

## Miniature Force Sensor

Type 9210AA...

for mold cavity pressure with diameter  $\varnothing 3.5$  mm

### Introduction

Quartz crystal force sensor for a measuring range from 0 to 250 N or for measurement of internal pressure up to 3,000 bar during the injection molding of plastics.

- Minimum size for installation in a mold insert
- Ideal for multi-cavity applications
- Indirect measurement via a measuring pin

### Description

This miniature version of the sensor Type 9210AA... measures the mold cavity pressure via a measuring pin. This pressure value is obtained from the force measured divided by the area of the measuring pin used. The integral single-wire cable with a very small cross-sectional area is designed to allow flexibility of mounting. With the single-wire technique, electrical shielding is guaranteed by the mold. It is therefore essential for the cable and connector to be integrated in the mold.

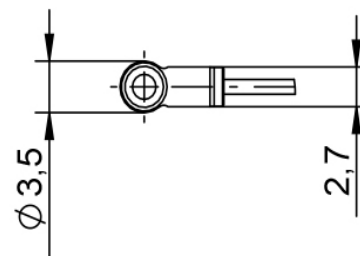
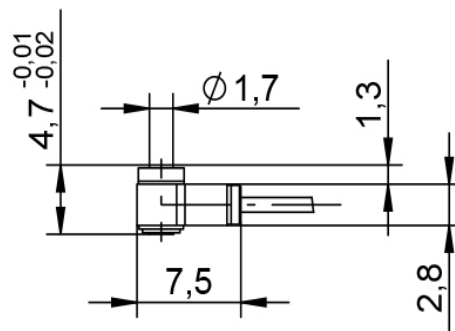
The charge signal (pC = picocoulomb) produced by the force sensor is converted into a proportional output voltage in a charge amplifier or a monitor. The maximum possible output voltage at the standard amplifier is 10 V, which corresponds to the maximum pressure value depending on the measuring pin area.

For multi-cavity applications the sensor Type 9210AAG without connector is used. The multichannel connectors Type 1708... and Type 1710... connect up to 4, respectively 8 sensors.

### Application

The sensor is primarily suitable for industrial applications in optimising, monitoring and controlling injection molding of thermoplastics.

The miniature sensor has been specially developed for mounting in multi-cavity molds where there is limited space. The sensor can be mounted directly under a mold insert by means of the lateral cable outlet. At the side, the sensor is secured via the case against rotation. Mounting is facilitated by using a measuring pin (for example a standart ejector pin). The pin can be adapted in situ to any cavity.



### Technical data

|                             |          |                |
|-----------------------------|----------|----------------|
| Measuring range             | N        | 0 ... 250      |
| Overload                    | N        | 300            |
| Sensitivity                 | pC/N     | -11            |
| Linearity                   | %FSO     | $\leq \pm 1$   |
| Operating temperature range | °C       | 0 ... 200      |
| Insulation resistance       |          |                |
| at 20°C                     | $\Omega$ | $\geq 10^{13}$ |
| at 120°C                    | $\Omega$ | $\geq 10^{12}$ |

**Force Sensor Type 9210AA...**

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

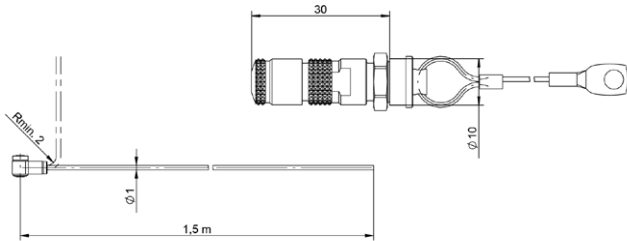


Fig. 1: Force Sensor Type 9210AA with cable and connector.

**Calculation of sensitivity for pressure measurement**

When mounting the force sensor for pressure measurement, the front area of the measuring pin must be considered. The nominal sensor sensitivity (pC/N) is converted into a corresponding pressure sensitivity using the following formula.

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

The measuring range of the sensor must be taken into account when selecting the measuring pin. The larger the area of the measuring pin, the higher will be the force on the sensor.

The following table shows the calculated sensitivity with the nominal sensitivity of Type 9210AA... and the maximum pressure for selecting the measuring pin.

