

azbil

# K1G Series High-Accuracy Position Sensor User's Manual

There are nine different manuals related to the K1G series. Read them as necessary for your specific requirements. (C P. iii )



Photo of K1G-S07



Photo of K1G-C04

This user's manual is for instrumentation that uses the K1G series' K1G-C04, K1G-C04M, and K1G-C04E controllers.

For CE- and KC-marked K1G-C04G, K1G-C04MG, and K1G-C04EG controllers, please refer to *K1G Series High-Accuracy Position Sensor Global Model User's Manual (CP-SP-1397E)*.

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**Azbil Corporation** 

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http://www.azbil.com/products/factory/order.html

#### NOTICE

Be sure that the user receives this manual before the product is used.

Copying or duplicating this user's manual in part or in whole is forbidden. The information and specifications in this manual are subject to change without notice.

Considerable effort has been made to ensure that this manual is free from inaccuracies and omissions. If you should find an error or omission, please contact the azbil Group.

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 $\mathsf{EtherCAT}^{\circ}$  is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

#### SAFETY PRECAUTIONS

The safety precautions explained in the following section aim to prevent injury to the operator and others, and to prevent property damage.



#### 

This device is a JIS class 1 laser product. As this device's emitter uses a semiconductor laser, observe the following cautions.

- Do not disassemble or modify sensor heads.
- Do not look into the laser beam directly.
- Do not look into the laser beam through a lens or other optical device.

Take sufficient safety measures to prevent damage or loss in the unlikely event that this device malfunctions.

Do not use this device for safety circuits designed for protection of the human body.

Do not disassemble.

Disassembly may cause electric shock or device failure.

Do not use this device in atmospheres containing corrosive or flammable gas, liquids, or powder.

Before removing, mounting, or wiring this device, be sure to turn off the power to the device and all connected devices. Failure to do so may cause electric shock.

Be sure to check that the device has been correctly wired before turning on the power. Incorrect wiring of the module can damage it or lead to hazardous conditions.

Do not touch electrically charged parts such as the power terminals. There is a risk of electric shock.

Firmly tighten the terminal screws to a torque of 0.4–0.6 N·m. If tightening is insufficient there is a risk of electric shock or fire.

	<b>∆</b> WARNING
$\bigcirc$	Do not use unused terminals on the device as relay terminals. Doing so may re- sult in electric shock, fire or device failure.
0	<ul> <li>In the following cases, turn off the power immediately and stop using the device.</li> <li>If the device gets wet (with water or another liquid).</li> <li>If the device is damaged.</li> <li>If the device produces an unusual smell or smoke.</li> </ul>
$\bigcirc$	The power supply rating for this device is 12–24 V DC. Do not apply 100–240 V AC. Doing so may cause device failure or fire.
0	Use this device within the operating ranges given in the specifications for temperature, humidity, voltage, vibration, shock, mounting orientation, atmosphere, etc. Otherwise, fire or device failure could result.
$\bigcirc$	Do not block ventilation holes. Doing so may cause fire or device failure.
0	Wire this device properly, according to the directions, using the specified power source and wiring methods. Failure to do so may cause fire or device failure.
$\bigcirc$	Do not allow wire clippings, metal shavings, water, etc., to enter the device's case. They may cause fire or device failure.
0	If there is a risk of a power surge caused by lightning, use a surge absorber (surge protector). Failure to do so may cause fire or device failure.
0	When discarding this device, dispose of it as industrial waste, following local regulations.
0	At the time of disposal, do not allow the optical surfaces to be exposed to direct sunlight in order to prevent concentration of the sunlight, which could cause a fire.
$\bigcirc$	Do not try to modify or fabricate the connectors and junction cable. Doing so may cause device failure, abnormal laser beam emission, or fire.
$\bigcirc$	Take care that cables are not pinched or caught on something. There is a danger of disconnection.
0	Connect the controller's frame ground terminals to the ground (for K1G-C04M, that includes the frame ground for MECHATROLINK-III, and for K1G-C04E it includes the frame ground for EtherCAT). If the terminals are not grounded, electromagnetic interference may result.

#### THE ROLE OF THIS MANUAL

A total of 9 different manuals are available for the K1G series. Read them as necessary for your specific requirements.

If a manual you require is not available, contact the Azbil Group or its dealer.



#### 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 Mo. CP-SP-1397E

If you need to use a CE- or KC-marked K1G controller, please purchase the K1G-C04G or the K1G-C04MG or the K1G-C04EG and read this manual.



#### 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 for EtherCAT Communication

#### Manual No. CP-SP-1419E

This manual describes EtherCAT communications specifications.

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#### 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. 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.

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#### Handling Precautions for the SZ-D01 Configuration Tool for K1G Series High-Accuracy Position Sensors Manual No. UM-5785JE

Personnel who use the configuration tool for K1G sensors should read this manual. The manual covers safety precautions, installation, and wiring.

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#### Handling Precautions for K1G Series High-Accuracy Position Sensor Junction Cables Manual No. UM-5787JE

Personnel in charge of the design or manufacture of equipment that incorporates these cables should read this document thoroughly. It contains safety precautions.

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#### Attachment Instructions for Ferrite Core and Shielded Junction Cables for K1G Series High-Accuracy Position Sensors Manual No. CP-UM-5810JE

Please read this manual if you use a CE- or KC-marked global model of the K1G series. This manual covers safety precautions, installation, and wiring.

## Introduction

Thank you for purchasing this Azbil Corporation product. This manual contains information for ensuring the safe and correct use of the product.

It should be read by those who design or maintain a control panel or other equipment that uses this product.

Also, the manual provides necessary information for installation, maintenance, and troubleshooting. Be sure to keep the manual nearby for handy reference.

#### **CONVENTIONS USED IN THIS MANUAL**

	: Indicates a tip for configuration or operation.	
! Handling Precautions	: Pay attention to the indicated points when handling the product.	
<b>₽</b>	: Refer to the indicated item or page.	
123	: Numbers indicate steps in a procedure.	
8888	: This font indicates what is shown on the 7-segment display.	
$\bigcirc$ $\bigotimes / \bigotimes$	: Keys on the operating panel	

#### **NOTES ON LASERS**

#### 

This set of sensor heads is a class 1 laser product using a semiconductor laser as the light source.

For this reason, note the following.

- · Do not disassemble or modify sensor heads.
- Do not look into the laser beam directly.
- Do not look into the laser beam through a lens or other optical device.

Sen	sor head model No.	K1G-S07	K1G-S15
Em	nission wavelength	650 nm	
Output		Less than	0.39 mW
Pulse width		25 µs	100 µs
Laser class	JIS standards	Class 1 laser p	roduct (JIS C)
IEC 60825-1		Class 1 Laser Product	
	FDA (CDRH) Part 1040.10	Class 1 Lase	er Product *

\* Laser product classification by FDA (CDRH) is based on IEC 60825-1, in accordance with Laser Notice No. 50.

#### HANDLING PRECAUTIONS

- As part of setup work or operation, check that this device is operating properly.
- If this device is used in combination with other devices, its functions and performance may not meet specifications, depending on the operating conditions and environment. Consider the combination carefully before use.
- If electromagnetic interference caused by this device affects other devices, use a shielded junction cable. For details, contact the azbil Group.

#### INSTALLATION ENVIRONMENT

To ensure the safe and correct use of the product, do not install it where it will be exposed to any of the following:

- Outdoor weather
- Direct vibration or shock
- Corrosive or combustible gas
- Steam, dust, or oily smoke
- Water, oil, organic solvents such as thinner, or other chemical substances used in processing (direct exposure)
- Sources of electrical noise
- Strong magnetic fields
- Sunlight or other strong light

#### **EFFECTS OF DIRT OR AMBIENT LIGHT INTERFERENCE**

Proper measurement may not be possible due to dirt or interference from ambient light.

- Do not allow dust, dirt, water, oil, or fingerprints to remain on the light-emitting or receiving surfaces of the sensor heads. After turning off the laser, clean the affected surface with a soft dust-free cloth.
- Use some kind of shielding to prevent external light with a wavelength of around 650 nm from striking the light-receiving surface of the sensor head.

#### **PRECAUTIONS FOR WIRING**



- Before wiring, be sure to check the model number and terminal numbers, referring to the label on the side of the device. After wiring, be sure to check that there are no mistakes.
- For screw terminal connections, use crimp terminals that are the correct size for M3 screws. The tightening torque for terminal screws is 0.4 to 0.6 N·m.
- The I/O signal wires should be at least 50 cm away from power wiring for motors, etc., and from power lines. Also, do not put these two types of wires in the same conduit or wiring duct.
- Be careful not to allow crimp terminal lugs, etc., to touch adjacent terminals.
- Make sure that connected devices or equipment have a basic level of insulation suitable for the maximum voltages of this device's power source and input/output components.

#### **CABLES FOR THE K1G**

Use JCS4364-compliant instrument cable or equivalents for K1G-C04 inputs and outputs (twisted shielded instrument cable).

The following cables are recommended.

Fujikura Ltd.	2 cores	IPEV-S-0.9 mm <sup>2</sup> ×1P
	3 cores	ITEV-S-0.9 mm <sup>2</sup> ×1T
Hitachi Metals, Ltd.	2 cores	KPEV-S-0.9 mm <sup>2</sup> ×1P
	3 cores	KTEV-S-0.9 mm <sup>2</sup> ×1T

If there is relatively little electromagnetic induction, shielded multi-core microphone cables (MVVS) can be used.

Use power cables with a nominal cross-sectional area of 0.75–2.00 mm<sup>2</sup>, a rated voltage of 300 V or more, and a rated temperature of 60  $^\circ$ C or more.

If off-the-shelf cable is used, the equivalent of CVV or VCT cable is recommended.

Use cables whose cross-sectional area is suitable for the crimp terminal lugs used. Cable length must be no longer than 30 m.

#### **COMMUNICATION CABLES FOR MECHATROLINK-III**

Use industrial mini I/O connectors for the communication cable of the MECHATROLINK-III that connects to the K1G-C04M. RJ-45 connectors are not compatible.

#### **COMMUNICATION CABLES FOR ETHERCAT**

For the EtherCAT communication cable connected to the K1G-C04E, use a Cat 5e or higher STP cable. The use of a double-shielded STP cable is recommended in an environment with heavy electrical noise (for example, an FA equipment environment).

#### **TERMINAL CONNECTION**

#### 

Firmly tighten the terminal screws to a torque of 0.4-0.6 N·m. If tightening is insufficient there is a risk of electric shock or fire.

Do not use unused terminals on the device as relay terminals. Doing so may result in electrical shock, fire or device failure

For controller connections, use crimp terminals compatible with M3 screws.



Compatible	Terminal dimensions (mm)		ensions	Recommended crimp terminal	Compatible wire size
screw	Α	В	B C (JIS standards)		
M3	6.1	5.8	5.8	RAV1.25-3	0.3–1.3 mm <sup>2</sup> 22–16 AWG

#### ! Handling Precautions

- In a place subject to vibration or shock, be sure to use round crimp terminals to prevent disconnection.
- Be careful not to allow crimp terminal lugs to touch adjacent terminals.
- The tightening torque for terminal screws is 0.4 to 0.6 N·m.

#### WIRING OF THE POWER AND GROUND

#### 

Before mounting, removing, or wiring, be sure to turn off the power to this device and all connected devices.

Failure to do so may result in electric shock.

The power supply rating for this device is 12–24 V DC. Do not apply 100–240 V AC. Doing so may cause device failure or fire.



Use the frame ground terminals of this device (A3 and the network frame ground terminals\*) for one ground connection only. Do not run wiring across to other terminals. If it is difficult to wire the shielded cable, etc., use a separate ground terminal (earth bar).

100 Ω max.

Ground wire: annealed copper wire with a cross sectional area of 2 mm<sup>2</sup> min. (14 AWG) Ground wire length: 20 m max.



#### WARM-UP

After the power has been turned on, wait for at least 30 minutes before use. Because the device's circuitry does not stabilize immediately after the power has been turned on, the measured value may change gradually.

Ground type:

#### **POWER-ON RESET**

The device begins making measurements about one second after the power has been turned on.

After the output response time has passed, analog output (AO) or digital output (DO) begins. A request to establish a MECHATROLINK-III communications connection can be accepted about one second after the power has been turned on.

For EtherCAT communication, check the specifications of the master device that the K1G is used with, and verify the startup operation of the actual device before use.

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# WHAT TO KNOW BEFORE USE

This chapter gives an overview of K1G series sensors and the names and functions of their parts.

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# 1-1 About the K1G Series

#### SYSTEM CONFIGURATION

The K1G series features a semiconductor laser emitter and a receiver with a line image sensor. These two sensor heads measure the position of a workpiece that is between them.



\*1. Necessary for connecting the sensor head cable to the sensor heads

\*2. The K1G-C04M supports MECHATROLINK-III communication and the K1G-C04E supports EtherCAT communication.

#### **EXAMPLES OF K1G MEASUREMENTS**

#### Determining edge position



#### Sensing the edge's status



#### Measuring blocked light width



#### Sensing the edge's status



#### Measuring width of light through gap





# WHAT TO KNOW BEFORE USE

# 1-2 Check of Included Items

#### **SENSOR HEADS**



Note: This product has been registered with the FDA (CDRH). It includes a label indicating compliance with FDA standards. In the case of export to the United States, attach the label to the product.

#### CONTROLLER





#### **JUNCTION CABLE**

Necessary for connection of the sensor head cable to the sensor heads.

The standard model or bend-tolerant model can be selected according to the installation conditions.

Shielded cables are also available.



Note: The user's manual for the cables (CP-UM-5787JE) is included in the package of all models.

#### **!** Handling Precautions

- If the cable is installed on a movable part, a bend-tolerant cable should be used.
- Please use the shielded cables if the sensor is used in a noisy environment.

# 1-3 Optional Parts

#### FRONT PANEL PROTECTIVE COVER FOR CONTROLLERS



#### **NOISE FILTER**

If there is a considerable amount of electrical noise from the power supply, a noise filter is used in combination with an isolation transformer. Choose the proper type according the noise.

----- Model No. 81442557-001 -

Line filter

---- Model No. 81446365-001 -

CR filter: for quick-rising noise

#### **FERRITE CORE**

This is used to reduce the effect of noise on the sensor heads and the power cable. Please choose a model appropriate for your purpose. For details, please refer to K1G Series High-Accuracy Position Sensor Global Model User's Manual (CP-SP-1397E).



#### **K1G CONFIGURATION TOOL**

This tool especially made for the K1G series is used for setup, parameter configuration, and monitoring.



1

#### **SENSOR HEADS**

#### **!** Handling Precautions

• Be sure that the emitter and receiver have the same serial number. If an emitter and receiver with different numbers are used, the product may not meet the listed specifications.



	Name	Description		
1	Light-emitting surface	Laser beam emitting surface		
2	Light-receiving surface	Laser beam receiving surface		
3	Orientation indicator	T: Top, B: Bottom		
4	Serial No.	Be sure that the emitter and receiver have the same serial number		
5	Light emission indicator	Lit when the laser beam is emitted*		
6	Emitter cable	Black		
7	Light reception indicator	Used for adjusting the beam alignment		
8	Receiver cable	Black		
9	Model No.			
10	Mounting holes	Thru-holes for M3 screws		

\* When the power is first turned on, the indicator may light up temporarily, but the laser beam is not emitted at this time.

Front

#### CONTROLLER



Name		Description			
	Operation and channel indicators	Run Ch1 Ch2 Ch3 Ch4 Lit to indicate which channel's mea- sured value is displayed on display 1. Lit while the status is "Run." Lit while the controller is operating properly.			
2	Display 1	Displays the measured value.			
3	Auxiliary display	Displays a setting that is being checked or changed.			

Name		Description			
4	Display 2	Displays the measured value.			
5	Status indicators	<ul> <li>Indicate the operating status of the channel selected for display 1.</li> <li>Hold—Lit when the status of the measured value is "Hold."</li> <li>Max —Lit when the max. digital input (DI) constant output function is used.</li> <li>Min —Lit when the min. digital input (DI) constant output function is used.</li> </ul>			
6	Sensor connection indicators	Indicate channel(s) to which sensor heads are connected. 1 2 3 4			
7	Digital input/out- put indicator	Indicates digital I/O status by lighting up when digital I/O is on.			
8	Key functions	Image: Constraint of the select       Image: Constraint of the select       Image: Constraint of the select         Image: Constraint of the select       Image: Constraint of the select       Image: Constraint of the select         Image: Constraint of the select       Image: Constraint of the select       Image: Constraint of the select         Image: Constraint of the select       Image: Constraint of the select       Image: Constraint of the select         Image: Constraint of the select       Image: Constraint of the select       Image: Constraint of the select         Image: Constraint of the select       Image: Constraint of the select       Image: Constraint of the select         Image: Constraint of the select       Image: Constraint of the select       Image: Constraint of the select         Image: Constraint of the select       Image: Constraint of the select       Image: Constraint of the select         Image: Constraint of the select       Image: Constraint of the select       Image: Constraint of the select         Image: Constraint of the select       Image: Constraint of the select       Image: Constraint of the select         Image: Constraint of the select       Image: Constraint of the select       Image: Constraint of the select         Image: Constraint of the select       Image: Constraint of the select       Image: Constraint of the select         Image: Constraint of the select       Image: Constraint of the select       I			

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Name		Description		
9	Sensor head cable connector	Connects the included sensor head cable and controller.		
10	Terminals	Used for wiring of the power and input/output signal wires.		
11	LEDs for MECHATROLINK-III	ERR 🗔 🗔 LK1		
		CON 🔲 🔛 LK2		
		LK1 (link 1, green): Lit when link CN1 is estab- lished LK1 (link 2, green): Lit when link CN2 is estab- lished ERR (error, red): Lit when an error occurs with MECHATROLINK-III CON (connection, green): Lit when a connec- tion is established		
12	Connector 1 for MECHATROLINK-III	-		
13	Connector 2 for MECHATROLINK-III	-		
14	ECAT ID setting switches	Sets the ECAT ID in two hexadecimal digits X10: 2nd digit X1: 1st digit		

Name		Description		
15	RJ45 port	Connects the network cable for EtherCAT com- munication. ECAT OUT: EtherCAT communica- tion OUT port ECAT IN: EtherCAT communica- tion IN port Link/Activity indicator: Green Shows the state of the EtherCAT communica- tion port physical link and data transmission.		
16	EtherCAT RUN/ERROR LEDs	<ul> <li>RUN</li> <li>ERROR</li> <li>RUN indicator: Green</li> <li>Indicates the state of EtherCAT communication.</li> <li>ERROR indicator: Red</li> <li>Indicates an EtherCAT error.</li> </ul>		

#### **DETAILS ON ETHERCAT INDICATORS**

#### Types of indicator states

Indicator states	Definition			
Off	Constantly OFF			
Flickering	ON for 50 ms and OFF for 50 ms			
Blinking	ON for 200 ms and OFF for 200 ms			
Single Flashes	ON for 200 ms and OFF for 1000 ms			
Double Flashes	ON for 200 ms and OFF for 200 ms and ON for 200 ms and OFF for 1000 ms			
On	Constantly ON			

#### Link/Activity LED: Green

Indicator states	Description
Off	No link
On	Link but no communication activity
Flickering	Link with communication activity

#### RUN LED: Green

Indicator states	Description	Description
Off	INIT	No communication is available.
Blinking	PRE-OPERATIONAL	Only mailbox communication is available.
Single Flashes	SAFE-OPERATIONAL	Process (input) data communication and mailbox communication are available.
On	OPERATIONAL	Process (input and output) data communica- tion and mailbox communication are available.

#### ERROR LED: Red

Indicator states	Description	Description
Off	No error	There is no EtherCAT error, or the device is not communicating.
Blinking	EtherCAT communi- cation setting error	Invalid configuration for EtherCAT communi- cation. Change the settings.
Single Flashes	Device behavior error	There is a controller application error.
Double Flashes	Process data watch- dog timeout or EtherCAT watchdog timeout	Sync Manager Watchdog timeout or Ether- CAT communication timeout has occurred. Check the communication cable connec- tions.
On	PDI watchdog time- out	PDI Watchdog timeout has occurred. There is a problem with the device. If the con- troller does not return to normal after the power is turned off and back on, replace the device.



# INSTALLATION AND WIRING

This chapter describes installation and wiring of the sensor heads and controller.

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# 2-1 Installing the Sensor Heads

#### SAFETY PRECAUTIONS

#### 



Do not do work while power is supplied. There is a risk of electric shock or device failure.

 $|\mathbb{C}|$ 

Do not use this device in atmospheres containing corrosive or flammable gas, liquids, or powder.

#### 

Take care that cables are not pinched or caught on something. There is a danger of disconnection.

#### Install the emitter and receiver so that the lightemitting and receiving surfaces face each other

Secure the sensor heads to a jig, etc. using commercially available M3 screws, working from the sensor side.



Tightening torque: 0.5 N·m max.

#### **!** Handling Precautions

- Secure the cable in a way that avoids stress where it exits the device and near the connector.
- Do not touch the optical surfaces during installation.
- Be sure that the emitter and receiver have the same serial number.
   If an emitter and receiver with different numbers are used, the product may not meet the listed specifications.
- Attach the sensor heads securely so that they will not come loose by vibration or shock.
- Install so that the workpiece does not come into contact with the sensor heads.
- Do not remove the sensor heads while power is being supplied.
- Pay attention to the orientation of the emitter and receiver during installation.

# **2-2** Install the controller in the panel.

# **1** Make a cutout in the panel

The controller is a panel-mount type. Make a cutout in the panel according to the following dimensions.

#### Individual mounting







Note: N represents the number of controllers.

#### ! Handling Precautions

- If three or more units are gang-mounted, the ambient temperature should not exceed 35  $^{\circ}\mathrm{C}.$
- During installation, leave clearance of at least 50 mm above and below.

## **2** Insert the controller into the cutout

Insert the controller from the front side of the panel.

Unit: mm

# **3** Attach the mounting brackets

Attach the included mounting brackets to the top and bottom of the controller. Attach the bottom bracket first.



#### **Tighten the screws**

Tighten the screws of the mounting brackets until there is no more play between the bracket and screw and panel, and then turn one revolution more only.

#### **!** Handling Precautions

- Excessive tightening of the screws can deform the controller case.
- The mounted controller should not be inclined from the horizontal by more than 10 degrees upward or downward.
- The mounting panel should be made of a rigid material 7 mm thick or less.

4

#### Attach the cables

#### **!** Precautions for wiring



• Secure the cable in a way that avoids stress where it exits the device and near the connector.

• Sensor head cable



#### Sensor head cable

Cable length: Connector type: Bend radius: Identification: 0.4 m Socket (panel-mount) R30 Each branched cable has a channel No. The cables for the receiver have an identifying mark.

#### Junction cable



#### Junction cable

Cable length: 1–25 m (standard model) 1–3 m (bend-tolerant model) Connector type: Socket Bend radius: R35 (K1G-L \_ \_) R40 (K1G-R \_ \_) Identification: Bend-tolerant cables for the receiver have an identifying mark.

#### **!** Handling Precautions

• The junction cable cannot be connected to another junction cable.

#### Sensor heads



#### Sensor heads

Cable length: Connector type: Bend radius: Identification: 0.2 m Socket (panel-mount) R30 The receiver has an identification mark.

