



# Infineon Sensors 4 Robots

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2022-07-05



# Table of contents

1	Infineon robotics product offering at a glance	3
2	Sensors 4 robots	7
3	Hall Switch – and their use in robotics	16
4	3D Hall– and their use in robotics	36
5	Angle Sensors– and their use in robotics	42
6	Current Sensors– and their use in robotics	58
7	A word on functional safety and quality	64
8	Infineon supportives to ease sensor designs 4 robotics	69

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6	Current Sensors– and their use in robotics	58
7	A word on functional safety and quality	64
8	Infineon supportives to ease sensor designs 4 robotics	69

# A world leader in semiconductor solutions



**Our vision**  
We are the link between the real and the digital world.

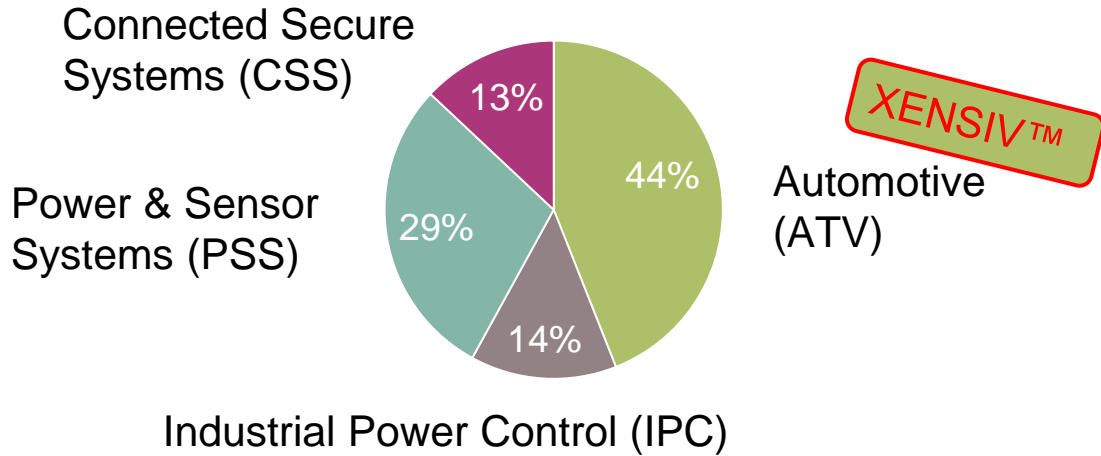
**Our values**  
We commit  
We partner  
We innovate  
We perform

**Our mission**  
We make life easier, safer and greener.

Part of your life. Part of tomorrow.

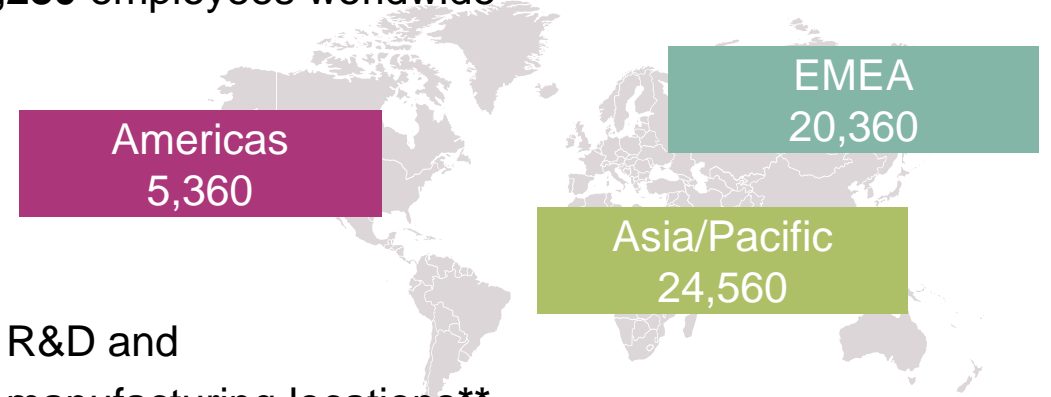
# Infineon at a glance

## Business segments revenue\*



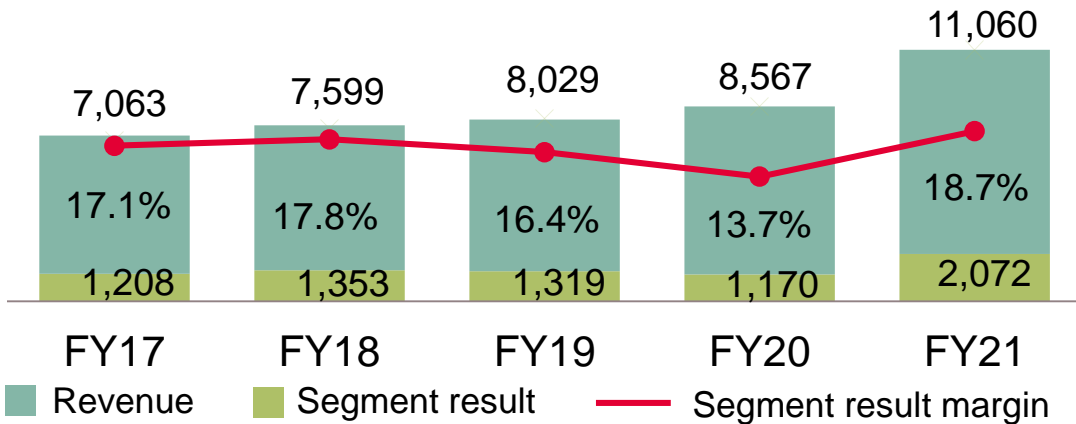
## Employees\*

50,280 employees worldwide



56 R&D and 20 manufacturing locations\*\*

## Financials



\*2021 Fiscal year (as of 30 September 2021)

\*\*as of 30 September 2021

## Market position

Automotive	Power	Microcontroller
<b># 1</b>	<b># 1</b>	<b># 3</b>
Strategy Analytics, April 2021	Omdia, September 2021	Omdia, August 2021

For further information: [Infineon Annual Report 2021](#)

# Infineon – THE One-stop-shop with broadest portfolio for service robots

Charger & SMPS		Main Control	Memory	Motor control				
MOSFETs	Gate Driver & AUX	Microcontrollers	RAM & Flash	Micro-controllers	Sensing	Gate driver ICs	MOSFETs	Others
<ul style="list-style-type: none"> <li>&gt; CoolMOS™</li> <li>&gt; OptiMOS™</li> <li>&gt; CoolSiC™</li> </ul>	<ul style="list-style-type: none"> <li>&gt; EiceDriver™</li> <li>&gt; CoolSET™</li> </ul>	<ul style="list-style-type: none"> <li>&gt; XMC1000 &amp; 4000</li> <li>&gt; PSoC™ 4 &amp; 6</li> <li>&gt; AURIX™</li> <li>&gt; TRAVEO II</li> </ul>	<ul style="list-style-type: none"> <li>&gt; NOR Flash, SEMPER™, HYPERFLASH™</li> <li>&gt; FRAM, SRAM, PSRAM, nvRAM</li> </ul>	<ul style="list-style-type: none"> <li>&gt; XMC1000 &amp; 4000</li> <li>&gt; PSoC™ 4 &amp; 6</li> <li>&gt; AURIX</li> <li>&gt; TRAVEO II</li> <li>&gt; iMotion</li> </ul>	<ul style="list-style-type: none"> <li>&gt; Current sensor</li> <li>&gt; Position sensor</li> <li>&gt; Speed sensor</li> </ul>	<ul style="list-style-type: none"> <li>&gt; EiceDRIVER™</li> </ul>	<ul style="list-style-type: none"> <li>&gt; OptiMOS™</li> <li>&gt; StrongIRFET™</li> <li>&gt; CoolMOS™</li> <li>&gt; CoolSiC™</li> <li>&gt; CoolGaN™</li> <li>&gt; Small Signal</li> </ul>	<ul style="list-style-type: none"> <li>&gt; IPMs</li> <li>&gt; DC-DC converters</li> <li>&gt; Voltage regulator / LDO</li> </ul>
Wireless charging								

Power	Battery management (BMS)			Connectivity		HMI	Security	Sensors
Management & Others	Management IC & MCU	MOSFETs	Gate driver ICs	Wi-Fi	Bluetooth	Cap Sensing	Authentications ICs	Sensing
<ul style="list-style-type: none"> <li>&gt; Power management IC (PMIC)</li> <li>&gt; DC-DC converters</li> <li>&gt; Integrated Point-of-Load (IPoL)</li> <li>&gt; Sensors / Switches interface ISOFACE™</li> </ul>	<ul style="list-style-type: none"> <li>&gt; TLE9012</li> <li>&gt; TLE9015</li> <li>&gt; XMC™</li> <li>&gt; PsoC™</li> </ul>	<ul style="list-style-type: none"> <li>&gt; OptiMOS™</li> <li>&gt; StrongIRFET™</li> <li>&gt; Small Signal</li> </ul>	<ul style="list-style-type: none"> <li>&gt; EiceDRIVER™</li> </ul>	<ul style="list-style-type: none"> <li>&gt; AIROC™ Wi-Fi Products</li> <li>&gt; AIROC™ Bluetooth &amp; Bluetooth Low Energy (BLE)</li> <li>&gt; AIROC™ Wi-Fi &amp; Combos</li> </ul>		<ul style="list-style-type: none"> <li>&gt; PSoC™ 4000 entry-level</li> <li>&gt; PSoC™ 4100 more touch buttons</li> <li>&gt; PSoC™ 4700 inductive sensing</li> </ul>	<ul style="list-style-type: none"> <li>&gt; OPTIGA™ Trust B</li> <li>&gt; OPTIGA™ Trust M</li> </ul>	<ul style="list-style-type: none"> <li>&gt; Radar</li> <li>&gt; 3D Time-of-Flight (ToF)</li> <li>&gt; Pressure sensor</li> <li>&gt; CO2 Sensor</li> <li>&gt; MEMS microphones</li> </ul>

# Table of contents

1	Infineon robotics product offering at a glance	3
2	<b>Sensors 4 robots</b>	<b>7</b>
3	Hall Switch – and their use in robotics	16
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# Key market drivers shaping the future of robots



**Aging population & social acceptance** to increase use of robot deployment in everyday life



**Automatization** (e-commerce, personal assistants) demands automated mode of operation, driving demand for **sensor solution in robots & drones (ToF, Radar, etc)**



**Real time operation and AI** require stable & secure communication (**Secure Connection**) + open opportunity for **5G & cloud computing**



System innovation, e.g. in motor control (smaller & cheaper drives) or charging solutions will pave the way for new technologies like **WBG, chip embedding** or **wireless charging**

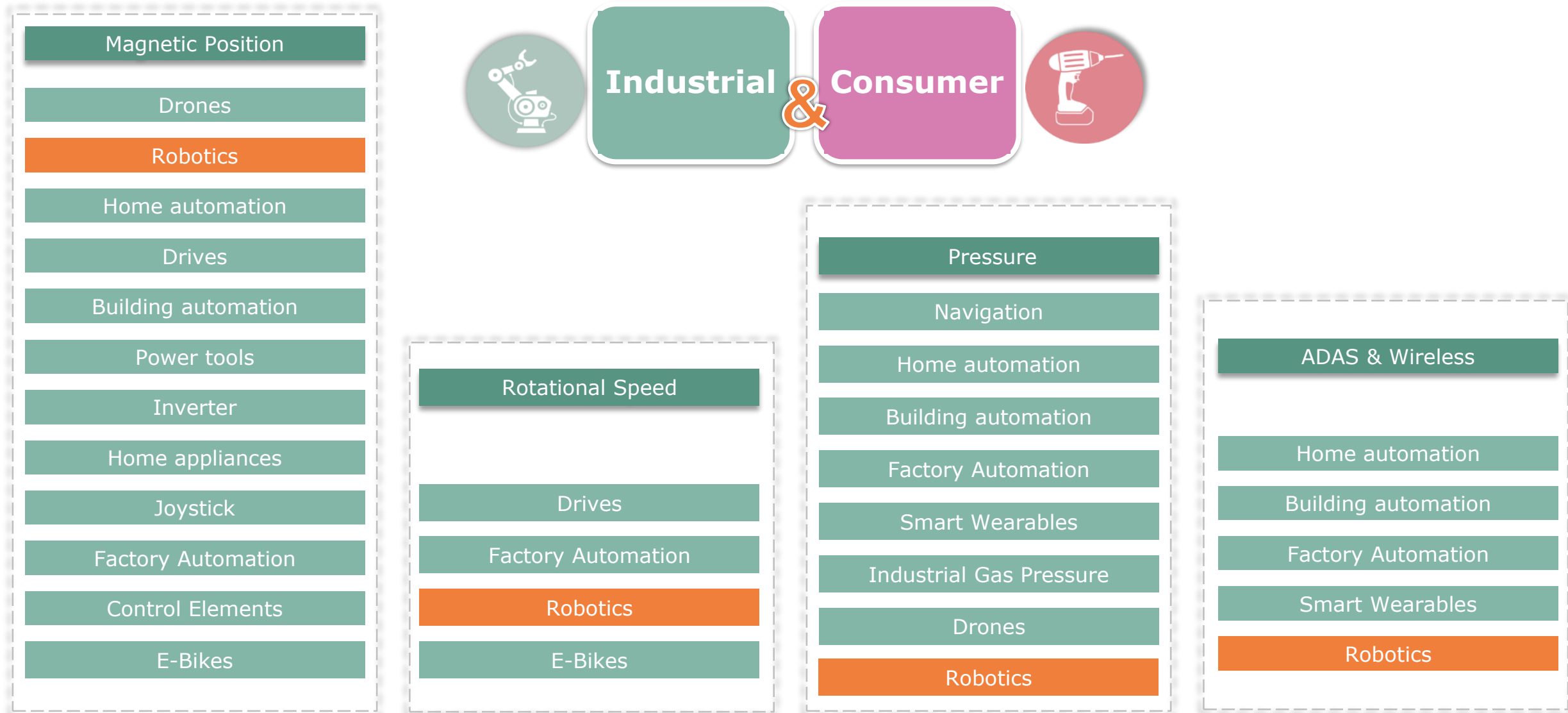


New technologies are widely used in various robot applications, but **standardization and government regulation fall behind** robotics fast development, i.e. regulations to restrict robot/drone deployment

