Further advances have been made in capacitance type displacement meters and thickness meters that have a reputation for high precision and stability. Non-contact measurement can now be performed in nanometer resolution, and a frequency response of 10 kHz has been achieved. They 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.
Electrostatic capacitance type thickness meter/displacement meter

System configuration

Electrostatic capacitance type non-contact thickness meter CL-5610 Series

**CL-5610**
- Built-in amplifier type
- Standard type for desktop measurement or measurement by installing into a small equipment

**Display/calculation unit**
**Signal cable**
- **VL Series**
- Cable length 1.5 m (non-extendable)
- *VE-5010/1020: Signal cable is not required. (Cable is directly attached to the sensor.)*

**Gap detector**
- **VE Series**

---

**CL-5610S**
- Gap converter separate type
- Useful for measurement on a large equipment incorporated the main unit into.
- *Distance between a main unit and a sensor: up to 11.5 m (standard: 4 m)*

**Display/calculation unit**
**External gap converter**
- **CL-0420**

---

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

**VT-5200 Series**
- Standard type with AC powered operation
- VT-5210 (Response frequency 4 kHz)
- VT-5220 (Response frequency 10 kHz)
  - Output offset function
  - 20-segment level meter
  - AC 100 to 240 V powered operation

**Main unit**
**Signal cable**
- **VL Series**
- Cable length 1.5 m (non-extendable)
- *VE-5010/1020: Signal cable is not required. (Cable is directly attached to the sensor.)*

**Gap detector**
- **VE Series**

---

**VT-5700 Series**
- Compact type with DC powered operation
- VT-5710 (Response frequency 4 kHz)
- VT-5720 (Response frequency 10 kHz)
  - Compact body
  - Suitable for the use in an incorporated structure
  - DC ±15 V powered operation

**Main unit**
**Signal cable**
- **VL Series**
- Cable length 1.5 m (non-extendable)
- *VE-5010/1020: Signal cable is not required. (Cable is directly attached to the sensor.)*

**Gap detector**
- **VE Series**
Feature

Electrostatic capacitance type non-contact measurement system can measure the gap between a target and VE sensor with high accuracy without contact. It is used in a combination with the VT series (electrostatic capacitance type non-contact displacement meter) and CL series (electrostatic capacitance type non-contact thickness meter). This system also can measure the thickness of a target with the function for gap measurement.

- **Non-contact measurement**
  Thickness of objects having a dislike of contact, such as semiconductor wafers, soft films, and easy to be damaged glass can be measured with non-contact detection. Also suitable for the measurement of motor shaft deviation, that is dangerous with a contact detection.

- **No need to calibrate for each target material**
  Calibration for each of material to be measured is not required for electrostatic capacitance type system, although required for eddy current type. Conductors can be measured with the same setting without recalibration, such as iron, aluminum, stainless steel, etc.

### Measurement principle

The VE series gap detectors measure the gap between the sensor bottom surface and the target using each of electrostatic capacitance. Relation among the electrostatic capacitance C, the electrode area S, and the gap D is expressed as the right formula. Electrostatic capacitance type non-contact measurement system measures and displays the gap (D) by measuring electrostatic capacitance.

To measure the capacitance, the following conditions of the measurement object are required:
- **Conductor (a substance that conducts electricity)**
- **Electrically connected to the sensor case (sensor outer-shell)**

- **Measuring thickness of conductors**
  For measuring the thickness of conductors, the electrostatic capacitance type non-contact thickness meter (LC-5610 series) and 2 gap detectors (VE series) are used.
  Install two sensors in parallel to sandwich the measurement target. At this time, the sensor can directly measure the gap “da” and “db” from the sensor to the target surface. When the distance D between both sensors is known in advance, the thickness of the target can be obtained by the following formula [1].

  \[ t = D - da - db \]

  In practice, it is difficult to accurately measure the distance D between both sensors, so a master piece of a conductor which thickness is already known is used to calculate the distance D between the two sensors as follows.

  \[ D = da + db + t \]

  This distance D between the two sensors can be used to measure the thickness of the target.

