HYUNDAI
HEAVY INDUSTRIES CO.,LTD.

WARNING

INSTALLATION SHOULD ONLY BE PERFORMED BY QUALIFIED INSTALLATION PERSONNEL AND MUST CONFORM TO ALL NATIONAL AND LOCAL CODES

Hyundai Robot

Hi5PI140101FMEN1

Hi5 Controller Function Manual

BD525 PROFINET-IO

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Printed in Korea – Jan. 2014 1st Edition

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1 Overview

1.1. Advance knowledge

In order to understand this manual clearly, the following information should be possessed.

- Method for using the Hi5 robot controller
- Basic knowledge about the PROFINET

1.2. Overview of PROFINET IO

PROFINET IO is an Ethernet-based open-type industrial communication protocol that has progressively evolved from PROFIBUS-DP and industrial Ethernet. It conforms to the provider/consumer model for data exchange and can be subdivided into three classes of product groups, namely, IO-Controller, IO-Device, and IO-Supervisor.

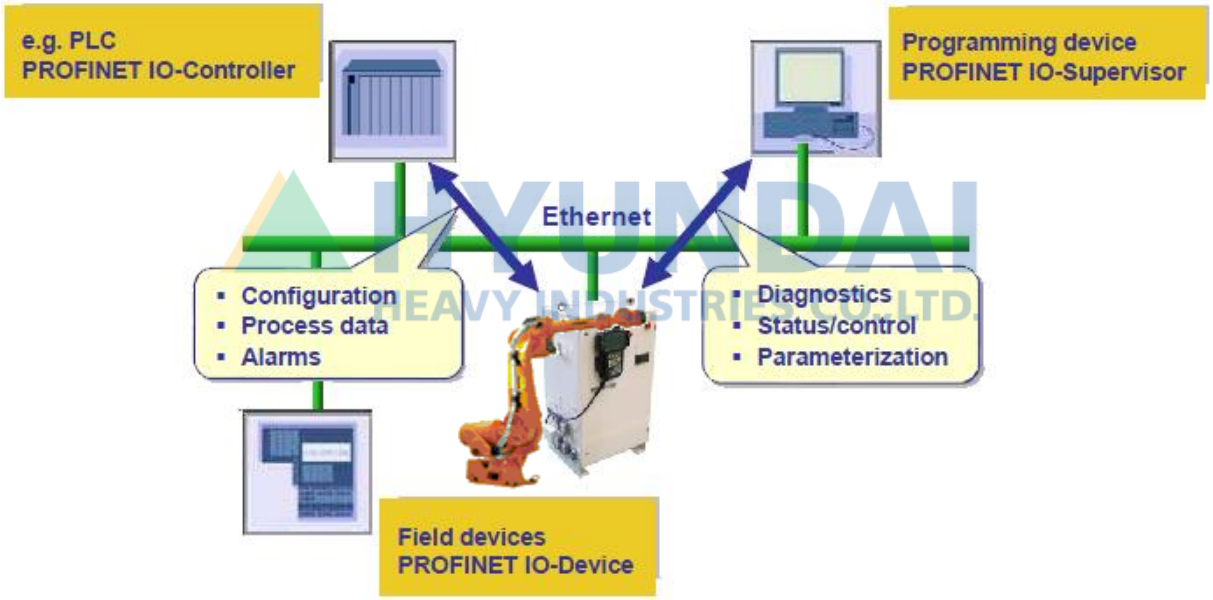

Figure 1.1 PROFINET IO communication connect

(1) IO-Controller
Equivalent to the existing PROFIBUS-DP Class1 Master and is operated by an automated program along with PLC. IO-Controller provides output data to the IO-Devices that are assigned to it and consumes data inputted by the IO-Devices.

(2) IO-Device
Equivalent to the existing PROFIBUS-DP Slave and is connected through PROFINET IO to the IO-Controller along with PLC. IO-Devices provide input data to IO-Controller and consume data outputted by IO-Controller.

(3) IO-Supervisor
Equivalent to the existing PROFIBUS-DP Class 2 Master, and is composed of programming device, PC, HMI, etc., for the purpose of network configuration and diagnosis.

1.3. Appearance of the BD525 board

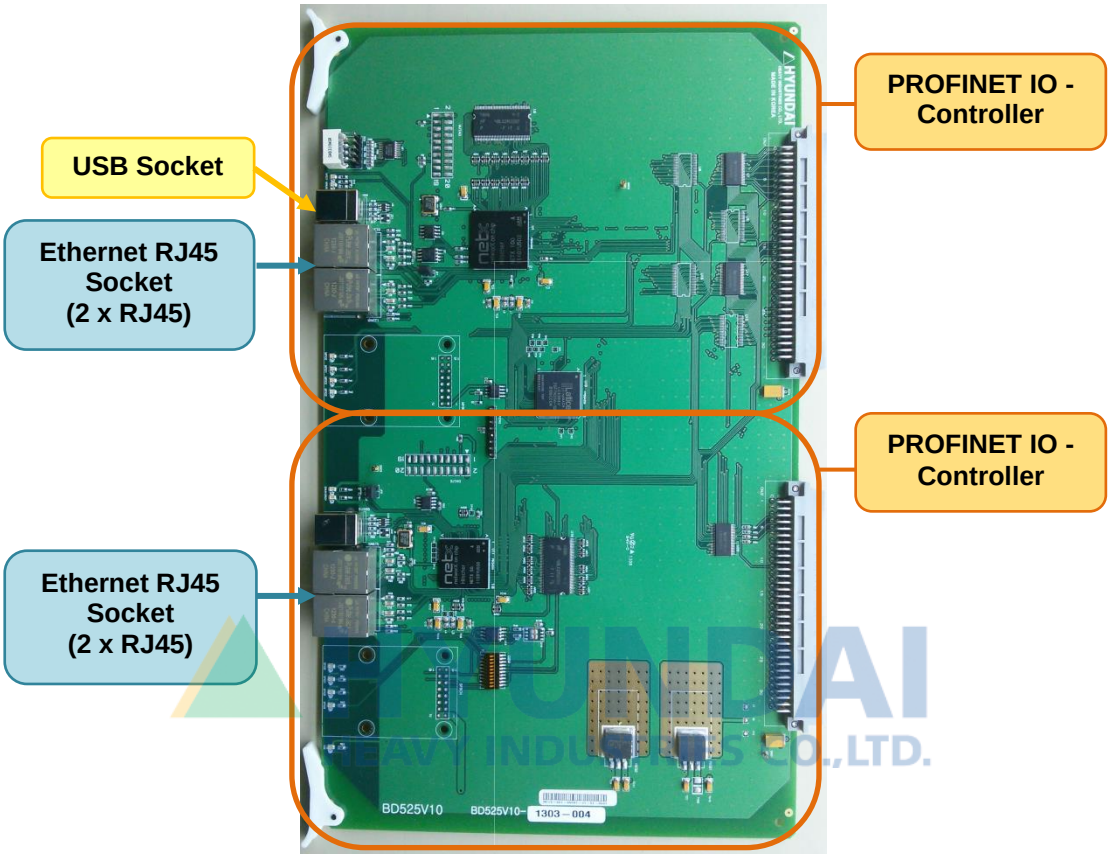

Figure 1.2 BD525 PROFINET IO communication board

BD525 board is composed of PROFINET IO-Controller and ROFINET IO-Device and can be supplied as either IO-Controller or IO-Device; assembled during production as needed.

1.3.1. PROFINET IO-Controller

- It has two RJ45 connectors to connect with PROFINET IO. As they are connected internally with an embedded switch, it is possible to use either of them to connection communication cables.
- For network configuration of the PROFINET IO-Controller of BD525, you should use separate software called SYCON.net. To connect with the configuration device in which SYCON.net is installed, a USB port is provided.

1.3.2. PROFINET IO-Device

- To connect with PROFINET IO, it has two RJ45 connectors that are connected internally with an embedded switch. To connect with the communication cable, any of them can be used.
- PROFINET IO-Device of BD525 does not require separate configuration software. The USB socket of the IO-Device is used for manufacturer maintenance.

1.4. BD525 PROFINET IO specification

Size of input and output data	Max.120Bytes
Input and output data mapping	PROFINET IO-Controller = FB1 object PROFINET IO-Device = FB3 object
Min. cycle time	1ms
Communication speed	10/100 Mbit/s (Auto-Negotiation supported)
Data transport layer	Ethernet II, IEEE 802.3
Integrated switch	Supported
DCP function	Supported

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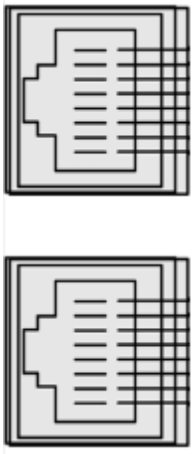
2 Ethernet Connection

2.1. Communication connector

BD525 provides two RJ45 sockets each for both IO-Controller and IO-Device to connect with PPROFINET IO.
Two Ethernet ports are connected internally through a switch.



Pin No.	Signal	Meaning
1	TD+	Sent data +
2	TD-	Received data -
3	RD+	Received data +
4	No use	
5	No use	
6	RD-	Received data -
7	No use	
8	No use	

Figure 2.1 RJ45 socket pin map

2.2. Communication cable

Cables of CAT5 or higher grade and RJ45 connectors need to be used for connecting the BD525 PROFINET IO board, through a network, with a hub, switches and other PROFINET IO devices. As the BD525 board supports the auto crossover function, direct or crossover connection can be made as necessary.

