Non-contact Thickness Meters/Displacement Meters
(Electrostatic capacitance type)

Non-contact
displacement meters
VT-5200/5700 Series

Gap detectors
VE Series

New advances have been made in displacement meters and thickness meters that use electrostatic capacitance, a method which has an established reputation for accuracy and stability.
Non-contact measurement can now be performed in nanometer resolution, and a frequency response of 10 kHz has been realized.
These instruments meet a wide range of applications, including the measurement of the thickness of conductors and semiconductors, and of the axial runout of rotating objects. They can be incorporated into production lines, and used for applications such as quality control and testing in a wide variety of fields.

Non-contact
thickness meters
CL-5600 Series

ONOSOKKI

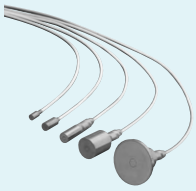
High-accuracy non-contact measurement. Utilize the power of these meters for measurement

CL-5600 Series Electrostatic capacitance-type non-contact thickness meters

Built-in gap converter type

CL-5600
Electrostatic capacitance-type non-contact thickness meter

+



VE Series
Electrostatic capacitance-type gap detectors

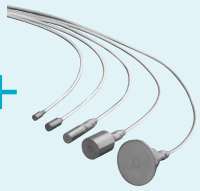
Separate gap converter type

CL-5600S
Electrostatic capacitance-type non-contact thickness meter
(Includes the separate CL-0420 Gap converter x 2 pcs.)

+ Signal cable (2.5m) +

CL-0420
Gap converter

+



VE Series
Electrostatic capacitance-type gap detectors

• Select the most appropriate combination to suit the sensor measurement range, required resolution and usage conditions.

Standard specifications

Maximum measurement range Sensor model name		Resolution	Display unit		Linearity
			CL-5600	CL-5600S	
500µm **VE-5010**		0.1µm	OK	OK	0.15%/F.S.
1000µm **VE-1020**		0.1µm	OK	OK	
1500µm **VE-1520**		0.5µm	OK	OK	
3000µm **VE-3020**		1µm	OK	OK	
8000µm **VE-8020**		2µm	OK	OK	

Specifications using optional CL-0200 high-resolution calculation function

Maximum measurement range Sensor model name		Resolution	Display unit		Linearity
			CL-5600	CL-5600S	
500µm **VE-5010**		0.05µm	OK	OK	0.12%/F.S.
200µm **VE-5010**		0.02µm			
1000µm **VE-1020**		0.1µm	OK	OK	
1500µm **VE-1520**		0.2µm	OK	OK	
3000µm **VE-3020**		0.5µm	OK	OK	
8000µm **VE-8020**		1µm	OK	OK	0.15%/F.S.

Comparison between CL-5600 and CL-5600S

CL-5600: Uses a 1.5-m sensor cable which cannot be extended.

CL-5600S: Uses a 1.5-m sensor cable which can be extended up to a maximum length of 10 m between the display unit and the gap converter when the gap converter is connected. The standard length provided is 2.5 m.

and control in a wide range of fields!

VT-5200/5700 Series Electrostatic capacitance-type non-contact displacement meters

VT-5210/5220
Electrostatic capacitance-type
non-contact displacement meters

VT-5710/5720
Electrostatic capacitance-type
non-contact displacement meters

Caution

The electrostatic capacitance-type gap detectors, the electrostatic capacitance-type non-contact displacement meters and the electrostatic capacitance-type non-contact thickness meters are not, in principle, provided with an over-voltage safeguard for the sensors or sensor amplifiers. If the object under measurement is electrically charged, the sensor amplifier may be damaged. In addition, to prevent an adverse effect on the measurement accuracy, be sure to affix anti-static brushes to the object under measurement or use an antistatic blower (to completely eliminate any static) before performing measurement.

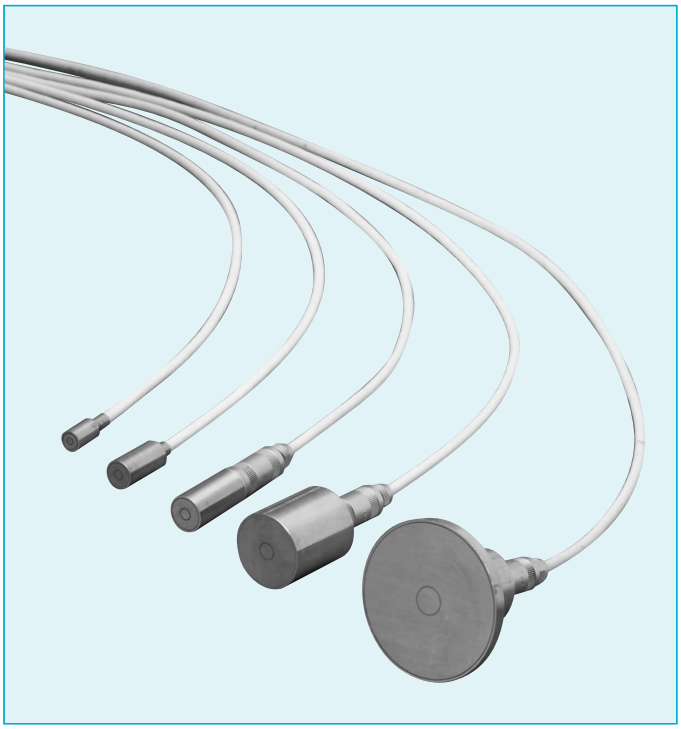
• Select the most appropriate combination to suit the functions required, your application and the usage conditions.

