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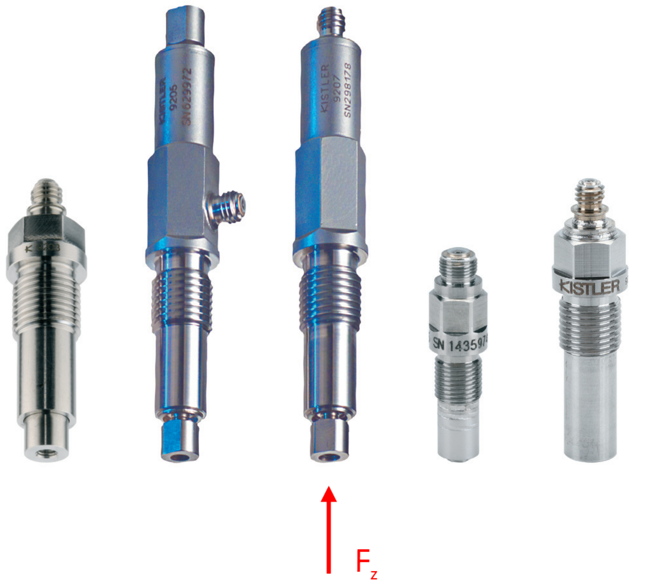
Sensors for Small Forces

–0,5 ... 0,5 N to –500 ... 500 N

Type 9203, 9205, 9207, 9215A, 9217A

These slim sensors are designed for dynamic and quasistatic tensile and compression forces. Depending on the design of the sensor, it is possible to measure small forces in measuring ranges between –0,5 ... 0,5 N to –500 ... 500 N. As a result of the high sensitivity of the integrated measuring element and special constructive measures during force application, the sensors' threshold is less than one millinewton. The sensors have a sealed housing and are designed for use in industry and the laboratory. Installation of the sensors directly into the structure is made possible by the thread on the shaft. Force is applied to the front side.

- 3 calibrated measuring ranges
- Highly sensitive, for forces from 1 mN
- For tensile and compression forces
- Slim design for small sensor distances



Type 9203 Type 9205 Type 9207 Type 9215A Type 9217A

Description

The sensors are based on the piezoelectric measurement principle. The force acting on the highly sensitive transversal measuring element generates a proportional charge at the signal output. The measuring amplifier to be placed downstream (e.g., ICAM Type 5073A...) or process monitoring system (e.g., maXYmos Type 5867B... /5877A...) converts this into a process signal or curve that can be evaluated (e.g., 0 ... 10 V). The slim, pen-like structural shape of the sensor bodies and the force application on the axial tapped hole are important features of these sensors.

Application

Due to their slim geometry, the sensors are especially suitable for confined spaces, e.g., to simultaneously measure objects that are placed close together.
Due to the special property of the piezoelectric measuring element – almost constant measurement accuracy over a wide force range – the same sensor can be used across a large force spectrum. This advantage is further supported by the possibility of switching between measuring ranges by using appropriate amplifiers (ICAM Type 5073A...). This makes it possible to measure highly diverse parts at the same measuring station. The 'wide range measuring chain' also offers decisive advantages for use in a laboratory, where frequent sensor changes are part of everyday work. In addition, the extremely high overload protection when using the lower measuring ranges means there is no need for costly protective measures.

Application Examples

- Contact measurement on keys, switches, relays, etc.
- Measuring spring characteristics
- Measuring pull-out forces on plug contacts
- Construction of highly sensitive miniature measuring platforms
- Force measurement on installation machines, robots, micromanipulators, etc.

Caution

These force sensors are very sensitive measuring instruments. The highest amount of vigilance is required when working with these sensors, as they are not equipped with a mechanical fuse against overload.

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Technical Data

Please note that all technical data and further information in this data sheet is subject to change at any time without prior notice.