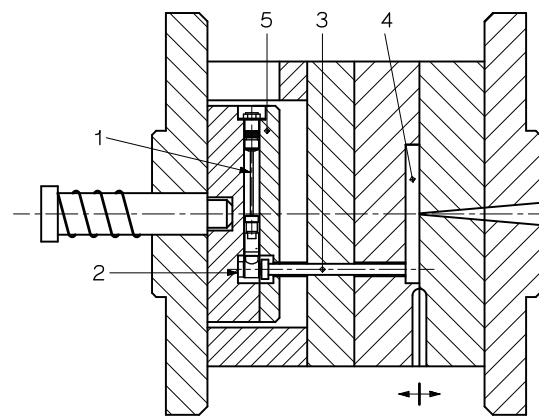
| Measuring pin Diameter [mm] | Sensitivity [pC/bar] | Maximum pressure [bar] |
|-----------------------------|----------------------|------------------------|
| 1,0                         | -0.86                | 3,183                  |
| 1,2                         | -1.24                | 2,211                  |
| 1,4                         | -1.69                | 1,624                  |
| 1,6                         | -2.21                | 1,243                  |
| 1,8                         | -2.80                | 982                    |
| 2,0                         | -3.46                | 796                    |
| 2,2                         | -4.18                | 658                    |

**Mounting**

The miniature force sensor has a very finely ground front face. The contact surface of the measuring pin should also be finely machined, flat, rigid and exactly parallel. The hardened thrust washer Type 9406 supplied should be used when mounting have in a blind hole. When selecting a measuring pin, a normal commercial injector pin can be used. When mounted, the sensor must not have any preload. The measuring pin must be installed with a clearance of from 0.01 to 0.03 mm.

The single-wire cable must be installed completely in the mold. The connector supplied must be mounted with the single-wire cable cut to size but with its insulation intact. This is then inserted with the mounting plate in the mold and secured. The nameplate should also be affixed alongside it giving details of the type of sensor and its sensitivity.

**Principle of function**

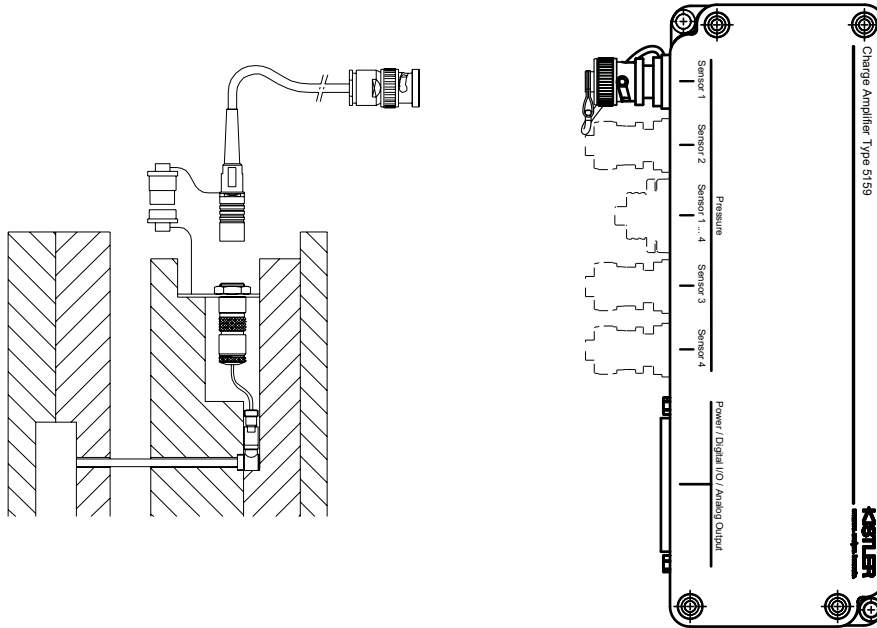


- 1 Force sensor
- 2 Thrust washer
- 3 Ejector pin
- 4 Cavity
- 5 Ejector plate

Fig. 2: Force sensor for indirect measurement of cavity pressure behind an ejector pin in the mold using the example of the Type 9211.

