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WARNING

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

Hyundai Robot

Hi5EI130701FMEN1

Hi5 Controller Function Manual

EtherNet/IP

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Contents

Figure Contents

Table Contents

1 Overview

1.1. Prior knowledge

Understanding this manual requires the following knowledge.

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

1.2. Overview of EtherNet/IP

EtherNet/IP is an Ethernet-based open industrial communication protocol developed by CI (ControlNet International) and ODVA (Open Device Vendor Association).

Diverse devices such as sensors, remote I/O, motor drivers, HMI, PLC and robot controllers in a factory can be connected through one single EtherNet/IP network regardless of manufacturers.

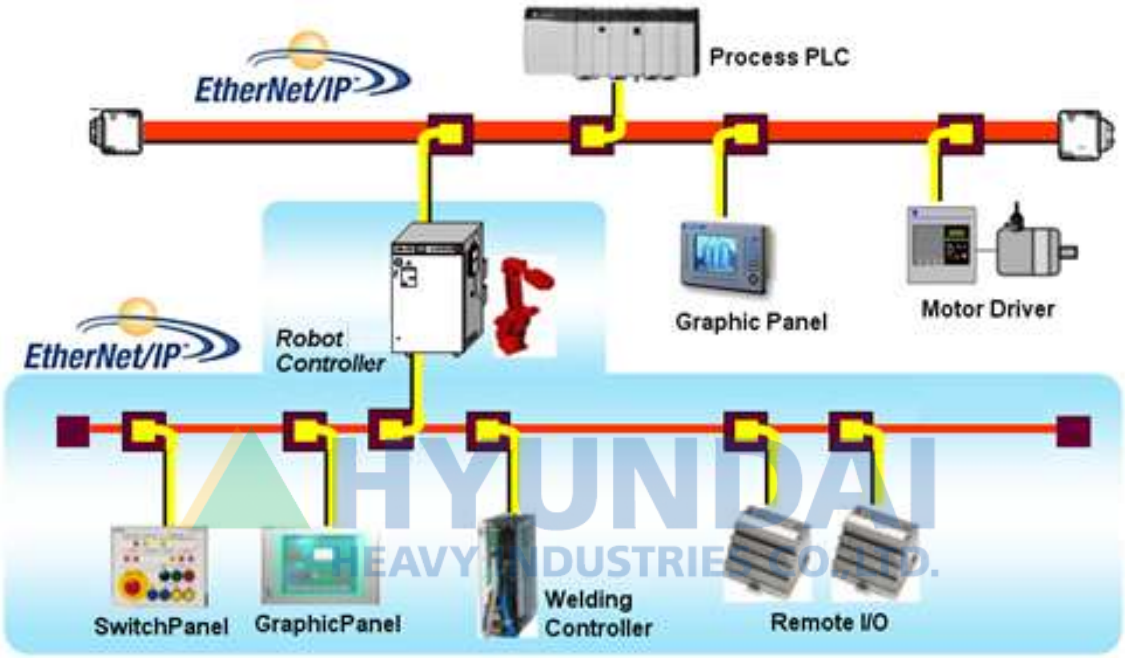

Figure 1.1 EtherNet/IP network

Depending on its communication functions, EtherNet/IP can be divided into 3 product groups, scanner class, adapter class, messaging class.

- **Scanner class**
  The products of the scanner class are equivalent to existing fieldbus masters. They can request I/O data from EtherNet/IP adapters or EtherNet/IP scanners

- **Adapter class**
  The products of the adapter class are equivalent to existing fieldbus slaves. They are the targets of the real time I/O data connection requested by scanners. Adapters can not send the real time I/O data for themselves without the help of scanners.

- **Messaging class**
  The products of the messaging class are capable of sending and receiving explicit messages for the products of all classes, while they do not support the sending and receiving of real time I/O data. Examples include computer interface cards for uploading and downloading programs and network setting tools.

1.3. Appearance of the BD525 board

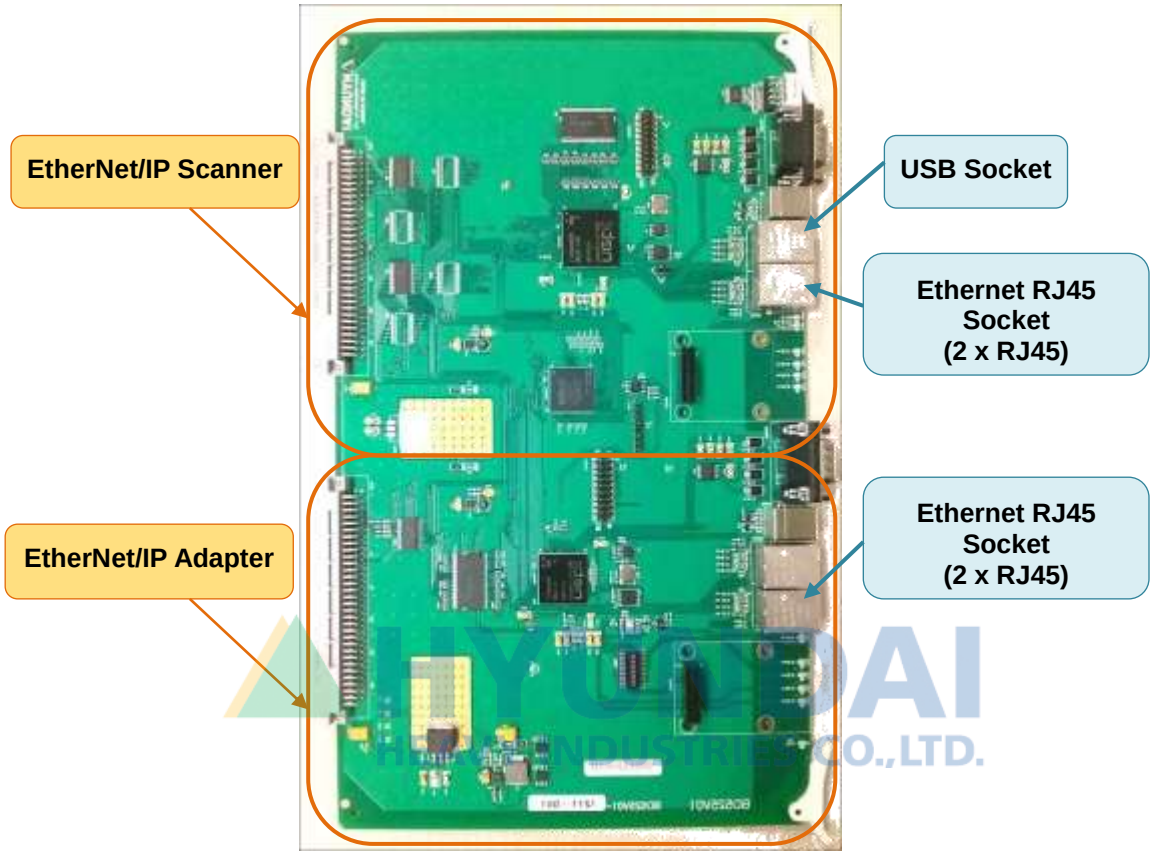

Figure 1.2 BD525 EtherNet/IP communication board

The BD525 EtherNet/IP board supports 1 channel of EtherNet/IP scanner, which is equivalent to the existing fieldbus master, and 1 channel of EtherNet/IP, which is equivalent to the existing fieldbus slave.

