. The IP degree required is depended on the circumstances of machine tool, so select the adequate degree in accordance with such environment.

II. MAINTENANCE

1 OVERVIEW

1.1 SYSTEM CONFIGURATION

I/O Unit-A is connected to a CNC and cell controller through a high-speed serial interface, I/O Link.



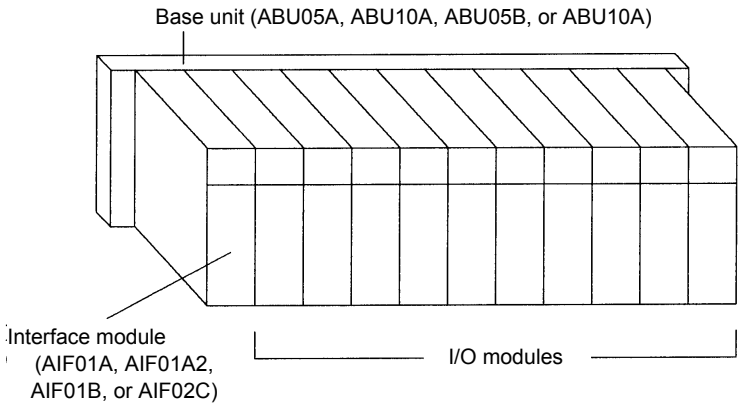
(*1) Operator's panel connection unit

(1) The I/O Link consists of a master and slaves.
Master: Series0-C, Series15/16/18/20/21,
Series15*i*/16*i*/18*i*/20*i*/21*i*/30*i*/31*i*/32*i*/0*i*,
Power Mate-D/H, Power Mate *i*-D/H, F-D Mate
Slave: I/O Unit-A, I/O Unit-B, Power Mate, operator's panel connection unit, and Series 0-C, and so on

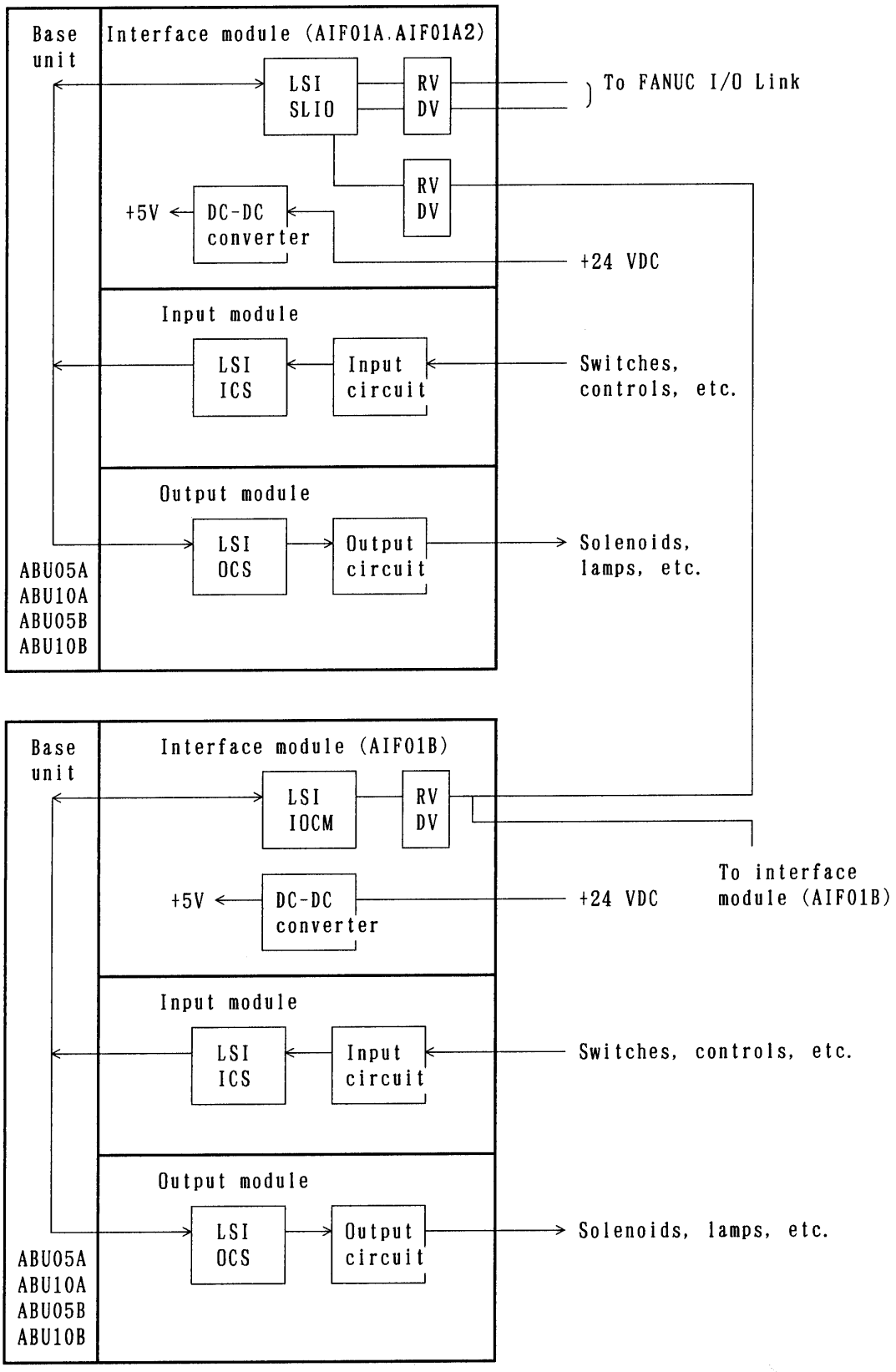
(2) One I/O Link can connect to up 16 groups of slaves. If the master is not a CNC, one slave group can contain up to 2 of I/O Unit A (2 base units). If the master is the F-D Mate, however, one group can contain up to 4 I/O Units.

