

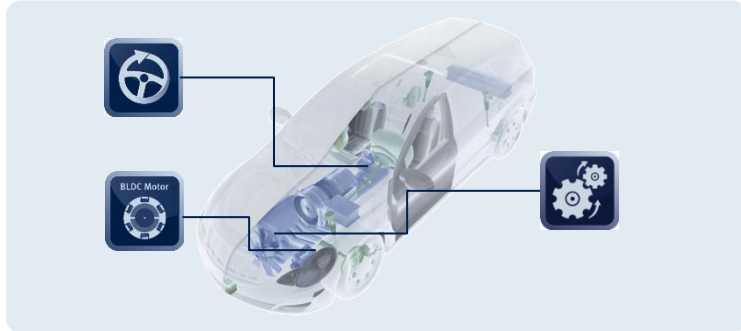
# Dual-Sensor Package Technology

Supporting ASIL-D in Safety-Related  
Automotive Applications  
SENSOR+TEST 2015, Nuremberg

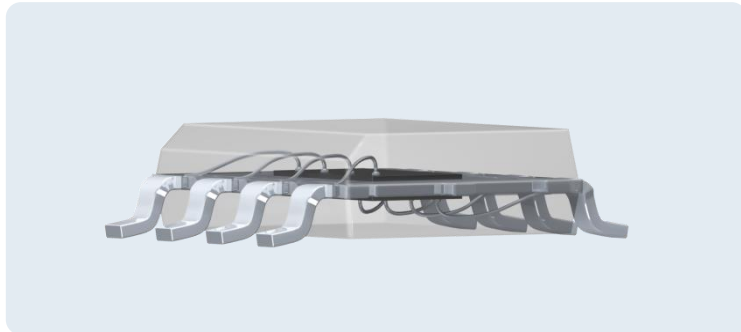
Dr. Wolfgang Scheibenzuber  
IFAG ATV SC IS ACS AEM



# Dual-Sensor Package Technology – Agenda



Safety Related Applications for Position Sensors

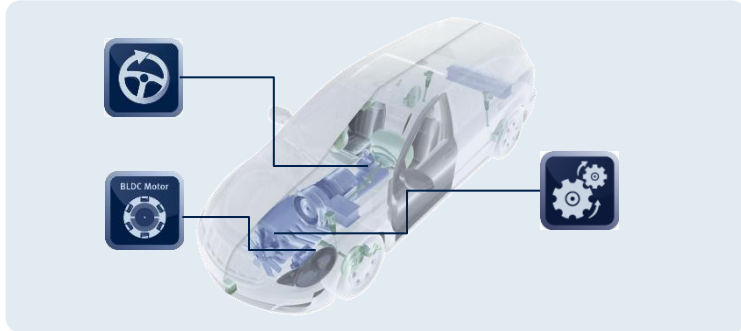


Enabling Functional Safety by Infineon Dual Sensors

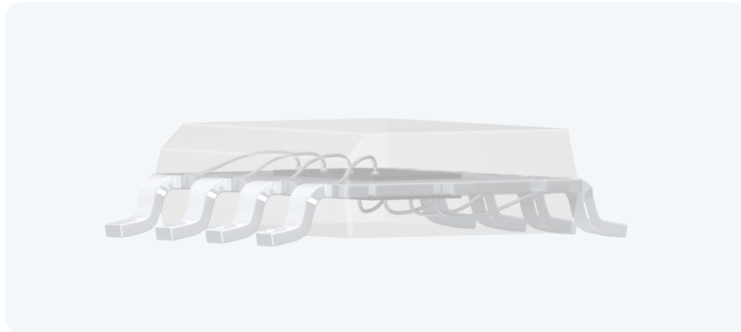


Cost-Reduction and Functionality Enhancement

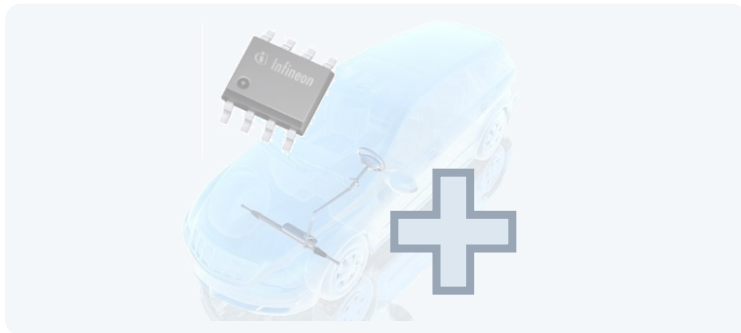
# Dual-Sensor Package Technology – Agenda



