

EtherCAT-compatible  
Communication Unit for HG Series

**SC-HG1-ETC**

**User's Manual**

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(MEMO)

## Introduction

Thank you for purchasing an **SC-HG1-ETC** EtherCAT-compatible Communication Unit for **HG** Series.

Before using this product, read and understand this User's Manual. Use the product correctly and in the optimum manner.

Keep this manual in a safe location for reference whenever necessary.

## Type of Manual

The following user's manuals are available for the **SC-HG1-ETC** series. Refer to the appropriate manual according to your need.

The user's manuals are also available for download from our website (<https://industry.panasonic.com/>).

Unit name or purpose of use	Manual name	Manual code
EtherCAT-compatible Communication Unit for <b>HG</b> Series	<b>SC-HG1-ETC</b> User's Manual	WUME-SCHG1ETC
Contact-Type Digital Displacement Sensor <b>HG-S</b> Series	<b>HG-S</b> User's Manual	WUME-HGS
Thru-Beam Type Digital Displacement Sensor <b>HG-T</b> Series	<b>HG-T</b> User's Manual	WUME-HGT

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- 5) EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.
- 6) The ownerships of all other trademarks belong to their respective owners.

## Manual Configuration

1 Before Using This Product	This chapter explains precautions for safe use, terminology, package contents, and the name and function of each component.
2 System Configuration	This chapter explains the types and conditions of devices that can be connected to this product.
3 Installation and Setup	This chapter explains the procedures for installation, connection to external devices, and communication setup.
4 EtherCAT Network Communication	This chapter explains the communication methods.
5 Specification and Dimensions	This chapter explains the specifications and dimensions.
6 Warranty	This chapter explains warranty.
7 Maintenance	This chapter explains maintenance and inspection.
8 Troubleshooting	This chapter explains troubleshooting and error codes.

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# 1 Before Using This Product

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## 1.1 Safety Precautions

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### 1.1 Safety Precautions Always observe

This section explains important rules that must be observed to prevent personal injury and property damage.

- The hazards that may occur if the product is used incorrectly are described and classified by level of harm.

 <b>WARNING</b> Risk of death or serious injury.
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 <b>CAUTION</b> Risk of minor injury or property damage.
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#### **WARNING**

- Never use this product as a sensing device for personnel protection.
- For sensing devices for personal protection, use products that conform to the laws and standards related to personal protection in each country, such as OSHA, ANSI, and IEC.



### 1.2 Handling Precautions

■ The following symbols are used to indicate safety information that must be observed.

	Indicates an action that is prohibited.
	Indicates an action that must be taken.
	Indicates a matter that requires caution.
	Indicates supplemental information.
	Indicates reference to details about the subject in question.
	Indicates points to be noted when the product is operated.

### Specifications

- This device has been developed / produced for industrial use only.
- This product uses an EEPROM. The EEPROM has a service life of one million setting operations.
- Do not use this product outside the range of the specifications. Risk of an accident and product damage.  
There is also a risk of a noticeable reduction of service life.

### Power supply

- Incorrect wiring damages the internal circuits, so check the wiring before turning ON the power.
- Verify that fluctuations of power input supply voltage do not exceed the rating, including the connected devices.
- Note that there is a risk of damage and burning if a voltage greater than the rated voltage is applied or AC power is directly applied.
- If power is supplied from a commercial switching regulator, ensure that the frame ground (F.G.) terminal is connected to an actual ground.
- Ensure that the power supply capacity is sufficient.
- Do not use this product during the initial transient time immediately after the power supply is switched ON.
- For DC power supply, always use an isolation transformer. If an autotransformer is used, the main unit or power supply may become damaged.
- If surges occur in the power supply that is used, connect a surge absorber to the source of the surge occurrence to absorb surges.

## 1.2 Handling Precautions

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### Wiring

- Before wiring or connection work, always make sure that the power is OFF. Failure to do so may result in electric shock or damage.
- When noise generating devices (such as switching regulators and inverter motors) are used around this product, always ground the frame ground (F.G.) terminal of each device separately.
- To avoid noise, make the wiring as short as possible.
- Do not wire the controller in parallel with a high-voltage line or power line or use the same conduit as these lines. Doing so may result in malfunctioning due to induction.
- Use Ethernet cables compatible with EtherCAT.
- Do not apply stress such as excessive bending or pulling to the connector base of the Ethernet cable. Doing so may result in malfunctioning due to damage or connection failure.
- Always ground the shield of the Ethernet cable on the master device side. This product does not have a grounding terminal.
- For the detailed connection specifications, refer to the EtherCAT Installation Guide published by the EtherCAT Technology Group (ETG).

### Operating environment

- This product is suitable for indoor use only.
- Avoid using the product in steamy or dusty locations or other similar locations.
- Avoid using the product in atmospheres that contain corrosive or other harmful gases.
- Ensure that the product does not come into contact with organic solvents such as thinner.
- Ensure that the product does not come into contact with strong acid or alkaline.
- Ensure that the product does not come into contact with oil or grease.
- This product cannot be used in an environment that contains flammable or explosive gases.
- Performance may not be satisfactory in a strong electromagnetic field.
- Do not use this product in locations subject to severe vibration or shock.
- Do not drop the product or otherwise subject to shock. Doing so may result in failure.
- For details on how to use the PC to be connected, refer to the instruction manual provided with the PC.

### Other precautions

- Never attempt to disassemble, repair, or modify the product.
- When the product becomes unusable or unneeded, dispose the product appropriately as industrial waste.
- Design the system so that protection and safety circuits for protecting the system from problems are located outside.

### 1.3 Terminology

	Term	Description
System terms	EtherCAT	A master-slave open network communication system using Real-Time Ethernet
	Cyclic communication	A function that transmits data bidirectionally in specified certain cycles
	Mailbox communication (CoE)	A handshake communication function that is used to exchange aperiodic data
	ESI file	An XML file that contains recognition information such as the manufacturer and model number of an EtherCAT slave device and information required for setup and communication
	Station alias	A station number assigned to each slave device on the EtherCAT network
Unit names	EtherCAT master device	A device that controls the entire network. It communicates with each slave device connected to the network.
	EtherCAT slave device	A device that connects to the network controlled by a master device and communicates with the master device
	Ethernet cable	Category 5e or higher Ethernet cables that satisfy the 100BASE-TX standard. (Double shielded twisted pair cable or straight cable)
	End plate or commercially available fitting	Used to secure on a DIN rail

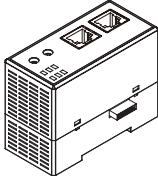
## 1.4 Contents of Package

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### 1.4 Contents of Package

The following items are included in the product package. Before using the product, make sure that no items are missing.

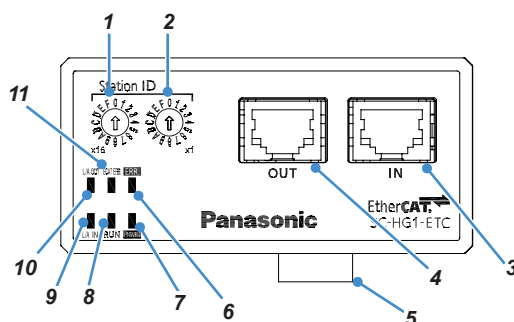
- Controller: 1 pc.



- Instruction manual (English / Japanese, Chinese / Korean): 2 pcs.
- General Information for Safety, Compliance, and Instructions: 1 pc.

## 1.5 Name and Function of Each Component

### 1.5 Name and Function of Each Component



	Name	Function
1	Station ID (x16)	Rotary switch for setting a station alias. (Note 1) [Station aliases can be set between 00 and FF]
2	Station ID (x1)	
3	IN	RJ45 connector for EtherCAT connection. This connector connects the master device and the Ethernet cable.
4	OUT	RJ45 connector for EtherCAT connection. This connector connects the slave device and the Ethernet cable.
5	Male connector for lateral connection	This connector connects a controller (master unit or slave unit). Electric power required for the communication unit is supplied from the master unit or slave unit through this connector.
6	ERR. indicator (Red)	This indicator indicates the state of communication between the communication unit and the controller connected to it. OFF: Normal operation state ON: Communication error occurs between the communication unit and the controller
7	POWER indicator (Green)	OFF : The power is OFF ON : The power is ON
8	RUN indicator (Green)	OFF: INIT state Flashing {single flash (Note 2)}: SAFE-OPERATIONAL state Flashing {blinking (Note 3)}: PRE-OPERATIONAL state ON: OPERATIONAL state
9	L/A IN indicator (Green)	OFF : The communication unit is not connected to the Ethernet Flashing : Link is normal and data is sent or received ON : Link is normal and data is not sent or received
10	L/A OUT indicator (Green)	
11	ECAT ERR indicator (Red)	OFF : Normal operation state Flashing {Double flash (Note 4)} : Watchdog timeout occurs Flashing {Blinking (Note 3)} : Configuration error occurs

Notes: 1) For numerical display on the switch, refer to each switch.

2) The indicator repeatedly lights for 0.2 seconds and goes out for 1 second.

3) The indicator repeatedly lights for 0.2 seconds and goes out for 0.2 seconds.

4) The indicator repeatedly lights for 0.2 seconds, goes out for 0.2 seconds, lights up for 0.2 seconds, and goes out for 1 second in this order.

#### Reference

- For details on how to set EtherCAT station aliases, refer to “3.3.1 Station Aliases” or the respective manuals for the EtherCAT master device and configuration tool that you use.
- For details on how to configure EtherCAT operation settings, refer to “4.3 Command Transmission Procedure”.

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# 2 System Configuration

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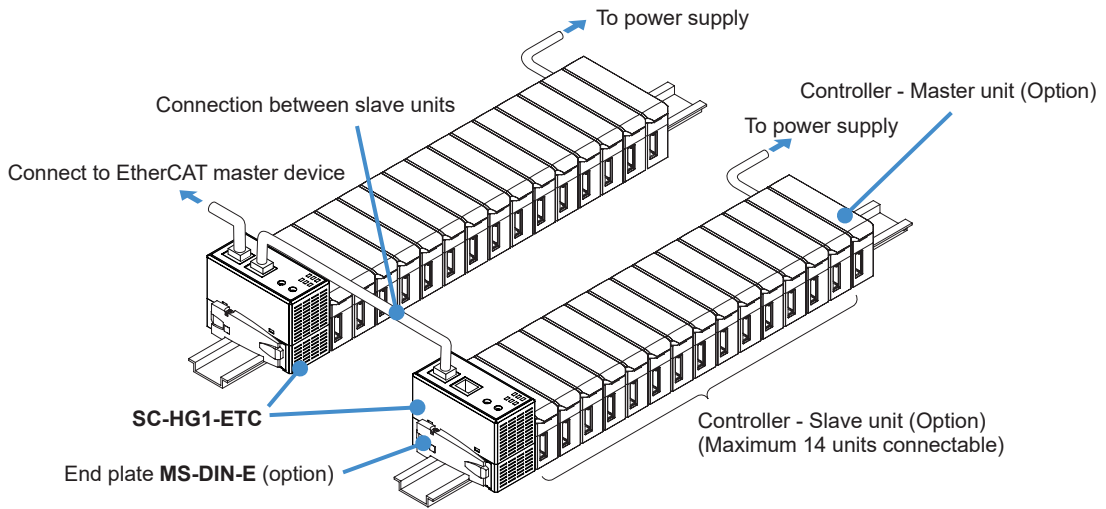
## 2.1 System Configuration of This Product

### 2.1 System Configuration of This Product

This product is a communication unit that monitors sensor ON/OFF output, the amount of detection, and other data through EtherCAT communications between each controller and the EtherCAT master device.

This product can be connected to up to 15 controllers (one master unit and 14 slave units).

Electric power required for this product is supplied from the master controller connected to it.



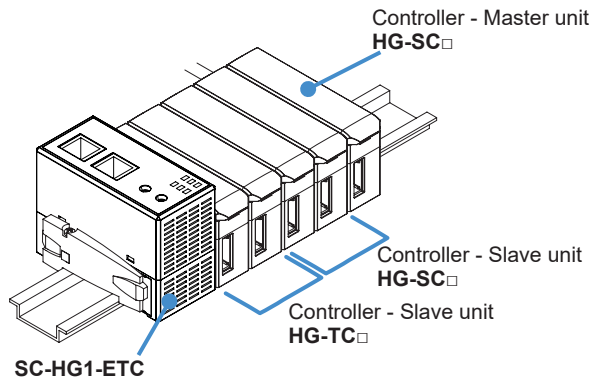


## 2.1 System Configuration of This Product

### Information

- If **HG-SC** series and **HG-TC** series controllers are used in combination, connect the slave controllers of the same series as the master controller on the near side of the master controller and connect the slave controllers of different series from the master controller on the far side of the master controller.

Example: When the master controller is **HG-SC**□



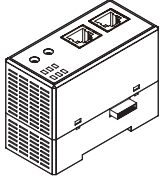
- If **HG-TC** series and **HG-SC** series controllers are used in combination, there are limitations on the functions below.

	Item	Description of limitation
1	Calculation function	Calculation is only performed when the slave unit is the same series as the master unit. Calculation is not performed when the slave unit series is different from the master unit series. "CALC" does not appear in the display of a slave unit of a different series.
2	Input all	The master unit only performs input all when the slave units are the same series. A slave unit of a different series from the master unit does not perform input even when the external input settings match those of the master unit.
3	Copy function	Copying is only performed when the slave unit is the same series as the master unit. When copying is executed, "NOW COPY" appears even on the display of a slave unit of a different series from the master unit, but copying is not performed.
4	Interference prevention	This function is only available on the <b>HG-TC</b> series controller. The function is not executed on the <b>HG-SC</b> series controller.

## 2.2 Compatible Devices

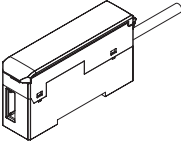
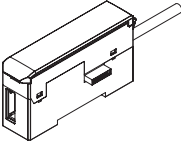
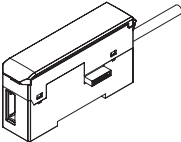
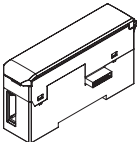
### 2.2 Compatible Devices

This product

Product name	Appearance	Model
EtherCAT-compatible Communication Unit for HG Series		<b>SC-HG1-ETC</b>

Controller

● **HG-SC** series

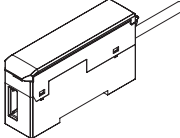
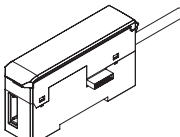
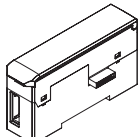
		Type	Appearance	Model	Output
Contact-type digital displacement sensor	Master unit	High-performance type (Analog current output + I/O)		<b>HG-SC101</b>	NPN open-collector transistor
				<b>HG-SC101-P</b>	PNP open-collector transistor
	Slave unit	High-performance type (Analog current output + I/O)		<b>HG-SC111</b>	NPN open-collector transistor
				<b>HG-SC111-P</b>	PNP open-collector transistor
		Standard type (I/O)		<b>HG-SC112</b>	NPN open-collector transistor
				<b>HG-SC112-P</b>	PNP open-collector transistor
	Wire-saving type		<b>HG-SC113</b>	—	



- When connecting slave units to the master unit, connect only NPN output type units or only PNP output type units. Dissimilar output types cannot be connected together.
- If an **HG-SC** series controller manufactured in January 2019 or earlier is connected with an **HG-TC** series controller, operation will not take place normally. Use an **HG-SC** series controller manufactured in February 2019 or later.

## 2.2 Compatible Devices


### ● HG-TC series

		Type	Appearance	Model	Output
Thru-beam type digital displacement sensor	Master unit	High-performance type (Analog output + I/O)		<b>HG-TC101</b>	NPN open-collector transistor
				<b>HG-TC101-P</b>	PNP open-collector transistor
	Slave unit	High-performance type (Analog output + I/O)		<b>HG-TC111</b>	NPN open-collector transistor
				<b>HG-TC111-P</b>	PNP open-collector transistor
		Wire-saving type		<b>HG-TC113</b>	—



- When connecting slave units to the master unit, connect only NPN output type units or only PNP output type units. Dissimilar output types cannot be connected together.
- If an **HG-SC** series controller manufactured in January 2019 or earlier is connected with an **HG-TC** series controller, operation will not take place normally. Use an **HG-SC** series controller manufactured in February 2019 or later.

### End plate

Product name	Appearance	Model
End plate		<b>MS-DIN-E</b>

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# 3 Installation and Setup

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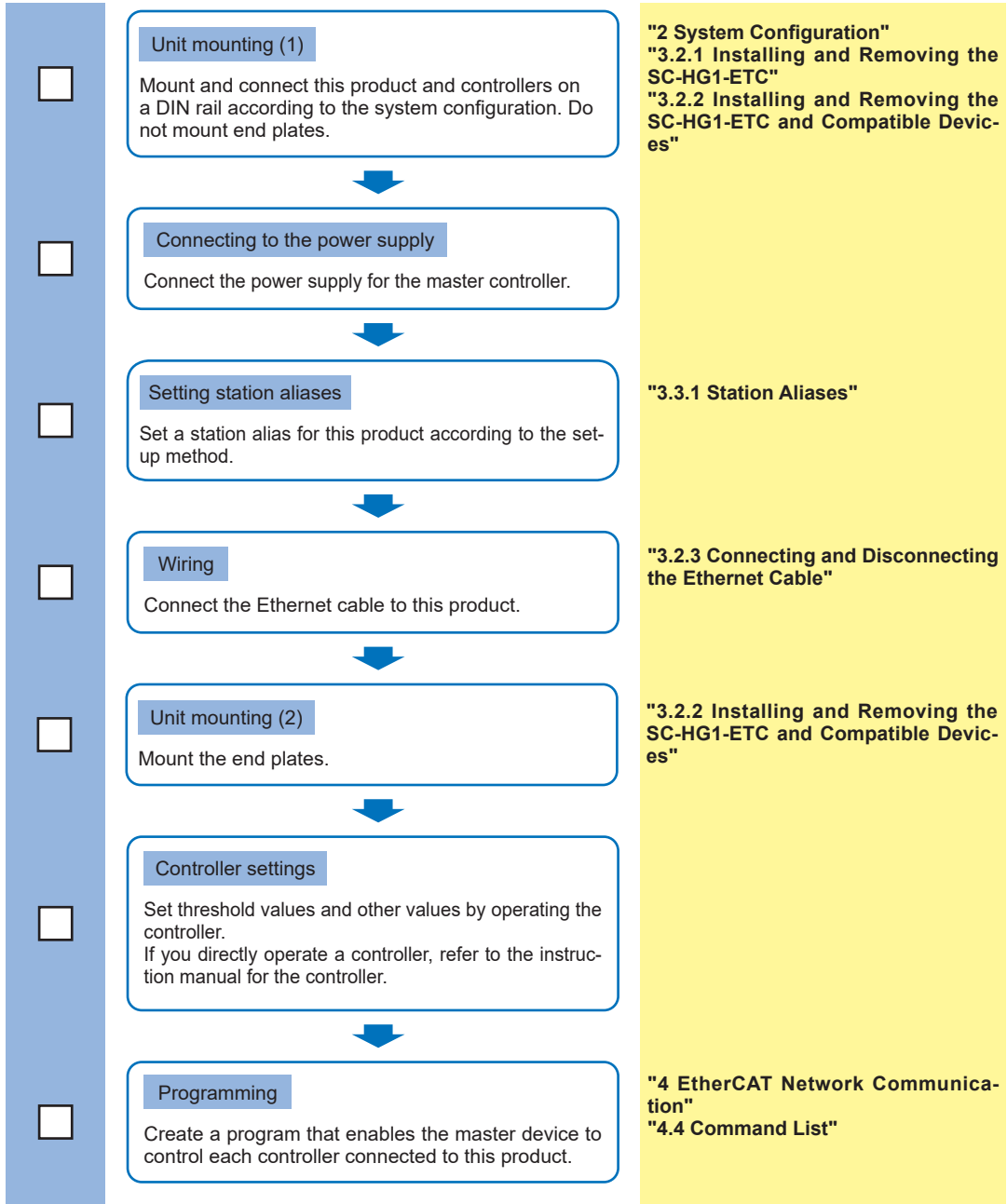
## 3.1 Preparation for Operation

### 3.1 Preparation for Operation

The procedure up to operation is shown below.

Check column

Reference section

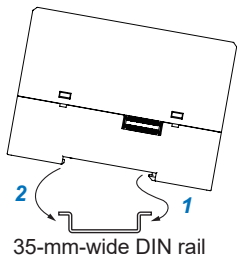


3.2 Installation

3.2.1 Installing and Removing the SC-HG1-ETC

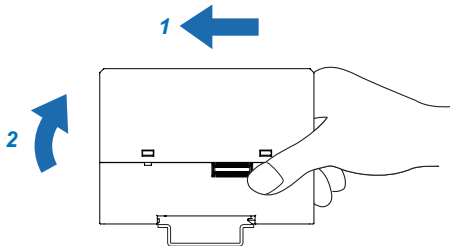
■ Mounting on a DIN rail

- 1. Hook the rear of the mounting part onto the 35-mm-wide DIN rail.
- 2. While pressing down on the rear of the mounting part, insert the front of the mounting part into the DIN rail.



