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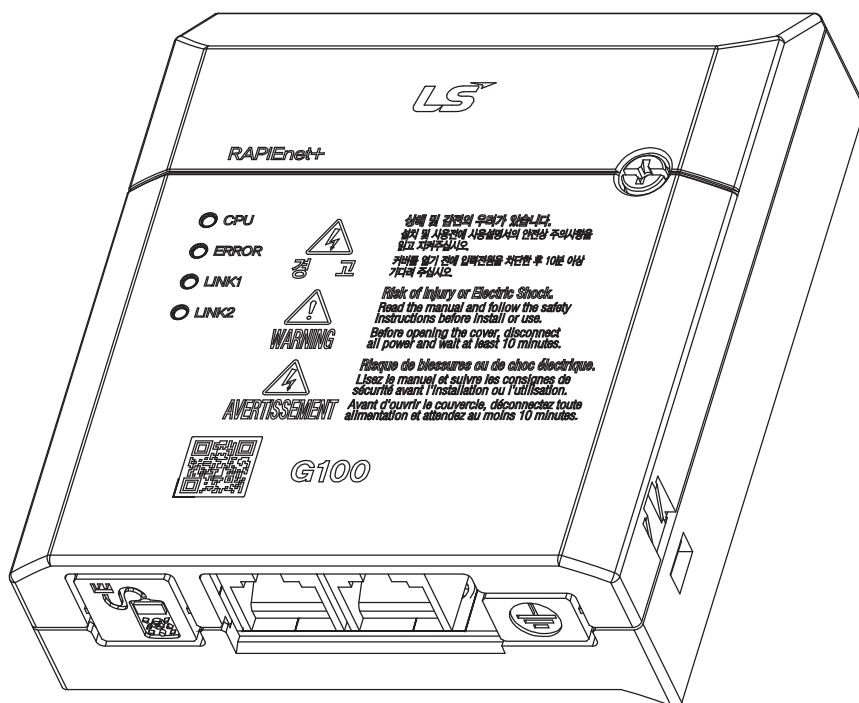
LS ELECTRIC strives to maximize your profits in gratitude for choosing us as your partner.

# RAPIEnet+ Option Module

LSLV-G100 series

User's Manual

[RAPIEnet, EtherNet/IP, Modbus TCP Protocol]



## Safety Instructions

- Use this board after read Safety Instruction of this manual carefully before using and follow the instructions exactly.
- Please hand this user manual to end user and trouble shooting manager
- After read this manual, keep it at handy for future reference.
- 사용 전에 '안전상의 주의사항'을 반드시 읽고 정확하게 사용하여 주십시오.
- 본 설명서는 제품을 사용하는 사람이 항상 볼 수 있는 곳에 잘 보관하십시오.

**LS**ELECTRIC

Before using the product

Thank you for purchasing the G100 RAPIEnet+ communication board.

# Safety Information

- Always follow safety instructions to prevent accidents and potentially hazardous situations.
- Safety precautions are classified into “WARNING” and “CAUTION,” and their meanings are as follows:

## Warning

Indicates a potentially hazardous situation which, if not avoided, may cause death or serious injury.

## Caution

Indicates a potentially hazardous situation, which, if not avoided, may cause minor injury or damage to the product.

- Symbols used in this document and on the product indicate the following.

 Read and follow the instructions carefully to avoid dangerous situations.

 Presence of “dangerous voltage” inside the product that may cause harm or electric shock.

- Keep the operating instructions handy for quick reference.
- Read the operating instructions carefully to fully understand the functions of the LSLV-G100 series inverters and use them properly.

## Caution

- **Be careful not to damage the CMOS elements on the communication board.**  
Static charge may cause malfunctioning of the product.
- **Turn off the inverter before connecting communication cables.**  
Otherwise, the module may be damaged or a communication error may result.
- **Correctly align the communication board to the installation connector for installation and ensure that it is firmly connected to the inverter.**  
Otherwise, the module may be damaged or a communication error may result.
- **Check the parameter units when configuring the parameter values.**  
Otherwise, a communication error may occur.

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# 1 Overview

The RAPIEnet+ communication board allows the LSLV-G100 inverter to connect to an EtherNet or RAPIEnet network that is compliant with international standards, Type 21 of IEC 61158 and RRP of IEC 62439. The RAPIEnet+ communication board supports three protocols: RAPIEnet, EtherNet/IP, and Modbus TCP.

By utilizing the 100 Mbps auto negotiation feature, the RAPIEnet+ communication board provides real-time network communication without collisions and allows for controlling and monitoring of the inverter via PLC sequence programs or a Profibus master module.

With simple network cable wiring, installation times can be reduced and maintenance becomes easier.

(When accessing a RAPIEnet v2.0 network with XG5000, LS ELECTRIC network master module XGL-EFMxB V8.0 or later is required.)

\*\* You can download the user manual ("Manual\_XGT\_FEnet") at: <https://www.lselectric.co.kr>

## Ref.

What is "RAPIEnet+"?

RAPIEnet+ is a hybrid networking solution that incorporates RAPIEnet, LS ELECTRIC's real-time industrial EtherNet based on international standards, with highly compatible Modbus TCP and EtherNet/IP network technologies. This highly efficient industrial EtherNet by LS ELECTRIC allows for integration of various future technologies required for factory automation, such as the IoT.

## 2 RAPIEnet+ technical specifications

| Items                   | Description                       |               |
|-------------------------|-----------------------------------|---------------|
| Communication Protocol  | RAPIEnet, EtherNet/IP, Modbus TCP |               |
| Communication speed     | 100Mbps                           |               |
| Communication type      | Auto negotiation                  |               |
| Communication range     | 100 m (twisted pair)              |               |
| Service                 | Smart scaling                     | Up to 8 words |
| Max. number of stations | 64 stations                       |               |
| Topology                | Line/Ring topology                |               |
| Communication range     | 100 m (twisted pair)              |               |
| Recommended cable       | UTP, FTP, STP                     |               |

\* The G100 RAPIEnet+ communication board supports all the features of the G100 EtherNet communication board.

### 3 Package components

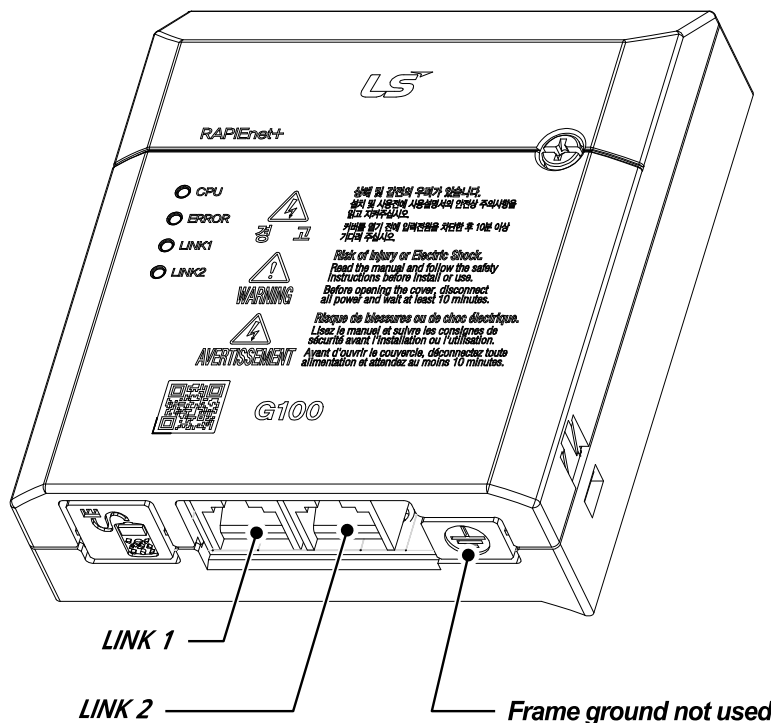
The product package contains: RAPIEnet+ communication board (1 ea), body connection cable (1 ea), and RAPIEnet+ communication board User Manual.

### 4 Device type for the G100 RAPIEnet+ communication board

Device type: CENT

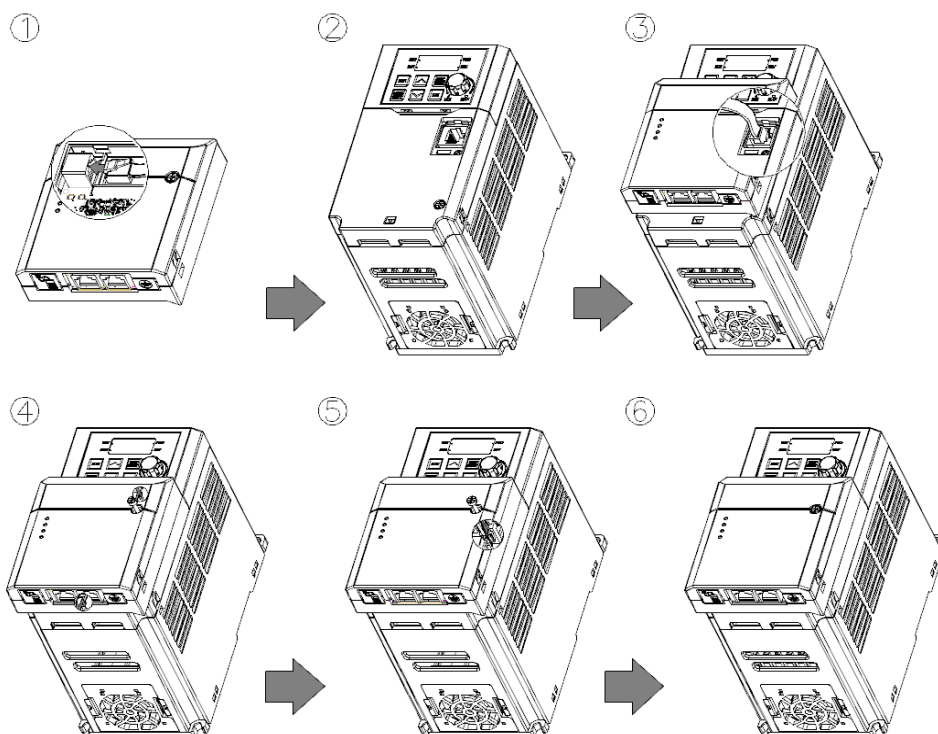
### 5 G100 RAPIEnet+ communication board layout and installation

#### 5.1 External layout





## 5.2 Installing the G100 RAPIEnet+ communication board



- 1 Connect the included RJ-45 cable to G100 RAPIEnet + communication board.
- 2 Remove the front cover from the G100 inverter.
- 3 Connect the G100 RAPIEnet + communication module to the G100 inverter using the included RJ-45 network cable.
- 4 Hook up the G100 RAPIEnet+ communication module to the installation slot on the inverter.
- 5 Install the fixing bolt provided with the G100 RAPIEnet+ communication module using an appropriate tool.
- 6 The G100 inverter and the G100 RAPIEnet + communication module have been connected.

### Warning

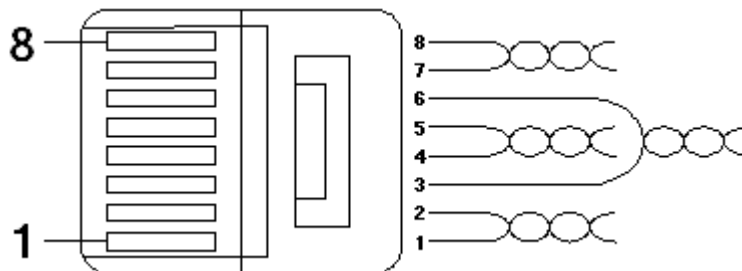
- Do not install or remove the RAPIEnet+ communication board to or from the G100 inverter while the inverter is turned on.
- Ensure that the electric charge in the capacitors inside the inverter is completely discharged before installing or uninstalling the RAPIEnet+ communication board.
- Ensure that the RJ-45 cable is firmly fixed to the inverter and the option board.
- Frame ground (FG) should not be used on the G100 RAPIEnet+ communication option boards.

## 6 Network connection

### 6.1 Network connection cable wiring

| Pin no. | Signal | Description           | Cable color  |
|---------|--------|-----------------------|--------------|
| 1       | TX+    | Data transmission (+) | White/Yellow |
| 2       | TX-    | Data transmission (-) | Yellow       |
| 3       | RX+    | Data reception (+)    | White/Green  |
| 4       | NONE   | Not used              | Blue         |
| 5       | NONE   | Not used              | White/Blue   |
| 6       | RX-    | Data reception (-)    | Green        |
| 7       | NONE   | Not used              | White/Brown  |
| 8       | NONE   | Not used              | Brown        |

### 6.2 Communication cable connector



\*\* The cables connected to pin 1 and pin 2 must be twisted in a pair.

\*\* The cables connected to pin 3 and pin 6 must be twisted in a pair.

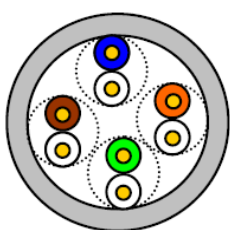
## 7 Network cable specifications

### 7.1 Frequency band

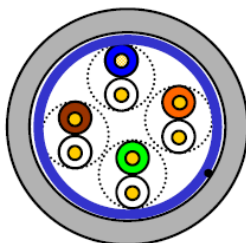
There are five types of UTP cable specifications according to different applications, from category 1 through category 5. Category 5 network cables are required for utilizing the RAPIEnet+ communication board.

Category 5 network cables support a frequency band up to 100 MHz, with up to 60 MHz channel performance and up to 100 Mbps data transmission speed.

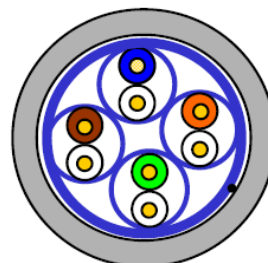
### 7.2 Twisted pair cable types



UTP



FTP



STP

| Category       | Description                                                                                                                                                                                         | Specifications/Usage                                                                                    |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| UTP<br>(U.UTP) | Unshielded Twisted Pair cable for high speed signals                                                                                                                                                | 200 MHz max.<br>Voice + Data + Low quality video signals                                                |
| FTP<br>(S.UTP) | Single insulation for the cable core<br>* Insulation material: AL / Plastic complex foil or copper braid                                                                                            | 100 MHz max.<br>Protection against EMI, electrically stable<br>Voice + Data + Low quality video signals |
| STP<br>(S.STP) | Dual insulation for the pair and the cable core<br>* Material for cable pair insulation: AL/Plastic complex foil<br>* Material for cable core insulation: AL / Plastic complex foil or copper braid | 500MHz max.<br>Voice + Data + Video signals<br>Replaces 75Ω coaxial cable                               |

## 8 Inverter communication address

Refer to “Chapter 11. Communication features” of the “G100 User Manual” for details.

