CAPACITIVE SENSORS

Links to further documents for this series:
Catalogue

KS SERIES

Key-Features:
- *extremely high resolution (Nanometer)*
- *Measurement ranges 50 µm up to 10 mm*
- *Accuracy is independent of temperature*
- *Temperature range -50 to +200 °C,*
- *custom probes up to +450 °C*
- *High class electronics, one or multi-channel*
- *Cost effective electronics KL*
- *Analog output 0...10 V*
- *Protection class sensors up to IP68*
- *Reliable measurements even in extreme environments, like nuclear radiation, high vacuum or near 0 K*
- *Customized probes feasible*

Content

TECHNICAL DATA - SENSORS

		K0005	K0020	K0050	K0100	K0200	K0300	K0500	K1000
Measurement range	[mm]	0.05	0.2	0.5	1	2	3	5	10
Linearity [1]	[%]	±0.4 / ±0.2							
Resolution dynamic	[%]	0.02							
Sensitivity	[µm/V]	5 ±0.2%	20 ±0.2%	50 ±0.2%	100 ±0.2%	200 ±0.2%	300 ±0.2%	500 ±0.2%	1000 ±0.2%
Tolerance of sensitivity [2]	[%]	±2	±1	±0.5					
Temperature error sensitivity	[x10^{-6}/K]	-3	-0,3	-11	-1.1	-3			
Coefficient of thermal expansion	[µm/K]	0.03		0.06		0.17			
Operating temperature	[°C]	-50...+200							
Diameter active area	[mm]	1.1	2.3	3.8	5.5	7.9	9.8	12.6	17.7
Minimum target diameter	[mm]	3	6	7	9	17	27	37	57
Connection cable [3]		L13-12, L13-14, L33-12, L33-14			L13-11, L13-13, L33-11, L33-13				
Weight	[g]	1.7	2.5	5.7	7.1	61	95	120	230
Housing material (nach DIN EN 10027-2)		1.3912		1.4104		1.4305			

[1] depending on the connected electronics
[2] manufacturing tolerance
[3] only use listed cables. For more information see section „Cable".

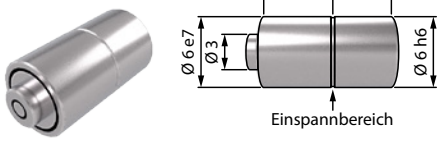
TECHNICAL DATA - ELECTRONICS

		KL	KL3M
Linearity [1] (at 0...40 °C, dielectric: air)	[%]	<±0.4	±0.2
Repeatability	[%]	0.02 [2]	
Sampling rate	[kHz]	0.5	
Power supply		100...240 V, 50 Hz / 60 Hz	
Power consumption	[VA]	5	
Operating temperature	[°C]	0...+70	0...+85
Storage temperature	[°C]	-20...+80	-20...+90
Warm up time	[min]	3	
Weight	[kg]	0.35	0.7
Dimensions (B x H x T)	[mm]	64 x 35 x 115	80 x 60 x 170
Housing construction		aluminium die-cast	
Voltage output		**„OUT"**	
Sensitivity [3]		10 V/mm ±0.2%	
Linearity	[%]	<±0.4	±0.2
Temperature error sensitivity	[%/°C]	<0.02	<0.01
Output voltage max.	[V]	±10	
Output current max.	[mA]	±5	
Frequency dependency		0...500 Hz (-3 dB)	
Noise		<10 mV_{ss}	
Connector		LEMO	BNC

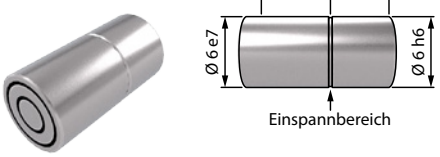
[1] based on the measurement range
[2] based on the resolution
[3] These specifications are valid for the use of the probe K0100. All other probes may also be used with the electronics. The reading has to be converted with an integer factor according to the used probe.

