

Assures Stable Detection of Glossy Metal Surfaces with Easy-to-see Visible Light

- Assures a resolution of 0.4 μm with a response speed of 100 ms when detecting white ceramics.
- Incorporated laser emits easy-to-use visible light.
- Incorporates easy-to-use range indicators.
- Incorporates Laser-OFF input and Enable output.
- Amplifier can be DIN track mounted.
- Conforms to EMC standards.
- Class II Laser Product (U.S. FDA 21 CFR1040.10) and Class 2 Laser Product (EN60825/JIS C6802)



Ordering Information

Sensing distance	Resolution	Model
30 \pm 2 mm	0.4 μm (100 ms) 4 μm (1 ms)	Z4M-N30V

■ Accessories (Order Separately)



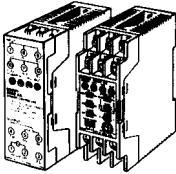
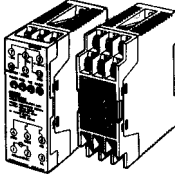
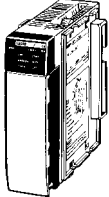
Extension Cable

Model	Z49-C1
Cable length	3 m, 8 m

Note: Specify the cable length when ordering.

■ Selecting a Controller

To display the linear output of the Z4M or use the Z4M for discriminating operation purposes, use the Z4M with one of the following Controllers.

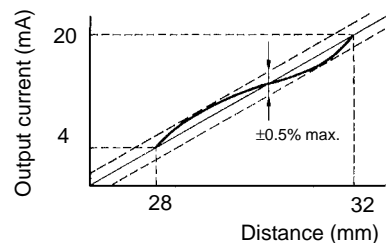
Unit					
Name	Intelligent Signal Processor	Scaling Meter	Sensor Controller	Linear Discrimination Unit	Linear Sensor Interface Unit
Model	K3TS-SD□□□□-□□	K3TJ	S3D2-□□	Z4W-DD1C	CQM1-LSE01/02
Features	High-speed sampling of 1.04 ms. Dual inputs with arithmetic functions. Forced zero function and other versatile functions incorporated. A sensor power supply with a capacity of 80 mA at 12 VDC incorporated. Five-level discrimination.	Wide scalability, including negative scaling. Highly-visible (14.2 mm) red or green display. Average process setting available.	Input response as short as 0.1 ms. Ideal for the control of two input signals. A sensor power supply with a high capacity of 200 mA incorporated.	4- to 20-mA analog input and PASS/NG discrimination output. A sensor power supply with a high capacity of 200 mA at 12 VDC incorporated. Built-in synchronous input function.	High-speed sampling of 1 ms (0.3 ms for timing input) without CQM1 programs. A forced-zero function lets you easily change reference points for different workpieces. Monitor output available with CQM1-LSE02.

Specifications

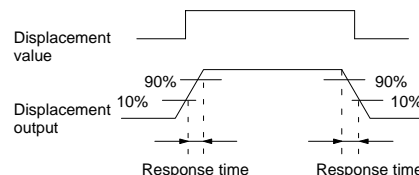
■ Ratings

Item		Z4M-N30V
Measurement range		±2 mm
Measurement point		30 mm
Light source		Visible-light semiconductor lasers with a wavelength of 670 nm and an output of 1 mW max.; class 2 (EN/IEC), class II (FDA)
Spot diameter (see note 1)		100 μm dia. max. (at measurement point)
Linearity (see note 2)		±0.5% FS (The full-scale value is 4 mm.)
Temperature drift (see note 3)		Sensor: 0.03% FS/°C Amplifier 0.02% FS/°C
Analog output	Current output	4 to 20 mA/28 to 32 mm Output impedance: 300 Ω max.
	Resolution (see note 4)	4 μm (1 ms) or 0.4 μm (100 ms)
	Response time (see note 5)	1/100 ms switch-selectable
Digital output	Output	12-bit binary output at a transmission cycle of 0.1 ms
	Repeat accuracy (see note 6)	10 μm
	Response time	0.4 ms
Control outputs	Output	NPN open collector, 100 mA max. at 30 VDC, residual voltage: 1 V max.
	Hysteresis	±1% FS
	Response time	ON: 0.4 ms, OFF: 1 ms (load current: 2 mA min.)
Enable output		NPN open collector, 100 mA max. at 30 VDC (residual voltage: 1 V max.)
Laser emission OFF input		ON with a max. current of 15 mA at a min. ON voltage of 10.2 V: Laser emission will be turned off. Open at a max. OFF voltage of 3 V: Laser emission will be turned on. A function holding all output and indicator statuses incorporated.

- Note:**
- The spot diameter is defined by $1/e^2$ (13.5%) of the Sensor's laser beam center. An object may not be detected accurately if there is light leakage outside the defined spot or depending on the object environment.
 - The linearity of the Sensor is checked with white alumina ceramic. The value deviated from the displacement linear output current is within the specified range as shown in the graph. The deviation value may vary with the object.



- The temperature drift in the table will be ensured if white alumina ceramic is detected on condition that white alumina ceramic fixed to the Sensor with an alumina jig.
- The resolution is the peak-to-peak displacement conversion value of the analog output on condition that white alumina ceramic is at the center of the measurement point. The values may not be guaranteed if the sensing object is in a strong electromagnetic field.
- The response time of the Sensor is the time required for the analog displacement output to increase from 10% to 90% of the full value (at the rise time) or decrease from 90% to 10% of the full value (at the fall time). To decrease the error ratio to within 1% at the rise time or at the fall time, the time required will be two or three times as long as the specified value.



- The repeat accuracy of the Sensor is a value obtained by converting the sampling data of digital output into distance data at $\pm 3\sigma$ when measuring white alumina ceramic at the measurement point.