\*\* You can download the “G100 User Manual” at: <https://www.lselectric.co.kr>

## 9 Keypad parameters for RAPIEnet+ communication board

The following table lists the inverter parameters related to RAPIEnet, EtherNet/IP, and Modbus TCP communication features. Application types for each parameter is specified in the “Protocol” column: R (RAPIEnet), E (EtherNet/IP), or M (Modbus TCP).

Set drv parameter (Cmd Source) to “4 (Fieldbus)” using the keypad to operate the G100 inverter via the RAPIEnet+ communication board.

Set Freq parameter (Frq Ref Src) to “8 (Fieldbus)” using the keypad to provide frequency reference via the RAPIEnet+ communication board.

| Keypad parameters related to G100 RAPIEnet+ communication board |                  |               |         |                                                                                                                                 |          |
|-----------------------------------------------------------------|------------------|---------------|---------|---------------------------------------------------------------------------------------------------------------------------------|----------|
| Code No.                                                        | Parameter Name   | Initial Value | Range   | Description                                                                                                                     | Protocol |
| drv                                                             | Cmd Source       | 1             | 0 – 4   | 4: Set to “Field Bus.”                                                                                                          | R/E/M    |
| Frq                                                             | Freq Ref Src     | 0             | 0 – 8   | 8: Set to “Field Bus.”                                                                                                          | R/E/M    |
| CM-06                                                           | FBus S/W Ver     | -             | -       | Indicates the version of the communication board installed.                                                                     | R/E/M    |
| CM-07                                                           | FBus ID          | 10            | 0 – 63  | Set the station number of the RAPIEnet+ communication board.                                                                    | R/E      |
| CM-09                                                           | FBus Led         |               |         | Displays the on/off status of the LED indicators on the RAPIEnet+ communication board.                                          | R/E/M    |
| CM-10                                                           | Opt Parameter1   | 192           | 0 – 255 | Sets the IP address.                                                                                                            | R/E/M    |
| CM-11                                                           | Opt Parameter2   | 168           | 0 – 255 | * To connect to the network via the RAPIEnet protocol after setting CM-25 to “2 (RAPIEnet Enable),” set CM-13 to “100 + CM-07.” |          |
| CM-12                                                           | Opt Parameter3   | 1             | 0 – 255 |                                                                                                                                 |          |
| CM-13                                                           | Opt Parameter4   | 101           | 0 – 255 |                                                                                                                                 |          |
| CM-14                                                           | Opt Parameter5   | 255           | 0 – 255 | Set the subnet mask.                                                                                                            | R/E/M    |
| CM-15                                                           | Opt Parameter6   | 255           | 0 – 255 |                                                                                                                                 |          |
| CM-16                                                           | Opt Parameter7   | 255           | 0 – 255 |                                                                                                                                 |          |
| CM-17                                                           | Opt Parameter8   | 0             | 0 – 255 |                                                                                                                                 |          |
| CM-18                                                           | Opt Parameter9   | 192           | 0 – 255 | Sets the Gateway address.                                                                                                       | R/E/M    |
| CM-19                                                           | Opt Parameter 10 | 168           | 0 – 255 |                                                                                                                                 |          |
| CM-20                                                           | Opt Parameter 11 | 1             | 0 – 255 |                                                                                                                                 |          |
| CM-21                                                           | Opt Parameter 12 | 10            | 0 – 255 |                                                                                                                                 |          |
| CM-22                                                           | Opt Parameter 13 | 0             | 0       | Set the network communication speed. (fixed to 100 Mbps Auto)                                                                   | R/E/M    |
| CM-23                                                           | Opt Parameter 14 | 1             | 0 – 11  | CIP Input Instance                                                                                                              | R/E      |

## Keypad parameters related to G100 RAPIenet+ communication board

|       |                  |   |        |                                           |     |
|-------|------------------|---|--------|-------------------------------------------|-----|
| CM-24 | Opt Parameter 15 | 1 | 0 – 11 | CIP Output Instance                       | R/E |
| CM-25 | Opt Parameter 16 | 2 | 0 – 2  | 2: RAPIenet Enable<br>0: RAPIenet Disable | R/E |

**Ref.**

After making changes to parameter CM-07 and parameters CM-10 – 25, you must set CM-94 (Comm-Update) to “1 (Yes)” to save the changes. (If CM-94 [Comm-Update] has not been set after making the parameter changes, the LED indicator will flash in red at 2-second intervals to warn the user.)

## Keypad parameters related to G100 RAPIenet+ communication board

| Code No. | Parameter Name  | Initial Value | Range             | Description                                                        | Protocol |
|----------|-----------------|---------------|-------------------|--------------------------------------------------------------------|----------|
| CM-30    | Para Status Num | 3             | 0 – 8             | Automatically set according to the CIP Input Instance.             | R/E      |
| CM-31    | Para Status-1   | 000A          | 0x0000<br>-0xFFFF | Sets up the inverter data address to be read by the client. (Hex.) | R/E      |
| CM-32    | Para Status-2   | 000D          | 0x0000<br>-0xFFFF | Sets up the inverter data address to be read by the client. (Hex.) | R/E      |
| CM-33    | Para Status-3   | 000F          | 0x0000<br>-0xFFFF | Sets up the inverter data address to be read by the client. (Hex.) | R/E      |
| CM-34    | Para Status-4   | -             | 0x0000<br>-0xFFFF | Sets up the inverter data address to be read by the client. (Hex.) | R/E      |
| CM-35    | Para Status-5   | -             | 0x0000<br>-0xFFFF | Sets up the inverter data address to be read by the client. (Hex.) | R/E      |
| CM-36    | Para Status-6   | -             | 0x0000<br>-0xFFFF | Sets up the inverter data address to be read by the client. (Hex.) | R/E      |
| CM-37    | Para Status-7   | -             | 0x0000<br>-0xFFFF | Sets up the inverter data address to be read by the client. (Hex.) | R/E      |
| CM-38    | Para Status-8   | -             | 0x0000<br>-0xFFFF | Sets up the inverter data address to be read by the client. (Hex.) | R/E      |
| CM-50    | Para Ctrl Num   | 2             | 0 – 8             | Automatically set according                                        | R/E      |

## Keypad parameters for RAPIenet+ communication board

| Keypad parameters related to G100 RAPIenet+ communication board |                |      |                                                                                       |                                                                          |       |
|-----------------------------------------------------------------|----------------|------|---------------------------------------------------------------------------------------|--------------------------------------------------------------------------|-------|
|                                                                 |                |      |                                                                                       | to the CIP Output Instance.                                              |       |
| CM-51                                                           | Para Control-1 | 0005 | 0x0000<br>-0xFFFF                                                                     | Sets up the client's command address. (Hex.)                             | R/E   |
| CM-52                                                           | Para Control-2 | 0006 | 0x0000<br>-0xFFFF                                                                     | Sets up the client's command address. (Hex.)                             | R/E   |
| CM-53                                                           | Para Control-3 | -    | 0x0000<br>-0xFFFF                                                                     | Sets up the client's command address. (Hex.)                             | R/E   |
| CM-54                                                           | Para Control-4 | -    | 0x0000<br>-0xFFFF                                                                     | Sets up the client's command address. (Hex.)                             | R/E   |
| CM-55                                                           | Para Control-5 | -    | 0x0000<br>-0xFFFF                                                                     | Sets up the client's command address. (Hex.)                             | R/E   |
| CM-56                                                           | Para Control-6 | -    | 0x0000<br>-0xFFFF                                                                     | Sets up the client's command address. (Hex.)                             | R/E   |
| CM-57                                                           | Para Control-7 | -    | 0x0000<br>-0xFFFF                                                                     | Sets up the client's command address. (Hex.)                             | R/E   |
| CM-58                                                           | Para Control-8 | -    | 0x0000<br>-0xFFFF                                                                     | Sets up the client's command address. (Hex.)                             | R/E   |
| CM-94                                                           | Comm Update    | 0    | 0: NO<br>1: YES                                                                       | Update keypad parameters related to network communication.               | R/E/M |
| Pr-12                                                           | Lost Cmd Mode  | None | 0: None<br>1: Free-Run<br>2: Dec<br>3: Hold Input<br>4: Hold Output<br>5: Lost Preset | Set the inverter operation for when a Lost Command has occurred. (Note1) | R/E/M |
| Pr-13                                                           | Lost Cmd Time  | 1.0  | 0.1 – 120                                                                             | Lost Command trigger time                                                | R/E/M |
| Pr-14                                                           | Lost Preset F  | 0.00 | 0.05 – 60.00                                                                          | Sets the Lost Preset speed                                               | R/E/M |

(Note1) Lost Command Mode

| Set value     | Function                                                                                  |
|---------------|-------------------------------------------------------------------------------------------|
| "None"        | Maintains the previous status.                                                            |
| "Free-Run"    | Lost Command Trip occurs and a free run stop is made.                                     |
| "Dec"         | Lost Command Trip occurs and a deceleration stop is made.                                 |
| "Hold Input"  | Lost Command Warning occurs and the inverter operates with the previous speed reference.  |
| "Hold Output" | Lost Command Warning occurs and the inverter operates with the previous running speed.    |
| "Lost Preset" | Lost Command Warning occurs and the inverter operates with speed reference set at PRT-14. |

## 10 Description of keypad parameters related to RAPIEnet+ communication board

### 10.1 Description of keypad parameters (simplified)

The following table lists the simplified information of keypad parameters. The detailed information is provided in the parameter group section.

| Code | Parameter Name  | Description                                                                   |
|------|-----------------|-------------------------------------------------------------------------------|
| drv  | Cmd Source      | Command Source                                                                |
| Frq  | Freq Ref Src    | Frequency reference source                                                    |
| CM   | 06 FBus S/W Ver | Communication option S/W version                                              |
|      | 07 FBus ID      | Station ID of the communication board<br>(communication board ID)             |
|      | 09 FBus Led     | Information about LED indicators on the<br>communication board                |
|      | 10 opt para-1   | Enter the 1st decimal number of the IP address.                               |
|      | 11 opt para-2   | Enter the 2nd decimal number of the IP address.                               |
|      | 12 opt para-3   | Enter the 3rd decimal number of the IP address.                               |
|      | 13 opt para-4   | Enter the 4th decimal number of the IP address.                               |
|      | 14 opt para-5   | Enter the 1st decimal number of the subnet address.                           |
|      | 15 opt para-6   | Enter the 2nd decimal number of the subnet address.                           |
|      | 16 opt para-7   | Enter the 3rd decimal number of the subnet address.                           |
|      | 17 opt para-8   | Enter the 4th decimal number of the subnet address.                           |
|      | 18 opt para-9   | Enter the 1st decimal number of the gateway address.                          |
|      | 19 opt para-10  | Enter the 2nd decimal number of the gateway address.                          |
|      | 20 opt para-11  | Enter the 3rd decimal number of the gateway address.                          |
|      | 21 opt para-12  | Enter the 4th decimal number of the gateway address.                          |
|      | 22 opt para-13  | Network communication speed<br>(0 fixed, automatically set to 100 Mbps)       |
|      | 23 opt para-14  | RAPIEnet: Set the Input Parameter Size<br>EtherNet/IP: Set the Input Instance |



| Code | Parameter Name    | Description                                                                       |
|------|-------------------|-----------------------------------------------------------------------------------|
|      | 24 opt para-15    | RAPIEnet: Set Output Parameter Size<br>EtherNet/IP: Set Output Instance           |
|      | 25 opt para-16    | Enable or disable RAPIEnet<br>2: Enable RAPIEnet (Default)<br>0: RAPIEnet Disable |
|      | 30 ParaStatus Num | Displays the number of transmitted data                                           |
|      | 31 Para Status-1  | Set address 1 for storing the transmitted data.                                   |
|      | 32 Para Status-2  | Set address 2 for storing the transmitted data.                                   |
|      | 33 Para Status-3  | Set address 3 for storing the transmitted data.                                   |
|      | 34 Para Status-4  | Set address 4 for storing the transmitted data.                                   |
|      | 35 Para Status-5  | Set address 5 for storing the transmitted data.                                   |
|      | 36 Para Status-6  | Set address 6 for storing the transmitted data.                                   |
|      | 37 Para Status-7  | Set address 7 for storing the transmitted data.                                   |
|      | 38 Para Status-8  | Set address 8 for storing the transmitted data.                                   |
|      | 50 Para Ctrl Num  | Displays the number of received data                                              |
|      | 51 Para Control-1 | Set address 1 for storing the received data.                                      |
|      | 52 Para Control-2 | Set address 2 for storing the received data.                                      |
|      | 53 Para Control-3 | Set address 3 for storing the received data.                                      |
|      | 54 Para Control-4 | Set address 4 for storing the received data.                                      |
|      | 55 Para Control-5 | Set address 5 for storing the received data.                                      |
|      | 56 Para Control-6 | Set address 6 for storing the received data.                                      |
|      | 57 Para Control-7 | Set address 7 for storing the received data.                                      |
|      | 58 Para Control-8 | Set address 8 for storing the received data.                                      |
|      | 94 Comm Update    | Reflect the network parameter changes.                                            |
| Pr   | 12 Lost Cmd Mode  | Select operation mode for a lost command.                                         |
|      | 13 Lost Cmd Time  | Set the decision time for a lost command.                                         |
|      | 14 Lost Preset F  | Set the start frequency for a lost command.                                       |

## 10.2 Operation Group

### ① [drv] Cmd Source: Command Source

Select the command source for the G100 inverter. Set to "4 (Field Bus)" to set the RAPIEnet communication board as the command source and provide commands via network.

### ② [Frq] Freq Ref Src: Frequency reference source

Select the frequency command source for the G100 inverter. Set to "8 (Field Bus)" to set the RAPIEnet communication board as the frequency command source and provide frequency commands via network.