■ Removing from a DIN rail

- 1. Grasp the product and push forward.
- 2. Lifting the front of the product removes it from the DIN rail.



**Note**

If you attempt to lift the front without pushing the product forward, you will break the hook on the rear of the mounting part.

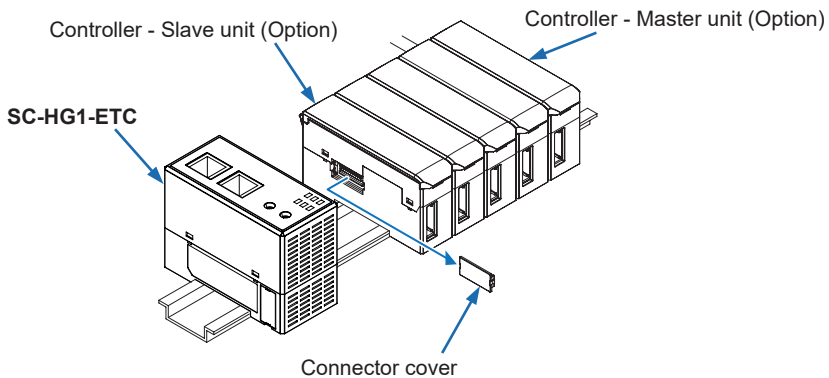
## 3.2 Installation

### 3.2.2 Installing and Removing the SC-HG1-ETC and Compatible Devices

- Do not pull the connector or cable forcefully. Doing so may damage the connector or break the wires.
  - Do not use any tools (such as pliers) to pull out the connector.
  - Firmly hold the connector when performing wiring work. Do not forcibly push wires into the connector. Doing so may result in injury.
  - Do not reuse any connectors that have been wire-pressed once. The performance of re-used wire-pressed connectors cannot be guaranteed.
- ⚠ Before wiring work, always turn OFF the master controller.
- ⚠ To connect units, always mount them on a DIN rail. When doing this, mount end plates **MS-DIN-E** (optional) so as to enclose the connected units at both ends.

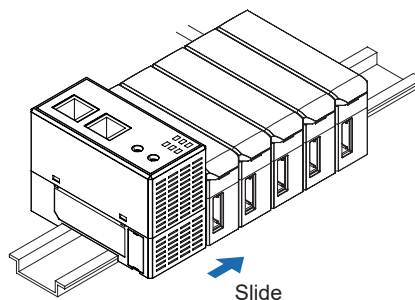
#### ■ How to connect

1. Mount this product on a 35-mm-wide DIN rail.
2. Remove the connector cover from the controller. (Note 1)



Note : Keep the connector cover removed from the controller in a safe place.

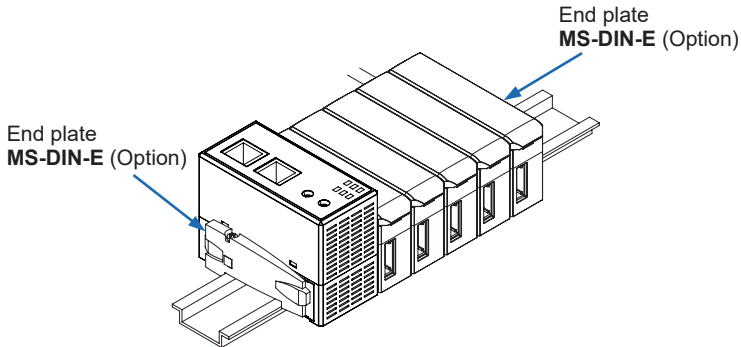
3. Slide this product until it directly contacts the controller.





## 3.2 Installation

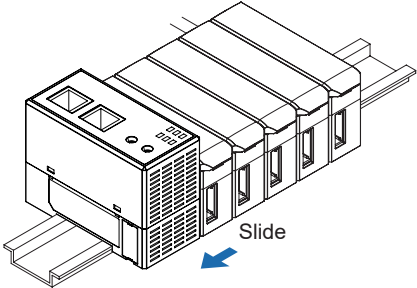
4. Attach end plates **MS-DIN-E** (optional) with the flat side facing in so as to enclose the connected units at the ends.



5. Secure the **MS-DIN-E** end plates by tightening the screws. Tighten the screws to a torque of 0.3 N·m or less.

■ How to disconnect

1. Loosen the screws on the **MS-DIN-E** end plates and then remove them.
2. Slide and remove this product and the controllers.



## 3.2 Installation

### 3.2.3 Connecting and Disconnecting the Ethernet Cable

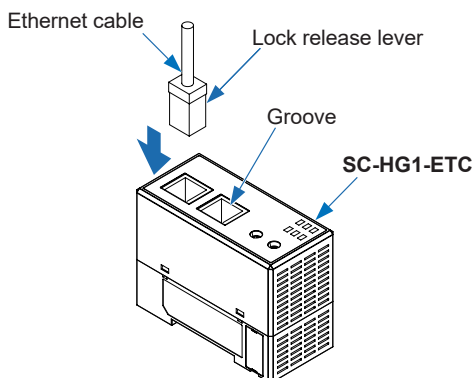
#### ■ Connecting the Ethernet cable

- For the Ethernet cable, use Category 5e or higher shielded twisted pair cables.
  - The communication distance must be within the specified range.
- !** Always run the Ethernet cable through a duct or secure the cable with clamps. Failure to do so may affect the contact state of the connectors due to vibration or impact, resulting in malfunction.

#### ▼ Reference

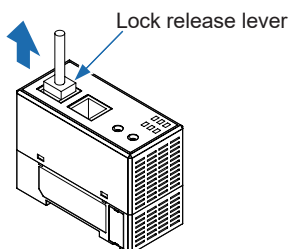
For the detailed connection specifications of EtherCAT, refer to the EtherCAT Installation Guide published by the EtherCAT Technology Group (ETG).

1. Hold the connector of the Ethernet cable and align the lock release lever of the Ethernet cable with the groove in IN or OUT.
2. Insert the connector until it snaps in.



#### ■ Disconnecting the Ethernet cable

1. Press on the lock release lever on the Ethernet cable and pull it out.



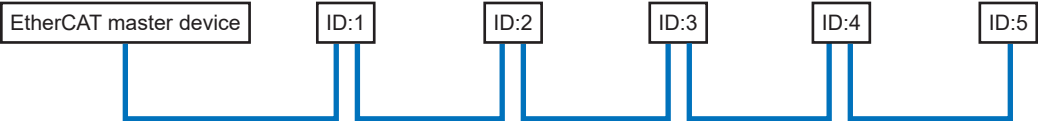
#### ▶ Note

- Attempting to pull out the connector without pressing the lock release lever may break the lock release lever. Do not use an Ethernet cable whose lock release lever is broken. Do not grasp the cable to pull, as this may cause wire breakage in the cable.
- To ensure communication reliability, always ground the shield of the Ethernet cable on the master device side. This product does not have a grounding terminal.

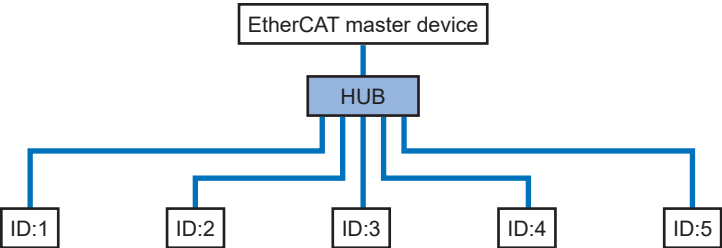
■ Network connection configuration for EtherCAT

The network connection configuration for EtherCAT is classified into line, star, tree, and ring types. Networks can also be configured by mixing the line and star types.

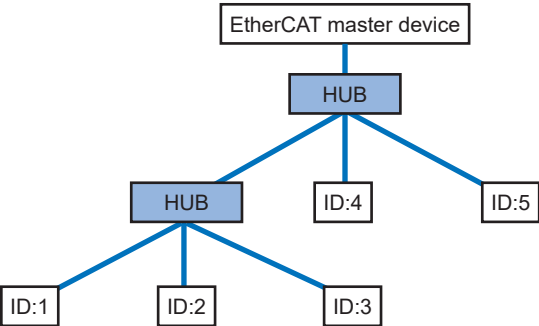
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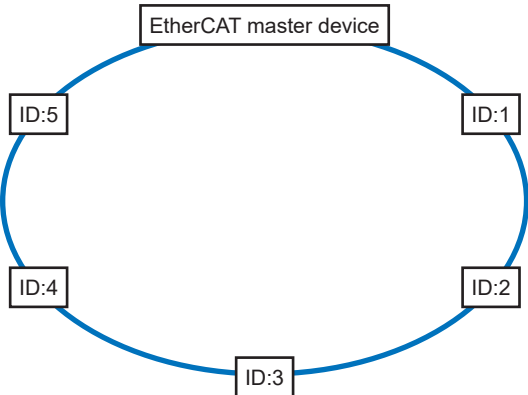
<Star type>



<Tree type>



<Ring type>



## 3.3 Setup

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### 3.3 Setup

#### 3.3.1 Station Aliases

This product uses the following three methods to set station aliases that enable the master to identify each slave during EtherCAT communications.

(1) Configured Station Alias (SII read)


This setup method is selected when 0x2001 (Station Alias Select) in the object dictionary is set to 1. Data is read from the master by setting the value of 0x0004 (Configured Station Alias) in SII into 0x0012 (Configured Station Alias) in the ESC register.

(2) Configured Station Alias (Station Alias Setup + Rotary switches)

This setup method is selected when 0x2001 (Station Alias Select) in the object dictionary is set to 0. Data is read from the master by setting the value (0x0000 to 0xFFFF) generated by 0x2000 (Station Alias Setup) in the object dictionary and the rotary switches into 0x0012 (Configured Station Alias) in the ESC register.

(3) Explicit Device ID (Station Alias Setup + Rotary switches)

This setup method is selected when Explicit Device is selected. Data is read from the master by setting the value (0x0000 to 0xFFFF) generated by 0x2000 (Station Alias Setup) in the object dictionary and the rotary switches into 0x0134 (AL Status Code) in the ESC register.

 **Note**

The actual setup method differs according to the master device and configuration tool that you use. This product supports the above three setup methods, but whether the master supports all these methods depends on the master device.

 **Information**

In the factory default settings of this product, 0x2001 (Station Alias Select) in the object dictionary is set to 1. If the factory default setting is used, the method in (1) above will be used to set station aliases.

■ Setting station aliases with the station ID switches

Station aliases for **SC-HG1-ETC** communication units can be set within the range between 00 and FFFF (hexadecimal number) by setting the last two digits with the station ID switches and adding the first two digits in 0x2000 in the object dictionary.

When using the station ID switches, configure settings according to the following procedure.

1. Use the station ID switches to set a station alias. The settable range for each station ID switch is from 00 to FF (hexadecimal number).

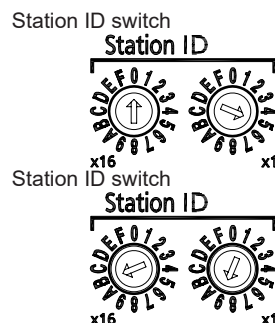
- The "x1" switch sets the first digit of the station alias. 0 to F (hexadecimal number) are valid.
- The "x16" switch sets the second digit of the station alias. 0 to F (hexadecimal number) are valid.  
(A=10, B=11, C=12, D=13, E=14, F=15)

<Example 1>

To set to "5", set to "05".

<Example 2>

To set to "185", set to "B9".



This completes the station alias setting procedure.

Note : The value specified as the station alias is set the when the power is turned ON .

After setting the station alias, do not change the settings of the station ID switches.

2. When the power is turned ON, EtherCAT network communications will be started using the station alias that has been set.



- Make sure that there is no duplication when setting station aliases.
- After changing the settings, always turn the power OFF and then ON.

(MEMO)

# 4 EtherCAT Network Communication

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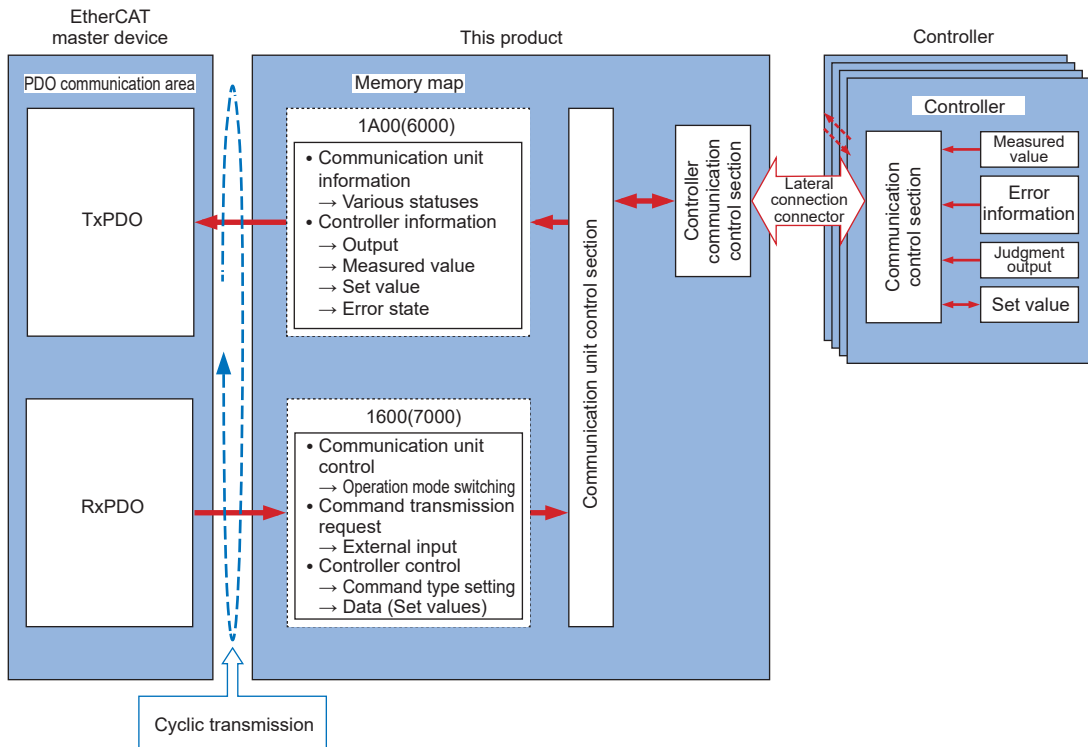
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## 4.1 Communication Overview

### 4.1 Communication Overview

#### 4.1.1 Communication with Master Device

Data exchange between this product and the master device is performed using process data objects (PDOs). PDO is classified into two types: RxPDO and TxPDO. RxPDO is used to send data from the master to a slave, while TxPDO is used to send data from a slave to the master. RxPDO and TxPDO are allocated to 1600 and 1A00, respectively, in the object dictionary. Data is updated periodically via cyclic transmission. The master station can use the functions of this product by accessing the PDO communication area allocated on the memory map.



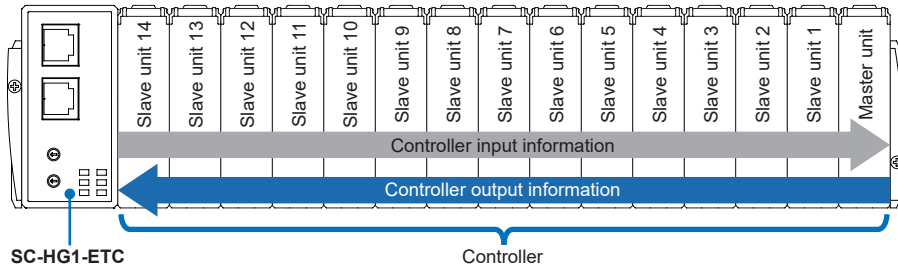


## 4.1 Communication Overview

### 4.1.2 Communication between SC-HG1-ETC and Controller

This product automatically converts EtherCAT network communication data to communicate with the controller connected to it.

I/O data and settings for the connected controller can be read and written via EtherCAT network communications.



## 4.2 Memory Allocation

### 4.2 Memory Allocation

#### 4.2.1 Object Dictionary

INDEX (HEX)	Subindex (HEX)	Name	Type	Access	Description
1000	0	Device type	U32	R	
1001	0	Error register	U8	R	Stores an AL Status Code error
1008	0	Manufacturer device name	VS	R	Product name
1009	0	Manufacturer hardware version	VS	R	Hardware version
100A	0	Manufacturer software version	VS	R	Software version
1018	0	Number of entries Identity object	U8	R	Number of entries (fixed)
	1	Vendor ID	U32	R	SII(0x0008)
	2	Product code	U32	R	SII(0x000A)
	3	Revision number	U32	R	SII(0x000C)
	4	Serial number	U32	R	SII(0x000E)
10F3	0	Number of entries Diagnosis history	U8	R	Number of entries
	1	Maximum messages	U8	R(W)	Number of subindexes following Subindex6
	2	Newest message	U8	R	Latest message number (0x06 to 0x13)
	3	Newest acknowledged message	U8	RW	Set value to be written: When 0 is set, all messages are cleared.
	4	New messages available	Bool	R	
	5	Flags	U16	-	ALL OFF at the time of startup
			LB0	R(W)	Emergency message function setting (0: Disable)
			LB1	RW	Information message storage disable setting (0: Enable)
			LB2	RW	Warning message storage disable setting (0: Enable)
			LB3	R(W)	Error message storage disable setting (0: Enable)
			LB4	R(W)	Log processing mode (0: Overwrite mode fixed)
			LB5	R	Overwrite/discard flag (1: Indicate implementation)
	LB6-16	R	Reserved		
	6	Diagnosis message 1	VS	R	Diagnostic message log 1
	7	Diagnosis message 2	VS	R	Diagnostic message log 2
	8	Diagnosis message 3	VS	R	Diagnostic message log 3
	9	Diagnosis message 4	VS	R	Diagnostic message log 4
	a	Diagnosis message 5	VS	R	Diagnostic message log 5
b	Diagnosis message 6	VS	R	Diagnostic message log 6	
c	Diagnosis message 7	VS	R	Diagnostic message log 7	
d	Diagnosis message 8	VS	R	Diagnostic message log 8	
e	Diagnosis message 9	VS	R	Diagnostic message log 9	
f	Diagnosis message 10	VS	R	Diagnostic message log 10	
10	Diagnosis message 11	VS	R	Diagnostic message log 11	
11	Diagnosis message 12	VS	R	Diagnostic message log 12	
12	Diagnosis message 13	VS	R	Diagnostic message log 13	
13	Diagnosis message 14	VS	R	Diagnostic message log 14	

## 4.2 Memory Allocation

INDEX (HEX)	Subindex (HEX)	Name	Type	Access	Description
1600	0	Number of entries Receive PDO mapping 1	U8	R	0 to 254
	1	1st receive PDO mapped	U32	R	Refer to “4.2.2 PDO Mapping”
	:	:	U32	R	
1A00	0	Number of entries Transmit PDO mapping 1	U8	R	0 to 254
	1	1st transmit PDO mapped	U32	R	Refer to “4.2.2 PDO Mapping”
	:	:	U32	R	
1C00	0	Number of used sync manager channels	U8	R	4 to 32 (Maximum 8 when ET1100 is used)
	1	Communication type sync manager 0	U8	R	MailBox reception (OUT)
	2	Communication type sync manager 1	U8	R	MailBox transmission (IN)
	3	Communication type sync manager 2	U8	R	RxPDO
	4	Communication type sync manager 3	U8	R	TxPDO
	:	:	U8	R	Unused
	20	Communication type sync manager 31	U8	R	Unused
1C10	0	Number of assigned PDOs Sync manager channel 0	U8	R	Fixed at 0 when allocated to MailBox
	1	PDO mapping object index of assigned 1	U16	R	
	FF	PDO mapping object index of assigned 255	U16	R	
1C11	0	Number of assigned PDOs Sync manager channel 1	U8	R	Fixed at 0 when allocated to MailBox
	1	PDO mapping object index of assigned 1	U16	R	
	FF	PDO mapping object index of assigned 255	U16	R	
2000	0	Station Alias Setup(High)	U16	RW	High-order byte setting when rotary switches are used
2001	0	Station Alias Selection	U16	RW	Station Alias specification method setting (1: The set value in SII is used)
2002	0	Number of entries System status	U8	R	Number of entries
	1	System Status	U16	R	System status
			LB0-8		Reserved
			LB9		Initial setting complete
LB10			Error state (occurrence state is maintained)		
LB11-15	Reserved				
2003	0	Number of entries System request	U8	R	Number of entries
	1	System Request	U16	R	System request
			LB0-8		Reserved
			LB9		Initial setting request
			LB10		Error clearing
LB11-15	Reserved				

