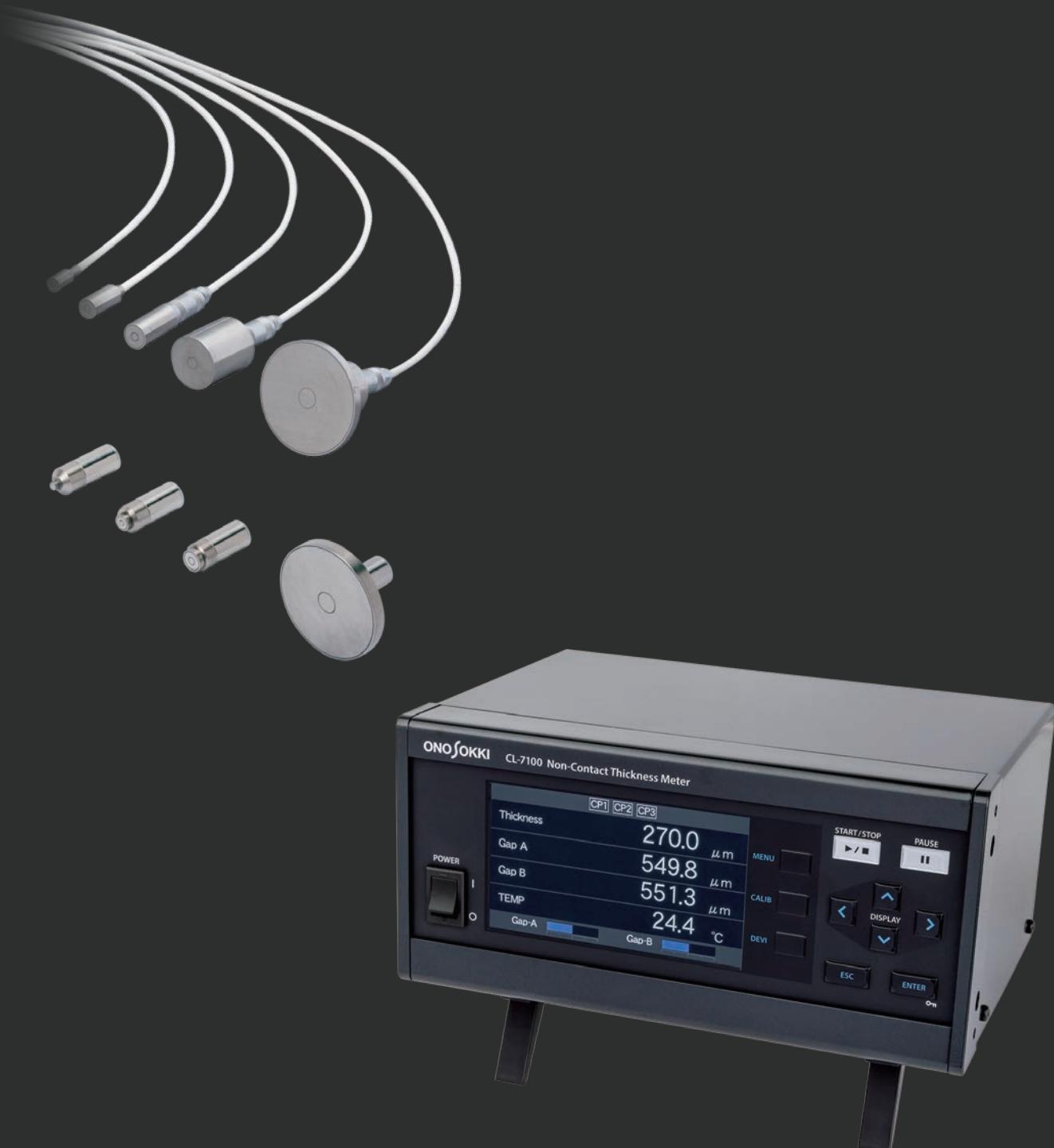


CL/VE series

ONO SOKKI

Electrostatic capacitance-type Non-contact Thickness Meter

Non-contact, High-Precision Thickness Measurement
for Conductors, Semiconductors, and Insulators



Electrostatic capacitance-type Non-contact Thickness Meter

High-precision, fast-response thickness meters that assist in streamlining inspection processes.

