

**BALLUFF**

**SIESENSORIK**

## Capacitive Sensors

... new possibilities in object detection and level sensing



**more added value**





## **BALLUFF**

**SIESENSORIK**

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

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.

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.

#### **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 upscaling

#### **2001**

Certification to DIN-ISO 9001:2000

#### **2002**

Introduction of the patented capacitive smartLEVEL technology

#### **2004**

Introduction of the capacitive microBOX in standard and smart-LEVEL technology

#### **2005**

Design-enhancement of the smart-LEVEL technology with introduction of the microLEVEL sensor

#### **2006**

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

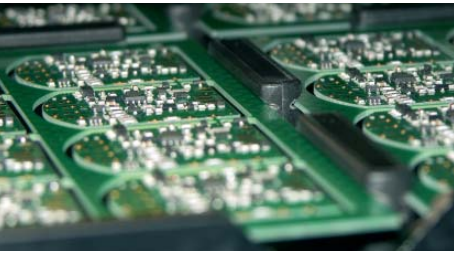
#### **2007**

SIE SENSORIK is acquired by Balluff GmbH.

## Table of Contents

Table of Contents	Article	Series	Page
Capacitive sensors – general description			<b>1.02 – 1.10</b>
Mini-sensors	0300	SK	<b>3.01 – 3.09</b>
Sensor amplifiers	0400	SV and SNG-..K...	<b>4.01 – 4.05</b>
Sensors for object detection	0600	SK1	<b>6.01 – 6.15</b>
Sensors for level sensing	0700	SK1	<b>7.01 – 7.12</b>
Sensors for level sensing, smartLEVEL-Technology	0710	SK1-FSA	<b>7.13 – 7.22</b>
microLEVEL	0710	SK1-FSA	<b>7.15 – 7.17</b>
microBOX	0710	SK1-FSA	<b>7.21</b>
Analog sensor	0800	SK1-A	<b>8.01 – 8.04</b>
Sensors for the high temperature range	0900	SK-HT	<b>9.01 – 9.03</b>
Sensor power packs	1200	SNG	<b>12.01 – 12.03</b>
Accessories	1300		<b>13.01 – 13.05</b>

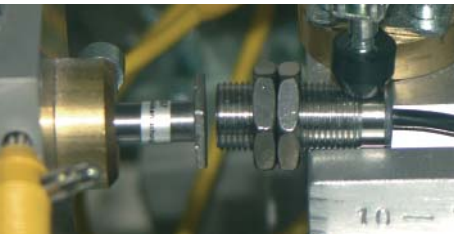
# Quality Assurance



Surface-Mounted-Technologies



Automatic assembly



Final inspection



Documentation



## 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

## Table of Contents

## Page

**Capacitive sensors – general description**

**1.02 – 1.10**

**Mini-sensors**

**3.01 – 3.09**

**Sensor amplifiers**

**4.01 – 4.05**

**Sensors for object detection**

**6.01 – 6.15**

**Sensors for level sensing**

**7.01 – 7.12**

**Sensors for level sensing, smartLEVEL-Technology**

**7.13 – 7.22**

**microLEVEL**

**7.15 – 7.17**

**microBOX**

**7.21**

**Analog sensor**

**8.01 – 8.04**

**Sensors for the high temperature range**

**9.01 – 9.03**

**Sensor power packs**

**12.01 – 12.03**

**Accessories**

**13.01 – 13.05**

# 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.

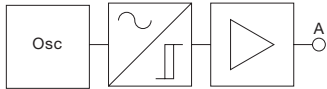


Fig. 1.02

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:

$$C = \epsilon_0 \times \epsilon_r \times F \times (1/S)$$

$\epsilon_r$ : as the relative dielectric coefficient (property of the sensed medium)

$\epsilon_0$ : 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 ( $\epsilon_r$ ) 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.



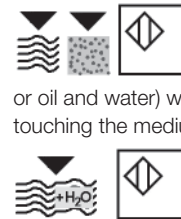
Fig. 1.03

### 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.

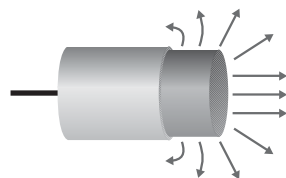


Fig. 1.04

## 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.

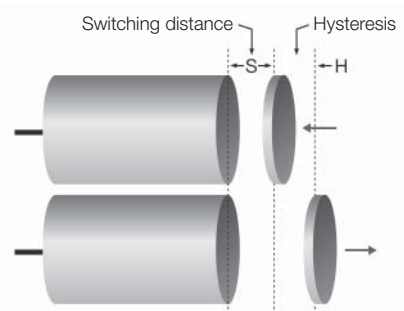


Fig. 1.05

# Capacitive sensors – general description

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

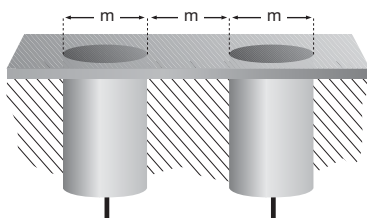


Fig. 1.07

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

## Mounting type, non-flush mountable

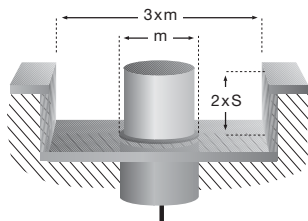


Fig. 1.08

## 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.

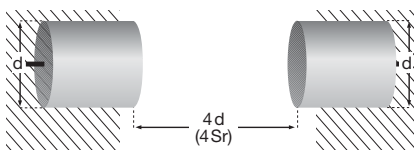


Fig. 1.09

## 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	(= Polybutyleneterephthalate/ Polyethyleneterephthalate)
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  $-30...+70^\circ\text{C}$  and sensors for more stringent temperature requirements up to max.  $+250^\circ\text{C}$ .



## 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.

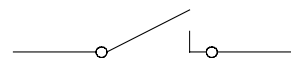


Fig. 1.10

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

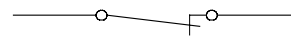


Fig. 1.11



# Capacitive sensors – general description

## Part numbering code – SIE standard units and pictograms

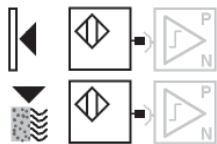
Chapter

0300	SK		4	M12		B				
0400	SV			45/30/15	P		S			
0600	SK1		3	M8/46	N	NB	O			Y1
0700										
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	2	3	4	5	6	7	8	9	10
1									
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, 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							CPTFE	
	115AC/24DC								
	230AC								
	115AC								

### Product line:

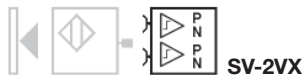
Minisensor **SK**, for object detection and level sensing



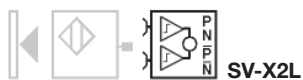
**SK** sensors require a sensor amplifier to function.



Standard amplifier

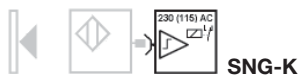


Double amplifier contains 2 independent SV units with both PNP and NPN output.



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

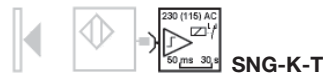
Amplifier for operating voltages 230/115VAC



Standard amplifier for AC operation



As before but with MinMax level control circuitry



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 Sensor for object detection for DC operation



SK1 Sensor for level sensing for DC operation

# Capacitive sensors – general description

SK1-sensors for particular applications

High-noise immune sensors.



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



SK1-level detector FSA

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



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.



The sensor cable contains the oscillator.



and is suitable for connecting to standard sensor amplifiers.

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



Supplies one sensor with the standardized 24 V.



Power pack contains electronics for minimum maximum level control.



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**

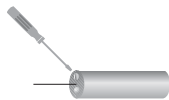


## Safety note:

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).

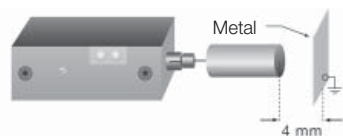


Fig. 1.12

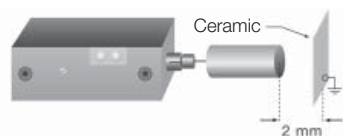


Fig. 1.13

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!**

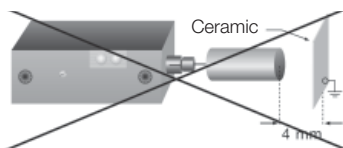


Fig. 1.14

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.



**2nd 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).

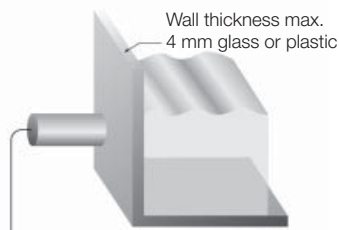


Fig. 1.15

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.

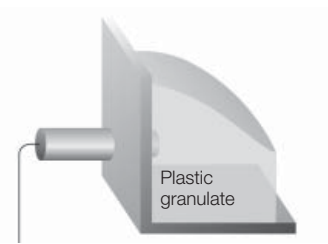


Fig. 1.16

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  $\epsilon_r$ , 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.

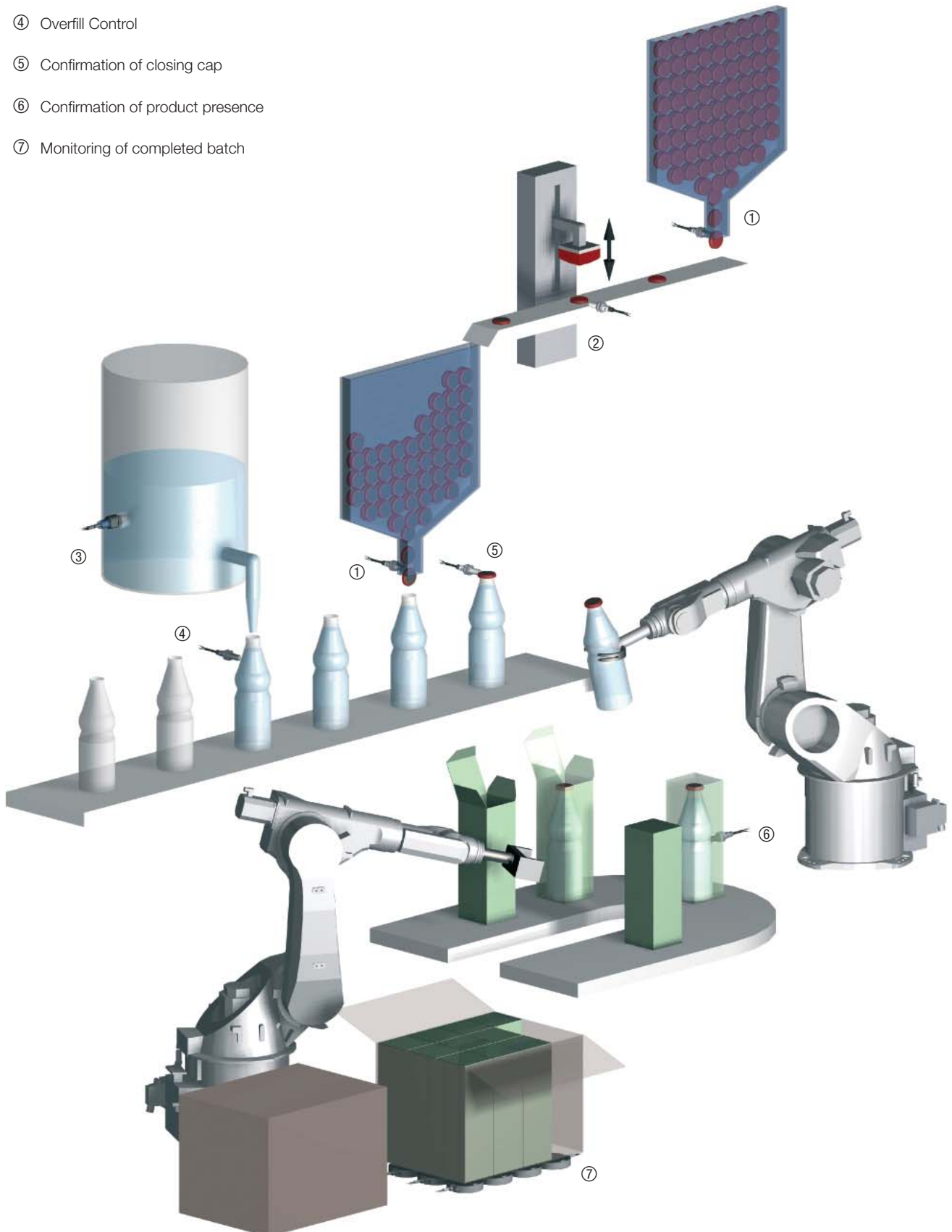


The SK1-FSA ... **smartLEVEL**

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



# BALLUFF

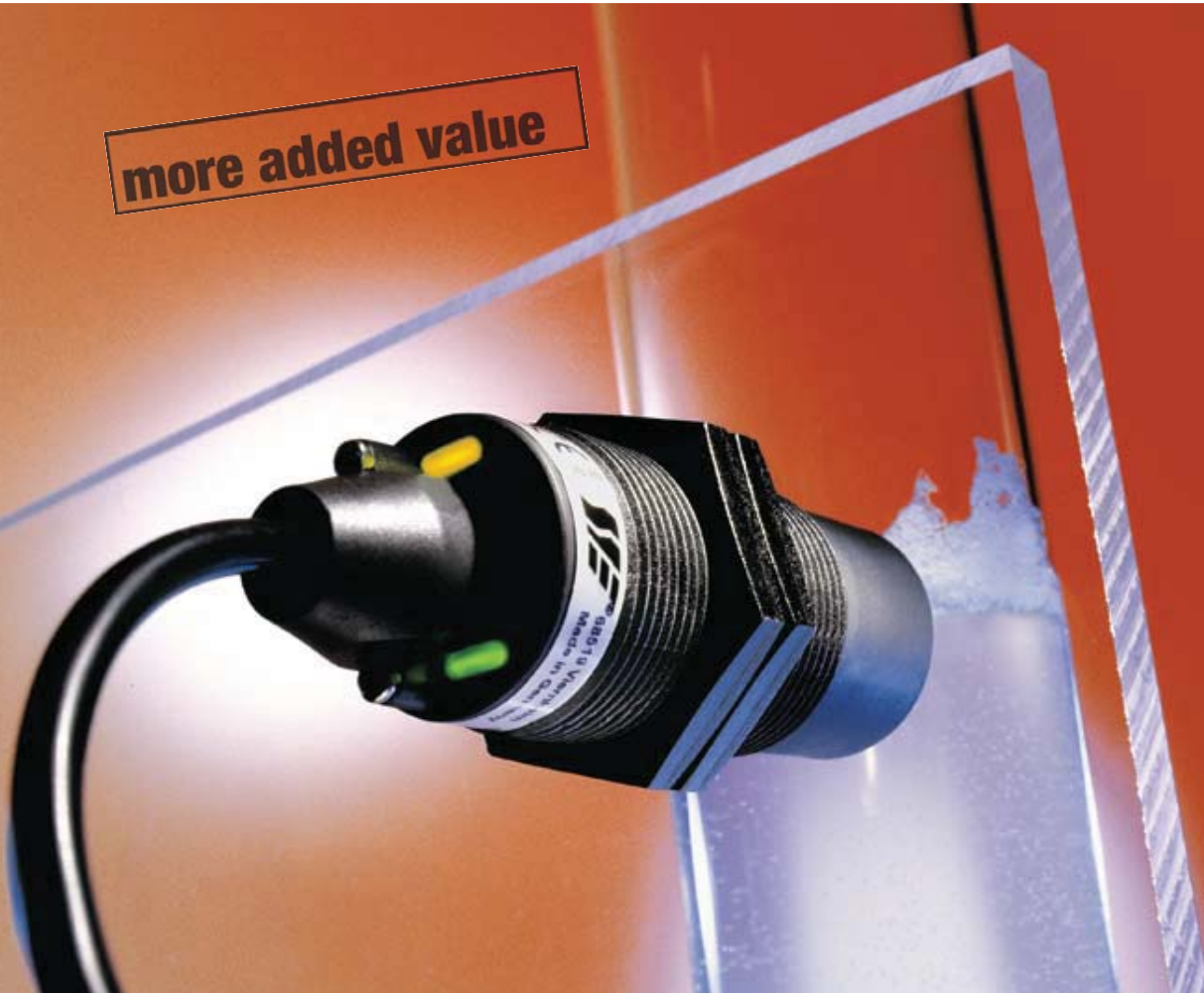
SIESENSORIK

## Capacitive Sensors

... new possibilities in object detection and level sensing



more added value



# 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



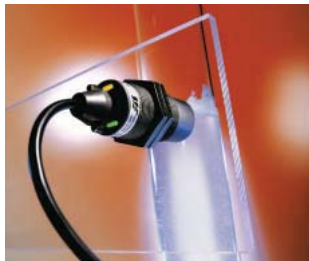
### Capacitive sensors for object detection, SK1-B

- 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

## Table of Contents

## Page

Capacitive sensors –  
general description

1.02 –  
1.10

Mini-sensors

3.01 –  
3.09

Sensor amplifiers

4.01 –  
4.05

Sensors for  
object detection

6.01 –  
6.15

Sensors for  
level sensing

7.01 –  
7.12

Sensors for level sensing,  
smartLEVEL-Technology

7.13 –  
7.22

microLEVEL

7.15 –  
7.17

microBOX

7.21

Analog sensor

8.01 –  
8.04

Sensors for the high  
temperature range

9.01 –  
9.03

Sensor power packs

12.01 –  
12.03

Accessories

13.01 –  
13.05

## Mini-sensors

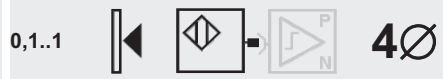
### Series SK 0300

- Housing starting at Ø 4 mm
- Flat disk shapes starting at Ø 18 mm
- Housing material V2A/PTFE
- Adjustment using sensor amplifiers 0400
- Sensor lead with plug



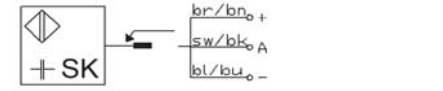
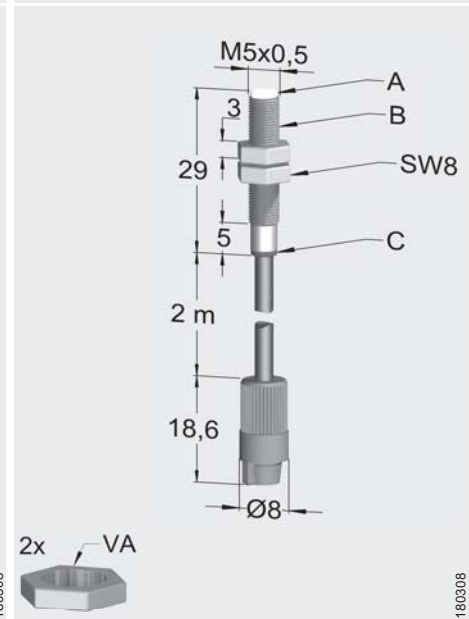
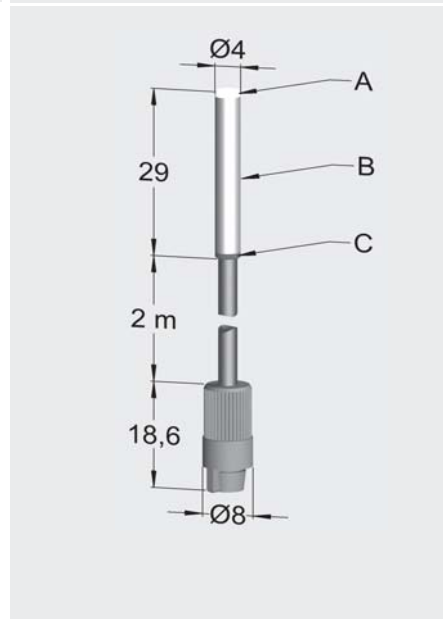
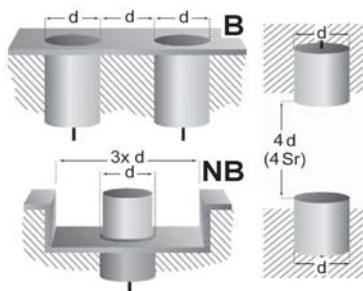
DIN EN ISO 9001:2000  
QA 05 100 1050

**BALLUFF**  
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Type code (abstract)

- SK sensor capacitive, w/o amplifier
- SKF sensor cap., w/o amplifier, flexible
- SK1 sensor capacitive, self-contained
- SV(D) sensor amplifier (dynamic)
- SNG sensor power pack
- HT### high temperature use
- TM pulse modulation technique (High noise immune)
- ## / FS(A) max sensing distance / Fill-level switch (adaptive)
- M30 model and/or dimension
- P output stage PNP, NPN, X (switchable)
- B mounting B=flush NB=non-flush
- S S=N.O. Ö=N.C. X=function switchable
- (C)PTFE Housing material, e.g. PTFE CPTFE=complete PTFE
- 1M2-Y2 cable & connector: Y# = connector 1M2 = 1.2m cable length

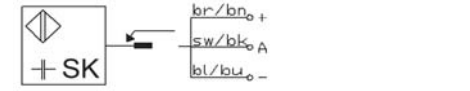
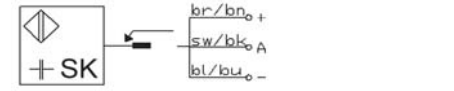
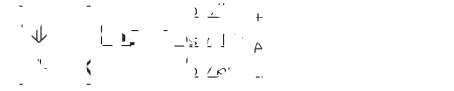
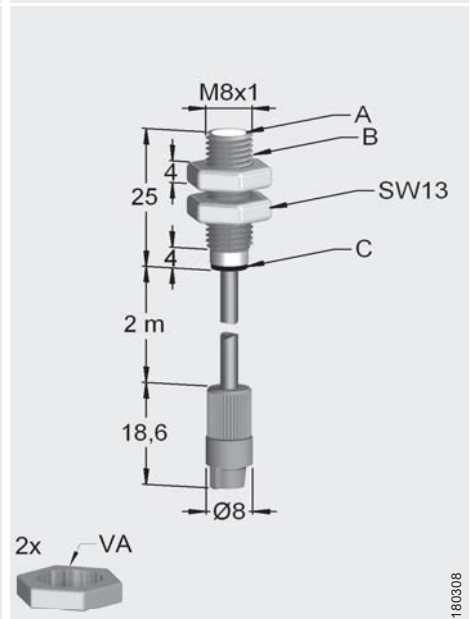
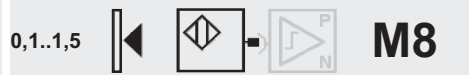
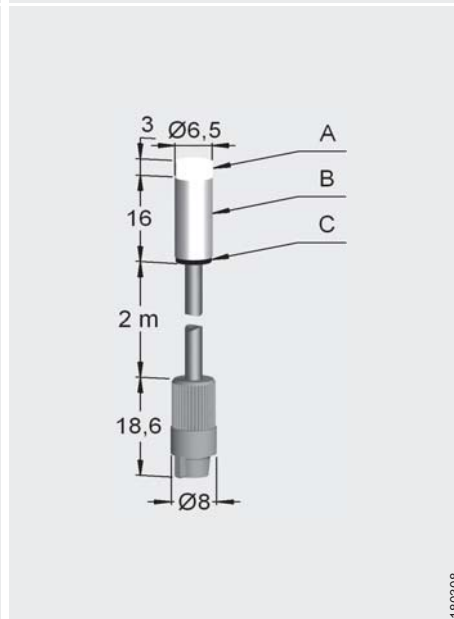
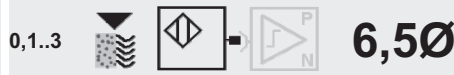
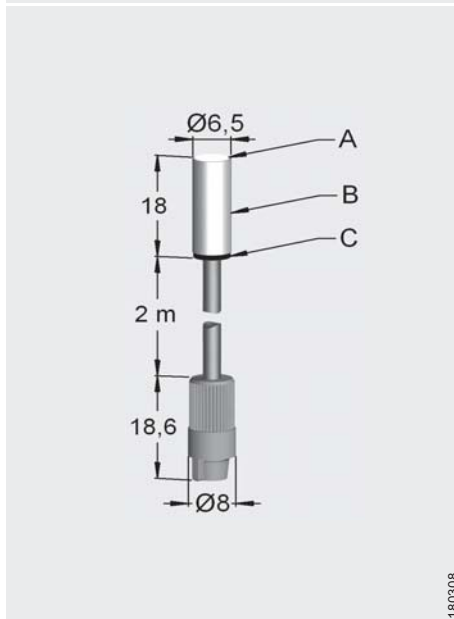


Typ / Type SK-1-4-B-VA/PTFE

Typ / Type SK-1-M5-B-VA/PTFE

Mounting [flush / nonflush]	[ B / NB ]	B	B
Operating distance Sn	[mm]	0,1... 1	0,1... 1
Hysteresis H	[%SR]	20	20
Frequency of operating cycles f	[Hz]	100	100
Repeat accuracy R	[%SR]	2	2
Operating temperature range Ta	[C°]	-30... 80	-30... 80
Temperature drift [range]	[%SR]	20 [+5... 55]	20 [+5... 55]
Protection class		IP 67	IP67
Rated insulation voltage Ui	[V]	75 d. c.	75 d. c.
Material of housing		A: PTFE; B: V2A; C: POM	A: PTFE; B: V2A; C: POM
Utilisation category			
Connection		2m / 3x 0,14mm <sup>2</sup> / PUR - ZA	2m / 3x 0,14mm <sup>2</sup> / PUR - ZA
Supply voltage range UB	[V]	4...8	4...8
No-load supply current Iomax.	[mA]		
Minimum operational current Im	[mA]		
Operational current Ie	[mA]		
Off-state current Ir	[mA]		
Voltage drop Ud @ Ie	[V]		
Time delay before availability tv	[ms]		
Indicator [UB / Output]			
Short circuit- overload-protection			
Reverse polarity protection			
Conformity EMC EEC-direct.		IEC 60947-5-2 : 2004 73/23	IEC 60947-5-2 : 2004 73/23
EMC		IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 1.2-5.4 Mhz.	IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 1.6-5 Mhz.
Associated equipment		SV-; SVD-; SNG-...-K; SNG-...-K-T SL-YA-m20	SV-; SVD-; SNG-...-K; SNG-...-K-T SL-YA-m20
Additional functionality			
Application			





Typ / Type  
SK-1.5-6.5-B-VA/PTFE

Typ / Type  
SK-3-6.5-NB-VA/PTFE

Typ / Type  
SK-1.5-M8-B-VA/PTFE

B
0,1... 1,5
10
100
2
-30... 80
20 [-5... 55]
IP 67
75 d. c.
A: PTFE; B: V2A; C: POM
2m / 3x 0,14mm <sup>2</sup> / PUR - ZA
4...8

NB
0,1... 3
10
100
2
-30... 80
20 [-5... 55]
IP 67
75 d. c.
A: PTFE; B: V2A; C: POM
2m / 3x 0,14mm <sup>2</sup> / PUR - ZA
4...8

B
0,1... 1,5
10
100
2
-30... 80
20 [-5... 55]
IP 67
75 d. c.
A: PTFE; B: V2A; C: POM
2m / 3x 0,14mm <sup>2</sup> / PUR - ZA
4...8

IEC 60947-5-2 : 2004  
73/23

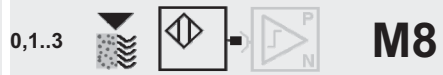
IEC 60947-5-2 : 2004  
73/23

IEC 60947-5-2 : 2004  
73/23

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.8-2.1 Mhz.  
SV-; SVD-; SNG-...-K; SNG-...K-T SL-YA-m20

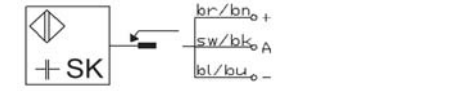
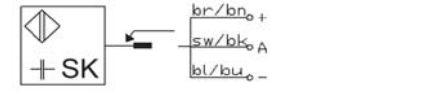
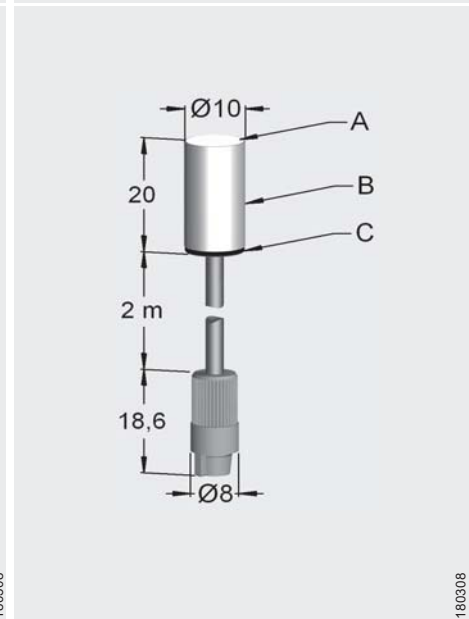
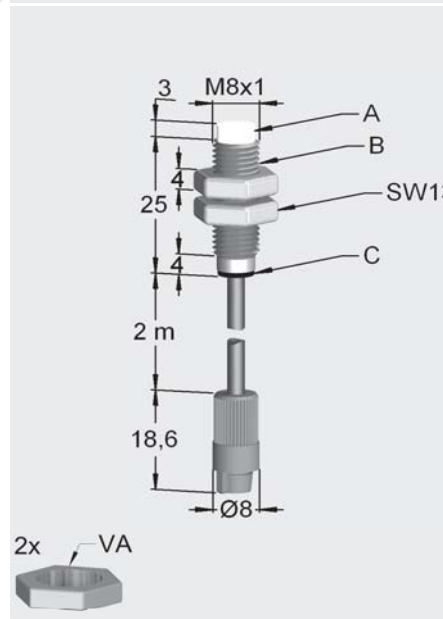
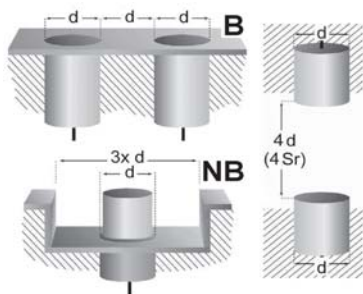
IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.7-2.8 Mhz.  
SV-; SVD-; SNG-...-K; SNG-...K-T SL-YA-m20

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.7-1.9 Mhz.  
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Type code (abstract)

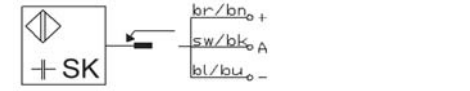
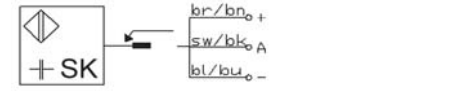
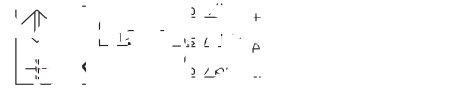
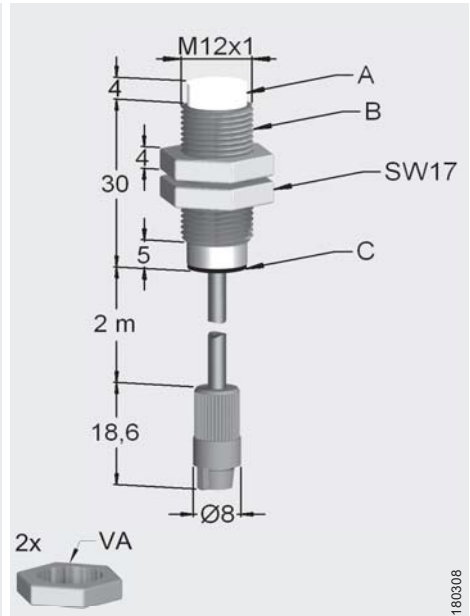
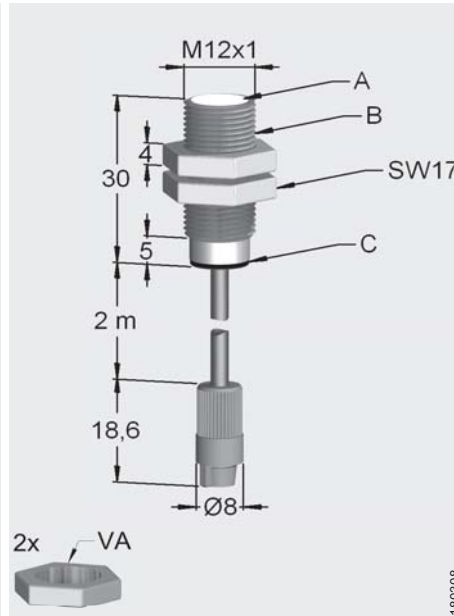
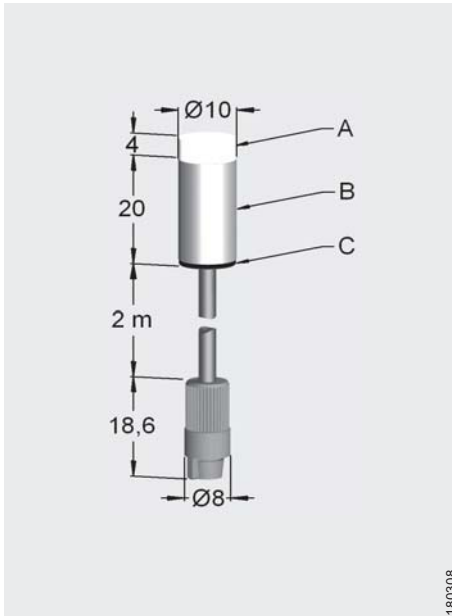
- SK sensor capacitive, w/o amplifier
- SKF sensor cap., w/o amplifier, flexible
- SK1 sensor capacitive, self-contained
- SV(D) sensor amplifier (dynamic)
- SNG sensor power pack
- HT### high temperature use
- TM pulse modulation technique (High noise immune)
- ## / FS(A) max sensing distance / Fill-level switch (adaptive)
- M30 model and/or dimension
- P output stage PNP, NPN, X (switchable)
- B mounting B=flush NB=non-flush
- S S=N.O. Ö=N.C. X=function switchable
- (C)PTFE Housing material, e.g. PTFE CPTFE=complete PTFE
- 1M2-Y2 cable & connector: Y# = connector 1M2 = 1.2m cable length



Typ / Type SK-3-M8-NB-VA/PTFE

Typ / Type SK-4-10-B-VA/PTFE

Mounting [flush / nonflush]	[ B / NB ]	NB	B
Operating distance Sn	[mm]	0,1... 3	0,1... 4
Hysteresis H	[%SR]	10	10
Frequency of operating cycles f	[Hz]	100	100
Repeat accuracy R	[%SR]	2	2
Operating temperature range Ta	[C°]	-30... 80	-30... 80
Temperature drift [range]	[%SR]	20 [-5... 55]	20 [-5... 55]
Protection class		IP 67	IP 67
Rated insulation voltage Ui	[V]	75 d. c.	75 d. c.
Material of housing		A: PTFE; B:V2A; C: POM	A: PTFE; B: V2A; C: POM
Utilisation category			
Connection		2m / 3x 0,14mm <sup>2</sup> / PUR ` ZA 	2m / 3x 0,14mm <sup>2</sup> / PUR ` ZA 
Supply voltage range UB	[V]	4...8	4...8
No-load supply current Iomax.	[mA]		
Minimum operational current Im	[mA]		
Operational current Ie	[mA]		
Off-state current Ir	[mA]		
Voltage drop Ud @ Ie	[V]		
Time delay before availability tv	[ms]		
Indicator [UB / Output]			
Short circuit- overload-protection			
Reverse polarity protection			
Conformity EMC EEC-direct.		IEC 60947-5-2 : 2004 73/23 	IEC 60947-5-2 : 2004 73/23 
EMC		IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.6-3.1 Mhz.	IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 1.1-3.1 Mhz.
Associated equipment		SV-; SVD-; SNG-...-K; SNG-...-K-T SL-YA-m20	SV-; SVD-; SNG-...-K; SNG-...-K-T SL-YA-m20
Additional functionality			
Application			



Typ / Type  
SK-8-10-NB-VA/PTFE

Typ / Type  
SK-4-M12-B-VA/PTFE

Typ / Type  
SK-8-M12-NB-VA/PTFE

NB
1... 8
10
100
2
-30... 80
20 [-5... 55]
IP 67
75 d.c.
A: PTFE; B: V2A; C: POM
2m / 3x 0,14mm <sup>2</sup> / PUR - ZA
4...8

B
0,1... 4
10
100
2
-30... 80
20 [-5... 55]
IP 67
75 d. c.
A: PTFE; B: V2A; C: POM
2m / 3x 0,14mm <sup>2</sup> / PUR - ZA
4...8

NB
1... 8
10
100
2
-30... 80
20 [-5... 55]
IP 67
75 d. c.
A: PTFE; B: V2A; C: POM
2m / 3x 0,14mm <sup>2</sup> / PUR - ZA
4...8

IEC 60947-5-2 : 2004  
73/23

IEC 60947-5-2 : 2004  
73/23

IEC 60947-5-2 : 2004  
73/23

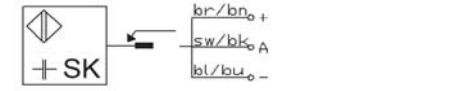
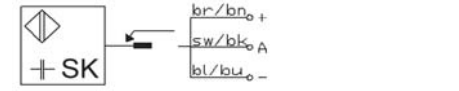
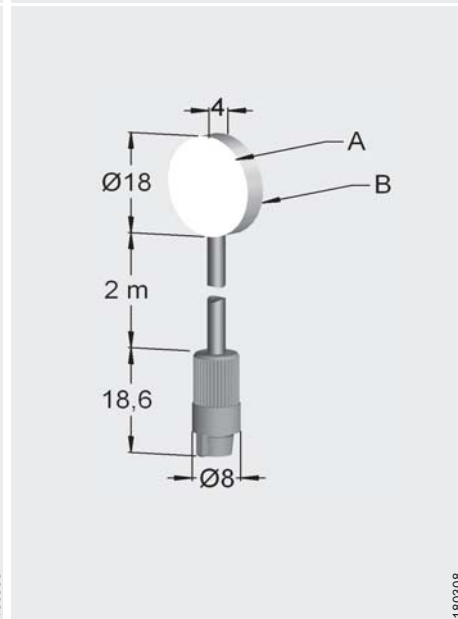
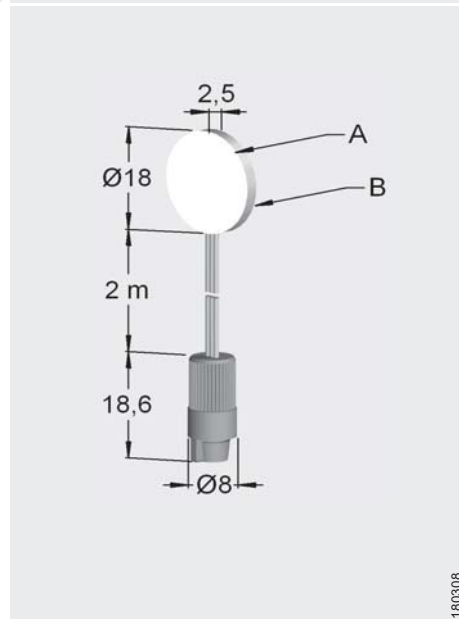
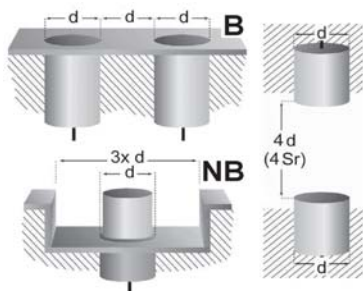
IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.7-3.8 Mhz.  
SV-; SVD-; SNG-...-K; SNG-...K-T SL-YA-m20

