ONO SOKKI

CL-7100/CL-7100S

Non-Contact Thickness Meter

Instruction Manual

ONO SOKKI

WEBSITE https://www.onosokki.co.jp/English/english.htm

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■ WARRANTY ■

1. This product is covered by a warranty for a period of one year from the date of purchase.
2. This warranty covers free-of-charge repair for defects judged to be the responsibility of the manufacturer, i.e., defects occurred while the product is used under normal operating conditions according to descriptions in this manual and notices on the unit label.
3. For free-of-charge repair, contact either your sales representative or our sales office nearby.
4. The following failures will be handled on a fee basis even during the warranty period.
   (a) Failures occurring through misuse, mis-operation, or modification
   (b) Failures occurring through mishandling (dropping) or transportation
   (c) Failures occurring through natural calamities (fires, earthquakes, flooding, and lightning), environmental disruption, or abnormal voltage.

* For repairs after the warranty period expired, contact your nearest Ono Sokki sales office or the distributor where you purchased the product.
* Outer appearance and specifications are subject to change without prior notice.

Introduction

This manual describes the functions, specifications, connection method, precautions for use, etc., for the CL-7100/CL-7100S Non-Contact Thickness Meter. Before using this product, be sure to read this manual for proper use.
Note that this manual contains some precautions which, if ignored, could cause property damage. Be sure to handle the product according to the procedure provided in this manual.

- This manual uses the illustrations of CL-7100 for the description of operations and functions common to CL-7100 and CL-7100S.

● Notations used in instruction manual

This manual uses the following symbols as well as safety symbols. Check these before reading this manual.

CAUTION	Indicates supplementary explanations and restrictions. It is recommended to read the contents.
IMPORTANT	Indicates important precautions to be observed. Be sure to read the contents.

CAUTION

- The content of this manual is subject to change without notice.
- Reprinting or altering this manual, in whole or in part, without permission is prohibited.
- Some illustrations or screen images used in this manual are processed for explanation. Therefore, they may be different from the actual screens.
- Every effort has been made to ensure that the content of this manual is correct. Should any unclear points or errors be found, inform us.
- Note that Ono Sokki Co., Ltd. (hereinafter referred to as “Ono Sokki”) shall not be responsible for results of using this product regardless of the previous paragraph.
- The company names and product names that appear in this manual are trademarks or registered trademarks of their respective companies.

For Your Safety

- Be sure to read this manual before using this product.
- Use this product by following the instructions described in this manual.
- The precautions specific to this product may be noted on the main unit or in other instruction manuals accompanying it. These precautions must also be observed when you use the product.
- Keep this manual in a safe place where it is readily available for future reference.
- The contents in this manual provide the information as of the writing of the manual. Note that the contact information (e.g., company address, phone number, website URL, e-mail address) is subject to change without prior notice.

■ Safety indications

● Meaning of notations

This manual uses the following symbols for safe use of the product.
These notations indicate the severity of effects if the instructions are not followed.

WARNING	Indicates a hazardous situation that, if not avoided, will result in death or serious injury.
CAUTION	Indicates a hazardous situation that, if not avoided, may result in minor injury or property damage.
NOTICE	Indicates a hazardous situation that, if not avoided, may result in property damage including failure of the equipment, system, or facility, but will not result in personal injury.

● Meaning of symbols

Cautions/indications for hazards are given by 3 different symbols: Each symbol has the following meaning.

Symbol	Definition	Meaning	Example
	Attention	Indicates that failure to observe the instructions may cause hazardous situation. The pictogram in the symbol indicates the type of hazard involved.	
	Prohibition	Indicates a prohibited action. The pictogram in or beside the symbol indicates a prohibited action.	
	Mandatory	Indicates a mandatory action. The pictogram in the symbol indicates a mandatory action. This action is necessary to avoid hazards.	

■ Precautions for use

WARNING

Only use fuses of the ratings (current, voltage, and fusing characteristic) specified for the instrument.

- Using unspecified fuses may cause fire.
  Be sure to turn the power off, disconnect the power cable, and wait for at least 1 minute before replacing fuses.

Do not use the instrument in an environment exceeding the operating temperature range (0 to 40 °C) defined in the specifications.

- Ignoring this may cause fire. Also, do not use the instrument under extremely high temperature conditions.

Do not use the instrument in an environment causing dew condensation.

- Using the instrument with dew condensation generated on it may cause short-circuit inside the unit or heat generation, resulting in fire or electric shock.

Do not block the heat radiation.

- Heat contained inside the instrument may cause fire. Install the instrument in a well-ventilated place away from walls.

Never uncover or disassemble the instrument.

- Using the instrument in the uncovered or disassembled state may cause trouble, such as failure and electric shock.
  For internal adjustment, inspection, or repair, contact your nearest Ono Sokki sales office or the distributor where you purchased the instrument.

Do not splash or spill water on the instrument.

- There is a risk of fire or electric shock due to short-circuit or increased heat.
  If the inside of the instrument gets wet, disconnect the power cable immediately and contact your nearest Ono Sokki sales office or the distributor where you purchased the instrument as soon as possible.

Do not touch the instrument with wet hands.

CAUTION

Do not use this product for the operations involving human lives or requiring a high level of reliability.

- This product is not intended to be incorporated in the following for the purpose of control: facility or equipment involving human lives or requiring a high level of reliability, such as medical equipment, nuclear facility and equipment, and aerospace equipment.
  Ono Sokki shall assume no responsibility and shall give no compensation for any physical injury, property loss, etc., resulting from using this product with such facility, equipment, or control system.

■ Precautions for power cable

WARNING

Be sure to turn the power switch off before connecting or disconnecting the power cable.
- Connecting or disconnecting the power cable while the power switch is on may cause electric shock.

Be sure to use the supplied power cable or a power cable specified by Ono Sokki.
- Using a power cable other than the one supplied, or one not specified by Ono Sokki, may cause fire or other hazards.

The power cable is intended for Class I protective ground. Be sure to connect it to the protective grounding terminal.

The supplied power cable (NR VM1391-VM1734 2M) is intended for use in Japan (100 VAC).
When using the instrument outside Japan, a power cable appropriate for the location is required.
- Using an inappropriate power cable may cause fire or electric shock. Be sure to contact your nearest Ono Sokki sales office or the distributor where you purchased the instrument.

CAUTION

Be sure to hold the plug when connecting or disconnecting the power cable.
- Pulling the cable with excessive force may damage or break the cable, possibly resulting in fire or electric shock.

Do not connect or disconnect the power cable with wet hands.
- There is a risk of electric shock.

Keep the power cable away from heaters or appliances heated to a high temperature.
- The sheath of the power cable may melt, possibly resulting in fire or electric shock.

To prevent electric shock due to deteriorated insulation or fire due to leakage, if the instrument will not be in use for a prolonged period of time, disconnect the power plug from the outlet or turn off the breaker on the distribution panel.

■ Precautions for protective ground

CAUTION

Before turning on the instrument, be sure to connect it to the protective ground.
- Otherwise, electric shock may result.
  If the instrument is not connected to the protective ground or you are not sure that the instrument is connected securely to the protective ground, do not turn on the power.

■ Precautions for electric shock

WARNING

Never cut the internal or external protective ground wire or disconnect the wire connected to the protective grounding terminal of the instrument.
- There is a risk of electric shock or damage to the instrument.

Before connecting the instrument to a measurement target or an external control circuit, make sure that the connection to the protective ground has been performed properly and that the instrument power is off.
- Connecting the instrument without connection to the protective ground or while the instrument power is on may cause electric shock.

Before touching the parts of voltage/current output section or circuits connected to such section, make sure that the instrument power is off.
- Touching such circuits without turning the power off may result in electric shock. Be sure to insulate the circuits to withstand the output voltage and current.

Be sure to use the power supply of the specified voltage and frequency.
- Using an unspecified power supply may cause electric shock, fire, or damage to the instrument.

During a thunderstorm, do not touch any metal part or plug of the instrument.
- There is a risk of electric shock from induced lightning. During a thunderstorm, do not use the instrument outdoors.

■ Precautions for power fuse

WARNING

If the power fuse blows, assume the instrument is in an abnormal state. Contact your nearest Ono Sokki sales office or the distributor where you purchased the instrument for repair and inspection as soon as possible.
- Use the power fuses of the same ratings and type to prevent fire.
- Power fuses are placed in the fuse holder on the rear panel.
- For checking or replacing a power fuse, refer to “Checking/replacing the power fuse” on page 107.

■ Precautions in case of abnormality

WARNING

If any metal, water, or foreign object should fall inside, unplug the instrument immediately.

- Using the instrument while allowing ingress of metal, water, or a foreign object may cause fire or electric shock. Disconnect the power plug immediately and contact your nearest Ono Sokki sales office or the distributor where you purchased the instrument as soon as possible.

If you perceive smoke, abnormal noise, or odor coming from the instrument or if you accidentally drop or damage it, unplug the instrument immediately.

- Using the instrument under such conditions may cause fire or electric shock. Disconnect the power plug immediately and contact your nearest Ono Sokki sales office or the distributor where you purchased the instrument as soon as possible.

■ Precautions for measurement

CAUTION

During measurement, do not connect or disconnect the input/output connectors.

- A measurement error occurs, and a failure signal is output to an external device.

Do not turn off the power while operating the buttons or communicating through an external interface.

- Doing so may cause a failure in the internal memory.

■ Precautions for installation and connection

CAUTION

Do not install the instrument in an unstable place.

- If the instrument should fall or topple, it may cause injury or damage to the instrument.

Do not place a large or heavy object on top of the instrument.

- If an object on top of the instrument should fall or topple, it may cause injury or damage to the instrument.

Do not install the instrument in a place exposed to oily smoke or steam, or in a humid or dusty place.

- The electricity conducted through oil, water, or dust may cause fire or electric shock.

Do not install the instrument in a place subject to extremely high temperatures or direct sunlight.

- There is a risk of fire.

■ Precautions for disposal

NOTICE

Dispose of this product and the provided optional parts in accordance with the local disposal rules.

- For details about disposal, contact the local government.

■ Precautions for electromagnetic environment

NOTICE

This product is intended to be used in an industrial electromagnetic environment.

- Using the product in a home environment may cause electromagnetic interference. In this case, the user may be required to take an appropriate measure.

■ Precautions for maintenance

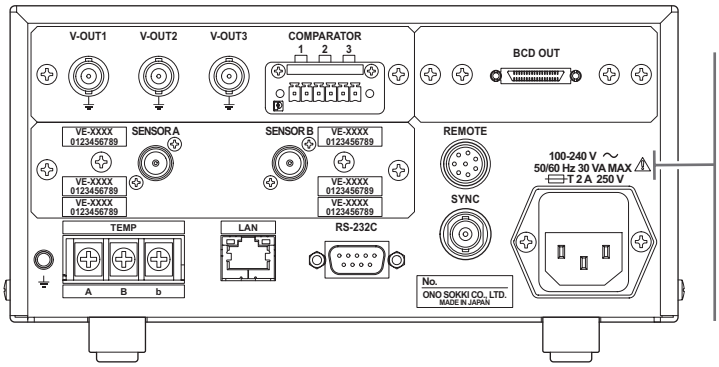
CAUTION

Always keep the instrument clean.

- Especially, dusty or oil-contaminated connectors may cause malfunction. When cleaning the panel surface, do not use volatile materials such as thinner.

■ Caution symbols and warning labels on the instrument

The following shows the locations and meanings of the caution symbols and warning labels on the case (rear panel) of the instrument. Be sure to check before use.



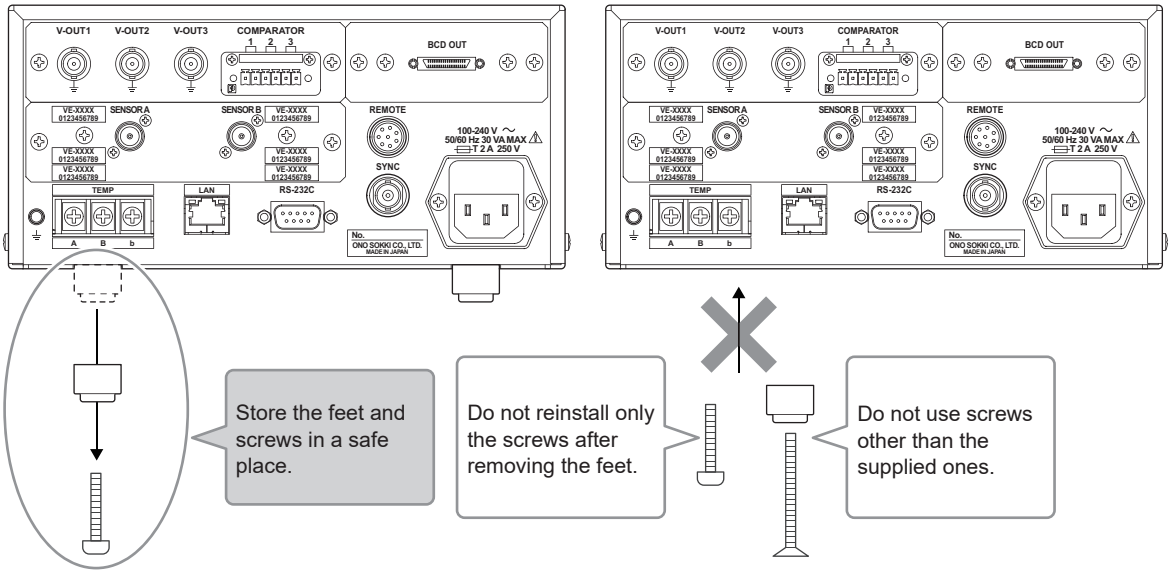
This is a warning symbol for the AC power.
For details, refer to the following sections.

- “Precautions for power cable” (Page 4)
- “Precautions for protective ground” (Page 4)
- “Precautions for electric shock” (Page 5)

■ Precautions when removing the feet

In a location where the instrument's feet interfere with installation, you may remove the feet. Observe the following precautions when using the instrument without feet. Otherwise, the internal board may be damaged.

- After removing the feet, do not attach the screws back to their original positions on the instrument.
- Do not secure the feet with screws other than the supplied ones.
- Do not use the screw holes for purposes other than securing the feet.



Checking Supplied Items

When unpacking the product, check that all the supplied items are included and that the unit has no visible damage.

Item	Quantity	Remarks
AC power cable	1	
REMOTE connector	1	ER03-PB8M-T (manufactured by Tajimi Electronics)
CL-7100S dedicated cable (2.5 m)	2	This is supplied only with CL-7100S.
Instruction Manual	1	This manual

CAUTION

- If any of the supplied items are missing or damaged, stop using the instrument immediately and contact your nearest Ono Sokki sales office or the distributor where you purchased the instrument.
- The supplied items listed above are delivered with the system having standard specifications. Optional items are not included. When you purchased an optional item, check that it is included.

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Chapter 1

Overview of CL-7100/CL-7100S

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1.1 Features

The CL-7100/CL-7100S Non-Contact Thickness Meter is used to measure the thickness of a measurement target without contact in combination with electrostatic capacitance-type gap detector VE sensors (hereinafter referred to as “VE sensors”).
This instrument enables non-contact measurement of the thickness of semiconductors, such as silicon wafers, and conductors, such as metal plates. By adding the optional insulator measurement function, you can also measure the thickness of insulators (such as plastic films).

- Achieves high reproducibility without physical impact on the measurement target due to its non-contact measurement method.
- Measures the thickness of conductors, semiconductors, and insulators (optional) with this single unit.
- Enables the simultaneous measurement of thickness and temperature and temperature correction by adding the temperature measurement function (option).
- Achieves highly reliable measurement due to its high accuracy, high stability, and high resolution.
- Equipped with a large color LCD touch panel to offer both visibility and intuitive operations.
- Supports inline thickness measurement, allowing real-time monitoring on the production line.
- Measures displacement as a 2-channel displacement sensor.

1.2 Measurement Targets

1.2.1 Conductors and Semiconductors

Basically, any objects made of conductive materials can be measured.
Examples:
- Silicon wafers, silicon carbide wafers, and gallium arsenide (GaAs) wafers
- Metal plates such as iron, aluminum, and stainless steel
- Carbon plates such as gasket materials

1.2.2 Insulators (Optional)

Insulators can be measured as long as they are made of a single material and have a stable relative permittivity regardless of the temperature or humidity.
- To measure insulators, the CL-0740 Insulator Measurement Function is required.

Examples:
- Plastic
- Glass
- Rubber
- Wood
- Paper

1.2.3 Objects Requiring Specific Measurement Conditions

■ Conductors and semiconductors

Small objects	The measurement target must be larger than the VE sensor outer diameter.
Round objects	A curved measurement target may cause errors.
Tilted objects	A measurement target tilted toward the VE sensor may cause errors.
Vibrating objects	Vertical movement within the gap between sensors does not affect measurement, but tilting vibration may cause errors.
Porous objects	A porous object may be measured to be thinner depending on the porosity.
Rough-surfaced objects	The measured value is almost the average over the surface unevenness. If the surface is too rough, the measured value may be unstable.
Surface-treated objects	An object with treatment on the surface, such as anti-static treatment, may cause errors.
Coated objects	An object coated with insulating paint may cause errors.
Alumites	An aluminum plate coated with alumite has an insulating layer on the surface, so the measured value may be unstable.
Others	Errors may occur depending on ambient conditions such as temperature, dust, and mist.

■ Insulators

CL-0740

- To measure insulators, the CL-0740 Insulator Measurement Function is required.

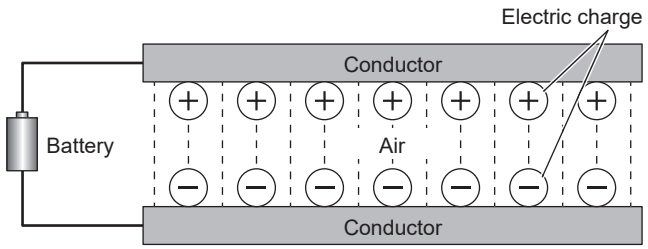
Composites	A composite made of different materials, such as glass epoxy and asbestos, may cause errors because relative permittivity may vary depending on the measurement point.
Laminates	A laminated composite made of 2 or more materials with different relative permittivity can be measured by treating these materials as a single material. If the proportion of each material's thickness significantly changes, errors may occur.
Objects with air bubbles	An object with air bubbles, such as expanded polystyrene, may cause errors due to low apparent permittivity.
Objects with moisture	A material with moisture, such as paper, may cause errors because its permittivity changes depending on the moisture content.

1.3 Measurement Principle

1.3.1 Overview

This instrument determines the thickness of the measurement target by measuring capacitance formed between the VE sensor and the measurement target and then calculating the distance (gap) using the capacitance.
Capacitance is a physical quantity that represents the ability to store electric charge between insulated conductors, and it varies depending on the distance and surface area between the conductors as well as the properties of the dielectric. VE sensors have the same structure in principle as capacitors. This type of sensor detects the variation in capacitance formed between itself and the measurement target with high sensitivity.

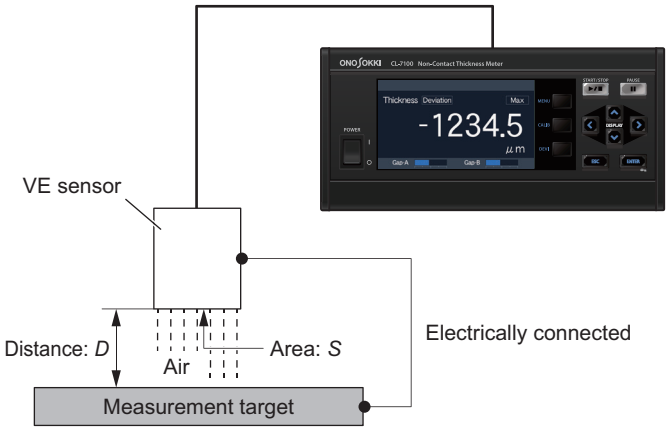
Structural image of capacitor



Capacitance: Ability to store electric charge between insulated conductors

Capacitance between 2 conductors can be measured by passing electricity between them

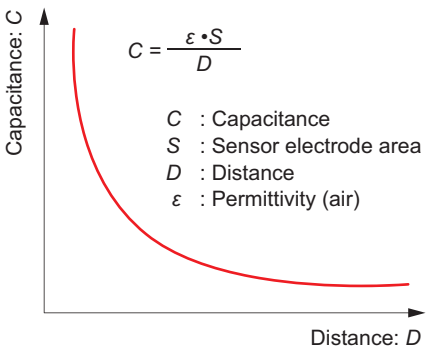
The diagram below illustrates a configuration of the VE sensor and the measurement target.
The VE sensor and the measurement target are placed facing each other while being electrically induced. In this state, capacitance is formed between these two, and this relationship is represented by the formula in the figure below. In this formula, the relative permittivity of air (ε) and the electrode area of the VE sensor (S) are used as fixed values because they are constant. Meanwhile, the capacitance (C) changes as the distance between the VE sensor and the measurement target (D) changes. For this reason, measuring the capacitance (C) allows the calculation of the distance between the VE sensor and the measurement target (D).



Relationship between the gap and the capacitance

$$C = \frac{\varepsilon \cdot S}{D}$$

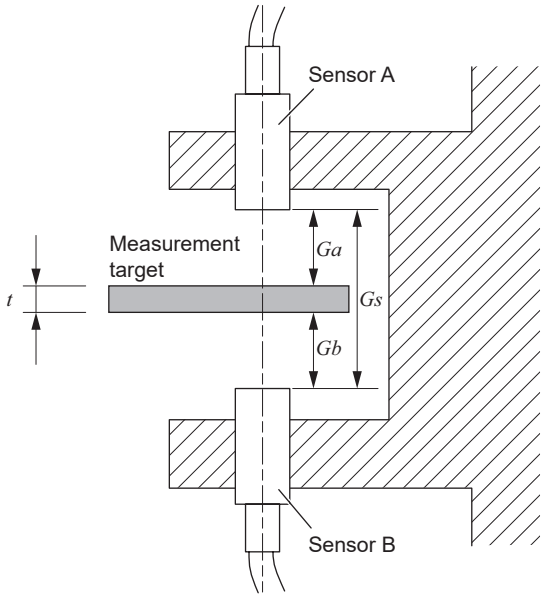
C : Capacitance
S : Sensor electrode area
D : Distance
ε : Permittivity (air)



Based on this principle, this instrument calculates the distance between the VE sensor and the measurement target (D) using the capacitance. To measure the capacitance correctly, the instrument and the measurement target must be electrically connected. Otherwise, correct capacitance cannot be detected, possibly causing a decline in measurement accuracy or errors.

1.3.2 Conductors and Semiconductors

Position the 2 VE sensors facing each other, and set the gap (Gs) between them using a reference piece of the measurement target with a known thickness. Insert the measurement target between VE sensors A and B. Measure the gap values (Ga and Gb) of each sensor, and subtract these values from the set gap between the sensors to obtain the thickness (t) of the measurement target.

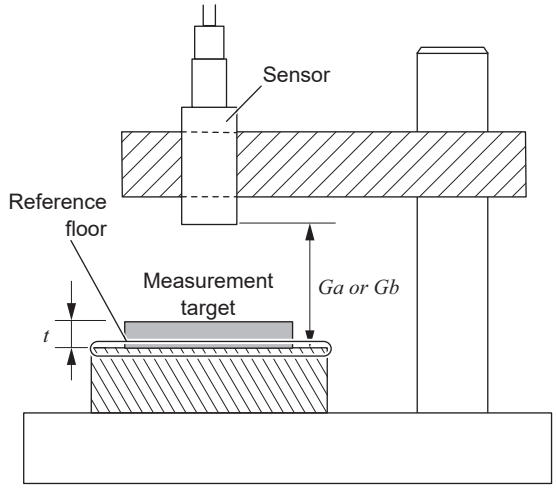


$t=Gs-(Ga+Gb)$

1.3.3 Insulators

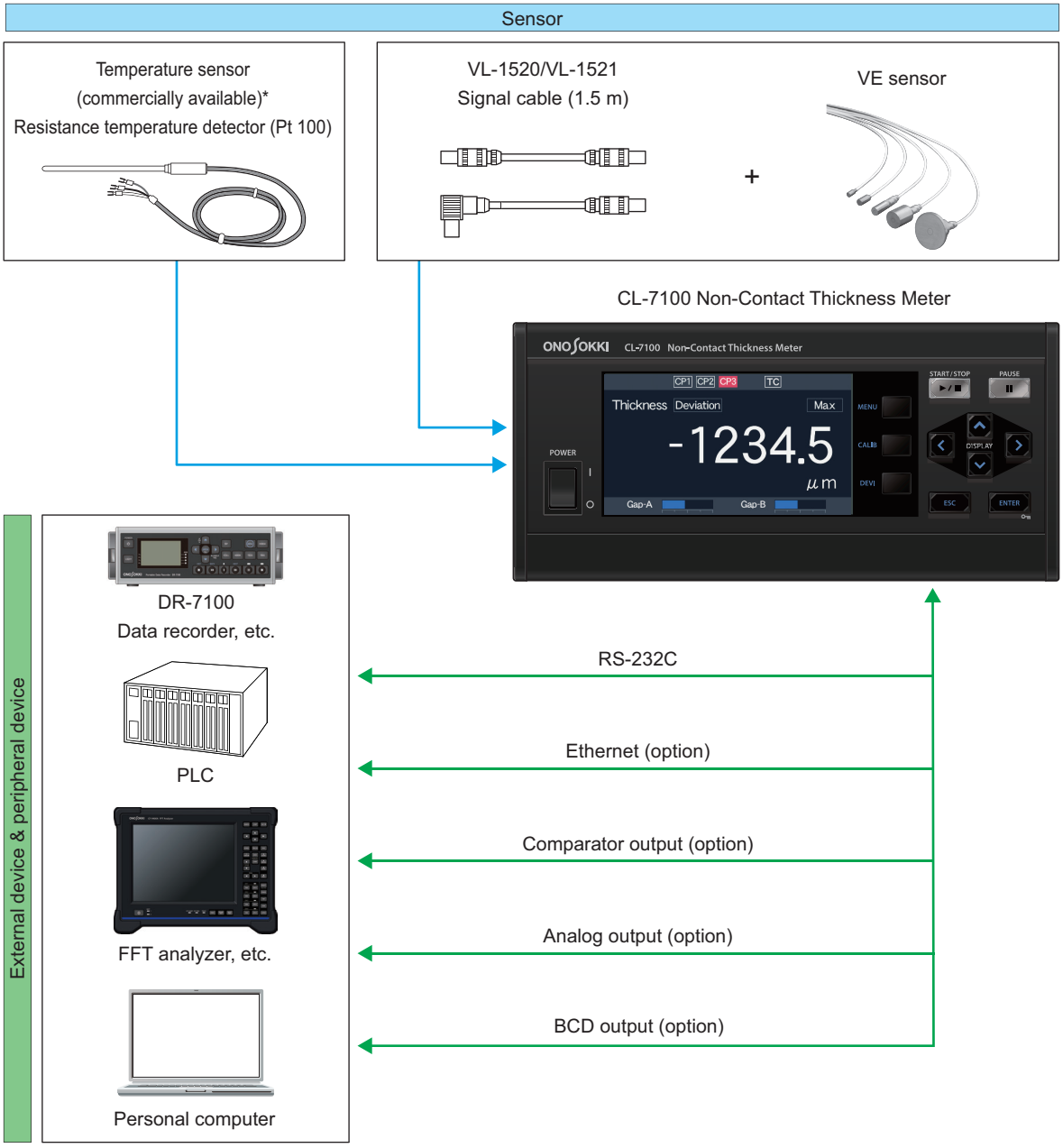
CL-0740

Position 1 VE sensor (choose A or B) and the reference floor parallel to each other, and set the reference gap when there is no measurement target. Then, insert the measurement target. The VE sensor output will change due to the thickness variation. Using this variation and the relative permittivity, calculate the thickness (t). You need to set the relative permittivity because it is different for each material.



