1412, TCFEN-156-005, 001

NACHI

CFD CONTROLLER TECHNICAL DOCUMENT 2

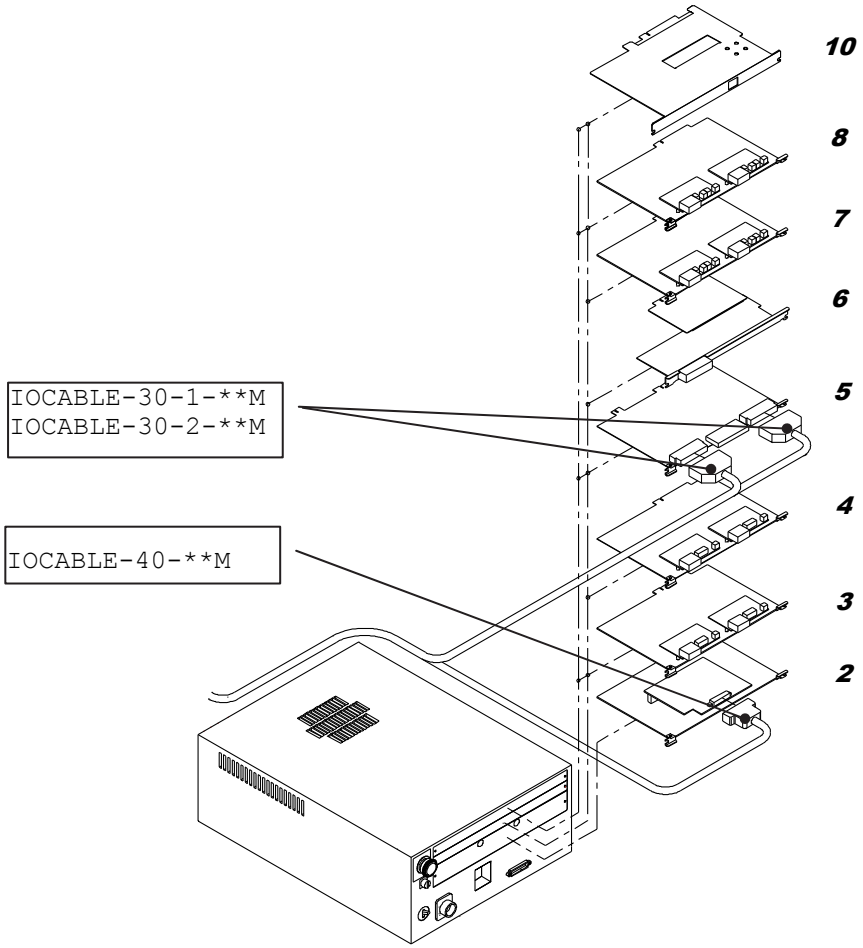
	Item	Part No.
2	Mini I/O Board	CFD-OP150-A,B IOCABLE-40-**M
3	EtherNet/IP Board	CFD-OP130-A,B,C,D,E
4	DeviceNet Board	CFD-OP131-A,B,C,D,E
5	Digital I/O Board	CFD-OP125-A,B, CFD-OP151-A,B IOCABLE-30-1-**M IOCABLE-30-2-**M
6	CC-Link Board	CFD-OP98-B
7	PROFIBUS Board	CFD-OP132-A,B,C,D,E
8	PROFINET Board	CFD-OP136-B,D
10	FL-net Board	CFD-OP101-A

5th edition

- Before attempting to operate the robot, please read through this operating manual carefully, and comply with all the safety-related items and instructions in the text.
- The installation, operation and maintenance of this robot should be undertaken only by those individuals who have attended one of our robot course.
- When using this robot, observe the low related with industrial robot and with safety issues in each country.
- This operating manual must be given without fail to the individual who will be actually operating the robot.
- Please direct any queries about parts of this operating manual which may not be completely clear or any inquiries concerning the after-sale service of this robot to any of the service centers listed on the back cover.

NACHI-FUJIKOSHI CORP.

This manual contains the installation and instruction of following CFD controller options.



No.	日本語名 JAPANESE	英語名 ENGLISH
2	小型 I/O 基板	Mini I/O board
3	EtherNet/IP 基板	EtherNet/IP board
4	DeviceNet 基板	DeviceNet board
5	デジタル I/O 基板	Digital I/O board
6	CC-Link 基板	CC-Link board
7	PROFIBUS 基板	PROFIBUS board
8	PROFINET 基板	PROFINET board
10	FL-net 基板	FL-net board

Left No. of above table is chapter No. of this manual.
Concerning the following optional cables, refer to the chapter for the respective I/O board.

- Connection cable for Digital I/O board `IOCABLE-30-1-**M` (in case of 1 board)
- Connection cable for Digital I/O board `IOCABLE-30-2-**M` (in case of 2 board)
- Connection cable for Mini I/O board `IOCABLE-40-**M`

Table of Contents

Chapter 4 EtherNet/IP

Chapter 5 DeviceNet

Chapter6 CC-Link

Chapter 7 PROFIBUS

Chapter 8 PROFINET

Chapter 9 Example to Use

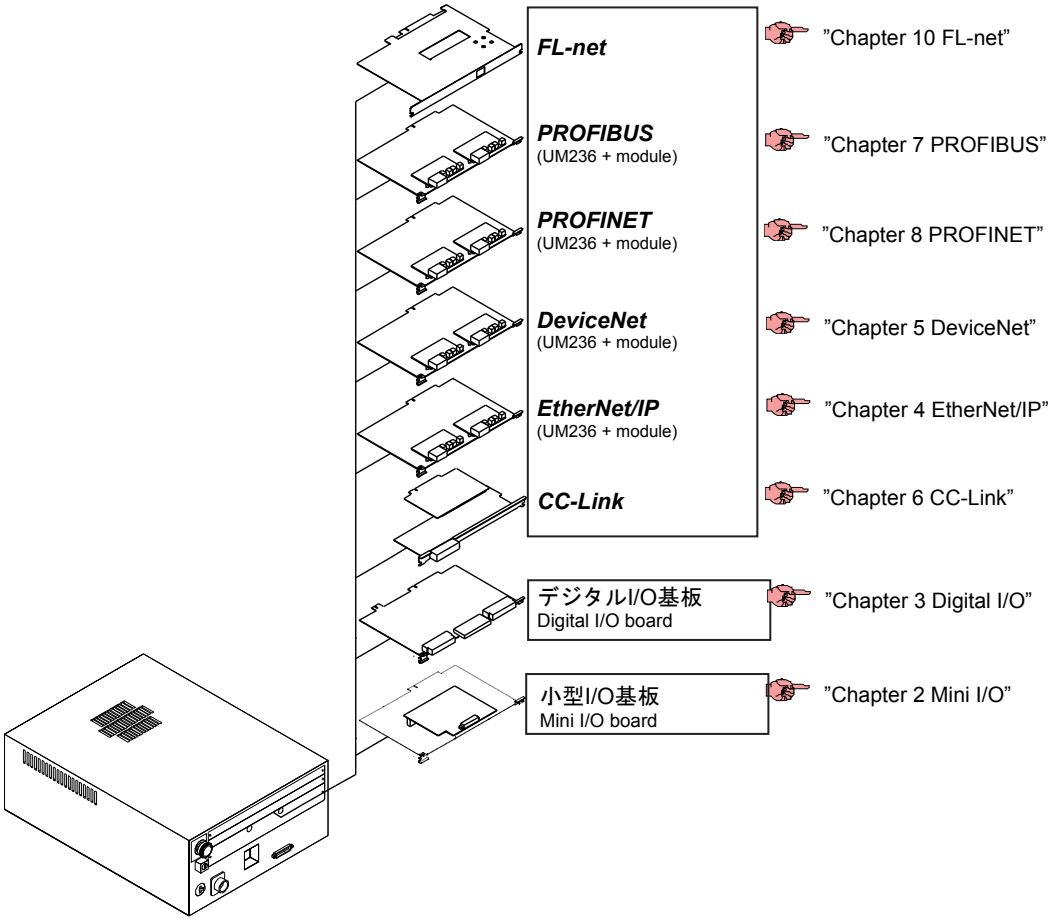
Chapter 10 FL-net(OPCN2)

NOTE

Chapter 1 Outline

1.1 I/O board variation

To connect an external device using physical I/O signals, at least one of option boards is required.



The relationship between each option board and logical I/O signals is shown below.

The relationship between each option board and logical I/O signals

Input signals	Pts.	Output signals	Pts.	PCB that is connected (initial setting)
I1 ～ I32	32	O1 ～ O32	32	Digital I/O board 1
I33 ～ I64	32	O33 ～ O64	32	Digital I/O board 2
I65 ～ I96	32	O65 ～ O96	32	None
I97 ～ I104	8	O97 ～ O104	8	Mini I/O board
I105 ～ I160	56	O105 ～ O160	56	None
I161 ～ I672	512	O161 ～ O672	512	Fieldbus board (1ch)
I673 ～ I1184	512	O673 ～ O1184	512	Fieldbus board (2ch)
I1185 ～ I1696	512	O1185 ～ O1696	512	Fieldbus board (3ch)
I1697 ～ I2048	352	O1697 ～ O2048	352	Fieldbus board (4ch)

Mini I/O board

Option No.	Num of PCB	IN	OUT	Internal power control	External power control
CFD-OP150-A	1	8 Non polarity	8 NPN	O	O
CFD-OP150-B	1	8 Non polarity	8 Relay output	O	O

IMPORTANT

The mini I/O board does not use the PCI slots. This board is installed on the sequence board.

Digital I/O board

Option No.	Num. of PCB	IN	OUT	Internal power control	External power control
CFD-OP125-A	1	32 Non polarity	32 NPN	O	O
CFD-OP125-B	2	64 Non polarity	64 NPN	X	O
CFD-OP151-A	1	32 Non polarity	32 PNP	O	O
CFD-OP151-B	2	64 Non polarity	64 PNP	X	O

IMPORTANT

- When using with other option board, CFD-OP125-B and CFD-OP151-B can not be used.
- It is also possible to use NPN specification and PNP specification.
(Example: CFD-OP125-A ＋ CFD-OP151-A)
- In case of CFD-OP125-B and CFD-OP151-B, external power supply is necessary.

Fieldbus boards

Option No.	Name	Configuration
CFD-OP98-B	CC-Link (CC-Link board)	MASTER or SLAVE
CFD-OP130-A	EtherNet/IP （UM236 + module）	SCANNER x1
CFD-OP130-B		ADAPTOR x1
CFD-OP130-C		SCANNER x1＋ADAPTOR x1
CFD-OP130-D		ADAPTOR x2
CFD-OP130-E		SCANNER x2
CFD-OP131-A	DeviceNet （UM236 + module）	MASTER 1ch
CFD-OP131-B		SLAVE 1ch
CFD-OP131-C		MASTER 1ch＋SLAVE 1ch
CFD-OP131-D		SLAVE1ch＋SLAVE 1ch
CFD-OP131-E		MASTER 1ch＋MASTER 1ch
CFD-OP136-B	PROFINET （UM236 + module）	SLAVE 1ch
CFD-OP136-D		SLAVE 2ch
CFD-OP132-A	PROFIBUS （UM236 + module）	MASTER 1ch
CFD-OP132-B		SLAVE 1ch
CFD-OP132-C		MASTER 1ch＋SLAVE 1ch
CFD-OP132-D		SLAVE 1ch＋SLAVE 1ch
CFD-OP132-E		MASTER 1ch＋MASTER 1ch
CFD-OP101-A	FL-net (FL-net board)	

IMPORTANT

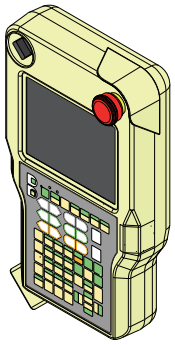
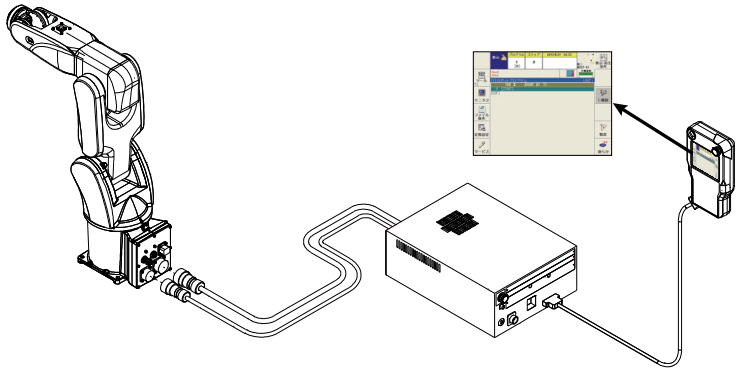
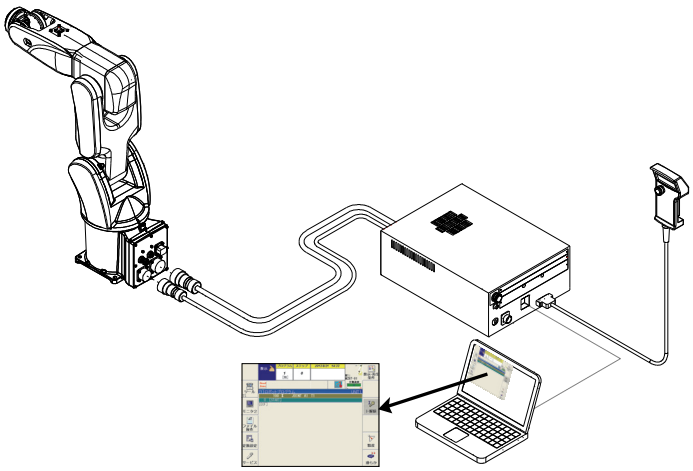
There would be some limitations of PCI slot number where the PCB can be installed because of the connector size etc. For details, please contact our sales person or service department.

1.2 Cautions of Operation

"Smart Teach Pendant" and "Compact Teach Pendant" can be used for this controller. These two types are selectable option which means one of them must be selected (can not been used at the same time).

"Compact TP" does not support t most of all operations to utilize option on this document. So operations on this document are based on using "Smart TP" if any notice is not written.
In case of using "Compact TP", please operate by referring to following table.

Two types of teach pendant

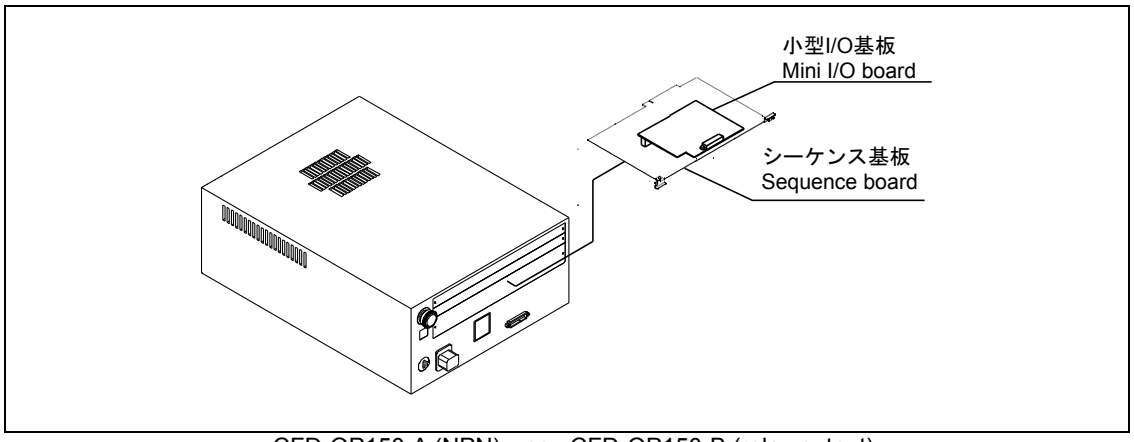
	Characteristics
Smart Teach Pendant 	All operation of this controller is possible. (This teach pendant and FD controller teach pendant is not same. Few specifications are different.) 
Compact Teach Pendant 	Basic operation from teaching and playback is possible. High performance operation such as PLC editing is not possible. Even one of necessary operation (set up operation and or so) is not supported by this TP. In order to do such necessary operation by this TP, please utilize PC tool "FD on Desk Light" (free software). Connect PC to this controller, same screen is displayed on PC with online communication.  Please refer to "FD on Desk Light" instruction manual for detail.

NOTE

Chapter 2 Mini I/O

2.1 Outline

Mini I/O board has 8 inputs and 8 outputs. There are NPN output type and Relay output type. Either one of them can be installed on the Sequence board.



CFD-OP150-A (NPN) or CFD-OP150-B (relay output)
8IN + 8OUT

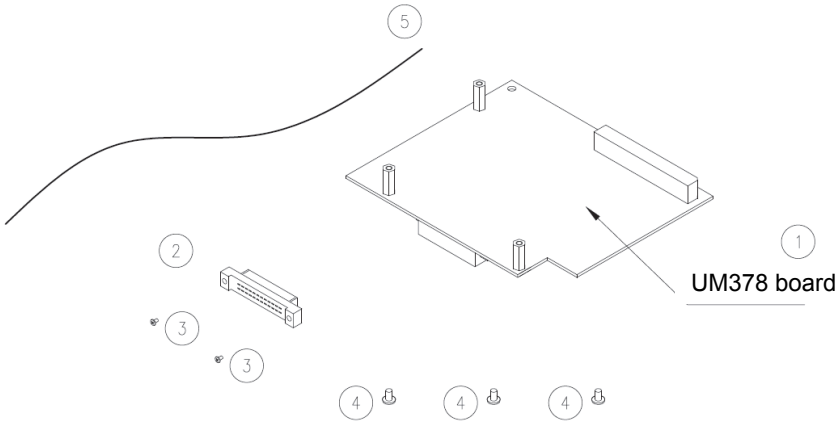
CAUTION

Following 2 PCBs cannot be used at the same time.
- CFD-OP150-A (NPN output specification)
- CFD-OP150-B (Relay output specification)

2.1.1 Contained Parts

Contained parts of this option

No.	Name	Parts No., type.	Note
1	UM378 board	UM378-10 (relay output) UM378-20 (NPN output)	
2	Connector	FCN-361J024-AU	Fujitsu component
3	Fixing screws for connector	M2.6 × 10mm	
4	Fixing screws for board	M3 × 6mm	
5	Isolation tube	—	



2.1.2 Electrical specifications of "Photo coupler input"

Electrical specifications of physical input (for 1 input signal point)

Items	Specifications
Input impedance	Approx. 3 kΩ
Input voltage	DC+24 V ±10 %
Input current	8 mA (typ.)

Specifications of the load for input circuit (prepared by customer)

Input load (prepared by customer)	Specifications	Remarks
Relay contact	Minimum applicable load should be DC24V, 5 mA	The input signals needs to be closed for 150ms or longer.
Open collector device	Leakage current should be 1 mA or less.	

2.1.3 Electrical specifications of "NPN output"

Prepare the output load that conforms to the used physical output signal.

Electrical specifications of physical output (for 1 input signal point)

Items	Specifications
Rated voltage	DC+24 V ±3 V
Rated current	0.1 A

- Be absolutely sure to use a surge killer for the load.
- Do not use power with the wrong polarity.

2.1.4 Electrical specifications of "Relay output"

Prepare the output load that conforms to the used physical output signal.

Electrical specifications of physical output (for 1 input signal point)

Items	Specifications
Output method	Relay contact
Rated voltage	AC 100 V or DC 30 V
Rated current	0.5A
Minimum applicable load	DC24V 5mA
Electrical expected life	Min. 10^5 (1A,100 V AC, 1A,30 V DC, resistive load, at 20 times/min.)

- Be absolutely sure to use a surge killer for the load.
- Since the value of minimum applicable load depends on the switching frequency, environment conditions, and expected reliable level, be sure to check with the actual load condition before operation.
- Electrical expected value is a reference value in case of using under the conditions described in parentheses. The value depends on the environmental conditions.

2.1.5 DC24V power supply

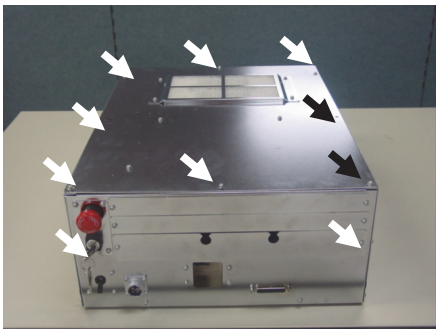
The capacity for the DC24V that can be supplied by the internal DC24V is 0.8A.
If the input/output current for the used external device exceeds this value, you need to prepare an external DC24V power supply.

2.2 Installation and Connection

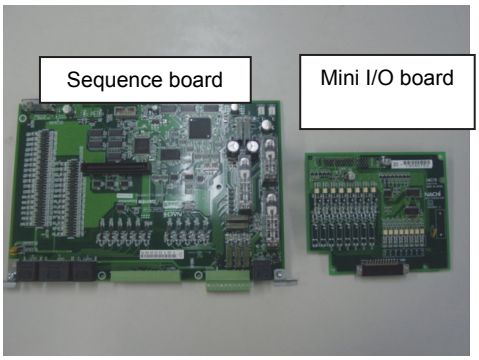
2.2.1 How to install

1 Turn OFF the controller power and disconnect the primary power source connector.

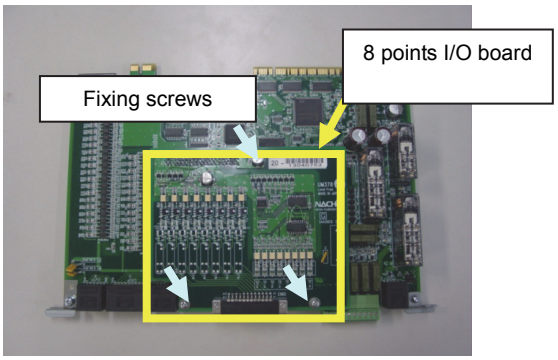
2 Loosen the screws on the top panel and the front side cable drawing panel.



3 Remove the sequence board.



4 Mount the 8 points I/O board onto the sequence board and fix it with screws.



5 Mount the sequence board to the original location.

6 Connect the connectors and fix them with fixing screws.

7 Install the removed panel.
Clamp cable to push, and attach bush to front panel.

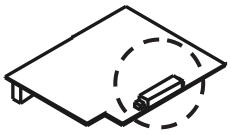
2.2.2 Pin assignment

Signals of the Mini I/O board (NPN specification)

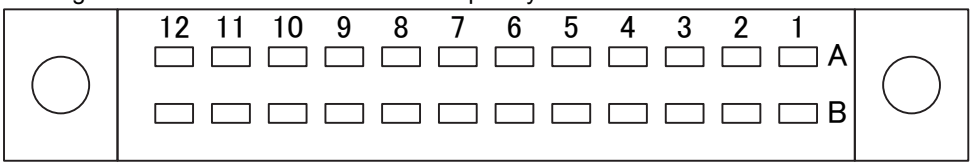
Pin No.	Signal name	Default function	Pin No.	Signal name	Default function
A1	O 97	General output O 97 to O 104	B1	I 97	General input I 97 to I 104
A2	O 99		B2	I 99	
A3	O 101		B3	I 101	
A4	O 103		B4	I 103	
A5	O 98		B5	I 98	
A6	O 100		B6	I 100	
A7	O 102		B7	I 102	
A8	O 104		B8	I 104	
A9			B9	Input common	Common for I97 to I104
A10	P1	Internal power 24V	B10	P1	Internal power 24V
A11	M1	Internal power 0V	B11	M1	Internal power 0V
A12	Output common	Common for O97 to O104	B12		

Signals of the Mini I/O board (Relay output specification)

Pin No.	Signal name	Default function	Pin No.	Signal name	Default function
A1	O 97	General output O 97～O 104	B1	I 97	General input I 97～I 104
A2	O 99		B2	I 99	
A3	O 101		B3	I 101	
A4	O 103		B4	I 103	
A5	O 98		B5	I 98	
A6	O 100		B6	I 100	
A7	O 102		B7	I 102	
A8	O 104		B8	I 104	
A9	Output common	Common for O97 to O104	B9	Input common	Common for I97 to I104
A10	P1	Internal power 24V	B10	P1	Internal power 24V
A11	M1	Internal power 0V	B11	M1	Internal power 0V
A12	MR	Relay power (-)	B12	PR	Relay power (+)



This figure shows the cable side connector pin layout as viewed from the soldered surface.

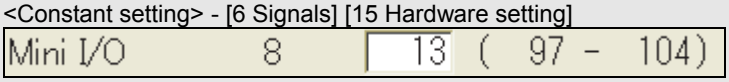


Connector type: FCN-361J024-AU (Soldering type female connector : Fujitsu component)

The pin layout of the 8 points I/O board connector

As the initial setting, the following logical I/O signals are assigned to the Mini I/O board.
`I97 ～ I104 / O97 ～ O104`
The physical I/O address of the Mini I/O board is `X0128` to `X0135`(IN) / `Y0128` to `Y0135`(OUT)

To change this assignment setting, please use the following menu.
<Constant setting> - [6 Signals] [15 Hardware setting]

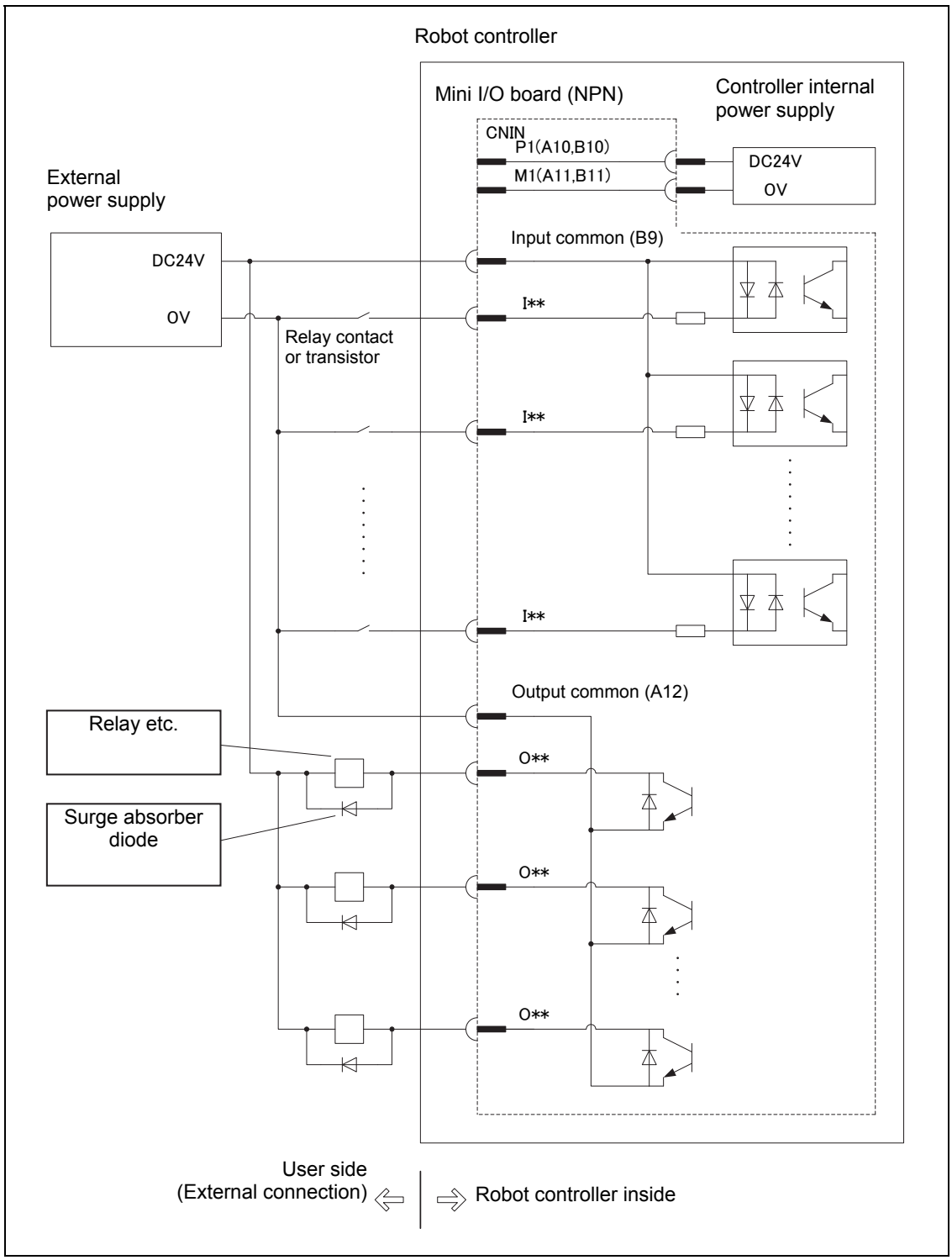


2.3 Connection circuit

2.3.1 NPN output, external power supply

CAUTION

- Be absolutely sure to use a surge killer for the load.
- Do not use power with the wrong polarity.

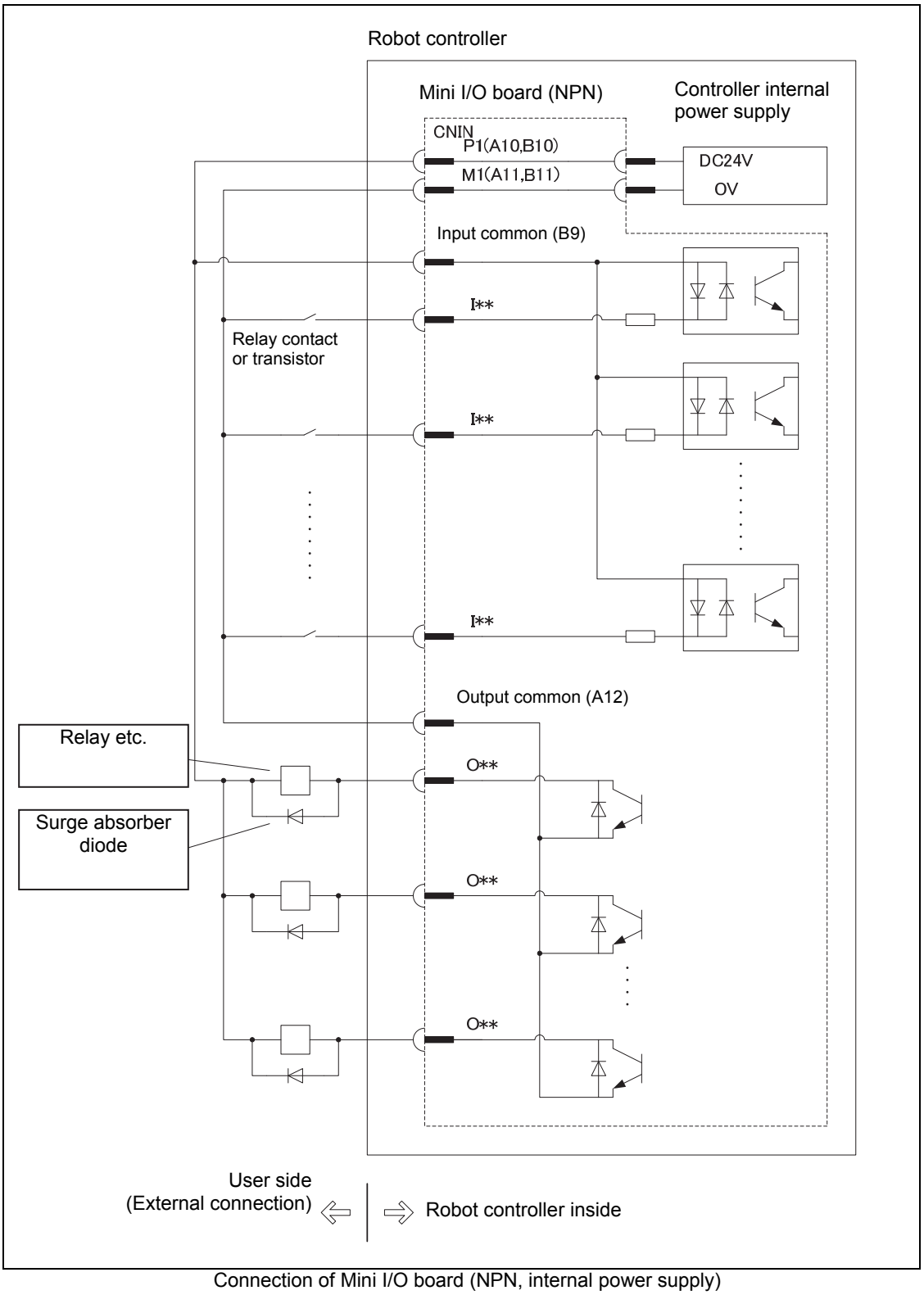


Connection of Mini I/O board (NPN, external power supply)

2.3.2 NPN output, internal power supply

CAUTION

- Be absolutely sure to use a surge killer for the load.
- Do not use power with the wrong polarity.

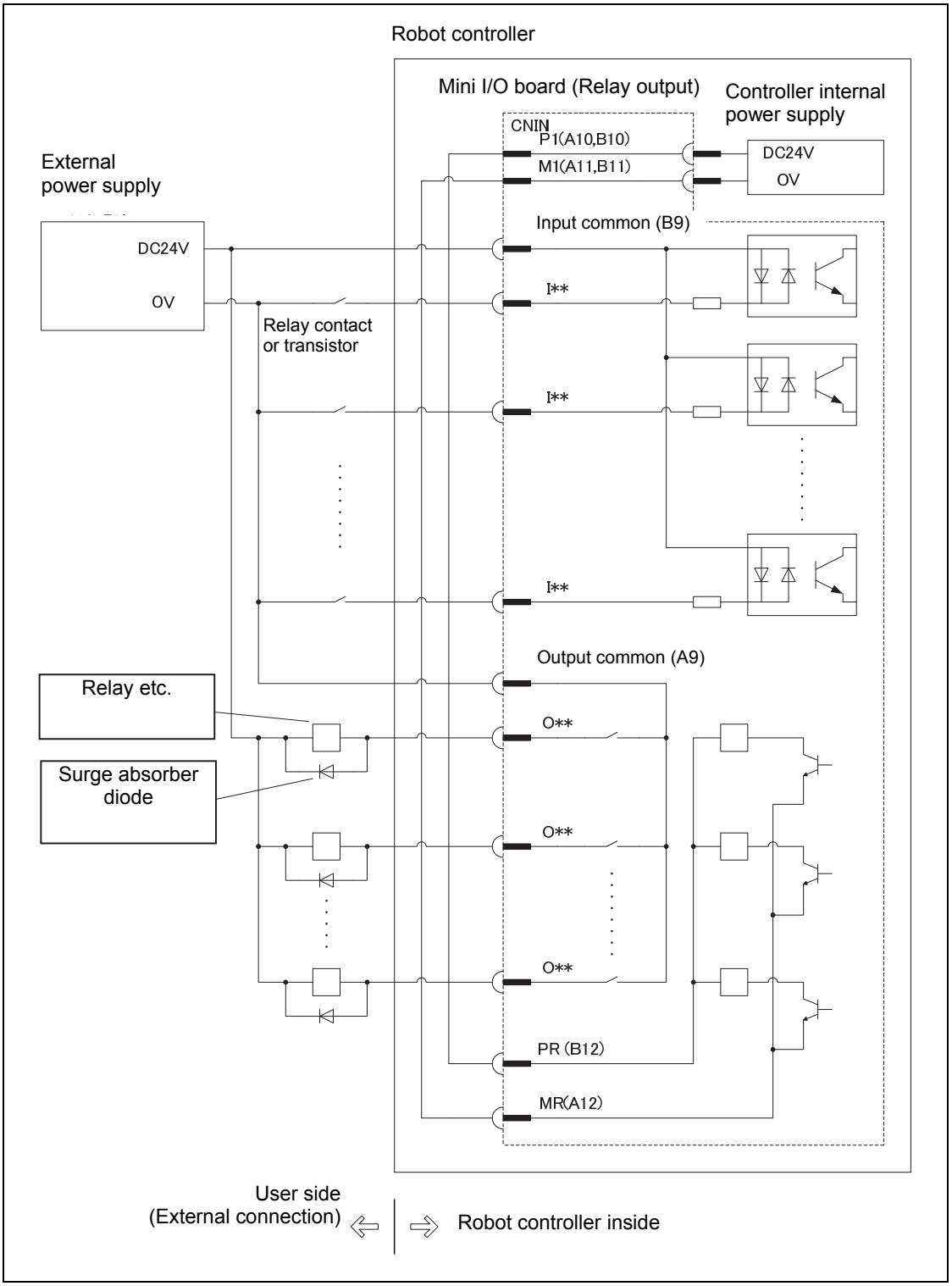


Connection of Mini I/O board (NPN, internal power supply)

2.3.3 Relay output / external power supply

CAUTION

- Be absolutely sure to use a surge killer for the load.
- Do not use power with the wrong polarity.

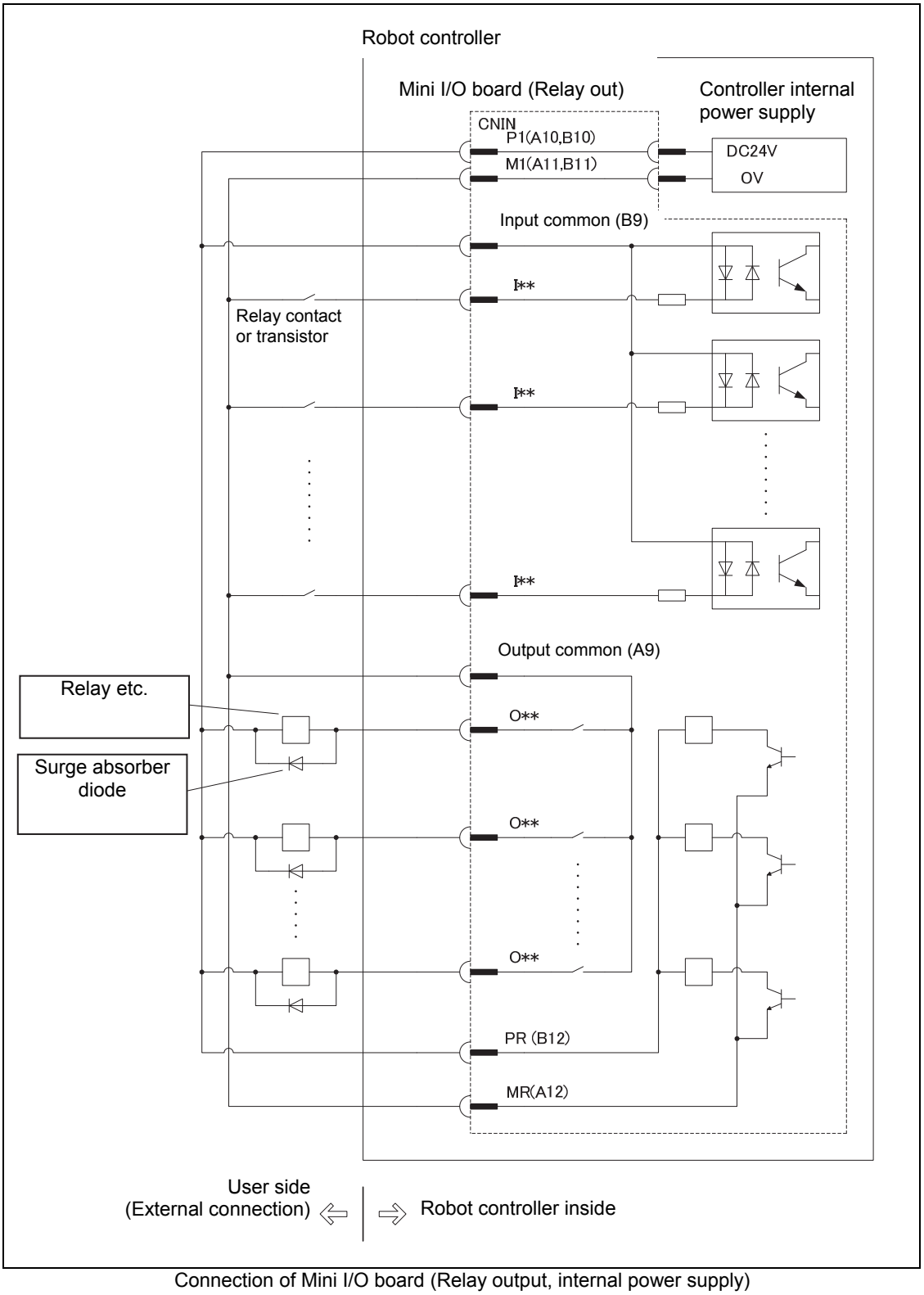


Connection of Mini I/O board (Relay output, external power supply)

2.3.4 Relay output / internal power supply

CAUTION

- Be absolutely sure to use a surge killer for the load.
- Do not use power with the wrong polarity.



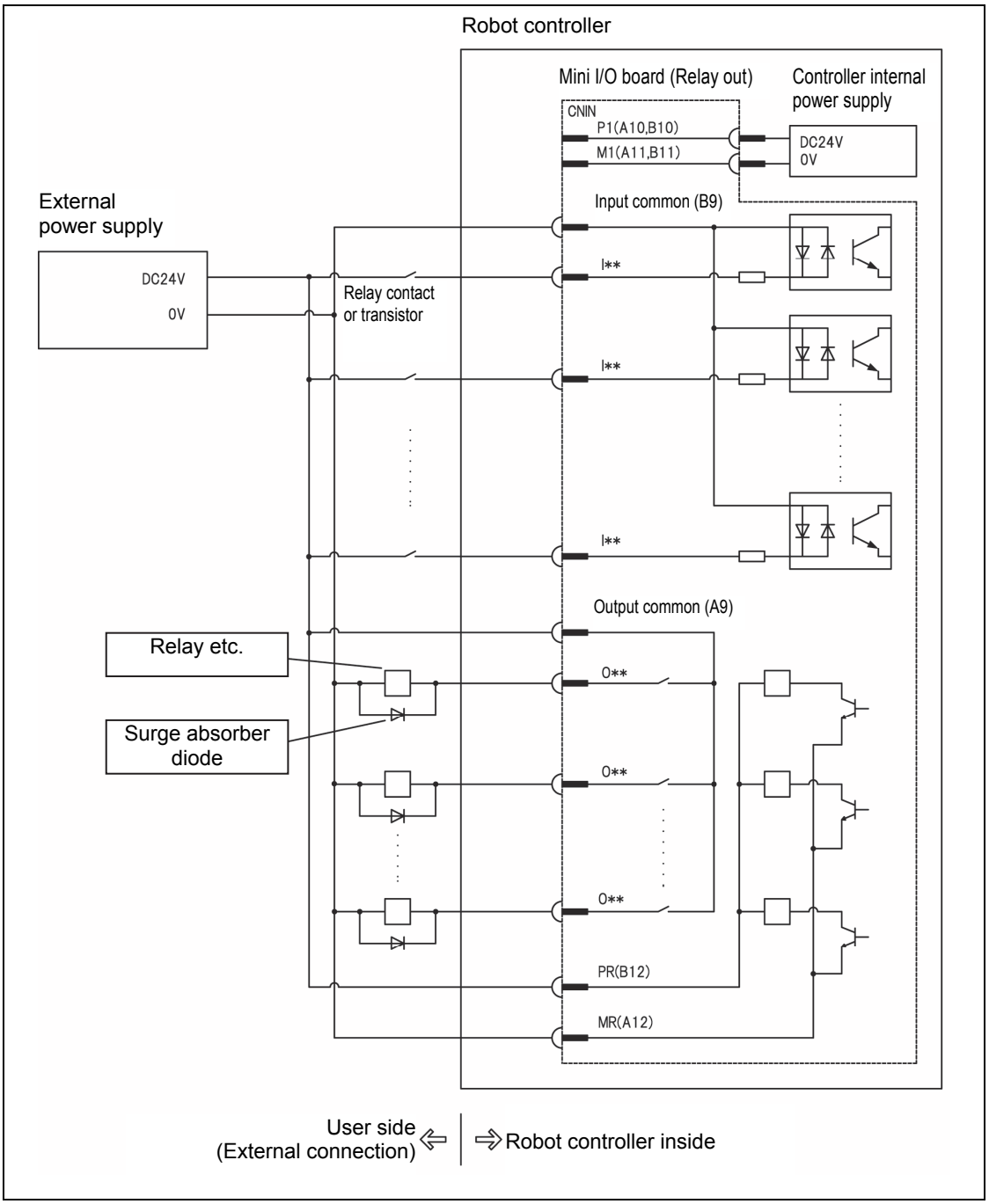
Connection of Mini I/O board (Relay output, internal power supply)

2.3.5 PNP, external power supply

By using a relay output specification mini I/O board, a connection like the following picture can be made.

CAUTION

- Be absolutely sure to use a surge killer for the load.
- Do not use power with the wrong polarity.



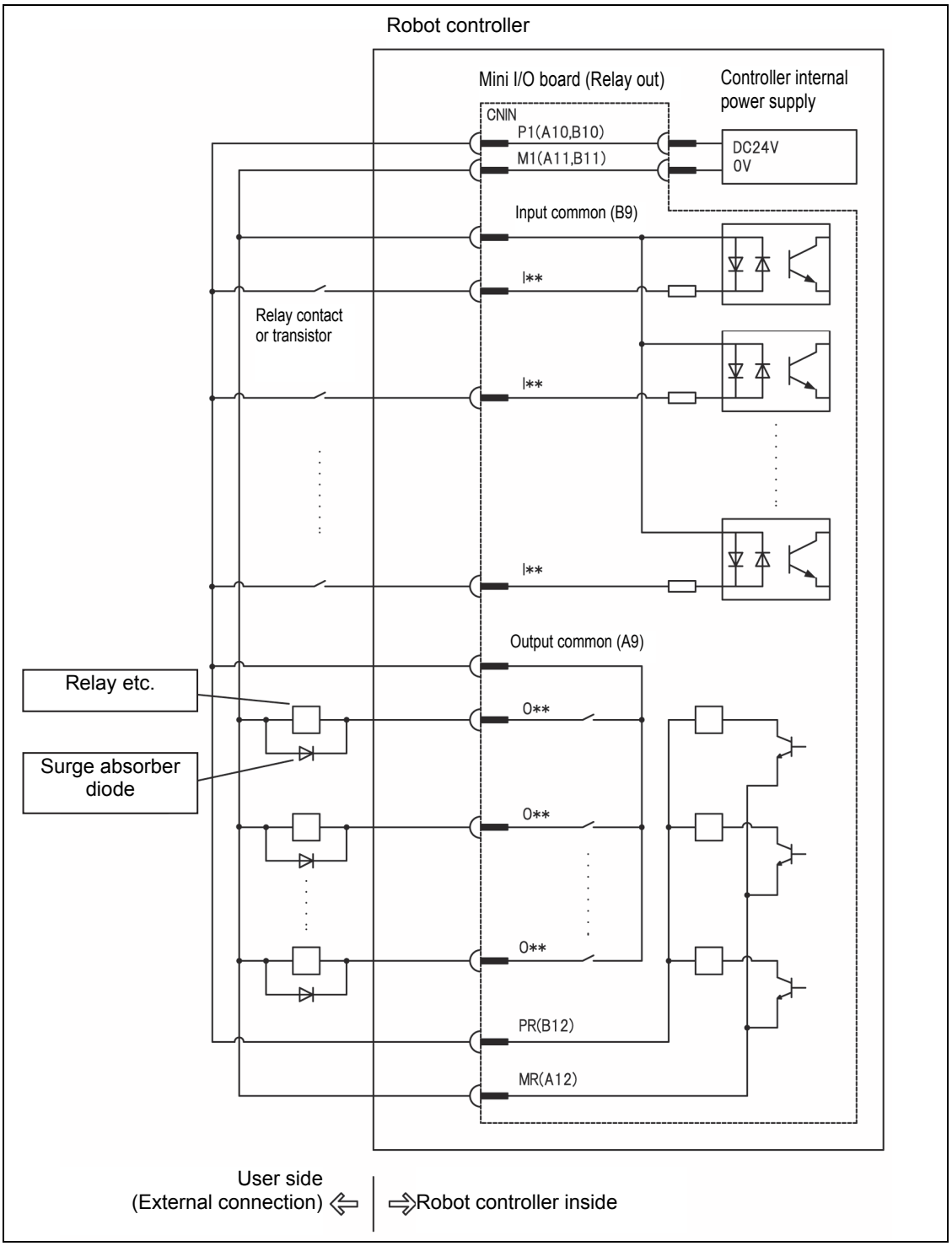
Connection of Mini I/O board (PNP, external power supply)

2.3.6 PNP, internal power supply

By using a relay output specification mini I/O board, a connection like the following picture can be made.

CAUTION

- Be absolutely sure to use a surge killer for the load.
- Do not use power with the wrong polarity.



Connection of Mini I/O board (PNP, internal power supply)

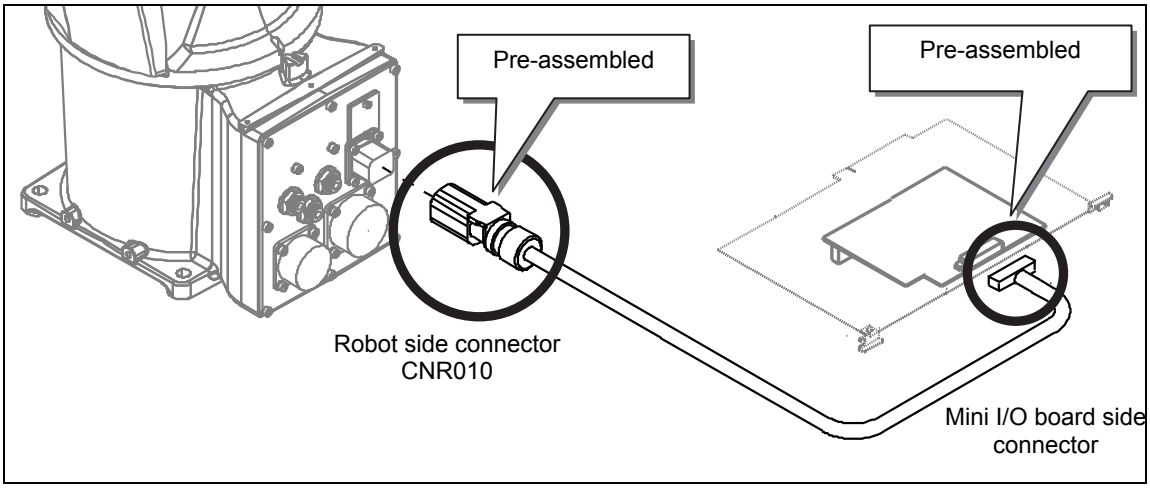
2.4 I/O cable for the mini I/O board (option)

2.4.1 Outline

When connecting the Mini I/O board and the robot (MZ series) directly, the following optional cable can be applied. Because the both side connectors (robot side connector and the Mini I/O board side connecter) are pre-assembled, it is easy to make the connection. When purchasing this cable, please select the cable length before ordering the cable.

Optional part number

IOCABLE-40-**M (** : L = 02, 05, 10, 15, 20, 25(cable length))



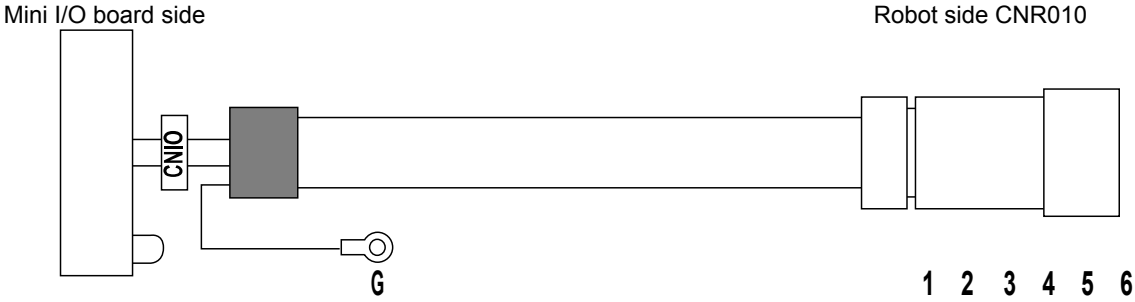
Details of the parts

Name	Model number	Maker	Qty	Remarks
Plug case	1939847-1	Tyco	1	Robot side connector
Housing	1939850-1	Tyco	1	Robot side connector
Contact	1827570-2	Tyco	23	Robot side connector #28～#22 φ1.08～1.6
Cable ground	E20M1420	SANKEI MANUFACTURING	1	φ12～14
Connector	FCN-361J024-AU	Fujitsu component	1	Mini I/O board side connector
Composite electric wire	RMCV-SB-A(2464)0.3X12P	DYDEN CORPORATION	L+0.7m (L=2,5,10,15,20,25)	The length differs from the option number. AWG#23, φ1.29 Sheath outer diameter φ13
Electric wire	UL1007#22 (Green / Yellow)		0.22m	AWG#22, φ1.7 For grounding connection
Electric wire	UL1007#22 (Blue)		0.14m	AWG#22, φ1.7 Jumper for A11-A12, B9-B10
Crimp type terminal	R1.25-3		1	For grounding connection
Cable tie	SG-100	S.G. Industrial	3	To fix the marking tube

CAUTION

This cable uses the **internal power supply** of the robot controller. The external power supply cannot be used in case of this cable. And, the jumper connection of the power source lines in this cable is only for NPN connection or relay connection. Therefore, this cable cannot be used for PNP connection.

Overview

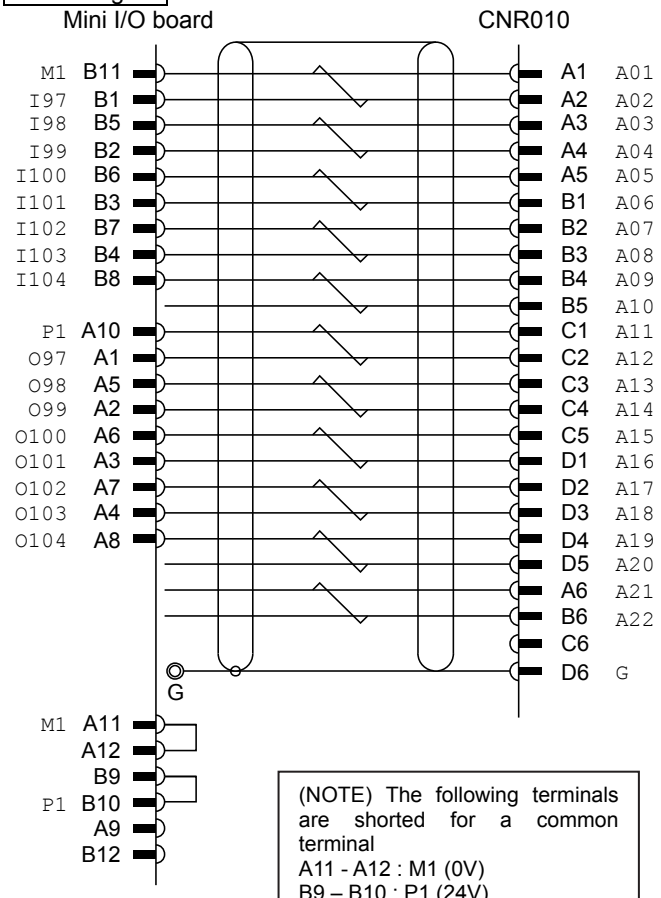


12	11	10	9	8	7	6	5	4	3	2	1	
		A11		A19	A17	A15	A13	A18	A16	A14	A12	A
	A01			A09	A07	A05	A03	A08	A06	A04	A02	B

1	2	3	4	5	6	
A16	A17	A18	A19	A20	G	D
A11	A12	A13	A14	A15		C
A06	A07	A08	A09	A10	A22	B
A01	A02	A03	A04	A05	A21	A

(NOTE) The following power is supplied from the board.
A10, B10 : P1 (24V)
A11, B11 : M1 (0V)

Circuit diagram



(NOTE) The following terminals are shorted for a common terminal
A11 - A12 : M1 (0V)
B9 – B10 : P1 (24V)

Cable color

No.	Twist pair	Signal No.
1	Blue / White	A01 / A02
2	Yellow / White	A03 / A04
3	Green / White	A05 / A06
4	Red / White	A07 / A08
5	Purple / White	A09 / A10
6	Blue / Brown	A11 / A12
7	Yellow / Brown	A13 / A14
8	Green / Brown	A15 / A16
9	Red / Brown	A17 / A18
10	Purple / Brown	A19 / A20
11	Blue / Black	A21 / A22
~~12~~	~~Yellow / Black~~	~~A23 / A24~~
13	Shield	G

No.12 twist pair is not used.

2.4.2 If the Mini I/O board is NPN output type

Concerning the connection example, see the following sections also.
"2.3.1 NPN output, external power supply"
"2.3.2 NPN output, internal power supply"

Mini I/O board side connector (NPN output)

The pin layout seeing from the soldering side

12	11	10	9	8	7	6	5	4	3	2	1	
OUTCOM	M1	P1		O104	O102	O100	O98	O103	O101	O99	O97	A
	M1	P1	INCOM	I104	I102	I100	I98	I103	I101	I99	I97	B

Col	Pin	Signal
A	A1	O97 (Y0128)
	A2	O99 (Y0130)
	A3	O101(Y0132)
	A4	O103(Y0134)
	A5	O98 (Y0129)
	A6	O100(Y0131)
	A7	O102(Y0133)
	A8	O104(Y0135)
	A9	-
	A10	P1
	A11	M1
	A12	OUTCOM
B	B1	I97 (X0128)
	B2	I99 (X0130)
	B3	I101(X0132)
	B4	I103(X0134)
	B5	I98 (X0129)
	B6	I100(X0131)
	B7	I102(X0133)
	B8	I104(X0135)
	B9	INCOM
	B10	P1
	B11	M1
	B12	-

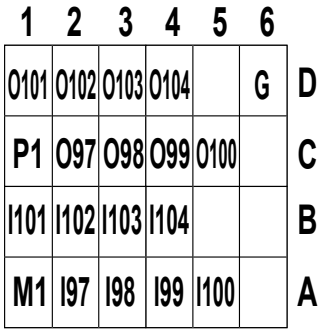
O97～O104	Logical output signals (factory assignment)
I97～I104	Logical input signals (factory assignment)
X0128～X0135	Physical input signals
Y0128～Y0135	Physical output signals
OUTCOM	O97～O104 common
INCOM	I97～I104 common
P1	Internal power supply 24V
M1	Internal power supply 0V

If the robot has solenoid valve option inside, it is possible to use the valves by the following signals.
For details, refer to the instruction manual ***"CFD technical document 1"***.

```
 O97 SOL1A
 O98 SOL1B
 O99 SOL2A
O100 SOL2B
O101 SOL3A
O102 SOL3B
```

Robot side connector CNR010 (NPN output)

The pin layout seeing from the soldering side



Pin	Signal	Remarks
A1	M1	(CN10A:A01)
A2	I97 (X0128)	(CN10A:A02)
A3	I98 (X0129)	(CN10A:A03)
A4	I99 (X0130)	(CN10A:A04)
A5	I100(X0131)	(CN10A:A05)
A6	-	Not used
B1	I101(X0132)	(CN10A:A06)
B2	I102(X0133)	(CN10A:A07)
B3	I103(X0134)	(CN10A:A08)
B4	I104(X0135)	(CN10A:A09)
B5	-	Not used
B6	-	Not used
C1	P1	
C2	O97 (Y0128)	
C3	O98 (Y0129)	
C4	O99 (Y0130)	
C5	O100(Y0131)	
C6	-	Not used
D1	O101(Y0132)	
D2	O102(Y0133)	
D3	O103(Y0134)	
D4	O104(Y0135)	
D5	-	Not used
D6	G	Shield line

(NOTE)
The pins of “Not used” are not connected to the Mini I/O board connector.

2.4.3 If the Mini I/O board is relay output type

Concerning the connection example, see the following sections also.
“2.3.3 Relay output / external power supply”
“2.3.4 Relay output / internal power supply”

Mini I/O board side connector (Relay output)

The pin layout seeing from the soldering side

12	11	10	9	8	7	6	5	4	3	2	1	
MR	M1	P1	OUTCOM	O104	O102	O100	O98	O103	O101	O99	O97	A
PR	M1	P1	INCOM	I104	I102	I100	I98	I103	I101	I99	I97	B

Col	Pin	Signal
A	A1	O97 (Y0128)
	A2	O99 (Y0130)
	A3	O101(Y0132)
	A4	O103(Y0134)
	A5	O98 (Y0129)
	A6	O100(Y0131)
	A7	O102(Y0133)
	A8	O104(Y0135)
	A9	OUTCOM
	A10	P1
	A11	M1
	A12	MR
B	B1	I97 (X0128)
	B2	I99 (X0130)
	B3	I101(X0132)
	B4	I103(X0134)
	B5	I98 (X0129)
	B6	I100(X0131)
	B7	I102(X0133)
	B8	I104(X0135)
	B9	INCOM
	B10	P1
	B11	M1
	B12	PR

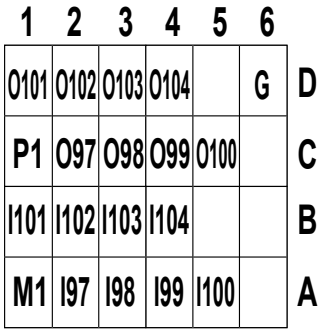
O97～O104	Logical output signals (factory assignment)
I97～I104	Logical input signals (factory assignment)
X0128～X0135	Physical input signals
Y0128～Y0135	Physical output signals
OUTCOM	O97～O104 common
INCOM	I97～I104 common
P1	Internal power supply 24V
M1	Internal power supply 0V
PR	Relay power source (+)
MR	Relay power source (-)

If the robot has solenoid valve option inside, it is possible to use the valves by the following signals.
For details, refer to the instruction manual ***“CFD technical document 1”***.

```
 O97 SOL1A
 O98 SOL1B
 O99 SOL2A
O100 SOL2B
O101 SOL3A
O102 SOL3B
```

Robot side connector CNR010 (Relay output)

The pin layout seeing from the soldering side



Pin	Signal	Remarks
A1	M1	(CN10A:A01)
A2	I97 (X0128)	(CN10A:A02)
A3	I98 (X0129)	(CN10A:A03)
A4	I99 (X0130)	(CN10A:A04)
A5	I100(X0131)	(CN10A:A05)
A6	-	Not used
B1	I101(X0132)	(CN10A:A06)
B2	I102(X0133)	(CN10A:A07)
B3	I103(X0134)	(CN10A:A08)
B4	I104(X0135)	(CN10A:A09)
B5	-	Not used
B6	-	Not used
C1	P1	
C2	O97 (Y0128)	
C3	O98 (Y0129)	
C4	O99 (Y0130)	
C5	O100(Y0131)	
C6	-	Not used
D1	O101(Y0132)	
D2	O102(Y0133)	
D3	O103(Y0134)	
D4	O104(Y0135)	
D5	-	Not used
D6	G	Shield line

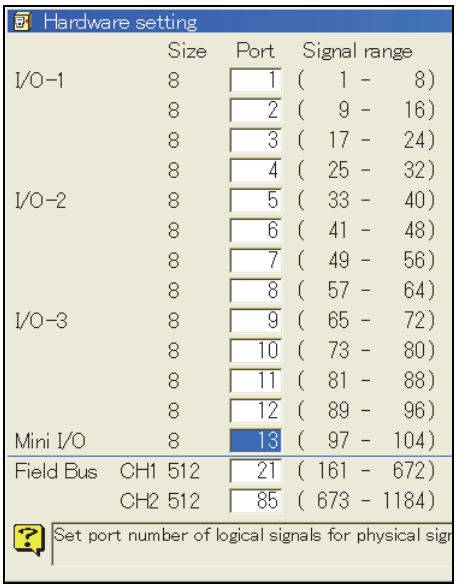
(NOTE)
The pins of “Not used” are not connected to the Mini I/O board connector.

