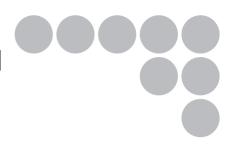
OMRON

Smart Sensors

Laser Displacement Sensors CMOS Type

ZX2 Series



User's Manual



Cat. No. Z310-E1-08

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SETTING TRANSITION CHARTS Thank you for purchasing the ZX2 Series Smart Sensor. This manual provides information regarding functions, performance and operating methods that are required for using the sensor.

When using the ZX2 Smart Sensor, make sure to observe the following:

- The ZX2 Smart Sensor must be operated by personnel knowledgeable in electrical engineering.
- To ensure correct use, please read this manual thoroughly to deepen your understanding of the product.
- Please keep this manual in a safe place so that it can be referred to whenever necessary.

Warranty, Limitations of Liability

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Exclusive Warranty

Omron's exclusive warranty is that the Products will be free from defects in materials and workmanship for a period of twelve months from the date of sale by Omron (or such other period expressed in writing by Omron). Omron disclaims all other warranties, express or implied.

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NEVER USE THE PRODUCT 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(S) IS PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

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Product specifications and accessories may be changed at any time based on improvements and other reasons. It is our practice to change part 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 part numbers may be assigned to fix or establish key specifications for your application. Please consult with your Omron's representative at any time to confirm actual specifications of purchased Product.

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		Meanings of Signal Words
CONTENTS	The following s	signal words are used in this manual.
INTRODUCTION		Indicates a potentially hazardous situation which, if not avoided, will result in minor or moderate injury, or may result in
PREPARATION For Measurement	<u>/!\</u> waf	serious injury or death. Additionally there may be significant property damage.
FLOW OF OPERATION		
BASIC		Meanings of Alert Symbols
SETUP	The following a	alert symbols are used in this manual.
MAIN APPLICATIONS & SETTING METHODS		
Height	*	Indicates the possibility of laser radiation.
Steps and Warpage		
Double Sheet Detection		Indicates prohibition when there is a risk of minor injury from electrical shock or other source if the product is disassembled.
Thickness		
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Laser Safety		CONTENTS
■ Sensor Head ZX2-LD50L, LD50, LD100L, LD100: Class 2		
		PREPARATION FOR MEASUREMENT
Never look into the laser beam. Doing so continuously will result in visual impairment.	^	FLOW OF OPERATION
		BASIC SETUP
Do not disassemble the product. Doing so may cause the laser beam to leak, resulting in the danger of visual impairment.		MAIN APPLICATIONS & SETTING METHODS
		Height

Sensor Head ZX2-LD50V: Class 1

Do not disassemble the product.

Doing so may cause the laser beam to leak, resulting in the danger of visual impairment.



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and Warpage Double Sheet

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In Europe, diffuse-reflective models in the ZX2 Series are categorized as Class 2 laser products and the regular-reflective model is classified as a Class 1 laser product according to EN60825-1 (see note).

In the U.S.A., diffuse-reflective models in the ZX2 Series are categorized as Class II laser

products, and the regular-reflective model is classified as a Class I laser product according to IEC60825-1 criteria, in accordance with the stipulations of the FDA standard

This product has already been registered with the CDRH (Center for Devices and

The ZX2 Series is meant to be built into final system equipment. Pay special attention to

The CE markings on the products also reflect these categorizations.

Radiological Health). (Accession Number: 1020665)

Place the laser warning label and the FDA label on the sensor.

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SETTING TRANSITION CHARTS the following precautions for the safe use of the product: Note: Europe: Class 1 and Class 2 of EN 60825-1: 1994 +A11:1996 +A2:2001

= IEC 60825-1:1993 +A1:1997 +A2:2001

U.S.A.: Class I and Class II of FDA (21 CFR1040.10)

(1) ZX2-LDDDD emits visual laser beam. Do not stare directly into the laser.

Make sure that the laser beam path is terminated. If specular objects are present in the laser beam path, make sure that they are prevented from reflecting the laser beam.

When used without an enclosure, make sure the laser path from eye level is avoided.

- (2) To avoid exposure to hazardous laser radiation, do not displace nor remove the protective housing during operation, maintenance, and any other servicing.
- (3) As for countries other than those of Europe and the U.S.A., observe the regulations and standards specified by each country.

(4) Label Indications

Laser Notice No. 50 (see note).

The EN and FDA labels are supplied with the product.

Replace the current labels with them according to the instructions given in the manuals.

Precautions for Safe Use

Please observe the following precautions for safe use of the products.

Installation Environment

- Do not use the product in environments where it can be exposed to inflammable/ explosive gas.
- Do not install the product close to high-voltage devices and power devices in order to secure the safety of operation and maintenance.

Power Supply and Wiring

- The supply voltage must be within the rated range (DC12 to 24 V±10%).
- Reverse connection of power supply is not allowed. Connection to AC power supply is also not allowed.
- · Open-collector outputs should not be short-circuited.
- High-voltage lines and power lines must be wired separately from this product.
 Wiring them together or placing in the same duct may cause induction, resulting in malfunction or damage.
- Always turn off the power supply before connecting or disconnecting cables and connectors.

Applicable standards

- EN61326-1
- Electromagnetic environment : Industrial electromagnetic environment

(EN/IEC 61326-1 Table 2)

 There may be cases that current output or voltage output fluctuate within 1%F.S when a sensor is experienced electromagnetic interference under the condition of the response time 30µs.

Others

- · Do not attempt to dismantle, repair, or modify the product.
- · Dispose of this product as industrial waste.

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SETTING TRANSITION CHARTS Please observe the following precautions to prevent failure to operate, malfunctions, or undesirable effects on product performance.

Installation of the Product

Installation Site

Do not install the product in locations subjected to the following conditions:

- Ambient temperature outside the rating
- Rapid temperature fluctuations (causing condensation)
- Relative humidity outside the range of 35 to 85%
- Presence of corrosive or flammable gases
- · Presence of dust, salt, or iron particles
- Direct vibration or shock
- Reflective sensor of intense light (such as other laser beams or electric arc-welding machines)
- · Direct sunlight or near heaters
- · Water, oil, or chemical fumes or spray
- · Strong magnetic or electric field

Component Installation and Handling

Power Supply and Wiring

- When using a commercially available switching regulator, make sure that the FG terminal is grounded.
- If surge currents are present in the power lines, connect surge absorbers that suit the operating environment.
- When connecting two or more amplifier units by using calculating units, make sure that the linear GND lines of the amplifier units are connected to each other. Supply power to all connected amplifier units at the same time.
- Before turning ON the power after the product is connected, make sure that the power supply voltage is correct, there are no incorrect connections (e.g. load shortcircuit) and the load current is appropriate. Incorrect wiring may result in breakdown of the product.
 - The ferrite core accessory must be attached to the sensor head cable before use. (For how to attach the ferrite core, see pages 24 and 28.)
- The cables must be 10 m or shorter in total length for amplifier units. For extension
 of the cable of amplifier units, shielded cables of the same type must be used. To
 extend the cable from the sensor head, an optional extension cable (ZX2-XC□R)
 must be used. Only one extension cable can be used.
 - When using calculating units, make sure that the linear GND lines of the amplifier units are connected to each other.

Warming Up

After turning ON the power supply, allow the product to stand for at least 10 minutes before use. The circuits are still unstable just after the power supply is turned ON, so measured values may fluctuate gradually.

A warmup of at least 10 minutes is also required after canceling LD-OFF input if LD-OFF input is being used.

Sensing Object

The product cannot accurately measure the following types of objects: Transparent objects, objects with an extremely low reflective sensor ratio, objects smaller than the beam size, objects with a large curvature, excessively inclined objects, etc.

Mutual Interference

Inserting a calculating unit between amplifier units can prevent mutual interference between two sensor heads.

Maintenance

- Always turn OFF the power supply before adjusting or connecting/disconnecting the sensor head.
- Do not use thinner, benzene, acetone or kerosene to clean the sensor head and amplifier units. If large dust particles adhere to the front filter of the sensor head, use a blower brush (used to clean camera lenses) to blow them off. Do not blow the dust away with your mouth. To remove smaller dust particles, use a soft cloth (for lenses) with a small amount of alcohol. Take care not to wipe them off with excessive force.

Scratches on the filter may cause errors.

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FOR

Page Format

This section explains the page format by using the Setting for MAIN APPLICATIONS AND SETTING METHODS chapter as an example.

Index label

Shows the chapter and header titles with white characters.

MEASUREMENT Header Height Indicates the measurement FLOW OF contents. OPERATION CONTENTS BASIC NTRODUCTION SETUP FOR WEASUREMENT Procedure for setting up height MAIN APPLICATIONS FLOW OF Flow Shows the flow of operation. & SETTING BASIC METHODS Heiaht Steps and Sensor installation/wiring Required 1 Warpage Has the Sensor been installed and wired? (See page 23.) Operation procedure Double Set the reference workpiece in place, adjust the position of the Sensor Head while looking at the digital display values on the Amplifier Unit or the indicators on the Sensor Head so that the height to be measured is near the measurement center Explains the operation Sheet Detection procedure. distance, and install the Sensor Head at this position. Select the desired mode to set 2 Set to the MENU mode Required Eccentricity and Surfac Thickness Button Explanation of Display Description of Operation Operation Selection Menu DETAILED Hold down the 👅 button for ۲ three seconds to switch to the ÷ -Positioning MENU mode TROUBLE-SHOOTING Press the I button to display * This operation is not dEERI L dEFBLL. required when hold and Eccentricity SPECIFI-4 trigger conditions are not to and Surface he set Deflection Press the 🗢 button to set the INDEX display to ON to set display of ΠN he detail mer \sim SETTING TRANSITI DETAILED SETTINGS 42 ZX2 User's M Heigh TROUBLE-SHOOTING Explanation of Selection Menu Provides a supplemental explanation of the selection menu. Description of Operation SPECIFI-Explains how to perform the operation by using buttons. CATIONS Display Shows what is displayed as a result of the operation. INDEX **Button Operation** Shows how to use the buttons. SETTING TRANSITION

CHARTS

Meanings of Symbols

Symbol	Meaning	CONTENTS
Important	Indicates points that are important to achieve the full product performance, such as operational precautions and applica- tion procedures.	INTRODUCTION
(For details about xxx, see page xx.)	Indicates pages where related information can be found.	PREPARATION FOR MEASUREMENT
Required (white characters on a black background)	Indicates a required setting in a setup procedure.	FLOW OF OPERATION
Optional (black characters on a white background)	Indicates an optional setting in a setup procedure.	BASIC SETUP
Pres to digay	Indicates which button to press to display the menu shown in the Display column.	MAIN APPLICATIONS & SETTING METHODS Height
Press to select the desired value.	Indicates that the user can select the menu that accords with their usage conditions by pressing the relevant button.	Steps and Warpage Double Sheet Detection
[Change numeric value]	Indicates that the user can specify a value that accords with	Thickness
Press to set. Set any value.	their usage conditions by pressing the relevant button.	Positioning
		Eccentricity and Surface Deflection

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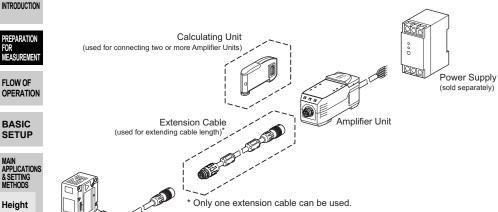
Part Names and Functions



FOR

Basic Configuration

The basic configuration of the ZX2 series Smart Sensors is shown below.



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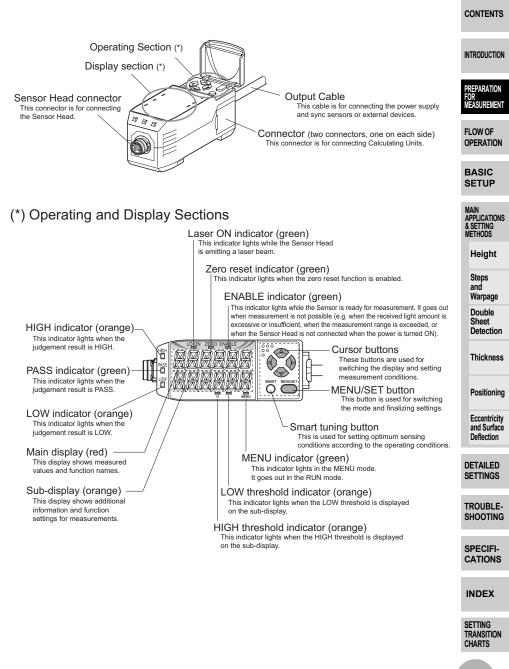


Sensor Head

See the following pages for details:

	Part Names and Functions	Specifications and Dimensions
Sensor Heads	p. 22	p. 138
Amplifier Units	р. 19	p. 136
Calculating Unit	p. 22	p. 143
Extension Cables	_	p. 142

Amplifier Unit



Digital Displays

The information displayed on the main and sub-displays depends on the currently selected mode. The default mode is the RUN mode.

When the power is turned ON, the model of Amplifier Unit (ZX2-LDA) will be displayed on the main display and the channel number will be displayed on the sub-display. Subsequently, the Sensor Head software version will be displayed on the main display and the Amplifier Unit software version will be displayed on the sub-display.

These details are displayed for approximately five seconds, and then data for the RUN mode will be displayed.

Mode	Main display (upper section, red)	Sub-display (lower section, orange)
RUN	The measured value (the value after the measurement conditions have been reflected) is displayed. For example, when the hold function is set, the held value will be displayed. Default measured values are as follows: Measurement range NEAR side + indication 0 Measurement center distance	By pressing the \$ button, the HIGH threshold, LOW threshold, analog output value, resolution (max. value of measured value during one second - min. value), current value (value before execution of zero reset, hold, scaling and 2-sensor operation), and BANK are displayed in this order.
MENU	The function names are displayed in order by pressing the \$ \$ buttons.	The setting for the function displayed on the main display is displayed.

(For details on setting transition charts, see page 158.)

Alphabet Display Format

The alphabet appears on the main and sub-displays as shown in the following table.

TIONS	А	В	С	D	Е	F	G	Н	I	J	К	L	Μ	
DEX	8	Ь	Γ	Ч	Ε	F	Б	Н		പ	К	L	М	
	Ν	0	Р	Q	R	S	Т	U	V	W	Х	Y	Ζ	
ring Nsition Rts	N		Ρ	D	R	5	F	Ц	1	N	X	Ч	2	

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Button Operation

The functions of buttons change according to the currently selected mode.

CONTENTS

Button type		Button function					
		RUN mode	MENU mode	INTRODUCTION			
button button		Normal press: Changes the sub-display content.* Both buttons held down for three seconds: Locks button operation.	Function changes depending on the setting. • Switches the function display. • Selects the digit of numerical values. • Stops setting.	PREPARATION FOR MEASUREMENT			
Cursor buttons	The second secon	Normal press: Executes timing input.	The function changes depending on the setting.	FLOW OF OPERATION			
Curs	I button	 Held down for one second: Executes zero reset. Both buttons held down for one second: Cancels a zero reset. 	 Changes the selection menu. Changes numerical values. 	BASIC SETUP			
MENU/SET button		Held down for 3 seconds: Changes the mode to the MENU mode.	 Normal press: Finalizes the set condition or value. 	APPLICATIONS & SETTING METHODS Height			
			Held down for 3 seconds: Changes to the RUN mode.	Steps			
Smart tuning button		Held down for one second, held down for three seconds, held down	Held down for one second, held down for three seconds, held down	and Warpage			
		for five seconds: Executes smart tuning according to the time the button is held down.	for five seconds: Executes smart tuning according to the time the button is held down.	Double Sheet Detection			
5		down for three seconds, held down for five seconds: Executes smart tuning according to the time the button is held	Held down for one second, held down for three seconds, held down for five seconds: Executes smart tuning according to the time the button is held	ar W De Si			

* For how to select the initial sub-display to be displayed when the power is turned on, see page 84.

Positioning

Eccentricity and Surface Deflection

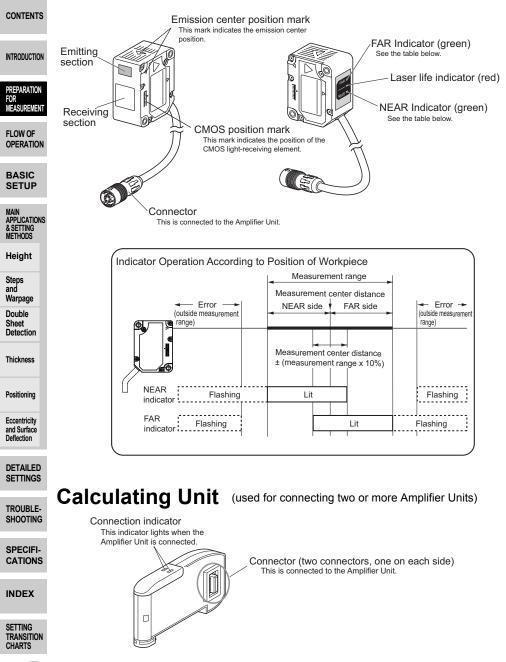
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Sensor Head



Installation

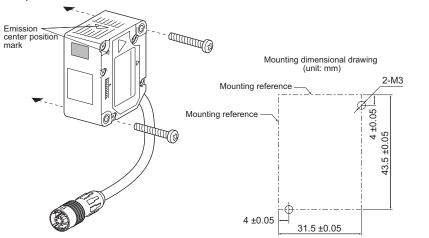
Important

Before connecting/disconnecting Smart Sensor components, make sure that the power to the Amplifier Unit is turned OFF. The Smart Sensor may malfunction if components are connected or removed while the power is ON.

Installing Sensor Heads

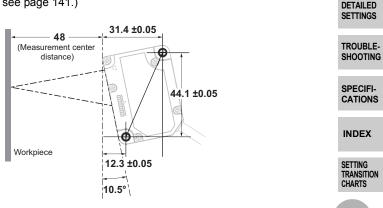
Installation Method

- · Check the Sensor Head setting position by its emission center mark.
- Fix the sensor head in place with M3 screws. The screws must be tightened with a torque of 0.5 N•m.



Tilt the regular-reflective model as shown below with respect to the workpiece.
 A mounting bracket can also be attached to the regular-reflective model to tilt it correctly. (E39-L178; see page 141.)

ZX2-LD50V



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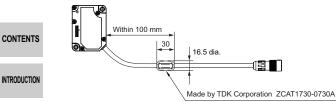
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· Be sure to attach the ferrite core accessory to the Sensor Head. Attach it within 100 mm of the Sensor Head side.



Important

MEASUREMENT FLOW OF

PREPARATION

FOR

· When mounting a Sensor Head, take care not to touch the emitter and receiver. Finger marks on the emitter and receiver may hinder correct measurements. If you have touched OPERATION them by mistake, wipe them with a clean, soft cloth.

· Fix the connectors in places that are not subject to vibration or impact.

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Installing the Amplifier Unit

Amplifier Units can be easily mounted to 35-mm DIN Track.

Hook on the connector end

decrease if the output cable end is hooked on the DIN Track first.

Installation Method

Hook the connector end of the Sensor Head on the DIN Track, and press in at the bottom until the Amplifier Unit locks into place. If necessary, fix it in place by the End Plate.

DIN Track (Option)

PFP-100N (shallow type/1 m) PFP-50N (shallow type/0.5 m)

PFP-100N2 (shallow type/1 m)

End Plate (Option)

PFP-M

Removal Method

Important

Push the Amplifier Unit and pull out from the connector end of the Sensor Head.

Hook the connector end of the Sensor Head on the DIN Track first. The mounting strength may

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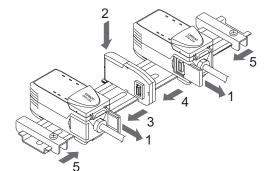
CONTENTS

Use a Calculating Unit to connect Amplifier Units when performing calculations between Amplifier Units and to prevent mutual interference between Sensor Heads.

INTRODUCTION The number of Amplifier Units that can be connected differs depending on the functions to be used.

PREPARATION FOR	Function	Number of Connectable Amplifier Units	See:
MEASUREMENT	Calculation	Up to two units (Up to five units can be connected. However, calculations are done between pairs of two.)	(A-B) calculation:
FLOW OF OPERATION		For (A-B) calculations A: CH2 or later	Calculation: Page 47 Thickness calculation:
BASIC SETUP		B: CH1 CH2 CH2 CH2 CH2 CH2 CH2 CH2 CH2 CH1	Page 57
MAIN APPLICATIONS & SETTING METHODS		(CH3-CH1) CH4 (CH4-CH1) (CH5-CH1)	
Height	Mutual interference prevention	Up to five units	Page 88
Steps and Warpage	Ľ		<u> </u>
Double Sheet Detection	For details on the cor	nnection method, see the next page.	
Thickness			
Positioning			
Eccentricity and Surface Deflection			
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00			

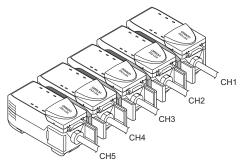
Connection Method



- **1** Open the connector cover on the Amplifier Unit. Open the connector cover by lifting and sliding it.
- **2** Mount the Calculating Unit to the DIN Track.
- **3** Slide and connect the Calculating Unit to the Amplifier Unit connector.
- **4** Slide and connect the second Amplifier Unit to the Calculating Unit connector.
- 5 Fix in place with the End Plate (sold separately: PFP-M).

Important

- To disconnect Amplifier Units and Calculating Units, perform the above operations in reverse order.
- The following diagram shows the channel numbers when multiple Amplifier Units are connected.



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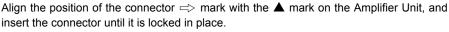
TROUBLE-SHOOTING

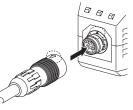
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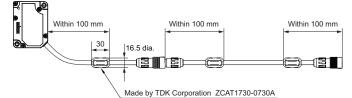
Important

• Extending the Sensor Head cable

An optional extension cable ($ZX2-XC\Box R$) must be used.

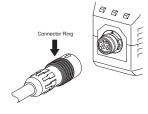
Only one extension cable can be used.

Be sure to attach the two supplied ferrite cores within 100 mm of each end of the extension cable.



Removal Method

To disconnect the Sensor Head, hold the Sensor Head's connector ring and the Amplifier Unit connector, and then pull them straight out.



Important

- Do not touch the terminals inside the connector.
- · Prevent the connector from being subjected to static electricity.
- When the Sensor Head is replaced with a different type, set all the setting data inside the Amplifier Unit again since it will be cleared. (default values: → See page 123.)



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Wiring Diagram

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Wiring Input/Output Cables

Wire the cable correctly. Incorrect wiring may damage the Smart Sensor.

The input/output cable has the following wires.

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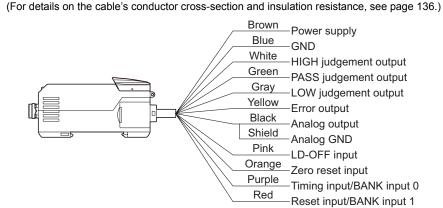
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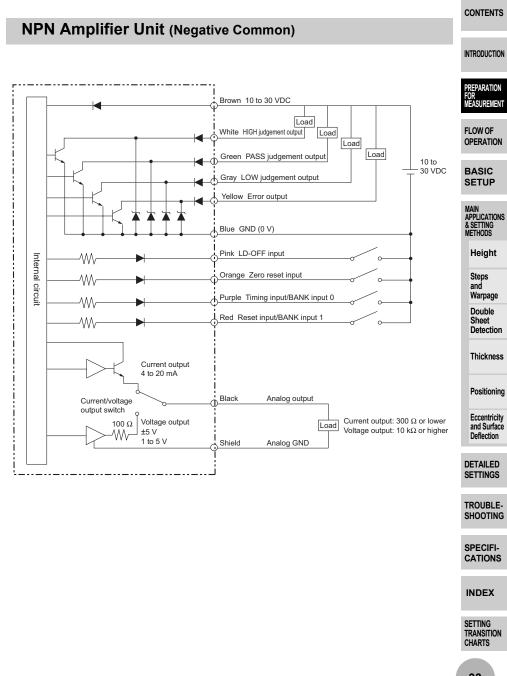
Cable color	Name	Function
Brown	Power supply	Connects the 10 to 30 VDC (including (p-p) 10% ripple) power supply. When using an Amplifier Unit with a PNP output, the power supply terminal is also the common I/O terminal for all I/O except for the analog output.
Blue	GND (0 V)	The GND terminal is the 0 V power supply terminal. When using an Amplifier Unit with an NPN output, the power supply terminal is also the common I/O terminal for all I/O except for the analog output.
White	HIGH judgement output	The HIGH judgement output outputs judgement results (HIGH).
Green	PASS judgment output	The PASS judgement output outputs judgement results (PASS).
Gray	LOW judgment output	The LOW judgement output outputs judgement results (LOW).
Yellow	Error output	This is output when the system detects an error. (For details on error messages, see page 130.)