1.2 I/O Unit-A CONFIGURATION

An I/O Unit-A consists of a base unit, interface module, and I/O modules.



1.3 BLOCK DIAGRAM



1.4 I/O Unit-MODEL A CONFORMING TO UL/C-UL

The units conforming to the UL/C-UL standard have different drawing numbers.
The following table lists the units conforming to the UL/C-UL standard and those not.

	I/O Unit-MODEL A conforming to the UL/C-UL standard	**I/O Unit-MODEL A not conforming to the UL/C-UL standard**
Unit drawing number	A03B-0819-Jxxx	A03B-0807-Jxxx
Unit specification (interface, dimensions, and weight)	Same specification	
Plastic case	Fire retardancy: 94V-0 (material less likely to burn)	Fire retardancy: 94HB
Unit nameplate	The nameplates for the base unit and interface module bear a UL mark.	The nameplates have no UL mark.

- Refer to Section 1.5, "LIST OF UNITS", in Part II for individual unit drawings.
- It is possible to use units conforming to the UL/C-UL standard and those not conforming together.

1.5 LIST OF UNITS

1.5.1 Units Conforming to UL/C-UL Standard: Ordering Information A03B-0819-Jxxx

Name				Unit conforming to UL/C-UL standard		
				Ordering information	Unit drawing number	Drawing number for printed circuit board in unit
Base unit	10 slots	Horizontal type	ABU10A	A03B-0819-J001	A03B-0819-C001	A20B-9001-0040
		Vertical type	ABU10B	A03B-0819-J004	A03B-0819-C004	A20B-2003-0100
	5 slots	Horizontal type	ABU05A	A03B-0819-J002	A03B-0819-C002	A20B-9001-0020
		Vertical type	ABU05B	A03B-0819-J003	A03B-0819-C003	A20B-2000-0510
Interface module		Power supply connector: SORIAU JAPAN 3-pin (former Burndy)	AIF01A	A03B-0819-J011	A03B-0819-C011	A20B-8000-0410
		Power supply connector: Tyco Electronics 3-pin	AIF01A2	A03B-0819-J014	A03B-0819-C014	A20B-8000-0411
		Power supply connector: SORIAU JAPAN 3-pin (former Burndy)	AIF01B	A03B-0819-J012	A03B-0819-C012	A20B-8000-0420
		Power supply connector: SORIAU JAPAN 3-pin (former Burndy)	AIF02C	A03B-0819-J013	A03B-0819-C013	A20B-8000-0710
DC input module	Non-insulations	32 points, 20ms, HONDA 50-pin	AID32A1	A03B-0819-J101	A03B-0819-C101	A20B-8002-0450 or -9000-0970
		32 points, 2ms, HONDA 50-pin	AID32B1	A03B-0819-J102	A03B-0819-C102	A20B-8002-0451 or -9000-0971
		32 points, 20 ms and 2 ms intermixed, HONDA 50-pin	AID32H1	A03B-0819-J111	A03B-0819-C111	A20B-8002-0452 or -9000-0972
	Insulations	16 points, NEG, 20ms, terminal block	AID16C	A03B-0819-J103	A03B-0819-C103	A20B-8002-0380 or -9000-0931
		16 points, NEG, 2ms, terminal block	AID16K	A03B-0819-J113	A03B-0819-C113	A20B-8002-0381 or -9000-0932
		16 points, POS, 20ms, terminal block	AID16D	A03B-0819-J104	A03B-0819-C104	A20B-8002-0370 or -9000-0901
		16 points, POS, 2ms, terminal block	AID16 L	A03B-0819-J114	A03B-0819-C114	A20B-8002-0371 or -9000-0902
		32 points, 20ms, HONDA 50-pin	AID32E1	A03B-0819-J105	A03B-0819-C105	A20B-8002-0150
		32 points, 20ms, HIROSE 50-pin	AID32E2	A03B-0819-J110	A03B-0819-C110	A20B-8002-0160
		32 points, 2ms, HONDA 50-pin	AID32F1	A03B-0819-J106	A03B-0819-C106	A20B-8002-0151
		32 points, 2ms, HIROSE 50-pin	AID32F2	A03B-0819-J109	A03B-0819-C109	A20B-8002-0161
AC input module		16 points, 100 to 115VAC terminal block	AIA16G	A03B-0819-J107	A03B-0819-C107	A20B-8000-0341