- When to be connected with a hub or a switch

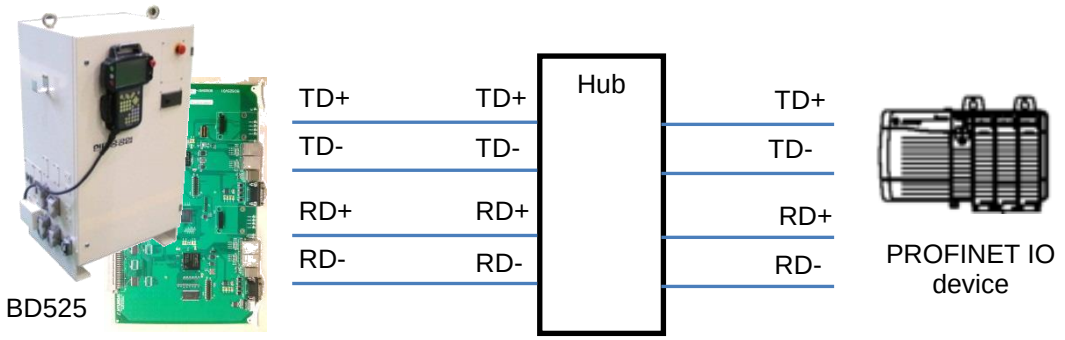


Figure 2.2 Connecting Direct cable

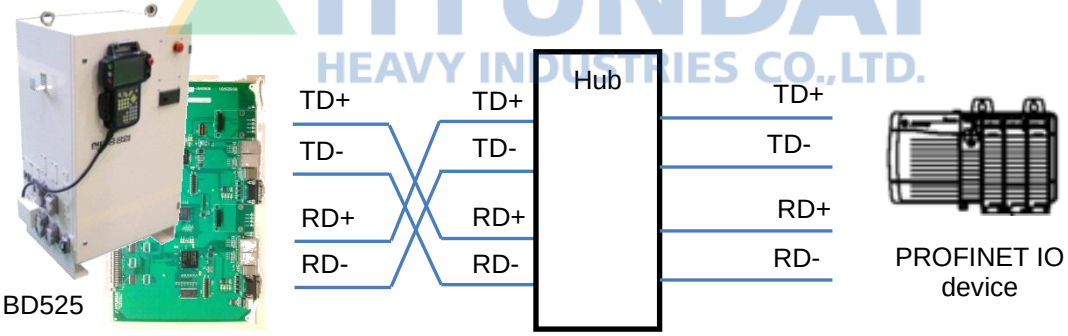


Figure 2.3 Connecting Crossover cable

■ When to be directly connected with an PROFINET IO device

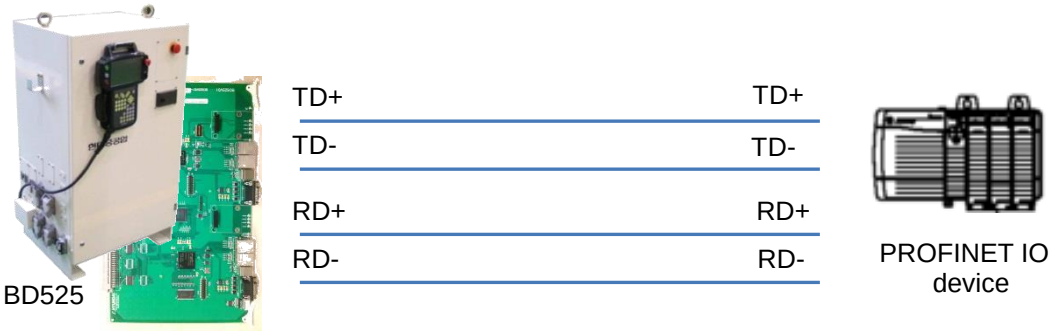


Figure 2.4 Connecting Direct cable

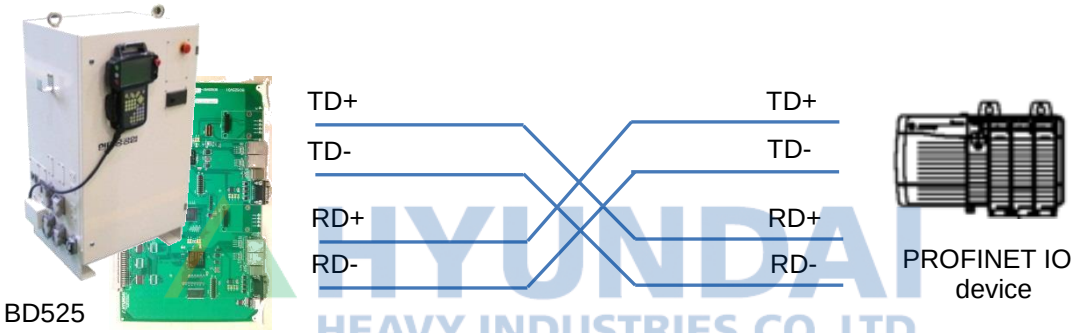


Figure 2.5 Connecting Direct cable

In order to increase noise immunity, **it is recommended to use STP (Shielded Twisted Pair) cables**. For details of cable wiring, please refer to the PNO installation guide.

3

PROFINET IO-Device Setting & Diagnosis

3.1. PROFINET IO-Device setting

It is required to set Device name and the size of input and output data to use an PROFINET IO-Device as shown in the following procedure.

(1) Select 『[F2]: System』 → 『2: Control parameter』 → 『2: Input/Output signal setting』 → 『14: BD525 real-time Ethernet setting and diagnosis』.

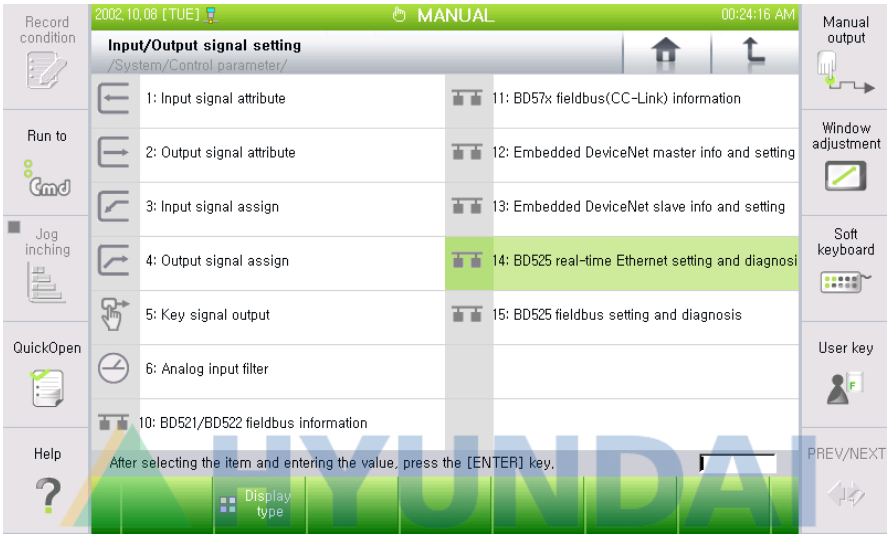


Figure 3.1 Real time Ethernet setting and diagnosis menus

(2) As the PROFINET IO-Device corresponds to Channel 3, Use the 『[F3]: Previous』 or 『[F4]: Next』key to shift to Channel 3 and then check whether the Device Type shows “PROFINET IO Device”.

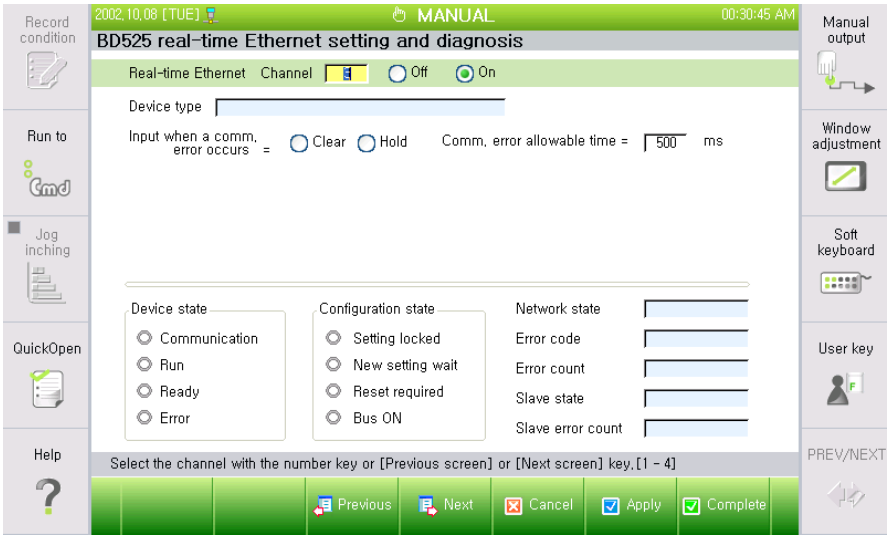


Figure 3.2 PROFINET IO-Device setting screen

(3) Input device name. The node is identified with the device name by PROFINET IO-Controller. Communication becomes available if the name is the same as the one used in the configuration software of PROFINET IO-Controller in STEP 7.

(4) Set size of I/O based on PROFINET IO-Controller. The input pertains to FB3.Y. The output pertains to FB3.X of the robot controller. The default size of the input and output data is 120 bytes.

(5) Configure handling option of input data in case of communication errors. If it is set as Clear, all FB3.X's will be cleared to 0 in case of a communication error. If it is set as Hold, the last valid value will be maintained in case of a communication error.

(6) In order to use the PROFINET IO-Device, shift it to the “On” position and then click the “Apply” or “Complete” button.