Wiring Diagram

Cable color	Name	Function	
Black	Analog output	The analog output outputs a current or voltage in accordance with the measured value. (For details on setting method, see page 109.)	CONTENTS
Shield	Analog GND (0 V)	The analog GND terminal is the 0 V terminal for the analog output. Important Use the shield for analog output separately from the blue	INTRODUCTION PREPARATION FOR MEASUREMENT
		 (0V) wire for power supply. When analog output is not used, be sure to connect this wire to the blue (0 V) wire. When using Calculating Units, make sure that the analog GND lines of the Amplifier Units are connected to each other. 	FLOW OF OPERATION BASIC SETUP
Pink	LD-OFF input	If this LD-OFF input signal is ON, the laser will stop emission, causing a light intensity error. In this case, the analog output, digital display, judgement output, and judgement output display signals will be output according to	MAIN APPLICATIONS & SETTING METHODS Height Steps
		the non-measurement settings. The sub-display will show LdDFF. Warm up the sensor for at least 10 minutes after canceling LD-OFF input. (For details on the output during non-measurement, see page 111.)	and Warpage Double Sheet Detection
Orange	Zero reset input	The zero reset input is used to execute and cancel zero reset. (For details, see page 101.)	Thickness Positioning
Purple	Timing input/ BANK input 0 (switched by external input	Timing input: Signal input wire for obtaining hold function timing. While this input is being input, the sub-display will show 님 제 NG.	Eccentricity and Surface Deflection
	setting)	BANK input 0: Signal input wire for bank switching. Banks are switched by ON/OFF combinations with BANK input 1.	DETAILED SETTINGS
		When connecting two or more Amplifier Units, use the CH1 Amplifier Unit for bank switching. The banks of the	TROUBLE- SHOOTING
		Amplifier Units of CH2 and later are switched together with CH1. (For details on switching and inputs, see page 118.)	SPECIFI- CATIONS

		•	
	Cable	Name	Function
	color		
	Red	Reset input/BANK	Reset input:
0011751170		input 1 (switched	While a reset signal is being input, $RESEE$ is displayed
CONTENTS		by external input	on the sub-display.
		setting)	 When the hold function is not used
INTRODUCTION			The output while a reset signal is being input is held in
INTRODUCTION			accordance with the output during non-measurement
			setting.
PREPARATION For			This feature can be used in cases such as to input a
MEASUREMENT			mask signal if you want to stop output for a certain
			period.
FLOW OF OPERATION			When the hold function is used If a react signal is input, the state in effect before the
OF LIVETION			If a reset signal is input, the state in effect before the hold function was set will be restored.
BASIC			(For details on the hold function, see page 93, and
SETUP			for details on the output during non-measurement,
			see page 111.)
MAIN APPLICATIONS			BANK input 1:
& SETTING			Signal input wire for bank switching. Banks are switched
METHODS			by ON/OFF combinations with BANK input 0.
Height			When connecting two or more Amplifier Units, use the
Stone			CH1 Amplifier Unit for bank switching. The banks of the
Steps and			Amplifier Units of CH2 and later are switched together
Warpage			with CH1.
Double Sheet			(For details on switching and inputs, see page 118.)
Detection	Eor tho tir	ning at which the	ر se signals are input, see the timing charts on pages 144
	to 146.	ning at which the	se signals are input, see the tinning charts on pages 144
Thickness	10 140.		
Positioning			
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PNP Amplifier Unit (Positive Common)

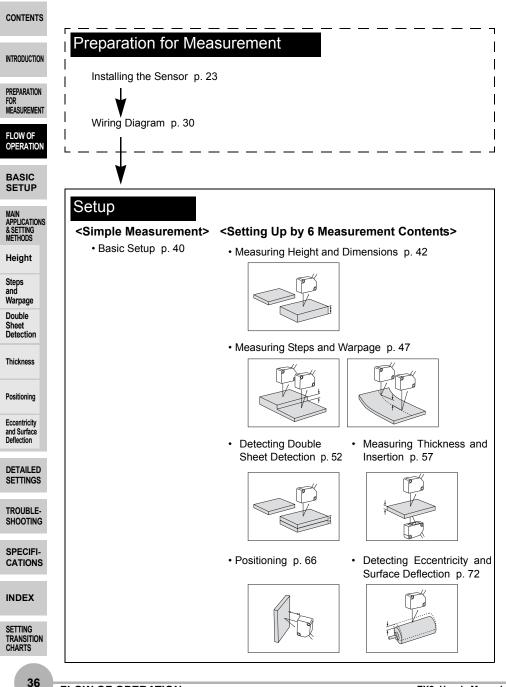
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	 Smart Tuning (Optimizing the Sensing Conditions) Selecting the Initial Sub-Display Connecting Two or More Amplifier Units Mutual Interference Prevention Setting the Hysteresis (Improving Unstable Measurement Near the Judgement Threshold) Setting Hold (Holding Measured Values Under Special Conditions) Bank Setting Zero Reset Sensing (Chapting Digital Values for Specific Measured Values) 	p. 93 p. 99 p. 101	PREPARATION FOR MEASUREMENT FLOW OF OPERATION BASIC SETUP
	 Scaling (Changing Digital Values for Specific Measured Values) Analog Output Output for Non-measurement (Output Setting During Input of the Reset Signal at an Error) 	p. 105 p. 109 p. 111	MAIN APPLICATIONS & SETTING METHODS
	• Timer	p. 114	Height
	Setting the Differential Function	p. 116	a .
	 External Input for Bank, Timing Input, Reset Input Setting the Detection Surface Selection 	p. 118 p. 120	Steps and Warpage
	(Decreasing Incorrect Measurement Caused by Multireflection on Workp		Double
	Key Lock FunctionInitializing Setting Data	p. 122 p. 123	Sheet Detection
ļ	r <u> </u>	 	Thickness
	When an Error Occurs	l	Positioning
	 Troubleshooting Error Messages Q&A p. 128 p. 130 	 	Eccentricity and Surface Deflection
l	<u> </u>	لا	DETAILED SETTINGS
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SMART MENU/SET

Hold down for 1 second

(response time and color/state of workpiece)

Display

Pressing down

Pressed down

NI N

Flashing

18RF

- indication: FAR side

Smart Tuning (Single Smart Tuning)





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* To tune multiple workpieces or to tune workpieces having a different surface condition: page 80

Explanation of

Selection Menu

If " FRI FRI" flashes on the

sub-display for three

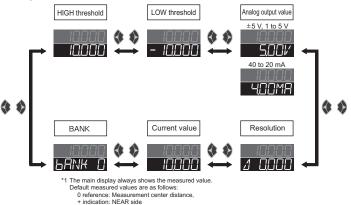
itry again.

seconds, it indicates that

tuning was not possible.

Change the response time

setting to a larger value, and



The numerals shown in the above diagram are an example only. The actual display may be different. For how to select the initial sub-display to be displayed when the power is turned on, see page 84.

Smart tuning sets optimum sensing conditions according to the operating conditions

Description of Operation

Set the reference workpiece in place, adjust the position of the Sensor Head while looking at the

digital display values on the

and the workpiece is the

position

Amplifier Unit or the indicators on the Sensor Head so that the distance between the Sensor Head

measurement center distance, and install the Sensor Head at this

51 NGLE is displayed, release

start execution of smart tuning.

your finger from the button to

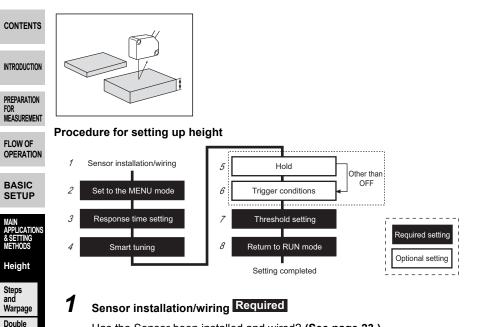
Press the ebutton for one

second. When SMARE/

MAIN APPLICATIONS & SETTING METHODS

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Eccentricity and Surface Deflection	72

Height



Has the Sensor been installed and wired? (See page 23.)

Set the reference workpiece in place, adjust the position of the Sensor Head while looking at the digital display values on the Amplifier Unit or the indicators on the Sensor Head so that the height to be measured is near the measurement center distance, and install the Sensor Head at this position.

Set to the MENU mode Required ∕

Select the desired mode to set the measurement conditions in.

and Surface					
Deflection	Button Operation	Display	Description of Operation	Explanation of Selection Menu	
DETAILED SETTINGS	SMART MENU/SET		Hold down the button for three seconds to switch to the		
TROUBLE- SHOOTING	Hold down for 3 seconds		MENU mode.		
	Press	<u>delai l</u>	Press the 🔇 button to display	 This operation is not required when hold and 	
SPECIFI- CATIONS	to display.	888888		trigger conditions are not to be set.	
INDEX		<u>delai l</u> NN	Press the ♥ button to set the display to □N to set display of the detail menu.		
SETTING TRANSITION CHARTS	Press to display.				

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Eccentricity

Button Operation	Display	Description of Operation	Explanation of Selection Menu	
SMART MENU/SET		Press the button to apply the setting.		CONTENTS

3 Response time setting Required

Select the response time to match the size and moving speed of the sensing object.

Button Operation	Display	Description of Operation	Explanation of Selection Menu	PREPARATION For
Press to display.	<u>59888</u> 888888	Press the \$ button to display SPEEd .	Default value: 500 ms	MEASUREMENT FLOW OF OPERATION
Press to select	SPEEd IM5 Select the desired value.	Press the 💲 button to select the response time.	Select the response time to match the size and moving speed of the sensing object. 60 µs, 120 µs, 240 µs, 500 µs, 1 ms, 2 ms, 4 ms, 8 ms, 12 ms, 20 ms, 36 ms, 66 ms, 128 ms, 250 ms, 500 ms	BASIC SETUP MAIN APPLICATIONS & SETTING METHODS Height Steps
SMART MENU/SET		Press the button to apply the setting.	* After the response time is changed, the smart tuning results are cleared, so be sure to re-execute tuning.	and Warpage Double Sheet Detection

4 Smart tuning Required

Smart tuning sets optimum sensing conditions according to the operating conditions (response time and color/state of workpiece)

Button Operation	Display	Description of Operation	Explanation of Selection Menu	Eccentricity and Surface Deflection
_	—	Check that the reference workpiece is set in place.		DETAILED SETTINGS
SMART MENU/SET Hold down for 1 second	Pressing down	Press the button for one second. When SMARL/ SI NGLE is displayed, release	If " FRILED " flashes on the Isub-display for three seconds, it indicates that tuning was not possible.	TROUBLE- SHOOTING
	Pressed down	your finger from the button to start execution of smart tuning.	Change the response time Isetting to a larger value, and	SPECIFI- CATIONS
	Di NULE Flashing		try again.	
	, lashing			INDEX

* To tune multiple workpieces or to tune workpieces having a different surface condition: **page 80**

SETTING TRANSITION CHARTS

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5 Hold Optional

Set this item to hold measured values during the measurement period according to preset hold conditions.

	-			
CONTENTS	Button Operation	Display	Description of Operation	Explanation of Selection Menu
INTRODUCTION	Press to display.	<u>HOLd</u> 888888	Press the ♦ button to display H□Ld.	Default value: OFF
PREPARATION FOR MEASUREMENT FLOW OF OPERATION	Press to select	PERK Select the desired value.	Press the 📚 button to select the hold conditions.	Hold OFF HVE The average measured value during the sampling period is
BASIC SETUP				held. PEPP The difference between the minimum and maximum values during the compliant
APPLICATIONS & SETTING METHODS				values during the sampling period is held. SRMPLE
Height Steps and Warpage				The measured value at the start of the sampling period is held.
Double Sheet Detection				The minimum value during the sampling period is held.
Thickness				The maximum value during the sampling period is held. (For details, see page 95.)
Positioning Eccentricity	SMART MENU/SET		Press the button to apply the setting.	* The clamp value is output until the first sampling period
and Surface Deflection			When other than DFF is selected, proceed to "6	is finished. (For details on the clamp value, see page 111.)
DETAILED SETTINGS			Trigger conditions," and when ☐FF is selected, proceed to "7 Threshold	
TROUBLE- SHOOTING			setting."	of the hold measurement
SPECIFI- CATIONS		er conditions	Optional period is to be	input.
INDEX	Button Operation	Display	Description of Operation	Explanation of Selection Menu
SETTING TRANSITION CHARTS	Press to display.	<u>ERIG</u> 888888	Press the ♦ button to display ERI [].	Default value: TIMING
				·

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Button Operation	Display	Description of Operation	Explanation of Selection Menu	
	ERIG El MING	Press the subtton to select the trigger conditions.	EI MI NG Enter the trigger by using the timing input or by pressing the button in the RUN	CONTENTS
Press to select	Select the desired value.		mode. The period that the timing signal is ON is the sampling period.	INTRODUCTION
			SELF-d The sampling period is the	PREPARATION FOR MEASUREMENT
			period that the measured value is lower than the specified self-trigger level.	FLOW OF OPERATION
			SELF-U The sampling period is the period that the measured	BASIC SETUP
			value is greater than the specified self-trigger level. (For details, see page 97.)	MAIN APPLICATIONS & SETTING METHODS
SMART MENU/SET		Press the button to apply the trigger conditions.		Height
		When SELF-U and		Steps and Warpage
		5ELF-d are selected, proceed to the next item, and		Double Sheet Detection
		when <code>LI MI N_</code> is selected, proceed to "7 Threshold setting."		Thickness
Press to	SELF <u>.</u> LV	Press the 🌢 button to display	Default value: 0.000	Positioning
display.	888888			Eccentricity and Surface Deflection
		Press the sutton to enable setting of the self-trigger level.		DETAILED SETTINGS
[Change numeric value]	<u>SELFL/</u>	Press the 🔹 button to move the digit, press the 💲 button to	* If the \$ button is pressed when the cursor is at the	TROUBLE- SHOOTING
Press to set.	Set any value.	change the numeric value, and set the self-trigger level.	right-most digit or the button is pressed when the cursor is at the left-most digit, the setting will be canceled.	SPECIFI- CATIONS
SMART MENU/SET		Press the button to apply the setting.		INDEX
				SETTING TRANSITION CHARTS

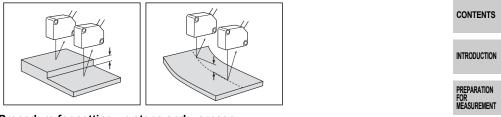
7 Threshold setting Required

Set the range of measured values to be judged as PASS by setting the HIGH and LOW thresholds.

CONTENTS	Button Operation	Display	Description of Operation	Explanation of Selection Menu
INTRODUCTION	Press to display.	Lit H L MENU	Press the to button to display the HIGH threshold.	Setting example: Non-defective product height 0 to 10 mm
Preparation For Measurement			Press the Soutton to enable setting of the HIGH threshold.	NG OK NG P
FLOW OF OPERATION				Set the MAX and MIN heights to be regarded as OK
BASIC SETUP	[Change numeric value]	Set any value.	Press the \$ button to move the digit, press the \$ button to change the numeric value, and set the HIGH threshold.	to the HIGH and LOW thresholds, respectively.
MAIN APPLICATIONS & SETTING METHODS	SMART MENU/SET		Press the button to apply the setting.	when the cursor is at the right-most digit or the &
Height Steps and Warpage	Press to display,	Lit H L MENU	Press the \$ button to display the LOW threshold.	button is pressed when the cursor is at the left-most digit, the setting will be canceled. * Set so that the HIGH
Double Sheet Detection			Press the 🏶 button to enable setting of the LOW threshold.	threshold is greater than the LOW threshold.
Thickness	[Change numeric value]	ושבכו	Press the 🐗 button to move	
Positioning	Move digit	Set any value.	the digit, press the subton to change the numeric value, and set the LOW threshold.	
and Surface Deflection	SMART MENU/SET		Press the button to apply the setting.	
DETAILED SETTINGS				
TROUBLE- SHOOTING	8 Retur	n to RUN mod	e Required Switch to the is performe	e mode in which measurement d.
SPECIFI-	Button Operation	Display	Description of Operation	Explanation of Selection Menu
	SMART MENU/SET Hold down for 3 seconds	H L MENU	Hold down the button for three seconds to switch to the RUN mode.	
SETTING TRANSITION CHARTS			settings, such as output and inp erence height to 0 (or the offset	-

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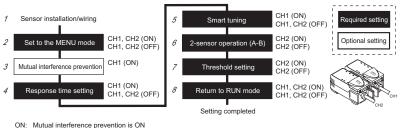
Steps and Warpage



Procedure for setting up steps and warpage

The Amplifier Units to set up differ depending on whether mutual interference prevention is set to ON or OFF.

Note that different channels are used to specify each menu item, as shown below.



ON: Mutual interference prevention is ON OFF: Mutual interference prevention is OFF

Sensor installation/wiring Required

Has the Sensor been installed and wired? (See page 23.)

Connect two Amplifier Units with a Calculating Unit in between. (The calculation result is displayed and output on the CH2 Amplifier Unit.)

Set the reference workpiece in place, adjust the position of the Sensor Head while looking at the digital display values on the Amplifier Unit or the indicators on the Sensor Head so that each of the heights to be measured is near the measurement center distance, and install the Sensor Head at this position.

2 Set to the MENU mode Required

Select the desired mode to set the measurement conditions in.

(Use CH1 and CH2 for these settings.)

_	Button peration	Display		ay	Description of Operation	Explanation of Selection Menu	INDEX
SMAR	T MENU/SET			Lit	Hold down the button for three seconds to switch to the		SETTING
	Hold down for 3 seconds	H	L	MENU	MENU mode.		TRANSITION

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	Button Operation	Display	Description of Operation	Explanation of Selection Menu
CONTENTS	Press to display.	dELRI L 888888	Press the I button to display dELRI L.	
INTRODUCTION		delai L	Press the ♣ button to set the display to □N to set display of the detail menu.	
PREPARATION FOR MEASUREMENT	Press to display.			
FLOW OF OPERATION	SMART MENU/SET		Press the button to apply the setting.	
BASIC SETUP		al interference CH1 for these s	prevention Optional interference	en to prevent the influence of mutual ce between two Sensor Heads.
MAIN APPLICATIONS & SETTING METHODS	Button Operation	Display	Description of Operation	Explanation of Selection Menu
Height	Press to	<u>SYNE</u>	Press the III button on the CH1 Amplifier Unit to display 5님NE.	Default value: OFF
Steps and Warpage	display,			
Double Sheet Detection		<u> </u>	Press the ✤ button to display □N.	
Thickness	Press to display.		Press the 👅 button to apply	* For datails on the reanance
Positioning	SMART MENU/SET		the setting.	* For details on the response time when connecting two or more Amplifier Units, see page 86.
and Surface Deflection				
DETAILED SETTINGS	c	onse time setti	ing Required and moving	esponse time to match the size speed of the sensing object.
TROUBLE-			prevention is set to OFF: Use CH	U U
SHOOTING	Button Operation	Display	Description of Operation	Explanation of Selection Menu
SPECIFI- CATIONS	Press to display	SPEEd	Press the Solution to display	Default value: 500 ms
INDEX	display.	000000		
SETTING TRANSITION CHARTS				

Button Operation	Display	Description of Operation	Explanation of Selection Menu	
	<u>SPEEd</u> IMS	Press the 💲 button to select the response time.	Select the response time to match the size and moving speed of the sensing object.	CONTENTS
Press to select	Select the desired value.		60 µs, 120 µs, 240 µs, 500 µs, 1 ms, 2 ms, 4 ms, 8 ms, 12 ms, 20 ms, 36 ms, 66 ms, 128 ms,	INTRODUCTION
SMART MENU/SET		Press the button to apply the setting.	250 ms, 500 ms * After the response time is changed, the smart tuning	PREPARATION FOR MEASUREMENT
		the setting.	results are cleared, so be sure to re-execute tuning.	FLOW OF OPERATION
5 Smar	t tuning Requ	ired according to the	s optimum sensing conditions operating conditions nd color/state of workpiece)	BASIC SETUP
		prevention is ON: Use CH prevention is set to OFF: Use CH	11 for these settings. 11 and CH2 for these settings.	MAIN APPLICATIONS & SETTING METHODS
Button Operation	Display	Description of Operation	Explanation of Selection Menu	Height
_	_	Check that the reference workpiece is set in place.		Steps and Warpage
SMART MENU/SET	Pressing down	Press the [™] button for one second. When SMARE/	If "FRILED" flashes on the sub-display for three	Double Sheet Detection
	Pressed down	SI NELE is displayed, release your finger from the button to	seconds, it indicates that tuning was not possible. Change the response time	Thickness
	<u>ELINI NG</u> si Si NGLE	Start execution of smart tuning.	Isetting to a larger value, and try again.	Positioning
	Flashing		prevention is set to ON, after smart tuning execution for	Eccentricity and Surface Deflection
			CH1 ends, it is also executed for the Amplifier Units of CH2 and later. If the tuning result	DETAILED SETTINGS
			is NG for either Amplifier Unit, the smart tuning setup results are not applied to any	TROUBLE- SHOOTING
			amplifier units.	SPECIFI-

* To tune multiple workpieces or to tune workpieces having a different surface condition: page 80

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6 2-sensor operation (A-B) Required

Set this item when calculating the difference between the measurement results from two Sensor Heads. The measurement result for CH1 is substracted from the measurement result of the channel being set.

CONTENTS (Use CH2 for these settings.)

INTRODUCTION	Button Operation	Display	Description of Operation	Explanation of Selection Menu
PREPARATION FOR MEASUREMENT FLOW OF OPERATION	Press to dicitary	<u>CALC</u> 888888	Press the ♦ button on the CH2 Amplifier Unit to display [ALC.	Calculating Unit
BASIC SETUP				CH2 (Calculation result is output.)
MAIN APPLICATIONS & SETTING METHODS	Press to select	<u>САLС</u> Я-Ь	Press the \$ button to display 用−占.	
Height Steps and Warpage Double	SMART MENU/SET		Press the button to apply the setting.	* For details on the response time when connecting two or more Amplifier Units, see page 86.

Thickness

E Sheet Detection

7 Threshold setting Required Set the range of measured values to be judged as PASS by setting the HIGH and LOW thresholds.

(Use CH2 for these settings.)

Positioning	Button Operation	Display	Description of Operation	Explanation of Selection Menu
Eccentricity	operation			Ocicetion Menu
and Surface Deflection	Press		Press the 🌒 button on the CH2	Setting example:
DETAILED	ss to display,	Lit H L MENU	Amplifier Unit to display the HIGH threshold.	Non-defective product step 3 to 8 mm
				DE OK NG
TROUBLE- SHOOTING				
SPECIFI- CATIONS				P
				Set the MAX and MIN steps
INDEX				to be regarded as OK to the HIGH and LOW thresholds,
				respectively.
SETTING TRANSITION				

SETTING TRANSITI CHARTS

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Button Operation	Display	Description of Operation	Explanation of Selection Menu	
		Press the Solution to enable setting of the HIGH threshold.	* If the to button is pressed when the cursor is at the right-most digit or the to button is pressed when the	CONTENTS
[Change numeric value]	12.345 8000	Press the () button to move the digit, press the () button to change the numeric value, and	cursor is at the left-most digit, the setting will be canceled.	INTRODUCTION
Press to set.	Set any value.	set the HIGH threshold.	* Set so that the HIGH threshold is greater than the	PREPARATION FOR MEASUREMENT
SMART MENU/SET		Press the button to apply the setting.	LOW threshold.	FLOW OF
Press to	Lit	Press the 🕸 button to display the LOW threshold.		BASIC
display.	H L MENU			SETUP
		Press the 🍩 button to enable setting of the LOW threshold.		MAIN APPLICATIONS & SETTING METHODS
				Height
[Change numeric value]	12,345 3000	Press the \$ button to move the digit, press the \$ button to change the numeric value, and		Steps and Warpage
Press to set.	Set any value.	set the LOW threshold.		Double Sheet Detection
SMART MENU/SET		Press the button to apply the setting.		Thickness

8 Return to RUN mode Required

Switch to the mode in which measurement is performed.

(Use CH1 and CH2 for these settings.)

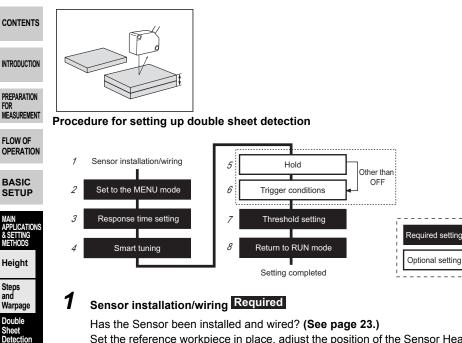
Button	D : 1		Explanation of	Defiection
Operation	Display	Description of Operation	Selection Menu	DETAILED
SMART MENU/SET	Out	Hold down the 🖱 button for		SETTINGS
Hold down for 3 seconds	H L MENU	three seconds to switch to the RUN mode.		TROUBLE- SHOOTING

* For details on optimizing settings, such as output and input, see "DETAILED SETTINGS."