Safety Related Applications for Position Sensors

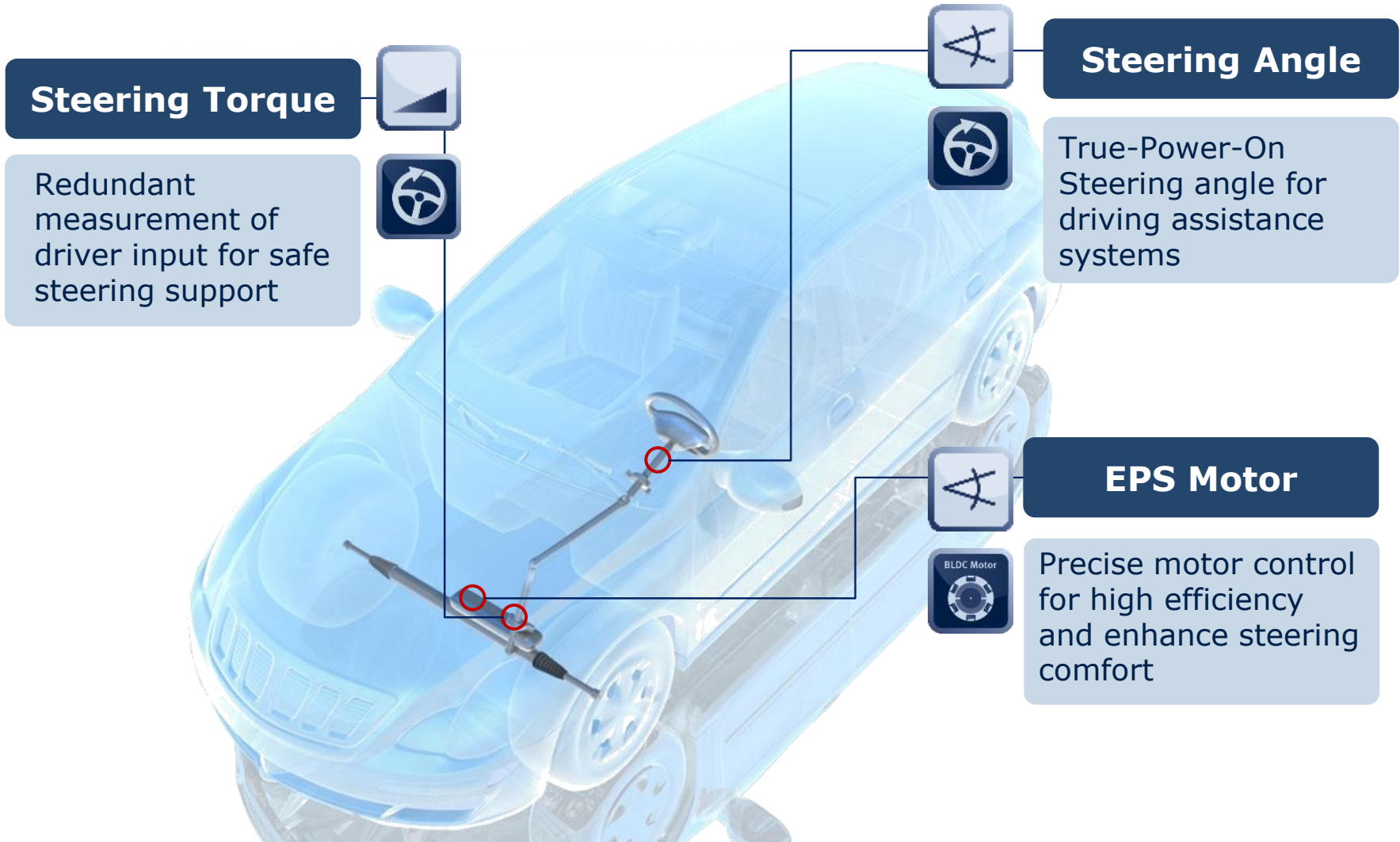


Enabling Functional Safety by Infineon Dual Sensors

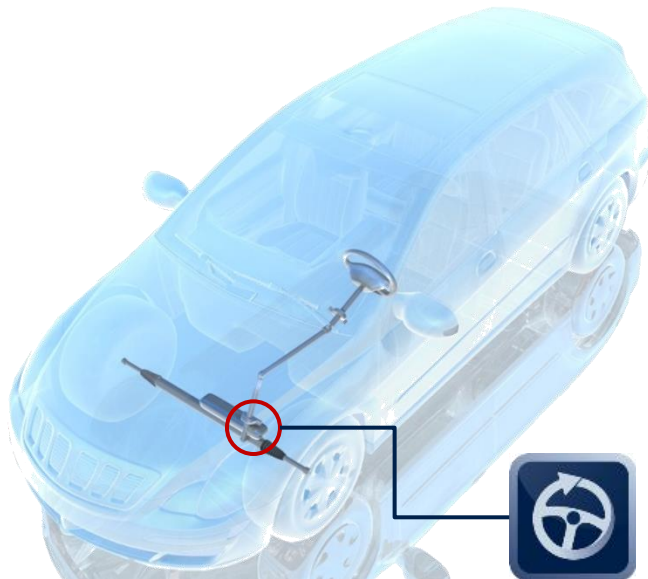


Cost-Reduction and Functionality Enhancement

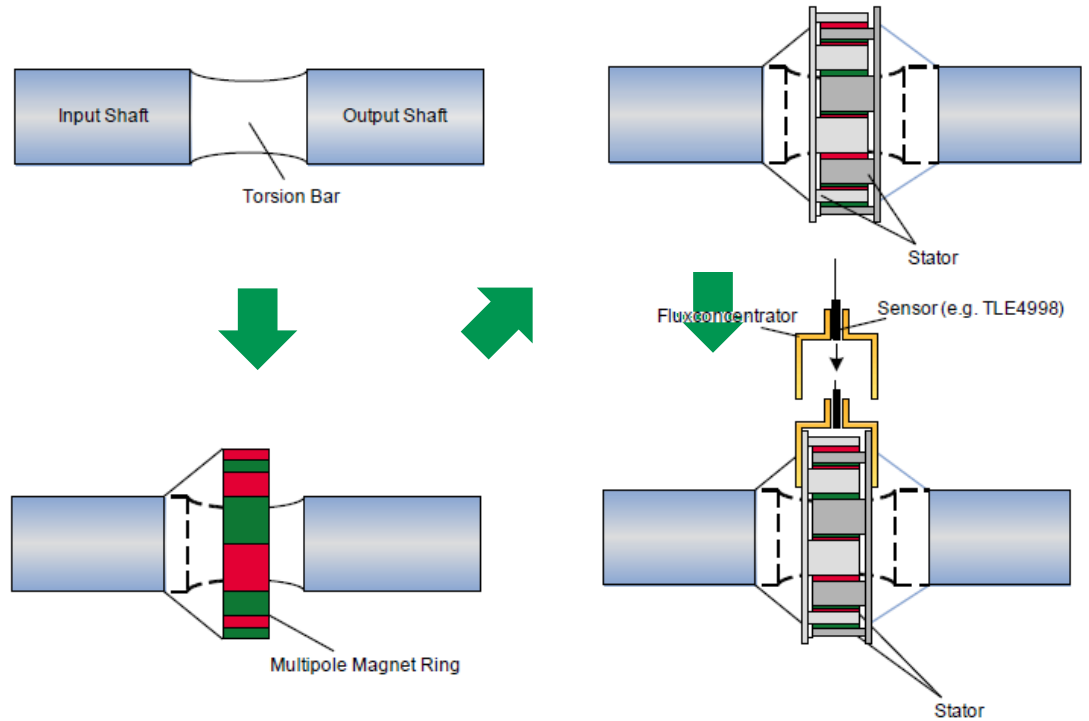
# Dual-Sensor Package: Applications



# EPS Steering Torque Sensor – Application



## Magnetic Circuit



## Key Facts

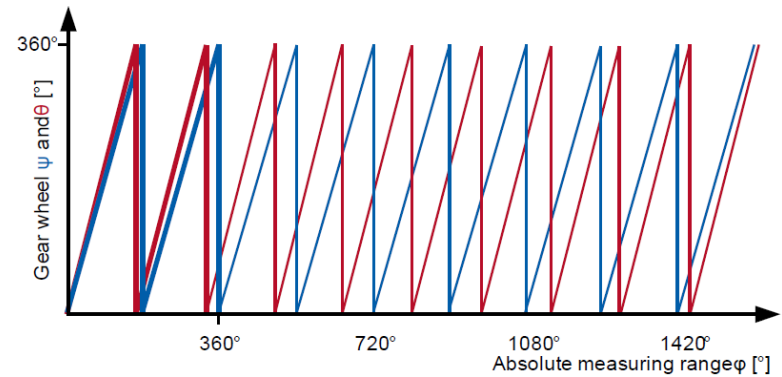
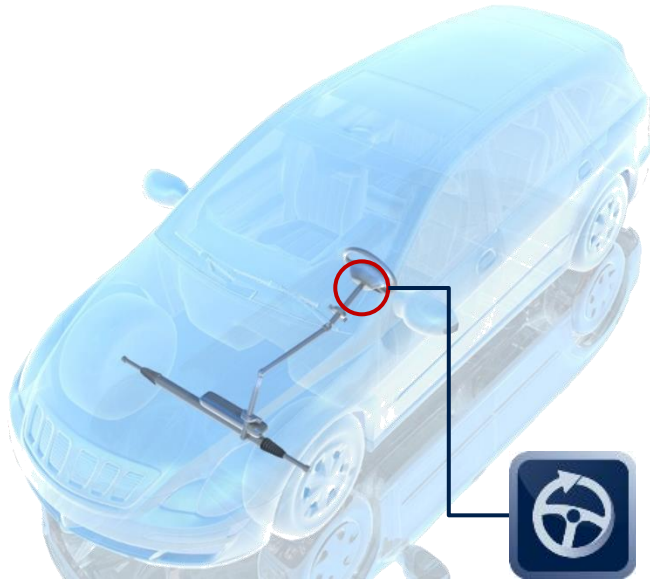
- **ASIL D** system
- Magnetic circuit converts torque → magnetic field
- Feedback loop with motor position sensor

## Critical Parameters

- Short **Latency**, Interface and Signal Propagation **Speed**
- **Thin Package** to fit in airgap, < 1 mm
- Efficient **Safety Diagnosis**
