Capacitive Proximity Sensors

DETECTION OF METALLIC AND NON-METALLIC OBJECTS

SICK
Sensor Intelligence.

Detection of metallic and non-metallic objects

When you need to know what is hidden behind a surface – a wall, a storage container, shipping container, or behind a cover capacitive proximity sensors are the solution. From solid materials like paper or wood, to granulates or liquids, the status of the product can be reliably detected during the production process and on final inspection. Is there something behind that cover? Is the filled package really full? How much paint is still left in the tank? For capacitive sensors, these are easy questions to answer.

SICK's capacitive sensors are never far from the action. Sensing ranges up to 25 mm allow them to be used in nearly all installation situations, making them extremely adaptable for a wide range of applications. These sensors are also remarkably resistant to malfunctions. Impurities, contamination, dust, and airborne spray particles have little effect on them, nor does electromagnetic interference. No wonder they are installed in a wide range of industries, such as food, automotive or in handling and warehousing systems.

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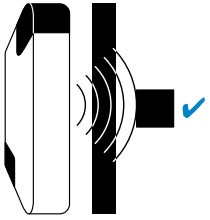
Subject to change without notice

Applications where capacitive sensors bring big advantages

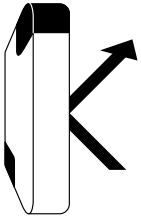
- Detection of objects in dusty environments
- Detection of agressive, contaminated media through plastic walls
- Detection of high light-absorbent objects such as wafers
- Detection of shiny or reflective objects such as glass or mirrors
- Detection of objects through packages

Detection all the way through the material



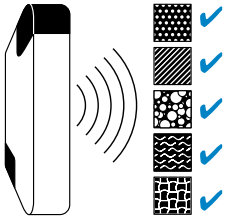
Wall thicknesses from 10 to 20 mm in the case of plastic or glass containers.

Tough/rough ambient conditions



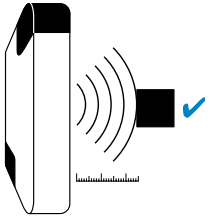
Highly resistant to vibrations, dust, dirt, etc.

Detection of (nearly) all materials



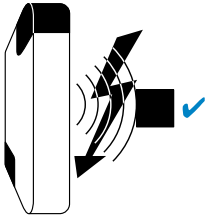
Wood, paper, metal, plastic, liquids, granules.

Relatively large sensing ranges with a compact design



Up to 25 mm S_n, CM30 and CQ35.

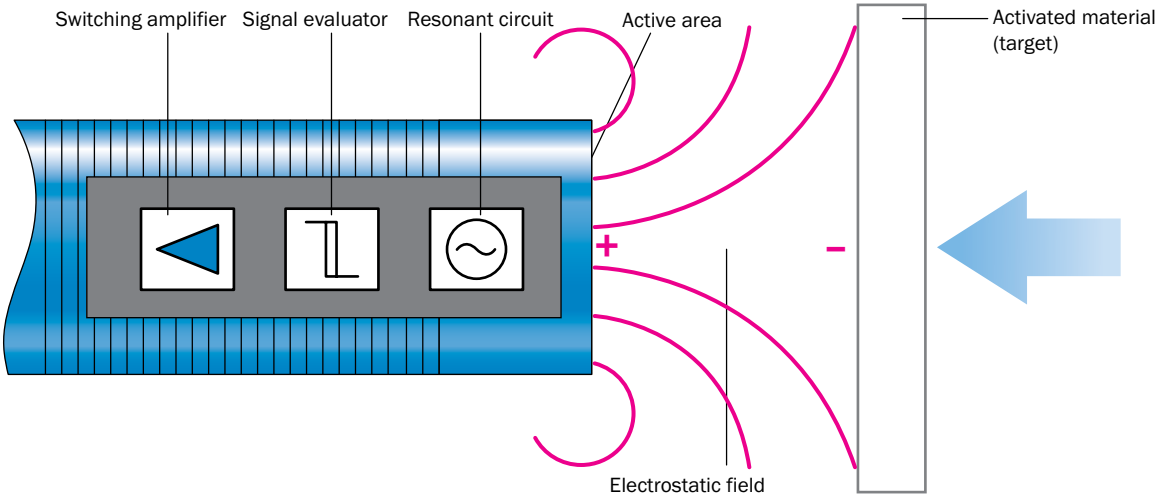
High electromagnetic and electrostatic compatibility



Thanks to Tripleshield technology.

Principle of operation

The function of the capacitive proximity sensor is based on the change of the electric field in front of its sensor electrode (active zone). The sensor operates with an RC oscillator circuit. It is the capacitance between the active electrode and the ground electric potential which is measured. Approaches a metallic or non-metallic material the active zone of the sensor the capacitance increases and thus influences the amplitude of the RC oscillator. The signal evaluator detects this change in amplitude and the switching amplifier signals to switch. The sensitivity of the sensor can be adjusted via a potentiometer or Teach-in-button.



Capacitance can be described using the following formula:

$$C = \varepsilon_r * A/d$$

ε_r = dielectric permittivity (dielectric constant)
A = electrode area (active zone)
1/d = distance between electrodes

The greater ε_r, the greater the A or the smaller the d, the greater the change in capacitance, and the easier an object will be to detect. Grounding increases the operating distance and thus the reliability of detection.