Positioning

Eccentricity and Surface

Double Sheet Detection



Set the reference workpiece in place, adjust the position of the Sensor Head while looking at the digital display values on the Amplifier Unit or the indicators on the Sensor Head so that the measured value at measurement of one product and at measurement of two products is within the measurement range, and install the Sensor Head at this position.

Select the desired mode to set 2 Set to the MENU mode Required the measurement conditions in. Eccentricity and Surface Deflection Button Explanation of Description of Operation Display Operation Selection Menu DETAILED Hold down the 👅 button for SETTINGS SMART MENU/SET Lit three seconds to switch to the Hold down for Н MENU MENU mode. TROUBLE-SHOOTING Press the \$ button to display * This operation is not dFF defai L. required when hold and SPECIFI-CATIONS trigger conditions are not to be set INDEX Press the 🗢 button to set the display to IN to set display of the detail menu. SETTING

TRANSITION CHARTS

Thickness

Positioning

Button Operation	Display	Description of Operation	Explanation of Selection Menu	
SMART MENU/SET		Press the button to apply the setting.		CONTENTS

3 Response time setting Required

Select the response time to match the size and moving speed of the sensing object.

INTRODUCTION	

Positioning

	Button Operation	Display	Description of Operation	Explanation of Selection Menu	PREPARATION FOR MEASUREMENT
	Press to displa		Press the to button to display	Default value: 500 ms	FLOW OF OPERATION
	×		Press the 💲 button to select the	Select the response time to	BASIC SETUP
	Press to select	Select the	response time.	match the size and moving speed of the sensing object.	MAIN APPLICATIONS & SETTING METHODS
		desired value.		60 μs, 120 μs, 240 μs, 500 μs, 1 ms, 2 ms, 4 ms, 8 ms, 12 ms, 20 ms, 36 ms, 66 ms, 128 ms, 260 ms, 500 ms	Height
-	SMART MENU/SET		Press the button to apply	After the response time is	and Warpage
			the setting.	changed, the smart tuning results are cleared, so be sure to re-execute tuning.	Double Sheet Detection
•	I			l	Thickness

4 Smart tuning Required

Smart tuning sets optimum sensing conditions according to the operating conditions (response time and color/state of workpiece)

Button Operation	Display	Description of Operation	Explanation of Selection Menu	Eccentricity and Surface Deflection
_	_	Check that the reference workpiece is set in place.		DETAILED SETTINGS
SMART MENU/SET Hold down for 1 second	Pressing down	Press the [™] button for one second. When SMRRE/	If " FRILED" flashes on the sub-display for three seconds, it indicates that	TROUBLE- SHOOTING
	Pressed down	your finger from the button to	tuning was not possible. Change the response time isetting to a larger value, and	SPECIFI- CATIONS
SI NGLE Flashing			try again.	INDEX

* To tune multiple workpieces or to tune workpieces having a different surface SETTING ransition: page 80

5 Hold Optional

Set this item to hold measured values during the measurement period according to preset hold conditions.

CONTENTS	Button Operation	Display	Description of Operation	Explanation of Selection Menu
INTRODUCTION	Press to display.	HOLd	Press the ♦ button to display H□Ld.	Default value: OFF
PREPARATION For Measurement		HGLJ PE8K	Press the 💲 button to select the hold conditions.	DFF Hold OFF R⊮E
FLOW OF OPERATION	Press to select	Select the desired value.		The average measured value during the sampling period is held.
BASIC SETUP				PECP The difference between the minimum and maximum
MAIN APPLICATIONS & SETTING METHODS				values during the sampling period is held.
Height				The measured value at the start of the sampling period is
Steps and Warpage				held. <u> BOLLEOM</u> The minimum value during
Double Sheet Detection				the sampling period is held.
Thickness				the sampling period is held. (For details, see page 95.)
Positioning	SMART MENU/SET		Press the button to apply the setting.	* The clamp value is output until the first sampling period
Eccentricity and Surface Deflection			When other than DFF is selected, proceed to "6	is finished. (For details on the clamp value, see page 111.)
DETAILED SETTINGS			Trigger conditions," and when DFF is selected, proceed to "7 Threshold setting."	
TROUBLE- SHOOTING			Set how timi	ng of the hold measurement
SPECIFI- CATIONS		er conditions [Optional period is to b	be input.
INDEX	Button Operation	Display	Description of Operation	Explanation of Selection Menu
SETTING TRANSITION CHARTS	Press to display.	<u>ERI 6</u> 888888	Press the ♦ button to display ERI [].	Default value: TIMING

Double Sheet Detection

Button Operation	Display	Description of Operation	Explanation of Selection Menu	
	EL MI NG	Press the 💲 button to select the trigger conditions.	Enter the trigger by using the timing input or by pressing the the button in the RUN	CONTENTS
Press to select	Select the desired value.		mode. The period that the timing signal is ON is the	INTRODUCTION
			sampling period. SELF-d The sampling period is the	PREPARATION FOR MEASUREMENT
			period that the measured value is lower than the specified self-trigger level.	FLOW OF OPERATION
			SELF-U The sampling period is the period that the measured	BASIC SETUP
			value is greater than the specified self-trigger level. (For details, see page 97.)	MAIN APPLICATIONS & SETTING METHODS
SMART MENU/SET		Press the button to apply the trigger conditions.		Height
		When SELF-U and		Steps and Warpage
		$\Box \in LF - d$ are selected, proceed to the next item, and when $E \mid M \mid N \subseteq$ is selected,		Double Sheet Detection
		proceed to "7 Threshold setting."		Thickness
Press to	<u>SELF,LV</u>	Press the ♦ button to display SELFLV	Default value: 0.000	Positioning
display.				Eccentricity and Surface Deflection
		Press the sutton to enable setting of the self-trigger level.		DETAILED SETTINGS
[Change numeric value]	SELFLV	Press the 👀 button to move the digit, press the 💲 button to	* If the \$ button is pressed when the cursor is at the	TROUBLE- SHOOTING
Press to set.	Set any value.	change the numeric value, and set the self-trigger level.	right-most digit or the button is pressed when the cursor is at the left-most digit, the setting will be canceled.	SPECIFI- CATIONS
SMART MENU/SET		Press the button to apply the setting.		INDEX
		une county.		SETTING TRANSITION CHARTS

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7 Threshold Setting Required

Set the range of measured values to be judged as PASS by setting the HIGH and LOW thresholds.

CONTENTS	Button Operation	Display	Description of Operation	Explanation of Selection Menu
INTRODUCTION	Press to display,	Lit H L MENU	Press the 🌒 button to display the HIGH threshold.	Examples:
FOR MEASUREMENT			Press the 🍣 button to enable setting of the HIGH threshold.	Set the HIGH and LOW thresholds right in the middle of the measured values of
FLOW OF OPERATION	[Change numeric value]	חוררו	Press the 🔹 button to move	sheets 1 and 2 and sheets 1 and 0, respectively.
BASIC SETUP	Press to set.	0,500 Set any value.	the digit, press the 3 button to change the numeric value, and set the HIGH threshold.	* If the to button is pressed when the cursor is at the right-most digit or the to
APPLICATIONS & SETTING METHODS	SMART MENU/SET		Press the button to apply the setting.	button is pressed when the cursor is at the left-most digit,
Height Steps and Warpage	Press to display.	Lit H L MENU	Press the to button to display the LOW threshold.	the setting will be canceled. * Set so that the HIGH threshold is greater than the LOW threshold.
Double Sheet Detection Thickness			Press the ✤ button to enable setting of the LOW threshold.	
Positioning Eccentricity	[Change numeric value]	- 0,500 Set any value.	Press the \$ button to move the digit, press the \$ button to change the numeric value, and set the LOW threshold.	
and Surface Deflection	SMART MENU/SET		Press the button to apply the setting.	
SETTINGS	8 Retur	n to RUN mod	e Required Switch to the is performed.	mode in which measurement
SHOOTING	Button Operation	Display	Description of Operation	Explanation of Selection Menu
SPECIFI- CATIONS	SMART MENU/SET	Uut H L MENU	Hold down the button for three seconds to switch to the RUN mode.	

* For details on optimizing settings, such as output and input, see "Detailed Settings." Example (Setting the reference height to 0 (or the offset value): Zero Reset \rightarrow page 101)

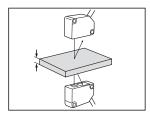
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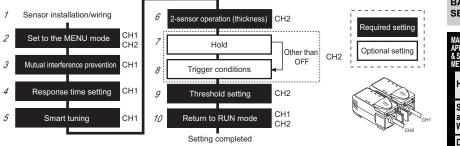
TRANSITION

Thickness



Procedure for setting up thickness

The Amplifier Units to set up differ for each menu. Note also that different channels are used to specify each menu item, as shown below.



Sensor installation/wiring Required

Has the Sensor been installed and wired? (See page 23.)

Connect two Amplifier Units with a Calculating Unit in between. (The calculation result is displayed and output on the CH2 Amplifier Unit.)

Set up the two Sensor Heads so that they are facing each other, adjust the positions of the Sensor Heads while looking at the digital display values on the Amplifier Units or the indicators on the Sensor Heads so that the clearance between the sensing object and each Sensor Head is near the measurement center distance, and install the Sensor Heads at these positions.

Prepare a reference sensing object of known thickness.

2 Set to the MENU mode Required

Select the desired mode to set the measurement conditions in.

(Use CH1 and CH2 for these settings.)

Button Operation	Display	Description of Operation	Explanation of Selection Menu	INDEX
SMART MENU/SET Hold down for 3 seconds	H L MENU	Hold down the button for three seconds to switch to the MENU mode.		SETTING TRANSITION CHARTS

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	Button Operation	Display	Description of Operation	Explanation of Selection Menu
CONTENTS	Press to deplay.	<u>dELRI L</u> 888888	Press the I button to display	
INTRODUCTION		dEERI L	Press the ♣ button to set the display to □N to set display of	
PREPARATION For Measurement	Press to display.		the detail menu.	
FLOW OF OPERATION	SMART MENU/SET		Press the button to apply the setting.	
BASIC SETUP		al interference CH1 for these s	prevention Required interferer	tem to prevent the influence of mutual ice between two Sensor Heads.
MAIN APPLICATIONS & SETTING METHODS	Button Operation	Display	Description of Operation	Explanation of Selection Menu
Height	Press to	<u> </u>	Press the 🆸 button on the CH1 Amplifier Unit to display 54NE.	Default value: OFF
Steps and Warpage	display.			
Double Sheet Detection	Press to display	<u>Sync</u> On	Press the ♣ button to display □N.	
Thickness Positioning	SMART MENU/SET		Press the button to apply the mutual interference prevention setting.	* For details on the response time when connecting two or more Amplifier Units, see page 86.
Eccentricity and Surface Deflection	4 Resp	onse time setti		sponse time to match the size
DETAILED SETTINGS	-	CH1 for these s	- 0	
TROUBLE- SHOOTING	Button Operation	Display	Description of Operation	Explanation of Selection Menu
SPECIFI- CATIONS	Pres to display.	<u>SPEEd</u> 888888	Press the the button on the CH1 Amplifier Unit to display	Default value: 500 ms
INDEX			·	
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	Button Operation	Display	Description of Operation	Explanation of Selection Menu	
		SPEEd	Press the 💲 button to select the response time.	Select the response time to match the size and moving	CONTENTS
	Press to select	Select the		speed of the sensing object.	
		desired value.		60 μs, 120 μs, 240 μs, 500 μs, 1 ms, 2 ms, 4 ms, 8 ms, 12 ms,	INTRODUCTION
			20 ms, 36 ms, 66 ms, 128 ms, 250 ms, 500 ms	PREPARATION	
	SMART MENU/SET		Press the button to apply the setting.	* After the response time is changed, the smart tuning	MEASUREMENT
			une setting.	results are cleared, so be sure to re-execute tuning.	FLOW OF OPERATION

5 Smart tuning Required

Smart tuning sets optimum sensing conditions according to the operating conditions (response time and color/state of workpiece)

(Use CH1 for these settings.)

Button Operation	Display	Description of Operation	Explanation of Selection Menu	APPLICATIONS & SETTING METHODS
_	_	Check that the reference workpiece is set in place.		Height Steps
SMART Hold down for 1 second	Pressing down	Press the button on the CH1 Amplifier Unit for one second. When SMRRL/SI NGLE is displayed, release your finger from the button to start execution of smart tuning.	If "File Content of the seconds, it indicates that seconds, it indicates that tuning was not possible. Change the response time setting to a larger value, and try again. * After smart tuning execution for CH1 ends, it is also executed for the Amplifier Units of CH2 and later. If the tuning result is NG for either Amplifier Unit, the smart tuning setup results are not applied to any amplifier units.	and Warpage Double Sheet Detection Thickness Positioning Eccentricity and Surface Deflection DETAILED SETTINGS TROUBLE- SHOOTING

* To tune multiple workpieces or to tune workpieces having a different surface condition: page 80

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6 2-sensor operation (thickness) Required

Make this initial setting to measure thickness when using two Sensor Head to measure thickness.

(Use CH2 for these settings.)

CONTENTS	Button	Display	Description of Operation	Explanation of
INTROPLICTION	Operation		Set the reference sensing object	Selection Menu
INTRODUCTION			of which thickness is known in place.	Calculating Unit
PREPARATION For Measurement	—	—	•	CH1
FLOW OF OPERATION				(Calculation result is output.)
BASIC SETUP	Press to display,	<u>EALE</u> 888888	Press the s button on the CH2 Amplifier Unit to display [RL[.	
MAIN APPLICATIONS & SETTING METHODS Height	Prest la salert	ERLE EHI EK	Press the 💲 button to display EHI [K .	
Steps and Warpage	SMART MENU/SET		Press the button to apply the thickness setting.	
Double Sheet Detection	[Change numeric value]	HK 99999	Press the \$ button to move the digit, press the \$ button to change the numeric value, and	* If the button is pressed when the cursor is at the
Positioning	Press to set.	Set any value.	set the thickness numeric value.	right-most digit or the a button is pressed when the cursor is at the left-most digit, the setting will be canceled.
Eccentricity and Surface Deflection	SMART MENU/SET		Press the button to apply the setting.	* The 2-sensor operation reference value is determined based on the measured values of CH1 and CH2 by the timing
DETAILED SETTINGS				that setting of the thickness numeric values is executed.
TROUBLE- SHOOTING				* For details on the response time when connecting two or more Amplifier Units, see page 86.
SPECIFI- CATIONS			1	·
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Important

- If analog output is to be used, the entered thickness value is used as the center value of the analog output range. (For example, 0 V is used if the analog output is ±5 V.)
- After thickness calculation, the maximum and minimum measurement range values (CH2 measurement values) are assigned as the maximum and minimum analog output range.
- Concerning the minimum and maximum analog output values, the analog output minimum value is output for the smaller of the post-thickness calculation values, and the analog output maximum value is output for the larger of these values.

Example: If the ZX2-LD50 is used, a thickness value of 20 mm is entered, and analog output from –5 to 5 V is specified.

Measured Value After	How the Measurement Value	Analog	FLOW OPERA
Thickness Calculation	Is Calculated	Output	OFERA
10.000	Thickness value- (CH2 measurement range/2)= 20.000-10.000	–5 V	BAS
20.000	Thickness value = 20.000	0 V	MAIN
30.000	Thickness value + (CH2 measurement range/2) = 20.000 + 10.000	5 V	APPLIC & SETTI METHO

* The measurement range for the ZX2-LD50 is ±10 mm.

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7 Hold Optional

Set this item to hold measured values during the measurement period according to preset hold conditions.

(Use CH2 for these settings.)

			• •	
CONTENTS	Button Operation	Display	Description of Operation	Explanation of Selection Menu
INTRODUCTION	Press to disp	HOLd	Press the to button on the CH2 Amplifier Unit to display Hald.	Default value: OFF
PREPARATION For Measurement		ע וחט	Press the 💲 button to select the	OFF
FLOW OF OPERATION	Press to select	PERK Select the	hold conditions.	Hold OFF <u>RVE</u> The average measured value
BASIC SETUP		desired value.		during the sampling period is held.
MAIN APPLICATIONS & SETTING METHODS				The difference between the minimum and maximum values during the sampling
Height				period is held. SRMPLE
Steps and Warpage				The measured value at the start of the sampling period is held.
Double Sheet Detection				DEEDM The minimum value during the sampling period is held.
Thickness				PERK The maximum value during
Positioning				the sampling period is held. (For details, see page 95.)
Eccentricity and Surface Deflection	SMART MENU/SET		Press the button to apply the setting.	* The clamp value is output until the first sampling period is finished.
DETAILED SETTINGS			When other than []FF is selected, proceed to "8 Trigger conditions," and	(For details on the clamp value, see page 111.)
TROUBLE- SHOOTING			when <i>DFF</i> is selected, proceed to "9 Threshold setting."	
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8 Trigger conditions Optional

(Use CH2 for these settings.)

Button Operation	Display	Description of Operation	Explanation of Selection Menu	CONTENTS
Press to displa	<u>ERI G</u> 888888	Press the ♦ button on the CH2 Amplifier Unit to display <i>上</i> , □.	Default value: TIMING	INTRODUCTION
*	- RI G	Press the 💲 button to select the trigger conditions.	ET MENG Enter the trigger by using the	PREPARATION FOR MEASUREMENT
Press to select	EI MI NE	ungger conditions.	timing input or by pressing the 🍲 button in the RUN	FLOW OF OPERATION
	desired value.		mode. The period that the timing signal is ON is the sampling period.	BASIC SETUP
			The sampling period is the period that the measured value is lower than the	MAIN APPLICATIONS & SETTING METHODS
			specified self-trigger level.	Height Steps and
			period that the measured value is greater than the specified self-trigger level.	Warpage Double Sheet Detection
SMART MENU/SET		Press the 🖱 button to apply	(For details, see page 97.)	Thickness
		the trigger conditions.		Positioning
		When $5ELF-U$ and $5ELF-d$ are selected, proceed to the next item, and		Eccentricity and Surface Deflection
		when <code>LI MI NL</code> is selected, proceed to "9 Threshold setting."		DETAILED SETTINGS
Press to dsp	SELFLV	Press the 🌢 button to display SELFLV .	Default value: 0.000	TROUBLE- SHOOTING
		Press the 🍣 button to enable		SPECIFI- CATIONS
		setting of the self-trigger level.		INDEX
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	Button Operation	Display	Description of Operation	Explanation of Selection Menu
CONTENTS	[Change numeric value]	99,999	Press the () button to move the digit, press the () button to change the numeric value, and set the self-trigger level.	* If the the button is pressed when the cursor is at the right-most digit or the the button is pressed when the
INTRODUCTION	Press to set.	Set any value.	set the sen-thygen level.	cursor is at the left-most digit, the setting will be canceled.
PREPARATION FOR MEASUREMENT	SMART MENU/SET		Press the button to apply the setting.	

9 Threshold Setting Required

Set the range of measured values to be judged as PASS by setting the HIGH and LOW thresholds.

(Use CH2 for these settings.)

BASIC	(Use CH2 for these settings.)				
SETUP	Button Operation	Display	Description of Operation	Explanation of Selection Menu	
MAIN APPLICATIONS & SETTING METHODS Height	Press to display.	Lit H L MENU	Press the \$ button on the CH2 Amplifier Unit to display the HIGH threshold.	Setting example: Non-defective product thickness 3 to 8 mm	
Steps and Warpage Double Sheet			Press the Soutton to enable setting of the HIGH threshold.	NG NG H 	
Detection Thickness	[Change numeric value] More digit	BODD Set any value.	Press the (**) button to move the digit, press the (**) button to change the numeric value, and set the HIGH threshold.	Set the MAX and MIN thicknesses to be regarded as OK to the HIGH and LOW thresholds, respectively.	
Positioning	SMART MENU/SET		Press the 👅 button to apply the setting.	* If the 🏘 button is pressed	
and Surface Deflection DETAILED SETTINGS	Press to display.	Lit H L MENU	Press the \$ button to display the LOW threshold.	when the cursor is at the right-most digit or the button is pressed when the cursor is at the left-most digit, the setting will be canceled.	
TROUBLE- SHOOTING			Press the Solution to enable setting of the LOW threshold.	* Set so that the HIGH threshold is greater than the LOW threshold.	
SPECIFI- CATIONS	[Change numeric value]	12,345 2000	Press the \$ button to move the digit, press the \$ button to		
INDEX	Press to set.	Set any value.	change the numeric value, and set the LOW threshold. Press the 👅 button to apply		
SETTING TRANSITION	SMART MENU/SET		the setting.		

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OPERATION

10 Return to RUN mode Required

Switch to the mode in which measurement is performed.

(Use CH1 and CH2 for these settings.)

Button Operation	Display	Description of Operation	Explanation of Selection Menu	CONTENTS
SMART MENU/SET Hold down for 3 seconds	Out	Hold down the button for three seconds to switch to the RUN mode.		INTRODUCTION

* For details on optimizing settings, such as output and input, see "DETAILED FOR MEASUREMENT"

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MAIN APPLICATIONS & SETTING METHODS

Height

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Thickness

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Eccentricity and Surface Deflection

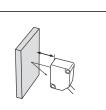
DETAILED SETTINGS

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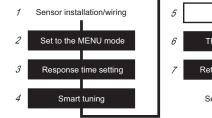
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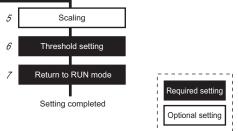
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SET TR/ CH/



Procedure for setting up positioning





Sensor installation/wiring Required

Has the Sensor been installed and wired? (See page 23.)

Set the sensing object in place, adjust the position of the Sensor Head while looking at the digital display values on the Amplifier Unit or the indicators on the Sensor Head so that the upper and lower limits of the distance between the Sensor Head and the sensing object is within the measurement range, and install the Sensor Head at this position.

2 Set to the MENU mode Required Select the desired mode to set the measurement conditions in.

Rouble- Hooting	Button Operation	Display	Description of Operation	Explanation of Selection Menu
PECIFI- ATIONS	SMART MENU/SET Hold down for 3 seconds	Lit H L MENU	Hold down the button for three seconds to switch to the MENU mode.	
IDEX ETTING RANSITION HARTS	Press to display.	<u>dELAI L</u> 888888	Press the � button to display dEERIL.	* This operation is not required when scaling is not to be set.

