Before using the product
Thank you for purchasing the Ethernet option board.

Safety Information

- Carefully read and follow the safety guidelines below. They are provided to prevent potential accidents and hazardous situations and ensure that you can operate this product safely and correctly.

- Safety information is classified in two categories: 'WARNING' and 'CAUTION.' Refer to the following for the meaning of the safety information.

⚠ 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 instructions carefully to avoid dangerous situations.

⚡ Presence of "dangerous voltage" inside the product that may cause harm or electric shock.

- After reading this user manual, keep it in an easily accessible place for future reference whenever operators need it.

- Carefully ready this use manual to safely operate the LSLV- G100 series inverter products. Ensure that this user manual is handed over to the next person who operates and maintains the product.

⊘ Caution

- **Be careful not to damage the CMOS elements on the PCB.**
  Static charge may damage the electronic components.
- **Turn off the inverter before connecting or disconnecting network cables.**
  Communication errors or device failure may otherwise result.
- **Install the network board correctly and ensure that it is firmly connected to the inverter.**
  Communication errors or device failure may otherwise result.
- **Check the parameter units when configuring the parameter values.**
  Communication errors may result if incorrect units are used.

Table of Contents

1 Overview

The Ethernet option board enables the LSLV-G100 inverter to connect to an Ethernet network.

The Ethernet option boards supports two Ethernet network protocols: Modbus TCP and EtherNet/IP.

Using the network features, controlling and monitoring of the inverter can be performed via a PLC sequence program or a master module. Because the Ethernet option board supports Ethernet connection and the IPV4 protocol, remote control and monitoring of the device is available from any place where Internet access is available, as long as the inverter is connected to a network that is connected to the Internet via a gateway.

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

2 Technical Ethernet specifications

Items	Description
Network speed	100 Mbps
Transmission type	Baseband (half, full duplex)
Max. distance between nodes	100 m (between node and hub)
Max. number of nodes	Depends on the hub specification (Maximum connected stations in a daisy chain: 64)
Auto negotiation	Supported
Max. frame size	1500 bytes
Communication zone access type	CSMA/CD
Frame error detection	CRC32
Recommended TCP socket	3 sockets
Recommended cable	UTP, FTP, STP (Refer to page 6)