2.4.4 How to use the Mini I/O board with O1-O8 and I1-I8 signals

By changing the setting like the following example, it becomes possible to control the mini I/O using O1-O8 and I1-I8 of the logical signals.

Factory setting (initial setting)

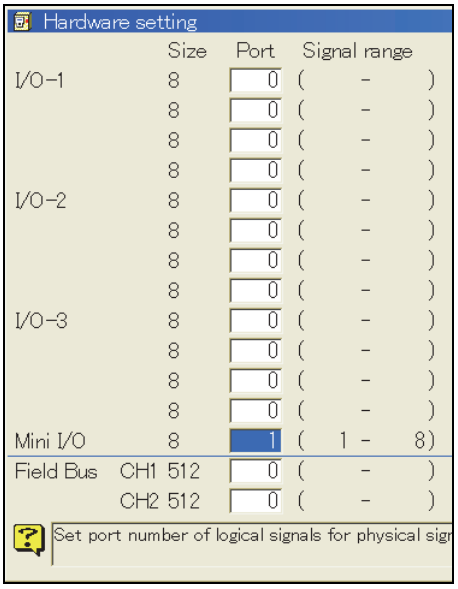
The logical signal address “97 to 104” are connected to the physical address of the mini I/O board.



Physical input	Logical input	Physical out	Logical output
X0128	I97	Y0128	O97
X0129	I98	Y0129	O98
X0130	I99	Y0130	O99
X0131	I100	Y0131	O100
X0132	I101	Y0132	O101
X0133	I102	Y0133	O102
X0134	I103	Y0134	O103
X0135	I104	Y0135	O104

Assignment change for the O1 - O8 and I1 - I8

If the setting is changed like the following picture, the logical signal address “1 to 8” are connected to the physical address of the mini I/O board.



Physical input	Logical input	Physical out	Logical output
X0128	I1	Y0128	O1
X0129	I2	Y0129	O2
X0130	I3	Y0130	O3
X0131	I4	Y0131	O4
X0132	I5	Y0132	O5
X0133	I6	Y0133	O6
X0134	I7	Y0134	O7
X0135	I8	Y0135	O8

An example of how to use I/O signals in a program

In this example, the O1 – O8 and I1 – I8 can control the mini I/O board.

Example: Turning ON/OFF a logical output signal

For example, the following application commands can turn ON/OFF the logical output signals.

FN32	SET	"Output signal ON"
FN34	RESET	"Output signal OFF"
FN105	SETM	"Output signal ON/OFF"

<Program sample>

The O1 signal will turn ON and OFF every 1 second.

```
  0  [START]
  1  SET[O1]                    FN32;Output signal set
  2  DELAY[1]                   FN50;Timer delay
  3  RESET[O1]                  FN34;Output signal res
  4  DELAY[1]                   FN50;Timer delay
  5  SETM[O1,1]                 FN105;Output signal
  6  DELAY[1]                   FN50;Timer delay
  7  SETM[O1,0]                 FN105;Output signal
  8  DELAY[1]                   FN50;Timer delay
  9  END                        FN92;End
[EOF]
```

And, if a solenoid valve option is installed in the robot, it is possible to turn ON/OFF those valves using these output signals.

(Example) If "OP-H6-004 (SOL1, 2, 3)" option is installed in a MZ07 robot

SET[O1]	SOL1A turns ON
SET[O2]	SOL1B turns ON
SET[O3]	SOL2A turns ON
SET[O4]	SOL2B turns ON
SET[O5]	SOL3A turns ON
SET[O6]	SOL3B turns ON
RESET[O1]	SOL1A turns OFF
RESET[O2]	SOL1B turns OFF
RESET[O3]	SOL2A turns OFF
RESET[O4]	SOL2B turns OFF
RESET[O5]	SOL3A turns OFF
RESET[O6]	SOL3B turns OFF

Example: Use a logical input signal for an interlock operation

By using application commands like `WAITI` etc, it is possible to use input signals (e.g. a signal from a sensor switch, a signal from a master PLC unit, etc.) for interlock operation.

<Program sample>

```
  0 [START]
  1    100 mm/s LIN   A1  T1
  2    100 mm/s LIN   A1  T1
  3 WAITI[I1]                    FN525;Wait Input cond
  4    100 mm/s LIN   A1  T1
  5    100 mm/s LIN   A1  T1
  6 END                          FN92;End
[EOF]
```

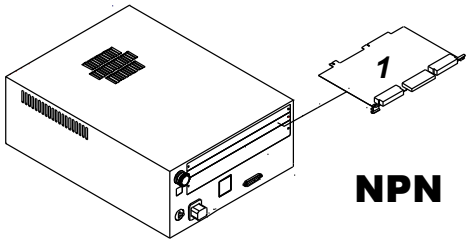
The robot will move at the step 3 like the following.

If the `I1` signal is ON, the robot will go to the next step 4.
If the `I1` signal is OFF, the robot will stop and wait for the input signal `I1` to turn ON.

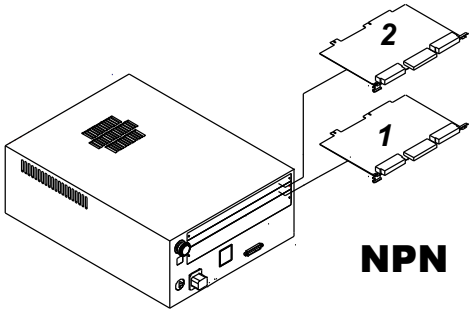
Chapter 3 Digital I/O

3.1 Outline

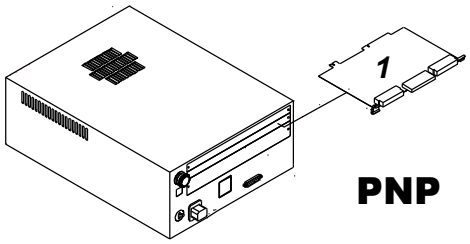
There are 4 types of Digital I/O board option configuration.
Because this board can be installed up to 2, 64 inputs + 64 outputs can be controlled at maximum.



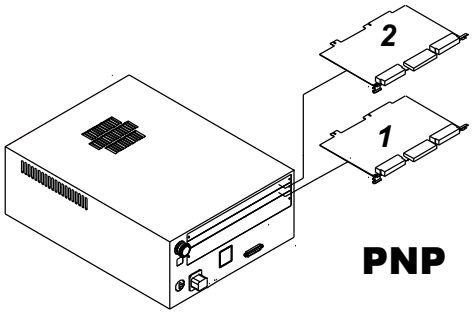
CFD-OP125-A (NPN)
32 IN + 32 OUT



CFD-OP125-B (NPN)
64 IN + 64 OUT



CFD-OP151-A (PNP)
32 IN + 32 OUT



CFD-OP151-B (PNP)
64 IN + 64 OUT

If more signals are necessary, please use the Fieldbus boards (DeviceNet, CC-LINK, PROFIBUS, etc.).

3.1.1 Contained Parts

Contained parts of this option

No.	Name	Parts No., type.	Note
1	UM356 board or UM381 board	UM356-10 (CFD-OP125-**) UM381-10 (CFD-OP151-**)	
2	Connector	MR-50F MR-50M MR-50L+	HONDA TSUSHIN KOGYO
3	Panel to connect cable		
4	Fixing screws for board	M4 × 8mm	

3.1.2 Electrical specifications of “Photo coupler input”

Electrical specifications of physical input (for 1 input signal point)

Items	Specifications
Input impedance	Approx. 3 kΩ
Input voltage	DC+24 V ±10 %
Input current	8 mA (typ.)

Specifications of the load for input circuit (prepared by customer)

Input load (prepared by customer)	Specifications	Remarks
Relay contact	Minimum applicable load should be DC24V, 5 mA	The input signals needs to be closed for 150ms or longer.
Open collector device	Leakage current should be 1 mA or less.	

3.1.3 Electrical specifications of “NPN and PNP output”

Prepare the output load that conforms to the used physical output signal.

Electrical specifications of physical output (for 1 input signal point)

Items	Specifications
Rated voltage	DC+24 V ±3 V
Rated current	0.1 A

CAUTION

- Be absolutely sure to use a surge killer for the load.
- Do not use power with the wrong polarity.

3.1.4 DC24V power supply

The capacity for the DC24V that can be supplied by the internal DC24V is 0.8A.

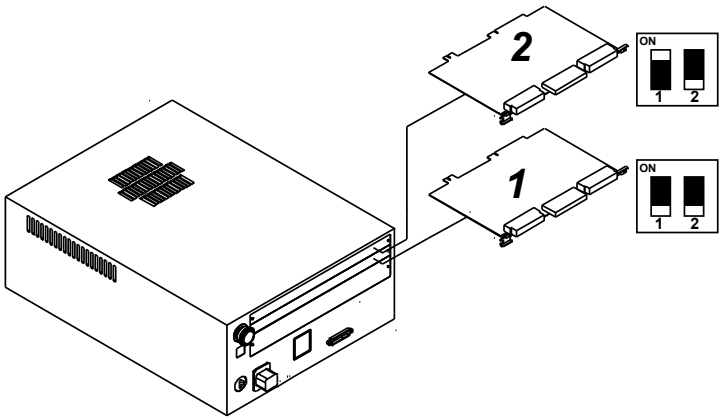
If the input/output current for the used external device exceeds this value, you need to prepare an external DC24V power supply.

3.2 Installation and Connection

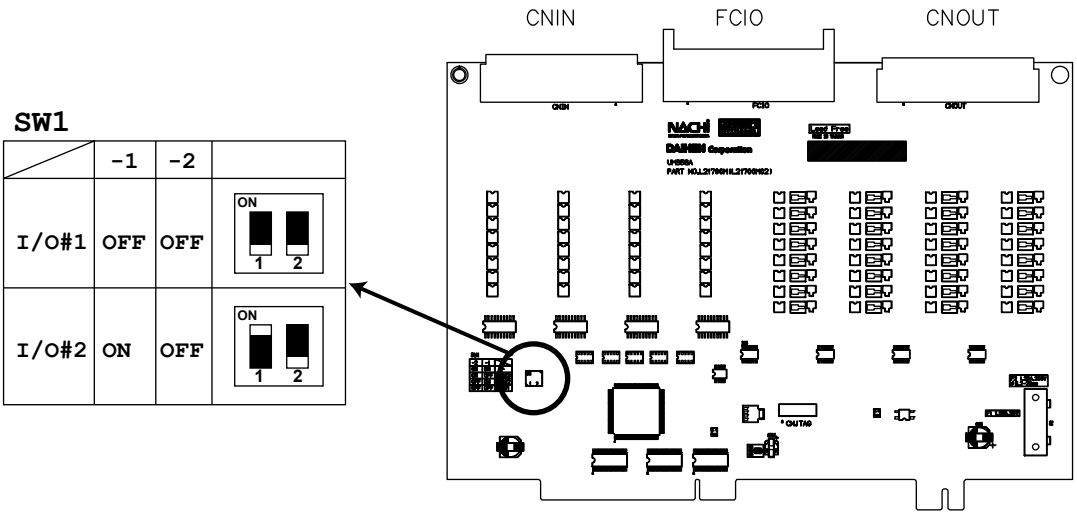
3.2.1 DIP SW settingl

When using the "Digital I/O board", it is necessary to set the SW1 to identify the I/O board.

SW1 setting

PCB No.	SW1-1	SW1-2	Figure
2	ON	OFF	
1	OFF	OFF	

In case of only 1 board, both SW1-1 and SW1-2 must be set to OFF.

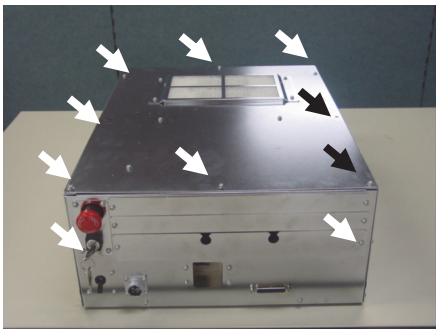


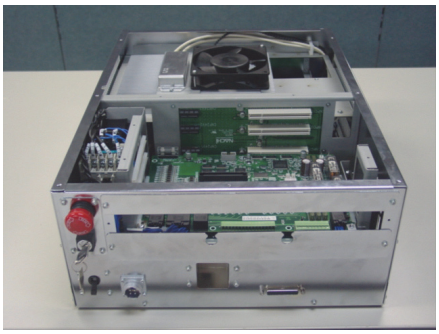
SW1 setting

3.2.2 How to install

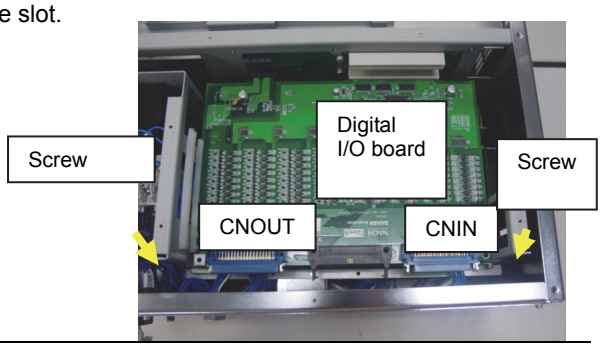
1 Turn OFF the controller power and disconnect the primary power source connector.

2 Loosen the screws on the top panel and the front side cable drawing panel.





3 Install the Digital I/O board to the slot.

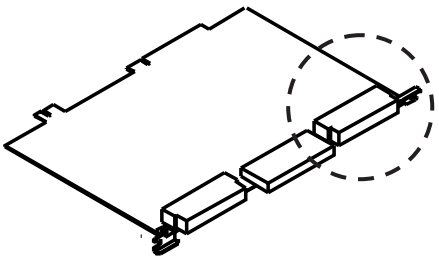


4 Connect the connectors and fix them with fixing screws.

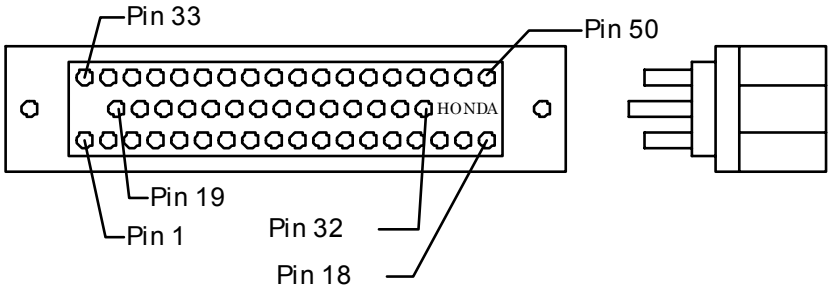
5 Install panels at they were.
(Please use the new “front side cable drawing panel”. Old one can not be used. But old “top panel” can be used again.)

3.2.3 CNIN connector

32 DC24V input signals are included in this connector.



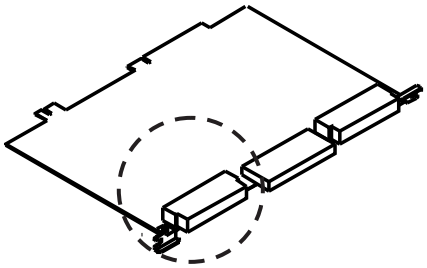
This figure shows the connector (CNIN) pin layout as viewed from the soldered surface. Connector model: MR-50LM
(Soldering type male connector by Honda Tsushin Kogyo)



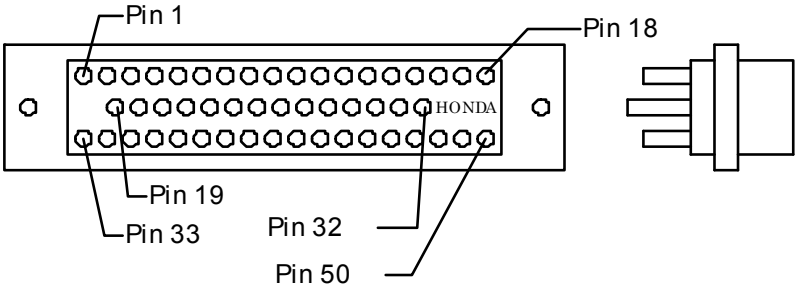
CNIN pin layout

3.2.4 CNOUT connector

32 DC24V output signals are included in this connector.



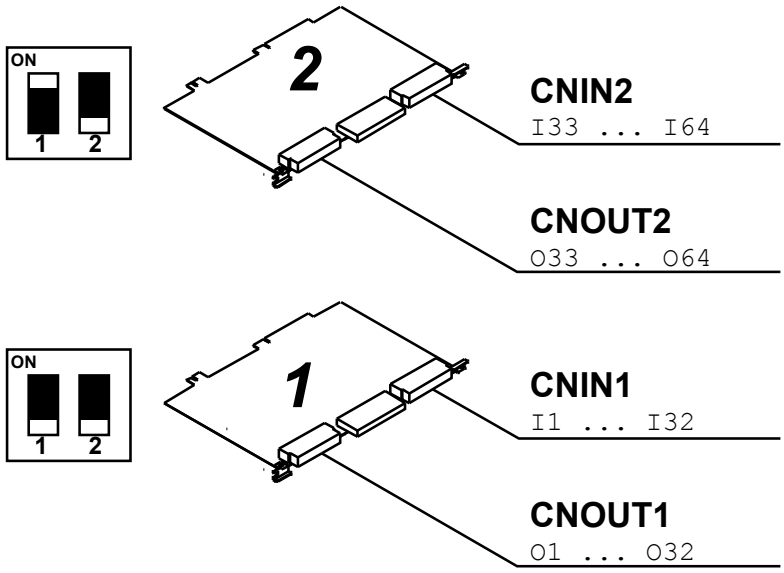
This figure shows the connector (CNOUT) pin layout as viewed from the soldered surface. Connector model: MR-50LF
(Soldering type female connector by Honda Tsushin Kogyo)



CNOUT pin layout

3.2.5 Pin assignment (common to NPN and PNP, external power supply)

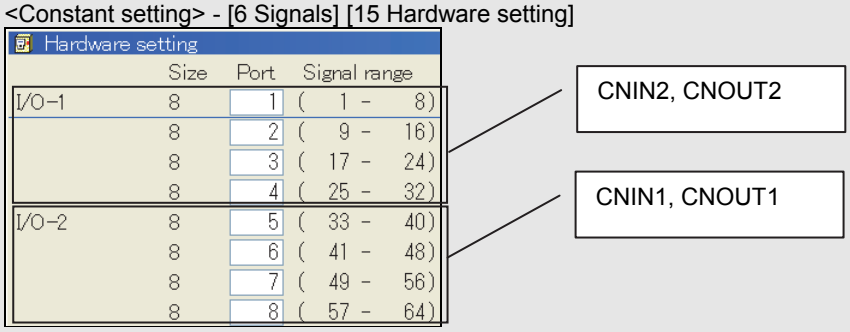
In case of 2 boards, it is necessary to prepare an external power supply unit for the I/O control.



As the initial setting, the following logical I/O signals are assigned to the Digital I/O board.

I1 ～ I32 : CNIN1
I33 ～ I64 : CNIN2
O1 ～ O32 : CNOUT1
O33 ～ O64 : CNOUT2

To change this assignment, please use the following menu.
<Constant setting> - [6 Signals] [15 Hardware setting]

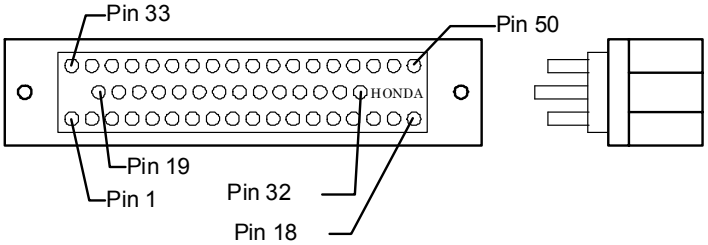


CAUTION

Note 1. Do not connect different power system signals to the same common. Doing so may cause malfunctions.
Note 2. Do not connect wires to pins 28-32, and 42-50 of the connector.
Note 3. When 2 Digital I/O boards are used, use an external DC24V power supply.

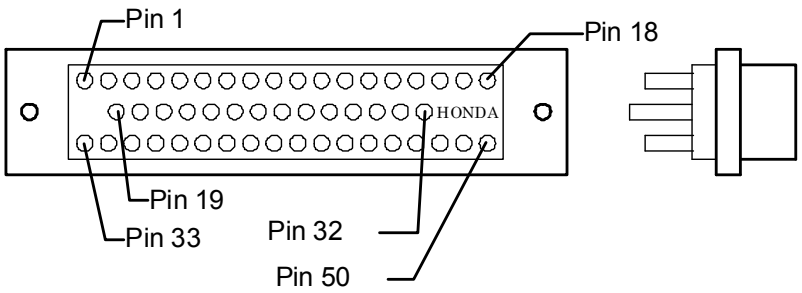
Pin assignment of the Digital I/O board (CNIN1 and CNIN2)

Pin No.	CNIN1		CNIN2	
	Name	Initial assignment	Name	Initial assignment
1	I1	General input signal I1～I8	I33	General input signal I33～I40
2	I2		I34	
3	I3		I35	
4	I4		I36	
5	I5		I37	
6	I6		I38	
7	I7		I39	
8	I8		I40	
9	Common	Common for Pin1 to 8 (I1 to I8) (Note 1)	Common	Common for Pin1 to 8 (I33 to I40) (Note 1)
10	I9	General input signal I9～I16	I41	General input signal I41～I48
11	I10		I42	
12	I11		I43	
13	I12		I44	
14	I13		I45	
15	I14		I46	
16	I15		I47	
17	I16		I48	
18	Common	Common for Pin10 to17 (I9 to I16) (Note 1)	Common	Common for Pin10 to17 (I41 to I48) (Note 1)
19	I17	General input signal I17～I24	I49	General input signal I49～I56
20	I18		I50	
21	I19		I51	
22	I20		I52	
23	I21		I53	
24	I22		I54	
25	I23		I55	
26	I24		I56	
27	Common	Common for Pin19 to 26 (I17 to I24) (Note 1)	Common	Common for Pin19 to 26 (I49 to I56) (Note 1)
28～32		Not used (Note 2)		Not used (Note 2)
33	I25	General input signal I25～I32	I57	General input signal I57～I64
34	I26		I58	
35	I27		I59	
36	I28		I60	
37	I29		I61	
38	I30		I62	
39	I31		I63	
40	I32		I64	
41	Common	Common for Pin33 to 40 (I25 to I32) (Note 1)	Common	Common for Pin33 to 40 (I57 to I64) (Note 1)
42～50		Not used (Note 2)		Not used (Note 2)



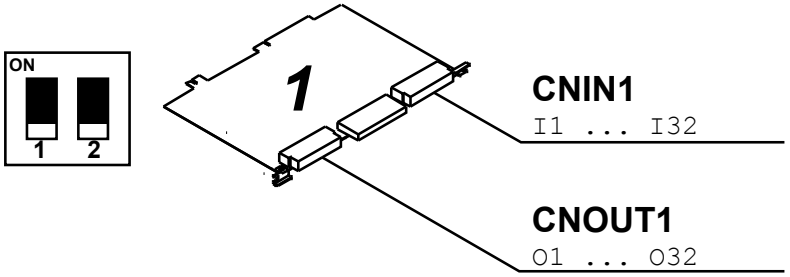
Pin assignment of the Digital I/O board (CNOUT1 and CNOUT2)

Pin No.	CNOUT1		CNOUT2	
	Name	Initial assignment	Name	Initial assignment
1	O1	General output signal O1～O8	O33	General output signal O33～O40
2	O2		O34	
3	O3		O35	
4	O4		O36	
5	O5		O37	
6	O6		O38	
7	O7		O39	
8	O8		O40	
9	Common	Common for Pin1 to 8 (O1 to O8) (Note 1)	Common	Common for O33 to O40 (Pin1 to 8) (Note 1)
10	O9	General output signal O9～O16	O41	General output signal O41～O48
11	O10		O42	
12	O11		O43	
13	O12		O44	
14	O13		O45	
15	O14		O46	
16	O15		O47	
17	O16		O48	
18	Common	Common for Pin10 to 17 (O9 to O16) (Note 1)	Common	Common for O41 to O48 (Pin10 to 17) (Note 1)
19	O17	General output signal O17～O24	O49	General output signal O49～O56
20	O18		O50	
21	O19		O51	
22	O20		O52	
23	O21		O53	
24	O22		O54	
25	O23		O55	
26	O24		O56	
27	Common	Common for Pin19 to 26 (O17 to O24) (Note 1)	Common	Common for O49 to O56 (Pin19 to 26) (Note 1)
28～32		Not used (Note 2)		Not used (Note 2)
33	O25	General output signal O25～O32	O57	General output signal O57～O64
34	O26		O58	
35	O27		O59	
36	O28		O60	
37	O29		O61	
38	O30		O62	
39	O31		O63	
40	O32		O64	
41	Common	Common for O25 to O32 (Pin33 to 40) (Note 1)	Common	Common for O57 to O64 (Pin33 to 40) (Note 1)
42～50		Not used (Note 2)		Not used (Note 2)



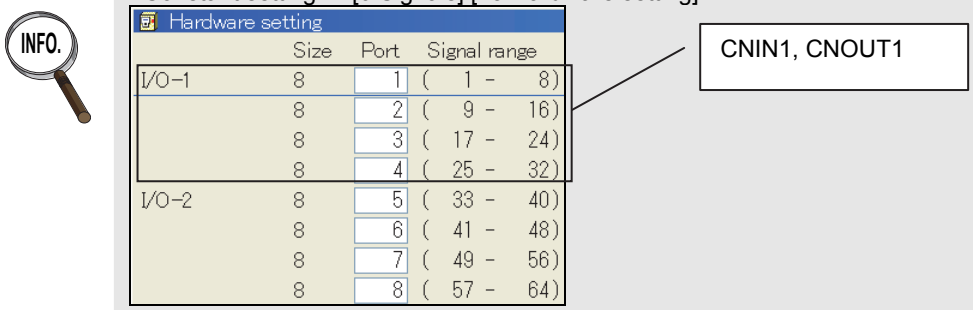
3.2.6 Pin assignment (NPN / PNP, internal power supply)

In case of only 1 board, it is possible to control the I/O signals using the internal power supply.
(Of course, external power supply is also available)



As the initial setting, the following logical I/O signals are assigned to the Digital I/O board.
I1 ～ I32 : CNIN1
O1 ～ O32 : CNOUT1

To change this assignment, please use the following menu.
<Constant setting> - [6 Signals] [15 Hardware setting]

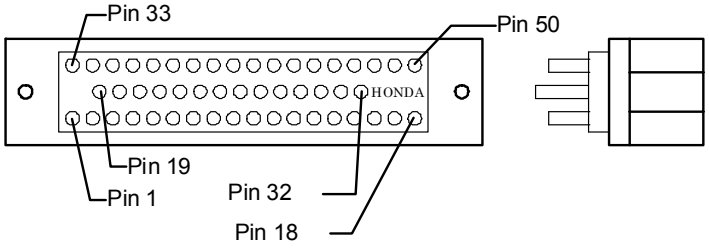


CAUTION

Note 1. Do not connect different power system signals to the same common. Doing so may cause malfunctions.
Note 2. Do not connect wires to pins 28-32, and 42-50 of the connector.
Note 3. When 2 Digital I/O boards are used, use an external DC24V power supply.

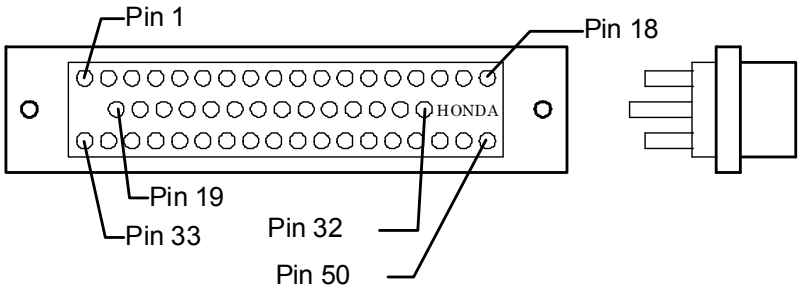
Pin assignment of the Digital I/O board: CNIN (when using internal power supply)

Pin No.	Name	Initial assignment
1	I1	General input signal I1～I8
2	I2	
3	I3	
4	I4	
5	I5	
6	I6	
7	I7	
8	I8	
9	common	Common for Pin1 to 8 (I1 to I8) (Note 1)
10	I9	General input signal I9～I16
11	I10	
12	I11	
13	I12	
14	I13	
15	I14	
16	I15	
17	I16	
18	common	Common for Pin10 to 17 (I9 to I16) (Note 1)
19	I17	General input signal I17～I24
20	I18	
21	I19	
22	I20	
23	I21	
24	I22	
25	I23	
26	I24	
27	common	Common for Pin19 to 26 (I17 to I24) (Note 1)
28～32		Not used (Note 2)
33	I25	General input signal I25～I32
34	I26	
35	I27	
36	I28	
37	I29	
38	I30	
39	I31	
40	I32	
41	common	Common for Pin33 to 40 (I25 to I32) (Note 1)
42-44		Not used (Note 2)
45-47	P1	Internal power source DC24V (Note 3)
48-50	M1	Internal power ground 0V (Note 3)



Pin assignment of the Digital I/O board: CNOUT (when using internal power source)

Pin No.	Name	Initial assignment
1	O1	General output signal O1～O8
2	O2	
3	O3	
4	O4	
5	O5	
6	O6	
7	O7	
8	O8	
9	common	Common for Pin1 to 8 (O1 to O8) (Note 1)
10	O9	General output signal O9～O16
11	O10	
12	O11	
13	O12	
14	O13	
15	O14	
16	O15	
17	O16	
18	common	Common for Pin10 to 17 (O9 to O16) (Note 1)
19	O17	General output signal O17～O24
20	O18	
21	O19	
22	O20	
23	O21	
24	O22	
25	O23	
26	O24	
27	common	Common for Pin19 to 26 (O17 to O24) (Note 1)
28-32		Not used (Note 2)
33	O25	General output signal O25～O32
34	O26	
35	O27	
36	O28	
37	O29	
38	O30	
39	O31	
40	O32	
41	common	Common for Pin33 to 40 (O25 to O32) (Note 1)
42-44		Not used (Note 2)
45-47	P1	Internal power source DC24V (Note 3)
48-50	M1	Internal power ground 0V (Note 3)

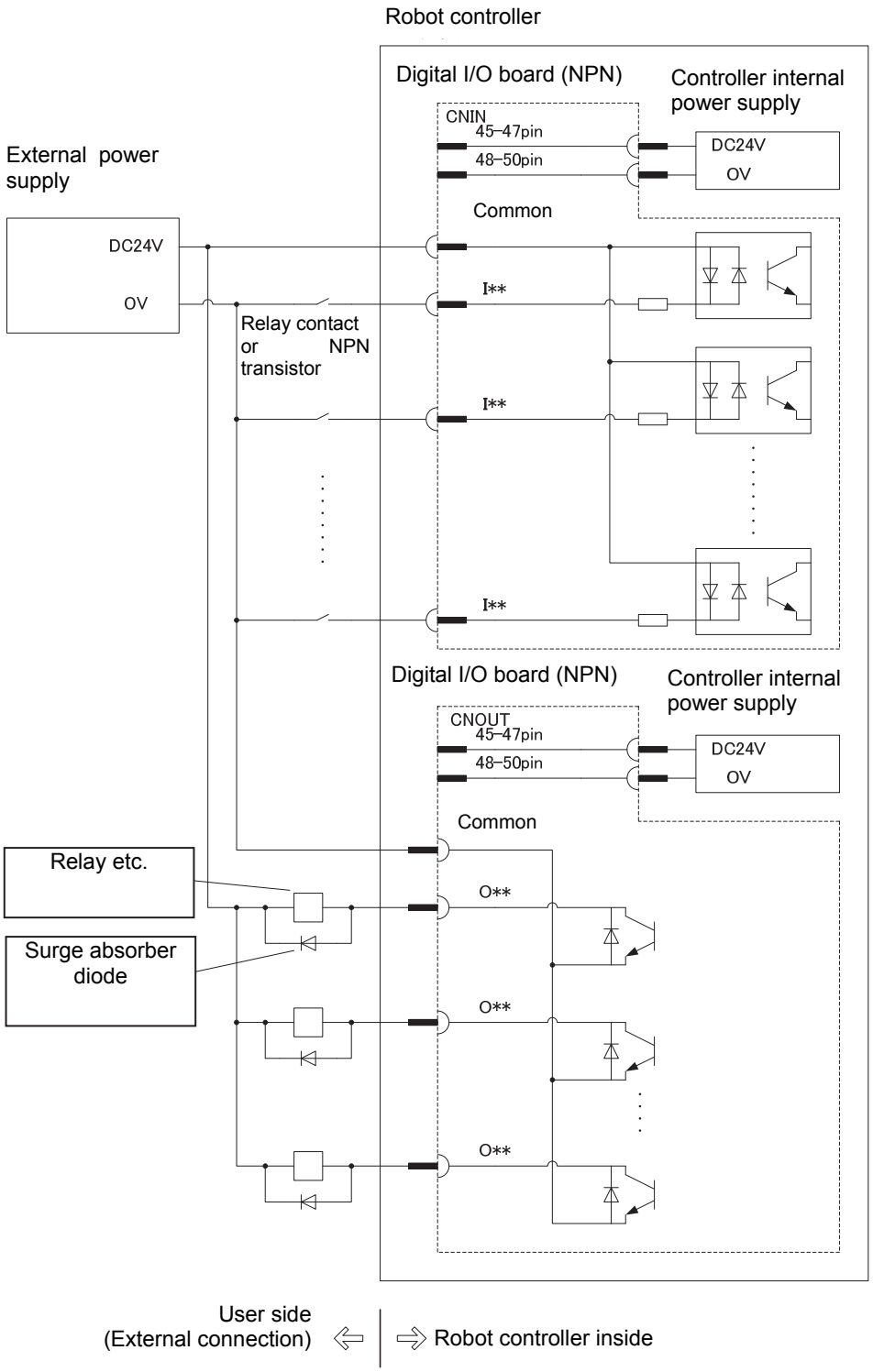


3.3 Connection circuit

3.3.1 NPN / external power supply

CAUTION

- Be absolutely sure to use a surge killer for the load.
- Do not use power with the wrong polarity.

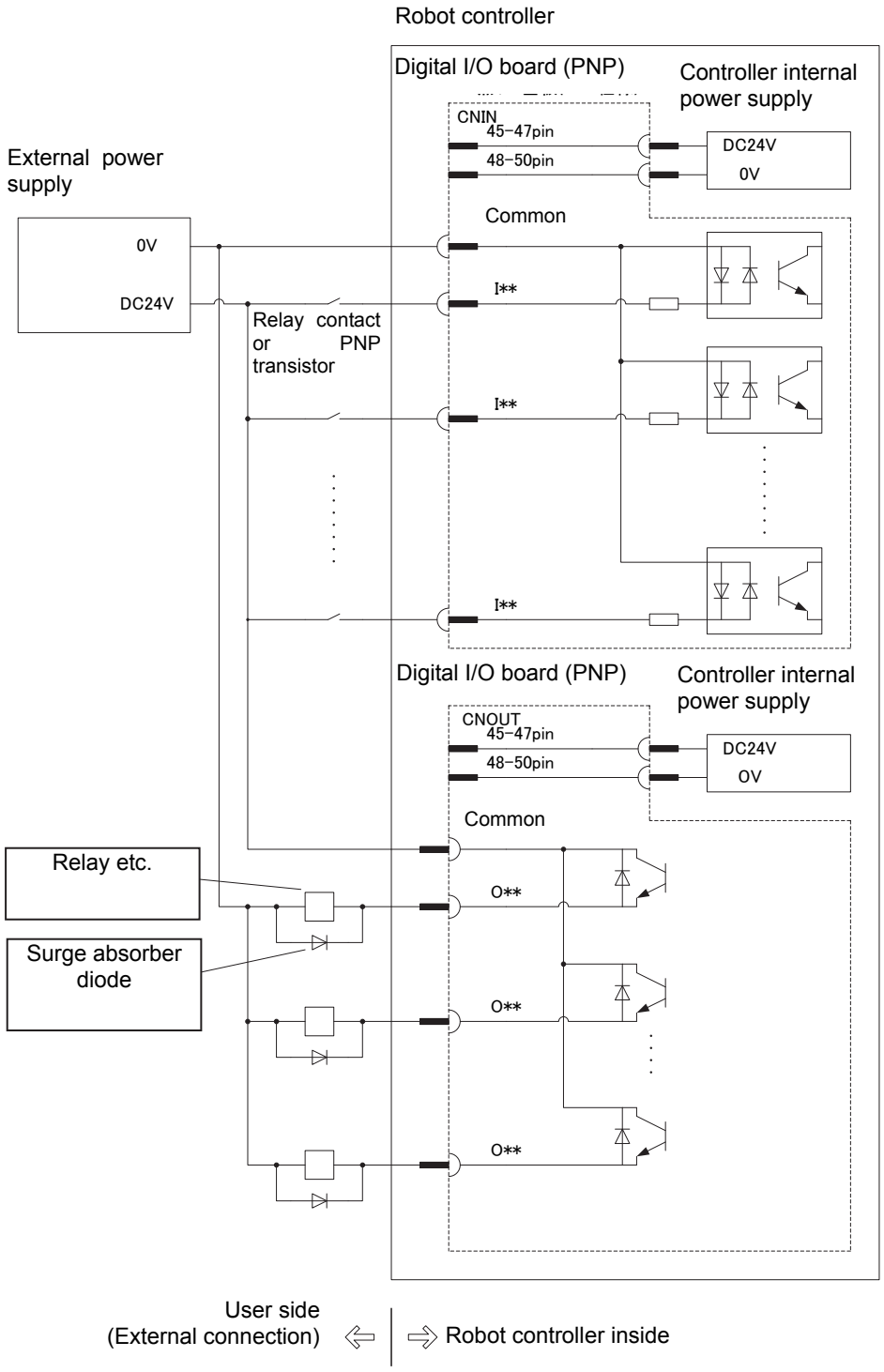


Connection of the Digital I/O board (NPN) (external power supply)

3.3.2 PNP / external power supply

CAUTION

- Be absolutely sure to use a surge killer for the load.
- Do not use power with the wrong polarity.

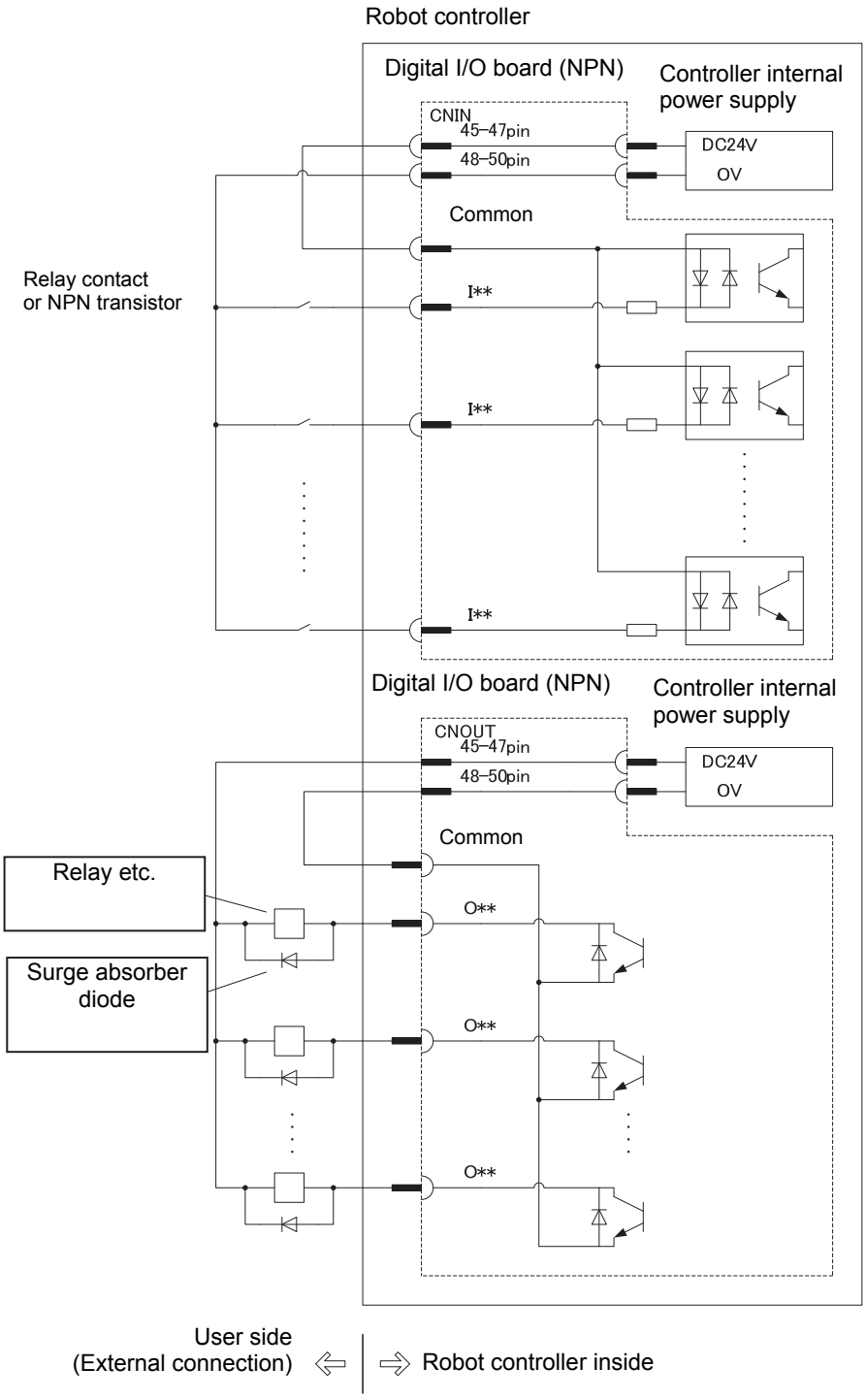


Connection of the Digital I/O board (PNP) (external power supply)

3.3.3 NPN / internal power supply

- For details on the electrical specifications for the input signals, see "3.1.3 Electrical specifications of “NPN and PNP output", “3.1.3 Electrical specifications of “NPN and PNP output”.
- For details on the electrical specifications for the internal power supply, see "3.1.4 DC24V power supply"

When using only 1 Digital I/O board, internal power supply can be used.



Connection of the Digital I/O board (NPN) (internal power supply

Internal and external power supplies can be used together since there is a separate common for every eight I/O circuits.

(Example)

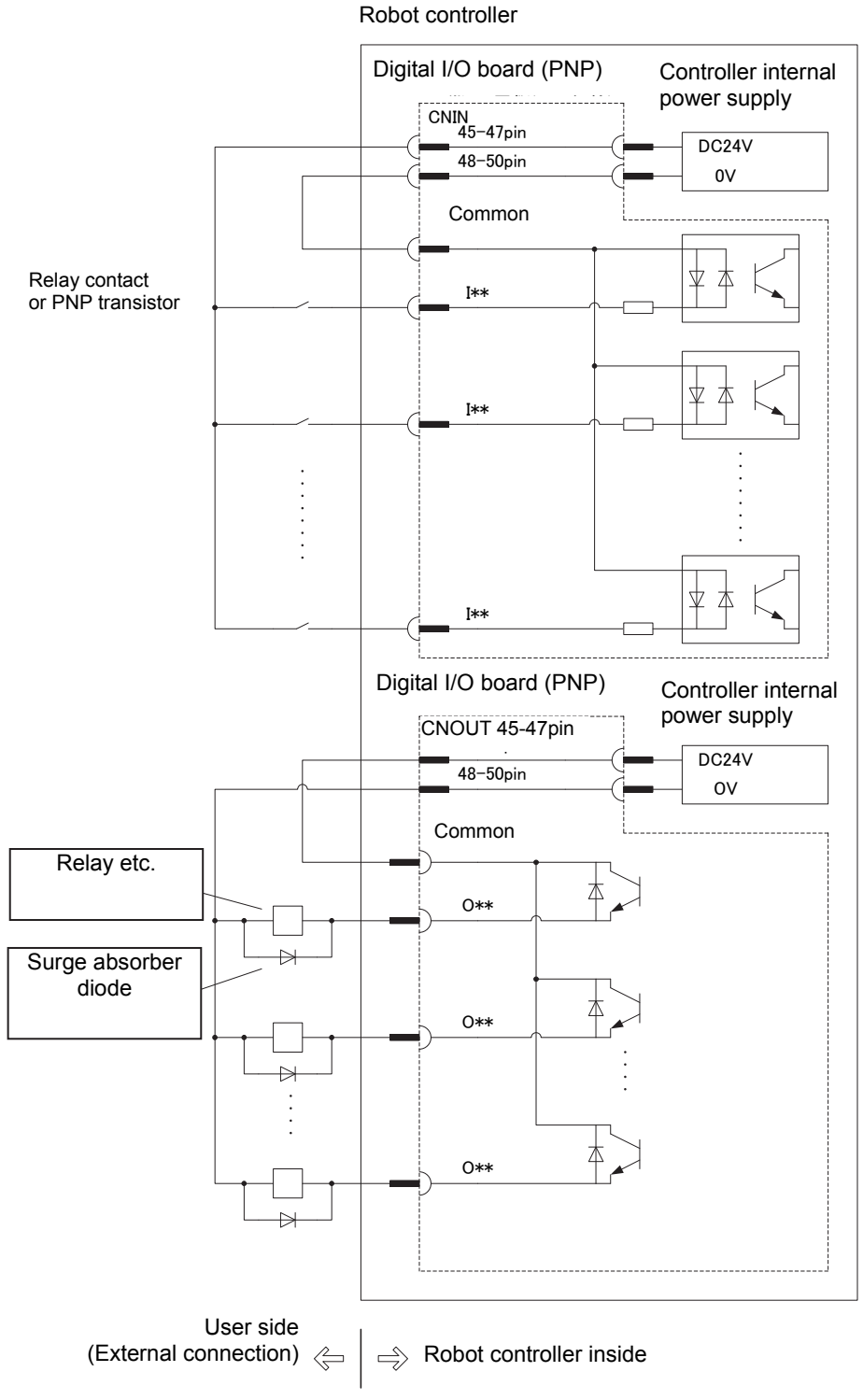
Input	Power supply
I1 ～ I8	Internal
I9 ～ I16	Internal
I17 ～ I24	Internal
I25 ～ I32	External

Output	Power supply
O1 ～ O8	Internal
O9 ～ O16	Internal
O17 ～ O24	Internal
O25 ～ O32	External

3.3.4 PNP / internal power supply

- For details on the electrical specifications for the input signals, see "3.1.3 Electrical specifications of “NPN and PNP output", “3.1.3 Electrical specifications of “NPN and PNP output”.
- For details on the electrical specifications for the internal power supply, see "3.1.4 DC24V power supply"

When using only 1 Digital I/O board, internal power supply can be used.



Connection of the Digital I/O board (PNP) (internal power supply)

Internal and external power supplies can be used together since there is a separate common for every eight I/O circuits.

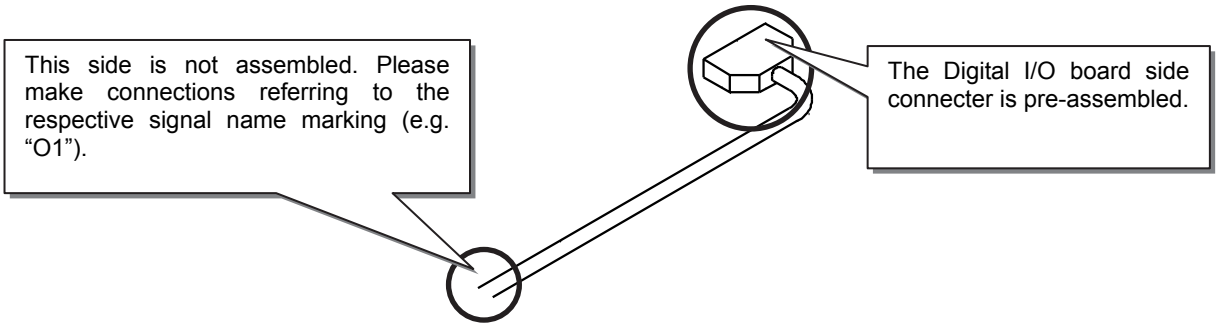
(Example)

Input	Power supply
I1 ～ I8	Internal
I9 ～ I16	Internal
I17 ～ I24	Internal
I25 ～ I32	External

Output	Power supply
O1 ～ O8	Internal
O9 ～ O16	Internal
O17 ～ O24	Internal
O25 ～ O32	External

3.3.5 I/O cable for the Digital I/O board (option)

Optional cable like the following is available.

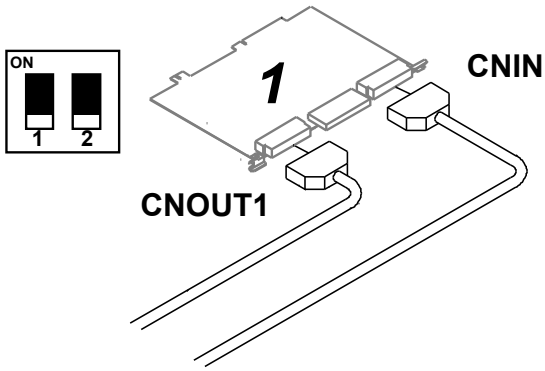


For 1 Digital I/O board

Option number

IOCABLE-30-**1**-02M (2m)
IOCABLE-30-**1**-05M (5m)
IOCABLE-30-**1**-10M (10m)
IOCABLE-30-**1**-15M (15m)
IOCABLE-30-**1**-20M (20m)
IOCABLE-30-**1**-25M (25m)

This option includes 2 cables;
CNOUT 1, CNIN 1

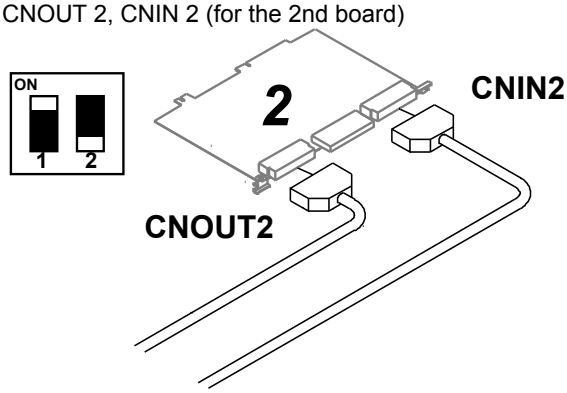


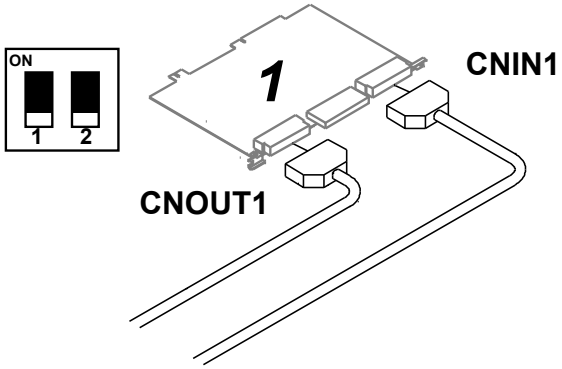
For 2 Digital I/O boards

Option number

IOCABLE-30-**2**-02M (2m)
IOCABLE-30-**2**-05M (5m)
IOCABLE-30-**2**-10M (10m)
IOCABLE-30-**2**-15M (15m)
IOCABLE-30-**2**-20M (20m)
IOCABLE-30-**2**-25M (25m)

This option includes 4 cables;
CNOUT 1, CNIN 1 (for the 1st board)
CNOUT 2, CNIN 2 (for the 2nd board)



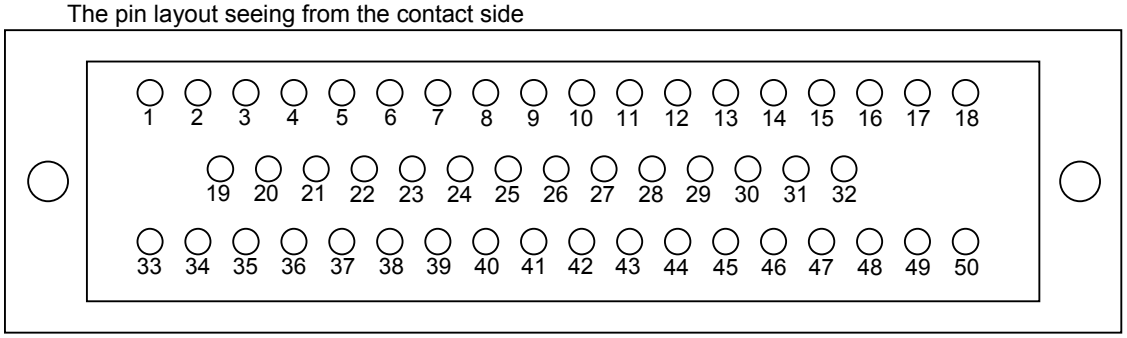


- When using this cable, please use the external power supply connection.
- This cable can be used for FD controller also.

Details of CNOUT 1

Name	Model number	Maker	Qty	Remarks
Connector	MRP 50LF01+	HONDA TSUSHIN KOGYO	1	
Female contact	MRP-F102(MRP-F112)	HONDA TSUSHIN KOGYO	36	AWG24～28
Cable	OTSC(U)-20PVB25	Onamba	L+0.75m (L=2,5,10,15,20,25)	φ11.3 AWG25
Cable tie	SG-80	S.G. Industrial	3	

The pin layout seeing from the contact side



PIN No.	Wire color (Base / line)	Signal name	PIN No.	Wire color (Base / line)	Signal name
1	Black	O1(Y0000)	26	Green / Red	O24(Y0023)
2	Black / White	O2(Y0001)	27	Yellow / Black	OCM03
3	Red	O3(Y0002)	28		
4	Red / White	O4(Y0003)	29		
5	Green	O5(Y0004)	30		
6	Green / White	O6(Y0005)	31		
7	Yellow	O7(Y0006)	32		
8	Yellow / White	O8(Y0007)	33	Brown / Black	O25(Y0024)
9	Brown	OCM01	34	Brown / Red	O26(Y0025)
10	Brown / White	O9(Y0008)	35	Blue / Black	O27(Y0026)
11	Blue / White	O10(Y0009)	36	Blue / Red	O28(Y0027)
12	Grey	O11(Y0010)	37	Grey / Black	O29(Y0028)
13	Grey / White	O12(Y0011)	38	Grey / Red	O30(Y0029)
14	Orange	O13(Y0012)	39	Orange / Black	O31(Y0030)
15	Orange / White	O14(Y0013)	40	Orange / Red	O32(Y0031)
16	Purple	O15(Y0014)	41	Purple / Black	OCM04
17	Purple / White	O16(Y0015)	42		
18	Light green	OCM02	43		
19	Pink	O17(Y0016)	44		
20	Pink / White	O18(Y0017)	45		
21	Light blue	O19(Y0018)	46		
22	Light blue / White	O20(Y0019)	47		
23	White	O21(Y0020)	48		
24	White / Black	O22(Y0021)	49		
25	Green / Black	O23(Y0022)	50		

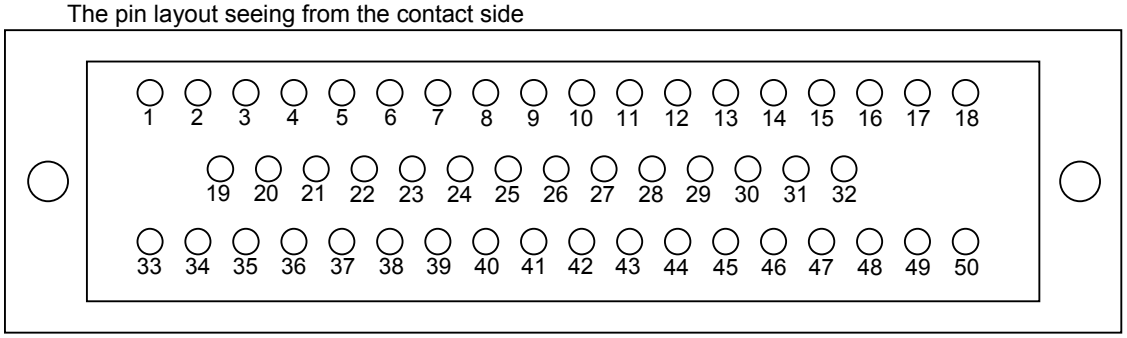
(NOTE)

O1～O32 : Logical output signals (Factory assignment)
Y0000～Y0031 : Physical output signals
OCM01 : O1～O8 common
OCM02 : O9～O16 common
OCM03 : O17～O24 common
OCM04 : O25～O32 common

Details of CNOUT 2

Name	Model number	Maker	Qty	Remarks
Connector	MRP 50LF01+	HONDA TSUSHIN KOGYO	1	
Female contact	MRP-F102(MRP-F112)	HONDA TSUSHIN KOGYO	36	AWG24～28
Cable	OTSC(U)-20PVB25	Onamba	L+0.75m (L=2,5,10,15,20,25)	ϕ11.3 AWG25
Cable tie	SG-80	S.G. Industrial	3	

The pin layout seeing from the contact side



PIN No.	Wire color (Base / line)	Signal name	PIN No.	Wire color (Base / line)	Signal name
1	Black	O33(Y0064)	26	Green / Red	O56(Y0087)
2	Black / White	O34(Y0065)	27	Yellow / Black	OCM07
3	Red	O35(Y0066)	28		
4	Red / White	O36(Y0067)	29		
5	Green	O37(Y0068)	30		
6	Green / White	O38(Y0069)	31		
7	Yellow	O39(Y0070)	32		
8	Yellow / White	O40(Y0071)	33	Brown / Black	O57(Y0088)
9	Brown	OCM05	34	Brown / Red	O58(Y0089)
10	Brown / White	O41(Y0072)	35	Blue / Black	O59(Y0090)
11	Blue / White	O42(Y0073)	36	Blue / Red	O60(Y0091)
12	Grey	O43(Y0074)	37	Grey / Black	O61(Y0092)
13	Grey / White	O44(Y0075)	38	Grey / Red	O62(Y0093)
14	Orange	O45(Y0076)	39	Orange / Black	O63(Y0094)
15	Orange / White	O46(Y0077)	40	Orange / Red	O64(Y0095)
16	Purple	O47(Y0078)	41	Purple / Black	OCM08
17	Purple / White	O48(Y0079)	42		
18	Light green	OCM06	43		
19	Pink	O49(Y0080)	44		
20	Pink / White	O50(Y0081)	45		
21	Light blue	O51(Y0082)	46		
22	Light blue / White	O52(Y0083)	47		
23	White	O53(Y0084)	48		
24	White / Black	O54(Y0085)	49		
25	Green / Black	O55(Y0086)	50		

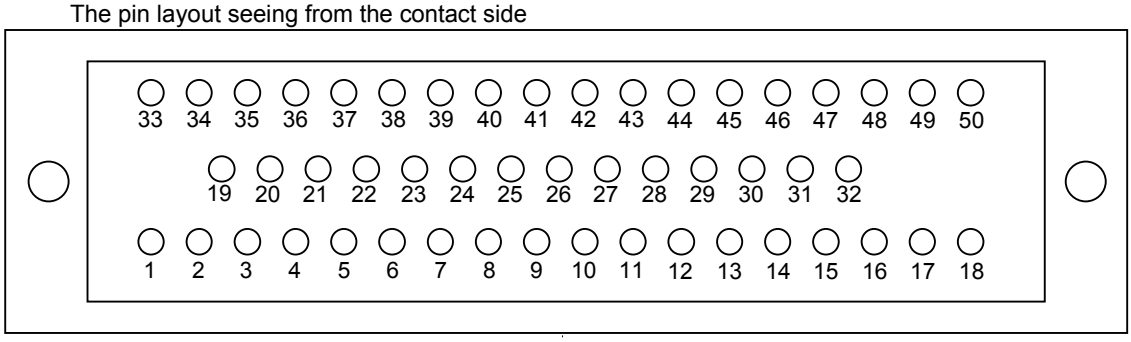
(NOTE)

O33～O64 : Logical output signals (Factory assignment)
Y0064～Y0095 : Physical output signals
OCM05 : O33～O40 common
OCM06 : O41～O48 common
OCM07 : O49～O56 common
OCM08 : O57～O64 common

Details of CNIN 1

Name	Model number	Maker	Qty	Remarks
Connector	MRP 50LM01+	HONDA TSUSHIN KOGYO	1	
Male contact	MRP-M102(MRP-M112)	HONDA TSUSHIN KOGYO	36	AWG24～28
Cable	OTSC(U)-20PVB25	Onamba	L+0.75m (L=2,5,10,15,20,25)	ϕ11.3 AWG25
Cable tie	SG-80	S.G. Industrial	3	

The pin layout seeing from the contact side



PIN No.	Wire color (Base / line)	Signal name	PIN No.	Wire color (Base / line)	Signal name
1	Black	I1(X0000)	26	Green / Red	I24(X0023)
2	Black / White	I2(X0001)	27	Yellow / Black	ICOM3
3	Red	I3(X0002)	28		
4	Red / White	I4(X0003)	29		
5	Green	I5(X0004)	30		
6	Green / White	I6(X0005)	31		
7	Yellow	I7(X0006)	32		
8	Yellow / White	I8(X0007)	33	Brown / Black	I25(X0024)
9	Brown	ICOM1	34	Brown / Red	I26(X0025)
10	Brown / White	I9(X0008)	35	Blue / Black	I27(X0026)
11	Blue / White	I10(X0009)	36	Blue / Red	I28(X0027)
12	Grey	I11(X0010)	37	Grey / Black	I29(X0028)
13	Grey / White	I12(X0011)	38	Grey / Red	I30(X0029)
14	Orange	I13(X0012)	39	Orange / Black	I31(X0030)
15	Orange / White	I14(X0013)	40	Orange / Red	I32(X0031)
16	Purple	I15(X0014)	41	Purple / Black	ICOM4
17	Purple / White	I16(X0015)	42		
18	Light green	ICOM2	43		
19	Pink	I17(X0016)	44		
20	Pink / White	I18(X0017)	45		
21	Light blue	I19(X0018)	46		
22	Light blue / White	I20(X0019)	47		
23	White	I21(X0020)	48		
24	White / Black	I22(X0021)	49		
25	Green / Black	I23(X0022)	50		

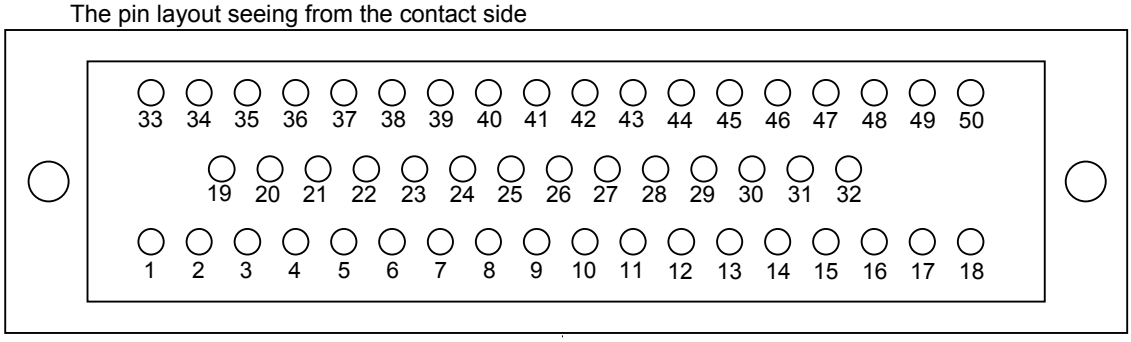
(NOTE)

I1～I32 : Logical input signals (Factory assignment)
X0000～X0031 : Physical input signals
ICOM1 : I1～I8 common
ICOM2 : I9～I16 common
ICOM3 : I17～I24 common
ICOM4 : I25～I32 common

Details of CNIN 2

Name	Model number	Maker	Qty	Remarks
Connector	MRP 50LM01+	HONDA TSUSHIN KOGYO	1	
Male contact	MRP-M102(MRP-M112)	HONDA TSUSHIN KOGYO	36	AWG24～28
Cable	OTSC(U)-20PVB25	Onamba	L+0.75m (L=2,5,10,15,20,25)	ϕ11.3 AWG25
Cable tie	SG-80	S.G. Industrial	3	

The pin layout seeing from the contact side



PIN No.	Wire color (Base / line)	Signal name	PIN No.	Wire color (Base / line)	Signal name
1	Black	I33(X0064)	26	Green / Red	I56(X0087)
2	Black / White	I34(X0065)	27	Yellow / Black	ICOM7
3	Red	I35(X0066)	28		
4	Red / White	I36(X0067)	29		
5	Green	I37(X0068)	30		
6	Green / White	I38(X0069)	31		
7	Yellow	I39(X0070)	32		
8	Yellow / White	I40(X0071)	33	Brown / Black	I57(X0088)
9	Brown	ICOM5	34	Brown / Red	I58(X0089)
10	Brown / White	I41(X0072)	35	Blue / Black	I59(X0090)
11	Blue / White	I42(X0073)	36	Blue / Red	I60(X0091)
12	Grey	I43(X0074)	37	Grey / Black	I61(X0092)
13	Grey / White	I44(X0075)	38	Grey / Red	I62(X0093)
14	Orange	I45(X0076)	39	Orange / Black	I63(X0094)
15	Orange / White	I46(X0077)	40	Orange / Red	I64(X0095)
16	Purple	I47(X0078)	41	Purple / Black	ICOM8
17	Purple / White	I48(X0079)	42		
18	Light green	ICOM6	43		
19	Pink	I49(X0080)	44		
20	Pink / White	I50(X0081)	45		
21	Light blue	I51(X0082)	46		
22	Light blue / White	I52(X0083)	47		
23	White	I53(X0084)	48		
24	White / Black	I54(X0085)	49		
25	Green / Black	I55(X0086)	50		

(NOTE)

I33～I64 : Logical input signals (Factory assignment)
X0064～X0095 : Physical input signals
ICOM5 : I33～I40 common
ICOM6 : I41～I48 common
ICOM7 : I49～I56 common
ICOM8 : I57～I64 common

Chapter 4 EtherNet/IP

4.1 Outline

Ethernet/IP is the industrial network system which is possible to transfer large capacity and wide variety of data with high speed.
By connecting the limit switches, photo sensors, operating boxes and industrial equipments such as robot through this network, these equipments are connected with logical access (network I/O). So communication between the equipments where the hardware connection was hard to be achieved is now improved and diagnosis of equipments is enabled.
Network speed from 10 Mbps to 100 Mpbps are selectable depending on the network size. (selected automatically depending on the network)

Two types of communication methods (I/O communication and Explicit communication) are available when using EtherNet/IP.
・I/O communication: Communication at high-speed cycle
・Explicit communication: Communication for settings / monitoring
In this controller, only I/O communications for transferring I/O signals over the network are supported.