It measures the thickness of silicon wafers, electromagnetic steel sheets for motors, and insulators used in films and electrodes for EV batteries without contact. By combining a variety of gap detectors with the renewed thickness meter (CL-7100 Series), it supports manufacturing sites and quality control for conductors, semiconductors, and insulators.



Features

The "CL series Electrostatic capacitance-type Non-contact Thickness Meter" can be combined with the "VE series Gap Detector" to measure with high precision the gap between the measurement target and the displacement sensor, and then calculate the thickness of the target based on the result. Furthermore, by connecting a PT-100 temperature sensor, temperature measurement and temperature compensation are also available (optional).

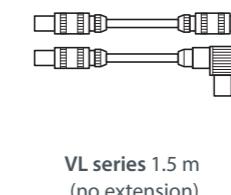
Non-contact measurement is ideal for measuring the thickness of materials where contact should be avoided, such as semiconductor wafers, soft films, and easily scratched glass. It can also be used for measurements where contact is difficult and hazardous, such as measuring motor shaft runout.

System configurations

Non-contact Thickness Meters



Signal cables



Displacement sensors



*1: extended up to 10 m (option)
*2: VE-5010, VE-1020 directly attached cable

CL-7100:

The CL-7100 has a built-in sensor amplifier and can be used to connect directly with the sensor of VE series. It is suitable for offline measurement in a desktop environment and enables easy measurement with a simple configuration.

CL-7100S:

By installing an external amplifier for the sensor, the detector and thickness meter can be installed separately. The standard cable length between the thickness meter and sensor amplifier is 2.5 m, and it can be extended up to 10 m as an option. It supports situations such as integrating into another equipment, where a certain distance between the detector and the main unit of the thickness meter is required, and is also suitable for real-time measurement.

Electrostatic capacitance-type Non-contact Thickness Meter

Non-contact measurement of conductors, semiconductors, and insulators*1—all in one device.

The CL-7100 series brings new possibilities to your production line.

Improved basic performance while maintaining compatibility with the existing model (CL-5610 series). You can continue using your current sensors and cables as they are*2.

*1: The CL-0740 Insulator Measurement Function (option) is required.

*2: Adjustment in combination with the thickness meter is required. Please contact to your nearest distributors or sales office.



What is Electrostatic capacitance-type Non-contact Thickness Meter?

There are wide range of measurement items.

It measures thickness and displacement with high precision. For each measured value, calculations such as deviation, maximum value, minimum value, and maximum range (maximum value – minimum value) are possible. In addition, it also supports temperature measurement.

Thickness measurement of insulator is available.

When the CL-0740 optional Insulator Measurement Function is installed, it allows measurement of insulators such as thin plastic film or glass sheet.

(Compound materials cannot be measured. Some materials cannot be measured because of their relative permittivity.)

Stable measurement even for samples where electrical conduction is difficult.

When the measurement target is held on a table coated with a fluorine-based film, it is difficult to ensure sufficient conductivity. Even in such cases, the CL-0721 High Impedance Grounding Mode (option) enables stable measurement.

Achieves integration with external devices through a variety of interfaces.

As external interfaces, remote terminals and RS-232C terminals are provided as standard. The BCD output terminals and Ethernet are available as options. The thickness meter can be incorporated into production facility to transmit data and control remotely.

High accuracy and high response measurement performance

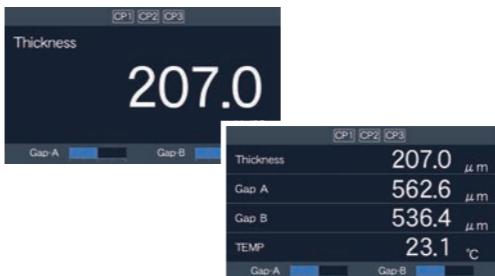


Supports high-precision measurement with accuracy of ± 0.05 to $\pm 0.12\%$ FS (depending on sensors).

The update cycle has been reduced from 20 ms to 10 ms.

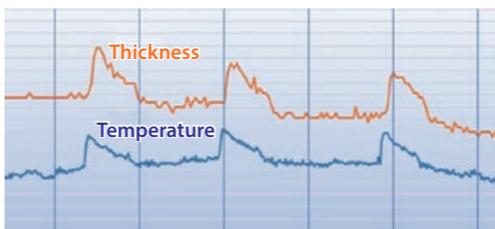
Effective for multi-point measurement and high-speed lines.