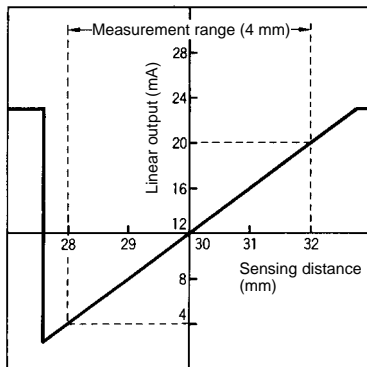
■ Characteristics

Item	Z4M-N30V
Power supply voltage	12 to 24 VDC±10%, ripple (p-p): 10% max.
Current consumption	200 mA max.
Dielectric strength	Sensor: 1,000 VAC, 50/60 Hz for 1 min Amplifier: 300 VAC, 50/60 Hz for 1 min
Vibration resistance	10 to 55 Hz (1.5-mm double amplitude) for 32 min each in X, Y, and Z directions
Ambient temperature	Operating: 0°C to 50°C (with no icing)
Ambient humidity	Operating: 35% to 85% (with no condensation)
Ambient illuminance	Operating: 3,000 lx max. (incandescent lamp)
Weight	Sensor: Approx. 250 g Amplifier: Approx. 250 g
Material	Sensor: Aluminum diecast Amplifier: ABS
Degree of protection	Sensor: IEC60529 IP40 Amplifier: IEC60529 IP20

Engineering Data

■ Linear Output vs. Sensing Distance

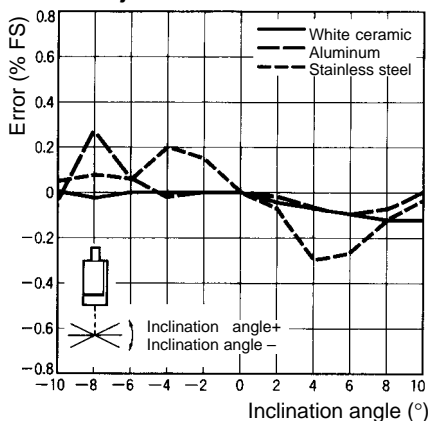
Z4M-N30V



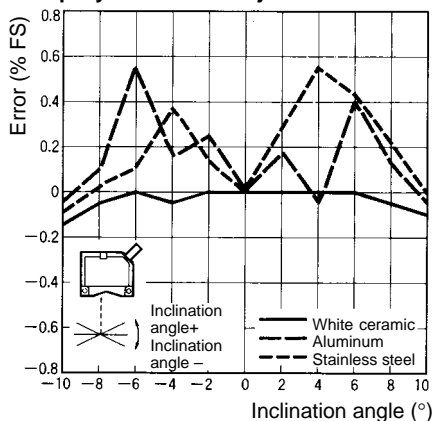
■ Angle Characteristics (Typical Example)

The angle characteristics are obtained by detecting an object with different angles of inclination at the measurement point and plotting the linear output error resulting from each operation.

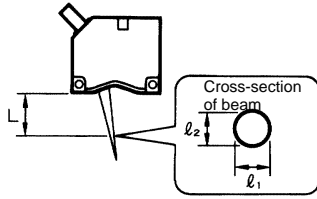
Inclined Object



Obliquely Positioned Object



■ Spot Diameter (Typical Example)



L	28 mm	30 mm	32 mm
l_1	96 μm	64 μm	58 μm
l_2	96 μm	55 μm	47 μm

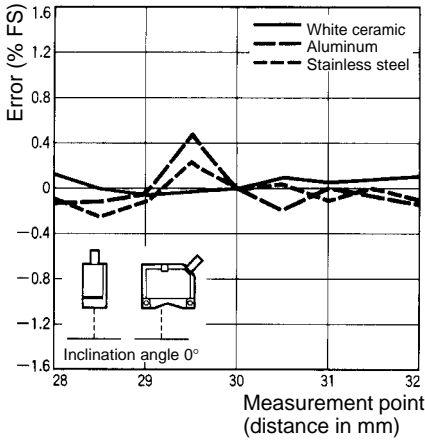
Note: Defined by $1/e^2$ (13.5%) of the Sensor's laser beam center.

■ Linearity Characteristics vs. Objects (Typical Example)

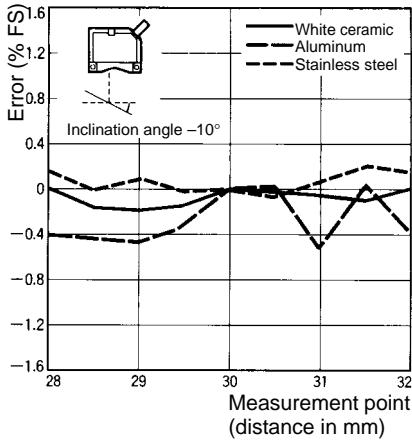
Linearity characteristic curves are obtained by detecting an object at different positions within the measurement range and plotting the linear output error resulting from each operation.

