XENSIV™ – sensing the world

Sensor solutions for automotive, industrial and consumer applications

www.infineon.com/sensors

Contents

Infineon XENSIV™ – sensing the world

Infineon XENSIV™ sensors are exceptionally precise thanks to industry-leading technologies. They are the perfect fit for various customer applications in automotive, industrial and consumer markets.

From the world leader in sensing technology, XENSIV™ sensors smartify lives by enabling “things” to “see”, “hear”, “feel” and “understand” their environment. Thanks to proven quality and outstanding reliability, customers can rely on XENSIV™ for system stability, durability and integrity. Providing exceptional accuracy and best-in-class measurement performance, XENSIV™ sensors add extraordinary value to customer applications. More than 40 years’ experience in sensing solutions and a deep-rooted system understanding result in the broadest portfolio of ready-to-use sensor solutions on the market. Ecosystem partners and our customers partner with us for leading technologies, perfect-fit solutions and continuous innovation.

At Infineon, we are committed to making cars safer, smarter and greener with our innovative and leading sensor portfolio. Today, a new car features numerous safety, body and powertrain applications that rely on sensors. Clearly focused on future trends, our outstanding portfolio of sensor ICs for numerous safety-relevant automotive systems makes cars much safer. In Electric Power Steering (EPS), our magnetic angle sensors and linear Hall sensors are used to measure the steering angle and steering torque. Since all our newly developed parts are based on an ISO 26262-compliant development flow, we do our utmost to support our customers’ designs in achieving the ASIL classification. This means that they can be deployed directly in all safety-relevant applications – making us a leader in supporting ISO 26262-compliant systems.

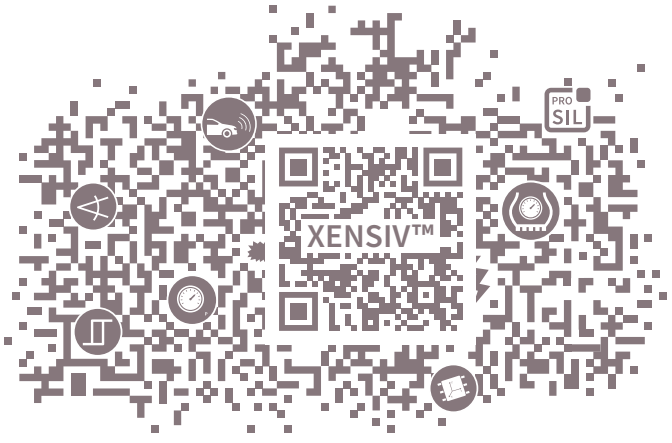
Furthermore Infineon offers a wide range of automotive qualified pressure sensors for side airbag application, barometric and manifold air pressure measurement as well as tire pressure monitoring systems (TPMS).

Infineon’s RASIC™ 77-GHz chips are used in radar-based driver assistance systems – such as adaptive cruise control and collision warning – which recognize objects at a range of up to 250 meters. With 100 million chips already shipped, we are the market leader in radar chips.

Our increasing range of XENSIV™ sensors families like XENSIV™ MEMS microphones and XENSIV™ barometric pressure supporting support numerous industrial and consumer applications.

With a proven track record in IoT innovation, we continue to seamlessly and securely connect people and machines. Many IoT trends such as smart devices and wearables, electromobility and connected cars, smart factories and homes, energy intelligence are being driven by technologies that we develop, with our XENSIV™ sensors families being one of the key elements. Today, we are already inspiring the next generation of smart environments – capable of understanding and responding to human communication. Our semiconductors are at the very heart of machine-to-machine (M2M), human-machine interface (HMI), mobile and wireless infrastructure technologies. As the technological boundary between humans and machines gradually disappears, these devices need even more advanced intelligence, enriched with voice assistance capabilities and the latest sensor fusion innovations, not to mention robust security technologies to protect personal data. Sensors and microphones from Infineon are already delivering this intelligent functionality and inspiring the next step in mobile connectivity.

Use the qr-code or visit us on www.infineon.com/sensors to get the whole portfolio overview, our latest downloads and videos.



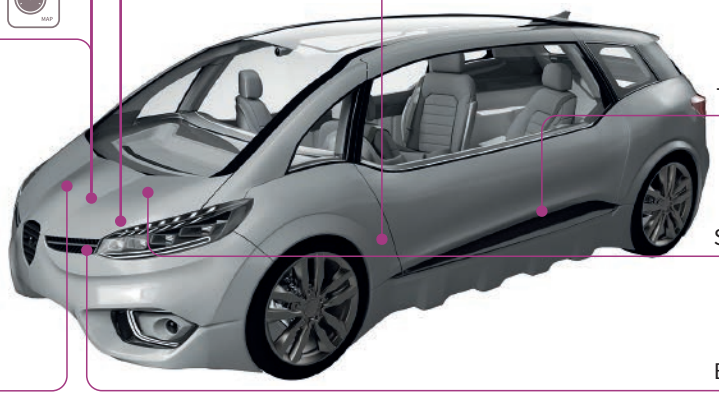
XENSIV™ sensors in powertrain applications

Engine

- Crankshaft
- Camshaft position
- Manifold air pressure
- Secondary air valve
- Turbo charger
- Throttle position
- Variable valve position
- HEV electric motor
- Pedal position
- Exhaust Gas Recirculation (EGR)
- DC/DC converter

Transmission

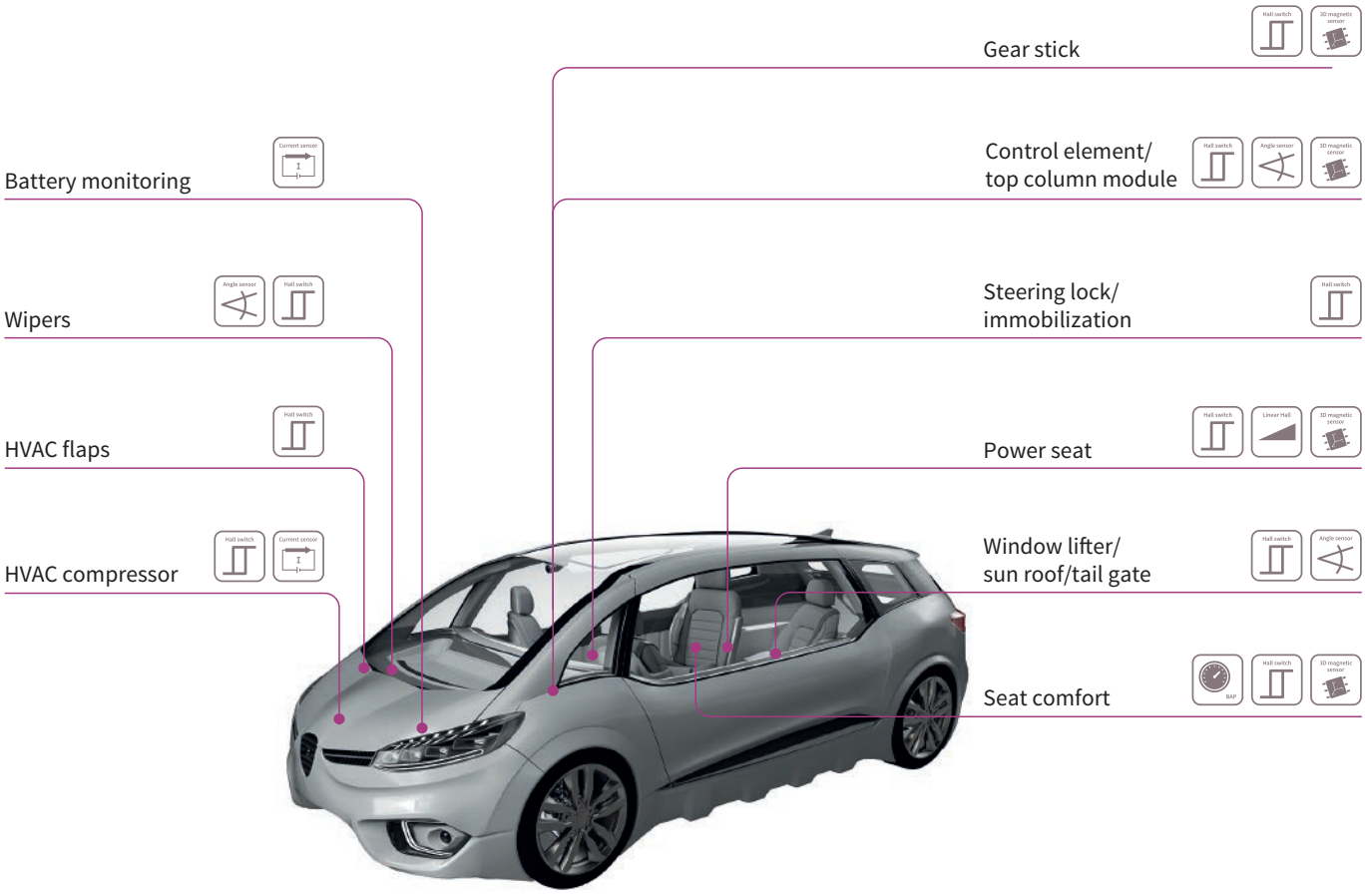
- Clutch position
- Clutch actuator
- Transmission speed
- Transmission actuator
- Transmission gear position
- Oil pump
- Park lock
- Gear stick
- Battery monitoring for EV
- Transfercase
- Starter generator
- Barometric air pressure



Switches · Linear Hall · Angle sensors · Current sensors · BAP · MAP · Speed sensors · 3D magnetic sensors

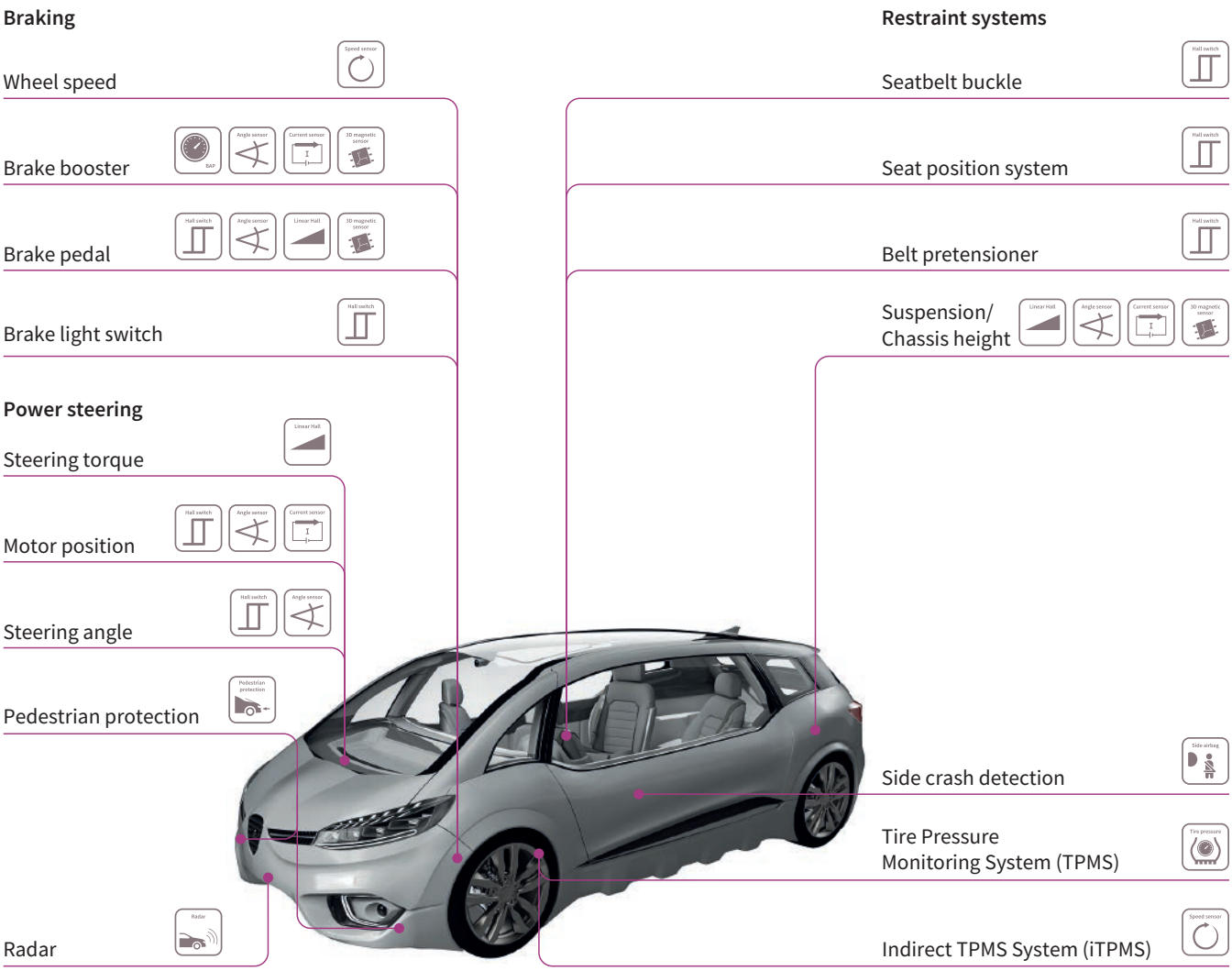
Crankshaft, camshaft and transmission speed sensors as well as MAP and BAP pressure sensors are only some of the key elements of multiple modern powertrain applications, such as engine and transmission, which significantly boost drivetrain efficiency. Our broad portfolio of products fits every customer requirement.

XENSIV™ sensors in body applications



The body segment presents the most diverse target market for sensors. Hall switches, for example, are deployed in classic applications such as window lift modules, whereas new seat comfort systems deploy pressure sensors to control individual pressure levels in seat cushions.

XENSIV™ sensors in safety applications



Switches · Linear Hall · Angle sensors · Pedestrian protection · Current sensors · 3D magnetic sensors

Radar · BAP · Speed sensors · Side airbag · Tire Pressure Monitoring System (TPMS)

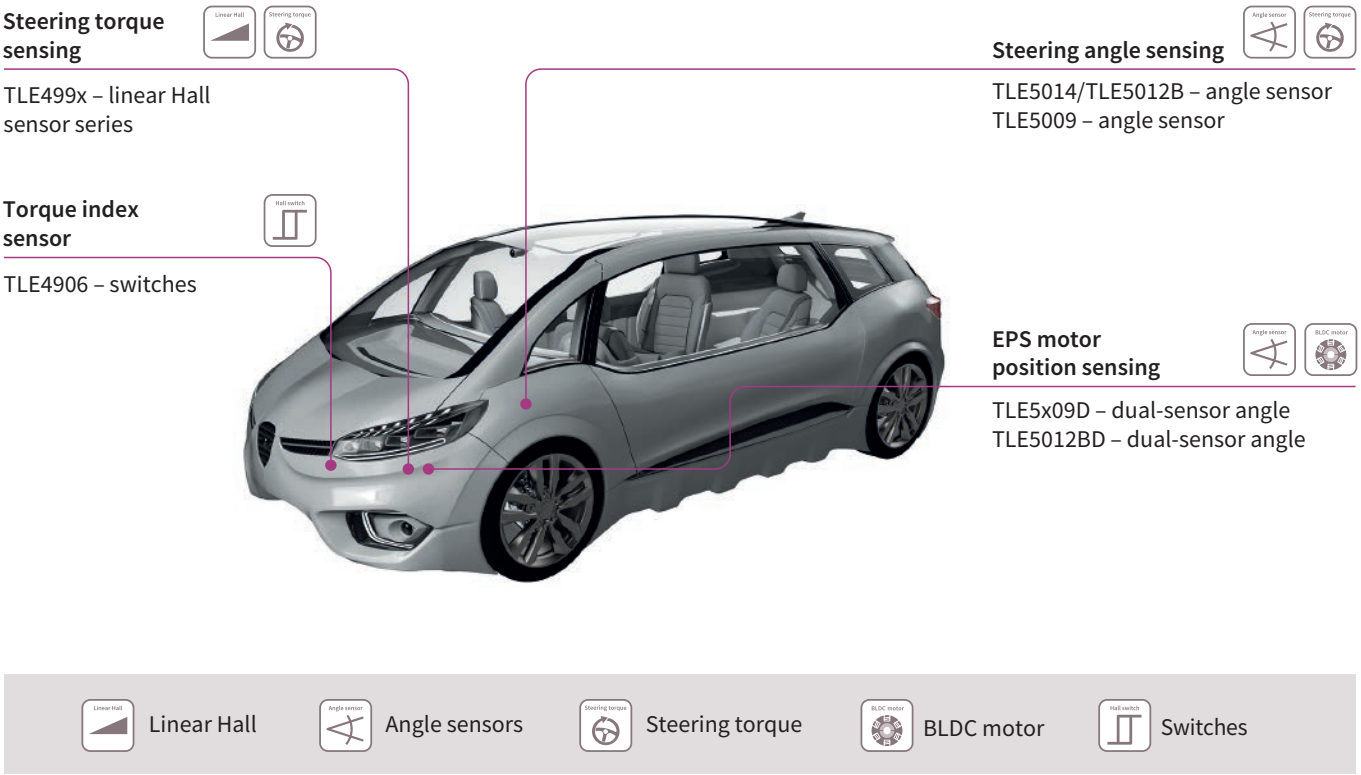
At Infineon, we focus in particular on sensors for safety applications. These include radars in automatic cruise control systems, wheel speed sensors in ABS and ESP features, pressure sensors in side airbags and pedestrian protection systems and TPMS sensors. We are the global market leader in most of these areas and our customers value the outstanding levels of quality and reliability that we deliver.

Magnetic position sensors for highest energy efficiency and functional safety in Electric Power Steering (EPS)

Compared to conventional hydraulic power steering solutions, Electric Power Steering (EPS) enables higher energy efficiency, increased steering functionality and reduced space requirements in passenger vehicles.

The functionality of EPS is based on several system-side position sensors, that measure the steering torque input from the driver, the position of the EPS motor, that moves the steering rack and the steering wheel's absolute position.

Typical application for Infineon magnetic position sensors in EPS



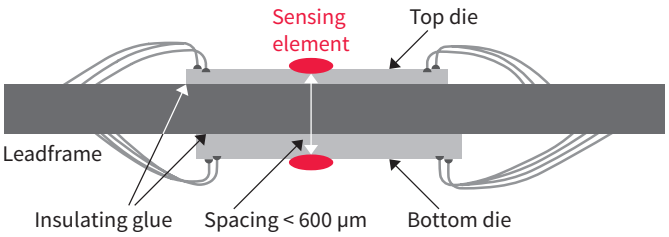
Position sensor applications in EPS are safety-related and typically rated with the highest ASIL-D safety level. The ISO 26262 standard sets high requirements for the diagnostic coverage of random failures and the avoidance of systematic failures in order to reach the highest ASIL-D safety level. These demanding specifications can typically be achieved by using redundant sensors as well as comparing their signals on a microcontroller.

Infineon offers dual-sensor solutions with two redundant sensors in the place of one for all position sensor applications in EPS. Our dual-sensor package integrates two magnetic position sensors with a separate power supply and separate signal outputs. They are electrically independent thanks to galvanic isolation. This means that the two sensors work independently, thereby increasing system reliability.

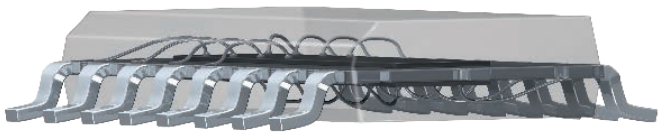
www.infineon.com/eps

Magnetic position sensors for the ultimate in energy efficiency and functional safety in Electric Power Steering (EPS)

Side view of Innovative stack-mounted dual-sensor technology with bonding wires



Transparent 3D-graph of dual-sensor TDSO-16-2 package



Thanks to the use of innovative stack-mounting technology, the devices of the angle sensor family combine two independent sensors within standard and space-saving TDSO packages which are only about 1 mm thick. It has the same width and length as a conventional single-sensor package. Compared to the common approach of side-by-side sensor placement, the advantages of the top-bottom placement include a more homogeneous magnetic field over the sensing elements and a significantly smaller footprint. This saves precious space and cuts down on expense in safety-critical applications, as a lower-cost ferrite magnet can provide a sufficient magnetic field for the sensors.

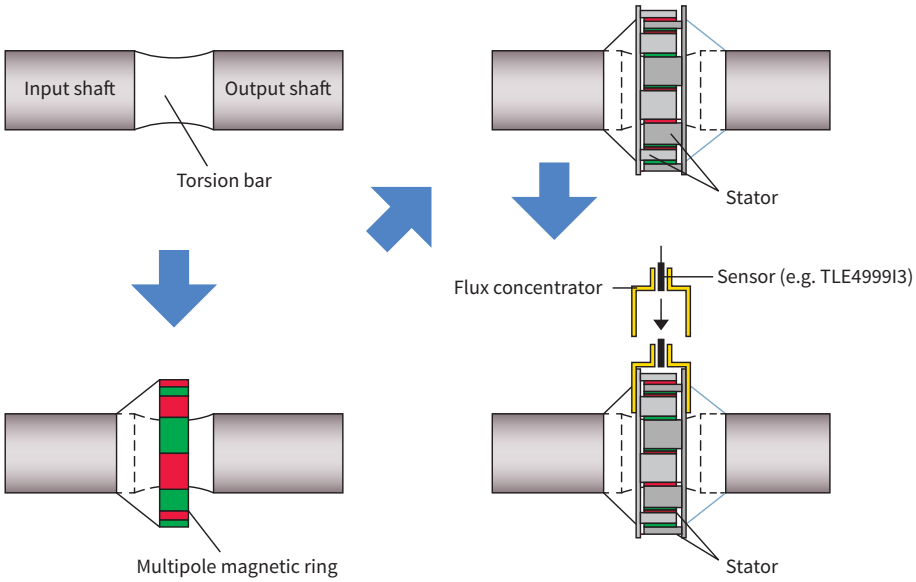
Steering torque sensors

In the field of steering torque sensing, Infineon's TLE499x series offers highly accurate linear Hall sensors for magnetic torque sensing assembly. In order to support a maximum of compatibility with various Electronic Control Unit (ECU) designs, the TLE499x sensors feature PWM, SENT, SPC or ratiometric analog output. They are available in leaded packages, as well as 1 mm-thick dual- or single-sensor SMD packages.

Linear Hall	TLE4997x	Programmable linear Hall sensor with temperature compensation and ratiometric analog output. Available in a 3- or 4-pin leaded package (with or without integrated capacitors) and an 8-pin dual- or single-sensor SMD package.
Linear Hall	TLE4998x	Programmable linear Hall sensor with digital stress and temperature compensation and PWM, SENT or Short-PWM-Code (SPC) output. Available in a 3- or 4-pin leaded package (with or without integrated capacitors) and an 8-pin dual- or single-sensor SMD package.