In case of EtherNet/IP scanners, network configuration requires separate configuration software, SYCON.net. SYCON.net and the BD535 board are to be connected through USB.

In case of EtherNet/IP adapters, separate software is not needed. IP address and size of input and output data, for example, can be set using a teach pendant.

When required, some parts of the EtherNet/IP scanner or of the EtherNet/IP adapter may not be assembled during the production process.

1.4. BD525 EtherNet/IP specification

Size of input and output data	Max. 120Bytes
Input and output data mapping	EtherNet/IP scanner = FB1 object EtherNet/IP adapter = FB3 object
I/O Connection	1 exclusive owner, up to 2 listen only
IO Connection type	Cyclic. Min. cycle time = 1ms
Communication speed	10/100 Mbit/s (Auto-Negotiation supported)
Data transport layer	Ethernet II, IEEE 802.3
Integrated switch	Supported
Reset service	Supported

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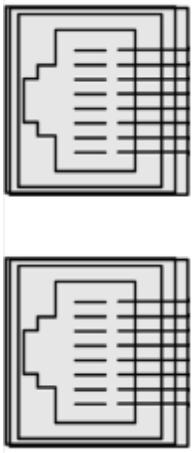
2 EtherNet Connection

2.1. Communication connector

BD525 provides 2 RJ45 sockets individually for the EtherNet/IP scanner and the EtherNet/IP adapter. 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 EtherNet/IP board, through a network, with a hub, switches and other EtherNet/IP 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

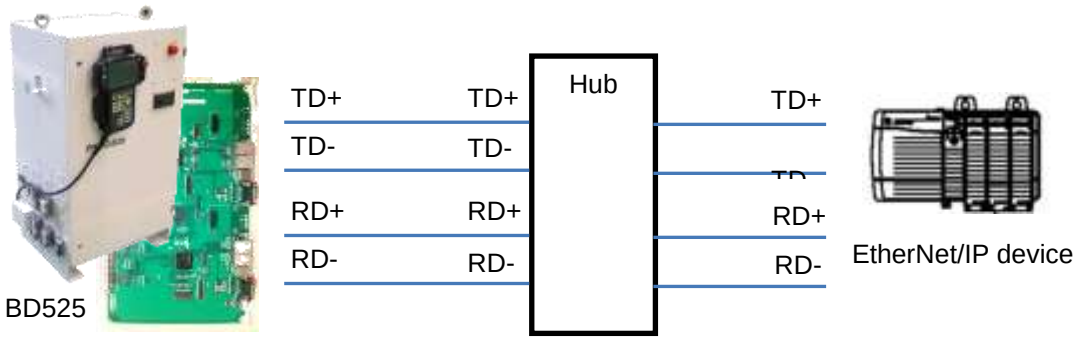


Figure 2.2 Direct cable connection

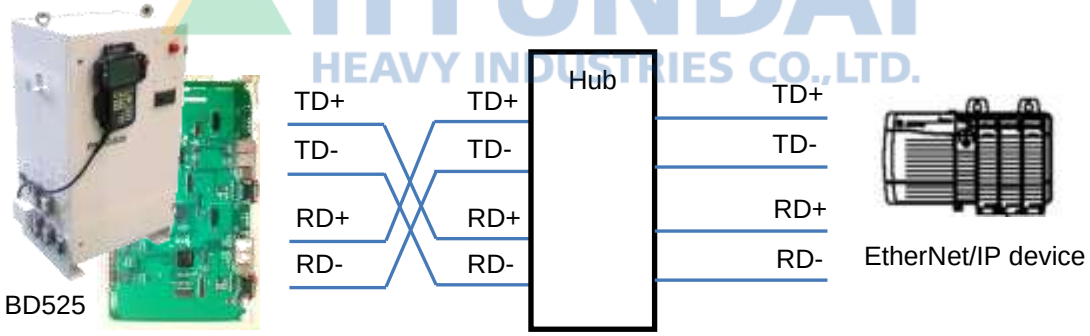


Figure 2.3 Crossover cable connection

■ When to be directly connected with an EtherNet/IP device

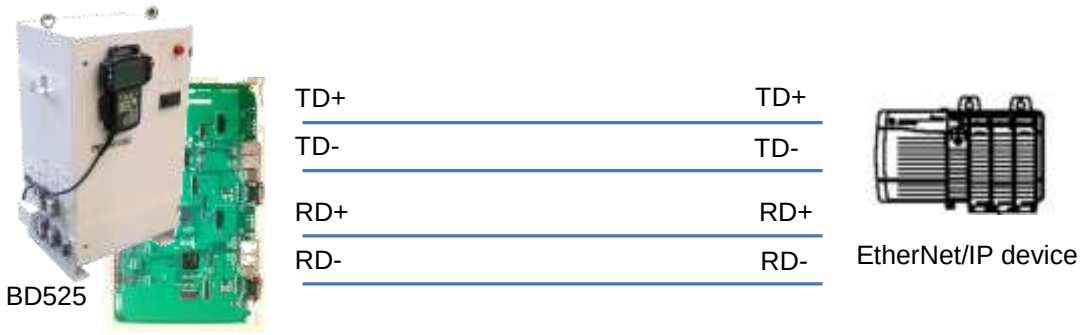


Figure 2.4 Direct cable connection

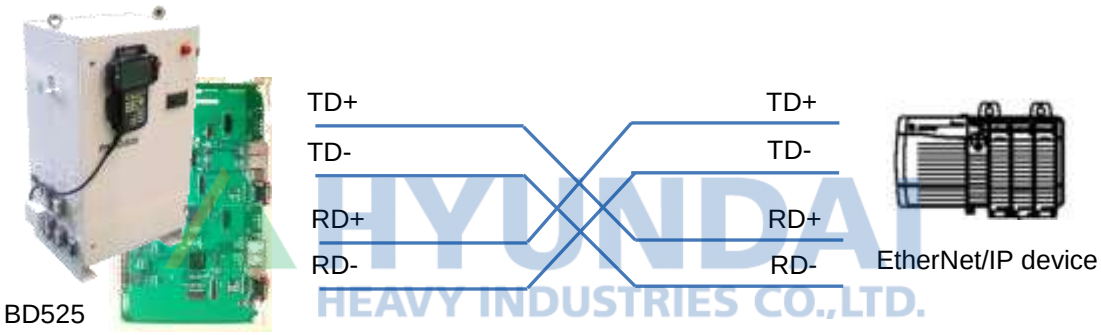


Figure 2.5 Crossover cable connection

It is recommended to use STP (Shielded Twisted Pair) cables to enhance noise immunity. Refer to Media Planning and Installation Manual of ODVA for more details about cable wiring.

3

EtherNet/IP Adapter Setting & Diagnosis

3.1. EtherNet/IP adapter setting

It is required to set an IP address and the size of input and output data to use an EtherNet/IP adapter as shown in the following procedure.

