OMRON

Confocal Fiber Displacement Sensor ZW Series

The 24×24×64-mm Sensor Head redefines the meaning of ultra-compact.

» Robust Sensor Head Structure

» Ultra-compact and Ultra-lightweight

» Stable Measurements for Any Material

realizing

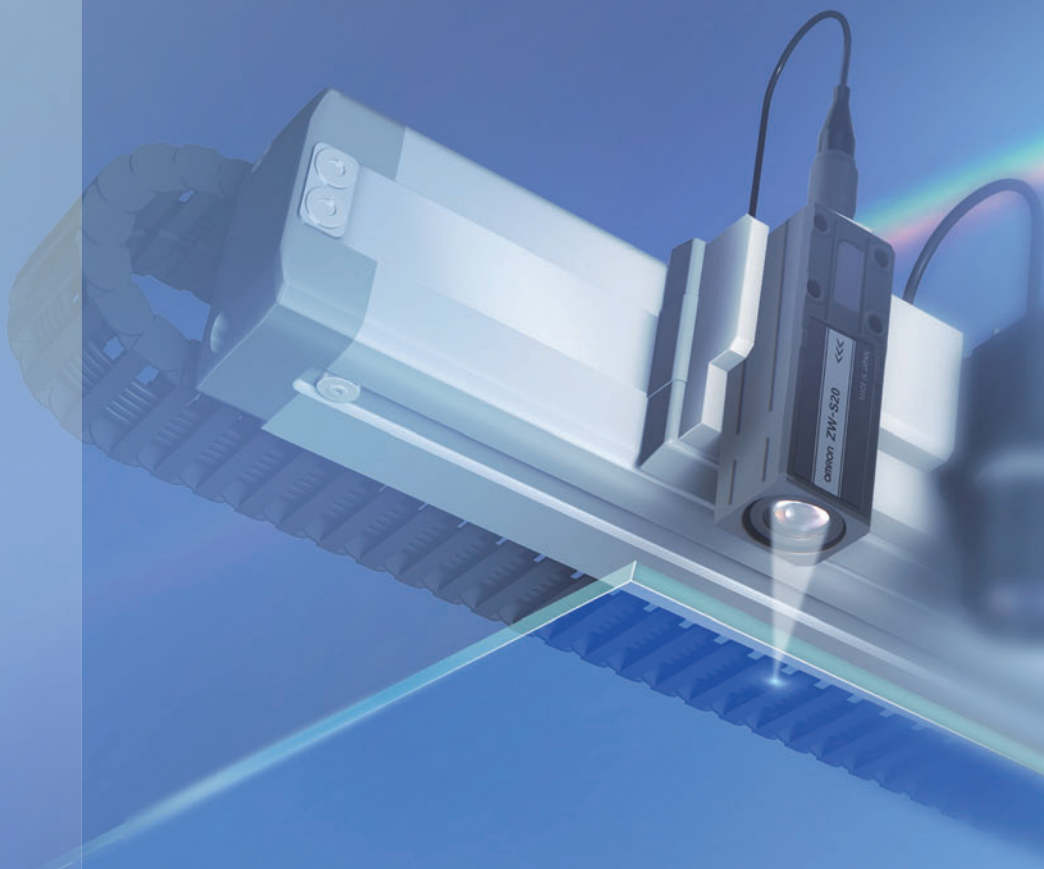
The Confocal Fiber Displacement Sensor beyond triangulation concepts with a new

Displacement Sensors are indispensable in non-contact measurement of heights, thicknesses, and other dimensions in machine operation control.However, building them into the system has always presented problems.The Confocal Fiber Displacement Sensor ZW Series solves these problems in ways that were not possible with traditional triangulation.

The ZW-series Sensors provide the compact size, light weight, immunity to electrical/magnetic noise, and other features to make them ideal for solving installation space problems.

And OMRON's new confocal principle provides the measurement resolution that is needed for operation control.

The ZW Series solves the problems that came with laser triangulation, such as deviations between different materials and inclination tolerance.



Min. Resolution 0.25 μm

ZW Series

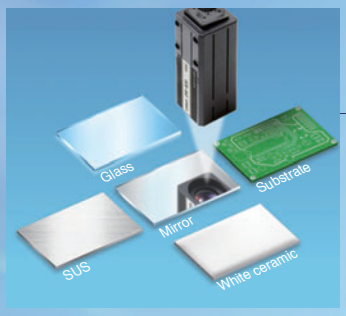
that goes principle.

The Three Benefits of OMRON's White Light Confocal Principle

Ultra-compact and Ultra-lightweight

The slim design measures only 24 × 24 mm.It weighs only 105 g.This incredibly compact size could not be achieved with traditional triangulation.And any objects can be measured with the Sensor mounted perpendicular to them to save even more space.

P.4



Stable Measurements for Any Material

You can measure objects of any material or color at the same position.A wide angle characteristic of ±8° enables high-resolution measurement of the position even for large objects with mirror-like surfaces without being affected by warping.

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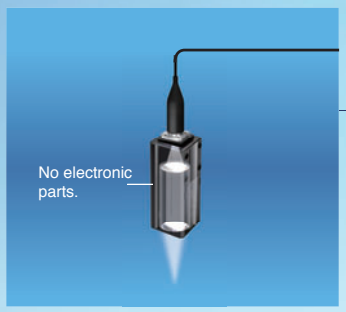


Robust Sensor Head Structure

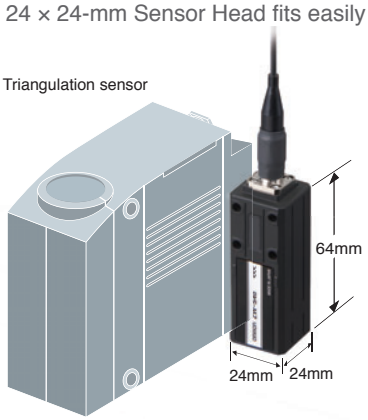
The Sensor Head is structured to be robust against electric and magnetic noise for reliable operation when in locations subject to noise.Also, the Sensor Heads and Flexible Fiber Cables do not give off noise or heat, so nearby devices are not affected.

P.8

Ultra-compact and Ultra-lightweight

Utilize Narrow Spaces in Machines

The 24 × 24-mm Sensor Head fits easily into essentially any machine.



Volume ratio 1/8*

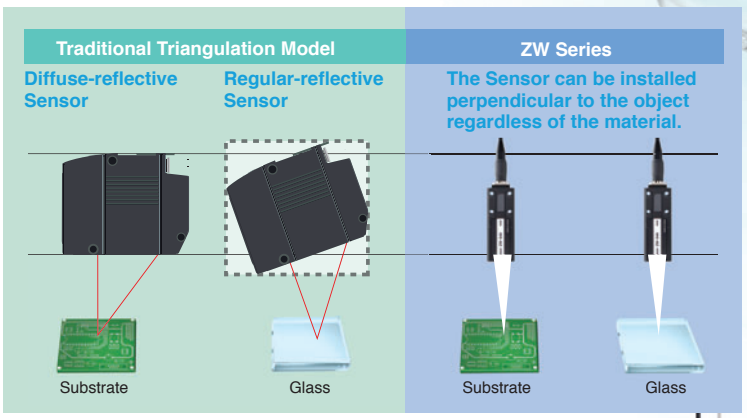
Weight ratio 1/8*

*In-house comparisons.

Mounting area Reduced to 1/7*

*In-house comparison.

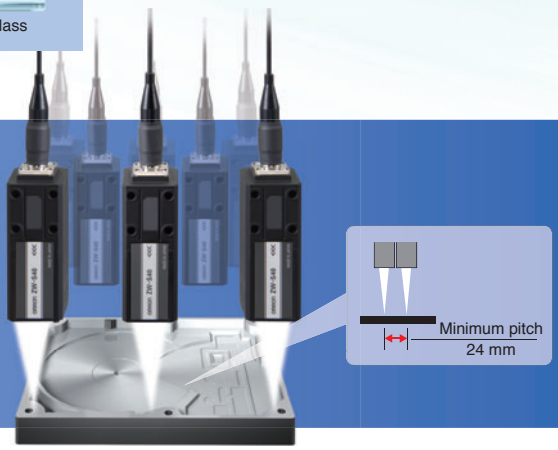
With traditional triangulation, it was necessary to use either diffuse reflection or regular reflection depending on the material.However, the confocal principle used for the ZW Series eliminates the need to change the Sensor installation even if the material changes.