Inclined Object

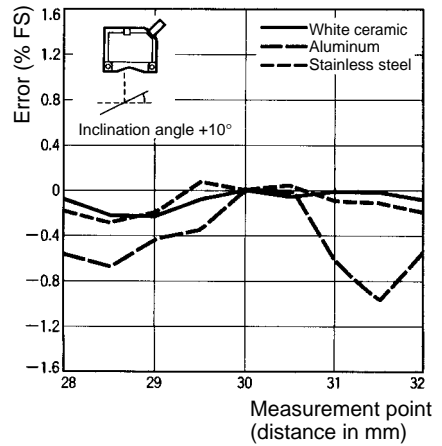
Angle: 0°



Angle: -10°

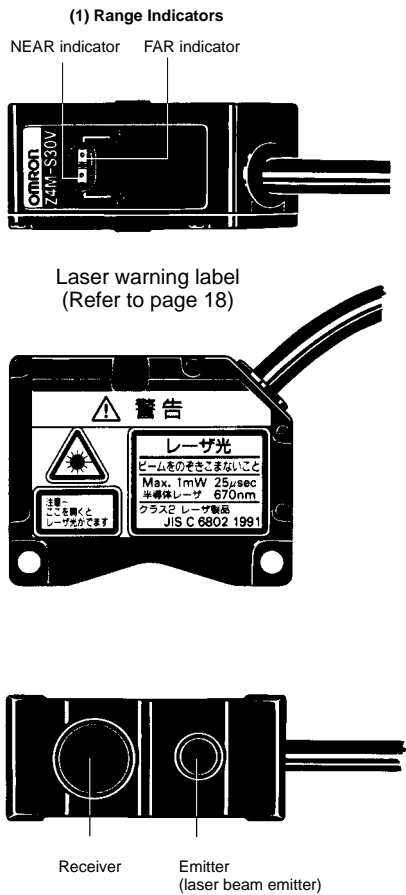


Angle: 10°

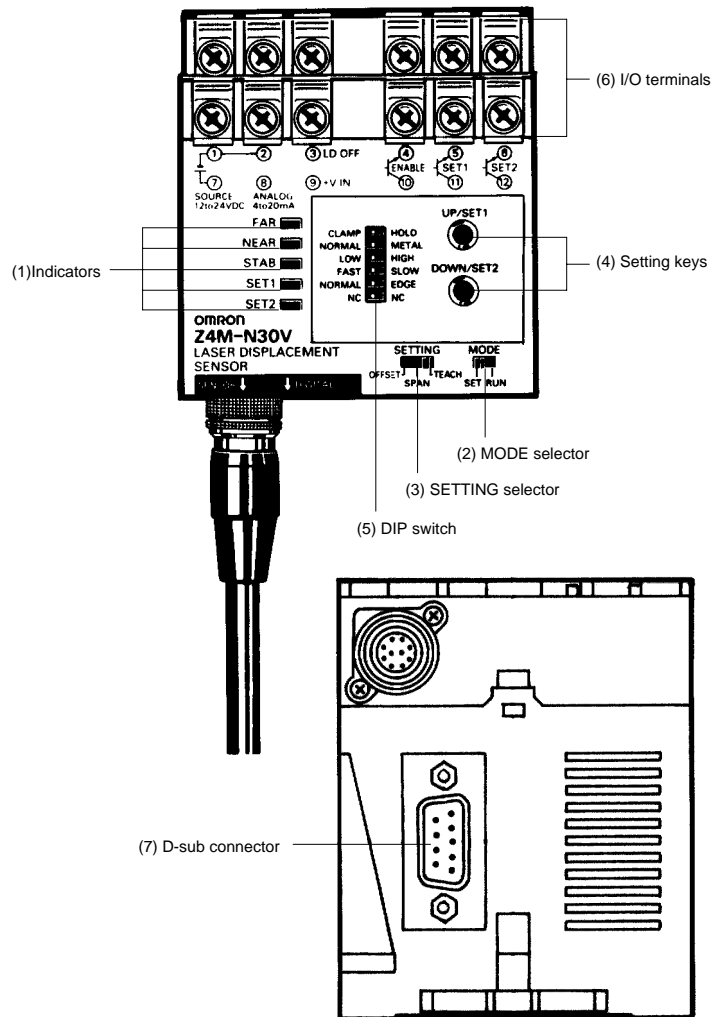


Nomenclature

Sensor



Amplifier



The numbers in parentheses refer to the nomenclature diagram above.

Classification		Description
(1) Indicators	FAR/NEAR (green)	Range Indicators (Sensor and Amplifier) Near: NEAR indicator is lit. Measurement point: NEAR and FAR indicators are lit. Far: FAR indicator is lit. Outside the range or insufficient or excessive light: Both the NEAR and FAR indicators flash.
	STAB (green)	Stability indicator (Amplifier)
	SET1/ SET2 (yellow)	Control output status indicator (Amplifier)
(2) MODE selector		RUN/SETTING Selection Set the MODE selector to RUN for set value processing and measurement. Be sure to set this selector to RUN before starting measurement.
(3) SETTING selector		Setting Selection Using Setting Keys OFFSET for offset setting SPAN for span adjustment TEACH for set values for SET1/SET2 teaching
(4) Setting keys	UP/SET1	Keys for offset/span adjustment and teaching for SET1/SET2 set values.
	DOWN/SET2	
(5) DIP switches (see note)	CLAMP/HOLD	Output status selection when the object is outside the measurement range.
	NORMAL/METAL	Laser power control
	LOW/HIGH	Sensitivity selection
	FAST/SLOW	Response speed selection (analog outputs)

Classification		Description
	NORMAL/EDGE	Analog output status selection
	NC/NC	Not used
(6) I/O terminals (see note)		---
(7) D-sub connector (see note)		---

Note: Refer to the following tables for details on the functions.

■ Inputs/Outputs

Classification		Description
I/O terminals	Analog output	An analog current signal will be output according to the sensing distance. Current output: 4 to 20 mA/28 to 32 mm Output impedance: 300 Ω max. The output will be locked between 21 and 26 mA when the object is outside the measurement range or in the case of insufficient or excessive light. In the case of measuring a metal or shiny object, an output of 4 to 20 mA may be ON even if the object is outside the measurement range.
	SET1/SET2 outputs (detection output)	The SET1 or SET2 output will be ON if the present displacement data is close to the distance set by teaching with the push-button switches. The SET1 or SET2 output will be OFF if the data is far from the distance. The SET1 output operates according to the UP/SET1 setting and the SET2 output operates according to the DOWN/SET2 setting. An open collector output of 100 mA maximum at 30 VDC will be obtained. When the object is outside the measurement range or in the case of insufficient or excessive light, the SET1 or SET2 output will be OFF. In the case of measuring a metal or shiny object, the SET1 or SET2 output may be ON even if the object is outside the measurement range.
	Enable output	The enable output is ON when the Sensor is in measuring operation. The enable output will be OFF when there is no object in front of the Sensor or in the case of insufficient or excessive light. An open collector output of 100 mA maximum at 30 VDC will be obtained. In the case of measuring a metal or shiny object, the enable output may be ON even if the object is outside the measurement range.
	Laser-OFF input	The laser OFF input controls laser emission. Laser emission will be turned on when there is no laser-OFF input. Laser emission will be turned off when a 12-to 24-V input is imposed on the power supply terminal and the laser-OFF input is short-circuited to the ground terminal of the external power supply. When laser emission is off, all displacement outputs and indicator status will be on hold. The response time required to turn on or off laser emission is 3 ms.
D-sub connector output	Digital output	The digital output of the Sensor can be used for processing displacement data, such as average processing, after the displacement data is sampled at high speed. Refer to <i>Connections</i> for details. A 12-bit digital displacement signal within a range between 1000 and 3000 (decimal) will be output according to the sensing distance (i.e., 28 to 32 mm). The signal will be in 4-bit blocks from the leftmost bit and output at a transmission cycle of 0.1 ms. The least readable value corresponds to 2 μm. An open collector output of 20 mA maximum will be obtained. The supply voltage must not exceed the supply voltage imposed on the Amplifier. When the object is outside the measurement range or in the case of insufficient or excessive light, the output will be set to 4000 (decimal). In the case of measuring a metal or glossy object, a data output within a range between 1000 and 3000 may be ON even if the object is outside the measurement range. The length of the digital output cable must be 2 m maximum.
Other function	Laser emission delaying function	When the Sensor is turned on, the NEAR and FAR indicators will flash for 2 to 6 s, thus alerting the user to laser emission. During this period, the output will be as follows: Analog output: 3 mA max. Digital output: 0 (decimal) Control outputs: OFF Enable output: OFF