With EtherNet/IP, the device called a “master” when using DeviceNet/IP is called a “scanner,” and the device called a “slave” is called an “adapter.”

EtherNet/IP is a trademark of ODVA (Open DeviceNet Vender Association, Inc.).

Performance table

Item	Specification
Number of channels	Up to four installed channels
Scanners / adapters	Scanners and adaptors can be used. Adaptors can be configured independently for each channel.
Communications	Supports I/O communication only
Number of I/O signals	Capable of using up to 2048 input signals (256 bytes) and up to 2048 output signals (256 bytes) for all channels combined, communication can be covered by the general-purpose signals of this controller. (When using embedded PLC)
Addresses	The IP address, subnet mask, and default gateway of this controller can be set for each channel by key entry from the teach pendant.
Transfer rate	10 Mbps, 100 Mbps The transfer rate is set automatically.
Processing of input data when a communication error occurs	You can select whether to maintain or clear input signal status when a communication error occurs.

Possible causes of errors are given below.
・Hardware error of the EtherNet/IP board
・Broken cable or hub error
・Incorrect node address setting

CAUTION

I/O status may not be normal if an error occurs and the LED indicating a problem lights. Take great care as the interlock functions of the robot, jigs, and/or other devices may fail to operate normally, resulting in unintended operation.

IMPORTANT

The following configuration tool (prepared by the user) is necessary to use the scanner function.
・RsNetworx for EtherNet/IP (from Rockwell)

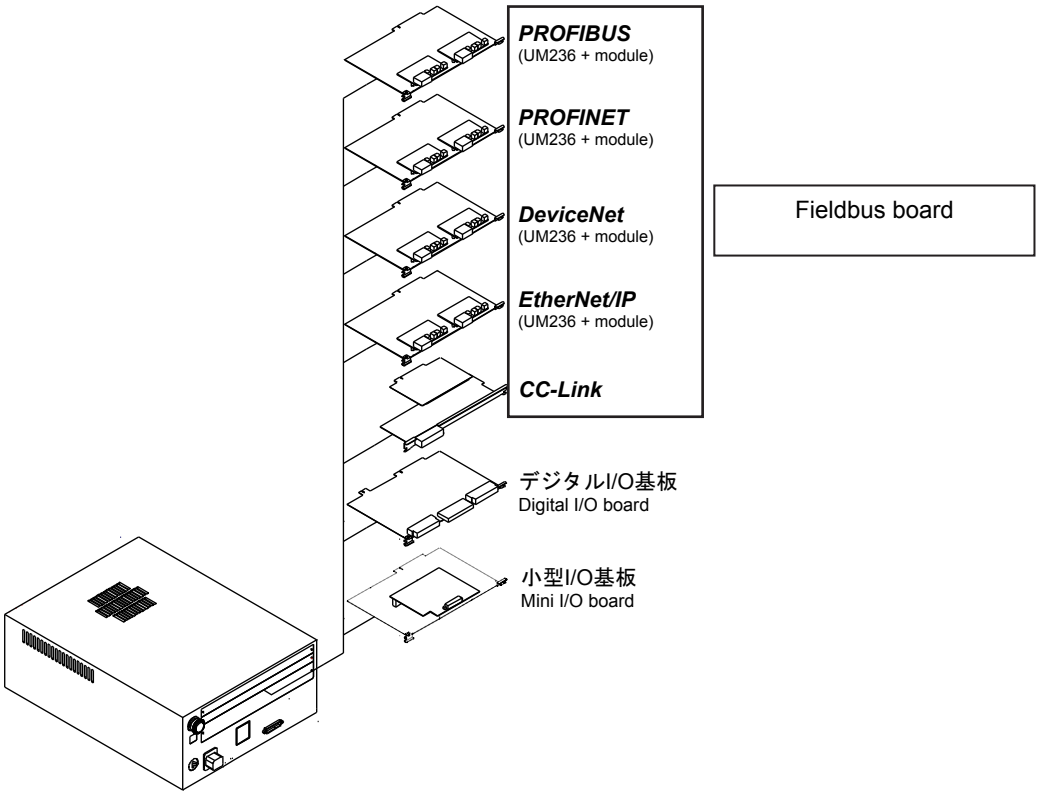
4.1.1 Contained Parts

Contained parts of this option

No.	Name	Parts No., type.	Note
1	Fieldbus board	UM236-10	
2	EtherNet/IP module	AB5057 AB4173	Scanner(Master) Adaptor(Slave)
3	Panel to connect cable		
4	Fixing screws for board	M4 × 8mm	

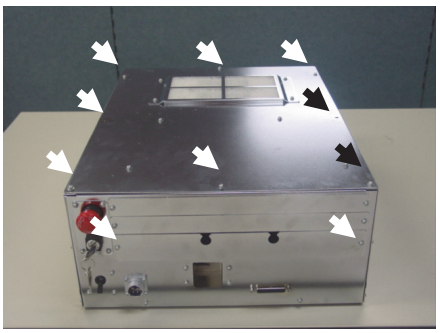
4.2 Installation and Connection

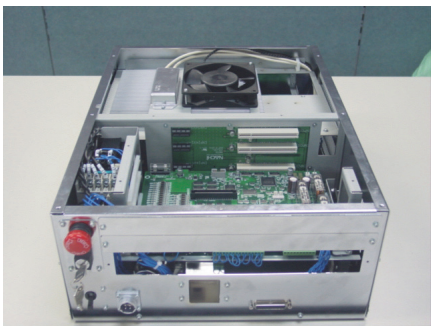
4.2.1 How to install



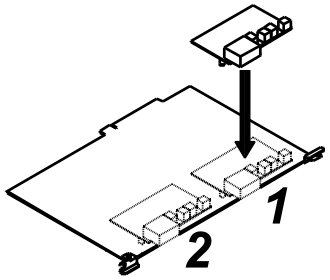
1 Turn OFF the controller power and disconnect the primary power source connector.

2 Loosen the screws on the top panel and the front side cable drawing panel.





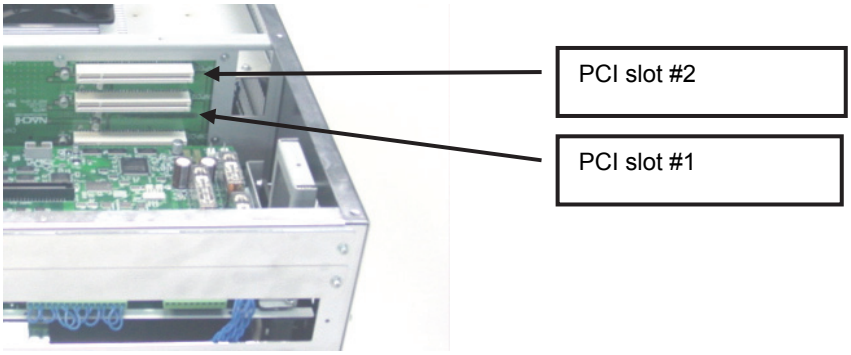
3 Mount each module on the fieldbus base board.(Except CC-LINK)



(Caution)

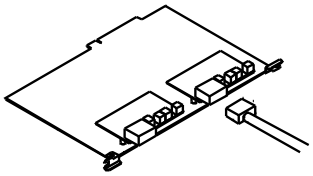
Appearance of MASTER module and SLAVE module may similar. Pay utmost attention when mounting on the fieldbus board.

4 Mount the fieldbus base board on PCI slot.
Lower slot is #1, upper slot is #2.



PCI slot number is important. Please memo the number.

5 Connect cable to the moduke on the fieldbus base board.

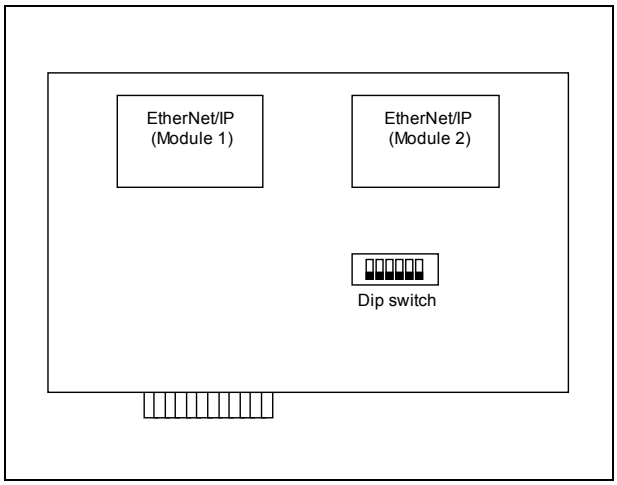


6 Install the removed panel.
(Please use the new “front side cable drawing panel”. Old one can not be used. But old “top panel” can be used again.)

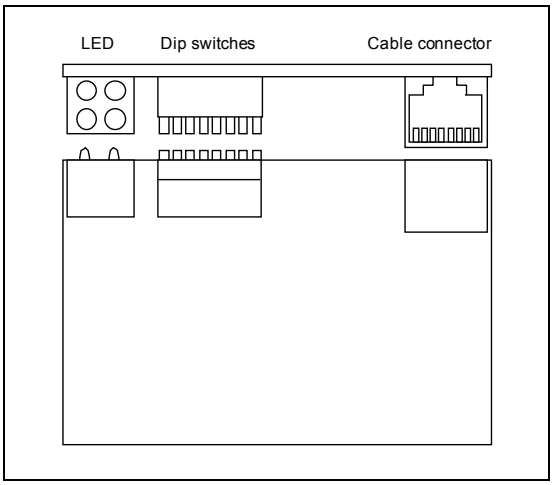
4.2.2 Hardware settings

This function is performed using HMS Industrial Networks “Anybus-S Ethernet module” or “Anybus-M Ethernet scanner modul” that is mounted on field bus base board. Up to two modules can be mounted on field bus base board.

It’s unnecessary to change the dip switches on field bus base board and EtherNet/IP module.



Appearance of field bus base board



Appearance of HMS EtherNet/IP module

4.2.3 EtherNet/IP network

Use category 5 or higher Ethernet cable for the EtherNet/IP network. In addition, make sure that the length of Ethernet cable as measured from switches to this controller does not exceed 100 m.

In order to maintain normal communication status, be sure to use a switch having the functions given below for the switch to be used as the accumulation point for the EtherNet network.

- Equipped with an L2 switch for preventing signal collision
- Capable of 100 Mbps communications
- Supports full duplex communications

If the network is large and traffic is high, be sure to configure the network using switches equipped with Quality of Service (QOS) and Virtual Local Area Network (VLAN) functions so that delays in I/O transfer do not occur.

4.3 Signal Assignment

4.3.1 Fieldbus I/O signals

I/O signal numbers is determined based on the field bus channel number to be used.

■ When software PLC is disabled (setting when shipped)

CH1 : I 161 ～ I 672 / O 161 ～ O 672 (512 points)
CH2 : I 673 ～ I1184 / O 673 ～ O1184 (512 points)
CH3 : I1185 ～ I1696 / O1185 ～ O1696 (512 points)
CH4 : I1697 ～ I2048 / O1697 ～ O2048 (35 points)

■ When software PLC is enabled

CH1 : X1000 ～ X1511 / Y1000 ～ Y1511 (512 points)
CH2 : X1512 ～ X2023 / Y1512 ～ Y2023 (512 points)
CH3 : X2024 ～ X2535 / Y2024 ～ Y2535 (512 points)
CH4 : X2536 ～ X3047 / Y2536 ～ Y3047 (512 points)

■ Assigning signals beyond the number of channels

The field bus can use up to four channels. If all four channels are not being used, it is possible to use the signal assignment region of channels not being used.
The description below gives an example in which software PLC is enabled. Signals can be assigned using a similar concept even if software PLC is disabled.

If only one channel is being used, all 2048 points can be used with just “Channel 1” by using “Channel 1”.

CH1 : X1000 ～ X3047 / Y1000 ～ Y3047 (2048 points)

When using two channels, 1024 points can be used for each channel, by using “Channel 1” and “Channel 3”.

CH1 : X1000 ～ X2023 / Y1000 ～ Y2023 (1024 points)
CH3 : X2024 ～ X3047 / Y2024 ～ Y3047 (1024 points)

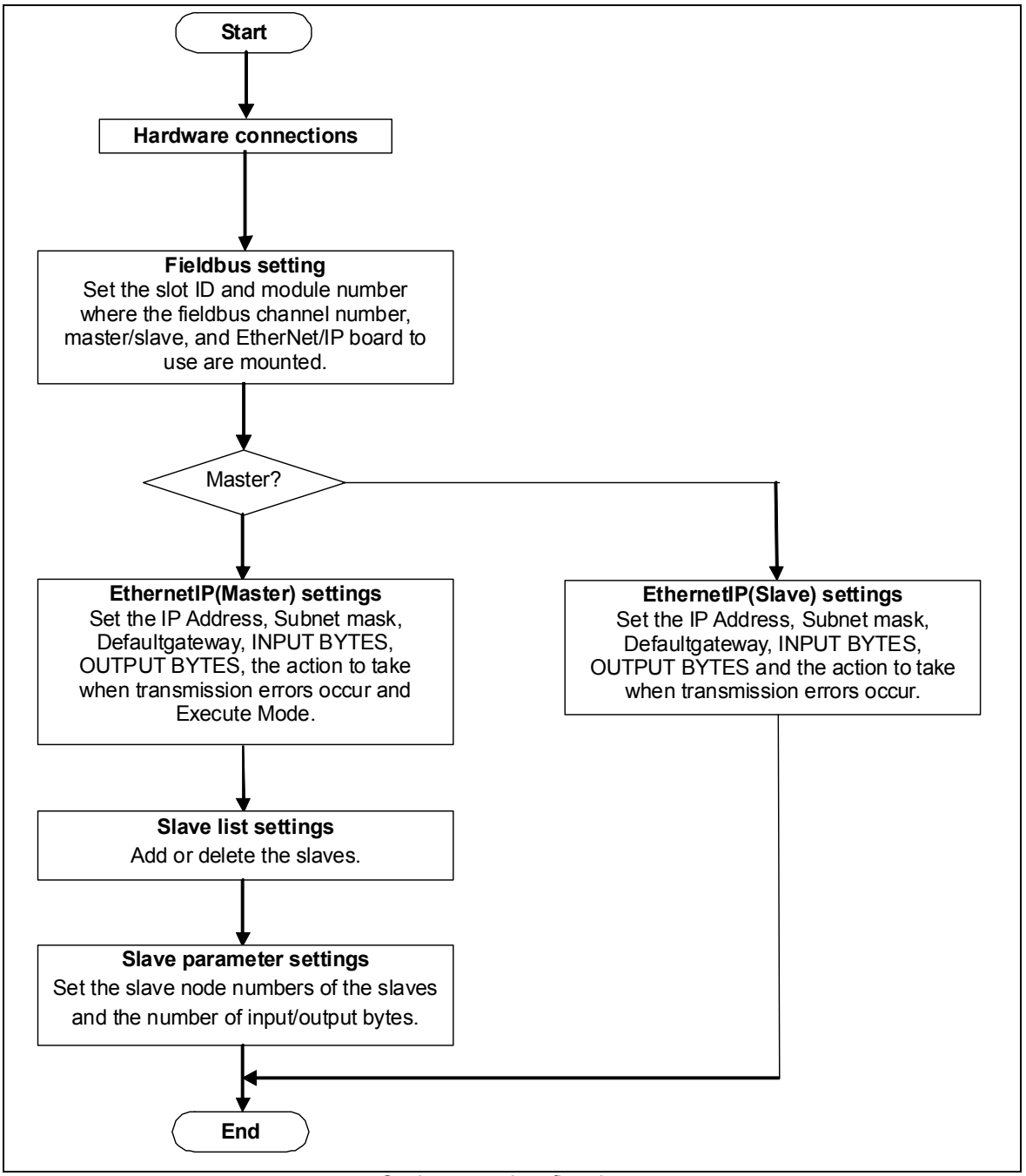
4.3.2 EtherNet/IP signal assignment

If the number of I/O bytes is smaller than the number of signals assigned to each channel, an unused assignment region results. Following example is to use “Channel 1” as the slave, with 2 bytes of input and 3 bytes of output.

CH1 : X1000 ～ X1015 / Y1000 ～ Y1023 (Usable area)
X1016 ～ X1511 / Y1024 ～ Y1511 (Unusable area)

4.4 Setting Procedure

The basic flow of the setting procedure is given below.



Setting procedure flowchart

Hardware connections are carried out at time of factory shipment.

To set the scanlist, it is necessary to have the setting PC and RSNetWorx for EtherNet/IP (paid software) by Rockwell.

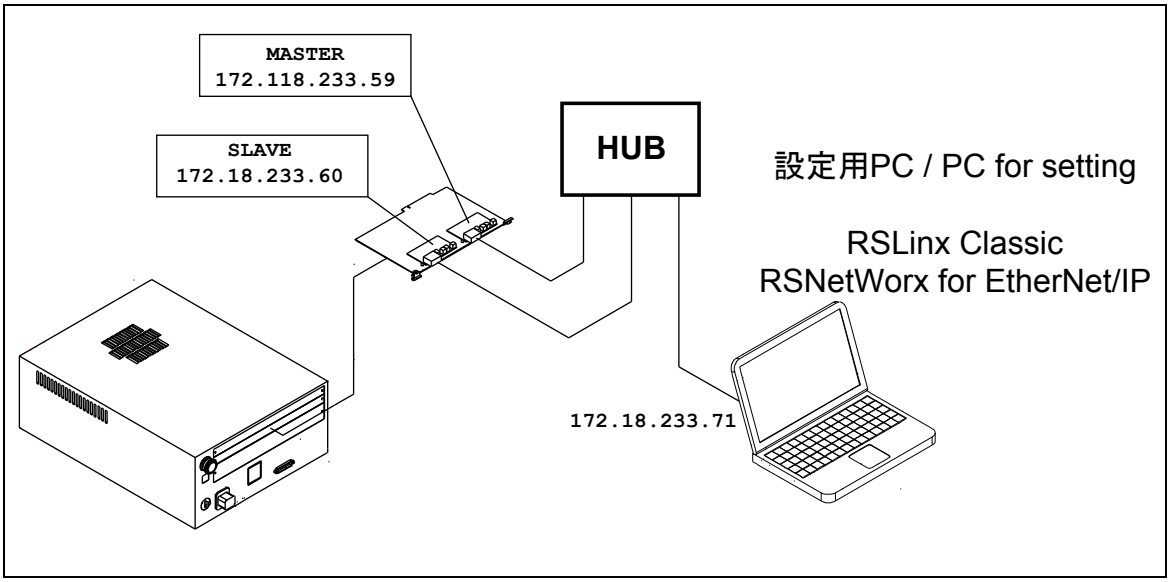
When software PLC is used for fieldbus I/O, PLC setting procedure is required separately. For details, refer to the instruction manual “Software PLC."

- In EtherNet/IP, the device called a “slave” on DeviceNet is called an “adapter”. ("EtherNet/IP slave" in this controller means "EtherNet/IP adapter".)
- In EtherNet/IP, the device called a “master” on DeviceNet is called an “scanner”. ("EtherNet/IP master" in this controller means "EtherNet/IP scanner".)

Setting example

The following figure shows the setting example of the configuration used in this chapter.

・Configuration of Robot controller
Set master as module1 of base board. Set slave as module2 of base board.
Connect them to setting PC via a hub.



Configuration example

・Setting of field bus
CH1 AnyBusEtherNet/IP Mater module 1
CH2 No use
CH3 AnyBusEtherNet/IP Slave module 2
CH4 No use

・Master detailed settings (CH1)
IP address and so on are omitted.
Input byte number 128
Output byte number 128

・Slave detailed settings (CH3)
IP address and so on are omitted.
Input byte number 128
Output byte number 128

・PC setting
IP address needs to be on the same network as this controller

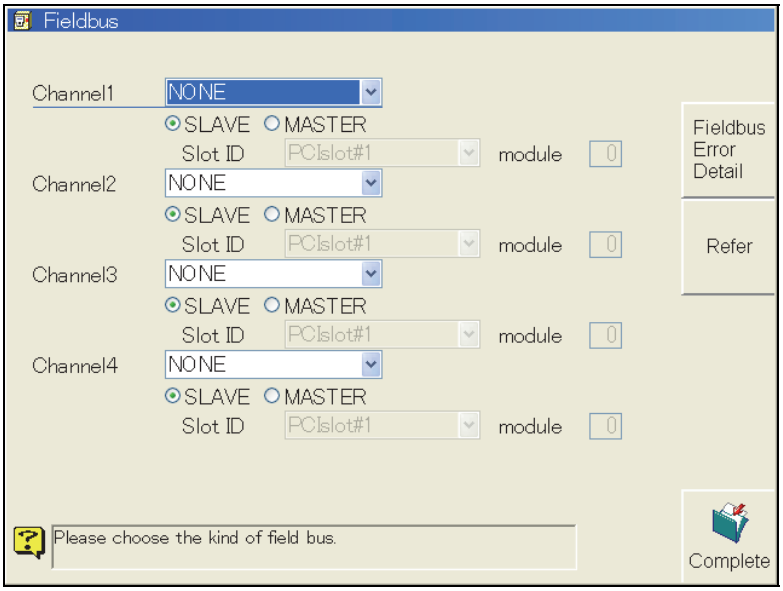
4.4.1 EtherNet/IP Slave settings

■ Fieldbus settings

Protocol settings

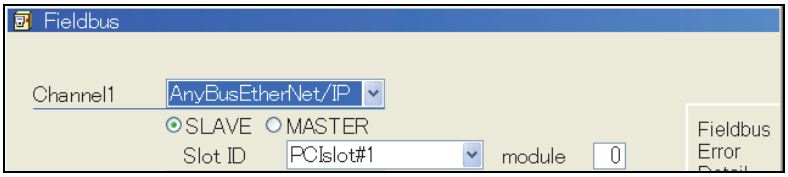
1 **Open <Constant Settings> - [8 Communications] - [3 Fieldbus] screen.**

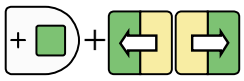
>> The following screen will appear.



2 **Align the cursor with the combo box of the "Channel" in which EtherNet/IP is to be used, and press the [Enter] key.**

>> Select "AnyBusEtherNet/IP", and press the [Enter] key.





3 **Use the [Enable] + [Left] or [Right] cursor keys to switch to the radio buttons (a horizontal row of selector buttons), and select "SLAVE".**

4 **Align the cursor with the combo box of "Slot ID", and press the [Enter].**

Select the Slot ID in which the field bus base board is installed, and press the [Enter].

>> The slot ID is required in order to specify the slot position where the fieldbus base board is installed. For the relationship between the slot position and the slot ID, refer to "4.2.1 How to install".

5 **Input the module number in the edit box of "module", and press the [Enter].**

>>"Module" is a number that specifies the position of the module on field bus base board. When "0" is set, the channel is disabled. For the position of the module, refer to "4.2.2 Hardware settings.

Now proceed to set the EtherNet/IP (slave).

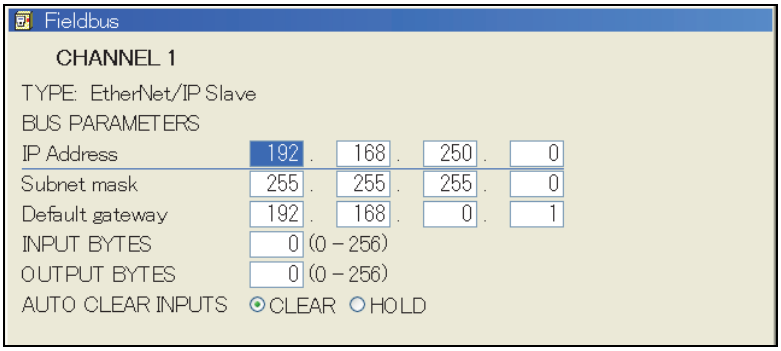
■ EtherNet/IP (slave) settings

Channel settings

Refer

1 On the [3 Fieldbus] setting screen, align the cursor with the channel for which EtherNet/IP (slave) is selected, and press the f key <Refer>.

>> The following screen will appear.



2 Set each parameter.

Parameter of [3 Fieldbus] setting screen (at the EtherNet/IP slave settings)

Parameter	Description of function
IP Address	Input the IP address for the corresponding node. It is used to identify the device on the network. Devices having the same node number cannot be set on the same network. Do not set “0” to the last box of IP address.
Subnet mask	Input the subnet mask for the corresponding node. It is used to manage the network by splitting it into sub-networks. Set the same value for all devices on the same network.
Default gateway	Input the default gateway for the corresponding node. Sometimes this setting is not required in cases where there is no router on the network. Be sure to consult with your network administrator when making settings.
INPUT BYTES	Input the input bytes from the field bus base board. It is the size of data input to this controller. Eight signals can be sent/received in one byte.
OUTPUT BYTES	Input the output bytes to the field bus base board. It is the size of data output from this controller.
AUTO CLEAR INPUTS	Select the input signal status when a communication error has occurred. When the input signal statuses are to be cleared, “CLEAR” is selected. On the other hand, when to be held, “HOLD” is selected.

OK

3 Upon completion of the settings, press the f key <OK>.

>> The display returns to [3 Fieldbus] setting screen.

Complete

4 On the [3 Fieldbus] setting screen, press the f key <Complete>

>> The setting is saved to the internal memory.

IMPORTANT

Be sure to use PLCEngine/EDS_ABS_EIP_V_1_9.eds located in system memory for the EDS file required to set this controller for scanners being used.

For details on how to set scanners, see the operating manual for your scanner hardware.

Latest EDS can be downloaded from HMS Industrial Newtorks URL.

http://www.anybus.jp/

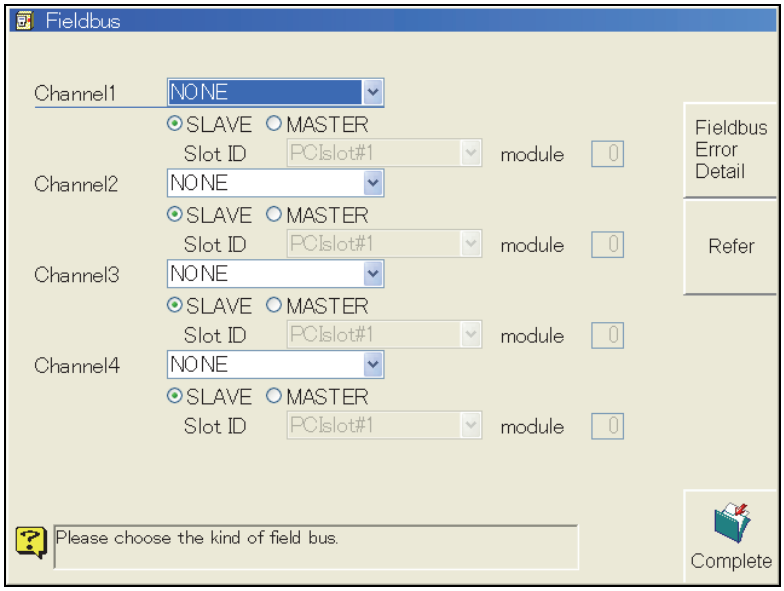
4.4.2 EtherNet/IP Master settings

■ Fieldbus settings

Protocol settings

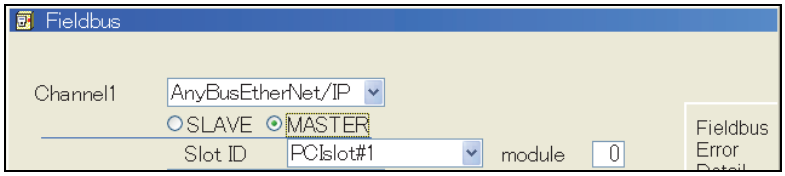
1 **Open <Constant Setting> - [8 Communication] - [3 Fieldbus] screen.**

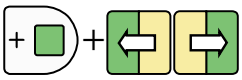
>> The following screen will appear.



2 **Align the cursor with the combo box of the "Channel" in which EtherNet/IP is to be used, and press the [Enter].**

>> Select "AnyBusEtherNet/IP", and press the [Enter].





3 **Use the [Enable] + [Left] or [Right] cursor keys to switch to the radio buttons (a horizontal row of selector buttons), and select "MASTER".**

4 **Align the cursor with the combo box of "Slot ID", and press the [Enter].**

Select the Slot ID in which the field bus base board is installed, and press the [Enter].

>> The slot ID is required in order to specify the slot position where the fieldbus base board is installed. For the relationship between the slot position and the slot ID, refer to "4.2.1 How to install".

5 **Input the module number in the edit box of "module", and press the [Enter].**

>>"Module" is a number that specifies the position of the module on field bus base board. When "0" is set, the channel is disabled. For the position of the module, refer to "4.2.2 Hardware settings.

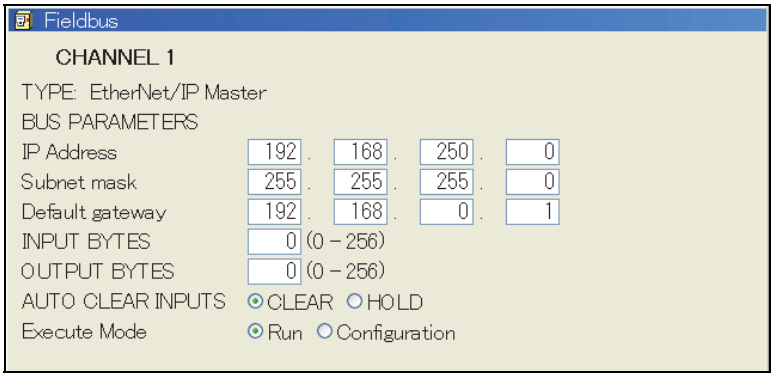
Now proceed to set the EtherNet/IP (master).

■ EtherNet/IP (Master) Settings

Channel Settings

1 **On the [3 Fieldbus] setting screen, align the cursor with the channel for which EtherNet/IP (master) is selected, and press the f key <Refer>.**

>> The following screen will appear.



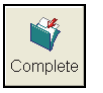
2 **Set each parameter.**

Parameter of [3 Fieldbus] setting screen (at the EtherNet/IP master settings)

Parameter	Description of function
IP Address	Input the IP address for the corresponding node. It is used to identify the device on the network. Devices having the same node number cannot be set on the same network. Do not set “0” to the last box of IP address.
Subnet mask	Input the subnet mask for the corresponding node. It is used to manage the network by splitting it into sub-networks. Set the same value for all devices on the same network.
Default gateway	Input the default gateway IP address for the corresponding node. Sometimes this setting is not required in cases where there is no router on the network. Be sure to consult with your network administrator when making settings.
INPUT BYTES	Input the input bytes from the field bus base board. It is the size of data input to this controller. Eight signals can be sent/received in one byte.
OUTPUT BYTES	Input the output bytes to the field bus base board. It is the size of data output from this controller.
AUTO CLEAR INPUTS	Select the input signal status when a communication error has occurred. When the input signal statuses are to be cleared, “CLEAR” is selected. On the other hand, when to be held, “HOLD” is selected.
Execute Mode	Select whether to do the scan list setting. When the scanning list is set, "Configuration" is selected. Besides, "Run" is selected. (Refer to “4.4.2 EtherNet/IP Master settings”)

3 **Upon completion of the settings, press the f key <OK>.**

>> The display now returns to [3 Fieldbus] setting screen.



4 **On the [3 Fieldbus] setting screen, press the f key <Complete>**

>> The setting is saved to the internal memory.

Now continue to the setting of scan list.

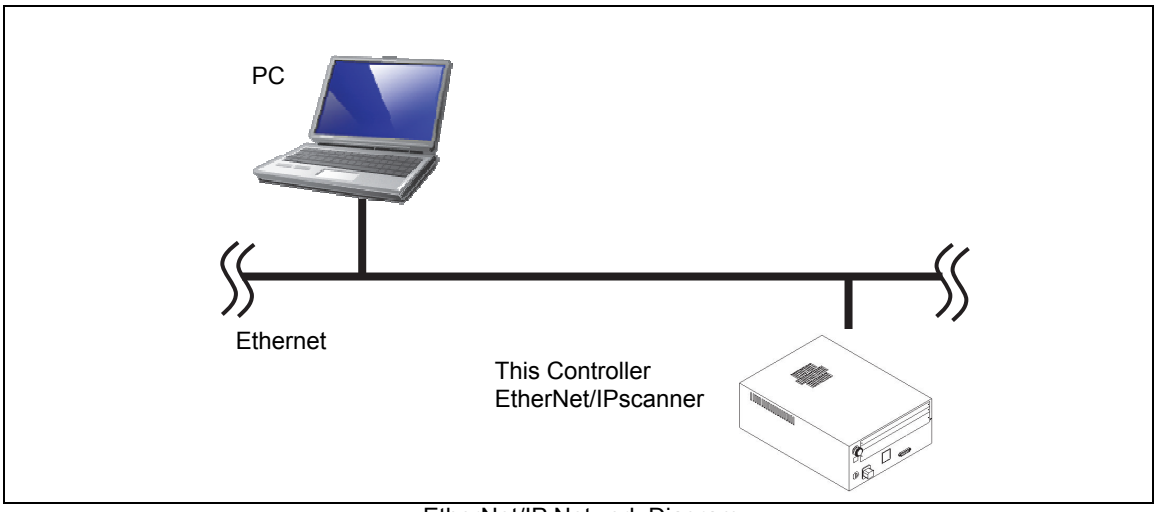
■ Setting of scan list

The following tools are necessary to set the scan list.

・Configuration tool: RsNetworx for EtherNet/IP (from Rockwell)

・Personal computer

When the scan list is set, the personal computer is connected with the same network as the EtherNet/IP scanner of this controller.



EtherNet/IP Network Diagram

Setting of EtherNet/IP driver

To use "RsNetworx for EtherNet/IP", the driver is set by using “RSLinx Classic Lite” (“RsNetworx for EtherNet/IP” attachment tool)".

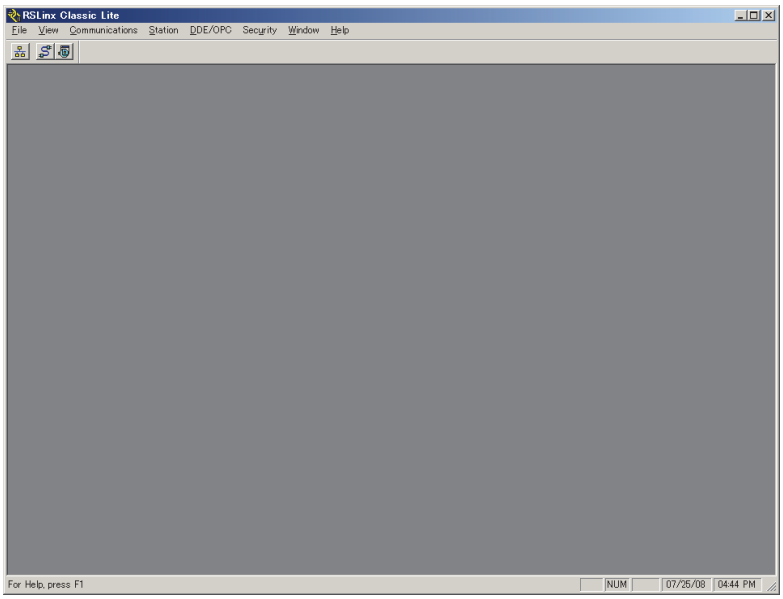
After setting the driver, the connection from the personal computer to the EtherNet/IP network becomes possible.

1 Set "Execute Mode" to "Configuration", referring to "4.4.2 EtherNet/IP Master settings ".

The following operations should be done with the personal computer.

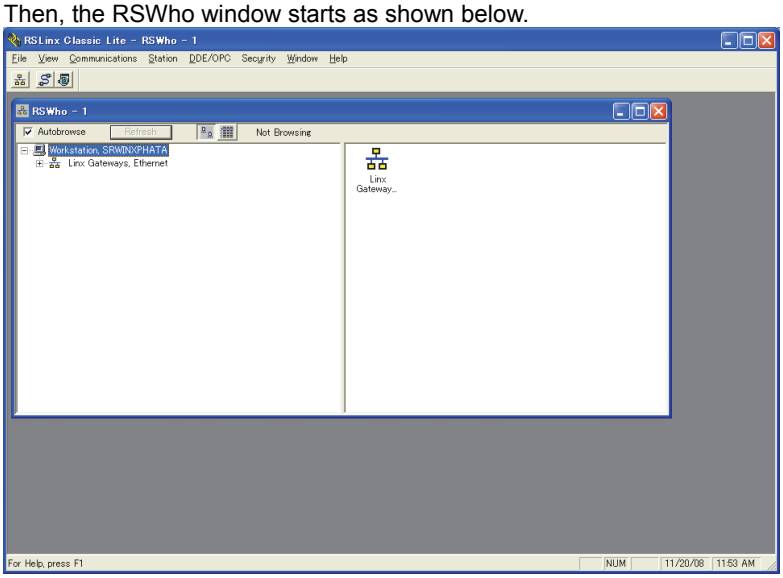
2 “RSLinx Classic Lite” is started with a personal computer.

>> The following screen will appear.

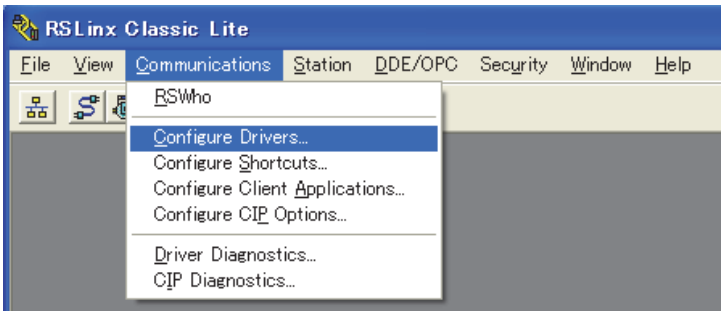


3 **Select “Communications->RSWho” in the Menu, or click the icon “RSWho” on the upper left of the screen.**

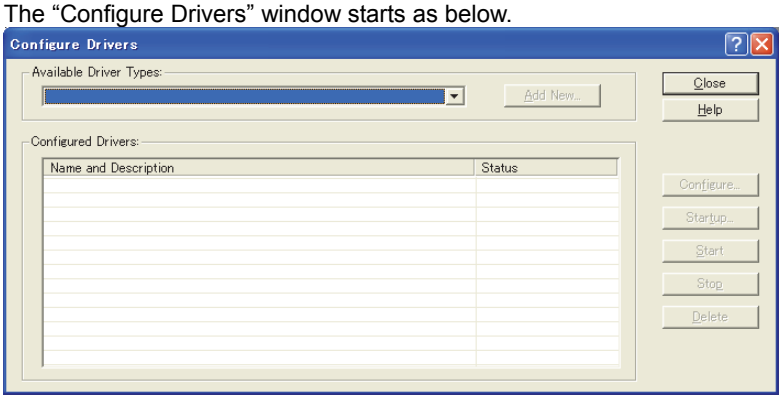
Then, the RSWho window starts as shown below.



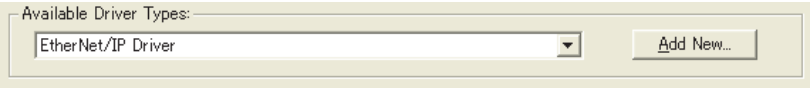
4 **Select ”Configure Drivers…” in the “Communications” menu, or click the icon “Configure Drivers” on the upper left of the screen.**



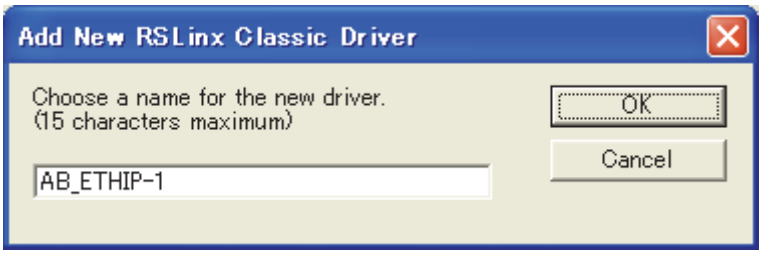
The “Configure Drivers” window starts as below.



5 **Select ”EtherNet/IP Driver” in “Available Driver Types”, and then press the “Add New...” button.**

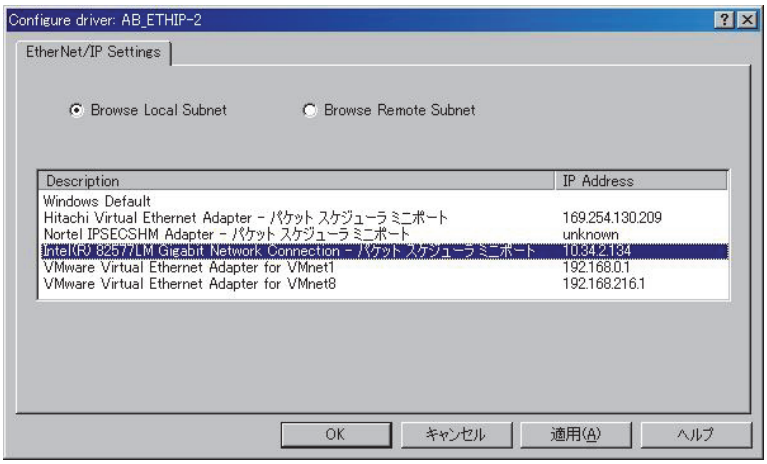


The window to input the name corresponding to the Driver Type starts as shown below. Input an arbitrary name, and press OK button.
Since a long-spelling name may cause a Path error (the maximum is 15 one-byte characters) depending on the environment by the setting of RSNetWorx, it is recommended to name it as short as possible.



Next, select a suitable network in the EtherNet/IP Settings, and then press “OK” button.

6 **Select “Browse Local Subnet” and select one port from the list that is connected to EtherNet/IP scanner. Then press [OK].**



Above list is just an example.

IP address needs to be on the same network as this controller. (IP address can not been changed on this screen.)

POINT

Make sure that the network selected on this screen is always connected to the EtherNet/IP (master) channel on the robot controller side appropriately beforehand.

In particular;
(1) Connect the setting PC and the EtherNet/IP board mounted on the robot controller side on its master channel side by the Ethernet cable.

(2) Use the setting PC to check the network connection with the "ping" command.
1. Open the command prompt screen of MS-DOS.
2. Check the connection with the IP address configured on the EtherNet/IP (master) channel on the robot controller side.

The following is an example when the master IP address is 172.18.233.59.

>ping 172.18.233.59

【Connected】
Pinging 172.18.233.59 with 32 bytes of data:

Reply from 172.18.233.59: bytes=32 time<1ms TTL=128
Reply from 172.18.233.59: bytes=32 time<1ms TTL=128
Reply from 172.18.233.59: bytes=32 time<1ms TTL=128
Reply from 172.18.233.59: bytes=32 time=1ms TTL=128

Ping statistics for 172.18.233.59:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 1ms, Average = 0ms

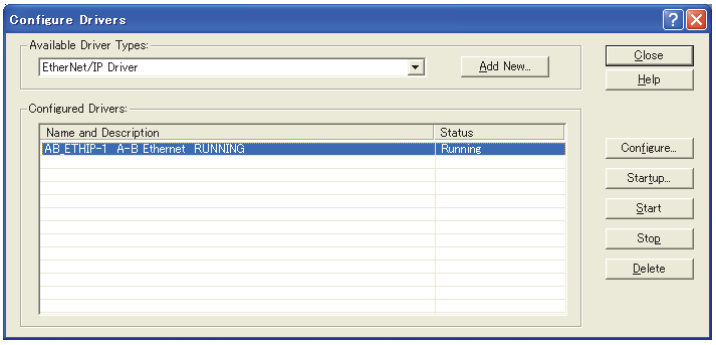
【Not connected】
Pinging 172.18.233.59 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 172.18.233.59:
Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

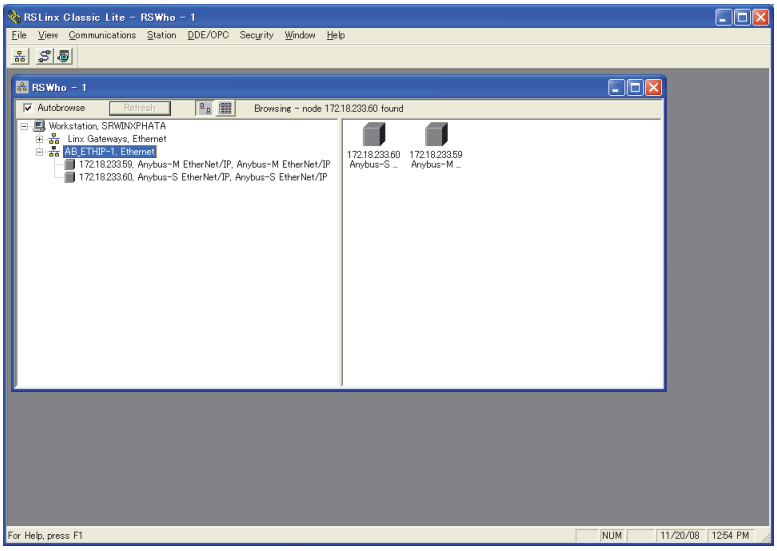
7 **Press “Close”.**

As shown below, the item corresponding to the added Driver is the Status: Running.



8 **Finish the setting of RSLinx Classic.**

As shown below, all the masters and slaves of the EtherNet/IP network appear. The displayed icon may be indicated as '??' if EDS files corresponding to the module have not been added by RSNetWorx. However, the icon will change from '??' to be displayed after setting as shown below.



Thus, the network setting in RSLinx Classic completes.

Setting of scan list

Next, the scanlist is set.

Before this setting, turn on the power supply of this controller, and set the fieldbus, referring to “0■ Fieldbus **settings**”.

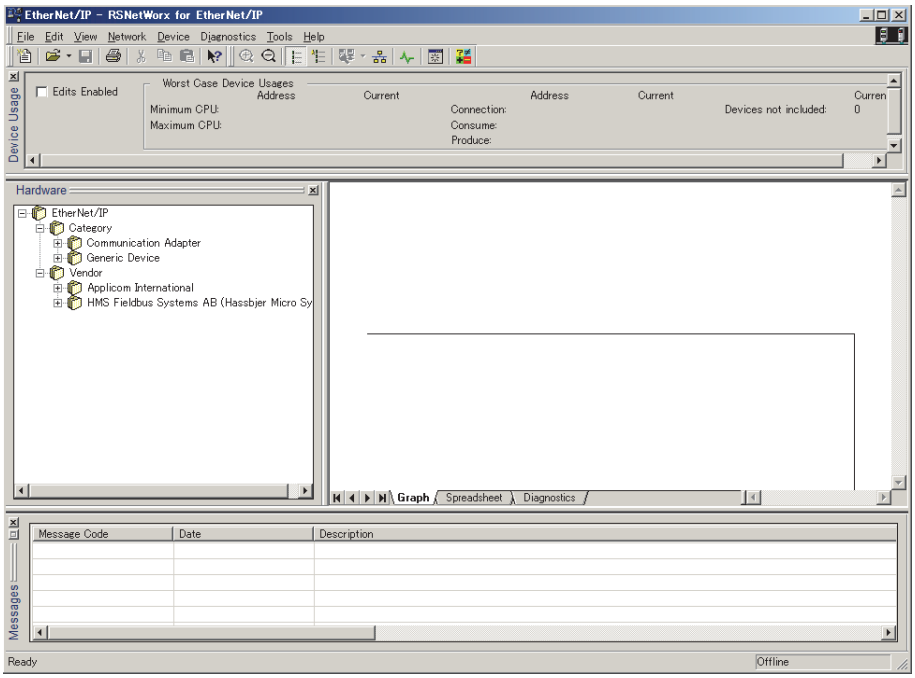
The description below gives an example in which "Anybus-S EtherNet/IP" communicates with "Anybus-M EtherNet/IP" by the one to one.

1 **Set "Execute Mode" to "Configuration", referring to "4.4.2 EtherNet/IP Master settings ".**

The following operations should be done with the personal computer.

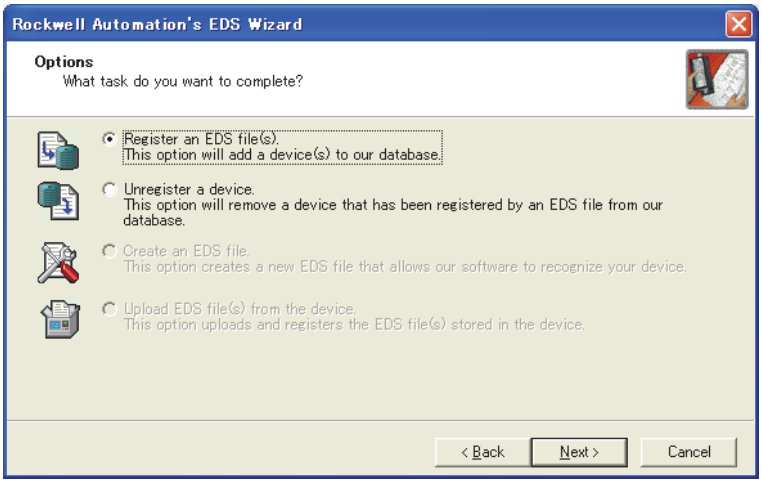
2 **“RsNetWorx for EtherNet/IP” is started with a personal computer.**

>> The following screen will appear.

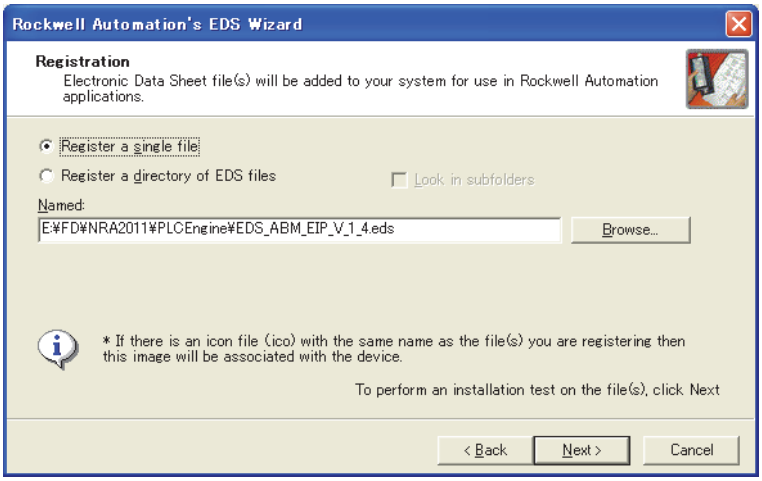


3 **Go to the menu “Tools->EDS Wizard” and register the EDS files in “Anybus-M EtherNet/IP” and “Anybus-S EtherNet/IP”.**

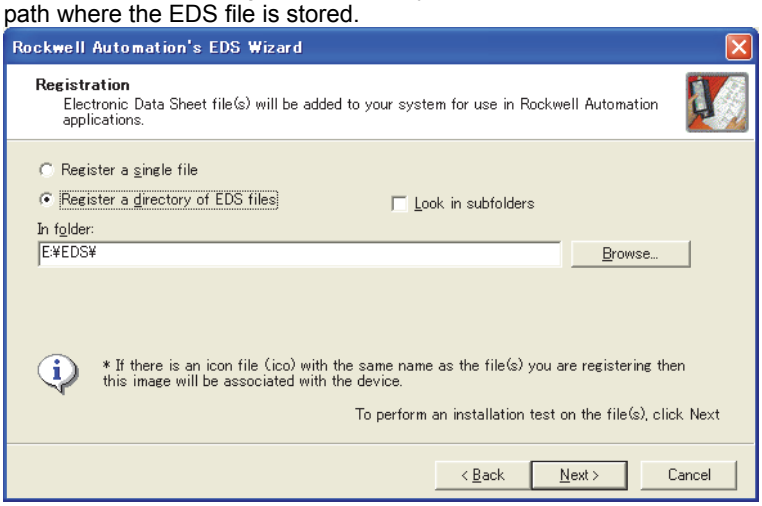
After starting up EDS Wizard, go to “Next” on the first screen.
On the Options select screen, choose “Register an EDS file(s)” and go to “Next”.



4 Select “Register a single file” on the Registration screen, and press “Browse” to set the path where the EDS file is stored.



Where there are two or more EDS files and they are stored in the same folder at the same time, select “Register a directory of EDS files” and press “Browse” to set the path where the EDS file is stored.



On the EDS File Installation Test Results screen, press “Next”.

POINT

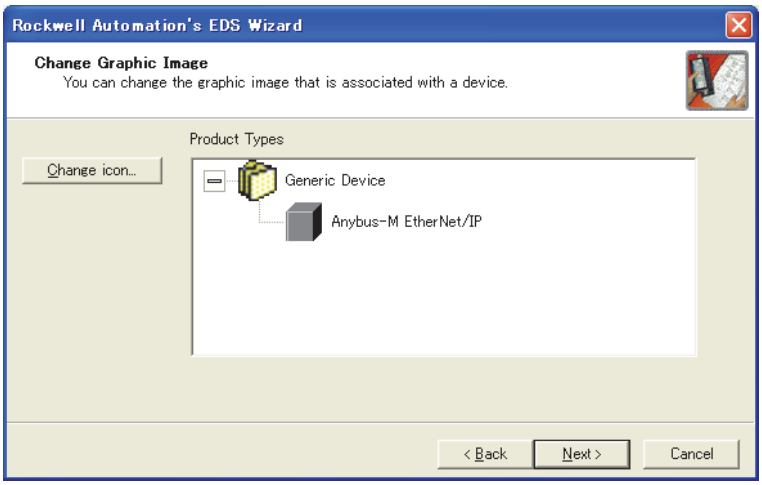
Store the EDS files beforehand in an arbitrary folder in the PC local drive (as the path is to be registered in the registry, unexpected troubles may be caused if referring through the network.)

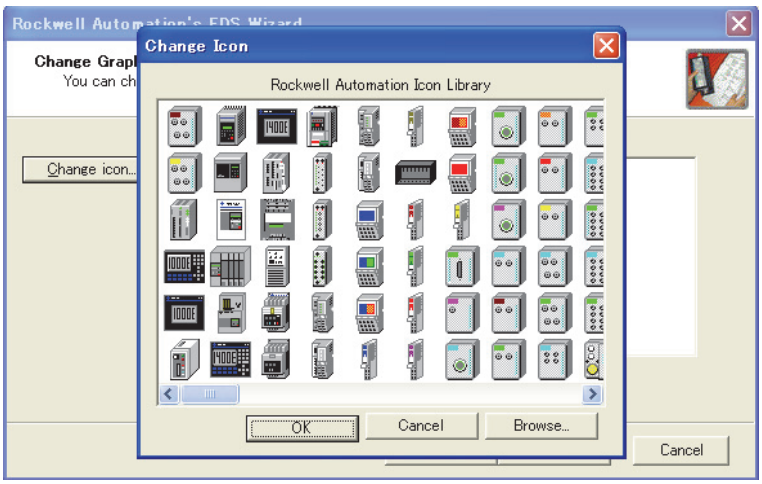
POINT

About the EDS file to be used:
EDS files are stored in the system CF folder “PLCEngine” of the robot controller.
For master : EDS_ABM_EIP_V_1_4.eds
For slave : EDS_ABS_EIP_V_1_9.eds
Latest EDS can be downloaded from HMS Industrial Newtorks URL.
http://www.anybus.jp/

5 It is available to change the icon on the Change Graphic Image screen.
As the change of icon does not affect the robot performance, configure the setting as you choose. On completion of setting, press “Next”.

Click "Change icon…" with “Anybus-M EtherNet/IP” selected from Product Types, the list of the icon is displayed. Select necessary icons, and click “Next” key.

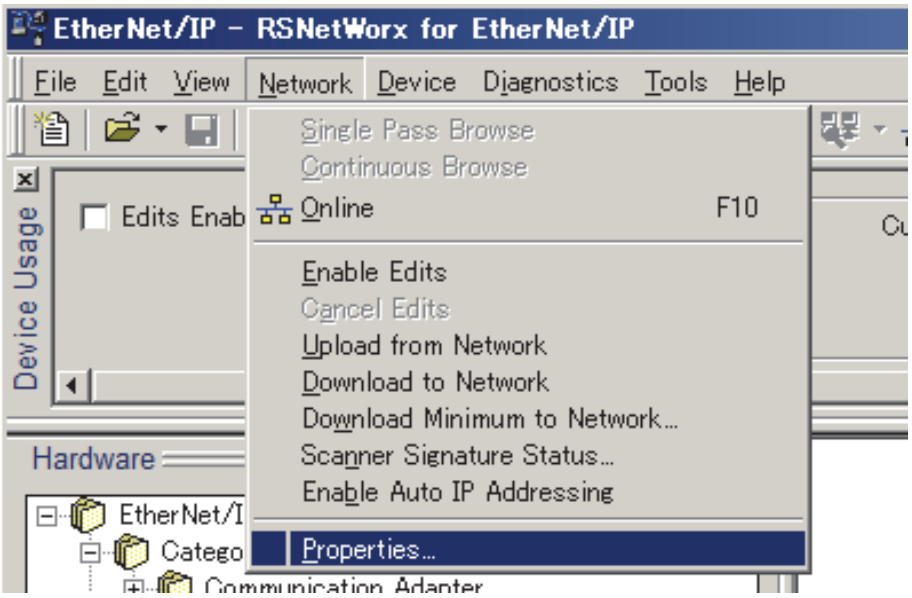




6 Keep clicking “Next” until the message “You have successfully completed the EDS Wizard.” appears.
On the screen “You have successfully completed the EDS Wizard., click “Complete”.
≫ The EDS files are to be added in the list “Hardware” when properly read into.