- **Measuring thickness of insulators**
  For measuring the thickness of insulators, the electrostatic capacitance type non-contact thickness meter (LC-5610 series) and 1 gap detector (VE series) are used.
  Install the gap detector VE series at a distance D opposite to the standard floor conductor. When the insulator to be measured is inserted between the sensor and the conductor serving as the reference floor, the output from the sensor changes to a value different from the output corresponding to the distance D.

  At this time, if the relative permittivity \( \varepsilon \) of the insulator is known, the thickness \( t \) of the insulator can be obtained by the following formula [2].

  \[ t = \frac{\varepsilon r}{1 - \varepsilon r} \times \Delta D \]

  In practice, it is difficult to accurately measure the relative permittivity, so a master piece (thickness tr) which is made with material same as the measurement target is used to obtain the relative permittivity of the target using the formula [2].

  When you do not know the thickness of the object “ t ”, you can obtain the thickness by using \( \varepsilon \) and \( \Delta D \) obtained earlier.

### Object that can be measured

- **Conductor:**
  Low resistance, carrying electricity. No limitaiton on the type.
  - **Semiconductor:**
    Silicon wafers etc. For low ground impedance targets, high impedance ground mode CL-0210 (option) may be required.
  - **Insulator:**
    Thickness of thin insulator can be measured. CL-0300 (Insulator measurement function: option) is required.
    - Plastic
    - Sapphire
    - Glass
    - Plastic film
    - Crystal etc.
  - **Gap measurement is not available.**
  - **Carbon:**
    Graphite or amorphous can be measured. However, it may not be measured if diamond (insulator) is included in the material.
  - **Composite materials:**
    Composites using multiple materials with different relative permittivity can not be measured. (Excluding the case of conductors)
  - **Painted, surface-treated material:**
    When it is a material coated with insulation paint on the surface or with alumite treatment, the measurement error will be larger than the value in specification.
  - **Material with rough surface or curved surface:**
    Almost the average of the unevenness of the surface is measured by VE series sensor, to the measurement principle. The same is true for curved surfaces.
  - **Materials containing moisture:**
    The measured value will be changed when the amount of moisture changes during measurement. Dirt or oil adhesion to the surface of the material may also be a measurement error.

  - **Able to measure**
  - **With restriction on measurement**
  - **Unable to measure**
CL-5610 Series
Electrostatic capacitance type non-contact thickness meter

Many measurement items
Thickness and gap can be measured. For each, the calculated value of deviation, maximum, maximum range (maximum-minimum) can be obtained.

Thickness measurement of insulators as well as conductors and semiconductors (with CL-0300: option)
The thickness of insulators such as thin plastic films and glass plates can be measured by the CL-0300 Insulator measurement function option. (*Composite materials cannot be measured. *Some insulators cannot be measured according to the amount of the relative permittivity.)

Stable thickness measurement even for samples that can not have completely conduction (with CL-0210: option)
Even if it is difficult to establish electrical continuity with the sample (such as when holding the sample on a table coated with a fluorine-based film, that requires wide area contact for stable electrical continuity), CL-0210 High-impedance grounding mode achieves stable electrical continuity with a small contact area between the sample and the table.

Saving the calibration values for six sensor types max.
VE series sensors need to be calibrated one-to-one with the CL-5610 series due to have individual differences in characteristics. The CL-5610 series can store the calibration information up to six sensors, so according to the measurement range and resolution, you can select and use the most suitable sensor from among the stored.

Output accuracy of SENSOR A and SENSOR B in CL-0110 output function (option): available only the combination with one sensor

Control of main unit from a PLC or PC, import of measurement data
Remote terminal, RS-232C terminal and BCD output terminal (option) are provided as external interface. Can be used incorporating into production line, and data can be read and controlled. Measurement data every 20ms can also be acquired from the BCD output terminal.