Large color LCD touch panel to offer both visibility and intuitive operations



The intuitive menu display allows up to four measurement data items to be shown on a single screen. It also supports hard key operation, enabling use even while wearing gloves.

Temperature measurement/correction functions (option)



*Simultaneous measurement of thickness and temperature (image diagram)

Environmental temperature measurement using the PT-100 temperature sensor and temperature correction are available. By acquiring temperature data simultaneously with thickness measurement, measurement errors caused by temperature variations are compensated, achieving higher-precision measurement.

Ethernet available (option)



Ethernet has been added to the external communication functions. By connecting to your own network, it enables centralized management, monitoring, and data collection by a host system.

Compact, lightweight and low power consumption



Approximately 50 % smaller and lighter than existing models. Its low-power consumption design reduces environmental impact.

Specifications

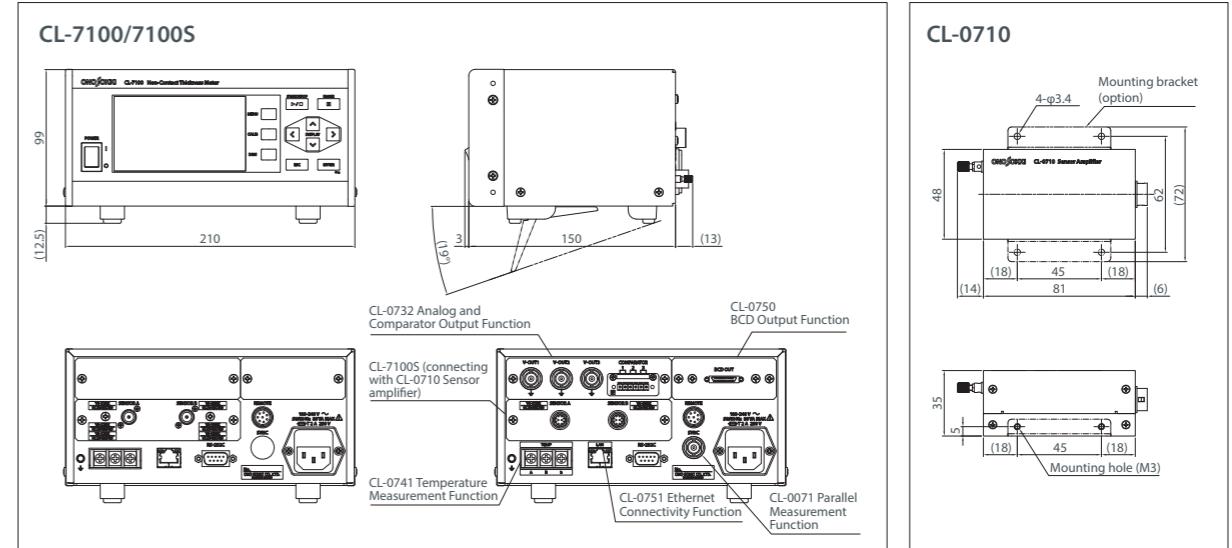
● CL-7100/7100S Non-contact Thickness Meter

