BALLUFF

SIESENSORIK

# Capacitive Sensors

... new possibilities in object detection and level sensing


Balluff is a worldwide leading company in the field of position detection.

Our product range includes electronic sensors, transducers which use various operating principles, identification systems, bus-capable sensors as well as electromechanical and inductive single and multiple position switches. Balluff products are found wherever accuracy and reliability are in demand.

Wherever processes are automated, objects detected, rotary and linear motion reported to controllers – Balluff is always the right partner.

Our QM system complies with the requirements of DIN EN ISO 9001:2000. Eleven Balluff companies have a certified QM system, and two a certified Environmental Management system. The use of mastered, process-capable production and assembly technologies and statistical process control allows us to achieve a consistently high level of product quality. Intensive testing before serial production begins guarantees reliable function.

With more than 50 years of experience in the field of sensor technology, Balluff today is one of the most capable manufacturers of both standardized and custom limit switches. Innovative technology and application-specific customer solutions are the outstanding features of the entire product range.

Highly qualified development engineers and experienced designers work closely together with the production areas to guarantee mature series production products which are successfully and reliably used in every field of automation – even under extreme and aggressive operating conditions.

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SIE SENSORIK Industrie-Elektronik GmbH was founded in Viernheim, Germany, in 1986. The company has specialized exclusively in the development, manufacture and worldwide sales of capacitive sensors.

The sophisticated product portfolio offered by SIE SENSORIK is used in all sectors of the capital goods industry, and maintains a leading position on the sensor market.

Innovative engineering, state-of-the-art electronics and application-driven customized solutions constitute the salient features of the entire capacitive product range.

For SIE SENSORIK, the corporate focus is firmly and invariably on the customer. Close communication between our customers and SIE SENSORIK is assured by our worldwide sales representatives, enabling SIE SENSORIK to provide can-do expertise and problem-solving efficacy on the spot.

**Milestones in the history of SIE SENSORIK Industrie-Elektronik GmbH**

**1986**
The company is founded, in Viernheim, Germany. Right from the start, its products are manufactured in state-of-the-art SMD technology

**1987**
A beginning is made in setting up a worldwide distribution network: in Europe (France, Denmark, Switzerland and the Netherlands), in the USA (Ohio) and in Asia (Semiconductor Sector Division, Japan)

**1988**
A beginning is made in setting up the firm's own nationwide sales network in Germany

**1993**
Founding of the subsidiary SIE Sensors in Toledo, Ohio

**2000**
Relocation to a new company building, for capacity upsizing

**2001**
Certification to DIN-ISO 9001:2000

**2002**
Introduction of the patented capacitive smartLEVEL technology

**2004**
Introduction of the capacitive microBOX in standard and smartLEVEL technology

**2005**
Design-enhancement of the smartLEVEL technology with introduction of the microLEVEL sensor

**2006**
2006 On 17 January, SIE SENSORIK celebrated its 20th anniversary

**2007**
SIE SENSORIK is acquired by Balluff GmbH.

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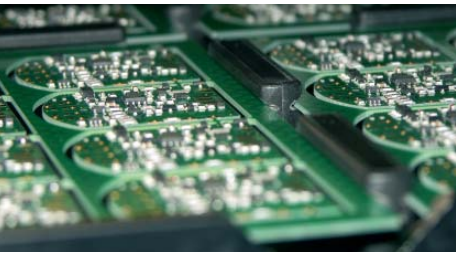
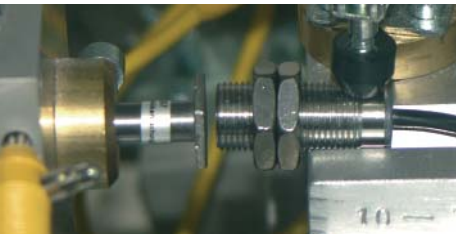
# Quality Assurance

