Appendix B: Ethernet Module ACG-ET2

Appendix

B

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Overview

The ACG-ET2 communication board allows the ACG drive to connect to an Ethernet network that is compliant with international standards, Type 21 of IEC 61158 and RRP of IEC 62439. The ACG-ET2 communication board supports two protocols: EtherNet/IP and Modbus TCP.

By utilizing the 100 Mbps auto negotiation feature, the ACG-ET2 communication board provides real-time network communication without collisions and allows for controlling and monitoring of the drive via PLC sequence programs.

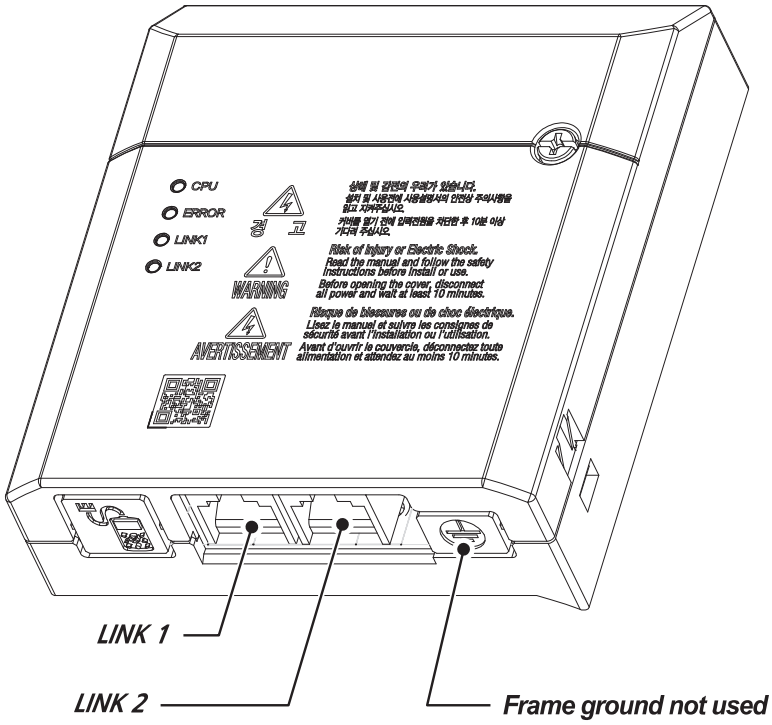
With simple network cable wiring, installation times can be reduced and maintenance becomes easier.

ACG-ET2 Technical Specifications

Items	Description	
Communication Protocol	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	

ACG-ET2 Communication Board Layout and Installation

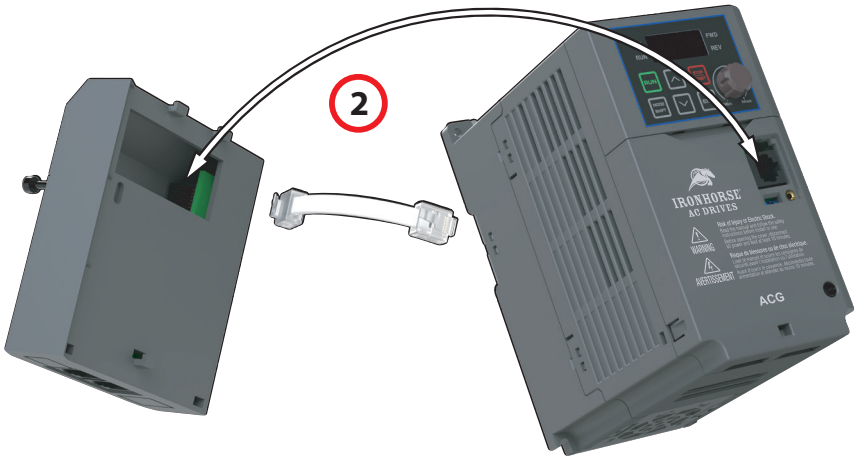
External Layout



Installing the ACG-ET2 Communication Board

1) Remove the small cover from the front of the ACG drive.

2) Connect the included cable to the ACG-ET2 and the ACG AC drive.