#### **!** Handling Precautions

After operation has begun, in order to switch to a different sensor head model it is necessary to reset the sensor head settings.
 C P. 4-106

INSTALLATION AND WIRING

# 2-4 Wiring the Controller (K1G-C04)

#### **TERMINAL LAYOUT**



	А		С		F	
1	Power +	Pow	DA	Com	AO1 +	
2	Power -	er su	DB	munic	AO1 -	
3	FG	pply	SG	ation	AO2 +	An
4	D01		DI1		AO2 -	alog
5	DO2		DI2	Inp	AO3 +	outp
6	DO3		DI3	but	AO3 -	out
7	DO4	Out	DI4		AO4 +	
8	DO5	put	(Emp	ty)	AO4 -	
9	D06					
10	D07		C			
11	DO8		Sensor head cable connecto			
12	(Emp	ty)				

#### **!** Handling Precautions

• Be sure to check that the module has been correctly wired before turning on the power. Mistakes in wiring can damage the device.
### WIRING OF DIGITAL OUTPUT (DO)



Output current (source or sink):	1 to 10 mA (per output)
ON-state voltage drop:	2 V max.
OFF-state leakage current:	0.3 mA max.
Common type:	8 (shared with power terminals)

-**o** 0 V

2-7

### WIRING OF DIGITAL INPUT (DI)





#### Input circuit



#### **!** Handling Precautions

• Do not connect digital outputs (DOs) and digital inputs (DIs) directly. To make a connection between them, install pull-up resistors for NPN or pull-down resistors for PNP in the external circuit. Select pull-up resistors or pull-down resistors so that the load current is about 10 mA.

Input current	NPN:	Approx. 3 mA
	PNP:	Approx. 1 mA (at 12 V DC)
		Approx. 4 mA (at 24 V DC)
Min. input tim	e:	6 ms (at a 250 μs measurement cycle)
		12 ms (at a 500 μs measurement cycle)
		24 ms (at a 1 ms measurement cycle)
Common type	:	4 (shared with power terminals)

### WIRING OF ANALOG OUTPUT (AO)



Note: AO1-, AO2-, AO3-, and AO4- are all connected inside this device.

#### Analog output circuit



#### **!** Handling Precautions

• If the analog outputs of the K1G and another device are connected to the same analog input device, the K1G's output signal may become unreliable due to factors such as the current coming from other circuits. In this case, attach an isolator between the K1G and the analog input device.

Load resistance: 10 k $\Omega$  min. (with voltage output)  $250 \ \Omega + 1 \ \% \text{ max. (with current output)}$ 

### **RS-485 COMMUNICATIONS**

If devices with 3-wire and 5-wire systems are both used



#### • When only devices with a 3-wire system are used



# 2-5 Wiring the Controller (K1G-C04M)

### **TERMINAL LAYOUT**



Power supply		MECHATROLINK-III	
A1	Power +	CN1	Connector 1
A2 Power -		CN2	Connector 2
A3 FG		C7	FG

#### **!** Handling Precautions

• Be sure to check that the module has been correctly wired before turning on the power. Mistakes in wiring can damage the device.

# 2-6 Wiring the Controller (K1G-C04E)

### **TERMINAL LAYOUT**



Power supply		E	therCAT
A1	Power +	CN1	ECAT OUT
A2	Power -	CN2	ECAT IN
A3	FG	C1	FG

#### **!** Handling Precautions

- Be sure to check that the module has been correctly wired before turning on the power. Mistakes in wiring can damage the device.
- There are two types of EtherCAT communication port: host (ECAT IN) and slave (ECAT OUT) If the cable is connected to the wrong port, the device cannot communicate.

### WIRING METHOD

To use the K1G-C04E properly, be sure to follow the wiring method described below.

#### Power cable and sensor head cable

• Attach the ferrite cores (included) to the power wires of the controller (not included).

Both power wires (V+ and V-) must be attached.

- Connect the controller's frame ground terminals A3 and C1 to the frame ground of the equipment.
- Attach the ferrite cores to the sensor head cables.



#### Shielded junction cable

- Use a shielded junction cable (K1G-L\_\_S or K1G-R\_\_S).
- · Ground the shielded wire of the junction cable.



#### Communication cable

- Use a double-shielded cable (not included) for communication.
- Remove the jacket at both ends and ground the shield using a cable clamp (not included).



\* Shielded cable grounding method



For more general information on how to install EtherCAT products, please refer to ETG.1600, EtherCAT Installation Guideline, issued by EtherCAT Technology Group.

If the controller is used in an environment with a large amount of electromagnetic noise, take the necessary countermeasures in the following ways.

- Move the controller and cables away from the noise source.
- Make more turns (2 or 3) when attaching the ferrite cores to the power wires.
- Make more turns (2) when attaching the ferrite cores to the sensor head cables.
- Use noise-resistant double-shielded STP cable for communication.



To use K1G-C04EG as a product compliant with CE or KC marking, refer to CP-UM-5810JE.





# INITIAL SETUP

The chapter describes the initial setup after the power to the controller has been turned on for the first time.

Initi	al Setup Flowchart	3-2
3-1	Analog Output (AO) Settings	3-3
3-2	Digital Input/Output (DI/DO) Settings	3-4
3-3	Setting the Station Address for MECHATROLINK-III	3-5
3-4	Setting the Number of Transmission Bytes for MECHATROLINK-III	3-6
3-5	Setting the Measurement Cycle	3-7
3-6	Receiver adjustment	3-8
3-7	Setting the ECAT ID (for K1G-C04E only)	-11

# **Initial Setup Flowchart**



# 3-1 Analog Output (AO) Settings





Analog output settings applies to all channels. The parameters cannot be changed for individual channels.

# Select the output method

 This cold
 cold

 This field
 cold

 This field

Select  $U_{oLE}$  or  $E_{roE}$  using  $\otimes / \otimes$ .

Parameter	Description	
UoLŁ	Voltage output (1–5 V)	
Ernt	Current output (4–20 mA)	

Display







# Save the parameter



Press  $\bigoplus_{\text{Enter}}$  to save it.



To change the analog output method, return all settings to the default values.

4-10 Returning All Settings to the Defaults (P. 4-114)

# 3-2 Digital Input/Output (DI/DO) Settings





The digital input/output applies to all channels. The parameters cannot be changed for individual channels.

# **1** Select the input/output method



)

 Parameter
 Description

 oPo
 NPN input/output

 PoP
 PNP input/output







# **2** Save the parameter



Press  $\bigcup_{\text{Enter}}$  to save it.



To change the digital input/output settings, return all settings to the default values.

4-10 Returning All Settings to the Defaults (P. 4-114)

# **3-3** Setting the Station Address for MECHATROLINK-III



 $\otimes$ 

# **1** Select the station address.



elect the st	ation address using $\otimes 7 \otimes .$
Parameter	Description

3h to EFh Station address







### Save the address

 $\operatorname{Press} \, \bigcup_{\operatorname{Enter}} \, \operatorname{to} \, \operatorname{finalize} \, \operatorname{your} \, \operatorname{selection}.$ 



The station address for MECHATROLINK-III can be changed after the initial setup is completed.

Changing MECHATROLINK-III Communication Settings (P. 4-108)

# **3-4** Setting the Number of Transmission Bytes for MECHATROLINK-III



# **1** Select the number of transmission bytes



Choose 48 or	32 using	$\otimes / \otimes$
--------------	----------	---------------------

Parameter	Description
48	No. of transmission bytes 48
32	No. of transmission bytes 32



Display



2

# Save the number of transmission bytes

Press  $\bigcap_{\text{Enter}}$  to finalize your selection.



The number of transmission bytes for MECHATROLINK-III can be changed after the initial setup is completed. SETTING THE NUMBER OF TRANSMISSION BYTES FOR MECHATRO-LINK-III (P. 4-111)

# 3-5 Setting the Measurement Cycle



The measurement cycle applies to all channels. This parameter cannot be changed for individual channels.

# Select the parameter



Select 250, 500, or	$1000  \text{u}$ , using $\otimes / \otimes$ .
---------------------	--

Parameter		Description
2500	250 µs	
500.	500 µs	
1000.	1 ms	









The selectable measurement cycle varies depending on the length of the junction cable.

C 7-2 Controllers (P. 7-5)





### Save the parameter



Press  $\bigcup_{\text{Enter}}$  to save it.



The measurement cycle can be changed after the initial setup is completed.

Changing the Measurement Cycle (P. 4-15)

# 3-6 Receiver adjustment



#### **!** Handling Precautions

- · Make sure that there is no workpiece before starting.
- If the laser beam emitting surface or receiving surface is dirty, beam alignment and intensity adjustment cannot be done correctly.
- If the sensor heads are misaligned, moved, or replaced, the sensitivity should be readjusted.



For readjustment, the mode must be switched to Ready. How to switch between Run/Ready modes (P. 4-4)

# Select the channel No.

Select the channel No. using O

Display



Run Ch1 Ch2 Ch3 Ch4 Green Red

The number of the selected channel is lit.

# 2

# Adjust the sensor head position

Display (when the K1G-S15 is connected)



– 15 ( "07" is displayed when the K1G-S07 is connected)

- See the description below.

During readjustment, display 1 shows the measured value.

#### The beam is aligned (receiver adjustment is possible).

If the LED bar shown on the left is lit, the receiver can be adjusted. Measurement can begin.
There is a big margin. Receiver adjustment is possible.

#### The beam is not aligned (receiver adjustment is not possible).

Check the emitter and receiver positions, and the beam angle.

BAAAAB	The light intensity at the receiver is insufficient.	
	The laser beam is offset to the bottom side (B) of the receiver.	
	The laser beam is offset to the top side (T) of the emitter.	

During intensity readjustment or a beam alignment check

	The upper part of the display shows the light inten- sity after adjustment.
--	--

During receiver adjust indicator works as sho	n Remit	
	Receiver adjustment is	Receiver adjustment
	possible.	is not possible.
Selected channel	Lit	Off
Unselected channel	Li	t

# Align the beam



3

When the beam is aligned, press  $\bigcup_{\text{Enter}}$ .

#### **!** Handling Precautions

• Beam alignment and intensity adjustment is necessary for every connected channel. Measurement is not possible with unadjusted sensor heads.

# **4** Complete the adjustments



Press  $\bigcup_{\text{Run}}^{-}$  for at least 3 seconds to end the adjustment.



### Choose whether to save the adjustment data



Select whether to save it using @/@.

Parameter	Description	
no	Do not save adjustments	
<i>465</i>	Save adjustments	

Note: If "no" is selected, and the power is turned off, the changed parameters will be lost.



Display

# **6** Start measurement



Press  $\bigcap_{\text{Enter}}$  to begin measurement.

# 3-7 Setting the ECAT ID (for K1G-C04E only)



# **1** Set the ID using the ECAT ID setting switches



Parameter	Description	
00	ECAT ID is not used	
🛙 I to FF	The set value is used as the ECAT ID	







The setting for the ECAT ID is read only when the power is turned on. Even if the setting is changed during operation, the ECAT ID does not reflect the new setting. To apply a new ID, turn the power off and back on.





# ADVANCED SETTINGS

This chapter describes various functions of the K1G series. As needed, the settings should be changed.

4-1	Settings that Can Be Changed
4-2	Changing the Display
4-3	Changing the Measurement Settings4-11
4-4	Changing the Analog Output (AO) Settings4-25
4-5	Using Digital Input (DI) and Digital Output (DO)4-36
4-6	Calculations that Use Measured Data4-61
4-7	Using Special Functions4-76
4-8	Other Functions
4-9	Changing MECHATROLINK-III Communication Settings4-108
4-10	Returning All Settings to the Defaults4-114

In this chapter, the following icons indicate the mode in which settings can be changed.

Ready : Settings can be changed in Ready mode.

Run

: Settings can be changed in Run mode.

# 4-1 Settings that Can Be Changed

## **CHANGING THE INITIAL SETTINGS**

To change the initial settings configured in chapter 3, see the pages indicated below.



#### Changing the AO range

- Changing the analog output (AO) range ...... (
- Changing the measurement zero adjustment value . (
- Changing (reversing) the output polarity...... (





#### Enabling disabled functions

• Calculations that use measured values of channels ( CP. 4-61 )	
• Working distance (WD) setting function(	
• PV hold	
• EPS filtering(CP. 4-83)	
• Smudge detection (CP. 4-90)	
• Event log function (CP. 4-95)	
• Power saving	
• Keylock	)

#### Other

• Test mode	( 🗭 P. 4-96 )
• Reverting all settings to the defaults	(CP. 4-114)

### HOW TO SWITCH BETWEEN RUN/READY MODES

Ready

Run

#### • How to check the current mode



To learn the current mode, check the operation indicator. If the LED is lit, the mode is "Run" (measuring).

On the following pages, in order to indicate which mode allows a setting change, one of the following icons is shown for each setting.

: Settings can be changed in Ready mode.

: Settings can be changed in Run mode.

#### How to switch between modes



Pressing the  $\bigcup_{\text{Run}}$  key for 3 seconds or more switches between Run and Ready.

#### Input/output operations in Ready mode.

Analog output (AO): Digital input (DI): Digital output (DO): Continues as it was before the mode change. Operates when there is input. Is forced OFF.

Note: For the K1G-C04M and K1G-C04E, network communication (K1G-C04M: MECHA-TROLINK-III, K1GC04E: EtherCAT) is available regardless of whether the device is in Run or Ready mode. However, since the settings might be changed accidentally, keep the controller in Run mode while the equipment is operating.

### PARAMETER CONFIGURATION





After switching to another column, the new column's [1] *I*] row is always displayed first. Example: If [703] is displayed and the column is changed to column B, [b1] *I*] is shown.

P. 9-10 (for details)

# 4-2 Changing the Display

### **CHANGING THE TYPE OF DISPLAY**

Display 1

Auxiliary display Display 2

The contents of the display while the controller is in Run mode can be selected according to the intended use. There are four display types for the K1G-C04, and five types for the K1G-C04M and K1G-C04E.

Run

Display type	Display 1	Auxiliary display	Display 2
1 Standard	The measured value for the selected channel	Shows which chan- nel's measured value is shown on display 2.	Measured values of channels that are not selected on dis- play 1.
<ul> <li>Received light intensity level</li> </ul>	Channels can be switched by pressing ch select ·	6 <i>8</i> r	The bar graph shows the intensity of the light received on the selected channel.
③ Peak/bottom value		PE (peak)or とと (bottom)	The peak or bottom value for the se- lected channel
4 Analog output (A	AO)	ጸ <sub>ወ</sub> <i>ነ</i> Ex.: Channel 1	The analog output value for the se- lected channel
<ul> <li>MECHATROLINK-I communication st tus check display ( K1G-C04M only)</li> </ul>	ll :a- for	Con (connected) or (not con- nected)	MECHATROLINK-III error status.
6 EtherCAT com- munication sta tus check displ (for K1G-C04E only)	- ay	Indicates the state of EtherCAT com- munication or whether the link to ECAT IN is estab- liched	Indicates a node ad- dress or whether the link to ECAT OUT is established.



#### 4-2 Changing the Display

#### 1) Standard

Display 1 shows the measured value from the selected channel. The auxiliary display shows the channel number of other channels, and display 2 shows measured values from these channels. If there are several unselected channels, the channels and measured values are

switched automatically every 2 seconds. For the K1G-C04E, the state of EtherCAT communication is also displayed. The display is the same as that explained in [6], "EtherCAT communication status check display." The display can be switched manually by pressing  $\langle n \rangle$ .

If no measurement parameters are assigned to channels other than the selected one: • For the K1G-C04 and K1G-C04M

The auxiliary display and display 2 show nothing.

· For the K1G-C04E

The auxiliary display and display 2 show the state of EtherCAT communication.

#### 2 Received light intensity level

Display 1 shows the measured value from the selected channel. The auxiliary display says "*bRr*." The bar graph on Display 2 shows the intensity of light received during measurement.

For the meaning of the bars, C refer to 3-6, "Receiver adjustment." Note that the intensity of light received cannot be adjusted from this display.

#### **3 Peak/bottom value**

Display 1 shows the measured value from the selected channel. The auxiliary display and display 2 show the peak or bottom value. The peak and bottom values can be switched by pressing  $\langle \! O \rangle \! / \langle \! D \rangle$ .

When the auxiliary display says "PE," display 2 shows the peak value. When the auxiliary display says "bE," display 2 shows the bottom value. Pressing  $\bigcup_{Back}$  will clear the values.

#### 4 Analog output (AO)

Display 1 shows the measured value from the selected channel. The auxiliary display shows the terminal number of an analog output terminal. While measurement is in progress, display 2 shows the analog output (1.0–5.0 for voltage, 4–20 for current).











ADVANCED SETTINGS

#### ⑤ MECHATROLINK-III communication status check display (for K1G-C04M only)

Display 1 shows the measured value from the selected channel. The auxiliary display shows the connection status of MECHATROLINK-III communication. When connected, " $\mathcal{L} \circ \sigma$ " is displayed. When disconnected, "- -" is displayed. Display 2 shows the error status of MECHATORLINK-III communication.

For details on the error status, refer to K1G Series High-Accuracy Position Sensor MECHATROLINK-III Communication Manual (No. CP-SP-1386E).

#### **6** EtherCAT communication status check display (for K1G-C04E only)

Display 1 shows the measured value from the selected channel. The auxiliary display and display 2 show either the EtherCAT status<sup>\*1</sup> or link status.<sup>\*2</sup> Switch between them by pressing  $\langle \! S \rangle / \langle \! S \rangle$ .

#### \*1. EtherCAT status

The auxiliary display shows the status of EtheCAT communication. Display 2 shows the node address.

Auxiliary display	Description	
, ñ	The device is in the Init state.	
Po	The device is in the Pre-Operational state.	
50	The device is in the Safe-Operational state.	
op	The device is in the Operational state.	
Ein	An error occurred in the Init state.	
EPo	An error occurred in the Pre-Operational state.	
E50	An error occurred in the Safe-Operational state.	
Eop	An error occurred in the Operational state.	

#### \*2. Link status

The auxiliary display shows whether the link to the RJ45 connector for ECAT IN is established. If the link is established, "Luca" is displayed. If not, "- uca" is displayed.

Display 2 shows whether the link to the RJ45 connector for ECAT OUT is established. If the link is established, "Lout" is displayed. If not, "-out" is displayed.







### **CHANGING THE DISPLAY RESOLUTION**

Changes the display of digits after the decimal point.



The display resolution applies to all channels. This parameter cannot be changed for each channel.

# Procedure

# Check that the mode is "Ready"

 If

 Runz

 Not lit

 If

 If

If "Run" is lit, press  $\bigcap_{Run}$  for 3 seconds or longer, and then check that "Run" is not lit (= Ready mode).

2

# Switch to the display for changing settings



Press Orara.



**3** Select RO2 (display resolution)



Select RG2 by pressing  $\otimes$ .



## Ready



Press  $\bigcup_{\text{Enter}}$  to finalize your selection of  $R \square 2$ .



### Select the parameter

Select one of the following by pressing  $\otimes / \otimes$ .

Parameter	Display range [mm]	Default setting
99.9	-99.9 to +99.9	
99.99	-99.99 to +99.99	
9.999	-9.999 to +9.999	<ul> <li>✓</li> </ul>
9.9999	0.0000 to 9.9999	



If 4 digits are shown after the decimal point, the display range is 0.0000 to 9.9999.

Note that the analog output (AO) range, and also the digital output (DO) threshold, are not changed automatically.



## Finalize your parameter selection



Press  $\bigcap_{\text{Enter}}$  to finalize your selection.



To change another setting, select the desired item by pressing  $\otimes / \otimes$  or  $\otimes / \otimes$ .

# **7** Exit the display for changing settings



Press  $\bigcirc_{\mathsf{Back}}$  .

# 8 Start measuring



To start measuring, press  $\bigcup_{\text{Run}}$  for 3 seconds or longer.

(The following procedure is followed if a parameter has been changed.)

# 8-1 Choose whether to save the parameter

Parameter

no

*YES* 



Choose whether to save by pressing @/@.

Description

Setting is not saved.

Setting is saved.

Display



Note: If "no" is selected and the power is turned off, the changed parameter will not be saved.



# 8-2 Finalize your selection and start measuring



Press  $\bigcap_{\text{Enter}}$  to finalize your selection and start measuring.

# **4-3** Changing the Measurement Settings

### **CHANGING THE MEASUREMENT MODE**

The measurement mode can be selected from ten types according to the object type, the application, and the object's direction of approach.

Measurement mode		Object type	Measurement orientation
1	Edge measure-	Opaque	Тор
2	ment	object	Bottom
3		Transparent	Тор
4		object	Bottom
5	Width measurement	Opaque	-
6	Gap measurement	object	-
7	Edge width mea-	Transparent	Тор
8	surement	object	Bottom
9	Measurement of		Тор
10	second edge		Bottom

Ready

#### **Edge measurement**

Determining edge position Transparent





#### Edge width measurement



#### Width measurement

Measuring blocked light width





Opaque

#### Gap measurement



#### Second edge measurement

Sensing the edge's status Transparent





# Procedure

# Check that the mode is "Ready"

If "Run" is lit, press  $O_{Run}$  for 3 seconds or longer, and then check that "Run" is not lit (= Ready mode).

2

### Select the channel whose settings will be changed



Select the channel No. by pressing

Display

Run Ch1 Ch2 Ch3 Ch4

Green Red The number of the selected channel is lit.

3

## Switch to the display for changing settings



Press Orara.



# **4** Select *b G 2* (measurement mode)

Press D to select D *i*, and then press D to select D *i*.







### Select the parameter



Select one of the following by pressing  $\otimes / \otimes$ .

Parameter	Measurement mode	Object type	Measurement orientation	Default setting
1		Opaque object	Тор	~
2	Edge		Bottom	
3	measurement	Transparent object	Тор	
ч			Bottom	
5	Width measurement	Opaque object	-	
Б	Gap measurement		-	
٦	Edge width	Transparent object	Тор	
8	measurement		Bottom	
9	Measurement of		Тор	
10	second edge		Bottom	



## Finalize your parameter selection



Press  $\bigcap_{\text{Enter}}$  to finalize your selection.



To change another setting, select the desired item by pressing  $\otimes/\otimes$ 

or 《/》.





# Start measuring



To start measuring, press  $\bigcup_{\text{Bun}}$  for 3 seconds or longer.

(The following procedure is followed if a parameter has been changed.)

**9**-1

### Choose whether to save the parameter



Choose whether to save by pressing @//@.

Display



Par

0.	
ameter	Description
<i>~ 0</i>	Setting is not saved.
<i>465</i>	Setting is saved.

Note: If "no" is selected and the power is turned off, the changed parameter will not be saved.



#### **9**-2 Finalize your selection and start measuring



Press  $\bigcap_{Enter}$  to finalize your selection and start measuring.
#### **CHANGING THE MEASUREMENT CYCLE**

Ready



The measurement cycle applies to all channels. This parameter cannot be changed for each channel.

### Procedure

### 1 Check that the mode is "Ready"

If "Run" is lit, press  $\bigcap_{Run}$  for 3 seconds or longer, and then check that "Run" is not lit (= Ready mode).



### Select 🕫 / (measurement cycle)



Press  $\bigcap_{Para}$  to select RD *!*.





2

## Enter 80 (



Press  $\bigoplus_{\text{Enter}}$  to finalize your selection.

#### 4

#### Select the parameter



Select one of the following by pressing  $\bigotimes / \bigotimes$ .

Parameter	Description	Default setting
2500	250 µs	
500.	500 µs	~
10000	1 ms	



The list of selectable measurement cycles varies depending on the cable length.

**C**7-2 Controllers (P. 7-5)



#### Finalize your parameter selection



Press  $\bigcup_{\text{Enter}}$  to finalize your selection.



To change another setting, select the desired item by pressing  $\bigotimes / \bigotimes$ or 《/》.

Exit the display for changing settings



Press  $\bigcirc_{\text{Back}}$ .

# 7 Start measuring



To start measuring, press  $\bigcup_{\text{Run}}$  for 3 seconds or longer.