## 10.3 CM Group

### ① [CM-06] FBus S/W Ver: Communication option S/W version

Automatically indicates the version of the communication board installed to the G100 inverter.

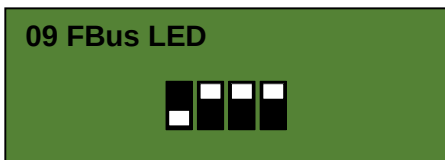
### ② [CM-07] FBus ID: Station ID of the communication board (communication board ID)

R: Set the station ID for the G100 RAPIEnet+ communication board. A total of 64 station IDs are available from 0 to 63. (The station ID must be set before you can configure network communication using the RAPIEnet protocol.)  
When setting the station ID, be careful not to use a station ID that is not already occupied by the PLC system or other network devices.  
After making setting changes, you must set CM-94 (Comm Update) to "1 (Yes)" before the changes can take effect.

### ③ [CM-09] FBus Led: Information about LED indicators on the communication board

Displays on the Keypad the status of the LED indicators on the G100 RAPIEnet+ communication board. Refer to sections "11.3/12.4 LED indications and troubleshooting."

Example of the COM-09 (FBus LED) indication



| LINK1      | LINK2     | ERROR     | CPU       |
|------------|-----------|-----------|-----------|
| LED is OFF | LED is ON | LED is ON | LED is ON |

④ **[CM-22] opt para-13: Set the network communication speed. (100 Mbps, Auto Negotiation)**

The EtherNet speed parameter is fixed at "0" by default for 100 Mbps communication speed.

G100G100

⑤ **[CM-23] opt para-14: Transmission data setting**

Used to monitor one of the smart scaling transmission data of the G100 RAPIEnet+ communication board. You can select one of the data transmission addresses from CM31 to CM38 for monitoring.

You can set "opt para-14 (smart scaling transmission data index)" to between "0" and "11." Refer to the following table for the description of the "opt para-14" settings.

The "opt para-14 (smart scaling transmission data index)" setting cannot be written while the inverter is operating. Stop inverter operation before making changes to the setting.

This parameter setting is also required for a service via EtherNet/IP protocol. It specifies the data format of the inverter status to be transmitted to the client (originator) during an I/O communication via a CIP (Common Industrial Protocol). Refer to the Assembly Object section of the EtherNet/IP.

| Set value | Input instance value (E) | Data size (R/E) | Number of parameters (R/E) |
|-----------|--------------------------|-----------------|----------------------------|
| 0         | 70                       | 4               | X                          |
| 1         | 71                       | 4               | X                          |
| 2         | 110                      | 4               | X                          |
| 3         | 111                      | 4               | X                          |
| 4         | 141                      | 2               | 1                          |
| 5         | 142                      | 4               | 2                          |
| 6         | 143                      | 6               | 3                          |
| 7         | 144                      | 8               | 4                          |
| 8         | 145                      | 10              | 5                          |
| 9         | 146                      | 12              | 6                          |
| 10        | 147                      | 14              | 7                          |
| 11        | 148                      | 16              | 8                          |

## ⑥ [CM-24] opt para-15: Reception data setting

Used to monitor one of the smart scaling reception data of the G100 RAPIEnet+ communication board. You can select one of the data reception addresses from CM51 to CM58 for monitoring.

You can set “opt para-15 (smart scaling reception data index)” to between “0” and “11.” The description of the “opt para-15” settings are as follows.

The “opt para-15 (smart scaling reception data index)” setting cannot be written while the inverter is operating. Stop inverter operation before making changes to the setting.

This parameter is also required for EtherNet/IP protocol service. It configures the format of the command data transmitted to the inverter by the client (originator) during the I/O communication via the CIP (Common Industrial Protocol). Refer to the Assembly Object section of the EtherNet/IP.

| Set value | Output instance value (E) | Data size (R/E) | Number of parameters (R/E) |
|-----------|---------------------------|-----------------|----------------------------|
| 0         | 20                        | 4               | X                          |
| 1         | 21                        | 4               | X                          |
| 2         | 100                       | 4               | X                          |
| 3         | 101                       | 4               | X                          |
| 4         | 121                       | 2               | 1                          |
| 5         | 122                       | 4               | 2                          |
| 6         | 123                       | 6               | 3                          |
| 7         | 124                       | 8               | 4                          |
| 8         | 125                       | 10              | 5                          |
| 9         | 126                       | 12              | 6                          |
| 10        | 127                       | 14              | 7                          |
| 11        | 128                       | 16              | 8                          |

## ⑦ [CM-25] RAPIEnet Enable/Disable settings

The RAPIEnet feature for the RAPIEnet+ communication board is “Enabled” by default. This feature is compatible with LS ELECTRIC products (XGL-EFMxB V8.0 or later) for the RAPIEnet v2 smart scaling service. (2: RAPIEnet v2 Enable / 0: RAPIEnet v2 Disable)

\*\* You can download the user manual (“Manual\_XGT\_FEnet”) at: <https://www.lselectric.co.kr>

If you have installed the G100 RAPIEnet+ communication board to an inverter made by another manufacturer (to utilize it as an G100 EtherNet communication board), set the parameter to “0,” then run “Comm Update” to operate the inverter with the RAPIEnet feature disabled.

### ⑧ **[CM-30] ParaStatus Num: Number of transmission data**

You can set CM-23 (opt para-14) to change the number of reception data to between “0” and “8.” The RAPIEnet+ communication board can transmit up to 8 pieces of data. You can configure the address of the transmission data with parameters CM-31 through CM-38.

### ⑨ **[CM-31] Para Status1 – [CM38] Para Status8: Transmission data address settings**

After setting the number of transmission data with CM-30, enter the matching number of data addresses for the data to transmit to the client (originator) with parameters CM-31 through CM-38.

This parameter setting is not required for Modbus TCP network communications.

### ⑩ **[CM-50] Para Ctrl Num: Number of reception data**

You can set CM-23 (opt para-14) to change the number of reception data to between “0” and “8.”

The RAPIEnet+ communication board can receive up to 8 pieces of data. You can configure the address for the received data with parameters CM-51 through CM-58.

### ⑪ **[CM-51] Para Control1 – [CM58] Para Control8: Reception data address settings**

After setting the number of reception data with CM-50, enter the matching number of data addresses for receiving command data from the client (originator) with parameters CM-51 through CM-58.

This parameter setting is not required for Modbus TCP network communications.

### ⑫ **[CM-94] Comm Update: Update setting changes via the communication board**

The CM group parameters display the settings stored on the inverter connected to the RAPIEnet+ communication board and the changes made on the keypad are not directly reflected on the RAPIEnet communication board.

The changed settings will be reflected on the RAPIEnet communication board when you set COM-94 (Comm Update) to “1 (Yes).” (Parameters that require communication updates include CM-7 and CM 10 through COM-25.)

## 10.4 PRT group (Lost Command)

### ① [Pr-12] Lost Cmd Mode: Operation mode for a command loss

You can select the operation mode for when a network failure or connection failure between the inverter and the communication occurs while the inverter is operated via network communication.

### ② [Pr-13] Lost Cmd Time: Decision time for a command loss

Set the time duration until the operation mode set with PR-12 will be reflected following a command loss. You can set a value between "0.1" and "120" seconds.

### ③ [Pr-14] Lost Preset F: Operation frequency for a command loss

When a lost command occurs, a protective function is activated and the inverter continues to operate using the frequency set with Pr-14. The setting value is from the start frequency to the max frequency [Hz].

### ④ Lost command conditions by protocol

- RAPIEnet

When the RAPIEnet master (XGL-EFMxB V8.0 or later) fails to receive data for the watchdog time, the communication board enters lost command mode, and the inverter will operate according to the settings at Pr-12 after the time set with Pr-13 has elapsed.

Refer to item 2 of section 11 for how to set the watchdog timer for the master module.

- EtherNet/IP

If the implicit message connection (Class 1 Connection) between the originator (a PLC or client) and the target (inverter) breaks for longer than one second, the EtherNet communication board enters lost command mode, and the inverter will operate according to the settings at Pr-12 after the time set with PRT-13 has elapsed.

- Modbus TCP

If the Modbus TCP receives no data from the client for five seconds, the EtherNet communication board enters lost command mode, and the inverter will operate according to the settings at Pr-12 after the time set with Pr-13 has elapsed.

# 11 Services with LS ELECTRIC products

## 11.1 Introduction

This chapter explains about services utilizing the RAPIEnet protocol when the communication board is connected with LS ELECTRIC products.

The keypad settings required to utilize the RAPIEnet service are as follows.

The RAPIEnet feature is enabled by default.

| RAPIEnet+ communication board CM25<br>[Opt Parameter-16] | RAPIEnet v2 Availability | EtherNet/IP Availability | Modbus TCP Availability |
|----------------------------------------------------------|--------------------------|--------------------------|-------------------------|
| Setting: '2'<br>RAPIEnet v2 Enable                       | O                        | O                        | O                       |
| Setting: '0'<br>RAPIEnet v2 Disable                      | X                        | O                        | O                       |

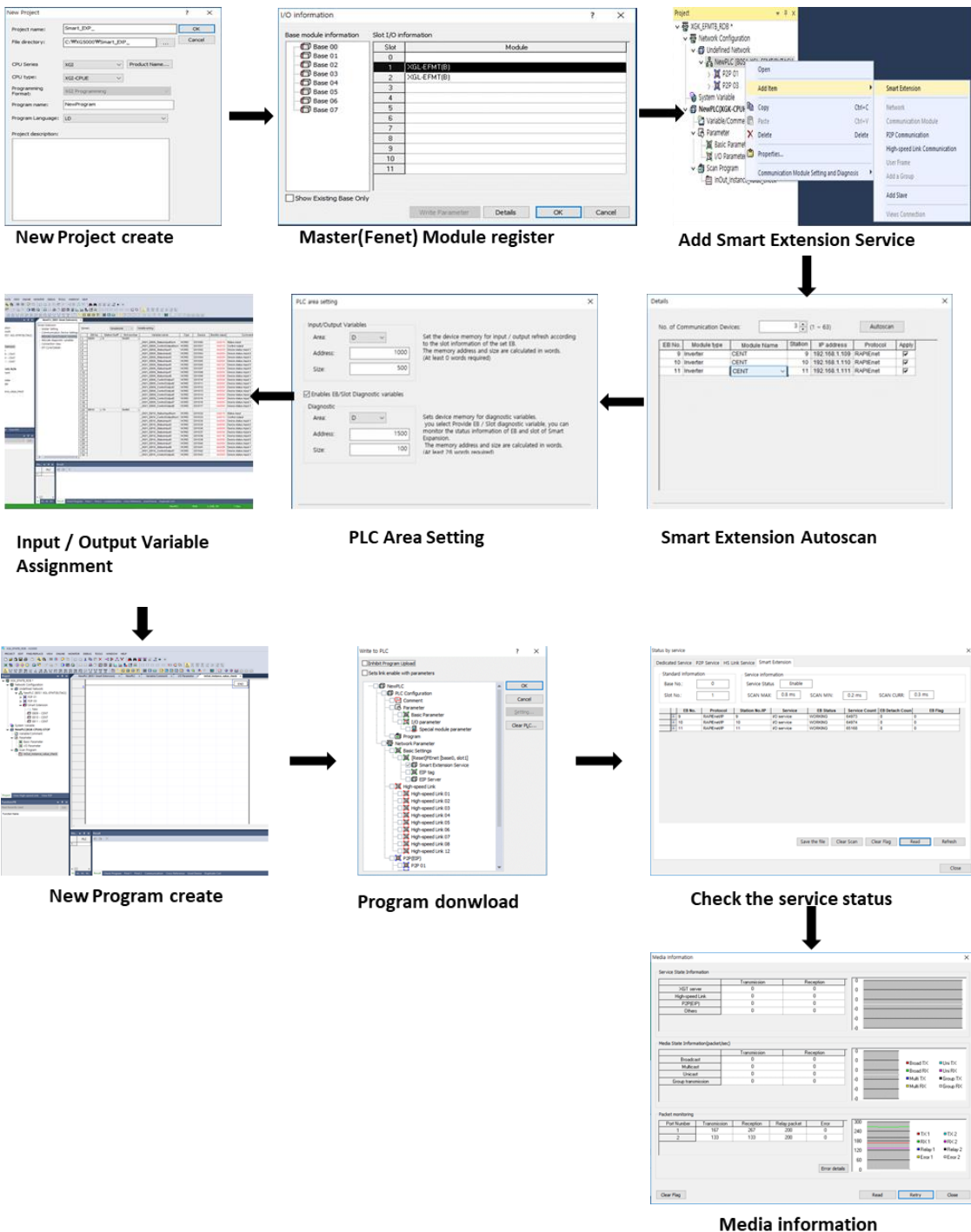
## 11.2 Smart scaling (LS ELECTRIC master module: XGL-EFMxB V8.0 or later)

The smart scaling service is a communication service between automation products that allows for the extension of multiple PLCs and inverters utilizing simple configurations, without the need for complicated parameters settings or programming. The smart scaling service also has the EtherNet/IP service integrated within.

The G100 RAPIEnet+ communication board enables 8-word data input/output transmissions via an LS ELECTRIC master module, simply by configuring the number of transmission/reception data (CM-30/CM-50) and the addresses for transmission/reception data (CM-31 – CM-38 / CM-51 – CM-58). Besides, it provides various features, such as, monitoring of diagnostic parameters, RAPIEnet auto scan, and system diagnosis.

\*\* You can download the user manual ("Manual\_XGT\_FEnet\_V3.00") at: <https://www.lselectric.co.kr>

The following figure shows an example of the XG5000 settings screen for an LS ELECTRIC network master module (XGL-EFMxB V8.0 or later).