<table>
<thead>
<tr>
<th>Sensor model name</th>
<th>Measurement range (µm)</th>
<th>Displayed resolution (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VE-2011</td>
<td>20 to 200</td>
<td>0.02</td>
</tr>
<tr>
<td>VE-5010</td>
<td>50 to 500</td>
<td>0.05/0.02*1</td>
</tr>
<tr>
<td>VE-5011</td>
<td>/20 to 200*1</td>
<td>0.1</td>
</tr>
<tr>
<td>VE-1020</td>
<td>100 to 1000</td>
<td>0.1</td>
</tr>
</tbody>
</table>

*1: Display resolution when the CL-0200 is installed and the measurement range is specified as 20 to 200 µm by the CL-0201 (measurement range change option).

* A guideline of the thickness of conductors to be measure: about 1/3 or less of the measurement range e.g.) Measurement using VE-1020: about 350 µm or less for the thickness of the insulator
### Specification

<table>
<thead>
<tr>
<th>Target</th>
<th>CL-5610</th>
<th>CL-5610S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item</td>
<td>Gap A between sensor A and the target (conductor/semiconductor)</td>
<td>Gap B between sensor B and the target (conductor/semiconductor)</td>
</tr>
<tr>
<td>Display</td>
<td>Fluorescent display tube</td>
<td>Display of measurement results can be selected from 1-line display (SINGLE) or 2-line display (DUAL).</td>
</tr>
<tr>
<td>Display mode</td>
<td>Gap, thickness</td>
<td>Calculation value: (measured value - measured value)/MAX (maximum value)/ MIN (minimum value), or Range (MAX-MIN from calculation start time)</td>
</tr>
<tr>
<td>Resolution</td>
<td>Depends on the sensor combination</td>
<td>0.1, 0.5, 1.2 µm (0.02, 0.05, 0.2, 0.5, 1 µm)*2</td>
</tr>
<tr>
<td>Accuracy (10 to 100 %, at F.S)</td>
<td>±0.15 %/F.S. (standard)</td>
<td>±0.12 %/F.S.*2 (When the optional CL-0200 High-resolution measurement function is installed.)</td>
</tr>
<tr>
<td>Sampling time</td>
<td>20 ms</td>
<td>Moving average: 1 to 64 times</td>
</tr>
<tr>
<td>Interface</td>
<td>RS-232C (connection cable: AX-5022 2 m option) BCD output (CL-0120 option required to install) External remote function: 5 commands operations (start, stop, thickness calibration etc.) SYNK function: Synchronized operation of several units of CL-5610/5610S*3</td>
<td></td>
</tr>
<tr>
<td>Printer</td>
<td>DPU-414 (signal cable provided as standard, exclusive AC adapter: PW-C0725-W2-U)</td>
<td></td>
</tr>
<tr>
<td>Power supply</td>
<td>100 to 240 VAC 50/60 Hz</td>
<td></td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>0 to +40 °C (guaranteed accuracy range: 23±2 °C)</td>
<td></td>
</tr>
<tr>
<td>Operating humidity range</td>
<td>20 to 80 %R.H. (with no condensation)</td>
<td></td>
</tr>
<tr>
<td>Option</td>
<td>Output function</td>
<td></td>
</tr>
<tr>
<td>Option</td>
<td>CL-0110</td>
<td></td>
</tr>
<tr>
<td>•Analog output</td>
<td>SENSOR A, SENSOR B terminals</td>
<td></td>
</tr>
<tr>
<td>•Output item: GAP output*4 for each sensor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>•Output voltage: 5 V/F.S. (with offset [-5 to 0 V] function)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>•Output accuracy: ±0.25 % F.S.*4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>•A-OUT terminal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>•Output item: Selectable from THICK, GAP-A, GAP-B, or A-B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>•Output voltage: -5 to 0 to +5 V (output scale: can be specified freely)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>•Output accuracy: ±0.25 % F.S.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>•Comparator output</td>
<td>COMP1, COMP2, COMP3</td>
<td></td>
</tr>
<tr>
<td>•Individual mode: Operated as window comparator by setting thresholds the UPPER and LOWER respectively</td>
<td></td>
<td></td>
</tr>
<tr>
<td>•ALL mode: Using comparator 1/2/3 for judgment of UPPER/OK/LOWER.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CL-0120</td>
<td>BCD output function</td>
<td></td>
</tr>
<tr>
<td>Output method: 6-digit parallel BCD, open collector output</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Update time: 20 ms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Applicable cable: AA-8207 (3 m, one end open)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CL-0200</td>
<td>High-resolution measurement function</td>
<td></td>
</tr>
<tr>
<td>Function: Improve display resolution and accuracy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resolution: Accuracy See “Measurement range and displayed resolution” on page 4.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CL-0210</td>
<td>High-impedance grounding mode</td>
<td></td>
</tr>
<tr>
<td>Measurement can be performed stably under the condition with great grounding resistance.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CL-0300</td>
<td>Insulator measurement function</td>
<td></td>
</tr>
<tr>
<td>Thickness measurement of insulators by calculating the relative permittivity.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Some insulators may not be measured according to the amount of the relative permittivity.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outer dimensions</td>
<td>210 (W) x 99 (H) x 275 (D) mm (not including protruded section)</td>
<td>210(W) x 99(H) x 275(D) mm (not including protruded section)</td>
</tr>
<tr>
<td>Weight</td>
<td>approx. 4.2 kg</td>
<td>approx. 4.2 kg</td>
</tr>
<tr>
<td>Accessory</td>
<td>Power supply cable x 1 Instruction manual x1 Remote connector x 1</td>
<td>Power supply cable x 1 Instruction manual x1 Remote connector x 1 Exclusive connection cable (2.5 m) x 2</td>
</tr>
</tbody>
</table>

