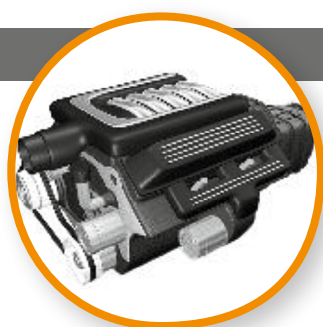


TE Connectivity's  
**SENSOR  
TECHNOLOGIES**  
for the Automotive Industry

# SENSOR TECHNOLOGIES FOR THE AUTOMOTIVE INDUSTRY

TE Connectivity (TE) is one of the largest sensor companies in the world, with innovative sensor solutions that help customers transform concepts into smart, connected creations. To transport passengers safely and efficiently, vehicles need data. Today's cars can sense and respond to changing conditions, inside and out.

TE sensors help provide the data for control, adaptation and response of vehicle functions that increase safety, comfort, and efficiency. Our technology is an integral part of many modern nervous systems in vehicles.



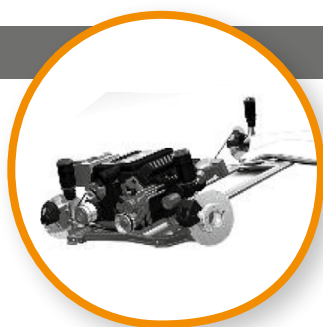
## ENGINE/E-MOTOR

Our engine and e-motor sensors are used in vehicle applications such as travel sensor for turbo charger actuator, pneumatic (EGR) Cylinder, CAM and Crank Shaft Speed sensors and resolvers for e-motor commutation.



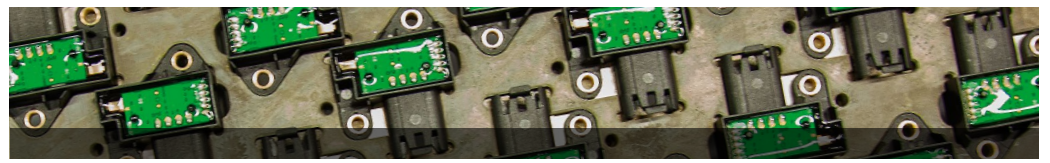
## EXHAUST

TE provides a range of sensors for exhaust gas applications, such as urea quality, level and temperature, urea pump pressure and exhaust gas temperature (EGTS). These sensors help the OEM to comply with the latest emission regulations and significant performance improvement of modern aftertreatment systems.



## CHASSIS

We provide a range of chassis solutions for roof and convertible switches, actuator and cylinder position, seat position and weight classification. Our humidity and temperature technologies are used in Heating, Ventilation and Air Conditioning (HVAC) systems to prevent wind screen fogging and for energy management.



TE Connectivity is committed to making cars safer, greener and more connected. We support this commitment by integrating innovative sensors in demanding application areas such as automated transmissions, engines, clutch, brake and other mission critical areas.

Our sensors are designed and manufactured to exacting specifications, often on a custom basis. Together with our customers, we are working to solve today's biggest application challenges in new and creative ways.



## BRAKE

Our brake sensors are used in vehicle applications such as travel sensor for brake master cylinder position (optional redundancy), travel sensor for rear axle steering, rotary sensor for brake pedal position detection (optional redundancy); contactless brake light switch and wheel speed sensor. We also provide pressure sensors such as the vacuum brake booster sensor and brake line pressure for ABS/ESC modules.



## TRANSMISSION

TE's transmission sensors are used in vehicle applications such as all gear / neutral detection for manual transmission (MT) to support start and stop function, drive mode (travel or rotary) for automatic (AT), continuously variable (CVT), or dual clutch (DCT) transmissions. We also provide pressure and temperature solutions.



## CLUTCH

The clutch sensors are used in vehicle applications such as Permanent-magnetic Linear Contactless Displacement (PLCD) sensors for concentric slave cylinder and clutch slave cylinder, rotary sensors for clutch pedal position detection; contactless switch for clutch master cylinder and travel sensor for clutch master cylinder and Dual Clutch Transmission (DCT).

**Sensor Technologies  
for the Automotive Industry**

	Page	Position	Pressure	Temperature	Humidity	Current
<b>Hall Switch SW01P</b>	<b>1 - 3</b>					
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Brake Vacuum Sensor	2		●			
Brake Cylinder Position Sensor	2	●				
Brake Light Sensor	2	●				
Brake Light Sensor (self-adjusting features)	2	●				
Wheel Speed Sensor - Option 1	3	●				
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Brake Pedal Sensor	3	●				
Hall Sensor T40MC2	3	●				
<b>Clutch Sensors</b>	<b>5 - 9</b>					
Introduction	5					
Clutch Position and Pressure Sensor	6	●	●			
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Clutch Position Sensor - Option 5	8	●				
Clutch Position Sensor - Option 5	8	●				
Clutch Position Sensor - Option 1	8	●				
Clutch Position Sensor - Option 2	8	●				
Clutch Position Sensor - Option 3	9	●				
Hall Sensor T40MC2	9	●				
Platform Sensor Clutch Master Cylinder (CMC)	9	●				



**Sensor Technologies  
for the Automotive Industry**

	Page	Position	Pressure	Temperature	Humidity	Current
<b>Engine / E-Motor / Exhaust Sensors</b>	<b>11 - 14</b>					
Introduction	11					
Single Coil Resolver	12	●				
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Ni1000 SOT	12			●		
GDI Sensor Element	12		●			
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HTD 2610	13				●	
Turbocharger Pneumatic Actuator Position Sensor (Truck)	13	●				
Turbocharger Pneumatic Actuator Position Sensor (Automotive)	13	●				
Urea Pressure Sensor U86B	14		●			
Urea Temperature Sensor	14			●		
NTC Temperature Sensor	14			●		
Pressure Sensor Transmission	14	●	●			

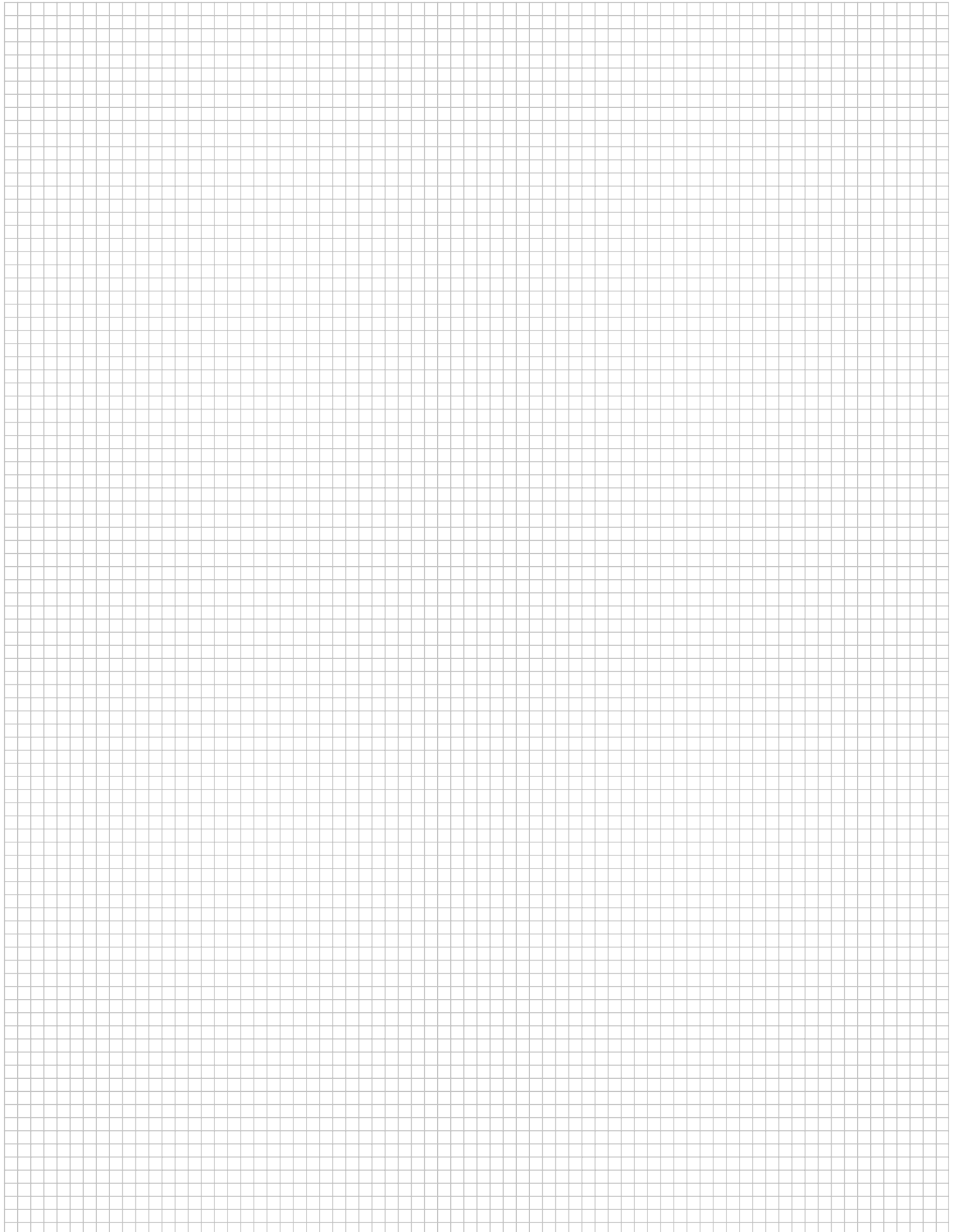
<b>Transmission Sensors</b>	<b>15 - 20</b>					
Introduction	15					
Speed Sensor Platform	16	●				
Hall Sensor T40MC2	16	●				
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Drive Mode Sensor	17	●				
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Speed Sensor SP1M	18	●				
DCT Transmission Sensor Module	18	●				
DCT Transmission Sensor Module	18	●				
DCT Transmission Sensor Module	18	●				