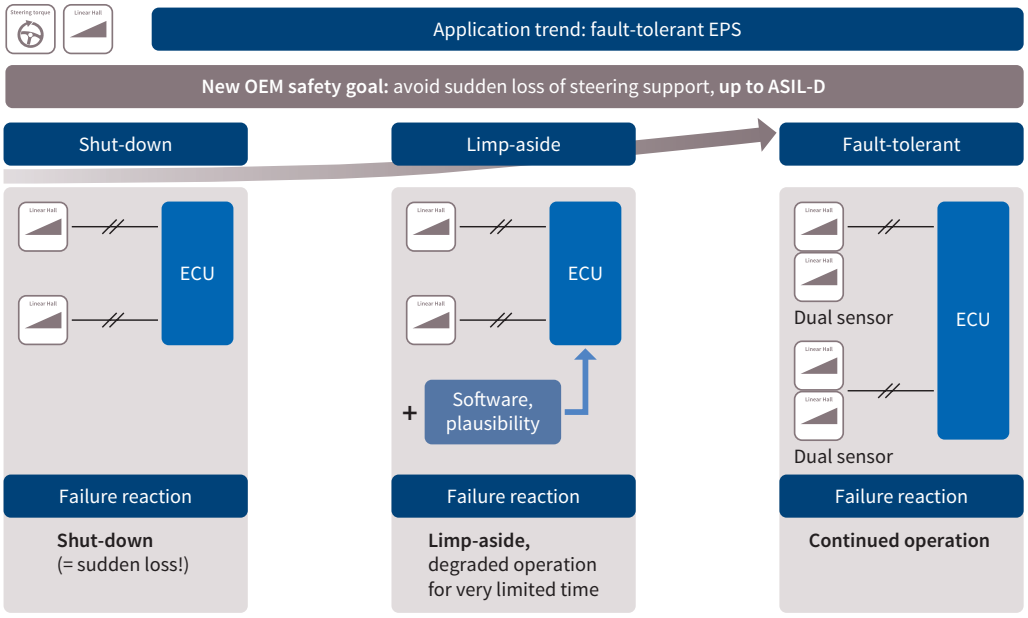
Magnetic position sensors for the ultimate in energy efficiency and functional safety in Electric Power Steering (EPS)

Magnetic torque sensing assembly



Conventional EPS systems use two linear Hall sensors for ASIL-D compliance have to shut-down in the event of a loss of one sensor signal. Therefore, the trend in EPS systems is to increase availability by implementing additional sensor signals or plausibility mechanisms. To support this trend towards high-availabilty EPS functionality, Infineon recommends the usage of two TLE4998 dual-sensors or two TLE4999I3, each of them with two highly accurate redundant Hall measurement channels (main and sub) integrated on one single chip. In case of one TLE4998 or TLE4999I3 signal loss, the remaining dual-sensor (TLE4998) or the single die two channels (TLE4999I3) in the system provides continued operation of the EPS, avoiding an immediate system shut-down.

Application trend: fault tolerant

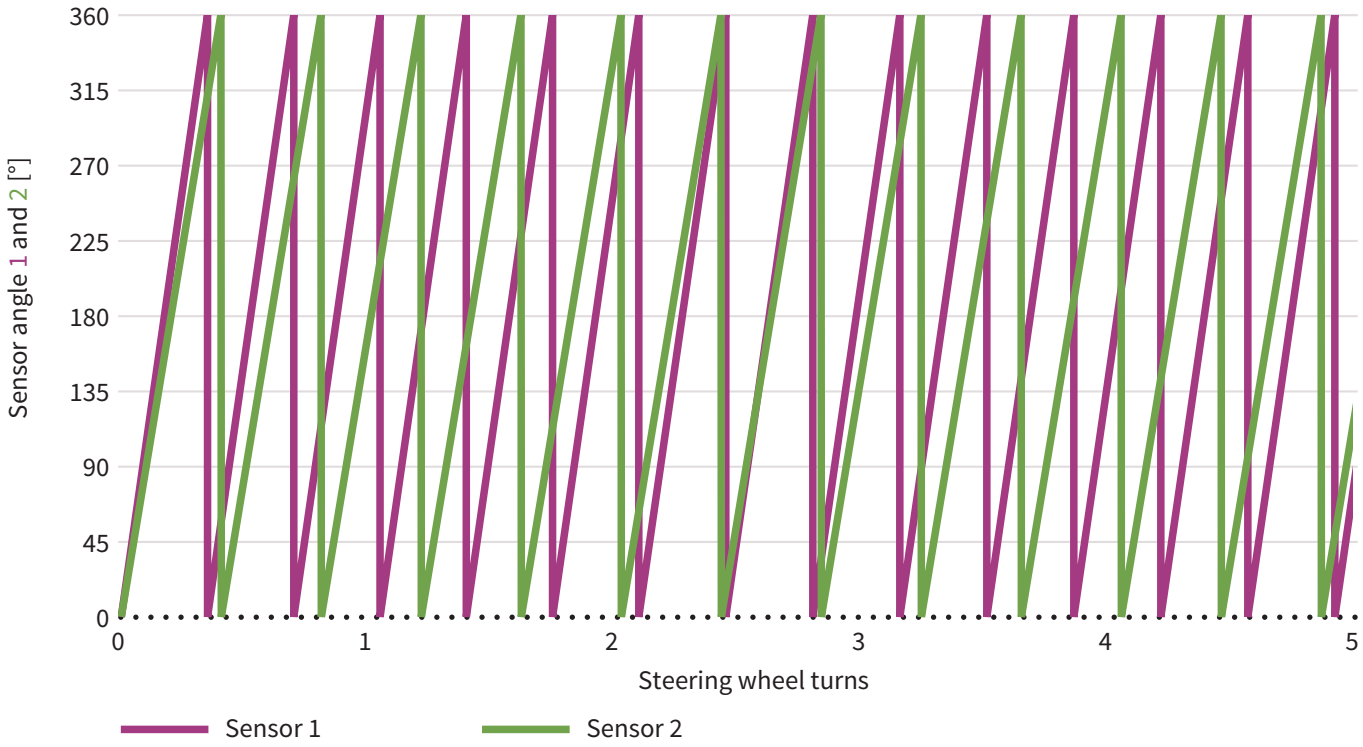


www.infineon.com/eps

Steering angle sensors

The absolute steering angle position is an input for the Electric Stability Program (ESP) and other driver assistance systems. A typical module design used for steering angle measurement is a design featuring gear wheels with a slightly different number of tooths. The angular positions of the gear wheels are measured by two angle sensors, where the absolute steering wheel position is calculated from those positions via the Vernier principle.

Schematic steering angle sensor module and illustration of the vernier principle



Steering angle sensors

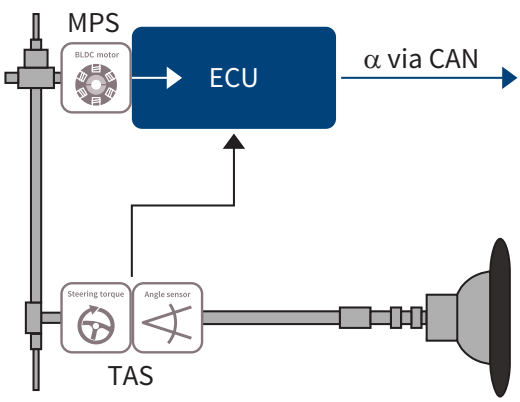
The angle sensors for absolute steering angle measurement are available as a single-sensor SMD package for conventional designs, which achieve the ASIL-D rating via a plausibility calculation of the two angle sensor signals as a result of a significant movement of the steering wheel.

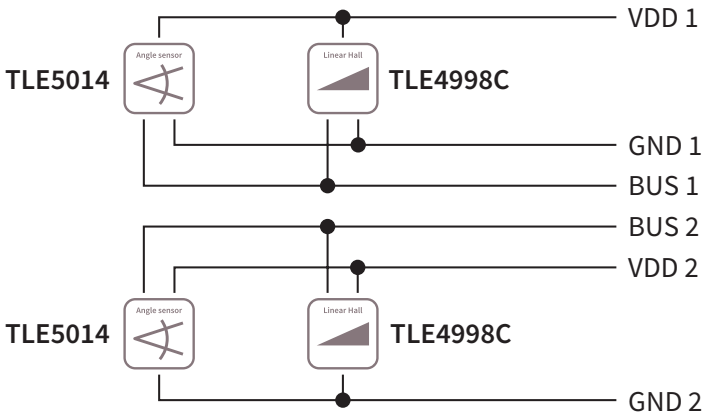
The sensors are also available in dual-sensor packages for module designs, that support an ASIL-D-rated steering angle directly at power-on (ASIL-D from start).

	TLE5009(D)	Fast Giant-Magneto Resistive (GMR) angle sensor with analog sin/cos output. Available in an 8-pin single, 16-pin single- and dual-sensor SMD package.
	TLE5109A16(D)	Fast Anisotropic Magneto Resistive (AMR) angle sensor with analog sin/cos output. Available in an 8-pin single, 16-pin single- and dual-sensor SMD package.
	TLE5014(D)	ISO 26262-compliant (ASIL-C-metric), programmable GMR angle sensor with PWM, SENT or SPC output. Supports Torque-Angle-Sensor (TAS) module bus configuration with TLE4998C. Available in a 16-pin single- and dual-sensor SMD package.
	TLE5501	ISO 26262-compliant (ASIL-D-metric) Tunneling Magneto Resisitive (TMR) angle sensor with analog sin/cos output. Available in an 8-pin single SMD package. Decoupled bridges for redundant external angle calculation and highest diagnostic coverage.

Infineon angle sensors support steering angle sensor configurations with an on-board microcontroller, as well as satellite sensor designs, due to a broad variety of supported communication interfaces. In particular, the SPC interface allows the connection of angle sensor(s) and linear Hall sensor(s) on a bus line in combined Torque-Angle-Sensor (TAS) modules. Compared to conventional designs with separate torque sensor and angle sensor modules, this configuration reduces the cost of wiring and saves module space.

Schematic TAS module set-up and SPC bus configuration of the TLE5014 and TLE4998C

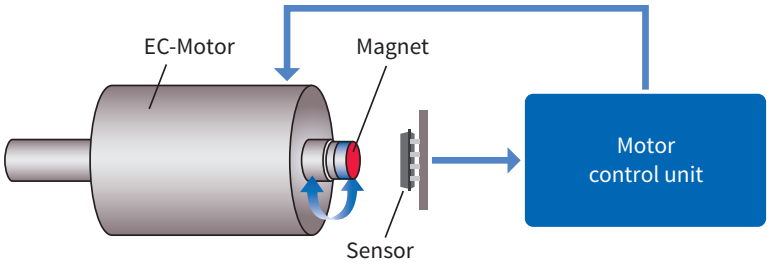




EPS motor position sensors

The motor, that drives the steering rack in an EPS system is usually a highly efficient brushless DC (BLDC) motor, which relies on a fast and accurate position sensor for commutation. In this application, short latency and high accuracy are essential, as these sensor parameters have a significant impact on torque stability and the energy efficiency of the motor.

Schematic of BLDC motor with a magnetic position sensor for commutation



A correct commutation of the EPS motor has to be ensured, in order to avoid a blocked steering or the erratic steering support. This application is also classified in the category of ASIL-D. To achieve this high level of functional safety, Infineon offers angle sensors in the dual-sensor package that allow the integration of two redundant sensors in the place of one.

The TLE5309D, in particular, meets the highest functional safety requirements by using a combination of AMR (Anisotropic-Magneto-Resistance) and GMR (Giant-Magne-to-Resistance) technology, which not just offers redundancy, but also integrated diversity in a single product. Depending on the overall EPS system architecture, the motor position sensor can be directly mounted on the steering ECU, or connected via a cable in a satellite configuration.

The very high level of sensor accuracy required for highest energy efficiency, comparable to the performance of costly resolver solutions, is typically achieved by implementing a continuous calibration algorithm on the steering ECU. By monitoring the sensors output signals and calculating the compensation parameters during operation, this algorithm compensates any drift errors that occur over temperature and lifetime.

Angle sensor	TLE5009A16(D)	Fast dual-GMR angle sensor with analog sin/cos output. Availablein a 16-pin dual-sensor SMD package.
Angle sensor	TLE5109A16(D)	Fast dual-AMR angle sensor with analog sin/cos output. Available in a 16-pin dual-sensor SMD package.
Angle sensor	TLE5309D	Combined AMR and GMR sensor for integrated diversity, featuring fast analog sin/cos output. Available in a 16-pin dual-sensor SMD package.
Angle sensor	TLE5012BD	Digital GMR angle sensor with SPI + incremental encoder interface or Hall switch emulation output. Available in a 16-pin dual-sensor SMD package.

2-wheeler and all-terrain vehicles

Our broad portfolio of Hall- and GMR-based sensors is ideal for motorcycle, three-wheel and all terrain vehicle applications. These solutions cover the full spectrum from switching through position measurement to engine and vehicle speed measurement, ABS sensing included.
www.infineon.com/cms/en/applications/light-vehicles

Commercial vehicles

We offer a broad portfolio of highly robust magnetic sensors tailored to the specific needs of commercial vehicles such as trucks or busses. Our Hall and xMR-based sensors were developed for switching functions as well as position and speed measurement. You are bound to find a dedicated solution for the individual body, powertrain and safety system of your commercial vehicle.
www.infineon.com/cms/en/applications/commercial-construction-and-agricultural-vehicles-cav

XENSIV™ sensors in industrial applications

Solar panel tracking

Solar inverter current

Barometric pressure sensing

Wind speed sensing

Proximity detection

Robot sensing
Tank level measurement

Electric Commutated (EC) motor

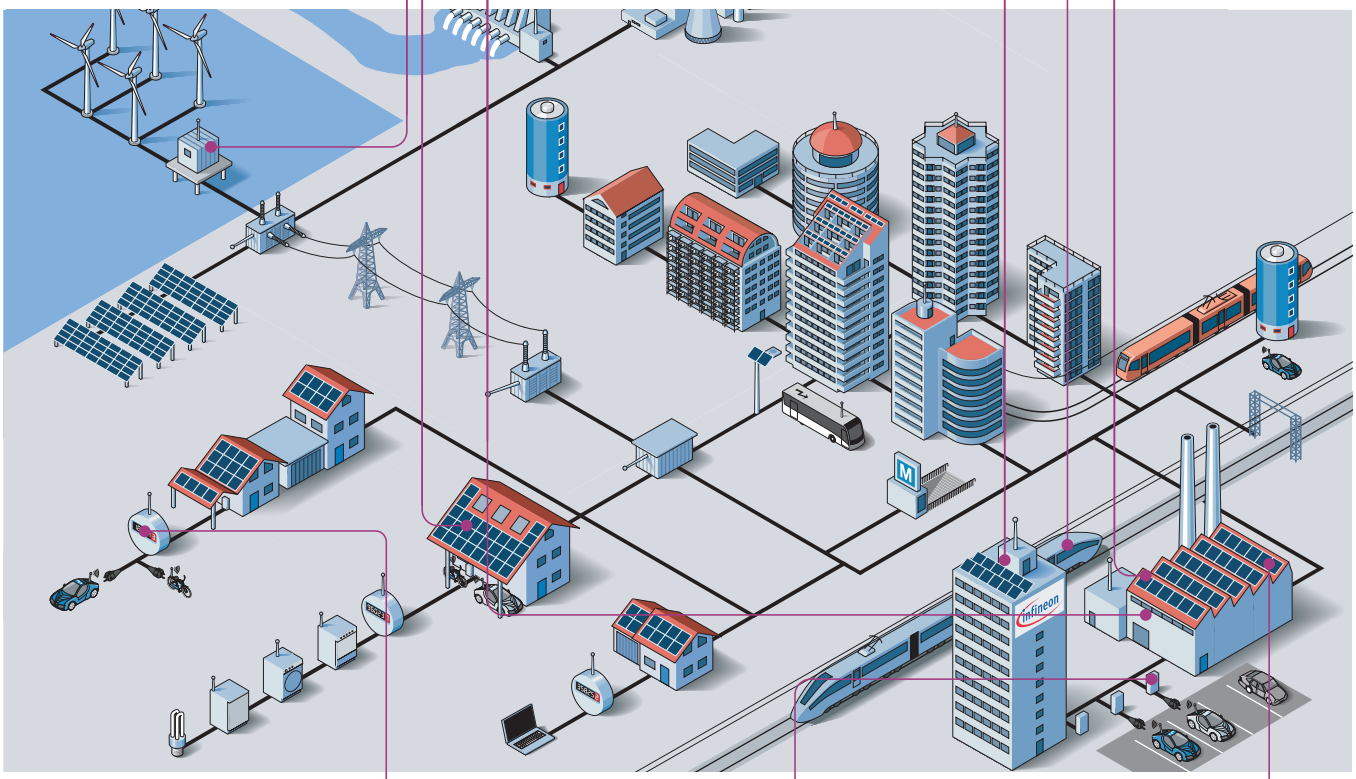
Valve position

Control elements

Gear wheel speed sensor

Predictive maintenance

Pneumatics



Smart metering

Charger and battery management

Absolute and incremental rotary encoder

Switches

Linear Hall

Angle sensors

Current sensors

Speed sensors

Pressure

3D magnetic sensors

BAP

Radar

Microphone

XENSIV™ sensors for industrial/home applications

Voice user interfaces/
Recording/
Active noise cancellation/
Predictive maintainance

Solar panel tracking/
Solar inverter
AC and DC current

Battery charging
and management

Electric
commutated
motor

Air quality measurement/
Temperature and air flow
management

Gas pressure

Smart metering

Position tracking
Index counting

People tracking and
occupancy detection
in IoT/smart home

Flap position/
Control elements

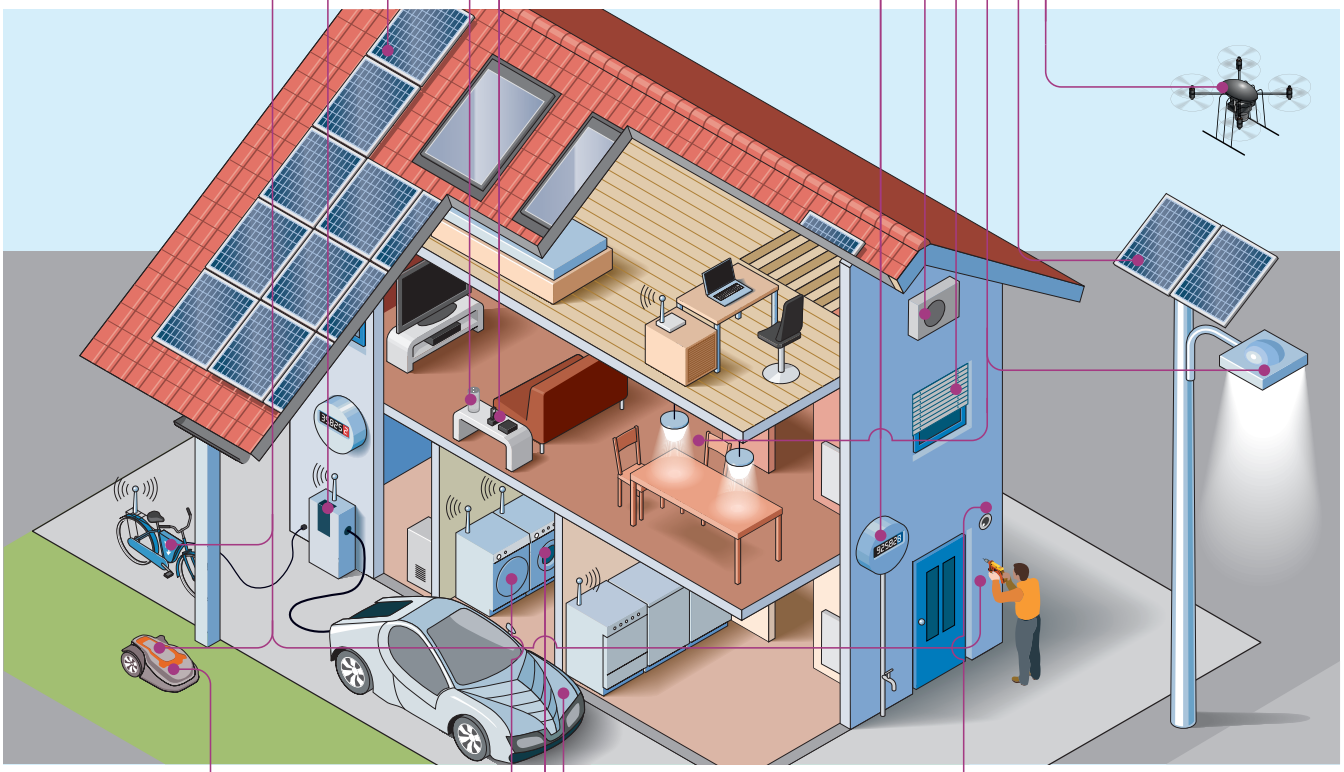
Intrusion detection

Indoor and outdoor
lighting systems

Battery management
and current monitoring

Air flight
control

Collision avoidance
in multicopters and
robotics



Collision
avoidance

Proximity sensor
to activate
appliances

Water level sensing

BSD (Blind Spot Detection)
in the car

Open/close detection

Imbalance and state of charge

Intruder alarm/Presence
detection in surveillance

Switches
Linear Hall
Angle sensors
Current sensors
Pressure
3D magnetic sensors
BAP
Radar
Microphone
Lighting

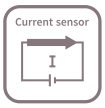
High precision coreless current sensors for industrial applications – based on Hall technology

Infineon's current sensors are high precision sensors for bi-directional AC and DC measurements. They are available with a digital (TLI4970) or an analog interface (TLI4971). All types offer overcurrent detection to support protection of the power circuitry. A galvanic isolation is intrinsically provided due to magnetic sensing principle.

Our well-established and robust monolithic Hall technology enables accurate and highly linear measurement of currents up to 120 A, depending on the sensor type. Negative effects, like saturation and hysteresis, commonly known from core based sensor techniques are not present in the Infineon open loop, core less sensors principle. The sensors use a differential signal sensing principle which makes the current sensor robust against stray fields.

An integrated primary conductor (current rail) with very low insertion resistance minimizes the power loss and enables miniaturization of the sensing circuit. XENSIV™ current sensors are shipped fully calibrated product without requiring any customer end-of-line calibration and come in a small TISON-8 leadless package, which allows standard SMD assembly.

