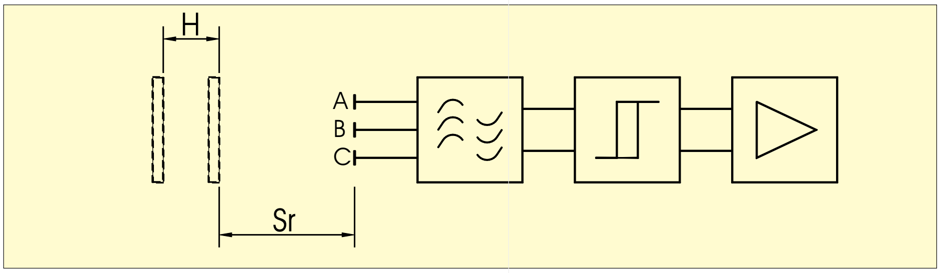
CAPACITIVE PROXIMITY SWITCH

■ Capacitive Proximity Switches

Capacitive proximity switches consist of an RC-oscillator with a special multi-part sensing electrode. The electrode and the oscillator circuit have a tube connected with earth potential for lateral shielding. This enables flush mounting of the sensor in metal, since the electrical field is only present in front of the sensing electrode. This field is the active zone of the sensor.

When the conductive material is removed from the active zone, the oscillator is undamped and the oscillation amplitude decreases. The amplifier of the oscillator voltage and the sensitivity of the sensor can be altered by the built-in potentiometer.

The middle electrode together with the built-in re-coupling gives very effective compensation under conditions of humidity, dust or icing. Special circuitry automatically compensates for these influences. The preset sensing distance remains nearly constant. The electrode design, along with the compensating circuitry of capacitive sensors, is a unique design, and provides performance advantages far superior to other capacitive sensors.



A indicates SENSOR ELECTRODE
B AND C indicates COMPENSATION ELECTRODES

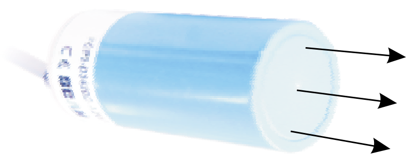
■ Applications

The capacitive switches may be used to limit the level in tanks and containers. The contents may be fluids, pulverized or granulated materials such as PVC powder, dyes, flour, sugar, powdered milk etc. Further applications are as end and limit switches for checking and regulating machinery setting, (even if the materials are non-metallic as in conveyor belt positioning and material stacking); checking drive belts and paper reels for sag and tear. Additionally they may be used as detectors for counting metal and non-metal components.

Areas of application for capacitive sensors.

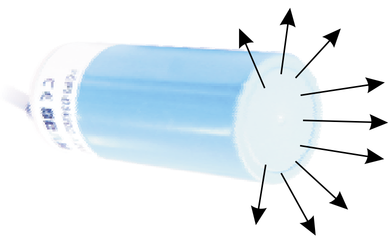
● Shielded configuration

Sensors with a straight-line electrical field. These units scan solids(e.g. wafers, components, PCB's, hybrids, cartons, paper piles, bottles, plastic blocks and stacks of paper at a distance, or liquids through a separating wall (glass or plastic up to a max. of 4 mm thick).



● Non-shielded configuration

Sensors with a spherical electrical field. These units are designed to touch the product, bulk goods or liquids (e.g. granulate, sugar, flour, corn, sand, or oil and water) with their active surface.



CAPACITIVE PROXIMITY SWITCH

■Sensing distance

The data was obtained using a 1 mm thick square steel plate(st37) as an actuator, with a side length equal to 3xSn. The steel plate was grounded. Ambient temperature was 25°C. The largest possible sensing distance is defined as the nominal sensing distance with a Tolerance ± 10%sn.

The sensing distance depends upon shape, size and nature of the object concerned. If the plate is made from a different material or has a smaller diameter, the sensing distance will be reduced.