TECHNICAL DRAWING - SENSORS

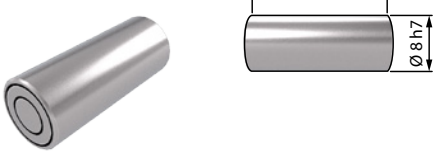
K0005



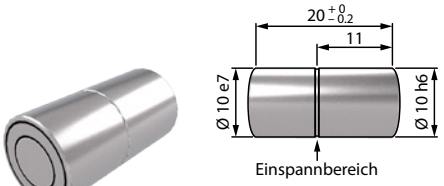
K0020



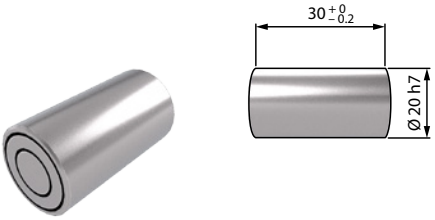
K0050



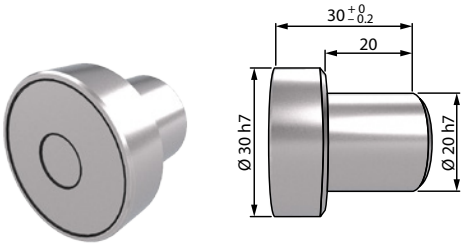
K0100



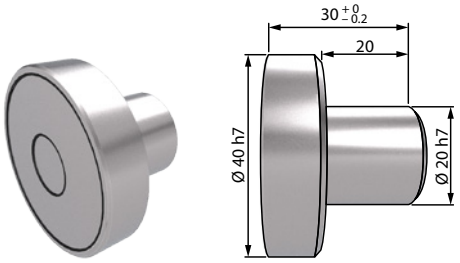
K0200



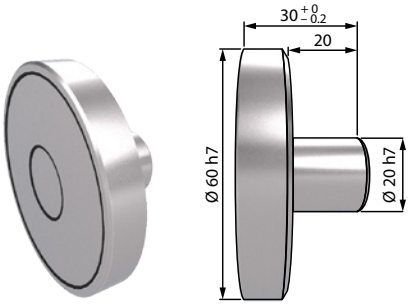
K0300



K0500

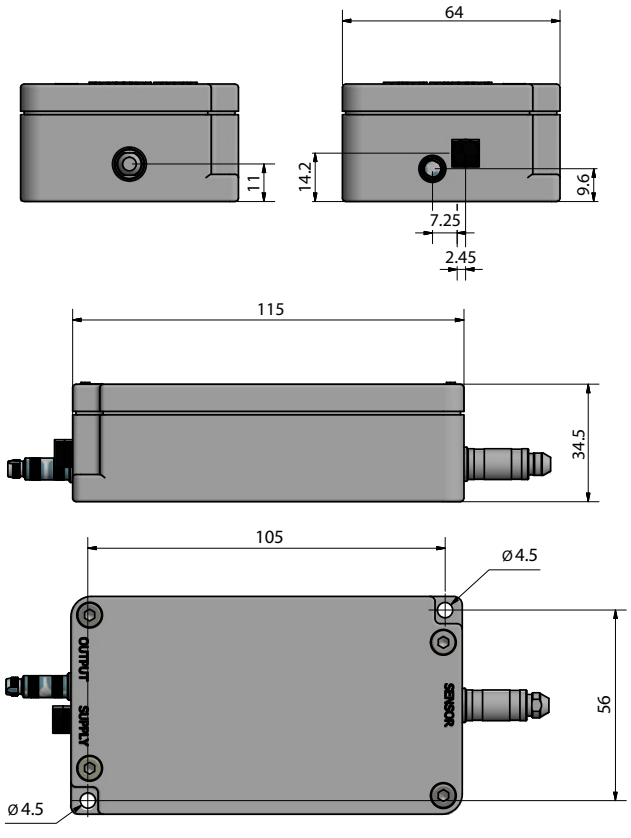


K1000

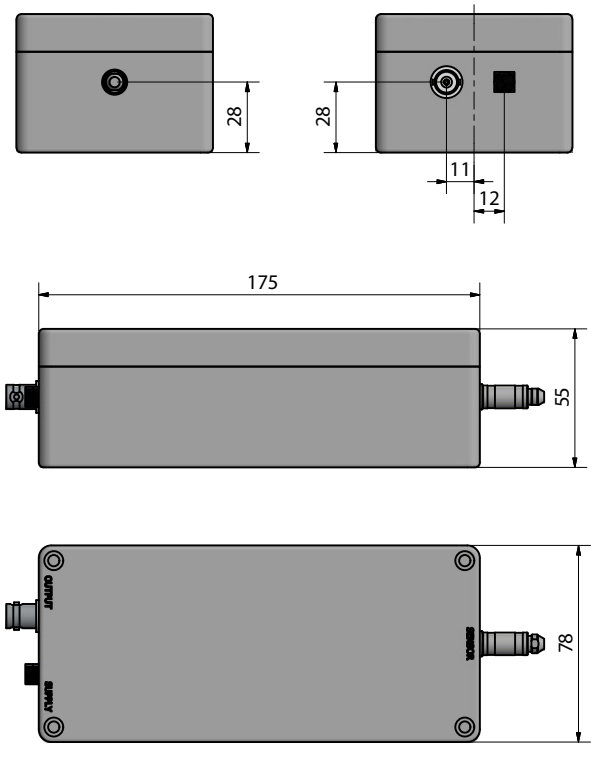


TECHNICAL DRAWING - ELECTRONICS

KL

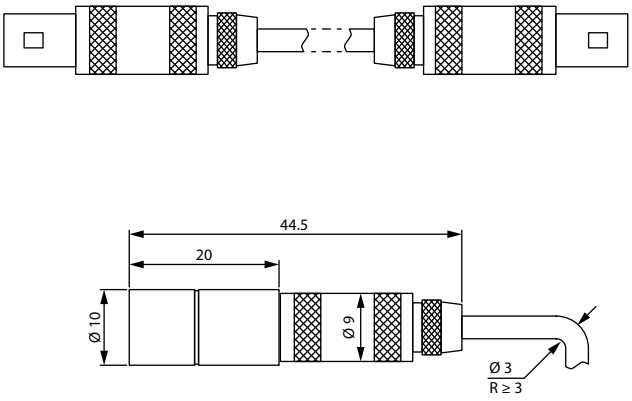


KL-3M



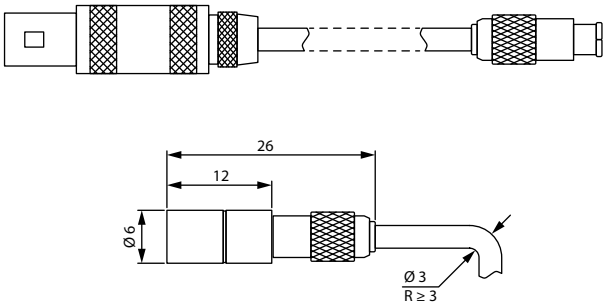