3 Package components

Ethernet communication card (1 ea) / fixing bolt (1 ea) / user manual

4 External appearance and installation

4.1 External appearance

LINK 1

LINK 2

Frame ground not used

4.2 Indication LEDs

Green LED0	Red LED1	2Color LED2	2Color LED3
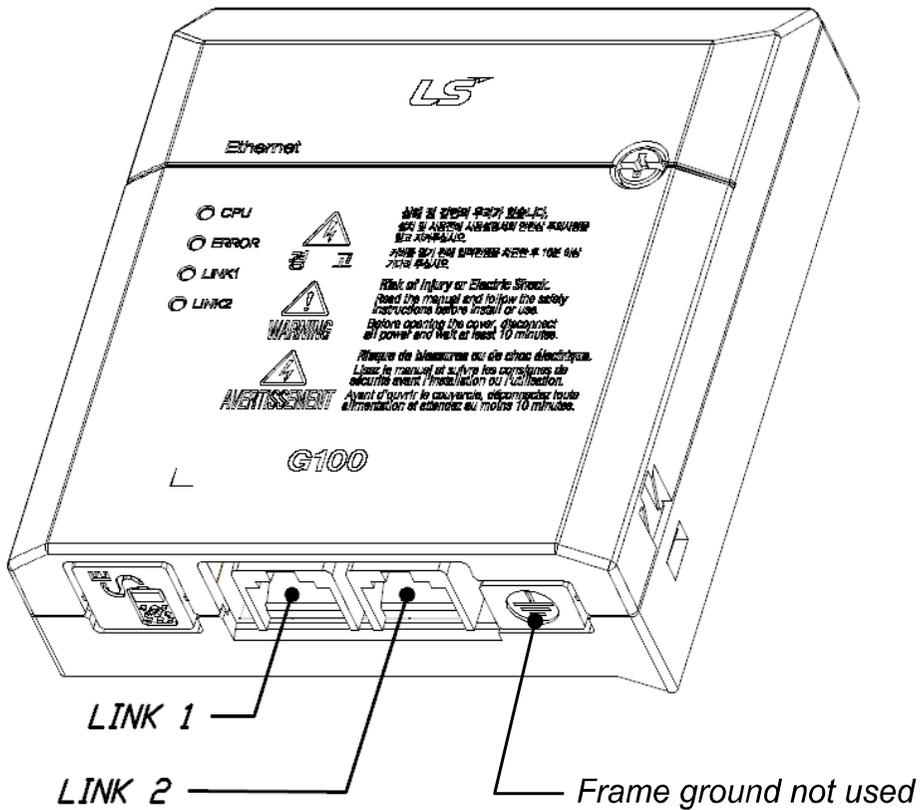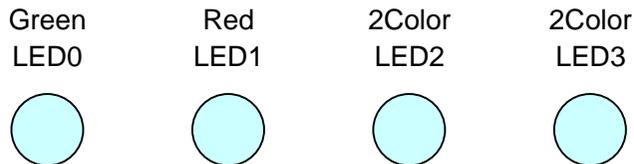
4.3 Installing the communication option board
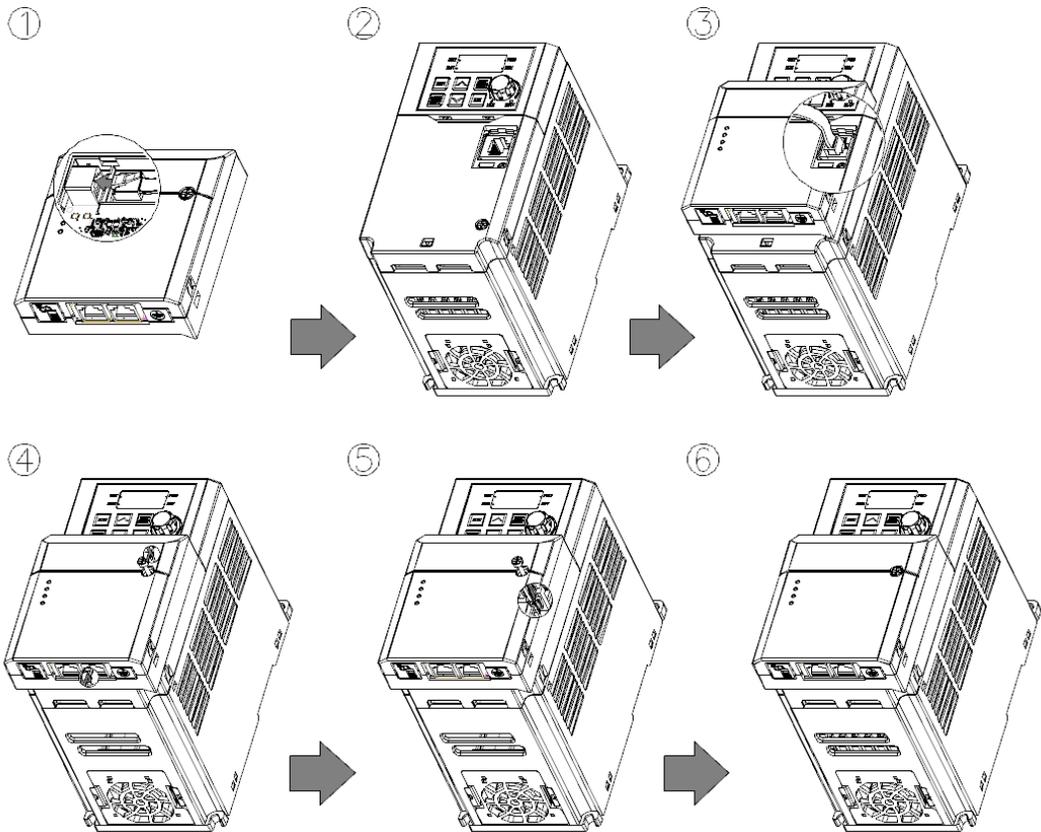
1 Remove the front cover from the G100 inverter.

2 Connect the G100 inverter and the communication option board using an RJ-45 network cable.

3 Hook up the communication option board to the installation slot.

4 Install the fixing bolt provided with the communication option board using an appropriate tool.

5 The installation is complete.

⚠ Warning

- Ensure that the G100 inverter is turned off before installing or uninstalling the Ethernet communication option board.
- Ensure that the electric charge in the capacitors inside the G100 inverter is completely discharged before installing or uninstalling the Ethernet communication option 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 Ethernet communication option boards.

