K1G Series High-Accuracy Position Sensor MECHATROLINK-III Communication Manual

Thank you for purchasing a K1G Series sensor.

This manual contains information for ensuring correct use of the K1G. It also provides necessary information for installation, maintenance, and troubleshooting.

This manual should be read by those who design and maintain equipment that uses the K1G. Be sure to keep this manual nearby for handy reference.

Azbil Corporation

The Role of This Manual

There are seven different manuals related to the K1G series. Read them as necessary for your specific requirements. If a manual you require is not available, contact the Azbil Group.
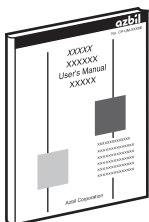
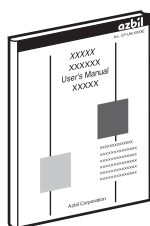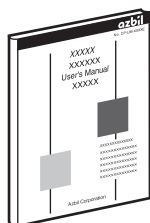**K1G Series High-Accuracy Position Sensor MECHATROLINK-III Communication Manual**
Manual No. CP-SP-1386E

This manual describes the MECHATROLINK-III communication specifications.

K1G Series High-Accuracy Position Sensor User's Manual
Manual No. CP-SP-1385E

This manual describes the hardware and all functions of the K1G.
Personnel in charge of the design, manufacture, operation, or maintenance of equipment that incorporates this device, or the design of communication software for equipment that uses this device's serial communication function, should read this manual thoroughly.
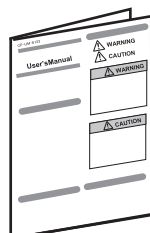
K1G Series High-Accuracy Position Sensor Global Model User's Manual
Manual No. CP-SP-1397E

If you need to use a CE- or KC-marked K1G controller, please purchase the K1G-C04G or the K1G-C04MG and read this manual.
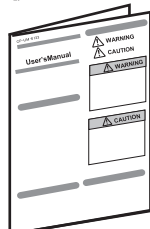
K1G Series High-Accuracy Position Sensor Controller User's Manual
Manual No. CP-UM-5783JE

Personnel in charge of the design or manufacture of equipment that incorporates this device should read this manual thoroughly. The manual covers safety precautions, installation, wiring, and primary specifications.

K1G Series High-Accuracy Position Sensor Head User's Manual
Manual No. CP-UM-5784JE

Personnel in charge of the design or manufacture of equipment that incorporates the sensor heads should read this manual thoroughly. It covers safety precautions, installation, wiring, and primary specifications.
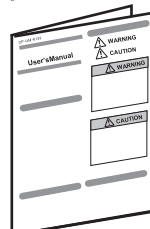
Handling Precautions for the SZ-D01 Configuration Tool for K1G Series High-Accuracy Position Sensors   **Manual No. CP-UM-5785JE**

Personnel who use the configuration tool for K1G sensors should read this manual. The manual covers safety precautions, installation, and wiring.
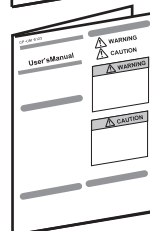
Handling Precautions for K1G Series High-Accuracy Position Sensor Junction Cables
Manual No. CP-UM-5787JE

This manual must be read by people who perform design and manufacturing of equipment where this cable is used. This describes safety information for using this device.

Contents

Chapter 4. MESSAGE COMMUNICATION

Chapter 5. ID_CODE

Chapter 6. VIRTUAL MEMORY SPACE

Chapter 7. ALARM AND WARNING CODES

Chapter 8. LED STATUS DISPLAY

Chapter 1.   WHAT IS MECHATROLINK-III

1 - 1   Overview

MECHATROLINK-III is a field network for performing decentralized control of multiple FA units (slave stations: servo drives, inverters, input/output modules, etc.) using a single FA controller (C1 master station).
The features of MECHATROLINK-III are shown below.

- High-speed data transmission (100Mbps)

- Synchronous communication

- Enables selection of optimum value for transmission cycle based on the number of connected stations and data transmission volume (Transmission cycle range: 31.25μs to 64ms)

- Supports connection of up to 62 slave stations (The actual number of connectable stations varies depending on the product specifications of the master module.)

- Enables design with reduced wiring between equipment

- Communication ASIC has error detection and retry functions for providing high-reliability data transmission

- Supports connection of FA Support Tool (C2 Master)

1 - 2　　　　MECHATROLINK-III Communication Specifications

Item	Description	
Communication protocol	MECHATROLINK-III	
Type	Slave	
Station address setting range	03 to EF (hexadecimal)	
Number of transmission bytes	32 or 48 bytes	
Supported transmission cycles	0.25, 0.5, 1 to 64 ms (0.5-ms steps)	
Supported communication cycles	0.25 to 64 ms	
Supported communication types	Cyclic communication, event-driven communication, message communication	
Synchronous mode	Synchronous/Asynchronous	
Other slave monitoring functions	Not supported	
C2 master	Not supported	
Supported profile	Standard I/O profile	
Supported commands	Cyclic communication	NOP, ID_RD, CONFIG, ALM_RD, ALM_CLR, SYNC_SET, CONNECT, DISCONNECT, DATA_RWA, DATA_RWS
	Event-driven communication	NOP, ID_RD, CONNECT, DISCONNECT
	Message communication	Read from memory, read maximum message size, vendor-specific commands

📖 **Note**

- ☞ K1G Series High-Accuracy Position Sensors User's Manual
  Manual No. CP-SP-1385E (for details on setup of the station address and number of transmission bytes).
- ☞ K1G Series High-Accuracy Position Sensor Global Model User's Manual
  Manual No. CP-SP-1397E

Chapter 2. STANDARD I/O PROFILE COMMANDS

2 - 1 Overview

The MECHATROLINK-III communication specifications describe the standard I/O profile for sending and receiving data with input/output devices. In the standard I/O profile, connection-type communication is performed based on the MECHATROLINK-III communication specifications.

The commands used in the standard I/O profile and the required support for this product are shown in the table below.

Table of Standard I/O Profile Commands

Profile	Command code (hex)	Command	Operation	Compliance [*1]	Communication phase[*2]			Compliance of this product
					1	2	3	
Common Commands	00	NOP	No operation	Mandatory	–	O	O	Compliant
	01	PRM_RD	Read parameter	Optional	–	O	O	Not compliant
	02	PRM_WR	Write parameter	Optional	–	O	O	Not compliant
	03	ID_RD	Read ID	Mandatory	–	O	O	Compliant
	04	CONFIG	Device setup request	Mandatory	–	O	O	Compliant
	05	ALM_RD	Read alarm/warning	Mandatory	–	O	O	Compliant
	06	ALM_CLR	Clear alarm/warning state	Mandatory	–	O	O	Compliant
	0D	SYNC_SET	Request for establishing synchronization	Optional	–	O	▲	Compliant
	0E	CONNECT	Request for establishing connection	Mandatory	O	▲	▲	Compliant
	0F	DISCONNECT	Request for releasing connection	Mandatory	O	O	O	Compliant
	1B	PPRM_RD	Read stored parameter	Optional	–	O	O	Not compliant
	1C	PPRM_WR	Write stored parameter	Optional	–	O	O	Not compliant
	1D	MEM_RD	Read memory	Optional	–	O	O	Not compliant
	1E	MEM_WR	Write memory	Optional	–	O	O	Not compliant
Standard I/O	20	DATA_RWA	Data read/write command (asynchronous)	Mandatory	–	O	O	Compliant
	21	DATA_RWS	Data read/write command (synchronous)	Optional	–	×	O	Compliant

[*1] Mandatory: To comply with the MECHATROLINK-III communication specifications, devices must support these commands.
Optional: Devices do not have to support these commands to comply with the MECHATROLINK-III communication specifications. Whether the commands are supported or not can be optionally specified in the product specifications.

[*2] The communication phase symbols are shown below.
× : Command error
O : Execution allowed
▲ : Ignored
– : Undetermined response data

2 - 2   Command Formats

This describes the data format for the commands and responses of the standard I/O profile. This product supports 32/48 transmission bytes, but this example explains using 32 bytes unless specified otherwise.
(If 48 bytes is used, the data from 32 to 47 bytes is "Reserved" except for DATA_RWA and DATA_RWS.)

Standard I/O Profile Data Format

Byte	Command	Response	Reference

0	CMD	RCMD	• CMD/RCMD:
			   This is the command code specified for each command
			   ☞ Table of Standard I/O Profile Commands (page 2-1).

1	WDT	RWDT	• WDT/RWDT: ☞ ■ Watchdog data (WDT/RWDT) (page 2-2).
2	CMD_CTRL	CMD_STAT	• CMD_CTRL: ☞ ■ Command control (CMD_CTRL) (page 2-3).
3			
4	CMD_DATA	RSP_DATA	• CMD_STAT: ☞ ■ Command status (CMD_STAT) (page 2-4).
5			
6			• CMD_DATA/RSP_DATA: This is specified for each command (See the details for each command starting from the next section).
7			
8			
9			
10			
11			
12			
13 to 31			
32 to 47	CMD_DATA (Reserved)	RSP_DATA (Reserved)	When the number of transmission bytes is 48, commands other than DATA_RWA and DATA_RWS are set to "Reserved."

■ Command codes (CMD/RCMD)

📖 Note

- ☞ Table of Standard I/O Profile Commands (page 2-1).

■ Watchdog data (WDT/RWDT)

During synchronous communication, the C1 master station and slave station exchange synchronous data for each communication cycle. This synchronous data is called watchdog data, and it is used to establish synchronous communication and detect shifts in synchronous communication.

● Data format

The WDT field (command data) and RWDT field (response data) of the C1 master station and slave station are used.
The format of each field is shown in the figure below.

	Bit 7	...	Bit 4	Bit 3	...	Bit 0
WDT-	SN: Master copies the RSN in previous RWDT			MN: Master becomes +1 at every communication cycle		

	Bit 7	...	Bit 4	Bit 3	...	Bit 0
RWDT-	RSN: Slave becomes +1 at every communication cycle			RMN: Slave copies the MN in the previous WDT		

● **Error detection**

After starting synchronous communication, the watchdog data for the other station that received the data (RSN data if the other station is a slave station and MN data if the other station is a C1 master station) is detected as an error if it does not equal the previous value + 1.

However, if a disconnection request command is issued by the C1 master station at the next communication cycle, then no error is detected if a communication error and transmission cycle error were already detected.

■ Command control (CMD_CTRL)

This explains the CMD_CTRL area of commands.

In MECHATROLINK-III, the 2nd and 3rd bytes of the command format are defined as the CMD_CTRL area.

The CMD_CTRL area is defined as shown below based on the communication specifications.

The command in this field is enabled even if a CMD_ALM has occurred.