*1: The CL-0300 Insulator measurement function (option) is required for insulator measurement.

*2: The CL-0200 High-resolution measurement function (option) is required.

*3: Up to two units can be synchronized to one master unit. To use the SYNC function, coordination between the devices is required. Please contact your nearest distributor or Ono Sokki sales office nearby for more details.

*4: Output accuracy of SENSOR A and SENSOR B: valid only the combination with one registered sensor for each. The output accuracy when connecting other than registered sensors is not guaranteed.
Interface

**BCD IN/OUT**

Measurement value is selectable for BCD output such as "Thickness data", "Gap between sensor A and measurement target", or "Gap between sensor B and measurement target". Data is updated every 20 ms of measurement.

- Applicable connector: HDRA-E36MA (Honda Tsushin Kogyo Co., Ltd.)
- Ono sokki standard cable: AA-8207 (3 m: one end open)

<table>
<thead>
<tr>
<th>Pin</th>
<th>I/O</th>
<th>Signal</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td>10^4 data output</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>2</td>
<td>10^4 data output</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>4</td>
<td>10^4 data output</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>8</td>
<td>10^4 data output</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>1</td>
<td>10^4 data output</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>2</td>
<td>10^4 data output</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td>4</td>
<td>10^4 data output</td>
</tr>
<tr>
<td>8</td>
<td>0</td>
<td>6</td>
<td>10^4 data output</td>
</tr>
<tr>
<td>9</td>
<td>0</td>
<td>1</td>
<td>10^4 data output</td>
</tr>
<tr>
<td>10</td>
<td>0</td>
<td>2</td>
<td>10^4 data output</td>
</tr>
<tr>
<td>11</td>
<td>0</td>
<td>4</td>
<td>10^4 data output</td>
</tr>
<tr>
<td>12</td>
<td>0</td>
<td>8</td>
<td>10^4 data output</td>
</tr>
<tr>
<td>13</td>
<td>0</td>
<td>1</td>
<td>10^4 data output</td>
</tr>
<tr>
<td>14</td>
<td>0</td>
<td>2</td>
<td>10^4 data output</td>
</tr>
<tr>
<td>15</td>
<td>0</td>
<td>4</td>
<td>10^4 data output</td>
</tr>
<tr>
<td>16</td>
<td>0</td>
<td>8</td>
<td>10^4 data output</td>
</tr>
<tr>
<td>17</td>
<td>0</td>
<td>1</td>
<td>10^4 data output</td>
</tr>
<tr>
<td>18</td>
<td>0</td>
<td>2</td>
<td>10^4 data output</td>
</tr>
<tr>
<td>19</td>
<td>0</td>
<td>4</td>
<td>10^4 data output</td>
</tr>
<tr>
<td>20</td>
<td>0</td>
<td>6</td>
<td>10^4 data output</td>
</tr>
</tbody>
</table>

**Individual mode**

- Operated as window comparator by setting thresholds the UPPER and LOWER respectively

**ALL mode**

- Using comparator 1/2/3 for judgment of UPPER/OK/LOWER.

