

# 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 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.

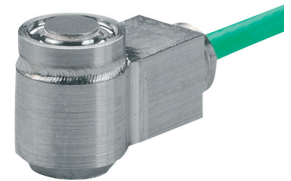
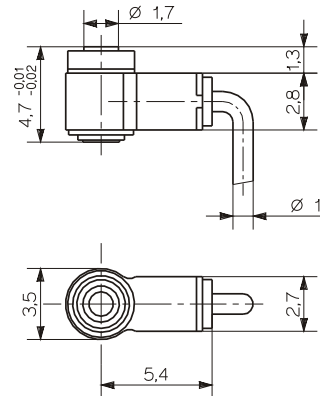
The charge signal (pC = picocoulomb) produced by the force sensor is converted into a proportional output voltage in a charge amplifier or a monitor. The maximum possible output voltage at the standard amplifier is 10 V, which corresponds to the maximum pressure value depending on the measuring pin area.

For multi-cavity applications the sensor Type 9210AAG without connector is used. The multi-channel connectors Type 1708A... and 1710A... 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.

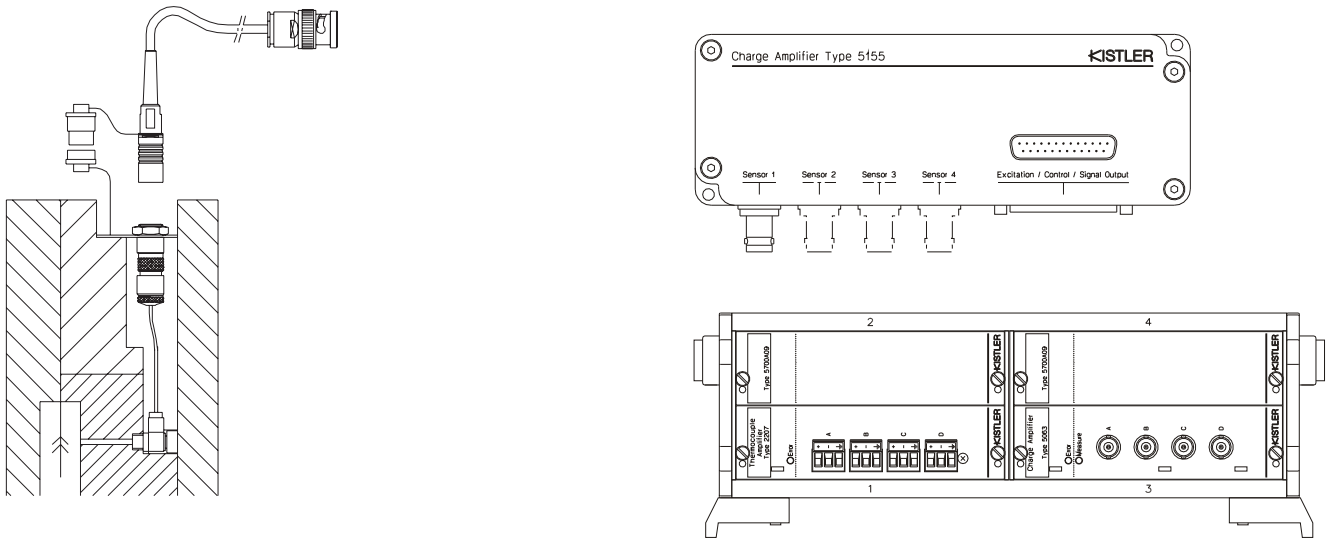
The miniature sensor has been specially developed for mounting in multi-cavity molds where there is limited space. The sensor can be mounted directly under a mold insert by means of the lateral cable outlet. At the side, the sensor is secured via the case against rotation. Mounting is facilitated by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