(The following procedure is followed if a parameter has been changed.)



#### Choose whether to save the parameter



Thoose whether to save by pressing $\sqrt[3]{3}$ .		
Parameter	Description	
<i>~ 0</i>	Setting is not saved.	
YES	Setting is saved.	
Note: If "no" is selected and the power		

is turned off, the changed parameter will not be saved.



Display

# **7-2** Finalize your selection and start measuring



Press  $\bigcap_{\text{Enter}}$  to finalize your selection and start measuring.

#### **CHANGING THE NO. OF MOVING AVERAGES**

Ready

A moving average is calculated from the measured data.

If more moving averages are calculated, the measurements become more reliable, but the response becomes slower.

#### Procedure

#### Check that the mode is "Ready"

If "Run" is lit, press  $\bigcup_{\text{Run}}$  for 3 seconds or longer, and then check that "Run" is not lit (= Ready mode).





# **2** Select the channel whose settings will be changed

Select the channel No. by pressing

Display

Run Ch1 Ch2 Ch3 Ch4

Green Red The number of the selected channel is lit.

 $\bigcirc$ 

**3** Switch to the display for changing settings











Press D to select D *i*, and then press D to select D *i*.





#### Enter 603

Press  $\bigcup_{\text{Enter}}$  to finalize your selection of  $b \square \exists$ .



7

#### Set the parameter.



By pressing $\bigotimes / \bigotimes$ , select a value from	I-500.
Press $\langle \! \rangle / \langle \! \rangle$ to move the cursor to anot	her digit.

Parameter	Display range [mm]	Default setting
1-500	1-500 (in increments of 1)	<u> 5</u> 4



If the parameter is set to 1, no moving average will be set.





Press  $\bigoplus_{\text{Enter}}$  to finalize your selection.



To change another setting, select the desired item by pressing  $\otimes / \otimes$  or  $\otimes / \otimes$ .







### Start measuring



To start measuring, press  $\bigcup_{\text{Run}}$  for 3 seconds or longer.

(The following procedure is followed if a parameter has been changed.)

*YE* 5

**9**-1

#### Choose whether to save the parameter



Display



©/()).	
Parameter	Description
<i>~ 0</i>	Setting is not saved.

Setting is saved. Note: If "no" is selected and the power is turned off, the changed parameter will not be saved.



#### **9**-2 Finalize your selection and start measuring



Press \_\_\_\_\_ to finalize your selection and start measuring.

#### **CHANGING THE EDGE DETECTION THRESHOLD**

#### Ready

The edge detection threshold is used to judge whether or not light is blocked. With the level of incoming light used for intensity adjustment as 100 %, if the amount of received light is less than the edge detection threshold, the light is judged to be blocked.



#### **Received light profile**



When the measurement mode ( $b \square 2$ ) is set ( $\bigcirc$  P. 4-11), the edge detection threshold is also automatically set.

For basic measurement, it is not necessary to change the edge detection threshold.

- 25 % for opaque objects
- 75 % for transparent objects

# Procedure

#### Check that the mode is "Ready"



If "Run" is lit, press  $\bigcup_{\text{Run}}$  for 3 seconds or longer, and then check that "Run" is not lit (= Ready mode).



Ch Select

Select the channel No. by pressing

Display

Run Ch1 Ch2 Ch3 Ch4

Green Red The number of the selected channel is lit.



4

5

#### Switch to the display for changing settings



Press  $\bigcirc_{\text{Para}}$ .



#### Select **b**25 (edge detection threshold)



Press to select  $b\square$  *i*, and then press to select  $b\square$  5.



Enter **b**85



Press  $\bigoplus_{\text{Enter}}$  to finalize your selection of b  $\square$  5.

# **6** Set the parameter



ress 🛞	/⊗ to	select	a value	from	5 to	95.
--------	-------	--------	---------	------	------	-----

		Object type		
Parameter	Description	Opaque	Transparent	
		object	object	
5-95	5–95 % (in increments of 1 %)	25	75	

Press ()/() to move the cursor to another digit.



#### Finalize the parameter value

Press  $\bigoplus_{\text{Enter}}$  to finalize the selected value.



To change another setting, select the desired item by pressing  $\otimes / \otimes$  or  $\otimes / \otimes$ .



#### Exit the display for changing settings



#### Press $\bigcirc_{\text{Back}}$ .

# 9 Start measuring



To start measuring, press  $\bigcup_{\text{Bun}}$  for 3 seconds or longer.

(The following procedure is followed if a parameter has been changed.)

**9**-1

#### Choose whether to save the parameter



Choose whether to save by pressing Display ()/().

©/()).	
Parameter	Description
<i>~ 0</i>	Setting is not saved.
YES	Setting is saved.

Note: If "no" is selected and the power is turned off, the changed parameter will not be saved.



### **9-2** Finalize your selection and start measuring



Press  $\bigcap_{\text{Enter}}$  to finalize your selection and start measuring.

# **4-4** Changing the Analog Output (AO) Settings

#### **CHANGING THE ANALOG OUTPUT (AO) RANGE**

The analog output range can be changed.

By using this function to narrow the measurement range, it is possible to obtain analog output with better resolution. The AO corresponds to changes in the measured value.



#### Check that the mode is "Ready"

If "Run" is lit, press  $\bigcup_{\text{Run}}$  for 3 seconds or longer, and then check that "Run" is not lit (= Ready mode).



**2** Select the channel whose settings will be changed



I	Select the channel No. by pressing
	0
I	Ch Select •

Correspondence of channels and analog outputs

Channel	Analog output
Ch1	A01
Ch2	A02
Ch3	A03
Ch4	A04

🔲 Run Ch1 Ch2 Ch3 Ch4

Green Red

The number of the selected channel is lit.

Ready





Press Orara.



### 4

#### Select *[ | |* (analog output range low limit)



Press ( to select  $\mathcal{L}\mathcal{D}$  *I*, and then press ( to select *L* / /.



With K1G-S07

6

#### Enter [ / /

Press  $\bigoplus_{\text{Enter}}$  to finalize your choice of  $\mathcal{L}$  /  $\mathcal{L}$ 



ADVANCED SETTINGS

#### Set the parameter



By pressing  $\otimes / \otimes$ , select a value from - 99.999-99.999.

Sensor heads	Parameter	Description	Default setting
K1G-S07	-99.999-99.999	–99.999 to +99.999 [mm] (in increments of 1 μm)	- 3.500
K1G-S15	- 99.999-99.999	–99.999 to +99.999 [mm] (in increments of 1 $\mu\text{m})$	- 7.500

Press @/@ to move the cursor to another digit.

#### Finalize your parameter selection



Press  $\bigoplus_{\text{Enter}}$  to finalize your parameter selection.



9



Press  $\bigotimes$  to select *L* 12.





Press  $\underset{\text{Enter}}{\overset{\bigcirc}{\longrightarrow}}$  to finalize your choice of *L* 12.





By pressing  $\otimes / \otimes$ , select a value from - 99.999–99.999.

Sensor heads	Parameter	Description	Default setting
K1G-S07	- 99.999-99.999	–99.999 to +99.999 [mm] (in increments of 1 μm)	3.500
K1G-S15	-99.999-99.999	-99.999 to +99.999 [mm] (in increments of 1 μm)	סס.5

Press  $\bigcirc / \bigcirc$  to move the cursor to another digit.



Set the parameters such that:  $\mathcal{L} + \mathcal{L}$  (low limit) <  $\mathcal{L} + \mathcal{L}$  (high limit)

# **11** Finalize your parameter selection





To change another setting, select the desired item by pressing  $\bigotimes / \bigotimes$  or  $\bigotimes / \bigotimes$ .

# **12** Exit the display for changing settings



Press  $\bigcup_{\text{Back}}$ .

# **13** Start measuring



To start measuring, press  $\bigcup_{\text{Run}}$  for 3 seconds or longer.

(The following procedure is followed if a parameter has been changed.)

# **13**-1 Choose whether to save the parameter



Choose whether to save by pressing ()/()

97 @·	
Parameter	Description
<i>~ 0</i>	Setting is not saved.
YES	Setting is saved.

Note: If "no" is selected and the power is turned off, the changed parameter will not be saved.



**13**-2 Finalize your selection and start measuring



Press  $\bigcap_{\text{Enter}}$  to finalize your selection and start measuring.



After the zero adjustment, change the analog output (AO) range so that the analog output correctly corresponds to the measured value. CP. 4-25

In addition, check the digital output (DO) high and low thresholds.

### Procedure



#### Check that the mode is "Ready"



If "Run" is lit, press  $\bigcap_{Run}$  for 3 seconds or longer, and then check that "Run" is not lit (= Ready mode).

# 2

#### Select the channel whose settings will be changed

Select the channel No. by pressing



Ch Select

Display

Run Ch1 Ch2 Ch3 Ch4

Green Red The number of the selected channel is lit.





Press  $\bigcap_{Para}$ .





#### Select **b D b** (zero adjustment value)



Press ( to select **b** $\square$  **!**, and then press ( to select **bDb**.







Press  $\bigcup_{\text{Enter}}$  to finalize your choice of **b** $\square$ **b**.



#### Set the parameter

By pressing  $\bigotimes / \bigotimes$ , select one of the following.

Sensor heads	Parameter	Description	Default setting
K1G-S07	- 3.500-3.500	-3.500 to +3.500 [mm] (in increments of 1 μm)	0.000
K1G-S15	- 7.500–7.500	-7.500 to +7.500 [mm] (in increments of 1 μm)	0.000

Press ()/() to move the cursor to another digit.



With the K1G-S07, for a measurement range of 0.000-7.000 [mm], set the parameter to - 3.500.

# **7** Finalize your parameter selection



Press  $\sum_{\text{Enter}}^{1}$  to finalize your parameter selection.





### Exit the display for changing settings





#### Start measuring



To start measuring, press  $\bigcup_{\text{Run}}$  for 3 seconds or longer.

(The following procedure is followed if a parameter has been changed.)

### **9**-1

### Choose whether to save the parameter



Choose whether to save by pressing @/@.

ParameterDescriptionnoSetting is not saved.YE5Setting is saved.

Note: If "no" is selected and the power is turned off, the changed parameter will not be saved.



Display

### **9-2** Finalize your selection and start measuring



Press  $\bigcap_{\text{Enter}}$  to finalize your selection and start measuring.

Ready

#### SETTING REVERSE POLARITY

The analog output (AO) polarity can be reversed.

AO polarity example (for K1G-S15)



### Procedure

#### Check that the mode is "Ready"



If "Run" is lit, press  $\bigcap_{Run}$  for 3 seconds or longer, and then check that "Run" is not lit (= Ready mode).

#### Select the channel whose settings will be changed

Select the channel No. by pressing



2

Ch Select

Display

🔲 Run Ch1 Ch2 Ch3 Ch4

Green Red The number of the selected channel is lit.





Press O .



### **4** Select *L I* (analog output reverse polarity)



Press ()) to select  $\Box \Box$  *I*, and then press ()) to select  $\Box$  *I*.





6



Press  $\bigoplus_{\text{Enter}}$  to finalize your choice of  $\mathcal{L}$  / $\mathcal{D}$ .

#### Set the parameter



Press  $\otimes / \otimes$  to select aFF or an.

	Parameter	Description	Default setting
	oFF	Disabled (positive polarity)	<ul> <li>✓</li> </ul>
-	00	Enabled (negative polarity)	

### **7** Finalize your parameter selection



Press  $\bigcap_{\text{Enter}}$  to finalize your parameter selection.



To change another setting, select the desired item by pressing  $\otimes / \otimes$  or  $\otimes / \otimes$ .



#### Exit the display for changing settings





### Start measuring



To start measuring, press  $\bigcup_{Run}$  for 3 seconds or longer.

(The following procedure is followed if a parameter has been changed.)

# 9-1 Choose whether to save the parameter



Choose whether to save by pressing Display ()

<b>⊘</b> / <i>©</i> .	
Parameter	Description
<i>~ 0</i>	Setting is not saved.
<i>4</i> 25	Setting is saved.

Note: If "no" is selected and the power is turned off, the changed parameter will not be saved.



### **9-2** Finalize your selection and start measuring



Press  $\bigcap_{\text{Enter}}$  to finalize your selection and start measuring.

# 4-5 Using Digital Input (DI) and Digital Output (DO)

#### **CHANGING DIGITAL INPUT (DI) SETTINGS**

Up to 4 digital inputs can be used.

Channels and event types can be combined freely.

DI operation type	Operation
Zero adjustment input	When DI is turned ON, the zero point for measurement is changed. (CC Changing the zero adjustment value (P. 4-29))
Input for cancellation of EPS filter output hold	While DI is ON, EPS filter output hold is canceled. (C Setting EPS filters (P. 4-83))
Input to forcibly cancel EPS filter output hold	When DI is turned ON, EPS filter output hold is forcibly canceled. ( 🗲 Setting EPS filters (P. 4-83))
Event log start input	When DI is turned ON, the event log function is activated. (CC Configuring the event log function (P. 4-95))
Input for PV hold	Used for the PV hold function. ( 🗲 Configuring the PV hold function (P. 4-79))
Laser start input	While DI is ON, the laser beam is emitted. (CP 9-7 Important Notes for Restarting the Laser Beam (P. 9-31))
Calculation OFF input	While DI is ON, calculation is suspended. Note: While DI is ON, the PV, AO, and DO are not updated.

DI operating conditions



The minimum input time (X ms) varies depending on the selected measurement cycle. 6 ms: when 250  $\mu$ s is selected 12 ms: when 500  $\mu$ s is selected 24 ms: when 1 ms is selected



"PV" refers to the output after calculation.

9-3 Processing Flowchart (P. 9-12)

### Procedure

#### Ready

#### 1

2

#### Check that the mode is "Ready"

If "Run" is lit, press  $\bigcap_{Run}$  for 3 seconds or longer, and then check that "Run" is not lit (= Ready mode).



# Select the channel whose settings will be changed

Select the channel No. by pressing



Ch Select			
Channel	Digital input		
Ch1	DI1		
Ch2	DI2		
Ch3	DI3		
Ch4	DI4		

Display

🗖 Run Ch1 Ch2 Ch3 Ch4

Green Red The number of the selected channel is lit.



#### Switch to the display for changing settings



Press Orange





#### Select *E II G* (DI function selection)



Press D to select  $\mathcal{E}\mathcal{I}$  *i*, and then press D to select  $\mathcal{E}\mathcal{I}\mathcal{I}$ .





#### Select the parameter



6

Press  $\otimes / \otimes$  to select one of the following parameters.

Parameter	Channel	Description	Default setting
0-8dJ	Specified	Zero adjustment input	~
EPS	channel	channel Input to cancel EPS filter output hold	
Pu-h		Input for PV hold	
RLL D-RdJ	All channels	Zero adjustment input	
RLL EPS		Input to cancel EPS filter output hold	
RLL Pu-h		Input for PV hold	
RLL F-EPS		Input to forcibly cancel EPS filter output hold	
RLL Ld-on		Laser start input	
RLL do-of		Calculation OFF input	
RLL Loū		Event log start input	

#### **!** Handling Precautions

- When using all-channel EPS filter output hold cancellation input (DI) to cancel the EPS filter on all channels, do not assign EPS hold cancellation input to another DI also.
- When using all-channel PV hold input (DI), do not assign PV hold input to another DI also.
- If the laser start input is assigned to multiple DIs, the laser beam will be emitted only when all of those DIs are ON.
- If calculation OFF input is assigned to multiple DIs, calculation will be stopped if any one of those DIs is ON.

#### Finalize your parameter selection





To change another setting, select the desired item by pressing  $\bigotimes / \bigotimes$  or  $\bigotimes / \bigotimes$ .



#### Exit the display for changing settings





#### Start measuring



To start measuring, press  $\bigcup_{\text{Run}}$  for 3 seconds or longer.

(The following procedure is followed if a parameter has been changed.)



#### Choose whether to save the parameter

Choose whether to save by pressing

<b>◎/</b> ②.	
Parameter	Description
<i>~ 0</i>	Setting is not saved.
<i>465</i>	Setting is saved.

Note: If "no" is selected and the power is turned off, the changed parameter will not be saved.



# **9-2** Finalize your selection and start measuring



Press Enter to finalize your selection and start measuring.

#### **DIGITAL OUTPUTS (DO)**

Up to 8 digital outputs can be used.

Channels and event types can be combined freely.

#### Using outputs during measurement





#### SETTING THE DIGITAL OUTPUT (DO) OPERATION TYPE: HIGH/LOW/PASS/OUT

#### **Configuration flowchart**





#### Procedure

#### Check that the mode is "Ready"

If "Run" is lit, press  $\bigcup_{\text{Run}}$  for 3 seconds or longer, and then check that "Run" is not lit (= Ready mode).





Select the digital output (channel) No.



Ch Select

Select the channel No. by pressing

Display

Run Ch1 Ch2 Ch3 Ch4

Green Red The number of the selected channel is lit.

#### Correspondence of channels and DO numbers

Channel	Selectable digital outputs		
Ch1	DO1	DO2	
Ch2	DO3	DO4	
Ch3	DO5	DO6	
Ch4	DO7	DO8	

3

2

#### Switch to the display for changing settings









#### Select *E* <sup>[]</sup> *i* or *E* <sup>[]</sup> <sup>[]</sup> 5 (event source)



**To select** *E □ 1*, press ()) to display *E □ 1*.





To select  $E \square 5$ , press  $\bigcirc$  to select  $E \square I$ , and then press  $\bigcirc$  to display  $E \square 5$ .

EUS do2 +\*1 [h]-\*2

\*1. The selected No. is displayed.\*2. The selected channel is displayed.

# **5** Enter *E G i* (or *E G* **5**)

Ente

Press  $\bigoplus_{\text{Enter}}$  to finalize your choice of *E*  $\square$  *I*/*E*  $\square$  *S*.

#### Select the parameter



Select one of the following by pressing  $\otimes / \otimes$ .

Parameter	Description
Eoñ	All channels (OR output)
[h 1	Ch1 (for PV1)
[24]	Ch2 (for PV2)
[h]	Ch3 (for PV3)
Erk	Ch4 (for PV4)

The default selection is the channel selected in step 2 above.

## **7** Finalize your parameter selection



 $\mbox{Press} \bigoplus_{\mbox{Enter}}$  to finalize your parameter selection.





#### Select *E D 2* or *E D b* (event type)



To select E □ 2, press ⊗.



To select E □ E, press ⊗.



\*The selected No. is displayed.

Enter ED2 (or ED5)



Press  $\bigoplus_{\text{Enter}}$  to finalize your choice of *E*  $\square$  *2* or *E*  $\square$  *E*.

# **10** Select the parameter



Select one of the following by pressing  $\otimes / \otimes$ .

Parameter	Description	Default setting
PRSS	Pass	✔ (E02)
out	Out	✓ (٤٥٤)
h ,	High	
Lo	Low	
EPS	EPS event	
hold	Holding	
L ,Ght	Smudge	
Er iG	Output update	
50 in 5	Normal operation	

Do not select shaded parameters.





Press  $\bigcap_{\text{Enter}}$  to finalize your parameter selection.



To use the delay timer, go to step 12. If it is not used, go to step 20 (  $rac{rac}{rac}$  P. 4-49 ).



# **12** Select *E D 3* or *E D 7* (delay setting)



**To select** *E □ 3*, press ⊗.

Display



**To select** *E □* 7, press ⊗.



\*The selected No. is displayed.

# **13** Finalize your parameter selection



Press  $\bigcap_{Enter}$  to finalize your parameter selection.

# **14** Select the parameter



Select one	of the fo	llowing	by	pressing	$\otimes$	∕⊗.
------------	-----------	---------	----	----------	-----------	-----

Parameter		Description	Default setting	
	nonE	No timer	<b>v</b>	
	on-d	ON-delay timer		
	oF-d	OFF-delay timer		

# **15** Finalize your parameter selection



Press  $\bigcap_{\text{Enter}}$  to finalize your parameter selection.



# **16** Select *ED*4 or *EDB* (delay time)



**To select** *E □ ч*, press ⊗.

Display



To select E□B, press ⊗.



\*The selected No. is displayed.

# **17** Enter *E* <sup>*G*</sup> <sup>*G*</sup> (or *E* <sup>*G*</sup> <sup>*B*</sup>)

5 6 7

Press  $\bigoplus_{\text{Enter}}$  to finalize your choice of *E*  $\square$  4 or *E*  $\square$  8.

# **18** Select the parameter



Select one of the following by pressing  $\otimes / \otimes$ .

Parameter	Description	Default setting
10	10 ms	
20	20 ms	
30	30 ms	
40	40 ms	V
50	50 ms	
60	60 ms	
סר	70 ms	



Press  $\bigcap_{\text{Enter}}$  to finalize your parameter selection.



# 20 Select 207 (low threshold)



Press to select  $\fbox{}$  *i*, and then press to select  $\pounds$   $\vcenter{}$  *i*.



With K1G-S15 sensor



Press  $\underset{\text{Enter}}{\bigcup}$  to finalize your choice of  $L \square 7$ .



Ente



**⊘** <sup>⊗</sup> **∫** 

Enter

By pressing  $\otimes / \otimes$ , select a value from -33.333-33.332.

Sensor heads	Parameter	Description	Default setting
K1G-S07	-99.999-99.999	-99.999 to +99.999 [mm] (in increments of 1 μm)	- 3.500
K1G-S15	-99.999-99.999	-99.999 to +99.999 [mm] (in increments of 1 μm)	- 7.500

Press @/ @ to move the cursor to another digit.

# **23** Finalize your parameter selection





With K1G-S15 sensor



Press  $\bigoplus_{\text{Enter}}$  to finalize your choice of *L*  $\square B$ .



By pressing  $\bigotimes / \bigotimes$ , select a value from -99.999-99.999.

Sensor heads	Parameter	Description	Default setting
K1G-S07	-99.999-99.999	-99.999 to +99.999 [mm] (in increments of 1 μm)	3.500
K1G-S15	-99.999-99.999	-99.999 to +99.999 [mm] (in increments of 1 μm)	7.500

Press @/ @ to move the cursor to another digit.

Enter

# **27** Finalize your parameter selection

 $\mbox{Press} \bigoplus_{\mbox{Enter}}$  to finalize your parameter selection.


## 28 Select []] (hysteresis)



Press <sup>⊗</sup> to select *L* □ *g*.





Press  $\bigcap_{\text{Enter}}$  to finalize your choice of *LDB*.

# **30** Set the parameter



By pressing  $\bigotimes / \bigotimes$ , select a value from  $\square \square \square \square \square$ .

Parameter	Description	Default setting
0.0 10- 1.000	Settable in increments of 1 µm	0.0 10

Press @/ @ to move the cursor to another digit.

## **31** Finalize your parameter selection



Press  $\bigoplus_{\text{Enter}}$  to finalize your parameter selection.



To change another setting, select the desired item by pressing  $\bigotimes / \bigotimes$  or  $\bigotimes / \bigotimes$ .

## **32** Exit the display for changing settings



Press  $\bigcup_{\text{Back}}$ .

## **33** Start measuring



To start measuring, press  $\bigcup_{\text{Run}}$  for 3 seconds or longer.

(The following procedure is followed if a parameter has been changed.)

# ADVANCED SETTINGS

# **33-1** Choose whether to save the parameter



Choose whether to save by pressing ()/().

Parameter	Description
n 0	Setting is not saved.
<i>4</i> £5	Setting is saved.

Note: If "no" is selected and the power is turned off, the changed parameter will not be saved.





## **33**-2Finalize your selection and start measuring



Press  $\bigcap_{\text{Enter}}$  to finalize your selection and start measuring.

