Control of Clamping Force with BAW
... in Plastic Injection Molding Machines
Analog Sensors

Improve Performance, Protect Injection Molding Machines and Increase Lifetime of Molds and Machinery

Tie-bar elongation in plastic injection molding machines

is a side-effect that can have useful implications.

Tie-bar elongation is proportional to the clamping force in mechanical toggle clamping systems. Depending on the machine size and clamping force, during ordinary operation the actual extension can be up to 2 mm (0.08`). This relatively large mechanical movement leads to an interesting application for Balluff BAW analog inductive displacement sensors. A high-resolution analog device for measuring small displacements of metal targets, the Balluff BAW can detect the extention of the tie-bar in-process, providing continuous measurement of the clamping force without the need for expensive instrumentation.

The Balluff BAW detects the elongation of the tie bar when placed in front of the tie-bar surface at the side of the stationary platen. With an operating range of up to 5 mm it provides the change of the length with a repeatability of ±10 µm (0.0004`), which is sufficient in most cases and gives a great cost-performance ratio. Since there is no need to modify the tie-bars, installation is simple and universal for all diameters.

The application helps to prevent tie-bar overload, machine wear and protects the expensive molds from severe damage. Besides possible damages, worn out bushings and supports of the platens will result in loss of accuracy if the machine is operated permanently with overload.

The performance of the machine and the quality of the molded products will be improved by continuous control of the clamping force. While increased mechanical stress is a result of too high force, nonfilled cavities and flash appears when the force is less than calculated.

Using Balluff BAW to control this important machine parameter represents a significant lower cost solution compared to the traditional strain gauge technology which is used for adjustment and quality control in the maintenance process.

Balluff BAW are available in different sizes and sensing distances:

Analog position sensors

Even the strongest shaft will stretch as a result of hydraulic forces. Analog sensors BAW can detect and signal this change in length with a signal that is proportional to the length change and the clamping force of the monitored tie-bars.

### Specifications

- **Housing size**: M12×1
- **Mounting**: flush
- **Output signal**: voltage 0...10 V
- **Linear range s**: 0.5...2 mm

### Ordering code

- **BAW M12MI-UAC20B-S04G**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated operational voltage Ue</td>
<td>24 V DC</td>
</tr>
<tr>
<td>Supply voltage Us</td>
<td>15...30 V DC</td>
</tr>
<tr>
<td>Ripple</td>
<td>≤ 15 % of Ue</td>
</tr>
<tr>
<td>Rated insulation voltage Ui</td>
<td>250 V AC</td>
</tr>
<tr>
<td>Rated sensing distance se</td>
<td>1.25 mm</td>
</tr>
<tr>
<td>Load resistance RL</td>
<td>≥ 2 kΩ</td>
</tr>
<tr>
<td>No-load supply current Is at Ue</td>
<td>≤ 10 mA</td>
</tr>
<tr>
<td>Protected against polarity reversal</td>
<td>yes</td>
</tr>
<tr>
<td>Short circuit protected</td>
<td>yes</td>
</tr>
<tr>
<td>Ambient temperature range Ta</td>
<td>–10...+70 °C</td>
</tr>
<tr>
<td>Temperature drift at s</td>
<td>≤ 5 % of Ua max.</td>
</tr>
<tr>
<td>Max. non-linearity at s</td>
<td>±3 % of Ua max.</td>
</tr>
<tr>
<td>Adjustment indication (end of linear range)</td>
<td>yes</td>
</tr>
<tr>
<td>Degree of protection per IEC 60529</td>
<td>IP 67</td>
</tr>
<tr>
<td>Insulation class</td>
<td>EN</td>
</tr>
<tr>
<td>Housing material</td>
<td>CuZn nickel plated</td>
</tr>
<tr>
<td>Material of sensing face</td>
<td>PA 12</td>
</tr>
<tr>
<td>Connection</td>
<td>connector</td>
</tr>
<tr>
<td>No. of wires × conductor cross section</td>
<td>cULus</td>
</tr>
<tr>
<td>Approval</td>
<td>BKS-B 19/BKS-B 20</td>
</tr>
<tr>
<td>Recommended connector</td>
<td>PUR, length 3 m = BP03</td>
</tr>
</tbody>
</table>

Please add the cable material and length to the ordering code for sensors with **cable!**
## M12, M18 Analog Sensors

### M12×1
- **flush**
- **non-flush**
- **voltage 0...10 V**
- **0.5...2 mm**
- **24 V DC**
- **15...30 V DC**
- **≤ 15 % of Ue**
- **250 V AC**
- **≥ 2 kΩ**
- **≤ 10 mA**
- **yes**
- **no**
- **–10...+70 °C**
- **≤ 5 % of Ua max.**
- **± 3 % of Ua max.**
- **yes**
- **IP 67**
- **CuZn nickel plated**
- **PA 12**
- **cable**
- **3x0.34 mm²**
- **cULus**
- **BAW M12MG2-UAC20B-S04G**
- **BAW M12MF2-UAC40F-S04G**

