Model LH-**-5V High-sensitivity Capacitive Sensor (5 V DC)

NPN transistor output

Model List	Detection Capacity	Operation Status
LH-1-5V	1PF	Normally open
LH-11-5V		Normally closed
LH-3-5V	3PF	Normally open
LH-31-5V		Normally closed
LH-5-5V	5PF	Normally open
LH-51-5V		Normally closed

PNP transistor output

Model List	Detection Capacity	Operation Status
LH-13-5V	1PF	Normally open
LH-14-5V		Normally closed
LH-33-5V	3PF	Normally open
LH-34-5V		Normally closed
LH-53-5V	5PF	Normally open
LH-54-5V		Normally closed

Output transistor is an open collector output with the emitter grounded.

Application

- Detection of powders, particles, and liquids

Features

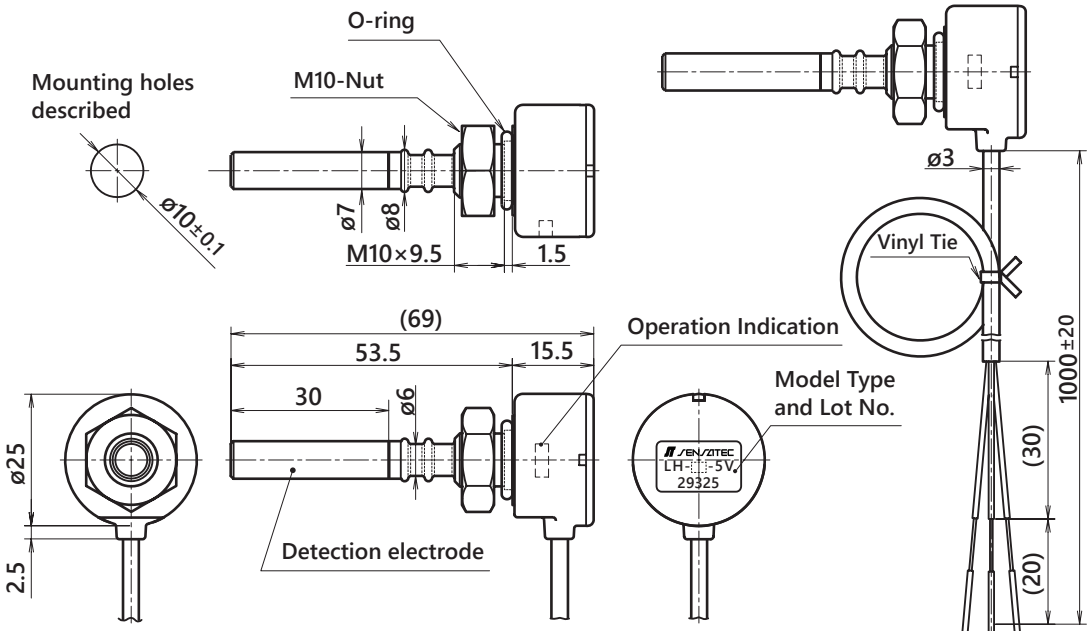
- A small and highly sensitive capacitive detection sensor.
- Sensing electrode erosion is prevented by using a polarization prevention capacitor.
- The orange LED turns on to show that the detection output is ON.
- The sensor can also be used as a high-sensitivity touch sensor.