Name				Unit conforming to UL/C-UL standard		
				Ordering information	Unit drawing number	Drawing number for printed circuit board in unit
DC output module	Non-insulations	32 points, NEG, 0.3A HONDA 50-pin	AOD32A1	A03B-0819-J162	A03B-0819-C162	A20B-8002-0460 or -9001-0110
	Insulations	8 points, NEG, 2A, terminal block	AOD08C	A03B-0819-J151	A03B-0819-C151	A20B-8002-0420 or -9001-0210
		8 points, POS, 2A, terminal block	AOD08D	A03B-0819-J152	A03B-0819-C152	A20B-8002-0410 or -9001-0220
		8 points, POS, 2A, output protection, terminal block	AOD08DP	A03B-0819-J183	A03B-0819-C183	A20B-8002-0060
		16 points, NEG, 0.5A, terminal block	AOD16C	A03B-0819-J153	A03B-0819-C153	A20B-8002-0400 or -9000-0941
		16 points, POS, 0.5A, terminal block	AOD16D	A03B-0819-J154	A03B-0819-C154	A20B-8002-0390 or -9000-0921
		16 points, POS, 2A HONDA 40-pin	AOD16D2	A03B-0819-J171	A03B-0819-C171	A20B-8002-0570
		16 points, POS, 2A Weidmüller 24-pin connector	AOD16D3	A03B-0819-J185	A03B-0819-C185	A20B-8002-0520
		16 points, POS, 0.3A, output protection, terminal block	AOD16DP	A03B-0819-J182	A03B-0819-C182	A20B-8002-0070
		32 points, NEG, 0.3A HONDA 50-pin connector	AOD32C1	A03B-0819-J155	A03B-0819-C155	A20B-8002-0430 or -9001-0070
		32 points, NEG, 0.3A HIROSE 50-pin connector	AOD32C2	A03B-0819-J172	A03B-0819-C172	A20B-8002-0440 or -9001-0530
		32 points, POS, 0.3A HONDA 50-pin connector	AOD32D1	A03B-0819-J156	A03B-0819-C156	A20B-8000-0440
		32 points, POS, 0.3A HIROSE 50-pin connector	AOD32D2	A03B-0819-J167	A03B-0819-C167	A20B-8000-0510
AC output module		5 points, 2A, 100 to 230VAC terminal block	AOA05E	A03B-0819-J157	A03B-0819-C157	A20B-8000-0470
		8 points, 1A, 100 to 230VAC terminal block	AOA08E	A03B-0819-J158	A03B-0819-C158	A20B-8000-0480
		12 points, 0.5A, 100 to 115VAC, terminal block	AOA12F	A03B-0819-J159	A03B-0819-C159	A20B-8000-0321
Relay output module		8 points, 4A, terminal block	AOR08G	A03B-0819-J160	A03B-0819-C160	A20B-8002-0470 or -9001-0200
		16 points, 2A, terminal block	AOR16G	A03B-0819-J161	A03B-0819-C161	A20B-8000-0101
		16 points, 2A, HIROSE 50-pin	AOR16H2	A03B-0819-J165	A03B-0819-C165	A20B-8000-0500
DC input/output hybrid module		DI: 24 points DO: 16 points, NEG HONDA 50-pin	AIO40A	A03B-0819-J200	A03B-0819-C200	A20B-9001-0240
Analog input module		12bit, terminal block	AAD04A	A03B-0819-J051	A03B-0819-C051	A20B-8000-0450
		16bit, terminal block	AAD04B	A03B-0819-J063	A03B-0819-C063	A20B-8002-0590
Analog output module		12bit, terminal block	ADA02A	A03B-0819-J052	A03B-0819-C052	A20B-8000-0460
		14bit, terminal block	ADA02B	A03B-0819-J060	A03B-0819-C060	A20B-8001-0980
High-speed counter module			ACT01A	A03B-0819-J053	A03B-0819-C053	A20B-8000-0540
Temperature input module		Pt/JPt	ATI04A	A03B-0819-J056	A03B-0819-C056	A74L-0001-0083#PT
		J/K	ATI04B	A03B-0819-J057	A03B-0819-C057	A74L-0001-0083#JK
		Pt/JPt	ATB01A	A03B-0819-J350	A03B-0819-C350	A20B-1005-0920
		J/K	ATB01B	A03B-0819-J351	A03B-0819-C351	A20B-1005-0930

1.5.2 Other Units (not Conforming to UL/C-UL)

Name	Ordering information	Drawing number for printed circuit
Optical I/O Link adapter	A13B-0154-B001	A20B-1004-0240
High-speed response type optical I/O Link adapter	A13B-0154-B002	A20B-1004-0241
Optical fiber junction adapter	A02B-0094-K841	-
I/O Link dummy unit	A13B-0167-B001	A20B-8000-0940
2-channel I/O Link connector adapter	A20B-1007-0680	A20B-1007-0680
3-channel I/O Link connector adapter	A20B-1008-0360	A20B-1008-0360

1.5.3 Early Units (Units not Conforming to UL/C-UL: Ordering Information A03B-0807-Jxxx)

The modules listed below are those produced before the factory was UL-approved.
The module's basic performance does not differ between A03B-0807-Jxxx and A03B-0819-Jxxx.
The units with the new ordering information A03B-0819-Jxxx are housed in cases made of material less likely to burn.