#### SETTING SPECIAL OUTPUTS

#### **Configuration flowchart**







#### Check that the mode is "Ready"



0

If "Run" is lit, press  $\bigcup_{\text{Run}}$  for 3 seconds or longer, and then check that "Run" is not lit (= Ready mode).



#### Select the digital output (channel) No.

Select the channel No. by pressing

Display

Run Ch1 Ch2 Ch3 Ch4

Green Red The number of the selected channel is lit.

#### Correspondence of channels and DO numbers

Channel	Selectable digital outputs	
Ch1	DO1	DO2
Ch2	DO3	DO4
Ch3	DO5	DO6
Ch4	DO7	DO8

**3** Switch to the display for changing settings









Display press ( to select  $E \square$  I, and then press ( to Ci ( \*2

> \*1. The selected No. is displayed. \*2. The selected channel is displayed.



6

4

## Enter $\mathcal{E}\mathcal{G}$ (or $\mathcal{E}\mathcal{G}\mathcal{S}$ )

display E05.



Press  $\bigoplus_{\text{Enter}}$  to finalize your choice of *ED !/ED*5.

#### Select the parameter



Select one of the following by pressing  $\bigotimes / \bigotimes$ .

Parameter	Description
Eoñ	All channels (OR output)
[h 1	Ch1 (for PV1)
[h2	Ch2 (for PV2)
[h]	Ch3 (for PV3)
Ehy	Ch4 (for PV4)

The default selection is the channel selected in step 2 above.

## **7** Finalize your parameter selection



 $\mbox{Press} \bigoplus_{\mbox{Enter}}$  to finalize your parameter selection.





9

## Select $E \square 2$ or $E \square 6$ (event type)



To select E □ 2, press ⊗.





To select E □ E, press ⊗.



\*The selected No. is displayed.

## Enter *E 02* (or *E 06*)

Enter



Select one of the following by pressing  $\bigotimes / \bigotimes$ .

## **10** Select the parameter



Parameter	Description	Default setting
PRSS	Pass	✓ (E02)
out	Out	🖌 (E05)
hi	High	
Lo	Low	
EPS	EPS event	
hold	Holding	
լ նհե	Smudge	
ני הב	Output update	
60 106	Normal operation	

Do not select shaded parameters.

# **11** Finalize your parameter selection



Press  $\bigoplus_{\text{Enter}}$  to finalize your parameter selection.





## **12** Select *E D 3* or *E D 7* (delay setting)



To select  $E \square 3$ , press  $\bigotimes$ .

Display





**To select** *E □* 7, press ⊗.



\*The selected No. is displayed.

# **13** Finalize your parameter selection



 $\label{eq:Press} \underset{\text{Enter}}{\bigcirc} \text{ to finalize your parameter selection.}$ 

## **14** Select the parameter



Select one of the f	following by	pressing	⊘/	$\otimes$
---------------------	--------------	----------	----	-----------

Parameter	Description	Default setting
nonE	No timer	<b>v</b>
on-d	ON-delay timer	
oF-d	OFF-delay timer	

## **15** Finalize your parameter selection



Press  $\bigcap_{\text{Enter}}$  to finalize your parameter selection.



# **16** Select *E* <sup>*D*</sup> <sup>*H*</sup> or *E* <sup>*D*</sup> <sup>*B*</sup> (delay time)



**To select** *E □ ч*, press ⊗.



To select E□B, press ⊗. Display





\*The selected No. is displayed.

# **17** Enter *E* <sup>*B*</sup> <sup>*Y*</sup> (or *E* <sup>*B*</sup> <sup>*B*</sup>)

Press  $\bigoplus_{Enter}$  to finalize your choice of *E*  $\square$  4 or *E*  $\square$  8.

# **18** Select the parameter

Select one of the following by pressing  $\bigotimes / \bigotimes$ .

Parameter	Description	Default setting
10	10 ms	
20	20 ms	
30	30 ms	
40	40 ms	<ul> <li>✓</li> </ul>
50	50 ms	
60	60 ms	
סר	70 ms	

# **19** Finalize your parameter selection



Press  $\bigcap_{\text{Enter}}$  to finalize your parameter selection.



To change another setting, select the desired item by pressing  $\bigotimes / \bigotimes$  or  $\bigotimes / \bigotimes$ .

# **20** Exit the display for changing settings



Press O .

# 21 Start measuring



To start measuring, press  $\bigcup_{\text{Bun}}$  for 3 seconds or longer.

(The following procedure is followed if a parameter has been changed.)

## **21**-1 Choose whether to save the parameter



Choose whether to save by pressing ()/()

Display

0.	
Parameter	Description
<i>~ 0</i>	Setting is not saved.
4E S	Setting is saved.

Note: If "no" is selected and the power is turned off, the changed parameter will not be saved.



# **21**-2 Finalize your selection and start measuring



Press  $\bigcap_{\text{Enter}}$  to finalize your selection and start measuring.

#### **OVERVIEW OF CALCULATIONS**

The controller can execute various calculations based on the measured data from the channels.



#### **!** Handling Precautions

- The following calculations are not possible with a measurement cycle of 250  $\mu s$ . If this speed is specified, the controller will perform no calculation.
  - ${\scriptstyle \bullet \, \theta \, calculation}$
  - Measurement range expansion calculation



If advanced calculations are used, check the analog output (AO) range and the high and low thresholds for digital output (DO).

#### SETUP OF THE FOUR ARITHMETIC OPERATIONS

Ready

The basic arithmetic operations can be executed on the measured data from 4 channels after their zero point has been adjusted.

These operations are used for width measurement of a workpiece, averaging of channel data, etc.

The basic arithmetic operations use the following formula:

 $\frac{(K1 \times Ch1 + K2 \times Ch2 + K3 \times Ch3 + K4 \times Ch4)}{C2} + C1$ 

Ch1-Ch4: Measured values from channels

- K1-K4: Multiplier
- C1: Addition/subtraction parameter
- C2: Division parameter

#### Parameter samples

Calculating variations in workpiece width using two sensors



Calculating the average of channels 2, 3, and 4 and the difference between the average and channel 1.



## Procedure

## Check that the mode is "Ready"

If "Run" is lit, press  $\bigcup_{\text{Run}}$  for 3 seconds or longer, and then check that "Run" is not lit (= Ready mode).





#### Select the channel whose settings will be changed

Select the channel No. by pressing

Display



Och Select

Display

Run Ch1 Ch2 Ch3 Ch4

Green Red The number of the selected channel is lit.



If channel 1 is selected, analog output 1 is set.



#### Switch to the display for changing settings



Press  $\bigcirc_{\text{Para}}$ .





## Select [] { (inter-channel calculation)



Press (1) to select [] 1.





#### Select parameter F - 4E h



6

Select F - YE h by pressing 🛞 .

Parameter Description		Default setting
nonE	Disabled	<b>v</b>
F-4[h	Four arithmetic operations	
F-RnG	θ calculation	
F-EHE	Measurement range expansion	
	calculation	

Do not select shaded parameters.



#### Finalize your parameter selection

Press  $\bigcup_{\text{Enter}}$  to finalize your parameter selection.

8

7

#### Select d 🛛 (calculation parameter K1)



Press () to select d I I.

Display





9

Press  $\bigoplus_{\text{Enter}}$  to finalize your choice of  $d\square$  !.

# **10** Set the parameter



Set a value from - 1000 - 1000 by pressing  $\bigotimes / \bigotimes$ .

ltem	Parameter	Description	Default setting
d0 I	- 1000- 1000	K1: Multiplier for Ch1	1

 $\otimes/\otimes$  to move the

## **11** Finalize your parameter selection



 $\mbox{Press} \bigoplus_{\mbox{Enter}}$  to finalize your parameter selection.

12 Set d02-d06 (calculation parameters K2, K3, K4, C1, C2)



For the setup procedure, see steps 8–11 for  $d\square$  !. In step 8, press  $\bigotimes$  to select  $d\square 2 - d\square 5$ .

ltem	Parameter	Description	Default setting
202	- 1000- 1000	K2: Multiplier for Ch2	1
603	- 1000- 1000	K3: Multiplier for Ch3	1
<i>40</i> 4	- 1000- 1000	K4: Multiplier for Ch4	1
d05	- 9.999-9.999	C1: Addition-subtraction parameter	0.000
406	1- 10000	C2: Division parameter	ч



To change another setting, select the desired item by pressing  $\bigotimes / \bigotimes$ or  $\langle \rangle \rangle$ .

## **13** Exit the display for changing settings



Press  $\bigcap_{\mathsf{Rack}}$ .





To start measuring, press  $\bigcup_{\text{Bun}}$  for 3 seconds or longer.

(The following procedure is followed if a parameter has been changed.)

## **14**-1 Choose whether to save the parameter



<b>(</b> 𝔅) / (𝔅).		
Parameter	Description	
<i>~ 0</i>	Setting is not saved.	
465	Setting is saved.	

Note: If "no" is selected and the power is turned off, the changed parameter will not be saved.





## **14**-2 Finalize your selection and start measuring



Press \_\_\_\_\_\_ to finalize your selection and start measurina.

#### SETUP OF O CALCULATION

#### Ready

The tilt angle ( $\theta$ ) of the edge is calculated from edge position measurement by sensor heads on two channels.

 $\theta$  calculation can be done with channels 1 and 2 or with channels 3 and 4.  $\theta$  calculation uses the following formula:

Channels 1 and 2

$$\theta = K1 \times \frac{180}{\pi} \times \tan^{-1} \left( \frac{Ch1 - Ch2}{C2} \right)$$

Ch1, Ch2: Measured values

K1: Multiplier for angle

C2: Distance between channel 1 and 2 sensors



## Procedure

Run Not lit

## Check that the mode is "Ready"

If "Run" is lit, press  $\bigcup_{\text{Run}}$  for 3 seconds or longer, and then check that "Run" is not lit (= Ready mode).



#### 2 Select the channel whose settings will be changed



Select the channel No. by pressing

Display

Run Ch1 Ch2 Ch3 Ch4 Red Green The number of the selected

channel is lit.



This function can be used for channels 2 and 4 only. If channel 1 or 3 is selected, nothing is displayed for the parameter setting.



4

#### Switch to the display for changing settings



Press Oraca.



ADVANCED SETTINGS

#### Select [] (inter-channel calculation)



Enter

Press () to select [] 1.



5 Enter [] / Para ๎⊚`

Press  $\underbrace{\bigcup}_{Enter}$  to finalize your choice of  $\underline{L} \, \underline{D} \, I$ .

## **6** Select parameter *F* - *B* - *G*



Parameter	Description	Default setting
nonE	Disabled	<b>v</b>
F-Y[h	Four arithmetic operations	
F-8-5	$\theta$ calculation (channels 2 or 4 only can be selected)	
F-EHE	Measurement range expansion calculation	

Do not select shaded parameters.





Press  $\bigoplus_{\text{Enter}}$  to finalize your parameter selection.



7

## Select d 2 (calculation parameter K1)



Press (1) to select d 1 1.





#### Enter 🖉 🕴



Press  $\bigoplus_{\text{Enter}}$  to finalize your choice of  $d \square$  !.

## **10** Set the parameter



Set a value from - 1000 - 1000 by pressing  $\otimes / \otimes$ . Press  $\otimes / \otimes$  to move the cursor to another digit.

Item	Parameter	Description	Default setting
d0 (	- 1000- 1000	K1: Multiplier parameter for angle	1

## **11** Finalize your parameter selection



Press  $\bigcap_{\text{Enter}}$  to save it.

## **12** Set *d* 🛛 5 (calculation parameter C2)



For the setup procedure, see steps 8–11 for  $d\square$  1. In step 8, press  $\bigotimes$  to select  $d\square B$ .

Item	Parameter	Description	Default setting
d05	I- 10000	C2: Distance between sensors	Ч



To change another setting, select the desired item by pressing  $\otimes / \otimes$  or  $\otimes / \otimes$ .

# **13** Exit the display for changing settings



Press  $\bigcap_{\text{Back}}$  .

# **14** Start measuring



To start measuring, press  $\bigcup_{\text{Bun}}$  for 3 seconds or longer.

(The following procedure is followed if a parameter has been changed.)

## **14**-1 Choose whether to save the parameter

Parar



Choose whether to save by pressing ()/().

Display

-		
rameter	Description	
<i>~o</i>	Setting is not saved.	
Setting is saved.		
e: If "no" is selected and the nower		

Note: If "no" is selected and the power is turned off, the changed parameter will not be saved.



## **14**-2 Finalize your selection and start measuring



Press  $\bigcap_{\text{Enter}}$  to finalize your selection and start measuring.

#### SETTING THE MEASUREMENT RANGE EXPANSION CALCULATION

#### Ready

Output to expand the measurement range is calculated from edge position measurements by two pairs of sensor heads. This function is used for measuring a width of 15 mm or more.

The measurement range expansion calculation can be done using channels 1 & 2 or using channels 3 & 4.



After installation of the sensor heads, executing zero adjustment for both channels is necessary to set the zero points for measurement. C Changing the zero adjustment value (P. 4-29)

#### Procedure

#### Check that the mode is "Ready"



If "Run" is lit, press  $\bigcup_{\text{Run}}$  for 3 seconds or longer, and then check that "Run" is not lit (= Ready mode).

#### **2** Select the channel whose settings will be changed



Select the channel No. by pressing

Ch Select

Display

Run <u>Ch1</u> Ch2 Ch3 Ch4

Green Red The number of the selected channel is lit.



This function uses channels 2 or 4 only. If channel 1 or 3 is selected, nothing is displayed for the parameter setting.



# Switch to the display for changing settings







## Select [] / (inter-channel calculation)



Press (1) to select E D 1.







Press  $\underset{\text{Enter}}{\overset{\frown}}$  to finalize your choice of  $L \square I$ .

#### 6 Select parameter *F* - *E H E*



Select F - EHE by pressing  $\bigotimes / \bigotimes$ .

Parameter	Description	Default setting
nonE	Disabled	~
F-Ydh	Four arithmetic operations	
F-8-5	$\theta$ calculation	
F-EHE	Measurement range expansion calculation (channels 2 or 4 only can be selected)	

Do not select shaded parameters.

Enter F - EHE

Enter

Press  $\bigoplus_{\text{Enter}}$  to finalize your selection.



To change another setting, select the desired item by pressing  $\otimes/\otimes$ 

or 《/》.

8

ADVANCED SETTINGS

7

#### Exit the display for changing settings





# 9 Start measuring



To start measuring, press  $\bigcup_{\text{Run}}$  for 3 seconds or longer.

(The following procedure is followed if a parameter has been changed.)



## Choose whether to save the parameter



Choose whether to save by pressing $@/@$ .			
Parameter Description			
Setting is not saved.			
Setting is saved.			
Note: If "no" is selected and the power			

is turned off, the changed parameter will not be saved.



## **9-2** Finalize your selection and start measuring



Press  $\bigcap_{\text{Enter}}$  to finalize your selection and start measuring.

# 4-7 Using Special Functions

#### **SETTING A WORKING DISTANCE (WD)**

Ready

This function can be used for future K1G products. It will not improve the accuracy of position measurement if it is used with model K1G-S07 or K1G-S15.



## **4** Select **b D ?** (working distance)



Press D to select D *I*, and then press D to select D *I*.





Enter **5 7** 

Enter

Press  $\bigcup_{\text{Enter}}$  to finalize your choice of  $b \square 7$ .



#### Set the parameter



Set one of the following by pressing  $\otimes / \otimes$ .

Sensor head	Parameter	Description	Default setting
All models	0-9	Disabled	0
K1G-S07	10-500	10–500 [mm] (set in increments of 1 mm)	-
K1G-S15	10-1500	10–1500 [mm] (set in increments of 1 mm)	-

## **7** Finalize your parameter selection



Press  $\bigcap_{\text{Enter}}$  to finalize your parameter selection.



To change another setting, select the desired item by pressing  $\otimes / \otimes$  or  $\otimes / \otimes$ .



## Exit the display for changing settings

Press O.





## Start measuring



To start measuring, press  $\bigcup_{\text{Run}}$  for 3 seconds or longer.

(The following procedure is followed if a parameter has been changed.)

## **9**-1

#### •1 Choose whether to save the parameter



Choose whether to save by pressing	
<b>◎</b> / <b>》</b> .	

Parameter	Description	
00	Setting is not saved.	
<i>4</i> £5	Setting is saved.	

Note: If "no" is selected and the power is turned off, the changed parameter will not be saved.



Display



**9-2** Finalize your selection and start measuring





#### **CONFIGURING THE PV HOLD FUNCTION**

#### Ready

When the PV hold input is set for a digital input (DI), if the digital input is ON, the PV is held at the maximum (or minimum) value whenever it is updated.

If the digital input (DI) turns OFF, the maximum (or minimum) PV will no longer be updated, but the PV will continue to be held until the input turns ON again.

#### **!** Handling Precautions

• During initialization, for example, after the power is turned on, the PV is held at 0. If this will cause a problem, cancel the hold status using the host controller.

#### Example of operation when digital input (DI) maximum hold is selected



#### Procedure



#### Check that the mode is "Ready"



If "Run" is lit, press  $\bigcup_{\text{Run}}$  for 3 seconds or longer, and then check that "Run" is not lit (= Ready mode).

## 2

#### Select the channel whose settings will be changed



Select the channel No. by pressing

Display

Run Ch1 Ch2 Ch3 Ch4

Green Red The number of the selected channel is lit.



## **4** Select *C D 2* (hold setting)



Press D to select  $\pounds \square$  *i*, and then press D to select  $\pounds \square 2$ .



## Enter []2



Press  $\bigoplus_{\text{Enter}}$  to finalize your choice of *LD2*.

Select one of the following by pressing  $\otimes / \otimes$ .

#### Select the parameter



Default Description Parameter setting Disabled nonE V PU-HI Digital input (DI) max. value hold function PU-h2 Digital input (DI) min. value hold function EPS-1 **EPS filter 1** EP5-2 EPS filter 2 EP5-3 **EPS filter 3** EPS-4 **EPS filter 4** EPS-5 EPS filter 5

Do not select shaded parameters.

5

6





Press  $\underset{\text{Enter}}{\bigcirc}$  to finalize your parameter selection.



To change another setting, select the desired item by pressing  $\otimes / \otimes$  or  $\otimes / \otimes$ .



#### Exit the display for changing settings



Press  $\bigcup_{Back}$  .

(



## Start measuring



To start measuring, press  $\bigcup_{\text{Run}}$  for 3 seconds or longer.

(The following procedure is followed if a parameter has been changed.)



#### Choose whether to save the parameter

Choose whether to save by pressing



Note: If "no" is selected and the power is turned off, the changed parameter will not be saved.







Press  $\bigcap_{\text{Enter}}$  to finalize your selection and start measuring.

#### **SETTING EPS FILTERS**

#### Ready

If there is a sudden change in the position of a workpiece's edge, an EPS filter can cope with this change by holding the output steady to prevent a change in the PV and analog output.

Five types of ESP filter are selectable to suit various purposes.



#### EPS filter 1

With zero change in the measured value as a basis, if the measured value exceeds the skip-over size, the output will be held.

If the measured value returns to the skip-over size or less, output will not be held. EPS filter 1 does not use the number of delays.

The hold state can be canceled by pressing the B key on the controller.

#### EPS filters 2–5

If there is a sudden change in the position of the edge, the output is held steady. The conditions for holding the output are configured using the number of delays and the skip-over size. If the measured value exceeds the skip-over size within the delay time (= measurement cycle × number of delays), the output is held steady. The cancellation timing and conditions are shown below.

Filter name	Cancellation timing	Cancellation conditions
EPS filter 2	When a fixed period (4 times the delay time) has passed.	When the held value and the actual value after the delay are compared, the difference is less than the skip-over size.
EPS filter 3		The hold status is canceled re- gardless of the measured value.
EPS filter 4	When the EPS hold cancellation input set for the digital input (DI) is	When the skip-over size is no longer exceeded
EPS filter 5	turned ON	The hold status is canceled re- gardless of the measured value.
All filters	When the B key on the controller is pressed.	The hold status is canceled re- gardless of the measured value.
	When the EPS hold forced cancel- lation input set for the digital input (DI) is turned ON	

#### Setup example for EPS filters 2–5



#### Calculate the time it takes for something that should be ignored to pass by

v = 6 m/min = 100 mm/sPassing time = w/v = 2/100 = 20 ms

## **2** Set the number of delays (*C I 3*: No. of EPS filter delays)

For the delay time, use about half of the passing time calculated in step **1** as a rough estimate.

Delay time = Measurement cycle  $\times$  No. of delays

Measurement cycle (RD I)	No. of delays (rough estimate)	
250 µs	40	
500 μs	20	
1 ms	10	

## 3

#### Set the skip-over size (*LGY*: EPS filter size)

Set it using about half of the length (h) as a rough estimate. Length of the target to ignore = 3.0 mm Skip-over size = **1.5 mm** 

#### 4

#### Set the skip-over direction (*CD*5: EPS filter direction)

Select dr o P (concave direction).

#### **5** Set the filter hold type (*CDE*: EPS filter output hold)

Select on (enabled).

## Procedure

#### Ready

1

## Check that the mode is "Ready"

If "Run" is lit, press  $\bigcup_{\text{Run}}$  for 3 seconds or longer, and then check that "Run" is not lit (= Ready mode).



## 2

#### Select the channel whose settings will be changed



Select the channel No. by pressing

O.

Display

Run Ch1 Ch2 Ch3 Ch4

Green Red The number of the selected channel is lit.

3

4

## Switch to the display for changing settings



Press Orara.



## Select []] (hold setting)



Press D to select  $\pounds \square$  *i*, and then press D to select  $\pounds \square 2$ .





## Select the parameter



Select the parameter by pressing $\bigcirc i \odot$ .		
Parameter	Description	Default setting
nonE	Disabled	~
РU-н (	Digital input (DI) max. value hold function	
PU-h2	Digital input (DI) min. value hold function	
EP5-1	EPS filter 1	
EP5-2	EPS filter 2	
EP5-3	EPS filter 3	
EPS-4	EPS filter 4	
505-5	EDS filtor 5	

 $\otimes | \otimes$ 

Do not select shaded parameters.

# ADVANCED SETTINGS

6

#### Finalize your parameter selection



Press  $\underset{\text{Enter}}{\bigcup}$  to finalize your parameter selection.

## 8






# 9 Set the parameter



Select one from l-256 by pressing  $\otimes / \otimes$ .

Parameter	Description	Default setting
1-256	1-256 (times)	1

# **10** Finalize your parameter selection



Press  $\bigoplus_{\text{Enter}}$  to finalize your parameter selection.

# **11** Set *E B 4 – E B 5* (EPS filter size / EPS filter direction / EPS filter output hold)

For the setup procedure, see steps 8–10 for  $\square \square$ . In step 8, press  $\bigotimes$  to select  $\square \square \square \square$ .

#### C 입 식: EPS filter size (skip-over size)

Parameter	Description	Default setting
0.100-50.000	0.1–50.000 [mm]	0. 100

#### *CG***5**: EPS filter direction (skip-over direction)

Parameter	Description	Default setting
both	Concave and convex	~
r iSE	Convex	
drop	Concave	

#### ۲۵۵: EPS filter output hold (enabled/disabled)

Parameter	Description	Default setting
oFF	Disabled	
00	Enabled	~

# **12** Finalize your parameter selection



Press  $\bigoplus_{\text{Enter}}$  to finalize your parameter selection.



To change another setting, select the desired item by pressing  $\otimes / \otimes$  or  $\otimes / \otimes$ .

# **13** Exit the display for changing settings



Press  $\bigcirc_{\text{Back}}$ .

# **14** Start measuring



To start measuring, press  $\bigcup_{\text{Run}}$  for 3 seconds or longer.

(The following procedure is followed if a parameter has been changed.)

