OMRON

Z4LC

Parallel Beam Line Sensor

Instruction Manual

OMRON Corporation

Cat. No. SCHA-716

Z4LC Parallel Beam Line Sensor

Instruction Manual

READ AND UNDERSTAND THIS DOCUMENT

Please read and understand this document before using the products. Please consult your OMRON representative if you have any questions or comments.

WARRANTY

OMRON's exclusive warranty is that the products are free from defects in materials and workmanship for a period of one year (or other period if specified) from date of sale by OMRON.

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In no event shall responsibility of OMRON for any act exceed the individual price of the product on which liability is asserted.

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The following are some examples of applications for which particular attention must be given. This is not intended to be an exhaustive list of all possible uses of the products, nor is it intended to imply that the uses listed may be suitable for the products:

- Outdoor use, uses involving potential chemical contamination or electrical interference, or conditions or uses not described in this document.
- Nuclear energy control systems, combustion systems, railroad systems, aviation systems, medical equipment, amusement machines, vehicles, safety equipment, and installations subject to separate industry or government regulations.
- Systems, machines, and equipment that could present a risk to life or property.

Please know and observe all prohibitions of use applicable to the products.
NEVER USE THE PRODUCTS FOR AN APPLICATION INVOLVING SERIOUS RISK

TO LIFE OR PROPERTY WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON PRODUCT IS PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

PERFORMANCE DATA

Performance data given in this document is provided as a guide for the user in determining suitability and does not constitute a warranty. It may represent the result of OMRON's test conditions, and the users must correlate it to actual application requirements. Actual performance is subject to the OMRON Warranty and Limitations of Liability.

CHANGE IN SPECIFICATIONS

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It is our practice to change model numbers when published ratings or features are changed, or when significant construction changes are made. However, some specifications of the product may be changed without any notice. When in doubt, special model numbers may be assigned to fix or establish key specifications for your application on your request. Please consult with your OMRON representative at any time to confirm actual specifications of purchased products.

DIMENSIONS AND WEIGHTS

Dimensions and weights are nominal and are not to be used for manufacturing purposes, even when tolerances are shown.

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Meanings of Signal Words

The following signal words are used in this manual.

⚠ WARNING	Indicates a potentially hazardous situation which, if not avoided, will result in minor or moderate injury, or may result in serious injury or death. Additionally there may be significant property damage.

	Indicates the possibility of laser radiation.

Laser Safety

The Z4LC Parallel Beam Line Sensor, is a Class 1 Laser Product according to EN60825 (IEC825) and JIS C6802 and a Class II Laser Product according to FDA (21 CFR1040.10) (see note). The Z4LC is meant to be built into final system equipment. Pay special attention to the following precautions for the safe use of the product:

Note: Europe: Class 1 of EN60825: 1991 = IEC825: 1984 & IEC825-A1: 1990
Japan: Class 1 of JIS C6802: 1991
U.S.A.: Class II of FDA (21 CFR1040.10)

1. Use this product as specified in this instruction manual. Otherwise, you may be exposed to hazardous laser radiation.
2. Be careful not to expose your eyes directly to the laser radiation or indirectly to laser radiation reflected from mirror or shiny surfaces.
3. To avoid exposure to hazardous laser radiation, do not displace nor remove the protective housing during operation, maintenance, and any other servicing.
4. The user should return the product to OMRON for all repair and servicing.
5. As for other countries, observe the regulations and standards specified by each country.

■ Requirements from Regulations and Standards

Manufacturer's Requirements

EN60825 "Radiation Safety of Laser Products, Equipment Classification, Requirements and User's Guide"

Requirements; Sub-clause	Classification				
	Class 1	Class 2	Class 3A	Class 3B	Class 4
Description of hazard class	Safe inherently by engineering design	Low power; eye protection normally afforded by aversion responses	Same as Class 2. Direct intrabeam viewing with optical aids may be hazardous	Direct intrabeam viewing may be hazardous	High power; diffused reflection may be hazardous

Requirements; Sub-clause	Classification				
	Class 1	Class 2	Class 3A	Class 3B	Class 4
Protective housing	Required for each laser product; limits access necessary for performance of functions of the products				
Safety interlock in protective housing	Designed to prevent removal of the panel until accessible emission values are below the AEL for the class assigned				
Remote control	Not required			Permits easy addition of external interlock in laser installation	
Key control	Not required			Laser inoperative when key is removed	
Emission warning device	Not required			Give audible or visible warning when laser is switched on or if capacitor bank of pulsed laser is being charged	
Attenuator	Not required			Give means beside ON/OFF switch to temporarily block beam	
Location controls	Not required		Controls located so adjustment does not require exposure to AEL above class 1 or 2		
Viewing optics	Emission from all viewing systems must be below Class 1 AEL's as applicable				
Scanning	Scan failure shall not cause product to exceed its classification				
Class label	Required wording	Warning and explanatory labels and specified wording			
Aperture label	Not required			Specified wording required	
Service entry label	Required as appropriate to the class of accessible radiation				
Override interlock label	Required under certain conditions as appropriate to the class of laser used				
User information	Operation manuals must contain instructions for safe use				
Purchasing and service information	Promotion brochures must reproduce classification labels; service manuals must contain safety information				
Medical products	Special calibration instructions required			Special calibration instructions, means for measurement and target-indicator required	
Fibre optic	Cable service connections require tool to disconnect if disconnection breaks protective housing and permits access above Class 1				

With respect to the requirements of remote interlock connector, key control, emission warning and attenuator, Class 3B laser products not exceeding five times the AEL of Class 2 in the wavelength range of 400 to 700 nm are to be treated as Class 3A laser products.

Note: This table is intended to provide a convenient summary of requirements. See text of standard for complete requirements.

JIS C6802 "Radiation Safety Standards for Laser Products"

Requirements; Sub-clause	Classification				
	Class 1	**Class 2**	**Class 3A**	**Class 3B**	**Class 4**
Description of hazard class	Safe inherently by engineering design	Low power; eye protection normally afforded by aversion responses	Same as Class 2. Direct intrabeam viewing with optical aids may be hazardous	Direct intrabeam viewing may be hazardous	High power; diffused reflection may be hazardous
Protective housing	Required for each laser product; limits access necessary for performance of functions of the products				
Safety interlock in protective housing	Designed to prevent removal of the panel until accessible emission values are below the AEL for the class assigned				
Remote control	Not required			Permits easy addition of external interlock in laser installation	
Key control	Not required			Laser inoperative when key is removed	
Emission warning device	Not required			Give audible or visible warning when laser is switched on or if capacitor bank of pulsed laser is being charged	
Attenuator	Not required			Give means beside On/Off switch to temporarily block beam	
Location controls	Not required		Controls located so adjustment does not require exposure to AEL above class 1 or 2		
Viewing optics	Emission from all viewing systems must be below Class 1 AEL's as applicable				
Scanning	Scan failure shall not cause product to exceed its classification				
Class label	Required wording	Warning and explanatory labels and specified wording			
Aperture label	Not required			Specified wording required	
Service entry label	Required as appropriate to the class of accessible radiation				

Require-ments; Sub-clause	Classification				
	Class 1	Class 2	Class 3A	Class 3B	Class 4
Override interlock label	Required under certain conditions as appropriate to the class of laser used				
User information	Operation manuals must contain instructions for safe use				
Purchasing and service information	Promotion brochures must reproduce classification labels; service manuals must contain safety information				
Additional requirements for laser optical fibre transmission system	Cable service connections require tool to disconnect if disconnection breaks protective housing and permits access above Class 1				

With respect to the requirements of remote interlock connector, key control, emission warning and attenuator, Class 3B laser products not exceeding five times the AEL of Class 2 in the wavelength range of 400 to 700 nm are to be treated as Class 3A laser products.

Note: This table is intended to provide a convenient summary of requirements. See text of standard for complete requirements.

FDA (21 CFR1040.10 "Laser Products")

Requirements	Class (see note 1)					
	I	IIa	II	IIIa	IIIb	IV
Performance (all laser products)						
Protective housing	R (see note 2)	R (see note 2)	R (see note 2)	R (see note 2)	R (see note 2)	R (see note 2)
Safety interlock	R (see notes 3, 4)	R (see notes 3, 4)	R (see notes 3, 4)	R (see notes 3, 4)	R (see notes 3, 4)	R (see notes 3, 4)
Location of controls	N/A	R	R		R	R
Viewing optics	R	R	R	R	R	R
Scanning safeguard	R	R	R	R	R	R
Performance (laser systems)						
Remote control connector	N/A	N/A	N/A	N/A	R	R
Key control	N/A	N/A	N/A	N/A	R	R
Emission indicator	N/A	N/A	R	R	R (see note 10)	R (see note 10)
Beam attenuator	N/A	N/A	R	R	R	R
Reset	N/A	N/A	N/A	N/A	N/A	R (see note 13)

Requirements	Class (see note 1)					
	I	IIa	II	IIIa	IIIb	IV
Performance (specific purpose products)						
Medical	S	S	S	S (see note 8)	S (see note 8)	S (see note 8)
Surveying, leveling, alignment	S	S	S	S	NP	NP
Demonstration	S	S	S	S	S (see note 11)	(see note 11)
Labeling (all laser products)						
Certification & identification	R	R	R	R	R	R
Protective housing	D (see note 5)	D (see note 5)	D (see note 5)	D (see note 5)	D (see note 5)	D (see note 5)
Aperture	N/A	N/A	R	R	R	R
Class warning	N/A	R (see note 6)	R (see note 7)	R (see note 9)	R (see note 12)	R (see note 12)
Information (all laser products)						
User information	R	R	R	R	R	R
Product literature	N/A	R	R	R	R	R
Service information	R	R	R	R	R	R

Abbreviations:

R: Required.
N/A: Not applicable.
S: Requirements: Same as for other products of that Class. Also see footnotes.
NP: Not permitted.
D: Depends on level of interior radiation.

Footnotes:

1. Based on highest level accessible during operation.
2. Required wherever & whenever human access to laser radiation above Class I limits is not needed for product to perform its function.
3. Required for protective housings opened during operation or maintenance, if human access thus gained is not always necessary when housing is open.
4. Interlock requirements vary according to Class of internal radiation.
5. Wording depends on level & wavelength of laser radiation within protective housing.
6. Warning statement label.
7. CAUTION logotype.
8. Requires means to measure level of laser radiation intended to irradiate the body.
9. CAUTION if 2.5 mW cm^2 or less, DANGER if greater than 2.5 mW cm^{-2}.
10. Delay required between indication & emission.
11. Variance required for Class IIb or iV demonstration laser products and light shows.
12. DANGER logotype.
13. Required after August 20, 1986.

User's Requirements

EN60825

Require-ments; Sub-clause	Classification				
	Class 1	**Class 2**	**Class 3A**	**Class 3B**	**Class 4**
Remote interlock	Not required			Connect to room or door circuits	
Key control	Not required			Remove key when not in use	
Beam attenuator	Not required			When in use prevents inadvertent exposure	
Emission indicator device	Not required			Indicates laser in energized	
Warning signs	Not required			Follow precautions on warning signs	
Beam path	Not required	Terminate beam at end of useful length			
Specular reflection	No requirements			Prevent unintentional reflections	
Eye protection	No requirements		Required if engineering and administrative procedures not practicable and MPE exceeded		
Protective clothing	No requirements			Sometimes required	Specific requirements
Training	No requirements		Required for all operator and maintenance personnel		

With respect to the requirements of remote interlock connector, key control, beam attenuator, and emission indicator, Class 3B laser products not exceeding five times the AEL of Class 2 in the wavelength range of 400 to 700 nm are to be treated as Class 3A laser products.

Note: This table is intended to provide a convenient summary of requirements. See text of standard for complete precautions.

JIS C6802

Item	Class 1	Class 2	Class 3A	Class 3B		Class 4
				3B*	3B	
Remote interlock	Not required				Connect the remote interlock of the laser beam to the emergency main interlock, the interlock of the room, or the interlock of the door.	
Key control	Not required				Do not keep the key in the lock when the laser beam is not used.	
Beam breaker or attenuator	Not required				Used to protect people from accidental radiation by the laser beam.	
Warning sign	Not required			Post a proper warning sign on the door to the room where laser beam equipment is installed.		
Beam path	Not required	The laser beam must be terminated and, as a rule, must be enclosed. If the laser beam is exposed, the vertical height of the beam must not be the same as that of the eyes.				
Mirror reflection	Not required			Appropriate optical elements must be securely attached and you must be able to control the optical elements during laser radiation.		
Eye protection	Not required				Use eye protectors except in special, specified locations.	
Protection clothes	Not required		Wear protection clothes if exposure of the skin to the laser beam may exceed the MPE of the skin.			
Training	Not required		The laser system must be operated by only properly trained people.			

Note: *Class 3B applies to any laser beam with a power of 5 mW maximum in the visible range of the laser beam.

ANSI Z136.1:1993 "American National Standard for the Safety Use of Lasers"

Control measures	Classification					
Engineering Controls	1	2a	2	3a	3b	4
Protective Housing	X	X	X	X	X	X
Without Protective Housing	LSO shall establish Alternate Controls					
Interlocks on Protective Housing	☆	☆	☆	☆	X	X
Service Access Panel	☆	☆	☆	☆	X	X
Key Control	---	---	---	---	•	X
Viewing Portals	---	---	MPE	MPE	MPE	MPE
Collecting Optics	MPE	MPE	MPE	MPE	MPE	MPE
Totally Open Beam Path	---	---	---	---	X NHZ	X NHZ
Limited Open Beam Path	---	---	---	---	X NHZ	X NHZ
Enclosed Beam Path	None is required if 4.3.1 and 4.3.2 fulfilled					
Remote Interlock Connector	---	---	---	---	•	X
Beam Stop or Attenuator	---	---	---	---	•	X
Activation Warning Systems	---	---	---	---	•	X
Emission Delay	---	---	---	---	---	X
Indoor Laser Controlled Area	---	---	---	---	X NHZ	X NHZ
Class 3b Laser Controlled Area	---	---	---	---	X	---
Class 4 Laser Controlled Area	---	---	---	---	---	X
Laser Outdoor Controls	---	---	---	---	X NHZ	X NHZ
Laser in Navigable Airspace	---	---	---	•	•	•
Temporary Laser Controlled Area	☆ MPE	☆ MPE	☆ MPE	☆ MPE	---	---
Remote Firing & Monitoring	---	---	---	---	---	•
Labels	X	X	X	X	X	X
Area Posting	---	---	---	•	X NHZ	X NHZ

Note: LEGEND
X: Shall
•: Should
---: No requirement
☆: Shall if enclosed Class 3b or Class 4
MPE: Shall if MPE is exceeded
NHZ: Nominal Hazard Zone analysis required

■ Laser Product Classifications

EN/JIS

Class	Description
Class 1	Safe inherently by engineering design.
Class 2	Low power in the visible spectrum (wavelength: 400 to 710 nm); eye protection normally afforded by aversion responses.
Class 3A	Direct intrabeam viewing with optical aids may be hazardous. Power of less than 5 mW max. for visible spectrum. Less than five times the output of the Class 1 for wavelengths other than the visible spectrum.
Class 3B	Direct intrabeam viewing may be hazardous. It is not hazardous to view the pulse laser radiation that does not focus due to scattered reflection and the power that allows safe viewing under certain conditions is less than 0.5 W.
Class 4	High power; diffused reflection may be hazardous and may lead to skin hazards or fire.

FDA/ANSI

Class	FDA definition	ANSI description
Class I/1	Limits applicable to devices that have emissions in the ultraviolet, visible, and infrared spectra, and limits below which biological hazards have not been established.	A Class 1 laser is considered to be incapable of producing damaging radiation levels during operation and maintenance and is, therefore, exempt from any control measures or other forms of surveillance.
Class IIa/2a	Limits applicable to products whose visible emission does not exceed Class I limits for emission durations of 1,000 seconds or less and are not intended for viewing.	Class 2 lasers are divided into two subclasses, 2 and 2a. A Class 2 laser emits in the visible portion of the spectrum (0.4 to 0.7 μm) and eye protection is normally afforded by the aversion response including the blink reflex.
Class II/2	Limits applicable to products that have emissions in the visible spectrum (400 to 710 nm) for emission durations in excess of 0.25 second, providing that emissions for other durations and/or wavelengths do not exceed the Class I limits. Class II products are considered hazardous for direct long-term ocular exposure.	
Class IIIa/3a	Limits to products that have emissions in the visible spectrum and that have beams where the total collectable radiant power does not exceed 5 milliwatts.	Class 3 lasers are divided into two subclasses, 3a and 3b. A Class 3 laser may be hazardous under direct and specular reflection viewing conditions, but the diffuse reflection is usually not a hazard.
Class IIIb/3b	Limits applicable to devices that emit in the ultraviolet, visible, and infrared spectra. Class IIIb products include laser systems ranging from 5 to 500 milliwatts in the visible spectrum. Class IIIb emission levels are ocular hazards for direct exposure throughout the range of the Class, and skin hazards at the higher levels of the Class.	
Class IV/4	Exceeding the limits of Class IIIb and are a hazard for scattered reflection as well as for direct exposure.	A Class 4 laser is a hazard to the eye or skin from the direct beam and sometimes from a diffuse reflection and also can be fire hazard. Class 4 lasers may also produce laser-generated air contaminants and hazardous plasma radiation.

Label Indications

EN

Note: Use of controls, adjustments, or procedures other than those specified herein may result in hazardous radiation exposure.

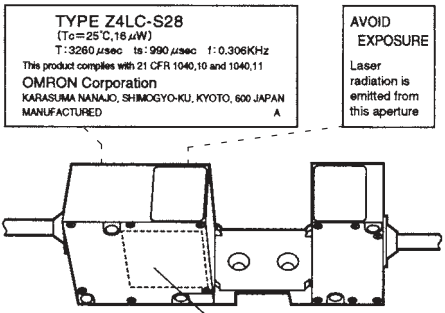
JIS

Note: Use of controls, adjustments, or procedures other than those specified herein may result in hazardous radiation exposure.

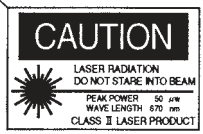
FDA

Certification and Identification Label

Aperture Label



Class II Caution Label Logo Type



Note: Use of controls, adjustments, or procedures other than those specified herein may result in hazardous radiation exposure.

Precautions

(1) Users must operate the product according to the performance and specifications described in the instruction manual.
(2) Do not connect or disconnect the connector between the Sensor and the Controller when the power is turned ON. Connecting or disconnecting while the power is ON could result in damage.

☐ Measurement Accuracy

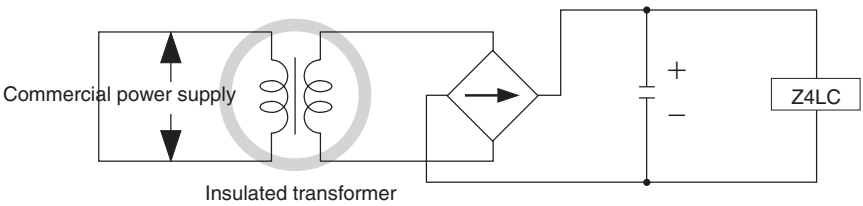
(1) To improve the measurement accuracy, place the object as close as possible to the receiver.
(2) Perform light volume data writing upon installing.

☐ Compatibility

(1) The Sensor or Controller can be used with another controller or sensor. However, the emitter and receiver are adjusted as a set.

☐ Power Supply and Wiring

(1) Do not impose voltage exceeding the rated voltage, otherwise the Sensor may be damaged.
(2) Do not short-circuit the load supplied with open collector output, otherwise the Sensor may be damaged.
(3) Do not lay power supply cable for the Z4LC together with high-voltage lines or power lines to prevent interference, damage, or malfunction.
(4) A Z49-C6 (2 or 8m long) can be connected to the sensor cables or amplifier cables. However, the total length of the sensor cables or amplifier cables must be 10m or less.
(5) Use an insulated transformer for the power supply of the Z4LC as shown in the illustration.



(6) When using a switching regulator, use a FG (Frame ground) terminal as a ground.