Measurement items	Thickness: Thickness of the measurement target (conductors/semiconductors/insulators*) *when CL-0740 installed	
	Gap A: Gap between Sensor A and the measurement target (conductors/semiconductors only)	
	Gap B: Gap between Sensor B and the measurement target (conductors/semiconductors only)	
	A-B: Height difference/parallelism (A-B) (conductors/semiconductors only)	
	Temperature: Temperature *when CL-0741 installed	
Compatible sensor/ Resolution	Sensor	Resolution
	VE-2011/VE-5011/VE-1021	0.1 μm
	VE-5010/VE-1020	0.5 μm
	VE-1520	0.5 μm
	VE-3020	1.0 μm
	VE-8020/VE-8021	
	VE-2011	0.02 μm
	VE-5010/VE-5011	0.05 μm *when CL-0722 installed: 0.02 μm
	VE-1020/VE-1021	0.1 μm
	VE-1520	0.2 μm
Measurement accuracy	Sensor	Accuracy
	VE-5010/VE-1020/VE-1520/VE-3020/ VE-8020/VE-2011/VE-5011/VE-1021/ VE-8021	± 0.15 % FS
	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
Sensor input cable	VL-1520 (1.5 m, both ends straight connector) / VL-1521 (1.5 m, L type ⇄ Straight connector)	
Display	4.3 inch touch panel LCD (up to 4 items display)	
Remote signal input/output	Output method	Output
	Input signal	START/STOP/PAUSE/CALIB
	Function	• Select from [Status] and [Error] • +5 V voltage output
	Compatible connector	ER03-PB8M-T manufactured by Tajimi Electronics
Interface	RS-232C, Ethernet (option, CL-0751)	
General specifications	Power supply	100 to 240 VAC ±10 %, 50/60 Hz, Power consumption: 36 VA or less
	Outer dimension	210 (W) x 99 (H) x 150 (D) mm (excluding protrusions)
	Weight	Approx. 1.6 kg
	Operating temperature range	0 °C to 40 °C
	Storage temperature range	-10 °C 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	II (3 pin)
	Overvoltage category	II
Operating environment	• Outdoor use (laboratory/factory) • Use at an altitude of up to 2,000 m • Contamination level: 2	
	Comforming to standards	RoHS Directive 2011/65/EU Standard: EN IEC 63000 Low Voltage Directive EN 61010-1
	Accessories	• AC power cable • Remote connector (made by Tajimi: ER03-PB8M) • Instruction manual
	CL-0710	Outer dimension 81 (W) mm x 48 (H) mm x 35 (D) mm (excluding protrusions)
Accessories for CL-7100S	Sensor amplifier	Weight Approx. 210 g
	Dedicated cable (2.5 m) *up to 10 m (option)	

● Options

CL-0720 High-resolution Measurement Function	CL-0732 Analog and Comparator Output Function
This option improves display resolution and calculation accuracy.	This option allows the simultaneous use of the analog output and comparator output functions.
CL-0721 High-impedance Grounding Mode	CL-0740 Insulator Measurement Function
This option ensures stable measurement even in an environment where the ground resistance is large or unstable.	This option enables thickness measurement of insulators.
CL-0722 Measurement Range Change Function	CL-0741 Temperature Measurement Function
This option changes the measurement range of VE-5010/VE-5011.	Supported sensor Resistance temperature detector (Pt 100), 3-wire bridge type
CL-0730 Analog Output Function	Measurement range 0 °C to 200 °C
Number of outputs 3	Display resolution 0.1 °C
Output items Select from [Thickness], [Gap A], [Gap B], [A-B], and [Temperature] *Deviation selectable	Measurement accuracy ± 0.3 % FS (excluding sensor accuracy)
Output range ± 5 V	Update cycle 200 ms or less
Load resistance 100 kΩ or more	Exciting current Approx. 1 mA
Accuracy (linearity) Within ± 0.2 % FS	Compatible connector M4 screw terminal connection
Update cycle 10 ms *Effective only for the first Gap A/Gap B moving average setting: 0.1 ms	CL-0750 BCD Output Function
Compatible connector BNC (C02 type)	Output method 6-digit parallel BCD, open collector • Measurement items: Thickness/Gap A/Gap B/A-B Output items Select a combination of the above or Display 1, 2, 3, or 4
CL-0731 Comparator Output Function	Output update cycle 10 ms
Number of outputs 3	Compatible connector HDRA-E36MA (manufactured by Honda Tushin Kogyo)
Output method 1 make contact output	Applicable cable AA-8207 (3 m/one end open)
Contact capacity Max. 60 VAC/DC, Max. 400 mA (resistance load) Select from separate/link mode	CL-0751 Ethernet Connectivity Function
Operation mode Separate mode Measurement items and upper and lower limits can be set separately for each port.	Transmission system Automatic selection of 10BASE-T/100BASE-TX
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.	Communication protocol TCP/IP (IPv4)
Output items Separate mode Select from OFF/Thickness/Gap A /Gap B/A-B Link mode Select from OFF/Thickness/Gap A /Gap B/A-B	Electrical specifications Compliance with IEEE802.3
Judgment interval 10 ms	Function Command control and data transmission (socket communication) using a dedicated port
Compatible connector MC 1,5/6-STF-3,81-1827745 (made by Phoenix Contact)	Compatible connector RJ-45
CL-0071 Parallel Measurement Function	CL-0071 Parallel Measurement Function
This option allows the use of synchronously connected 2 units of CL-7100/CL-7100S.	

● Outline drawings (Unit: mm)



Gap Detector

The VE Series Gap Detector is a displacement sensor that detects the gap between the sensor and the measurement target with high precision.

