Analog sensor

Series SK1-A 0800

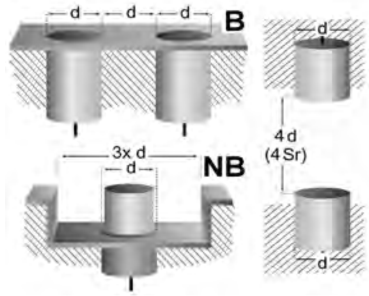
- Measuring range 0...8 mm adjustable
- Flush mounting
- Output signal current 4...20 mA
- Housing M18

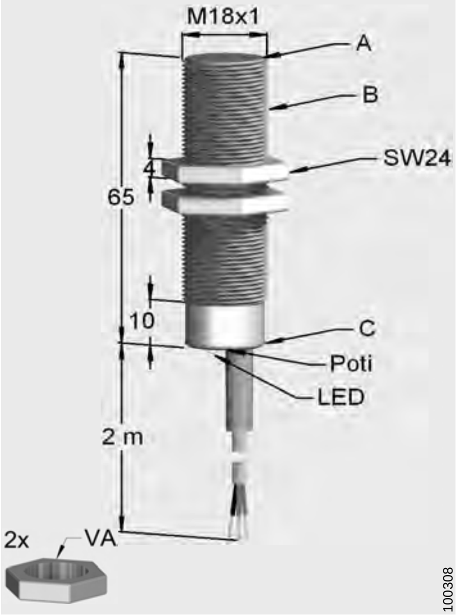
8.01 –
8.04

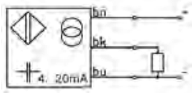
DIN EN ISO 9001:2000
QA 05 100 1050

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	ouput 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



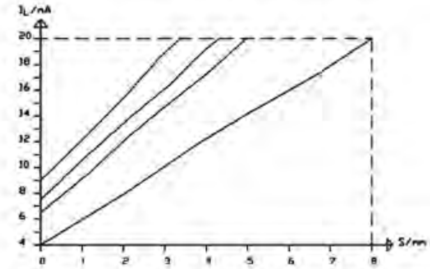




Typ / Type
SK1-A-8-M18-4I20-B-VA/PBT

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

Calibration
When performing measurements on objects with a low relative dielectric coefficient (εr ☐ 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 ther e 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 εr 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	4,0	0...2,8	4...20	0,35
(PVC)	6,0	0...3,25		0,41
Acryl glass	8,0	0...3,45		0,47
(PMMA)	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 adjust after delivery.
The as-delivered condition is calibration on a metal target

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.

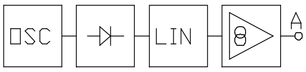


Fig. 8.01

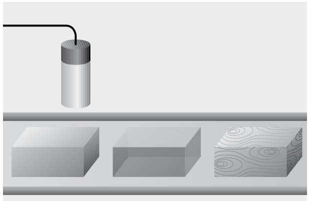
The criteria for an analog evaluation are the material properties, the size of the object involved, and its distance from the "active sensor surface". For objects deviating from the standard target, the maximum working distance is reduced
(see Fig. 8.06 on page 8.04).
In actual operation, the optimum 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

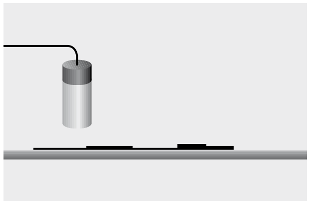
The capacitive analog sensor scans objects without contact. This means that the object scanned is not subjected to any mechanical wear and tear. Nor do colors and surface roughnesses have any negative effect on the measured result.
In the case of differing object materials, the output signal deviates 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

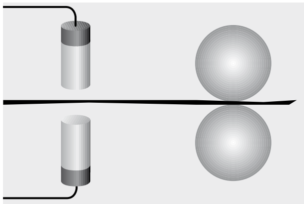
The capacitive analog sensor makes linear evaluation of a position for the first time; as soon as an object is located within the sensor's measuring range, a precise output current is produced.
The uses shown represent only a fraction of the multifaceted application options provided by the capacitive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