☐ Environment

(1) Do not use in strong electromagnetic fields or in environment where the operation of the Sensor is subject to the reflection of intensive light (such as other laser beams or electric ark welding machine).
(2) The Sensor may not detect the object or the resolution may be insufficient depending on the material or shape of objects. (i.e. transparent objects, etc.)
(3) Do not install the Z4LC in locations subject to the following conditions.
Direct vibration or shock / Direct sunlight or heaters / High humidity / Dust, salt, or iron particles / Corrosive or flammable gases / Water, oil, or chemical fumes or spray / Strong magnetic or high-voltage field / Condensation due to rapid temperature fluctuations / Icing due to cold temperature

Maintenance

(1) Be sure to turn OFF the power when making adjustments or removing the Sensor.

(2) Install the Sensor in clean environment and keep the filter on the front panel of the Sensor free from oil and dust. If affected by oil or dust, clean the filter as follows.

- Use a blower brush (used to clean camera lenses) to blow large dust particles from the surface. Do not blow the dust away with your mouth.
- Use a soft cloth (for lenses) with a little alcohol to remove the remaining dust. Do not use a scrubbing action when cleaning as scratches on the filter could result in the Sensor malfunctioning.
- Do not use thinners or benzene. The optical characteristics of a filter may be damaged.

General Precautions

The user must operate the product according to the performance specifications described in the instruction manual.

Before using the product under conditions which are not described in the manual or applying the product to nuclear control systems, railroad systems, aviation systems, vehicles, combustion systems, medical equipment, amusement machines, safety environment, and other systems, machines, and equipment that may have a serious influence on lives and property if used improperly, consult your OMRON representative.

Make sure that the ratings and performance characteristics of the product are sufficient to the systems, machines, and equipment, and be sure to provide the systems, machines, and equipment with double safety mechanisms.

Contents

1

Installation

This section describes features, functions, menu configuration and installation.

1.1 Features / Principle

■ Features

・Suitable for applications such as size discrimination, positioning, pin pitch inspection, etc.

→ 1-dimensional CCD line sensor is adopted for receiver elements

・Compact body and easy measurement

・Easy-to-see LED display and discrimination output

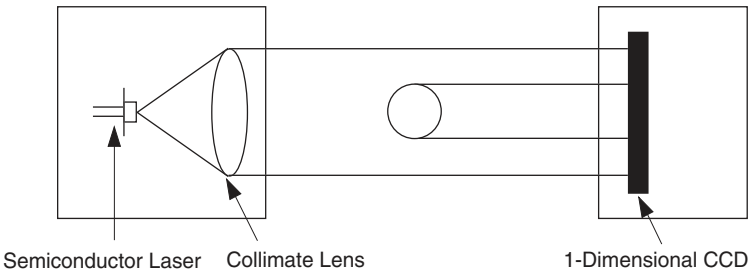
→ 7-segment LED display, 3-level discrimination output

・The outputs can be connected with a variety of devices.

→ 4 to 20mA output, 12-bit binary output, RS-232C output

■ Measurement Principle

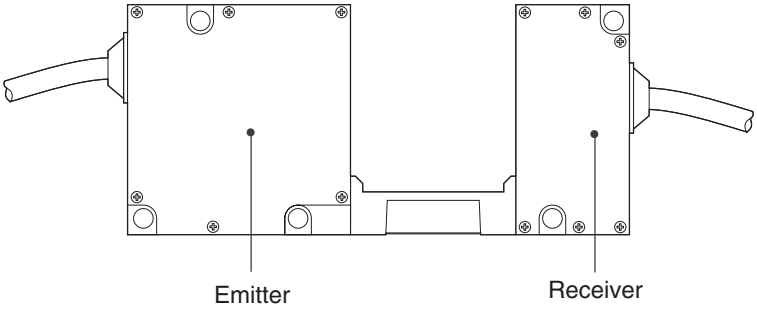
A collimate lens transforms the laser beam emitted from visible-light semiconductor laser into parallel beam. Sensing objects interrupt the beam and create dark in proportion to the size of the object. Receiver elements, 1-dimensional CCD line sensor, receive the size and the position of the dark. They are calculated and measured as the size and the position of the sensing objects.



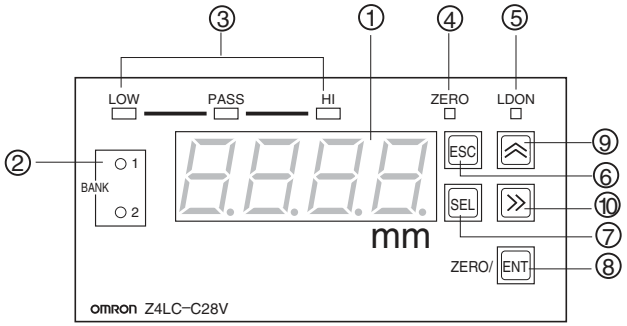
1.2 Nomenclature

The Z4LC consists of a sensor and a controller.

■ Sensor



■ Controller



● Front Panel

① Display

Displays output values while measuring. Also, error messages will be displayed when errors occur. Menus, parameter items and setting values are displayed while operating setting menus.

②Bank No.LED

The selected bank number will be lit.

③ Discrimination LED

Displays discrimination results by 3 levels.

④ ZERO LED

Lit when forced zero function is effective in normal measurement mode.

⑤ LDON LED

Lit while laser emission.

⑥ ESC Key

A key to cancel the operation and go back to the last display.

⑦ SEL Key

A key to select a menu.

⑧ ZERO / ENT Keys

・ZERO:In measurement mode

Switches Forced Zero Function ON/OFF.

Refer to “4.3 Forced Zero Function” in page 77 for details.

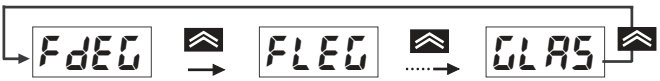
・ENT: In setting mode or maintenance mode

A key to confirm the change of settings. After pressed, the next menu will appear.

⑨ Value Setting Key

A key to change setting.

・Used when selecting parameter items from the menu.

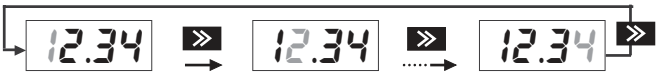


・Used when changing the setting value.

⑩Digit Key

A key to change setting.

・Used when selecting the digit to be changed.



1.3 Measurement Procedure

STEP 1 Installation

Install the Sensor and the Controller.

Refer to Page 6 "1.4 Installation"

STEP 2 Connections and Wiring

Connect each connector and cable.

Refer to Page 8 "1.5 Connections"

STEP 3 Turning on Power

Turn on power.

Refer to Page 15 "1.7 Turning on Power"

STEP 4 Setting Operation Conditions

Set light volume data writing, binary level, etc. when starting to use or reinstalling the Z4LC .

Refer to Page 25 "Section 2 Maintenance Mode"

STEP 5 Setting Measurement Conditions, Output Conditions and Communication Conditions

Set measurement conditions, discrimination values and communication conditions.

Refer to Page 39 "Section 3 Setting Mode"

STEP 6 Starting Measurements

Start measurements in normal measurement mode under the conditions being set.

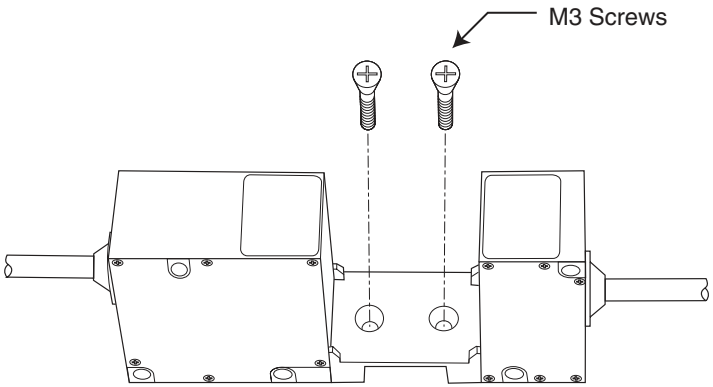
Refer to Page 73
"Section 4 Normal Measurement Mode"

1.4 Installation

⚠ Caution

Do not touch optical filters of the Sensor. If stained with finger prints, etc., measurements may not be performed correctly. When touch them accidentally, clean with a soft cloth.

1 Sensor Installation



■ Z4LC-S2840

There are two mounting holes on the bracket between the receiver and emitter. Secure the Sensor with screws. When installing, the head of screws should not enter to the beam.

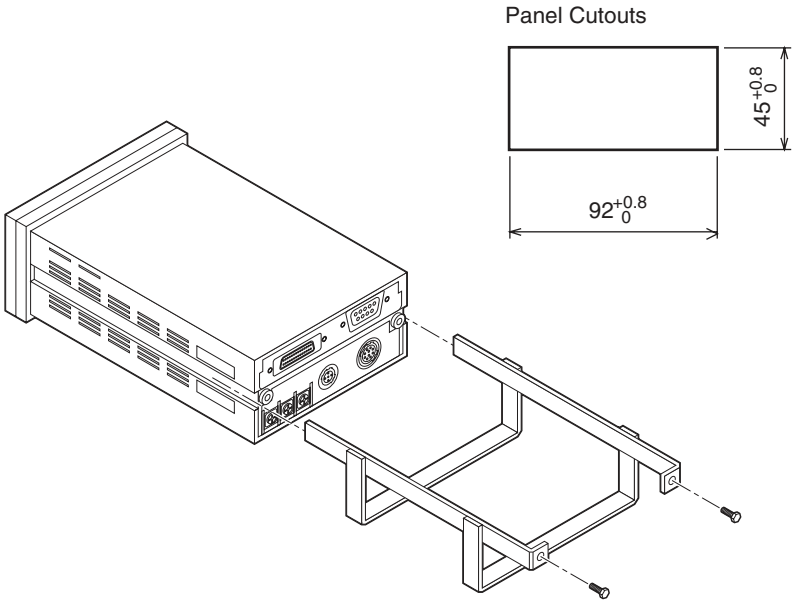
■ Z4LC-S28

In the case of Z4LC-S28, which is an emitter/receiver separable type, install for the tolerance of light path to be 0.5 mm or under.

Notes

After installation, make sure to perform Page 26 “2.1 Light Volume Data Writing”.

2 Controller Installation



- The recommended panel thickness is 1 to 3.2 mm.
- Attach the mounting brackets to the Controller from behind and tighten the mounting screws of the brackets to a torque of 0.49 N·m (5 Kgf·cm).

Notes

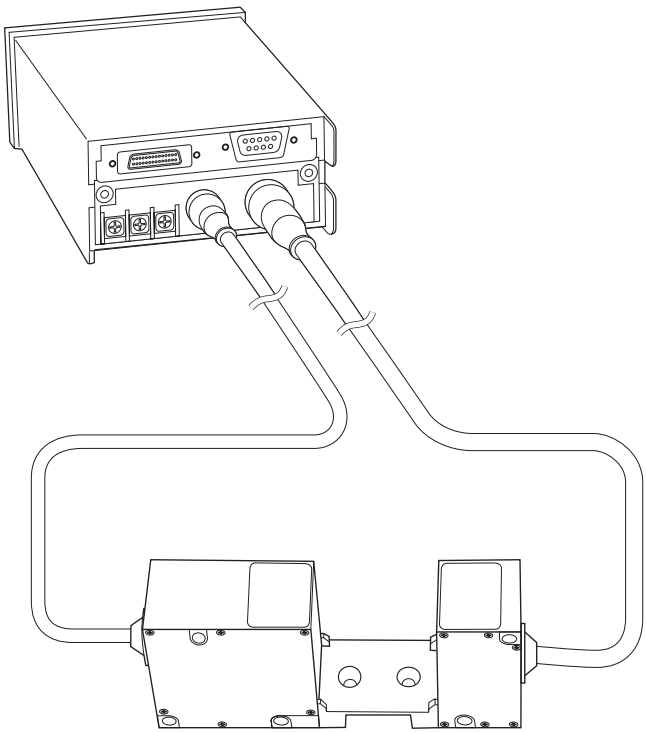
Mounting brackets are attached to the Controller when shipped.

1.5 Connections

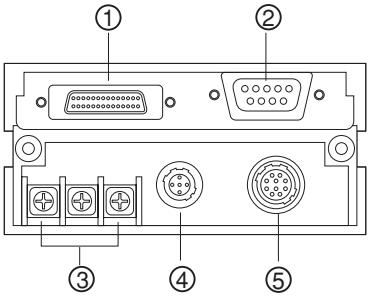
Connect connectors, etc. after completing the installation of the Sensor and the Controller.

Operation

1. Connect the connector cable out from the emitter and receiver to the back side of the controller.
2. Connect the output cable to the 28-pin connector.
3. Connect the communication cable to the D-sub 9-pin connector.
4. Connect power supply to the terminal block.



■ Connector / Terminal Block



① 28-pin connector (for I/O)
② D-sub 9-pin connector (for communication)
③ Terminal block (for power supply)
④ Emitter connector
⑤ Receiver connector

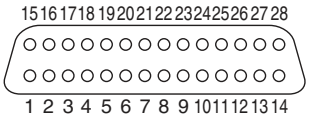
1.6 Input / Output Specifications

1 28-Pin Connector

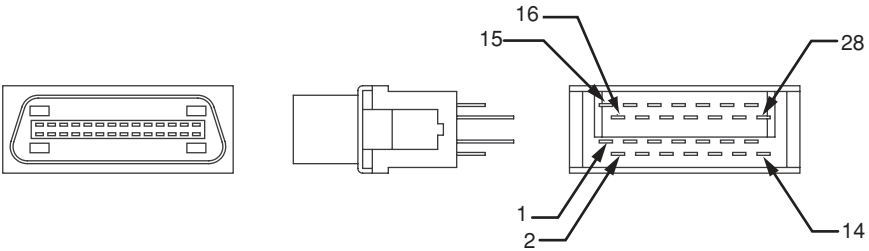
Used to input operation control signals and output measurement results.

I/O	Signals	Specifications
Input signals	Enable input ($\overline{\text{ENABLE}}$) LD OFF input ($\overline{\text{LD-OFF}}$) Bank switch input ($\overline{\text{BANK}}$) Forced zero input ($\overline{\text{ZERO}}$) External reset input ($\overline{\text{EXRESET}}$)	Photocoupler input Input voltage : 12 to 24 VDC ± 10% ON voltage : 10.2 VDC min. OFF voltage : 3.0 VDC max. Input current : 10 mA (Typ.)
Output signals	Discrimination output ($\overline{\text{HI}}$, $\overline{\text{PASS}}$, $\overline{\text{LO}}$) Error output ($\overline{\text{ERR}}$)	NPN open collector output 30 VDC 20 mA max. Residual voltage 2 V max.
Binary data output	$\overline{\text{D0}}$ to $\overline{\text{D11}}$, $\overline{\text{STB}}$	NPN open collector output 30 VDC 20 mA max. Residual voltage 2 V max.
Linear output	Linear output Linear output GND	4 to 20 mA Load impedance 300 Ω max.

■ Pin Shape



■ Applicable Connectors



● Pin No. and Signals

Pin No.	I/O	Signals	Pin No.	I/O	Signals
1	O	Output COM	15	O	Output COM
2	O	$\overline{\text{D0}}$ (LSB)	16	O	$\overline{\text{D1}}$
3	O	$\overline{\text{D2}}$	17	O	$\overline{\text{D3}}$
4	O	$\overline{\text{D4}}$	18	O	$\overline{\text{D5}}$
5	O	$\overline{\text{D6}}$	19	O	$\overline{\text{D7}}$
6	O	$\overline{\text{D8}}$	20	O	$\overline{\text{D9}}$
7	O	$\overline{\text{D10}}$	21	O	$\overline{\text{D11}}$ (MSB)
8	O	$\overline{\text{STB}}$	22	O	$\overline{\text{HI}}$
9	O	$\overline{\text{PASS}}$	23	O	$\overline{\text{LOW}}$
10	O	$\overline{\text{ERR}}$	24	I	$\overline{\text{LD-OFF}}$
11	I	$\overline{\text{ZERO}}$	25	I	$\overline{\text{BANK}}$
12	I	$\overline{\text{ENABLE}}$	26	I	$\overline{\text{EXRESET}}$
13	I	Input COM	27	I	Input COM
14	O	Linear Output GND	28	O	Linear Output

■ Input Signals

· Enable Input ($\overline{\text{ENABLE}}$) :

When voltage is imposed on the terminal while enable input is ON, the measurement value is displayed and output in the mode being set.

· LD OFF Input ($\overline{\text{LD-OFF}}$):

When voltage is imposed on the terminal, laser diode (LD) stops laser emission and [LdoF] is displayed. Binary data output is fixed to OFF, error output ON, and linear output 4 mA.

· Bank Switch Input ($\overline{\text{BANK}}$):

The Bank No. is 1 if voltage is not imposed on the terminal and the Bank No. is 2 if it is imposed on the terminal when the bank setting input is set to [rERr].

· Forced Zero Input ($\overline{\text{ZERO}}$):

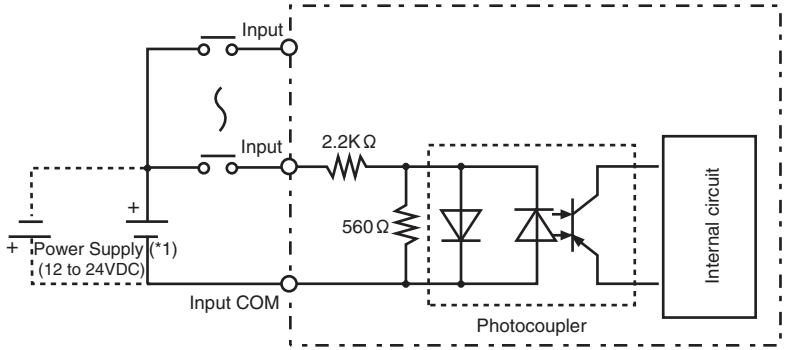
When voltage is imposed on the terminal, Forced Zero ON/OFF is switched.

· External Reset Input ($\overline{\text{EXRESET}}$):

When voltage is imposed on the terminal, the Sensor will be reset.

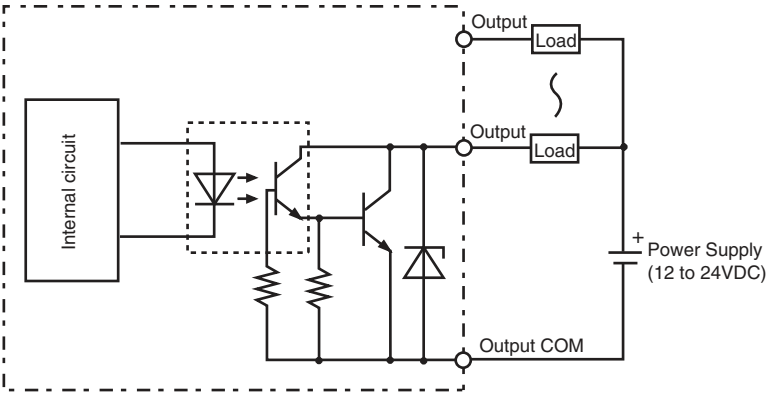
■ Input / Output Circuit

● Input Circuit



*1 There is no need to be concerned about the polarity of power supply.

● Output Circuit



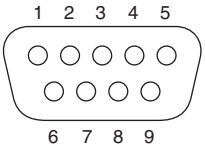
2 D-sub 9-pin Connector

Used for RS-232C communication.

■ Communications Specifications

Electric Characteristics	RS-232C	Default Setting
Synchronization	Stop-start (asynchronous)	-
Baud Rate	1200, 2400, 4800, 9600, 19200 bps	9600 bps
Data Length	7, 8-bit ASCII	8 bit
Parity	Even, Odd, None	Even
Stop Bit	1-bit, 2-bit	1 bit
Header / Footer	CR, CR+LF, STX+ETX	STX+ETX

■ Pin Shape



● Pin No. and Signals

Pin No.	Signals	Description	I/O
1	—	—	—
2	RD	Receiving Data	I
3	SD	Sending Data	O
4	—	—	—
5	SG	Signal Ground	—
6	—	—	—
7	—	—	—
8	—	—	—
9	—	—	—

· Pins ④ and ⑥, ⑦ and ⑧ are respectively connected internally.