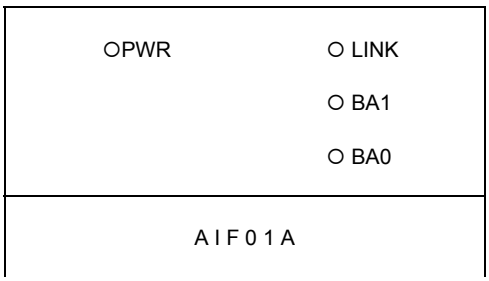
Name				Early unit		
				Early ordering information	Early-unit drawing number	Drawing number for printed circuit board in early unit
Base unit	10 slots	Horizontal type	ABU10A	A03B-0807-J001	A03B-0807-C001	A20B-9001-0040
		Vertical type	ABU10B	A03B-0807-J004	A03B-0807-C004	A20B-2003-0100 or -2000-0550
	5 slots	Horizontal type	ABU05A	A03B-0807-J002	A03B-0807-C002	A20B-9001-0020
		Vertical type	ABU05B	A03B-0807-J003	A03B-0807-C003	A20B-2000-0510
Interface module			AIF01A	A03B-0807-J011	A03B-0807-C011	A20B-8000-0410
			AIF01B	A03B-0807-J012	A03B-0807-C012	A20B-8000-0420
			AIF02C	A03B-0807-J013	A03B-0807-C013	A20B-8000-0710
DC input module	Non-insulations	32 points, 20ms, HONDA 50-pin	AID32A1	A03B-0807-J101	A03B-0807-C101	A20B-9000-0970
		32 points, 2ms, HONDA 50-pin	AID32B1	A03B-0807-J102	A03B-0807-C102	A20B-9000-0971
		32 points, 20 ms and 2 ms intermixed, HONDA 50-pin	AID32H1	A03B-0807-J111	A03B-0807-C111	A20B-9000-0972
	Insulations	16 points, NEG, 20ms, terminal block	AID16C	A03B-0807-J103	A03B-0807-C103	A20B-9000-0931
		16 points, NEG, 2ms, terminal block	AID16K	A03B-0807-J113	A03B-0807-C113	A20B-9000-0932
		16 points, POS, 20ms, terminal block	AID16D	A03B-0807-J104	A03B-0807-C104	A20B-9000-0901
		16 points, POS, 2ms, terminal block	AID16 L	A03B-0807-J114	A03B-0807-C114	A20B-9000-0902
		32 points, 20ms, HONDA 50-pin	AID32E1	A03B-0807-J105	A03B-0807-C105	A20B-8002-0150 or -9001-0010
		32 points, 20ms, HIROSE 50-pin	AID32E2	A03B-0807-J110	A03B-0807-C110	A20B-8002-0160 or -9001-0280
		32 points, 2ms, HONDA 50-pin	AID32F1	A03B-0807-J106	A03B-0807-C106	A20B-8002-0151 or -9001-0011
		32 points, 2ms, HIROSE 50-pin	AID32F2	A03B-0807-J109	A03B-0807-C109	A20B-8002-0161 or -9001-0281
AC input module		16 points, 100 to 115VAC terminal block	AIA16G	A03B-0807-J107	A03B-0807-C107	A20B-8000-0341