Button Operation	Display	Description of Operation	Explanation of Selection Menu	
Press to display.	<u>delai l</u> On	Press the button to set the display to □N to set display of the detail menu.		CONTENTS
SMART MENU/SET		Press the button to apply the setting.		INTRODUCTION
3 Resp	onse time setti	ing Required Select the read of the read o	esponse time to match the size I speed of the sensing object.	PREPARATION For Measurement
Button Operation	Display	Description of Operation	Explanation of Selection Menu	FLOW OF OPERATION
Press to display	<u>SPEEd</u> 888888	Press the 🌒 button to display SPEEd .	Default value: 500 ms	BASIC SETUP MAIN APPLICATIONS & SETTING
Press to select	SPEEd IMS Select the desired value.	Press the 💲 button to select the response time.	Select the response time to match the size and moving speed of the sensing object. 60 µs, 120 µs, 240 µs, 500 µs, 1 ms, 2 ms, 4 ms, 8 ms, 12 ms, 20 ms, 36 ms, 66 ms, 128 ms, 250 ms, 500 ms	Marifoos Height Steps and Warpage Double Sheet Detection
SMART MENU/SET		Press the to apply the setting.	* After the response time is changed, the smart tuning results are cleared, so be sure to re-execute tuning.	Thickness Positioning
		·	·	Eccentricity and Surface Deflection

TROUBLE-SHOOTING

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SETTING TRANSITION CHARTS

4 Smart tuning Required

Smart tuning sets optimum sensing conditions according to the operating conditions (response time and color/state of workpiece)

		-	(
CONTENTS	Button Operation	Display	Description of Operation	Explanation of Selection Menu
INTRODUCTION	_		Check that the reference workpiece is set in place.	
PREPARATION FOR MEASUREMENT FLOW OF OPERATION BASIC	Hold down for 1 second	Pressing down SMARE SINGLE Pressed down EUNING SINGLE Flashing	Press the button for one second. When SMRRL/ SI NGLE is displayed, release your finger from the button to start execution of smart tuning.	If "FALLEC" flashes on the isub-display for three seconds, it indicates that tuning was not possible. Change the response time isetting to a larger value, and try again.
SETUP MAIN APPLICATIONS & SETTING METHODS	* To tune condition:		ieces or to tune workpieces	having a different surface
Height	5 Scalir	ng Optional	Set this item to change the display a digital value on the Amplifier U measured value. (e.g. to display t	nit different from the actual
Steps and Warpage Double	Button Operation	Display	Description of Operation	Explanation of Selection Menu
Sheet Detection Thickness	Press to display	<u>SCALE</u> 888888	Press the to button to display	Default value: OFF
Positioning Eccentricity and Surface Deflection	Press to display.	<u>SCALE</u> ON	Press the 拳 button to display □N.	
DETAILED SETTINGS	SMART MENU/SET		Press the button to enable setting of scaling.	
TROUBLE- SHOOTING				
SPECIFI- CATIONS				
INDEX				
SETTING TRANSITION CHARTS				
68	Positioning			ZX2 User's Manual

Button Operation	Display	Description of Operation	Explanation of Selection Menu	
Press to display.	<u>5 I-6EF</u> -99999	Press the ♦ button to display 5 I-BEF .	<to actual="" display="" distance="" sensing="" the=""></to>	CONTENTS
		Press the 🏶 button to enable setting of S1-Before.	-808 ↓ 585042	INTRODUCTION
[Change numeric value]		Press the 🔹 button to move	58	PREPARATION FOR MEASUREMENT
Press to set.	- 8000 [Numeric	the digit, press the s button to change the numeric value, and set the measured value before	42 After	FLOW OF OPERATION
	value before change] Set any value.	S1 is changed.	8 -8 -1 S1 S2	BASIC SETUP
SMART MENU/SET		Press the button to apply the numeric value of S1-Before.	* If the \$ button is pressed when the cursor is at the	MAIN APPLICATIONS & SETTING METHODS
Press to dis	<u>S I-AFE</u>	Press the ♦ button to display 5 I-RFE .	right-most digit or the \$ button is pressed when the cursor is at the left-most digit,	Height Steps
			the setting will be canceled.	and Warpage
		Press the sutton to enable setting of S1-After.		Double Sheet Detection
[Change numeric value]	S I-RFE	Press the 🗱 button to move the digit, press the 🕱 button to		Thickness
Press to set.	[Numeric value after change] Set any value.	change the numeric value, and set the measured value after S1 is changed.		Positioning Eccentricity and Surface Deflection
SMART MENU/SET		Press the button to apply the numeric value of S1-After.		DETAILED SETTINGS
				TROUBLE- SHOOTING

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SETTING TRANSITION CHARTS

	Button Operation	Display	Description of Operation	Explanation of Selection Menu
CONTENTS	Press to display.	<u>52-66F</u> -99999	Press the \$ button to display 52-66F.	58 42 After
INTRODUCTION			Press the 🏶 button to enable setting of S2-Before.	8 Before
PREPARATION For Measurement	[Change numeric value]		Press the 🕸 button to move	* If the \$ button is pressed
FLOW OF OPERATION	Press to set.	52-555 8000 [Numeric	the digit, press the s button to those the numeric value, and set the measured value before	when the cursor is at the right-most digit or the button is pressed when the cursor is at the left-most digit,
BASIC SETUP		value before change] Set any value.	S2 is changed.	the setting will be canceled.
APPLICATIONS & SETTING METHODS	SMART MENU/SET		Press the button to apply the numeric value of S2-Before.	
Height	Press t	52-RFE	Press the 🌢 button to display	
Steps and Warpage	o display.			
Double Sheet Detection			Press the 拳 button to enable setting of S2-After.	
Thickness	[Change numeric value]		Press the 👀 button to move	
Positioning		<u>52-RFL</u> 42000	the digit, press the subtton to move the digit, press the subtton to change the numeric value, and	
Eccentricity and Surface Deflection	Press to set.	[Numeric value after change]	set the measured value after S2 is changed.	
DETAILED SETTINGS	SMART MENU/SET	Set any value.	Press the 👅 button to apply	
TROUBLE- SHOOTING			the numeric value of S2-After.	
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SETTING TRANSITION CHARTS				

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6 Threshold Setting Required

Set the range of measured values to be judged as PASS by setting the HIGH and LOW thresholds.

Button Operation	Display	Description of Operation	Explanation of Selection Menu	CONTENTS
Press to display.	Lit H L MENU	Press the 🌒 button to display the HIGH threshold.	Setting example: Non-defective product position 49 to 51 mm	INTRODUCTION
		Press the 🍣 button to enable setting of the HIGH threshold.		PREPARATION FOR MEASUREMENT
			51 49 Set the positioning MAX and	FLOW OF OPERATION
[Change numeric value]	Set any value.	Press the (() button to move the digit, press the () button to change the numeric value, and set the HIGH threshold.	MIN distances to the HIGH and LOW thresholds, respectively.	BASIC SETUP
SMART MENU/SET		Press the button to apply the setting.	* If the to button is pressed when the cursor is at the right-most digit or the to button is pressed when the cursor is at the left-most digit, the setting will be canceled.	MAIN APPLICATIONS & SETTING METHODS
Pres	H L MENU	Press the \$ button to display the LOW threshold.		Height
ss to display.				Steps and Warpage
		Press the 🏶 button to enable setting of the LOW threshold.	* Set so that the HIGH threshold is greater than the	Double Sheet Detection
			LOW threshold.	Thickness
[Change numeric value]	49,000	Press the (**) button to move the digit, press the (**) button to change the numeric value, and		Positioning
Press to set.	Set any value.	set the LOW threshold. Press the 👅 button to apply		Eccentricity and Surface Deflection
		the setting.		DETAILED SETTINGS

7 Return to RUN mode Required

Switch to the mode in which measurement is performed.

Button Operation	Display	Description of Operation	Explanation of Selection Menu	SPECIFI- CATIONS
SMART MENU/SET	Out H L MENU	Hold down the button for three seconds to switch to the RUN mode.		INDEX

For details on optimizing settings, such as output and input, see "DETAILED * SETTINGS."

SETTING TRANSITION CHARTS

TROUBLE-

SHOOTING

Eccentricity and Surface Deflection

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FLOW OF OPERATION

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Height Steps

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1

Sheet Detection

Thickness

Positioning

Eccentricity and Surface Deflection

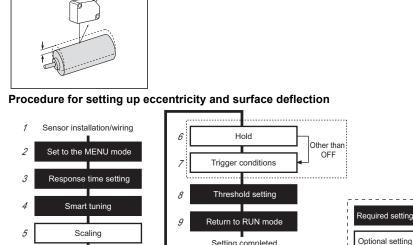
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SET TRA CHARTS



Sensor installation/wiring Required

Has the Sensor been installed and wired? (See page 23.)

Set the sensing object in place, adjust the position of the Sensor Head while looking at the digital display values on the Amplifier Unit or the indicators on the Sensor Head so that the clearance between the Sensor Head and the sensing object is near the measurement center distance, and install the Sensor Head at this position.

Setting completed

2 Set to the MENU mode Required Select the desired mode to set the measurement conditions in.

TAILED	Button Operation	Display	Description of Operation	Explanation of Selection Menu
TTINGS OUBLE- OOTING	SMART MENU/SET Hold down for 3 seconds	Lit H L MENU	Hold down the button for three seconds to switch to the MENU mode.	
PECIFI-	Press to display.	<u>dELRI L</u> 888888	Press the 🌢 button to display dELRI L.	* This operation is not required when scaling, hold and trigger conditions are not to be set.
DEX ITING ANSITION ARTS	Press to display.	<u>delri L</u> On	Press the button to set the display to □N to set display of the detail menu.	

Operation Display Description of Operation Selection Menu
MENU/SET Press the button to apply
the setting.

3 Response time setting Required

=Ed

Display

Smart tuning Required

Button

Operation

4

Select the response time to match the size

i	ng Required and moving	g speed of the sensing object.	INTRODUCTION
	Description of Operation	Explanation of Selection Menu	PREPARATION For Measurement
	Press the to button to display	Default value: 500 ms	FLOW OF OPERATION
	Press the 💲 button to select the response time.	Select the response time to match the size and moving	BASIC SETUP
		speed of the sensing object.	MAIN APPLICATIONS & SETTING

Press to select	Select the desired value.			speed of the sensing object. 60 μs, 120 μs, 240 μs, 500 μs, 1 ms, 2 ms, 4 ms, 8 ms, 12 ms, 20 ms, 36 ms, 66 ms, 128 ms, 250 ms, 500 ms	MAIN APPLICATIONS & SETTING METHODS Height Steps
SMART MENU/SET		Press the 👅 b	outton to apply	* After the response time is	and Warpage
		the setting.		changed, the smart tuning results are cleared, so be sure to re-execute tuning.	Double Sheet Detection
				sure to re excoute turning.	

Smart tuning sets optimum sensing conditions according to the operating conditions

(response time and color/state of workpiece)

Thickness

Positioning

Button Operation	Display	Description of Operation	Explanation of Selection Menu	Eccentricity and Surface Deflection
_	_	Check that the reference workpiece is set in place.		DETAILED SETTINGS
Hold down for 1 second	Pressing down SMARE SINGLE Pressed down EUNING SINGLE Flashing	Press the button for one second. When SMRRL/ SINGLE is displayed, release your finger from the button to start execution of smart tuning.	If " FALLED " flashes on the sub-display for three seconds, it indicates that tuning was not possible. Change the response time setting to a larger value, and try again.	TROUBLE- SHOOTING SPECIFI- CATIONS INDEX

To tune multiple workpieces or to tune workpieces having a different surface condition: page 80

5 Scaling Optional

Set this item to change the display scale when you want to display a digital value on the Amplifier Unit different from the actual measured value. (e.g. to reverse the - and + indications)

CONTENTS	Button Operation	Display	Description of Operation	Explanation of Selection Menu
INTRODUCTION	Press to display.	<u>SCALE</u> 888888	Press the \$ button to display SEALE .	Default value: OFF
PREPARATION FOR MEASUREMENT FLOW OF OPERATION	Press to display.	<u>SCALE</u> On	Press the ✤ button to display □N.	
BASIC	SMART MENU/SET		Press the button to enable setting of scaling.	
SETUP MAIN APPLICATIONS & SETTING METHODS	Press to display.	<u>5 I-6EF</u> -99999	Press the 🌒 button to display 5 I-BEF -	To set the NEAR and FAR sides as - and + indications to the sensor:
Height			Press the 🏶 button to enable setting of S1-Before.	
Steps and Warpage	[Change pumeric value]		Press the 👀 button to move	
Double Sheet Detection	Move dgil	- <u>2,000</u> [Numeric	the digit, press the to button to the digit, press the to button to change the numeric value, and set the measured value before	2 - 1
Thickness	Press to set.	value before change] Set any value.	S1 is changed.	2 Before
Positioning	SMART MENU/SET		Press the button to apply the numeric value of S1-Before.	-1After
Eccentricity and Surface Deflection	Press to dis	<u>5 I-AFE</u>	Press the ♦ button to display 5 I-用FL .	s1 s2
DETAILED SETTINGS	play.			* If the \$ button is pressed when the cursor is at the
TROUBLE- SHOOTING			Press the 🏶 button to enable setting of S1-After.	right-most digit or the \$ button is pressed when the cursor is at the left-most digit,
SPECIFI- CATIONS	[Change numeric value]	<u>5 I-RFE</u> 2000	Press the \$ button to move the digit, press the \$ button to change the numeric value, and	the setting will be canceled.
INDEX	Press to set.	[Numeric value after change] Set any value.	set the measured value after S1 is changed.	
SETTING TRANSITION CHARTS	SMART MENU/SET		Press the button to apply the numeric value of S1-After.	

Button Operation	Display	Description of Operation	Explanation of Selection Menu	
Press to display.	<u>52-66F</u> -99999	Press the \$ button to display 52-66F.	2 1 1 2 Before	CONTENTS
		Press the 🏶 button to enable setting of S2-Before.	-1 After	
[Change numeric value]	CD_LCC	Press the 🗱 button to move	S1 S2	PREPARATION FOR MEASUREMENT
Press to set.	[Numeric value before	the digit, press the s button to change the numeric value, and set the measured value before S2 is changed.	* If the \$ button is pressed when the cursor is at the right-most digit or the \$	FLOW OF OPERATION
	change] Set any value.		button is pressed when the cursor is at the left-most digit, the setting will be canceled.	BASIC SETUP
SMART MENU/SET		Press the button to apply the numeric value of S2-Before.	The setting will be canceled.	MAIN APPLICATIONS & SETTING METHODS
Press to display	<u>52-AFE</u> -99999	Press the \$ button to display 52-RFL .		Height Steps
		Press the 🏶 button to enable setting of S2-After.		and Warpage Double Sheet Detection
[Change numeric value]	S2-RFL	Press the 🗱 button to move the digit, press the 💲 button to		Thickness
Press to set.	[Numeric value after	change the numeric value, and set the measured value after S2 is changed.		Positioning
	change] Set any value.			Eccentricity and Surface Deflection
SMART MENU/SET		Press the button to apply the numeric value of S2-After.		DETAILED SETTINGS
6 Hold	Optional	Set this item to hold measured valu period according to preset hold co		TROUBLE- SHOOTING

Button Operation	Display	Description of Operation	Explanation of Selection Menu	SPECIFI- CATIONS
Press to d	HOLd	Press the ♦ button to display H□L d .	Default value: OFF	INDEX
splay.				SETTING TRANSITION CHARTS

	Button Operation	Display	Description of Operation	Explanation of Selection Menu
CONTENTS	Press to select	PERK Select the	Press the 💲 button to select the hold conditions.	Hold OFF RVE The average measured value
INTRODUCTION		desired value.		during the sampling period is held.
PREPARATION FOR MEASUREMENT				The difference between the minimum and maximum
FLOW OF OPERATION				values during the sampling period is held.
BASIC SETUP				The measured value at the start of the sampling period is held.
MAIN APPLICATIONS & SETTING METHODS				The minimum value during the sampling period is held.
Height				The maximum value during the sampling period is held.
Steps and Warpage			MALINT .	(For details, see page 95.)
Double Sheet Detection	SMART MENU/SET		Press the button to apply the setting.	* The clamp value is output until the first sampling period is finished.
Thickness			When other than DFF is selected, proceed to "7	(For details on the clamp value, see page 111.)
Positioning			Trigger conditions," and when []FF is selected, proceed to "8 Threshold	
Eccentricity and Surface Deflection			setting."	

DETAILED SETTINGS

7 Trigger conditions Optional

Set how timing of the hold measurement period is to be input.

TROUBLE- SHOOTING	Button Operation	Display	Description of Operation	Explanation of Selection Menu
SPECIFI- CATIONS	Press to display,	<u> </u>	Press the ♦ button to display 上RI [].	Default value: TIMING
INDEX				

Button Operation	Display	Description of Operation	Explanation of Selection Menu	
	ERIG EI MI NG	Press the 💲 button to select the trigger conditions.	Enter the trigger by using the timing input or by pressing the the button in the RUN	CONTENTS
Press to select	Select the desired value.		mode. The period that the timing signal is ON is the	INTRODUCTION
			sampling period. SELF-d The sampling period is the	PREPARATION For Measurement
			period that the measured value is lower than the specified self-trigger level.	FLOW OF OPERATION
			The sampling period is the period that the measured	BASIC SETUP
			value is greater than the specified self-trigger level. (For details, see page 97.)	MAIN APPLICATIONS & SETTING METHODS
SMART MENU/SET		Press the button to apply the trigger conditions.		Height
		When SELF-∐ and		Steps and Warpage
		SELF - d are selected, proceed to the next item, and when ∠ M N is selected,		Double Sheet Detection
		proceed to "8 Threshold setting."		Thickness
Press to d	<u>SELFL/</u>	Press the ♦ button to display SELFLI′ .	Default value: 0.000	Positioning
splay.				Eccentricity and Surface Deflection
		Press the Sutton to enable setting of the self-trigger level.		DETAILED SETTINGS
[Change numeric value]	<u>561.617</u> 99999	Press the \$\$ button to move the digit, press the \$ button to	* If the \$ button is pressed when the cursor is at the	TROUBLE- SHOOTING
Press to set.	Set any value.	change the numeric value, and set the self-trigger level.	right-most digit or the button is pressed when the cursor is at the left-most digit, the setting will be canceled.	SPECIFI- CATIONS
SMART MENU/SET		Press the button to apply the setting.		INDEX
		<u> </u>	<u> </u>	SETTING TRANSITION CHARTS

8 Threshold Setting Required

Set the range of measured values to be judged as PASS by setting the HIGH and LOW thresholds.

CONTENTS	Button Operation	Display	Description of Operation	Explanation of Selection Menu
INTRODUCTION	Press to display.	Lit H L MENU	Press the the button to display the HIGH threshold.	Setting example: Non-defective product eccentricity -1 to 1 mm
PREPARATION FOR MEASUREMENT FLOW OF OPERATION			Press the 🏶 button to enable setting of the HIGH threshold.	1 mm -1 mm
BASIC SETUP	[Change numeric value]	COD Set any value.	Press the \$ button to move the digit, press the \$ button to change the numeric value, and set the HIGH threshold.	H P_L Set the eccentricity MAX and MIN distances to be regarded as OK to the HIGH
MAIN APPLICATIONS & SETTING METHODS	SMART MENU/SET		Press the button to apply the setting.	and LOW thresholds, respectively.
Height Steps and Warpage	Press to display.	H L MENU	Press the \$ button to display the LOW threshold.	* If the \$ button is pressed when the cursor is at the right-most digit or the \$ button is pressed when the
Double Sheet Detection			Press the 🍣 button to enable setting of the LOW threshold.	cursor is at the left-most digit, the setting will be canceled.
Thickness				* Set so that the HIGH
Positioning	[Change numeric value]	 – (□□□ Set any value. 	Press the \$ button to move the digit, press the \$ button to change the numeric value, and set the LOW threshold.	threshold is greater than the LOW threshold.
and Surface Deflection	SMART MENU/SET		Press the button to apply the setting.	

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SETTING TRANSITION CHARTS Return to RUN mode Required

Switch to the mode in which measurement is performed.

CIFI- IONS	Button Operation	Display	Description of Operation	Explanation of Selection Menu
EX	SMART MENU/SET Hold down for 3 seconds	Out	Hold down the button for three seconds to switch to the RUN mode.	

* For details on optimizing settings, such as output and input, see "DETAILED SETTINGS."

DETAILED SETTINGS

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Smart Tuning

Setting channels used when connecting multiple units If mutual interference prevention is ON: CH1 If mutual interference prevention is set to OFF: Each CH

Smart tuning:

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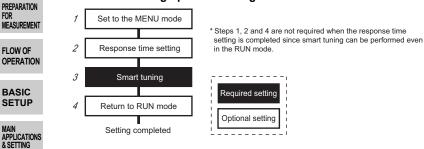
Double Sheet

Detection

Thickness

This setting option sets optimum sensing conditions according to the operating conditions (response time and color/state of workpiece).

Procedure for setting up smart tuning



Important

 When connecting two or more Amplifier Units and mutual interference prevention is set to ON, use the CH1 Amplifier Unit to execute tuning. After smart tuning execution for CH1 ends, it is also executed for the Amplifier Units of CH2 and later.

If the tuning result is NG for either Amplifier Unit, the smart tuning setup results are not applied to any amplifier units.

1 Set to the MENU mode Optional

Positioning	Button Operation	Display	Description of Operation	Explanation of Selection Menu
Eccentricity and Surface Deflection	SMART MENU/SET	1.14	Hold down the button for three seconds to switch to the MENU mode.	
DETAILED				

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2 Resp	2 Response time setting Optional								
Button Operation	Display	Description of Operation	Explanation of Selection Menu						
Press to display.		Press the \$ button to display SPEEd.	Default value: 500 ms						

Button Operation	Display	Description of Operation	Explanation of Selection Menu	
Press to select	SPEE d IMS Select the	Press the 💲 button to select the response time.	Select the response time to match the size and moving speed of the sensing object.	CONTENTS
	desired value.		60 μs, 120 μs, 240 μs, 500 μs, 1 ms, 2 ms, 4 ms, 8 ms, 12 ms, 20 ms, 36 ms, 66 ms, 128 ms, 250 ms, 500 ms	INTRODUCTION
SMART MENU/SET		Press the button to apply	* After the response time is	FOR MEASUREMENT
		the setting.	changed, the smart tuning results are cleared, so be sure to re-execute tuning.	FLOW OF OPERATION

3 Smart tuning Required

Select from one of the following three methods to execute smart tuning:

- (1) Tuning of a single stationary workpiece: Single smart tuning
- (2) Tuning of multiple stationary workpieces: Multi-smart tuning (a mix of workpieces having different color and state)
- (3) Tuning of workpieces having different surface states: Active smart tuning (execution of tuning while workpieces are moving)

(1) Tuning of a single stationary workpiece: Single smart tuning

Button Operation	Display	Description of Operation	Explanation of Selection Menu	Thickness
_	_	Set the reference workpiece in place.		Positioning
Hold down for 1 second	Pressing down	your finger from the button to start execution of smart tuning.	If "FRILED" flashes on their sub-display for three seconds, it indicates that tuning was not possible. Change the response time setting to a larger value, and try again.	Eccentricity and Surface Deflection DETAILED SETTINGS TROUBLE- SHOOTING

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(a mix of workpieces having unrefer color and state)					
	Button Operation	Display	Description of Operation	Explanation of Selection Menu	
CONTENTS	_	_	Set reference workpiece 1 in place.		
INTRODUCTION	SMART MENU/SET Hold down for 3 seconds	Pressing down	Press the button for three seconds. When SMARE /	* SMARE /SI NGLE is displayed for one to three	
PREPARATION For Measurement		M∐LEI ↓ Pressed down	MULEI is displayed, release your finger from the button to start execution of smart tuning.	seconds after the button is pressed, and then SMRRE/ MULEI is displayed.	
FLOW OF OPERATION				If "FRILED" flashes on the sub-display for three seconds, it indicates that	
BASIC SETUP		Flashing		tuning was not possible. Change the response time setting to a larger value, and	
MAIN APPLICATIONS				try again.	
MAIN APPLICATIONS & SETTING METHODS			Swap the workpiece with		
Height	_	—	reference workpiece 2 and set it in place.		
Steps and Warpage	SMART MENU/SET Hold down for 3 seconds	Pressing down	Press the button for three seconds. When SMARE / MULEI is displayed, release	The optimum conditions are set for either reference workpiece 1 or 2 is set.	
Double Sheet Detection		Pressed down	your finger from the button to start execution of smart tuning.	* SMARE /SI NGLE is displayed for one to three	
Thickness		<u>EUNI NG</u> MULEI	When there are three or more reference workpieces, swap	seconds after the button is pressed, and then SMARE/ MULE/ is displayed.	
Positioning		Flashing	each workpiece and repeat the procedure.	If you release your finger from the button SMARE / SI NGLE, the result of tuning	
Eccentricity and Surface Deflection				workpiece 1 will not be reflected.	
DETAILED SETTINGS				sub-display for three seconds, it indicates that tuning was not possible.	
TROUBLE- SHOOTING				Change the response time setting to a larger value, and try again.	
SPECIFI- CATIONS					
INDEX					
SETTING TRANSITION CHARTS					

(2) Tuning of multiple stationary workpieces: Multi-smart tuning (a mix of workpieces having different color and state)

(executio	(execution of tuning while workpieces are moving)				
Button Operation	Display	Description of Operation	Explanation of Selection Menu		
Hold down for 5 seconds	Pressing down	Press the button for five seconds with the workpiece set	* SMARE/SENGLE and SMARE/MULEE are	CONTENTS	
	Pressed down	in place. When SMRRE/ REELIFE is displayed, release your finger from the button to	displayed for one to five seconds after the button is pressed, and then SMARE /	INTRODUCTION	
	<u>EUNI NG</u> ACEI VE	start execution of smart tuning.	RELIVE is displayed.	PREPARATION For Measurement	
	Flashing	smart tuning continues, move the workpiece.		FLOW OF OPERATION	
Hold down for 5 seconds		At the end of the desired tuning period, press the tuning again for 5 to end tuning.	The optimum setting conditions will be set.	BASIC SETUP	
			sub-display for three seconds, it indicates that tuning was not possible.	MAIN APPLICATIONS & SETTING METHODS	
			Change the response time setting to a larger value, and try again.	Height	
4 Retur	n to RUN mod	e Optional		Steps and Warpage	

(3) Tuning of workpieces having different surface states: Active smart tuning (execution of tuning while workpieces are moving)

				Double
Button Operation	Display	Description of Operation	Explanation of Selection Menu	Sheet Detection
SMART MENU/SET	Out	Hold down the button for three seconds to switch to the		Thickness
Hold down for 3 seconds	H L MENU	RUN mode.		Positioning



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Selecting the Initial Sub-Display

CONTENTS

Initial sub-display:

The initial sub-display is the display that appears when the power is turned on.