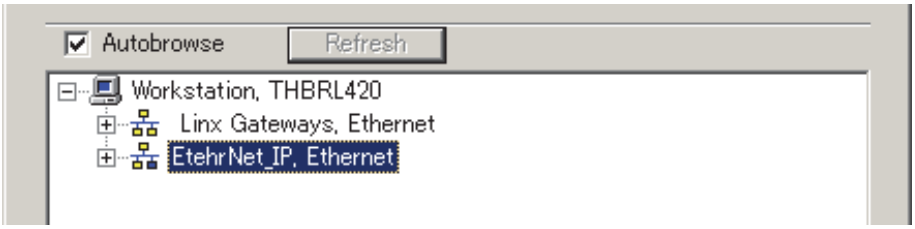
7 **Click “Properties…” of the “Network” menu.**

>> Select the network driver.



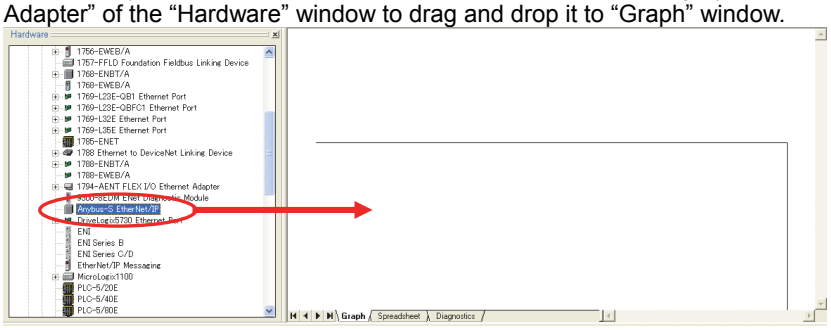
8 **When "Set Online Path…" key is clicked, the selection screen on the network is displayed.**

>> Select “EtherNet/IP Driver” set with “RsLinx”.

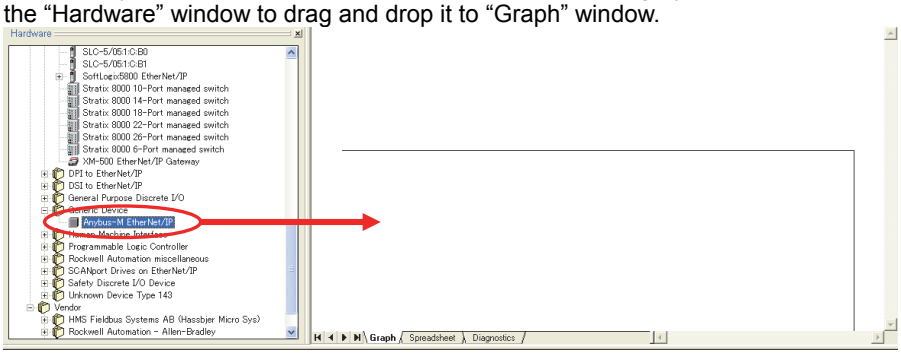


9 On the “Hardware” window, drag and drop an appropriate node to the “Graph” window to register it.

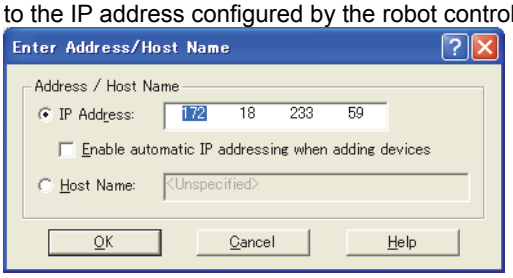
Select “Anybus-S EtherNet/IP” on the “EtherNet/IP->Category->Communication Adapter” of the “Hardware” window to drag and drop it to “Graph” window.



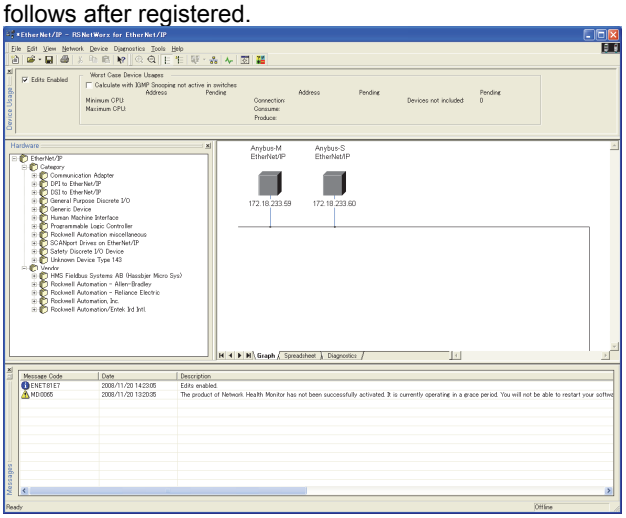
Select “Anybus-M EtherNet/IP” on the “EtherNet/IP->Category->Generic Device” of the “Hardware” window to drag and drop it to “Graph” window.



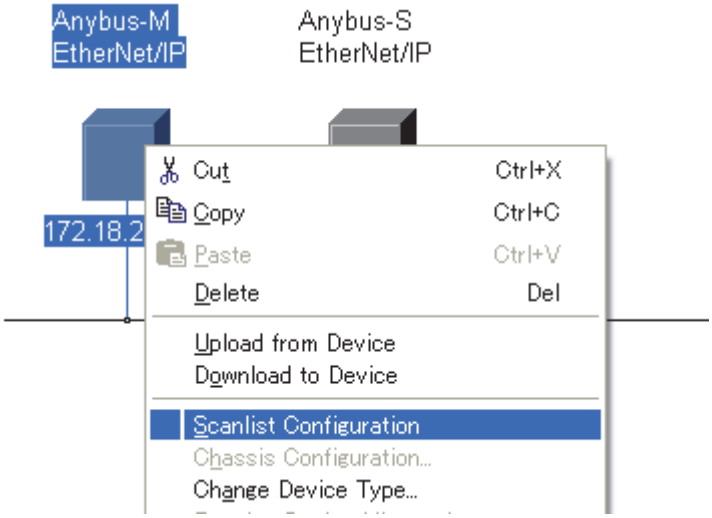
As the following window starts up when dragging and dropping the node, set the appropriate IP address in “IP Address”. (For the IP address, set the number according to the IP address configured by the robot controller beforehand.)



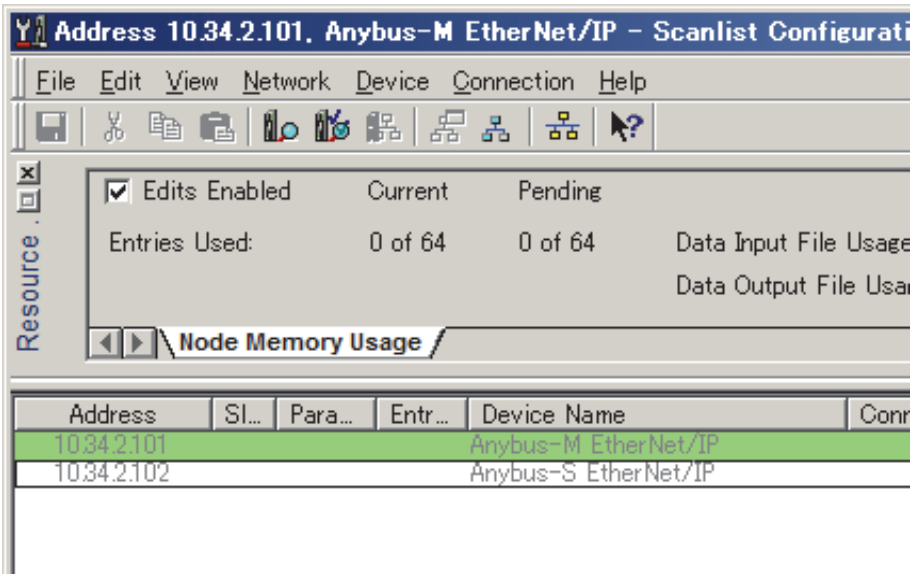
As shown below, register all the necessary nodes.
The following examples show the configuration of master 1 and slave 1, appeared as follows after registered.



10 **Select the master (Anybus-M EtherNet/IP) on the “Graph” window, right-click to display the menu, and then click “Scanlist Configuration”.**

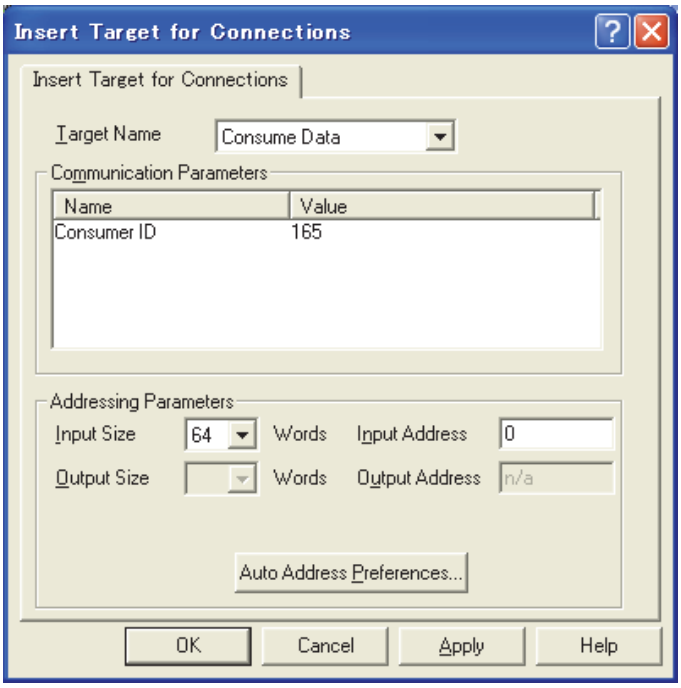


11 **The following screens are displayed.**



12 **Double-click the master in the list, and set the input byte count.**

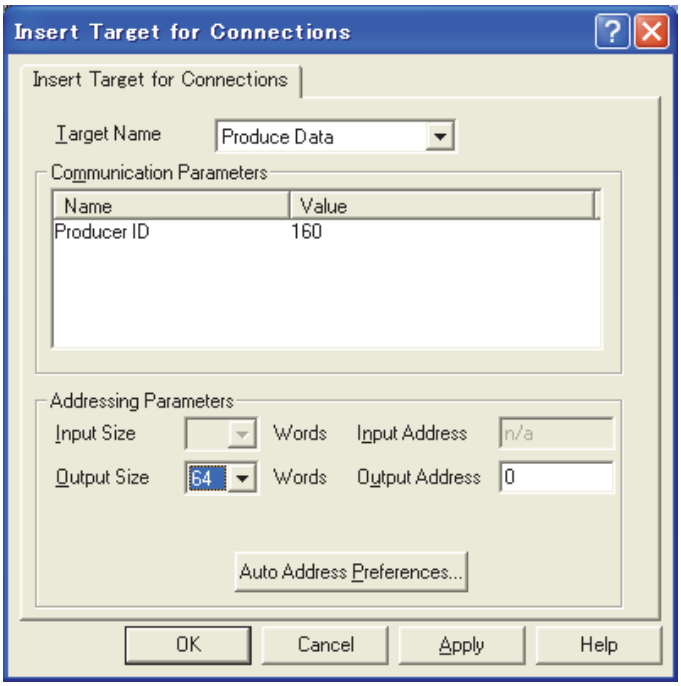
Select “Consume Data” in the “Target Name”, set the input byte count (2-byte words) in the “Input Size”, and then set the IP address in the “Input Address”.



Set I/O etc., and click the “OK” key at the end.

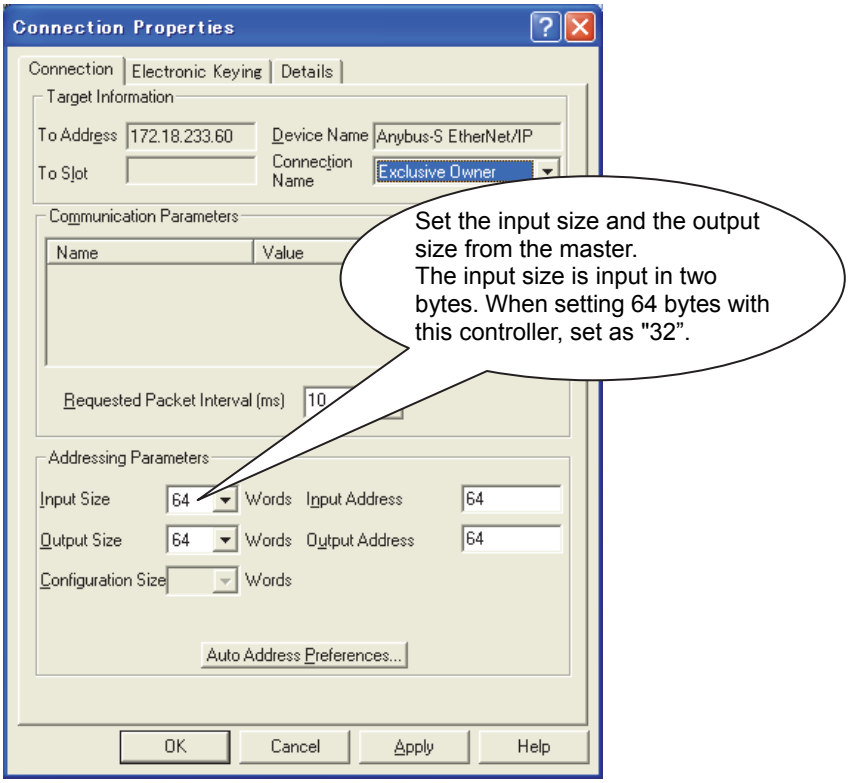
13 **Double-click the master in the list, and set the output byte count.**

Select “Produce Data” in the “Target Name”, set the output byte count (2-byte words) in the “Output Size”, and then set the output address in the “Output Address”.



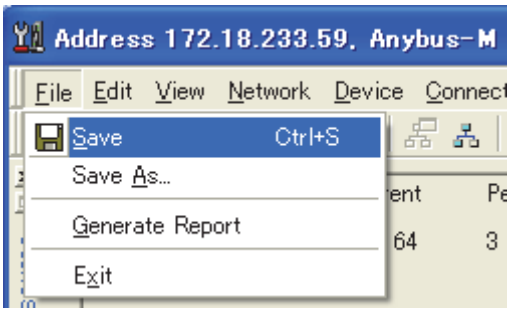
14 **Double-click the slave in the list, and set the input/output byte count.**

Select “Exclusive Owner” in the “Connection Name”, set the input/output byte count (2-byte words) in the “Input Size” and “Output Size”, and then set the input/output address in the “Input Address” and “Output Address”.



15 **Click “Save” of the “File” menu.**

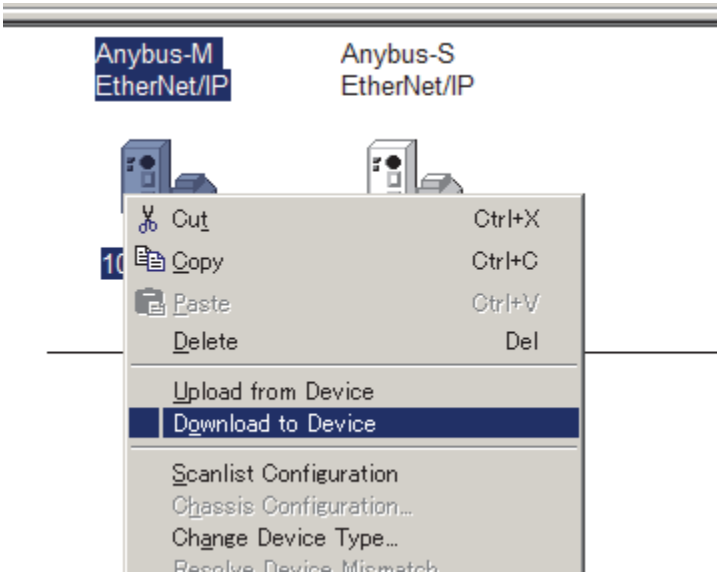
>> Save the list.



16 **Right-click in the icon of master, and click "Download to Device".**

>> The setting for “Scanlist Configuration” is to be downloaded into the master module.

Wait until the progress bar moves up to the right, and the dialog disappears.



Thus, the setting for Scanlist by the RSNetWorx for EtherNet/IP is completed.
The following operation should be done with the teach pendant of this controller.

17 **Set "Execute Mode" to "Run", referring to "4.4.2 EtherNet/IP Master settings ".**

POINT

When the setting is properly done, and "Execute Mode" of master has been set to ”Run”, the EIP MASTER and EIP SLAVE become "Device began scanned" on the fieldbus monitor.

4.4.3 Change of the Network Environment

To reconstruct the network environment by changing the IP address of master or slave, another operation different from the initial setting operation is necessary.

Note that this operation can be completed by resetting on the robot controller side if not changing the IP address.

■ Resetting of the fieldbus and EtherNet/IP (master and slave)

Change “0■ Fieldbus **settings**”4.4.1 EtherNet/IP Slave settings “and “4.4.2 EtherNet/IP Master settings” if needed. For detailed operation, refer to each chapter.

Resetting on the robot controller side

1 Select <Constant Setting> - [8 Communication].

2 Select [3 Fieldbus**].**
If any change has been made, make a setting.

>>Refer to “4.4.1 EtherNet/IP Slave settings”.

3 Select the channel to change, and press <Refer**> button.**
Change the appropriate items of the master and slave.
If the IP address has been changed, set "Execute Mode" of master to “Configuration”.

>> Refer to “4.4.2 EtherNet/IP Master settings”.
>> Refer to “4.4.1 EtherNet/IP Slave settings”.

4 Press <Complete> on the fieldbus setting screen.

If the IP address has been changed, continue to make a resetting of Scanlist.
If the IP address has not been changed, resetting operation is now completed.

■ Resetting of Scanlist

If changing the IP address in “4.4.3 Change of the Network Environment”, it is necessary to make a resetting of network.

Resetting of network by RSLinx Classic

1 Set ”Execute Mode” for EtherNet/IP (master) to “Configuration**” and write in the fieldbus setting to initialize the module.**
It is necessary to detect all the masters and slaves in the network by RSLinx Classic. To do this, the robot controller to be used in the Ethernet IP network has to be done with resetting of the master (”Execute Mode” : Setting) and slave first, and started up connected to the Ethernet/IP network.

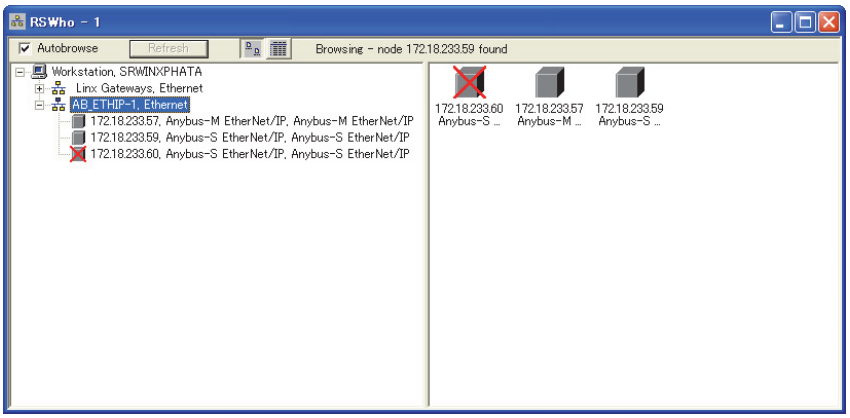
2 Connect the setting PC to the hub in the EtherNet/IP network.

3 Start up RSLinx Classic using the setting PC.

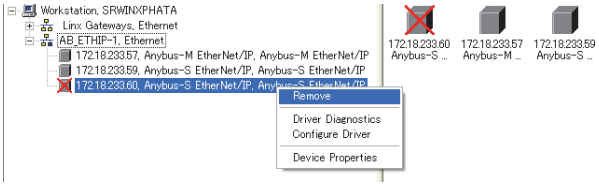
4 **Click “Communications->RSWho” in the menu, or the icon “RSWho” on the upper left of the screen.**

When the RSWho window starts up, the node already changed appears as the “EtherNet/IP Driver” has been set by “Configure Drivers”. At this time, remove the display of node indicated by a “×” sign. Select a target node and right-click to press “Remove”. Although it depends on the details of resetting for the network configuration, there may be no node with “×” sign even if changing the IP address.

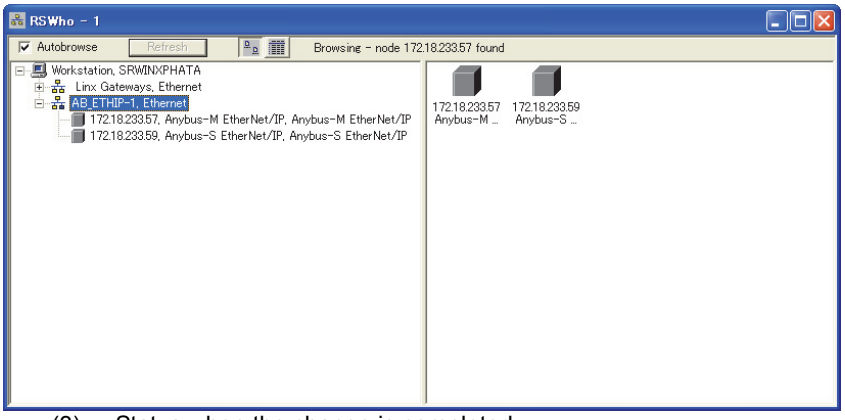
＜Example of change＞
Master：Change from 172.18.233.59 → 172.18.233.**57**
Slave：Change from 172.18.233.60 → 172.18.233.**59**



(1) The setting on the robot controller side is completed, and RSLinx is started up.



(2) Remove the node indicated by a “×” sign. Select “YES” on the dialog appeared.



(3) Status when the change is completed.

5 **Finish the setting for RSLinx Classic.**

Make sure that all the nodes are valid, and then finish the RSLinx Classic.

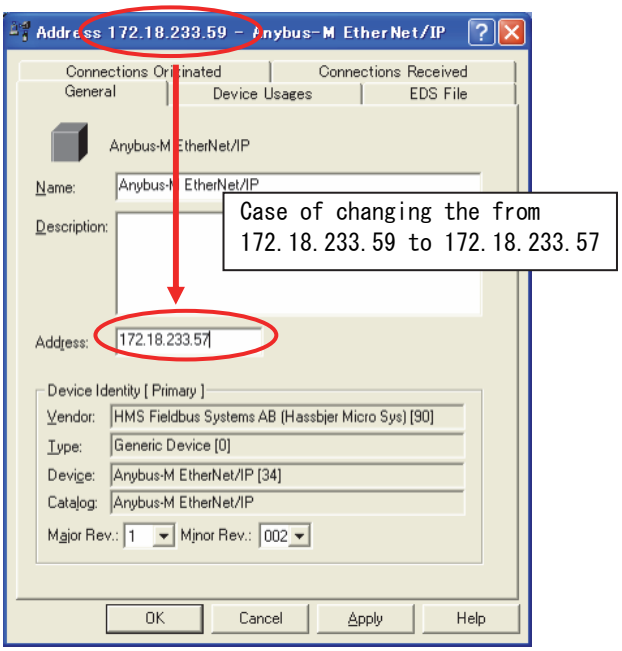
Thus, the resetting of the network by RSLinx Classic is completed.
Continue to make a resetting of the Scanlist by RSNetWorx for EtherNet/IP.

Resetting of the Scanlist by RSNetWorx for EtherNet/IP

1 **Use the setting PC to start up RSNetWorx for EtherNet/IP.**

2 **Change the node of which IP address has been modified on the “Graph”, remove unnecessary nodes if needed, and add the appropriate node if necessary by dragging and dropping from the Hardware.**

＜Changing the node＞
When the number of nodes for the master and slave remains the same or comparable situations, change only the IP address of the existing node. First select a target node on the “Graph”, and right-click to press “Properties”. Change the IP address in the “General” tab: Address to the value you desire.



※ When the dialog appears, select “YES”. (The dialog does not always appear.)

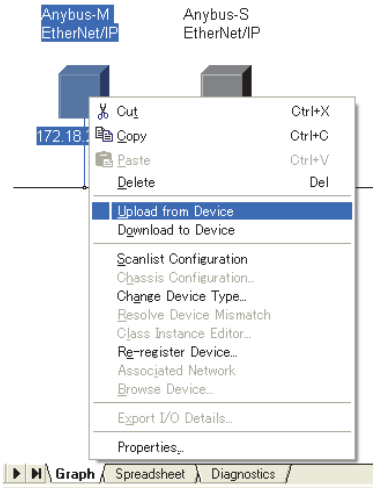
＜Removing the node＞
To remove the slave, select the target node to remove on the “Graph” and right-click to press “Delete”. While to remove the master, it is necessary to remove all the related slave nodes.

＜Adding the node＞
For more nodes of the master and slave, drag and drop the appropriate ones from the Hardware.

Set all the nodes to the value modified by the robot controller.

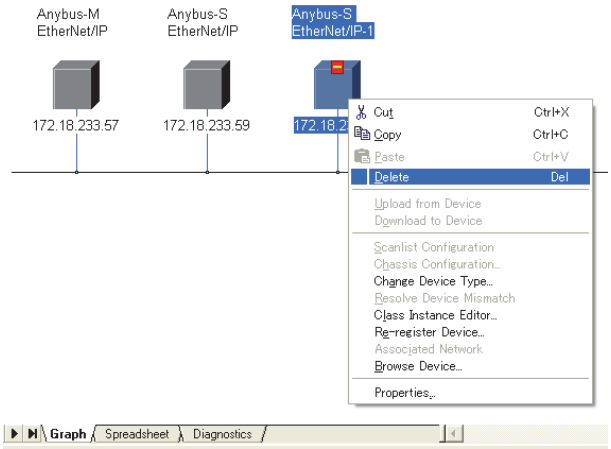
3 Select “master” on the Graph, and right-click to press “Upload from Device”.

Upload the IP address to change from the device, and apply it. This operation is available only by the master. Even if it is not required to change the IP address of master but slave only, the same operation is needed.



4 Press the menu “Network->Upload from Network”.

The network reset by RSLinx is read into.
If changing/removing/adding of the node has been properly done, the State shows all OK.
In the case where the nodes not in connection appear depending on the details of the change of IP address, delete them as long as you consider unnecessary according to their setting details (IP address).



※If the node not in connection is unnecessary, select the target one and right-click to press “Delete”.

When the state of the necessary node shows “Missing” or “Mismatch”, or another kind of error appears, the setting details should have been a problem. In that case, review the network connection status between the robot controller and the setting details of each node.

5 Select the master (Anybus-M EtherNet/IP) on the “Graph” window, and right-click to display the menu to press “Scanlist Configuration”.

Start up the “Scanlist Configuration” window, and make a resetting as needed.

6 Save the setting to complete “Scanlist Configuration”.

7 Press the menu “Network->Download to Network”.

Download the detail of resetting to the network, and apply it.

8 Right-click the master, and press “Download to Device”.

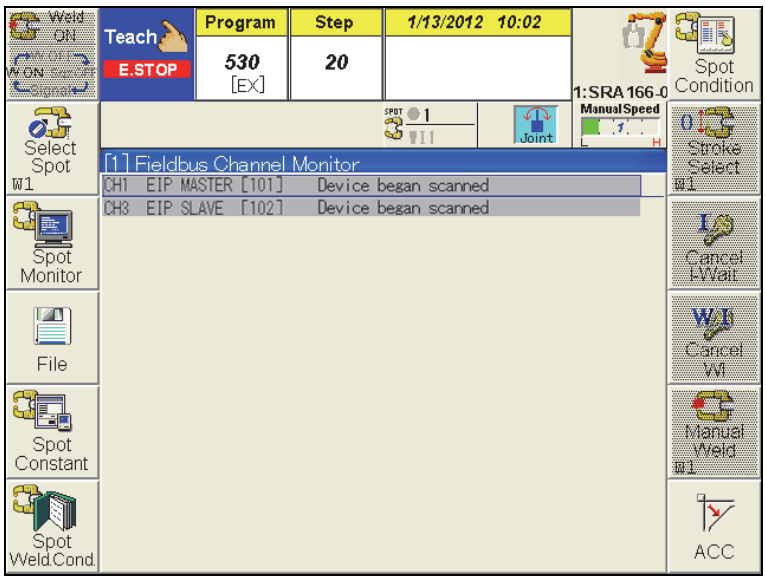
Download the details of resetting of the “Scanlist Configuration” to the master module.

Thus, resetting of the Scanlist by RSNetWorx for EtherNet/IP is completed. Setting the ”Execute Mode” of the master of the robot controller to ”Run”, EtherNet/IP communication is going to be active.

If resetting operation is properly done with the ”Execute Mode” of the master set to ”Run", the fieldbus monitor shows the EIP MASTER and EIP SLAVE specified as "Device began scanned".

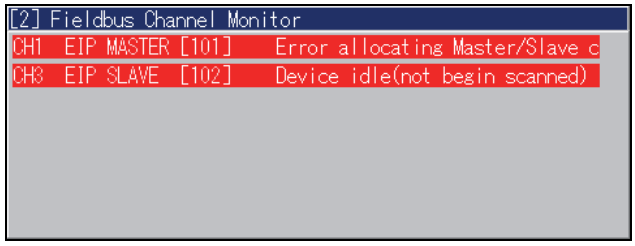
4.4.4 Fieldbus Channel Monitor

"Fieldbus Channel Monitor" can confirm the state of the fieldbus.
When the communication is normal, the monitor is shown below.



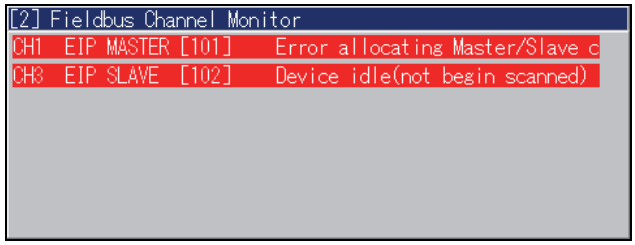
Fieldbus Channel Monitor

When a communication error occurs by the slave, it is displayed as "Error allocating Master/Slave connection set". In EtherNet/IP, the slave that occurs a communication error is not displayed unlike other fieldbuses. Use the external diagnosis tool such as "RSNetWorxMD Diagnostics" for the slave's situation confirmation.



Fieldbus Channel Monitor (When abnormality occurs by the slave)

When a communication error occurs by the master, the monitor is shown below.



Fieldbus Channel Monitor (When abnormality occurs by the master)

4.4.5 Output signal “Fieldbus acting correctly”

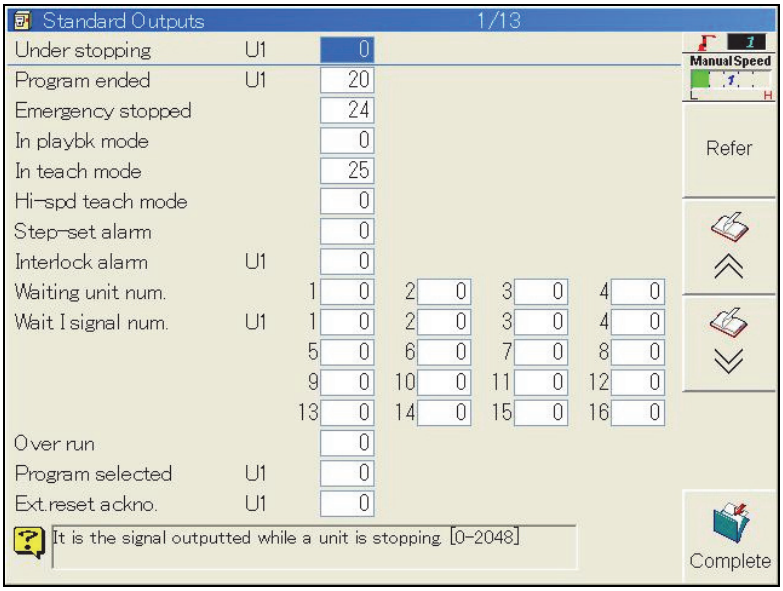
Output signal (signal name s “Fieldbus act.”) is prepared to confirm that robot controller is communicating correctly with external device in EtherNet/IP system. This output signal turns to OFF when EtherNet/IP is disconnected, for example field bus disconnection.

Please utilize this output signal by referring to the procedure written below, if needed.

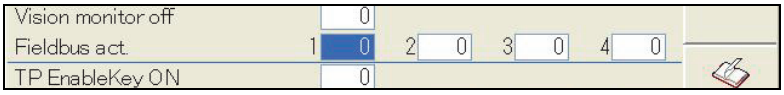
How to assign “Fieldbus act.” Output signal

1 **Open <Constant Settings>-[6 Signals]-[3 Output Signal Assignment]-[1 Standard Outputs].**

>> The following screen will appear.



2 **Align the cursor with the “Fieldbus act.” edit box of the same number as the Ethernet/IP channel number. Then input the signal number and press [Enter] key.**



3 **Press the f key <Complete>.**

4.4.6 Error check delay for EtherNet/IP

Due to the specification of EtherNet/IP device, it needs some time to wait for the establishment of EtherNet/IP communication, for example at the timing of power on or initializing sequence. In this case, robot controller may detect the error of “E960: Some or all I/O links are currently stopped”. In order to avoid this error, it is possible to delay the error check timing.

IMPORTANT

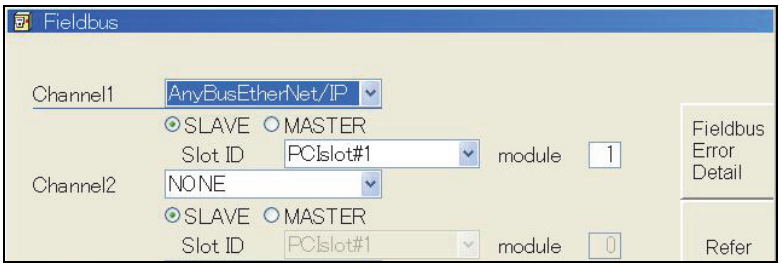
When error check delay is used, it is possible to operate the robot before EtherNet/IP communication is established. If any operation such as start is attempted in this period, robot controller detects the error of “E960: Some or all I/O links are currently stopped” even before elapsing of the error check delay time.

How to set the EtherNet/IP error check delay time

Constant Setting

1 Open <Constant Settings> -[8 Communication] -[3 Fieldbus].

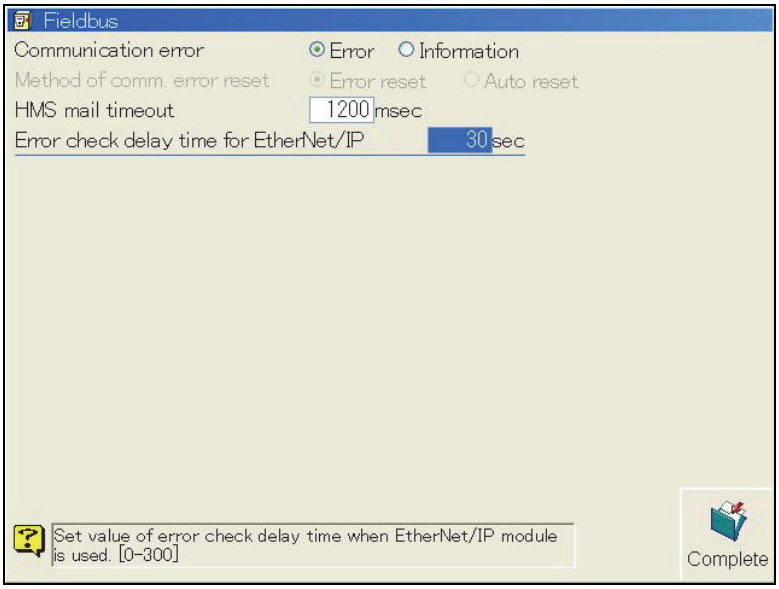
>> The following screen will appear.



Fieldbus Error Detail

2 Press the f key <Fieldbus Error Detail>.

>> The following screen will appear.



3 Set the “EtherNet/IP error check delay time” and press [Enter] key.

4 Press the f key <Complete>.

Complete

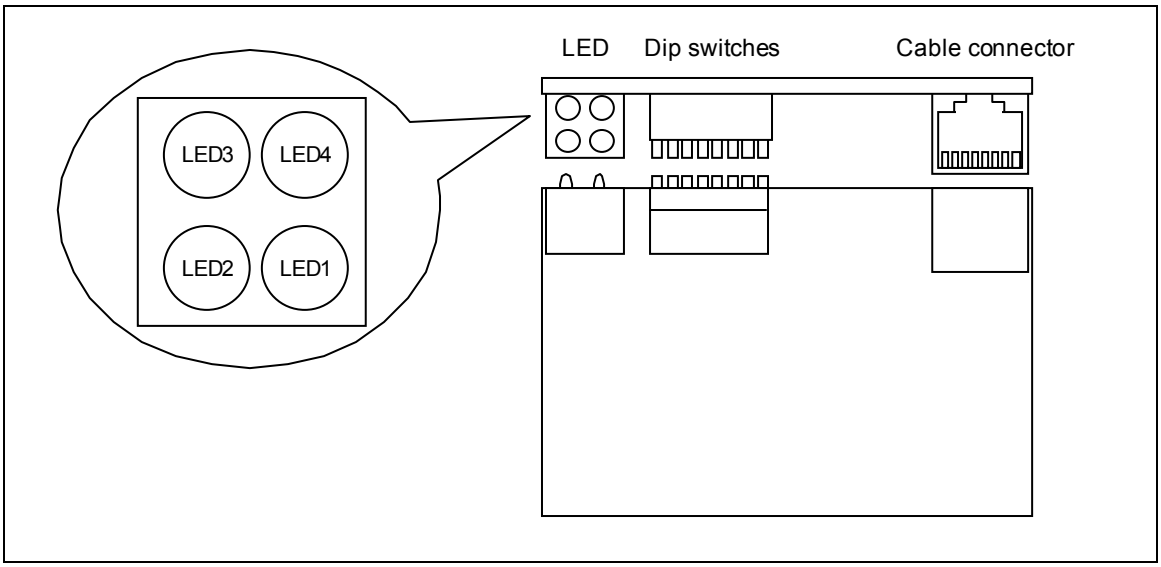
POINT

At the timing of the EtherNet/IP communication establishment , “Fieldbus act.” output signal is immediately turned on even before elapsing of the error check delay time.

4.5 Troubleshooting

4.5.1 Error Detection on EtherNet/IP Module

The current status of HMS EtherNet/IP module is indicated using up to four LEDs.



HMS EtherNet/IP module

Each LED indicates the following status for the slave module.

- LED1: Network reception status
- LED2: Current module status
- LED3: Current communication status
- LED4: Scanner status

LEDs and field bus base board Status for the Slave Module

LED	Color	Status		Description
LED1	Green	Lit	Online	—
	—	Unlit	Offline	—
LED2	Green	Lit	Run State	Currently communicating with scanner
	Green	Flashing	Not set / Idle State	Settings are not complete or no communication with scanner
	Red	Flashing	Error	Non-critical error detected
	Red	Lit	Error	Critical error detected
	—	Unlit	—	No power supply
LED3	Green	Lit	Online / Currently connected	Online
	Green	Flashing	Online / Not connected	Online / No communication partner
	Red	Lit	Error	Fatal error detected (duplicate IP address, etc.)
	Red	Flashing	Error	Non-critical error detected
	Red green	Flashing	Self-diagnostics	Currently performing self-diagnostics
	—	Unlit	—	Initialization incomplete / No power supply
LED4	Green	Flashing	Packet sending and receiving	Currently sending and receiving the packet

Each LED indicates the following status for the master module.

- LED1: Network reception status
- LED2: Current module status
- LED3: Current communication status
- LED4: Not used

LEDs and field bus base board Status for the Master Module

LED	Color	Status		Description
LED1	Green	Lit	Online	—
	Green	Flashing	Packet sending and receiving	Currently sending and receiving the packet
	—	Unlit	Offline	—
LED2	Green	Lit	Run State	Currently communicating with scanner
	Green	Flashing	Not set / Idle State	Settings are not complete or no communication with scanner
	Red	Flashing	Error	Non-critical error detected
	Red	Lit	Error	Critical error detected
	Red green	Flashing	Self-diagnostics	Currently performing self-diagnostics
	—	Unlit	—	No power supply
LED3	Green	Lit	Online / Currently connected	Online
	Green	Flashing	Online / Not connected	Online / No communication partner
	Red	Lit	Error	Duplicate IP address
	Red	Flashing	Error	Connected time-out
	—	Unlit	—	Initialization incomplete / No power supply

LED3 is green and lit as long as communications are established with at least one node.

4.5.2 Error Detection on this Controller

No.	E0956
Message	Communication error.
Cause	A list of possible causes is given below. ・field bus base board error ・Broken cable ・Baud rate mismatch ・Incorrect node address setting ・Network power failure
Remedy	The system will recover once the problems listed above are resolved.

No.	E0957
Message	System error detected.
Cause	Either the EtherNet/IP setting file does not exist or its contents are invalid.
Remedy	Check that EtherNet/IP settings are correct on the Fieldbus Hardware Setting window.

No.	E0958
Message	Error detected by communication board self-check.
Cause	A list of possible causes is given below. ・Faulty field bus base board ・Incorrect detailed EtherNet/IP settings (Ex; Last box of IP address is set to “0”)
Remedy	The system will recover once the problems listed above are resolved.

No.	E0959
Message	Cannot find communication board.
Cause	The field bus base board specified on the Constant Settings window cannot be found.
Remedy	Confirm the slot ID of the fieldbus hardware setting. Even if the field bus base board is correctly connected, the field bus base board itself may have failed if this error occurs. Replace the field bus base board.

No.	E0960
Message	Some or all I/O links are currently stopped.
Cause	I/O links have stopped.
Remedy	The system automatically recovers once the problem is resolved. (It may be necessary in some cases to turn power off and on again in order to resolve this problem.)

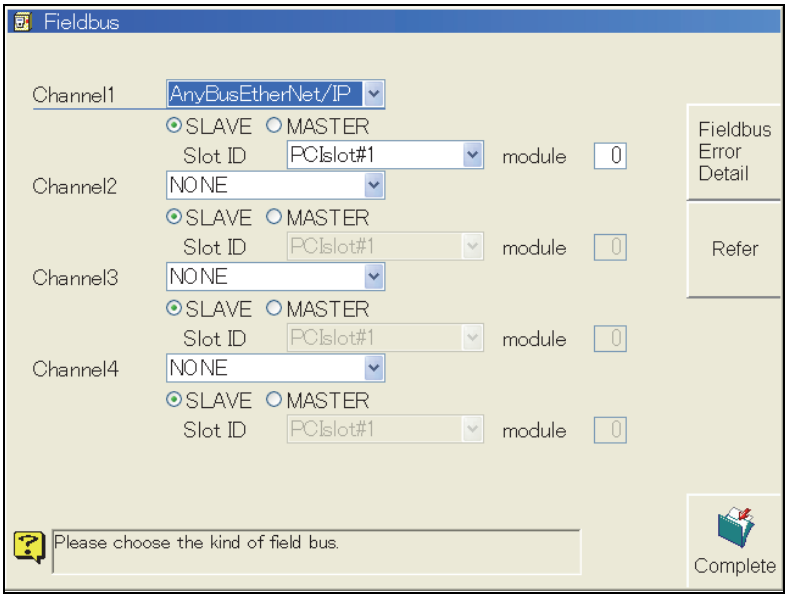
No.	I3960
Message	Some or all I/O links are currently stopped.
Cause	I/O links have stopped.
Remedy	The system automatically recovers once the problem is resolved. (It may be necessary in some cases to turn power off and on again in order to resolve this problem.)

In the case of E0960 and I3960, E0960 and I3960 are selected based on settings made on the [Detailed Field Bus Error Settings] screen. For details, see “4.5.3 Detail Field Bus Error Setting”.

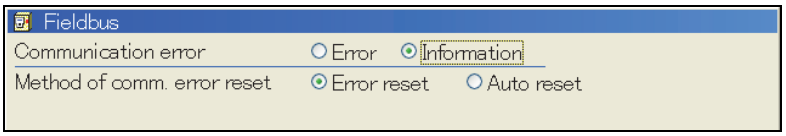
4.5.3 Detail Field Bus Error Setting

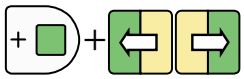
The following settings can be made regarding operations when an I/O link error occurs.
・Error type when a communication error occurs
・Communication error reset method for restoring communications
The setting method is given below.

1 **Open <Constant settings> - [8 Communications] - [3 Fieldbus] screen.**
>> The following screen will appear.

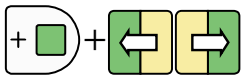


2 **Press the f-key < Fieldbus Error Detail>.**
>> The following screen will appear.





3 **Align the cursor with “Communication error” and Use the [Enable] + [Left] or [Right] cursor keys to switch to the radio buttons (a horizontal row of selector buttons), and select “Error” or “Information”.**
>> When an I/O link error occurs;
・If “Error” is selected, E0960 is generated.
・If “Information” is selected, I3960 is generated.



4 **Align the cursor with “Method of comm. error reset” and switch the radio buttons, and select “Error reset” or “Auto reset”.**
>> When recovering from a communication error;
・If error reset is selected, a communication error is maintained until the system is reset.
・If automatic reset is selected, a communication error is automatically reset.

This item cannot be selected if “Communication error” is set to “error.”

5 **Press the f-key < Complete > to save settings.**

Chapter 5 DeviceNet

5.1 Outline

DeviceNet is a network which is becoming the de facto standard in the industry. By enabling network connections for limit switches, photo sensors, operation boards, robots and other industrial devices at a low cost and by enabling logical access to the inputs and output (network I/O) provided by each of these devices, DeviceNet improves communication between devices which is difficult to achieve through hardware connections, and it enables diagnoses for each individual device. The maximum number of nodes in the network is 64, and the baud rate can be set from 125 Kbps to 500 Kbps in accordance with the size of the network.
Presented in the diagram below is an example where this controller is connected to DeviceNet as a slave.

DeviceNetis a trademark of ODVA (Open DeviceNet Vender Association, Inc.).

Performance table

Item	Specification
Number of channels	Maximum number of channels installed: 4
Master or Slave	Can function as master or slave. Master or slave can be set independently for each channel.
Number of inputs/outputs	A maximum of 2048 inputs (256 bytes) and 2048 outputs (256 bytes) can be used for all the channels, and these numbers cover all the general-purpose signals of this controller. (When the built-in PLC (software PLC) is used.)
Node address	By means of key input from the teach pendant, the node addresses at this controller side can be selected from 0 to 63 and set for each channel.
Baud rate	125 K, 250 K or 500 Kbps can be set enabling the optical rate for the scale of the network to be selected.
Input data processing when communication trouble has occurred	It is possible to select whether the input signal statuses are to be held or cleared when communication trouble has occurred.
Change of state IO communication	HMS DeviceNet module can make an I/O communication with "Change of state" method. This communication type sends the data when the condition of the I/O signals has been changed.
Quick Connect	HMS DeviceNet module can make an I/O communication with "Quick connect" method. This type can initiate the communication quickly by delaying the detection of duplicated node.
Connection precautions	If this controller is the last device connected to the network, a terminator (terminating resistance) should be connected.

Listed below are the possible causes of trouble.
- Trouble in the Fieldbus base board/DeviceNet module hardware
- Broken or disconnected cable
- Mismatched baud rate
- Erroneous node address setting
- Trouble in network power supply

CAUTION

If an error has occurred or an LED indicating trouble lights up, the I/O statuses may not be correct. Care should be taken since this may cause the robot, jigs and other interlocks to fail to operate correctly, possibly resulting in a sudden or unanticipated operation.

CAUTION

“Quick Connect” communication is enabled only when the corresponding slave model is used and necessary setting is completed in this controller.

This method delays the detection of duplicated node. So if duplicated node is set to “Quick Connect”, unexpected phenomenon may occur. Pay utmost attention.

Needed time to re-establish the “Quick Connect” connection depends on the type of slave and system construction. If it was too slow, please check the system.

5.1.1 Contained Parts

Contained parts of this option

No.	Name	Parts No., type.	Note
1	Fieldbus board	UM236-10	
2	DeviceNet module	AB5021 AB4004	Master Slave
3	Panel to connect cable		
5	Fixing screws for board	M4 × 8mm	

5.2 Installation and Connection

5.2.1 How to install

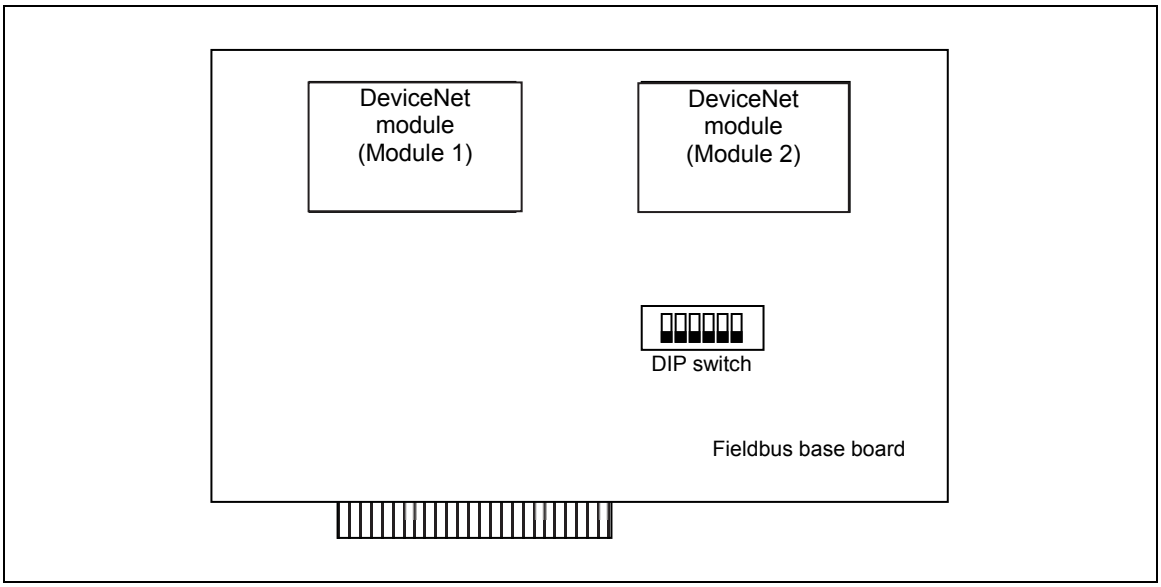
All fieldbus board can be mounted in same way.

Refer to “Chapter 4 EtherNet/IP”, “4.2.1 How to install” for detail.

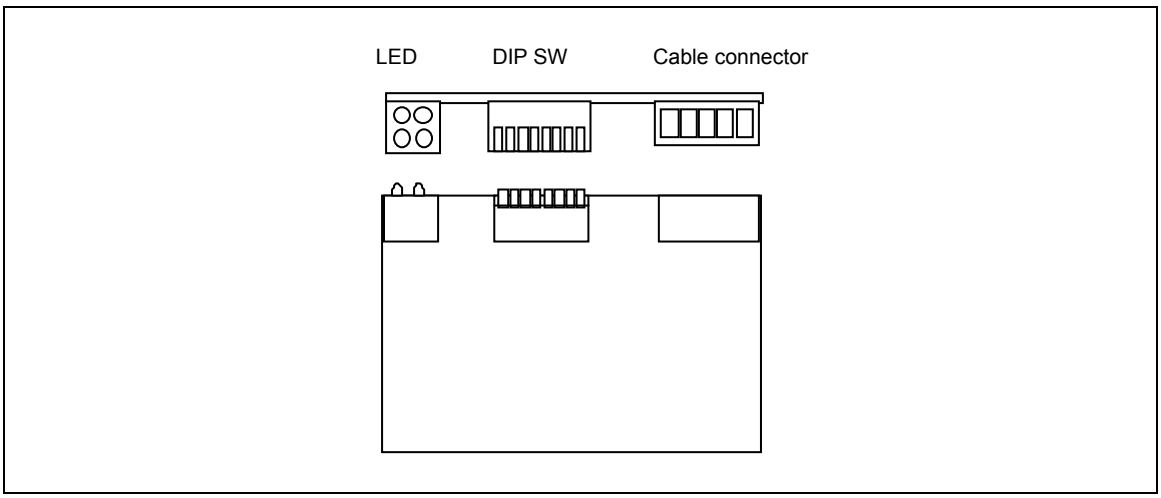
5.2.2 Hardware setting

The fieldbus base board can be equipped with up to DeviceNet modules made by HMS. There are 2 types of HMS DeviceNet module (Master/Slave).

The DIP switch on the HMS DeviceNet module is not used. It is not necessary to make a setting on the switch.



External view of the fieldbus base board



External view of the HMS DeviceNet module

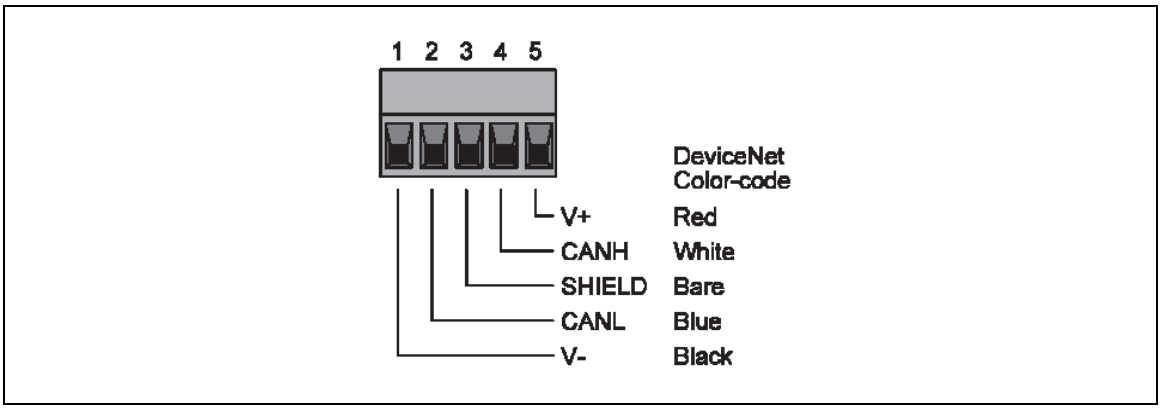
INFO.

The DIP switches on the fieldbus base board are set shown as below. However, these settings are done suitably when shipping. So, in the usual cases, customers do not have to perform those settings.

DIP switch setting of the fieldbus base board for HMS DeviceNet module

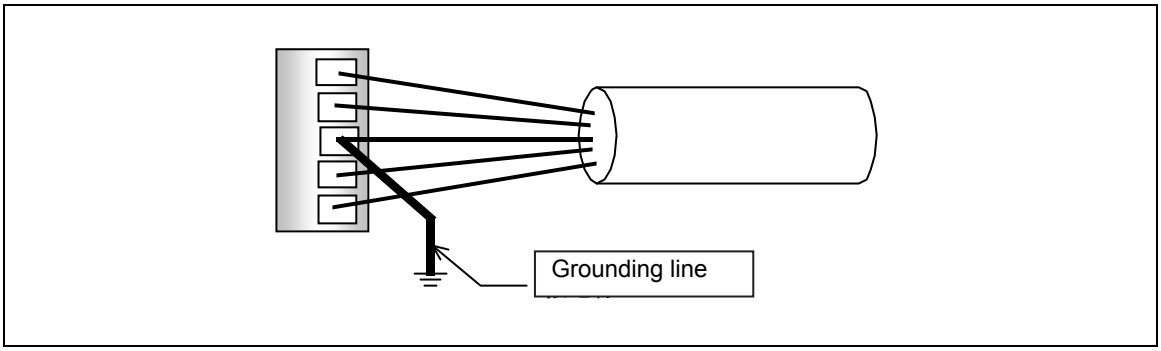
Installed module	module1 setting			module2 setting		
	SW1	SW2	SW3	SW4	SW5	SW6
Not installed	OFF	OFF	OFF	OFF	OFF	OFF
Maste module	ON	OFF	OFF	ON	OFF	OFF
Slave module	OFF	ON	OFF	OFF	ON	OFF

5.2.3 Cable connection



Details of the cable connector

The power source should be supplied from the network. And, if the channel is the end of the network, a terminating resistor should be applied.



An example of the grounding

Concerning DeviceNet, the grounding should be done only at one point of the network not to make any ground loops. When connecting ground on this controller, extract an exclusive line from the SHIELD of the connector and connect ground.

5.3 Signal Assignment

5.3.1 Fieldbus I/O signals

I/O signal numbers is determined based on the field bus channel number to be used.

■ **When software PLC is disabled (setting when shipped)**

CH1 : I 161 ～ I 672 / O 161 ～ O 672 (512 points)
CH2 : I 673 ～ I1184 / O 673 ～ O1184 (512 points)
CH3 : I1185 ～ I1696 / O1185 ～ O1696 (512 points)
CH4 : I1697 ～ I2048 / O1697 ～ O2048 (352 points)

■ **When software PLC is enabled**

CH1 : X1000 ～ X1511 / Y1000 ～ Y1511 (512 points)
CH2 : X1512 ～ X2023 / Y1512 ～ Y2023 (512 points)
CH3 : X2024 ～ X2535 / Y2024 ～ Y2535 (512 points)
CH4 : X2536 ～ X3047 / Y2536 ～ Y3047 (512points)

■ **Assigning signals beyond the number of channels**

The field bus can use up to four channels. If all four channels are not being used, it is possible to use the signal assignment region of channels not being used.
The description below gives an example in which software PLC is enabled. Signals can be assigned using a similar concept even if software PLC is disabled.

If only one channel is being used, all 2048 points can be used with just “Channel 1” by using “Channel 1”.

CH1 : X1000 ～ X3047 / Y1000 ～ Y3047 (2048 points)

When using two channels, 1024 points can be used for each channel, by using “Channel 1” and “Channel 3”.

CH1 : X1000 ～ X2023 / Y1000 ～ Y2023 (1024 points)
CH3 : X2024 ～ X3047 / Y2024 ～ Y3047 (1024 points)

5.3.2 DeviceNet signal assignment

■ **When this controller is used as a slave**

If the number of I/O bytes is smaller than the number of signals assigned to each channel, an unused assignment region results. Following example is to use “Channel 1” as the slave, with 2 bytes of input and 3 bytes of output.

CH1 : X1000 ～ X1015 / Y1000 ～ Y1023 (Usable are)
X1016 ～ X1511 / Y1024 ～ Y1511 (Unusable are)

■ **When this controller is used as a master**

Signal positions are determined by the sequence in which the slaves are displayed on the slave list screen (refer to 5.4 Setting Procedure”).The signal assignment is determined by the numbers of the input bytes and output bytes of each slave.
Given below is an example of signal assignment when channel 1 is made to serve as the master.

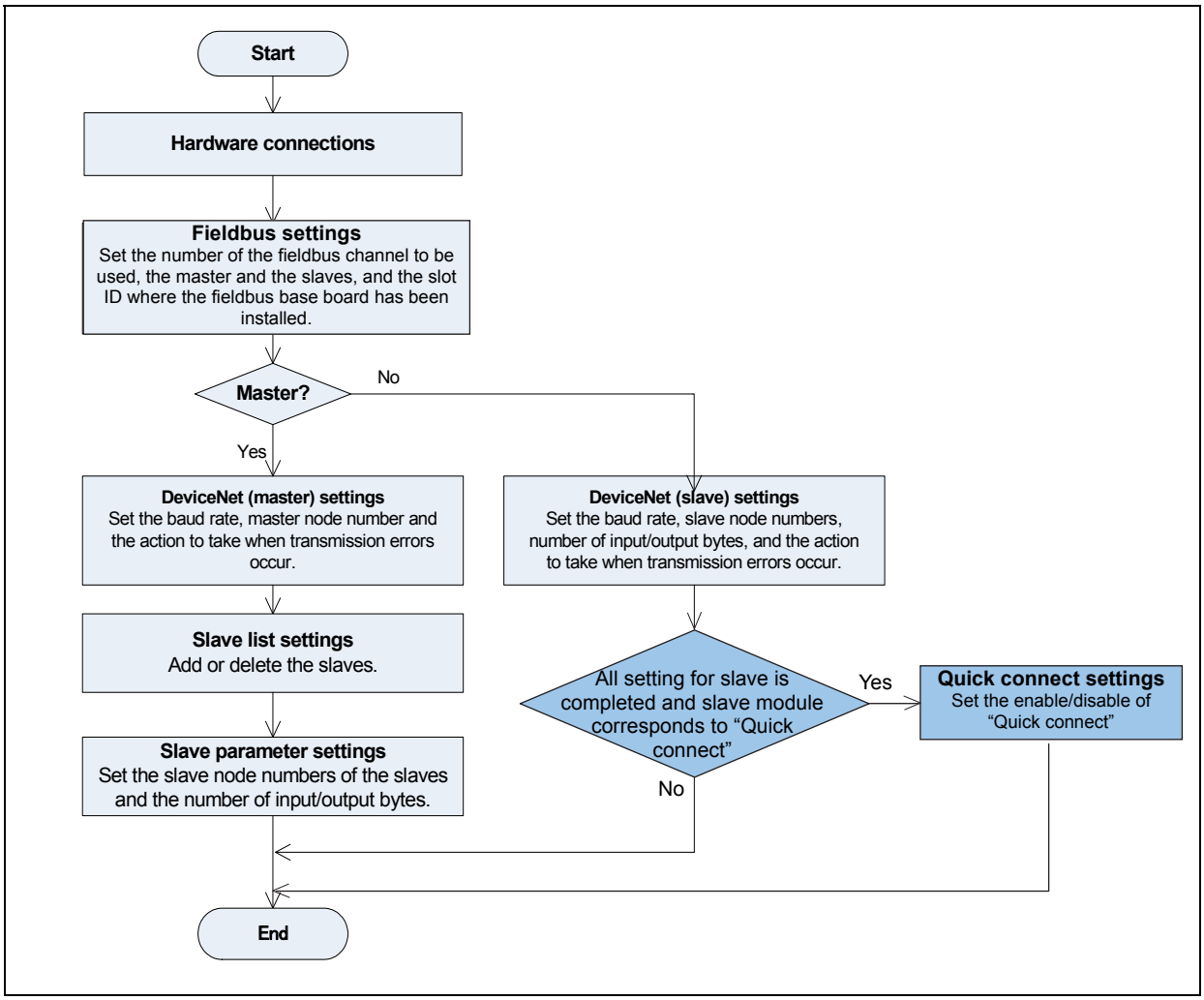
Example of master signal assignment

Slave list	Slave outputs		Slave inputs	
	Number of bytes	Signal	Number of bytes	Signal
Slave 1	2	X1000～X1015	1	Y1000～Y1007
Slave 2	2	X1016～X1031	2	Y1008～Y1023
Slave 3	1	X1032～X1039	2	Y1024～Y1039

As shown above, the signals are arranged in sequence in accordance with the number of bytes set.