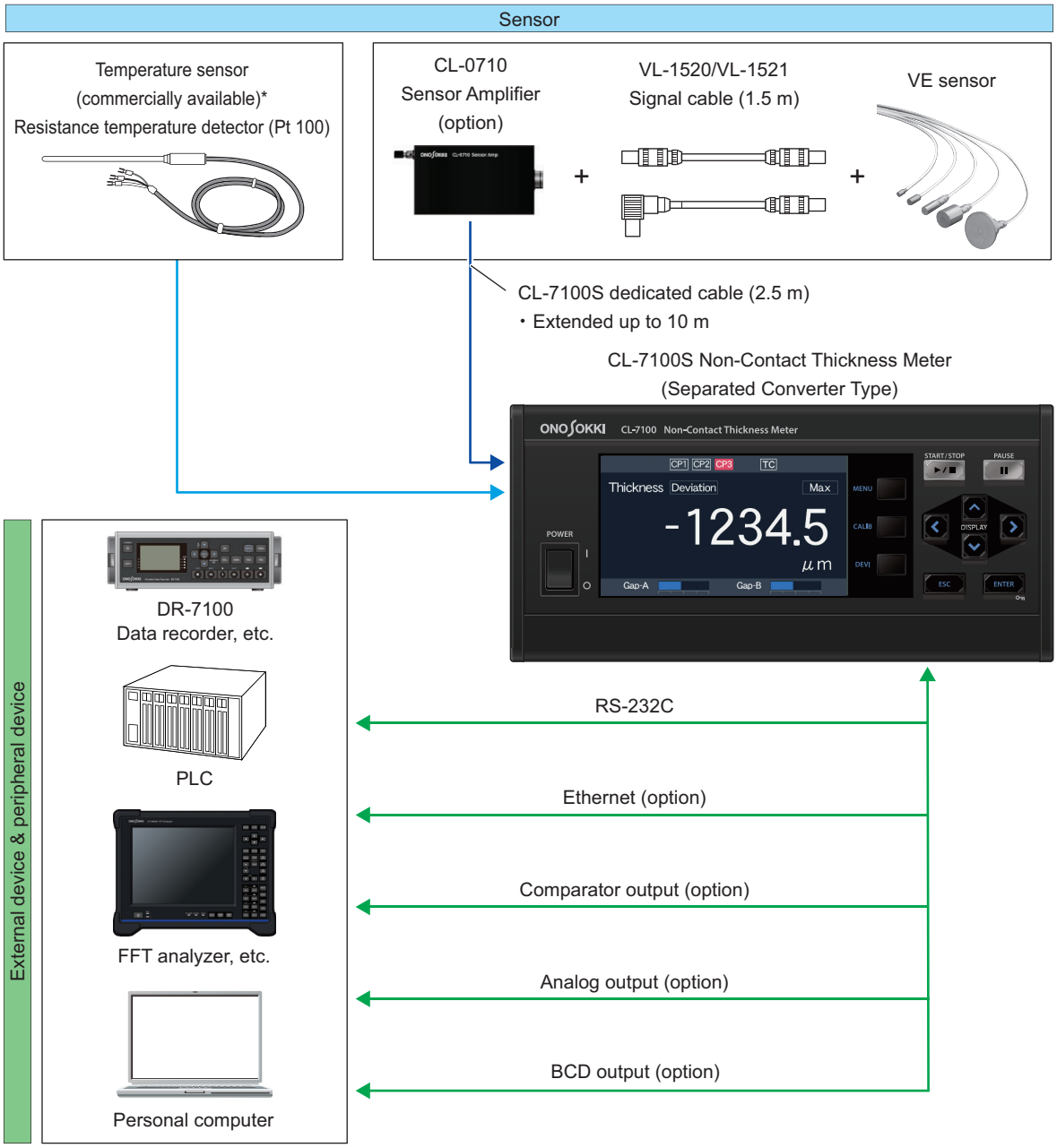
1.4 System Configuration

1.4.1 CL-7100 (Built-in Sensor Amplifier)



* Only when the CL-0741 Temperature Measurement Function is installed

1.4.2 CL-7100S (Separate Sensor Amplifier)



* Only when the CL-0741 Temperature Measurement Function is installed

1.4.3 List of Optional Functions and Items

CAUTION

- For details about the description of the optional functions and items or any purchase inquiries, contact your nearest Ono Sokki sales office or the distributor where you purchased the instrument.

Model	Function/item name	Description
CL-0720	High-resolution Measurement Function	This option improves display resolution and calculation accuracy.
CL-0721	High-impedance Grounding Mode	This option ensures stable measurement even in an environment where the ground resistance is large or unstable.
CL-0722	Measurement Range Change Function	This option changes the measurement range of VE-5010/ VE-5011 from “50 to 500 µm” to “20 to 200 µm” to improve resolution and measurement accuracy.
CL-0730	Analog Output Function	This option adds 3 analog outputs (Gap A/Gap B/ calculated value).
CL-0731	Comparator Output Function	This option adds 3 comparator outputs (CP1/CP2/CP3).
CL-0732	Analog and Comparator Output Function	This option allows the simultaneous use of the analog output and comparator output functions.
CL-0740	Insulator Measurement Function	This option enables thickness measurement of insulators.
CL-0741	Temperature Measurement Function	This option enables temperature measurement and temperature correction.
CL-0750	BCD Output Function	This option outputs measured values in BCD format.
CL-0751	Ethernet Connectivity Function	This option enables Ethernet communication.
CL-0071	Parallel Measurement Function	This option allows the use of synchronously connected 2 units of CL-7100/CL-7100S.
CL-0710	Sensor Amplifier	This external sensor amplifier (C/V board) is used to connect VE sensors to CL-7100S.
CL-015	Wafer slide table	This compact manual slide table is used to measure workpieces such as silicon wafers. 150 mm lapping is provided as the standard specification, but special specifications can also be accommodated, such as 300 mm lapping or fluorine coating.
AA-8207	BCD Cable	This is a 3 m BCD output cable with one end open.

- For the functions that are available only when the above options are enabled, the respective model icons are displayed in this manual.

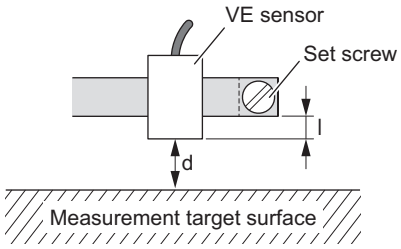
1.5 VE Sensors

1.5.1 List of Compatible Sensors

This instrument has been factory-adjusted to match the paired VE sensor so that measurement results fall within the specified accuracy.

Model	Measurement range (μm)	Minimum measurement diameter	Holding section	Cable length	Operating temperature range
VE-5010	50 to 500	⌀6	⌀6	1.5 m Built-in cable type	0 to 80 °C
VE-1020	100 to 1000	⌀8	⌀8		
VE-2011	20 to 200	⌀3	⌀10	1.5 m VL-1520/VL-1521	
VE-5011	50 to 500	⌀6			
VE-1021	100 to 1000	⌀8			
VE-1520	150 to 1500	⌀10			
VE-8021	800 to 8000	⌀40			
VE-3020	300 to 3000	⌀20	⌀20		
VE-8020	800 to 8000	⌀40			

- Measurement range: A measurable range from the end face of the VE sensor to the measurement target.
- Minimum measurement diameter: The measurement target facing the VE sensor must be greater than the minimum measurement diameter.
- Operating temperature range: The VE sensor's operational temperature range.
- Temperature influence: The influence of temperature is calculated from the following formula.



$\Delta d \fallingdotseq (k_1 \times l + k_2 \times d) \times \Delta t$

K_1 : Linear expansion coefficient of the sensor housing material (1.7×10^{-5})

K_2 : Area expansion coefficient of the sensor electrode material (3.4×10^{-5})

l : Distance between the sensor surface and the fixed point

Δt : Temperature change

d : Measurement gap

Δd : Converter output change

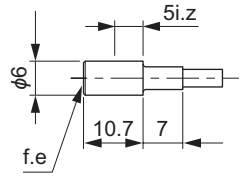
Temperature coefficient

$k_1 = 1.7\times10^{-5}$

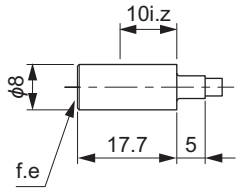
$k_2 = 3.4\times10^{-5}$

1.5.2 List of VE Sensor Outer Diameter Drawings

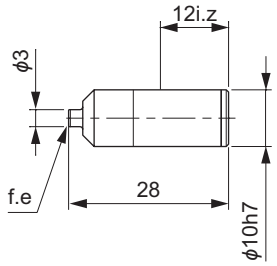
VE-5010



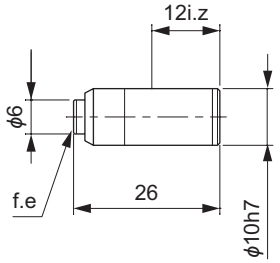
VE-1020



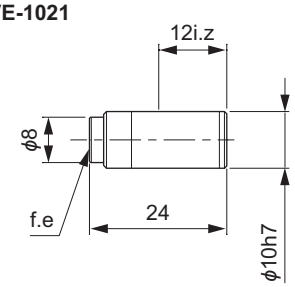
VE-2011



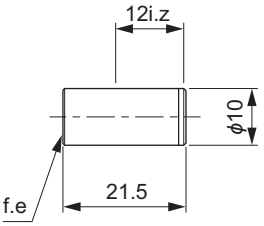
VE-5011



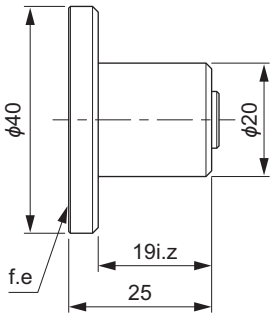
VE-1021



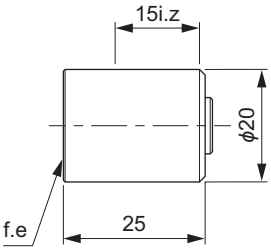
VE-1520



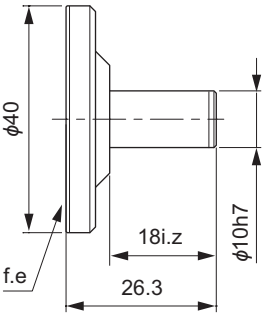
VE-8020



VE-3020



VE-8021



- f.e: It stands for “face end”, representing the end face of the sensor.
- i.z: It stands for “insert zone”. When fixing the sensor, it must be held within this insert zone.

1.5.3 Selecting Sensor

Refer to the following when selecting a VE sensor.

● **Accuracy and resolution**

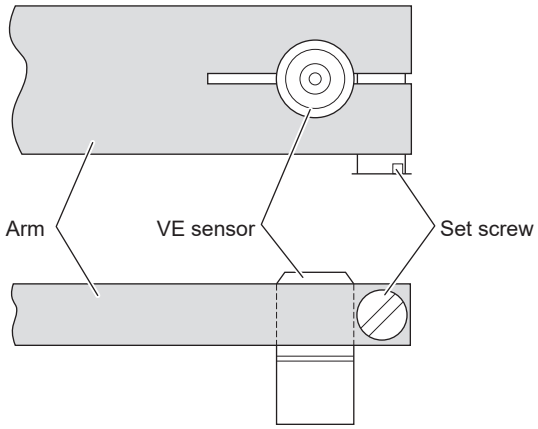
Resolution is determined by the type of VE sensor to use.
In general, the narrower the measurement range of the sensor, the higher the resolution, and the wider the measurement range, the lower the resolution. Select the sensor in consideration of the balance between the required resolution and the required measurement range.

● **Measurement target size**

The surface of the measurement target must be larger than the outer diameter of the sensor. If the target is small, check the compatibility with the sensor size in advance.

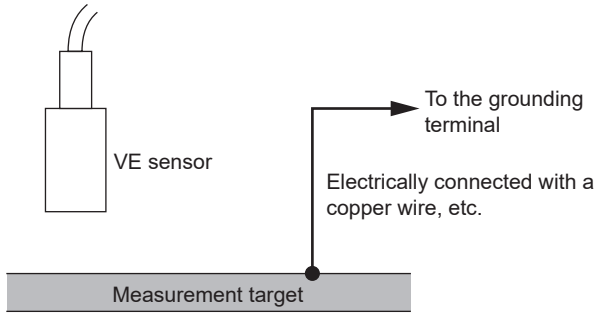
1.5.4 Precautions When Fixing Sensor

A VE sensor must be firmly fixed to keep the electrode surface parallel to the measurement target so that the sensor is not affected by vibration. For this reason, it is recommended that the sensor be fixed with a grip arm. It is a method of clamping the VE sensor inside the arm using a slit provided at the tip of the arm and a screw, as shown in the figure below. With this method, the load on the sensor is small, and height adjustment is easy.



- Fixing the sensor with a set screw is not recommended. If the screw is tightened too much, the VE sensor may be damaged or deformed. When deformed, the sensor may become difficult to remove or may cause failure or malfunction.
- When fixing the VE sensor, do not apply force to areas other than the insert zone (refer to “1.5.2 List of VE Sensor Outer Diameter Drawings” on page 25). Non-insert zone areas are structurally weak and may be damaged if excessive force is applied.
- The outer diameter of the VE sensor insert zone is machined with a fit tolerance of h7. It is recommended that the hole diameter of the corresponding mounting bracket be machined with a fit tolerance of G7.

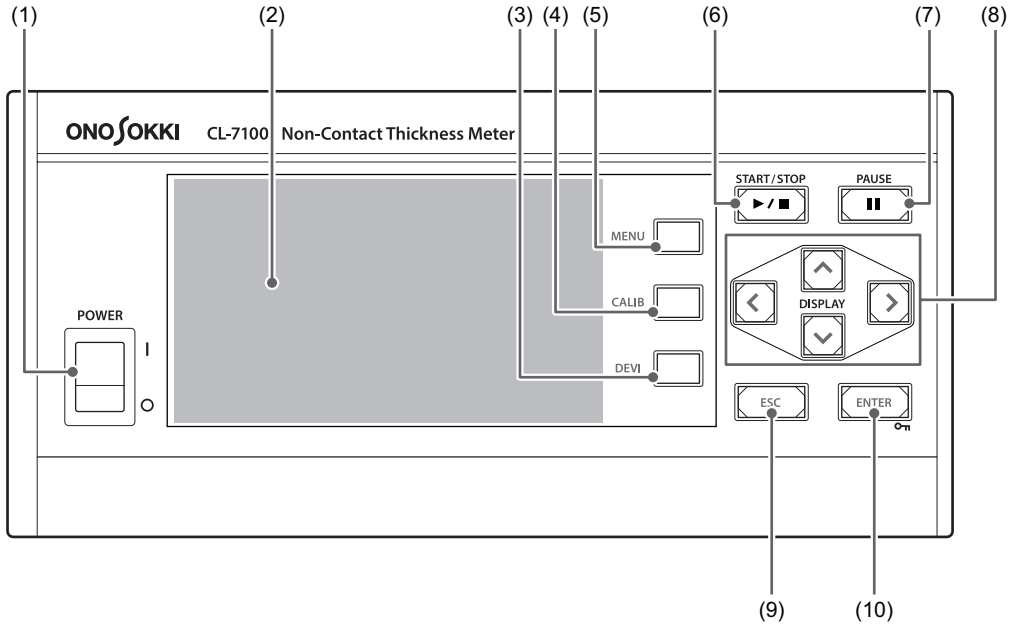
- The external enclosure of the VE sensor must be electrically at the same potential as the surface of the measurement target. If the same potential is not maintained, measurement errors may occur. Make the grounding terminal and the measurement target electrically at the same potential as needed by connecting them with a copper wire, as shown in the figure below.
  However, if the ground wire picks up noise, it may affect measured values. Therefore, it is recommended that the ground be connected directly from the VE sensor.



- To measure small capacitance, the electrode surface of the VE sensor is precisely polished. Take extra caution not to damage the electrode surface.
- If an oil film or dust is attached to the electrode surface, measurement errors may occur. Make sure that the electrode surface is always kept clean.
- Glass is used as the insulator inside the VE sensor. Handle it with extra care, as it may be damaged if excessive force or impact is applied.
- For a VE sensor with an integrated cable (VE-5010/VE-1020), do not bend or pull the cable near the VE sensor. Otherwise, it may cause stress inside the VE sensor, resulting in damage.

1.6 Parts Names and Functions

1.6.1 Front Panel (CL-7100/CL-7100S)



No.	Name	Mode	Description
(1)	POWER switch	-	Turns on (I)/off (O) the power. When you turn on (I) the power, the ONOSOKKI logo will be displayed for a few seconds, and then the measurement mode screen will be displayed.
(2)	LCD	-	Displays measurement results and statuses. Executing calibration, changing settings, etc., are available via the touch panel.
(3)	DEVI button	Measurement mode	Configures the deviation reference value used for deviation calculation. Deviation calculation is a function to determine the difference between the measured value and the deviation reference value. • Short press: Switches to the deviation setting mode. • Long press: Sets the current measured value as the deviation reference value.
		Deviation setting mode	Switches to the measurement mode.

No.	Name	Mode	Description
(4)	CALIB button	Measurement mode (conductors and semiconductors)	• Short press: Switches to the calibration mode and displays the reference piece setting screen. On this screen, you can change the calibration settings and perform calibration. For details about the calibration procedure, refer to "2.4.2 Performing Calibration" on page 51. • Long press: Performs calibration based on the current measured value and the set reference piece.
		Measurement mode (insulators)	• Short press: Switches to the calibration mode and displays the reference gap/relative permittivity selection screen. On this screen, you can change the calibration settings and perform calibration. For details about the calibration procedure, refer to "2.5.2 Performing Calibration" on page 54. • Long press: Performs calibration based on the current measured value and the set reference piece.
		Calibration mode	Switches to the measurement mode.
(5)	MENU button	Measurement mode	Switches to the setting mode.
		Setting mode	Switches to the measurement mode. • Switching modes cancels the specified items.
(6)	START/STOP button	Measurement mode (calculation stopped)	Starts the calculation of Max (maximum value), Min (minimum value), and Range (maximum value - minimum value) of each measured value and the comparator judgment processing.
		Measurement mode (calculation in progress)	Stops calculation.
(7)	PAUSE button	Measurement mode (calculation in progress)	Pauses calculation. While calculation is paused, the calculation of Max (maximum value), Min (minimum value), and Range (maximum value - minimum value) of each measured value is stopped.
		Measurement mode (calculation paused)	Restarts calculation.
(8)	DISPLAY ∧ / ∨ / < / > button*	Measurement mode	Changes the number of display items on the measurement mode screen. • ∧: Cycles through the displays in the following order: 1-line display → 2-line display → 3-line display → 4-line display → 1-line display → … • ∨: Cycles through the displays in the following order: 4-line display → 3-line display → 2-line display → 1-line display → 4-line display → …
		Setting mode	Selects a setting item, moves the digit when inputting a value, or changes a value.

No.	Name	Mode	Description
(9)	ESC button*	Setting mode	Cancels a setting or input value, and returns the screen to the previous menu level. If there is no previous menu level, the screen switches to the measurement mode.
(10)	ENTER/ button*	Measurement mode	Holding down this button for approximately 3 seconds enables/disables button protection.
		Setting mode/ calibration mode/ deviation setting mode	Confirms settings or input value.

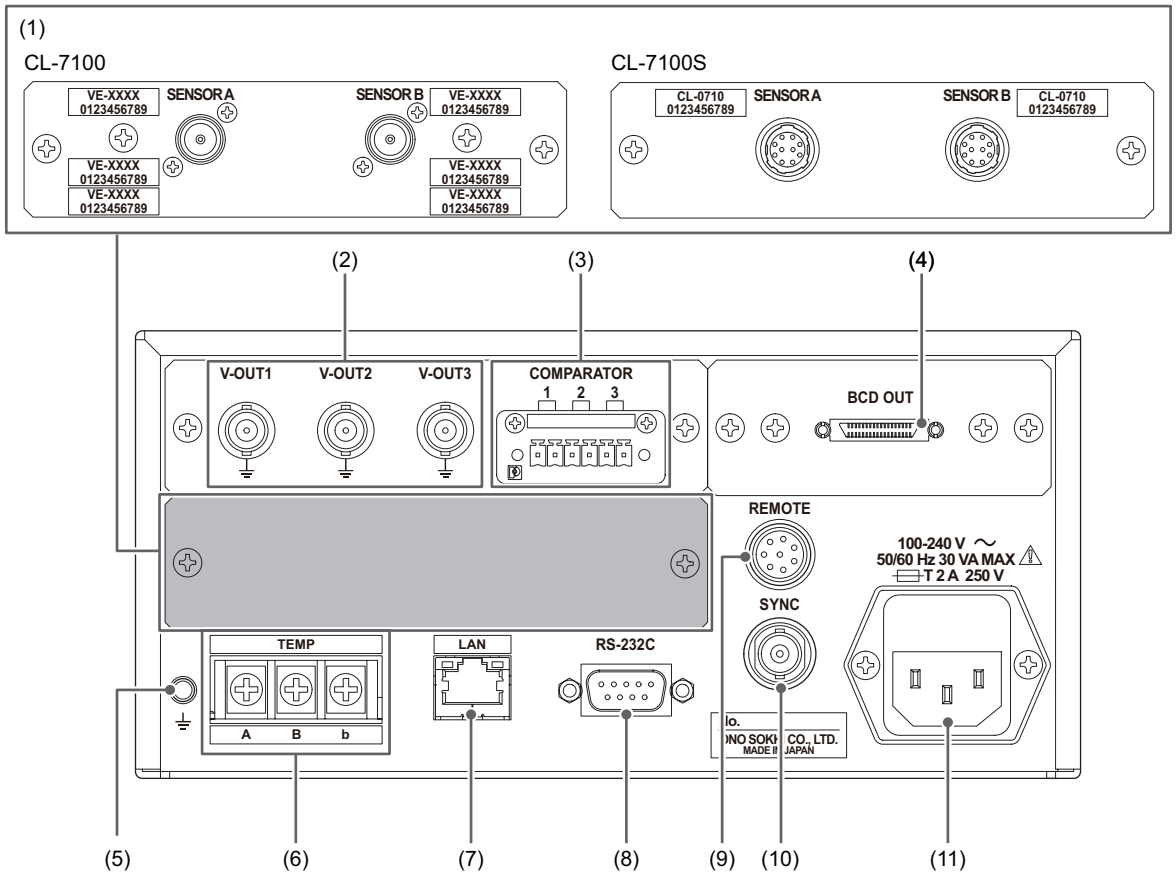
* The action is the same as that of the button on the touch panel. This manual mainly describes the operations of the touch panel buttons. When a button is displayed on the touch panel, the corresponding button on the front panel can be used to perform the same operation.