### Technical Data

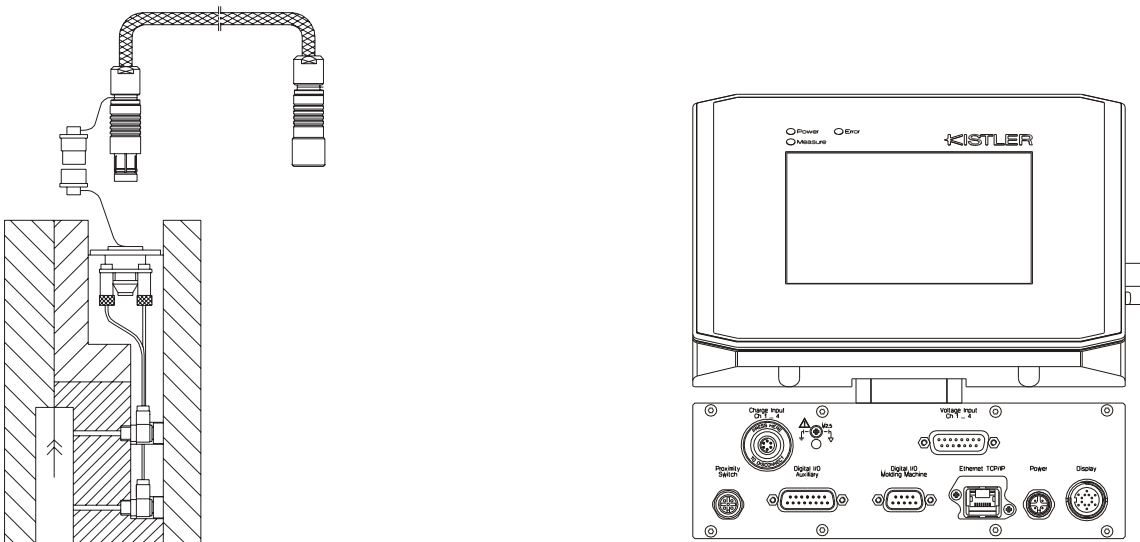
|                             |          |                |
|-----------------------------|----------|----------------|
| Measuring range             | N        | 0 ... 250      |
| Overload                    | N        | 300            |
| Sensitivity                 | pC/N     | -11            |
|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

**Cable and Amplifier for Measuring Chain with Sensor Type 9210AA...**



| 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. 1: Sensor Type 9210AA... 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... on connector Type 1710A... |
|---|--|
| Type 2869A0xx   | Type 2869A2xx  |
| Type 2869A1xx   |  |

Fig. 2: Sensor Type 9210AA... with monitoring system CoMo Injection Type 2869A...

9210AA\_000-601e-10.06

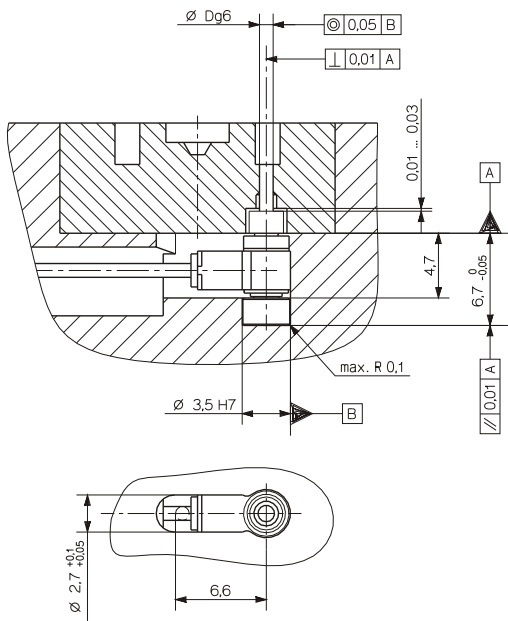


Fig. 3: Mounting in blind hole with measuring pin and hardened thrust washer  $\varnothing$  3,5 mm (Art. No. 3.211.585)