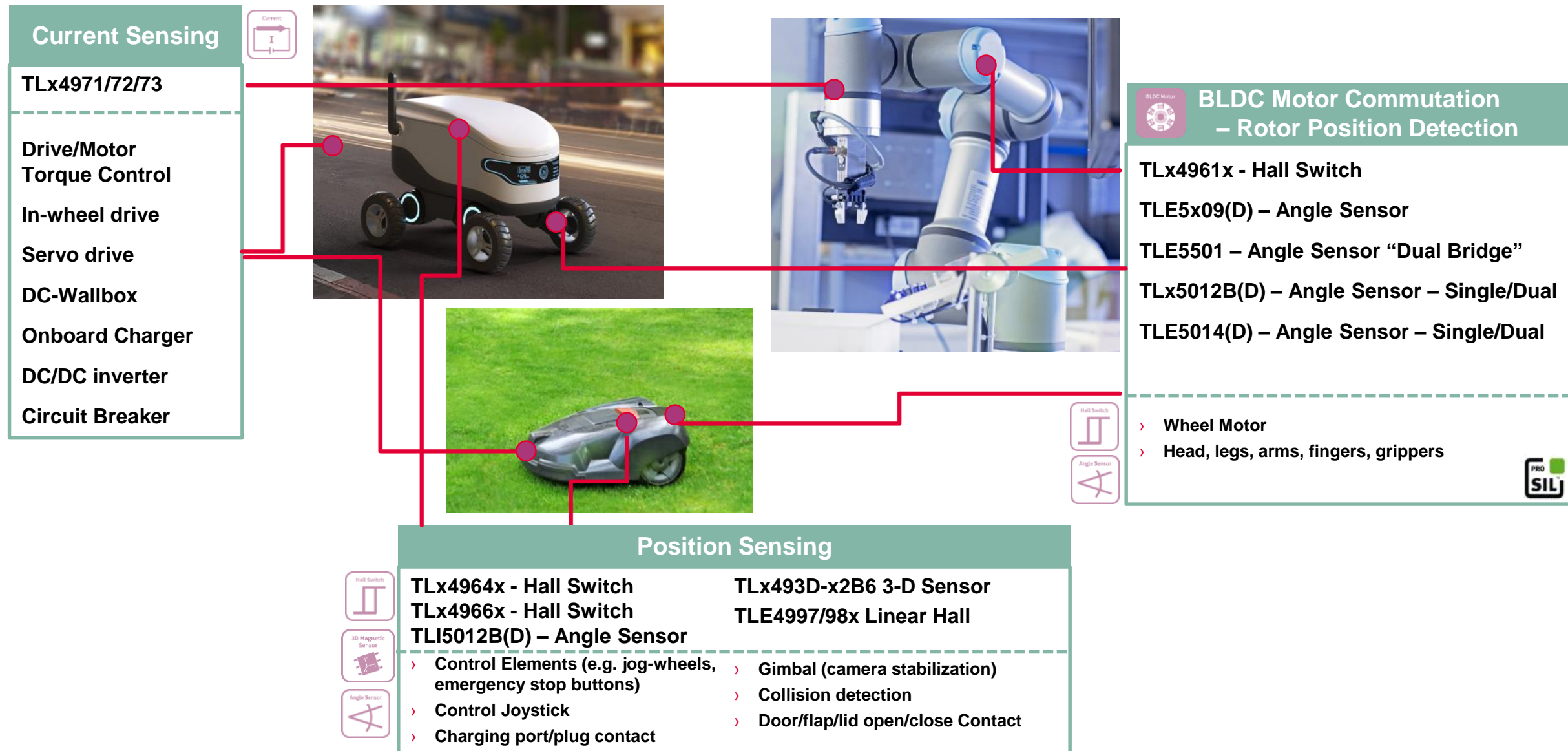


# Application Overview – Industrial and Consumer

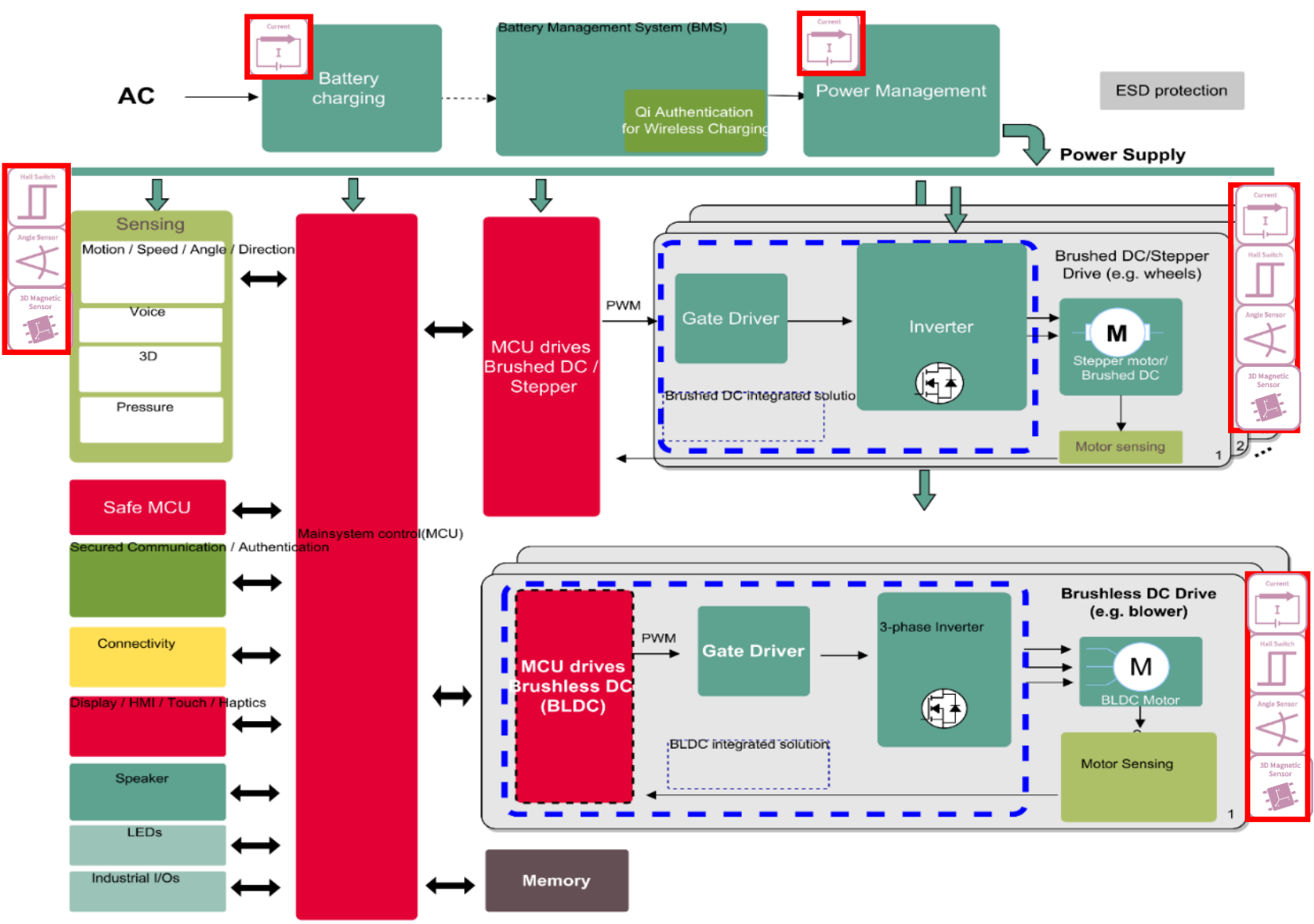
## Various XENSIV™ sensors for plenty of applications



# Application examples: Magnetic XENSIV™ sensors for robots



# Block diagram of a typical service robot



## Current Sensing

- > Wall/Onboard Charger,
- > AC/DC/AC inverter
- > Circuit Breaker
- > Drive/Motor - Torque Control

## Position Sensing

- > Control Elements (e.g. jog-wheels, emergency stop buttons)
- > Control Joystick
- > Charging port/plug contact
- > Gimbal (camera stabilization)
- > Collision detection
- > Door/flap/lid open/close Contact

## BLDC Motor Commutation – Rotor Position Detection

- > Wheel Motor
- > Head, legs, arms, fingers, grippers

# Magnetic Position & Current Sensors I (Position sensing and HMI)

## Overview Linear Hall, Switches & Current sensors

### Switch



#### Ind./Con. Range

##### TLI496x family

- › High precision Hall Switch family for voltages between 3.0V and 32.0V

##### TLV496x-xTA/TB family

- › High precision Hall Switch family for consumer applications in a leaded package



#### Automotive Range

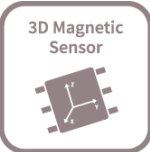
##### TLE496x family

- › High precision Hall Switch family for up to 32V

##### TLE4966 family

- › Two-in-one double Hall Switch family

### 3D



#### Ind./Con. Range

##### TLI493D-A2B6

- › Increased update frequency and field range

##### TLV493D-A1B6

- › First generation consumer 3D sensor
- › Reduced update frequency and field range



#### Automotive Range

##### TLE493D-A2B6

- › Functional safety (catch-up)

##### TLE493D-W2B6 (0-4 var types)

- › Wake-up upon magnetic field
- › Functional safety (catch-up)

### Linear



#### Product

TLI5590



#### Features

- › Analog magnetic encoder
- › Differential
- › Ratiometric
- › WLB package

#### Product

TLE4997  
TLE4998P  
TLE4998S  
TLE4998C



#### Features

- › Features ratiometric analog output
- › Pulse Width Modulation (PWM)
- › Single Edge Nibble Transmission (SENT)
- › Short PWM Codes (SPC)

# Magnetic Position & Current Sensors II (Motor Control)

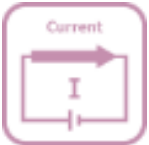
## Overview Angle and Current sensor

### Angle



	iGMR  360°	iAMR  180°	iTMR  360°	Output
	TLE5012B(D) TLI5012B (industrial device) TLE5014(D)			Digital angle
	TLE5011			Digital sin/cos
	TLE5009 TLE5009A16 TLE5009A16D	TLE5109A16(D) TLE5309D		Analog sin/cos
			TLE5501	Analog sin/cos w/o amplification

### Current



#### Ind. Range

- TLx4971
- > Pre-calibrated sensor with **integrated current rail** for currents up to  $70A_{RMS}$  (120A peak)
  - > **High bandwidth** typical **240kHz**
  - > High accuracy **differential current sensor** with intrinsic stray-field cancellation
  - > **Analog output signal** (single ended or differential)
  - > 2 digital outputs for **fast overcurrent detection (<1μs)**
  - > **Ultra low sensing resistance (220μOhm) and inductance (<1nH)**

- TLE4972
- > **High precision** core-less current sensor, external current rail
  - > Magnetic **measurement range: 0 to 31mT** (0A to >2kA)
  - > Typical **bandwidth of 210kHz**
  - > Dedicated **overcurrent detection pin**: very low response time (**<1μs**)
  - > **Programmable** gain and overcurrent thresholds
  - > Two package options for PCB and bus-bar implementation (**PG-TDSO-16, PG-VSON-6**)
  - > **ISO26262** compliant for safety requirements up to ASIL B

# Application Example: Sensors for efficiency & safety in robotic drives

## Current Sensing

### TLI4971/TLE4971 family

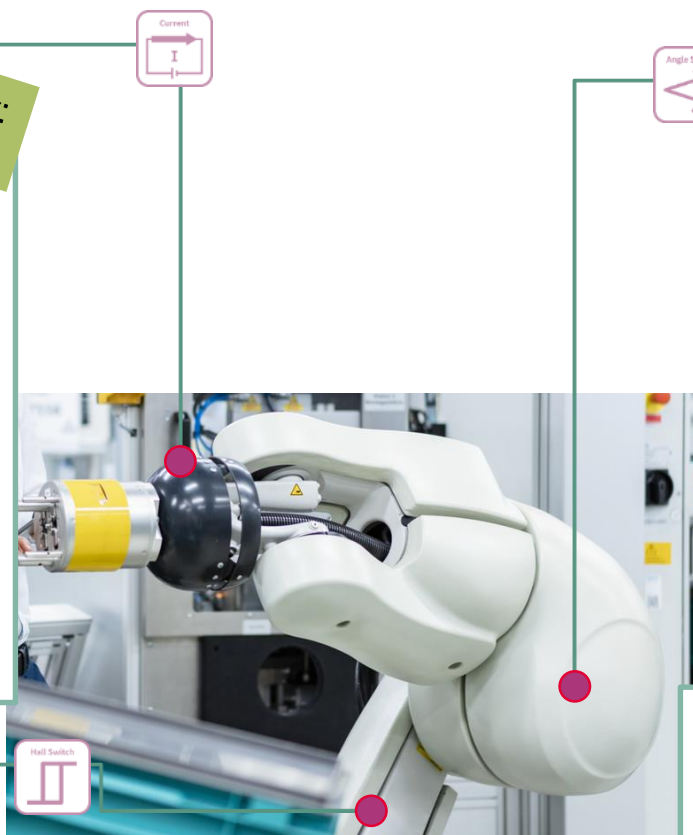
- > Up to 70A<sub>RMS</sub> (120A FSR)
- > **High bandwidth** typical 240kHz/210kHz
- > Intrinsic stray field cancellation
- > Superior **linearity (over temperature and lifetime)**
- > **Analog output signal PLUS 2x digital fast overcurrent detection (OCD)**
- > Integrated Functional Isolation Supporting 1150V V(IORM)
- > SMD sensor package with **integrated low sensing resistance current rail (220μΩ)** and **inductance of less than 1nH**
- > **TLE4971** offers an **improved accuracy** for **lower torque ripple** and **functional safety**

Alternatively:  
TLE4972

## Lower Resolution Rotor Position Sensing

### TLx4961/65 - Hall Switch

- > High precision Hall Switch
- > Very low current consumption (1.6mA)
- > High supply voltage + overvoltage up to 42V
- > Versions in leaded packages (SSO) as well as SMD with smallest footprint (SOT23)



## High Resolution Rotor Position Sensing

### TLE5009(D) – Angle Sensor

iGMR

- > iGMR based angle sensor with full 360° Analog Sin/Cos output
- > Pre-amplified temp. compensated signals
- > Very short signal delay
- > For speed up to 30.000rpm

### TLx5012B(D) – Angle Sensor

iGMR

- > iGMR based angle sensor with full 360°
- > 1° accuracy over Temperature and lifetime
- > Integrated angle calculation
- > Interfaces: SPI, IIF, PWM, SPC, HSM
- > Temp. compensation and auto-calibration

### TLE5501 – Angle Sensor “Single Dual Die”

- > First ever Infineon TMR
- > Analog sin/cos
- > ISO26262-compliant development targeting ASIL D(D)

iTMR







### TLE5014(D) – Angle Sensor - Single & Dual

- > Programmable iGMR digital angle sensor, E2PROM and look-up table
- > SENT, SPC, PWM, SPI Interface
- > High accuracy (<1° error)
- > ISO26262-compliant dev. targeting ASIL C(D)

iGMR



# Sensors used to control an electric motors

Feature	Block Commutation	Sinus Commutation	FOC: Field Oriented Control	
			Sensor-based	“Sensor-less”
Complexity	Low	Medium	High	Very High (SW)
Efficiency	Low	Medium	High	High
Torque Ripple	High	Medium/Low	Low	Low
Dynamics	Low	Medium/High	High	Low
Application, Use Case	Basic Applications, Continuous running loads	Silent Drive, Continuous running	High Power, Position Control	Continuous running, low dynamic, large size motors
Sensors	 Hall Latches	 Angle Sensors	 Angle & Current Sensors	 Current sensor only

Ease of implementation Need for external  $\mu$ C processing power

# Table of contents

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# Hall Switches use case examples for robotics

## Position detection

*Open/close detection lid  
Position @ charging point*



*HMI controls*



**TLx4964x - Hall Switch**

## BLDC commutation

*Rotor Position Detection*

- > Wheel Motor
- > Head, legs, arms, fingers, grippers



**TLx4961-1M - Hall Latch  
TLx4963-1M - Hall Latch  
TLV4961-1TA/B Hall Latch**

## Anti-pinch detection

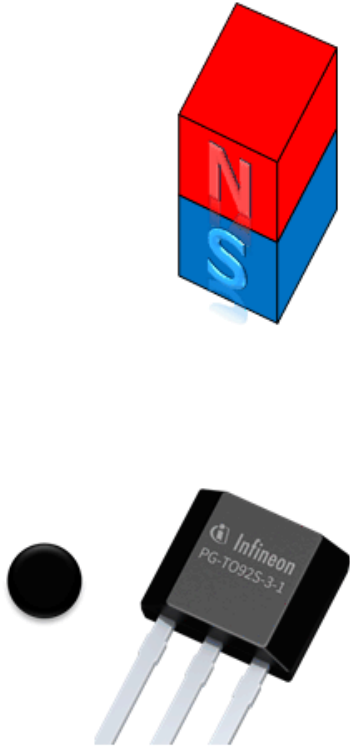
*Power Closing Systems/lids  
Arms and joints*



**TLI4966G  
TLE4966V-1G**

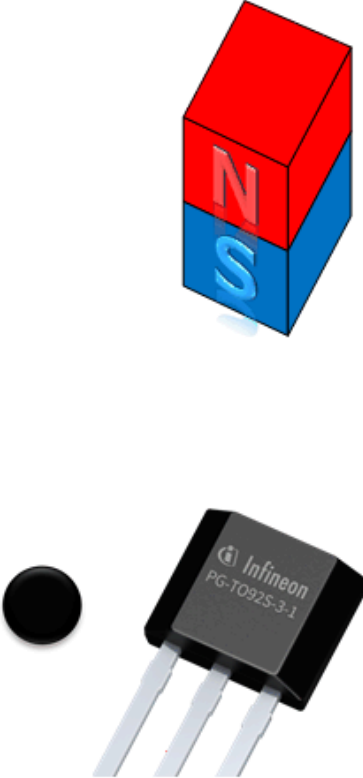
# Hall Switches -working principles

## Hall Switches Position Detection



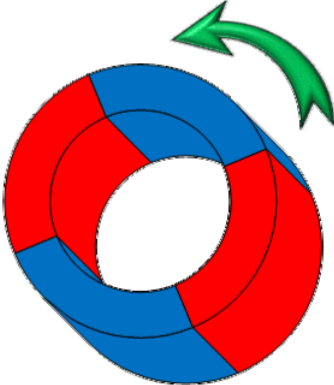
TLI4965-5M  
TLV4964-4TA/B

## Hall Latches BLDC Commutation



TLI4963-1M  
TLV4961-1TA/B

## Double Hall Switches Anti-pinch detection



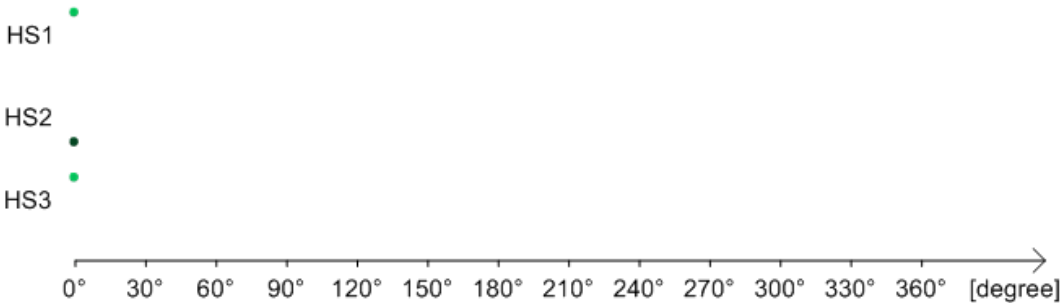
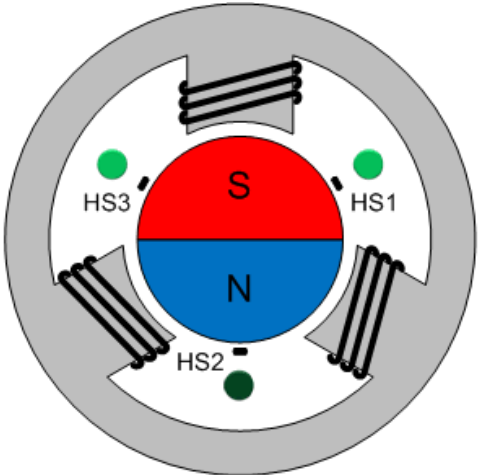
Speed:   
Direction: 