● **Status transition in the measurement mode**

	Measurement status		
	Calculation stopped	Calculation in progress	Calculation paused
Operation	• Calculation*: Disabled • Analog output: Updated • Comparator output: OFF	• Calculation*: Enabled • Analog output: Updated • Comparator output: Judgment operation	• Calculation*: Retained • Analog output: Updated • Comparator output: Retained
Button operation			
START/STOP	Starts calculation	Stops calculation	Stops calculation
PAUSE	-	Pauses calculation	Restarts calculation (resumes from pause)
DISPLAY ∧ / ∨	Changes the number of display items		
MENU	Switches to the setting mode	-	-
CAL	Switches to the calibration mode	-	-
CAL (long press)	Performs calibration based on the set reference piece	-	-
DEVI	Switches to the deviation setting mode	-	-
DEVI (long press)	Sets the current instantaneous value as the deviation reference value	-	-
ENTER (long press)	Enables/disables button protection	-	-

* Calculation: Max (maximum value), Min (minimum value), and Range (maximum value - minimum value)

1.6.2 Rear Panel (CL-7100/CL-7100S)

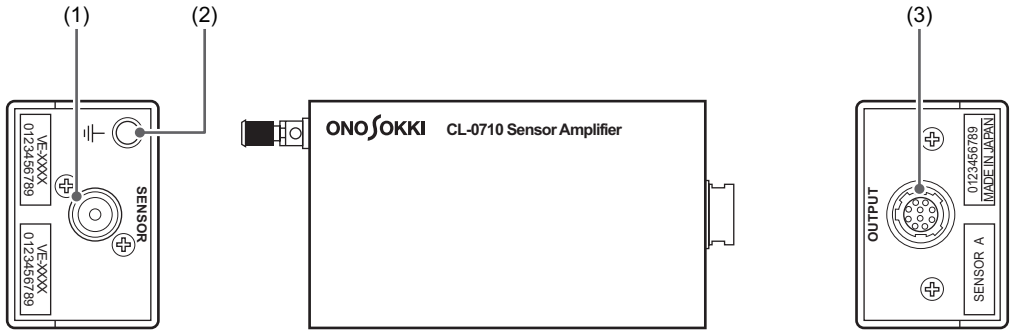


No.	Name	Description	Compatible connector
(1)	SENSOR A/B connector	• CL-7100: A connector for a VE sensor. This instrument has been factory-adjusted to match the paired VE sensor so that measurement results fall within the specified accuracy. Check the serial numbers of the target VE sensor and VL cable before connection. • CL-7100S: A connector for the CL-0710 Sensor Amplifier. Connect the amplifier with the supplied CL-7100S dedicated cable.	-
(2)	V-OUT connector CL-0730 CL-0732	A connector for an analog voltage input device. It outputs the thickness and Sensor A and B gaps as analog voltages.	C02 type (BNC)
(3)	COMPARATOR connector CL-0731 CL-0732	A connector for a comparator. It outputs the comparison results via contact (Photo-Mos output).	MC 1,5/6-STF-3,81 (1827745) (manufactured by Phoenix Contact)

No.	Name	Description	Compatible connector
(4)	BCD OUT connector CL-0750	A connector for a BCD indicator. It outputs the measured value of the selected measurement item in BCD format.	HDRA-E36MA (manufactured by Honda Tsushin Kogyo)
(5)	Grounding terminal	A terminal to make the measurement target electrically at the same potential as CL-7100/ CL-7100S.	-
(6)	TEMP terminal CL-0741	A terminal for a temperature sensor (resistance temperature detector). It measures the temperature, as well as the gap and thickness, at the same time. Temperature correction is also possible for the measured thickness.	-
(7)	LAN connector CL-0751	A connector used to connect to an external system, such as a personal computer, with a LAN cable. It allows instrument status controls, measured value reads, and setting changes and reads from the external system through socket communication over TCP/IP (IPv4).	-
(8)	RS-232C connector	A connector for RS-232C communication. It is used to connect to an external system, such as a personal computer, with a D-sub 9-pin cross cable. It allows instrument status controls, measured value reads, and setting changes and reads from the external system.	-
(9)	REMOTE connector	A contact input connector dedicated to external remote operation. It is used to start or stop calculation and instruct calibration from an external device.	ER03-PB8M (manufactured by Tajimi Electronics)
(10)	SYNC connector CL-0071	A connector used to prevent interference when measuring the same specimen by using multiple CL-7100/CL-7100S units.	C02 type (BNC)
(11)	Power supply connector	A power input connector for 100 to 240 VAC. It contains a fuse for the AC power internal circuit protection. • For replacing the fuse, refer to “Checking/ replacing the power fuse” on page 107.	-

1.6.3 Sensor Amplifier (CL-0710)

The CL-0710 Sensor Amplifier is an option dedicated to CL-7100S.

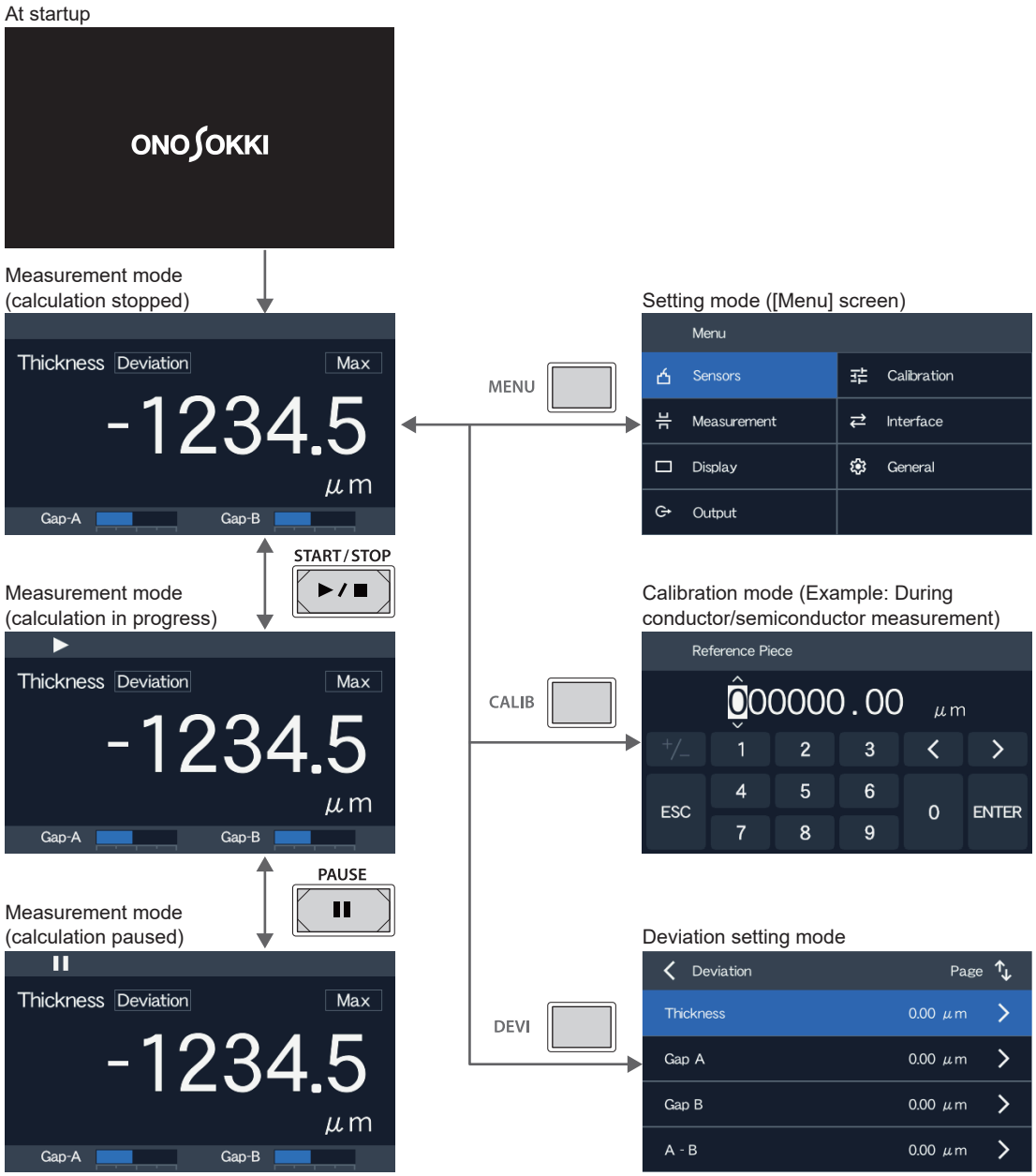


No.	Name	Description
(1)	SENSOR connector	A connector for a VE sensor. This instrument has been factory-adjusted to match the paired VE sensor so that measurement results fall within the specified accuracy. Check the serial numbers of the target VE sensor and VL cable before connection.
(2)	Grounding terminal	A terminal to make the measurement target electrically at the same potential as CL-7100S.
(3)	OUTPUT connector	A connector for CL-7100S. It has been factory-adjusted to match CL-7100S and the paired VE sensor so that measurement results fall within the specified accuracy. Check the channel and serial number of the target CL-7100S before connection.

1.7 Operation Screen

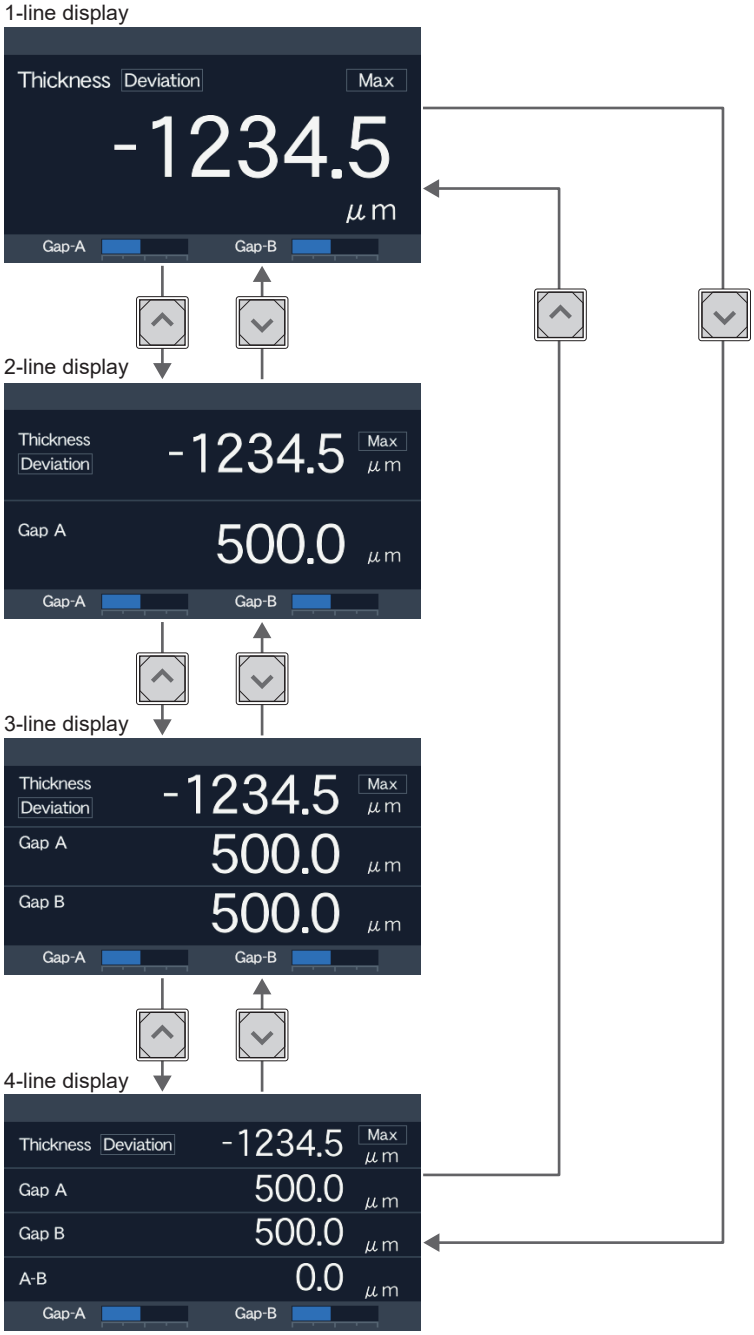
1.7.1 Operation Mode Transition

When you turn on (|) the POWER switch of the instrument, the ONOSOKKI logo will be displayed for a few seconds, and then the measurement mode screen will be displayed. Use the buttons on the front panel to switch to the setting mode or calibration mode. In the setting mode, calibration mode, or deviation setting mode screen, you can change the settings using the touch panel.

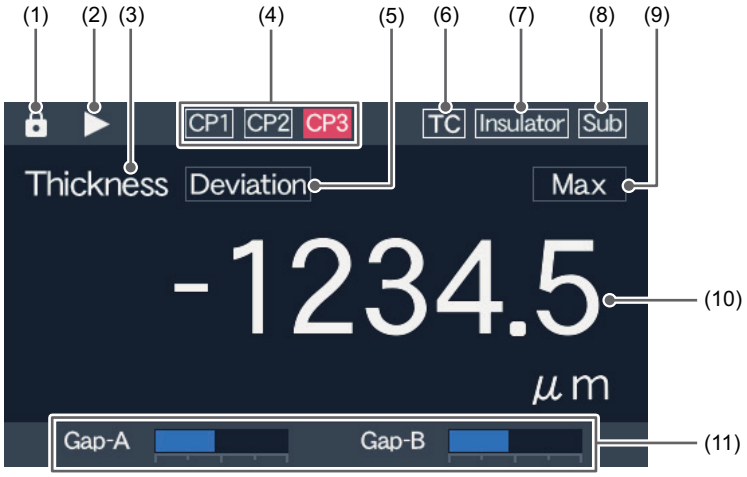


■ Changing the number of measurement items

Pressing the DISPLAY ∧ / ∨ button on the front panel in the measurement mode changes the number of display items.



■ Measurement mode screen

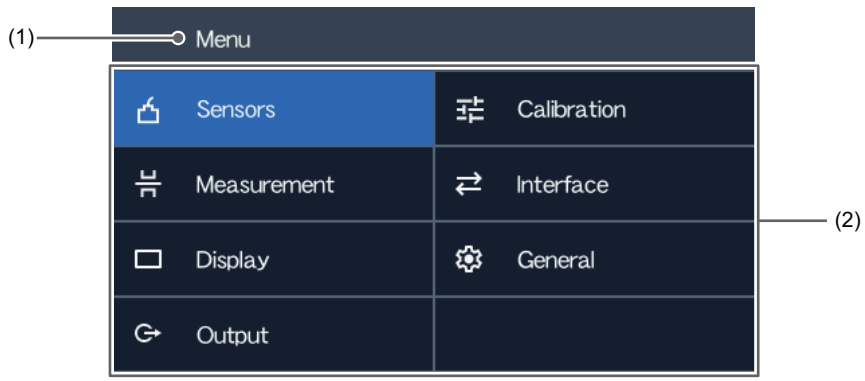


No.	Information/status	Description
(1)	Button protection status	Displays the button protection status. Holding down the ENTER button for approximately 3 seconds enables/disables button protection. • 🔒: Button protection enabled • Indicator off: Button protection disabled
(2)	Calculation status	Displays the calculation status. • ▶ : Measurement in progress • ❚❚ : Paused • Indicator off: Stopped
(3)	Measurement item	Displays the measurement item that has been set.
(4)	Comparator status CL-0731 CL-0732	Displays the comparator (CP1/CP2/CP3) status. • Not highlighted: Contact OFF • Highlighted (red): Contact ON
(5)	Deviation indication status	Displays the deviation indication status. • Deviation: Deviation indication enabled • Indicator off: Deviation indication disabled
(6)	Temperature correction function status CL-0741	Displays the status of the temperature correction function for the measured thickness. • TC: Temperature correction function enabled • Indicator off: Temperature correction function disabled
(7)	Measurement target mode CL-0740	Displays the measurement target. • Insulator: The measurement target is an insulator ([Mode] is set to [Insulator]). • Indicator off: The measurement target is a conductor or semiconductor ([Mode] is set to [Conductor]).

No.	Information/status	Description
(8)	Instrument mode CL-0071	Displays the main or sub setting of the instrument when multiple units are synchronously connected. The main unit can be used when it is not connected to the sub unit, but the sub unit must be connected to the main unit with the SYNC connector to perform measurement. • Sub: The unit in use is the sub unit. • Indicator off: The unit in use is the main unit.
(9)	Calculation item	Displays the measurement item that has been set. • Indicator off: Instantaneous value • Max: Maximum value • Min: Minimum value • Range: Maximum value - minimum value
(10)	Measured value	Displays the measured value according to the set measurement, deviation, calculation, and unit.
(11)	Gap status	Displays the Gap A/B statuses. • If the gap is above the rated range, the ▶ (Over) indicator is displayed. • If the gap is below the rated range, the ◀ (Under) indicator is displayed.

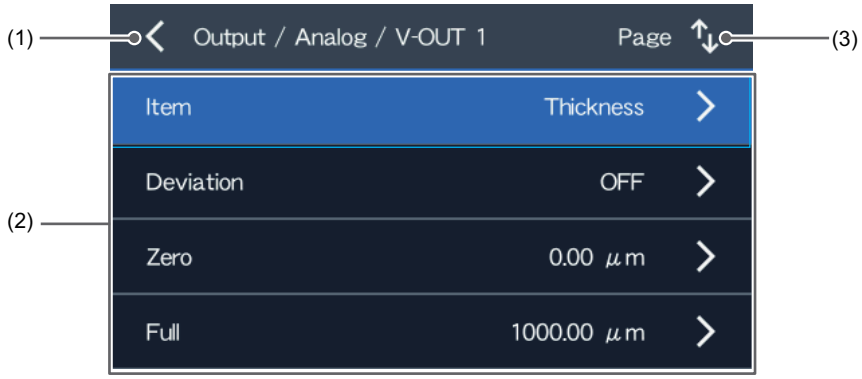
■ Setting/calibration/deviation setting mode

● **Menu screen**



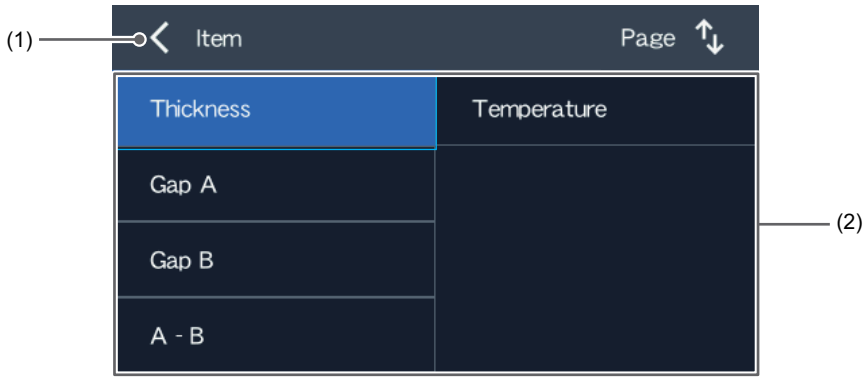
No.	Name	Description
(1)	Displayed menu level	Displays the currently displayed menu level and setting.
(2)	Setting types	Displays the setting types. Tap the item you want to change or check, or select the item using the DISPLAY ∧ / ∨ / ＜ / ＞ button on the front panel, and then press the ENTER button to display the setting screen. Pressing the ESC button switches to the measurement mode.

● **Item selection screen**



No.	Name	Description
(1)	Displayed menu level	Displays the currently displayed menu level and setting. Tapping [❮] returns the screen to the previous menu level.
(2)	Setting items	Displays the detailed information of the selected item. Tap the item you want to change, or select the item using the DISPLAY ∧ / ∨ button on the front panel. Then press the ENTER button to display the setting change screen. Pressing the ESC button returns the screen to the previous menu level.
(3)	Page switching button	Moves to the next page when there are many display items. This is displayed when there are 5 or more items.

● **Setting selection screen**



No.	Name	Description
(1)	Displayed menu level	Displays the currently displayed menu level and setting. Tapping [❮] returns the screen to the previous menu level.
(2)	Setting selection items	Displays the selection items of the selected setting. Tap the target item or select the item using the DISPLAY ∧ / ∨ / ❮ / ❯ button on the front panel, and then press the ENTER button to change and confirm the setting. Pressing the ESC button cancels the setting and returns the screen to the previous menu level.

● **Value setting screen**

No.	Name	Description
(1)	Displayed menu level	Displays the currently displayed menu level and setting.
(2)	Value setting	Displays the value that is being set. Tap the value input buttons (3) or enter a value using the DISPLAY ∧/∨/ < / > button on the front panel, and then press the ENTER button to change and confirm the value. • ∧/∨ button: Increases or decreases the highlighted digit. To change the sign, tap [+/−]. • < / > button: Moves the cursor to change the value input position. • ENTER button: Confirms the value that is being set and returns the screen to the previous menu level. • ESC button: Cancels the setting and returns the screen to the previous menu level.
(3)	Value input button	Enters a value. • Numeric button (0 to 9): Changes the value of the digit at the cursor position. • [+/−]: Changes the sign. • [<]/[>]: Moves the cursor to change the value input position. • [ENTER]: Confirms the value that is being set and returns the screen to the previous menu level. • [ESC]: Cancels the setting and returns the screen to the previous menu level.

Chapter 2

Thickness Measurement

2.1 Basic Measurement Procedure 42

2.2 Preparation 43

2.3 Setting Measurement 46

2.4 Installing VE Sensor and Performing Calibration for Conductor/Semiconductor Measurement 50

2.5 Installing VE Sensor and Performing Calibration for Insulator Measurement 53

2.6 Starting/Stopping Measurement 57

2.1 Basic Measurement Procedure

(1) Connection and power-on

Connect the sensor, ground, and AC power cable. Then, turn the power on. Refer to “2.2 Preparation” on page 43.

(2) Measurement settings

Change the settings for measurement. Refer to “2.3 Setting Measurement” on page 46.

- Display settings
- Measurement item selection
- Calculation function settings
- Deviation calculation settings

(3) VE sensor installation and calibration

Install the VE sensors and perform calibration.

- During conductor/semiconductor measurement: Refer to “2.4 Installing VE Sensor and Performing Calibration for Conductor/Semiconductor Measurement” on page 50.
- During insulator measurement (only when the CL-0740 Insulator Measurement Function is installed): Refer to “2.5 Installing VE Sensor and Performing Calibration for Insulator Measurement” on page 53.

(4) Measurement

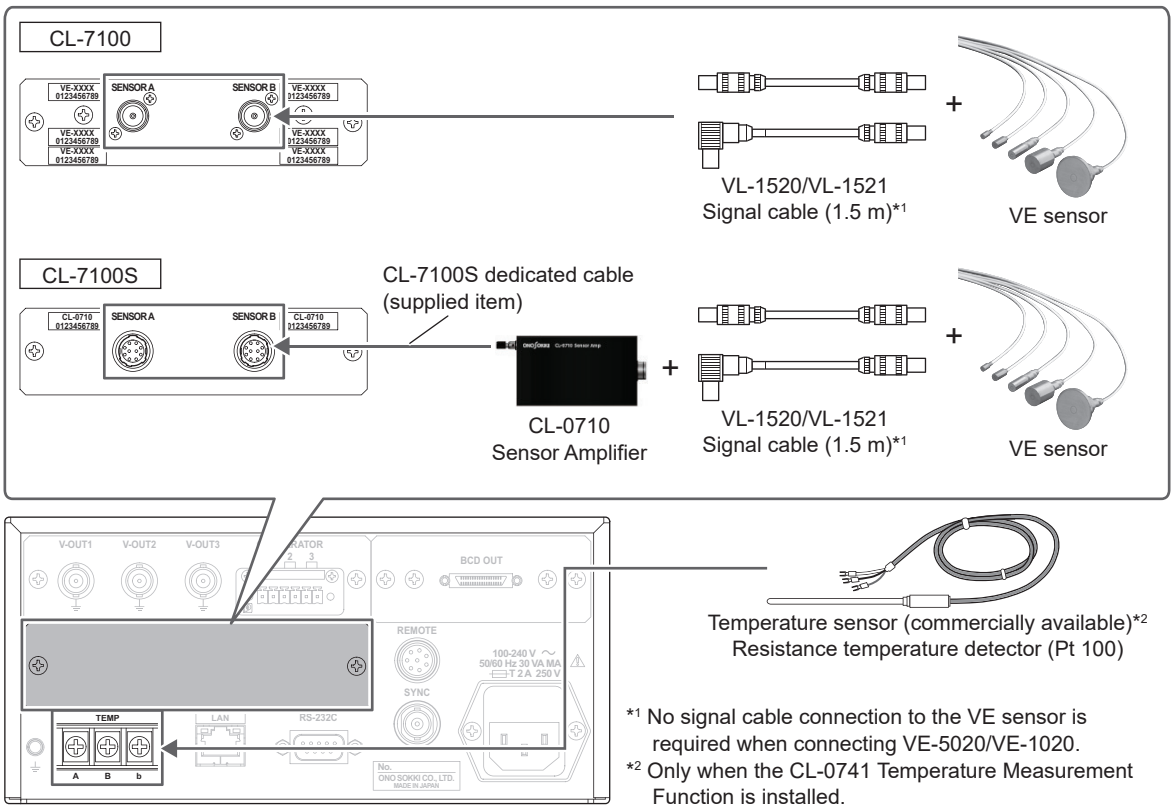
Start/stop measurement. Refer to “2.6 Starting/Stopping Measurement” on page 57.

2.2 Preparation

2.2.1 Connecting Sensor

Be sure to turn off the power before connecting a sensor to the instrument (refer to “Turning off the power” on page 45).

- VE sensor:
  Connect it to the SENSOR A/SENSOR B connector.
  For CL-7100S, connect the VE sensor to the CL-0710 Sensor Amplifier (option) and connect the amplifier to the instrument with the CL-7100S dedicated cable (supplied item).
  - The supplied CL-7100S dedicated cable (standard: 2.5 m) can be extended up to 10 m. For details, contact your nearest Ono Sokki sales office or the distributor where you purchased the instrument.
- Temperature sensor (only when the CL-0741 Temperature Measurement Function is installed):
  Connect it to the TEMP terminal. Using a temperature sensor allows you to check the temperature of the measurement target and correct the temperature as needed. This reduces the effect of changes in the temperature of the measurement target on the thickness to ensure more stable measurement results. For details, refer to “3.4 Temperature Sensor (Resistance Temperature Detector)” on page 73.