INTRODUCTION Procedure for setting up initial sub-display

1

2

3

1

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& SETTIN

Set to the MENU mode

Set to the MENU mode

Sub-display memory setting

Return to RUN mode Setting completed

& SETTING METHODS	Button	Display	Description of Operation	Explanation of
Height	Operation	Display		Selection Menu
Steps and Warpage	SMART MENU/SET	Lit	Hold down the model button for three seconds to switch to the MENU mode.	
Double	5 3030103		MENO HIDDE.	

Double Sheet Detection

2 Sub-display memory setting

Thickness	Button Operation	Display	Description of Operation	Explanation of Selection Menu
Positioning	T A	SUBMEM	Press the & button to display	Default value: HIGH
Eccentricity and Surface Deflection	Press to display.	888888	SULMEM .	
DETAILED			Press the 💲 button to select the	HI GH
SETTINGS			sub-display memory.	HIGH threshold
TROUBLE-	Press to select	Select the		LUM LOW threshold
SHOOTING		desired value.		RNALOG
				Analog output value
SPECIFI- CATIONS				<u>A</u> Resolution
				RFRI
INDEX				Current value
				68NK
SETTING TRANSITION				BANK

TRANSITION CHARTS

Button Operation	Display	Description of Operation	Explanation of Selection Menu	
SMART MENU/SET		Press the button to apply the setting.		CONTENTS

3 Return to RUN mode

Button Operation	Display	Description of Operation	Explanation of Selection Menu	PREPARATION
SMART MENU/SET	Out	Hold down the button for three seconds to switch to the		FOR MEASUREMENT
Hold down for 3 seconds	H L MENU	RUN mode.		FLOW OF OPERATION



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Connecting Two or More Amplifier Units

CONTENTS

Use a Calculating Unit to connect Amplifier Units when performing calculations between Amplifier Units and to prevent mutual interference between Sensor Heads.

The number of Amplifier Units that can be connected differs depending on the functions to be used.

	Function	ı	Number of (Connectable Amplifier Units	See:		
PREPARATION FOR	Calculation		Up to two units (Up	to five units can be connected.	(A-B)		
MEASUREMENT			However, calculation	ns are done between pairs of two.)	calculation: Page 47		
			For (A-B)	For (A-B) calculations			
FLOW OF OPERATION A: CH2				r later	Thickness		
	B: CH1 cald				calculation:		
BASIC				Page 57			
SETUP							
MAIN APPLICATIONS				CH4 (CH3-CH1) (CH4-CH1) (CH5-CH1)			
& SETTING METHODS	Mutual interfere		l la ta five valta	(CH3-CH1)	Dara 00		
METHODS	Mutual interfere	ence	Up to five units		Page 88		
Height	prevention						
Stone	Important						
Steps and		r to all	connected Amplifier	Units at the same time.			
Warpage				Units, the response times (maximul	m values) are as		
Double Sheet		sung ti			ii values) are as		
Detection			Two-Sensor				
	Prevention		Operation Total Response Time				
Thickness			OFF	Response time setting for ea	ach CH		
	OFF		(A – B), THICK	(Total response time setting for e	each CH) +		
Positioning			(4 ms × number of connected		d units)		
	ON		OFF	(Response time per unit (T) in the t	,		
Eccentricity			(A – B), THICK number of connected uni		lits		
and Surface Deflection	<	Respo	nse time if mutual in	nterference prevention is set to Ol	N>		
]	CH1	Response Time Setting	Response Time per Unit (T)	1		
DETAILED			60 µs	3 ms	1		
SETTINGS			120 µs	3 ms			
			240 µs	3 ms			
TROUBLE- SHOOTING			500 µs	4 ms	_		
SHOUTING			1 ms	8 ms	_		
			2 ms 4 ms	16 ms 32 ms	_		
SPECIFI- CATIONS	-		4 ms	64 ms	-		
ertheite	I		12 ms	72 ms	-		
	-		20 ms	80 ms	-		
INDEX			36 ms	100 ms	1		
			66 ms	160 ms	1		
SETTING			128 ms	280 ms			
TRANSITION CHARTS			250 ms	520 ms			
	ſ		500 ms	15	1		

500 ms

1 s

The displayed and set up menus differ depending on the channel when two or more Amplifier Units are connected and when mutual interference prevention is set to ON.

Use the Amplifier Units of the corresponding channel numbers to specify settings by referring to the tables below.

INTRODUCTION

CONTENTS

<Menus and setting channels when two or more Amplifier Units are connected>

Menu	CHs Used to Specify Settings	CHs Not Used to Specify Settings	Notes	PREPARATION FOR MEASUREMENT
Mutual interference prevention 도님NC			The setting of CH1 is also applied to Amplifier Units of CH2 and later.	FLOW OF OPERATION
Two-sensor operation setting	CH2 to CH5	CH1: This cannot be used. (The setting menu is not displayed on the digital display.)		BASIC SETUP
Thickness setting				MAIN APPLICATIONS & SETTING METHODS
Bank switching setting 占日NK	CH1	CH2 to CH5: These cannot be used. (The setting menu is not displayed on the digital display.)	The Amplifier Units of CH2 and later are switched together with CH1. (Bank	Height
			registration is possible for individual amplifier units.) • Also use CH1 to switch the	Steps and Warpage
			banks by means of an external input.	Double Sheet Detection
Initialization I NI E	CH1	CH2 to CH5: These cannot be used. (The setting menu is not displayed on the digital display.)	The Amplifier Units of CH2 and later are initialized together with CH1.	Thickness

<Menus and setting channels when mutual interference prevention is set to ON>

Menu	CHs Used to Specify Settings	CHs Not Used to Specify Settings	Notes	Eccentricity and Surface Deflection
Response time setting SPEEd	CH1	(The setting menu is not displayed on	The setting of CH1 is also applied to Amplifier Units of CH2 and later.	DETAILED SETTINGS
Smart tuning		executed for these separately.	Smart tuning for the Amplifier Units of CH2 and later are executed together with CH1.	TROUBLE- SHOOTING

(For details on the setup procedure when mutual interference prevention is set to ON, see the next page.)

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CATIONS

Positioning

Mutual Interference Prevention Setting channel: CH1

Calculating Unit

CH5

Amplifier Unit

CH2

снз CH4

Set on CH1 Amplifier Unit

CH1

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Mutual interference prevention:

Set to the MENU mode

Mutual interference

prevention setting

Return to RUN mode

Setting completed

Procedure for setting up mutual interference prevention

This refers to the function for preventing the influence of Sensor Heads when mounted close to each other. (This function can be used for up to five Amplifier Units connected by using Calculating Units (ZX2-CAL).)

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MAIN APPLICATIONS & SETTING METHODS

Height

Set to the MENU mode

Steps and Warpage	Button Operation	Display	Description of Operation	Explanation of Selection Menu
Double Sheet Detection Thickness	SMART MENU/SET Hold down for 3 seconds	Lit H L MENU	Hold down the button of the CH1 Amplifier Unit for three seconds to switch to the MENU mode.	
Positioning Eccentricity and Surface	Press to display.	delai L	Press the I button to display dELRI L.	* This step is not required if detail menu display is already set to ON in the MENU mode.
Deflection DETAILED SETTINGS	Press to display.	<u>dELRI L</u> ON	Press the ♥ button to set the display to □N to set display of the detail menu.	
TROUBLE- SHOOTING	SMART MENU/SET		Press the button to apply the setting.	

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2 Mutual interference prevention setting

Button Operation	Display	Description of Operation	Explanation of Selection Menu	
Operation			Selection Menu	CONTENTS
Pres	SUNC	Press the 🕸 button to display	Default value: OFF	CONTENTO
s to display,	888888			INTRODUCTION
		Press the 🧇 button to display		PREPARATION
	 []N	ON.		FOR MEASUREMENT
Press to display.				FLOW OF
SMART MENU/SET		Press the 🖱 button to apply		OFERATION
		the setting.		BASIC
				SETUP

3 Return to RUN mode

					APPLICATIONS
Button	Disp	lav	Description of Operation	Explanation of	& SETTING METHODS
Operation	peration			Selection Menu	Height
SMART MENU/SET			Hold down the 🖱 button for		
		Out	three seconds to switch to the		Steps
Hold down for 3 seconds	HL	MENU	RUN mode.		and Warpage
					Double

Important

• When CH1 is used to specify a setting while mutual interference prevention is set to ON, the menus for which the same setting is applied to the Amplifier Units of CH2 and later are shown in the following table.

Specify settings for the menus in the following table after setting mutual interference prevention to ON.

Menu	Displayable and Specifiable CH Number	Notes		Eccentricity and Surface Deflection
Response time setting		The setting of CH1 is also applied to Amplifier Units of CH2 and later.	1	DETAILED
Smart tuning		Smart tuning for the Amplifier Units of CH2 and later are executed together with CH1.		SETTINGS

When connecting two or more Amplifier Units, the response times (maximum values) are as follows:
 TROUBLE-SHOOTING

Mutual InterferenceTwo-SensorPreventionOperation		Total Response Time	SPECIFI-
	OFF	Response time setting for each CH	CATIONS
OFF	(A – B), THICK	(Total response time setting for each CH) + (4 ms × number of connected units)	INDEX
ON	OFF	(Response time per unit in the table below) ×	
	(A – B), THICK	number of connected units	SETTING

SETTING TRANSITION CHARTS

MAIN

Sheet Detection

Thickness

Positioning

<Response time if mutual interference prevention is set to ON>

-	
CH1 Response Time Setting	Response Time per Unit
60 µs	3 ms
120 µs	3 ms
240 µs	3 ms
500 µs	4 ms
1 ms	8 ms
2 ms	16 ms
4 ms	32 ms
8 ms	64 ms
12 ms	72 ms
20 ms	80 ms
36 ms	100 ms
66 ms	160 ms
128 ms	280 ms
250 ms	520 ms
500 ms	1 s

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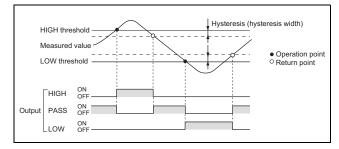
TROUBLE-SHOOTING

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Hysteresis width:

This refers to the difference between the operation point and return point. Set the hysteresis width for the upper and lower limits of the judgements if the HIGH, PASS or LOW judgement is unstable near the threshold values.



Procedure for setting up the hysteresis width



1 Set to the MENU mode

Button Operation	Display	Description of Operation	Explanation of Selection Menu	Positioning
SMART MENU/SET		Hold down the button for three seconds to switch to the MENU mode.		Eccentricity and Surface Deflection
Pres to display.	<u>dELRI L</u> 888888	Press the 🏶 button to display dEERIL.	* This step is not required if detail menu display is already set to ON in the MENU mode.	SETTINGS TROUBLE- SHOOTING
	<u>delri L</u> On	Press the button to set the display to □N to set display of the detail menu.		SPECIFI- CATIONS
SMART MENU/SET		Press the button to apply the setting.		INDEX SETTING TRANSITION

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> Height Steps

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and Warpage

Double Sheet Detection

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2 Hysteresis width setting

CONTENTS	Button Operation	Display	Description of Operation	Explanation of Selection Menu
INTRODUCTION	Press to display.	888888 888888	Press the � button to display H님도 .	Default value: 0.000
PREPARATION FOR MEASUREMENT			Press the 🏶 button to enable setting of the hysteresis width.	
FLOW OF OPERATION	Press to display.		Press the 👀 button to move	* If the \$ button is pressed
BASIC SETUP	Rove dgn	Set any value.	the digit, press the 3 button to change the numeric value, and set the hysteresis width.	when the cursor is at the right-most digit or the \$ button is pressed when the
MAIN APPLICATIONS & SETTING METHODS				cursor is at the left-most digit, the setting will be canceled.
Height	SMART MENU/SET		Press the button to apply the setting.	
Steps and	3 Botur	n to PLIN mod	•	·

3 **Return to RUN mode**

Double Sheet Detection	Button Operation	Display	Description of Operation	Explanation of Selection Menu
Thickness	SMART MENU/SET	Out	Hold down the button for three seconds to switch to the	
Positioning	Hold down for 3 seconds	H L MENU	RUN mode.	

Important

- The hysteresis width for HIGH, PASS or LOW judgment is disabled when the hold function is enabled.
- The hysteresis width is enabled when the self-trigger is set.

Warpage Double Sheet

Eccentricity and Surface Deflection

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Setting the Hold Function | Setting channels used when connecting multiple units: Each CH

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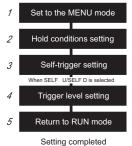
METHODS

OPERATION

Hold:

The hold function holds any values during the measurement period (sampling period), and outputs these values at the end of measurement.

Procedure for setting up hold



1 Set to the MENU mode

Button Operation	Display	Description of Operation	Explanation of Selection Menu	Steps and Warpage
SMART MENU/SET	Lit H L MENU	Hold down the button for three seconds to switch to the MENU mode.		Double Sheet Detection
Press	defai r	Press the ♦ button to display	* This step is not required if detail menu display is	Thickness
Press to display.	888888		already set to ON in the MENU mode.	Positioning
	delai l	Press the ⇔ button to set the display to □N to set display of		Eccentricity and Surface Deflection
Press to display.		the detail menu.		DETAILED SETTINGS
SMART MENU/SET		Press the 🖱 button to apply		OL THINGS
		the setting.		TROUBLE- SHOOTING

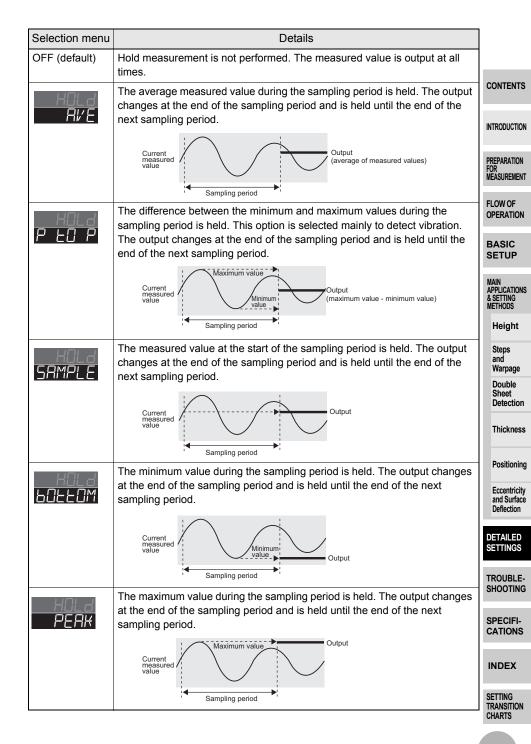
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2 Hold conditions setting

CONTENTS	Button Operation	Display	Description of Operation	Explanation of Selection Menu
CONTENTS	Pre	HDLA	Press the 🕸 button to display H미니네.	Default value: OFF
INTRODUCTION	st to display.	888888		
PREPARATION FOR MEASUREMENT		HCLJ PERK	Press the 🕄 button to select the hold conditions.	DFF Hold OFF RVE
FLOW OF OPERATION	Press to select	Select the desired value.		The average measured value during the sampling period is held.
BASIC SETUP				PECP The difference between the minimum and maximum
MAIN APPLICATIONS & SETTING METHODS				values during the sampling period is held.
Height				The measured value at the
Steps and Warpage				start of the sampling period is held.
Double Sheet Detection				The minimum value during the sampling period is held.
Thickness				The maximum value during the sampling period is held. (For details, see the
Positioning				following page.)
Eccentricity and Surface Deflection	SMART MENU/SET		Press the button to apply the setting.	* The clamp value is output until the first sampling period is finished.
DETAILED SETTINGS			When other than <i>DFF</i> is selected, proceed to "3 Self-trigger setting."	(For details on the clamp value, see page 111.)
TROUBLE- Shooting			·	
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0577110				

SETTING TRANSITION CHARTS



3 Self-trigger setting

CONTENTS	Button Operation	Display	Description of Operation	Explanation of Selection Menu
CONTENTS	P	ERI G	Press the 🕸 button to display	Default value: TIMING
INTRODUCTION	Press to display,		ERI G.	
PREPARATION For Measurement		<u>ERIS</u> El MING	Press the 💲 button to select the self-trigger.	EI MI NC Enter the trigger by using the timing input or by pressing
FLOW OF OPERATION	Press to select	Select the desired value.		the Sutton in the RUN mode. The period that the timing signal is ON is the
BASIC SETUP				sampling period. SELF-2 The sampling period is the
MAIN APPLICATIONS & SETTING METHODS				period that the measured value is lower than the specified self-trigger level.
Height				SELF-U The sampling period is the
Steps and Warpage				period that the measured value is greater than the
Double Sheet Detection				specified self-trigger level. (For details, see the
Thickness	SMART MENU/SET		Press the button to apply the self-trigger.	following page.)
Positioning			(When $5ELF-U$ and	
Eccentricity and Surface Deflection			SELF-d are selected, proceed to the next item, and when EI MI N□ is selected,	
DETAILED SETTINGS			proceed to "5 Return to RUN mode."	
TROUBLE- SHOOTING				
SPECIFI- CATIONS				
INDEX				

SETTING TRANSITION CHARTS

Selection menu	Details	
ERIG El MING	Either input the timing signal from an external device, or enter the trigger for starting sampling by pressing the	CONTENTS
(Default)	Timing input OFF	INTRODUCTION
	(For details on external inputs, see page 118.)	
	The sampling period is the period that the measured value is lower than the specified self-trigger level. Hold measurement is possible without a	PREPARATION FOR MEASUREMENT
	sync input. Measured value	FLOW OF OPERATION
	Self-trigger level Self-trigger level Sampling period Sampling period Sampling period	BASIC SETUP
	The sampling period is the period that the measured value is greater than the specified self-trigger level. Hold measurement is possible without a	MAIN APPLICATIONS & SETTING METHODS
5667-0	sync input.	Height
	Self-trigger level	Steps and Warpage
	Geration point € ● Operation point Sampling period Sampling period ○ Return point	Double Sheet Detection
Λ	·	Thickness

4 Trigger level setting

Button Operation	Display	Description of Operation	Explanation of Selection Menu	Positioning Eccentricity
Press to deplay	<u>SELF.L/</u> 888888	Press the ♦ button to display SELFLV .	Default value: 0.000	DETAILED SETTINGS
		Press the ♣ button to enable setting of the self-trigger level.		TROUBLE- SHOOTING
[Change numeric value]	SELFLV 99999	Press the 🗱 button to move the digit, press the 💲 button to	* If the \$ button is pressed when the cursor is at the	SPECIFI- CATIONS
	22222	change the numeric value, and	right-most digit or the 🕸	
Press to set.	Set any value.	set the self-trigger level.	button is pressed when the cursor is at the left-most digit,	INDEX
			the setting will be canceled.	SETTING TRANSITION

Button Operation	Display	Description of Operation	Explanation of Selection Menu
SMART MENU/SET		Press the button to apply the setting.	

INTRODUCTION

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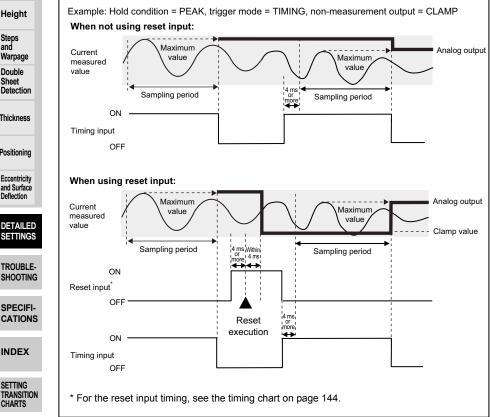
5 Return to RUN mode

PREPARATION	Button Operation	Display	Description of Operation	Explanation of Selection Menu
MEASUREMENT	SMART MENU/SET	Out	Hold down the button for three seconds to switch to the	
FLOW OF OPERATION	Hold down for 3 seconds	D MEN MEN L L	RUN mode.	

Important

· Generally, the held value continues to be output until the next measurement ends (the sampling time elapses).

If you want to reset the held value before the next measurement ends, set the external input to *L*/ *MR*5*L* (see page 118) and input a reset signal using the external input wire.



MAIN APPLICATIONS & SETTING METHODS

Heiaht

Steps and Warpage Double

Sheet Detection

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Positioning

Eccentricity and Surface Deflection

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Bank Setting

Setting channels used when connecting multiple units Bank switching: CH1 Bank registration: Each CH

The following menu settings can be registered to banks:

HIGH threshold LOW threshold Response time

Hysteresis width

Self-trigger level Display during zero reset

Sensing conditions when executing smart tuning

Measured value display scaling

Pre-scaling display value 1 Post-scaling display value 1

Pre-scaling display value 2

Post-scaling display value 2

Bank setting:

1

2

3

Δ

Up to four sets of settings can be stored in memory. (Default: bank 0) This is recommended, for example, when measuring on multi-lot lines.

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SETTING TRANSITION CHARTS

		inter executing	on are tarming
Amplifier Un	0	ore Amplifier Units, use the CH1 A ater are switched together with CH ode	
Button Operation	Display	Description of Operation	Explanation of Selection Menu
SMART MENU/SET Hold down for 3 seconds		Hold down the button for three seconds to switch to the MENU mode.	
Pres b display	dELRI L	Press the I button to display dELAI L.	* This step is not required if detail menu display is already set to ON in the MENU mode.
Press to display.	<u>delai l</u> On	Press the ♣ button to set the display to ☐N to set display of the detail menu.	
SMART MENU/SET		Press the button to apply	

the setting.

Procedure for setting up banks

Set to the MENU mode

Bank switching

Various settings

Return to RUN mode

Setting completed

2 Bank switching

CONTENTS	Button Operation	Display	Description of Operation	Explanation of Selection Menu
CONTENTS	Press	ЬЯNK	Press the 🕸 button to display	Default value: 0
INTRODUCTION	ss to display,	888888	. איותם	
PREPARATION FOR MEASUREMENT		<u> </u>	Press the 💲 button to select the bank.	to 3
FLOW OF	Press to select	Select the		
OPERATION		desired value.	10077	
BASIC SETUP	SMART MENU/SET		Press the button to apply the setting.	



Height

Steps and

Warpage

Double Sheet Detection

Thickness

Positioning

3 Various settings

Set the various menu items that require setting.

Execute smart tuning for each bank to be used because the smart tuning results are not applied to other banks.

4 Return to RUN mode

Button Operation	Display	Description of Operation	Explanation of Selection Menu
SMART MENU/SET	Out	Hold down the button for three seconds to switch to the RUN mode.	

Either switch banks by following the steps $1 \rightarrow 2 \rightarrow 4$ described above, or input the

The following explains how to switch banks and perform measurement.

required signal from an external device to switch the bank.

Eccentricity and Surface Deflection

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SETTING TRANSITION CHARTS

Zero Reset

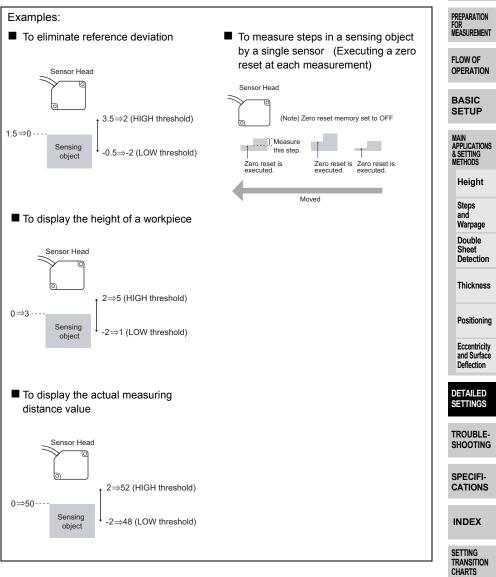
Setting channels used when connecting multiple units: Each CH

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Zero reset:

This refers to setting the reference value to "0" or any desired numeric value so that the measured value can be displayed and output as a positive or negative deviation (tolerance) from the reference value. The measured value can be set to "0" or any desired numeric value at any timing in the RUN mode.



Procedure for setting up zero reset

Display

Zero reset memory setting

Π \Box

പ

Lit

MENU

	7 Set to the MENU mode
	2 Zero reset memory setting
ENTS	<i>3</i> Display setting at zero reset
UCTION	4 Return to RUN mode
UCTION	5 Zero reset execution
RATION	Setting completed

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1 Set to the MENU mode

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SMART MENU/SET

SMART MENU/SET

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Hold down for 3 seconds

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OPERATION	

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Double Sheet Detection

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Positioning

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DETAIL SETTING

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SETTING TRANSIT CHARTS

Zero Reset

Select whether or not to hold the measured value after the zero reset was performed when the power is turned OFF.