# **14**-1 Choose whether to save the parameter





$\bigcirc$ $\land$ $\bigcirc$ $\land$	
Parameter	Description
<i>~ 0</i>	Setting is not saved.
<i>485</i>	Setting is saved.

Note: If "no" is selected and the power is turned off, the changed parameter will not be saved.



# **14**-2 Finalize your selection and start measuring



 $\ensuremath{\mathsf{Press}}\xspace \ensuremath{\mathsf{Enter}}\xspace$  to finalize your selection and start measuring.

### **CHANGING SMUDGE DETECTION FUNCTION SETTINGS**

#### Ready

A change in the amount of received light caused by a smudge (foreign matter) on the sensing surface or interference from ambient light can be detected and sent to the host device. The light intensity change rate calculated by the following formula is used as an index that indicates the significance of the effect from a smudge or interference from ambient light.

Light intensity change rate =  $(S2/S1) \times 100$ 

S1 is the total light intensity estimated from the edge position and S2 is the total light intensity in the profile of received light.



If there is a shadow in the profile of received light due to a smudge on the light-receiving surface, S2 will decrease, and thus the light intensity change rate will be lower.

A decrease in total light intensity caused by a smudge



To enable the smudge detection function, set the smudge detection threshold to 1 to 100 %. If the light intensity change rate of 100 % shifts by an amount that is more than the smudge detection threshold, the controller judges that there is a smudge. If the smudge detection threshold is set to 0 %, this function will be disabled. In this case, regardless of the amount of light received, the controller will not detect a smudge.

Example of smudge detection: If the smudge detection threshold is set to 20 %



#### **!** Handling Precautions

- This function is available if a measurement mode for opaque objects is selected.
- If the gap for entry of light is not wide enough, smudge detection will be unreliable. Under the following conditions, regardless of light intensity, "smudge detected" events will be forcibly cleared.

Measurement mode	K1G-S07	K1G-S15
Opaque object edge position (top)	The edge position is less than 1.5 mm from the bottom.	The edge position is less than 2.0 mm from the bottom.
Opaque object edge measurement (bottom)	The edge position is less than 1.5 mm from the top.	The edge position is less than 2.0 mm from the top.
Opaque object width measurement	The width of blocked light is greater than 4 mm.	The width of blocked light is greater than 11 mm.
Opaque object gap measurement	The gap for entry of light is less than 1.5 mm.	The gap for entry of light is less than 2.0 mm.

Setting the smudge detection threshold to 10 % or greater is recommended. Setting a smaller threshold will make detection of a slight smudge possible, but false detection could result depending on the measurement environment. Check the operation with the actual device and specify an appropriate value.

# Procedure

# Check that the mode is "Ready"

If "Run" is lit, press  $\bigcap_{Run}$  for 3 seconds or longer, and then check that "Run" is not lit (= Ready mode).



# **2** Select the channel whose settings will be changed



Select the channel No. by pressing

⊖ Ch Select∙ Display ⊐ Run Ch1 Ch2 Ch3 Ch4

Green Red The number of the selected channel is lit.

# Switch to the display for changing settings









3

# Select **b 🖥 4** (smudge detection threshold)



Press D to select  $\square \square$  , and then press D to select  $\square \square \square$ .



# 5 Enter **b**<sup>D</sup>Y



Press  $\bigoplus_{\text{Enter}}$  to finalize your choice of  $B \square \mathcal{A}$ .

Digital output (DO) must be configured in order to use the smudge detection function. CP P. 4-41

# **6** Set the parameter



Set one of th	e following by pressing $^{()}/^{()}$ .

Parameter	Description	Default setting
0	Disabled	~
I- I00	1–100 % (set in increments of 1 %)	

# 7

# Finalize your parameter selection



 $\label{eq:Press} \underset{\text{Enter}}{\bigcirc} \text{ to finalize your parameter selection.}$ 



To change another setting, select the desired item by pressing  $\otimes / \otimes$  or  $\otimes / \otimes$ .



# Exit the display for changing settings



Press  $\bigcirc_{\text{Back}}$ .

# 9 Start measuring



To start measuring, press  $\bigcup_{\text{Run}}$  for 3 seconds or longer.

(The following procedure is followed if a parameter has been changed.)

**9**-1

### Choose whether to save the parameter



Ρ

Choose whether to save by pressing Display ()/().

)/( <u>)</u> .	
arameter	Description
n 0	Setting is not saved.
YES	Setting is saved.

Note: If "no" is selected and the power is turned off, the changed parameter will not be saved.



# **9-2** Finalize your selection and start measuring



Press  $\bigcap_{\text{Enter}}$  to finalize your selection and start measuring.

### **CONFIGURING THE EVENT LOG FUNCTION**

The event log function, triggered when the specified trigger signal turns ON, saves a received light profile for the selected single channel (normalized light intensities) and the process values from all channels ( $32 \times 4$  channels) to the controller.

To check the event log settings and saved data, the K1G configuration tool or the communication function is used.



The event log records only the log data from the first occurrence of the event. Later occurrences of the event are ignored.

If one of the settings related to the event log is changed by a host device, the event log will be cleared.

necessary settings for the use of the event log function
--

ltem	Explanation	Setting method
Trigger signal	Selects the DI operation type used as the trigger signal.	SZ-D01 configuration tool or by communica-
Trigger target	Select the channel of the trigger.	tion
Trigger type	Select the type of event that will act as the trigger.	
Capture channel	Select the source channel for the re- ceived light profile.	
Event log point	Select the ratio of process values to obtain before and after the trigger.	

### **TEST MODE**

Ready

After power-on and after the initial setup is complete, the wiring can be checked by using analog and digital output.



# Check that the mode is "Ready"

If "Run" is lit, press  $\bigcap_{\text{Run}}$  for 3 seconds or longer, and then check that "Run" is not lit (= Ready mode).

# Press the [Para] and [Back] keys for at least 3 seconds at the same time



Press  $\bigcap_{Para}$  and  $\bigcap_{Back}$  for at least 3

seconds at the same time.



\* The analog output type selected at the initial setup is displayed.



2

### 



Analog output check

£E5£ 8 ULE -\* Ro 1 E



\* The analog and digital output types selected at the initial setup are displayed.

# **4** Check the wiring



Check analog output (AO). Change the analog output status for the selected channel by pressing  $\bigotimes / \bigotimes$ . Change the analog output number by press-





\*1. The output method is displayed.

ULE: Voltage output

- EUr: Current output
- \*2. The analog output status is displayed.

*R\_o\_h*:5V or 20 mA

- Ro\_E: 3 V or 12 mA
- Ro\_L:1V or 4 mA
- "\_" represents the selected channel No.



#### Check digital output (DO).

Change the digital output status for the se-

lected No. by pressing  $\otimes / \otimes$ .



- \*1. The output type is displayed.
  - PoP: NPN output
- \*2. The digital output status is displayed.
  - do I-doB: Digital output Nos.
  - RLL: All outputs are ON
  - ---: All outputs are OFF

# **5** Quit the test mode



Press  $\bigcup_{Back}$  to exit.

### **SAVING ELECTRICITY**

#### Ready



In power-saving mode, the sensor heads and controller each reduce current consumption.

Sensor heads: The light reception indicator only is turned

off while power-saving mode is enabled. In this case, the indicator is also not lit during receiver adjustment.

Controller:

After the power-saving mode is enabled, if there is no key operation for 20 seconds or longer in Run mode, power saving mode is applied automatically. In power-saving mode, all indicators are off except those that are shown as lit in the figure on the left. Pressing any key temporarily cancels powersaving mode.

# Procedure

# Check that the mode is "Ready"



If "Run" is lit, press  $\bigcup_{Run}$  for 3 seconds or longer, and then check that "Run" is not lit (= Ready mode).

# 2



Press O



# 3

# Select RDY (controller power-saving mode) and RDS (sensor head power-saving mode)



For the controller Press  $\bigotimes$  to select RD4.



For the sensor heads Press ⊗ to select R05.







Press  $\bigoplus_{\text{Enter}}$  to finalize your choice of RD4 or RD5.



# Select the parameter



Select  $\_FF$  or  $\_a a$  by pressing  $\bigotimes / \bigotimes$ .

Parameter	Description	Default setting
oFF	Power-saving mode disabled	<b>v</b>
01	Power-saving mode enabled	



### Finalize your parameter selection



Press  $\bigcap_{\text{Enter}}$  to finalize your parameter selection.



To change another setting, select the desired item by pressing  $\otimes / \otimes$  or  $\otimes / \otimes$ .

# 7





Press  $\bigcup_{\mathsf{Back}}$  .



# Start measuring



To start measuring, press  $\bigcup_{\text{Bun}}$  for 3 seconds or longer.

(The following procedure is followed if a parameter has been changed.)



### 1 Choose whether to save the parameter



Choose whether to save by pressing	Display
@/D.	

Parameter	Description
<i>~ 0</i>	Setting is not saved.
<i>465</i>	Setting is saved.

Note: If "no" is selected and the power is turned off, the changed parameter will not be saved.





# 8-2 Finalize your selection and start measuring



Press  $\bigcap_{\text{Enter}}$  to finalize your selection and start measuring.

# 9

# Transition to power-saving mode

Run Col (h ) (h) Run Col (h) Run

If no key is pressed for 20 seconds or longer, power-saving mode goes into effect automatically.

### **CONFIGURING THE KEY LOCK**

#### Ready

This function prevents wrong settings due to key operation by disabling all keys on the controller in Run mode.

The key lock goes into effect 60 seconds after the mode has been switched to Run.



The key lock setting applies to all channels. This parameter cannot be changed for individual channels.

# Procedure

# Check that the mode is "Ready"



If "Run" is lit, press  $\bigcup_{\text{Run}}$  for 3 seconds or longer, and then check that "Run" is not lit (= Ready mode).



2

# Switch to the display for changing settings







# **3** Select *R***03** (key lock)



Press <sup>⊗</sup> to select *R*□3.







Press Enter to finalize your choice of RG3.



# Select the parameter

 01 2 3 4
 0
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
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 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2.3.4
 1.2

Select oFF or on by press	ing $\bigotimes / \bigotimes$ .
---------------------------	---------------------------------

	0,0	
Parameter	Description	Default setting
۶۶۵	Key lock disabled	<b>v</b>
01	Key lock enabled	



### Finalize your parameter selection



Press  $\bigoplus_{enter}$  to finalize your parameter selection.



To change another setting, select the desired item by pressing  $\,\,\otimes / \,\,\otimes$ 



ADVANCED SETTINGS





Press  $\bigcap_{\text{Back}}$ .



# Start measuring

 D
 3 4 5 6 7 8 (1 2 3 4 0)

 O
 S

 O
 S

 O
 S

 D
 S

 D
 S

 D
 S

 D
 S

 D
 S

 D
 S

 D
 S

 D
 S

 D
 S

 D
 S

 D
 S

 D
 S

To start measuring, press  $\bigcup_{\text{Bun}}$  for 3 seconds or longer.

(The following procedure is followed if a parameter has been changed.)

**8**-1

### Choose whether to save the parameter



Choose whether to save by pressing @/@

Display

©/ <i>©</i> .	
Parameter	Description
<i>~ 0</i>	Setting is not saved
<i>4</i> 85	Setting is saved.

Note: If "no" is selected and the power is turned off, the changed parameter will not be saved.



# 8-2 Finalize your selection and start measuring



Press  $\bigcap_{\text{Enter}}$  to finalize your selection and start measuring.

### **CANCELING THE KEY LOCK**

#### Ready

# Procedure

# Canceling the key lock temporarily

Press 🛞 for at least 2 seconds while pressing







The key lock will go into effect again in 60 seconds.

If necessary, disable it by changing the parameter to "Key lock disabled."

### **RESETTING WHEN CHANGING THE SENSOR HEADS**

After the initial setup is complete, in order to switch to a different sensor head model it is necessary to reset the sensor head settings.



Check that the sensor connection indicator of the channel whose sensor heads have been replaced is blinking





# Check that the mode is "Ready"

indicator blinks and display 2 shows - - - - .



If "Run" is lit, press  $\bigcup_{Run}$  for 3 seconds or longer, and then check that "Run" is not lit (= Ready mode).

If a reset of the sensor head settings is needed, the sensor connection

2

# **3** Select the channel to be reset

Select the channel No. by pressing



# Press the [Para] and [Enter] keys at the same time for at least 3 seconds



Press  $\bigcap_{Para}$  and  $\bigcap_{Enter}$  for at least 3 seconds at the same time.

5

# Check that the sensor connection indicator of the channel whose sensor heads have been replaced is lit



After the resetting, adjust the receiver.

After receiver adjustment, the following parameters must be reset.

P. 4-29

C P. 4-42

- Zero adjustment value [b 🛛 &]
- Working distance (WD) [607]
   CP P. 4-76
   Low threshold [207]
   CP P. 4-42
- Low threshold [[2]]
- High threshold [[08]
- Analog output range low limit [*L* + 1] CP P. 4-25
- Analog output range high limit [[ 12] 🖙 P. 4-25

### SETTING THE STATION ADDRESS FOR MECHATROLINK-III

# Procedure

1

# Check that the mode is "Ready"



If "Run" is lit, press  $\bigcup_{\text{Run}}$  for 3 seconds or longer, and then check that "Run" is not lit (= Ready mode).

# 2

### Switch to the display for changing settings



# Press Orara.



3

ADVANCED SETTINGS

# Select 809



Press ⊗ to select *R*□*S*.





Press Enter to finalize your choice of RIII.

# **5** Set the parameter

Set the address using ⊗/⊗	∂.
---------------------------	----

Parameter	Description	Default setting
3h to EFh	3 to 239	Зл



4

### Finalize your parameter selection



Press  $\bigoplus_{\text{Enter}}$  to finalize your parameter selection.



To change another setting, select the desired item by pressing  $\otimes / \otimes$  or  $\otimes / \otimes$ .







# Start measuring

O Run ( ്ത

To start measuring, press  $\bigcup_{\text{Run}}$  for 3 seconds or longer.

(The following procedure is followed if a parameter has been changed.)

**8**-1

### Choose whether to save the parameter



Choose whether to save by pressing

Display

	<b>@/)</b> .
Back	Paramete
	00
	985

meter	Description
0	Setting is not saved.
E 5	Setting is saved.

Note: If "no" is selected and the power is turned off, the changed parameter will not be saved.



#### **8**-2 Finalize your selection and start measuring



Press  $\bigcap_{\text{Enter}}$  to finalize your selection and start measuring.

### SETTING THE NUMBER OF TRANSMISSION BYTES FOR MECHATROLINK-III

# Procedure

# Check that the mode is "Ready"

If "Run" is lit, press  $\bigcup_{\text{Run}}$  for 3 seconds or longer, and then check that "Run" is not lit (= Ready mode).





1

# Switch to the display for changing settings



Press  $\bigcup_{Para}$ .





# Select # /D



Press ⊗ to select 𝕫 🕫.







 $\bigotimes$ 

Enter



# **5** Set the parameter

Para C C (DADER)	

	Select one of the following by pressing
L	<u> </u>

⊘/ ⊗.
 Parameter Description Default setting

32	32 transmission bytes	
48	48 transmission bytes	<ul> <li>✓</li> </ul>



For the number of transmission bytes, see user's manual No. CP-SP-1386E.



7

# Finalize your parameter selection



Press  $\bigoplus_{\text{Enter}}$  to finalize your parameter selection.



To change another setting, select the desired item by pressing  $\otimes / \otimes$  or  $\otimes / \otimes$ .

# Exit the display for changing settings



Press  $\bigcirc_{\text{Back}}$ .



# Start measuring



To start measuring, press  $\bigcup_{\text{Run}}$  for 3 seconds or longer.

(The following procedure is followed if a parameter has been changed.)



# Choose whether to save the parameter



Choose whether to save by pressing $@/@$ .				
Parameter	Description			
Setting is not saved.				
<i>4E</i> 5	Setting is saved.			
Note: If "no" is selected and the power				

is turned off, the changed parameter will not be saved.



#### **8**-2 Finalize your selection and start measuring



Press \_\_\_\_\_ to finalize your selection and start measuring.

# 4-10 Returning All Settings to the Defaults

#### **!** Handling Precautions

• All settings will be cleared and returned to the defaults.



### 1

# Restore all default settings



While  $\bigcup_{\text{Run}}$  and  $\bigcup_{\text{Enter}}$  are being pressed at the same time, turn the power on.



Do the initial setup again. For more information on the initial setup, see the following.

G 3-1 Analog Output (AO) Settings (P. 3-3)

# COMMUNICATION SETTINGS (CONNECTION TO OTHER DEVICES)



This chapter describes RS-485 communications (Modbus/RTU) with other devices. For connection to MECHATROLINK- III, see User's Manual No. CP-SP-1386E. For connection to EtherCAT, see user's manual No. CP-SP-1419E.

5-1	Overview of Communications	5-2
5-2	Changing the Communications Conditions	5-4
5-3	Message Format	.5-13
5-4	Function Codes	.5-16

# 5-1 Overview of Communications

This device is compatible with RS-485 and can communicate with host devices such as a PC or PLC using a user-created communications program.

Reading and writing of most parameters between the master station and the controller can be done through communication.

- Communication protocol: Modbus/RTU
- No. of connectable controllers: Up to 15 K1G controllers can be connected to a single master station.

RS-485 communications



15 max.

### SETTINGS

For Modbus communication, configure the following in advance.

Description	Parameter	Default setting
Station address P. 5-4	ם: No communication מ- 21 ק	٥
Transmission speed P. 5-7	9.5: 9600 bps 19.2: 9200 bps 38.4: 38,400 bps 1 15.2: 115,200 bps	5.5
Parity, stop bits P. 5-10	DenE:No parity (2 stop bits)EUEn:Even parity (1 stop bit)edd:Odd parity (1 stop bit)	nonE

### **COMMUNICATION PROCEDURE**

- An instruction message is sent from the host device (master station) to the desired single controller (slave station).
- 2 The K1G controller (slave station) reads or writes data in accordance with the instruction message.
- **3** The K1G controller (slave station) sends back a response message related to the requested processing.
- **4** The master station receives the response message.

#### **!** Handling Precautions

 In the case of Modbus communications, the communications address (parameter) to the controller set on the host device may change to [address – 1] in a message.
 Example: If the communication address (parameter) is set to 1001 on the host device, it changes to 1000 in the message.

The K1G controller sends/receives messages to/from specified communication addresses (parameters).

Take the host device's specifications into account when using the controller.

### SETTING THE STATION ADDRESS

# Procedure

1

# Check that the mode is "Ready"

If "Run" is lit, press  $\bigcup_{\text{Run}}$  for 3 seconds or longer, and then check that "Run" is not lit (= Ready mode).





### Switch to the display for changing settings



Press Orara.



### Select 885



Press ⊗ to select *R*□*E*.









# Set the parameter



By pressing  $\otimes / \otimes$ , select a value from 0–127.

Parameter	Description	Default setting
0- 127	0–127 (0: Communication is disabled)	0



Press  $\bigoplus_{\text{Enter}}$  to finalize your selection.



To change another setting, select the desired item by pressing  $\otimes / \otimes$  or  $\otimes / \otimes$ .



8

# Start measuring

 0
 3
 5
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 7
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 3
 5
 6
 7
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 5
 6
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To start measuring, press  $\bigcup_{\text{Bun}}$  for 3 seconds or longer.

(The following procedure is followed if a parameter has been changed.)

**8**-1

### Choose whether to save the parameter



Choose whether to save by pressing ()/().

Display

97 <i>©</i> ,	
Parameter	Description
<i>~ 0</i>	Setting is not saved.
<i>985</i>	Setting is saved.

Note: If "no" is selected and the power is turned off, the changed parameter will not be saved.



# 8-2 Finalize your selection and start measuring



Press  $\bigcap_{\text{Enter}}$  to finalize your selection and start measuring.

### SETTING THE TRANSMISSION SPEED

# Procedure

# Check that the mode is "Ready"

If "Run" is lit, press  $\bigcup_{\text{Run}}$  for 3 seconds or longer, and then check that "Run" is not lit (= Ready mode).





# Switch to the display for changing settings



Press  $\bigcirc_{\text{Para}}$  .





# Select RD 7



Press ⊗ to select *R*□7.









Press  $\operatorname{Enter}$  to finalize your choice of  $R \square 7$ .

# 5

# Select the parameter



Ente

Select one of the following by pressing $\mathfrak{O}/$	)/⊚	16	ressing	pres	by	llowing	f	of the	one	Select
---	-----	----	---------	------	----	---------	---	--------	-----	--------

	Parameter	Description	Default setting
ļ	9.6	9600 bps	~
	19.2	19200 bps	
	38.4	38,400 bps	
	1 15.2	115,200 bps	



### Finalize your parameter selection

Press  $\underset{\text{Enter}}{\bigcirc}$  to finalize your parameter selection.



To change another setting, select the desired item by pressing  $\otimes / \otimes$  or  $\otimes / \otimes$ .



# Exit the display for changing settings



Press OBack .
# 8

# Start measuring



To start measuring, press  $\bigcup_{\text{Run}}$  for 3 seconds or longer.

(The following procedure is followed if a parameter has been changed.)



# Choose whether to save the parameter



$\mathbb{O}/\mathbb{O}$ .				
Parameter	Description			
00	Setting is not saved.			
Setting is saved.				
Note: If "no" is selected and the power				

is turned off, the changed parameter will not be saved.



8-2 Finalize your selection and start measuring



Press  $\bigcap_{\text{Enter}}$  to finalize your selection and start measuring.

# SETTING THE COMMUNICATIONS FORMAT (PARITY AND STOP BITS)



1

# Check that the mode is "Ready"



If "Run" is lit, press  $\bigcup_{\text{Run}}$  for 3 seconds or longer, and then check that "Run" is not lit (= Ready mode).



# Switch to the display for changing settings



Press Orara .



3





Press  $\otimes$  to select *RDB*.

Display

nar



# **5** Select the parameter

DO 1 2 3 CONTRACTOR

Ente

Select one of the following	) by pressing	⊘/⊗.
-----------------------------	---------------	------

Parameter Description		Default setting
nonE	No parity (2 stop bits)	~
EUEn	Even parity (1 stop bit)	
odd	Odd parity (1 stop bit)	



# Finalize your parameter selection

 $\label{eq:Press} \underset{\text{Enter}}{\bigcirc} \text{ to finalize your parameter selection.}$ 



To change another setting, select the desired item by pressing  $\otimes / \otimes$  or  $\otimes / \otimes$ .



# Exit the display for changing settings



Press  $\bigcirc_{\text{Back}}$ .

# 8 Start measuring



To start measuring, press  $\bigcup_{\text{Run}}$  for 3 seconds or longer.

(The following procedure is followed if a parameter has been changed.)

**8**-1

# Choose whether to save the parameter



Choose whether to save by pressing Display ()/().

©/()).	
Parameter	Description
<i>~ 0</i>	Setting is not saved.
YES	Setting is saved.

Note: If "no" is selected and the power is turned off, the changed parameter will not be saved.



8-2 Finalize your selection and start measuring



Press  $\bigcap_{\text{Enter}}$  to finalize your selection and start measuring.

# 5-3 Message Format

All messages use binary data.

A Modbus/RTU message consists of (1)–(5) below.

(5)	(1)	(2)	(3)	(4)	(5)
Start	1 byte	1 byte	n bytes (1 byte or more)	2 bytes	End

#### (1) Station address

The K1G controller creates a response message only if its station address is in the received message. In the message, the station address is 1 byte.

However, if the station address is 0, even if the addresses match, there is no response to the message.

In its response, the K1G controller returns the same station address as that in the received message.

#### (2) Function codes

The K1G controller then executes the processing indicated by the received function code.