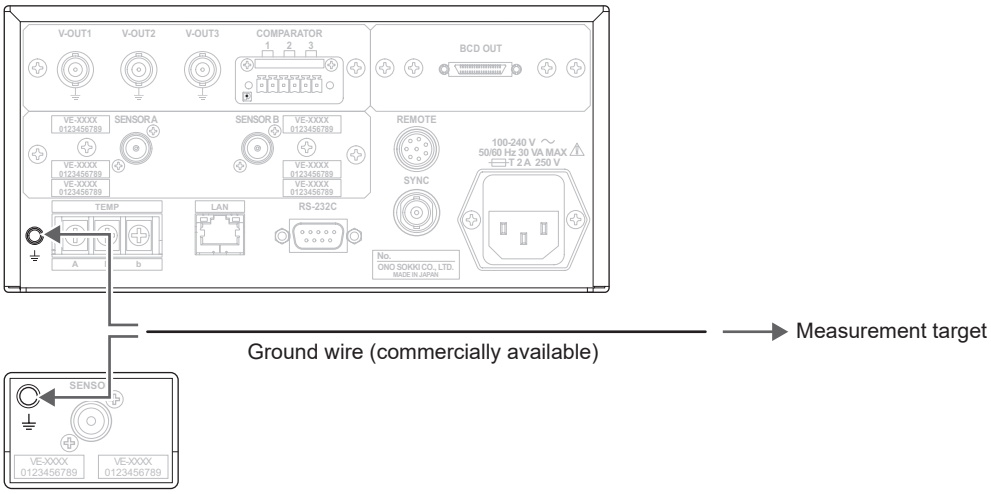
*1 No signal cable connection to the VE sensor is required when connecting VE-5020/VE-1020.
*2 Only when the CL-0741 Temperature Measurement Function is installed.

2.2.2 Connecting Ground

To make the measurement target electrically at the same potential as CL-7100/CL-7100S, connect the grounding terminal to the measurement target.

- For CL-7100S, connect the grounding terminal on the rear of the instrument or the grounding terminal of the CL-0710 Sensor Amplifier to the measurement target.

CL-7100/CL-7100S



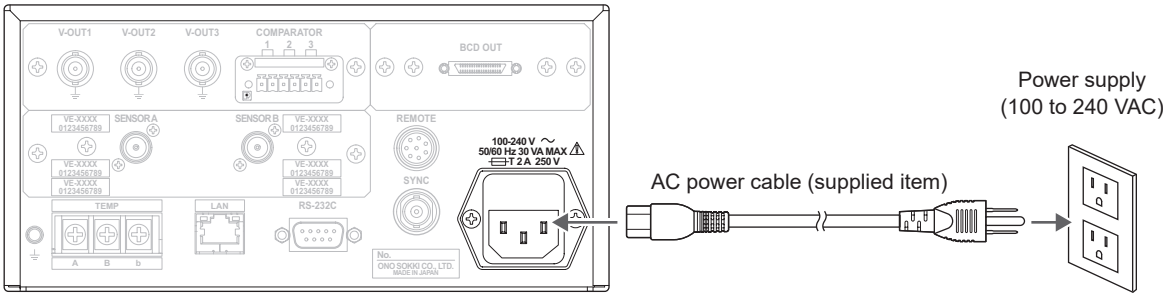
CL-0710

2.2.3 Preparing Power Supply

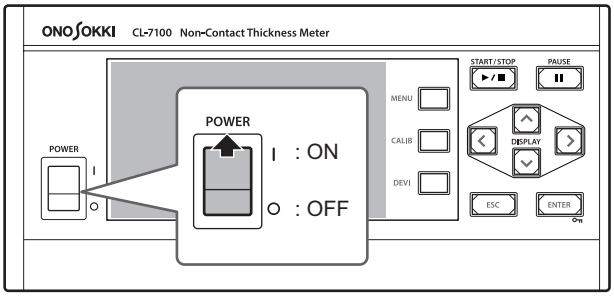
■ Connecting the power cable

Connect the AC power cable (supplied item) between the power supply connector on the rear panel of the instrument and the 100 to 240 VAC power supply.

• Do not use any AC power cable other than the supplied one.



■ Turning on the power



When you turn on (I) the power, the ONOSOKKI logo will be displayed for a few seconds, and then the measurement mode screen will be displayed.

• To ensure stable measurement results, allow about a 30-minute warm-up time after power-on.

● Turning off the power

Turn the POWER switch off (O).

2.3 Setting Measurement

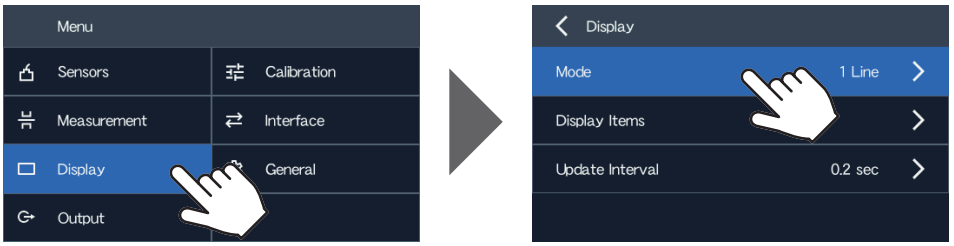
This section describes the basic items to be set before measurement.
For other detailed settings, refer to Chapter 4 “Settings”.

2.3.1 Selecting Number of Measurement Items to Display

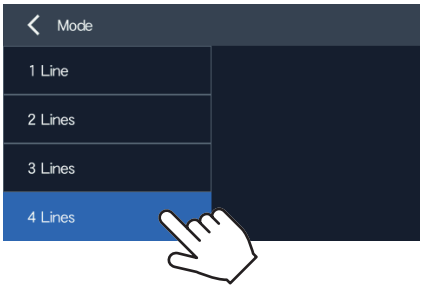
This instrument can display up to 4 measurement items on the screen.
Select the number of measurement items to be displayed on the screen.

1 Display the [Menu] screen.

2 Display the [Mode] screen.



3 Select the number of measurement items to be displayed on the screen ([1 Line]/[2 Lines]/[3 Lines]/[4 Lines]).



The setting is changed, and the screen returns to the previous menu level ([Display]).

4 **Return to the measurement mode screen, and confirm that the number of display lines has been changed.**

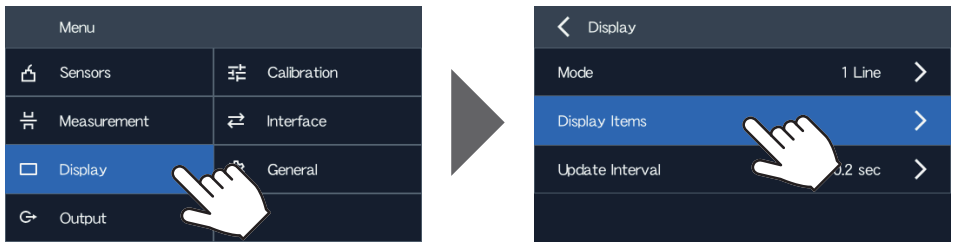
The measurement items are displayed in the display lines selected in step **3**.

2.3.2 Selecting Measurement Items and Calculation Method

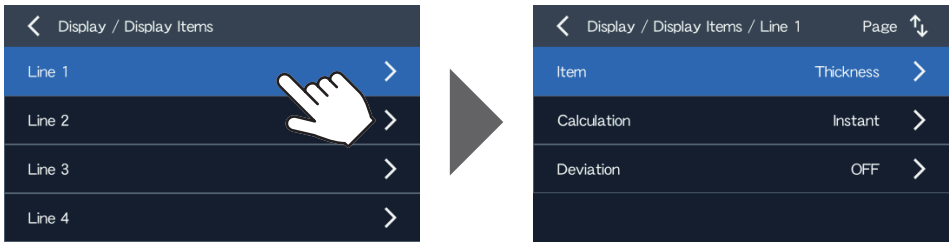
This instrument can measure the thickness, gap (Gap A/Gap B), difference between Gap A and Gap B, and temperature (only when the CL-0741 Temperature Measurement Function is installed).
For each measurement item, the maximum value, minimum value, difference (range) between the maximum and minimum values, and deviation from the set value can be calculated and displayed.

1 **Display the [Menu] screen.**

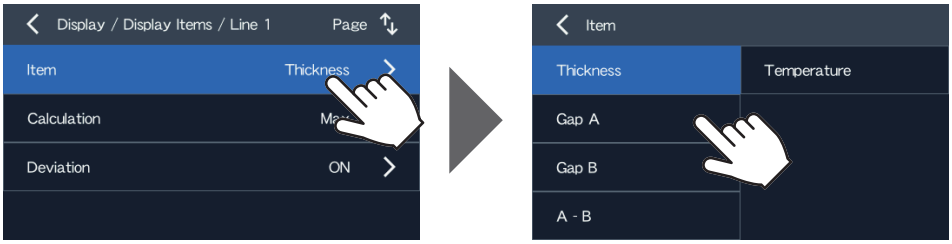
2 **Display the [Display Items] screen.**



3 **Select the target location ([Line 1]/[Line 2]/[Line 3]/[Line 4]) where you want to display the measurement item.**



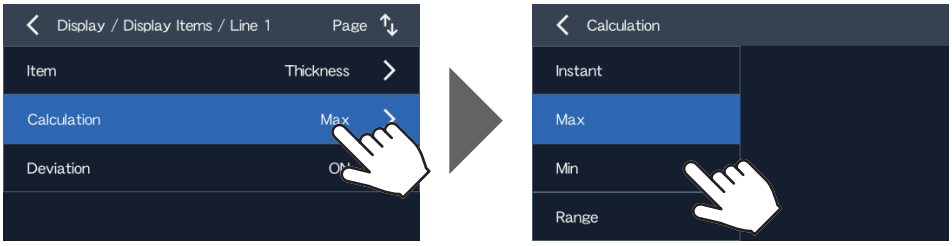
4 **Select the measurement item.**



Setting item	Description
Thickness	Measures the thickness.
Gap A	Measures the Gap A value.
Gap B	Measures the Gap B value.
A-B	Measures the difference between Gap A and Gap B.
Temperature CL-0741	Measures the temperature.

The setting is changed, and the screen returns to the previous menu level ([Line #]) (# denotes a number).

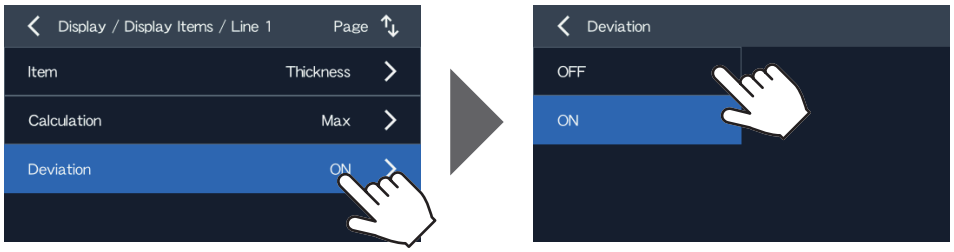
5 **Select the calculation method.**



Setting item	Description
Instant	Displays the latest measured value (instantaneous value).
Max	Displays the maximum measured value since the start of measurement.
Min	Displays the minimum measured value since the start of measurement.
Range	Displays the difference between the maximum and minimum measured values since the start of measurement.

The setting is changed, and the screen returns to the previous menu level ([Line #]) (# denotes a number).

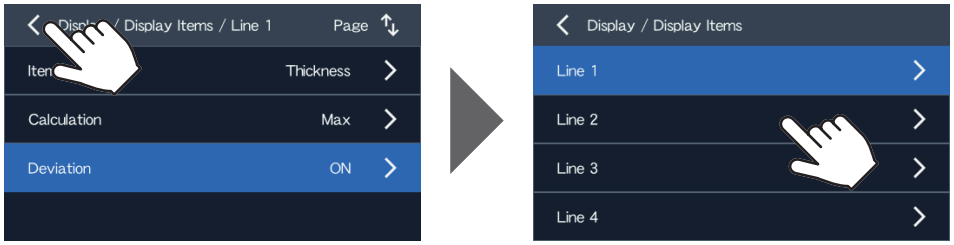
6 **Select whether to perform deviation calculation.**



Setting item	Description
OFF	Does not perform deviation calculation.
ON	Performs deviation calculation to determine the difference between the measured value and the deviation reference value. • For setting the measurement reference value for deviation calculation, refer to “4.1.4 Setting Deviation Reference Value” on page 91.

The setting is changed, and the screen returns to the previous menu level ([Line #]) (# denotes a number).

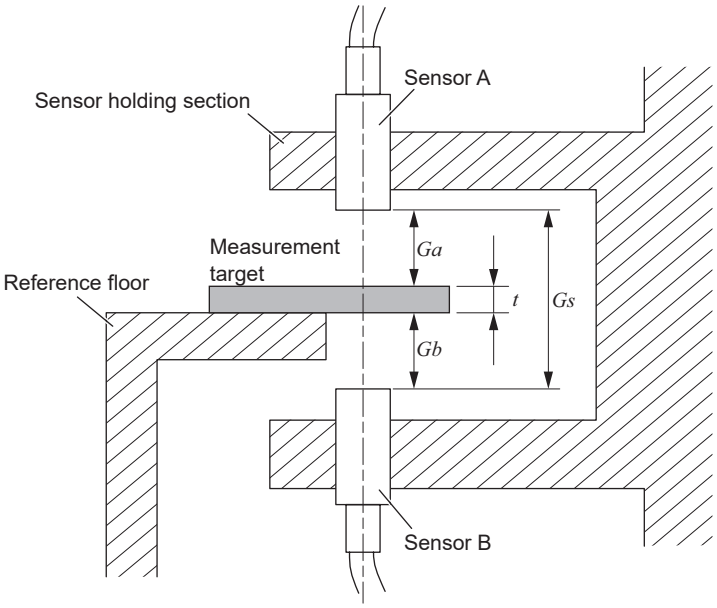
7 **Set the measurement item and calculation method for all the necessary lines.**
Tap [❮] to display the [Display Items] screen, and select another location ([Line 1]/[Line 2]/[Line 3]/[Line 4]) to set. Repeat steps **4** to **6** to set the measurement item and calculation method for all the necessary lines.



2.4 Installing VE Sensor and Performing Calibration for Conductor/Semiconductor Measurement

2.4.1 Installing VE Sensor

To measure the thickness of a conductor or semiconductor, use 2 VE sensors, and install them as shown in the figure below.



$t=Gs-(Ga+Gb)$

■ Key points for sensor installation

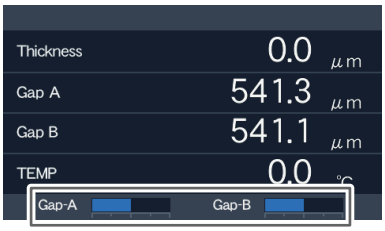
Note the following when installing a VE sensor.

- Make sure that the electrode surfaces of all VE sensors are parallel.
- Make sure that the centerlines of all VE sensors are aligned.
- Make sure that each VE sensor is electrically connected to the measurement target.
  If it is difficult to be electrically connected, it is recommended that the CL-0721 High-impedance Grounding Mode be added.

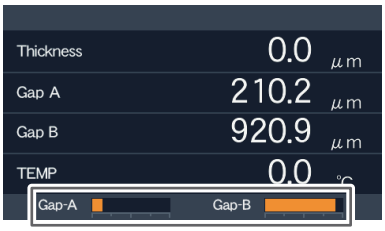
For installing a sensor, refer to “1.5.3 Selecting Sensor” on page 26 and “1.5.4 Precautions When Fixing Sensor” on page 26.

■ Checking and adjusting VE sensor installation locations

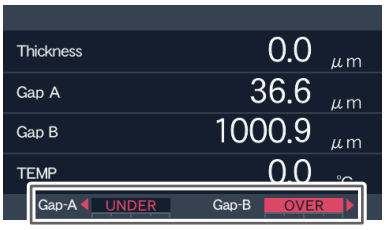
The installation location of each VE sensor can be checked with the gap indicator on the measurement mode screen.
Place the measurement target in the measurement position and adjust the VE sensor position until the indicator is displayed in blue.



Within the rated range



20 % or less, or 90 % or more of the rated range



Outside the rated range

Indicator color	Description
Blue	The gap is within the rated range. Measurement is possible.
Yellow	Measurement is possible, but the gap is 20 % or less, or 90 % or more of the full scale. It is recommended to adjust the sensor position.
Red	The gap is outside the rated range. Adjust the sensor position. • OVER: The gap is above the rated range. • UNDER: The gap is below the rated range.

2.4.2 Performing Calibration

Before measuring the thickness of a conductor or semiconductor, set the gap between sensors (GS). The following 2 methods are available.

- Use a reference piece
- Enter a value directly

Before performing calibration, set [Mode] in [Measurement] to [Conductor].

■ Setting the gap between sensors using a reference piece

Set the gap between sensors (GS) using a reference piece made of the same material as the measurement target and with a known thickness.

- It is recommended that the reference piece have a thickness close to that of the actual measurement target.

1 **Insert the reference piece between the VE sensors.**
Make sure that the gap (GA/GB) between each VE sensor and the reference piece is within the VE sensor measurement range.

2 **Switch to the calibration mode.**
The screen switches to the [Reference Piece] screen and displays the reference piece thickness (default: 0) registered at the last calibration.

3 **Enter the reference piece thickness.**
Enter the thickness of the inserted reference piece, and use [ENTER] to return to the measurement mode screen. The gap between sensors (GS) is automatically set.
- For entering values, refer to “Value setting screen” on page 39.

■ Setting the gap between sensors by entering a value directly

In the setting mode, enter a value for specifying the gap between sensors (GS).
- Before setting the value, set [Mode] in [Measurement] to [Conductor].

1 **Display the [Menu] screen.**
On the conductor/semiconductor measurement mode screen, press the MENU button on the front panel.

2 **Display the [Sensor Distance] screen.**
Select [Calibration] → [Sensor Distance] from the [Menu] screen.

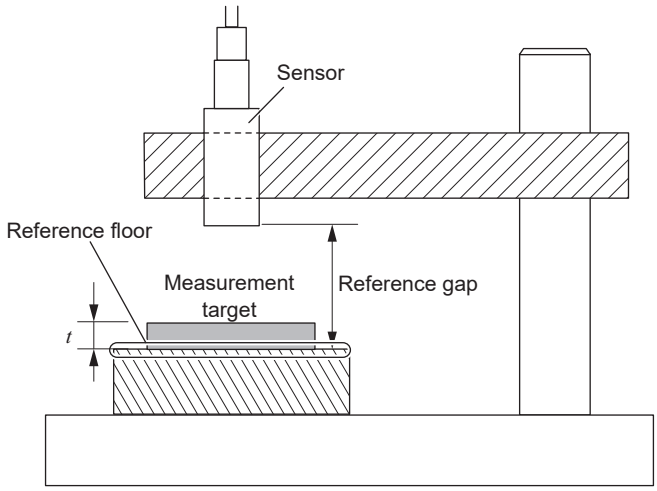
3 **Enter a value for the gap between sensors (GS).**
On the [Sensor Distance] screen, enter a value for the gap between sensors (GS), and use [ENTER] to return the screen to the previous menu level.
- For entering values, refer to “Value setting screen” on page 39.

2.5 Installing VE Sensor and Performing Calibration for Insulator Measurement

CL-0740

2.5.1 Installing VE Sensor

To measure the thickness of an insulator, use 1 VE sensor, and install it as shown in the figure below.



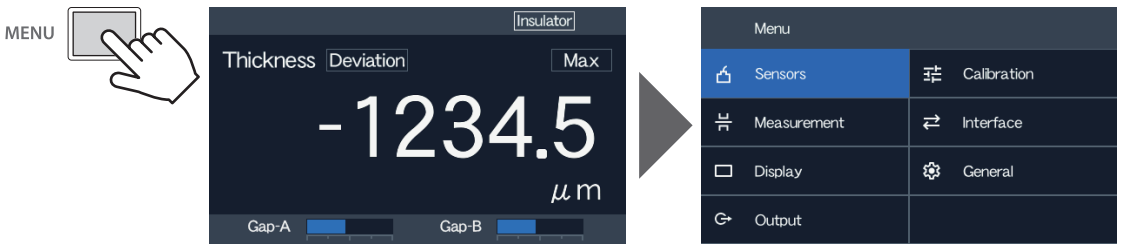
- For installing a sensor, refer to “1.5.3 Selecting Sensor” on page 26 and “1.5.4 Precautions When Fixing Sensor” on page 26.
- For checking and adjusting the VE sensor installation position, refer to “Checking and adjusting VE sensor installation locations” on page 51.

■ Setting the sensor to use

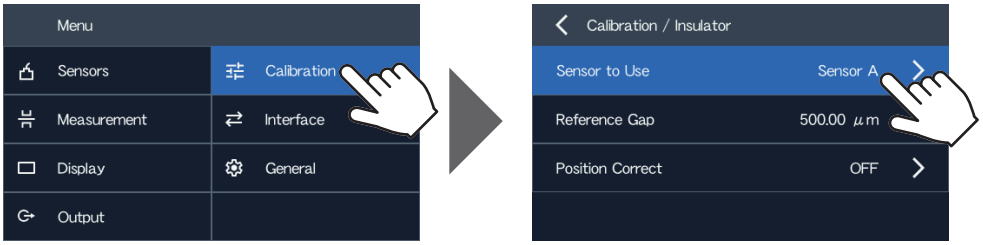
Either Sensor A or Sensor B is required to measure an insulator. Before starting measurement, specify the sensor used to measure the insulator.

- Before specifying the sensor, set [Mode] in [Measurement] to [Insulator].

1 Display the [Menu] screen.

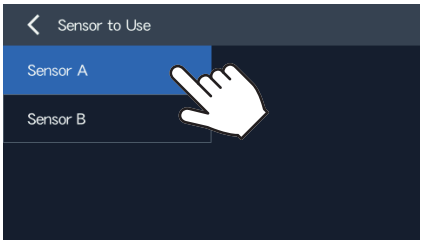


2 Display the [Sensor to Use] screen.



3 Select the sensor used for measurement.

Select [Sensor A] or [Sensor B] according to the installed state.



2.5.2 Performing Calibration

Before measuring the thickness of an insulator, set the reference gap and the measurement target's relative permittivity in this order.
Before performing calibration, set [Mode] in [Measurement] to [Insulator].

■ Setting the reference gap

The following 2 methods are available to set the reference gap.

- Set the current gap value as the reference gap
- Enter a value directly

● Setting the reference gap using the current value

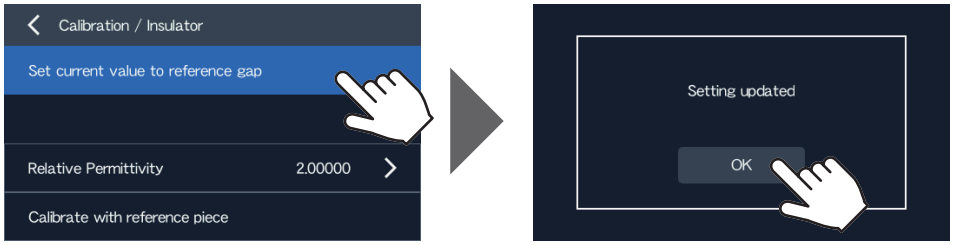
Set a gap when no measurement target is present as a reference gap.

1 Ensure that there is no measurement target.

Make sure that there is no measurement target under the sensor.

2 Switch to the calibration mode.

3 **Set the current gap as the reference gap.**



● Setting the reference gap by entering a value directly

In the setting mode, enter the reference gap.

1 **Display the [Menu] screen.**
On the insulator measurement mode screen, press the MENU button on the front panel.

2 **Display the [Reference Gap] screen.**
Select [Calibration] → [Reference Gap] from the [Menu] screen.

3 **Enter a value for the reference gap.**
Enter a value for the reference gap, and use [ENTER] to return the screen to the previous menu level.
- For entering values, refer to “Value setting screen” on page 39.

■ Setting the relative permittivity

The following 2 methods are available to set the relative permittivity.
- Use a reference piece
- Enter a value directly

● Setting the relative permittivity using a reference piece

Set the relative permittivity using a reference piece made of the same material as the measurement target and with a known thickness.
- It is recommended that the reference piece have a thickness close to that of the actual measurement target.

1 **Place the reference piece.**
Insert the reference piece between the VE sensor and the reference floor.

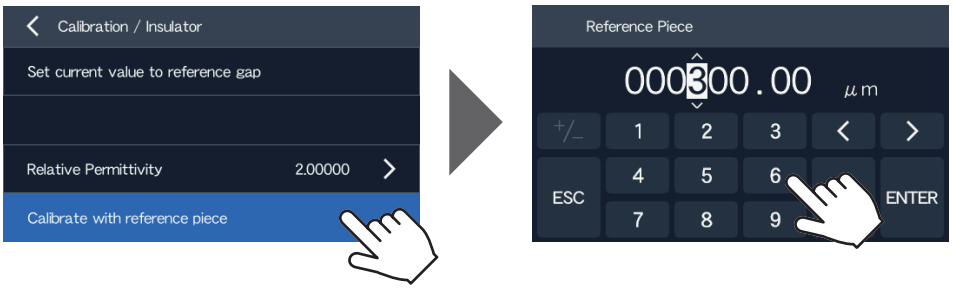
2 **Switch to the calibration mode.**

3 **Display the [Reference Piece] screen, and enter the reference piece thickness.**

The [Reference Piece] screen displays the reference piece thickness (default: 000000.00 µm) registered at the last calibration.

Enter the thickness of the inserted reference piece, and use [ENTER] to return the screen to the previous menu level.

- For entering values, refer to “Value setting screen” on page 39.



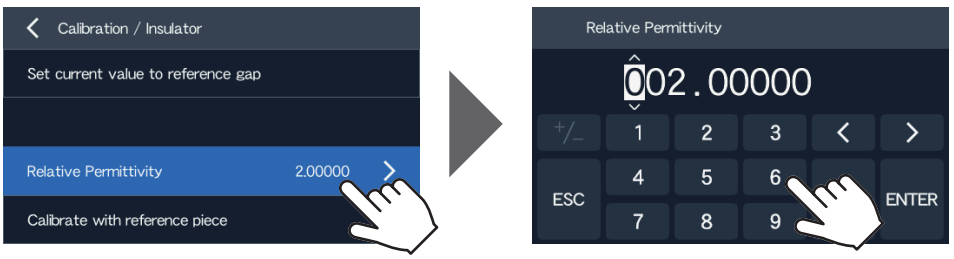
● **Setting the relative permittivity by entering a value directly**

1 **Switch to the calibration mode.**

2 **Display the [Relative Permittivity] screen, and enter the relative permittivity.**

Enter the relative permittivity, and use [ENTER] to return the screen to the previous menu level.

