Sensor Solutions for Automotive and Industrial Applications

www.infineon.com/sensors

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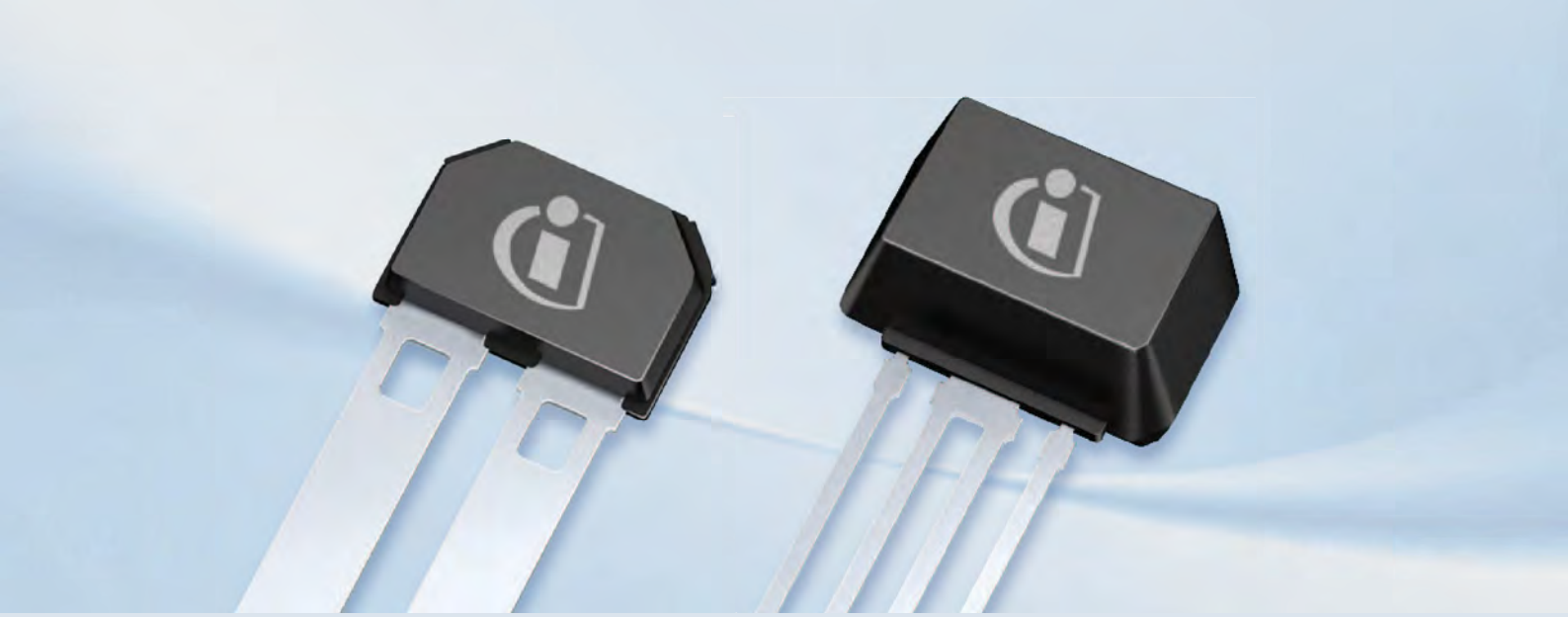


Infineon Sensors – Making lives easier, safer and more comfortable

At Infineon, we strive for in making lives **easier**, **safer** and **more comfortable by application of sensor technologies.** Leveraging our full innovation potential, our sensor ICs are at the heart of a wide range of sensing applications. They transform physical readings such as barometric air pressure, car tire pressure or various magnetic fields into electronic signals, which can then be processed further. To do this, the sensor ICs have to be in direct contact with the outside world, often functioning as standalone satellites that are not part of a protected circuit board. This means that they are exposed to significantly harsher mechanical, chemical and electrical forces than conventional semiconductor devices. The ability to withstand these environments calls for special packaging technologies, dedicated silicon processes and robust sensing elements – making sensor ICs complex and challenging devices to manufacture.

The sensor IC business is one of the fastest growing segments in the electronics market. Today, for example, Infineon already ships over one million sensor ICs every day, destined for a wide range of applications in the automotive, consumer and industrial sectors. We have established a very strong position in the **automotive** sector with the **broadest magnetic sensor portfolio** in the market, extending from standard Hall switches and angle sensors through highly accurate linear Hall sensors to all types of speed sensors. Approximately four of the 20 magnetic sensors found in every car worldwide are produced by Infineon.

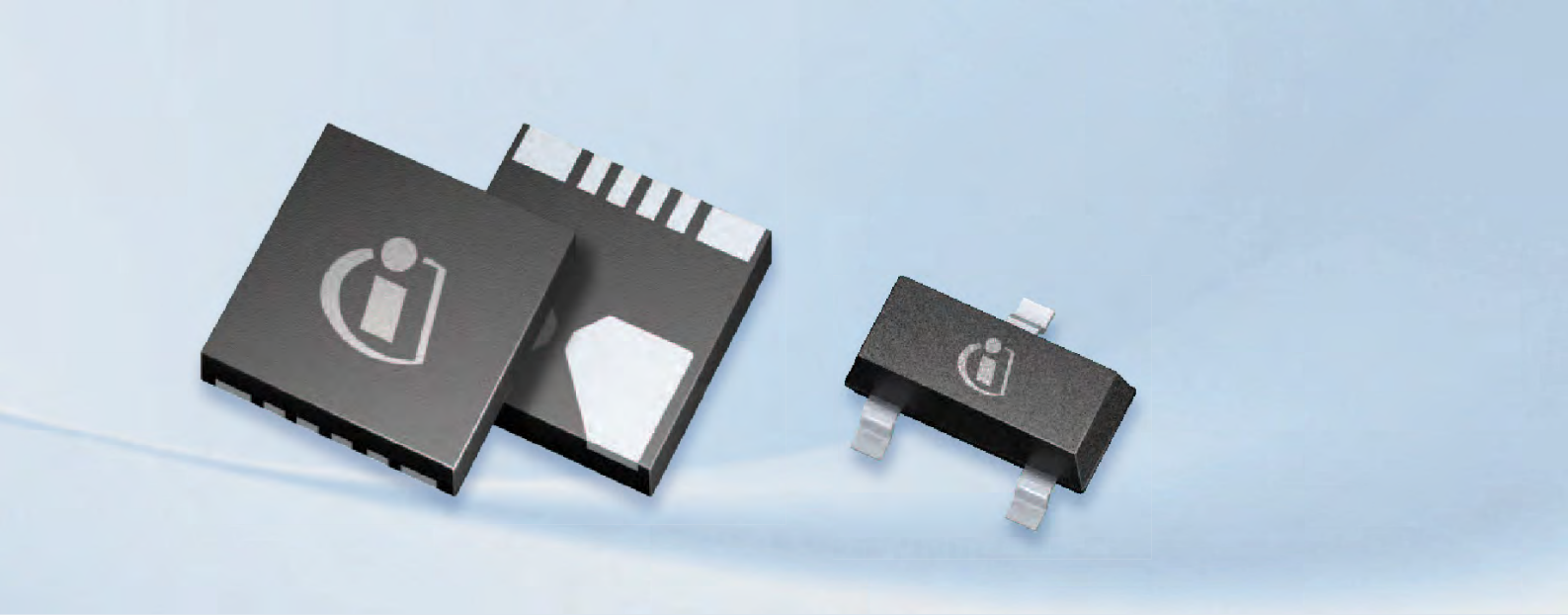
Today, a new car features up to 80 applications that rely on magnetic sensors. And this number is growing. We have kept pace with this development by diversifying our product offering. Whereas ten years ago, one type of speed sensor would have covered most speed sensing applications, we now have dedicated product lines for wheel speed, transmission speed, crankshaft and camshaft sensing. Our magnetic sensor portfolio now comprises over 250 different products.

At Infineon, we are committed to making cars **safer**. Our **side airbag pressure sensors**, for example, detect the spike in pressure caused by a side impact and trigger the side airbag. These sensors are located in the door compartments of a car and are regarded as the fastest method of deploying life-saving side airbags. Similar devices are also used in new pedestrian protection systems. These are designed to release a car's hood if it is involved in a collision with a pedestrian, thus lessening the impact for the pedestrian. The sensors are located in a tube in the car's bumper and trigger the hood if they detect a spike in pressure.

Our sensors for **Tire Pressure Monitoring System** (TPMS) also help to raise car safety levels by warning drivers of any loss in tire pressure. These important safety features are also good for energy efficiency – a car with tires that are not fully inflated consumes more fuel and the tires wear down more quickly. Pressure-related downtime is a significant cost factor for many operators of commercial vehicles, for instance. We have already shipped over 150 million TPMS sensors covering all tire pressure ranges, making us the **leading provider** of these safety-critical components for automotive system suppliers.

Ease of use is another factor that impacts driver comfort and safety. Our SiGe-based 77-GHz RF transmitters/receivers, for example, come in high-volume eWLB packages and are the ideal building blocks for cost-efficient **radar** systems used in Automotive Cruise Control (ACC), Blind-Spot Detection (BSD) and Auto-Emergency-Braking (AEB) applications. They also address upcoming Euro NCAP requirements for active passenger and pedestrian safety features.