5 Network connection

Communication network terminals

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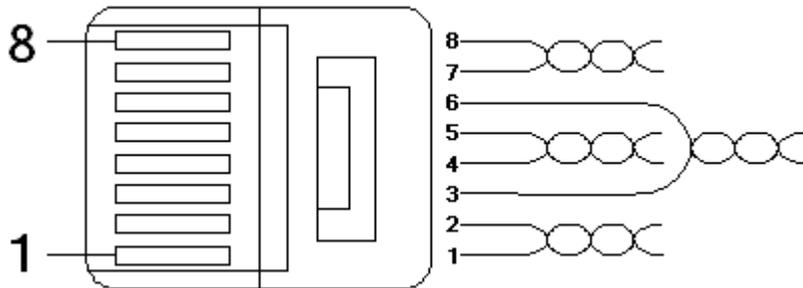
※ The cables connected to pin 1 and pin 2 must be twisted in a pair.

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

6 Network cable specifications

6.1 Frequency band

Use Category 5 network cables. 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.

6.2 Twisted pair cable types

Category	Description	Specifications/Usage
UTP (U.UTP)	Unshielded Twisted Pair cable for high speed signals	200 MHz max. Voice + Data + Low quality video signals
FTP (S.UTP)	Foil screened Twisted Pair cable	100 MHz max. Protection against EMI, electrically stable Voice + Data + Low quality video signals
STP (S.STP)	Shielded Twisted Pair cable	500 MHz max. Voice + Data + Video signals Replaces 75Ω coaxial cable
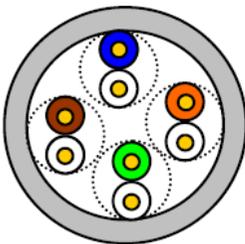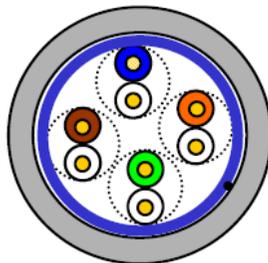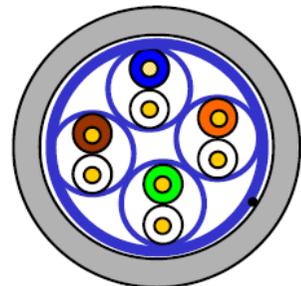
UTP   FTP   STP

7 Keypad parameters related to Ethernet communication

The following table lists the inverter parameters related to Modbus TCP and EtherNet/IP communication features. In the "Protocol" column, M stand for Modbus TCP and E stands for EtherNet/IP.

Ethernet related keypad parameters in the G100 inverter					
Code Number	Parameter name	Default	Set value	Description	Protocol
CM-06	FBus S/W Ver	-	-	Indicates the version of the communication board installed.	M/E
CM-09	FBus Led			Displays the on/off status of the LED indicators on the communication board.	M/E
CM-10	Opt Parameter1	192	0 – 255	Sets the IP address.	M/E
CM-11	Opt Parameter2	168	0 – 255		
CM-12	Opt Parameter3	0	0 – 255		
CM-13	Opt Parameter4	101	0 – 255		
CM-14	Opt Parameter5	255	0 – 255	Sets the subnet mask.	M/E
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.	M/E
CM-19	Opt Parameter 10	168	0 – 255		
CM-20	Opt Parameter 11	0	0 – 255		
CM-21	Opt Parameter 12	10	0 – 255		
CM-22	Opt Parameter 13	0	0	Sets the Ethernet communication speed.	M/E
CM-23	Opt Parameter 14	1	0 – 11	CIP Input Instance	E
CM-24	Opt Parameter 15	1	0 – 11	CIP Output Instance	E
CM-30	Para Status Num	-	0 – 8	Automatically set according to the CIP Input Instance.	E
CM-31	Para Status-1	-	0x0000 -0xFFFF	Sets up the inverter data address to be read by the client.	E
CM-32	Para Status-2	-	0x0000 -0xFFFF	Sets up the inverter data address to be read by the client.	E