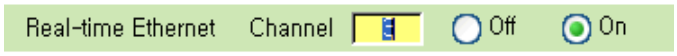
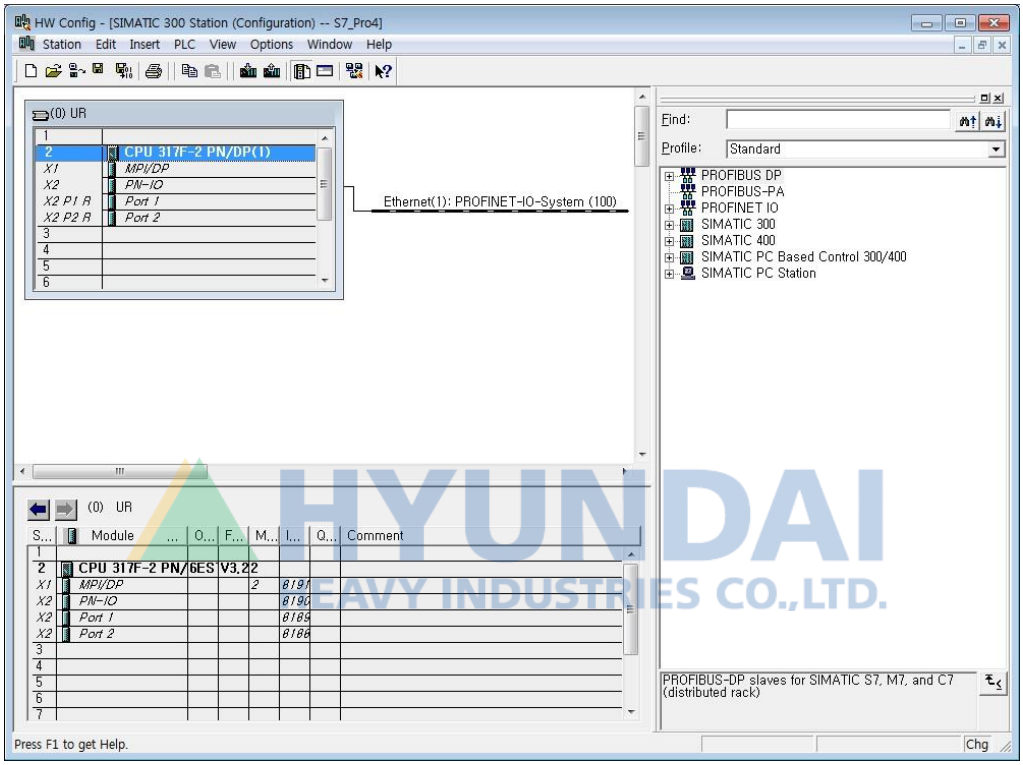


Figure 3.3 Function On/Off setting screen

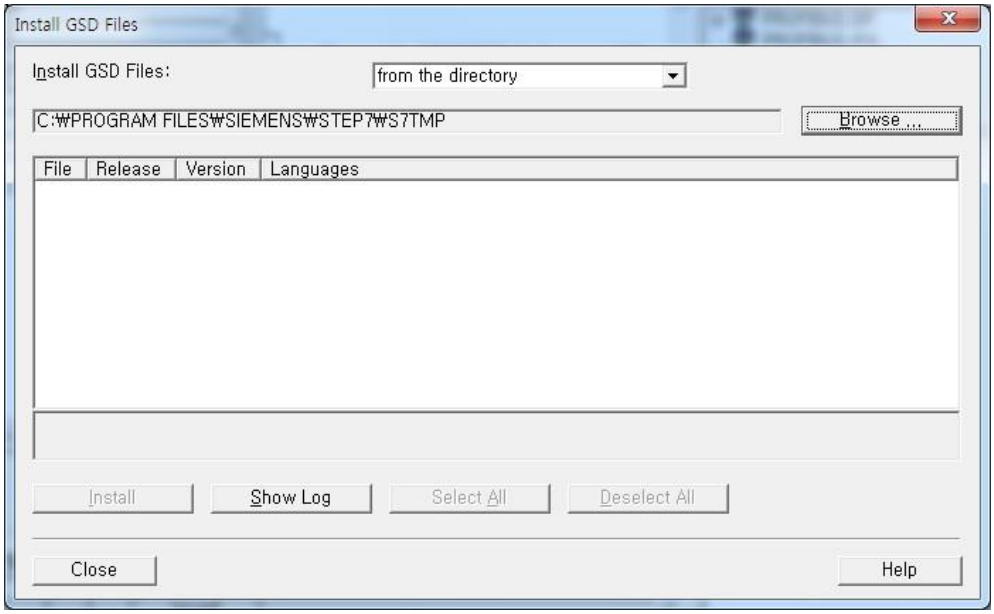
3.2. STEP7 PROFINET IO-Device setting

The following is an example of the configuration method of connecting PROFINET IO-Device of the Hi5 robot controller using STEP 7.

(1) Run 『HW Config』 of STEP 7.

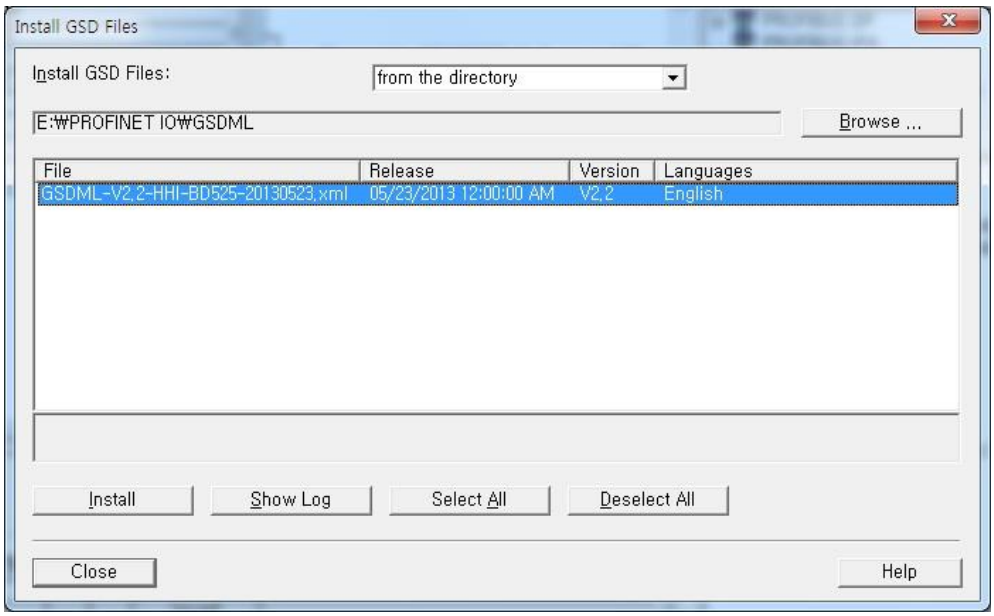


(2) In the 『Option』 menu list, click 『Install GSD File』.



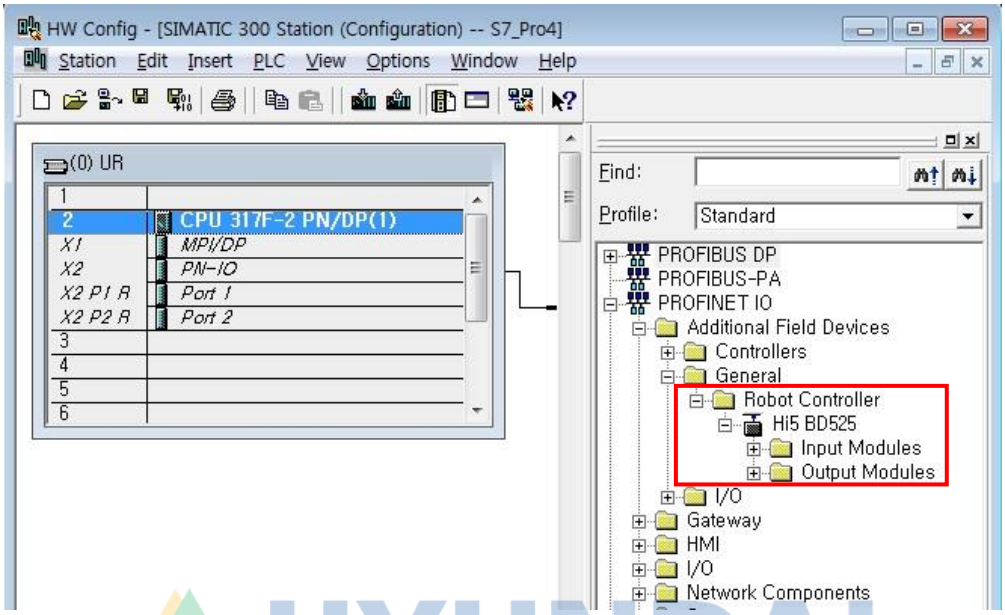
(3) In the 『Install GSD Files』 dialog box, select 『from the directory』 and click the 『Browse』 button.

(4) Select the PROFINET IO-Device GSDML file of Hi5 controller and click the 『install』 button. When the warning message appears, confirm and click the 『Yes』 button.

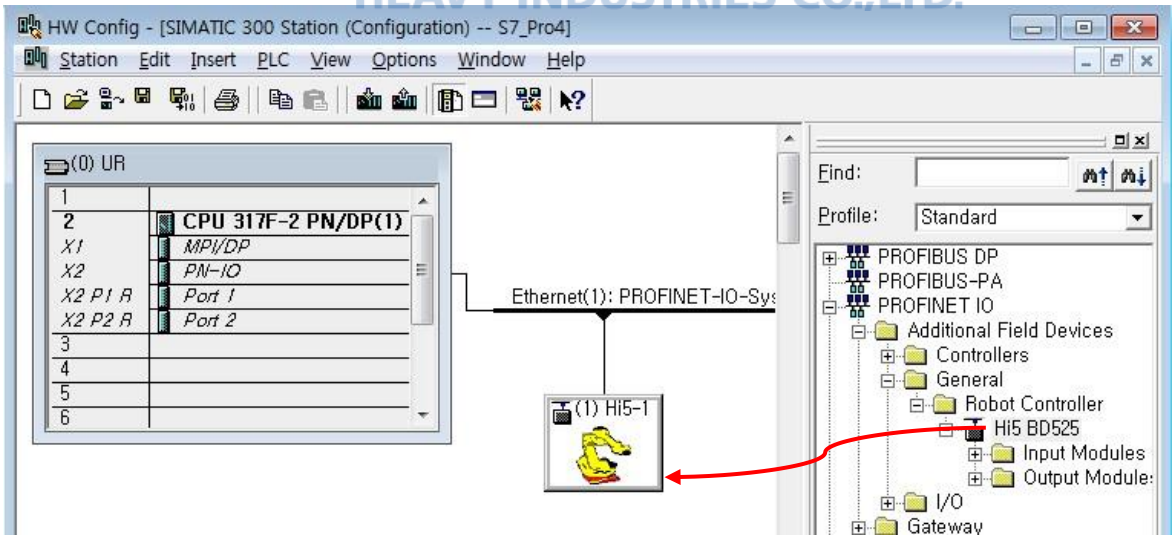


(5) When the GSDML file of Hi5 controller has been installed, click 『OK』, and click the 『Close』 button of 『Install GSD Files』.