## Ref.

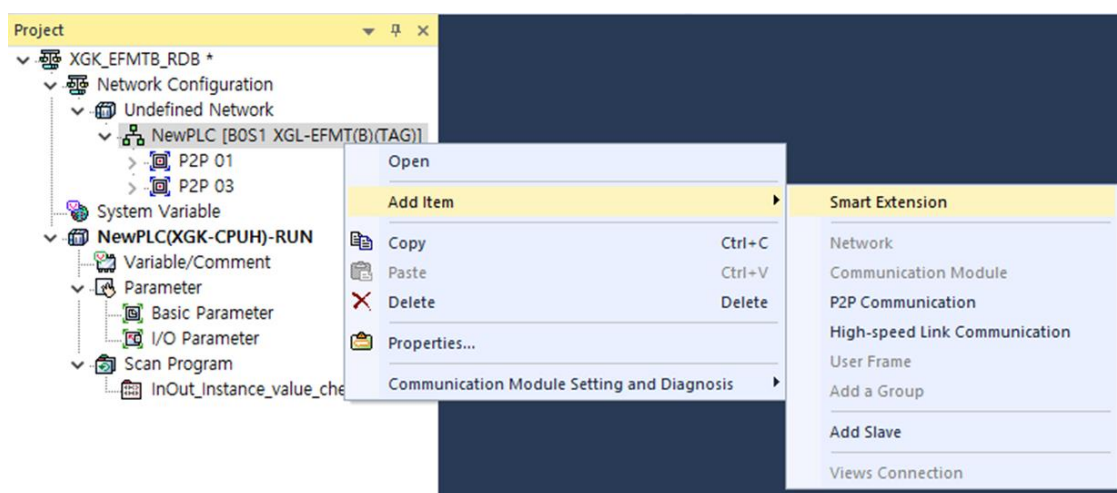
“Smart scaling memory area settings”: The G100 RAPIEnet+ communication board has a 64-byte (32 Word) memory area assigned for it (fixed). When configuring the addresses, be careful not to use addresses already occupied by other programs to avoid collisions. Separate warnings are not provided, nor are duplicated addresses prohibited because users may configure a certain area of the addresses to be superimposed for special purposes.

### 11.2.1 Configuring the XG5000 program for the PLC

For an G100 inverter to communicate with the PLC via the RAPIEnet+ communication board, the XGL-EFMxB module (RAPIEnet I/F module) must be utilized. For a smart scaling service, the station ID (EB) and the IP address of the smart scaling device must be specified first: Ex. PAR->COM-07 (FBUS ID): “05,” PAR->COM-13 (Opt Parameter4): “100 + FBUS ID (05)” = “105” (This prevents IP address collisions between the communication boards installed to the inverters.) Refer to the user manual provided with the XGL-EFMxB product for detailed instructions.

Also, to configure a network communication utilizing a PLC system, installation of the XG5000 program is required. You can download XG5000 program from the LS ELECTRIC website.

\*\* Access the website (<https://www.lselectric.co.kr>) and download the document.

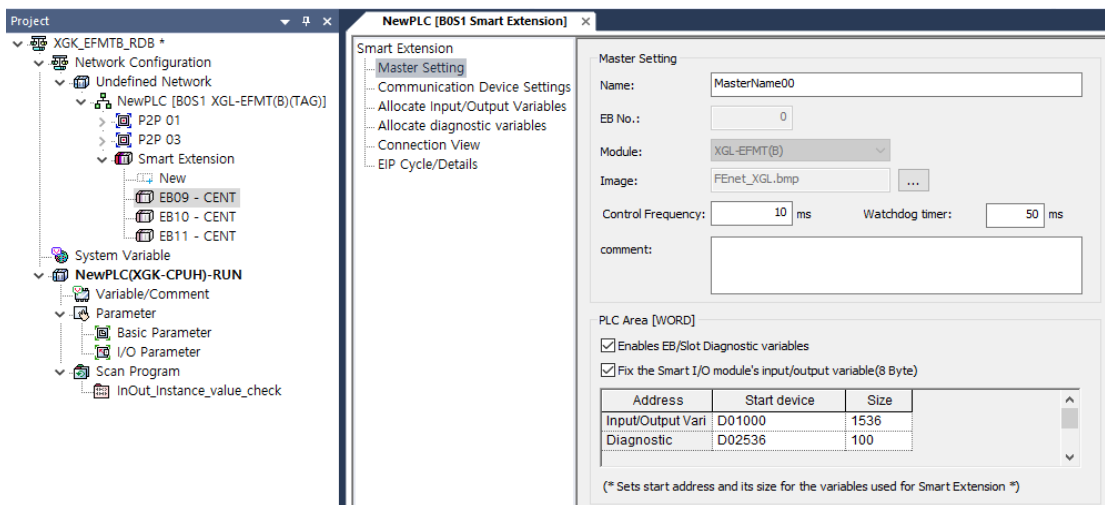


In the Connection tab of the Add Network Device window, you can configure the properties and click “OK” to add a network device [CENT] (RAPIEnet+ communication board) for a smart scaling service.

## 11.2.2 Configuring the master module

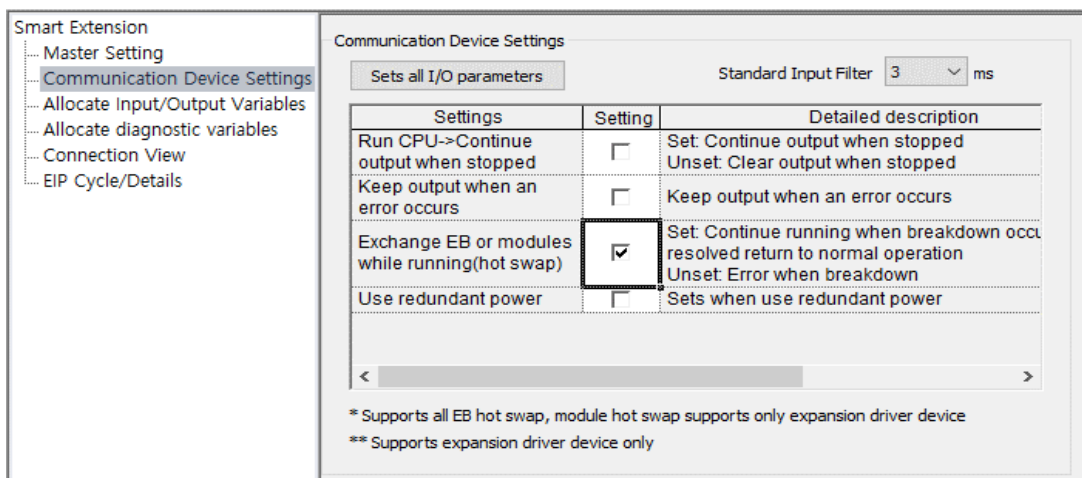
You can configure the “Watchdog timer” for a master module (XGL-EFMxB V8.0 or later). If lost command mode (Parameter->Pr-12 [Lost Cmd Mode]) is enabled on the keypad, the lost command time (Parameter->Pr-13 [Lost Cmd Time]) is extended by the time set as the watchdog time for the master module. Therefore, the watchdog time must be considered when setting the Parameter->Pr-13 (Lost Cmd Time) parameter value.

Watchdog timer: The time for the network device (G100 RAPIEnet+ communication board) to monitor the uninterrupted network connection with the master module.



## 11.2.3 Network device settings

Select the hot swap feature. If the hot swap feature is not selected, losing one station ID (EB) on the network will cause the entire network to stop communicating.



## 11.2.4 Input/Output parameter settings

The following settings enable an automatic 8 word / 8 word communication of input/output parameters.

Smart Extension

Master Setting

Communication Device Settings

Allocate Input/Output Variables

Allocate diagnostic variables

Connection View

EIP Cycle/Details

Format: 

Hexadecimal

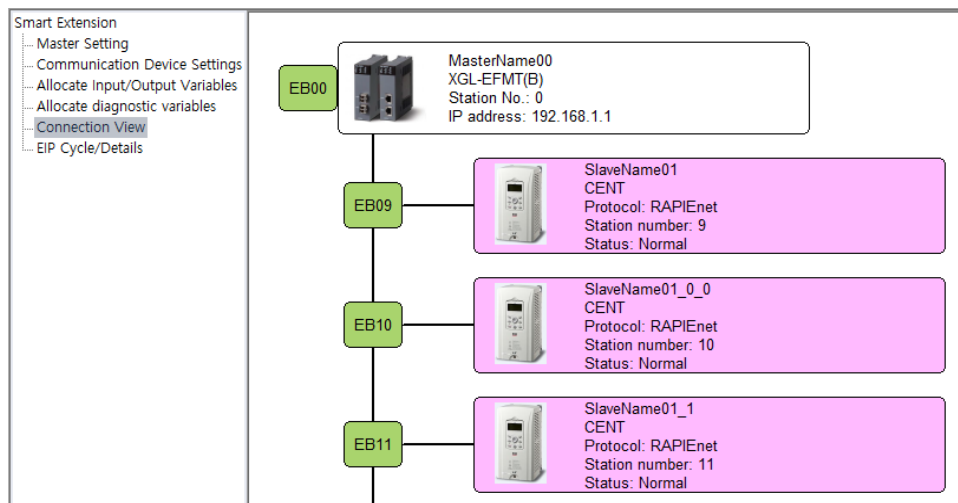
Variable setting

|    | EB No. | Station No/IP | Slot number | Variable name               | Type | Device | Monitor value | Comment               |
|----|--------|---------------|-------------|-----------------------------|------|--------|---------------|-----------------------|
| 1  | EB09   | 9             | Slot00      | _0001_EB09_StatusInputNum   | WORD | D01000 | 0x0010        | Status input          |
| 2  |        |               |             | _0001_EB09_ControlOutputNum | WORD | D01001 | 0x0010        | Control output        |
| 3  |        |               |             | _0001_EB09_StatusInput1     | WORD | D01002 | 0x0000        | Device status input 1 |
| 4  |        |               |             | _0001_EB09_StatusInput2     | WORD | D01003 | 0x0000        | Device status input 2 |
| 5  |        |               |             | _0001_EB09_StatusInput3     | WORD | D01004 | 0x0000        | Device status input 3 |
| 6  |        |               |             | _0001_EB09_StatusInput4     | WORD | D01005 | 0x0000        | Device status input 4 |
| 7  |        |               |             | _0001_EB09_StatusInput5     | WORD | D01006 | 0x0129        | Device status input 5 |
| 8  |        |               |             | _0001_EB09_StatusInput6     | WORD | D01007 | 0x0000        | Device status input 6 |
| 9  |        |               |             | _0001_EB09_StatusInput7     | WORD | D01008 | 0x0000        | Device status input 1 |
| 10 |        |               |             | _0001_EB09_StatusInput8     | WORD | D01009 | 0x000B        | Device status input 1 |
| 11 |        |               |             | _0001_EB09_ControlOutput1   | WORD | D01010 | 0x0000        | Device status input 1 |
| 12 |        |               |             | _0001_EB09_ControlOutput2   | WORD | D01011 | 0x0000        | Device status input 1 |
| 13 |        |               |             | _0001_EB09_ControlOutput3   | WORD | D01012 | 0x0000        | Device status input 1 |
| 14 |        |               |             | _0001_EB09_ControlOutput4   | WORD | D01013 | 0x0000        | Device status input 1 |
| 15 |        |               |             | _0001_EB09_ControlOutput5   | WORD | D01014 | 0x0000        | Device status input 1 |
| 16 |        |               |             | _0001_EB09_ControlOutput6   | WORD | D01015 | 0x0000        | Device status input 1 |
| 17 |        |               |             | _0001_EB09_ControlOutput7   | WORD | D01016 | 0x0000        | Device status input 1 |
| 18 |        |               |             | _0001_EB09_ControlOutput8   | WORD | D01017 | 0x0000        | Device status input 1 |
| 19 |        |               |             |                             |      |        |               |                       |