5.4 Setting Procedure

Shown below is the general sequence of the steps for performing the setting.



Flow chart of the setting procedure

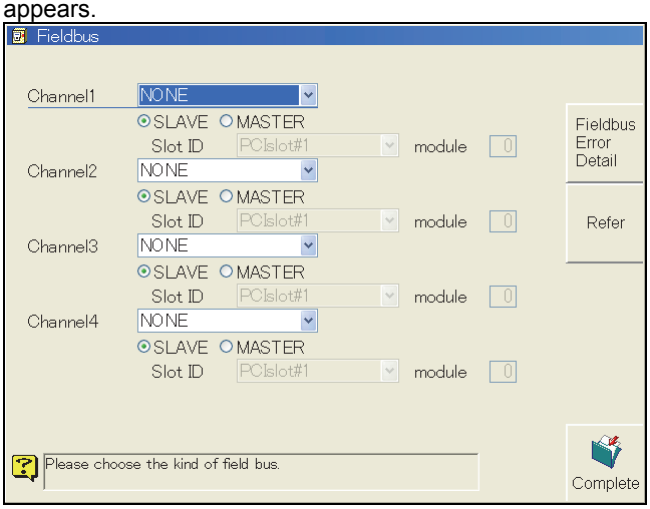
When the PLC is used to input and output the DeviceNet signals, the PLC settings must be performed as well. For further details, refer to "FD11 Controller Operating Manual: Software PLC."
If "Quick connect” is needed, salve module must be corresponding to “Quick connect” specification.

5.4.1 Field bus settings

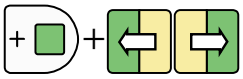
Protocol settings

1 Open <Constant Setting> - [8 Communication] [3 Fieldbus]

≫The screen used to perform the various communications settings shown below appears.



2 In the combobox, align the cursor to the [AnyBusDeviceNet] item using up or down key and press the [Enter] key



3 Use the [Enable] and left or right cursor keys to switch to the radio buttons (a horizontal row of selector buttons), and select master or slave..

4 Align the cursor with the slot ID combo box, and press the [Enter] key. In the dialog box displayed, align the cursor with the slot ID concerned using the up or down cursor key, and press the [Enter] key.

≫The slot ID is required in order to check the position where the fieldbus base board has been installed. Please refer to “Chapter 4 EtherNet/IP”, ”4.2.1 How to install” for the relationship between the position and the ID of the slots.

5 Align the cursor with the dialog box for the module and input the module number (1 or 2) and press [Enter] key.

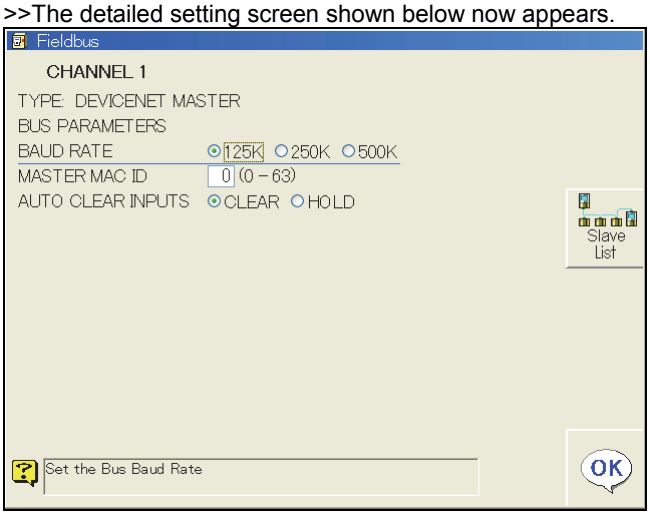
≫The module number is a number that is necessary to confirm the position where the module is installed on the fieldbus base board. If 0 is set for the module number, the channel is not used.

Now proceed to set the DeviceNet (master) or DeviceNet (slave).

5.4.2 DeviceNet Master settings

Channel settings

1 **On the [3 Fieldbus] screen, align the cursor with the channel where DeviceNet (master) has been selected, and press the <Refer> button.**
>>The detailed setting screen shown below now appears.



2 **Enter the respective parameters.**

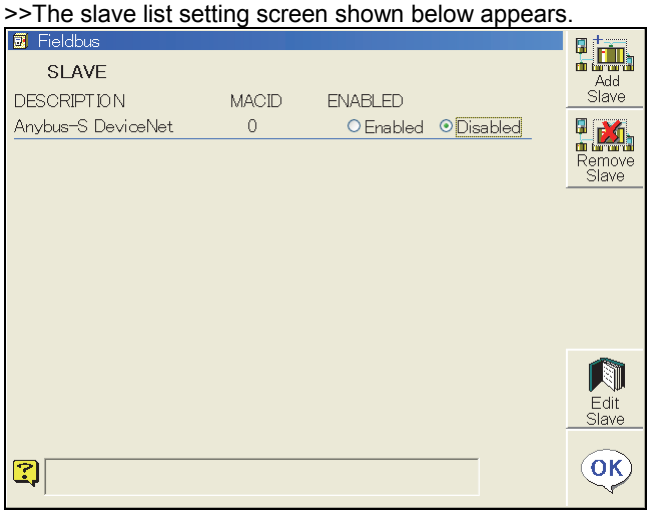
BAUD RATE	A baud rate of 125 K, 250 K or 500 kbit/sec can be selected. The same baud rate must be set for all the devices in one network.
MASTER MAC ID	The MAC IDs (0 to 63) identify the devices in the network. It is not possible to set devices with the same MAC ID in one network. If a MAC ID has been set more than once, normal communication will no longer be possible.
AUTO CLEAR INPUTS	It is possible to select whether the input signal statuses are to be held or cleared when communication trouble has occurred.

3 After completing the setting, press <OK>

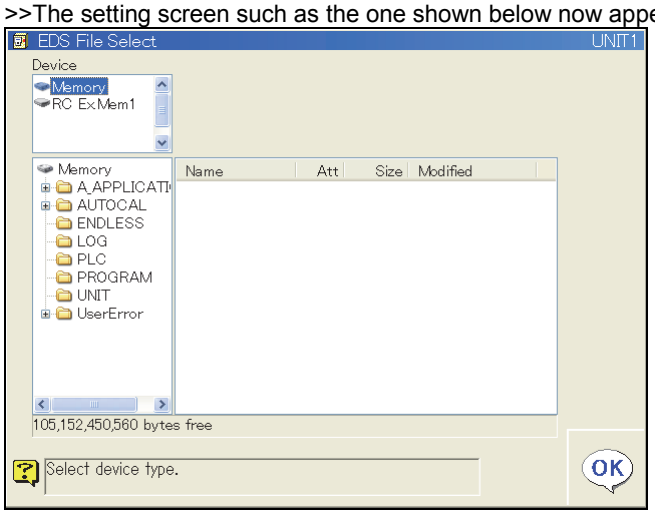
Now continue with the setting of slave list.

Slave list settings

1 **Press the <Slave List> button on the DeviceNet (master) detailed setting screen.**
>>The slave list setting screen shown below appears.

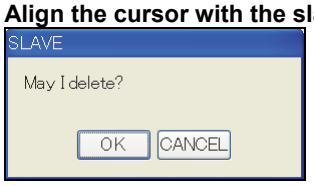


2 **Press f key <Add Slave>.**
>>The setting screen such as the one shown below now appears.



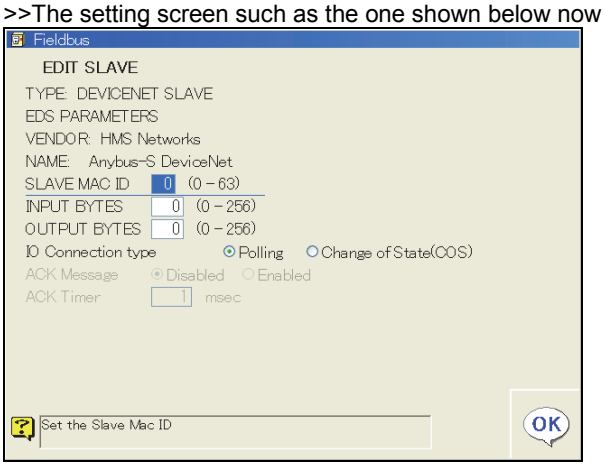
3 **Select the EDS file of the slave to be added, and press the f key [OK].**
The EDS file is a file describing the data required when setting slaves, and it is provided by the device manufacturer.

4 To delete a slave from the slave list:
Align the cursor with the slave to be deleted, and press the f key <Remove Slave>.



A confirmation message now appears. Select the [OK] button to delete the slave or the [CANCEL] button to cancel the deletion, and press the [Enter] key.

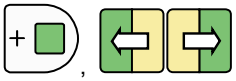
5 **On the slave list setting screen, align the cursor with the slave whose slave parameters are to be set, and press the f key <Edit Slave>.**
>>The setting screen such as the one shown below now appears.



6 **Enter the respective parameters.**

SLAVE MAC ID	The MAC IDs (0 to 63) identify the devices in the network. It is not possible to set devices with the same MAC ID in one network. If a MAC ID has been set more than once, normal communication will no longer be possible.
INPUT BYTES	This is the PRODUCED BYTES of the slave side. These are inputs when they are seen from the standpoint of this controller.
OUTPUT BYTES	This is the CONSUMED BYTES of the slave side. These are outputs when they are seen from the standpoint of this controller.
IO Correction type	In case "Polling", the slave nodes will make communication when they receive the order from the master node. In case of "Change of state (COS)", the communication will be done when the condition of the I/O changes.
ACK message	In case of "Change of state", it is possible to enhance the reliability by send back a message to show that the data is received. Please enable/disable this setting considering the slave device specification.
ACK Timer	This is the waiting time of the ACK Message. Please make this setting considering the performance of the slave devices. If too short time (compared with the performance of the slae devices) is set, E0960 may be detected.

7 **After completing the setting, press <OK>.**
The display now returns to the slave list setting screen.



8 **Use the [Enable] and left or right cursor keys to switch to the radio buttons, and select the setting of "ENABLED" ("Enabled" or "Disabled") for the slave device.**

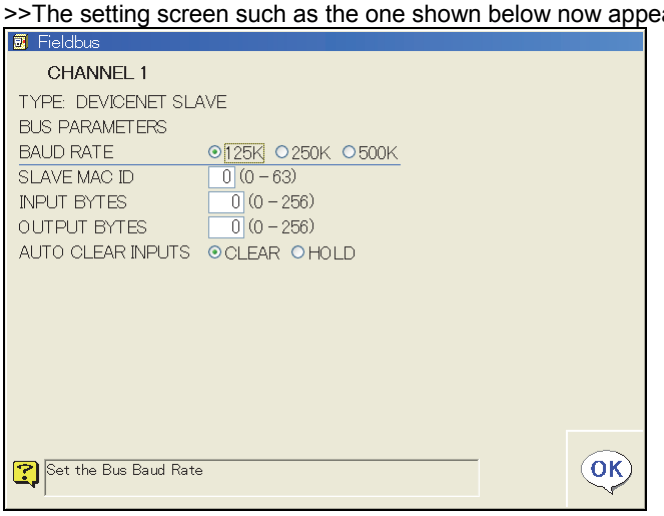
9 **After completing the setting, press <OK>.**
The display now returns to the detailed screen of the DeviceNet master setting screen.

5.4.3 DeviceNet Slave settings

Channel settings

Refer

1 **On the [3 Fieldbus] screen, align the cursor with the channel where DeviceNet (slave) has been selected, and press the "Refer" button.**
>>The setting screen such as the one shown below now appears.



2 **Enter the respective parameters.**

BAUD RATE	A baud rate of 125 K, 250 K or 500 kbit/sec can be selected. The same baud rate must be set for all the devices in one network.
SLAVE MAC ID	The MAC IDs (0 to 63) identify the devices in the network. It is not possible to set devices with the same MAC ID in one network. If a MAC ID has been set more than once, normal communication will no longer be possible.
INPUT BYTES	This is the CONSUMED BYTES of the slave side. These are inputs when they are seen from the standpoint of this controller.
OUTPUT BYTES	This is the PRODUCED BYTES of the slave side. These are outputs when they are seen from the standpoint of this controller.
AUTO CLEAR INPUTS	It is possible to select whether the input signal statuses are to be held or cleared when communication trouble has occurred.

OK

3 **After completing the setting, press <OK>.**
>>The display now returns to the [3 Fieldbus] screen.

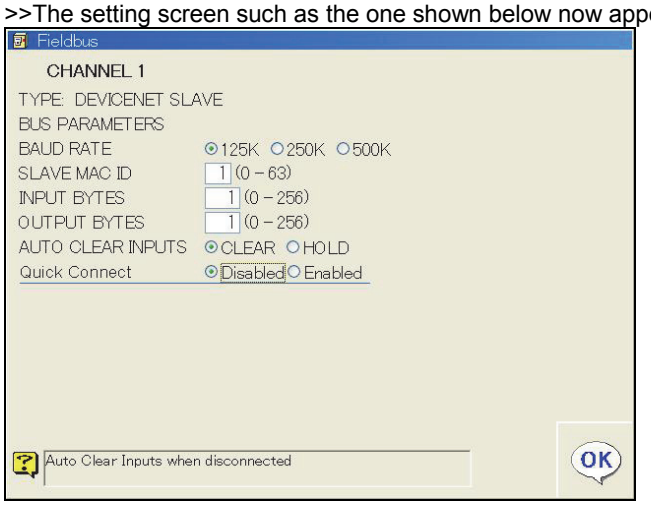
"Quick connect" settings

IMPORTANT

After f key <Complete> is pressed on [3 Fieldbus] screen, "Quick connect" setting can be started by following to the procedure written below.

Refer

1 **In case that "Quick connect" option board is used, on the [3 Fieldbus] screen, align the cursor with the channel where DeviceNet (slave) has been selected, and press the "Refer" button.**
>>The setting screen such as the one shown below now appears.



2 **Enter the respective parameters.**
(Item marked "＊" appears only when Devicenet module corresponding to "Quick connect" is used.)

BAUD RATE	A baud rate of 125 K, 250 K or 500 kbit/sec can be selected. The same baud rate must be set for all the devices in one network.
SLAVE MAC ID	The MAC IDs (0 to 63) identify the devices in the network. It is not possible to set devices with the same MAC ID in one network. If a MAC ID has been set more than once, normal communication will no longer be possible.
INPUT BYTES	This is the CONSUMED BYTES of the slave side. These are inputs when they are seen from the standpoint of this controller.
OUTPUT BYTES	This is the PRODUCED BYTES of the slave side. These are outputs when they are seen from the standpoint of this controller.
AUTO CLEAR INPUTS	It is possible to select whether the input signal statuses are to be held or cleared when communication trouble has occurred.
＊Quick connect	This is select disabled/enabled of quick connect.

OK

3 **After completing the setting, press <OK>.**
>> The display now returns to the [3 Fieldbus] screen.

5.4.4 EDS file

When this controller is used as a slave, it is necessary to give information for the DeviceNet slave setting to the DeviceNet master. The file where such information is described is "EDS file".
Please refer to the manual of the DeviceNet master for the use of the "EDS file".

The EDS file that is necessary when using this controller as a slave device is shown below. This EDS file is stored in the folder "PLCEngine" in the internal memory.

EDS file for this controller

Part name	EDS file name
Fieldbus base board + HMS DeviceNet module	EDS_ABS_DEV_V_2_3.eds
Fieldbus base board + HMS DeviceNet module For Quick connect	EDS_ABS_DEV_V_2_2.eds

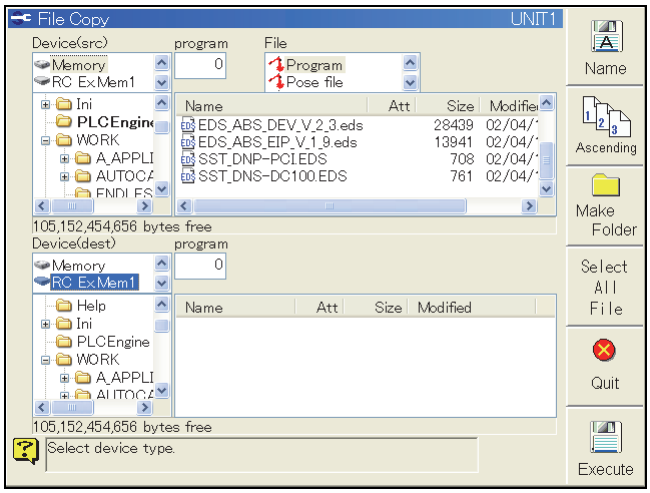
To retrieve this EDS file, follow the procedure shown below.

How to take out the "EDS files"

1 **Please switch the operator class to *EXPERT* or higher in advance.**

2 **Select [Service Utilities][7 File Manager][1 File Copy] screen.**

3 **"Device (src)" is set to "Memory", and the “PLCEngine" folder is selected.**
>> A screen shown as below will appear.



The file name display column can be enhanced by pushing [Enable] key + [←][→] key.

4 **A necessary “EDS file” is copied onto "RC Ex.Mem1"(USB memory).**

5.4.5 Quick Connect Attribute setting in flash memory of Devicenet slave

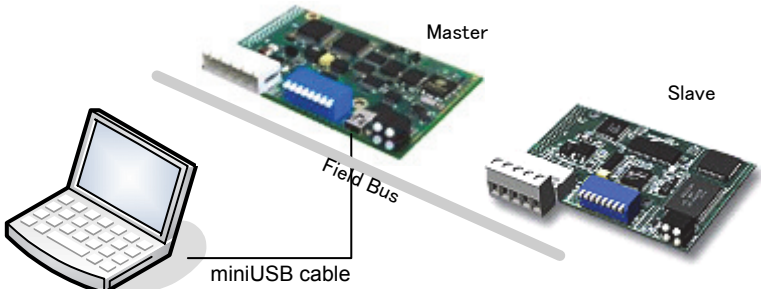
Please set the “Quick Connect Attribute” of HMS Devicenet slave module to be enabled by following to the procedure written below.

This procedure is also available by utilizing the setting tool of master device. In such a case, please refer to the respective instruction manual delivered by the master device manufacturer.

Followings are necessary

- EDS file (**EDS_ABS_DEV_V_2_2.eds**) stored in this controller
- Devicenet master device (For example; HMS Master module)
- Tool that can operate Devicenet master device from external (For example; HMS NetTool)
- PC
- Cable to connect Devicenet master device with PC (For example; miniUSB cable)

Establish the fieldbus communication between master and slave of this controller. Then connect PC with miniUSB cable.

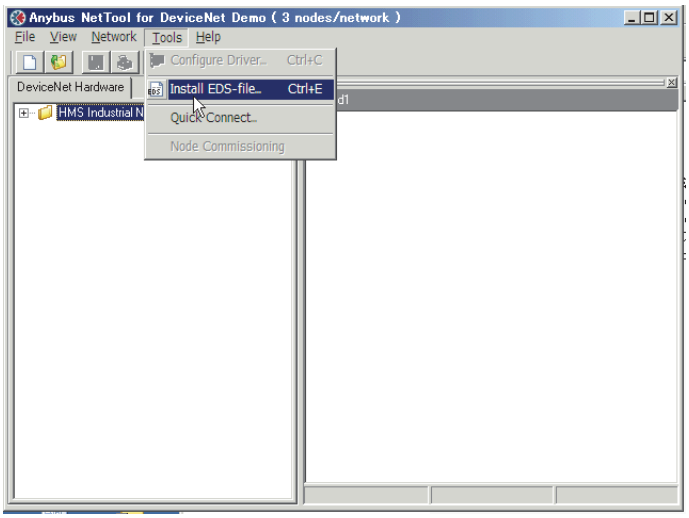


Preparing “Anybus NetTool” for DeviceNet

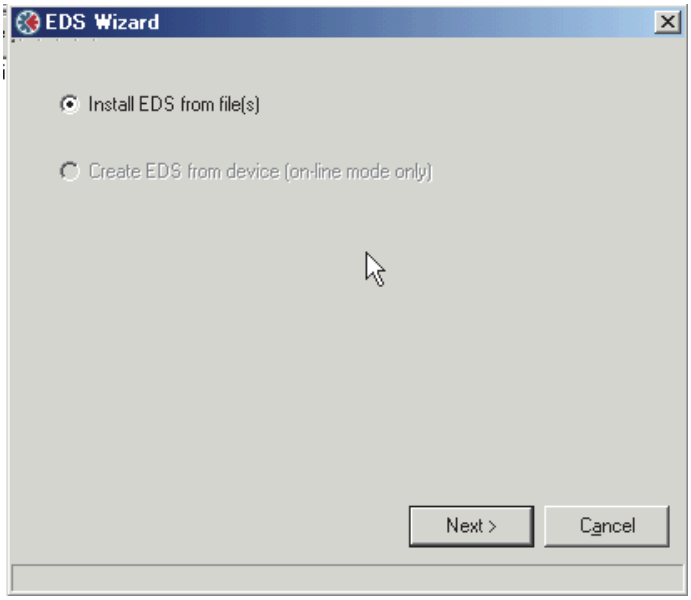
1 Get the EDS file from this controller. Please refer to “5.4.4 EDS file” for detail.

2 Download the following file from URL of HMS
272-8586-Anybus NetTool for DeviceNet (Demo Version) Setup 3.5.1.3.zip
and install it. (Above file name is just an sample. Version number and file name may change by HMS company.)

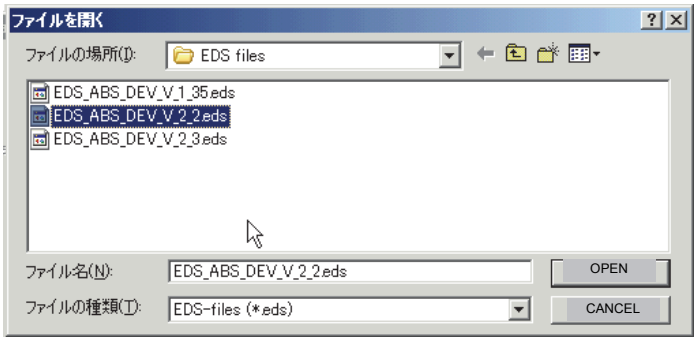
3 **Install EDS file of needed salve module to “Anybus NetTool for DeviceNet”. Start ”Anybus NetTool for DeviceNet” and click following menu.**
>> A screen shown as below will appear.



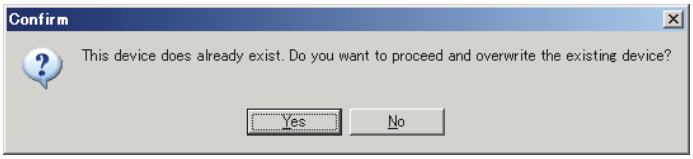
4 **Following pop up window will appear. Then click [Next>] button.**



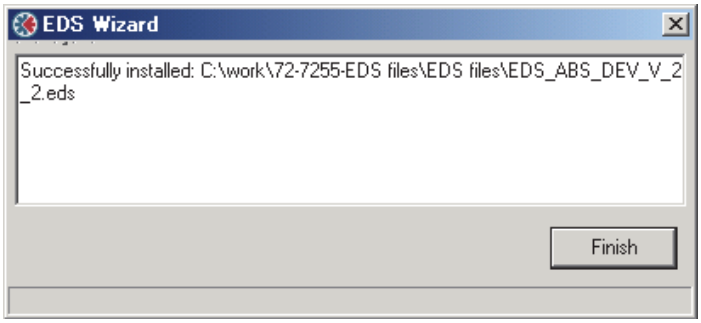
5 **Following window will appear. Then select [EDS_ABS_DEV_V_2_2.eds] and click [Open] button.**



6 **Following window will appear. Then click [Yes] button.**



7 **Following window, to show the procedure is completed, will appear. Then click [Finish] button. Now it is ready to set the slave module of this controller.**



Communicating to the slave device

IMPORTANT

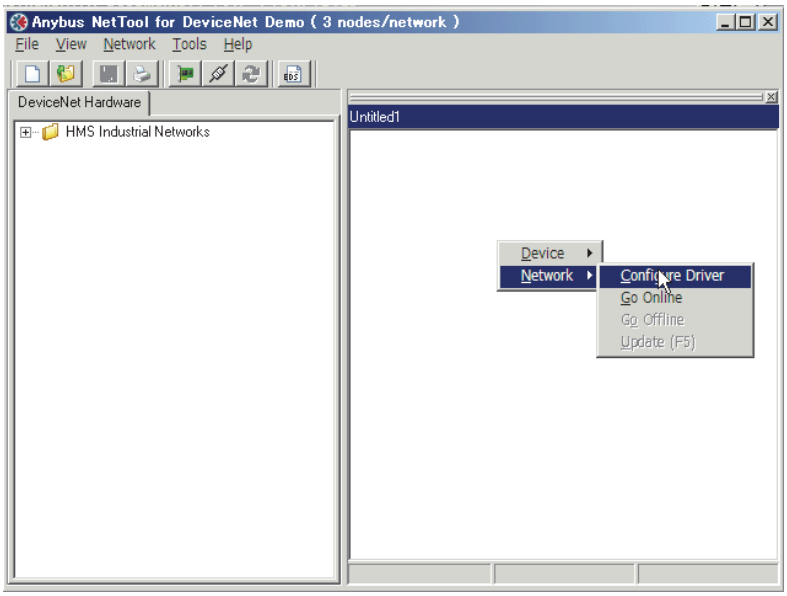
In order to set again “Quick connect” to the slave device, beware that target slave device must exist in the same fieldbus network as master. Also, in advance, this slave is set to **“Quick connect” enabled** and **communication must be established**.

IMPORTANT

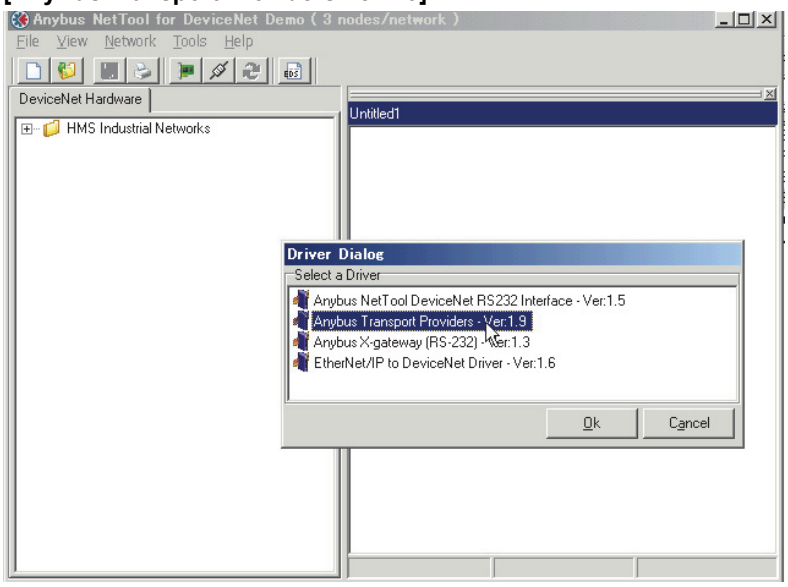
In case of communicating with HMS Devicenet master module via USB, its COM port number must be found in advance.

1 **Start “AnyBus NetTool for DeviceNet Demo” and click right button on the right side screen. Then select [Configure Driver] on pop up menu.**

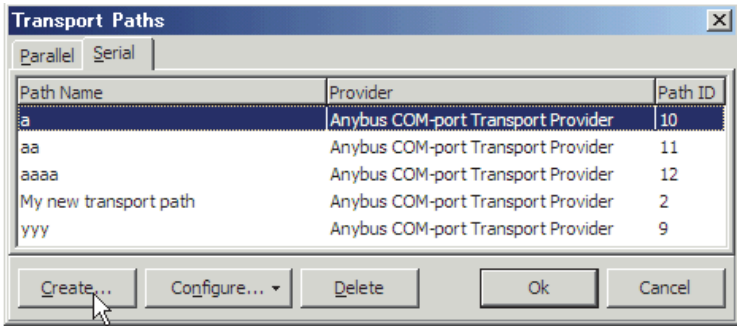
>> A screen shown as below will appear.



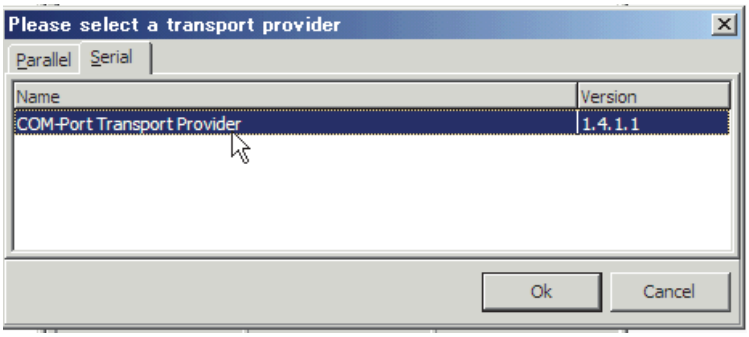
2 **Next window to select the communication driver will appear. Then select [AnyBus Transport Providers Ver.1.9].**



3 **Select [Serial] tab. New screen to select [Path Name] will appear, then click [Create] button.**

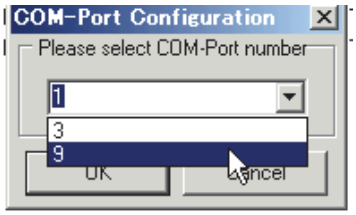


4 **New screen to set the communication method will appear, then select [Serial] tab. Select [COM-Port Transport Provider] and click [OK] button.**

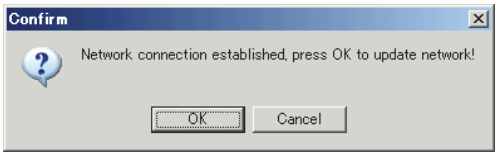


5 **New screen to set the [Path Name] will appear, then input the characters to define the name and click [OK] button.**

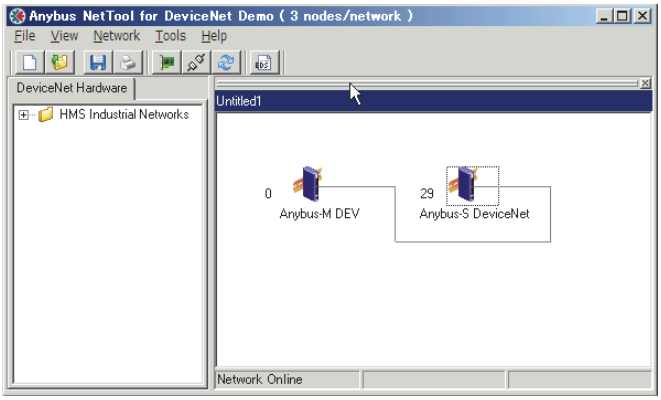
6 **When connecting by USB, new screen to set the USB serial port number will appear. Input the COM port number here.**



7 **New screen to acquire the status of communication module will appear, then click [OK] button.**



>> If communication was successfully established, following screen will appear.

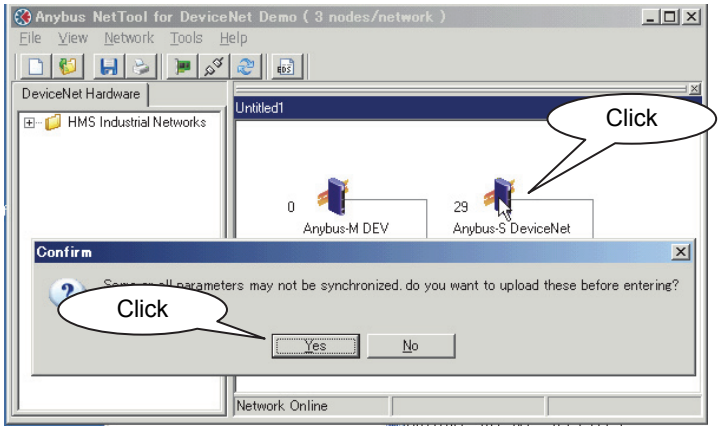


Quick connect attributes setting in flash memory of DeviceNet slave

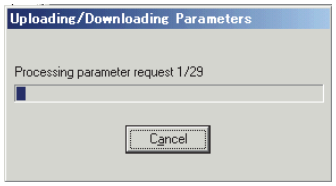
IMPORTANT

In order to set again “Quick connect” to the slave device, beware that target slave device must exist in the same fieldbus network as master. Also, in advance, this slave is set to **“Quick connect” enabled** and **communication must be established**.

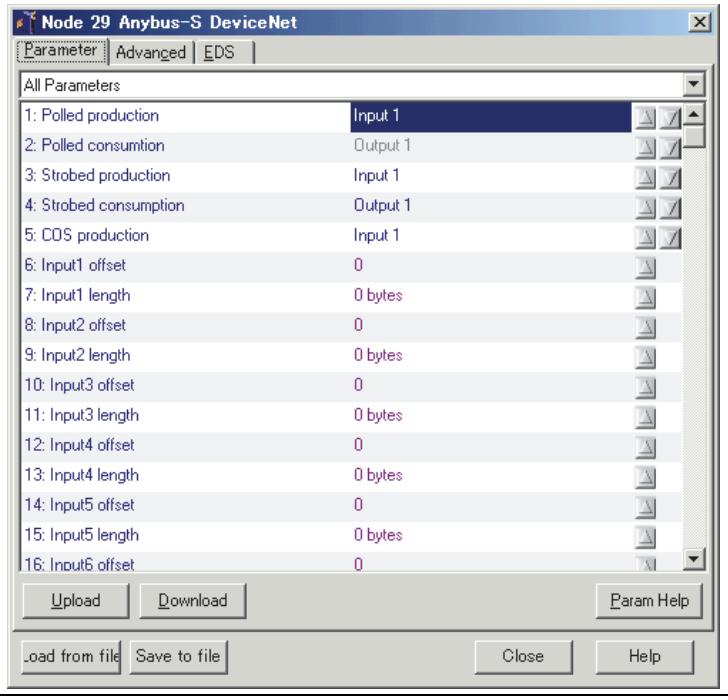
1 **On the right screen, click [AnyBus-S DeviceNet] icon, then select [Yes] on the confirmation window.**



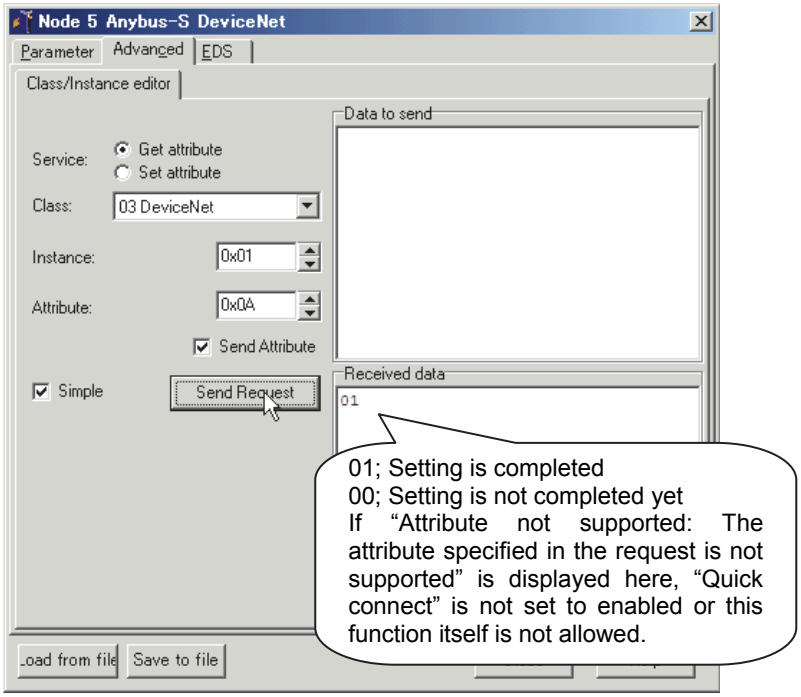
2 Next window shows that current status is to be acquiring now,



Few seconds later, following screen will appear.

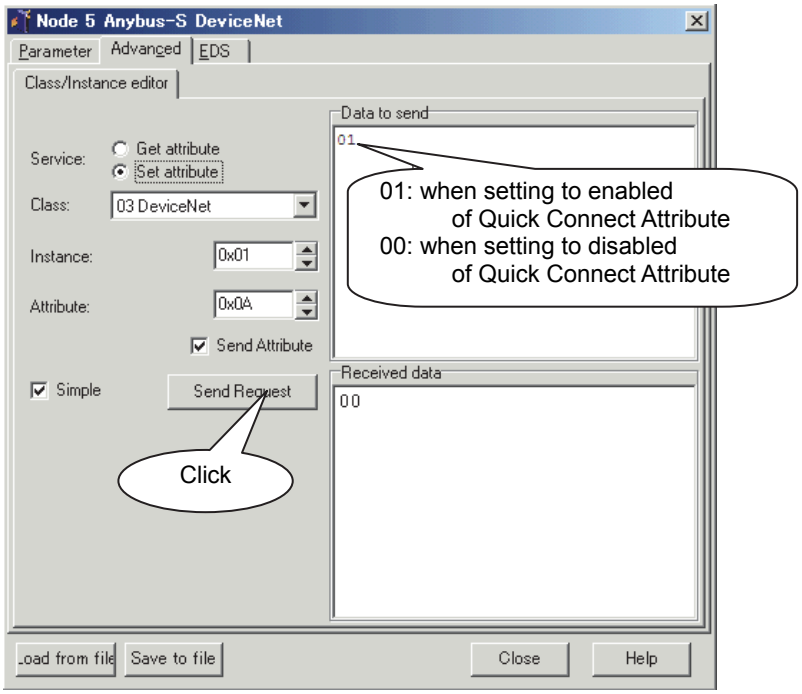


3 **Select [Advanced] tab. Set “03 DeviceNet” in “Class”, and set “0x0A” in “Attribute”, then click [Send Request] button.**



4 **In order to set to enabled from disabled (= not set yet), select [Set attribute] of [Service] radio button and input [01] in [Data to send] window. Then click [Send Request] button.**

In case of setting to disabled, on the other hand, input [00].



Now quick connect setting in flash memory is completed.

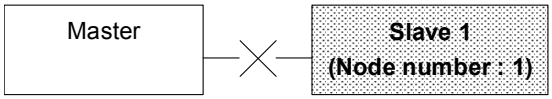
5 **Select [Get attribute] of [Service] radio button and confirm “received data” i s changed to “01” by referring to step 3.**

In same way, “Quick Connect Attribute” of HMS slave module flash memory can be confirmed.

5.5 Disconnecting Fieldbus

5.5.1 Outline

The "Fieldbus release (disconnecting) function" is a function to disable the error detection for the desired slave node when this controller is working as a master node. This function is to be used when a slave node is disconnected from the network physically because of mechanism change etc.

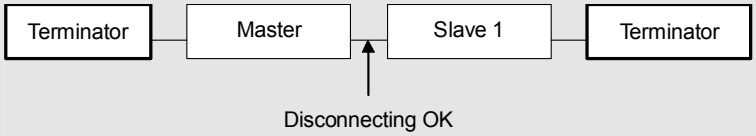


IMPORTANT

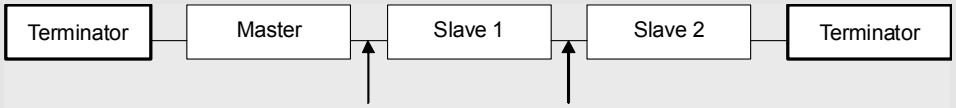
When plural slaves are connected, this disconnecting function is not available because terminating register has been disconnected.

<Example of disconnection available>

Disconnection is available because slave is only one.



<Example of disconnection not available>

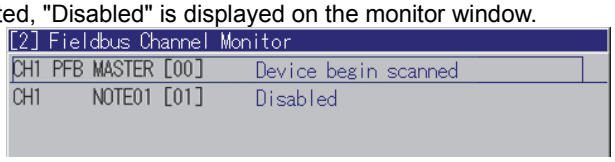


CAUTION

As long as the slave device is physically on the filedbus, it is possible to execute the I/O communication even if the filedbus function is released for the slave device. However, in the condition, do not leave the device released. Because the communication errors for the device are not detected and it is very dangerous.

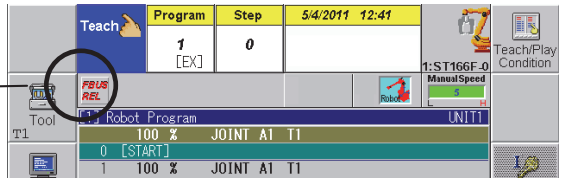
5.5.2 How to know the current status

If the fieldbus is disconnected, "Disabled" is displayed on the monitor window.



When at least one slave is disconnected, following icon is displayed on screen.

Status display for the fieldbus



5.5.3 Connection/Disconnection by function command

By utilizing this function, fieldbus can be disconnected and connected from robot program.

■ **Example**

This is an example of mechanism change system with a tool changer.
In this system, the signals are assigned like the figure shown as right.
(This is just an example. The details may be different depending on the actual system environments etc.

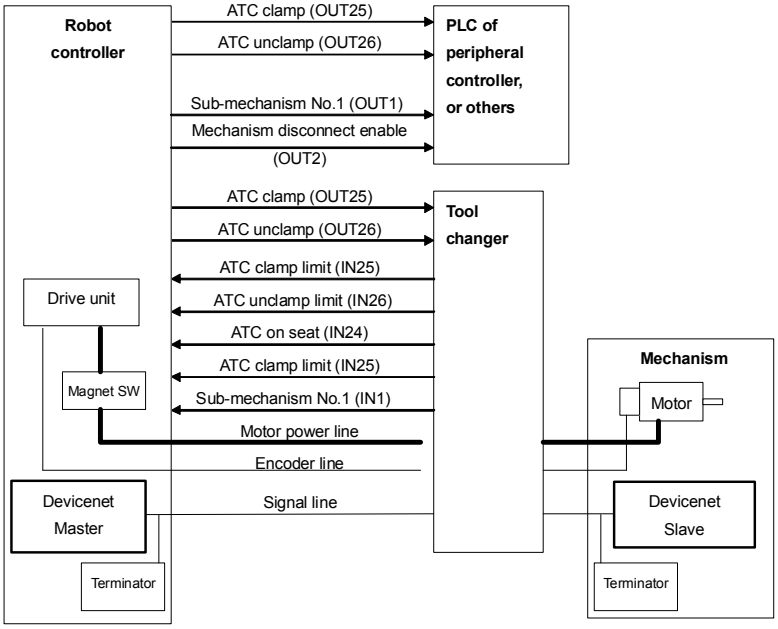


Fig. 5.5.1 Example of tool changer connection

STEP N	**500mm/s LIN A1 T31**		
STEP N+1	**100mm/s LIN A1 T1**		Move to seat position
STEP N+2	**FBUSREL[1,1,0]**	FN312; Fieldbus Release	Disable error detection
STEP N+3	**CHGGUN[0]**	FN95; Mount mechanism 2	Disconnection
STEP N+4	**RESET[O25]**	FN34; Output signal reset	Unclamp
STEP N+5	**SET[O26]**	FN32; Output signal set	
STEP N+6	**WAIT[I26]**	FN525; Wait input cond.	Waiting for unclamp
STEP N+7	**100mm/s LIN A1 T31**		Move to seat position
STEP N+8	**DELAY[0.5]**	FN50; Timer delay	
STEP N+9	**WAIT[I24]**	FN525; Wait input cond.	Waiting for settling on seat
STEP N+10	**RESET[O26]**	FN34; Output signal reset	Clamp
STEP N+11	**SET[O25]**	FN32; Output signal set	
STEP N+12	**WAITI[I25]**	FN525; Wait input cond.	Waiting for clamp
STEP N+13	**CHGGUN[1]**	FN95; Mount mechanism 2	Connection
STEP N+14	**100mm/s LIN A1 T1**		Move from seat
STEP N+15	**FBUSREL[1,1,1]**	FN312; Fieldbus Release	Enable error detection

On the stepN+2, the fieldbus release operation (the error detection disabling operation) for the designated slave node is executed before executing the mechanism disconnection function so that any error is not detected even if the slave node is released from the fieldbus physically.
On the stepN+13, the mechanism is connected. And then, after the enough time to establish the fieldbus communication again has passed, the fieldbus release operation (the error detection enabling operation) for the designated slave node is executed on the stepN+15 to restart the error detection of fieldbus for the slave node.

■ **Parameters**

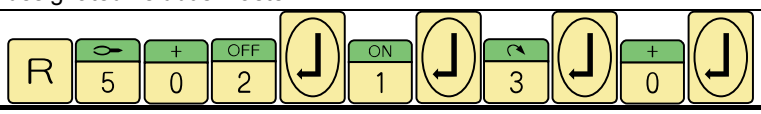
1st parameter: The channel number that is used by the fieldbus master (1 - 4)
2nd parameter: The target slave node number for the error detection (0 - 127)
3rd parameter: Enable/Disable switch for the error detection (0 = disable / 1 = enable)

■ **Display**

FBUSREL [1,3,0]	FN312; Fieldbus Release

5.5.4 Connection/Disconnection by manual operation

By using shortcut R502, fieldbus can be connected / disconnected manually.
To use this shortcut operation, switch the operator class to ***EXPERT*** or higher in advance.

Code number	502
Name	Fieldbus release
Outline	This is a shortcut to enable/disable the error detection of a designated slave node on a designated fieldbus master.
Input example	

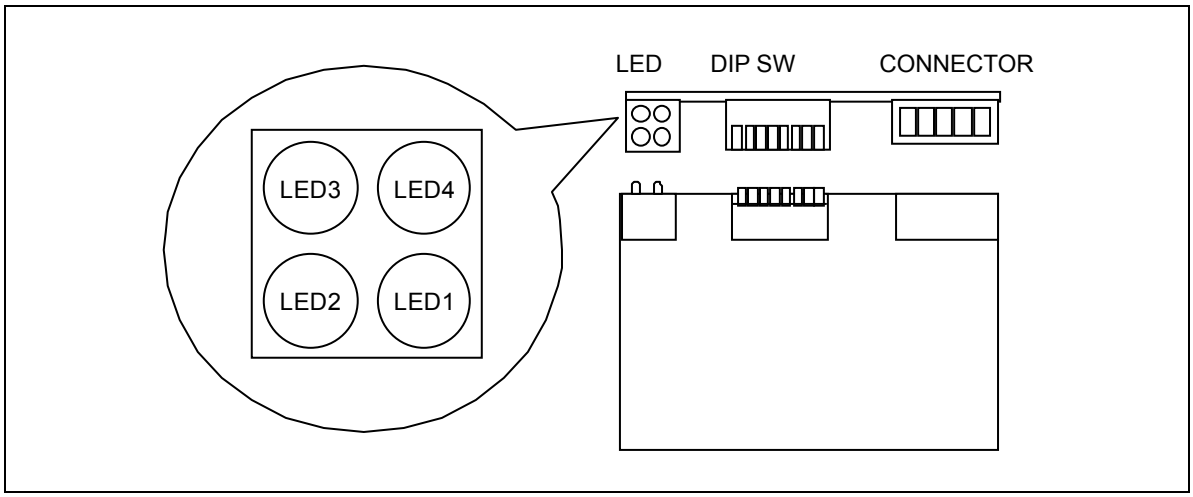
Input parameters

No.	Name	Description
1	Channel number	Enter the channel number that the master device is using. (1 – 2)
2	Slave node number	Enter the slave's node number to connect/disconnect. (0 - 127)
3	Error detection	Set the error detection enabled/disabled condition. When 0 is set, the error detection is disabled (this means that the slave node is released). When 1 is set, the error detection is enabled (this means that the slave node is connected). (0 = disabled(=released) / 1 = enabled(=connected))

5.6 Troubleshooting

5.6.1 Error Detection on DeviceNet Module

DeviceNet module shows the current statuses by the 4 LEDs shown in the figures listed below.



HMS DeviceNet module

Concerning a Master module, each LED displays the status listed below.

LED1 : not used
LED2 : Network status
LED3 : Module status
LED4 : Operation mode

LED status and DeviceNet status for a Master module

LED	Color	Status		Description
LED1	―	OFF	―	―
LED2	Green	ON	Online/communication established	On-line, one or more connections are established
		Flashing	Online/communication not established	On-line, no connection established
	Red	ON	Communication error	Critical link failure
		Flashing	Communication error	Minor fault, one or more connections have a minor fault
	―	OFF	Offline	Major fault
LED3	Green	ON	Normal	Module status is OK
	Red	Flashing	Hardware error	Minor Hardware fault
		ON	Hardware error	Major Hardware fault
	―	OFF	―	No power or not initialized
LED4	Green	ON	Run mode	Scan running
		Flashing	Idle mode	Scan idling
	―	OFF	―	No power or not initialized

Please be sure that LED2 is turned ON (Green) only if communication with at least one node is established.

Concerning a Slave module, each LED displays the status listed below.

LED1 : not used
LED2 : Network status
LED3 : Module status
LED4 : not used

LED status and DeviceNet status for a Slave module

LED	Color	Status		Description
LED1	―	OFF	―	―
LED2	Green	ON	Online/communication established	On-line, communicating with the Master node
		Flashing	Online/communication not established	On-line, no connection established
	Red	ON	Communication error	Critical link failure
		Flashing	Communication error	Communication timeout
	―	OFF	Offline	No power or not initialized
LED3	Green	ON	Normal	Module status is OK
		Flashing	parameter error	Data size fault
	Red	ON	Hardware error	Major Hardware fault
		Flashing	Hardware error	Minor Hardware fault
	―	OFF	―	No power or not initialized
LED4	―	OFF	―	―

5.6.2 Error Detection on this Controller

When this controller detects an error, it displays one of the error messages listed below.

No.	E0956
Message	Communication trouble has occurred.
Cause	Listed below are the possible causes of trouble. · Trouble in the communication board (fieldbus base board + DeviceNet module) · Broken or disconnected cable · Mismatched baud rate · Erroneous node address setting · Trouble in network power supply
Remedy	Communication resumes when the trouble above is remedied.

No.	E0957
Message	System trouble has been detected.
Cause	Either the DeviceNet configuration file does not exist or its contents are illegal.
Remedy	On the field bus hardware setting screen, check whether the DeviceNet has been set correctly.

No.	E0958
Message	Trouble has been detected by the communication board's self-check function.
Cause	The communication board (fieldbus base board + DeviceNet module) specified on the constants setting screen cannot be found.
Remedy	Replace the communication board.

No.	E0959
Message	Communication board cannot be found.
Cause	The communication board (fieldbus base board + DeviceNet module) specified on the constants setting screen cannot be found.
Remedy	Check the slot ID among the fieldbus hardware settings. If this error occurs even though the communication board has been connected correctly, a failure in the communication board itself may be to blame. Replace the communication board.

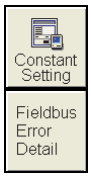
No.	E0960
Message	Some or all I/O links are shut down.
Cause	I/O links are shut down.
Remedy	Operation is automatically restored when the problem is solved. (It may be necessary to turn off the power and turn it back on again in order to solve the problem.)

No.	I3960
Message	Some or all I/O links are shut down.
Cause	I/O links are shut down.
Remedy	Operation is automatically restored when the problem is solved. (It may be necessary to turn off the power and turn it back on again in order to solve the problem.)

*As to E0960 and I3960, either of errors set on the Error Details Setting screen is output. For details, refer to information in “5.6.3 Detail Fieldbus Error Setting”.

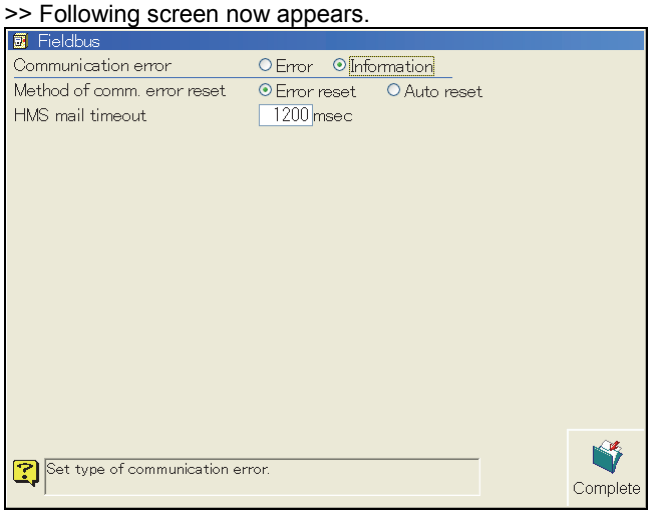
5.6.3 Detail Fieldbus Error Setting

For operations when an I/O link error occurs, the following settings can be made.
• Type of error when a communication error occurs
• Method of resetting the communication error when communication is recovered
The following section shows the method of settings.

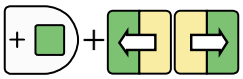


1 **Open <Constant settings>-[8 Communications]-[3 Fieldbus].**

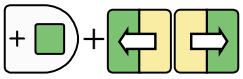
2 **Then press the f-key < Fieldbus Error Detail>.**
>> Following screen now appears.



(Supplement) “HMS timeout” is not used in this function. Not to be changed.



3 **Select “Error” or “Information” with [ENABLE] and the [Right] or [Left] cursor key.**
>> If an I/O link error occurs
・ If “Error” is selected, E0960 will occur.
・ If “Information” is selected, I3960 will occur.



4 **Select “Error resetting” or “Automatic resetting” with [ENABLE] and the [Right] or [Left] cursor key.**
>> If a communication error is recovered
・ If “Error resetting” is selected, the communication error will be held until it is reset.
・ If “Automatic resetting” is selected, the communication error will be automatically reset.
If an error occurs in the setting of communication error, this item cannot be selected.

5 **Press the f-key < Complete > to save settings.**

Chapter6 CC-Link

6.1 Outline

CC-Link (Control & Communication Link) refers to a field network system that can achieve controlling and processing information data simultaneously and rapidly, in order to meet the various needs of the users of FA system. By enabling network connections for limit switches, photo sensors, operation boards, robots and other industrial devices and by enabling logical access to the inputs and output (network I/O) provided by each of these devices,
CC-Link improves communication between devices which is difficult to achieve through hardware connections, and it enables diagnoses for each individual device. The maximum number of nodes in the network is 64, and the baud rate can be set from 156 Kbps to 10 Mbps in accordance with the size of the network.

CC-Link is a trademark of CC-Link *Partner Association : CLPA.*

Performance table

Item	Specification
Number of channels	Maximum number of channels installed: 3
Master/Slave	Can function as master or slave. Master or slave can be set independently for each channel. When using it as a slave, set it as an “intelligent device station” on the master side.
Number of inputs/outputs (when used as a master)	A maximum of 2,048 inputs (256 bytes) and 2,048 outputs (256 bytes) can be used for all the channels, and these numbers cover all the general-purpose signals of this controller. (when the software PLC is used.)
Number of inputs/outputs (when used as a slave)	When remote registers are not used, up to 112 inputs and 112 outputs can be used. When remote registers are used, a maximum of 368 inputs and 368 outputs can be used.
Number of slaves connected	Up to 64 slave stations can be connected to one master station. Note that the following conditions must be satisfied. (1) { (1 * a) + (2 * b) + (3 * c) + (4 * d) } ≤ 64 a: number of stations occupying 1 station b: number of stations occupying 2 stations c: number of stations occupying 3 stations d: number of stations occupying 4 stations (2) { (16 * A) + (54 * B) + (88 * C) } ≤ 2304 A: number of remote I/O stations (64 or less) B: number of remote device stations (42 or less) C: number of local stations, waiting master stations, and intelligent device stations (26 or less) (3) { 32× α + (32+64)× β } ≤ 2048 (PLC is used), 1888 (PLC is not in use) α: Number of stations using no remote registers, β: Number of stations using remote registers.
Node address	By means of key input from the teach pendant, the node addresses at this controller side can be selected from 1 to 64 and set for each channel.
Baud rate	5 steps, from 156 Kbps to 10 Mbps, can be set enabling the optical rate for the scale of the network to be selected.
Input data processing when communication trouble has occurred	It is possible to select whether the input signal statuses are to be held or cleared when communication trouble has occurred.
Connection precautions	If this controller is the last device connected to the network, a terminator (terminating resistance) should be connected.

Listed below are the possible causes of trouble.

- Broken or disconnected cable
- Mismatched baud rate
- Erroneous node address setting
- Trouble in CC-Link board hardware

CAUTION

If an error has occurred or a LED indicating trouble lights up, the I/O statuses may not be correct. Care should be taken since this may cause the robot, jigs and other interlocks to fail to operate correctly, possibly resulting in a sudden or unanticipated operation.

IMPORTANT

There is a case that “intelligent device station” can not been selected according to the device type. Before use, please confirm that “intelligent device station” can been selected.

6.1.1 Contained Parts

Contained parts of this option

No.	Name	Parts No., type.	Note
1	CC-Link board	Q80BD-J61BT11N	Mitsubishi Denki
2	Panel to fix board		
3	Fixing screws for board	M4 × 8mm	

6.2 Installation and Connection

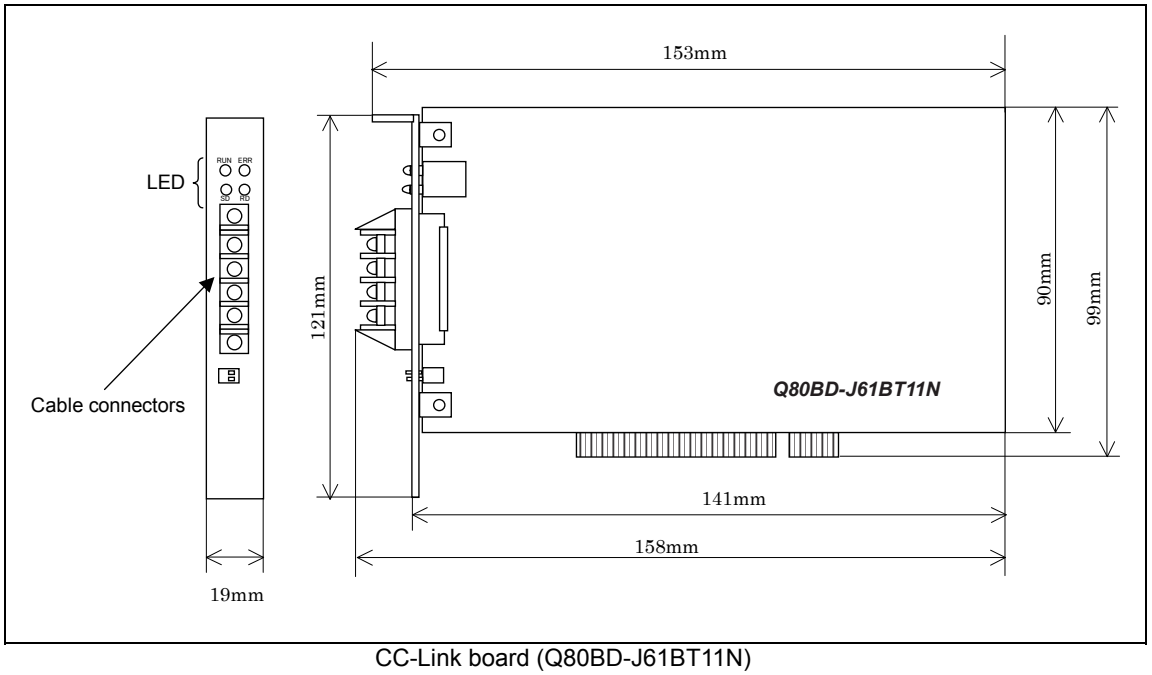
6.2.1 How to install

All fieldbus board can be mounted in same way.

Refer to “Chapter 4 EtherNet/IP”, “4.2.1 How to install” for detail.

6.2.2 Hardware

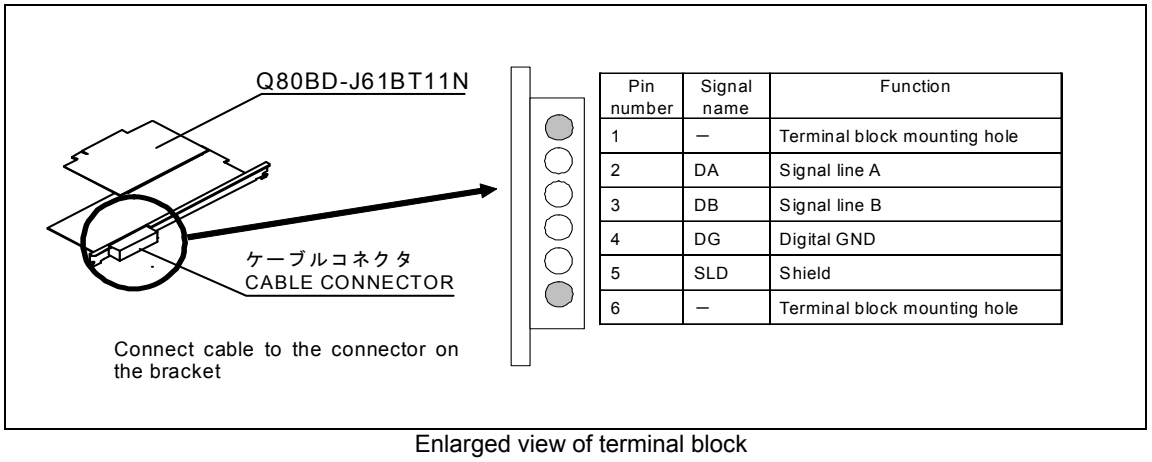
Although CC-Link board (Q80BD－J61BT11N) itself can support CC-Link V.2, this controller can support only CC-Link V1.0.