■ Connection Examples

Z4LC-C28

Signals	Pin No.
-	1
RD	2
SD	3
-	4
SG	5
-	6
-	7
-	8
-	9

CQM1

Pin No.	Signals
1	FG
2	SD
3	RD
4	RS
5	CS
6	
7	
8	
9	SG

Connection cables
OMRON
XW2Z-200S-V (2m)
XW2Z-500S-V (5m)

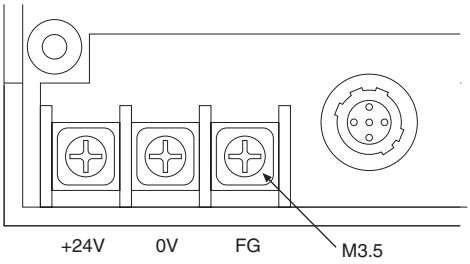
3 Terminal Block

Used for power supply.

■ Power Supply Specifications

Power supply voltage	24 VDC +10% -15%
Current consumption	0.4 A max.

■ Pin Shape



1.7 Turning on Power

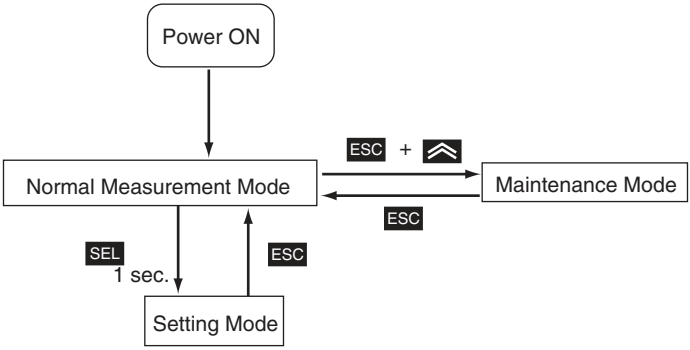
Turn on the power once you finish connecting the Sensor and the Controller and each input/output terminal. The operation check starts for 5 seconds upon turning on the power. The below display will appear on a front panel during the operation check.

The measurement value will be displayed if no errors are found in the operation check. Refer to page 91 “Section 5 Error Displays and Error Codes” if any error code is displayed.

1.8 Menu Configuration

This section describes the menu configuration, key operations to switch displays and reference pages in this manual.

1 Menu Contents



■ Maintenance Mode

Operation conditions (i.e. binary level, protection, back up, etc.) can be set when starting operation or reinstalling. Also, used to reset setting values to default settings.

■ Setting Mode

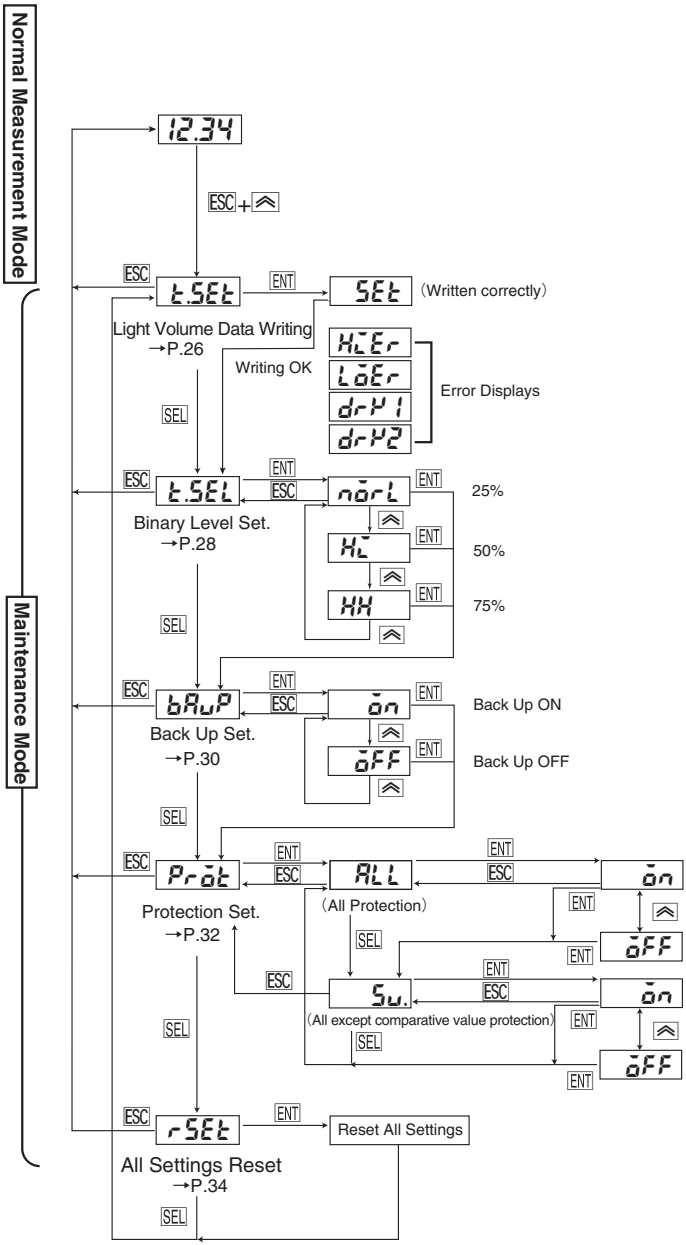
Measurement conditions, discrimination conditions and communication conditions can be set.

■ Normal Measurement Mode

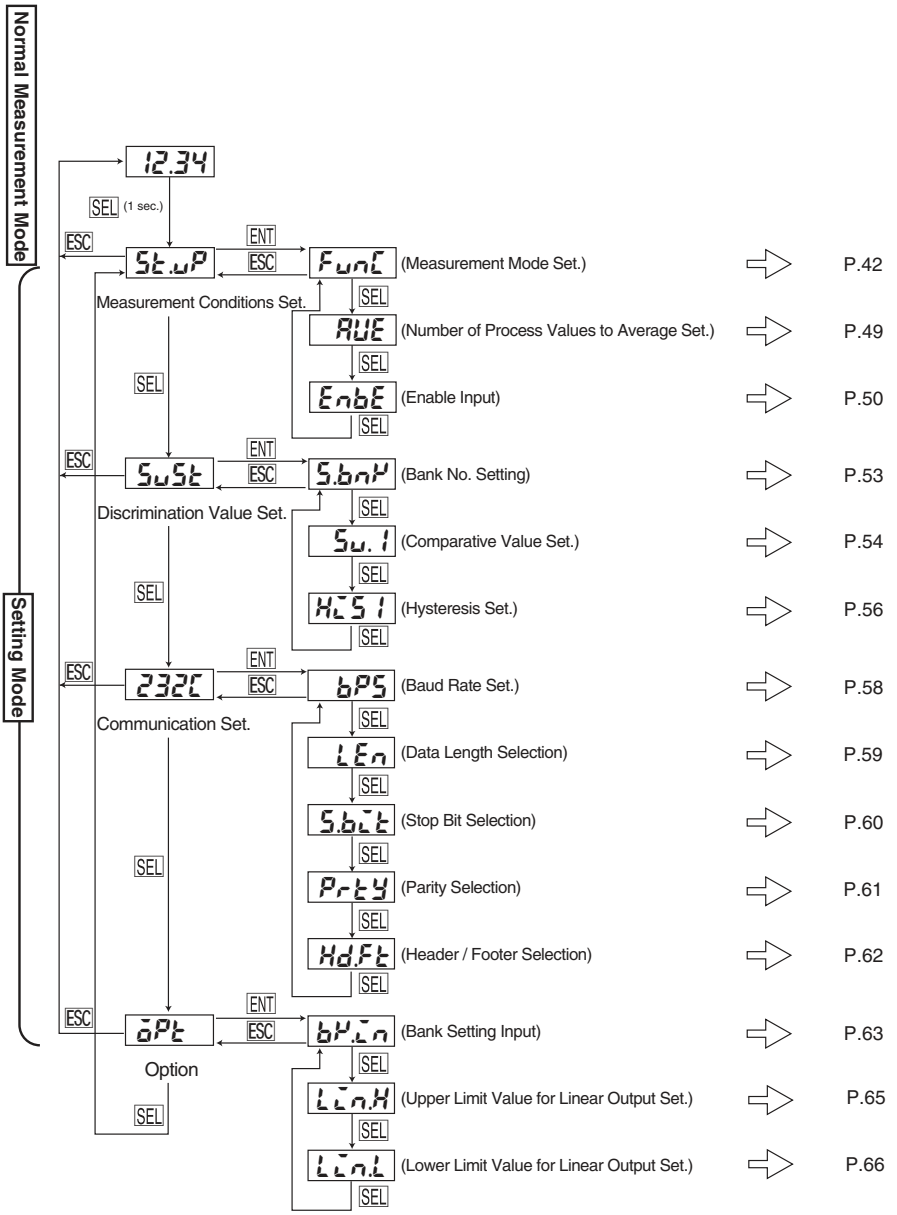
Measurements are performed under the conditions being set in maintenance mode or setting mode.

2 Menu Tree

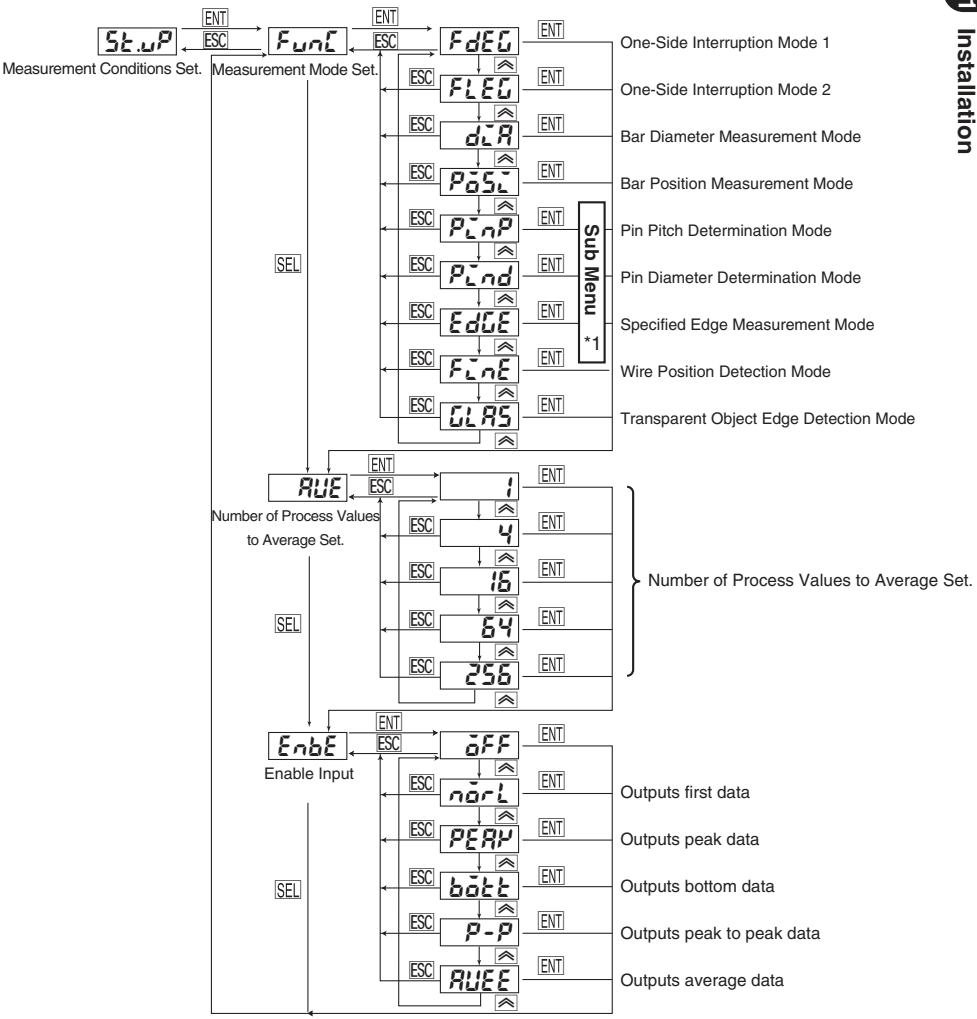
■ Maintenance Mode



■ Setting Mode

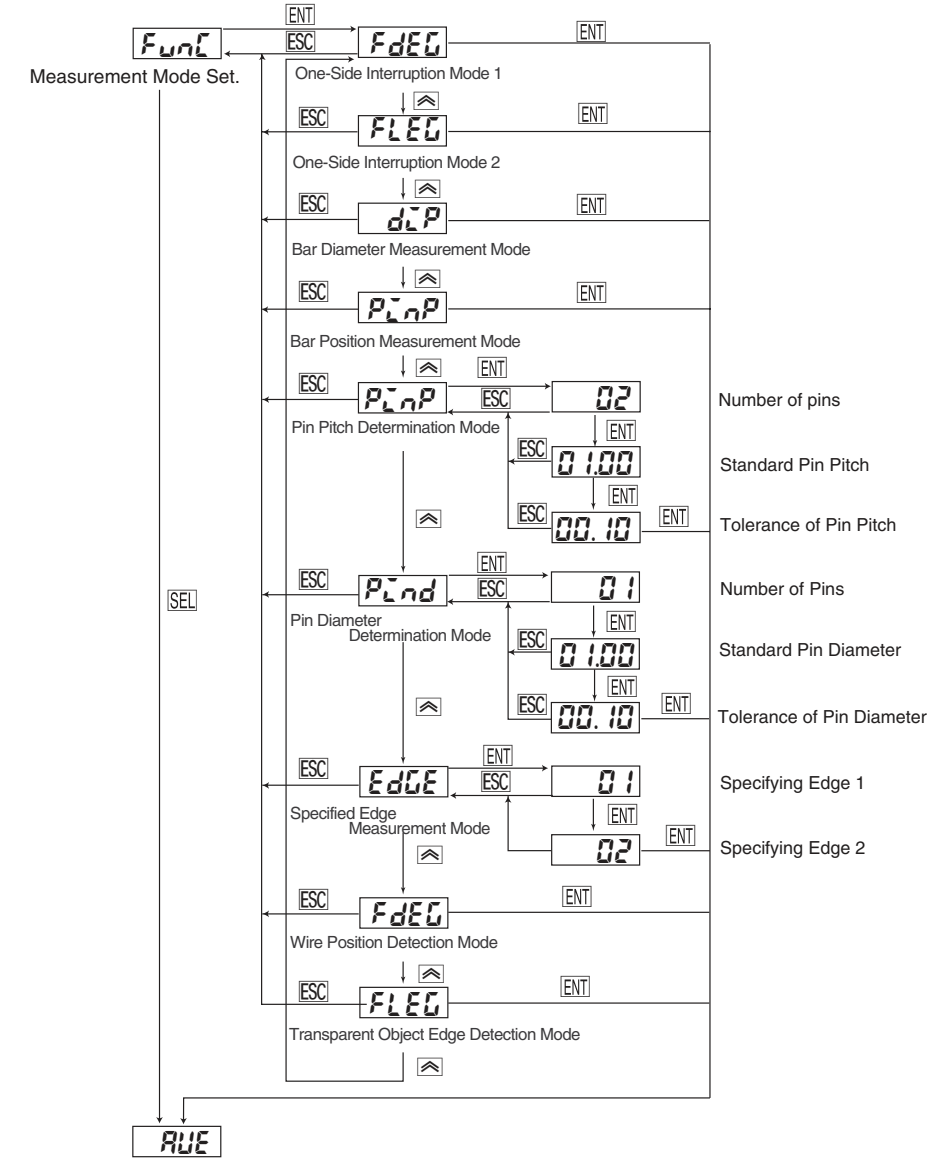


● Measurement Conditions Setting Mode

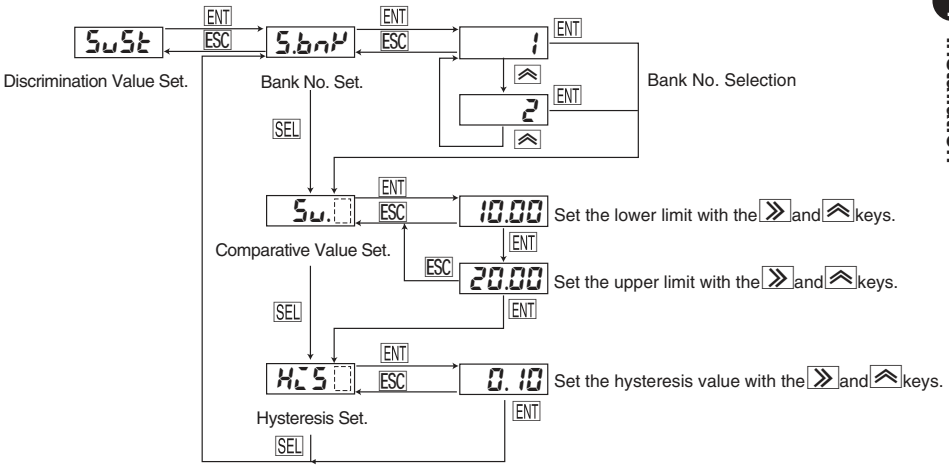


* 1 Refer to Page 20 for the details of the sub menu.

・Sub-Menu

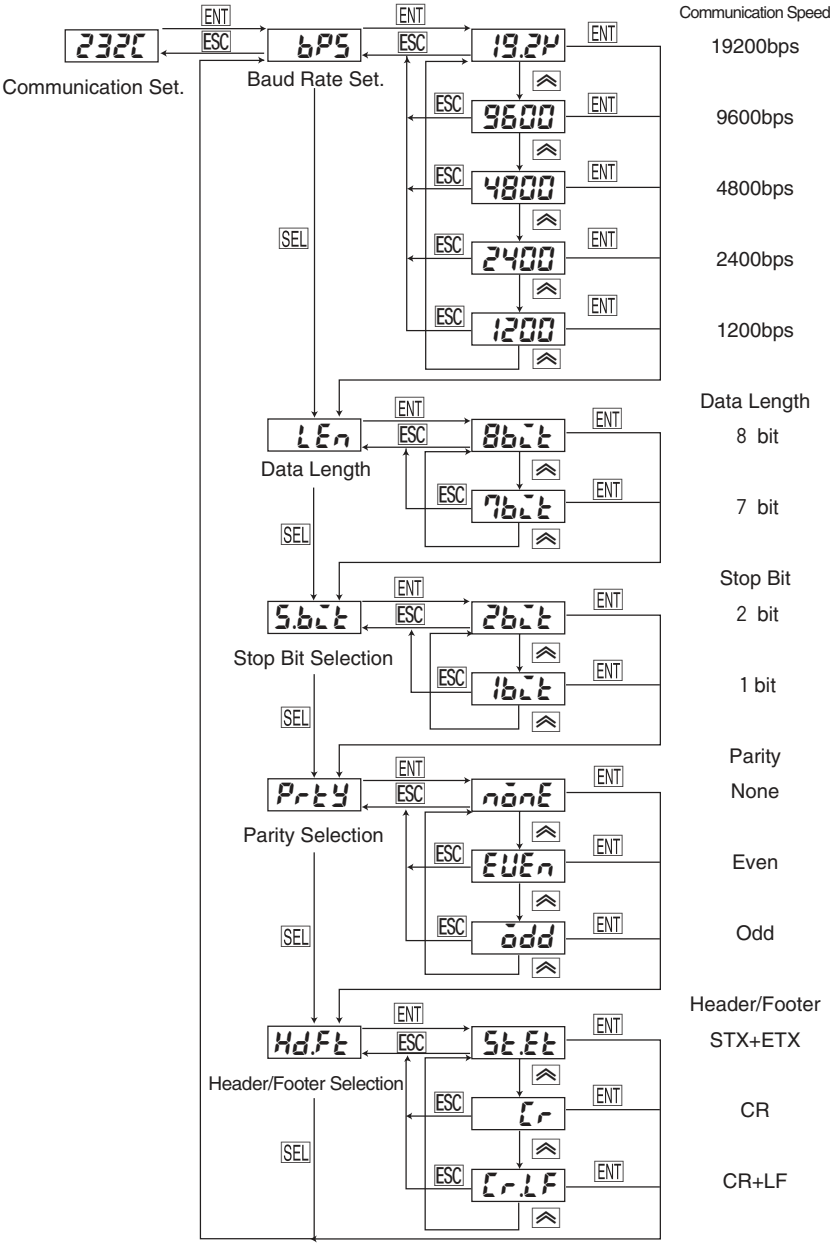

ENT
ESC
FunC
FdEG
Measurement Mode Set.
One-Side Interruption Mode 1
FLEG
One-Side Interruption Mode 2
dCP
Bar Diameter Measurement Mode
PCnP
Bar Position Measurement Mode
PCnP
02
Number of pins
Pin Pitch Determination Mode
01.00
Standard Pin Pitch
00.10
Tolerance of Pin Pitch
PCnd
01
Number of Pins
Pin Diameter
Determination Mode
01.00
Standard Pin Diameter
00.10
Tolerance of Pin Diameter
EdGE
01
Specifying Edge 1
Specified Edge
Measurement Mode
02
Specifying Edge 2
FdEG
Wire Position Detection Mode
FLEG
Transparent Object Edge Detection Mode
SEL
AVE
Number of Process Values to Average Set.