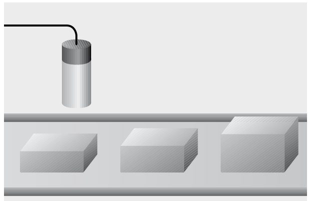
Material selection



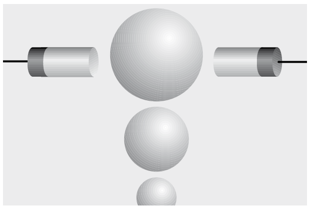
Measuring nonmetallic coating thicknesses



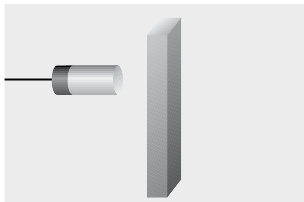
Product thickness monitoring



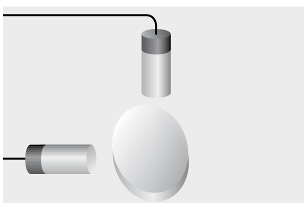
Height measurement



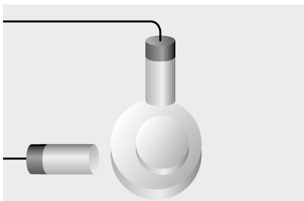
Determining diameters



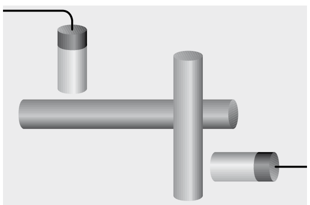
Static/dynamic movement



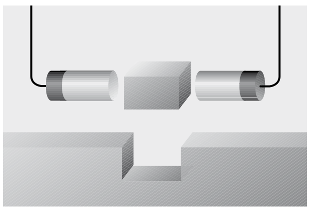
Registering radial runout



Concentricity and eccentricity



Axial and radial runout deviation



Monitoring fit

Functional principle

Calibration

When performing measurements on objects with a low relative dielectric coefficient ($\varepsilon_r < 10$), 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).

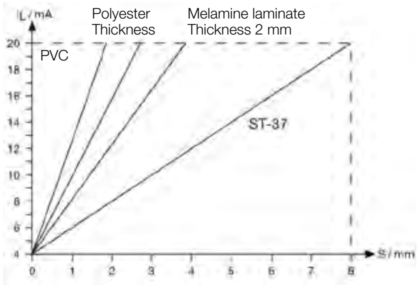


Fig. 8.02

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.

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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 adjust 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 RL

$R_L = [(40 \times U_B/V) - 200]\ \Omega$
with U_B/V = 12...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.

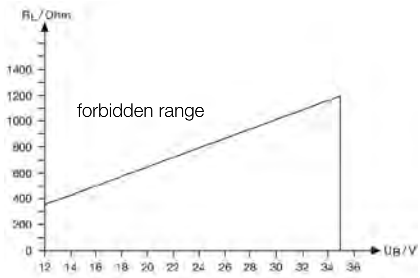

Fig. 8.03

Dimensioning example
(Fig. 8.04)
Application data: U_B = 24 V
To find: possible impedance range for load impedance.

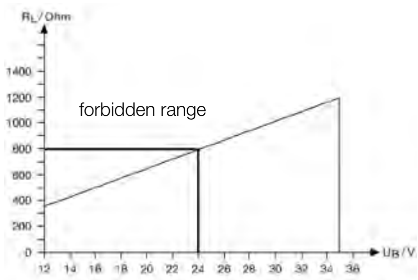

Fig. 8.04

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 Ω. You will thus obtain a permissible load impedance range of 0...760 Ω 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_A / mA	Reduction-factor
Steel ST-37	1.5	0...8	4...20	/
Brass Ms	1.5	0...8	4...20	/
Water				/
Polyvinyl chloride	4.0	0...2.8	4...20	0.35
(PVC)	6.0	0...3.25		0.41
Acrylic	8.0	0...3.45		0.47
(PMMA)	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