■ DIP Switches

Classification	Description
CLAMP/HOLD	Output status selection when the sensing object is outside the measurement range CLAMP: For normal measurement. Analog output is locked between 21 and 26 mA. HOLD: For obtaining stable measurement results without being affected by flaws, hair lines, or level differences in the sensing objects such as metals. The previous status of each output will be on hold.
NORMAL/METAL	Laser power control depending on sensing objects NORMAL: For normal measurement. METAL: For measuring objects with high light reflection rates and those with low light reflection rates alternately, such as angled IC pins.
LOW/HIGH	Sensitivity selection LOW: For normal measurement HIGH: For measuring objects with low light reflection rates, such as black paper and rubber.
FAST/SLOW	Analog output response speed selection FAST: 1 ms SLOW: 100 ms
NORMAL/EDGE	Analog output status selection NORMAL: For normal measurement EDGE: For sensing subtle level differences. Variations in level differences are differentiated for analog outputs. The analog output is fixed at 12 mA for flat surfaces irrespective of different displacements.

Operation

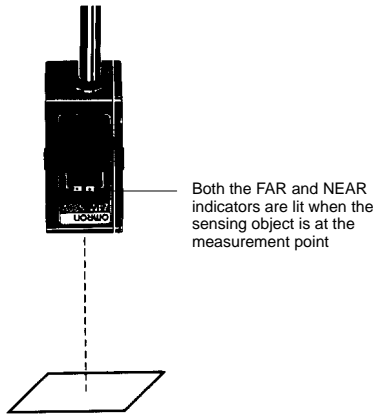
Distance and Axis Adjustment

The Sensor incorporates a laser beam delaying circuit, so the laser beam will start emitting 2 to 6 s after the Sensor is turned on.

During the period of 2 to 6 seconds, the NEAR and FAR indicators keep on flashing, indicating that the laser light is off.

Adjust the distance between the sensing object and Sensor so that both NEAR and FAR indicators will be lit when the spot of the beam strikes the center of the object displacement.

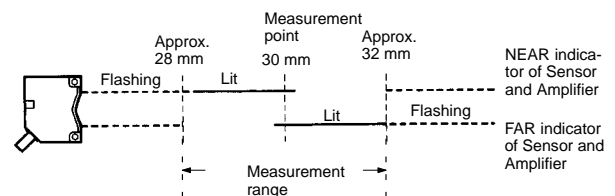
Adjust the position of the sensing object or the Sensor so that the spot of the beam will be focused on the object.



The NEAR or FAR indicators will be lit when the object is within the measurement range of the Sensor.

When the object is outside the measurement range or in the case of insufficient or excessive light, both the NEAR and FAR indicators will flash.

When the laser-OFF input is ON, the previous status will be on hold (i.e., the indicators will be lit or flash).



Confirmation of Measurement Status

- Stable measurement can be confirmed through the STAB indicator.

The indicator will be lit when the object is within the measurement range and the receiver receives intense-enough light reflected from the object.

The indicator will not be lit when the object is outside the measurement range or in the case of insufficient or excessive light.

The indicator will flash if the receiver does not receive an intense-enough light reflected from the object.

- The SET1 or SET2 indicator will not be lit when the object is outside the measurement range or the receiver does not receive an intense-enough light reflected from the object.

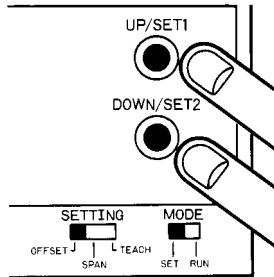
Offset and Span Adjustment (Displacement Output)

Offset and span adjustments are made before shipping with white ceramic.

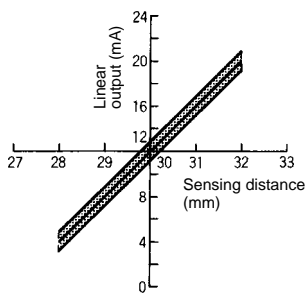
To calibrate the displacement output scale for the sensing object, make offset adjustment first and then span adjustment.

• **Offset Adjustment**

Set the MODE selector to SET and the SETTING selector to OFF-SET for offset adjustment. The measurement point (30 mm) becomes the reference measurement position. If fine adjustment is necessary, adjust the displacement output by pressing the UP/SET1 or DOWN/SET2 Key so that 12 mA output will be obtained at this reference position. The adjustable range is ± 0.2 mm of the sensing distance (i.e., ± 0.8 mA of linear output).