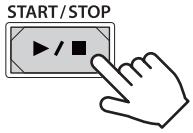
- For entering values, refer to “Value setting screen” on page 39.



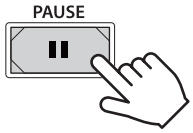
2.6 Starting/Stopping Measurement

■ Starting measurement

When you start measurement, Max (maximum value), Min (minimum value), and Range (maximum value - minimum value) are calculated.
Even if measurement is not started, Instant (instantaneous value) is updated.

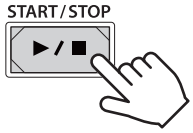


● **Pausing measurement**



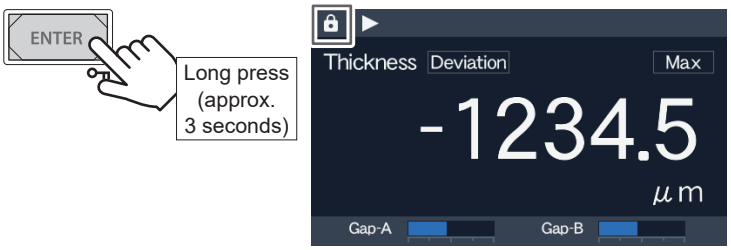
• To restart the measurement, press the ❚❚ button again on the front panel.

■ Stopping measurement



■ Preventing erroneous operation during measurement (button protection)

Enabling button protection on the measurement mode screen prevents erroneous button operation during measurement.



- When button protection is enabled, the [🔒] indicator is displayed.

● Canceling button protection

Hold down the ENTER/ 🔑 button on the front panel for approximately 3 seconds until the [🔒] indicator is turned off.

Chapter 3

External Connection

3.1. Remote Signals 60

3.2. Analog Output 64

3.3. Comparator Output 67

3.4. Temperature Sensor (Resistance Temperature Detector) 73

3.5. BCD Output 76

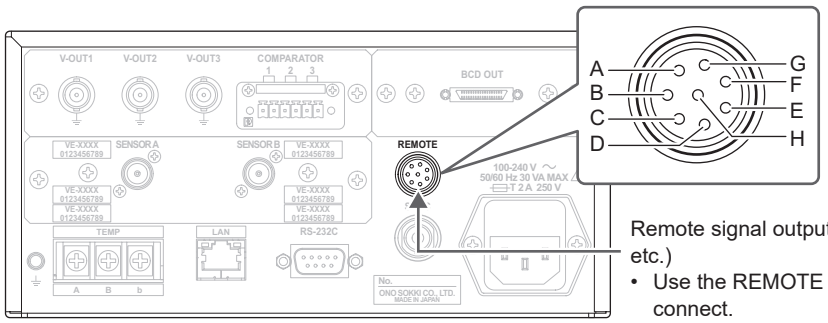
3.6. Synchronous Connection 81

3.7. Digital Interface 82

3.1 Remote Signals

Connecting a remote signal output device to the REMOTE connector allows you to remotely operate the instrument.

3.1.1 Connecting Device



Remote signal output device (remote controller, PLC, etc.)
- Use the REMOTE connector (supplied item) to connect.

■ REMOTE connector specifications

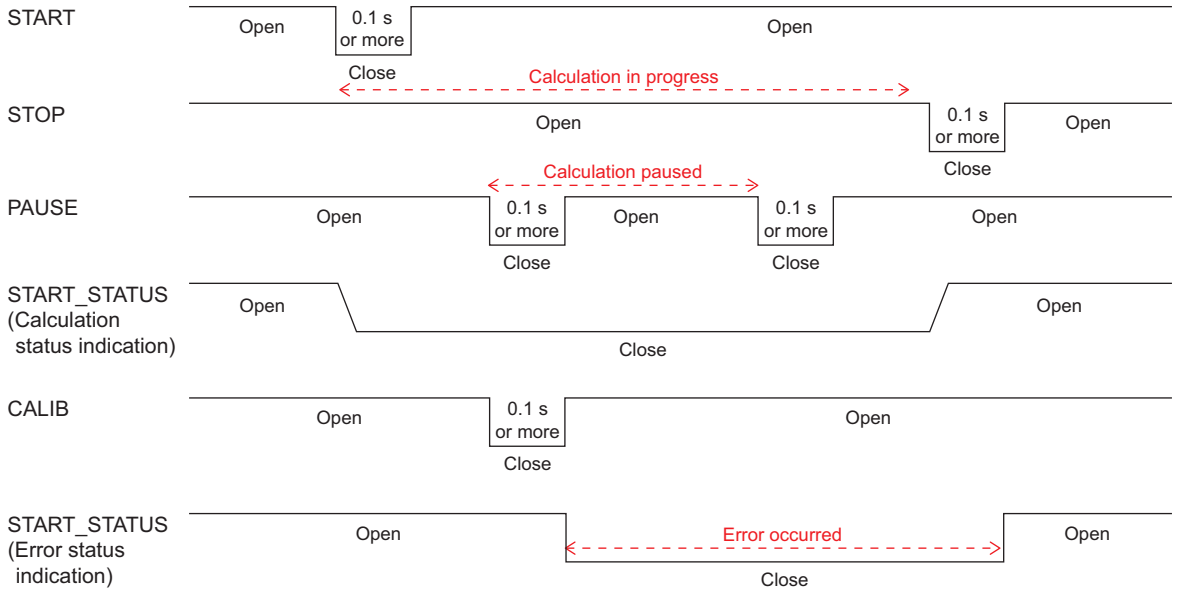
Compatible connector	ER03-PB8M-T (manufactured by Tajimi Electronics)	
Input/output type	Input	For the input type, refer to “3.1.3 Recommended Interface” on page 62.
	Output	1 make contact output (normally open contact output)
Load voltage	680 VAC/DC	
Load current	50 mA	
ON resistance	Approx. 2 Ω	

■ Pin arrangement and input/output signals

Pin	Signal	Description
A	Power supply	Inputs 5 to 24 VDC (refer to “3.1.3 Recommended Interface” on page 62). • When using 12 VDC, make connection through a resistor of 470 Ω. • When using 24 VDC, make connection through a resistor of 1 kΩ.
B	START	Starts calculation.
C	STOP	Stops calculation.
D	PAUSE	Pauses calculation.
E	CALIB	Performs calibration using the registered measurement target reference piece data. • This function is available only for conductor measurement. • The thickness of the measurement target reference piece cannot be changed.

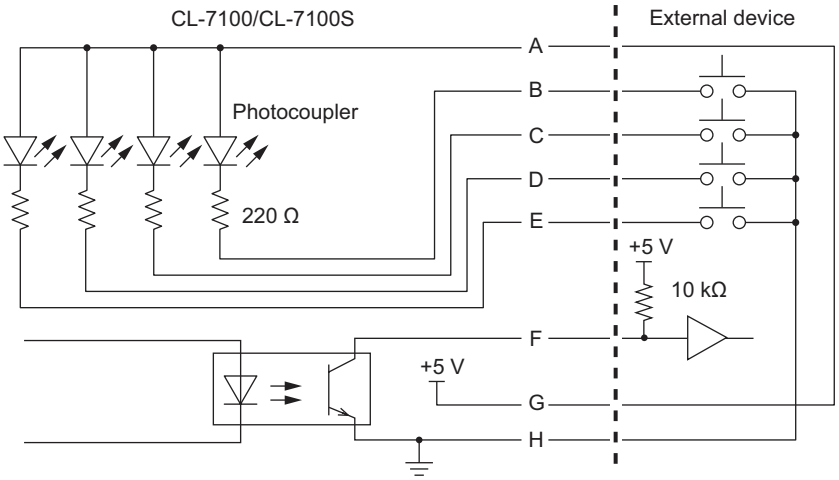
Pin	Signal	Description
F	STATUS	Views the calculation/error status. • Calculation status indication - Open: When not in “calculation in progress” or “calculation paused” - Close: When in “calculation in progress” or “calculation paused” • Error status indication - Open: No error - Close: Error occurred For details about the error status, refer to “5.1 List of Error Messages” on page 106.
G	Power supply output	Outputs +5 V (Max: 0.3 A).
H	COM	Connects as the reference potential (0 V) for the control signal.

3.1.2 Remote Signal Input/Output Timing

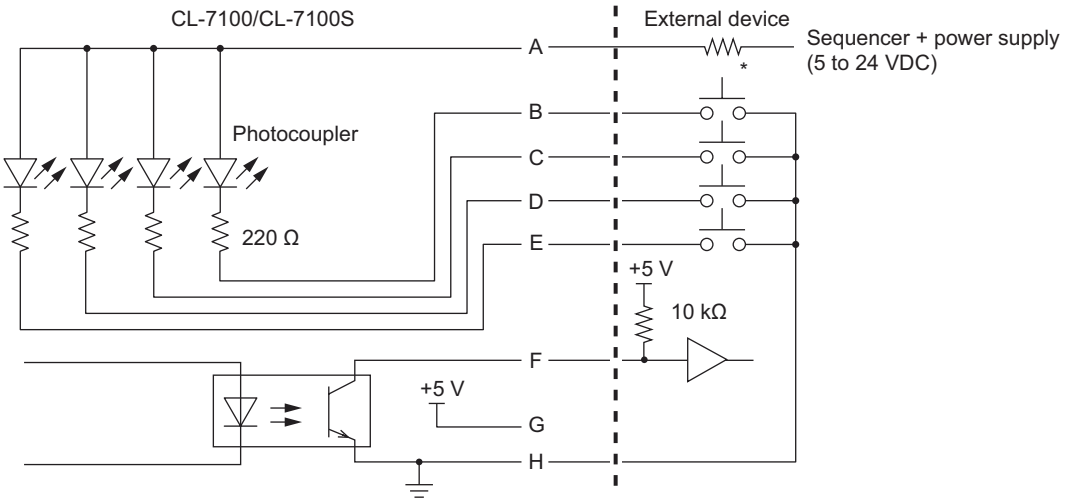


3.1.3 Recommended Interface

■ Recommended interface when using internal power supply



■ Recommended interface when using external power supply



* When connecting a DC power supply, insert an appropriate resistor as follows.
- When connecting 5 VDC: 0 Ω (Do not insert a resistor.)
- When connecting 12 VDC: Insert a resistor of 470 Ω.
- When connecting 24 VDC: Insert a resistor of 1 kΩ.

3.1.4 Selecting Remote Signal (STATUS) to Output

Selecting the STATUS signal to be output from the REMOTE connector allows you to check the calculation status or error status.

1 **Display the [Menu] screen.**
Press the MENU button on the front panel.

2 **Display the [Remote] screen.**
Select [Interface] → [Remote] from the [Menu] screen.

3 **Select the type of STATUS signal to output.**
Select [Item] and select an item to output.

Setting	Description
Status	You can check the calculation status. • Open: When not in “calculation in progress” or “calculation paused” • Close: When in “calculation in progress” or “calculation paused”
Error	You can check the existence of an error. • Open: No error • Close: Error occurred

- For details about the error status, refer to “5.1 List of Error Messages” on page 106.

3.2 Analog Output

CL-0730
CL-0732

To use an analog voltage input device by connecting it to this instrument, the CL-0730 Analog Output Function or CL-0732 Analog and Comparator Output Function is required.

3.2.1 Setting Analog Output

■ Selecting analog output item and setting deviation

Select an item to be output from the analog output connector and enable/disable the deviation function for the item.

1 **Display the [Menu] screen.**
Press the MENU button on the front panel.

2 **Display the [Analog] screen.**
Select [Output] → [Analog] from the [Menu] screen.

3 **Select an analog output connector to set.**
Select the target connector from [V-OUT 1], [V-OUT 2], or [V-OUT 3].

4 **Select the item and conditions to be output from the selected analog output connector.**
Select the item and change the settings.
When you confirm the settings, the screen returns to the previous menu level ([V-OUT 1]/[V-OUT 2]/[V-OUT 3]). Set all the necessary items.

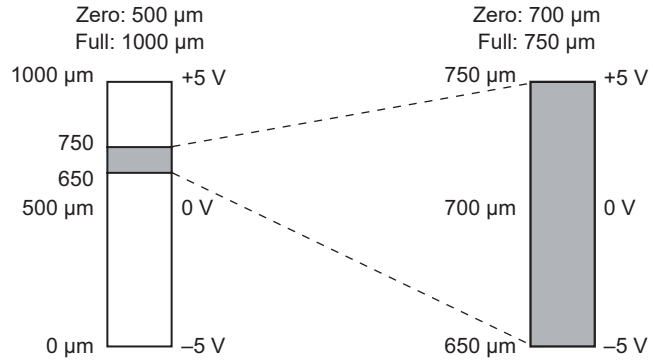
Setting	Description	
Item	Selects the analog output item.	
	Thickness	Outputs the thickness value of the measurement target.
	Gap A	Outputs the gap value between Sensor A and the measurement target.
	Gap B	Outputs the gap value between Sensor B and the measurement target.
	A-B	Outputs the difference between Gap A and Gap B.
	Temperature CL-0741	Outputs the temperature value.
Deviation	Enables/disables the deviation function for the selected output item.	
	OFF	Outputs the analog voltage of the measured value at a full scale of ±5 V.
	ON	Outputs the analog voltage of the difference between the measured value and the set measurement reference value at a full scale of ±5 V.

5 **Set the output item and enable/disable the deviation function also for other output connectors as needed.**
Tap [❮] to display the [Analog] screen, and repeat steps **3** and **4** to set the output item and enable/disable the deviation function also for other output connectors.

■ Setting analog output range

The analog output connector (V-OUT1/V-OUT2/V-OUT3) can output an analog voltage signal at a full scale of ±5 V. By setting the zero point and full-scale point of the output range, the voltage can be output according to the set values (±5 V range) from the analog output connector (V-OUT1/V-OUT2/V-OUT3).

Setting examples



1 **Display the [Menu] screen.**
Press the MENU button on the front panel.

2 **Display the [Analog] screen.**
Select [Output] → [Analog] from the [Menu] screen.

3 **Select an analog output connector to set.**
Select the target connector from [V-OUT 1], [V-OUT 2], or [V-OUT 3].

4 **Set the range of voltage output from the selected analog output connector.**

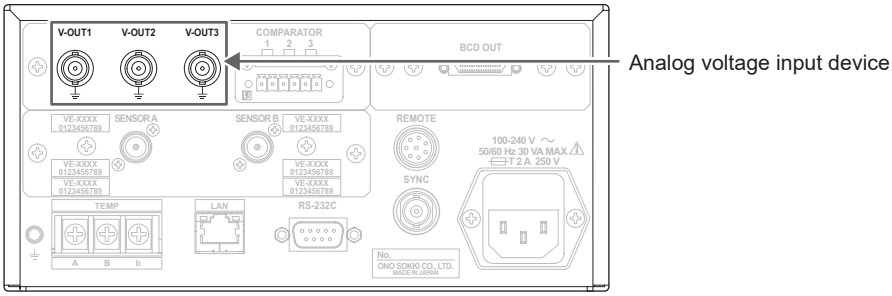
Setting	Description
Zero	Enter the zero point of the analog output. (Setting range: −999999.99 to 999999.99 µm)
Full	Enter the full-scale point of the analog output. (Setting range: −999999.99 to 999999.99 µm)

Select [Zero] and enter the value of zero point. Use [ENTER] to confirm the setting and return the screen to the previous menu level ([V-OUT 1]/[V-OUT 2]/[V-OUT 3]).
Select [Full] and enter the value of full-scale point. Use [ENTER] to confirm the setting.
The setting is changed, and the screen returns to the previous menu level ([V-OUT 1]/[V-OUT 2]/[V-OUT 3]).

• For entering values, refer to “Value setting screen” on page 39.

5 **Set the analog voltage output range also for other output connectors as needed.**
Tap [❮] to display the [Analog] screen, and repeat steps **3** and **4** to set the analog voltage output range also for other output connectors.

3.2.2 Connecting Device



■ Analog output connector (V-OUT1/V-OUT2/V-OUT3) specifications

Compatible connector	C02 type (BNC)
Voltage output range	±5 V
Number of bits	16 bits
DC offset	±10 mV or less
Load resistance	100 kΩ or more
Update cycle	10 ms • When Gap A/Gap B is output, the update cycle changes depending on the set [Average] value. If [Average] in [Measurement] is set to [1], the update cycle is approximately 0.1 ms. For details about the [Average] setting, refer to “Measurement” on page 98.
Accuracy	±0.2 % FS

3.3 Comparator Output

CL-0731
CL-0732

To use a comparator by connecting it to this instrument, the CL-0731 Comparator Output Function or CL-0732 Analog and Comparator Output Function is required.
Using the comparator function allows quality judgment, which determines whether measurement results are within the setting range.

- The comparator function works only while the calculation is in progress on the measurement mode screen.

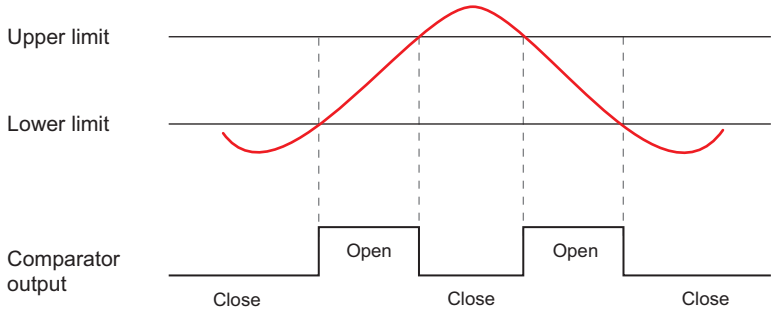
3.3.1 Setting Comparator Output

The comparator function judges whether the measured value is within the setting range.
The following 2 modes are available on this instrument.

- [Separate]: Assigns measurement items to CH-1/CH-2/CH-3 and judges whether each measured value is within the setting range.
- [Link]: Monitors the measured value of the specified measurement item, judges whether it is above, within, or below the range, and outputs the result to CH-1/CH-2/CH-3.

■ Separate mode

The separate mode allows you to set the Thickness/Gap A/Gap B/A-B measurement items and the upper and lower limits to CH-1/CH-2/CH-3 to judge whether measured values are within the set range. In this mode, you can also check if an error occurs.



Set upper limit < measured value
or
Set lower limit > measured value
In the above case, the comparator output is closed.

● **Setting the comparator separate mode**

1 **Display the [Menu] screen.**
Press the MENU button on the front panel.

2 **Display the [Comparator] screen.**
Select [Output] → [Comparator] from the [Menu] screen.

3 **Set the comparator mode to [Separate].**
Select [Mode] → [Separate].
The setting is changed, and the screen returns to the previous menu level ([Comparator]).

4 **Select a channel to set.**
Select a channel to set.

Setting	Description
CH-1	Select this when setting the channel connected to the COMPARATOR 1 terminal.
CH-2	Select this when setting the channel connected to the COMPARATOR 2 terminal.
CH-3	Select this when setting the channel connected to the COMPARATOR 3 terminal.

5 **Set the judgment conditions and output item of the selected channel.**
Select the item and change the settings.
When you confirm the settings, the screen returns to the previous menu level ([CH-1]/[CH-2]/[CH-3]). Set all the necessary items.

Setting	Description	
Item	Selects measurement items to be judged.	
	OFF	Disables the comparator function of the target channel.
	Thickness	Uses the thickness value for judgment.
	Gap A	Uses the Gap A value for judgment.
	Gap B	Uses the Gap B value for judgment.
	A-B	Uses the difference between Gap A and Gap B for judgment.
	Error	Outputs the error status. • Output open: No error • Output close: Error occurred For details about the error status, refer to “5.1 List of Error Messages” on page 106.

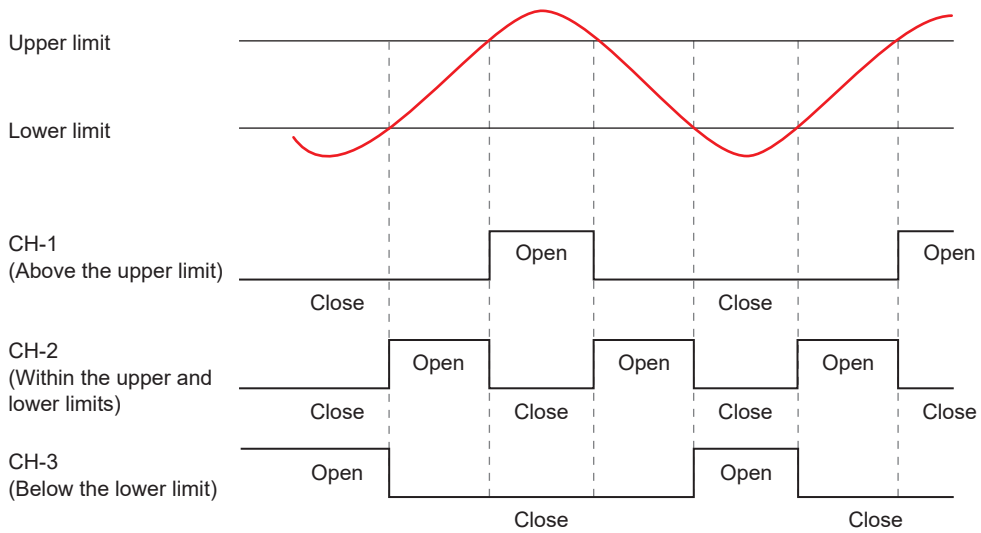
Setting	Description	
Deviation	Enables/disables the deviation function for the measurement item of the selected judgment target.	
	OFF	Compares the measured value and the set upper and lower limits.
	ON	Compares the difference between the measured value and the set measurement reference value with the set upper and lower limits.
Upper	Enter the judgment range (upper and lower limits) and use [ENTER] to confirm the setting. For entering values, refer to “Value setting screen” on page 39. (Setting range: −999999.99 to 999999.99 µm)	
Lower		

6 **Set the judgment conditions for other channels as needed.**
Tap [❮] to display the [Comparator] screen, and repeat steps **4** and **5** to set the judgment conditions for other channels.

■ Link mode

The link mode monitors the measured value of each measurement item simultaneously using 3 channels (CH-1/CH-2/CH-3) and automatically classifies and judges which range the measured value is in. The role and judgment criteria of each channel are as follows.

Channel	Judgment content	Condition
CH-1	Above the upper limit	Measured value > upper limit
CH-2	Within the upper and lower limits	Lower limit ≦ measured value ≦ upper limit
CH-3	Below the lower limit	Measured value < lower limit



● **Setting the comparator link mode**

1 **Display the [Menu] screen.**
Press the MENU button on the front panel.

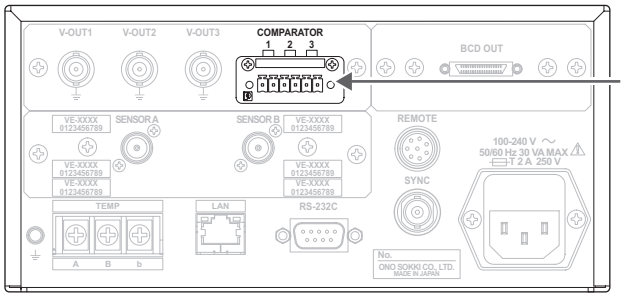
2 **Display the [Comparator] screen.**
Select [Output] → [Comparator] from the [Menu] screen.

3 **Set the comparator mode to [Link].**
Select [Mode] → [Link].
The setting is changed, and the screen returns to the previous menu level ([Comparator]).

4 **Set the judgment conditions.**
Select [Judgment Condition], select the item, and change the settings.
When you confirm the settings, the screen returns to the previous menu level ([Judgment Condition]). Set all the necessary items.

Setting	Description	
Item	Selects measurement items to be judged.	
	OFF	Disables the comparator function.
	Thickness	Uses the thickness value for judgment.
	Gap A	Uses the Gap A value for judgment.
	Gap B	Uses the Gap B value for judgment.
	A-B	Uses the difference between Gap A and Gap B for judgment.
Deviation	Enables/disables the deviation function for the measurement item of the selected judgment target.	
	OFF	Compares the measured value and the set upper and lower limits.
	ON	Compares the difference between the measured value and the set measurement reference value with the set upper and lower limits.
Upper	Enter the judgment range (upper and lower limits) and use [ENTER] to confirm the setting. For entering values, refer to “Value setting screen” on page 39. (Setting range: −999999.99 to 999999.99 µm)	
Lower		

3.3.2 Connecting Device



Comparator
- COMPARATOR 1: CH-1
- COMPARATOR 2: CH-2
- COMPARATOR 3: CH-3

■ COMPARATOR connector specifications

Compatible connector	MC 1,5/6-STF-3,81-1827745 (manufactured by Phoenix Contact)
Output method	1 make contact output (normally open contact output)
Load voltage	60 VAC/DC
Load current	50 mA
ON resistance	Approx. 2 Ω
Update cycle	10 ms

3.3.3 Using Comparator Function to Judge Measured Value

1 **Configure the comparator setting.**
Refer to “3.3.1 Setting Comparator Output” on page 67.
- If the comparator function is not used, set [Item] in [Comparator] to [OFF].

2 **Start measurement.**
Press the START/STOP button on the front panel to start measurement.

3 **Check the judgment result.**
When the CL-0731 Comparator Output Function is installed, the corresponding indicator (CP1/CP2/CP3) is displayed.
- When the comparator output is closed, the indicator is highlighted in red. For details about the comparator output open/close conditions, refer to “3.3.1 Setting Comparator Output” on page 67.