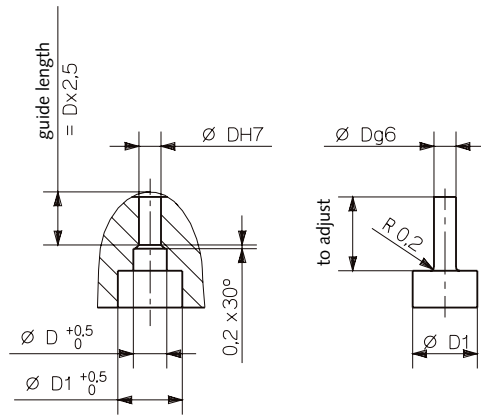


Fig. 4: Hole and dimensions of the measuring pin

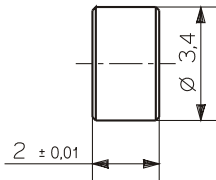


Fig. 5: Thrust washer (Art. No. 3.211.585)

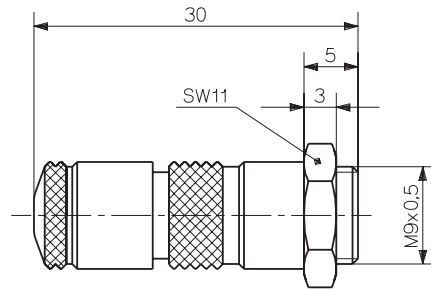


Fig. 6: Connector Type 1839

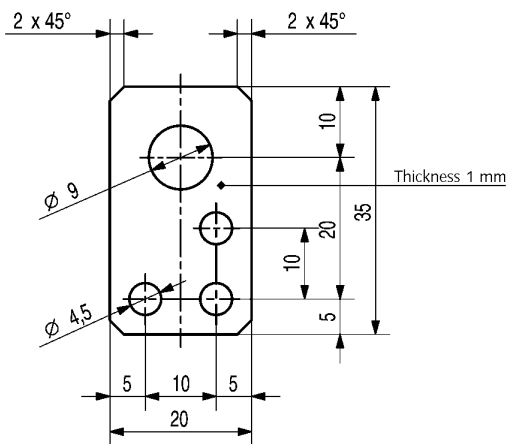


Fig. 7: Mounting plate (Art. No. 3.520.328)

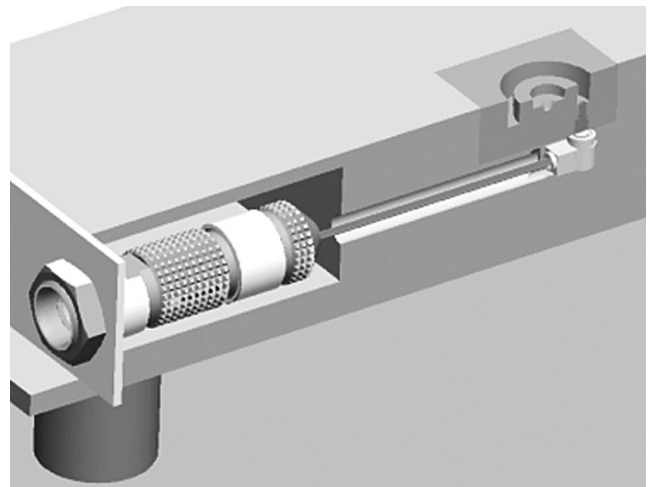


Fig. 8: Sensor, cable, connector and mounting plate

9210AA\_000-601e-10.06

**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.

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

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                         | -0,82                | 3 000                  |
| 1,2                         | -1,18                | 2 500                  |
| 1,4                         | -1,61                | 1 800                  |
| 1,6                         | -2,11                | 1 400                  |
| 1,8                         | -2,67                | 1 100                  |
| 2,0                         | -3,29                | 900                    |
| 2,2                         | -3,99                | 750                    |

**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 (Art. 3.211.585) supplied should be used when mounting 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 (Fig. 3).

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.

**Accessories Included**

- Thrust washer Type/Art. No. 3.211.585
- Connector with short-circuit cap 1839
- Mounting plate 3.520.328
- Identification plate 3.520.842

**Optional Accessories**

- 4-Channel connector 1708A...
- 8-Channel connector 1710A...

**Ordering Key**

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

9210AA\_000-601e-10.06