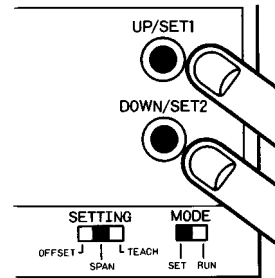


Offset adjustment

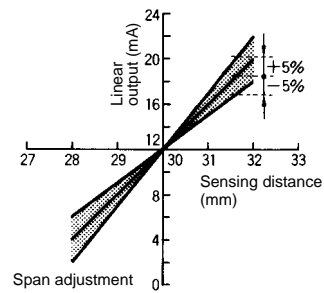


• **Span Adjustment**

Set the MODE selector to SET and the SETTING selector to SPAN for span adjustment. Locate the sensing object at the standard distance. Then, press the UP/SET1 or DOWN/SET2 Key while moving the sensing object so that the displacement of the Sensor output will change according to the displacement of the sensing object. The adjustable range is $\pm 5\%$ of measurement range (4 mm).



Span adjustment

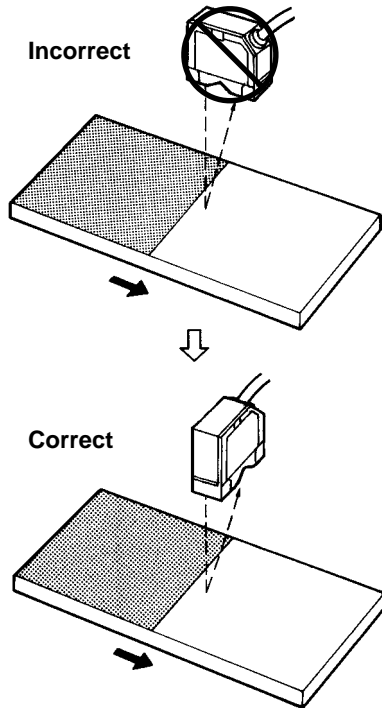


Set the MODE selector to RUN after adjustment.



Sensor Mounting Position

An error may result if the sensing object has a border dividing the sensing object into two portions different in color or material. In that case mount the Sensor so that the mounting direction of the Sensor will be in parallel to the border as shown in the following illustration to minimize errors.



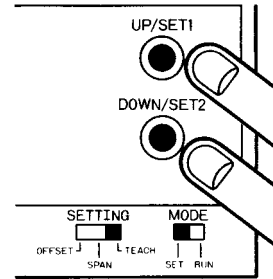
SET1/SET2 Set Value Teaching

To discriminate whether the sensing object is within the desired range, set the upper and lower limits of the desired range.

To set the upper and lower limits, set the MODE selector to SET and SETTING selector to TEACH.

Move the sensing object closest to the upper limit and press the UP/SET1 Key.

Move the sensing object closest to the lower limit and press the DOWN/SET2 Key.



Set the MODE selector to RUN, at which time the set value will be stored.



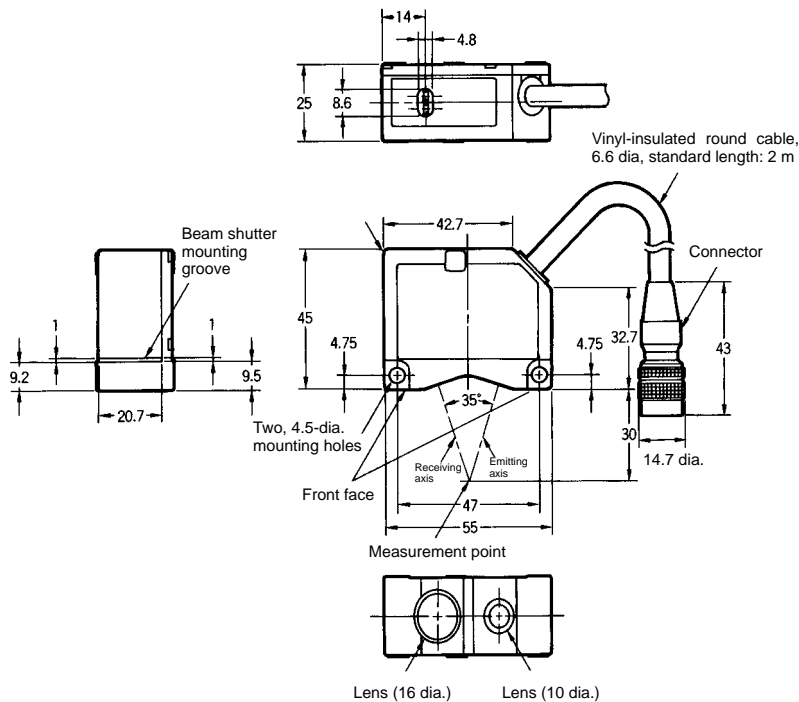
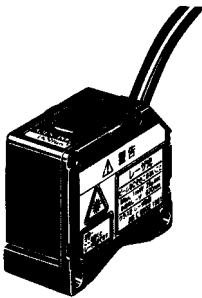
If the sensing object is within the desired range, the SET1 output is ON and the SET2 output is OFF.

It is possible to perform teaching with two levels independent from each other.

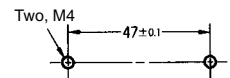
Dimensions

Note: All units are in millimeters unless otherwise indicated.