TLI4970/TLI4971



TLI4970

Features

- Fully calibrated digital output
- High accuracy over life time due to on-chip temperature and stress compensation
- Programmable low-pass filter for measuring current (0 to 18 kHz)
- Fast, configurable overcurrent detector (< 1.8 µs typ.)
- Inherent magnetic stray field suppression
- Small package size and weight for SMD mounting

Applications

- Photovoltaic and general purpose inverters
- Power supplies (SMPS)
- Battery chargers
- Lighting applications
- Electrical drives

TLI4971

Features

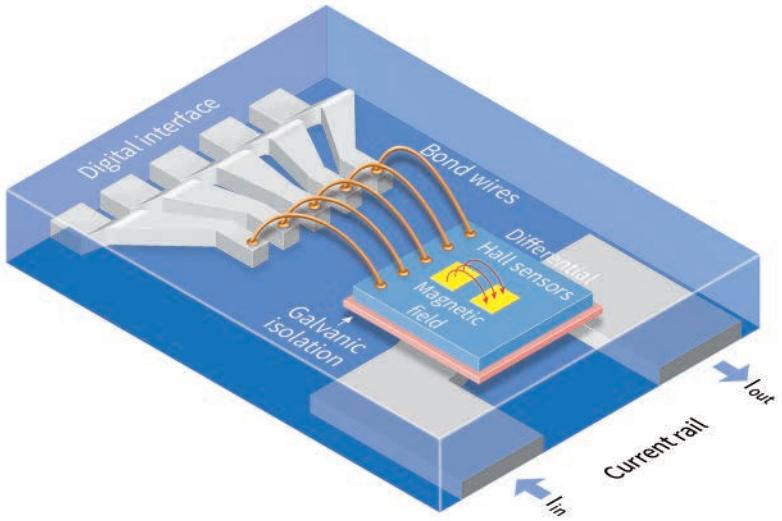
- Measurement up to 70 A_{RMS} at 690 V_{RMS} within ±120 A FSR (Full Scale Range)
- Accurate and stable current measurement due to on-chip temperature and stress compensation
- Low power loss through current rail (RPN specified at 225 µΩ typical)
- Analog output signal with 120 kHz bandwidth
- Two fast over current detection outputs (typ. response time 1 µs)

Applications

- Industrial inverter and electric drives up to 690 V_{RMS}
- Photovoltaic inverters
- Power supplies
- Battery management systems
- Overload or overcurrent detection in high voltage power circuits

Product	Accuracy [1] [%]	Current range [A]	Bandwidth [kHz]	Resolution/sensitivity	UL certified	Industrial	Package
TLI4970-D025T4	±1.6	±25	18	6.25 mA/LSB	●	●	TISON-8
TLI4970-D025T5	±3.5	±25	18	6.25 mA/LSB	●	●	TISON-8
TLI4970-D050T4	±1.6	±50	18	12.5 mA/LSB	●	●	TISON-8
TLI4970-D050T5	±3.5	±50	18	12.5 mA/LSB	●	●	TISON-8
TLI4971-A120T5[2]	±3.0	±120	120	10 mV/A	–	●	TISON-8
TLI4971-A120T5-U[2]	±3.0	±120	120	10 mV/A	●	●	TISON-8

1) Total error over lifetime and temperature
2) Coming soon



www.infineon.com/current-sensors

Magnetic sensors

Exceptionally precise magnetic sensors comprising industry-leading Hall switches, linear Halls, angle sensors, 3D Halls as well as speed sensors

Infineon XENSIV™ sensors are exceptionally precise thanks to industry-leading technologies. Our benchmark and innovative magnetic sensor portfolio is the perfect fit for various customer applications in automotive, industrial and consumer markets. We offer all magnetic sensor technologies with in-house production, thus our customers can choose between Hall sensors, AMR (Anisotropic Magneto Resistive), GMR (Giant Magneto Resistive) or TMR (Tunnel Magneto Resistive) sensors in order to find their best-fit solution for their application. Infineon's XENSIV™ magnetic sensors combine highest-accuracy with proven quality and more than 40 years of experience in sensing solutions.

Generally, magnetic sensors are able to detect magnetic fields and process this information. The outcome on the position, angle and strength (Hall-effect) or the direction (Magneto Resistive) of an applied magnetic field can be converted into specific output signals. Our magnetic sensor portfolio comprises Hall switches, linear Hall sensors, angle sensors, 3D Hall sensors as well as magnetic speed sensors with their respective field of application.

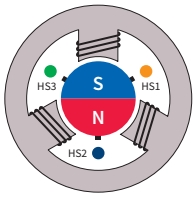
Hall switches

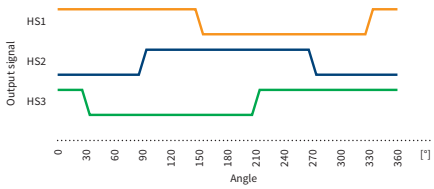
Broadest energy saving portfolio of high precision Hall switches for automotive, industrial and consumer applications

TLE/TLI/TLV4961/64/68
Energy-efficient Hall switch family for up to 32 V

The TLE/TLI/TLV496x-xM/L family of Hall switches saves energy and enables designers to create precise, compact systems. With an operational current consumption of just 1.6 mA, TLE/TLI/TLV496x-xM/L products can cut energy consumption by up to 50 percent compared with similar competitor products. Thanks to its small magnetic hysteresis, the family paves the way for precise switching points in systems. The integrated temperature profile compensates magnetic drifts and enables stable performance over temperature and lifetime.

TLE/TLI/TLV496x-xM products come in the smallest SOT23 package, thus reducing height by 10 percent compared with predecessor products. The sensors also feature an integrated functionality test for better system control.





Features

- Current consumption of just 1.6 mA
- 3 to 32 V supply voltage range (over voltage up to 42 V)
- 7 kV ESD protection (HBM)
- Overtemperature and overcurrent protection
- Temperature compensation
- Smallest SOT23 package
- Dedicated products for industrial applications (TLI496x)
- AEC-Q100 qualified

Applications

- Window lifter
- Power closing
- Gear stick
- Seat belt
- BLDC commutation
  (e.g. wiper, seat belt pretentioner, pump, seating)
- Service robots
- Power tools
- White goods

Product	Type	Operating point B_{OP}	Release point B_{RP}	Hysteresis ΔB_{HY}	Automotive	Industrial	Consumer	Package
TLE4961-1M/L	Latch	2.0	-2.0	4.0	●	●	●	SOT23/SSO-3-2
TLE4961-2M	Latch	5.0	-5.0	10.0	●	●	●	SOT23
TLE4961-3M/L	Latch	7.5	-7.5	15.0	●	●	●	SOT23/SSO-3-2
TLE4964-1M	Switch	18.0	12.5	5.5	●	●	●	SOT23
TLE4964-2M	Switch	28.0	22.5	5.5	●	●	●	SOT23
TLE4964-3M	Switch	12.5	9.5	3.0	●	●	●	SOT23
TLE4964-5M	Switch	7.5	5.0	2.5	●	●	●	SOT23
TLE4968-1M/L	Bipolar	1.0	-1.0	2.0	●	●	●	SOT23/SSO-3-2
TLE4961-5M	Latch	15.0	-15.0	30.0	●	●	●	SOT23
TLE4961-4M	Latch	10.0	-10.0	20.0	●	●	●	SOT23
TLE4964-4M	Switch	10.0	8.5	1.5	●	●	●	SOT23
TLE4964-6M	Switch	3.5	2.5	1.0	●	●	●	SOT23
TLI4961-1M/L	Latch	2.0	-2.0	4.0	–	●	●	SOT23/SSO-3-2
TLV4961-1M	Latch	2.0	-2.0	4.0	–	–	●	SOT23
TLV4961-3M	Latch	7.5	-7.0	15.0	–	–	●	SOT23
TLV4964-1M	Switch	18.0	12.5	5.5	–	–	●	SOT23
TLV4964-2M	Switch	28.0	22.5	5.5	–	–	●	SOT23

www.infineon.com/hall-switches

TLE/TLI4963/65-xM
5 V high-precision automotive/industrial Hall-effect sensor

TLE/TLI496x-xM are integrated Hall-effect sensors specially designed for highly accurate applications. The sensors provide an easy-to-use and cost-effective solution for position sensing applications, requiring high temperature stability of the magnetic threshold.

Target applications for TLE/TLI496x-xM are all low-power applications requesting a precision Hall latch or Hall switch with a broad operating temperature range.

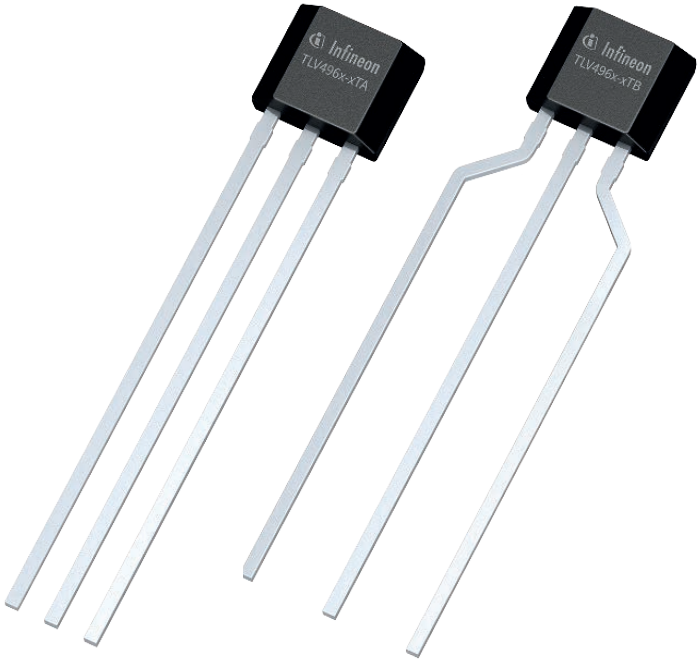
By offering an excellent magnetic behavior Infineon's switches are ideally suited for:
- Index counting application with a pole wheel
- Rotor position detection (BLDC motors)
- Open/close detection

Features
- 3.0 to 5.5 V operating supply voltage
- Low current consumption 1.4 mA
- ESD protection 4 kV HBM
- Active error compensation (chopped)
- High stability of magnetic thresholds
- Low jitter (typ. 0.35 µs)
- Operating temperature range:
  - from -40 to +170°C (TLE496x-xM)
  - from -40 to +125°C (TLI496x-xM)
- Small SMD package SOT23
- TLE: AEC-Q100 qualified
- TLI: JEDEC qualified

Product	Type	Operating point B_{OP}	Release point B_{RP}	Hysteresis ΔB_{HY}	Automotive	Industrial	Package
TLE4963-1M	Latch	2.0	-2.0	4.0	●	–	SOT23
TLE4963-2M	Latch	5.0	-5.0	10.0	●	–	SOT23
TLE4965-5M	Unipolar switch	7.5	5.0	2.5	●	–	SOT23
TLI4963-1M	Latch	2.0	-2.0	4.0	–	●	SOT23
TLI4963-2M	Latch	5.0	-5.0	10.0	–	●	SOT23
TLI4965-5M	Unipolar switch	7.5	5.0	2.5	–	●	SOT23

TLV496x-xTA/B
Precision Hall-effect sensor for consumer applications in leaded package

The TLV496x-xTA/B Hall sensor family comprises a line of Hall switches for contactless position sensing. The sensors are specially designed to provide an easy-to-use and cost-effective solution for position sensing applications.



Features
- 3.0 to 26 V operating supply voltage
- Low current consumption 1.6 mA
- ESD protection 4 kV HBM
- Operating temperature range from -40 to +125 °C
- Leaded package TO92S

Applications
- BLDC motor commutation for consumer devices (e.g. e-bikes, fans, aircons)
- Position detection e.g. flaps and control buttons

Product	Type	Operating point B_{OP}	Release point B_{RP}	Hysteresis ΔB_{HY}	Consumer	Package
TLV4961-1TA	Latch	2.0	-2.0	4.0	●	TO92S-3-1
TLV4961-1TB	Latch	2.0	-2.0	4.0	●	TO92S-3-2
TLV4961-3TA	Latch	7.5	-7.5	15.0	●	TO92S-3-1
TLV4961-3TB	Latch	7.5	-7.5	15.0	●	TO92S-3-2
TLV4964-4TA	Unipolar switch	10.0	8.5	1.5	●	TO92S-3-1
TLV4964-4TB	Unipolar switch	10.0	8.5	1.5	●	TO92S-3-2
TLV4964-5TA	Unipolar switch	7.5	5.0	2.5	●	TO92S-3-1
TLV4964-5TB	Unipolar switch	7.5	5.0	2.5	●	TO92S-3-2
TLV4968-1TA	Latch	1.0	-1.0	2.0	●	TO92S-3-1
TLV4968-1TB	Latch	1.0	-1.0	2.0	●	TO92S-3-2

TLX4966 xG family
Two-in-one double Hall sensor

Our XENSIV™ TLE4966 xG family features two integrated, calibrated sensor elements for detecting direction and counting indexes in one device. This two-in-one feature eliminates the need for a second sensor, which in turn cuts engineering and production costs. Using just one sensor ensures perfect alignment of the sensor elements raising system quality and reliability.

Features

- Two Hall probes
- Excellent matching between the two Hall probes
- Hall plate distance of 1.45 mm
- Industry standard
- Outstanding quality
- Information on direction and speed
- TSOP6 package
- AEC-Q100 qualified

Applications

- Window lifter
- Sunroof
- Automatic tailgate
- Automated doors
- Sun blinds

Product	Application segment	Production samples	Temperature range [°C]	Operating voltage [V]	Magnetic thresholds	Output	Comment	Package
TLI4966G		Available	-40 to +125	2.7–24	B_{op}: +7.5 mT B_{rp}: -7.5 mT	Speed and direction	› Horizontal Hall plates › For industrial application › SMD package	TSOP6-6
TLE4966G		Available	-40 to +150	2.7–24	B_{op}: +7.5 mT B_{rp}: -7.5 mT	Speed and direction	› Horizontal Hall plates › SMD package	TSOP6-6
TLE4966-2G		Available	-40 to +150	2.7–24	B_{op}: +7.5 mT B_{rp}: -7.5 mT	Speed and speed	› Horizontal Hall plates › SMD package	TSOP6-6
TLE4966-3G		Available	-40 to +150	2.7–24	B_{op}: +2.5 mT B_{rp}: -2.5 mT	Speed and direction	› Horizontal Hall plates › SMD package	TSOP6-6
TLE4966V-1G		Available	-40 to +150	3.5–32	B_{op}: +2.5 mT B_{rp}: -2.5 mT	Speed and direction	› Horizontal Hall plates › SMD package	TSOP6-6
TLE4966L		Available	-40 to +150	2.7–24	B_{op}: +7.5 mT B_{rp}: -7.5 mT	Speed and direction	› Horizontal Hall plates › Leaded package	SSO-4

www.infineon.com/hall-switches

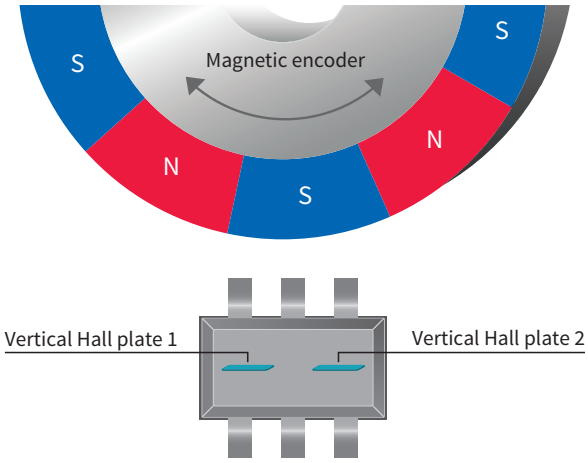
TLE4966V-1G
Vertical dual-Hall sensor

The Infineon vertical double Hall switch TLE4966V-1G is a further development of the TLX4966 xG family. Completely new is the vertical orientation of the Hall plates resulting in in-plane field sensitivity which enables entirely new application layouts. Designed in a new technology, this device offers high voltage capabilities with very small current consumption. The product can be operated from unregulated power supplies, which offers our customers unique freedom of design for their system. This product is AEC-Q100 certified and enables our customers to build systems for the highest automotive quality requirements.

Features

- Saves space
- Easy mounting of sensor and PCB board
- Allows increased mounting flexibility
- Enables new, compact system designs

Sensing direction parallel to target to wheel



Product	Type	Operating point B_{OP}	Release point B_{RP}	Hysteresis ΔB_{HY}	Automotive	Industrial	Package
TLE4966K/L	Double Hall, speed and direction output	7.5	-7.5	15	●	–	TSOP6/SSO-4-1
TLE4966-2G	Double Hall, two independent outputs	7.5	-7.5	15	●	–	TSOP6
TLE4966-3G	Double Hall, speed and direction output	2.5	-2.5	5	●	–	TSOP6
TLE4966V-1G	Vertical double Hall, speed and direction output	2.5	-2.5	5	●	–	TSOP6
TLI4966G	Double Hall, speed and direction output	7.5	-7.5	15	–	●	TSOP6

TLE/TLI/TLV49x6 family
High-precision Hall switches

The TLE49x6, TLI49x6, and the TLV49x6 family comprises high-precision, unipolar Hall-effect switches and latches for different magnetic sensitivities. TLE/TLI/TLV49x6 products have proven successful in many automotive, industrial and consumer applications. The family includes two-wire sensors with a current interface.

Features

- Broad, successful family concept
- Best in class quality
- Chopped Hall system for high sensitivity
- High jitter performance
- SMD and leaded packages
- Open collector or current interface
- Temperature compensation
- Up to 18 V supply
- Dedicated products for industrial (TLI49x6) and consumer applications (TLV49x6)
- AEC-Q100 qualified (option TLE)

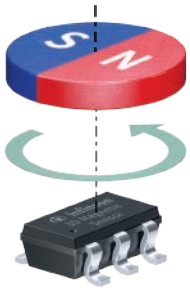
Applications

- Power closing
- Gear stick
- Seat belt
- HVAC flap
- BLDC commutation
- Two-wheeler applications

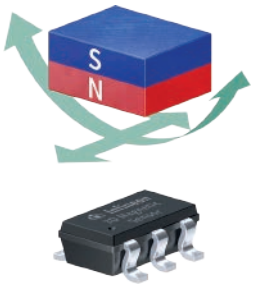
Product	Type	Operating point B_{OP}	Release point B_{RP}	Hysteresis ΔB_{HY}	Automotive	Industrial	Consumer	Package
TLE4906K/L	Unipolar switch	10.0	8.5	1.5	●	●	–	SC59/SSO-3-2
TLE4906-2K	Unipolar switch	18.0	12.5	5.5	●	●	–	SC59
TLE4906-3K	Unipolar switch	28.0	22.5	5.5	●	●	–	SC59
TLE4946K	Latch	14.0	-14.0	28.0	●	●	–	SC59
TLE4946-1L	Latch	15.0	-15.0	30.0	●	●	–	SSO-3-2
TLE4946-2K/L	Latch	2.0	-2.0	4.0	●	●	–	SC59/SSO-3-2
TLE4976L	Unipolar switch/ Current interface	6.0	4.0	2.0	●	●	–	SSO-3-2
TLE4976-1K	Unipolar switch/ Current interface	9.25	7.25	2.0	●	●	–	SC59
TLE4976-2K	Unipolar switch/ Current interface	4.5	2.7	1.8	●	●	–	SC59
TLV4946-2K	Unipolar switch	18.0	12.5	5.5	–	–	●	SC59
TLV4976-2K	Unipolar switch / Current interface	4.5	2.7	1.8	–	–	●	SC59

TLV493D-A1B6/TLI493D-A2B6
3D magnetic sensors for consumer and industrial market

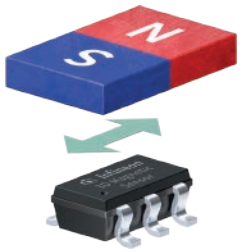
The TLV493D-A1B6 sensor realizes an accurate three-dimensional sensing with extremely low power consumption in a small 6-pin package. Capable of detecting the magnetic field in the x, y, and z-direction, the sensor is ideally suited for the measurement of linear, rotation or 3 dimensional movements. Thanks to its small package and low power consumption, the TLx493D-AxB6 can be used in new applications, replacing potentiometer and optical solutions. Featuring contactless position sensing and high temperature stability of the magnetic threshold, the sensor allows systems getting smaller, more accurate and more robust.



Rotation movement



3D movement



Linear movement

Features

- 3D magnetic sensing
- Integrated temperature sensing
- Low current consumption
  - 7 nA in power-down mode
  - 10 µA in ultra-low power mode
- 2.8 to 3.5 V operating supply voltage
- Digital output via a 2-wire standard I²C interface
- Bx, By and Bz linear field measurement up to ±160 mT
- JESD47 qualified
- 12-bit data resolution for each measurement direction
- Various resolution options from 65 µT/LSB to 130 µT
- Operating temperature range up to -40 to +125°C

Product	Temperature range	Qualification	Linear magnetic range	Resolution	I_{DD}	Update rate	Package	Ordering code
TLV493D-A1B6	-40 … 125°C	JESD47	±130 mT (typ)	98 µT/LSB	7 nA – 3.7 mA	10 Hz – 3.3 kHz	TSOP6	SP001286056
TLI493D-A2B6	-40 … 105°C	JESD47	±160 mT (min) ±100 mT (min)	130 µT/LSB (65 µT/LSB)[1]	7 nA – 3.3 mA	10 Hz – 8.4 kHz	TSOP6	SP001689844

1) Half range mode

While the TLV493D-A1B6 just supports a typical value for the linear magnetic range of ±130 mT, the TLI493D-A2B6 specification includes also a minimum value with ±160 mT.

With the TLI493D-A2B6 a broader microcontroller compatibility as well an enhanced feature set is included.

New features

- Sensor address read back
- Half mode range setting, focusing to half of the magnetic range ensuring higher accuracy
- Higher update frequency allows for an application field that requires faster update speed
- Angular mode (for x and y read out only)

Applications

- Anti tempering protection in smart meters
- Joysticks e.g. for medical equipment, cranes, CCTV-control, game consoles
- Control elements e.g. white goods multifunction knobs

www.infineon.com/3Dmagnetic

TLE493D-A2B6/W2B6
3D magnetic sensors for automotive low-power applications

The TLE493D-x2B6 enables for all kind of automotive control element applications within the passenger compartment or under the hood with a temperature range of -40 to +125°C with linear magnetic range requirements up to ±160 mT.

Features

- 3D magnetic sensing
- Integrated temperature sensing
- 2.8 to 3.5 V operating supply voltage
- Low current consumption
  - 0.007 µA in power-down mode
  - 10 µA in ultra-low power mode
  - Up to 10 power modes
- Digital output via a 2-wire standard I²C interface
- Bx, By and Bz linear field measurement ±160 mT
- AEC-Q100 qualified
- 12-bit data resolution for each measurement direction
- Various resolution options from 67 µT/LSB to 134 µT
- Operating temperature range up to -40 to +125°C

Product	Temperature range	Qualification	Linear magnetic range	Resolution	I_{DD}	Update rate	Wake-up	Package	Ordering code
TLE493D-A2B6	-40 … 125°C	AEC-Q100	±160 mT (min) ±100 mT (min)	130 µT/LSB (65 µT/LSB)[1)]	7 nA – 3.3 mA	10 Hz – 8.4 kHz	No	TSOP6	SP001689848
TLE493D-W2B6 A0 TLE493D-W2B6 A1 TLE493D-W2B6 A2 TLE493D-W2B6 A3	-40 … 125°C	AEC-Q100	±160 mT (min) ±100 mT (min)	130 µT/LSB (65 µT/LSB)[1)]	7 nA – 3.3 mA	0.05 Hz – 8.4 kHz	Yes	TSOP6	SP001655334 SP001655340 SP001655344 SP001655348

1) Half range mode

The TLE493D-A2B6 features include a sensor address read back feature for additional communication verification, a half range mode focusing to half of the magnetic range ensuring higher accuracy and an angular mode (for x and y read out only).

