

Miniature Force Sensor

Type 9211B...

for Mold Cavity Pressure with diameter 6 mm

Quartz force sensor for the measuring range from 0 ... 2 500 N or for measuring mold cavity pressure of up to >3 000 bar during injection molding of plastics.

- Extremely compact
- Replaceable cable
- Available with single-wire technology

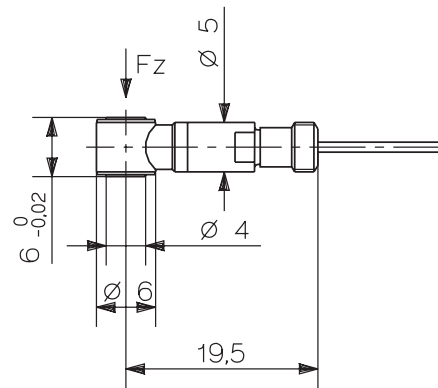
Description

The 9211B... miniature sensor offers high resolution and has extremely small dimensions and a rugged, welded case. The charge signal (pC = pico coulombs) output by the force sensor is converted in the Kistler charge amplifier or in a monitoring unit into a proportional output voltage that is largely independent of the length of the sensor cable. The maximum possible output voltage from the standard amplifier is 10 V. In the most sensitive range this gives 1 N/V. The replaceable cables allow a wide choice of connecting cables, including the single-wire version. With single-wire technology an individual cable is shortened to the required length and connected to the connector using the proven cut and grip technique. With this arrangement the mold serves as a shield for signal transmission.

For multi cavity applications the sensor Type 9211B is used without the single-wire connector Type 1839. The Multi Cavity Set Type 6829A... and the Multi Sensor System Type 6831A... are described in the appropriate data sheets.

Application

Thanks to its compactness the miniature force sensor is suitable for dynamic and quasistatic force measurements. This is particularly useful for an application like injection molding, where space is critical and forces are high. Indirect pressure measurement is particularly suitable for molds with small cavities or a large number of ejectors. The sensor is positioned under the ejector pin in the ejector plate, and measures the force curve by means of the ejector. This allows calculation of the actual mold cavity pressure.



Technical Data

Measuring range	N	0 ... 2 500
Calibrated partial range	N	0 ... 250
Overload	N	3 000
Threshold	mN	10
Sensitivity	pC/N	-4,4
Linearity, all ranges	%FSO	±1
Operating temperature range	°C	-40 ... 200
Insulation resistance		
at 20 °C	Ω	≥10 ¹³
at 120 °C	Ω	≥10 ¹²

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Force Sensor Type 9211BE

Indirect measuring sensor with replaceable single-wire cable. Suitable for mounting as complete module in the ejector plate.

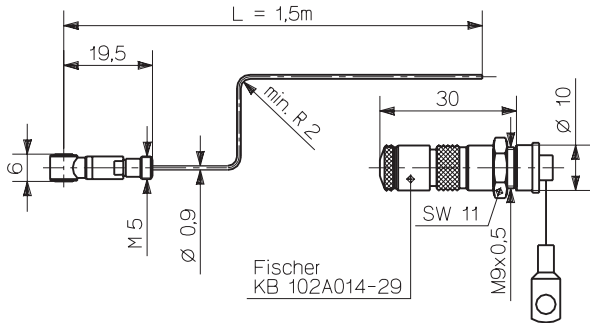


Fig. 1: Force Sensor Type 9211BE with cable and connector

Force Sensor Type 9211B0,4/0,6/0,8/sp

Indirect measuring sensor with replaceable coaxial connecting cable in lengths of 0,4/0,6/0,8 m or special lengths.