Ethernet related keypad parameters in the G100 inverter					
Code Number	Parameter name	Initial Value	Set value	Description	Protocol
CM-33	Para Status-3	-	0x0000 -0xFFFF	Sets up the inverter data address to be read by the client.	E
CM-34	Para Status-4	-	0x0000 -0xFFFF	Sets up the inverter data address to be read by the client.	E
CM-35	Para Status-5	-	0x0000 -0xFFFF	Sets up the inverter data address to be read by the client.	E
CM-36	Para Status-6	-	0x0000 -0xFFFF	Sets up the inverter data address to be read by the client.	E
CM-37	Para Status-7	-	0x0000 -0xFFFF	Sets up the inverter data address to be read by the client.	E
CM-38	Para Status-8	-	0x0000 -0xFFFF	Sets up the inverter data address to be read by the client.	E
CM-50	Para Ctrl Num	-	0 – 8	Automatically set according to the CIP Output Instance.	E
CM-51	Para Control-1	-	0x0000 -0xFFFF	Sets up the client's command address.	E
CM-52	Para Control-2	-	0x0000 -0xFFFF	Sets up the client's command address.	E
CM-53	Para Control-3	-	0x0000 -0xFFFF	Sets up the client's command address.	E
CM-54	Para Control-4	-	0x0000 -0xFFFF	Sets up the client's command address.	E
CM-55	Para Control-5	-	0x0000 -0xFFFF	Sets up the client's command address.	E
CM-56	Para Control-6	-	0x0000 -0xFFFF	Sets up the client's command address.	E
CM-57	Para Control-7	-	0x0000 -0xFFFF	Sets up the client's command address.	E
CM-58	Para Control-8	-	0x0000 -0xFFFF	Sets up the client's command address.	E
CM-94	Comm Update	0	0: NO 1: YES	Updates the communication related keypad parameters.	M/E

7.1 Communication option board version (Option version information, CM-06)

Automatically indicates the version of the installed communication option board.

7.2 Communication option board LED status (FBus Led, CM-09)

Keypad parameter CM-09 displays the on/off status of the 4 LED indicators on the communication option board.

On the keypad, access CM-9 FBus LED. Four bits are displayed on the screen. From right to left, the four bits at CM-09 indicate the CPU, ERR, LINK2, and LINK1 LED status respectively.

The bits display 1 when the LED is turned on, and 0 when the LED is turned off.

Bit	Details
0	CPU LED
1	ERROR LED
2	LINK2 LED
3	LINK1 LED

An example of LED status displayed at CM-09

LINK1 LED	LINK2 LED	ERR LED	CPU LED
OFF	ON	ON	ON

7.3 Configuring the IP, subnet mask, and gateway addresses for the communication option board (CM-10 to CM-21)

The communication option board supports IP version 4.

All network and mask addresses are expressed in four decimal numbers between 0 and 255 (i.e. 255.255.255.255).

7.4 Ethernet Speed (CM-22)

The Ethernet speed parameter is fixed to 0 by default for 100 Mbps communication speed.

7.5 CIP input instance (CM-23)

This parameter is required for EtherNet/IP protocol service. It configures the format of the inverterr status data transmitted to 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	Input instance	Data size	Number of parameters
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

7.6 CIP output instance (CM-24)

This parameter is 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	Data size	Number of parameters
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

7.7 Para status (CM-30 to CM-38)

This parameter is not available for Modbus TCP communication.

It is displayed only when the Input instance (CM-23) is set to 4 or more for EtherNet/IP, and when the Comm UpDate (CM-94) parameter is set to YES. The Para Status Num (CM-30) displays the number of the configured parameters of the instance, therefore it is not configurable. Enter the matching number of the inverter data address at parameters CM-31 to CM-38.

7.8 Para control (CM-50 to CM-58)

This parameter is not available for Modbus TCP communication.

It is displayed only when the Input instance (CM-24) is set to 4 or more for EtherNet/IP, and when the Comm UpDate (CM-94) parameter is set to YES. The Para Status Num (CM-50) displays the number of the configured parameters of the instance, therefore it is not configurable. Enter the matching number of the inverter data address in parameters CM-51 to CM-58.

7.9 Comm update (CM-94)

When the inverter is turned on, the communication option board parameters display the set values. However, such set values will not take effect immediately,

but they are reflected only after Comm update (CM-94) is set to Yes, after which the communication option board is automatically rebooted.

8 Inverter communication address

Refer to Chapter 7, Communication Features, in the user manual provided with the G100 inverter.

9 Modbus/TCP Frame

9.1 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 bytes	Unique transmission number, which increases by 1 each time the client sends data frame to the server.
Protocol identifier	2 bytes	Fixed at 0.
Length	2 bytes	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 "(2) Function codes" below for detailed information.

9.2 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.