(6) In 『PROFINET IO\Additional Field Devices\General\Robot Controller』 of the 『Catalog』 window under 『HW Config』, check for the Hi5 BD525 item.

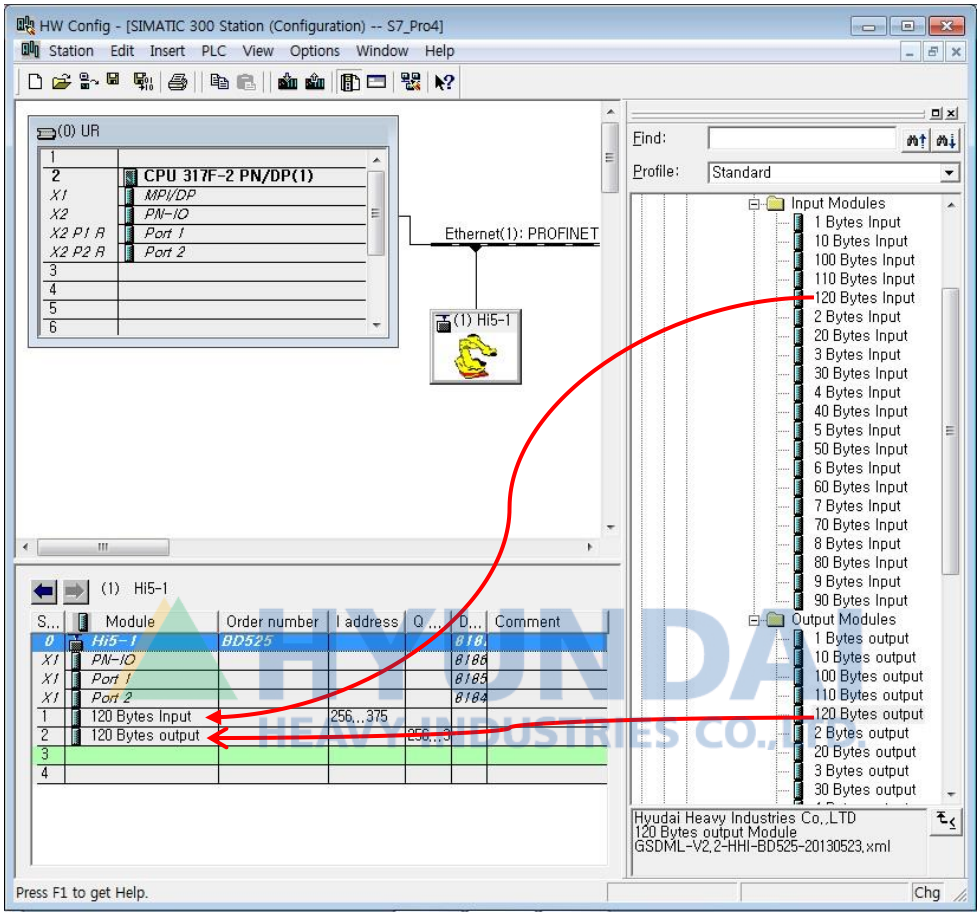


(7) Drag and drop Hi5 BD525 to the 『PROFINET IO』 of 『HW Config』.



(8) In the BD525 device of the 『Catalog』 window, expand the 『Input Modules』 folder and the 『Output Modules』 folder.

(9) Click the Hi5 BD525 icon of the PROFINET IO bus. Drag 120 bytes input to slot 1 and drag 120 bytes output to slot 2 to match the I/O size configured at the Hi5 controller.



Reference)

The default size of the input data of the Hi5 controller is 120 bytes. If you have modified configuration of the I/O size of the Hi5 controller, you have to the drag input data size, which matches the modified I/O size, to the pertaining slot.
When input data size is 1~9, 10 bytes, 20 bytes, 30 bytes, 40 bytes, 50 bytes, 60 bytes, 70 bytes, 80 bytes, 90 bytes, 100 bytes, 110 bytes, or 120 bytes, the input module will use slot 1. Otherwise, two slots (slot 1 and slot 2) will be used as follows, and the output module will use slots from slot 3.

- slot 1 = input data size / 10
- slot 2 = input data size % 10

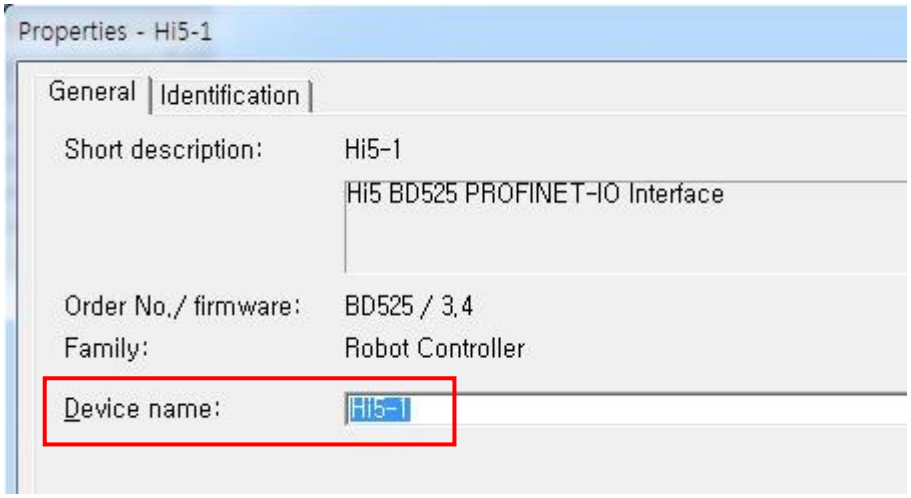
When output data size is 1~9, 10 bytes, 20 bytes, 30 bytes, 40 bytes, 50 bytes, 60 bytes, 70 bytes, 80 bytes, 90 bytes, 100 bytes, 110 bytes, or 120 bytes, the output module will use only one slot. Otherwise, two slots will be used as follows. (n: starting number of output module slot).

- slot n = output data size / 10
- slot n+1 = output data size % 10

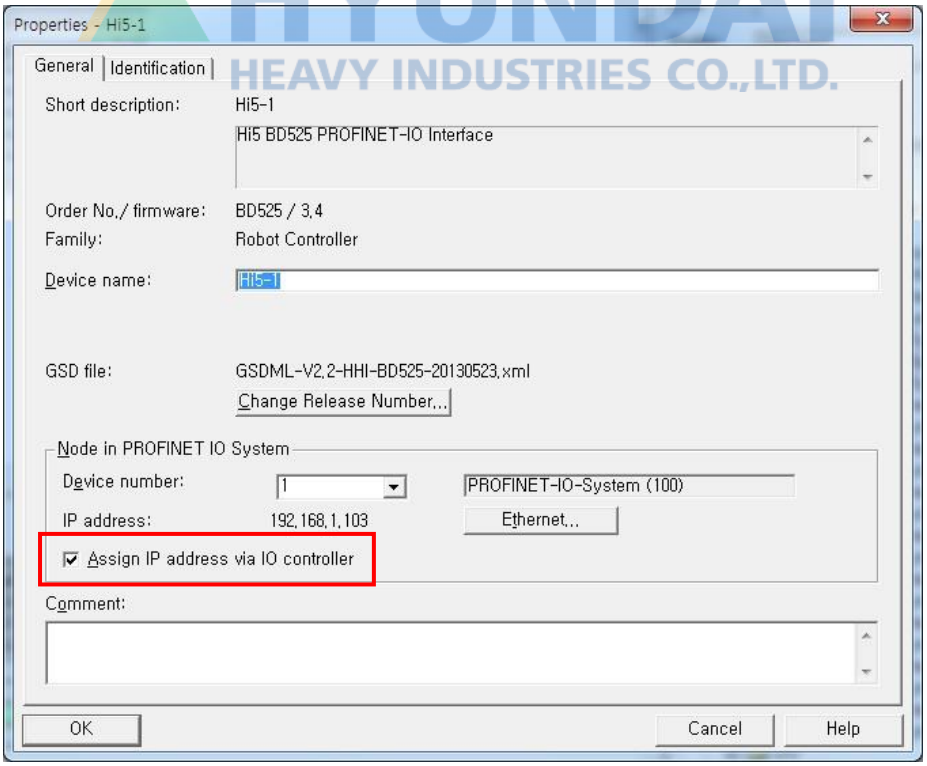
For example, if the input data size is 119 bytes, and the output data size is 32 bytes, the module will be configured as follows:

- slot 1 = 110 Bytes input
- slot 2 = 9 Bytes input
- slot 3 = 30 Bytes output
- slot 4 = 2 Bytes output

(10) Double click the Hi5 BD525 icon of the PROFINET IO bus to open the 『Object Property』 box. In the 『Device name』 column, input the device name that was configured at the Hi5 controller.



(11) Check the 『Assign IP address via IO controller』 item in the 『Object Property』 box of Hi5 BD525 and click the 『OK』 button.



(12) Click 『Save and Compile』 in the 『Station』 menu.

(13) Click 『Download』 in the 『PLC』 menu.

3.3. PROFINET IO-Device diagnosis

It is possible to use a teach pendant to check the diagnosis information such as communication state, setting state and error information.

(1) Select 『[F2]: System』 → 『2: Control parameter』 → 『2: Input/Output signal setting』 → 『14: Real time Ethernet setting and diagnosis』.

(2) As the PROFINET IO-Device corresponds to the channel 3, use the 『[F3]: Previous』 or 『[F4]: Next』 key to shift to the channel 3.

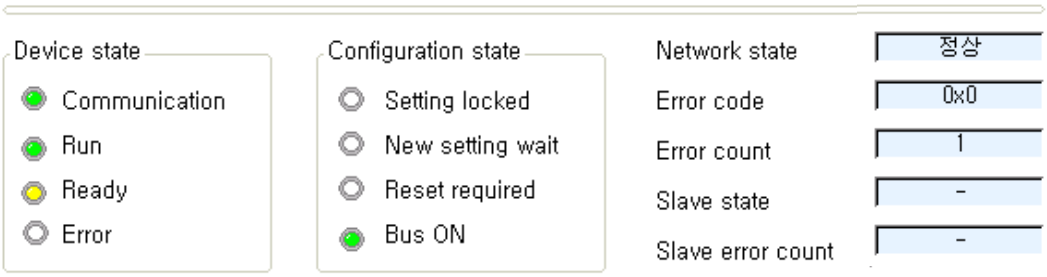


Figure 3.4 PROFINET IO-Device diagnosis screen

(3) Can check the information such as system state, setting state and error codes.

