

# Model **DCS-45** Differential Capacitance Type Proximity Sensor



Model List	Detection Level
<b>DCS-45</b>	0 to 45 mm

Ideal for small volume detections

Analog output

## Application

- Paper remaining amount detection - Detection of banknotes - Coin quantity detection
- Human proximity detection - Detection of remaining liquid level - Detection of remaining level of grains
- Detection of kerosene level (non-contact) - Level detection of coffee powder (non-contact)

## Features

- Detection of minute capacitance change is possible by the differential capacitance detection method.
- Minute capacitance changes in the fF (femto farad) range can be detected.
- Capacitance change can be output as an analog voltage.
- Detection of changes due to the thickness of a single sheet of paper.
- Non-contact detection of liquid inside plastic piping.
- Non-metallic liquid in the tank can be detected without contact.

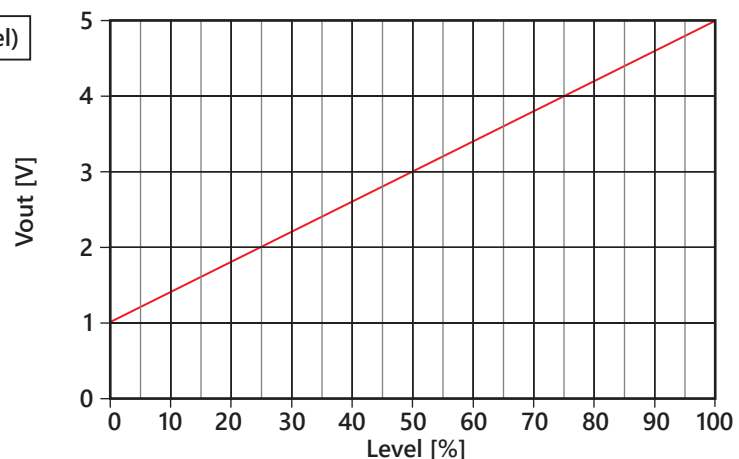
## Rating/Performance

Model	<b>DCS-45</b>
Detection Surface	Upper side detection
Detection Level	0 to 45 mm
Power Voltage	12 V to 24 V DC (Operating voltage range : 10 V to 30 V DC)
Power Consumption	10 mA DC or less (At 24 V DC)
Output Voltage	0 to 5 V DC, non-detection output 1 V
Output Impedance	1 k $\Omega$
Response Time	10 ms or less
Temperature Range	0 to 50 °C (-10 to 55 °C during storage)(Without dew condensation or freezing)
Humidity Range	30 to 80 % RH (30 to 85 % RH during storage)(Without dew condensation)
Load Resistance	100 k $\Omega$ or more
Breakdown Voltage	500 V AC, 50/60 Hz for 1 min (Between live parts and the case)
Insulation Resistance	50 M $\Omega$ or more, at 500 V DC megger (Between live parts and the case)
Vibration Resistance	Durability : 10 to 55 Hz, Double amplitude: 1.5 mm in X-, Y-, and Z-direction, each 2 hours (Device not powered)
Shock Resistance	Durability : 500 m/s <sup>2</sup> (Approx. 50 G) in X-, Y-, and Z-direction, each 3 times (Device not powered)
Ingress Protection	IP64
Case Material	PPS
Cable	$\varnothing$ 3, 3-core round cord of 0.15 mm <sup>2</sup> and insulation 1.0 mm and 1 m in length (Oil and heat resistant)
Weight	Approx. 40 g