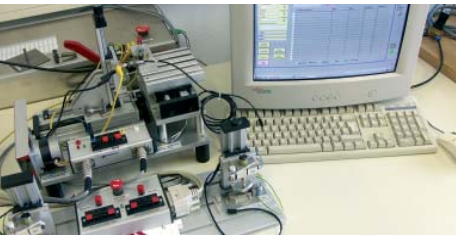


Surface-Mounted-Technologies

Automatic assembly



Final inspection



Documentation


TÜV CERT
ZERTIFIKAT
Die TÜV CERT-Zertifizierungsstelle für Managementsysteme der TÜV Pfalz Anlagen und Betriebstechnik GmbH
bescheinigt gemäß TÜV CERT-Verfahren, dass das Unternehmen
S.I.E. SENSORIK Industrie-Elektronik GmbH
D-66519 Vierrheim / www.sie-sensorik.de
für den Geltungsbereich
Entwicklung, Produktion und weltweiter Vertrieb von elektronischen Sensoren
ein Qualitätsmanagementsystem eingeführt hat und anwendet.
DIN EN ISO 9001:2000
TÜV

**Success factors**

- Quality
- Innovations
- Customer proximity
- Reliability
- Flexibility
- Global network

**Market segments**

- Machine building
- Specialty machinery building
- Paper and printing industries
- Semiconductor industry
- Packaging industry
- Industrial cleaning technology
- Plastics industry
- Medical technology
- Timber and furniture industries
- Automobile industry
- Foods industry
- Chemical industry
- Electronics industry
- Process industry, CD and DVD manufacture

# Overview

**Capacitive Mini-sensors, SK**
- Housings in V2A/PTFE from Ø 4 mm
- Flat disk form from Ø 18 mm by only 2.5 mm high
- Sensing distance adjustable on the amplifier
- Variety of processing electronics available

**Capacitive sensors for object detection, SK1-B**
- Housings made of metal or plastic
- Compact sizes with potentiometer starting at Ø 6.5 mm
- Disc sizes up to Ø 50 mm
- Sensing distance up to 25 mm
- Flush mounting
- Connecting lead or plug connector

**Capacitive sensors for level sensing, SK1-NB**
- Housings M12 and larger in metal, plastic and PTFE
- Cable, connector and terminal versions available
- Operating temperature up to 125 °C at 10 bar pressure rating
- Dependable switching for granules, powders and liquids

**Sensors for level sensing**
**Capacitive smartLEVEL sensors, FSA**
- For aqueous media
- No adjustment in standard application
- Self-compensating
- Through glass or plastic
- Flush and non-flush versions

**Sensors for level sensing**
**Capacitive microBOX sensors**
- As sensors for object detection of in smartLEVEL technology
- Compact housing design
- Variety of mounting options
- Mounting bracket included
- Polypropylene housing
- 3-D cable exit

# Capacitive sensors – general description

**Functional principle**
The proximity-action capacitive sensor converts a variable of interest in technical production terms (e.g. distance or level) into a signal which can be processed further.
The function is based on the alteration in the electrical field around its active zone.
The sensor basically consists of an oscillator, an electrode assembly as the pickup, a demodulator and an output stage.

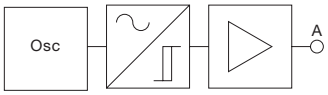
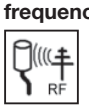


Fig. 1.02

The approach of metals or non-metals into the active zone of the capacitive sensor causes a change in capacitance, which in turn causes the RC oscillator to begin to vibrate. This causes the trigger stage downstream of the oscillator to flip, and the switching amplifier to change its output status. The switching function at the output is either an N.O., N.C. or changeover contact, depending on the type of unit involved.
The function of the capacitive sensor can be explained in terms of variation in all parameters of the equation for capacitance:

$C = \varepsilon_0 \times \varepsilon_r \times F \times (1/S)$
$\varepsilon_r$: as the relative dielectric coefficient (property of the sensed medium)
$\varepsilon_0$: as the absolute dielectric coefficient = const.
F: as area
S: as distance
From the formula above it follows that objects which have a sufficiently large relative dielectric coefficient ($\varepsilon_r$) and surface will be detected by the capacitive sensor.
Besides the **standard (multi-purpose) sensor technology,** in which the pickup is a constituent part of the oscillator circuit, there are also more modern processes designed to meet special application requirements.



