

Capacitive sensors



For almost 50 years, Baumer electric has specialized in the research, development and production of high-precision switches for industry, including the capacitive proximity switches presented below. Capacitive proximity switches are non-contact sensors capable of detecting a wide range of materials such as paper, glass, plastic, oil, water, as well as all metals. The sensor output responds when the object to be detected is located at a certain distance from the sensor element. A potentiometer allows you to make adjustments to fine tune the sensor for your application.

Exhaustive quality checks in production and assembly, together with a one hundred percent final inspection all go to ensure that Baumer electric products offer the optimum in switching and controlling reliability, whatever your application.

Design and mode of operation

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Mounting

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Metal housings

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Capacitive fill level sensor

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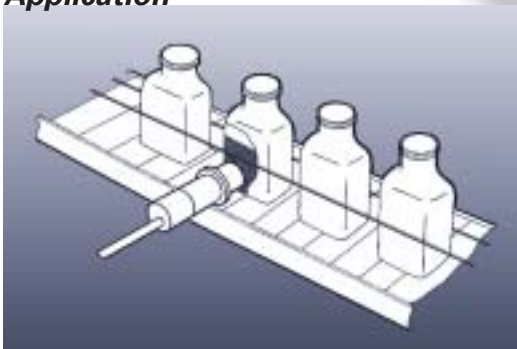
Capacitive high temperature sensor

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Installation dimensions and accessories

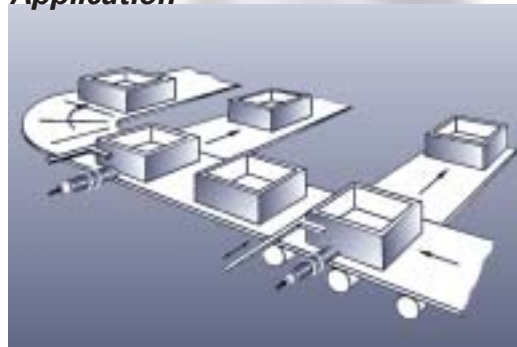
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Application



Liquid level within a plastic or glass container

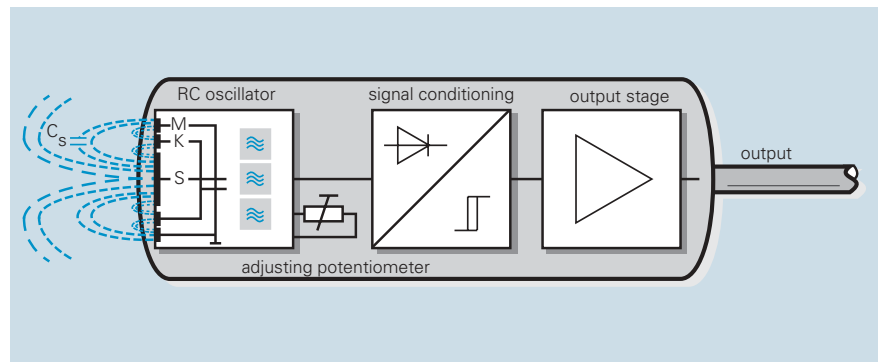
Application



Product presence verification during packaging and assembly operations

Design and mode of operation

Theory of operation



The RC oscillator starts up when the sensitive capacitance C_s of the sensing element is affected by an external object. The internal change in current is detected by an adjustable trigger which controls the sensor output.

Cause of change in capacitance C_s

- Proximity to **conductive objects**

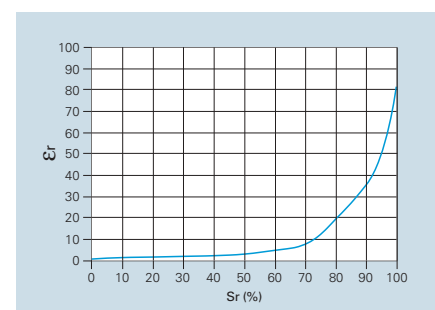
If an object of conductive material is located within the sensing distance of the sensor, it will form two series connected capacitances with sensor areas S and M. The series connected capacitances are much larger than the capacitance of the undamped oscillator. Maximum sensing distance can be achieved with conductive objects like metals, water etc..

- of **non-conductive objects**

If a non-conductive object is moved into the sensor field, the field will be amplified in relation to the relative permittivity (ϵ_r) of the material to be detected and thus increase capacitance C_s . As from a relative permittivity of $\epsilon_r = 81$ (water), sensing distances can be achieved that are equivalent to those for conductive materials. The sensing distance is reduced for materials with a lower ϵ_r .