**Sensor Technologies  
for the Automotive Industry**

	Page	Position	Pressure	Temperature	Humidity	Current
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Neutral Position Sensor	19	●				
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Gear Detection Sensor	19	●				
Redundant Neutral Position Sensor	20	●				
Shift Detection Sensor	20	●				
Drive Mode/Transmission Rotary Sensor (TRS)	20	●				
Pressure Sensor Transmission	20	●	●			
<b>Chassis Sensors</b>	<b>21 - 25</b>					
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Seat Track Position Custom Sensor	22	●				
Seat Track Position Platform Sensor	22	●				
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Coreless Current Sensor	22					●
Integrated Current Sensor	23					●
Cylinder Hall Switch	23	●				
Hall Switch Cable Assemblies	23	●				
Roof Sensor	23	●				
Seat Buckle Switch	24	●				
Steering Position Sensor	24	●				
Truck Rear Axle Steering Sensor	24	●				
Weight Sensor	24		●			
P-SIS Side Impact Sensor	25		●			
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Seat Track Position Sensor - Option 3	25	●				
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**Sensor Technologies  
for the Automotive Industry**

	Page	Position	Pressure	Temperature	Humidity	Current
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Hall Switch SW01P	28	●				
Hall Switch SW02P	28	●				
Hall Sensor T40MC2	28	●				
PLCD-15M	29	●				
PLCD-25M	29	●				
PLCD-50M	29	●				
Hall Sensor R360MC2	29	●				
Multi-Coil Resolver (MCR) Sensor	30	●				
Single Coil Resolver (SCR) Sensor	30	●				
Speed Sensor	30	●				
H2TG/D Defogging Sensor	30				●	
PLCD-15M	31	●				
PLCD-25M	31	●				
PLCD-50M	31	●				
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## Brake Sensors

### INTRODUCTION

Our brake sensors are used in vehicle applications such as brake master cylinder position detection, travel sensor for rear axle steering to support advanced ESP, rotary sensor for brake pedal position detection, hall brake light switch and wheel speed sensors.

Many of our sensors offer optional redundant output signals for increased safety.

#### Position

- Brake Light
- Regenerative Brake
- Pedal Simulator
- Angular/Linear Actuator

#### Pressure

- Vacuum Brake Booster
- Electronic Stability Control Brake Pressure

#### Speed

- Wheel Speed (ABS/ESC)
- Brake Pad\*

\* in development

### Brake Vacuum Sensor



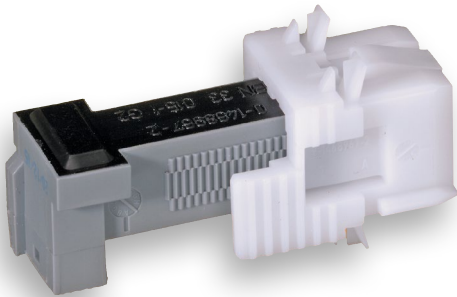
- Industry** Automotive
- Application** Start-Stop System
- Functions** Measuring pressure of brake booster
- Technology** MEMS
- Features**
- Operating Voltage: 5V (4.5 - 5.5 V)
  - Operating Temperature: -40 to +150°C
  - Operating Pressure Range:  $\pm 1.05$  bar (programmable for each customer)
  - Analog or Digital (SENT) output
  - Burst Pressure: 5 Bar
  - Accuracy over lifetime: 1.5%
  - Compliance with ASIL "C"

### Brake Cylinder Position Sensor



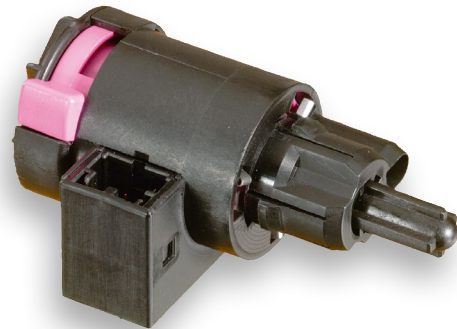
- Industry** Automotive
- Application** Regenerative Braking
- Functions** Measuring piston position of Brake Master Cylinder
- Technology** Active PLCD (moving magnet)
- Features**
- Non-contact travel measurement through cylinder wall
  - Optional redundancy

### Brake Light Sensor



- Industry** Automotive
- Application** Pedal Box
- Functions** Measuring Brake Pedal Position
- Technology** Hall Switch (magnet integrated in sensor)
- Features**
- Easy adjustment to brake pedal
  - High switching point accuracy
  - No wear and tear
  - Non-contacting
  - Two- and three-wire interface available
  - Dual output for added safety

### Brake Light Sensor (self-adjusting features)



- Industry** Automotive
- Application** Pedal Box
- Functions** Measuring Brake Pedal Position
- Technology** Hall Switch (magnet integrated in sensor)
- Features**
- Easy adjustment to brake pedal (self-adjusting features)
  - High switching point accuracy
  - Redundancy



**Wheel Speed Sensor - Option 1**



**Industry** Automotive  
 Industrial & Commercial Transportation

**Application** Anti-lock brake system

**Functions** Wheel speed detection

**Technology** Hall (magnet integrated in sensor)

**Features**

- Long life time and high reliability
- Compact size and comparative price
- Flexible design depending on customer's requirements
- Non-contact hall sensor
- Rapid response time
- Tone wheel detection

**Wheel Speed Sensor - Option 2**



**Industry** Automotive  
 Industrial & Commercial Transportation

**Application** Anti-lock brake system

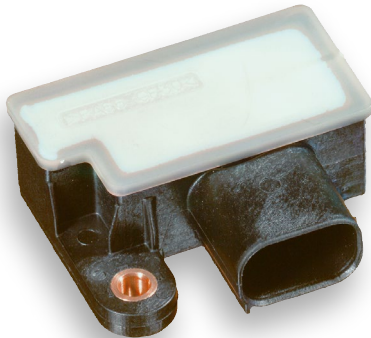
**Functions** Wheel speed detection

**Technology** Hall (magnet integrated in sensor)

**Features**

- Long life time and high reliability
- Compact size and comparative price
- Flexible design depending on customer's requirements
- Non-contact hall sensor
- Rapid response time
- Tone wheel detection

**Brake Pedal Sensor**



**Industry** Automotive

**Application** Regenerative Braking

**Functions** Measuring position of brake pedal

**Technology** Active PLCD (moving magnet)

**Features**

- Non-contact travel measurement
- Optional redundancy
- 5V supply (optional 12V)
- Analog or PWM output

**Hall Sensor T40MC2**



**Industry** Automotive

**Application** Brake, Engine, Transmission, Clutch, Chassis

**Functions** Measuring travel position

**Technology** Hall (moving magnet)

**Features**

- Non-contact measurement of magnet target
- up to 360° angular measurement
- up to 40mm linear measurement
- Highly insensitive to vibration
- Temperature range -40°C ... +150°C
- Analog or PWM interface
- Small geometry
- Optional redundancy
- Supply 5V (optional 12V)
- 4-way MCON connector interface
- Optional alternative output protocol (e.g. SENT)





## Clutch Sensors

### INTRODUCTION

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Our clutch sensors are used in vehicle applications such as Concentric Slave Cylinder (CSC) and clutch slave cylinder position, rotary clutch pedal and Clutch Master Cylinder (CMC) position, and Dual Clutch Transmission (DCT) travel.

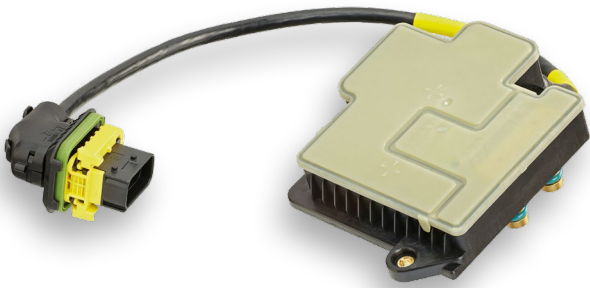
#### Position

- Clutch Pedal
- Master Cylinder CMC
- Slave Cylinder CSC
- Clutch Actuator

#### Pressure

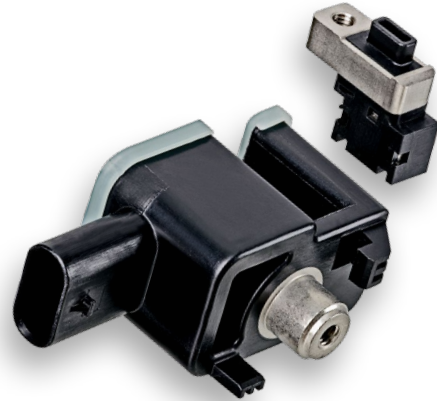
- Clutch Fluid

**Clutch Position and Pressure Sensor**



- Industry** Industrial & Commercial Transportation
- Application** Dual Clutch Transmission for Delivery Trucks
- Functions** Measuring piston position of concentric slave cylinder
- Technology** 2 PLCD Sensors  
2 Pressure Sensors
- Features**
  - Non-contact measurement
  - Operating Temperature -40°C ... 140°C
  - Integrated module with two position and two pressure sensors
  - Travel range: 0 - 42mm
  - Pressure range: 0 - 10bar (20bar burst pressure)
  - HDSCS sealed connector for harsh environment