Maximum measurement range	500µm	1000µm	1500µm	3000µm	8000µm
Sensor model name	**VE-5010**	**VE-1020**	**VE-1520**	**VE-3020**	**VE-8020**
					

	Electrostatic capacitance-type displacement meter			
	VT-5710	**VT-5720**	**VT-5210**	**VT-5220**
Power requirement	±15 VDC	±15 VDC	100 to 240 VAC	100 to 240 VAC
Frequency response	4 kHz	10 kHz	4 kHz	10 kHz
Linearity*[1]	0.2%/F.S.	0.25%/F.S.	0.2%/F.S.	0.25%/F.S.
Offset function	Not provided	Not provided	Provided	Provided
Monitor display	10-segment LED	10-segment LED	20-segment LED	20-segment LED
Setting	Built-in type	Built-in type	Stand-alone type	Stand-alone type

*1: Linearity is the shifting rate between the actual line and ideal line.
Note: F.S. refers to the sensor's maximum measurement range.

VE Series Electrostatic capacitance-type gap detectors



(Status with the cable connected)

Outline

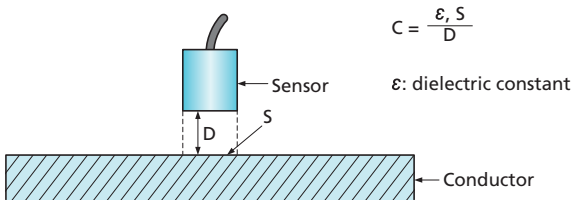
A gap detector is a vibration/displacement sensor that uses non-contact technology for the high-accuracy measurement of the amount of displacement. It is used in combination with the VT-5200/5700 Series and CL-5600 Series.
It demonstrates its best performance when used for the measurement and control of the vibration and surface vibration of rotating shafts such as the main shafts of turbines, electric motors, compressors and industrial machinery, and of the thickness and width of moving objects.
In addition to the measurement of the amount of displacement, a gap detector can also be used for a wide range of other measurement and control applications such as the measurement and monitoring of the amount of slack and the detection of warping and objects.

Features

- Can be used for any type of conductor without the need for any adjustments.
- Simple structure; extremely durable.
- High accuracy, high stability and high resolution.

Measurement principle

The VE Series gap detectors measure and display the gap (displacement) from the electrostatic capacitance between the sensor and the target measurement object. The electrostatic capacitance C is a function of the area of the conductor that is facing the sensor S and the gap D. If the sensor and the conductor that it is facing (object under measurement) are parallel flat plates, we can use the following equation to obtain the gap D by measuring the electrostatic capacitance C.



Objects that can be measured

If the material of the object to be measured is a conductor, then it can be measured. There are several different types of conductors available as follows.

- Metal plates:
  Steel, aluminum stainless steel, etc.
- Silicon wafers:
  Can be measured in the same way as metal plates
- Copper-clad laminated plates:
  The thickness of both surfaces can be measured prior to etching.
- Pastes:
  Pastes such as battery pole plates prior to firing
- Carbon plates:
  Plates which include a large amount of the carbon material used for gaskets, etc.

Objects that require care when they are measured

- Alumite:
  Aluminum plates which have undergone alumite processing have an insulating film on the surface which may cause unstable measurement.
- Coated objects:
  Objects coated with an insulating layer include errors in the measured values.
- Round objects:
  VE sensors operate on the premise that the object under measurement has a flat surface. If the surface is curved, measurement errors may occur.
- Objects with a rough surface:
  If the surface is rough, the measured values will be smaller when compared to the values obtained when measurement is performed by a contact-type instrument. This instrument averages out the surface roughness. If the surface is very rough, there may be cases when measurement cannot be performed.
- Spongy objects:
  If the object under measurement is spongy, measurement may be smaller due to the open area ratio.

Measurement of insulators

Gap measurement cannot be performed when the target measurement object is an insulator. Examples of insulators include the following. (With a non-contact thickness meter, the thickness is obtained from the dielectric constant and calculation performed. Please refer to the section on non-contact thickness meters.)