## 11.2.5 Diagnostic parameter settings

|                                                                                                                                                                                                                                                    |      |                                                                |               |               |                         |      |          |               |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------------------------------------------------|---------------|---------------|-------------------------|------|----------|---------------|
| Smart Extension                                                                                                                                                                                                                                    |      | Format: <span>Hexadecimal</span> <span>Variable setting</span> |               |               |                         |      |          |               |
| <ul style="list-style-type: none"> <li>Master Setting</li> <li>Communication Device Settings</li> <li>Allocate Input/Output Variables</li> <li><b>Allocate diagnostic variables</b></li> <li>Connection View</li> <li>EIP Cycle/Details</li> </ul> |      | EB No.                                                         | Station No/IP | Variable Kind | Variable name           | Type | Device   | Monitor value |
| 1                                                                                                                                                                                                                                                  | EB00 | 0/192.168.1.1                                                  | System diag   |               | _0001_STATUS_CHG_CNT    | UINT | D02536   | 0x0002        |
| 2                                                                                                                                                                                                                                                  |      |                                                                |               |               | _0001_SCAN_MAX          | UINT | D02537   | 0x0006        |
| 3                                                                                                                                                                                                                                                  |      |                                                                |               |               | _0001_SCAN_MIN          | UINT | D02538   | 0x0003        |
| 4                                                                                                                                                                                                                                                  |      |                                                                |               |               | _0001_SCAN_CUR          | UINT | D02539   | 0x0004        |
| 5                                                                                                                                                                                                                                                  |      |                                                                |               |               | _0001_SYSTEM_ER         | BIT  | D02540.0 | 0             |
| 6                                                                                                                                                                                                                                                  |      |                                                                |               |               | _0001_SYSTEM_WAR        | BIT  | D02540.1 | 0             |
| 7                                                                                                                                                                                                                                                  |      |                                                                |               |               | _0001_EB_DEER           | BIT  | D02540.2 | 0             |
| 8                                                                                                                                                                                                                                                  |      |                                                                |               |               | _0001_EB_BASE_INFO_ER   | BIT  | D02540.3 | 0             |
| 9                                                                                                                                                                                                                                                  |      |                                                                |               |               | _0001_IO_TYER           | BIT  | D02540.4 | 0             |
| 10                                                                                                                                                                                                                                                 |      |                                                                |               |               | _0001_IO_DEER           | BIT  | D02540.5 | 0             |
| 11                                                                                                                                                                                                                                                 |      |                                                                |               |               | _0001_FUSE_ER           | BIT  | D02540.6 | 0             |
| 12                                                                                                                                                                                                                                                 |      |                                                                |               |               | _0001_REF_TIME_OUT      | BIT  | D02540.7 | 0             |
| 13                                                                                                                                                                                                                                                 |      |                                                                |               |               | _0001_EB_CRC_ER         | BIT  | D02540.8 | 0             |
| 14                                                                                                                                                                                                                                                 |      |                                                                |               |               | _0001_TAG_ER            | BIT  | D02540.9 | 0             |
| 15                                                                                                                                                                                                                                                 |      |                                                                |               |               | _0001_SCAN_CLEAR        | BIT  | D02541.E | 0             |
| 16                                                                                                                                                                                                                                                 |      |                                                                |               |               | _0001_ERR_CLEAR         | BIT  | D02541.F | 0             |
| 155                                                                                                                                                                                                                                                |      |                                                                |               |               | _0001_EB09_CFG_ER       | BIT  | D02558.0 | 0             |
| 156                                                                                                                                                                                                                                                |      |                                                                |               |               | _0001_EB09_DEER         | BIT  | D02558.1 | 0             |
| 157                                                                                                                                                                                                                                                |      |                                                                |               |               | _0001_EB09_REF_TIME_OUT | BIT  | D02558.2 | 0             |
| 158                                                                                                                                                                                                                                                |      |                                                                |               |               | _0001_EB09_P1_CRC_ER    | BIT  | D02558.3 | 0             |
| 159                                                                                                                                                                                                                                                |      |                                                                |               |               | _0001_EB09_P2_CRC_ER    | BIT  | D02558.4 | 0             |
| 160                                                                                                                                                                                                                                                |      |                                                                |               |               | _0001_EB09_IO_TYER      | BIT  | D02559.1 | 0             |
| 161                                                                                                                                                                                                                                                |      |                                                                | Slot00        |               |                         |      |          |               |
| 162                                                                                                                                                                                                                                                |      |                                                                |               |               | _0001_EB09_S00_IO_TYER  | BIT  | D02560.0 | 0             |
| 163                                                                                                                                                                                                                                                | EB10 | 10                                                             | EB diagnosis  |               |                         |      |          |               |
| 164                                                                                                                                                                                                                                                |      |                                                                |               |               | _0001_EB10_CFG_ER       | BIT  | D02560.8 | 0             |
| 165                                                                                                                                                                                                                                                |      |                                                                |               |               | _0001_EB10_DEER         | BIT  | D02560.9 | 0             |
| 166                                                                                                                                                                                                                                                |      |                                                                |               |               | _0001_EB10_REF_TIME_OUT | BIT  | D02560.A | 0             |
| 167                                                                                                                                                                                                                                                |      |                                                                |               |               | _0001_EB10_P1_CRC_ER    | BIT  | D02560.B | 0             |
| 168                                                                                                                                                                                                                                                |      |                                                                |               |               | _0001_EB10_P2_CRC_ER    | BIT  | D02560.C | 0             |
| 169                                                                                                                                                                                                                                                |      |                                                                |               |               | _0001_EB10_IO_TYER      | BIT  | D02561.9 | 0             |
| 170                                                                                                                                                                                                                                                |      |                                                                | Slot00        |               |                         |      |          |               |
| 171                                                                                                                                                                                                                                                |      |                                                                |               |               | _0001_EB10_S00_IO_TYER  | BIT  | D02562.8 | 0             |

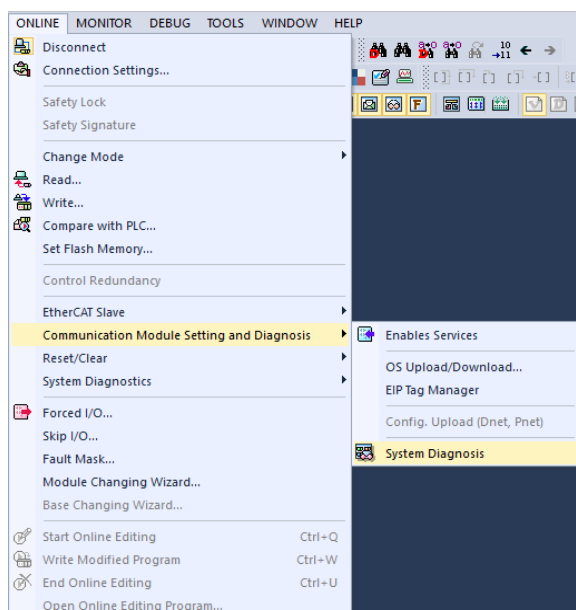
## 11.2.6 Network device connections



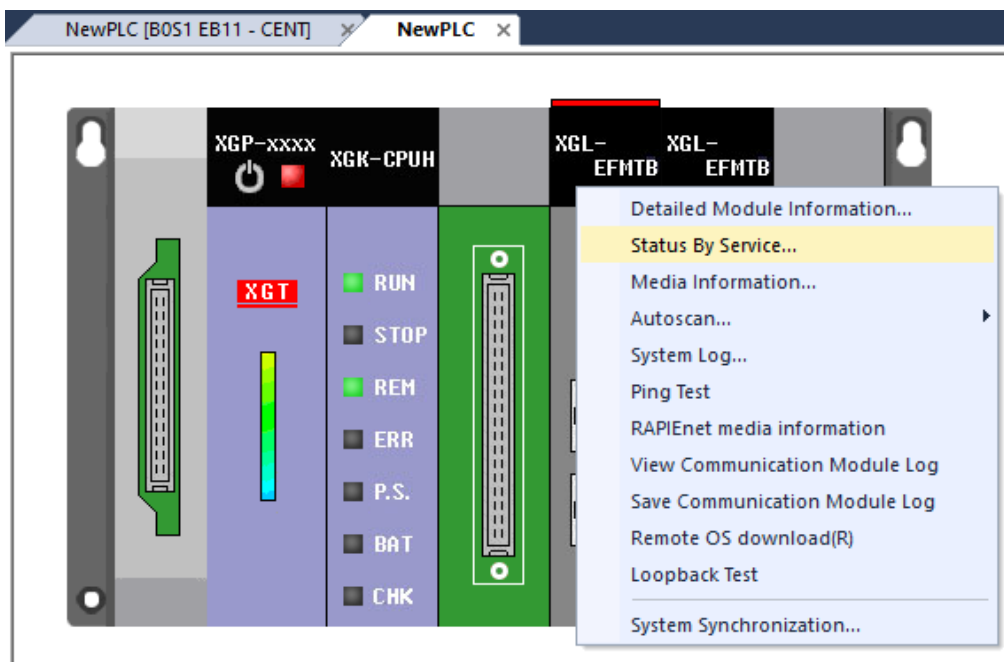
## 11.2.7 Service status

Service status shows the service operation status of the scaling service, service counts, and error counts. (Service status can be provided only when the system is online.)

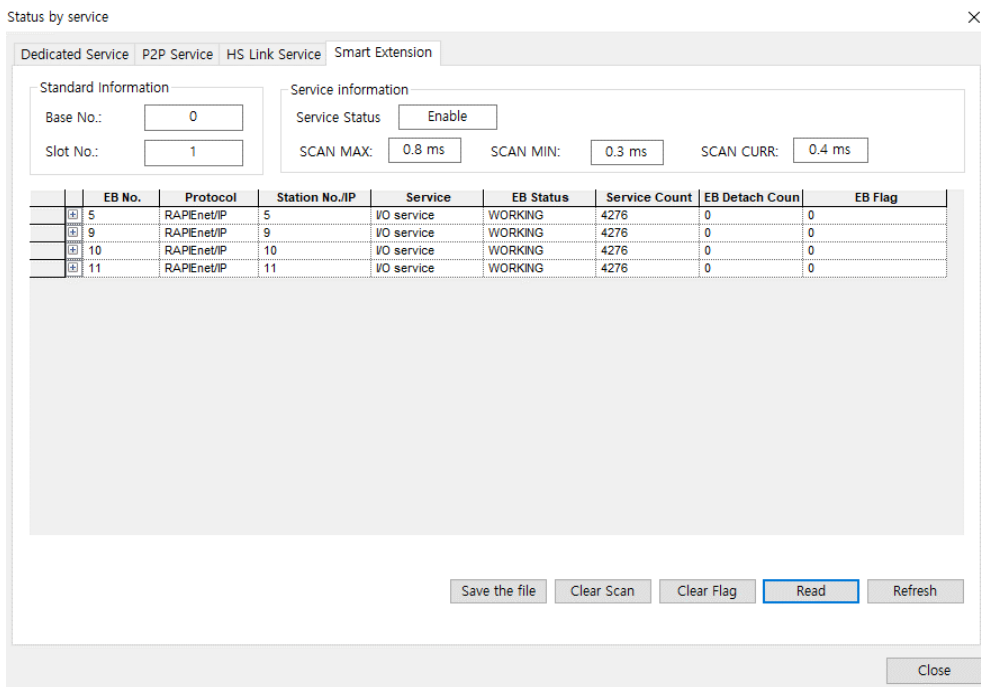
- ① Click [Online] -> [Network module settings and diagnosis] -> [System diagnosis].



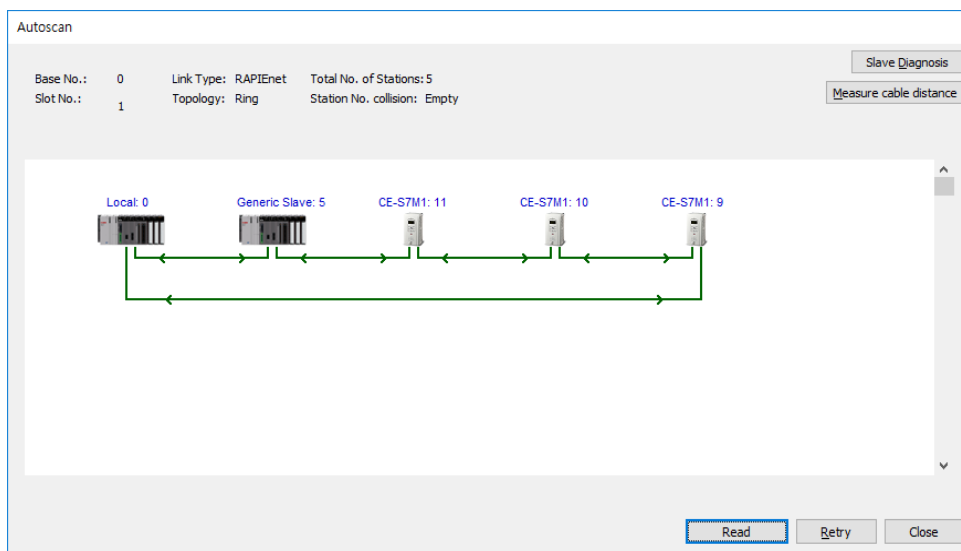
- ② In the [System diagnosis] window, right-click the master module (XGL-EFMxB) on the figure, then click Service status.



- ③ Click [Service status] -> [Smart scaling] tap to view the scaling service status.



- ④ In step ②, you can click the [Auto scan] tap to view the RAPIEnet connection status.



## 11.3 LED Indications and troubleshooting

| LED name | Color  | Description            | Status | Status                                                                                               |
|----------|--------|------------------------|--------|------------------------------------------------------------------------------------------------------|
| LINK1    | Green  | Network normal         | ON     | Network connection at LINK 1 is operating normal                                                     |
|          | Orange | Check network settings | ON     | Check RAPIEnet network settings *1<br>When the communication cycle stops for longer than one second. |
|          | -      | LINK 1 Not connected   | OFF    | RAPIEnet communication is operating, but the network is not connected to LINK 1.                     |
| LINK2    | Green  | Network normal         | ON     | Network connection at LINK 2 is operating normal                                                     |
|          | Orange | Network fault          | ON     | Check RAPIEnet network settings *1<br>When the communication cycle stops for longer than one second. |
|          | -      | LINK 1 Not connected   | OFF    | RAPIEnet communication is operating, but the network is not connected to LINK 2.                     |

\*1: For a RAPIEnet network communication, check keypad parameter settings for CM-7, CM-13, CM-30, and CM-50, and the PLC settings. (When the RAPIEnet+ communication board is communicating with an LS ELECTRIC master module and the RAPIEnet network feature is enabled, the CM-7 [station ID] and CM-13 [IP address] parameters must be set to avoid collisions with other RAPIEnet+ communication boards on the same network.)

| LED name | Color | Description      | Status                                                      | Status                                                                                                           |
|----------|-------|------------------|-------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| ERROR    | Red   | Normal operation | OFF                                                         | Communication between the communication board and the inverter is normal.                                        |
|          |       | Network fault    | Flashing Synchronous flashing with LED0 (1 second interval) | Communication between the RAPIEnet+ communication board and the inverter is abnormal.                            |
|          |       |                  | Flashing (2 second interval)                                | The communication board parameters are set differently from the communication parameter settings on the keypad*2 |
|          |       |                  | ON                                                          | EEPROM failure<br>No network connection to LINK 1 and LINK 2<br>Station ID or IP address collision is detected.  |
| CPU      | Green | Normal operation | Flashing (1 second interval)                                | The communication board has been properly installed to the inverter.                                             |

\*2: To synchronize the Keypad parameter settings with the communication module settings, check the CM group settings and set CM-94 (Comm Update) to "1 (Yes)."

## 12 Services with LS ELECTRIC products or other manufacturer's products

### 12.1 Introduction

This chapter explains the services utilizing EtherNet/IP and Modbus TCP protocols when the communication board is connected with LS ELECTRIC products or another manufacturer's products.

The following keypad settings are required to disable the RAPIEnet service.