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.9-2.4 Mhz.  
SV-; SVD-; SNG-...-K; SNG-...K-T SL-YA-m20

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.7-3.5 Mhz.  
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Type code (abstract)

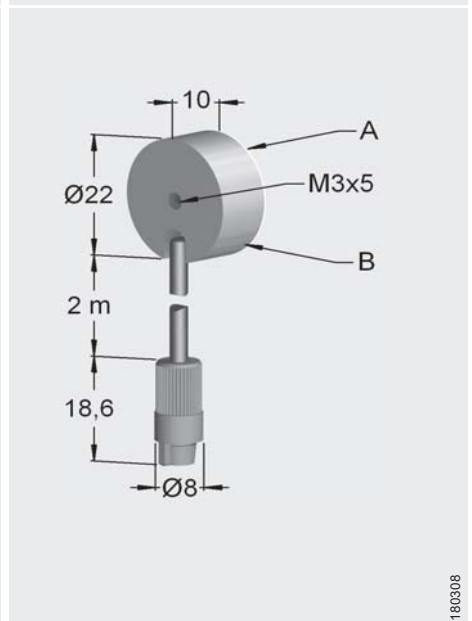
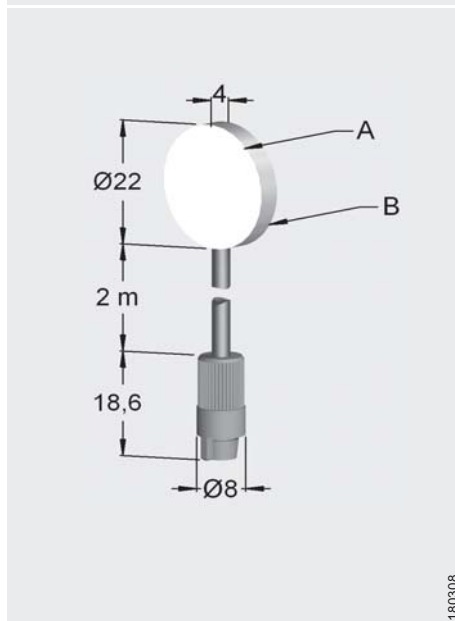
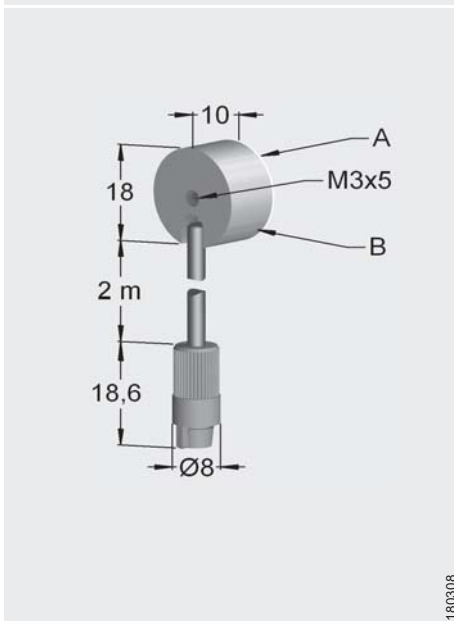
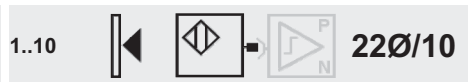
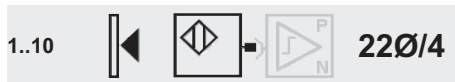
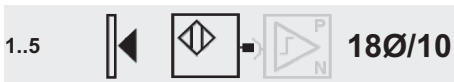
- SK sensor capacitive, w/o amplifier
- SKF sensor cap., w/o amplifier, flexible
- SK1 sensor capacitive, self-contained
- SV(D) sensor amplifier (dynamic)
- SNG sensor power pack
- HT### high temperature use
- TM pulse modulation technique (High noise immune)
- ## / FS(A) max sensing distance / Fill-level switch (adaptive)
- M30 model and/or dimension
- P output stage PNP, NPN, X (switchable)
- B mounting B=flush NB=non-flush
- S S=N.O. Ö=N.C. X=function switchable
- (C)PTFE Housing material, e.g. PTFE CPTFE=complete PTFE
- 1M2-Y2 cable & connector: Y# = connector 1M2 = 1.2m cable length



Typ / Type SK-3-18/2.5-B-VA/PTFE

Typ / Type SK-5-18/4-B-VA/PTFE

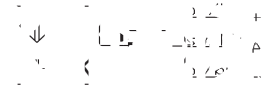
Mounting [flush / nonflush]	[ B / NB ]	B	B
Operating distance Sn	[mm]	0,1... 3	1... 5
Hysteresis H	[%SR]	15	15
Frequency of operating cycles f	[Hz]	100	100
Repeat accuracy R	[%SR]	2	2
Operating temperature range Ta	[C°]	-30... 70	-30... 80
Temperature drift [range]	[%SR]	20 [-5... 55]	20 [-5... 55]
Protection class		IP 66	IP 66
Rated insulation voltage Ui	[V]	75 d. c.	75 d. c.
Material of housing		A: PTFE; B: V2A	A: PTFE; B: V2A
Utilisation category			
Connection		2m / 3x 0,09mm <sup>2</sup> / PVC · ZA 	2m / 3x 0,14mm <sup>2</sup> / PUR · ZA 
Supply voltage range UB	[V]	4...8	4...8
No-load supply current Iomax.	[mA]		
Minimum operational current Im	[mA]		
Operational current Ie	[mA]		
Off-state current Ir	[mA]		
Voltage drop Ud @ Ie	[V]		
Time delay before availability tv	[ms]		
Indicator [UB / Output]			
Short circuit- overload-protection			
Reverse polarity protection			
Conformity EMC EEC-direct.		IEC 60947-5-2 : 2004 73/23 	IEC 60947-5-2 : 2004 73/23 
EMC		IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 2.9-6.9 Mhz.	IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.8-2.2 Mhz.
Associated equipment		SV-; SVD-; SNG-...-K; SNG-...-K-T SL-YA-m20	SV-; SVD-; SNG-...-K; SNG-...-K-T SL-YA-m20
Additional functionality			
Application			



180308

180308

180308



Typ / Type  
SK-5-18/10-B-VA/PTFE

Typ / Type  
SK-10-22/4-B-VA/PTFE

Typ / Type  
SK-10-22/10-B-VA/PTFE

B
1... 5
15
100
2
-30... 80
20 [-5... 55]
IP 66
75 d. c.
A: PTFE; B: VA
2m / 3x 0,14mm <sup>2</sup> / PUR - ZA
4...8

B
1... 10
15
100
2
-30... 80
20 [-5... 55]
IP 66
75 d. c.
A: PTFE; B: V2A
2m / 3x 0,14mm <sup>2</sup> / PUR - ZA
4...8

B
1... 10
15
100
2
-30... 80
20 [-5... 55]
IP 66
75 d. c.
A:PTFE; B: VA
2m / 3x 0,14mm <sup>2</sup> / PUR - ZA
4...8

IEC 60947-5-2 : 2004

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.8-2.3 Mhz.  
SV-; SVD-; SNG-...-K; SNG-...K-T SL-YA-m20



IEC 60947-5-2 : 2004

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.4-2.1 Mhz.  
SV-; SVD-; SNG-...-K; SNG-...K-T SL-YA-m20

IEC 60947-5-2 : 2004

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.3-1.9 Mhz.  
SV-; SVD-; SNG-...-K; SNG-...K-T SL-YA-m20

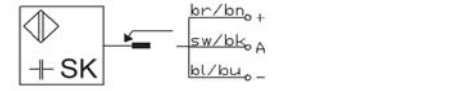
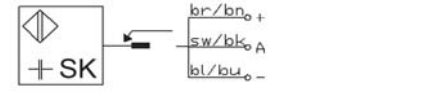
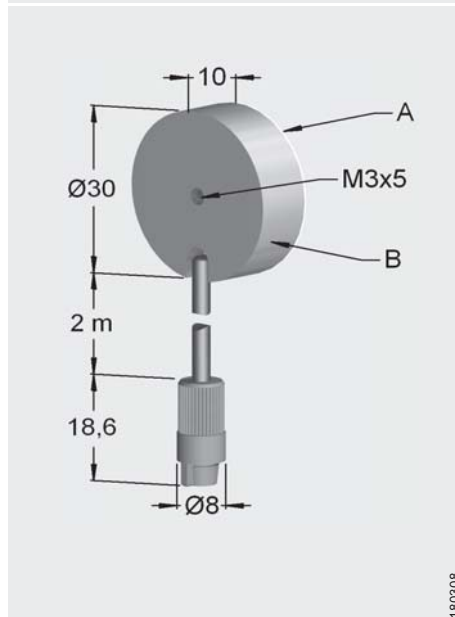
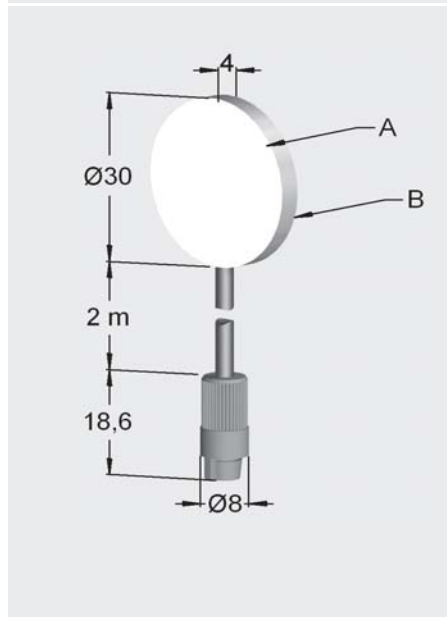
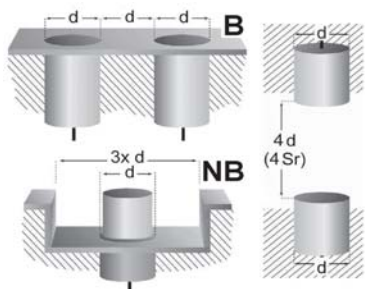
**BALLUFF**  
SIESENSORIK

1..15   **30Ø/4**

1..15   **30Ø/10**





Type code (abstract)

- SK sensor capacitive, w/o amplifier
- SKF sensor cap., w/o amplifier, flexible
- SK1 sensor capacitive, self-contained
- SV(D) sensor amplifier (dynamic)
- SNG sensor power pack
- HT### high temperature use
- TM pulse modulation technique (High noise immune)
- ## / FS(A) max sensing distance / Fill-level switch (adaptive)
- M30 model and/or dimension
- P output stage PNP, NPN, X (switchable)
- B mounting B=flush NB=non-flush
- S S=N.O. Ö=N.C. X=function switchable
- (C)PTFE Housing material, e.g. PTFE CPTFE=complete PTFE
- 1M2-Y2 cable & connector: Y# = connector 1M2 = 1.2m cable length

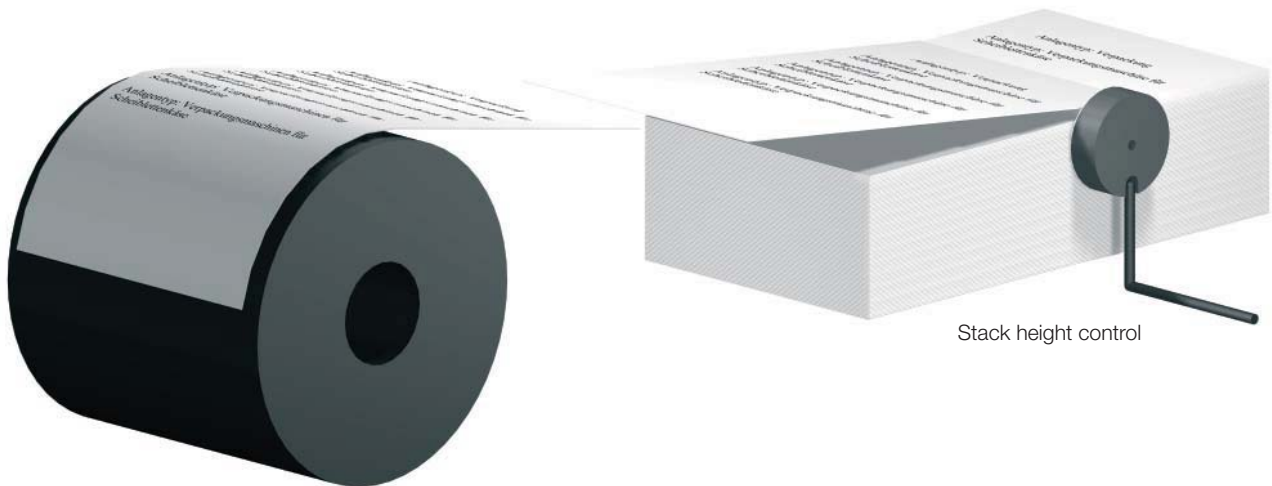
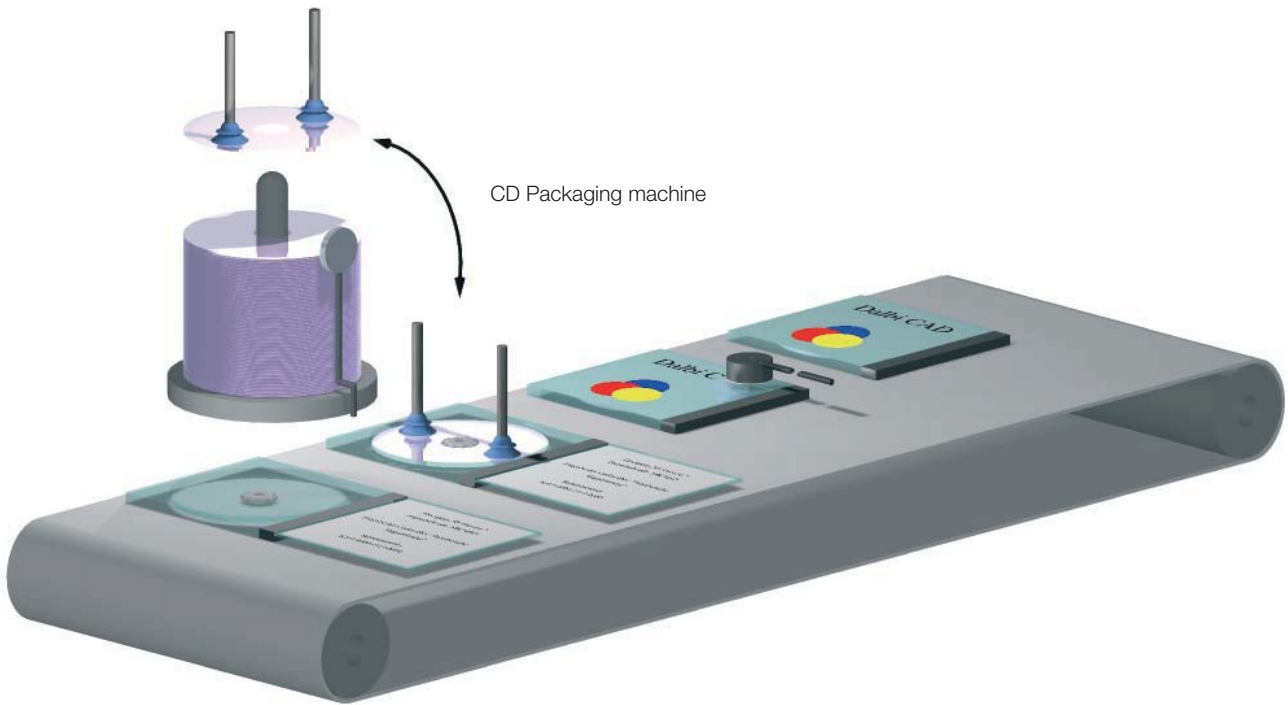


Typ / Type SK-15-30/4-B-VA/PTFE

Typ / Type SK-15-30/10-B-VA/PTFE

Mounting [flush / nonflush]	[ B / NB ]	B	B
Operating distance Sn	[mm]	1... 15	1... 15
Hysteresis H	[%SR]	15	15
Frequency of operating cycles f	[Hz]	100	100
Repeat accuracy R	[%SR]	2	2
Operating temperature range Ta	[C°]	-30... 80	-30... 80
Temperature drift [range]	[%SR]	20 [-5... 55]	20 [-5... 55]
Protection class		IP 66	IP 66
Rated insulation voltage Ui	[V]	75 d. c.	75 d. c.
Material of housing		A: PTFE; B:V2A	A: PTFE; B: VA
Utilisation category			
Connection		2m / 3x 0,14mm <sup>2</sup> / PUR - ZA 	2m / 3x 0,14mm <sup>2</sup> / PUR - ZA 
Supply voltage range UB	Ub [V]	4...8	4...8
No-load supply current Iomax.	[mA]		
Minimum operational current Im	[mA]		
Operational current Ie	[mA]		
Off-state current Ir	[mA]		
Voltage drop Ud @ Ie	[V]		
Time delay before availability tv	[ms]		
Indicator [UB / Output]			
Short circuit- overload-protection			
Reverse polarity protection			
Conformity EMC EEC-direct.		IEC 60947-5-2 : 2004 	IEC 60947-5-2 : 2004 
EMC		IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.6-2.8 Mhz.	IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.6-2.6 Mhz.
Associated equipment		SV-; SVD-; SNG-...-K; SNG-...-K-T SL-YA-m20	SV-; SVD-; SNG-...-K; SNG-...-K-T SL-YA-m20
Additional functionality			
Application			

## Applications



# 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

## Table of Contents

## Page

Capacitive sensors –  
general description

1.02 –  
1.10

Mini-sensors

3.01 –  
3.09

Sensor amplifiers

4.01 –  
4.05

Sensors for  
object detection

6.01 –  
6.15

Sensors for  
level sensing

7.01 –  
7.12

Sensors for level sensing,  
smartLEVEL-Technology

7.13 –  
7.22

microLEVEL

7.15 –  
7.17

microBOX

7.21

Analog sensor

8.01 –  
8.04

Sensors for the high  
temperature range

9.01 –  
9.03

Sensor power packs

12.01 –  
12.03

Accessories

13.01 –  
13.05



## Sensor amplifiers

### Series SV, SNG...-K-... 0400

- For sensors SK and SKF
- Sensing distance adjustable
- DC or AC versions
- Logic amplifier
- Min-Max control



DIN EN ISO 9001:2000  
QA 05 100 1050



**Type code (abstract)**

SK sensor capacitive, w/o amplifier  
 SKF sensor cap. w/o amplifier, flexible  
 SK1 sensor capacitive, self-contained  
 SV(D) sensor amplifier (dynamic)  
 SNG sensor power pack

HT### high temperature use  
 TM pulse modulation technique (High noise immune)

## / FS(A) max sensing distance / Fill-level switch (adaptive)

M30 model and/or dimension

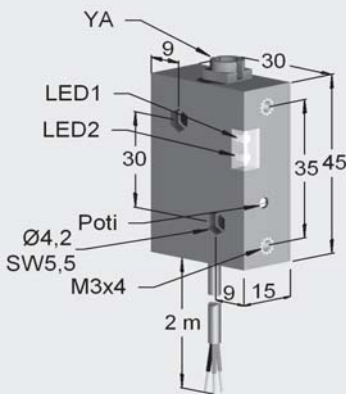
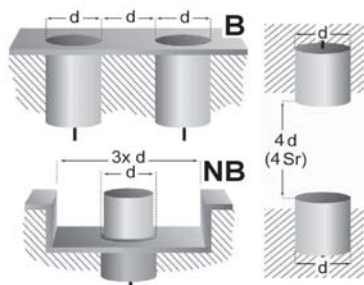
P output stage PNP, NPN, X (switchable)

B mounting B=flush  
 NB=non-flush

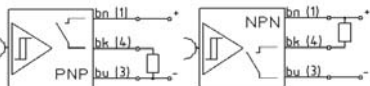
S S=N.O. Ö=N.C.  
 X=function switchable

(C)PTFE Housing material, e.g. PTFE  
 CPTFE=complete PTFE

1M2-Y2 cable & connector:  
 Y# = connector  
 1M2 = 1.2m cable length



180308

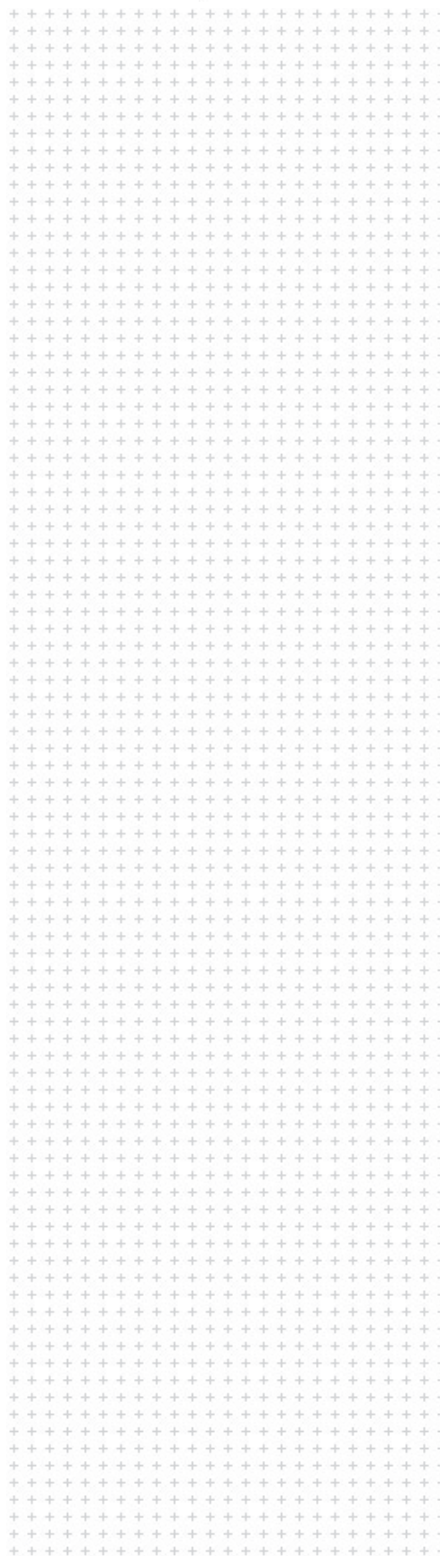


**Typ / Type**

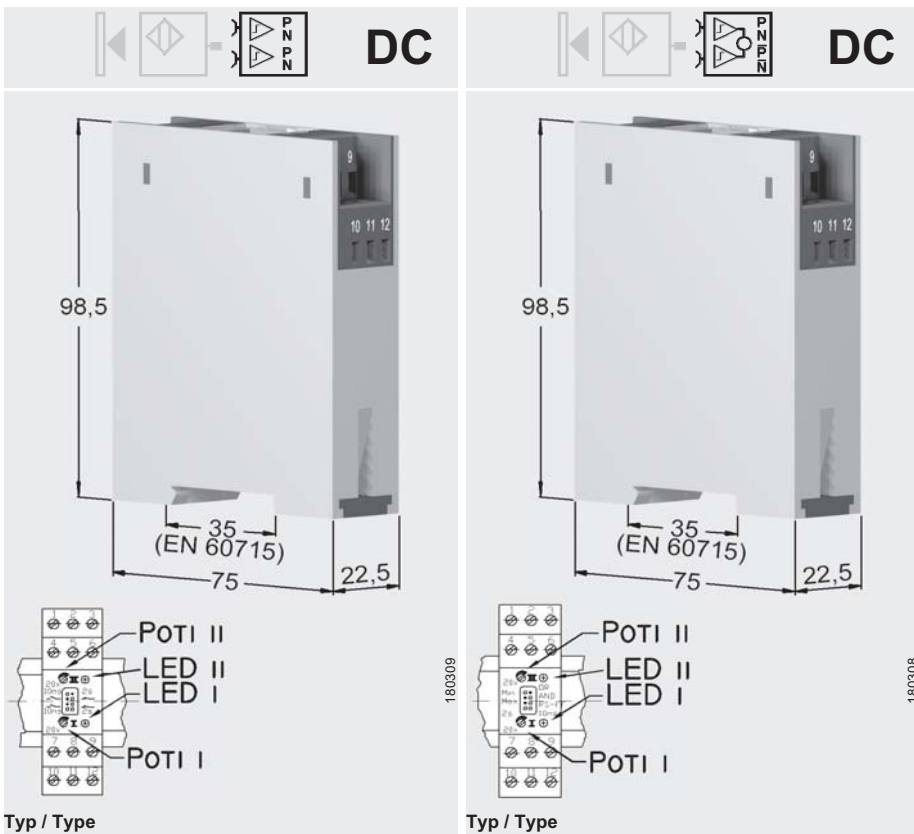
- SV-45/30/15-PS
- SV-45/30/15-PO
- SV-45/30/15-NS
- SV-45/30/15-NO

**Function overview**

- LED 1: Control state indicator
- LED 2: Indicated operating voltage present
- Pos. 1: Through-hole Ø4,2 (4.2 mm in diameter), hexagonal on both sides, for inserting an M3 nut in each case



Mounting [flush / nonflush]	[ B / NB ]	
Operating distance	Sn [mm]	
Hysteresis	H [%SR]	
Frequency of operating cycles	f [Hz]	100
Repeat accuracy	R [%SR]	
Operating temperature range	Ta [C°]	-30... 70
Temperature drift [range]	[%SR]	
Protection class		IP 67 → IP40
Rated insulation voltage	Ui [V]	75 d. c.
Material of housing		PC
Utilisation category		DC13
Connection		YA - 2m / 3x 0,14mm <sup>2</sup> / PUR → SV
Supply voltage range UB	Ub [V]	12... 35
No-load supply current	Iomax. [mA]	20
Minimum operational current	I <sub>m</sub> [mA]	
Operational current	I <sub>e</sub> [mA]	300
Off-state current	I <sub>r</sub> [mA]	
Voltage drop	U <sub>d @ I<sub>e</sub></sub> [V]	0,8
Time delay before availability	t <sub>v</sub> [ms]	< 300
Indicator [UB / Output]		• / •
Short circuit- overload-protection		• / •
Reverse polarity protection		•
Conformity	EMC EEC-direct.	IEC 60947-5-2 : 2004 CE
EMC		
Associated equipment		SK-...
Additional functionality		
Application		



Typ / Type  
SV-2VX-LDG12

Typ / Type  
SV-X2L-LDG12

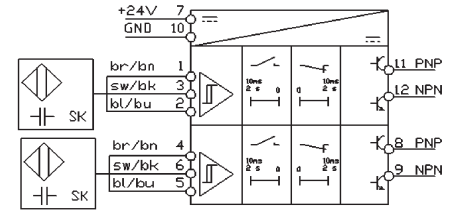
100		100	
-30... 70		-30... 70	
IP 40 / 20	⊘	IP 40 / 20	⊘
75 d. c.		75 d. c.	
PC		PC	
DC13		DC13	
max. 2,5mm <sup>2</sup> / AWG 14	⊘	max. 2,5mm <sup>2</sup> / AWG 14	⊘
10... 35		10... 35	
15		25	
PNP: 300 / NPN: 300		PNP: 300 / NPN: 300	
0,8		0,8	
< 300		< 300	
•/•		-/•	
•/•		•/•	
•		•	
IEC 60947-5-2 : 2004	CE	IEC 60947-5-2 : 2004	CE

SK-...	SL-YA-m20	SK-...	SL-YA-m20
S / Ö NO / NC		10ms / 2s	
10ms / 2s		OR , AND , RS-FlipFlop , MinMax	
2x SV = 1x 2VX		P / N - A/Q & P / N Ain/Qinv	
P / N - A/Q per SV			

application notes

**SV-2VX**

- Two separate sensor amplifiers in one housing
- Connection for two Mini-SK or SKF Sensors
- PNP and NPN transistor output
- Function switchable between N.O./N.C.
- Pick-up delay (N.O. contact) switchable between 10 ms/2 s
- Drop-out delay (N.C. contact) switchable between 10 ms/2 s
- Clamp terminal
- Sensing distance of sensors can be adjusted separately
- Control state signalled by two separate LED indicators



**SV-X2L**

- Sensor amplifier with logic
- Connection for two Mini-SK or SKF sensors
- Two outputs each (PNP/NPN) for Q and Q'
- Pick-up delay switchable between 10 ms / 2 s
- Function selectable between OR/AND/RS-FF/Min-Max
- Clamp terminal
- Sensing distance of sensors can be adjusted separately
- Control state signalled by two separate LED indicators

**OR function**

Output Q active when one or both sensors are activated.

**AND function**

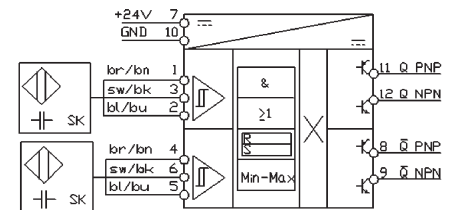
Output Q active only when both sensors are activated.

**RS-FF function**

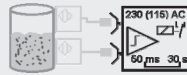
Output Q active when sensor is activated once at the set input. This state is retained until the sensor is activated at the reset input.

**Min-Max function**

Output Q is active when both sensors are activated. The output is reset only when both sensors are no longer activated.



**BALLUFF**  
SIESENSORIK

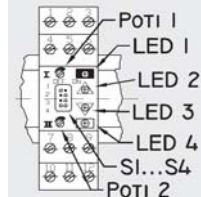
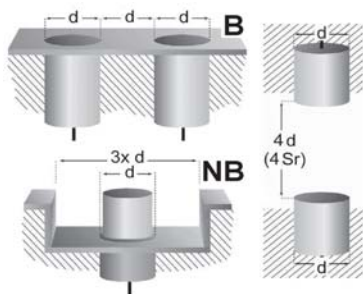


**AC**

application notes

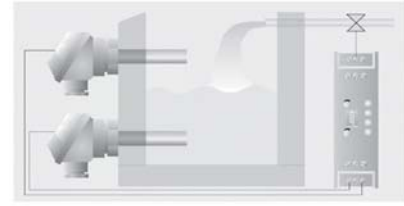
**Type code (abstract)**

- SK sensor capacitive, w/o amplifier
- SKF sensor cap. w/o amplifier, flexible
- SK1 sensor capacitive, self-contained
- SV(D) sensor amplifier (dynamic)
- SNG sensor power pack
- HT### high temperature use
- TM pulse modulation technique (High noise immune)
- ## / FS(A) max sensing distance / Fill-level switch (adaptive)
- M30 model and/or dimension
- P output stage PNP, NPN, X (switchable)
- B mounting B=flush NB=non-flush
- S S=N.O. Ö=N.C. X=function switchable
- (C)PTFE Housing material, e.g. PTFE CPTFE=complete PTFE
- 1M2-Y2 cable & connector: Y# = connector 1M2 = 1.2m cable length

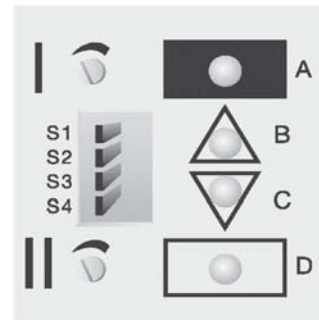


Typ / Type  
SNG-230AC-K-MinMax  
SNG-115AC-K-MinMax

**Function**



When both sensors are de-activated, the relay switches on "LED-empty" lights up (contact 7/9 locked out). When the minimum sensor gives a closed signal, the "LED-filling" illuminates. As soon as both sensors are activated, the relay switches off "LED-full" lights up (contact 7/9 open). When the maximum sensor signals open, the "LED indicating empty" will light up. The relay will not switch on again until both sensors are de-activated. Further functions are possible with the Mini-Dip-Switch (see below).



Mounting [flush / nonflush]	[ B / NB ]	
Operating distance	Sn [mm]	
Hysteresis	H [%SR]	
Frequency of operating cycles	f [Hz]	5
Repeat accuracy	R [%SR]	
Operating temperature range	Ta [C°]	-30... 70
Temperature drift [range]	[%SR]	
Protection class		IP 40 / 20  IP 20
Rated insulation voltage	Ui [V]	250 a.c.
Material of housing		PC
Utilisation category		-
Connection		max. 2,5mm <sup>2</sup> / AWG 14
Supply voltage range UB	Ub [V]	230 (115) V 40... 60 Hz
No-load supply current	Iomax. [mA]	20 / 40
Minimum operational current	Imin [mA]	
Operational current	Ie [mA]	380VAC / 250VDC / 8A
Off-state current	Ir [mA]	
Voltage drop	Ud @ Ie [V]	
Time delay before availability	tv [ms]	< 300
Indicator [UB / Output]		- / •
Short circuit- overload-protection		-
Reverse polarity protection		-
Conformity	EMC EEC-direct.	IEC 60947-5-2 : 2004 73/23
EMC		
Associated equipment	SK...	SL-YA-m20
Additional functionality		Min Sensor: 0,2 s / 5s Max-Sensor: 0,2s / 5s INIT-set-up
Application		

**Dip-switch function**

Sensor setting (sketch) = as-delivered condition

- S1 Time-delay max-sensor (off: approx. 0.2 s; on: approx. 5 s)
- S2 Time-delay min-sensor (off: approx. 0.2 s; on: approx. 5 s)
- S3 Power-on set-up (off: filling; on: emptying)
- S4 Output (relay inverses)

**Functions description**

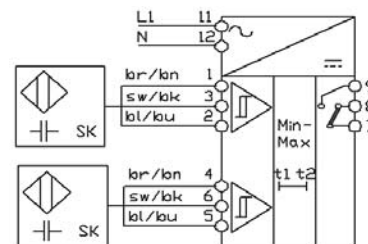
A full - B filling - C emptying - D empty

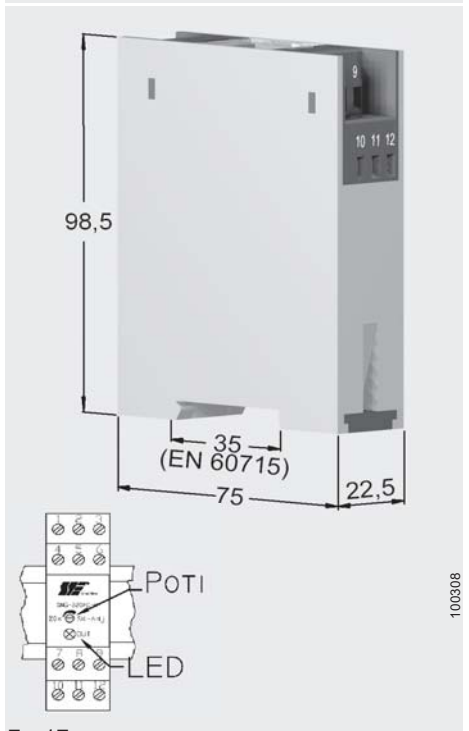
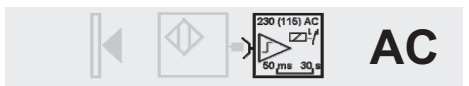
**Sensoradjustment**

Max-sensor: pot I  
Min-sensor: pot II

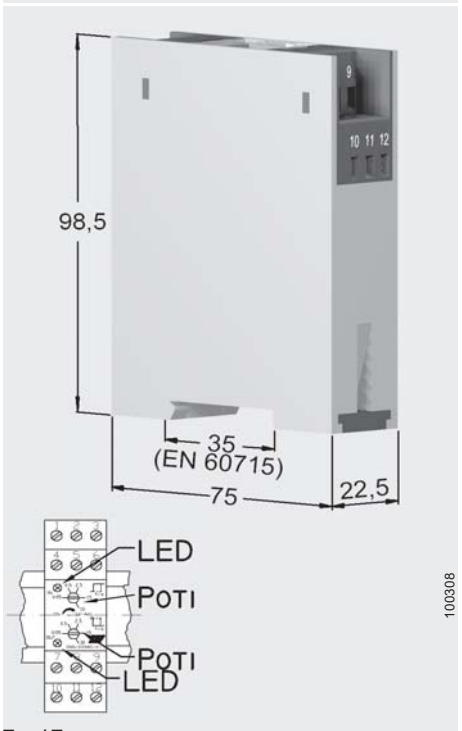
**Features**

- Min- and max-level sensor controls
- Connection points for the two SK- or SKF series sensors, with separate pot adjustment
- Short circuit proof on the DC side
- Separate switchable delays for either min- and max-sensor



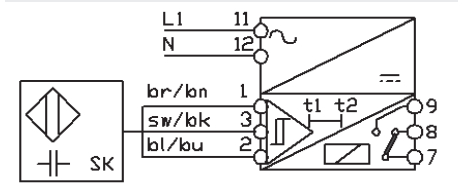


Typ / Type  
SNG-230AC-K  
SNG-115AC-K



Typ / Type  
SNG-230AC-K-T  
SNG-115AC-K-T

application notes



10	10
-30... 70	-30... 70
IP 40  IP 20	IP 40  IP 20
250 a.c.	250 a.c.
PC	PC
-	-
max. 2,5mm <sup>2</sup> / AWG 14	max. 2,5mm <sup>2</sup> / AWG 14
230 (115) V 40... 60 Hz	230 (115) V 40... 60 Hz
20	20
380VAC / 250VDC / 8A	380VAC / 250VDC / 8A
< 300	< 300
- / •	- / •
-	-
-	-
IEC 60947-5-2 : 2004 73/23	IEC 60947-5-2 : 2004 73/23