CC-Link board (Q80BD-J61BT11N)

If the channel is located at the end of the network, terminating resistances must be connected.

6.2.3 Cable connections



Pin number	Signal name	Function
1	—	Terminal block mounting hole
2	DA	Signal line A
3	DB	Signal line B
4	DG	Digital GND
5	SLD	Shield
6	—	Terminal block mounting hole

Enlarged view of terminal block

6.3 Signal Assignment

6.3.1 Fieldbus I/O signals

I/O signal numbers is determined based on the field bus channel number to be used.

■ When software PLC is disabled (setting when shipped)

CH1 : I 161 ～ I 672 / O 161 ～ O 672 (512 points)
CH2 : I 673 ～ I1184 / O 673 ～ O1184 (512 points)
CH3 : I1185 ～ I1696 / O1185 ～ O1696 (512 points)
CH4 : I1697 ～ I2048 / O1697 ～ O2048 (352 points)

■ When software PLC is enabled

CH1 : X1000 ～ X1511 / Y1000 ～ Y1511 (512 points)
CH2 : X1512 ～ X2023 / Y1512 ～ Y2023 (512 points)
CH3 : X2024 ～ X2535 / Y2024 ～ Y2535 (512 points)
CH4 : X2536 ～ X3047 / Y2536 ～ Y3047 (512points)

■ Assigning signals beyond the number of channels

The field bus can use up to four channels. If all four channels are not being used, it is possible to use the signal assignment region of channels not being used.
The description below gives an example in which software PLC is enabled. Signals can be assigned using a similar concept even if software PLC is disabled.

If only one channel is being used, all 2048 points can be used with just “Channel 1” by using “Channel 1”.

CH1 : X1000 ～ X3047 / Y1000 ～ Y3047 (2048 points)

When using two channels, 1024 points can be used for each channel, by using “Channel 1” and “Channel 3”.

CH1 : X1000 ～ X2023 / Y1000 ～ Y2023 (1024 points)
CH3 : X2024 ～ X3047 / Y2024 ～ Y3047 (1024 points)

6.3.2 CC-Link I/O signals

■ **When this controller is used as a slave**

If this controller is going to be used as a slave, the signals are simply allocated from the signal positions determined by the channels. The number of the occupied stations is fixed at 4. Therefore, 112 inputs/outputs are available.

*1: If no remote registers are used, a local station will be able to use 128 I/O at maximum. Since 16 of them are occupied as the system I/O, however, the station will be able to freely use 112 I/O at maximum.

*2: If remote registers are used, a local station will be able to use 384 I/O at maximum. Since 16 of them are occupied as the system I/O, however, the station will be able to freely use 368 I/O at maximum.

The following section shows the signal assignment when this controller is used as the slave.

Signal assignment when no remote registers are used

	Channel 1		Channel2		Channel3		Channel4		Number of I/O
	PLC enabled	PLC disabled	PLC enabled	PLC disabled	PLC enabled	PLC disabled	PLC enabled	PLC disabled	
Remote I/O	X1000 to X1111	I161 to I272	X1512 to X1623	I673 to I784	X2024 to X2135	I1185 to I1296	X2536 to X2647	I1697 to I1808	112
	Y1000 to Y1111	O161 to O272	Y1512 to Y1623	O673 to O784	Y2024 to Y2135	O1185 to O1296	Y2536 to Y2647	O1697 to O1808	
System region (unusable)	X1112 to X1127	I273 to I288	X1624 to X1639	I785 to I800	X2136 to X2151	I1297 to I1312	X2648 to X2663	I1809 to I1824	16
	Y1112 to Y1127	O273 to O288	Y1624 to Y1639	O785 to O800	Y2136 to Y2151	O1297 to O1312	Y2648 to Y2663	O1809 to O1824	
Unallocated region	X1128 to X1511	I289 to I672	X1640 to X2023	I801 to I1184	X2152 to X2535	I1313 to I1696	X2664 to X3047	I1825 to I2048	384 (*)
	Y1128 to Y1511	O289 to O672	Y1640 to Y2023	O801 to O1184	Y2152 to Y2535	O1313 to O1696	X2664 to X3047	O1825 to O2048	

* With PLC disabled, the number of I/O for the unallocated region of Channel 4 will be 224.

Signal assignment when remote registers are used

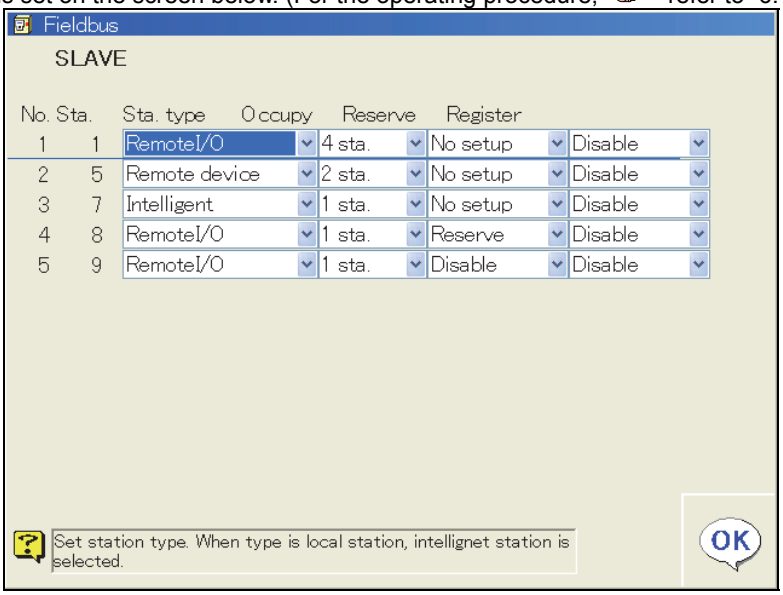
	Channel 1		Channel2		Channel3		Channel4		Number of I/O
	PLC enabled	PLC disabled	PLC enabled	PLC disabled	PLC enabled	PLC disabled	PLC enabled	PLC disabled	
Remote I/O	X1000 to X1111	I161 to I272	X1512 to X1623	I673 to I784	X2024 to X2135	I1185 to I1296	X2536 to X2647	I1697 to I1808	112
	Y1000 to Y1111	O161 to O272	Y1512 to Y1623	O673 to O784	Y2024 to Y2135	O1185 to O1296	Y2536 to Y2647	O1697 to O1808	
System region (unusable)	X1112 to X1127	I273 to I288	X1624 to X1639	I785 to I800	X2136 to X2151	I1297 to I1312	X2648 to X2663	I1809 to I1824	16
	Y1112 to Y1127	O273 to O288	Y1624 to Y1639	O785 to O800	Y2136 to Y2151	O1297 to O1312	Y2648 to Y2663	O1809 to O1824	
Remote register	X1128 to X1383	I289 to I544	X1640 to X1895	I801 to I1056	X2152 to X2407	I1313 to I1568	X2664 to X2919	I1825 to I2048	256 (*1)
	Y1128 to Y1383	O289 to O544	Y1640 to Y1895	O801 to O1056	Y2152 to Y2407	O1313 to O1568	Y2664 to Y2919	O1825 to O2048	
Unallocated region	X1384 to X1511	I545 to I672	X1896 to X2023	I1057 to I1184	X2408 to X2535	I1569 to I1696	X2920 to X3047	—	128 (*2)
	Y1384 to Y1511	O545 to O672	Y1896 to Y2023	O1057 to O1184	Y2408 to Y2535	O1569 to O1696	X2920 to X3047	—	

*1 With PLC disabled, the number of I/O for remote registers of Channel 4 will be 224.
*2 With PLC disabled, Channel 4 has no unallocated region.

■ **When this controller is used as the master**

If this controller is going to be used as the master, the signal positions are determined by the sequence in which the slaves are displayed on the slave list screen.

The slave list is set on the screen below. (For the operating procedure, refer to “6.4 Setting Procedure”)



The signal assignment is determined by the number of occupancy stations by each slave.

Given below is an example of signal assignment when channel 1 is made to serve as the master.

Example of master signal assignment

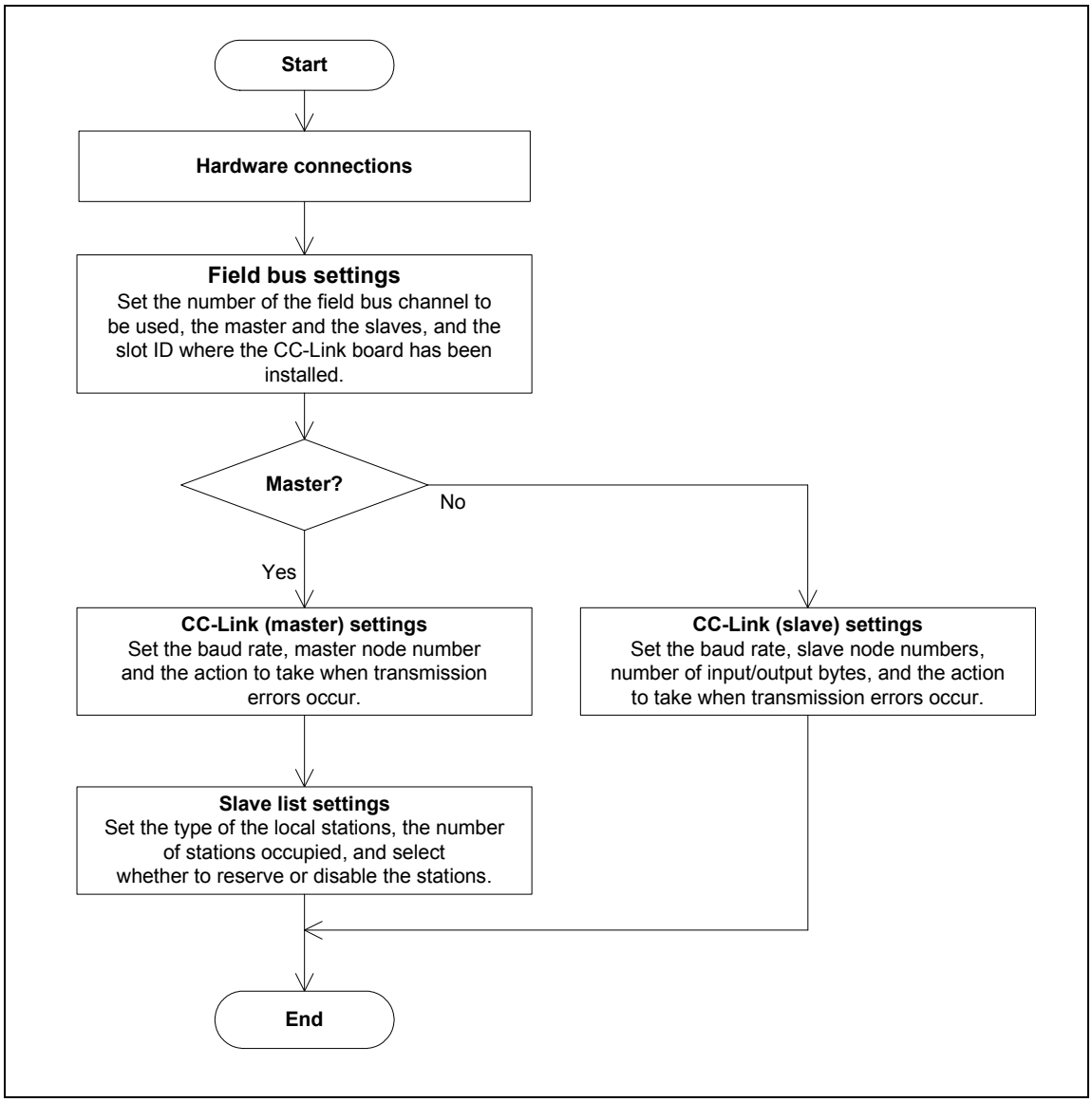
Number of station	Type of station	Signal name	Signal assignment with PLC enabled	Signal assignment with PLC disabled	Number of signals
1	Remote I/O station	Remote I/O	X1000 to X1111 Y1000 to Y1111	I161 to I272 O161 to O272	112
		System region (unusable)	X1112 to X1127 Y1112 to Y1127	I273 to I288 O273 to O288	16
5	Remote device station	Remote I/O	X1128 to X1175 Y1128 to Y1175	I289 to I336 O289 to O336	48
		System region (unusable)	X1176 to X1191 Y1176 to Y1191	I337 to I352 O337 to O352	16
7	Intelligent station	Remote I/O	X1192 to X1207 Y1192 to Y1207	I353 to I368 O353 to O368	16
		System region (unusable)	X1208 to X1223 Y1208 to Y1223	I369 to I384 O369 to O384	16
		Remote register	X1224 to X1287 Y1224 to Y1287	I385 to I448 O385 to O448	64
8	Remote I/O station	Remote I/O	X1288 to X1303 Y1288 to Y1303	I449 to I464 O449 to O464	16
		System region (unusable)	X1304 to X1319 Y1304 to Y1319	I465 to I480 O465 to O480	16
9	Remote I/O station	Remote I/O	X1320 to X1335 Y1320 to Y1335	I481 to I496 O481 to O496	16
		System region (unusable)	X1336 to X1351 Y1336 to Y1351	I497 to I512 O497 to O512	16

CAUTION

Depending on the station type (slave/master), manufacturer etc. of the device, there are some cases where the device does not have a system region. For the details of the system region, please refer to the instruction manual of those devices.

6.4 Setting Procedure

Shown below is the general sequence of the steps for performing the setting.



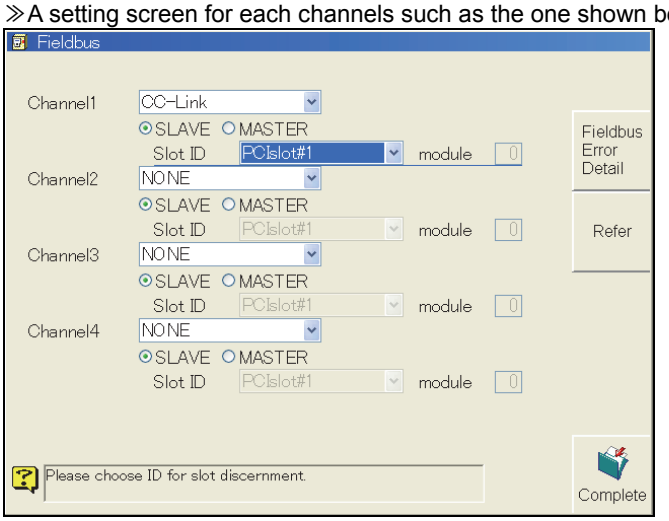
Setting procedure flowchart

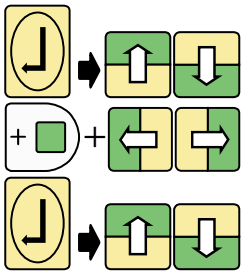
When the software PLC is used for field bus input/output signals, the software PLC settings must be performed as well. For further details, refer to “Software PLC manual”.

6.4.1 Field bus settings

Protocol settings

1 **Open <Constant Setting> - [8 Communication] – [3 Fieldbus].**
≫A setting screen for each channels such as the one shown below appears





2 **Align cursor with channel combo box, and select [CC-Link].**

3 **Select master or slave with [ENABLE] and [Left] or [Right] cursor keys.**

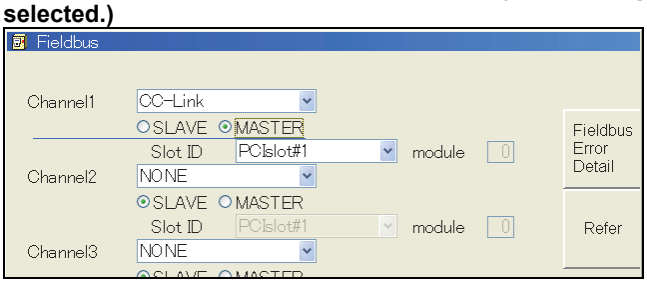
4 **Align cursor with slot ID combo box, and select slot ID number where CC-link board is inserted. (#1 to #3)**.
≫The slot ID is required in order to check the position where the fieldbus base board has been installed. Please refer to “Chapter 4 EtherNet/IP”, ”4.2.1 How to install” for the relationship between the position and the ID of the slots.

Now proceed to set the CC-Link (master) or CC-Link (slave).

6.4.2 CC-Link Master settings

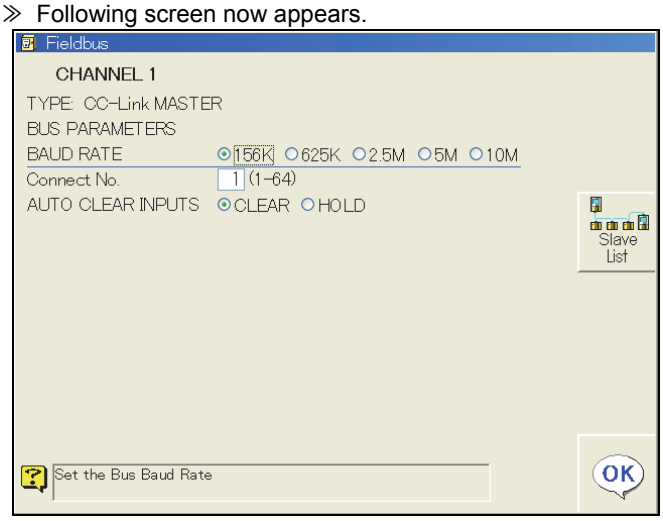
Channel settings

1 **On the "Fieldbus" screen, align cursor with the channel where CC-Link (master) has been selected, and press "Refer" f-key. (In the figure below, channel 1 is selected.)**



Refer

≫ Following screen now appears.



2 **Align cursor and set needed parameters.**

Baud Rate	A baud rate from 156 Kbps to 10 Mbps can be selected. The same baud rate must be set for all the devices in one network.
Connect No.	Input the number of slaves to be connected to the master.
AUTO CLEAR INPUTS	It is possible to select whether the input signals from the CC-Link are to be held or cleared when communication trouble has occurred.

3 **This now completes the settings of the master. However, for use as the master, the slave devices connected to the master must also be set. Proceed with the slave list settings starting with the next item.**

4 **Upon completion of the settings, press the f12 <OK> key.**

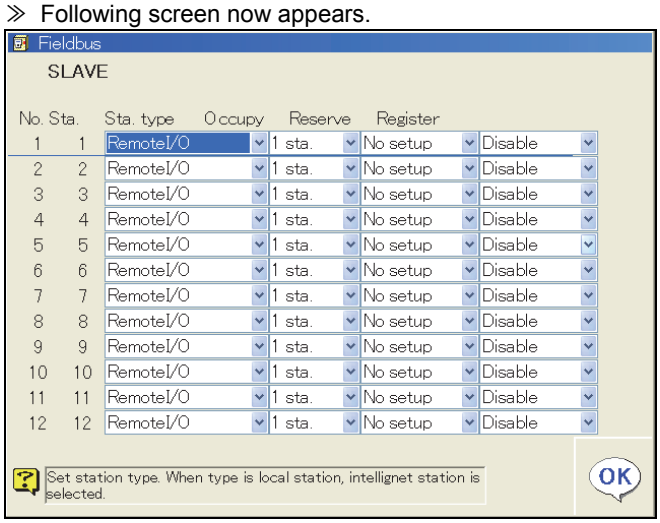
OK

Now continue to the setting of slave list.

Slave list settings

1 **Press “Slave List” f-key on the CC-Link (master) detailed setting screen.**

≫ Following screen now appears.



2 **Align cursor and set needed parameters.**

Sta. type	Select one of remote I/O, remote device, or intelligent, and press [Enter] key. When this controller is to be connected as a slave, select “Intelligent device station.”
Occupancy sta.	Select one of 1, 2, 3, or 4 stations, and press [Enter] key. When this controller is to be connected as a slave, select “4 stations.” As soon as the number of the occupancy stations is set, the station number is updated automatically.
Reserve sta.	Select one of “No setup,” “Reserve,” “Disenable”, and press [Enter] key. Normally select “No setting.” If “reserved” is selected, no error is detected even though it is not connected to the network. If “disabled” is selected, this station is considered not to exist.
Register	Select one of “Disabled” or “Enabled”, and press [Enter] key. If “Enabled” is selected, in addition to normal I/O, remote registers with 64 I/O per station can be used. If the type of station is set to “Remote I/O station”, this item cannot be set to “Enabled”. Furthermore, if the type of station is switched to “Remote I/O station”, the set value of this item will be automatically switched to “Disabled”.

3 **Upon completion of the settings, press the f12 <OK> key.**

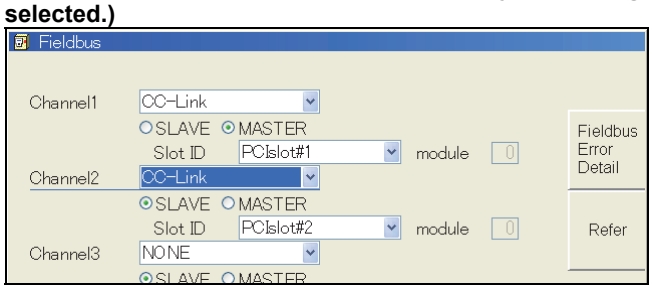
≫The display now returns to the CC-Link master setting screen.

In order to use remote registers, the remote registers should be set to “Enabled” on both the slave and the master. If the setting of remote register Enabled/Disabled on the master disagrees with that on the slave, any error or else is not detected but the remote registers cannot be used.
For the method of enabling the remote registers of devices to be connected to this controller, refer to information in the Operating manual of each device.

6.4.3 CC-Link Slave settings

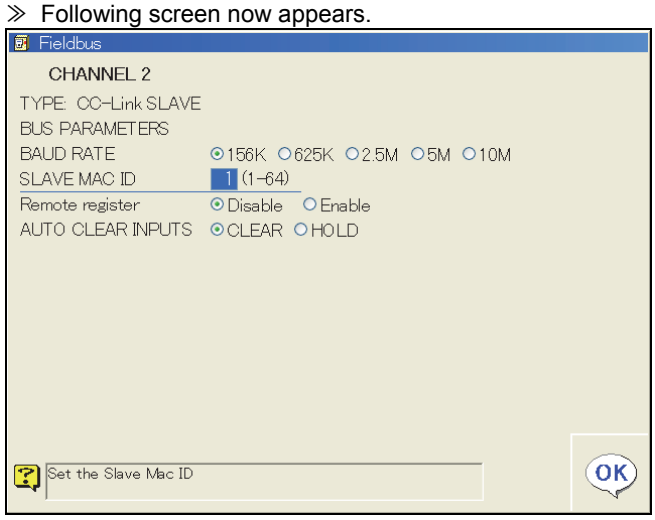
Channel settings

1 **On the "Fieldbus" screen, align cursor with the channel where CC-Link (slave) has been selected, and press "Refer" f-key. (In the figure below, channel 2 is selected.)**



Refer

≫ Following screen now appears.



2 **Align cursor and set needed parameters.**

BAUD RATE	A baud rate from 156 Kbps to 10 Mbps can be selected. The same baud rate must be set for all the devices in one network.
SLAVE MAC ID	The node numbers (1 to 64) denote the station numbers of the CC-Link.
Remote register	If "Enabled" is selected, in addition to normal I/O, remote registers with 64 I/O per station can be used.
AUTO CLEAR INPUTS	It is possible to select whether the input signals from the CC-Link are to be held or cleared when communication trouble has occurred.

OK

6 **Upon completion of the settings, press the f12 <OK> key.**
≫The display now returns to the Fieldbus screen.

Settings for the master

When this controller is used as a slave, perform the following settings for the master.
・Sta. type: **Intelligent device**
・Occupancy sta.: **4 stations**
It is not necessary to set "Buffer specification for intelligent devices."

IMPORTANT

In order to use remote registers, the remote registers should be set to "Enabled" on both the slave and the master. If the setting of remote register Enabled/Disabled on the master disagrees with that on the slave, any error or else is not detected but the remote registers cannot be used.
For the method of enabling the remote registers, refer to information in the Operating manual of each device.

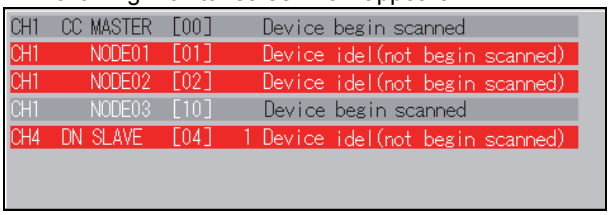
6.4.4 Operation check

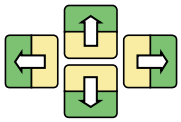
The “fieldbus monitor” is used for confirming that CC-Link channels that have been set are working correctly. Note that the fieldbus monitor can be operated only by an operator with qualifications class of ***EXPERT*** or higher.

FieldBus monitor

1 **Open <Service Utilities> – [Monitor 1/2/3/4] – [Fieldbus monitor].**

≫ Following monitor screen now appears.





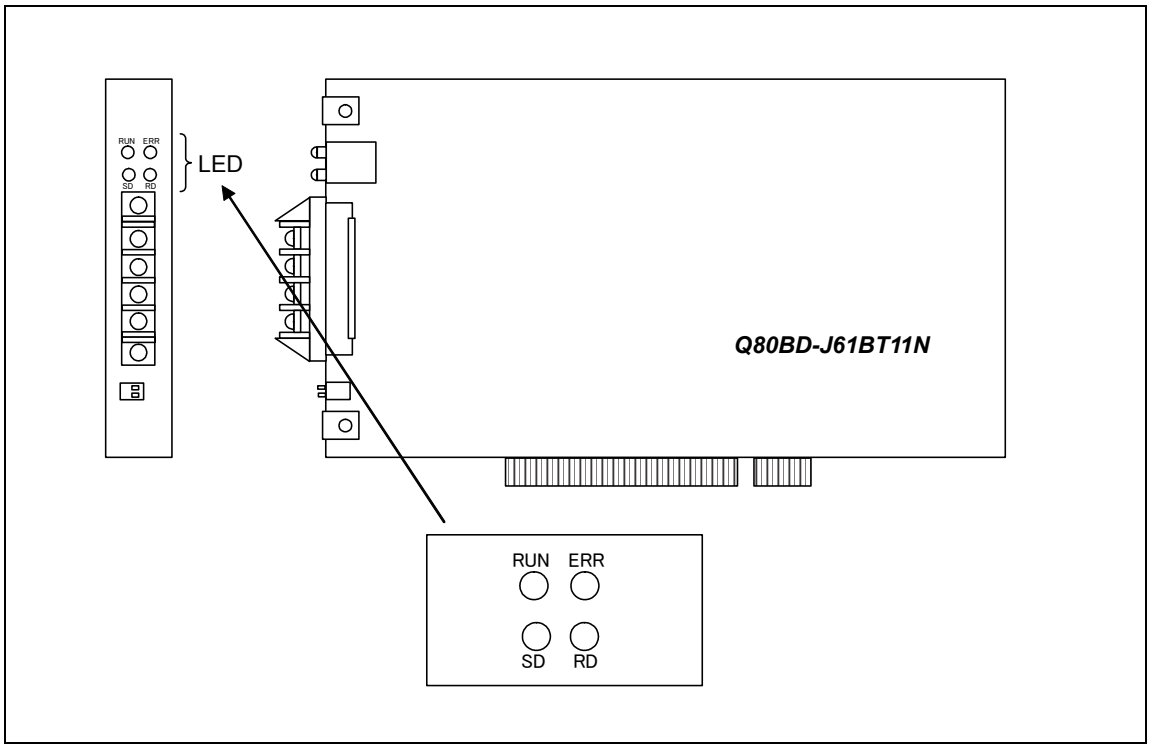
2 **Scroll the monitor.**

Item	Content
CH*	This is the channel number.
CC	This denotes the network type. “CC” is displayed for the CC-Link.
MSTR(Q)/SLV(Q)	This indicates whether this channel is set as the master/slave of Q80BD-J61BT11N.
NODE**[**]	This indicates a node (slaves) connected to the network when the channel concerned is used as the master. In the [ ] the node number is displayed.
Device begin scanned	The device is working correctly.
Device idel	The device is not working (if the device is not working correctly, the status is displayed in a red frame).

6.5 Troubleshooting

6.5.1 Error Detection on CC-Link Module

The CC-Link board uses the four LEDs shown in the figure below to indicate the current status.



Four LEDs

Status of LED and the CC-Link board

Name of LED	ON	OFF	Details
RUN	CC-Link board in the normal status	• WDT error • Power off	Lights when the CC-Link board is in the normal status, and goes off when a WDT error occurs.
ERR.	Data link communication error	Data link communication error	Lights when a network communication error occurs.
SD	Lights when sending the data		Flashes when sending the data on the data link
RD	Lights when receiving the data		Flashes when receiving the data on the data link

6.5.2 Error Detection on this Controller

When this controller detects an error, it displays one of the error messages listed below.

No.	E0956
Message	Communication trouble has occurred.
Cause	Listed below are the possible causes of trouble. ・ Trouble in the CC-Link board ・ Broken or disconnected cable ・ Mismatched baud rate ・ Erroneous node address setting ・ Trouble in network power supply
Remedy	Communication resumes when the trouble above is remedied.

No.	E0957
Message	System trouble has been detected.
Cause	The CC-Link configuration file does not exist, or its contents are illegal.
Remedy	On the fieldbus hardware setting screen, check whether the CC-Link settings are correct.

No.	E0958
Message	Trouble has been detected by the communication board's self-check function.
Cause	The CC-Link board may have a defect
Remedy	Replace the CC-Link board

No.	E0959
Message	Communication board cannot be found.
Cause	The CC-Link board specified on the constants setting screen cannot be found
Remedy	Check the slot ID among the fieldbus hardware settings. If this error occurs even if the CC-Link board is connected correctly, the CC-Link board itself may have some defects. Replace the CC-Link board.

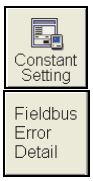
No.	E0960
Message	Some or all I/O links are shut down.
Cause	I/O links are shut down.
Remedy	Operation is automatically restored when the problem is solved. (It may be necessary to turn off the power and turn it back on again in order to solve the problem.)

No.	I3960
Message	Some or all I/O links are shut down.
Cause	I/O links are shut down.
Remedy	Operation is automatically restored when the problem is solved. (It may be necessary to turn off the power and turn it back on again in order to solve the problem.)

* As to E0960 and I3960, either of errors set on the Error Details Setting screen is output.
For details, refer to “6.5.3 Detail Fieldbus Error Setting”.

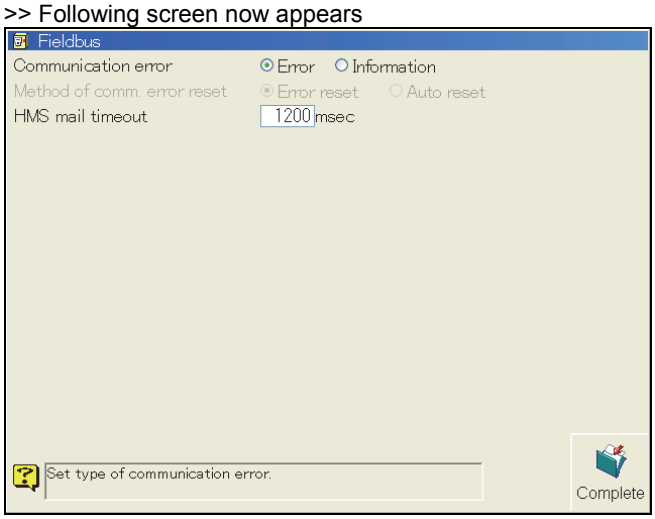
6.5.3 Detail Fieldbus Error Setting

For operations when an I/O link error occurs, the following settings can be made.
• Type of error when a communication error occurs
• Method of resetting the communication error when communication is recovered
The following section shows the method of settings.

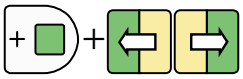


1 Open <Constant settings>-[8 Communications]-[3 Fieldbus].

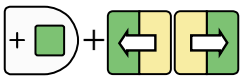
2 Then press the f-key < Fieldbus Error Detail>.
>> Following screen now appears



(Supplement) “HMS timeout” is not used in this function. Not to be changed.



3 Select “Error” or “Information” with [ENABLE] and the [Right] or [Left] cursor key.
>> If an I/O link error occurs
・ If “Error” is selected, E0960 will occur.
・ If “Information” is selected, I3960 will occur.



4 Select “Error resetting” or “Automatic resetting” with [ENABLE] and the [Right] or [Left] cursor key.
>> If a communication error is recovered
・ If “Error resetting” is selected, the communication error will be held until it is reset.
・ If “Automatic resetting” is selected, the communication error will be automatically reset.
If an error occurs in the setting of communication error, this item cannot be selected.

5 Press the f-key <Complete> to save the settings.

NOTE

Chapter 7 PROFIBUS

7.1 Outline

PROFIBUS is certified according to IEC661158 international standard and EN50170 European fieldbus standard, and this is a network with reliability and openness proven in many factories and processes. By enabling network connections for limit switches, photo sensors, operation boards, robots and other industrial devices at a low cost and by enabling logical access to the input and output (network I/O) provided by each of these devices, the PROFIBUS improves communication between devices which is difficult to achieve through hardware connections, and it enables diagnoses for each individual device. Up to 32 devices can be connected to the network, and the baud rate can be selected, from 9.6 Kbps to 12 Mbps, in accordance with the network size.

PROFIBUS is a trademark of PROFIBUS & PROFINET International.

Performance table

Item	Specifications
Number of channels	Maximum number of channels installed: 4
Master/Slave	Can function as master or slave. Master or slave can be set independently for each channel.
Number of inputs/outputs	A maximum of 1,952 inputs (244 bytes) and 1,952 outputs (244 bytes) can be used for all the channels. A total of 2,048 general-purpose signals are provided for input and the same number provided for output, so most of the general purpose signals can be covered. (When the software PLC is used.)
Configuration	When this controller is used as the master, a dedicated configuration tool is used on the personal computer. When this controller is used as a slave, the node addresses at this controller side can be selected from 0 to 126 by means of key input from the teach pendant.
Baud rate	9 steps from 9.6kbps up to 12Mbps can be set and an optimum rate can be selected according to the network configuration. (9 steps of 9.6kbps, 19.2kbps, 93.75kbps, 187.5kbps, 500kbps, 1.5Mbps, 3Mbps, 6Mbps and 12Mbps can be set. Note that 750kbps cannot be set.)
Input data processing when communication error occurred	It is possible to select whether the input signal statuses are to be held or cleared when communication trouble has occurred.
Connection precautions	In case this controller is terminated on the network, turn on the dipswitch of the terminator (terminating resistor) on the PROFIBUS board.

Listed below are the possible causes of trouble.

- Trouble in PROFIBUS board hardware
- Broken or disconnected cable
- Mismatched baud rate
- Erroneous node address setting

CAUTION

I If an error has occurred or an LED indicating trouble lights up, the I/O statuses may not be correct. Care should be taken since this may cause the robot, jigs and other interlocks to fail to operate correctly, possibly resulting in a sudden or unanticipated operation.

7.1.1 Contained Parts

Contained parts of this option

No.	Name	Parts No., type.	Note
1	Fieldbus board	UM236-10	
2	PROFIBUS module	ABM-DPV1 AB4005	Master Slave
3	Panel to connect cable		
4	Fixing screws for board	M4 × 8mm	

7.2 Installation and Connection

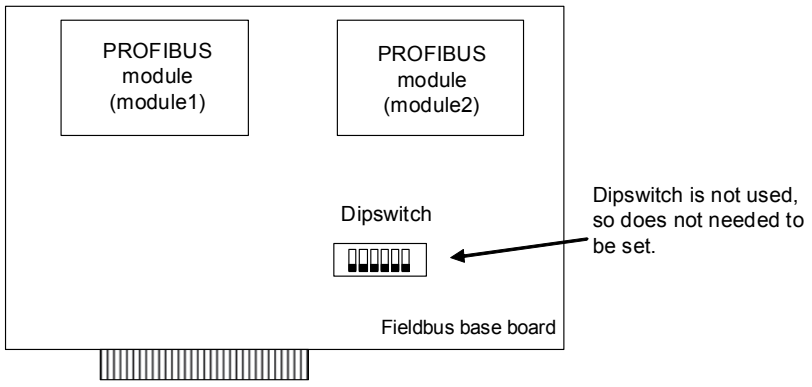
7.2.1 How to install

All fieldbus board can be mounted in same way.

Refer to “Chapter 4 EtherNet/IP”, “4.2.1 How to install” for detail.

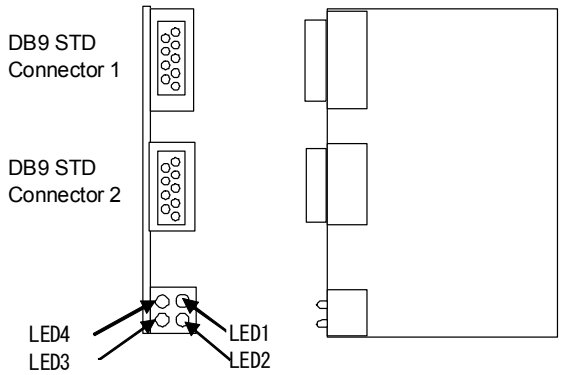
7.2.2 Hardware setting

“Fieldbus base board” and PROFIBUS module are needed.
“Fieldbus base board” is incorporated with a maximum of 2 PROFIBUS modules for use.



PROFIBUS board

PROFIBUS module has two kinds, those are “Master” and “Slave”.

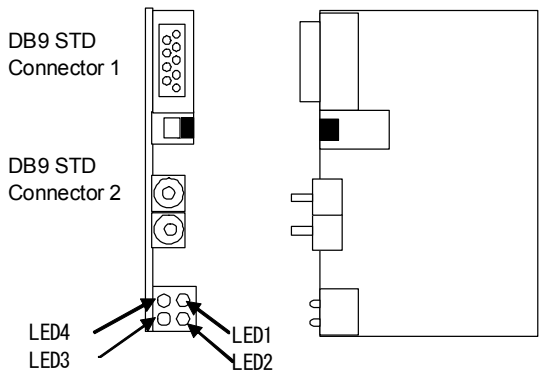


DB9 STD connector 1 is used for connection of the PROFIBUS module.
DB9 STD connector 2 is a serial port for setting the master module. (This connector is not used for this robot controller)

Note that the shape of these connectors is same

For details of LED1 to 4, refer to “7.6 Troubleshoot”.

PROFIBUS master module



Rotary switch for setting the node address is not used, so does not needed to be set.

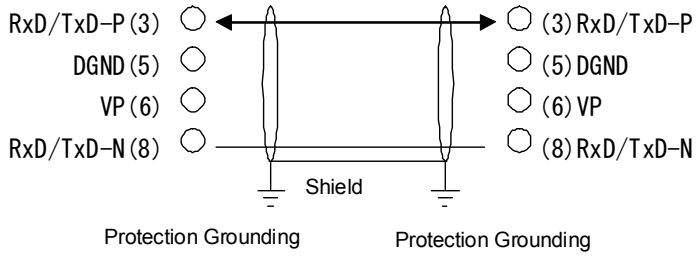
If this module is the termination of network, set the terminator switch to ON side.

For details of LED1 to 4, refer to “7.6 Troubleshoot”.

PROFIBUS slave module

7.2.3 Cable connection

Please use a D-SUB connector. Cable and the connectors should be prepared by customers. For the detail of connection, please refer to the following figure.



Signal	Description
RxD/TxD-P	This pin is used to send/receive the signal.
RxD/TxD-N	This pin is used to send/receive the signal.
DGND	The ground for the VP.
VP	This is the power supply line for the terminators. +5 V is outputted from the PROFIBUS device.

DB9 connector

When slave module is used and this channel is the termination of network, set the terminator switch to ON side.

7.3 Signal Assignment

7.3.1 Fieldbus I/O signals

I/O signal numbers is determined based on the field bus channel number to be used.

■ When software PLC is disabled (setting when shipped)

CH1 : I 161 ～ I 672 / O 161 ～ O 672 (512 points)
CH2 : I 673 ～ I1184 / O 673 ～ O1184 (512 points)
CH3 : I1185 ～ I1696 / O1185 ～ O1696 (512 points)
CH4 : I1697 ～ I2048 / O1697 ～ O2048 (352 points)

■ When software PLC is enabled

CH1 : X1000 ～ X1511 / Y1000 ～ Y1511 (512 points)
CH2 : X1512 ～ X2023 / Y1512 ～ Y2023 (512 points)
CH3 : X2024 ～ X2535 / Y2024 ～ Y2535 (512 points)
CH4 : X2536 ～ X3047 / Y2536 ～ Y3047 (512points)

■ Assigning signals beyond the number of channels

The field bus can use up to four channels. If all four channels are not being used, it is possible to use the signal assignment region of channels not being used.
The description below gives an example in which software PLC is enabled. Signals can be assigned using a similar concept even if software PLC is disabled.

If only one channel is being used, all 2048 points can be used with just “Channel 1” by using “Channel 1”.

CH1 : X1000 ～ X3047 / Y1000 ～ Y3047 (2048 points)

When using two channels, 1024 points can be used for each channel, by using “Channel 1” and “Channel 3”.

CH1 : X1000 ～ X2023 / Y1000 ～ Y2023 (1024 points)
CH3 : X2024 ～ X3047 / Y2024 ～ Y3047 (1024 points)

7.3.2 PROFIBUS I/O signals

■ When this controller is used as a slave

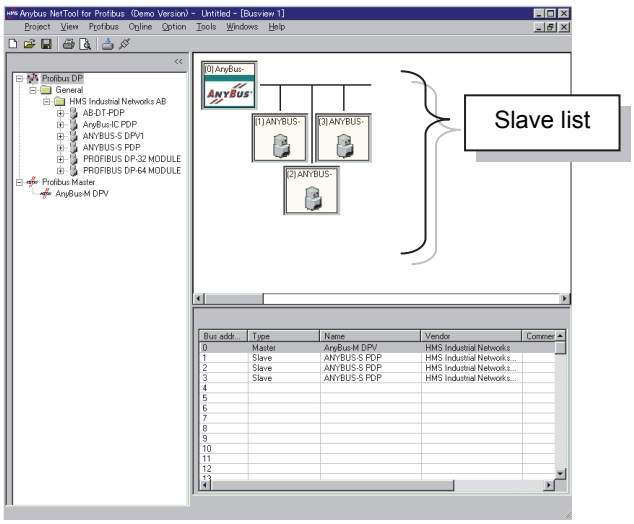
Using a number of input/output bytes which is less than size allocated for each channel results in unused areas. Presented below is an example where 3 input bytes and 3 output bytes have been set with channel 1 as the slave.

CH1 : X1000 ～ X1015 / Y1000 ～ Y1023 (Usable area)
X1016 ～ X1511 / Y1024 ～ Y1511 (Unusable area)

■ When this controller is used as a master

If this controller is the master, the signal positions are determined by the attached configuration tool.

Set the slave unit with the following tool which is to be purchased separately. For detailed method of setting, refer to help contents of the configuration tool.



For the configuration, customer needs to prepare the configuration software "*Anybus NetTool for Profibus*". This is not free. Please contact the following URL for the detail of this tool.

HMS Industrial Networks, headquarters in Sweden: http://www.anybus.com
HMS Industrial Networks, Japan branch: http://www.anybus.com/jap/

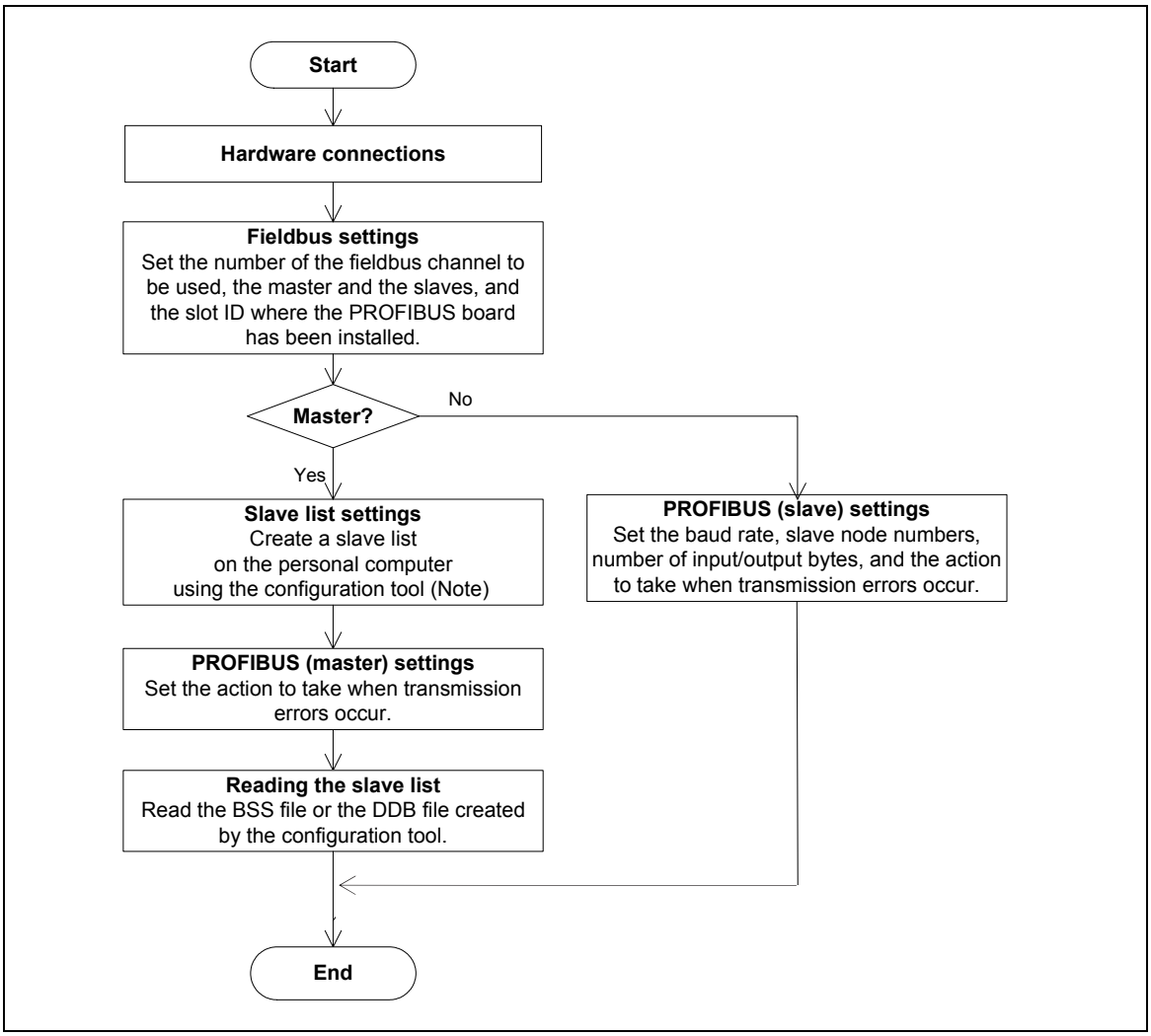
The signal allocation is determined by the numbers of the input bytes and output bytes of each slave. Given below is an example of signal allocation when channel 1 is made to serve as the master.

Slave list sequence	Slave outputs			Slave inputs		
	Number of bytes	Address	Signal	Number of bytes	Address	Signal
Slave 1	2	0 ～ 1	X1000～X1015	1	0	Y1000～Y1007
Slave 2	2	2 ～ 3	X1016～X1031	2	1 ～ 2	Y1008～Y1023
Slave 3	1	4	X1032～X1039	2	3 ～ 4	Y1024～Y1039

As shown in the example above, the signals are arranged in sequence in accordance with the number of bytes set and address.

7.4 Setting Procedure

Shown below is the general sequence of the steps for performing the setting.



Setting procedure flowchart

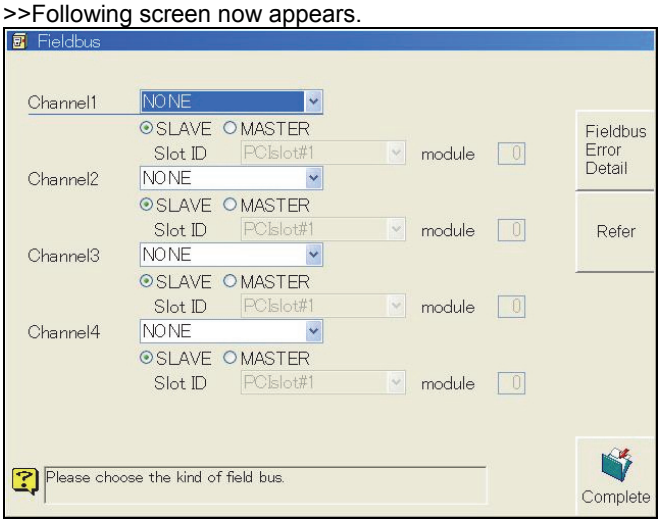
(Note) Configuration tool is not provided. Customer needs to purchase it.

When the software PLC is used for PROFIBUS input/output signals, the software PLC settings must be performed as well. For further details, refer to the instruction manual “Software PLC”.

7.4.1 Fieldbus settings

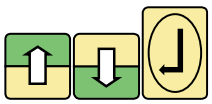
Protocol settings

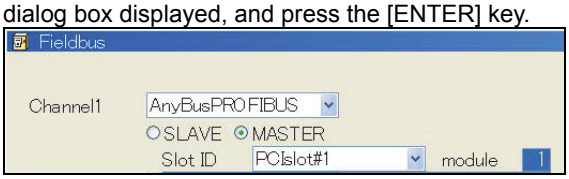
1 Select <Constant Setting> - [8 Communication] - [3 Fieldbus].
>>Following screen now appears.

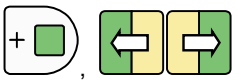


2 Align the cursor with the combo box of a channel which is going to use the PROFIBUS, and press the [ENTER] key.

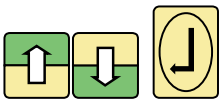
Align the cursor with the [AnybusPROFIBUS] using the [Up/Down cursor] key on the dialog box displayed, and press the [ENTER] key.



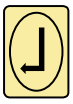




3 Use the [ENABLE] and [Left/Right cursor] key to select master or slave.



4 Align the cursor with the slot ID combo box, and press the [Enter] key. In the dialog box displayed, align the cursor with the slot ID concerned using the [Up/Down cursor] key, and press the [Enter] key.
≫The slot ID is required in order to check the position where the fieldbus base board has been installed. Please refer to “Chapter 4 EtherNet/IP”, ”4.2.1 How to install” for the relationship between the position and the ID of the slots.



5 Align the cursor with the dialog box of the module, input the applicable module number, and press the [ENTER] key.
>>The module number is a number necessary to confirm the module built-in position on the fieldbus base board. If 0 is set to the module number, the applicable channel is not used.

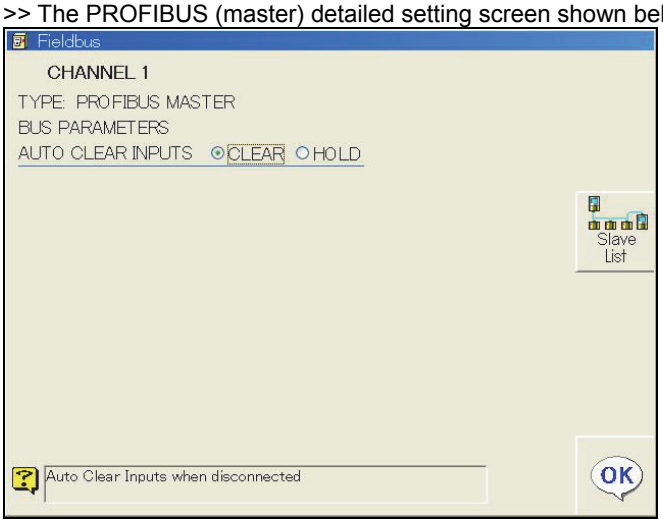
Now proceed to set the PROFIBUS (master) or PROFIBUS (slave).

7.4.2 PROFIBUS Master settings

Channel settings

Refer

1 **On Fieldbus setting screen, align the cursor with a channel where the AnybusPROFIBUS is selected, and press f key <Refer>.**
>> The PROFIBUS (master) detailed setting screen shown below now appears.



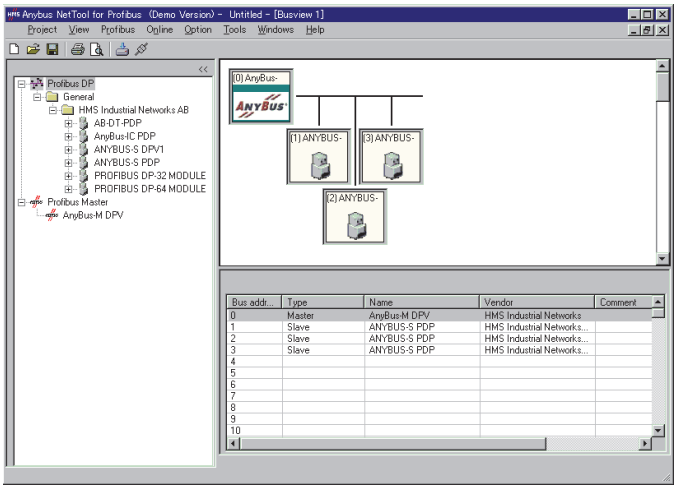
2 **Align the cursor with "AUTO CLEAR INPUTS," use the [ENABLE] and [Left/Right cursor] keys, and select the signal status for when communication trouble has occurred.**
It is possible to select whether the input signals from the PROFIBUS are to be held or cleared when communication trouble has occurred.

Now continue to the setting of slave list.

Slave list settings

(Operation on PC)

1 **Creating the slave list**
Create the slave list on a personal computer, using the configuration tool (*Anybus NetTool for PROFIBUS*) which is going to be purchased separately.

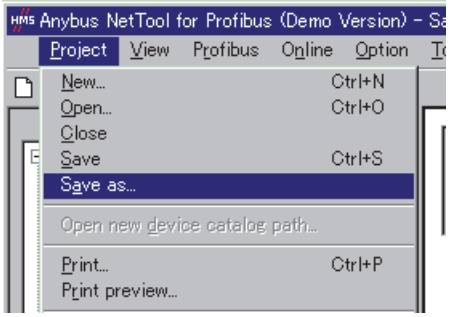


For the method of tool operation, refer to help contents of the configuration tool.

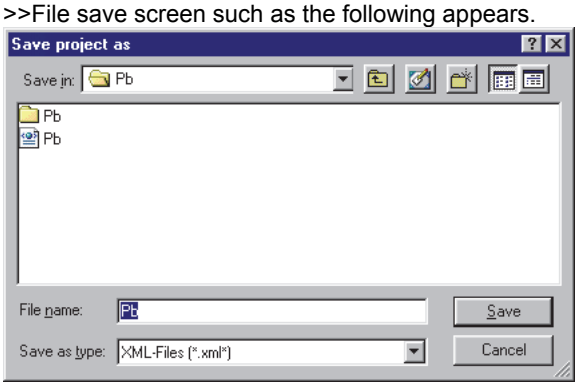
(Operation on PC)

2 **Outputting the DDB file**

Select "Save as .." from the "Project" menu.)



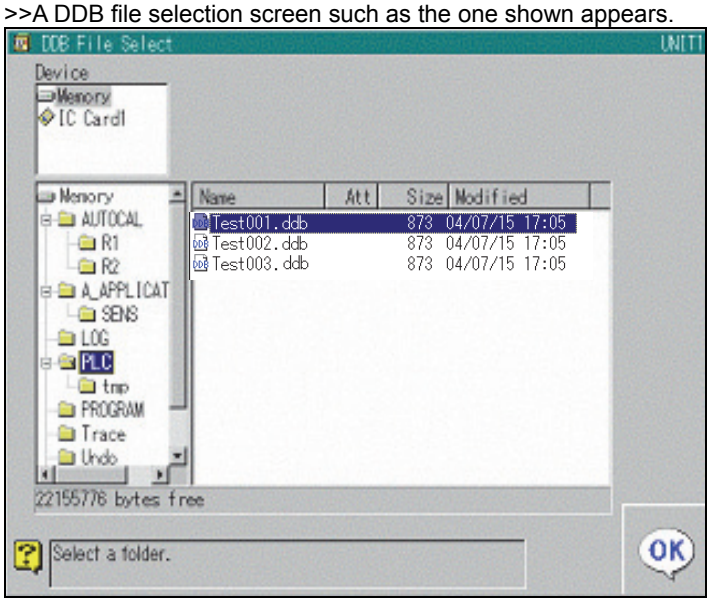
>>File save screen such as the following appears.



If the file name is input an the [SAVE] button is pressed, the folder of the file name input is created and the DDB file is created in the created folder.
Save the DDB file in the compact flush.

3 **Press f key <Slave List> on the PROFIBUS (master) detail setting screen.**

>>A DDB file selection screen such as the one shown appears.



4 **Select the DDB file and press f key <OK>.**

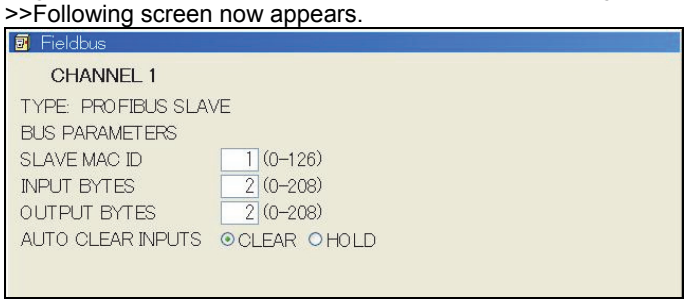
A DDB file is now stored in the internal memory [PLCengine] folder of this controller.
File name is “ABProf#.ddb”. (# is channel number)

The screen returns to the master setting screen.

7.4.3 PROFIBUS Slave settings

Channel settings

1 **On Fieldbus setting screen, align the cursor with a channel where the AnybusPROFIBUS (slave) is selected, and press f key <Refer>.**
>>Following screen now appears.



2 **Set each parameter.**

SLAVE MAC ID	Node number is to identify a device on the network. A device with the same number in one network cannot be permitted. If this number is overlapped, correct communication is disabled.
INPUT BYTES	The input byte as seen from this controller.
OUTPUT BYTES	The output byte as seen from this controller.
AUTO CLEAR INPUTS	Select whether to hold or clear the input from the PROFIBUS when communication error occurs.

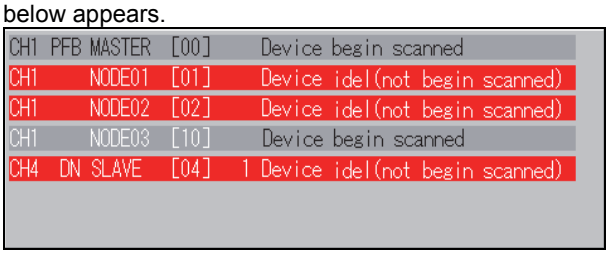
3 **If the setting is completed, press the f key <OK>.**
The screen returns to the field bus setting screen.

7.4.4 Operation check

The “fieldbus monitor” is used for confirming that PROFIBUS channels that have been set are working correctly.

Fieldbus monitor

1 **Select <Service Utilities> – [Monitor *] – [Fieldbus monitor.]**
>>A monitor that shows the connection status of the fieldbus such as the one shown below appears.



Displayed item	description
CH *	This is the channel number.
PFB,DN	This is the network type. In the case of the PROFIBUS, “PFB” is displayed.
MASTER/SLAVE	This indicates whether this channel is set as the master or a slave.
NODE * * [* *]	This indicates a node (slave) connected to the network when the channel concerned is used as the master. In the [ ] the node number is displayed.
Device begin scanned	The device is working correctly.
Device idle	The device is not working (if the device is not working correctly, the status is displayed in a red frame)

7.4.5 GSD file

When using this controller as a PROFIBUS slave station, it is necessary to give the information about the I/O that will be used by the slave station to the PROFIBUS master.
It is necessary to configure a slave list on a PC using a configuration software "*AnyBus NetTool for Profibus*".
And, a data file to give the information about the master/slave station to the configuration software is called as "GSD file".
Concerning how to use the GSD file, please refer to the instruction manual of "*Anybus NetTool for profibus*".

GSD file name

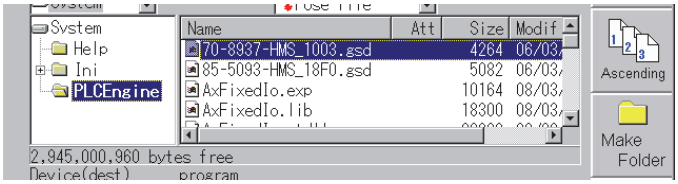
	File name
Master	85-5093-HMS_18F0.gsd
Slave	HMSB1003.gsd

GSD files are stored in this controller, and it is possible to get them when needed.
Operator class of ***EXPERT*** or higher is necessary for this operation.
Please refer to the instruction manual “BASIC OPERATION” for the detail of copy operation.

How to get the GSD file

1 **Open <Service Utilities> - [7 File manager] - [1 File Copy].**

2 **Set the "Device (src)" to "System" and select "PLCEngine" folder.**



The file name display column can be enhanced by [Enable] + [Left/Right cursor] key.

3 **Copy the desired GSD file to USB memory.**

7.4.6 Back up BSS files and DDB files

IMPORTANT

・If the DDB file is not restored normally, a message of "E0958 The error was detected with the self check of a communication board." will be displayed when power on. Please restore the DDB file by the procedures in the following pages or make the settings of the slave list again referring to "7.4.2 PROFIBUS Master settings".
・It is not necessary to copy (backup) the BSS file or the DDB file with manual File Copy operation because those files are automatically backed up via the normal backup operation.
・It is not necessary to restore the BSS file or the DDB file with manual File Copy operation because those files are automatically restored via the normal restore operation.

Operator class of ***EXPERT*** or higher is necessary for this operation.
Please refer to the instruction manual “BASIC OPERATION” for the detail of copy operation.