Barometric air pressure sensors, for example, apply different pressure levels to various segments in a car seat to increase **comfort** levels. **Wheel speed** sensor ICs are also used to measure the speed of each wheel and detect whether a wheel blocks during breaking (ABS). This measurement is also the basic input signals for a car's Electronic Stability Program (ESP). ESP makes it easier – and therefore safer – for drivers to handle a car in critical situations. **Magnetic angle sensors** and **linear Hall** sensors are also used to measure **steering angle** and **steering torque**.



The number of **industrial and consumer** applications that rely on magnetic and pressure sensor ICs is also on the rise, further fuelling demand for our products. Hall switches and magnetic angle sensors, for example, are ideal solutions for current commutation in brushless drives (BLDC). Many applications require conventional block commutation – and Hall Switches are the perfect fit here. Efficiency levels can be raised further by directly measuring the rotor angle. This saves energy and eliminates vibrations, which in turn cuts noise levels and ensures **smoother integration**. The same angle sensor products are used in **e-bikes**, paving the way for more comfortable and energy-saving mobility concepts.

Providing sensor ICs for all of the examples above requires a very broad mix of technologies. As a **technology leader**, we use Hall and magnet to resistive sensing elements (GMR and AMR) for our monolithically integrated magnetic sensors. Our pressure sensors are built on surface and bulk micro machined MEMS technologies. Including our time within the Siemens organization, we have notched up over **40 years** of experience in the design, manufacture and marketing of a broad range of sensor types. Since Infineon itself was founded in 2001, we have shipped over **2 billion magnetic sensors** to customers in the automotive, consumer and industrial sectors. Our extensive offering and exacting quality standards reflect our commitment to making lives **easier**, **safer** and **more comfortable**. We are often regarded as the industry benchmark.

Broad portfolio of Hall Switches and Magnetic Angle Sensors for brushless DC industrial drives offering reliable operation and increased efficiency.

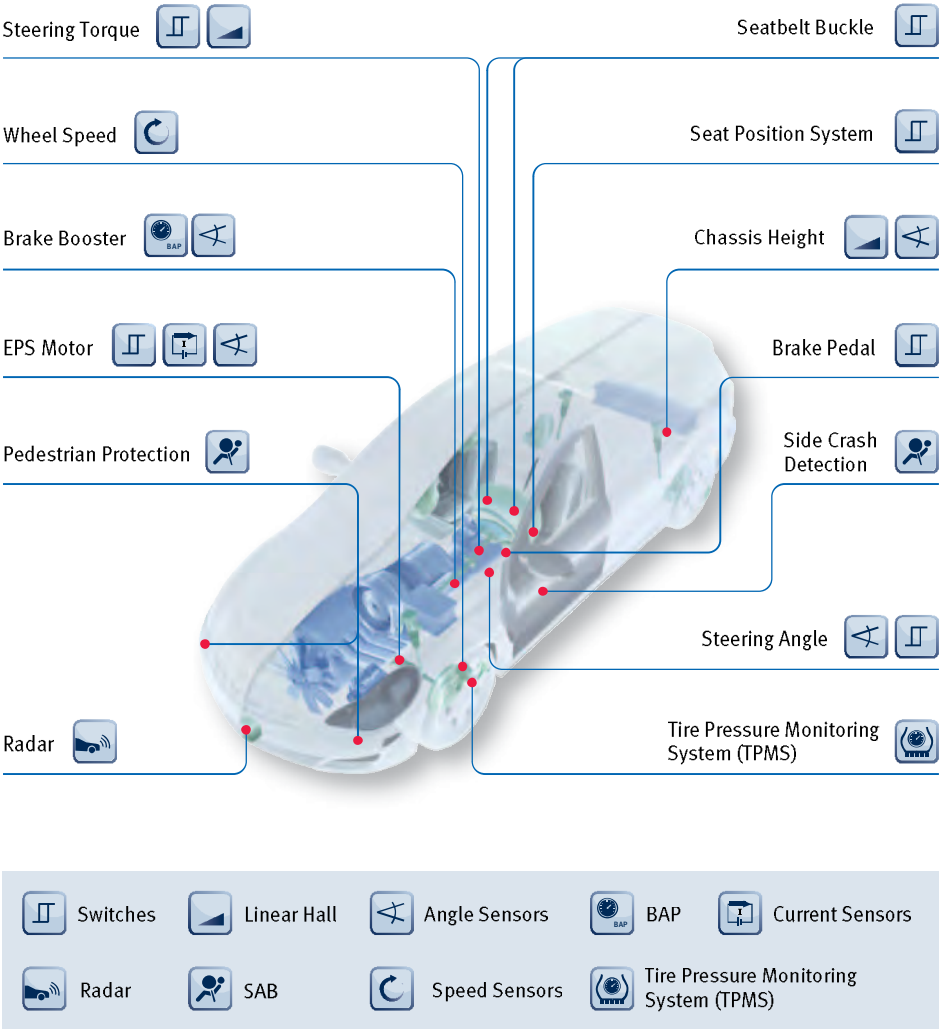
No. 1 for wheel speed sensor ICs in automotive. Strong position in engine & transmission speed. Leader in side airbag pressure sensors.

More than 2 billion sensors sold in the past ten years

Around four of the 20 Magnetic and Low Pressure Sensors used in today's cars are supplied by Infineon.

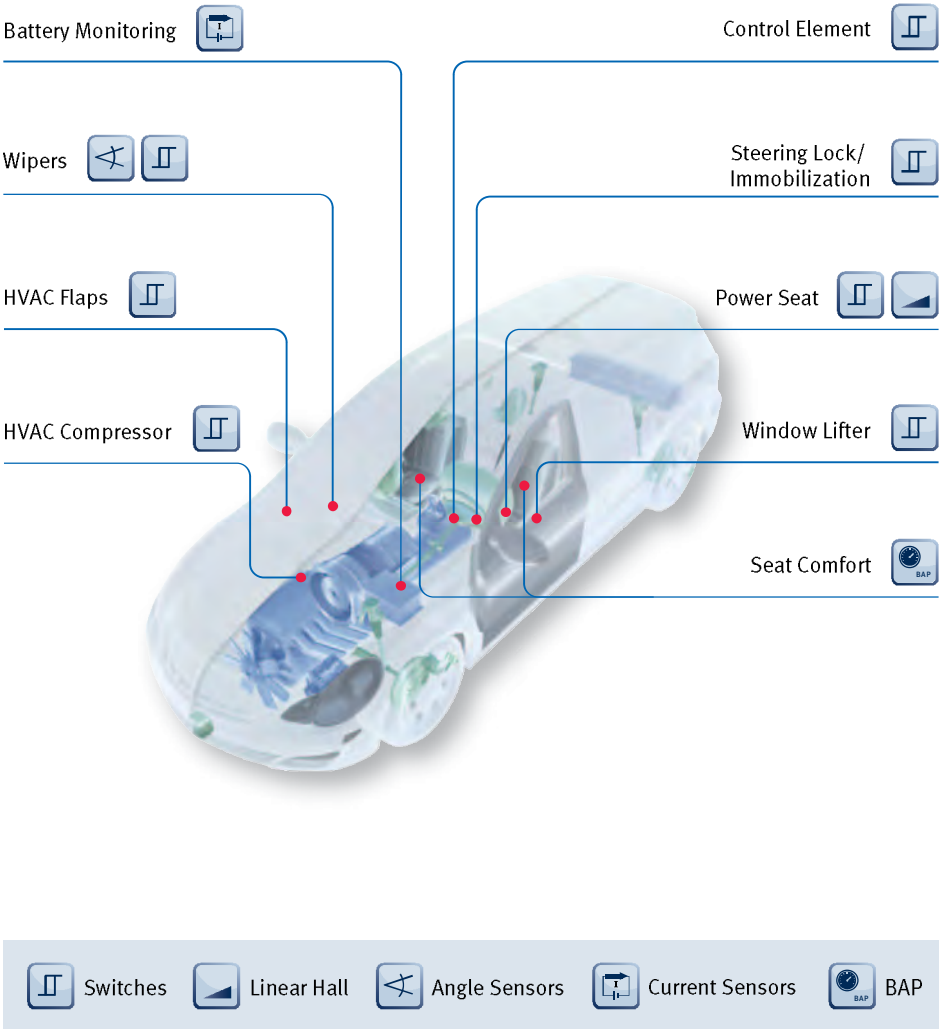
Only provider of Magnetic Sensors to cover the complete technology portfolio – Hall, AMR, GMR and TMR.