**Differential Axle Clutch Position Sensor**



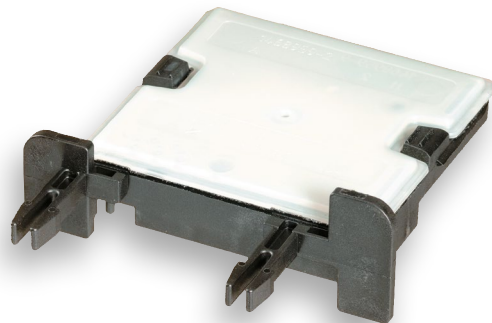
- Industry** Automotive  
Industrial & Commercial Transportation
- Application** Position of differential locking clutch
- Functions** Determine the position of clutch for electronic locking
- Technology** Hall (moving magnet)
- Features**
  - Non-contact measurement
  - Small package and robust design
  - Up to 3 output channels (witch or sensor)
  - Integrated magnetic shield to minimize external magnetic influences
  - 3pos MCON sealed connector interface
  - Operating temperature: -40°C ... 150°C

**Dual Clutch Position Sensors**



- Industry** Industrial & Commercial Transportation
- Application** Dual Clutch Transmission
- Functions** Measure position of shift rails/forks (linear) and shift lever selector (angular)
- Technology** 3D Hall (moving magnet)
- Features**
  - Non-contact linear travel and rotary measurement
  - Robust design for truck application
  - Pigtail solutions with routing protection and pre-capture fasteners
  - Operating temperature: -40°C ... +150°C

**Dual Clutch Position Sensor**



- Industry** Automotive
- Application** Dual Clutch Transmission
- Functions** Measuring piston position of clutch actuator
- Technology** Active PLCD (moving magnet)
- Features**
  - Two sensors in one housing
  - Small and robust design
  - Oil sealed design
  - Easy assembly

**Clutch Position Sensor - Option 1**



**Industry** Automotive  
**Application** Cruise control, Engine management, Interlock, Electrical park brake  
**Functions** Measuring piston position of Clutch Master Cylinder  
**Technology** Hall (moving magnet)  
**Features**

- Non-contact measurement through cylinder wall
- Up to three switching points or travel measurement up to 40mm

**Clutch Position Sensor - Option 2**



**Industry** Automotive  
**Application** Cruise control, Engine management, Interlock  
**Functions** Measuring piston position of Clutch Master Cylinder  
**Technology** Hall (moving magnet)  
**Features**

- Non-contact measurement through cylinder wall
- Up to three switching points
- Small and flat design

**Clutch Position Sensor - Option 3**



**Industry** Automotive  
**Application** Automated Manual Transmission (AMT)  
**Functions** Measuring piston position of Concentric Slave Cylinder inside the gearbox  
**Technology** Passive PLCD (moving magnet)  
**Features**

- Non-contact travel measurement
- Robust design (temperatures up to +160°C)
- Signal processing in transmission controller

**Clutch Position Sensor - Option 4**

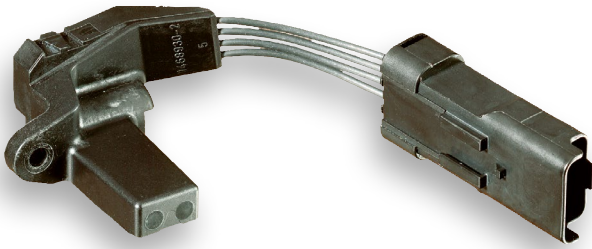


**Industry** Automotive  
**Application** Automated Manual Transmission (AMT)  
**Functions** Measuring piston position of Concentric Slave Cylinder  
**Technology** Passive PLCD (moving magnet)  
**Features**

- Non-contact travel measurement
- Short term peak temperature up to +150°C

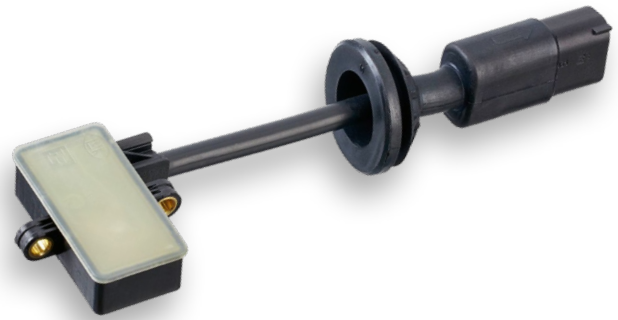


**Clutch Position Sensor - Option 5**



- Industry** Automotive
- Application** Automated Manual Transmission (AMT)
- Functions** Measuring piston position of Concentric Slave Cylinder inside the gearbox
- Technology** Passive PLCD (moving magnet)
- Features**
- Non-contact travel measurement
  - Robust design (temperatures up to +160°C)
  - Signal processing in transmission controller

**Clutch Position Sensor - Option 5**



- Industry** Automotive
- Application** Automated Manual Transmission (AMT)
- Functions** Measuring piston position of Concentric Slave Cylinder
- Technology** Passive PLCD (moving magnet)
- Features**
- Non-contact travel measurement
  - Short term peak temperature up to +150°C

**Clutch Position Sensor - Option 1**



- Industry** Industrial & Commercial Transportation
- Application** Automated Manual Transmission (AMT) for truck
- Functions** Measuring piston position of Clutch Slave Cylinder
- Technology** Passive PLCD (moving magnet)
- Features**
- Non-contact travel measurement through cylinder wall
  - Robust design for truck application

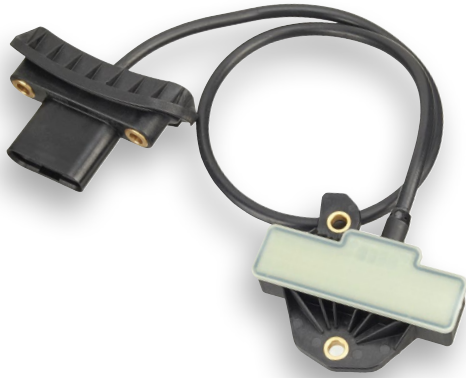
**Clutch Position Sensor - Option 2**



- Industry** Industrial & Commercial Transportation
- Application** Automated Manual Transmission (AMT)
- Functions** Measuring piston position of Concentric Slave Cylinder
- Technology** Passive PLCD (moving magnet)
- Features**
- Non-contact travel measurement
  - Highly insensitive against vibration and temperature (up to +150°C)
  - Pigtail interface with truck compatible connector



**Clutch Position Sensor - Option 3**



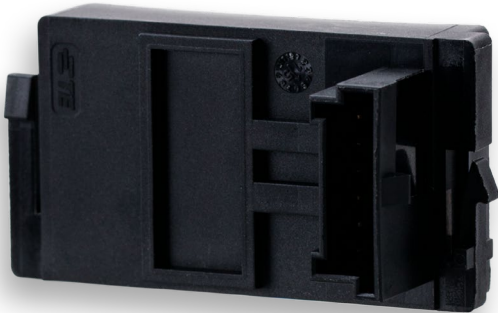
- Industry** Industrial & Commercial Transportation
- Application** Automated Manual Transmission (AMT)
- Functions** Measuring piston position of Concentric Slave Cylinder
- Technology** Passive PLCD (moving magnet)
- Features**
  - Non-contact travel measurement
  - Highly insensitive against vibration and temperature (up to +150° C)
  - Pigtail interface with truck compatible connector

**Hall Sensor T40MC2**



- Industry** Industrial & Commercial Transportation
- Application** Clutch, Engine, Transmission, Chassis, Brake
- Functions** Measuring travel position
- Technology** Hall (moving magnet)
- Features**
  - Non-contact measurement up to 40mm
  - Highly insensitive to vibration
  - Temperature up to +150° C
  - Analog or PWM interface
  - Small geometry
  - Optional redundancy
  - Supply 5V (optional 12V)
  - 4-way MCON connector interface

**Platform Sensor Clutch Master Cylinder (CMC)**



- Industry** Automotive
- Application** Start-/Stop System
- Functions** Travel sensor for Clutch Master Cylinder (CMC)
- Technology** Hall Array
- Features**
  - Operating voltage: 12V (6-16V)
  - Operating temperature: -40° C ... +80° C
  - Operating travel range: 33.5mm
  - Analog and digital (SENT) output: Analog output (2 switch signals and 1 PWM output)
  - Accuracy over lifetime: Accuracy of switch signal: ±3mm; accuracy of PWM output: ±5%
  - Compliance with ASIL "C"





## Engine / E-Motor / Exhaust Sensors

Our Engine / E-Motor sensors are used in vehicle applications such as travel sensor for turbo charger actuator (truck), pneumatic EGR Cylinder (truck), and pneumatic turbo charger actuator; rotary sensor for EGR actuator, and resolver for e-motor commutation.