## 4.2 Memory Allocation

### 4.2.2 PDO Mapping

<Input data - TxPDO (SC-HG1-ETC → Master)>

Mapping object		Application object		
INDEX	Name	INDEX	Type	Description
1A00:01	Send Complete	6000:01	BOOL	Command response: Transmission complete
1A00:02	Command Err Flag	6000:02	BOOL	Command response: Error flag
1A00:03	Non use	6000:03	BOOL	Unused
1A00:04	Non use	6000:04	BOOL	Unused
1A00:05	Non use	6000:05	BOOL	Unused
1A00:06	Non use	6000:06	BOOL	Unused
1A00:07	Non use	6000:07	BOOL	Unused
1A00:08	Non use	6000:08	BOOL	Unused
1A00:09	Judge Value Mode	6001:01	BOOL	Sensor response data switching response: Judgment value
1A00:0A	Normal Value Mode	6001:02	BOOL	Sensor response data switching response: Normal measured value
1A00:0B	Calculation Value Mode	6001:03	BOOL	Sensor response data switching response: Calculated value
1A00:0C	Head Value Mode	6001:04	BOOL	Sensor response data switching response: Sensor head value
1A00:0D	Command Mode	6001:05	BOOL	Sensor response data switching response: Command
1A00:0E	Non use	6001:06	BOOL	Unused
1A00:0F	Error Code Mode	6001:07	BOOL	Sensor response data switching response: Error code
1A00:10	Non use	6001:08	BOOL	Unused
1A00:11	Output1 Unit1	6002:01	BOOL	Judgment output 1: Master unit
1A00:12	Output1 Unit2	6002:02	BOOL	Judgment output 1: Slave unit 1
1A00:13	Output1 Unit3	6002:03	BOOL	Judgment output 1: Slave unit 2
1A00:14	Output1 Unit4	6002:04	BOOL	Judgment output 1: Slave unit 3
1A00:15	Output1 Unit5	6002:05	BOOL	Judgment output 1: Slave unit 4
1A00:16	Output1 Unit6	6002:06	BOOL	Judgment output 1: Slave unit 5
1A00:17	Output1 Unit7	6002:07	BOOL	Judgment output 1: Slave unit 6
1A00:18	Output1 Unit8	6002:08	BOOL	Judgment output 1: Slave unit 7
1A00:19	Output1 Unit9	6002:09	BOOL	Judgment output 1: Slave unit 8
1A00:1A	Output1 Unit10	6002:0A	BOOL	Judgment output 1: Slave unit 9
1A00:1B	Output1 Unit11	6002:0B	BOOL	Judgment output 1: Slave unit 10
1A00:1C	Output1 Unit12	6002:0C	BOOL	Judgment output 1: Slave unit 11
1A00:1D	Output1 Unit13	6002:0D	BOOL	Judgment output 1: Slave unit 12
1A00:1E	Output1 Unit14	6002:0E	BOOL	Judgment output 1: Slave unit 13
1A00:1F	Output1 Unit15	6002:0F	BOOL	Judgment output 1: Slave unit 14
1A00:20	Non use	6002:10	BOOL	Unused
1A00:21	Output2 Unit1	6003:01	BOOL	Judgment output 2: Master unit
1A00:22	Output2 Unit2	6003:02	BOOL	Judgment output 2: Slave unit 1
1A00:23	Output2 Unit3	6003:03	BOOL	Judgment output 2: Slave unit 2
1A00:24	Output2 Unit4	6003:04	BOOL	Judgment output 2: Slave unit 3
1A00:25	Output2 Unit5	6003:05	BOOL	Judgment output 2: Slave unit 4
1A00:26	Output2 Unit6	6003:06	BOOL	Judgment output 2: Slave unit 5
1A00:27	Output2 Unit7	6003:07	BOOL	Judgment output 2: Slave unit 6
1A00:28	Output2 Unit8	6003:08	BOOL	Judgment output 2: Slave unit 7
1A00:29	Output2 Unit9	6003:09	BOOL	Judgment output 2: Slave unit 8
1A00:2A	Output2 Unit10	6003:0A	BOOL	Judgment output 2: Slave unit 9

## 4.2 Memory Allocation

Mapping object		Application object		
INDEX	Name	INDEX	Type	Description
1A00:2B	Output2 Unit11	6003:0B	BOOL	Judgment output 2: Slave unit 10
1A00:2C	Output2 Unit12	6003:0C	BOOL	Judgment output 2: Slave unit 11
1A00:2D	Output2 Unit13	6003:0D	BOOL	Judgment output 2: Slave unit 12
1A00:2E	Output2 Unit14	6003:0E	BOOL	Judgment output 2: Slave unit 13
1A00:2F	Output2 Unit15	6003:0F	BOOL	Judgment output 2: Slave unit 14
1A00:30	Non use	6003:10	BOOL	Unused
1A00:31	Output3 Unit1	6004:01	BOOL	Judgment output 3: Master unit
1A00:32	Output3 Unit2	6004:02	BOOL	Judgment output 3: Slave unit 1
1A00:33	Output3 Unit3	6004:03	BOOL	Judgment output 3: Slave unit 2
1A00:34	Output3 Unit4	6004:04	BOOL	Judgment output 3: Slave unit 2
1A00:35	Output3 Unit5	6004:05	BOOL	Judgment output 3: Slave unit 4
1A00:36	Output3 Unit6	6004:06	BOOL	Judgment output 3: Slave unit 5
1A00:37	Output3 Unit7	6004:07	BOOL	Judgment output 3: Slave unit 6
1A00:38	Output3 Unit8	6004:08	BOOL	Judgment output 3: Slave unit 7
1A00:39	Output3 Unit9	6004:09	BOOL	Judgment output 3: Slave unit 8
1A00:3A	Output3 Unit10	6004:0A	BOOL	Judgment output 3: Slave unit 9
1A00:3B	Output3 Unit11	6004:0B	BOOL	Judgment output 3: Slave unit 10
1A00:3C	Output3 Unit12	6004:0C	BOOL	Judgment output 3: Slave unit 11
1A00:3D	Output3 Unit13	6004:0D	BOOL	Judgment output 3: Slave unit 12
1A00:3E	Output3 Unit14	6004:0E	BOOL	Judgment output 3: Slave unit 13
1A00:3F	Output3 Unit15	6004:0F	BOOL	Judgment output 3: Slave unit 14
1A00:40	Non use	6004:10	BOOL	Unused
1A00:41	Output Alarm Unit1	6005:01	BOOL	Alarm output: Master unit
1A00:42	Output Alarm Unit2	6005:02	BOOL	Alarm output: Slave unit 1
1A00:43	Output Alarm Unit3	6005:03	BOOL	Alarm output: Slave unit 2
1A00:44	Output Alarm Unit4	6005:04	BOOL	Alarm output: Slave unit 3
1A00:45	Output Alarm Unit5	6005:05	BOOL	Alarm output: Slave unit 4
1A00:46	Output Alarm Unit6	6005:06	BOOL	Alarm output: Slave unit 5
1A00:47	Output Alarm Unit7	6005:07	BOOL	Alarm output: Slave unit 6
1A00:48	Output Alarm Unit8	6005:08	BOOL	Alarm output: Slave unit 7
1A00:49	Output Alarm Unit9	6005:09	BOOL	Alarm output: Slave unit 8
1A00:4A	Output Alarm Unit10	6005:0A	BOOL	Alarm output: Slave unit 9
1A00:4B	Output Alarm Unit11	6005:0B	BOOL	Alarm output: Slave unit 10
1A00:4C	Output Alarm Unit12	6005:0C	BOOL	Alarm output: Slave unit 11
1A00:4D	Output Alarm Unit13	6005:0D	BOOL	Alarm output: Slave unit 12
1A00:4E	Output Alarm Unit14	6005:0E	BOOL	Alarm output: Slave unit 13
1A00:4F	Output Alarm Unit15	6005:0F	BOOL	Alarm output: Slave unit 14
1A00:50	Non use	6005:10	BOOL	Unused
1A00:51	Output Err Unit1	6006:01	BOOL	Error output: Master unit
1A00:52	Output Err Unit2	6006:02	BOOL	Error output: Slave unit 1
1A00:53	Output Err Unit3	6006:03	BOOL	Error output: Slave unit 2
1A00:54	Output Err Unit4	6006:04	BOOL	Error output: Slave unit 3
1A00:55	Output Err Unit5	6006:05	BOOL	Error output: Slave unit 4
1A00:56	Output Err Unit6	6006:06	BOOL	Error output: Slave unit 5
1A00:57	Output Err Unit7	6006:07	BOOL	Error output: Slave unit 6
1A00:58	Output Err Unit8	6006:08	BOOL	Error output: Slave unit 7
1A00:59	Output Err Unit9	6006:09	BOOL	Error output: Slave unit 8
1A00:5A	Output Err Unit10	6006:0A	BOOL	Error output: Slave unit 9
1A00:5B	Output Err Unit11	6006:0B	BOOL	Error output: Slave unit 10
1A00:5C	Output Err Unit12	6006:0C	BOOL	Error output: Slave unit 11
1A00:5D	Output Err Unit13	6006:0D	BOOL	Error output: Slave unit 12

## 4.2 Memory Allocation

Mapping object		Application object		
INDEX	Name	INDEX	Type	Description
1A00:5E	Output Err Unit14	6006:0E	BOOL	Error output: Slave unit 13
1A00:5F	Output Err Unit15	6006:0F	BOOL	Error output: Slave unit 14
1A00:60	Output Err CommunicationUnit	6006:10	BOOL	Error output: Communication unit
1A00:61	Response Unit1	6007:01	BOOL	Command response sensor: Master unit
1A00:62	Response Unit2	6007:02	BOOL	Command response sensor: Slave unit 1
1A00:63	Response Unit3	6007:03	BOOL	Command response sensor: Slave unit 2
1A00:64	Response Unit4	6007:04	BOOL	Command response sensor: Slave unit 3
1A00:65	Response Unit5	6007:05	BOOL	Command response sensor: Slave unit 4
1A00:66	Response Unit6	6007:06	BOOL	Command response sensor: Slave unit 5
1A00:67	Response Unit7	6007:07	BOOL	Command response sensor: Slave unit 6
1A00:68	Response Unit8	6007:08	BOOL	Command response sensor: Slave unit 7
1A00:69	Response Unit9	6007:09	BOOL	Command response sensor: Slave unit 8
1A00:6A	Response Unit10	6007:0A	BOOL	Command response sensor: Slave unit 9
1A00:6B	Response Unit11	6007:0B	BOOL	Command response sensor: Slave unit 10
1A00:6C	Response Unit12	6007:0C	BOOL	Command response sensor: Slave unit 11
1A00:6D	Response Unit13	6007:0D	BOOL	Command response sensor: Slave unit 12
1A00:6E	Response Unit14	6007:0E	BOOL	Command response sensor: Slave unit 13
1A00:6F	Response Unit15	6007:0F	BOOL	Command response sensor: Slave unit 14
1A00:70	Non use	6007:10	BOOL	Unused
1A00:71	Response Code	6008:01	U16	Command response code
1A00:72	Response Data Unit1	6009:01	INT32	Response data: Master unit
1A00:73	Response Data Unit2	6009:02	INT32	Response data: Slave unit 1
1A00:74	Response Data Unit3	6009:03	INT32	Response data: Slave unit 2
1A00:75	Response Data Unit4	6009:04	INT32	Response data: Slave unit 3
1A00:76	Response Data Unit5	6009:05	INT32	Response data: Slave unit 4
1A00:77	Response Data Unit6	6009:06	INT32	Response data: Slave unit 5
1A00:78	Response Data Unit7	6009:07	INT32	Response data: Slave unit 6
1A00:79	Response Data Unit8	6009:08	INT32	Response data: Slave unit 7
1A00:7A	Response Data Unit9	6009:09	INT32	Response data: Slave unit 8
1A00:7B	Response Data Unit10	6009:0A	INT32	Response data: Slave unit 9
1A00:7C	Response Data Unit11	6009:0B	INT32	Response data: Slave unit 10
1A00:7D	Response Data Unit12	6009:0C	INT32	Response data: Slave unit 11
1A00:7E	Response Data Unit13	6009:0D	INT32	Response data: Slave unit 12
1A00:7F	Response Data Unit14	6009:0E	INT32	Response data: Slave unit 13
1A00:80	Response Data Unit15	6009:0F	INT32	Response data: Slave unit 14
1A00:81	Response Data CommunicationUnit	6009:10	INT32	Response data: Communication unit
1A00:82	System Status	2003:01	U16	System status
1A00:83	Unit Status Notice	600A:01	U16	Sensor status : Notification
1A00:84	Unit Status Warning	600A:02	U16	Sensor status : Caution
1A00:85	Unit Status Error	600A:03	U16	Sensor status : Fault

## 4.2 Memory Allocation

<Output data - RxDPO (Master → **SC-HG1-ETC**)>

Mapping object		Application object		
INDEX	Name	INDEX	Type	Description
1600:01	Send Command	7000:01	BOOL	Command request: Transmission request
1600:02	Write Flag	7000:02	BOOL	Command request: Write flag
1600:03	Non use	7000:03	BOOL	Unused
1600:04	Non use	7000:04	BOOL	Unused
1600:05	Non use	7000:05	BOOL	Unused
1600:06	Non use	7000:06	BOOL	Unused
1600:07	Non use	7000:07	BOOL	Unused
1600:08	Non use	7000:08	BOOL	Unused
1600:09	Judge Value Mode	7001:01	BOOL	Sensor response data switching request: Judgment value
1600:0A	Normal Value Mode	7001:02	BOOL	Sensor response data switching request: Normal measured value
1600:0B	Calculation Value Mode	7001:03	BOOL	Sensor response data switching request: Calculated value
1600:0C	Head Value Mode	7001:04	BOOL	Sensor response data switching request: Sensor head value
1600:0D	Command Mode	7001:05	BOOL	Sensor response data switching request: Command
1600:0E	Non use	7001:06	BOOL	Unused
1600:0F	Error Code	7001:07	BOOL	Sensor response data switching request: Error code
1600:10	Non use	7001:08	BOOL	Unused
1600:11	External Input1 Unit1	7002:01	BOOL	External input 1: Master unit
1600:12	External Input1 Unit2	7002:02	BOOL	External input 1: Slave unit 1
1600:13	External Input1 Unit3	7002:03	BOOL	External input 1: Slave unit 2
1600:14	External Input1 Unit4	7002:04	BOOL	External input 1: Slave unit 3
1600:15	External Input1 Unit5	7002:05	BOOL	External input 1: Slave unit 4
1600:16	External Input1 Unit6	7002:06	BOOL	External input 1: Slave unit 5
1600:17	External Input1 Unit7	7002:07	BOOL	External input 1: Slave unit 6
1600:18	External Input1 Unit8	7002:08	BOOL	External input 1: Slave unit 7
1600:19	External Input1 Unit9	7002:09	BOOL	External input 1: Slave unit 8
1600:1A	External Input1 Unit10	7002:0A	BOOL	External input 1: Slave unit 9
1600:1B	External Input1 Unit11	7002:0B	BOOL	External input 1: Slave unit 10
1600:1C	External Input1 Unit12	7002:0C	BOOL	External input 1: Slave unit 11
1600:1D	External Input1 Unit13	7002:0D	BOOL	External input 1: Slave unit 12
1600:1E	External Input1 Unit14	7002:0E	BOOL	External input 1: Slave unit 13
1600:1F	External Input1 Unit15	7002:0F	BOOL	External input 1: Slave unit 14
1600:20	Non use	7002:10	BOOL	Unused
1600:21	External Input2 Unit1	7003:01	BOOL	External input 2: Master unit
1600:22	External Input2 Unit2	7003:02	BOOL	External input 2: Slave unit 1
1600:23	External Input2 Unit3	7003:03	BOOL	External input 2: Slave unit 2
1600:24	External Input2 Unit4	7003:04	BOOL	External input 2: Slave unit 3
1600:25	External Input2 Unit5	7003:05	BOOL	External input 2: Slave unit 4
1600:26	External Input2 Unit6	7003:06	BOOL	External input 2: Slave unit 5
1600:27	External Input2 Unit7	7003:07	BOOL	External input 2: Slave unit 6
1600:28	External Input2 Unit8	7003:08	BOOL	External input 2: Slave unit 7
1600:29	External Input2 Unit9	7003:09	BOOL	External input 2: Slave unit 8
1600:2A	External Input2 Unit10	7003:0A	BOOL	External input 2: Slave unit 9
1600:2B	External Input2 Unit11	7003:0B	BOOL	External input 2: Slave unit 10
1600:2C	External Input2 Unit12	7003:0C	BOOL	External input 2: Slave unit 11
1600:2D	External Input2 Unit13	7003:0D	BOOL	External input 2: Slave unit 12
1600:2E	External Input2 Unit14	7003:0E	BOOL	External input 2: Slave unit 13
1600:2F	External Input2 Unit15	7003:0F	BOOL	External input 2: Slave unit 14

## 4.2 Memory Allocation

Mapping object		Application object		
INDEX	Name	INDEX	Type	Description
1600:2F	Non use	7003:10	BOOL	Unused
1600:30	External Input3 Unit1	7004:01	BOOL	External input 3: Master unit
1600:31	External Input3 Unit2	7004:02	BOOL	External input 3: Slave unit 1
1600:32	External Input3 Unit3	7004:03	BOOL	External input 3: Slave unit 2
1600:33	External Input3 Unit4	7004:04	BOOL	External input 3: Slave unit 3
1600:34	External Input3 Unit5	7004:05	BOOL	External input 3: Slave unit 4
1600:35	External Input3 Unit6	7004:06	BOOL	External input 3: Slave unit 5
1600:36	External Input3 Unit7	7004:07	BOOL	External input 3: Slave unit 6
1600:37	External Input3 Unit8	7004:08	BOOL	External input 3: Slave unit 7
1600:38	External Input3 Unit9	7004:09	BOOL	External input 3: Slave unit 8
1600:39	External Input3 Unit10	7004:0A	BOOL	External input 3: Slave unit 9
1600:3A	External Input3 Unit11	7004:0B	BOOL	External input 3: Slave unit 10
1600:3B	External Input3 Unit12	7004:0C	BOOL	External input 3: Slave unit 11
1600:3C	External Input3 Unit13	7004:0D	BOOL	External input 3: Slave unit 12
1600:3D	External Input3 Unit14	7004:0E	BOOL	External input 3: Slave unit 13
1600:3E	External Input3 Unit15	7004:0F	BOOL	External input 3: Slave unit 14
1600:3F	Non use	7004:10	BOOL	Unused
1600:40	Command Request Unit1	7005:01	BOOL	Command request sensor: Master unit
1600:41	Command Request Unit2	7005:02	BOOL	Command request sensor: Slave unit 1
1600:42	Command Request Unit3	7005:03	BOOL	Command request sensor: Slave unit 2
1600:43	Command Request Unit4	7005:04	BOOL	Command request sensor: Slave unit 3
1600:44	Command Request Unit5	7005:05	BOOL	Command request sensor: Slave unit 4
1600:45	Command Request Unit6	7005:06	BOOL	Command request sensor: Slave unit 5
1600:46	Command Request Unit7	7005:07	BOOL	Command request sensor: Slave unit 6
1600:47	Command Request Unit8	7005:08	BOOL	Command request sensor: Slave unit 7
1600:48	Command Request Unit9	7005:09	BOOL	Command request sensor: Slave unit 8
1600:49	Command Request Unit10	7005:0A	BOOL	Command request sensor: Slave unit 9
1600:4A	Command Request Unit11	7005:0B	BOOL	Command request sensor: Slave unit 10
1600:4B	Command Request Unit12	7005:0C	BOOL	Command request sensor: Slave unit 11
1600:4C	Command Request Unit13	7005:0D	BOOL	Command request sensor: Slave unit 12
1600:4D	Command Request Unit14	7005:0E	BOOL	Command request sensor: Slave unit 13
1600:4E	Command Request Unit15	7005:0F	BOOL	Command request sensor: Slave unit 14
1600:4F	Non use	7005:10	BOOL	Unused
1600:50	Command Request Code	7006:01	U16	Command request code
1600:51	Command Data Unit1	7007:01	INT32	Command data: Master unit
1600:52	Command Data Unit2	7007:02	INT32	Command data: Slave unit 1
1600:53	Command Data Unit3	7007:03	INT32	Command data: Slave unit 2
1600:54	Command Data Unit4	7007:04	INT32	Command data: Slave unit 3
1600:55	Command Data Unit5	7007:05	INT32	Command data: Slave unit 4
1600:56	Command Data Unit6	7007:06	INT32	Command data: Slave unit 5
1600:57	Command Data Unit7	7007:07	INT32	Command data: Slave unit 6
1600:58	Command Data Unit8	7007:08	INT32	Command data: Slave unit 7
1600:59	Command Data Unit9	7007:09	INT32	Command data: Slave unit 8
1600:5A	Command Data Unit10	7007:0A	INT32	Command data: Slave unit 9
1600:5B	Command Data Unit11	7007:0B	INT32	Command data: Slave unit 10
1600:5C	Command Data Unit12	7007:0C	INT32	Command data: Slave unit 11
1600:5D	Command Data Unit13	7007:0D	INT32	Command data: Slave unit 12
1600:5E	Command Data Unit14	7007:0E	INT32	Command data: Slave unit 13
1600:5F	Command Data Unit15	7007:0F	INT32	Command data: Slave unit 14
1600:60	Non use	7007:10	INT32	Unused
1600:61	System Request	2003:01	U16	System request



## 4.3 Command Transmission Procedure

### 4.3 Command Transmission Procedure

You must send commands when checking controller operating statuses or changing settings.

#### 4.3.1 Read Command

If the read command is sent, operating statuses or settings will be returned from each unit (controller).