Height Control of a Dispenser Nozzle

Sensor Installation in a Row with No Interference

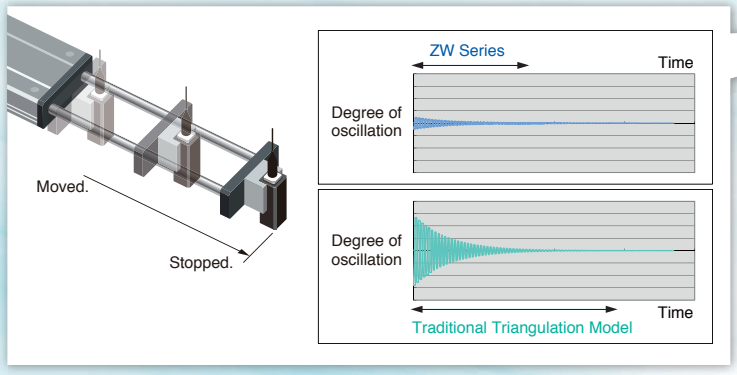
Mutual interference or space restrictions often prevent the installation of traditional triangulation sensors where necessary. Here, the compact ZW-series Sensor Heads allow you to install more sensors, in a row or otherwise.

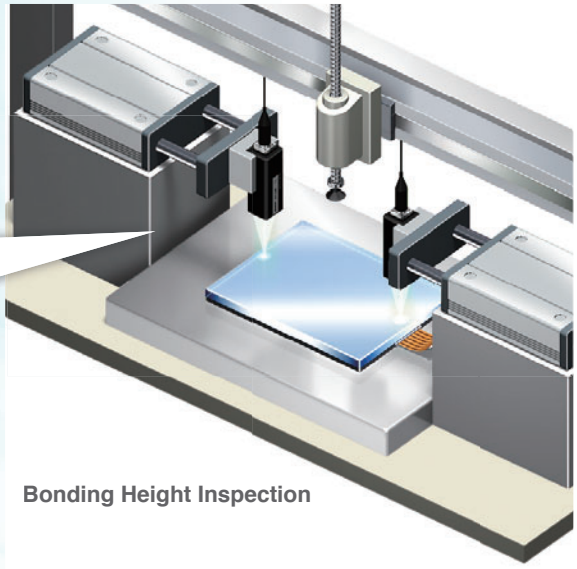


Non-contact Flatness Inspection of HDD Cases

Smooth Movement and Stopping

Using power cylinders to move sensors to measurement positions only when necessary so that the sensors do not interfere with machine motion results in delays in measurements while waiting for oscillation to stop after cylinder operation if the sensors are heavy.A ZW-series Sensor Head, however, weighs only 105 g so that measurements can be made as soon as the cylinder operation stops.



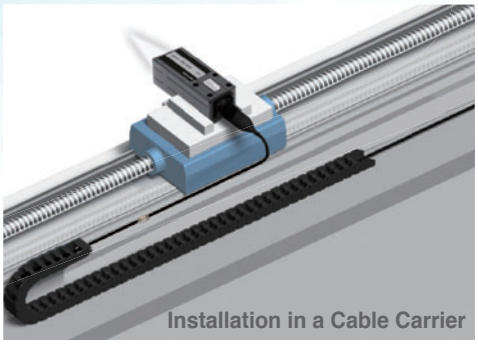


Bonding Height Inspection

Flexible Fiber Cable for Easy Installation

The Controller connects to the Sensor Head with a 2-mm-diameter Flexible Fiber Cable.The Cable has cleared a bending test consisting of 2,000,000* repetitions for reliable application on moving parts.

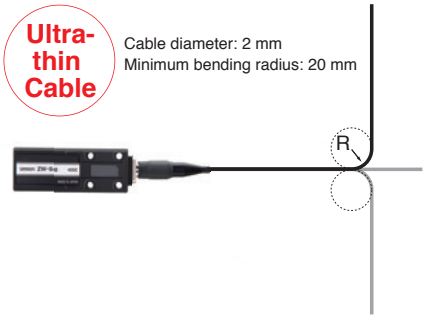
*Cable was tested with OMRON's bending test consisting of 2,000,000 bends to a 70-mm bending radius and 1,000,000 bends to a 20-mm bending radius.



Installation in a Cable Carrier

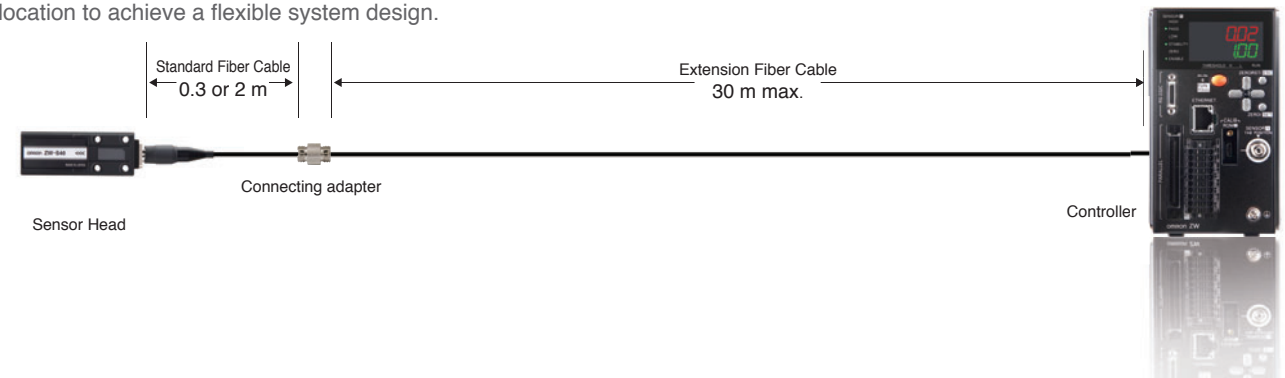
Ultra-thin Cable

Cable diameter: 2 mm
Minimum bending radius: 20 mm



Cable Extendable to 32 m

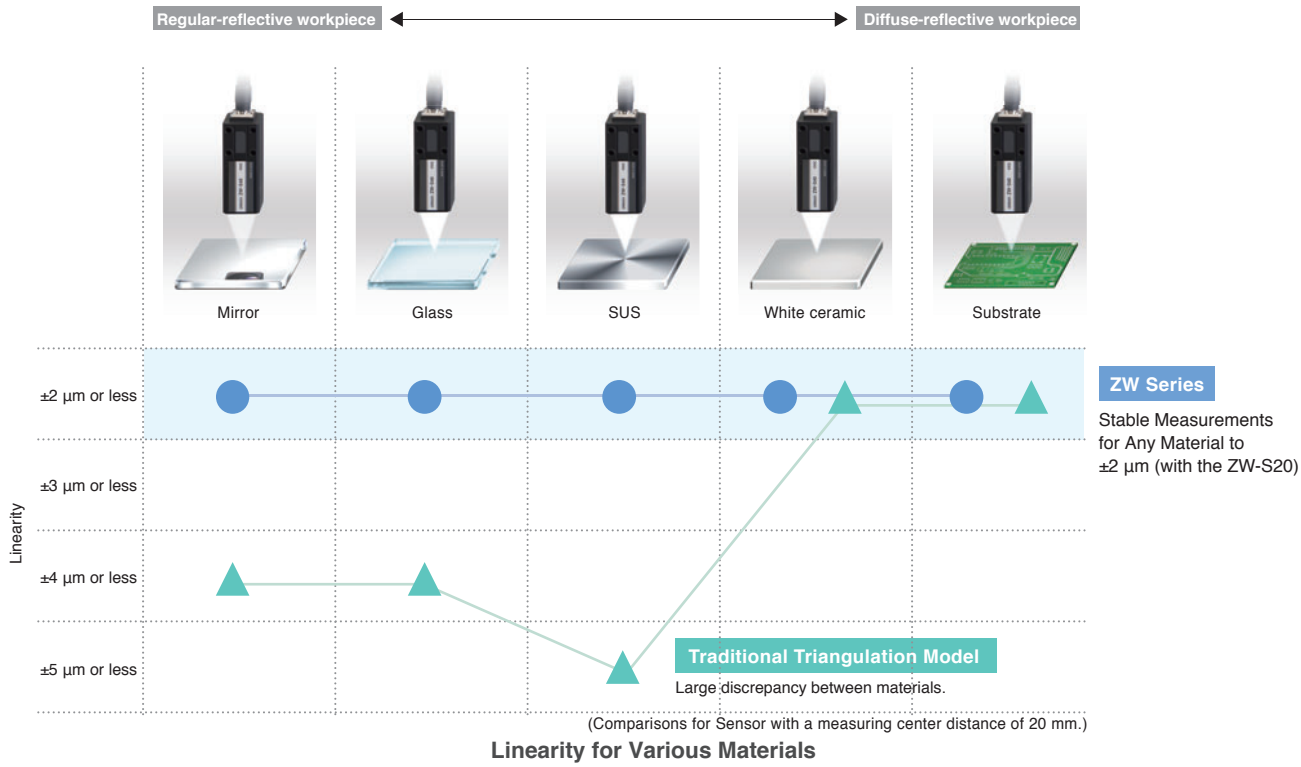
An Extension Fiber Cable can be used between the Sensor Head and Controller to extend the distance to up to 32 m.Attach the Sensor Head to a moving part and place the Controller in the control panel or other convenient location to achieve a flexible system design.