3) Attach the ACG-ET2 communication card to the front of the ACG drive. Ensure the connector cable fits inside the open space on the inside of the communication card. The card should snap loosely into place.

4) Tighten the screw on the front of the communication card to secure the ACG-ET2 to the ACG drive.

WARNING:

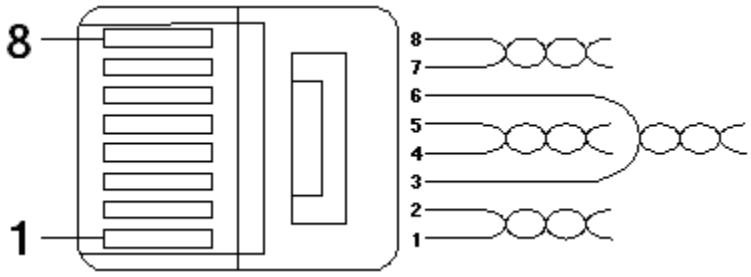
- *DO NOT INSTALL OR REMOVE THE ACG-ET2 COMMUNICATION BOARD TO OR FROM THE ACG DRIVE WHILE THE DRIVE IS TURNED ON.*
- *ENSURE THAT THE ELECTRIC CHARGE IN THE CAPACITORS INSIDE THE DRIVE IS COMPLETELY DISCHARGED BEFORE INSTALLING OR UNINSTALLING THE ACG-ET2 COMMUNICATION BOARD.*
- *ENSURE THAT THE RJ-45 CABLE IS FIRMLY FIXED TO THE DRIVE AND THE OPTION BOARD.*
- *FRAME GROUND (FG) SHOULD NOT BE USED ON THE ACG-ET2 COMMUNICATION OPTION BOARDS.*

Network Connection

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

Communication Cable Connector



NOTE:
*** 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.*

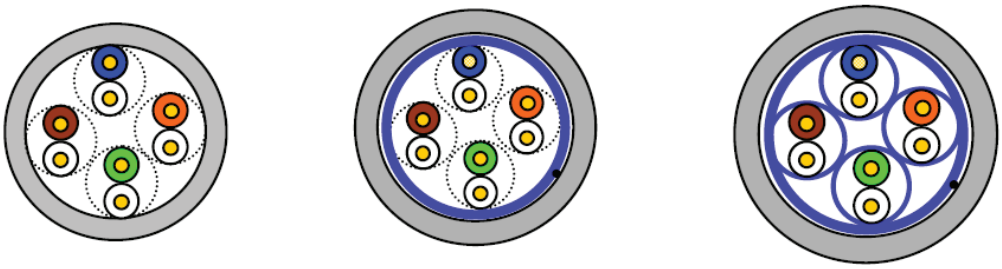
Network cable specifications

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 ACG-ET2 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.

Twisted pair cable types



UTP FTP STP

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)	Single insulation for the cable core. Insulation material: AL / Plastic complex foil or copper braid.	100 MHz max. Protection against EMI, electrically stable. Voice + Data + Low quality video signals.
STP (S.STP)	Dual insulation for the pair and the cable core. Material for cable pair insulation: AL/Plastic complex foil. Material for cable core insulation: AL / Plastic complex foil or copper braid.	500MHz max. Voice + Data + Video signals Replaces 75Ω coaxial cable

Network CM Parameter Setting Details

IP Address, Subnet Mask, Gateway (CM.10–CM.21) Setting

Ethernet communication cards must have their own unique IP address. The IP addresses (and subnet masks) of the communication card need to be compatible with any other devices that connect to the drive. For an easy subnet mask calculator, please visit www.subnet-calculator. com.

The IPv4 is supported by the Ethernet module. All the addresses and masks are expressed with (decimal).(decimal).(decimal).(decimal) and each decimal number is within 0–255. In the Ethernet communication module, decimal numbers can be entered in Opt Parameter directly. Each Opt Parameter has a value of 0 through 255, which is implemented with each field of addresses divided with '.'.

Example:

To set up IP Address 196.168.10.131, enter the Opt Parameter as shown in the table below.

Pr. Code	Parameter Name	Opt Parameter
CM.10	Opt Parameter 1	196
CM.11	Opt Parameter 2	168
CM.12	Opt Parameter 3	10
CM.13	Opt Parameter 4	131

NOTE: After making changes to parameter CM.7 and parameters CM.10-CM.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.)