- High **Accuracy** for precise control and steering comfort

# EPS Steering Angle Sensor – Application

## Magnetic Circuit



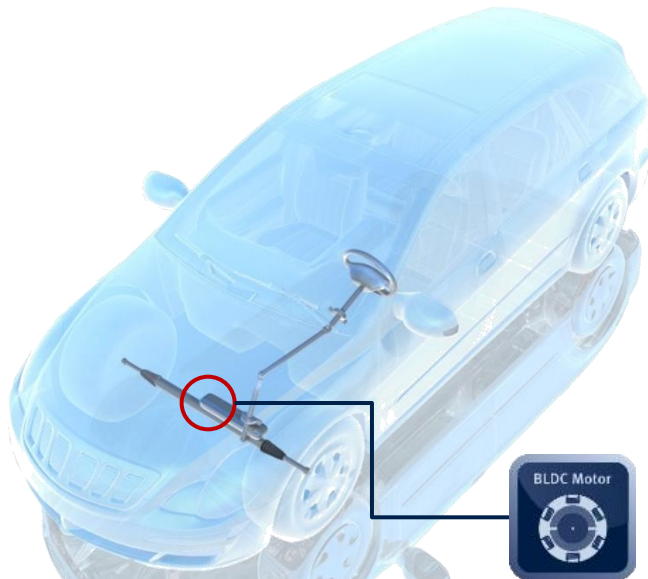
## Key Facts

- **ASIL D** System
- Vernier principle used for full steering wheel turn range
- Required for electronic stability program (ESP)

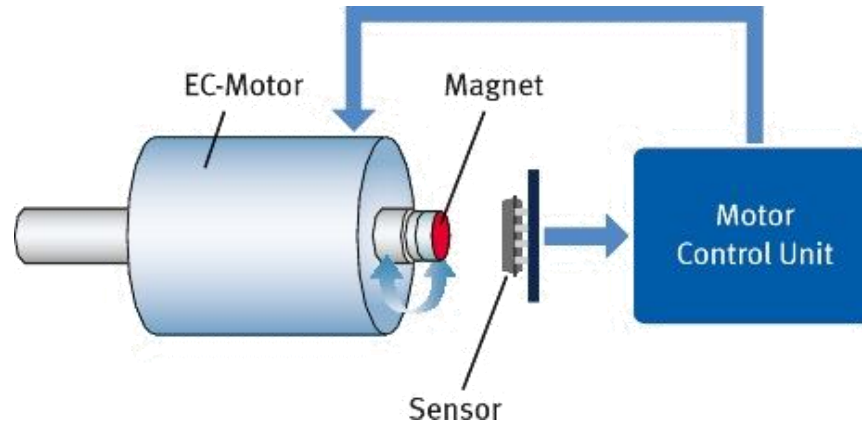
## Critical Parameters

- High **Temperature** stability
- High **Voltage** capability
- **EMC** Robustness
- Efficient **Safety Diagnosis**
- End-of-Line **programmability**, EEPROM

# EPS Motor Position Sensor – Application



## Magnetic Circuit



considerable **system cost-advantage** compared to **resolver** solution

## Key Facts

- **ASIL D** system
- Sinusoidal motor commutation
- Feedback loop with steering torque sensor