Name				Early unit		
				Early ordering information	Early-unit drawing number	Drawing number for printed circuit board in early unit
DC output module	Non-insulations	32 points, NEG, 0.3A, HONDA 50-pin	AOD32A1	A03B-0807-J162	A03B-0807-C162	A20B-9001-0110
	Insulations	8 points, NEG, 2A, terminal block	AOD08C	A03B-0807-J151	A03B-0807-C151	A20B-9001-0210 or -9000-0951
		8 points, POS, 2A, terminal block	AOD08D	A03B-0807-J152	A03B-0807-C152	A20B-9001-0220 or -9000-0911
		16 points, NEG, 0.5A, terminal block	AOD16C	A03B-0807-J153	A03B-0807-C153	A20B-9000-0941
		16 points, POS, 0.5A, terminal block	AOD16D	A03B-0807-J154	A03B-0807-C154	A20B-9000-0921
		16 points, POS, 2A, HIROSE 40-pin	AOD16D2	A03B-0807-J171	A03B-0807-C171	A20B-8002-0570 or -9001-0490
		16 points, POS, 0.3A, output protection, terminal block	AOD16DP	A03B-0807-J182	A03B-0807-C182	A20B-8002-0070
		32 points, NEG, 0.3A, HONDA 50-pin	AOD32C1	A03B-0807-J155	A03B-0807-C155	A20B-9001-0070
		32 points, NEG, 0.3A, HIROSE 50-pin	AOD32C2	A03B-0807-J172	A03B-0807-C172	A20B-9001-0530
		32 points, POS, 0.3A, HONDA 50-pin	AOD32D1	A03B-0807-J156	A03B-0807-C156	A20B-8000-0440
		32 points, POS, 0.3A, HIROSE 50-pin	AOD32D2	A03B-0807-J167	A03B-0807-C167	A20B-8000-0510
AC output module		5 points, 2 A , 100 to 230VAC terminal block	AOA05E	A03B-0807-J157	A03B-0807-C157	A20B-8000-0470 or -8000-0251
		8 points, 1 A , 100 to 230VAC terminal block	AOA08E	A03B-0807-J158	A03B-0807-C158	A20B-8000-0480 or -8000-0381
		12 points, 0.5 A , 100 to 115VAC terminal block	AOA12F	A03B-0807-J159	A03B-0807-C159	A20B-8000-0321
Relay output module		8 points, 4 A , terminal block	AOR08G	A03B-0807-J160	A03B-0807-C160	A20B-9001-0200 or -9000-0961
		16 points, 2 A , terminal block	AOR16G	A03B-0807-J161	A03B-0807-C161	A20B-8000-0101
		16 points, 2 A , HIROSE 50-pin	AOR16H2	A03B-0807-J165	A03B-0807-C165	A20B-8000-0500
Analog input module		12bit, terminal block	AAD04A	A03B-0807-J051	A03B-0807-C051	A20B-8000-0450
Analog output module		12bit, terminal block	ADA02A	A03B-0807-J052	A03B-0807-C052	A20B-8000-0460
		14bit, terminal block	ADA02B	A03B-0807-J060	A03B-0807-C060	A20B-8001-0980
High-speed counter module			ACT01A	A03B-0807-J053	A03B-0807-C053	A20B-8000-0540
Temperature input module		Pt/JPt	ATI04A	A03B-0807-J056	A03B-0807-C056	A74L-0001-0083#PT
		J/K	ATI04B	A03B-0807-J057	A03B-0807-C057	A74L-0001-0083#JK
		Pt/JPt	ATB01A	A03B-0807-J350	A03B-0807-C350	A20B-1005-0920
		J/K	ATB01B	A03B-0807-J351	A03B-0807-C351	A20B-1005-0930

2 INDICATION

The interface modules and the I/O modules with up to 16 input/output points have LEDs to indicate their states.

2.1 INTERFACE MODULE (AIF01A, AIF01A2) LED INDICATORS



Marking	Name	Description
PWR	Power-on	On: The interface module is supplied with power of 24 VDC.
LINK	Link	On: The I/O Link is operating properly. Normally, this LED lights several to ten-odd seconds after the master is turned on.
BA1 BA0	Base address	These LEDs indicate which base unit the inter-face module is transferring data with. If a failure occurs (the LINK LED is turned on, then off), BA0 or BA1, whichever is operating, is turned on.

BA1	BA0	Base number
○	○	Base #0
○	●	Base #1
●	○	Base #2
●	●	Base #3

○ : Off
● : On

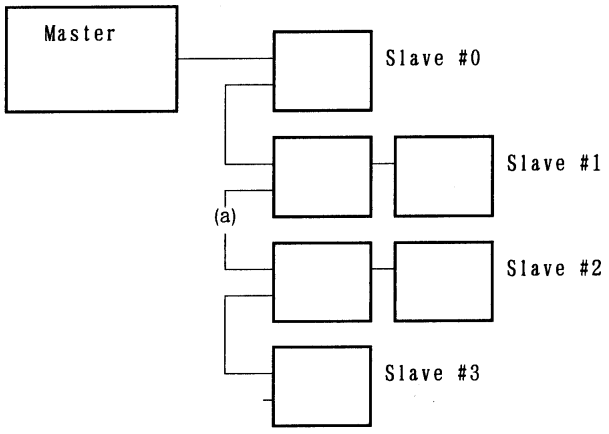
Failures, their causes, and required actions

(1) PWR is off.
  ① Power (24 VDC) is not supplied or the supply voltage is abnormal.
    ⇒ Supply power of 24 VDC ± 10%.
  ② A The fuse in the interface module has blown.
    ⇒ Eliminate the cause that made the fuse to blow, then replace the fuse with a spare. (See Chapter 3.) The following may cause the fuse to blow:
    - A sum of power requirements for all input modules exceeds the rating. (Refer to Section 4.4 in Part I.)
    - A voltage of +24 VDC, supplied from input module AID32A1, AID32B1 or AID32H1 to the outside, is short-circuited to the cabinet or the like.
    - The interface module or any of the I/O modules is defective.

③ An I/O module is defective.
⇒ Remove the I/O modules sequentially to pinpoint the defective one. Then, replace it with a spare.
④ An interface module is defective.
⇒ Replace it with a spare.