● Discrimination Value Setting Menu

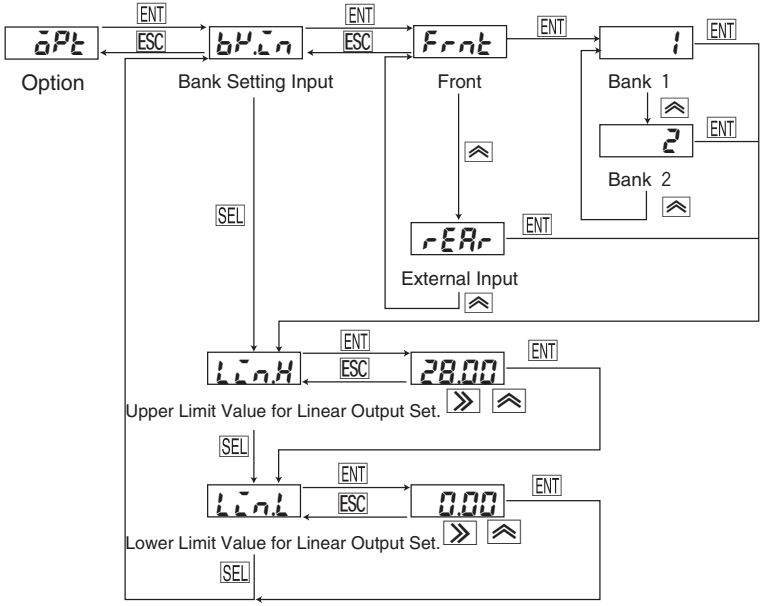


The selected Bank No. is displayed in [ ].

● Communication Setting Menu



● Optional Menu



MEMO

2

Maintenance Mode

This section describes operation conditions to set when starting operation or reinstalling.

2.1 Light Volume Data Writing

For the precious measurement, perform light volume data writing upon installing the Sensor.

Operation

1 Press ESC and ^ simultaneously while in normal measurement mode to go to maintenance mode.

(Normal measurement mode) (Light volume data writing)

2 Press ENT.

If the correct light volume data are obtained, the below display SEt will appear and the data are written to the internal memory for approx. 3 sec.

When completing the processing, binary level setting in the next menu will appear automatically.

(Light volume data writing) (Set) (Binary level set.)

■ When the correct light volume data are not obtained:

When the correct light volume data are not obtained in the operation 2, the following error code is displayed. After taking the proper measure, press SEL to display E. SET and repeat the operation until SET will appear.

Display	Cause	Remedy
Err 1 (Error 1)	Excessive external light interference	Change the place to install the receiver or place a shield to prevent external light interference.
Err2 (Error 2)	Dirt or obstacle on the emitter or receiver	Clean the optical filter of the emitter and receiver with soft cloth (lens cleaner, etc.).
drY1 (Dark 1)	Insufficient light	Place the emitter and receiver closer.
drY2 (Dark 2)	Dirt or obstacle on the emitter or receiver	Clean the emitter and receiver, Remove the obstacle.
HiEr (High error)	Position displacement	Move up the emitter.
LoEr (Low error)	Position displacement	Move down the emitter.
LdoF (Laser off)	LD OFF input is ON	Release LD OFF.

Notes

In light volume data writing after Error 5 is occurred, E. SET will appear following SET. Press ESC to switch to measurement mode.

2.2 Binary Level Setting

Set the binary level according to the light permeation level of the sensing object.

Binary level	Sensing object
Normal (25%) (*1)	Opaque
Hi (50%)	Transparent (*2)
HH (75%)	Transparent (*2)

(*1)When the measurement mode is "Wire Position Detection Mode" or "Transparent Object Edge Detection Mode", binary level is automatically set to 50% even if set to Normal (25%) .

(*2) Binary level for stable measurement varies depending on the characteristics of sensing objects. It is recommended to confirm the conditions of edge detection by using the communication command [e].

Operation

1 Select binary level setting in maintenance mode.

(Normal measurement mode) (Light volume data writing) (Binary level set.)

2 Press ENT.

The current binary level will be displayed.

(Light volume data writing) (Normal: 25%)

3 Every time is pressed, the binary level is switched. Select the binary level to use and press ENT.

It will be saved and back up setting will appear.

(Normal: 25%) (High: 50%) (HH: 75%) (Back up set.)

Notes

1. Use 25% for normal measurements. Select 50% or 75% only when undetectable with 25%. When 50% or 75% is selected, the repeatability stated in the catalog or instruction manual may not be obtained.

2. When 50% or 75% is selected, the condition of edge detection may be different from that of 25%. In case of unusual measurement results, confirm the condition of edge detection by the communication command [e].

■ Confirming binary level setting

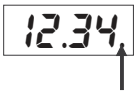
During measurement, the binary level setting can be confirmed with the decimal display on a front panel.

【e.g.】 When the measurement result is 12.34:

① Binary Level: 25%

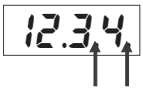
Normal Display

② Binary Level: 50%



The first right decimal will flash.

③ Binary Level: 75%



The first and second right decimals will flash.

2.3 Back Up Setting

When measurement conditions (i.e. measurement mode, comparative value, forced zero, etc.) are set, those setting data are stored in the internal non-volatile memory (EEPROM) as back up data. The number that the EEPROM can be overwritten is restricted. For the measurement conditions to be changed frequently, set the conditions with back up function OFF. (The EEPROM can be overwritten approximately 1 million times.)

Operation

1 Select back up setting in maintenance mode.

(Normal measurement mode) (Light volume data writing) (Binary level set.) (Back up set.)

2 Press ENT.

The current back up setting will be displayed.

(Back up set.) (Back up: ON)

3 Every time ^ is pressed, ON/OFF are switched. Select ON or OFF and then press ENT.

It will be saved and protection setting will appear.

(Back up: ON) (Back up: OFF) (Protection set.)

Notes

Measurement conditions can be changed using a front panel or communication while back up function OFF, but the settings are not stored in EEPROM. Therefore, the measurement conditions immediately after turning on power are the setting just before back up function is turned OFF. The setting of back up ON/OFF is stored in EEPROM so that back up OFF is effective upon turning on power if back up OFF is set. Some settings are always backed up regardless of back up function ON/OFF.

(Back up ON/OFF can be set.)

Bank No., High/Low Comparative Values, Hysteresis, Measurement Mode, Bank Setting Input Selection, Enable Input Selection, Communication (Baud Rate etc.), Number of Process Values to Average, Linear Output Measurement H/L, Setting for Pin Pitch Determination, Setting for Pin Diameter Determination, Specified Edge 1/2, Binary Level Setting, and Forced Zero Function

(Always backed up)

Light Volume Data Writing, Protection Setting, and Back Up Setting

Point

In case of changing the measurement conditions very often, set as follows:

【e.g.】 A reference sample object and the tolerance are often changed when measuring bar diameter.

1. Set the back up function to ON in back up setting in maintenance mode. (The default setting is back up function ON.)
2. Set the measurement mode to bar diameter measurement mode and also set the necessary measurement conditions (i.e. communication, bank, etc.). In this setting, set the items which are not to be changed often.
3. Set the back up function to OFF in back up setting in maintenance mode.
4. Start measurement. The measurement conditions can be changed using a front panel or communication, but not stored in EEPROM.
5. Turn ON power. The measurement starts with the conditions being set in the operation 2.

■ Displays when back up setting and measurement conditions are changed.

When changing measurement conditions on a front panel, the display differs depending on back up function ON or OFF. When measurement conditions are changed and ENT is pressed, the LED indicator will be lit once and the next display will appear when back up function is ON. When back up function is OFF, the next display will appear without the LED lit.

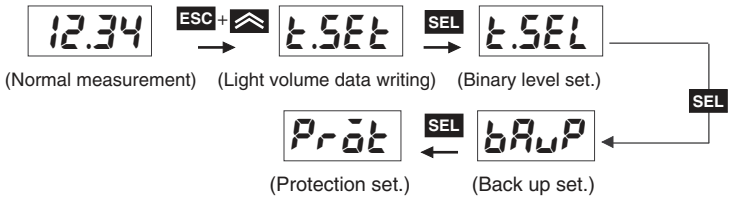
2.4 Protection Setting

Protects the setting values or internal data against unexpected front panel operations. However, communication commands by RS-232C can not be protected.
There are two parameters for protection setting. Once the setting is turned ON, the menu will disappear.

Display	Items to be protected
ALL (All protection)	All menus are prohibited to change. When the protection setting is turned OFF, key operations become effective.
Su. (All except comparative value protection)	Only the comparative value setting in discrimination value setting menu and forced zero function can be operated. Other menus are prohibited to change. When the protection setting is turned OFF, key operations become effective.

Operation

1 Select protection setting in maintenance mode.

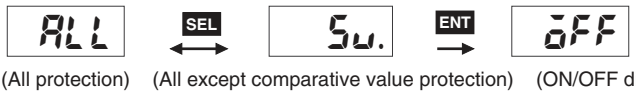


2 Press ENT.

The protection setting items will be displayed.

3 Every time SEL is pressed, the protection item will be switched. Select the protection item and press ENT.

ON/OFF setting will appear.



4 Every time [^] is pressed, ON/OFF will be switched. Select ON or OFF, then press [ENT].

It will be saved and the protection item in the next menu will appear. (The following is displayed when “All protection” is selected.)

(OFF) (ON) (All except comparative value protection)

5 Press [ESC] to go back to protection setting.

(All except comparative value protection) (Protection set.)

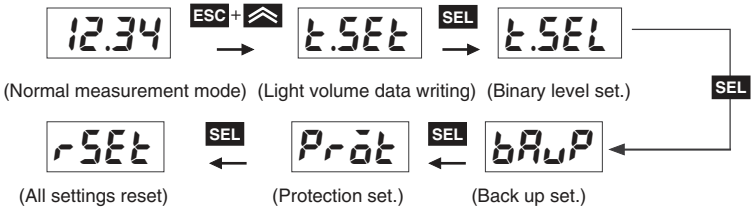
Notes All except comparative value protection is effective only when “All protection” is turned OFF.

2.5 All Settings Reset

Resets parameters being set in setting mode or maintenance mode to the default settings.

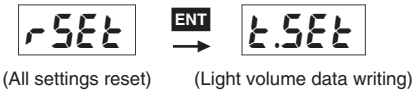
Operation

1 The display is switched from protection setting to all settings reset.



2 All settings will be reset when ENT is pressed while “rset” is displayed.

The next menu will appear.



Notes

Light volume data can not be reset.

■ Default Settings

	Setting Parameters	Settings
Maintenance Mode	All protection	oFF (released)
	All except comparative value protection	oFF (released)
	Binary level setting	25% (Normal)
	Back up setting	Back up function ON
Setting Mode	Bank No.	1
	H comparative value	20 (for Bank No. 1 and 2)
	L comparative value	10 (for Bank No. 1 and 2)
	Hysteresis	0.10 mm (for Bank No. 1 and 2)
	Measurement mode	diA (Bar diameter measurement mode)
	Bank setting input selection	Frnt (front)
	ENABLE input selection	oFF (not used)
	Baud rate	9600 bps
	Data bit length	8 bit
	Stop bit length	1 bit
	Parity	EVEn (even numbers)
	Header	STX
	Footer	ETX
	Number of process values to average	16
	Upper limit value for linear output	28.00 mm
	Lower limit value for linear output	0.00 mm
	Number of pins (for pin pitch determination)	2
	Standard pin pitch (for pin pitch determination)	1.00 mm
	Tolerance of pin pitch (for pin pitch determination)	0.10 mm
	Number of pins (for pin diameter determination)	1
	Standard pin diameter (for pin diameter determination)	1.00 mm
	Tolerance of pin pitch (for pin diameter determination)	0.10 mm
	Specified edge 1	1
	Specified edge 2	2
Normal Measurement Mode	Forced zero function	Forced zero function OFF

2.6 Operation and Setting by Communication

"Light Volume Data Writing" and "All Settings Reset" can be performed by RS-232C communication. Also, the setting conditions for binary level setting and back up setting can be confirmed.

1 Operation by Communication

When the codes in the below table are received, light volume data writing and all settings reset are performed.

【e.g. 1】 Header: STX, Footer: ETX **Light volume data writing**
(STX)(T)(ETX)

【e.g. 2】 Header: None, Footer: CR+LF **All settings reset**
(r)(CR)(LF)

When each code is received correctly, operation starts immediately after sending "OK". When received incorrectly, error codes will be sent. Refer to "Section 5. Error Displays and Error Codes" in page 91.

【e.g. 1】 Header: None, Footer: CR+LF **Set correctly**
(O)(K)(CR)(LF)

【e.g. 2】 Header: None, Footer: CR **Receiving codes error**
(N)(G)(CR)

■ Maintenance Operation Codes

The following receiving codes indicate commands in the upper section and ASCII codes in the lower section.

*The header and footer being set are to be attached to all codes.

Function	Receiving code	Setting
Light Volume Data Writing	_ _ _ _ _ _T_ _ _ _ _ _ 54h	Writing light volume data
All Settings Reset	_ _ _ _ _ _r_ _ _ _ _ _ 72h	Reset all parameters to default settings.

2 Setting by Communication

When the codes in the below table are received, binary level and back up are to be set.

【e.g.】 Header: STX, Footer: ETX Setting binary level to Normal (25%)
(STX)(t)(1)(ETX)

When each code is received correctly, operation starts immediately after sending “OK”. When the setting has not been changed correctly, error codes will be sent. Refer to “Section 5. Error Displays and Error Messages” in page 91.

【e.g. 1】 Header: None, Footer: CR+LF Set correctly
(O)(K)(CR)(LF)

【e.g. 2】 Header: None, Footer: CR Receiving codes error
(N)(G)(CR)

【e.g. 3】 Header: STX, Footer: ETX Communication parameter error
(STX)(E)(r)(r)(4)(ETX)

■ Codes for Setting

The following receiving codes indicate commands in the upper section and ASCII codes in the lower section.

*The header and footer being set are to be attached to all codes.

Function	Receiving code	Setting
Binary Level Setting	t1 74h 31h	Binary level Normal (25%)
	t2 74h 32h	Binary level Hi (50%)
	t3 74h 33h	Binary level HH (75%)
Back Up Setting	X1 58h 31h	Back up function ON
	X2 58h 32h	Back up function OFF

3 Confirming by Communication

When the codes in the below table are received, the data in accordance with the setting conditions for binary level setting or back up setting are sent.

【e.g.】Header: None, Footer: CR Binary level Hi (50%)

Receiving codes: (R)(t)(CR)

Sending codes: (2)(CR)

■ Codes to Confirm Settings

The following receiving codes indicate commands in the upper section and ASCII codes in the lower section.

* The header and footer being set are to be attached to all codes.

Function	Receiving code	Setting	Response
Binary level setting	Rt 52h 74h	25%	(header) 1 (footer)
		50%	(header) 2 (footer)
		75%	(header) 3 (footer)
Back up setting	RX 52h 58h	Back up function ON	(header) 1 (footer)
		Back up function OFF	(header) 2 (footer)

3

Setting Mode

This section describes the setting for measurement conditions, output conditions and communication conditions.

3.1 Measurement Conditions Setting

1 Measurement Mode Setting

Sets the proper measurement mode for the application. There are nine modes available as following.

1 .Measurement Mode

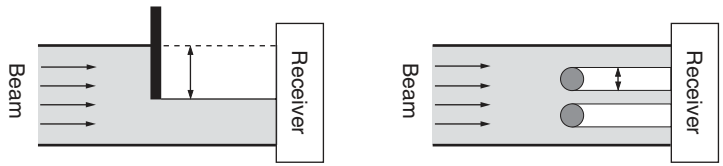
(1)	FdEG	First dark edge	One-side Interruption Mode 1
(2)	FLEG	First light edge	One-side Interruption Mode 2
(3)	dIA	Diameter	Bar Diameter Measurement Mode
(4)	POSI	Position	Bar Position Measurement Mode
(5)	PInP	Pin Pitch	Pin Pitch Determination Mode
(6)	PInd	Pin Diameter	Pin Diameter Determination Mode
(7)	EdGE	Edge	Specified Edge Measurement Mode
(8)	FInE	Fine line	Wire Position Detection Mode
(9)	GLAS	Glass	Transparent Object Edge Detection Mode

There are sub menus to be set for (5), (6) and (7).

2. Explanation of Each Mode

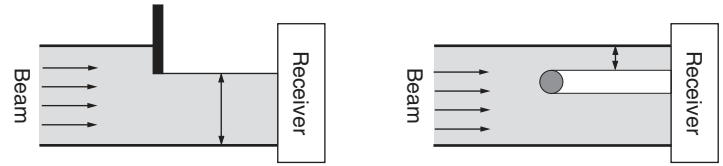
(1) One-side Interruption Mode 1 (First Dark Edge) FdEG

Measures the width from the edge of the beam to the end of the first dark section.



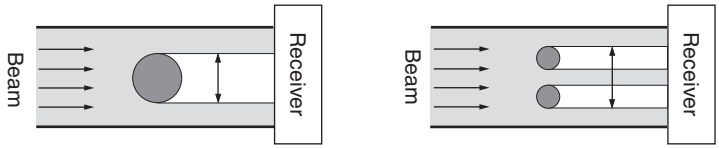
(2) One-side Interruption Mode 2 (First Light Edge) FLEG

Measures the width from the edge of the beam to the end of the first light section.



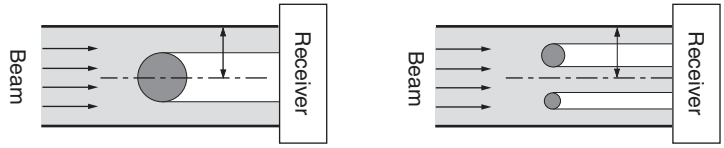
(3) Bar Diameter Measurement Mode (Diameter) dIA

Measures the width from the first edge to the last edge of the beam.



(4) Bar Position Measurement Mode (Position) POSI

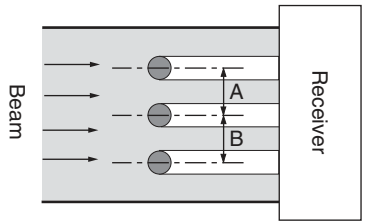
Measures the center point between the first edge and the last edge of the beam.



(5) Pin Pitch Determination Mode (Pin Pitch) PInP

Measures the pin pitch and determines if pins are centered or not. It is passed if all pin pitch are within the tolerance and rejected if not. The result will be shown as below.

Passed PASS Rejected nG



Examples (3 pins) A: 1st pitch
B: 2nd pitch

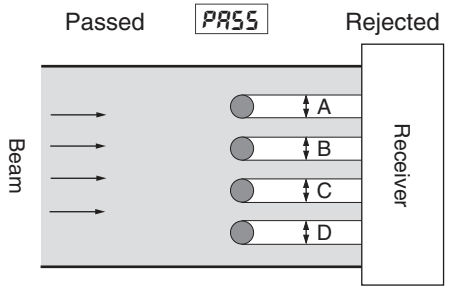
$\overline{\text{PASS}}$ output turns ON when passed. $\overline{\text{HI}}$ and $\overline{\text{LO}}$ outputs turn ON when rejected. All binary data are off. Linear output is always 4 mA.