Comm Update (CM.94)

When Communication settings parameters are changed, the value is not applied immediately. The Communication update parameter (CM.94) must be set to 1 to apply the change. After any Comm settings changes be sure to set CM.94=1. This action will restart Ethernet Communication. In addition, this action will prevent any data loss from a drive power loss.

Keypad parameters for ACG-ET2 communication board

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

Set drv parameter (Cmd Source) to "4 (Fieldbus)" using the keypad to operate the ACG drive via the ACG-ET2 communication board.

Set Freq parameter (Frq Ref Src) to "8 (Fieldbus)" using the keypad to provide frequency reference via the ACG-ET2 communication board.

Keypad Parameters Related to ACG-ET2 Communication Board					
Pr. Code	**Parameter Name**	**Default Value**	**Range**	**Description**	**Protocol**
drv	Cmd Source	1	0–4	4: Set to "Field Bus."	E/M
Frq	Freq Ref Src	0	0–8	8: Set to "Field Bus."	E/M
CM.6	FBus S/W Ver	–	–	Indicates the version of the communication board installed.	E/M
CM.7	FBus ID	10	0–220	Set the station number of the ACG-ET2 communication board.	E
CM.9	FBus Led			Displays the on/off status of the LED indicators on the ACG-ET2 communication board.	E/M
CM.10	Opt Parameter 1	192	0–255	Sets the IP address.	E/M
CM.11	Opt Parameter 2	168	0–255		
CM.12	Opt Parameter 3	1	0–255		
CM.13	Opt Parameter 4	101	0–255		
CM.14	Opt Parameter 5	255	0–255	Set the subnet mask.	E/M
CM.15	Opt Parameter 6	255	0–255		
CM.16	Opt Parameter 7	255	0–255		
CM.17	Opt Parameter 8	0	0–255		
CM.18	Opt Parameter 9	192	0–255	Sets the Gateway address.	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)	E/M
CM.23	Opt Parameter 14	1	0–11	CIP Input Instance	E/M
CM.24	Opt Parameter 15	1	0–11	CIP Output Instance	E/M

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.)

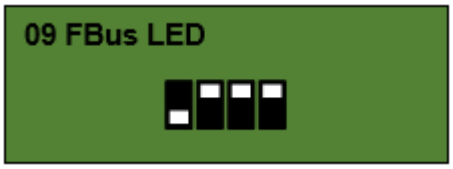
Keypad Parameters Related to ACG-ET2 Communication Board					
Code No.	**Parameter Name**	**Default Value**	**Range**	**Description**	**Protocol**
CM.30	Para Status Num	3	0–8	Automatically set according to the CIP Input Instance.	E/M
CM.31	Para Status-1	000A	0x0000–0xFFFF	Sets up the drive data address to be read by the client. (Hex.)	E/M
CM.32	Para Status-2	000E	0x0000–0xFFFF	Sets up the drive data address to be read by the client. (Hex.)	E/M
CM.33	Para Status-3	000F	0x0000–0xFFFF	Sets up the drive data address to be read by the client. (Hex.)	E/M
CM.34	Para Status-4	–	0x0000–0xFFFF	Sets up the drive data address to be read by the client. (Hex.)	E/M
CM.35	Para Status-5	–	0x0000–0xFFFF	Sets up the drive data address to be read by the client. (Hex.)	E/M
CM.36	Para Status-6	–	0x0000–0xFFFF	Sets up the drive data address to be read by the client. (Hex.)	E/M
CM.37	Para Status-7	–	0x0000–0xFFFF	Sets up the drive data address to be read by the client. (Hex.)	E/M
CM.38	Para Status-8	–	0x0000–0xFFFF	Sets up the drive data address to be read by the client. (Hex.)	E/M
CM.50	Para Ctrl Num	2	0–8	Automatically set according to the CIP Output Instance.	E/M
CM.51	Para Control-1	0005	0x0000–0xFFFF	Sets up the client's command address. (Hex.)	E/M
CM.52	Para Control-2	0006	0x0000–0xFFFF	Sets up the client's command address. (Hex.)	E/M
CM.53	Para Control-3	–	0x0000–0xFFFF	Sets up the client's command address. (Hex.)	E/M
CM.54	Para Control-4	–	0x0000–0xFFFF	Sets up the client's command address. (Hex.)	E/M
CM.55	Para Control-5	–	0x0000–0xFFFF	Sets up the client's command address. (Hex.)	E/M
CM.56	Para Control-6	–	0x0000–0xFFFF	Sets up the client's command address. (Hex.)	E/M
CM.57	Para Control-7	–	0x0000–0xFFFF	Sets up the client's command address. (Hex.)	E/M
CM.58	Para Control-8	–	0x0000–0xFFFF	Sets up the client's command address. (Hex.)	E/M
CM.94	Comm Update	0	0: NO 1: YES	Update keypad parameters related to network communication.	E/M
Pr.12	Lost Cmd Mode	None	0: None 1: Free-Run 2: Dec 3: Hold Input 4: Hold Output 5: Lost Preset	Set the drive operation for when a Lost Command has occurred.*	E/M
Pr.13	Lost Cmd Time	1.0	0.1–120	Lost Command trigger time	E/M
Pr.14	Lost Preset F	0.00	0.05–60.00	Sets the Lost Preset speed	E/M
** Lost Command Mode*					