### INTRODUCTION

#### Position

- Actuator Valve
- Resolver Commutation
- Oil Level \*

#### Pressure

- Oil Pressure
- Air Intake
- GDI Pressure
- MAP / TMAP / TMAP and Humidity \*

#### Temperature

- Engine Oil

#### Humidity

- Air Intake
- Combined Humidity / Pressure / Temperature

\* in development

**Single Coil Resolver (SCR)**



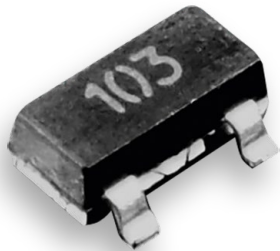
- Industry** Automotive
- Application** Hybrid powertrain / e-motor
- Functions** Angular position sensor for electric motors for EV and HEV cars
- Technology** Inductive Magnetic Field
- Features**
  - Temperature range -40°C to +170°C (works in oil if necessary)
  - Up to 20,000/min (rpm)
  - High accuracy
  - Pole pair numbers: 2-, 3-, 4-, 5-, 6-, 10-, 12-, and 18-speed
  - Customized cable assembly and connector interface
  - Fault-tolerant with excentricity (static/dynamic) through patented winding scheme
  - Fault-tolerant against external fields

**Multi-Coil Resolver (MCR)**



- Industry** Automotive
- Application** E-motor for hybrid and electrical vehicles
- Functions** Measuring rotor position of E-motor
- Technology** MCR (Multi-Coil Resolver)
- Features**
  - Non-contact measurement of rotor position
  - Analog output
  - High accuracy
  - Temperature up to +150°C
  - Rotational speed up to 20,000 rpm
  - Adaptable to pole pairs of E-motor

**Ni1000SOT**



- Industry** Automotive
- Application** Engine Oil Temperature
- Functions** Measuring temperature of engine oil
- Technology** Nickel RTD
- Features**
  - Resistance: 1000 ohms at 0°C
  - Temperature range: -55°C to +160°C
  - Measurement current: 0-5mA, typ. 0.2mA
  - ESD class 1
  - Tolerance:  $\pm (0.4+0.007 \times |T|)$  in range from 0°C to +160°C

**GDI Sensor Element**



- Industry** Automotive
- Application** GDI Engine
- Functions** Measuring pressure of fuel pipe
- Technology** Kristal Bond
- Features**
  - Pressure range up to 300bar
  - Small Diameter <6mm

**EGR Actuator Sensor**



- Industry** Industrial & Commercial Transportation
- Application** Exhaust Gas Recirculation
- Functions** Measuring piston position of Pneumatic Cylinder for truck
- Technology** Active PLCD (moving magnet)
- Features**
  - Non-contact travel measurement through cylinder wall
  - Robust design for truck application

**HTD 2610**



- Industry** Automotive
- Application** Humidity at air intake manifold
- Functions** Dew point measurement
- Technology** Capacitive
- Features**
  - Humidity range: 0% RH to 100% RH
  - Humidity time constant (with 2m/s flow rate): typical 5 S
  - Temperature range: -40° C to +125° C
  - Calibration: +/-1° DP at 25° C
  - Operating Voltage: 12 V
  - LIN output

**Turbocharger Pneumatic Actuator Position Sensor (Truck)**



- Industry** Industrial & Commercial Transportation
- Application** Turbo charger for truck
- Functions** Measuring piston position of Pneumatic Actuator (over pressure)
- Technology** Active PLCD (moving magnet)
- Features**
  - Non-contact travel measurement
  - Highly insensitive against vibration and temperature (up to +160° C)

**Turbocharger Pneumatic Actuator Position Sensor (Automotive)**



- Industry** Automotive
- Application** Turbo charger
- Functions** Measuring piston position of pneumatic actuator (vacuum)
- Technology** 3D Hall (moving magnet)
- Features**
  - Non-contact travel measurement inside the actuator
  - Unguided magnet
  - Wear and tear free
  - High life time accuracy



**Urea Pressure Sensor U86B**



- Industry** Automotive  
Industrial & Commercial Transportation
- Application** Selective Catalytic Reduction (SCR)
- Functions** Pressure measurement of urea liquid in SCR systems
- Technology** Piezoresistive
- Features**
- Analog or SENT output
  - Pressure range: 0-3, 7, 10, or 14 bar
  - Total Error Band:  $\pm 2.0$
  - Operating temperature:  $-7^{\circ}\text{C} \dots +105^{\circ}\text{C}$
  - Cable option

**Urea Temperature Sensor**



- Industry** Industrial & Commercial Transportation
- Application** Selective Catalytic Reduction (SCR)
- Functions** Pressure measurement of urea liquid in SCR systems
- Technology** NTC
- Features**
- Suitable for high pressure applications
  - NTC – Custom tolerances available:  $\pm 2\%$ ,  $\pm 3\%$ , and  $\pm 5\%$ ,
  - Beta 25/85: 3976
  - Operating temperature:  $-40^{\circ}\text{C} \dots +125^{\circ}\text{C}$
  - 8mm sensor tip diameter
  - Freeze cycle proven design

**NTC Temperature Sensor**



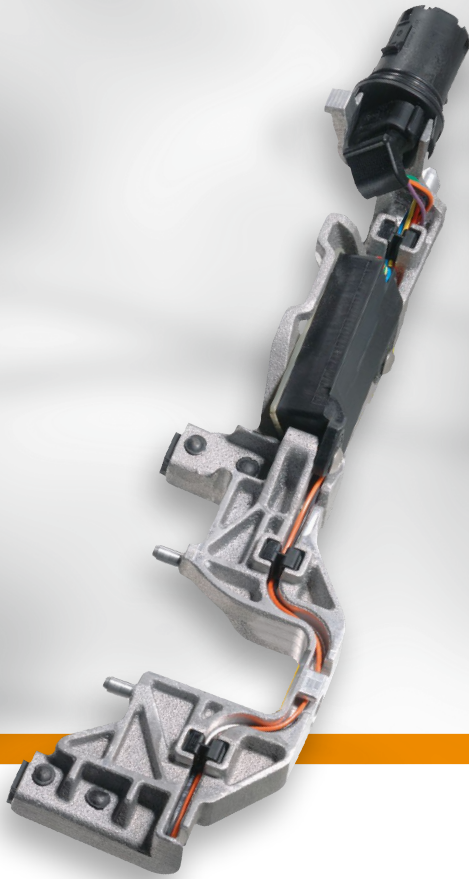
- Industry** Automotive
- Application** 48V Beltdriven Starter Generator (BSG) temperature monitoring
- Functions** Monitor the temperature inside of the 48V motor
- Technology** NTC
- Features**
- Operating temperature:  $-40^{\circ}\text{C} \dots +200^{\circ}\text{C}$
  - Resistance @  $25^{\circ}\text{C}$ : 30KOhms
  - Beta value 25/85: 3960K

**Pressure Sensor Transmission**



- Industry** Automotive
- Application** Transmission CVT, DCT, AT & others
- Functions** Measuring transmission oil pressure
- Technology** Semiconductor Strain Gage (SemSG)
- Features**
- Lightweight: <18 grams
  - Operating pressure: 1 - 80 / 20 bar (gauge)
  - Proof pressure: >2x or more to operating range
  - Burst pressure: > 500bar or more to operating range
  - Operating temperature:  $-40^{\circ}\text{C}$  to  $+140^{\circ}\text{C}$
  - Interface: Analog or SENT
  - Compliance with ASIL "B", optional ASIL "C"





## Transmission Sensors

Our transmission sensors are used in vehicle applications such as neutral detection sensor for Manual Transmission (MT) to support the start and stop function; drive mode sensor (travel or rotary measurement) for Automatic Transmission (AT), Continuously Variable Transmission (CVT), and Dual Clutch Transmission (DCT).

### INTRODUCTION

#### Position

- All Gear Detection
- Drive Mode (P - R - N - D - L)
- DCT Gear / Shift
- Clutch

#### Pressure

- Transmission Control Unit (TCU) Hydraulic Oil
- Pneumatic Air
- Transfer Case 4WD

#### Temperature

- Oil Sump
- Wet Clutch
- Oil Pump

#### Speed

- Input Speed (TISS)
- Output Speed (TOSS)
- Gear Speed

### Speed Sensor Platform



- Industry** Automotive
- Application** Transmission, Engine, Clutch, Chassis, Brake
- Functions** Measuring gear speed, travel and angle position
- Technology** Hall (moving magnet)
- Features**
- Triggered by ferromagnetic gear wheel
  - Current interface with direction detection
  - Sealed connector interface
  - Diagnostics ability due to two-wire interface
  - IP6K9
  - Temperature range: -40°C up to +150°C

### Hall Sensor T40MC2



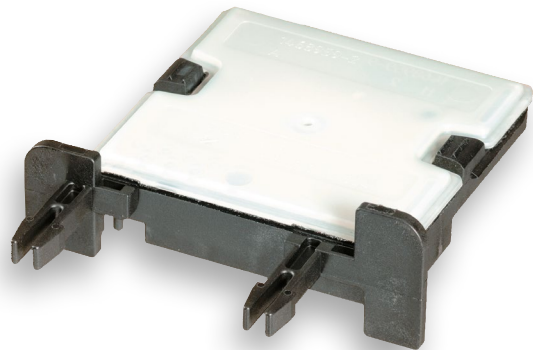
- Industry** Automotive
- Application** Transmission, Engine, Clutch, Chassis, Brake
- Functions** Measuring travel position
- Technology** Hall (moving magnet)
- Features**
- Non-contact measurement up to 40mm
  - Highly insensitive to vibration
  - Temperature up to +150°C
  - Analog or PWM interface
  - Small geometry
  - Optional redundancy
  - Supply 5V (optional 12V)
  - 4-way MCON connector interface
  - Optional protocol (e.g. SENT)

### AMT Position Sensor



- Industry** Industrial & Commercial Transportation
- Application** Automated Manual Transmission (AMT)
- Functions** Measure position of shift rails / forks (linear)
- Technology** 3D Hall (moving magnet)
- Features**
- Non-contact travel
  - Robust design for truck application
  - One fastener interface to reduce installation time
  - 3D Hall with temperature compensation factor
  - 4-way MCON sealed connector interface
  - Operating temperature: -40°C ... +150°C