Stable Measurements for Any Material with Superior Angle Characteristic

Stable Measurements from the Same Mounting Position Even for Different Materials

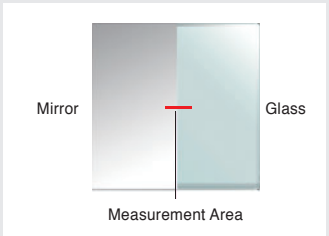
There is no need to change or tune the Sensor for each material. Even if the material changes, you can continue to achieve stable measurements with the same Sensor from the same mounting position.

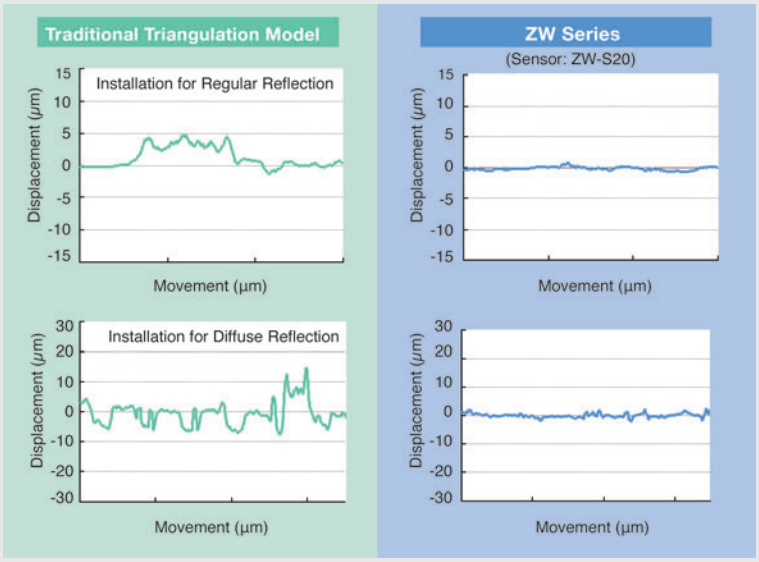


(Comparisons for Sensor with a measuring center distance of 20 mm.)

Linearity for Various Materials

Stable Measurements across Boundaries between Materials





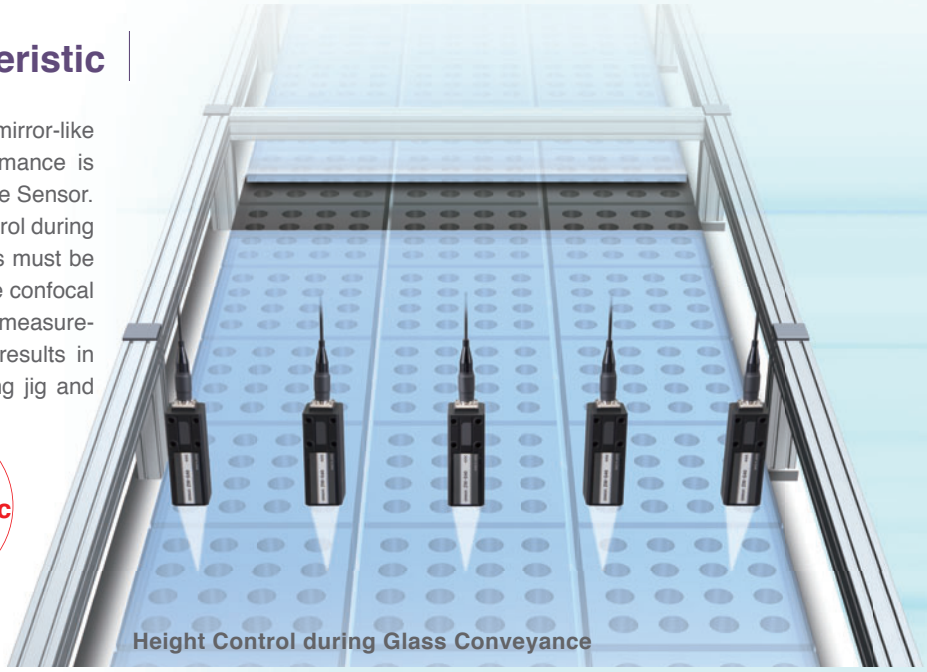
(All measurement graphs represent typical examples.)

Superior Angle Characteristic

When measuring an object that has a mirror-like surface with traditional triangulation, performance is greatly reduced depending on the angel of the Sensor. When many Sensors are used for height control during glass conveyance, the angles of the Sensors must be adjusted with high precision during setup.The confocal Sensor ZW series enables high-resolution measurements without strict angle adjustment.This results in reduction of cost and space for the adjusting jig and time for adjustment.

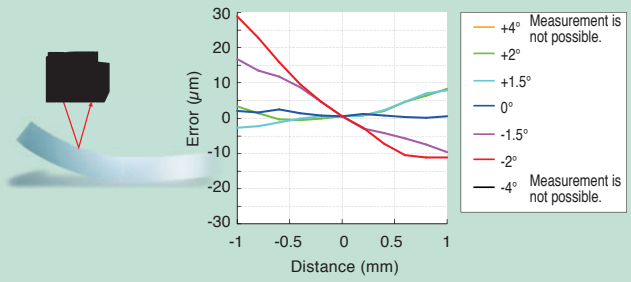
* This is not a guaranteed value. Refer to Characteristic Data (P17) for typical examples.

Angle characteristic ±8° *


Height Control during Glass Conveyance

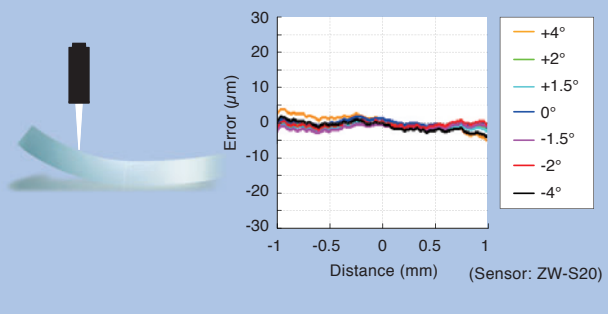
Traditional Triangulation Model

With triangulation, even if the angle is adjusted with high precision during the setup of the Sensor, stable measurement results are difficult to obtain when the measurement object is warped or inclined.



ZW Series

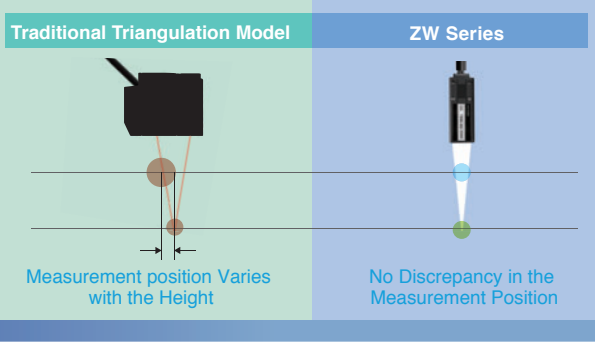
ZW-series Sensors operate on the confocal principle, so high-resolution measurements are possible regardless of inclination and warping of the measurement object.