● **CMD_CTRL area**

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
CMD_ID		Reserved	Reserved	ALM_CLR	Reserved	Reserved	Reserved

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
Reserved							

■ ALM_CLR: Clear communication alarms and warnings

• Definition

0: Disable clearing of alarms and warnings

1: Execute clearing of alarms and warnings

• Description

The alarm/warning status is cleared by the rising edge.

This performs the same operation as ALM_CLR_MODE=0 (clear current alarm/warning status) of the ALM_CLR command.

■ CMD_ID: Command ID

This is not used in the standard I/O profile commands.

■ Command status (CMD_STAT)

This explains the CMD_STAT area of responses.
In MECHATROLINK-III, the 2nd and 3rd bytes of the response format are defined as the CMD_STAT area.
The CMD_STAT area is defined as shown below based on the communication specifications.
The command in this field is enabled even if a CMD_ALM has occurred.

● CMD_STAT area

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
RCMD_ID		Reserved	Reserved	ALM_CLR_CMP	CMDRDY	D_WAR	D_ALM

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
COMM_ALM				CMD_ALM			

● D_ALM

- Definition
  1: Device alarm status in progress
  0: Other status (including statuses that come under COMM_ALM and CMD_ALM described in the product specifications)
- Description
  This bit indicates the device alarm status of the slave station.
  If measurement cannot be resumed due to a severe problem (controller status "2" occurs (Failure mode activated)), the status becomes D_ALM=1.
  COMM_ALM and CMD_ALM are independent.
  If a slave station changes from a device alarm status to a normal status by ALM_CLR command and CMD_CTRL.ALM_CLR, the status becomes D_ALM=0.
  However, a power reset of this device is required for resetting the alarm status in this device.

● D_WAR

- Definition
  1: Device warning status in progress
  0: Other status (including statuses that come under COMM_ALM and CMD_ALM described in the product specifications)

- Description
  This bit indicates the device warning status of the slave station.
  If a disconnected wire of the sensor head is detected during usage of two or more sensor heads (controller status "1" occurs (sensor head disconnected wire)), the status becomes D_WAR=1. (If all of the sensor heads being used have a disconnected wire, an alarm status occurs.)
  COMM_ALM and CMD_ALM are independent.
  If a slave station changes from a device warning status to a normal status by ALM_CLR command and CMD_CTRL.ALM_CLR, the status becomes D_WAR=0.
  However, a power reset of this device is required for resetting the warning status in this device.

● CMDRDY

• Definition
1: Command allowed
0: Other

• Description
CMDRDY=0 indicates that a command process is being executed. During this time, the command process that is currently being executed is continued. (New commands received when CMDRDY=0 are discarded.)
However, the DISCONNECT command only is executed immediately regardless of the CMDRDY value.
The check of whether command execution is complete is performed using a method shown in the complete check method of the respective command.
The CMDRDY=0 retention time is specified for each command.
Even when in an alarm or warning status, this becomes CMDRDY=1 whenever command execution is possible.

● ALM_CLR_CMP

• Definition
1: ALM_CLR execution complete
0: Other

• Description
ALM_CLR_CMP=1 indicates that CMD_CTRL.ALM_CLR=1 was received and the alarm clear process was completed.
ALM_CLR_CMP is cleared by setting CMD_CTRL.ALM_CLR to "0."

● RCMD_ID

This is not used in standard I/O profile commands, but in this product, CMD_CTRL.CMD_ID (command ID) performs an echo-back.

● CMD_ALM

• Definition
This sends notification of the command error status.

• Description
This code indicates a command error. COMM_ALM is independent from D_ALM and D_WAR.
After a command error occurs, if a normal command is received, CMD_ALM is automatically cleared.
The phase is not changed even if CMD_ALM is not "0".

Code		Description	Notes
	0	Normal	
Warning	1	–	Not used.
	2	–	
	3	–	
	4	–	
	5	–	
	6	–	
	7	–	
Alarm	8	Unsupported command received	Notification is sent for alarm status, and command is not executed.
	9	Outside the data range	
	A	–	
	B	–	
	C	Phase error	
	D	–	
	E	–	
	F	–	

■ COMM_ALM

- Definition

  This sends notification of the communication error status.

- Description

  This code indicates an error status in MECHATROLINK communication. CMD_ALM is independent of D_ALM and D_WAR.

  COMM_ALM is cleared by the CMD_CTRL.ALM_CLR rising edge or ALM_CLR command.

Code		Description	Notes
	0	Normal	
Warning	1	FCS error	This occurs when isolated errors are detected.
	2	Command data not received	
	3	Synchronous frame not received	
	4	–	
	5	–	
	6	–	
	7	–	
Alarm	8	FCS error	This occurs when an error is detected using the methods below. If the communication phase is 3, this changes to communication phase 2. Error detection methods: 8, 9, A: Detected when error occurs two consecutive times by the error detection method of the above warning. B, C: Detected as single error occurrence.
	9	Command data not received	
	A	Synchronous frame not received	
	B	Synchronous interval error	
	C	WDT error	
	D	–	
	E	–	
	F	–	

2 - 3   Command Details

■ No Operation Command (NOP: 00H)

The NOP command is used for network control.
A response is sent to indicate the current status.

● Completion check

The completion check is based on RCMD=NOP(=00H) and CMD_STAT.
CMDRDY=1.
If CMD_STAT.D_ALM or CMD_STAT.D_WAR=1, use ALM_RD to read the
alarm code of the current alarm, and take the appropriate corrective action.
If CMD_STAT.CMD_ALM or CMD_STAT.COMM_ALM≠0, take the appropriate
corrective action based on the alarm code.
☞ ■ Command status (CMD_STAT) (page 2-4).

● Command classification

Device group: Common command group
Communication type: Asynchronous communication command

● Data format

Data Format (NOP)

Byte	Command	Response	Reference
0	NOP (00H)	NOP (00H)	• WDT/RWDT: ☞ ■ Watchdog data (WDT/RWDT) (page 2-2).
1	WDT	RWDT	• CMD_CTRL: ☞ ■ Command control (CMD_CTRL) (page 2-3).
2	CMD_CTRL	CMD_STAT	
3			• CMD_STAT: ☞ ■ Command status (CMD_STAT) (page 2-4).
4	Reserved	Reserved	
5			
6			
7			
8			
9			
10			
11			
12			
13 to 31			

■ Read ID Command (ID_RD: 03H)

This is the read command for the device ID. The product information is read as ID data.

Detailed selection of the ID data is performed by specifying ID_CODE.

● **Completion check**

The completion check is based on RCMD=ID_RD(=03H), CMD_STAT. CMDRDY=1, DEVICE_CODE, OFFSET, and SIZE.

If CMD_STAT.D_ALM or CMD_STAT.D_WAR=1, use ALM_RD to read the alarm code of the current alarm, and take the appropriate corrective action.

If CMD_STAT.CMD_ALM or CMD_STAT.COMM_ALM≠0, take the appropriate corrective action based on the alarm code. (☞ ■ Command status (CMD_STAT) (page 2-4)).

● **Command classification**

Device group: Common command group

Communication type: Asynchronous communication command

● **Data format**

Data Format (ID_RD)

Byte	Command	Response	Reference
0	ID_RD (03H)	ID_RD (03H)	• WDT/RWDT: ☞ ■ Watchdog data (WDT/RWDT) (page 2-2).
1	WDT	RWDT	• CMD_CTRL: ☞ ■ Command control (CMD_CTRL) (page 2-3).
2	CMD_CTRL	CMD_STAT	• CMD_STAT: ☞ ■ Command status (CMD_STAT) (page 2-4).
3			• This can be used in phases 2 and 3.
4	ID_CODE	ID_CODE	• If ID_CODE is outside the range, CMD_ALM is set to "9H".
5	OFFSET	OFFSET	• If OFFSET is outside the range, CMD_ALM is set to "9H".
6	SIZE	SIZE	• If SIZE does not match, CMD_ALM is set to "9H".
7			
8	Reserved	ID	• The ID data is indeterminate if a CMD_ALM occurs.
9			
10			
11			
12			
13 to 31			

● **Command parameters**

• ID_CODE: ID data selection code

• OFFSET: ID read offset

• SIZE: Read data size (bytes)

• ID: ID data

📖 **Note**

• ☞ Chapter 5. ID_CODE

■ Setup Device Command (CONFIG: 04H)

This performs setup of the device.
If a certain function is not available in the product, an immediate process complete response is returned.

● Completion check

The completion check is based on RCMD=CONFIG(=04H), CMD_STAT. CMDRDY=1, and CONFIG_MOD.
If CMD_STAT.D_ALM or CMD_STAT.D_WAR=1, use ALM_RD to read the alarm code of the current alarm, and take the appropriate corrective action.
If CMD_STAT.CMD_ALM or CMD_STAT.COMM_ALM≠0, take the appropriate corrective action based on the alarm code. (☞ ■ Command status (CMD_STAT) (page 2-4)).

● Command classification

Device group :　　　　Common command group
Communication type:　Asynchronous communication command

● Data format

Data Format (CONFIG)

Byte	Command	Response	Reference
0	CONFIG (04H)	CONFIG (04H)	• WDT/RWDT: ☞ ■ Watchdog data (WDT/RWDT) (page 2-2).
1	WDT	RWDT	• CMD_CTRL: ☞ ■ Command control (CMD_CTRL) (page 2-3).
2	CMD_CTRL	CMD_STAT	
3			• CMD_STAT: ☞ ■ Command status (CMD_STAT) (page 2-4).
4	CONFIG_MOD	CONFIG_MOD	• This can be used in phases 2 and 3.
5	Reserved	Reserved	• If CONFIG_MOD is outside the range, CMD_ALM is set to "9H".
6			
7			
8			
9			
10			
11			
12			
13 to 31			

● Command parameters

• CONFIG_MOD: Configuration mode
0: Parameter recalculation and setup
1: Batch write of command parameters to involatile memory (not supported)
2: Initialization to default parameter setting values (not supported)

● **State of each status when executing CONFIG command**

This indicates the state of each status before and after the CONFIG command process.

Status	Before CONFIG	During CONFIG	After CONFIG
ALM	Current state	Current state	Current state
CMDRDY	1	0	1
Other status	Current state	Undetermined	Current state

■ Read Alarm or Warning Command (ALM_RD: 05H)

The ALM_RD command is used to read the alarm or warning state.
Codes for the alarm status and warning status of current alarms and warnings are read into ALM_DATA.

● **Completion check**

The completion check is based on RCMD=ALM_RD(=05H), CMD_SAT.
CMDRDY=1, ALM_RD_MOD, and ALM_INDEX.