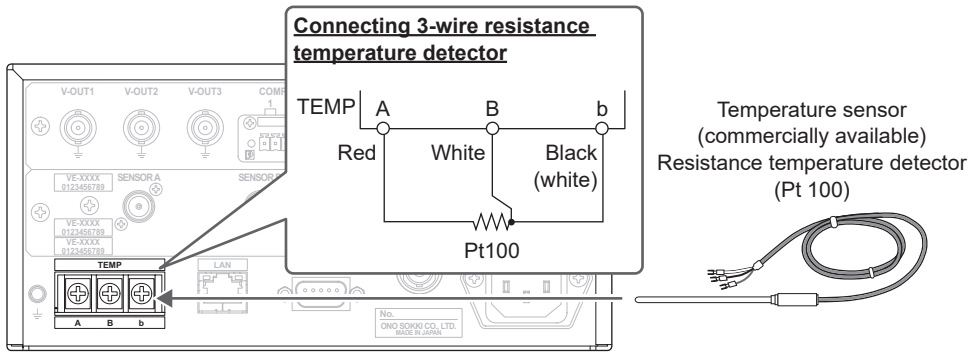
- To stop the measurement, press the START/STOP button on the front panel.

3.4 Temperature Sensor (Resistance Temperature Detector)

CL-0741

To use a temperature sensor (resistance temperature detector) by connecting it to this instrument, the CL-0741 Temperature Measurement Function is required.
Connecting a temperature sensor (resistance temperature detector) to the instrument allows you to use the temperature measurement and temperature correction functions.
The temperature correction function corrects the variation in thickness due to temperature.
The reference temperature and the thickness variation range per °C are set, and linear interpolation of the calculated thickness is performed based on the temperature measured by the temperature sensor (resistance temperature detector).

3.4.1 Connecting Temperature Sensor (Resistance Temperature Detector)



- The wire color may differ depending on the resistance temperature detector. Check the color in the data sheet for your resistance temperature detector.

■ TEMP terminal specifications

Connectable sensor	Resistance temperature detector (Pt 100), 3-wire bridge type	
Measurement range	0 to 200 °C	
Display resolution	0.1 °C	
Measurement accuracy	±0.3 % FS (excluding sensor accuracy)	
Update cycle	200 ms or less	
Exciting current	Approx. 1 mA	
Compatible terminal	Stud diameter	Minimum ⌀4.2 mm
	Outside dimensions	Maximum 9 mm

3.4.2 Setting Temperature Correction Function

The temperature correction function operates according to the following correction formula.

- Thickness after correction = thickness before correction − coefficient × (measured temperature − reference temperature)

To enable the temperature correction function, you need to set the thickness variation range per °C and the reference temperature.
Reference temperature is a temperature at which a correction value for the measured temperature is 0.
On the [Temperature Correction] screen, enable the temperature correction function, and set the coefficient and the reference temperature.

- The temperature correction function is available only for [Thickness]. It is not applied to [Gap A], [Gap B], or other measured values/calculated values.
- If no temperature sensor (resistance temperature detector) is connected when the temperature correction function is [ON], [-] is displayed in the [Thickness] and [Temperature] fields, showing no measured values.

1 **Display the [Menu] screen.**
Press the MENU button on the front panel.

2 **Display the [Temperature Correction] screen.**
Select [Measurement] → [Temperature Correction] from the [Menu] screen.

3 **Set the temperature correction conditions.**
When you confirm the settings, the screen returns to the previous menu level ([Temperature Correction]).
Set all the necessary items.

- For entering values, refer to “Value setting screen” on page 39.

Setting	Description	
Correction	Selects whether or not to use the temperature correction function.	
	ON	Enables the temperature correction function.
	OFF	Disables the temperature correction function.
Coefficient	Enter the coefficient and use [ENTER] to confirm the setting. • Setting range: −999999.99 to 999999.99 µm/°C (values other than 0)	
Reference Temperature	Enter the reference temperature and use [ENTER] to confirm the setting. • Setting range: −999.9 to 999.9 °C	

- When you finish the settings, press the MENU button on the front panel to return to the measurement mode screen.
- When the temperature correction function is enabled, the [TC] indicator is displayed.

3.4.3 Measuring Temperature

When the CL-0741 Temperature Measurement Function is installed, [Temperature] can be selected under [Display] → [Display Items] → [Line x] → [Item] from the [Menu] screen (refer to “2.3.2 Selecting Measurement Items and Calculation Method” on page 47).
Set [Item] to [Temperature] and measure the temperature using the same procedure as for thickness measurement (refer to “2.6 Starting/Stopping Measurement” on page 57).

3.5 BCD Output

CL-0750

To use a BCD indicator by connecting it to this instrument, the CL-0750 BCD Output Function is required.
For the items that can be output to the BCD indicator, refer to “3.5.1 Setting BCD Output” on page 76.

3.5.1 Setting BCD Output

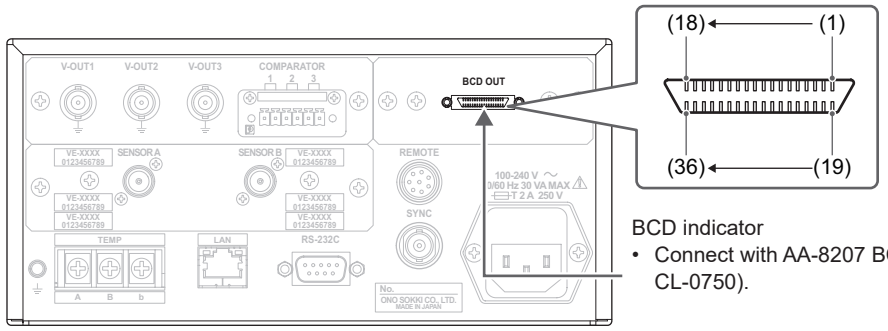
1 **Display the [Menu] screen.**
Press the MENU button on the front panel.

2 **Display the [BCD] screen.**
Select [Output] → [BCD] from the [Menu] screen.

3 **Select content and conditions to be displayed on the BCD indicator.**
When you confirm the settings, the screen returns to the previous menu level ([BCD]). Set all the necessary items.

Setting	Description	
Item	Selects an item to be displayed on the BCD indicator.	
	Thickness	Displays the thickness value.
	Gap A	Displays the Gap A value.
	Gap B	Displays the Gap B value.
	A-B	Displays the difference between Gap A and Gap B.
	Display 1	Displays the information in Line 1 on the measurement mode screen.
	Display 2	Displays the information in Line 2 on the measurement mode screen.
	Display 3	Displays the information in Line 3 on the measurement mode screen.
	Display 4	Displays the information in Line 4 on the measurement mode screen.
Calculation	If either Thickness, Gap A, Gap B, or A-B is to be displayed on the BCD indicator, selects the display value type.	
	Instant	Displays the current value (instantaneous value).
	Max	Displays the maximum value.
	Min	Displays the minimum value.
	Range	Displays the maximum-minimum range.
Deviation	If either Thickness, Gap A, Gap B, or A-B is to be displayed on the BCD indicator, enables/disables the deviation function for the selected measurement item.	
	OFF	Displays the measured value/calculated value.
	ON	Displays the difference between the measured value and the reference value, or its calculated value.

3.5.2 Connecting Device



BCD indicator

- Connect with AA-8207 BCD Cable (supplied with CL-0750).

■ BCD OUT connector specifications

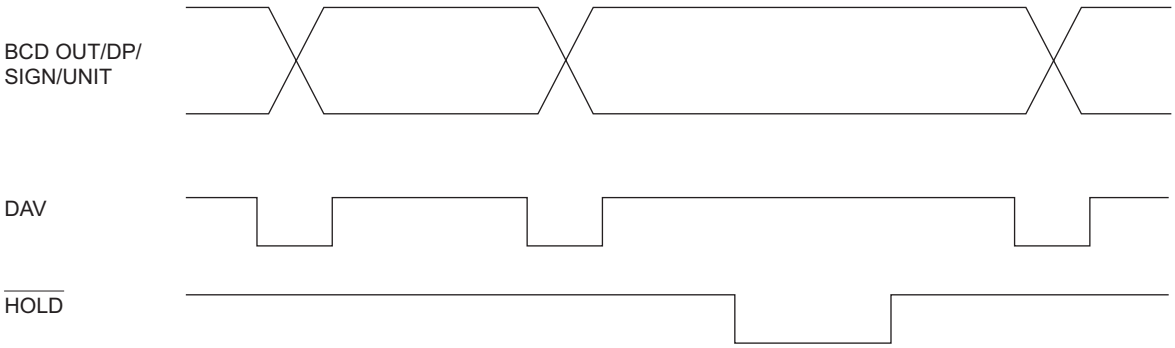
Compatible connector	HDRA-E36MA (manufactured by Honda Tsushin Kogyo)
Output method	6-digit parallel BCD Open collector
Output update cycle	10 ms
Connection cable	AA-8207 (3 m, one end open)

■ Pin arrangement and input/output signals

Pin	I/O	Signal		Function
(1)	O	1	10^0 data output	Output logic: Positive logic
(2)	O	2		
(3)	O	4		
(4)	O	8		
(5)	O	1	10^1 data output	
(6)	O	2		
(7)	O	4		
(8)	O	8		
(9)	O	1	10^2 data output	
(10)	O	2		
(11)	O	4		
(12)	O	8		
(13)	O	1	10^3 data output	
(14)	O	2		
(15)	O	4		
(16)	O	8		
(17)	O	1	10^4 data output	
(18)	O	2		
(19)	O	4		
(20)	O	8		
(21)	O	1	10^5 data output	
(22)	O	2		
(23)	O	4		
(24)	O	8		
(25)	O	SIGN		Outputs the sign. • High: − • Low: +
(26)	O	0	DP0	Outputs the decimal point of the measured value. • DP 2 1 0 H H L XXXXXX L L H XXXXX.X L H L XXXX.XX L H H XXX.XXX H L L XX.XXXX H L H X.XXXXX
(27)	O	1	DP1	
(28)	O	2	DP2	

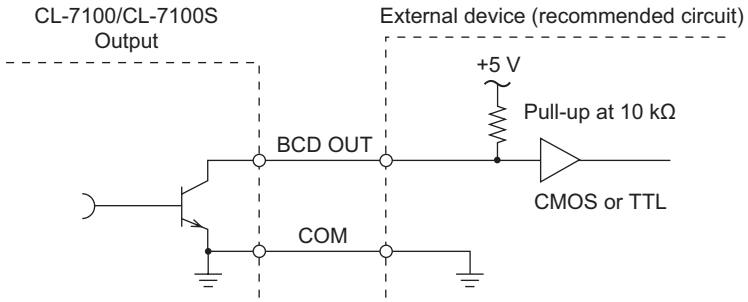
Pin	I/O	Signal		Function
(29)	O	0	UNIT0	Outputs the unit that is currently set. • UNIT 2 1 0 H H L mm H H H µm H L H °C
(30)	O	1	UNIT1	
(31)	O	2	UNIT2	
(32)	O	START		The signal becomes high level (open) during the calculation mode.
(33)	O	ERROR		The signal becomes high level (open) under one of the following conditions. • When the measured value of Gap A/Gap B exceeds the rated value of the sensor • When the calculated value of Thickness is negative • When the calculated value exceeds the display digits • When the measured temperature is out of the rated range or the temperature sensor is not connected (when the CL-0741 Temperature Measurement Function is installed) For details about the error status, refer to “5.1 List of Error Messages” on page 106.
(34)	I	#HOLD		When a low-level signal is input, the BCD data update is stopped, and the display value at that point is retained.
(35)	O	DAV		BCD data is valid when the signal is high level (open).
(36)	-	COM		

3.5.3 BCD Signal Input/Output Timing



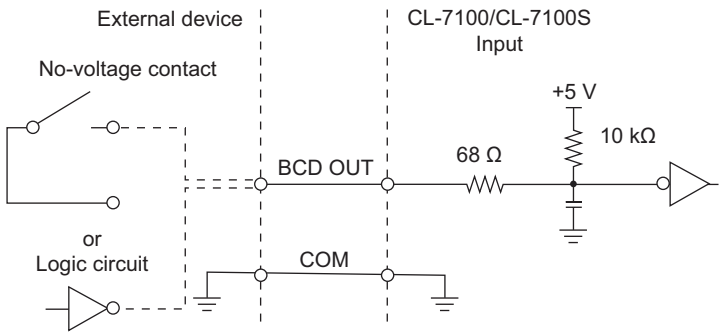
3.5.4 Recommended Interface

■ 10^0 to 10^5/SIGN/DP0 to DP2/UNIT0 to UNIT2/START/ERROR/DAV output



■ HOLD input

Be sure to input a non-chattering signal.



3.6 Synchronous Connection

CL-0071

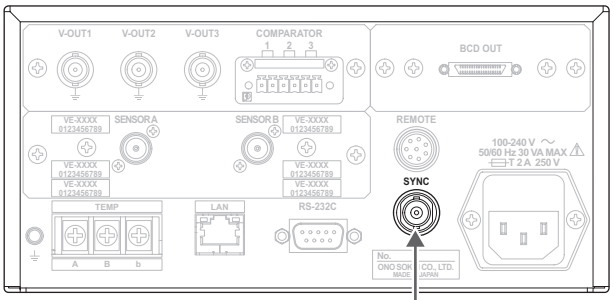
3.6.1 Overview of Synchronous Connection

If the same specimen is measured using multiple CL-7100/CL-7100S Non-Contact Thickness Meters, each unit outputs its own carrier signal for measurement, which may cause interference between sensors and result in unstable measurement data.
To obtain stable measurement data and prevent interference, configure one CL-7100/CL-7100S Non-Contact Thickness Meter as the main unit, and others as the sub units. The units then perform synchronized operation using common carrier signals, which reduces interference.

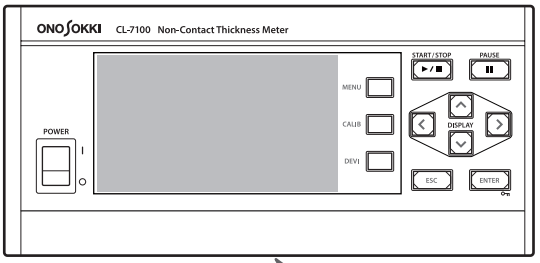
- To use the parallel measurement function, the CL-0071 Parallel Measurement Function is required.

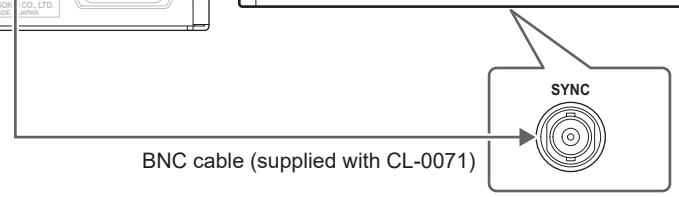
3.6.2 Synchronously Connecting CL-7100/CL-7100S Units

CL-7100/CL-7100S main



CL-7100/CL-7100S sub





- One sub unit can be connected to each main unit.
- Be sure to check if a sub unit has been set before connection. A connection between main units may cause failure. Be sure to connect the CL-7100/CL-7100S set as a sub unit to the main unit.
  The main/sub unit settings can be checked with the unit mode indicator on the measurement mode screen.

Main unit

Sub unit

3.7 Digital Interface

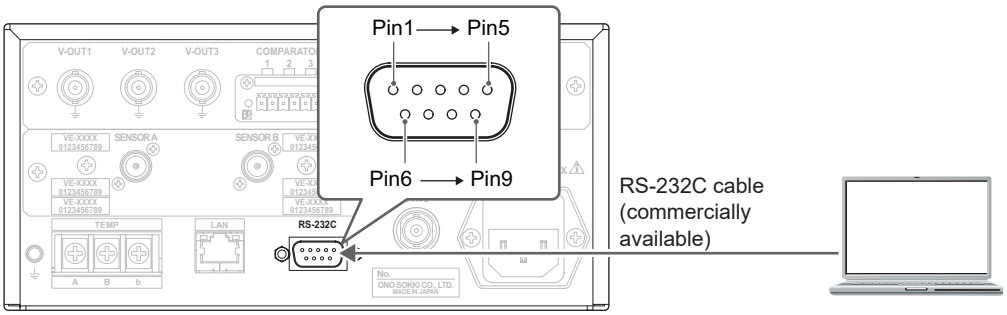
Connecting a personal computer to this instrument allows digital interface communication, such as instrument settings, function controls, and data transmission, using personal computer programs.

- For communication commands, refer to “5.4.1 Communication Commands (RS-232C/Ethernet)” on page 116.

3.7.1 RS-232C Communication

RS-232C is a serial communication interface standardized by EIA (Electronic Industries Association).

■ Connecting to RS-232C connector



● RS-232C connector specifications

Communication type	Asynchronous full-duplex mode
Compatible connector	D-sub 9-pin (female)
Baud rate	9600/19200/115200 bps • For setting the baud rate transfer speed, refer to “Setting RS-232C communication” on page 83.
Data bit	8 bits
Parity bit	None
Stop bit	1 bit
Flow control	Hardware
Terminator	CR+LF

● **Pin arrangement and input/output signals**

Pin	Signal	Application	Input/output
1	N.C.	-	-
2	RxD	Receiving data	Input
3	TxD	Transmitting data	Output
4	N.C.	-	-
5	COM	Signal ground	-
6	N.C.	-	-
7	RTS	Transmission request	Output
8	CTS	Transmittable	Input
9	N.C.	-	-

■ Setting RS-232C communication

1 **Display the [Menu] screen.**
Press the MENU button on the front panel.

2 **Display the [RS-232C] screen.**
Select [Interface] → [RS-232C] from the [Menu] screen.

3 **Set the RS-232C communication conditions.**
When you confirm the settings, the screen returns to the previous menu level ([RS-232C]). Set all the necessary items.

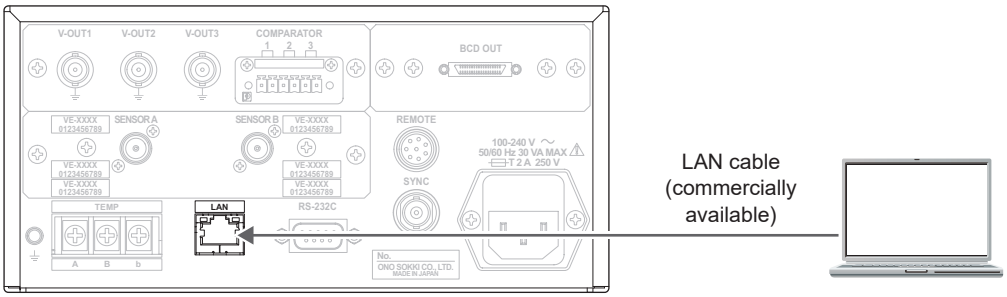
Setting	Description	
Baud Rate	Selects the baud rate transfer speed from the following options. • 115200 bps • 19200 bps • 9600 bps	
Response	Selects whether or not to transmit the return value “G” when a command is received successfully.	
	ON	Responds by transmitting “G” when a command is received.
	OFF	Does not respond even when a command is received. • Return data and error commands are transmitted.
Auto Save	Selects whether or not to automatically save a communication command upon transmission. • Changing this setting also changes the [Auto Save] setting in [Ethernet]. • For details about saving communication commands, refer to “3.7.3 Saving Communication Commands” on page 86.	
	ON	Automatically saves the settings changed with the command.
	OFF	Does not save the settings changed with the command.

3.7.2 Ethernet Communication

CL-0751

To use the Ethernet-based digital interface communication function, the CL-0751 Ethernet Connectivity Function is required.

■ Connecting to LAN connector



● LAN connector specifications

Electrical specifications	In compliance with IEEE802.3
Transmission system	Automatic selection of 10BASE-T/100BASE-TX
Communication protocol	Socket communication over TCP/IP (IPv4)
Compatible connector	RJ-45

- This instrument serves as a server, so a communication device must be connected as a client.
- Ethernet communication transmits commands in ASCII format. Use port number 54000 to connect a device.
- The IP address, subnet mask, and default gateway can be configured in this instrument. Set these items according to your device environment. For the settings, refer to “Setting Ethernet communication” on page 85.
- The timeout length is approximately 600 seconds. If the non-communication state continues for more than 300 seconds, transmit the communication command “NOP” to avoid a timeout.

■ Setting Ethernet communication

1 **Display the [Menu] screen.**
Press the MENU button on the front panel.

2 **Display the [Ethernet] screen.**
Select [Interface] → [Ethernet] from the [Menu] screen.

3 **Set the Ethernet communication conditions.**
When you confirm the settings, the screen returns to the previous menu level ([Ethernet]). Set all the necessary items.
• For entering values, refer to “Value setting screen” on page 39.

Setting	Description	
MAC Address	Displays the MAC address of the instrument.	
IP Address	Sets the IP address of the instrument to communicate with the personal computer connected via Ethernet. Enter the IP address and use [ENTER] to confirm the setting.	
Subnet Mask	Sets the subnet mask of the instrument to communicate with the personal computer connected via Ethernet. Enter the subnet mask and use [ENTER] to confirm the setting.	
Default Gateway	Sets the default gateway of the instrument to communicate with the personal computer connected via Ethernet. Enter the default gateway and use [ENTER] to confirm the setting.	
Auto Save	Selects whether or not to automatically save a communication command upon transmission. • Changing this setting also changes the [Auto Save] setting in [RS-232C]. • For details about saving communication commands, refer to “3.7.3 Saving Communication Commands” on page 86.	
	ON	Automatically saves the settings changed with the command.
	OFF	Does not save the settings changed with the command.

3.7.3 Saving Communication Commands

In digital interface communication, communication commands can be automatically saved after being transmitted.
To enable the auto save, set [Auto Save] to [ON].
Even when [Auto Save] is set to [OFF], the communication command “SAV” is transmitted when the [Menu] screen switches to the measurement screen, so that communication commands are saved.
The saved setting is applied to the instrument at the next startup.

- The communication command auto save setting is common to RS-232C and Ethernet communications, and it cannot be individually configured.
- The instrument has a limit to the number of writes (approximately 1 million). To transmit the set communication command frequently, it is recommended that [Auto Save] be set to [OFF].

Chapter 4

Settings

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4.1 Measurement and Display Settings

4.1.1 Selecting Sensor to Use

For using this instrument, you need to specify a sensor to connect (Sensor A/Sensor B).
You can select the sensor from the sensors that have been adjusted to match the instrument (up to 3 sensors), as well as from sensors listed in “1.5.1 List of Compatible Sensors” on page 24.
If the sensor in use is not adjusted to match the instrument, accuracy is not guaranteed.

1 **Display the [Menu] screen.**
Press the MENU button on the front panel.

2 **Display the [Sensors] screen.**
Select [Sensors] from the [Menu] screen.

3 **Select a sensor to set.**
Select [Sensor A] or [Sensor B].

4 **Select a VE sensor to use.**
Select a sensor to use from sensors factory-adjusted to match the instrument, [VE-201x], [VE-501x], [VE-102x], [VE-152x], [VE-302x], [VE-802x], or [OFF].
- If you do not use the selected sensor, select [OFF].

- If you need to set another sensor, tap [❮] to display the [Sensors] screen, and repeat steps **3** and **4**.

4.1.2 Setting Measurement Processing

Before measurement, set the measurement processing, such as averaging and the display unit.

1 **Display the [Menu] screen.**
Press the MENU button on the front panel.

2 **Display the [Measurement] screen.**
Select [Measurement] from the [Menu] screen.

3 **Set the necessary items.**

Item	Description	
Average	Sets the moving average processing. (Setting range: 1 to 200) A moving average is applied to the measured value of Gap A/Gap B using the entered averaging points, and the result is displayed. • If you do not perform the moving average processing, enter “001”. • For entering numbers, refer to “Value setting screen” on page 39.	
Resolution	Selects the measurement resolution ([Standard]/[High Res]). • The resolution when [Standard] or [High Res] is selected varies depending on the sensor. For the resolution for each sensor, refer to “List of resolutions by sensor” on page 90.	
	Standard	Performs measurement with a standard resolution.
	High Res CL-0720	Improves the resolution of the sensor (except for VE-1021).
Mode	Selects the measurement mode (the material of the measurement target). For details about the measurement mode and its principle, refer to “1.2 Measurement Targets” on page 17 and “1.3 Measurement Principle” on page 19.	
	Conductor	Measures the conductor or semiconductor material.
	Insulator CL-0740	Measures the insulator material.
Unit	Selects the display unit ([mm]/[µm]) of measured values.	
High Impedance Grounding CL-0721	Enables/disables the high impedance grounding function. When this is set to [ON], stable measurement is feasible even when the external enclosure of the VE sensor or the grounding terminal of the instrument is connected to the measurement target with a certain level of impedance. This is particularly effective in environments where the ground resistance is high or unstable.	
	ON	Enables the high impedance grounding function to stabilize measurement in an unstable environment.
	OFF	Disables the high impedance grounding function.
Temperature Correction CL-0741	Configures the settings related to temperature measurement and correction. • For details, refer to “3.4.2 Setting Temperature Correction Function” on page 74.	

■ List of resolutions by sensor

Sensor	Setting	Resolution
VE-2011	Standard	0.1 µm
	High Res	0.02 µm
VE-5010/VE-5011	Standard	0.1 µm
	High Res	0.05 µm
VE-1020/VE-1021	Standard	0.1 µm
	High Res	0.1 µm
VE-1520	Standard	0.5 µm
	High Res	0.2 µm
VE-3020	Standard	1 µm
	High Res	0.5 µm
VE-8020/VE-8021	Standard	1 µm
	High Res	0.5 µm
VE-5010/VE-5011 (when the CL-0722 Measurement Range Change Function is installed)	Standard	0.1 µm
	High Res	0.02 µm

4.1.3 Setting Interval to Update Measured Value/Calculated Value

You can change the interval to update the measured value/calculated value displayed on the measurement mode screen.
The measured value/calculated value displayed on the measurement mode screen represents an average value of data over the set update interval.

1 **Display the [Menu] screen.**
Press the MENU button on the front panel.

2 **Display the [Update Interval] screen.**
Select [Display] → [Update Interval] from the [Menu] screen.

3 **Select the interval to update the measured value/calculated value.**
Select the interval to update the measured value/calculated value displayed on the measurement mode screen from [1.0 sec], [0.5 sec], or [0.2 sec].

4.1.4 Setting Deviation Reference Value

This instrument can perform deviation calculation during measurement, which determines the difference between the measured value and the set deviation reference value.
To enable the deviation calculation, set [Deviation] to [ON] on the [Display] screen.
Note that the deviation of Range (maximum value - minimum value) is disabled.
To perform deviation calculation, you need to set the deviation reference value.
The following 2 methods are available to set the deviation reference value.