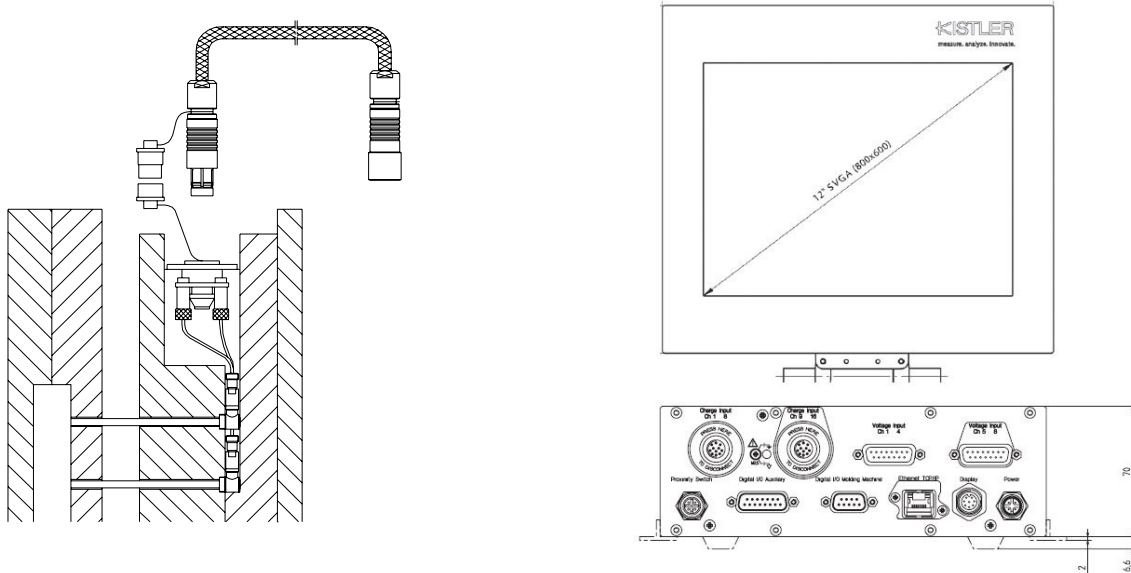
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**Cable and amplifier for measuring chain with sensor Type 9210AA...**



|   |
|---|
| <b>Cable Type 1667B... or Type 1661A... (BNC-Stecker)</b> |
| Type 5159A...   |

Fig. 3: Sensor Type 9210AA... with charge amplifier Type 5159A...



|   |   |
|---|---|
| <b>4-channel cable Type 1995A... to connector Type 1708..</b> | <b>8-channel cable Type 1997A... on connector Type 1710A...</b> |
| Type 2869B0xx   | Type 2869B2xx   |
| Type 2869B1xx   | Type 2869B3xx   |

Fig. 4: Sensor Type 9210AA... with Monitoring System CoMo Injection Type 2869B...

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Mounting examples

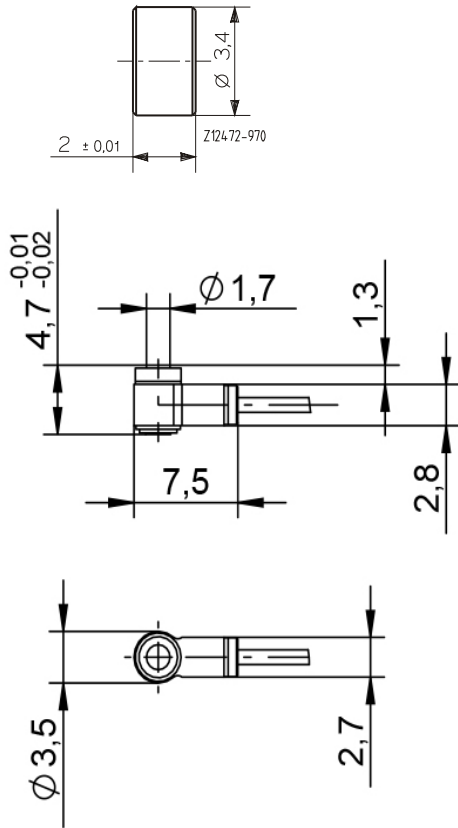
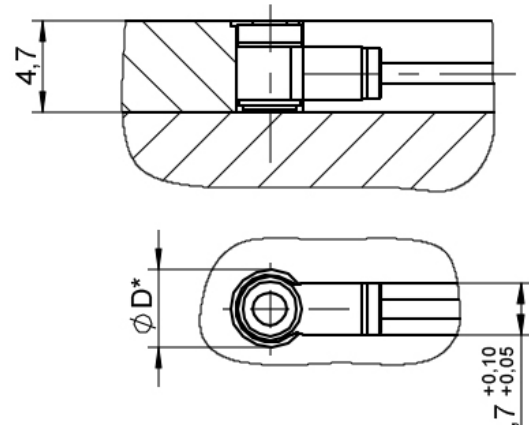
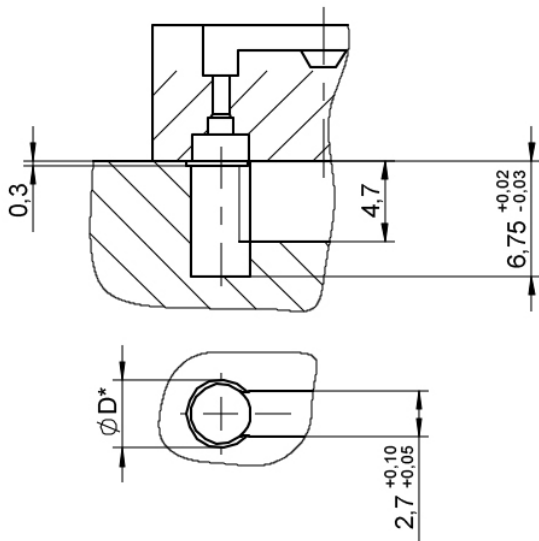