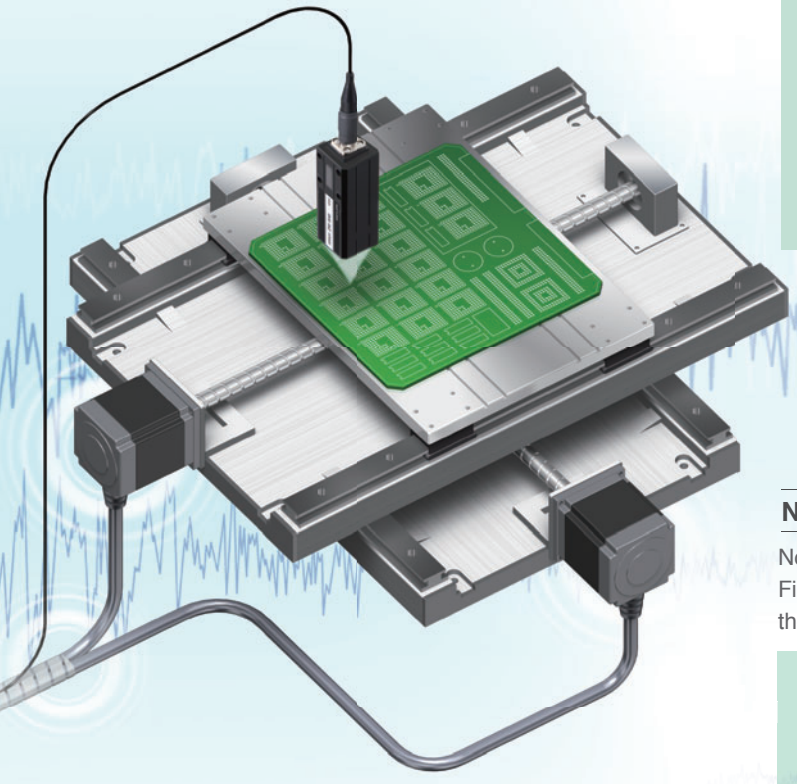
(Sensor: ZW-S20)

No Discrepancy in the Measurement Point

Superior angle characteristics are not the only advantage of a confocal principle.With a traditional triangulation, the measurement position and spot size vary with the height. This means there are times when the position cannot be measured with high resolution due to warping and inclination.With the confocal principle used for the ZW Series, the measurement point remains the same at any position in the measuring range so that precise measurements can always be made.



Robust Sensor Head Structure



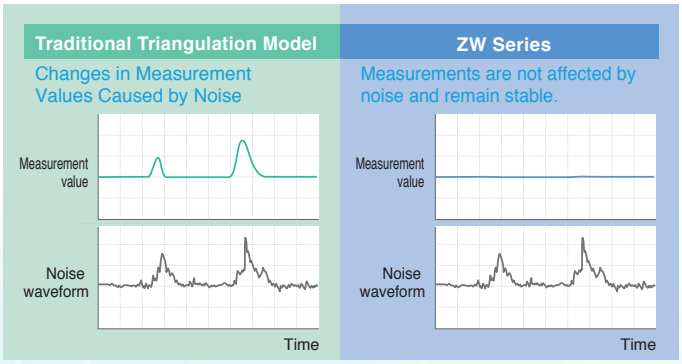
Substrate Height Inspection

No Noise

Reduced Work for EMC Countermeasures

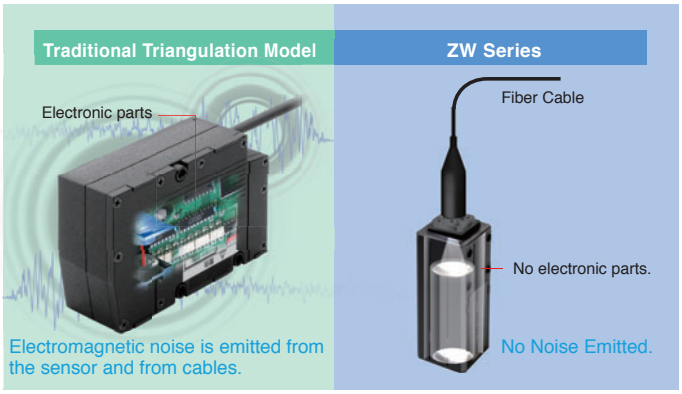
Not Affected by Noise

To ensure high-resolution measurements with normal sensors, countermeasures must be implemented to protect the sensor from the electromagnetic noise that is emitted by any nearby devices.The ZW-series Sensor Heads, however, contain no electronic parts to enable stable measurements even near power sections.Also, the Fiber Cable that connects the Sensor Head to the Controller can be placed near power lines or other cables that emit noise without affecting operation.



No Noise Emission

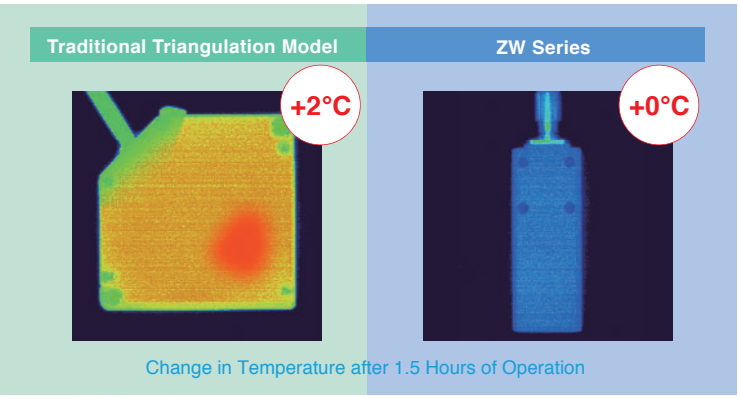
No electronic parts are used in the ZW-series Sensor Heads or Fiber Cables, so they give off no electromagnetic noise. You can therefore use them reliably together with other devices.



No Heat Generation

Reduced Work in Thermal Design

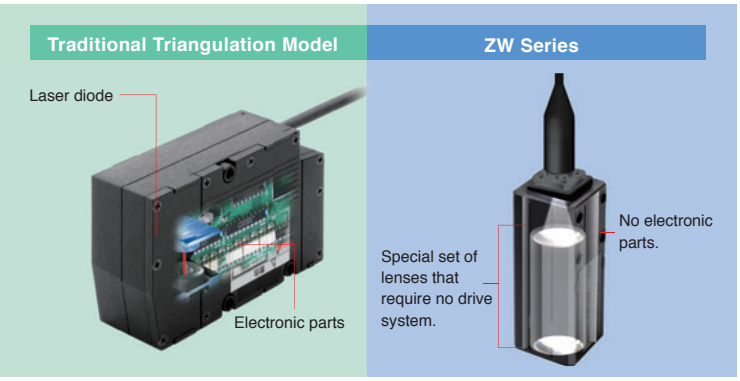
In high-resolution machine control, the heat generated by a sensor head can adversely affect nearby equipment and cause the error to increase.The ZW-series Sensor Heads, however, generate no heat and therefore do not affect nearby equipment.You can also install many Sensor Heads side by side and still be sure of reliable operation.



No Electronic Parts

Reduced Maintenance Costs

Displacement sensors are often installed in moving sections and other locations that are subject to vibration. It is important that they can withstand this type of environment.The ZW-series Sensor Heads consist of only the lenses and fiber. They contain no electronic parts or PCBs.The number of parts in them is greatly less than for a traditional sensor that uses triangulation, and this greatly reduces the maintenance frequency.Also they use LEDs as the source of light, so the safety measures that are required for lasers are not necessary either.



White Light Confocal Principle

To achieve a compact Sensor Head and high-resolution measurements, the ZW Series uses a white light confocal principle to detect objects. This principle is described below.

OCFL Module

The OCFL module contains a special lens set developed by OMRON that changes the focal point for each color (i.e., wavelength) of white light.The spot diameter is the same at any position within the measuring range. It does not change the way it does for a triangulation. High-precision lens manufacturing technology has allowed us to achieve a lens structure that is extremely small and that also does not require a drive mechanism.