Sensors using the patented **clock frequency modulation process.** Here, the sensor is not part of an oscillator circuit, but is activated by an oscillator's output. This entails significantly higher levels of interference immunity, above and beyond the product standard, meeting the requirements of the German Basic Standard for Industrial Applications.

Sensors using the patented **FSA process.** Here, the sensor consists of several sensor electrodes, appropriately integrated into an oscillator circuit. This process has been specially developed for detecting the fill levels of aqueous solutions, and scores in terms of special compensation characteristics for coping with different tank walls and media adhesion levels.


In addition, a selection of M30 and Ø 30 standard sensors are specially protected against high ESD voltages (electrostatic discharge). This enables them to be used in plastic granule conveyor systems.

The SIE SENSORIK company manufactures capacitive sensors in two versions:

**1. SK version**
Here only the oscillator or a capacitive pickup is contained in the sensor housing. The evaluation electronics are located in a separate housing. The sensor can be separated from the evaluation electronics.

**2. SK1 version**
Here the oscillator and the evaluation electronics are contained in one sensor housing.
Electronic circuits and relays can be directly actuated by signal preprocessing inside the device.

Typical applications:
- Controlling and monitoring machine processes
- Sensor for counting tasks
- Fill level detection in tanks and through nonmetallic tank walls

**Application**
A distinction is drawn between two different application categories for capacitive sensors:

**1. SIE designation:**
**Sensors for object detection (flush-mount sensor version)**


Sensors with a rectilinear electrical field. These devices scan solids (e.g. wafers, components, PCBs, hybrids, cartons, stacks of paper, bottles, plastic blocks and sheets) from a distance or liquids through a partition wall (glass or plastic, thickness max. 4 mm), and should in each individual case be tested beforehand with samples. See also the section on adjustment.


Fig. 1.03

**2. SIE designation:**
**Sensors for level detection (non-flush sensor version)**
Sensors with a spherical electrical field. These units are designed to detect the product, bulk goods or liquids (e.g. granulate, sugar, flour, corn, sand, or oil and water) with their active surface, by touching the medium or through tank wall.


The choice of the appropriate sensor depends on the operating conditions and the kind of medium and should in each case be tested beforehand with samples. See also the section on adjustment.

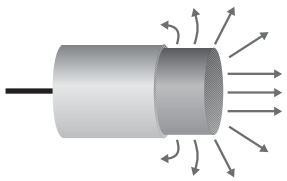


Fig. 1.04

**Sensing distance S**
This is the distance between the active sensor surface and the product being scanned at the moment of output-signal change as the object is approached.
It depends on shape, size and nature of the object concerned.

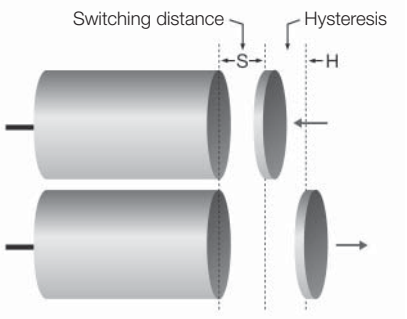


Fig. 1.05

### Hysteresis
Hysteresis is the distance differential between the switch-on point (as the object approaches) and the switch-off point (as the object recedes again).

### Repeatability
Repeatability is the maximum sensing distance differential between any two measurements, measured within 8 hours with multiple „approaches“ to the object being scanned.