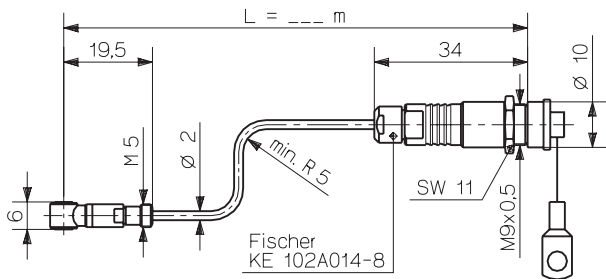


Fig. 2: Force Sensor Type 9211B0,4/0,6/0,8/sp with cable and connector

Computation of sensitivity for the pressure measurement

The front face of the ejector pin must be taken into account when mounting the force sensor for pressure measurement. The nominal sensor sensitivity (pC/N) is converted into a corresponding pressure sensitivity using the following formula.

$$\text{Calculated pressure sensitivity [pC/bar]} = \frac{\text{Nominal force sensitivity [pC/N]} \cdot \text{area of ejector pin [mm}^2]}{0,1}$$

The measuring range of the sensor must be taken into account when choosing the ejector pins. The larger the ejector pin area the higher the force on the sensor.

The following table shows the calculated sensitivity with the nominal sensitivity of the Type 9211B... and the maximum pressure for a selection of ejector pins.

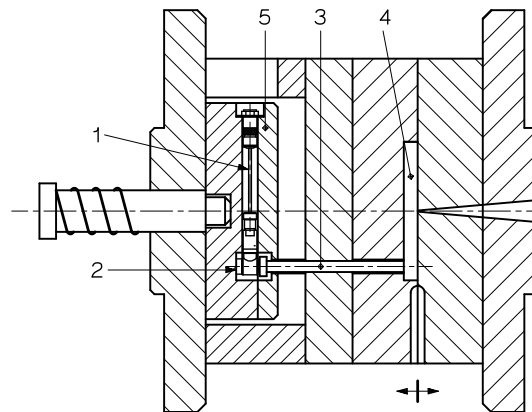
Diameter ejector pin [mm]	Sensitivity [pC/bar]	Maximum pressure [bar]
1,6	-0,88	>3 000
2	-1,38	
2,5	-2,16	
3	-3,11	2 000
4	-5,53	
5	-8,64	1 250

Mounting

The miniature force sensor has a precision ground face. The bearing surface of the ejector pin must also be finely machined, flat, rigid and exactly parallel. A hardened thrust washer must be used when mounting in a blind hole. Once mounted the sensor must not have any preload. A clearance of 0,03mm is recommended.

When using the single-wire technology, it must be ensured that the single-wire cable is kept in the ejector plate and that the Type 1839 connector is also mounted in this plate. When installing the connector in a different plate, electrical shielding by the mold must be ensured.