9.2.1 Read Holding registers

Read Holding 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 bytes	0x0000–0xFFFF
Number of data requests	2 bytes	1–16 (LSIS inverters)

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

Request 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 x 2 bytes	Data value of the given number from the comm. address

9.2.2 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 bytes	0x0000–0xFFFF
Number of data requests	2 bytes	1–16 (LSIS inverters)

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

Request 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 x 2 bytes	Data value of the given number from the comm. address

9.2.3 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 bytes	0x0000 – 0xFFFF
Data value	2 bytes	0x0000 – 0xFFFF

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

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

9.2.4 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	1 byte	0x10
Comm. address	2 bytes	0x0000–0xFFFF
Number of data to write	2 bytes	1–16 (LSIS inverters)
Byte Count	1 byte	2 x the number of data
Number of data to write	Number of data x 2 bytes	Data to write

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

Request frame	Length	Value
Function code	1 byte	0x10
Comm. address	2 bytes	0x0000–0xFFFF
Number of data to write	2 bytes	1–16 (LSIS inverters)

9.3 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	1 byte	0x80 + function code requested by the client
Exception Code	1 byte	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 (CAN communication with the drive, option board initialization error, data communication error with the drive)
SLAVE DEVICE BUSY	0x06	Server is unable to respond because it is executing another process (drive parameter initialization, carrying out the initial setting of the option board, etc.)
WRITE PERMITION ERROR	0x20	Unique code for LSIS inverters. An attempt was made to change a write-protected parameter

10 EtherNet/IP

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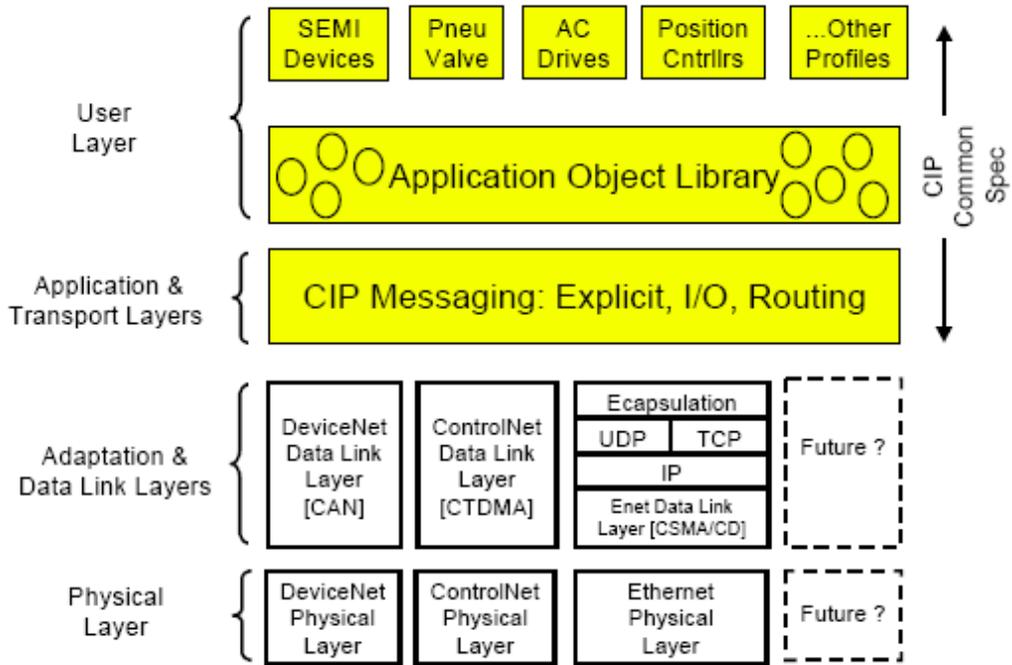
The EtherNet/IP is a protocol which implements the CIP (Common Industrial Protocol, specified by the ODVA) using the TCP and UDP protocols.

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. Inverter are examples of targets.

10.2 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.

10.2.1 Scope of support

Transport Type
> Originator→Target: Point to Point, Multicast
> Target→Originator: Point to Point, Multicast

Transport Trigger: Cyclic

Configuration Connection: 1

Connection Tag: Not available

Priority
> Originator→Target: Scheduled
> Target→Originator: Scheduled

Configuration Data: Not available

10.2.2 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						Running1 (Fwd)		Faulted
	1								
	2	Speed Actual (Low Byte) – RPM unit (note 1)							
	3	Speed Actual (High Byte) – RPM unit							
71	0	At Reference	Ref From Net	Ctrl From Net	Ready	Running2 (Rev)	Running1 (Fwd)	Warning	Faulted
	1	Drive State							
	2	Speed Actual (Low Byte) – RPM unit							
	3	Speed Actual (High Byte) – RPM unit							