Sensors in Safety Applications



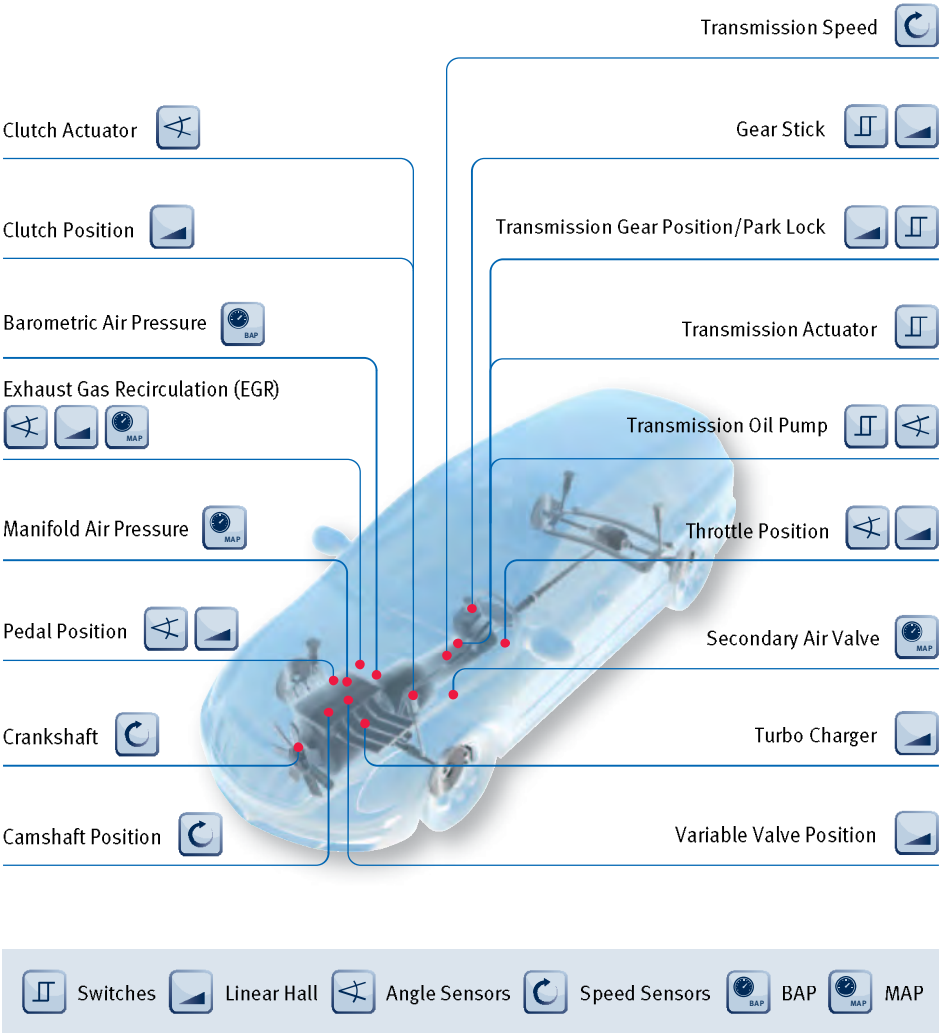
At Infineon, we focus in particular on sensors for safety applications. These include radars in automatic cruise control systems, wheel speed sensors in ABS and ESP features, pressure sensors in side airbags and pedestrian protection systems and TPMS sensors. We are the global market leader in most of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

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.

Sensors in Powertrain Applications



MAP and BAP pressure sensors as well as crankshaft, camshaft and transmission speed sensors are key elements of modern powertrain systems. They significantly raise drivetrain efficiency. We help to optimize powertrain designs with a broad portfolio of products to fit every customer requirement.

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/sev

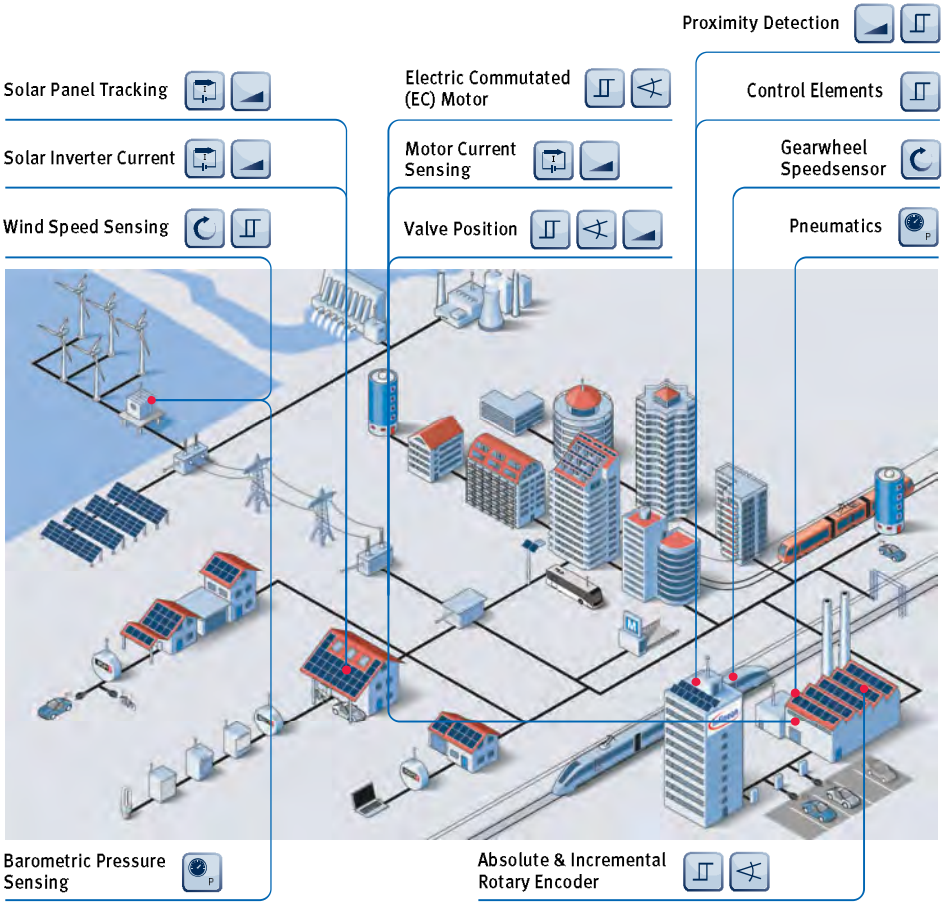


Commercial Vehicles

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 will find a dedicated solution for your individual body, powertrain and safety system commercial application.
www.infineon.com/truck



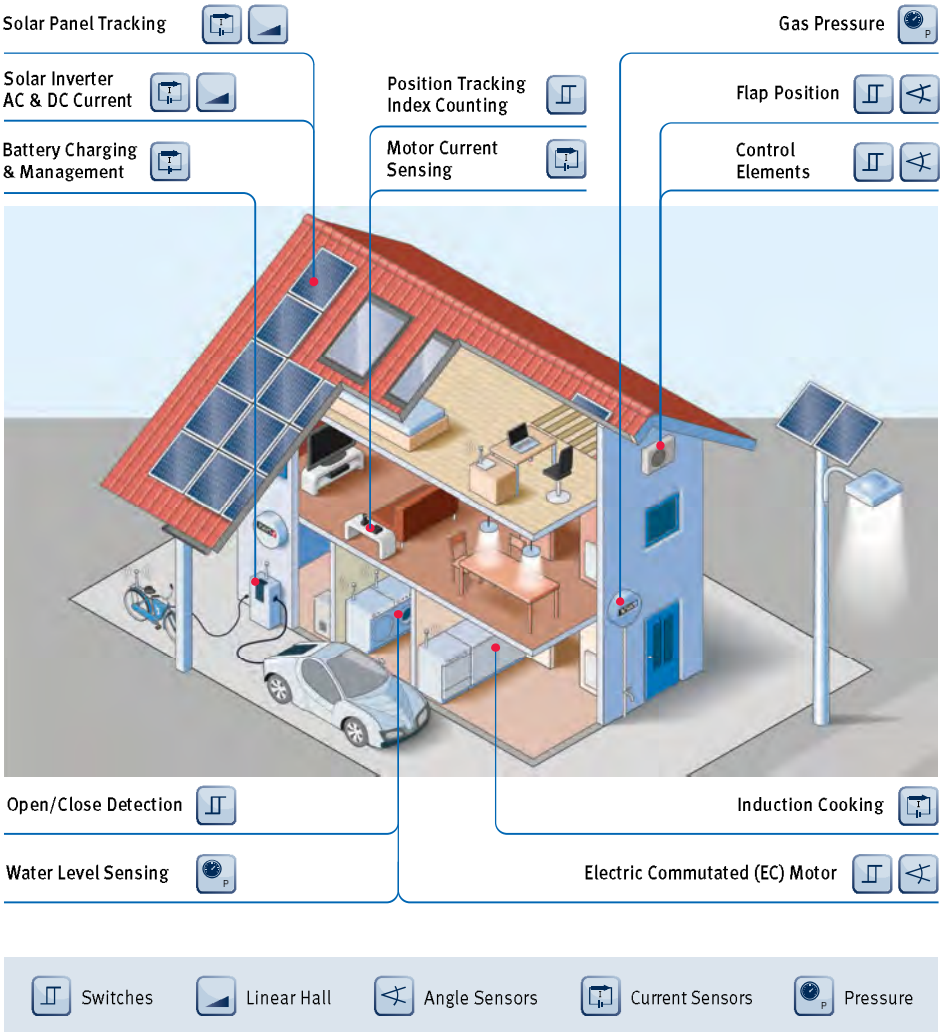
Sensors in Industrial Applications



Switches | Linear Hall | Angle Sensors | Current Sensors | Speed Sensors | Pressure

We develop sensors for a wide range of industrial applications, including renewable energy, industrial automation and e-mobility. Our offering here includes products such as magnetic position and speed sensors as well as integrated pressure sensors and current sensors. In the case of electric drives – a key area in industrial applications – our portfolio comprises a full range of energy-saving sensors for electric commutated drives. In the increasingly important solar sector, our current sensors help our customers achieve optimum system efficiency and meet country-specific regulations.