How to backup the BSS files and the DDB files

1 **Open <Service Utilities> - [7 File Manager] - [1 File Copy].**

2 **Set the "Device (src)" to "Memory" and select "PLCEngine" folder.**

3 **Copy "ABProf#.ddb" file to USB memory. (# is channel number)**

How to restore the BSS files and the DDB file

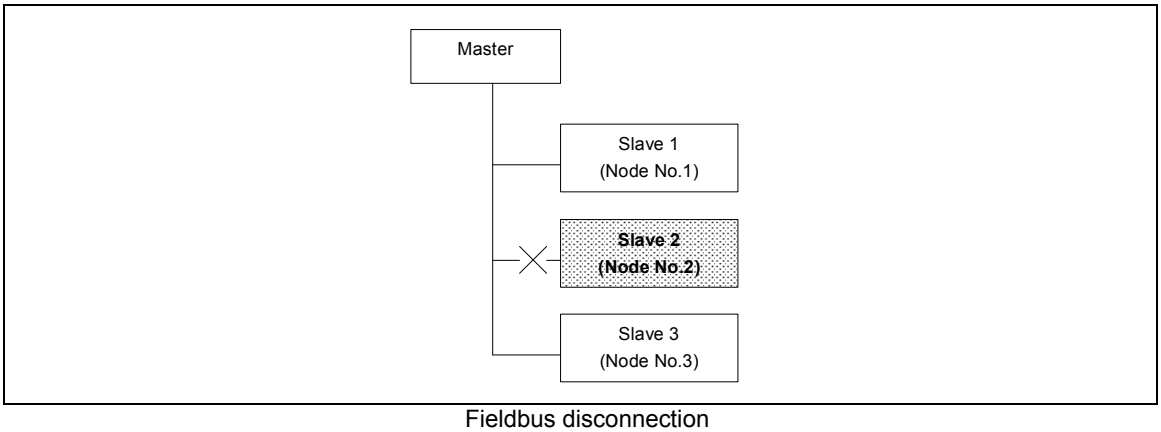
1 **In same screen,**
Set the "Device (src)" to "Memory" and select "PLCEngine" folder.

2 **Copy the "ABProf#.ddb" file to the "PLCEngine" folder in the "Memory".**
(# is channel number)

7.5 Disconnecting Fieldbus

7.5.1 Outline

The "fieldbus release" function is to disable the error detection for the desired slave node when this controller is working as a master node. This function is to be used when a slave node is disconnected from the network physically because of mechanism change etc.
In the following example, the error detection for the "slave 2" node is disabled. In this figure, if an error occurs in the slave 1, the master will detect an error. But even if the slave 2 makes an error, the error is not detected by the master node.

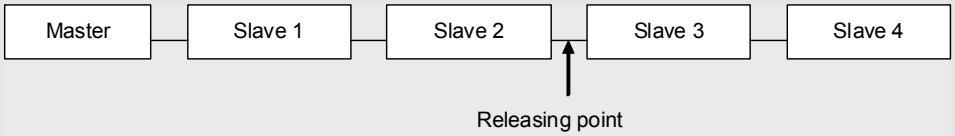


Fieldbus disconnection

IMPORTANT

After the slave device is physically disconnected (released) from the fieldbus, it is necessary to connect a terminating resistor on the other slave device because the terminating point will move to another place. Therefore, the slave device that will become the terminating point after the releasing operation must have a repeater function.

For example, if the releasing operation is done on the position in the following figure, the slave 2 must have a repeater function. At this time, the releasing operation should be executed for the slave 3 and 4 in this robot controller.

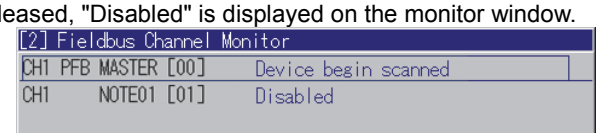


CAUTION

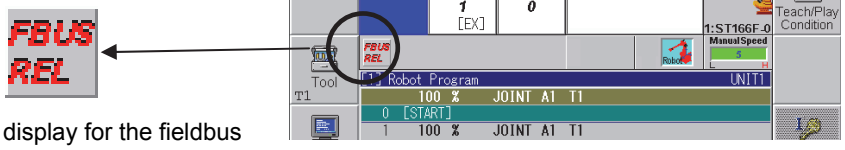
As long as the slave device is physically on the fieldbus, it is possible to execute the I/O communication even if the fieldbus function is released for the slave device. However, in the condition, do not leave the device released. Because the communication errors for the device are not detected and it is very dangerous.

7.5.2 How to know current status

If the fieldbus is released, "Disabled" is displayed on the monitor window.



When at least one slave is disconnected, following icon is displayed on screen.



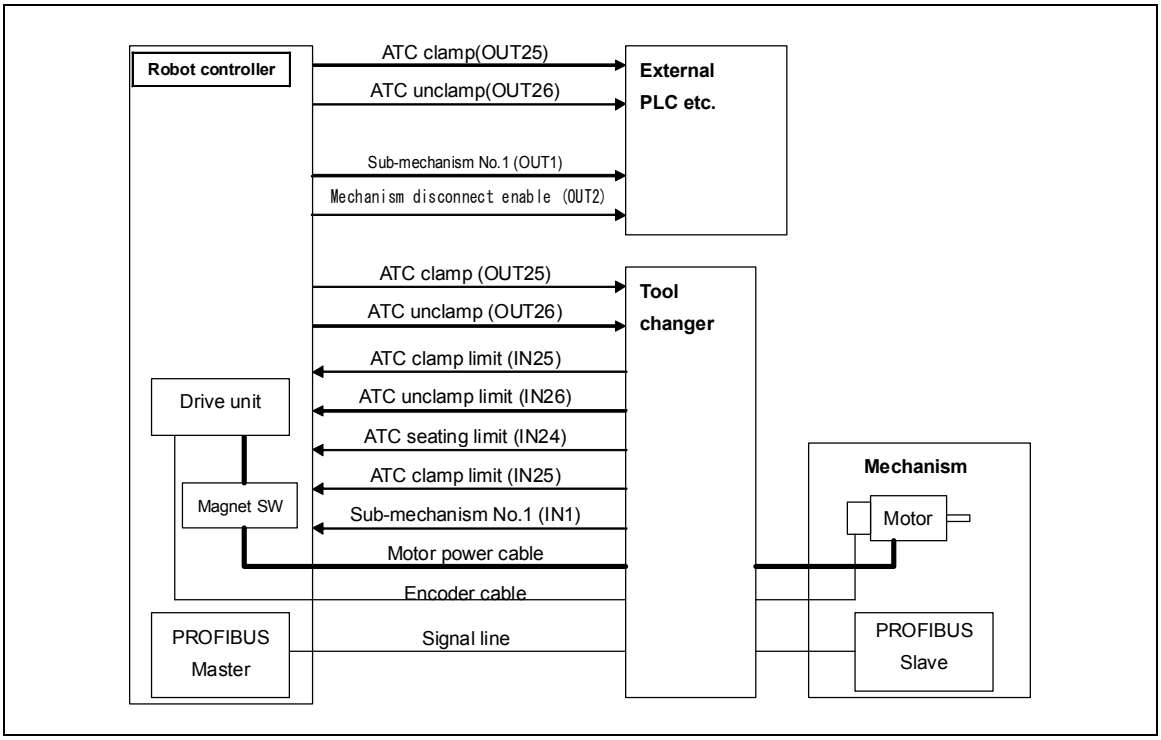
Status display for the fieldbus

7.5.3 Connection/Disconnection by function command

It is possible to connect / release the fieldbus by using **FN312:FBUSREL** function command.

■ Example

This is an example of mechanism change system with a tool changer.
In this system, the signals are assigned like the figure shown as below.
(This is just an example. Details may be different depending on the actual system environments etc.)



An example (connection to the tool changer)

```
STEP N       500mm/s LIN A1 T31
STEP N+1     100mm/s LIN A1 T1                                  Move to the mount/dismount position
STEP N+2     FBUSREL[1,1,0]          FN312;Fieldbus Release     Disable the error detection
STEP N+3     CHGGUN[0]               FN95;Mount Mechanism2      Make a logical disconnection
STEP N+4     RESET[O25]              FN34;Output signal reset   Make unclamp operation
STEP N+5     SET[O26]                FN32;Output signal set
STEP N+6     WAIT[I26]               FN525;Wait Input cond       Waiting for the unclamp complete signal
STEP N+7     100mm/s LIN A1 T31                                 Move to the mount/dismount position
STEP N+8     DELAY[0.5]              FN50;Timer delay
STEP N+9     WAIT[I24]               FN525;Wait Input cond       Waiting for the seating limit signal
STEP N+10    RESET[O26]              FN34;Output signal reset   Make clamp operation
STEP N+11    SET[O25]                FN32;Output signal set
STEP N+12    WAITI[I25]              FN525;Wait Input cond       Waiting for the clamp complete signal
STEP N+13    CHGGUN[1]               FN95;Mount Mechanism2      Make a logical connection
STEP N+14    100mm/s LIN A1 T1                                  Lifting up the mechanism from the table
STEP N+15    FBUSREL[1,1,1]          FN312;Fieldbus Release     Enable the error detection
```

On the stepN+2, the fieldbus release operation (to disable error detection) is executed before executing the mechanism disconnection so that error is ignored even when the slave is disconnected physically.
On the stepN+13, the mechanism is connected. And then, after the enough time elapsed to establish the fieldbus communication again, the fieldbus release operation (to enable error detection) is executed on the stepN+15 to restart the error detection.

■ Parameter(s)

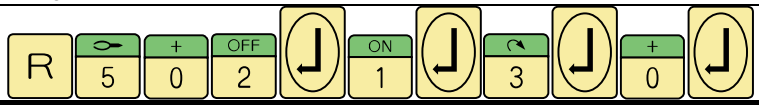
1st parameter: The channel number that is used by the fieldbus master (1 - 4)
2nd parameter: The target slave node number for the error detection (0 - 127)
3rd parameter: Enable/Disable switch for the error detection (0 = disable / 1 = enable)

■ Display example

FBUSREL [1,3,0]	FN312; Fieldbus Release

7.5.4 Connection/Disconnection by manual operation

By using shortcut R502, fieldbus can be connected / disconnected manually.
To use this shortcut operation, switch the operator class to ***EXPERT*** or higher in advance.

Code number	502
Name	Fieldbus release
Outline	This is a shortcut to enable/disable the error detection of a designated slave node on a designated fieldbus master.
Input example	

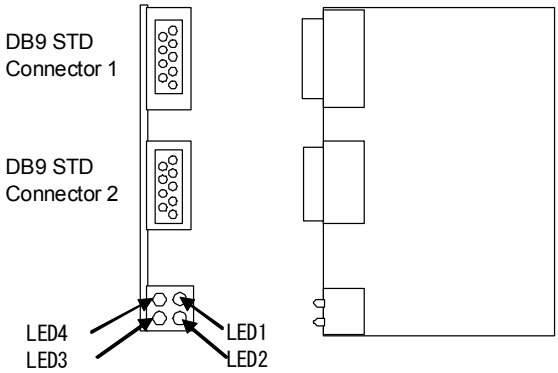
Input parameters

No.	Name	Description
1	Channel number	Enter the channel number that the master device is using. (1 – 2)
2	Slave node number	Enter the slave's node number to connect/disconnect. (0 - 127)
3	Error detection	Set the error detection enabled/disabled condition. When 0 is set, the error detection is disabled (this means that the slave node is released). When 1 is set, the error detection is enabled (this means that the slave node is connected). (0 = disabled(=released) / 1 = enabled(=connected))

7.6 Troubleshooting

7.6.1 Error Detection of PROFIBUS Module

The PROFIBUS master module displays the present status by means of 4 LEDs.



LED1	indicates the status of board.
LED2	indicates the status of database.
LED3	indicates the communication status.
LED4	indicates the status of token.

LED on PROFIBUS master module

LED and status of PROFIBUS master module

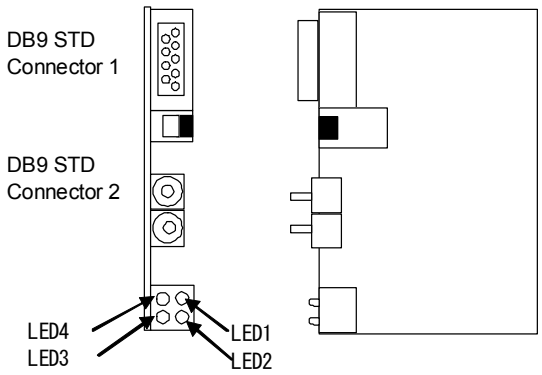
LED	Color	Status		Content
LED1	Green	ON	Normal	Initialized and operating
	Green	Flashing	Clear	Status being cleared
	Red	ON	Stop	Stopping
	-	OFF	Offline	Incomplete initialization
LED2	Green	ON	Normal	Configuration data downloaded, and operating
	Green	Flashing	Down loading	Downloading configuration data
	Red	ON	Database error	Configuration data error
	-	OFF	No database	Configuration data not downloaded
LED3	Green	ON	Communication/ all nodes	Network in normal state **(Communication established with all nodes.)**
	Green	Flashing	Communicating/ partial node	Network in normal state **(Communication established with more than 1 node.)**
	Red	ON	Communication error	Communication error
	-	OFF	Offline	Offline
LED4	Green	ON	Token held	Token held
	-	OFF	Token not held	Token not held

POINT

If there are some problems for the communication, please check the condition of the LED.
Popular examples of the LED conditions and points to be checked are shown as below.

LED condition	Points to be checked
LED 1.2.4 ON (Green) LED 3 OFF	The all slave nodes are not connected. Please check if there are not any problems on the communication cables. And, if there is only 1 slave node, please check if the node number is correct or not.
LED 1.2.4 ON (Green) LED 3 Flashing (Green)	One or more slave nodes are not connected. Please open the fieldbus monitor and check the conditions of the node ID or cables of the node for which the scanning is stopping.
LED 1.2.4 ON (Green) LED 3 Unperiodical flash in green	Check if a terminating resistor is attached at the end of the network.

The PROFIBUS board slave module displays the present status by means of4 LEDs shown in the diagram.



LED1	is not in use.
LED2	indicates the online status.
LED3	indicates the offline status.
LED4	indicates the error status of the board.

LED on PROFIBUS slave module

LED and status of PROFIBUS slave module

LED	Color	Status		Content
LED1	-	OFF	Not used	-
LED2	Green	ON	BUS is online	Network is in normal state. Data exchange is possible.
	-	OFF	BUS is not online	State other than online
LED3	Red	ON	BUS is offline	BUS is offline
	-	OFF	BUS is not online	State other than offline
LED4	Red	Flashing (1Hz)	Error in configuration data	Error in configuration data
	Red	Flashing (2Hz)	Error in parameter data	Error in parameter data
	Red	Flashing (4Hz)	Error in initialization	Error in initialization of the communication
	-	OFF	No error	No error

POINT

If there are some problems for the communication, please check the condition of the LED.
Popular examples of the LED conditions and points to be checked are shown as below.

LED condition	Points to be checked
Random flash of LED2 (Green) and 3 (Red)	Check if a terminating resistor is attached at the end of the network.
LED 3 ON (Red)	Not connected to the network. Please check the following items. - If the node ID is correct or not - Connection of the cable - If a terminating resistor is attached at the end of the network or not
LED 3 ON (Red) LED 4 Flashing (Red) at frequency of 1Hz	Check if the I/O size of the slave node matches the setting of the master.

7.6.2 Error Detection on this Controller

When this controller detects an error, the error messages listed below are displayed on screen.

Number	E0956
Message	Communication trouble has occurred.
Cause	The following causes are possible. - Trouble in the fieldbus base board - Broken or disconnected cable - Mismatched baud rate - Erroneous node address setting. - Failure of network power supply
Remedy	Communication resumes when the trouble above is remedied.

Number	E0958
Message	Trouble has been detected by the communication board's self-check function.
Cause	The following troubles may occur. - PROFIBUS module is not installed on the fieldbus base board - PROFIBUS module is not connected on the fieldbus base board securely. - The slave list file does not exist or the file is incorrect - PROFIBUS module or the fieldbus base board is not working correctly.
Remedy	Please check whether PROFIBUS module is installed on the fieldbus base board. Please check the connection between the fieldbus base board and PROFIBUS module. Make a setting of the slave list file. Check whether the slave file list is correct or not using configuration tool. If this error is detected even if the fieldbus base board or the PROFIBUS module is connected correctly, hardware of the fieldbus base board or PROFIBUS module may be broken. Please replace the fieldbus base board or PROFIBUS module.

Number	E0959
Message	Communication board cannot be found.
Cause	The following troubles may occur. - The fieldbus base board is not installed. - The slot ID in the fieldbus hardware setting is incorrect. - The Module in the fieldbus hardware setting is incorrect.
Remedy	Install the fieldbus base board. Check the slot ID in the fieldbus hardware settings. Check the Module in the fieldbus hardware settings. If this error occurs even if the fieldbus base board is connected correctly, hardware of the fieldbus base board or PROFIBUS module may be broken. Please replace the fieldbus base board or PROFIBUS module.

Number	E0960
Message	Some or all I/O links are shut down.
Cause	The following troubles may occur. - Failure of the fieldbus base board or the PROFIBUS module. - Cable disconnection or bad contact - Node address setting is incorrect - I/O links are shutdown.
Remedy	Operation is automatically restored when the problem is solved. (It may be necessary to turn off and on the controller power in order to solve the problem.)

NOTE

Chapter 8 PROFINET

8.1 Outline

PROFINET is an industrial Ethernet standard made by PROFIBUS & PROFINET International. This is an industrial network system which makes it possible to send/receive large amount of data in wide range.
By enabling network connections for limit switches, photo sensors, operation panels, robots and other industrial devices and by enabling logical access to the input and output (network I/O) provided by each of these devices, the PROFINET improves communication between devices which is difficult to achieve through hardware connections, and it enables diagnoses for each individual device.

PROFINET is a trademark of PROFIBUS & PROFINET International.

IMPORTANT

There are following 2 profiles in PROFINET.
PROFINET IO
PROFINET CBA
This controller provides only PROFINET IO communication for input/output signals handling on the network.

IMPORTANT

The communication speed of 100 Mbps or more is required to use the PROFINET.
Please prepare a switching HUB that supports the communication speed of 100M bps or more.

Performance table

Item	Specification
Number of channels	Up to 4 channels at maximum.
Master / Slave	Only Slave station is supported. Each channel can be set as an independent Slave station.
Communication	Only I/O communication
Number of inputs / outputs	A maximum of 2,048 inputs (256 bytes) and 2,048 outputs (256 bytes) can be used for all the channels, and these numbers cover all the general-purpose signals of this controller. (When built-in PLC is used.)
Address	AX controller's station name, IP address, subnet-mask, default gateway address can be set for each channel via the key operation on the teach pendant. And, address setting based on DCP is also available.
Input data processing when communication trouble has occurred	It is possible to select whether the input signal statuses are to be held or cleared when communication trouble has occurred.

Listed below are the possible causes of trouble.
- Trouble in PROFINET module hardware
- Broken or disconnected cable
- Erroneous node address setting

CAUTION

If an error has occurred or an LED indicating trouble lights up, the I/O statuses may not be correct. Care should be taken since this may cause the robot, jigs and other interlocks to fail to operate correctly, possibly resulting in a sudden or unanticipated operation.

8.1.1 Contained Parts

Contained parts of this option

No.	Name	Parts No., type.	Note
1	Fieldbus board	UM236-10	
2	PROFINET module	AB4392	Slave
3	Panel to connect cable		
4	Fixing screws for board	M4 × 8mm	

8.2 Installation and Connection

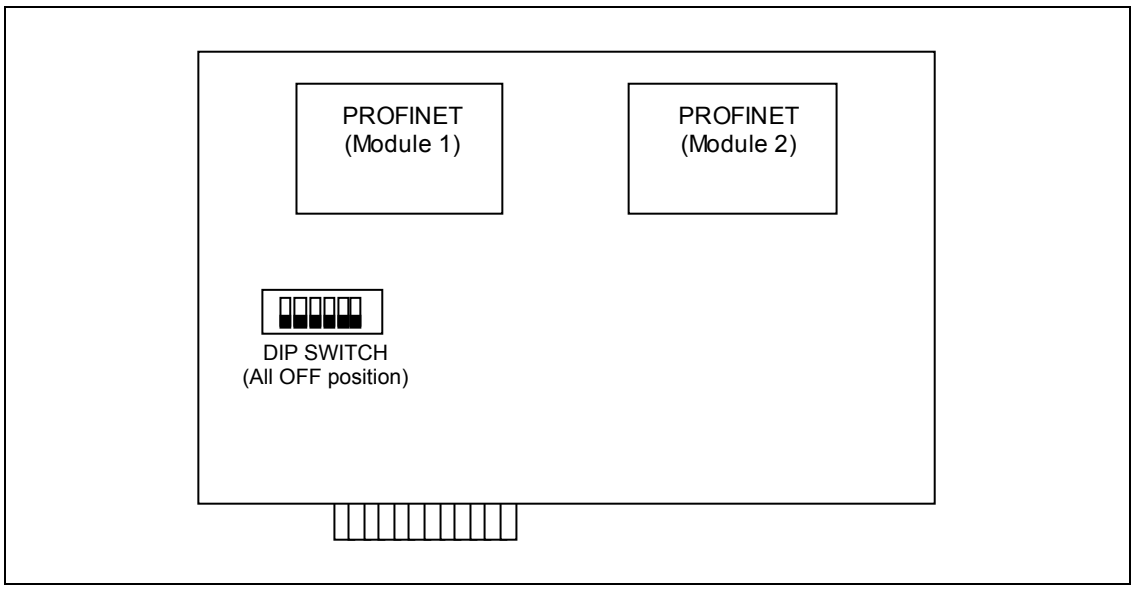
8.2.1 How to install

All fieldbus board can be mounted in same way.

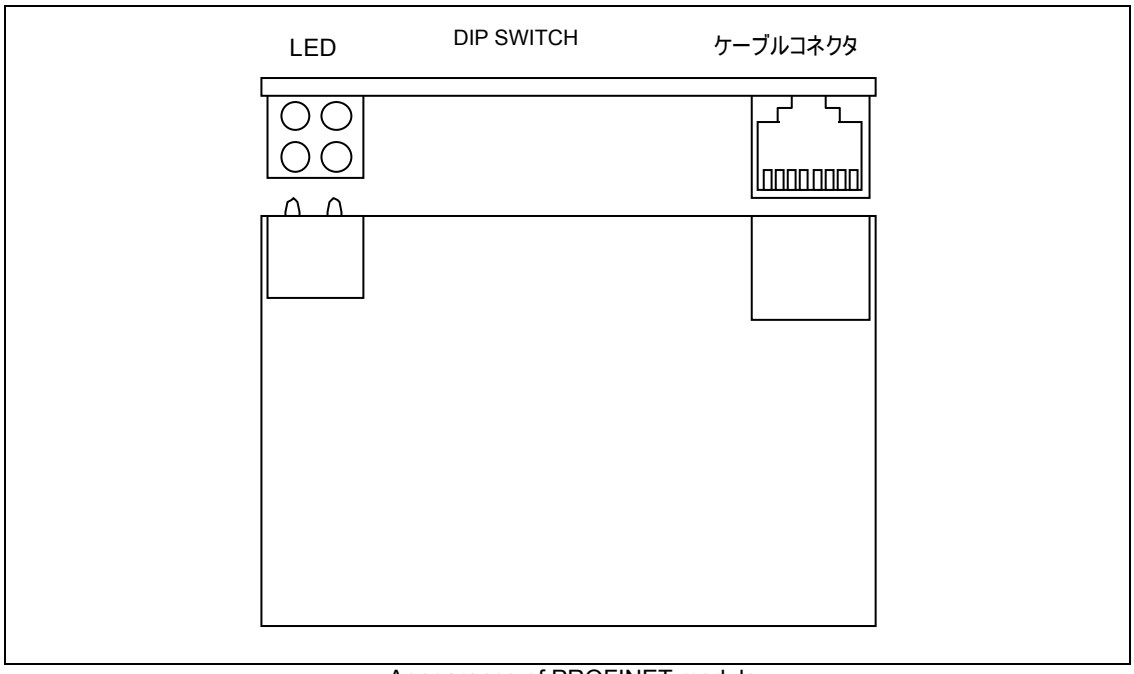
Refer to “Chapter 4 EtherNet/IP”, “4.2.1 How to install” for detail.

8.2.2 Hardware setting

In PROFINET, “FIELDBUS base board” and “PROFINET module” are used in a combination.
On “FIELDBUS base board”, it is possible to install up to 2 “PROFINET modules” at maximum.
The DIP switches on “FIELDBUS base board” are not used.



Appearance of FIELDBUS base board



Appearance of PROFINET module

8.3 Signal Assignment

8.3.1 Fieldbus I/O Signals

I/O signal numbers is determined based on the field bus channel number to be used.

■ When software PLC is disabled (setting when shipped)

CH1 : I 161 ～ I 672 / O 161 ～ O 672 (512 points)
CH2 : I 673 ～ I1184 / O 673 ～ O1184 (512 points)
CH3 : I1185 ～ I1696 / O1185 ～ O1696 (512 points)
CH4 : I1697 ～ I2048 / O1697 ～ O2048 (352 points)

■ When software PLC is enabled

CH1 : X1000 ～ X1511 / Y1000 ～ Y1511 (512 points)
CH2 : X1512 ～ X2023 / Y1512 ～ Y2023 (512 points)
CH3 : X2024 ～ X2535 / Y2024 ～ Y2535 (512 points)
CH4 : X2536 ～ X3047 / Y2536 ～ Y3047 (512points)

■ Assigning signals beyond the number of channels

The field bus can use up to four channels. If all four channels are not being used, it is possible to use the signal assignment region of channels not being used.
The description below gives an example in which software PLC is enabled. Signals can be assigned using a similar concept even if software PLC is disabled.

If only one channel is being used, all 2048 points can be used with just “Channel 1” by using “Channel 1”.

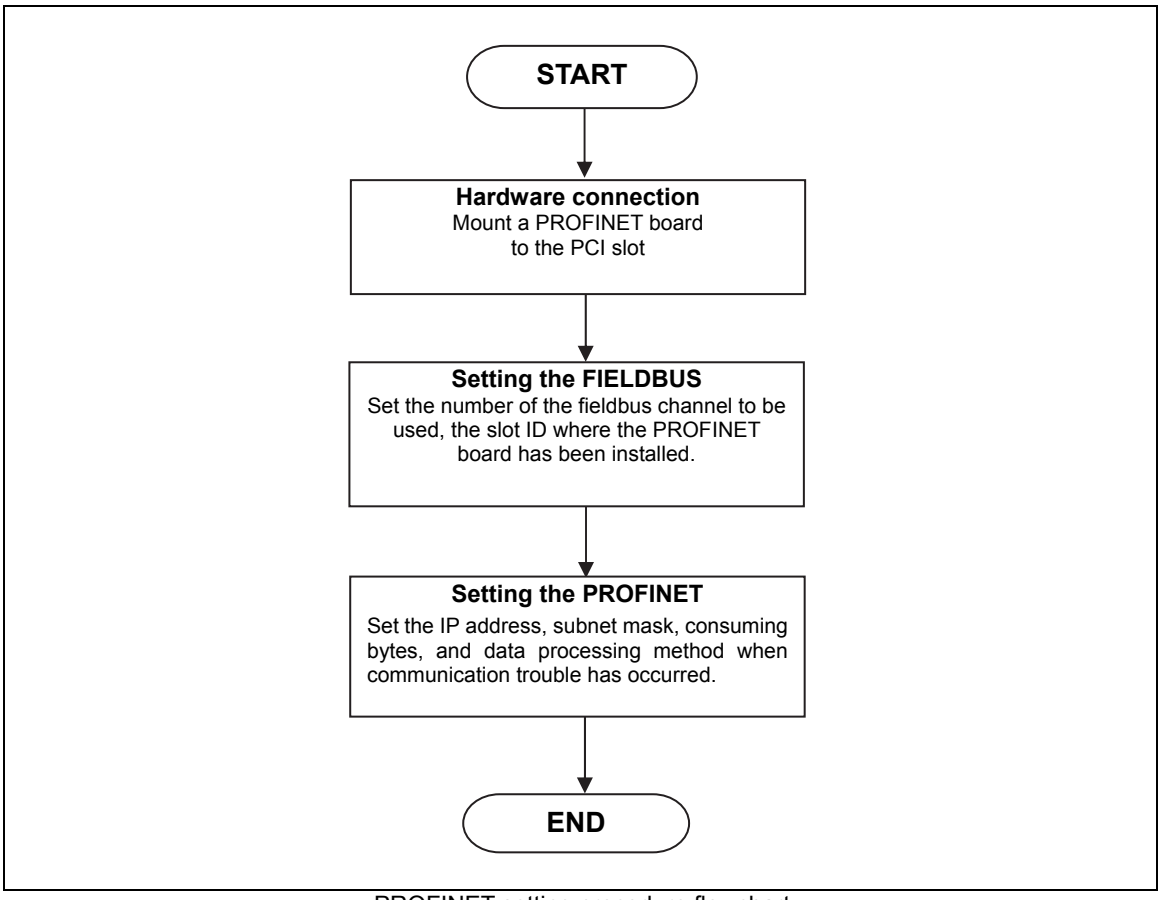
CH1 : X1000 ～ X3047 / Y1000 ～ Y3047 (2048 points)

When using two channels, 1024 points can be used for each channel, by using “Channel 1” and “Channel 3”.

CH1 : X1000 ～ X2023 / Y1000 ～ Y2023 (1024 points)
CH3 : X2024 ～ X3047 / Y2024 ～ Y3047 (1024 points)

8.4 Setting Procedure

Shown below is the general sequence of the steps for performing the setting.



PROFINET setting procedure flowchart

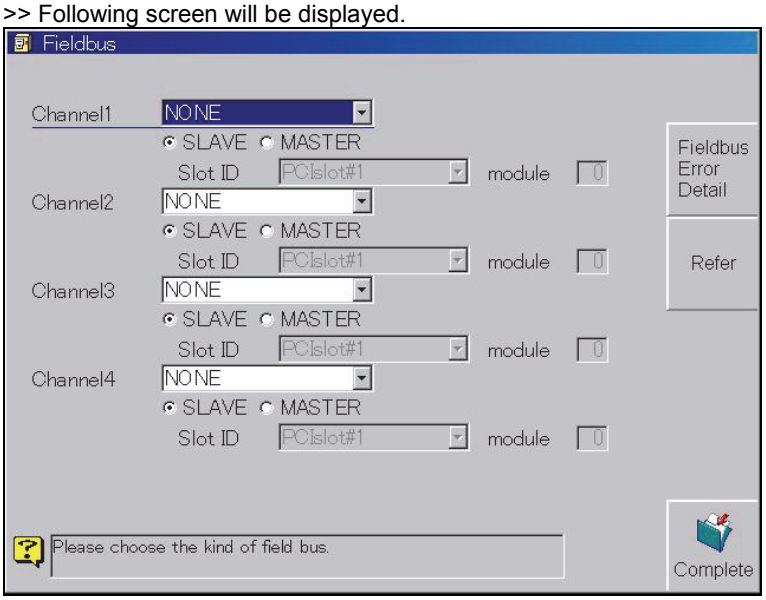
Hardware connection may be done when shipping.

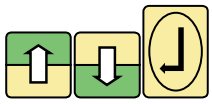
When built-in PLC is used for PROFINET input/output signals, built-in PLC settings must be done as well. For further details, refer to “Software PLC” instruction manual.

8.4.1 Fieldbus Settings

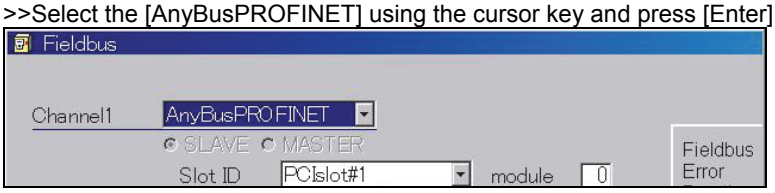
Protocol settings

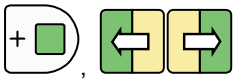
1 **Open <Constant Setting> - [8 Communication] - [3 Fieldbus].**
>> Following screen will be displayed.



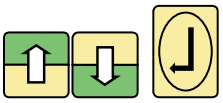


2 **Align the cursor with the combo box of a channel which is going to use the PROFINET, and press [Enter] key.**
>>Select the [AnyBusPROFINET] using the cursor key and press [Enter] key.





3 **Select “Slave” with [Enable] + [Left / Right] key.**
>>Select the Slot ID using the cursor key and press the [Enter] key.



4 **Align the cursor with the "Slot ID" combo box, and press [Enter] key.**
Select the Slot ID where PROFINET board is mounted and press [Enter] key.
≫The slot ID is required in order to check the position where the fieldbus base board has been installed. Please refer to “Chapter 4 EtherNet/IP”, ”4.2.1 How to install” for the relationship between the position and the ID of the slots.

5 **Align the cursor with the edit box of the "module". Input the applicable module number, and press [Enter] key**.
>> ”PROFINET module” number is necessary to confirm the installed position on “FIELDBUS base board”. If 0 is set to the module number, the applicable channel is not used. Refer to "8.2.2Hardware setting" for detail of its location.

Now proceed to set the PROFINET (SLAVE).

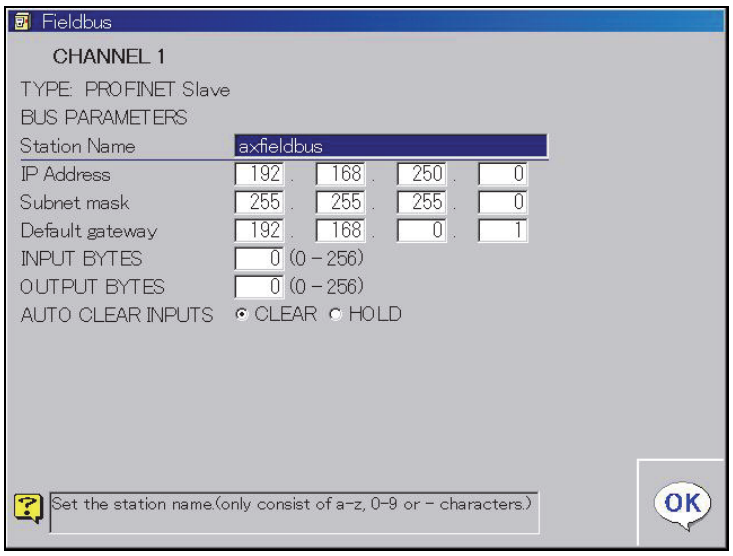
8.4.2 PROFINET (SLAVE) Settings

Channel settings

Refer

1 In [3 Fieldbus] screen, align the cursor with the channel where PROFINET is selected and press <Refer>.

>> Following screen is displayed.



2 Set the respective parameters.

Item	Description
Station Name	Input the station name for the concerned node. Use alphanumeric (small letter) for the station name. Symbols, signs, or marks cannot be used. The length is 63 letters at maximum. This station name is used to identify the device on the network. Plural nodes that have the same station name can not be set in one network.
IP Address	Input the IP address for the concerned node. IP address is used to identify the device on the network. Plural nodes that have the same IP address can not be set in one network.
Subnet mask	Input the subnet mask for the concerned node. Subnet mask are values to manage a network by dividing it into several sub network. In the same sub network, the all devices must have the same setting values for this subnet mask.
Default gateway	Input the IP address of the Default gateway for the concerned node. This setting may not be necessary if a router does not exist in the network. Please consult with the network administrator and set this parameter if necessary.
INPUT BYTES	Set the INPUT BYTES from the PROFINET board to this controller. 8 points are included in 1 byte.
OUTPUT BYTES	Set the OUTPUT BYTES from this controller to the PROFINET board. 8 points are included in 1 byte.
AUTO CLEAR INPUT	This is a setting to select whether to hold or clear the input from the PROFINET under transmission error. If CLEAR is selected, the condition of the signals will be cleared when detection transmission error. If HOLD is selected, the condition of the signals will be kept.

IMPORTANT

The setting of IP address using DCP (Discovery and Basic Configuration Protocol) can be done in spite of the setting of IP address in this setting screen.

However, do not change the settings from the external devices when the robot and its peripheral devices etc. are running. Because the settings are changed while the robot is running, unexpected and dangerous accidents may occur due to the change of the I/O conditions.

POINT

Concerning the relationship between the setting of INPUT/OUTPUT BYTES and the I/O signal numbers, refer to "8.3 Signal Assignment".

3 **After finishing the settings, press <OK>.**

>>The screen will return to [3 Fieldbus].

4 **Press <Complete> in [3 Fieldbus] screen.**

>>The settings will be saved to the internal memory.

IMPORTANT

A GSDML file that is necessary to use this controller as a SLAVE unit is stored in the system memory of this controller. Please copy this file to your Master unit's configuration tool in advance.

(The file is "PLCEngine/GSDML-V2.2-HMS-ABSPRT-20100119.xml")

Concerning the setting procedures, please refer to the instruction manual of the Master unit.

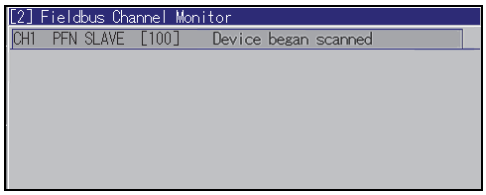
POINT

For the terminology of network (e.g. Ethernet, IP address etc.), please refer to the treatises in the market also if necessary.

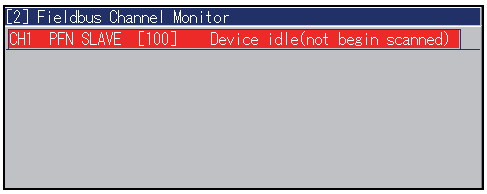
8.5 Troubleshooting

8.5.1 Fieldbus Monitor

Current state of the fieldbus can be confirmed by “Fieldbus Channel Monitor”.



When communicating correctly

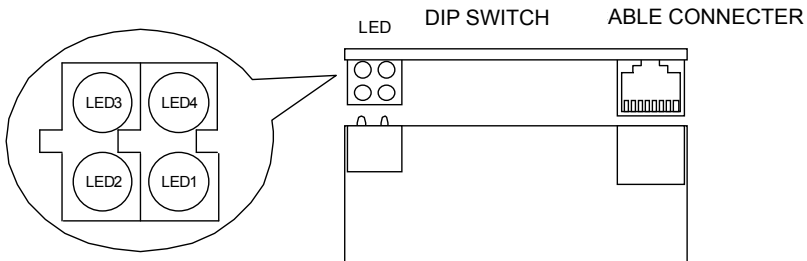


When error occurs in communication

Error display on Fieldbus channel monitor

8.5.2 Error Detection on PROFINET Module

The current status of PROFINET module is indicated using up to four LEDs.



LED1	Ethernet connection status
LED2	IO connection and communication status
LED3	Module status
LED4	not used

PROFINET module

The LED status and PROFINET board status on a SLAVE module

LED	Color	Status		Description
LED1	Green	Lit	Link established	The Ethernet link was established.
	Green	Flashing	Sending and receiving	The data is being sent and received.
	-	Unlit	OFF	The link is not established or the power supply is OFF.
LED2	Green	Lit	Run State	The connection to the IO controller is completed and the IO communication is running.
	Green	Flashing	Idle State	The connection to the IO controller is completed but the IO communication is not running.
	-	Unlit	Offline	Not connected to the IO controller
LED3	Green	Lit	Initialization completed	The initialization is normally finished.
	Green	Flashing 1	Under diagnosis	Under diagnosis.
	Green	Flashing 2	Under diagnosis	Under diagnosis via external tool.
	Red	Flashing 1	Illegal setting	The setting is incorrect. (e.g. Abnormal IO size etc.)
	Red	Flashing 3	Address error	IP address is not allocated.
	Red	Flashing 4	Internal error	An error occurs inside the module. Please contact our support department.
	-	Unlit	OFF	The initialization is not finished, or the power supply is OFF.
LED4	-	—	—	—

From "Flashing 1" to "Flashing 4" show the number of the flashing in one cycle. For example, in case of "Flashing 3", the LED repeat the following operation; "3 times flashing -> Unlit for a while"

8.5.3 Error Detection on this Controller

This controller will display the following error messages when detecting an error.

No.	E0958
Message	Error detected by communication board self-check.
Cause	A list of possible causes is given below. ・Faulty PROFINET board ・Incorrect detailed PROFINET settings
Remedy	The system will recover once the problems listed above are resolved.

No.	E0959
Message	The communication board not found.
Cause	The PROFINET board specified on the Constant Settings window cannot be found.
Remedy	Confirm the slot ID of the fieldbus hardware setting. Even if the PROFINET board is correctly connected, the PROFINET board itself may have failed if this error occurs. Replace the PROFINET board.

No.	E0960
Message	Some or all I/O links are currently stopped.
Cause	I/O links have stopped.
Remedy	The system automatically recovers once the problem is resolved. (It may be necessary in some cases to turn power off and on again in order to resolve this problem.)

No.	I3960
Message	Some or all I/O links are currently stopped.
Cause	I/O links have stopped.
Remedy	The system automatically recovers once the problem is resolved. (It may be necessary in some cases to turn power off and on again in order to resolve this problem.)

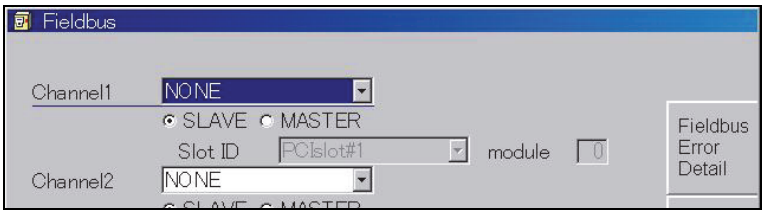
E0960 and I3960 are selected based on settings made on [Detailed Field Bus Error Settings] screen. For details, see “8.5.4Detail Fieldbus Error Setting”.

8.5.4 Detail Fieldbus Error Setting

Settings such as the behavior when an I/O link error occurs are set here.

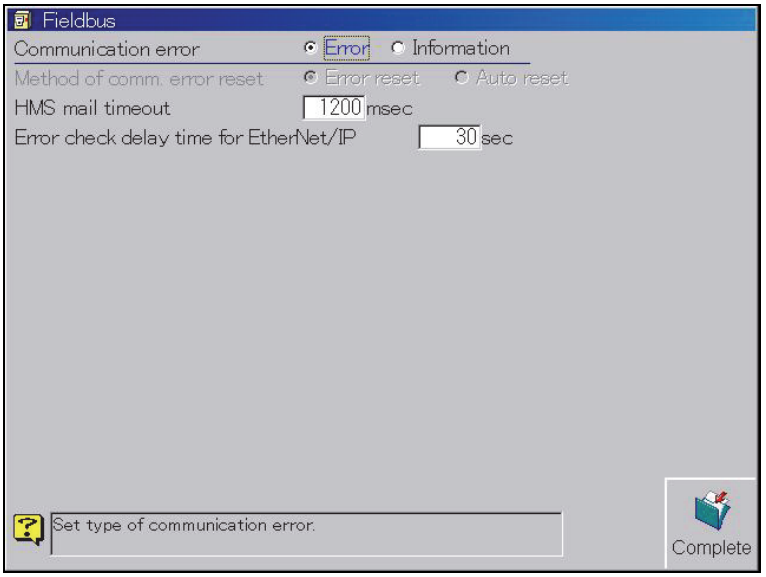
1 **Open <Constant settings> - [8 Communications] - [3 Fieldbus].**

>> Following screen will appear.



2 **Press < Fieldbus Error Detail>.**

>> Following screen will appear.



3 **Set each item by referring to the following table.**

4 **Press < Complete > to save settings.**

Fieldbus Error Detail

Setting item	Description	
Communication error	This is to define the abnormality level when I/O link error occurs.	
	Error	E0960 is detected.
	Information	I3960 is detected.
Method of com. reset	This is to define the recovering from a communication error; This item cannot be selected if “Communication error” is set to “error.”	
	Error reset	Communication error is maintained until the reset operation is done.
	Auto reset	Communication error is automatically reset
HMS mail timeout	This is to define the time out limit of fieldbus initialization. Normally do not have to change the initial setting. In case that PROFINET module fails initialization, it may be possible to solve this problem by changing this value longer.	
Error check delay time of EtherNet/IP	This value is not used for PROFINET. Do not change this.	

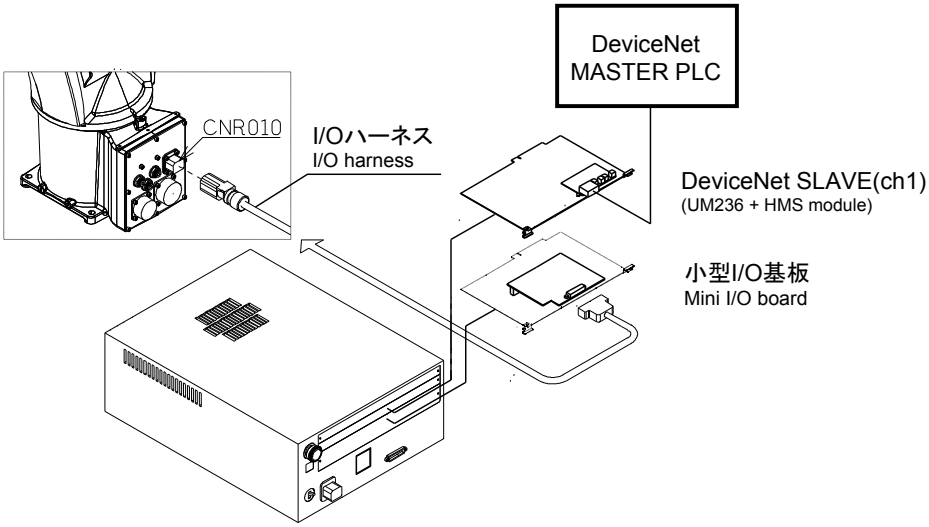
NOTE

Chapter 9 Example to Use

9.1 DeviceNet SLAVE and Mini I/O at the same time

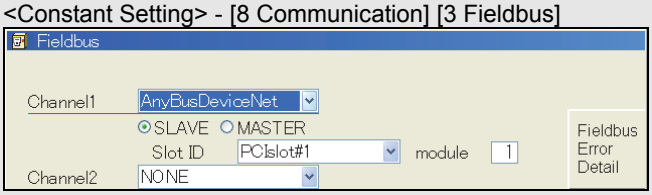
In this section, one sample configuration is explained.

- The external PLC works as a "DeviceNet MASTER".
- The CFD controller works as a "DeviceNet SLAVE". (CFD-OP131-B is installed to the PCI Slot#1")
- A gripper is mounted to the robot.
- The CFD controller controls this gripper using the "Mini I/O board". (CFD-OP150-A)



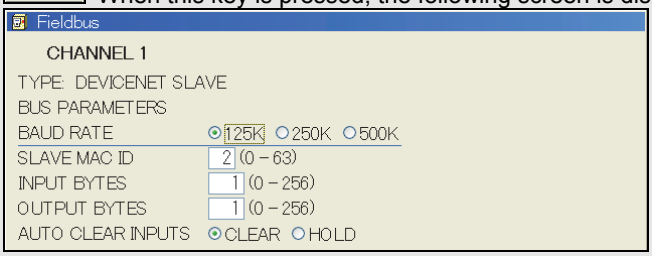
DeviceNet settings

<Constant Setting> - [8 Communication] [3 Fieldbus]



Refer

When this key is pressed, the following screen is displayed.



INPUT BYTES = 1 (I161～I168)
OUTPUT BYTES = 1 (O161～O168)

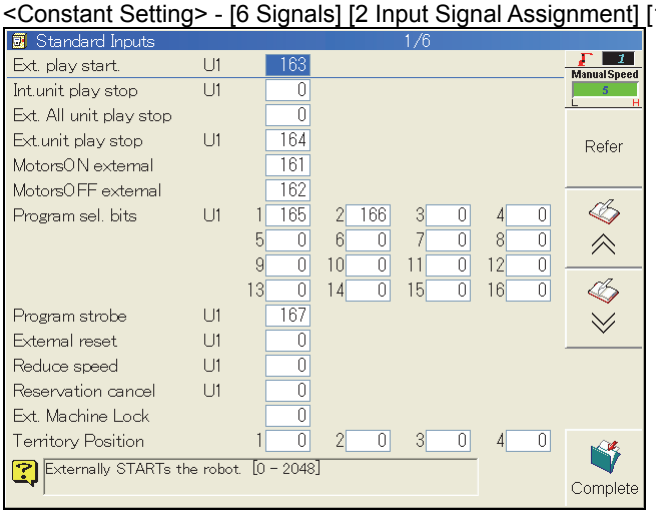
9.2 Setting

9.2.1 Signals for the DeviceNet SLAVE

INPUT SIGNALS

No.	Name	Remarks
I161	MotorsON external	
I162	MotorsOFF external	
I163	External playback start	
I164	External UNIT playback stop	N.C. (Normal Close signal) The robot stops when this signal turns OFF
I165	Program selection bits 1	1st bit of the binary signal
I166	Program selection bits 2	2nd bit of the binary signal
I167	Program strobe	

<Constant Setting> - [6 Signals] [2 Input Signal Assignment] [1 Standard Inputs]



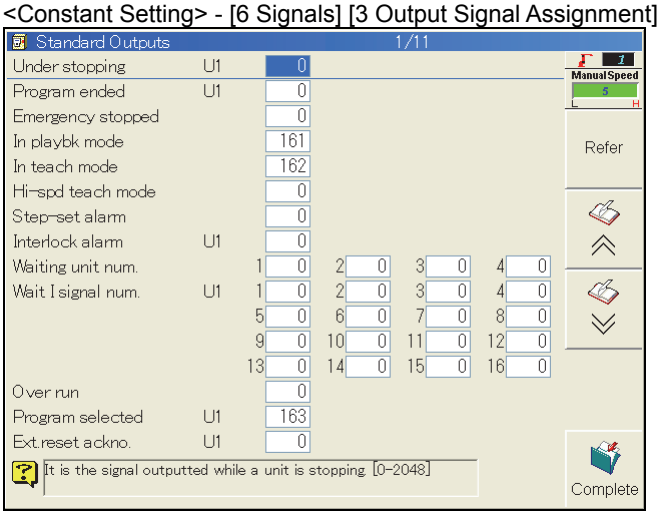
Location in the I/O map

No.	Hardware	Description
I1 : I32	Digital I/O board 1 (32 points)	 SW1-1:OFF / SW1-2:OFF
I33 : I64	Digital I/O board 2 (32 points)	 SW1-1:ON / SW1-2:OFF
I65 : I96	(32 points)	
I97 : I104	Mini I/O board (8 points)	This is used to control the gripper.
I105 : I160	(56 points)	
I161 : I672	Fieldbus 1CH (512 points)	In this example, only 1 byte from the head is used by the DeviceNet. These signals are the input signals from the MASTER PLC.
I673 : I1184	Fieldbus 2CH (512 points)	
I1185 : I1696	Fieldbus 3CH (512 points)	
I1697 : I2048	Fieldbus 4CH (352 points)	

OUTPUT SIGNALS

No.	Hardware	Description
O161	In teach mode	
O162	In playback mode	
O163	Program selected	"Acknowledge" signal

<Constant Setting> - [6 Signals] [3 Output Signal Assignment] [1 Standard Outputs]



Location in the I/O map

No.	Hardware	Description
O1 : O32	Digital I/O board 1 (32 points)	 SW1-1:OFF / SW1-2:OFF
O33 : O64	Digital I/O board 2 (32 points)	 SW1-1:ON / SW1-2:OFF
O65 : O96	(32 points)	
O97 : O104	Mini I/O board (8 points)	This is used to control the gripper.
O105 : O160	(56 points)	
O161 : O672	Fieldbus 1CH (512 points)	In this example, only 1 byte from the head is used by the DeviceNet. These signals are the output signals to the MASTER PLC.
O673 : O1184	Fieldbus 2CH (512 points)	
O1185 : O1696	Fieldbus 3CH (512 points)	
O1697 : O2048	Fieldbus 4CH (352 points)	

For details about the signals, refer to the following manual.
TFDEN-007 "EXTERNAL INPUT / OUTPUT"

9.2.2 Signals for Mini I/O board

These signals are used to control the gripper that is attached on the robot wrist flange directly.

INPUT SIGNALS

No.	Assignment	Name	Remarks
I97	No assign This is used as a General input signal.	CLAMP CHECK	Connected to the "Clamp check input signal" from the gripper.
I98	No assign This is used as a General input signal.	UNCLAMP CHECK	Connected to the "Unclamp check input signal" from the gripper.

OUTPUT SIGNALS

No.	Assignment	Name	Remarks
O97	No assign This is used as a General output signal.	CLAMP	Connected to the Solenoid valve in the robot arm (Clamp side).
O98	No assign This is used as a General output signal.	UNCLAMP	Connected to the Solenoid valve in the robot arm (unclamp side).

- It is possible to put signal names to the general I/O signals.

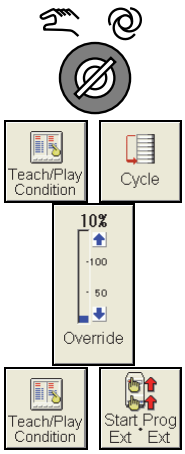
<Constant Setting> -[6 Signals] [7 Signal Attribute] [1 Input signals]
<Constant Setting> -[6 Signals] [7 Signal Attribute] [2 Output signals]
(This is only for "General I/O signals (=signals that are not assigned to any functions)".)

The General I/O signals that have name will be displayed on the screen like the following when they are used in FN commands.

```
SETM[O97,1](CLAMP)          FN105
WAITI[I97](CLAMP CHECK)     FN525
```

9.3 How to use

9.3.1 How to select program 1 and start robot using external signals



1 Select playback mode.

2 Make a setting in <Teach / Playback condition> menu.
"1 Playback mode" = "1 cycle"
And, for safety, **"5 Playback speed override"** setting should be approx. 10%.

3 Make a setting in <Teach / Playback condition> menu.
"2 MotorsON / START selection source" = "External"
"3 Playback mode program selection" = "External"

4 Turn ON **"I161 Motors ON external"** signal.

5 Set following 2 input signals (=Program number is "1")
"I165 Program selection bits 1" = ON
"I166 Program selection bits 2" = OFF

6 Turn ON **"I167 Program strobe"** signal.

7 Turn ON **"I163 External playback start"** signal.
Keep this signal more than 200 [ms] pulse.
>> Now program 1 is initiated. "**O163 Program ACK**" output is turned ON.

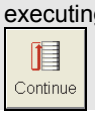
8 In order to stop robot. Turn OFF "**I164 External Stop**" input signal.
>> Program execution is terminated. Motor power is still turned ON.

9 Turn ON "**I164 External Stop"** signal, and turn ON "**I163 External playback start**" again.
>> Program 1 is re-started from terminated step.

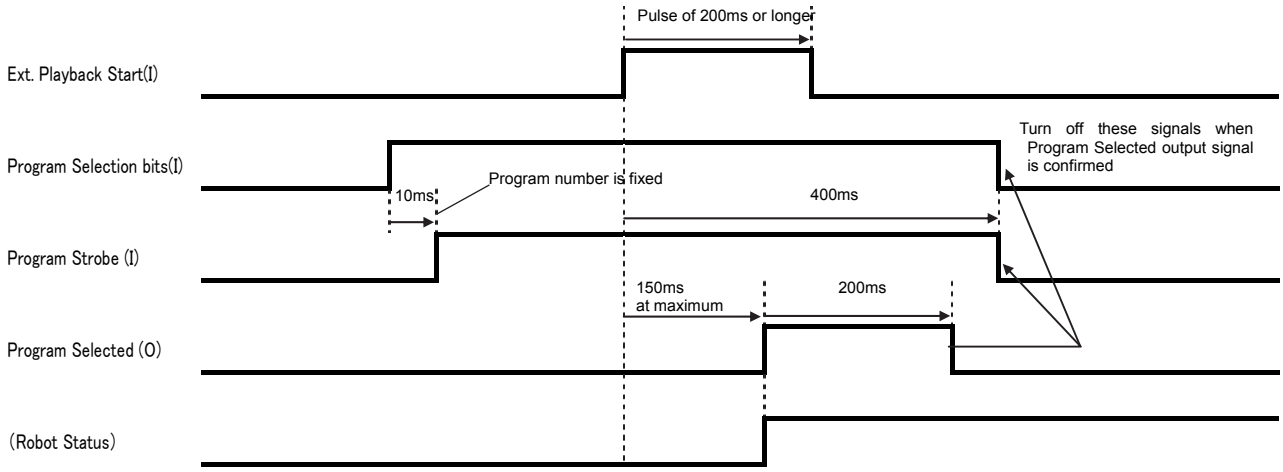
10 Robot stops when END command is executed.
>> Motor power is still turned ON.

11 Turn ON "**I162 External Motor Off"** input signal.
>> Motor power is turned OFF.

・Please do not forget to record the function command "FN92 END" at the last step of program. Otherwise error occurs when playback.
・If CONTINUOUS Playback mode is selected, robot will initiate same program again after executing the function command "FN92 END" .



■ (Reference) Timing Chart (Motor power is already turned ON prior to this time chart)



(I) means input signal (Customer's controller-> this controller) / (O) means output signal (this controller -> Customer's controller)

CAUTION

(Note 1) "Ext. play start" signal should be a pulse signal of 200ms or more.
(Note 2) "Program strobe" signal should be inputted after "Program sel.bits" signals are inputted and all of those signals get stable and 10ms or more passed. If the "Program strobe" signal is inputted during the "Program sel.bits" are still unstable, an unexpected program number may be chosen.
(Note 3) The pulse's width of the "Program selected" signal is 200ms at the factory(default) setting. But the width can be changed in the following setting menu.
→<Constant Setting>[6 Signals][1 Signal condition][6 Program acknowledge time] (unit : sec)
(Note 4) "Program Selected" are outputted when the actually selected program starts.
(Note 5) When the "Program selected" is outputted, turn OFF the "Program sel.bits" and the "Program strobe" signals altogether.

9.3.2 Clamp operation in program

(Notes) “O98 UNCLAMP” output signal needs to be turned OFF prior to this operation. (SETM[O98,0])

```
SETM[O97,1](CLAMP)              FN105
WAITI[I97](CLAMP CHECK)         FN525
```

(1) Execute the function command “FN105 SETM (Output signal)”

SETM[O97,1](CLAMP)

>> Clamp motion is initiated.

(2) Execute the function command “FN525 WAITI (Wait input condition)”

WAITI[I97](CLAMP CHECK)

>> Clamp stroke end is checked by I97 input signal. After I97 is turned ON, robot will proceed with next step.

9.3.3 Unclamp operation is program

(Notes) “O97 CLAMP” output signal needs to be turned OFF prior to this operation. (SETM[O97,0])

```
SETM[O98,1](UNCLAMP)            FN105
WAITI[I98](UNCLAMP CHECK)       FN525
```

(1) Execute the function command “FN105 SETM (Output signal)”

SETM[O98,1](UNCLAMP)

>> Unclamp motion is initiated.

(2) Execute the function command “FN525 WAITI (Wait input condition)”

WAITI[I98](UNCLAMP CHECK)

>> Unclamp stroke end is checked by I98 input signal. After I98 is turned ON, robot will proceed with next step.

9.3.4 Check current mode in customer’s PLC

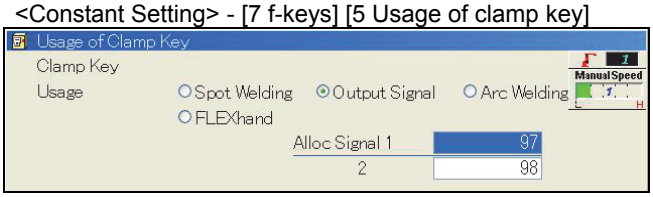
(1) Read the signal “O161 Teach mode” outputted from this controller.
If O161 = ON, current mode is teach mode.

(2) Read the signal “O162 Playback mode” outputted from this controller.
If O162 = ON, current mode is playback mode.

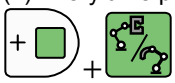
9.3.5 Clamp/unclamp manual operation (Smart TP)

(1) Assign signal ON/OFF operation for Clamp key in following menu.

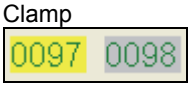
<Constant Setting> - [7 f-keys] [5 Usage of clamp key]



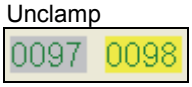
(2) Every time pressing [Enable]+[Clamp] keys at the same time, clamp / unclamp motion is initiated.



Clamp

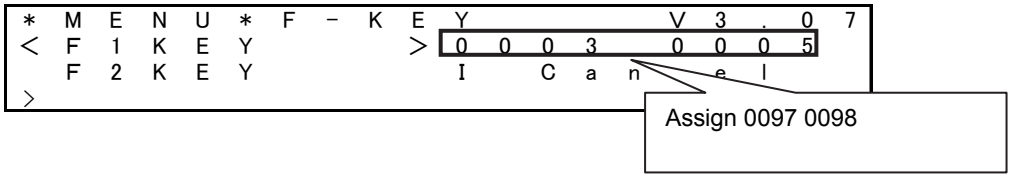


←→ Unclamp



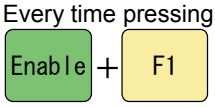
9.3.6 Clamp/unclamp manual operation (Compact TP)

By making the setting so that O97 and O98 turn ON/OFF in opposite way by [Enable] + [F1] keys, clamp / unclamp motion is initiated. The setting can be made in the menu of [START/MENU] - <SETTING> - <F-KEY>. For details, please refer to “Start Up” manual. (TCFEN-154)

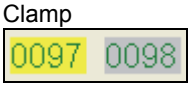


Assign 0097 0098

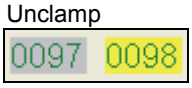
Every time pressing [Enable] + [F1] keys at the same time, clamp / unclamp motion is initiated.



Clamp



←→ Unclamp



Chapter 10 FL-net(OPCN2)

10.1 What is FL-net (OPCN-2)

10.1.1 Characteristics

FL-net (OPCN-2) (hereafter FL-net) is a standard specification of FA controller network developed by Manufacturing Science and Technology Center.

POINT

The features of the FL-net

- It is an open FA network that enables a communication network between multivendor PLC, NC, and robot controllers to be established.
- This network is "masterless," which enables the nodes to be connected or disconnected freely without affecting communication of other nodes.(For safety, if other nodes do not participate the network, the robot will stop.)
- The network devices commonly used for the Ethernet, such as hubs, cables, LAN cards for PC, can be used.
- Two transmission methods are provided: one is the cyclic transmission that enables the nodes to share the same data using the common memories; the other is the message transmission with which data is transmitted between the specific nodes.