Instance	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
110	0						Running1 (Fwd)		Faulted
	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	Running2 (Rev)	Running1 (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 (Hi Byte)							
142	0	Status Parameter - 1 data (Low Byte)							
	1	Status Parameter - 1 data (Hi Byte)							
	2	Status Parameter - 2 data (Low Byte)							
	3	Status Parameter - 2 data (Hi Byte)							
143	0	Status Parameter - 1 data (Low Byte)							
	1	Status Parameter - 1 data (Hi Byte)							
	2	Status Parameter - 2 data (Low Byte)							
	3	Status Parameter - 2 data (Hi Byte)							
	4	Status Parameter - 3 data (Low Byte)							
	5	Status Parameter - 3 data (Hi Byte)							
144	0	Status Parameter - 1 data (Low Byte)							
	1	Status Parameter - 1 data (Hi Byte)							
	2	Status Parameter - 2 data (Low Byte)							
	3	Status Parameter - 2 data (Hi Byte)							
	4	Status Parameter - 3 data (Low Byte)							
	5	Status Parameter - 3 data (Hi Byte)							
	6	Status Parameter - 4 data (Low Byte)							
	7	Status Parameter - 4 data (Hi Byte)							
145	0	Status Parameter - 1 data (Low Byte)							
	1	Status Parameter - 1 data (Hi Byte)							
	2	Status Parameter - 2 data (Low Byte)							
	3	Status Parameter - 2 data (Hi Byte)							
	4	Status Parameter - 3 data (Low Byte)							
	5	Status Parameter - 3 data (Hi Byte)							
	6	Status Parameter - 4 data (Low Byte)							
	7	Status Parameter - 4 data (Hi Byte)							

Instance	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	8	Status Parameter - 5 data (Low Byte)							
	9	Status Parameter - 5 data (Hi Byte)							
146	0	Status Parameter - 1 data (Low Byte)							
	1	Status Parameter - 1 data (Hi Byte)							
	2	Status Parameter - 2 data (Low Byte)							
	3	Status Parameter - 2 data (Hi Byte)							
	4	Status Parameter - 3 data (Low Byte)							
	5	Status Parameter - 3 data (Hi Byte)							
	6	Status Parameter - 4 data (Low Byte)							
	7	Status Parameter - 4 data (Hi Byte)							
	8	Status Parameter - 5 data (Low Byte)							
	9	Status Parameter - 5 data (Hi Byte)							
	10	Status Parameter - 6 data (Low Byte)							
	11	Status Parameter - 6 data (Hi Byte)							
147	0	Status Parameter - 1 data (Low Byte)							
	1	Status Parameter - 1 data (Hi Byte)							
	2	Status Parameter - 2 data (Low Byte)							
	3	Status Parameter - 2 data (Hi Byte)							
	4	Status Parameter - 3 data (Low Byte)							
	5	Status Parameter - 3 data (Hi Byte)							
	6	Status Parameter - 4 data (Low Byte)							
	7	Status Parameter - 4 data (Hi Byte)							
	8	Status Parameter - 5 data (Low Byte)							
	9	Status Parameter - 5 data (Hi Byte)							
	10	Status Parameter - 6 data (Low Byte)							
	11	Status Parameter - 6 data (Hi Byte)							
	12	Status Parameter - 7 data (Low Byte)							
	13	Status Parameter - 7 data (Hi Byte)							
148	0	Status Parameter - 1 data (Low Byte)							
	1	Status Parameter - 1 data (Hi Byte)							
	2	Status Parameter - 2 data (Low Byte)							
	3	Status Parameter - 2 data (Hi Byte)							
	4	Status Parameter - 3 data (Low Byte)							
	5	Status Parameter - 3 data (Hi Byte)							
	6	Status Parameter - 4 data (Low Byte)							
	7	Status Parameter - 4 data (Hi Byte)							
	8	Status Parameter - 5 data (Low Byte)							
	9	Status Parameter - 5 data (Hi Byte)							
	10	Status Parameter - 6 data (Low Byte)							

Instance	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	11	Status Parameter - 6 data (Hi Byte)							
	12	Status Parameter - 7 data (Low Byte)							
	13	Status Parameter - 7 data (Hi Byte)							
	14	Status Parameter - 8 data (Low Byte)							
	15	Status Parameter - 8 data (Hi Byte)							

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

Name	Description	Related attribute	
		Class	**Class**
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

10.2.3 Output Instance

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							

Instance	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
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
	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)							

Instance	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	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)							
	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)							

Instance	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	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.

10.3 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.

