



Sensor Solutions for Automotive Applications

Vehicle Safety, Body and Powertrain Applications



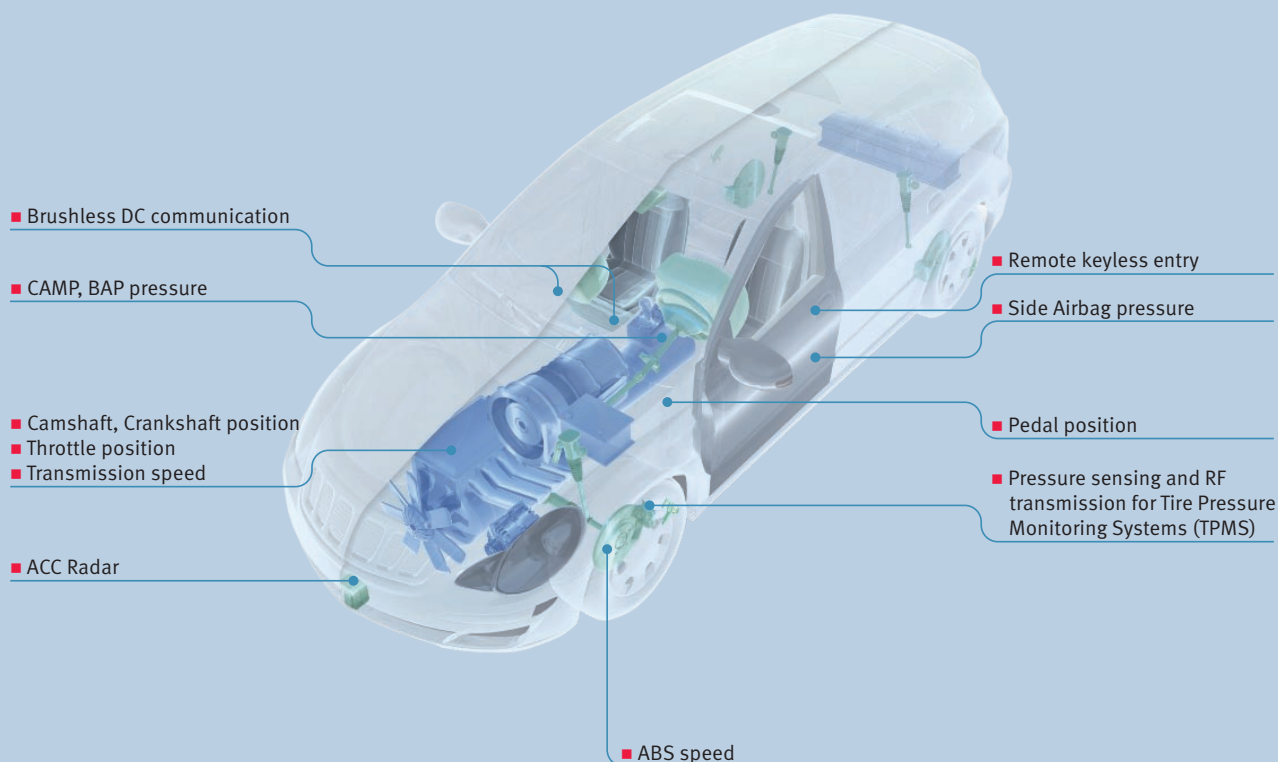
TODAY SEMICONDUCTOR SENSORS in cars are widely deployed in safety applications e.g. Anti Blocking System/Vehicle Stability Control, Radar, Airbag or Tire Pressure Monitoring Systems. Semiconductor sensors are also used in engine and transmission applications, where they are a key element in reducing fuel consumption and lowering emissions.

INCREASING REQUIREMENTS for higher accuracy, self-test capabilities and the need for fast data transmission are fueling the trend towards more intelligent sensors. A growing number of semiconductor sensors feature digital interfaces. Additionally, they have started taking over functions from the microcontroller, such as pre-processing tasks. Higher demands for convenience are driving the application of wireless interconnections, such as remote keyless entry. At the same time, remote sensor measurement requirements, as in tire Pressure Monitoring Systems, are driving the demand for wireless sensor interfaces.

MORE THAN 30 YEARS experience in automotive electronics enable us to steadily develop smarter sensors and combine different requirements taken from sensor and wireless technologies. The wide experience we have gained, on the one hand, and the continuous support of our customers, on the other, has made us the leading sensor supplier in key applications such as Anti-Blocking Systems, remote keyless entry, monitoring of side airbags or Tire Pressure Sensors. Worldwide we supply pressure and magnetic sensors as well as wireless control ICs and radar devices in areas such as safety, powertrain and body electronics.

INFINEON'S AUTOMOTIVE COMPONENTS, including our sensors and wireless control devices, have to comply with the high demands laid out in our automotive excellence programs. All components are tested to meet the highest quality standards and optimized accordingly. For example, our sensors are designed to work under extreme ambient temperature conditions, such as minus 40 and plus 150 degree Celsius, as well as at high humidity. This is achieved by focusing specially on package developments in order to protect the sensor chip and, at the same time, allow for high-precision measurement of environmental parameters. Our very high level of quality helps to continuously increase the reliability of cars.

Included in this brochure you will find details of our latest sensor products.



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Hall ICs

POSITION SENSING IS A KEY ELEMENT for improving system performance in automotive and industrial applications. The TLE 49xx series provides a wide range of sensors for position detection, i.e. Hall-effect switches and linear Hall-effect sensors. Both types of sensors use the well-known Hall-effect to transform the position information into an electrical signal. This allows for the design of very robust systems, e.g. against wear and tear, dust and particles.