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

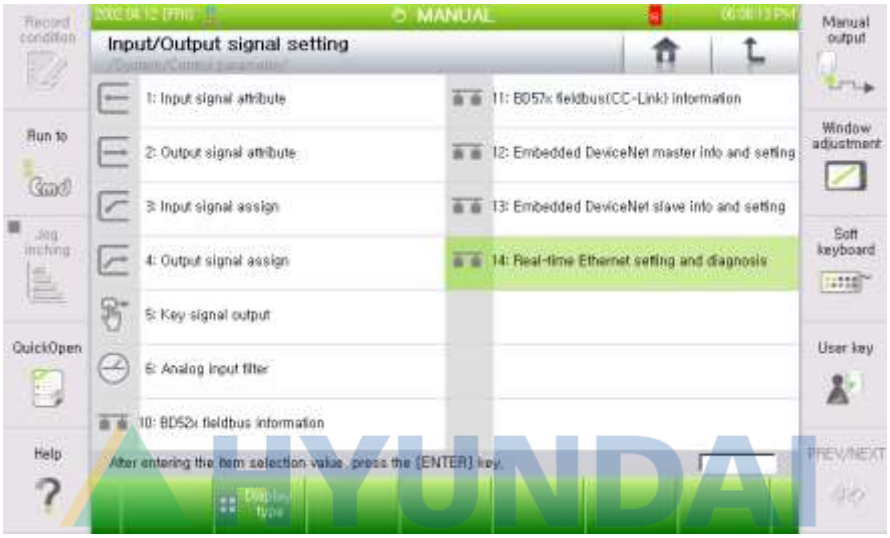


Figure 3.1 Real time Ethernet setting and diagnosis menus

(2) As the EtherNet/IP adapter 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 “EtherNet/IP Adapter”.

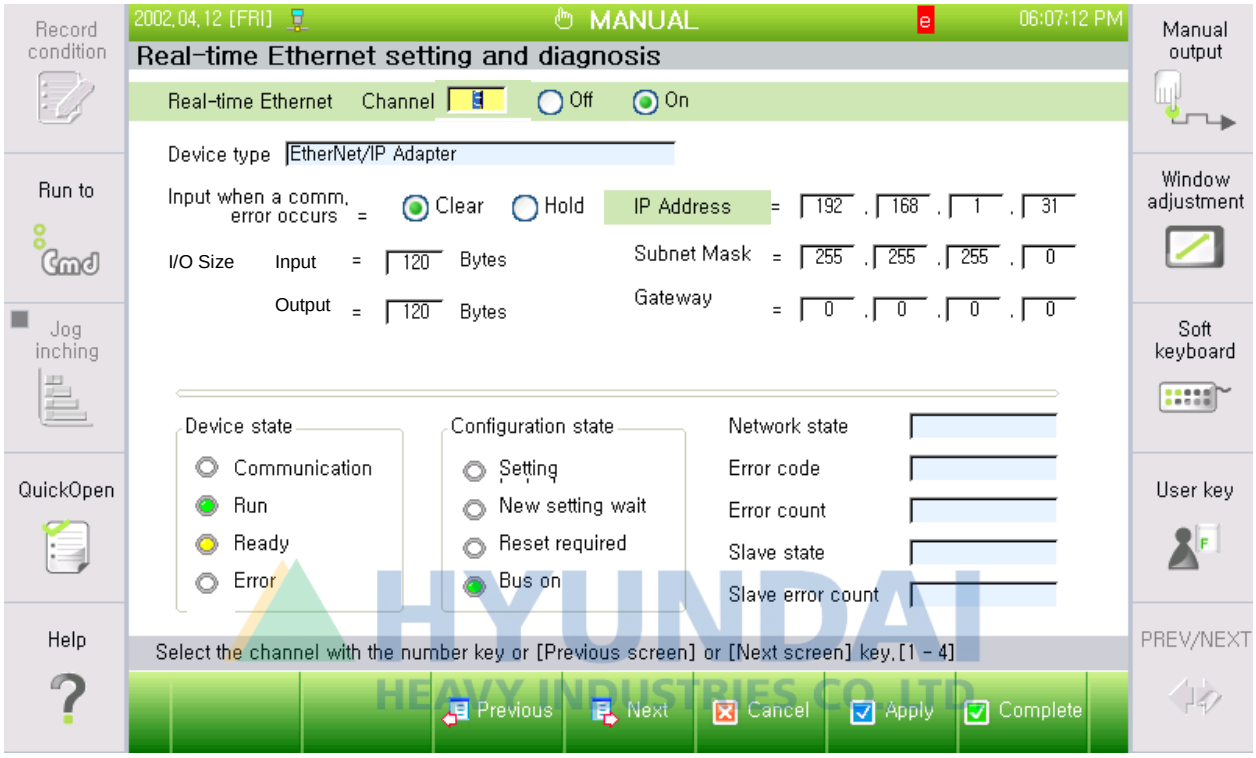


Figure 3.2 EtherNet/IP adapter setting screen

(3) Set the Ethernet information such as the IP address, the subnet mask and the gateway.

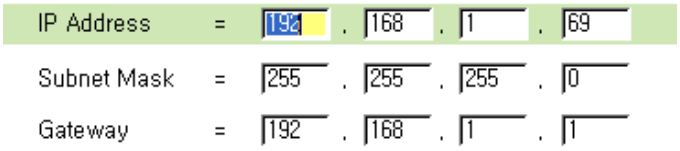


Figure 3.3 IP address setting screen

(4) Set the size of input and output data and the option for handling input data when a communication error occurs.

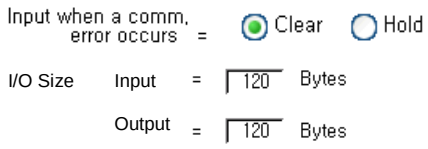


Figure 3.4 I/O setting screen

- Input when a communication error occurs:
  This is an option for handling input data (FB3.X) when an EtherNet/IP communication error occurs. When it is set as “Clear”, all the input data will be cleared to be “0” and when it is set as “Hold”, the last valid value that is to be generated when the error occurs will be maintained.

- I/O size:
  This is for setting the size of input and output data when it comes to the EtherNet/IP scanner. When it comes to the robot controller, the input corresponds to FB3.Y and the output corresponds to FB3.X. The default of the size of the input and output data is 120Byte.

(5) In order to use the EtherNet/IP adapter, shift it to the “On” position and then click the “Apply” or “Complete” button.

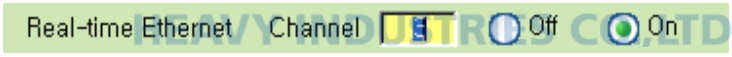


Figure 3.5 Function on/off setting screen

* Reference:
When the setting of the EtherNet/IP adapter changes, it is required to reset ((Off → On) or reboot the robot controller to apply the newly set values.

3.2. EtherNet/IP adapter 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 EtherNet/IP adapter corresponds to the channel 3, use the 『[F3]: Previous』 or 『[F4]: Next』 key to shift to the channel 3.