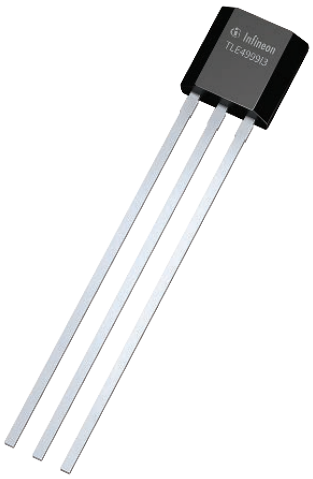
With the TLE493D-W2B6 A0-A3, a 3D sensor has been developed, which includes an enhanced dynamic wake up feature. Four pre-programmed address options (A0-A3) will be available, enabling for a fast start up initialization, when used in I²C bus configurations. It also includes enhanced test options and a safety documentation is available to enable the usage of this sensor in the context of ASIL-B systems.

Applications

- Control elements for infotainment/navigation systems, air conditions, multifunctional steering wheels, seat controls
- Top column modules e.g. direction indicator, wiper control
- Gear stick position sensing

TLE4999I3
Fully ISO 26262-compliant linear Hall IC

Dual channel linear Hall sensor with PSI5 interface, designed to meet the requirements of safety critical automotive and industrial applications



Our newest member in our broadest XENSIV™ magnetic position sensor portfolio is the world's first fully ISO 26262-compliant linear Hall sensor for high precision applications. The TLE4999I3 is a dual channel linear Hall sensor with a synchronous digital PSI5-compatible interface, compliant to ISO 26262, supporting safety requirements on system level rated up to ASIL-D. Our linear Hall IC TLE4999I3 features two highly accurate Hall measurement channels on one chip. A plausibility check of the two redundant channels on system level enables a high diagnostic coverage. Highest accuracy over a wide temperature range and lifetime is achieved by an integrated digital temperature- and stress-compensation.

Features

- Two highly accurate redundant Hall measurement channels (main and sub) integrated on one chip
- Developed compliant to ISO 26262 for safety requirements rated up to ASIL-D
- PSI5 v2.1-compatible interface in synchronous mode with high speed P10P-400/4H protocol
- Bi-directional interface for programming via fast SICI interface
- 13-bit output signals, protected by CRC and rolling counters
- Digital temperature and stress compensation
- 3-pin leaded package for mounting in PCB-less modules
- Operating junction temperature range -40°C to 150°C
- Main and sub channel programmable independently in EEPROM
- 16-bit user-configurable ID in EEPROM
- Supply voltage 5.5 to 7 V

Applications

- Brake and acceleration pedals
- Valve or flap position sensing
- Steering torque sensing
- High-speed applications
- Automotive and Industrial safety
- Any other kind of precise and fast linear measurement application

www.infineon.com/linear-hall

TLE499x family
Programmable analog/digital linear Hall sensor family

PRO SIL 1)

Infineon's family of TLE499x linear Hall ICs is tailored to the needs of highly accurate angular and linear position detection and current measurement applications. Each product measures the vertical component of a magnetic field and outputs a signal that is directly proportional to the magnetic field. These programmable linear Hall sensors come with different interface options: TLE4997 features ratiometric analog output while TLE4998P comes with Pulse Width Modulation (PWM), TLE4998S with Single Edge Nibble Transmission (SENT), TLE4998C with Short PWM Codes (SPC) and the TLE4999I with Peripheral Serial Interface (PSI5). While the TLE4998 devices base on a 12-bit resolution, the TLE4999I delivers a resolution of 13-bits. All sensors feature an EEPROM memory for flexible programming across a wide range of parameters.

Thanks to digital signal processing based on a 20-bit DSP architecture plus digital temperature compensation, these sensors deliver outstanding temperature stability compared with similar compensation methods. TLE4999 and TLE4998 sensors also include stress compensation to withstand stress effects from the package, such as moisture, thus ensuring best-in-class accuracy over the device's lifetime.

Features
- Best-in-class accuracy with low drift of output signal temperature range lifetime (including stress compensation in TLE4998 and TLE4999)
- Programmable transfer function (gain, offset), clamping, bandwidth and temperature characteristics
- AEC-Q100 qualified
- Available in various packages including SSO-3-9 with two integrated capacitors to improve ESD and ESC behavior
- Dual-die SMD package
- TLE4997, TLE4998 ISO 26262 ready
- TLE4999I3 fully ISO 26262 compliant

Applications
- Detecting linear and angular position
- Detecting pedal and throttle position
- Steering torque measurement
- Headlight leveling
- High-current sensing
- Seat position and occupant detection
- Suspension control
- Detecting gear stick/lever positions
- Detecting liquid levels in fuel tanks
- Current sensing e.g. for battery management

One chip per package

Product	Programmable	Number of pins	Sensitivity (programmable range)	Magnetic offset	Supply voltage (extended range)	Automotive	ISO 26262	Interface	Package
TLE4997	EEPROM	3/Single die SMD 8	±12.5 to ±300 mV/mT	< ±400 µT	5 V ±10% (7 V)	●	––	Analog	SSO-3-10 TDSO-8
TLE4998P	EEPROM	3/4/Single die SMD 8	±0.2 to ±6%/mT	< ±400 µT	5 V ±10% (16 V)	●	Ready	PWM	SSO-3-10 SSO-4-1 SSO-3-9 (2 capacitors) TDSO- 8
TLE4998S	EEPROM	3/4/Single die SMD 8	±8.2 to ±245 LSB_{12}/mT	< ±400 µT	5 V ±10% (16 V)	●	Ready	SENT	SSO-3-10 SSO-4-1 SSO-3-9 (2 capacitors) TDSO-8
TLE4998C	EEPROM	3/4/Single die SMD 8	±8.2 to ±245 LSB_{12}/mT	< ±400 µT	5 V ±10% (16 V)	●	Ready	SPC	SSO-3-10 SSO-4-1 SSO-3-9 (2 capacitors) TDSO-8
TLE4999I3	EEPROM	3	±73.72 to ±147.44* LSB_{13}/mT	< ±300 µT	5.5–7 V ±10% (16 V)	●	Compliant	PSI5	SSO-3-12

* 147.44 LSB_{13} converts to 294.88 LSB_{12}

1) More information on PRO-SIL™, see page 62

PRO SIL ISO 26262 compliant

PRO SIL ISO 26262 ready

www.infineon.com/linear-hall

Two sensors in one SMD package

The SMD package (TDSO) includes two independent sensors with separate power supply and separate signal outputs. Due to special mounting technology, Infineon is able to keep dual-sensor package size very small to enable compact PCB layouts and small magnet sizes.

Infineon offers a wide range of Hall sensors in the TDSO package. The two sensors in one package offer sensor redundancy in one package. Sensor redundancy is especially interesting for new generation EPS steering systems with increased ISO 26262 requirements and other safety critical applications. All sensors are automotive qualified.

Most products are also available as single-sensor solution with only one sensor.

The newest member of the TLE499x family, the TLE4999I3, is a fully ISO 26262 compliant linear Hall sensor that includes 2 sensor channels on one chip. With the SSO-3 package it allows for PCB – less application flexibility and with the PSI5 interface is enables for low EMI at high speed communication with minimum wiring.

Features

- Two sensors in one package
- Separate power supply and signal output
- AEC-Q100 qualified
- Temperature range from -40 to +125°C
- Outstanding quality
- Single-sensor versions available
- 16-pin and 8-pin versions available
- ISO 26262 ready
- TLE4999I3 ISO 26262 compliant

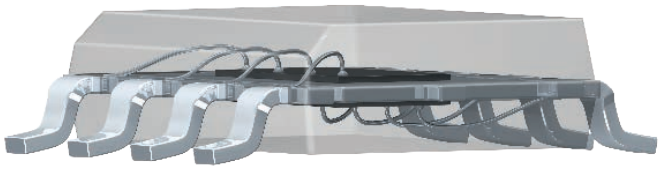
Automotive applications

- Steering torque systems
- Pedal position
- Any other safety critical application

Two sensor channels in one package

Product	Interface	Dual-/ single-sensor available	ISO 26262	Package
TLE4997A8D	Analog	yes/yes	Ready	TDSO-8
TLE4998P8D	PWM	yes/yes	Ready	TDSO-8
TLE4998S8D	SENT	yes/yes	Ready	TDSO-8
TLE4998C8D	SPC	yes/yes	Ready	TDSO-8
TLE4999I3	PSI5	monolithic*	Compliant	SSO-3

* 2 sensor channels on one chip



ISO 26262 ready

ISO 26262 compliant

1) More information on PRO-SIL™, see page 62

Angle sensors

Compact designs in small outline packages – at highest functional safety

Highest variety – low end to high end, standardized and specialized in all three xMR magnetic technologies: GMR, AMR and TMR

Infineon offers a broad variety of high-precision angle sensors in all common technologies such as AMR (Anisotropic Magnetoresistive), GMR (Giant Magnetoresitive) and also TMR (Tunnel Magnetoresitive). The xMR technologies are complementary. Addressing any kind of rotation applications Infineon's sensor portfolio consists of analogue and digital outputs, as single and dual-chip channel variants and as products for safety-relevant applications. The two-channel analogue TMR angle sensors TLE5501, the digital GMR angle sensor family TLE5014 and the high-precision AMR-based TLE5109 products are among the latest additions to the growing sensor portfolio, which includes all common technologies and is designed for both industrial and automotive applications.

Infineon's new magnetic sensor products TLE5501, are fast analogue TMR-based angle sensors dedicated to automotive applications. Their fields of use range from steering angle applications, with the highest functional safety requirements, to motors for wipers, pumps and actuators and electric motors in general. They are also ready to be used in industrial and consumer applications like robotics or gimbal. Angle sensors detect the orientation of an applied magnetic field by measuring sine and cosine angle components with monolithically integrated magneto resistive elements.

Infineon's broad portfolio of iGMR sensors are ideal for applications with a wide angle range, such as BLDC motors or steering sensors. They are pre-calibrated and ready-to-use. Different levels of signal processing integration enable designers to optimize system partitioning.

The new TLE5109A16 products address the need for very precise, fast and yet cost-efficient angle measurement at the highest functional safety levels in automotive and industrial applications. These include position measurement in brushless DC motors for pumps, wipers or brakes, position measurements of valves, flaps or pedals and steering angle measurement.

iGMR, iAMR and iTMR based angle sensors

Diverse redundant sensor with analog and digital interface

Product	Technology	Die configuration	Sin/cos output	Angle output	Second interface	Accuracy	ISO 26262	Package
TLE5009	GMR	Single die	Analog sin/cos	–	–	0.9°	Ready	DSO-8
TLE5009A16(D)	GMR	Dual die	Analog sin/cos	–	–	1.0°	Ready	TDSO-16
TLE5011	GMR	Single die	SSC (SPI)	–	–	1.6°	Ready	DSO-8
TLI5012B	GMR	Single die	SSC (SPI)	SSC (SPI)	PWM/IIF/SPC/HSM	1.9°	Ready	DSO-8
TLE5012B(D)	GMR	Single & dual die	SSC (SPI)	SSC (SPI)	PWM/IIF/SPC/HSM	1.0°	Ready	DSO-8/ TDSO-16
TLE5014C16(D)	GMR	Single & dual die	–	SPC	–	1.0°	Compliant	TDSO-16
TLE5014P16(D)	GMR	Single & dual die	–	PWM	–	1.0°	Compliant	TDSO-16
TLE5014S16(D)	GMR	Single & dual die	–	SENT	–	1.0°	Compliant	TDSO-16
TLE5014SP16(D)	GMR	Single & dual die	–	SPI	–	1.0°	Compliant	TDSO-16
TLE5109A16(D)	AMR	Single & dual die	Analog sin/cos	–	–	0.5°	Ready	TDSO-16
TLE5309D	AMR + GMR	Dual die	Analog sin/cos	SSC (SPI)	–	AMR 0.5°, GMR 1.0°	Ready	TDSO-16
TLE5501	TMR	Single die	Analog sin/cos	–	–	1.0°	Compliant	DSO-8

SPI = Serial peripheral interface
IIF = Incremental interface
PWM = Pulse width modulation

ISO 26262 compliant

ISO 26262 ready

www.infineon.com/angle-sensors

iTMR based angle sensors

Tunneling Magneto Resistive (iTMR) technology is offering high sensing sensitivity with a high output voltage, reducing the need for an internal amplifier. Thus, the sensor can be connected directly to the microcontroller without any further amplification. In addition, iTMR technology shows a very low temperature drift, reducing external calibration and compensation efforts. The iTMR technology is also well known for its low current consumption.

TLE5501

With the TLE5501 products, Infineon is currently launching the first angle sensor products based on iTMR technology. TLE5501 is available in two versions.

TLE5501 – product versions with different pin out:
- TLE5501 E0001: pin-compatible to TLE5009
  Automotive qualified acc. AEC-Q100
- TLE5001 E0002: decoupled bridges for redundant external angle calculation and highest diagnostic coverage, realizing ISO 26262-compliant development ASIL-D

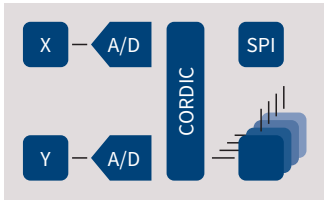
Features
- Large output signals of up to 0.37 V/V for direct microcontroller connection
- Discrete bridge with differential sine and cosine output
- Very low supply current: ~2 mA
- Magnetic field range (20–100 mT)
- Typ. angle error ~ 1.0° (overtemperature and lifetime)
- DSO-8 package
- AEC-Q100, grade 0: T_A = -40 to 150°C (ambient temperature)
- For TLE5501 E0002:
  - Reaching ASIL-D with just one single sensor chip
  - ISO 26262-compliant development ASIL-D

Applications
- Steering angle sensor
- BLDC motor commutation (e.g. wipers, pumps and actuators)
- Angular position sensing for e.g. robotics or gimbal
- Electric motors
- Industrial automation
- Safety applications

TLE5014(D)
Digital iGMR sensor with an easy-to-use plug-and-play concept for highest functional safety applications

PRO SIL 1)

All XENSIV™ TLE5014 angle sensors are available as single and dual die products. The products come pre-configured and pre-calibrated as plug-and-play sensors and are easy to use. Customers can choose between the interfaces SENT, PWM, SPC an SPI. On top of those protocol options, the sensors can be adapted to any kind of application setup via their programmable E²PROM interfaces. TLE5014 magnetic angle sensors meet ISO 26262 ASIL-C for the single die and ISO 26262 ASIL-D for the dual die versions. All products are ready for applications with the highest functional safety requirements. The sensors show an extremely small angle error of less than 1° across the entire temperature profile and lifetime. This is particularly helpful in applications with the need for very accurate position sensing such as steering angle sensing or motor commutation. Further application areas range from rotor position measurement, electric power steering (EPS), pedal position to any other kind of position measurement.



Features
- Easy-to-use, plug-and-play sensors, pre-configured and pre-calibrated
- Offering high flexibility:
  - Available as single and dual die products
  - 12-bit digital interface with protocol options PWM, SENT, SPC and SPI
  - E²PROM 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
- Development fully compliant with ISO 26262
  - Developed acc. ASIL-D level
  - Dual die sensors reaching ASIL-D, single die sensors ASIL-C metrics
- Safety manual and safety analysis summary report available on request

Applications
- Steering angle sensing (SAS)
- Motor commutation
- Rotor position measurement
- Pedal position
- Safety applications
- Any other kind of high-accuracy position measurement

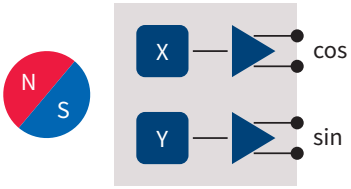
1) More information on PRO-SIL™, see page 62

TLE5109A16(D)
Analog iAMR sensor with temperature compensation

PRO SIL 1)

The TLE5109 product family covers Infineon Technologies AG's new ultra-precise, fast analog AMR-based angle sensors which can be used within a very broad magnetic field range, starting at 10 mT reaching up to more than 500 mT. One major benefit of the Infineon iAMR technology is its high angle accuracy, reaching typical values of only 0.1° angle error. Especially at low magnetic fields of 10 … 20 mT where typically the angle error significantly increases, TLE5109 products are outperforming the market due to their benchmark small typical angle error of only 0.2°. Reaching such low error values at low magnetic fields, TLE5102 products enable very cost-efficient systems as customers can use less powerful and thus more economical magnets.

The AMR-based XENSIV™ TLE5109A16 family is complementing the already existing GMR-based TLE5109A16 and diverse TLE5309D products from Infineon. Identical pin-configuration and interfaces of all TLE5x09 sensors inside TDSO-16 package enable customers to switch from one to another product or product version very quickly and at low design-in efforts.



Features

- Wide magnetic field range: from 10 mT up to > 500 mT
- High angle accuracy with only 0.1° overall angle error (typ.)
- Best-in-class typ. angle error of only 0.2° within range 10 … 20 mT
- Separate supply pins for top and bottom sensor
- Low current consumption
- Quick start-up
- Optimized 3.3 V or 5 V supply voltage
- Pre-amplified output signals for differential or single-ended applications for AMR sensor
- TDSO-16 package
- Automotive qualified acc. to AEC-Q100
- Ready for ISO 26262, targeting ASIL-D (dual die)

Applications

- BLDC motor position (e.g. pumps, wipers, brakes and other actuators)
- EPS rotor position
- Pedals and rotary switches
- Valve or flap position sensing
- Steering Angle Sensing (SAS)
- Electric motors
- Magnetic encoders
- High-speed applications
- Automotive and industrial safety

PRO SIL ISO 26262 ready

1) More information on PRO-SIL™, see page 62

www.infineon.com/angle-sensors

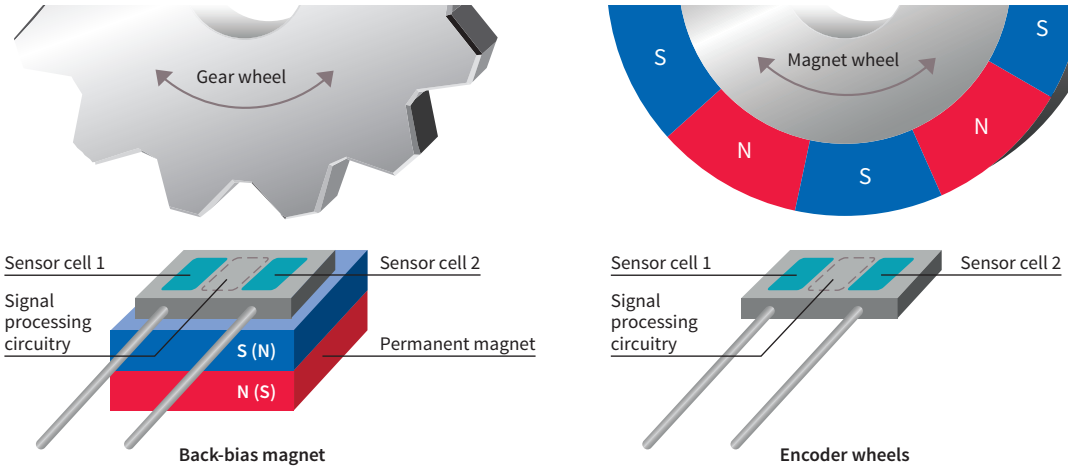
Magnetic speed sensors

Our Hall- and GMR-based speed sensors are designed to measure speed in safety and powertrain applications such as ESP, ABS, camshafts/crankshafts and automatic transmissions. They may be also used in comparable applications in the industrial sector. The sensors use a ferromagnetic toothed wheel or a magnetic encoder structure to measure rotational speed. We offer a broad range of options to ensure the perfect fit for individual customer applications, including voltage and current interfaces with a variety of different protocols and algorithms, such as e.g. vibration suppression. By integrating the magnetic Hall or GMR sensing cell and the signal processing unit on a single chip, we deliver optimum performance and cost savings.

The majority of sensors also feature additional benefits such as integrated capacitors (C- types) for high EMC robustness and the highest levels of ESD protection.

We have an outstanding record of excellence in the automotive sector. Infineon's sensors deliver extremely reliable results in safety-relevant applications such as ESP and ABS, and in extremely harsh environments such as engines and transmissions.

Typical application of a magnetic differential sensor



TLE4921-5U
Highly robust and cost-effective speed sensor

TLE4921-5U is a highly robust and cost-effective solution for measuring speed in a wide range of automotive and industrial applications, delivering outstanding performance while enabling simple, low-cost magnetic circuit designs, making it ideal for all entry-level speed sensing applications.

Features

- Good sensing performance and high sensitivity
- Well suited to harsh environments thanks to dynamic offset cancellation, EMI robustness, reverse polarity and overvoltage protection
- Suitable for a broad temperature range
- Flexible sensor module interface that can be configured for two-wire and three-wire interfaces
- AEC-Q100 qualified

Applications

- Engine speed and position (e.g. crankshaft)
- Transmission speed
- Speedometer
- Industrial speed and position sensing

www.infineon.com/speed-sensors

TLE4922
Two wheeler speed sensors – cost effective, highly robust, easy-to-use, twist-independent mounting

This sensor is specially designed for vehicle or industrial speed sensing applications. TLE4922 can be back-biased using a simple, low-cost bulk magnet, while providing a good air-gap performance and switching accuracy. Its hidden adaptive hysteresis and calibration algorithm enables good accuracy over air-gap jumps and immunity to vibrationerse and run-out events. Thanks to its mono-cell design, it is the perfect choice for applications requiring twist-independent mounting. Thus the TLE4922 is well suited for replacing passive sensors, such as Variable Reluctance Sensors (VRS), in automotive and 2-wheeler applications by providing the user with higher accuracy and a better jitter performance.

Features

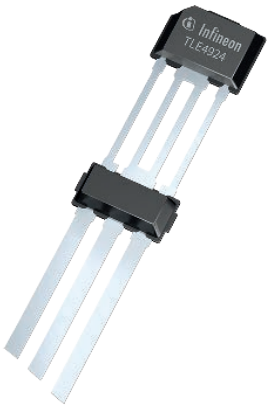
- Large operating air-gap capability
- Twist-independent mounting
- Hidden adaptive hysteresis
- Low current consumption
- Reverse magnetic polarity capability
- Wide operating temperature ranges of -40°C ≤ T_j ≤ ±150°C
- Advanced protection technology
  - Reverse voltage protection at V_S-pin
  - Short-circuit protection
  - Overtemperature protection
- High ESD robustness up to ±4 kV HBM
- 3-wire PWM voltage interface

Applications

- 2-wheeler
- Automotive vehicle speed

TLE4924/26/27/28C
High-performance speed sensor family

Our proven family of TLE492x differential Hall speed sensors is designed for a broad range of high-performance speed sensing applications in harsh environments, due to the hysteresis and dynamic self-calibration algorithm. All sensors have a three-wire voltage interface, fast start-up time, symmetrical switching thresholds and optional south or north pole pre-induction.



Features

- High sensitivity and large operating air-gaps
- Excellent switching performance down to a 1 Hz cut-off frequency
- Broad operating temperature range
- High protection against reverse voltage, short circuit and overtemperature
- Strong EMC robustness and micro-cut performance thanks to module-style package with integrated 47 nF/4.7 nF capacitors
- Option to use innovative iBB package solution
- AEC-Q100 qualified

Applications

- Engine speed and position (i.e. crankshaft)
- Transmission speed
- Speedometer
- Industrial speed and position sensing

Product	Hysteresis	Comment	Standard
TLE4924C-1	Visible fixed	–	SSO-3-9
TLE4924C-2	Visible adaptive	–	SSO-3-9
TLE4926C	Hidden fixed	–	SSO-3-9
TLE4926C-HT	Hidden fixed	High temperature profile	SSO-3-9
TLE4927C	Hidden adaptive	–	SSO-3-9
TLE4928C	Hidden fixed	200 ms watchdog reset	SSO-3-9

www.infineon.com/speed-sensors

TLE4929
Fully programmable crankshaft sensor

The TLE4929 is an active Hall sensor ideally suited for crankshaft applications and similar industrial applications, such as speedometer or any speed-sensor with high accuracy and low jitter capabilities.