- Plastics
- Plastic film
- Sapphires
- Crystals
- Glass

Sensor calibration

In order to keep the specified accuracy, the calibration has been performed for one-to-one each other of the sensor with the converter or the display unit before delivery.
Recalibration is required if the sensor shall be replaced.

VE Series Specifications

Model name	VE-5010	VE-1020	VE-1520	VE-3020	VE-8020
Measurement range (μm)*1	0 to 500	0 to 1000	0 to 1500	0 to 3000	0 to 8000
Minimum diameter of target (mm)	ϕ6	ϕ8	ϕ10	ϕ20	ϕ40
Cable length	1.5 m (attached cable as standard)		1.5 m (VL-1520 as sold separately)		
Temperature function*4	k1 = 1.7 x 10-5, k2 = 3.4 x 10-5				
Operating temperature range*3	0 to +80°C				

Note: The VL-1520 signal cable is sold separately.

Note: Please refer to the page 2 and 7 for the resolution and accuracy of the VE Series.

*1: The measurement range refers to the maximum gap between the surface of the sensor tip and the object under measurement.

*2: The surface measurement area of the object under measurement must be larger than the external diameter of the sensor.

*3: The operating temperature range is the temperature range in which the sensor can operate, not the operating range for which accuracy is guaranteed. The operating range for which accuracy is guaranteed at 23±2°C. The temperature characteristics of the VE series are shown in the formula below.

Temperature characteristics

$\Delta D \fallingdotseq (K_1 \times \ell + K_2 \times D)\, \Delta t$

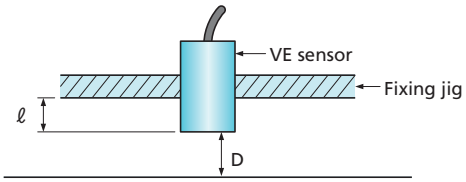
K_1 : Linear expansion coefficient of the sensor housing (1.7×10^{-5})

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

Δt : Change in temperature

D : Measured gap

ΔD: Change in the output of the converter



Precautions to note when the object to be measured is columnar

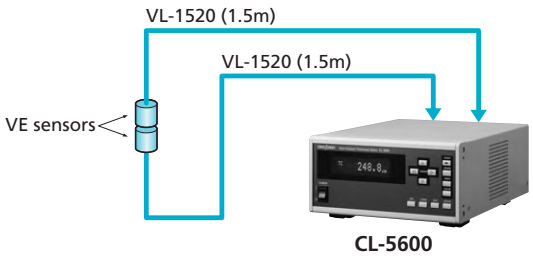
The initial calibration is made for target measurement objects that have a flat surface. Measurement can be performed if the target diameter is larger than the sensor diameter, but if the surface of the object is curved, it may include error in the measured value depending on the diameter of the curved surface.

CL-5600 Series Electrostatic capacitance-type non-contact th

Outline

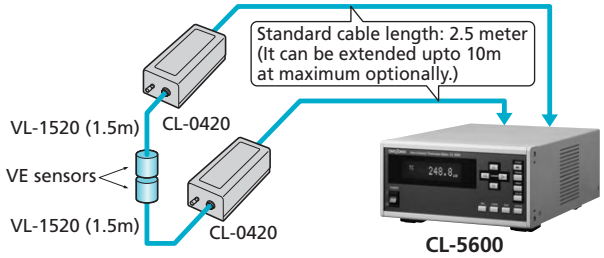
The CL-5600 Series non-contact thickness meters use an electrostatic capacitance-type gap detector to measure conductors, semiconductors and insulators. The VE Series electrostatic capacitance-type gap detectors have shown proven results as non-contact electrostatic capacitance-type sensors, and enable high-accuracy, stable thickness measurement using easy operations.
The CL-5600 Series offers both a conductor/semiconductor measurement function that uses two sensors (standard) and an insulator measurement function (option: CL-0300) that uses one sensor.
Featuring a new outward appearance and enhanced functions, they utilize the revamped electrostatic capacitance-type converters, the VE Series gap detectors.
The measurement range has been expanded, and an easy-to-read fluorescent display has been utilized for the display unit. Moreover, the separation of the gap converter from the main unit enables the addition of an analog output, a comparator function (option: CL-0100) and a high-resolution display function (option: CL-0200) for even more flexibility and improved ease of use.

CL-5600: Model with gap converters built into the main unit



(Signal cable (1.5 meter) is attached directly to the VE-5010 and VE-1020. VL-1520 signal cable is required for other models of VE series.)

CL-5600S: Model with gap converters (CL-0420) that are separated from the main unit



(Signal cable (1.5 meter) is attached directly to the VE-5010 and VE-1020. VL-1520 signal cable is required for other models of VE series.)