SK-...	SL-YA-m20	SK-...	SL-YA-m20
		50ms...30s	
		50ms...30s	

# 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

## Table of Contents

## Page

Capacitive sensors –  
general description

1.02 –  
1.10

Mini-sensors

3.01 –  
3.09

Sensor amplifiers

4.01 –  
4.05

Sensors for  
object detection

6.01 –  
6.15

Sensors for  
level sensing

7.01 –  
7.12

Sensors for level sensing,  
smartLEVEL-Technology

7.13 –  
7.22

microLEVEL

7.15 –  
7.17

microBOX

7.21

Analog sensor

8.01 –  
8.04

Sensors for the high  
temperature range

9.01 –  
9.03

Sensor power packs

12.01 –  
12.03

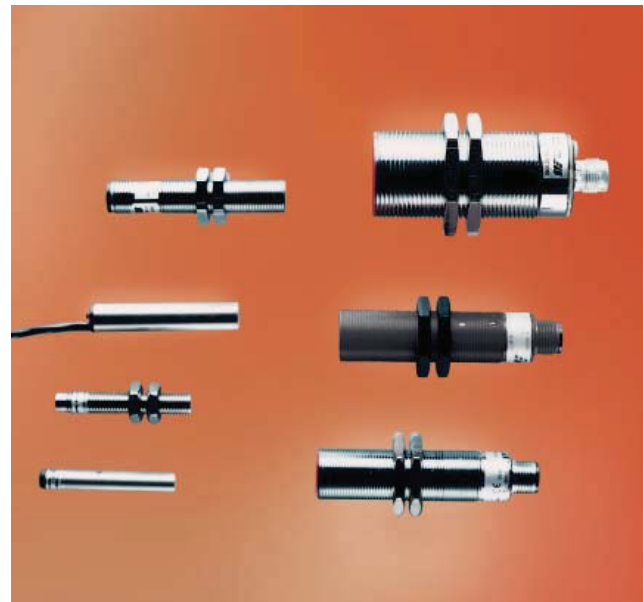
Accessories

13.01 –  
13.05

## Sensors for object detection

### Series SK1 0600/0650

- Model with output stage from  $\varnothing$ -6.5 mm
- Sensing distance adjustable
- Flush mounting
- Connecting lead or plug connector



DIN EN ISO 9001:2000  
QA 05 100 1050

**BALLUFF**  
SIESENSORIK

0,1...1,5



6,5Ø

0,1...1,5



6,5Ø

Type code (abstract)

SK sensor capacitive, w/o amplifier  
SKF sensor cap., w/o amplifier, flexible  
SK1 sensor capacitive, self-contained  
SV(D) sensor amplifier (dynamic)  
SNG sensor power pack

HT### high temperature use  
TM pulse modulation technique (High noise immune)

## / FS(A) max sensing distance / Fill-level switch (adaptive)

M30 model and/or dimension

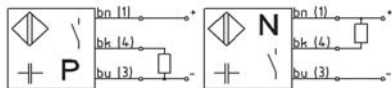
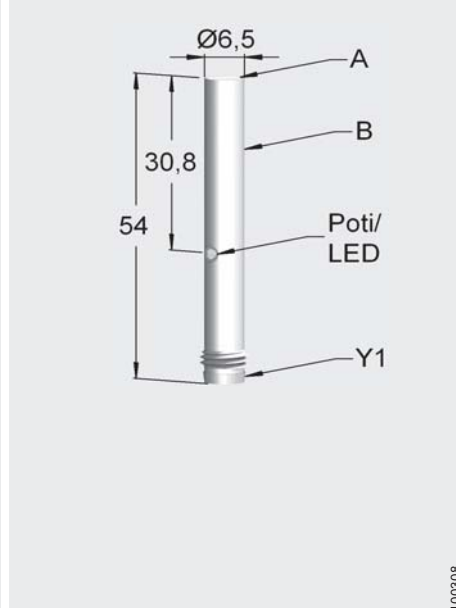
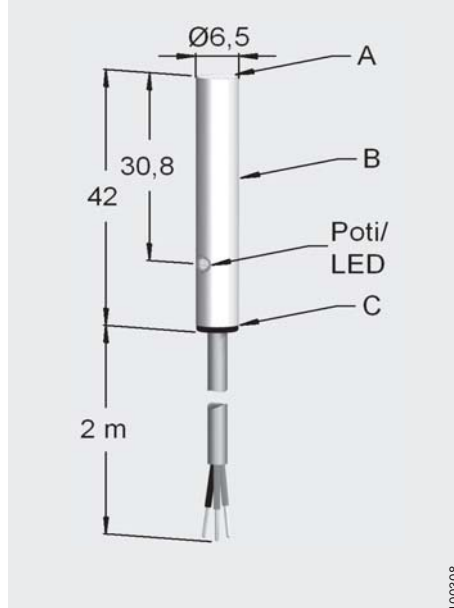
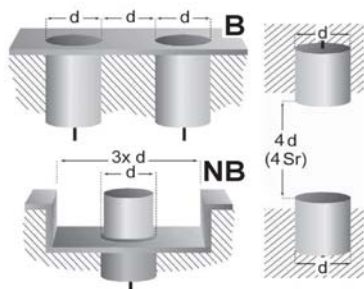
P output stage PNP, NPN, X (switchable)

B mounting B=flush NB=non-flush

S S=N.O. Ö=N.C. X=function switchable

(C)PTFE Housing material, e.g. PTFE CPTFE=complete PTFE

1M2-Y2 cable & connector: Y# = connector 1M2 = 1.2m cable length

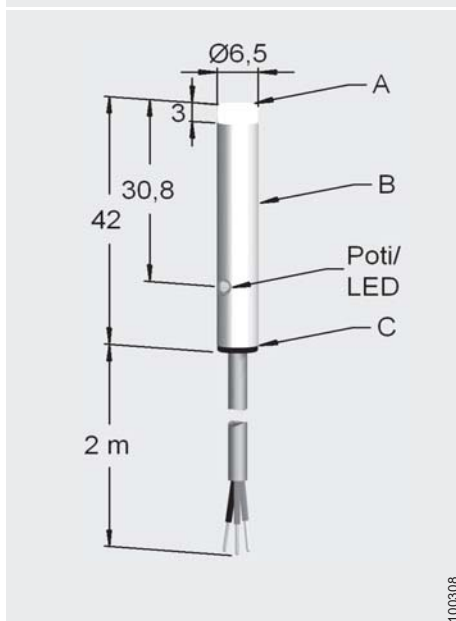


Typ / Type  
SK1-1.5-6.5-PBS-VA/PTFE  
SK1-1.5-6.5-PBO-VA/PTFE  
SK1-1.5-6.5-NBS-VA/PTFE  
SK1-1.5-6.5-NBO-VA/PTFE

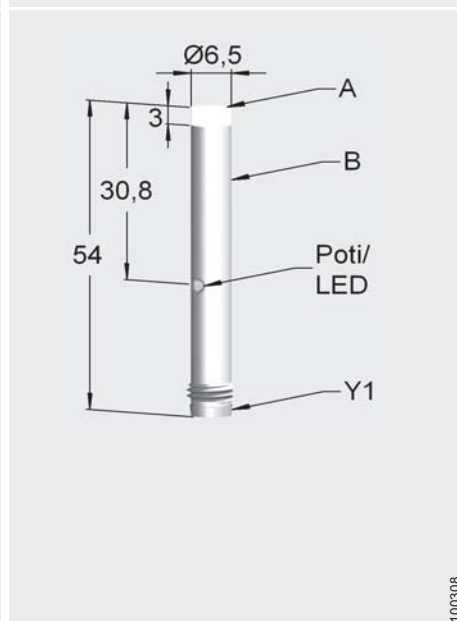
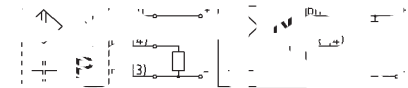
Typ / Type  
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SK1-1.5-6.5-PBO-VA/PTFE-Y1  
SK1-1.5-6.5-NBS-VA/PTFE-Y1  
SK1-1.5-6.5-NBO-VA/PTFE-Y1

Mounting [flush / nonflush]	[ B / NB ]	B	B
Operating distance	Sn [mm]	0,1...1,5	0,1...1,5
Hysteresis	H [%SR]	15	15
Frequency of operating cycles	f [Hz]	100	100
Repeat accuracy	R [%SR]	2	2
Operating temperature range	Ta [C°]	-10... 70	-10... 70
Temperature drift [range]	[%SR]	15 [ -5... 55]	15 [ -5... 55]
Protection class		IP 65	IP 65
Rated insulation voltage	Ui [V]	75 d. c.	75 d. c.
Material of housing		A: PTFE; B: V2A; C: POM	A: PTFE; B: V2A; C: PA
Utilisation category			
Connection		2m / 3x 0,14mm <sup>2</sup> PUR	Z10; Z11
Supply voltage range UB	Ub [V]	11...30	11...30
No-load supply current	Iomax. [mA]	10	10
Minimum operational current	I <sub>m</sub> [mA]		
Operational current	I <sub>e</sub> [mA]	50	50
Off-state current	I <sub>r</sub> [mA]		
Voltage drop	U <sub>d</sub> @ I <sub>e</sub> [V]	2	2
Time delay before availability	t <sub>v</sub> [ms]		
Indicator [UB / Output]		- / •	- / •
Short circuit- overload-protection		• / •	• / •
Reverse polarity protection		•	•
Conformity	EMC EEC-direct.	IEC 60947-5-2 : 2004	IEC 60947-5-2 : 2004
EMC		IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.5-0,8 Mhz.	IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.5-0,8 Mhz.
Associated equipment			SNG-###AC...
Additional functionality			
Application			

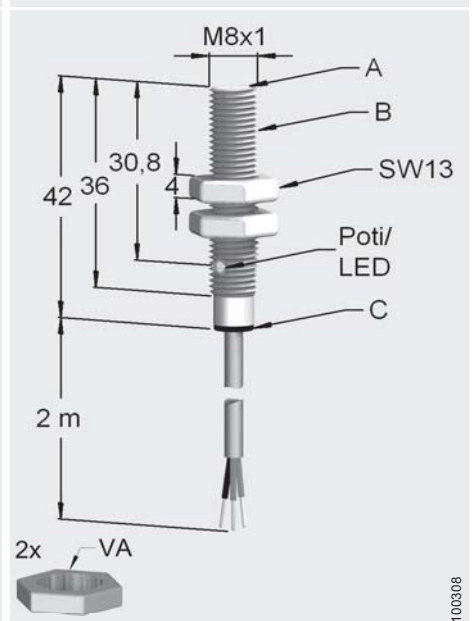




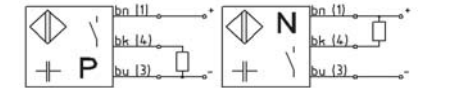
100308



100308



100308



Typ / Type
SK1-3-6.5-PNBS-VA/PTFE
SK1-3-6.5-PNBO-VA/PTFE
SK1-3-6.5-NNBS-VA/PTFE
SK1-3-6.5-NNBO-VA/PTFE

NB
0,1...3
15
100
2
-10... 70
15 [-5... 55]
IP 65
75 d. c.
A: PTFE; B: V2A; C: POM
2m / 3x 0,14mm <sup>2</sup> PUR
11...30
10
50
2
- / •
• / •
•

IEC 60947-5-2 : 2004

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.3-1.1 Mhz. SNG-###AC...

Typ / Type
SK1-3-6.5-PNBS-VA/PTFE-Y1
SK1-3-6.5-PNBO-VA/PTFE-Y1
SK1-3-6.5-NNBS-VA/PTFE-Y1
SK1-3-6.5-NNBO-VA/PTFE-Y1

NB
0,1...3
15
100
2
-10... 70
15 [-5... 55]
IP 65
75 d. c.
A: PTFE; B: V2A; C: PA
DC13
Z10; Z11
11...30
10
50
2
- / •
• / •
•

IEC 60947-5-2 : 2004

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.3-1.1 Mhz. SNG-###AC...

Typ / Type
SK1-1.5-M8-PBS-VA/PTFE
SK1-1.5-M8-PBO-VA/PTFE
SK1-1.5-M8-NBS-VA/PTFE
SK1-1.5-M8-NBO-VA/PTFE

B
0,1...1,5
15
100
2
-10... 70
15 [-5... 55]
IP 65
75 d. c.
A: PTFE; B: V2A; C: POM
DC13
2m / 3x 0,14mm <sup>2</sup> PUR PUR
11...30
10
50
2
- / •
• / •
•

IEC 60947-5-2 : 2004

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.5-0.8 Mhz. SNG-###AC...



0,1...1,5



M8

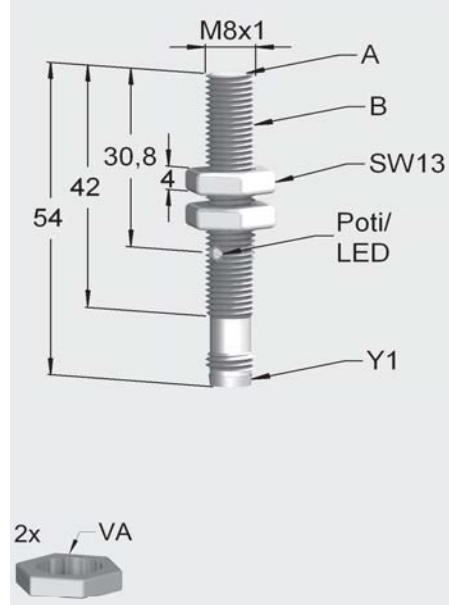
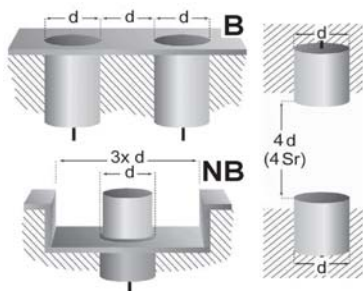
0,1...3



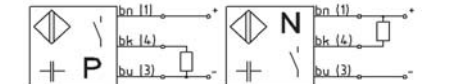
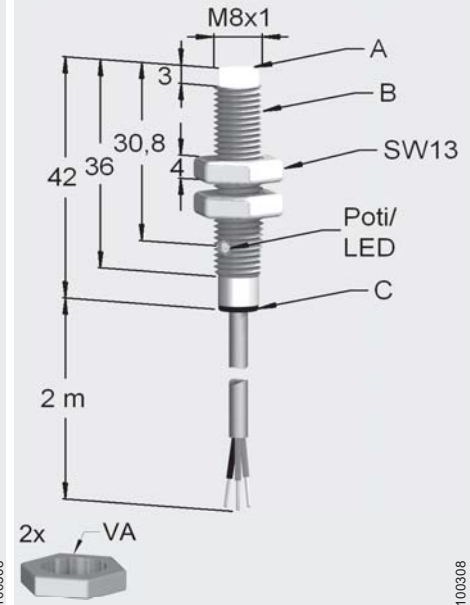
M8

Type code (abstract)

- SK sensor capacitive, w/o amplifier
- SKF sensor cap., w/o amplifier, flexible
- SK1 sensor capacitive, self-contained
- SV(D) sensor amplifier (dynamic)
- SNG sensor power pack
- HT### high temperature use
- TM pulse modulation technique (High noise immune)
- ## / FS(A) max sensing distance / Fill-level switch (adaptive)
- M30 model and/or dimension
- P output stage PNP, NPN, X (switchable)
- B mounting B=flush NB=non-flush
- S S=N.O. Ö=N.C. X=function switchable
- (C)PTFE Housing material, e.g. PTFE CPTFE=complete PTFE
- 1M2-Y2 cable & connector: Y# = connector 1M2 = 1.2m cable length

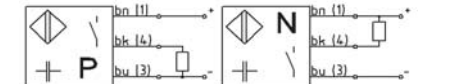
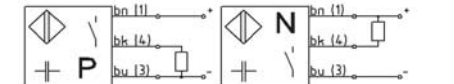
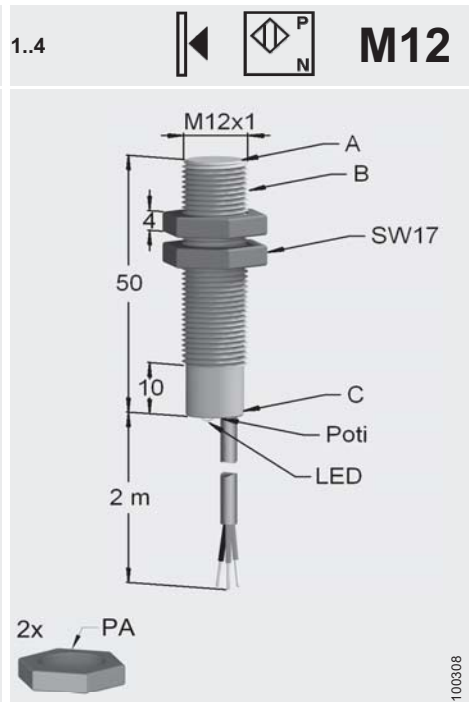
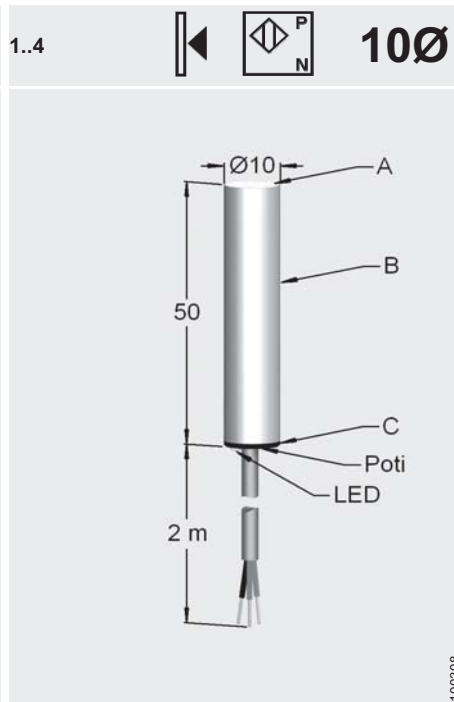
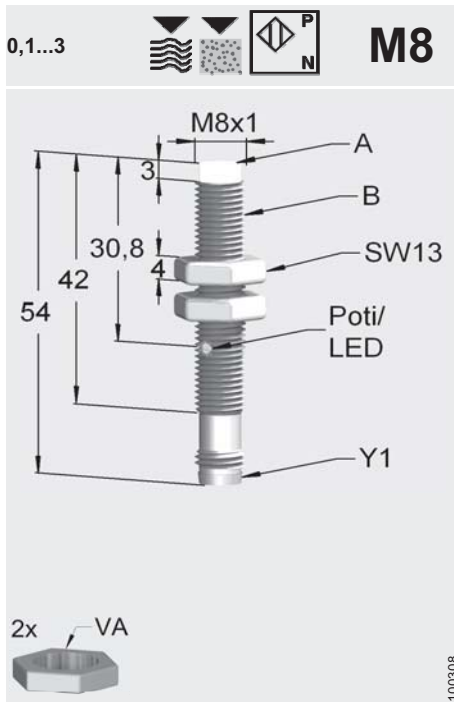


- Typ / Type
- SK1-1.5-M8-PBS-VA/PTFE-Y1
  - SK1-1.5-M8-PBO-VA/PTFE-Y1
  - SK1-1.5-M8-NBS-VA/PTFE-Y1
  - SK1-1.5-M8-NBO-VA/PTFE-Y1



- Typ / Type
- SK1-3-M8-PNBS-VA/PTFE
  - SK1-3-M8-PNBO-VA/PTFE
  - SK1-3-M8-NNBS-VA/PTFE
  - SK1-3-M8-NNBO-VA/PTFE

Mounting [flush / nonflush]	[ B / NB ]	B	NB
Operating distance	Sn [mm]	0,1...1,5	0,1...3
Hysteresis	H [%SR]	15	15
Frequency of operating cycles	f [Hz]	100	100
Repeat accuracy	R [%SR]	2	2
Operating temperature range	Ta [C°]	-10... 70	-10... 70
Temperature drift [range]	[%SR]	15 [ -5... 55]	15 [ -5... 55]
Protection class		IP 65	IP 65
Rated insulation voltage	Ui [V]	75 d. c.	75 d. c.
Material of housing		A: PTFE; B: V2A	A: PTFE; B: V2A; C: POM
Utilisation category		DC13	DC13
Connection		Z10; Z11	2m / 3x 0,14mm² PUR
Supply voltage range UB	Ub [V]	11...30	11...30
No-load supply current	Iomax. [mA]	10	10
Minimum operational current	Imin [mA]		
Operational current	Ie [mA]	50	50
Off-state current	Ir [mA]		
Voltage drop	Ud @ Ie [V]	2	2
Time delay before availability	tv [ms]		
Indicator [UB / Output]		- / •	- / •
Short circuit- overload-protection		• / •	• / •
Reverse polarity protection		•	•
Conformity	EMC EEC-direct.	IEC 60947-5-2 : 2004	IEC 60947-5-2 : 2004
EMC		IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.5-0.8 Mhz. SNG-###AC...	IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.25-1.1 Mhz. SNG-###AC...
Associated equipment			
Additional functionality			
Application			



**Typ / Type**  
 SK1-3-M8-PNBS-VA/PTFE-Y1  
 SK1-3-M8-PNBO-VA/PTFE-Y1  
 SK1-3-M8-NNBS-VA/PTFE-Y1  
 SK1-3-M8-NNBO-VA/PTFE-Y1

**Typ / Type**  
 SK1-4-10-PBS-VA/PTFE  
 SK1-4-10-PBO-VA/PTFE  
 SK1-4-10-NBS-VA/PTFE  
 SK1-4-10-NBO-VA/PTFE

**Typ / Type**  
 SK1-4-M12-PBS-PVC  
 SK1-4-M12-PBO-PVC  
 SK1-4-M12-NBS-PVC  
 SK1-4-M12-NBO-PVC

NB
0,1...3
15
100
2
-10... 70
15 [ -5... 55]
IP 65
75 d. c.
A: PTFE; B: V2A
DC13
Z10; Z11
11...30
10
50
2
- / •
• / •
•

B
1... 4
15
100
2
-30... 70
20 [ -5... 55]
IP 65
75 d. c.
A: PTFE; B: V2A; C: POM
DC13
2m / 3x 0,14mm <sup>2</sup> PUR
12... 35
10
200
0,8
- / •
• / •
•

B
1... 4
15
100
2
-30... 60
20 [ -5... 55]
IP 65
75 d. c.
A: PVC; B: PVC; C: PVC
DC13
2m / 3x 0,14mm <sup>2</sup> PUR
12... 35
10
200
0,8
- / •
• / •
•

IEC 60947-5-2 : 2004

IEC 60947-5-2 : 2004

IEC 60947-5-2 : 2004

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.25-1.1 Mhz. SNG-###AC...

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.5-0.8 Mhz. SNG-###AC...

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.4-1.3 Mhz. SNG-###AC...

1..4



**M12**

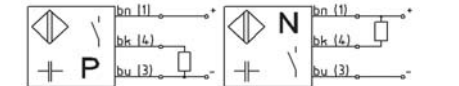
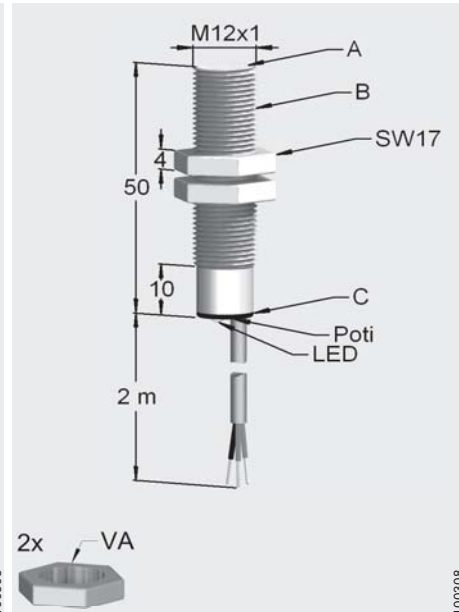
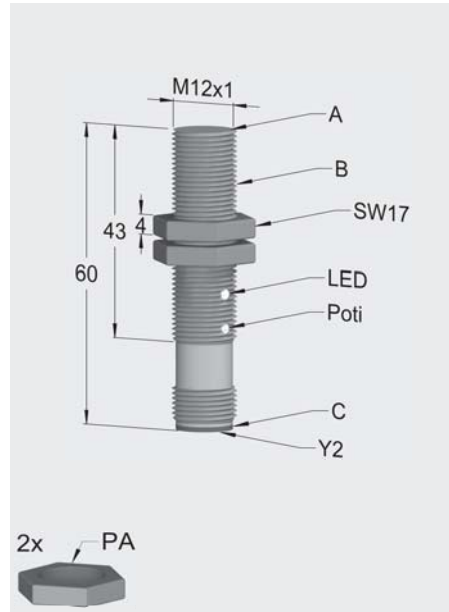
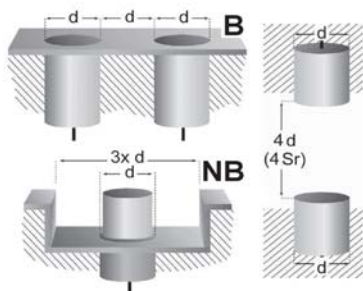
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**M12**

**Type code (abstract)**

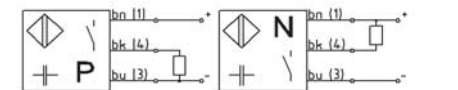
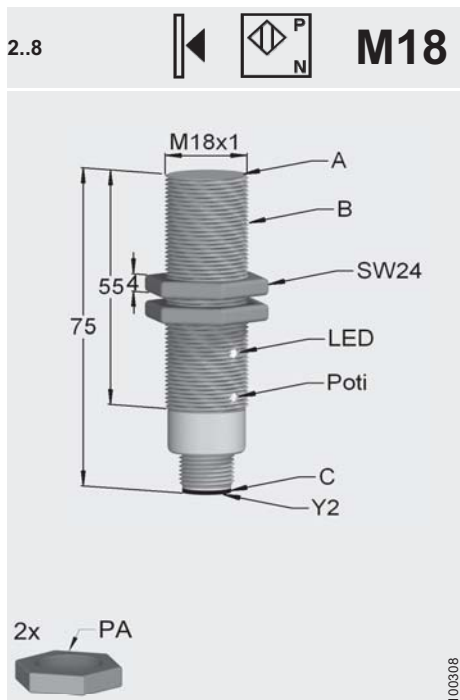
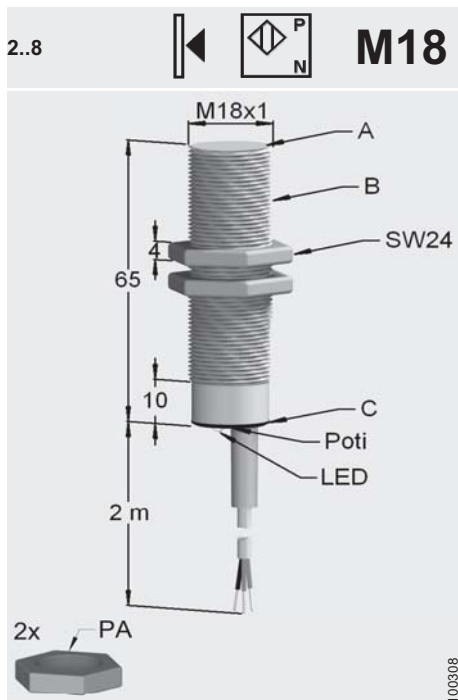
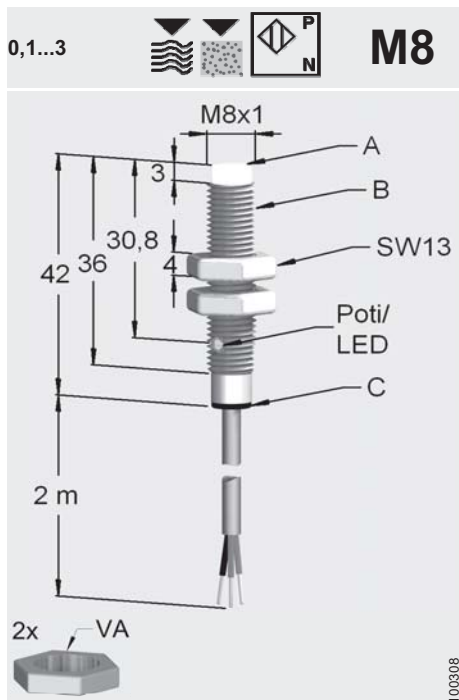
- SK sensor capacitive, w/o amplifier
- SKF sensor cap., w/o amplifier, flexible
- SK1 sensor capacitive, self-contained
- SV(D) sensor amplifier (dynamic)
- SNG sensor power pack
- HT### high temperature use
- TM pulse modulation technique (High noise immune)
- ## / FS(A) max sensing distance / Fill-level switch (adaptive)
- M30 model and/or dimension
- P output stage PNP, NPN, X (switchable)
- B mounting B=flush NB=non-flush
- S S=N.O. Ö=N.C. X=function switchable
- (C)PTFE Housing material, e.g. PTFE CPTFE=complete PTFE
- 1M2-Y2 cable & connector: Y# = connector 1M2 = 1.2m cable length



- Typ / Type**
- SK1-4-M12-PBS-PVC-Y2
  - SK1-4-M12-PBO-PVC-Y2
  - SK1-4-M12-NBS-PVC-Y2
  - SK1-4-M12-NBO-PVC-Y2

- Typ / Type**
- SK1-4-M12-PBS-VA/PTFE
  - SK1-4-M12-PBO-VA/PTFE
  - SK1-4-M12-NBS-VA/PTFE
  - SK1-4-M12-NBO-VA/PTFE

Mounting [flush / nonflush]	[ B / NB ]	B	B
Operating distance	Sn [mm]	1... 4	1... 4
Hysteresis	H [%SR]	15	15
Frequency of operating cycles	f [Hz]	100	100
Repeat accuracy	R [%SR]	2	2
Operating temperature range	Ta [C°]	-30... 60	-30... 70
Temperature drift [range]	[%SR]	20 [-5... 55]	20 [-5... 55]
Protection class		IP 65	IP 65
Rated insulation voltage	Ui [V]	75 d. c.	75 d. c.
Material of housing		A: PVC; B: PVC; C:PA	A: PTFE; B: VA; C: POM
Utilisation category		DC13	DC13
Connection		Z20; Z21	2m / 3x 0,14mm <sup>2</sup> PUR
Supply voltage range UB	Ub [V]	12... 35	12... 35
No-load supply current	Iomax. [mA]	10	10
Minimum operational current	I <sub>m</sub> [mA]		
Operational current	I <sub>e</sub> [mA]	200	200
Off-state current	I <sub>r</sub> [mA]		
Voltage drop	U <sub>d</sub> @ I <sub>e</sub> [V]	1,6	0,8
Time delay before availability	t <sub>v</sub> [ms]		
Indicator [UB / Output]		- / •	- / •
Short circuit- overload-protection		• / •	• / •
Reverse polarity protection		•	•
Conformity	EMC EEC-direct.	IEC 60947-5-2 : 2004	IEC 60947-5-2 : 2004
EMC		IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.4-1.3 Mhz. SNG-###AC...	IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.5-0.8 Mhz. SNG-###AC...
Associated equipment			
Additional functionality			
Application			



**Typ / Type**  
 SK1-3-M8-PNBS-VA/PTFE  
 SK1-3-M8-PNBO-VA/PTFE  
 SK1-3-M8-NNBS-VA/PTFE  
 SK1-3-M8-NNBO-VA/PTFE

**Typ / Type**  
 SK1-8-M18-PBS-PVC  
 SK1-8-M18-PBO-PVC  
 SK1-8-M18-NBS-PVC  
 SK1-8-M18-NBO-PVC

**Typ / Type**  
 SK1-8-M18-PBS-PVC-Y2  
 SK1-8-M18-PBO-PVC-Y2  
 SK1-8-M18-NBS-PVC-Y2  
 SK1-8-M18-NBO-PVC-Y2

NB
0,1...3
15
100
2
-10... 70
15 [ -5... 55]
IP 65
75 d. c.
A: PTFE; B: V2A; C: POM
DC13
2m / 3x 0,14mm <sup>2</sup> PUR
11...30
10
50
2
- / •
• / •
•

B
2... 8
15
100
2
-30... 60
15 [ -5... 55]
IP 67
75 d. c.
A: PVC; B: PVC; C: PBT
DC13
2m / 3x 0,25mm <sup>2</sup> PVC
10... 35
10
300
1,5
- / •
• / •
•

B
2... 8
15
100
2
-30... 60
15 [ -5... 55]
IP 67
75 d. c.
A: PVC; B: PVC; C: PA
DC13
Z20; Z21
10... 35
10
300
1,5
- / •
• / •
•

IEC 60947-5-2 : 2004

IEC 60947-5-2 : 2004

IEC 60947-5-2 : 2004

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.25-1.1 Mhz. SNG-###AC...

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.45-1.2 Mhz. SNG-###AC...

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.55-2 Mhz. SNG-###AC...

2..8



**M18**

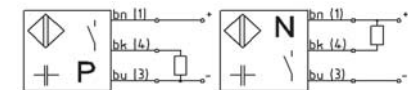
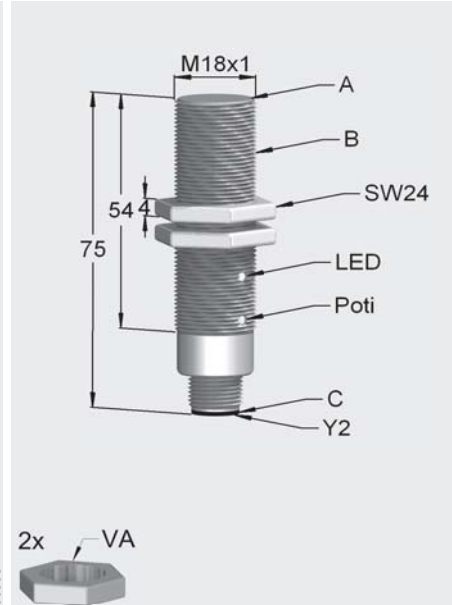
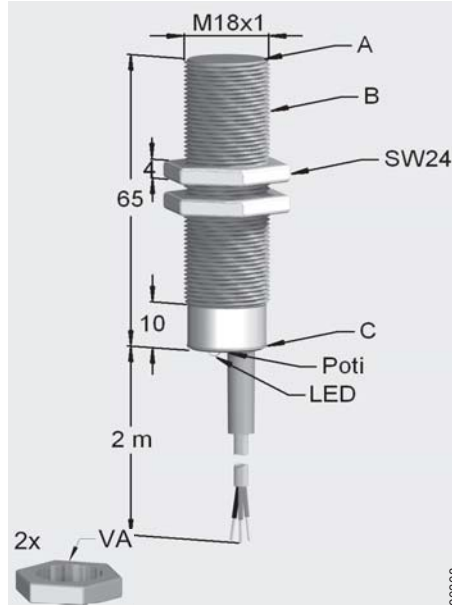
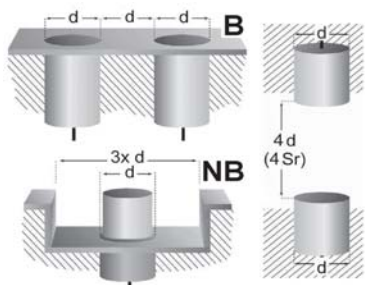
2..8



**M18**

**Type code (abstract)**

- SK sensor capacitive, w/o amplifier
- SKF sensor cap., w/o amplifier, flexible
- SK1 sensor capacitive, self-contained
- SV(D) sensor amplifier (dynamic)
- SNG sensor power pack
- HT### high temperature use
- TM pulse modulation technique (High noise immune)
- ## / FS(A) max sensing distance / Fill-level switch (adaptive)
- M30 model and/or dimension
- P output stage PNP, NPN, X (switchable)
- B mounting B=flush NB=non-flush
- S S=N.O. Ö=N.C. X=function switchable
- (C)PTFE Housing material, e.g. PTFE CPTFE=complete PTFE
- 1M2-Y2 cable & connector: Y# = connector 1M2 = 1.2m cable length

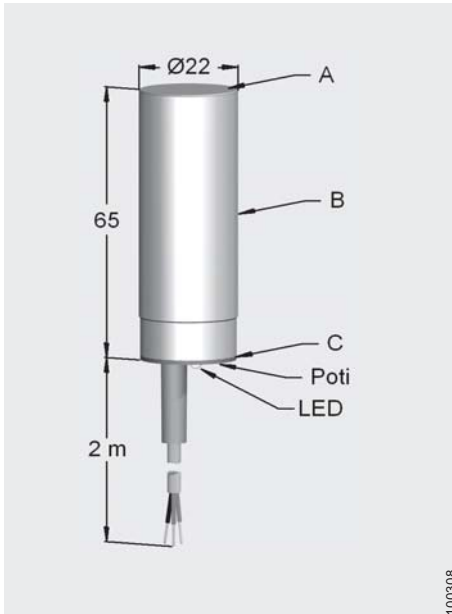


**Typ / Type**  
SK1-8-M18-PBS-VA/PBT  
SK1-8-M18-PBO-VA/PBT  
SK1-8-M18-NBS-VA/PBT  
SK1-8-M18-NBO-VA/PBT

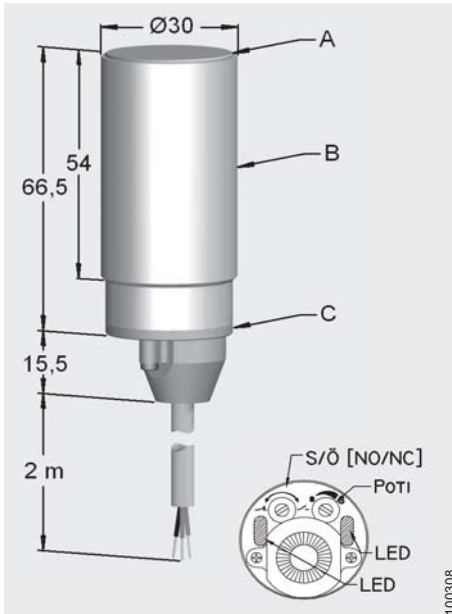
**Typ / Type**  
SK1-8-M18-PBS-VA/PBT-Y2  
SK1-8-M18-PBO-VA/PBT-Y2  
SK1-8-M18-NBS-VA/PBT-Y2  
SK1-8-M18-NBO-VA/PBT-Y2

Mounting [flush / nonflush]	[ B / NB ]	B	B
Operating distance	Sn [mm]	2.. 8	2.. 8
Hysteresis	H [%SR]	15	15
Frequency of operating cycles	f [Hz]	100	100
Repeat accuracy	R [%SR]	2	2
Operating temperature range	Ta [C°]	-30... 70	-30... 70
Temperature drift [range]	[%SR]	15 [ -5... 55]	15 [ -5... 55]
Protection class		IP 67	IP 67
Rated insulation voltage	Ui [V]	75 d. c.	75 d. c.
Material of housing		A: PBT; B: VA; C:PBT	A: PBT; B: VA; C: PA
Utilisation category		DC13	DC13
Connection		2m / 3x 0,25mm <sup>2</sup> PVC	Z20; Z21
Supply voltage range UB	Ub [V]	10... 35	10... 35
No-load supply current	Iomax. [mA]	10	10
Minimum operational current	I <sub>m</sub> [mA]		
Operational current	I <sub>e</sub> [mA]	300	300
Off-state current	I <sub>r</sub> [mA]		
Voltage drop	U <sub>d</sub> @ I <sub>e</sub> [V]	1,5	1,5
Time delay before availability	t <sub>v</sub> [ms]		
Indicator [UB / Output]		- / •	- / •
Short circuit- overload-protection		• / •	• / •
Reverse polarity protection		•	•
Conformity	EMC EEC-direct.	IEC 60947-5-2 : 2004	IEC 60947-5-2 : 2004
EMC		IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.5-0.8 Mhz.	IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.75-2.5 Mhz.
Associated equipment		SNG-###AC...	SNG-###AC...
Additional functionality			
Application			

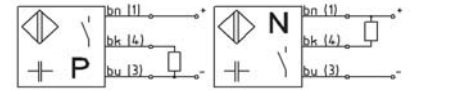
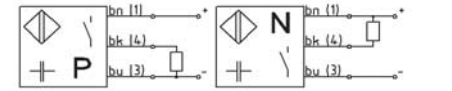
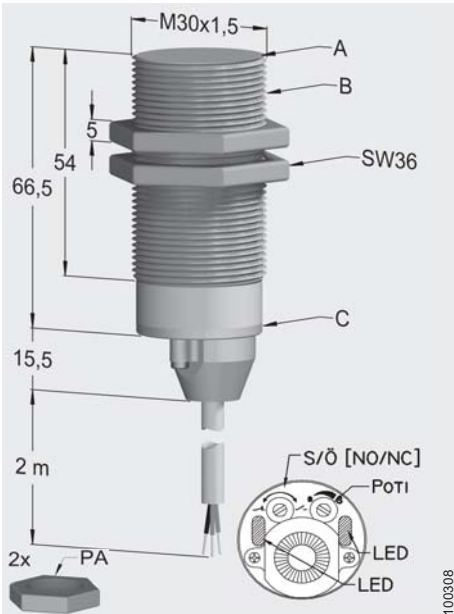
2..10  **22Ø**



2..20  **30Ø**



1..20  **M30**



**Typ / Type**  
 SK1-10-22-PBS-VA/PVC  
 SK1-10-22-PBO-VA/PVC  
 SK1-10-22-NBS-VA/PVC  
 SK1-10-22-NBO-VA/PVC

**Typ / Type**  
 SK1-20-30-PBX-VA/PBT  
 SK1-20-30-NBX-VA/PBT

**Typ / Type**  
 SK1-20-M30-PBX-PBT  
 SK1-20-M30-NBX-PBT

B
2... 10
15
100
2
-30... 60
20 [-5... 55]
IP 67
75 d. c.
A: PVC; B: VA; C: PVC
DC13
2m / 3x 0,25mm <sup>2</sup> PVC
10... 35
10
300
1,5
- / •
• / •
•

B
2... 20
15
100
5
-30... 70
20 [-5... 55]
A, B: IP 66 / IP 68; C: IP 64
75 d. c.
A: PBT; B: VA; C: PBT/PE
DC13
2m / 3x 0,34mm <sup>2</sup> PUR
10... 35
<15
300
1,8
• / •
• / •
•

B
1... 20
15
100
5
-30... 70
20 [-5... 55]
A, B: IP 66 / IP 68; C: IP 64
75 d. c.
A: PBT; B: PBT; C: PBT/PE
DC13
2m / 3x 0,34mm <sup>2</sup> PUR
10... 35
<15
300
1,8
• / •
• / •
•

IEC 60947-5-2 : 2004



IEC 60947-5-2 : 2004



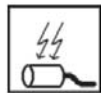
IEC 60947-5-2 : 2004



IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.5-0.8 Mhz. SNG-###AC...