(2) LINK has never been turned on since power is supplied.
① If PWR is off, go to item 1).
② The attempted power turn-on sequence was incorrect.
⇒ The slaves (I/O Unit-A, Power Mate, Series 0, etc.) must be supplied with power at the same time or before the master (CNC or F-D Mate) is supplied with power. (Refer to Section 4.2 in Part I.)
If an attempt is made to supply power to a slave on an interface module after the master is turned on, LINK on the interface module is not turned on provided that the interface module corresponds to that slave or to any slave ahead of that slave (one on the far side with respect to the master).
③ I/O Link cables are broken or short-circuited.
⇒ With reference to Note below, check the cables, and take an appropriate action.
④ Any device on the I/O Link is defective.
⇒ With reference to Note below, find a defective device, and take an appropriate action. If an I/O Unit seems to be defective, replace interface module with a spare.

NOTE
How to pinpoint a failure in the I/O Link in event of items ② to ④.
Check the LEDs on the master to find out which group contains slaves whose I/O Link is established with the master. (Refer to the maintenance manual for the master.)



For example, if the master is linked to slaves (slave #0 and #1) that belong to separate groups, the timing of turning on slave #2 is bad, the cable is broken or short-circuited at point (a), slave #2 is defective.

If the master is not linked to any slave, the master may be defective.

(3) LINK is turned on once, then off.

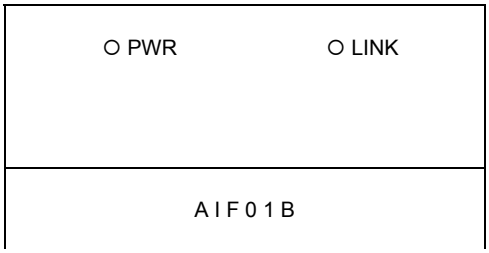
① One of the devices on the I/O Link is turned off.
⇒ Turn off all devices, then turn them on.

② The DI/DO assignment for the master is invalid.
⇒ When I/O Unit bases 1 to 3 (units under control of interface module AIF01B) are not connected, if DI/DO units are assigned to these bases, LINK is turned on, but turned off immediately.
Correct the DI/DO assignment.

③ The I/O Link cable is broken or short-circuited.
⇒ Check the cable, and take an appropriate action.

④ Any device on the I/O Link is defective.
⇒ With reference to the maintenance manual for the master, find a defective device, and take an appropriate action. If an I/O Unit seems defective, replace the interface module (AIF01A, AIF01A2, or AIF01B) installed in the base unit indicated by BA1 or BA0.

2.2 INTERFACE MODULE (AIF01B) LED INDICATORS



Marking	Name	Description
PWR	Power-on	On: The interface module is supplied with power of 24 VDC.
LINK	Link	On: The I/O Link is operating properly. Normally, this LED lights several to ten-odd seconds after the master is turned on.

Failures, their causes, and required actions

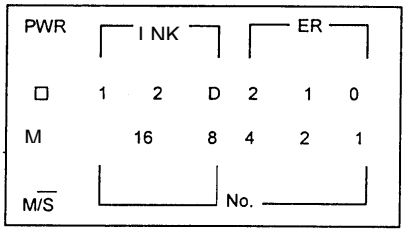
(1) PWR is off.
- ① Power (24 VDC) is not supplied or the supply voltage is abnormal.
  - ⇒ Supply power of 24 VDC ±10%.
- ② The fuse in the interface module has blown.
  - ⇒ Eliminate the cause that made the fuse to blow, then replace the fuse with a spare. (See Chapter 3.) The following may cause the fuse to blow:
  - A sum of power requirements for all input modules exceeds the rating. (Refer to Section 4.4 in Part I.)
  - A voltage of +24 VDC, supplied from input module AID32A1, AID32B1 or AID32H1 to the outside, is short-circuited to the cabinet or the like.
  - The interface module or any of the I/O modules is defective.
- ③ An I/O module is defective.
  - ⇒ Remove the I/O modules sequentially to pinpoint the defective one. Then, replace it with a spare.
- ④ An interface module is defective.
  - ⇒ Replace it with a spare.

(2) LINK has never been turned on since power is supplied.
- ① If PWR is off, go to item 1).
- ② If LINK on the AIF01A or AIF01A2 in the same group is off, go to Section 2.1.
- ③ The signal cable between I/O Units in the same group is broken or short-circuited.
  - ⇒ Check the cable, and take an appropriate action.
- ④ An interface module is defective.
  - ⇒ Replace it with a spare.

(3) LINK is turned on once, then turned off.
- ① See section 2.1.

2.3 INTERFACE MODULE (AIF02C) LED INDICATORS

The LED indicator panel of the AIF02C is shown below. Each of its components are described in the following paragraphs.



2.3.1 PWR Indicator

This LED lights when the power is switched on.

2.3.2 LNK Indicators

(1) LNK-1 : Lights when the I/O link for the I/O Unit-A is operating normally.
(2) LNK-2 : Lights when the I/O link for the I/O Unit-B is operating normally.
(3) LNK-D : Lights when the distributed link with the I/O Unit-B is operating normally. (The indicator dims if only a few base units are connected.)

2.3.3 ER Indicators

An ER indicator lights if an error occurs on the distributed link.
See the tables on the following page for details.