Sensors for Industrial/Home Applications



Our broad and deep sensor offering provides the perfect fit for various industrial/home applications, including renewable energy, white goods, home automation and power tools. In the home appliances sector, electric commutated BLDC drives are being increasingly used to reduce overall power consumption. We offer a competitive range of position sensors such as Hall switches and angle sensors for reliable, energy-efficient motor commutation in BLDC drives. Our sensors are also used in applications such as smart metering, solar inverters and sun blinds.

TLE49x6 Family

High Precision Hall Switches

The TLE49x6 family comprises high-precision, unipolar and bipolar Hall-effect switches as well as switches and latches for different magnetic sensitivities. TLE49x6 products have proven successful in many automotive and industrial applications. The family also includes two-wire sensors with a current interface as well as a low-power model that consumes just 4µA.

Features

- Broad, successful family concept
- High quality
- Chopped Hall system for high sensitivity
- High jitter performance
- SMD and leaded packages
- Open collector or current interface
- Low-power version available
- Temperature compensation
- Up to 18V supply
- Dedicated products for industrial applications (TLI49x6)

Applications

- Power closing (index counting)
- Gear stick (position detection)
- Seat belt (position detection)
- HVAC flap (position detection)
- BLDC commutation
- Two-wheeler applications

Product	Type	Operating Point B_{OP}	Release Point B_{RP}	Hysteresis ΔB_{HY}	ATV	Industrial	Package
TLE4906K/L	Unipolar switch	10.0	8.5	1.5	●	●	SC59/SSO-3
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
TLE4946-2K/L	Latch	2.0	-2.0	4.0	●	●	SC59/SSO-3
TLE4976L	Unipolar Switch/ Current Interface	6.0	4.0	2.0	●		SSO-3
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
TLE4916-1K	Low Power	3.5	-3.5	7.0	●		SC59

TLE496x-xM/L

Energy Efficient Hall Switch Family

The new TLE496x-xM/L family of Hall switches saves energy and enables designers to create precise, compact systems. With current consumption of just 1.6mA, TLE496x-xM/L products can cut energy needs 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 overtemperature and lifetime.

TLE496x-xM/L products come in the smallest SOT23 package, thus reducing height by 10 percent compared with predecessor products. The new sensors also feature an integrated functionality test for better system control.

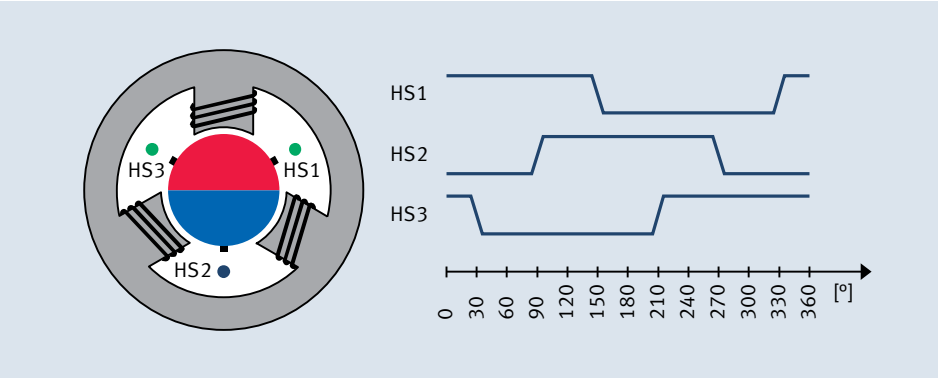
Features

- Current consumption of just 1.6mA
- 3 to 32V supply voltage range
- 7kV ESD protection (HBM)
- Overtemperature and overcurrent protection
- Temperature compensation
- Smallest SOT23 package

Applications

- Window lifter (index counting)
- Power closing (index counting)
- Gear stick (position detection)
- Seat belt (position detection)
- BLDC (commutation)

Block Commutation for BLDC Motors



Product	Type	Operating Point B_{OP}	Release Point B_{RP}	Hysteresis ΔB_{HY}	ATV	Package
TLE4961-1M/L	Latch	2.0	-2.0	4.0	●	SOT23/SSO-3
TLE4961-2M	Latch	5.0	-5.0	10.0	●	SOT23
TLE4961-3M/L	Latch	7.5	-7.5	15.0	●	SOT23/SSO-3
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

TLE4966

Two-In-One Double Hall Sensor

TLE4966 features two integrated, calibrated sensor elements for detecting direction and counting indexes. This two-in-one feature eliminates the need for a second sensor, which in turn cuts engineering and production costs. Using just one sensor also raises system quality and reliability.

Features

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

Applications

- Window lifter
- Sunroof
- Door power closing

Product	Type	Operating Point B_{OP}	Release Point B_{RP}	Hysteresis ΔB_{HY}	ATV	Package
TLE4966K/L	Double Hall, speed and direction output	7.5	-7.5	15.0	●	TSOP-6/SSO-4
TLE4966-2K	Double Hall, two independent outputs	7.5	-7.5	15.0	●	TSOP-6
TLE4966-3K	Double Hall, speed and direction output	2.5	-2.5	5.0	●	TSOP-6

TLE499x Family

Programmable Analog/Digital Linear Hall Sensor Family

Our 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 radiometric analog output while TLE4998P comes with pulse width modulation (PWM), TLE4998S with single edge nibble transmission (SENT) and TLE4998C with short PWM codes (SPC). These high-precision 12-bit resolution linear Hall sensors feature 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. TLE4998 also includes 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 overtemperature and lifetime (including stress compensation in TLE4998)
- Programmable transfer function (gain, offset), clamping, bandwidth and temperature characteristics
- AEC-Q100 qualified
- Available in various packages including PG-SSO-3-9 with two integrated capacitors to improve ESD and ESC behavior plus a single- and dual-die SMD package

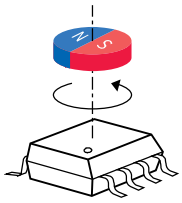
Applications

- 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
- Battery management
- Motor control

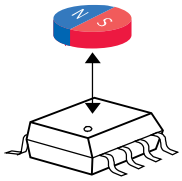
Product	Program-mable	Number of Pins	Sensitivity	Magnetic Offset	Supply Voltage (extended range)	ATV	Industrial	Package
TLE4997	EEPROM	3	±12.5 to ±300mV/mT	< ±400µT	5V ±10% (7V)	●	●	PG-SSO-3-10 PG-TDSO-8
TLE4998P	EEPROM	3/4	±0.2 to ±6%/mT	< ±400µT	5V ±10% (16V)	●	●	PG-SSO-3-10 PG-SSO-4-1 PG-SSO-3-9 (2 Capacitors) PG-TDSO-8
TLE4998S	EEPROM	3/4	±8.2 to ±245LSB/mT	< ±400µT	5V ±10% (16V)	●	●	PG-SSO-3-10 PG-SSO-4-1 PG-SSO-3-9 (2 Capacitors) PG-TDSO-8
TLE4998C	EEPROM	3/4	±8.2 to ±245LSB/mT	< ±400µT	5V ±10% (16V)	●	●	PG-SSO-3-10 PG-SSO-4-1 PG-SSO-3-9 (2 Capacitors) PG-TDSO-8

Angle Sensors

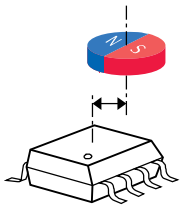
We offer a family of angle sensors based on integrated Magneto Resistive (ixMR) technologies. The sensors detect the orientation of an applied magnetic field by measuring sine and cosine angle components with monolithically integrated magneto resistive elements. ixMR technology is now widely used in automotive and industrial applications and provides a wide range of benefits.



Low sensitivity to air gap variations: The ixMR element senses a field's direction, not its intensity. Variations in field intensity within the sensor's range therefore have a minimal impact on angle accuracy.



Improved tolerance to misalignment: The area sensitive to ixMR is very small. It is therefore easier to keep it within the homogeneous zone of the magnetic field, in case of a small mechanical failure.



High speed: ixMR technology is extremely fast. Its speed is not limited by the reaction time of the MR element but by delays in the amplifier circuit.

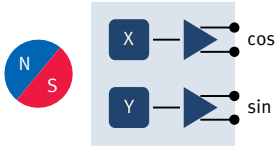
High degree of integration: The data processing and communication interfaces are integrated in the same silicon chip as the sensing elements. This enables compact designs using small outline packages. The angle sensors are available with a wide variety of communication interfaces as well as different levels of data processing and self-testing capabilities, making them ideal for safety-relevant applications in the automotive sector.

iGMR Sensors

Our iGMR sensors are ideal for applications with a wide angle range, for example BLDC motor or steering sensors. They are pre-calibrated and ready to use. Different levels of signal processing integration enable designers to optimize system partitioning.