If processing is successfully completed, the received function code will be returned. If processing is not successfully completed and a response indicating an error is returned, the MSB\* of the received function code will be set to "1" and returned. \*Most significant bit

#### (3) Data

Data corresponding to the function code is added.

The data types handled by this controller are 16-bit data (2 bytes) and 32-bit data (4 bytes).

The data size of an address is 16 bits. In the case of 32-bit data, 2 addresses compose one data record.

## Data format

16-bit data (2 bytes)

The first 8 bits are assigned to the first byte and the last 8 bits to the last byte.

Byte	Data (hex)	Description
1st	12	First 8 bits of data
2nd	34	Last 8 bits of data

#### Example: If the 16-bit data is 1234

#### • 32-bit data (4 bytes)

The last16 bits are assigned to the address with the smaller number and the first 16 bits to the address with the larger number.

The byte data order for each address is the same as that of 16-bit data.

#### Example: If the 32-bit data is 12345678 (addresses 0000-0001)

Address (HEX)	Data (HEX)	Description	Byte	Data (HEX)	Description
	5670	Least 1 Chite of data	1st	56	First 8 bits of address 0000
0000 567	50/8	S678 Last 16 bits of data	2nd	78	Last 8 bits of address 0000
0001	1224	First 16 bits of data	3rd	12	First 8 bits of address 0001
0001	1234 FIRST 16 DIts of data	FIRST TO DITS OF GATA	4th	34	Last 8 bits of address 0001

· How to handle negative values

Negative values are expressed in 2's complement format.

The inverted bits of a positive value plus "1" means a negative value.

#### Example: If the 16-bit data is -1

1 (positive) = 01	000000000000000000000000000000000000000
$\downarrow$	
1's complement (inverted)	111111111111111110
2's complement (1's complement $+ 1$ ) = $-1 = FF$	11111111111111111111

#### (4) Check code (CRC)

CRC check codes are added to both command and response messages by using Modbus/RTU communication protocol.

The section from the station address to just before the check code in the message is included in the calculation.

For calculation, the binary data in the message is used without change. The check code is 16-bit data and can be calculated using the C programming language function "get\_crc16()" shown in the following section. In a message, the first bytes of the code follow the last bytes. This order is the reverse of that of other 16-bit data.

#### Example: If the check code is 1234

Byte	Data (hex)	Description
1st	34	Last 8 bits of the data
2nd	12	First 8 bits of the data

```
<Sample of CRC check code calculation>
[Argument 1] Character string length (No. of bytes)
[Argument 2] Character string's head pointer
 [Function value] Calculation result
 UH get_crc16(INT len, UB *p)
{
  UH dt_16;
  UH next;
  UH carry;
  INT i;
  dt 16 = 0xffff;
  while (len > 0) {
    next = (UH)*p;
    dt 16 ^= next;
    for (i = 0; i < 8; i++) {
      carry = (UH)(dt \ 16 \& 0x0001);
      dt_16 >>= 1;
      if (carry != 0) {
        dt 16 ^= 0xA001;
      }
    }
    p++;
    len--;
  return dt_16;
}
```

(5) Start and end

In the Modbus/RTU communication protocol, a silent interval (non-communication time) equivalent to at least 3.5 characters is required for both the start and end of a command message and response message. However, the following specifications apply to the K1G controller.

Transmission speed	Silent interval
9,600 bps	8 ms
19,200 bps	4 ms
38,400 bps	2 ms
115,200 bps	1 ms

# LIST OF FUNCTION CODES

The following function codes are available for the controller.

Code (hex)	Function name	Description
03	Continuous data read	Reads the specified No. of continuous data records from the specified address.
10	Continuous data write	Writes the specified No. of continuous data records from the specified address.

# **CONTINUOUS DATA READ (FUNCTION CODE: 03)**

Reads the specified No. of continuous data records from the specified address. Up to 125 data records can be read with a single instruction message.

03

# Command format

Chatian	From etile an en el e		CDC	
Station	Function code	Address	No. of data records	CRC
(1)	(2)	(3)	(4)	(5)
1 byte	1 byte	2 bytes	2 bytes	2 bytes

(1) Station address

(2) Function code:

(3) Starting address for reading data

(4) No. of read data records (addresses)

(5) Check code (CRC)

## Response format (for a normal response)

Charling	Europei en en el e		CDC			
Station	tion Function code		1st data record	Nth data record	CRC	
(1)	(2)	(3)	(4)	 (5)	(6)	
1 byte	1 byte	1 byte	2 bytes	2 bytes	2 bytes	

(1) Station address

(2) Function code: 03

(3) No. of read data bytes: double the sum of (4)+(5)

(4) 1st data record

(5) Nth data record

(6) Check code (CRC)

Exception responses (P. 5-18)

# **CONTINUOUS DATA WRITE FUNCTION (FUNCTION CODE: 10)**

Writes the specified No. of continuous data records from the specified address. Up to 123 data records can be written with a single instruction message.

If settings are changed in Run mode, an amount of time equivalent to 128 samples (128  $\times$  sampling time) will be spent in Ready mode to apply the changed settings, and then the mode will return to Run.

# • Command format

	Function code	DATA						
Station		Address	No. of data	Byte	1st data		Nth data	CRC
			records		record		record	
(1)	(2)	(3)	(4)	(5)	(6)	]	(7)	(8)
1 byte	1 byte	2 byte	2 byte	1 byte	2 bytes		2 bytes	2 bytes

(1) Station address

(2) Function code:

(3) Starting address for writing data

(4) No. of write data records (No. of addresses)

(5) No. of write data bytes: double the sum of (6)+(7)

10

(6) 1st data record

(7) Nth data record

(8) Check code (CRC)

# Response format (for a normal response)

Ctation	Function code		CDC	
Station	Function code	Address	ess No. of data records	
(1)	(2)	(3)	(4)	(5)
1B	1B	2B	2B	2B

(1) Station address

(2) Function code: 10

(3) Starting address for writing data

(4) No. of write data records

(5) Check code (CRC)



Exception responses (P. 5-18)

# **EXCEPTION RESPONSES**

If the controller was not able to process the received function code successfully, it will return an exception response according to the Modbus communications protocol. An error involving any function code results in the exception response.

## Format of the exception response

Station	Function code	Error code	CRC
(1)	(2)	(3)	(4)
1 byte	1 byte	1 byte	1 byte

(1) Station address

(2) Function code: Continuous read data = 03 (hex): 83 (hex)

Continuous write data = 10 (hex): 90 (hex)

Note: The command's function code + 80

- (3) Error code: See the list of error codes.
- (4) Check code (CRC)

#### List of error codes

Code (hex)	Name	Description
01	Illegal function	Unsupported function code
02	Illegal data address	Data address error (inaccessible area) Error in the number of data records (the No. is out of range, inaccessible area)
03	Illegal data	The written value is out of range. Error in the number of bytes of the function code. Error in the number of data records or bytes. Writing or reading is prohibited due to instrument conditions.
10	Application error 1	Reserved
11	Application error 2	Reserved
12	Application error 3	High-speed trend overrun error
13	Application error 4	Write mode error
14	Application error 5	Reserved
15	Application error 6	Reserved



# SZ-D01 CONFIGURATION TOOL

This chapter describes the SZ-D01 configuration tool. Before use, please read "Handling Precautions for the SZ-D01 Configuration Tool for K1G Series High-Accuracy Position Sensors" (manual No. CP-UM-5785JE), which is included with the SZ-D01. Also, read "GP-4201TM/4301TM Installation Guide" and "Warning/Caution Information" (both included with the display unit) in order to use the equipment correctly.

6-1	System Configuration	6-2
6-2	Installation and Wiring	6-4
6-3	Basic Operation and Functions	6-7

# 6-1 System Configuration

# SYSTEM CONFIGURATION

The SZ-D01 configuration tool consists of a display unit with the pre-installed dedicated software, stand, cables, etc.



# **FUNCTIONS**

ltem		Description			
Setting/Adjustr	nent	Setup of various parameters and receiver adjustment.			
MonitoringTrend monitorCollects data from 4 cha displays data in a graphHigh- speed trendCollects data from 1 cha surement cycle (250 µs/ displays the data in a graph		Collects data from 4 channels on a 1 s (minimum) cycle and displays data in a graph format.			
		Collects data from 1 channel 40000 times during the mea- surement cycle (250 µs/500 µs/1 ms) set for the K1G, and displays the data in a graph format.			
Event Log		Reads out and displays various event log settings and data collected and saved to the controller by the event log func- tion.			
Other		I/O test, Replacement procedure, Application specific set- ting.			

# DATA STORAGE USING A USB STORAGE DEVICE

The settings and acquired monitoring data, etc., can be saved to a USB storage device (not included).

An operational check has been done with the following USB storage devices connected to the display unit.

Manufacturer	Product name	Capacity
Buffalo Inc.	RUF-C/U2	1 GB
	RUF-C256M/U2	256 MB
Green House Co., Ltd.	GH-UFD1GSLT	1 GB
Transcend Japan	JFV10	1 GB

Depending on the production date, some USB flash drives cannot be used due to a change in manufacturing specifications.

Because of this, do an operational check before use.

# Data storage directories

Data saved to a USB storage device will be stored as shown below.



# 6-2 Installation and Wiring

For installation and wiring, see also user's manual GP-4201TM/4031TM, which is included with the display unit.

# ATTACHING THE DISPLAY UNIT TO THE STAND

Attach the anti-rotation tee to the display module. Insert the display module connector and tee into the appropriate holes in the stand. Attach the nut to the display module connector and tighten it using the included socket wrench



! Handling Precautions

• Tightening torque: 1.2–2 N·m.

SZ-D01 CONFIGURATION TOOL

# Insert the rear module connector into the display module connector until the modules are properly combined.

! Handling Precautions

• When combining the two modules, take care to orient them as shown in the figure below. If the orientation is wrong, the connectors may be damaged.



# **POWER WIRING**

# Connect the DC jack cable (sold separately) to the power plug

For the mounting screws, use a flat-tip screwdriver whose tip size is 0.6 x 3.5 mm.



! Handling Precautions

- Tightening torque: 0.5–0.6 N·m
- Do not solder the cable connections.

# **2** Connect the wired power plug to the display unit



Connect the DC jack cable to the AC adapter (both sold separately)



# **CONNECTING THE LOADER CABLE**

Connect the serial connector on the loader cable to the display unit



**2** Connect the loader cable jack to the loader port on the controller



# 6-3 Basic Operation and Functions

# SCREEN TRANSITION DIAGRAM



# **SWITCHING THE MODE**



Ready and Run modes can be checked and changed.

Before changing other settings, change the mode to Ready.

# ICONS

lcon	Name	Description
	Тор	Redisplays the top menu screen.
BACK	Back	Moves the display one level above the current one.
	Next	Moves the display to the next settings screen.
	Camera	Captures a screen and stores it to the USB storage device.
	Camera NG	Screen capture function is OFF. Connect a USB storage device.
٩	Loupe	Zooms into and out of the trend monitoring screen.
$\diamond$	Change	Changes between screen display modes.
HELP	Help	Shows further notes.

# MONITORING

# Measurement data

The measurements on each channel, event status, etc., can be checked.



# Trend monitor

Displays the measurements on as many as 4 channels in graph format.



\* Unit: seconds. Range: 0 to 65535 (when 0 is specified, there is no sampling)

# High-speed trend monitor

Obtains data from 1 channel 40000 times per measurement cycle and displays the data in graph format.



# **REPLACEMENT PROCEDURE**

Pressing an icon like this one b displays the corresponding step of the procedure.

Replacement proc of the controller	cedure 🚮 📥					
Save configuration	The configuration file is saved to external memory					
Power supply OFF	Controller power supply is turned OFF					
Replacement	Replace the controller					
Power supply ON	Controller power supply is turned ON					
Initial setting	Initial setting of the controller is perform					
Read configuration	The configuration file is read from external memory					
Mode Ready Run						
	$\uparrow$					

Pressing an icon displays the corresponding step of the procedure.

# SETTINGS/ADJUSTMENTS

Various parameters can be changed and light reception can be adjusted.

### • Settings screen

DI/O setting[1]		1	To configure all channels at the same time, touch and change the value under ALL.
-3.500        -3.500        -3.500        0.000          Event threshold upper limit        PV1        PV2        PV3          3.500        3.500        3.500        0.000	-2	2	To configure an individual channel, touch and change the relevant value.
PV3 PV2 PV3 PV4 ← ALL 0.010 0.010 0.010 0.010 0.000 0.000	-3	3	Saves changed settings to the controller.
Mode Ready Run b b b	-4	4	Finalizes a changed setting.
	-(5)	5	Undoes the preceding change.

In Ready mode, the changed setting can be saved to the controller.

# Receiver adjustment screen

Light receiving adjustment[2]		1	Changes between the graphs for each channel.
Ch1 / Ch2 / Ch3 / Ch4		2	Adjusts the received light.
adjustment	)−∠ ]−3	3	Saves the adjustment data to the controller.
	,		
Mode Ready Run			

# Waveform example: receiver adjustment is possible.



# Waveform example: receiver adjustment is not possible.



# I/O TEST



# **EVENT LOG**

Event log settings and acquired data can be checked.

# Settings screen



# Log data



# • Light receiving profile capture



# PERFORMANCE SPECIFICATIONS FOR THE DISPLAY UNIT

Display device	TFT color LCD		
Display size	5.7 inches		
No. of display dots	320 × 240 (QVGA)		
Displayed colors	65356		
Backlight	White LED (cannot be changed)		
Brightness adjustment	16 levels (adjustable by the touch panel)		
External data storage	USB 2.0 connector: Type A (1) Supply voltage: 5 V DC ±5 % Max. communication distance: 3 m		
Supported languages	Japanese, English, Korean, Chinese (simplified & traditional), German		
Backup memory	128 KB		
Rated voltage	24 V DC		
Power consumption	6.8 W max.		



# SPECIFICATIONS

This chapter gives the specifications for the K1G series.

7-1	Sensor Heads	7-2
7-2	Controllers	7-5
7-3	Junction Cables	7-8

# 7-1 Sensor Heads

# **SPECIFICATIONS**

Model No		K1G-S07	K1G-S15
Connectable controller		K1G-C04 _	
Sensing m	nethod	Th	ru-scan
Sensing d	istance	10–500 mm	10–1000 mm
Measurem	nent width	7 mm	15 mm
Light sour	ce	Red semiconductor lase	r (peak wavelength: 650 nm),
		SIC	class 1
Standard	target object	Opaqu	e knife edge
Repeatabi	ility	±1µ	m max.*1
Moving ad	curacy	±20 μm max. for a	movement of 0.5 mm *2
Indicators	Emitter	Laser emission i	ndicator (green LED)
	Receiver	Normal operation / k	beam alignment indicator
		(gre	een LED)
Operat-	Operating temperature	0	–50 ℃
ing envi-	Storage temperature	-20 to +70 °C (without freezing)	
ronment	Operating ambient humidity	30–85 % RH (wi	thout condensation)
	Vibration resistance	9.	8 m/s <sup>2</sup>
		(10 to 55 Hz for 2 h ea	ch in x, y, and z directions)
	Protective structure	IP40 (IE	C standard)
Material	Controller		PPS
	Light-emitting and receiving		Glass
	surfaces		
	Cable		PVC

\*1. The accuracy specifications are under the conditions shown below, at an ambient temperature of 23  $\pm$ 2 °C.

Model No.	SD	WD	Workpiece position	No. of moving averages
K1G-S07	20 mm	10 mm	Center of measurement width	64
K1G-S15	100 mm	50 mm	1.0 mm from center of measurement width	64

\*2. The accuracy specifications are under the conditions shown below, at an ambient temperature of 23  $\pm 2$  °C.

Model No.	SD	WD	Workpiece position
K1G-S07	20 mm	10 mm	Center of measurement width
K1G-S15	100 mm	50 mm	1.0 mm from center of measurement width

SD: sensing distance (emitter to receiver) WD: working distance (target object to receiver)



# **EXTERNAL DIMENSIONS**

# • K1G-S07 (sensor heads)

Unit: mm



SPECIFICATIONS

# • K1G-S15 (sensor heads)

Unit: mm



\*<sup>1</sup> Total light emission area:  $23(H) \times 6(W)$ \*<sup>2</sup> Center of the measurement width

		SPECIFICATION	IS		
Model No.		K1G-C04	K1G-C04M	K1G-C04E	
Compatible	sensor	K1G-	S		
Max. pairs of	sensor heads	Z	1		
Junction cal	ble	K1G-L,	, K1G-R		
Min. display	unit	0.1	μm		
Display range	With KG-S07	±3.5	mm		
	With KG-S15	± 7.5	āmm		
Measureme (output upd	nt cycle late cycle)	250 μs / 500 μs / 1	ms (switchable)*1		
Analog outp	out	4 1–5 V (voltage output) or 4–20 mA (current output) Load resistance: 10 kΩ min. (with voltage output) 250 Ω +1 % max. (with current output)	-		
Digital outp	ut *2	8 common outputs (shared with power terminals) NPN or PNP output (selectable) Output current: 1–10 mA (each output) ON-state voltage drop: 2 V max. OFF-state leakage current: 0.3 mA max.	-		
Digital inpu	t	4 common outputs (shared with power terminals) Non-voltage contacts and open collector NPN or PNP output (selectable) Input current: Approx. 4 mA max. Min. input time: 6 ms (at a 250 µs measurement cycle) 12 ms (at a 500 µs measurement cycle) 24 ms (at a 1 ms measurement cycle)	-		
Communicat	ions function	RS-485 (Modbus RTU)	MECHATROLINK-III	EtherCAT	
Supply pow	er	12-24 V [	DC ±10 %		
Current con	sumption	1 A max. at 24 V,	2 A max. at 12 V		
Inrush curre	nt	20 A (0.2	2 s) max.		
Operating te	emperature	0–50 °C (0–35 °C when 3 or m	nore units are gang-m	ounted)	
Storage tem	perature	-20 to +70 °C (w	(ithout freezing)		
Operating am	bient humidity	30–85 % RH (with	out condensation)		
Vibration re	sistance	2 m/s <sup>2</sup> (10 to 60 Hz for 2 h e	ach in x, y, and z dired	ctions)	
Shock resist	ance	10 m/s <sup>2</sup> , 3 times in x	k, y, and z directions		
Protection c	ircuit	Power miswiri	ng protection		
Pollution de	egree	Pollution degree 2			

\*1. The list of selectable measurement cycles varies depending on the cable length. See the following table to select the cable length corresponding to the desired measurement cycle.

MadalNa	Measurement cycle			
wodel No.	250 µs	500 µs	1 ms	
K1G-L	5 m max.	20 m max.	25 m max.	
K1G-R	3 m max.	5 m max.	10 m max.	

Note: The listed lengths are for junction cables. CP P. 7-8

\*2. Not open collector output.

# **EXTERNAL DIMENSIONS**

# K1G-C04 (controller)



K1G-C04M (controller)



SPECIFICATIONS





Sensor head cable



# SPECIFICATIONS

# Standard model

Model No.	K1G-L01	K1G-L03	K1G-L05	K1G-L10	K1G-L25
Cable length (L)	1 m	3 m	5 m	10 m	25 m

# Bend-tolerant model

Model No.	K1G-R01	K1G-R03
Cable length (L)	1 m	3 m

# **EXTERNAL DIMENSIONS**

# Standard model



# Bend-tolerant model



Unit: mm

SPECIFICATIONS



# **TROUBLE SHOOTING**

This chapter tells how to determine the causes of problems that may arise while using K1G series sensors, and what corrective actions to take.

# Troubleshooting

# **FREQUENTLY ASKED QUESTIONS**





# Problems with the sensor heads

No.	Problem	What to check	Corrective action	Reference page
1	Emitter indicator does not light up.	Wiring for the emitter	Correct the wiring.	🕼 P. 2-7
(2)	Receiver indicator	Wiring for the receiver	Correct the wiring.	🕩 Р. 2-5
)	does not light up.	Optical axis position (in Ready mode)	Adjust the optical axis position correctly.	🗭 Р. 3-8
		Power-saving mode	Turn off power-saving mode.	🕞 P. 4-98

# Problems with the controller

No.	Problem	What to check	Corrective action	Reference page
-	The display is blank.	Power wiring for the controller	Correct the wiring.	C P. 2-7
1	The operation indi- cator is not lit.	-	Contact the azbil Group.	-
2	The mode cannot be switched to Run.	Initial setup completion	Complete the initial setup.	<b>С</b> Р. 3-3
3	No values are dis- played.	Power-saving mode	Turn off power-saving mode.	🕩 P. 4-98
	The displayed value does not change.	Calculation OFF input is enabled.	Disable calculation OFF input.	C P. 4-36
		Hold function status (is "Hold" status indicator lit?)	Disable the hold func- tion.	P. 4-36 P. 4-79

# Troubleshooting

No.	Problem	What to check	Corrective action	Reference page
4	A sensor connec- tion indicator is	Initial setup completion	Adjust the receiver of the blinking channel.	<b>ГЭ</b> Р. 3-8
	blinking.	Were sensor heads re- placed?	Reset, then adjust posi- tion of optical axis.	€ P.4-106
	A sensor connec- tion indicator is not lit.	Wiring for the sensor heads	Correct the wiring.	C P. 2-5
5	DO signal is not	Wiring for the DO signal	Correct the wiring.	🗭 P. 2-7
	output.	Ready mode.	Switch the mode to Run.	СЭР. 4-4
	There is no re-	Wiring for the DI signal	Correct the wiring.	🗭 P. 2-8
	input.	Calculation OFF input is enabled.	Disable calculation OFF input.	🅩 P. 4-36
6	Keys do not oper- ate.	Key lock	Disable the key lock.	€ P.4-105
	Cannot set param- eters.	Run mode	Switch the mode to Ready.	ГЭР. 4-4
7	AO signal is not output.	Wiring for the AO signal	Correct the wiring.	<b>ГЭ</b> Р. 2-9
	The AO signal does not change.	Ready mode.	Switch the mode to Run.	р. 4-4 Гр. 4-4
		Calculation OFF input is enabled.	Disable calculation OFF input.	🖙 P. 4-36
		Hold function status (is "Hold" status indicator lit?)	Disable the hold func- tion.	P. 4-36 P. 4-79

### Troubleshooting

Measurement problems				
No.	Problem	What to check	Corrective action	Reference page
1	Measured values fluctuate.	Smudge on the sensor heads	Wipe with a soft dust- free cloth.	🕩 P. vi
2		Vibration of the work- piece	Reexamine the mea- surement position, etc.	-
3		Sensor head optical axis alignment	Check the optical axes and adjust the receiver.	<b>Г</b> Р. 3-8
4		Workpiece settings	Adjust the settings.	🗭 P. 4-11
5		Ambient light interfer- ence	Reexamine the mea- surement position, etc.	-
6	The measured value is not correct.	Smudge on the sensor heads	Wipe with a soft dust- free cloth.	🖙 P. vi
7		Workpiece settings	Adjust the settings.	🗭 P. 4-11
8		Zero adjustment	Check the zero adjust- ment setting.	🕞 P. 4-29
9	The DO for mea- surement status is not correct.	DO settings	Check DO operation type, thresholds, etc.	P. 4-42
10		Selected channel	Check the setting for the selected channel.	P. 4-42

#### Measurement problems
## • Communication problems

No.	Problem	What to check	Corrective action	Reference page
1	RS-485 communi- cation is not work-	Wiring for communica- tions	Correct the wiring.	<b>С</b> Р. 2-6
2	ing normally.	Communication set- tings	Check communica- tion-related settings.	СЭ́Р. 5-2
3	MECHATROLINK-III communication is not working nor-	Cable connection status (check link indicators LK1 and LK2).	Insert the connector until it clicks.	C P. 2-12
4	mally.	Station address and No. Correct the relevant settings including those of the master station and other devices.		€ P.4-108 € P.4-111
5	EtherCAT com- munication is not working properly.	Check the Link/Activity indicator to check the communication cable connections.	Insert the connector until it clicks.	<b>С</b> ЭР. 2-13
6		Check the RUN and ERROR indicators.	Determine the state of EtherCAT com- munication from the indicators and take appropriate counter- measures.	<b>€</b> P. 1-14
7		Check the settings of the ECAT ID setting switches.	Check the master de- vice for the ID of other slave devices and specify a unique ID.	<b>С</b> Р. 3-11
8		Check if there is a source of heavy electri- cal noise in the environ- ment.	Reexamine the instru- mentation method.	СЭ́Р. 2-14

Error massages									
Display 1	Display 2	Error	Corrective action						
Error	<b>888</b> 8888	System error	Replace the controller.						
		System error							
		System error							
		Data corruption in EE- PROM	Contact the azbil Group.						
		Channel 1 sensor head disconnection	Check the relevant cables, etc., and replace the sensor heads if necessary.						
		Channel 2 sensor head disconnection	If multiple sensor head sets are used, unless all of them are dis- connected, "Error" will not be						
	<b>5</b> 4	Channel 3 sensor head disconnection	displayed.						
	<b>128</b>	Channel 4 sensor head disconnection							
	255	MECHATROLINK-III error	Check the MECHATROLINK-III communication configuration, referring to user's manual No. CP-SP-1386E. Also, check the relevant settings for the master station.						
	5 12	EtherCAT communica- tion error	Replace the controller.						