### Material correction factor
If the material of the object concerned is not a metal or water, the sensing distance (S) will be reduced. Table 1.06 provides a guide to the reduction factors applying for the different materials involved. The precise values must be individually determined with the sensor actually being used.

| Material | Thickness d/mm | $\varepsilon_r$ | Reduction factor |
|---|---|---|---|
| Steel ST-37 | 1.5 | | 1.0 |
| Brass Ms | 1.5 | | 1.0 |
| Water | | approx. 81 | 1.0 |
| Mikanite 132 (Mica) | 2<br>4<br>6 | 4.5 | 0.35<br>0.41 |
| UP (Polyester, fiberglass-reinforced) | 2<br>4<br>6 | 4.0 | 0.47<br>0.47 |
| Polyamide A (Nylon 6.6) | 2<br>4<br>6 | 4.2 atm. humidity | 0.69<br>0.22 |
| Polyamide B (Nylon 6) | 3<br>6<br>9 | 5.3 atm. humidity | 0.25 |
| Melamine Fabric base laminate (HGW 2271) | 2<br>4<br>6 | 7 | 0.53<br>0.62<br>0.66 |
| Paper base laminate (HP 2061) | 2<br>4<br>6 | 5 | 0.56<br>0.62<br>0.68 |
| Polystyrene (PS) | 2<br>4<br>6 | 2.5 DIN 53483 | 0.24<br>0.31<br>0.36 |
| Polycarbonate (PC) | 2<br>4<br>6 | 2.92 DIN 53484 | 0.26<br>0.36<br>0.40 |
| Polymethyl-methacrylate (Acrylic glass, PMMA) | 5<br>10<br>15 | 2.9 DIN 53483 | 0.39<br>0.45<br>0.47 |
| Polyvinyl chloride (PVC) | 6<br>12 | 2.9 | 0.41<br>0.47 |
| PVC foamed | 3<br>6 | 1.5-2.5 | 0.22<br>0.25 |

Fig. 1.06

### Sensing distance range or detection range (Sd)
The sensing distance range or detection range is the range in which the sensing distance can be adjusted.

### Effective sensing distance (Sr)
The effective sensing distance is the sensing distance measured for a sensor aimed at an earthed metal plate in accordance with IEC 60947-5-2.
It is sized so as to ensure that the edge length (m) of the square metal plate equals the sensor's diameter or corresponds to three times the nominal sensing distance Sr, whichever is greater. If the plate is made from a different material, is of smaller dimensions, not earthed or features a different shape or different characteristics, this will entail shorter sensing distances.

### Installation: flush-mounted

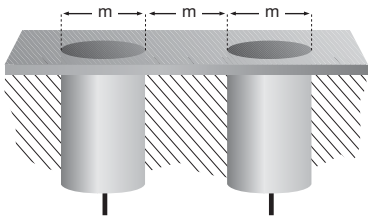



Fig. 1.07

For flush-mountable sensors in plastic housings, the sensing distance must be adjusted after installation.

### Mounting type, non-flush mountable

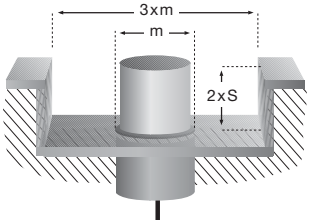



Fig. 1.08

### Installation: opposite
Applies for flush and non-flush-mountable sensors.

### Important!
The clearance for non-flush-mountable sensors (Fig. 1.08) must be complied with.

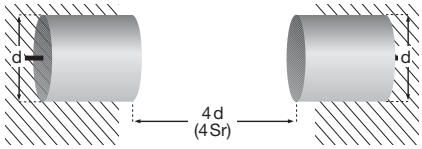



Fig. 1.09

### Mounting torques
To ensure that the sensors are not mechanically destroyed during installation, make sure that you comply with the following torque figures.

Housing made of metal, approx.:

| | |
|---|---|
| M5x0.5 / V2A | 3 Nm |
| 8x1 / V2A | 15 Nm |
| M12x1 / V2A | 40 Nm |
| M12x1 / MS | 10 Nm |
| M18x1 / V2A | 60 Nm |
| M18x1 / MS | 25 Nm |
| M30x1.5/M32x1.5 / V2A | 90 Nm |
| M30x1.5/M32x1.5 / MS | 65 Nm |

### Housing materials
By choosing and combining the appropriate housing materials, sensors can be supplied for almost all environmental conditions.