By combining it with the CL series Electrostatic capacitance-type Non-contact Thickness Meter, it can be widely used for measuring shaft vibration and run-out of rotating shafts such as turbines, electric motors, compressors, and machine tool spindles, as well as for measuring the thickness and shape of objects.



Specifications

	VE-2011	VE-5011	VE-1021	VE-8021
Measurement range (μm)	20 to 200	50 to 500 20 to 200* ²	100 to 1000	800 to 8000
Minimum measurement diameter (mm)	φ3 (holding section φ10)	φ6 (holding section φ10)	φ8 (holding section φ10)	φ40 (holding section φ10)
Connection method	Connector using the dedicated cable			
Dedicated cable (1.5 m)	VL-1520 (both ends straight connector), VL-1521 (L type ⇄ Straight connector), no extension			
Operating temperature range* ¹			0 to 80 °C	

	VE-5010	VE-1020	VE-1520	VE-3020	VE-8020
Measurement range (μm)	50 to 500 20 to 200* ²	100 to 1000	150 to 1500	300 to 3000	800 to 8000
Minimum measurement diameter (mm)	φ6	φ8	φ10	φ20	φ40 (holding section φ20)
Connection method	Directly attached cable (1.5 m)		Connector using the dedicated cable		
Dedicated cable (1.5 m)			VL-1520 (both ends straight connector) VL-1521 (L type ⇄ Straight connector), no extension		
Operating temperature range* ¹			0 to 80 °C		

*1: The operating temperature range is the temperature range in which the sensor can operate.

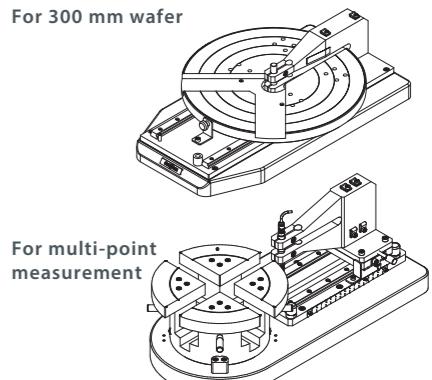
The operating range for which accuracy is guaranteed at 23±2 °C.

*2: When CL-0722 (option) installed

Wafer slide table

This is a manual slide table designed to be used in combination with the CL-7100 series and VE sensors (VE-5011, 1021, 1520) to measure the thickness of conductive wafers such as silicon wafers in a non-contact manner. The sensors are positioned to sandwich the wafer from above and below the table. The wafer mounting surface is designed with grooves, allowing smooth operation of vacuum tweezers.

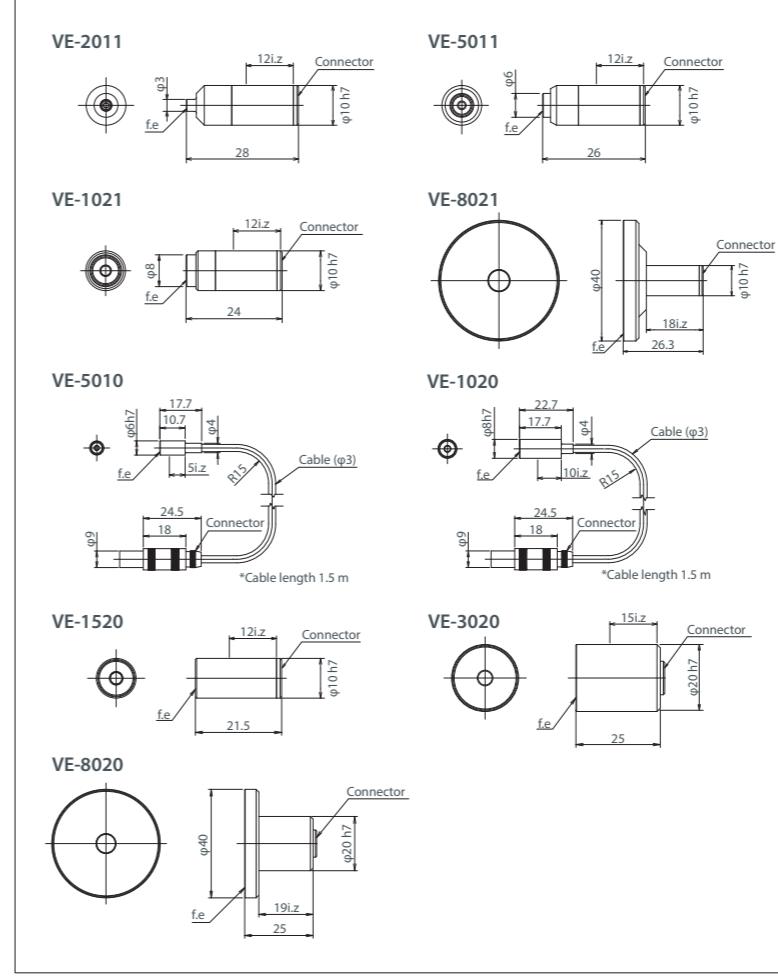
CL-015	For 300 mm wafer (Made to order)	For multi-point measurement (Made to order)
Size	100 to 150 mm	100 to 300 mm
Thickness		0.1 to 1.5 mm
Table processing	Selectable from lapping/Teflon coating (metal contamination, scratch prevention)	
Table diameter	155 mm	305 mm
Sensor holding section	φ10 (available φ8 using conversion adapter for sensor holding)	
Work unloading section	V groove	Clearance cutout for sensor arm slide
Accessory		Dummy shaft



