# Product Focus

<table>
<thead>
<tr>
<th>Fuel Management Systems</th>
<th>Fuel Level</th>
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<tr>
<td></td>
<td>Throttle Position &amp; Electronic Throttle Control</td>
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<td>Accelerator and Brake Pedal</td>
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<table>
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<tr>
<th>Steering and Stability Control</th>
<th>Angle</th>
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<tr>
<td></td>
<td>Torque</td>
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<td></td>
<td>Motor Position</td>
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<td>Chassis</td>
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<tr>
<th>Speed Sensors</th>
<th>Wheel</th>
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<tr>
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<td>Transmission</td>
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<thead>
<tr>
<th>Other Angle and Position</th>
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<tr>
<th>Multifuse® PTC Resettable Fuses</th>
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<th>Components</th>
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**BOURNS**

Automotive Division
Steering and Stability Control
Product Evolution Steering Sensors

- **EVO SAS 1996**
- **DIFFERENTIAL TORQUE 1998**
- **GEN I/II TORQUE 2003**
- **GEN I SAS 2004**
- **QUADRASTEER 2005**
- **GEN III TORQUE INDEX SENSOR 2008**
- **GENERIC SAS JAN 2007**
- **ACTIVE STEER 2005**
- **GEN II SAS 2007**
- **TORQUE ONLY SENSOR 2012 SOP**
- **LCEC TORQUE JAN 2010**
- **8 TURN SAS MAR 2007**
- **COMBINATION MAR 2010**
- **TORQUE ONLY SENSOR JAN 2011**
- **TORQUE ANGLE SENSOR OCT 2011**
### Steering Angle and Torque Sensors Experience

<table>
<thead>
<tr>
<th>Description</th>
<th>Production Period</th>
<th>Production Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contacting steering angle and rear steering angle sensor</td>
<td>in production since 1996</td>
<td>approx. 775,000 pieces per year</td>
</tr>
<tr>
<td>Non-contacting MR based torque Sensors for EPS systems</td>
<td>in production since 2002</td>
<td>approx. 7,000,000 pieces a year</td>
</tr>
<tr>
<td>Non-contacting MR based steering angle sensors ESC systems</td>
<td>in production since 2004</td>
<td>approx. 3 million pieces a year</td>
</tr>
<tr>
<td>Non-contacting MR based motor position sensors for EPS systems</td>
<td>in production since 2006</td>
<td>approx. 400,000 pieces a year</td>
</tr>
<tr>
<td>Non-contacting MR based steering angle sensor – ESC heavy truck</td>
<td>in production since 2007</td>
<td>approx. 10,000 pieces per year</td>
</tr>
<tr>
<td>Non-contacting MR based steering angle sensors</td>
<td>in production since 2009</td>
<td>approx. 1.2 million pieces per year maximum volume</td>
</tr>
</tbody>
</table>
### Steering Angle and Torque Sensors Experience cont.

<table>
<thead>
<tr>
<th>Sensor Type</th>
<th>Production Start</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-contacting MR based steering angle sensors</td>
<td>Aug 2011</td>
<td>Approx. 1.0 million pieces per year max</td>
</tr>
<tr>
<td>for ESC systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-contacting MR based steering angle sensors</td>
<td>2012</td>
<td>Approx. 30,000 pieces per year max</td>
</tr>
<tr>
<td>for ESC system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-contacting torque sensors with steering</td>
<td>2012</td>
<td>Approx. 50,000 pieces per year max</td>
</tr>
<tr>
<td>angle for EPS systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-contacting MR based torque sensors for EPS</td>
<td>2012</td>
<td>Approx. 700,000 pieces a year max</td>
</tr>
<tr>
<td>system</td>
<td></td>
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</tbody>
</table>
Steering Angle Sensor
for Passenger Cars

sensor principle: non-contacting (AMR technology)
angular resolution: 0.1 °
range: -780 ° to 780 °
temperature range: -40 ° to +85 °C
signal output: via CANBUS

in production since: 2004

Application: steering angle sensor; measures angle position & speed
Steering Angle Sensor for Commercial Vehicles

sensor principle: non-contacting (AMR technology)
angular resolution: 0.1 °
rang: -1440 ° to 1440 °
temperature range: -40 ° to +85 °C
signal output: via CANBUS

in production since: 2007

Application: steering angle sensor; measures angle position & speed
**Contacting Steering Sensor**

Application: Electrical variable orifice control for hydraulic power assisted steering. The sensor controls the pump output which modifies the amount of fluid in the system. This allows the amount of assistance to be varied according to conditions.