TLE4966-G  
TLE4966V-1G

# Hall effect switches for BLDC motor block commutation

## Typical Application Setup:

3 Hall latches are used to define the rotor position



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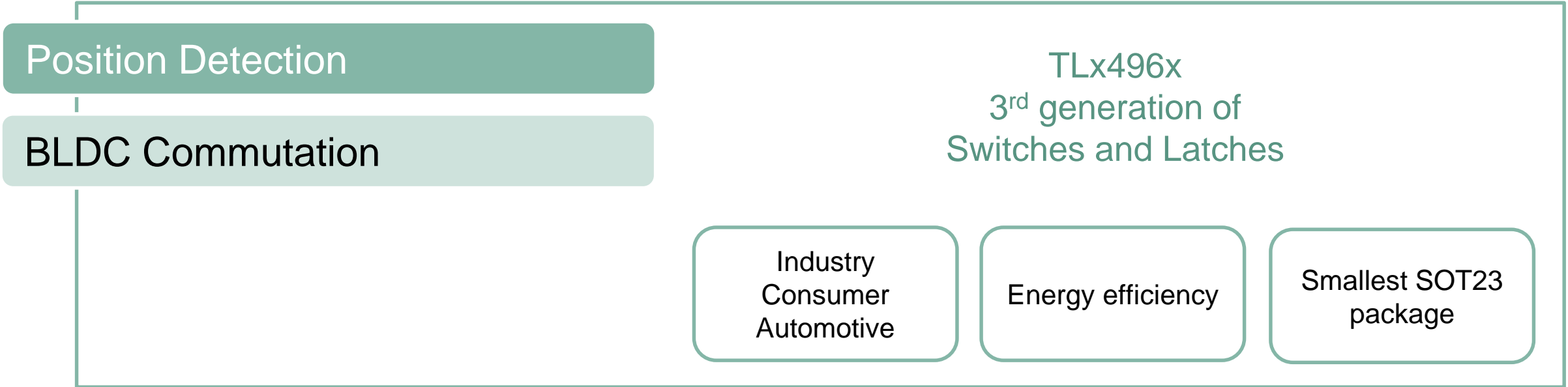


## Application Benefits for Customers

- › High speed motor applications up to 600.000 RPM
- › High robustness up to 170° C
- › Accurate rotor position detection
- › Accurate switching points
- › Improved energy efficiency and longer battery life
- › Higher torque, smaller motor and reduced weight
- › Cost efficient solution

# Infineon switch portfolio consists of two families

- to serve the main robotics applications



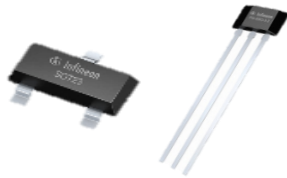
### TLx496x

3<sup>rd</sup> generation of Hall Switches and Latches

#### Automotive - TLE496x -

➤ **Temperature:**  
-40° to 170°C

➤ **Package:**  
PG-SOT23  
PG-SSO3



➤ **Supply voltage:**  
3.0 V to 5.5 V  
3.0 to 32.0 V

➤ **Current consumption**  
1,5 mA to 1,6 mA

#### Industry - TLI496x -

➤ **Temperature:**  
-40° to 125°C

➤ **Package:**  
PG-SOT23  
PG-SSO3



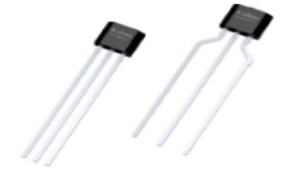
➤ **Supply voltage:**  
3.0 V to 5.5 V  
3.0 to 32.0 V

➤ **Current consumption**  
1,5 mA to 1,6 mA

#### Consumer - TLV496x -

➤ **Temperature:**  
-40° to 125°C

➤ **Package:**  
PG-TO92S



➤ **Supply voltage:**  
3.0 to 26.0 V

➤ **Current consumption**  
1,6 mA

**PRICE**

**PRICE**

**Broad portfolio of available thresholds**

# TLx4961/4/8 – 3<sup>rd</sup> generation Hall Switch family

## low current consumption and large voltage operating range



### Technical highlights

#### Family of Hall switches and latches for energy and cost efficient systems

- › 3.0 V to 32 V operating supply voltage
- › Low current consumption of 1.6mA
- › Overvoltage capability up to 42 V without external resistor
- › Output overcurrent & overtemperature protection
- › Reverse polarity protection (-18 V)
- › High stability of magnetic thresholds

### Product features

- › More than 40 products available and continuous update of product portfolio
- › Dedicated products for industrial, consumer and automotive applications
- › Standardized leaded and SMD packages
- › Large range of magnetic thresholds
- › IFX zero defect commitment



### Technical highlights

#### Family of Hall switches and latches for cost effective PCB based systems

- › 3.0 V to 5.5 V operating supply voltage
- › Low current consumption of 1.5mA
- › Active error compensation
- › High stability of magnetic thresholds
- › High ESD performance (4kV HBM)
- › SOT23 package for small systems

### Product features

- › Industrial and automotive versions
- › Different magnetic thresholds
- › Enables cost effective PCB based systems

#### Applications:

- › BLDC motor commutation
  - › IND: power tools, service robots
  - › ATV: auxiliary drives (pumps, seating)
- › Position sensing: e.g. open/ close detection

## Hall Switches for consumer applications in leaded package



### Technical highlights

- › 3.0 V to 26.0 V operating supply voltage
- › Operation from unregulated power supply
- › Output overcurrent & overtemperature protection
- › Active error compensation
- › High stability of magnetic thresholds
- › High ESD performance
- › Leaded and halogen-free package **PG-TO92S**
- › JESD47 qualified

### Product features

- › **Brushless DC motor** (E-Bike, dishwasher, washing machine, PC/home server cooling fans...)
- › **Power closing in home automation** (sun blind, garage door)
- › **Open/close detection** (white goods or home security systems...)
- › **Power tools and gardening**



# TLE4913 – Low power Hall Switch for industrial applications



## Technical highlights

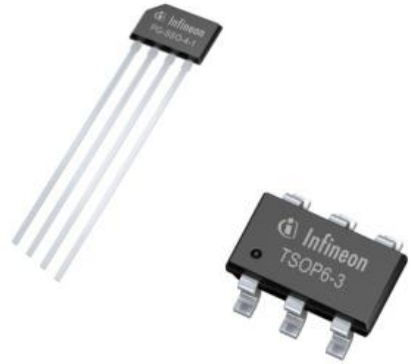
- › Micro power design (Average current in standby mode  $\sim 4\mu\text{A}$ )
- › 2.4 V to 5.5 V battery operation
- › High sensitivity and high stability of the magnetic switching points
- › High resistance to mechanical stress
- › Digital output signal
- › Switching for both poles of a magnet (omnipolar)
- › Standardized SMD package PG-SC59

## Product features

- › **White goods** (washing machine, dryer, dishwasher...)
- › **Access control** (open/close detection of windows/doors)
- › **Industrial automation** (automated doors, shutters...)
- › Control elements

# TLI4966G –

## High Precision Hall-Effect Switch with Direction Detection



### Highlights

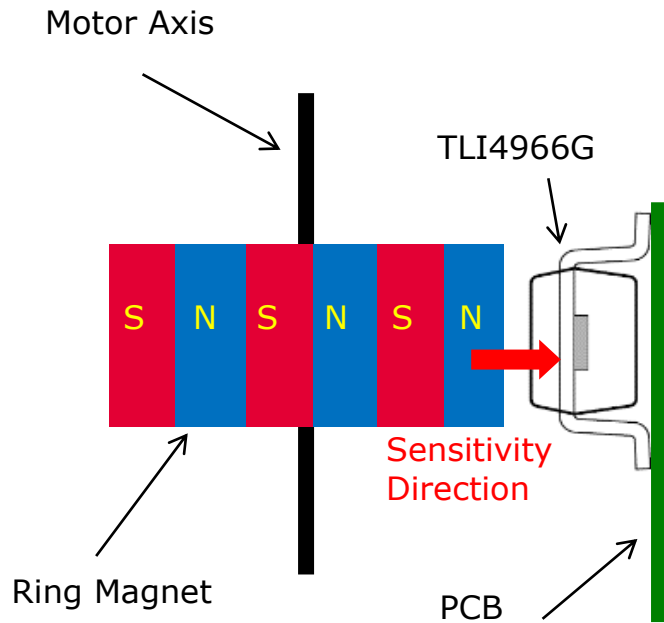
- › **Direction detection and speed** due to two integrated Hall sensor elements
- › **Excellent sensitivity and stability** of the magnetic **switching points**
- › Operation even from **unregulated power supply** plus **reverse battery protection (-18V)**

### Technical features

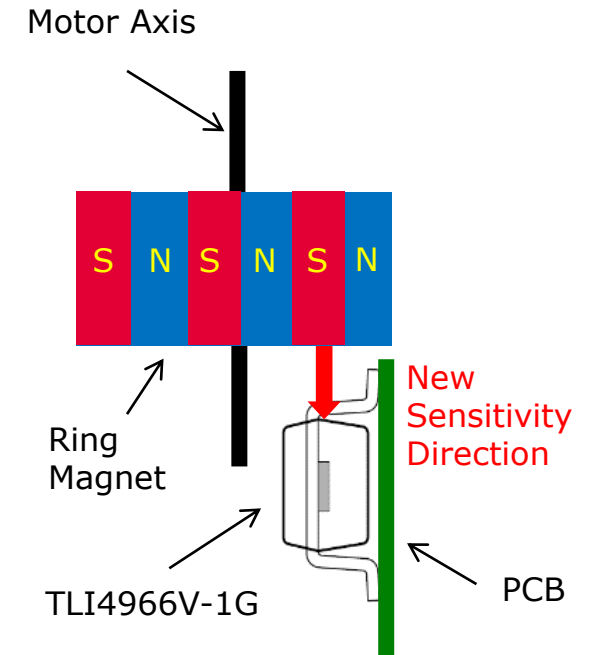
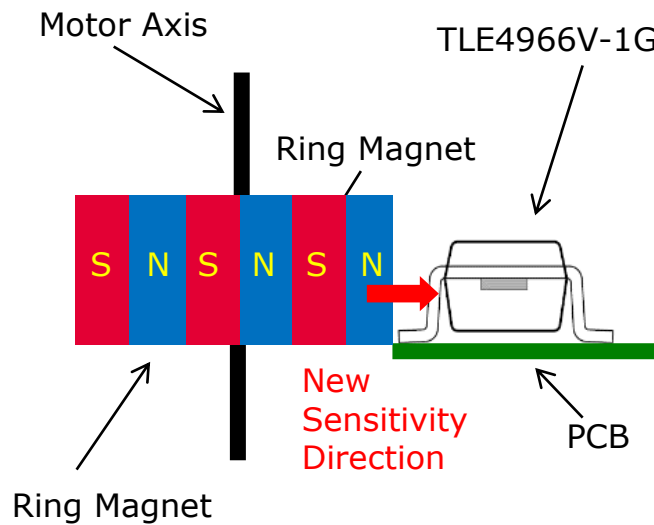
TLI4966G	TLE4966V-1G
› Horizontal sensing	› Vertical Hall for In-Plane Sensing
› 2.7V to 24V operating supply voltage	› 3.5V to 32V operating supply voltage
	› Overvoltage capability up to 42V without external resistor
	› Low current consumption
› PG-TSOP6	› PG-TSOP6

# Different positioning of Hall elements in TLE4966 family for mounting flexibility

## Horizontal TLE4966G



## Vertical TLE4966V-1G



The availability of **horizontal** and **vertical** TLE4966 brings more flexibility in system design (e.g. mounting position, system size).

# Index Counting – for anti-pinch detection

> Change

## Index counting

*Well established @ Power Closing Systems and Electrical Shutters*

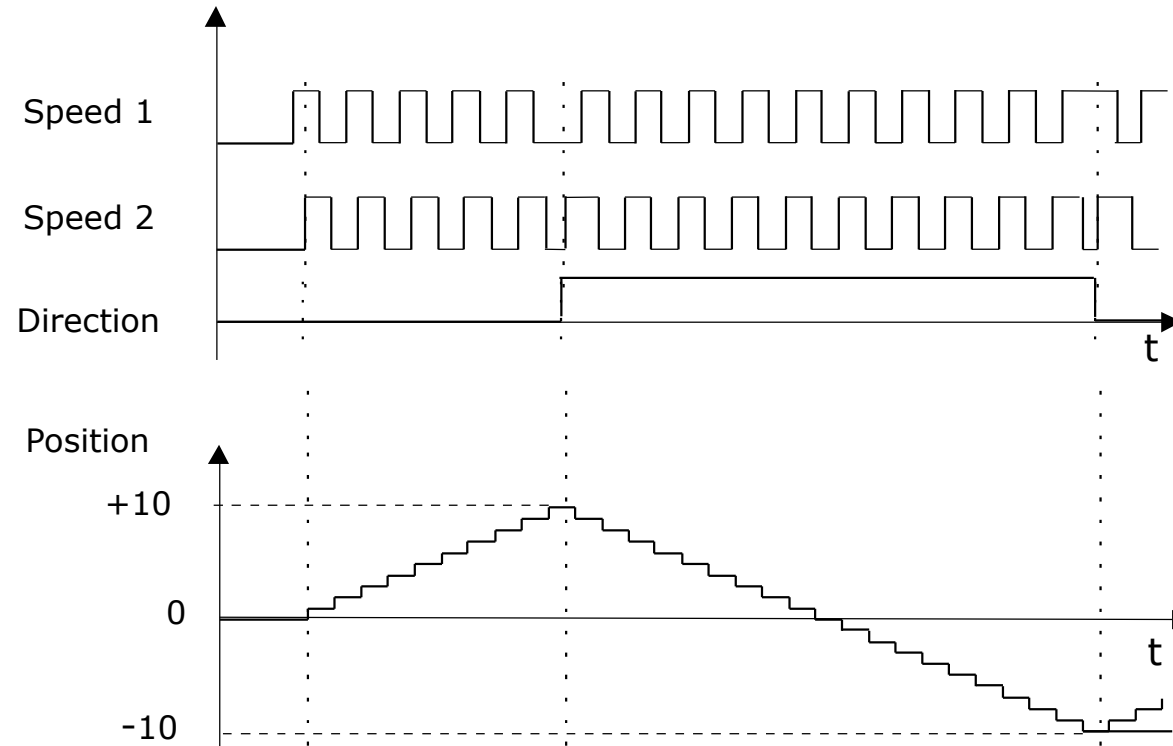
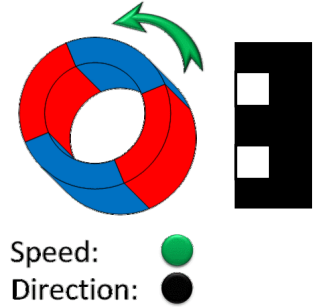


*Future importance for collaborative robots*

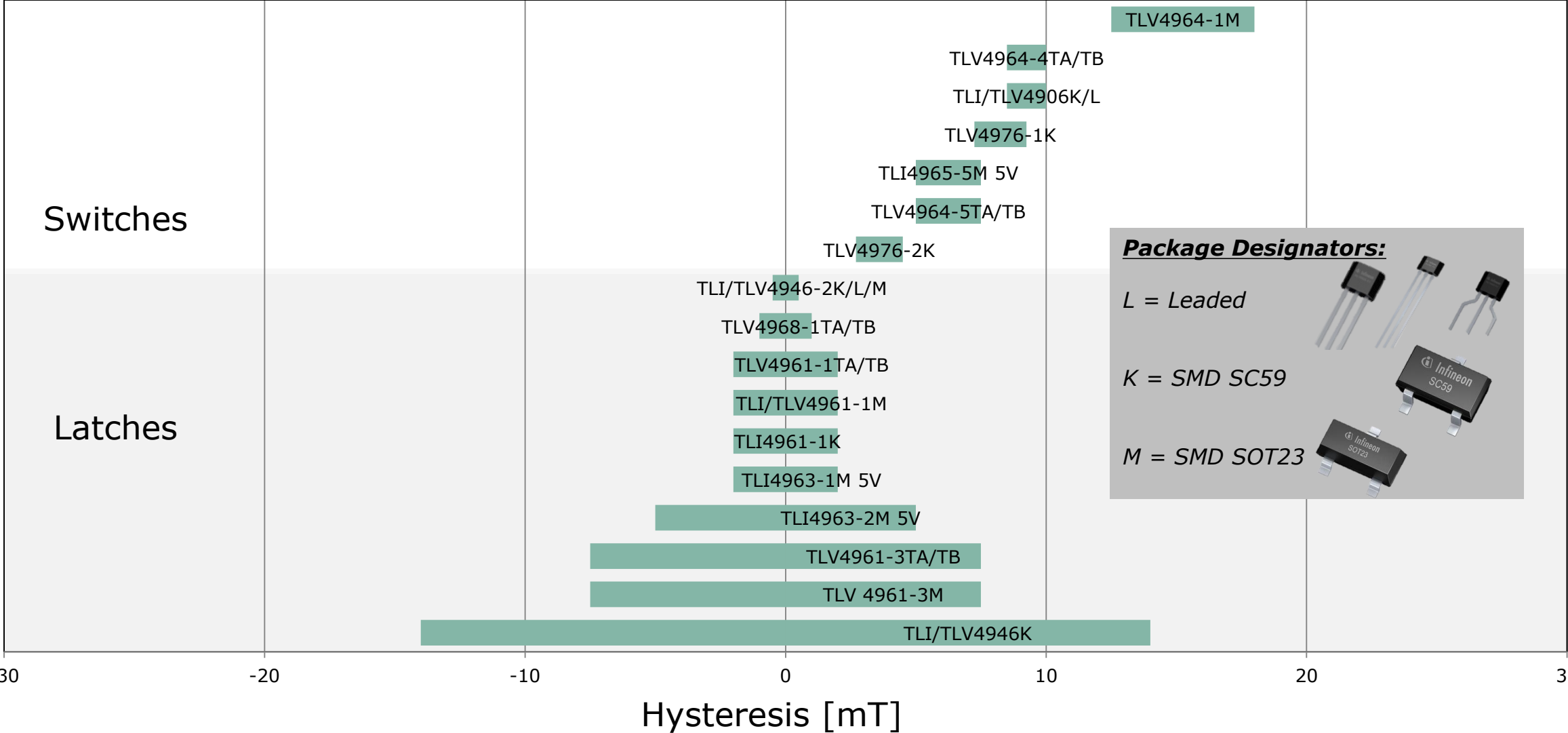


## > TLI4966G – Double Hall sensor

- > Speed and Direction information
- > Combination of **2 sensing elements** in **one sensor**