- Use the current measured value as the deviation reference value
- Set the deviation reference value by entering a value directly

■ Setting the deviation reference value using the current value

● Setting the current measured value as the deviation reference value for all measurement items

On the measurement mode screen, hold down the DEVI button on the front panel for approximately 1 second.
The current measured value is set as the deviation reference value for all measurement items.

● Setting the current measured value as the deviation reference value for each measurement item

1 **Switch to the deviation setting mode.**
On the measurement mode screen, press the DEVI button on the front panel.

2 **Select a measurement item for which you want to set the deviation reference value.**
Select the target measurement item ([Thickness]/[Gap A]/[Gap B]/[A-B]/[Temperature]*) on the [Deviation] screen.

3 **Set the current measured value as the deviation reference value.**
Select [Use Current Value]. The current measured value is set as the deviation reference value.

* [Temperature] is available only when the CL-0741 Temperature Measurement Function is installed.

■ Setting the deviation reference value by entering a value directly

1 **Switch to the deviation setting mode.**
On the measurement mode screen, press the DEVI button on the front panel.

2 **Select a measurement item for which you want to set the deviation reference value.**
Select the target measurement item ([Thickness]/[Gap A]/[Gap B]/[A-B]/[Temperature]*) on the [Deviation] screen.

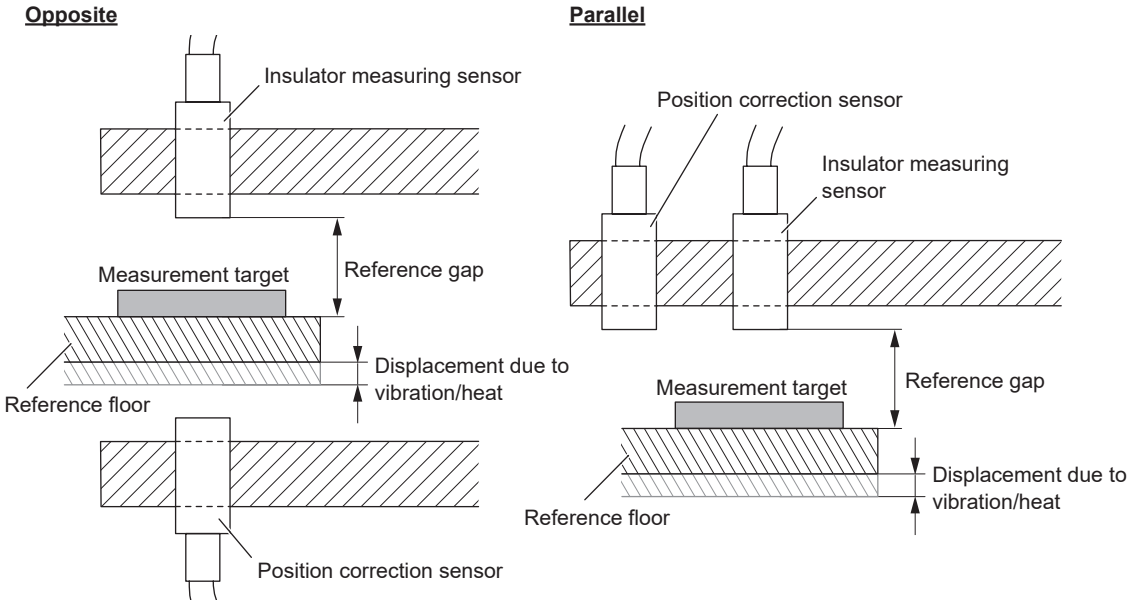
3 **Display the [Input Value] screen.**
Select [Input Value].

4 **Enter the deviation reference value.**
Enter the deviation reference value, and use [ENTER] to return to the measurement mode screen.
- For entering values, refer to “Value setting screen” on page 39.

4.2 Calibration Settings

4.2.1 Correcting Reference Gap (During Insulator Measurement)

The reference gap, which is set for calibration of insulator measurement, changes due to vibration or thermal expansion. A sensor that is not used for measurement can be used to correct positions and the reference gap. To enable the position correction function, select the installation position ([Parallel]/[Opposite]) of the position correction sensor.



■ Setting position correction

1 **Display the [Menu] screen.**
Press the MENU button on the front panel.

2 **Display the [Position Correct] screen.**
Select [Calibration] → [Position Correct] from the [Menu] screen.

3 **Enable/disable the position correction function.**
To enable the position correction function, select the installation position of the position correction sensor.

Setting item	Description
Parallel	Enables the position correction function. Select this when the position correction sensor is installed parallel to the insulator measuring sensor.
Opposite	Enables the position correction function. Select this when the position correction sensor is installed opposite to the insulator measuring sensor.
OFF	Disables the position correction function.

4 **Perform the calibration to update the reference gap for the position correction sensor.**
Refer to “2.5.2 Performing Calibration” on page 54 for instructions.
The reference gap for the position correction sensor will be updated when the reference piece is calibrated.

4.3 Environment Settings

4.3.1 Initializing Settings

1 **Display the [Menu] screen.**
Press the MENU button on the front panel.

2 **Display the [Initialize] screen.**
Select [General] → [Initialize] from the [Menu] screen.

3 **Reset the settings to the default.**
The message “Reset to default settings?” will be displayed. Select [Yes (ENTER)] to initialize the settings.
- To cancel the initialization, select [No (ESC)] to return to the previous screen.

4.3.2 Display Language Settings

You can change the language displayed on the setting screen.

1 **Display the [Menu] screen.**
Press the MENU button on the front panel.

2 **Display the [Language] screen.**
Select [General] → [Language] from the [Menu] screen.

3 **Select a language to be displayed on the setting screen.**

Setting	Description
English	Displays the information in English.
Japanese	Displays the information in Japanese.

4.4 Checking Instrument Information

You can display the information about the options installed on the instrument and the information about the main unit.

1 **Display the [Menu] screen.**
Press the MENU button on the front panel.

2 **Display the [General] screen.**
Select [General] from the [Menu] screen.

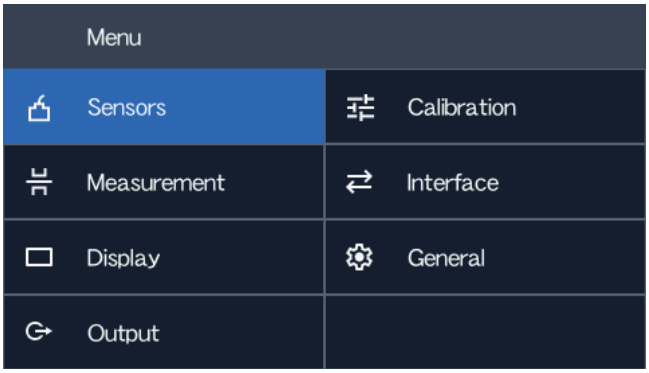
3 **Select an item to check.**

Item	Description
Option Information	Displays a list of optional functions installed on the instrument.
About	Displays the product information about the instrument.

4.5 List of Menu Items

The [Menu] screen allows you to check settings and information.
To display the [Menu] screen, press the MENU button on the front panel on the measurement mode screen.

- For operations on the [Menu] screen, refer to “Setting/calibration/deviation setting mode” on page 37.



■ Sensor

Sets the type of sensor required for measurement.

Item	Setting	Reference
Sensor A	Selects a VE sensor for Sensor A and Sensor B separately. • A sensor factory-adjusted to match the instrument (Default) Example: VE-1020 (SN: 9999) • VE-201x • VE-501x • VE-102x • VE-152x • VE-302x • VE-802x • OFF	Page 88
Sensor B		

■ Measurement

Sets the measurement processing conditions.

Item	Setting		Reference
Average	Enter the number of moving average points. If you do not perform the moving average processing, enter “001”. • Setting range: 1 to 200 (Default: 1)		Page 89
Resolution	When the CL-0720 High-resolution Measurement Function is installed, the measurement resolution can be selected. • Standard (Default) • High Res (Only when the CL-0720 High-resolution Measurement Function is installed)		Page 89
Mode	When the CL-0740 Insulator Measurement Function is installed, the measurement mode (the material of the measurement target) can be selected. • Conductor (Default) • Insulator (Only when the CL-0740 Insulator Measurement Function is installed)		Page 89
Unit	Selects the display unit of measured values. • mm • µm (Default)		Page 89
High Impedance Grounding CL-0721	Enables/disables the high impedance grounding function. • ON • OFF (Default)		Page 89
Temperature Correction CL-0741	Configures the settings related to temperature measurement and correction.		Page 74
	Correction	Selects whether or not to use the temperature correction function. • ON • OFF (Default)	
	Coefficient	Enter the coefficient. • Setting range: −999999.99 to 999999.99 (values other than 0) (Default: 1.00 µm/°C)	
	Reference Temperature	Enter the reference temperature. • Setting range: −999.9 to 999.9 °C (Default: 20.0 °C)	

■ Display

Sets the number of display items, measurement items, and calculation method.

Item	Setting		Reference
Mode	Selects the number of measurement items displayed on the screen in the measurement mode. • 1 Line • 2 Lines • 3 Lines • 4 Lines		Page 46
Display Items	Selects the measurement item and calculation method for each display line ([Line 1]/[Line 2]/[Line 3]/[Line 4]).		Page 47
	Item	Selects the measurement item. • Thickness (Default) • Gap A • Gap B • A-B • Temperature (Only when the CL-0741 Temperature Measurement Function is installed)	
	Calculation	Selects the calculation method. • Instant (Default) • Max • Min • Range	
	Deviation	Selects whether or not to perform deviation calculation. • OFF (Default) • ON	
Update Interval	Selects the interval to update the measured value/calculated value displayed on the measurement mode screen. • 1.0 sec • 0.5 sec • 0.2 sec (Default)		Page 91

■ Output

Sets the analog output, BCD output, and comparator output items and output conditions.

Item	Setting		Reference
Analog CL-0730 CL-0732	Sets the analog output for each terminal ([V-OUT 1]/[V-OUT 2]/[V-OUT 3]).		Page 64
	Item	Selects the analog output item. • Thickness • Gap A • Gap B • A-B • Temperature (Only when the CL-0741 Temperature Measurement Function is installed)	
	Deviation	Enables/disables the deviation function for the selected output item. • OFF (Default) • ON	
	Zero	Enter the zero point and full-scale point of the analog output. • Setting range: −999999.99 to 999999.99 µm (Default: Zero point 0.00 µm/Full-scale point 1000.00 µm)	
	Full		
BCD CL-0750	Sets the BCD output.		Page 76
	Item	Selects an item to be displayed on the BCD indicator. • Thickness (Default) • Gap A • Gap B • A-B • Display 1 • Display 2 • Display 3 • Display 4	
	Calculation	Selects the display value type. • Instant (Default) • Max • Min • Range	
	Deviation	Enables/disables the deviation function for the selected output item. • OFF (Default) • ON	

Item	Setting		Reference
Comparator CL-0731 CL-0732	Sets the comparator output.		Page 67
	Mode	Selects the comparator mode. • Separate (Default) • Link	
	Item	Selects the measurement item ([OFF]/[Thickness]/[Gap A]/[Gap B]/[A-B]/[Error]) to be judged.	
	Deviation	Enables/disables the deviation function for the measurement item of the selected judgment target. • OFF (Default) • ON	
	Upper	Enters the judgment range ([Upper]/[Lower]). • Setting range: −999999.99 to 999999.99 µm (Lower < Upper) (Default: Upper 999999.99 µm/Lower 0.00 µm)	
	Lower		

■ Calibration

Configures the necessary calibration settings and performs calibration.
Items displayed on the [Calibration] screen vary depending on the material of the measurement target selected in [Mode] in [Measurement].

● Calibration/Conductor

Sets the following items when [Mode] in [Measurement] is set to [Conductor].

Item	Setting	Reference
Sensor Distance	Enter a value for the gap between sensors. • Setting range: 0.00 to 999999.99 µm (Default: 0.00 µm)	Page 52

● Calibration/Insulator

CL-0740

Sets the following items when [Mode] in [Measurement] is set to [Insulator].

Item	Setting	Reference
Sensor to Use	Selects a sensor to use for insulator measurement. • Sensor A (Default) • Sensor B	Page 53
Reference Gap	Enter a value for the reference gap. • Setting range: 0.00 to 999999.99 µm (Default: 0.00 µm)	Page 55
Position Correct	Enables/disables the position correction function to correct the reference gap. • Parallel • Opposite • OFF (Default)	Page 93

■ Interface

Configures the settings related to the communication interface.

Item	Setting		Reference
RS-232C	Configures the RC-232C communication settings.		Page 83
	Baud Rate	Selects the baud rate transfer speed. • 115200 bps (Default) • 19200 bps • 9600 bps	
	Response	Selects whether or not to transmit the return value “G” when a command is received successfully. • ON (Default) • OFF	
	Auto Save	Enables/disables the automatic save of a transmitted communication command. Changing this setting also changes the [Auto Save] setting in [Ethernet]. • ON • OFF (Default)	
Ethernet CL-0751	Sets the Ethernet communication conditions. • These settings are available only when the CL-0751 Ethernet Connectivity Function is installed.		Page 85
	MAC Address	Displays the MAC address of the instrument.	
	IP Address	Enter the IP address/subnet mask/default gateway of the instrument to communicate with the personal computer connected via Ethernet.	
	Subnet Mask		
	Default Gateway		
	Auto Save	Enables/disables the automatic save of a transmitted communication command. Changing this setting also changes the [Auto Save] setting in [RS-232C]. • ON • OFF (Default)	
Remote	Selects the type of STATUS signal to be output from the REMOTE connector.		Page 85
	Item	• Status (Default) • Error	

■ General

Changes the display language, initializes the settings, and displays options and product information.

Item	Setting	Reference
Language	Selects the display language. • English • Japanese (Default)	Page 95
Initialize	Initializes the settings of the instrument.	Page 95
Option Information	Displays a list of optional functions installed on the instrument.	Page 96
About	Displays the product information about the instrument.	Page 96

Chapter 5

Appendix

5.1. List of Error Messages 106

5.2. Maintenance and Inspection 107

5.3. Specifications 109

5.4. Technical Information 116

5.1 List of Error Messages

Message	Cause/Remedy
An error has been detected.	This message is displayed when an unmeasurable failure is detected during a startup check. If this message is displayed again even after the instrument is restarted or initialized, contact your nearest Ono Sokki sales office or the distributor where you purchased the instrument.
Settings have been initialized due to corrupted memory.	This message is displayed when a corruption of hardware configuration is detected during a startup check. If this message is displayed again even after the instrument is restarted, initialize the instrument (refer to “4.3.1 Initializing Settings” on page 95).
Please enter a value that is different from the zero scale value.	These messages are displayed when an invalid value is entered during value setting. Select [OK] and modify the value.
Please enter a value that is different from the full scale value.	
Please enter a value greater than the lower limit.	
Please enter a value less than the upper limit.	
Please enter a value other than 0.	
This value is invalid.	
Relative permittivity could not be calculated.	This message is displayed when the master piece is measured during calibration, and the calculated relative permittivity falls outside the valid range. Check if the entered master piece thickness is correct.
Temperature cannot be measured.	Check if the temperature sensor is connected correctly.

5.2 Maintenance and Inspection

■ About power fuse

If the power fuse blows, assume the instrument is in an abnormal state.
Contact your nearest Ono Sokki sales office or the distributor where you purchased the instrument for repair and inspection as soon as possible.

- Use the power fuses of the same ratings to prevent fire.
  The following power fuse is used in this instrument.

Item	0218002.MXP (manufactured by Littelfuse)
Rating	2 A/250 VAC

- Power fuses are placed in the fuse holder on the rear panel. For checking or replacing the power fuse, refer to “Checking/replacing the power fuse” on page 107.

■ Checking/replacing the power fuse

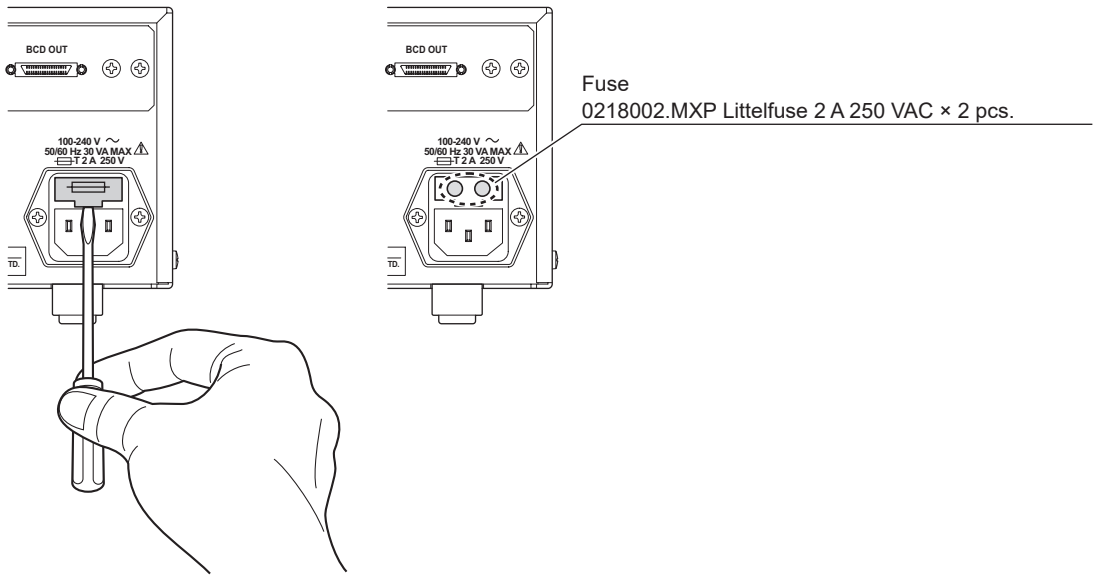
1 **Turn the POWER switch off (○).**

2 **Disconnect the AC power cable from the 100 to 240 VAC power input connector.**

3 **Wait at least 1 minute after disconnecting the AC power cable.**

4 **Using a slotted screwdriver, etc., pull out the fuse holder on the rear panel toward you.**

5 **Check or replace the fuses and then return the fuse holder to its original position.**



5.2.1 Troubleshooting

Problem	Cause/Remedy
The power is not turned on.	Check the power cable connection (refer to “Connecting the power cable” on page 45).
	Check if the fuse has blown. If so, replace it with a new one (refer to “Checking/replacing the power fuse” on page 107).
The system does not start.	Check the power cable connection (refer to “Connecting the power cable” on page 45).
	Check if the POWER switch has been turned on (❙) (refer to “Turning on the power” on page 45).
Measured values are unstable.	Check if the material of the measurement target matches the [Mode] setting in [Measurement].
	Check that the measurement target is electrically connected to the grounding terminal of the instrument (refer to “2.2.2 Connecting Ground” on page 44).
	Check if the used VE sensor has been adjusted to match the instrument.
	Make sure that the end face of the VE sensor and the measurement surface of the measurement target are clean.
	Make sure that the measurement target has a flat surface larger than the outer diameter of the VE sensor.
	Check for cracks, damage, or other abnormalities in the VE sensor cable.
	Check if the appropriate VE sensor is selected on the [Sensors] screen (refer to “4.1.1 Selecting Sensor to Use” on page 88).
	If the ambient temperature is not constant, measured values may be unstable due to the expansion or contraction of the measurement target. In addition, this instrument is affected by ambient temperature, causing variations in measured values. Make sure that the temperature in the operating environment is constant.
The comparator function does not work.	The comparator function works only while the calculation is in progress. Make sure that the measurement mode screen is displayed and the calculation has started.
The instrument does not enter the setting mode.	You cannot switch to the setting mode while the calculation is in progress or paused. Stop the calculation before switching modes.

5.3 Specifications

5.3.1 Specifications

■ Display

Method	Transmissive LCD with white LED backlight	
Size	272 × 480 dots (4.3 inches)	
Item	Thickness	Thickness of the measurement target (conductors/ semiconductors)
	Gap A	Gap between Sensor A and the measurement target
	Gap B	Gap between Sensor B and the measurement target
	A-B	(Difference between Sensor A and Sensor B) Height difference/parallelism (A-B)
	Thickness CL-0740	Thickness of the measurement target (insulators)
	Temperature CL-0741	Temperature
Number of items	1/2/3/4 • This can be set freely from the measurement items	
Calculation	Display is switchable between Max (maximum value)/Min (minimum value)/ Range (maximum value - minimum value)	
Deviation	Deviation display is switchable	
Unit	μm/mm	
Resolution	VE-2011/VE-5011/VE-1021/VE-5010/VE-1020	0.1 μm
	VE-1520	0.5 μm
	VE-3020/VE-8020/VE-8021	1.0 μm
Resolution: When the option is installed CL-0720	VE-2011	0.02 μm
	VE-5010/VE-5011	0.05 μm (When the CL-0722 Measurement Range Change Function is used together: 0.02 μm)
	VE-1020/VE-1021	0.1 μm
	VE-1520	0.2 μm
	VE-3020/VE-8020/VE-8021	0.5 μm
Update interval	0.2 s/0.5 s/1.0 s	

Language	Japanese/English
Screen operation	Touch panel/button operation

■ Sensor input

Input cable	VL-1520/VL-1521	
Compatible sensor	VE-5010/VE-1020/VE-1520/VE-3020/VE-8020/VE-2011/VE-5011/VE-1021/VE-8021	
Measurement accuracy	Standard	±0.15 % FS
	High resolution CL-0720	• VE-2011: ±0.12 % FS • VE-5010/VE-5011: ±0.10 % FS • VE-1020/VE-1021/VE-1520/VE-3020/VE-8020/VE-8021: ±0.05 % FS
Temperature characteristics	Within ±0.05 % FS/°C Reference temperature: 23 °C	
Moving average	1 to 200 times	

■ Temperature input CL-0741

Supported sensor	Resistance temperature detector (Pt 100), 3-wire bridge type
Measurement range	0 to 200 °C
Display resolution	0.1 °C
Measurement accuracy	±0.3 % FS (excluding sensor accuracy)
Update cycle	200 ms or less
Exciting current	Approx. 1 mA
Compatible connector	M4 screw terminal connection

■ Remote signal output

Output method	1 make contact output (normally open contact output)	
Contact capacity	Max. 60 VAC/DC, Max. 400 mA (resistance load)	
Judgment interval	0.1 s	
Function	Input signal	START/STOP/PAUSE/CALIB
	Output signal	• Select from [Status] and [Error] • +5 V voltage output
Compatible connector	ER03-PB8M-T (manufactured by Tajimi Electronics)	

■ Analog output

CL-0730 CL-0732

Number of outputs	3
Output item	Select from [Thickness], [Gap A], [Gap B], [A-B], and [Temperature]* • Deviation selectable
Output range	±5 V
Number of bits	16 bits
DC offset	±10 mV or less
Temperature coefficient	Within ±0.05 % FS/°C
Load resistance	100 kΩ or more
Accuracy (linearity)	Within ±0.2 % FS
Update cycle	10 ms • Effective only for the first Gap A/Gap B moving average setting: 0.1 ms
Compatible connector	C02 type (BNC)

* [Temperature] is available only when the CL-0741 Temperature Measurement Function is installed.

■ BCD output

CL-0750

Output method	6-digit parallel BCD, open collector
Output item	• Measurement items: Thickness/Gap A/Gap B/A-B • Calculation: Instant/Max/Min/Range • Deviation: OFF/ON Select a combination of the above or Display 1, 2, 3, or 4
Output update cycle	10 ms
Compatible connector	HDRA-E36MA (manufactured by Honda Tsushin Kogyo)
Applicable cable	AA-8207 (3 m, one end open)

■ Comparator output

CL-0731 CL-0732

Number of outputs	3	
Output method	1 make contact output (normally open contact output)	
Contact capacity	Max. 60 VAC/DC, Max. 400 mA (resistance load)	
Operation mode	Select from separate/link mode	
	Separate mode	Measurement items and upper and lower limits can be set separately for each port.
	Link mode	• Port 1 is open when the measured value is above the upper limit. • Port 2 is open when the measured value is between the upper and lower limits. • Port 3 is open when the measured value is below the lower limit.