Calculating the assured operating distance:

$$Sa = S_n \text{ (min)} \times 0{,}72 \times K_w$$

Material	Dielectric permittivity ε_r	Material correction factor (K_w)
Metal	80	1.00
Water	80	1.00
Alcohol	30	0.70
Glass	8	0.60
Ceramic	7	0.50
PVC	6	0.40
Ice	5	0.35
Oil	2	0.25
Air (vacuum)	1	0.00

CM - Cylindrical thread design

Figure	Housing	Sensing range S_n	Installation type	Output function	Output type	Connection	Type	Part no.
	M12	8 mm	Flush, Non-flush	Programmable	PNP, NPN	Connector M12, 4-pin	CM12-08EBP-KC1	6051030
						Cable, 2 m, PVC	CM12-08EBP-KW1	6051029
	M18	8 mm	Flush	Programmable	PNP	Cable, 2 m, PVC	CM18-08BPP-KW1	6020136
						Connector M12, 4-pin	CM18-08BPP-KC1	6020388
						Cable, 2 m, PVC	CM18-08BPP-TW0 [1]	6026195
					NPN	Cable, 2 m, PVC	CM18-08BNP-TW0 [1]	6026194
		12 mm	Non-flush	Programmable	PNP	Cable, 2 m, PVC	CM18-12NPP-KW1	6020389
						Connector M12, 4-pin	CM18-12NPP-KC1	6020410
					NPN	Connector M12, 4-pin	CM18-12NNP-KC1	6021458
	M30	16 mm	Flush	Programmable	PNP	Cable, 2 m, PVC	CM30-16BPP-KW1	6020473
						Connector M12, 4-pin	CM30-16BPP-KC1	6020475
					NPN	Connector M12, 4-pin	CM30-16BNP-KC1	6021460
		25 mm	Non-flush	Programmable	PNP	Cable, 2 m, PVC	CM30-25NPP-KW1	6020476
						Connector M12, 4-pin	CM30-25NPP-KC1	6020477
					NPN	Connector M12, 4-pin	CM30-25NNP-KC1	6021462

[1] PTFE-housing

CQ - Rectangular housings

Figure	Housing	Sensing range S_n	Installation type	Output function	Output type	Connection	Type	Part no.
	16 mm x 39.5 mm x 12 mm	8 mm	Non-flush, flush	NO	PNP	Cable, 2 m, PVC	CQ4-08EPSKU1	6051009
						Connector M8, 3-pin	CQ4-08EPSKT1	6051004
						Cable with connector M8, 3-pin, 2 m, PVC	CQ4-08EPSKP1	6051000
					NPN	Cable, 2 m, PVC	CQ4-08ENSKU1	6051011
						Connector M8, 3-pin	CQ4-08ENSKT1	6051006
						Cable with connector M8, 3-pin, 2 m, PVC	CQ4-08ENSKP1	6051002
				NC	PNP	Cable, 2 m, PVC	CQ4-08EPOKU1	6051010
						Connector M8, 3-pin	CQ4-08EPOKT1	6051005
						Cable with connector M8, 3-pin, 2 m, PVC	CQ4-08EPOKP1	6051001
					NPN	Cable, 2 m, PVC	CQ4-08ENOKU1	6051012
						Connector M8, 3-pin	CQ4-08ENOKT1	6051007
						Cable with connector M8, 3-pin, 2 m, PVC	CQ4-08ENOKP1	6051003
	28 mm x 46 mm x 5,5 mm	10 mm	Non-flush	Program-mable	PNP	Cable, 2 m, PVC	CQ28-10NPP-KW1	6030132
					NPN	Cable, 2 m, PVC	CQ28-10NNP-KW1	6030133
	35 mm x 15 mm x 55 mm	25 mm	Non-flush	Program-mable	PNP	Cable, 2 m, PVC	CQ35-25NPP-KW1	6020478
						Connector M12, 4-pin	CQ35-25NPP-KC1	6020479
					NPN	Cable, 2 m, PVC	CQ35-25NNP-KW1	6021463
						Connector M12, 4-pin	CQ35-25NNP-KC1	6021464

Feature	Advantage	Benefit
Tripleshield technology	Outstanding protection against electro-static discharge, electromagnetic radiation and surge voltage interference	High machine availability thanks to fail-safe sensors
Potentiometer or teach-in function	Easy adjustment of operating distances	Fast commissioning to ensure correct detection
Programmable output function	Choice of normally open or normally closed functionality	Minimal storage, resulting in cost savings
Completely enclosed	Highly resistant to vibrations and shocks	Process reliability even in extremely tough environments

Tip 1

Grounded and conductive targets provide maximum detection reliability and operating distances.

Tip 2

If the sensors sensitivity is adjusted too high (maximum seeting) the sensor can hang-up (is not swtiching off). So the sensitivity has to be reduced.

Tip 3

A capacitive sensor detects through non-metallic walls. This if the electrical permittivity of the object/medium behind the wall is higher than the electrical permittivity of the wall.

Tip 4

The detection is mainly influenced by the distance between the active zone of the sensor and the object/medium, the size of the active zone and the electrical permittivity of the object/medium.

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SICK AT A GLANCE

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We have extensive experience in various industries and understand their processes and requirements. With intelligent sensors, we can deliver exactly what our customers need. In application centers in Europe, Asia and North America, system solutions are tested and optimized in accordance with customer specifications. All this makes us a reliable supplier and development partner.

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