Features

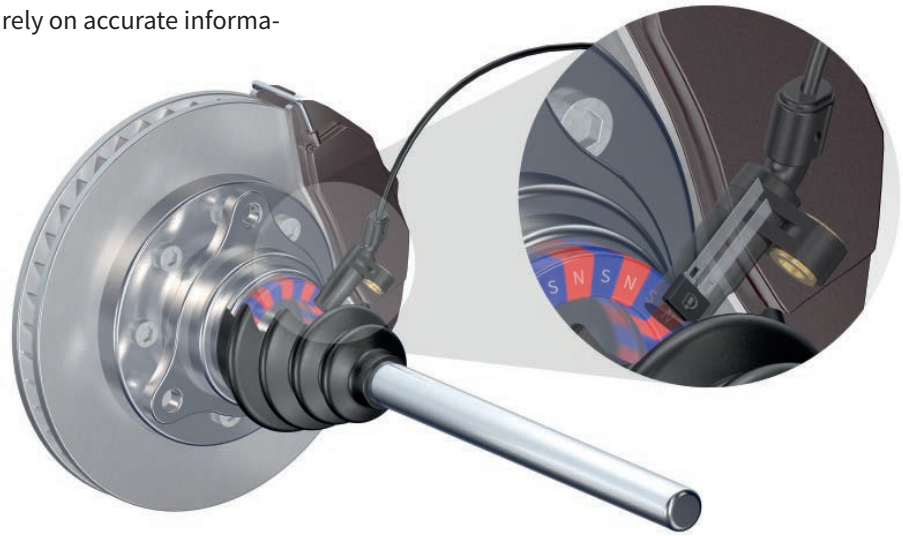
- Differential Hall speed sensor to measure speed and position of tooth/pole wheels
- Switching point in middle of the tooth enables backward compatibility
- Robustness over magnetic stray-field due to differential sensing principle
- Digital output signal with programmable output-protocol including diagnosis interface
- Direction detection and Stop-Start-Algorithm
- High accuracy and low jitter
- High sensitivity enable large air-gap
- End-of-line programmable to adapt engine parameters
- Can be used as a differential Camshaft sensor
- Automotive operating temperature range

Safety first by Infineon wheel speed sensors

Nowadays, wheel speed sensors have to support an ever-growing list of applications. Years ago, ABS systems simply needed to know if a wheel was blocked, and then ESC used the accurate speed of all four wheels for its corrections. Since then, an increasing number of modules in the car take the wheel speed into account for their intelligent functions. The electrical parking brake, for example, needs to know about every inch a car moves when it's supposed to be stationary, and iTPMS uses sophisticated algorithms to determine if a wheel lacks air pressure, and even the central locking locks the doors after a couple of meters and the radio turns up the volume in line with increasing speed. All of the above rely on accurate information from the wheel speed sensor.

Applications

- Wheel speed sensing in automotive applications
- Antilock Braking Systems (ABS)
- Electronic Stability Programs (ESP)
- Automatic transmissions
- iTPMS TLE5041plusC, TLE5045iC and TLE5046iC



www.infineon.com/speed-sensors

TLE4941plusC/TLE4942-1C/TLE4943C
My car, how fast and how far does it drive?

The TLE4941plusC, our best selling sensor, has become an industry standard for wheel speed sensing. TLE4942-1C and TLE4943C are complementing this sensor with additional direction information using PWM or AK protocol, respectively.

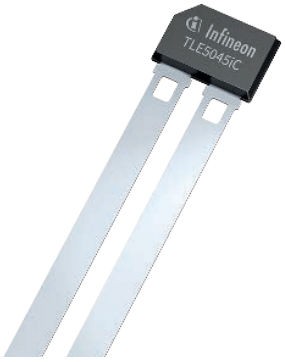
As a single chip sensor it magnetically measures the cars wheel speed with its differential Hall technology, making it the ideal all-purpose sensor, equally suitable for pole wheel and steel wheel applications. Theses sensors are immune towards any kind of undesired magnetic stray fields, ferromagnetic particles or other disturbances, because of their differential principle.

Features
- Family of hall sensors available with and without direction detection
- Excellent stray field robustness

Applications
- Pole wheel applications
- Steel/tooth wheel applications by using back bias magnet

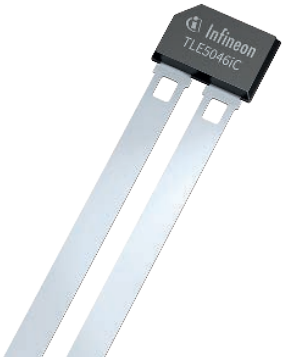
TLE5045iC, TLE5046iC
High end GMR wheel speed sensors

iGMR



The TLE5045/46iC is Infineon's next generation wheel speed sensor family based on GMR technology. The family consists of a designed-to-cost speed-only TLE5045iC, and a high-end TLE5046iC providing not only direction detection but also offering true "zero-speed" capability as well as possibilities of self-diagnostics.

TLE5045iC and TLE5046iC are developed according ISO 26262 to fulfill ASIL-B, supporting ASIL-D systems. The TLE5046iC with direction detection is available with PWM or AK protocol.



Features
- One family of speed sensors for all wheel speed sensing applications in same package
- Best in class in sensitivity, jitter and duty cycle, independent from magnetic target wheel
- "Zero speed" capability
- ISO 26262 compliant ASIL-B development, supporting system ASIL-D
- Multiple protocol variants with and without self-diagnosis functionality
- Integrated circuitry for improved EMC and ESD robustness even without external capacitor

Applications
- Pole wheel applications
- Autonomous driving (e.g. park assist)

Wheel speed sensor selection guide for high selling product portfolio

Product	Sensor technology	Pole wheel	Steel wheel	ISO 26262	Direction detection	Protocol	iTPMS
TLE4941plusC	Hall differential	●	●	–	–	Standard	–
TLE4942-1C	Hall differential	●	●	–	●	PWM	–
TLE4943C	Hall differential	●	●	–	●	AK	–
TLE5045iC	iGMR differential	●	–	ASIL-B(D)	–	Standard	●
TLE5046iC-PWM	iGMR differential	●	–	ASIL-B(D)	●	PWM	●
TLE5046iC-AK	iGMR differential	●	–	ASIL-B(D)	●	AK	●

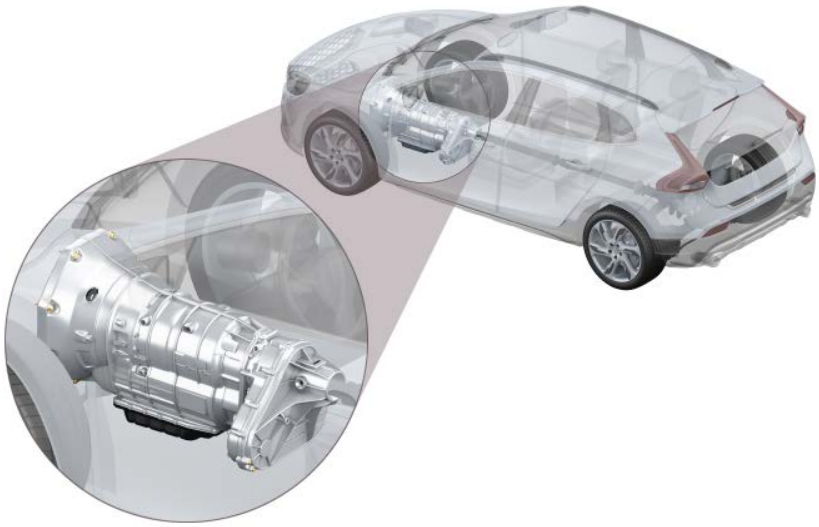
www.infineon.com/speed-sensors

TLE4953C
The two-wire transmission speed sensor

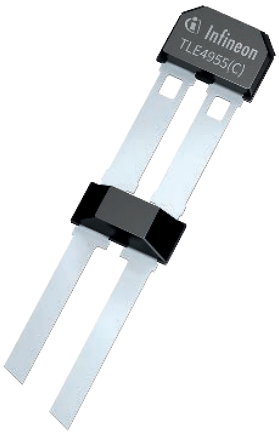
The differential Hall sensor TLE4953C can detect direction and was developed specifically to meet the needs of high-end transmission applications. Its jitter performance and high sensitivity enables designers to create high-accuracy systems with excellent vibration suppression. Adaptive hysteresis and the dynamic self-calibration algorithm ensure outstanding measurement results with both fine and coarse target wheels. As with other Infineon speed sensors, the south and north poles can be pre-inducted. TLE4953 features a current interface and comes in a two-wire package with an integrated 1.8 nF overmolded capacitor for improved EMC.

Features
- Detection of rotation direction
- Highly accurate speed measurements from zero to 12 kHz over large operating air-gaps
- Excellent vibration suppression
- Broad operating temperature range
- AEC-Q100 qualified

Applications
- Automatic transmission systems
- Industrial speed sensing using current sensor interfaces



TLE4955(C)
Leading the way in vibration robustness



TLE4955 is a new family of differential Hall sensors specifically designed to meet the latest requirements in transmission vibration suppression. It provides best-in-class vibration suppression for applications, that require a two-wire current interface. The TLE4955 family provides a similar algorithm plus dynamic self-calibration, jitter and sensitivity levels as our proven TLE4953, thus ensuring accurate speed measurements in the harshest of environments for both fine and coarse target wheels.
Designers can choose different interface protocol versions.

Features
- Detection of rotation direction
- Best-in-class vibration suppression
- Highly accurate speed measurements from zero to 12 kHz over large operating air-gaps
- Broad operating temperature range
  – Four different interface protocols
- AEC-Q100 qualified

Applications
- Automatic transmission systems
- Industrial speed sensing using current sensor interfaces

www.infineon.com/speed-sensors

TLE4957C
Three-wire transmission speed sensor

Differential Hall sensor TLE4957 is the ideal choice for designers, who prefer using a three-wire voltage interface rather than a two-wire current interface in applications such as transmission speed sensing. TLE4957 outperforms other devices thanks to its higher Digital Noise Constant (DNC) at start-up and its switching algorithm's increased hysteresis level. It is also available with adaptive hidden or adaptive visible hysteresis. The dynamic self-calibration principle together with the option of south or north pole pre-induction, sophisticated protection technology make TLE4957 ideal for automotive and industrial speed sensing applications.

Features

- Greater robustness against vibration
- Highly accurate speed measurements from 1 Hz to 8 kHz over large operating air-gaps
- Common three-wire voltage interface
- Broad operating temperature range
- AEC-Q100 qualified

Applications

- Automatic transmission systems
- Engine speed (crankshaft)
- Industrial speed sensing

TLE4959C(-FX)
State-of-the-art three-wire transmission speed sensor with direction detection

With our TLE4959 you now can also address your 3-wire applications with the latest state-of-the art technology of IFX transmission sensors. Differential Hall sensor TLE4959 is your choice when you need a 3-wire-sensor with direction detection and active vibration suppression. Beside it's outstanding airgap and best of class Hall jitter performance, with it's high immunity against strayfields it is the ideal match not only for traditional transmissions but also particularly for hybrid applications.

While TLE4959C is provided with the standard protocol, the FX version gives access to different protocols (e.g.speed only) as it is to be programmed at the customer's premises.

Features

- Active vibration suppression
- Highly accurate speed measurements from 0 Hz to 10 kHz over large operating air-gaps (up to 20k for -FX)
- Common three-wire voltage interface
- Broad operating temperature range
- AEC-Q100 qualified
- FX version customer programmable (protocol, hysteresis level)

Applications

- Automatic (hybrid) transmission systems

TLE4959-5U (-FX)
State-of-the-art 4-wire transmission speed sensor with direction detection

Infineon released its new transmission speed sensors, the XENSIV™ TLE4959-5U and the TLE4959-5U-FX. These are 4-wire voltage interface differential hall speed sensor for transmission speed applications with vibration suppression and direction detection output. The FX version flexible in terms of protocol, it has customer programmable EEPROM.

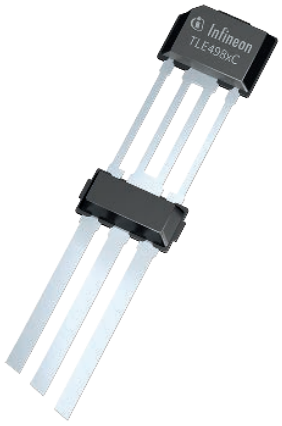
State-of-the-art 4-wire transmission speed sensor with direction detection. The TLE4959-5U (FX) is an integrated differential Hall speed sensor ideally suited for transmission applications. Its basic function is to provide rotational speed and direction of rotation information to the transmission control unit. Sophisticated vibration suppression with excellent air-gap performance. TLE4959-5U (FX) includes a sophisticated algorithm which actively suppresses vibration while keeping excellent air-gap performance.

Features
- Voltage interface
- Active vibration suppression
- Direction detection output
- Dynamic self-calibration
- 0 Hz capability
- FX: flexible protocol through customer programmable EEPROM

Target applications
- Automatic transmission applications
- Transmission applications with speed with direction detection

TLE4983/84C
Outstanding camshaft sensing

Our TLE4983/84 chopped mono-Hall sensor family comprises an excellent dedicated feature set. It is highly robust and is equipped with a module-style package with integrated capacitors. Due combining all these features, its the ideal opportunity for automotive camshaft applications. The product family meets all key camshaft sensor requirements including true power-on, Twist-Independent Mounting (TIM) and high phase accuracy for optimum fuel-injection timing. Both sensors deploy a dynamic self-calibration algorithm with programmable power-on and a dynamic switching point. TLE4984, for example, uses an algorithm, that enables fast threshold adjustments with small step sizes during the pre-calibration phase. This, in turn, allows thresholds to be adjusted very accurately. In contrast, the step sizes used by TLE4983 in the pre-calibration phase are approximately 10 times larger. TLE4983 therefore requires only half of the switching events used by TLE4984 to reach calibration mode. These flexible options give designers the freedom to choose the best start-up concept for individual system requirements.



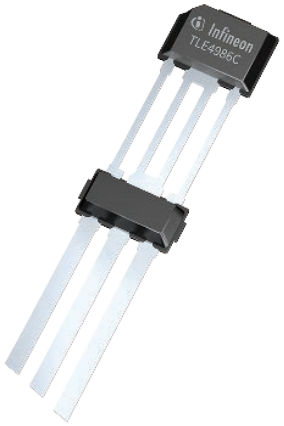
Features
- True power-on and high phase accuracy for optimal fuel injection timing
- Self-calibration algorithm for fast start-up and precise calibration
- Twist-Independent Mounting (TIM)
- High temperature operating range and EMC robustness
- Three-wire digital voltage interface (PWM)
- AEC-Q100 qualified

Applications
- Camshaft speed and position sensing

www.infineon.com/speed-sensors

TLE4986C
Leading performance

TLE4986C is the latest chopped mono-Hall sensor for automotive camshaft applications. It meets the most stringent requirements for phase accuracy, true power-on, EMC and temperature robustness. TLE4986C can be programmed to achieve the highest system performance with the widest range of target wheels, thus enabling designers to optimize the costs of a mechanical system, while obtaining the highest phase accuracy and greatest robustness against effects such as run-out. The temperature coefficient of the magnet can also be configured to ensure, that the sensor is adapted to the magnetic back-bias design. As with the TLE4983/84 family, TLE4986C also comes with proven features such as a dynamic self-calibration algorithm and module-style package plus integrated capacitors for optimal micro-break and EMC behavior.



Features

- True power-on and highest phase accuracy for optimum fuel injection timing
- Extensive programming options for flexible design of magnetic circuits and optimized performance
- Self-calibration algorithm for fast start-up and precise calibration
- Highest temperature operating range and EMC robustness
- Best-in-class micro-break performance
- Twist-Independent Mounting (TIM) capability
- Three-wire digital voltage interface (PWM)
- AEC-Q100 qualified

Applications

- Camshaft speed and position sensing

TLE5027C/28C
iGMR-based speed sensor

iGMR

TLE5027C is the world's first speed sensor solution based on Giant Magneto Resistive (iGMR) technology. It provides a higher air-gap and greatly reduced jitter over frequency and temperature performance. All of which puts it ahead of other magnetic sensing technologies and makes it the preferred solution for high-accuracy powertrain speed sensor systems – both today and in the future. TLE5027C can detect the rotation direction of a wheel and transmit this information during the first output pulse, making it the perfect fit for the latest engine systems that use a start-stop feature as well as for automatic transmission applications in the automotive sector. The TLE5028C adds an improved immunity towards ESD and EMC to adress the problems, caused by harsh high power environments like from hybrid systems. TLE5027C and TLE5028C are available in our well-established, module-style package with integrated capacitors. It uses a three-wire digital voltage interface (PWM).

Features

- Outstanding jitter performance thanks to giant magneto resistive technology
- High sensitivity (B_{min} < 1 mT) and large air-gap capability
- Detection and transmission of rotation direction during the first output pulse
- Three-wire digital voltage interface (PWM)
- Large frequency range
- Broad operating temperature range
- AEC-Q100 qualified
- Improved EMC and ESD immunity from TLE5028C

Applications

- Automatic transmission systems
- Engine speed (crankshaft)

www.infineon.com/speed-sensors

Overview of magnetic speed sensors

	Icon/ Description	TLE4921	TLE4922	TLE4924	TLE4926	TLE4927	TLE4928	TLE4929	TLE4941	TLE4941plusC	TLE4942	TLE4943	TLE4953	TLE4955	TLE4957	TLE4959	TLE4983	TLE4984	TLE4986	TLE5025	TLE5027	TLE5028	TLE5041plusC	TLE5045	TLE5046
Automotive	Wheel speed	–	●	–	–	–	–	–	●	●	●	●	–	–	–	–	–	–	–	–	–	–	●	●	●
	Camshaft	–	●	●	–	●	–	–	–	–	–	–	–	–	–	–	●	●	●	●	–	–	–	–	–
	Crankshaft	●	●	●	●	●	●	●	–	–	–	–	–	–	●	–	–	–	–	●	●	●	–	–	–
	Transmission	●	●	–	–	–	–	–	●	●	●	–	●	●	●	●	–	–	–	–	–	–	–	–	–
Industrial		●	●	●	–	●	●	●	–	●	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Sensor technology		Diff. Hall	Mono-Hall	Diff. Hall	Diff. Hall	Diff. Hall	Diff. Hall	Diff. Hall	Diff. Hall	Diff. Hall	Diff. Hall	Diff. Hall	Diff. Hall	Diff. Hall	Diff. Hall	Diff. Hall	Mono-Hall	Mono-Hall	Mono-Hall	iGMR	iGMR	iGMR	iGMR	iGMR	iGMR
Improved air-gap/jitter performance		–	–	–	–	–	–	●	–	–	–	–	–	–	–	●	–	–	–	●	●	●	●	●	●
Direction information available		–	–	–	–	–	–	●	–	–	●	●	●	●	–	●	–	–	–	–	●	●	–	–	●
True Power On (TPO)		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	●	●	●	–	–	–	–	–	–
Twist-Independent Mounting (TIM)		–	●	–	–	–	–	–	–	–	–	–	–	–	–	–	●	●	●	–	–	–	–	–	–
Vibration suppression algorithm included		–	–	–	–	–	–	●	–	–	–	–	●	●	●	●	–	–	–	–	–	–	–	–	–
Type of hysteresis[1]		V	H	V	H	H	H	H/V	H	H	H	H	V	V	V/H	V	H	H	V/H	H	H	H	H	H	H
		F	A	A/F	F	A	F	A/F	F	F	F	A	A	A	A	A	F	F	P/A	A	A	A	F	A	A
Interface[2]	# of pins	4	4	3	3	3	3	3	2	2	2	2	2	2	3	3	3	3	3	3	3	3	2	2	2
	Interface	V	V	V	V	V	V	V	C	C	C	C	C	C	V	V	V	V	V	V	V	V	C	C	C
	Protocol	S	S	S	S	S	S	S/P	S	S	P	AK	P	P	S	P	S	S	S	S	P	P	S	S	P/AK
Electrostatic Discharge (ESD)	Human Body Model (HBM)	2 kV	3 kV	6 kV	6 kV	6 kV	6 kV	6 kV	12 kV	12 kV	12 kV	12 kV	12 kV	12 kV	6 kV	6 kV	4 kV	4 kV	6 kV	8 kV	8 kV	6 kV	12 kV	12 kV	12 kV
Package without integrated capacitor		●	●	–	–	–	●	–	●	–	–	–	●	●	–	–	–	–	–	–	–	–	–	●	●
Package with integrated capacitor		–	–	●	●	●	●	●	–	●	●	●	●	●	●	●	●	●	●	●	●	●	●	–	–

1) H = Hidden; V = Visible; F = Fixed; A = Adaptive; P = Programmable
2) AK = AK protocol; C = Current; V = Voltage interface; S = Single pulse; P = PWM protocol

XENSIV™ pressure sensors

For automotive, industrial and consumer applications

Our comprehensive family of XENSIV™ sensors includes a wide choice of pressure sensors tailored specifically to the needs of automotive, industrial and consumer sectors. Offering rapid time-to-market, our XENSIV™ portfolio ensures the perfect fit for all performance and integrity needs. Featuring analog and digital interfaces, these sensors give customers a high degree of design flexibility, while also enabling manufacturers to meet evolving market and compliance demands.

www.infineon.com/pressure

Cars have to act and perform in the same way whether driving along a coast or through mountains. As a result Of diferent locations, the composition and the quality of the air around changes. It is important that the engine react immediately to these changes. Infineon offers various pressure sensors for barometric measurements with analog and digital interface and various pressure ranges.

Powertrain systems have to fulfill the constantly increasing stringent media requirements. Environmental legislation aims to deliver cleaner air by ensuring a steady global decrease in CO_2 emissions. Thanks to their accurate measurement capability, Infineon MAP and turbo MAP product with analog or digital interface enable engines to meet these requirements.

Our XENSIV™ family of digital barometric pressure sensors also gives designers the best choice when it comes to mobile and wearable devices. Highlights include small form factors to facilitate system integration, highest precision and relative accuracy over a wide temperature range, fast read-out speeds via the serial I^2C/SPI interface, and low power consumption to ensure longer battery lifetimes.