Note: If multiple errors occur at the same time, the sum of the error codes will be displayed.



Parameters, 7-segment LED characters and numbers, etc.

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# 9-1 Parameters

Display	Description	Parameter	Default setting	Reference page
R0 I	Measurement cycle	250 μ: 250 μs	500	P. 4-15
		500 μ: 500 μs		
		1000 u: 1 ms		
802	Display resolution	<b>39.9:</b> 1 digit after the decimal point	9.999	🗭 P. 4-8
		<b>39.99</b> : 2 digits after the decimal point		
		<b>9.999:</b> 3 digits after the decimal point		
		<b>9.9999:</b> 4 digits after the decimal point		
R03	Key lock	oFF: Disabled	oFF	P.4-102
		on: Enabled		
804	Controller power-	oFF: Disabled	oFF	🇭 P. 4-98
	saving mode	on: Enabled		
ROS	Sensor head power-	oFF: Disabled	oFF	🗭 P. 4-98
	saving mode	on: Enabled		
R06	Station address		0	🗭 P. 5-4
	<b>-</b> · · · ·	(U: communication is disabled)		
XU 1	Iransmission speed	9.6 kbps	9.6	P. 5-7
		19.2: 19.2 kbps		
		38.4 kbps		
		115.2: 115.2 kbps		
808	Communication	nenE: No parity (2 stop bits)	nonE	🕼 P. 5-10
	Iormat	EUEn: Even parity (1 stop bit)		
		odd: Odd parity (1 stop bit)		
809	MECHATROLINK-III address	3h-EFh Note: "3" is displayed on the K1G- C04, but it cannot be changed.	36	P. 4-108 CP-SP- 1386E
R 10	No. of transmission bytes for MECHA-	Ч <b>В</b> : 48 byte	48	СР-SP-
	TROLINK-III Note: This param- eter will not be displayed on the K1G-C04.	<i>32</i> : 32 byte		1386E
Ь₿ (	Sensor head type	: Not connected		
	(display only, un-	□ 7: K1G-S07	-	-
	changeable)	/5:K1G-S15		

Display	Description		Р	arameter		Default setting	Reference page
602	Measurement mode		Measure- ment mode	Target ob- ject type	Measurement orientation	1	P. 4-11
		1		Opaque	Тор		
			Edge mea-	објест	Bottom		
		3	surement	parent	Dettere		
		4		object	Bottom		
		5	Width measure- ment	Opaque	-		
		Б	Gap mea- surement	object	-		
		7	Edge		Тор		
		8	measure- ment	Trans- parent	Bottom		
		9	Measurement	object	Тор		
		10	of second edge		Bottom		
ь03	No. of moving averages	1-	500			64	🗭 P. 4-18
604	Smudge detection thresh- old	1-	100 (%) (0	0	🖙 P. 4-90		
605	Edge detection thresh- old	5-	95 (%)			25	P. 4-21
606	Zero adjustment	Wit	h K1G-S07 ser	nsor: - <u>3.500</u>	7– <i>3</i> .5 <i>00</i> (mm)	0.000	🕩 P. 4-29
	value	Wit	h K1G-S15 ser	nsor: - 7.500			
607	Working distance	All	models:	0-9	(disabled)	0	🗭 P. 4-76
		Wit	h K1G-S07 s	ensor: 10-	-5 <i>00</i> (mm)		
		Wit	h K1G-S15 s	ensor: 10			
CO I	Inter-channel cal-	F - 4Lh: Four arithmetic operations				nonE	🗭 P. 4-62
	culation						
			F-BoL: θ calculation (channel 2 or 4 only can be selected)				
		F -	EHE: Meas expa (chai selec	surement insion calc nnel 2 or 4 cted)	range ulation only can be		

#### 9-1 Parameters

Display	Description	Parameter	Default setting	Reference page
203	Hold setting	nonE: disabled	nonE	C P. 4-79
		Pu - h I: Digital input (DI) max. value hold function		
		Pu-h2: Digital input (DI) min. value hold function		
		EP5 - 1:EPS filter 1		
		EPS-Z:EPS filter 2		
		EPS - 3:EPS filter 3		
		EPS-5:EPS filter 5		
<i>CO3</i>	No. of EPS filter delavs	1-256	1	C P. 4-83
604	EPS filter size	<i>0. 100–50.000</i> (mm)	0. 100	P. 4-83
<i>C O S</i>	EPS filter direction	both: Concave and convex	both	C P. 4-83
		r ،5٤: Convex		
		droP: Concave		
C 0 6	EPS filter output	oFF: Disabled	00	C P. 4-83
	hold	on: Enabled		
٢٥٦	Low threshold	With K1G-S07: - \$9.999 to + \$9.999 (mm)	- 3.500	C P. 4-42
		With K1G-S15: - 99.999 to + 99.999 (mm)	- 7.500	
C 0 8	High threshold	With K1G-S07: - \$3.555 to + \$3.555 (mm)	3.500	C P. 4-42
		With K1G-S15: - 99.999 to + 99.999 (mm)	00 ר.	
<i>C 0 9</i>	Hysteresis	0.0 10- 1.000 (mm)	0.0 10	C P. 4-42
C 10	Analog output re-	ه ۶۶: disabled (positive polarity)	oFF	P. 4-33
	verse polarity	ه n: enabled (negative polarity)		
[	Analog output range	With K1G-S07: - 99.999 to + 99.999 (mm)	- 3.500	C P. 4-25
	low limit	With K1G-S15: - 99.999 to + 99.999 (mm)	- 7.500	
E 12	Analog output range	With K1G-S07: - 99.999 to + 99.999 (mm)	3.500	C P. 4-25
	high limit	With K1G-S15: - 99.999 to + 99.999 (mm)	7.500	
40 (	Calculation parameter K1	- 1000 to + 1000	1	🗭 P. 4-62
202	Calculation parameter K2	- 1000 to + 1000	1	🗭 P. 4-62
403	Calculation parameter K3	- 1000 to + 1000	1	🗭 P. 4-62
d04	Calculation parameter K4	- 1000 to + 1000	1	🗭 P. 4-62
80S	Calculation parameter C1	- <i>9.999</i> to + <i>9.999</i>	0.000	🗭 P. 4-62
405	Calculation parameter C2	I- IOOOO	Ч	🗭 P. 4-62
E0 1	Event source	្រឹ ១ភិៈ All channels (OR output)	Selected	C P. 4-42
		Eh I: Channel 1 (for PV1)	channel	
		Eh2: Channel 2 (for PV2)		
		Lhd: Channel 3 (for PV3)		
		したう: Channel 4 (for PV4)		

Display	Description	Parameter	Default setting	Reference page
802	Event type	PR55: Pass out: Out h :: High	PR55	P. 4-42
		EPS: EPS event hoLd: Holding L iEhE: Smudge		
		ມີ ເດຍີ: Normal operation		
E03	Delay setting	o o o E : Disabled o o o d : ON delay	nonE	P. 4-42
EOY	Delay time	ID: D: Off delay   ID: 10 (ms)   ZD: 20 (ms)   ZD: 30 (ms)   YD: 40 (ms)   SD: 50 (ms)	40	P.4-42
		<b>Ε</b> <sup>[]</sup> : 60 (ms)		
E05	Event source	にいて(ms) こった: All channels (OR output) こちに Channel 1 (for PV1) こちご: Channel 2 (for PV2) こちご: Channel 3 (for PV3) こちど: Channel 4 (for PV4)	Selected channel	P. 4-42
E05	Event type	PR55:   Pass     out:   Out     h ::   High     L o:   Low     EP5:   EPS event     hoLd:   Holding     L : Lok:   Smudge     Er : Low:   Output update     Low:   Normal operation	002	P. 4-42
ר ם פ	Delay setting	مەمىتى: Disabled مەمىتى: ON delay مەتە- ما: OFF delay	nonE	P. 4-42

#### 9-1 Parameters

Display	Description		Parameter	Default setting	Reference page
E 0 8	Delay time	<i>ዘ</i> ር: 10 (ms)		40	P. 4-42
		20:20 (ms)			
		30 (ms)			
		<i>낙립</i> : 40 (ms)			
		50 (ms)			
		<i>Б ជ</i> : 60 (ms)			
		70:70 (ms)			
E09	DI function selection	0-84J:	Zero adjustment for the specified channel	0-843	🇭 P. 4-36
		EP5:	EPS hold cancellation input for the specified channel		
		Pu-h:	PV hold input for the specified channel		
		RLL D-RJ	ن: Zero adjustment for all channels		
		RLL EPS:	EPS hold cancellation input for all channels		
		ALL PU-H	: PV hold input for all channels		
		RLL F-EP	5: Forced EPS hold can- cellation input for all channels		
		RLLLd-o	n: Laser start input for all channels		
		RLL do-o	F: Calculation OFF input for all channels		
		RLL LoG:	Event log start input for all channels		

# 9-2 Configuration Flowcharts

## **OVERALL FLOWCHART**

For details, see the page noted under the item.











# 9-3 Processing Flowchart



9 APPENDIX

# 9-4 Alphanumeric Characters

The 7-segment LED display of the controller shows numbers as follows.

0	1	2	3	4	5	6	7	8	9
	1	<u>ר</u>	ורין	4	5	5	71	B	

Alphabetic characters appear as follows on the LED display.

Α	В	С	D	E	F	G	Н		J	K	L	М
$\mathbb{R}$	5	Ľ	<i>d</i> ′	E	F	5	ት	1	1	<i>¦_'</i>	1	Ē
N	0	Р	Q	R	S	Т	U	V	W	Х	Y	Z
п	ū	P	9	<i>г</i>	5	1-			11	H	Ч	-

**9** APPENDIX

# 9-5 If the Product Is Used Outside Japan

# **CE MARK AND KOREA CERTIFICATION MARK**

This product is not CE- or KC-marked. Please purchase the K1G-C04G or K1G-C04MG and refer to K1G Series High-Accuracy Position Sensor Global Model User's Manual (CP-SP-1397E).

# IF THE PRODUCT IS USED IN THE UNITED STATES

If equipment incorporating this device is exported to the United States, it will be subject to U.S. FDA laser safety requirements.

This product has been registered with the FDA (CDRH).

It includes a label indicating compliance with FDA standards. In the case of export to the United States, attach the label to the product.

# **DETAILS ON COMMUNICATIONS DATA**

Definitions of items in the tables below are as follows.

Address :	Controller memory address (hexadecimal)
Size :	Parameter size (number of addresses) 1 : (16-bit data) 2 : (32-bit data)
Access rights :	Parameter access rights R : read W : write
Change enabled mode :	The mode in which parameters can be written RDY : Ready mode RUN : Run mode UT : UserTest mode

## FOR MONITORING

Address (hex)	Size	Access rights	Change en- abled mode	Description	Notes
1000	2	R	-	PV1	Integer, ± 999999
					(in 0.1 µm increments)
1002	2	R	-	PV2	Integer, ± 999999
					(in 0.1 µm increments)
1004	2	R	-	PV3	Integer, ± 999999
					(in 0.1 µm increments)
1006	2	R	-	PV4	Integer, ± 999999
					(in 0.1 µm increments)
1008	1	R	-	Event occurrence	Table 1-A
				(channels 1–4, OR)	
1009	1	R	-	Ch1 event occurrence	Table 1-A
100A	1	R	-	Ch2 event occurrence	Table 1-A
100B	1	R	-	Ch3 event occurrence	Table 1-A
100C	1	R	-	Ch4 event occurrence	Table 1-A
100D	1	R	-	DI status	Table 1-B
100E	1	R	-	DO status	Table 1-C
100F	1	R	-	Controller status	Table 1-D
1010	1	R	-	Error status bit	Table 1-E
1011	1	R	-	Sensor head pair 1 status	Table 1-F
1012	1	R	-	Sensor head pair 2 status	Table 1-F
1013	1	R	-	Sensor head pair 3 status	Table 1-F
1014	1	R	-	Sensor head pair 4 status	Table 1-F

#### 9-6 Communication Parameters

Table 1-A						
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	Hold event occurrence					
Bit 6	Smudge detection event occurrence					
Bit 7	Output update event occurrence					
Bit 8	Normal operation event occurrence					
Bits 9–15	No assignment (always 0)					

Ta	b	le	1	-B

Assignment	Event occurrence
Bit 0	DI1: ON =1, OFF = 0
Bit 1	DI2: ON =1, OFF = 0
Bit 2	DI3: ON =1, OFF = 0
Bit 3	DI4: ON =1, OFF = 0
Bits 4–15	No assignment (always 0)

Note: 1 = event occurrence, 0 = no occurrence

### Table 1-C

Assignment	Event occurrence					
Bit 0	DO1: ON =1, OFF = 0					
Bit 1	DO2: ON =1, OFF = 0					
Bit 2	DO3: ON =1, OFF = 0					
Bit 3	DO4: ON =1, OFF = 0					
Bit 4	DO5: ON =1, OFF = 0					
Bit 5	DO6: ON =1, OFF = 0					
Bit 6	DO7: ON =1, OFF = 0					
Bit 7	DO8: ON =1, OFF = 0					
Bits 8–15	No assignment (always 0)					

Table 1-D Assignment Controller status Bit 0 No error Bit 1 Partial sensor head disconnection Device failure Bit 2

#### Table 1-E

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

Table 1-F

Value	Sensor head status		
0 Not connected			
1	Not adjusted		
2	In use		
3	Wrong connection		
4	Disconnected		
5	Prohibited		

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Note: 1 = event occurrence, 0 = no occurrence

# FOR SETTINGS

## Shared settings

Address (hex)	Size	Access rights	Change enabled mode	Description	Notes
2000	1	R/W	RUN, RDY	Measurement cycle	0: 250 μs 1: 500 μs 2: 1000 μs
2001	1	R/W	RUN, RDY	Display resolution	No. of digits after the decimal point 0: 3 1: 2 2: 1 3: 4
2002	1	R/W	RUN, RDY	Key lock	0: disabled 1: enabled
2003	1	R/W	RUN, RDY	Controller power- saving mode	0: disabled 2: enabled
2004	1	R/W	RUN, RDY	Sensor head power- saving mode	0: disabled 3: enabled
2005	1	R/W	RUN, RDY	Station address	0–127 (0: RS-485 disabled)
2006	1	R/W	RUN, RDY	Transmission speed	0: 9.6 kbps 1: 19.2 kbps 2: 38.4 kbps 3: 115.2 kbps
2007	1	R/W	RUN, RDY	Communications format (parity)	0: None 1: Even 2: Odd
2008	1	R/W*1	RUN, RDY	MECHATROLINK-III address	03-EF(HEX)
20A1	1	R/W*2	RUN, RDY	No. of transmission bytes for MECHATROLINK-III	2: 32 bytes 3: 48 bytes

\*1. "R" (READ) only in the case of K1G-C04. \*2. No access in the case of K1G-C04.

## • Individual channel settings

Ch1 address (hex)	Ch2 address (hex)	Ch3 address (hex)	Ch4 address (hex)	Size	Access rights	Change en- abled mode	Description	Notes
2009	2010	2017	201E	1	R	-	Sensor head type	0: Not connected 1: K1G-S07 2: K1G-S15
200A	2011	2018	201F	1	R/W	RUN, RDY	Workpiece	Table 2-A
200B	2012	2019	2020	1	R/W	RUN, RDY	No. of moving averages	1–500
200C	2013	201A	2021	1	R/W	RUN, RDY	Smudge detec- tion threshold	0–100 %
200D	2014	201B	2022	1	R/W	RUN, RDY	Edge detection threshold	5–95 %
200E	2015	201C	2023	1	R/W	RUN, RDY	Zero adjust- ment value	Integer, -3500 to +3500 μm Integer, -7500 to +7500 μm
200F	2016	201D	2024	1	R/W	RUN, RDY	Working dis- tance (WD)	S07: 0–500 S15: 0–1500, 0–9: Invalid

## • Individual PV settings

PV1 address (hex)	PV2 address (hex)	PV3 address (hex)	PV4 address (hex)	Size	Access rights	Change en- abled mode	Description	Notes
2025	2035	2045	2055	1	R/W	RUN, RDY	Inter-channel calculation	0: No calculation 1: Four arithmetic operations 2: θ calculation* 3: Measurement range expansion calculation*
2026	2036	2046	2056	1	R/W	RUN, RDY	Hold setting	Table 2-B
2027	2037	2047	2057	1	R/W	RUN, RDY	No. of EPS filter delays	1–256
2028	2038	2048	2058	1	R/W	RUN, RDY	EPS filter size	Integer, 100 to 50000 μm
2029	2039	2049	2059	1	R/W	RUN, RDY	EPS filter direc- tion	0: Concave and convex 1: Convex 2: Concave
202A	203A	204A	205A	1	R/W	RUN, RDY	EPS filter output hold	0: Disabled 1: Enabled
202B	203B	204B	205B	2	R/W	RUN, RDY	Low threshold	Integer, -99999 to +99999 μm
202D	203D	204D	205D	2	R/W	RUN, RDY	High threshold	Integer, -99999 to +99999 μm
202F	203F	204F	205F	1	R/W	RUN, RDY	Hysteresis	Integer, 10 to 1000 μm
2030	2040	2050	2060	1	R/W	RUN, RDY	Analog output reverse polarity	0: Disabled 1: Enabled
2031	2041	2051	2061	2	R/W	RUN, RDY	Analog output range low limit	Integer, -99999 to +99999 μm
2033	2043	2053	2063	2	R/W	RUN, RDY	Analog output range high limit	Integer, -999999 to +99999 μm
2065	206B	2071	2077	1	R/W	RUN, RDY	Calculation parameter K1	-1000 to +1000
2066	206C	2072	2078	1	R/W	RUN, RDY	Calculation parameter K2	-1000 to +1000
2067	206D	2073	2079	1	R/W	RUN, RDY	Calculation parameter K3	-1000 to +1000
2068	206E	2074	207A	1	R/W	RUN, RDY	Calculation parameter K4	-1000 to +1000
2069	206F	2075	207B	1	R/W	RUN, RDY	Calculation parameter C1	Integer, -999999 to +99999 μm
206A	2070	2076	207C	1	R/W	RUN, RDY	Calculation parameter C2	1 to 10000

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\* "2" and "3" can be set for PV2 or PV4 only.

## • DI and DO settings

Address (hex)	Size	Access rights	Change en- abled mode	Description	Notes
207D	1	R/W	RUN, RDY	DO1 Event source	0: Any 1: Ch1 2: Ch2 3: Ch3 4: Ch4
207E	1	R/W	RUN, RDY	DO1 event type	Table 2-C
207F	1	R/W	RUN, RDY	DO1 delay setting	0: No delay 1: ON delay 2: OFF delay
2080	1	R/W	RUN, RDY	DO1 delay time	Table 2-D
2081	1	R/W	RUN, RDY	DO2 event source	0: Any 1: Ch1 2: Ch2 3: Ch3 4: Ch4
2082	1	R/W	RUN, RDY	DO2 event type	Table 2-C
2083	1	R/W	RUN, RDY	DO2 delay setting	0: No delay 1: ON delay 2: OFF delay
2084	1	R/W	RUN, RDY	DO2 delay time	Table 2-D
2085	1	R/W	RUN, RDY	DI1 function selection	Table 2-E
2086	1	R/W	RUN, RDY	DO3 event source	0: Any 1: Ch1 2: Ch2 3: Ch3 4: Ch4
2087	1	R/W	RUN, RDY	DO3 event type	Table 2-C
2088	1	R/W	RUN, RDY	DO3 delay setting	0: No delay 1: ON delay 2: OFF delay
2089	1	R/W	RUN, RDY	DO3 delay time	Table 2-D
208A	1	R/W	RUN, RDY	DO4 event source	0: Any 1: Ch1 2: Ch2 3: Ch3 4: Ch4
208B	1	R/W	RUN, RDY	DO4 event type	Table 2-C
208C	1	R/W	RUN, RDY	DO4 delay setting	0: No delay 1: ON delay 2: OFF delay
208D	1	R/W	RUN, RDY	DO4 delay time	Table 2-D
208E	1	R/W	RUN, RDY	DI2 function selection	Table 2-E

Address (hex)	Size	Access rights	Change en- abled mode	Description	Notes
208F	1	R/W	RUN, RDY	DO5 event source	0: Any 1: Ch1 2: Ch2 3: Ch3 4: Ch4
2090	1	R/W	RUN, RDY	DO5 event type	Table 2-C
2091	1	R/W	RUN, RDY	DO5 delay setting	0: No delay 1: ON delay 2: OFF delay
2092	1	R/W	RUN, RDY	DO5 delay time	Table 2-D
2093	1	R/W	RUN, RDY	DO6 event source	0: Any 1: Ch1 2: Ch2 3: Ch3 4: Ch4
2094	1	R/W	RUN, RDY	DO6 event type	Table 2-C
2095	1	R/W	RUN, RDY	DO6 delay setting	0: No delay 1: ON delay 2: OFF delay
2096	1	R/W	RUN, RDY	DO6 delay time	Table 2-D
2097	1	R/W	RUN, RDY	DI3 function selection	Table 2-E
2098	1	R/W	RUN, RDY	DO7 event source	0: Any 1: Ch1 2: Ch2 3: Ch3 4: Ch4
2099	1	R/W	RUN, RDY	DO7 event type	Table 2-C
209A	1	R/W	RUN, RDY	DO7 delay setting	0: No delay 1: ON delay 2: OFF delay
209B	1	R/W	RUN, RDY	DO7 delay time	Table 2-D
209C	1	R/W	RUN, RDY	DO8 event source	0: Any 1: Ch1 2: Ch2 3: Ch3 4: Ch4
209D	1	R/W	RUN, RDY	DO8 event type	Table 2-C
209E	1	R/W	RUN, RDY	DO8 delay setting	0: No delay 1: ON delay 2: OFF delay
209F	1	R/W	RUN, RDY	DO8 delay time	Table 2-D
20A0	1	R/W	RUN, RDY	DI4 function selection	Table 2-E