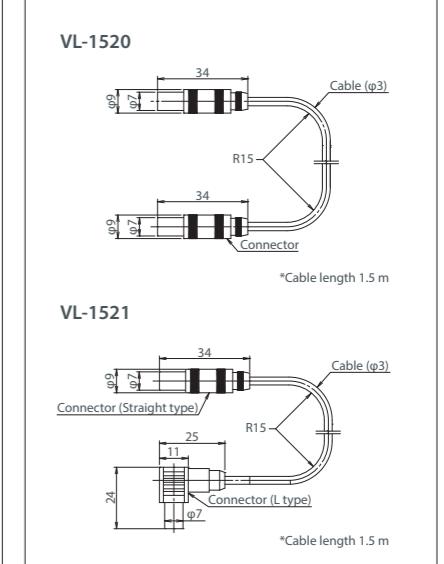
*Image of using wafer slide table

Outline drawing (Unit: mm)

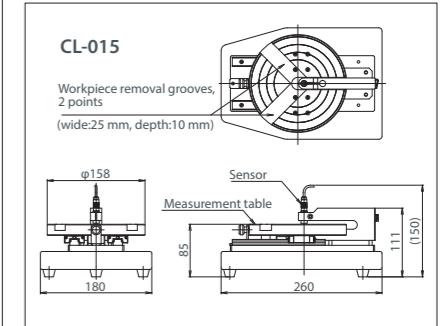
● Gap detector



● Signal cable



● Slide table



Measurement principles

The VE sensor measures the gap between the sensor bottom and the measurement target from the capacitance between the two. The capacitance (C), the sensor electrode area (S), and the distance to the measurement target (D) have the relationship shown on the right. Based on this principle, this system calculates the distance, i.e. gap (D) by measuring the capacitance (C). In order to measure capacitance, the measurement target, which is placed opposite the sensor, must be a conductor and must be electrically connected to the sensor housing.

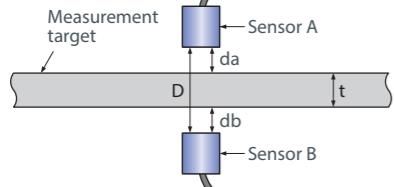
Thickness measurement of conductors

When measuring thickness of conductors, use the CL-7100 series, Non-contact Thickness Meter and two VE series Gap detectors. Position the 2 VE sensors facing each other. If the values measured by the sensor (the gap from the sensor to the target surface; da and db) and the distance between the two sensors (D) are obtained, the thickness of the target (t) can be obtained by the following formula (1).

$$t = D - da - db \dots \text{Formula (1)}$$

Since it is difficult to measure the distance (D) between the two sensors, by using a reference piece of the measurement target with a known thickness (tr), the distance (D) between the two sensors is calculated from the equation $D = da + db + tr$.

By using this (D), the thickness of target can be obtained.



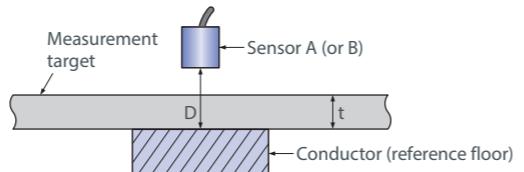
*The sensor housing and the measurement target are assumed to have equal potential.