### Dual Clutch Position Sensor



- Industry** Automotive
- Application** Dual Clutch Transmission
- Functions** Measuring piston position of clutch actuator
- Technology** Active PLCD (moving magnet) or Hall
- Features**
- Two sensors in one housing
  - Small and robust design

**Drive Mode Sensor**



**Industry** Automotive  
**Application** Automated Transmission (AT)  
**Functions** Measuring drive mode position (PRND) inside the gearbox  
**Technology** Active PLCD (moving magnet) or Hall  
**Features**

- Non-contact travel measurement
- Robust and oil sealed design
- High measurements accuracy
- No wear and tear

**All Gear Detection Sensor**



**Industry** Automotive  
**Application** Manual Transmission (MT)  
**Functions** Measuring gear and shift position  
**Technology** 3D Hall  
**Features**

- Non-contact rotary and travel measurement integrated in one housing
- Robust design

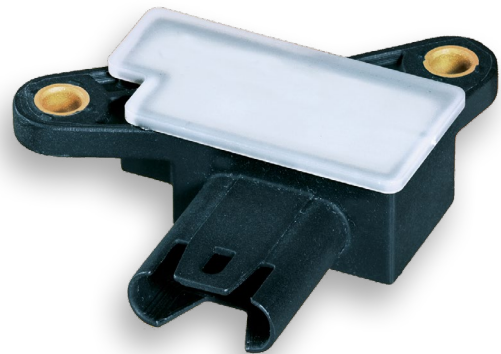
**Gear Fork Position Sensor**



**Industry** Automotive  
**Application** Dual Clutch Transmission  
**Functions** Measuring gear fork position  
**Technology** Active PLCD (moving magnet) or Hall  
**Features**

- Non-contact measurement through transmission wall
- High life time accuracy
- Small magnet design

**Neutral Position Sensor**



**Industry** Automotive  
**Application** Start-/Stop application  
**Functions** Measuring gear lever position inside manual transmission  
**Technology** Active PLCD (moving magnet) or Hall  
**Features**

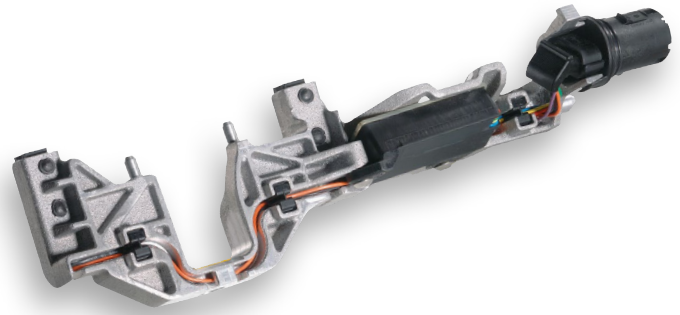
- Non-contact measurement through transmission wall
- High life time accuracy
- Small magnet design
- Diagnostics ability due to two-wire interface

**Speed Sensor SP1M**



- Industry** Automotive
- Application** Transmission
- Functions** Measuring gear speed
- Technology** Hall (with integrated magnet)
- Features**
  - Triggered by ferromagnetic gear wheel
  - Current interface with direction detection
  - Sealed connector interface
  - Diagnostics ability due to two-wire interface
  - IP69K
  - Temperature range: -40° C ... +150° C

**DCT Transmission Sensor Module**



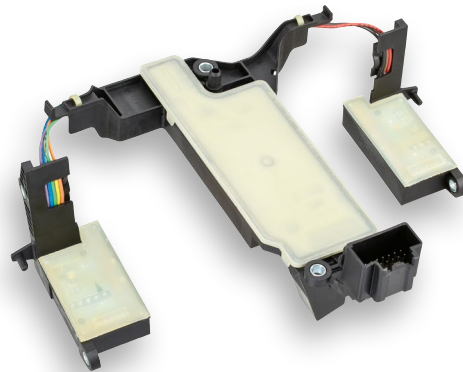
- Industry** Automotive
- Application** Dual Clutch Transmission
- Functions** Measuring drive mode position and gear speed inside transmission
- Technology** Active PLCD or Hall
- Features**
  - Sensor module with integrated position and speed sensors
  - Oil sealed pass through connector system
  - Highly robust design

**DCT Transmission Sensor Module**



- Industry** Automotive
- Application** Dual Clutch Transmission
- Functions** Measuring shift fork position, gear speed and temperature inside transmission
- Technology** Hall and NTC
- Features**
  - Sensor module with integrated speed (2x), position (4x) and temperature sensors
  - Oil sealed 12 pin pass through connector system
  - Highly insensitive against vibration, temperature and pollution inside the transmission

**DCT Transmission Sensor Module**



- Industry** Automotive
- Application** Dual Clutch Transmission
- Functions** Measuring shift fork position, gear speed and temperature inside transmission
- Technology** Active PLCD, Hall and NTC
- Features**
  - Sensor module with integrated speed (2x), position (4x) and temperature sensors
  - Oil sealed connector system
  - Highly insensitive to vibration, temperature and pollution inside the transmission



**Gear-Shift-Split Detection Sensor**



**Industry** Industrial & Commercial Transportation  
**Application** Automated Manual Transmission (AMT)  
**Functions** Measuring gear-shift and split position  
**Technology** Active PLCD (moving magnet)  
**Features**

- Non-contact measurement
- High life time accuracy
- Small magnet design

**Neutral Position Sensor**



**Industry** Automotive  
**Application** Start-/Stop application  
**Functions** Measuring gear lever position inside manual transmission  
**Technology** Hall (moving magnet)  
**Features**

- Non-contact measurement
- Oil tight connector interface
- High life time accuracy
- Small magnet design
- Diagnostics ability due to three-wire interface

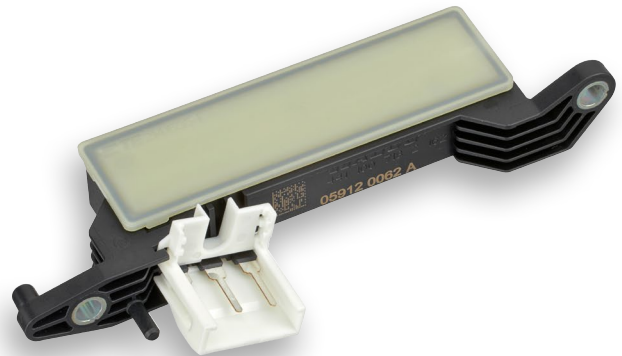
**Water in Fuel Detection Sensor**



**Industry** Automotive  
**Application** Fuel Filter  
**Functions** Water detection  
**Technology** Resistance measurement  
**Features**

- Flexible electrical interface (AC or DC, 12V or 24V)
- Different measurement levels
- Bayonet or thread interface
- Optional header or pigtail interface

**Gear Detection Sensor**



**Industry** Industrial & Commercial Transportation  
**Application** Automated Manual Transmission  
**Functions** Measuring gear position  
**Technology** Active PLCD (moving magnet)  
**Features**

- Non-contact measurement
- High life time accuracy
- Small magnet design
- Highly insensitive to vibration, temperature and pollution inside the transmission

**Redundant Neutral Position Sensor**



- Industry** Automotive
- Application** Start/Stop application
- Functions** Measuring gear lever position inside manual transmission
- Technology** Active PLCD (moving magnet) or Hall
- Features**
  - Non-contact measurement through transmission wall
  - High lifetime accuracy
  - Small magnet design
  - Diagnostics ability due to two-wire interface

**Shift Detection Sensor**



- Industry** Industrial & Commercial Transportation
- Application** Automated Manual Transmission
- Functions** Measuring shift position
- Technology** Active PLCD (moving magnet)
- Features**
  - Non-contact measurement
  - High lifetime accuracy
  - Small magnet design
  - Highly insensitive to vibration, temperature and pollution inside the transmission

**Drive Mode / Transmission Rotary Sensor (TRS)**



- Industry** Automotive
- Application** Transmission
- Functions** Drive mode and shift drum detection
- Technology** Hall 3D with integrated magnet
- Features**
  - Operating voltage:  $5 \pm 0.5V$
  - Operating temperature:  $-40^{\circ}C$  to  $+140^{\circ}C$
  - Operating travel range:  $360^{\circ}$
  - Analog and digital (SENT) output
  - Accuracy over lifetime 1%
  - Compliance with ASIL "C"

**Pressure Sensor Transmission**



- Industry** Automotive
- Application** Transmission CVT, DCT, AT & others
- Functions** Measuring transmission oil pressure
- Technology** Semiconductor Strain Gage (SemSG)
- Features**
  - Lightweight:  $< 18$  grams
  - Operating pressure: 1 - 80 / 20 bar (gauge)
  - Proof pressure:  $> 2x$  or more to operating range
  - Burst pressure:  $> 500$  bar or more to operating range
  - Operating temperature:  $-40^{\circ}C$  to  $+140^{\circ}C$
  - Interface: Analog or SENT
  - Compliance with ASIL "B", optional ASIL "C"





## Chassis Sensors

Our chassis sensors are used in vehicle applications such as travel sensors for rear axle steering, wheel speed sensors for advanced Electronic Stability Program (ESP), steering angle position sensors, seat track position sensors and hall switches for position detection.