OCFL

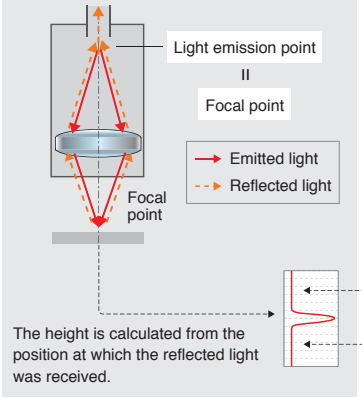
*OCFL : Omron Chromatic Focus Lens

Confocal principle Confocal Light Emission and Reception

Based on the confocal principle, the emitted light and received light are positioned along the same axis. Light is received only when it is focused on the measurement object, allowing the height to be calculated.Unlike triangulation, the received light waveform is not disrupted by the material or inclination of the measurement object. The received light waveform is always stable, which enables high-resolution measurements.

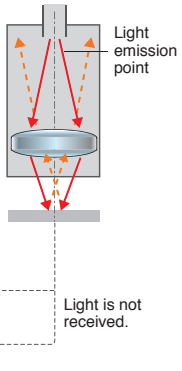
Object Located at Focal Point

The reflected light is focused at the same point as the emitted light.The reflected light becomes the received light signal.



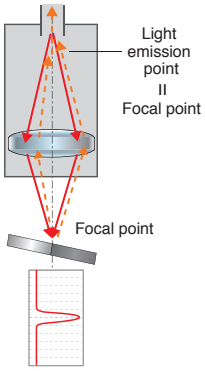
Object Not Located at Focal Point

Reflected light is not received because the reflected light is not focused at the light emission point.



Inclination and Differences in Materials

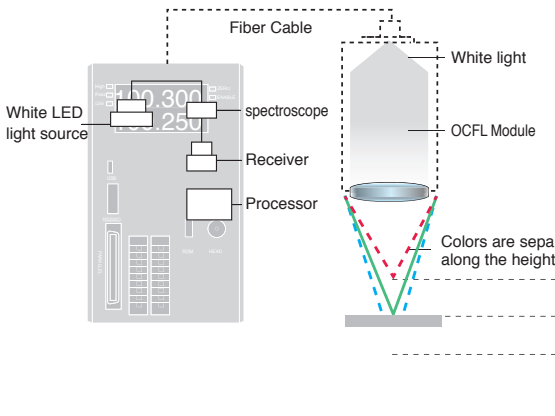
Even if the measurement object is inclined or contains different materials, the reflected light will be focused at the light emission point as long as the measurement object is at the focal point.



White White Light Separation into Colors with Different Wavelengths at Emission

Patent Pending

The white light from the LED is focused at different points for each color (i.e., wavelength) due to a special set of lenses in the OCFL module in the Sensor Head.As a result, only the color of light that is focused on the measurement object is returned, allowing the distance from the Sensor Head to the measurement object to be calculated based on the color of the reflected light.The Sensor Head contains the special set of lenses that separates white light into different colors and the Controller contains the white LED light source, and the spectroscope and processor that convert the color of the reflected light to a distance.There is no needs for a lens drive mechanism or electronic parts in the Sensor Head, even though they were considered to be standard in previous confocal models. This achieves a much more compact design and much greater immunity to noise than triangulation models and or previous confocal models.

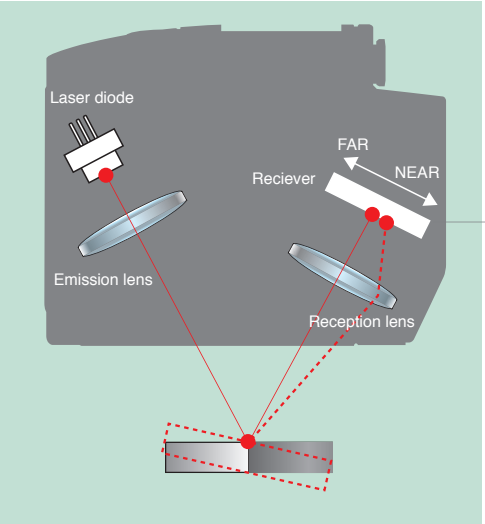


The height is detected based on the wavelength.

The reflected light of the wavelength that was focused on the surface of the measurement object passes through the fiber and the spectroscope in the Controller converts the wavelength to a distance.

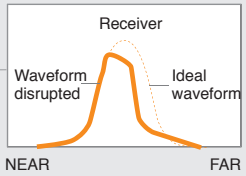
Problems with Previous Models

Triangulation



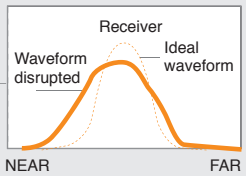
Triangulation measures the height of an object based on the position of the spot on a receiver (CCD or CMOS).The peak, center of gravity, and other features are calculated from the received light waveform to reduce error, but in principle, the received waveform is offset or disrupted due to differences in materials or inclination. This results in measurement error.

Light Reception for Different Materials



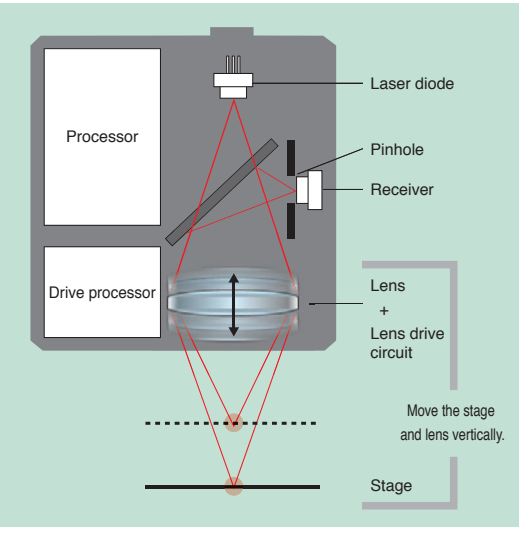
Different materials have different reflection factors. This disrupts the waveform that is received on the receiver.The peak in the waveform or the center of gravity are used to calculate the height, but error will remain in the measurement results.

Light Reception for Inclination



If the measurement object is inclined, the received waveform is offset or disrupted due to the effects of aberration. This results in measurement error.

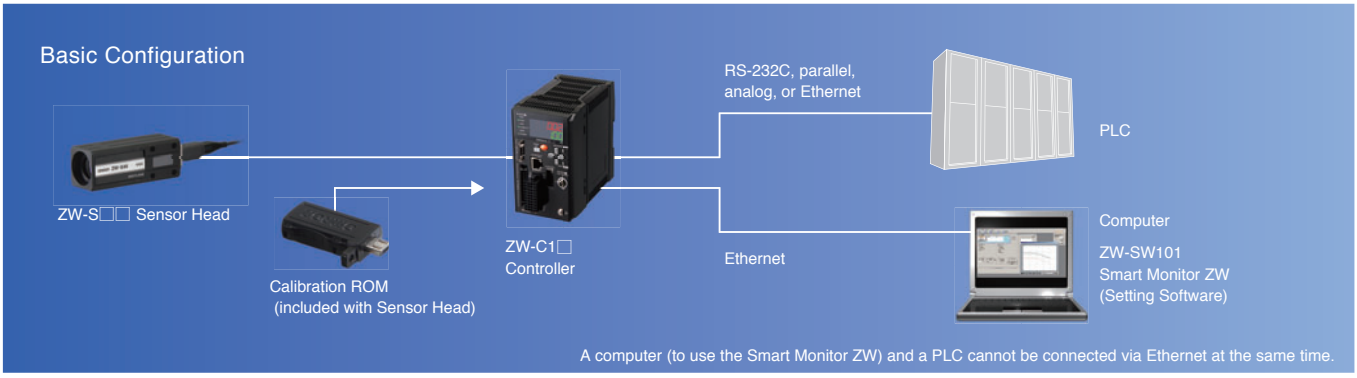
Normal Confocal Principle



In a normal confocal model, a stage and lens are driven vertically to change the focal point.This requires a more complex structure, and the large number of parts interferes with downsizing.The use of a laser beam increases the chances of interference, and the received light waveform can be disrupted by the surface conditions within the small spot on the measurement object.