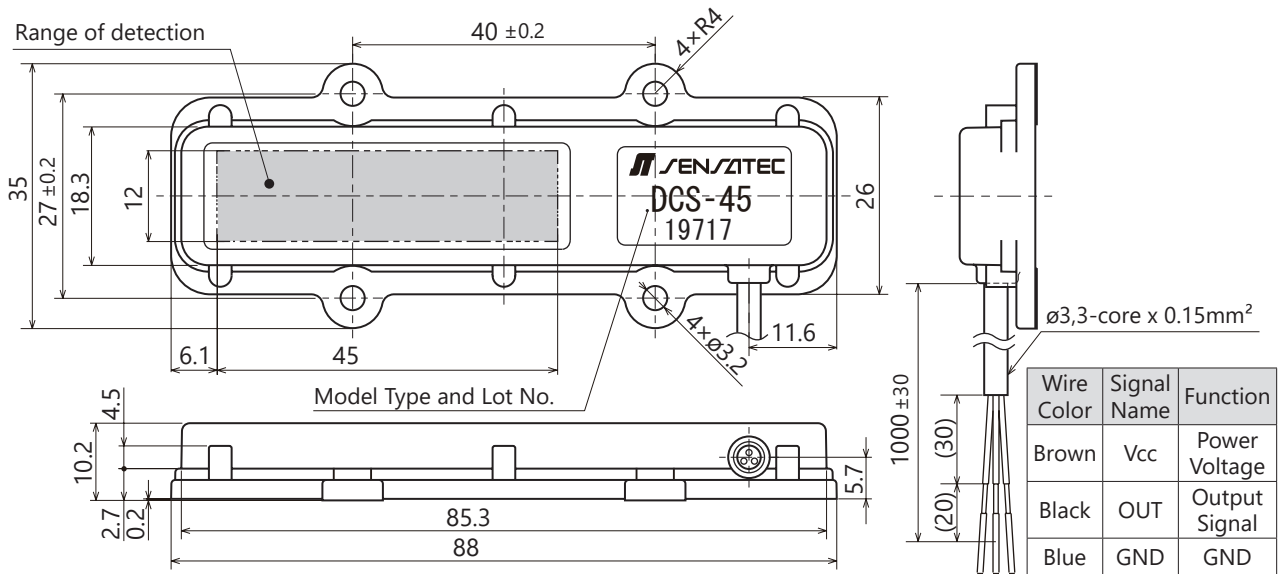
## Characteristics Graph (Typical Example)

Example of remaining level (ground model)

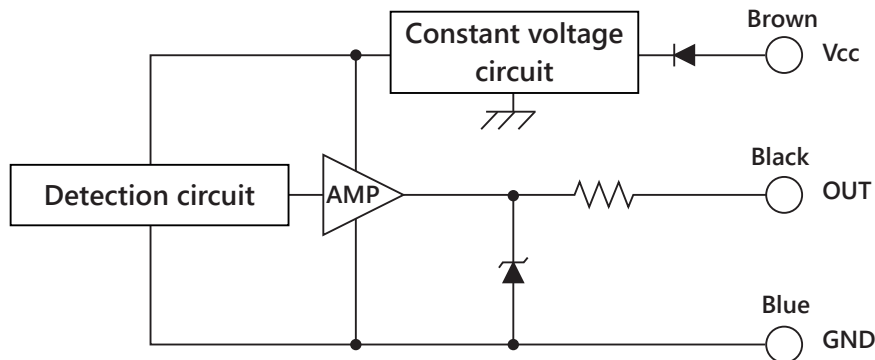
\*Depending on the type of detector and the distance from the sensor to the detector.



## Dimensions

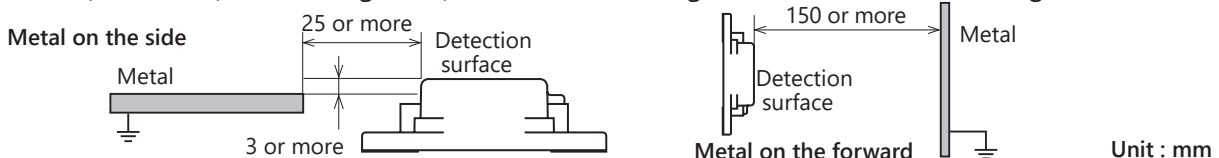


## Output Circuit



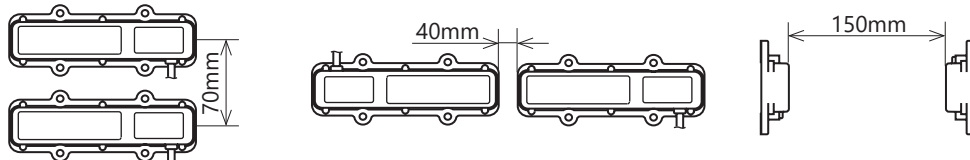
## Influence By Surrounding Metals

The sensor detection side and the back are shielded and less susceptible to interference, but if minute effects (tens of mV) cannot be ignored, use them with enough distance as shown in the figure below.



## Mutual Interference

When using two or more sets of sensor of the same frequency type, separate them in the distance shown below more to avoid possible mutual interference.