### INTRODUCTION

#### Position

- Rear Axle Steering
- Seat Position
- Chassis Switch
- Convertible Roof
- Fluid Level

#### Pressure

- Fuel Pump (Low Pressure)
- Power Steering
- Weight Classification
- Impact
- HVAC Fluid \*

#### Temperature

- Fuel Temperature
- Passenger Cabin
- Ambient Air / HVAC
- Seat Heater
- Battery Management

#### Humidity

- Ambient
- Cabin
- Fog / Moisture
- HVAC
- EV Battery Management

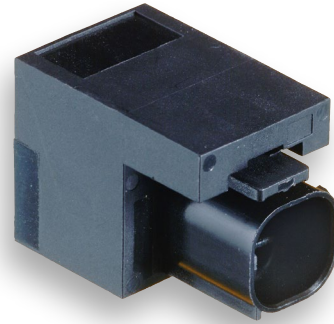
\* in development

### Seat Track Position Custom Sensor



<b>Industry</b>	Automotive
<b>Application</b>	Measure position of seat track
<b>Functions</b>	Input for dual stage airbags
<b>Technology</b>	Hall Switch (magnet integrated in sensor)
<b>Features</b>	<ul style="list-style-type: none"><li>• Non-contact switch triggered by seat track or ferrous target</li><li>• No moving magnets</li><li>• Custom package size and sensor mounting</li><li>• Optional bushing</li><li>• Operating temperature: -40°C to +85°C</li></ul>

### Seat Track Position Platform Sensor



<b>Industry</b>	Automotive
<b>Application</b>	Measure position of seat track
<b>Functions</b>	Input for dual stage airbags
<b>Technology</b>	Hall Switch (magnet integrated in sensor)
<b>Features</b>	<ul style="list-style-type: none"><li>• Non-contact switch triggered by seat track or ferrous target</li><li>• No moving magnets</li><li>• Small package size</li><li>• Operating temperature: -40°C to +85°C</li></ul>

### H2TG/D Defogging Sensor



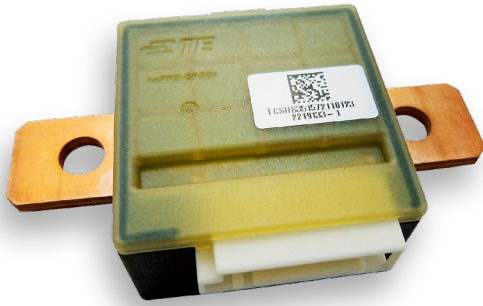
<b>Industry</b>	Automotive
<b>Application</b>	Cabin energy management and defogging (HVAC)
<b>Functions</b>	Measuring dew point and windshield temperature measurement
<b>Technology</b>	Capacitive and NTC
<b>Features</b>	<ul style="list-style-type: none"><li>• Humidity range: 0% RH to 100% RH</li><li>• Temperature range: -40°C ... +125°C</li><li>• Calibration: ± 1.5° DP at 10°C, ± 0.8°C at 25°C</li><li>• Operating voltage: 12V</li><li>• Analog or digital (LIN) output</li></ul>

### Coreless Current Sensor



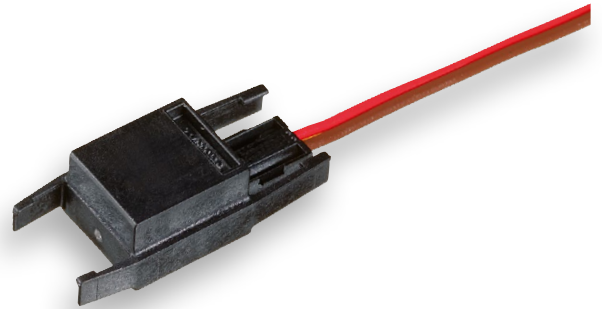
<b>Industry</b>	Automotive
<b>Application</b>	Battery Pack (BDU: Battery Disconnect Unit) Battery Management for xEV application
<b>Functions</b>	Measuring current of battery
<b>Technology</b>	Hall
<b>Features</b>	<ul style="list-style-type: none"><li>• Operating voltage: 5V (4.5 to 5.5V)</li><li>• Operating temperature: -40°C to +85°C</li><li>• Operating current range: -350A - +350A</li><li>• Analog output</li><li>• Accuracy @ 25°C: 1% (Hall)</li></ul>

**Integrated Current Sensor**



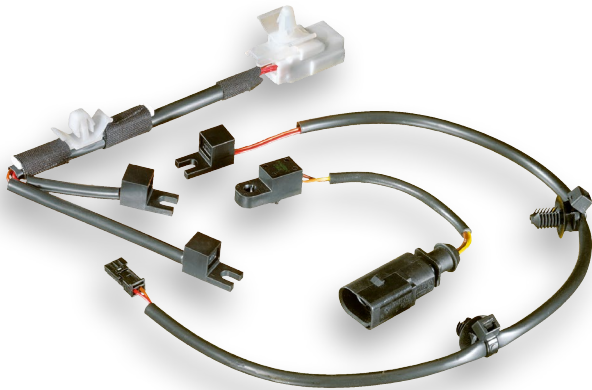
- Industry** Automotive
- Application** Battery Pack (BDU: Battery Disconnect Unit)  
Battery Management for xEV application
- Functions** Measuring current of battery
- Technology** Hall or Shunt
- Features**
  - Operating voltage: 5V (4.5 to 5.5V)
  - Operating temperature: -40°C ... +85°C
  - Operating current range: -350 A ~ +350 A
  - Analog output
  - Accuracy @ 25°C: 1% (Hall)
  - Tolerance: 100 μΩ ± 5%
  - Temperature sensor: NTC

**Cylinder Hall Switch**



- Industry** Automotive
- Application** Hydraulic cylinder for convertible roofs
- Functions** Measuring piston position of hydraulic cylinder
- Technology** Hall Switch (magnet integrated in sensor)
- Features**
  - No moving magnet inside cylinder
  - Small and robust design
  - Pigtail with flexible connector interface

**Hall Switch Cable Assemblies**



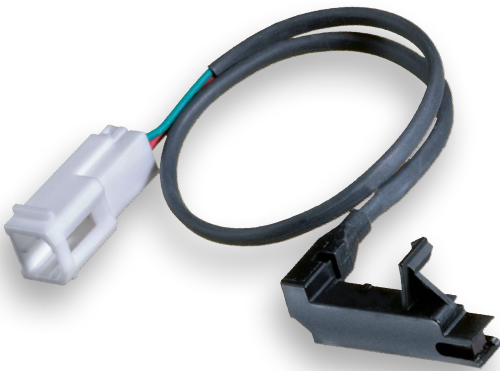
- Industry** Automotive
- Application** Convertible roof systems
- Functions** Digital position detection
- Technology** Hall Switch (magnet integrated in sensor)
- Features**
  - Variety of cable assembly with integrated Hall switches

**Roof Sensor**



- Industry** Automotive
- Application** Roof railing detection
- Functions** Adaptive ESP support
- Technology** Hall (moving magnet)
- Features**
  - Current interface
  - Small geometry
  - Diagnostics ability due to two-wire interface

### Seat Buckle Switch



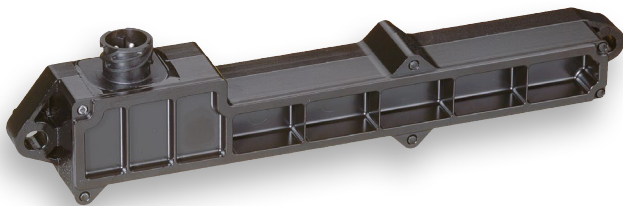
- Industry** Automotive
- Application** Airbag
- Functions** Detecting buckle up status
- Technology** Hall Switch (magnet integrated in sensor)
- Features**
- Non-contact measurement
  - Small design

### Steering Position Sensor



- Industry** Automotive
- Application** Steering / Attention Assistant
- Functions** Measuring steering angle
- Technology** Hall (moving magnet)
- Features**
- Non-contact measurement
  - High resolution of steering angle (single turn)
  - Adapted to actuator motor

### Truck Rear Axle Steering Sensor



- Industry** Industrial & Commercial Transportation
- Application** Truck Rear Axle Steering
- Functions** Measuring piston position of Hydraulic Steering Cylinder
- Technology** Active PLCD (moving magnet)
- Features**
- Non-contact measurement through cylinder wall
  - Robust design
  - Truck specific connector interface

### Weight Sensor



- Industry** Automotive
- Application** Passenger detection
- Functions** Measuring seat weight to classify passenger for airbag deployment
- Technology** Strain gage technology
- Features**
- High resolution of weight
  - Very small package (integration to seat track)
  - Sensor array with ECU for in system calibration
  - Mechanical overload protection
  - Very robust design



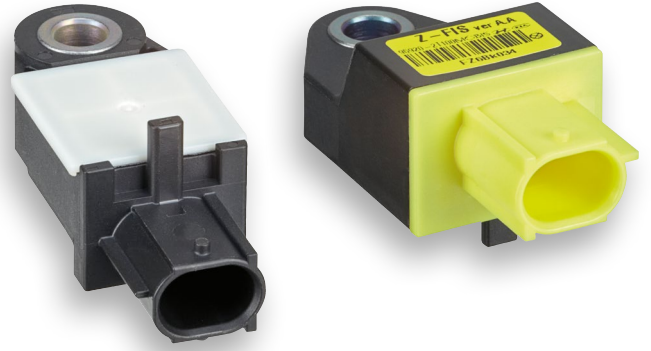
**P-SIS Side Impact Sensor**



**Industry** Automotive  
**Application** Side impact detection  
**Functions** Measuring the quick increase of pressure within the cavities of passenger car door to determine the airbag deployment  
**Technology** MEMS  
**Features**