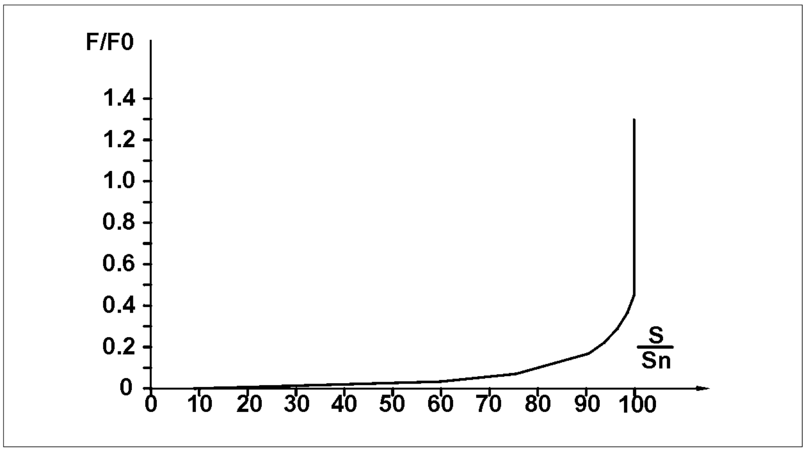
• Size correction factor

For objects which are not flat and are smaller in relation to the active sensor surface, the following sensing distances are obtained depending on the scaled object surface F/F0, where:

F = sensor front surface (active surface), and F0 = front surface of the object being scanned. The figures in the table below refer to flush sensors, and objects in the form of long thin rods.

scaled object surface F/F0	sensing distance Sn in mm	C of object in mm	F in mm 2	S in mm
1.50	100	22.0	380.0	8.0
1.24	100	20.0	314.0	8.0
0.80	100	16.0	201.0	8.0
0.61	100	10.0	154.0	8.0
0.31	94.0	14.0	79.0	7.5
0.20	85.0	8.0	50.0	6.8
0.15	82.5	7.0	38.0	6.6
0.05	67.5	4.0	13.0	5.4
0.03	57.5	3.0	7.0	4.6

The three right-hand columms of the table reflect the application example for a CCM1-1808A-A3 sensor.
The diagram below shows in graphic form the data from the table.



CAPACITIVE PROXIMITY SWITCH

■ Material correction factor

If the material of the object in question is not metal or water, the sensing distance is reduced.

The reduction factors for the different materials are shown in the table below.

Actuating Material	Sensing-distance Compared to a surface of water			
	20mm	10mm	15mm	10mm
Hand	20	10	15	10
Square steel plate (100x100x1)	20	10	15	10
Round Steel Plate (30ϕX1)	11	6	4	2
Stone (marble)	18	8.5	8	5
Wood	13	5	5	3
Glass	12	4	6	2.5
Carbon	19	9	12	9
PVC-block (30x30x5)	8	4	1.5	—
Lupulin granulate 1800H	8	3	2.5	Head approx. 2mm immersed
Polystyrene 454H	9.5	3	4	1
Hostalen GC 8960H	8.2	1.5	2	Head approx. 1mm immersed
Vestyron 719-50	7.9	1.2	2	Head approx. 3mm immersed
Hostyren	8.2	3	3	Head approx. 1mm immersed
BM scrap material (Z)	6.7	1.4	1	Head surrounded
Hostalen GC coarse powder	8	2	1.5	Head approx. 3mm immersed
Lupulin fine granulate	7.7	1.5	1	Head approx. 3mm immersed
Hostaform C	9.8	3.5	4	1
Hostyren (polystyrene)	7.4	2	2.5	Head approx. 2mm immersed
Hostalit S	7.5	2	1.5	Head surrounded
Hostalen PP	5	1.5	1.5	Head surrounded
Hostalit E	7.2	1	1	Head approx. 4mm immersed
Styropor unfoamed	8.1	3	3	0.5
Styropor ϕ1.5	—	—	—	—
Antimony-trioxide	6.2	0.9	2.5	Direct contact
Oil	9	3	5	3
Maximum sensing-distance Critical point	55		110	