Smart Application of High-resolution Measurements

System Configuration

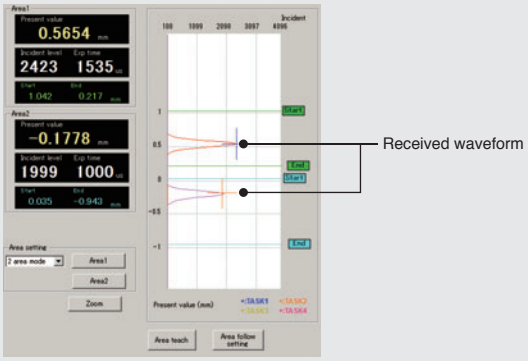


Smart Monitor ZW Setting Software (Computer Software)

This Setting Software allows you to use a computer to make the ideal setup and to collect and analyze data with powerful functions.

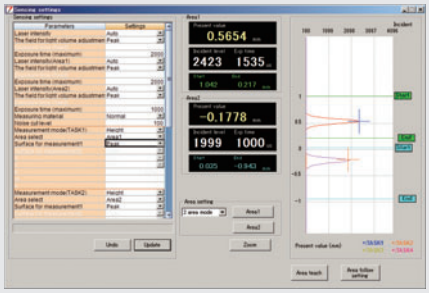
Display the Received Light Waveforms

You can display the waveforms that were received on the image element.This feature is very effective when measuring transparent objects, which return multiple waveforms.



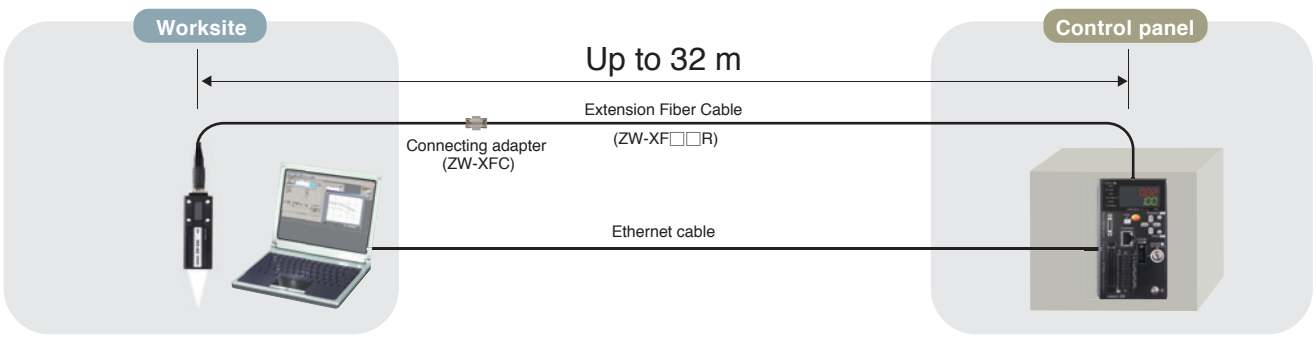
Data Logging

You can log measurement results at various times to evaluate and record inspection results.



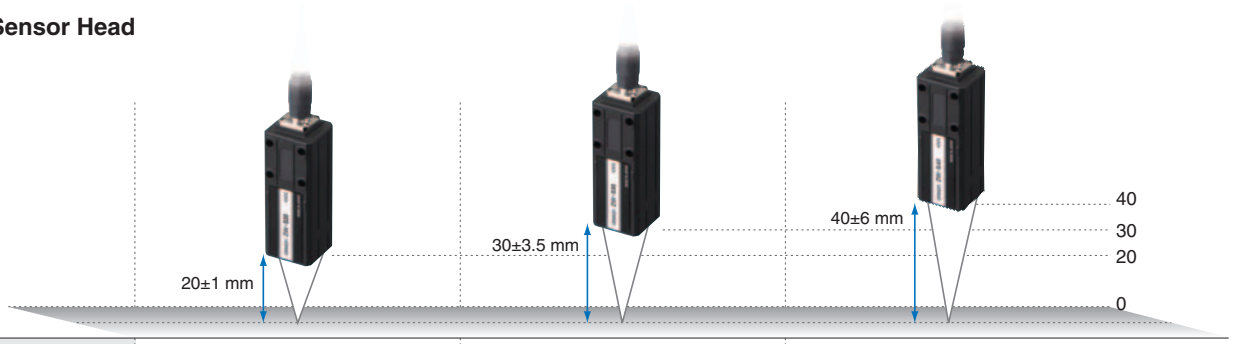
*Some of the data may not be logged depending on the computer environment.Use a computer with the recommended system requirements or better.

You can connect the computer and Controller via Ethernet so that you can set up and install the system while monitoring the waveform from a computer that is close to the Sensor Head even if the Controller is installed in a control panel at a more remote location.



Order Information

●Sensor Head



Measuring range	20±1 mm	30±3.5 mm	40±6 mm
Spot diameter	40 µm dia.	60 µm dia.	80 µm dia.
Static resolution	0.25 µm	0.25 µm	0.25 µm
Model	**ZW-S20**	**ZW-S30** (Upcoming)	**ZW-S40**

Note: When ordering, specify the cable length (0.3 m, 2.0 m).
The specifications of the "upcoming" product are subject to change without notice.

●Controller

Appearance	Power supply	Output type	Model
	24 VDC	NPN	**ZW-C10T**
			ZW-C10AT (See note.)
		PNP	**ZW-C15T**
			ZW-C15AT (See note.)

Note: Setting software Smart Monitor ZW is attached.

●Cable

Appearance	Item	Cable length	Model
	Sensor Head - Controller Extension Fiber Cable (flexible cable) (Fiber Adapter ZW-XFC provided)	2 m	**ZW-XF02R**
		5 m	**ZW-XF05R**
		10 m	**ZW-XF10R**
		20 m	**ZW-XF20R**
		30 m	**ZW-XF30R**
	Fiber Adapter (between Sensor Head pre-wired cable and Extension Fiber Cable)	–	**ZW-XFC**
	Parallel cable	2 m	**ZW-XCP2**
	RS-232C Cable For personal computer	2 m	**ZW-XRS2**
	RS-232C Cable For PLC/programmable terminal	2 m	**ZW-XPT2**

●Setting Software

Item	Model
Smart Monitor ZW	**ZW-SW101**

Specifications

●Sensor Head

Item		ZW-S20	ZW-S40
Measuring center distance		20 mm	40 mm
Measuring range		±1 mm	±6 mm
Static resolution (See note 1.)		0.25 μm	0.25 μm
Linearity (See note 2.)		±1.2 μm	±7.0 μm
Spot diameter (See note 3.)	Near	45 μm dia.	90 μm dia.
	Center	40 μm dia.	80 μm dia
	Far	45 μm dia.	90 μm dia
Measuring cycle		500 μs to 10 ms	
Operating ambient illumination		Illumination on object surface 10,000 lx or less: incandescent light	
Ambient temperature range		Operating: 0 to 50°C, Storage: −15 to 60°C (with no icing or condensation)	
Ambient humidity range		Operating and storage: 35% to 85% (with no condensation)	
Degree of protection		IP40 (IEC60529)	
Vibration resistance (destructive)		10 to 150 Hz, 0.35 mm single amplitude, 80 min each in X, Y, and Z directions	
Shock resistance (destructive)		150 m/s² 3 times each in six directions (up/down, left/right, forward/backward)	
Temperature characteristic (See note 4.)		1.5 μm/°C	4.8 μm/°C
Materials		Case: aluminum die-cast Fiber cable sheat: PVC Calibration ROM: PC	
Fiber cable length		0.3 m, 2 m (Flex-resistant cable)	
Fiber cable minimum bending radius		20 mm	
Insulation resistance (Calibration ROM)		Between case and all terminals: 20 MΩ (by 250 V megger)	
Dielectric strength (Calibration ROM)		Between case and all terminals: 1,000 VAC, 50/60 Hz, 1 min	
Weight		Approx. 105 g (Chassis, fiber cable total)	
Accessories		Instruction sheet, Fixing screw (M2) for Calibration ROM, Precautions for correct use	

Note: 1. Capacity value when Omron standard mirror surface target is measured at the measurement center distance as the average of 4,096 times.

2. Material setting for the Omron standard mirror surface target: Error from an ideal straight line when measuring on mirror surface. The reference values for linearity when targets to measure other than the above are as in the table below.

Item	ZW-S20	ZW-S40
Grass	±1.2 μm	±7.0 μm
SUS BA	±1.4 μm	±8.5 μm
White ceramic	±1.7 μm	±9.5 μm

3. Capacity value defined by $1/e^2$ (13.5%) of the center optical intensity in the measured area.

4. Temperature characteristic at the measurement center distance when fastened with an aluminum jig between the Sensor Head and the target and the Sensor Head and the controller are set in the same temperature environment.