Notes

It is regarded as 0.00 when the position of the edge is between 0.00 and 0.29, and as 28.00 when that is between 27.71 and 28.00.

(6) Pin Diameter Determination Mode (Pin Diameter) PInd

Measures the pin diameters (more than one pin can be measured) and determines whether they are within a set range. 1 to 14 pins can be measured. It is passed if all pin diameters are within the range and rejected if not. The result will be shown as below.



Examples (4 pins) A : 1st pin diameter
B : 2nd pin diameter
C : 3rd pin diameter
D : 4th pin diameter

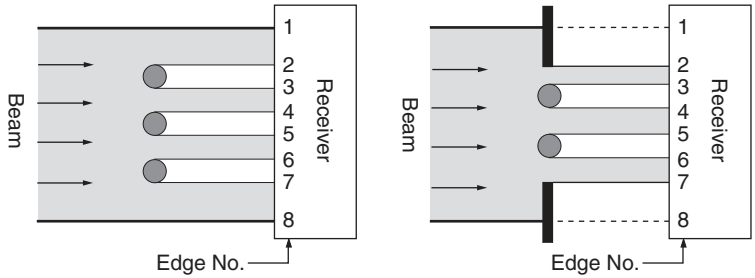
$\overline{\text{PASS}}$ output turns on when passed. $\overline{\text{HI}}$ and $\overline{\text{LO}}$ outputs turn on when rejected. All binary data are off. Linear output is always 4 mA.

(7) Specified Edge Measurement Mode (Edge) EdGE

Measures the width of two specified edges.

● **Normal Edge Width Measurement**

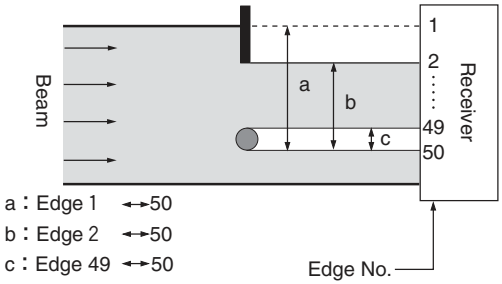
The edge number is from 1 to 30.



The upper edge of the beam is always edge 1. The lower edge of the beam is always the last edge.

● **Special Edge Measurement**

Measures the width from the edge of the beam to the end of the last dark section (a), the width from the first to the last dark section (b), and the width of the last dark section (c).



Edge 50 : The lower edge of the last dark section
Edge 49 : The upper edge of the last dark section

Other than (a), (b) and (c) can not be set. (Err6)

(8) Wire Position Detection Mode (Fine Line) FLnE

Measures the position of fine lines with minimum of ϕ 0.1 mm. The measurement details are the same as that of bar position measurement mode.

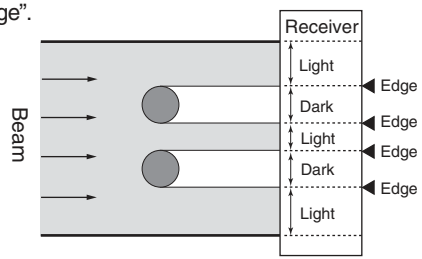
(9) Transparent Object Edge Detection Mode (Glass) GLAS

Detects the edge of glass boards and transparent sheets. The distance between the upper edge of the beam and the edge of the transparent object is measured.

Notes

What is “Edge” ?

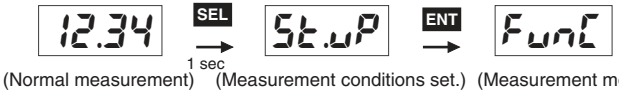
The Z4LC emits beam toward CCD in a receiver. A sensing object interrupts the beam. The area light interrupted is called “Dark (section)”. The area light permeated is called “Light (section)”. The boundary between the dark and light section is defined as “Edge”.



3. Selecting a mode

Operation

1 Select measurement mode setting in the measurement conditions setting menu.



(Normal measurement) (Measurement conditions set.) (Measurement mode set.)

2 Press ENT.

Measurement modes will be displayed.

(Measurement mode set.) (One-side interruption mode 1)

3 Every time ⩓ is pressed, the mode will be switched. Select the mode to use and press ENT.

It will be saved and the setting for the number of process values to average in the next menu will appear.

(One-side interruption mode 1) (One-side interruption mode 2) (Transparent object edge detection mode) (Number of process values to average set.)

Notes

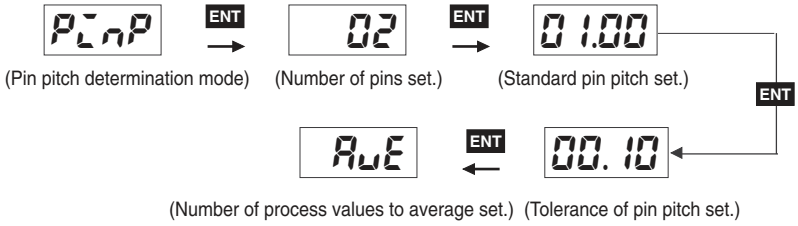
There are sub-menu settings following the operation 3 for pin pitch determination mode, pin diameter determination mode and specified edge measurement mode.

4. Sub-Menu Setting

Sub-menu setting is required if pin pitch determination mode, pin diameter determination mode or specified edge measurement mode is selected.

■ Pin Pitch Determination Mode

Set three parameters in the sub-menu for pin pitch determination mode.



Operation

1 Setting the number of pins: Set the number of pins to measure by pressing ⩓.

Press ENT to save the setting. Then, standard pin pitch setting will appear.

Setting range: 2 to 14

2 Setting the standard pin pitch: Press ⩔ and move the flashing signal to the digit to be set. Then, press ⩓ to set the figure.

Press ENT to save the setting. Then, setting for the tolerance of pin pitch will appear.

Setting range: 00.60 to 28.00

3 Setting the tolerance of pin pitch: Press [≫] and move the flashing signal to the digit to be set. Press [≪] to change the figure.

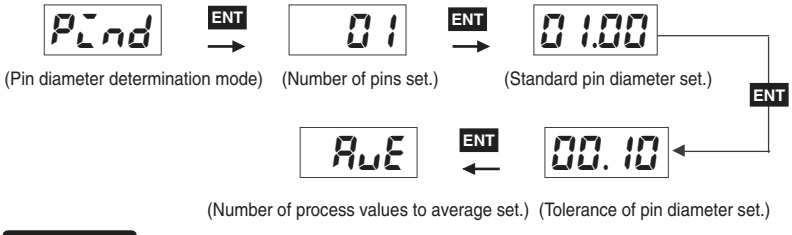
Press [ENT] to save the setting. The setting for the number of process values to average in the next menu will appear. If it is set as 0.1, determines by ±0.1mm clearance to the standard pin pitch.

Setting range: 00.00 to 28.00 mm

(Select the digit) (Set the figure) (Number of process values to average set.)

■ Pin Diameter Determination Mode

There are three parameters to be set in the sub menu for pin diameter determination mode.



(Pin diameter determination mode) (Number of pins set.) (Standard pin diameter set.)

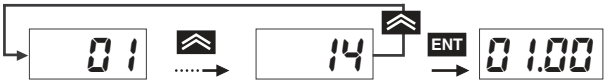
(Number of process values to average set.) (Tolerance of pin diameter set.)

Operation

1 Setting the number of pins: Set the number of pins to measure by pressing ⩓ .

Press ENT to save the setting. Then, standard pin diameter setting will appear.

Setting range: 1 to 14



(Number of pins set.) (Standard pin diameter set.)

2 Setting the standard pin pitch: Press ⩔ and move the flashing signal to the digit to be set. Then, press ⩓ to set the figure.

Press ENT to save the setting. Then, setting for the tolerance of pin diameter will appear.

Setting range: 00.30 to 28.00 mm

(Select the digit) (Set the figure) (Tolerance of pin diameter set.)

3 Setting the tolerance of pin diameter: Press ⩔ and move the flashing signal to the digit to be set. Press ⩓ to change the figure.

Press ENT to save the setting. The setting for the number of process values to average in the next menu will appear. If it is set as 0.1, determines by ±0.1mm clearance to the standard pin pitch.

Setting range: 00.00 to 28.00 mm

(Select the digit) (Set the figure) (Number of process values to average set.)

■ Specified Edge Measurement Mode

There are two parameters to be set in the sub menu for specified edge measurement mode.

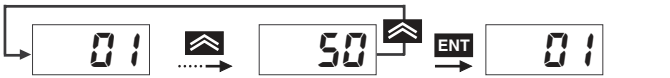
(Specified edge measurement mode) (1st edge) (2nd edge) (Number of process values to average set.)

Operation

1 Specifying the 1st edge: Press ⩓ to select the figure.

Press ENT to save the setting and the setting for the 2nd edge will appear.

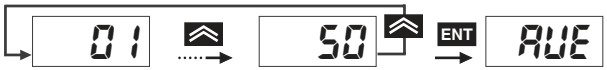
Setting range:1 to 30, 49 and 50



(Setting the 1st edge) (Setting the 2nd edge)

2 Specifying the 2nd edge: Press ⩓ to select the figure.

Press ENT to save the setting and the setting for the number of process values to average in the next menu will appear.



(Setting the 2nd edge) (Number of process values to average set.)

2 Setting the Number of Process Values to Average

Sets the number of process values to average. The average is arithmetic average.

Operation

1 Select the number of process values to average in the measurement conditions setting menu.

(Measurement conditions set.) (Measurement mode set.) (Number of process values to average set.)

2 Press ENT.

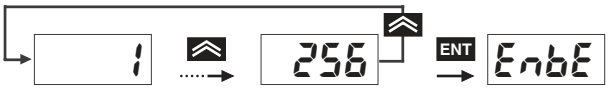
The numeric value (number of process values to average) will appear.

(Number of process values to average set.)

3 Every time ^ is pressed, the number of process values to average will change. Select the number and press ENT.

It will be saved and enable input setting in the next menu will appear.

Setting number: 1, 4, 16, 64 and 256



(Enable input set.)

3 Enable Input Setting

Measurement data such as average, maximum, etc. can be set to output by using enable input signals.

1. Enable Signals

There are five selections for enable input.

(1) oFF (Enable Input OFF Mode)

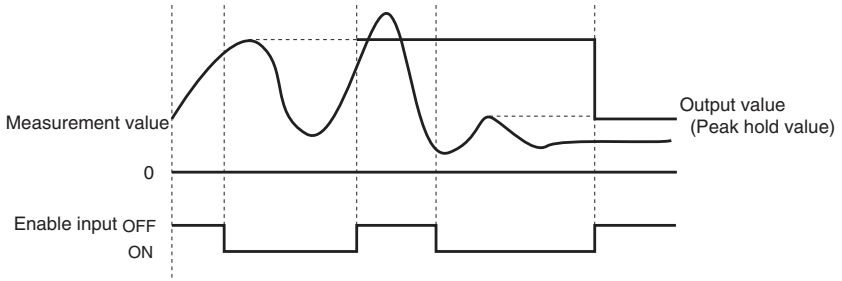
Turns OFF enable input and performs continuous measurement.

(2) norL (NORMAL Mode)

Outputs the average of "n" samplings (n=number of process values to average being set) immediately after enable input is turned ON.

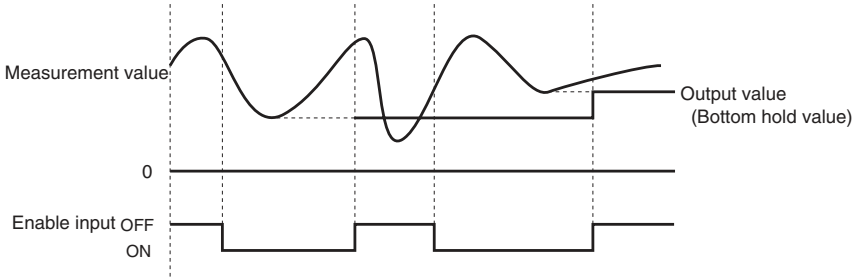
(3) PEAK (PEAK Mode)

Outputs and holds the maximum value of "n" samplings (n=number of process values to average being set) while enable input is ON.



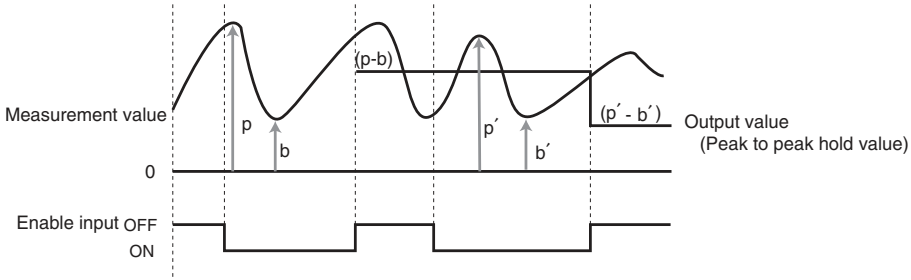
(4) botT (BOTTOM Mode)

Outputs and holds the minimum value of "n" samplings (n=number of process values to average being set) while enable input is ON.



(5) P-P (PEAK-PEAK Mode)

Outputs and holds the peak-to-peak value (the difference between the maximum value and minimum value) of “n” samplings (n=number of process values to average being set) while enable input is ON.



(6) AVEE (AVERAGE Mode)

Outputs and holds the average of all measurement values while enable input is ON. (The number of process values to average is invalid.)

Refer to “4.4.3 Enable ON” in page 82 for outputs during enable input mode.

Notes

When the mode is switched from enable input OFF mode to enable input mode (NORMAL mode, PEAK mode, etc.), “0.00” will be displayed until enable input turns ON. All outputs are off and analog outputs are 4 mA.

Notes

In NORMAL mode, PEAK mode, BOTTOM mode, or PEAK-PEAK mode, data are not stored if enable input turns OFF before completing average processing by sampling “n” times. In AVERAGE mode, data are not stored if enable input turns OFF before completing a measurement.

2. Selecting a mode

Operation

1 Select enable input setting in measurement conditions setting menu.

(Measurement conditions set.) (Measurement mode set.) (Number of process values to average set.) (Enable input set.)

2 Press ENT.

Selection items will appear.

(Enable input)

3 Every time ⌃ is pressed, the selection item changes. Select the item and press ENT.

It will be saved and measurement mode setting will appear.

(Enable OFF mode) (NORMAL mode) (AVERAGE mode) (Measurement mode set.)

Notes

In pin pitch determination mode or pin diameter determination mode, NORMAL mode is in effective even if PEAK mode, BOTTOM mode, or PEAK-PEAK mode is set.

3.2 Discrimination Value Setting

1 Selecting the Bank No. for Comparative Value Setting

Select a Bank No. for comparative value setting. There are two banks available. Set the comparative value and hysteresis value for the selected Bank No.

Operation

1 Select Bank No. setting in discrimination value setting mode.

(Normal measurement) (Measurement conditions set.) (Discrimination value set.) (Bank No. set.)

2 Press ENT.

The numeric value (bank no.) will appear.

(Bank No. set.)

3 Every time ^ is pressed, the Bank No. changes. Select the Bank No. to use and press ENT.

It will be saved and comparative value setting in the next menu will appear.

indicates the bank no. currently set.

(Bank No. 1 and 2) (Comparative value set.)

2 Comparative Value Setting

Sets the comparative value for the selected Bank No.

Operation

1 After selecting the Bank No., comparative value setting will appear.

The selected Bank No. is shown in the right digit.

(Bank No. set.) (Comparative value set.)

■ Setting L (LOW) Comparative Value

2 Press ENT.

The numeric value setting will appear and the LOW LED will be lit.

LOW

(L comparative value set.)

3 Press ≫ to move the flashing signal to the digit to be set and press ≪ to set the figure.

Setting range: -9.99 to 28.00 mm

(Select the digit) (Set the figure)

4 Set the L comparative value and press ENT.

It will be saved and H comparative setting will be displayed. The LOW LED will be turned OFF and the HI LED will be turned ON.

(H comparative value set.)

■ Setting H (HIGH) Comparative Value

5 Press [≫] to move the flashing signal to the digit to be set and press [^] to set the figure.

Setting range: -9.99 to 28.00 mm

(Select the digit) (Set the figure)

6 Set the H comparative value and press [ENT].

It will be saved and hysteresis value setting will be displayed.

(H comparative value set.) (Hysteresis value set.)

Notes

If the L comparative value is set to bigger than the H comparative value, the error (Error 6) occurs. Set the value again. Press [SEL] to go back to comparative value setting.

(Error 6) (Comparative value set.)

3 Hysteresis Value Setting

Sets the hysteresis width of the comparative value to discriminate for the selected Bank No.

Operation

1 After setting the comparative value for the selected Bank No., hysteresis value setting will be displayed.

The selected Bank No. is shown in the right digit.

(H comparative value set.) (Hysteresis value set.)

2 Press ENT.

The numeric value setting will appear.

3 Press ≫ to move the flashing signal to the digit to be set and press ⌃ to set the figure.

Setting range: 0.00 to 0.50 mm

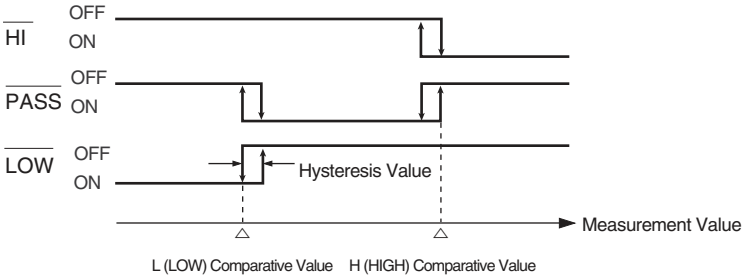
(Select the digit) (Set the figure)

4 Set the hysteresis width and press ENT.

It will be saved and Bank No. setting will appear.

(Bank No. set.)

■ Discrimination Output Chart



Notes

If it is set outside the setting range, the error (Err 6) occurs. Set the value again.
Press SEL to go back to hysteresis setting.

(Error 6) (Hysteresis set.)

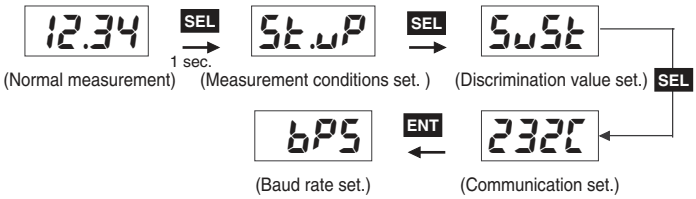
3.3 Communication Setting

1 Baud Rate Setting

Communication speed is set in baud rate setting.

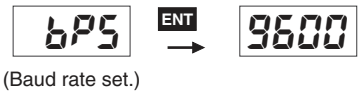
Operation

1 Select baud rate setting in communication setting menu.



2 Press ENT.

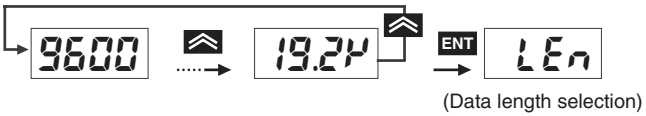
The numeric value (communication speed) will appear.



3 Every time ^ is pressed, the baud rate changes. Select the baud rate to use and press ENT.

It will be saved and the data length selection in the next menu will appear.

Setting range:19.2k, 9600, 4800, 2400, and 1200



2 Data Length Selection

Sets the number of bits in a letter. Select the number of bits 7 or 8.

Operation

1 Select data length selection in communication setting menu.

(Communication set.) (Baud rate set.) (Data length selection)

2 Press ENT.

The numeric value (number of bits) will appear.

(Data length selection)

3 Every time ^ is pressed, the number of bits changes. Select the number of bits to use and press ENT.

It will be saved and stop bit selection in the next menu will appear.

(Stop bit selection)

3 Stop Bit Selection

Sets the number of bits for signals to recognize the end of data. Select the number of bits 1 or 2.

Operation

1 Select stop bit selection in communication setting menu.

(Communication set.) (Baud rate set.) (Data length selection) (Stop bit selection)

2 Press ENT.

The numeric value (number of bits) will appear.