Material	Relative permittivity (ϵ_r)
Air, vacuum	1
Paper	1,2 - 3
Paraffin oil	2,2
PVC	3
Glass	3 - 5
Wood	2 - 7
Marble	8,4 - 14
Alcohol	25
Methanol	33,5
Water	81

Sensing distance in relation to ϵ_r



Close range shielding

The capacitive sensor responds to all materials whose relative permittivity ϵ_r is greater than 1 (air, vacuum). This means that dirt deposits and moisture on the sensor surface are also detected. In order to avoid this unwanted effect, Baumer sensors have been equipped with an additional compensating electrode (K).

This electrode is used to generate an electric field close to the sensor surface which counteracts the main field. A field free area is produced in proximity to the electrode in which objects may be located without being detected by the sensor. Although this design is a very effective solution to the problem of unwanted switching it is not completely foolproof.



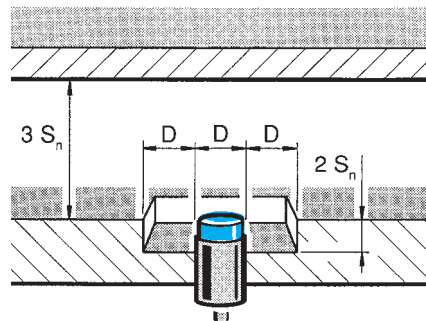
Mounting instructions

○ unshielded (non-flush) mounting

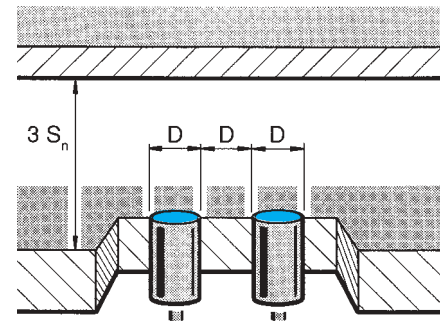
● shielded (flush) mounting

When installing unshielded capacitive sensors, they must be mounted such that there is no interfering material within a certain perimeter around the active face. This perimeter has a radius of $2 \times$ the diameter of the sensing head. Unshielded capacitive sensors are insensitive to soiling as well as condensation on the sensing head. They are especially suited for the detection of conductive target materials like metals, water etc.

Shielded capacitive sensors may be flush-mounted in metal and other materials. They are especially suited for the detection of non-conductive target materials, such as plastics, wood, glass, etc. As compared to unshielded versions, shielded sensors have a slightly increased sensitivity to soiling and condensation on the sensor's face.



- unshielded (non-flush) mounting




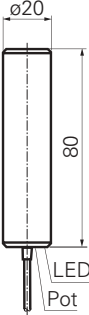
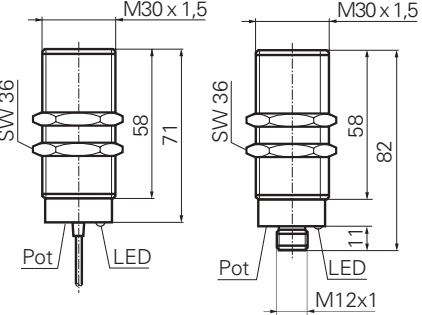
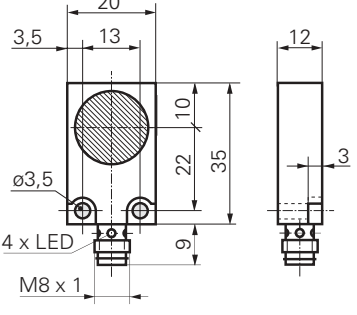


- shielded (flush) mounting

Capacitive sensors




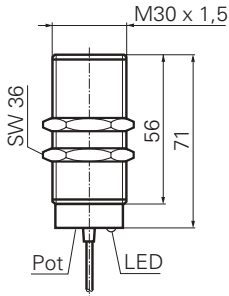
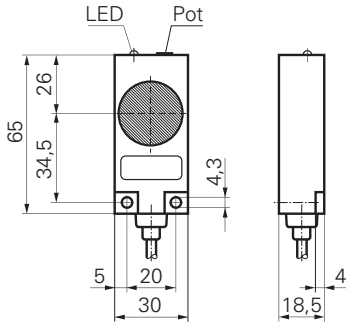
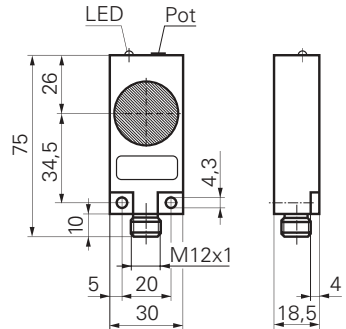
Brass nickel plated housings