●Setting Software Smart Monitor ZW ZW-SW101

Recommended System Requirements

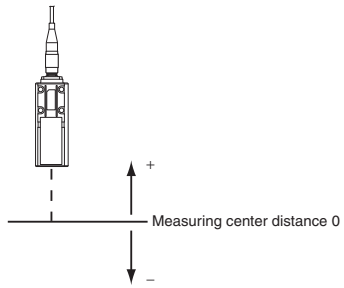
Item	Condition
OS	Windows 7 (32 or 64-bit version) Windows XP (Service Pack3 or more, 32-bit version)
CPU	Intel Pentium III, 850 MHz or more (2 GHz or more is recommended.)
Memory	1 GB or more
Free hard disk space	50 MB or more
Display	1024 x 768 dots or more, 16 million colors or more
Supported languages	Japanese/English
Communication port	Ethernet port

●Controller

Item				ZW-C10T	ZW-C10AT	ZW-C15T	ZW-C15AT
Input/Output type				NPN		PNP	
Number of connected Sensor Heads				1 per Controller			
Sensor Head compatibility				Available			
Light source for measurement				White LED			
Segment display	Main display			11-segment red display, 6 digits			
	Sub-display			11-segment green display, 6 digits			
LED display	Status indicators			HIGH (orange), PASS (green), LOW (orange), STABILITY (green), ZERO (green), ENABLE (green), THRESHOLD-H (orange), THRESHOLD-L (orange), RUN (green)			
External interface	Ethernet			1 port , 100BASE-TX, 10BASE-T			
	RS-232C			1 port, 115,200 bps max.			
	20-pole terminal block	Judgment output (HIGH1/PASS1/LOW1)		Transistor output system Output voltage: 21.6 to 30 VDC Load current: 50 mA or less Residual voltage when turning ON: 1.2 V or less Leakage voltage when turning OFF: 0.1 mA or less			
		BUSY output (BUSY1)					
		ALARM output (ALARM1)					
		ENABLE output (ENABLE)					
		Analog voltage output (OUT1V)		−10 to 10 V, Output impedance: 100 Ω			
		Analog current output (OUT1A)		4 to 20 mA, Max. load resistance: 300 Ω			
		LED OFF input (LED OFF1)		DC input system Input voltage: 24 VDC ±10% (21.6 to 26.4 VDC) Input current: 7 mA Typ. (24 VDC) Voltage/Current when turning ON: 19 V/3 mA or more Voltage/Current when turning OFF:5 V/1 mA or less		
		ZERO RESET input (BUSY1)					
		TIMING output (TIMING1)					
		RESET output (RESET1)					
	52-pole extension connector	Binary	Measured value output (BAINARY 0 to 20)	Transistor output system Output voltage: 21.6 to 30 VDC Load current: 50 mA or less Residual voltage when turning ON: 1.2 V or less Leakage voltage when turning OFF: 0.1 mA or less			
			Gate signal output (GATE)				
			Selected task output (BINARY_ OUT1/2)				
			Selected task input (BAINARY_ SEL1/2)	DC input system Input voltage: 24 VDC ±10% (21.6 to 26.4 VDC) Input current: 7 mA Typ. (24 VDC) Voltage/Current when turning ON: 19 V/3 mA or more Voltage/Current when turning OFF: 5 V/1 mA or less		
		Bank	Selected bank output (BANK_OUT 1 to 3)	Transistor output system Output voltage: 21.6 to 30 VDC Load current: 50 mA or less Residual voltage when turning ON: 1.2 V or less Leakage voltage when turning OFF: 0.1 mA or less			
			Selected bank input (BANK_SEL 1 to 3)	DC input system Input voltage: 24 VDC ±10% (21.6 to 26.4 VDC) Input current: 7 mA Typ. (24 VDC) Voltage/Current when turning ON: 19 V/3 mA or more Voltage/Current when turning OFF:5 V/1 mA or less		
Main functions	Exposure time			Auto/Manual			
	Measuring cycle			500 μm to 10 ms			
	Material setting			Standard/Mirror/Diffusion surfaces			
	Measurement Item			Height/Thickness/Calculation			
	Filtering			Median/Average/Differentiation/High pass/Low pass/Band pass			
	Outputs			Scaling/Different holds/Zero reset/Logging for a measured value			
	Display			Measured value/Threshold value/Analog output voltage or current value/ Judgment result/Resolution/Exposure time			
	Number of configurable banks			Max. 8 banks			
	Task process			Multi-task (up to 4 tasks per bank)			
	System			Save/Initialization/Display measurement information/Communication settings/ Sensor Head calibration/Key-lock/Trigger-key input			
Ratings	Power supply voltage			21.6 to 26.4 VDC (including ripple)			
	Current consumption			500 mA max.			
	Insulation resistance			Across all lead wires and controller case: 20 MΩ (by 250 V megger)			
	Dialectic strength			Across all lead wires and controller case: 1,000 VAC, 50/60 Hz, 1 min.			
Environmental immunity	Degree of protection			IP20 (IEC60529)			
	Vibration resistance (destructive)			10 to 55 Hz, 0.35-mm single amplitude, 50 min each in X, Y, and Z directions			
	Shock resistance (destructive)			150 m/s^2, 3 times each in six directions (up/down, left/right, forward/backward)			
	Ambient temperature			Operating: 0 to 40°C Storage: −15 to 60°C (with no icing or condensation)			
	Ambient humidity			Operating and storage: 35% to 85% (with no condensation)			
Grounding				D-type grounding (Grounding resistance of 100 Ω or less) Note: For conventional Class D grounding			
Materials				Case: PC			
Weight				Approx. 750 g (main unit only)			
Accessories				Instruction sheet, Member registration sheet	Instruction sheet, Member registration sheet and software for setting (CD-ROM)	Instruction sheet, Member registration sheet	Instruction sheet, Member registration sheet and software for setting (CD-ROM)

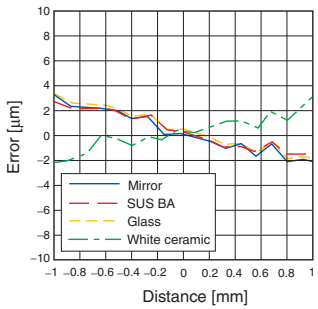
Characteristic data (typical examples)