■ System state

LED	Meaning	Color	State	Remarks
Communication	communication state	(Green)	Communication in progress	
		(White)	Communication stopped	
Run	setting state	(Green)	Setting normal	
		(White)	Setting abnormal	
Ready	system state	(Yellow)	System normal	
		(White)	System abnormal	
Error	error state	(Red)	Error generated	Refer to error codes
		(White)	No error	

■ Setting state

LED	Meaning	Color	State	Remarks
Setting lock	Whether setting is locked	(Green)	Locked	
		(White)	Unlocked	
New setting ready	Whether new setting is ready	(Green)	Setting ready	
		(White)	Setting not ready	
Reset needed	Whether system reset is needed	(Green)	Reset is needed	
		(White)	Reset not needed	
Bus on	Whether bus communication is in progress	(Green)	Communication started	
		(White)	Communication stopped	

■ Network state

State	Meaning
Normal	Ethernet communication is in progress normally.
Stopped	Ethernet communication is stopped.
Idle	No communication.
Offline	The network is offline.

■ Error codes

Error codes	Meaning
0x00000000	No error
0xC0000145	Ethernet cable connection is poor
0xC0000144	IP address is overlapped
0xC0000142	Connection timeout
0xC0000141	Disconnected
0xC0000140	Other types of network problems
Others	Inquiry to the manufacturers

■ Error frequency: Accumulated number of communication errors

4

PROFINET IO-Controller Setting & Diagnosis

4.1. SYCON.net

The BD525 PROFINET IO-Device can be set and diagnosed using a teach pendant. However, for setting the PROFINET IO-Controller, a separate network configuration tool, SYCON.net, which is software for Windows, is needed. Support is provided for the USB connection between SYCON.net and the BD525 board.

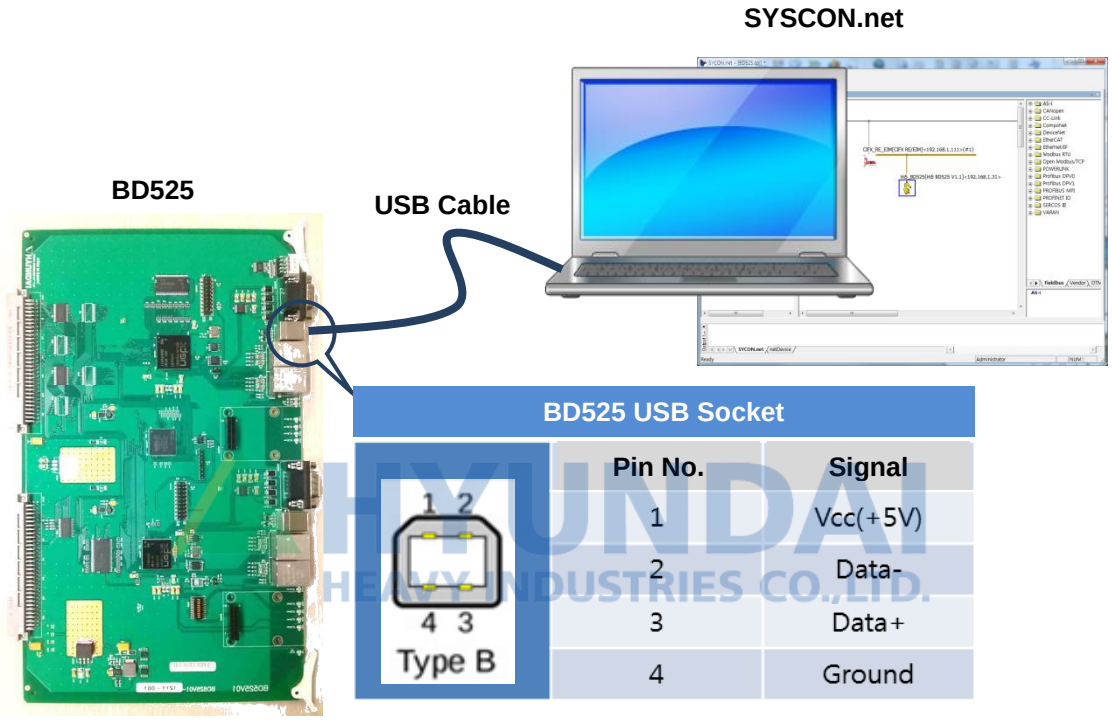
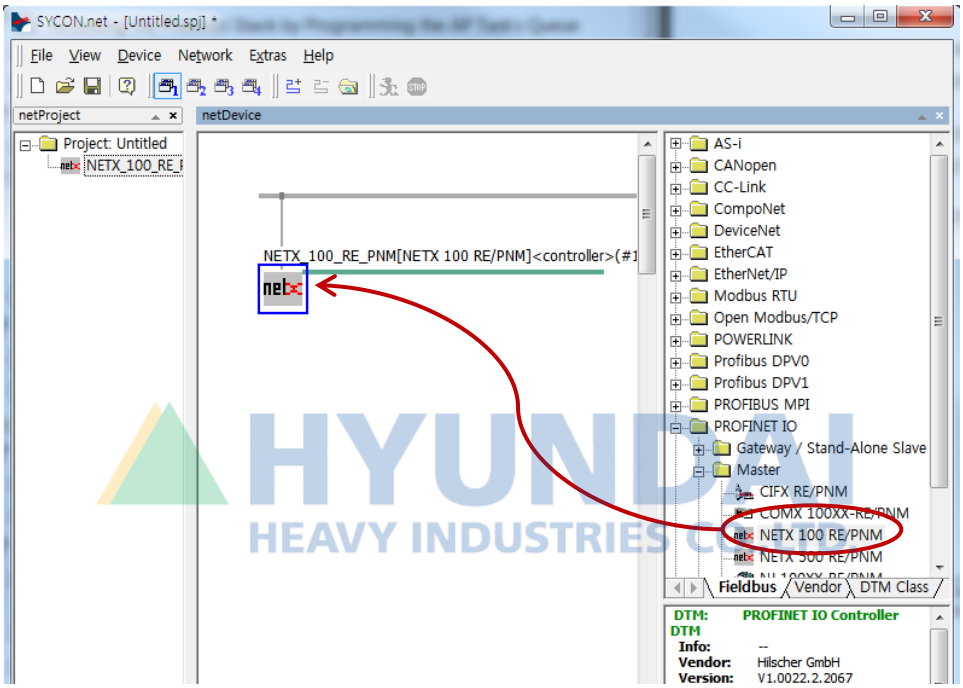


Figure 4.1 USB connection between SYCON.net and BD525

4.2. PROFINET IO network configuration

The following procedure should be observed to configure the network of the BD525 PROFINET IO-Controller. Refer to the SYCON.net manual for more details.

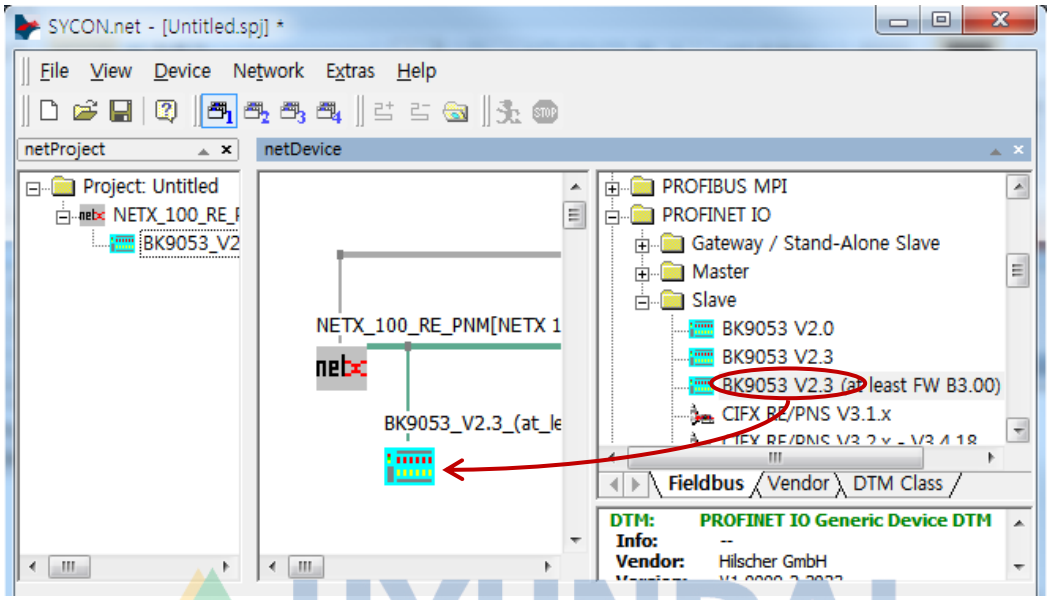
(1) Insert the PROFINET IO-Controller NETX 100 RE/PNM
Drag the “NETX 100 RE/PNM” from the device catalog of SYCON.net and drop it to the [network view] line.