Explanation of

Selection Menu

* This step is not required if

detail menu display is

MENU mode.

already set to ON in the

ace				
n LED	Button Operation	Display	Description of Operation	Explanation of Selection Menu
NGS BLE- TING	Press to display.	ZRMEM	Press the 🌢 button to display ZRMEM .	Default value: OFF
IFI- DNS		ZRMEM OFF	Press the 💲 button to select the zero reset memory setting.	Saves the current measured result.
x	Press to select	Select the desired value.		Does not save the current measured result.
g Tion S				When executing a zero reset at each measurement, set to OFF.

Description of Operation

Hold down the 🖱 button for

three seconds to switch to the

Press the \$ button to display

Press the Solution to set the

Press the button to apply

display to DN to set display of

MENU mode

the detail menu.

the setting.

HEFRU .



Button Operation	Display	Description of Operation	Explanation of Selection Menu	
SMART MENU/SET		Press the button to apply the setting.		CONTENTS

Important

3

Display setting at zero reset

• If zero reset memory is set to ON, the zero reset level will be written in the Amplifier Unit's non-volatile memory (EEPROM) each time a zero reset is executed.

non-volatile memory (EEPROM) each time a zero reset is executed. The EEPROM can be written a maximum of 100,000 times. Writing the zero reset level for each measurement can, therefore, use up the life of the memory and lead to malfunctions.

Set the zero reset memory function to set the

reference value to any numeric value.

FLOW OF OPERATION

INTRODUCTION

BASIC SETUP

Button Operation	Display	Description of Operation	Explanation of Selection Menu	MAIN
Press to display	<u>ZRai SP</u>	Press the 🌒 button to display ZRdl SP .	Default value: 0.000	& SETTING METHODS Height
		Press the 🏶 button to enable		Steps and Warpage
		setting of values at a reset.		Double Sheet Detection
[Change numeric value]	ZRJI SP	Press the 🔹 button to move the digit, press the 💲 button to	* If the the button is pressed when the cursor is at the	Thickness
Press to set.	Set any value.	change the numeric value, and set the offset level.	right-most digit or the button is pressed when the cursor is at the left-most digit,	Positioning
			the setting will be canceled.	Eccentricity and Surface
SMART MENU/SET		Press the button to apply the setting.		Deflection DETAILED
				SETTINGS

4 Return to RUN mode

Button	Display	Description of Operation	Explanation of	SHOOTING
Operation	Display	Description of Operation	Selection Menu	SPECIFI-
SMART MENU/SET	Out	Hold down the button for three seconds to switch to the		CATIONS
Hold down for 3 seconds	H L MENU	RUN mode.		INDEX

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TROUBLE-

5 Zero reset execution

CONTENTS	Button Operation	Display	Description of Operation	Explanation of Selection Menu
INTRODUCTION	_	_	Set the sensing object to be used for executing the zero reset.	
PREPARATION FOR MEASUREMENT	Hold both down for 1 second		Either press the s button for one second in the RUN mode, or input the zero reset signal (4 ms to 1 s) from an external device.	(For details on external inputs, see page 118.)
FLOW OF OPERATION			device.	

BASIC SETUP

MAIN APPLICATIONS & SETTING METHODS

Heiaht

Steps and Warpage Double

Sheet Detection

Thickness

Positioning

Eccentricity and Surface Deflection

DE SE

TR SH

SF C

IN

SE TR CH

Important

measurement range.

- The minimum display value is -99.999, and the maximum display value is 999.999. If the measured value is below the minimum value after execution of zero reset, -99.999 will be displayed. 999.999 will be displayed if the measured value is above the maximum value. Zero reset can be executed only if the measured value is within ±10% of the rated
 - · Even if a zero reset is executed, the threshold does not change from the setting before execution of the zero reset.

(For example, even if a zero reset is executed so that the measured value 2 becomes 0, the HIGH threshold stays at 5 if it is 5 before zero reset is executed.)

· After a zero reset, analog values are output in a range that corresponds to the zero-reset display value (initial value: 0 mm), which accords with the zero-reset distance point. (When the zero-reset display is 0 mm and scaling is set to OFF, the analog output value will be 3 V if the range is 1 to 5 V, 0 V if the range is -5 to 5 V, and 12 mA if the range is 4 to 20 mA.)

Procedure for canceling a zero reset

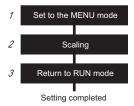
eflection DETAILED	Button Operation	Display	Description of Operation	Explanation of Selection Menu
ROUBLE- HOOTING	Hold both down for 1 second Hold both down for 1 second	50,000 888888	Either press the S button for one second in the RUN mode, or input the zero reset signal (3 s or more) from an external	
SPECIFI- CATIONS			device.	
NDEX				
ETTING RANSITION HARTS				

Scaling

Scaling:

The display scale can be changed when you want to display a digital value on the Amplifier Unit different from the actual measured value. (For example, when you want to set the measured value as the actual measuring distance.)

Procedure for setting up scaling



1 Set to the MENU mode

Button Operation	Display	Description of Operation	Explanation of Selection Menu	Height
SMART MENU/SET	Lit	Hold down the 👅 button for		Steps and Warpage
Hold down for 3 seconds	H L MENU	three seconds to switch to the MENU mode.		Double Sheet Detection
Press to dap	<u>dELAI L</u> 888888	Press the I button to display dELRI L.	* This step is not required if detail menu display is already set to ON in the	Thickness
ay.		Press the 🗢 button to set the	MENU mode.	Positioning
Press to display.	<u>delai l</u> On	display to DN to set display of the detail menu.		Eccentricity and Surface Deflection
SMART MENU/SET		Press the button to apply the setting.		DETAILED SETTINGS

2 Scaling

Button Operation	Display	Description of Operation	Explanation of Selection Menu	SPECIFI- CATIONS
Press to dis	<u>SCALE</u>	Press the III button to display	Default value: OFF	INDEX
sp lay.				SETTING TRANSITION

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TROUBLE-

SHOOTING

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MAIN APPLICATIONS & SETTING

METHODS

	Button Operation	Display	Description of Operation	Explanation of Selection Menu
CONTENTS	Press to display.	<u>SCRLE</u> ON	Press the 拳 button to display □N.	
INTRODUCTION	SMART MENU/SET		Press the button to enable setting of scaling.	
PREPARATION FOR MEASUREMENT	Press to display	<u>5 -66F</u> -99999	Press the 🌒 button to display 5 I-BEF .	<to actual="" display="" distance="" sensing="" the=""></to>
FLOW OF OPERATION			Press the 🏶 button to enable setting of S1-Before.	
BASIC SETUP				
MAIN APPLICATIONS & SETTING METHODS	[Change numeric value]	<u>– 8000</u> [Numeric	Press the (() button to move the digit, press the () button to change the numeric value, and set the measured value before	58 After
Height	Press to set.	value before change]	S1 is changed.	8 Before
Steps and Warpage	SMART MENU/SET	Set any value.	Press the 👅 button to apply	S1 S2
Double Sheet			the numeric value of S1-Before.	* If the the button is pressed when the cursor is at the
Detection Thickness	Press to display.	<u>5 I-AFE</u> -99999	Press the the button to display 5 I-RFE.	right-most digit or the button is pressed when the cursor is at the left-most digit, the setting will be canceled.
Positioning Eccentricity and Surface Deflection			Press the 🏶 button to enable setting of S1-After.	
DETAILED SETTINGS	[Change numeric value]	5 - 855 58,000 [Numeric	Press the (() button to move the digit, press the () button to change the numeric value, and set the measured value after S1	
TROUBLE- SHOOTING		value after change] Set any value.	is changed.	
SPECIFI- CATIONS	SMART MENU/SET		Press the button to apply the numeric value of S1-After.	
INDEX				
SETTING TRANSITION CHARTS				

Button Operation	Display	Description of Operation	Explanation of Selection Menu	
Press to display.	<u>52-66F</u> -99999	Press the \$ button to display 52-667.	58 42 After	CONTENTS
		Press the 🏶 button to enable setting of S2-Before.	8 -8 	INTRODUCTION
[Change numeric value]	52-6EF	Press the 👀 button to move the digit, press the 3 button to	* If the \$ button is pressed when the cursor is at the	PREPARATION FOR MEASUREMENT
Press to set.	[Numeric value before change] Set any value.	change the numeric value, and set the measured value before S2 is changed.	right-most digit or the button is pressed when the cursor is at the left-most digit, the setting will be canceled.	FLOW OF OPERATION
SMART MENU/SET		Press the button to apply the numeric value of S2-Before.		BASIC SETUP
Press to display.	<u>52-AFE</u> -99999	Press the \$ button to display 52-8FE .		MAIN APPLICATIONS & SETTING METHODS
		Press the 🏶 button to enable setting of S2-After.		Height Steps and Warpage
[Change numeric value]	52-RFL	Press the (**) button to move the digit, press the (**) button to change the numeric value, and		Double Sheet Detection
Press to set.	[Numeric value after change] Set any value.	set the measured value after S2 is changed.		Thickness
SMART MENU/SET		Press the button to apply the numeric value of S2-After.		Positioning
3 Retur	n to RUN mod	e	<u> </u>	Eccentricity and Surface Deflection

3 Return to RUN mode

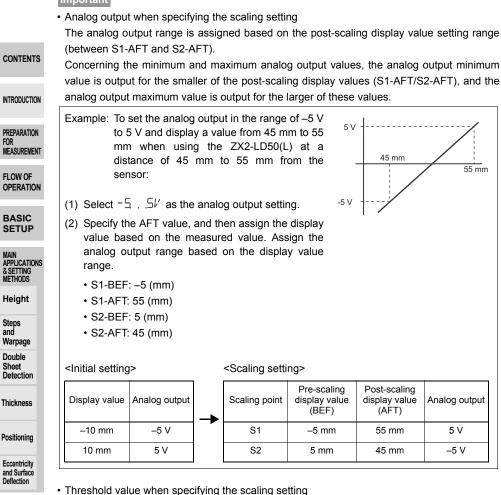
Button Operation	Display	Description of Operation	Explanation of Selection Menu	DETAILED SETTINGS
SMART MENU/SET	H L MENU	Hold down the button for three seconds to switch to the RUN mode.		TROUBLE- SHOOTING

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SETTING TRANSITION CHARTS

Important



DETAILED Even if scaling is executed, the threshold does not change from the setting before execution SETTINGS of scaling. (For example, the HIGH threshold stays at 5 if it was 5 before scaling is executed.)

TROUBLE-SHOOTING

SPECIFI-CATIONS

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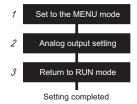
Analog Output

Analog output:

CONTENTS This refers to the conversion of measurement results to 4 to 20 mA current output or to -5 to +5 V/1 to 5 V voltage output.

The relationship between display values and analog output values can be freely INTRODUCTION specified. (Monitor focus)

Procedure for setting up analog output





Steps and **Button** Explanation of Display Description of Operation Selection Menu Operation Warpage Double Hold down the 👅 button for Sheet SMART MENU/SET Lit Detection three seconds to switch to the ΠĽ MENU Hold down for 3 seconds MENU mode. Thickness

2 Analog output setting

Button Operation	Display	Description of Operation	Explanation of Selection Menu	Eccentricity and Surface Deflection
Press to display.	<u>8-005</u> 888888	Press the ♦ button to display R-□UE .	Default value: -5 to +5 V	DETAILED SETTINGS
	R-OUL	Press the 💲 button to select analog output.	U. 20MA Current output 4 to 20 mA	TROUBLE- SHOOTING
Press to select	Select the desired value.		ఓ .5⊬ Voltage output 1 to 5 V −5 5⊬	SPECIFI- CATIONS
		MINIST	Voltage output 5 to +5 V	INDEX
SMART MENU/SET		Press the button to apply the setting.		
		the setting.		SETTING TRANSITION

CHARTS

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3 Return to RUN mode

	Button	Display	Description of	Operation		nation of
CONTENTS	Operation		Hold down the		Selecti	on Menu
INTRODUCTION	MART MENU/SET Hold down for 3 seconds	H L MENU	three seconds to s RUN mode.			
	Freely specify	ying the relati	onship between d	lisplay value	s and analog	output values
PREPARATION FOR	(equivalent to	the former Z	X-L-N monitor fo	cus)		
MEASUREMENT	 To specify an 	ny analog outpu	ut value for a displa	y value, assig	n the analog c	utput range and
FLOW OF OPERATION	the minimum setting up sc		n analog output val	ues by selecti	ng the analog	output and then
BASIC	(If scaling is	not set up, the	measurement range	e is the same a	is the analog o	utput range.)
SETUP	The analog of	outout range is	assigned based on	the post-scali	ing display val	ue setting range
MAIN	•	-AFT and S2-A	-		ing display val	
APPLICATIONS & SETTING METHODS	•		nd maximum analo	g output value	s, the analog	output minimum
Height			ler of the post-scali			2-AFT), and the
	analog outpu	it maximum val	ue is output for the	arger of these	values.	
Steps and Warpage	To only spec	ify the analog o	utput range, withou	t changing dis	olay values	
Double Sheet Detection	Example: To set the analog output in the range of –5 V to 5 V when using the ZX2-LD50(L) at a distance of 45 mm to 55 mm from the sensor:					
Thickness	(1) Select -	$5 \dots 5^{l'}$ as the	analog output settir	na.	_5 mm	5 mm
_	. ,		ent range to use for	•	nd	5 mm
Positioning	AFT val		assign the analo			5 V
Eccentricity and Surface	• S1-BE	⁼ : –5 (mm)				
Deflection	• S1-AF1	$F: -5 \text{ (mm)} \rightarrow S$	et the same value a	IS S1-BEF		
DETAILED		=: 5 (mm)				
SETTINGS	• S2-AF	$1: \mathfrak{s} (mm) \to Se$	t the same value as	SZ-BEF		
TROUBLE-	<initial settin<="" th=""><th>g></th><th><scaling settin<="" th=""><th>ng></th><th></th><th></th></scaling></th></initial>	g>	<scaling settin<="" th=""><th>ng></th><th></th><th></th></scaling>	ng>		
SHOOTING	Display value	Analog output	Scaling point	Pre-scaling display value	Post-scaling display value	Analog output
SPECIFI- CATIONS			→	(BEF)	(AFT)	
0,11,0110	-10 mm	–5 V	S1	–5 mm	–5 mm	–5 V
INDEX	10 mm	5 V	\$2	5 mm	5 mm	5 V
	To specify the	e analog output	t range after changi	ng display valu	ies	
SETTING TRANSITION CHARTS	(For details	on scaling, se	e page 108.)			

Output for Non-measurement | Setting channels used when connecting multiple units: Each CH

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Steps and

Warpage Double

Sheet Detection

Thickness

Positionin

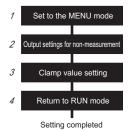
Output for non-measurement:

CONTENTS This refers to specifying the output contents when an error occurs (Error-dark or Error-bright), when a reset is being input, or before measured values are finalized.

(For details on these errors, see page 130.)

O ala ati an Manu	Output Contents		
Selection Menu	Judgment Output	Analog Output	PREPARATION
KEEP (Default)	The measurement value immediately before the non-measurement state is entered is held and output.		FOR MEASUREMENT
CLAMP	All OFF The specified CLAMP value is output. The following options are available. • For voltage output: -5.00 to 5.00 V (in 1-V steps), or		FLOW OF OPERATION
		the maximum (approximately 5.5 V) • For current output: 4.00 to 20.00 mA (in 1-mA steps), or the maximum (approximately 22 mA)	BASIC SETUP

Procedure for setting up output for non-measurement



Set to the MENU mode

	Button Operation	Display	Description of Operation	Explanation of Selection Menu	Eccentricity and Surface
-	SMART MENU/SET		Hold down the button for three seconds to switch to the		Deflection
	Hold down for 3 seconds	H L MENU	MENU mode.		DETAILED SETTINGS
			Press the 🕸 button to display	* This step is not required if	
	Press to Gappay		dEERI L.	detail menu display is already set to ON in the MENU mode.	TROUBLE- SHOOTING
	<u> </u>			MENO Mode.	
		delai l	Press the 拳 button to set the display to □N to set display of		SPECIFI- CATIONS
			TIN the detail menu.		
_	Press to display.				INDEX
	SMART MENU/SET		Press the 🖱 button to apply		
-			the setting.		SETTING TRANSITION

2 Output settings for non-measurement

CONTENTS	Button Operation	Display	Description of Operation	Explanation of Selection Menu
INTRODUCTION	Pres to display.	RSEDUE	Press the I button to display RSEDUE -	Default value: KEEP
PREPARATION FOR MEASUREMENT		RSEQUE KEEP	Press the 💲 button to select output for non-measurement.	KEEP The measured value status before measurement is
FLOW OF OPERATION	Press to select	Select the desired value.		stopped is held and output.
BASIC SETUP				Analog output: The preset clamp value is output.
MAIN APPLICATIONS & SETTING METHODS	SMART MENU/SET		Press the button to apply the setting.	
Height				

3 Clamp value setting

Steps and	3 Clam	3 Clamp value setting					
Warpage Double Sheet	Button Operation	Display	Description of Operation	Explanation of Selection Menu			
Detection			Press the 🌒 button to display	Default value: MAX			
Thickness	Press to display	888888	CLAMP.	The clamp value is output			
Positioning				from when the power is turned on until the measured value is finalized, even when			
Eccentricity and Surface Deflection				KEEP is selected, so be sure to set this value.			
DETAILED SETTINGS		AMP 00//	Press the 💲 button to display the clamp value.	For voltage output: <u>-5001</u> to <u>5001</u> In 1 V units			
TROUBLE- SHOOTING	Press to select	Select the desired value.		MAX For current output:			
SPECIFI- CATIONS				In 1 mA units			
INDEX	SMART MENU/SET		Press the button to apply the setting.				
SETTING TRANSITION CHARTS							



Button Operation	Display	Description of Operation	Explanation of Selection Menu	CONTENTS
SMART MENU/SET	Out	Hold down the button for three seconds to switch to the		CONTENTS
Hold down for 3 seconds	H L MENU	RUN mode.		INTRODUCTION

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Steps and Warpage

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DETAILED SETTINGS

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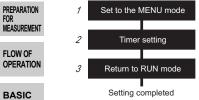
INDEX

Timer

CONTENTS Th

The timing for judgement outputs can be adjusted to match the operation of external devices. (Timer accuracy: Up to 1 ms)

NTRODUCTION Procedure for setting up the timer



1

BASIC SETUP

DETAILED

SETTINGS

MAIN

Set to the MENU mode

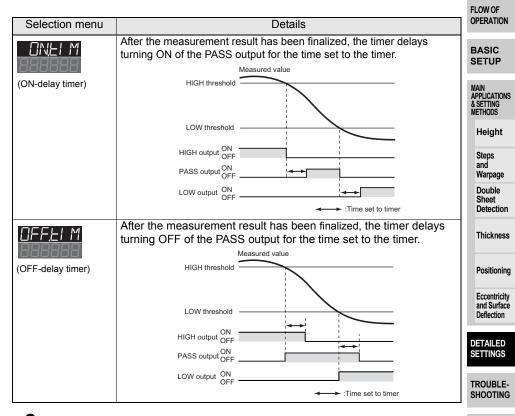
APPLICATIONS & SETTING				
METHODS	Button Operation	Display	Description of Operation	Explanation of Selection Menu
Height	SMART MENU/SET	Lit	Hold down the 🖱 button for	
Steps and Warpage	Hold down for 3 seconds	H L MENU	three seconds to switch to the MENU mode.	
Double Sheet Detection	Press to display.	dELRI L 888888	Press the I button to display dELAI L.	* This step is not required if detail menu display is already set to ON in the MENU mode.
Positioning		delai l On	Press the 巻 button to set the display to ☐N to set display of the detail menu.	
Eccentricity and Surface Deflection	SMART MENU/SET		Press the button to apply the setting.	

2 Timer setting

TROUBLE- SHOOTING	Button Operation	Display	Description of Operation	Explanation of Selection Menu
SPECIFI- CATIONS	Press to display.	Select the	Press the the button to display DNLI M when setting the ON- delay and DFFLI M when setting the OFF-delay.	ON-delay timer OFF-delay timer OFF-delay timer
INDEX		desired value.		(For details, see the following page.)
SETTING TRANSITION CHARTS			Press the sutton to enable setting of the timer.	

Timer

Button Operation	Display	Description of Operation	Explanation of Selection Menu	
[Change numeric value]		Press the 👀 button to move the digit, press the 🕱 button to	* If the \$ button is pressed	_
Press In set		change the numeric value, and set the time set to the time.	when the cursor is at the right-most digit or the (CONTENTS
Press to set.			button is pressed when the cursor is at the left-most digit,	INTRODUCTION
			the setting will be canceled.	
SMART MENU/SET		Press the button to apply the setting.		PREPARATION FOR MEASUREMENT



3 Return to RUN mode

Button Operation	Display	Description of Operation	Explanation of Selection Menu	INDEX
SMART MENU/SET Hold down for 3 seconds	Uut H L MENU	Hold down the button for three seconds to switch to the RUN mode.		SETTING TRANSITION CHARTS

SPECIFI-CATIONS

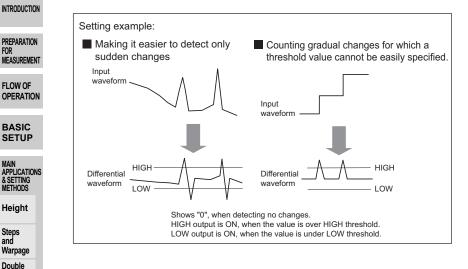
Setting the Differential Function

Setting channels used when connecting multiple units: Each CH

Differential function:

CONTENTS

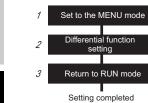
This function is used to display measurement change amounts when it is difficult to specify a threshold for the measured value, making it easier to detect only sudden changes in the measured values.



Important

• The detection effectiveness varies depending on the response time setting.

Procedure for setting up differential function



TROUBLE-SHOOTING

Sheet Detection

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and Surface

Deflection

DETAILED SETTINGS

Set to the MENU mode

SPECIFI- CATIONS	Button Operation	Display	Description of Operation	Explanation of Selection Menu
	SMART MENU/SET		Hold down the 👅 button for	
INDEX	Hold down for 3 seconds	H L MENU	three seconds to switch to the MENU mode.	

SETTING TRANSITION CHARTS

Button Operation	Display	Description of Operation	Explanation of Selection Menu	
Press to display.	dELRI L 888888	Press the I button to display dELRI L.	* This step is not required if detail menu display is already set to ON in the MENU mode.	CONTENTS
	<u>delai l</u> On	Press the button to set the display to □N to set display of the detail menu.		INTRODUCTION
Press to display.		Press the 👅 button to apply		PREPARATION FOR MEASUREMENT
		the setting.		FLOW OF OPERATION

2 Differential function setting

L Diller		rsetting		BASIC
Button Operation	Display	Description of Operation	Explanation of Selection Menu	SETUP
Press to d	di FF	Press the 🌢 button to display dl FF .		MAIN APPLICATIONS & SETTING METHODS
display.				Height
	ai FF	Press the 拳 button to set the display to □N .		Steps and Warpage
Press to display.				Double Sheet Detection
SMART MENU/SET		Press the 👅 button to apply the setting.		Thickness

3 Return to RUN mode

Button Operation	Display	Description of Operation	Explanation of Selection Menu	Eccentricity and Surface Deflection
SMART MENU/SET Hold down for 3 seconds	UUL OUL	Hold down the three button for three seconds to switch to the RUN mode.		DETAILED SETTINGS

Positioning

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External Input for Bank, Timing Input, Reset Input

Setting channels used when connecting multiple units: Each CH, Bank switching: CH1

External input:

1

2

3

1

Button

Operation

SMART MENU/SET

SMART MENU/SET

Hold down for

Procedure for setting up external input

Set to the MENU mode

External input terminal setting

Return to RUN mode

Setting completed

7 7

Гü

Set to the MENU mode

Display

Lit

MENU

This refers to inputting the bank switching signal, the timing signal during a hold and the reset signal from an external device to execute these operations.

Description of Operation

Hold down the 🖱 button for

three seconds to switch to the

Press the \$ button to display

Press the \Leftrightarrow button to set the display to $\Box N$ to set display of

Press the button to apply

MENU mode.

the detail menu.

the settina.

deeri L.