Ethernet Parameter Details

Operation Group

Code	Parameter Name	Description
drv	Cmd Source: Command Source	Select the command source for the ACG drive. Set to "4 (Field Bus)" to set the ACG-ET2 communication board as the command source and provide commands via network.
Frq	Freq Ref Src: Frequency reference source	Select the frequency command source for the ACG drive. Set to "8 (Field Bus)" to set the ACG-ET2 communication board as the frequency command source and provide frequency commands via network.

CM Group

Code	Parameter Name	Description
CM.6	FBus S/W Ver: Communication option S/W version	Automatically indicates the version of the communication board installed to the ACG drive.
CM.7	FBus ID: Station ID of the communication board (communication board ID)	R: Set the station ID for the ACG-ET2 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.
CM.9	FBus Led: Information about LED indicators on the communication board	Displays on the Keypad the status of the LED indicators on the ACG-ET2 communication board. Refer to sections "11.3/12.4 LED indications and troubleshooting." Example of the CM.9 (FBus LED) indication:  LINK1: LED is OFF; LINK2: LED is ON; ERROR: LED is ON; CPU: LED is ON
CM.10–CM.21	Opt Parameters 1–12	Set IP address, Mask address, and Gateway address.
CM.22	Opt Parameter 13: Network Communication Speed	Set the network communication speed. (100 Mbps, Auto Negotiation). The Ethernet speed parameter is fixed at "0" by default for 100 Mbps communication speed.
CM.23	Opt Parameter 14: CIP Input Instance	Selection of the data transmission addresses from CM.31 to CM.38 for monitoring. • This parameter can be set between "0" and "11." Refer to the table below for data size of each setting. • The setting cannot be written while the drive is operating. Stop drive operation before making changes to the setting. • This parameter setting is required for a service via EtherNet/IP protocol. It specifies the data format of the drive 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. See Network CM Parameter Setting Details on page B–13 for more information.

Code	Parameter Name	Description
CM.24	Opt Parameter 15: CIP Output Instance	Select one of the data reception addresses from CM.51 to CM.58 for monitoring. You can set this parameter 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 drive is operating. Stop drive 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 drive 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. See Network CM Parameter Setting Details on page B–13 for more information.
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 ACG-ET2 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.
CM.31–CM.38	Para Status1–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.
CM.50	Para Ctrl Num: Number of reception data	You can set CM-24 (opt para-15) to change the number of reception data to between "0" and "8." The ACG-ET2 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.
CM.51–CM.58	Para Control1–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.
CM.94	Comm Update: Update setting changes via the communication board	The CM group parameters display the settings stored on the drive connected to the ACG-ET2 communication board and the changes made on the keypad are not directly reflected on the ACG-ET2 communication board. The changed settings will be reflected on the ACG-ET2 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.)