2.3.4 LED Indicators

(1) When the unit No. (1 to 16) is off (o-on and ×-off)

M/S	ER2	ER1	ER0	Error	Description	Major cause of error
○	×	×	○	Interface unit peripheral error	The interface unit is abnormal.	Interface unit failure
○	×	○	×	Interface unit RAM parity error	The interface unit is abnormal.	Interface unit failure
○	○	×	×	I/O link error reception	An error has occurred in a unit connected to the I/O link.	Failure in a unit connected to the I/O link
○	○	×	○	I/O link framing error	The I/O link communication end signal is abnormal.	-
○	○	○	×	I/O link CRC error	I/O link communication data is abnormal.	-
○	○	○	○	Interface unit watchdog timer error	Communication from the I/O link host has stopped.	-

(2) When the unit No. (1 to 16) is on (o-on and ×-off)

M/S	ER2	ER1	ER0	Error	Description	Major cause of error
×	×	×	○	Basic unit peripheral error	The basic unit is abnormal.	Basic unit failure
○	×	○	×	Basic unit number error	A unit with an invalid unit number has responded to the interface unit.	-
×	×	○	○	Basic unit reception data count error	The number of communication bytes has exceeded four.	Two or more units have the same unit number, or the unit of interest is not provided with a terminating resistor.
×○ (*1)	○	×	×	Basic unit framing error	The communication end signal is abnormal.	Two or more units have the same unit number, or the unit of interest is not provided with a terminating resistor.
×○ (*1)	○	×	○	Basic unit DMI error	The communication waveform has been distorted.	Two or more units have the same unit number, or the unit of interest is not provided with a terminating resistor.
×○ (*1)	○	○	×	Basic unit CRC error	The communication data is abnormal.	Two or more units have the same unit number, or the unit of interest is not provided with a terminating resistor.
×	○	○	○	Basic unit watchdog timer error	Communication with the interface unit has stopped.	-

NOTE (*1)
If M/S lights, it means that the interface module (AIF02C) detected the error.
If it does not light, it means that the basic unit of the I/O Unit-B detected the error.

2.3.5 M/$\overline{S}$ Indicator

If an error occurs on a distributed link, the M/S indicator indicates whether the error was detected in the interface module or basic error side.

On: The error has been detected on the interface module side.
Off: The error has been detected on the basic unit side.

2.3.6 No. Indicators

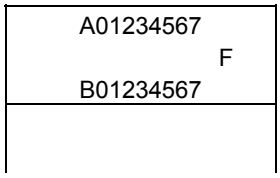
If an error occurs on a distributed link, the No. indicators indicate the basic unit No. where the error is detected. The sum of the values for which a lamp lights corresponds to the basic unit No.

Example)

No.					Unit No.
16	8	4	2	1	
×	×	×	×	○	1
×	×	○	×	○	5
×	○	×	○	×	10
○	×	○	×	×	20

○-On
×-Off

2.4 LED INDICATORS ON THE INPUT/OUTPUT MODULES (HAVING 16 OR FEWER INPUT/OUTPUT POINTS)



Label	Name	Description
A0 to 7 B0 to 7	Input/output indicator	On : The corresponding input or output is on.
F	Fuse alarm	On : A fuse incorporated in the output module has blown.

3 FUSES

The modules listed below have built-in fuses. If a fuse blows, remove the cause, then replace the fuse with a spare.

Module	Indication	Rating	Fuse specification
Interface module AIF01A	PWR is off	3.2A	A60L-0001-0290#LM32
Interface module AIF01A2	PWR is off	3.2A	A60L-0001-0290#LM32
Interface module AIF01B	PWR is off.	3.2A	A60L-0001-0290#LM32
Interface module AIF02C	PWR is off.	3.2A	A60L-0001-0290#LM32
Output module with 8 DC points AOD08C	F is on.	5A	A60L-0001-0260#5R00
Output module with 8 DC points AOD08D	F is on.	5A	A60L-0001-0260#5R00
Output module with 16 DC points AOD08D3	F is on.	5A	A60L-0001-0046#5.0
Output module with 5 AC points AOA05E	F is on.	3.15A	A60L-0001-0276#3.15
Output module with 8 AC points AOA08E	F is on.	3.15A	A60L-0001-0276#3.15
Output module with 12 AC points AOA12F	F is on.	3.15A	A60L-0001-0276#3.15

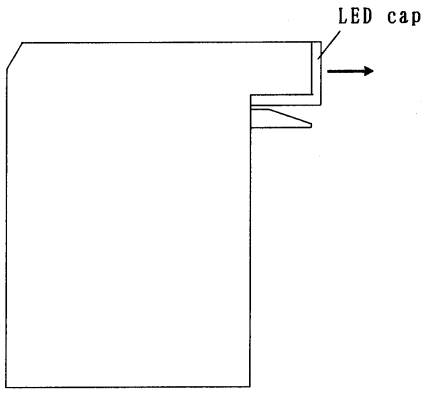
The fuses are on the PC boards in the modules.