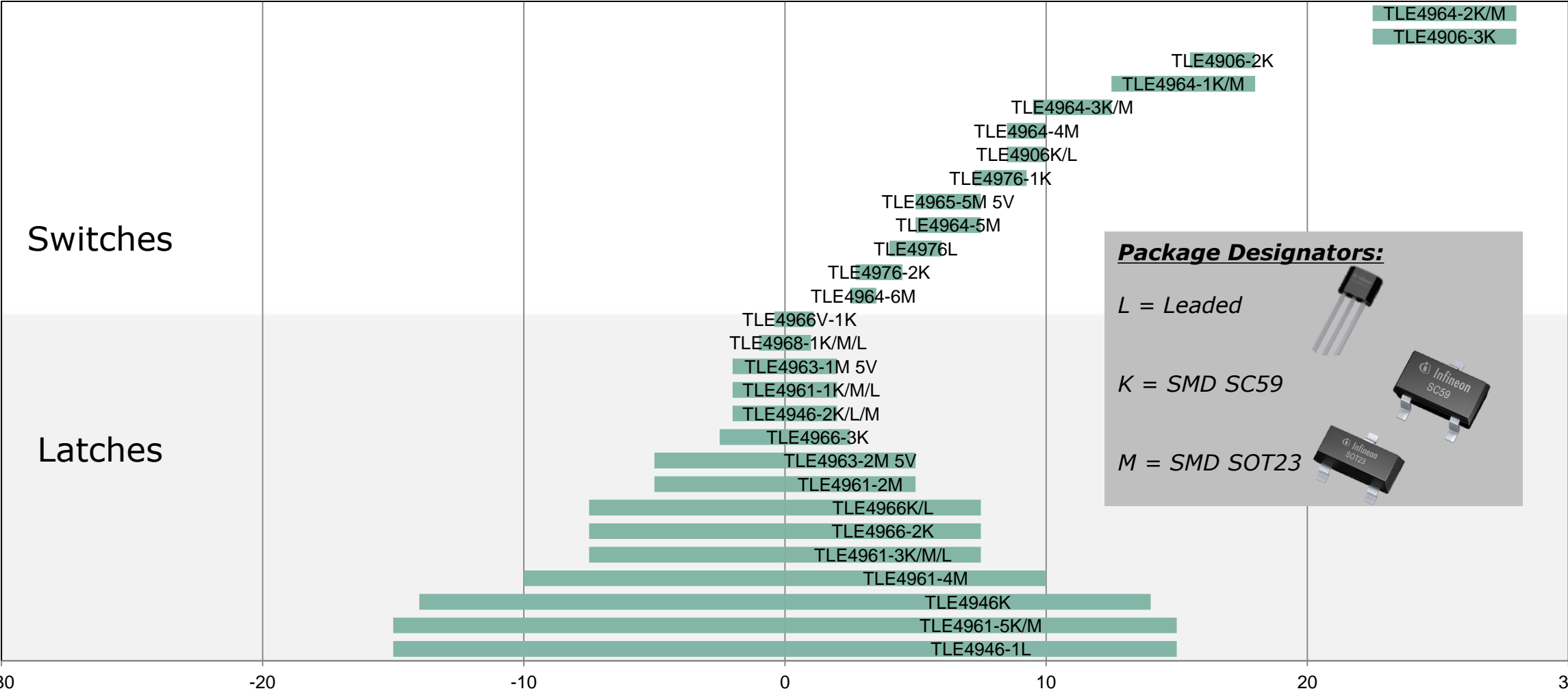
# Magnetic sensitivities (industrial, consumer)



**Package Designators:**

- L = Leaded
- K = SMD SC59
- M = SMD SOT23

# Further products available as automotive variants...

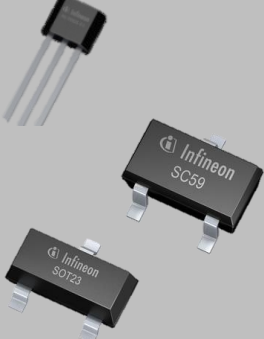


**Package Designators:**




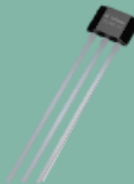
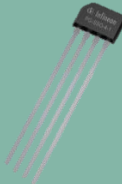
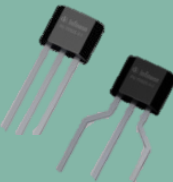
L = Leaded

K = SMD SC59

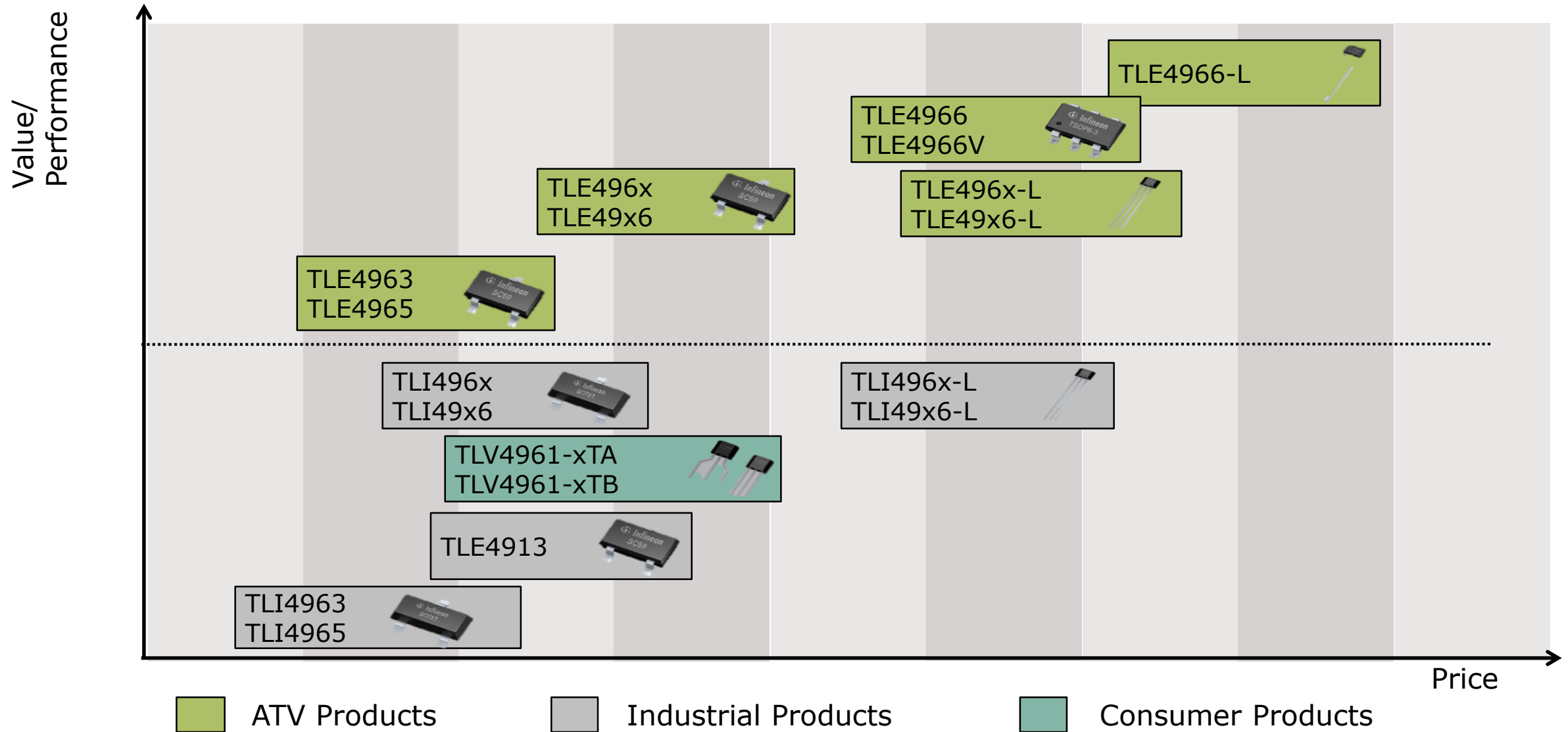
M = SMD SOT23



# Differentiation Hall Switches – Packages




	PG-SC59	PG-SOT23	PG-TSOP6-6-5	PG-SSO-3-2	PSSO-4-1	PG-T092S
						
Industry -40° to 125° C	<ul style="list-style-type: none"> <li>• TLI49x6</li> <li>• TLI496x</li> </ul>	<ul style="list-style-type: none"> <li>• TLI496x-xM</li> </ul>	-	<ul style="list-style-type: none"> <li>• TLI49x6-xL</li> <li>• TLI496x-xL</li> </ul>	-	-
Consumer -40° to 125° C	<ul style="list-style-type: none"> <li>• TLV49x6</li> <li>• TLV496x</li> </ul>	<ul style="list-style-type: none"> <li>• TLV496x-xM</li> </ul>	-	<ul style="list-style-type: none"> <li>• TLV49x6-xL</li> </ul>	-	<ul style="list-style-type: none"> <li>• TLV496x-xTA/TB</li> </ul>
Automotive -40° to 170° C	<ul style="list-style-type: none"> <li>• TLE49x6</li> <li>• TLE496x</li> </ul>	<ul style="list-style-type: none"> <li>• TLE496x-xM</li> </ul>	<ul style="list-style-type: none"> <li>• TLE4966</li> <li>• TLE4966V</li> </ul>	<ul style="list-style-type: none"> <li>• TLE49x6-xL</li> <li>• TLE496x-xL</li> </ul>	<ul style="list-style-type: none"> <li>• TLE4966L</li> </ul>	-
Functionality	<ul style="list-style-type: none"> <li>• Switches</li> <li>• Latches</li> </ul>	<ul style="list-style-type: none"> <li>• Switches</li> <li>• Latches</li> </ul>	<ul style="list-style-type: none"> <li>• Double Hall latch</li> </ul>	<ul style="list-style-type: none"> <li>• Switches</li> <li>• Latches</li> </ul>	<ul style="list-style-type: none"> <li>• Double Hall latch</li> </ul>	<ul style="list-style-type: none"> <li>• Switches</li> <li>• Latches</li> </ul>
Benefits		<ul style="list-style-type: none"> <li>• Smallest available package</li> <li>• 5V family available</li> </ul>	<ul style="list-style-type: none"> <li>• Speed and direction from one sensor</li> </ul>	<ul style="list-style-type: none"> <li>• Current interface available</li> </ul>	<ul style="list-style-type: none"> <li>• Speed and direction from one sensor</li> </ul>	<ul style="list-style-type: none"> <li>• Cost-effective leaded packages</li> </ul>

# Differentiation Hall Switches – Product Families

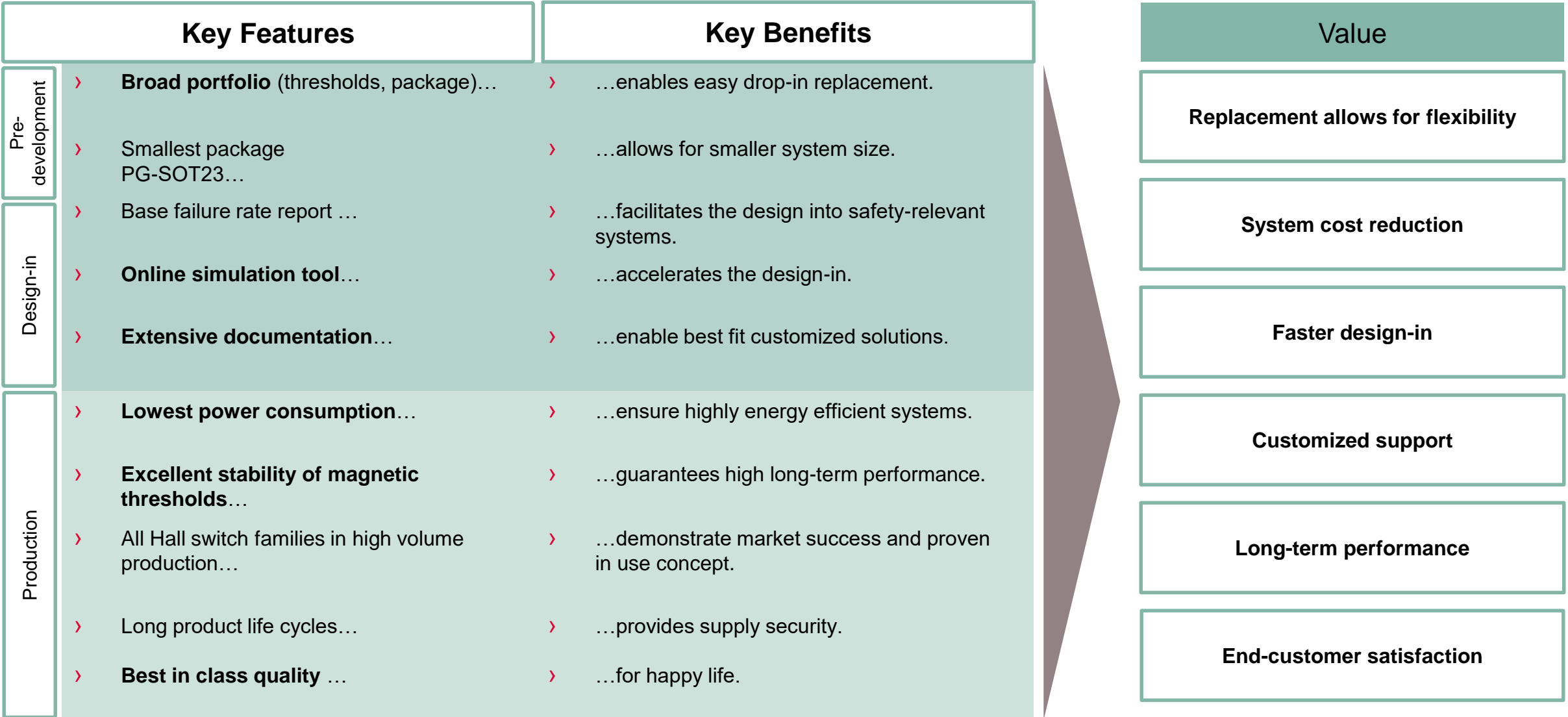




# Competitive advantage by using TLx496x

Product	Applications	Competitive Advantage
<p data-bbox="242 364 445 406">TLx496x</p>  <ul data-bbox="191 1170 433 1278" style="list-style-type: none"> <li>• Industry</li> <li>• Consumer</li> <li>• Automotive</li> </ul>	<p data-bbox="777 392 828 771" style="writing-mode: vertical-rl; transform: rotate(180deg);">Position Detection</p>  <p data-bbox="904 756 1337 821">e.g. docking position, HMI, wiping water level sensor</p> <p data-bbox="777 828 828 1235" style="writing-mode: vertical-rl; transform: rotate(180deg);">BLDC commutation</p>  <p data-bbox="891 1178 1248 1242">e.g. propulsion motor, suction motor</p>	<ul style="list-style-type: none"> <li data-bbox="1528 364 1885 435"><b>Large portfolio with standardized packages</b> → Easy drop-in replacement</li> <li data-bbox="1528 514 1770 585"><b>Low power consumption</b> → Enables energy efficient systems</li> <li data-bbox="1528 671 1872 706"><b>5V family available</b> → Enables cost effective systems</li> <li data-bbox="1528 763 1898 906"><b>Worldwide smallest package for automotive hall-switches</b> → Saves PCB space and enables compact systems</li> <li data-bbox="1528 935 1898 1078"><b>High supply voltage range (3,0 Volt to 32 Volt)</b> → Cost-savings by eliminating the voltage regulator</li> <li data-bbox="1528 1106 1821 1178"><b>High load dump (42V)</b> → Reduces external resistors</li> <li data-bbox="1528 1206 1796 1306"><b>Infineon Zero-Defect Commitment</b> → Best-in-class field quality and OEM satisfaction</li> </ul>

# Value proposition



# Success story

## Vacuum-mop robot – Hall switches



Design contains further IFX components – such as  $\mu$ C, motor driver, MOSFETs, BMS, etc.