Conditions:

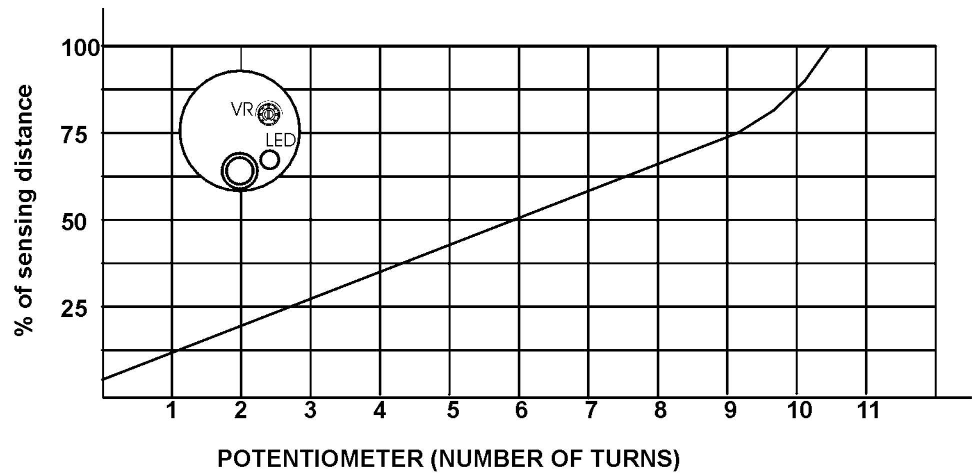
Tu = 25℃; V_A = 24VDC

In each case, the measurements were made from a level surface.

CAPACITIVE PROXIMITY SWITCHES

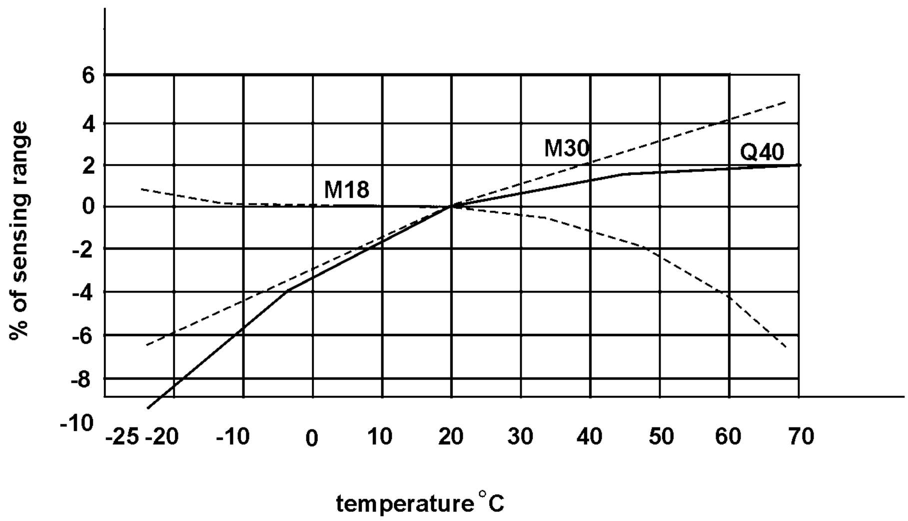
•Sensitivity adjustment

Capacitive proximity sensors have a fourteen turn potentiometer. The potentiometer must be adjusted to suit most applications. Turn clockwise to increase sensitivity. From the original setting of 0.7-0.8xSn(Sn=norminal range), the norminal sensing range is reached after 2-3 clockwise turns. This, however, leads to nonlinearity of the curve and oversensitivity, which may lock on the sensor. If this occurs, decrease sensitivity by turning the potentiometer 2-3 turns counterclockwise.



■ Temperature

Capacitive proximity switches will function within a temperature range of -25°C to +70°C The switching distance deviation is 20% provided that the switching distance is not greater Than the nominal switching distance (taking into consideration the reduction factors of the material).