Features

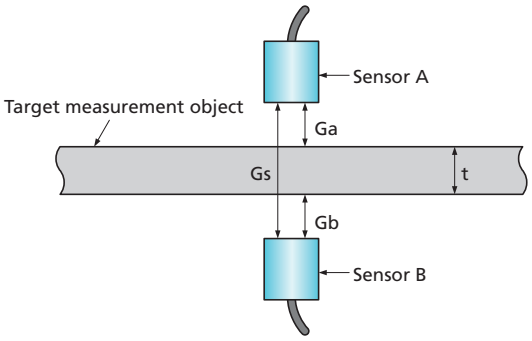
(1) The high-resolution calculation function enables a resolution at 0.02μm by using VE-5010 with optional CL-0200.
(2) The gap measurement range has been increased considerably (Maximum 8 mm when VE-8020 is used.).
(3) The length of the cable between the sensor and the gap converter is 1.5 m.
(4) The CL-5600S features separate gap converters (CL-0420). The length of the cable between each gap converter and the main unit is 2.5 m as standard specification (Max. 10 m is possible on request as an option.).
(5) An easy-to-read vacuum fluorescent display has been utilized at the display unit.
(6) The RS-232C interface connection enables connection to a printer.
(7) Analog and comparator output functions are both provided as optional CL-0100.
(8) A function for measuring the thickness of conductors and semiconductors is provided as standard, while a function for measuring the thickness of insulators is provided as optional CL-0300.

Measurement methods

- **When measuring conductors or semiconductors**

  Install two sensors in parallel within the measurement range for the target measurement object. Specify the space (Gs) between these two sensors at the CL-5600 Series. Insert the target measurement object between sensors A and B and measure the gap between each sensor and the target measurement object (Ga and Gb) to obtain the thickness (t).

  t = Gs - (Ga + Gb)

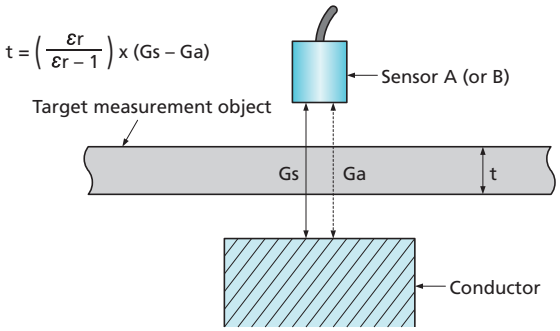


Note: The sensor case and the material are assumed to have equal potential.

- **When measuring insulators (CL-0300 Insulator measurement function)**

  Specify the space (Gs) between the sensor and the conductor (reference area) at the CL-5600 Series. When the target measurement object is inserted between the sensor and the conductor (reference area), the sensor output becomes Ga. The thickness (t) is obtained from the amount of change in the sensor output and the relative dielectric constant εr.

  εr.: Dielectric constant (When the dielectric constant of a vacuum is 1 the dielectric constant of the target measurement object is referred to as the relative dielectric constant.)



Note: The sensor case and the material are assumed to have equal potential.

Objects that can be measured

- **Conductors, semiconductors (when using the CL-5600 or CL-5600S's standard functions)**

  Metal, conductive materials such as silicon wafers, double-sided copper-clad laminated plates, pastes.
  Carbon plates.

- **Insulators (when using the CL-0300 option's additional function)**

  Thin objects that are composed of a uniform, simple material throughout can be measured.
  Relatively thin objects such as glass, crystal wafers, sapphire wafers, film and plastic.

Compatible sensors, display resolution and linearity

The display resolution and linearity when used in combination with the VE Series electrostatic capacitance-type gap detectors are as follows.

Model	Measurement range (μm)	External diameter (mm)	Standard		High-resolution calculation function (CL-0200 option)	
			Display resolution (μm)	Linearity (% F.S./10 to 100% F.S.)	Display resolution (μm)	Linearity (% F.S./10 to 100% F.S.)
VE-5010	200*	φ6	0.1	0.15	0.02	0.12
	500		0.1	0.15	0.05	0.12
VE-1020	1000	φ8	0.1	0.15	0.1	0.12
VE-1520	1500	φ10	0.5	0.15	0.2	0.12
VE-3020	3000	φ20	1	0.15	0.5	0.12
VE-8020	8000	φ40	2	0.15	1	0.15

- The VE-5010/1020 come with a cable attached (1.5 m cable length as standard).
- The VE-1520/3020/8020 require the separated optional VL-1520 Cable (1.5-m cable length).
- The high-resolution calculation function (CL-0200) is an option.

* VE-5010 with 200μm can be used with the CL-5600 Series only.
It cannot be used in combination with the VT-5200/5700 Series.
Perform calibration on the CL-5600 Series so that the correlation with "VE-5010 200-μm" is "one by one".