Pr Group (Lost Command)

<table>
<tr><th>Code</th><th>Parameter Name</th><th>Description</th></tr>
<tr><td>Pr.12</td><td>Lost Cmd Mode: Operation mode for a command loss</td><td>You can select the operation mode for when a network failure or connection failure between the drive and the communication occurs while the drive is operated via network communication.
<table>
<tr><th>Set Value</th><th>Function</th></tr>
<tr><td>"None"</td><td>Maintains the previous status.</td></tr>
<tr><td>"Free-Run"</td><td>Lost Command Trip occurs and a free run stop is made.</td></tr>
<tr><td>"Dec"</td><td>Lost Command Trip occurs and a deceleration stop is made.</td></tr>
<tr><td>"Hold Input"</td><td>Lost Command Warning occurs and the drive operates with the previous speed reference.</td></tr>
<tr><td>"Hold Output"</td><td>Lost Command Warning occurs and the drive operates with the previous running speed.</td></tr>
<tr><td>"Lost Preset"</td><td>Lost Command Warning occurs and the drive operates with speed reference set at Pr.14.</td></tr>
</table></td></tr>
<tr><td>Pr.13</td><td>Lost Cmd Time: Decision time for a command loss</td><td>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.</td></tr>
<tr><td>Pr.14</td><td>Lost Preset F: Operation frequency for a command loss</td><td>When a lost command occurs, a protective function is activated and the drive continues to operate using the frequency set with Pr.14. The setting value is from the start frequency to the max frequency [Hz].</td></tr>
<tr><td>–</td><td>Lost command conditions by protocol</td><td><u>EtherNet/IP</u>
If the implicit message connection (Class 1 Connection) between the originator (a PLC or client) and the target (drive) breaks for longer than one second, the ethernet communication board enters lost command mode, and the drive will operate according to the settings at Pr.12 after the time set with Pr.13 has elapsed.

<u>Modbus TCP</u>
If the Modbus TCP receives no data from the client for five seconds, the Ethernet communication board enters lost command mode, and the drive will operate according to the settings at Pr.12 after the time set with Pr.13 has elapsed.</td></tr>
</table>

Network CM Parameter Setting Details

CIP Input Instance (CM.23)

This parameter sets up the data format of the drive status sent from the drive to the Client (Originator) during the I/O communication module of the CIP (Common Industrial Protocol). Refer to the Assembly Object of the EtherNet/IP.

Set Value	Input Instance Value	Data Size	Parameter Number
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

CIP Output Instance (CM.24)

This parameter sets up the data format of the drive command sent from the Client (Originator) to control the drive during the I/O communication module of the CIP (Common Industrial Protocol). Refer to the Assembly Object of the EtherNet/IP.

Set Value	Output Instance Value	Data Size	Parameter Number
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

CM.23 and CM.24 Settings Comarison

CM.23 and CM.24	CM.23		CM.24
Set Value	Input Instance Value		Output Instance Value
0	70	⟷	20
1	71	⟷	21
2	110	⟷	100
3	111	⟷	101
4	141	⟷	121
5	142	⟷	122
6	143	⟷	123
7	144	⟷	124
8	145	⟷	125
9	146	⟷	126
10	147	⟷	127
11	148	⟷	128