Automotive applications
- Barometric absolute pressure
- Seat comfort systems
- Manifold absolute pressure
- Exhaust gas recirculation
- Secondary air valve
- Fuel vapor
- Natural gas vehicle
- Side crash detection
- Pedestrian impact detection
- Battery monitoring for EV
- Brake booster

Industrial applications
- Industrial and process controls
- Gas flow
- Level meter
- Barometric pressure
- Altitude compensation systems
- Weather stations
- Engine management systems
- Medical equipment

Consumer applications
- Multicopter
- Health and fitness
- Outdoor navigation
- Indoor navigation
- Smart home
- Air flow control
- Health care

www.infineon.com/pressure

KP23x

Analog Barometric Air Pressure (BAP) sensor IC family

Everybody expects a car, that always acts and performs in the same way- whether driving along a coast or through mountains. As a result of different locations, the composition and the quality of the air around changes. Due to these changes its thus of fundamental importance, that the engine react immediately. Infineon offers various pressure sensors for barometric measurement with different interfaces (analog and digital) and various pressure ranges.

Features

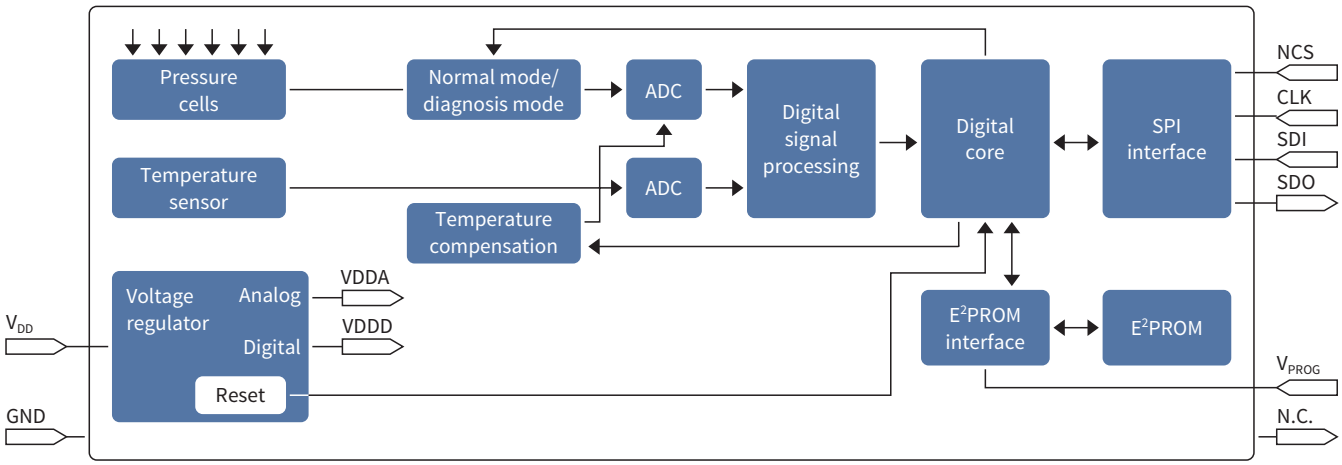
- Absolute air pressure measurement
- Excellent accuracy of 1.0 kPa over a large temperature range
- Ratiometric analog voltage output proportional to the applied pressure
- Output signal fully compensated across pressure and temperature range
- Pressure range from 40 to 115 kPa
- Temperature range from -40 to 125°C
- Serial service interface
- Open Bond Detection for supply and GND (OBD)
- Inverse polarity protection
- Green SMD package

KP25x

SPI digital barometric air pressure sensor IC family

Features

- SPI – digital interface
- Absolute air pressure measurement
- Excellent accuracy of 1.0 kPa over a large temperature range
- Output signal fully compensated across pressure and temperature range
- Pressure range from 10 to 165 kPa
- Temperature range from -40 to 125°C (140°C)
- Self-diagnosis routines and diagnosis codes
- Reverse polarity protection
- Diagnosis checks during operation
- Green SMD package



KP21x/KP22x

Analog manifold air pressure sensor IC family (MAP + turbo MAP)

Powertrain systems have to fulfill the constantly increasing stringent media requirements. Environmental legislation aims to deliver cleaner air by ensuring a steady global decrease in CO_2 emissions. Thanks to their accurate measurement capability, Infineon MAP and turbo MAP products with an analog interface enable engines to meet these requirements.

Features

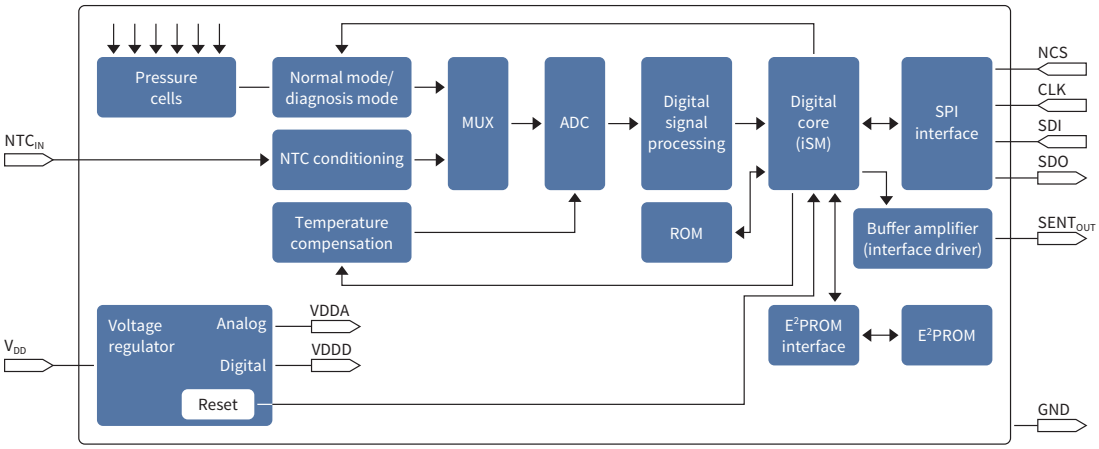
- Manifold air pressure measurement – MAP and turbo MAP
- Excellent accuracy of up to 1.0 kPa over a large temperature range
- Ratiometric analog voltage output proportional to the applied pressure
- Output signal fully compensated over pressure and temperature
- Pressure range from 10 to 400 kPa
- Temperature range from -40 to +140°C
- Output clamping (optional)
- Complete product family available with multiple transfer function
- Reverse polarity protection
- Green SMD package

KP275/276

Media robust MAP sensor with digital interface

Features

- Media robustness for current automotive requirements
- Digital interface SENT
- Excellent accuracy of ±0.77 percent FFS
- Green SMD package
- Temperature range -40 to +170°C
- Integrated NTC temperature sensor functionality
- Excellent accuracy of ±0.77 % FSS



Overview of integrated pressure sensor ICs for manifold and barometric air pressure

Product	Pressure range [kPa]	Max. accuracy [kPa]	Max. operating temperature [°C]	Automotive	Industrial
KP21x	10 … 150	1.0	140	●	●
KP22x	10 … 400	2.5	140	●	●
KP23x	40 … 115	1.0	125	●	●
KP236N6165	60 … 165	1.0	125	●	●
KP253	60 … 165	1.0	125	●	●
KP254	40 … 115	1.5	125	●	●
KP255	10 … 125	1.4	140	●	●
KP256	60 … 165	1.0	125	●	●
KP27x	10 … 400	2.5	170	●	●

www.infineon.com/pressure

Digital barometric pressure sensors

For mobile and wearable devices

Infineon's digital barometric pressure sensor family is the best choice for mobile and wearable devices due to its small form factor, high precision and low power consumption. Pressure sensing is based on capacitive technology which guarantees ultra-high precision (up to ±2 cm) and relative accuracy (±0.6 hPa) over a wide temperature range. The sensor's internal signal processor converts the output from the pressure and temperature sensor elements to 24-bit results. Each pressure sensor has been calibrated individually and contains calibration coefficients. The coefficients are used in the application to convert the measurement results to true pressure and temperature values. All sensors have a FIFO that can store the latest 32 measurements. Since the host processor can remain in a sleep mode for a longer period between readouts, a FIFO can reduce the system power consumption. Sensor measurements and calibration coefficients are available via the serial I^2C/SPI interface.

DPS310

Barometric pressure sensor with very low power consumption, recommended for applications where power consumption is critical and highest precision in pressure metering is required.

DPS368

DPS368 offers best-in-class resolution (±2 cm), very fast read-out speed and low current consumption. The sensor can be used in harsh environment and facilitates board handling in assembly line, as it is robust against water (IPx8 – 50 m under water for 1 hour), dust & humidity. The small package size saves up to 80% space compared to other waterproof sensors and makes the DPS368 ideal for mobile applications and wearable devices.

DPS422

Monolithic chip solution having an ultra-small critical area and a very thin package (0.73 mm typ.). Beneath high precision pressure metering, DPS422 offers also highly accurate absolute temperature sensing (±0.4°C). Therefore it can be used in applications like weather stations / smart thermostats and offer additional features by pressure sensing (e.g. intruder detection, weather forecast).

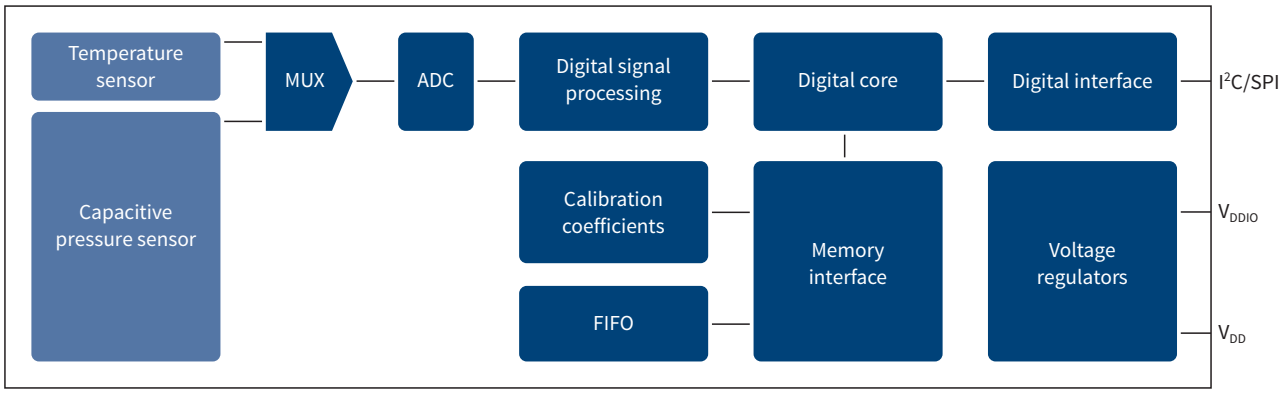
Typical applications:

- Drones: Altitude detection and height stability
- Health and fitness: Accurate elevation gain and step counting (e.g. for smart watches)
- Outdoor navigation: GPS start-up time / accuracy improvement; dead-reckoning (e.g. in tunnels)
- Indoor navigation: Floor detection e.g. in shopping malls and parking garages
- Smart home: Micro weather forecasting; room temperature control; intruder detection
- Air flow control: Smart filter replacement alarm (e.g. in home appliances); predictive maintenance
- Health care: Fall detection; respiratory devices; smart inhalers

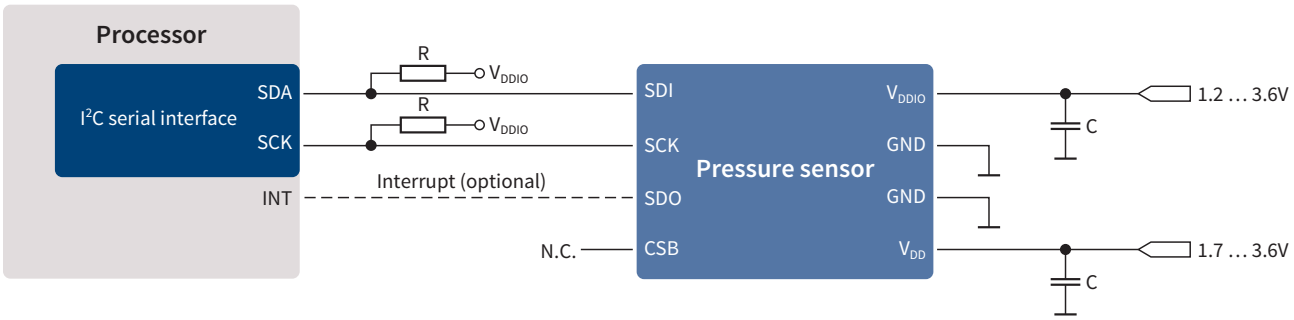
Key product features	DPS368	DPS310	DPS422
Package	8 pins LGA: 2.0 x 2.5 x 1.1 mm – environmentally protected	8 pins LGA: 2.0 x 2.5 x 1.0 mm	8 pins LGA: 2.0 x 2.5 x 0.73 mm
Operating pressure range	300 … 1200 hPa		
Operating temperature range	-40 … 85°C		
Pressure level precision	±0.002 hPa (or ±0.02 m)	±0.005 hPa (or ±0.05 m)	
Relative accuracy	±0.06 hPa (or ±0.5 m)		
Absolute accuracy	±1 hPa (or ±8 m)		
Temperature accuracy	0.5°C		< 0.4°C
Pressure temperature sensitivity	0.5 Pa/K		
Measurement time	3.6 ms (low precision); 27.6 ms (standard mode)		
Average current consumption at 1 Hz sampling rate	1.7 µA pressure measurement, 1.5 µA temp. measurement, standby 0.5 µA		1.7 µA pressure measurement, 2.0 µA temp. measurement, standby < 1 µA
Supply voltage	V_{DDIO}: 1.2–3.6 V; V_{DD}: 1.7–3.6 V		
Operating modes	Command (manual), background (automatic), standby		
Interface	I^2C and SPI, both with optional interrupt		

www.infineon.com/pressure

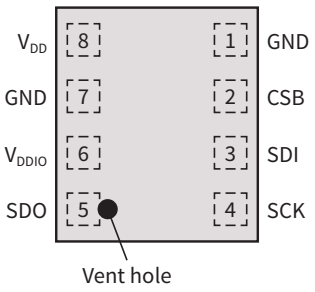
Functional block diagram



Application circuit example (in I²C configuration)



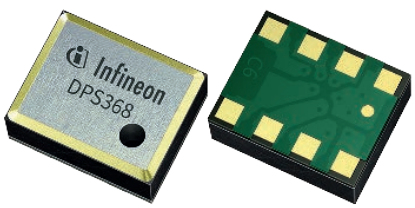
Pin configuration (Top view)



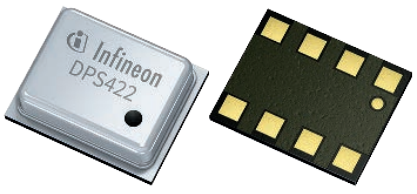
Pin	Name	Function
1	GND	Ground
2	CSB	Chip select
3	SDI	Serial data in/out
4	SCK	Serial clock
5	SDO	Serial data out
6	V_{DDIO}	Digital interface supply
7	GND	Ground
8	V_{DD}	Analog supply

DPS310 package drawing

DPS368 package drawing



DPS422 package drawing



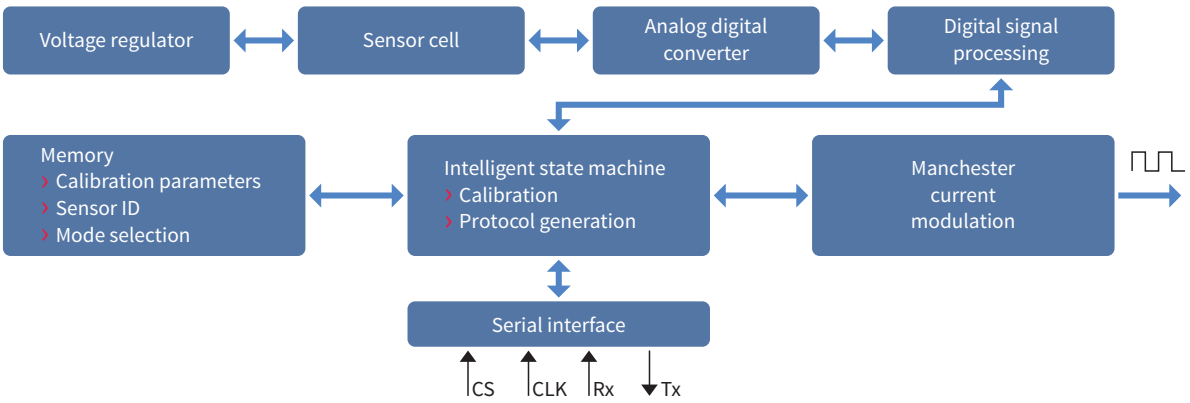
KP200/KP201/KP204

PSI5 PRO-SIL™ ready pressure sensor ICs for side crash detection and pedestrian protection

PRO SIL 1)

Features

- Two-wire interface with on-chip current modulator for PSI5 communication
- Fully PSI5 compliant with support for multiple modes
- Synchronous or asynchronous data transmission
- EEPROM for unique ID number, calibration and mode selection
- Serial service interface for EEPROM programming
- On-chip voltage regulator
- Reverse polarity protection
- Fully AK-LV29 and AK-LV38 compliant
- Patented online diagnosis for pressure cells and circuitry
- PRO-SIL™ support in line with IEC 61508 and ISO 26262
- Green SMD package
- KP201 qualified for higher operating temperatures up to 125°C
- KP204 with 4-hole lid supporting insect intrusion protection



1) More information on PRO-SIL™, see page 62

SP27

Pressure sensor for industrial and automotive applications

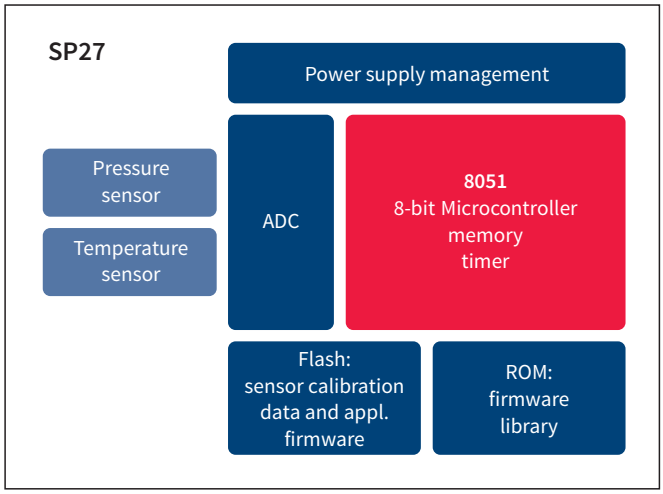
The SP27 is a pressure sensor designed for the harshest automotive and industrial environments. Among its unique selling points, the device offers a wide pressure range up to 1300 kPa and a proven sensor technology, which is robust against various media.

It can be used in both wired and battery-supplied applications.

The SP27 is a complete system on package since it integrates a microcontroller with 6 kB flash and several peripherals (such as temperature and voltage sensors on top of the pressure sensor); it requires very few external components.

Its data interface is I²C; nevertheless, the integrated microcontroller allows the implementation of specific communication protocols such as SPI, SPC, SENT or PWM. The integrated microcontroller is instruction-set compatible with a standard 8051 processor. Integrated on-chip flash memory can be used to store a customer-specific application code, along with its unique ID number and the calibration data for the sensors. Additional on-chip ROM memory is available and includes functions (developed by Infineon) that cover standard tasks used by the application.

The device can be programmed to wake-up at regular intervals via its low-power interval-timer or per an external wake-up source connected to a General Purpose Input/Output (GPIO), thus allowing the application to save energy by spending most of the time in powerdown state.



Features

- Pressure sensor (100 to 1300 kPa)
- Temperature sensor
- Embedded 8051 compatible 8-bit microcontroller
- 6 KB on-chip flash memory
- 256 Byte RAM
- Advanced power control/wake-up system to minimize power consumption
- Ultra-low powerdown current of < 0.7 µA
- Supply voltage range of 1.9 to 3.6 V
- Operating temperature range of -40 to +125°C
- DSOSP-14-6 package
- RoHS compliant, green package

Parameter	Values		Unit	Note/test condition
	Min.	Max.		
Input pressure range	100	500	kPa	T = -40 … 125°C
Measurement error 100 … 500 kPa	-21	+21	kPa	T = 25 … 80°C
	-46	+46	kPa	T = -40 … 125°C
Input pressure range	500	1300	kPa	T = -40 … 125°C
Measurement error 500 … 1300 kPa	-31	+31	kPa	T = 25 … 80°C
	-60	+60	kPa	T = -40 … 125°C
Temperature measurement error	-3	+3	°C	T = -20 … 70°C
	-5	+5	°C	T = -40 … -20°C T = 70 … 125°C

SP40

Tire pressure sensor for Tire Pressure Monitoring Systems (TPMS)

SP40 provides a very high level of integration and is optimized to perform all of the functions necessary to implement a state-of-the-art Tire Pressure Monitoring System (TPMS) sensor module. With its integrated micro controller, sensors and convenient peripherals, the SP40 needs the addition of only a few passive components and a battery to form a complete TPMS sensor assembly.

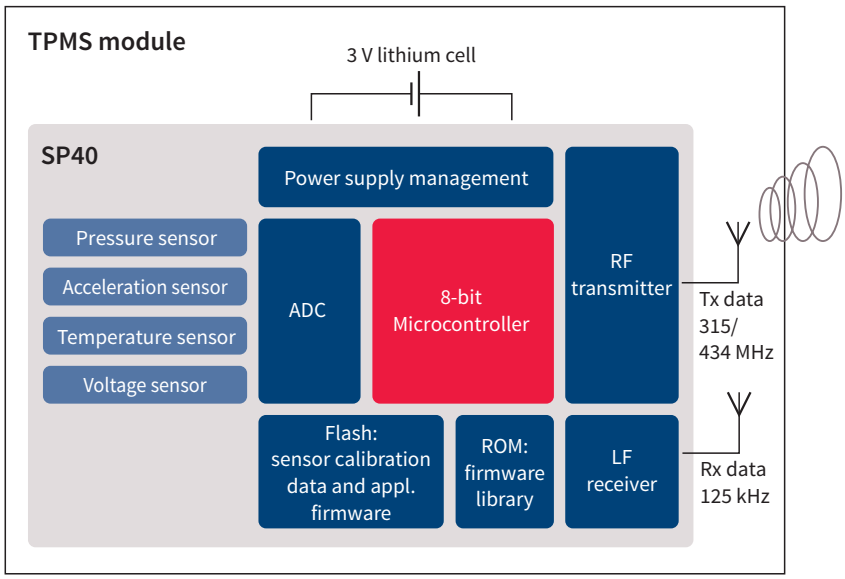
SP40 measures pressure, radial acceleration, temperature and supply voltage and is certified as a green package com¬pliant with RoHS. SP40 comes with a pressure-auto-ranging feature, providing best-in-class pressure-accuracy in the range from 100 to 900 kPa, making it the ideal choice for passenger vehicle and lights truck applications.

Compared to the previous generation SP37, the SP40 family offers even lower current consumption and more features like larger flash and better sensor accuracy.