CL-5600 Series Specifications

	CL-5600	CL-5600S
Measurement parameters	Thickness of the conductor or semiconductor that is under measurement	
	Gap A between sensor A and the object under measurement	
	Gap B between sensor B and the object under measurement	
	Thickness of the insulator that is under measurement (CL-0300 option)*1	
Display modes	ABS: Measured values	
	DEVI: Deviation values (Measured values – reference values)	
	Maximum, Minimum, Maximum – Minimum	
Interface	RS-232C (Cable: AX-5022/Sold separately)	
SYNC function	Possible for the cascade connection with CL-5600 series	
Remote functions	External start/stop of calculation function, thickness calibration, etc.	
Gap converter	—	CL-0420 (a 2.5-m length cable is supplied as standard. ; can be optionally increased up to a length of 10 m.)
Measurable objects	Conductors, semiconductors, insulators*1	
Display parameters	Thickness, Gap A, Gap B	
Resolution	Depends on which sensors are used. 0.1, 0.5, 1, 2 µm (0.02, 0.05, 0.2, 0.5, 1µm by using optional CL-0200*2)	
Sampling time	20 ms	
Averaging	Moving mean, 1 to 64 times	
Display	Vacuum fluorescent display; either 2-row display or 1-row display (large character size) can be selected.	
Comparator function (Option: CL-0100*3)	3-CH output	
Analog output (Option: CL-0100*3)	Thickness, Gap A, B (linearity ±0.2% F.S./10% to 100% F.S.)	
Compatible printer (option)	DPU-414 (Connection cable is provided as standard part.) * AC Power supply adaptor: PW7007 series (Sold as an option)	
Power requirement	100 to 240 VAC, 50/60 Hz	
Operatating temperature range (achieving the specified accuracy)	+21 to +25°C	
Operating temperature range	0 to +40°C	
Operating humidity range	20 to 80% RH	
External dimensions, weight	210(W) mm x 99 (H) mm x 276(D) mm, 4.5 kg	210(W) mm x 99 (H) mm x 276(D) mm, 4.5 kg CL-0420: 42(W) mm x 56 (H) mm x 120 (D) mm, 0.6 kg

*1: CL-0300 Insulator measurement function (option) *2: CL-0200 High-resolution function (option) *3: CL-0100 Output function (option)

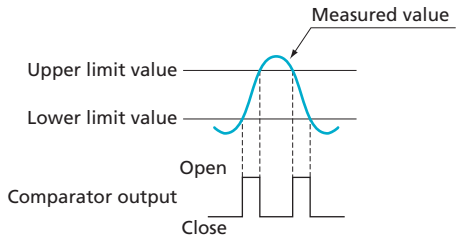
Remote functions (pin arrangement and input signals)

Pin	Signal name	Details
A	Power supply	Inputs 5 to 24 VDC • If 6 VDC or higher is supplied from an external source, incorporate a resistor.
B	START	Same function as the START key
C	STOP	Stops the calculation mode
D	PAUSE	Same function as the PAUSE key
E	CALIB	Performs calibration using the reference data of the registered object to be measured. • Only valid for conductor measurement. • The thickness of the reference data of the registered object to be measured cannot be changed.
F	START STATUS	Used to switch to the active status when the meter is in the calculation mode or the calculation stopped mode.
G	COMMON	Connects to 0V
H	+5 V output	Outputs +5 V (Max: 0.4 A)

• Suitable connector: R03-PB8M

Comparator output (terminal block)

The items for comparison and the threshold can be set respectively for each of the three comparator channels (COMP1/COMP2/COMP3). The comparator operates as shown in the figure below.

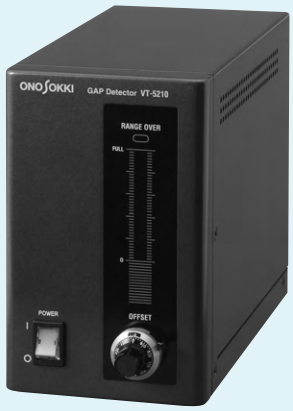


The comparator contact output closes when the specified upper limit value (UPPER) is less than the specified value or when the specified lower limit value (LOWER) is larger than the specified value.

VT-5220/5700 Series Electrostatic capacitance-type non-contact displacement meters

The VT Series comprises the VT-5200 Series with AC powered operation and VT-5700 Series with ±15 VDC specifications. 4 kHz or 10 kHz output response frequency is provided depending on the model to enable you to select the most suitable frequency for your application.