● **Command classification**

Device group : Common command group
Communication type: Asynchronous communication command

● **Data format**

Data Format (ALM_RD)

Byte	Command	Response	Reference
0	ALM_RD (05H)	ALM_RD (05H)	• WDT/RWDT: ☞ ■ Watchdog data (WDT/RWDT) (page 2-2).
1	WDT	RWDT	• CMD_CTRL: ☞ ■ Command control (CMD_CTRL) (page 2-3).
2	CMD_CTRL	CMD_STAT	• CMD_STAT: ☞ ■ Command status (CMD_STAT) (page 2-4).
3			
4	ALM_RD_ MOD	ALM_RD_ MOD	• This can be used in phases 2 and 3.
5			• If ALM_RD_MOD is outside the range, CMD_ALM is set to "9H".
6	ALM_INDEX	ALM_INDEX	• If ALM_INDEX is outside the range, CMD_ALM is set to "9H".
7			
8	Reserved	ALM_DATA	
9			
10			
11			
12			
13 to 31			

Note: In ALM_DATA, two bytes are used to specify one alarm.
The history data is arranged in order starting from the newest alarm. The normal status is specified by "0".

● **Command parameters**

• ALM_RD_MODE: Read mode

0: Current alarm/warning status read

1: Alarm history read

Maximum of 12 alarms/warnings (bytes 8 to 31 in 2-byte steps)

If the number of alarms and warnings is less than 12, the bytes are filled with "0".

2: Details of the alarm/warning that currently occurred are obtained individually. (Not supported)

3: Details of the alarm history are obtained separately. (Not supported)

• ALM_INDEX: Alarm index (Not supported)

• ALM_DATA: Alarm/warning code (☞ Chapter 7.   Alarm and Warning Codes.)

■ Clear Alarm of Warning Command (ALM_CLR: 06H)

This clears the alarm status or warning status. This command changes the status of the slave station, and it does not clear the cause of the alarm/warning. After eliminating the cause of the alarm/warning, use this command to clear the status.
If a communication error (receive error) or synchronous communication error (watchdog data error) occurred during synchronous communication, after this command is executed, synchronous communication must be recovered using a SYNC_SET command.

● **Completion check**

The completion check is based on RCMD=ALM_CLR(=06H), CMD_STAT. CMDRDY=1, and ALM_CLR_MOD.
If CMD_STAT.D_ALM or CMD_STAT.D_WAR=1, use ALM_RD to read the alarm code of the current alarm, and take the appropriate corrective action.
If CMD_STAT.CMD_ALM or CMD_STAT.COMM_ALM≠0, take the appropriate corrective action based on the alarm code. (☞ ■ Command status (CMD_STAT) (page 2-4).)

● **Command classification**

Device group :   Common command group
Communication type: Asynchronous communication command

● **Data format**

Data Format (ALM_CLR)

Byte	Command	Response	Reference
0	ALM_CLR (06H)	ALM_CLR (06H)	• WDT/RWDT: ☞ ■ Watchdog data (WDT/RWDT) (page 2-2).
1	WDT	RWDT	• CMD_CTRL: ☞ ■ Command control (CMD_CTRL) (page 2-3).
2	CMD_CTRL	CMD_STAT	
3			• CMD_STAT: ☞ ■ Command status (CMD_STAT) (page 2-4).
4	ALM_CLR_MOD	ALM_CLR_MOD	• This can be used in phases 2 and 3.
5			• If ALM_CLR_MOD is outside the range, CMD_ALM is set to "9H".
6	Reserved	Reserved	
7			
8			
9			
10			
11			
12			
13 to 31			

● **Command parameters**

ALM_CLR_MODE: Alarm clear mode
0: Clears current alarm/warning
1: Clears alarm history

■ Start Synchronous Communication Command (SYNC_SET: 0DH)

This is a command for requesting the start of synchronous communication. Synchronous communication is started when this command is completed. If communication is switched to asynchronous communication due to a communication error or other cause, this command is used to recover synchronous communication. Synchronization is established based on the changing edge of the watchdog data (WDT) during issuing of this command.
The C1 master station holds this command until command processing is complete. After this command is completed, watchdog data error detection begins.

● **Completion check**

The completion check is based on RCMD=SYNC_SET (=0DH) and CMD_STAT. CMDRDY=1.
If CMD_STAT.D_ALM or CMD_STAT.D_WAR=1, use ALM_RD to read the alarm code of the current alarm, and take the appropriate corrective action.
If CMD_STAT.CMD_ALM or CMD_STAT.COMM_ALM≠0, take the appropriate corrective action based on the alarm code. (☞ ■ Command status (CMD_STAT) (page 2-4).)

● **Command classification**

Device group :   Common command group
Communication type: Asynchronous communication command

● **Data format**

Data Format (SYNC_SET)

Byte	Command	Response	Reference
0	SYNC_SET (0DH)	SYNC_SET (0DH)	• WDT/RWDT: ☞ ■ Watchdog data (WDT/RWDT) (page 2-2).
1	WDT	RWDT	• CMD_CTRL: ☞ ■ Command control (CMD_CTRL) (page 2-3).
2	CMD_CTRL	CMD_STAT	• CMD_STAT: ☞ ■ Command status (CMD_STAT) (page 2-4).
3			• If this is already phase 3, a normal response is sent without performing any operation.
4	Reserved	Reserved	
5			• If the value of COMM_ALM is 8 or higher, this command must be sent to restart synchronous communication.
6			
7			
8			
9			
10			
11			
12			
13 to 31			

■ Establish Connection Command (CONNECT: 0EH)

The CONNECT command is used to establish a MECHATROLINK connection. After this command is completed, control of a slave station by MECHATROLINK communication is started.

● Completion check

The completion check is based on RCMD=CONNECT(=0EH), CMD_STAT. CMDRDY=1, and setting data (VER, COM_MODE, COM_TIME, and PROFILE_TYPE).

If CMD_STAT.D_ALM or CMD_STAT.D_WAR=1, use ALM_RD to read the alarm code of the current alarm, and take the appropriate corrective action.

If CMD_STAT.CMD_ALM or CMD_STAT.COMM_ALM≠0, take the appropriate corrective action based on the alarm code. (☞ ■ Command status (CMD_STAT) (page 2-4).)

● Command classification

Device group :   Common command group
Communication type: Asynchronous communication command

● Data format

Data Format (CONNECT)

Byte	Command	Response	Reference
0	CONNECT (0EH)	CONNECT (0EH)	• WDT/RWDT: ☞ ■ Watchdog data (WDT/RWDT) (page 2-2).
1	WDT	RWDT	• CMD_CTRL: ☞ ■ Command control (CMD_CTRL) (page 2-3).
2	CMD_CTRL	CMD_STAT	
3			• CMD_STAT: ☞ ■ Command status (CMD_STAT) (page 2-4).
4	VER	VER	• This can be used in phase 1.
5	COM_MOD	COM_MOD	• When using phases 2 or 3, a normal response is sent to this com-
6	COM_TIM	COM_TIM	mand, but the command is not executed.
7	PROFILE_TYPE	PROFILE_TYPE	• If VER is outside the range, CMD_ALM is set to "9H".
8	Reserved	Reserved	• If COM_TIM is outside the range, CMD_ALM is set to "9H".
9			
10			• If PROFILE_TYPE is outside the range, CMD_ALM is set to "9H".
11			
12			
13 to 31			

● **Command parameters**

- VER: MECHATROLINK application layer version
  VER = 30H is specified.

- COM_MODE: Communication mode

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
SUBCMD	0	0	0	DTMODE		SYNCMODE	0

- SYNCMODE: Synchronization setting
  1: Synchronous communication is performed.
  (Watchdog data error detection is enabled. Synchronous communication commands can be used.)

  0: Asynchronous communication is performed.
  (Watchdog data error detection is disabled. Synchronous communication commands cannot be used.)

- DTMODE: Data transfer method
  00: Single transmission
  01: Consecutive transmission (not supported)
  10: Reserved
  11: Reserved

- SUBCMD: Subcommand setting
  0: Subcommand disabled
  1: Subcommand enabled (not supported)

- COM_TIME: Communication cycle setting
  This sets the multiplier of the transmission cycle that is used as the communication cycle.
  Example: To use a communication cycle of 2 (ms) at a transmission cycle of 0.5 (ms), set COM_TIME=2/0.5=4.

- PROFILE_TYPE: Profile type setting
  This sets the profile type that is used.
  To set the standard I/O profile command, specify PROFILE_TYPE=30H.

■ Release Connection Command (DISCONNECT: 0FH)

When releasing a connection, the C1 master station transmits the DISCONNECT command for two or more communication cycles. When disconnecting, the slave station aborts the current process and performs the required initialization for reestablishing a connection.

Then, a connection request wait for the C1 master station is performed.

This command can be issued regardless of the status of CMD_STAT.CMDRDY.

If this command is issued when CMD_STAT.CMDRDY=0, the process is aborted, and the process for this command is executed.

● Completion check

The command issuing time for the C1 master station is managed as two or more communication cycles.

● Command classification

Device group :   Common command group

Communication type: Asynchronous communication command

● Data format

Data Format (DISCONNECT)

Byte	Command	Response	Reference
0	DISCONNECT (0FH)	DISCONNECT (0FH)	• This can be used in all phases. • When this command is received, operation changes to phase 1. • If the power of the slave device is turned off simultaneously with receiving this command, the response data is indeterminate.
1	Reserved	Reserved	
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13 to 31			

■ Asynchronous Data Read/Write Command (DATA_RWA: 20H)

The DATA_RWA command is used to refresh I/O data asynchronously.

● **Completion check**

The completion check is based on RCMD=DATA_RWA (=20H) and CMD_STAT.CMDRDY=1.
If CMD_STAT.D_ALM or CMD_STAT.D_WAR=1, use ALM_RD to read the alarm code of the current alarm, and take the appropriate corrective action.
If CMD_STAT.CMD_ALM or CMD_STAT.COMM_ALM≠0, take the appropriate corrective action based on the alarm code. (☞ ■ Command status (CMD_STAT) (page 2-4).)

