Quartz Miniature Force Sensor with Single-Wire Technique

Sensor for indirect cavity pressure measurement in injection molding.

- Ideally suited for industrial application
- Single-wire technique

Description
Miniature quartz force sensor for measuring dynamic and quasistatic pressures in the mold in injection molding via an ejector or measuring pin (s. Fig. 4). Very high resolution, high natural frequency, very small dimensions, welded construction.

Simplified sensor installation by means of the single-wire cable, which can be flexibly installed in the mold and cut to length as required. The connector is exchangeable. The cable is tightly attached to the sensor case.

The charge signal of the sensor (pC = pico Coulombs) is transformed into a proportional output voltage in the Kistler charge amplifier. Within wide limits, the output voltage does not depend on the length of the sensor cable. At the standard amplifier output it has a max. value of 10 V. On the most sensitive range 1 N/V is obtained for the force sensor Type 9211AAE.

This product complies with the CE standard 89/336/EEC.

Application
This sensor is particularly suitable for optimizing, monitoring and controlling the injection molding process of thermoplastics, elastomers, thermosets and SMC.

Technical Data

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>0 ... 2500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calibrated partial range</td>
<td>N</td>
<td>0 ... 250</td>
</tr>
<tr>
<td>Overload</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Threshold</td>
<td>mN</td>
<td>10</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>pC/N</td>
<td>–4,4</td>
</tr>
<tr>
<td>Linearity, all ranges</td>
<td>%FSO</td>
<td>≤±T</td>
</tr>
<tr>
<td>Hysteresis, all ranges</td>
<td>%FSO</td>
<td>≤±T</td>
</tr>
<tr>
<td>Rigidity</td>
<td>N/µm</td>
<td>400</td>
</tr>
<tr>
<td>Natural frequency</td>
<td>kHz</td>
<td>≥200</td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>°C</td>
<td>–40 ... 150</td>
</tr>
<tr>
<td>Temperature coefficient of sensitivity</td>
<td>%/°C</td>
<td>–0,02</td>
</tr>
<tr>
<td>Capacitance</td>
<td>pF</td>
<td>≥50</td>
</tr>
<tr>
<td>Insulation resistance at 20 °C</td>
<td>Ω</td>
<td>≥10¹³</td>
</tr>
<tr>
<td>at 120 °C</td>
<td>Ω</td>
<td>≥10¹⁷</td>
</tr>
<tr>
<td>Connecting plug Type 9211AAE</td>
<td>KE102A014-8 neg.</td>
<td></td>
</tr>
<tr>
<td>Weight incl. cable and plug</td>
<td>g</td>
<td>20</td>
</tr>
<tr>
<td>without cable and plug</td>
<td>g</td>
<td>1,2</td>
</tr>
</tbody>
</table>
Mounting
The miniature force sensor has ground faces. Also the mount-
ing surfaces must be perfectly flat, finely machined, rigid and
absolutely parallel. For mounting in a blind hole the application
of a hardened washer is recommended.

The single-wire cable with a cross-sectional area of approx.
0,6 mm² can be installed in a flexible manner and cut to length
as required. With the single-wire technique, the mold provides
electrical screening. The cable must therefore be integrated in
the ejector plate. On no account must the cable be installed
outside the ejector plate.

As a general rule, the cable must be installed in bores and thus
well protected against mechanical damage. The single-wire
cable must on no account be installed together with other
electrical cables in the cable bore.

The connector (Type 1839) included in the sensor delivery
schedule must be fitted onto the single-wire cable which has
been cut to length but with its insulation remaining intact.

The connector has to be mounted on to the ejector plate
(Fig. 7). With the single-wire cable fully ducted through the
ejector plate.

For the calculation of the sensitivity in psi/pC the following
formule has to be used:

\[
Sp \ [\text{psi/pC}] = \frac{\pi \cdot D^2}{580,15} \cdot S_f \ [\text{pC/N}]
\]

\(Sp\) = Pressure sensitivity
\(S_f\) = Force sensitivity
\(D\) = Pin diameter

The extension cable has to be fixed to the ejector plate
(s. Fig. 9).

Installation: Single-Wire Cable with Connector (Art. No. 5.511.322)

1) Open the connector anti-clockwise.

2) Connector must be opened up to produce a gap of ~3 mm.

3) Insert single-wire cable cut to length with insulation
intact into the connector up to the limit.

4) Close the connector clockwise. This automatically strips the
insulation from the cable and clamps it.
**Mounting Examples**

**Fig. 1:** Mounting in a blind hole

**Fig. 2:** Mounting in a holding plate

**Fig. 3:** Mounting plate 3.520.328 (included in the delivery) for Fischer connector KE 102A014

**Fig. 4:** Force sensor for indirect injection-mold cavity pressure measurement behind an ejector pin in the mold

**Fig. 5:** Mounting plate (Art. No. 3.520.328)

**Fig. 6:** Connector (Art. No. 5.511.322)

---

This information corresponds to the current state of knowledge. Kistler reserves the right to make technical changes. Liability for consequential damage resulting from the use of Kistler products is excluded.
Quratz Miniature Force Sensor with Single-Wire Technology, Type 9211AAE

Fig. 7: Screwing the mounting plate onto the ejector plate

Fig. 8: Mounting of Type 9211AAE

Cable fixed to ejector plate

Fig. 9: Mounting of Type 9211AAE

Accessories Included
- Identification label
- Connector for single-wire technique
- Mounting plate
- Washer

<table>
<thead>
<tr>
<th>Art. No./Type</th>
<th>Ordering Key</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.520.325</td>
<td>Quartz miniature force sensor</td>
</tr>
<tr>
<td>1839</td>
<td>Type 9211AAE</td>
</tr>
<tr>
<td>3.520.328</td>
<td></td>
</tr>
<tr>
<td>9411</td>
<td></td>
</tr>
</tbody>
</table>

Optional Accessories
- High-temperature extension cable with connectors
  Fischer SE 102A014/BNC pos.
  Length 2 m
  Length 5 m

<table>
<thead>
<tr>
<th>Type</th>
<th>Art. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1667B2</td>
<td></td>
</tr>
<tr>
<td>1667B5</td>
<td></td>
</tr>
</tbody>
</table>