TECHNICAL DRAWING - CABLES

L13-11, L33-11



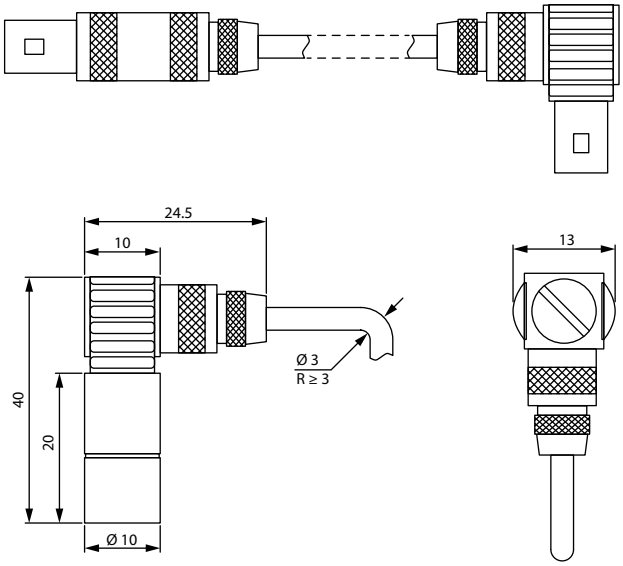
dimensions with K0100

L13-12, L33-12



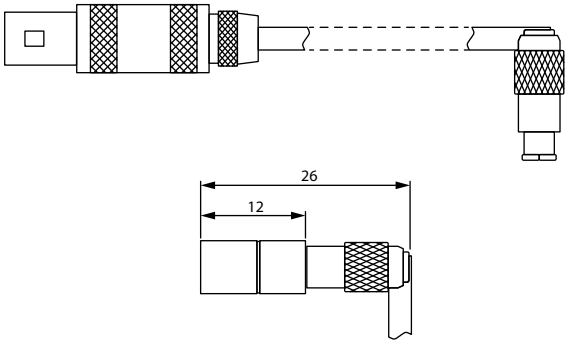
dimensions with K0020

L13-13, L33-13



dimensions with K0100

L13-14, L33-14



dimensions with K0020

Attention: The cable is part of the resonant circuit and must therefore not be shortened, bent or changed in any other way. The cable is a specially manufactured triaxial-cable, designed for best measurement results. Please use original cables only.