	Type	9203	9205	9207	9215A	9217A
Measuring range F_z	N	–500 ... 500	–50 ... 50	–50 ... 50	–20 ... 200	–500 ... 500
Overload F_z	N	–600 / 600	–75 / 150	–75 / 150	–30 / 300	–600 / 600
Calibrated measuring ranges, F_z 100 %	N	0 ... 500	–50 ... 50	–50 ... 50	0 ... 200	0 ... 500 0 ... –500
10 %	N	0 ... 50 0 ... –50	–5 ... 5	–5 ... 5	0 ... 20	0 ... 50 0 ... –50
1 %	N	0 ... 5	–0.5 ... 0.5	–0.5 ... 0.5	0 ... 2	0 ... 5
Threshold, F_z	N	<0,001	<0,0005	<0,0005	<0,0005	<0,001
Sensitivity, F_z	pC / N	≈–40	≈–115	≈–115	≈–95	≈–105
Linearity, all measuring ranges	%FSO			≤±1		
Linearity, typically	%FSO	–	–	–	–	<0.2
Hysteresis, all measuring ranges	%FSO	≤±1	≤±0,5	≤±0,5	≤±1	≤±1
Hysteresis, typically	%FSO	–	–	–	–	<0.2
Side load[1)], max., F_{xy}	N	25	10	10	90	50
Side load sensitivity $F_{x,y} \rightarrow F_z$	N / N	≤±0,25	≤±0,05	≤±0,05	≤±0,05	≤±0,02
Bending moment, max., $M_{x,y}$	N·m	0,59	0,25	0,25	0,5	1,78
Sensitivity to bending moment $M_{x,y} \rightarrow F_z$	N / N·m	–	≤±3	≤±3	≤±20	–
Torque, max., M_z	N·m	0,67	0,15	0,15	1,0	1,35
Rigidity, c_z (F_z)	N / µm	≈40	≈4	≈4	≈100	≈15
Natural frequency, f_n (F_z)	kHz	>27	>10	>10	>50	>20
Acceleration sensitivity axial	N / g	<0,02	<0,03	<0,03	$<2 \cdot 10^{-3}$	<0,035
radial	N / g	<0,002	<0,003	<0,003	$<4 \cdot 10^{-4}$	<0,0022
Operating temperature range	°C	–150 ... 240	–50 ... 150	–50 ... 150	–50 ... 180	–50 ... 150
Temperature coefficient of sensitivity, F_z	% / °C	≈–0,01	≈–0,02	≈–0,02	≈<0,04	≈<0,04
Insulation resistance at 20 °C	Ω			$>10^{13}$		
Capacity C	pF	≈22	≈26	≈26	≈15	≈45
Connection		KIAG 10-32 neg.	KIAG 10-32 neg.	KIAG 10-32 neg.	M4x0.35 neg.	KIAG 10-32 neg.
Protection class (with connected cable)	EN 60529			IP65		
Case material	DIN			1,4542		
Weight	g	13	19	19	2.5	16
Tightening torque, max., M_A M2	N·m				0.2	
M3	N·m	0.5	0.2	0.2		0.5
M5x0.5	N·m				2	
M10x1	N·m	10	10	10		10