VT-5200 Series



VT-5210

VT-5220

Model name	VT-5210	VT-5220
Output	0 to 5 V/0 to 100% F.S.	
Linearity	±0.2% F.S./10% to 100% F.S.	±0.25% F.S./10% to 100% F.S.
Temperature characteristic	Within ±0.05% F.S/°C	
Response frequency	DC to 4 kHz	DC to 10 kHz
Monitor display	20-segment LED Analog output offset function	
Power requirement	100 to 240 VAC, 10 VA	
External dimensions, weight	95 (W) x 150 (H) x 195 (D), Approx. 2 kg	

Note: F.S. refers to the sensor's maximum measurement range.

VT-5700 Series

VT-5710

VT-5720

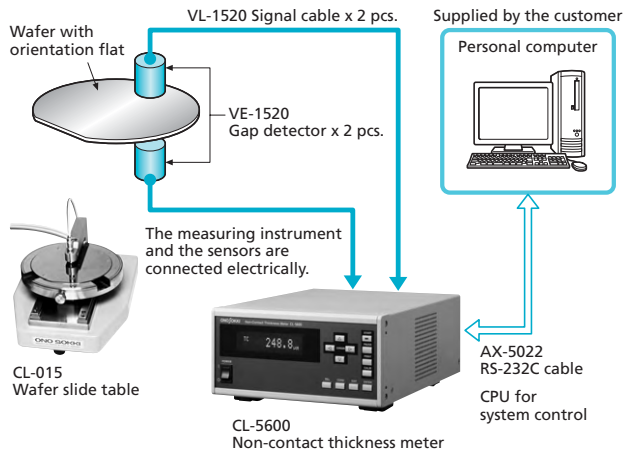
Model name	VT-5710	VT-5720
Output	0 to 5 V/0 to 100% F.S.	
Linearity	±0.2% F.S./10% to 100% F.S.	±0.25% F.S./10% to 100% F.S.
Temperature characteristic	Within ±0.05% F.S/°C	
Response frequency	DC to 4 kHz	DC to 10 kHz
Monitor display	10-segment LED	
Power requirement	±15 VDC, 100 mA	
External dimensions, weight	42(W) mm x 56(H) mm x 120(D) mm, Approx. 0.6 kg	

Note: F.S. refers to the sensor's maximum measurement range.

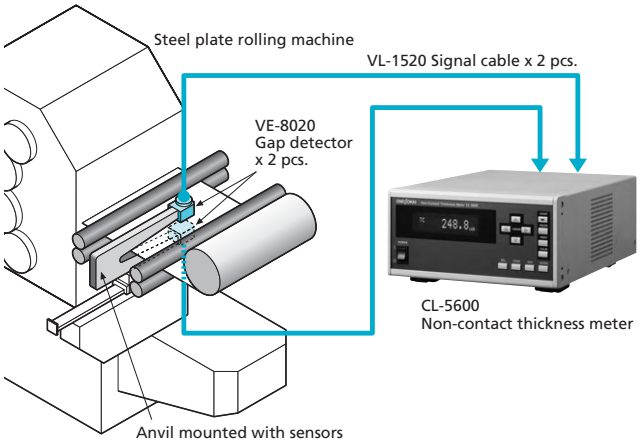
Examples of the measurement

Conductor/semiconductor thickness measurement

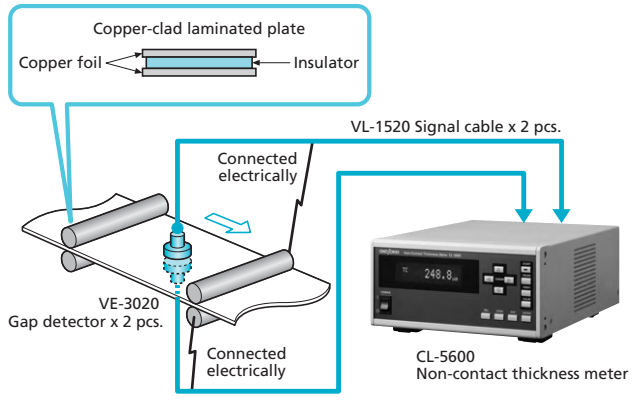
Measurement of a silicon wafer



Thickness measurement during a running operation



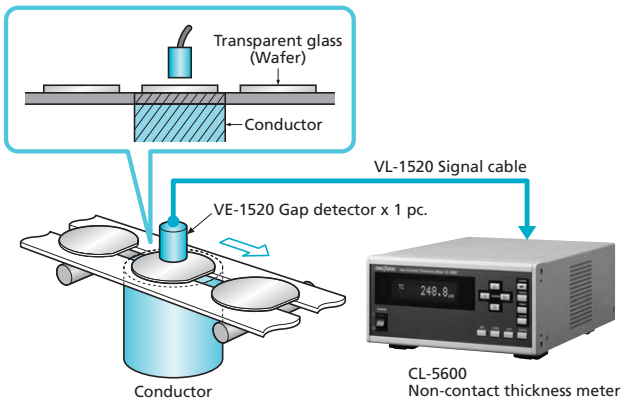
Measurement of copper-clad laminated plates



Insulator thickness measurement (when the CL-0300 option is installed.)