### Project description

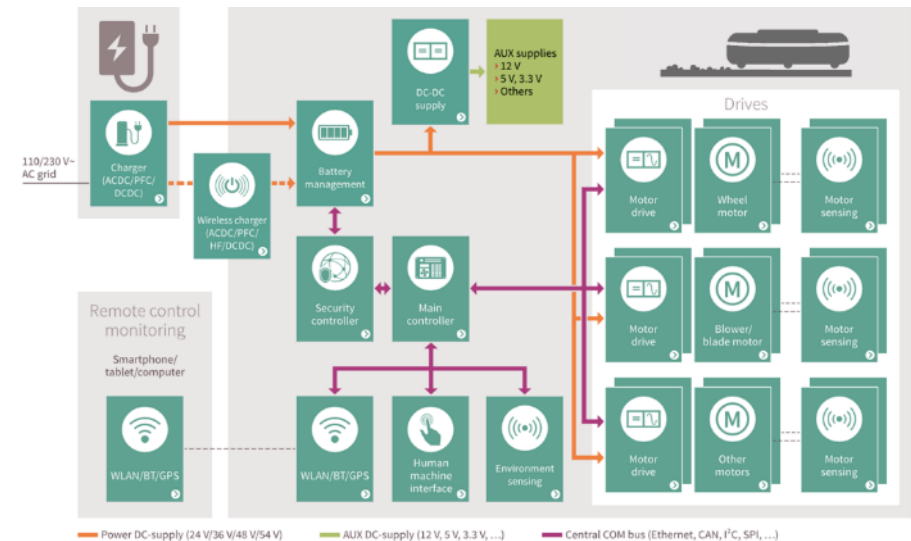
- > Application : **Vacuum-mop robot**
- > Sub-Application: BLDC motor commutation
- > Customer: German household appliance manufacturer
- > Product (s): **TLV4968-1TA/TB**
- > Competitor(s): Hall Switch Manufacturers
- > Related applications: **Lawn mower, wiper robot, ...**



### Success factors

- > 3.0 V to 26.0 V operating supply voltage
- > **Operation from unregulated power supply**
- > Active error compensation (chopping)
- > High stability of magnetic thresholds
- > High ESD performance (4 kV HBM)
- > **Cost-optimized consumer package PG-T092S**
- > **Low current consumption 1.6 mA**
- > Operating temperature range from -40 ° C to 125 ° C

### Block diagram



# Table of contents

1	Infineon robotics product offering at a glance	3
2	Sensors 4 robots	7
3	Hall Switch – and their use in robotics	16
4	<b>3D Hall– and their use in robotics</b>	<b>36</b>
5	Angle Sensors– and their use in robotics	42
6	Current Sensors– and their use in robotics	58
7	A word on functional safety and quality	64
8	Infineon supportives to ease sensor designs 4 robotics	69

# Magnetic 3D Sensors use case examples for robotics

## Position detection

---

*Open/close detection lid,  
collision detection  
Position @ charging point*



**TLI493D-A2B6**  
**TLV493D-A1B6**

*HMI controls, Joysticks,  
Jogwheels*



**TLI493D-A2B6**  
**TLV493D-A1B6**

# New 3D Sensors for Industrial Range

## TLV493D-A1B6

**# of Power Modes: 4**  
**Max. Update Frequency: 3,3kHz**  
**Magnetic field range: +/- 130mT**

### Typical spec values only

3D Sensing  
 Min. Power Consumption: 7nA  
 Temp-Range: -40°C to +125°C  
 Package: small 6pin SMD package  
 Data resolution: 12bit  
 Interface: I<sup>2</sup>C digital interface



## TLI493D-A2B6

**# of Power Modes: 4**  
**Max. Update Frequency: 7,8kHz**  
**Magnetic field range: +/- 160mT**  
**Sensor address read back**  
**Set to 1/2 magnetic range**  
**Angular mode (x,y read out)**

### Includes minimum spec values

3D Sensing  
 Min. Power Consumption: 7nA  
 Temp-Range: -40°C to + 105°C  
 Package: small 6pin SMD package  
 Data resolution: 12bit  
 Interface: I<sup>2</sup>C digital interface



## TLI493D-W2BW

**Wake-Up functionality**  
**# of Power Modes: 8**  
**Max. Update Frequency: 7,8kHz**  
**Magnetic field range: +/- 160mT**  
**Initial Start Up Address IDs (0-3)**  
**Broader uC compatibility**  
**Sensor address read back**  
**Set to 1/2 magnetic range**  
**Angular mode (x,y read out)**  
**Test features**

3D Sensing  
 Min. Power Consumption: 7nA  
 Temp-Range: -40°C to +125°C  
 Package: **WLB-5 (1.13 x 0.93 x 0.59 mm)**  
 Data resolution: 12bit  
 Interface: I<sup>2</sup>C digital interface



# 3D Sensors for Automotive Range

## TLE493D-A1B6

**# of power podes: 4**  
**Max. update frequency: 7,8kHz**  
**Magnetic field range: +/- 60mT**

3D sensing  
 Min. power consumption: 7nA  
 Temp-range: -40°C to +125°C  
 Package: Small 6pin SMD package  
 Data resolution: 12bit  
 Interface: I<sup>2</sup>C digital interface



## TLE493D-A2B6

**# of power modes: 4**  
**Max. update frequency: 7,8kHz**  
**Magnetic field range: +/- 160mT**

Broader uC compatibility  
Sensor address read back  
Set to 1/2 magnetic range  
**Angular mode (x,y read out)**

3D sensing  
 Min. power consumption: 7nA  
 Temp-range: -40°C to +125°C  
 Package: small 6pin SMD package  
 Data resolution: 12bit  
 Interface: I<sup>2</sup>C digital interface



## TLE493D-W2B6

**Wake-Up functionality**  
**# of power modes: 8**  
**Max. update frequency: 7,8kHz**  
**Magnetic field range: +/- 160mT**  
**Initial start up address IDs (0-3)**  
Broader uC compatibility  
Sensor address read back  
Set to 1/2 magnetic range  
**Angular mode (x,y read out)**  
**Test features**



3D sensing  
 Min. power consumption: 7nA  
 Temp-range: -40°C to +125°C  
 Package: small 6pin SMD package  
 Data resolution: 12bit  
 Interface: I<sup>2</sup>C digital interface



# Key Features and Benefits, Value Drivers

## Key Features

- > Bx, By and Bz linear field measurement (available up to  $\pm 130$  mT or up to  $\pm 160$  mT)
- > X-Y angular measurement mode
- > **Low** current consumption
- > 0.007  $\mu$ A in **power down** mode
- > 10  $\mu$ A in ultra **low power** mode
- > I<sup>2</sup>C interface
- > 12-bit data resolution for each measurement direction plus **10-bit temperature sensor**
- > Operating temperature range from **-40 ° C up to 125 °**

## Key Benefits

- > **Component reduction** due to 3D magnetic measurement principle
- > Wide application range addressable due to **high flexibility**
- > Platform adaptability due to device **configurability**
- > **Disturbance** of smaller stray fields are **negligible** compared to the high magnetic flux measurement range

## Value

**System Cost Reduction**

**Multi-Platform Usage**

**Application Robustness**

**Market Competitiveness**

**Greater User-Experience**

**Faster Time-to-Market**



# Success Story

## 3D Hall for Robotic Lawn Mower



### Project Description

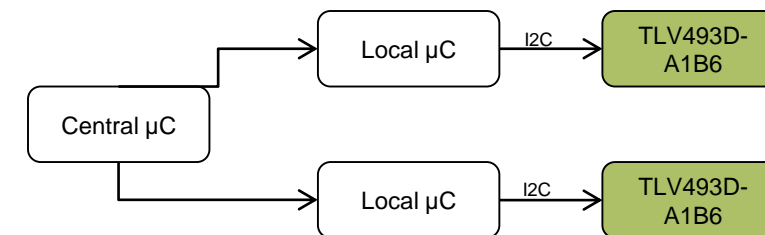
- › Application : **Lawn mower**
- › Sub-Application: **Collision and lift detection**
- › Customer: **Major EU OEM for Lawn and Gardening equipment**
- › Product (s): **TLV493D-A1B6 (3D magnetic Hall Sensor)**
- › Competitor(s): **none**
- › Related applications: **Vacuum cleaning robots**



### Success Factors

- › TLV493D-A1B6 3D Hall is a perfect fit to detect changes in the relative position between the chassis and the shell of the lawn mower
- › Excellent customer support in close cooperation with our distributor:
  - simulations of the magnetic field
  - provided guidelines for magnet position and selection
  - online simulation tool: [Link](#)
- › Customer is now evaluating the 3D sensor for other applications such as throttle control and on/off switch
- › Attractive price level compared to existing sensors

### Block Diagram



#### Explanation

The relative movement of a magnet versus the 3D Hall sensor determines the tilt respectively collision detection in a very reliable way.

Depending on the architecture, 1 or more  $\mu\text{C}$ s are in place. Here, also Infineon XMC™  $\mu\text{C}$  can be used. Communication between the  $\mu\text{C}$  and the 3D Hall sensor is done via I2C.

# Table of contents

1	Infineon robotics product offering at a glance	3
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# Angle Sensors use case examples for robotics

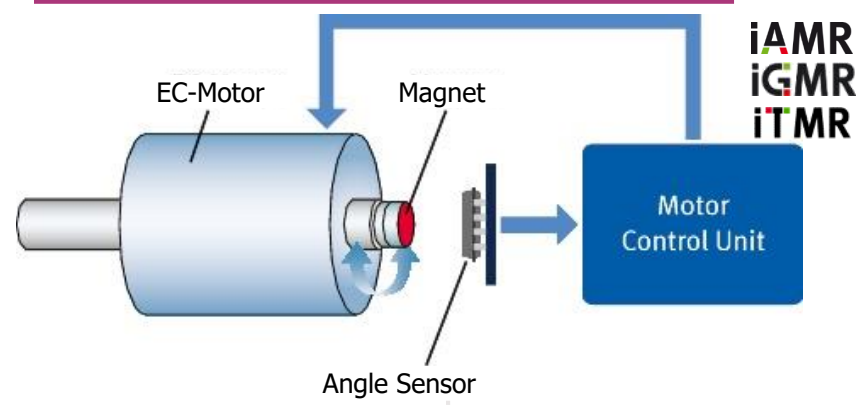
## BLDC Motor Commutation



iGMR  
iTMR

- TLE5012B(D) Single&Dual
- TLI5012B Single
- TLE5014x(D) Single&Dual
- TLE5501 "Single Dual Die"

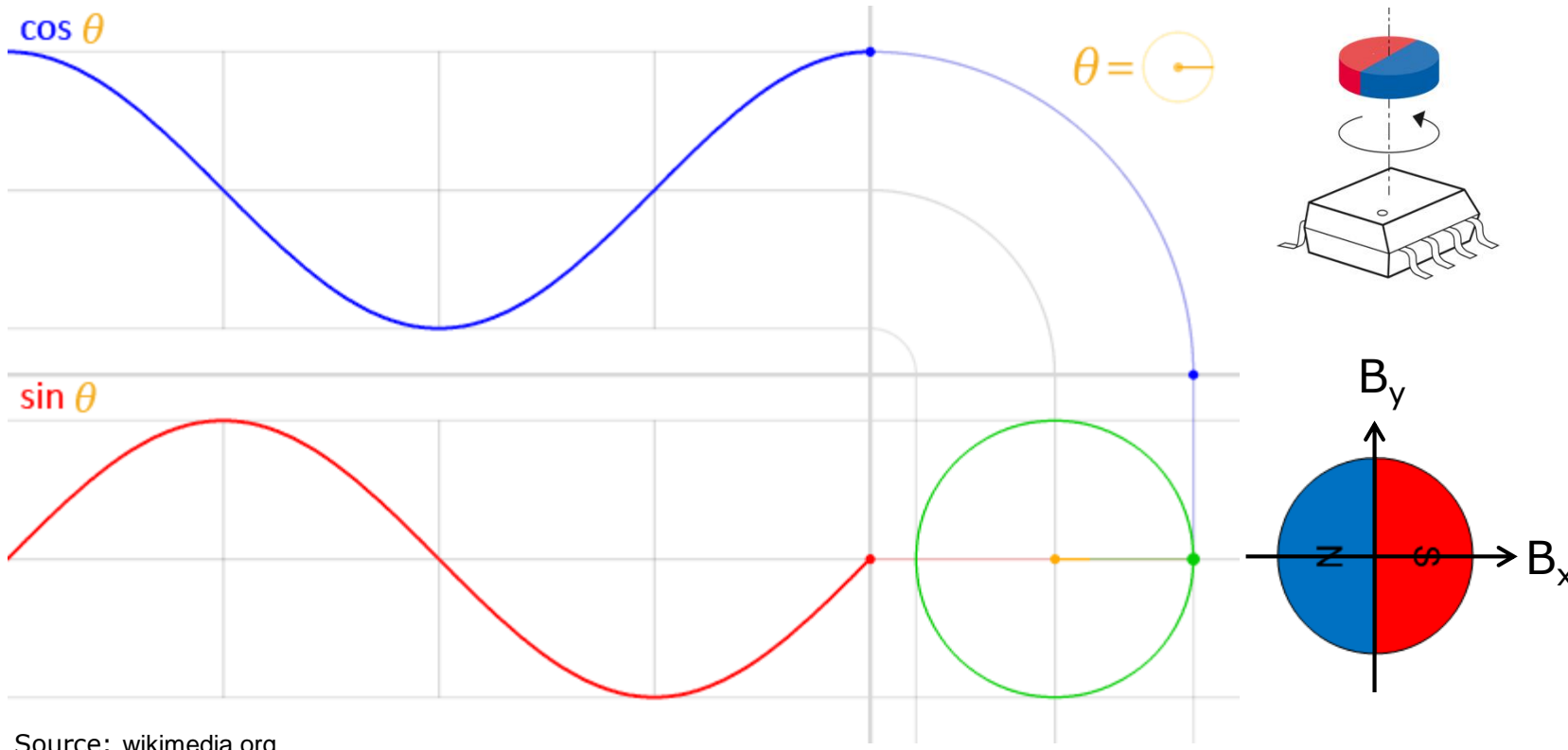
## Encoders



iAMR  
iGMR  
iTMR

- TLE5109A16(D) Single&Dual
- TLE5012(D) Single&Dual
- TLE5501 "Single Dual Die"

# Hall effect angle sensors for BLDC continuous commutation



Source: wikimedia.org

**Typical Application Setup:**  
The angle sensor is positioned at the end of shaft to define the exact rotor position

**B<sub>x</sub>** component results in a sine wave

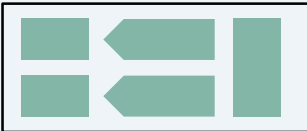
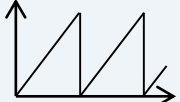
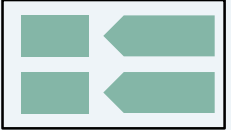

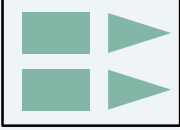

**B<sub>y</sub>** in a cosine wave

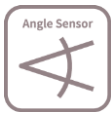
Absolute angle is defined by **arc tangent** calculation

## Application Benefits for Customers

- > Accurate positioning of the motor (e.g. servo)
- > Very Accurate rotor position detection
- > Very smooth and efficient commutation
- > Improved energy efficiency and longer battery life
- > Higher torque, smaller motor and reduced weight

# An expanding Angle Sensor product portfolio...

	iAMR	iGMR	iTMR
 <p>Digital angle</p>  <p>0110100</p>			<p><b>TLE5012B</b>  <b>TLE5012B(D)</b>            TLE5014(D)</p>
 <p>Digital sin/cos</p>  <p>0110100 1101010</p>			<p><b>TLE5011</b></p>
 <p>Analog sin/cos</p> 	<p>TLE5109A16(D)</p>	<p><b>TLE5309D</b></p>	<p><b>TLE5009</b>  <b>TLE5009A16(D)</b></p> <p>TLE5501(D)</p>
<p><b>bold = productive</b>            under development            planned</p>			



# TLI5012B E1000: 360° Digital Angle Sensor for industrial applications



## Highlights

- > **Integrated angle calculation**
- > **Incremental Interface (IIF), SPI with 8Mbit/s**
- >  **$\leq 1,9^\circ$  angle error over temp. / lifetime**
- > **Integrated giant magneto resistance (iGMR) based angle sensor**
- > **15bit representation of absolute angle value on output (resolution of  $0.01^\circ$ )**
- > **Bi-directional SSC interface (~8Mbit/s)**
- > Suitable: **Bus mode operation of multiple sensors** possible with SPC

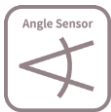
## Product Information

- > Packages: SMD (PG-DSO-8)
- > Tape & reel (2.5k)
- > In production

**iGMR**

JEDEC47  
(Tj-40° C / 125° C)

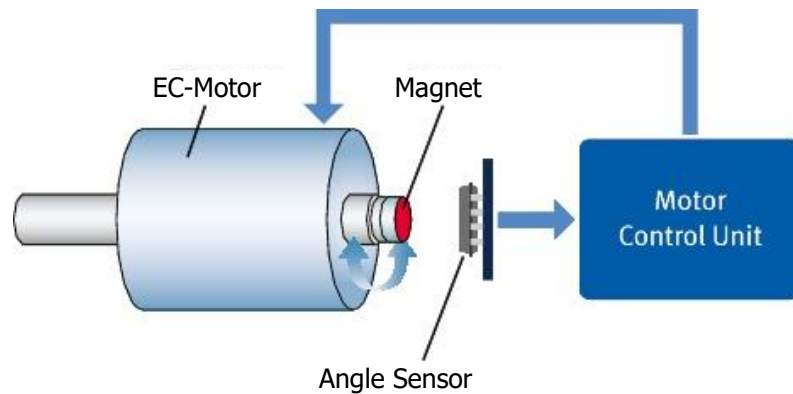




# TLE5012B(D) – Single and Dual Sensor Digital Angle Sensor with Autocalibration



**Suitable for rotor position sensing  
with multiple interface options**



## Highlights

- > **Integrated angle calculation**
- > **Selectable interfaces**  
(PWM, IIF, SPC, SPI, HSM)
- > **Integrated giant magneto resistance (iGMR) based angle sensor**
- > **15bit** representation of **absolute angle value on output** (resolution of  $0.01^\circ$  )
- > **Bi-directional SSC interface** (~8Mbit/s)
- > Suitable: **Bus mode operation of multiple sensors** possible with SPC

## Product Information

- > Packages: SMD (PG-DSO-8) and Dual Die (PG-TDSO-16)
- > Tape & reel (2.5k)
- > In production