### M18×1
- **flush**
- **voltage 0...10 V**
- **1...4 mm**
- **24 V DC**
- **15...30 V DC**
- **≤ 15 % of Ue**
- **250 V AC**
- **≥ 2 kΩ**
- **≤ 10 mA**
- **yes**
- **yes**
- **–10...+70 °C**
- **≤ 5 % of Ua max.**
- **± 3 % of Ua max.**
- **yes**
- **IP 67**
- **CuZn nickel plated**
- **PA 12**
- **cable**
- **3x0.34 mm²**
- **cULus**
- **BAW M18MI-UAC50B-S04G**

### M18×1
- **flush**
- **voltage 0...10 V**
- **1...5 mm**
- **24 V DC**
- **15...30 V DC**
- **≤ 15 % of Ue**
- **75 V DC**
- **3 mm**
- **≥ 2 kΩ**
- **≤ 10 mA**
- **yes**
- **yes**
- **–10...+70 °C**
- **≤ 5 % of Ua max.**
- **± 3 % of Ua max.**
- **yes**
- **IP 67**
- **CuZn nickel plated**
- **PA 12**
- **cable**
- **3x0.34 mm²**
- **cULus**
- **BAW M18MF2-UAC40F-S04G**

### M18×1
- **flush**
- **voltage 0...10 V**
- **1...5 mm**
- **24 V DC**
- **15...30 V DC**
- **≤ 15 % of Ue**
- **75 V DC**
- **3 mm**
- **≥ 2 kΩ**
- **≤ 10 mA**
- **yes**
- **yes**
- **–10...+70 °C**
- **≤ 5 % of Ua max.**
- **± 3 % of Ua max.**
- **yes**
- **IP 67**
- **CuZn nickel plated**
- **PA 12**
- **cable**
- **3x0.34 mm²**
- **cULus**
- **BAW M18ME-UAC50B-S04G**

### M18×1
- **flush**
- **voltage 0...10 V**
- **1...5 mm**
- **24 V DC**
- **15...30 V DC**
- **≤ 15 % of Ue**
- **75 V DC**
- **3 mm**
- **≥ 2 kΩ**
- **≤ 10 mA**
- **yes**
- **yes**
- **–10...+70 °C**
- **≤ 5 % of Ua max.**
- **± 3 % of Ua max.**
- **yes**
- **IP 67**
- **CuZn nickel plated**
- **PA 12**
- **cable**
- **3x0.34 mm²**
- **cULus**
- **BAW M18ME-UAC50B-S04G**

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For more sensors see main catalog “The Sensor Line” on CD-ROM or online!
Analog Sensors

Connectors, Approach Curve, Processing Programmable Switchpoints

Application examples

Some of the numerous applications in measuring and controlling include:

- Distance measurement
- Thickness measurement
- Run-off measurement
- Belt/band width measurement
- Detection of surface waves
- Counting
- Positioning
- Position monitoring
- General monitoring
- Selection of parts of various sizes and materials

Features

- Distance-proportional analog signal
- Housing sizes M8...80×80
- Sensing ranges 1...50 mm
- Non-contact, absolute operating principle
- High repeat accuracy
- Low temperature drift
- LED for setup aid
- Compact, sealed, rugged and reliable

Connector Type

<table>
<thead>
<tr>
<th>Type</th>
<th>BKS-B 19</th>
<th>BKS-B 20</th>
</tr>
</thead>
<tbody>
<tr>
<td>No LED</td>
<td>BKS-B 19-1-</td>
<td>BKS-B 20-1-</td>
</tr>
<tr>
<td>Supply voltage $U_B$</td>
<td>10...30 V DC</td>
<td>10...30 V DC</td>
</tr>
<tr>
<td>Cable</td>
<td>molded-on PVC/PUR</td>
<td>molded-on PVC/PUR</td>
</tr>
<tr>
<td>No. of wires × conductor cross section</td>
<td>3×0.34 mm²/4×0.25 mm²</td>
<td>3×0.34 mm²/4×0.25 mm²</td>
</tr>
<tr>
<td>Degree of protection per IEC 60529</td>
<td>IP 67</td>
<td>IP 67</td>
</tr>
<tr>
<td>Ambient temperature range $T_a$</td>
<td>-25...+ 85 °C</td>
<td>-25...+ 85 °C</td>
</tr>
</tbody>
</table>

Please add the cable material and length to the ordering code!

PUR, length 3 m = PU-03

Approach curve

Distance changes in the sensor axis result in proportionally changing output signals.

Sensing a rotating object

Eccentric cams, lobes or imbalances result in a periodic change of the output signal.

Lateral approach

Detecting larger travel by sensing an inclined surface.

Sensing various materials

With the distance constant, the output signal will change only of the object material changes.

Processing programmable switchpoints

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