1) Application of force on the flange level

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Dimensions

Dimensions of Type 9203

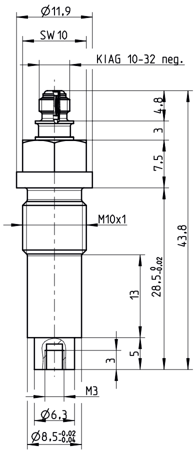

Fig. 1: Dimensions of sensor for small forces Type 9203

Dimensions of Type 9205

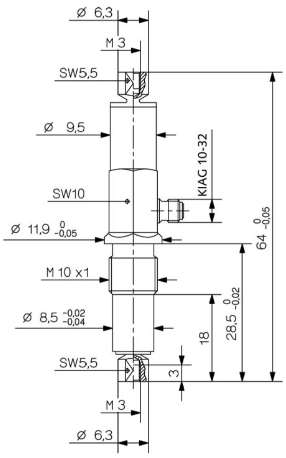

Fig. 2: Dimensions of sensor for small forces Type 9205

Dimensions of Type 9207

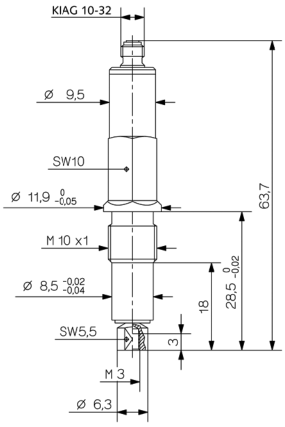

Fig. 3: Dimensions of sensor for small forces Type 9207

Dimensions of Type 9215A

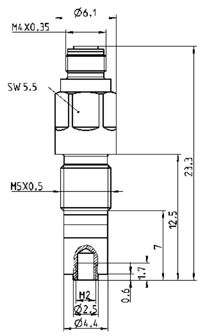

Fig. 4: Dimensions of sensor for small forces Type 9215A

Dimensions of Type 9217A

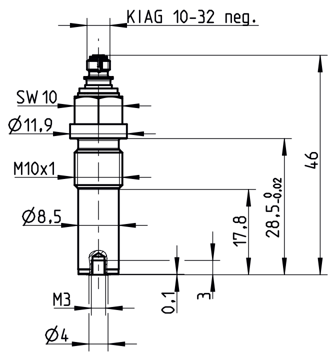

Fig. 5: Dimensions of sensor for small forces Type 9217A

Mounting Examples

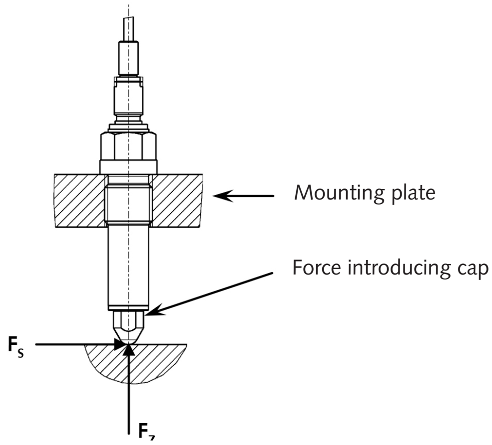

Fig. 6: Force application on force introducing cap

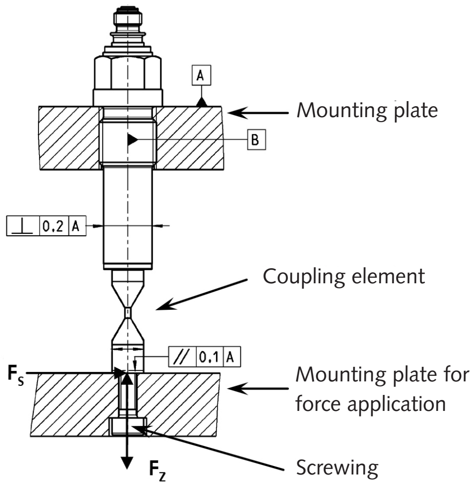

Fig. 7: Mounting with coupling element

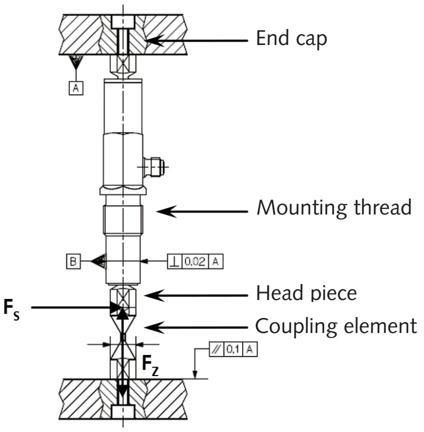

Fig. 8: Mounting of Type 9205 between two plates with coupling element

Accessories

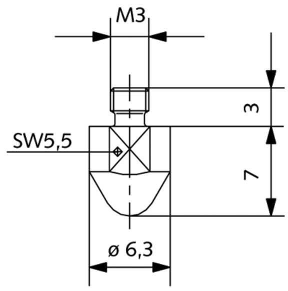

Fig. 9: Force introducing cap Art. No. 3.220.139 for Type 9203, 9205, 9207, and 9217A

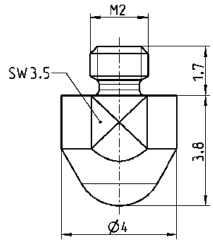

Fig. 10: Force introducing cap Art. No. 3.220.217 for Type 9215A

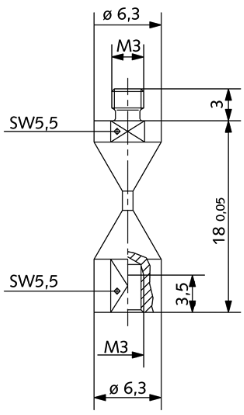

Fig. 11: Coupling element Type 9405 for Type 9203, 9205, 9207, and 9217A

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Optional Accessories

	Type
• Force introducing cap	3.220.139
• Coupling element for Type 9203, 9205, 9207, and 9217A	9405
• Connecting cable KIAG 10-32 pos. – BNC pos.	
Length 1 m	1631C1
Length 2 m	1631C2
Length 5 m	1631C5
Length 10 m	1631C10
• Fluoropolymer connecting cable, oil-proof for Type 9203, 9205, 9207, 9217A KIAG 10-32 pos. int. – BNC pos.	
Length 2 m	1983AD2
Length 5 m	1983AD5
• Connecting cable M4x0.35 pos. – BNC pos. for Type 9215A	
Length 1 m	1651C1
Length 2 m	1651C2
Length 5 m	1651C5
Length 10 m	1651C10
• Fluoropolymer connecting cable, oil-proof for Type 9215A M4x0.35 pos. int. – KIAG 10-32 pos. int	
Length 1 m	1983AB1
Length 2 m	1983AB2
Length 3 m	1983AB3
Length 5 m	1983AB5
• Coupling for Type 9203, 9205, 9207, 9217A KIAG 10-32 neg. – KIAG 10-32 neg.	1729A
• Angle coupling for Type 9203, 9205, 9207, 9217A KIAG 10-32 pos. int. – KIAG 10-32 neg.	1700A29
• Cleaning and insulation spray 250 ml	1003
• Insulation testing device	5493

For connection, extension, and connecting cables, see data sheet for Cables for Force, Torque, and Strain Sensors (1631C_000-346).

For cable connectors, couplings, and accessories, see data sheet for Coaxial Cable Connectors (1700_000-347).

Ordering Code

	Type
• Highly sensitive force sensor M10x1, axial connection, –500 … 500 N	**9203**
• Sensor for small forces M10x1, radial connection, –50 … 50 N	**9205**
• Sensor for small forces M10x1, axial connection, –50 … 50 N	**9207**
• Sensor for small forces M5x0.5, axial connection, –20 … 200 N	**9215A**
• Sensor for small tensile and compression forces M10x1, axial connection, –500 … 500 N	**9217A**

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