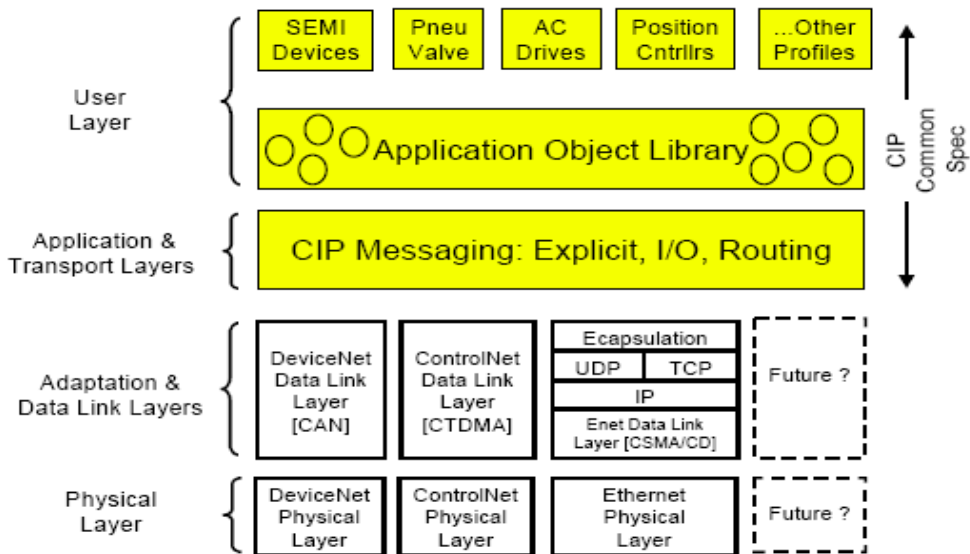
The RAPIEnet service feature is enabled by default.

| RAPIEnet+ communication board CM25<br>[Opt Parameter-16] | RAPIEnet v2 Availability | EtherNet/IP Availability | Modbus TCP Availability |
|----------------------------------------------------------|--------------------------|--------------------------|-------------------------|
| Setting: '2'<br>RAPIEnet v2 Enable                       | O                        | O                        | O                       |
| Setting: '0'<br>RAPIEnet v2 Disable                      | X                        | O                        | O                       |



## 12.2 EtherNet/IP

### 12.2.1 Basic protocol structure



The EtherNet/IP is a protocol which implements the CIP (Common Industrial Protocol, specified by the ODVA) using the TCP and UDP protocols.

**Originator:** Devices that make connection requests, which are also called clients.

PLCs or scanners are examples of originators.

**Target:** Devices that respond to connection requests, which are also called servers.

Inverters are examples of targets.

## 12.2.2 Implicit message

Implicit messages are also called I/O messages. It refers to the data communicated between the client (originator) and the server (target) at predefined intervals, via input and output instances.

The class 1 connection is used for implicit messages.

### ① Scope of support

Transport type

Originator->Target: Point to Point

Target->Originator: Multicast

Transport trigger: Cyclic

Configuration connection: 1

Connection tag: Not available

Priority

Originator->Target: Scheduled

Target->Originator: Scheduled

Configuration data: Not available

### ② Input instances

Input instances refer to the status data periodically sent from the inverter to PLC or other client devices.

| Instance | Byte | Bit 7                                       | Bit 6              | Bit 5               | Bit 4 | Bit 3                 | Bit 2                 | Bit 1   | Bit 0   |
|----------|------|---------------------------------------------|--------------------|---------------------|-------|-----------------------|-----------------------|---------|---------|
| 70       | 0    |                                             |                    |                     |       |                       | Running<br>1<br>(Fwd) |         | Faulted |
|          | 1    |                                             |                    |                     |       |                       |                       |         |         |
|          | 2    | Speed Actual (Low Byte) – RPM unit (note 1) |                    |                     |       |                       |                       |         |         |
|          | 3    | Speed Actual (High Byte) – RPM unit         |                    |                     |       |                       |                       |         |         |
| 71       | 0    | At<br>Reference                             | Ref<br>From<br>Net | Ctrl<br>From<br>Net | Ready | Running<br>2<br>(Rev) | Running<br>1<br>(Fwd) | Warning | Faulted |
|          | 1    | Drive State                                 |                    |                     |       |                       |                       |         |         |
|          | 2    | Speed Actual (Low Byte) – RPM unit          |                    |                     |       |                       |                       |         |         |
|          | 3    | Speed Actual (High Byte) – RPM unit         |                    |                     |       |                       |                       |         |         |
| 110      | 0    |                                             |                    |                     |       |                       | Running<br>1<br>(Fwd) |         | Faulted |

| Instance | Byte | Bit 7                                      | Bit 6        | Bit 5         | Bit 4 | Bit 3           | Bit 2           | Bit 1   | Bit 0   |
|----------|------|--------------------------------------------|--------------|---------------|-------|-----------------|-----------------|---------|---------|
|          | 1    |                                            |              |               |       |                 |                 |         |         |
|          | 2    | Speed Actual (Low Byte) – Hz unit (note 1) |              |               |       |                 |                 |         |         |
|          | 3    | Speed Actual (High Byte) – Hz unit         |              |               |       |                 |                 |         |         |
| 111      | 0    | At Reference                               | Ref From Net | Ctrl From Net | Ready | Running 2 (Rev) | Running 1 (Fwd) | Warning | Faulted |
|          | 1    | Drive State                                |              |               |       |                 |                 |         |         |
|          | 2    | Speed Actual (Low Byte) – Hz unit          |              |               |       |                 |                 |         |         |
|          | 3    | Speed Actual (High Byte) – Hz unit         |              |               |       |                 |                 |         |         |
| 141      | 0    | Status Parameter - 1 data (Low Byte)       |              |               |       |                 |                 |         |         |
|          | 1    | Status Parameter - 1 data (High Byte)      |              |               |       |                 |                 |         |         |
| 142      | 0    | Status Parameter - 1 data (Low Byte)       |              |               |       |                 |                 |         |         |
|          | 1    | Status Parameter - 1 data (High Byte)      |              |               |       |                 |                 |         |         |
|          | 2    | Status Parameter - 2 data (Low Byte)       |              |               |       |                 |                 |         |         |
|          | 3    | Status Parameter - 2 data (High Byte)      |              |               |       |                 |                 |         |         |
| 143      | 0    | Status Parameter - 1 data (Low Byte)       |              |               |       |                 |                 |         |         |
|          | 1    | Status Parameter - 1 data (High Byte)      |              |               |       |                 |                 |         |         |
|          | 2    | Status Parameter - 2 data (Low Byte)       |              |               |       |                 |                 |         |         |
|          | 3    | Status Parameter - 2 data (High Byte)      |              |               |       |                 |                 |         |         |
|          | 4    | Status Parameter - 3 data (Low Byte)       |              |               |       |                 |                 |         |         |
|          | 5    | Status Parameter - 3 data (High Byte)      |              |               |       |                 |                 |         |         |
| 144      | 0    | Status Parameter - 1 data (Low Byte)       |              |               |       |                 |                 |         |         |
|          | 1    | Status Parameter - 1 data (High Byte)      |              |               |       |                 |                 |         |         |
|          | 2    | Status Parameter - 2 data (Low Byte)       |              |               |       |                 |                 |         |         |
|          | 3    | Status Parameter - 2 data (High Byte)      |              |               |       |                 |                 |         |         |
|          | 4    | Status Parameter - 3 data (Low Byte)       |              |               |       |                 |                 |         |         |
|          | 5    | Status Parameter - 3 data (High Byte)      |              |               |       |                 |                 |         |         |
|          | 6    | Status Parameter - 4 data (Low Byte)       |              |               |       |                 |                 |         |         |
|          | 7    | Status Parameter - 4 data (High Byte)      |              |               |       |                 |                 |         |         |
| 145      | 0    | Status Parameter - 1 data (Low Byte)       |              |               |       |                 |                 |         |         |
|          | 1    | Status Parameter - 1 data (High Byte)      |              |               |       |                 |                 |         |         |
|          | 2    | Status Parameter - 2 data (Low Byte)       |              |               |       |                 |                 |         |         |
|          | 3    | Status Parameter - 2 data (High Byte)      |              |               |       |                 |                 |         |         |
|          | 4    | Status Parameter - 3 data (Low Byte)       |              |               |       |                 |                 |         |         |
|          | 5    | Status Parameter - 3 data (High Byte)      |              |               |       |                 |                 |         |         |
|          | 6    | Status Parameter - 4 data (Low Byte)       |              |               |       |                 |                 |         |         |
|          | 7    | Status Parameter - 4 data (High Byte)      |              |               |       |                 |                 |         |         |
|          | 8    | Status Parameter - 5 data (Low Byte)       |              |               |       |                 |                 |         |         |
|          | 9    | Status Parameter - 5 data (High Byte)      |              |               |       |                 |                 |         |         |
| 146      | 0    | Status Parameter - 1 data (Low Byte)       |              |               |       |                 |                 |         |         |

| Instance | Byte | Bit 7                                 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|----------|------|---------------------------------------|-------|-------|-------|-------|-------|-------|-------|
|          | 1    | Status Parameter - 1 data (High Byte) |       |       |       |       |       |       |       |
|          | 2    | Status Parameter - 2 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 3    | Status Parameter - 2 data (High Byte) |       |       |       |       |       |       |       |
|          | 4    | Status Parameter - 3 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 5    | Status Parameter - 3 data (High Byte) |       |       |       |       |       |       |       |
|          | 6    | Status Parameter - 4 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 7    | Status Parameter - 4 data (High Byte) |       |       |       |       |       |       |       |
|          | 8    | Status Parameter - 5 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 9    | Status Parameter - 5 data (High Byte) |       |       |       |       |       |       |       |
|          | 10   | Status Parameter - 6 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 11   | Status Parameter - 6 data (High Byte) |       |       |       |       |       |       |       |
| 147      | 0    | Status Parameter - 1 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 1    | Status Parameter - 1 data (High Byte) |       |       |       |       |       |       |       |
|          | 2    | Status Parameter - 2 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 3    | Status Parameter - 2 data (High Byte) |       |       |       |       |       |       |       |
|          | 4    | Status Parameter - 3 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 5    | Status Parameter - 3 data (High Byte) |       |       |       |       |       |       |       |
|          | 6    | Status Parameter - 4 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 7    | Status Parameter - 4 data (High Byte) |       |       |       |       |       |       |       |
|          | 8    | Status Parameter - 5 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 9    | Status Parameter - 5 data (High Byte) |       |       |       |       |       |       |       |
|          | 10   | Status Parameter - 6 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 11   | Status Parameter - 6 data (High Byte) |       |       |       |       |       |       |       |
|          | 12   | Status Parameter - 7 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 13   | Status Parameter - 7 data (High Byte) |       |       |       |       |       |       |       |
| 148      | 0    | Status Parameter - 1 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 1    | Status Parameter - 1 data (High Byte) |       |       |       |       |       |       |       |
|          | 2    | Status Parameter - 2 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 3    | Status Parameter - 2 data (High Byte) |       |       |       |       |       |       |       |
|          | 4    | Status Parameter - 3 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 5    | Status Parameter - 3 data (High Byte) |       |       |       |       |       |       |       |
|          | 6    | Status Parameter - 4 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 7    | Status Parameter - 4 data (High Byte) |       |       |       |       |       |       |       |
|          | 8    | Status Parameter - 5 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 9    | Status Parameter - 5 data (High Byte) |       |       |       |       |       |       |       |
|          | 10   | Status Parameter - 6 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 11   | Status Parameter - 6 data (High Byte) |       |       |       |       |       |       |       |
|          | 12   | Status Parameter - 7 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 13   | Status Parameter - 7 data (High Byte) |       |       |       |       |       |       |       |

| Instance | Byte | Bit 7                                 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|----------|------|---------------------------------------|-------|-------|-------|-------|-------|-------|-------|
|          | 14   | Status Parameter - 8 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 15   | Status Parameter - 8 data (High Byte) |       |       |       |       |       |       |       |

The following table explains the data (bytes 0 and 1) for instances 70, 71, 110, and 111.

| Name          | Description                  | Related attribute |          |
|---------------|------------------------------|-------------------|----------|
|               |                              | Class             | Attr. ID |
| Faulted       | Inverter Error               | 0x29              | 10       |
| Warning       | Not supported                | 0x29              | 11       |
| Running1      | Motor is running Forward     | 0x29              | 7        |
| Running2      | Motor is running Reverse     | 0x29              | 8        |
| Ready         | Motor is ready for operation | 0x29              | 9        |
| Ctrl From Net | Run/Stop control             | 0x29              | 15       |
| Ref From Net  | Speed control                | 0x2A              | 29       |
| At Reference  | Reached reference Speed      | 0x2A              | 3        |
| Drive State   | Current motor status         | 0x29              | 6        |
| Actual speed  | Reference speed              | 0x2A              | 7        |

### ③ Output instances

Out instance refers to the status data periodically sent from the PLC or other client devices to the inverter.

| Instance | Byte | Bit 7                                  | Bit 6           | Bit 5           | Bit 4 | Bit 3 | Bit 2       | Bit 1   | Bit 0   |
|----------|------|----------------------------------------|-----------------|-----------------|-------|-------|-------------|---------|---------|
| 20       | 0    |                                        |                 |                 |       |       | Fault reset |         | Run Fwd |
|          | 1    | 0                                      |                 |                 |       |       |             |         |         |
|          | 2    | Speed Reference (Low Byte) – RPM unit  |                 |                 |       |       |             |         |         |
|          | 3    | Speed Reference (High Byte) – RPM unit |                 |                 |       |       |             |         |         |
| 21       | 0    |                                        | NetRef (note 2) | NetCtrl (note2) |       |       | Fault reset | Run Rev | Run Fwd |
|          | 1    | 0                                      |                 |                 |       |       |             |         |         |
|          | 2    | Speed Reference (Low Byte) – RPM unit  |                 |                 |       |       |             |         |         |
|          | 3    | Speed Reference (High Byte) – RPM unit |                 |                 |       |       |             |         |         |
| 100      | 0    |                                        |                 |                 |       |       | Fault reset |         | Run Fwd |
|          | 1    | 0                                      |                 |                 |       |       |             |         |         |
|          | 2    | Speed Reference (Low Byte) – Hz unit   |                 |                 |       |       |             |         |         |
|          | 3    | Speed Reference (High Byte) – Hz unit  |                 |                 |       |       |             |         |         |
| 101      | 0    |                                        | NetRef          | NetCtrl         |       |       | Fault reset | Run Rev | Run Fwd |