● **Command classification**

Device group : Common command group
Communication type: Asynchronous communication command

● **Data format**

Data Format (DATA_RWA): 32 bytes

Byte	Command	Response	Reference
0	DATA_RWA (20H)	DATA_RWA (20H)	• WDT/RWDT: ☞ ■ Watchdog data (WDT/RWDT) (page 2-2).
1	WDT	RWDT	
2	CMD_CTRL	CMD_STAT	• CMD_CTRL: ☞ ■ Command control (CMD_CTRL) (page 2-3).
3			
4	DI	PV1	• CMD_STAT: ☞ ■ Command status (CMD_STAT) (page 2-4).
5			
6	Reserved		• This can be used in phases 2 and 3.
7			
8		PV2	
9			
10			
11			
12		PV3	
13			
14			
15			
16		PV4	
17			
18			
19			
20		Ch. 1 event occurrence status	
21			
22		Ch. 2 event occurrence status	
23			
24		Ch. 3 event occurrence status	
25			
26		Ch. 4 event occurrence status	
27			
28		Controller status	
29			
30		Error status bit	
31			

● **Data format**

Data Format (DATA_RWA): 48 bytes

Byte	Command	Response	Reference
0	DATA_RWA (20H)	DATA_RWA (20H)	• WDT/RWDT: ☞ ■ Watchdog data (WDT/RWDT) (page 2-2).
1	WDT	RWDT	
2	CMD_CTRL	CMD_STAT	• CMD_CTRL: ☞ ■ Command control (CMD_CTRL) (page 2-3).
3			
4	DI	PV1	• CMD_STAT: ☞ ■ Command status (CMD_STAT) (page 2-4).
5			
6	Reserved		• This can be used in phases 2 and 3.
7			
8		PV2	
9			
10			
11			
12		PV3	
13			
14			
15			
16		PV4	
17			
18			
19			
20		Event occurrence status (Channels 1-4 all OR)	
21			
22		Ch. 1 event occurrence status	
23			
24		Ch. 2 event occurrence status	
25			
26		Ch. 3 event occurrence status	
27			
28		Ch. 4 event occurrence status	
29			
30		DI status	
31			
32		DO status	
33			
34		Controller status	
35			
36		Error status bit	
37			
38		Sensor head 1 status	
39			
40		Sensor head 2 status	
41			
42		Sensor head 3 status	
43			
44		Sensor head 4 status	
45			
46		Reserved	
47			

● **Command parameters**

☞ ■ DATA_RWA and DATA_RWS command parameters (page 2-21).

■ Synchronous Data Read/Write Command (DATA_RWS: 21H)

The DATA_RWS command is used to refresh I/O data synchronously.

● Completion check

The completion check is based on RCMD=DATA_RWS (=21H) and CMD_STAT.CMDRDY=1.
If CMD_STAT.D_ALM or CMD_STAT.D_WAR=1, use ALM_RD to read the alarm code of the current alarm, and take the appropriate corrective action.
If CMD_STAT.CMD_ALM or CMD_STAT.COMM_ALM≠0, take the appropriate corrective action based on the alarm code. (☞ ■ Command status (CMD_STAT) (page 2-4).)

● Command classification

Device group :   Common command group
Communication type: Synchronous type command

● Data format

Data Format (DATA_RWS): 32 bytes

Byte	Command	Response	Reference
0	DATA_RWS (21H)	DATA_RWS (21H)	• WDT/RWDT: ☞ ■ Watchdog data (WDT/RWDT) (page 2-2).
1	WDT	RWDT	• CMD_CTRL: ☞ ■ Command control (CMD_CTRL) (page 2-3).
2	CMD_CTRL	CMD_STAT	• CMD_STAT: ☞ ■ Command status (CMD_STAT) (page 2-4).
3			
4	DI	PV1	• This can be used in phase 3.
5			
6	Reserved		• If phase 2 is used, CMD_ALM is set to "C".
7			
8		PV2	
9			
10			
11			
12		PV3	
13			
14			
15			
16		PV4	
17			
18			
19			
20		Ch. 1 event occurrence status	
21			
22		Ch. 2 event occurrence status	
23			
24		Ch. 3 event occurrence status	
25			
26		Ch. 4 event occurrence status	
27			
28		Controller status	
29			
30		Error status bit	
31			

● **Data format**

Data Format (DATA_RWS): 48 bytes

Byte	Command	Response	Reference
0	DATA_RWS (21H)	DATA_RWS (21H)	• WDT/RWDT: ☞ ■ Watchdog data (WDT/RWDT) (page 2-2).
1	WDT	RWDT	• CMD_CTRL: ☞ ■ Command control (CMD_CTRL) (page 2-3).
2	CMD_CTRL	CMD_STAT	• CMD_STAT: ☞ ■ Command status (CMD_STAT) (page 2-4).
3			
4	DI	PV1	• This can be used in phase 3.
5			
6	Reserved		• If phase 2 is used, CMD_ALM is set to "C".
7			
8		PV2	
9			
10			
11			
12		PV3	
13			
14			
15			
16		PV4	
17			
18			
19			
20		Event occurrence status (Channels 1-4 all OR)	
21			
22		Ch. 1 event occurrence status	
23			
24		Ch. 2 event occurrence status	
25			
26		Ch. 3 event occurrence status	
27			
28		Ch. 4 event occurrence status	
29			
30		DI status	
31			
32		DO status	
33			
34		Controller status	
35			
36		Error status bit	
37			
38		Sensor head 1 status	
39			
40		Sensor head 2 status	
41			
42		Sensor head 3 status	
43			
44		Sensor head 4 status	
45			
46		Reserved	
47			

● **Command parameters**

📖 **Note**

• ☞ ■ DATA_RWA and DATA_RWS command parameters (page 2-21).

■ DATA_RWA and DATA_RWS command parameters

The parameters of the DATA_RWA and DATA_RWS commands are described below. The parameters are the same as those for monitoring with MODBUS/RTU communication, which is implemented on the K1G-C04 and K1G-C04G. For details, please refer to the section on communication parameters of K1G Series High-Accuracy Position Sensor User's Manual (☞ CP-SP-1385E) or K1G Series High-Accuracy Position Sensor Global Model User's Manual (☞ CP-SP-1397E).

● DI

The digital input bit is set in this field. Bits 0 to 3 correspond to digital input 1 to 4.

Assignment	DI status
Bit 0	DI1: 1 at make, 0 at break
Bit 1	DI2: 1 at make, 0 at break
Bit 2	DI3: 1 at make, 0 at break
Bit 3	DI4: 1 at make, 0 at break
Bits 4-15	No assignment (always 0)

● PV1 to PV4

The value* measured by this product is stored to this field as a 32-bit signed integer. The values in this field are in submicron steps, and negative numbers are expressed as two's complement. An example for PV1 to PV4 is shown below.

Measured value (mm)	Field value (Decimal expression)	Field value (Hexadecimal expression)
99.9999	999999	000F423F
7.5000	75000	000124F8
0.0000	0	00000000
-7.5000	-75000	FFFEDB08
-99.9999	-100000	FFF0BDC1

* The range of measured values is ±99.9999 (mm). If no value is measured, it is read as 0.0000 (mm).

● Event occurrence status (Channels 1–4 all OR) and Channel 1–4 event occurrence status

This field stores results where the measurement status is determined and events that indicate the operation status.

Assignment	Event occurrence status
Bit 0	Pass event occurrence
Bit 1	Out event occurrence
Bit 2	High event occurrence
Bit 3	Low event occurrence
Bit 4	EPS event occurrence
Bit 5	Holding event occurrence
Bit 6	Contamination event occurrence
Bit 7	Output update event occurrence
Bit 8	Normal operation event occurrence
Bits 9-15	No assignment (always 0)

Note: The value of a bit is 1 if the event occurred. Otherwise, it is 0.

● **DO status**

The digital output status is stored in this field.

Assignment	DO status
Bit 0	DO1: 1 at make, 0 at break
Bit 1	DO2: 1 at make, 0 at break
Bit 2	DO3: 1 at make, 0 at break
Bit 3	DO4: 1 at make, 0 at break
Bit 4	DO5: 1 at make, 0 at break
Bit 5	DO6: 1 at make, 0 at break
Bit 6	DO7: 1 at make, 0 at break
Bit 7	DO8: 1 at make, 0 at break
Bits 8-15	No assignment (always 0)

● **Controller status**

The controller status is stored in this field.

Value	Controller status
0	No error
1	Disconnected wire in sensor head
2	Failed

● **Error status bit**

The controller error status is stored in this field.

Assignment	Error status bit
Bit 0	CPU overload
Bit 1	FPGA failed
Bit 2	ROM error
Bit 3	EEPROM error
Bit 4	Disconnected wire in Ch1 sensor head
Bit 5	Disconnected wire in Ch2 sensor head
Bit 6	Disconnected wire in Ch3 sensor head
Bit 7	Disconnected wire in Ch4 sensor head
Bit 8	MECHATROLINK-III communication error
Bits 9-15	No assignment (always 0)

● **Sensor head 1 to 4 status**

The status of each sensor head is stored in this field.

Value	Sensor head status
0	Not connected
1	Not adjusted
2	In use
3	Connected incorrectly
4	Disconnected wire
5	Prohibited

Chapter 3.   PROFILE COMMANDS FOR ID INFORMATION ACQUISITION IN EVENT-DRIVEN COMMUNICATION

3 - 1   Overview

MECHATROLINK-III communication specifications have two modes. One is the cyclic communication mode, where communication is performed at fixed cycles, and the other is the event-driven communication mode where communication is performed non-periodically.

For event-driven communication, the profile for ID information acquisition in event-driven communication is specified as a special profile for acquiring ID data from slave devices. In this profile, connection-type communication compliant with the MECHATROLINK-III communication specifications is performed. The number of transmission bytes is fixed at 16 (with data length fixed at 64 bytes).

A list of profile commands for ID information acquisition in event-driven communication that are supported by this product is given below.

Table of Profile Commands for ID information acquisition in event-driven communication

Profile	Command code (hex)	Command	Operation	Compliance *1	Communication phase*2		Compliance of this product
					1	2	
Common commands	00	NOP	No operation	Mandatory	○	○	Compliant
	03	ID_RD	Read ID	Mandatory	−	○	Compliant
	0E	CONNECT	Request for establishing connection	Mandatory	○	▲	Compliant
	0F	DISCONNECT	Request for releasing connection	Mandatory	○	○	Compliant
	1D	MEM_RD	Read memory	Optional	−	○	Not compliant

*1 Mandatory: To comply with the MECHATROLINK-III communication specifications, devices must support these commands.
   Optional: Devices do not have to support these commands to comply with the MECHATROLINK-III communication specifications. Whether the commands are supported or not can be optionally specified in the product specifications.

*2 The communication phase symbols are shown below.
   × : Command error
   ○ : Execution allowed
   ▲ : Ignored
   − : Undetermined response data

3 - 2   Command Formats

This describes the data format for the commands and responses of the profile for obtaining event-driven communication ID information.

Data Format of Profile for ID information acquisition in event-driven communication

Byte	Command	Response	Reference
0	CMD	RCMD	• CMD/RCMD: This is the command code specified for each command (☞ ■ Command codes (CMD/RCMD) (page 3-2).)
1	WDT	RWDT	
2	CMD_CTRL	CMD_STAT	• WDT/RWDT: Not used.
3			• CMD_CTRL: ☞ ■ Command control (CMD_CTRL) (page 3-2).
4	CMD_DATA	RSP_DATA	• CMD_STAT: ☞ ■ Command status (CMD_STAT) (page 3-3).
5			
6			• CMD_DATA/RSP_DATA:
7			This is specified for each command (see the details for each command starting from the next section).
8			
9			
10			
11			
12			
13			
14			
15			

■ Command codes (CMD/RCMD)

☞ Table of Profile Commands for Obtaining Event-Driven Communication ID Information (page 3-1).