TLE5009

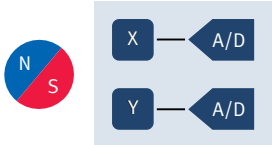
Analog iGMR Sensor with Temperature Compensation



TLE5009 features a differential or single-ended analog interface for sine and cosine values as well as internal temperature drift compensation for gain and offset.

TLE5011

iGMR Sensor with Digital Interface

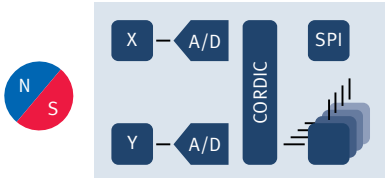


Features

- 16-bit representation of sine/cosine values on the interface
- Bi-directional SSC (SPI-compatible) interface up to 2Mbit/s
- Diagnostic function for sensor elements and circuitry with PRO-SIL™ support

TLE5012B

iGMR Sensor with Integrated Angle Calculation and Multiple Interfaces



Features

- Integrated angle calculation with CORDIC algorithm
- 15-bit representation of calculated angle value
- High update rate up to 43µs (23kHz)
- Range of selectable interfaces
- SPI-compatible synchronous serial communication (SSC)
- Bi-directional communication up to 8Mbit/s
- Pulse Width Modulation (PWM)
- Hall Switch Mode (HSM) for motor commutation
- Incremental interface (IIF)
- Temperature compensation and auto-calibration algorithm
- Diagnostic function for sensor elements and circuitry with PRO-SIL™ support

Applications

- Steering angle
- Brushless DC motor commutation (for example electric power steering, EPS)
- Rotary switches
- General angular sensing
- Incremental or absolute magnetic encoders

1) More information on PRO-SIL™, see page 38

iAMR Sensors

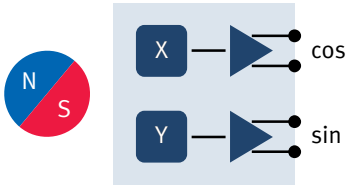
iAMR

180°

Our iAMR sensors are particularly well suited to applications with small angle ranges, including wipers, pedals and flaps. Thanks to their outstanding accuracy, they can also be used for some BLDC applications that only require information up to 180°.

TLE5109

180° Sensor with Analog Interface



Features

- Differential or single-ended analog interface for sine and cosine values
- Internal temperature drift compensation for gain and offset

Applications

- Contactless angle measurement
- Steering angle
- Motor commutation
- Wiper position
- Rotational position measurement

Device	Technology	Sin/Cos Output	Angle Output	Second Interface	Accuracy	ATV	Industrial
TLE5009	GMR	Analog			2.3°	•	•
TLE5011	GMR	SPC (SPI)			1.6°	•	•
TLE5012B	GMR	SPC (SPI)	SPC (SPI)	PWM/IIF/SPC/HCM	1°	•	•
TLE5109	AMR	Analog			0.9°	•	•

Magnetic Speed Sensors

Our Hall- and GMR-based magnetic speed sensors are designed to measure speed in safety and powertrain applications such as speedometers, ABS, camshafts/crankshafts and automatic transmissions. They are also used in similar applications in the industrial sector. The sensors use a ferromagnetic gear tooth or encoder structure to measure linear or rotational speed and position. Hall sensor measuring rotational speed with a gear tooth and a magnetic encoder wheel.

We offer a broad range of options to ensure the perfect fit for individual customer applications, including voltage and current interfaces with optional current detection or 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.

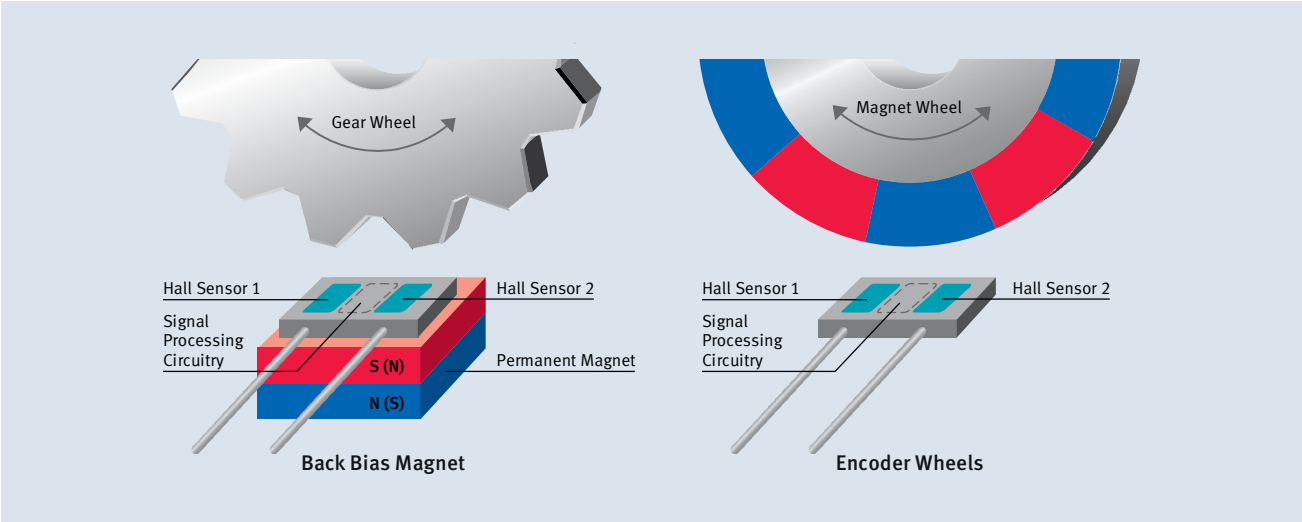
The majority of sensors also feature additional benefits such as integrated capacitors (-C types) for high EMC robustness and the highest levels of ESD protection. Our sensors also come in a range of innovative package designs with integrated back bias magnets (iBB package).

We have an outstanding record of excellence in the automotive sector. Over two billion of our integrated magnetic sensors are installed in cars all over the world, delivering extremely reliable results in safety-relevant applications such as ABS, and in extremely harsh environments such as engines and transmissions.

The Speed Sensing Family

Product	ATV	Industrial	Sensor Technology	AEC-Q100 Qualified	Package				Product Status
					Number of Pins	Interface[1]	Integrated Capacitor Available	iBB Package Option	
TLE4921	yes	yes	Differential Hall	yes	4	V			In Production
TLE4923	yes		Differential Hall	yes	3	C			In Production
TLE4924	yes	yes	Differential Hall	yes	3	V	yes (only)	yes	In Production
TLE4926	yes		Differential Hall	yes	3	V	yes (only)		In Production
TLE4927	yes	yes	Differential Hall	yes	3	V	yes (only)	yes	In Production
TLE4928	yes		Differential Hall	yes	3	V	yes		In Production
TLE4941	yes		Differential Hall	yes	2	C	yes		In Production
TLE4941plusC	yes		Differential Hall	yes	2	C	yes (only)	yes	In Production
TLE4942	yes		Differential Hall	yes	2	C	yes		In Production
TLE4943	yes		Differential Hall	yes	2	C	yes		In Production
TLE4951	yes	yes	Differential Hall	yes	2	C	yes (only)	yes	To be released in 2013
TLE4953	yes		Differential Hall	yes	2	C	yes (only)		In Production
TLE4954	yes	yes	Differential Hall	yes	2	C	yes (only)	yes	To be released in 2013
TLE4957	yes	yes	Differential Hall	yes	3	V	yes (only)	yes	In Production
TLE4983	yes		Mono-Hall	yes	3	V	yes (only)		In Production
TLE4984	yes		Mono-Hall	yes	3	V	yes (only)	yes	In Production
TLE4986	yes		Mono-Hall	yes	3	V	yes (only)	yes	To be released in 2013
TLE5025	yes		iGMR	yes	3	V	yes (only)		In Production
TLE5027	yes		iGMR	yes	3	V	yes (only)		In Production

Typical Application of a Magnetic Differential Sensor



1) C = Current; V = Voltage Interface

Integrated Back Bias Magnet (iBB) Package for Magnetic Speed Sensors

Our innovative PG-SSOM-x-x package solution with an integrated back bias (iBB) magnet is ideal for speed and position sensing applications that use ferromagnetic structures, for example gear wheels. This iBB package solution builds on our wealth of expertise in semiconductor manufacturing to deliver an extensive suite of benefits that reduces design effort and saves both time and costs.

With our extensive portfolio, we have the right solution and iBB package for a host of applications such as ABS, camshafts/crankshafts and transmissions.