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.15-2.5 Mhz. SNG-###AC...

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.15-2.5 Mhz. SNG-###AC...





**Type code (abstract)**

SK sensor capacitive, w/o amplifier  
 SKF sensor cap., w/o amplifier, flexible  
 SK1 sensor capacitive, self-contained  
 SV(D) sensor amplifier (dynamic)  
 SNG sensor power pack

HT### high temperature use  
 TM pulse modulation technique (High noise immune)

## / FS(A) max sensing distance / Fill-level switch (adaptive)

M30 model and/or dimension

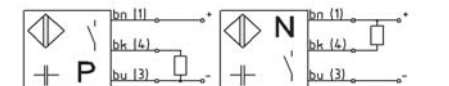
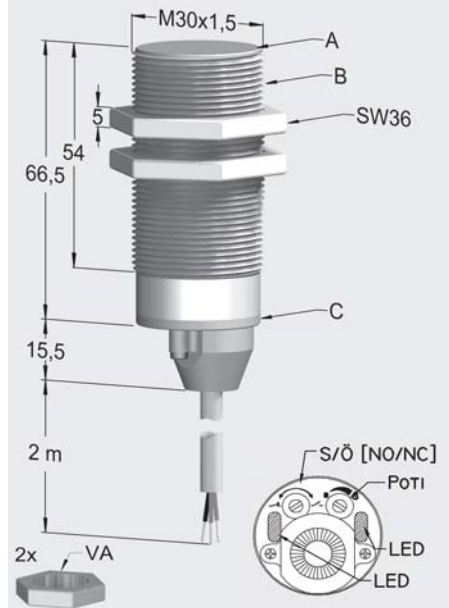
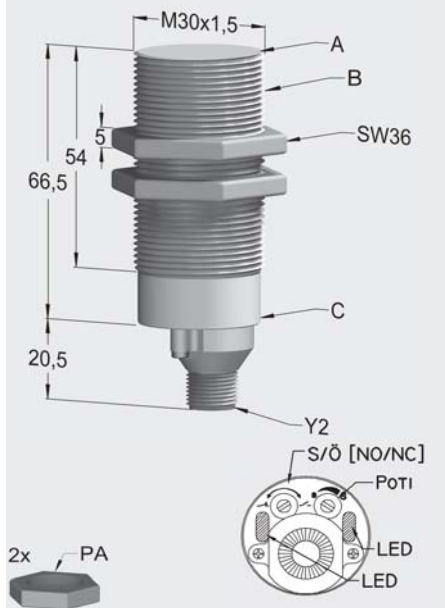
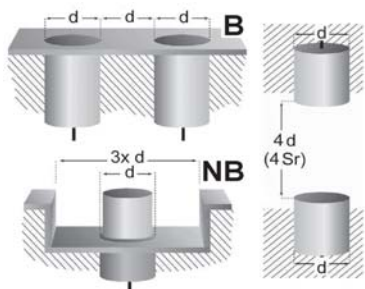
P output stage PNP, NPN, X (switchable)

B mounting B=flush NB=non-flush

S S=N.O. Ö=N.C. X=function switchable

(C)PTFE Housing material, e.g. PTFE CPTFE=complete PTFE

1M2-Y2 cable & connector: Y# = connector 1M2 = 1.2m cable length



**Typ / Type**  
 SK1-20-M30-PBX-PBT-Y2  
 SK1-20-M30-NBX-PBT-Y2

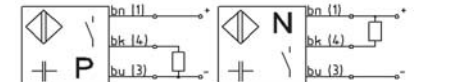
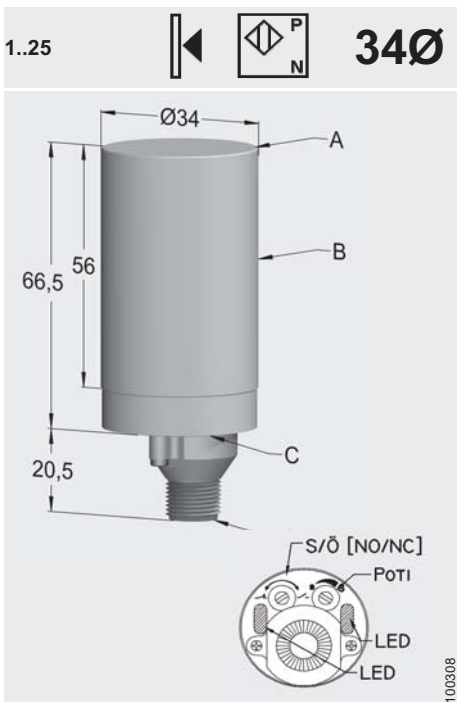
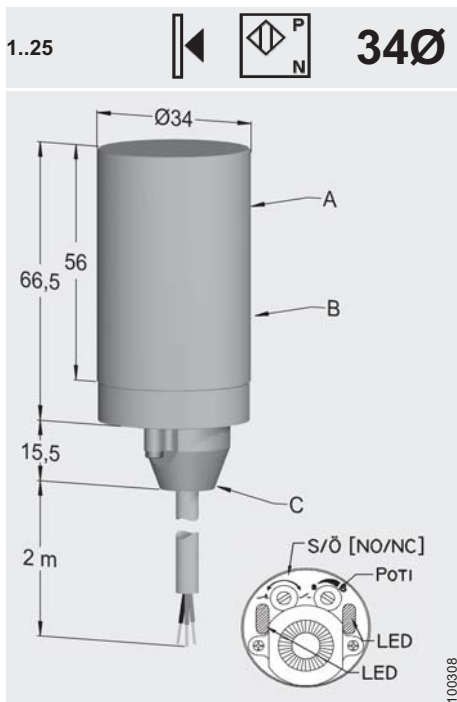
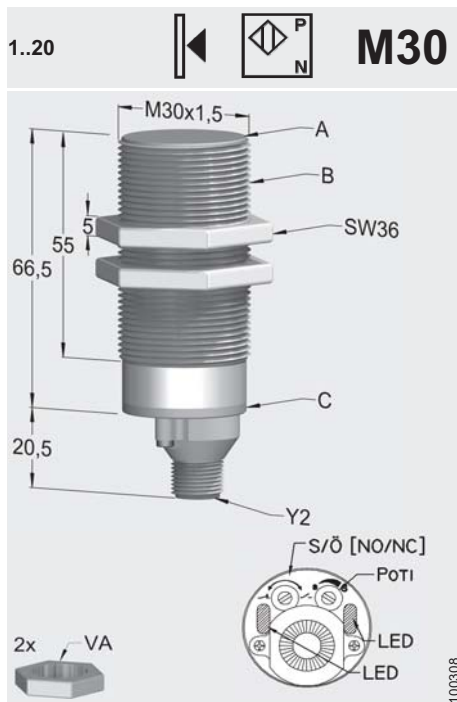
**Typ / Type**  
 SK1-20-M30-PBX-VA/PBT  
 SK1-20-M30-NBX-VA/PBT

Mounting [flush / nonflush]	[ B / NB ]	B	B
Operating distance Sn	[mm]	1... 20	1... 20
Hysteresis H	[%SR]	15	15
Frequency of operating cycles f	[Hz]	100	100
Repeat accuracy R	[%SR]	5	5
Operating temperature range Ta	[C°]	-30... 70	-30... 70
Temperature drift [range]	[%SR]	20 [-5... 55]	20 [-5... 55]
Protection class		A, B: IP 66 / IP 68; C: IP 64	A, B: IP 66 / IP 67; C: IP 64
Rated insulation voltage Ui	[V]	75 d. c.	75 d. c.
Material of housing		A: PBT; B: PBT; C: PBT/PE	A: PBT; B: VA; C: PBT/PE
Utilisation category		DC13	DC13
Connection		Z20; Z21	2m / 3x 0,34mm <sup>2</sup> PUR
Supply voltage range UB	[V]	10... 35	10... 35
No-load supply current Iomax.	[mA]	<15	<15
Minimum operational current Im	[mA]		
Operational current Ie	[mA]	300	300
Off-state current Ir	[mA]		
Voltage drop Ud @ Ie	[V]	1,8	1,8
Time delay before availability tv	[ms]		
Indicator [UB / Output]		• / •	• / •
Short circuit- overload-protection		• / •	• / •
Reverse polarity protection		•	•
Conformity EMC EEC-direct.		IEC 60947-5-2 : 2004	IEC 60947-5-2 : 2004
EMC		IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.15-2.5 Mhz. SNG-###AC...	IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.15-2.5 Mhz. SNG-###AC...
Associated equipment			
Additional functionality		S / Ö NO / NC	S / Ö NO / NC

Application







**Typ / Type**  
 SK1-20-M30-PBX-VA/PBT-Y2  
 SK1-20-M30-NBX-VA/PBT-Y2

**Typ / Type**  
 SK1-25-34-PBX-PVC  
 SK1-25-34-NBX-PVC

**Typ / Type**  
 SK1-25-34-PBX-PVC-Y2  
 SK1-25-34-NBX-PVC-Y2

B
1... 20
15
100
5
-30... 70
20 [-5... 55]
A, B: IP 66 / IP 67; C: IP 64
75 d. c.
A: PBT; B: VA; C: PBT/PE
DC13
Z20; Z21
10... 35
<15
300
1,8
•/•
•/•
•

B
1... 25
15
100
5
-30... 60
20 [-5... 55]
A, B: IP 66 / IP 68; C: IP 64
75 d. c.
A: PVC; B: PVC; C: PBT/PE
DC13
2m / 3x 0,34mm <sup>2</sup> PUR
10... 35
<15
300
1,8
•/•
•/•
•

B
1... 25
15
100
5
-30... 60
20 [-5... 55]
A, B: IP 66 / IP 68; C: IP 64
75 d. c.
A: PVC; B: PVC; C: PBT/PE
DC13
Z20; Z21
10... 35
<15
300
1,8
•/•
•/•
•

IEC 60947-5-2 : 2004

IEC 60947-5-2 : 2004

IEC 60947-5-2 : 2004

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.15-2.5 Mhz. SNG-###AC...

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.15-2.4 Mhz. SNG-###AC...

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.15-2.5 Mhz. SNG-###AC...

S / Ö NO / NC

S / Ö NO / NC

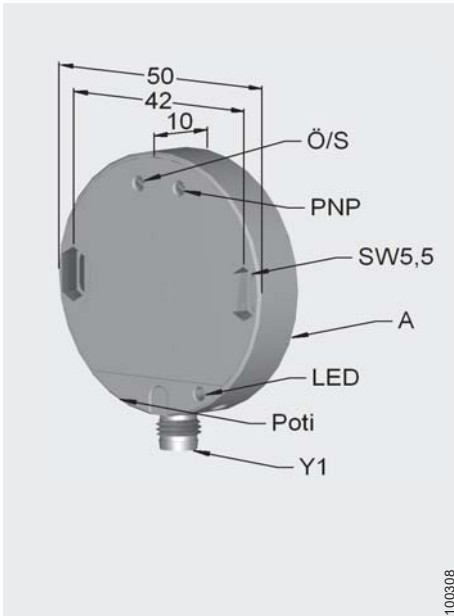
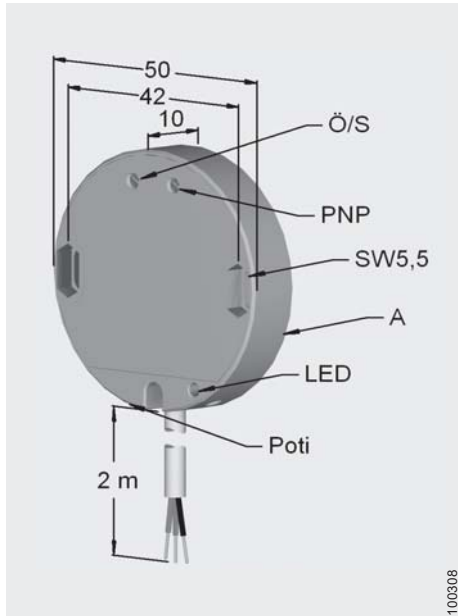
S / Ö NO / NC



<b>BALLUFF</b> SIESENSORIK		6 ±10%		<b>22Ø/4</b>	2..15		<b>30Ø/4</b>
<b>Type code (abstract)</b> SK sensor capacitive, w/o amplifier SKF sensor cap., w/o amplifier, flexible SK1 sensor capacitive, self-contained SV(D) sensor amplifier (dynamic) SNG sensor power pack HT### high temperature use TM pulse modulation technique (High noise immune) ## / FS(A) max sensing distance / Fill-level switch (adaptive) M30 model and/or dimension P output stage PNP, NPN, X (switchable) B mounting B=flush NB=non-flush S S=N.O. Ö=N.C. X=function switchable (C)PTFE Housing material, e.g. PTFE CPTFE=complete PTFE 1M2-Y2 cable & connector: Y# = connector 1M2 = 1.2m cable length							
		<b>Typ / Type</b> SK1-6F-22/4-PBS-VA/PTFE SK1-6F-22/4-NBS-VA/PTFE			<b>Typ / Type</b> SK1-15-30/4-PBS-VA/PTFE SK1-15-30/4-PBO-VA/PTFE SK1-15-30/4-NBS-VA/PTFE SK1-15-30/4-NBO-VA/PTFE		
Mounting [flush / nonflush] [ B / NB ]		B			B		
Operating distance Sn [mm]		6... ±10%			2... 15		
Hysteresis H [%SR]		15			15		
Frequency of operating cycles f [Hz]		100			100		
Repeat accuracy R [%SR]		2			2		
Operating temperature range Ta [C°]		-30... 70			-30... 70		
Temperature drift [range] [%SR]		10 [ -5... 55]			10 [ -5... 55]		
Protection class		IP 67			IP 67		
Rated insulation voltage Ui [V]		75 d. c.			75 d. c.		
Material of housing		A: PTFE; B: V2A			A:PTFE; B: V2A		
Utilisation category		DC13			DC13		
Connection		2m / 3x 0,14 mm <sup>2</sup> PUR			2m / 3x 0,14 mm <sup>2</sup> PUR		
Supply voltage range UB Ub [V]		12... 30			10... 35		
No-load supply current Iomax. [mA]		< 10			< 10		
Minimum operational current Im [mA]							
Operational current Ie [mA]		300			300		
Off-state current Ir [mA]							
Voltage drop Ud @ Ie [V]		0,8			0,8		
Time delay before availability tv [ms]							
Indicator [UB / Output]		- / -			- / •		
Short circuit- overload-protection		• / •			• / •		
Reverse polarity protection		•			•		
Conformity EMC EEC-direct.		IEC 60947-5-2 : 2004			IEC 60947-5-2 : 2004		
EMC		IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.15-0.6 Mhz. SNG-###AC...			IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.15-1.7 Mhz. SNG-###AC...		
Associated equipment							
Additional functionality							
Application							

2...25		<b>50Ø/10</b>	2...25		<b>50Ø/10</b>
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application notes



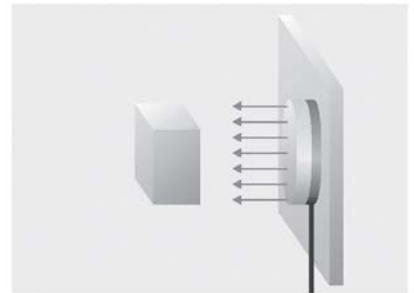
**Range of use**

As a distance sensor with an adjustable sensing distance of up to 25 mm, the compact-size disk sensor, 50 mm diameter, is suitable for scanning plastics, glass, ceramics, wood, etc. This sensor's large active surface also enables it to be used as a fill level indicator, since it can detect liquids and granules through plastic or glass walls.

**Applications**

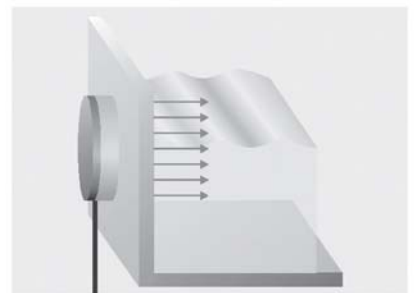
**1. Object detection**

Detecting plastics, glass, ceramics, wood and all metals, etc.



**2. Fill level monitoring**

Level control of liquids and granules like water, blood, cereals, coffee beans, etc.



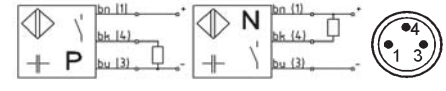
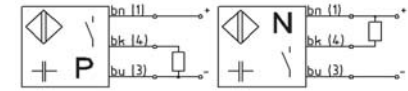
Glass- or plastic wall max. 4 mm, depending on the material of the container wall.

**Adjustment**

The sensor is adjusted using a flushmounted Potentiometer, adjustment instructions for flush sensor versions see on page 1.09.

**Signal evaluation**

The SNG series (page 12.01-12.03) of sensor devices is available for signal evaluation. Depending on the application involved, you can choose between a power supply, a power supply with timer function, or a MinMax control unit. The sensor can also be run from a PLC.



Typ / Type  
SK1-25-50/10-XBX-POM

Typ / Type  
SK1-25-50/10-XBX-POM-Y1

B	B
2... 25	2... 25
20	20
50	50
2	2
-30... 60	-30... 60
20 [-5... 55]	20 [-5... 55]
IP 67	IP 65
75 d. c.	75 d. c.
POM	POM
DC13	DC13
2m / 3x 0,25mm <sup>2</sup> PVC	Z10; Z11
10... 30	10... 30
< 15	< 15
150	150
2	1,5
- / •	- / •
• / •	• / •
•	•

IEC 60947-5-2 : 2004

IEC 60947-5-2 : 2004

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.55-1.6 Mhz. SNG-###AC...

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.55-1.6 Mhz. SNG-###AC...

PNP / NPN  
S / Ö NO / NC

PNP / NPN  
S / Ö NO / NC

# BALLUFF

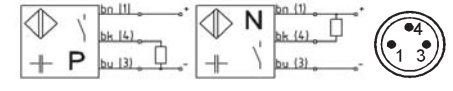
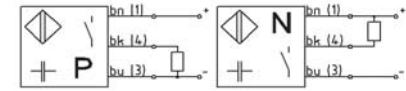
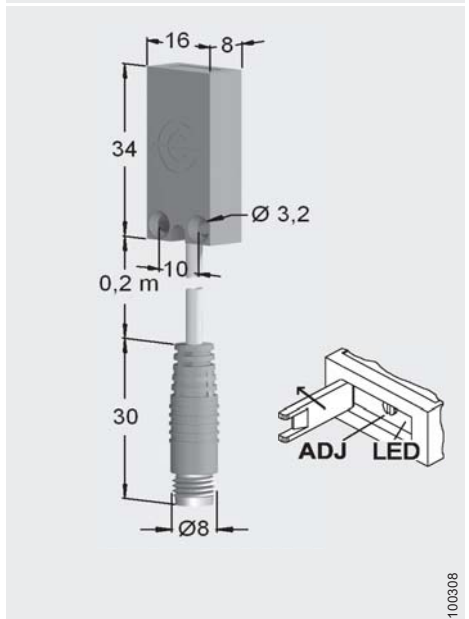
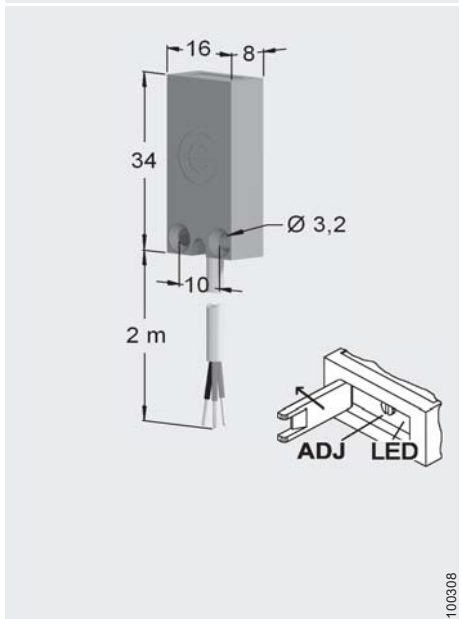
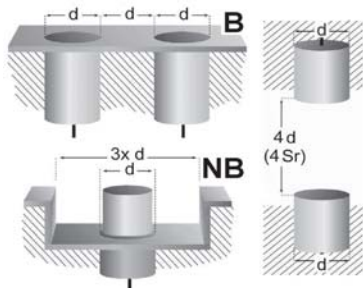
SIESENSORIK

1...8 mm   microBOX

1...8 mm   microBOX




**Type code (abstract)**

- SK sensor capacitive, w/o amplifier
- SKF sensor cap., w/o amplifier, flexible
- SK1 sensor capacitive, self-contained
- SV(D) sensor amplifier (dynamic)
- SNG sensor power pack
- HT### high temperature use
- TM pulse modulation technique (High noise immune)
- ## / FS(A) max sensing distance / Fill-level switch (adaptive)
- M30 model and/or dimension
- P output stage PNP, NPN, X (switchable)
- B mounting B=flush NB=non-flush
- S S=N.O. Ö=N.C. X=function switchable
- (C)PTFE Housing material, e.g. PTFE CPTFE=complete PTFE
- 1M2-Y2 cable & connector: Y# = connector 1M2 = 1.2m cable length



**Typ / Type**  
 SK1-8-34/16/8-PBS-PP  
 SK1-8-34/16/8-PBO-PP  
 SK1-8-34/16/8-NBS-PP  
 SK1-8-34/16/8-NBO-PP

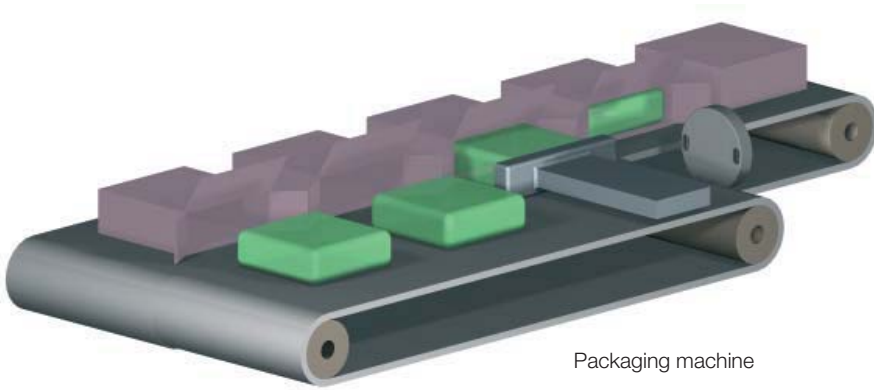
**Typ / Type**  
 SK1-8-34/16/8-PBS-PP-M2/Y1  
 SK1-8-34/16/8-PBO-PP-M2/Y1  
 SK1-8-34/16/8-NBS-PP-M2/Y1  
 SK1-8-34/16/8-NBO-PP-M2/Y1

Mounting [flush / nonflush]	[ B / NB ]	B	B
Operating distance Sn	[mm]	1...8	1...8
Hysteresis H	[%SR]	15	15
Frequency of operating cycles f	[Hz]	100	100
Repeat accuracy R	[%SR]	5	5
Operating temperature range Ta	[C°]	-30... 70	-30... 70
Temperature drift [range]	[%SR]	20 [-5... 55]	20 [-5... 55]
Protection class		IP 67	IP 67
Rated insulation voltage Ui	[V]	75 d. c.	75 d. c.
Material of housing		PP	PP
Utilisation category		DC13	DC13
Connection		2m / 3x 0,14 mm <sup>2</sup> PUR	0,2m / 3x 0,14mm <sup>2</sup> PUR; Z10; Z11 
Supply voltage range UB	Ub [V]	12... 30	12... 30
No-load supply current Iomax.	[mA]	< 10	< 10
Minimum operational current Im	[mA]	-	-
Operational current Ie	[mA]	50	50
Off-state current Ir	[mA]		O.C.
Voltage drop Ud @ Ie	[V]	1,5	1,5
Time delay before availability tv	[ms]	< 100	< 100
Indicator [UB / Output]		- / •	- / •
Short circuit- overload-protection		• / •	• / •
Reverse polarity protection		•	•
Conformity EMC EEC-direct.		IEC 60947-5-2 : 2004 	IEC 60947-5-2 : 2004 
EMC		IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.25-3 Mhz. SNG-###AC...	IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.25-3 Mhz. SNG-###AC...
Associated equipment			
Additional functionality			

**Application**



## Applications



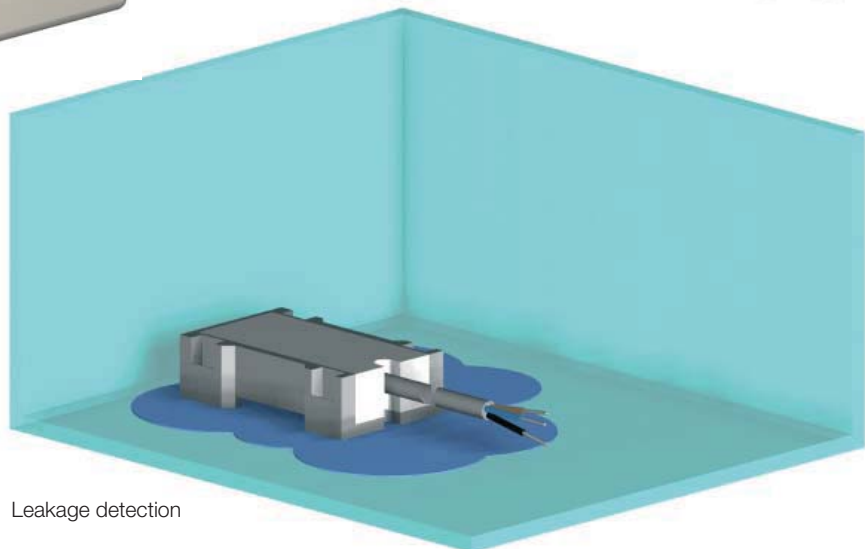
Packaging machine



Sensing small metal or plastic parts in a tube type feeder



Bulk material sensing through



Leakage detection

# BALLUFF

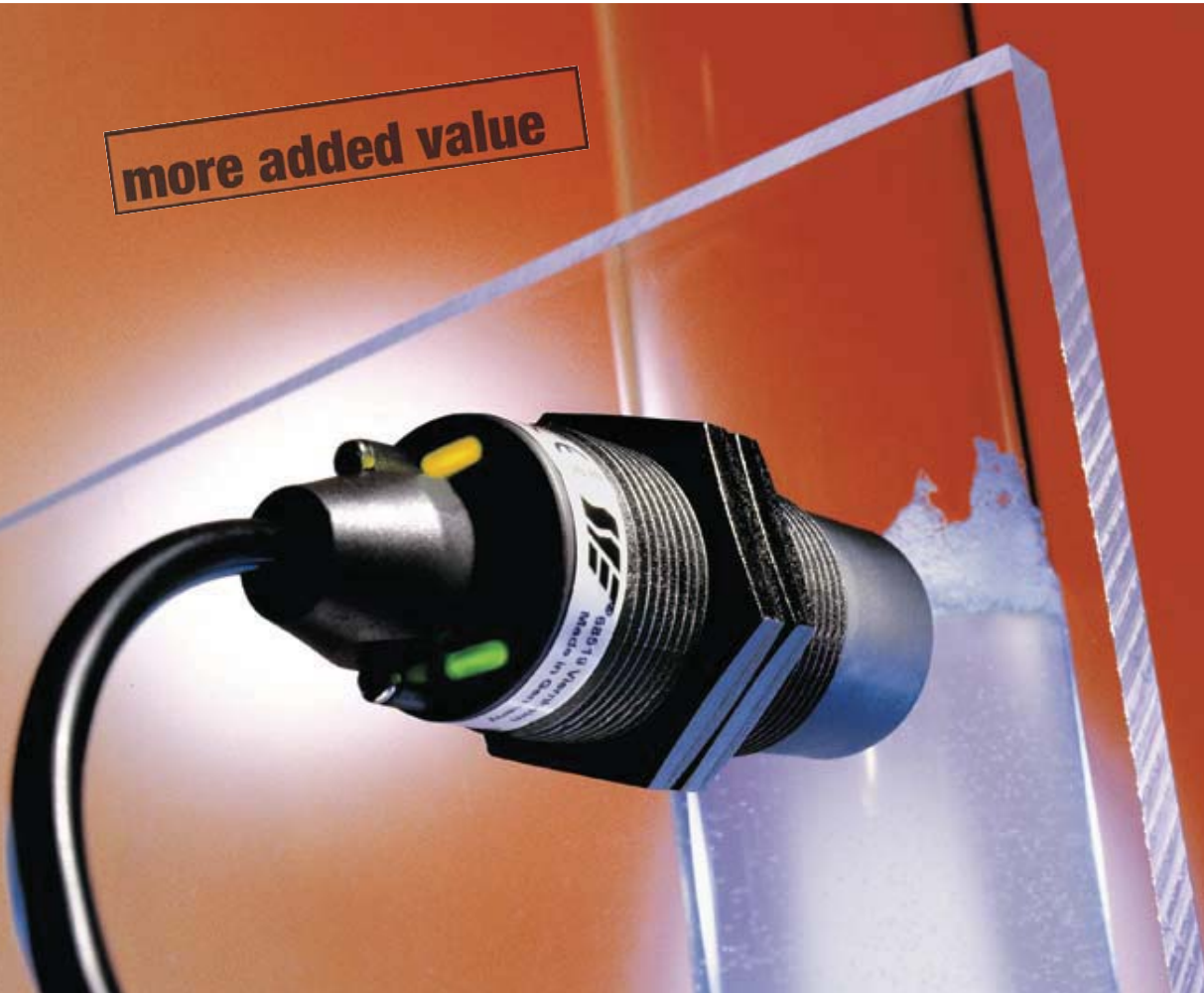
SIESENSORIK

## Capacitive Sensors

... new possibilities in object detection and level sensing



more added value



# 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

## Table of Contents

## Page

Capacitive sensors –  
general description

1.02 –  
1.10

Mini-sensors

3.01 –  
3.09

Sensor amplifiers

4.01 –  
4.05

Sensors for  
object detection

6.01 –  
6.15

Sensors for  
level sensing

7.01 –  
7.12

Sensors for level sensing,  
smartLEVEL-Technology

7.13 –  
7.22

microLEVEL

7.15 –  
7.17

microBOX

7.21

Analog sensor

8.01 –  
8.04

Sensors for the high  
temperature range

9.01 –  
9.03

Sensor power packs

12.01 –  
12.03

Accessories

13.01 –  
13.05

## Sensors for level sensing

### Series SK1 0700/0750

- Model with output stage from Ø-M12
- Sensing distance adjustable
- Non-flush mountable
- Connecting lead, plug connector, terminal connection
- Housing plastic, metal, PTFE



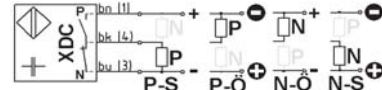
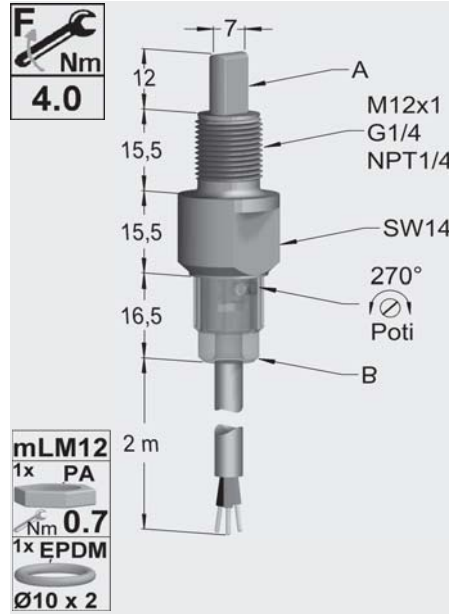
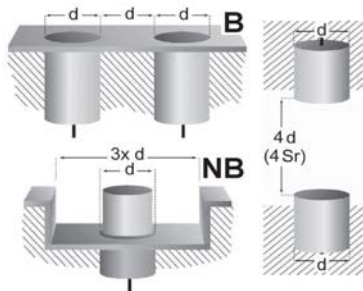


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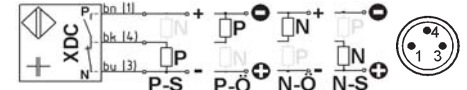
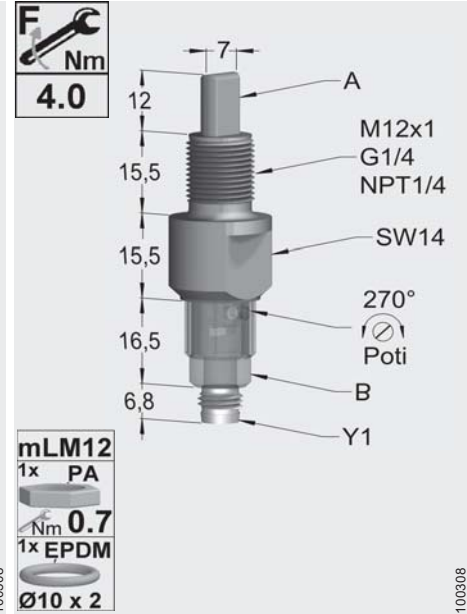
SIESENSORIK

Type code (abstract)

- SK sensor capacitive, w/o amplifier
- SKF sensor cap., w/o amplifier, flexible
- SK1 sensor capacitive, self-contained
- SV(D) sensor amplifier (dynamic)
- SNG sensor power pack
- HT### high temperature use
- TM pulse modulation technique (High noise immune)
- ## / FS(A) max sensing distance / Fill-level switch (adaptive)
- M30 model and/or dimension
- P output stage PNP, NPN, X (switchable)
- B mounting B=flush NB=non-flush
- S S=N.O. Ö=N.C. X=function switchable
- (C)PTFE Housing material, e.g. PTFE CPTFE=complete PTFE
- 1M2-Y2 cable & connector: Y# = connector 1M2 = 1.2m cable length



Typ / Type  
 SK1-FS-MLM12-XDC-PSU  
 SK1-FS-MLG1/4-XDC-PSU  
 SK1-FS-MLNPT1/4-XDC-PSU



Typ / Type  
 SK1-FS-MLM12-XDC-PSU-Y1  
 SK1-FS-MLG1/4-XDC-PSU-Y1  
 SK1-FS-MLNPT1/4-XDC-PSU-Y1

Mounting [flush / nonflush]	[ B / NB ]	NB	NB
Operating distance	Sn [mm]	FS	FS
Hysteresis	H [%SR]		
Frequency of operating cycles	f [Hz]	5	5
Repeat accuracy	R [%SR]		
Operating temperature range	Ta [C°]	-10... 70	-10... 70
Temperature drift [range]	[%SR]		
Protection class		A : IP 68 / 10bar; B : IP 69K	A : IP 68 / 10bar; B : IP 69K
Rated insulation voltage	Ui [V]	75 d. c.	75 d. c.
Material of housing		PSU	PSU
Utilisation category		DC13	DC13
Connection		2m / 3x 0,34mm <sup>2</sup> PUR	Z10; Z11
Supply voltage range UB	Ub [V]	10... 35	10... 35
No-load supply current	Iomax. [mA]	20	20
Minimum operational current	Imin [mA]	-	-
Operational current	Ie [mA]	50 / 50 XDC	50 / 50 XDC
Off-state current	Ir [mA]	-	-
Voltage drop	Ud @ Ie [V]	3	3
Time delay before availability	tv [ms]	< 300	< 300
Indicator [UB / Output]		•/•	•/•
Short circuit- overload-protection		•/•	•/•
Reverse polarity protection		!	!
Conformity	EMC EEC-direct.	IEC 60947-5-2 : 2004	IEC 60947-5-2 : 2004
EMC		IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.5-0.8 Mhz.	IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.5-0.8 Mhz.
Associated equipment			
Additional functionality			
Application			

**microLEVEL**

**F** Nm **4.0**

Dimensions: 7, 12, 15,5, 15,5, 16,5, 6,8

Labels: A, SW14, M12x1, G1/4, NPT1/4, 270°, Poti, B, Y1

**mLM12**  
1x PA  
Nm **0.7**  
1x EPDM  
Ø10 x 2

100308

**Typ / Type**  
 SK1-FS-MLRM12-XDC-PSU-Y1  
 SK1-FS-MLRG1/4-XDC-PSU-Y1  
 SK1-FS-MLRNPT1/4-XDC-PSU-Y1

NB
FS
5
-10... 70
A : IP 68 / 10bar; B : IP 64
75 d. c.
PSU
DC13
Z10; Z11
10... 35
20
-
50 / 50 XDC
-
3
< 300
•/•
•/•
!