**Comparator Output**

- Output of BCD signal
- The following circuit is recommended for the external device side to be connected to the output signal of CL-5610.

**Input/Output of external control terminal**

- Applicable connector: R03-PB8M (Tajimi Electronic Co., Ltd.)
- Output format: Semiconductor relay (Photo-Mos) non-voltage contact (1a)
- Load voltage: AC/DC 60 V
- Load current: 400 mA
- ON resistance: 2 Ω or less

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Power supply</td>
<td>Input DC5 to 24 V (See “Recommended Interface”) • Insert a resistor when supplying DC 6 V or more externally.</td>
</tr>
<tr>
<td>B</td>
<td>START</td>
<td>Same function as START key</td>
</tr>
<tr>
<td>C</td>
<td>STOP</td>
<td>Stop the calculation mode</td>
</tr>
<tr>
<td>D</td>
<td>PAUSE</td>
<td>Same function as PAUSE key</td>
</tr>
<tr>
<td>E</td>
<td>CALIB</td>
<td>Calibrated with the reference material data of the registered measurement target • Only for conductor measurement • The thickness of the reference material cannot be changed.</td>
</tr>
<tr>
<td>F</td>
<td>START STATUS</td>
<td>Switch to active in Calculation mode and Calculation suspend mode</td>
</tr>
<tr>
<td>G</td>
<td>+5 V</td>
<td>Output +5 V (MAX:0.3 A)</td>
</tr>
<tr>
<td>H</td>
<td>COMMON</td>
<td>Connect to 0 V</td>
</tr>
</tbody>
</table>

**Recommended Interface** (When using the internal power supply)

- CL-5610/5610S output
- BCD-OUT
- Pull up with 10kΩ
- CMOS or TTL

- Output format: Open collector
- IC: 74LS07
- Withstand voltage: 24 V max
- Sink current: 32 mA max
- Residual voltage: 0.6 V max

**Recommended Interface** (When using the external power supply)

- CL-5610/5610S input
- BCD IN/OUT
- Comparator Output
- Input/Output of external control terminal

**Output of Hold signal**

The following circuit is recommended to input hold signals to the CL-5610 series.

- At contact output
- At logic output
Electrostatic capacitance type non-contact displacement meter **VT series**

Electrostatic capacitance type non-contact displacement meter VT series is a displacement meter that detects a gap with a conductor as an analog voltage in combination with the VE series (gap detector). It is useful for detecting deflection of a rotating shaft, and for controlling the position adjustment on a stage at a minute level. The cable length between the non-contact displacement meter and the external device is max. 10m in length.

VT-5200 series is operated on AC power, VT-5700 series is operated on DC power.

The VT-5210 / 5710 has 4 kHz of response frequency, and the VT-5220 / 5720 has 10 kHz of response frequency.