- Sensor principle: contacting
- Linearity (indep.): ±1 °
- Resolution: essentially infinite
- Range: 0 ° to 360 °
- Temperature range: -40 ° to +140 °C
- Signal output: analog

In production since: 1996
Steering Sensor for Rear Wheel Prototype

- **sensor principle:** contacting
- **linearity:** ±2 %
- **range:** ±540 °
- **temperature range:** -40 ° to +105 °C
- **signal output:** dual analog

**Application:** Quadrasteer rear position sensor. The position sensor measures the angle of the steering actuator’s pinion and provide an output in the form of dual analog signals.
Differential Non-Contacting Angle Sensor

Application: Electric Power Steering, Active Steering, Park Assist

sensor principle: non-contacting (AMR technology)
accuracy/resolution: 2 % of full scale
range: +/-4 °
temperature range: -40 ° to +125 °C
signal output: PAS4, PSI5, Sent, PWM and SPI possible
dual or single channel
torque sensor with index feature available
non-clockspring design available
in production since: 2002
Differential Angle Sensor Prototype

**Application:** Designed to track the differential displacement of two rotors. In this arrangement, the torque shaft moves approximately ±8° relative to the steering shaft. Movement of the torque shaft indicates that the driver of the vehicle is experiencing resistive torque when turning the steering wheel.

- **Sensor principle:** contacting
- **Linearity:** ±1.5%
- **Range:** -810° to +810°
- **Temperature range:** -40° to +100°C
- **Signal output:** dual analog
Electrical Design – Index Function

**Index Measurement**
- designed for production
- Hall based switch and magnet provide index function
- switch window controlled by width of south pole of index magnet
Motor Position Sensor  
(Electric Power Assisted Steering = EPAS)

sensor principle: non-contacting  
(AMR technology)

angular resolution: 0.18 °

range: 180 ° and 360 °

temperature range: -40 ° to +130 °C

signal output: PAS4, PSI5, Sent, 
PWM, SPI possible

in production since: 2006

**Application:** EPAS motor position, electronic differential position, electronic integrated transfer case, electronically actuated clutch, compliant steer position feedback. Non-contacting angle sensor in the EPS motor cap, supplied since 2006. Used in conjunction with the torque sensor to provide steering angle.
Chassis Level Sensor

Application: Dynamic headlamp level adjustment, AFLS headlamp adjustment, air suspension positional feedback, continuous electronic damping control, tilting vehicle applications for invalid access, lifting axle position detection, vehicle and trailer load ride height position

sensor principle: contacting
accuracy/resolution: 0.05 °
range: -72 ° to +72 °
temperature range: -45 ° to +85 °C
signal output: analog, PWM, SPI possible

in production since: 1994
Chassis Level Sensor

sensor principle: non-contacting
accuracy/resolution: 0.05 °
range: -72 ° to +72 °
temperature range: -45 ° to +85 °C
signal output: analog, PWM, SPI possible

Application: Dynamic headlamp level adjustment, AFLS headlamp adjustment, air suspension positional feedback, continuous electronic damping control, tilting vehicle applications for invalid access, lifting axle position detection, vehicle and trailer load ride height position
Combo Sensor
Steering-Torque

sensor principle: non-contacting
accuracy/resolution: 0.4 ° / 0.01 °
range: torque: +/-8 °
        angle: +/-3.6 turns
        = +/-1296 ° mechanically
        30 ° electrically (repeated
sawtooth signal)
temperature range: -40 ° to +120 °C
signal output: analog
New Products – Linear Sensors
Linear Sensing Applications

Transmission sensor
for neutral gear position detection
start/stop applications
(digital or analog 1D/2D)

Neutral and reverse gear detection
(start/stop and reverse light activation)
(digital or analog)

Lever position sensor
for automated transmission gearbox

Park position detection sensor
for automated and semi-automated gearbox applications
(digital or analog 2D)

Gear position detection sensor up to 50mm
for automated and semi-automated gearbox applications
(digital or analog 1D)
# Representative Steering Angle & Torque Sensor Tier ones and OEM’s

<table>
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<tr>
<th>Audi</th>
<th>JTEKT</th>
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<tr>
<td>BMW</td>
<td>Kia</td>
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<tr>
<td>Chery</td>
<td>Mando</td>
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<tr>
<td>Daimler</td>
<td>Seat</td>
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<tr>
<td>Delphi</td>
<td>Showa</td>
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<td>EBM Papst</td>
<td>Skoda</td>
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<tr>
<td>Ford</td>
<td>TRW</td>
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<tr>
<td>Geely</td>
<td>VW</td>
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<td>GM</td>
<td>Wabco</td>
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<tr>
<td>Honda</td>
<td>Yasaki</td>
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<tr>
<td>Hyundai</td>
<td>ZF Lenksysteme</td>
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<tr>
<td>Hyundai Mobis</td>
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