- Small package and robust design
- PAS4 data transmission mode

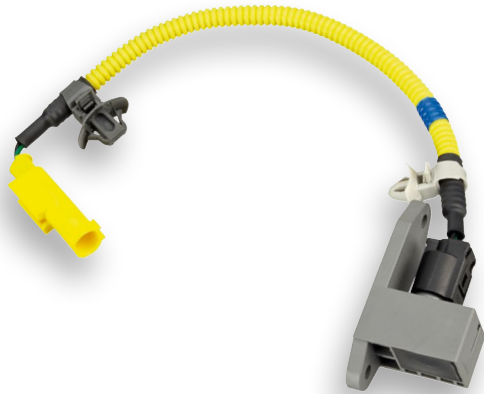
**FIS / Z-Fis Front Impact Sensor**



**Industry** Automotive  
**Application** Front impact detection  
**Functions** Measuring acceleration data for front impact detection  
**Technology** MEMS  
**Features**

- Small package and robust design
- PSI5-A data transmission mode

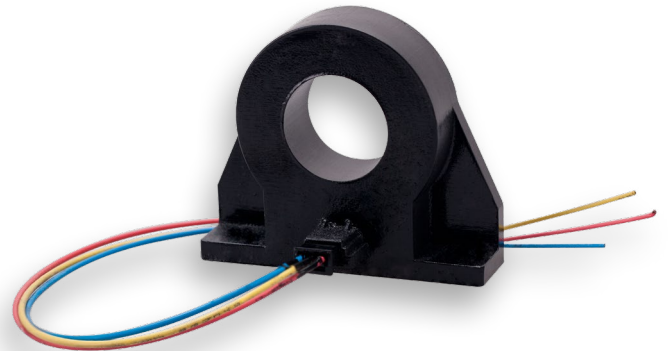
**Seat Track Position Sensor - Option 3**



**Industry** Automotive  
**Application** Dual staged airbag  
**Functions** Measuring seat track position  
**Technology** Hall Switch (magnet integrated in sensor)  
**Features**

- Triggered by seat track (no moving magnet)
- Current interface
- Small geometry
- Diagnostics ability due to two-wire interface

**Current Sensor for BMS**

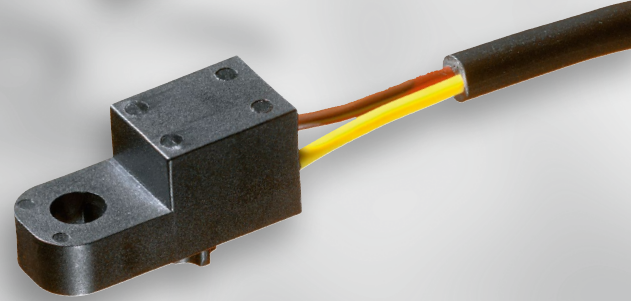
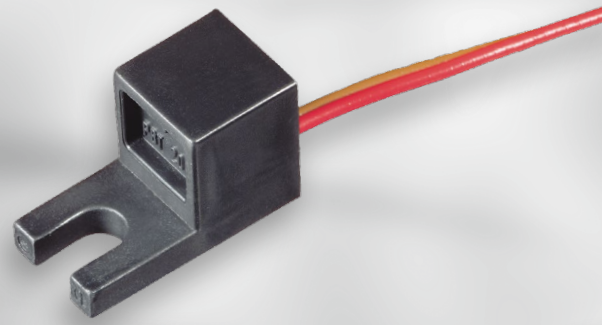


**Industry** Automotive  
**Application** Current sensing for Battery Management System (BMS)  
**Functions** Indicates the real-time current flowing through the battery, which would be used to calculate the "start of charge" of the battery  
**Technology** Fluxgate  
**Features**

- Operating voltage: ±12V or 0-12V
- Operating temperature: -40°C to +85°C
- Operating current range: 0 - 300 A
- Analog and digital (SENT) output: current output or analog output
- Accuracy @ room temperature: 1%







## Platform Sensors

In the automotive industry, development time is a key factor for successful market positioning. TE Connectivity's answer is a platform strategy for non-contact travel, angle and speed sensors.

Standardized designs and production processes offer short-term availability of fully functional sensors for system testing and low-volume production. Depending on the field of application, different technologies will be used.

The first platform is the PLCD travel sensor for measurement ranges up to 55mm. Thanks to the system's robustness, the possibility of large-scale integration and the high linear performance of PLCD in high-vibration and high-temperature applications, this technology is preferred for harsh environment systems (e.g. transmission, clutch).

The second platform TE Connectivity can offer is the hall technology based travel and angular sensor for measurement ranges up to 40mm or angle up to 360°. Travel and angle measurement can be realized within one sensor package. The hall technology used is a 2D/3D measurement principle that results in a significant measurement performance increase compared to existing hall sensors.

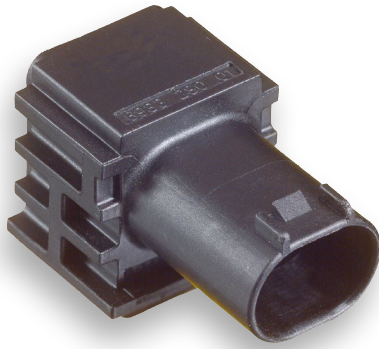
### INTRODUCTION

This sensor exhibits high performance related to linearity error and temperature drift. It also enables the opportunity to incorporate 12V board net supply, safety level B according ISO 26262 and up to three outputs, which can operate as programmable linear or switch outputs.

Compared to inductive systems, TE Connectivity's hall sensor platform needs a minimum of space and makes more cost-effective production possible. Our platform sensors are all suitable for IP class applications of 69K, which makes them suitable for harsh automotive environments. At the same time, the hall platform sensors can be programmed to suit customer specifications regarding measurement range and electrical interface (PWM or analog).

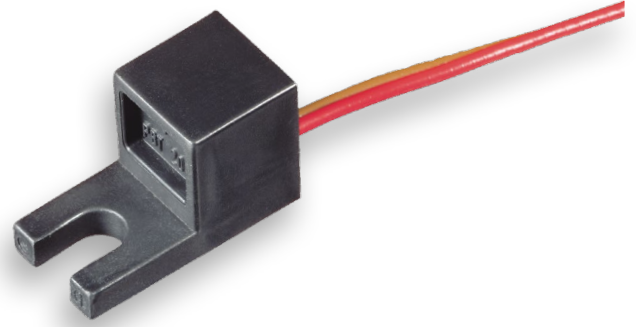
Our third platform is the speed sensor for gear speed measurement. This back-biased hall sensor is triggered by ferromagnetic gear or tone wheel. Thanks to its compact and robust packaging with integrated sealed connector interface (IP69K), it can be used for all kinds of application (e.g. transmission). The sensor also provides diagnostic functionality, thanks to two-wire technology, and is validated for a temperature range from -40°C to +150°C.

### Hall Flap Switch SW01M



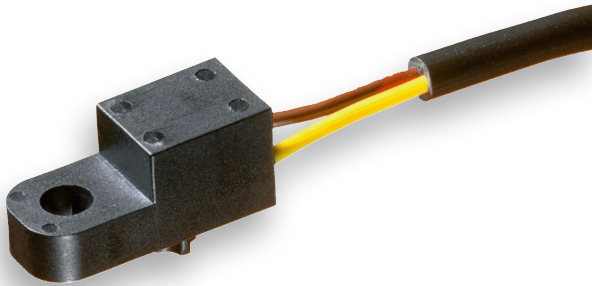
- Industry** Automotive
- Application** Powertrain, Chassis, Brake
- Functions** Digital position detection
- Technology** Hall Switch (magnet integrated in sensor)
- Features**
- Triggered by ferromagnetic part (no moving magnet)
  - Current interface
  - Sealed connector interface
  - Diagnostics ability due to two-wire interface
  - IP69K
  - Temperature range -40°C ... 105°C

### Hall Switch SW01P



- Industry** Automotive
- Application** Body and Chassis
- Functions** Digital position detection
- Technology** Hall Switch (magnet integrated in sensor)
- Features**
- Triggered by ferromagnetic part (no moving magnet)
  - Current interface
  - Diagnostics ability due to two-wire interface
  - Temperature range -40°C ... 105°C

### Hall Switch SW02P



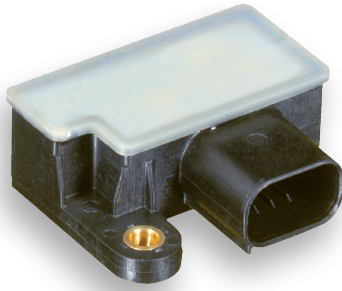
- Industry** Automotive
- Application** Body and Chassis
- Functions** Digital position detection
- Technology** Hall Switch (magnet integrated in sensor)
- Features**
- Triggered by ferromagnetic part (no moving magnet)
  - Current interface
  - Diagnostics ability due to two-wire interface
  - Temperature range -40°C up to 105°C

### Hall Sensor T40MC2



- Industry** Automotive  
Industrial & Commercial Transportation
- Application** Engine, Transmission, Clutch, Chassis, Brake
- Functions** Measuring travel position
- Technology** Hall (moving magnet)
- Features**
- Non-contact measurement up to 40mm
  - Highly insensitive to vibration
  - Temperature up to +150°C
  - Analog or PWM interface
  - Small geometry
  - Optional redundancy
  - Supply 5V (optional 12V)
  - 4-way MCON connector interface