Dimensions	12 mm	18 mm																										
Sensing distance	4 mm	8 mm																										
<table border="1"> <tr> <td rowspan="2">PNP</td> <td>normally open</td> <td>NO</td> <td>CFAM 12P1600</td> <td>CFAM 12P1600/S14</td> <td>CFAM 18P1600</td> <td>CFAM 18P1600/S14</td> </tr> <tr> <td>normally closed</td> <td>NC</td> <td>CFAM 12P3600</td> <td>CFAM 12P3600/S14</td> <td>CFAM 18P3600</td> <td>CFAM 18P3600/S14</td> </tr> <tr> <td rowspan="2">NPN</td> <td>normally open</td> <td>NO</td> <td>CFAM 12N1600</td> <td>CFAM 12N1600/S14</td> <td>CFAM 18N1600</td> <td>CFAM 18N1600/S14</td> </tr> <tr> <td>normally closed</td> <td>NC</td> <td>CFAM 12N3600</td> <td>CFAM 12N3600/S14</td> <td>CFAM 18N3600</td> <td>CFAM 18N3600/S14</td> </tr> </table>	PNP	normally open	NO	CFAM 12P1600	CFAM 12P1600/S14	CFAM 18P1600	CFAM 18P1600/S14	normally closed	NC	CFAM 12P3600	CFAM 12P3600/S14	CFAM 18P3600	CFAM 18P3600/S14	NPN	normally open	NO	CFAM 12N1600	CFAM 12N1600/S14	CFAM 18N1600	CFAM 18N1600/S14	normally closed	NC	CFAM 12N3600	CFAM 12N3600/S14	CFAM 18N3600	CFAM 18N3600/S14		
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	normally closed	NC	CFAM 12N3600	CFAM 12N3600/S14	CFAM 18N3600	CFAM 18N3600/S14																						
technical data																												
voltage supply range +Vs	10 - 35 VDC	10 - 35 VDC																										
supply current	< 15 mA	< 15 mA																										
max. switching current	200 mA	200 mA																										
voltage drop	< 1,5 V	< 1,5 V																										
max. switching frequency	50 Hz	50 Hz																										
nominal sensing distance S_n	4 mm	8 mm																										
sensing distance	0,5...4 mm adjustable	2...8 mm adjustable																										
sensitivity adjustment	Pot, 270°	Pot, 10 turn																										
mounting	shielded	shielded																										
output indicator	yellow LED	yellow LED																										
short circuit protection	yes	yes																										
reverse polarity protection	yes	yes																										
temperature range	-25...+75 °C	-25...+75 °C																										
temperature drift (+10...+70 °C)	±15%	±15%																										
housing material	brass nickel plated	brass nickel plated																										
protection class	IP 65	IP 65																										
connector options / installation dimensions see accessories section	ES 14, ES 18, ESW 33, ESG 34	ES 14, ES 18, ESW 33, ESG 34																										

20 mm		30 mm		20 mm	
10 mm		15 mm		5 mm	
					
CFBM 20P1600		CFAM 30P1600	CFAM 30P1600/S14	CFDM 20P1500/S35L	
CFBM 20P3600		CFAM 30P3600	CFAM 30P3600/S14	CFDM 20P3500/S35L	
CFBM 20N1600		CFAM 30N1600	CFAM 30N1600/S14	CFDM 20N1500/S35L	
CFBM 20N3600		CFAM 30N3600	CFAM 30N3600/S14	CFDM 20N3500/S35L	
10 - 35 VDC		10 - 35 VDC		10 - 35 VDC	
< 15 mA		< 15 mA		< 15 mA	
200 mA		200 mA		200 mA	
< 1,5 V		< 1,5 V		< 1,5 V	
50 Hz		50 Hz		50 Hz	
10 mm		15 mm		5 mm	
2...10 mm adjustable		4...15 mm adjustable		-	
Pot, 18 turn		Pot, 18 turn		none	
shielded		shielded		shielded	
yellow LED		yellow LED		4 quadrant LED	
yes		yes		yes	
yes		yes		yes	
-25...+75 °C		-25...+75 °C		-25...+75 °C	
±15%		±15%		±15%	
brass nickel plated		brass nickel plated		brass nickel plated	
IP 65		IP 65		IP 65	
Support bracket 101769		ES 14, ES 18, ESW 33, ESG 34		ESW 31, ESG 32	
					

Capacitive sensors Plastic housings (PBT)

Dimensions	12 mm	18 mm
Sensing distance	4 mm	8 mm
PNP	CFAK 12P1600	CFAK 18P1600
normally open NO	CFAK 12P3600	CFAK 18P3600
normally closed NC		
NPN	CFAK 12N1600	CFAK 18N1600
normally open NO	CFAK 12N3600	CFAK 18N3600
normally closed NC		
technical data		
voltage supply range +Vs	10 - 35 VDC	10 - 35 VDC
supply current	< 15 mA	< 15 mA
max. switching current	200 mA	200 mA
voltage drop	< 1,5 V	< 1,5 V
max. switching frequency	50 Hz	50 Hz
nominal sensing distance S_n	4 mm	8 mm
sensing distance	0,5...4 mm adjustable	2...8 mm adjustable
sensitivity adjustment	Pot, 270°	Pot, 10 turn
mounting	shielded	shielded
output indicator	yellow LED	yellow LED
short circuit protection	yes	yes
reverse polarity protection	yes	yes
temperature range	-25...+75 °C	-25...+75 °C
temperature drift (+10...+70 °C)	±15%	±15%
housing material	PBT	PBT
protection class	IP 65	IP 65
connector options / installation dimensions see accessories section		