10.4 Supported objects

10.4.1 Identity Object (Class 0x01, Instance 1)

Attribute

Attribute ID	Access	Attribute Name	Data Length	Attribute Value
1	Get	Vendor ID (LS Industrial System)	Word	259
2	Get	Device Type (inverter)	Word	2
3	Get	Product Code	Word	100 (Note1)
4	Get	Revision Low Byte - Major Revision High Byte - Minor Revision	Word	(Note2) 0x0102
5	Get	Status	Word	(Note3)
6	Get	Serial Number	Double Word	(Note4)
7	Get	Product Name	7 Byte	CENT

(Note1) Product Code 100 refers to the LSIS Drive.

(Note2) The revision is identical to the version of the Ethernet option board. Upper byte refers to major revisions, and lower byte refers to minor revisions. For example, 0x0102 indicates version 2.01.
The version of Ethernet option board can be verified with the keypad parameter CM-6 (FBus S/W Ver).

(Note3) Definition of status bits

Bit	Description
0	0: Device is not connected to the master 1: Device is connected to the master
1	Reserved
2	Configured (fixed as '0' because LSIS EtherNet/IP is not supported)
3	Reserved
4	0: Unknown
5	2: Faulty IO connection
6	3: IO connection has not been made 5: Major fault
7	6: IO connection has been made
8	Minor recoverable fault (Inverter is in warning status)

Bit	Description
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

10.4.2 Motor Data Objects (Class 0x28, Instance 1)

Attribute

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

Attribute ID	Access	Attribute Name	Range	Definition
7	Get/Set	Motor Rated Volt	0–690	[Get] Reads the value of the BAS-15 Rated Voltage. [Set] Set value is reflected in the BAS-15 Rated Voltage. Scale 1

Service

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

10.4.3 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)

Attribute ID	Access	Attribute Name	Range	Definition
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 value changes from FALSE to TRUE. (Note2)
			1	
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 Command

Inverter operation using 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 option 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 option 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	Ethermal	Ethermal
	InPhaseOpen	InPhaseOpen	InPhaseOpen
	ParaWriteTrip	ParaWriteTrip	ParaWriteTrip
	OptionTrip1	OptionTrip1	OptionTrip1
	LostCommand	LostCommand	LostCommand
0x2200	OverLoad		
0x2310	OverCurrent1		
0x2330	GFT		
0x2340	OverCurrent2		
0x3210	OverVoltage		
0x3220	LowVoltage		
0x2330	GroundTrip		
0x4000	NTCOpen		
0x4200	OverHeat		
0x5000	FuseOpen		FuseOpen
0x7000	FanTrip		
0x7120	No Motor Trip		
0x7300	EncorderTrip		
0x8401	SpeedDevTrip		
0x8402	OverSpeed		
0x9000	ExternalTrip		ExternalTrip

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 option board to send a RESET reference 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

10.4.4 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	-	
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).

Attribute ID	Access	Attribute Name	Range	Definition
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 deceleration 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 dr-10 (Torque Control) and AP-01 (App Mode) settings. When dr-10 (Torque Control) is set to Yes, the Drive Mode becomes "Torque Control," and when AP-01 (App Mode) is set to Proc PID, MMC, then the Drive Mode becomes "Process Control (e.g. PI)."

(Note2) The Acc. Time value for the Operation group.

(Note3) The Dec. Time value for the Operation group.

Service

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

10.4.5 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 (dr Group)	Get/Set	Identical to the code listed in the G100 inverter user manual	G100 Keypad Title (Refer to the G100 inverter user manual)	Parameter setting range for the G100 inverter (Refer to the G100 inverter user manual)
2 (bA Group)		Identical to the code listed in the G100 inverter user manual		
3 (Ad Group)		Identical to the code listed in the G100 inverter user manual		
4 (Cn Group)		Identical to the code listed in the G100 inverter user manual		

Instance	Access	Attribute Number	Attribute Name	Attribute Value
5 (In Group)		Identical to the code listed in the G100 inverter user manual		
6 (OU Group)		Identical to the code listed in the G100 inverter user manual		
7 (CM Group)		Identical to the code listed in the G100 inverter user manual		
8 (AP Group)		Identical to the code listed in the G100 inverter user manual		
9 (Reserved)				
10 (Reserved)				
11 (Pr Group)		Identical to the code listed in the G100 inverter user manual		
12 (M2 Group)		Identical to the code listed in the G100 inverter user manual		
13 (DRV Group)		Identical to the code listed in the G100 inverter user manual		

Service

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

11   Lost Command

11.1 Inverter Keypad Parameter

Code number	Parameter name	Default	Set value	Description
PRT-12	Lost Cmd Mode	"None"	"None" "Free-Run" "Dec" "Hold Input" "Hold Output" "Lost Preset"	Sets the inverter operation for when a Lost Command has occurred. (Note1)
PRT-13	Lost Cmd Time	1.0	0.1 – 120.0 sec	Lost Command trigger time
PRT-14	Lost Preset F	0	0 – 600.00 Hz	Sets the Lost Preset speed

(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.