**PLCD-15M**



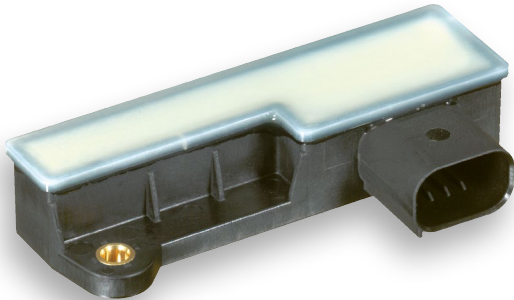
- Industry** Automotive
- Application** Transmission, Chassis, Engine
- Functions** Measuring travel or angle position
- Technology** Active PLCD (moving magnet)
- Features**
- Measurement range 5–18mm
  - Highly insensitive to vibration
  - Temperature up to 150°C
  - Redundancy possible
  - Analog or PWM interface
  - Supply 5V (optional 12V)
  - 4-way MQS sealed contact
  - Wide range of magnet design

**PLCD-25M**



- Industry** Automotive
- Application** Transmission, Brake, Clutch, Steering, Engine
- Functions** Measuring travel or angle position
- Technology** Active PLCD (moving magnet)
- Features**
- Measurement range 15–28mm
  - Highly insensitive to vibration
  - Temperature up to 150°C
  - Redundancy possible
  - Analog or PWM interface
  - Supply 5V (optional 12V)
  - 4-way MQS sealed contact
  - Wide range of magnet design

**PLCD-50M**



- Industry** Automotive
- Application** Transmission, Brake, Clutch, Steering, Engine
- Functions** Measuring travel or angle position
- Technology** Active PLCD (moving magnet)
- Features**
- Measurement range 25–53mm
  - Highly insensitive to vibration
  - Temperature up to 150°C
  - Redundancy possible
  - Analog or PWM interface
  - Supply 5V (optional 12V)
  - 4-way MQS sealed contact
  - Wide range of magnet design

**Hall Sensor R360MC2**



- Industry** Automotive  
Industrial & Commercial Transportation
- Application** Transmission, Chassis, Engine, Steering, Clutch, Brake
- Functions** Measuring angle position
- Technology** Hall (moving magnet)
- Features**
- Non-contact measurement up to 360°
  - Highly insensitive to vibration
  - Temperature up to +150°C
  - Analog or PWM interface
  - Small geometry
  - Redundancy possible
  - Supply 5V (optional 12V)
  - 4-way MCON connector interface

**Multi-Coil Resolver (MCR)**



- Industry** Automotive
- Application** E-Motor for hybrid and electrical vehicles
- Functions** Measuring rotor position of E-Motor
- Technology** MCR (Multi-Coil Resolver)
- Features**
  - Non-contact measurement of rotor position
  - Analog output
  - High accuracy
  - Temperature up to +150° C
  - Rotational speed up to 20.000 rpm
  - Adaptable to pole pairs of E-Motor

**Single Coil Resolver (SCR)**



- Industry** Automotive
- Application** E-Motor for hybrid and electrical vehicles
- Functions** Measuring rotor position of E-Motor
- Technology** SCR (Single Coil Resolver)
- Features**
  - Non-contact measurement of rotor position
  - Analog output
  - High accuracy for high temperature applications
  - Slim design for IMG applications in combination with oil
  - Rotational speed up to 20.000 rpm
  - Adaptable to pole pairs of E-Motor

**Speed Sensor**



- Industry** Automotive
- Application** Transmission
- Functions** Measuring gear speed
- Technology** Hall (with integrated magnet)
- Features**
  - Triggered by ferromagnetic gear wheel
  - Current interface with direction detection
  - Sealed connector interface
  - Diagnostics ability due to two-wire interface
  - IP6K9
  - Temperature range -40° C up to +150° C

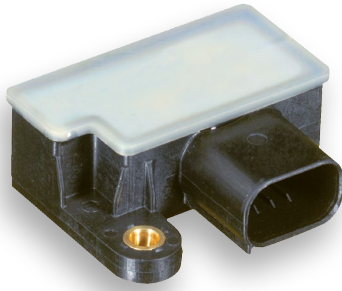
**H2TG/D Defogging Sensor**



- Industry** Automotive
- Application** Cabin energy management and defogging (HVAC)
- Functions** Measuring dew point and windshield temperature measurement
- Technology** Capacitive
- Features**
  - Humidity range: 0% RH to 100% RH
  - Temperature range: -40° C to +125° C
  - Calibration: ± 1.5° DP at 10° C, ± 0.8° C at 25° C
  - Operating voltage: 12V
  - Analog and digital (LIN) output



**PLCD-15M**



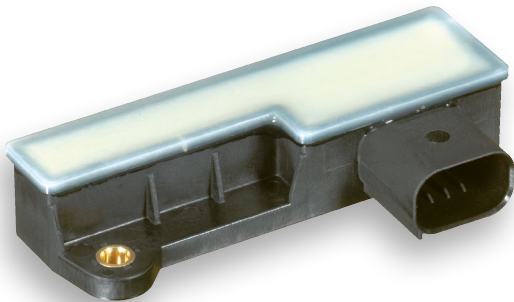
- Industry** Automotive
- Application** Transmission, Chassis, Engine
- Functions** Measuring travel or angle position
- Technology** Active PLCD (moving magnet)
- Features**
- Measurement range 5–18mm
  - Highly insensitive to vibration
  - Temperature up to 150°C
  - Redundancy possible
  - Analog or PWM interface
  - Supply 5V (optional 12V)
  - 4-way MQS sealed contact
  - Wide range of magnet design

**PLCD-25M**



- Industry** Automotive
- Application** Transmission, Brake, Clutch, Steering, Engine
- Functions** Measuring travel or angle position
- Technology** Active PLCD (moving magnet)
- Features**
- Measurement range 15–28mm
  - Highly insensitive to vibration
  - Temperature up to 150°C
  - Redundancy possible
  - Analog or PWM interface
  - Supply 5V (optional 12V)
  - 4-way MQS sealed contact
  - Wide range of magnet design

**PLCD-50M**



- Industry** Automotive
- Application** Transmission, Brake, Clutch, Steering, Engine
- Functions** Measuring travel or angle position
- Technology** Active PLCD (moving magnet)
- Features**
- Measurement range 25–53mm
  - Highly insensitive to vibration
  - Temperature up to 150°C
  - Redundancy possible
  - Analog or PWM interface
  - Supply 5V (optional 12V)
  - 4-way MQS sealed contact
  - Wide range of magnet design







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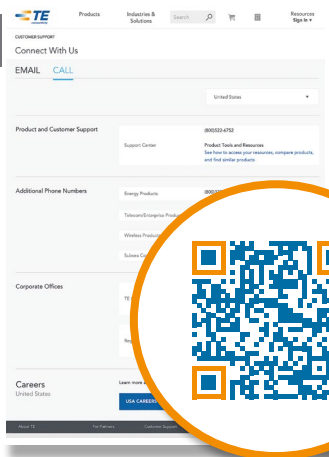
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Shanghai  
Phone: +86 21-3398-0000  
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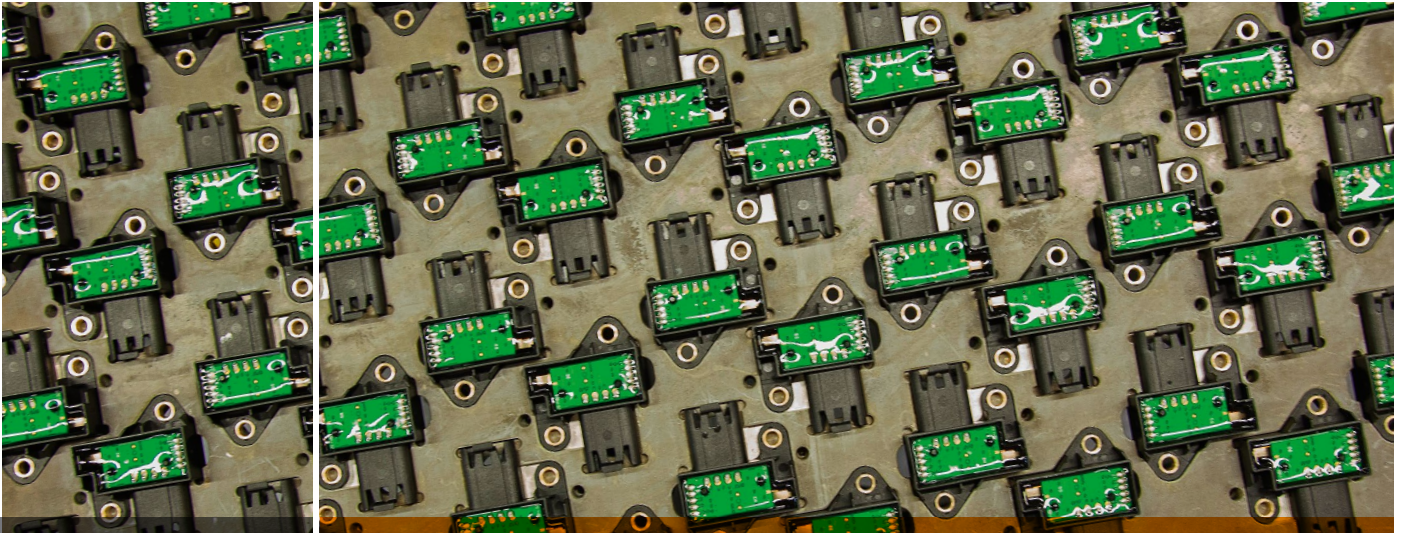
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## TE Connectivity Germany GmbH

Ampèrestrasse 12-14 | 64625 Bensheim | Germany  
Phone: +49 (0)6251 133-0  
Fax: +49 (0)6251 133-1600



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