30 mm	30 mm	30 mm
15 mm	15 mm	15 mm
		
CFAK 30P1600 CFAK 30P3600	CFDK 30P1600 CFDK 30P3600	CFDK 30P1600/S14 CFDK 30P3600/S14
CFAK 30N1600 CFAK 30N3600	CFDK 30N1600 CFDK 30N3600	CFDK 30N1600/S14 CFDK 30N3600/S14
10 - 35 VDC < 15 mA 200 mA < 1,5 V 50 Hz 15 mm 4...15 mm adjustable Pot, 18 turn	10 - 35 VDC < 15 mA 200 mA < 1,5 V 50 Hz 15 mm 4...15 mm adjustable Pot, 18-turn	10 - 35 VDC < 15 mA 200 mA < 1,5 V 50 Hz 15 mm 4...15 mm adjustable Pot, 18-turn
shielded yellow LED yes yes	shielded yellow LED yes yes	shielded yellow LED yes yes
-25...+75 °C ±15% PBT IP 65	-25...+75 °C ±15% PBT IP 65	-25...+75 °C ±15% PBT IP 65
		ES 14, ES 18, ESW 33, ESG 34
		

Capacitive fill level sensor for electrically conductive liquids and aqueous solutions



Reliable detection of liquid levels

The new capacitive fill level sensor reliably detects liquid fill levels even under the most difficult ambient conditions. The compact M12 x 40 mm device is IP 67 sealed and is available in PBT, PVDF, PA 6.6 and PP plastic enclosures. The availability of various housing materials covers a wide range of fill level monitoring applications ranging from the chemical industry to the food processing industry.

The non-flush sensor has been specifically designed so that soiling and condensation on the sensor's face do not cause false triggers. The product, featuring an EMI immunity far exceeding the limits specified by the applicable CE sensor norm, offers an excellent price to performance ratio.

Some of Baumer electric's photoelectric, pressure and ultrasonic products can also be used as fill level sensors.

Please consult our application engineers or ask for our special literature.

Capacitive high temperature sensor -40...+250 °C

Some like it hot -
some do not!

Many applications demand process temperatures of up to +200 °C and more. These high temperatures spell disaster for most electronic devices. Not so for our high temperature capacitive sensors from the CFAH series! These sensors are right "at home" when things get hot. Target materials

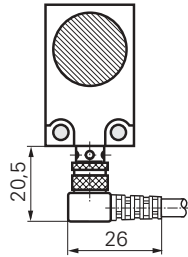
such as liquids, granulates, pastes and similar substances can be detected reliably even at very high ambient temperatures. Since conventional electronic components cannot stand temperatures of +100 °C or more over longer periods, this sensor has simply been "split" into hot and cold components. The actual "hot" sensor head, which can be used at an ambient temperature of -40 to +200 °C (optional up to +250°C), is made of chemical-resistant Teflon and stainless steel. The high temperature sensor CFAH is the ideal substitute for mechanical sensors in a wide range of applications. Due to its high chemical resistance, it can also be used in chemically harsh environments. This sensor will operate in nearly any environment and not even break a sweat.



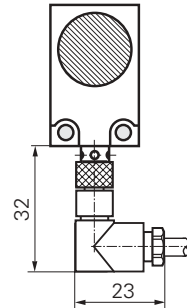
Installation dimensions and accessories

Series 20
rectangular

ESW 31

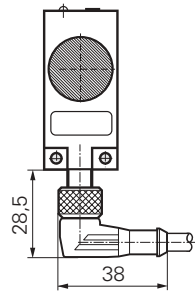


ES 22

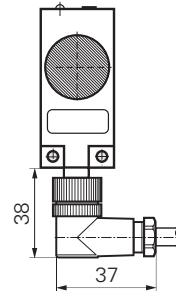


Series 30
rectangular

ESW 33



ES 14

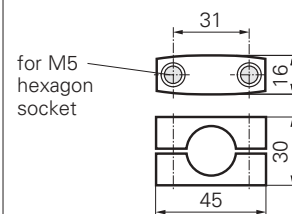


Color code DC

wire color	short name	signal
blue	BU	0 V
black	BK	output
brown	BN	+Vs

Support bracket (2x) 143377

for 20 mm diameter proximity switches
material plastic (PA 6.6. black)



Test set

Part No. 115437



For connectors see pages 7. 02 - 7. 03