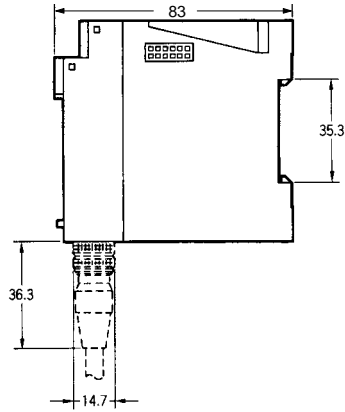
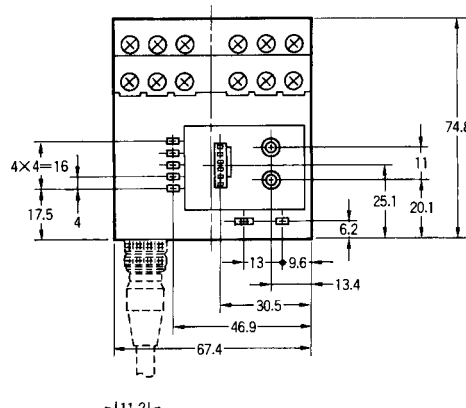
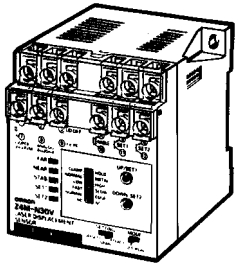
Sensor
Z4M-S30V



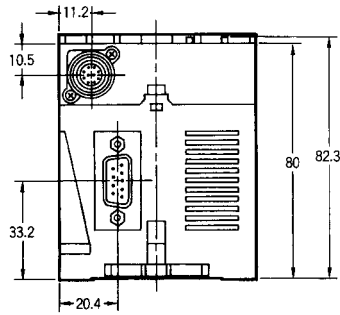
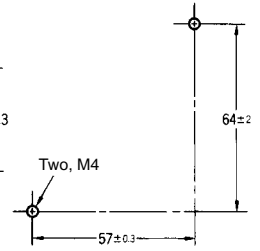
Mounting Holes



Amplifier
Z4M-N30C

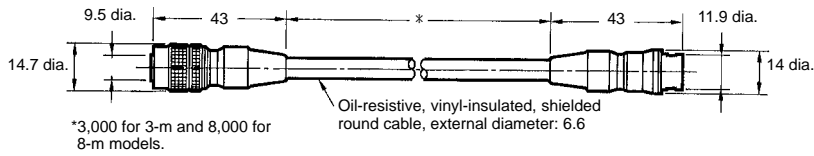


Mounting Holes



Extension Cable

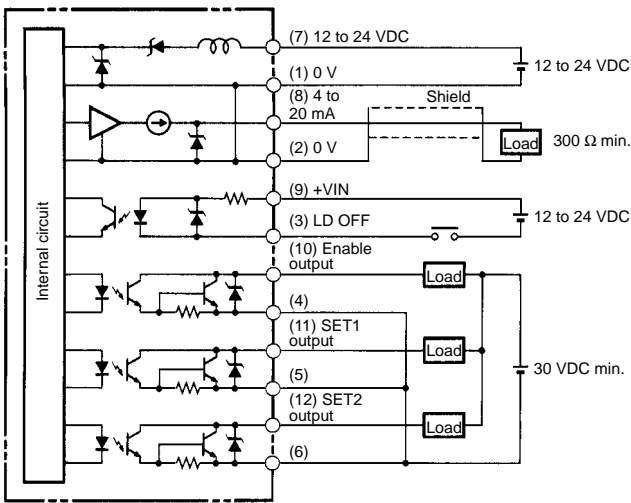
Z49-C1



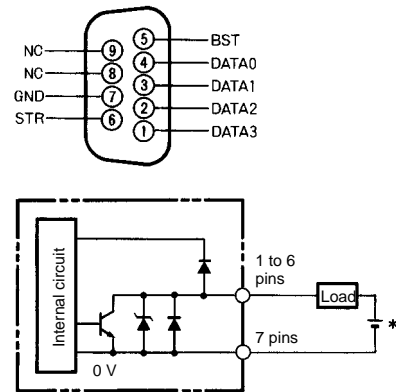
Installation

Output Circuit Diagram

Terminal Block



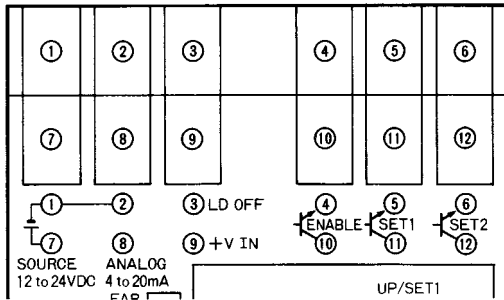
D-sub Connector Output



* The supply voltage must not exceed the permissible voltage imposed on terminal 7.

Connections

Terminal Block



(7) Power supply:

Supply 200 mA min. at 12 to 24 VDC.

(1) 0 V:

0-V terminal

(8) Analog output:

A current output of 4 to 20 mA will be obtained according to the displacement.

(2) 0 V:

Used as a ground terminal for analog outputs to the Sensor Controller.

(9) Laser-OFF input (power supply of laser-OFF input):

To turn laser emission off, supply 15 mA min. at 12 to 24 VDC.

(3) Laser-OFF input:

Laser emission will be turned off if the voltage between terminals 9 and 3 is 10.2 V min.

Laser emission will be turned on if the voltage between terminal 9 and 3 is 3 V max. or these terminals are open.

The laser-OFF input is an open collector input.

(10) Enable output:

Turned on with open collector output when the Sensor can be operated.

(11) Control output (SET1):

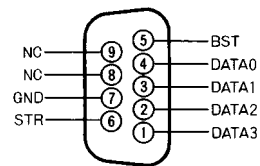
Operates according to the displacement values stored with UP/SET1 setting.

(12) Control output (SET2):

Operates according to the displacement values stored with DOWN/SET2 setting.

(4) to (6) Common terminals for control output and enable output

D-sub Connector



Pins 1 to 4:

Twelve-bit binary data is output from these pins in 4-bit blocks at 25-μs intervals and a transmission cycle of 0.1 ms.

The data range is between 1000 and 3000 (decimal) for a sensing distance range between 28 to 32 mm, which means a single bit of data corresponds to 2 μm.

Pin 5:

A signal indicating the start of 12-bit binary data is output.

Pin 6:

A strobe signal indicating the reception timing for 1- to 5-pin signals is output.