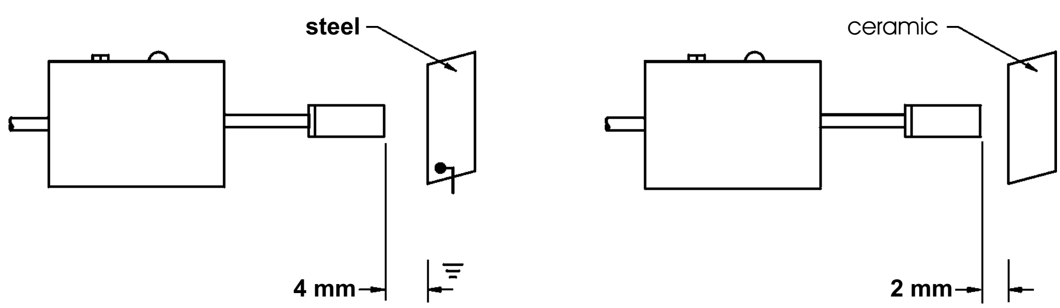
CAPACITIVE PROXIMITY SWITCH

■ SENSORS FOR SHIELDED MOUNTING

Normally, the linear field of shielded sensors scans block materials for distance. In order to obtain faultless switching of sensors, check the maximum switching gap as described below before putting the device into operation:

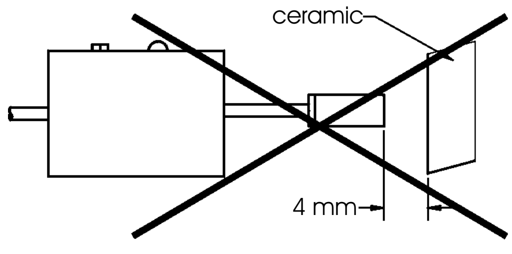
● Example:

To be scanned by a DC capacitive mini CCM1-1104 and its' amplifier CP-700N-ACU. Set the sensor to the maximum switching gap Sn of 4 mm over steel or hand using its amplifier. After setting a gap of 4 mm, move the sensor over the ceramic plate. approximately 2 mm.



The distance of 2 mm is now the maximum switching gap on the ceramic plate. Optimum switching is ensured if the sensor scans the ceramic plate under 2 mm and the calibration is not exceeded.

Note:

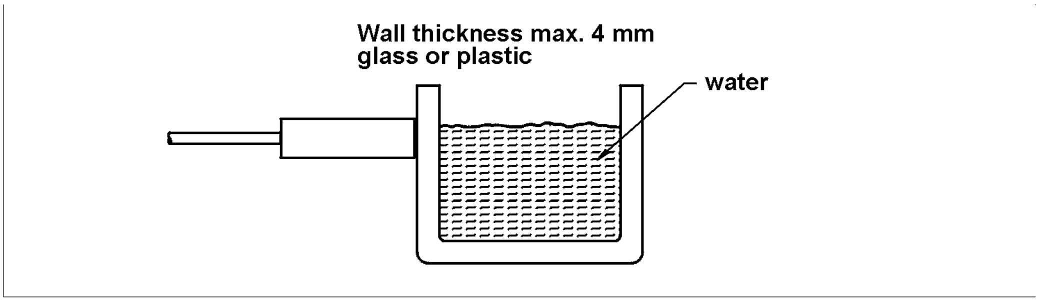


The sensors are set to a greater switching gap than the rated switching gaps Sn specified in the catalog to ensure operation within the technical specifications. If the operator increases the switching gap to 4 mm over the ceramic plate as described above, the sensor will be operating outside its range. This may lead to faulty switching in the sensor due to temperature effects and voltage transients in the power source.

CAPACITIVE PROXIMITY SWITCHES

• Example:

A liquid e.g. water, is to be scanned through a partition wall by a flush sensor type CCP1-3425P-A3. The partition wall made of glass or plastic with a max. thickness of 4 mm. To calculate the wall thickness, the thickness in mm will be 10...20% of the switching gap of the sensor but a max. of 4 mm.