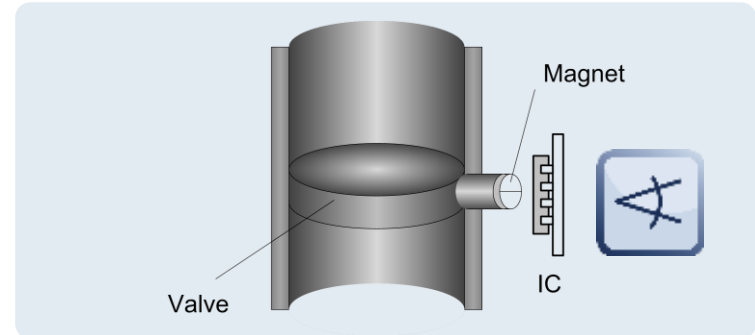
## Critical Parameters

- High **accuracy**: < 0.5° for resolver replacement
- Analog Sin/Cos output or fast digital interfaces
- Efficient **Safety Diagnosis**
- **Short signal delay** (turn speeds up to 10000 RPM)

# Safety-Related Applications – Continued

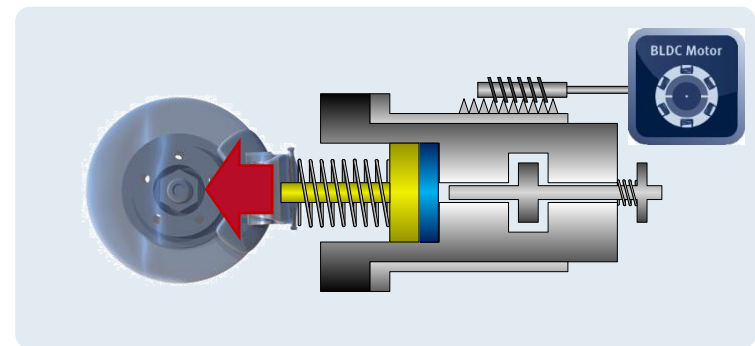
## Throttle Valve

Functional safe intake control



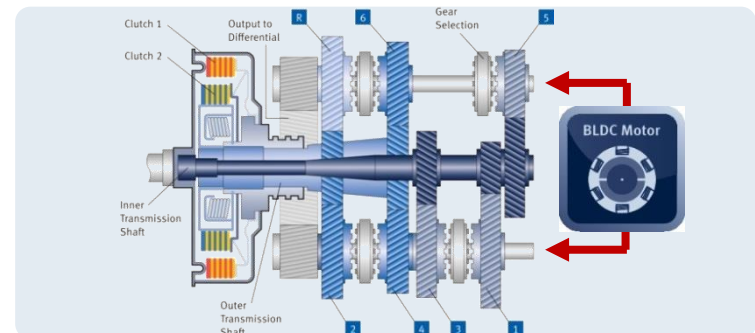
## Brake Booster

Functional safe brake assistance



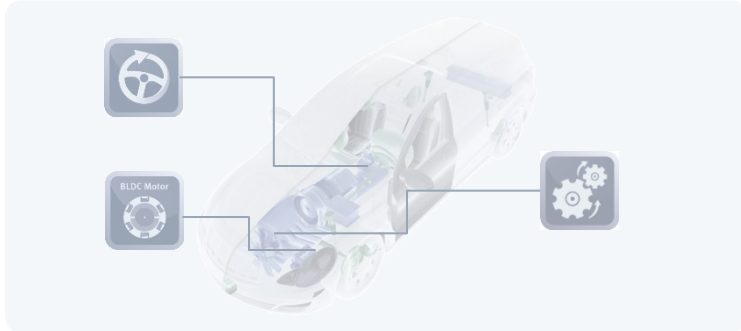