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TROUBLE-

SHOOTING

2 External input terminal setting

SPECIFI- CATIONS	Button Operation	Display	Description of Operation	Explanation of Selection Menu
INDEX	Press to display	<u> E×E-I N</u> 888888	Press the * button to display EXE-I N.	Default value: TIM.RST
SETTING				

SETTING TRANSITION CHARTS

112	
110	Extor

Explanation of

Selection Menu

* This step is not required if

detail menu display is

MENU mode.

already set to ON in the

Button Operation	Display	Description of Operation	Explanation of Selection Menu	
Press to select	EXE-IN EI MRSE Select the	Press the 💲 button to select the external input terminal.	LI MRSE timing input/reset input <u>BRNK</u> Bank switching	CONTENTS
SMART MENU/SET	desired value.	Press the button to apply		INTRODUCTION
MARI MENU/SEI		the setting.		PREPARATION FOR MEASUREMENT

3 Return to RUN mode

Button Operation	Display		Description of Operation	Explanation of Selection Menu	OPERATION
Operation			Hold down the 👅 button for		BASIC SETUP
SMART MENU/SET		Out	three seconds to switch to the		SETUP
Hold down for 3 seconds	ΗL	MENU	RUN mode.		MAIN APPLICATION

Procedure for executing external input

Each of the functions is executed when signals are input using the external input wire in table 1 below.

Timing input, reset input and bank switching are executed by a signal input of 4 ms or more. While the signal in table 2 below is being input, measurement is performed based on the settings of the specified bank.

When connecting two or more Amplifier Units, use the CH1 Amplifier Unit for bank switching. The banks of the Amplifier Units of CH2 and later are switched together with CH1.

Table 1 External Input Wiring

Amplifier Unit Connector Cable Color Setting	Purple	Red
EI MRSE	Timing input	Reset input
6ANK	BANK input 0	BANK input 1

Table 2 Bank Signal Switching Wiring

	BANK Input 0 (purple)	BANK Input 1 (red)
BANK 0	OFF	OFF
BANK 1	ON	OFF
BANK 2	OFF	ON
BANK 3	ON	ON

Bank signal switching is enabled only in the RUN mode. Note:

NS METHODS

Height

Steps and Warpage

Double Sheet Detection

Thickness

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Eccentricity and Surface Deflection

DETAILED SETTINGS

TROUBLE-SHOOTING

SPECIFI-CATIONS

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Setting the Detection Surface Selection

Setting channels used when connecting multiple units: Each CH

Measurement performed with

correct reflection components

(with the MAX setting)

Detection surface selection:

Sensor Head

Measurement

while moving

Correct reflection --- Multireflection

The default value is FIRST. Setting the value to MAX can decrease incorrect measurements caused by diffused reflection or multireflection due to the shape of the workpiece.

Correct

Measurement performed on

(with the FIRST setting)

Multireflection

the NEAR side

NEAR

reflection

FAR

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Set to the MENU mode

Setting completed

	Button			Explanation of
Eccentricity and Surface Deflection	Operation	Display	Description of Operation	Selection Menu
Denection	SMART MENU/SET	Lit	Hold down the 👅 button for	
DETAILED SETTINGS	Hold down for 3 seconds	H L MENU	three seconds to switch to the MENU mode.	
TROUBLE- SHOOTING	Pres to deplay.	dELRI L 888888	Press the I button to display dELRI L.	* This step is not required if detail menu display is already set to ON in the MENU mode.
SPECIFI- CATIONS		JELAL DN	Press the ♣ button to set the display to ☐N to set display of the detail menu.	
INDEX	Press to display.		Duran the Manager has the second of	
SETTING TRANSITION	SMART MENU/SET		Press the button to apply the setting.	

CHARTS

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Procedure for setting up detection surface selection 1 Set to the MENU mode Detection surface 2 selection setting 3 Return to RUN mode

2 Detection surface selection setting

Button Operation	Display	Description of Operation	Explanation of Selection Menu	_
Press to dsplay,	<u>dELECL</u> 888888	Press the 🌒 button to display dELECE .		
Press to select	Select the desired value.	Press the ♣ button to display MBX.	FLR5E During normal measurement MRX When an incorrect measurement occurs due to diffused reflection or multireflection	PREPARATION FOR MEASUREMENT FLOW OF OPERATION BASIC
SMART MENU/SET		Press the button to apply the setting.		SETUP
3 Retur	n to RUN mod	e	L	MAIN APPLICATIONS & SETTING METHODS

3 Return to RUN mode

Button	Disalau		Explanation of	Height
Operation	Display	Description of Operation	Selection Menu	Steps and
SMART MENU/SET		Hold down the 🖱 button for		Warpage
Hold down for 3 seconds	Out	three seconds to switch to the RUN mode.		Double Sheet Detection

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Key Lock Function

CONTENTS

Key Lock Function:

CONTENTS The key lock function disables all keys. Once keys have been disabled, no key input will be accepted until the lock is released. This function is useful for preventing inadvertent changes to settings.

(Although button operations are disabled, external input is still possible.)

Key Lock Function

FLOW OF	
OPERATION	

PREPARATION FOR MEASUREMENT

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Button Operation	Display	Description of Operation	Explanation of Selection Menu
Hidd ban dawn fe	<u> </u>	Hold both the (a) buttons down for three seconds in the RUN mode.	

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Key Lock Function	n

Canceling	the Key Loc	k	
Button Operation	Display	Description of Operation	Explanation of Selection Menu
I A I		Hold both the 🐢 buttons down	

for three seconds in the RUN

К

mode.

Initializing Settings Data Setting channels used when connecting multiple units: Each CH

Initialization: This function resets all settings to their default values.

Default Values

Function	Default Value	INTRODUCTION
Display	0 reference: Measurement center distance	
	+ indication: NEAR side	PREPARATION FOR
	- indication: FAR side	MEASUREMENT
HIGH threshold	Measurement range maximum value	FLOW OF
LOW threshold	Measurement range minimum value	OPERATION
Response time	500 ms	54010
Analog output setting	–5 to +5 V	BASIC SETUP
Detail menu display selection	OFF	MAIN
Bank switching settings	0	& SETTING METHODS
Mutual interference prevention	OFF	Height
Hysteresis width	0.000	Steps and
Two-Sensor operation	OFF	Warpage
setting		Double Sheet
Thickness setting	0.000	Detection
Measured value display scaling	OFF	Thickness
Differential function	OFF	Positioning
Hold setting	OFF	
Trigger mode	TIMING (self-trigger timing input)	Eccentricity and Surface
Self-trigger level	0.000	Deflection
Output for non- measurement	KEEP	DETAILED SETTINGS
Clamp value	MAX	
ON-delay time	0 ms	TROUBLE- SHOOTING
OFF-delay time	0 ms	
Zero reset memory	OFF	SPECIFI- CATIONS
Display during zero reset	0.000	
External input terminal setting	TIM.RST (timing input/reset input)	
Detection surface selection	FIRST	TRANSITION CHARTS

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CONTENTS

Procedure for initializing settings data

and later channels cannot be used to do this.

Set to the MENU mode

Display

Setting data initialization

Display

NI

Displayed

1 digit at a time

ΊK

Lit

MENU

Note that CH2 and later channels are initialized together with CH1.

MENU mode.

INI E.

FXF.

When connecting two or more Amplifier Units, use CH1 to perform initialization because CH2

Description of Operation

Hold down the 🛑 button for

three seconds to switch to the

Description of Operation

Press the \$ button to display

Press the 🗢 button to display

Press the 🖱 button.

When $\square H$ is displayed, this

means that initialization is

completed.



Important

1

Button

Operation

SMART MENU/SET

2

Hold down for 3 seconds

Button

Operation

MENU/SET

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Explanation of

Selection Menu

Explanation of

Selection Menu



3 Return to RUN mode

Button Operation	Display	Description of Operation	Explanation of Selection Menu	
SMART MENU/SET		Hold down the button for three seconds to switch to the		CONTENTS
Hold down for 3 seconds	H L MENU	RUN mode.		INTRODUCTION

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Troubleshooting

CONTENTS

This section describes countermeasures for temporary hardware problems. Check the malfunction in this section before sending the hardware for repair.

INTRODUCTION	Category	Problem	Probable cause and possible countermeasure	Pages	
PREPARATION		The device restarts during operation.	 Is the power supply device connected correctly? Are the Calculating Units connected correctly?	p.30 p.26	
MEASUREMENT		No input signal is received.	Are all cables connected correctly?Is the input signal line disconnected?	p.30	
OPERATION		The measured values fluctuate and are not stable	This problem may be due to temperature characteristics. Execute zero reset periodically using	p.101	
BASIC SETUP	Operation	depending on day and time.	the standard object to correct this problem.		
MAIN	pera	Laser light is not emitted.	Is the LD-OFF input short-circuited?	p.30	
APPLICATIONS & SETTING METHODS	ō	Bank switching by signals from the external input terminal is not functioning.	 Is the external input terminal set to 占用NK? Is the cable connected correctly? 	p.118 p.30	
Height		The state returns to	Is the external input terminal set to FL MRSE?	p.118	
Steps and Warpage Double		<i>bRNK</i> ☐ in the RUN mode even if after a bank is switched by button			
Sheet Detection	-	operation.	- Has a timing input been made while held is enabled	n 02	
Thickness			The main display stays at [].	 Has a timing input been made while hold is enabled and the trigger mode is <i>L</i> <i>M</i> <i>N</i> ? If the hold function is enabled and the trigger type is <i>SELF-U</i> or <i>SELF-d</i>, has the self-trigger level been set to an appropriate value? 	p.93
Positioning Eccentricity and Surface Deflection		An abnormal distance is displayed when the object is clearly outside the measurement range.	This problem may occur due to the characteristics of the sensor. Make sure that the distance to the sensing object is appropriate.	_	
DETAILED SETTINGS	Display	LddlWN is displayed on the sub-display when the power is turned ON.	The laser of the Sensor Head has deteriorated. Replace the Sensor Head.	—	
TROUBLE- SHOOTING	ā	Ld⊡FF is displayed on the sub-display.	Is the LD-OFF input short-circuited?	p.30	
SPECIFI-		님 께 N급 is displayed on the sub-display.	Is the timing input short-circuited?	p.30	
CATIONS		RESEE is displayed on the sub-display.	Is the reset input short-circuited?	p.30	
INDEX		Even though the installation conditions are	Is the zero-reset input short-circuited?	p.30	
SETTING TRANSITION CHARTS		the same, measured values differ considerably.			

Category	Problem	Probable cause and possible countermeasure	Pages	
Display	E - BRGE is displayed on the main display	 Is the distance between the Sensor Head and the workpiece within the measurement range? 	p.139	CONTENTS
Disp	E - dRK is displayed on the main display.	 Is the distance between the Sensor Head and the workpiece within the measurement range? 	p.139	1
	Judgements are not output to external devices.	Are all cables connected correctly?Is the output signal line disconnected?	p.30	INTRODUCTION
Output		 Is the reset input short-circuited? Is the HIGH threshold set to a value larger than the LOW threshold? 		PREPARATION For Measurement
	Analog output levels are strange.	Are the analog output settings correct?	p.109	FLOW OF OPERATION

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Error Messages

CONTENTS

This section outlines the error messages displayed on the Amplifier Unit and the countermeasures for those messages. While displaying an error, the error output signal is also output. (There are some

exceptions.)

Display Error Countermeasure Error-bright Saturated light amount intensity. Install so that the distance between PREPARATION FOR measurement error. the Sensor Head and the E-BRGE MEASUREMENT (The error output signal is not output.) workpiece is within the measurement range. FLOW OF If two or more Amplifier Units have OPERATION Error-channel • There is only one Amplifier Unit even though mutual interference been installed, turn OFF the power E-CH prevention is set to ON. supply and check that the Amplifier BASIC SETUP There is only one Amplifier Unit Units and Calculating Units are even though two-Sensor operation connected correctly. MAIN APPLICATIONS is set to ON. If only one Amplifier Unit is being used, connect another Amplifier & SETTING Error-channel Two Amplifier Unit communication METHODS error. Unit temporarily and turn OFF Heiaht mutual interference prevention and two-Sensor operation, or initialize Steps and the setting data. Error-dark Install so that the distance between Warpage Insufficient received light intensity, Double measurement error. the Sensor Head and the F-488K Sheet (The error output signal is not output.) workpiece is within the Detection measurement range. Frror-head The Sensor Head is disconnected Turn OFF the power supply, check Thickness Or. a sensor communications error the Sensor Head connection, and E-HERd EDMOT has occurred. then turn ON the power supply Positioning again. Error-head If the above countermeasure does E-HERd Eccentricity not solve the problem, the Sensor רחאחד and Surface Deflection Head is malfunctioning. Replace Error-head the Sensor Head <u>E-HERa</u> COMO3 DETAILED SETTINGS Error-head Sensor Head laser error. TROUBLE-E-HERd SHOOTING 1 77 1 Error-head The Sensor Head internal memory is SPECIFIin error. E-HERd CATIONS MEMOI Error-head INDEX E-HERd MEMOZ

SETTING TRANSITION CHARTS

Display	Error		Countermeasure	I
Error-head <u>E-HERd</u> 5950 I	Sensor Head system error.	•	Turn OFF the power supply, check the Sensor Head connection, and then turn ON the power supply	
Error-head		•	again. If the above countermeasure does not solve the problem, the Sensor	CONTENTS
SYSB2 Error-head E-HERd			Head is malfunctioning. Replace the Sensor Head.	INTRODUCTION
54203			10 - subjets	PREPARATION FOR
Error-head	Because the Sensor Head version is old, the connected Amplifier Unit	•	Contact the company with which your company is doing business or	MEASUREMENT
VER.	cannot be used.		the OMRON sales representative handling your company.	FLOW OF OPERATION
Error-memory	Amplifier Unit setting memory error.	•	Turn OFF the power supply, check if wiring is connected correctly, and then turn ON the power supply	BASIC SETUP
		•	again. If the above countermeasure does not solve the problem, the	MAIN APPLICATIONS & SETTING METHODS
			Amplifier Unit is malfunctioning. Replace the Amplifier Unit.	Height
Error-memory	Amplifier Unit setting memory error.	•	Initialize the settings by holding down the SET key for at least three seconds.	Steps and Warpage
		•	If the above countermeasure does not solve the problem, the	Double Sheet Detection
			Amplifier Unit is malfunctioning. Replace the Amplifier Unit.	Thickness
Error-short	One or all of the judgment outputs are short-circuited.	•	Turn OFF the power supply, check that the HIGH, PASS, LOW or error output lines are not short-	Positioning
			circuited, then turn ON the power supply again.	Eccentricity and Surface Deflection
Error-system	Amplifier Unit system error.		Turn OFF the power supply, check if wiring is connected correctly, and then turn ON the power supply again.	DETAILED SETTINGS
		•	If the above countermeasure does not solve the problem, the Amplifier Unit is malfunctioning. Replace the Amplifier Unit.	TROUBLE- SHOOTING
Tuning-failed	Smart Tuning failed.	•	Change the response time setting	SPECIFI- CATIONS
<u>EUN ING</u> FA ILEd	(The error output signal is not output.)		to a larger value, and try again. Make sure that the distance between the Sensor and	INDEX
			Workpiece is within the measurement range, and try again.	SETTING TRANSITION CHARTS

	Display	Error	Countermeasure
1	LD.down	The laser of the Sensor Head has	Replace the Sensor Head.
	888888	deteriorated.	
CONTENTS	LddGWN		
CONTENTS		Measured values are not output because the reset signal is being	 Normally, measured values are displayed once they can be output.
	888888	input, calculations are in progress,	displayed once they can be output.
INTRODUCTION		timing is before the hold sampling	
		time, etc.	
PREPARATION		(The error output signal is not output.)	
FOR MEASUREMENT			
FLOW OF OPERATION			
of Livenon			
BASIC			
SETUP			
ΜΔΙΝ			
MAIN APPLICATIONS & SETTING METHODS			
METHODS			
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Stone			
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menness			
Desitioning			
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Eccentricity			
and Surface Deflection			
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SPECIFI-			
CATIONS			
INDEX			
0			
SETTING TRANSITION			
CHARTS			
132	Error Message	25	ZX2 User's Manual

Question	Answer	CONTENTS
What is the positional variation range with	The range is $\pm 0.5^{\circ}$ of the ideal emitter axis in	
respect to the machine axis of the emitter beam spot?	the dimensional drawing on page 138.	INTRODUCTION
After the response time is changed, is it necessary to re-execute smart tuning?	Yes. After the response time is changed, the smart tuning results are cleared. Therefore, re-execute tuning.	PREPARATION FOR MEASUREMENT
If using a different bank for the first time, is it necessary to execute smart tuning?	Yes. The smart tuning results are not applied to other banks. If using a different bank for the first time, execute smart tuning.	FLOW OF OPERATION
For the line beam type, is it possible to detect beam-spot-internal steps?	Spot-internal steps cannot be measured. Use the line beam spot so that it is at only one height.	BASIC SETUP
Is it possible to add additional extension cables between the Sensor Head and Amplifier Unit?	Regardless of the length, only one extension cable can be added. It is not possible to add multiple extension cables.	MAIN APPLICATIONS & SETTING METHODS
About how much signal input and open time is required for each input operation?	These times can be checked using the timing charts in this manual (on page 144).	Height
Can calculations be performed when Sensor Heads that have different measurement	Yes. This is possible without specifying any special settings.	Steps and Warpage
ranges are connected to two Amplifier Units? How can I prevent an incorrect value being measured and output due to the shape of the	If the incorrect measurement is caused by multireflection due to the shape of the	Double Sheet Detection
workpiece?	workpiece, setting the detection surface selection to MAX might improve the	Thickness
Does the sensor need to be warmed up after canceling LD-OFF input?	measurement accuracy. (See page 120.) Yes. The sensor must be warmed up for at least 10 minutes in the same way as when	Positioning
	turning on the power.	Eccentricity and Surface Deflection
Can the sensor head of a diffuse-reflective model be tilted like that of a regular-reflective model?	Yes it can, but because the sensor is tilted, the actual measurement distance between the sensor and the workpiece will differ from the distance displayed.	DETAILED
	In this case, use a regular-reflective model whose linearity has been optimized by using regular-reflective optics.	TROUBLE- SHOOTING

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CONTENTS INTRODUCTION PREPARATION For Measurement FLOW OF OPERATION BASIC SETUP MAIN APPLICATIONS & SETTING METHODS Height Steps and Warpage Double Sheet Detection Thickness Positioning Eccentricity and Surface Deflection DETAILED SETTINGS TROUBLE-SHOOTING SPECIFI-CATIONS INDEX SETTING TRANSITION CHARTS

SPECIFICATIONS

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Engineering Data (Reference Value)	147

Specifications and Dimensions

Amplifier Units CONTENTS ZX2-LDA11/LDA41 INTRODUCTION (Unit: mm) PREPARATION FOR MEASUREMENT 11.7 ₩ E FLOW OF OPERATION Vinvl insulated round cable. 5.2 dia., 11 conductors (Conductor cross-section 0.09 mm²/ Insulator diameter: 0.7 mm) Note: The analog output line (black) BASIC has double shielding and SETUP 72 (cover open, 84.6) 6.2* the diameter of the insulator is 2.3 mm. 30 Standard length: 2 m 47.6 4.2 Minimum bending radius: 30 mm MAIN APPLICATIONS & SETTING METHODS в в н 38.4 (cover open, 56) 9.6 6 Height 34.2 16.6 Steps and 16.9 Warpage <− Double 20.7 36.8 Sheet 10.9 15.4 6.1 Detection * Min. length when connected: 50

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SETTING TRANSITION CHARTS 50 mm

E

F

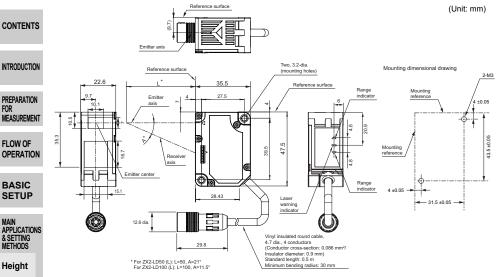
Model Item	ZX2-LDA11	ZX2-LDA41			
Measurement period (*1)	Min. 30 μs				
Response time	60 μs, 120 μs, 240 μs, 500 μs, 1 ms, 2 ms, 4 ms, 8 ms, 12 ms, 20 ms, 36 ms, 66 ms, 128 ms, 250 ms, 500 ms				
Analog output (*2)	4 to 20 mA, Max. load resistance: 300 $\Omega,$ ±5 VDC or 1 to 5 VDC, Output impedance: 100 Ω				
Judgment outputs (HIGH/PASS/ LOW: 3 outputs), error output	NPN open-collector outputs, 30 VDC, 50 mA max. (residual voltage: 1 V max. for load current 10 mA max., 2 V max. for load current above 10 mA	PNP open-collector outputs, 30 VDC, 50 mA max. (residual voltage: 1 V max. for load current 10 mA max., 2 V max. for load current above 10 mA	PREPARATION FOR MEASUREMENT FLOW OF		
Laser OFF input, zero reset input, timing input, reset input, bank input	ON: Short-circuited with 0-V terminal or 1.2 V or less. OFF: Open (leakage current: 0.1 mA max.)	ON: Supply voltage short-circuited or supply voltage within –1.2 V OFF: Open (leakage current: 0.1 mA max.)	BASIC SETUP		
Functions	Smart tuning, scaling, sample hold, peak hold, bottom hold, peak-to-peak hold, self-peak hold, self-bottom hold, average hold, zero reset, On-delay timer, OFF-delay timer, keep/clamp switch, (A-B) calculations (*3), thickness calculation (*3), mutual interference prevention (*3), laser deterioration detection, bank function (4 banks), differential function				
Indications	Judgement indicators: HIGH (orange), PASS (green), LOW (orange),11-segment main display (red), 11-segment sub-display (orange), laser ON (green), zero reset (green), ENABLE (green), MENU (green), HIGH threshold (orange), LOW threshold (orange)				
Power supply voltage	10 to 30 VDC, including 10% ripple(p-p)				
Power consumption	3,000 mW max. (at 24 VDC: 125 mA max., at 12 VDC: 250 mA max.)				
Ambient temperature	Operating: 0 to +50°C, Storage: -15 to +70°C (with no icing or condensation)				
Ambient humidity	Operating and storage: 35% to 85% (with n	o condensation)	Positioning		
Dielectric strength	1,000 VAC, 50/60 Hz for 1 minute		Eccentricity		
Vibration resistance (destruction)	10 to 150 Hz, 0.7-mm double amplitude, 80 minutes each in X, Y, and Z directions				
Shock resistance (destruction)	300 m/s ² 3 times each in six directions (up/down, left/right, forward/backward)				
Degree of protection	IEC60529, IP40				
Connection method	Prewired (standard cable length: 2 m)				
Weight (packed state)	Approx. 200 g (main unit only: approx. 135	g)	SHOOTING		
Materials	Case: PBT (polybutylene terephthalate), Cover: Polycarbonate, Display: Acrylic resin, Buttons: Polyacetal, Cable: PVC				
Accessories	Instruction sheet		CATIONS		

(*2) In the MENU mode, select and set current output (4 to 20 mA) and voltage output (±5 V or 1 to 5 V).

(*3) A Calculating Unit (ZX2-CAL) is required. SETTING TRANSITION Mutual interference prevention is possible for up to five Amplifier Units, and calculations are possible for up to two. CHARTS

Sensor Heads

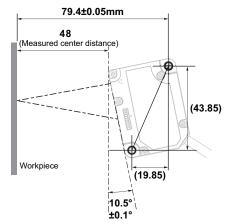
ZX2-LD50/LD50L, ZX2-LD100/LD100L, ZX2-LD50V



Setting Up the Regular-reflective Model

Tilt the regular-reflective model as shown below with respect to the workpiece. See page 141 if attaching a bracket to tilt the regular-reflective model.

ZX2-LD50V



Adjust the installation so that the angle is 10.5° ±0.1°. *The mounting hole dimensions in parentheses (reference values) are for when the Sensor is installed at 10.5°.