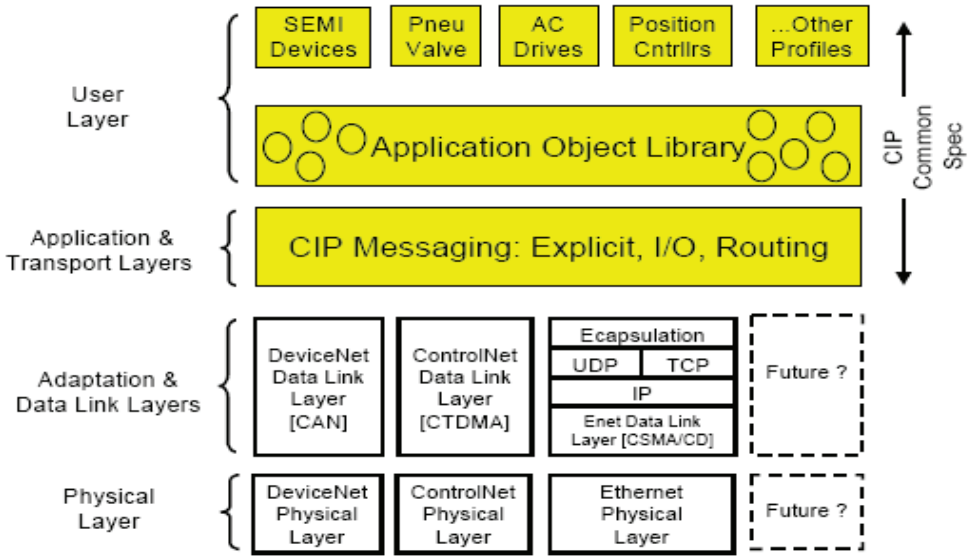
Services

Introduction

This chapter explains the services using EtherNet/IP and Modbus TCP protocols when the communication board is connected with the ACG drive.

EtherNet/IP

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. Drives are examples of targets.*

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.

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*

Input instances

Input instances refer to the status data periodically sent from the drive 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	Running 2 (Rev)	Running1 (Fwd)	Warning	Faulted
	1	Drive State							
	2	Speed Actual (Low Byte) – RPM unit							
	3	Speed Actual (High Byte) – RPM unit							
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	Running 2 (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 (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)							

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

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

Output Instances

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

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
	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)							

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

Instance	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
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[1]	Forward Run Command	0x29	3
Run Rev[1]	Reverse Run Command	0x29	4
Fault reset[1]	Fault Reset Command	0x29	12
NetRef[2]	Not used	0x2A	4
NetCtrl[2]	Not used	0x29	5
Speed Reference	Reference speed	0x2A	8

1 - Refer to the Drive Run and Fault sections in the "Control Supervisor Object (Class 0x29)".
2 - Reference speed and Run/Stop control can be set only on the LED control panel. Network control instances 21 and 101 (NetRef, NetCtrl) are not available.

Explicit Messages

Explicit messages refer to non-periodic data communications used for reading or writing attribute values of an drive 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.

Supported Objects

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 (drive)	Word	2
3	Get	Product Code	Word	100*
4	Get	Revision High Byte - Major Revision Low Byte - Minor Revision	Word	0x0101**
5	Get	Status	Word	See definition table below
6	Get	Serial Number	Double Word	Serial number uses the last 4 digits of the MAC ID.
7	Get	Product Name	4 Byte	CENT

** – Product Code 100 refers to the ACG drive.*

*** – The revision number is identical to the version of the ACG-ET2 ethernet communication card. 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 communication card can be displayed on the Keypad using the CM.6 (FBus S/W Ver) parameter.*

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 ACG EtherNet/IP is not supported)
3	Reserved
4	0: Unknown 2: Faulty IO connection 3: IO connection has not been made 5: Major fault 6: IO connection has been made
5	
6	
7	
8	Minor recoverable fault (Drive is in warning status)
9	Minor unrecoverable fault (N/A)
10	Major recoverable fault (drive H/W trip occurred)
11	Major recoverable fault (drive non-H/W trip occurred)

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

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 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
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

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 (see Run Command table below)
4	Get/Set	Reverse Run Cmd.	0	Stopped
			1	Reverse run (see Run Command table below)
5	N/A	Net Control	-	Configurable only with the drive 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	Drive 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 (see drive fault codes below).
			1	
13	Get	Drive Fault Codes		Refer to the following Drive Fault Code table (see drive fault codes below).
14	Get	Control From Net.	0	Commands are made using sources other than the ACG-ET2 communication. → Control is from local
			1	Commands are made using the ACG-ET2 communication as the source. → Control is from Network

Drive Run Drive 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 drive; it indicates the operation command value on the Ethernet communication board.