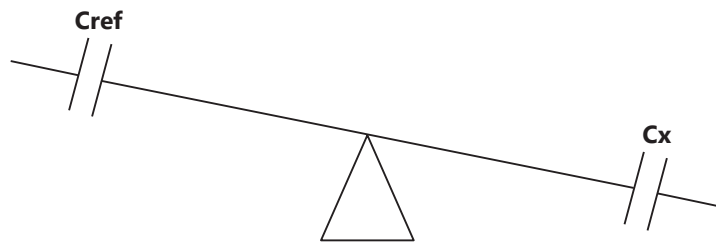
## Precautions During Use

- The principle of operation of differential capacitance type proximity sensors is an analog output sensor that detects the difference between a reference capacitance inside the sensor and the capacitance of the sensor detection surface. There are two motion models, the "ground model" in which the capacitance decreases in principle and the "floating model" where the capacitance increases. The output voltage is set to 1 V at the time of non-detection, and if the detection object has a large capacitive coupling with ground, the ground model is applied and the output voltage increases from 1 V to 5 V. When the detection object has small capacitive coupling with ground, the floating model is applied if it comes close enough to come into contact with the detection surface, at which time the output voltage falls from 1 V to 0 V.
- Never peel off the film on the detection surface as this will prevent capacitance from being detected.
- For other precautions, please refer to "General Precautions" of differential capacitance type proximity sensors.

# General Precautions for Differential Capacitance Type Proximity Sensor

## 1 Principle of Differential Capacitance Proximity Sensor

The differential capacitance type proximity sensor is a sensor that detects the difference ( $\Delta C$ ) between a reference capacitance ( $C_{ref}$ ) inside the sensor and the capacitance ( $C_x$ ) at the sensor detection surface. Since it detects changes in lines of electric force coming from the detection surface, it is a sensor that can output minute capacitance changes as an analog voltage.

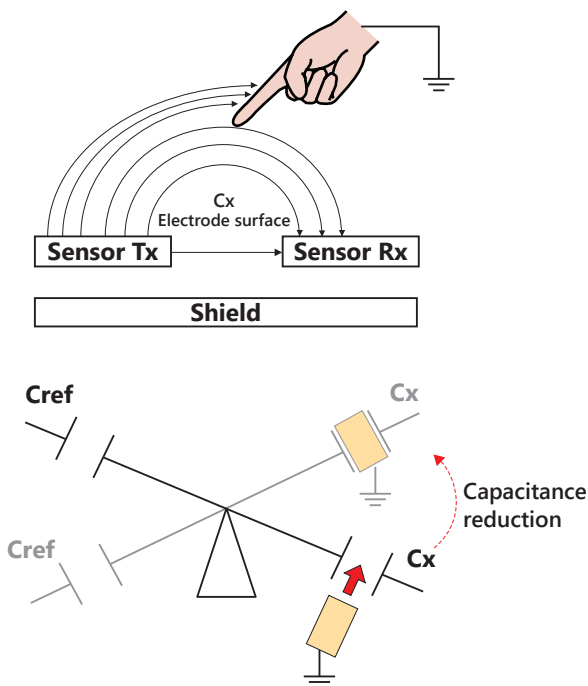


[Conceptual diagram]

## 2 Two motion models

### [Grounding model]

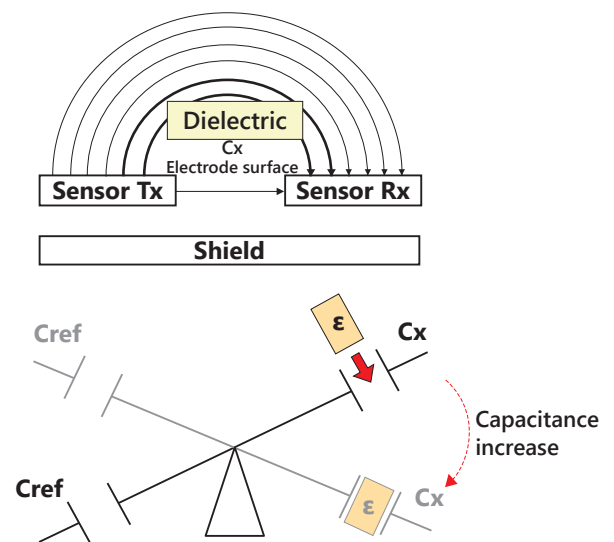
A person or a detected object with a large surface area has a large capacitive coupling and is equivalent as if it is grounded to earth, GND. When a finger or the like approaches the detection surface, electric lines of force occurring between the electrodes are attracted to the finger and so the lines of electric force between the electrodes are reduced. As a result, capacitance ( $C_x$ ) decreases.