Rating / Performance

Model	Normally open	LH-1-5V	LH-3-5V	LH-5-5V	LH-13-5V	LH-33-5V	LH-53-5V
	Normally closed	LH-11-5V	LH-31-5V	LH-51-5V	LH-14-5V	LH-34-5V	LH-54-5V
Withstand Pressure Resistance		0.3 Mpa (At atmospheric pressure outside tank : 0.1 Mpa)					
Container mounting hole		ø10 mm					
Power Supply Voltage		5 V DC (Operating voltage range : 4.5 V to 5.5 V DC)					
Current Consumption		15 mA DC or less					
Output		NPN transistor open collector 30 V DC, 50 mA DC or less			PNP transistor open collector 30 V DC, 50 mA DC or less		
Output Residual Voltage		1 V DC or less (Load current 50 mA DC at cable 1 m)					
Operation Indicator		Orange LED (Lit when the output is ON)					
Response Time		100 ms max					
Temperature Range		-25 to 70 °C (-15 to 65 °C strage temperature range) (Without dew condensation or icing)					
Humidity Range		25 to 95 % RH or less (25 to 85 % RH or less strage humidity range) (Without dew condensation)					
Dielectric Strength		500 V AC for 1 minute (Between live parts and the mounting nuts)					
Insulation Resistance		50 MΩ or more, at 500 V DC megger (Between live parts and the mounting nuts)					
Vibration Resistance		10 to 55 Hz, 1.5mm double amplitude in X, Y, and Z-directions for 2 hours each (at power off)					
Shock Resistance		500 m/s^2 (Approx. 50 G) in each X, Y, and Z-directions 10 times each (at power off)					
Protection		IP 67 (JIS standard, excluding cable terminations)					
Material		Case cover : SPS with glass, Detection electrode : SUS304 [Accessories] Hexagon nut : M10 SPS with glass, O-ring : Φ11 W2.4mm, Silicone rubber					
		The materials used in parts that come into direct contact with water/moisture conform to "Standards for Food Additives" in Japan, defined under the Japan Food Sanitation Law.					
Cable		ø3, 3-core round cord of 0.15 mm^2 and insulation 0.9 mm and 1 m in length (Oil and heat resistant)					
Weight		Approx. 30 g					

* Since the detection electrode is connected to internal circuitry, do not apply DC voltages higher than the power supply voltage, or any AC voltages.

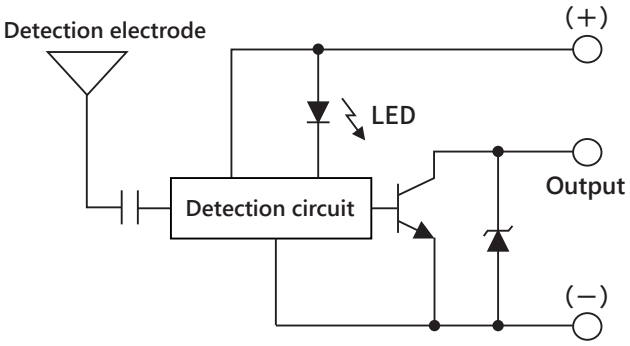
Dimensions



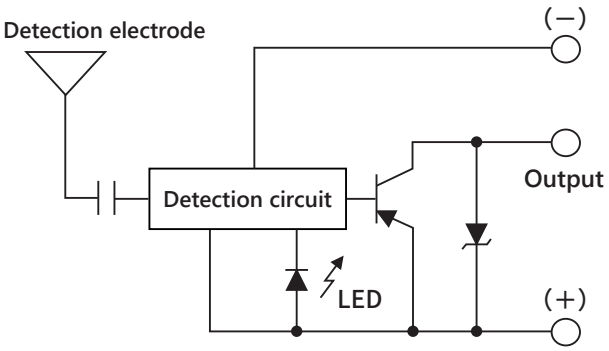
Wire Color	Signal Name	Function
Brown	(+)	Power Supply Voltage
Black	Output	Output signal
Blue	(−)	Power Supply Voltage

Output Circuit

NPN transistor output



PNP transistor output



Indication of Detection Sensitivity

The displayed value of detection sensitivity indicates the capacitance value between the detection target and the ground connection to the electrode when the sensor is mounted inside a metal container (wall thickness 1 mm) with a ø10 mm mounting hole.
The detection signal will be output at a capacitance value slightly larger than the rated value (approx. 0.4 pF) when a plastic container is used. Conversely, the detection signal will be output at a capacitance value smaller than the rated value when thicker-walled metal container is used.
Please check the usage carefully before use.
Be sure to use the supplied plastic nut for the M10 nut for mounting the sensor.

For long term reliability

1 Since the detection electrode is connected to the internal circuitry, do not apply DC voltages higher than the power supply voltage, or any AC voltages.