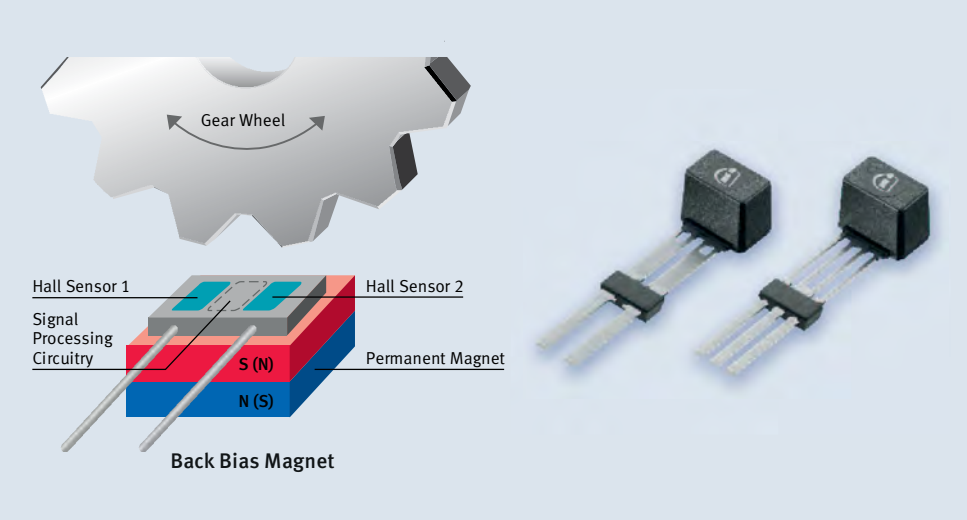
Features

- Extremely precise magnet shaping and magnet-to-sensor positioning for optimized sensor performance
- No special expertise required in magnetic circuit design for applications that carry out sophisticated speed and positioning measurements (camshafts, magneto resistive sensors)
- Good fit for welding and soldering processes
- Small iBB package size
- Cost-effective solution
- Easy to use

Applications

- Antilock Braking Systems (ABS)
- Camshafts/crankshafts
- Transmission
- Speedometer
- Industrial speed and position sensing

Gear Wheel Application with Back Bias Magnet



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. This differential Hall sensor delivers 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 cancelation, 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

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 speed sensing applications. Each sensor provides the highest levels of quality, robustness and cost efficiency. Thanks to the hysteresis and dynamic self-calibration algorithm, they are ideally suited to high-performance speed sensing applications in harsh environments, such as automotive engine or transmission applications.
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 1Hz 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 47nF/4.7nF 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

Type	Hysteresis	Comment	Package Option	
			Standard	iBB
TLE4924C-1	Visible fixed		PG-SSO-3-9	
TLE4924C(B)-2	Visible adaptive		PG-SSO-3-9	PG-SSOM-3-11
TLE4926C	Hidden fixed		PG-SSO-3-9	
TLE4926C-HT	Hidden fixed	High temperature profile	PG-SSO-3-9	
TLE4927C(B)	Hidden adaptive		PG-SSO-3-9	PG-SSOM-3-11
TLE4928C	Hidden fixed	200ms watchdog reset	PG-SSO-3-9	

TLE4941plusC

Analog and Digital Signal Processing On a Single Chip

TLE4941plusC is a differential Hall sensor that magnetically measures a car's wheel speed. It is the latest addition to our extremely successful TLE4941 family and also its drop-in replacement. TLE4941plusC is based on our most recent sensor technologies for front- and back-end systems.
Like its predecessors, TLE4941plusC is a single-chip solution that combines Hall sensor elements as well as analog and digital signal processing on a single chip. Its differential principle makes it immune to any kind of undesired magnetic fields and disturbances. The distance between Hall elements has been reduced to 2 mm, thus making it suitable for smaller encoders.

TLE4941plusC features a number of improvements to electrical and magnetic performance, including accelerated calibration during start-up and greater load dump robustness. First-edge-detection, which was optional in predecessor models, is now included as standard, thus ensuring that a reliable output signal is transmitted during rapid start-up before calibration is complete.

TLE4941plusC features a two-wire current interface and high ESD robustness as standard. It also functions in the broad temperature range required for harsh automotive environments. A sophisticated self-calibration algorithm compensates for magnetic and device offsets immediately after start-up.

Our commitment to outstanding quality and our position as a leading automotive semiconductor manufacturer mean that TLE4941plusC is an extremely robust product. With several hundred million units sold, our active wheel speed sensors have proven to deliver the functionality, robustness and flexibility needed for wheel speed sensing applications.

Features

- Two-wire current interface for minimum wiring
- Dynamic self-calibration principle to compensate for offsets
- Single-chip solution for outstanding reliability
- High sensitivity for large air gap applications
- Suitable for encoders and tonewheels, and also available with an integrated magnet for back bias applications
- High resistance to piezo effects for sensor overmolding
- Wide operating temperature range tailored to the needs of braking systems
- Integrated 1.8nF overmolded capacitor enhances EMC & microbreak resistance with no external components needed

Applications

- Wheel speed sensing in automotive applications
- Antilock Braking Systems (ABS)
- Electronic Stability Programs (ESP)
- Automatic transmissions

TLE5041plusC

iGMR

iGMR-Based Wheel Speed Sensor

The TLE5041plusC wheel speed sensor is designed for sophisticated vehicle control systems. It accurately senses rotational speed, enabling designers to integrate indirect tire pressure monitoring in anti-lock breaking (ABS) and electronic stability control (ESP) systems. TLE5041plusC is based on integrated Giant Magneto Resistive (GMR) elements that can detect the direction of a magnetic field. It delivers consistent performance and outstanding sensitivity over a wide temperature range, and features maximum robustness to electrostatic discharge (ESD) as well as electromagnetic compatibility (EMC). All of which enables it to meet the stringent requirements of harsh automotive environments. TLE5041plusC harnesses state-of-the art BiCMOS technology for the monolithic integration of sensing elements and signal conditioning circuitry, and therefore does not require external components.

Features

- Designed for indirect tire pressure monitoring systems
- Low jitter
- High sensitivity
- Wide air gap performance
- 2mm sensing iGMR element pitch for use with magnetic encoder wheels
- Differential front end highly immune to disruptive fields
- Two-wire current interface
- Monolithic integration on a single die
- No external components required
- Resistant to mechanical stress
- Wide temperature range from -40°C to +150°C

Applications

- Wheel speed sensing (ABS) or stability control systems with indirect TPMS feature (iTPMS)
- General wheel speed sensing (ABS)
- ESP
- Circumference-based tire pressure monitoring (TPMC)
- Frequency-based tire pressure monitoring (TPMF)

Type	Comment	ATV	Package
TLE4941	Differential sensor for wheel speed	●	PG-SSO-2-1
TLE4941C	As TLE4941 plus integrated capacitor	●	PG-SSO-2-2
TLE4941-1	As TLE4941 plus first-edge detection	●	PG-SSO-2-1
TLE4941-1C	As TLE4941-1 plus integrated capacitor	●	PG-SSO-2-2
TLE4942-1	Includes direction detection, air gap warning and assembly position diagnosis	●	PG-SSO-2-1
TLE4942-1C	As TLE4942-1 plus integrated capacitor	●	PG-SSO-2-2
TLE4941plusC	Successor to TLE4941 family and current high runner	●	PG-SSO-2-53
TLE4941plusCB	As TLE4941plusC plus integrated back bias	●	PG-SSOM-2-53
TLE5041plusC	Next generation wheel speed sensor plus improved sensitivity and low jitter	●	PG-SSO-2-53

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 1.8nF overmolded capacitor for improved EMI.

Features

- Detection of rotation direction
- Highly accurate speed measurements from zero to 12kHz 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

TLE4951/54C(B)

Leading the Way in Vibration Robustness

TLE4951/54 is a new family of differential Hall sensors specifically designed to meet the latest requirements in transmission vibration suppression. Each sensor provides best-in-class vibration suppression for applications that require a two-wire current interface. The TLE4951/54 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.

The TLE4951/54 speed sensor family provides the perfect fit every time. Designers can choose from a range of additional options to further customize their systems. TLE4954, for example, features direction detection. Different interface protocol versions of TLE4954 are also available as an integrated back bias magnet package (iBB).

Features

- Best-in-class vibration suppression
- Highly accurate speed measurements from zero to 12kHz over large operating air gaps
- Broad operating temperature range
- Option to use innovative iBB package solution
- Additional features for TLE4954
  - Direction detection
  - Four different interface protocol options for optimized system design
- AEC-Q100 qualified

Applications

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

TLE4957C(B)

Three-Wire Transmission Speed Sensor

Differential Hall sensor TLE4957 is the ideal choice for designers who prefer to use 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 and optional iBB-package make TLE4957 ideal for automotive and industrial speed sensing applications.