Output item	Separate mode	Select from [OFF], [Thickness], [Gap A], [Gap B], [A-B], and [Error]
	Link mode	Select from [OFF], [Thickness], [Gap A], [Gap B], and [A-B]
Judgment interval	10 ms	
Compatible connector	MC 1,5/6-STF-3,81-1827745 (manufactured by Phoenix Contact)	

■ RS-232C communication

Communication type	Asynchronous full-duplex mode
Baud rate	9600 bps/19200 bps/115200 bps
Data bit	8 bits
Parity	None
Stop bit	1 bit
Flow control	Hardware
Terminator	CR+LF
Compatible connector	D-sub 9-pin (female)

■ Ethernet communication

CL-0751

Transmission system	Automatic selection of 10BASE-T/100BASE-TX
Communication protocol	TCP/IP (IPv4)
Electrical specifications	In compliance with IEEE802.3
Function	Command control and data transmission (socket communication) using a dedicated port
Compatible connector	RJ-45

■ CL-0710 Sensor Amplifier/CL-7100S dedicated cable

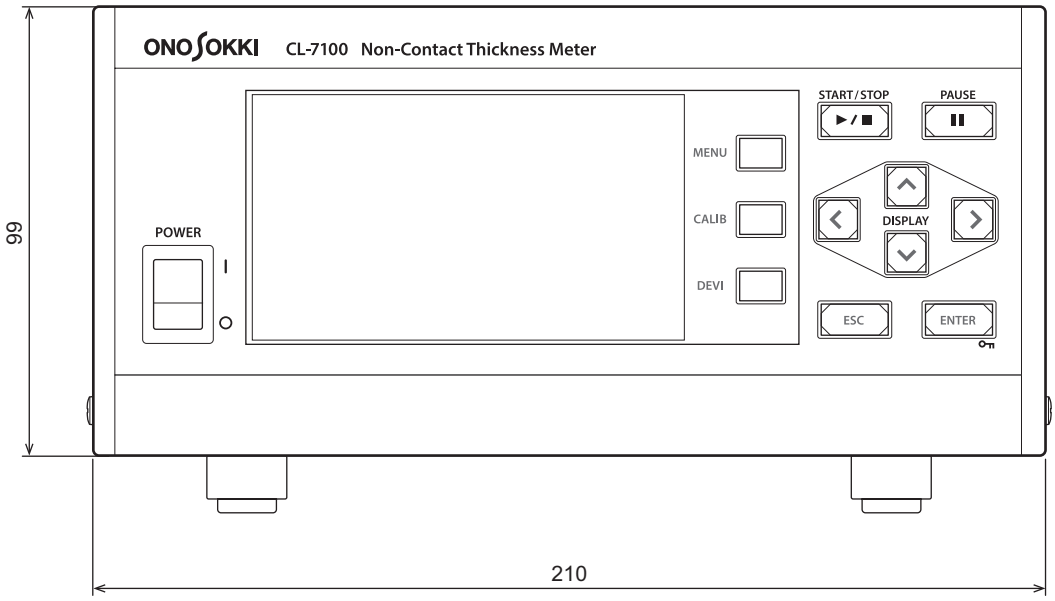
Sensor amplifier	Outside dimensions (W/H/D)	81 mm × 48 mm × 35 mm (excluding protrusions)
	Weight	Approx. 210 g
	Compatible connector	HR10A-10P-10S(73) (manufactured by Hirose Electric)
Dedicated cable	Compatible connector	Instrument side: HR10G-10R-10S(71) (manufactured by Hirose Electric) Amplifier side: HR10G-10R-10P(73) (manufactured by Hirose Electric)
	Conversion cable length	2.5 m (standard) • Max. 10 m (optionally)

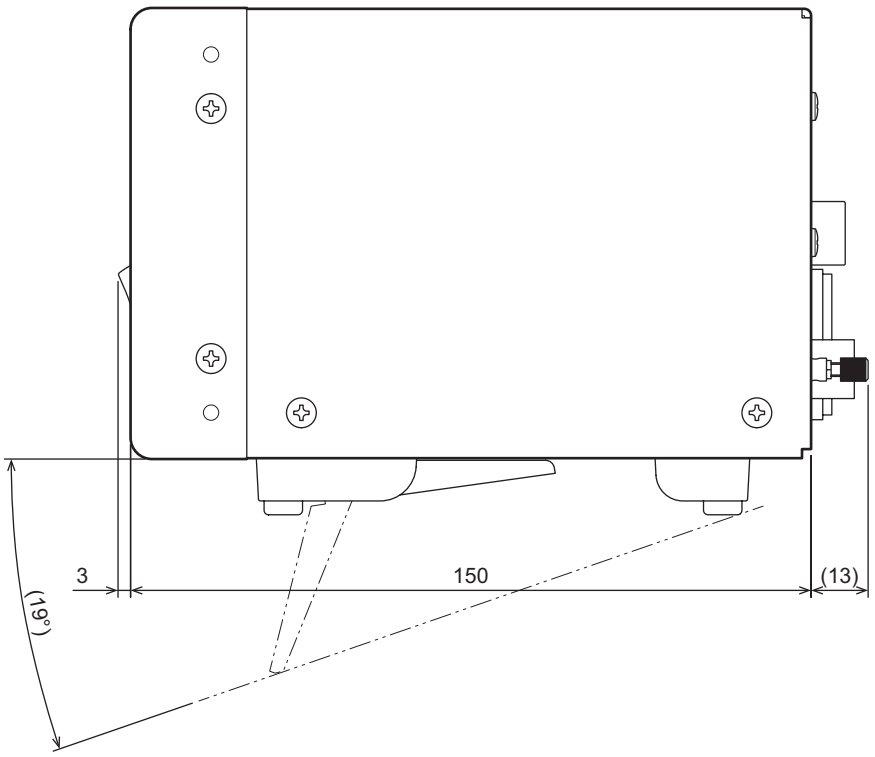
■ General specifications

Power supply	100 to 240 VAC ±10 %, 50/60 Hz, Power consumption: 36 VA or less	
Outside dimensions (W/H/D)	210 mm × 99 mm × 150 mm (excluding protrusions)	
Weight	Approx. 1.6 kg	
Operating temperature range	0 to 40 °C	
Storage temperature range	−10 to 50 °C	
Operating humidity range	20 to 85 % (no condensation)	
Storage humidity range	20 to 85 % (no condensation)	
Warm-up time	At least 40 minutes	
Electric shock protection class	I (3-pin)	
Overvoltage category	II	
Operating environment	• Indoor Use (laboratory/factory) • Use at an altitude of up to 2,000 m • POLLUTION DEGREE: 2	
Applicable standards	RoHS Standard	EN IEC 63000
	Safety Standard	EN 61010-1
Supplied item	• AC power cable • REMOTE connector (ER03-PB8M-T, manufactured by Tajimi Electronics) • CL-7100S dedicated cable (2.5 m) • Instruction manual (this manual)	

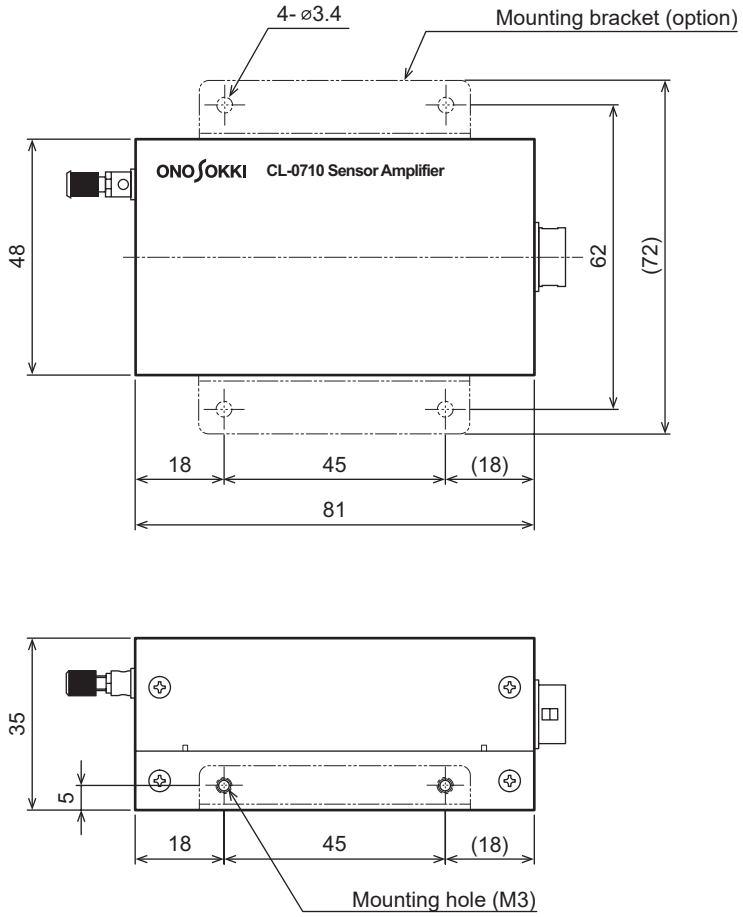
5.3.2 Outside Dimensions

■ CL-7100/CL-7100S





■ CL-0710


4- ⌀3.4
Mounting bracket (option)
ONOSOKKI
CL-0710 Sensor Amplifier
48
62
(72)
18
45
(18)
81
35
5
18
45
(18)
Mounting hole (M3)

5.4 Technical Information

5.4.1 Communication Commands (RS-232C/Ethernet)

When a command is successfully received, “G” or response data is transmitted.
Otherwise, an error command is transmitted.

- For details about error commands, refer to “Standard responses” on page 127.
- For RS-232C communication, when [Response] is set to [OFF], “G” is not transmitted upon successful data reception (refer to “Setting RS-232C communication” on page 83).

■ General commands

Command	Function	Transmit (+CRLF)	Receive (+CRLF)
MOR	Reads out the current mode or status.	“MOR”	“0”: Measurement mode “1”: Calculation in progress “2”: Calculation paused “3”: Setting mode “4”: Calibration mode “5”: Deviation setting mode
VER	Reads out the version.	“VER”	“**********” (* denotes a character) • 9 characters including decimal points, commas, and digits
UNT	Reads out the product model.	“UNT”	“CL-7100” or “CL-7100S”
SNR	Reads out the serial number.	“SNR”	A 1- to 10-digit integer
OPT	Reads out the installation status of optional features.	“OPT”	“①, ②, ③, ④, ⑤, ⑥, ⑦, ⑧, ⑨, ⑩, ⑪” ①: Analog Output Function ②: Comparator Output Function ③: BCD Output Function ④: High-resolution Measurement Function ⑤: High-impedance Grounding Mode ⑥: Insulator Measurement Function ⑦: Ethernet Connectivity Function ⑧: Temperature Measurement Function ⑨: Measurement Range Change Function ⑩: Reserved ⑪: Parallel Measurement Function (sub unit) • “1” when installed, and “0” when not installed
NOP	Prevents a timeout during time series data output.	“NOP”	None

■ Measurement commands

Command	Function	Transmit (+CRLF)	Receive (+CRLF)
CST	Starts calculation.	“CST”	Standard response
CSP	Stops calculation.	“CSP”	Standard response
CPS	Pauses calculation.	“CPS”	Standard response
CCS	Restarts calculation.	“CCS”	Standard response
MDR	Reads out the measurement result of the specified item.	“MDR①” ① = 0: Thickness 1: Gap A 2: Gap B 3: A-B 4: Temperature (optional)	“ERR27” or “①” • ①: Up to 8 characters, including signs and decimal points • The currently set unit is used.
ADR	Reads out all measured data.	“ADR”	“①, ②, ③, ④ (,⑤)” ①: Thickness ②: Gap A ③: Gap B ④: A-B ⑤: Temperature (optional) • Up to 8 characters, including signs and decimal points • The currently set unit is used.
DDR	Reads out the display value.	“DDR①” ① = 0: Display item 1 1: Display item 2 2: Display item 3 3: Display item 4	“①” • ①: Up to 8 characters, including signs and decimal points • The currently set unit is used.
DRA	Reads out all display values.	“DRA”	“①, ②, ③, ④” ①: Display item 1 ②: Display item 2 ③: Display item 3 ④: Display item 4 • Up to 8 characters, including signs and decimal points • The currently set unit is used.
CSR	Reads out the comparator status. CL-0730 CL-0731	“CSR①” ① = 0: CH-1 1: CH-2 2: CH-3 3: Link mode	“0”: OFF “1”: Above the upper limit “2”: Within the upper and lower limits “3”: Below the lower limit
STT	Starts the link output. • Output interval: 1 s	“STT”	“①, ②, ③, ④, ⑤ (, ⑥)” ①: Instrument status (same as “SER”) ②: Thickness ③: Gap A ④: Gap B ⑤: A-B ⑥: Temperature (optional) • Up to 8 characters, including signs and decimal points • The currently set unit is used.
STP	Stops the link output.	“STP”	“G”

Command	Function	Transmit (+CRLF)	Receive (+CRLF)
SER	Reads out the system status.	“SER”	“①” • ① represents one of the following error causes by logical disjunction (OR) using the corresponding bit. When an error occurs, the relevant bit is set to “1”. 1: Gap A UNDER error 2: Gap A OVER error 4: Gap B UNDER error 8: Gap B OVER error 16: Thickness calculation error 32: Temperature correction calculation error

■ Calibration commands

Command	Function	Transmit (+CRLF)	Receive (+CRLF)
MAR	Reads out the reference piece thickness.	“MAR①” ① = 0: Conductor reference piece 1: Insulator Gap A 2: Insulator Gap B • 1 and 2 are available when the option is enabled.	“①” • ①: Up to 8 characters, including signs and decimal points • The currently set unit is used.
MAS	Sets the reference piece thickness.	“MAS①, ②” ① = 0: Conductor reference piece 1: Insulator Gap A 2: Insulator Gap B • 1 and 2 are available when the option is enabled. ② = 0 to 999999.99 [µm] • Conductor reference piece: The gap between sensors combined with the measured value must not exceed the valid range. • Insulator: The reference gap combined with the measured value must not exceed the reference gap.	Standard response
GAR	Reads out the gap between sensors.	“GAR”	“①” • ①: Up to 8 characters, including signs and decimal points • The currently set unit is used.
GAS	Sets the gap between sensors.	“GAS①” ① = 0 to 999999.99 [µm]	Standard response
RER	Reads out the insulator reference gap. CL-0740	“RER”	“①” • ①: Up to 8 characters, including signs and decimal points • The currently set unit is used.
RES	Sets the insulator reference gap. CL-0740	“RES①” ① = 0 to 999999.99 [µm]	Standard response

Command	Function	Transmit (+CRLF)	Receive (+CRLF)
REG	Sets the current measured value as the insulator reference gap. CL-0740	“REG”	Standard response
RDR	Reads out the insulator permittivity. CL-0740	“RDR①” ① = 0: Sensor A 1: Sensor B	“①” • ①: Up to 8 characters, including signs and decimal points • The currently set unit is used.
RDS	Sets the insulator permittivity. CL-0740	“RDS①, ②” ① = 0: Sensor A 1: Sensor B ② = (Permittivity) 1.00001 to 100	“G”

■ Setting commands

Command	Function	Transmit (+CRLF)	Receive (+CRLF)
RLR	Reads out the measurement reference value.	“RLR①” ① = 0: Thickness 1: Gap A 2: Gap B 3: A-B 4: Temperature (optional)	“①” • ①: Up to 8 characters, including signs and decimal points • The currently set unit is used.
RLS	Sets the measurement reference value.	“RLS①, ②” ① = 0: Thickness 1: Gap A 2: Gap B 3: A-B 4: Temperature (optional) ② = 0 to 999999.99 [µm] (① = 0 to 3) –999.9 to 999.9 [°C] (① = 4)	Standard response
REL	Sets the current measured value as the measurement reference value.	“REL①” ① = 0: Thickness 1: Gap A 2: Gap B 3: A-B 4: Temperature (optional) 5: All items	Standard response
DRR	Reads out the display update interval.	“DRR”	“①” ① = 0: 1.0 second 1: 0.5 seconds 2: 0.2 seconds
DRS	Sets the display update interval.	“DRS①” ① = 0: 1.0 second 1: 0.5 seconds 2: 0.2 seconds	Standard response

Command	Function	Transmit (+CRLF)	Receive (+CRLF)
DIR	Reads out the measurement item to display.	“DIR①” ① = 0: Display item 1 1: Display item 2 2: Display item 3 3: Display item 4	“①” ① = 0: Thickness 1: Gap A 2: Gap B 3: A-B 4: Temperature (optional)
DIS	Sets the measurement item to display.	“DIS①, ②” ① = 0: Display item 1 1: Display item 2 2: Display item 3 3: Display item 4 ② = 0: Thickness 1: Gap A 2: Gap B 3: A-B 4: Temperature (optional)	Standard response
DMR	Reads out the display mode.	“DMR①” ① = 0: Display item 1 1: Display item 2 2: Display item 3 3: Display item 4	“①, ②” ① = 0: Deviation OFF 1: Deviation ON ② = 0: Instant 1: Max 2: Min 3: Range
DMS	Sets the display mode.	“DMS①, ②, ③” ① = 0: Display item 1 1: Display item 2 2: Display item 3 3: Display item 4 ② = 0: Deviation OFF 1: Deviation ON ③ = 0: Instant 1: Max 2: Min 3: Range	Standard response
DTR	Reads out the number of display items.	“DTR”	“①” ① = 0: 1 line 1: 2 lines 2: 3 lines 3: 4 lines
DTS	Sets the number of display items.	“DTS①” ① = 0: 1 line 1: 2 lines 2: 3 lines 3: 4 lines	Standard response

Command	Function	Transmit (+CRLF)	Receive (+CRLF)
UNR	Reads out the display unit.	“UNR”	“①” ① = 0: µm 1: mm
UNS	Sets the display unit.	“UNS①” ① = 0: µm 1: mm	Standard response
STR	Reads out the sensor type.	“STR①” ① = 0: Sensor A 1: Sensor B	“①” ① = 1: VE-501x 2: VE-102x 3: VE-152x 4: VE-302x 5: VE-802x 6: VE-201x 7: Equalize 1 8: Equalize 2 9: Equalize 3 F: OFF
STS	Sets the sensor type.	“STS①, ②” ① = 0: Sensor A 1: Sensor B ② = 1: VE-501x 2: VE-102x 3: VE-152x 4: VE-302x 5: VE-802x 6: VE-201x 7: Equalize 1 8: Equalize 2 9: Equalize 3 F: OFF	Standard response
SSR	Reads out the equalized sensor information.	“SSR①” ① = 0: Sensor A/Equalize 1 1: Sensor A/Equalize 2 2: Sensor A/Equalize 3 3: Sensor B/Equalize 1 4: Sensor B/Equalize 2 5: Sensor B/Equalize 3	“①” ① = 0: VE-5010 200 µm 1: VE-5010 2: VE-1020 3: VE-1520 4: VE-3020 5: VE-8020 6: VE-2011 7: VE-5011 200 µm 8: VE-5011 9: VE-1021 A: VE-3021 (discontinued product) B: VE-8021
ANR	Reads out the number of moving average points.	“ANR”	Integer between 1 and 200
ANS	Sets the number of moving average points.	“ANS①” ① = Integer between 1 and 200	Standard response

Command	Function	Transmit (+CRLF)	Receive (+CRLF)
AIR	Reads out the analog output item. CL-0730 CL-0732	“AIR①” ① = 0: V-OUT 1 1: V-OUT 2 2: V-OUT 3	“①” ① = 0: Thickness 1: Gap A 2: Gap B 3: A-B 4: Temperature (optional)
AIS	Sets the analog output item. CL-0730 CL-0732	“AIS①, ②” ① = 0: V-OUT 1 1: V-OUT 2 2: V-OUT 3 ② = 0: Thickness 1: Gap A 2: Gap B 3: A-B 4: Temperature (optional)	Standard response
AMR	Reads out the analog output judgment mode. CL-0730 CL-0732	“AMR①” ① = 0: V-OUT 1 1: V-OUT 2 2: V-OUT 3	“①” ① = 0: Deviation OFF 1: Deviation ON
AMS	Sets the analog output judgment mode. CL-0730 CL-0732	“AMS①, ②” ① = 0: V-OUT 1 1: V-OUT 2 2: V-OUT 3 ② = 0: Deviation OFF 1: Deviation ON	Standard response
AFR	Reads out the full-scale value of analog output. CL-0730 CL-0732	“AFR①” ① = 0: V-OUT 1 1: V-OUT 2 2: V-OUT 3	“①” • ①: Up to 8 characters, including signs and decimal points • The currently set unit is used.
AFS	Sets the full-scale value of analog output. CL-0730 CL-0732	“AFS①, ②” ① = 0: V-OUT 1 1: V-OUT 2 2: V-OUT 3 ② = 0 to 999999.99 [µm] –999.9 to 999.9 [°C]	Standard response
AZR	Reads out the zero-scale value of analog output. CL-0730 CL-0732	“AZR①” ① = 0: V-OUT 1 1: V-OUT 2 2: V-OUT 3	“①” • ①: Up to 8 characters, including signs and decimal points • The currently set unit is used.

Command	Function	Transmit (+CRLF)	Receive (+CRLF)
AZS	Sets the zero-scale value of analog output. CL-0730 CL-0732	"AZS①, ②" ① = 0: V-OUT 1 1: V-OUT 2 2: V-OUT 3 ② = 0 to 999999.99 [µm] –999.9 to 999.9 [°C]	Standard response
COR	Reads out the comparator operation mode. CL-0731 CL-0732	"COR"	"①" ① = 0: Separate 1: Link
COS	Sets the comparator operation mode. CL-0731 CL-0732	"COS①" ① = 0: Separate 1: Link	Standard response
CMR	Reads the comparator item. CL-0731 CL-0732	"CMR①" ① = 0: CH-1 1: CH-2 2: CH-3 3: Link mode	"①, ②" ① = 0: OFF 1: Thickness 2: Gap A 3: Gap B 4: A-B 5: Error ② = 0: Separate 1: Link
CMS	Sets the comparator item. CL-0731 CL-0732	"CMS①, ②, ③" ① = 0: CH-1 1: CH-2 2: CH-3 3: Link mode ② = 0: OFF 1: Thickness 2: Gap A 3: Gap B 4: A-B 5: Error (① = 0 to 2) ③ = 0: Separate 1: Link	Standard response
CHR	Reads out the upper limit of the comparator. CL-0731 CL-0732	"CHR①" ① = 0: CH-1 1: CH-2 2: CH-3 3: Link mode	"①" • ①: Up to 8 characters, including signs and decimal points • The currently set unit is used.
CHS	Sets the upper limit of the comparator. CL-0731 CL-0732	"CHS①, ②" ① = 0: CH-1 1: CH-2 2: CH-3 3: Link mode ② = 0 to 999999.99 [µm]	Standard response

Command	Function	Transmit (+CRLF)	Receive (+CRLF)
CLR	Reads out the lower limit of the comparator. CL-0731 CL-0732	“CLR①” ① = 0: CH-1 1: CH-2 2: CH-3 3: Link mode	“①” • ①: Up to 8 characters, including signs and decimal points • The currently set unit is used.
CLS	Sets the lower limit of the comparator. CL-0731 CL-0732	“CLS①, ②” ① = 0: CH-1 1: CH-2 2: CH-3 3: Link mode ② = 0 to 999999.99 [µm]	Standard response
RSR	Reads out the high resolution option. CL-0720	“RSR”	“①” ① = 0: Standard 1: High resolution
RSS	Sets the high resolution option. CL-0720	“RSS①” ① = 0: Standard 1: High resolution	Standard response
THR	Reads out the measurement target. CL-0740	“THR”	“①” ① = 0: Conductors/semiconductors 1: Insulators
THS	Sets the measurement target. CL-0740	“THS①” ① = 0: Conductors/semiconductors 1: Insulators	Standard response
GPR	Reads out the insulator measuring sensor. CL-0740	“GPR”	“①” ① = 0: Sensor A 1: Sensor B
GPS	Sets the insulator measuring sensor. CL-0740	“GPS①” ① = 0: Sensor A 1: Sensor B	Standard response
GCR	Reads out the position correction setting for insulator measurement. CL-0740	“GCR”	“①” ① = 0: Parallel 1: Opposite 2: OFF
GCS	Sets the position correction setting for insulator measurement. CL-0740	“GCS①” ① = 0: Parallel 1: Opposite 2: OFF	Standard response
ARR	Reads out whether or not to respond to an RS-232C command.	“ARR”	“①” ① = 0: ON 1: OFF

Command	Function	Transmit (+CRLF)	Receive (+CRLF)
ARS	Sets whether or not to respond to an RS-232C command.	“ARS①” ① = 0: ON 1: OFF	Standard response
BOR	Reads out the BCD output item. CL-0750	“BOR”	“①” ① = 0: Thickness 1: Gap A 2: Gap B 3: A-B 4: Display item 1 5: Display item 2 6: Display item 3 7: Display item 4
BOS	Sets the BCD output item. CL-0750	“BOS①” ① = 0: Thickness 1: Gap A 2: Gap B 3: A-B 4: Display item 1 5: Display item 2 6: Display item 3 7: Display item 4	Standard response
BMR	Reads out the BCD output mode. CL-0750	“BMR”	“①, ②” ① = 0: Deviation OFF 1: Deviation ON ② = 0: Instant 1: Max 2: Min 3: Range
BMS	Sets the BCD output mode. CL-0750	“BMS①, ②” ① = 0: Deviation OFF 1: Deviation ON ② = 0: Instant 1: Max 2: Min 3: Range	Standard response
SBR	Reads out the high impedance grounding mode option. CL-0721	“SBR”	“①” ① = 0: ON 1: OFF
SBS	Sets the high impedance grounding mode option. CL-0721	“SBS①” ① = 0: ON 1: OFF	Standard response
TMR	Reads out the temperature correction function setting. CL-0741	“TMR”	“①” ① = 0: ON 1: OFF

Command	Function	Transmit (+CRLF)	Receive (+CRLF)
TMS	Sets the temperature correction function. CL-0741	“TMS①” ① = 0: ON 1: OFF	Standard response
TCR	Reads out the temperature correction coefficient and the reference temperature. CL-0741	“TCR”	“①, ②” ① = –999999.99 to 999999.99 [µm/°C] (coefficient) ② = –999.9 to 999.9 (reference temperature)
TCS	Sets the temperature correction coefficient and the reference temperature. CL-0741	“TCS①, ②” ① = –999999.99 to 999999.99 [µm/°C] (coefficient) ② = –999.9 to 999.9 (reference temperature)	Standard response
ROR	Reads out the remote signal STATUS mode.	“ROR”	“①” ① = 0: Calculation status indication 1: Error status indication
ROS	Sets the remote signal STATUS mode.	“ROS①” ① = 0: Calculation status indication 1: Error status indication	Standard response
INT	Initializes the setting items other than the communication settings.	“INT”	Standard response
SAV	Saves the settings.	“SAV”	Standard response
ACR	Reads out the interface auto save function.	“ACR”	“①” ① = 0: ON 1: OFF
ACS	Sets the interface auto save function.	“ACS①” ① = 0: ON 1: OFF	Standard response
LNR	Reads out the display language.	“LNR”	“①” ① = 0: Japanese 1: English
LNS	Sets the display language.	“LNS①” ① = 0: Japanese 1: English	Standard response

■ Standard responses

Command	Function
G	Successful completion
ERR24	Unregistered command error
ERR25	Argument error
ERR26	Condition error (a command was received at a prohibited timing)
ERR27	Option not installed error

■ Revision history

Revision date	Version	Revision details
10/30/2025	1.0	CL-7100/CL-7100S Instruction Manual, the first edition issued

ONO SOKKI CO., LTD.

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