(Stop bit selection)

3 Every time ^ is pressed, the number of bits changes. Select the number of bits to use and press ENT.

It will be saved and parity selection in the next menu will appear.

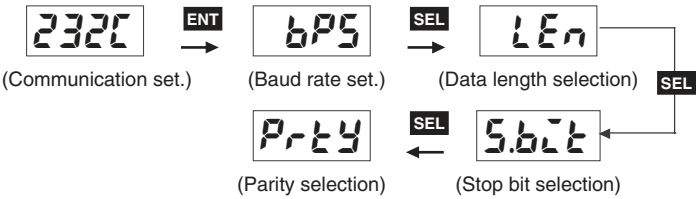
(Parity selection)

4 Parity Selection

Selects the parity when checking if data are transmitted correctly. The parity is selectable from None, Even, or Odd.

Operation

1 Select parity selection in communication setting menu.



(Communication set.) (Baud rate set.) (Data length selection) (Parity selection) (Stop bit selection)

2 Press ENT.

The parity selection item will appear.

(Parity selection)

3 Every time ^ is pressed, the parity item changes. Select the parity condition and press ENT.

It will be saved and header / footer selection in the next menu will appear.

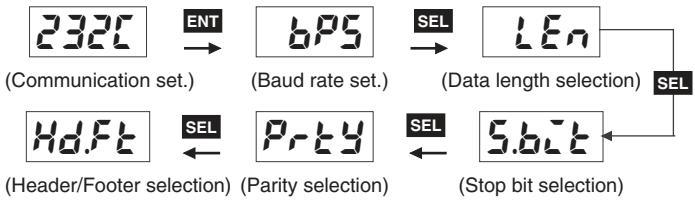
(None) (Even) (Odd) (Header/Footer selection)

5 Header / Footer Selection

Sets the command for starting and ending communication.

Operation

1 Select header / footer selection in communication setting menu.

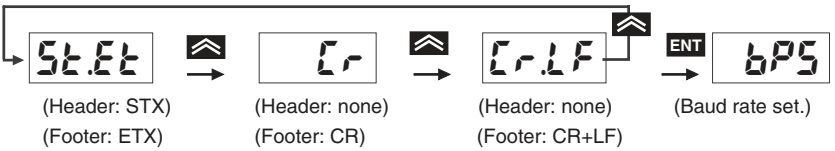


2 Press [ENT] .

The header / footer selection item will appear.

3 Every time [^] is pressed, the header / footer selection item changes. Select the header / footer to use and press [ENT].

It will be saved and baud rate setting will appear.



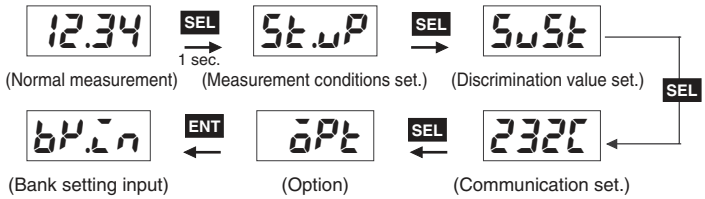
3.4 Option

1 Bank Setting Input

Sets whether switching the bank by front panel (or serial communication input) or external terminal input.

Operation

1 Select bank setting input from optional menu.



(Normal measurement) (Measurement conditions set.) (Discrimination value set.)

(Bank setting input) (Option) (Communication set.)

2 Press ENT.

(Bank setting input) (Front)

3 Every time ^ is pressed, the item changes. Select the either one and press ENT.

It will be saved and the display will be switched.

(Front) (External terminal input)

4 When "Front" is selected:

Select the Bank No. 1 or 2 by pressing ^ and press ENT.

It will be saved and the setting for the upper limit value for linear output will appear.

(Bank 1) (Bank 2) (Upper limit value for linear output set.)

4 When “External terminal input” is selected:

Press ENT .

It will be saved and the setting for the upper limit value for linear output will appear.

(Upper limit value for linear output set.)

2 Setting the Upper Limit Value for Linear Output

Sets the measurement value for the upper linear output 20 mA.

Operation

1 Select the upper limit value for linear output setting in option menu.

(Option) (Bank setting input) (Upper limit value for linear output set.)

2 Press ENT.

The numeric value setting will be displayed and HI LED will be lit.

HI

(Upper limit value for linear output set.)

3 Press ≫ to move the flashing signal to the digit to be set and press ≪ to set the figure.

(Select the digit) (Set the figure)

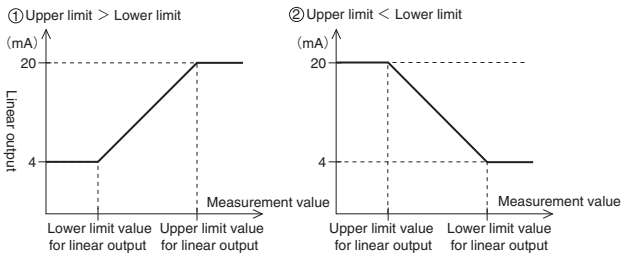
4 After setting the value, press ENT.

It will be saved and the setting for the lower limit will appear.

(Lower limit value for linear output set.)

Measurement values and linear outputs

∗Scaling is possible if necessary.
(1 mA / mm, etc.)



3 Setting the Lower Limit Value for Linear Output

Sets the lower limit value for the linear output 4 mA.

Operation

1 After setting the upper limit value, the setting for the lower limit value for linear output will be displayed.

(Lower limit value for linear output set.)

2 Press ENT.

The numeric value setting will be displayed and LOW LED will be lit.

LOW

(Lower limit value for linear output set.)

3 Press ≫ to move the flashing signal to the digit to be set and press ≪ to set the figure.

(Select the digit) (Set the figure)

4 After setting the value, press ENT .

It will be saved and bank setting input will appear.

(Bank setting input)

Notes

If the upper limit value or lower limit value is set outside the range 0.00 to 28.00, the error (Err6) occurs. Set the figure again. Press SEL to go back to the setting for the upper limit value for linear output.

(Error 6) (Upper limit value for linear output set.)

3.5 Setting by Communication

Setting and setting conditions of each mode (measurement conditions, discrimination values, communication conditions and option) can be set and also the setting status can be confirmed by RS-232C communication.

1 Setting Each Mode

Changes the measurement conditions, discrimination values, communication conditions and option when the code in the table is received.

【e.g.1】 Header: STX, Footer: ETX
Number of process values to average: 4
(STX)(A)(2)(ETX)

【e.g.2】 Header: none, Footer: CR
Bar position measurement mode
(K)(4)(CR)

When the setting has been changed correctly upon receiving each code, new setting conditions will become effective immediately after “OK” is sent. If not changed correctly, the error code will be sent. Refer to “Section 5 Error Displays and Error Codes” in page 91.

【e.g.1】 Header: none, Footer: CR+LF **Correctly set**
(O)(K)(CR)(LF)

【e.g.2】 Header: none, Footer: CR **Receiving code error**
(N)(G)(CR)

【e.g.3】 Header: STX, Footer: ETX **Communication parameter error**
(STX)(E)(r)(r)(4)(ETX)

■ Table: Codes for Setting

In the table, □ indicates a numeric value. Send the ASCII code according to the number of □s. Characters are fixed. Even if the upper digit is 0, it can not be omitted. The following receiving codes indicate commands in the upper section and ASCII codes in lower section.

*The header and footer being set are to be attached to all codes.

Function	Receiving code	Setting
Bank No. selection	B1 42h 31h	Bank 1
	B2 42h 32h	Bank 2
Discrimination output comparative value setting	C□□□□ 43h □□□□	H comparative value for the selected bank (□ shall be -999 to 2800)
	D□□□□ 44h □□□□	L comparative value for the selected bank (□ shall be -999 to 2800)
Hysteresis value selection	H□□ 48h □□	Hysteresis value for the selected bank (□ shall be 00 to 50)
Setting mode selection	K1 4Bh 31h	One-side interruption mode 1
	K2 4Bh 32h	One-side interruption mode 2
	K3 4Bh 33h	Bar diameter measurement mode
	K4 4Bh 34h	Bar position measurement mode
	K5 4Bh 35h	Pin pitch determination mode
	K6 4Bh 36h	Pin diameter determination mode
	K7 4Bh 37h	Specified edge measurement mode
	K8 4Bh 38h	Wire position detection mode
	K9 4Bh 39h	Transparent object edge detection mode
Pin pitch determination mode setting	F□□ 46h □□	Number of pins (□ shall be 02 to 14)
	I□□□□ 49h □□□□	Standard pin pitch (□ shall be 0060 to 2800)
	J□□□□ 4Ah □□□□	Tolerance of pin pitch (□ shall be 0000 to 2800)

*The header and footer being set are to be attached to all codes.

Function	Receiving code	Setting
Pin diameter determination mode setting	L□□ 4Ch □□	Number of pins (□ shall be 01 to 14)
	M□□□□ 4Dh □□□□	Standard pin diameter (□ shall be 0030 to 2800)
	N□□□□ 4Eh □□□□	Tolerance of pin diameter (□ shall be 0000 to 2800)
Specified edge measurement mode setting	P□□■■ 50h □□■■	Specified edge 1 (□ shall be 01 to 30, 49, 50) Specified edge 2 (■ shall be 01 to 30, 49, 50)
Bank input selection	W5 42h 35h	Front panel input (FRONT)
	W6 42h 36h	Bank switch terminal input (REAR)
Enable input setting	E1 45h 31h	Enable input OFF mode
	E2 45h 32h	NORMAL mode
	E3 45h 33h	PEAK mode
	E4 45h 34h	BOTTOM mode
	E5 45h 35h	PEAK-PEAK mode
	E6 45h 36h	AVERAGE mode
Baud rate selection	b1 62h 31h	19200 bps
	b2 62h 32h	9600 bps
	b3 62h 33h	4800 bps
	b4 62h 34h	2400 bps
	b5 62h 35h	1200 bps
Data bit length selection	d1 64h 31h	8 bit
	d2 64h 32h	7 bit

*The header and footer being set are to be attached to all codes.

Function	Receiving code	Setting
Stop bit length selection	s1 73h 31h	1 bit
	s2 73h 32h	2 bit
Parity bit setting selection	p1 70h 31h	None
	p2 70h 32h	Even
	p3 70h 33h	Odd
Header / Footer setting	h1 68h 31h	STX/ETX
	h2 70h 32h	None/CR
	h3 70h 33h	None/CR+LF
Number of process values to average selection	A1 41h 31h	1
	A2 41h 32h	4
	A3 41h 33h	16
	A4 41h 34h	64
	A5 41h 35h	256
Setting for the Upper / Lower limit value for linear output	U □□□□ 55h □□□□	Upper limit value for linear output (□ shall be 0000 to 2800)
	V □□□□ 56h □□□□	Lower limit value for linear output (□ shall be 0000 to 2800)

2 Confirming the setting conditions of each mode

The data according to the setting of measurement conditions, discrimination values, communication conditions and option are sent when the codes in the table is received.

【e.g.】 Confirm the number of pins in pin pitch determination mode

Header: STX, Footer: ETX

Number of pins: 4

Receiving code : (STX)(R)(F)(ETX)

Response code : (STX)(0)(4)(ETX)

■ Codes for Confirming Setting Conditions

In the table, □ indicates a numeric value. Send the ASCII code according to the number of □s. Characters are fixed. Even if the upper digit is 0, it can not be omitted. The following receiving codes indicate commands in the upper section and ASCII codes in lower section.

*The header and footer being set are to be attached to all codes.

Function	Receiving code	Setting	Response form
Bank No.	RB 52h 41h	Bank 1	(header) 1 (footer)
		Bank 2	(header) 2 (footer)
Discrimination output comparative value	RC 52h 43h	H Comparative value	(header) □□□□(footer)
	RD 52h 44h	L Comparative value	(header) □□□□ (footer)
Hysteresis setting value	RH 52h 48h	Hysteresis width	(header) □□ (footer)
Measurement mode	RK 52h 4Bh	One-side interruption mode 1	(header) 1 (footer)
		One-side interruption mode 2	(header) 2 (footer)
		Bar diameter measurement mode	(header) 3 (footer)
		Bar position measurement mode	(header) 4 (footer)
		Pin pitch determination mode	(header) 5 (footer)
		Pin diameter determination mode	(header) 6 (footer)
		Specified edge measurement mode	(header) 7 (footer)
		Wire position detection mode	(header) 8 (footer)
		Transparent object edge detection mode	(header) 9 (footer)
Pin pitch determination mode setting	RF 52h 46h	Number of pins	(header) □□ (footer)
	RI 52h 49h	Standard pin pitch	(header) □□□□ (footer)
	RJ 52h 4Ah	Tolerance of pin pitch	(header) □□□□ (footer)

*The header and footer being set are to be attached to all codes.

Function	Receiving code	Setting	Response form
Pin diameter determination mode setting	RL 52h 4Ch	Number of pins	(header) □□ (footer)
	RM 52h 4Dh	Standard pin diameter	(header) □□□□ (footer)
	RN 52h 4Eh	Tolerance of pin diameter	(header) □□□□ (footer)
Specified edge measurement mode setting	RP 52h 50h	Specified edge 1	(header) □□ (footer)
	RQ 52h 51h	Specified edge 2	(header) □□ (footer)
Bank input selection	RW 52h 42h	FRONT	(header) F (footer)
		REAR	(header) R (footer)
Enable input setting	RE 52h 45h	Enable input OFF mode	(header) 1 (footer)
		NORMAL mode	(header) 2 (footer)
		PEAK mode	(header) 3 (footer)
		BOTTOM mode	(header) 4 (footer)
		PEAK-PEAK mode	(header) 5 (footer)
		AVERAGE	(header) 6 (footer)
Baud rate setting	Rb 52h 62h	19200bps	(header) 1 (footer)
		9600bps	(header) 2 (footer)
		4800bps	(header) 3 (footer)
		2400bps	(header) 4 (footer)
		1200bps	(header) 5 (footer)
Data bit length selection	Rd 52h 64h	8bit	(header) 8 (footer)
		7bit	(header) 7 (footer)
Stop bit length selection	Rs 52h 73h	2bit	(header) 2 (footer)
		1bit	(header) 1 (footer)
Parity bit selection	Rp 52h 70h	none	(header) 1 (footer)
		even	(header) 2 (footer)
		odd	(header) 3 (footer)
Header/Footer setting	Rh 52h 68h	STX/ETX	(header) 1 (footer)
		None /CR	(header) 2 (footer)
		None /CR+LF	(header) 3 (footer)
Number of process values to average setting	RA 52h 41h	1	(header) 1 (footer)
		4	(header) 2 (footer)
		16	(header) 3 (footer)
		64	(header) 4 (footer)
		256	(header) 5 (footer)
Setting for the Upper/ Lower limit value for linear output	RU 52h 55h	Upper limit value for linear output	(header) □□□□ (footer)
	RV 52h 56h	Lower limit value for linear output	(header) □□□□ (footer)

4

Normal Measurement Mode

This section describes measurement data outputs and discrimination methods in normal measurement mode.

4.1 How to Use

The Z4LC starts operation in normal measurement mode when the power is turned ON.

■ Setting discrimination conditions

Set the measurement conditions in “Setting Mode”. Refer to “Section 3. Setting Mode” in page 39.

■ Outputting measurement data

The Z4LC outputs the following data according to the result of measurement.

[Measurement Value Output]

- Binary data output: Outputs measurement results in 12-bit binary form.
  Refer to “4.2.1 Binary Data Output” in page 75.
- Linear output: Outputs measurement results in current 4 to 20 mA.
  Refer to “4.2.2 Linear Output” in page 75.

[Discrimination Result Output]

- Discrimination data output: Outputs the result HI, PASS or LOW.
  Refer to “4.2.3 Discrimination Data Output” in page 76.

The following data are sent by RS-232C communication:

- Measurement data output: Sends measurement values.
  Refer to “4.5.1 How to Use [O] Command” in page 84.

- Edge position data output: Sends edge position data.
  Refer to “4.5.2 How to Use [e] Command” in page 87.

4.2 Measurement Value and Discrimination Result Outputs

1 Binary Data Output

Outputs the measurement result in 12-bit binary form ($\overline{D0}$ to $\overline{D11}$).

【e.g.】 When the measurement result is 12.34:

$(1234)_{10}=(4D2)_{16}=(010011010010)_2$ → $\overline{D1}$,$\overline{D4}$,$\overline{D6}$,$\overline{D7}$ and $\overline{D10}$ turn ON.

Please note that $\overline{D0}$ to $\overline{D11}$ turn OFF while in pin diameter determination or pin pitch determination mode.

Notes

Binary data output does not change even if forced zero function is set.

2 Linear Output

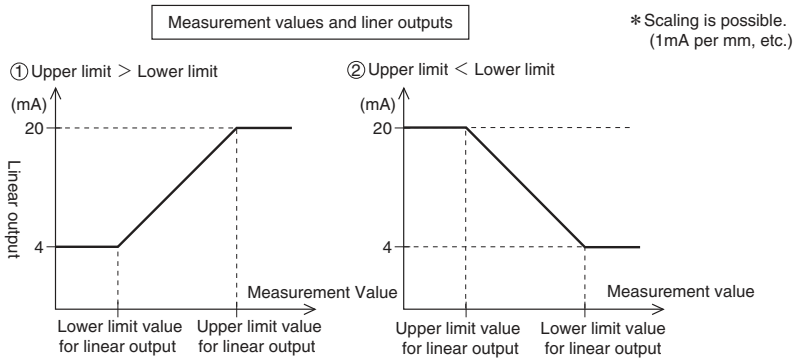
Outputs the measurement result in current 4 to 20 mA.

■ Measurement modes:

"One-side Interruption Mode 1", "One-side Interruption Mode 2", "Bar Diameter Measurement Mode", "Bar Position Measurement Mode", "Specified Edge Measurement Mode", "Wire Position Detection Mode", and "Transparent Object Edge Detection Mode"

The measurement result is converted into 4 to 20 mA current consumption.

The relation between measurement values and linear outputs are to be determined by "Upper limit value for linear output" and "Lower limit value for linear output".



Notes

Linear output does not change even if forced zero function is set.

■ Measurement modes:

"Pin Diameter Determination Mode" and " Pin Pitch Determination Mode"

4 mA is always output regardless of the measurement result.

3 Discrimination Data Output

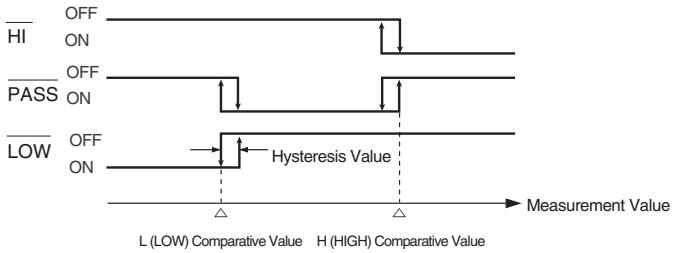
Outputs the discrimination result HI, PASS, or LOW.

■ **Measurement modes:**

"One-side Interruption Mode 1", "One-side Interruption Mode 2", "Bar Diameter Measurement Mode", "Bar Position Measurement Mode", "Specified Edge Measurement Mode", "Wire Position Detection Mode", and "Transparent Object Edge Detection Mode"

According to the discrimination result, $\overline{\text{HI}}$, $\overline{\text{PASS}}$ or $\overline{\text{LOW}}$ will be output.

● **Discrimination output**



■ **Measurement modes:**

"Pin Diameter Determination Mode" and "Pin Pitch Determination Mode"

According to the discrimination result, $\overline{\text{HI}}$, $\overline{\text{PASS}}$ or $\overline{\text{LOW}}$ will be output.

