Low-profile pressure transmitters for industry 4.0

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Enhanced requirements for industry 4.0

Higher requirements for low-profile and more accurate pressure sensors
New application areas in production process control

- Predictive maintenance
- Filter control
- Cost-efficient
- Faster
- Climate control
- Clean
- Smart
- Exhaust
- Flexible
- Cost savings
- Robust
- Efficiency

Faster, Clean, Smart, Cost savings, Efficiency, Robust, Flexible, Climate control, Exhaust, Cost-efficient, Filter control, Predictive maintenance, Faster, Flow Control
## Key performance parameters for industry 4.0 applications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Value</th>
<th>Value</th>
<th>Value</th>
<th>Value</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absolute accuracy (mbar)</td>
<td>1000 mbar</td>
<td>500 mbar</td>
<td>1000 mbar</td>
<td>500 mbar</td>
<td>1000 mbar</td>
<td>500 mbar</td>
</tr>
<tr>
<td>Relative Accuracy (mbar/bar)</td>
<td>10 mbar/bar</td>
<td>5 mbar/bar</td>
<td>10 mbar/bar</td>
<td>5 mbar/bar</td>
<td>10 mbar/bar</td>
<td>5 mbar/bar</td>
</tr>
<tr>
<td>Temperature hysteresis</td>
<td>10 mbar</td>
<td>5 mbar</td>
<td>10 mbar</td>
<td>5 mbar</td>
<td>10 mbar</td>
<td>5 mbar</td>
</tr>
<tr>
<td>Temperature coefficient (mbar/C)</td>
<td>10 mbar/C</td>
<td>5 mbar/C</td>
<td>10 mbar/C</td>
<td>5 mbar/C</td>
<td>10 mbar/C</td>
<td>5 mbar/C</td>
</tr>
<tr>
<td>Output data rate (Hz)</td>
<td>100 data/second</td>
<td>50 data/second</td>
<td>100 data/second</td>
<td>50 data/second</td>
<td>100 data/second</td>
<td>50 data/second</td>
</tr>
<tr>
<td>Power (µA)</td>
<td>1000 µA</td>
<td>500 µA</td>
<td>1000 µA</td>
<td>500 µA</td>
<td>1000 µA</td>
<td>500 µA</td>
</tr>
<tr>
<td>Noise (Pa RMS)</td>
<td>100 Pa RMS</td>
<td>50 Pa RMS</td>
<td>100 Pa RMS</td>
<td>50 Pa RMS</td>
<td>100 Pa RMS</td>
<td>50 Pa RMS</td>
</tr>
<tr>
<td>Environmental compatibility</td>
<td>i4.0</td>
<td>i4.0</td>
<td>i4.0</td>
<td>i4.0</td>
<td>i4.0</td>
<td>i4.0</td>
</tr>
</tbody>
</table>

### Total long-term signal deviation
- Signal offset due to temperature stress on the package
- Pressure output sensitivity to temperature
- Data per second

### Short-term signal deviation between two pressures

### Stability during contact with water and chemical compounds
- Sensor current consumption at 1 Hz ODR
- Variation in sensor output at constant condition
- Stability during contact with water and chemical compounds
- Stability during contact with water and chemical compounds
Advantage of piezoresistive pressure sensors for industry 4.0

**Capacitive**

Suitable for consumer applications

**Piezoresistive**

Suitable for automotive and industrial applications

- High absolute accuracy
- No temperature hysteresis
- Good temperature coefficient
- Environmental compatibility

Piezoresistive pressure sensors ensure longtime stability due to:

- Directly convert diaphragm stress to electrical signal
- Directly convert diaphragm deflection to electrical signal

[Diagram showing capacitive and piezoresistive sensors with their respective principles of operation.]
Piezoresistive pressure sensing methods

<table>
<thead>
<tr>
<th>Absolute</th>
<th>Gauge</th>
<th>Differential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure applied</td>
<td>Pressure applied</td>
<td>Pressure applied</td>
</tr>
<tr>
<td>Atmospheric (101 kPa)</td>
<td>Atmospheric Pressure</td>
<td>Pressure applied</td>
</tr>
<tr>
<td>Vacuum (0 Pa)</td>
<td>Vacuum (0 Pa)</td>
<td>Vacuum (0 Pa)</td>
</tr>
</tbody>
</table>

- **Absolute**: e.g. for automotive applications
- **Gauge**: e.g. for home appliances
- **Differential**: e.g. for predictive maintenance and process control
Low-profile pressure transmitter

MiniCell® pressure transmitter

High-performance pressure sensors combine miniaturized package and outstanding long-term stability
Low-profile pressure transmitter with digital interface

- **Accuracy**: ±1 % FS
- **Max. rated pressures**: 16 mbar to 7 bar
- **Operating temperature**: -25 °C ≤ TOP ≤ +85 °C
- **Digital interface**: SPI
- **Resolution**: 16 bit

**High-performance sensor**
- High mechanical robustness
- High accuracy at low pressures
- Excellent “absolute pressure” accuracy

**Simplified integration**
- Miniaturized and low profile
- No tubes required
- Easy screw-on mounting

**Benefits for industry 4.0**
- Fast data acquisition
- Suitable for integration in sensor topologies (daisy chain)
Robust and accurate MiniCell® technology

- Robust design
- High accuracy over full temperature range and lifetime
- Adaptable pressure range
- Long-term stability

Accuracy: <1.5 % FS
Max. rated pressure: 0.5 to 10 bar
Operating temperature: -40 °C ≤ T_{OP} ≤ +140 °C

High-performance sensor

- Miniaturized design
- Low insertion height

Benefits for industrial applications

- Hermetically sealed electronics with oil-filled and media-separated sensor cells
- High media resistance thanks to stainless steel membrane
- Wide temperature range

Simplified integration

- Miniaturized design
- Low insertion height
Advanced pressure sensing platform for industry 4.0

MiniCell® pressure transmitter

Low-profile pressure transmitter

Flat designs with both analog and digital output