IEC 60947-5-2 : 2004

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.5-0.8 Mhz.

**application notes**

**Standard Level Sensors**  
 can detect solids like sand, granules and pellets as well as all nonconductive liquids.

**Mounting**  
**Standard through hole mounting** can be done using the enclosed nut. It is not required but recommended while mounted in a female thread. Sealing can be done using an O-ring or flat type gasket. We recommend to close the pot access hole by the use of the circular clip.

100308

A liquid limit switch of any length can be realized by the use of a **reverse mount sensor**. Sealing can be done using an O-ring or flat type gasket.

**microLEVEL** with protective mounting well available in thread size M18 or G 1/2" (see catalog section 13). Probe end fully surrounded by protective cover.

**1..8** **M12**

Dimensions: 10, 4, 50, 2 m

Labels: M12x1, A, B, Sw17, C, Poti, LED

2x PA

100308

**Typ / Type**  
 SK1-8-M12-PNBS-PVC  
 SK1-8-M12-PNBO-PVC  
 SK1-8-M12-NNBS-PVC  
 SK1-8-M12-NNBO-PVC

NB
1... 8
15
100
2
-30... 60
15 [ -5... 55]
IP 65
75 d. c.
A. PVC; B: PVC; C: PVC
DC13
2m / 3x 0,14mm <sup>2</sup> PUR
12... 35
10
-
200
0,8
- / •
• / •
•

IEC 60947-5-2 : 2000

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.45-2,9 Mhz. SNG-###AC...

1..6



**M12**

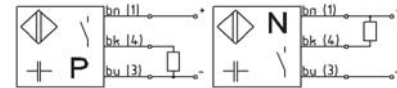
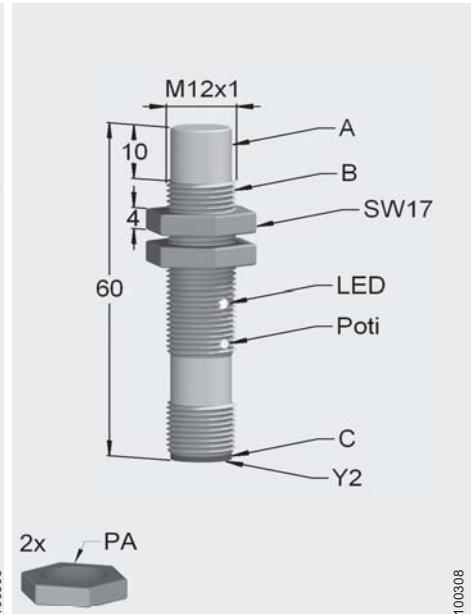
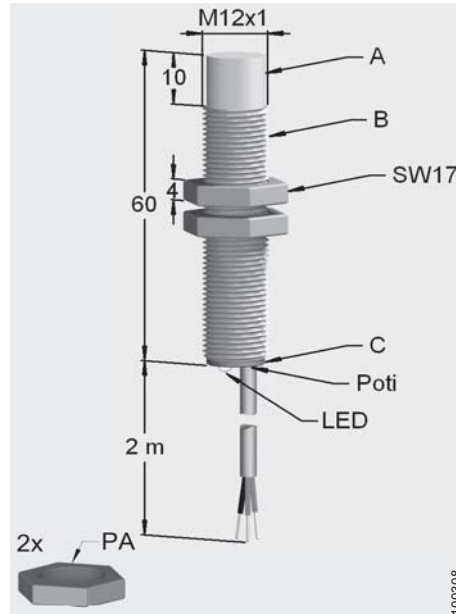
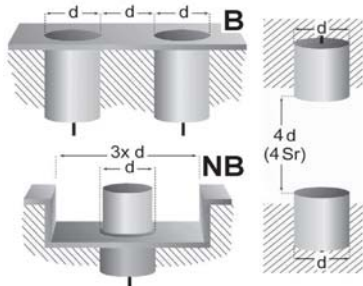
1..8



**M12**

**Type code (abstract)**

- SK sensor capacitive, w/o amplifier
- SKF sensor cap., w/o amplifier, flexible
- SK1 sensor capacitive, self-contained
- SV(D) sensor amplifier (dynamic)
- SNG sensor power pack
- HT### high temperature use
- TM pulse modulation technique (High noise immune)
- ## / FS(A) max sensing distance / Fill-level switch (adaptive)
- M30 model and/or dimension
- P output stage PNP, NPN, X (switchable)
- B mounting B=flush NB=non-flush
- S S=N.O. Ö=N.C. X=function switchable
- (C)PTFE Housing material, e.g. PTFE CPTFE=complete PTFE
- 1M2-Y2 cable & connector: Y# = connector 1M2 = 1.2m cable length



**Typ / Type**  
SK1-TM-6-M12/60-PNBS-PVC  
SK1-TM-6-M12/60-PNBO-PVC  
SK1-TM-6-M12/60-NNBS-PVC  
SK1-TM-6-M12/60-NNBO-PVC

**Typ / Type**  
SK1-8-M12-PNBS-PVC-Y2  
SK1-8-M12-PNBO-PVC-Y2  
SK1-8-M12-NNBS-PVC-Y2  
SK1-8-M12-NNBO-PVC-Y2

Mounting [flush / nonflush]		[ B / NB ]	NB	NB
Operating distance	Sn	[mm]	1... 6	1... 8
Hysteresis	H	[%SR]	15	15
Frequency of operating cycles	f	[Hz]	25	100
Repeat accuracy	R	[%SR]	2	2
Operating temperature range	Ta	[C°]	-30... 60	-30... 60
Temperature drift [range]		[%SR]	15 [-5... 55]	15 [-5... 55]
Protection class			IP 65	IP 65
Rated insulation voltage	Ui	[V]	75 d. c.	75 d. c.
Material of housing			A: PVC; B: PVC; C: PVC	A: PVC; B: PVC; C: PA
Utilisation category			DC13	DC13
Connection			2m / 3x 0,14mm <sup>2</sup> PUR	Z20; Z21
Supply voltage range UB	Ub	[V]	13... 35	12... 35
No-load supply current	Iomax.	[mA]	15	10
Minimum operational current	I <sub>m</sub>	[mA]		
Operational current	I <sub>e</sub>	[mA]	200	200
Off-state current	I <sub>r</sub>	[mA]		
Voltage drop	U <sub>d</sub> @ I <sub>e</sub>	[V]	0,8	0,8
Time delay before availability	t <sub>v</sub>	[ms]		
Indicator [UB / Output]			- / •	- / •
Short circuit- overload-protection			• / •	• / •
Reverse polarity protection			•	•
Conformity	EMC EEC-direct.		IEC 60947-5-2 : 2004	IEC 60947-5-2 : 2004

EMC

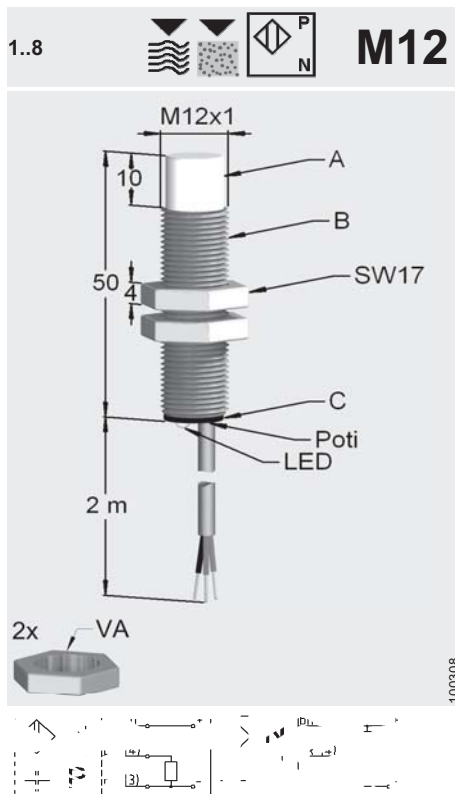
IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.25-1,8 Mhz. SNG-###AC...

Associated equipment  
Additional functionality

SNG-###AC...

Application





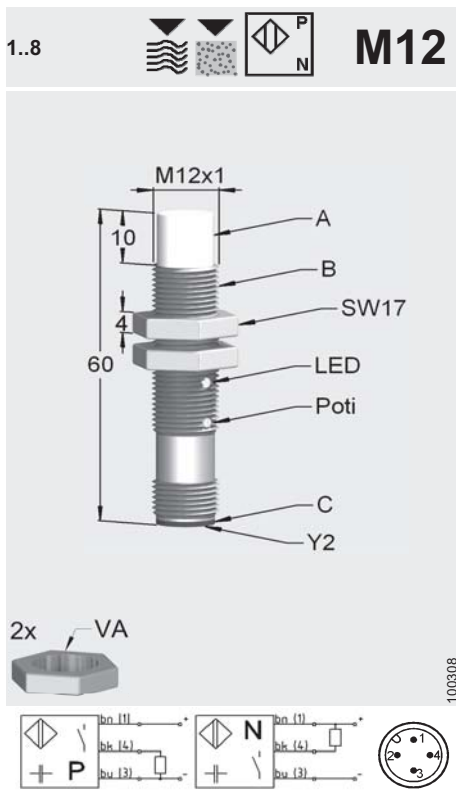
**Typ / Type**  
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 SK1-8-M12-PNBO-VA/PTFE  
 SK1-8-M12-NNBS-VA/PTFE  
 SK1-8-M12-NNBO-VA/PTFE

NB
1... 8
15
100
2
-30... 70
15 [ -5... 55]
IP 65
75 d. c.
A: PTFE; B: VA; C: POM
DC13
2m / 3x 0,14mm <sup>2</sup> PUR
12... 35
10
200
0,8
- / •
• / •
•

IEC 60947-5-2 : 2004



IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.6-2 Mhz. SNG-###AC...



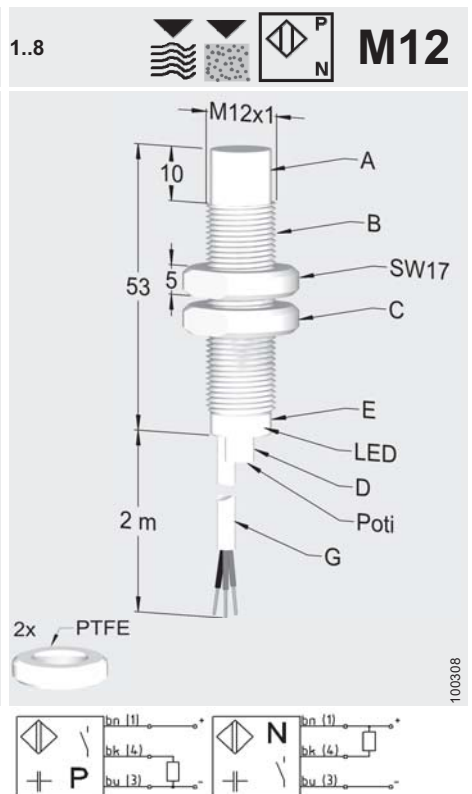
**Typ / Type**  
 SK1-8-M12-PNBS-VA/PTFE-Y2  
 SK1-8-M12-PNBO-VA/PTFE-Y2  
 SK1-8-M12-NNBS-VA/PTFE-Y2  
 SK1-8-M12-NNBO-VA/PTFE-Y2

NB
1... 8
15
100
2
-30... 70
15 [ -5... 55]
IP 65
75 d. c.
A: PTFE; B: VA; C: PA
DC13
Z20; Z21
12... 35
10
200
0,8
- / •
• / •
•

IEC 60947-5-2 : 2004



IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.5-1.7 Mhz. SNG-###AC...



**Typ / Type**  
 SK1-8-M12-PNBS-CPTFE  
 SK1-8-M12-PNBO-CPTFE  
 SK1-8-M12-NNBS-CPTFE  
 SK1-8-M12-NNBO-CPTFE

NB
1... 8
15
100
2
-30... 70
15 [ -5... 55]
IP 65
75 d. c.
A - G: PTFE
DC13
2m / 3x 0,2mm <sup>2</sup> PTFE
12... 35
10
200
0,8
- / •
• / •
•

IEC 60947-5-2 : 2004



IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.2-1.9 Mhz. SNG-###AC...



# BALLUFF

SIESENSORIK

1..6



**M12**

2..15



**M18**

**Type code (abstract)**

SK sensor capacitive, w/o amplifier  
 SKF sensor cap., w/o amplifier, flexible  
 SK1 sensor capacitive, self-contained  
 SV(D) sensor amplifier (dynamic)  
 SNG sensor power pack

HT### high temperature use  
 TM pulse modulation technique (High noise immune)

## / FS(A) max sensing distance / Fill-level switch (adaptive)

M30 model and/or dimension

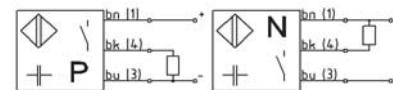
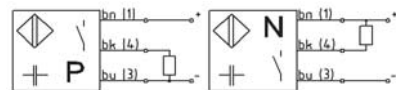
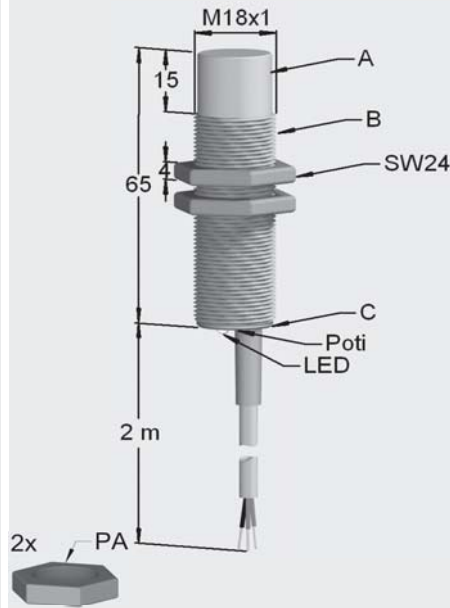
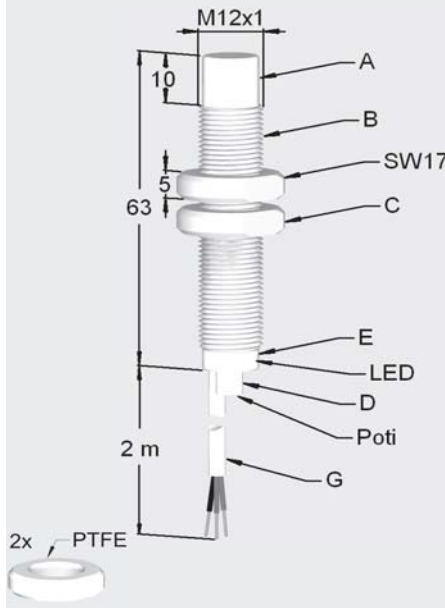
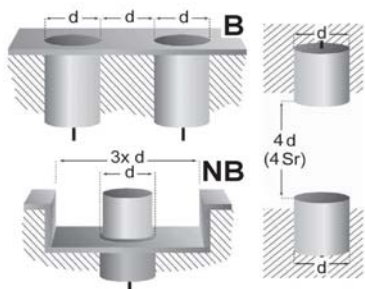
P output stage PNP, NPN, X (switchable)

B mounting B=flush NB=non-flush

S S=N.O. Ö=N.C. X=function switchable

(C)PTFE Housing material, e.g. PTFE CPTFE=complete PTFE

1M2-Y2 cable & connector: Y# = connector 1M2 = 1.2m cable length



**Typ / Type**  
 SK1-TM-6-M12/63-PNBS-CPTFE  
 SK1-TM-6-M12/63-PNBO-CPTFE  
 SK1-TM-6-M12/63-NNBS-CPTFE  
 SK1-TM-6-M12/63-NNBO-CPTFE

**Typ / Type**  
 SK1-15-M18-PNBS-PVC  
 SK1-15-M18-PNBO-PVC  
 SK1-15-M18-NNBS-PVC  
 SK1-15-M18-NNBO-PVC

Mounting [flush / nonflush]	[ B / NB ]		NB
Operating distance	Sn [mm]	1.. 6	2... 15
Hysteresis	H [%SR]	15	15
Frequency of operating cycles	f [Hz]	25	100
Repeat accuracy	R [%SR]	2	2
Operating temperature range	Ta [C°]	-30... 60	-30... 60
Temperature drift [range]	[%SR]	15 [-5... 55]	15 [-5... 55]
Protection class		IP 65	IP 67
Rated insulation voltage	Ui [V]	75 d. c.	75 d. c.
Material of housing		A -G: PTFE	A: PVC; B: PVC; C: PBT
Utilisation category		DC13	DC13
Connection		2m / 3x 0,2mm <sup>2</sup> PTFE	2m / 3x 0,25mm <sup>2</sup> PVC
Supply voltage range UB	Ub [V]	12... 35	10... 35
No-load supply current	Iomax. [mA]	10	10
Minimum operational current	I <sub>m</sub> [mA]		
Operational current	I <sub>e</sub> [mA]	200	300
Off-state current	I <sub>r</sub> [mA]		
Voltage drop	U <sub>d</sub> @ I <sub>e</sub> [V]	0,8	1,5
Time delay before availability	t <sub>v</sub> [ms]		
Indicator [UB / Output]		- / • LED int.	- / •
Short circuit- overload-protection		• / •	• / •
Reverse polarity protection		•	•
Conformity	EMC EEC-direct.	IEC 60947-5-2 : 2004	IEC 60947-5-2 : 2004

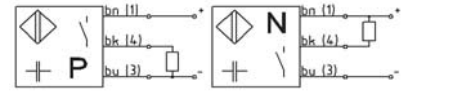
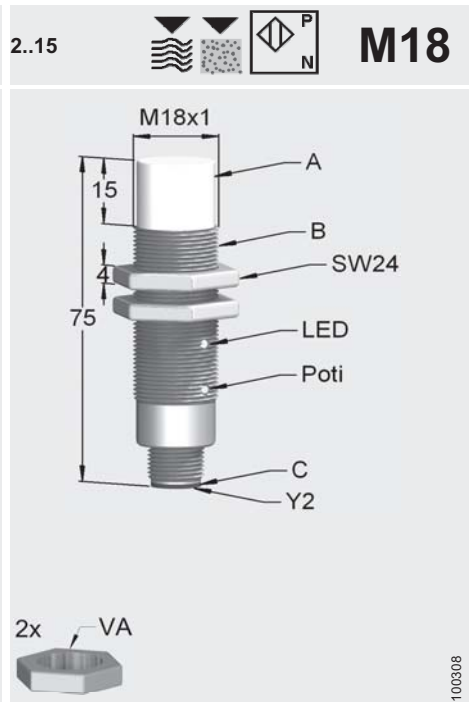
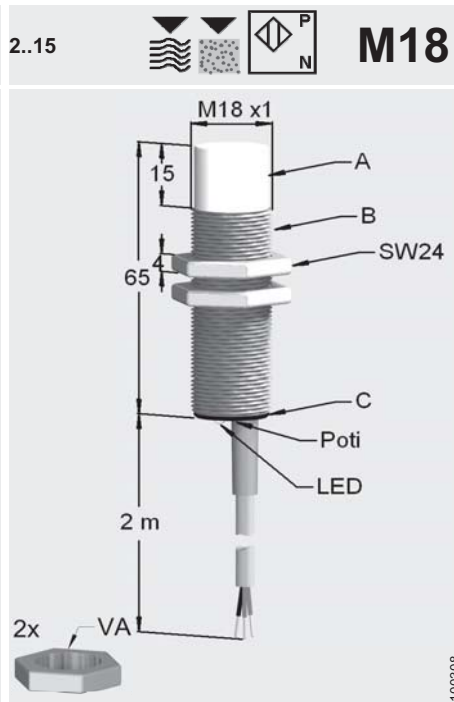
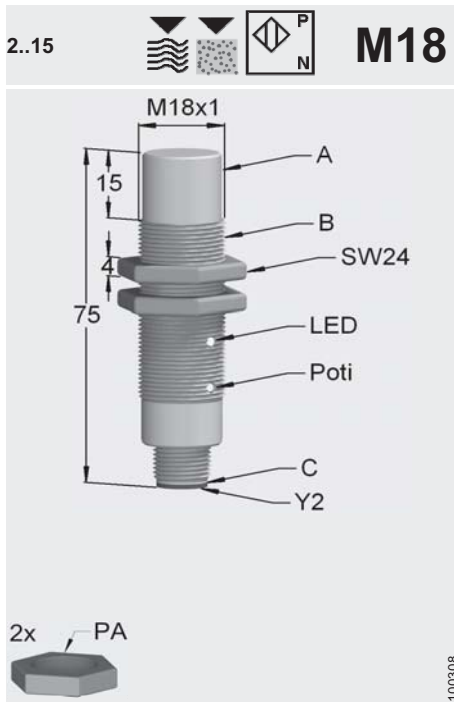
EMC

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.6-5 Mhz.

Associated equipment SNG-###AC...  
 Additional functionality

Application





**Typ / Type**  
 SK1-15-M18-PNBS-PVC-Y2  
 SK1-15-M18-PNBO-PVC-Y2  
 SK1-15-M18-NNBS-PVC-Y2  
 SK1-15-M18-NNBO-PVC-Y2

**Typ / Type**  
 SK1-15-M18-PNBS-VA/PTFE  
 SK1-15-M18-PNBO-VA/PTFE  
 SK1-15-M18-NNBS-VA/PTFE  
 SK1-15-M18-NNBO-VA/PTFE

**Typ / Type**  
 SK1-15-M18-PNBS-VA/PTFE-Y2  
 SK1-15-M18-PNBO-VA/PTFE-Y2  
 SK1-15-M18-NNBS-VA/PTFE-Y2  
 SK1-15-M18-NNBO-VA/PTFE-Y2

NB
2... 15
15
100
2
-30... 60
15 [ -5... 55]
IP 67
75 d. c.
A: PVC B: PVC; C: PA
DC13
Z20; Z21
10... 35
10
300
1,5
- / •
• / •
•

NB
2... 15
15
100
2
-30... 70
15 [ -5... 55]
IP 67
75 d. c.
A: PTFE; B: VA; C: POM
DC13
2m / 3x 0,25mm <sup>2</sup> PVC
10... 35
10
300
1,5
- / •
• / •
•

NB
2... 15
15
100
2
-30... 70
15 [ -5... 55]
IP 67
75 d. c.
A: PTFE; B: VA; C: PA
DC13
Z20; Z21
10... 35
10
300
1,5
- / •
• / •
•

IEC 60947-5-2 : 2004

IEC 60947-5-2 : 2004

IEC 60947-5-2 : 2004

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.6-5 Mhz. SNG-###AC...

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.5-0.8 Mhz. SNG-###AC...

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.5-0.8 Mhz. SNG-###AC...



2...15



M18

1...30



M30

Type code (abstract)

SK sensor capacitive, w/o amplifier  
 SKF sensor cap., w/o amplifier, flexible  
 SK1 sensor capacitive, self-contained  
 SV(D) sensor amplifier (dynamic)  
 SNG sensor power pack

HT### high temperature use  
 TM pulse modulation technique (High noise immune)

## / FS(A) max sensing distance / Fill-level switch (adaptive)

M30 model and/or dimension

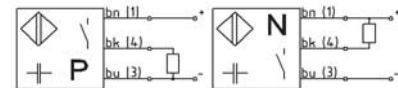
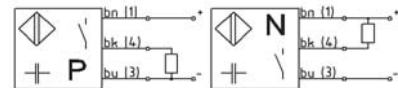
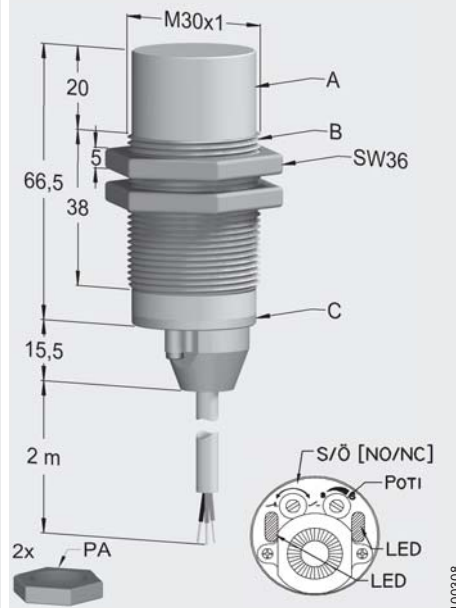
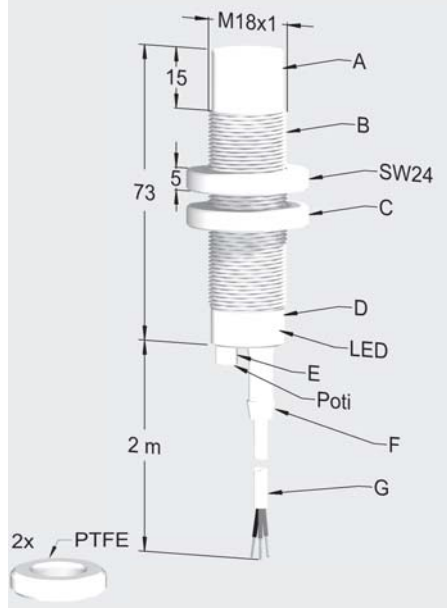
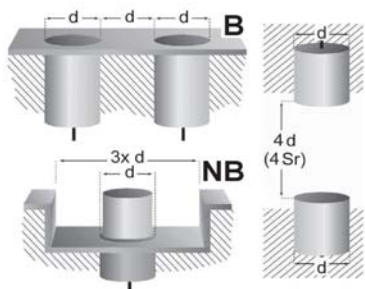
P output stage PNP, NPN, X (switchable)

B mounting B=flush NB=non-flush

S S=N.O. Ö=N.C. X=function switchable

(C)PTFE Housing material, e.g. PTFE CPTFE=complete PTFE

1M2-Y2 cable & connector: Y# = connector 1M2 = 1.2m cable length



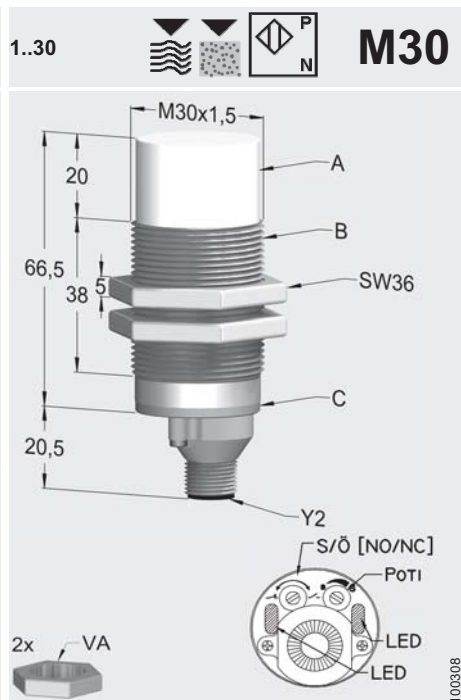
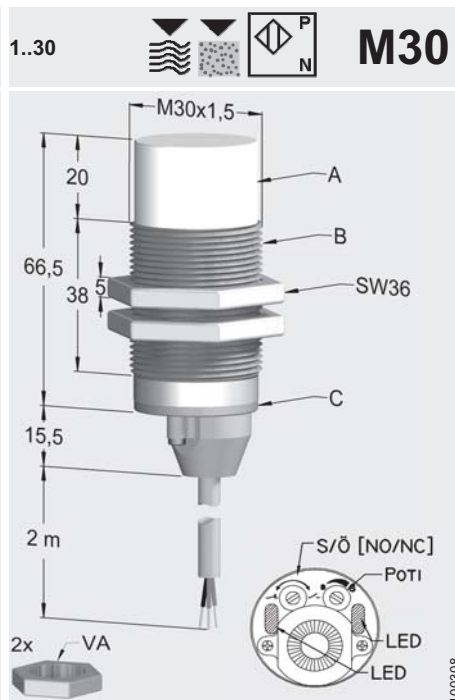
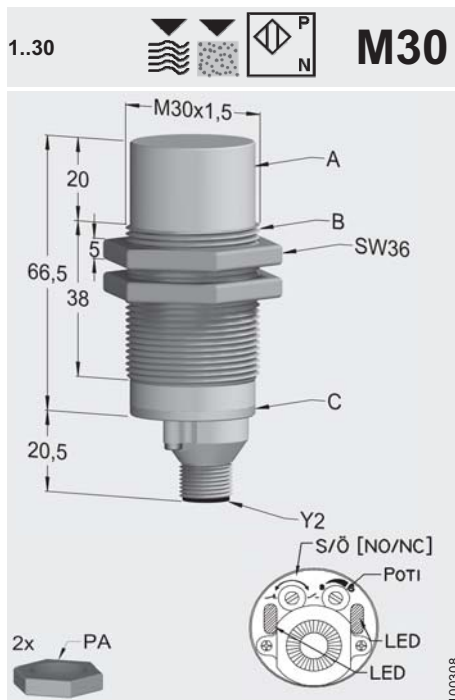
Typ / Type  
 SK1-15-M18-PNBS-CPTFE  
 SK1-15-M18-PNBO-CPTFE  
 SK1-15-M18-NNBS-CPTFE  
 SK1-15-M18-NNBO-CPTFE

Typ / Type  
 SK1-30-M30-PNBX-PBT  
 SK1-30-M30-NNBX-PBT

Mounting [flush / nonflush]	[ B / NB ]	NB	NB
Operating distance	Sn [mm]	2... 15	1... 30
Hysteresis	H [%SR]	15	15
Frequency of operating cycles	f [Hz]	100	100
Repeat accuracy	R [%SR]	2	5
Operating temperature range	Ta [C°]	-30... 70	-30... 70
Temperature drift [range]	[%SR]	15 [ -5... 55]	15 [ -5... 55]
Protection class		IP 67	A, B: IP 66 / IP 68; C: IP 64
Rated insulation voltage	Ui [V]	75 d. c.	75 d. c.
Material of housing		A-G : PTFE	A: PBT; B: PBT; C: PBT/PE
Utilisation category		DC13	DC13
Connection		2m / 3x 0,2mm <sup>2</sup> PTFE	2m / 3x 0,34mm <sup>2</sup> PUR
Supply voltage range UB	Ub [V]	10... 35	10... 35
No-load supply current	Iomax. [mA]	10	15
Minimum operational current	I <sub>m</sub> [mA]		
Operational current	I <sub>e</sub> [mA]	300	300
Off-state current	I <sub>r</sub> [mA]		
Voltage drop	U <sub>d</sub> @ I <sub>e</sub> [V]	1,5	1,8
Time delay before availability	t <sub>v</sub> [ms]		
Indicator [UB / Output]		- / • LED int.	• / •
Short circuit- overload-protection		• / •	• / •
Reverse polarity protection		•	•
Conformity	EMC EEC-direct.	IEC 60947-5-2 : 2004	IEC 60947-5-2 : 2004
EMC		IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.45-3.5 Mhz. SNG-###AC...	IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.15-4.1 Mhz. SNG-###AC...
Associated equipment			
Additional functionality			S / Ö NO / NC

Application





**Typ / Type**  
SK1-30-M30-PNBX-PBT-Y2  
SK1-30-M30-NNBX-PBT-Y2

**Typ / Type**  
SK1-30-M30-PNBX-VA/PTFE  
SK1-30-M30-NNBX-VA/PTFE

**Typ / Type**  
SK1-30-M30-PNBX-VA/PTFE-Y2  
SK1-30-M30-NNBX-VA/PTFE-Y2

NB
1... 30
15
100
5
-30... 70
15 [-5... 55]
A, B: IP 66 / IP 68; C: IP 64
75 d. c.
A: PBT; B: PBT; C: PBT/PE
DC13
Z20; Z21
10... 35
15
300
1,8
•/•
•/•
•

NB
2... 30
15
100
5
-30... 70
15 [-5... 55]
A, B: IP 66 / IP 67; C: IP 64
75 d. c.
A: PTFE; B: VA; C: PBT/PE
DC13
2m / 3x 0,34mm <sup>2</sup> PUR
10... 35
15
300
1,8
•/•
•/•
•

NB
1... 30
15
100
5
-30... 70
15 [-5... 55]
A, B: IP 66 / IP 67; C: IP 64
75 d. c.
A: PTFE; B: VA; C: PBT/PE
DC13
Z20; Z21
10... 35
15
300
1,8
•/•
•/•
•

IEC 60947-5-2 : 2004

IEC 60947-5-2 : 2004

IEC 60947-5-2 : 2004

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.15-4.1 Mhz. SNG-###AC...

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.15-4.1 Mhz. SNG-###AC...

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.15-4.1 Mhz. SNG-###AC...

S / O NO / NC

S / O NO / NC

S / O NO / NC



# BALLUFF

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2...30



M30



DC M18

Type code (abstract)

SK sensor capacitive, w/o amplifier  
 SKF sensor cap., w/o amplifier, flexible  
 SK1 sensor capacitive, self-contained  
 SV(D) sensor amplifier (dynamic)  
 SNG sensor power pack

HT### high temperature use  
 TM pulse modulation technique (High noise immune)

## / FS(A) max sensing distance / Fill-level switch (adaptive)

M30 model and/or dimension

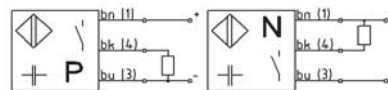
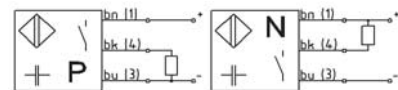
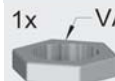
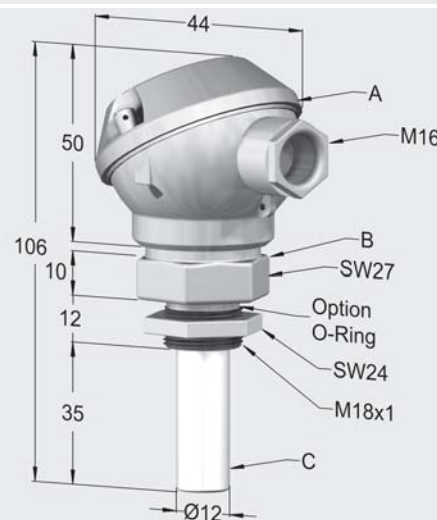
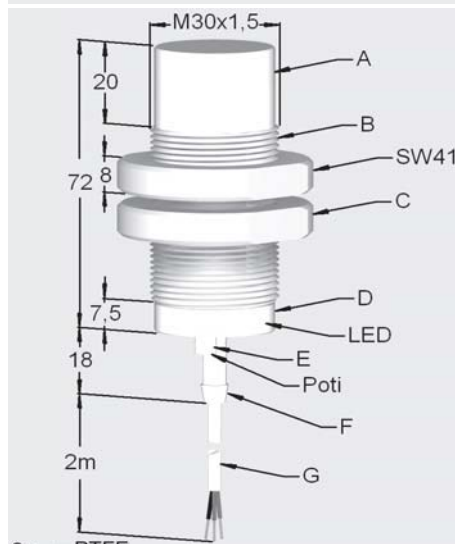
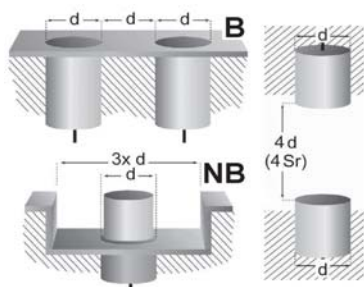
P output stage PNP, NPN, X (switchable)

B mounting B=flush NB=non-flush

S S=N.O. Ö=N.C. X=function switchable

(C)PTFE Housing material, e.g. PTFE CPTFE=complete PTFE

1M2-Y2 cable & connector: Y# = connector 1M2 = 1.2m cable length



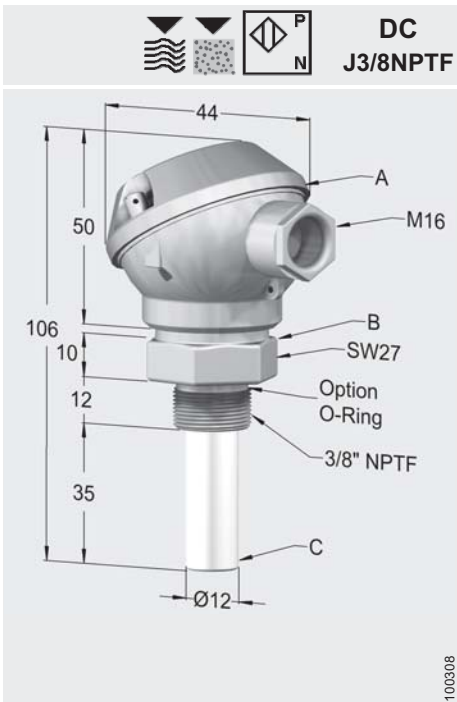
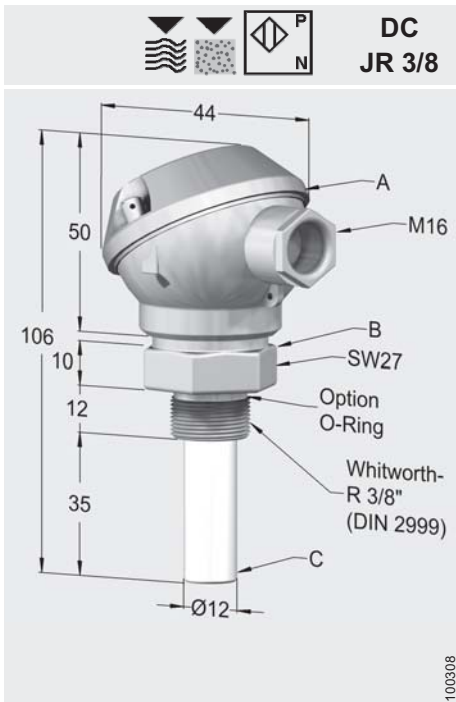
Typ / Type  
 SK1-30-M30-PNBS-CPTFE  
 SK1-30-M30-PNBO-CPTFE  
 SK1-30-M30-NNBS-CPTFE  
 SK1-30-M30-NNBO-CPTFE

Typ / Type  
 SK1-HT125-FS-JM18-PS-VA/PTFE  
 SK1-HT125-FS-JM18-PO-VA/PTFE  
 SK1-HT125-FS-JM18-NS-VA/PTFE  
 SK1-HT125-FS-JM18-NO-VA/PTFE

Mounting [flush / nonflush]	[ B / NB ]	NB	
Operating distance	Sn [mm]	2... 30	
Hysteresis	H [%SR]	10	
Frequency of operating cycles	f [Hz]	100	
Repeat accuracy	R [%SR]	2	
Operating temperature range	Ta [C°]	-30... 70	-30... 125 [-30... 100]LED
Temperature drift [range]	[%SR]	15 [-5... 55]	
Protection class		IP 67	
Rated insulation voltage	Ui [V]	75 d. c.	
Material of housing		A-G : PTFE	
Utilisation category		DC13	
Connection		2m / 3x 0,2mm <sup>2</sup> PTFE	
Supply voltage range UB	Ub [V]	10... 35	
No-load supply current	Iomax. [mA]	10	
Minimum operational current	Imin [mA]		
Operational current	Ie [mA]	300	
Off-state current	Ir [mA]	200	
Voltage drop	Ud @ Ie [V]	1,5	
Time delay before availability	tv [ms]	2,7	
Indicator [UB / Output]		- / •	LED int.
Short circuit- overload-protection		• / •	
Reverse polarity protection		•	
Conformity	EMC EEC-direct.	IEC 60947-5-2 : 2004	IEC 60947-5-2 : 2004
EMC		IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.15-4.1 Mhz. SNG-###AC...	IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 2.3-19.2 Mhz. MA-M18-###/10-V2A
Associated equipment			
Additional functionality			

Application

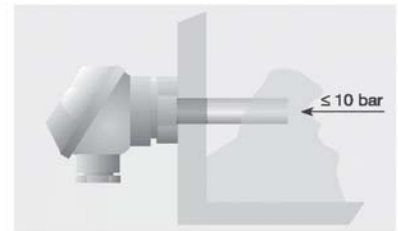




application notes

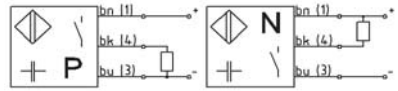
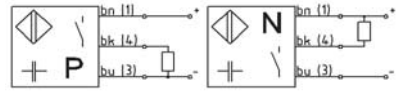
**Sensor applicability**  
 This capacitive level sensor can detect liquids and other pourable products, even when installed in high-temperature surroundings. A sensor of such caliber can be used where there is a difficulty in managing or controlling product flows or levels.