●Linearity Characteristic by Materials

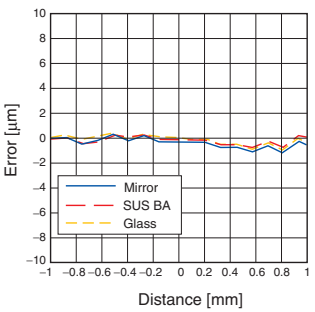


ZW-S20

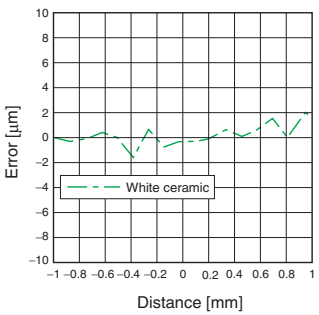
Material setting: Normal



Material setting: Mirror surface

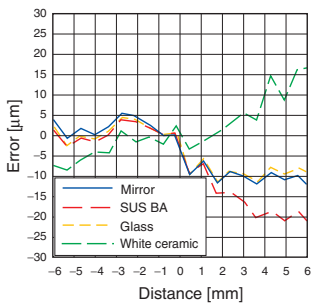


Material setting: Diffusion surface

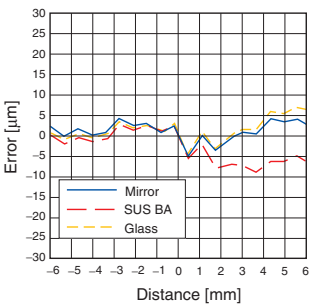


ZW-S40

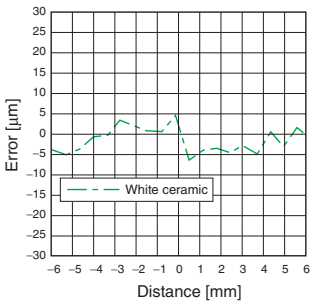
Material setting: Normal



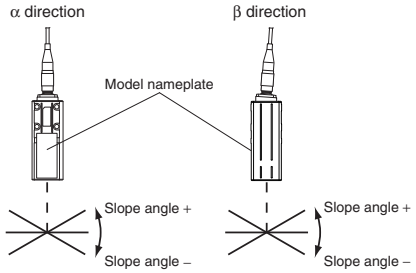
Material setting: Mirror surface



Material setting: Diffusion surface

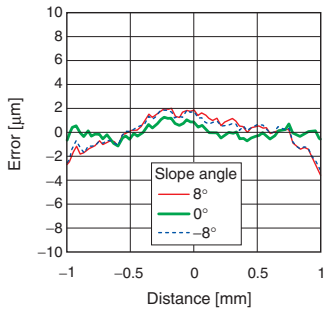


●Angle Characteristic *

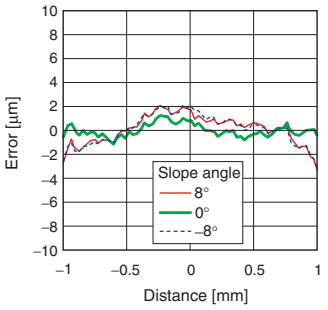


ZW-S20

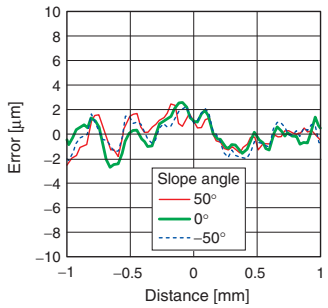
Mirror α direction



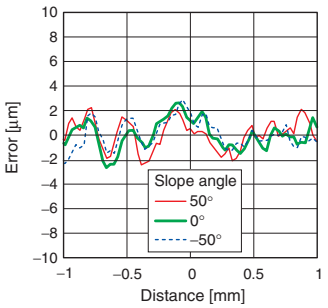
Mirror β direction



White ceramic α direction

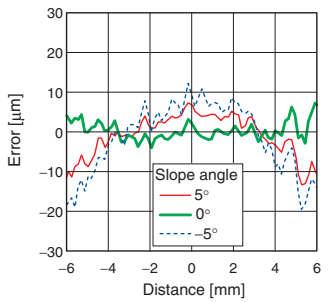


White ceramic β direction

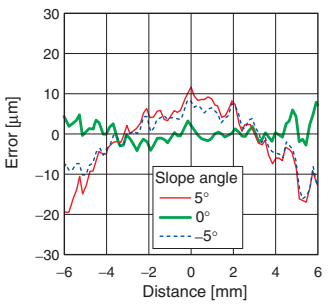


ZW-S40

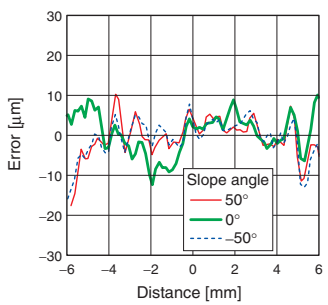
Mirror α direction



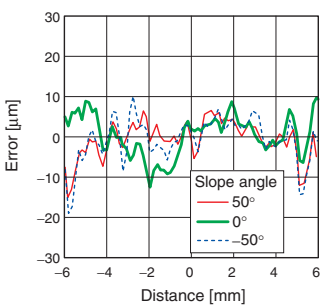
Mirror β direction



White ceramic α direction



White ceramic β direction



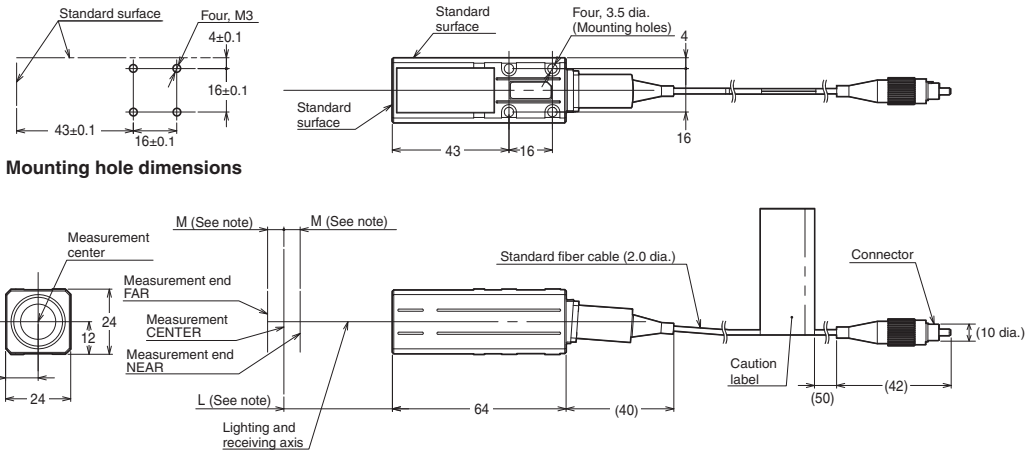
* The above show the results after executing scaling.

External Dimensions

(Unit: mm)

Sensor Head

ZW-S20/-S40

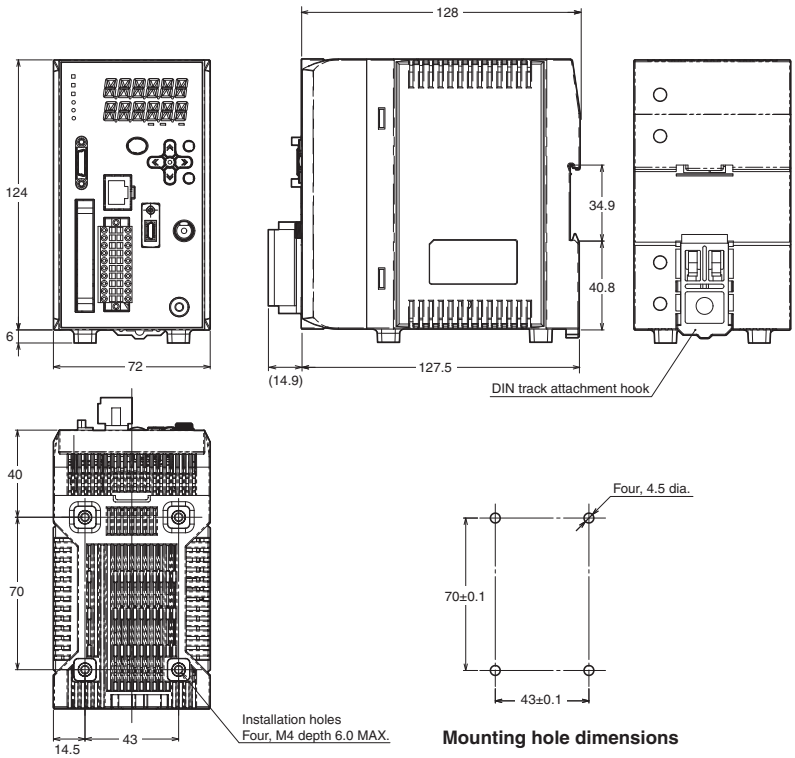


Note:

Model	L	M	X
ZW-S20	20	1	11.8
ZW-S40	40	6	11.7

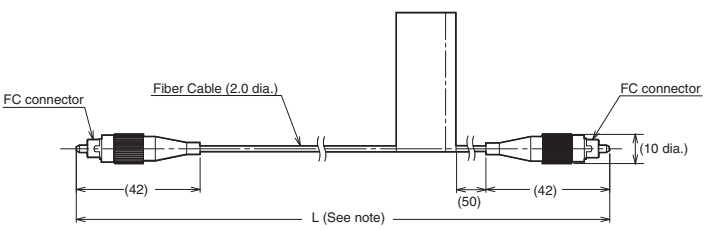
Controller

ZW-C10T/-C15T



Extension Fiber Cable

ZW-XF02R/-XF05R/-XF10R/-XF20R/-XF30R



Note: The following table lists cable lengths per models.

Model	Cable length	L
ZW-XF02R	2 m	2,000±20
ZW-XF05R	5 m	5,000±50
ZW-XF10R	10 m	10,000±100
`ZW-XF20R	20 m	20,000±200
ZW-XF30R	30 m	30,000±300

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