## Gearbox Actuator

Functional safe automatic gear shifting

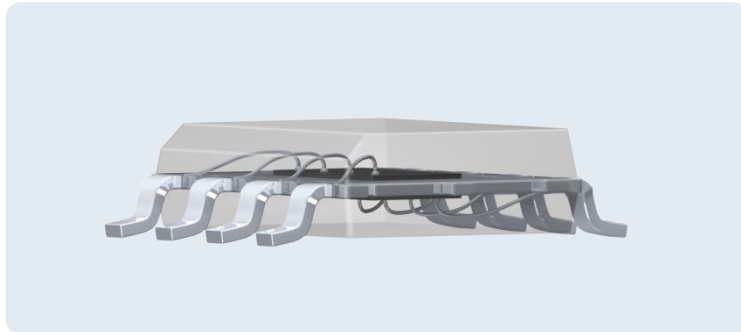




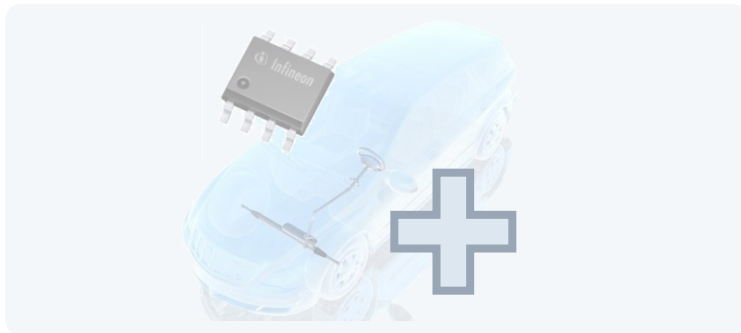
# Dual-Sensor-Package Technology



Safety Related Applications for Position Sensors



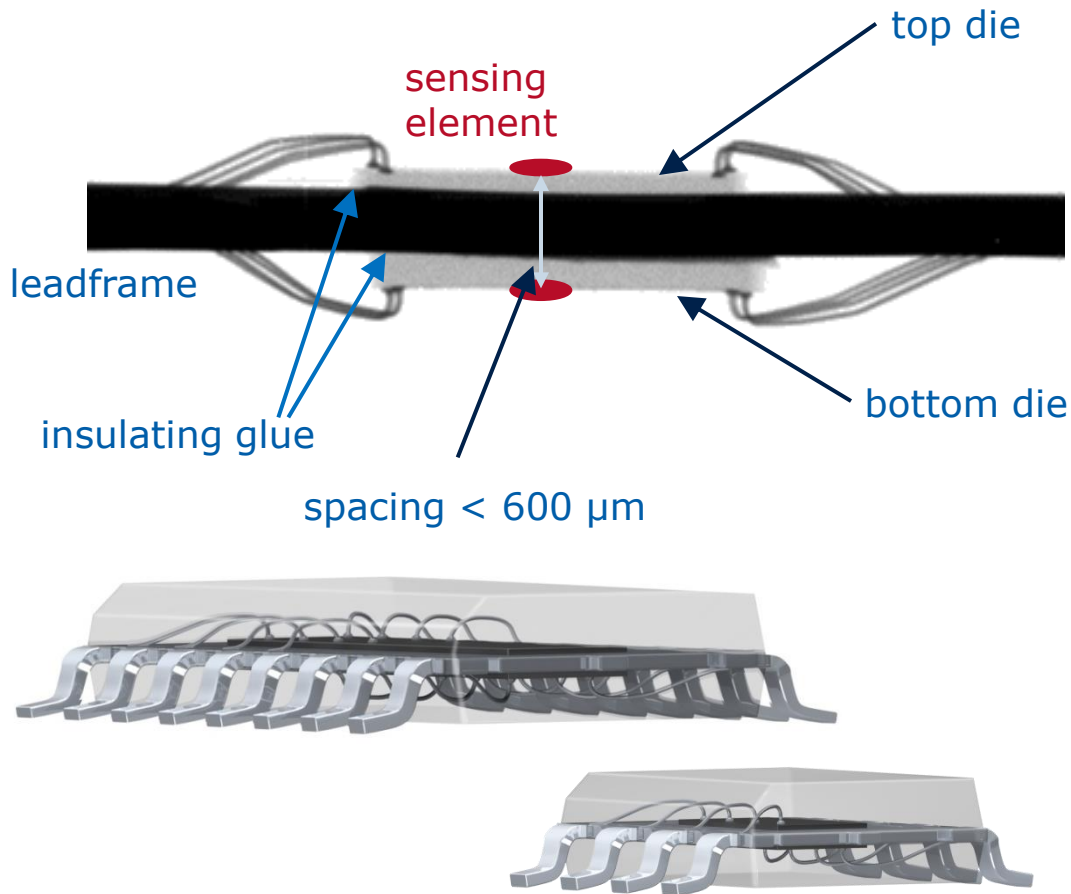
Enabling Functional Safety by Infineon Dual Sensors



Cost-Reduction and Functionality Enhancement

# Dual Sensors: Enabling Functional Safety

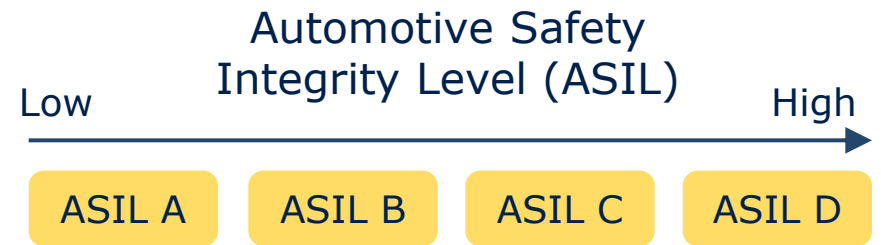
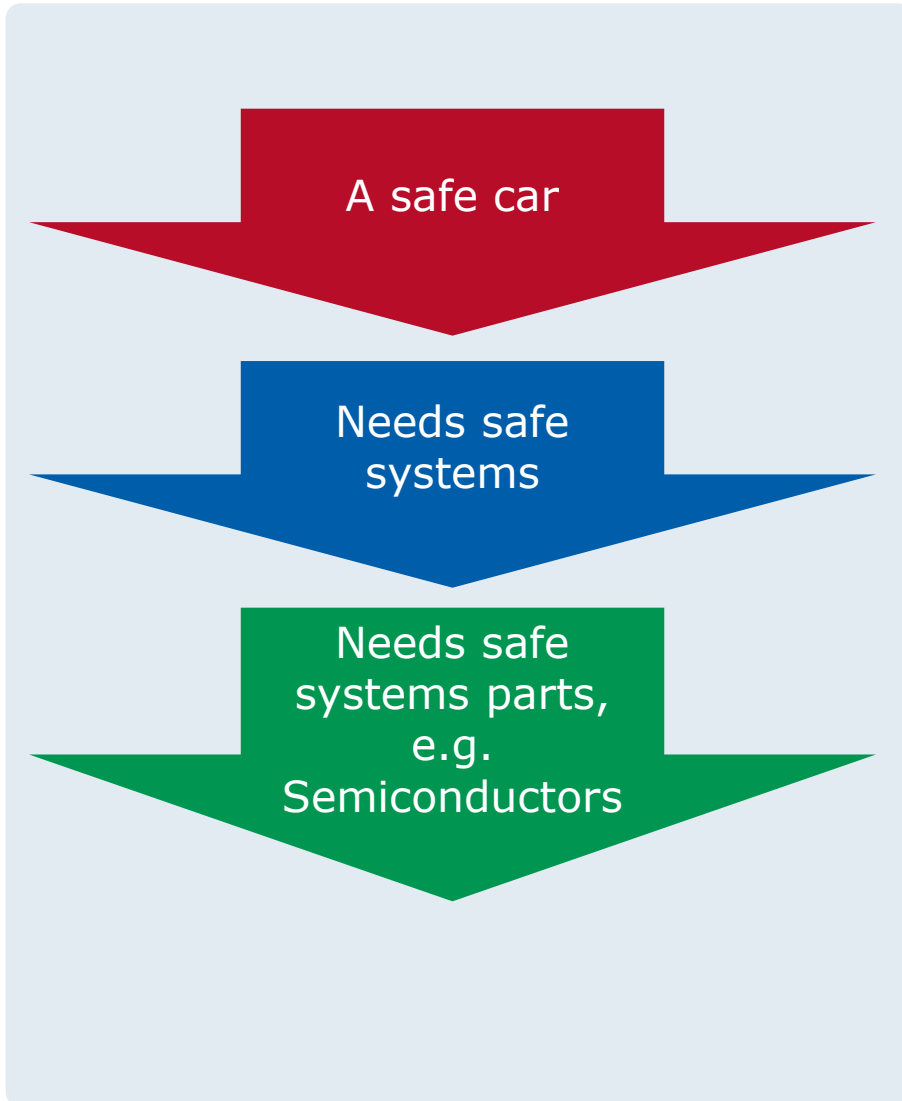
## Side View