| Instance | Byte | Bit 7                                  | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|----------|------|----------------------------------------|-------|-------|-------|-------|-------|-------|-------|
|          | 1    | 0                                      |       |       |       |       |       |       |       |
|          | 2    | Speed Reference (Low Byte) – Hz unit   |       |       |       |       |       |       |       |
|          | 3    | Speed Reference (High Byte) – Hz unit  |       |       |       |       |       |       |       |
| 121      | 0    | Control Parameter - 1 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 1    | Control Parameter - 1 data (High Byte) |       |       |       |       |       |       |       |
| 122      | 0    | Control Parameter - 1 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 1    | Control Parameter - 1 data (High Byte) |       |       |       |       |       |       |       |
|          | 2    | Control Parameter - 2 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 3    | Control Parameter - 2 data (High Byte) |       |       |       |       |       |       |       |
| 123      | 0    | Control Parameter - 1 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 1    | Control Parameter - 1 data (High Byte) |       |       |       |       |       |       |       |
|          | 2    | Control Parameter - 2 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 3    | Control Parameter - 2 data (High Byte) |       |       |       |       |       |       |       |
|          | 4    | Control Parameter - 3 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 5    | Control Parameter - 3 data (High Byte) |       |       |       |       |       |       |       |
| 124      | 0    | Control Parameter - 1 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 1    | Control Parameter - 1 data (High Byte) |       |       |       |       |       |       |       |
|          | 2    | Control Parameter - 2 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 3    | Control Parameter - 2 data (High Byte) |       |       |       |       |       |       |       |
|          | 4    | Control Parameter - 3 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 5    | Control Parameter - 3 data (High Byte) |       |       |       |       |       |       |       |
|          | 6    | Control Parameter - 4 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 7    | Control Parameter - 4 data (High Byte) |       |       |       |       |       |       |       |
| 125      | 0    | Control Parameter - 1 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 1    | Control Parameter - 1 data (High Byte) |       |       |       |       |       |       |       |
|          | 2    | Control Parameter - 2 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 3    | Control Parameter - 2 data (High Byte) |       |       |       |       |       |       |       |
|          | 4    | Control Parameter - 3 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 5    | Control Parameter - 3 data (High Byte) |       |       |       |       |       |       |       |
|          | 6    | Control Parameter - 4 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 7    | Control Parameter - 4 data (High Byte) |       |       |       |       |       |       |       |
|          | 8    | Control Parameter - 5 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 9    | Control Parameter - 5 data (High Byte) |       |       |       |       |       |       |       |
| 126      | 0    | Control Parameter - 1 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 1    | Control Parameter - 1 data (High Byte) |       |       |       |       |       |       |       |
|          | 2    | Control Parameter - 2 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 3    | Control Parameter - 2 data (High Byte) |       |       |       |       |       |       |       |
|          | 4    | Control Parameter - 3 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 5    | Control Parameter - 3 data (High Byte) |       |       |       |       |       |       |       |

| Instance | Byte | Bit 7                                  | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|----------|------|----------------------------------------|-------|-------|-------|-------|-------|-------|-------|
|          | 6    | Control Parameter - 4 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 7    | Control Parameter - 4 data (High Byte) |       |       |       |       |       |       |       |
|          | 8    | Control Parameter - 5 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 9    | Control Parameter - 5 data (High Byte) |       |       |       |       |       |       |       |
|          | 10   | Control Parameter - 6 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 11   | Control Parameter - 6 data (High Byte) |       |       |       |       |       |       |       |
| 127      | 0    | Control Parameter - 1 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 1    | Control Parameter - 1 data (High Byte) |       |       |       |       |       |       |       |
|          | 2    | Control Parameter - 2 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 3    | Control Parameter - 2 data (High Byte) |       |       |       |       |       |       |       |
|          | 4    | Control Parameter - 3 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 5    | Control Parameter - 3 data (High Byte) |       |       |       |       |       |       |       |
|          | 6    | Control Parameter - 4 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 7    | Control Parameter - 4 data (High Byte) |       |       |       |       |       |       |       |
|          | 8    | Control Parameter - 5 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 9    | Control Parameter - 5 data (High Byte) |       |       |       |       |       |       |       |
|          | 10   | Control Parameter - 6 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 11   | Control Parameter - 6 data (High Byte) |       |       |       |       |       |       |       |
|          | 12   | Control Parameter - 7 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 13   | Control Parameter - 7 data (High Byte) |       |       |       |       |       |       |       |
| 128      | 0    | Control Parameter - 1 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 1    | Control Parameter - 1 data (High Byte) |       |       |       |       |       |       |       |
|          | 2    | Control Parameter - 2 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 3    | Control Parameter - 2 data (High Byte) |       |       |       |       |       |       |       |
|          | 4    | Control Parameter - 3 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 5    | Control Parameter - 3 data (High Byte) |       |       |       |       |       |       |       |
|          | 6    | Control Parameter - 4 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 7    | Control Parameter - 4 data (High Byte) |       |       |       |       |       |       |       |
|          | 8    | Control Parameter - 5 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 9    | Control Parameter - 5 data (High Byte) |       |       |       |       |       |       |       |
|          | 10   | Control Parameter - 6 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 11   | Control Parameter - 6 data (High Byte) |       |       |       |       |       |       |       |
|          | 12   | Control Parameter - 7 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 13   | Control Parameter - 7 data (High Byte) |       |       |       |       |       |       |       |
|          | 14   | Control Parameter - 8 data (Low Byte)  |       |       |       |       |       |       |       |
|          | 15   | Control Parameter - 8 data (High Byte) |       |       |       |       |       |       |       |

The following table explains the data (bits for byte 0) for instances 20, 21, 100, and 101.

| Name                | Description         | Related attribute |          |
|---------------------|---------------------|-------------------|----------|
|                     |                     | Class             | Attr. ID |
| Run Fwd (Note1)     | Forward Run Command | 0x29              | 3        |
| Run Rev (Note1)     | Reverse Run Command | 0x29              | 4        |
| Fault reset (Note1) | Fault Reset Command | 0x29              | 12       |
| NetRef (Note2)      | Not used            | 0x2A              | 4        |
| NetCtrl (Note2)     | Not used            | 0x29              | 5        |
| Speed Reference     | Reference speed     | 0x2A              | 8        |

(Note1) Refer to the Drive Run and Fault sections in the "Control Supervisor Object (Class 0x29)".

(Note2) Reference speed and Run/Strop control can be set only on the LCD control panel. Network control instances 21 and 101 (NetRef, NetCtrl) are not available.

### 12.2.3 Explicit messages

Explicit messages refer to non-periodic data communications used for reading or writing attribute values of an inverter or an EtherNet/IP.

Using the UCMM communication, data exchange is made without connecting the originator and the target, and periodic data exchange is available as well using the Class 3 connection.



## 12.2.4 Supported objects

### ① Identity Object (Class 0x01, Instance 1)

#### Attribute

| Attribute ID | Access | Attribute Name                                                      | Data Length | Attribute Value   |
|--------------|--------|---------------------------------------------------------------------|-------------|-------------------|
| 1            | Get    | Vendor ID                                                           | Word        | 259               |
| 2            | Get    | Device Type (inverter)                                              | Word        | 2                 |
| 3            | Get    | Product Code                                                        | Word        | 100 (Note1)       |
| 4            | Get    | Revision<br>High Byte - Major Revision<br>Low Byte - Minor Revision | Word        | (Note2)<br>0x0101 |
| 5            | Get    | Status                                                              | Word        | (Note3)           |
| 6            | Get    | Serial Number                                                       | Double Word | (Note4)           |
| 7            | Get    | Product Name                                                        | 4 Byte      | CENT              |

(Note1) Product Code 100 refers to the LS ELECTRIC inverter.

(Note2) The revision number is identical to the version of the EtherNet communication board.  
The high byte stands for a major revision number, and the low byte stands for a minor revision number. For example, "0x0102" stands for "version 1.02."  
The version of the EtherNet communication board can be displayed on the Keypad using the CM-6 (FBus S/W Ver) parameter.

(Note3) Definition of status bits

| Bit | Description                                                                      |
|-----|----------------------------------------------------------------------------------|
| 0   | 0: Device is not connected to the master<br>1: Device is connected to the master |
| 1   | Reserved                                                                         |
| 2   | Configured (fixed as '0' because LS ELECTRIC EtherNet/IP is not supported)       |
| 3   | Reserved                                                                         |
| 4   | 0: Unknown                                                                       |
| 5   | 2: Faulty IO connection                                                          |
| 6   | 3: IO connection has not been made                                               |
| 7   | 5: Major fault                                                                   |
| 7   | 6: IO connection has been made                                                   |
| 8   | Minor recoverable fault (Inverter is in warning status)                          |
| 9   | Minor unrecoverable fault (N/A)                                                  |
| 10  | Major recoverable fault (inverter H/W trip occurred)                             |
| 11  | Major recoverable fault (inverter non-H/W trip occurred)                         |

(Note4) Serial number uses the last 4 digits of the MAC ID.

E.g.) The serial number is 0x29000022 when the MAC ID is "00:0B:29:00:00:22".

## Service

| Service code | Definition           | Support for class | Support for instance |
|--------------|----------------------|-------------------|----------------------|
| 0x0E         | Get Attribute Single | No                | Yes                  |
| 0x05         | Reset                | No                | Yes                  |
| 0x01         | Get Attribute All    | No                | Yes                  |

## ② Motor data object (Class 0x28, Instance 1)

### Attribute

| Attribute ID | Access  | Attribute Name   | Range        | Definition                                                                                                                                                                                                                                                                                            |
|--------------|---------|------------------|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3            | Get     | Motor Type       | 0 – 10       | 0: Non-standard motor<br>1: PM DC Motor<br>2: FC DC Motor<br>3: PM Synchronous Motor<br>4: FC Synchronous Motor<br>5: Switched Reluctance Motor<br>6: Wound Rotor Induction Motor<br>7: Squirrel Cage Induction Motor<br>8: Stepper Motor<br>9: Sinusoidal PM BL Motor<br>10: Trapezoidal PM BL Motor |
| 6            | Get/Set | Motor Rated Curr | 0.0 – 1000.0 | [Get]<br>Reads the value at BAS-13 Rated Curr.<br>[Set]<br>Set value is reflected to BAS-13 Rated Curr.<br>Scale 0.1                                                                                                                                                                                  |
| 7            | Get/Set | Motor Rated Volt | 0 – 690      | [Get]<br>Reads the value of the BAS-15 Rated Voltage.<br>[Set]<br>Set value is reflected in the BAS-15 Rated Voltage.<br>Scale 1                                                                                                                                                                      |

## Service

| Service code | Definition           | Support for class | Support for instance |
|--------------|----------------------|-------------------|----------------------|
| 0x0E         | Get Attribute Single | No                | Yes                  |
| 0x10         | Set Attribute Single | No                | Yes                  |

### ③ Control Supervisor Objects (Class 0x29, Instance 1)

## Attribute

| Attribute ID | Access  | Attribute Name    | Range | Definition                                                         |
|--------------|---------|-------------------|-------|--------------------------------------------------------------------|
| 3            | Get/Set | Forward Run Cmd.  | 0     | Stopped                                                            |
|              |         |                   | 1     | Forward run (Note1)                                                |
| 4            | Get/Set | Reverse Run Cmd.  | 0     | Stopped                                                            |
|              |         |                   | 1     | Reverse run (Note1)                                                |
| 5            | N/A     | Net Control       | -     | Configurable only with the inverter parameter.                     |
| 6            | Get     | Drive State       | 0     | Vendor Specific                                                    |
|              |         |                   | 1     | Startup                                                            |
|              |         |                   | 2     | Not Ready (resetting in progress)                                  |
|              |         |                   | 3     | Ready (stopping in progress)                                       |
|              |         |                   | 4     | Enabled (running, not applicable to deceleration stop)             |
|              |         |                   | 5     | Stopping (decelerating)                                            |
|              |         |                   | 6     | Fault Stop                                                         |
|              |         |                   | 7     | Faulted (trip occurred)                                            |
| 7            | Get     | Running Forward   | 0     | Drive stopped.                                                     |
|              |         |                   | 1     | Running Forward                                                    |
| 8            | Get     | Running Reverse   | 0     | Drive stopped.                                                     |
|              |         |                   | 1     | Running Reverse                                                    |
| 9            | Get     | Drive Ready       | 0     | Resetting in progress or trip occurred                             |
|              |         |                   | 1     | Inverter is ready for operation                                    |
| 10           | Get     | Drive Fault       | 0     | Trip has not occurred                                              |
|              |         |                   | 1     | Trip has occurred                                                  |
| 12           | Get/Set | Drive Fault Reset | 0     | Trip reset to release the trip. Resetting will begin only when the |

| Attribute ID | Access | Attribute Name    | Range | Definition                                                              |
|--------------|--------|-------------------|-------|-------------------------------------------------------------------------|
|              |        |                   | 1     | value changes from FALSE to TRUE. (Note2)                               |
| 13           | Get    | Drive Fault Codes |       | Refer to the following Drive Fault Code table (Note2)                   |
| 14           | Get    | Control From Net. | 0     | Commands are made using sources other than the DeviceNet communication. |
|              |        |                   | 1     | Commands are made using the DeviceNet communication as the source.      |

(Note1) Drive Run Inverter operation using Command Forward Run Cmd. and Reverse Run Cmd.

| Run1  | Run1  | Trigger Event | Run Type |
|-------|-------|---------------|----------|
| 0     | 0     | Stop          | NA       |
| 0 → 1 | 0     | Run           | Run1     |
| 0     | 0 → 1 | Run           | Run2     |
| 0 → 1 | 0 → 1 | No Action     | NA       |
| 1     | 1     | No Action     | NA       |
| 1 → 0 | 1     | Run           | Run2     |
| 1     | 1 → 0 | Run           | Run1     |

In the table above, Run1 indicates Forward Run Cmd. and Run 2 indicates Reverse Run Cmd. Commands are made by the EtherNet communication board when the value changes from 0 (FALSE) to 1 (TRUE). The Forward Run Cmd. value does not indicate the present operation status of the inverter; it indicates the operation command value on the EtherNet communication board.

(Note2) Drive Fault

The Drive Fault becomes TRUE when the inverter is tripped.  
The Drive Fault Codes for the trips are as follows.