Pin 7:

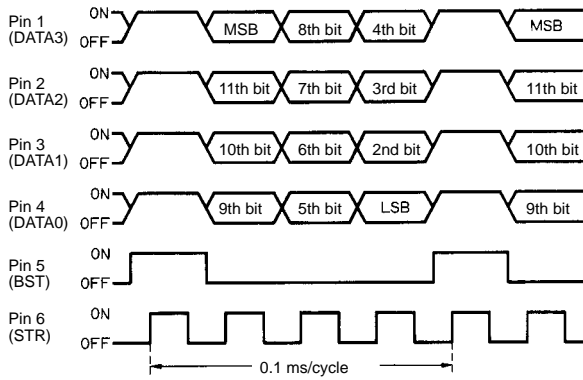
A common ground pin for 1- to 6-pin outputs. This pin is connected to the internal ground terminal.

Pins 8 and 9:

Not used.

Refer to the following timing chart for 1- to 6-pin input timings.

Open Collector Output

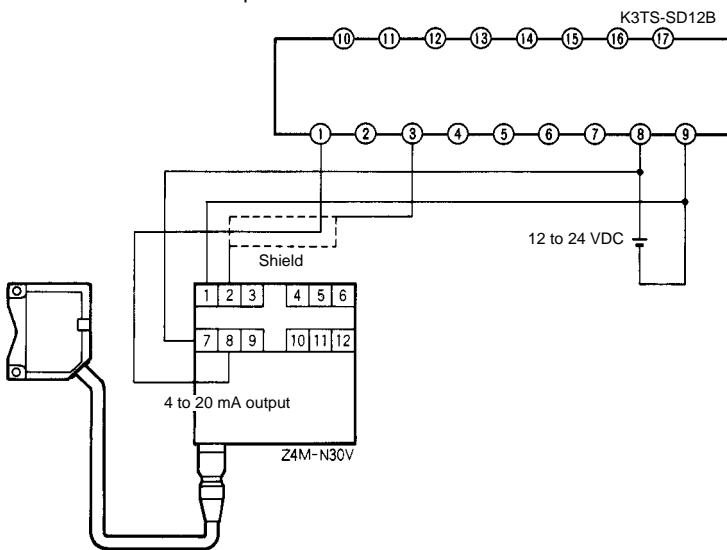


Use one of the following D-sub connector plugs, which are sold separately.

Plug: XM2A-0901 or XM2S-0911

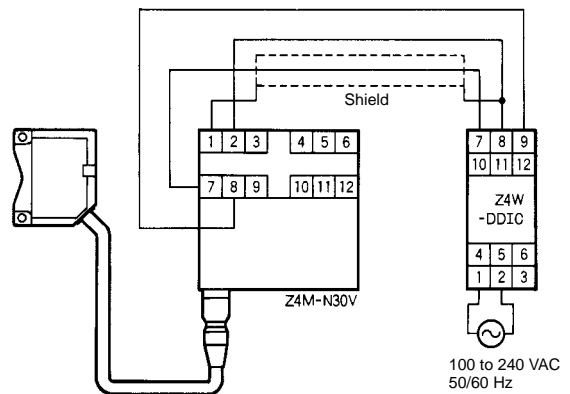
Connection with K3TS Intelligent Signal Processor

Distance indication, high-speed and high-precision operation, and 5-level discrimination are possible.



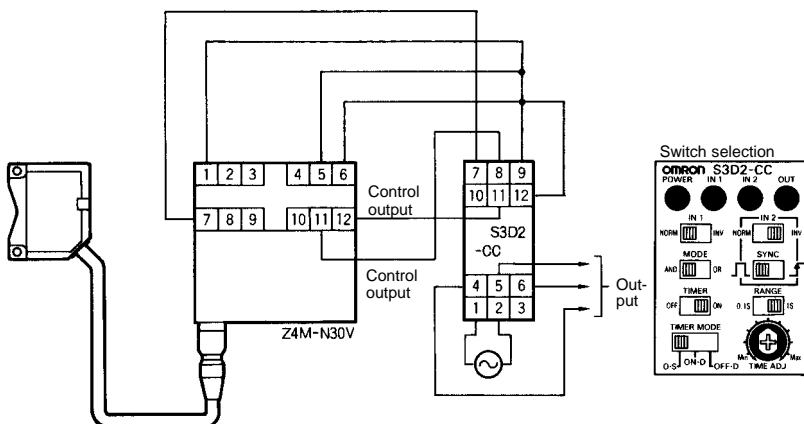
Connection with Z4W-DD1C Linear Discrimination Unit

Simple PASS/NG discrimination is possible. A sensor power supply is built in.



Connection with S3D2 Sensor Controller (Connection Example of Control Outputs)

Discriminating whether the sensing object is within the desired range.



Precautions

The Z4M-N30V Regular Reflective Displacement Sensor, is a Class 2 Laser Product according to EN60825 (IEC825) and JIS C6802 and a Class II Laser Product according to FDA (21 CFR1040.10) (see note). The Z4M-N30V 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 2 of EN60825: 1991 = IEC825: 1984 & IEC825-A1: 1990
Japan: Class 2 of JIS C6802: 1991
U.S.A.: Class II of FDA (21 CFR1040.10)

1. Use this product as specified in this datasheet. 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
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 (Refer to page 18)			
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 (Refer to page 18)			
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				
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	Ila	II	IIla	IIlb	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)
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

Requirements; 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					
	1	2a	2	3a	3b	4
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

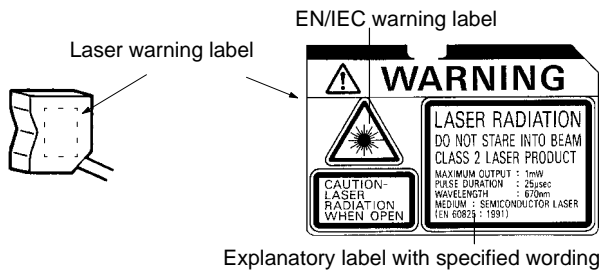
Class	Description
Class 1	Safe inherently by engineering design.
Class 2	Low power in the visible spectrum (wavelength: 400 to 710 nm); eye protection normally afforded by aversion responses.
Class 3A	Direct intrabeam viewing with optical aids may be hazardous. Power of less than 5 mW max. for visible 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