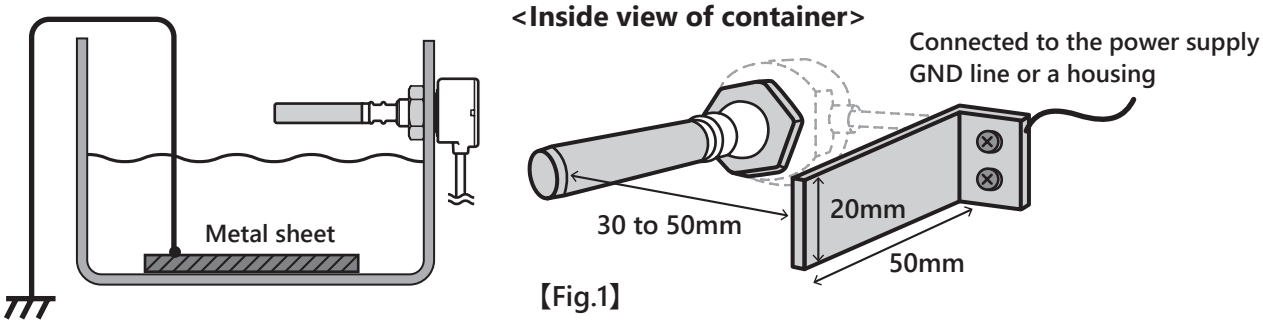
2 Since the electrode is screw-mounted to the PCB, do not apply any rotational force to it.
Also, since the detection electrode is connected to the internal circuitry at its thinnest machined part, do not apply any bending stress to it. Doing so may cause damage.
If there is a detection target that may fall directly onto the electrode, provide an auxiliary plate at least 30 mm above the detection electrode to prevent the detection target from striking the electrode.

3 This sensor detects the capacitance value generated between the detection electrode and the power supply 0V line when the detection electrode nears or comes into contact with the detection target.
Therefore, the detection target may be detected with an inaccurate capacitance value, if (1) the capacitance between the detection target and ground is small (i.e. the target object is floating), or (2) distributed capacitance between ground and the sensor wiring is small.
Please carefully ascertain how to use beforehand.

Examples of (1) include the following cases:
The container for the detection target is small and made of plastic or another material with a low relative dielectric constant (εs), or the detection target is made of a material with a low relative dielectric constant (εs) and is present in a small amount.
If the container is small and made of thin plastic, attempt detection by attaching a metal foil or metal sheet with an area of 50 x 50 mm or more to the inside or outside base of the container and then connecting the metal to a nearby conductive housing or similar.

If the container wall is thick, attempt detection by attaching the metal body to the inside base of the container and connecting the wiring as described above.
When the detection target is made of a material with a low relative dielectric constant (εs) and is present in a small amount, attempt detection by providing an auxiliary GND electrode using a metal plate approx. 20 mm wide and 50 mm long parallel to the sensor electrode, approx. 30 to 50 mm away from the sensor electrode, and wiring it to the frame ground.

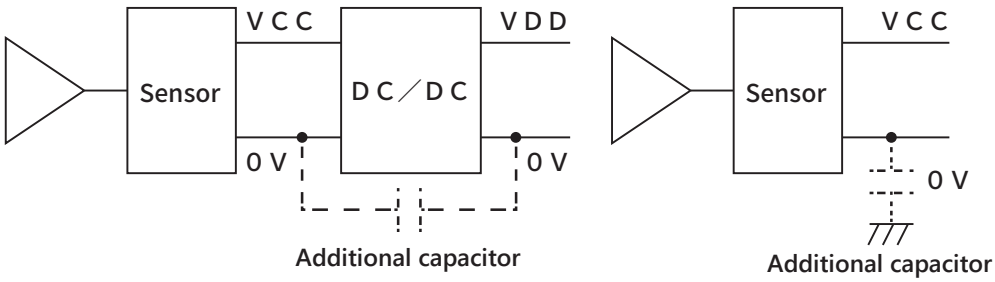
Fig.1 shows an example.