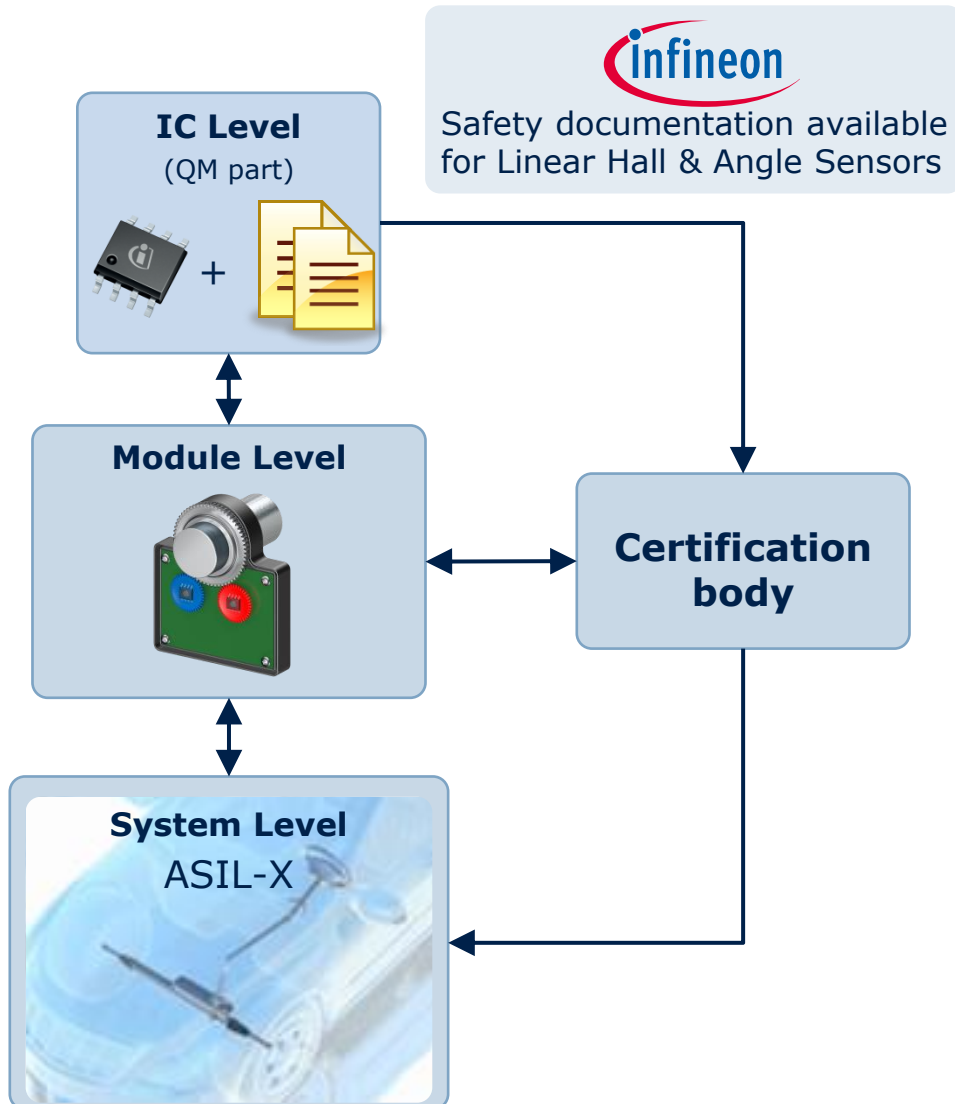
## Dual Sensors Magnetic Angle and Linear Hall

- Two redundant sensors in one 1mm thin package
- Footprint identical to single die sensor
- Sensing elements placed in same lateral position
- Available for iAMR, iGMR and Linear Hall sensors
- Comparison of redundant sensors enable up to ASIL D

# Dual Sensors: Enabling Functional Safety



# Dual-Sensors: Enabling Functional Safety



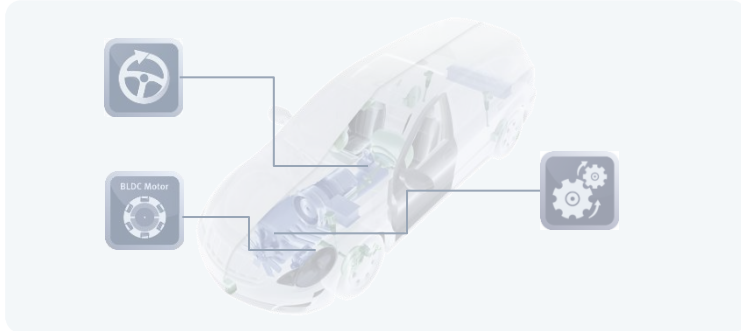
## Customer Value

- Reuse of existing module designs in new OEM platforms
- Reduced Functional safety effort
- Low development risk – reliable safety case can be made upfront