Principle of Operation

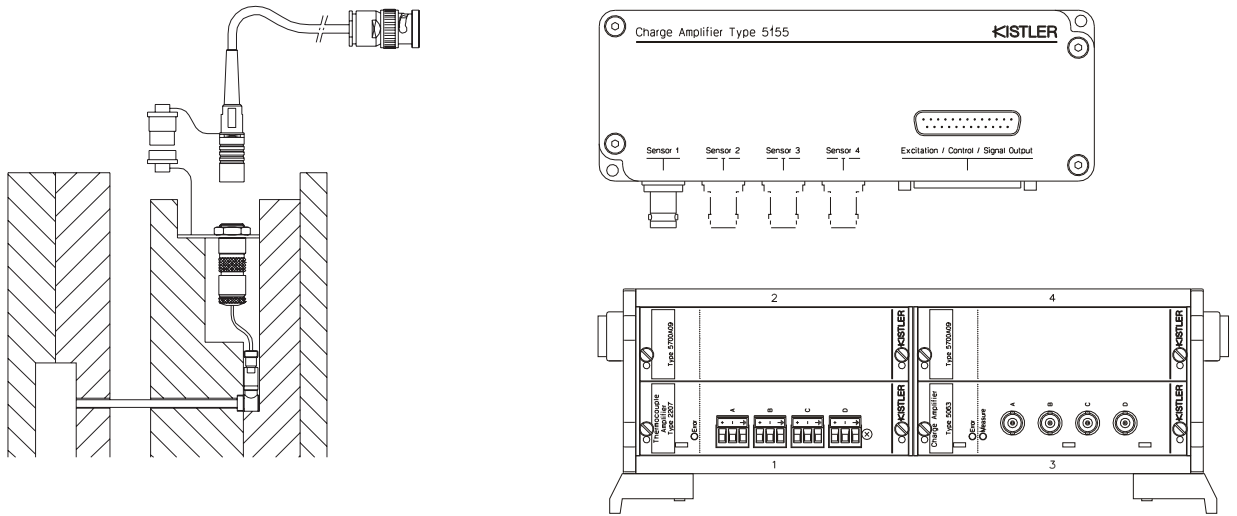


- 1 Force sensor
- 2 Thrust washer
- 3 Ejector pin
- 4 Cavity
- 5 Ejector plate

Fig. 3: Force sensor for indirect measurement of mold cavity pressure behind an ejector pin in the mold.

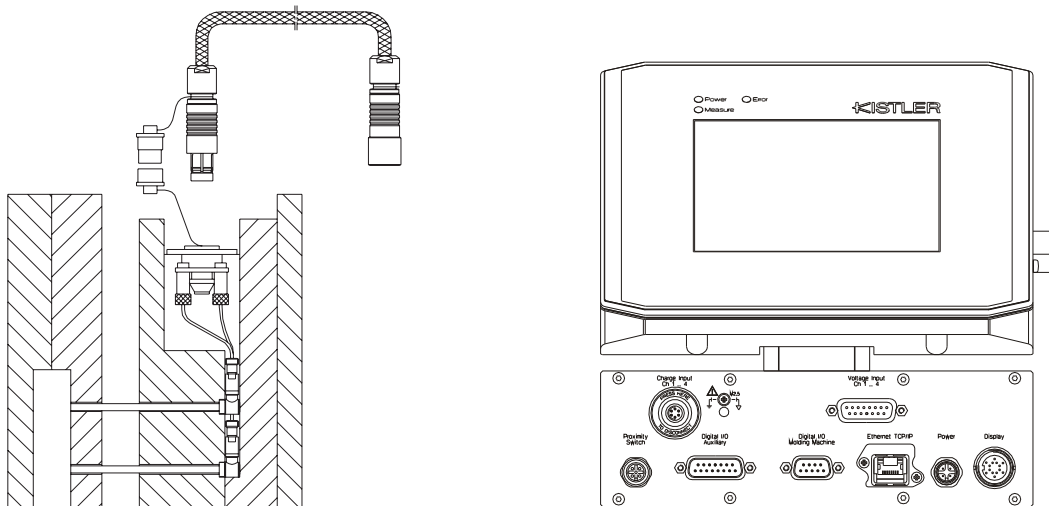
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Cable and Amplifier for Measuring Chains with Sensor Type 9211B...



Cable Type 1667B... (BNC connector)	Cable Type 1672B... (TNC connector)
Type 5039Axx2	Type 5039Axx1
Type 5049Axx2	Type 5049Axx1
Type 5155Axx2x/Axx4x/Axx8x	Type 5155Axx1x/Axx3x/Axx7x
Type 5063A1 in Type 2859A.../2865A...	

Fig. 4: Sensor Type 9211B... with charge amplifier Type 5155A... or signal conditioner Type 2859 / 2865A...



4-Channel Cable Type 1995A... to Connector Type 1708A...	8-Channel Cable Type 1997A... to Connector Type 1710A...
Type 2869A0xx	Type 2869A2xx
Type 2869A1xx	

Fig 5: Sensor Type 9211B... with monitoring system CoMo® Injection Type 2869A...