【Fig.1】

Examples of (2) include the following cases:
A DC-DC converter circuit with a small coupling capacitance between the primary and secondary power, or else a small battery pack is used as the power supply for the sensor.
In such cases, attempt detection by connecting the primary 0V line and the secondary 0V line directly or via a capacitor with a capacitance of 2200 pF or higher, or by connecting the 0V line for the sensor to a large housing or the GND line directly or via a capacitor similar to that described above.
In the case of a battery, attempt detection by connecting the 0V line directly or via a capacitor with a capacitance of 2200 pF or higher, as described above.
When connecting the lines via a capacitor, be sure to use a capacitor with sufficient breakdown voltage as required by the equipment.

Fig.2 shows an example.
Since the detection electrode of this sensor is directly connected to the detection circuit, be sure to use a power supply that satisfies the equipment's breakdown voltage and insulation resistance.
Do not apply any voltage, whether AC or DC, between the sensor wiring line and the detection electrode.



【Fig.2】

4 This sensor uses an arrester to protect the circuit from electrostatic discharges reaching the detection electrode and destroying the circuit.
However, when the amount of electrostatic charge is large, for example when there are airborne plastic particles or dried particles/powders, the large static electricity can be built up.
If this excessive charge is continuously applied to the electrode, the protective capacity of the arrester may be exceeded and the detection circuit may be damaged by static electricity.
In such cases, install a metal auxiliary GND plane for removing static electricity near the sensor's detection electrode and wire it to the frame ground to discharge any static electricity present before using the sensor.

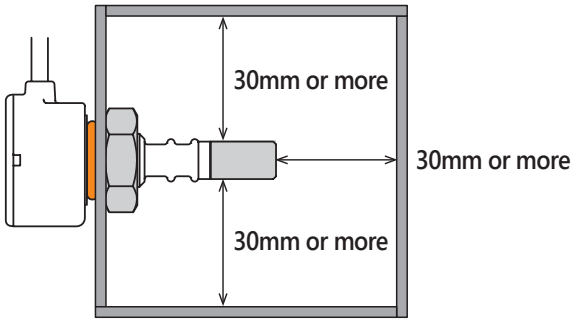
5 This sensor is made of the following materials:
- Case/cover: SPS with glass
- Electrode: SUS304
- O-ring: Silicone rubber
- M10 nut: SPS with glass

Before use, make sure that the material of the detection target is compatible with the detection electrode and case. Also, since the detection electrode is fixed to the PCB, do not apply any rotational force or bending stress to it. Tighten the sensor mounting nut with a torque of no more than 1.5 N · m (15.4 kgf · cm).
(SPS···Syndiotactic polystyrene resin)

6 Changes in the moisture content of the detection target significantly affect the relative dielectric constant (εs), and this cause the detection point to shift. Please check carefully before use.

7 This sensor is not explosion-proof. Carefully observe all relevant laws and regulations, particularly when the detection target is a flammable liquid or when the surrounding environment contains flammable gases.
Be sure to review the safety laws and regulations before use.

8 When installing the sensor, be aware that malfunctions may occur if the detection target adheres to or propagates across the surface between the container wall and the detection electrode, or if the detection target is itself conductive and adheres to a surface out-of-bounds. Ensure a clearance of at least 30 mm between the container wall and the detection electrode.



9 Capacitance detection unit

This sensor is connected to the detection electrode via a plastic pipe from the internal circuitry. The pipe is part of the detection electrode. Be sure to keep the pipe away from metal or other objects near ground potential.

10 This sensor is a capacitive sensor, but if the detection target absorbs moisture and its DC resistance decreases, the sensor may also detect this DC resistance. Please confirm the sensor's characteristics are understood before use.