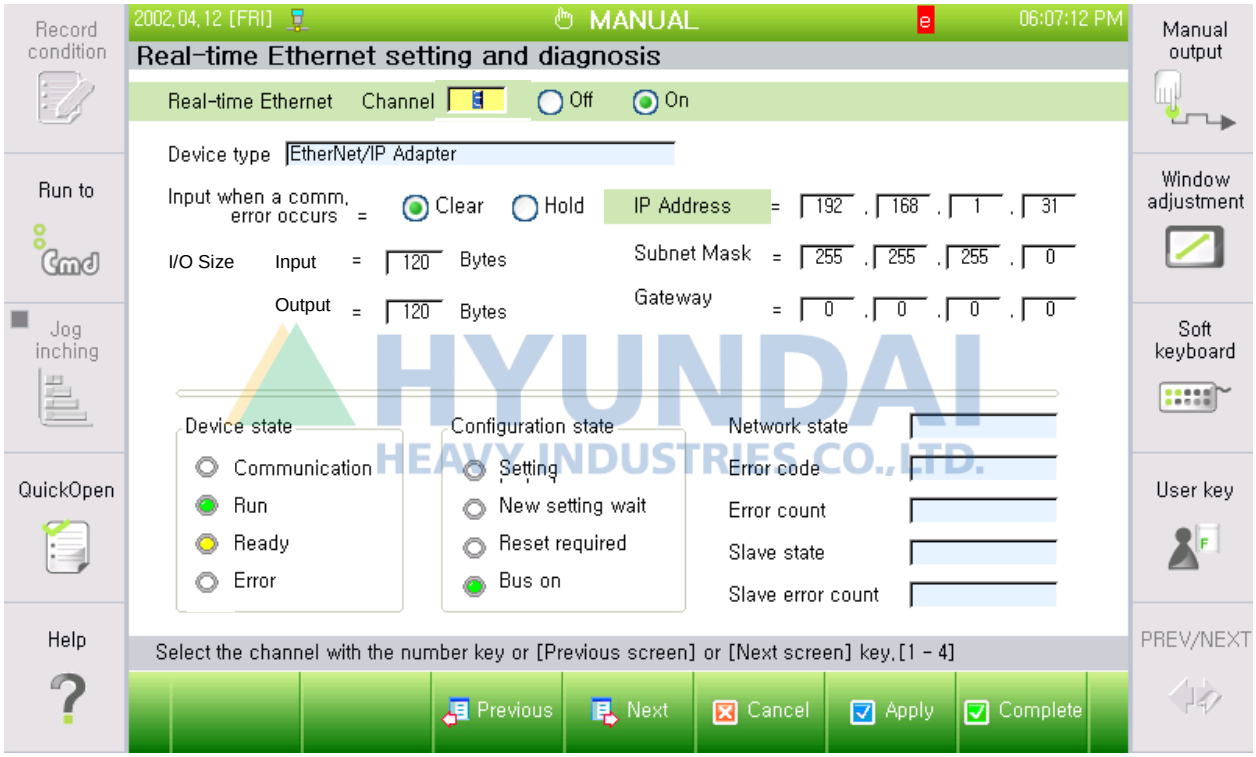


Figure 3.6 EtherNet/IP diagnosis screen

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

■ System state

LED	Meaning	Color	State	Remarks
Communication	EtherNet/IP communication state	(Green)	Communication in progress	
		(White)	Communication stopped	
Run	EtherNet/IP setting state	(Green)	Setting normal	
		(White)	Setting abnormal	
Ready	EtherNet/IP system state	(Yellow)	System normal	
		(White)	System abnormal	
Error	EtherNet/IP 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

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4

EtherNet/IP Scanner Setting & Diagnosis

4.1. SYCON.net

The BD525 EtherNet/IP adapter can be set and diagnosed using a teach pendant. However, for setting the EtherNet/IP scanner, 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.

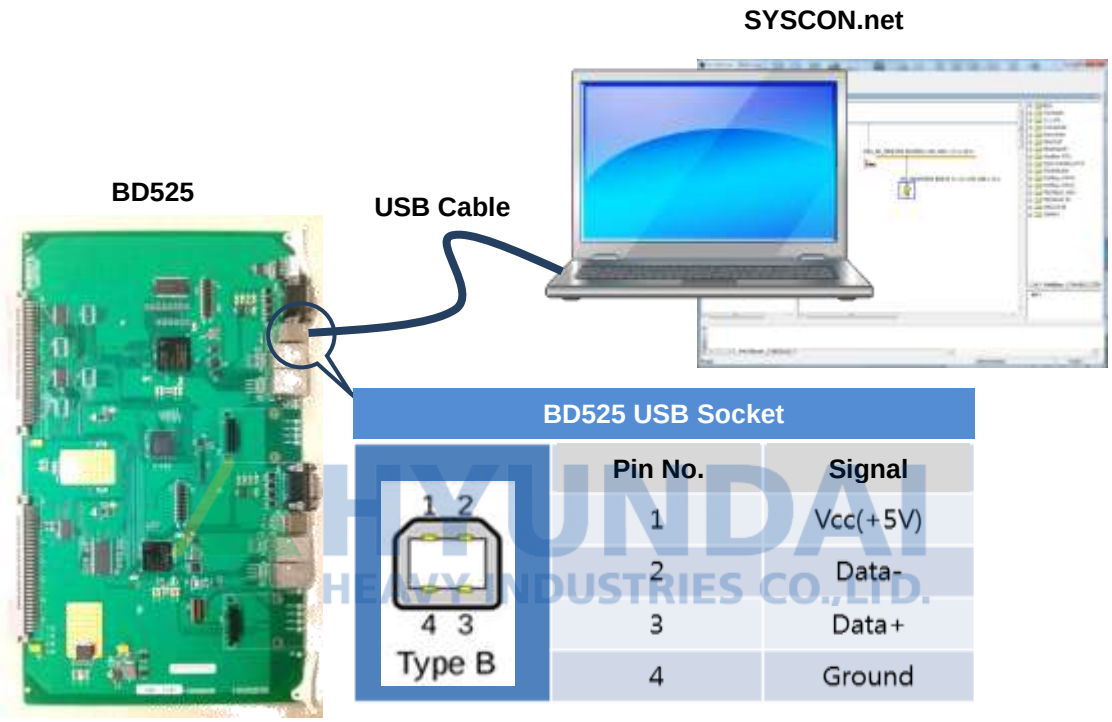


Figure 4.1 USB connection between SYCON.net and BD525

4.2. EtherNet/IP network configuration

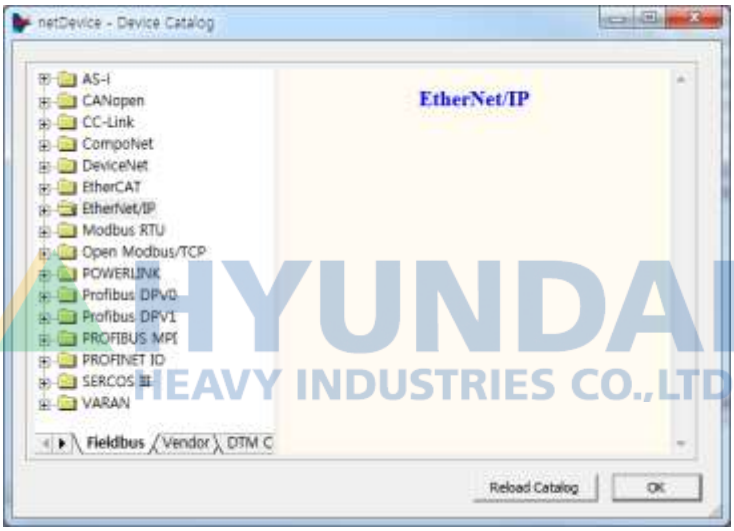
The following procedure should be observed to configure the network of the BD525 EtherNet.IP scanner. Refer to the DTM for EtherNet/IP Scanner Devices manual for more details.