**Application examples**  
 Level sensing of nearly all products: viscous medium, grainy materials, powder and liquids.



**Adjustment**  
 The device is adjusted using the potentiometer. Note that a mean value between the switch-on and switch-off points of the tripped sensor must be set. In individual cases, when high temperature dynamic response and very adhesive media are involved, a slight re-adjustment may be necessary. The adjustment instructions for non-flush sensors on page 1.09 also apply.

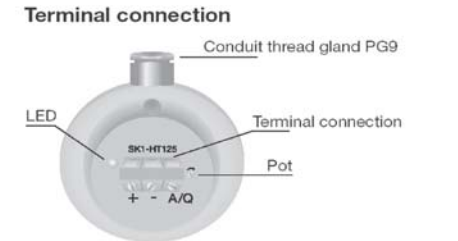
**Signal evaluation**  
 The SNG series (page 12.01-12.03) is available for signal evaluation. Depending on the application involved, you can choose between a power supply, a power supply with timer function, or a MinMax control unit. This level sensor can also be run from a PLC.



**Typ / Type**  
 SK1-HT125-FS-JR3/8-PS-VA/PTFE  
 SK1-HT125-FS-JR3/8-PO-VA/PTFE  
 SK1-HT125-FS-JR3/8-NS-VA/PTFE  
 SK1-HT125-FS-JR3/8-NO-VA/PTFE

**Typ / Type**  
 SK1-HT125-FS-J3/8NPTF-PS-VA/PTFE  
 SK1-HT125-FS-J3/8NPTF-PO-VA/PTFE  
 SK1-HT125-FS-J3/8NPTF-NS-VA/PTFE  
 SK1-HT125-FS-J3/8NPTF-NO-VA/PTFE

5	5
-30... 125	-30... 125
[ -30... 100 ] LEC	[ -30... 100 ] LEC
IP 67 / IP 68 - 10 bar	IP 67 / IP 68 - 10 bar
75 d. c.	75 d. c.
A: Al-Druckguss; B: V2A; C: PTFE	A: Al-Druckguss; B: V2A; C: PTFE
DC13	DC13
Klemmen	Klemmen
10... 35	10... 35
10	10
100	100
200	200
2,7	2,7
- / • LED int.	- / • LED int.
• / •	• / •
•	•



IEC 60947-5-2 : 2004

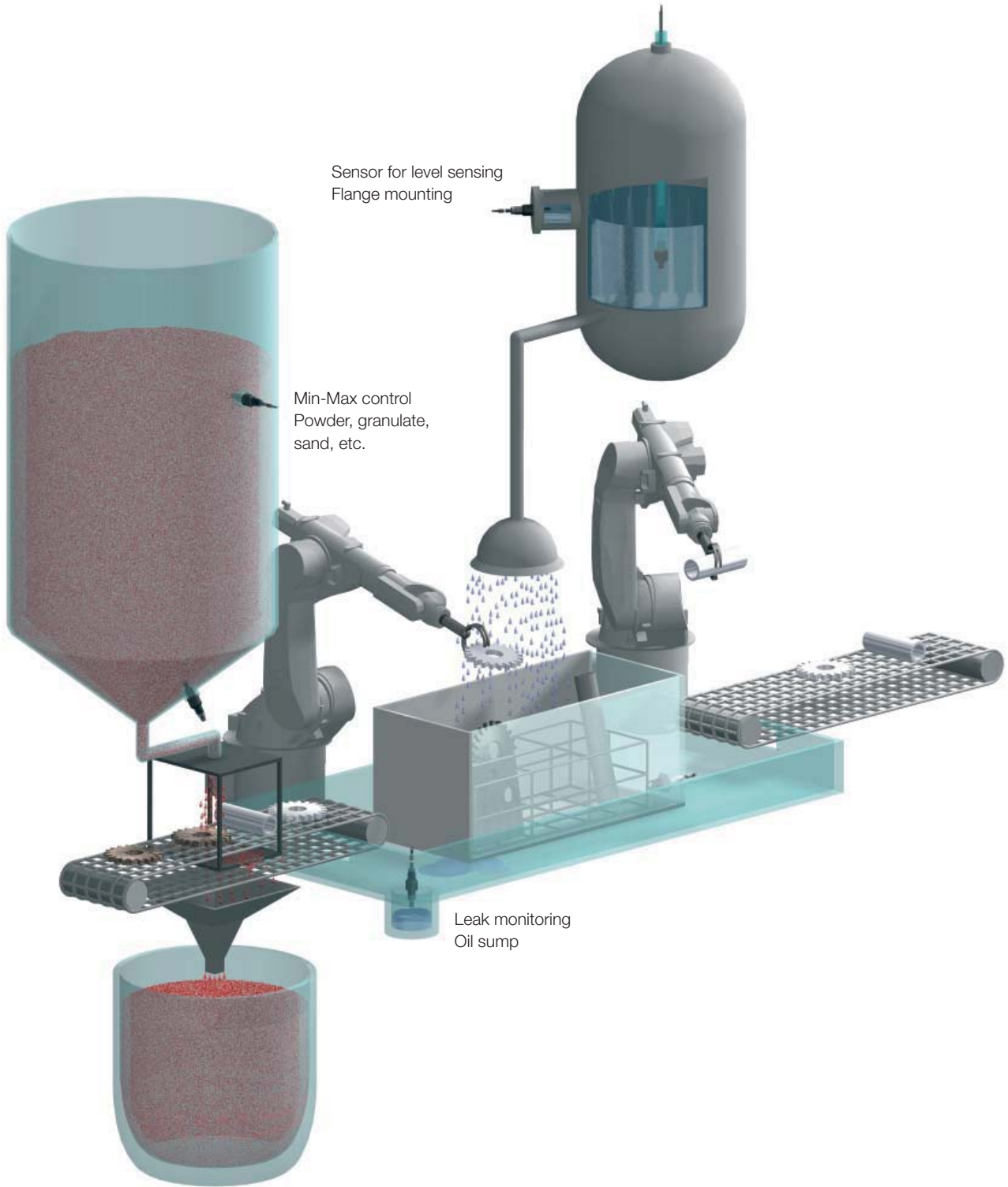
IEC 60947-5-2 : 2004

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 2.4-19.2 Mhz. MA-M18####/10-V2A

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.5-0.8 Mhz. MA-M18####/10-V2A



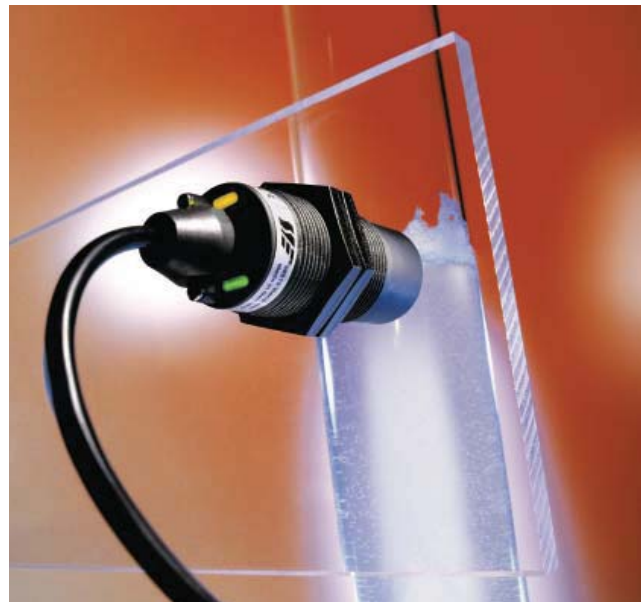
## Applications



## Sensors for level sensing smartLEVEL-Technology

### Series SK1-FSA 0710

- For aqueous media
- No adjustment in standard application
- Self-compensating
- Through glass or plastic walls
- Versions for flush and non-flush mounting



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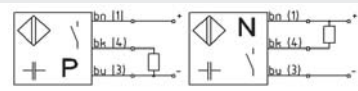
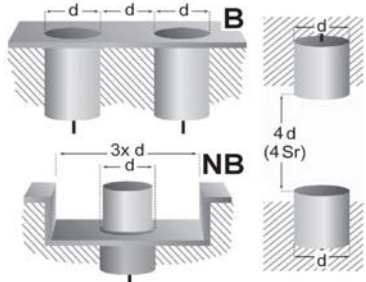
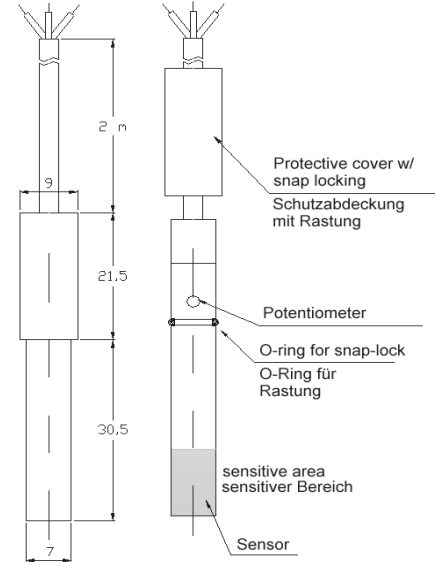
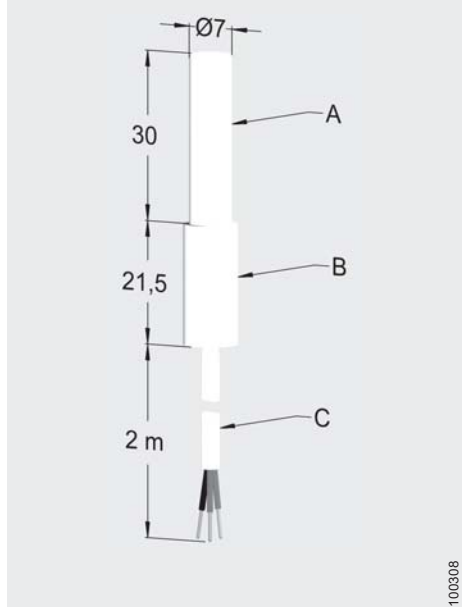


Ø7x52

application notes

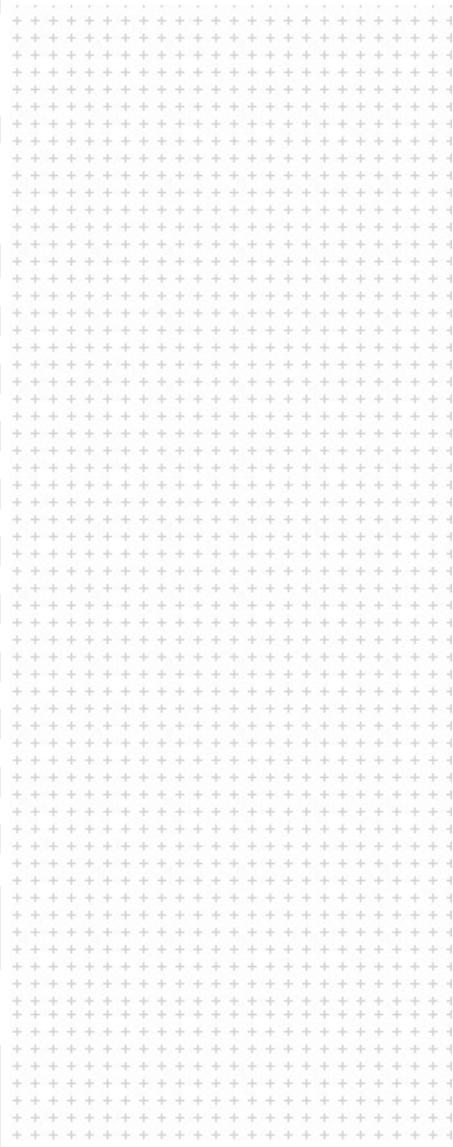
Type code (abstract)

- SK sensor capacitive, w/o amplifier
- SKF sensor cap. w/o amplifier, flexible
- SK1 sensor capacitive, self-contained
- SV(D) sensor amplifier (dynamic)
- SNG sensor power pack
- HT### high temperature use
- TM pulse modulation technique (High noise immune)
- ## / FS(A) max sensing distance / Fill-level switch (adaptive)
- M30 model and/or dimension
- P output stage PNP, NPN, X (switchable)
- B mounting B=flush NB=non-flush
- S S=N.O. Ö=N.C. X=function switchable
- (C)PTFE Housing material, e.g. PTFE CPTFE=complete PTFE
- 1M2-Y2 cable & connector: Y# = connector 1M2 = 1.2m cable length



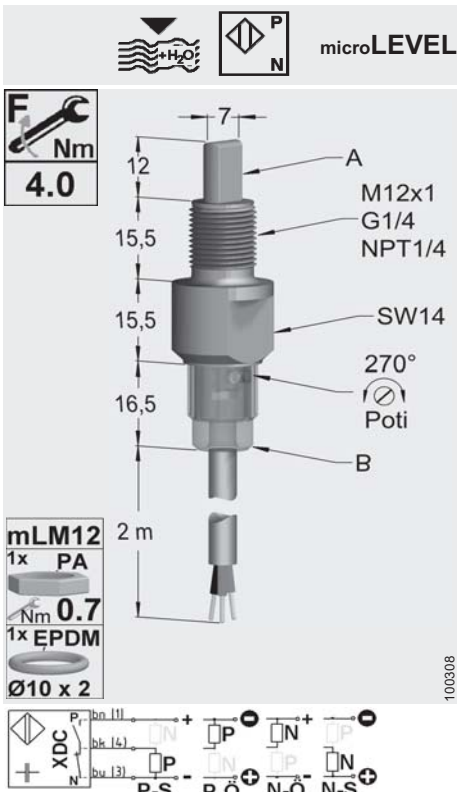
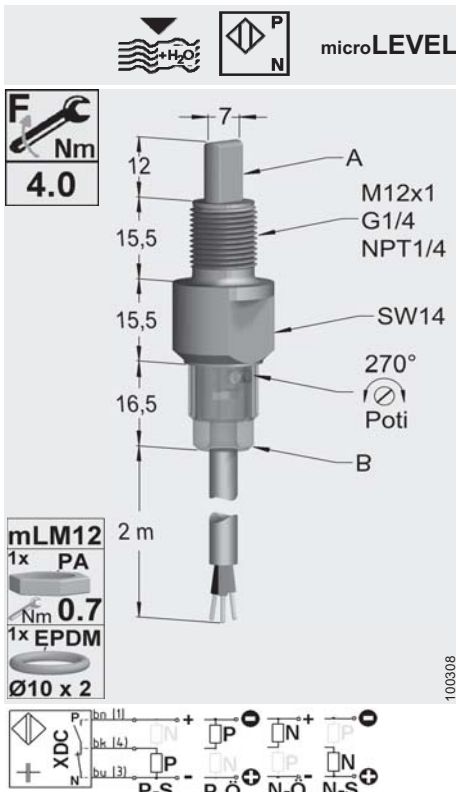
- SK1-FSA-D7B9/52-PNBS-CPTFE
- SK1-FSA-D7B9/52-PNBO-CPTFE
- SK1-FSA-D7B9/52-NNBS-CPTFE
- SK1-FSA-D7B9/52-NNBO-CPTFE

Mounting [flush / nonflush]	[ B / NB ]	NB
Operating distance	Sn [mm]	FSA
Hysteresis	H [%SR]	-
Frequency of operating cycles	f [Hz]	10
Repeat accuracy	R [%SR]	-
Operating temperature range	Ta [C°]	5...100
Temperature drift [range]	[%SR]	-
Protection class		IP 66 / A: IP 68
Rated insulation voltage	Ui [V]	75 d. c.
Material of housing		A-B: PTFE
Utilisation category		DC13
Connection		2m / 3x 0,2mm <sup>2</sup> PTFE
Supply voltage range UB	Ub [V]	10... 30
No-load supply current	Iomax. [mA]	< 10
Minimum operational current	Im [mA]	-
Operational current	Ie [mA]	50 O.C.
Off-state current	Ir [mA]	< 10
Voltage drop	Ud @ Ie [V]	< 1,5
Time delay before availability	tv [ms]	< 100
Indicator [UB / Output]		- / -
Short circuit- overload-protection		- / -
Reverse polarity protection		• +/- UB
Conformity	EMC EEC-direct.	IEC 60947-5-2 : 2004
EMC		IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 1-14.1 Mhz.
Associated equipment		
Additional functionality		



Application

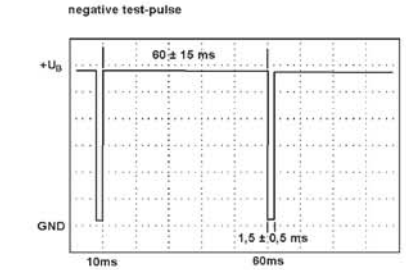
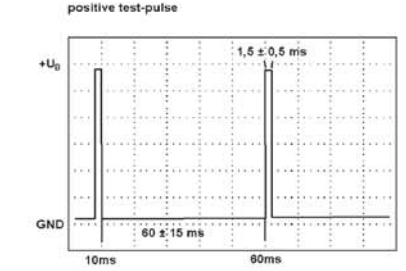




application notes

The **microLEVEL** in Smart Level FSA-Technology have been adjusted in the factory for most applications. With this setting, the Smart Level Sensors are suitable for detecting water based media without any further adjustment. The setting compensates within wide limits for foaming, condensation and product filming.

**i** The continuous self-test signal (CST) overlaps the output signal.



Typ / Type  
 SK1-FSA-MLM12-XDC-PSU  
 SK1-FSA-MLG1/4-XDC-PSU  
 SK1-FSA-MLNPT1/4-XDC-PSU

Typ / Type  
 SK1-FSA-MLM12-XDCS-PSU  
 SK1-FSA-MLG1/4-XDCS-PSU  
 SK1-FSA-MLNPT1/4-XDCS-PSU

NB	FSA
5	100
-10... 105	-10... 105
A : IP 68 / 10bar; B : IP 69K	A : IP 68 / 10bar; B : IP 69K
75 d. c.	75 d. c.
PSU	PSU
DC13	DC13
2m / 3x 0,34mm <sup>2</sup> PUR	2m / 3x 0,34mm <sup>2</sup> PUR
10... 35	10... 35
20	20
50 / 50 XDC	50 / 50 XDC
3	3
< 300	< 300
•/•	•/•
•/•	•/•
!	!
IEC 60947-5-2 : 2004	IEC 60947-5-2 : 2004

NB	FSA
100	5
-10... 105	-10... 105
A : IP 68 / 10bar; B : IP 69K	A : IP 68 / 10bar; B : IP 69K
75 d. c.	75 d. c.
PSU	PSU
DC13	DC13
2m / 3x 0,34mm <sup>2</sup> PUR	2m / 3x 0,34mm <sup>2</sup> PUR
10... 35	10... 35
20	20
50 / 50 XDC	50 / 50 XDC
3	3
< 300	< 300
•/•	•/•
•/•	•/•
!	!
IEC 60947-5-2 : 2004	IEC 60947-5-2 : 2004

Specialized applications  
 Sensors in Smart Level FSA-Technology can also be used with water based media in until now unsolved and critical applications. For this purpose, the factory setting can be altered by the user. Adjustment instructions are supplied with the sensor.

**N.B.!**  
 The cable can not be wound for the sensor to function properly. Excess length cable has to be shortened or wound in meander windings.

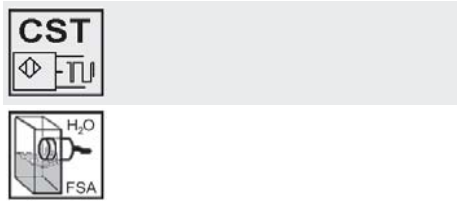
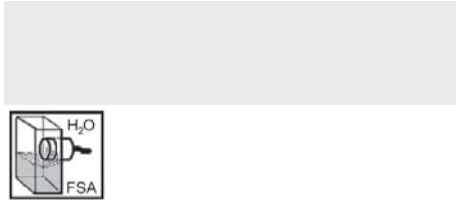


**Mounting**  
 Standard through hole mounting can be done using the enclosed nut. It is not required but recommended while mounted in a female thread. Sealing can be done using an O-ring or flat type gasket. We recommend to close the pot access hole by the use of the circular clip.



IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 1.95-13.1 Mhz.

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 1.95-13.1 Mhz.



**BALLUFF**  
SIESENSORIK



microLEVEL

application notes

Type code (abstract)

SK sensor capacitive, w/o amplifier  
SKF sensor cap. w/o amplifier, flexible  
SK1 sensor capacitive, self-contained  
SV(D) sensor amplifier (dynamic)  
SNG sensor power pack

HT### high temperature use  
TM pulse modulation technique (High noise immune)

## / FS(A) max sensing distance / Fill-level switch (adaptive)

M30 model and/or dimension

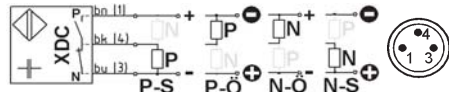
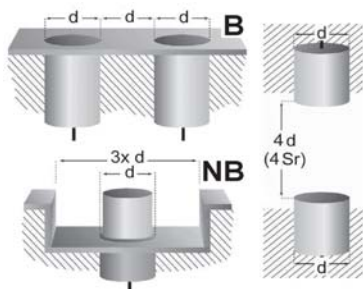
P output stage PNP, NPN, X (switchable)

B mounting B=flush  
NB=non-flush

S S=N.O. Ö=N.C.  
X=function switchable

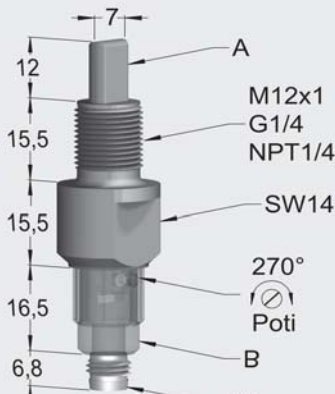
(C)PTFE Housing material, e.g. PTFE  
CPTFE=complete PTFE

1M2-Y2 cable & connector:  
Y# = connector  
1M2 = 1.2m cable length



Typ / Type

SK1-FSA-MLM12-XDC-PSU-Y1  
SK1-FSA-MLG1/4-XDC-PSU-Y1  
SK1-FSA-MLNPT1/4-XDC-PSU-Y1



The microLEVEL in Smart Level FSA-Technology have been adjusted in the factory for most applications. **With this setting, the Smart Level Sensors are suitable for detecting water based media without any further adjustment.** The setting compensates within wide limits for foaming, condensation and product filming.

Specialized applications

Sensors in Smart Level FSA-Technology can also be used with water based media in until now unsolved and critical applications. For this purpose, the factory setting can be altered by the user. Adjustment instructions are supplied with the sensor.

N.B.!

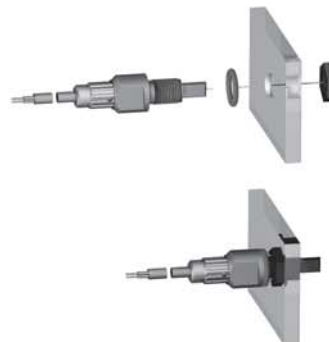
The cable can not be wound for the sensor to function properly. Excess length cable has to be shortened or wound in meander windings.



Mounting

Standard through hole mounting can be done using the enclosed nut. It is not required but recommended while mounted in a female thread. Sealing can be done using an O-ring or flat type gasket.

We recommend to close the pot access hole by the use of the circular clip.



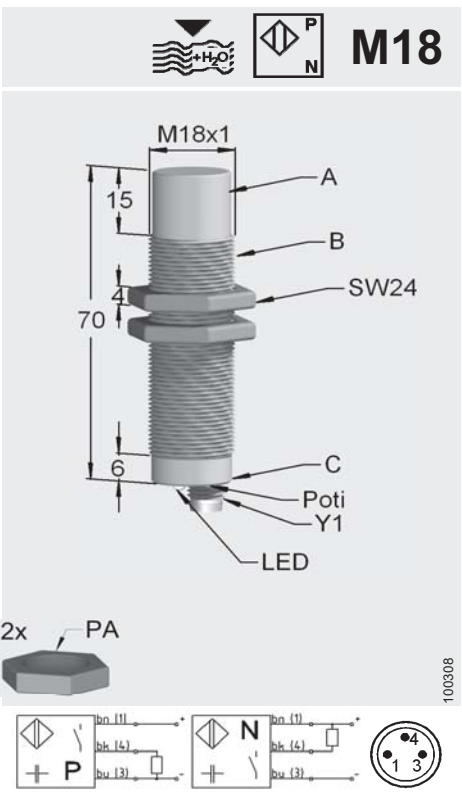
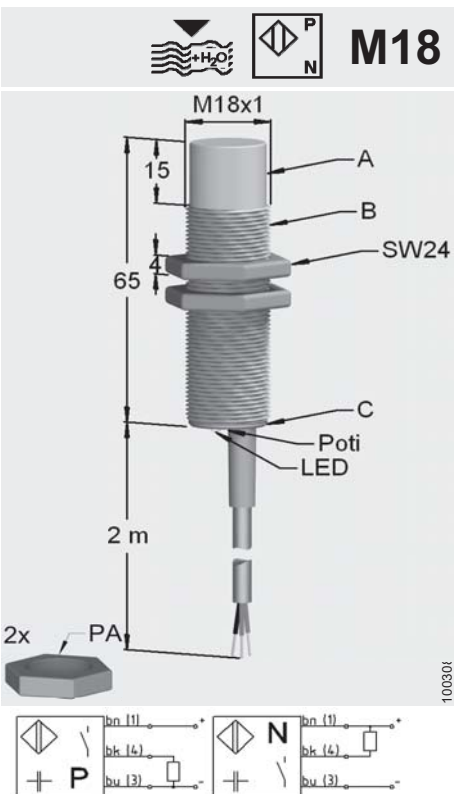
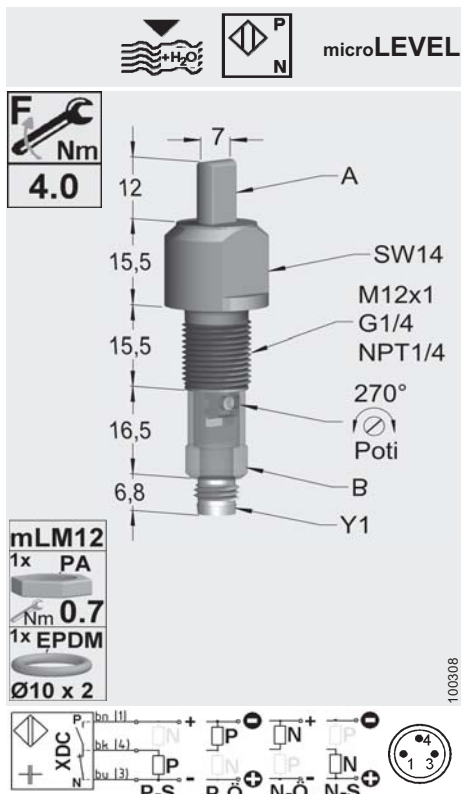
A liquid limit switch of any length can be realized by the use of a **reverse mount sensor**. Sealing can be done using an O-ring or flat type gasket.



Mounting [flush / nonflush]	[ B / NB ]	NB
Operating distance	Sn [mm]	FSA
Hysteresis	H [%SR]	
Frequency of operating cycles	f [Hz]	5
Repeat accuracy	R [%SR]	
Operating temperature range	Ta [C°]	-10... 105
Temperature drift [range]	[%SR]	
Protection class		A : IP 68 / 10bar; B : IP 69K
Rated insulation voltage	Ui [V]	75 d. c.
Material of housing		PSU
Utilisation category		DC13
Connection		Z10; Z11
Supply voltage range UB	Ub [V]	10... 35
No-load supply current	Iomax. [mA]	20
Minimum operational current	Imin [mA]	-
Operational current	Ie [mA]	50 / 50 XDC
Off-state current	Ir [mA]	-
Voltage drop	Ud @ Ie [V]	3
Time delay before availability	tv [ms]	< 300
Indicator [UB / Output]		• / •
Short circuit- overload-protection		• / •
Reverse polarity protection		!
Conformity	EMC EEC-direct.	IEC 60947-5-2 : 2004
	EMC	IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 2.1-13.5 Mhz.
Associated equipment		
Additional functionality		

Application





**Typ / Type**  
 SK1-FSA-MLRM12-XDC-PSU-Y1  
 SK1-FSA-MLRG1/4-XDC-PSU-Y1  
 SK1-FSA-MLRNPT1/4-XDC-PSU-Y1

**Typ / Type**  
 SK1-FSA-M18-PNBS-PVC  
 SK1-FSA-M18-PNBO-PVC  
 SK1-FSA-M18-NNBS-PVC  
 SK1-FSA-M18-NNBO-PVC

**Typ / Type**  
 SK1-FSA-M18-PNBS-PVC-Y1  
 SK1-FSA-M18-PNBO-PVC-Y1  
 SK1-FSA-M18-NNBS-PVC-Y1  
 SK1-FSA-M18-NNBO-PVC-Y1

NB
FSA
5
-10... 105
A : IP 68 / 10bar; B : IP 64
75 d. c.
PSU
DC13
Z10; Z11
10... 35
20
-
50 / 50 XDC
-
3
< 300
•/•
•/•
!
IEC 60947-5-2 : 2004

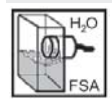
NB
FSA
2
-10... 60
A, B: IP 66 / IP 68; C: IP 64
75 d. c.
A: PVC; B: PVC; C: PBT
DC13
2m / 3x 0,25mm <sup>2</sup> PVC
10... 35
20
-
300
1,8
-/•
•/•
•
IEC 60947-5-2 : 2004

NB
FSA
2
-10... 60
A, B: IP 66 / IP 68; C: IP 64
75 d. c.
A: PVC; B: PVC; C: PVC
DC13
Z10; Z11
10... 35
20
-
300
1,8
-/•
•/•
•
IEC 60947-5-2 : 2004

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 2.1-13.5 Mhz.

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 2.65-14.9 Mhz. SNG-###AC...

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 2.65-11 Mhz. SNG-###AC...



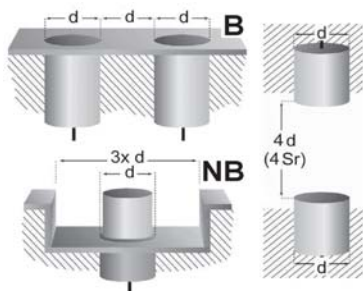


# BALLUFF

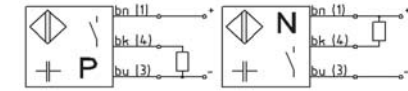
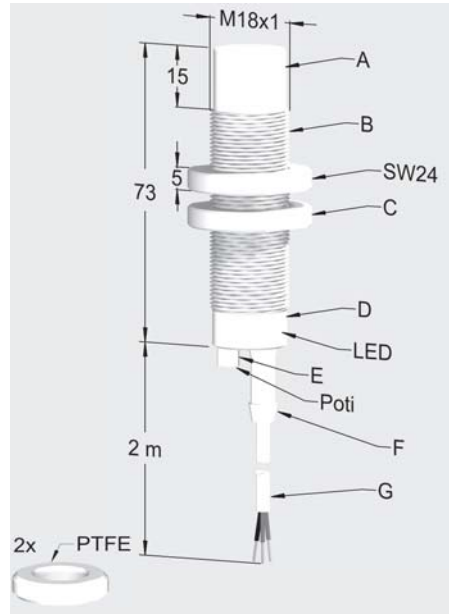
SIESENSORIK

Type code (abstract)

- SK sensor capacitive, w/o amplifier
- SKF sensor cap., w/o amplifier, flexible
- SK1 sensor capacitive, self-contained
- SV(D) sensor amplifier (dynamic)
- SNG sensor power pack
- HT### high temperature use
- TM pulse modulation technique (High noise immune)
- ## / FS(A) max sensing distance / Fill-level switch (adaptive)
- M30 model and/or dimension
- P output stage PNP, NPN, X (switchable)
- B mounting B=flush NB=non-flush
- S S=N.O. Ö=N.C. X=function switchable
- (C)PTFE Housing material, e.g. PTFE CPTFE=complete PTFE
- 1M2-Y2 cable & connector: Y# = connector 1M2 = 1.2m cable length

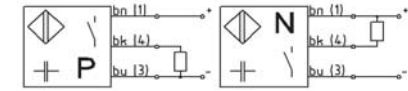
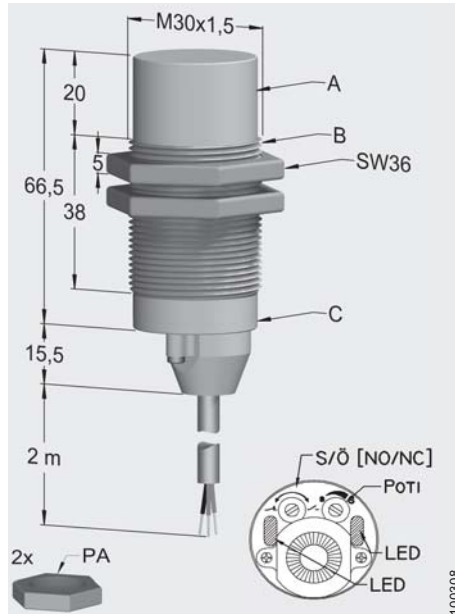


## M18



- Typ / Type
- SK1-FSA-M18-PNBS-CPTFE
  - SK1-FSA-M18-PNBO-CPTFE
  - SK1-FSA-M18-NNBS-CPTFE
  - SK1-FSA-M18-NNBO-CPTFE

## M30

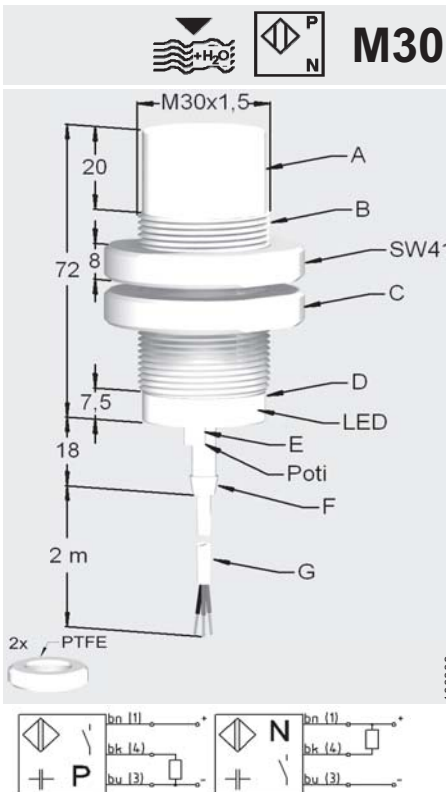
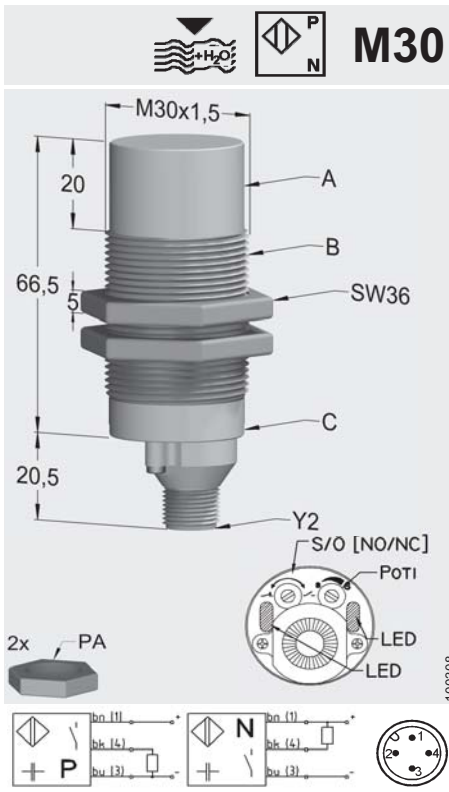


- Typ / Type
- SK1-FSA-M30-PNBX-PBT
  - SK1-FSA-M30-NNBX-PBT

Mounting [flush / nonflush]	[ B / NB ]		NB
Operating distance	Sn [mm]		FSA
Hysteresis	H [%SR]		
Frequency of operating cycles	f [Hz]		2
Repeat accuracy	R [%SR]		
Operating temperature range	Ta [C°]		-10... 60
Temperature drift [range]	[%SR]		
Protection class			A, B: IP 66 / IP 68; D: IP 64
Rated insulation voltage	Ui [V]		75 d. c.
Material of housing			A-G : PTFE
Utilisation category			DC13
Connection			2m / 3x 0,2mm <sup>2</sup> PTFE
Supply voltage range UB	Ub [V]		10... 35
No-load supply current	Iomax. [mA]		20
Minimum operational current	I <sub>m</sub> [mA]		
Operational current	I <sub>e</sub> [mA]		300
Off-state current	I <sub>r</sub> [mA]		
Voltage drop	U <sub>d</sub> @ I <sub>e</sub> [V]		1,8
Time delay before availability	t <sub>v</sub> [ms]		
Indicator [UB / Output]			- / • LED int.
Short circuit- overload-protection			• / •
Reverse polarity protection			•
Conformity	EMC EEC-direct.		IEC 60947-5-2 : 2004
EMC			IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 2.65-11 Mhz.
Associated equipment			SNG-###AC...
Additional functionality			S / Ö NO / NC

Application



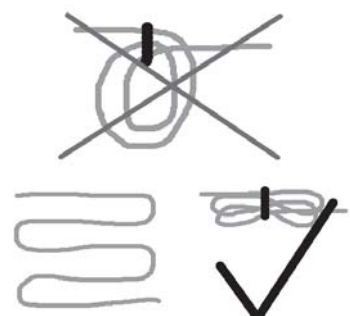


application notes

The Smart Level Sensors of the SK1-FSA... series have been adjusted in the factory for standard applications. With this setting, the Smart Level Sensors are suitable for detecting water based liquids through glass or plastic walls without any further adjustment. The factory setting can automatically mask out glass or plastic walls (approx. 0.5 mm to 6 mm), and compensates within wide limits for foam, moisture and dirt adhering to the inside and outside of the tank concerned.