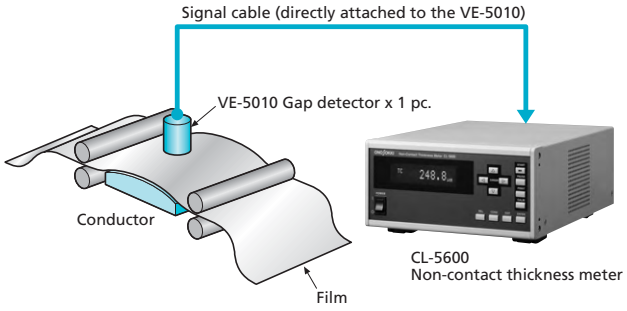
Example of the measurement of objects such as thin glass or crystal

Non-contact thickness measurement of glass masks for semiconductors on a production line



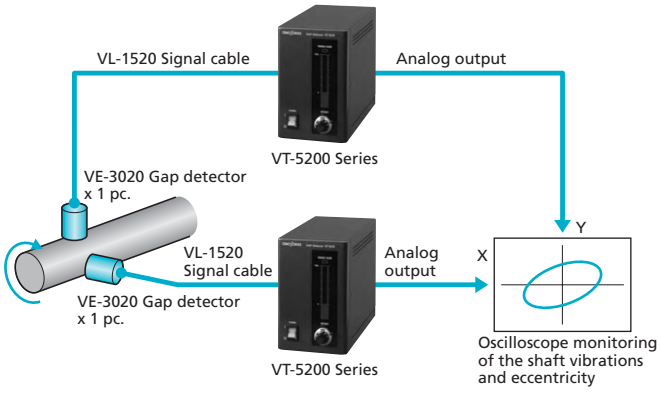
Non-contact thickness measurement of film on a production line

Place the film so that it contacts the conductor that is to be measured.



Displacement measurement of conductors/semiconductors

Non-contact monitoring of the vibrations and eccentricity of a rotating shaft

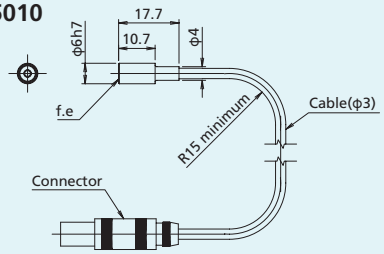


Note: The above examples represent only a few of the diverse system configurations that have actually been implemented.

External Dimensions (Unit: mm)

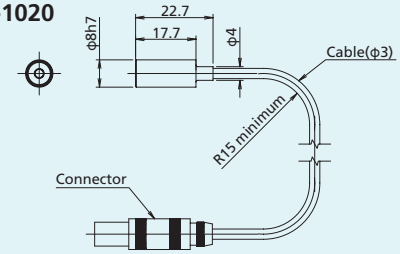
Gap detectors

VE-5010



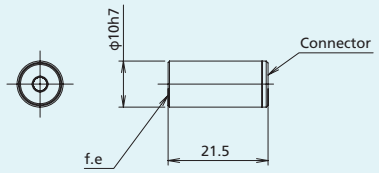
Cable length (cable part) 1.5 m

VE-1020

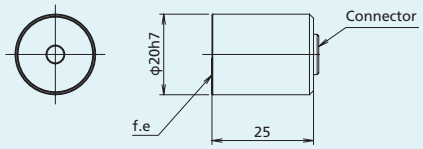


Cable length (cable part) 1.5 m

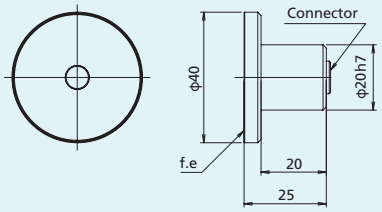
VE-1520



VE-3020



VE-8020



VL-1520 Signal cable

(connecting VE-1520, VE-3020, VE-8020)

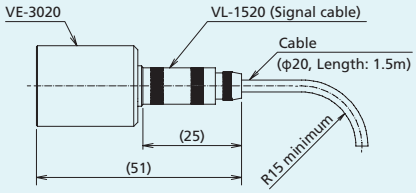
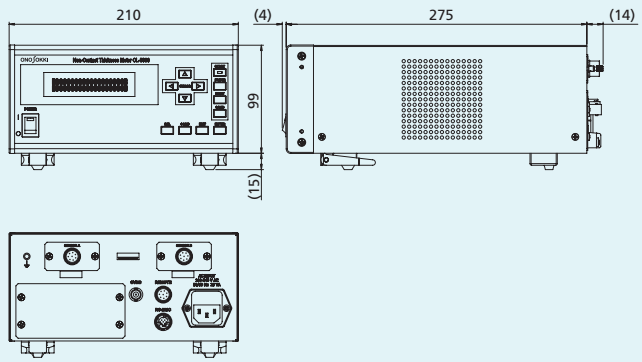


*Figure is connection drawing of VL-1520 with VE-3020.