**iGMR**



## Key features and benefits

### Key features

**Integrated angle calculation**

**Selectable interfaces**  
(IIF, SPI, HSM)

**Auto Calibration & Prediction Mode**

**15bit representation of absolute angle value on output** (resolution of 0.01° )

**Dual Die Option**

**ISO26262 ready (comparable to SIL2/3)**

### Key benefits

- Ready angle available (vs. sin/cos signal)
- HSM allows easy replacement of 3 Hall switches for block commutated motors.
- SPI Sign/Cos raw data available to support advanced compensation algorithm in  $\mu\text{C}$
- IIF eases replacement of optical encoders
- AutoCal for increased accuracy  
Prediction to reduce signal latency
- Easy to use (no end of line calibration required)
- Dual Die allows high flexibility (single/dual = pin compatible) for safety critical applications
- ISO26262 eases implementation of functional safety in application

### Value

Relieve  $\mu\text{C}$  from demanding arctan operation routines, cheaper  $\mu\text{C}$  usable

**EOS eases assembly – reduces cost**

**Allows own calibration algorithms to further improve performance** for highly demanding applications

**Easy plug&play replacement for encoders**  
(no further adaption needed)

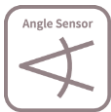
Higher accuracy and reduced latency lead to reduced motor noise&ripple,  
**improves torque& efficiency**

Safe EoL calibration effort&cost

**One PCB design fits single and dual die version** – none safety/safety scalability

Reduce documentation effort for functional safety critical applications





# TLE5009A16(D) – Single and Dual Sensor Analog Angle Sensor with highest accuracy



**Excellent for highly dynamic applications**



## Highlights

- > TLE5009 chip on improved package
- > **Higher accuracy thanks negligible hysteresis error**
- > **Same package (PG-TDSO-16) used for the single and dual sensor versions**
- > **Fast output & short delay time (<9µs)**
- > With and without temperature compensation
- > **Very high angle accuracy**  
(typ. 0.5° overall angle error)
- > Safety manual available

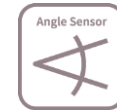
## Product Information

- > Packages: PG-TDSO-16
- > Tape & reel (2.5k)
- > In production



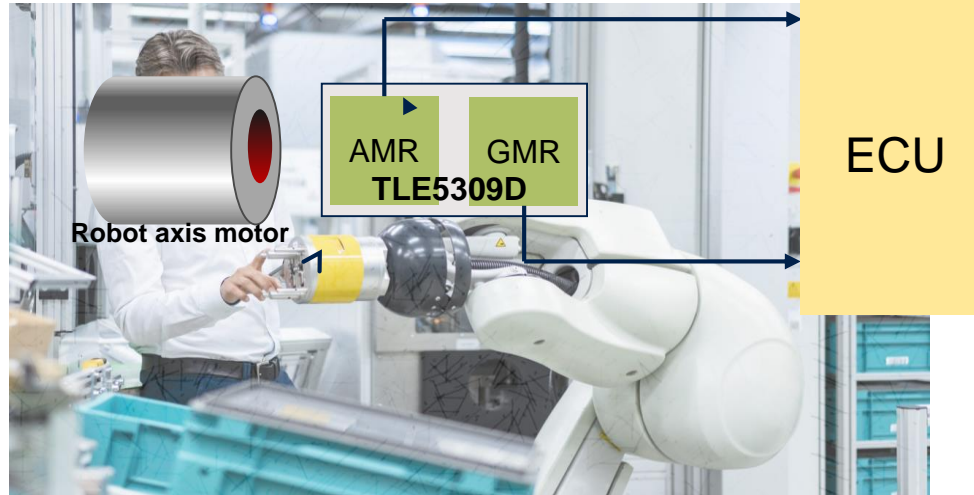
# TLE5x09D

## Analog Rotor Position Sensors



TLE5309D / TLE5109(D) / TLE5009(D)

**iGMR** **iAMR**



### TLE5009D:

**ASIL-D capability** for even and uneven pole pair motor

### TLE5109D:

**ASIL-D capability** for even pole pair motor

### TLE5309D:

**ASIL-D capability** for even and uneven pole pair motor and integrated **Diversity** (AMR+GMR)

### TLE5x09D Customer Benefits:

- > Supports SIL and up to **ASIL D** on **system level** for motor commutation
- > **Diverse technology** -> beneficial to functional safety
- > Fast analog **Sin/Cos** output
- > **Short propagation delay:** 9  $\mu$ s, supports fast rotation speeds
- > **Fast power-on:** < 100  $\mu$ s, for low power consumption in turn-counter mode

# TLE5109A16(D)

## Key features and benefits



### Key features

**Highest angle accuracy:** typ. only 0.1° overall angle error

**Best in-class** angle error of **only 0.2°** typ. at **10...20mT**

Broad magnetic field range  
**10mT ...>500mT**

**Best-in-class** fast **start-up time** of only 40...70 us

**Identical pin-configuration and interfaces** for all TLE5x09

Product versions for **3.3V** as well as **5V supply voltage**

**Ready for ISO26262,** targeting ASIL D (dual die)

### Key benefits

- Highest Angle Accuracy
- **Best in class** Accuracy at low magnetic fields
- Widest magnetic field range
- **Best-in-Class** reaction time
- **Quick & easy product version interchange** of all TLE5x09
  - > Optimized for both 3.3 V and 5 V supply voltage
  - > Safety Manual on Request: Minimizing Customer Safety Documentation Efforts

### Value

Enabling **ultra-precise** angle measurement

**System Cost Benefit:** enabling **cost-efficient systems** due to use of **less powerful magnets**

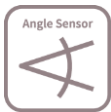
Right Fit for Systems with **lowest to highest magnetic fields**

Perfect for for **high speed & high availability**

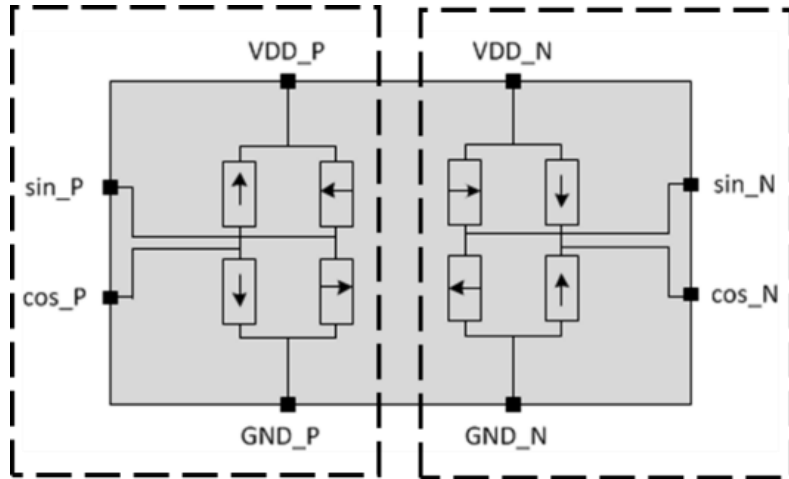
Increased **design-in flexibility** and **lower design-in effort**

Ready for **3.3V as well as 5V**

Ready for **Industrial and Automotive Safety**



### Redundant analog angle sensing



### Highlights

- > **Precise analog rotation sensing**
  - > **Typ. angle error ~ 1.0 ° (over Temperature & lifetime)**
  - > Add. error reduction by external SW-based compensation methods
- > **Designed for Safety:**
  - > **2 independent dual channel sensors**
  - > **Development according ASIL-D**
- > Supply current: ~2mA
- > Magnetic field range (20mT to 100mT)
- > DSO8 for single sensor → Grade 0

### Product Information

- > SMD package (DSO-8)
- > QM and ASIL-D compliant versions
- > In production



# TLE5501 E0001

## Key features and benefits



### Key features

Infineon TMR technology's high sensing sensitivity

Infineon TMR technology's very low temperature drift

Pin-Compatible to the established TLE5009

TLE5501 supply current ~2mA

Typ. angle error ~ 1.0 ° over the whole temperature & lifetime

Automotive Qualification and Grade-0 package

### Key benefits

- > no internal amplifier needed
- > reducing external calibration and compensation efforts
- > cost-efficient drop-in for applications using the pin-compatible established Infineon TLE5009
- > Very low current consumption
- > Perfect fit for precise rotation sensing

### Value

Reduced system costs

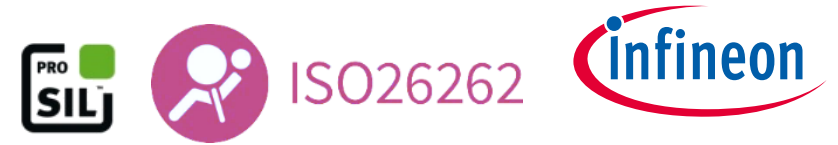
Highest efficiency and power density

Highest Precision Rotation Measurements

Ready for harsh application environments

# TLE5501 E0002

## Key features and benefits



### Key features

World record: reaching ASIL D with just one single sensor chip

ISO26262-compliant development ASIL D,

Infineon TMR technology's high sensing sensitivity

Very low temperature drift

Low supply current ~2mA

Typ. angle error ~ 1.0 °

Grade-0 package

### Key benefits

- > ASIL D with one chip only: reducing component count, system complexity and thus system costs
- > Functional Safety Documentation acc. ISO26262 available
- > no internal amplifier needed
- > reducing external calibration and compensation efforts
- > Very low current consumption
- > Perfect fit for precise rotation sensing

### Value

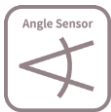
Realizing the highest Functional Safety Level ASIL D at

- lowest system complexity
- lowest component count
- lower system cost

Minimizing Customer Safety Documentation Efforts due to full product safety documentation available

Highest precision rotation measurements

Ready for harsh application environments



# TLE5014: ISO26262 compliant, easy-to-use highest accuracy digital angle sensors



## TLE5014 – Characteristics



- > **Easy-to-use plug & play sensors:** pre-configured and pre-calibrated
- > Offering **high flexibility:**
  - Available as **single** and **dual die** products
  - **12bit digital interface** with protocol options **PWM, SENT, SPC, SPI**
  - **E<sup>2</sup>PROM** and **look-up table** for customer configuration and calibration
- > **High angle accuracy:** max. 1.0° over temperature and lifetime
- > **High voltage capability** up to 26 V
- > **Fully compliant development according ISO26262 (also usable in Industrial)**
  - developed acc. **ASIL-D** level
  - sensor reaching **ASIL-C** metrics



## TLE5014 – Products

TLE5014 C16	TLE5014 C16D	TLE5014 P16	TLE5014 P16D	TLE5014 S16	TLE5014 S16D	TLE5014 SP16	TLE5014 SP16D
SPC		PWM		SENT		SPI	
Single die	Dual die	Single die	Dual die	Single die	Dual die	Single die	Dual die
<b>NEW - IN PRODUCTION</b>							

# Success Story

## Service robots



### Project Description

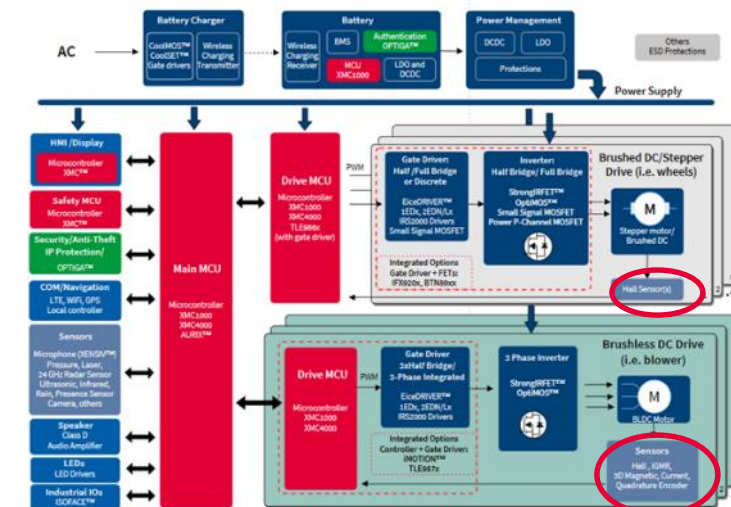
- › Application : **High Value Toy Robots, Collaborative Service Robots**
- › Sub-Application: **BLDC Rotor Position detection for var. joints (arms, head, legs)**
- › Customer: **Chinese Robots OEM**
- › Product (s): **TLI5012B E1000 (iGMR Angle Sensor)**
- › Competitor(s): **Korean Competitor**
- › Related applications: **Industrial Robots**



### Success Factors

- › Digital SPI Interface provides a ready to use angle value to 8 bits MCU
- › Highlight iGMR benefit to get high reliability.
- › Excellent customer support in close cooperation with distributor:
  - › simulations of the magnetic field
  - › provided guidelines for magnet position and selection
  - › online simulation tool: [Link](#)
- › Close cooperation with Value Added Reseller
- › Customer intimacy and Strong design support of Value Added Reseller
- › Bundle offer with other components, e.g, MOSFET possible

### Application Details

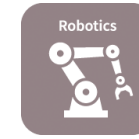


Contact: Jürgen Mann, creation date August 2018



# Success Story

## Manufacturing Robot– angle sensor



### Project Description

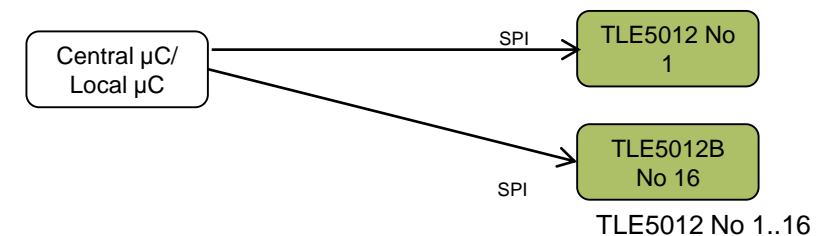
- › Application : **Industrial Robot**
- › Sub-Application: **Angle detection of Robot arm**
- › Customer: **Major Japanese manufacturer of Automation equipment**
- › Product (s): **16 x TLE5012B per unit (Angle Sensor)**
- › Competitor(s): **n/a**
- › Related applications: **Collaborative Robots, Industrial Robots**



### Success Factors

- › High Sensor accuracy required for exact positioning
- › Autocal enables easy Start Up
- › Cost efficient
- › Different interfaces supported (SPI,SENT)
- › We supported the customer with simulations of the magnetic field and provided guidelines for magnet position and selection. See also online simulation tool: [Link](#)
- › Close cooperation with our distributor by technical Q&A.

### Block Diagram



#### Explanation

TLE5012 measures precisely the angle of a robot arm movement  
16 degrees of freedom are served by 16 sensors  
Communication between the  $\mu\text{C}$  and the angle sensor is done via SPI.

Contact: Jürgen Mann, creation date August 2018

# Table of contents

1	Infineon robotics product offering at a glance	3
2	Sensors 4 robots	7
3	Hall Switch – and their use in robotics	16
4	3D Hall– and their use in robotics	36
5	Angle Sensors– and their use in robotics	42
6	<b>Current Sensors– and their use in robotics</b>	<b>58</b>
7	A word on functional safety and quality	64
8	Infineon supportives to ease sensor designs 4 robotics	69

# Current Sensors use case examples for robotics

## Motor Torque Control

- > Motor Torque Control
- > In-wheel motor
- > Servos
- > Overcurrent Detection



**TLI4971**  
**TLE4971**  
**TLE4972**

## Charging Devices

- > EV-DC-Charger
- > Onboard Charger
- > DC/DC converter



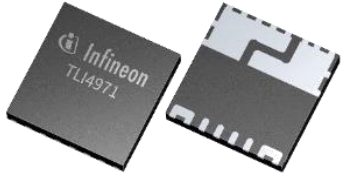
**TLI4971**  
**TLE4971**  
**TLE4972**

## Circuit Breaker (smart fuse)



**TLI4971**  
**TLE4972**

# TLx4971 Family – Industrial current sensor summary



Current sensors featuring integrated current rail:  
Key features



## Key value



### Multiple Options

The TLx4971 offers **broad flexibility** as many settings can be optimized by customers in the application. Additionally pre-programmed devices are available

**8 different variants each**  
120A, 75A, 50A and 25A  
**(UL and non-UL)**



### Application range

A **bandwidth of 240kHz**, the intrinsic linearity and the very low insertion **resistance of 220  $\mu\Omega$  and less than 1nH inductance** allows a wide range applications, in special **GaN and SiC applications**

**Wide range of applications**



### System compatibility

**Stray field robust** design with differential measurement of magnetic field allows **accurate measurement** with parallel or multiple current rails

Optimized for **parallel measurement**  
e.g. multiple phases



### Cost optimization

**Reduced BOM cost** due to two integrated OCD (Over-Current Detection) pins with less than 1 $\mu$ s reaction time and a small **8x8mm power package**

**Lower costs due to less external components and small package size**



### Robust design

Enables galvanic isolated measurement for **high voltage** and **high current applications** without heat sink due to the **superior thermal heat dissipation**