Features

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

Applications

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

TLE4983/84C(B)

Outstanding Camshaft Sensing

Our TLE4983/84 chopped mono-Hall sensor family comprises an excellent dedicated feature set. It is highly robust and comes with a module-style package with integrated capacitors. All of which makes it the perfect fit 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)
- Option to use innovative iBB-package solution with TLE4984
- AEC-Q100 qualified

Applications

- Camshaft speed and position sensing

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

iGMR

iGMR-Based Speed Sensor

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. TLE5027C is 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} < 1mT) 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

Applications

- Automatic transmission systems
- Engine speed (crankshaft)

Overview of Powertrain Speed Sensors

	Icon/ Description	TLE4921	TLE4923	TLE4924	TLE4926	TLE4927	TLE4928
Automotive	Wheel Speed		yes				
	Camshaft			yes		yes	
	Crankshaft	yes		yes	yes	yes	yes
	Transmission	yes		yes		yes	yes
Industrial		yes		yes		yes	
Sensor Technology		Diff. Hall	Diff. Hall	Diff. Hall	Diff. Hall	Diff. Hall	Diff. Hall
Improved Air Gap/ Jitter Performance							
Direction Information Available							
True Power On (TPO)							
Vibration Suppression Algorithm Included							
Type of Hysteresis[1]		V	V	V	H	H	H
		F	F	A/F	F	A	F
Interface[2]	# of pins	4	3	3	3	3	3
	Interface	V	C	V	V	V	V
	Protocol	S	S	S	S	S	S
Package without Integrated Capacitor		yes	yes				yes
Package with Integrated Capacitor				yes	yes	yes	yes
iBB-Package				yes		yes	

1) H = Hidden; V = Visible; F = Fixed; A = Adaptive; P = programmable
2) C = Current; V = Voltage Interface; S = Single Pulse; P = PWM Protocol; A = AK-Protocol
3) Coming soon

TLE4941	TLE4941plusC	TLE4942	TLE4943	TLE4951[3)]	TLE4953	TLE4954[3)]	TLE4957	TLE4983	TLE4984	TLE4986[3)]	TLE5025	TLE5027	TLE5041[3)]
yes	yes	yes	yes										yes
								yes	yes	yes	yes		
							yes				yes	yes	
yes		yes		yes	yes	yes	yes				yes	yes	
				yes		yes	yes						
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
											yes	yes	yes
		yes		yes	yes	yes						yes	
								yes	yes	yes			
				yes	yes	yes	yes						
H	H	H	H	V	V	V	V/H	H	H	V/H	H	H	H
F	F	F	F	A	A	A	A	F	F	P/A	A	A	A
2	2	2	2	2	2	2	3	3	3	3	3	3	2
C	C	C	C	C	C	C	V	V	V	V	V	V	C
S	S	P	A	P	P	P	S	S	S	S	S	P	S
yes				yes		yes							
	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
	yes						yes		yes	yes			

TLI4970

High-Precision Current Sensor

TLI4970 is a high-precision current sensor based on our proven Hall technology. The coreless concept significantly reduces footprint compared with existing solutions. TLI4970 is an easy-to-use, fully digital solution that does not require external calibration or additional parts such as A/D converters, OP amps or reference voltage. It thus significantly reduces overall implementation effort as well as PCB space and cost.

TLI4970 is more accurate than existing open- or closed-loop systems with magnetic cores. It also provides additional functions such as overcurrent detection and programmable filters yet has a significantly smaller footprint and lower power consumption.

TLI4970 is extremely robust against external magnetic fields thanks to implemented stray field suppression and is also suitable for fast overcurrent detection at a pre-configurable level. This allows the control unit to switch off independently of the main measurement path and protect power consumers from damage.

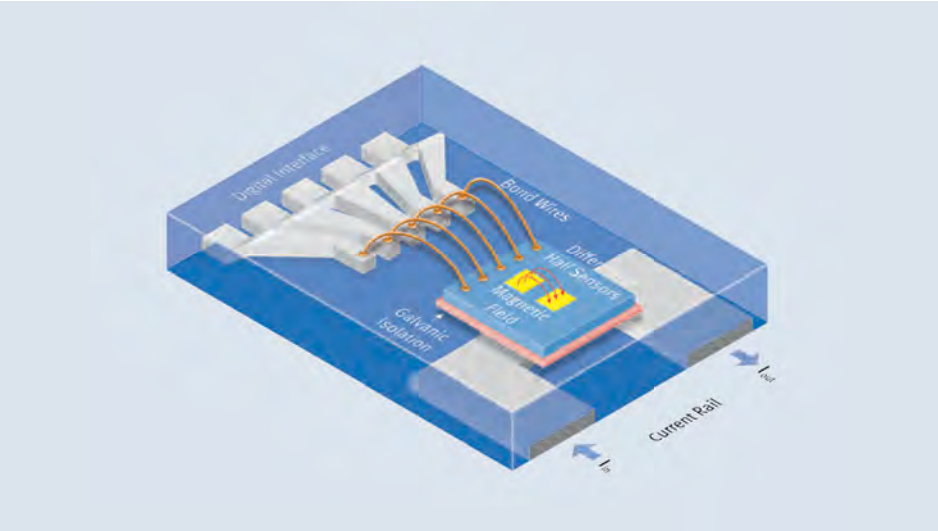
Features

- Fully calibrated digital output
- On-chip temperature and stress compensation
- Programmable low-pass filter for measuring current (0–10kHz)
- Fast, configurable overcurrent detector (>150kHz)
- Inherent magnetic stray field rejection
- Small package size and weight for SMD mounting

Applications (AC and DC current measurement)

- Photovoltaic inverters
- PFC power supplies
- Automotive and industrial battery chargers
- Torque control for electrical drives

Product	Programmable	Accuracy	Current Range	Internal Bandwidth	Resolution	ATV	Industrial	Package
TLI4970	EEPROM	±1% (FS)	±50A	150kHz	12.5mA	●	●	PG-TISON-8



Integrated Pressure Sensor ICs

Our integrated pressure sensor family uses unique multiple surface micro-machined capacitive sensor cell arrays that support powerful self-diagnosis features such as mechanical and electrical verification of sensor functionality. Monolithic integration onto a single chip enables state-of-the-art production using a standard automotive-qualified BiCMOS process. Sophisticated sensor cell design combined with fully digital signal conditioning and processing based on high-volume production flows ensures superior quality over the entire lifecycle.

These pressure sensors are ideal for a wide range of applications in the automotive and industrial sectors. The analog and digital interfaces of our pressure sensors provide customers with a high degree of design flexibility and enable manufacturers to meet evolving market demands.

Our digital interface portfolio ranges from PSI5 for safety products (for example side crash detection and pedestrian protection systems) through SPI for automotive powertrain and body applications (for example Barometric Air Pressure (BAP), fuel vapor and seat comfort systems) to I²C and SENT with SPC functionality for upcoming engine management products (for example MAP, Turbo MAP (with NTC) and secondary air valves).

Current automotive restraint systems use Infineon's side airbag pressure sensors to fulfill the steadily increasing safety requirements for passenger cars. In this safety-critical application, the pressure sensor is assembled within the car's side doors and provides – within fractions of a second – a digital crash signal to the central airbag unit. Self-diagnosis routines reliable proper operation every time.

As the safety standards for passenger vehicles increases beyond the side airbag for inmates to secure the safety of pedestrians, Infineon's new sensors (KP200 and KP201 for higher operating temperature) allow our customers to get the highest 5 stars evaluation for vehicle safety.

KP200/KP201

PSI5 PRO-SIL™ Pressure Sensor ICs for Side Crash Detection and Pedestrian Protection

Features

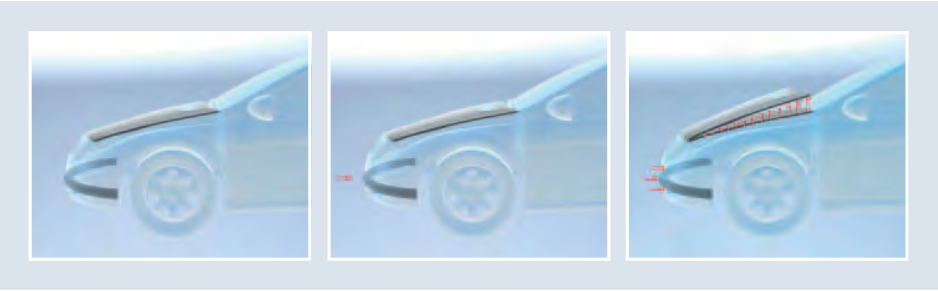
- Fully PSI5 compliant with support for multiple modes
- Fully AK-LV29 compliant
- Patented online diagnosis for pressure cells and circuitry with PRO-SIL™ support in line with IEC 61508 and ISO WD 26262
- Synchronous or asynchronous data transmission
- Two-wire interface with on-chip current modulator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

KP108/KP109

Multi-Protocol Pressure Sensor ICs for Side Crash Detection

Features

- Multiple protocols (including PAS3 and PAS4)
- Synchronous or asynchronous data transmission
- User-specific protocols available
- Two-wire interface with on-chip current modulator for Manchester communication
- EEPROM for ID number, calibration and mode selection
- Patented online diagnosis for pressure cells and circuitry
- Serial service interface
- On-chip voltage regulator
- Reverse polarity protection
- Green SMD package



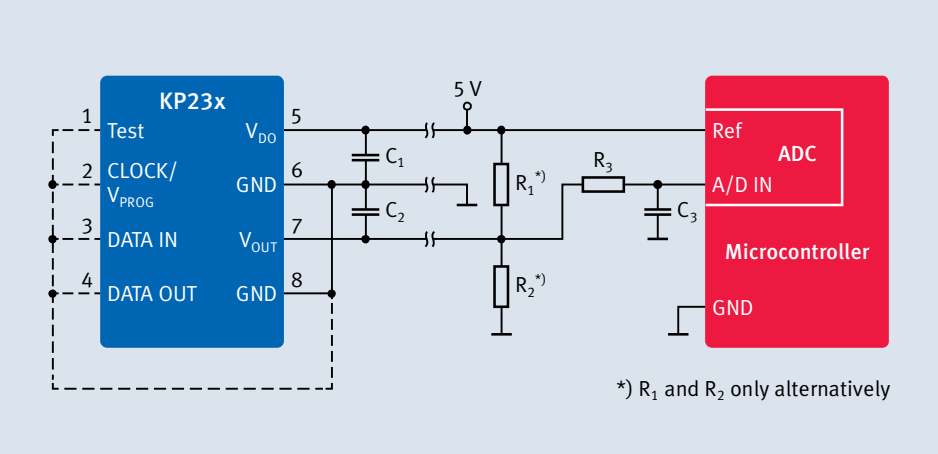
1) More information on PRO-SIL™, see page 38