11.2 Modbus TCP Lost Command conditions

If the Modbus TCP receives no data from the client for 3 seconds, the Ethernet option board enters the Lost Command status. After the time set at PRT-13 has elapsed, the inverter operates according to the conditions set at PRT-12.

11.3   EtherNet/IP Lost Command conditions

If the implicit message connection (Class 1 Connection) between the originator (a PLC or client) and the target (inverter) breaks for longer than 1 second, the Ethernet option board enters the Lost Command status. After the time set at PRT-13 has elapsed, the inverter operates according to the conditions set in PRT-12.

12   LED Indications and troubleshooting
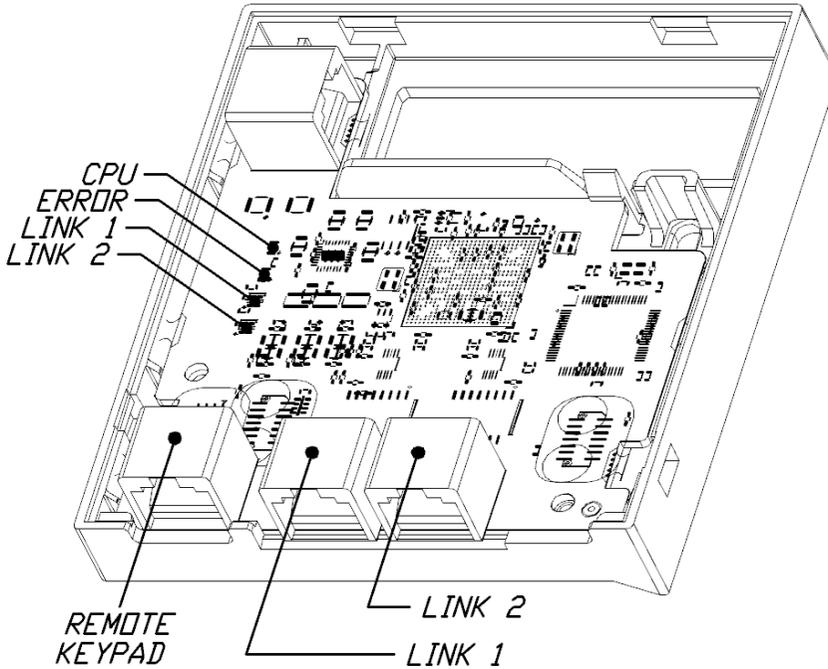
	LED Indication	Color	Description	Status	Remarks
LED0	LINK1	Green	Network normal	ON	Network connection at LINK 1 is operating normal (Note1)
		Orange	Check network settings	ON	Check Ethernet settings (Note2) Periodic communication broke for longer than 1 second
		-	LINK 1 Not connected	OFF	Trying Ethernet communication, network cable not connected to LINK 1
LED1	LINK2	Green	Network normal	ON	Network connection at LINK 2 is operating normal
		Orange	Check network settings	ON	Check Ethernet settings (Note2) Periodic communication broke for longer than 1 second
		-	LINK 1 Not connected	OFF	Trying Ethernet communication, network cable not connected to LINK 2

(Note1) If the product is turned off and on during normal network operations, a delay of 3 to 6 seconds may occur for the LINK to be connected to the network.

(Note2) If a communication fault occurs, check the inverter keypad parameter settings at [CM-10], [CM-11], [CM-14], [CM-15], [CM-23], and [CM-24], and match the setting values with the client (i.e. PLC).

	LED Indication	**Color**	**Description**	**Status**	**Remarks**
LED2	ERROR	Red	Normal	OFF	Communication board is communicating with the inverter normally
			Network fault	Flashing Asynchronous flashing with LED0 (1 second interval)	Ethernet communication fault
				Flashing Synchronous flashing with LED0 (1 second interval)	Communication fault between the Ethernet option board and the inverter
				Flashing (2 second interval)	The Ethernet option board parameters are set differently from the Keypad communication settings (Note3)
				ON	Internal flash writing failed No network connection to LINK 1 and LINK 2 IP collision occurred
LED3	CPU	Green	Normal	Flashing (1 second interval)	Ethernet option board is successfully installed.

(Note3) To keep the Ethernet option board settings identical to the keypad parameter settings, check the CM Group parameter settings and set CM-94 (Comm. Update) to "1-yes."