4 REMOVING PC BOARDS

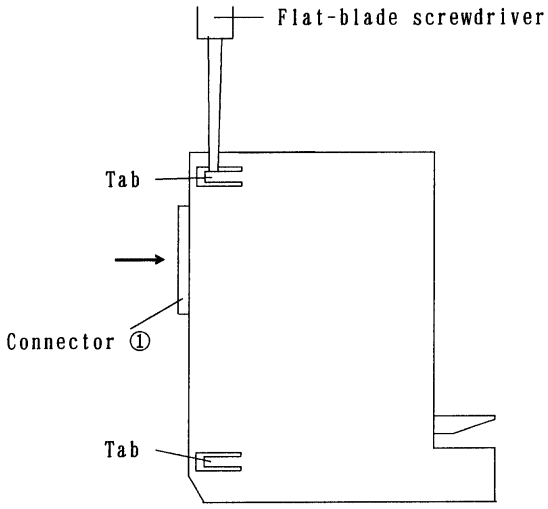
4.1 HOW TO REMOVE TERMINAL BOARD-TYPE I/O MODULE PC BOARDS

① Remove the terminal board. (Refer to 4.5 in Part I.)

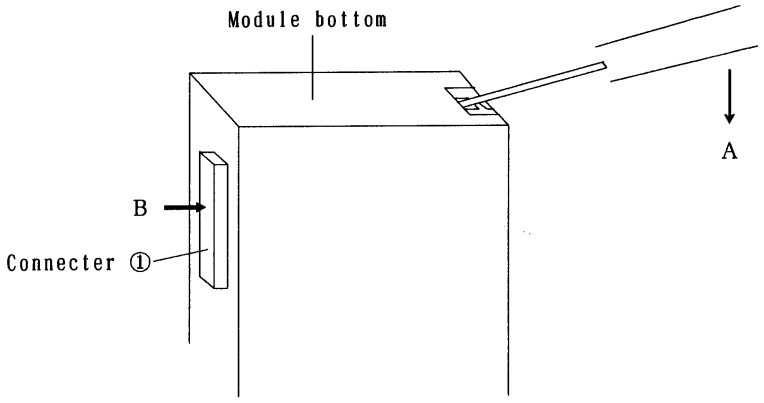
② Pull the LED cap in the direction of the arrow to remove it.



③ While pressing connector ① in the direction of the arrow, raise the tabs (two) on the module case with a flat-blade screwdriver.

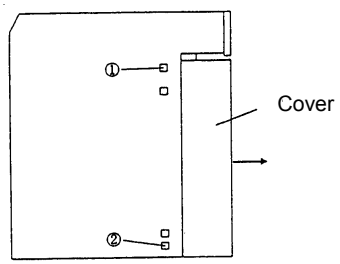


④ Put the tip of a flat-blade screwdriver into the gap between the module case and terminal board connector, as shown below. While pressing the screwdriver in the direction of arrow A, push connector ① in the direction of arrow B, and the PC board will come out.

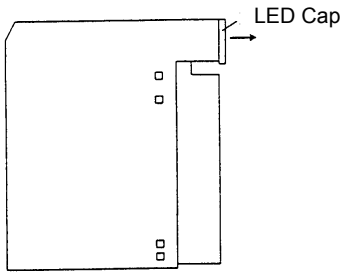


4.2 HOW TO REMOVE INTERFACE AND CONNECTOR-TYPE I/O MODULE PC BOARDS

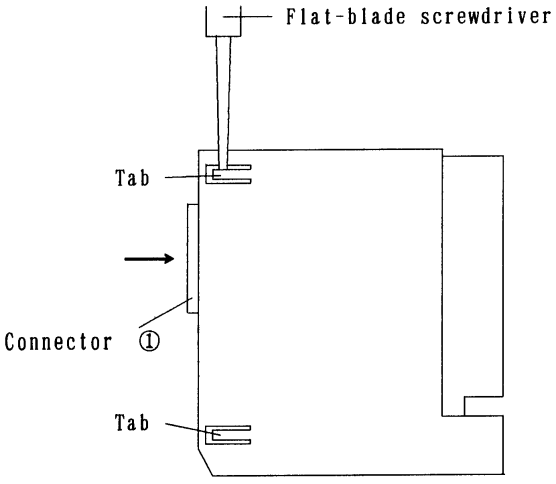
① While pulling the cover in the direction of the arrow, press points ① and ② (on each side) with a flat-blade screwdriver to remove the cover.



② Pull the LED cap in the direction of the arrow to remove it.



③ While pressing connector ① in the direction of the arrow, raise the tabs (two for a connector type I/O module and 4 for an interface module) with a flat-screwdriver, then push connector ① in the direction of the arrow, and e PC board will come out.



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Revision Record

FANUC I/O Unit-MODEL A CONNECTION AND MAINTENANCE MANUAL (B-61813E)

04	May, 2005	- Total revision			
03	Feb., 2000	- Addition of “I/O Link dummy unit” - Addition of Inter face module (AIF02C) - Addition of Input module (AID16K, AID16L) - Addition of High-resolution type analog output module (ADA02B) - Addition of “Temperature input module” - Modification of “High speed counter module”			
02	Apr., 1992	- Addition of high speed counter module - Addition of Optical fiber Cable			
01	Dec., 1990	———————————————			
Edition	Date	Contents	Edition	Date	Contents