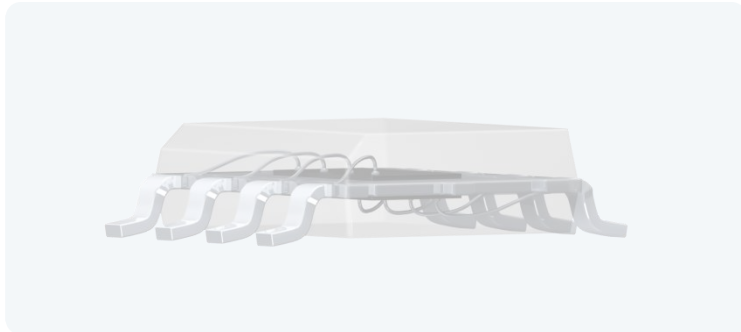
## Outlook

- Future sensor products developed fully compliant to ISO26262

# Dual-Sensor Package Technology



Safety Related Applications for Position Sensors



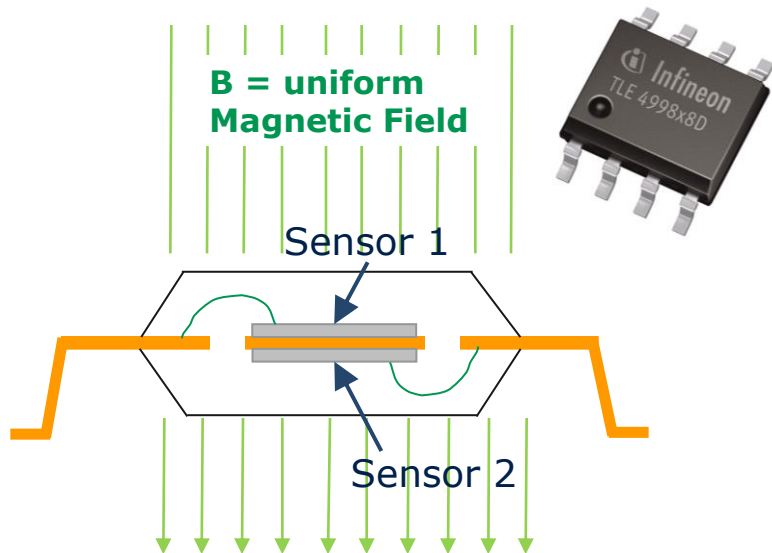
Enabling Functional Safety by Infineon Dual Sensors



Cost-Reduction and Functionality Enhancement

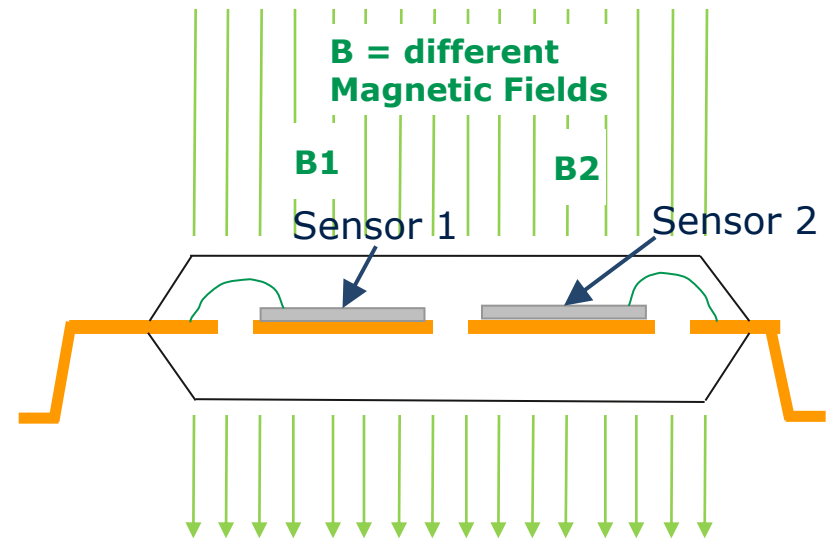
# Dual-Sensors: Customer Benefits

## Top-Bottom Concept by Infineon



- Small footprint
- Same field at both sensors
- Allows use of inexpensive magnet

## Side-by-side Concept by Infineon



- Double size package
- Affected by field inhomogeneity
- Rare earth magnet required

# EPS High-Availability Torque Sensor

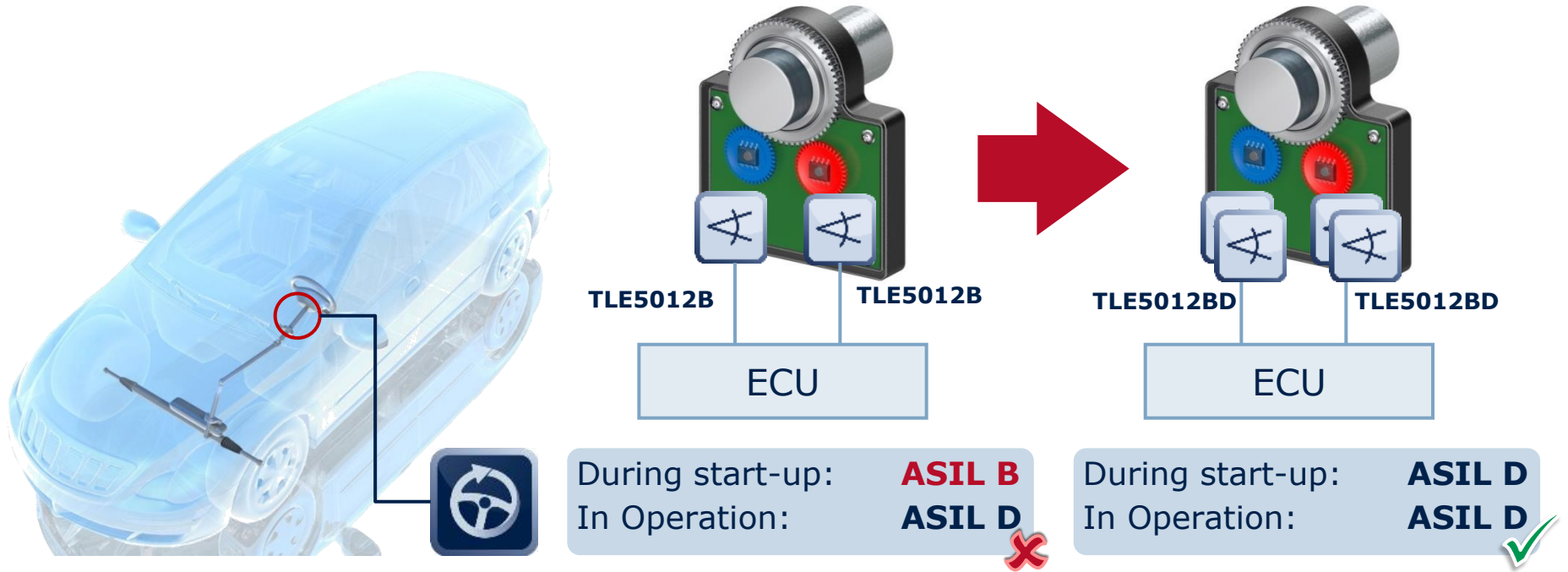
## Functionality Enhancement: High Availability Torque Sensor