10.1.2 Performance table

Item	Specifications
Number of channels	Maximum number of channels installed: 2
Method of controlling the communication priority	Token-passing method
Method of controlling the communication stations	Masterless method
Number of inputs/outputs	When Software PLC is used, a maximum of 2,048 inputs (256 bytes) and 2,048 outputs (256 bytes) can be used for all the channels, and these numbers cover all the general-purpose signals of this controller. When Software PLC is not used, a maximum of 1,888 inputs (236 bytes) and 1,888 outputs (236 bytes) can be used for all the channels.
Node address	By means of key input from the teach pendant, the node addresses at this controller side can be selected from 1 to 254 and set for each channel. The details are as follows. • An IP address in the class C is used for the settings. • The first three bytes of the IP address is set in the range of 192.0.0.0 to 223.255.255.0, and the last one byte is used as the node address. The initial setting value is 192.168.250.1. • If another node with the same node address is detected when logging in to the network (initializing), the log-in is rejected.
Number of nodes connected	A maximum of 32 nodes can be connected to an FL-net board. More than 32 can be also connected, yet the response speed is not assured.
Baud rate	10Mbps
Common memory size	Area 1 and area 2 are available. • Area 1 is made up of 8k bits. (0.5k words) • Area 2 is made up of 8k words. If the area is also allocated to another node, that node can log in to the network and receive data, yet it cannot send data. Only one area is available for data input and data output. Input and output area can be different.
Token monitoring time	The time that is taken until the token is issued from when it was obtained. The node must complete transmitting the data within the token observation time. The time can be set from 10 to 255msec. ■ Token monitoring time calculate method in FL-PCI/V2 "Token monitoring time" = (all cyclic frame number of the own node + 2) * transmission time of 1 frame + (all cyclic frame number of the own node + 2)

	* minimum permissive frame interval ・All cyclic frame number of this controller is 1. ・Transmission time of 1 frame of FL-PCI/V2 is 2.5 msec ・Minimum permissive frame interval (Note1) is 0 msec
Maximum nodes connected	Specifies the node's range where the data is to be obtained. • The input data will be obtained after participation/nonparticipation to the network of the nodes, from node address 1 to the specified node address, are checked. If the node within the specified range cannot participate in the network, an I/O link error will occur and E0960 "A part or all I/O links are stopping" will be displayed. • If "0" is set, participation/nonparticipation of the nodes from node address 1 to 254 is inspected and the input data will be obtained. In this settings, an I/O link error will not occur even for "nonparticipation" of the node.
Input data processing when communication trouble has occurred	It is possible to select whether the input signal statuses are to be held or cleared when communication trouble has occurred. If they are to be cleared, the input signals of the nodes disconnected from the network will be cleared.
Node name	Any node name can be set until ASCII 10 characters.
Version	The FL-net for this controller is version 2.0.

If the set value of the maximum node connected is increased, a longer time will be taken for checking participation・nonparticipation and obtaining the input data, making this controller carry a bigger load. Furthermore, if "0" is set, the load will be the same as when 254 is set and may effect the robot movement. Therefore, be sure to input numerical value of the number of nodes that are necessary for the network.

Notes1 : Minimum permissive frame interval
Frame interval is the time since receiving Token from the other node until releasing frame. "Minimum permissive frame interval" is the minimum needed time for each node to release frame.
In FL-net system, this "Minimum permissive frame interval" is common in the network.
Each node renews this value by reading "Minimum permissive frame interval" and selecting the maximum value from all node participating the network.

10.1.3 Data transmission methods

The token-passing method is used for the FL-net.

This method controls the data sending priority by having a packet called token traveling around the network. Only the node that has captured the token can send data.
Two data transmission methods are provided: one is the cyclic transmission, which is used for input/output of the I/O signals; the other is the message transmission, which is used to send/receive inherent information of each device.

10.1.4 IP Address of the FL-net

By using the IP address of class C, the node number (node address) of each node in the FL-net will be set individually. The IP address's default value of the FL-net is 192.168.250.n. The "n" will be the IP address and the value can be selected from 1 to 254 for usage.

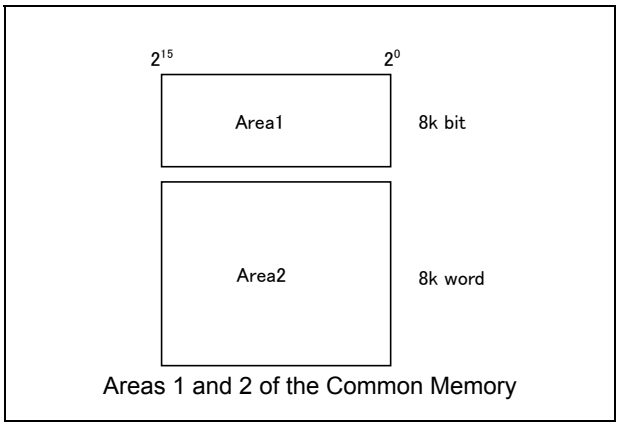
IP Address of the FL-net

Network Address	Node Address	
192.168.250	n (n: ***1~254***)	
	1～249	For usual FL-net devices
	250～254	For FL-net maintenance
	255	Used inside the FL-net (used for broadcast transmission)
	0	Used inside the FL-net

10.1.5 Cyclic transmission

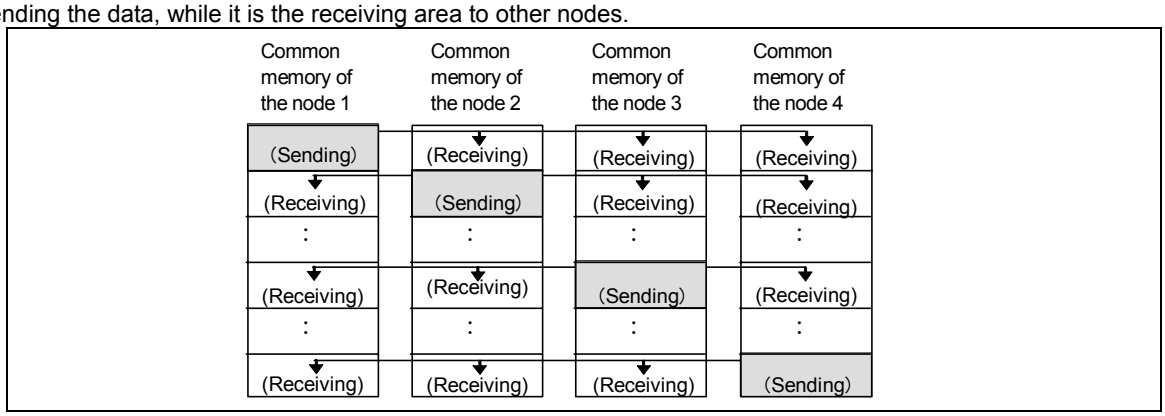
This method cyclically broadcasts the data stored in the common memory to all the nodes. The cyclic transmission enables data stored in the nodes on the network to be captured through the common memory.

The common memory has to areas; area 1 and area 2. Area 1 is made up of 8k bits (0.5k words) and area 2 is made up of 8k words. A certain area of the common memory is allocated to each node. The configuration and the data of the common memory are stored in each FL-net device. Since all the nodes share the same configuration of the common memory, this memory can be used commonly between the nodes performing the cyclic transmission.
In the case of this controller, the common memory is installed in the RAM of the FL-net board.



Areas 1 and 2 of the Common Memory

The cyclic transmission with four nodes is shown in the lower diagram. The shaded areas are the areas allocated to each node. When a node captures the token traveling around the network, the node broadcasts the data stored in the data area allocated to itself to all the other nodes. This data area is the sending area to the node that is sending the data, while it is the receiving area to other nodes.



Common memory areas in the cyclic transmission

10.1.6 Message transmission

POINT

The features of the message transmission

- It is possible to communicate with a specific node (or all the nodes) at any moment.
- A maximum of 1,024 bytes can be transmitted at a time.

Here the node that requests data is called "client," and the one that responds to the request is called "server." The message transmission services are listed in the lower table. This controller supports the services indicated by "O."

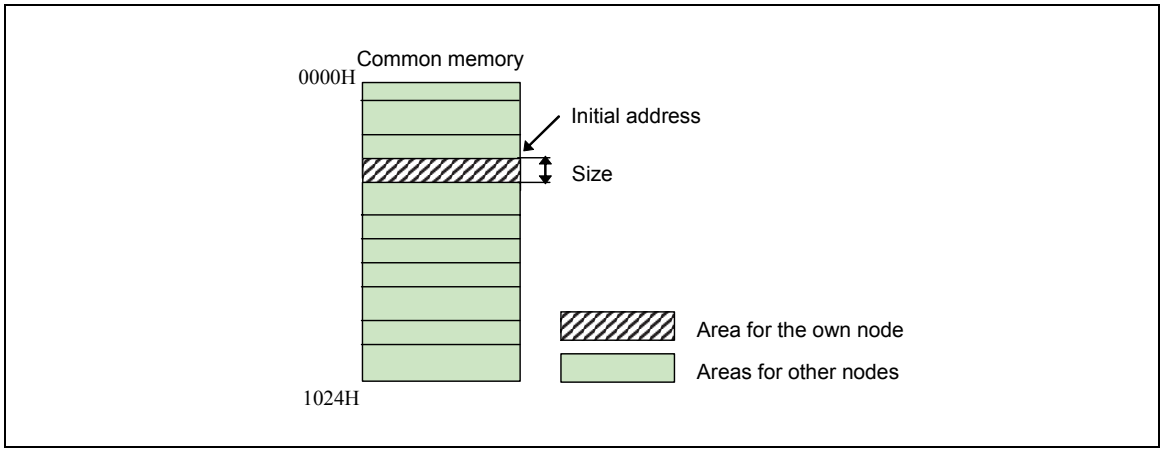
Message transmission services list

Name of service	Server function		Client function		Details
	1:1	1:N	1:1	1:N	
Byte block reading service	×	×	×	×	Reads the data of the node on the other side byte by byte.
Byte block writing service	×	×	×	×	Writes the data to the node on the other side byte by byte.
Word block reading service	×	×	×	×	Reads the data of the node on the other side word by word.
Word block writing service	×	×	×	×	Writes the data to the node on the other side word by word.
Network parameter reading service	○	×	×	×	Reads the network parameter of the node on the other side.
Network parameter writing service	×	×	×	×	Writes the network parameter to the node on the other side.
Stop command service	×	×	×	×	Requests a stop command from the node on the other node.
Start command service	×	×	×	×	Requests a start command from the node on the other side.
Profile reading service	○	×	×	×	Reads the profile of the node on the other side.
Transmission type	×	×	×	×	Sends the user definition service to the node on the other side.
Log data reading service.	○	×	×	×	Reads the log data of the node on the other side.
Log data clearing service	○	○	×	×	Clears the log data of the node on the other side.
Message returning service	○	×	×	×	Returns the message that has been received.

1 word: 16 signals

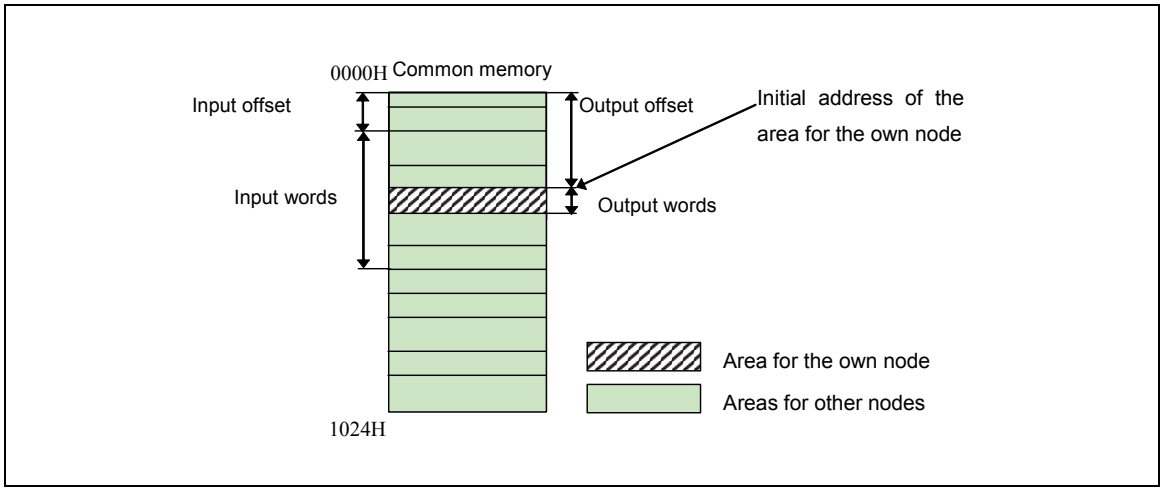
10.1.7 Common memory allocation and input/output settings

In the cyclic transmission, data input/output is performed in the common memory of each device.
Therefore, when outputting data from a device, the device must have the data written in the area of its common memory allocated to the device itself.
In order to allocate an area, specify the initial position and the size of the node area in the settings for the own node in lower diagram.
Although this diagram is for area 1, the setting procedure for the area 2 is the same.
The allocation data of the other nodes is automatically collected and managed when logging in to the network.
When allocating, care must be taken not to allocate the same area to two or more devices on the network.
If an area is allocated to two or more devices, they can log in to the network, yet data output is disabled.



Area allocation in the common memory

For this controller, output offset and output words are used for settings for the area allocated to the own node.
In order to obtain data in the common memory, specify an address in the common memory by the input offset as the obtaining start position, and specify the data size to be obtained by the number of the input words. The relationship between this controller settings parameters and the common memory is shown below. An address and data size must set by word.



The relationship between the setting parameters and the common memory

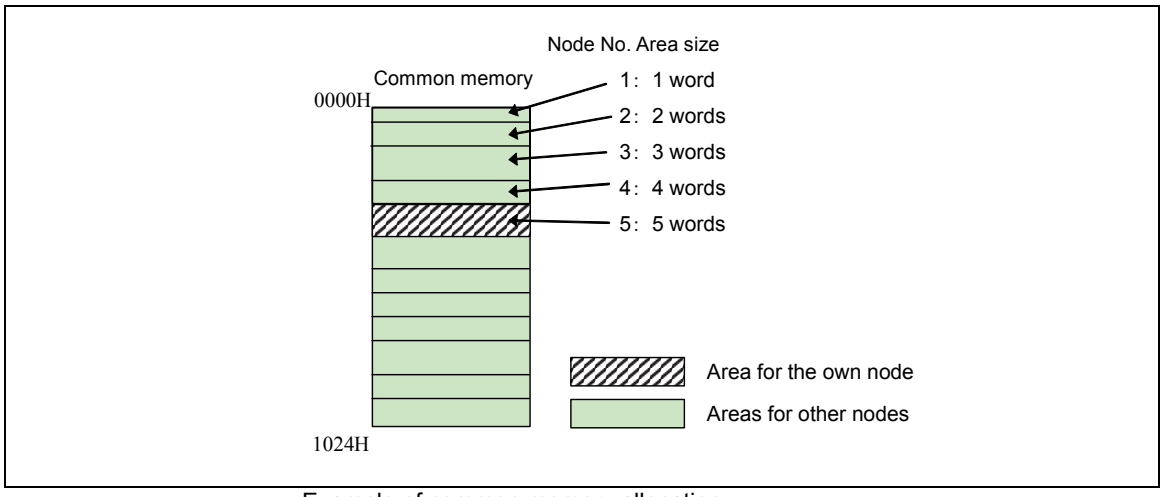
■ Allocation example of the common memory

As shown in the lower diagram, when allocating 1 word to the node 1, 2 words to the node 2, 3 words to the node 3, 2 words to the node 4, and 2 words to the node 5 in the common memory, the settings shown in the lower table is applied. Suppose the node 5 denotes this controller here, whose common memory is now mentioned.

・Settings for obtaining data

In order for this controller to obtain all the data from the areas for the nodes 1 to 5, set the input offset to "0 words" as the starting address of the node 1 area in the common memory. For the number of the input words, set "10 words" as the total size of the areas for nodes 1 to 5.

When obtaining all the data in the data areas for the nodes 3 and 4, set "3 words" as the input offset, and "5 words" as the number of input words.



Example of common memory allocation

Area allocation setting value

Node No.	Output offset	Number of output words
1	0	1
2	1	2
3	3	3
4	6	2
5	8	2

10.1.8 Contained Parts

Containd parts of this option

No.	Name	Parts No., type	Note
1	FL-net board	FL-PCI/V2-100	Century systems
2	Panel to fix board		
3	Fixing screws for board	M4 × 8mm	

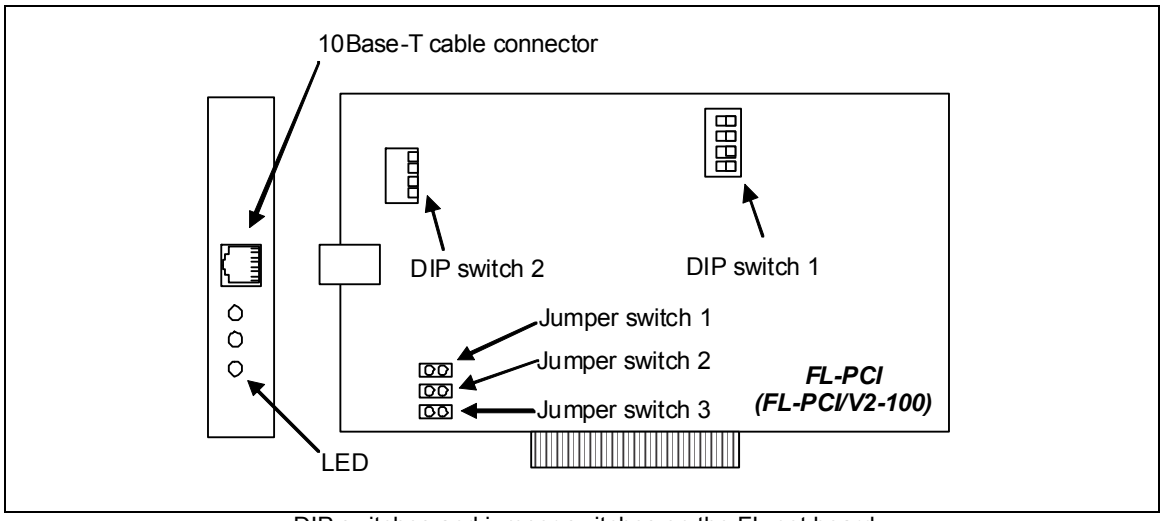
10.2 Installation and Connection

10.2.1 How to install

All fieldbus board can be mounted in same way.

Refer to “Chapter 4 EtherNet/IP”, “4.2.1 How to install” for detail.

10.2.2 Hardware



DIP switches and jumper switches on the FL-net board

DIP switch setting

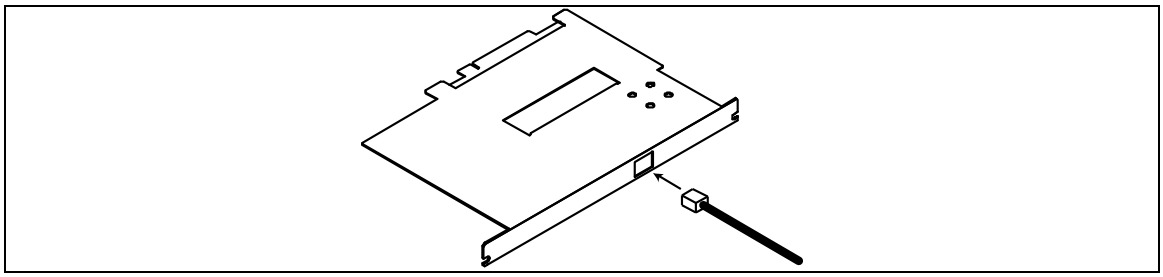
DIP switch 1				DIP switch 2			
SW1	SW2	SW3	SW4	SW1	SW2	SW3	SW4
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

Jumper switch setting

Jumper Switch1	Jumper Switch 2	Jumper Switch 3
Open	Open	Short

10.2.3 Cable connections

Connect the cable to the connector on the bracket attached to the FL-net board.



Cable connection

The characteristics of 10BASE-T: The numerical values in the parentheses are when repeat has been put to usage.

- Twist pair cable (UTP)
- 100m (500m) is the maximum transmission distance per segment
- a maximum of 254 devices can be connected to a single segment

Generally, for the formulation of the FL-net, 10BASE-T will be used within the control board and 10BASE-5 will be used for the main interconnection.

10.3 Signal Assignment

10.3.1 Fieldbus I/O signals

I/O signal numbers is determined based on the field bus channel number to be used.

■ When software PLC is disabled (setting when shipped)

CH1 : I 161 ～ I 672 / O 161 ～ O 672 (512 points)
CH2 : I 673 ～ I1184 / O 673 ～ O1184 (512 points)
CH3 : I1185 ～ I1696 / O1185 ～ O1696 (512 points)
CH4 : I1697 ～ I2048 / O1697 ～ O2048 (352 points)

■ When software PLC is enabled

CH1 : X1000 ～ X1511 / Y1000 ～ Y1511 (512 points)
CH2 : X1512 ～ X2023 / Y1512 ～ Y2023 (512 points)
CH3 : X2024 ～ X2535 / Y2024 ～ Y2535 (512 points)
CH4 : X2536 ～ X3047 / Y2536 ～ Y3047 (512points)

■ Assigning signals beyond the number of channels

The field bus can use up to four channels. If all four channels are not being used, it is possible to use the signal assignment region of channels not being used.
The description below gives an example in which software PLC is enabled. Signals can be assigned using a similar concept even if software PLC is disabled.

If only one channel is being used, all 2048 points can be used with just “Channel 1” by using “Channel 1”.

CH1 : X1000 ～ X3047 / Y1000 ～ Y3047 (2048 points)

When using two channels, 1024 points can be used for each channel, by using “Channel 1” and “Channel 3”.

CH1 : X1000 ～ X2023 / Y1000 ～ Y2023 (1024 points)
CH3 : X2024 ～ X3047 / Y2024 ～ Y3047 (1024 points)

10.3.2 FL-net signal allocation

The head signal position is determined depending on which fieldbus channel the signals have been set in. Furthermore, in the case of the FL-net (OPCN-2), this signal position is determined by allocation to the common memory.

■Signal allocation to the own node

The output signals of the own node are simply allocated from the signal position determined by the channel. Using a number of input/output bytes which is less than the size allocated for each channel leaves the rest of the size unused. The following is an example where the number of input words is set to 8 and the number of output words to 1 for the channel 1.

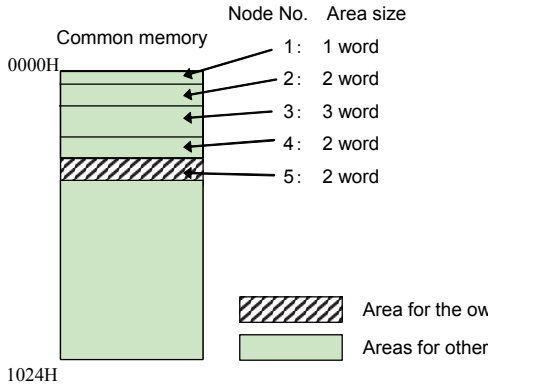
Channel number	Input	Output	Number of signals
Channel ***1***	X1000 to X1127	Y1000 to Y1015	Usable area
	X1128 to X1511	Y1016 to Y1511	Non-usable area

■**The relationship between input/output signals and setting parameters**

Depending the setting of the starting address for the input data setting item, the common memory address indicated by the starting position of the input signal will change. An example of the relationship among the starting address, data size setting, and the I/O signals in the input/output data setting items are shown below.

Allocation example 1

In this sample, the used channel No. is 1 and node No. of this controller is 5.
In order to obtain the all data from node 1 to node 5, head address of input data setting item is 0 and data size is 10 words.
The relationship between each node data obtained by this controller and input signals is shown in the following table.



Example of an allocation in the common memory

Node No.	Output (set for each node)		Input (on the side of the node 5)	
	Offset	Number of words	When the software PLC is enabled	When the software PLC is disabled
1	0	1	X1000 to X1015	I161 to I176
2	1	2	X1016 to X1047	I177 to I208
3	3	3	X1048 to X1095	I209 to I256
4	6	2	X1096 to X1127	I257 to I288
5 (the own node)	8	2	X1128 to X1159	I289 to I320

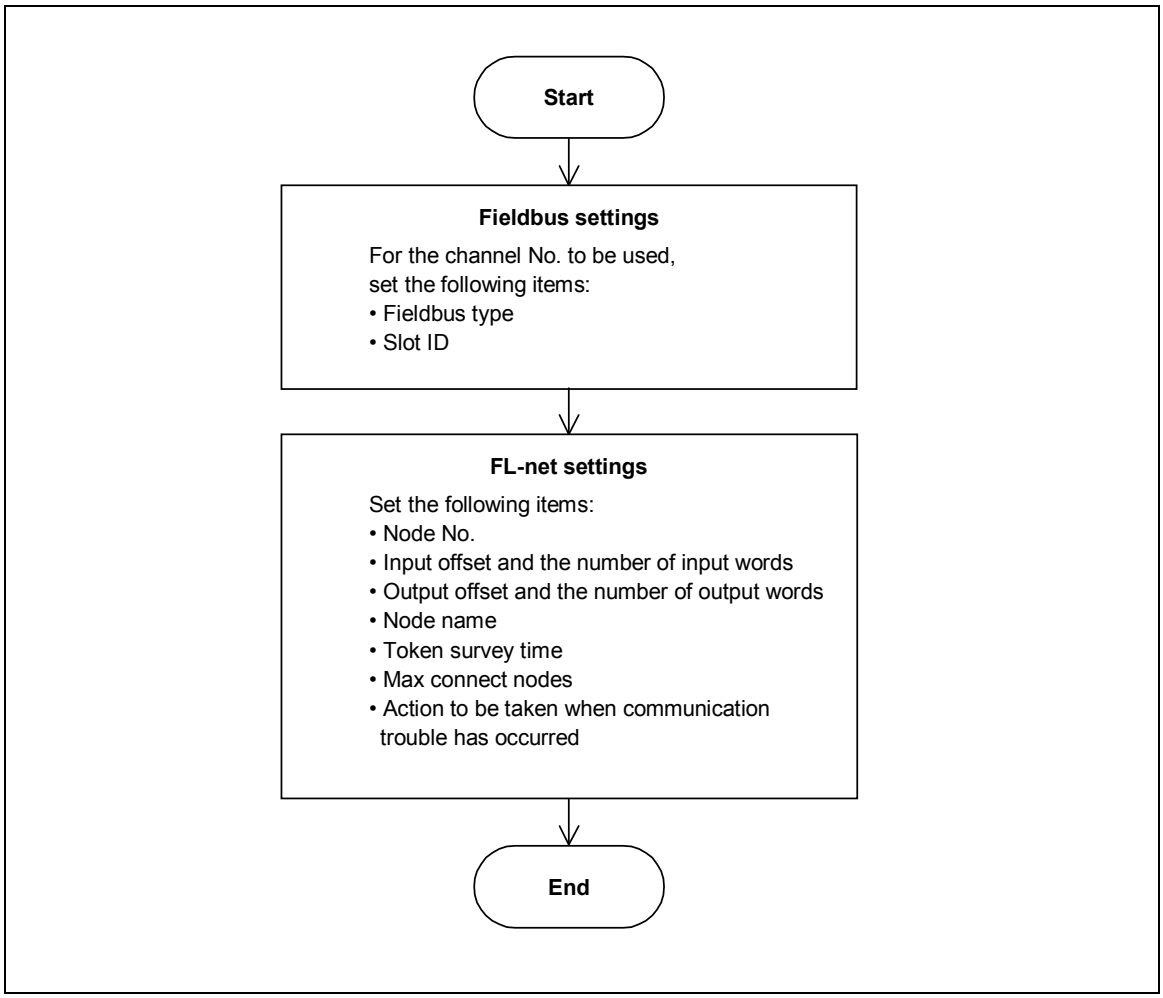
Allocation example 2

Allocation of common memory is the same with the example 1. When node 3 data is allocated at the top of input signals and all data of node3 and node 4 is needed to be obtained, head address of input data setting item is 3 and data size is 5 words. The relationship between each node data obtained by this controller and input signals is shown in the following table.

Node No.	Output (set for each node)		Input (on the side of the node 5)	
	Offset	Number of words	When the software PLC is enabled	When the software PLC is disabled
1	0	1	None	None
2	1	2	None	None
3	3	3	X1000 to X1047	I161 to I208
4	6	2	X1048 to X1079	I209 to I240
5 (the own node)	8	2	None	None

10.4 Setting Procedure

In the setting works, the fieldbus settings and the FL-net settings are performed as shown bellow.



Setting procedure flowchart

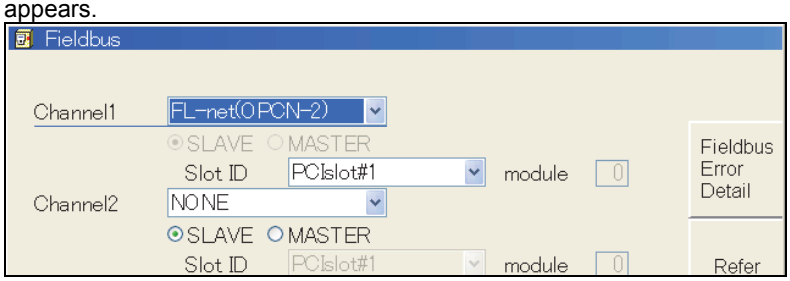
POINT

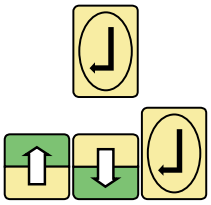
- Care must be taken not to assign the same node number, output offset, or number of output words already assigned to another node.
- When the PLC is used to input and output the FL-net signals, the PLC settings must be performed as well. For further details, refer to “Software PLC manual”.

10.4.1 Fieldbus settings

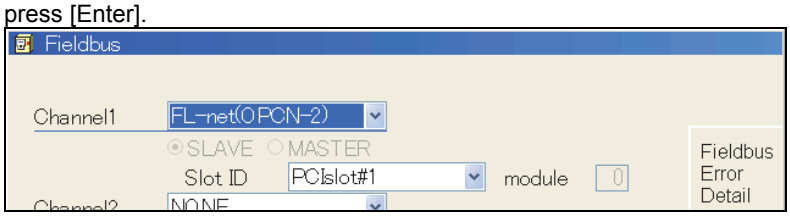
Protocol settings

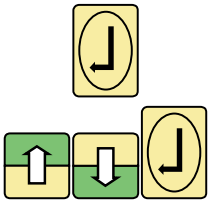
1 **Select <Constant Setting> – [8 Communication] [3 Fieldbus].**
>>The screen used to perform the various communications settings shown below appears.



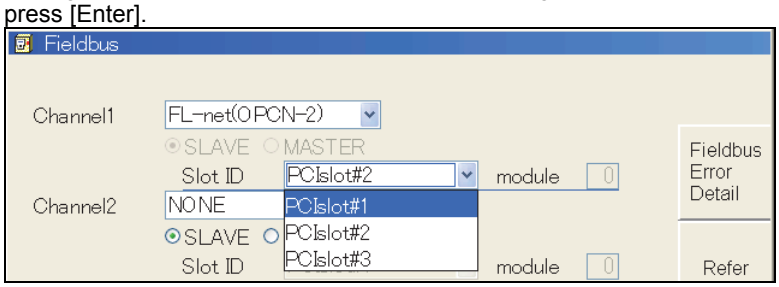


3 **Align the cursor with the combo box of the channel in which FL-net (OPCN-2) is to be used, and press [Enter].**
>> Align the cursor with “FL-net (OPCN-2)” using the [Up] or [Down] cursor key, and press [Enter].

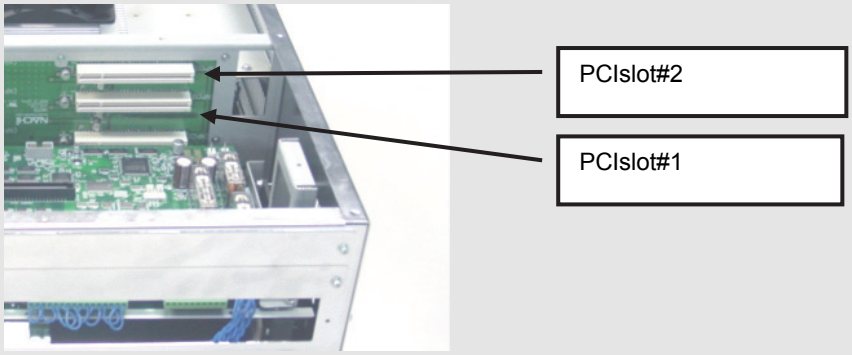




4 **Align the cursor with the slot ID (combo box) of the channel in which FL-net (OPCN-2) is to be used, and press [Enter].**
>> Align the cursor with the slot ID concerned using the [Up] or [Down] cursor key, and press [Enter].



The slot ID is an ID to check the insert position of the board.
The lower slot is "PCIslot#1" and the upper slot is "PCIslot#2"



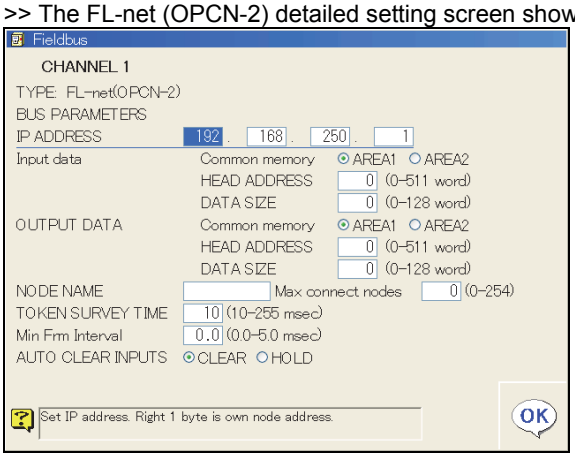
Now proceed to the FL-net settings.

10.4.2 FL-net (OPCN-2) settings

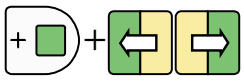
Channel settings

1 **On the [3 Fieldbus] screen, align the cursor with the channel where the FLnet has been selected, and press f9 <Refer>.**

>> The FL-net (OPCN-2) detailed setting screen shown below now appears.



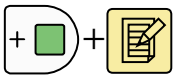
2 **Specify "IP address."**



3 **Specify the area for inputting the data.**
Align the cursor with “Common memory” pressing the [Enable] cursor key and using the [Left] or [Right] cursor key.
Specify whether to use areas 1 or 2 of the common memory.

4 **Specify "Input offset," "Input word."**

5 **Specify "Output offset" and "Output word."**

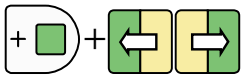


6 **Specify the "Node name."**
Pressing the [Enable] cursor key and the [EDIT] cursor key, open the soft keyboard screen. Specify the node name that is to be used in the network within ASCII 10 characters, and press [Enter].

7 **Specify the "Max connect nodes."**

8 **Specify the "Token monitoring time."**

9 **Specify the "Minimum admissible frame interval."**
Set the interval until one’s node is transmitted, after it has been received.

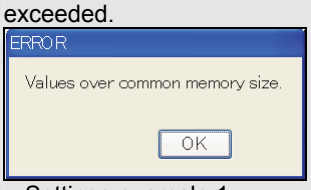


10 **Align the cursor with "AUTO CLEAR INPUTS," use the [ENABLE] and [Left] or [Right] cursor keys to switch to the radio buttons (a horizontal row of selector buttons), and select the signal status for when communication trouble has occurred.**

11 **Upon completion of the settings, press f12 <OK>.**
>> The display now returns to the [3 Fieldbus] setting screen.

POINT

The message shown above announces that the usable size of the common memory has been exceeded.



■ Settings example 1
Input data – [Input offset] = “500”, [Input word] = “32”
Output data – [Output offset] = “500”, [Output word] = “2”
>> The area, due to the input setting item of the leading address and the setting of the data size, is exceeding the usable common memory area 1 (512 words).

■ Settings example 2
Input data – [Input offset] = “0”, [Input word] = “256”
Output data – [Output offset] = “8177”, [Output word] = “256”
>> The area, due to the output setting item of the leading address and the setting of the data size, is exceeding the usable common memory area 2 (8192 words).

13 **Press f12 <Complete> on the fieldbus setting screen.**
>> The fieldbus begins to be initialized.

POINT

The FL-net begins to be initialized.

If an erroneous setting is found, a message is displayed.
Error messages are also displayed, for instance, when an IP address is assigned to two or more channels of this controller or when the input/output signal allocation settings result in violation.

Input / output allocation when software PLC “disabled”

Items	Contents
IP address	This is specifying the IP address of own node. Lower byte of IP address is own node No.(1 to 254). Node No. is used to specify the node in the network so same node No. must not exist in one network. If same No. is defined, correct communication never be performed. Node No. 250 to 254 is reserved for the FL-net maintenance. Factory setting: 192.168.250. 1
Input data Common memory	This is specifying which common memory is used “AREA1” or “AREA2”. “AREA1” has 512 words, “AREA2” has 8192 words.
Input data Head address	This is specifying the offset of common memory for the input signals inputted to this controller. Input range is 0 to 511 for “AREA1”, 0 to 8191 for “AREA2”. Input unit; word
Input data Data size	This is specifying the input data size of the common memory which addressed by “Head address”. Maximum 128 words can be defined. Input unit; word
Output data Common memory	This is specifying which common memory is used “AREA1” or “AREA2”.
Output data Head address	This is specifying the offset of common memory when allocating the area of own node. Input unit; word
Output data Data size	This is specifying the output data size. Input unit; word
Node name	This is specifying the node name used in the network. (within 10 characters)

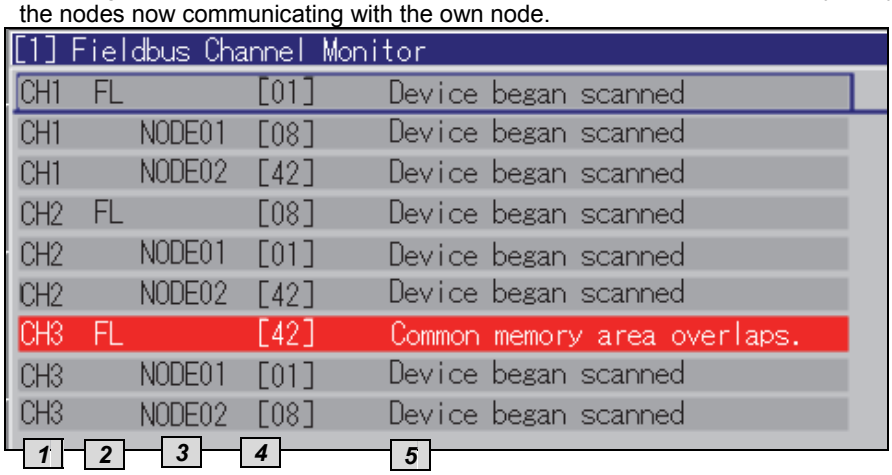
Items	Contents
Max connect nodes	This is specifying the maximum node No. to be obtained data by this controller. • Participation for the network is checked for every node from node address 1 to the designated address, and data is obtained. If any node was no-participation, I/O link error (E0960) is detected. • When set to “0”, participation for the network is checked for every node from node address 1 to 254. If any node was no-participation, I/O link error is not detected. Higher setting value makes this controller's software CPU load higher, because participation checking and data obtaining needs longer time. When set to “0”, CPU load is similar with when set to “254”. Then robot motion may be affected by the FL-net communication. Real needed value for the network should be set here.
Token survey time	This is specifying the time since getting “token” until the releasing. If “token” is not scanned normally, make this value bigger. In general this is not needed to be changed from the factory setting. Factory setting: 10msec (Input range : 10 to 255 msec)
Min Frm time	This is specifying the waiting time between the frame when transmitting cyclic data. This is needed no be set If cyclic data exceeds one frame (1024 bytes). Factory setting: 0msec (Input range : 0.0 to 5.0 msec)
Auto clear inputs	This is specifying whether clear the input data or hold the input data from FL-net（OPCN-2）when communication error occurs. Clear : Input data of the node which left from the network is cleared to 0. Hold : When error occurs, all input data to this controller are hold.

10.5 Troubleshooting

10.5.1 Fieldbus monitor

The communication status of the FL-net can be confirmed in the monitor.

1 **Select <monitor 2> – [38 Fieldbus monitor].**
>> A setting screen such as the one shown below appears. The monitor displays only the nodes now communicating with the own node.



POINT

Furthermore, to confirm the I/O signals, if the PLC is under the condition where it is enabled, the signals can be checked in the [ladder monitor].
If the PLC is disabled, the signals can be checked in the [user inputs monitor] or [user outputs monitor].

1 Channel number

2 Protocol “FL”:FL-net(OPCN-2）

3 Connected node “NODE” : The node communicating with the own node.

4 Node address

5 Communication status

Display	Contents
Device began scanned	Communicating without problem.
Device idle(not begin scanned)	Communication paused.
Common memory area overlaps.	Common memory area overlap is detected. Output from own node is paused. Input from other nodes is receiving.
Own node address overlaps.	Communication paused because own node address overlaps.
ERROR DEVICE	Device error.

10.5.2 Error detection

When this controller detects an error, it displays one of the error messages listed below.

No.	E0956
Message	The communication error occurred.
Cause	When initializing the FL-net board, a parameter with an error was detected.
Remedy	Check the IP address, the leading address and the data size of the output data setting item, and the token monitoring time setting. When this error has been displayed, the robot's PLAYBACK operation cannot be performed.

No.	E0958
Message	The error was detected with the self check of a communication board.
Cause	The FL-net (OPCN-2) board may have a defect.
Remedy	Replace the FL-net (OPCN-2) board. When this error has been displayed, the robot's PLAYBACK operation cannot be performed.

No.	E0959
Message	A communication board is not found.
Cause	The FL-net (OPCN-2) board specified on the "Constant Setting" screen cannot be found.
Remedy	Check the slot ID among the field bus hardware settings. If this error occurs even if the FL-net (OPCN-2) board is connected correctly, the FL-net (OPCN-2) itself may have some defects. Replace the FL-net (OPCN-2) board. When this error has been displayed, the robot's PLAYBACK operation cannot be performed.

No.	I3960
Message	A part or all I/O links are stopping.
Cause	I/O links are stopping.
Remedy	Refer to the E0960.

(Supplement)
For E0960 and I0960, only the one that is selected in the screen of “Error details” is outputted.
(See also; “10.5.3Detail Fieldbus Error Setting”)

No.	E0960
Message	A part or all I/O links are stopping.
Remedy	The I/O link has stopped due to the causes such as the following. [Cause 1] Disconnection of the cable. [Remedy 1] Check whether the cable has been unplugged. If the robot was playing back, it will stop. The robot will recover by solving the cause to this problem. [Cause 2] There is a mistake in the IP address setting. [Remedy 2] Check whether the IP address is correct. If the IP address is duplicated with another node, reset it and initialize the FL-net or restore the power of this controller. [Cause 3] There are no nodes within the network to perform communication with this controller. [Remedy 3] If the robot was playing back, it will stop. Under the condition where values from 1 to 254 are set to the maximum node connection, the robot will recover when all of the nodes, until the maximum node that has been set, participate in the network. If the maximum node connection is set to “0”, the robot will recover if more than one node participates in the network. [Cause 4] Under the condition where a value from 1 to 254 is set to the maximum node connection, there is a node within the set range that is not participating in the network. [Remedy 4] If the robot was playing back, it will stop. If the nonparticipating node joins the network, the robot can perform PLAYBACK operation. [Cause 5] Power failure of the network [Remedy 5] Check the power. [Cause 6] Failure of FL-net [Remedy 6] Change the FL-net board.

No.	E2961
Message	Setted area of common memory is overlapped.
Cause	The common memory’s area that was allotted in this controller is already being used by another node.
Remedy	After changing the allotment of this controller, to a consistent setting, reinitialize the FL-net or reinitialize the FL-net after changing the allotment of the node that is the cause of duplication. The robot cannot perform PLAYBACK operation when this error is displayed.

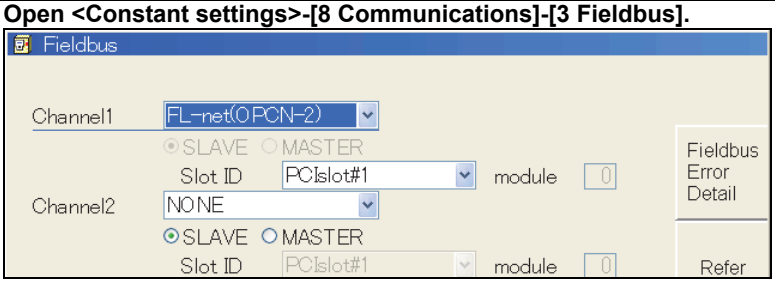
CAUTION

When an error occurs, the I/O may not be under a normal condition. For this reason, each type of interlock of the robots, jigs, etc. will not operate normally, and may be a cause of sudden, unexpected movements. Therefore, please be extremely careful.

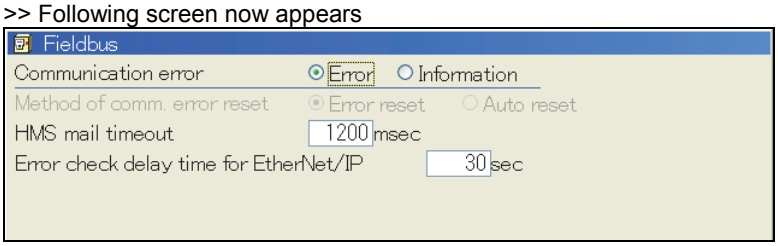
10.5.3 Detail Fieldbus Error Setting

For operations when an I/O link error occurs, the following settings can be made.
• Type of error when a communication error occurs
• Method of resetting the communication error when communication is recovered
The following section shows the method of settings.

1 Open <Constant settings>-[8 Communications]-[3 Fieldbus].



2 Then press the f-key < Fieldbus Error Detail>.
>> Following screen now appears



3 Sset the parameters referring to the table.

4 Press the f-key <Complete> to save the settings.

Fieldbus error settings

Item	Description	
Communication error	Select the error detection level for the I/O link error.	
	Error	E0960 occurs
	Information	I3960 occurs
Method of communication error reset	Select the reset method after a communication error occurs. If "" is set to "Error", this item cannot be selected.	
	Error reset	If “Error reset” is selected, the communication error will be held until it is reset.
	Auto reset	If “Auto reset” is selected, the communication error will be automatically reset.
HMS mail timeout	This item is not needed to be set.	
Error check delay time for Ethernet/IP	This item is not needed to be set.	

Chapter 11 Appendix

11.1 CFD controller I/O address table

11.1.1 Input signals

Logical input signals	Physical input signals	Remarks
I1～I32	X0000～X0031	Digital I/O board 1 (CNIN)
I33～I63	X0064～X0095	Digital I/O board 2 (CNIN)
I64～I96	X0096～X0127	Not used
I97～I104	X0128～X0135	Mini I/O board
I105～I160		No connection to the physical input signals
I161～I672	X1000～X1511	Fieldbus input CH1(512 points)
I673～I1184	X1512～X2023	Fieldbus input CH2(512 points)
I1185～I1696	X2024～X2535	Fieldbus input CH3(512 points)
I1697～I2048	X2536～X3047	Fieldbus input CH4(352 points)

(NOTE) The following address is used for the ***"System input signals (Fixed input signals)"***
X0032～X0063

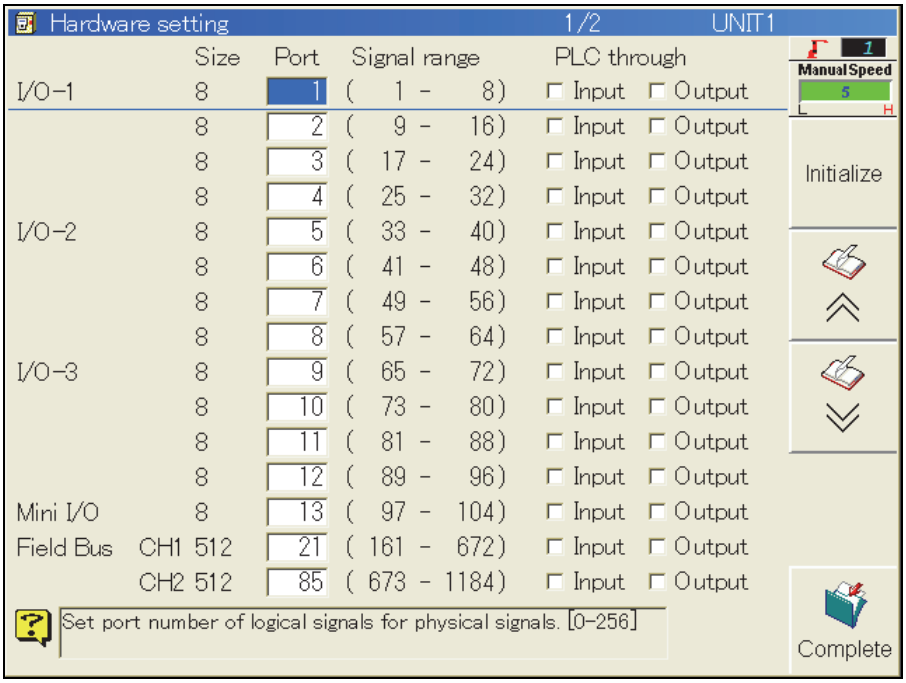
11.1.2 Output signals

Logical output signals	Physical output signals	Remarks
O1～O32	Y0000～Y0031	Digital I/O board 1 (CNOUT)
O33～O63	Y0064～Y0095	Digital I/O board 2 (CNOUT)
O64～O96	Y0096～Y0127	Not used
O97～O104	Y0128～Y0135	Mini I/O board
O105～O160		No connection to the physical input signals
O161～O672	Y1000～Y1511	Fieldbus output CH1(512 points)
O673～O1184	Y1512～Y2023	Fieldbus output CH2(512 points)
O1185～O1696	Y2024～Y2535	Fieldbus output CH3(512 points)
O1697～O2048	Y2536～Y3047	Fieldbus output CH4(352 points)

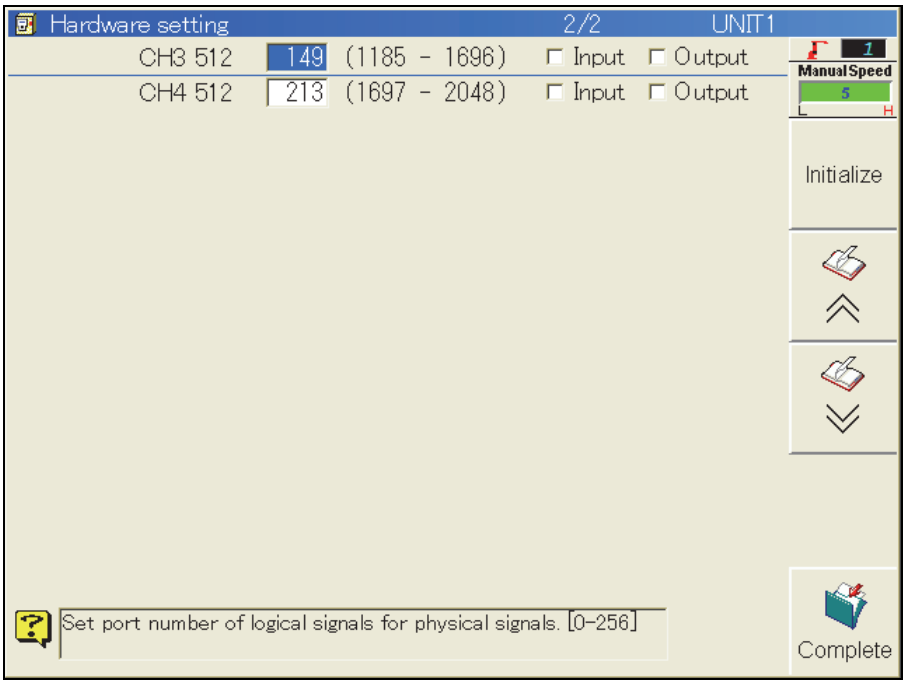
(NOTE) The following address is used for the ***"System output signals (Fixed output signals)"***
Y0032～Y0063

11.1.3 The initial setting of the “Hardware setting”

The initial setting (factory setting) for the menu of
<Constant setting> - [6 Signals] [15 Hardware setting] is shown as below.



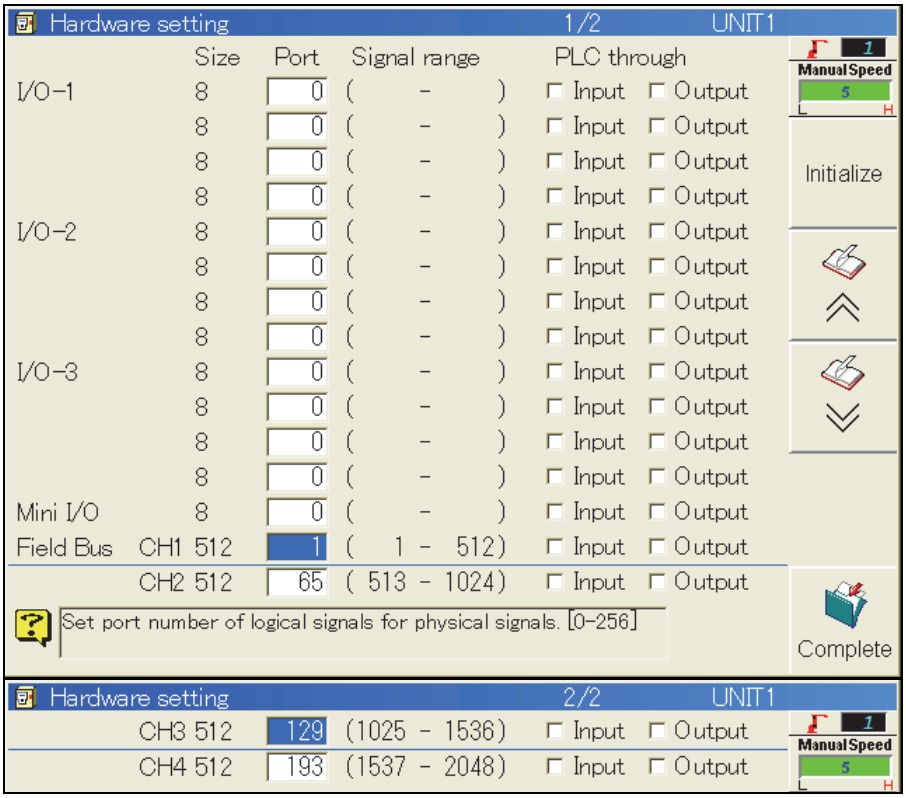
- In case of the CFD controller, the “I/O -3” cannot be used.
- In case of the CFD controller, ***“Mini I/O”*** is displayed. In case of the FD controller, ***“Arc IF-IO”*** is displayed. (Only the name is different. The hardware address is the same.)



Please be sure that CH4 has only 352 points.

11.1.4 How to use the all logical I/O via the Fieldbus

By making the setting like the following pictures, it is possible to connect the all logical I/O signals to the fieldbus (e.g. DeviceNet etc.). In this setting, it is possible to control the all I/O signals via only the fieldbus.



The connection table is shown as below.

Input signals

Logical input signals	Physical input signals	Remarks
I1～I512	X1000～X1511	Fieldbus input CH1(512 points)
I513～I1024	X1512～X2023	Fieldbus input CH2(512 points)
I1025～I1536	X2024～X2535	Fieldbus input CH3(512 points)
I1537～I2048	X2536～X3047	Fieldbus input CH4(512 points)

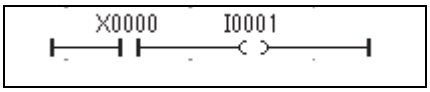
Output signals

Logical output signals	Physical output signals	Remarks
O1～O512	Y1000～Y1511	Fieldbus output CH1(512 points)
O513～O1024	Y1512～Y2023	Fieldbus output CH2(512 points)
O1025～O1536	Y2024～Y2535	Fieldbus output CH3(512 points)
O1537～O2048	Y2536～Y3047	Fieldbus output CH4(512 points)

11.1.5 An example for the Software PLC ladder program

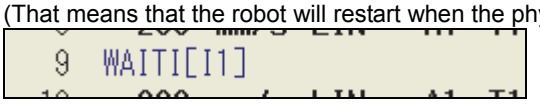
When using the ***"SOFTWARE PLC"*** function, it is necessary to make the connections between the logical I/O signals and the physical I/O signals one by one like the followings. For details, refer to the instruction manual for the SOFTWARE PLC function.

An example of the input circuit



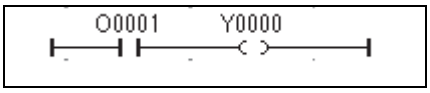
In this example, the logical input signal "I1" will turn ON when the physical input signal "X0000" turns ON.

To use the logical input signal for the "Interlock" operation in a robot program, please use "FN525 WAITI" etc.
In the following example, the robot will stop at the step 9 and wait for the logical input signal "I1" to turn ON.
(That means that the robot will restart when the physical input signal X0000 turns ON)



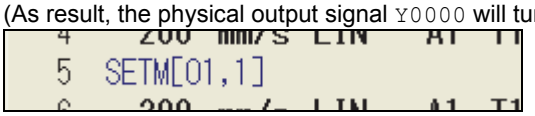
However, the interlock related functions (like FN525 etc.) are available only for "***General input signals***". (That stands for the signals that are not assigned to specific functions as "***Condition input signals***") For example, if the input signal is assigned to "***Ext.unit play stop***", it cannot be used for the FN525.

An example of the output circuit



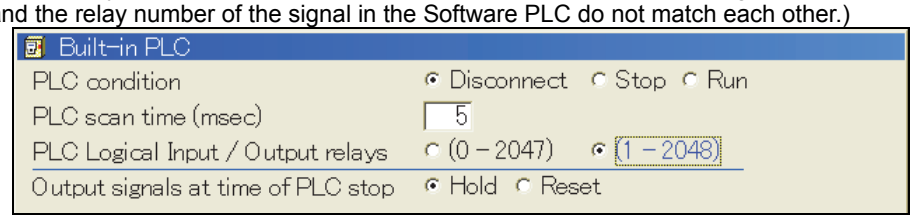
In this example, the physical output signal "Y0000" will turn ON when the logical output signal "O1" turns ON.

To turn ON a logical output signal, use "FN105 SETM" etc.
In the following example, the logical output signal "O1" will turn ON at the step 5.
(As result, the physical output signal Y0000 will turn ON.)



However, the ON/OFF operation like this is applicable only for "***General output signals***" (The signals that are not assigned as "***Condition output signals***"). Please be careful.

(Supplement)
In this page, the setting of <Constant Setting> - [1 Control Constants] [6 Built-in PLC] [PLC Logical Input / Output relays] is ***"1-2048"*** to make the explanation easier. (If this setting is "0-2047", the logical I/O signal number and the relay number of the signal in the Software PLC do not match each other.)



NACHI NACHI-FUJIKOSHI CORP.			http://www.nachi-fujikoshi.co.jp/
Japan Main Office	Phone: +81-3-5568-5245	Fax: +81-3-5568-5236	Shiodome Sumitomo Bldg. 17F, 1-9-2 Higashi-Shinbashi Minato-ku, TOKYO, 105-0021 JAPAN
Nachi Robotic Systems Inc. (NRS)			http://www.nachirobotics.com/
North America Headquarters	Phone: 248-305-6545	Fax: 248-305-6542	42775 W. 9 Mile Rd. Novi, Michigan 48375, U.S.A
Indiana Service Center	Phone: 502-517-1553	Fax: 317-535-3659	715 Pushville Road, Greenwood, Indiana, 46143, U.S.A.
South Caroline Service Center	Phone: 864-458-8000	Fax: 864-458-8256	1310 Garlington Road, Suite L, Greenville, SC 29615, U.S.A.
Canada Branch Office	Phone: 905-760-9542	Fax: 905-760-9477	89 Courtland Ave., Unit No.2, Concord, Ontario, L4K 3T4, CANADA
Mexico Branch Office	Phone :+52-555312-6556	Fax:+52-55-5312-7248	Urbina No.54, Parque Industrial Naucalpan, Naucalpan de Juarez, Estado de Mexico C.P. 53489, MEXICO
NACHI EUROPE GmbH			http://www.nachi.de/
Central Office Germany	Phone: +49-2151-65046-0	Fax: +49-2151-65046-90	Bischofstrasse 99, 47809, Krefeld, GERMANY
U.K. branch	Phone: +44-0121-423-5000	Fax: +44-0121-421-7520	Unit 3, 92, Kettles Wood Drive, Woodgate Business Park, Birmingham B32 3DB, U.K.
Czech branch	Phone: + 420-255-734-000	Fax: +420-255-734-001	Obchodni 132, 251 01 Cestlice, PRAGUE-EAST CZECH REPUBLIC
NACHI AUSTRALIA PTY. LTD.			http://www.nachi.com.au/
Robotic Division & Victoria office	Phone: +61-(0)3-9796-4144	Fax: +61-(0)3-9796-3899	38, Melverton Drive, Hallam, Victoria 3803, , AUSTRALIA
Sydney office	Phone: +61-(0)2-9898-1511	Fax: +61-(0)2-9898-1678	Unit 1, 23-29 South Street, Rydalmere, N.S.W, 2116, AUSTRALIA
Brisbane office	Phone: +61-(0)7-3272-4714	Fax: +61-(0)7-3272-5324	7/96 Gardens Dr,Willawong,QLD 4110, , AUSTRALIA
NACHI SHANGHAI CO., LTD.			http://www.nachi.com.cn/
Shanghai office	Phone: +86-(0)21-6915-2200	Fax: +86-(0)21-6915-2200	11F Royal Wealth Centre, No.7 Lane 98 Danba Road Putuo District, Shanghai 200062, China
NACHI KOREA			http://www.nachi-korea.co.kr/
Seoul office	Phone: +82-(0)2-469-2254	Fax: +82-(0)2-469-2264	2F Dongsan Bldg. 276-4, Sungsu 2GA-3DONG, Sungdong-ku, Seoul 133-123, KOREA

Robot Division
1-1-1, FUJIKOSHIHONMACHI, TOYAMA CITY, JAPAN 930-8511
Phone +81-76-423-5137
Fax +81-76-493-5252

Original manual is written in Japanese.