### VT-5200 series

<table>
<thead>
<tr>
<th>Model name</th>
<th>VT-5210 (4 kHz)</th>
<th>VT-5220 (10 kHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>0 to 5 V / 0 to 100 % F.S.</td>
<td>0 to 5 V / 0 to 100 % F.S.</td>
</tr>
<tr>
<td>Output offset range</td>
<td>-5 to 0 V of offset voltage can be set to the output.</td>
<td>-5 to 0 V of offset voltage can be set to the output.</td>
</tr>
<tr>
<td>Linearity (at 10 to 100 %F.S.)</td>
<td>±0.2 %F.S.</td>
<td>±0.25 %F.S.</td>
</tr>
<tr>
<td>Temperature characteristics</td>
<td>Within ±0.05 % F.S./˚C</td>
<td>Within ±0.05 % F.S./˚C</td>
</tr>
<tr>
<td>Response frequency</td>
<td>DC to 4 kHz</td>
<td>DC to 10 kHz</td>
</tr>
<tr>
<td>Monitor display</td>
<td>20-segment LED, analog output offset function</td>
<td>10-segment LED</td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>0 to +40 ˚C (guaranteed accuracy range: 23±2 ˚C)</td>
<td>0 to +40 ˚C (guaranteed accuracy range: 23±2 ˚C)</td>
</tr>
<tr>
<td>Power requirement</td>
<td>AC100 to 240 V /10 VA</td>
<td>AC±15 V (within ±0.5 V/100 mA)</td>
</tr>
<tr>
<td>Outer dimensions</td>
<td>95 (W) x 150 (H) x 195 (D) mm (not including protruded section)</td>
<td>56 (W) x 42.4 (H) x 122 (D) mm (not including protruded section)</td>
</tr>
<tr>
<td>Weight</td>
<td>approx. 2 kg</td>
<td>approx. 0.5 kg</td>
</tr>
<tr>
<td>Accessory</td>
<td>AC power cable x 1, instruction manual x 1</td>
<td>Connector for voltage output/ power connection (R03PB8M) x 1, instruction manual x 1</td>
</tr>
</tbody>
</table>

### VT-5700 series

<table>
<thead>
<tr>
<th>Model name</th>
<th>VT-5710 (4 kHz)</th>
<th>VT-5720 (10 kHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>0 to 5 V / 0 to 100 % F.S.</td>
<td>0 to 5 V / 0 to 100 % F.S.</td>
</tr>
<tr>
<td>Linearity (at 10 to 100 %F.S.)</td>
<td>±0.2 %F.S.</td>
<td>±0.25 %F.S.</td>
</tr>
<tr>
<td>Temperature characteristics</td>
<td>Within ±0.05 % F.S./˚C</td>
<td>Within ±0.05 % F.S./˚C</td>
</tr>
<tr>
<td>Response frequency</td>
<td>DC to 4 kHz</td>
<td>DC to 10 kHz</td>
</tr>
<tr>
<td>Monitor display</td>
<td>20-segment LED, analog output offset function</td>
<td>10-segment LED</td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>0 to +40 ˚C (guaranteed accuracy range: 23±2 ˚C)</td>
<td>0 to +40 ˚C (guaranteed accuracy range: 23±2 ˚C)</td>
</tr>
<tr>
<td>Power requirement</td>
<td>AC100 to 240 V /10 VA</td>
<td>DC±15 V (within ±0.5 V/100 mA)</td>
</tr>
<tr>
<td>Outer dimensions</td>
<td>95 (W) x 150 (H) x 195 (D) mm (not including protruded section)</td>
<td>56 (W) x 42.4 (H) x 122 (D) mm (not including protruded section)</td>
</tr>
<tr>
<td>Weight</td>
<td>approx. 2 kg</td>
<td>approx. 0.5 kg</td>
</tr>
<tr>
<td>Accessory</td>
<td>AC power cable x 1, instruction manual x 1</td>
<td>Connector for voltage output/ power connection (R03PB8M) x 1, instruction manual x 1</td>
</tr>
</tbody>
</table>
The VE series gap detector is a displacement sensor that detects the gap from the sensor to the measurement target with high accuracy. Useful for measuring vibration and surface deflection of rotating shafts such as turbines, motors, compressors and machine tool spindles, and thickness and shape of targets by combining with the VT series electrostatic capacitance type non-contact displacement meter and the CL series electrostatic capacitance type non-contact thickness meter.