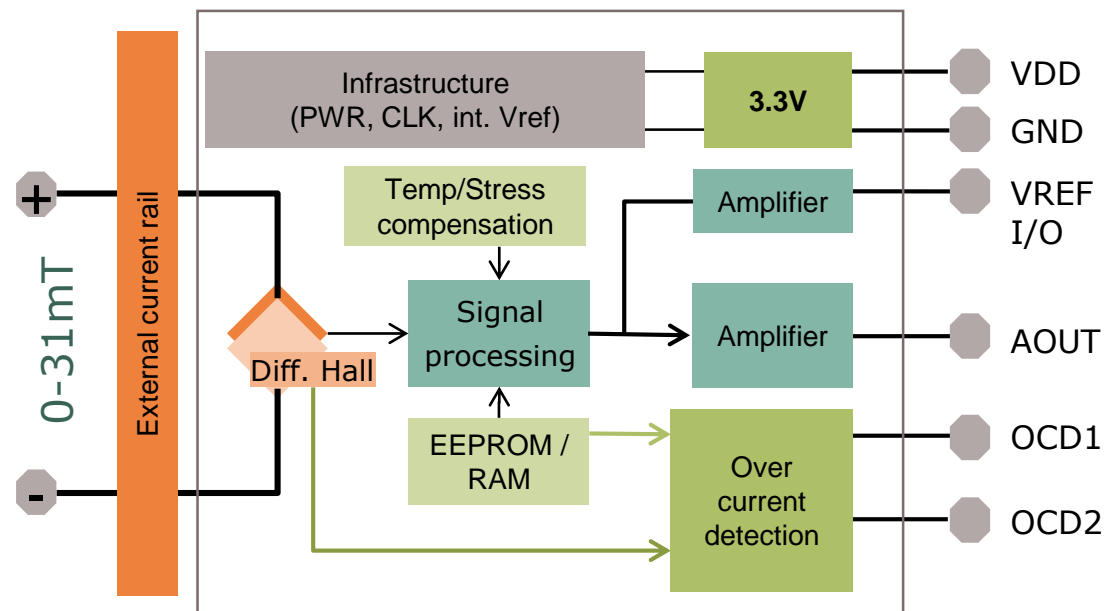
**Galvanic isolation plus outstanding thermal performance**

# TLE4972 - Infineon current sensor optimized for drives

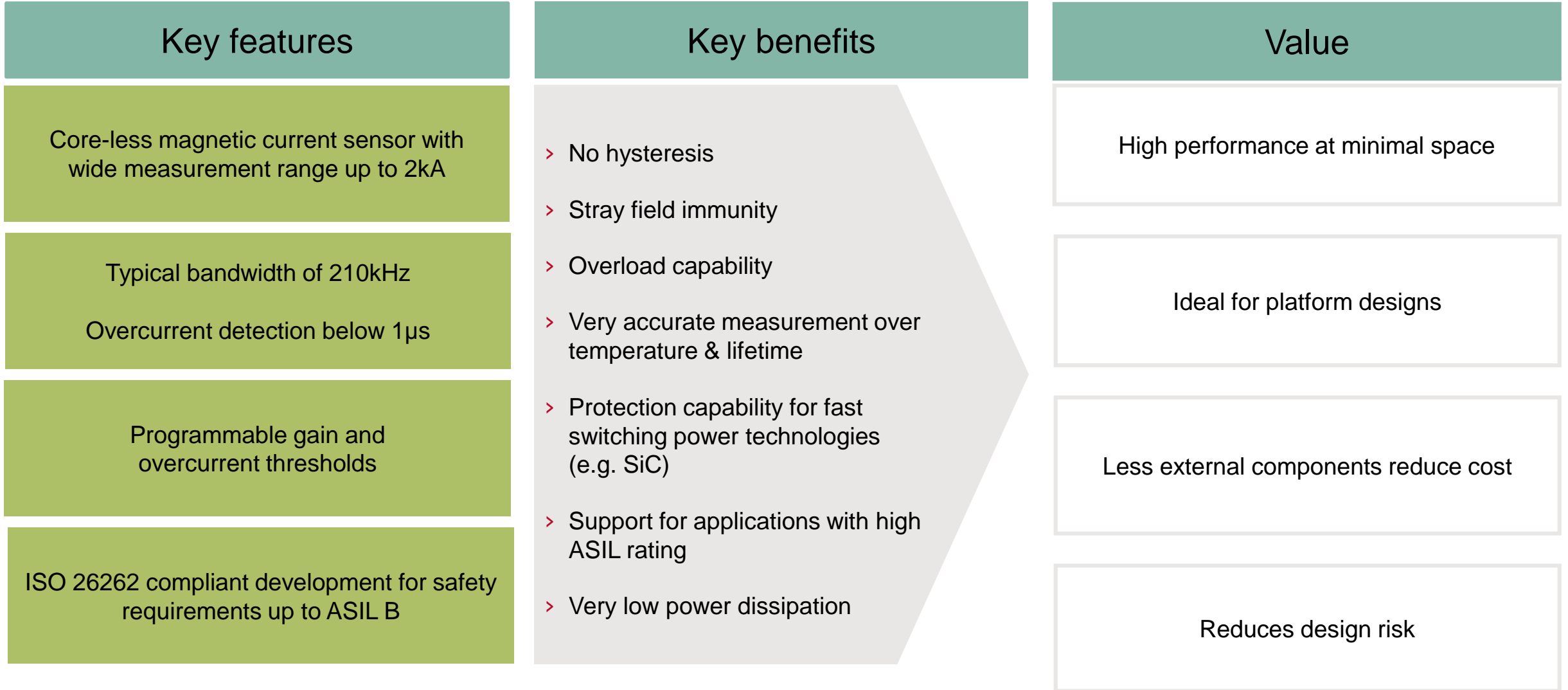
## Product features

- › Measurement range **0 to 31mT** (0A to 2kA) enabling large measurement range
- › Fast overcurrent detection output **OCD**
- › **Analog output**
- › High bandwidth (typ. 210kHz) for fast measurement
- › **3.3V** supply voltage
- › High accuracy over temperature & lifetime
- › Intrinsic stray-field robustness through differential measurement
- › **ISO26262** complaint development
  - Component rating: ASIL B

## Block diagram & packages



# XENSIV™ TLE4972 – high precision coreless current sensor



### Project Description

- › Application: **Robot**
- › Sub-Application: **Servo Drive**
- › Customer: **Major OEM for industrial robots**
- › Product (s): **TLI4971-A050T5-U-E0001 current sensor**
- › Competitor(s): various

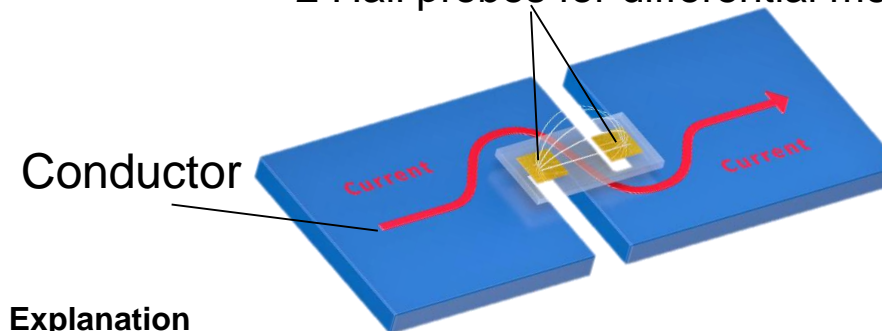


### Success Factors

- › Low insertion resistance
- › Low insertion inductance
- › Thermal performance (superior heat dissipation)
- › Analog out

### Product functionality

2 Hall probes for differential measurement



#### Explanation

- › TLI4971 used for motor control
- › Product provides isolation against high voltage through integrated isolation

Contact: Sebastian März, creation date May 2022

# Table of contents

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1	Infineon robotics product offering at a glance	3
2	Sensors 4 robots	7
3	Hall Switch – and their use in robotics	16
4	3D Hall– and their use in robotics	36
5	Angle Sensors– and their use in robotics	42
6	Current Sensors– and their use in robotics	58
7	<b>A word on functional safety and quality</b>	<b>64</b>
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# PRO-SIL™ as Infineon brand for automotive safety since 2017

Brands our **safety products** for over 12 years!

Copied by our competitors

e.g.  
SafeTI by Texas Instruments  
SafeAssure by NXP

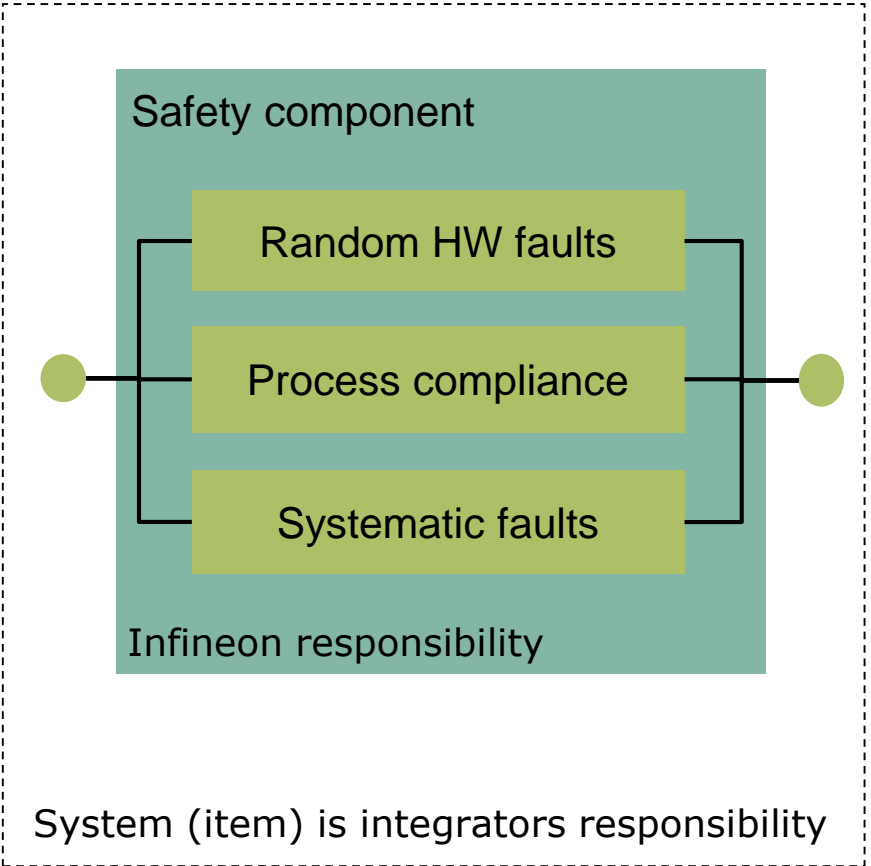


Brands our **leadership** in automotive safety

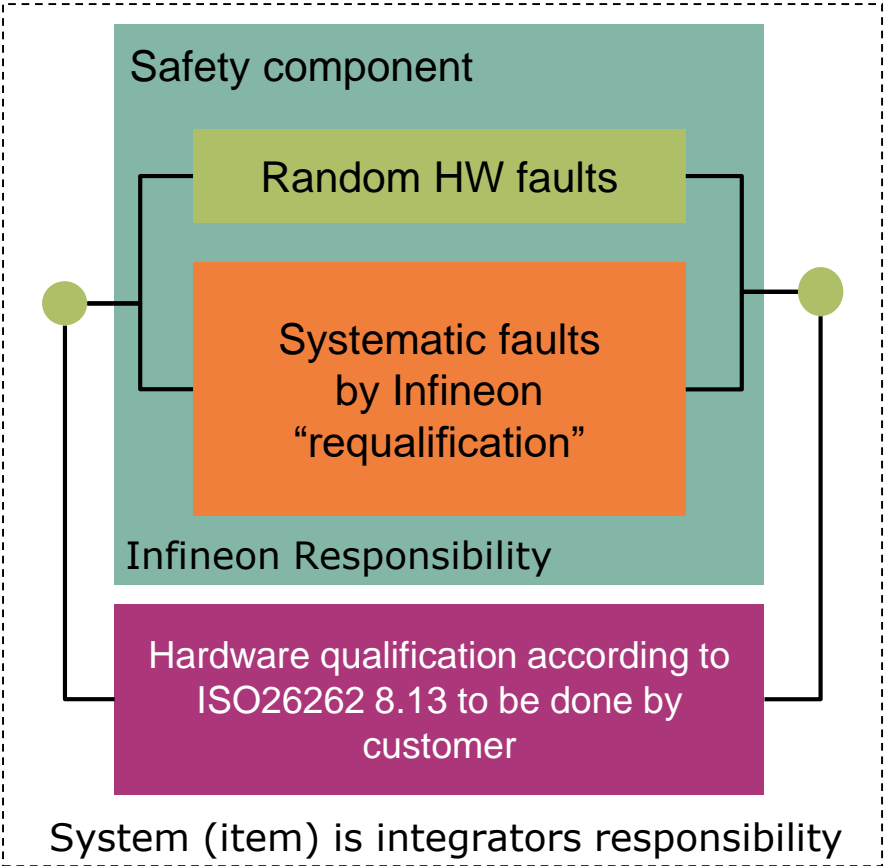
Now its time to take it to the next level!!!

# PRO-SIL™ use in automotive

## ISO26262-compliant

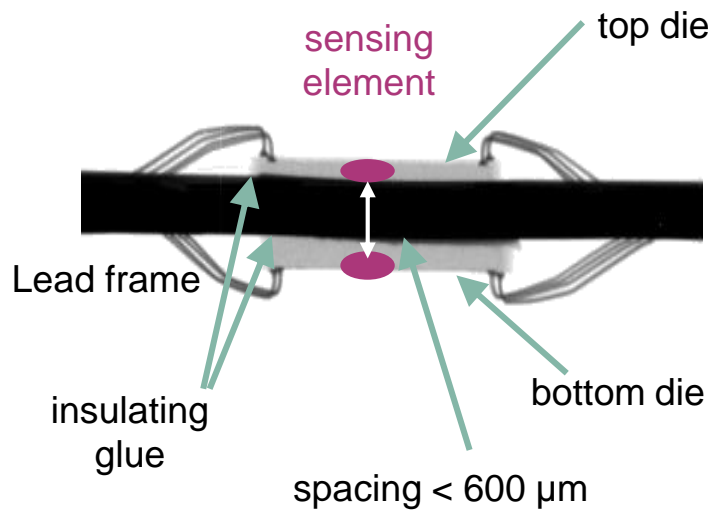


## ISO26262-ready



# Infineon's dual dies support high reliable or safety critical robotic applications – interacting with human beings

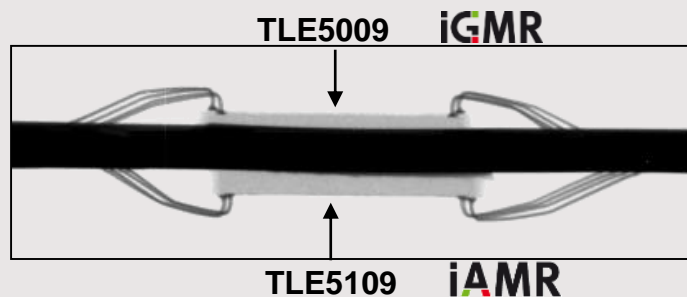
Angle Sensors Products: dual dies TLE5x09D, TLE5012BD, TLE5014D



## Dual die advantages

- > Separate power supply & **separate signal outputs**
- > **Electrically independent** with galvanic isolation
- > Top-bottom configuration **simplifies magnet design**
- > **Same footprint** for single and dual sensor versions
- > Redundancy & diversity to support **ASIL D systems**
- > Diagnostic & safety mechanisms for **limp-home functionality and safe emergency shutdown**