● **Discrimination output**

Passed: $\overline{\text{PASS}}$ turns ON

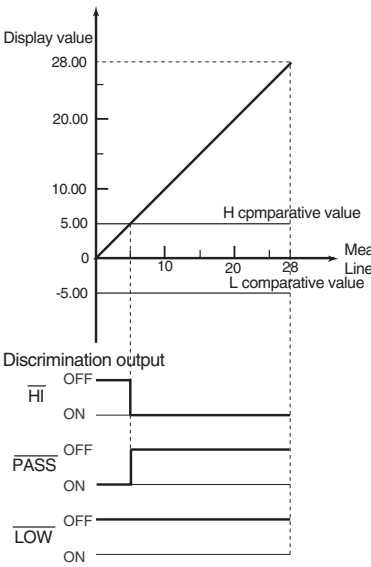
Rejected: $\overline{\text{HI}}$ or $\overline{\text{LOW}}$ turns ON

4.3 Forced Zero Function

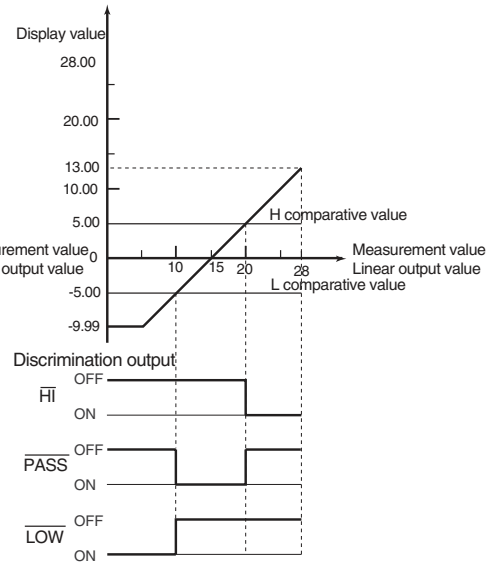
Sets the reference value to “0.00” and discriminates by the ± tolerance.

【e.g.】 Measurement mode: One-side Interruption Mode 1
L comparative value =-5.00, H comparative value=5.00

(Forced zero function: OFF)



(Forced zero function: ON, Measurement value: 15.00)



The display range while forced zero function is used is from -9.99 to (28.00 minus “forced zero value”). Set the comparative value within the range.

Notes

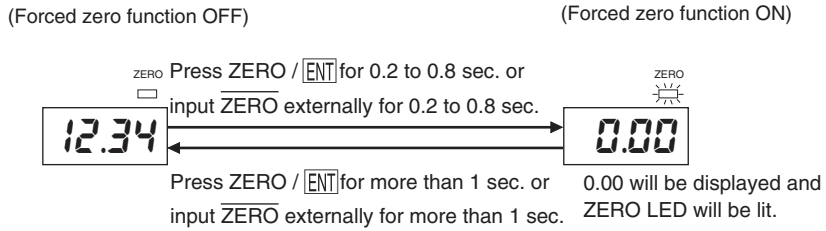
Regardless of the forced zero function, the measurement value from 0 to 28.00 will be output for linear output, binary data output or communication output.

Notes

Forced zero function can not be used while in “Pin Diameter Determination Mode” or “Pin Pitch Determination Mode”.

1 Forced Zero Setting

The key input on a front panel or forced zero input ($\overline{\text{ZERO}}$) can switch forced zero function ON / OFF.



When ZERO / ENT on a front panel is pressed or $\overline{\text{ZERO}}$ is input externally for 0.2 to 0.8 sec. while measuring a sample of the reference object, forced zero function turns ON and the measurement value is set as a forced zero value. Then, ZERO LED will be lit.

Notes

If ZERO / ENT on a front panel is pressed or $\overline{\text{ZERO}}$ is input externally for 0.2 to 0.8 sec. while forced zero function is ON, the measurement value is set as a forced zero value so that the forced zero setting can be performed continuously.

When ZERO / ENT on a front panel is pressed or $\overline{\text{ZERO}}$ is input externally for 1 sec., forced zero function turns OFF and ZERO LED will be turned off.

Notes

If forced zero is input while enable input is effective, the last confirmed value is set as a forced zero value.

2 Forced Zero Setting by Communication

Forced zero can be set by RS-232C communication.

【e.g.1】 Header: STX, Footer: ETX **Turning ON forced zero function**
(STX)(Z)(1)(ETX)

【e.g.2】 Header: none, Footer: CR **Turning OFF forced zero function**
(Z)(2)(CR)

When codes are received and the setting has been changed correctly, the new setting becomes effective immediately after “OK” is sent. When not changed correctly, the error code will be sent. Refer to “Section 5 Error Displays and Error Codes” in page 91 for details.

【e.g.1】 Header: none, Footer: CR+LF **Correctly set**
(O)(K)(CR)(LF)

【e.g.2】 Header: none, Footer: CR **Receiving code error**
(N)(G)(CR)

【e.g.3】 Header: STX, Footer: ETX **Communication parameter error**
(STX)(E)(r)(r)(4)(ETX)

■ Codes for Setting

The following receiving codes indicate commands in the upper section and ASCII codes in the lower section.

*The header and footer being set are to be attached to all codes.

Function	Receiving code	Setting
Forced zero function setting	Z1 5Ah 31h	Turns ON forced zero function
	Z2 5Ah 32h	Turns OFF forced zero function

3 Confirming Forced Zero Setting by Communication

The setting conditions of forced zero function can be confirmed by RS-232C communication.

【e.g.】 Header: STX, Footer: ETX Forced zero function ON

Receiving code: (STX)(R)(Z)(ETX)

Response code: (STX)(1)(ETX)

■ Codes for setting

The following receiving codes indicate commands in the upper section and ASCII codes in the lower section.

*The header and footer being set are to be attached to all codes.

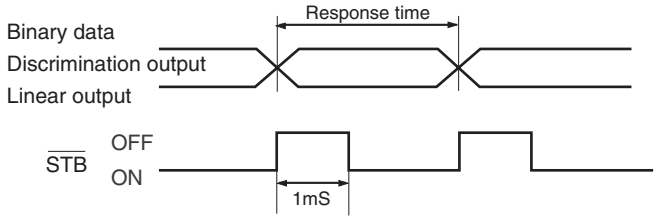
Function	Receiving code	Setting	Response form 1
Forced zero function setting	RZ 52h 5Ah	ON	(header) 1 (footer)
		OFF	(header) 2 (footer)

4.4 Timing and Response Time for Data Output

1 Enable OFF

Outputs will vary according to the response time. Obtain data while $\overline{\text{STB}}$ signal is ON.

■ Timing Chart



2 Number of Process Values to Average and Response Time

Number of Process Values to Average	Response Time	
	Measurement mode ①	Measurement mode ②
1	3.3 ms	6.6 ms
4	13.2 ms	26.4 ms
16	52.8 ms	105.6 ms
64	211.2 ms	422.4 ms
256	844.8 ms	1689.6 ms

Measurement mode ①:

One-side Interruption Mode 1, One-side Interruption Mode 2, Bar Diameter Measurement Mode, Specified Edge Measurement Mode and Transparent Object Edge Detection Mode.

Measurement mode ②:

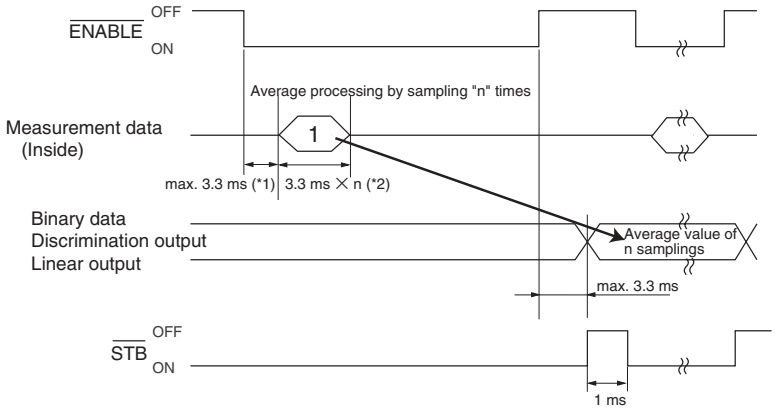
Pin Diameter Determination Mode and Pin Pitch Determination Mode

3 Enable ON

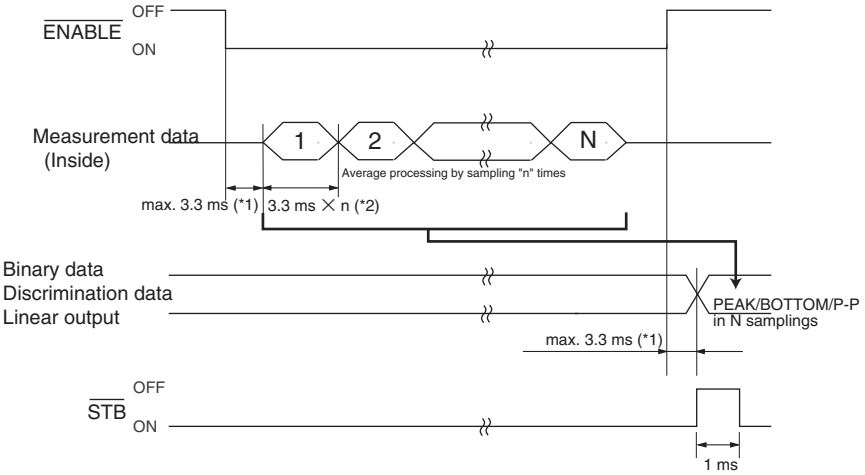
Refer to “ 3.1.3 Enable Input Setting” in page 50 for details.

■ Timing Chart

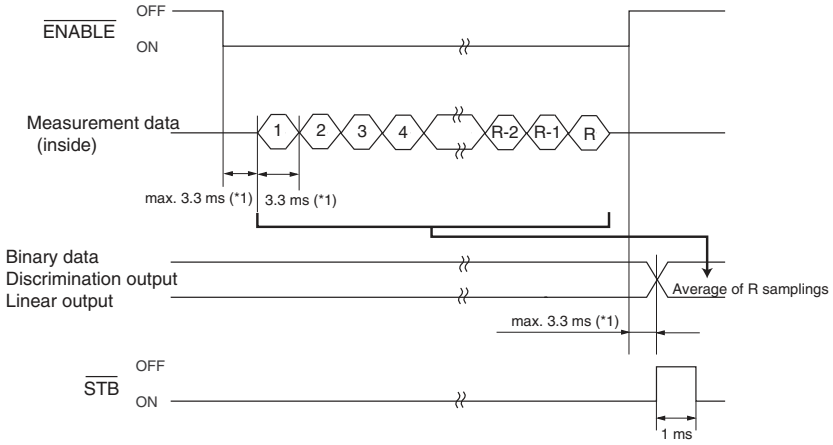
① NORMAL Mode



② PEAK, BOTTOM, and PEAK-PEAK Mode



③ AVERAGE Mode



(*1) It is 6.6 ms when the measurement mode is “Pin Diameter Determination mode” or “Pin Pitch Determination Mode”.

(*2) It is 6.6 ms × n when the measurement mode is “Pin Diameter Determination Mode” or “Pin Pitch Determination Mode”.

4.5 Data Output by Communication

Sends measurement values, edge position data, etc. by RS-232C communication in normal measurement mode.

1 How to Use [O] Command

When the communication command [O] is received, the measurement value will be sent once.

1. Measurement Data Output Control Input

The following receiving codes indicate commands in the upper section and ASCII codes in the lower section.

* The header and footer being set are to be attached to all codes.

Function	Receiving code	Sending
Measurement value output	O 4Fh	Sends the measurement value once.

2. Sending Data

The format of sending data is different depending on the measurement mode.
All sending data are ASCII codes.

■ When one of the following measurement modes is selected:

"One-side Interruption Mode 1", "One-side Interruption Mode 2", "Bar Diameter Measurement Mode", "Bar Position Measurement Mode", "Specified Edge Measurement Mode", "Wire Position Detection Mode", or "Transparent Object Edge Detection Mode"

The measurement value will be sent in the below format when correctly measured.

Header	10's digit (mm)	1's digit (mm)	1st decimal (mm)	2nd decimal (mm)	Footer

【e.g.1】Sending data: "1.23mm", Header:STX, Footer: ETX
(STX)(0)(1)(2)(3)(ETX)

【e.g.2】Sending data: "LdoF", Header: none, Footer: CR+LF
(L)(d)(o)(F)(CR)(LF)

When errors occur, error codes will be sent. Refer to "Section 5 Error Displays and Error Codes" in page 91.

■ When “Pin Diameter Determination Mode” or “ Pin Pitch Determination Mode” is selected:

The measurement result will be sent in the below format when correctly measured.

・When the measurement result is “PASS”:

Header	P	Footer

・When the measurement result is “NG”:

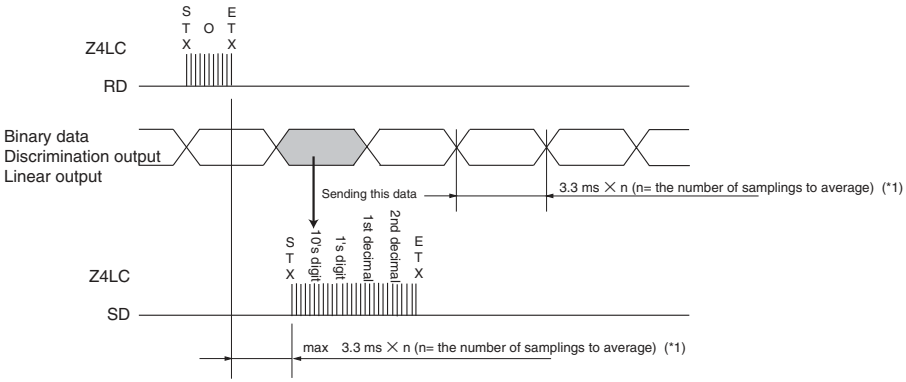
Header	N	Footer

When errors occur, error codes will be sent. Refer to “Section 5 Error Displays and Error Codes” in page 91.

■ Timing Chart

After receiving [O] command, the first confirmed data will be sent.

【e.g.】 Header / Footer: STX+ETX



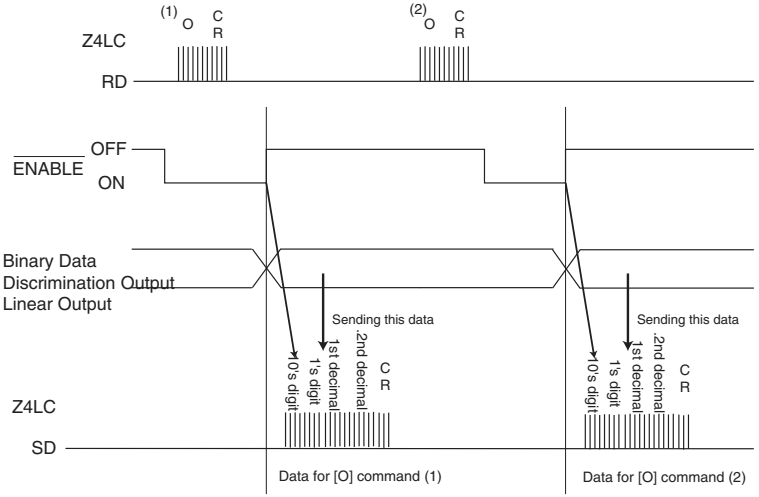
(*1) When the measurement mode is “Pin Diameter Determination Mode” or “Pin Pitch Determination Mode”, it is 6.6 ms × n (n= the number of samplings to average).

Notes

The Z4LC can not accept commands while sending data. When sending commands continuously, be sure to send the command after the Z4LC is completed to send data.

While $\overline{\text{ENABLE}}$ is effective, the data obtained by $\overline{\text{ENABLE}}$ input will be output when ENABLE signals turned off after receiving [O] command.

【e.g.】Header: none, Footer: CR



2 How to Use [e] Command

Sends the data of the number of edges and edge position when the communication command [e] is received.

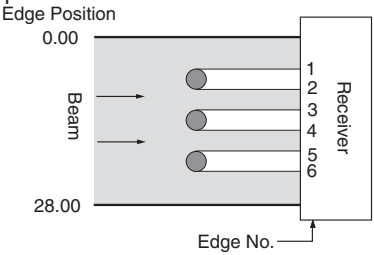
■ Definition of Edge Position / Number of Edges / Edge Order while the command [e] is used:

Please note that the way of counting the upper and the lower edges of the beam is different from that of specified edge measurement mode.

①Count the edge1, 2, 3, ・・・ from the upper beam in order of Light → Dark, Dark → Light, Light → Dark・・・.

②The edge position is 0.00 for the top end and 28.00 for the bottom end.

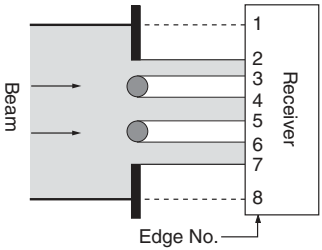
【e.g.1】 Number of edges=6



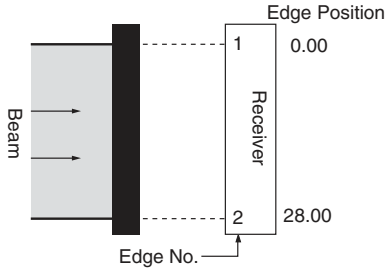
③When the upper edge of the beam is dark, count it as an edge and the edge position is 0.00.

④When the lower edge of the beam is dark, count it as an edge and the edge position is 28.00.

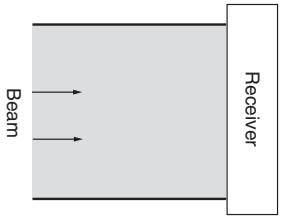
【e.g.2】 Number of edges=8



【e.g.3】 Number of edges=2



【e.g.4】 Number of edges=0



1. Measurement Data Output Control Input

The following receiving codes indicate commands in the upper section and ASCII codes in the lower section.

*The header and footer being set are to be attached to all codes.

Function	Receiving code	Sending
Outputs edge position data	– – e – – – 65h	Sends the data of the number of edges and the edge position.

2. Sending Data

Outputs the data of the number of edges and the edge position with the below format.

Data	Header	Number of Edges	Edge 1 Position	Edge 2 Position	Edge 3 Position	Edge 4 Position	.....	Edge n Position	Footer
bytes	—	2	4	4	4	4	.....	4	—

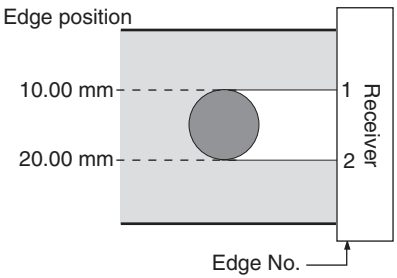
Number of edges: 2 bytes (1 → 01, 10 → 10)

10's digit	1's digit

Edge position data: 4 bytes

10's digit (mm)	1's digit (mm)	1st decimal (mm)	2nd decimal (mm)

【e.g.】Header: STX, Footer: ETX, Number of edges: 2, Edge position 10.00, Position of edge 2: 20.00



Sending data: (STX)(0)(2)(1)(0)(0)(0)(2)(0)(0)(0)(ETX)

Number of edges Position of edge 1 Position of edge 2

The maximum 32 edges can be detected. If exceeds 32, “Err2” will be sent.

【e.g.】 (header)(E)(r)(r)(2)(footer)

When the number of edges is 0, only 2 bytes will be sent.

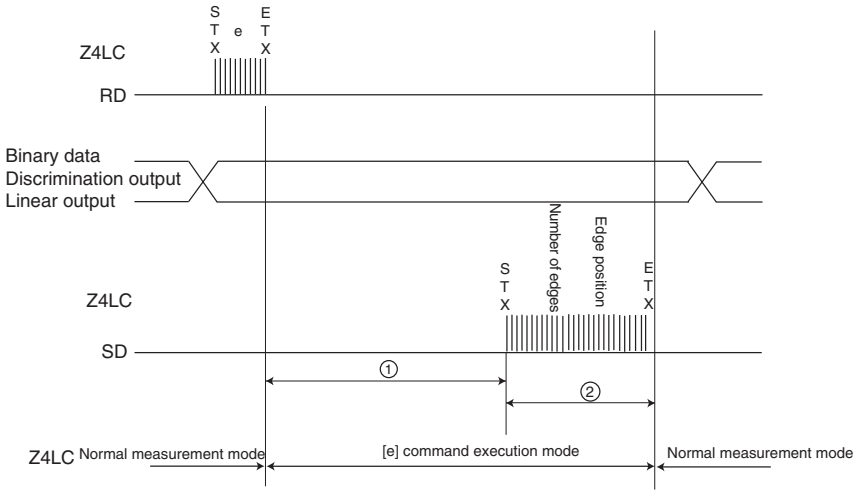
【e.g.】 (header) 00 (footer)

When errors occur, the error code will be sent. Refer to “Section 5 Error Displays and Error Codes” in page 91.