Features

- Pressure sensor
- Radial acceleration sensor
- Temperature sensor
- Supply voltage sensor
- Embedded 8051 compatible 8-bit microcontroller
- 12 kB on-chip flash memory, plus optional additional 2 kB (for example for LF-bootloader)
- 160 Byte retention RAM hinzufügen
- 315 and 434 MHz FSK/GFSK/OOK/ASK RF transmitter
- Output power of 5 dBm
- 125 kHz ASK high-sensitivity LF receiver
- Advanced power control/wake-up system to minimize battery consumption
- Ultra-low powerdown current of < 540 nA
- Supply voltage range from 1.6 to 3.6 V
- Operating temperature range from -40 to +125°C
- DSOSP-14-82 package
- RoHS compliant, green package

Product	Pressure range [kPa]	On-chip flash memory [kB]	Key features
SP400-11-01	100–900	12	› Highest integration › Very low energy consumption › Robust g- and p- sensor › High LF sensitivity
SP400-11-11	100–900	12 + 2	



SP40 fully supports all necessary requirements for a Tire Pressure Monitoring System (TPMS)

XENSIV™ radar sensors ICs

Giving “eyes” to all sorts of things

Radar offers a host of advantages over passive infrared (PIR) technology in motion detection applications. These include greater accuracy and more precise measurement of detected objects, paving the way for new capabilities in speed detection and motion sensing. These advanced capabilities enable all sorts of “things” such as robots, cars, smart home devices and even lights to “see” their surroundings and respond dynamically.

Market leader in radar chips, we offer a wide portfolio of mmWave radar sensors as part of our XENSIV™ family. Designed to support different industrial, home and consumer applications, this portfolio includes the smallest 24 GHz MMIC in the market as well as the largest and most integrated 24 GHz radar transceiver family currently available. In addition, customers can rely on us for the full range of automotive radar 24/77/79 GHz front-end MMICs (RASIC™) supporting everything from safety-critical applications such as automatic emergency braking to driver assistance systems.

RASIC™ automotive radar 77/79 GHz

Front-end ICs for automotive radars

RXS816xPL – family of single-chip front-end MMICs for 77/79 GHz automotive RADAR

Infineon has been delivering automotive 77GHz radar products for over 10 years. Infineon's family of radar transceiver IC (RASIC™) addresses the needs of 77/79 GHz radar for all safety-critical applications from automatic emergency-braking (AEB) to high-resolution radars in automated driving. It supports high modulation bandwidth up to 2 GHz using fast ramps for precise distance measurement and simultaneous transmitter operation for MIMO.

RXS816xPL is a highly integrated device that performs all functions of a radar front-end in a single device – from FMCW signal conditioning to generation of digital receive data output. On-chip sensors for temperature, output power andmultiplemonitors/supervisory circuits allow for calibration and monitoring. Programming and Status are communicated via SPI.

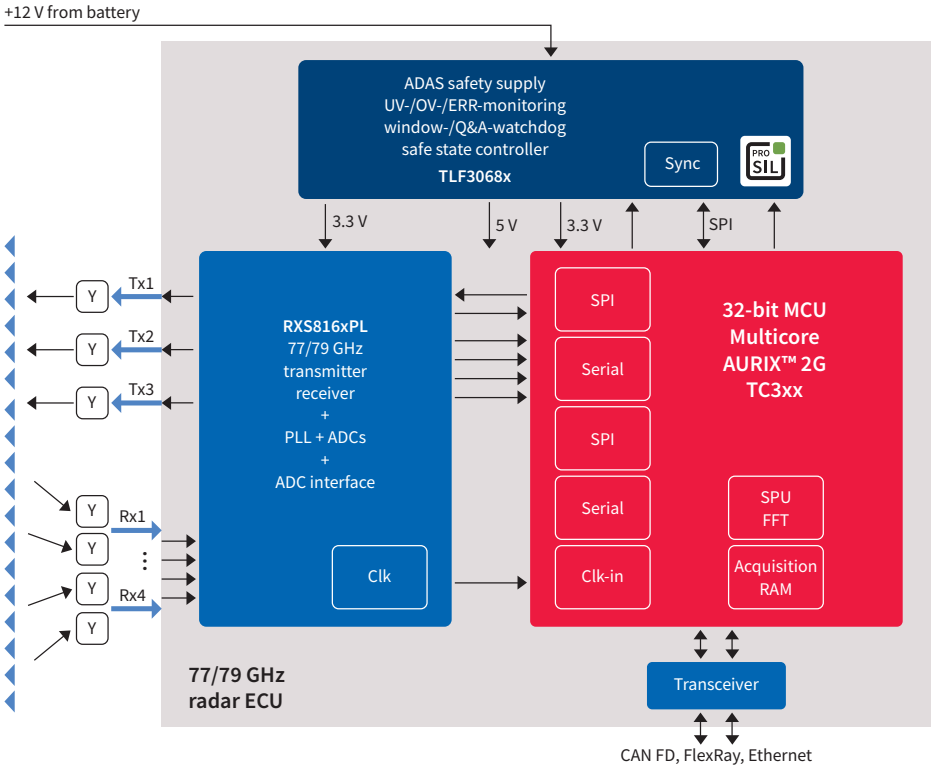
Infineon offers a complete suite of 77/79 GHz radar chipsets consisting of

- Radar 77/79 GHz RF Millimeter Wave IC family (RASIC™ RXS816xPL)
- Radar MCU family featuring radar signal processing units (2nd generation AURIX™ TC3xx)
- Radar system power supply with numerous safety functions (TLF3068x)
- Very compact 3-chip configuration (RXS816xPL+ AURIX™ TC3xx + TLF3068x) for e.g. AEB sensor

Customer benefits:

- One 77/79 GHz radar platform supporting all types of automotive radar applications
- Scalability by cascading multiple RF MMICs and MCUs enabling most advanced sensors
- Flexibility through numerous configuration parameters and on-chip monitoring functions
- ASIL-C support reducing customer R&D efforts

Product	Configuration	Key benefits	Features
RXS816xPL (coming soon)	3Tx4Rx	Single- and multi-chip versions in 7 x 8.5 mm eWLB package	› Flexible FMCW waveform generation › Up to 2 GHz modulation bandwidth › Four receive channels featuring integrated filters + AD converters › 4 channel LVDS data interface
RXS8156PLA (coming soon)	2Tx4Rx	Cost efficient solution for corner radars in 7 x 7.5 mm eWLB package	



www.infineon.com/rasic

24 GHz radar sensor ICs

Infineon offers a wide portfolio of mmWave radar sensors to address different customer requirements. The BGT24M/L family is the largest and highest integrated 24 GHz radar transceiver family currently on the market, saving ~30 percent board space compared to discrete line ups. Infineon provides a total of four 24 GHz industrial radar chips, providing a range of different transmitter and receiver channel configurations, supporting different application requirements.

Applications

- Building and smart home (IoT)
- Indoor/outdoor lighting
- Security
- UAV/multicopters
- Robotics
- Smart street lighting

Key benefits

- Direction, proximity and speed detection
- Hidden mounting capability
- Maintains operation through harsh weather conditions
- Motion tracking
- Sensitive enough to capture breathing and heartbeat
- Target positioning
- Adaptable to different application requirements

In addition to the Infineon BGT24M/L family of MMIC chips, Infineon provides a continuously expanding range of evaluation and demo boards to support the testing and development of radar in multiple applications. All boards are provided with base level software to support ease-of-use and faster to market integration.

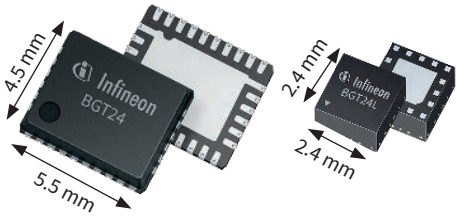
Utilizing our strong network of partners, the radar portfolio is extended to include a range of easy-to-integrate modules which each contain an Infineon 24 GHz MMIC.

Infineon's radar offerings

Infineon MMIC	Evaluation and demo boards	Radar modules
BGT24M/L family	Supporting testing and development	Turnkey modules and design support

Infineon BGT24M/L family of MMIC chips

The Infineon range of 24 GHz industrial radar chips provide four configurations of transmit and receiver channels ensuring there is a chip to support your specific application. From basic applications such as motion detection in security systems which only require one transmit and one receive channel, through to more complex applications like 3D positioning which require two or more receive channels, our range of radar chips support all of your requirements.

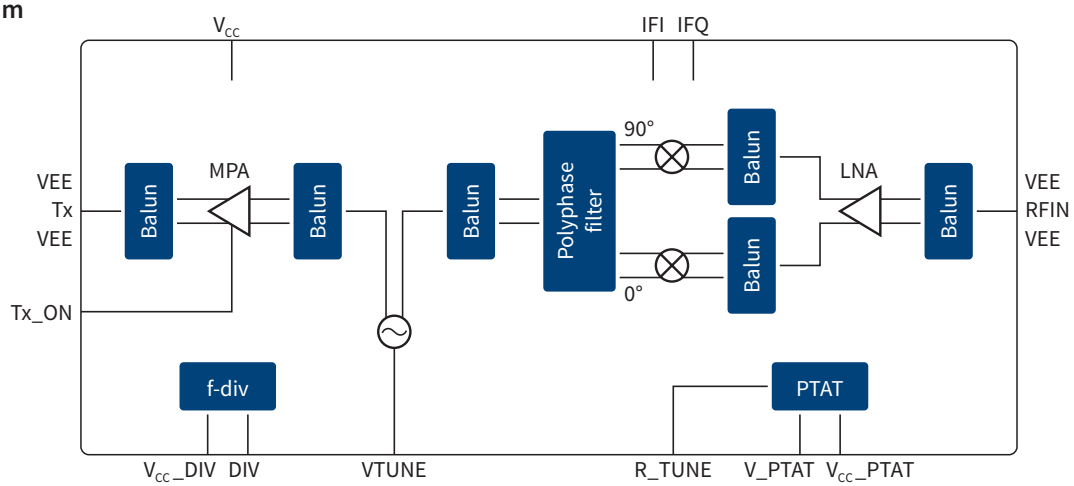
Features	Infineon MMIC	Benefits
› 24 GHz ISM band operation for motion, speed, direction movement and distance measurements › 4 MMIC chips available › Highly integrated		› Long range distance detection of moving objects up to 50 m › Wide range speed detection up to ±100 km/h › Lower BOM costs

Product	Configuration	Features
BGT24MTR11	1Tx + 1Rx	› Measures not just motion, but also speed, direction, and distance › Small form factor › Resistance to moisture, dirt and temperature › Increased area coverage › Discrete design › Energy savings › Privacy protection › Adaptable to different application requirements › Highly integrated chips eliminating costly external components
BGT24MR2	2Rx	
BGT24MTR12	1Tx + 2Rx	
BGT24LTR11	1Tx + 1Rx	

The BGT24LTR11N16 key features

- 24 GHz transceiver MMIC
- Fully integrated low phase noise V_{CO}
- Built in temperature compensation circuit for VCO stabilization
- Low power consumption
- Fully ESD protected device
- Single ended RF and IF terminals
- 200 GHz bipolar SiGe:C technology B7HF200
- Single supply voltage 3.3 V
- Divider output for PLL operation
- Smallest 24 GHz transceiver in the market

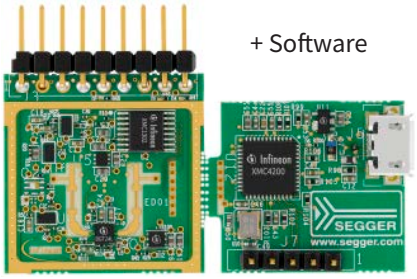
Block diagram



www.infineon.com/24GHz

24 GHz evaluation and demo boards

Our range of 24 GHz evaluation and demo boards continues to expand to support the needs of our customers and the increasing number of innovative ways radar is being incorporated into new applications.

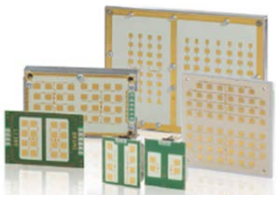
Features	Infineon development kit	Benefits
› Three system boards available › All include 24 GHz radar and XMC™ microcontroller › Kit contains user manual, GUI, MATLAB compiler and Gerber files › Requires software	 + Software Demokit with SW, reference design	› Capability to detect motion, speed and direction of movement (approaching or retreating) distance and angle of arrival based on hardware › Firmware/software available for each radar mode

Sense2GOL (BGT24LTR11 + XMC1300)	Distance2Go (BGT24MTR11 + XMC4200)	Position2Go (BGT24MTR12 + XMC4700)
› Capability to detect motion, speed and direction of movement (approaching or retreating) › Precise measurement of object detection compared to PIR › Operates in harsh environments and detects through non-metallic materials › Low power mode for enhanced battery life › One of the world's smallest complete radar + MCU development kit › BGT24LTR11 – 24 GHz highly integrated RF MMIC › XMC1300 ARM® Cortex®-M0 –32-bit industrial microcontroller › Debug over cortex 10 pin debug connector › Integrated multiple element patch antennas	› Capability to detect distance of multiple targets › Capability to detect motion, speed and direction of movement (approaching or retreating) › Operates in harsh environments and detects through non-metallic materials › BGT24MTR11 – 24 GHz highly integrated RF MMIC › XMC4200 ARM® Cortex®-M4 –32-bit industrial microcontroller › Debug over cortex 10 pin debug connector › Integrated multiple element patch antennas	› Capability to detect position of multiple targets › Capability to detect distance of multiple targets › Capability to detect motion, speed and direction of movement (approaching or retreating) › Operates in harsh environments and detects through non-metallic materials › BGT24MTR12 – 24 GHz highly integrated RF MMIC › XMC4700 ARM® Cortex®-M4 –32-bit industrial microcontroller › Debug over cortex 10 pin debug connector › Integrated multiple element patch antennas
Main applications › Security › Lighting control › Automatic door opener › Vital sensing	**Main applications** › Drone: soft landing/obstacle avoidance › Smart toilets › Tank level sensing › Intelligent switches	**Main applications** › Drone/robots: obstacle avoidance › Security › People tracking (IoT, smart home) › Vital sensing
Board dimensions › 25 mm x 25 mm (pictured with the Segger Debugger break-off board for reprogramming)	**Board dimensions** › Board 36 mm x 45 mm	**Board dimensions** › Board 50 mm x 45 mm
Kit contents › User's manual › SW GUI to operate kit › Schematic and bill-of-materials of module › Demonstration board	**Kit contents** › User's manual › SW GUI to operate kit › FMCW FW and SW[1)] › Doppler FW and SW[1)] › Schematic and bill-of-materials of module › Demonstration board › Corner reflector	**Kit contents** › User's manual › SW GUI to operate kit › FMCW FW and SW › Doppler FW and SW › Schematic and bill-of-materials of module › Demonstration board › Corner reflector

1) Usage of the FMCW and/or Doppler FW and SW requires agreeing to Infineon's user's agreement and licensing terms.

24 GHz modules

Partnering with the leading radar solution providers enables Infineon to connect our customers looking for turnkey solutions and design support for a complete range of applications.

Features	Partner modules using Infineon chips	Benefits
› Complete module, including radar MMIC, antenna options, MCU signal processing options, and SW options (Doppler, FSK and FMCW versions available)	 Module (RF module; RF module + MCU including SW)	› Ease-of-design › Turnkey solution, no need for test and certification

By integrating Infineon's 24 GHz MMIC chip into the partners easy-to-use and simple-to-integrate modules the complexity and time to market for a range of applications such as home automation, multicopter, robotics and street lighting, are reduced.

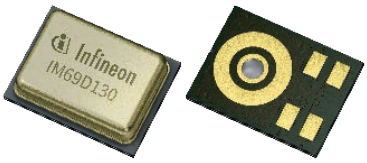
New application or simple PIR replacement? Radar has it covered.

Radar used in motion detection applications increases accuracy when compared to passive infrared (PIR) technology allowing a more precise measurement of object detection and providing new capabilities such as the detection of speed and direction of moving objects. Radar is also superior to camera-based systems by allowing detection of the objects while keeping identities anonymous.

Visit the link below to view our network of partners who provide modules and design support for all 24 GHz industrial applications: www.infineon.com/24GHzpartners

XENSIV™ MEMS microphone

Time to debottleneck your audio chain



The popularity of voice user interfaces and the usage of audio recording to share information and experiences are increasing dramatically. However, the performance of microphones often limits the potential of today's cutting edge devices. Not anymore!

Infineon's XENSIV™ MEMS microphones introduce a new performance class for digital MEMS microphones that overcome existing audio chain limitations. IM69D130 is designed for applications where low self-noise (high SNR), wide dynamic range, low distortions and a high acoustic overload point are required.

Don't miss a single thing!
With XENSIV™ MEMS microphones, you can create a new user experience benchmark in audio recording.

Talk to tomorrow and be heard!
With XENSIV™ MEMS microphones, you can define the benchmark in speech recognition for a new user experience.

Hear nothing but your favorite beats!
With XENSIV™ MEMS microphones, you can create headsets offering users a benchmark noise cancellation experience.

Features

- 69 dB(A) signal-to-noise ratio (SNR)
- Below 1 percent distortions at 128 dBSPL (130 dBSPL AOP)
- Digital (PDM) interface with 6 µs group delay at 1 kHz
- Tight sensitivity (-36 ±1 dB) and phase (± 2 deg) tolerances
- 28 Hz low frequency roll-off
- 4.0 x 3.0 x 1.2 mm package

Benefits

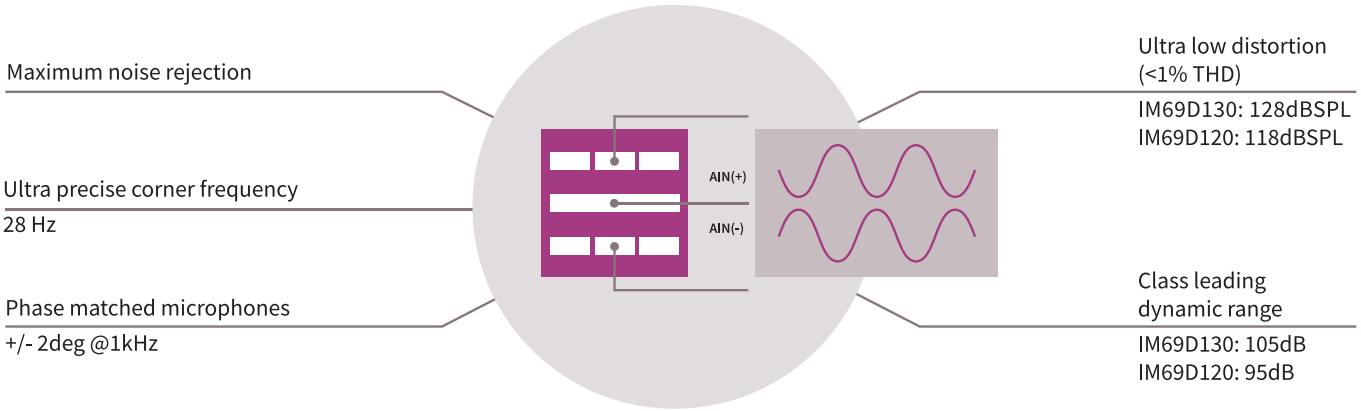
- High fidelity and far field audio recording
- Matched, noise and distortion free audio signals for advanced audio processing
- Ultralow group delay for latency-critical applications
- No analog components required

Typical applications

- High quality audio capturing: e.g. cameras, camcorders, conference systems
- Voice user interface: e.g. smart speaker, home automation and IoT devices
- Active noise cancellation: headphones and earphones
- Audio pattern detection: predictive maintenance, security or safety applications

www.infineon.com/microphones

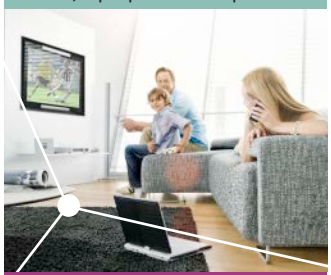
Infineon's dual backplate MEMS technology is based on a miniaturized symmetrical microphone design, similar as utilized in studio condenser microphones, and results in high linearity of the output signal within a dynamic range of 105 dB. The microphone noise floor is at 25 dB[A] (69 dB[A] SNR) and distortion does not exceed 1 percent even at sound pressure levels of 128 dB SPL (AOP 130 dB SPL). The flat frequency response (28 Hz low-frequency roll-off) and tight manufacturing tolerance result in close phase matching of the microphones, which is important for multi-microphone (array) applications.



Product	OPN	Current consumption [µA]	Sensitivity [dBFS]	Signal to noise [dB]	Supply voltage [V]	Package
IM69D130	IM69D130V01XTSA1	980	-36	69	1.62–3.6	LLGA-5-1
IM69D120	IM69D120V01XTSA1	980	-26	69	1.62–3.6	LLGA-5-1

Devices with voice user interface

TV, laptop and set top box



+ Highest beam-forming precision

Digital voice assistance and robots

+ Best speech recognition

Smart home appliances

+ Extended voice pick-up distance

Audio

+ Best audio quality

Conference

+ Ultra clear voice pick-up

Security

+ Sensitive to softest audio signals

Headsets

+ Best noise attenuation

Industry 4.0

+ Smallest pattern deviation detection

www.infineon.com/microphones

Functional safety – ISO 26262

ISO 26262

ISO 26262 defines the development of electric and electronic automotive systems with regard to their functional safety. The aim of this standard is to reduce possible hazards caused by the failure and malfunction of such systems. The safety requirements for the development process depend on the ASIL rating of the target application and can range from ASIL-A to ASIL-D. Applications such as steering or braking systems are rated with the highest ASIL-D level. A failure in such a system can lead to an out-of-control vehicle, possibly resulting in fatal injuries.

All newly developed parts, which are addressing a certain safety goal will be based on an ISO 26262-compliant development flow, thereby allowing direct use in all safety-relevant applications.

Devices which are developed prior to the ISO 26262 as a QM part can nevertheless be used in ISO-compliant systems as outlined in part 8 clause 13 of the standard. In such cases, it is mandatory “to provide evidence of the suitability of hardware components and parts” for use in ISO-compliant systems and also to provide failure modes, their distribution and diagnostic capability.

To support our customers as they strive to achieve the highest ASIL on system level, Infineon provides PRO-SIL™ ISO 26262-ready products the necessary support for qualification of existing pre-ISO 26262 products, , and fully PRO-SIL™ ISO 26262-compliant products the future:

What does ISO 26262 compliant mean?

PRO SIL ISO 26262 compliant

Infineon PRO-SIL™ ISO 26262-compliant safety sensors fulfil the properties required by the ISO 26262 (Automotive Safety) Standard. PRO-SIL™ ISO 26262-compliant product development follows a product specific safety plan defined by Infineon. The product development follows the Infineon V-model based development lifecycle which encompasses all ISO 26262 required activities and work products related to the product scope. Product relevant safety requirements and required metrics are captured and verified through the development of the product, this includes the product safety concept and ultimately a product safety case which provides the argumentation and evidence showing achievement of the defined safety requirements and process compliance, including all essential supporting processes.

An independent functional safety management organization supports the ISO 26262 conformance safety lifecycle.

For ISO 26262-compliant products a Safety Manual and a Safety Analysis Summary Report can be delivered to our customers in addition to Infineon standard documentation.

Moreover Infineon offers expert support for system integrators to achieve the required ASIL on system level. Infineon’s activities result in a simplified integration in safety-related applications.

What does ISO 26262 ready mean?

ISO 26262 ready

Infineon PRO-SIL™ ISO 26262-ready sensors are developed according to Infineon's sophisticated Automotive Development and Quality Standards. For ISO 26262-ready products additional functional safety analysis will be provided. ISO 26262-ready enables our customers to use Infineon's (QM) products in safety related applications.