■ Command control (CMD_CTRL)

This explains the CMD_CTRL area of commands. In MECHATROLINK-III, the 2nd and 3rd bytes of the command format are defined as the CMD_CTRL area. The CMD_CTRL area is defined as shown below based on the communication specifications.
The command in this field is enabled even if a CMD_ALM has occurred.

● CMD_CTRL area

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
CMD_ID		Reserved	Reserved	ALM_CLR	Reserved	Reserved	Reserved

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
Reserved							

● ALM_CLR: Clear communication alarms and warnings

• Definition
 0: Disable clearing of alarms and warnings
 1: Execute clearing of alarms and warnings

• Description
 The alarm/warning status is cleared by the rising edge.
 This performs the same operation as ALM_CLR_MODE=0 (clear current alarm/warning status) of the ALM_CLR command.

● **CMD_ID: Command ID**

This is not used in profile commands for obtaining event-driven communication ID information.

■ Command status (CMD_STAT)

This explains the CMD_STAT area of responses. In MECHATROLINK-III, the 2nd and 3rd bytes of the response format are defined as the CMD_STAT area.
The CMD_STAT area is defined as shown below based on the communication specifications.
The command in this field is enabled even if a CMD_ALM has occurred.

● **CMD_STAT area**

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
RCMD_ID		Reserved	Reserved	ALM_CLR_CMP	CMDRDY	D_WAR	D_ALM

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
COMM_ALM				CMD_ALM			

● **D_ALM**

• Definition
1: Device alarm status
0: Other status (including statuses that come under COMM_ALM and CMD_ALM described in the product specifications)

• Description
This bit indicates the device alarm status of the slave station.
If measurement cannot be resumed due to a severe problem (controller status "2" occurs (failure mode activated)), the status becomes D_ALM=1.
COMM_ALM and CMD_ALM are independent.
If a slave station changes from a device alarm status to a normal status by ALM_CLR command and CMD_CTRL.ALM_CLR, the status becomes D_ALM=0.
However, a power reset of this device is required for resetting the alarm status in this device.

● **D_WAR**

• Definition
1: Device warning status in progress
0: Other status (including statuses that come under COMM_ALM and CMD_ALM described in the product specifications)

• Description
This bit indicates the device warning status of the slave station.
If a disconnected wire of the sensor head is detected during usage of two or more sensor heads (controller status "1" occurs (sensor head disconnected wire)), the status becomes D_WAR=1. (If all of the sensor heads being used have a disconnected wire, an alarm status occurs.)
COMM_ALM and CMD_ALM are independent.
If a slave station changes from a device warning status to a normal status by ALM_CLR command and CMD_CTRL.ALM_CLR, the status becomes D_WAR=0.
However, a power reset of this device is required for resetting the warning status in this device.

● CMDRDY

• Definition
 1: Command allowed
 2: Other

• Description
 CMDRDY=0 indicates that a command process is being executed. During this time, the command process that is currently being executed is continued. (New commands received when CMDRDY=0 are discarded.)
 However, the DISCONNECT command only is executed immediately regardless of the CMDRDY value.
 The check of whether command execution is complete is performed using a method shown in the complete check method of the respective command.
 The CMDRDY=0 retention time is specified for each command.
 Even when in an alarm or warning status, this becomes CMDRDY=1 whenever command execution is possible.

● ALM_CLR_CMP

• Definition
 1: ALM_CLR execution complete
 0: Other

• Description
 ALM_CLR_CMP=1 indicates that CMD_CTRL.ALM_CLR=1 was received and the alarm clear process was completed.
 ALM_CLR_CMP is cleared by setting CMD_CTRL.ALM_CLR to "0".

● RCMD_ID

This is not used in profile commands for obtaining event-driven communication ID information, but in this product, CMD_CTRL.CMD_ID (command ID) performs an echo-back.

● CMD_ALM

• Definition
 This sends notification of the command error status.

• Description
 This code indicates a command error. COMM_ALM is independent from D_ALM and D_WAR.
 After a command error occurs, if a normal command is received, CMD_ALM is automatically cleared.
 The phase is not changed even if CMD_ALM is not "0".

Code		Description	Notes
–	0	Normal	
Warning	1	–	Not used.
	2	–	
	3	–	
	4	–	
	5	–	
	6	–	
	7	–	
Alarm	8	Received unsupported command	Notification is sent for alarm status, and command is not executed.
	9	Outside the data range	
	A	–	
	B	–	
	C	Phase error	
	D	–	
	E	–	
	F	–	

● **COMM_ALM**

• Definition

This sends notification of the communication error status.

• Description

This code indicates an error status in MECHATROLINK communication. CMD_ALM is independent from D_ALM and D_WAR.

COMM_ALM is cleared by the CMD_CTRL.ALM_CLR rising edge or ALM_CLR command.

Code		Description	Notes
–	0	Normal	
Warning	1	FCS error	This occurs when isolated errors are detected.
	2	Receive error	
	3	–	
	4	–	
	5	–	
	6	–	
	7	–	
Alarm	8	FCS error	This occurs when an error is detected using the methods below. Error detection methods: 8, 9: Detected when error occurs two consecutive times by the error detection method of the above warning.
	9	Receive error	
	A	–	
	B	–	
	C	–	
	D	–	
	E	–	
	F	–	

3 - 3   Command Details

■ No Operation Command (NOP: 00H)

The NOP command is used for network control.

A response is sent to indicate the current status.

● Completion check

The completion check is based on RCMD=NOP(=00H) and CMD_STAT.
CMDRDY=1.

If CMD_STAT.D_ALM or CMD_STAT.D_WAR=1, take the appropriate corrective
action.

If CMD_STAT.CMD_ALM or CMD_STAT.COMM_ALM≠0, take the appropriate
corrective action based on the alarm code. (☞ ■ Command status (CMD_STAT)
(page 3-3).)

● Command classification

Device group :   Common command group

Communication type: Asynchronous communication command

● Data format

Data Format (NOP)

Byte	Command	Response	Reference
0	NOP (00H)	NOP (00H)	• WDT/RWDT: Not used.
1	WDT	RWDT	• CMD_CTRL: ☞ ■ Command control (CMD_CTRL) (page 3-2).
2	CMD_CTRL	CMD_STAT	
3			• CMD_STAT: ☞ ■ Command status (CMD_STAT) (page 3-3).
4	Reserved	Reserved	
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

■ Read ID Command (ID_RD: 03H)

This is the read command for the device ID. The product information is read as ID data.

Detailed selection of the ID data is performed by specifying ID_CODE.

● Completion check

The completion check is based on RCMD=ID_RD(=03H), CMD_STAT. CMDRDY=1, DEVICE_CODE, OFFSET, and SIZE.

If CMD_STAT.D_ALM or CMD_STAT.D_WAR=1, take the appropriate corrective action.

If CMD_STAT.CMD_ALM or CMD_STAT.COMM_ALM≠0, take the appropriate corrective action based on the alarm code. (☞ ■ Command status (CMD_STAT) (page 3-3).)

● Command classification

Device group :   Common command group

Communication type: Asynchronous communication command

● Data format

Data Format (ID_RD)

Byte	Command	Response	Reference
0	ID_RD (03H)	ID_RD (03H)	• WDT/RWDT: Not used.
1	WDT	RWDT	• CMD_CTRL: ☞ ■ Command control (CMD_CTRL) (page 3-2).
2	CMD_CTRL	CMD_STAT	• CMD_STAT: ☞ ■ Command status (CMD_STAT) (page 3-3).
3			
4	ID_CODE	ID_CODE	• This can be used in phase 2.
5	OFFSET	OFFSET	• If ID_CODE is outside the range, CMD_ALM is set to "9H".
6	SIZE	SIZE	• If OFFSET is outside the range, CMD_ALM is set to "9H".
7			
8	Reserved	ID	• If SIZE does not match, CMD_ALM is set to "9H".
9			• The ID data is indeterminate if a CMD_ALM occurs.
10			
11			
12			
13			
14			
15			

● Command parameters

• ID_CODE: ID data selection code

• OFFSET: ID read offset

• SIZE: Read data size (bytes)

• ID: ID data

📖 Note

• For details on ID_CODE and its content, ☞ Chapter 5.   ID_CODE.

■ Establish Connection Command (CONNECT: 0EH)

The CONNECT command is used to establish a MECHATROLINK connection. After this command is completed, control of a slave station by MECHATROLINK communication is started.

● Completion check

The completion check is based on RCMD=CONNECT(=0EH), CMD_STAT. CMDRDY=1, and setting data (VER, COM_MODE, COM_TIME, and PROFILE_TYPE).
If CMD_STAT.D_ALM or CMD_STAT.D_WAR=1, take the appropriate corrective action.
If CMD_STAT.CMD_ALM or CMD_STAT.COMM_ALM≠0, take the appropriate corrective action based on the alarm code. (☞ ■ Command status (CMD_STAT) (page 3-3).)

● Command classification

Device group :　　　Common command group
Communication type: Asynchronous communication command

● Data format

Data Format (CONNECT)

Byte	Command	Response	Reference
0	CONNECT (0EH)	CONNECT (0EH)	• WDT/RWDT: Not used.
1	WDT	RWDT	• CMD_CTRL: ☞ ■ Command control (CMD_CTRL) (page 3-2).
2	CMD_CTRL	CMD_STAT	
3			• CMD_STAT: ☞ ■ Command status (CMD_STAT) (page 3-3).
4	VER	VER	• This can be used in phase 1.
5	COM_MOD	COM_MOD	• When using phase 2, this command is ignored.
6	COM_TIM	COM_TIM	
7	PROFILE_TYPE	PROFILE_TYPE	• If VER is outside the range, CMD_ALM is set to "9H".
8	Reserved	Reserved	• If COM_TIM is outside the range, CMD_ALM is set to "9H".
9			
10			• If PROFILE_TYPE is outside the range, CMD_ALM is set to "9H".
11			
12			
13			
14			
15			

● Command parameters

• VER: MECHATROLINK application layer version
 VER = 30H is specified.

• COM_MODE: Communication mode
 COM_MODE = 00H is specified.

• COM_TIME: Communication cycle
 COM_TIM = 00H is specified.

• PROFILE_TYPE: Profile type
 PROFILE_TYPE = 01H is specified.