Value	Workpiece
1	Opaque object edge measurement (top)
2	Opaque object edge measurement (bottom)
3	Transparent object edge measurement (top)
4	Transparent object edge measurement (bottom)
5	Opaque object width measurement
6	Opaque object gap measurement
7	Transparent object edge width measurement (top)
8	Transparent object edge width measurement (bottom)
9	Transparent object 2nd edge position measurement (top)
10	Transparent object 2nd edge position measurement (bottom)

Table 2-B					
Value Hold setting					
0	No hold				
1	External input max. value hold				
2	2 External input min. value hold				
3	EPS filter 1				
4	EPS filter 2				
5	EPS filter 3				
6	EPS filter 4				

EPS filter 5

## Table 2-C

Value	Event type
0	Pass
1	Out
2	High
3	Low
4	EPS event
5	Hold
6	Smudge detection
7	Output update
8	Normal operation

## Table 2-D

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Value	Delay time				
0	10 ms				
1	20 ms				
2	30 ms				
3	40 ms				
4	50 ms				
5	60 ms				
6	70 ms				

### Table 2-E

Value	DI signal function selection
0	Zero adjustment input
1	Input to cancel EPS filter output hold
2	Input for PV hold
3	Zero adjustment input for all channels
4	Input to cancel EPS filter output hold for all PVs
5	PV hold input for all PVs
6	Input to forcibly cancel EPS filter output hold
7	Laser start input
8	Calculation OFF input
9	Event log start input

# **FOR CHANNELS 1-4**

Ch1 address (hex)	Ch2 address (hex)	Ch3 address (hex)	Ch4 address (hex)	Size	Access rights	Change en- abled mode	Description	Notes
3000	4000	5000	6000	1	R	-	1st edge posi- tion cell No.	
3001	4001	5001	6001	1	R	-	2nd edge posi- tion cell No.	
3002	4002	5002	6002	2	R	-	Actual 1st edge position	Integer, ± 999999 (in 0.1 µm increments)
3004	4004	5004	6004	2	R	-	Actual 2nd edge position	Integer, ± 999999 (in 0.1 µm increments)
3006	4006	5006	6006	2	R	-	1st edge position	Integer, ± 999999 (in 0.1 µm increments)
3008	4008	5008	6008	2	R	-	2nd edge position	Integer, ± 999999 (in 0.1 µm increments)
300A	400A	500A	600A	2	R	-	PV before hold	Integer, ± 999999 (in 0.1 µm increments)
300C	400C	500C	600C	2	R	-	PV after hold	Integer, ± 999999 (in 0.1 µm increments)
300E	400E	500E	600E	2	R	-	PV after moving average	Integer, ± 999999 (in 0.1 µm increments)
3010	4010	5010	6010	2	R	-	Displayed value	Value displayed on controller without decimal point
3012	4012	5012	6012	2	R	-	Bottom value	Value displayed on controller without decimal point
3014	4014	5014	6014	2	R	-	Peak value	Value displayed on controller without decimal point
3016	4016	5016	6016	1	R	-	Analog output level	Percentage (0–100 %)
3017	4017	5017	6017	1	R	-	Event data	Table 3-A
3018	4018	5018	6018	1	R	-	1/8 of actual light intensity	Table 3-B
3019	4019	5019	6019	1	R	-	1/8 of normalized light intensity	Table 3-C
301A	401A	501A	601A	2	R	-	Total normalized light intensity	Integer
301C	401C	501C	601C	2	R	-	Estimated nor- malized light intensity	Integer
301E	401E	501E	601E	1	R	-	Normalized light in- tensity change rate	Percentage

Assignment	Event data
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	Hold event occurrence
Bit 6	Smudge detection event occurrence
Bit 7	Output update event occurrence
Bit 8	Normal operation event occurrence
Bits 9–15	No assignment (always 0)
Bit 0 Bit 1 Bit 2 Bit 3 Bit 4 Bit 5 Bit 6 Bit 7 Bit 8 Bits 9–15	Pass event occurrence Out event occurrence High event occurrence Low event occurrence EPS event occurrence Hold event occurrence Smudge detection event occurrence Output update event occurrence Normal operation event occurrence No assignment (always 0)

Table 3-A

Note: 1 = event occurrence, 0 = no occurrence

#### Table 3-B

Assignment	Actual light intensity distribution
Bit 0	Light intensity at the top margin is sufficient for receiver adjustment.
Bit 1	Light intensity at all cells in block 1 is sufficient for receiver adjustment (top).
Bit 2	Light intensity at all cells in block 2 is sufficient for receiver adjustment.
Bit 3	Light intensity at all cells in block 3 is sufficient for receiver adjustment.
Bit 4	Light intensity at all cells in block 4 is sufficient for receiver adjustment.
Bit 5	Light intensity at all cells in block 5 is sufficient for receiver adjustment.
Bit 6	Light intensity at all cells in block 6 is sufficient for receiver adjustment.
Bit 7	Light intensity at all cells in block 7 is sufficient for receiver adjustment.
Bit 8	Light intensity at all cells in block 8 is sufficient for receiver adjustment
	(bottom).
Bit 9	Light intensity at the bottom margin is sufficient for receiver adjustment.
Bits 10–15	No assignment (always 0)

Notes 1. A block is 1/8 of the measurement range. The number of cells differs for S07 and S15. 2. If receiver adjustment is possible, the value is 1. If not, the value is 0.

#### Table 3-C

Assignment	Normalized light intensity distribution
Bit 0	Not used (always 0)
Bit 1	Normalized light intensity in block 1 is 80 to 120 % (top).
Bit 2	Normalized light intensity in block 2 is 80 to 120 %.
Bit 3	Normalized light intensity in block 3 is 80 to 120 %.
Bit 4	Normalized light intensity in block 4 is 80 to 120 %.
Bit 5	Normalized light intensity in block 5 is 80 to 120 %.
Bit 6	Normalized light intensity in block 6 is 80 to 120 %.
Bit 7	Normalized light intensity in block 7 is 80 to 120 %.
Bit 8	Normalized light intensity in block 8 is 80 to 120 % (bottom).
Bits 9–15	No assignment (always 0)

Notes 1. A block is 1/8 of the measurement range. The number of cells differs for S07 and S15. 2. If receiver adjustment is possible, the value is 1. If not, the value is 0.

## FOR LIGHT INTENSITY

Address (hex)	Size	Access rights	Change en- abled mode	Description	Notes
7000	1	W	RDY, RUN	Type of light intensity data to acquire	Table 4-A
7100	1	R	-	Data for cell 1 Top	Type of light intensity data specified by 7000
7101	1	R	-	Data for cell 2	Type of light intensity data specified by 7000
7102	1	R	-	Data for cell 3	Type of light intensity data specified by 7000
7103	1	R	-	Data for cell 4	Type of light intensity data specified by 7000
7104	1	R	-	Data for cell 5	Type of light intensity data specified by 7000
7105	1	R	-	Data for cell 6	Type of light intensity data specified by 7000
7106	1	R	-	Data for cell 7	Type of light intensity data specified by 7000
÷	:	:	÷	:	:
71FF	1	R	-	Data for cell 256 Bottom	Type of light intensity data specified by 7000

Note: When the K1G-S07 is connected, 7180–71FF are 0.

### Table 4-A

Value	Type of light intensity data to acquire
0	Return a response without acquiring data.
1	Channel 1: normalized light intensity
2	Channel 2: normalized light intensity
3	Channel 3: normalized light intensity
4	Channel 4: normalized light intensity
5	Channel 1: actual light intensity when the laser diode (LD) = ON
6	Channel 2: actual light intensity when the LD = ON
7	Channel 3: actual light intensity when the LD = ON
8	Channel 4: actual light intensity when the LD = ON
9	Channel 1: actual light intensity when the LD = OFF
10	Channel 2: actual light intensity when the LD = OFF
11	Channel 3: actual light intensity when the LD = OFF
12	Channel 4: actual light intensity when the LD = OFF
13	Channel 1: normalized parameter
14	Channel 2: normalized parameter
15	Channel 3: normalized parameter
16	Channel 4: normalized parameter
17 and later	Message is ignored.

# FOR ADJUSTMENT

Address (hex)	Size	Access rights	Change en- abled mode	Description	Notes
8000	1	W	RDY, RUN	Receiver adjustment	Table 5-A
8001	1	R	-	Channel 1: adjustment result	0: Adjustment in progress 1: Succeeded 2: Failed
8002	1	R	-	Channel 2: Adjustment result	0: Adjustment in progress 1: Succeeded 2: Failed
8003	1	R	-	Channel 3: Adjustment result	0: Adjustment in progress 1: Succeeded 2: Failed
8004	1	R	-	Channel 4: Adjustment result	0: Adjustment in progress 1: Succeeded 2: Failed
8100	1	W	RDY, RUN	Zero adjustment	Table 5-A
8101	1	R	-	Channel 1 zero adjust- ment result	0: Adjustment in progress 1: Complete
8102	1	R	-	Channel 2 zero adjust- ment result	0: Adjustment in progress 1: Complete
8103	1	R	-	Channel 3 zero adjust- ment result	0: Adjustment in progress 1: Complete
8104	1	R	-	Channel 4 zero adjust- ment result	0: Adjustment in progress 1: Complete
8200	1	W	RDY, RUN	Analog output low limit adjustment	Table 5-A
8201	1	R	-	Channel 1 analog output low limit adjustment result	0: Adjustment in progress 1: Complete
8202	1	R	-	Channel 2 analog output low limit adjustment result	0: Adjustment in progress 1: Complete
8203	1	R	-	Channel 3 analog output low limit adjustment result	0: Adjustment in progress 1: Complete
8204	1	R	-	Channel 4 analog output low limit adjustment result	0: Adjustment in progress 1: Complete
8300	1	W	RDY, RUN	Analog output high limit adjustment	Table 5-A
8301	1	R	-	Channel 1 analog output high limit adjustment result	0: Adjustment in progress 1: Complete
8302	1	R	-	Channel 2 analog output high limit adjustment result	0: Adjustment in progress 1: Complete
8303	1	R	-	Channel 3 analog output	0: Adjustment in progress

Address (hex)	Size	Access rights	Change en- abled mode	Description	Notes
8304	1	R	-	Channel 4 analog output high limit adjustment result	0: Adjustment in progress 1: Complete
8400	1	W	See table men- tioned at right	Controller mode change	Table 5-B2
8401	1	R	-	Controller mode	Current mode Table 5-B1
8402	1	W	RUN	Return to Run mode	1: Execute
8500	1	W	RDY	Save data to EEPROM	1: Execute
8501	1	R	-	Progress of data copy to EEPROM	0: In progress 1: Complete
8600	1	W	RUN	Forcibly cancel EPS filter output hold	1: Execute
8700	1	W	RDY, RUN	Event log start	1: Execute
8800	1	W	RDY, RUN, UT	Channel change	Table 5-C
8801	1	R	-	Channel selection status	Table 5-C
8900	1	W	RUN	Peak/bottom value switch	0: Peak 1: Bottom
8901	1	W	RUN	Peak/bottom value deletion	1: Execute
8A00	1	W	RUN	Disabling of key lock	"1" disables
8A01	1	R	-	Key lock status	0: Key lock off 1: Key lock on
8B00	1	W	RUN	Disabling of controller power-saving	"1" disables
8B01	1	R	-	Sleep status	0: Sleep off 1: Sleep on
8C00	1	W	RDY, RUN	(Reserved)	Do not write data.
8C01	1	R	-	(Reserved)	0 can be read.
8D00	1	W	RDY, RUN	Laser emission stop	1: Laser stop 0: Laser start
8D01	1	R	-	Laser status	0: Laser ON 1: Laser OFF
8E00	1	W	All	Disabling of all keys	1: Disables all keys 0: Enables all keys
8E01	1	R	-	Status of key dis- abling	0: All keys are enabled 1: All keys are disabled
8E02	1	W	RDY	Sensor head recognition	Table 5-D
8F00	1	W	UT	AO1 test output	Value to be written to AO (0–100 %)

### 9-6 Communication Parameters

Address (hex)	Size	Access rights	Change en- abled mode	Description	Notes
8F01	1	W	UT	AO2 test output	Value to be written to AO (0–100 %)
8F02	1	W	UT	AO3 test output	Value to be written to AO (0–100 %)
8F03	1	W	UT	AO4 test output	Value to be written to AO (0–100 %)
8F04	1	W	UT	DO test output	Bits 0–7 are assigned to DO1–DO8.

#### Table 5-A

Value	Operation
0	Take no action but return a response.
1	Channel 1: execute
2	Channel 2: execute
3	Channel 3: execute
4	Channel 4: execute
5	All channels: execute
6 and later	An error message is returned.

Table 5-B1 When data is read

Value	Mode
0	FirstBoot mode
1	Ready mode
2	Run mode
3	Test mode
4	Failure mode
5	Adjust mode
6	Config mode

Table 5-B2 Mode correspondence table for changing the mode using communication when data is written

Commenters de	Т	Target mode				
Current mode	Ready	Run	Test			
Ready	-	~	<b>v</b>			
Run	~	-	<b>v</b>			
UserTest	~	~	-			

If the mode is changed to a mode indicated as -, an application error will occur.

Value	Channel selection
0	Take no action but return a re-
	sponse.
1	Channel 1: select
2	Channel 2: select
3	Channel 3: select
4	Channel 4: select
5 and later	An error message is returned.

Table 5-D					
Value	Sensor head recognition				
0	Take no action but return a re-				
	sponse.				
1	Channel 1: recognize				
2	Channel 2: recognize				
3	Channel 3: recognize				
4	Channel 4: recognize				
5 and later	An error message is returned.				

## FOR SPECIAL FUNCTIONS

## • Shared settings

Address (hex)	Size	Access rights	Change en- abled mode Description		Notes
F000	1	R/W	RDY	Output type (1): volt- age/current	0: Voltage output 1: Current output *
F001	1	R/W	RDY	Output type (2): NPN/ PNP	0: NPN 1: PNP *
F002	1	R/W	RDY, RUN	Event source	0: Any 1: CH1 2: CH2 3: CH3 4: CH4
F003	1	R/W	RDY, RUN	Event type	Table 6-A
F004	1	R/W	RDY, RUN	Designation of chan- nel for sensor head snapshot	1: CH1 2: CH2 3: CH3 4: CH4
F005	1	R/W	RDY, RUN	Trigger point setting	Table 6-B
F006	1	R/W	RDY, RUN	High-speed trend channel	1: CH1 2: CH2 3: CH3 4: CH4
F007	1	R/W	RDY, RUN	Re-sampling counter	1 to 4000

\* When a parameter is written, add AA00 in hexadecimal (43520 in decimal) to it.

Event log data for individual PVs

PV1 address (hex)	PV2 address (hex)	PV3 address (hex)	PV4 address (hex)	Size	Access rights	Change enabled mode	Description
F100	F200	F300	F400	2	R	-	Event log PV time 01
F102	F202	F302	F402	2	R	-	Event log PV time 02
F104	F204	F304	F404	2	R	-	Event log PV time 03
F106	F206	F306	F406	2	R	-	Event log PV time 04
F108	F208	F308	F408	2	R	-	Event log PV time 05
F10A	F20A	F30A	F40A	2	R	-	Event log PV time 06
F10C	F20C	F30C	F40C	2	R	-	Event log PV time 07
F10E	F20E	F30E	F40E	2	R	-	Event log PV time 08
F110	F210	F310	F410	2	R	-	Event log PV time 09
F112	F212	F312	F412	2	R	-	Event log PV time 10
F114	F214	F314	F414	2	R	-	Event log PV time 11
F116	F216	F316	F416	2	R	-	Event log PV time 12
F118	F218	F318	F418	2	R	-	Event log PV time 13
F11A	F21A	F31A	F41A	2	R	-	Event log PV time 14
F11C	F21C	F31C	F41C	2	R	-	Event log PV time 15
F11E	F21E	F31E	F41E	2	R	-	Event log PV time 16
F120	F220	F320	F420	2	R	-	Event log PV time 17
F122	F222	F322	F422	2	R	-	Event log PV time 18
F124	F224	F324	F424	2	R	-	Event log PV time 19
F126	F226	F326	F426	2	R	-	Event log PV time 20
F128	F228	F328	F428	2	R	-	Event log PV time 21
F12A	F22A	F32A	F42A	2	R	-	Event log PV time 22
F12C	F22C	F32C	F42C	2	R	-	Event log PV time 23
F12E	F22E	F32E	F42E	2	R	-	Event log PV time 24
F130	F230	F330	F430	2	R	-	Event log PV time 25
F132	F232	F332	F432	2	R	-	Event log PV time 26
F134	F234	F334	F434	2	R	-	Event log PV time 27
F136	F236	F336	F436	2	R	-	Event log PV time 28
F138	F238	F338	F438	2	R	-	Event log PV time 29
F13A	F23A	F33A	F43A	2	R	-	Event log PV time 30
F13C	F23C	F33C	F43C	2	R	-	Event log PV time 31
F13E	F23E	F33E	F43E	2	R	-	Event log PV time 32

## • Event log snapshot data

Address (hex)	Size	Access rights	Change enabled mode	Description
F500	1	R	-	Event log snapshot cell 1
F501	1	R	-	Event log snapshot cell 2
:	:	•	•	:
F5FE	1	R	-	Event log snapshot cell 255
F5FF	1	R	_	Event log snapshot cell 256

Table 6-A

Value	Event log trigger setting
0	Pass event occurrence
1	Out event occurrence
2	High event occurrence
3	Low event occurrence
4	ESP event occurrence
5	Hold state occurrence
6	Smudge detection (abnormal light intensity)
7	Event log start input ON

Table 6-B

Value	Event log trigger point setting
0	25 % (8 points before, 24 points after trigger)
1	50 % (16 points before and after trigger)
2	75 % (24 points before, 8 points after trigger)

# 9-7 Important Notes for Restarting the Laser Beam

This device can control the state of laser beam emission using laser start input, RS-485 communication, and setting tool communication functions. These functions can be used to restart laser emission as follows.

### Example: Using laser start input

Initial status is RUN mode and laser start input is ON.

- **1.** Stop control operation that uses analog output.
- **2.** Turn off laser start input to turn the laser beam off (analog output becomes invalid).
- **3.** Change to READY mode to prepare for starting laser beam.
- 4. Turn on the laser start input to start measurement.
- 5. Change to RUN mode (analog output becomes valid).
- **6.** Wait for the circuits to stabilize (approximately 30 minutes, the same as the warm-up time).
- 7. Start control operation that uses analog output.



"Invalid" analog output is the state in which analog output is not updated, and "valid" is the state in which analog output is updated according to the results of measurement.

If the circuit stabilization time (above, **6**) is not sufficient, measurements that do not satisfy the accuracy specification may be reflected in the analog output. For controllers manufactured in and after September 2017, by following **step 4** above and turning on laser start input, analog output becomes valid. (**Steps 3** and **5** can be omitted.) However, make sure that the circuit stabilization time is sufficient.

# Revision History of CP-SP-1385E

Printed	Edn.	Revised pages	Description
Mar. 2015	1		
Dec. 2015	2	Cover	A parenthetical sentence was deleted.
		ii	A description was added to a caution.
		iii	Changes were made in descriptions of manuals.
		vi	A description was added to a caution in the "PRECAUTIONS FOR
			WIRING" section.
		vii	The "COMMUNICATION CABLES FOR MECHATROLINK-III" section was added.
		ix	A paragraph was added and the bottom diagram was changed. A paragraph was added in the "POWER-ON RESET" section.
		ix, 1-3, 4-9	Figures were corrected.
		1-4	"Available soon" was deleted.
		1-10	Drawing and description of K1G-C04M were added.
		2-1	Reference to another manual was deleted.
		2-3	A note was added.
		2-5	Old page 2-3 became section 2-3 (page 2-5), "Connecting the Sensor Heads."
		2-12	Section 2-5, "Wiring the Controller (K1G-C04)," was added.
		3-2	Flowchart and description were changed.
		3-5	Section 3-3, "Setting the Station Address for MECHATROLINK-III," was added.
		3-6	Section 3-4, "Setting the Number of Transmission Bytes for
			MECHATROLINK-III," was added.
		3-7~	Former pages 3-5 to 3-8
		3-7	References to other pages were added/changed.
		4-1	
		4-4	Note on K1G-C04M was added.
		4-5	Display type 5 was added.
		4-6~	Former pages 4-7 to 4-102
		4-59	A sentence was added to the Handling Precautions.
		4-66, 4-71	A sentence was deleted from the tip.
		4-74	Introductory sentence was changed.
		4-77	The Handling Precautions section was added.
		4-104	Section 4-9, "SETTING THE STATION ADDRESS FOR MECHATROLINK-
			III," was added.
		4-110	Former page 4-105. Screenshots were deleted from the tip.
		7-2	Temperature characteristics and shock resistance were omitted.
		7-4	"*2" was added to "Digital output."
		7-5	KIG-C04M drawing was added.
		/-/	Former page 7-6. External Dimensions diagrams were replaced.
		8-4	communication item was omitted from the Measurement problems table
		0 5	MECHATROLINK III error was added
		0.2	Description of A00 was changed and item A10 was added
		9-4 9-5	For F01 and F05 "(AND output)" was changed to "(OR output) "
		9-8 9-9	The diagrams were changed
		9-10	A 10 was added to the diagram
		9-16	Table 1-F was changed
		9-17	Shared settings table was changed
		9-22	Reversed "High value" and "Low value" were corrected
		9-26	Multiple occurrences of "Other values are ignored" were deleted
		9-27	Multiple occurrences of "Message is ignored" were changed to "An error mes-
			sage is returned."

Printed	Edn.	Revised pages	Description
Sep. 2016	3	Cover 1-5 1-6 9-14 9-15, 9-17 9-18, 9-22,9-26	Description of this document was changed. Description of junction cables was moved to 1-2, "Check of Included Items." Description of a ferrite core was added. Description of CE marking and KC marking was changed. Table notes were changed.
June 2017	4	ii iii viii viii ix x 1-2 1-4 to 1-5 1-12 1-13 2-13 2-13 2-14 3-2 3-11 4-4 4-5 to 4-7 4-5 to 4-7 4-5 to 4-7 4-5 to 4-7 4-5 to 4-7 4-5 to 4-7 8-5 8-6 9-2 9-8 9-9 9-8 9-9	A caution was added to "CAUTIONS AND WARNINGS." Descriptions in "THE ROLE OF THIS MANUAL? were changed. "COMMUNICATION CABLES FOR EtherCAT" was added. Descriptions in "WIRING OF THE POWER AND GROUND" were changed. A description was added to "POWER-ON RESET." "If K1G-C04M is used" was changed to "If K1G-C04M or K1G-C04E is used" Descriptions were changed. A drawing of the back of K1G-C04E was added. Descriptions of RJ45 ports and EtherCAT RUN/ERROR LEDs were added to the table. Section 2-6, "Wiring the Controller (K1G-C04E)," was added. "WIRING METHOD" was added. Descriptions and the flowchart in "Initial Setup Flowchart" were changed. Section 3-7, "Setting the ECAT ID (for K1G-C04E only)," was added. Descriptions in "Input/output operations in Ready mode" were changed. Descriptions were changed. Page numbers were formerly 4-6 and following Descriptions in "CHANGING SMUDGE DETECTION FUNCTION SETTINGS" were changed. A description was added to the table. Drawings of K1G-C04E (controller) were added. K1G-C04E was added to the table. Drawings of K1G-C04E (controller) were added. EtherCAT communication problems were added to "TROUBLE SHOOTING." ERROR 512 was added. A flowchart for K1G-C04E initial setting was added. "EtherCAT communication etatus check diendar" was added.
Jan. 2018	5	4-36 9-31	A reference was added for laser start input in the table. Section 9-7, "Important Notes for Restarting the Laser Beam," was added.



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Specifications are subject to change without notice. (09)