PTFE is a special case among housing materials, by virtue of its outstanding resistance to chemicals.
The SIE company offers a wide choice of sensors entirely in PTFE (CPTFE).

The following housing materials are standard for capacitive sensors:

| | |
|---|---|
| PVC | (= Polyvinyl chloride) |
| PTFE | (= Polytetrafluoroethylene) |
| FEP | (= Tetrafluoroethylene-Perfluoropropylene) |
| PUR | (= Polyurethane) |
| PBT/PET | (= Polybutyleneterephtalate/ Polyethyleneterephtalate) |
| PE | (= Polyethylene) |
| POM | (= Polyoxymethylene) |
| PA | (= Polyamide) |
| PSU | (= Polysulfone) |
| PC | (= Polycarbonate) |
| MS/Cr | (= Brass) chrome plated steel/ V2A (= Stainless steel) Steel/V2A 1.4301 ; 1.4305 |

### Laying the leads
The control leads to the sensors should be laid separately or shielded from the main power lines.

# Capacitive sensors – general description

**EMC Directive and CE labeling**
The sensors, sensor amplifiers and sensor secondary switchgear we produce comply with the statutory provisions of the European EMC Directive No. 89/336 EEC and thus with the Low-Voltage Directive No. 73/23 EEC.
The limit values stipulated in the Product Standard IEC 60947-5-2 are complied with. We also provide sensors which meet the EMC specification according to the Generic Standard for Industrial Use.
SIE sensors are designed to best perform under severe application conditions. They compensate for many performance depleting factors such as temperature, humidity and material built-up but having a high electro-magnetic noise immunity (EMC). The use of our well approved oscillator technologies is essential for application functionality. Under difficult EMC-Noise conditions and when the disturbant frequency hits the sensor's oscillator frequency functional errors are possible. SIE informs about the individual sensor working frequency and susceptibility bandwidth upon request and if not stated in the related datasheet section.

**Voltage drop $U_d$**
The voltage drop is the voltage measured across the active output of the proximity switch when carrying the operational current flows under specified conditions.

**Core identification**
The individual cores of the sensor cables are color-coded.

**DC units:**
Brown (br/bn) = +
Blue (bl/bu) = –
Black (sw/bk) = Output

**IP degree of protection**
The degrees of protection IP 20, IP 40, IP 54, IP 64 up to IP 68 are in accordance with IEC 60529.
Code letters IP (International Protection) designate protection against shock hazard, ingress of solid foreign bodies, and water, for electrical equipment.

**First digit:**
2 protection against penetration of solid bodies larger than 12 mm, shielding from tools or wires.
4 protection against penetration of solid bodies larger than 1 mm, shielding from tools or wires.
5 protection against harmful dust deposits, complete shock-hazard protection.
6 protection against penetration of dust, complete shock-hazard protection.

**Second digit:**
0 no special protection.
4 protection against water spraying from all directions against the piece of equipment concerned.
5 protection against a water jet from a nozzle, directed from all directions against the piece of equipment concerned.
7 protection against water, when the piece of equipment concerned (housing) is immersed in water under specified pressure and time conditions.
8 Protection against water during continuous submersion

IPx4...x6

IPx7...x8

Housings for a multitude of applications are labeled with the appropriate code number for jet-water and submersion.

**Switching frequency**
The switching frequency is a succession of periodically repeated activation and de-activation of the sensors during one second. Measuring method in conformity with IEC 60947-5-2.

**Standby current**
This is the current the sensor consumes at maximum supply voltage without a connected load.

**Operating voltage ($U_B$) or supply voltage**
The operating voltage ($U_B$) or supply voltage is the voltage range in which flawless functioning of the sensor is assured. It subsumes all voltage tolerances and residual ripples.