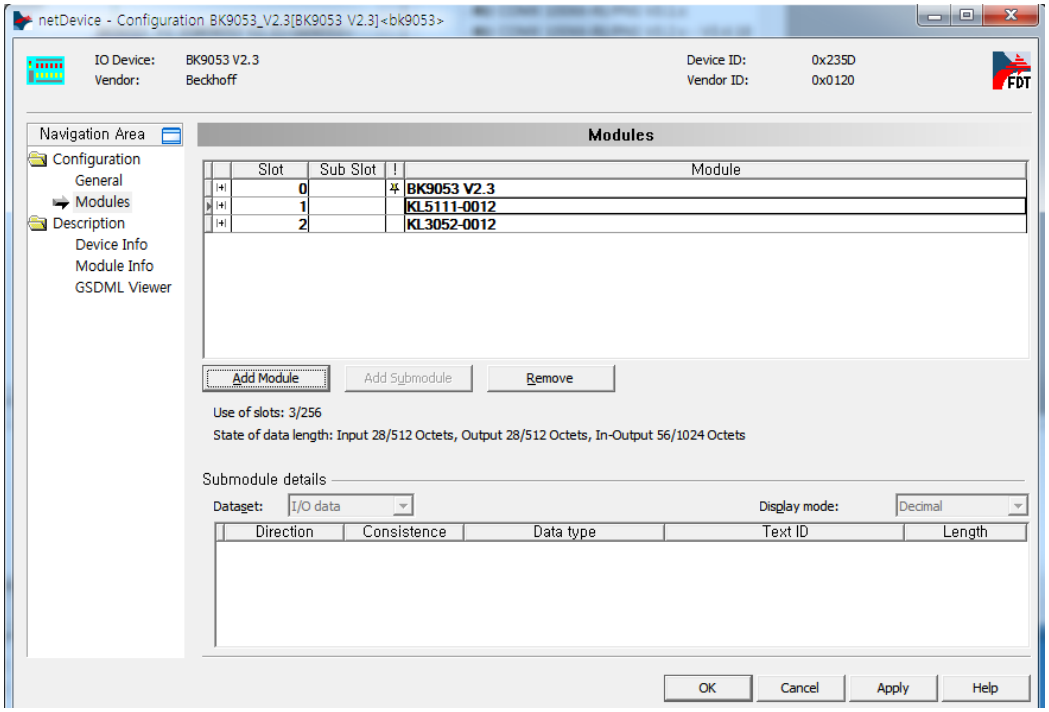
(2) Register the PROFINET IO-Device GSDML file to SYCON.net
Execute ***[Network > Import Device Description]*** to register the GSDML file of the PROFINET IO-Device that needs to be connected to the PROFINET IO-Controller, and then register it to the [device catalog] of SYCON.net

(3) Reload the device catalog
After executing ***[Network > Device Catalog]***, click the [Reload Catalog] button to reload the [device catalog] of SYCON.net to allow the newly registered adapter to be displayed.

(4) Insert the PROFINET IO-Device
Drag the PROFINET IO-Device that needs to be connected to BD525 from the device catalog of SYCON.net, and drop and connect it to the bus of the [network view].

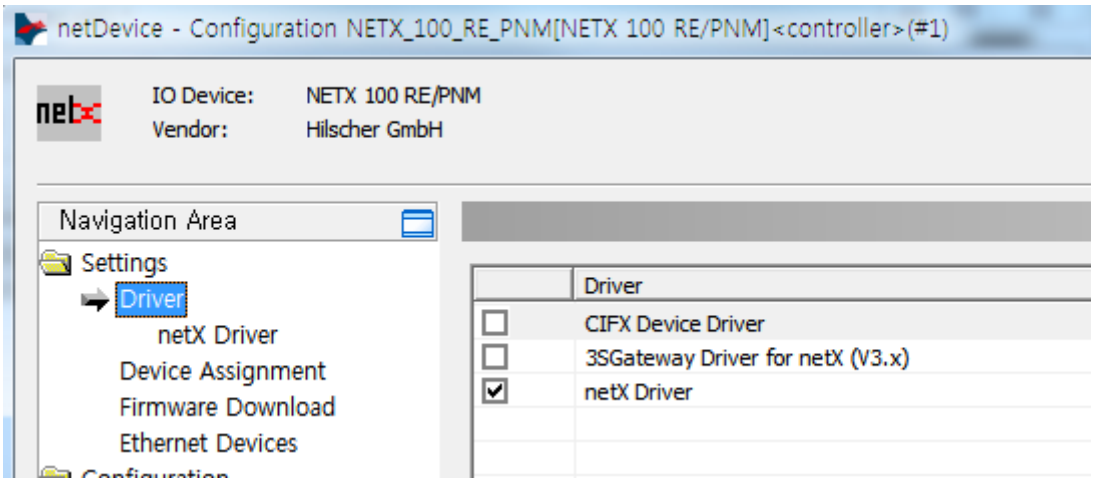


(5) PROFINET IO-Device Module Setting
Double click the icon of the PROFINET IO-Device module that is to be connected with BD525 and set module configuration. Click the 「Modules」 item under "Configuration" located to the left of netDevice, and click the "Add Module" button to add the module.

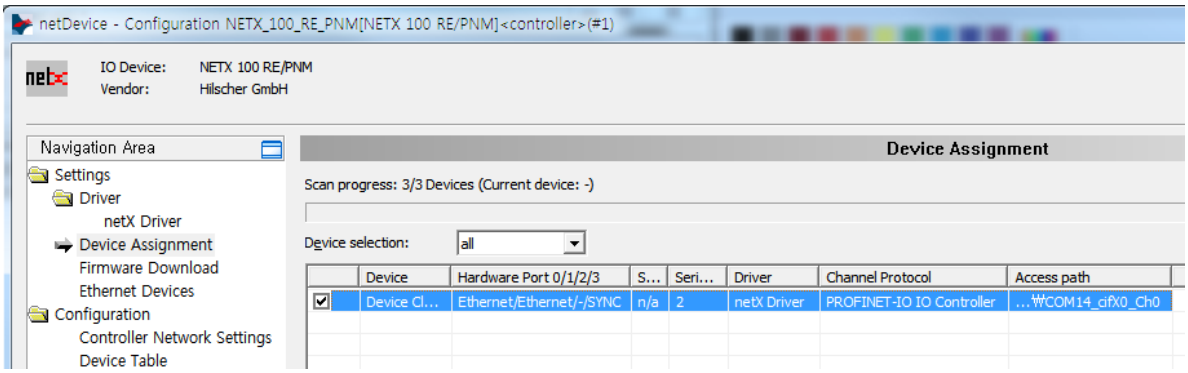


(6) Set the PROFINET IO-Controller (NETX 100 RE/PNM)
Double-click the NETX 100 RE/PNM icon to set the following items.

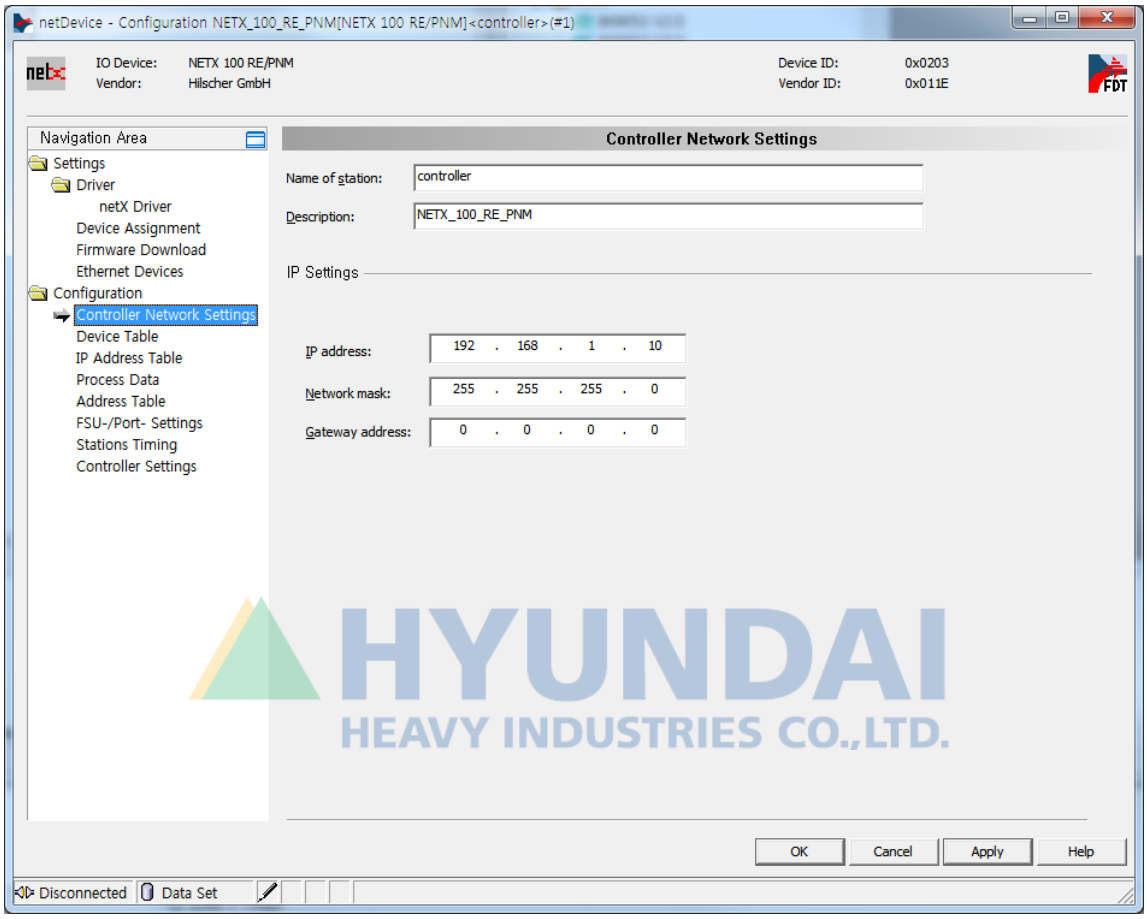
① Select ***[Settings > Driver]*** and [netX Driver] and click the “Apply” button.
(Check the checkbox for [netX Driver] and then click the “Apply” button.)