<table>
<thead>
<tr>
<th></th>
<th>VE-2011</th>
<th>VE-5011</th>
<th>VE-1021</th>
<th>VE-8021</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement range (µm)</td>
<td>20 to 200</td>
<td>50 to 500</td>
<td>100 to 1000</td>
<td>800 to 8000</td>
</tr>
<tr>
<td>External diameter (mm)</td>
<td>ø3 (holding part:ø10)</td>
<td>ø6 (holding part:ø10)</td>
<td>ø8 (holding part:ø10)</td>
<td>ø40 (holding part:ø10)</td>
</tr>
<tr>
<td>Cable connection method*1</td>
<td>Connector (use with exclusive cable)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Display resolution (µm)*2</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>2</td>
</tr>
<tr>
<td>Linearity</td>
<td>Depends on the displacement meter and thickness meter to be connected. Please check the specifications for each sensor.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating temperature range*3</td>
<td>0 to +80 °C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exclusive cable (1.5 m)</td>
<td>LV-1520/VL-1521</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>VE-5010</th>
<th>VE-1020</th>
<th>VE-1520</th>
<th>VE-3020</th>
<th>VE-8020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement range (µm)</td>
<td>50 to 500</td>
<td>100 to 1000</td>
<td>150 to 1500</td>
<td>300 to 3000</td>
<td>800 to 8000</td>
</tr>
<tr>
<td>External diameter (mm)</td>
<td>ø6</td>
<td>ø8</td>
<td>ø10</td>
<td>ø20</td>
<td>ø40 (holding part:ø20)</td>
</tr>
<tr>
<td>Cable connection method*1</td>
<td>Cable direct attached (1.5m)</td>
<td>Connector</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Display resolution (µm)*2</td>
<td>0.1</td>
<td>0.1</td>
<td>0.5</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Linearity</td>
<td>Depends on the displacement meter and thickness meter to be connected. Please check the specifications for each sensor.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating temperature range*3</td>
<td>0 to +80 °C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exclusive cable (1.5m)</td>
<td>LV-1520/VL-1521</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*1: Only the exclusive cable can be used (not extendable).
*2: Display resolution when measuring in conductor mode and standard mode connecting to CL-5610/5610S.
*3: Temperature range that operates without damage to the sensor. The display resolution and linearity are guaranteed in the range of 23 ±2 °C.
Examples of measurement

**Conductor/semiconductor thickness measurement**

**Measurement of a silicon wafer**

- Wafer with orientation flat
- CL-015 Wafer slide table
- CL-5610 Non-contact thickness meter
- VL-1520 Signal cable x 2
- VE-1520 Gap detector x 2
- Supplied by customers
- Personal computer

**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
- Transparent glass (Wafer)
- AX-5022 RS-232C cable
- CPU for system control
- CL-5610 Non-contact thickness meter
- VL-1520 Signal cable

**Thickness measurement during a running operation**

- Steel plate rolling machine
- Anvil mounted with sensors
- CL-5610 Non-contact thickness meter
- VL-1520 Signal cable x 2

**Non-contact thickness measurement of film on a production line**

- Place the film so that it contacts the opposing conductor.
- Film
- Conductor
- VE-510 Gap detector x 1
- CL-5610 Non-contact thickness meter
- VL-1520 Signal cable

**Measurement of copper-clad laminated plates**

- Copper-clad laminated plate
- Copper foil
- Insulator
- Connected electrically
- VE-3020 Gap detector x 2
- CL-5610 Non-contact thickness meter
- VL-1520 Signal cable x 2

**Displacement measurement of conductors/semiconductors**

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

- Analog output
- Oscilloscope monitoring of the shaft vibration and eccentricity
- Connected electrically
- VT-5200 Series
- Connected electrically
- VE-3020 Gap detector x 1
- CL-5610 Non-contact thickness meter
- VL-1520 Signal cable
- Connected electrically
- VE-3020 Gap detector x 1
For Stable Measurement

**Influence by temperature change**

Temperature change during measurement causes the dimensions of the sensor or the jig that fixes the sensor will change, so that measurement errors occur. The ambient temperature range for measurement accuracy specified in this system is 23 ± 2 °C. When using the sensor outside the range, make corrections with reference to the influence of the temperature change of the sensor shown below.

\[ \Delta d = (k_1 \cdot l + k_2 \cdot d) \times \Delta t \]

- \( k_1 \): Linear expansion coefficient of the sensor housing \((1.7 \times 10^{-5})\)
- \( k_2 \): Coefficient of area expansion of the sensor electrode material \((3.4 \times 10^{-5})\)
- \( l \): Distance from sensor surface to the fixed point
- \( \Delta t \): Change in temperature
- \( d \): Measurement gap
- \( \Delta d \): Change in the output of the converter

* Please make correction for the dimensional change of the jig fixing the sensor separately.