**Specialized applications**  
The Smart Level Sensors of the SK1-FSA... series can also be used with water based liquids in hitherto insoluble and critical applications, e.g. with glass or plastic walls thicker than 6 mm. For this purpose, the factory setting can be altered by the user.

**N.B.!**  
The cable can not be wound for the sensor to function properly. Excess length cable has to be shortened or wound in meander windings.



Typ / Type  
SK1-FSA-M30-PNBX-PBT-Y2  
SK1-FSA-M30-NNBX-PBT-Y2

Typ / Type  
SK1-FSA-M30-PNBS-CPTFE  
SK1-FSA-M30-PNBO-CPTFE  
SK1-FSA-M30-NNBS-CPTFE  
SK1-FSA-M30-NNBO-CPTFE

NB
FSA
2
-10... 60
A, B: IP 66 / IP 68; C: IP 64
75 d. c.
A: PBT; B: PBT; C: PBT/PE
DC13
Z20; Z21
10... 35
20
300
1,8
•/•
•/•
•

NB
FSA
2
-10... 60
A, B: IP 66 / IP 68; D: IP 64
75 d. c.
A-G : PTFE
DC13
2m / 3x 0,2mm <sup>2</sup> PTFE
10... 35
20
300
1,8
-/• LED int.
•/•
•

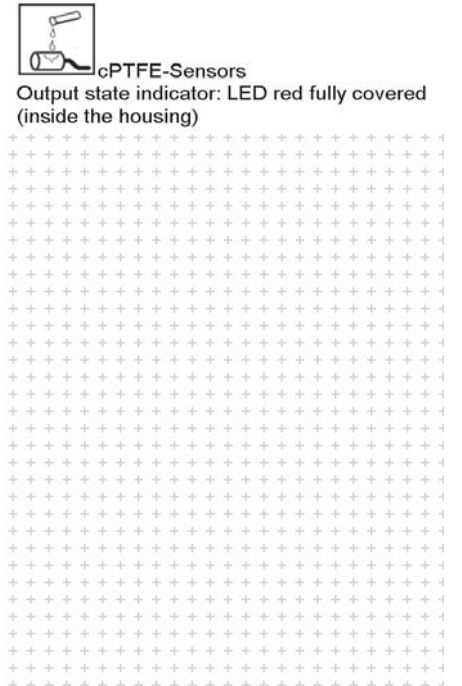
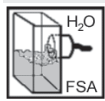
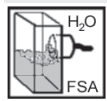
IEC 60947-5-2 : 2004

IEC 60947-5-2 : 2004

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 1.15-14.9 Mhz. SNG-###AC...

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 1.15-14.9 Mhz. SNG-###AC...

S / Ö NO / NC

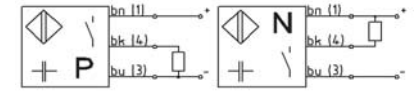
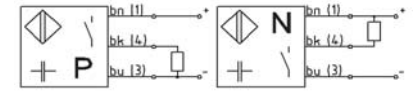
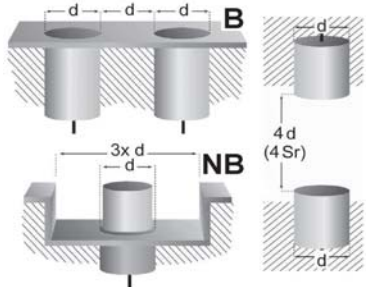
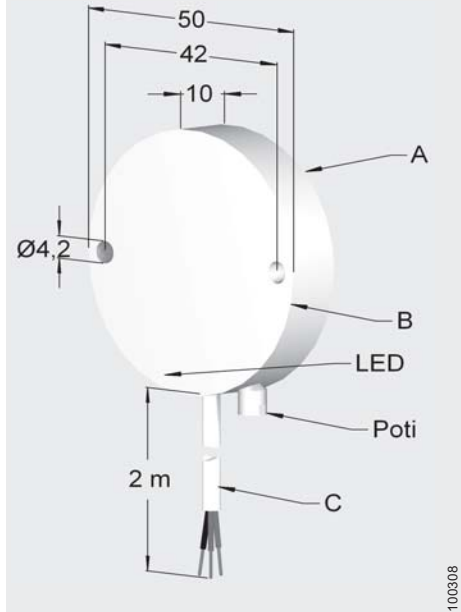
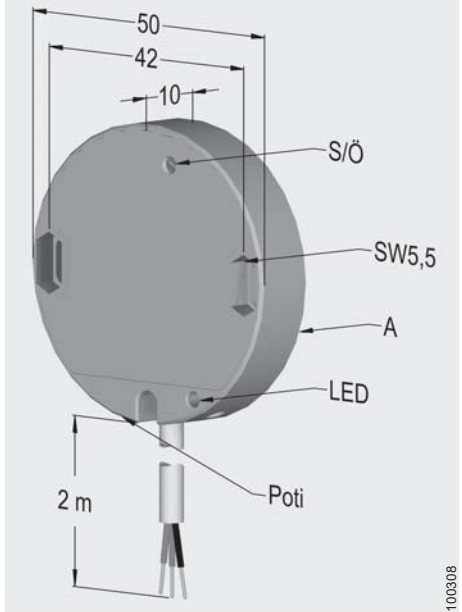


**BALLUFF**  
SIESENSORIK



Type code (abstract)

- SK sensor capacitive, w/o amplifier
- SKF sensor cap., w/o amplifier, flexible
- SK1 sensor capacitive, self-contained
- SV(D) sensor amplifier (dynamic)
- SNG sensor power pack
- HT### high temperature use
- TM pulse modulation technique (High noise immune)
- ## / FS(A) max sensing distance / Fill-level switch (adaptive)
- M30 model and/or dimension
- P output stage PNP, NPN, X (switchable)
- B mounting B=flush NB=non-flush
- S S=N.O. Ö=N.C. X=function switchable
- (C)PTFE Housing material, e.g. PTFE CPTFE=complete PTFE
- 1M2-Y2 cable & connector: Y# = connector 1M2 = 1.2m cable length

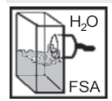


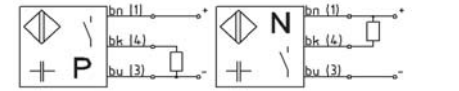
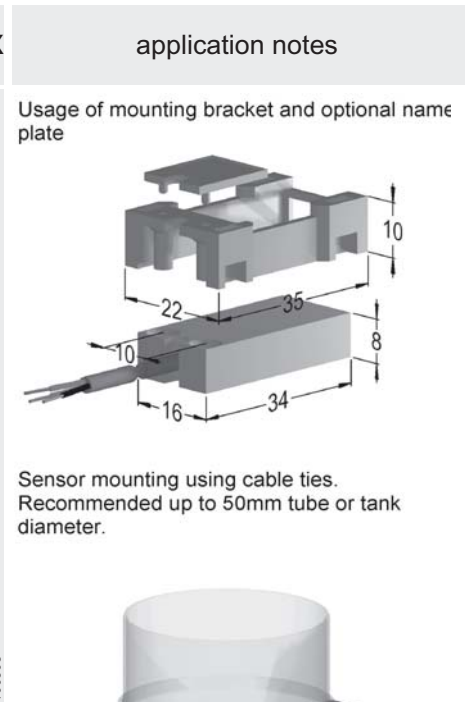
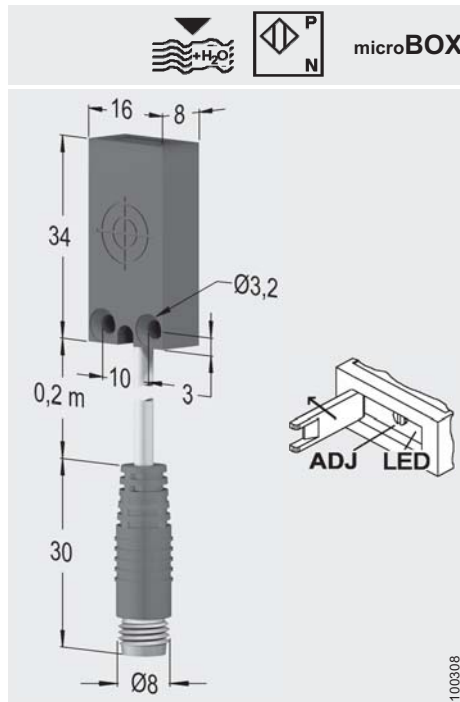
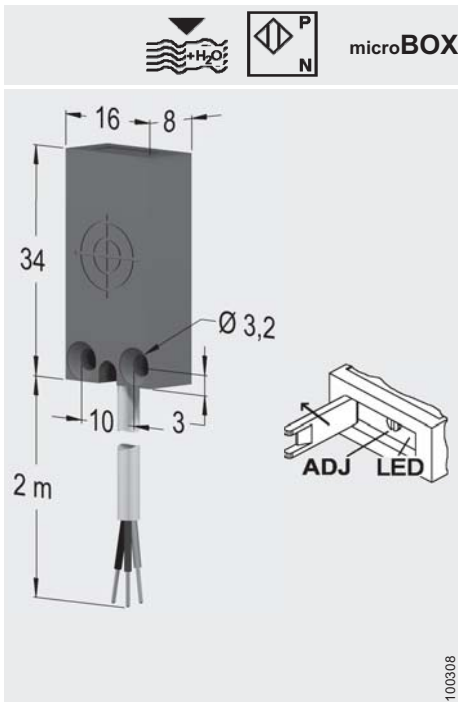
Typ / Type  
SK1-FSA-50/10-PBX-POM  
SK1-FSA-50/10-NBX-POM

Typ / Type  
SK1-FSA-50/10-PBS-CPTFE  
SK1-FSA-50/10-PBO-CPTFE  
SK1-FSA-50/10-NBS-CPTFE  
SK1-FSA-50/10-NBO-CPTFE

Mounting [flush / nonflush]	[ B / NB ]	B	B
Operating distance	Sn [mm]	FSA	FSA
Hysteresis	H [%SR]		
Frequency of operating cycles	f [Hz]	2	2
Repeat accuracy	R [%SR]		
Operating temperature range	Ta [C°]	-10... 60	-10... 60
Temperature drift [range]	[%SR]		
Protection class		IP 67	IP 67
Rated insulation voltage	Ui [V]	75 d. c.	75 d. c.
Material of housing		POM	A-C : PTFE
Utilisation category		DC13	DC13
Connection		2m / 3x 0,25mm <sup>2</sup> PVC	2m / 3x 0,2mm <sup>2</sup> PTFE
Supply voltage range UB	Ub [V]	10... 35	10... 35
No-load supply current	Iomax. [mA]	20	20
Minimum operational current	Im [mA]		
Operational current	Ie [mA]	300	300
Off-state current	Ir [mA]		
Voltage drop	Ud @ Ie [V]	1,8	1,8
Time delay before availability	tv [ms]		
Indicator [UB / Output]		- / •	- / • LED int.
Short circuit- overload-protection		• / •	• / •
Reverse polarity protection		•	•
Conformity	EMC EEC-direct.	IEC 60947-5-2 : 2004	IEC 60947-5-2 : 2004
EMC		IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.8-9.8 Mhz.	IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.8-9.8 Mhz.
Associated equipment		SNG-###AC...	SNG-###AC...
Additional functionality		S / Ö NO / NC	

Application





**Typ / Type**  
 SK1-FSA-34/16/8-PBS-PP  
 SK1-FSA-34/16/8-PBO-PP  
 SK1-FSA-34/16/8-NBS-PP  
 SK1-FSA-34/16/8-NBO-PP

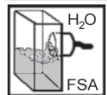
**Typ / Type**  
 SK1-FSA-34/16/8-PBS-PP-M2/Y1  
 SK1-FSA-34/16/8-PBO-PP-M2/Y1  
 SK1-FSA-34/16/8-NBS-PP-M2/Y1  
 SK1-FSA-34/16/8-NBO-PP-M2/Y1

B
FSA
2
5
-30... 70
IP 67
75 d. c.
PP
DC13
2m / 3x 0,14 mm <sup>2</sup> / PUR
12... 30
< 10
-
50
O.C.
1,5
< 100
- / •
• / •
•
IEC 60947-5-2 : 2004

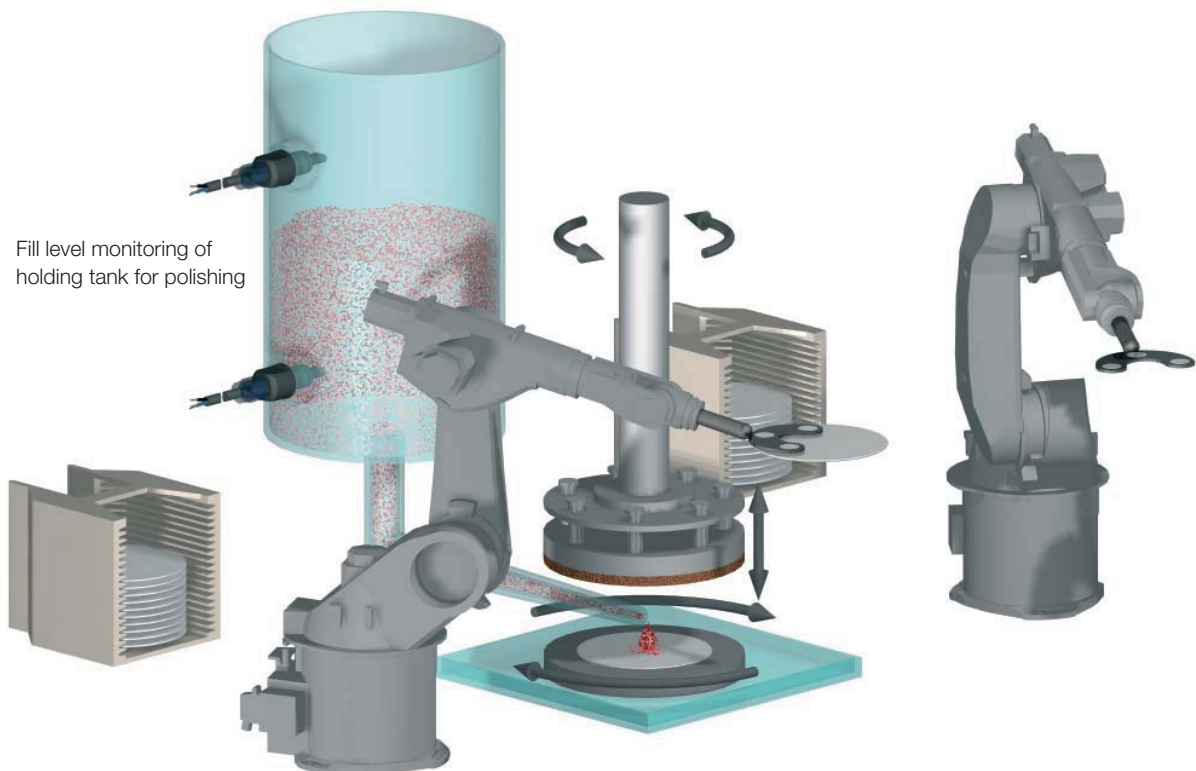
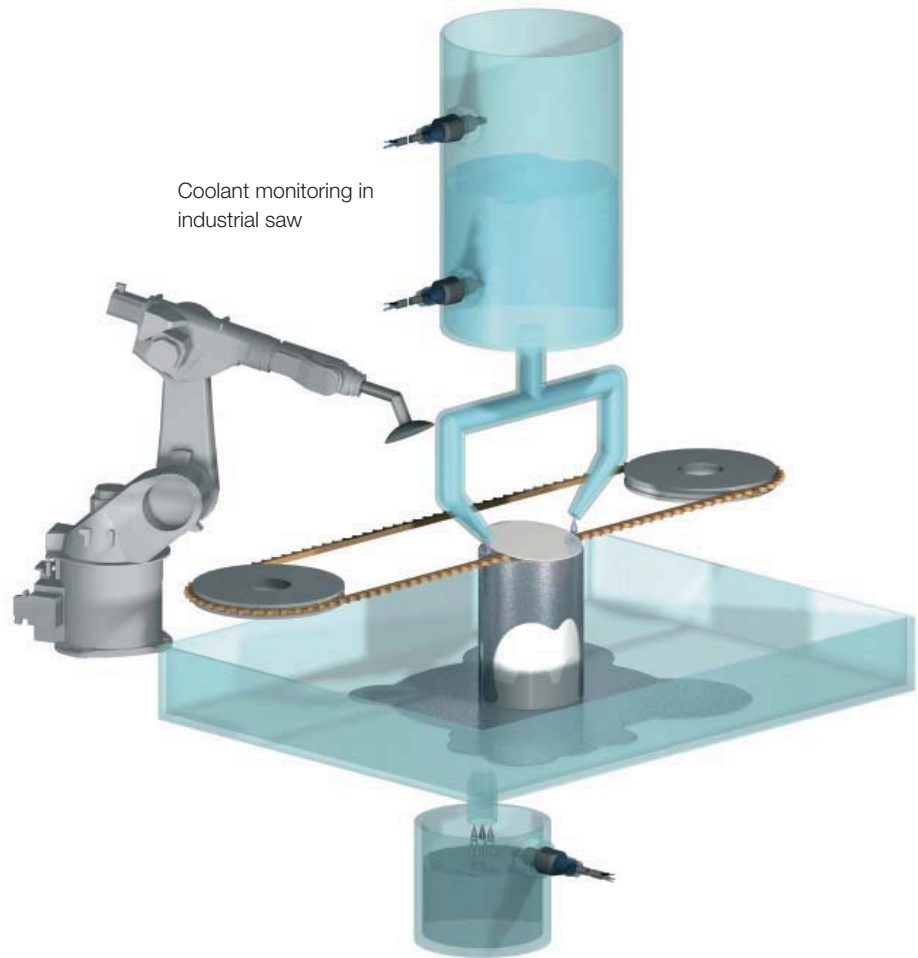
B
FSA
2
5
-30... 70
IP 67
75 d. c.
PP
DC13
0,2m / 3x 0,14mm <sup>2</sup> PUR; Z10; Z11
12... 30
< 10
-
50
O.C.
1,5
< 100
- / •
• / •
•
IEC 60947-5-2 : 2004

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.85-8.3 Mhz. SNG-###AC...

IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 0.85-8.3 Mhz. SNG-###AC...



## Applications



**BALLUFF**

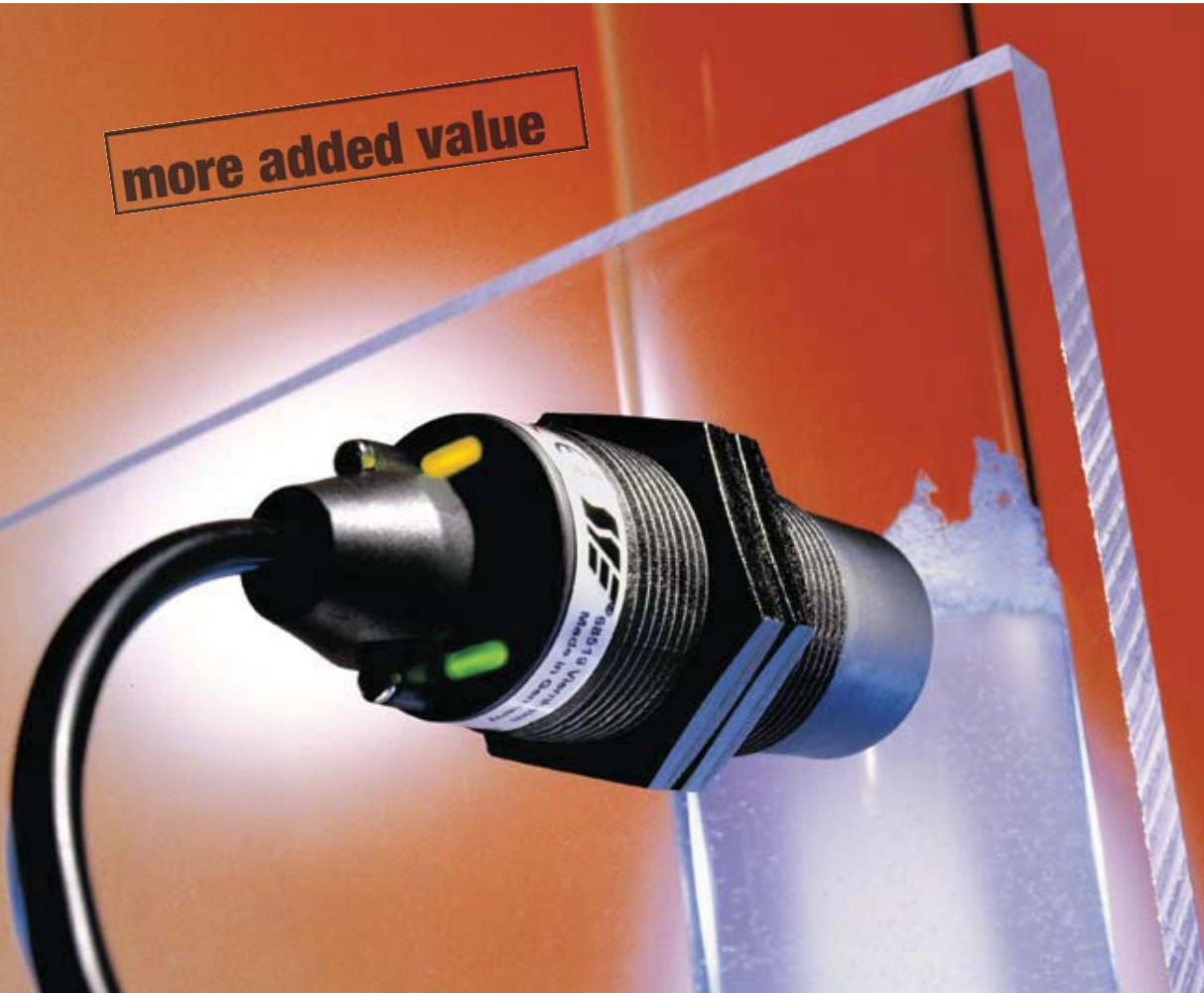
**SIESENSORIK**

## Capacitive Sensors

... new possibilities in object detection and level sensing



**more added value**



# 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



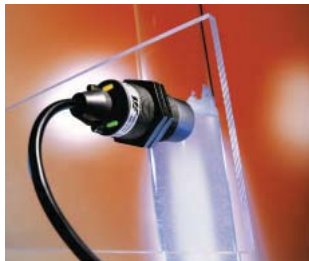
### Capacitive sensors for object detection, SK1-B

- 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

### Table of Contents

### Page

Capacitive sensors –  
general description

1.02 –  
1.10

Mini-sensors

3.01 –  
3.09

Sensor amplifiers

4.01 –  
4.05

Sensors for  
object detection

6.01 –  
6.15

Sensors for  
level sensing

7.01 –  
7.12

Sensors for level sensing,  
smartLEVEL-Technology

7.13 –  
7.22

microLEVEL

7.15 –  
7.17

microBOX

7.21

Analog sensor

8.01 –  
8.04

Sensors for the high  
temperature range

9.01 –  
9.03

Sensor power packs

12.01 –  
12.03

Accessories

13.01 –  
13.05

## Analog sensor

### Series SK1-A 0800

- Measuring range 0...8 mm adjustable
- Flush mounting
- Output signal current 4...20 mA
- Housing M18



8.01 -  
8.04



DIN EN ISO 9001:2000  
QA 05 100 1050





0..8

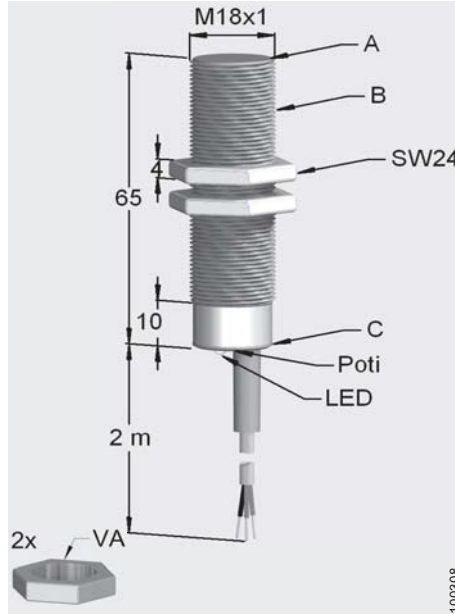
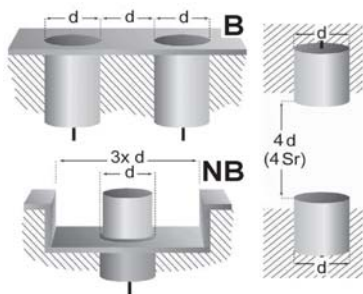


M18

application notes

Type code (abstract)

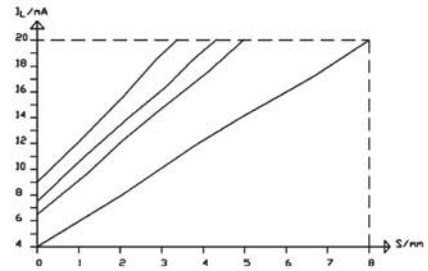
- SK sensor capacitive, w/o amplifier
- SKF sensor cap. w/o amplifier, flexible
- SK1 sensor capacitive, self-contained
- SV(D) sensor amplifier (dynamic)
- SNG sensor power pack
- HT### high temperature use
- TM pulse modulation technique (High noise immune)
- ## / FS(A) max sensing distance / Fill-level switch (adaptive)
- M30 model and/or dimension
- P output stage PNP, NPN, X (switchable)
- B mounting B=flush NB=non-flush
- S S=N.O. Ö=N.C. X=function switchable
- (C)PTFE Housing material, e.g. PTFE CPTFE=complete PTFE
- 1M2-Y2 cable & connector: Y# = connector 1M2 = 1.2m cable length



Typ / Type  
SK1-A-8-M18-4I20-B-VA/PBT

Calibration

When performing measurements on objects with a low relative dielectric coefficient ( $\epsilon_r \leq 10$ ), it is possible to calibrate the sensor to match the specific material properties involved (Fig. 8.02) or the size of the object in order to maintain the full output signal range (4...20 mA).



For this purpose, the object in question is held against the sensor (distance  $S = 0$  mm) and the trimming potentiometer (which can be operated from the rear of the sensor) adjusted until the signal LED lights up green. While performing the calibration procedure, make sure that the object is lying flush against the sensor surface and that there is no other object (which might disturb the procedure) located directly behind the object in the direct extension of the active sensor surface. If the signal LED lights up red, turn the trimming potentiometer to the right (clockwise); when this LED lights up orange, turn it to the left. The sensor has now been calibrated to match the properties of the new object.

This calibration procedure ensures that the sensor will always supply the full output signal range as long as the size of the object is sufficient and the object possesses a relative dielectric coefficient still allowing evaluation. In the case of objects with insufficient dielectric coefficient or insufficient size, the signal range is restricted. Objects with a relative dielectric coefficient  $\epsilon_r$  of about 1 or objects which are too small will not cause the output signal to alter. For appropriate reduction factors in dependence on the object properties involved, please consult the table.

Material	Thickness d / mm	Measuring range S / mm	$I_A$ / mA	Reduction-factor
Steel ST-37	1,5	0...8	4...20	/
Brass Ms	1,5	0...8	4...20	/
Water				/
Polyvinylchloride (PVC)	4,0	0...2,8	4...20	0,35
	6,0	0...3,25		0,41
Acryl glass (PMMA)	8,0	0...3,45		0,47
	12,0	0...3,75		0,47
Hard paper	6,5	0...5,5	4...20	0,69
Foamed PVC	3	0...1,75	6,5...20	0,22
	6	0...2	5,7...20	0,25

If the sensor has to be used for material selection in a particular application, the calibration can be dispensed with if the trimming potentiometer has not been adjusted after delivery. The as-delivered condition is calibration on a metal target.

Mounting [flush / nonflush]	[ B / NB ]	B
Operating distance	$S_n$ [mm]	0... 8
Hysteresis	H [%SR]	
Frequency of operating cycles	f [Hz]	100
Repeat accuracy	R [%SR]	0,05mm
Operating temperature range	$T_a$ [C°]	10... 55
Temperature drift [range]	[%SR]	10[10... 55]
Protection class		IP 67
Rated insulation voltage	$U_i$ [V]	75 d. c.
Material of housing		A: PBT; B: VA; C: PVC
Utilisation category		
Connection		2m / 3x 0,25mm <sup>2</sup> PVC
Supply voltage range $U_B$	$U_b$ [V]	12... 35
No-load supply current	$I_{omax}$ [mA]	17
Minimum operational current	$I_m$ [mA]	
Operational current	$I_e$ [mA]	4... 20
Off-state current	$I_r$ [mA]	
Voltage drop	$U_d @ I_e$ [V]	
Time delay before availability	$t_v$ [ms]	
Indicator [UB / Output]		• / • Duo-LED
Short circuit- overload-protection		• / •
Reverse polarity protection		•
Conformity	EMC EEC-direct.	IEC 60947-5-2 : 2004
EMC		IEC 61000-4-6 (Testlevel 3V) Functional errors may occur in partition of working frequency 1.2 Mhz.
Associated equipment		
Additional functionality		
Application		

## Functional principle

### Function principle

The functional principle behind the capacitive analog position pickup is similar to that of a capacitive proximity switch. It detects objects which are within its response range without touching them. The function is based on the effect on the electric field in the vicinity of its "active sensor surface". The basic structure of the sensor consists of an oscillator, a demodulator, the linearization network and the controlled current source.



Fig. 8.01

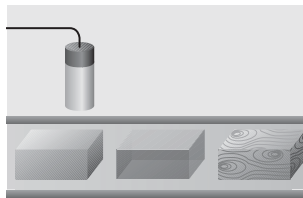
The criteria for an analog evaluation are the material properties, the size of the object involved, and its distance from the "active sensor surface". For objects deviating from the standard target, the maximum working distance is reduced (see Fig. 8.06 on page 8.04). In actual operation, the optimum calibration to be performed from the rear of the housing over a trimming potentiometer is signaled to the user by the adjacent LED. As a further special feature, this LED also signals if the load impedance at the output is too high or non-existent.

### Advantages of the capacitive analog pickup

The capacitive analog sensor scans objects without contact. This means that the object scanned is not subjected to any mechanical wear and tear. Nor do colors and surface roughnesses have any negative effect on the measured result. In the case of differing object materials, the output signal deviates from the standard output signal of 4...20 mA, and can be returned by a simple-to-perform user calibration procedure to the standard output signal.

### Applications

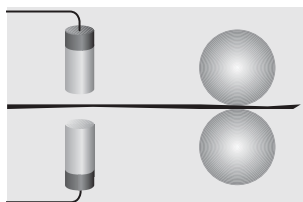
The capacitive analog sensor makes linear evaluation of a position for the first time; as soon as an object is located within the sensor's measuring range, a precise output current is produced. The uses shown represent only a fraction of the multifaceted application options provided by the capacitive analog sensor.



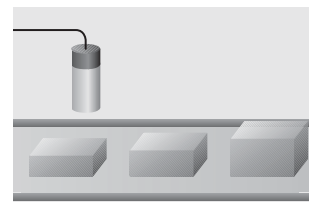
Material selection



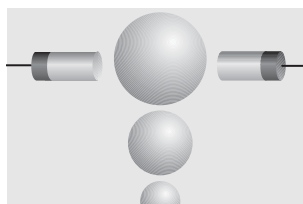
Measuring nonmetallic coating thicknesses



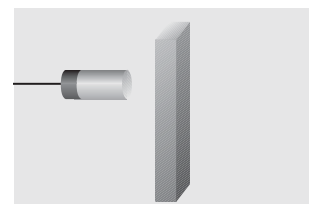
Product thickness monitoring



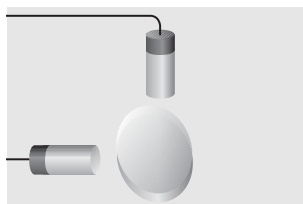
Height measurement



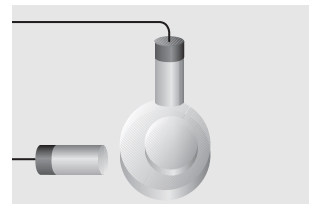
Determining diameters



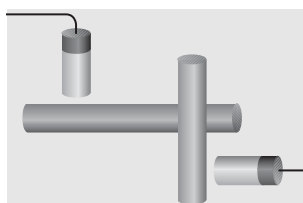
Static/dynamic movement



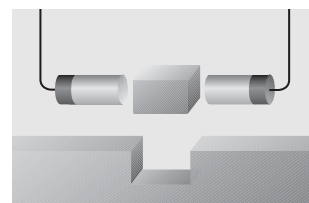
Registering radial runout



Concentricity and eccentricity



Axial and radial runout deviation



Monitoring fit

# Functional principle

## Calibration

When performing measurements on objects with a low relative dielectric coefficient ( $\epsilon_r < 10$ ), it is possible to calibrate the sensor to match the specific material properties involved (Fig. 8.02) or the size of the object in order to maintain the full output signal range (4...20 mA).

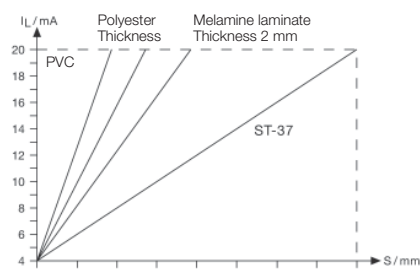


Fig. 8.02

For this purpose, the object in question is held against the sensor (distance  $S = 0$  mm) and the trimming potentiometer (which can be operated from the rear of the sensor) adjusted until the signal LED lights up green. While performing the calibration procedure, make sure that the object is lying flush against the sensor surface and that there is no other object (which might disturb the procedure) located directly behind the object in the direct extension of the active sensor surface. If the signal LED lights up red, turn the trimming potentiometer to the right (clockwise); when this LED lights up orange, turn it to the left. The sensor has now been calibrated to match the properties of the new object.

This calibration procedure ensures that the sensor will always supply the full output signal range as long as the size of the object is sufficient and the object possesses a relative dielectric coefficient still allowing evaluation. In the case of objects with insufficient dielectric coefficient or insufficient size, the signal range is restricted. Objects with a relative dielectric coefficient  $\epsilon_r$  of about 1 or objects which are too small will not cause the output signal to alter.

For appropriate reduction factors in dependence on the object properties involved, please consult the table of Fig. 8.06.

If the sensor has to be used for material selection in a particular application, the calibration can be dispensed with if the trimming potentiometer has not been adjusted after delivery. The as-delivered condition is calibration on ST-37 target.

## Determining the load impedance

### Mathematical determination of the max. permissible value for load impedance $R_L$

$$R_L = [(40 \times U_B / V) - 200] \Omega$$

with  $U_B / V = 12 \dots 35$  VDC

Please note:

Care must be taken to ensure that the load impedance is made up of the line impedance  $R_{ZL}$  and the actual load impedance  $R_L$ . The sum of these two impedance values must be within the impedance range mentioned above.

### Graphical determination of the maximum permissible load impedance

Fig. 8.03 shows the diagram used for determining permissible load impedance values  $R_L$  in dependence on the sensor supply voltage  $U_B$ .

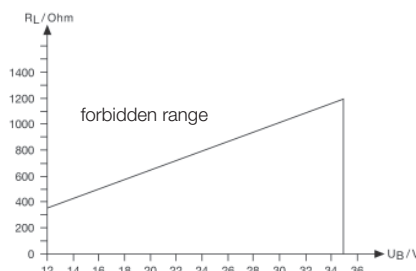


Fig. 8.03

### Dimensioning example

(Fig. 8.04)

Application data:  $U_B = 24$  V

To find: possible impedance range for load impedance.