■ Release Connection Command (DISCONNECT: 0FH)

When releasing a connection, the C1 master station transmits the DISCONNECT command for two or more communication cycles. When disconnecting, the slave station aborts the current process and performs the required initialization for reestablishing a connection.

Then, a connection request wait for the C1 master station is performed.

This command can be issued regardless of the status of CMD_STAT.CMDRDY. If this command is issued when CMD_STAT.CMDRDY=0, the process is aborted, and the process for this command is executed.

● **Completion check**

The command issuing time for the C1 master station is managed as two or more communication cycles.

● **Command classification**

Device group :   Common command group
Communication type: Asynchronous communication command

● **Data format**

Data Format (DISCONNECT)

Byte	Command	Response	Reference
0	DISCONNECT (0FH)	DISCONNECT (0FH)	• This can be used in all phases.
1	Reserved	Reserved	• When this command is received, operation changes to phase 1.
2			
3			• If the power of the slave device is turned off simultaneously with receiving this command, the response data is indeterminate.
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

Chapter 4. MESSAGE COMMUNICATION

4 - 1 Overview

The communication type for MECHATROLINK-III message communication is master-slave communication (half-duplex communication) where the slave returns a response message to a command message sent from the master. Command messages (communication start) can be issued from the master only. The slave executes functions specified by the command message and returns a response message.

4 - 2   Format

The message format consists of the command/response and components in the data format shown below.

Message Format

Byte	Description
0	Slave address
1	Function code
2	Extended address
3	Command status/response status
4	Subfunction code
5	Mode/Data type
6	Data count (data size) (Hi)
7	Data count (data size) (Lo)
8 and higher	Data

● **Slave address**

This is the slave address (03H to EFH). When a command message is sent by the master to the slave, the slave address is set in this field. The slave receives only command messages addressed specifically to it. Whenever the slave returns a response message to the master, its own address is written. This enables the master to know which slave the reply was sent from.

● **Function code**

This is a code that indicates the MECHATROLINK message function, and it is fixed at 42H.

After execution, if a response message is returned, the same function code is written in a normal response message, and the function code +80H is written in an error response message.

This enables the master to know which function code this response message is for.

● **Extended address**

This is not used in this product. A value of "0" is specified.

● **Command status/response status**

This is not used in this product. A value of "0" is specified.

● **Subfunction code**

This is a code that indicates the message function. The master uses the function code to specify the function to be executed by the slave. For details on the functions available in this product, ☞ 4 - 4   Table of Function Codes.

● **Mode/Data type**

• Bit 7 to bit 4: Mode
(When using memory access subfunction (01H))
1H: RAM or other volatile memory is specified.
2H: EEPROM or other non volatile memory is specified: Not supported

• Bit 3 to bit 0: Data type
(When using memory access subfunction (01H))
1H: Byte type (1 byte): Not supported
2H: Short type (2 bytes): Not supported
3H: Long type (4 bytes)
4H: Long long type (8 bytes): Not supported

● **Data count/data size**

(When using memory access subfunction (01H))
This specifies the data count using the specified data type as the units. (This is sequenced in big endian.)

● **Data**

This sets data defined for each function code. The data length, components, and meaning are specified by the respective function code. (The data is sequenced in big endian.)
For details, see the description of the message format for the respective function code.
Up to 768 bytes can be used in the data area.

4 - 3   Types of Slave Response

There are three types of slave response to command messages from the master.

■ Normal response

If the command message was received normally and the process was performed normally, a normal response message is returned.

■ Error response

If the command message was received normally, but the process could not be performed for some reason, an error response message is returned. In the error response message, the function code +80H is written in the function code field, and an error code is written in the mode/data type field.

☞ 4 - 5 Table of Error Codes.

■ No response

The slave does not send any response in the cases below.

• When a transmission error (overrun, framing, parity, etc.) is detected in the command message

• When the slave address in the command message does not match the slave address that was assigned to the slave

• When the data length of the command message is invalid

4 - 4   Table of Function Codes

This is a table of function codes.

Function Code	Sub-function Code	Function	Compliance of this product
42H	MECHATROLINK message function		
	01H	Read memory	Compliant
	02H	Write memory	Not compliant
	03H	Read memory (non-contiguous)	Not compliant
	04H	Write memory (non-contiguous)	Not compliant
	06H	Write memory with mask	Not compliant
	11H	Read maximum message size	Compliant
	21H	Message abort	Not compliant
	31H	Download request	Not compliant
	32H	Download data	Not compliant
	33H	Download complete	Not compliant
	34H	Upload request	Not compliant
	35H	Upload data	Not compliant
	36H	Upload complete	Not compliant
	7FH	Vendor-specific commands	Compliant
	80H-FFH	Not usable (Reserved: Error sub-function code)	–

4 - 5   Table of Error Codes

The error codes used in response messages when an error occurs are shown in the table below.

Error code		Details
01H	Function code error	An unsupported function or sub-function code is specified.
02H	Memory address error	The memory addresses to which access was attempted is not registered.
03H	Data length error	The length of data to be read or written is not within the specified range.
04H	Data type error	The specified mode or data type is not supported. An unsupported protocol ID or device code is specified.
81H	Protocol ID setting error	The protocol ID set upon executing a vendor-specific command does not match that of the connected device.
82H	Data length setting error	The data length set upon executing a vendor-specific command does not match the length of the data that is actually set for the vendor-defined area (from the 12th byte onward).
83H	Vendor-defined area error	There is an error in the vendor-defined area (from the 12th byte onward) upon executing a vendor-specific command. (Details of the error are notified using the vendor-defined area.)

4 - 6   Message Details

Details on MECHATROLINK message functions supported by this product are described in detail below.

■ Read memory (Subfunction code: 01H)

● Function

Consecutive virtual memory content is read for the specified data count of the specified memory type from the specified start address (32-bit length).
(☞ Chapter 6. Virtual Memory Space.)
The maximum value of the data count that can be read in one operation can be calculated from the message size that is read in "Read maximum message size" (subfunction code: 11H).

● Message format

Data Format (Read memory)

Byte	Command	Response	
		Normal	Error
0	Slave address	Slave address	Slave address
1	Function code (42H)	Function code (42H)	Function code+80H (C2H)
2	Extended address (00H)	Extended address (00H)	Extended address (00H)
3	Command status (00H)	Response status (00H)	Response status (00H)
4	Subfunction code (01H)	Subfunction code (01H)	Subfunction code (01H)
5	Mode/Data type (13H)	Mode/Data type (13H)	Error code
6	Long data count	Long data count	Reserved (0000H)
7			
8	Start address	Data #1	Error detection address
9			
10			
11			
12		Data #2	
13			
14			
15	–		–
16			
17		⋮	
18 and higher			

■ Read maximum message size (Subfunction code: 11H)

● Function

This reads the maximum size of the message. The maximum message size is unsigned 32-bit data, and the byte count is sent as a response.

Based on the maximum message size, the command transmitter can convert the maximum reading/writing data count for each command.

● Message format

Data Format (Read Maximum Message Size)

Byte	Command	Response	
		Normal	Error
0	Slave address	Slave address	Slave address
1	Function code (42H)	Function code (42H)	Function code + 80H (C2H)
2	Extended address (00H)	Extended address (00H)	Extended address (00H)
3	Command status (00H)	Response status (00H)	Response status (00H)
4	Subfunction code (11H)	Subfunction code (11H)	Subfunction code (11H)
5	Reserved (00H)	Reserved (00H)	Error code
6	Reserved (0000H)	Reserved (0000H)	Reserved (0000H)
7			
8	–	Maximum message size (bytes)	–
9			
10			
11			

■ Vendor-specific commands (Subfunction code: 7FH)

● Function

This is a command defined specifically for this product.
The MODBUS/RTU command installed in K1G-C04 (G) is stored in the data.

● Message format

Data Format (Vendor-Specific Commands)

Byte	Command	Response	
		Normal	Error
0	Slave address	Slave address	Slave address
1	Function code (42H)	Function code (42H)	Function code + 80H (C2H)
2	Extended address (00H)	Extended address (00H)	Extended address (00H)
3	Command status (00H)	Response status (00H)	Response status (00H)
4	Subfunction code (7FH)	Subfunction code (7FH)	Subfunction code (7FH)
5	Reserved (00H)	Reserved (00H)	Error code
6	Protocol ID (048AH)	Protocol ID (048AH)	Protocol ID (048AH)
7			
8	Data length[1] (byte count)	Data length[1] (byte count)	Data length[1] (byte count)
9			
10			
11			
12	Reserved (00H)	Reserved (00H)	Vendor error code[4]
13	Azbil protocol ID[2] (00000001H)	Azbil protocol ID[2] (00000001H)	Azbil protocol ID[2] (00000001H)
14			
15			
16	MODBUS/RTU[3] command	MODBUS/RTU[3] response	Error code
17			Reserved (000000H)
18			MODBUS RTU[3] [5]
19			Error response
20 and higher			

*1 The data length after the 12th byte is set in byte units.

*2 This is an ID for identifying the format starting from the 16th byte.

*3 The format of the MODBUS/RTU command is the same as that of the RS-485 communication message for the K1G-C04 (analog output model). The station address specified in the message is the same as the slave address specified in MECHA-TROLINK-III communication messages. For details, please refer to the section on communication settings in K1G Series High-Accuracy Position Sensor User's Manual (☞ CP-SP-1385E) or K1G Series High-Accuracy Position Sensor Global Model User's Manual (☞ CP-SP-1397E).

*4 If the error code is a vendor-defined area error (83H), the vendor error codes below are used.

*5 If the vendor error code is not a MODBUS error response (81H), it is 16-byte response data.

■ Vendor error code

Error code	Description	
01H	Azbil protocol ID setting error	The specified Azbil protocol ID is not supported.
81H	MODBUS/RTU error response	MODBUS/RTU sent an error response.

Chapter 5.   ID_CODE

ID_CODE is a value returned based on the details in the MECHATROLINK-III communication specifications.