1. Use 1600:0D to set a sensor response data switching request in the command.
2. Use 1A00:0D to check that the sensor response data switching response is a command.
3. Use 1600:40 to 1600:4E to set the unit (controller) to which the command is to be sent.
4. Set the command code to be sent in 1600:50.
5. Set the command data (parameter settings) to be sent in 1600:51 to 1600:5F.
6. Set the transmission request flag in 1600:01. (The command will be sent.)
7. Check the transmission completion flag in 1A00:01 and the error flag in 1A00:02 to see that the command has been completed successfully.
8. Check that the command response sensor in 1A00:61 to 1A00:6F and the command response code in 1A00:71 match the contents of the sent request and then read the response data in 1A00:72 to 1A00:80.
9. To send another command successively, clear the transmission request flag in 1600:01, check that the transmission completion flag in 1A00:01 has been cleared, and then repeat the procedure starting from Step 3.

RxPDO	Name	Description
1600:01	Send Command	Command request: Transmission request
1600:02	Write Flag	Command request: Write flag
1600:03	Non use	Unused
?		
1600:08	Non use	Unused
1600:09	Judge Value Mode	Sensor response data switching request: Judgment value
1600:0A	Normal Value Mode	Sensor response data switching request: Normal measured value
1600:0B	Calculation Value Mode	Sensor response data switching request: Calculated value
1600:0C	Head Value Mode	Sensor response data switching request: Sensor head value
1600:0D	Command Mode	Sensor response data switching request: Command
1600:0E	Non use	Unused
1600:0F	Error Code	Sensor response data switching request: Error code
1600:10	Non use	Unused
?		

6. After setting the command to be sent, set a transmission request.

1. Set in the command.

### 4.3 Command Transmission Procedure

RxPDO	Name	Description
1600:40	Command Request Unit1	Command request sensor: Master unit
1600:41	Command Request Unit2	Command request sensor: Slave unit 1
1600:42	Command Request Unit3	Command request sensor: Slave unit 2
1600:43	Command Request Unit4	Command request sensor: Slave unit 3
1600:44	Command Request Unit5	Command request sensor: Slave unit 4
1600:45	Command Request Unit6	Command request sensor: Slave unit 5
1600:46	Command Request Unit7	Command request sensor: Slave unit 6
1600:47	Command Request Unit8	Command request sensor: Slave unit 7
1600:48	Command Request Unit9	Command request sensor: Slave unit 8
1600:49	Command Request Unit10	Command request sensor: Slave unit 9
1600:4A	Command Request Unit11	Command request sensor: Slave unit 10
1600:4B	Command Request Unit12	Command request sensor: Slave unit 11
1600:4C	Command Request Unit13	Command request sensor: Slave unit 12
1600:4D	Command Request Unit14	Command request sensor: Slave unit 13
1600:4E	Command Request Unit15	Command request sensor: Slave unit 14
1600:4F	Non use	Unused
1600:50	Command Request Code	Command request code
1600:51	Command Data Unit1	Command data: Master unit
1600:52	Command Data Unit2	Command data: Slave unit 1
1600:53	Command Data Unit3	Command data: Slave unit 2
1600:54	Command Data Unit4	Command data: Slave unit 3
1600:55	Command Data Unit5	Command data: Slave unit 4
1600:56	Command Data Unit6	Command data: Slave unit 5
1600:57	Command Data Unit7	Command data: Slave unit 6
1600:58	Command Data Unit8	Command data: Slave unit 7
1600:59	Command Data Unit9	Command data: Slave unit 8
1600:5A	Command Data Unit10	Command data: Slave unit 9
1600:5B	Command Data Unit11	Command data: Slave unit 10
1600:5C	Command Data Unit12	Command data: Slave unit 11
1600:5D	Command Data Unit13	Command data: Slave unit 12
1600:5E	Command Data Unit14	Command data: Slave unit 13
1600:5F	Command Data Unit15	Command data: Slave unit 14

3. Select the unit (controller) to which the command is to be sent.

4. Set the command to be sent.

5. Set the command data (parameter settings) to be sent.

## 4.3 Command Transmission Procedure

TxPDO	Name	Description
1A00:01	Send Complete	Command response: Transmission complete
1A00:02	Command Err Flag	Command response: Error flag
1A00:03	Non use	Unused
?		
1A00:08	Non use	Unused
1A00:09	Judge Value Mode	Sensor response data switching response: Judgment value
1A00:0A	Normal Value Mode	Sensor response data switching response: Normal measured value
1A00:0B	Calculation Value Mode	Sensor response data switching response: Calculated value
1A00:0C	Head Value Mode	Sensor response data switching response: Sensor head value
1A00:0D	Command Mode	Sensor response data switching response: Command
1A00:0E	Non use	Unused
1A00:0F	Error Code Mode	Sensor response data switching response: Error code
1A00:10	Non use	Unused
?		
1A00:61	Response Unit1	Command response sensor: Master unit
1A00:62	Response Unit2	Command response sensor: Slave unit 1
1A00:63	Response Unit3	Command response sensor: Slave unit 2
1A00:64	Response Unit4	Command response sensor: Slave unit 3
1A00:65	Response Unit5	Command response sensor: Slave unit 4
1A00:66	Response Unit6	Command response sensor: Slave unit 5
1A00:67	Response Unit7	Command response sensor: Slave unit 6
1A00:68	Response Unit8	Command response sensor: Slave unit 7
1A00:69	Response Unit9	Command response sensor: Slave unit 8
1A00:6A	Response Unit10	Command response sensor: Slave unit 9
1A00:6B	Response Unit11	Command response sensor: Slave unit 10
1A00:6C	Response Unit12	Command response sensor: Slave unit 11
1A00:6D	Response Unit13	Command response sensor: Slave unit 12
1A00:6E	Response Unit14	Command response sensor: Slave unit 13
1A00:6F	Response Unit15	Command response sensor: Slave unit 14
1A00:70	Non use	Unused
1A00:71	Response Code	Command response code
1A00:7C	Response Data Unit11	Response data: Slave unit 10
1A00:7D	Response Data Unit12	Response data: Slave unit 11

7. Check that the command has been completed successfully.

7. If a communication error flag is set, the communication command has not been sent normally.

2. Set in the command.

8. Check that it matches the unit to which the command has been sent.

8. Check that it matches the command that has been sent.

### 4.3 Command Transmission Procedure

TxPDO	Name	Description
1A00:72	Response Data Unit1	Response data: Master unit
1A00:73	Response Data Unit2	Response data: Slave unit 1
1A00:74	Response Data Unit3	Response data: Slave unit 2
1A00:75	Response Data Unit4	Response data: Slave unit 3
1A00:76	Response Data Unit5	Response data: Slave unit 4
1A00:77	Response Data Unit6	Response data: Slave unit 5
1A00:78	Response Data Unit7	Response data: Slave unit 6
1A00:79	Response Data Unit8	Response data: Slave unit 7
1A00:7A	Response Data Unit9	Response data: Slave unit 8
1A00:7B	Response Data Unit10	Response data: Slave unit 9
1A00:7C	Response Data Unit11	Response data: Slave unit 10
1A00:7D	Response Data Unit12	Response data: Slave unit 11
1A00:7E	Response Data Unit13	Response data: Slave unit 12
1A00:7F	Response Data Unit14	Response data: Slave unit 13
1A00:80	Response Data Unit15	Response data: Slave unit 14
1A00:81	Response Data CommunicationUnit	Response data: Communication unit
1A00:82	System Status	System status
1A00:83	Unit Status Notice	Sensor status : Notification
1A00:84	Unit Status Warning	Sensor status : Caution
1A00:85	Unit Status Error	Sensor status : Fault

8. Read the data that has been sent.

## 4.3 Command Transmission Procedure

### 4.3.2 Write Command

The transmission procedure for the write command is the same as that described in “4.3.1 Read Command”.

Set the command data (parameter settings) to be sent in 1600:51 to 1600:5F and then set the write flag in 1600:02.

RxPDO	Name	Description
1600:01	Send Command	Command request: Transmission request
1600:02	Write Flag	Command request: Write flag
1600:03	Non use	Unused
}		
1600:08	Non use	Unused
1600:09	Judge Value Mode	Sensor response data switching request: Judgment value
1600:0A	Normal Value Mode	Sensor response data switching request: Normal measured value
1600:0B	Calculation Value Mode	Sensor response data switching request: Calculated value
1600:0C	Head Value Mode	Sensor response data switching request: Sensor head value
1600:0D	Command Mode	Sensor response data switching request: Command
1600:0E	Non use	Unused
1600:0F	Error Code	Sensor response data switching request: Error code
1600:10	Non use	Unused
}		
1600:10	Non use	Unused
1600:40	Command Request Unit1	Command request sensor: Master unit
1600:41	Command Request Unit2	Command request sensor: Slave unit 1
1600:42	Command Request Unit3	Command request sensor: Slave unit 2
1600:43	Command Request Unit4	Command request sensor: Slave unit 3
1600:44	Command Request Unit5	Command request sensor: Slave unit 4
1600:45	Command Request Unit6	Command request sensor: Slave unit 5
1600:46	Command Request Unit7	Command request sensor: Slave unit 6
1600:47	Command Request Unit8	Command request sensor: Slave unit 7
1600:48	Command Request Unit9	Command request sensor: Slave unit 8
1600:49	Command Request Unit10	Command request sensor: Slave unit 9
1600:4A	Command Request Unit11	Command request sensor: Slave unit 10
1600:4B	Command Request Unit12	Command request sensor: Slave unit 11
1600:4C	Command Request Unit13	Command request sensor: Slave unit 12
1600:4D	Command Request Unit14	Command request sensor: Slave unit 13
1600:4E	Command Request Unit15	Command request sensor: Slave unit 14
1600:4F	Non use	Unused
1600:50	Command Request Code	Command request code

After setting the command data (parameter settings) to be sent, set the write flag.

### 4.3 Command Transmission Procedure

---

RxPDO	Name	Description
1600:51	Command Data Unit1	Command data: Master unit
1600:52	Command Data Unit2	Command data: Slave unit 1
1600:53	Command Data Unit3	Command data: Slave unit 2
1600:54	Command Data Unit4	Command data: Slave unit 3
1600:55	Command Data Unit5	Command data: Slave unit 4
1600:56	Command Data Unit6	Command data: Slave unit 5
1600:57	Command Data Unit7	Command data: Slave unit 6
1600:58	Command Data Unit8	Command data: Slave unit 7
1600:59	Command Data Unit9	Command data: Slave unit 8
1600:5A	Command Data Unit10	Command data: Slave unit 9
1600:5B	Command Data Unit11	Command data: Slave unit 10
1600:5C	Command Data Unit12	Command data: Slave unit 11
1600:5D	Command Data Unit13	Command data: Slave unit 12
1600:5E	Command Data Unit14	Command data: Slave unit 13
1600:5F	Command Data Unit15	Command data: Slave unit 14

Set the command data (parameter settings) to be sent.

The allocation of data to be returned when the write command is issued is the same as for the read command, except that “0” is returned when write processing terminates normally. If any value other than “0” is returned, write processing has not been executed normally due to an error.

For information returned in the event of an error, refer to “**8 Troubleshooting**”.

### 4.4 Command List

#### 4.4.1 HG-S Series Command List

The following table shows the command parameters that are used to read and write controller settings and statuses and to send operation commands to controllers.  
For details, refer to the “HG-S User’s Manual”.

Attributes R: Read, W: Write, R/W: Read/Write

Command	Attribute	Name	Response/Setting parameter
0x0001	R	Status/Error	When status is normal = 0 When error occurs = Error code
0x0002 to 0x0004	-	System reserved	Do not use.
0x0005	W	Controller reset	Reset the controller. (Master unit only)
0x0006	W	Initialization (RESET)	Return the settings to the factory default state. Do not specify "0".
0x0007 to 0x000F	-	System reserved	Do not use.
0x0010	R	Judgment value (JUDGE.V)	Integer indicating minimum resolution units of controller. -1999999 to 1999999
0x0011	R	Normal measured value (NORM.V)	Integer indicating minimum resolution units of controller. -1999999 to 1999999
0x0012	R	Calculated value (CALC)	Integer indicating minimum resolution units of controller. If a calculated value is not set, the judgment value is output. -1999999 to 1999999
0x0013	R	Sensor head measured value (HEAD.V)	Integer indicating minimum resolution units of controller. -1999999 to 1999999
0x0014	R/W	LOW set value (LO.SET)	Integer indicating minimum resolution units of controller. -1999999 to 1999999
0x0015	R/W	HIGH set value (HI.SET)	Integer indicating minimum resolution units of controller. -1999999 to 1999999
0x0016 to 0x0017	-	System reserved	Do not use.
0x0018	R/W	Hysteresis (HYSTER)	Integer indicating minimum resolution units of controller. 0 to 1999999
0x0019	-	System reserved	Do not use.
0x001A	R/W	Output operation (OUTPUT)	0: N.O. 1: N.C.
0x001B	-	System reserved	Do not use.
0x001C	R	Output state	bit0: External output 1 (0 = OFF / 1 = ON) bit1: External output 2 (0 = OFF / 1 = ON) bit2: External output 3 (0 = OFF / 1 = ON) The high bit is "0".
0x001D	R	Input state	bit0: External input 1 (0 = OFF / 1 = ON) bit1: External input 2 (0 = OFF / 1 = ON) bit2: External input 3 (0 = OFF / 1 = ON) The high bit is "0".
0x001E	W	Execute bank load (LOAD)	Bank numbers 1 to 3 are loaded
0x001F	W	Execute bank save (SAVE)	Bank numbers 1 to 3 are saved
0x0020	R/W	Key lock (LOCK)	0: Key lock OFF 1: Key lock ON
0x0021	R/W	Eco mode (ECO)	0: Eco mode OFF 1: Eco mode ON
0x0022	R	Maximum value during P-P measurement	Integer indicating minimum resolution units of controller. If the measurement mode is not P-P or P-P/2, a judgment value is output. -1999999 to 1999999

## 4.4 Command List

Command	Attribute	Name	Response/Setting parameter
0x0023	R	Minimum value during P-P measurement	Integer indicating minimum resolution units of controller. If the measurement mode is not P-P or P-P/2, a judgment value is output. -1999999 to 1999999
0x0024 to 0x003F	-	System reserved	Do not use.
0x0040	R/W	Preset (PRESET)	0: OFF 1: ON
0x0041	R/W	Preset value (PR. VAL)	Integer indicating minimum resolution units of controller. -1999999 to 1999999
0x0042	R/W	Preset data selection (PR.OBJ)	0: Normal measured value (NORM.V) 1: Judgment value (JUDGE.V)
0x0043	R/W	Preset save (PR.SAVE)	0: OFF 1: ON
0x0044	R/W	Label 1 (LABEL)	Label [1st to 4th character] Part of character code is usable. (Note 1)
0x0045	R/W	Label 2 (LABEL)	Label [5th to 6th character] Part of character code is usable. (Note 1)
0x0046	R/W	Response time (SPEED)	0: 3ms 1: 5ms 2: 10ms 3: 100ms 4: 500ms 5: 1000ms
0x0047	R/W	Measurement direction (DIRECT)	0: Normal display 1: Reverse display
0x0048	R/W	Alarm delay count (DELAY)	Delay count: 1 to 1000
0x0049	R/W	Teaching type (TEACH)	0: 1-point teaching 1: 2-point teaching 2: 3-point teaching
0x004A	R/W	Input all (ALL IN)	0: Individual input 1: Simultaneous input
0x004B	R/W	External input (EXT.IN)	0: Preset / Reset / Trigger (P/R/T) 1: Bank A / Bank B / Preset (BANK/P) 2: Bank A / Bank B / Reset (BANK/R) 3: Bank A / Bank B / Trigger (BANK/T)
0x004C	R/W	External output (EXT.OUT)	0: 3-value (3VAL) 1: 2-value (2VAL) 2: Logic (LOGIC) 3: Logic 2 (LOGIC2)
0x004D	R/W	Analog scaling (ANALOG)	0: Default 1: Free
0x004E	R/W	Scaling upper limit value (ANA.HI)	Integer indicating minimum resolution units of controller. -1999999 to 1999999
0x004F	R/W	Scaling lower limit value (ANA.LO)	Integer indicating minimum resolution units of controller. -1999999 to 1999999
0x0050	R/W	Number of digits displayed (DIGIT)	0: 0.0001 1: 0.001 2: 0.01 3: 0.1
0x0051	R/W	Calibration selection (CAL.SEL)	0: Default 1: User setting
0x0052	W	1st point calibration execution (CL.SET1)	Acquire the first point measurement value. Specify "0".
0x0053	R/W	2nd point calibration target value (AJ.VAL2)	Integer indicating minimum resolution units of controller. -1999999 to 1999999

HG-S series



## 4.4 Command List

Command	Attribute	Name	Response/Setting parameter
0x0054	W	2nd point calibration execution (CL.SET2)	Acquire the 2nd point measurement value. Specify "0".
0x0055	R/W	1-point teaching tolerance setting (TOL<±>)	Integer indicating minimum resolution units of controller. -1999999 to 1999999
0x0056	W	1st point teaching execution (SET.1)	Execute 1st point of teaching. Specify "0".
0x0057	W	2nd point teaching execution (SET.2)	Execute 2nd point of teaching. Specify "0".
0x0058	W	3rd point teaching execution (SET.3)	Execute 3rd point of teaching. Specify "0".
0x0059 to 0x005D	-	SOther model command area	Do not use.
0x005E to 0x009F	-	System reserved	Do not use.
0x00A0	R	Fault	bit0 : Controller memory function damaged bit1 : Sensor head memory function damaged bit2 : Output section short-circuit error bit3 : Detection circuit damaged bit4 : System error
0x00A1	-	System reserved	Do not use.
0x00A2	R	Notification	bit0 : Sensor head unconnected bit2 : Connected unit count check error bit3 : NPN / PNP output type mixture error bit4 : Calculated unit count error bit5 : Copy executionerror ( Slave unit problem) bit10 : Out-of-specification pressure error bit11 : Catch check bit12 : Pressure check
0x00A3 to 0x00FF	-	System reserved	Do not use.
0x0100	R/W	Leverage ratio (LEVER)	Leverage ratio ×10 1 to 1000
0x0101	R/W	Pressure check (PRS.CHK)	0: OFF 1: ON
0x0102	R/W	Set value for pressure check (PRS.SET)	Integer indicating minimum resolution units of controller. -1999999 to 1999999
0x0103	R/W	Stuckness check (CAT.CHK)	0: OFF 1: ON
0x0104	R/W	Hold setting (HOLD)	Set the sum of the values below according to the states of the measurement mode, trigger mode, self trigger edge direction, and self trigger delay settings. • Measurement mode (MEAS) 0x0000 = Sample hold 0x1000 = Peak hold 0x2000 = Bottom hold 0x3000 = Peak to peak hold 0x4000 = Peak to peak hold P-P/2 0x5000 = NG hold 0x6000 = Self sample hold 0x7000 = Self peak hold 0x8000 = Self bottom hold • Trigger mode (TRIG) 0x000 = One-shot 0x100 = Hold • Self trigger edge direction (SLF.EDG) 0x00 = Rising 0x10 = Falling • Self trigger delay (SLF.DLY) 0x0 = Static width 0x1 = Delay timer

## 4.4 Command List

	Command	Attribute	Name	Response/Setting parameter
HG-S series	0x0105	R/W	Self trigger level (SLF.LV)	Integer indicating minimum resolution units of controller. -1999999 to 1999999
	0x0106	R/W	Static width (DLY.WD)	Integer indicating minimum resolution units of controller. -1999999 to 1999999
	0x0107	R/W	Self trigger delay timer (DLY.TIM)	Delay time: 0 to 9999ms
	0x0108	R/W	Calculation mode (MODE) / Calculation application selection (APPLI)	0: No calculation 1: Maximum value (MAX) 2: Minimum value (MIN) 3: Flatness (FLAT) 4: Average value (AVERAG) 5: Standard difference (STAND) 6: Torsion (TORSIN) 7: Curvature (CURVEA) 8: Thickness/Width (THICK)
	0x0109	R/W	Copy select individual (CPY.SEL)	0: Not target / 1: Target For each target, set 0 or 1 for the bit. bit0 : Response time bit1 : Leverage ratio bit2 : Preset save bit3 : Preset data bit4 : Preset value bit5 : Hysteresis bit6 : LOW set value bit7 : HIGH set value bit8 : Measurement direction bit9 : Teaching type bit10 : Number of digits displayed bit11 : Eco mode bit12 : External output bit13 : External input bit14 : Hold setting bit15 : Output operation bit22 : Alarm setting bit23 : Tolerance <±>
	0x010A	W	Copy execution (CPY.EXE)	Execute copying. Specify "0".
	0x010B	R/W	Copy lock (LOCK)	0: Copy lock OFF 1: Copy lock ON
	0x010C	R/W	Bank save selection (BNK.DAT)	0: All 1: HIGH set value, LOW set value 2: HIGH set value, LOW set value, preset value
	0x010D	R/W	Display switching mode	0: Normal measured value 1: Calculated value (during calculation) 2: Label 3: LOW set value 4: HIGH set value 5: Sensor head measured value
	0x010E	R	Total stroke operation log (SUM.REC)	Units of 1 m
	0x010F	R	Maximum peak value (MAX.VAL)	Integer indicating minimum resolution units of controller. -1999999 to 1999999
	0x0110	R	Maximum peak value operation log (MAX.REC)	Units of 1 m
	0x0111	R	Overstroke log (OVR.NUM)	Number of times
0x0112	R/W	Connected unit count check (CON.CHK) (Note 2)	0: OFF 1: ON	

# 4.4 Command List

Notes: 1) Usable ASCII character codes (0x20 is a "space")

		1st digit															
		F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
2nd digit	0																
	1																
	2	/		-		+	*										
	3		>		<			9	8	7	6	5	4	3	2	1	0
	4	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A	
	5				\		Z	Y	X	W	V	U	T	S	R	Q	P
	6																
	7																

2) This function can be used on **HG-SC** series controllers manufactured in February 2019 and later.