KP23x

Analog Barometric Air Pressure (BAP) Sensor IC Family

Features

- Absolute air pressure measurement
- Excellent accuracy of 1.0kPa 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 115kPa
- Temperature range from -40 to +125°C
- Serial service interface
- Open Bond Detection for supply and GND (OBD)
- Self-diagnosis routines
- Inverse polarity protection
- Green SMD package



KP21x/KP22x

Analog Manifold Air Pressure Sensor IC Family (MAP + Turbo MAP)

Features

- Manifold air pressure measurement – MAP and Turbo MAP
- Excellent accuracy of up to 1.0kPa 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 400kPa
- Temperature range from -40 to +140°C
- Output clamping (optional)
- Complete product family available with multiple transfer function
- Reverse 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 1.0kPa over a large temperature range
- Output signal fully compensated across pressure and temperature range
- Pressure range from 40 to 165kPa
- Temperature range from -40 to +125°C
- Self-diagnosis routines & diagnosis codes
- Reverse polarity protection
- Diagnosis checks during operation
- Green SMD package

Automotive Applications Pressure Sensors

Applications

- BAP
- Seat comfort systems
- Fuel vapor
- Idle stop

Industrial Applications Pressure Sensors

Applications

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

Product	Pressure Range [kPa]	Max. Accuracy [kPa]	Max. Operating Temperature [°C]	ATV	Industrial
KP23x	40 ... 115	1.0	125	●	●
KP236N6165	60 ... 165	1.0	125	●	●
KP21x	10 ... 115	1.0	140	●	●
KP22x	10 ... 400	2.5	140	●	●
KP253	60 ... 165	1.0	125	●	●
KP254	40 ... 115	1.5	125	●	●
KP256	60 ... 165	1.0	125	●	●

SP27

General Sensor for Pressure Monitoring Systems (PMS)

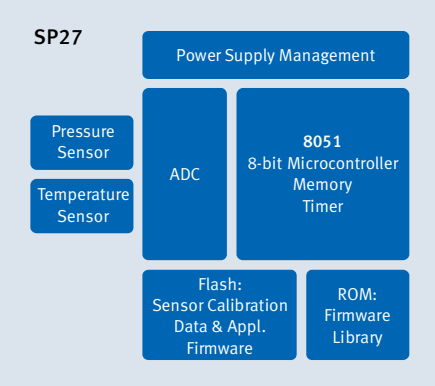
The SP27 sensor is designed for measuring pressure in PMS applications. With its microcontroller and integrated peripherals, the SP27 is a single package solution, requiring very few external components.

Pressure and temperature measurements are controlled by software. The microcontroller formats and processes the data for transmission. An intelligent wake-up mechanism reduces power consumption, while an interval timer controls the timing of measurements. The circuitry can be programmed to wake up at regular intervals. An external wakeup source can also be connected to a general purpose input/output (GPIO).

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 program code and is also used to store an unique ID number and the calibration data for the sensors. Additional on-chip ROM memory is available and contains ROM library functions (developed by Infineon) that cover standard tasks used by the application.

Features

- Pressure sensor (100 to 1300kPa)
- Temperature sensor
- Embedded 8051 compatible 8-bit microcontroller
- 6kB on-chip Flash memory
- 256Byte RAM
- Advanced power control/wake-up system to minimize power consumption
- Ultra-low standby current of < 0.7µA
- Supply voltage range of 1.9 to 3.6V
- Operating temperature range of -40 to 125°C
- PG-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	-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	-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

RASIC™

Front-End ICs for Automotive RADARs

Since volume production started in 2009, RASIC™ chips have become the market leader in the 77GHz SiGe MMIC segment. They can be used in different configurations to build RF front-end modules for sensors in applications such as Long-Range RADARs (LRR) (for example ACC), Lane Change Assist (LCA) and Blind Spot Detection (BSD) systems as well as in Collision Mitigation (CM) and Emergency Brake Assist (EBA) features. All components are AEC-Q100 qualified and specified over the full -40 ... +125°C automotive temperature range.

RXN774x Transceiver
4-channel transceiver for use in 2Tx 4Rx systems. Different antenna configurations can be supported.

RON7701 Transceivers
Optional dielectric reference oscillator/mixer (DRO) RON7701 for PLL-based systems (bare-die).

RTN7730 Transmitter and RRN7740 Receiver
RTN7730 and RRN7740 form a scalable radar platform comprising a three-channel transmitter and a four-channel receiver to build Long- and Mid-Range Systems (bare-die).

RTN7735P Transmitter and RRN7745P Receiver in eWLB
RTN7735P and RRN7745P are the first 77GHz solutions based on an eWLB package instead of a bare-die. They form a scalable platform comprising a three-channel transmitter and a four-channel receiver to build Long- and Mid-Range Systems.

RCC1010 RADAR Companion Chip
The RCC1010 radar companion is a CMOS chip which provides a fully digital interface to RTN7730 and RTN7735P. It features freely programmable modulation waveform generation and PLL frequency control.

SP37

Tire Pressure Sensor for Tire Pressure Monitoring Systems (TPMS)

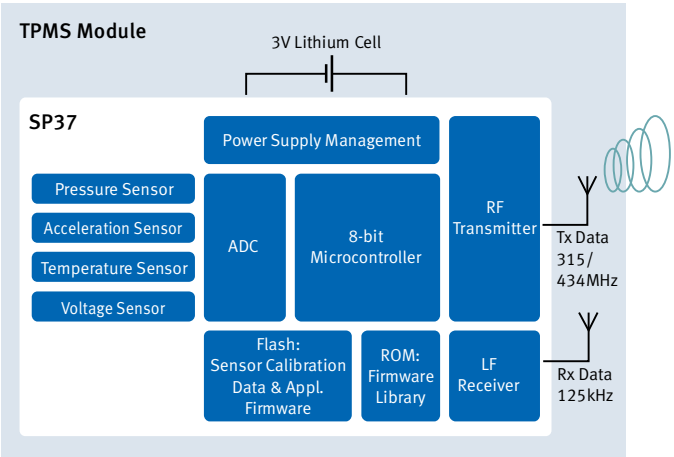
SP37 is a highly integrated device that performs all functions required for a Tire Pressure Monitoring System (TPMS) wheel module. It is ideal for high-volume applications, bundling the sensing elements, microcontroller, LF receiver, RF transmitter and other components in a single package. Only very few external components are required to create a TPMS module.

SP37 measures pressure, radial acceleration, temperature and supply voltage and is certified as a green package in line with RoHS. SP37 comes in a number of variants with different pressure ranges (100 to 450kPa, 100 to 900kPa and 100 to 1300kPa), making it the ideal choice for light vehicle and heavy truck applications.

Features

- Pressure sensor
- Radial acceleration sensor
- Temperature sensor
- Supply voltage sensor
- Embedded 8051 compatible 8-bit microcontroller
- 6kB on-chip Flash memory
- 256Byte RAM
- 315 and 434MHz FSK/ASK
- RF transmitter
- Output power of 5 or 8dBm
- 125kHz ASK high-sensitivity LF receiver
- Advanced power control/wake-up system to minimize battery consumption
- Ultra low standby current of < 0.7µA
- Supply voltage range from 1.9 to 3.6V
- Operating temperature range from -40 to +125°C
- PG-DSOSP-14-6 package
- RoHS compliant, green package

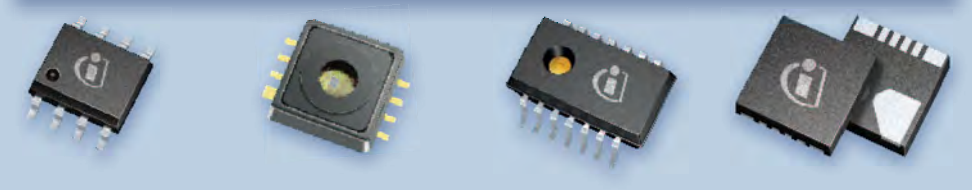
Product Name	Pressure Range	Key Benefits
SP370-25-106-0	100–450kPa	■ Single-pressure ■ Field-programmable via LF ■ RF datarate up to 20kbit/s
SP370-25-116-0	100–900kPa	■ Automatic pressure ■ Field-programmable via LF ■ RF datarate up to 20kbit/s
SP370-23-156-0	100–1300kPa	■ Single-pressure ■ RF datarate up to 10kbit/s



SP37 fully supports all necessary requirements for a Tire Pressure Monitoring System (TPMS)

Packages

PG-DSO-8/PG-TDSO-8 | PG-DSOF-8 | PG-DSOSP-14 | PG-TISON-8



SC59 | SOT23 | SOT89 | TSOP6

PG-SSO-2-1 | PG-SSO-2-2 | PG-SSO-2-53 | PG-SSO-3-2

PG-SSO-3-9 | PG-SSO-3-10 | PG-SSO-4-1 | PG-SSOM-2-11 | PG-SSOM-3-1

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