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Mounting Examples

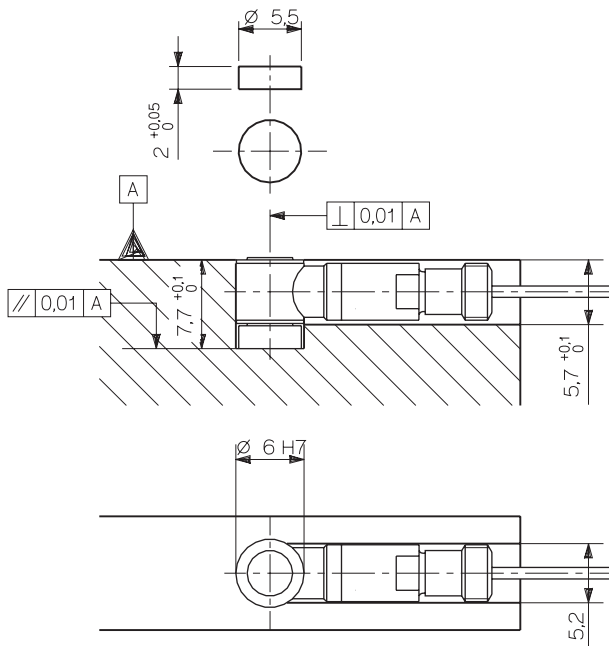


Fig. 6: Mounting in a blind hole with hardened $\varnothing 5,5$ mm thrust washer Type 9411

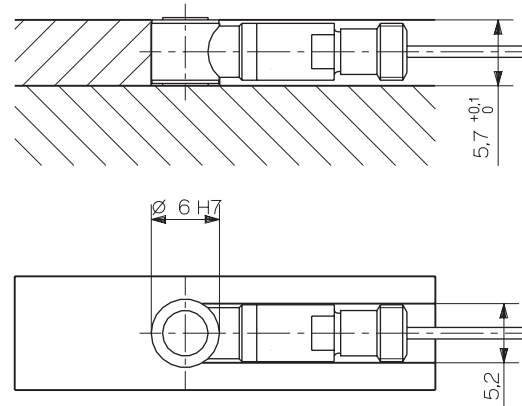


Fig. 7: Mounting in retaining plate

Accessories included

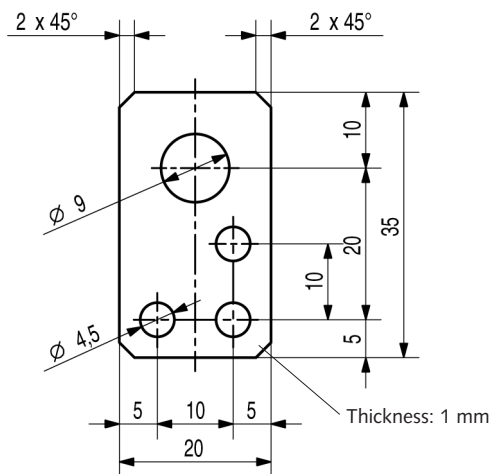


Fig. 8: Mounting plate Art. No. 3.520.328

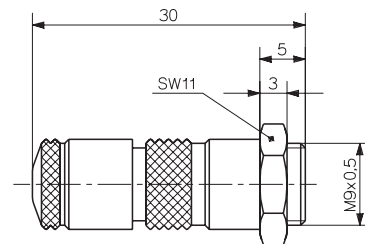


Fig. 9: Single-wire connector Type 1839

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Accessories Included

Miniature force sensor Type 9211BE
with single-wire cable

- Connector
- Mounting plate
- Thrust washer
- Identification plate

Type/Art. No.

1839
3.520.328
9411
3.520.235

Ordering Key

Single-wire cable, L = 1,5 m	E
Coaxial cable, L = 0,2 m	0,2
Coaxial cable, L = 0,4 m	0,4
Coaxial cable, L = 0,6 m	0,6
Coaxial cable, L = 0,8 m	0,8
Coaxial cable with special length, specify cable length L in m (L _{min} = 0,1 m / L _{max} = 5 m)	sp
Sensor Type 9211BE without connector	G

Type 9211B



Miniature force sensor Type 9211B0,4/0,6/
0,8/sp with coaxial cable and connector

- Mounting plate
- Thrust washer
- Identification plate

3.520.328
9411
3.520.235

Optional Accessories

High temperature extension cable Viton®
with BNC connector

- Length 2 m
- Length 5 m
- Length 10 m
- Special length
(between 0,5 m and 8 m)

Type/Art. No.

1667B2
1667B5
1667B10
1667Bsp

High temperature extension cable with
metal tubing and BNC connector

- Length 2 m
- Length 5 m
- Length 10 m
- Special length
(between 0,5 m and 8 m)
- 4-channel connector
- 8-channel connector

1661A2
1661A5
1661A10
1661Asp
1708A...
1710A...

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