## 4.4 Command List

### 4.4.2 HG-T Series Command List

The following table shows the command parameters that are used to read and write controller settings and statuses and to send operation commands to controllers.  
For details, refer to the “HG-T User’s Manual”.

Attributes R: Read, W: Write, R/W: Read/Write

Command	Attribute	Name	Response/Setting parameter
0x0001	R	Status/Error	When status is normal = 0 When error occurs = Error code
0x0002 to 0x0004	-	System reserved	Do not use.
0x0005	W	Controller reset	Reset the controller. (Master unit only)
0x0006	W	Initialization (RESET)	Return the settings to the factory default state. Do not specify "0".
0x0007 to 0x000F	-	System reserved	Do not use.
0x0010	R	Judgment value (JUDGE.V)	Integer indicating minimum resolution units of controller. -1999999 to 1999999
0x0011	R	Normal measured value (NORM.V)	Integer indicating minimum resolution units of controller. -1999999 to 1999999
0x0012	R	Calculated value (CALC)	Integer indicating minimum resolution units of controller. If a calculated value is not set, the judgment value is output. -1999999 to 1999999
0x0013	R	Sensor head measured value (HEAD.V)	Integer indicating minimum resolution units of controller. -1999999 to 1999999
0x0014	R/W	LOW set value (LO.SET)	Integer indicating minimum resolution units of controller. -1999999 to 1999999
0x0015	R/W	HIGH set value (HI.SET)	Integer indicating minimum resolution units of controller. -1999999 to 1999999
0x0016 to 0x0017	-	System reserved	Do not use.
0x0018	R/W	Hysteresis (HYSTER)	Integer indicating minimum resolution units of controller. 0 to 1999999
0x0019	-	System reserved	Do not use.
0x001A	R/W	Output operation (OUTPUT)	0: N.O. 1: N.C.
0x001B	-	System reserved	Do not use.
0x001C	R	Output state	bit0: External output 1 (0 = OFF / 1 = ON) bit1: External output 2 (0 = OFF / 1 = ON) bit2: External output 3 (0 = OFF / 1 = ON) The high bit is "0".
0x001D	R	Input state	bit0: External input 1 (0 = OFF / 1 = ON) bit1: External input 2 (0 = OFF / 1 = ON) bit2: External input 3 (0 = OFF / 1 = ON) The high bit is "0".
0x001E	W	Execute bank load (LOAD)	Bank numbers 1 to 3 are loaded
0x001F	W	Execute bank save (SAVE)	Bank numbers 1 to 3 are saved
0x0020	R/W	Key lock (LOCK)	0: Key lock OFF 1: Key lock ON
0x0021	R/W	Eco mode (ECO)	0: Eco mode OFF 1: Eco mode ON

## 4.4 Command List

	Command	Attribute	Name	Response/Setting parameter
HG-T series	0x0022	R	Maximum value during P-P measurement	Integer indicating minimum resolution units of controller. If the measurement mode is not P-P, a judgment value is output. -1999999 to 1999999
	0x0023	R	Minimum value during P-P measurement	Integer indicating minimum resolution units of controller. If the measurement mode is not P-P, a judgment value is output. -1999999 to 1999999
	0x0024 to 0x003F	-	System reserved	Do not use.
	0x0040	R/W	Preset (PRESET)	0: OFF 1: ON
	0x0041	R/W	Preset value (PR. VAL)	Integer indicating minimum resolution units of controller. -1999999 to 1999999
	0x0042	R/W	Preset data selection (PR.OBJ)	0: Normal measured value (NORM.V) 1: Judgment value (JUDGE.V)
	0x0043	R/W	Preset save (PR.SAVE)	0: OFF 1: ON
	0x0044	R/W	Label 1 (LABEL)	Label [1st to 4th character] Part of character code is usable. (Note 1)
	0x0045	R/W	Label 2 (LABEL)	Label [5th to 6th character] Part of character code is usable. (Note 1)
	0x0046	R/W	Average count (SPEED)	0: 1 time 1: 2 times 2: 4 times 3: 8 times 4: 16 times 5: 32 times 6: 64 times 7: 128 times 8: 256 times 9: 512 times 10: 1024 times
	0x0047	R/W	Measurement direction (DIRECT)	0: TOP 1: BOTTOM
	0x0048	R/W	Alarm delay count (DELAY)	Delay count: 1 to 1000
	0x0049	R/W	Teaching type (TEACH)	0: 1-point teaching 1: 2-point teaching 2: 3-point teaching
	0x004A	R/W	Input all (ALL IN)	0: Individual input 1: Simultaneous input
	0x004B	R/W	External input (EXT.IN)	0: Preset / Reset / Trigger (P/R/T) 1: Bank A / Bank B / Preset (BANK/P) 2: Bank A / Bank B / Reset (BANK/R) 3: Bank A / Bank B / Trigger (BANK/T) 4: Preset / Trigger / Laser emission stop (P/T/L)
	0x004C	R/W	External output (EXT.OUT)	0: 3-value (3VAL) 1: 2-value (2VAL) 2: Logic (LOGIC) 3: Logic 2 (LOGIC2) 4: Hold (HOLD)
	0x004D	R/W	Analog scaling (ANALOG)	0: Default 1: Free
0x004E	R/W	Scaling upper limit value (ANA.HI)	Integer indicating minimum resolution units of controller. -1999999 to 1999999	

## 4.4 Command List

Command	Attribute	Name	Response/Setting parameter
0x004F	R/W	Scaling lower limit value (ANA.LO)	Integer indicating minimum resolution units of controller. -1999999 to 1999999
0x0050	R/W	Number of digits displayed (DIGIT)	1: 0.001 2: 0.01 3: 0.1
0x0051	R/W	Calibration selection (CAL.SEL)	0: Default 1: User setting 2: Calibration start
0x0052	W	1st point calibration execution (CL.SET1)	Acquire the first point measurement value. Specify "0".
0x0053	R/W	2nd point calibration target value (AJ.VAL2)	Integer indicating minimum resolution units of controller. -1999999 to 1999999
0x0054	W	2nd point calibration execution (CL.SET2)	Acquire the 2nd point measurement value. Specify "0".
0x0055	R/W	1-point teaching tolerance setting (TOL<±>)	Integer indicating minimum resolution units of controller. -1999999 to 1999999
0x0056	W	1st point teaching execution (SET.1)	Execute 1st point of teaching. Specify "0".
0x0057	W	2nd point teaching execution (SET.2)	Execute 2nd point of teaching. Specify "0".
0x0058	W	3rd point teaching execution (SET.3)	Execute 3rd point of teaching. Specify "0".
0x0059	R/W	Sampling cycle (SAMPLI)	0: Standard sampling (NORMAL) 1: High-speed sampling (HI-SPD)
0x005A	R/W	Analog output selection (A/O.SEL)	0: Voltage output 1: Current output
0x005B	R/W	External output delay timer selection (OUT.DLY)	0: OFF 1: On delay 2: Off delay 3: Single shot delay
0x005C	R/W	External output delay timer time (OD.TIME)	1 to 9999ms
0x005D	R/W	1st point calibration target value (AJ.VAL1)	Integer indicating minimum resolution units of controller -1999999 to 1999999
0x005E to 0x009F	-	System reserved	Do not use.
0x00A0	R	Fault	bit0 : Controller memory function damaged bit1 : Sensor head memory function damaged bit2 : Output section short-circuit error bit3 : Detection circuit damaged bit4 : System error
0x00A1	R	Caution	bit0 : Controller cumulative run time limit exceeded bit1 : Sensor head cumulative run time limit exceeded bit2 : Controller memory saving count limit exceeded bit3 : Sensor head memory saving count limit exceeded
0x00A2	R	Notification	bit0 : Sensor head unconnected bit1 : Connected sensor head incompatible bit2 : Connected unit count check error bit3 : NPN / PNP output type mixture error bit4 : Calculated unlit count error bit5 : Copy execution error (Slave unit problem) bit16 : Detection capability limit (obtained edge information) bit17 : Ambient light bit18 : Stain check bit20 : Reverse insertion check

HG-T Series

## 4.4 Command List

Command	Attribute	Name	Response/Setting parameter
0x00A3 to 0x00FF	-	System reserved	Do not use.
0x0100 to 0x0112	-	Other model command area	Do not use.
0x0113 to 0x02FF	-	System reserved	Do not use.
0x0300	R/W	Operation mode (OP.MODE)	0: Auto edge detection mode 1: Edge detection mode 2: External form/width detection mode 3: Inside diameter/gap detection mode 5: Center position detection mode 8: User assigned edge detection mode
0x0301	-	System reserved	Do not use.
0x0302	R/W	edge1 (EDGE1)	0: TOP 1~10: 1st to 10th counting from TOP 255: BOTTOM
0x0303	R/W	edgw2 (EDGE2)	0: TOP 1~10: 1st to 10th counting from TOP 255: BOTTOM
0x0304	R/W	Sensitivity setting (SEN.ADJ)	0: DEFAULT 1: USER
0x0305	R/W	Judgment level (JDG.LVL)	10 to 90
0x0306	R/W	Judgment filter (JDG.FIL)	3 to 50
0x0307	R/W	Reference waveform save (BW.SAVE)	0: OFF 1: ON
0x0308	R/W	Interference prevention function (INTF.PR)	0: OFF 1: ON
0x0309	R/W	Alarm state selection (ALM.CND)	0: HOLD (hold previous value) 1: ALARM (alarm output)
0x030A to 0x030B	-	System reserved	Do not use.
0x030C	R/W	Stain check (STA.CHK)	0: Stain check OFF (OFF) 1: Low sensitivity setting ON (LOW) 2: High sensitivity setting ON (HIGH) 3: User setting ON (USER)
0x030D	R/W	Stain threshold (STA.THR)	50 to 95
0x030E	R/W	Hold setting (HOLD)	Set the sum of the values below according to the states of the measurement mode and trigger mode settings. • Measurement mode (MEAS) 0x0000 = Sample hold 0x1000 = Peak hold 0x2000 = Bottom hold 0x3000 = Peak to peak hold 0x4000 = Peak to peak hold P-P/2 0x5000 = NG hold 0x0900 = Tab Cancellation • Trigger mode (TRIG) 0x000 = One-shot 0x100 = Hold
0x030F to 0x0311	-	System reserved	Do not use.
0x0312	R/W	Tab threshold (TB.THRS)	1000~200000
0x0313	R/W	Tab counts (TB.CNT)	5~23
0x0314 to 0x0315	-	System reserved	Do not use.
0x0316	R/W	Calculation mode (MODE) / Calculation application selection (APPLI)	0: No calculation 1: Maximum value (MAX) 2: Minimum value (MIN) 4: Average value (AVERAG) 5: Standard difference (STAND) 8: Thickness/Width (THICK)

## 4.4 Command List

Command	Attribute	Name	Response/Setting parameter	
HG-T Series	0x0317	R/W	Copy select individual (CPY.SEL)	0 = Not target / 1 = Target For each target, set the bit to 0 or 1. Bit 0: Operation mode selection Bit 1: Measurement direction Bit 2: HIGH set value Bit 3: LOW set value Bit 4: Hysteresis Bit 5: Teaching type Bit 6: Tolerance setting Bit 7: Preset value Bit 8: Preset data selection Bit 9: Preset save Bit 10: Reference waveform save Bit 11: Average count Bit 12: Output pattern Bit 13: Analog output selection Bit 14: Hold setting Bit 15: External input Bit 16: External output Bit 17: External output delay timer selection Bit 18: Number of digits displayed Bit 19: Eco mode Bit 20: Alarm Bit 21: Key lock setting selection Bit 22: Reverse of measured value
	0x0318	-	System reserved	Do not use.
	0x0319	W	Copy execution (CPY.EXE)	Execute copying. Specify "0".
	0x031A	R/W	Copy lock (LOCK)	0: Copy lock OFF 1: Copy lock ON
	0x031B	R/W	Bank save selection (BNK.DAT)	0: All 1: HIGH set value, LOW set value 2: HIGH set value, LOW set value, preset value
	0x031C	R/W	Display switching mode	0: Normal measured value 1: Calculated value (during calculation) 2: Label 3: LOW set value 4: HIGH set value 5: Sensor head measured value 6: Work insertion direction (Note 2)
	0x031D	R	Controller cumulative run time (RUN.TIM)	Units of 1 hour
	0x031E	R	Sensor head cumulative run time (HD.TIME)	Units of 1 hour
	0x031F to 0x0322	-	System reserved	Do not use.
	0x0323	R/W	Connected unit count check (CON.CHK)	0: OFF 1: ON
	0x0324	R/W	Key lock (KEYLOC)	0: MANUAL 1: AUTO
	0x0325	R/W	Reverse insertion check (DIR.CHK)	0: OFF 1: ON



## 4.4 Command List

Command	Attribute	Name	Response/Setting parameter																																					
HG-T Series	0x0326	R	Work insertion direction state (Note 2)	<ul style="list-style-type: none"> <li>• Auto edge detection mode</li> <li>0: TOP</li> <li>1: BOTTOM</li> <li>2: Indeterminate</li> <li>• Edge detection mode, center position detection mode</li> <li>0: TOP</li> <li>1: BOTTOM</li> <li>2: Indeterminate</li> <li>• External form / width detection mode, inside diameter / gap detection mode, User assigned edge detection mode</li> <li>2: Indeterminate</li> </ul>																																				
	0x0327 to 0x035F	-	System reserved	Do not use.																																				
	0x0360	W	Beam axis adjustment mode start	Start beam axis adjustment. Specify "0". Always send during measurement.																																				
	0x0361	R	Beam axis adjustment status	bit0 to bit12: Reserved																																				
				<table border="1"> <thead> <tr> <th>bit15</th> <th>bit14</th> <th>bit13</th> <th>Beam axis state</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> <td>Immediately after beam axis adjustment starts</td> </tr> <tr> <td>0</td> <td>0</td> <td>1</td> <td>Beam axis aligned state</td> </tr> <tr> <td>0</td> <td>1</td> <td>0</td> <td>Receiver has shifted toward TOP side (emitter has shifted toward BOTTOM side)</td> </tr> <tr> <td>0</td> <td>1</td> <td>1</td> <td>Receiver has shifted toward BOTTOM side (emitter has shifted toward TOP side)</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> <td>Beam axis is completely out of position (fully blocked state)</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> <td>The light intensity is too much</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> <td>The light intensity is too little</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>Objects intercepting light or stains (adhering substances) exist inside measurement area</td> </tr> </tbody> </table>	bit15	bit14	bit13	Beam axis state	0	0	0	Immediately after beam axis adjustment starts	0	0	1	Beam axis aligned state	0	1	0	Receiver has shifted toward TOP side (emitter has shifted toward BOTTOM side)	0	1	1	Receiver has shifted toward BOTTOM side (emitter has shifted toward TOP side)	1	0	0	Beam axis is completely out of position (fully blocked state)	1	0	1	The light intensity is too much	1	1	0	The light intensity is too little	1	1	1	Objects intercepting light or stains (adhering substances) exist inside measurement area
				bit15	bit14	bit13	Beam axis state																																	
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1	1	0	The light intensity is too little																																					
1	1	1	Objects intercepting light or stains (adhering substances) exist inside measurement area																																					
0x0362	W	Reference waveform registration execution	Execute reference waveform registration. Specify "0". Always send with beam axis in aligned state																																					
0x0363	R	Reference waveform registration status	0: Registration completed 1: Registration failed 2: Registering																																					
0x0364	W	Beam axis adjustment end	End beam axis adjustment. Specify "0".																																					
0x0365 to 0x036F	-	System reserved	Do not use.																																					

## 4.4 Command List

	Command	Attribute	Name	Response/Setting parameter
HG-T Series	0x0370	R	Waveform read setting (Note 3)	bit0 to bit7 : Select a waveform type. 0x00 : Reference waveform 0x10 : Waveform during beam axis adjustment 0x11 : Measured waveform bit8 : Reserved bit9 : Status 0: Waveform information has not been saved (For example, immediately after the unit starts up, operation mode is changed, or measured values are reset) 1: Waveform information has been saved bit10 to bit15: Reserved
		W		bit0 to bit7 : Select a waveform type. 0x00 : Reference waveform 0x10 : Received light waveform during beam axis adjustment 0x11 : Measured waveform bit8 to bit15 : Reserved Always set "0x01".
	0x0371	R	Waveform read data 1	Obtains four bytes of received light waveform data ("Received light intensity 0" to "Received light intensity 3")
	0x0372	R	Waveform read data 2	Obtains four bytes of received light waveform data ("Received light intensity 4" to "Received light intensity 7")
	0x0373	R	Waveform read data 3	Obtains four bytes of received light waveform data ("Received light intensity 8" to "Received light intensity 11")
	0x0374	R	Waveform read data 4	Obtains four bytes of received light waveform data ("Received light intensity 12" to "Received light intensity 15")
	0x0375	R	Waveform read data 5	Obtains four bytes of received light waveform data ("Received light intensity 16" to "Received light intensity 19")
	0x0376	R	Waveform read data 6	Obtains four bytes of received light waveform data ("Received light intensity 20" to "Received light intensity 23")
	0x0377	R	Waveform read data 7	Obtains four bytes of received light waveform data ("Received light intensity 24" to "Received light intensity 27")
	0x0378	R	Waveform read data 8	Obtains four bytes of received light waveform data ("Received light intensity 28" to "Received light intensity 31")
	0x0379	R	Waveform read data 9	Obtains four bytes of received light waveform data ("Received light intensity 32" to "Received light intensity 35")
	0x037A	R	Waveform read data 10	Obtains four bytes of received light waveform data ("Received light intensity 36" to "Received light intensity 39")
	0x037B	R	Waveform read data 11	Obtains four bytes of received light waveform data ("Received light intensity 40" to "Received light intensity 43")

## 4.4 Command List

	Command	Attribute	Name	Response/Setting parameter
HG-T Series	0x037C	R	Waveform read data 12	Obtains four bytes of received light waveform data ("Received light intensity 44" to "Received light intensity 47")
	0x037D	R	Waveform read data 13	Obtains four bytes of received light waveform data ("Received light intensity 48" to "Received light intensity 51")
	0x037E	R	Waveform read data 14	Obtains four bytes of received light waveform data ("Received light intensity 52" to "Received light intensity 55")
	0x037F	R	Waveform read data 15	Obtains four bytes of received light waveform data ("Received light intensity 56" to "Received light intensity 59")
	0x0380	R	Waveform read data 16	Obtains four bytes of received light waveform data ("Received light intensity 60" to "Received light intensity 63")
	0x0381	R	Waveform read data 17	Obtains four bytes of received light waveform data ("Received light intensity 64" to "Received light intensity 67")
	0x0382	R	Waveform read data 18	Obtains four bytes of received light waveform data ("Received light intensity 68" to "Received light intensity 71")
	0x0383	R	Waveform read data 19	Obtains four bytes of received light waveform data ("Received light intensity 72" to "Received light intensity 75")
	0x0384	R	Waveform read data 20	Obtains four bytes of received light waveform data ("Received light intensity 76" to "Received light intensity 79")
	0x0385	R	Waveform read data 21	Obtains four bytes of received light waveform data ("Received light intensity 80" to "Received light intensity 83")
	0x0386	R	Waveform read data 22	Obtains four bytes of received light waveform data ("Received light intensity 84" to "Received light intensity 87")
	0x0387	R	Waveform read data 23	Obtains four bytes of received light waveform data ("Received light intensity 88" to "Received light intensity 91")
	0x0388	R	Waveform read data 24	Obtains four bytes of received light waveform data ("Received light intensity 92" to "Received light intensity 95")
	0x0389	R	Waveform read data 25	Obtains four bytes of received light waveform data ("Received light intensity 96" to "Received light intensity 99")
	0x038A	R	Waveform read data 26	Obtains four bytes of received light waveform data ("Received light intensity 100" to "Received light intensity 103")
	0x038B	R	Waveform read data 27	Obtains four bytes of received light waveform data ("Received light intensity 104" to "Received light intensity 107")
	0x038C	R	Waveform read data 28	Obtains four bytes of received light waveform data ("Received light intensity 108" to "Received light intensity 111")
0x038D	R	Waveform read data 29	Obtains four bytes of received light waveform data ("Received light intensity 112" to "Received light intensity 115")	
0x038E	R	Waveform read data 30	Obtains four bytes of received light waveform data ("Received light intensity 116" to "Received light intensity 119")	