### Drive Fault Codes

| Fault Code Number | Description    |
|-------------------|----------------|
| 0x0000            | None           |
| 0x1000            | Ethermal       |
|                   | Out Phase Open |
|                   | InPhaseOpen    |
|                   | ThermalTrip    |
|                   | UnderLoad      |
| 0x2200            | ParaWriteTrip  |
|                   | IOBoardTrip    |
|                   | PrePIDFail     |
| 0x2310            | OptionTrip1    |
|                   | OptionTrip2    |
|                   | OptionTrip3    |
|                   | LostCommand    |
|                   | UNDEFINED      |
|                   | LostKeypad     |
| 0x2200            | OverLoad       |
| 0x2310            | OverCurrent1   |

| Fault Code Number | Description   |        |
|-------------------|---------------|--------|
| 0x2330            | GFT           |        |
| 0x2340            | OverCurrent2  |        |
| 0x3210            | OverVoltage   |        |
| 0x3220            | LowVoltage    |        |
| 0x2330            | GroundTrip    |        |
| 0x4000            | NTCOpen       |        |
| 0x4200            | OverHeat      |        |
| 0x5000            | FuseOpen      | HWDiag |
| 0x7000            | FanTrip       |        |
| 0x7120            | No Motor Trip |        |
| 0x7300            | EncoderTrip   |        |
| 0x8401            | SpeedDevTrip  |        |
| 0x8402            | OverSpeed     |        |
| 0x9000            | ExternalTrip  | BX     |

### Drive Fault Reset

The Drive Fault Reset gives TRIP RESET reference to the inverter when the setting value changes from 0 to 1 (FALSE to TRUE). Overwriting 1 (TRUE) over 1 (TRUE) does not generate RESET reference for a trip. To allow the EtherNet communication board to send a RESET command to the inverter when the value is 1 (TRUE), write 0 (FAULT) first, then write 1 (TRUE) again.

### Service

| Service code | Definition           | Support for class | Support for instance |
|--------------|----------------------|-------------------|----------------------|
| 0x0E         | Get Attribute Single | No                | Yes                  |
| 0x10         | Set Attribute Single | No                | Yes                  |

### ④ Inverter Objects (Class 0x2A, Instance 1)

#### Attribute

| Attribute ID | Access | Attribute Name | Range | Definition                                                    |
|--------------|--------|----------------|-------|---------------------------------------------------------------|
| 3            | Get    | At Reference   | 0     | The output frequency has not reached the reference frequency. |
|              |        |                | 1     | The output frequency has reached the reference frequency.     |
| 4            | N/A    | Net Reference  | -     |                                                               |

| Attribute ID | Access  | Attribute Name            | Range          | Definition                                                                                                |
|--------------|---------|---------------------------|----------------|-----------------------------------------------------------------------------------------------------------|
| 6            | Get     | Drive Mode (Note1)        | 0              | Vendor Specific Mode                                                                                      |
|              |         |                           | 1              | Open Loop Speed (Frequency)                                                                               |
|              |         |                           | 2              | Closed Loop Speed Control                                                                                 |
|              |         |                           | 3              | Torque Control                                                                                            |
|              |         |                           | 4              | Process Control (e.g. PI)                                                                                 |
| 7            | Get     | SpeedActual               | 0 – 24000      | Displays the present output frequency in [rpm].                                                           |
| 8            | Get/Set | SpeedRef                  | 0 – 24000      | Displays the reference frequency in [rpm]. Reflected when DRV-07 (Freq Ref Src) is set to FieldBus.       |
| 9            | Get     | Actual Current            | 0 – 111.0 A    | Monitors the present current in 0.1 A increment/decrement.                                                |
| 29           | Get     | Ref.From Network          | 0              | Command source is not the DeviceNet communication.                                                        |
|              |         |                           | 1              | Command source is the DeviceNet communication.                                                            |
| 100          | Get     | Actual Hz                 | 0 – 400.00 Hz  | Monitors the present operation frequency (Hz).                                                            |
| 101          | Get/Set | Reference Hz              | 0 – 400.00 Hz  | Speed reference may be given via a network communication if DRV-07 (Freq Ref Src) is set to 8 (FieldBus). |
| 102          | Get/Set | Acceleration Time (Note2) | 0 – 6000.0 sec | Sets/monitors the acceleration time of the inverter.                                                      |
| 103          | Get/Set | Deceleration Time (Note3) | 0 – 6000.0 sec | Sets/monitors the deceleration time of the inverter.                                                      |

(Note1) Related to the DRV-10 (Torque Control) and APP-01 (App Mode) settings. When DRV-10 (Torque Control) is set to Yes, the Drive Mode becomes "Torque Control", and when APP-01 (App Mode) is set to Proc PID, MMC, then the Drive Mode becomes "Process Control (e.g. PI)."

(Note2) Value at DRV-03 (Acc Time)

(Note3) Value at DRV-04 (Dec Time)

## Service

| Service code | Definition           | Support for class | Support for instance |
|--------------|----------------------|-------------------|----------------------|
| 0x0E         | Get Attribute Single | No                | Yes                  |
| 0x10         | Set Attribute Single | No                | Yes                  |

### ⑤ Class 0x64 (Inverter Object) – Manufacture Profile

This object is used to access the Keypad Parameters of the inverter.

#### Attribute

| Instance       | Access  | Attribute Number                          | Attribute Name                                                | Attribute Value                                                                           |
|----------------|---------|-------------------------------------------|---------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| 1 (DRV Group)  | Get/Set | Identical to the G100 Manual Code number. | G100 Keypad Title<br>(Refer to the G100 inverter user manual) | Parameter setting range for the G100 inverter<br>(Refer to the G100 inverter user manual) |
| 2 (BAS Group)  |         | Identical to the G100 Manual Code number. |                                                               |                                                                                           |
| 3 (ADV Group)  |         | Identical to the G100 Manual Code number. |                                                               |                                                                                           |
| 4 (CON Group)  |         | Identical to the G100 Manual Code number. |                                                               |                                                                                           |
| 5 (IN Group)   |         | Identical to the G100 Manual Code number. |                                                               |                                                                                           |
| 6 (OUT Group)  |         | Identical to the G100 Manual Code number. |                                                               |                                                                                           |
| 7 (COM Group)  |         | Identical to the G100 Manual Code number. |                                                               |                                                                                           |
| 8 (APP Group)  |         | Identical to the G100 Manual Code number. |                                                               |                                                                                           |
| 9 (AUT Group)  |         | Identical to the G100 Manual Code number. |                                                               |                                                                                           |
| 10 (APO Group) |         | Identical to the G100 Manual Code number. |                                                               |                                                                                           |
| 11 (PRT Group) |         | Identical to the G100 Manual Code number. |                                                               |                                                                                           |
| 12 (M2 Group)  |         | Identical to the G100 Manual Code number. |                                                               |                                                                                           |

#### Service

| Service code | Definition           | Support for class | Support for instance |
|--------------|----------------------|-------------------|----------------------|
| 0x0E         | Get Attribute Single | No                | Yes                  |
| 0x10         | Set Attribute Single | No                | Yes                  |

## 12.3 Modbus TCP frame

### 12.3.1 Modbus TCP frame structure

|                       |                          |
|-----------------------|--------------------------|
| MBAP Header (7 bytes) | PDU (5 bytes or greater) |
|-----------------------|--------------------------|

In general, EtherNet communication uses EtherNet II frames.

#### MODBUS Application Protocol header (MBAP header)

The following table explains the components of a MBAP header.

| Section                | Length | Description                                                                                                                                                                                                |
|------------------------|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Transaction identifier | 2 byte | Unique transmission number, which increases by 1 each time the client sends data frame to the server.                                                                                                      |
| Protocol identifier    | 2 byte | Fixed at 0.                                                                                                                                                                                                |
| Length                 | 2 byte | Data frame length of the Modbus communication, which represents the length (in byte unit) from the MBAP header to the unit identifier.                                                                     |
| Unit identifier        | 1 byte | When communications using Modbus TCP and Modbus RTU are connected via a gateway, the unit identifier indicates the slave number. The address is fixed to 0xFF when Modbus TCP communication is used alone. |

#### Protocol Data Unit (PDU)

PDU is the actual data in the Modbus TCP communication, which is composed of a function code and data.

Refer to "12.3.2 Function codes" below for detailed information.



## 12.3.2 Function codes

The Modbus TCP communication involves clients and a server. During communication, clients send commands to the server, and the server responds to the commands. In general, devices such as a PLC, HMI, and PC are used as the client, and the inverter works as a server.

### ① Read Holding registers

Read Input registers are functions used to read the server (inverter) data.

The following table explains the components of a request data frame from a client to a server.

| Request frame           | Length | Value                        |
|-------------------------|--------|------------------------------|
| Function code           | 1 byte | 0x03                         |
| Comm. address           | 2 byte | 0x0000–0xFFFF                |
| Number of data requests | 2 byte | 1–16 (LS ELECTRIC inverters) |

The following table explains the components of a response data frame from a server to a master.

| Response frame          | Length                               | Value                                                    |
|-------------------------|--------------------------------------|----------------------------------------------------------|
| Function code           | 1 byte                               | 0x03                                                     |
| Comm. address           | 1 byte                               | 2 x the number of data requests                          |
| Number of data requests | Number of data requests<br>x 2 bytes | Data value of the given number from<br>the comm. address |

### ② Read Input registers

Read Input registers are functions used to read the server (inverter) data.

The following table explains the components of a request data frame from a client to a server.

| Request frame           | Length | Value                        |
|-------------------------|--------|------------------------------|
| Function code           | 1 byte | 0x04                         |
| Comm. address           | 2 byte | 0x0000–0xFFFF                |
| Number of data requests | 2 byte | 1–16 (LS ELECTRIC inverters) |

The following table explains the components of a response data frame from a server to a master.

| Response frame          | Length                               | Value                                                    |
|-------------------------|--------------------------------------|----------------------------------------------------------|
| Function code           | 1 byte                               | 0x03                                                     |
| Comm. address           | 1 byte                               | 2 x the number of data requests                          |
| Number of data requests | Number of data requests<br>x 2 bytes | Data value of the given number from<br>the comm. address |

### ③ Write Single register

Write Single registers are functions used to write a single server (inverter) data.

The following table explains the components of a request data frame from a client to a server.

| Request frame | Length | Value         |
|---------------|--------|---------------|
| Function code | 1 byte | 0x06          |
| Comm. address | 2 byte | 0x0000–0xFFFF |
| Data value    | 2 byte | 0x0000–0xFFFF |

The following table explains the components of a response data frame from a server to a master.

| Response frame | Length | Value         |
|----------------|--------|---------------|
| Function code  | 1 byte | 0x06          |
| Comm. address  | 2 byte | 0x0000–0xFFFF |
| Data value     | 2 byte | 0x0000–0xFFFF |

### ④ Write Multiple register

Write Multiple registers are functions used to write 1 to 16 consecutive data items on the server (inverter).

The following table explains the components of a request data frame from a client to a server.

| Request frame           | Length                          | Value                        |
|-------------------------|---------------------------------|------------------------------|
| Function code           | 1bytes                          | 0x10                         |
| Comm. address           | 2bytes                          | 0x0000–0xFFFF                |
| Number of data to write | 2byte                           | 1–16 (LS ELECTRIC inverters) |
| Byte Count              | 1byte                           | 2 x the number of data       |
| Number of data to write | The number of data x 2<br>bytes | Data to write                |

The following table explains the components of a response data frame from a server to a master.

| Response frame          | Length | Value                        |
|-------------------------|--------|------------------------------|
| Function code           | 1 byte | 0x10                         |
| Comm. address           | 2 byte | 0x0000–0xFFFF                |
| Number of data to write | 2 byte | 1–16 (LS ELECTRIC inverters) |

### 12.3.3 Exception (Except) frame

An exception frame is a response frame from a server when an error occurs while responding to the client.

The following table explains the components of an exception frame.

| Error frame    | Length | Value                                        |
|----------------|--------|----------------------------------------------|
| Error code     | 1bytes | 0x80 + function code requested by the client |
| Exception code | 1bytes | 0x0000–0xFFFF                                |

#### Exception code

| Type                   | Code | Description                                                                                                                                                                  |
|------------------------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ILLEGAL FUNCTION       | 0x01 | Unsupported function has been requested                                                                                                                                      |
| ILLEGAL DATA ADDRESS   | 0x02 | An unused address has been requested or modification has been requested for the data at an unused address.                                                                   |
| ILLEGAL DATA VALUE     | 0x03 | A data modification request has been made out of the range of the available value.                                                                                           |
| SLAVE DEVICE FAILURE   | 0x04 | Server error occurred<br>(CAN communication error with the drive, communication board initialization error, or data communication error with the drive)                      |
| SLAVE DEVICE BUSY      | 0x06 | Server is unable to respond because it is executing another process<br>(in the middle of a drive parameter initialization or the initial setting of the communication board) |
| WRITE PERMISSION ERROR | 0x20 | Unique code for LS ELECTRIC inverters.<br>An attempt was made to change a write-protected parameter                                                                          |

## 12.4 LED Indications and troubleshooting

| LED name | Color  | Description            | Status | Status                                                                                      |
|----------|--------|------------------------|--------|---------------------------------------------------------------------------------------------|
| LINK1    | Green  | Network normal         | ON     | Network connection at LINK 1 is operating normal                                            |
|          | Orange | Check network settings | ON     | Check EtherNet settings*1<br>When the communication cycle stops for longer than one second. |
|          | -      | LINK 1 Not connected   | OFF    | Trying EtherNet communication, network cable not connected to LINK 1                        |
| LINK2    | Green  | Network normal         | ON     | Network connection at LINK 2 is operating normal                                            |
|          | Orange | Network fault          | ON     | Check EtherNet settings*1                                                                   |
|          | -      | LINK 1 Not connected   | OFF    | Trying EtherNet communication, network cable not connected to LINK 2                        |

\*1: For EtherNet network settings, check keypad parameters COM-10, COM-11, COM-14, COM-15, COM-23, and COM-24, and the settings for the client devices, such as the PLC.

| LED name | Color | Description      | Status                                                      | Status                                                                                                           |
|----------|-------|------------------|-------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| ERROR    | Red   | Normal operation | OFF                                                         | Communication between the communication board and the inverter is normal.                                        |
|          |       | Network fault    | Flashing Synchronous flashing with LED0 (1 second interval) | Communication between the RAPIEnet+ communication board and the inverter is abnormal.                            |
|          |       |                  | Flashing (2 second interval)                                | The communication board parameters are set differently from the communication parameter settings on the keypad*2 |
|          |       |                  | ON                                                          | EEPROM failure<br>No network connection to LINK 1 and LINK 2<br>IP collision occurred                            |
| CPU      | Green | Normal operation | Flashing (1 second interval)                                | The communication board has been properly installed on the inverter.                                             |

\*2: To synchronize the EtherNet communication board settings with the keypad parameter settings, check the CM Group parameter settings and set CM-94 (Comm. Update) to "1 (yes)."