Measurements (i.e. one-side interruption, bar diameter measurement, etc.) are not performed against the measurement for edge outputs. [————] is displayed while sending data. The conditions immediately before the [e] command is received will be hold for linear output, binary data output, and discrimination output. Other measurements or any change to the operation can not be accepted until the data is completely sent.

■ Data Output Timing

【e.g.】 The header and footer are set to STX+ETX:



①It takes within 15 ms to start sending data after receiving the communication command [e].

②The data sending time varies with the communication setting and the number of edges.

Notes

The Z4LC can not accept commands while sending data. When sending commands continuously, be sure to send the command after the Z4LC is completed to send data.

4.6 LD OFF Function

When voltage is imposed on the LD OFF terminal ($\overline{\text{LD-OFF}}$) on a 28 pin connector, the emission of laser diode (LD) will stop and LdōF is displayed. All binary data are fixed to OFF, error output ON and linear output 4 mA.

5

Error Displays & Error Codes

This section describes error displays and error codes displayed when errors occur.

5.1 Error Displays and Error Codes

When errors occurred, make sure the error displays on a front panel and take the proper procedure according to the below table. When operating by communication, error codes will be sent. Please note that all binary data are fixed to OFF, error outputs ON, and linear output 4 mA when errors are occurred.

1 Errors when turning ON power

Error Display Error Code	Cause	Remedy	Procedure
Err3 (Error 3) (header) Err 3 (footer)	LD deterioration	Replace the sensor head.	Power-on reset
Err5 (Error 5) (*1)	Light volume data error	Set the light volume data writing again.	Press ^ and ESC simultaneously to perform light volume data writing. (Refer to Page 26 for light volume data writing.)
Err7 (Error 7) (header) Err 7 (footer)	Sensor connection error	Check the sensor connector.	Power-on reset
Err8 (Error 8) (header) Err 8 (footer)	System error	Perform power-on reset. If errors still occur after the power-on reset, contact OMRON representative.	
Err9 (Error 9) (*1)	EEPROM data error	Set parameter settings again.	Press SEL to reset all settings to default settings.
LdoF (Laser OFF) (header) LdoF (footer)	LD OFF input is ON	Release LD OFF.	Automatic reset

(*1) Error codes are not sent for initial setting.

2 Errors in Normal Measurement Mode

Error Display Error Code	Cause	Remedy	Procedure
Err 1 (Error 1) (header) Err 1(footer)	External light interference	Change the place to install the receiver or place a shield to prevent external light interference.	Automatic reset
Err2 (Error 2) (header) Err 2 (footer)	Dirt on the emitter or receiver	Clean the optical filter of the emitter and receiver with soft cloth (lens cleaner, etc.)	
	More than 32 edges	The Sensor can not measure 32 or more edges. (*2)	
Err3 (Error 3) (header) Err 3 (footer)	LD deterioration	Replace the sensor head.	Power-on reset
Err4 (Error 4) (header) Err 4 (footer)	Communication conditions error	Use the same communication conditions for sending and receiving.	Press SEL to go to communication setting menu and check the setting.
	Receiving data error	Do not input commands while sending data. (*3)	
Err7 (Error 7) (header) Err 7 (footer)	Sensor connection error	Check the sensor connectors.	Power-on reset
Err8 (Error 8) (header) Err 8 (footer)	System error	Perform power-on reset. If errors still occur after the power-on reset, contact OMRON representative.	
LdoF (Laser off) (header) LdoF (footer)	LD OFF input is ON	Release LD OFF.	Automatic reset
(*1) (header)NG(footer)	Receiving data error	Check the data and communicate again.	
		Do not input commands while sending data. (*3)	

(*1) No error messages are displayed for receiving data errors.

(*2) When the sensing object is transparent or translucent, edges may be formed due to the reflection of the laser beam.

(*3) The Z4LC cannot accept commands while it is transmitting data. In case of sending commands continuously to the Z4LC, send the command in 6.6ms or more after the Z4LC is completed to transmit data.

3 Errors in Setting Mode

Error display Error Code	Cause	Remedy	Procedure
Err3 (Error 3) (header) Err 3 (footer)	LD deteriorations	Replace the sensor head.	Power-on reset
Err4 (Error 4) (header) Err 4 (footer)	Communication conditions error	Use the same communication conditions for sending and receiving.	Press SEL to go to communication setting menu and check the setting.
	Receiving data error	Do not input commands while sending data. (*2)	
Err6 (Error 6) (header) Err 6 (footer)	Parameter setting error	Set parameters again.	Press SEL to enter each setting menu.
Err7 (Error 7) (header) Err 7 (footer)	Sensor connection error	Check the sensor connectors.	Power-on reset
Err8 (Error 8) (header) Err 8 (footer)	System error	Perform power-on reset. If errors still occur after the power-on reset, contact OMRON representative.	
(*1) (header)NG(footer)	Receiving data error	Check the data and communicate again.	Automatic reset
		Do not input commands while sending data. (*2)	

(*1) No error messages are displayed for receiving data errors.

(*2) The Z4LC cannot accept commands while it is transmitting data. In case of sending commands continuously to the Z4LC, send the command in 6.6ms or more after the Z4LC is completed to transmit data.

4 Errors in Light Volume Data Writing

Error Display Error Code	Cause	Remedy	Procedure
Err 1 (Error 1) (header) Err 1 (footer)	External light interference	Change the place to install the receiver or place a shield to prevent external light interference.	Press SEL to go to the menu for light volume data writing.

Error Display Error Code	Cause	Remedy	Procedure
Err2 (Error 2) (header) Err 2 (footer)	Dirt or obstacle exist on the emitter or receiver	Clean the optical filter of the emitter and receiver with soft cloth (lens cleaner, etc.)	Press SEL to enter communication setting menu and check the setting.
Err3 (Error 3) (header) Err 3 (footer)	LD deteriorations	Replace the sensor head.	Power-on reset
Err4 (Error 4) (header) Err 4 (footer)	Communication conditions error	Use the same settings for sending and receiving.	Press SEL to enter communication setting menu and check the setting.
	Receiving data error	Do not input commands while sending data. (*2)	
Err7 (Error 7) (header) Err 7 (footer)	Sensor connection error	Check the sensor connectors.	Power-on reset
Err8 (Error 8) (header) Err 8 (footer)	System error	Perform power-on reset. If errors still occur after the power-on reset, contact OMRON representative.	
drY1 (Dark 1) (header) drk 1 (footer)	Insufficient light	Place the emitter and the receiver closer.	Press SEL to go to the menu for light volume data writing.
drY2 (Dark 2) (header) drk 2 (footer)	Dirt or obstacle exist on the emitter or receiver	Clean the surface on the emitter and receiver or remove the obstacle.	
HiEr (Hi error) (header) HiEr (footer)	Position displacement	Move up the emitter.	
LoEr (Low error) (header) LoEr (footer)	Position displacement	Move down the emitter.	
LdoF (Laser off) (header) LdoF (footer)	LD OFF input is ON	Release LD OFF.	
(1) (header) NG (footer)	Receiving data error	Check the data and communicate again.	Automatic reset
		Do not input commands while sending data. (*2)	

(*1) No error messages are displayed for receiving data errors.

(*2) The Z4LC cannot accept commands while it is transmitting data. In case of sending commands continuously to the Z4LC, send the command in 6.6ms or more after the Z4LC is completed to transmit data.

MEMO

6

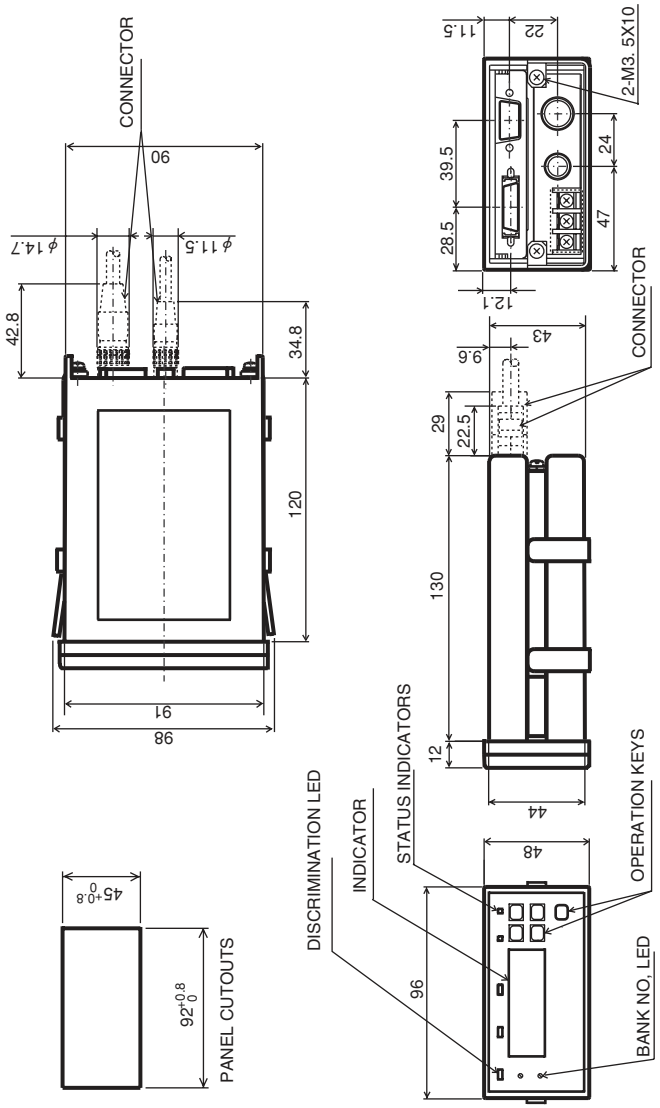
Specifications

This section describes performance and specifications.

6.1 Dimensions

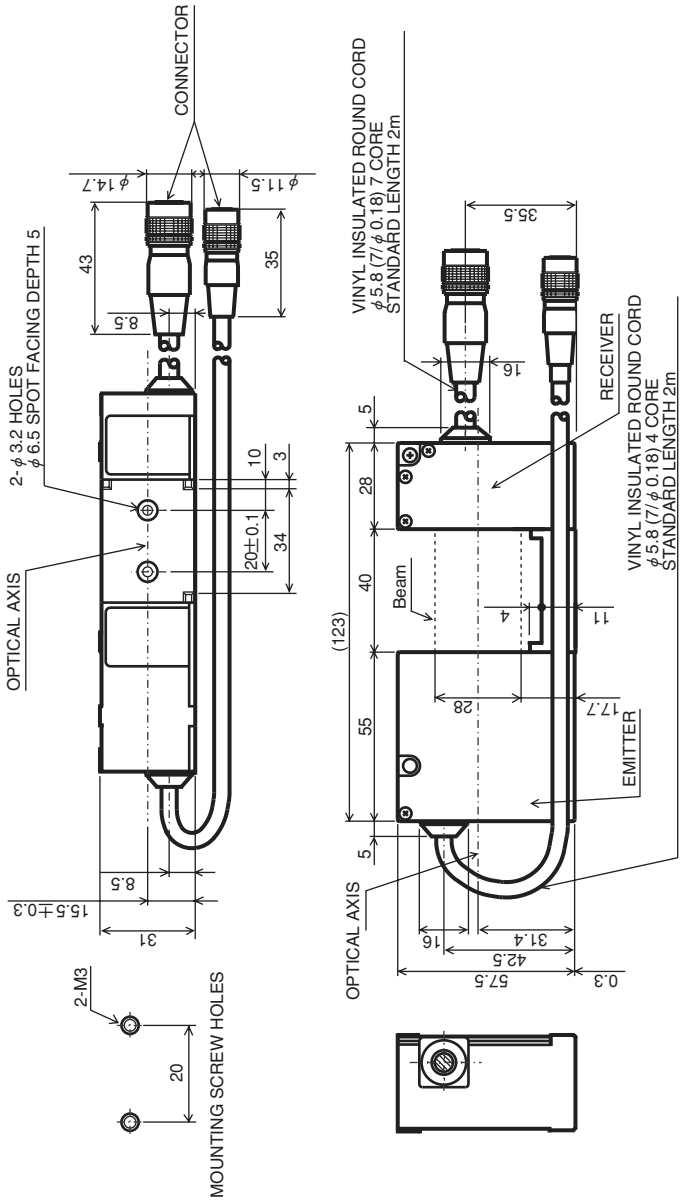
■ Controller

● Z4LC-C28

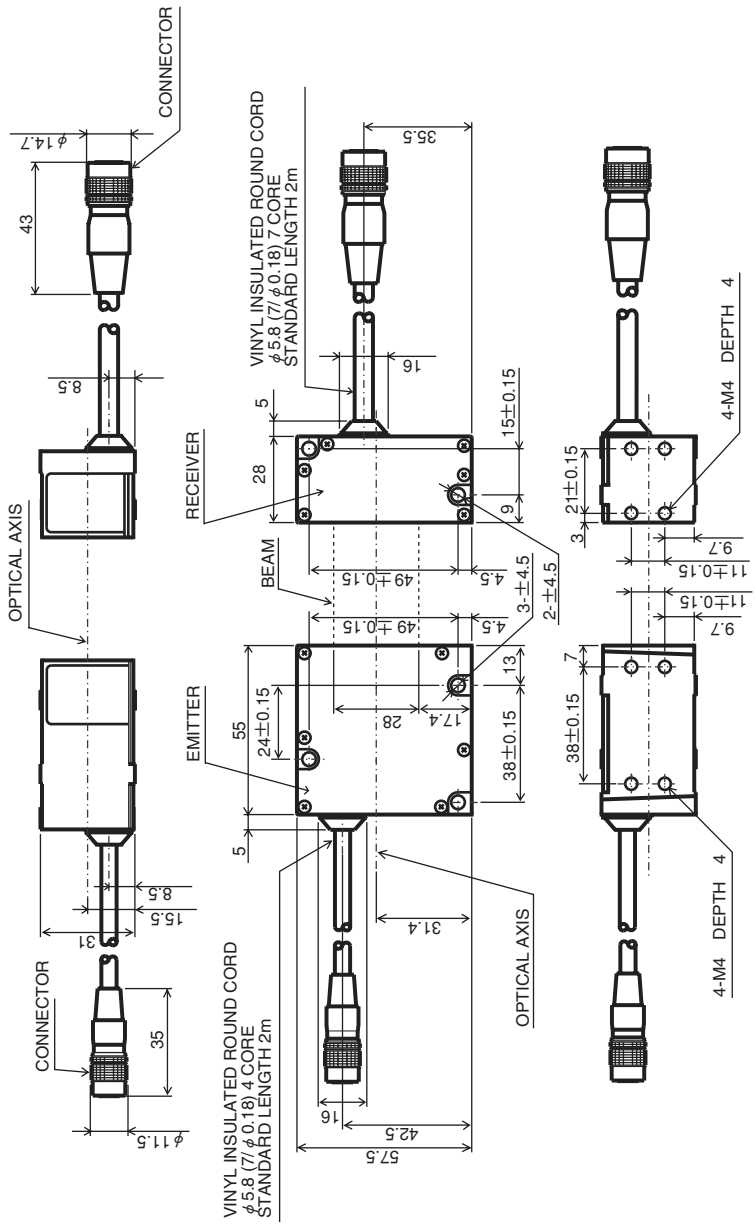


■ Sensor

● Z4LC-S2840



● Z4LC-S28


CONNECTOR
φ14.7
43
8.5
OPTICAL AXIS
8.5
15.5
31
CONNECTOR
35
φ11.5
VINYL INSULATED ROUND CORD
φ5.8 (7/φ0.18) 4 CORE
STANDARD LENGTH 2m
EMITTER
RECEIVER
BEAM
VINYL INSULATED ROUND CORD
φ5.8 (7/φ0.18) 7 CORE
STANDARD LENGTH 2m
35.5
16
5
28
15±0.15
9
49±0.15
4.5
3-±4.5
2-±4.5
55
24±0.15
17.4
13
38±0.15
5
31.4
16
42.5
57.5
OPTICAL AXIS
4-M4 DEPTH 4
21±0.15
3
9.7
11±0.15
7
38±0.15
4-M4 DEPTH 4

6.2 Specifications/Performance

■ Sensor

Item		Z4LC-S2840	Z4LC-S28
Light source		Visible-light semiconductor laser diode (wavelength: 670nm, JIS class 1)	
Measurement width		28 mm	
Sensing distance		40 mm	0 to 300 mm
Min. sensing object		ϕ 0.2 mm	ϕ 0.5 mm
Linearity *1, *2		± 0.1%F.S.	
Temperature drift *1		0.01%F.S. / ℃ max.	
Ambient temperature		Operating: 0 to +40℃, Storage: -15 to +50℃ (with no icing or condensation)	
Ambient humidity		Operating / Storage: 35 to 85% (with no condensation)	
Ambient illuminance	Incandescent lamp	1000 lx max.	
	Sun light	3000 lx max.	
Vibration		10 to 150 Hz Half-amplitude of 0.75 mm or acceleration of 100m/s^2 (whichever is smaller)	
Degree of protection		IEC60529 IP40	
Material		Diecast aluminum	
Cable length		2 m	
Weight		Approx. 520 g (including a 2 m cable)	Emitter : approx. 250 g Receiver: approx. 250 g (including a 2 m cable)

* 1. The values given are typical values for one-side interruption mode 1 with the distance between an emitter and a receiver set to 40 mm and the sensing object placed 20 mm from the receiver.

* 2. Linearity: The value deviated from the ideal straight line of measurement value outputs in one-side interruption mode 1 when the distance between an emitter and a receiver is set to 40 mm and the sensing object placed 20 mm from the receiver.

■ Controller

Item			Z4LC-C28
Display			7-segment, LED 4 digits
Minimum reading			10 μm
Repeatability *1, *2			20 μm (number of process values to average: 16)
Measurement value output	Analog	Output form	4 to 20 mA, Load impedance 300 Ω max.
		Response time	3.3 ms (number of process values to average: 1)
	Digital	Output form	12-bit binary output NPN open collector output 30 VDC 20 mA max. Residual voltage 2 V max.
		1digit *3	10 μm
		Response time	3.3 ms (number of process values to average: 1)
Output signals		Discrimination output (HI, PASS, LO)	NPN open collector output 30 VDC 20 mA max. Residual voltage 2 V max.
Input signals		Enable input LD OFF input Bank switch input Forced zero input External reset input	Photocoupler input Input voltage : 12 to 24 VDC ± 10% ON voltage : 10.2 VDC min. OFF voltage : 3.0 VDC max. Input current : 10 mA (Typ.)
Communications			RS-232C
Temperature drift			0.005%F.S./℃
Power supply voltage			24 VDC +10% -15% Ripple (p-p)10% max.
Current consumption			0.4 A max.
Main functions			Measurement value display, measurement mode selection, discrimination value setting selection, number of process values to average selection, forced zero function, bank number selection , linear output range setting, enable mode measurement
Ambient temperature			Operating: 0 to +50℃, Storage: -15 to +60℃ (with no icing or condensation)
Ambient humidity			Operating / Storage: 35 to 85% (with no condensation)
Vibration			10 to 150 Hz half-amplitude of 0.15 mm or acceleration of 20 m/s^2 (whichever is smaller)
Degree of protection			IEC60529 IP20
Material			ABS/PC
Weight			Approx. 290 g

*1. The values given are typical values for one-side interruption mode 1 with the distance between an emitter and a receiver set to 40 mm and the sensing object placed 20 mm from the receiver.

*2. The repeatability is the variation in the display and digital output when the sensing object is stationary. Performance specifications may not be satisfied depending on the environment such as strong magnetic field.

*3. The value converted to a distance corresponding to the 1LSB of the digital output.

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Authorized Distributor:

Printed in Japan
OMRON Industrial Automation Global: **www.ia.omron.com**
Cat. No. SCHA-716A
0408-1M (0507) (C)