## 4.4 Command List

	Command	Attribute	Name	Response/Setting parameter
HG-T Series	0x038F	R	Waveform read data 31	Obtains four bytes of received light waveform data ("Received light intensity 120" to "Received light intensity 123")
	0x0390	R	Waveform read data 32	Obtains four bytes of received light waveform data ("Received light intensity 124" to "Received light intensity 127")
	0x0391	R	Waveform read data 33	Obtains four bytes of received light waveform data ("Received light intensity 128" to "Received light intensity 131")
	0x0392	R	Waveform read data 34	Obtains four bytes of received light waveform data ("Received light intensity 132" to "Received light intensity 135")
	0x0393	R	Waveform read data 35	Obtains four bytes of received light waveform data ("Received light intensity 136" to "Received light intensity 139")
	0x0394	R	Waveform read data 36	Obtains four bytes of received light waveform data ("Received light intensity 140" to "Received light intensity 143")
	0x0395	R	Waveform read data 37	Obtains four bytes of received light waveform data ("Received light intensity 144" to "Received light intensity 147")
	0x0396	R	Waveform read data 38	Obtains four bytes of received light waveform data ("Received light intensity 148" to "Received light intensity 151")
	0x0397	R	Waveform read data 39	Obtains four bytes of received light waveform data ("Received light intensity 152" to "Received light intensity 155")
	0x0398	R	Waveform read data 40	Obtains four bytes of received light waveform data ("Received light intensity 156" to "Received light intensity 159")
	0x0399	R	Waveform read data 41	Obtains four bytes of received light waveform data ("Received light intensity 160" to "Received light intensity 163")
	0x039A	R	Waveform read data 42	Obtains four bytes of received light waveform data ("Received light intensity 164" to "Received light intensity 167")
	0x039B	R	Waveform read data 43	Obtains four bytes of received light waveform data ("Received light intensity 168" to "Received light intensity 171")
	0x039C	R	Waveform read data 44	Obtains four bytes of received light waveform data ("Received light intensity 172" to "Received light intensity 175")
	0x039D	R	Waveform read data 45	Obtains four bytes of received light waveform data ("Received light intensity 176" to "Received light intensity 179")
	0x039E	R	Waveform read data 46	Obtains four bytes of received light waveform data ("Received light intensity 180" to "Received light intensity 183")
	0x039F	R	Waveform read data 47	Obtains four bytes of received light waveform data ("Received light intensity 184" to "Received light intensity 187")
	0x03A0	R	Waveform read data 48	Obtains four bytes of received light waveform data ("Received light intensity 188" to "Received light intensity 191")
0x03A1	R	Waveform read data 49	Obtains four bytes of received light waveform data ("Received light intensity 192" to "Received light intensity 195")	

## 4.4 Command List

	Command	Attribute	Name	Response/Setting parameter
HG-T Series	0x03A2	R	Waveform read data 50	Obtains four bytes of received light waveform data ("Received light intensity 196" to "Received light intensity 199")
	0x03A3	R	Waveform read data 51	Obtains four bytes of received light waveform data ("Received light intensity 200" to "Received light intensity 203")
	0x03A4	R	Waveform read data 52	Obtains four bytes of received light waveform data ("Received light intensity 204" to "Received light intensity 207")
	0x03A5	R	Waveform read data 53	Obtains four bytes of received light waveform data ("Received light intensity 208" to "Received light intensity 211")
	0x03A6	R	Waveform read data 54	Obtains four bytes of received light waveform data ("Received light intensity 212" to "Received light intensity 215")
	0x03A7	R	Waveform read data 55	Obtains four bytes of received light waveform data ("Received light intensity 216" to "Received light intensity 219")
	0x03A8	R	Waveform read data 56	Obtains four bytes of received light waveform data ("Received light intensity 220" to "Received light intensity 223")
	0x03A9	R	Waveform read data 57	Obtains four bytes of received light waveform data ("Received light intensity 224" to "Received light intensity 227")
	0x03AA	R	Waveform read data 58	Obtains four bytes of received light waveform data ("Received light intensity 228" to "Received light intensity 231")
	0x03AB	R	Waveform read data 59	Obtains four bytes of received light waveform data ("Received light intensity 232" to "Received light intensity 235")
	0x03AC	R	Waveform read data 60	Obtains four bytes of received light waveform data ("Received light intensity 236" to "Received light intensity 239")
	0x03AD	R	Waveform read data 61	Obtains four bytes of received light waveform data ("Received light intensity 240" to "Received light intensity 243")
	0x03AE	R	Waveform read data 62	Obtains four bytes of received light waveform data ("Received light intensity 244" to "Received light intensity 247")
	0x03AF	R	Waveform read data 63	Obtains four bytes of received light waveform data ("Received light intensity 248" to "Received light intensity 251")
	0x03B0	R	Waveform read data 64	Obtains four bytes of received light waveform data ("Received light intensity 252" to "Received light intensity 255")
	0x03B1	R	Edge information at the time of waveform reading	The information to be read differs according to the waveform type selected in "Waveform read setting". See below. <ul style="list-style-type: none"> <li>• When "Reference waveform" (0x00) is selected → "4.5.3 Reading Reference Waveforms"</li> <li>• When "Waveform during beam axis adjustment" (0x10) is selected → "4.6 Registering Reference Waveforms"</li> <li>• When "Measured waveform" (0x11) is selected → "4.5.2 Reading Measured Waveforms"</li> </ul>
	0x03B2	R	Measured value at the time of waveform reading (HEAD.V)	Integer indicating minimum resolution units of controller. -1999999 to 1999999

## 4.4 Command List

Command	Attribute	Name	Response/Setting parameter												
0x03B3	R	Edge position at the time of waveform reading	<ul style="list-style-type: none"> <li>Edge position 0 bit8 to bit15: 0x00 to 0xFF</li> <li>Edge position 1 bit0 to bit7: 0x00 to 0xFF</li> </ul>												
0x03B4 to 0x03BB	-	System reserved	Do not use.												
0x03BC	R	Edge data read setting	bit0 to bit8 : Reserved bit9 : Status 0: Edge data has not been read (For example, immediately after the unit starts up, operation mode is changed, or measured values are reset) 1: Edge data has been read bit10 to bit15: Reserved												
	W		bit0 to bit7 : Reserved Always write "0x00". bit8 to bit15 : Reserved Always write "0x01".												
0x03BD	R	Edge information at the time of edge data reading	bit0 to bit12: Reserved bits 13 and 14: Edge information 2												
			<table border="1"> <thead> <tr> <th>bit14</th> <th>bit13</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>Both edges disabled (When the beam axis state is "indeterminate", "fully blocked state", or "measurement alarm 1")</td> </tr> <tr> <td>0</td> <td>1</td> <td>Only one edge enabled</td> </tr> <tr> <td>1</td> <td>0</td> <td>Both edges enabled</td> </tr> </tbody> </table>	bit14	bit13	Description	0	0	Both edges disabled (When the beam axis state is "indeterminate", "fully blocked state", or "measurement alarm 1")	0	1	Only one edge enabled	1	0	Both edges enabled
			bit14	bit13	Description										
			0	0	Both edges disabled (When the beam axis state is "indeterminate", "fully blocked state", or "measurement alarm 1")										
			0	1	Only one edge enabled										
1	0	Both edges enabled													
bit 15: Edge information 1															
<table border="1"> <thead> <tr> <th>bit15</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Falling edge</td> </tr> <tr> <td>1</td> <td>Rising edge</td> </tr> </tbody> </table>	bit15	Description	0	Falling edge	1	Rising edge									
bit15	Description														
0	Falling edge														
1	Rising edge														
0x03BE	R	Measured value at the time of edge data reading (HEAD.V)	Integer indicating minimum resolution units of controller. -1999999 to 1999999												
0x03BF	R	Edge position at the time of edge data reading	<ul style="list-style-type: none"> <li>Edge position 0 bit8 to bit15: 0x00 to 0xFF</li> <li>Edge position 1 bit0 to bit7: 0x00 to 0xFF</li> </ul>												
0x03EF	R/W	Reverse of measured value (REVERS)	Enabled/Disabled the reverse of measured value function. 0 : Reverse of measured value disabled 1 : Reverse of measured value enabled												

Notes: 1) Usable ASCII character codes (0x20 is a "space")

		1st digit															
		F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
2nd digit	0																
	1																
	2	/	-		+	*											
	3	>		<			9	8	7	6	5	4	3	2	1	0	
	4	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A	
	5				\		Z	Y	X	W	V	U	T	S	R	Q	P
	6																
7																	

- 2) In auto edge detection mode, the work insertion direction state is output.  
 In edge detection mode or center position detection mode, the measurement direction setting is output.
- 3) For details on how to read waveforms, refer to "4.5 Reading Received Light Waveforms".

## 4.5 Reading Received Light Waveforms

### 4.5 Reading Received Light Waveforms

This function is used only for the **HG-T** series controllers.

When reading received light waveforms, select measured waveforms, reference waveforms, or waveforms during beam axis adjustment (Note), so that you can read waveform data and other information.

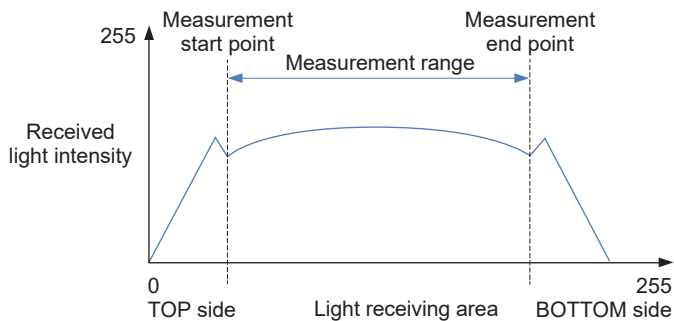
Note: For details on waveforms during beam axis adjustment, refer to “4.6 Registering Reference Waveforms”.

#### 4.5.1 Format of Received Light Waveform

Reading received light waveforms makes it possible to obtain simplified received light waveforms that represent the maximum received light width (CMOS cell) of the receiver by 256 areas (0 to 255) and the received light intensity by 256 gradations (0 to 255).

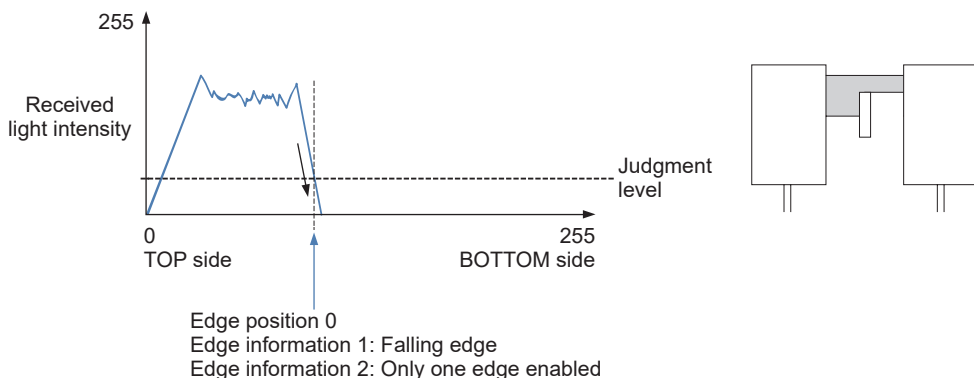
- Measurement start point and measurement end point

Measurement start points and measurement end points can be obtained only in reference waveform acquisition mode. Obtaining the measurement start point and measurement end point makes it possible to know the range that is used for measurement within the simplified received light waveform.

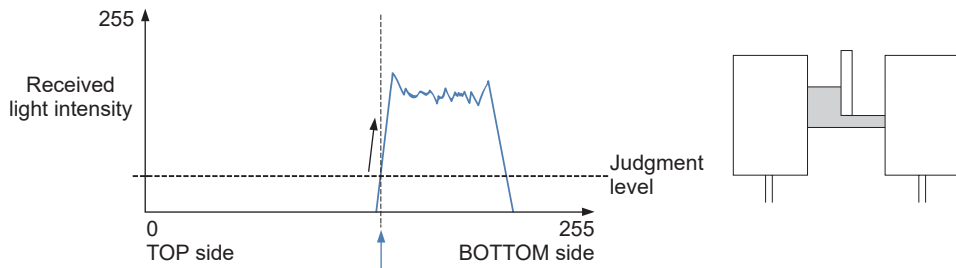


- Edge information and edge position

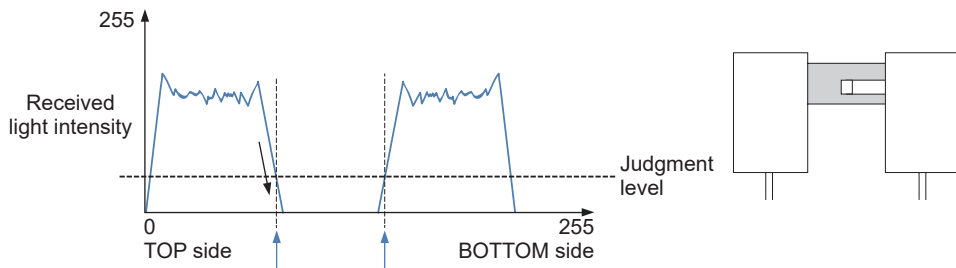
Edge information can be obtained as information indicating a rising edge or falling edge at each edge position (edge information 1) and effective edge mode information (edge information 2). Edge positions are points on the borderline between light interception and light entry within the received light intensity waveform when a measured object is inserted. The edge position on the top side is 0.



## 4.5 Reading Received Light Waveforms



Edge position 0  
Edge information 1: Rising edge  
Edge information 2: Only one edge enabled



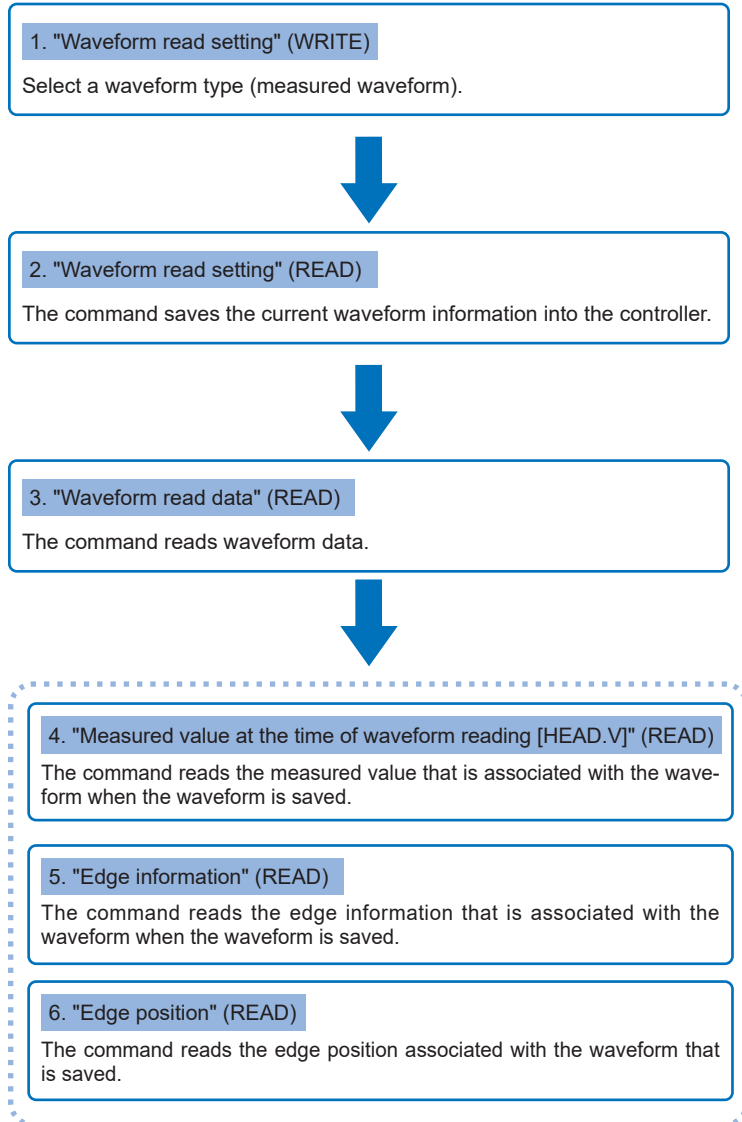
Edge position 0  
Edge information 1: Falling edge  
Edge information 2: Both edges enabled



### 4.5.2 Reading Measured Waveforms

The following procedure is used to read waveforms.

■ Flowchart of measured waveform reading



## 4.5 Reading Received Light Waveforms

### ■ Examples of sent / received commands

1. Send the “Waveform read setting” command (WRITE) to set the waveform type.  
(Command code: 0x0370)

Send this command only for the first time after starting the communication unit or when switching the type of the waveform to be read.

Write data															
High							Low								
Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Reserved (Always write 0x01.)							Waveform type								
							Bit7 to Bit0		Select a waveform type. 0x11: Measured waveform						

2. Send the “Waveform read setting” command (READ). (Command code: 0x0370)

If the response is normal, the following response data will be returned.

Read data															
High							Low								
Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Reserved						Status	Reserved	Waveform type (0x11: Measured waveform)							
						Bit9	Status 1: Waveform information has been saved 0: Waveform information has not been saved (For example, immediately after the unit starts up, operation mode is changed, or measured values are reset)								

The waveform information that is obtained when this command is sent will be saved in the controller.

3. Send the “Waveform read data” command (READ). (Command code: 0x0371 to 0x03B0)

The “Waveform read data” command can obtain four bytes of received light data by using a single address. Measured waveform data can be obtained by sending command codes from 0x0371 through to 0x03B0 in this order and then concatenating the data obtained.

If the response is normal, the following response data will be returned.

<Example: When the command code is 0x0371>

Read data			
Received light intensity [0]	Received light intensity [1]	Received light intensity [2]	Received light intensity [3]
0x00 to 0xFF	0x00 to 0xFF	0x00 to 0xFF	0x00 to 0xFF

- Reading waveforms continuously

When continuously reading waveforms with the same waveform ID, repeatedly send the commands described in 2. and subsequent steps. The update interval of compressed waveform information is 64 ms. Leave an interval of at least 1 ms when sending each command.

## 4.5 Reading Received Light Waveforms

4. To read the measured value associated with the saved waveform, send the “Measured value at the time of waveform reading[HEAD.V]” command (READ). (Command code: 0x03B2)

If the response is normal, the following response data will be returned.

Read data			
Measured value: Bit 7 to Bit 0	Measured value: Bit 15 to Bit 8	Measured value: Bit 23 to Bit 16	Measured value: Bit 31 to Bit 24
-1999999 to 1999999			

Note: If it is unnecessary to obtain the measured value associated with the waveform, there is no need to send the command.

5. To read the edge information associated with the saved waveform, send the “Edge information” command (READ). (Command code: 0x03B1)

If the response is normal, the following response data will be returned.

Read data															
High								Low							
Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Edge information 1	Edge information 2	Reserved						Reserved							

Item	Bit15	Description	
Edge information 1	0	Falling edge	Information about whether edge position 0 is a rising edge or falling edge when viewed from the TOP side
	1	Rising edge	

Item	Bit14	Bit13	Set value	Description
Edge information 2	0	0	Both edges disabled (When the beam axis state is "indeterminate", "fully blocked state", or "measurement alarm 1")	Information about whether edge positions are disabled or enabled. If edge positions are enabled, this item also identifies whether information for only edge position 0 is enabled or information for both edge position 0 and edge position 1 is enabled.
	0	1	Only one edge enabled	
	1	0	Both edges enabled	

Note: If it is unnecessary to obtain the edge information associated with the waveform, there is no need to send the command.

6. To read the edge positions associated with the saved waveform, send the “Edge position” command (READ). (Command code: 0x03B3)

If the response is normal, the following response data will be returned.

Read data															
High								Low							
Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Edge position 0 (0x00 to 0xFF)								Edge position 1 (0x00 to 0xFF) (Note 1)							

Notes: 1) If edge information 2 is set to “Only one edge enabled”, edge position 1 will be indeterminate.  
2) If it is unnecessary to obtain the edge position associated with the waveform, there is no need to send the command.