**Operating current ($I_e$) or output current**
The operating current ($I_e$) or output current is the maximum current with which the sensor may be loaded at its output in continuous operation.

**Residual current ($I_r$)**
The residual current ($I_r$) is the current that can flow in the load circuit in the blocked state of the switching output stage.

**Residual ripple**
This is the maximum permissible AC voltage which may be superimposed on the supply voltage without affecting the function of the sensor.

**Short-circuit protection and overload protection**
All DC sensors feature this protection device. In the event of overload or short-circuit at the output, the output transistor is automatically switched off. As soon as the malfunction has been corrected, the output stage is reset to normal functioning.

**Polarity reversal protection**
The sensor electronics are protected against possible polarity reversal or interchanging of the connection wires.

**Ambient temperature**
The ambient temperature specifies the temperature range at which the sensor may be operated.
SIE SENSORIK manufactures both sensors for the standard temperature range –30...+70° C and sensors for more stringent temperature requirements up to max. +250°C.


**Temperature drift**
This states the amount by which the sensing distance may change in dependence on temperature.

**Switching function**
N.O. contact: the switching output of the sensor is not switched through in its de-activated state.

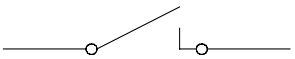


Fig. 1.10

N.C. contact: the switching output of the sensor is switched through in its de-activated state.

Fig. 1.11

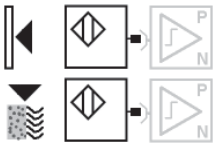
## Part numbering code – SIE standard units and pictograms

| Chapter | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 0300 | SK | | 4 | M12 | | B | | | | |
| 0400 | SV | | | 45/30/15 | P | | S | | | |
| 0600<br>0700 | SK1 | | 3 | M8/46 | N | NB | O | | | Y1 |
| 0650 | SK1 | | 20 | M30 | | B | X | | PBT | Y2 |
| 0710 | SK1 | FSA | | 50/10 | P | B | X | | POM | |
| 0900 | SK | HT180 | FS | R3/8 | | | | | | |
| 1200 | SNG | 230AC/24DC | | | | | | T | | |
| | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ |

| POS<br>1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|
| Unit code | Subgroup | Switching distance | Dimensions Figure | Switching output | Mounting | Signal polarity | Additional function | Material | Connection |
| SK | A | Figure | M12/60 | P | B | S | T | PVC | Y2 |
| SK1 | HT125,<br>HT250, HT180 | FS | 30/4 | N | NB | O | MINMAX | PTFE | Y1 |
| SV | TM | | JM18 | | | X | K | MS | KL |
| | FSA | | 45/30/15 | 4I20 | | | K-T | V2A | |
| SNG | 2VX | | LDG12 | X | | | | PBT | |
| SLK | X2L | | R3/8 | | | | | POM | |
| | 230AC/24DC<br>115AC/24DC | | | | | | | CPTFE | |
| | 230AC<br>115AC | | | | | | | | |

**Product line:**

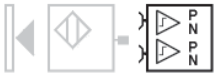
Minisensor **SK**, for object detection and level sensing



**SK** sensors require a sensor amplifier to function.

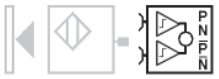
**SV**

Standard amplifier



**SV-2VX**

Double amplifier contains 2 independent SV units with both PNP and NPN output.



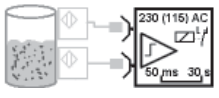
**SV-X2L**

Logic amplifier with AND/OR-/FlipFlop-/ MinMax function for 2 sensors.

Amplifier for operating voltages 230/115VAC

**SNG-K**

Standard amplifier for AC operation



**SNG-K-MinMax**

As before but with MinMax level control circuitry

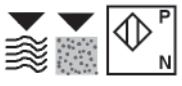
**SNG-K-T**

Sensor amplifier for AC use with timer functionality.

Series **SK1** capacitive sensors with built-in switching amplifier for DC operation (3-wire**DC** incl. switching output).