(1) Register the EtherNet/IP adapter to SYCON.net

Execute ***Network > Import Device Description*** to register the EDS file of the EtherNet/IP adapter that needs to be connected to the EtherNet/IP scanner, and then register it to the device catalog of SYCON.net.

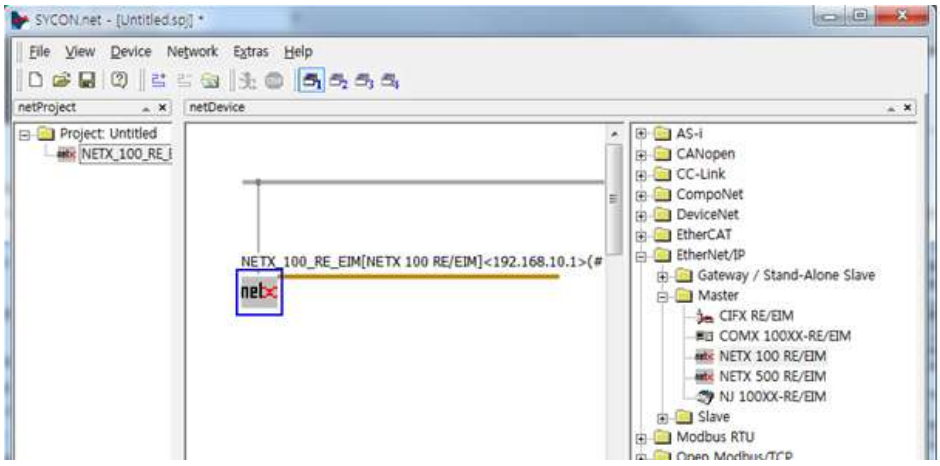
(2) Reload the device catalog

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.



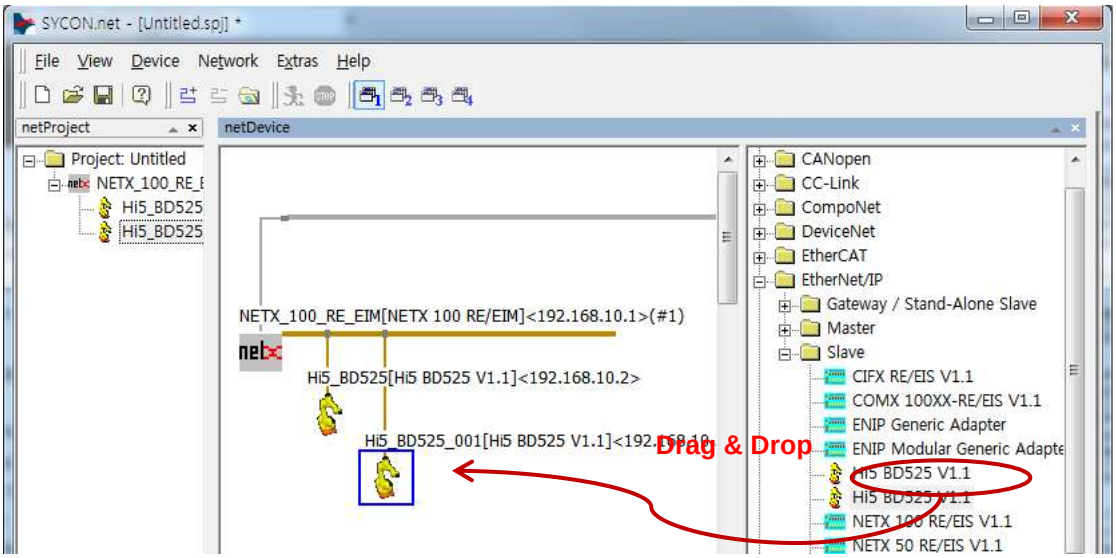
(3) Insert the EtherNet/IP scanner, NETX 100 RE/EIM

Drag the EtherNet/IP scanner from the device catalog of SYCON.net and drop it to the network view line. In case of the BD525 EtherNet/IP scanner, the NETX 100 RE/EIM of the master folders of the EtherNet/IP folder needs to be used.



(4) Insert the EtherNet/IP adapter

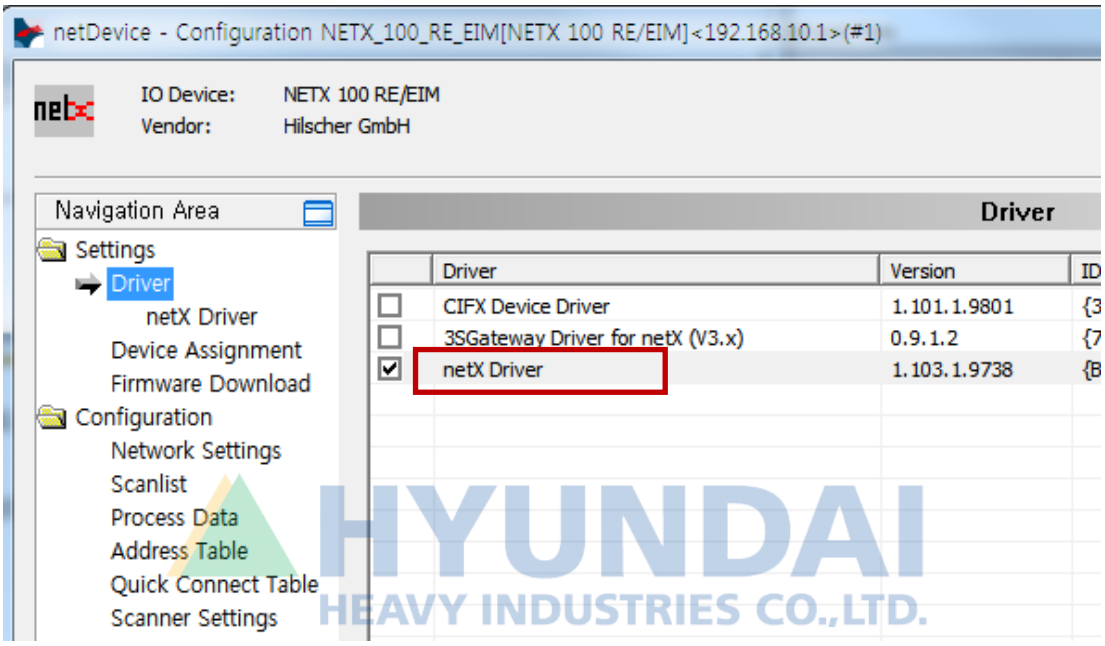
Drag the EtherNet/IP adapter that needs to be connected to BD525 from the device catalog of SYCON.net, and drop and connect it to the bus of the network view.