The Drive Fault becomes TRUE when the drive 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	InverterOLT
	InPhaseOpen	ThermalTrip	UnderLoad
	ParaWriteTrip	IOBoardTrip	PrePIDFail
	OptionTrip1	OptionTrip2	OptionTrip3
	LostCommand	UNDEFINED	LostKeypad
0x2200	OverLoad		
0x2310	OverCurrent1		
0x2330	GFT		
0x2340	OverCurrent2		
0x3210	OverVoltage		
0x3220	LowVoltage		
0x2330	GroundTrip		
0x4000	NTCOpen		
0x4200	OverHeat		
0x5000	FuseOpen	HWDiag	
0x7000	FanTrip		
0x7120	No Motor Trip		
0x7300	EncorderTrip		
0x8401	SpeedDevTrip		
0x8402	OverSpeed		
0x9000	ExternalTrip	BX	

Drive Fault Reset

The Drive Fault Reset gives TRIP RESET reference to the drive 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 drive 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

Drive 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[1]	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 operation parameter frq (Freq Ref Src) is set to FieldBus (Ethernet).
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[2]	0–6000.0 sec	Sets/monitors the acceleration time of the drive.
103	Get/Set	Deceleration Time[3]	0–6000.0 sec	Sets/monitors the deceleration time of the drive.

1– 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)."
2– Value at DRV-03 (Acc Time)
3– 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

Class 0x64 (Drive Object) – Manufacture Profile

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

Attribute				
Instance	**Access**	**Attribute Number**	**Attribute Name**	**Attribute Value**
1 (Dr Group)	Get/Set	Identical to the ACG Manual Code number.	ACG Keypad title (refer to the ACG Drive User Manual)	Parameter setting range for the ACG drive (refer to the ACG Drive User Manual)
2 (bA Group)		Identical to the ACG Manual Code number.		
3 (AD Group)		Identical to the ACG Manual Code number.		
4 (Cn Group)		Identical to the ACG Manual Code number.		
5 (In Group)		Identical to the ACG Manual Code number.		
6 (OU Group)		Identical to the ACG Manual Code number.		
7 (CM Group)		Identical to the ACG Manual Code number.		
8 (AP Group)		Identical to the ACG Manual Code number.		
10 (AP Group)		Identical to the ACG Manual Code number.		
11 (Pr Group)		Identical to the ACG Manual Code number.		
12 (M2 Group)		Identical to the ACG 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

Modbus TCP Frame

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 "Function codes" below for detailed information.

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 drive works as a server.

Read Holding registers

Read Input registers are functions used to read the server (drive) 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 (ACG drives)

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

Read Input registers

Read Input registers are functions used to read the server (drive) 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 (ACG drives)

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

Write Single register

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

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

Write Multiple register

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

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 (ACG drives)
Byte Count	1byte	2 x the number of data
Number of data to write	The 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 byte	0x0000–0xFFFF
Number of data to write	2 byte	1–16 (ACG drives)

Read/Write Multiple register

Read/Write Multiple registers are functions used to write 1 to 16 consecutive data items on the server (drive). At the same time this function is used to read data items on the server (drive).

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

Request Frame	Length	Value
Function code	1bytes	0x17
Comm. address	2bytes	0x0000 ~ 0xFFFF
Number of data to write	2byte	1–16 (ACG drives)
Byte Count	1byte	2 x the number of data
Value of data to write	The number of data x 2	Data to write

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 (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 (in the middle of a drive parameter initialization or the initial setting of the communication board)
WRITE PERMITION ERROR	0x20	Unique code for ACG drives. An attempt was made to change a write-protected parameter

LED Indications and Troubleshooting

LED Name	Color	Meaning	Status	Description
LINK1	Green	Network normal	ON	Network connection at LINK 1 is operating normal.
	Orange	Check network settings	ON	Check Ethernet settings*. 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*.
	-	LINK 1 Not connected	OFF	Trying Ethernet communication, network cable not connected to LINK 2.
Error	Red	Normal operation	OFF	Communication between the communication board and the drive is normal.
		Network fault	Flashing Synchronous flashing with LED0 (1 second interval)	Communication between the ACG-ET2 communication board and the drive is abnormal.
			Flashing (2 second interval)	The communication board parameters are set differently from the communication parameter settings on the keypad**
			ON	EEPROM failure No network connection to LINK 1 and LINK 2 IP collision occurred
CPU	Green	Normal operation	Flashing (1 second interval)	The communication board has been properly installed on the drive.

** For Ethernet network settings, check keypad parameters CM.10, CM.11, CM.14, CM.15, CM.23, and CM.24, and the settings for the client devices, such as the PLC.*

*** 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)."*