### [Floating model]

When the capacitive coupling with ground is small, as the dielectric approaches a position between the electrodes, the capacitance increases with the magnitude of the dielectric constant ( $\epsilon$ ).

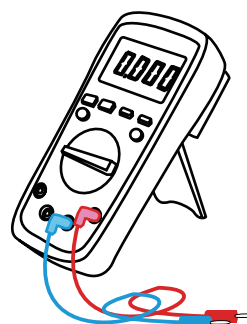
$$C = \epsilon \frac{S}{d}$$



## 3 Noise control

Because differential capacitance type proximity sensors detect changes in weak electric fields (electric field lines), be sure to connect the sensor power supply GND (0 V) directly or via a capacitor of 0.1  $\mu\text{F}$  or more to the metal chassis so that it is at the same electric potential.

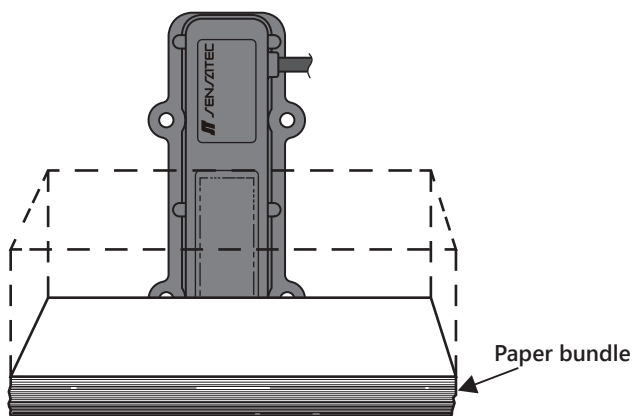
- " How to check the noise voltage "
- Set the tester to its AC voltage range
  - If the output voltage is 10 mVrms or less, it is no problem



## 1 Ground model Usage example

" Level detection (direct) "

- Copy paper, paper cup
- Plastic, glass, metal

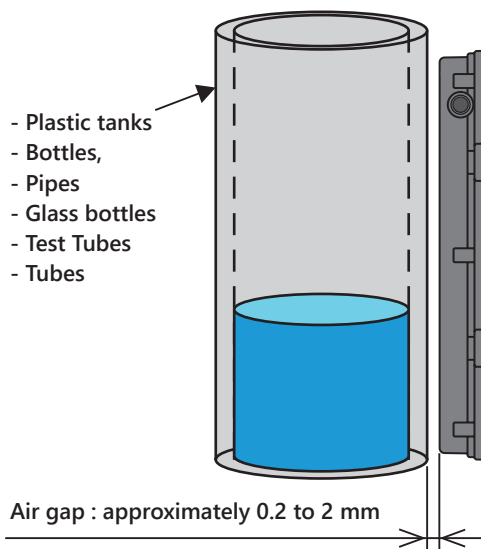


\* When an object comes into contact with the sensor, the floating model may become dominant, so in that case, please provide a suitable air gap.

[Paper remaining detection]

" Level detection (indirect) "

- Liquids (water, chemical liquids, kerosene)
- Powders (coffee powder, wheat flour, toner)



[Liquid level detection]

## 2 Floating model Usage example

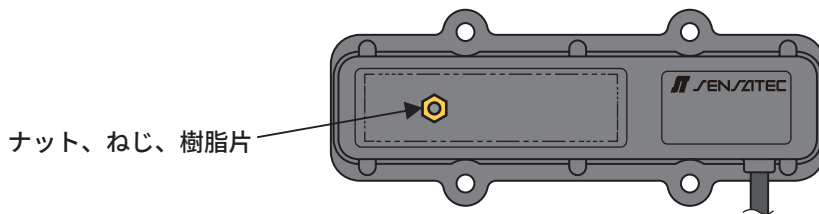
"Presence detection "

- Single sheets of paper, resin plate, glass plate



[Paper presence detection]

- Nuts, screws, resin parts



[Nut detection]