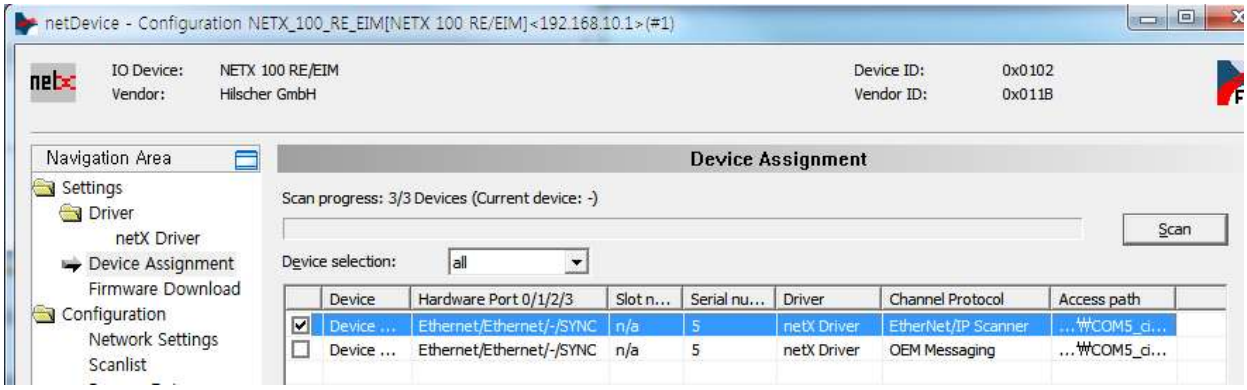
(5) Set the EtherNet/IP scanner (NETX 100 RE/EIM)

Double-click the NETX 100 RE/EIM icon to set the following items.

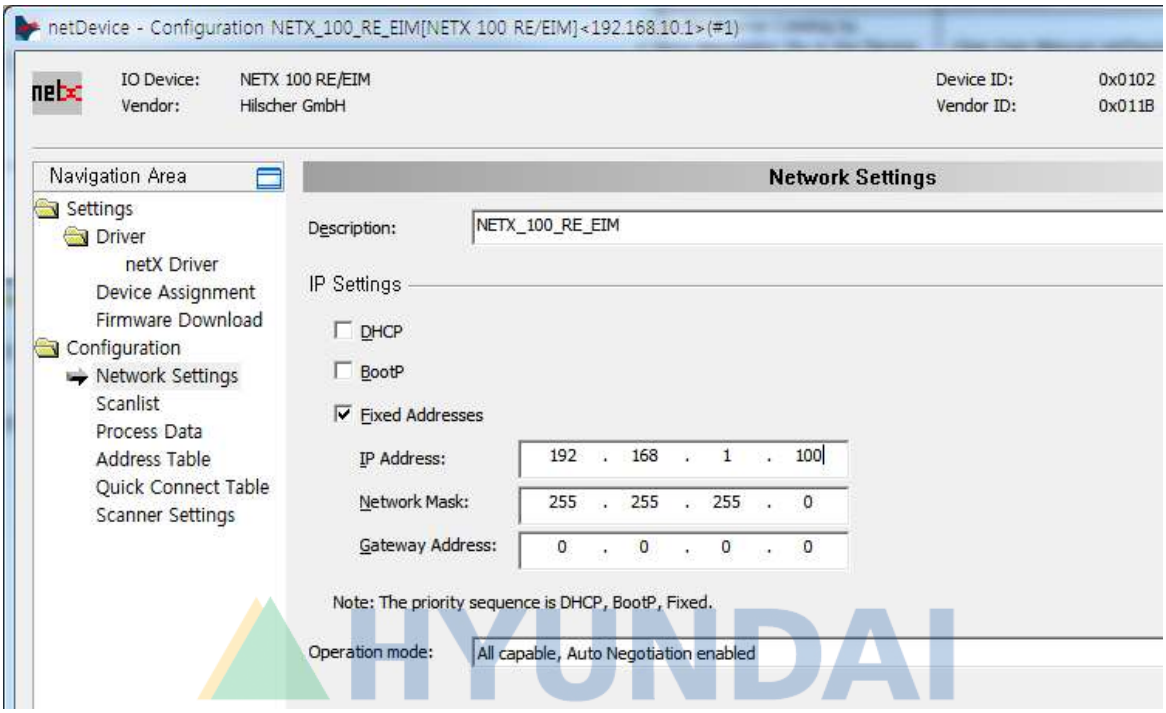
① Select ***Settings > Driver*** and "netX Driver" and click the "Apply" button (Check the checkbox for "netX Driver" and then click the "Apply" button.



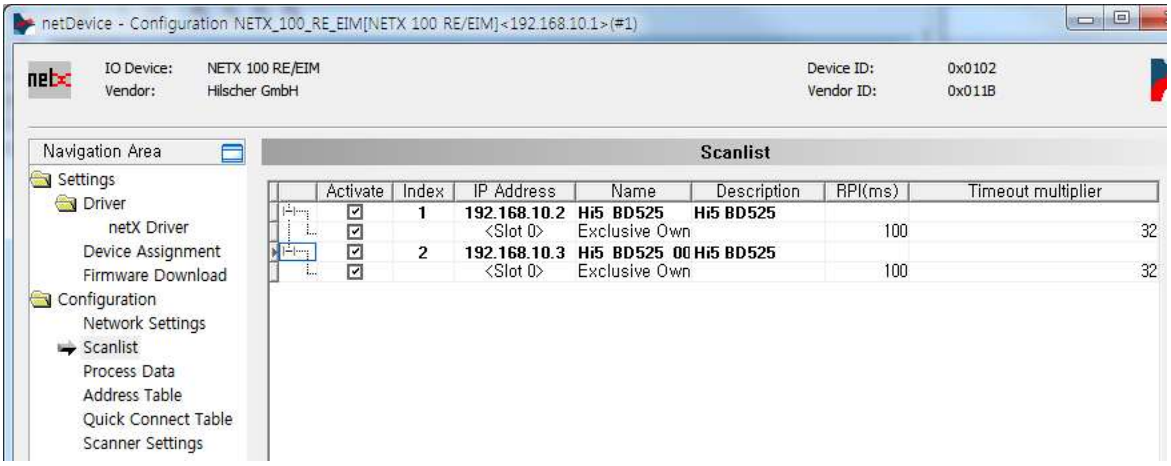
② Select ***Settings > Device Assignment*** and then select the scanner and then click the "Apply" button. If the EtherNet/IP scanner does not show up, change the "Device selection" to the "All" state and then click the "Scan" button.



③ Select ***Configuration > Network Settings*** and then set the network information such as the IP address of the EtherNet/IP scanner and then click the “Apply” button.



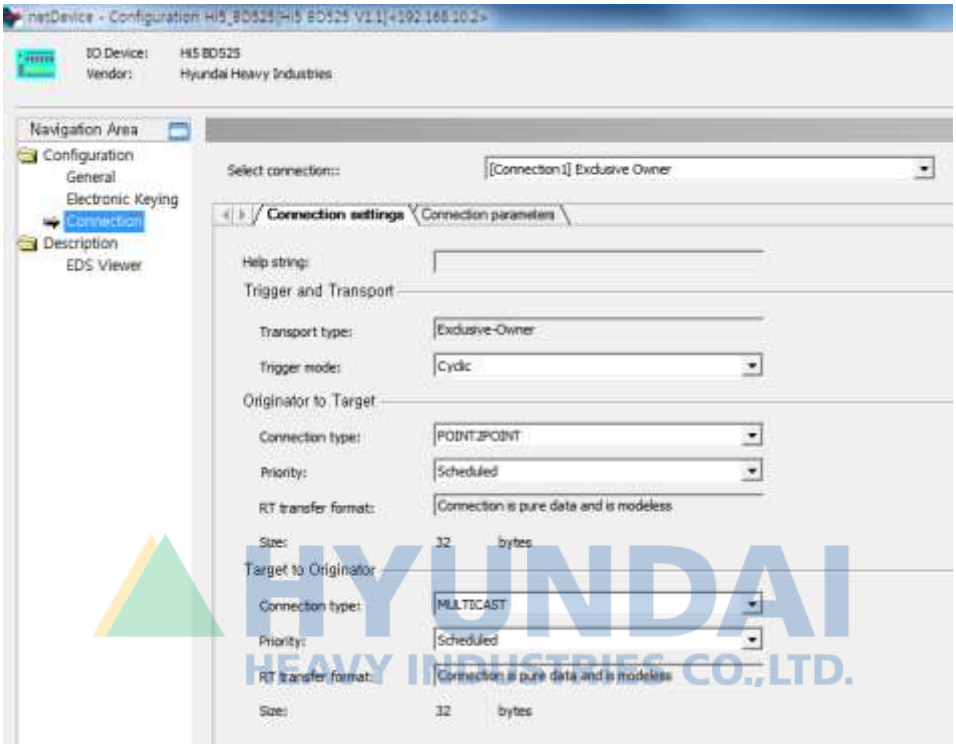
④ Select ***Configuration > Scanlist*** and then set the network information such as the IP address of the EtherNet/IP scanner and its name, and then click the “Apply” button.