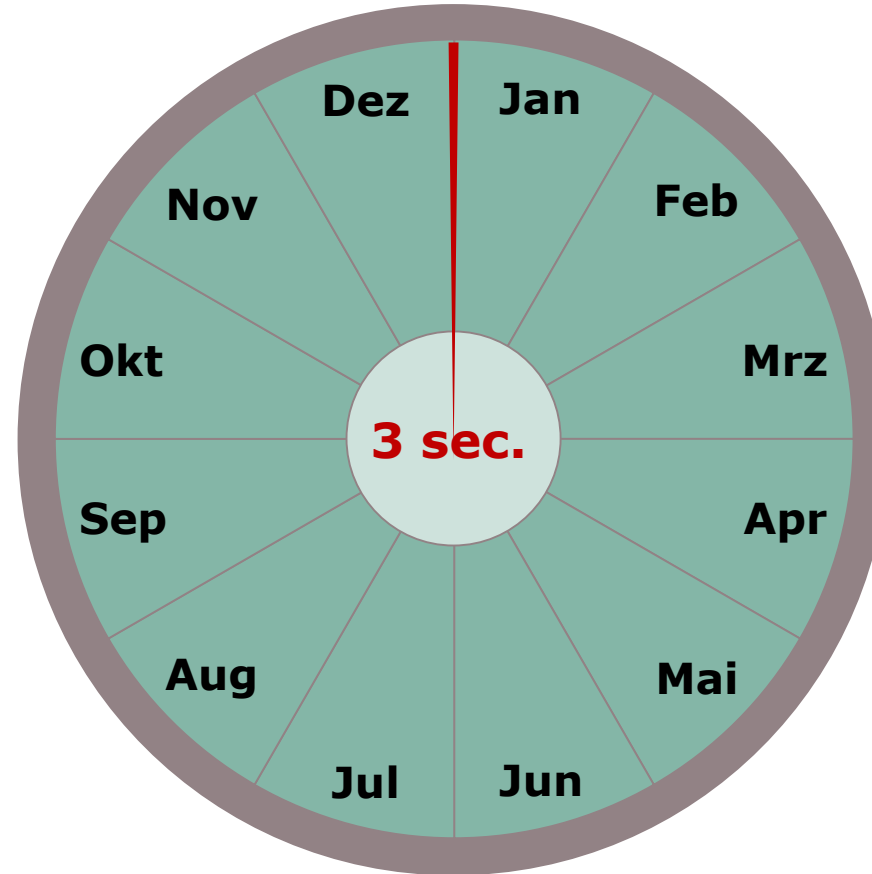
e.g. TLE5309



# Infineon XENSIV™ Position & Current Sensors: Premium Quality Service for Automotive Systems



**Infineon  
Production**  
**24**  
Hours  
A day  
  
**7**  
Days  
a week  
  
**365**  
Days a year



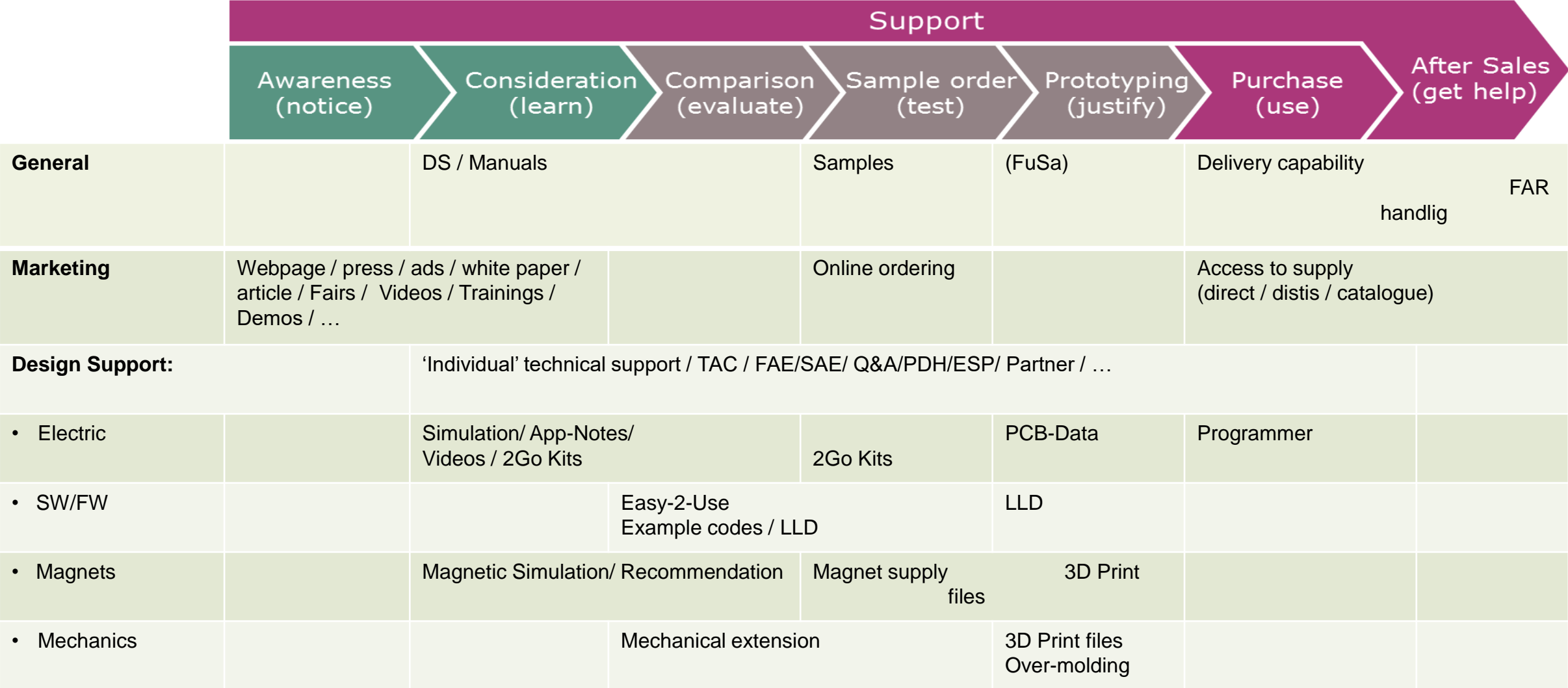
...the clock ticks 31.536.000 seconds per year....

We are able to deliver ZERO DEFECT position sensors for all  
but 3 sec last year.

# Table of contents

1	Infineon robotics product offering at a glance	3
2	Sensors 4 robots	7
3	Hall Switch – and their use in robotics	16
4	3D Hall– and their use in robotics	36
5	Angle Sensors– and their use in robotics	42
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# We support our customers – along their complete ‘journey’!



# Competitive advantage by using Infineon XENSIV™ Sensors

## Hall Switches Competitive Advantage

TLx496x



- Industry
- Consumer
- Automotive
- Hall Switches and Hall Latches available

<b>Large portfolio with standardized packages</b>	→	Easy drop-in replacement
<b>Low power consumption</b>	→	Enables energy efficient systems
<b>5V family available</b>	→	Enables cost effective systems
<b>Small SMD and package + Leaded options</b>	→	Saves PCB space - enables compact systems, flexibility
<b>High supply voltage range (3,0 Volt to 32 Volt)</b>	→	Cost-savings by eliminating the voltage regulator
<b>High load dump (42V)</b>	→	Reduces external resistors
<b>Infineon Zero-Defect Commitment</b>	→	Best-in-class field quality and OEM satisfaction

## 3D magnetic Competitive Advantage

TLx493D-AxB6  
TLI493D-WxBW



- Consumer
- Industry

<b>Wake Up, Ultra low power concept</b>	→	Extended battery runtime in application/ reduce battery size
<b>Accurate 3D magnetic measurement</b>	→	High accuracy (3.5% XY matching drift ) ->relax mechanical setup ->overall system cost reduction
<b>Tiny WLB Package 1.13x0.93x0.59 mm</b>	→	package allows high flexibility in design and manufacturing

## Angle Sensors Competitive Advantage

TLx5012  
TLE5x01/09



- Consumer
- Industry

<b>Broad portfolio Analog/Digital</b>	→	Right product for almost any application and budget
<b>Accurate rotor position detection</b>	→	High efficiency, silent run, controlled torque

Large amount DI Support material available (ANs, SW, Simulation, Kits&Boards) -> Ease of design in, faster time to market

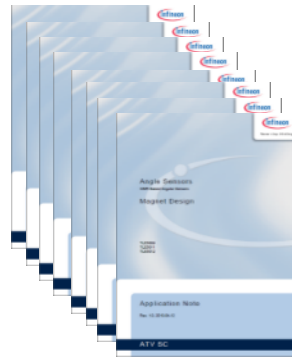
# Infineon provides 5 pillars to support rapid time-2-market from a customer perspective

## Documentation

- › Datasheets, product briefs, user manuals
- › Updated product presentations



## Application Notes



- › Anti-Tampering
- › Joystick
- › 3D Hall for Multifunction knob
- › 3D Hall for Gearstick
- › 3D Hall for linear Movement
- › 3D Hall for Angle measurement
- › ... and more ...

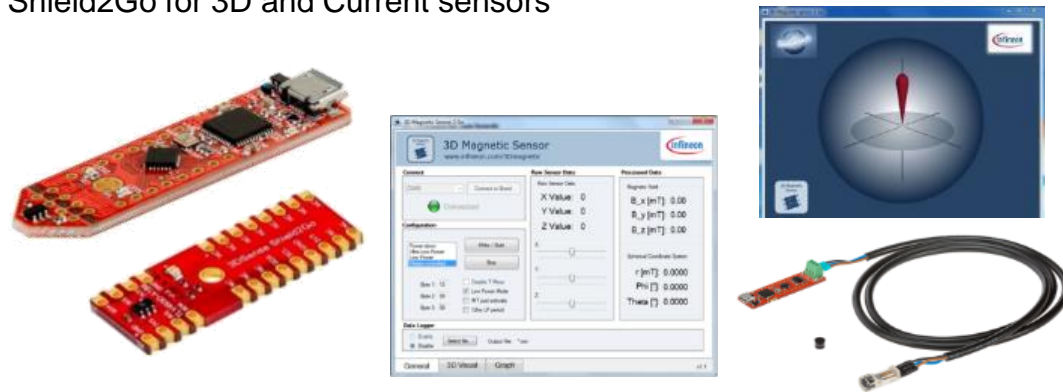
## Online Simulation Tools

- › Several basic configurations available, and more to come



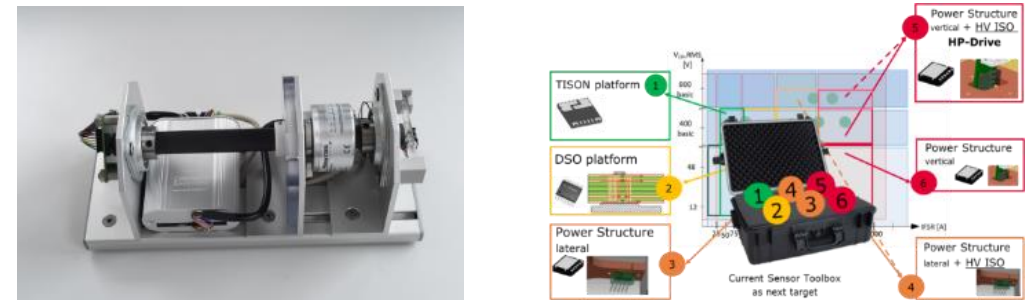
## Fast Evaluation Tools

- › Sensor-2-go kit for 3D Hall sensors incl. extensions
- › Sensor-2-go kit for speed sensor & current sensor
- › Shield2Go for 3D and Current sensors



## Sensing Toolboxes

- › Sensing toolbox for shaft sensing (end-of-shaft, integrated end-of-shaft) available
- › Sensing toolbox for current sensing in work right now
- › Main purpose: adapt fast to dedicated application





# Infineon tools, documentations, support and programmers

- for easy and fast design



## (Support) Documentation

Data Sheet and Application Notes

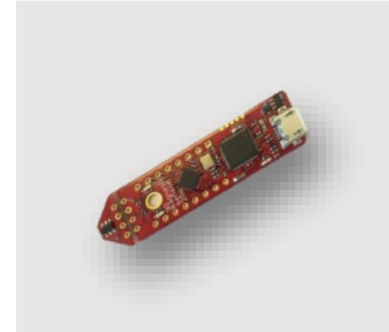


Product Brief



## Tools

Sensor 2Go Kits



Sensor 2Go Adapter



PGSISI EvalKits



## Support

- › Online simulations for
- › Recommendations for magnets and module assembly



## Production Programmer

- › End of Line Programmer for use in production



# Infineon Value Proposition

## – for all sensor product families

### Key Features

### Key Benefits

### Value

Pre-development

Design-in

Production

- > Broad product and technology portfolio (Hall, iGMR, iAMR, iTMR, package)...
- > Smallest package PG-SOT23, WLB...
- > Base failure rate report, SASR, safety manuals ...
- > Online simulation tool...
- > Extensive documentation...
- > Lowest power consumption...
- > Excellent stability of magnetic thresholds...
- > All product families in high volume production...
- > Long product life cycles...
- > Best in class quality ...

- > ...enables easy drop-in replacement.
- > ...allows for smaller system size.
- > ...facilitates the design into safety-relevant systems.
- > ...accelerates the design-in.
- > ...enable best fit customized solutions.
- > ...ensure highly energy efficient systems.
- > ...guarantees high long-term performance.
- > ...demonstrate market success and proven in use concept.
- > ...provides supply security.
- > ...for hassle-free operation over lifetime.



**Replacement allows for flexibility and supply stability**

**Reduce system cost, reduction**

**Faster design-in**

**Customized support**

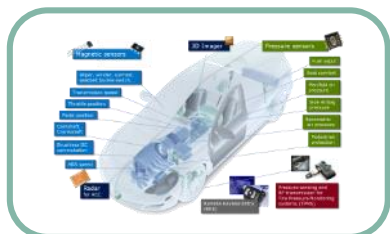
**Long-term performance**

**End-customer satisfaction**

# Infineon – A competent Partner for Sensors!



> Infineon – **market leader in Automotive** magnetic sensors – provides more than **one million sensors per day** to the automotive and industrial market.



> Infineon provides **magnetic speed sensors, magnetic position sensors, pressure sensors, radar, Wireless Control and TOF** to the market



> As a broadliner, Infineon is the sensor supplier with the **broadest magnetic sensor portfolio** in the market



> As experienced supplier, we sold more than **five billion integrated sensors** in the last 14 years looking back to **over 40 years experience** in sensor design and production.

### Microcontroller

#### [XMC™](#)

- › 32 bit
- › Arm® Cortex®-M

#### [PSoC](#)

### Driver ICs

- › [EiceDRIVER](#)

### Magnetic Sensor

#### [Angle Sensors](#)

- › Encoder/Resolver replacement

#### [Current Sensors](#)

- › Phase current
- › Bus current

### Sensors

- › [REAL3 3D Sensor](#)
- › [XENSIV™ 24GHz Radar](#)
- › [XENSIV™ 60 GHz Radar](#)

### Wi-Fi & BLE

#### [AIROC™](#)

- › Wi-Fi
- › Bluetooth

### Discrete Power (MOSFETs)

- › [OptiMOS & StrongIRFET](#)
- › [CoolMOS](#)
- › [CoolGaN & CoolSiC](#)

### Security

- › [OPTIGA™ Trust](#)
- › [OPTIGA™ TPM](#)

### PMICs

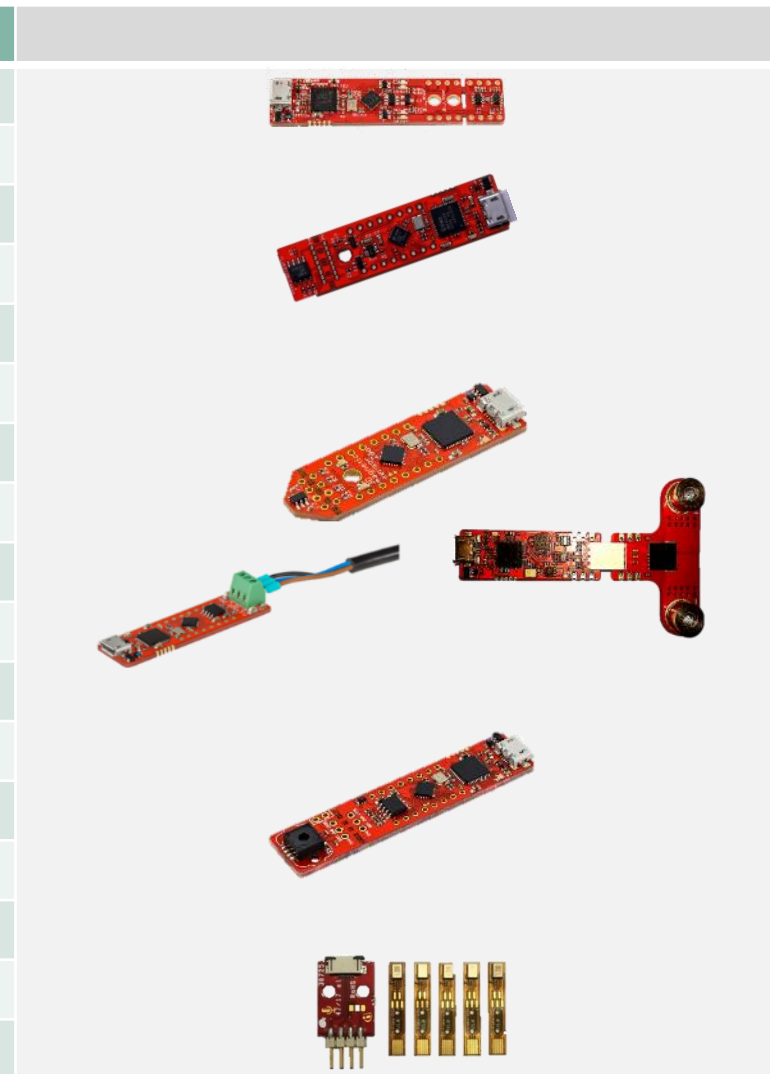
- › [NovalithiC](#)



Part of your life. Part of tomorrow.

# XENSIV™ 2GO kits portfolio overview

#	Product Group	Sales Name	Ordering Code
1	Hall Switches	TLE4966_MS2GO	SP005406992
2	Angle	TLE5012B_E1000_MS2GO	SP002133956
3		TLE5012B_E5000_MS2GO	SP002133964
4		TLE5012B_E9000_MS2GO	SP002133968
5		TLI5012B_E1000_MS2GO	SP002133960
6		3D Hall	TLE493D-P2B6MS2GO
7	TLE493D-W2B6_MS2GO		SP001707578
8	TLV493D-A1B6_MS2GO		SP001707574
9	Current	TLI4971_MS2GO	SP005345474
10	Speed	TLE4922_MS2GO	SP003029974
11	MAP/BAP	KP215F1701-PS2GO-KIT	SP002676652
12		KP229E3518-PS2GO-KIT	SP002676656
13		KP236-PS2GO-KIT	SP002676664
14		KP254-PS2GO-KIT	SP002676660
15		KP275-PS2GO-KIT	SP002676648
16	Microphone	EVAL_IM69D130_FLEXKIT	SP005537489
17		EVAL_IM67D120_FLEXKIT	SP005560671



# XENSIV™ Add ons portfolio overview



Check out for adjustable Add on 3D printing files: <https://www.infineon.com/sensors-2go>

#	Product Group	Sales Name	Ordering Code	
1	Hall Switches	OPENCLOSE2GOHS	SP005544849	
2	Angle	ROTATE KNOB ANGLE 2GO	SP002441192	
3	3D Hall	ROTATE KNOB 3D 2 GO KIT	SP001504602	
4		OUT OF SHAFT FOR 3D 2 GO	SP003475178	
5		JOYSTICK FOR 3D 2 GO KIT	SP001491834	
6		LINEAR-SLIDER 2GO	SP002043034	
7		DIR_INDICATOR2GO	SP005350196	
8		POWER_DRILL2GO	SP005350194	
9		MINI_CONTROL2GO	SP005350192	
10		PLAY2GO FOR 3D 2 GO KIT	<i>Will come soon!</i>	
11		LINEAR SPINDLE MOVEMENT FOR 3D 2 GO	<i>Will come soon!</i>	
12		CONTACTLESS SWITCH ARRAY FOR 3D 2GO	<i>Self-services → Adjustable printing files available for download</i>	