**Calibration of sensor and display unit**

A displacement meter and a thickness meter connected to a sensor should be adjusted one-on-one in electrostatic capacitance measurement system. When ordered CL series (electrostatic capacitance type non-contact thickness meter) and VE series (gap detector) at the same time: up to two sensors are adjusted for free. When ordered VT series (electrostatic capacitance type non-contact displacement meter) and the VE series (gap detector) at the same time: one sensor is adjusted for free.

**Note on measurement**

- Do not contact the measurement electrode of the sensor with the target to be measured in electrostatic capacitance type measurement system to avoid damage of the amplifier. Also, for the same reason, make sure not to be charged the measurement target with static electricity.
- The outer shell of the sensor and the measurement target (reference floor for insulator measurement) must be electrically connected. If conduction is not sufficient, stable measurement cannot be performed.

**Outer dimensions (unit: mm)**

**Electrostatic capacitance type non-contact thickness meter**

<table>
<thead>
<tr>
<th>Model</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>CL-5610</td>
<td>210 x 275 x 275</td>
</tr>
<tr>
<td>CL-5610S</td>
<td>210 x 275 x 275</td>
</tr>
</tbody>
</table>

*Note: CL series sensors are compatible with VT series jigs.*

---

Influence by temperature change

- Linear expansion coefficient of the sensor housing: \(1.7 \times 10^{-5}\)
- Coefficient of area expansion of the sensor electrode material: \(3.4 \times 10^{-5}\)
- Distance from sensor surface to the fixed point
- Change in temperature
- Measurement gap
- Change in the output of the converter

Calibration of sensor and display unit

A displacement meter and a thickness meter connected to a sensor should be adjusted one-on-one in electrostatic capacitance measurement system.

Note on measurement

- Do not contact the measurement electrode of the sensor with the target to be measured in electrostatic capacitance type measurement system to avoid damage of the amplifier. Also, for the same reason, make sure not to be charged the measurement target with static electricity.
- The outer shell of the sensor and the measurement target (reference floor for insulator measurement) must be electrically connected. If conduction is not sufficient, stable measurement cannot be performed.
### Gap detector

*(Note) When fixing the sensor, fix it within the range of i.z (insert zone).*

---

**VE-2011**

- Connector
- Min. R15
- Cable (ø3)
- *Cable length (cable section) 1.5 m*

**VE-5011**

- Connector
- Min. R15
- Cable (ø3)
- *Cable length (cable section) 1.5 m*

**VE-1021**

- Connector
- Min. R15
- Cable (ø3)
- *Cable length (cable section) 1.5 m*

**VE-8021**

- Connector
- Min. R15
- Cable (ø3)
- *Cable length (cable section) 1.5 m*

**VE-5010**

- Connector
- Min. R15
- Cable (ø3)
- *Cable length (cable section) 1.5 m*

**VE-1020**

- Connector
- Min. R15
- Cable (ø3)
- *Cable length (cable section) 1.5 m*

**VE-1520**

- Connector
- Min. R15
- Cable (ø3)
- *Cable length (cable section) 1.5 m*

**VE-3020**

- Connector
- Min. R15
- Cable (ø3)
- *Cable length (cable section) 1.5 m*

**VE-8020**

- Connector
- Min. R15
- Cable (ø3)
- *Cable length (cable section) 1.5 m*

**VL-1520**

- Connector
- Min. R15
- Cable (ø3)
- *Cable length (cable section) 1.5 m*

**VL-1521**

- Connector (straight type)
- Connector (L-shape)
- *Cable length (cable section) 1.5 m*
CL-015 is a simple type manual slide table that can be used together with the CL-5610 series to perform non-contact thickness measurements of conductive wafers such as silicon wafers. Grooves have been provided in the table surface to facilitate the use of the tweezers for vacuum adsorption.

- **Measurable wafer size**
  - Outer diameter: 100 to 150 mm
  - Thickness: 0.1 to 1 mm
- Other special tables for 200 mm and 300 mm wafers can also be manufactured to order.

Note: The sensors are required to set up and down of the table. (Please refer to the page 9 “Example of measurements”.)