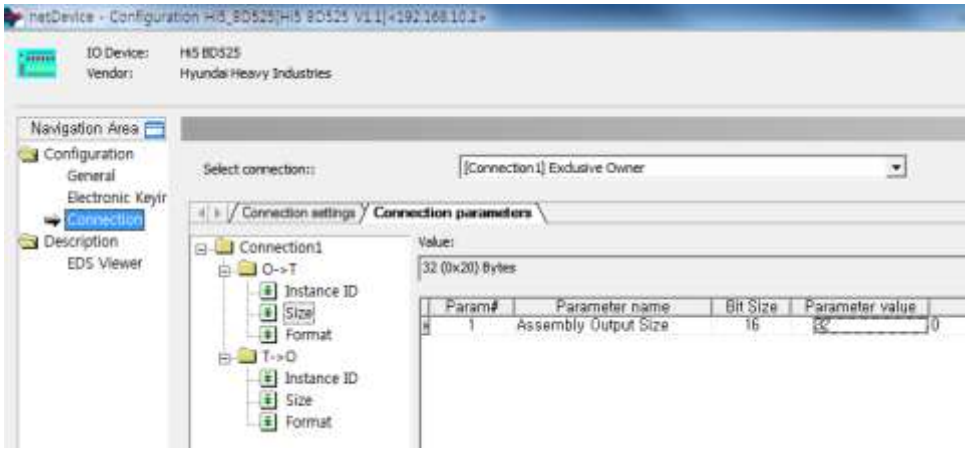
(6) Set the EtherNet/IP adapter

Double-click the icon of the EtherNet/IP adapter for setting the following items.

① Click ***Configuration > Connection*** for setting “Connection settings”.



② Set the size of the input and output data through the Connection Parameters tab.



(7) Download

Click ***Device > Download*** to download the set information through the BD525 EtherNet/IP scanner.

4.3. EtherNet/IP scanner setting

The following procedure should be observed to set the teach pendant to use the EtherNet/IP scanner.

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

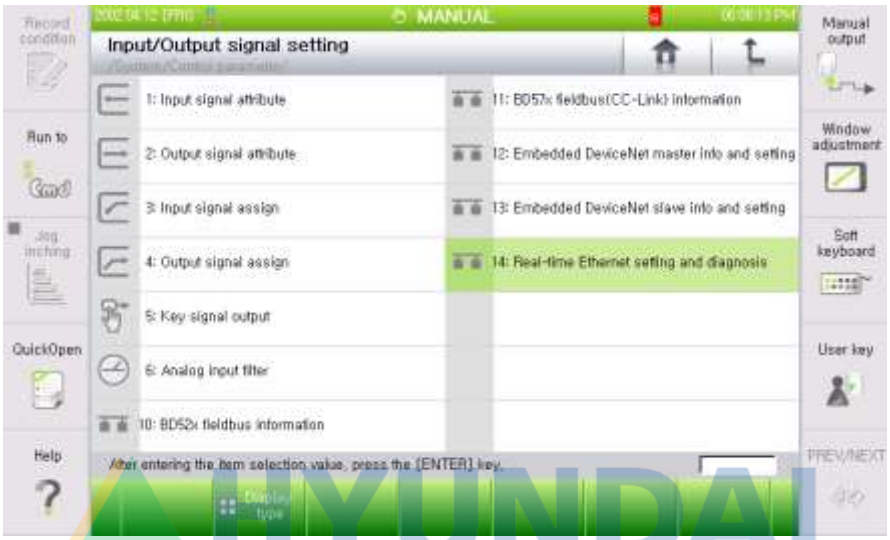


Figure 4.2 Real time Ethernet setting and diagnosis menus

(2) As the EtherNet/IP scanner 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 “EtherNet/IP Scanner”.

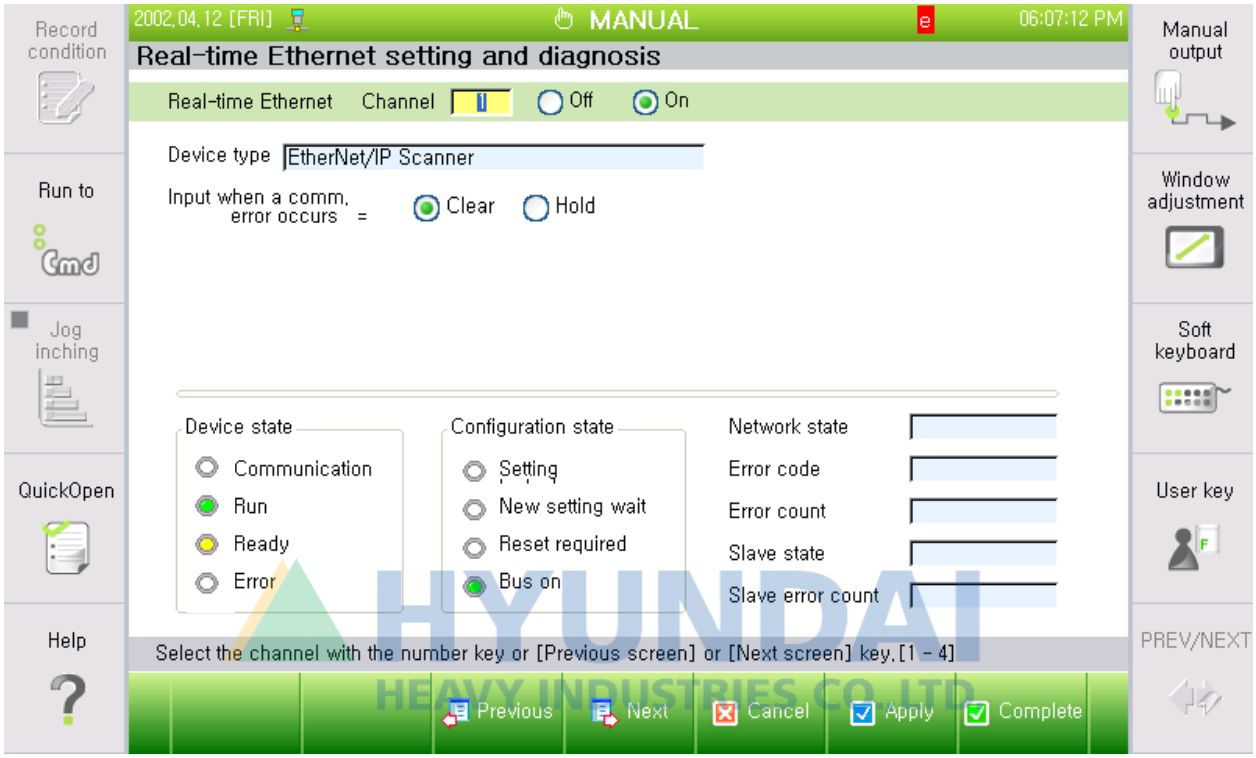


Figure 4.3 EtherNet/IP scanner setting screen

(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 EtherNet/IP scanner, shift it to the “On” position and then click the “Apply” or “Complete” button.