Thickness measurement of insulators

When measuring thickness of insulators, use the CL-7100 series, Non-contact Thickness Meter and one VE series Gap detector. Position 1 VE sensor and the reference floor parallel to each other, and set the gap (D) between the sensor and the conductor (reference floor). When inserting the measurement target between the sensor and the conductor (reference floor), the sensor output will change (D"). This is because the dielectric constant between the sensor and the conductor (reference floor) changed due to the insertion of the insulator with a relative permittivity of ϵ_r . If the relative permittivity of the insulator is obtained, the thickness of the target (t) can be obtained by the following formula (2).

$$t = (\epsilon_r / \epsilon_r - 1) \cdot (\Delta D = D - D'') \dots \text{Formula (2)}$$

Since it is difficult to obtain ϵ_r , by using a reference piece (thickness: tr) of the same material as the measurement target, the relative permittivity ϵ_r of the target is obtained from Formula (2). The measurement target with unknown thickness can be obtained by using the previously obtained ϵ_r and ΔD .



*The sensor housing and the conductor (reference floor) are assumed to have equal potential.

*The thickness of the insulation that can be measured should be approximately 1 / 3 or less of the gap between the sensor and the reference floor.

Measurement targets

Conductor

: Any material that conducts electricity with low resistance is suitable.
: Measurement is possible even on semiconductors such as silicon wafers. For objects with high ground impedance, high impedance Grounding mode CL-0721 (optional) may be required.

Insulator

: While gap measurement is not possible for insulating materials, thickness measurement is feasible for thin materials (insulator thickness).
The CL-0740 measurement function [optional] is required.

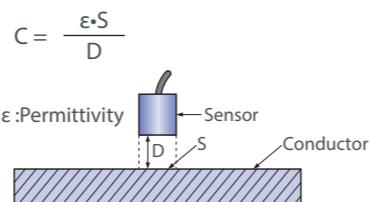
- plastic, sapphire, glass, plastic film, crystal, etc.

: Graphite and amorphous forms can be measured. However, diamond is an insulator; if present in the material, measurement is not possible.

There may be cases.

Carbon

: Measurement is not possible for composites utilising multiple materials with differing dielectric constants (except where conductors are involved).



- Painted and surface-treated materials
- Items with a rough surface or curved shape
- Items containing moisture

: When materials are coated with insulating paint on their surface or undergo anodising treatment, measurement errors may exceed the specified tolerance.
: The measurement principle of VE sensors results in a value that is essentially the average of surface irregularities. This applies equally to curved surfaces.
: During measurement, changes in moisture content cause the measured values to fluctuate. Furthermore, if dirt or oil adheres to the material surface, This will be an error.

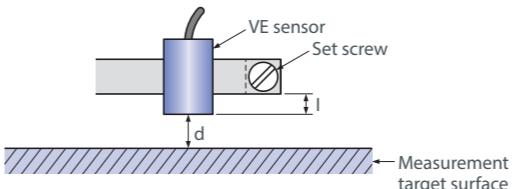
For stable measurement

Temperature influence

If there is a temperature change during measurement, the dimensions of the sensor and the sensor fixing jig will change, causing measurement errors. The ambient temperature range of measurement accuracy guaranteed by this system is $23 \pm 2^\circ\text{C}$. When using the sensor outside of the range, make correction referring to the influence of temperature calculated from the following formula.

* The change in the dimensions of the sensor fixing jig should be corrected by the customer.

* The figure below is the case of the grip arm fixing.



$$\Delta d \approx (k_1 \cdot l + k_2 \cdot d) \cdot \Delta t$$

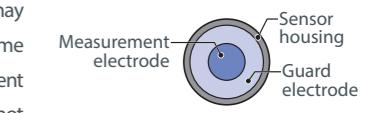
K1 : Linear expansion coefficient of the sensor housing material (1.7×10^{-5})
K2 : Area expansion coefficient of the sensor electrode material (3.4×10^{-5})

l : Distance between the sensor surface and the fixed point

Δt : Temperature change

d : Measurement gap

Δd : Converter output change



Calibration for sensor and thickness meter

In a capacitive measurement system, the sensor and thickness meter to be connected must be calibrated as a pair. When ordering a CL series thickness meter together with VE series gap detector, calibration of up to two detectors is provided free of charge. If you use new sensors after product delivery, you must return the thickness meter so that we may perform the calibration. The calibration fee in this case will be charged.