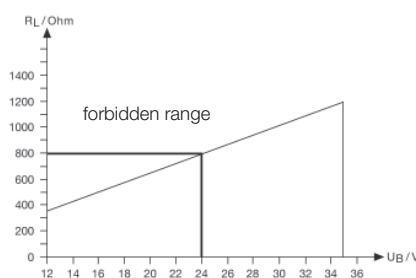


Fig. 8.04

How to proceed:

Move vertically upwards from the defined supply voltage value  $U_B$  to obtain an intersection point with the load impedance limit curve. The maximum permissible value for load impedance  $R_L$  can now be read off on the Y-axis at the height of this intersection point. The minimal value for load impedance  $R_L$  is always  $0 \Omega$ . You will thus obtain a permissible load impedance range of  $0 \dots 760 \Omega$  for the supply voltage value mentioned above.

## Error messages

The analog sensor automatically detects whether the load impedance connected has been too generously dimensioned.

In this case, proper function of the sensor is no longer guaranteed, since the behavior of the output signal is no longer proportional to the distance from the object. An operating error of this type is indicated by the flashing calibration display.

To check the sensor for proper function, the following two tests should be performed:

- Object located as close as 0 mm to the object: signal LED permanently lit up green.
- Object outside the response range of the sensor: signal LED permanently lit up orange.

If these two tests have given the above results, the load impedance selected is okay. If these two tests produce different LED displays, this indicates impermissible operating conditions. An error analysis can be performed using the table below (Fig. 8.05).

Distance Sensor-Object	Display	Meaning of Display
0 mm	red flashing	calibration too low/ $R_L$ too high
0 mm	green flashing	calibration okay/ $R_L$ too high
0 mm	orange flashing	calibration too high/ $R_L$ too high
0 mm	red steady	calibration too low/ $R_L$ ?
0 mm	green steady	calibration okay/ $R_L$ ?
0 mm	orange steady	calibration too high/ $R_L$ ?
>11 mm	orange flashing	calibration?/ $R_L$ too high
<11 mm	orange steady	calibration?/ $R_L$ okay

Fig. 8.05

If the signal LED is permanently flashing (even if the output has been short-circuited to ground), this means that there is a cable break. In this case, check the cable between sensor and evaluation device, and replace it if necessary.

### Material correction table

The measuring ranges reduced due to different material properties can be taken from the following table (Fig. 8.06)

Material	Thickness d / mm	Measuring range S / mm	$I_L$ / mA	Reduction-factor
Steel ST-37	1.5	0...8	4...20	/
Brass Ms	1.5	0...8	4...20	/
Water				/
Polyvinyl chloride (PVC)	4.0	0...2.8	4...20	0.35
Acrylic (PMMA)	6.0	0...3.25		0.41
	8.0	0...3.45		0.47
	12.0	0...3.75		0.47
Hard paper	6.5	0...5.5	4...20	0.69
Foamed PVC	3	0...1.75	6.5...20	0.22
	6	0...2	5.7...20	0.25

Fig. 8.06

## Sensors for the high temperature range

### Series SK-HT 0900

- Ambient temperature up to 180 °C and up to 250 °C
- Housing M18, M30 and 3/8" in V2A/PTFE
- Connection sensor lead with plug connector
- Non-flush mountable
- Adjustment using sensor amplifiers 0400



9.01 -  
9.03



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SIESENSORIK

1..10 **M18**

1..20 **M30**

Type code (abstract)

SK sensor capacitive, w/o amplifier  
SKF sensor cap., w/o amplifier, flexible  
SK1 sensor capacitive, self-contained  
SV(D) sensor amplifier (dynamic)  
SNG sensor power pack

HT### high temperature use  
TM pulse modulation technique (High noise immune)

## / FS(A) max sensing distance / Fill-level switch (adaptive)

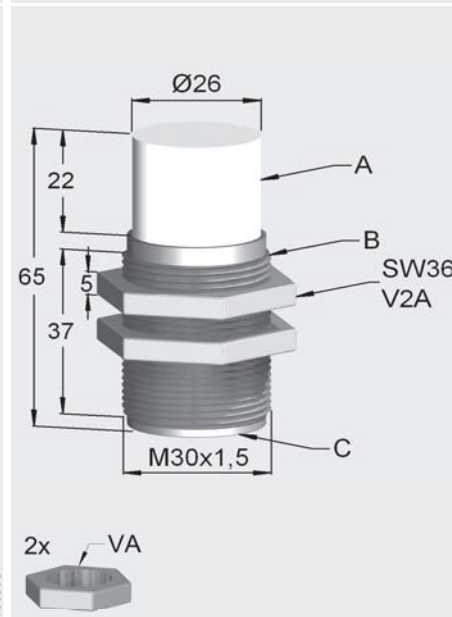
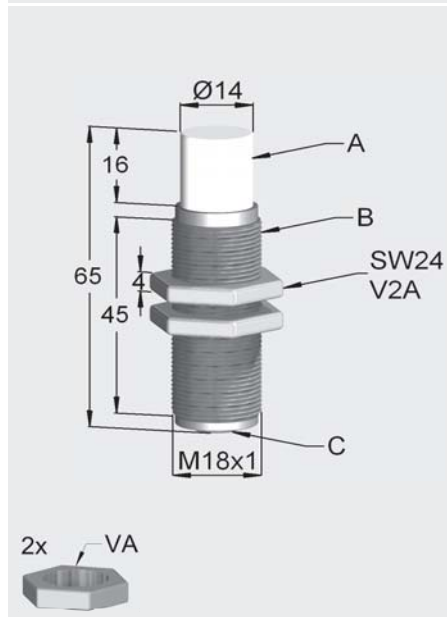
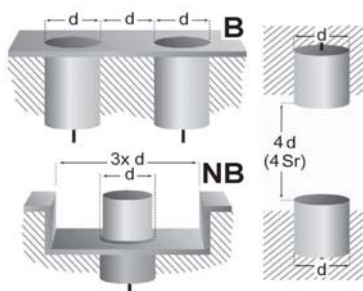
M30 model and/or dimension  
P output stage PNP, NPN, X (switchable)

B mounting B=flush  
NB=non-flush

S S=N.O. Ö=N.C.  
X=function switchable

(C)PTFE Housing material, e.g. PTFE  
CPTFE=complete PTFE

1M2-Y2 cable & connector:  
Y# = connector  
1M2 = 1.2m cable length



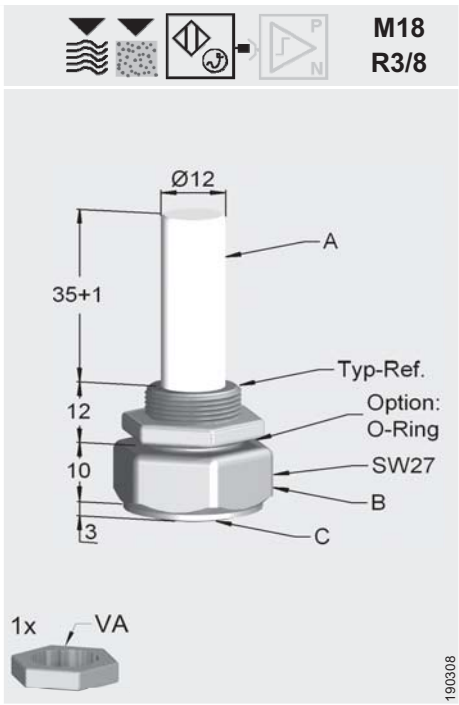
Typ / Type  
SK-HT250-10-M18-NB-VA/PTFE

Typ / Type  
SK-HT250-20-M30-NB-VA/PTFE

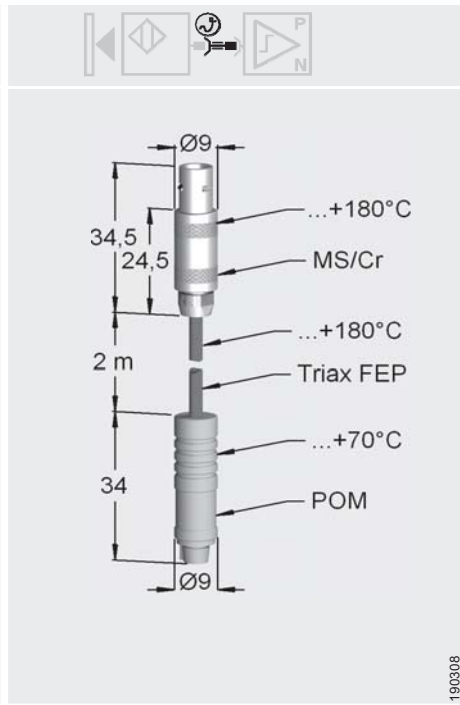
Mounting [flush / nonflush]	[ B / NB ]	NB	NB
Operating distance	Sn [mm]	1... 10	1... 20
Hysteresis	H [%SR]	15	15
Frequency of operating cycles	f [Hz]		
Repeat accuracy	R [%SR]	2	2
Operating temperature range	Ta [C°]	-180... 250	-180...250
Temperature drift [range]	[%SR]		
Protection class		IP 66 / IP 54	IP 66 / IP 54
Rated insulation voltage	Ui [V]		
Material of housing		A: PTFE; B: V2A; C: PTFE/MS/Cr	A: PTFE; B: V2A; C: PTFE/MS/Cr
Utilisation category			
Connection		SLK-HT	SLK-HT
Supply voltage range UB	Ub [V]		
No-load supply current	Iomax. [mA]		
Minimum operational current	Imin [mA]		
Operational current	Ie [mA]		
Off-state current	Ir [mA]		
Voltage drop	Ud @ Ie [V]		
Time delay before availability	tv [ms]		
Indicator [UB / Output]			
Short circuit- overload-protection			
Reverse polarity protection			
Conformity	EMC EEC-direct.	IEC 60947-5-2 : 2004	IEC 60947-5-2 : 2004
EMC		IEC 61000-4-6 (3V) Functional errors may occur in frequency range 0.25-0.6 Mhz (sensor grounded)	IEC 61000-4-6 (3V) Functional errors may occur in frequency range 0.25-0.6 Mhz (sensor grounded)
Associated equipment		SLK-HT	SLK-HT
Additional functionality			

Application





190308

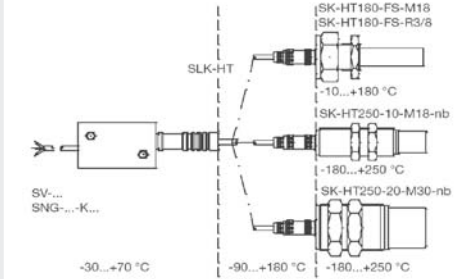


190308

application notes

The capacitive high temperature sensors are especially suitable for applications where the sensor head is exposed to a high ambient temperature, or comes directly into contact with hot materials. The units are used as fill level detectors in liquids and bulk goods, or as distance sensors for detecting block materials in hot surroundings.

Application



Sensors of the SK-HT series connected only via additional lead / triax FEP 2 m fix with integrated oscillator, Type SLK-HT, Art. No. 09007

Typ / Type	Typ / Type
SK-HT180-FS-M18-VA/PTFE	SKL-HT
SK-HT180-FS-R3/8-VA/PTFE	
SK-HT180-FS-J3/8NPTF-VA/PTFE	
NB	
-10... 180	-10...70
IP 68 (6 bar max ) / IP 54	IP 54
A: PTFE; B: V2A; C: PTFE/MS/Cr	
SLK-HT	2m Triax FEP
IEC 60947-5-2 : 2004	IEC 60947-5-2 : 2004
IEC 61000-4-6 (3V) Functional errors may occur in frequency range 0.25-0.6 Mhz (sensor grounded)	see SK-HT### sensors
SLK-HT	SV-; SNG-...-K & SL-YA-m20; SL-YAZA-3m



## Sensor power packs

### Series SNG 1200

- Clamps housing width 22.5 mm
- Quick-mount
- Relay output
- Supply voltage 230 VAC or 115 VAC
- Sensor input PNP and NPN
- Min-Max control



12.01 -  
12.03



DIN EN ISO 9001:2000  
QA 05 100 1050

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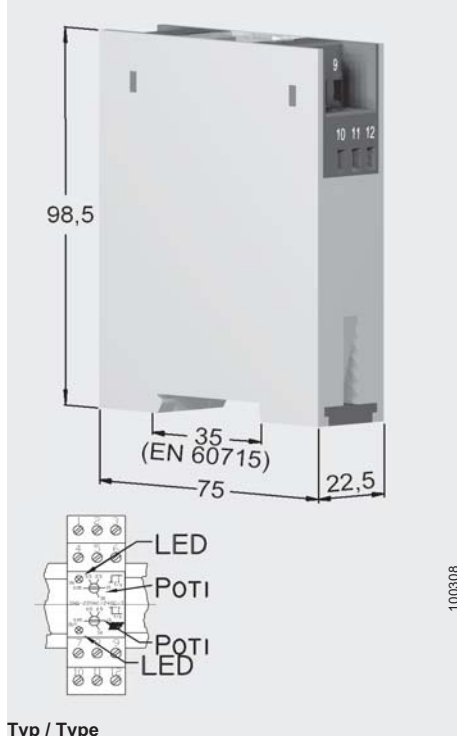
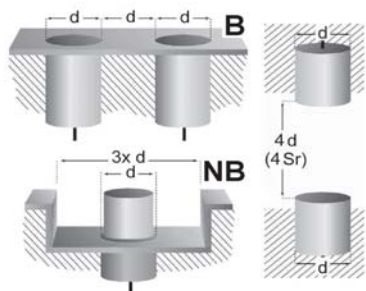


**DC**

application notes

Type code (abstract)

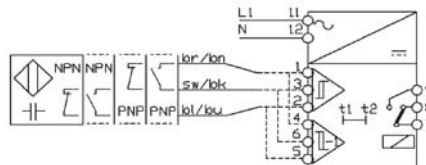
- SK sensor capacitive, w/o amplifier
- SKF sensor cap. w/o amplifier, flexible
- SK1 sensor capacitive, self-contained
- SV(D) sensor amplifier (dynamic)
- SNG sensor power pack
- HT### high temperature use
- TM pulse modulation technique (High noise immune)
- ## / FS(A) max sensing distance / Fill-level switch (adaptive)
- M30 model and/or dimension
- P output stage PNP, NPN, X (switchable)
- B mounting B=flush NB=non-flush
- S S=N.O. Ö=N.C. X=function switchable
- (C)PTFE Housing material, e.g. PTFE CPTFE=complete PTFE
- 1M2-Y2 cable & connector: Y# = connector 1M2 = 1.2m cable length



Typ / Type  
SNG-230AC/24DC-T  
SNG-115AC/24DC-T

**Not for use with XDC-output stage (e.g. microLEVEL)**

Wiring diagramm



Mounting [flush / nonflush]	[ B / NB ]		
Operating distance	Sn [mm]		
Hysteresis	H [%SR]		
Frequency of operating cycles	f [Hz]	10	
Repeat accuracy	R [%SR]		
Operating temperature range	Ta [C°]	-30... 70	
Temperature drift [range]	[%SR]		
Protection class		IP 40 / 20	⊘ IP 20
Rated insulation voltage	Ui [V]		
Material of housing		Makrolon 8020, 2800	
Utilisation category			
Connection		Klemmen	⊘
Supply voltage range UB	Ub [V]	230 (115) V 40... 60 Hz	
No-load supply current	lomax. [mA]	20 / 40	
Minimum operational current	Im [mA]		
Operational current	Ie [mA]	380VAC / 250VDC / 8A	☑ ☒
Off-state current	Ir [mA]		
Voltage drop	Ud @ Ie [V]		
Time delay before availability	tv [ms]		
Indicator [UB / Output]		- / •	
Short circuit- overload-protection			
Reverse polarity protection			
Conformity	EMC EEC-direct.	IEC 60947-5-2 : 2004 73/23	CE
EMC			
Associated equipment			
Additional functionality		50ms...30s 50ms...30s	☑ ☒
Application			

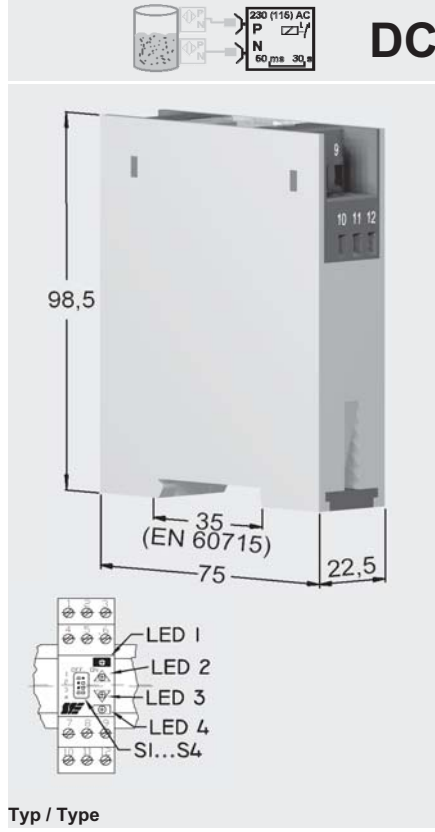
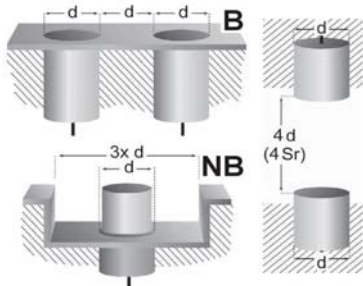


# BALLUFF

SIESENSORIK

Type code (abstract)

- SK sensor capacitive, w/o amplifier
- SKF sensor cap., w/o amplifier, flexible
- SK1 sensor capacitive, self-contained
- SV(D) sensor amplifier (dynamic)
- SNG sensor power pack
- HT### high temperature use
- TM pulse modulation technique (High noise immune)
- ## / FS(A) max sensing distance / Fill-level switch (adaptive)
- M30 model and/or dimension
- P output stage PNP, NPN, X (switchable)
- B mounting B=flush NB=non-flush
- S S=N.O. Ö=N.C. X=function switchable
- (C)PTFE Housing material, e.g. PTFE CPTFE=complete PTFE
- 1M2-Y2 cable & connector: Y# = connector 1M2 = 1.2m cable length



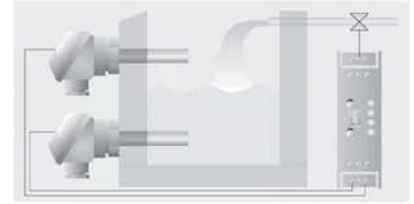
Typ / Type  
SNG-230AC-MINMAX  
SNG-115AC-MINMAX

100308

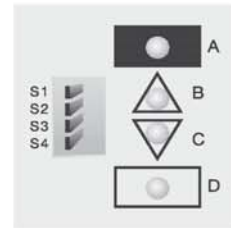
application notes

**Not for use with XDC-output stage (e.g. microLEVEL)**

Function



When both sensors are de-activated, the relay switches on "LED-empty" lights up (contact 7/9 locked out). When the minimum sensor gives a closed signal, the "LED-filling" illuminates. As soon as both sensors are activated, the relay switches off "LED-full" lights up (contact 7/9 open). When the maximum sensor signals open, the "LED indicating empty" will light up. The relay will not switch on again until both sensors are de-activated. Further functions are possible with the Mini-Dip-Switch (see below).



Dip-Switch Function

- Sensing setting (sketch) = as-delivered condition
- S1 Time-delay Max sensor (off: approx. 0.2 sec.; on: approx. 5 sec.)
  - S2 Time-delay Min sensor (off: approx. 0.2 sec.; on: approx. 5 sec.)
  - S3 Power-on set-up (off: filling; on: emptying)
  - S4 Output (Relay invers)

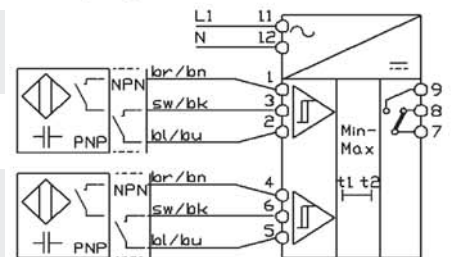
Display

A fill - B filling - C emptying - D empty

Features

- Min/Max level sensor controls
- automatical adapting PNP and NPN
- Connection points for two sensors SK-1 series (N.O.)
- Short circuit proof on the DC side
- Separate switchable delays for either Min - Max sensor from approx. 0,2 sec / 5sec

Wiring diagramm



Mounting [flush / nonflush]	[ B / NB ]		
Operating distance	Sn	[mm]	
Hysteresis	H	[%SR]	
Frequency of operating cycles	f	[Hz]	5
Repeat accuracy	R	[%SR]	
Operating temperature range	Ta	[C°]	-30... 70
Temperature drift [range]		[%SR]	
Protection class			IP 40 / 20
Rated insulation voltage	Ui	[V]	
Material of housing			Makrolon 8020, 2800
Utilisation category			
Connection			Klemmen
Supply voltage range UB	Ub	[V]	230 (115) V 40... 60 Hz
No-load supply current	Iomax.	[mA]	20 / 40
Minimum operational current	Im	[mA]	
Operational current	Ie	[mA]	380VAC / 250VDC / 8A
Off-state current	Ir	[mA]	
Voltage drop	Ud @ Ie	[V]	
Time delay before availability	tv	[ms]	
Indicator [UB / Output]			- / •
Short circuit- overload-protection			
Reverse polarity protection			
Conformity	EMC EEC-direct.		IEC 60947-5-2 : 2004 73/23
EMC			
Associated equipment			
Additional functionality			Min Sensor: 0,2 s / 5s Max-Sensor: 0,2s / 5s INIT-set-up

Application

## Accessories

### Series 1300

- Mounting blocks
- Plugs
- Connection leads
- Threaded adapters



13.01 –  
13.05



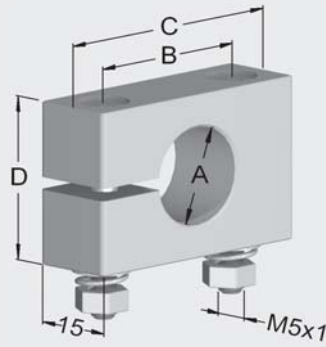
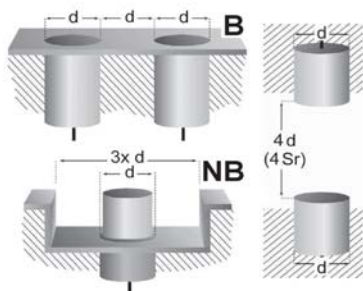
DIN EN ISO 9001:2000  
QA 05 100 1050

# BALLUFF

SIESENSORIK

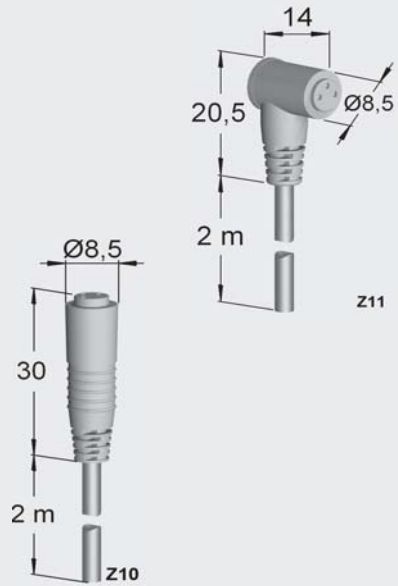
**Type code (abstract)**

- SK sensor capacitive, w/o amplifier
- SKF sensor cap., w/o amplifier, flexible
- SK1 sensor capacitive, self-contained
- SV(D) sensor amplifier (dynamic)
- SNG sensor power pack
- HT### high temperature use
- TM pulse modulation technique (High noise immune)
- ## / FS(A) max sensing distance / Fill-level switch (adaptive)
- M30 model and/or dimension
- P output stage PNP, NPN, X (switchable)
- B mounting B=flush NB=non-flush
- S S=N.O. Ö=N.C. X=function switchable
- (C)PTFE Housing material, e.g. PTFE CPTFE=complete PTFE
- 1M2-Y2 cable & connector: Y# = connector 1M2 = 1.2m cable length



	13001	13002	13003	13004
	ø18	ø22	ø30	ø34
A	18	22	30	34
B	30	30	45	45
C	45	45	60	60
D	30	30	45	45

Typ / Type  
 MB-18  
 MB-22  
 MB-30  
 MB-34

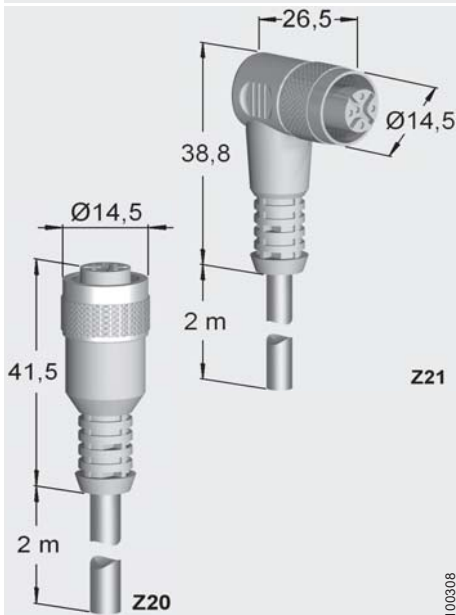


Typ / Type  
 Z10  
 Z11

Mounting [flush / nonflush]	[ B / NB ]		
Operating distance	Sn [mm]		
Hysteresis	H [%SR]		
Frequency of operating cycles	f [Hz]		
Repeat accuracy	R [%SR]		
Operating temperature range	Ta [C°]	-30... 60	-30... 70
Temperature drift [range]	[%SR]		
Protection class			
Rated insulation voltage	Ui [V]		
Material of housing		PVC	PUR
Utilisation category			
Connection			2m / 3x 0,14mm <sup>2</sup> PUR
Supply voltage range UB	Ub [V]		
No-load supply current	Iomax. [mA]		
Minimum operational current	Im [mA]		
Operational current	Ie [mA]		
Off-state current	Ir [mA]		
Voltage drop	Ud @ Ie [V]		
Time delay before availability	tv [ms]		
Indicator [UB / Output]			
Short circuit- overload-protection			
Reverse polarity protection			
Conformity	EMC EEC-direct.		
EMC			
Associated equipment			
Additional functionality			
Application			



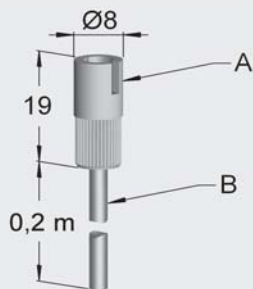
application notes



Z21

Z20

100308



Ø8

19

0,2 m

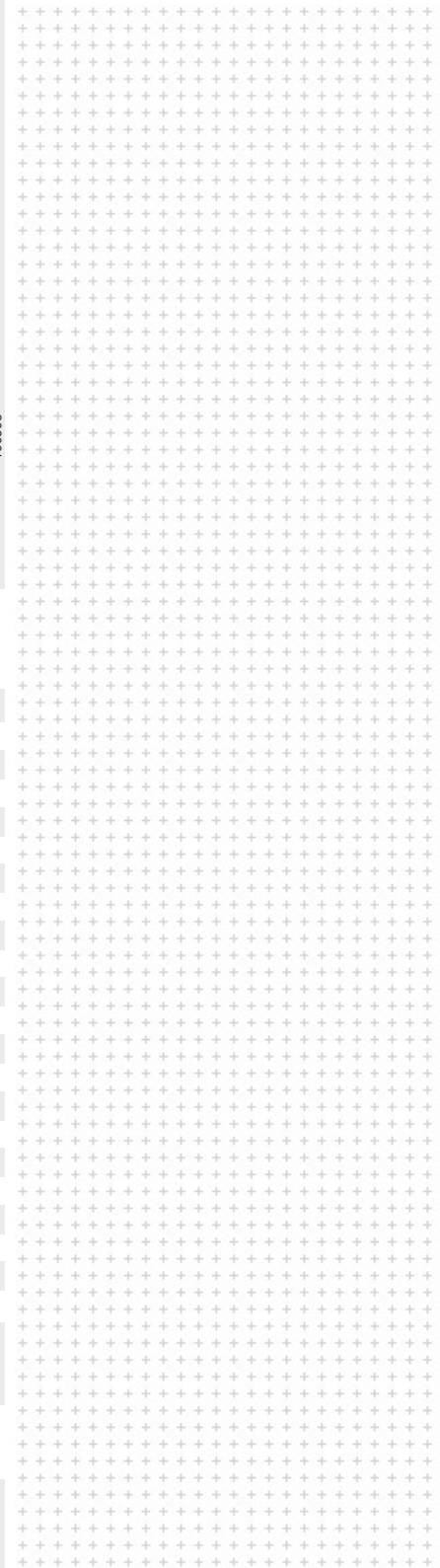
A

B

100308

General note:  
Application notes not available. Please follow the general requirements given in the product catalog.

Notes:



Typ / Type  
Z20

Typ / Type  
SL-YA-M20

Z21

-30... 70

-30... 70

PUR

A: PA; B: PUR

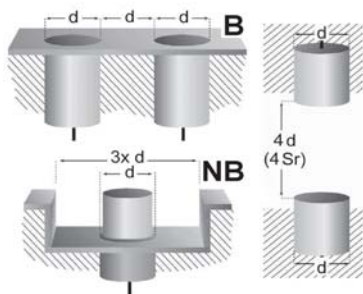
2m / 3x 0,34mm<sup>2</sup> PUR

0,2m / 3x 0,14mm<sup>2</sup> PUR

**BALLUFF**  
SIESENSORIK

Type code (abstract)

- SK sensor capacitive, w/o amplifier
- SKF sensor cap., w/o amplifier, flexible
- SK1 sensor capacitive, self-contained
- SV(D) sensor amplifier (dynamic)
- SNG sensor power pack
- HT### high temperature use
- TM pulse modulation technique (High noise immune)
- ## / FS(A) max sensing distance / Fill-level switch (adaptive)
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- 1M2-Y2 cable & connector: Y# = connector 1M2 = 1.2m cable length

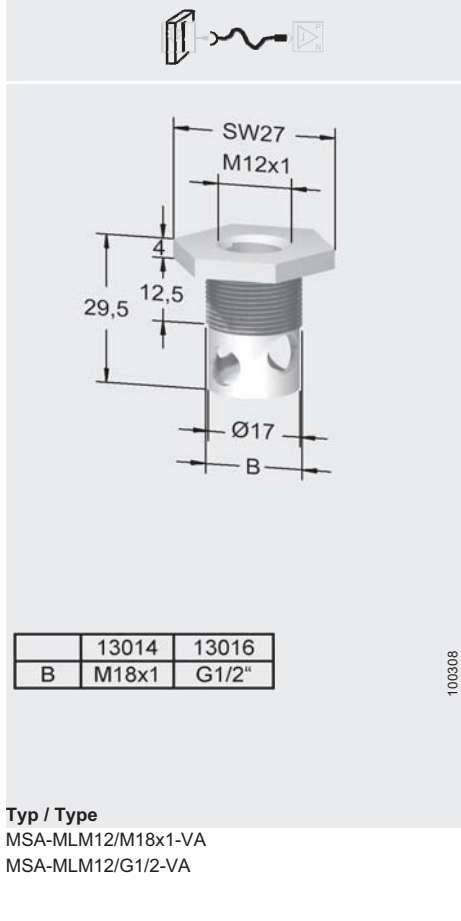
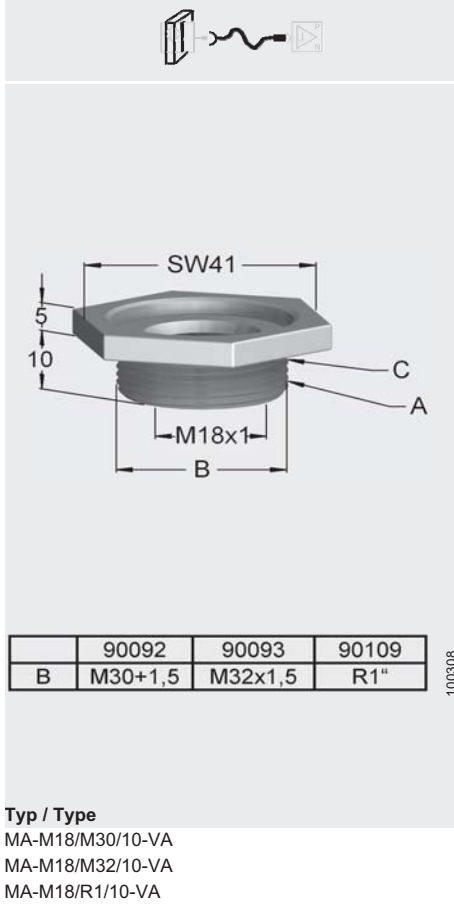


	90092	90093	90109
B	M30+1,5	M32x1,5	R1"

Typ / Type  
MA-M18/M30/10-VA  
MA-M18/M32/10-VA  
MA-M18/R1/10-VA

	13014	13016
B	M18x1	G1/2"

Typ / Type  
MSA-MLM12/M18x1-VA  
MSA-MLM12/G1/2-VA



Mounting [flush / nonflush]	[ B / NB ]		
Operating distance	Sn [mm]		
Hysteresis	H [%SR]		
Frequency of operating cycles	f [Hz]		
Repeat accuracy	R [%SR]		
Operating temperature range	Ta [C°]		
Temperature drift [range]	[%SR]		
Protection class			
Rated insulation voltage	Ui [V]		
Material of housing		A: V2A;C: O-Ring	V2A
Utilisation category			
Connection			
Supply voltage range UB	Ub [V]		
No-load supply current	Iomax. [mA]		
Minimum operational current	I <sub>m</sub> [mA]		
Operational current	I <sub>e</sub> [mA]		
Off-state current	I <sub>r</sub> [mA]		
Voltage drop	U <sub>d</sub> @ I <sub>e</sub> [V]		
Time delay before availability	t <sub>v</sub> [ms]		
Indicator [UB / Output]			
Short circuit- overload-protection			
Reverse polarity protection			
Conformity	EMC EEC-direct.		
EMC			
Associated equipment			
Additional functionality			
Application			





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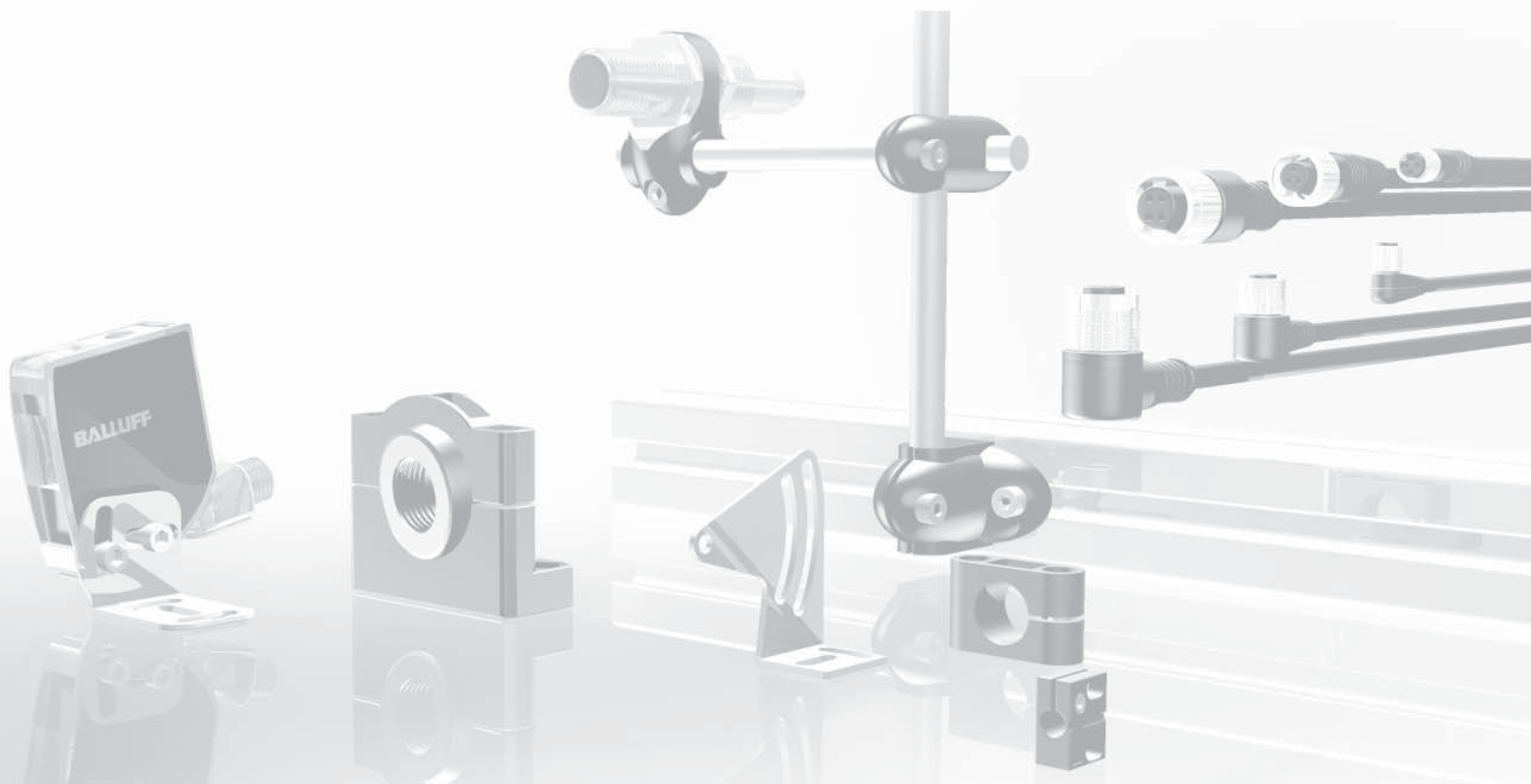
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-  Mounting System



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Additional accessories can be found in the Internet, our "Accessories" catalog or the "Object Detection" catalog.



**Object Detection**



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**Linear Position Sensing**



**Linear Position Sensing**

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**Industrial Identification**



**Industrial Identification**

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 Industrial RFID Systems BIS L  
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 Industrial RFID Systems BIS S  
 Vision Sensor BVS

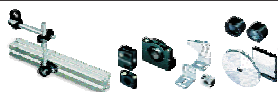
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**Industrial Networking and Connectivity**

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**Mechanical Accessories**

Attachments  
 Mounting System BMS

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**Industrial Networking and Connectivity**



**Mechanical Accessories**



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