4.4. EtherNet/IP scanner diagnosis

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

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

(2) As the EtherNet/IP scanner corresponds to the channel 1. Use the 『[F3]: Previous』or 『[F4]: Next』 key to shift to the channel 1.

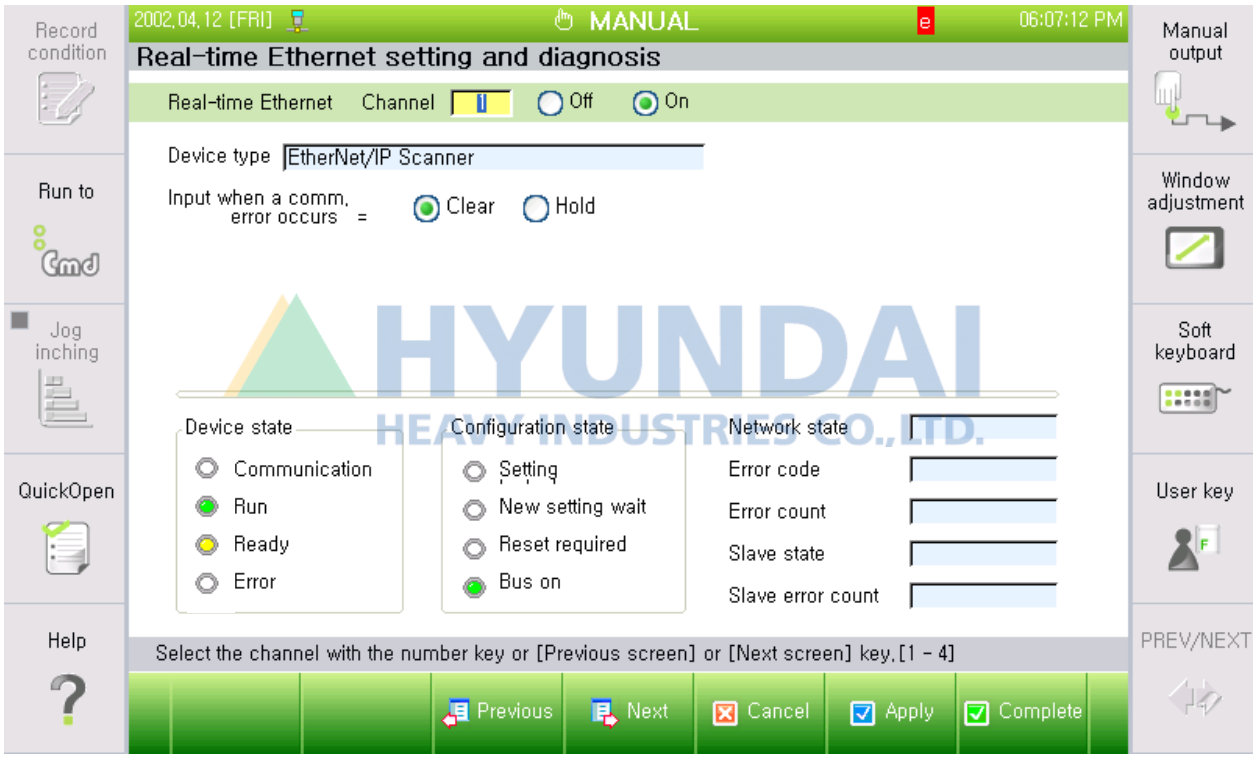


Figure 4.4 EtherNet/IP scanner diagnosis screen

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

■ System state

LED	Meaning	Color	State	Remarks
Communication	EtherNet/IP communication state	(Green)	Communication in progress	
		(White)	Communication stopped	
Run	EtherNet/IP setting state	(Green)	Setting normal	
		(White)	Setting abnormal	
Ready	EtherNet/IP system state	(Yellow)	System normal	
		(White)	System abnormal	
Error	EtherNet/IP 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 errors are occurring to more than one EtherNet/IP adapters.

■ Number of slaves that have errors: Shows the number of the EtherNet/IP adapters that have communication errors.

5
I/O Mapping

5.1. EtherNet/IP I/O mapping

The input and output data of the BD525 EtherNet/IP scanner and adapter 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 EtherNet/IP input and output data

Classification		Command grammar	Size	Description	Remarks
BD525 EtherNet/IP scanner	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 EtherNet/IP Adapter	Controller output	FB3.Y1~960	960	Bit signal output	For EtherNet/IP → Input
		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	For EtherNet/IP Scanner → Output
		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 an EtherNet/IP 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.

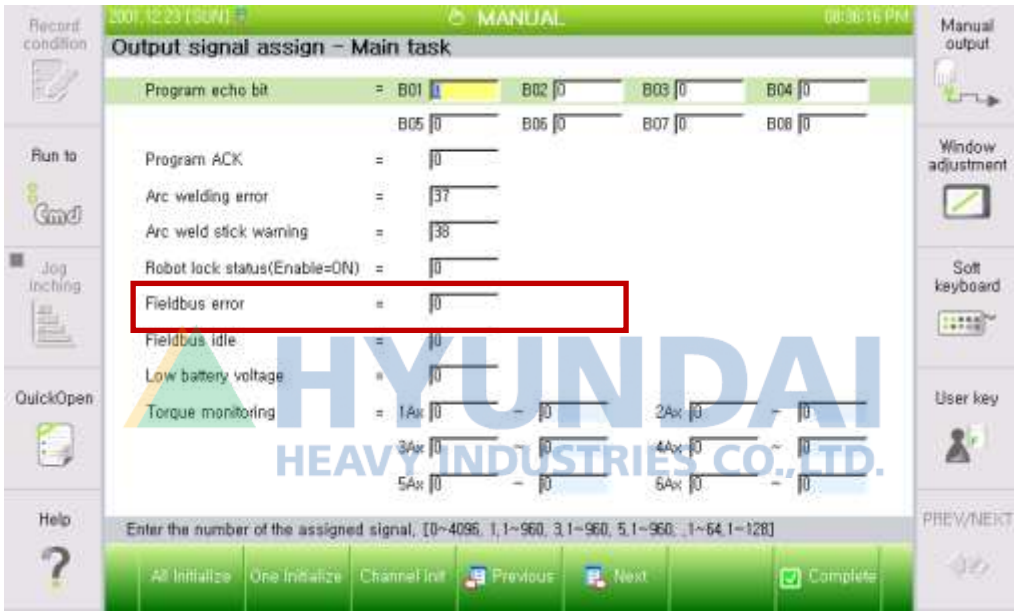


Figure 5.1 Communication error output signal assignment

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