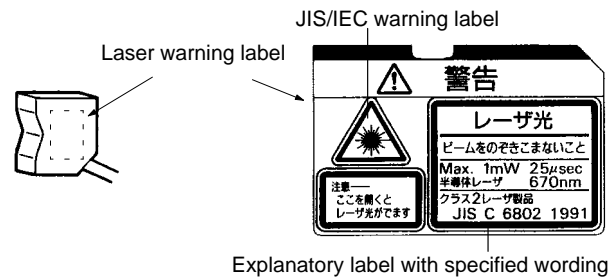
Class	FDA definition	ANSI description
Class I/1	Limits applicable to devices that have emissions in the ultraviolet, visible, and infrared spectra, and limits below which biological hazards have not been established.	A Class 1 laser is considered to be incapable of producing damaging radiation levels 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



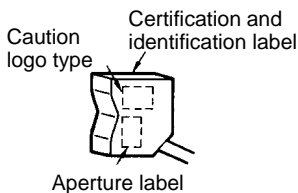
JIS



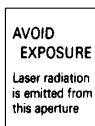
Note: Use of controls, adjustments, or procedures other than those specified herein may result in hazardous radiation exposure.

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

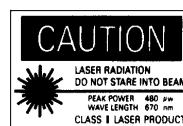
FDA



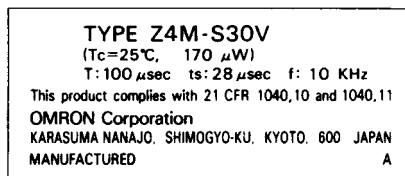
Aperture Label



Class II Caution logo type



Certification and Identification Label



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

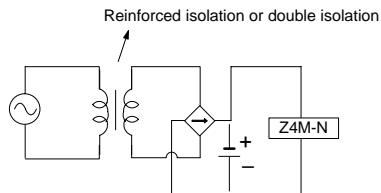
■ Precautions When Using Power Supply

Use an isolated DC power supply such as:

UL/CSA: Class 2 power source

EN/IEC standards: Safety Extra Low Voltage (SELV) power source

Example: SELV Power Source



■ Notes

Compatibility

The Sensor and Amplifier are adjusted as a set and they have the same serial number. The Sensor or Amplifier cannot be used with another Amplifier or Sensor.

Environment

Install the Sensor in a 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:

1. Use a blower brush (used to clean camera lenses) to blow away large dust particles from the surface. Do not blow the dust away with your mouth.
2. Use a soft cloth (for lenses) with a little alcohol to remove the remaining dust.

Note: Do not use a scrubbing action when cleaning as scratches on the filter could result in Sensor malfunction.

Do not use the Regular Reflective Displacement Sensor in strong electromagnetic fields or in environments where the operation of the Sensor is subject to the reflection of intensive light (such as other laser beams or electric arc welding machines).

The Regular Reflective Displacement Sensor cannot accurately detect the following types of objects: mirror-like objects, transparent objects, objects with an extremely low reflection ratio, objects smaller than the Sensor's sensing spot diameter, or largely inclined objects.

Mutual Interference

Sensors can be closely mounted. Do not, however, make each laser beam closer, otherwise the Sensors may malfunction.

Wiring

Do not impose voltage exceeding the rated voltage, otherwise the Sensor may be broken.

Do not short-circuit the load supplied with open collector output, otherwise the Sensor may be broken.

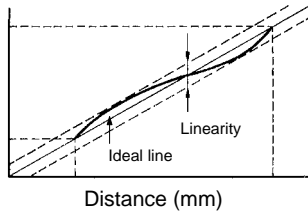
Do not lay power supply cable for the Z4M together with high-voltage lines or power lines to prevent interference, damage, or malfunction.

A Z49-C1 Extension Cable (3 or 8 m long) can be connected to the sensor cable or amplifier cable. The total length of the sensor cables or amplifier cables, however, must be 10 m or less. Use a shielded cable to extend the amplifier cable, in which case the same kind of shielded cable as that of the amplifier cable must be used.

■ Glossary

Linearity

The peak-to-peak value deviated from the displacement linear output voltage.

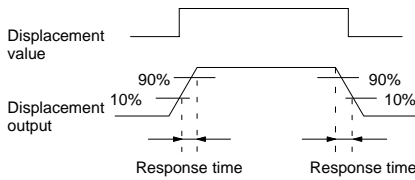


Resolution

The linear output fluctuates slightly due to internal noise while the sensing object remains stationary. The distance converted from the fluctuation width is referred to as the "resolution."

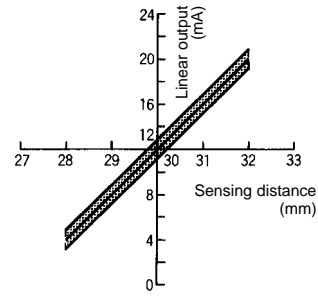
Response Time

Sensor response time is the time required for the analog displacement output to increase from 10% to 90% of the full value (at the rise time) or decrease from 90% to 10% of the full value (at the fall time). To decrease the error ratio to within 1% at the rise time or at the fall time, the time required will be two or three times as long as the specified value.



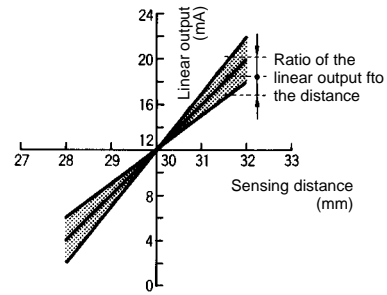
Offset Adjustment

Offset adjustment shifts the actual linear output to adjust the output.



Span Adjustment

The span adjuster is used to adjust the relationship between displacement and displacement output.



Temperature Drift

The fluctuation of the analog output due to changes in the ambient temperature. The value indicates the fluctuation for 1°C.

ALL DIMENSIONS SHOWN ARE IN MILLIMETERS.
 To convert millimeters into inches, multiply by 0.03937. To convert grams into ounces, multiply by 0.03527.

Cat. No. E261-E1-1A In the interest of product improvement, specifications are subject to change without notice.

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