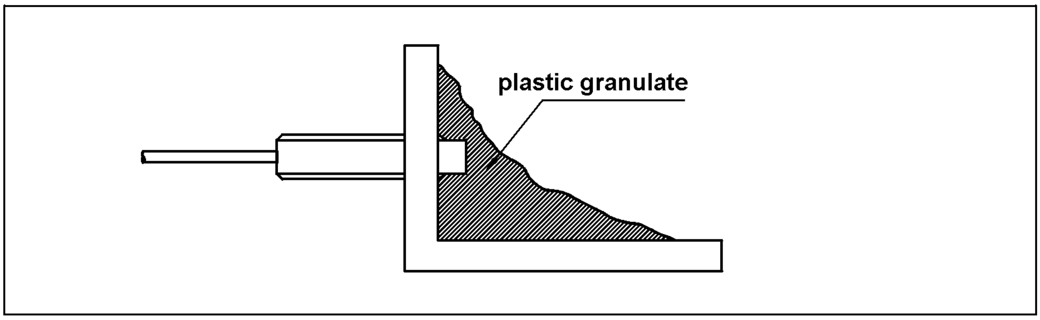
The face (active surface) of the sensor is bonded to the glass or plastic wall. The vessel is filled with water until approx. 75% of the active surface of the sensor is covered. Turn the potentiometer of the sensor counterclockwise (reduce sensitivity) until the LED and the output signal turn off.
Turn the potentiometer clockwise (increase sensitivity) until the LED and the output signal switch on.
Using the calibration process described ensures that the sensor does not detect the wall or the water residue on the wall.
It only switches when the liquid has reached the 75% level described above.

■ Sensor for non-shielded mounting

Due to their spherical fields, capacitive sensors are suitable for applications such as filling level indicators and plastic granulate or powder.

• Example

A granulate in a vessel is to be scanned by a non-shielded mounted sensor type CCM2-3030P-A3. The sensor is mounted so its active surface (free zone at head) projects into the product in the vessel, as shown below, the sensor must be completely covered by the product before calibration.

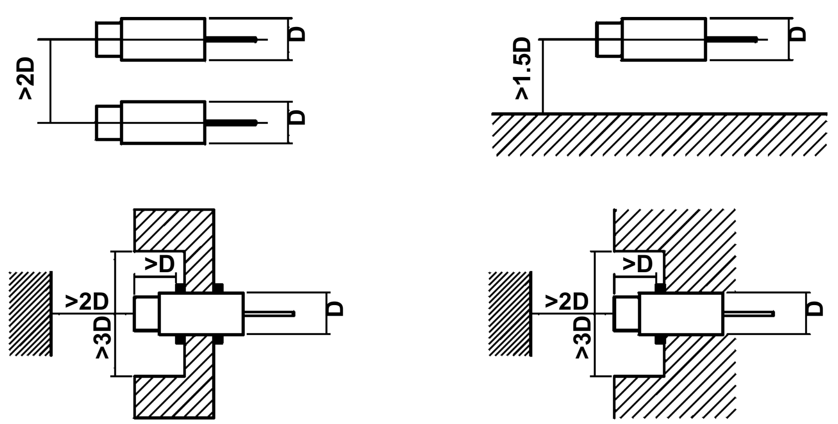


Turn the potentiometer of the sensor counterclockwise (reduce sensitivity) until the LED and the output signal turn off.
Turn the potentiometer clockwise (increase sensivity) until the LED and the output signal switch on. Make an additional 1/4 turn (90°turn) in the clockwise direction.
This is to compensate for temperature fluctuations or changes in the humidity of the product scanned.