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Model Item	ZX2-LD50L	ZX2-LD50	ZX2-LD100L	ZX2-LD100	
Optical system	Diffuse-reflective]
Light source	Visible-light semiconductor laser with a wavelength of 660 nm and an output of 1 mW max.				
(wave length)	EN class 2, FDA class 2 (*5)				CONTENT
Measurement center distance	50 mm		100 mm		
Measurement range	±10 mm		±35 mm		INTRODUCTI
Beam shape	Line	Spot	Line	Spot	
Beam size (*1)	Approx. 60 µm x 2.6 mm	Approx. 60 µm dia.	Approx. 110 µm x 2.7 mm	Approx. 110 µm dia.	PREPARATIO FOR
Resolution (*2)	1.5 µm		5 µm		MEASUREMEN
Linearity (*3)	±0.05% F.S. (40 to 50 mm)	±0.1% F.S. (40 to 50 mm)	±0.05% F.S. (65 to 100 mm)	±0.1% F.S. (65 to 100 mm)	FLOW OF OPERATION
	±0.1% F.S. (entire range)	±0.15% F.S. (entire range)	±0.1% F.S. (entire range)	±0.15% F.S. (entire range)	
Temperature characteristic (*4)	0.02% F.S./°C				BASIC SETUP
Ambient illumination	Incandescent lamp: 10,000 lx max. (on light receiving side)				MAIN
Ambient temperature	Operating: 0 to +50°C, Storage: -15 to +70°C (with no icing or condensation)				APPLICATIO & SETTING METHODS
Ambient humidity	Operating and storage: 35% to 85% (with no condensation)				Height
Dielectric strength					
Vibration resistance (destruction)	······································				Steps and Warpage
Shock resistance (destruction)	300 m/s ² 3 times each in six directions (up/down, left/right, forward/backward)				Double Sheet
Degree of protection	IEC60529, IP67				Detectio
Connection method	Connector connection (standard cable length: 500 mm)				Thicknes
Weight (packed state)	Approx. 160 g (main unit only: approx. 75 g)				Positioni
Materials	Case and cover: Polybutylene terephthalate, Optical window: Glass, Screw sections: Brass, Cable: PVC				Eccentrici
Accessories	Instruction sheet, ferrite core x 1 (made by TDK Corp. ZCAT1730-0730A), laser warning label (English), FDA certification label				and Surfa Deflection

(Note) Highly reflective objects can result in incorrect detection by causing out-of-range measurements.

(*1) Beam size: The beam size is defined by 1/e² (13.5%) of the strength of the beam at the beam center (measured value). Incorrect detection may occur if there is light leakage outside the defined spot and the material around

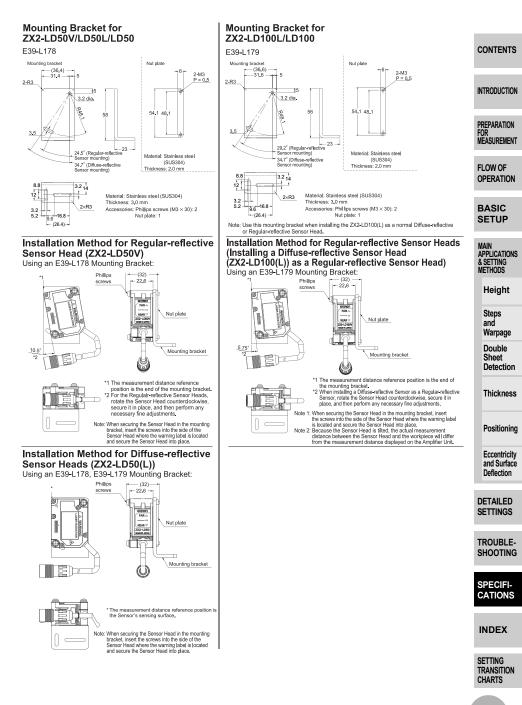
- the sensing object is more reflective than the sensing object.
 (*2) Resolution: The resolution is the deviation (±3\circ) in the analog output when connected to the ZX2-LDA Amplifier Unit. (The resolution is measured with the standard reference object (white ceramic), at the measurement point when the response time of the ZX2-LDA is set to 128 ms.) The resolution is given at the repeat accuracy for a stationary workpiece, and is not an indication of the distance accuracy. The resolution may be adversely affected under strong electromagnetic fields.
- (*3) Linearity: The linearity is given as the error in an ideal straight line displacement output when measuring the standard reference object. The linearity and measurement values vary with the object being measured. F.S. is the entire
- measurement range. (ZX2-LD50□:20mm)
 (*4) Temperature characteristic: The temperature characteristic is measured at the measurement center distance with the Sensor and reference object (OMRON's standard reference object) secured with an aluminum jig.
- (*5) Categorized as Class 2 by IEC60825-1 criteria in accordance with the stipulations of the FDA standard Laser Notice No. 50, and registered with CDRH (Center for Devices and Radiological Health) (accession number: 1020665)

SETTING TRANSITION CHARTS

INDEX

	Model Item	ZX2-LD50V		
	Optical system	Regular-reflective		
CONTENTS	Light source (wave length)	Visible-light semiconductor laser with a wavelength of 660 nm and an output of 0.24 mW max.		
		EN class 1, FDA class 1 (*5)		
INTRODUCTION	Measurement center distance	48 mm		
PREPARATION	Measurement range	±5 mm		
FOR MEASUREMENT	Beam shape	Spot		
	Beam size (*1)	Approx. 60 µm		
FLOW OF	Resolution (*2)	1.5 μm		
OPERATION	Linearity (*3)	±0.3% F.S. (entire range)		
BASIC	Temperature characteristic (*4)	0.06% F.S./°C		
SETUP	Ambient illumination	Incandescent lamp: 10,000 lx max. (on light receiving side)		
MAIN APPLICATIONS & SETTING	Ambient temperature	Operating: 0 to +50°C, Storage: -15 to +70°C (with no icing or condensation)		
METHODS	Ambient humidity	Operating and storage: 35% to 85% (with no condensation)		
Height	Dielectric strength	1,000 VAC, 50/60 Hz for 1 minute		
Steps and	Vibration resistance (destruction)	10 to 150 Hz, 0.7-mm double amplitude, 80 minutes each in X, Y, and Z directions		
Warpage Double	Shock resistance (destruction)	300 m/s ² 3 times each in six directions (up/down, left/right, forward/backward)		
Sheet Detection	Degree of protection	IEC60529, IP67		
Thickness	Connection method	Connector connection (standard cable length: 500 mm)		
Positioning	Weight (packed state)	Approx. 160 g (main unit only: approx. 75 g)		
Eccentricity	Materials	Case and cover: Polybutylene terephthalate, Optical window: Glass, Screw sections: Brass, Cable: PVC		
and Surface Deflection	Accessories	Instruction sheet, ferrite core \times 1 (made by TDK Corp. ZCAT1730-0730A), laser warning label (English), FDA certification label		
DETAILED SETTINGS	 (Note) Highly reflective objects can result in incorrect detection by causing out-of-range measurements. (*1) Beam size: The beam size is defined by 1/e² (13.5%) of the strength of the beam at the beam center (measured value). Incorrect detection may occur if there is light leakage outside the defined spot and the material aroun 			
TROUBLE- SHOOTING	 the sensing object is more reflective than the sensing object. (*2) Resolution: The resolution is the deviation (±3σ) in the analog output when connected to the ZX2-LDA Amplifier Unit. (The resolution is measured with the standard reference object (1/4 λ flat mirror), at the measurement point when the response time of the ZX2-LDA is set to 128 ms.) The resolution is given at the repeat accuracy for a stationary workpiece, and is not an indication of the distance accuracy. The resolution may be adversely affected under strong electromagnetic fields. (*3) Linearity: The linearity is given as the error in an ideal straight line displacement output when measuring 			
SPECIFI- CATIONS				
INDEX	the standard reference object. The linearity and measurement values vary with the object being measured. F.S. is the en measurement range.			
	(*4) Temperature characteristic: The temperature characteristic is measured at the measurement center distance with the Sensor and reference object (OMRON's standard reference object) secured with an aluminum jig.			
SETTING TRANSITION CHARTS	(*5) Categorized as Class 1 by IEC60825-1 criteria in accordance with the stipulations of the FDA standa Laser Notice No. 50, and registered with CDRH (Center for Devices and Radiological Health) (accession number: 1020665)			
140	Specificatio	ns and Dimensions ZX2 User's Manual		

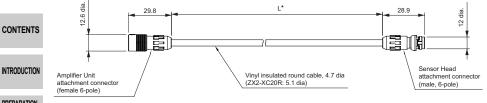
Mounting Bracket



Sensor Head Extension Cables

ZX2-XC1R, ZX2-XC4R, ZX2-XC9R, ZX2-XC20R

(Unit: mm)



PREPARATION FOR MEASUREMENT

*L Cable lengths: ZX2-XC1R: 1 m, ZX2-XC4R: 4 m, ZX2-XC9R: 9 m, ZX2-XC20R: 20 m

Note. Two or more extension cables cannot be connected in series.

FLOW OF OPERATION	Model Item	ZX2-XC1R	ZX2-XC4R	ZX2-XC9R	ZX2-XC20R	
	Cable type	Flex-resistance type				
BASIC SETUP	Degree of protection IP67					
	Dielectric strength (connector)	no breakdown at A	akdown at AC 300 V for 1 minute			
	Insulation resistance (connector)	1000 MΩ min. (at 100 VDC)				
MAIN APPLICATIONS & SETTING METHODS	Weight (packed state)	Approx. 70 g	Approx. 450 g	Approx. 600 g	Approx. 1050 g	
	Materials	Connector: PPS and PBT, Cable: PVC				
	Minimum bend radius	30 mm				
Height	Accessories	Ferrite core x 2 (made by TDK Corp. ZCAT1730-0730A)				



Height

Double Sheet Detection

Thickness

Positioning

Eccentricity and Surface Deflection

DETAILED SETTINGS

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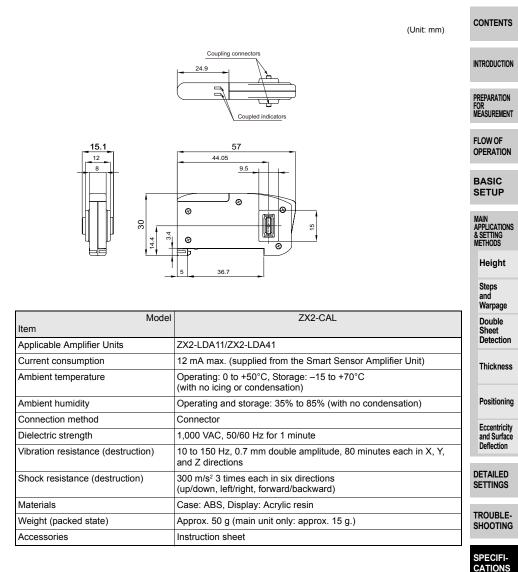
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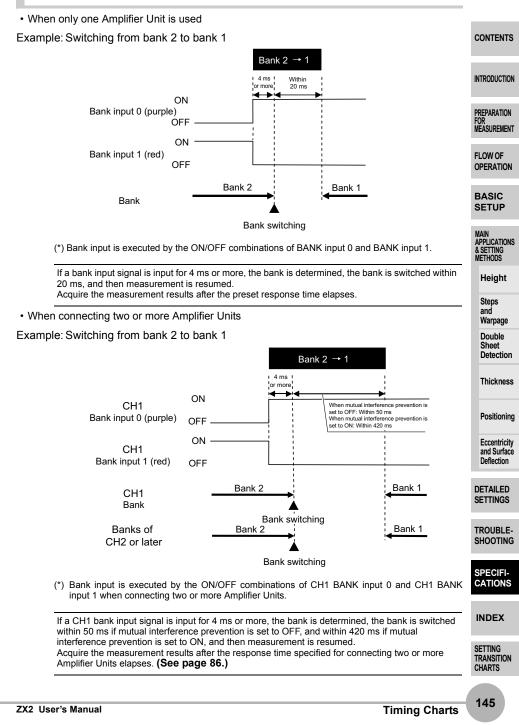
Timing Charts

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This section explains the timing charts for the I/O signals that are exchanged between the Controller and external devices.

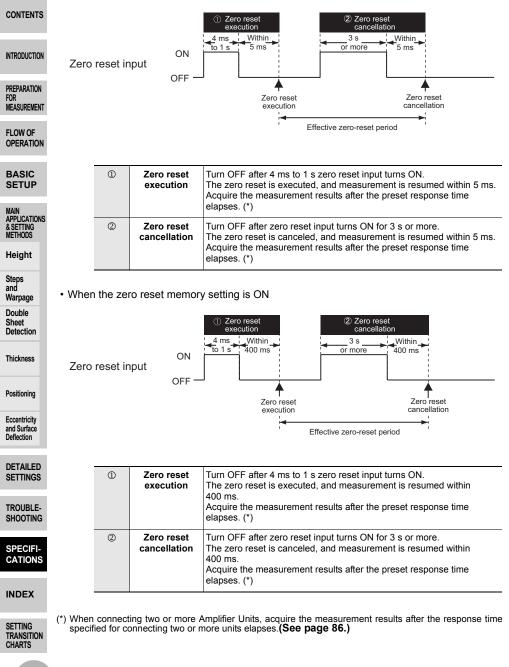
Laser OFF input INTRODUCTION ①Laser emission ON→OFF (2) Laser emission OFF→ON PREPARATION 4 ms Within 4 ms Within FOR 20 ms (*) 8 ms (*) MEASUREMENT or more or more ON Laser OFF input FLOW OF OFF OPERATION ON BASIC Laser emission SETUP OFF MAIN APPLICATIONS Laser emission 1 If laser OFF input is ON for 4 ms or more, the signal is received, and & SETTING $ON \rightarrow OFF$ laser emission is turned OFF within 8 ms. METHODS 2 Laser emission If laser OFF input is OFF for 4 ms or more, the signal is received, and Heiaht $OFF \rightarrow ON$ laser emission is turned ON within 20 ms. Steps (*) The value is within 150 ms when mutual interference prevention is set to ON. and Warpage Reset input Double Sheet Detection Output value Output value reset cancellation reset execution 4 ms Within or more 4 ms (*1) Thickness 4 ms or more ON Reset input Positioning OFF Eccentricity and Surface Deflection Effective reset period DETAILED SETTINGS 1 Output value If reset input is ON for 4 ms or more, the signal is received, and output reset execution is reset within 4 ms. TROUBLE-2 Output value If reset input is OFF for 4 ms or more, measurement is resumed. SHOOTING reset Acquire the measurement results after the preset response time cancellation elapses. (*2) SPECIFI-(*1) The value is within 150 ms when mutual interference prevention is set to ON. CATIONS (*2) When connecting two or more Amplifier Units, acquire the measurement results after the response time specified for connecting two or more units elapses. (See page 86.) Note. • When the hold function is not used INDEX The output while a reset signal is being input is held in accordance with the output during nonmeasurement setting. When the hold function is used SETTING If a reset signal is input, the state in effect before the hold function was set will be restored. TRANSITION (For details on the hold function, see page 93, and for details on the output during CHARTS non-measurement, see page 111.) 144

Bank input



Zero reset input

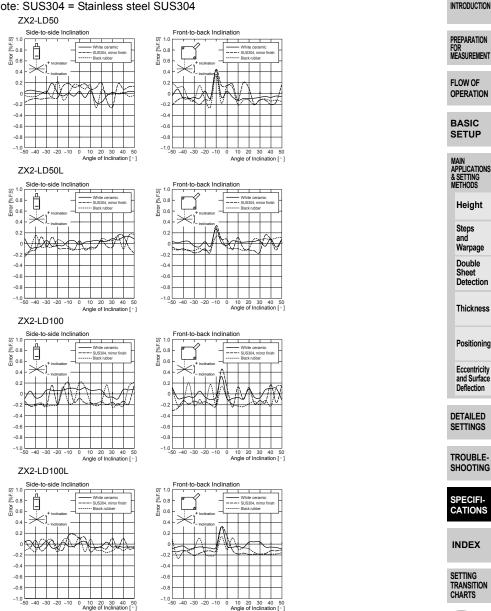
· When the zero reset memory setting is OFF



Engineering Data (Reference Value)

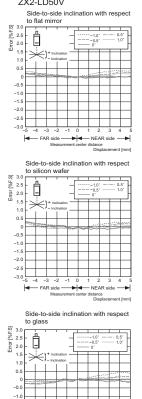
Angle Characteristic

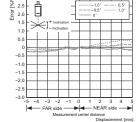
The angle characteristic is a plot of the inclination of the sensing object in the measurement range and the maximum value of the error to analog output. Note: SUS304 = Stainless steel SUS304

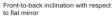


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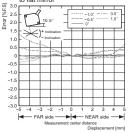
ZX2-LD50V



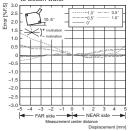




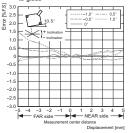
Error



Front-to-back inclination with respect to silicon wafer



Front-to-back inclination with respect to glass



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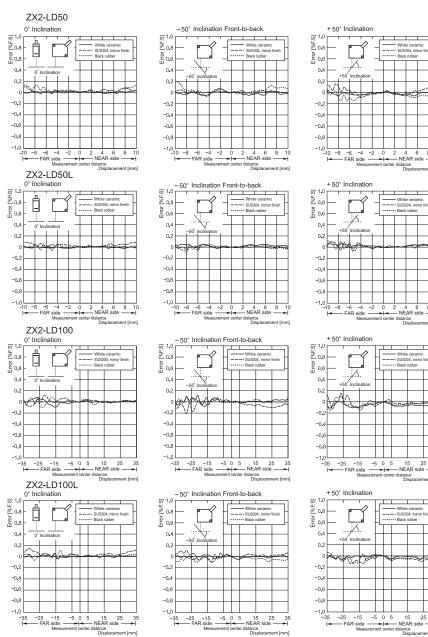
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25 35

Displacement (mm)

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Note. X axis displacement: Measurement distance displayed on the Amplifier Unit

and the NEAR and FAR sides from the sensor are displayed by + and -, respectively.

For the measurement distance displayed on the Amplifier Unit, the measurement center distance is displayed as 0,

Linearity Characteristic for Different Materials

CONTENTS

ZX2-LD50V 0° Inclination

ග^{1.0} ₩ 20.8

JO 0.6 0.4 0.2

> 0 -0.2 -0.4

> -0.6

-0.8

-1.0

i.

Spot Beams

-2 -1

-

- FAR side -

Beam Size

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PREPARATION FOR MEASUREMENT

FLOW OF OPERATION

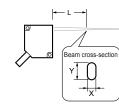
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MAIN APPLICATIONS & SETTING METHODS

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Warpage Double Sheet Detection Thickness

Steps and



Flat mirror

– NEAR side –

side ______ Measurement center distance Displacement [mm]

Silicon wafe

ZX2-LD50

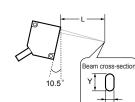
	L	+10 mm	0 mm	-4 mm	–10 mm
	Х	Approx. 600 µm	Approx. 160 µm	Approx. 40 µm	Approx. 220 µm
	Y	Approx. 350 µm	Approx. 90 µm	Approx. 60 µm	Approx. 130 µm

ZX2-LD100

+35 mm -20 mm -35 mm L 0 mm Positioning х Approx. Approx. Approx. Approx. 1.1 mm 400 µm 250 µm 70 µm Eccentricity Y Approx. Approx. Approx. Approx. and Surface 550 µm 190 µm 110 µm 150 µm Deflection

DETAILED SETTINGS

TROUBLE-SHOOTING



L	+5 mm	0 mm	-4.2 mm	–5 mm
Х	Approx.	Approx.	Approx.	Approx.
	350 µm	160 µm	40 µm	50 µm
Y	Approx.	Approx.	Approx.	Approx.
	180 µm	90 µm	60 µm	70 µm

SPECIFI-CATIONS

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SETTING TRANSITION CHARTS

50V	
nm 0 mm –4.2 mm –5 mm	

ZX2-LD5

Note. L: Measurement distance displayed on the Amplifier Unit (For the measurement distance displayed on the Amplifier Unit, the measurement center distance is displayed as 0, and the NEAR and FAR sides from the sensor are displayed by + and -, respectively.)

Line Beams

Note. X axis displacement: Measurement distance displayed on

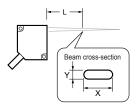
the measurement center distance is displayed as 0,

For the measurement distance displayed on the Amplifier Unit,

and the NEAR and FAR sides from the sensor are displayed by

the Amplifier Unit

+ and -, respectively.



7X2-I D501

L	+10 mm	0 mm	–4 mm	–10 mm
Х	Approx.	Approx.	Approx.	Approx.
	2.6 mm	2.6 mm	2.6 mm	2.6 mm
Y	Approx.	Approx.	Approx.	Approx.
	350 µm	90 µm	60 µm	130 µm

ZX2-LD100L

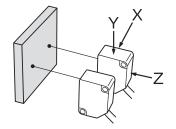
L	+35 mm	0 mm	–20 mm	–35 mm
Х	Approx. 2.1 mm	Approx. 2.5 mm	Approx. 2.7 mm	Approx. 2.9 mm
Y	Approx. 550 µm	Approx. 190 µm	Approx. 110 µm	Approx. 150 µm

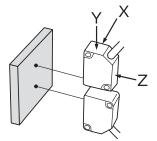
Reference: Distance between two diffusereflective models that causes malfunction when mutual interference prevention is turned off

The distance at which the resolution exceeded the rated value when sensors were moved towards each other (in all the X, Y, and Z directions) while mutual interference prevention was turned off was measured. (Workpiece: white ceramic; positioned facing the sensor, not on an angle.)

Horizontal direction

Vertical direction





Results: For all models, the distance that causes malfunction is 0 mm in all the X, Y, and Z directions.

Note. The above result was obtained when the white ceramic workpiece was positioned facing the sensor, not on an angle.

Note that mutual interference can occur when using different types of workpieces or when the sensors are attached at an angle, so it is recommended to use the sensors with mutual interference prevention turned on.

Warpage Double Sheet Detection

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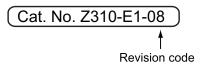
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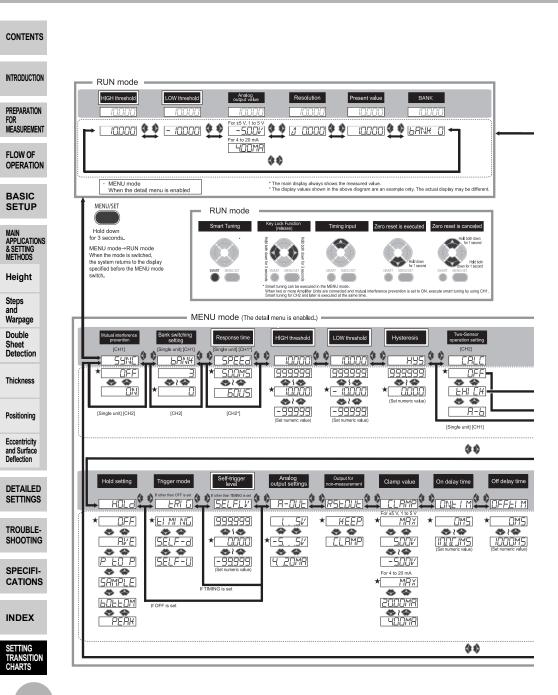
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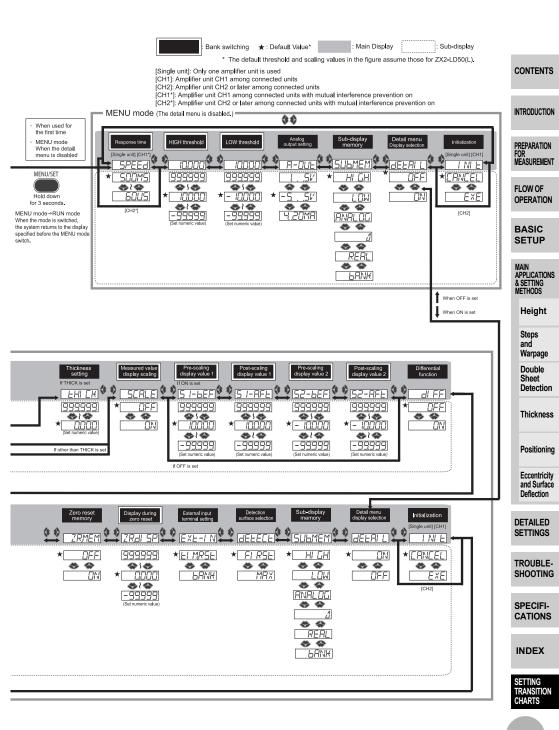
A manual revision code appears as a suffix to the catalog number at the bottom of the front and back covers of this manual.



Revision code	Date	Revised contents
01	Oct. 2010	Original production
02	Jan. 2011	General revision (calculating unit launched)
03	Apr. 2011	General revision (differential function and detection surface selection function added)
04	Jul. 2011	Revision (regular-reflective model launched)
05	Dec. 2011	Minor corrections
06	Nov. 2013	Pages 5 to 7: Updated terms and conditions agreement. Page 10: Changed information on FDA standards. Page 137: Changed specification of power consumption. Page 138: Changed L and A values for ZX2-LD100 (L). Page 139: Changed information on FDA standards. Page 140: Changed information on FDA standards and changed specification of accessories. Page 141: Revised dimensions of E39-L178/L179 Mounting Brackets. Page 147: Changed "Typical" to "Reference Value."
07	Mar. 2015	Pages 26 and 86: Corrected channel designations for formula in figure. Page 50: Added sentence at top right of page. Page 136: Added callouts to figure. Page 138: Changed figure at bottom of page. Pages 139 and 140: Added material for screw sections.
08	July 2015	Page 11 : Added applicable standards. Corrected mistakes.

SETTING TRANSITION CHARTS





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