Cable	**L13-11**	**L13-12**	**L13-13**	**L13-14**	**L33-11**	**L33-12**	**L33-13**	**L33-14**
Length	1 m				3 m			
Cable diameter	3 mm							
Operating temperature	-50...+150 °C							
For sensor heads	K0100 K0200 K0300 K0500 K1000	K0005 K0020 K0050	K0100 K0200 K0300 K0500 K1000	K0005 K0020 K0050	K0100 K0200 K0300 K0500 K1000	K0005 K0020 K0050	K0100 K0200 K0300 K0500 K1000	K0005 K0020 K0050

EXAMPLES - SENSORS

EXAMPLES - APPLICATIONS

- Dynamic measurement on turbines and motors
- Offset and wear measurement on bearings
- Concentricity measurement on axes, shafts and bores
- Measurement of modulus of elasticity and thermal expansion
- Distance measurement in the low temperature range and high temperature range up to 450 °C
- Reference system for other distance sensors
- Tolerance verification in mass production
- Vibration measurements
- Elongation measurements
- Thickness measurement and control of thin metal foils and plastic foils, also during production
- Measurement of thickness, bevel and deflection of wafers in semiconductor production

K0200 with KL3M Electronic

MEASUREMENT PRINCIPLE

The design of capacitive sensors is based on the fact that the reactance of an ideal plate capacitor is proportional to the distance between the plates. The measurement sensor is a guard ring capacitor, whose guard ring is connected to the inner shield of the double shielded measuring cable. A negative feedback amplifier keeps this protective shield tuned exactly to the potential of the sensor centre electrode. This ensures an almost homogeneous field between the capacitor plates along the entire measuring range and nearly complete independence of changes in cable capacity. If an alternating current of constant amplitude and frequency passes through the sensor capacitor, the amplitude of the alternating voltage between the capacitor plates (electrode of sensor and object to be measured) is proportional to the distance between the two. Through a low-pass filter and an amplifier the voltage difference is conducted towards the output terminal.
The measurement of the distance meter is affected by the properties of the dielectric. Generally, the sensor will be used for measurements in air.

Measurements in liquids
The measurements is affected by impurities and by gas bubbles. The real distance is found by multiplying the distance (provided by the meter) with the dielectric constant (epsilon) of the fluid.. Please also consider that generally the dielectric constants of liquids are temperature dependent and that the dielectric losses of the liquids used must be negligible, i.e. the liquids must be insulating.

Magnetic fields
Magnetic fields can be neglected, as long as there is no exertion of force to the measurement system. On request the sensor heads can be made of non-magnetic material, like Titanium.

Measurements on insulation material
The capacitive sensors can also be used to measure the thickness of non-conductive materials such as plastics, foils, quartz, glass, ceramics, etc.

Specific resistance
The relatively low carrier frequency of the system allows measurement at materials in the micro ohm to kilo ohm range without special recalibration. This also covers the entire range of the semiconductor silicon. This fact is of great importance when measuring on case-hardened shafts in the mechanical engineering sector. This is because an inhomogeneous micro-structure has no influence on the measurement results. There is almost no other method to control the displacement of a shaft running in oil in a sliding bearing than by a capacitive sensor.

ORDER CODE

K – ☐

Sensor head	
Measurement range 0...0.05 mm	0005
Measurement range 0...0.2 mm	0020
Measurement range 0...0.5 mm	0050
Measurement range 0...1 mm	0100
Measurement range 0...2 mm	0200
Measurement range 0...3 mm	0300
Measurement range 0...5 mm	0500
Measurement range 0...10 mm	1000

L ☐ **3 - 1** ☐

Sensor cable	
Cable length 1 m	1
Cable length 3 m	3

	Cable version for MR ≤0.5 mm
2	2 x straight connector
4	1 x angular, 1 x straight connector
	Cable version for MR ≥1 mm
1	2 x straight connector
3	1 x angular, 1 x straight connector

K – ☐

Electronics	
Electronic for 1 m cable [1)]	L
Electronic for 3 m cable [1)]	L3M

[1)] **Please order the cable separately**.
Scope of delivery KL electronics: power supply unit, LEMO connector for output.
Scope of delivery KL3M electronics: power supply unit.

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