**SK1**

SK1 Sensor for object detection for DC operation



**SK1**

SK1 Sensor for level sensing for DC operation

# Capacitive sensors – general description

SK1-sensors for particular applications

High-noise immune sensors.


**SK1-TM**

For sensing conductive media through vessel walls with wet build-ups.


**SK1-FSA**

SK1-level detector FSA

Beside those detection type sensors (proximity and level switches) measuring devices are also available.


**SK1-A**

Capacitive proximity sensor supplying an analog current output signal (4...20 mA).

Sensors for object detection and level sensing for high temperature applications. Self contained and passive probe versions are available. The „active“ supply line cable (contains the oscillator housed in the customized amplifier-end connector) drives a standard or any other amplifier out of our product range.


**SK-HT**

The sensor cable contains the oscillator.

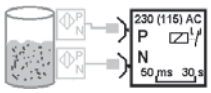

**SLK-HT**

and is suitable for connecting to standard sensor amplifiers.

The line is rounded out by sensor power packs for the SK1 sensors.


**SNG**

Supplies one sensor with the standardized 24 V.




**SNG-MinMax**

Power pack contains electronics for minimum maximum level control.


**SNG-T**

Power pack with built-in timer

**Function pictograms:**

NO/NC user selectable


PNP/NPN user selectable


Automatic PNP/NPN input compensation

User adjustable switch-on delay.

User adjustable switch-off delay.

Relay output (SPDT). Available for power packs only.

**Connection:**

Sensor with lead

Sensor with built in connector.

Sensor with lead and connector.


Input connector, output lead connection

Clamp terminal


Input and output clamp terminal

**Stress care identifier:**

Sensor with highest chemical resistance.


Sensor for high temperature use

Sensor with improved ESD noise immunity


Sensor with improved RF noise immunity (radiated and conducted)

**Application identifier:**


Proximity switch


In touch level detection

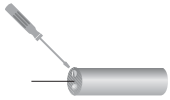
Through wall level detection


Level sensing through container wall with compensation properties
**>> smartLEVEL**

**Safety note:**
The products of SIE SENSORIK must not be used in areas in which a technical defect or any failure of the devices would endanger people's health or lives.
SIE SENSORIK does not give any guarantee for the products' use.

# Capacitive Sensors – calibration

**Important:** when calibrating capacitive sensors, the different material properties of the product being scanned must always be taken into consideration. Capacitive sensors are accordingly fitted with a trimming potentiometer, which can be used to adjust the device's sensitivity. Turning the potentiometer clockwise increases the sensitivity. Turning the potentiometer counter-clockwise decreases the sensitivity.



**Sensor version flush-mounted ...-B-...**
Normally, the rectilinear field of flush-mounted sensors scans block material from a distance. In order to ensure that the sensor concerned switches faultlessly, check the maximum sensing distance as described below before putting the device into operation:


1st **example:** a ceramic plate is to be scanned by an SK-4-10-B-VA/PTFE device. Using the sensor amplifier, first set the sensor to the maximum sensing distance S of 4 mm (specified in our catalogue) for metal or for an approximation for your hand (Fig. 1.12). With this preset distance of 4 mm, move the sensor towards the ceramic plate. The sensing distance S for the ceramic plate will then have decreased to approx. 2 mm (Fig. 1.13).

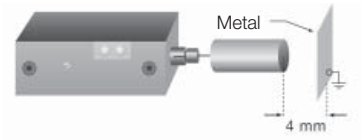



Fig. 1.12

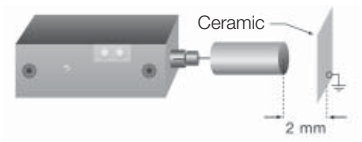



Fig. 1.13

The distance of 2 mm is now the maximum permissible sensing distance for the ceramic plate. You can also adjust for smaller sensing distances than 2 mm.