- New OEM **Safety Requirement**: Avoid sudden loss of steering support, ASIL B
- High-Availability sensor has 4 Redundant Torque Signals instead of 2
- System can **continue operation** in case of a failure

# EPS True-Power-On Steering Angle Sensor

## Functionality Enhancement: True-Power-On Steering Angle Sensor

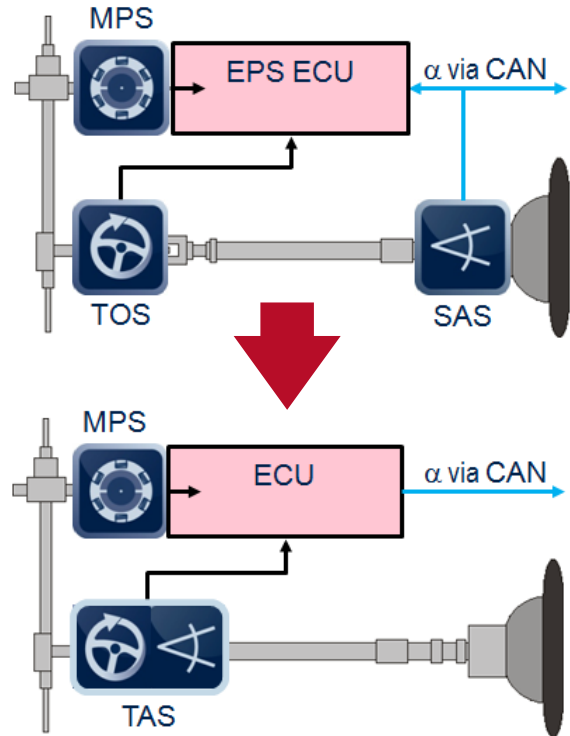
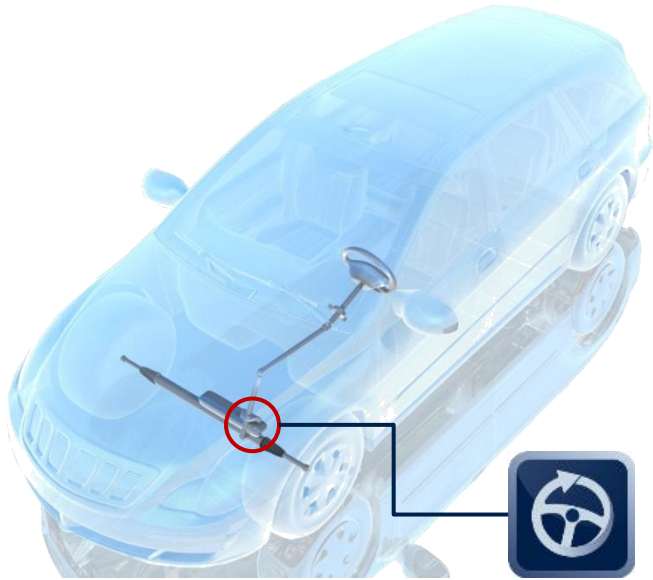


- New OEM **Safety Requirement**: Steering angle information has to reach ASIL D level already during start-up phase (true-power-on)
- True-Power-On Steering angle sensors has redundant signals for both gear wheels



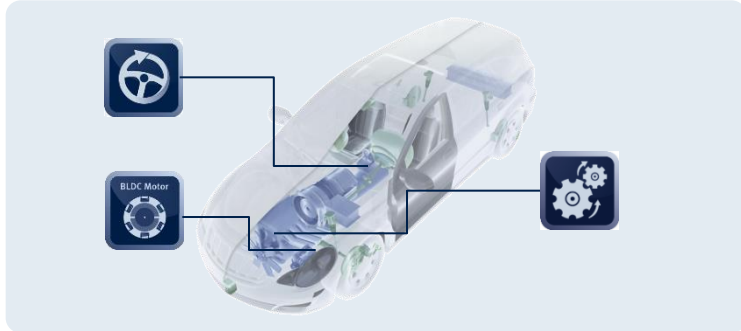
# EPS Torque-and-Angle Sensor (TAS)

## Cost Saving: Combine Steering Torque and Angle in one Module



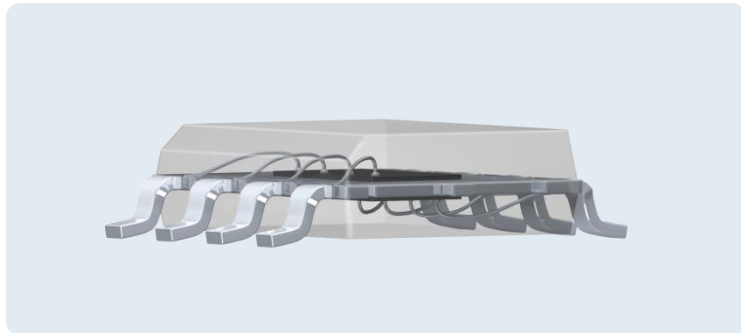
- **Save wires** using SPC bus interface: Combine up to 4 sensors on one signal line
- Only **one module** instead of two
- Can incorporate high availability steering torque and true-power-on angle sensor

# Summary



## Safety-related automotive position sensing requires:

- High safety integrity level
- Effective diagnosis on position measurement



## Infineon dual sensors enable highest safety level on system:

- Built-in redundancy for effective diagnosis
- Safety implementation support available



## Cost-reduction and functionality enhancement:

- Usage of low-cost magnets possible
- Application trends for higher safety and availability supported



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