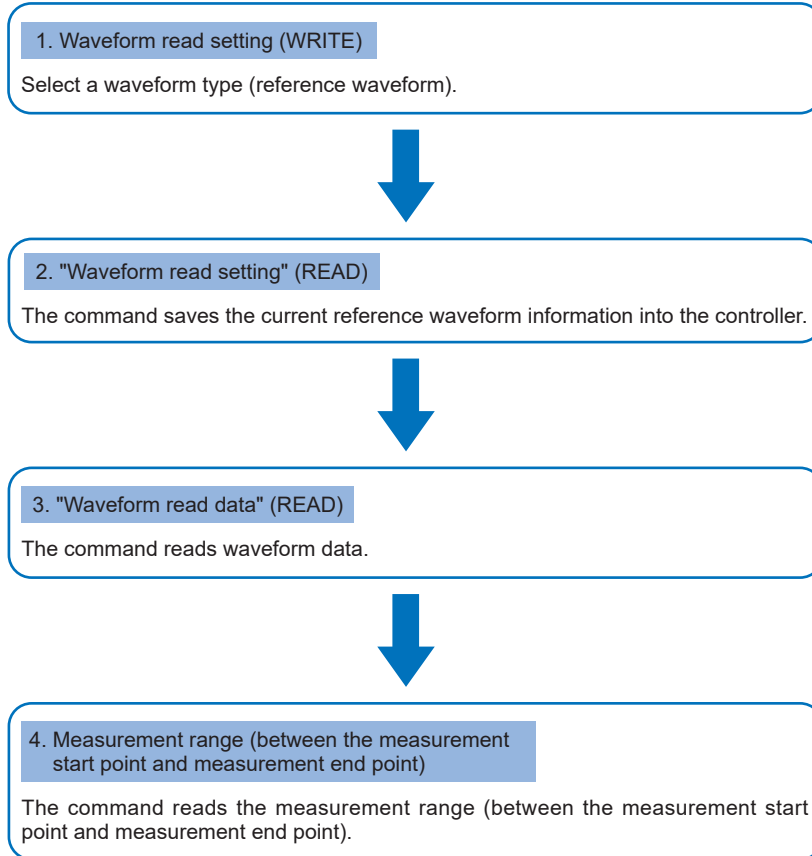
## 4.5 Reading Received Light Waveforms

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### 4.5.3 Reading Reference Waveforms

The following procedure is used to read waveforms.

■ Flowchart of reference waveform reading

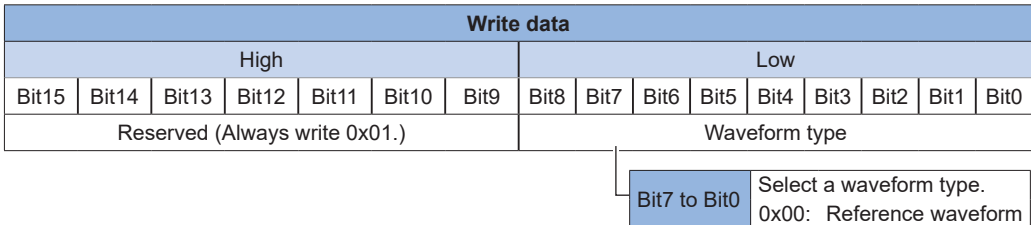


## 4.5 Reading Received Light Waveforms

### ■ Examples of sent / received commands

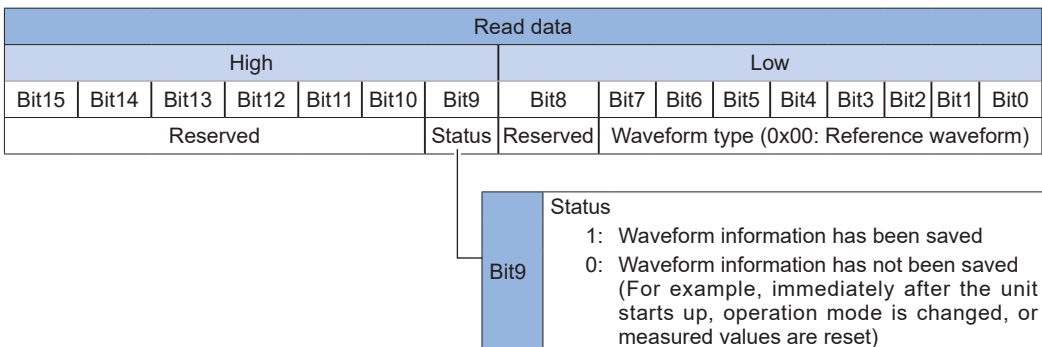
1. Send the “Waveform read setting” command (WRITE) to set the waveform type.  
(Command code: 0x0370)

Send this command only for the first time after starting the communication unit or when switching the type of the waveform to be read.



2. Send the “Waveform read setting” command (READ). (Command code: 0x0370)

If the response is normal, the following response data will be returned.



3. Send the “Waveform read data” command (READ). (Command code: 0x0371 to 0x03B0)

The “Waveform read data” command can obtain four bytes of received light data by using a single address. Reference waveform data can be obtained by sending command codes from 0x0371 through to 0x03B0 in this order and then concatenating the data obtained. If the response is normal, the following response data will be returned.

<Example: When the command code is 0x0371>

Read data			
Received light intensity [0] 0x00 to 0xFF	Received light intensity [1] 0x00 to 0xFF	Received light intensity [2] 0x00 to 0xFF	Received light intensity [3] 0x00 to 0xFF

## 4.5 Reading Received Light Waveforms

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4. To obtain the measurement range (between the measurement start point and measurement end point), send the “Measurement range acquisition” command (READ) (command code: 0x03B1).

If the response is normal, the following response data will be returned.

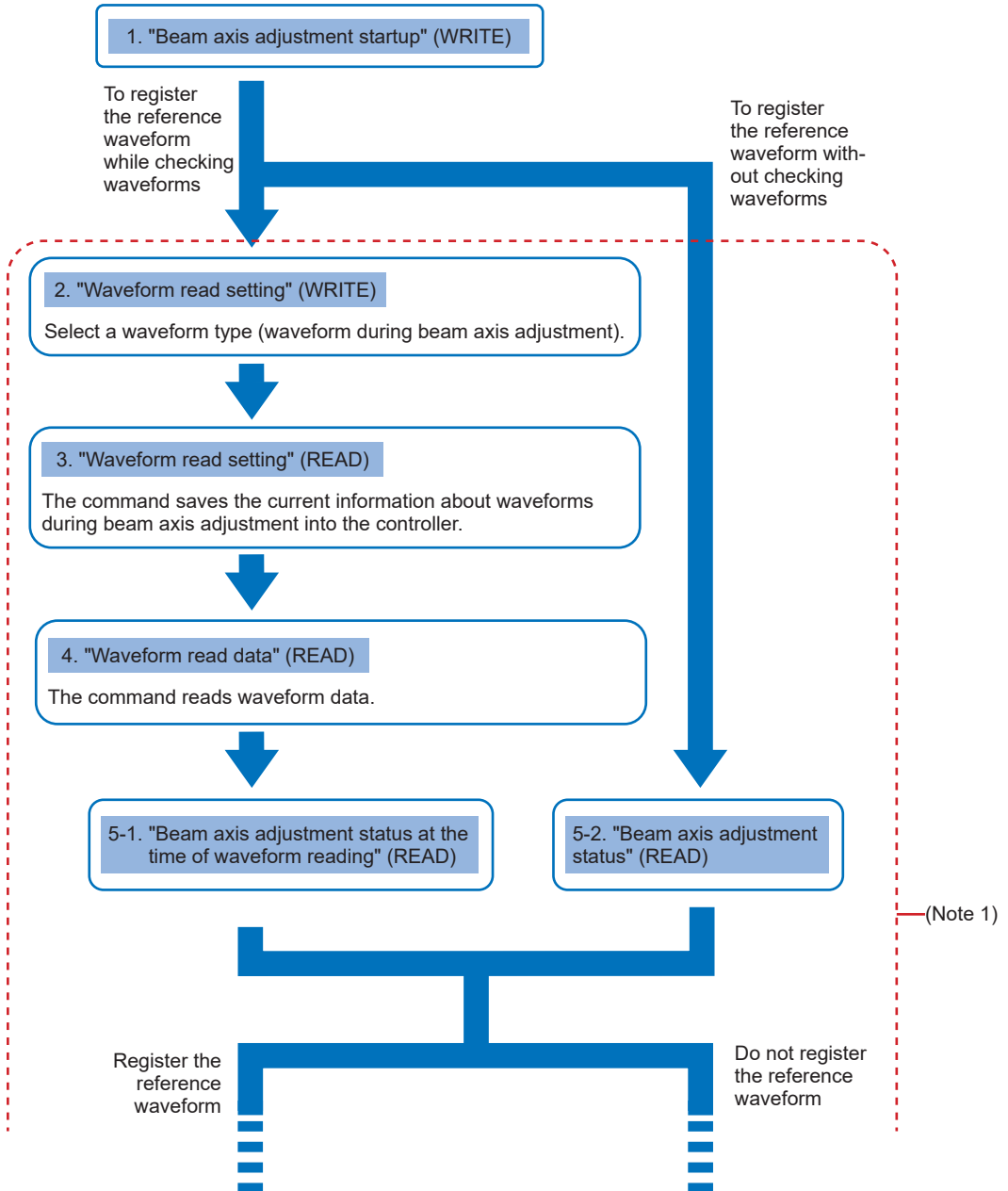
Read data	
Measurement end point	Measurement start point
0x00 to 0xFF	0x00 to 0xFF

Note: If it is unnecessary to obtain the measurement range, there is no need to send the command.

### 4.6 Registering Reference Waveforms

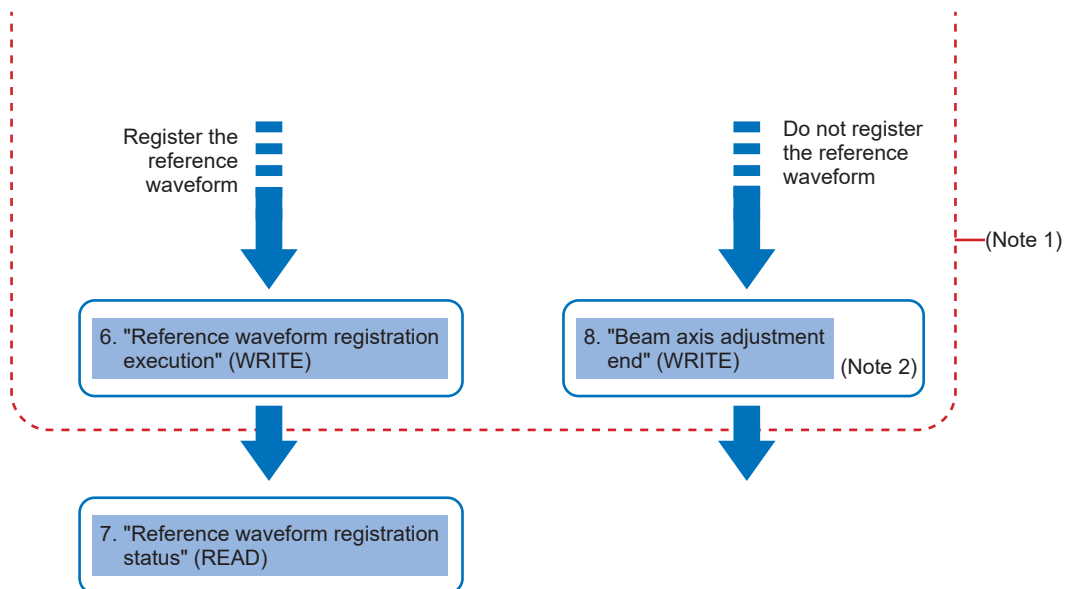
The following flowchart shows the procedure for reading and registering waveforms to register the reference waveform. To register the reference waveform, you must invoke beam axis adjustment mode.

■ Flowchart of reference waveform registration



## 4.6 Registering Reference Waveforms

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- Notes: 1) The inside of the frame indicated by the red dotted lines represents beam axis adjustment mode.  
2) Beam axis adjustment mode can be terminated at any procedure step by using "8. Beam axis adjustment end (WRITE)" command.



## 4.6 Registering Reference Waveforms

### ■ Examples of sent / received commands

1. Send the “Beam axis adjustment startup” command (WRITE). (Command code: 0x0360)  
Write data “0”.

To adjust the beam axis without checking waveforms, go to Step [5-2](#).

2. Send the “Waveform read setting” command (WRITE) to set the waveform type.  
(Command code: 0x0370)  
Send this command only for the first time after starting the communication unit or when switching the type of the waveform to be read.

Write data															
High							Low								
Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Reserved (Always write 0x01.)							Waveform type								
							Bit7 to Bit0		Select a waveform type. 0x10: Waveform during beam axis adjustment						

3. Send the “Waveform read setting” command (READ). (Command code: 0x0370)  
The waveform information that is obtained when this command is sent will be saved in the controller.

If the response is normal, the following response data will be returned.

Read data															
High							Low								
Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Reserved						Status	Reserved	Waveform type (0x10: Waveform during beam axis adjustment)							
						Bit9	Status 1: Waveform information has been saved 0: Waveform information has not been saved (For example, immediately after the unit starts up, operation mode is changed, or measured values are reset)								

4. Send the “Waveform read data” command (READ). (Command code: 0x0371 to 0x03B0)

The “Waveform read data” command can obtain four bytes of received light data by using a single address. Measured waveform data can be obtained by sending command codes from 0x0371 through to 0x03B0 in this order and then concatenating the data obtained.

If the response is normal, the following response data will be returned.

<Example: When the command code is 0x0371>

Read data			
Received light intensity [0] 0x00 to 0xFF	Received light intensity [1] 0x00 to 0xFF	Received light intensity [2] 0x00 to 0xFF	Received light intensity [3] 0x00 to 0xFF

## 4.6 Registering Reference Waveforms

- Reading waveforms continuously

When continuously reading waveforms with the same waveform ID, repeatedly send the commands described in **3.** and subsequent steps. The update interval of compressed waveform information is 64 ms. Leave an interval of at least 1 ms when sending each command.

**5.** To check the beam axis status, execute either of the following commands.

**5-1.** To check the beam axis adjustment status after reading the waveform, send the “Beam axis adjustment status at the time of waveform reading” command (READ). (Command code: 0x03B1)

**5-2.** To check the beam axis adjustment status without reading waveforms, send the “Beam axis adjustment status” command (READ). (Command code: 0x0361)

If the response is normal, the following response data will be returned.

Read data															
High								Low							
Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Beam axis state			Reserved												

Details of beam axis status

Bit15	Bit14	Bit13	Beam axis status
0	0	0	Immediately after beam axis adjustment starts
0	0	1	Beam axis aligned state
0	1	0	Receiver has shifted toward TOP side (emitter has shifted toward BOTTOM side)
0	1	1	Receiver has shifted toward BOTTOM side (emitter has shifted toward TOP side)
1	0	0	Beam axis is completely out of alignment (fully blocked state)
1	0	1	The light intensity is too much
1	1	0	The light intensity has decreased
1	1	1	Objects intercepting light or stains (adhering substances) exist inside measurement area

**6.** To register the reference waveform after checking the beam axis adjustment status, send the “Reference waveform registration execution” command (WRITE). (Command code: 0x0362)  
Write data “0”.

- Notes: 1) To save data in EEPROM when registering the reference waveform with the command, set the “Reference waveform save [BW.SAVE]” command (READ/WRITE) (command code: 0x0307) to ON beforehand.  
2) By default, data is not saved in EEPROM when the reference waveform is registered with the command. When the power is turned OFF and then ON again, the reference waveform returns to the pre-registration state.

After the command is executed, the system is automatically reset from beam axis adjustment mode .

## 4.6 Registering Reference Waveforms

7. To check whether the reference waveform has been registered after registering it, send the "Reference waveform registration status" command (READ). (Command code: 0x363)

If the response is normal, the following response data will be returned.

Read data															
High								Low							
Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Reserved														Status	

### Details of "Status"

0	The "Reference waveform registration execution" command (WRITE) that was executed last time is successful.
1	The "Reference waveform registration execution" command (WRITE) that was executed last time is unsuccessful and the reference waveform status has not been updated from the previous state. (If the power is turned OFF and then ON, the history of beam axis adjustment failures will be erased.)
2	Reference waveform registration is in progress.

8. To quit beam axis adjustment mode without registering the reference waveform, send the "Beam axis adjustment end" command (WRITE). (Command code: 0x0364)

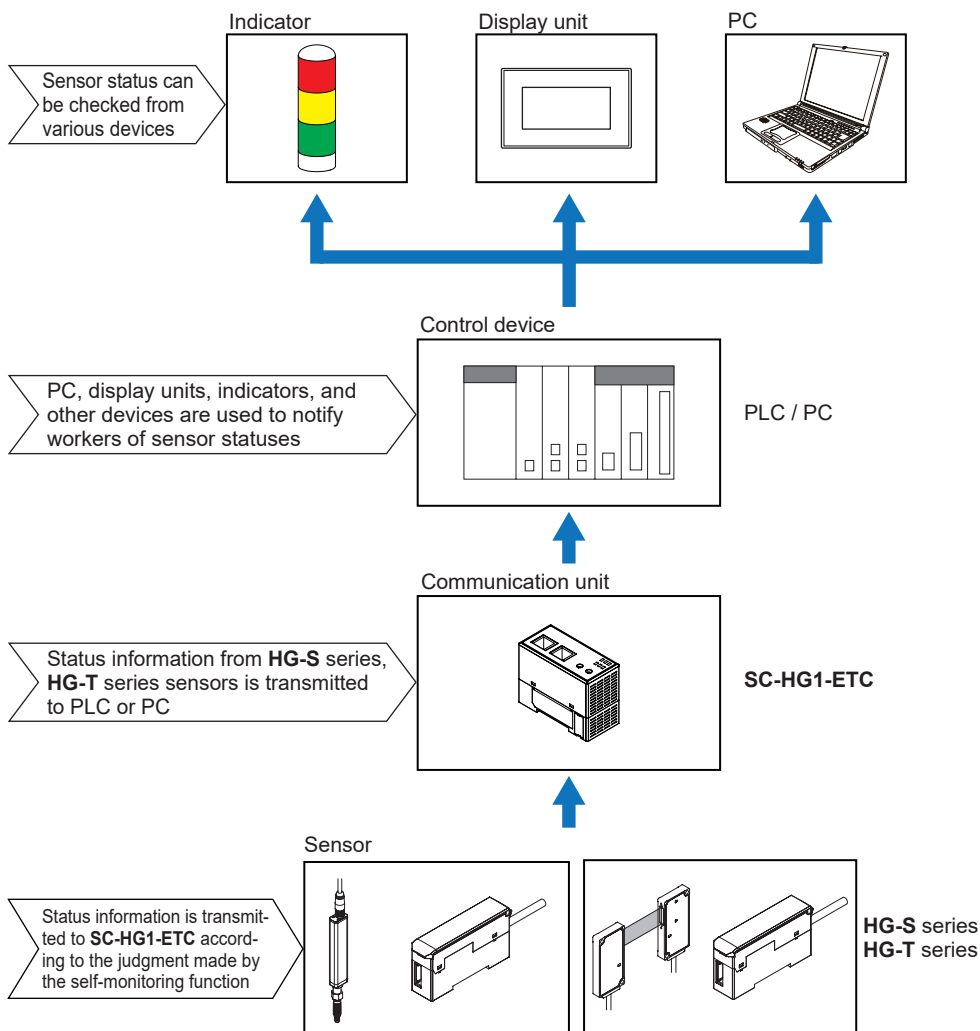
## 4.7 Self-monitoring Function

### 4.7 Self-monitoring Function

Self-monitoring Function enables the sensor itself to judge various statuses (“normal status”, “unstable detection status”, “caution-required status”, and “abnormal status”) within its own device and send the status information to the host device. **HG-S** series, and **HG-T** series sensors incorporate the self-monitoring function.

#### 4.7.1 Using the Self-monitoring Function

By combining the control system connected to PLC or PC via a network, this product, and the sensor(**HG-S** series, **HG-T** series ) you can easily check the sensor status (normal, notification, caution, or fault). The sensor itself judges even the causes of cautions and errors, making cause investigation easier.



## 4.7 Self-monitoring Function

### 4.7.2 Statuses and Measures

The statuses judged by the self-monitoring function are classified into the following four categories. When the status is “notification”, “caution”, or “fault”, you must check the installation state or maintain or replace the product.

Status	Description	Remarks
Normal	Normal state	The device is operating normally.
Notification	Unstable detection state	Review the settings.
Caution	State in which the device must be replaced	The device has almost reached its service life.
Fault	State in which the device is uncontrollable	The device is short-circuited or broken.

If “notification”, “caution”, or “fault” status is notified, take measures as shown in the following table.

- **HG-SC** series

For details on Response Parameter address, refer to “4.4.1 HG-S Series Command List”.

	Response parameter	Measures	Error code (Note)	Alarm (Note)
Notifi- cation	Sensor head unconnected	Status check	E200	–
	Connected unit count check error	Status check	E160 (For master units only)	–
	NPN / PNP output type mixture error	Status check	E100 (For master units only)	–
	Calculated unlit count error	Status check	E110 (For master units only)	–
	Copy executionerror ( Slave unit problem)	Status check	E170 (For master units only)	–
	The thrust on the sensor head stroke is above the specified range.	Status check	E210	–
	Pressure check	Status check	–	Alarm
Catch check	Status check	–	Alarm	
Fault	Controller memory function damaged	Controller replacement	E600 / E610 / E620	–
	Sensor Head memory function damaged	Sensor head replacement	E630	–
	Output section short-circuit error	Status check / Replacement	E700	–
	Detection circuit damaged	Sensor head replacement	E240	–
	System error	Controller replacement	E900 / E910 / E911 / E912 / E920	–

Note: Error codes and alarms are displayed on **HG-SC**□ controllers.

## 4.7 Self-monitoring Function

- **HG-TC series**

For details on Response Parameter address, refer to “4.4.2 HG-T Series Command List”.