CAPACITIVE PROXIMITY SWITCHES

■ Installation Requirements

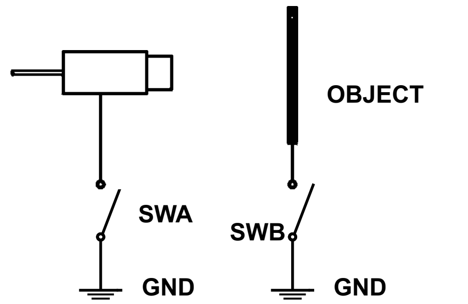
Surrounding objects will affect capacitive proximity switches by affecting switch capacitance or sensing the object. It is necessary to maintain a standard distance between a capacitive proximity switches and the surrounding objects when installing the capacitive proximity switch.



■ Connection Ground

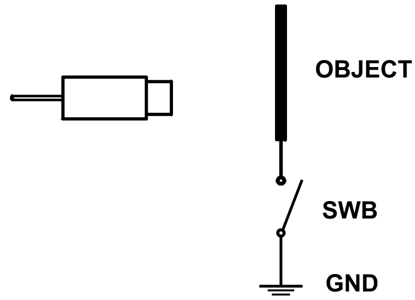
Connected to ground, both the standard sensing object(60x60x1t iron) and capacitive proximity switch, affects the change of operating distance.

• CCM-3020N-A



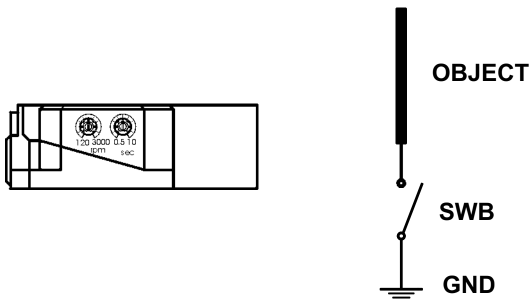
GND	switch a	ON	OFF	ON	OFF
	switch b	ON	ON	OFF	OFF
sensing distance		20	20	12	12

• CCP-1815N-A



GND switch b	ON	OFF
sensing distance	15	8

• QCP-4030N-A

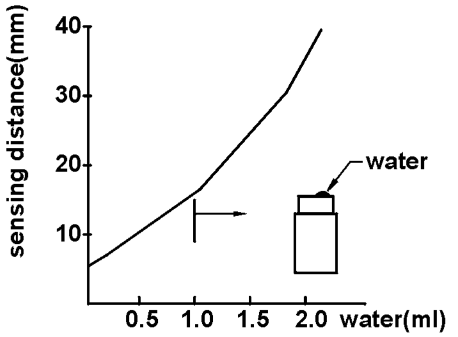


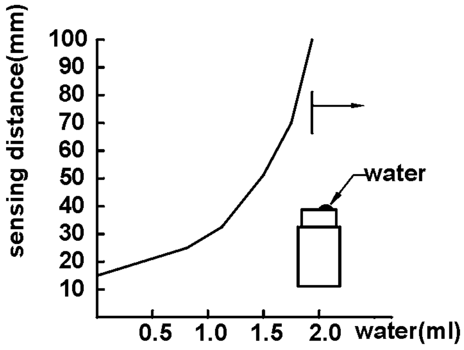
GND switch b	ON	OFF
sensing distance	30	17

CAPACITIVE PROXIMITY SWITCHES

■ Influence to sensing face covered with drops of water

The following figures show the changes to operating distance caused by drops of water on the sensing face of capacitive proximity switches.
If the water drops are 0.2 ml (about 2-3 drops), the operating distance will be increased about 20%, as the attached water drops on the sensing face cover the surface and is flowing operating distance is increased over 300%.





■ Caution

- If ice, frost, moisture, oil or dust is on the active surface, it will cause faultly operation.
- The detecting of liquid or powder on non-metallic tanks, if the liquids or powders are attached to tank wall, it will cause faulty operation.
- The application of a DC capacitive proximity switch, connectted to a heavy load current (current over 200 mA, (electric motor, electrical-magnetic contact) the output transistor will break down. It should be connected through a relay.