Non-contact thickness meter

CL-5600

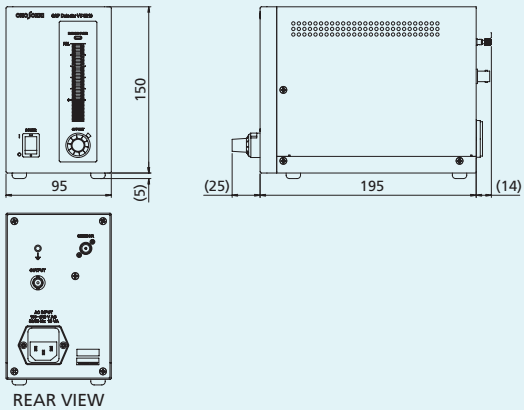


REAR VIEW

Note: Please see the below drawing of VT-5710/VT-5720/CL-0420 for the dimension of CL-0420.

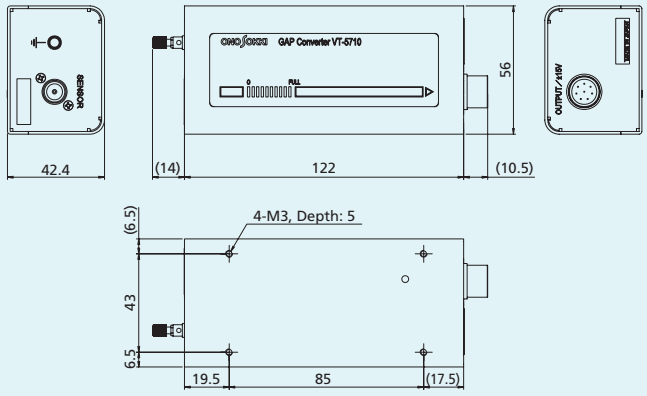
Non-contact displacement meters

VT-5210/5220



REAR VIEW

VT-5710/5720/CL-0420

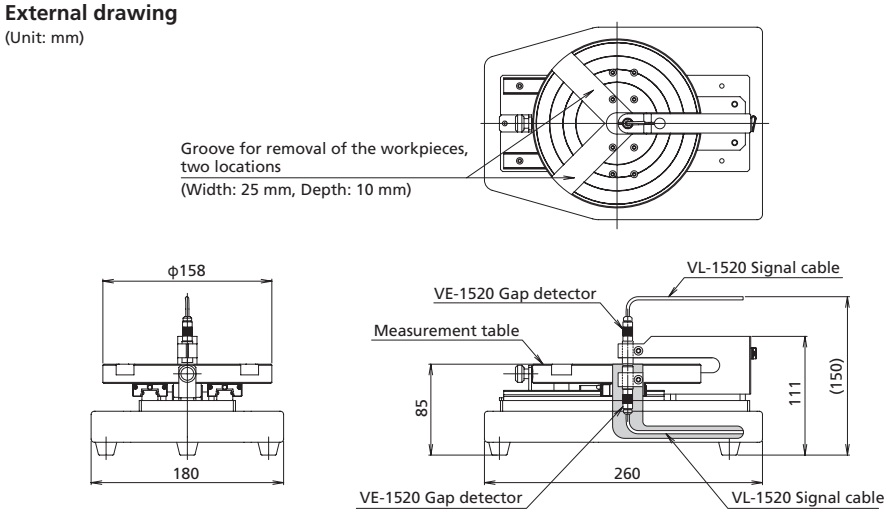


Example of the measurement for the wafer thickness

- **CL-015 Wafer slide table (manufactured upon receipt of order)**

External drawing

(Unit: mm)



Please refer to the "Measurement of a silicon wafer" on page 10 for this application in details.

The CL-015 is a simple manual slide table that can be used together with the CL-5600 Series, VE-1520 Gap detector (2 pcs.) and VL-1520 Signal cable (2 pcs.) to perform non-contact thickness measurements of conductive wafers such as silicon wafers. Grooves have been provided in the table surface to facilitate use of the tweezers used for vacuum adsorption.

Compatible wafer size: Diameter 100 to 150mm, Thickness 0.1 to 1mm

Note: Other special tables for 200-mm and 300-mm wafers can also be manufactured to order.

ONO SOKKI

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

URL: http://www.onosokki.co.jp/English/english.htm

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