ID_CODE Table

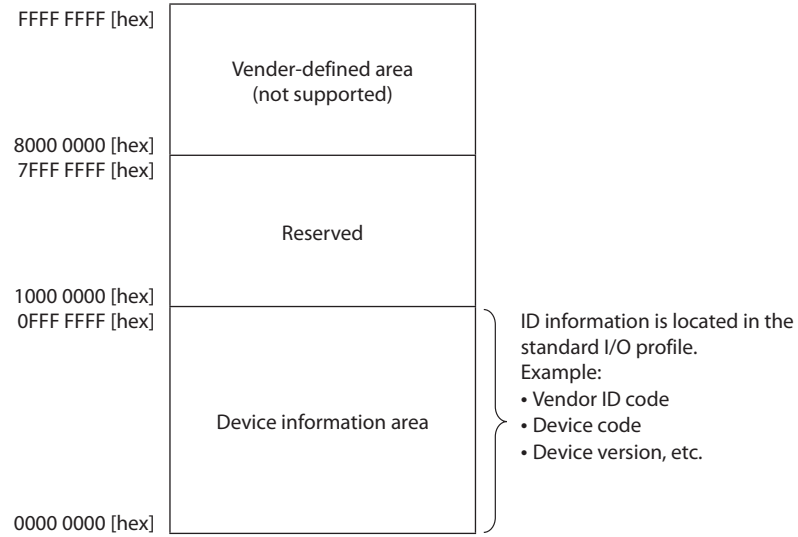| ID number (hex)	Name	Description	Size	Supported	Value (hex)	Notes
01	Vendor ID code	ID code that specifies the vendor	4	Supported	0000048A	Azbil: MMC1162
02	Device code	Code specific to this product	4	Supported	00000001	–
03	Device version	Version information for this product	4	Supported	00000100	Communication protocol version
04	Device Information (MDI) file version	Vender information of the device information file (MDI) supported by his product	4	Supported	00001000	–
05	Extended Address Setting	Extended address specification count supported by this product	4	Supported	00000001	–
06	Serial No.	Serial number of this product (ASCII code, delimiter "00")	32	Supported	XXXXXXXX YYYYYYYY ZZZZZZZZ 00000000 00000000 00000000 00000000 00000000	XXXXXXXX: Production year (2014 is the year 2014) YYYYYYYY: Production month and date (1002 is October 2) ZZZZZZZZ: Sequential number for production date
10	Profile Type 1	Profile type 1 supported by this product	4	Supported	00000030	Standard I/O profile
11	Profile Version 1	Profile version 1 supported by this product	4	Supported	00000100	–
12	Profile Type 2	Profile type 2 supported by this product	4	Supported	000000FF	Not supported
13	Profile Version 2	Profile version 2 supported by this product	4	Supported	00000000	–
14	Profile Type 3	Profile type 3 supported by this product	4	Supported	000000FF	Not supported
15	Profile Version 3	Profile version 3 supported by this product	4	Supported	00000000	–
16	Minimum Value of Transmission Cycle	Minimum value of transmission cycle supported by this product (units: 0.01 μs)	4	Supported	000061A8	250μs
17	Maximum Value of Transmission Cycle	Maximum value of transmission cycle supported by this product (units: 0.01 μs)	4	Supported	0061A800	64ms
18	Transmission Cycle Increment (Granularity)	The increment of transmission cycle supported by this product	4	Supported	00000002	Supports 31.25, 62.5, 125, 250, 500 μs, and 1 to 64ms (0.5 msec steps)
19	Minimum Value of Communication Cycle	Minimum value of communication cycle supported by this product (units: 0.01 μs)	4	Supported	000061A8	250 μs
1A	Maximum Value of Communication Cycle	Maximum value of communication cycle supported by this product (units: 0.01 μs)	4	Supported	0061A800	64ms
1B	Number of Transmission Bytes	The number of transmission bytes supported by this product	4	Supported	0000000C	32 or 48 bytes
1C	Number of Transmission Bytes (current setting value)	The number of transmission bytes that is currently set for the device	4	Supported	XXXXXXXX	32 or 48 bytes
1D	Profile Type (current selection value)	Profile type selected by CONNECT command	4	Supported	XXXXXXXX	Standard I/O profile (30H) or profile for obtaining event-driven communication ID information (01H)
20	Supported Communication Mode	Communication mode supported by this product	4	Supported	00000007	Message, cyclic communication, and event-driven communication

ID number (hex)	Name	Description	Size	Supported	Value (hex)	Notes
21	MAC Address	MAC address	8	Not supported	–	
30	List of Supported Main Commands	List of main commands supported by this product	32	Supported	0000E079	NOP,ID_RD, CONFIG, ALM_RD, ALM_CLR, SYNC_SET, CON-NECT, DISCONNECT, DATA_RWA, DATA_RWS
					00000003	
					00000000	
					00000000	
					00000000	
					00000000	
					00000000	
					00000000	
38	List of Supported Subcommands	List of subcommands supported by device	32	Not supported	–*	Not used in standard I/O profile
40	List of Supported Common Parameters	List of common parameter numbers supported by device	32	Not supported	–*	Not used in standard I/O profile
60	List of Supported Message Communication Sub-functions	MECHATROLINK message communication function (42H) subfunction support list	32	Supported	00020002	Vendor-specific commands
					00000000	
					00000000	
					80000000	
					00000000	
					00000000	
					00000000	
					00000000	
68	Message Communication Message Relay Support	Support status for message relay commands and maximum number of supportable relay steps	4	Supported	00030001	Relay cmd.: supported Maximum number of relay steps: 3
69	Message Communication Timeout Period	Command process timeout time for message command	4	Supported	00000005	5s
6A	Message Communication Timeout Period (For file access commands)	Command process timeout time for file access command	4	Supported	00000005	5s
80	Main Device Name	Main device name (ASCII code, delimiter "00")	32	Supported	2D47314B	K1G-C04M
					4D343043	
					00000000	
					00000000	
					00000000	
					00000000	
					00000000	
					00000000	
90	Sub Device 1 Name	Subdevice 1 name	32	Not supported	–*	–
98	Sub Device 1 Version	Subdevice version 1 version	4	Not supported	–*	–
A0	Sub Device 2 Name	Subdevice 2 name	32	Not supported	–*	–
A8	Sub Device 2 Version	Subdevice version 2 version	4	Not supported	–*	–
B0	Sub Device 3 Name	Subdevice 3 name	32	Not supported	–*	–
B8	Sub Device 3 Version	Subdevice version 3 version	4	Not supported	–*	–

* All unsupported IDs have a value of 0.

Chapter 6.   VIRTUAL MEMORY SPACE

6 - 1   Allocation of Virtual Memory Space

The address space for the virtual memory is defined as shown below for unifying the different memory spaces of various vendors in MECHATROLINK-III. The vender-defined area can be used freely by any vendor.

```
FFFF FFFF [hex]  ┌─────────────────────┐
                 │                     │
                 │  Vender-defined area│
                 │   (not supported)   │
                 │                     │
8000 0000 [hex]  ├─────────────────────┤
7FFF FFFF [hex]  │                     │
                 │                     │
                 │      Reserved       │
                 │                     │
1000 0000 [hex]  ├─────────────────────┤      ┐  ID information is located in the
0FFF FFFF [hex]  │                     │      │  standard I/O profile.
                 │                     │      │  Example:
                 │                     │      ┤  • Vendor ID code
                 │ Device information area│    │  • Device code
                 │                     │      │  • Device version, etc.
0000 0000 [hex]  └─────────────────────┘      ┘
```

6 - 2   Device Information Area Details

The data configuration table for the device information area is shown below. (Unspecified values are all 0.)

Address	Description
0000 0000 to 0000 0003	Not specified
0000 0004 to 0000 0007	Vendor ID code
0000 0008 to 0000 000B	Device code
0000 000C to 0000 000F	Device version
0000 0010 to 0000 0013	Device information (MDI) file version
0000 0014 to 0000 0017	Extended address setting
0000 0018 to 0000 0037	Serial number
0000 0038 to 0000 003F	Not specified
0000 0040 to 0000 0043	Profile type 1
0000 0044 to 0000 0047	Profile version 1
0000 0048 to 0000 004B	Profile type 2
0000 004C to 0000 004F	Profile version 2
0000 0050 to 0000 0053	Profile type 3
0000 0054 to 0000 0057	Profile version 3
0000 0058 to 0000 005B	Transmission cycle minimum value
0000 005C to 0000 005F	Transmission cycle maximum value
0000 0060 to 0000 0063	Transmission cycle increment
0000 0064 to 0000 0067	Communication cycle minimum value
0000 0068 to 0000 006B	Communication cycle maximum value
0000 006C to 0000 006F	Number of transmission bytes
0000 0070 to 0000 0073	Number of transmission bytes (current setting value)
0000 0074 to 0000 0077	Profile type (current selection value)
0000 0078 to 0000 007F	Not specified
0000 0080 to 0000 0083	Supported communication mode
0000 0084 to 0000 008B	MAC address (not supported)
0000 008C to 0000 00BF	Not specified
0000 00C0 to 0000 00DF	Main command support list
0000 00E0 to 0000 00FF	Subcommand support list (not supported)
0000 0100 to 0000 011F	Common parameter support list (not supported)
0000 0120 to 0000 017F	Not specified
0000 0180 to 0000 019F	Message communication: subfunction support list
0000 01A0 to 0000 01A3	Message communication: message relay support
0000 01A4 to 0000 01A7	Message communication: timeout time
0000 01A8 to 0000 01AB	Message communication: timeout time (for file access command)
0000 01AC to 0000 01FF	Not specified
0000 0200 to 0000 021F	Main device name
0000 0220 to 0000 023F	Not specified
0000 0240 to 0000 025F	Subdevice 1 name (not supported)
0000 0260 to 0000 0263	Subdevice 1 version (not supported)
0000 0264 to 0000 027F	Not specified
0000 0280 to 0000 029F	Subdevice 2 name (not supported)
0000 02A0 to 0000 02A3	Subdevice 2 version (not supported)
0000 02A4 to 0000 02BF	Not specified
0000 02C0 to 0000 02DF	Subdevice 3 name (not supported)
0000 02E0 to 0000 02E3	Subdevice 3 version (not supported)
0000 02E4 to 0FFF FFFF	Not specified (0300H to 0FFFFFFFH: access not allowed)

Chapter 7.   ALARM AND WARNING CODES

The alarms and warnings that are generated by the MECHATROLINK communication functions are shown below.