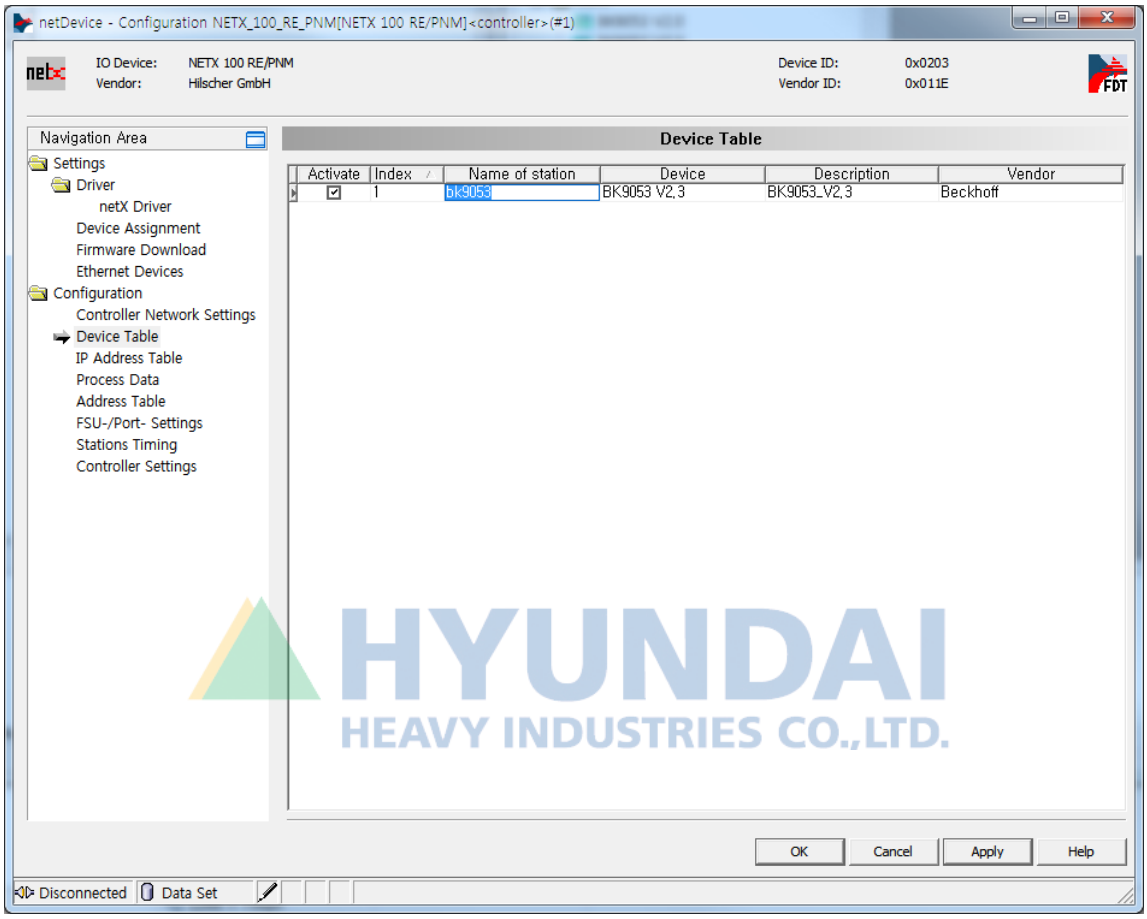
② Select ***[Settings > Device Assignment]*** and then select the scanner and then click the “Apply” button. If the PROFINET IO-Controller does not show up, change the [Device selection] to the “All” state and then click the “Scan” button.



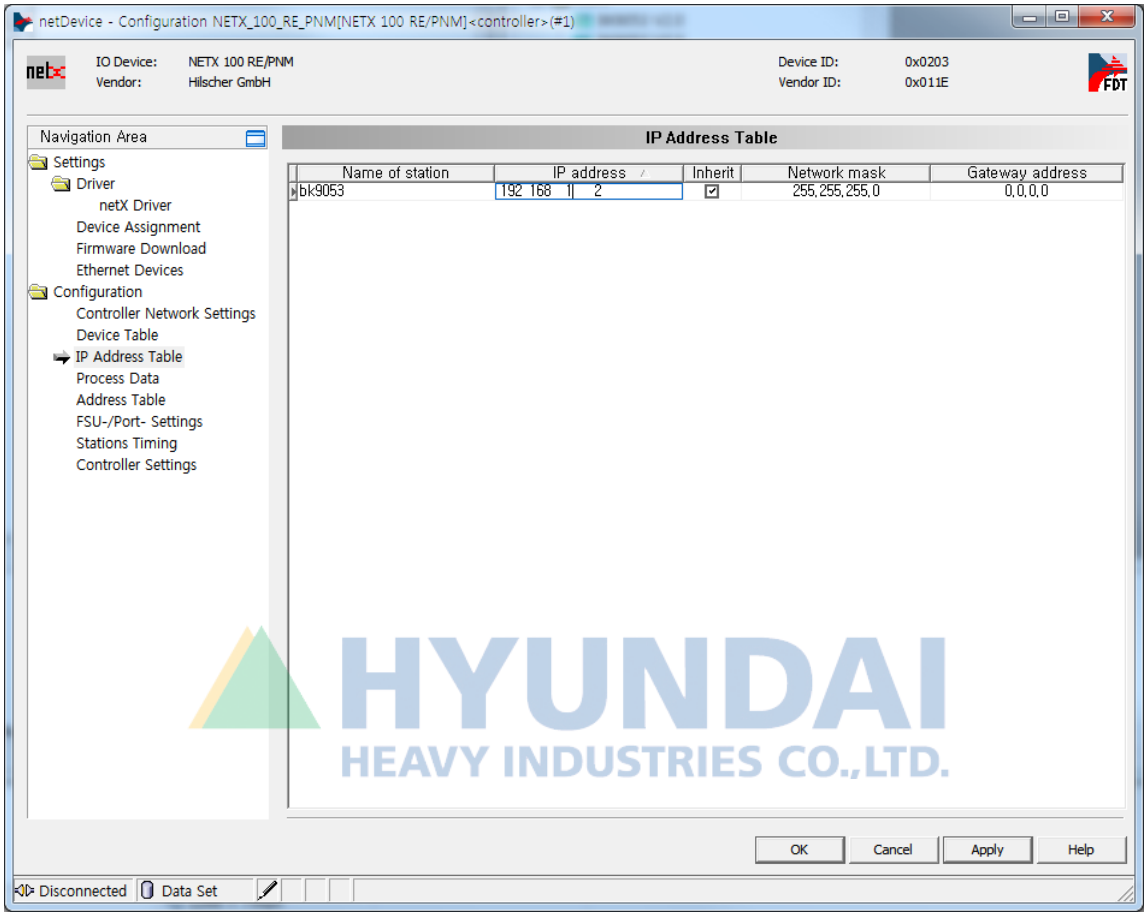
③ Select ***Configuration > Network Settings*** and then set the network information such as the IP address of the PROFINET IO-Controller and then click the “Apply” button.



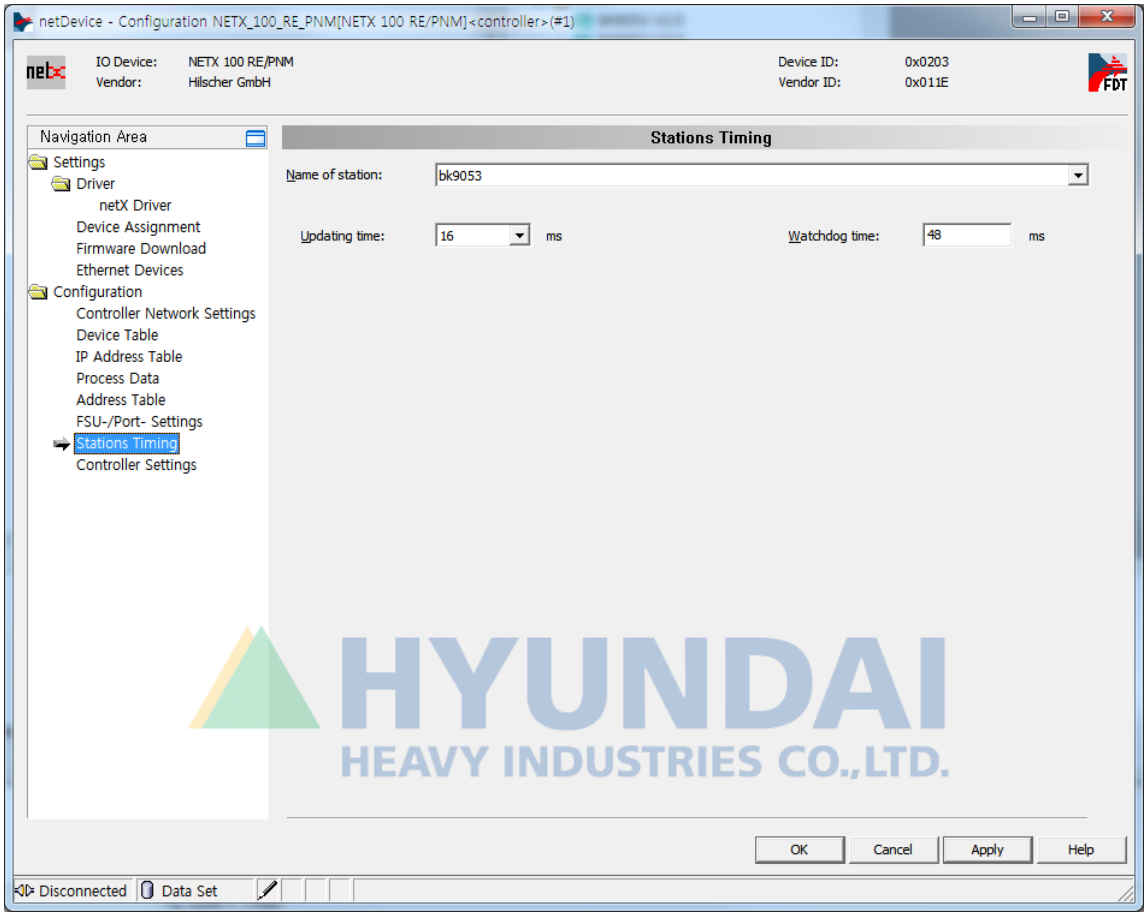
④ Select ***[Configuration > Device Table]***, set [Name of station], and click the "Apply" button.



⑤ Select ***[Configuration > IP Address Table]***, set IP, and click the "Apply" button.



⑥ Select ***[Configuration > Station Timing]***, set IO scan time, and click the "Apply" button.



(7) PROFINET IO-Controller (NETX 100 RE/PNM) setting
Click the ***[Device > Download]*** menu, and download the set information.