11 The syndiotactic polystyrene resin with glass used for the LH series cases and cover materials has excellent chemical resistance to acids and alkalis. However, glass fiber, which is blended as a reinforcing material for syndiotactic polystyrene resin, has a limit in resistance to strong acids and strong alkaline solutions. Therefore, if the skeletal structure of glass fiber is chemically deteriorated by acid or alkali, it will cause cracks in the case or cover. Solvents of relatively less impact on the product when exposed to high temperatures for long periods of time are aromatic, chlorinated organic, and ketone-based solvents. Be sure to perform the test in the usage environment before using it.

12 The material of the O-ring (Φ11 W2.4 mm) for preventing water leakage from the tank when the sensor is mounted is silicone rubber. Silicone rubber is a breathable rubber material, so please evaluate carefully whether this good breathability will affect your equipment before using it.
If the breathability of silicone rubber is a problem, please consider other materials.

13 The material of the detection electrode is SUS304. Stainless steel has excellent corrosion resistance due to the formation of an oxide film on its surface, but it is not invulnerable. If chloride ions are present in the liquid, the oxide film may be locally destroyed by foreign matter adhering to the electrode surface or by the difference in oxygen concentration of water, and then corrosion may occur very slowly.
To prevent this corrosion, there are measures such as avoiding chloride ions and regularly removing any attached foreign matter, but it is difficult to completely prevent corrosion. Since ordinary tap water is sterilized with chlorine, it contains chloride ions at a concentration of 0.1 ppm to several ppm. However, the detection of this sensor is not affected because the corrosion progresses very slowly at this very low concentration.
Corrosion prevention measures can be examined by selecting appropriate detection electrode materials in consideration of usage conditions. If you are concerned about the progress of corrosion, then please consult us about changing materials. Also, for liquid detection of chemicals (acids, alkalis, solvents, oils, etc.), the material of the detection electrode may not be sufficiently corrosion resistant. Please use only after first carefully evaluating the conditions of use and confirming that the electrode is safe to use.

14 Do not pull the cable to apply stress.
Do not put a load on the cable at any time (during storage or use).
When mounting the sensor, firmly fix the cable near the sensor body.
If the cable continues to be stressed, the cable may come off the sensor body or break inside the cable.

15 No measures against sulfurization are taken. The sensor may stop functioning if used for detecting hot spring water containing sulfide ions, or if used in an environment where rubber is often present.

16 As a guide, perform maintenance inspections (daily inspections and regular inspections) once every six months to one year. Depending on the operating conditions such as operating temperature, humidity, and pressure, perform them more frequently.

17 The detection electrode and case that come into direct contact with the detection targets may experience considerable wear. Be sure to inspect and check them periodically.
In particular, the case should be designed with an additional protective mechanism to prevent wear.

18 According to its operating principles, this sensor detects the capacitance between the sensor's detection electrode and ground via the detection target. False detection may occur in environments where there is a high level of common mode noise present between the sensor circuit and ground.
A typical source of common mode noise is an inverter circuit which is not connected to F.G. and therefore the common mode noise is not being discharged to ground.
In particular, if you are using a switching regulator, pulse motor, or inverter device with the same power supply as the sensor power supply, be sure to use a method to discharge the common mode noise to ground.
If possible, connect the power supply 0V line to ground or to a large housing directly or via capacitor with a capacitance of at least 2200 pF to discharge common mode noise.
See 3 above for further precautions.

19 If a magnet with strong magnetic flux density is placed close to the circuit part of the case, the magnetic field may cause malfunction or affect the detection sensitivity. If such conditions are expected, be sure to check for compatibility before use.

20 This sensor uses a low power high-frequency signal. If there is a powerful medium-wave radio transmission antenna nearby emitting at approximately 100 kHz to 3 MHz, the indoor wiring will function as a reception antenna and generate high-voltage common mode noise. If this common mode noise reaches the sensor, it may affect the characteristics of the sensor. Be sure to check for compatibility before use.
If such interference is expected, connect the sensor's 0V line to the housing directly, or via capacitor to short the interference to ground. The capacitance value should be approximately 2200 pF for low-level common mode noise rejection and approximately 0.01 μF for high-level rejection.
Fit and check before use. Please refer to 3 above.

*For other detailed specifications, refer to the specification sheet of the corresponding model.