**Important!**

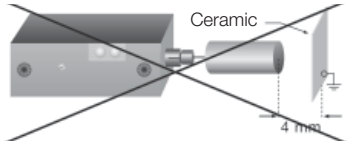



Fig. 1.14

To ensure that our sensors operate reliably within your technical specification, the devices have a larger detection range than the maximum sensing distance S stated in the catalogue. If you now adjust the sensing distance for 4 mm for the ceramic plate described above, the sensor will be working in an impermissible range (Fig. 1.14). This entails a risk that temperature and other environmental factors, plus electrical interference in the mains, may lead to faulty switching by the sensor.

2**nd** example: a liquid, e.g. water, is to be scanned through a partition wall by a flush-mounted sensor of the type SK1-20-M30-PBS-PBT. This partition wall may only be made of glass or plastic. Basically, to calculate the wall thickness, the thickness in mm will be approx. 10…20 % of the sensor's sensing distance, but max. 4 mm (for standard sensor technology).

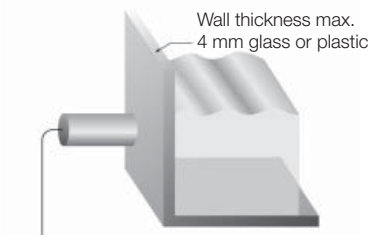



Fig. 1.15

The sensor's face (active surface) is now glued to the glass or plastic wall or mounted on it in a maximally form-fitting configuration. The tank is then filled with water until approx. 30 to 50 % of the sensor's active surface is covered (Fig. 1.15).

When small and ultra-small quantities of liquid are being scanned, particularly, and if the sensor has not been mounted in a form-fitting configuration (flat sensor surface on a tank wall with a small radius), 30 % should be selected as the coverage area. Now turn the sensor's potentiometer counter-clockwise (lower sensitivity) until the sensor switches off (with the NO contact versions S „LED OFF"). Now turn the potentiometer clockwise again (higher sensitivity) until the LED, and thus the output signal, just about switch on again. Using the calibration process described here ensures that the sensor does not detect the wall or the media residues on the wall, but only switches when the liquid has again reached the above-described level of 30 to 50 %.

**Sensor version non-flush mounting ...-NB-...**
Due to their spherical fields, these capacitive sensors are particularly suitable for applications as fill level sensors for liquids, plastic granules or powder.

**Example:** granules in a tank are to be scanned by a non-flush-mounted sensor of the type SK1-30-M30-PNBS-PBT.The sensor is now installed in the tank with its active surface (free zone at the head as described in the catalogue), in a configuration ensuring that the head is completely covered by the product.

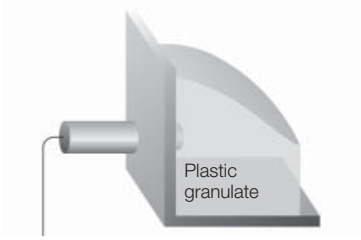



Fig. 1.16

Now turn the sensor's potentiometer counter-clockwise (lower sensitivity) until the LED, and thus the output signal, switch off. Then turn the potentiometer clockwise (higher sensitivity) until the LED, and thus the output signal, just about switch on again. To conclude, make an additional ¼ turn (90° turn) in a clockwise direction.
This is to compensate for possible temperature fluctuations or changes in the moisture level of the product being scanned.
If a medium has a high $\varepsilon_r$, especially water, the sensor will react much more sensitively. For this reason, you should perform calibration with about 50…80 % coverage, or use a sensor from the SK1-FSA series.


The SK1-FSA … **smartLEVEL** Sensors are ideal fill level sensors for all aqueous media. They enable you to detect (mostly without calibration) all conductive and also adhering liquids, both when touching the material and also through relatively thick tank walls.

# Applications of capacitive sensors

① Separation of sealing caps

② Position control for cap printing

③ Low level control for main tank

④ Overfill Control

⑤ Confirmation of closing cap

⑥ Confirmation of product presence

⑦ Monitoring of completed batch