4.3. PROFINET IO-Controller setting

The following procedure should be observed for the configuration of PROFINET IO-Controller at the robot controller:

(1) Select 『[F2]: System』 → 『2: Control parameter』 → 『2: Input/Output signal setting』 → 『14: BD525 real-time Ethernet setting and diagnosis』

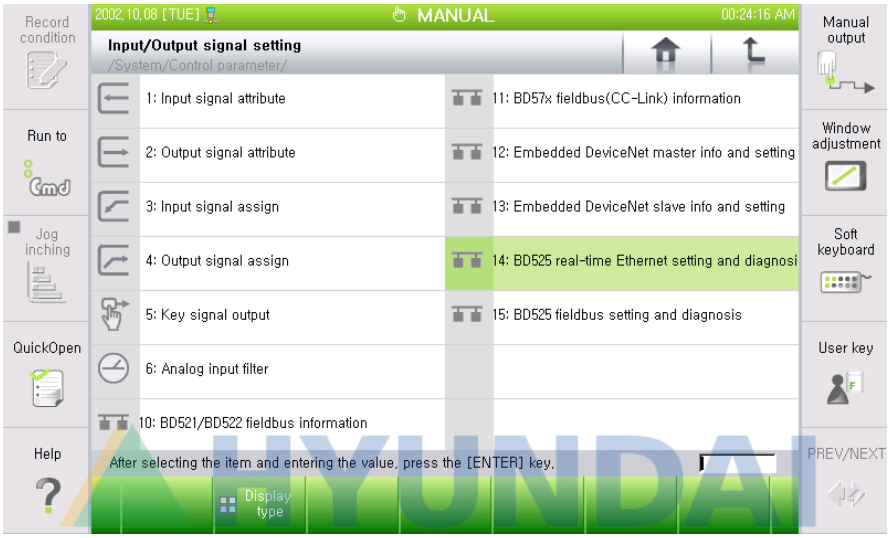


Figure 4.2 Real time Ethernet setting and diagnosis menus

(2) As the PROFINET IO-Controller corresponds to the channel 1, use the 『[F3]: Previous』 or 『[F4]: Next』 key to shift to the channel 1, and then check whether Device Type shows “PROFINET IO-Controller”.

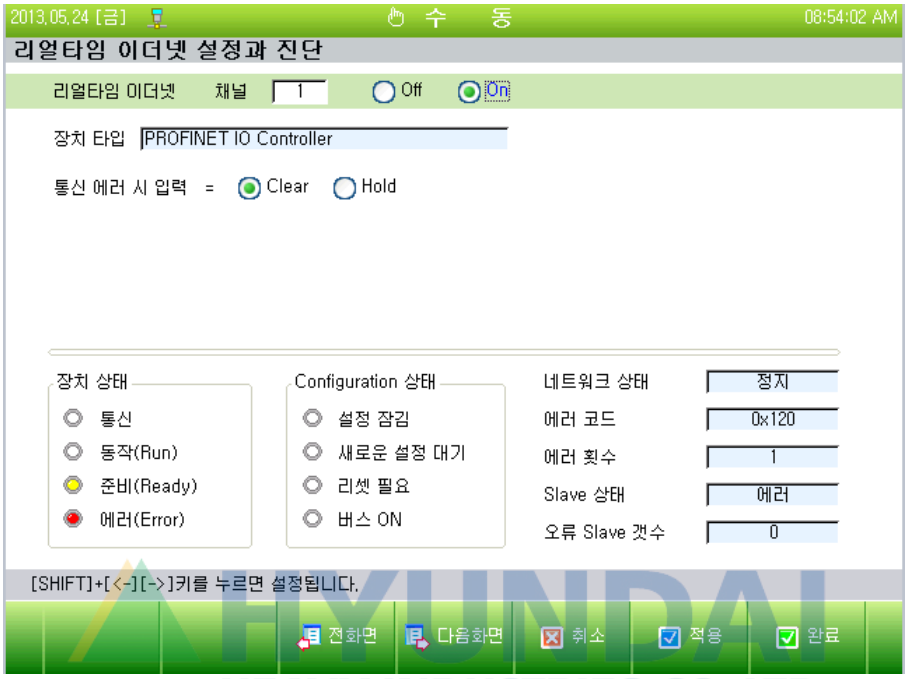


Figure 4.3 PROFINET IO-Controller setting screen

(3) Can select an option regarding how to handle the input when a communication error occurs. When the option is set as “Clear”, the input data (FB1.X) will be cleared to be “0. On the contrary, if it is set as “Hold”, the last valid value that is to be generated when the error occurs will be maintained.

(4) In order to use the PROFINET IO-Controller, shift it to the “On” position and then click the “Apply” or “Complete” button.

4.4. PROFINET IO-Controller diagnosis

It is possible to use a teach pendant to check the diagnosis information such as communication state, setting state and error information of PROFINET IO-Controller.

(1) Select 『[F2]: System』 → 『2: Control parameter』 → 『2: Input/Output signal setting』 → 『14: Real time Ethernet setting and diagnosis』

(2) As the PROFINET IO-Controller corresponds to the channel 1. Use the 『[F3]: Previous』 or 『[F4]: Next』 key to shift to the channel 1.

Figure 4.4 PROFINET IO-Controller diagnosis screen

(3) Can check various information such as system state, setting state and error codes.

■ System state

LED	Meaning	Color	State	Remarks
Communication	communication state	(Green)	Communication in progress	
		(White)	Communication stopped	
Run	setting state	(Green)	Setting normal	
		(White)	Setting abnormal	
Ready	system state	(Yellow)	System normal	
		(White)	System abnormal	
Error	error state	(Red)	Error generated	Refer to error codes
		(White)	No error	

■ Setting state

LED	Meaning	Color	State	Remarks
Setting lock	Whether setting is locked	(Green)	Locked	
		(White)	Unlocked	
New setting ready	Whether new setting is ready	(Green)	Setting ready	
		(White)	Setting not ready	
Reset needed	Whether system reset is needed	(Green)	Reset needed	
		(White)	Reset not needed	
Bus on	Whether bus communication is in progress	(Green)	Communication started	
		(White)	Communication stopped	

■ Network state

State	Meaning
Normal	Ethernet communication is in progress normally.
Stopped	Ethernet communication is stopped.
Idle	No communication.
Offline	The network is offline.

- Error codes

Error codes	Meaning
0x00000000	No error
0xC0000145	Ethernet cable connection is poor
0xC0000144	IP address is overlapped
0xC0000142	Connection timeout
0xC0000141	Disconnected
0xC0000140	Other types of network problems
Others	Inquiry to the manufacturers

- Error frequency: Accumulated number of communication errors

- Slave state

Slave state	Meaning
Normal	No error
Error	communication error occurs

- Number of slaves that have errors: Shows the number of the PROFINET IO-Device that has communication errors.

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5
I/O Mapping

5.1. PROFINET IO Input & Output Signal Mapping

The input and output data of the BD525 PROFINET IO-Controller and IO-Device will be mapped individually not only to the robot language, but also to the FB1 and FB3 objects of the embedded PLC. There are 960 X inputs and 960 Y outputs. They are accessible through 5 different types as shown in Table 5-1.

Table 5-1 PROFINET IO input and output data

Classification		Command grammar	Size	Description	Remarks
BD525 PROFINET IO-Controller	Controller output	FB1.Y1~960	960	Bit signal output	
		FB1.YB1~120	120	Byte signal output	
		FB1.YW1~60	60	Word signal output	
		FB1.YL1~30	30	Double word signal output	
		FB1.YF1~30	30	Float signal output	
	Controller input	FB1.X1~960	960	Bit signal input	
		FB1.XB1~120	120	Byte signal input	
		FB1.XW1~60	60	Word signal input	
		FB1.XL1~30	30	Double word signal input	
		FB1.XF1~30	30	Float signal input	
BD525 PROFINET IO-Device	Controller output	FB3.Y1~960	960	Bit signal output	
		FB3.YB1~120	120	Byte signal output	
		FB3.YW1~60	60	Word signal output	
		FB3.YL1~30	30	Double word signal output	
		FB3.YF1~30	30	Float signal output	
	Controller input	FB3.X1~960	960	Bit signal input	
		FB3.XB1~120	120	Byte signal input	
		FB3.XW1~60	60	Word signal input	
		FB3.XL1~30	30	Double word signal input	
		FB3.XF1~30	30	Float signal input	

5.2. Assignment of output signals related to communication errors

Setting can be made in a way that the designated hard-wired output signal can be turned on when a PROFINET IO communication error occurs.

(1) Select 『[F2]: System』 → 『2: Control parameter』 → 『2: Input/Output signal setting』 → 『4: Output signal assign』.

(2) After shifting using the 『[F4]: Previous』 or 『[F5]: Next』 key, enter the desired signal number in the “Fieldbus error” section, and then save the information using the 『[F7]: Complete』 key.

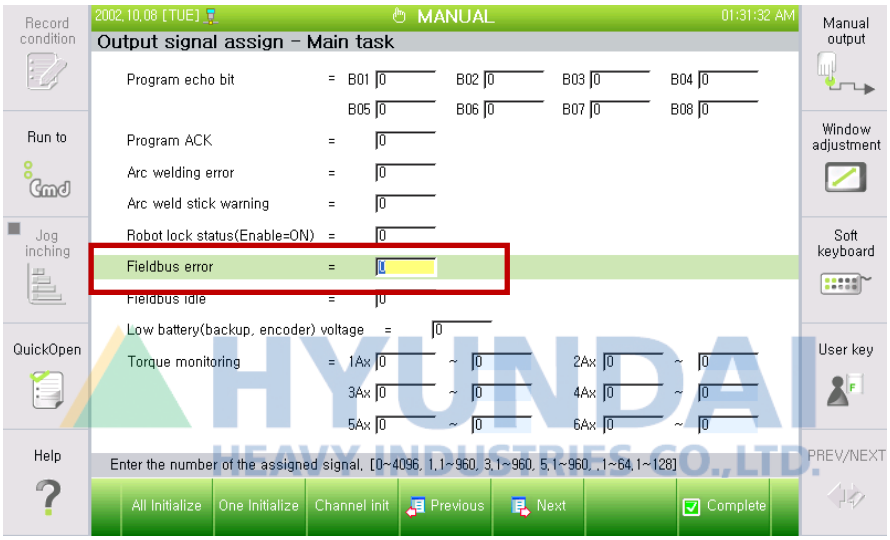

Figure 5.1 Communication error output signal assignment

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