Fig. 5: Sensor Type 9210 with thrust washer Type 9406



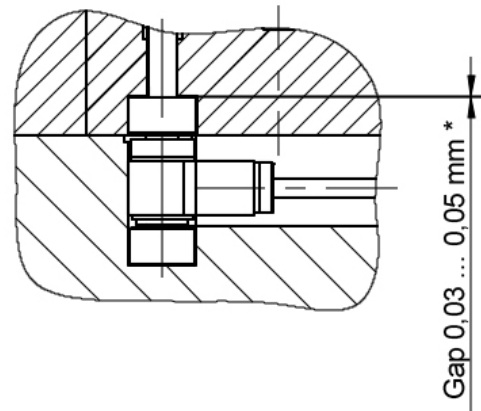
$D^* = 0.5$  mm larger than the diameter of the ejector head

Fig. 6: Mounting in retaining plate



$D^* = 0.5$  mm larger than the diameter of the ejector head

Fig. 7: Mounting bore with thrust washer Type 9406



\* Sensor should not be preloaded. Consider this value as a minimum during construction and realisation of the mold. Depending on deformation, it could be necessary to have a bigger gap. Check clearance before mounting the sensor.

Fig. 8: Mounting bore with thrust washer Type 9406 and ejector pin

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**Accessories included**

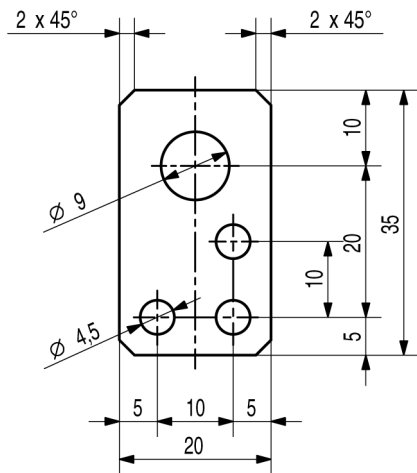


Fig. 9: Mounting plate Art. Nr. 3.520.328

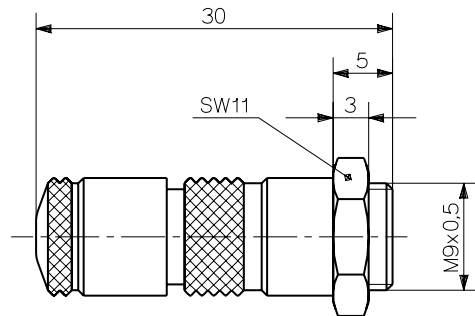


Fig. 10: Single-wire connector Type 1839

**Accessories included**

- Thrust washer
- Connector with short-circuit cap
- Mounting plate
- Identification plate

**Type/Mat. No.**

- 9406
- 1839
- 3.520.328
- 3.520.842

**Optional accessories**

- 4-Channel connector
- 8-Channel connector

**Type/Mat. No.**

- 1708...
- 1710...

**Ordering key**

| Type 9210AA                   |   |   |
|-------------------------------|---|---|
| Sensor with single-wire cable | E | ↑ |
| Length 1,5 m with connector   |   |   |
| Sensor Type 9210AAE           | G | ↑ |
| Without connector             |   |   |

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