	Response parameter	Measures	Error code (Note 1)	measurement alarm (Note 1)
Notification	Sensor head unconnected	Status check	E200	–
	Connected sensor head incompatible	Status check	E230	–
	Connected unit count check error	Status check	E160 (For master units only)	–
	NPN / PNP output type mixture error	Status check	E100 (For master units only)	–
	Calculated unlit count error	Status check	E110 (For master units only)	–
	Copy execution error ( Slave unit problem)	Status check	E170 (For master units only)	–
	Detection capability limit (obtained edge information) (Note 2)	Sensing object check	–	Measurement alarm 1
	The amount of entering light is too much due to the influences of ambient light, etc. (Note 2)	Status check	–	Measurement alarm 1
	The amount of entering light decreases due to stain on the detection surface, beam axis misalignment, etc.	Sensing object check	–	Measurement alarm 2
	The specified measurement direction differs from the insertion direction of the detected object	Status check / Sensing object check	–	Measurement alarm 2
Caution	Controller cumulative run time limit exceeded (87,600 hours)	Controller replacement	–	–
	Sensor head cumulative run time limit exceeded (87,600 hours)	Sensor head replacement	–	–
	Controller memory saving count limit exceeded (1,000,000 times)	Controller replacement	–	–
	Sensor head memory saving count limit exceeded (for receivers only, 1,000,000 times)	Sensor head replacement	–	–
Fault	Controller memory function damaged	Controller replacement	E600 / E610 / E620	–
	Sensor head memory function damaged	Sensor head replacement	E630 (For receivers only) E640 (For emitters only)	–
	Output section short-circuit error	Status check / Replacement	E700	–
	Detection circuit damaged	Sensor head replacement	E240	–
	System error	Controller replacement	E900 / E910 / E911 / E912 / E920	–

Notes: 1) Error codes and alarms are displayed on **HG-TC**□ controllers.

2) If “Alarm condition selection (ALM.CND)” is set to “Hold last value (HOLD)”, Measurement alarm 1 is not notified.

### 4.8 Other Precautions

- For the **HG-T** series controllers, measured values will be temporarily reset during measurement if the following commands are written.

Command code	Name	Remarks
0x001E	BANK LOAD execution (LOAD)	—
0x0046	Average count (SPEED)	—
0x0047	Measurement direction (DIRECT)	—
0x0048	Alarm delay count (DELAY)	For write only
0x0059	Sampling cycle (SAMPLI)	For write only
0x0300	Operation mode (OP.MODE)	For write only
0x0304	Sensitivity setting	For write only
0x0305	Judgment level (JDG.LVL)	For write only
0x0306	Judgment filter (JDG.FIL)	For write only
0x030C	Stain check (STA.CHK)	For write only
0x030D	Stain threshold (STA.THR)	For write only
0x031E	Sensor head cumulative run time (HD.TIME)	—
0x0325	Reverse insertion check (DIR.CHK)	For write only
0x03EF	Reverse of measured value (REVERS)	For write only

- For the **HG-T** series controllers, approximately five seconds after the power is turned ON, measured values are synchronously collected from the heads connected to each controller.

(MEMO)



# 5 Specification and Dimensions

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5.1. Specifications .....	5-2
5.2. Dimensions .....	5-3

## 5.1. Specifications

### 5.1. Specifications

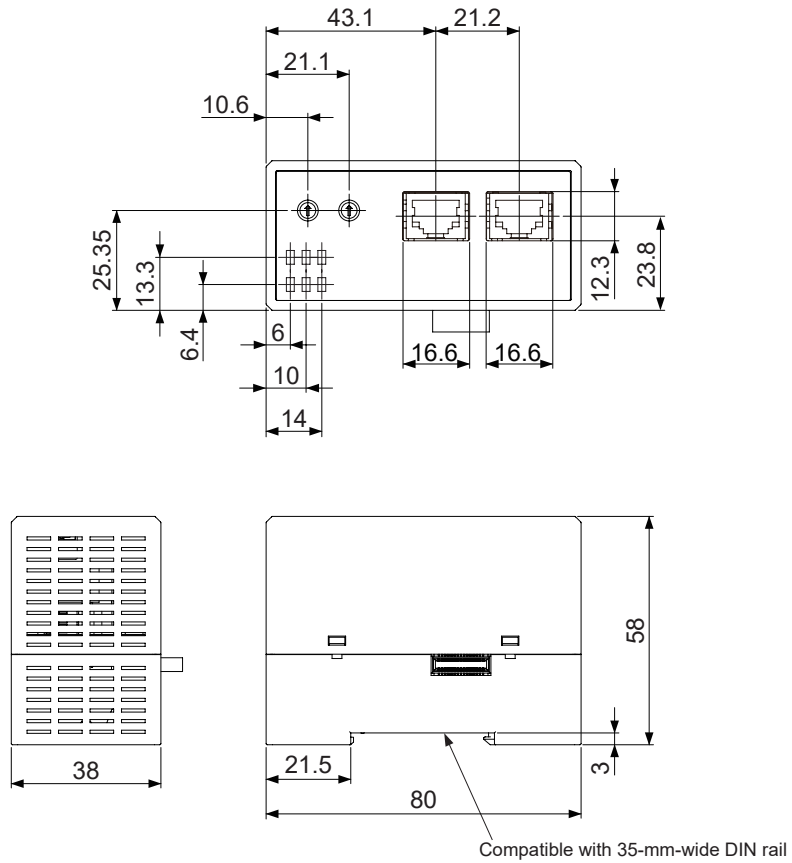
Product name	EtherCAT-compatible Communication Unit for HG Series
Model	<b>SC-HG1-ETC</b>
Power supply voltage (Note 1)	24 VDC $\pm$ 10%, including 0.5 V ripple (P-P)
Current consumption	100 mA or less
Communication protocol	EtherCAT
Compliance	IEEE802.3u(100BASE-TX)
Communication speed	100Mbps(100BASE-TX)
Telecommunications connector	RJ-45 $\times$ 2
Node-to-node distance	100 m or less
Compatible controllers	<b>HG-SC</b> $\square$ , <b>HG-TC</b> $\square$
Maximum number of sensor units that can be connected	Up to 15 controllers (1 master controller and 14 slave controllers) can be connected to a single <b>SC-HG1-ETC</b> communication unit.
Supported functions	Process data object communication (cyclic communication) Mailbox communication (message communication) CoE Explicit Device ID Station aliases supported
Ambient temperature	-10 to +45°C (No condensation or icing), Storage: -20 to +60°C
Ambient humidity	35% to 85% RH, Storage: 35% to 85% RH
Operating altitude (Note 2)	2,000 m or less
Contamination level	2
Withstand voltage	1,000 VAC for one minute between all supply terminals and case
Insulation resistance	20 M $\Omega$ or higher, using 250 VDC megohmmeter connected between all supply terminals and case
Vibration resistance	10 to 150 Hz with 0.75 mm amplitude (10 to 58 Hz) at acceleration of 49 m/s <sup>2</sup> (58 to 150 Hz) in X, Y, and Z directions for two hours each
Shock resistance	98 m/s <sup>2</sup> (approx. 10G) 5 times each in X, Y, and Z directions
Telecommunications cable	Category 5e (shielded twisted pair cable recommended)
Grounding method	Casing: Floating type
Material	Case: Polycarbonate
Weight (main unit only)	Approx. 90 g
Standards compliance	European Standards (EN)

Notes: 1) Electric power required for this product is supplied from the controller (master unit or slave unit) connected to it.

2) Do not use or store this product in environments where ambient air is pressurized to an air pressure higher than the atmospheric pressure at an altitude of 0 m.

### 5.2. Dimensions

Units: mm



(MEMO)

# 6 Warranty

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6.1 Important Information about Order and Use of This Product ..... 6-2

## 6.1 Important Information about Order and Use of This Product

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### 6.1 Important Information about Order and Use of This Product

The products and specifications listed in this manual are subject to change (including changes to specifications and discontinuation of manufacturing) without notice as occasioned by the improvements that we introduce into our products. Consequently, when you place orders for these products, we ask you to contact one of our customer service representatives and check that the details listed in the manual are commensurate with the most up-to-date information.

We strive to improve the quality and reliability of our products, but malfunctions generally occur in electrical parts and devices with a certain probability. Durability of products differs according to the operating environment or operating conditions under which they are used.

Before using this product, always conduct testing using an actual machine under the actual operating conditions. Continuing to use the product with deteriorated performance could generate abnormal heat, smoke, or fire due to insulation deterioration. We request that safety design (such as redundant design, fire spread prevention design, and malfunction prevention design) and regular maintenance be implemented to prevent accidents resulting in injury or death, fire accidents, social damages, and other problems due to product failures or longevity.

#### 1. WARRANTIES:

- (1) Subject to the exclusions stated in 2 (EXCLUSIONS) herein below, Panasonic Industry warrants the Products to be free of defects in material and workmanship for a period of one (1) year from the date of shipment under normal usage in environments commonly found in manufacturing industry.
- (2) Any Products found to be defective must be shipped to Panasonic Industry with all shipping costs paid by Purchaser or offered to Panasonic Industry for inspection and examination. Upon examination by Panasonic Industry, Panasonic Industry will, at its sole discretion, repair or replace at no charge, or refund the purchase price of, any Products found to be defective.

#### 2. EXCLUSIONS:

- (1) This warranty does not apply to defects resulting from any cause:
  - (i) which was due to abuse, misuse, mishandling, improper installation, improper interfacing, or improper repair by Purchaser;
  - (ii) which was due to unauthorized modification by Purchaser, in part or in whole, whether in structure, performance or specification;
  - (iii) which was not discoverable by a person with the state-of-the-art scientific and technical knowledge at the time of manufacture;
  - (iv) which was due to an operation or use by Purchaser outside of the limits of operation or environment specified by Panasonic Industry;
  - (v) which was due to normal wear and tear;
  - (vi) which was due to Force Majeure; and
  - (vii) which was due to any use or application expressly discouraged by Panasonic Industry in 4 (CAUTIONS FOR SAFE USE) hereunder.
- (2) This warranty extends only to the first purchaser for application, and is not transferable to any person or entity which purchased from such purchaser for application.

#### 3. DISCLAIMERS

- (1) Panasonic Industry's sole obligation and liability under this warranty is limited to the repair or replacement, or refund of the purchase price, of a defective Product, at Panasonic Industry's option.
- (2) THE REPAIR, REPLACEMENT, OR REFUND IS THE EXCLUSIVE REMEDY OF THE PURCHASER, AND ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT OF PROPRIETARY RIGHTS, ARE HEREBY EXPRESSLY DISCLAIMED. IN NO EVENT SHALL Panasonic Industry AND ITS

## 6.1 Important Information about Order and Use of This Product

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AFFILIATED ENTITIES BE LIABLE FOR DAMAGES IN EXCESS OF THE PURCHASE PRICE OF THE PRODUCTS, OR FOR ANY INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES OF ANY KIND, GENERAL TERMS AND CONDITIONS 4 OR ANY DAMAGES RESULTING FROM LOSS OF USE, BUSINESS INTERRUPTION, LOSS OF INFORMATION, LOSS OR INACCURACY OF DATA, LOSS OF PROFITS, LOSS OF SAVINGS, THE COST OF PROCUREMENT OF SUBSTITUTED GOODS, SERVICES OR TECHNOLOGIES, OR FOR ANY MATTER ARISING OUT OF OR IN CONNECTION WITH THE USE OR INABILITY TO USE THE PRODUCTS.

### 4. CAUTIONS FOR SAFE USE

- (1) The applications shown in the catalogue are only suggestions, and it is Purchaser's sole responsibility to ascertain the fitness and suitability of the Products for any particular application, as well as to abide by Purchaser's applicable local laws and regulations, if any.
- (2) Never use the Products NOT rated or designated as "SAFETY SENSOR" in any application involving risk to life or property. When such a use is made by Purchaser, such Purchaser shall indemnify and hold harmless Panasonic Industry from any liability or damage whatsoever arising out of or in relation to such use.
- (3) In incorporating the Products to any equipment, facilities or systems, it is highly recommended to employ fail-safe designs, including but not limited to a redundant +++design, flame propagation prevention design, and malfunction prevention design so as not to cause any risk of bodily injury, fire accident, or social damage due to any failure of such equipment, facilities or systems.
- (4) The Products are each intended for use only in environments commonly found in manufacturing industry, and, unless expressly allowed in the catalogue, specification or otherwise, shall not be used in, or incorporated into, any equipment, facilities or systems, such as those:
  - (a) which are used for the protection of human life or body parts;
  - (b) which are used outdoors or in environments subject to any likelihood of chemical contamination or electromagnetic influence;
  - (c) which are likely to be used beyond the limits of operations or environments specified by Panasonic Industry in the catalogue or otherwise;
  - (d) which may cause risk to life or property, such as nuclear energy control equipment, transportation equipment (whether on rail or land, or in air or at sea), and medical equipment;
  - (e) which are operated continuously each day for 24 hours; and
  - (f) which otherwise require a high level of safety performance similar to that required in those equipment, facilities or systems as listed in (a) through (e) above.

### 5. EXPORT CONTROL LAWS

In some jurisdictions, the Products may be subject to local export laws and regulations. If any diversion or re-export is to be made, Purchaser is advised to abide by such local export laws and regulations, if any, at its own responsibility.

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# 7 Maintenance

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## 7.1 Maintenance and Inspection

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### 7.1 Maintenance and Inspection

#### 7.1.1 Maintenance Precautions

- Before cleaning, always turn the power OFF.
- Never use thinner, benzene, or other organic solvents to wipe off dirt or dust.
- Use a clean, soft cloth to wipe off any dirt that adheres to the controller.

#### 7.1.2 Main Inspection Items

Inspect the product regularly to maintain performance and enable optimum use. The main inspection items are as follows:

- Have any input and output terminals become loose or come off?
- Is the supplied power within the rated voltage range (24 VDC  $\pm$ 10%)?
- Is the ambient operating temperature within the specified range (-10 to +45°C)?
- Is the ambient operating humidity within the specified range (35% to 85% RH)?

# 8 Troubleshooting

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## 8.1 Error Codes and Solutions

Solutions to frequently encountered problems and errors are described below.

### 8.1 Error Codes and Solutions

Notification source	Code	Description	Action method
SC-HG1-ETC	100	This command cannot be used with the target controller.	Check an appropriate command by referring to “ <b>4.4 Command List</b> ”.
	101	An out-of-range parameter setting was requested.	The parameter setting is invalid. Check an appropriate parameter setting by referring to “ <b>4.4 Command List</b> ”.
	102	A write request was issued with settings that cannot be used with the target controller.	The parameter setting is invalid. Check an appropriate parameter setting by referring to “ <b>4.4 Command List</b> ”.
	103	A read request was issued with settings that cannot be used with the target controller.	The parameter setting is invalid. Check an appropriate parameter setting by referring to “ <b>4.4 Command List</b> ”.
	200	No sensor head is connected.	Check the connection state of the sensor head.
	300	The system received a command that cannot be used because there is no calculation setting.	Set the master unit to calculation mode by referring to the user's manual of the sensor.
	301	The system received a command that cannot be used because P-P or P-P/2 is not set in hold settings.	Set the master unit to P-P or P-P/2 by referring to the user's manual of the sensor.
	400	When a calibration was executed, an alarm, indeterminate state, or out-of-display-range error occurred.	The sensor head value is invalid. Check the state of the sensor head.
	401	A calibration was not implemented normally.	A calibration failed. Check the setup procedure by referring to the user's manual of the sensor.
	500	When teaching was executed, an alarm, indeterminate state, or out-of-display-range error occurred.	The sensor head value is invalid. Check the state of the sensor head.
	501	Teaching was not implemented normally.	Teaching failed. Check the setup procedure by referring to the user's manual of the sensor.
	600	When a preset was executed, an alarm, indeterminate state, or out-of-display-range error occurred.	The sensor head value is invalid. Check the state of the sensor head.
	700	When an attempt was made to load or save data from/to a bank, the bank number was out of range.	Send appropriate parameter settings by referring to the user's manual of the sensor.
	800	Data failed to be written to internal memory.	Turn the power OFF and then ON to initialize the controller. If the controller does not recover even after the above action is taken, consult your Panasonic representative.
	4095	Before receiving a response to a request, the user sent a next request.	Resend the command after waiting for a certain time period.
	900	A response to a request has timed out.	Check the connection state between the communication unit and the controller.
	1900	This product failed to communicate with controllers.	Switch OFF the power, make sure the controllers are connected correctly, and then switch ON the power again.
	2000		Switch OFF the power, make sure the controllers are connected correctly, and then switch ON the power again.
	2200		The specified destination unit cannot be found. Switch OFF the power, make sure the controllers are connected correctly, and then switch ON the power again.

## 8.1 Error Codes and Solutions

Notification source	Code	Description	Action method
SC-HG1-ETC	2400	This product failed to communicate with controllers.	A command was received from the host during recovery from a lateral connection error (timeout). Switch OFF the power, make sure the controllers are connected correctly, and then switch ON the power again.
	2500		A command was received from the host during recovery from a lateral connection error (CRC error). Switch OFF the power, make sure the controllers are connected correctly, and then switch ON the power again.
	2600	Before receiving a response to a request, the user sent a next request.	Resend the command after waiting for a certain time period.
	2700	This product failed to communicate with controllers.	Switch OFF the power, make sure the controllers are connected correctly, and then switch ON the power again.
	2800		A CRC error has occurred. Switch OFF the power, make sure the controllers are connected correctly, and then switch ON the power again.
	2900		A packet has not been received for at least 1 ms. Switch OFF the power, make sure the controllers are connected correctly, and then switch ON the power again.
	3100		Too many units are connected. At least 17 units are connected. The maximum number of slave controllers that can be connected is 14.

## 8.2 Solutions to Problems

### 8.2 Solutions to Problems

Indicator	State	Description	Corrective action
L/A IN L/A OUT	Lit	Physical layer link establishment	The system is waiting for operation after a physical layer link has been established.
ECAT ERR indicator (Red)	Blinking (double flash (Note 1))	Communication error (watchdog timeout)	<ul style="list-style-type: none"> <li>• Check whether the telecommunications cables are laid correctly.</li> <li>• There could be any source of noise near the telecommunications cables. Review the wiring method.</li> </ul> After checking the wiring, turn the power OFF and then ON.
		Hardware fault	If the problem cannot be resolved even after the above measures have been taken, the product could be faulty. In such a case, replace this product.
	Blinking (blinking (Note 2))	Station alias setting error	Check whether the station ID setting is within the specified range. After changing the setting, turn the power OFF and then ON.
		Nonvolatile memory data error	Nonvolatile memory data could have been changed. Restore the nonvolatile memory data to the factory default settings by using the configurator software provided with the engineering tool manufactured by the PLC manufacturer. After writing the data, turn the power OFF and then ON.
		Configuration error	The communication settings are invalid. Check the settings of the master device by referring to the manuals of the master device.
	Hardware fault	If the problem cannot be resolved even after the above measures have been taken, the product could be faulty. In such a case, replace this product.	
Lit	Hardware fault	Turn the power OFF and then ON. If the problem cannot be resolved even after this action has been taken, the product could be faulty. In such a case, replace this product.	
ERR. indicator (Red)	Blinking	Inter-sensor communication error	<ul style="list-style-type: none"> <li>• An error has occurred in Panasonic-specific inter-sensor communications. Review the communication method by referring to the error code list. (For example, the sensor specification in the command transmission destination may be incorrect. In such a case, check the number of connected sensors and then send the command to the specified sensor.)</li> <li>• There is a problem with the installation of this product and sensor controllers. Check the installation condition.</li> <li>• The sensor controller connected to this product could be faulty. In such a case, replace with a new controller.</li> </ul>
		Hardware fault	If the problem cannot be resolved even after the above measures have been taken, the product could be faulty. In such a case, replace this product.
POWER indicator (Green)	Unlit	Power supply voltage anomaly detection	<ul style="list-style-type: none"> <li>• The power supply voltage is outside the specified range.</li> <li>• Check whether electric power (24 V) is supplied to this product.</li> <li>• Check the wiring of the power supply. For details on how to connect the power supply, refer to the user's manual of the controller connected to this product.</li> <li>• The power supply capacity varies according to the controller type or the number of controllers connected. Check the specifications of the controller connected to this product.</li> </ul>
		Hardware fault	If the problem cannot be resolved even after the above measures have been taken, the product could be faulty. In such a case, replace this product.

- Notes: 1) The indicator repeatedly lights up for 0.2 seconds, goes out for 0.2 seconds, lights up for 0.2 seconds, and goes out for 1 second in this order.  
 2) After lighting for 0.2 seconds, the indicator repeatedly goes out for 0.2 seconds.

- An EEPROM error (E600 or E620) is displayed on the connected controller.

Cause	Corrective action
A command is sent immediately after the power supply is turned ON.	Send a command after five seconds has elapsed since the power supply is turned ON.

#### Note

If the product still does not operate normally after you check the above, consult our technical support center.

Revision history	Revision date	Revision item
First edition	7/01/2019	—
Second edition	12/01/2019	Commands related to the self-monitoring function were added, "4.7 Self-monitoring Function" added
Third edition	12/4/2020	Commands related to the addition of <b>HG-T</b> functions have been added. "5. EtherCAT Operating Procedure" deleted "10. Sample Programs" deleted
Fourth edition	4/01/2024	Made revisions in line with the change of the company name.

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Please visit our website for inquiries and about our sales network.

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