Table of Alarm and Warning Codes

Type	Alarm code	–	Alarm description
System error (D_ALM)	1XXXH	–	Bit 0: CPU overload Bit 1: FPGA failed Bit 2: ROM error Bit 3: EEPROM error Bit 4: Disconnected wire in Channel 1 sensor head Bit 5: Disconnected wire in Channel 2 sensor head Bit 6: Disconnected wire in Channel 3 sensor head Bit 7: Disconnected wire in Channel 4 sensor head Bit 8: MECHATROLINK-III communication error
System error (D_WAR)	10X0H	–	Bit 4: Disconnected wire in Channel 1 sensor head Bit 5: Disconnected wire in Channel 2 sensor head Bit 6: Disconnected wire in Channel 3 sensor head Bit 7: Disconnected wire in Channel 4 sensor head
Communication setting error	2001H (Station address setting error)	–	A slave that is set with a station address identical to its own station address was found on the same network
	2002H (Communication data size setting error)	–	Communication data could not be received

Type	Alarm code	COMM_ALM	Alarm description
Communication error (COMM_ALM)	3001H (FCS error warning)	1	After CONNECT was completed, an FCS error occurred
	H3002 (Receive error warning)	2	After CONNECT was completed, a receive error occurred
	3003H (Synchronous frame not received warning)	3	After CONNECT was completed, a synchronous frame was not received
	H3008 (FCS error)	8	After CONNECT was completed, an FCS error occurred two consecutive times
	3009H (Receive error)	9	After CONNECT was completed, a receive error occurred two consecutive times
	300AH (Synchronous frame not received)	A	After CONNECT was completed, a synchronous frame was not received two consecutive times
	300BH (Synchronous interval error)	B	The measurement value of the transmission cycle does not match the value that was set by the CONNECT command
	300CH (WDT error)	C	After synchronous communication was started, the watchdog data for the other station does not equal the previous value +1

Type	Alarm code	COMM_ALM	Alarm description
Command error (CMD_ALM)	4008H (Received unsupported command)	8	A command not specified in the MECHATROLINK-III communication specifications or an unsupported command was received
	4009H (Outside the data range)	9	The command data is outside the range
	400CH (Phase error)	C	An unexecutable command was received in the current phase

Chapter 8.   LED STATUS DISPLAY

The controller status is indicated by the on/off state of the LEDs.

LED Status Display

LED name	Color		LED meaning
LK1	Green	Off	CN1 link not established
		On	CN1 link established
LK2	Green	Off	CN2 link not established
		On	CN2 link established
CON	Green	Off	CONNECT not established
		On	CONNECT established
ERR	Red	Off	Normal status
		On	System error (D_ALM): 1XXXH System error (D_WAR): 10X0H Communication setting errors • Station address setting error: 2001H • Communication data size setting error: 2002H Communication error (alarm) occurred • Communication error (FCS error): 3008H • Communication error (receive error): 3009H • Communication error (synchronous frame not received): 300AH • Communication error (synchronous interval error): 300BH • Communication error (WDT error): 300CH Command error (alarm) occurred • Command error (unsupported command received): 4008H • Command error (outside the data range): 4009H • Command error (phase error): 400CH

📖 **Note**

- ☞ K1G Series High-Accuracy Position Sensors User's Manual
  Manual No. CP-SP-1385E (for details on setup of the station address and number of transmission bytes).
- ☞ K1G Series High-Accuracy Position Sensor Global Model User's Manual
  Manual No. CP-SP-1397E

Revision History of CP-SP-1386E

Printed	Edn.	Revised pages	Description
Dec. 2015	**1**		
Sep. 2016	**2**	i 1-2, 2-21, 2-22, 4-9 End of the manual	The Role of This Manual was changed. CP-SP-1397E was added. K1G-C04→K1G-C04(G). Note was changed. The version of Terms and Conditions was updated to AAS-511A-014-09.

Terms and Conditions

We would like to express our appreciation for your purchase and use of Azbil Corporation's products.
You are required to acknowledge and agree upon the following terms and conditions for your purchase of Azbil Corporation's products (system products, field instruments, control valves, and control products), unless otherwise stated in any separate document, including, without limitation, estimation sheets, written agreements, catalogs, specifications and instruction manuals.

1. Warranty period and warranty scope
    1.1 Warranty period
        Azbil Corporation's products shall be warranted for one (1) year from the date of your purchase of the said products or the delivery of the said products to a place designated by you.
    1.2 Warranty scope
        In the event that Azbil Corporation's product has any failure attributable to azbil during the aforementioned warranty period, Azbil Corporation shall, without charge, deliver a replacement for the said product to the place where you purchased, or repair the said product and deliver it to the aforementioned place.
        Notwithstanding the foregoing, any failure falling under one of the following shall not be covered under this warranty:
        (1) Failure caused by your improper use of azbil product
            (noncompliance with conditions, environment of use, precautions, etc. set forth in catalogs, specifications, instruction manuals, etc.);
        (2) Failure caused for other reasons than Azbil Corporation's product;
        (3) Failure caused by any modification or repair made by any person other than Azbil Corporation or Azbil Corporation's subcontractors;
        (4) Failure caused by your use of Azbil Corporation's product in a manner not conforming to the intended usage of that product;
        (5) Failure that the state-of-the-art at the time of Azbil Corporation's shipment did not allow Azbil Corporation to predict; or
        (6) Failure that arose from any reason not attributable to Azbil Corporation, including, without limitation, acts of God, disasters, and actions taken by a third party.
        Please note that the term "warranty" as used herein refers to equipment-only-warranty, and Azbil Corporation shall not be liable for any damages, including direct, indirect, special, incidental or consequential damages in connection with or arising out of Azbil Corporation's products.

2. Ascertainment of suitability
    You are required to ascertain the suitability of Azbil Corporation's product in case of your use of the same with your machinery, equipment, etc. (hereinafter referred to as "Equipment") on your own responsibility, taking the following matters into consideration:
        (1) Regulations and standards or laws that your Equipment is to comply with.
        (2) Examples of application described in any documents provided by Azbil Corporation are for your reference purpose only, and you are required to check the functions and safety of your Equipment prior to your use.
        (3) Measures to be taken to secure the required level of the reliability and safety of your Equipment in your use
            Although azbil is constantly making efforts to improve the quality and reliability of Azbil Corporation's products, there exists a possibility that parts and machinery may break down.
            You are required to provide your Equipment with safety design such as fool-proof design, *1 and fail-safe design*2 (anti-flame propagation design, etc.), whereby preventing any occurrence of physical injuries, fires, significant damage, and so forth. Furthermore, fault avoidance, *3 fault tolerance,*4 or the like should be incorporated so that the said Equipment can satisfy the level of reliability and safety required for your use.

            *1. A design that is safe even if the user makes an error.
            *2. A design that is safe even if the device fails.
            *3. Avoidance of device failure by using highly reliable components, etc.
            *4. The use of redundancy.

3. Precautions and restrictions on application
    Azbil Corporation's products other than those explicitly specified as applicable (e.g. azbil Limit Switch For Nuclear Energy) shall not be used in a nuclear energy controlled area (radiation controlled area).
    Any Azbil Corporation's products shall not be used for/with medical equipment.
    The products are for industrial use. Do not allow general consumers to install or use any Azbil Corporation's product.
    However, azbil products can be incorporated into products used by general consumers. If you intend to use a product for that purpose, please contact one of our sales representatives.
    In addition,
    you are required to conduct a consultation with our sales representative and understand detail specifications, cautions for operation, and so forth by reference to catalogs, specifications, instruction manual, etc. in case that you intend to use azbil product for any purposes specified in (1) through (6) below.
    Moreover, you are required to provide your Equipment with fool-proof design, fail-safe design, anti-flame propagation design, fault avoidance, fault tolerance, and other kinds of protection/safety circuit design on your own responsibility to ensure reliability and safety, whereby preventing problems caused by failure or nonconformity.
        (1) For use under such conditions or in such environments as not stated in technical documents, including catalogs, specification, and instruction manuals
        (2) For use of specific purposes, such as:
            * Nuclear energy/radiation related facilities
              [For use outside nuclear energy controlled areas] [For use of Azbil Corporation's Limit Switch For Nuclear Energy]
            * Machinery or equipment for space/sea bottom
            * Transportation equipment
              [Railway, aircraft, vessels, vehicle equipment, etc.]
            * Antidisaster/crime-prevention equipment

* Burning appliances
* Electrothermal equipment
* Amusement facilities
* Facilities/applications associated directly with billing

    (3) Supply systems such as electricity/gas/water supply systems, large-scale communication systems, and traffic/air traffic control systems requiring high reliability

    (4) Facilities that are to comply with regulations of governmental/public agencies or specific industries

    (5) Machinery or equipment that may affect human lives, human bodies or properties

    (6) Other machinery or equipment equivalent to those set forth in items (1) to (5) above which require high reliability and safety

4. Precautions against long-term use

Use of Azbil Corporation's products, including switches, which contain electronic components, over a prolonged period may degrade insulation or increase contact-resistance and may result in heat generation or any other similar problem causing such product or switch to develop safety hazards such as smoking, ignition, and electrification.

Although acceleration of the above situation varies depending on the conditions or environment of use of the products, you are required not to use any Azbil Corporation's products for a period exceeding ten (10) years unless otherwise stated in specifications or instruction manuals.

5. Recommendation for renewal

Mechanical components, such as relays and switches, used for Azbil Corporation's products will reach the end of their life due to wear by repetitious open/close operations.

In addition, electronic components such as electrolytic capacitors will reach the end of their life due to aged deterioration based on the conditions or environment in which such electronic components are used.

Although acceleration of the above situation varies depending on the conditions or environment of use, the number of open/close operations of relays, etc. as prescribed in specifications or instruction manuals, or depending on the design margin of your machine or equipment, you are required to renew any Azbil Corporation's products every 5 to 10 years unless otherwise specified in specifications or instruction manuals.

System products, field instruments (sensors such as pressure/flow/level sensors, regulating valves, etc.) will reach the end of their life due to aged deterioration of parts.

For those parts that will reach the end of their life due to aged deterioration, recommended replacement cycles are prescribed. You are required to replace parts based on such recommended replacement cycles.

6. Other precautions

Prior to your use of Azbil Corporation's products, you are required to understand and comply with specifications (e.g., conditions and environment of use), precautions, warnings/cautions/notices as set forth in the technical documents prepared for individual Azbil Corporation's products, such as catalogs, specifications, and instruction manuals to ensure the quality, reliability, and safety of those products.

7. Changes to specifications

Please note that the descriptions contained in any documents provided by azbil are subject to change without notice for improvement or for any other reason.

For inquires or information on specifications as you may need to check, please contact our branch offices or sales offices, or your local sales agents.

8. Discontinuance of the supply of products/parts

Please note that the production of any Azbil Corporation's product may be discontinued without notice.

For repairable products, we will, in principle, undertake repairs for five (5) years after the discontinuance of those products. In some cases, however, we cannot undertake such repairs for reasons, such as the absence of repair parts.

For system products, field instruments, we may not be able to undertake parts replacement for similar reasons.

9. Scope of services

Prices of Azbil Corporation's products do not include any charges for services such as engineer dispatch service.

Accordingly, a separate fee will be charged in any of the following cases:

    (1) Installation, adjustment, guidance, and attendance at a test run

    (2) Maintenance, inspection, adjustment, and repair

    (3) Technical guidance and technical education

    (4) Special test or special inspection of a product under the conditions specified by you

Please note that we cannot provide any services as set forth above in a nuclear energy controlled area (radiation controlled area) or at a place where the level of exposure to radiation is equivalent to that in a nuclear energy controlled area.

azbil

Specifications are subject to change without notice. (09)