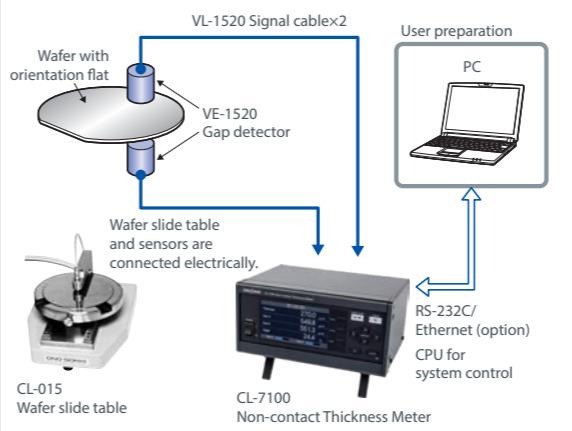
Precautions

• Do not make the sensor electrode to come into contact with the measurement target, as this may damage the amplifier. For the same reason, ensure that the measurement target is treated so that it does not become charged with static electricity.

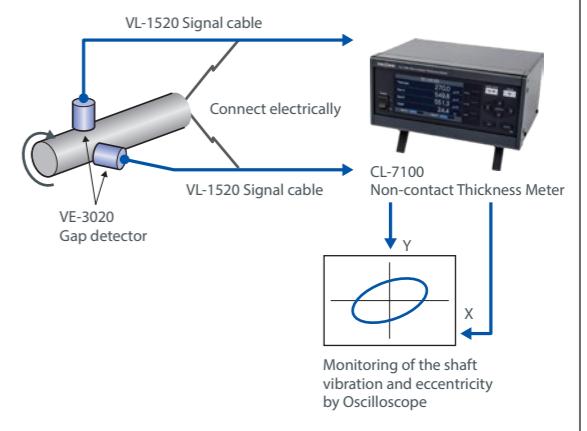
• It is necessary that the sensor housing and the measurement target (in the case of insulator measurement, the reference floor) are electrically connected. Please ensure sufficient electrical conduction for stable measurement.

Application examples

Non-contact thickness measurement of silicon wafer



Monitoring shaft vibration and eccentricity of rotating shaft



■ Product list

Non-contact Thickness Meters

Model name	Product name
CL-7100	Non-contact Thickness Meter (built-in sensor amplifier)
CL-7100S	Non-contact Thickness Meter (separated sensor amplifier)
CL-0720	High-resolution Measurement Function
CL-0721	High-impedance Grounding Mode
CL-0722	Measurement Range Change Function
CL-0730	Analog Output Function
CL-0731	Comparator Output Function
CL-0732	Analog and Comparator Output Function
CL-0740	Insulator Measurement Function
CL-0741	Temperature Measurement Function
CL-0750	BCD Output Function
CL-0751	Ethernet Connectivity Function

Gap Detectors

Model name	Measurement range (μm)	Minimum measurement diameter (mm)
VE-5010	50 to 500	φ6
VE-1020	100 to 1000	φ8
VE-1520	150 to 1500	φ10
VE-3020	300 to 3000	φ20
VE-8020	800 to 8000	φ40 (holding section φ20)
VE-2011	20 to 200	φ3 (holding section φ10)
VE-5011	50 to 500	φ6 (holding section φ10)
VE-1021	100 to 1000	φ8 (holding section φ10)
VE-8021	800 to 8000	φ40 (holding section φ10)

*The dedicated cable is required for the Gap Detector (except VE-5010, VE-1020).

■ Other related products

• Waveform analyzers

CF-9200A/94400A
2ch/4ch FFT Analyzer



They are all-in-one portable FFT analyzers, which can be performed with the integrated hard keys and touch panel without an external PC for analysis.

• Vibration related devices

NP series
Accelerometer



There are 2 types of sensors; the built-in preamplifier type and the charge output type. A wide variety of options are available, including tri-axial, waterproof, high-sensitivity, and TEDS-compatible models.

VC-2200/3200
Vibration Comparator



This is a stationary type, high-performance signal processor used for monitoring machinery abnormalities and assessing product quality.

*Please note that the CL-7100, CL-7100S are subject to List Controls under Japan's Foreign Exchange and Foreign Trade Act (FEFTA).

*Outer appearance and specifications are subject to change without prior notice.

URL: <https://www.onosokki.co.jp/English/english.htm>

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