For ISO 26262-ready products Safety Manual and a Safety Analysis Summary Report can be delivered to our customers in addition to Infineon standard documentation. These reports are provided to customers to serve as building block for their system level safety concept. Moreover Infineon offers expert support for system integrators to achieve the required ASIL on system level. Infineon's activities result in a simplified integration in safety-related applications.

Infineon PRO-SIL™

The functional complexity and levels of integration of real-time, safety-critical applications continue to increase.

Norms such as IEC 61508 and ISO 26262 mandate more robust products and functional safety concepts in automotive and industrial applications.

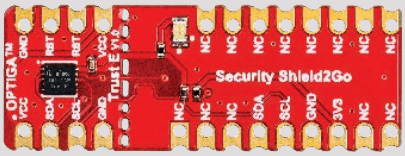
Infineon's PRO-SIL™ trademark designates Infineon products, which contain SIL-supporting (Safety Integrity Level) features. The SIL-supporting features are intended to assist the overall system design in attaining the desired SIL (according to IEC 61508) or A-SIL (according to ISO 26262) level for safety systems with high efficiency. Products with the PRO-SIL™ label will help you to select Infineon products for safety-relevant (automotive) systems.

More information on PRO-SIL™ can be found at www.infineon.com/prosil

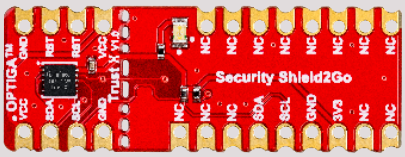
Shield2Go

Infineon's Shield2Go boards offer a unique customer and evaluation experience – the boards are equipped with one Infineon IC and come with a ready to use Arduino library. Customers can now develop their own system solutions by combining 2GO boards together with Infineon MyIoT adapters. MyIoT adapters are gateways to external hardware solutions like Arduino and Raspberry PI, which are popular IoT hardware platforms. All this enables the fastest evaluation and development of IoT system.

Security

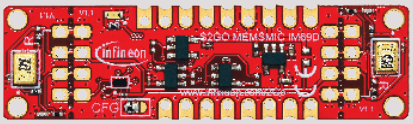


Product name: OPTIGA™ Trust E Security Shield2Go
Sales name: S2GO_Security_OPTIGA_E
SP: SP001820138
More at: https://www.infineon.com/cms/en/product/evaluation-boards/s2go-security-optiga-e/

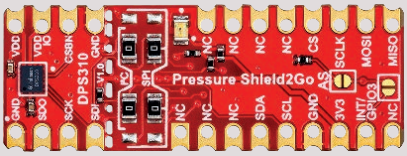


Product name: OPTIGA™ Trust X Security Shield2Go
Sales name: S2GO SECURITY OPTIGA X
SP: SP002349576
More at: https://www.infineon.com/cms/en/product/evaluation-boards/s2go-security-optiga-x/

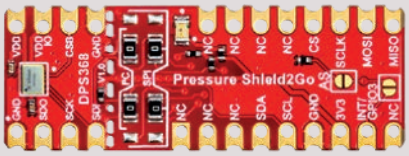
Sensors



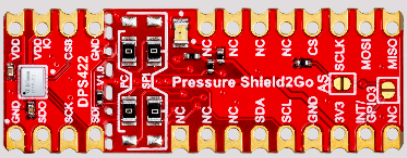
Product name: IM69D130 Microphone Shield2Go
Sales name: S2GO MEMSMIC IM69D
SP: SP002851544
More at: https://www.infineon.com/cms/en/product/evaluation-boards/s2go-memsmic-im69d/



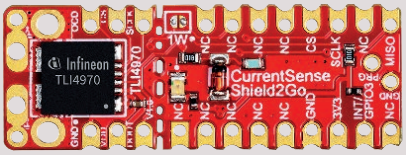
Product name: S2GO Pressure Sensor DPS310
Sales name: S2GO_PRESSURE_DPS310
SP: SP001777630
More at: https://www.infineon.com/cms/en/product/evaluation-boards/s2go-pressure-dps310



Product name: S2GO Pressure Sensor DPS368
Sales name: S2GO PRESSURE DPS368
Featured product: XENSIV™ pressure sensor DPS368
OPN: S2GOPRESSUREDPS368TOBO1
More at: https://www.infineon.com/cms/en/tools/landing/infineon-for-makers/shield-2go-my-iot/



Product name: S2GO Pressure Sensor DPS422
Sales name: S2GO PRESSURE DPS422
Featured product: XENSIV™ pressure sensor DPS422
OPN: S2GOPRESSUREDPS422TOBO1
More at: https://www.infineon.com/cms/en/product/evaluation-boards/s2go-pressure-dps422/

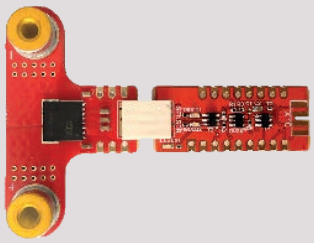


Product name: TLI4970 Current Sense Shield2Go
Sales name: S2GO_CUR-SENSE_TLI4970
SP: SP001823682
More at: https://www.infineon.com/cms/en/product/evaluation-boards/s2go_cur-sense_tli4970

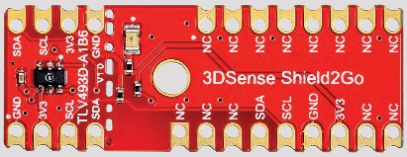
www.infineon.com/s2go-myiot

Shield2Go

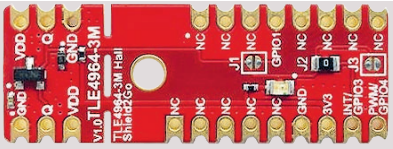
Sensors



Product name: TLI4971 Current Sense Shield2Go (coming soon)
Sales name: S2GO_CUR-SENSE_TLI4971
SP: SP005345472

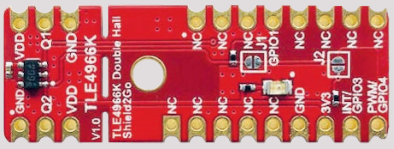


Product name: TLV493D 3DSense Shield2Go
Sales name: S2GO_3D-SENSE_TLV493D
SP: SP001823678
More at: https://www.infineon.com/cms/en/product/evaluation-boards/s2go_3d-sense_tlv493d



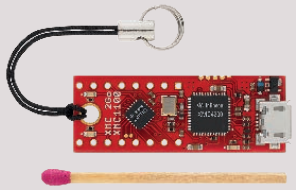
Product name: TLE4964-3M Hall Sense Shield2Go
Sales name: S2GO_HALL_TLE4964-3M
SP: SP004308590

Product name: TLE493DW2B6 3DSense Shield2Go
Sales name: S2GO_3D_TLE493DW2B6-A0
SP: SP004308594



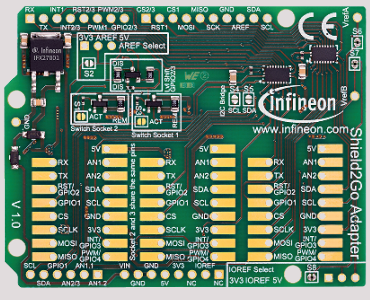
Product name: TLE4966K Double Hall Shield2Go
Sales name: S2GO_2_HALL_TLE4966K
SP: SP004308598

Microcontroller



Product name: XMC 2Go Kit
Sales name: KIT_XMC_2GO_XMC1100_V1
SP: SP001199544
More at: https://www.infineon.com/cms/en/product/evaluation-boards/kit_xmc_2go_xmc1100_v1

MyIoT – Adapter



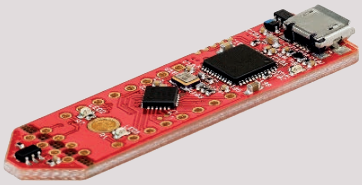
Product name: MyIoT Adapter
Sales name: MYIOTADAPTERTOBO1
SP: SP002434972

Infineon's 2Go boards offer a unique customer and evaluation experience – the boards are equipped with one Infineon IC and come with a ready to use Arduino library. Customers can now develop their own system solutions by combining 2Go boards together with Infineon MyIoT adapters.
MyIoT adapters are gateways to external hardware solutions like Arduino and Raspberry PI, which are popular IoT hardware platforms. All this enables the fastest evaluation and development of IoT system.

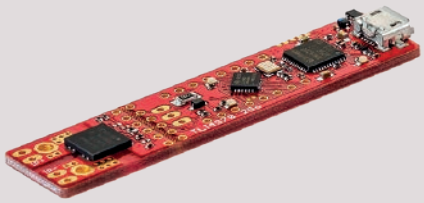
www.infineon.com/s2go-myiot

Sensor 2GO kits

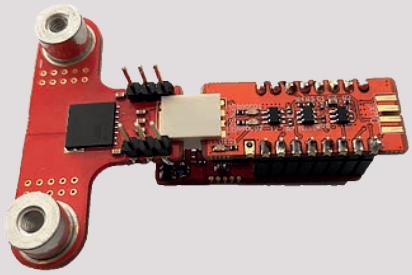
Infineon's XENSIV™ sensor 2GO kits are new budget-priced evaluation boards that are already equipped with a sensor combined with an ARM® Cortex®-M0 CPU. The sensor 2GO kits provide a complete set of on-board devices, including an on-board debugger. Build your own application and gadget with the sensor 2GO kits. Our 2GO kits are ready-to-use plug-and-play boards.



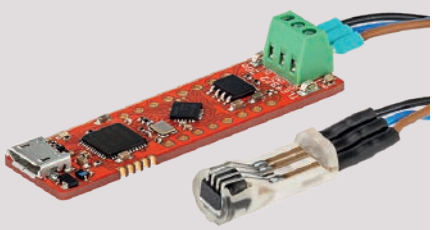
3D Magnetic Sensor 2GO kit
Product name: TLE493D-A2B6 MS2GO/TLE493D-W2B6 MS2GO/TLV493D-A1B6 MS2GO
SP: SP001707582/SP001707578/SP001707574
Features
- We offer three different derivatives
  - TLE493D-A2B6 (three dimensional magnetic sensor)
  - TLE493D-W2B6 (three dimensional magnetic sensor)
  - TLV493D-A1B6 (three dimensional magnetic sensor)
- XMC1100 (ARM® Cortex™-M0 based)
- On-board J-Link Lite Debugger (Realized with XMC4200 Microcontroller)
- Power over USB (Micro USB), ESD and reverse current protection
- GUI for free download



Current Sensor 2GO kit
Product name: TLI4970050 MS2GO
SP: SP003119148
Features
- TLI4970-D050T4 (current sensor with digital interface)
- XMC1100 (ARM® Cortex®-M0 based)
- On-board J-link lite debugger (realized with XMC4200 microcontroller)
- Power over USB (micro USB), ESD and reverse current protection
- GUI for free download



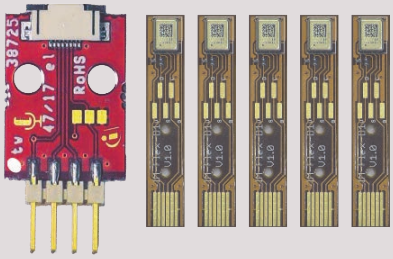
Current Sensor TLI4971 2GO kit (coming soon)
Product name: TLI4971 Shield2Go MS2GO
SP: SP00534547
Features
- XENSIV™ magnetic current sensor TLI4971-A120T5
- Plug-and-measure evaluation board
- First measurements possible within minutes



Speed Sensor 2GO kit
Product name: TLE4922 Speed-2-Go-Kit
SP: SP001624692
Features
- Budget-priced evaluation board for speed sensing
- Complete speed sensor incl. back-bias magnet, fixing and cable
- TLE4922 (active mono cell Hall sensor)
- XMC1100 (ARM® Cortex™-M0 based)
- On-board J-Link Lite Debugger (realized with XMC4200 microcontroller)
- Power over USB (Micro USB), ESD and reverse current protection
- GUI based tool for real in-application evaluation for free download

Sensor 2GO kits

Angle Sensor 2GO kit
Product name: TLE5012B_E1000_MS2GO/TLI5012B_E1000_MS2GO/ TLE5012B_E5000_MS2GO/TLE5012B_E9000_MS2GO
SP: SP002133956/SP002133960/SP002133964/SP002133968
Features
- Budget-priced evaluation board for angle and position sensing
- We offer three four derivatives:
  - TLE5012B E1000 version: automotive predefined variant with SSC and IIF communication protocols
  - TLE5012B E5000 version: automotive predefined variant with SSC and PWM communication protocols
  - TLE5012B E9000 version: automotive predefined variant with SSC and SPC communication protocols
  - TLI5012B E1000 version: industrial predefined variant with SSC and IIF communication protocols
- TLE5012B/TLI5012B GMR digital angle sensor
- XMC1100 (ARM® Cortex™-M0 based)
- On-board J-Link Lite Debugger (realized with XMC4200 microcontroller)
- The kit is compatible with the angle rotate knob for fast evaluation
- GUI based tool for real in-application evaluation for free download

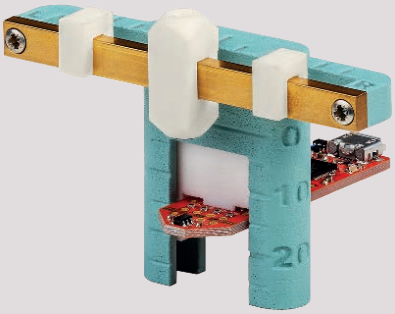


MEMS 2Go
Product name: EVAL_IM69D130_FLEXKIT
SP: SP002153022
The flex evaluation kit allows simple and easy evaluation of XENSIV™ MEMS microphone IM69D130. The flex board can be easily connected to audio testing setup. The evaluation kit includes five IM69D130 mounted on flex board and one adapter board.
Features
- Quick and easy evaluation of XENSIV™ MEMS microphones
- Flex dimensions: 25 x 4.5 mm
- Adapter dimensions: 20 x 15 mm

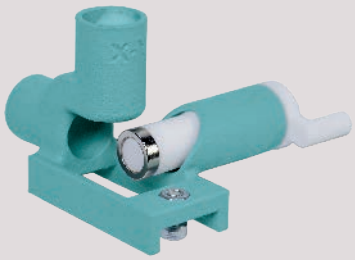
Add ons for Sensor 2GO kits and Shield2Go

Joystick for all 3D magnetic sensor 2GO kits and Shield2Go
Product name: JOYSTICK FOR 3D 2 GO KIT
SP: SP001491834
Features
- Easy mounting on all 3D magnetic sensor 2GO kits and Shield2Go
- Joystick with magnet
- Use case: 3 dimensional movements of Joysticks

Rotate Knob for all 3D magnetic sensor 2GO kits, angle sensor 2GO kits and 3D magnetic sensor Shield2Go
Product name: ROTATE KNOB 3D 2 GO KIT
SP: SP001504602
Features
- Easy mounting on all 3D magnetic and angle sensor 2GO kits as well as 3D magnetic sensor Shield2Go
- Rotate knob with magnet as used in control elements and push buttons
- Use cases 3D magnetic sensors: rotational and vertical movements of control elements and push buttons
- Use cases angle sensors: simulates rotational movements for angle measurements



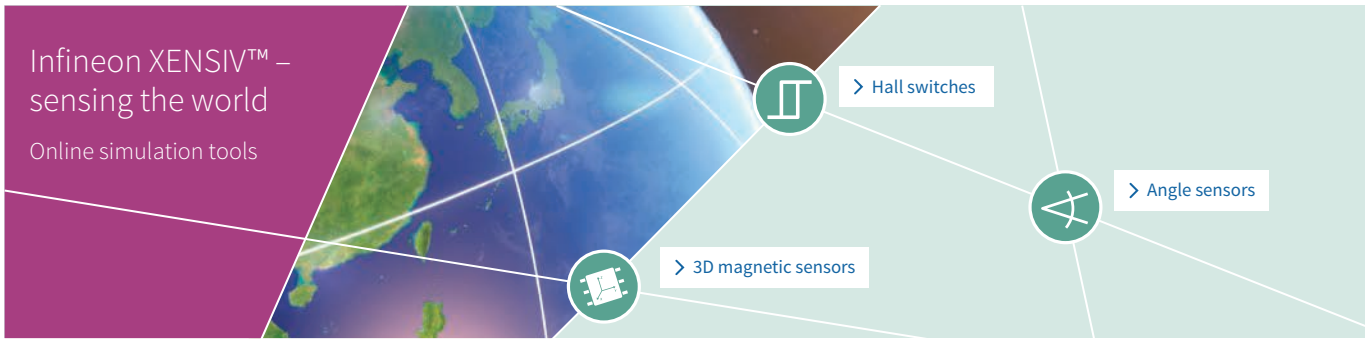
Linear Slider for all 3D magnetic sensor 2GO kits and Shield2Go
Product name: LINEAR-SLIDER 2GO
SP: SP002043034
Features
- Easy mounting on all 3D magnetic sensor 2GO kits and Shield2Go
- First magnetic Linear evaluations within minutes
- Use case: linear movements
- Linear slider with magnet – flexible setup: adaptable air-gaps, two different magnetic strengths/materials and distance limiters

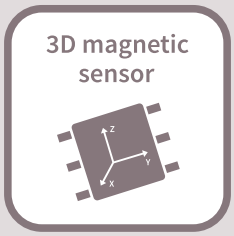


Out of shaft adapter for all 3D magnetic sensor 2GO kits and Shield2Go
Product name: OUT OF SHAFT FOR 3D 2 GO
SP: SP003475178
Features
- Easy mounting on all 3D magnetic sensor 2GO kits and Shield2Go
- Use case: angle measurement in out of shaft configuration with 3D Hall sensor
- Three different out of shaft configurations possible (x-z, y-z and x-y axis)
- Magnetic rotation bar with ring magnet included

Choose the best fit magnetic sensor solution from broadest portfolio

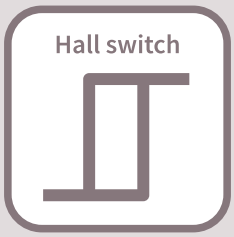
Our sensor simulation tools allow you to compare products in application conditions. The tools are easy-to-use and will guide you in identifying the most suitable Infineon XENSIV™ - Sensor combined with the best-fit magnet.





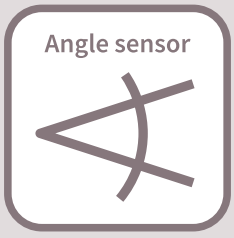
3D magnetic sensors simulation tool
The sensor family, with low current consumption and cost-optimized design, specifically addresses the needs of new magnetic sensor applications in consumer, industrial and automotive. They are ideally suited for the measurement of three dimensional movement within a magnetic field, linear slide movement as well as 360° angle rotation.

Direct link to the 3D magnetic sensors simulation tool:
http://www.infineon.com/3dsim



Hall switches simulation tool
Discover Infineon's broad energy saving portfolio of Hall switches in smallest package. Simulate your Hall switch applications and see the results in an accurate simulation of the magnetic field and the switching behavior of the Hall switch in the application.

Direct link to the Hall switches simulation tool:
http://www.infineon.com/hallsim

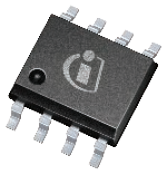
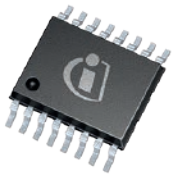
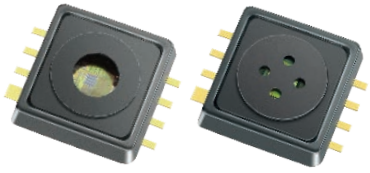
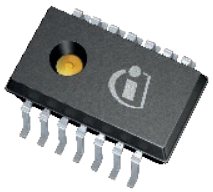


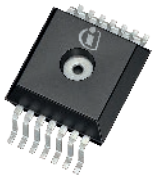
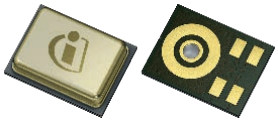
Angle sensors simulation tool
Highest variety – low end to high end, standardized and specialized in all four magnetic technologies: GMR, AMR and TMR. This tool calculates the valid distance from the magnet surface to the sensor and the assembly error, given certain parameters: magnetic properties , sensor specification and assembly tolerances.

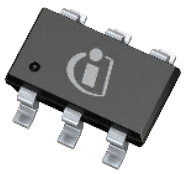
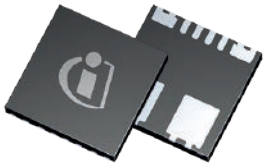
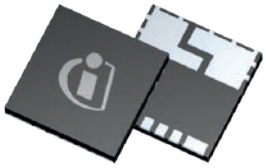
Direct link to the angle sensors simulation tool:
http://www.infineon.com/anglesim

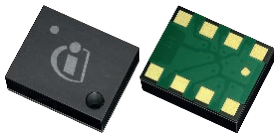
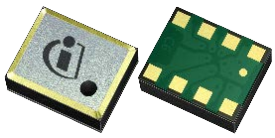
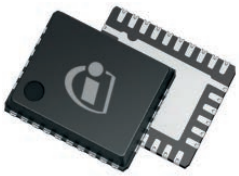
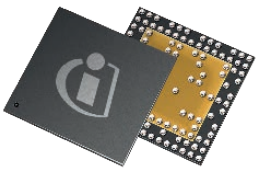
All simulation tools can be easily accessed via this link: https://www.infineon.com/cms/en/tools/landing/sensor.html

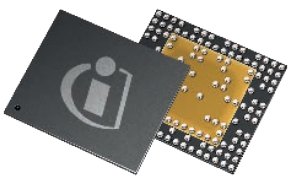
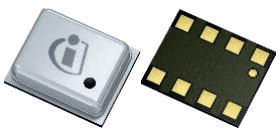
Packages

DSO-8/TDSO-8	TDSO-16	DSOF-8	DSOSP-14-6
			

DSOSP-14-82	LLGA-5	SC59	SOT23
			

TSOP6	TISON-8-1	TISON-8-5	TSNP-16
			

VLGA-8-1	VLGA-8-2	VQFN-32	WFWLB-131 (eWLB)
			

WFWLB-138 (eWLB)	WLGA-8
	

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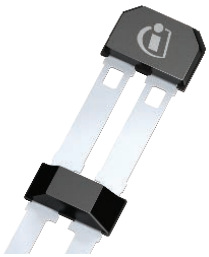
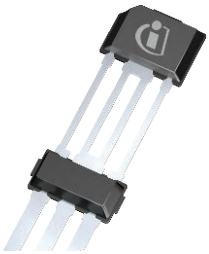
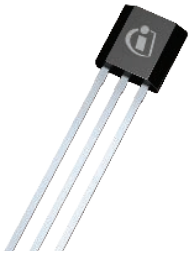
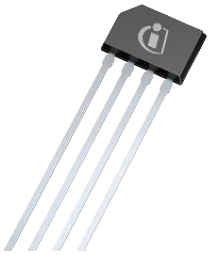
SSO-2-1	SSO-2-4	SSO-2-53	SSO-3-2
			

SSO-3-9/SSO-3-52/SSO-3-53	SSO-3-10	SSO-4-1	TO92S-3-1
			

TO92S-3-2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