TLE 49x5: Uni- and Bipolar Hall IC Switches for Magnetic Field Applications

THIS INTEGRATED Hall IC SWITCH SERIES consists of uni- and bipolar Hall switches which offer high reliability at low cost. The products are intended for automotive, industrial and consumer applications.

Features

- Temperature-compensated magnetic performance
- Digital output signal
- For unipolar and alternating magnetic fields
- Large temperature range
- Protection against reversed polarity
- Output protection against electrical disturbances
- Available in leaded (PG-SSO-3-2, designator "L") and SMD (SOT89, designator "G") packages

Applications

- Position/proximity indicator
- Rotational indexing
- Brushless DC motor control

Type	B_{OP}		B_{RP}		ΔB_{HY}		Package	Comment
	min.	max.	min.	max.	min.	max.		
TLE 4905L/G	7	18	5	16	2	6	PG-SSO-3-2/SOT89	unipolar switch
TLE 4935L/G	10	20	-20	-10	20	40	PG-SSO-3-2/SOT89	bipolar latch
TLE 4945L	-6	10	-10	6	2	10	PG-SSO-3-2	bipolar switch
TLE 4945-2L/G	-3	6	-6	3	1	5	PG-SSO-3-2/SOT89	bipolar switch

in mT at $T_j = 25^\circ\text{C}$

TLE 49x6: Chopped Uni- and Bipolar Hall IC Switches for Magnetic Field Applications

THE TLE 49x6 IS A FAMILY OF HIGH PRECISION, uni- and bipolar Hall-effect switches based on chopped Hall probes. Building on the successful TLE 49x5 Hall-effect family of switches, the improved TLE 49x6 product family broadens the existing product portfolio. These new devices are ideal for automotive and industrial applications such as sensing, commutation and index counting. The TLE 49x6 offers enhanced accuracy and robustness against electrical disturbances. This product is available as a two-wire sensor with current interface, a unipolar switch, a bipolar latch and a double Hall-effect latch with speed signal and direction information. Tiny SMD packages and slim leaded packages are available for high flexibility in design.

Features

- Chopped Hall system for high sensitivity and stability of magnetic switching points
- High jitter performance
- High resistance to mechanical stress due to active error compensation
- Low supply voltage capability
- Available in leaded (PG-SSO-3-2, PG-SSO-4-1, designator "L") and SMD (SC59, TSOP6-3, designator "K") packages
- Double Hall switch (TLE 4966L/K) with two independent Hall probes spaced at 1.45mm on one die, providing speed and direction information
- Two-wire current interface output (TLE 4976)

Applications

- Position detection systems (e.g. seat position, gear stick position, buckle switch state)
- Brushless DC motor commutation
- Index counting

Type	B_{OP}		B_{RP}		ΔB_{HY}		Package	Comment
	min.	max.	min.	max.	min.	max.		
TLE 4906L/K	6.5	13.5	5	12	0.7	3	PG-SSO-3-2/SC59	unipolar switch
TLE 4946K	11	17	-17	-11	22	34	SC59	latch
TLE 4946-1L	11	19	-19	-11	22	38	PG-SSO-3-2	latch
TLE 4946-2K/L	0.5	3.5	-0.5	-3.5	1.0	6.0	PG-SSO-3-2/SC59	latch
TLE 4966L/K	5	10	-10	-5	10	20	PG-SSO-4-1/TSOP6-3	double latch
TLE 4976L	1	6	3	8	0.5	3.5	PG-SSO-3-2	unipolar switch/current interface
TLE 4976-1K	5.5	11	5	11	0.5	3	SC59	unipolar switch/current interface
TLE 4976-2K	0.5	4.8	2	6	0.5	3	SC59	unipolar switch/current interface

in mT at $T_j = 25^\circ\text{C}$

TLE 4913/16-1K/17: Low Power Hall IC Switches

EXTREMELY LOW POWER CONSUMPTION and a tiny SMD package define both the TLE 4913 and the TLE 4917 as the ideal switches for applications such as cover detection in battery-powered devices (cellular phones, PDAs, etc.). Due to their outstanding sensitivity, small and low-cost magnets can be applied.

TLE 4916-1K is additionally specifically designed with its extended temperature range for automotive low power applications.

Features

- Low power consumption (10 μ W)
- Min. supply voltage of 2.4V
- Omnipolar magnetic switching characteristics (TLE 4913/17)
- TLE 4917: Output selectable by programming pin to regular or inverse
- SMD packages: TLE 4913/16-K in SC59 and TLE 4917 in TSOP6
- Low harmful substances compliant to RoHS
- TLE 4916-1K: Extended temperature range (-40°C ... +150°C) and automotive qualified



Type	B_{OP}	B_{RP}	ΔB_{HY}	Package
TLE 4913	3.5	2.7	0.8	SC59 (SOT23 pin compatible)
TLE 4916-14	3.5	-3.5	7	SC59
TLE 4917	5.0	4.0	1.0	TSOP6-1

in mT

Linear Hall ICs

ALL PRODUCTS OF OUR Linear Hall family work on the basis of measuring the vertical component of a magnetic field. The output signal they generate is directly proportional to the sensed magnetic field. Based on these principles, our TLE 499x family of Linear Hall ICs has been specifically designed to meet the requirements of highly accurate angular and linear position detection, as well as for current measurement applications.

Typical applications for our Linear Hall family include

- Linear and angular position sensing
- Pedal & throttle position
- Suspension control
- Steering angle
- Torque sensing
- Gear stick/lever position
- Liquid level sensing, e.g. in fuel tanks
- Headlight leveling
- Seat position or occupation detection
- High current sensing
- Battery management
- Motor control

TLE 4990: Programmable Analog Linear Hall Sensor

The TLE 4990 is a Linear Hall sensor based on an analog signal path, providing a ratiometric analog output signal. Its gain and offset as well as the sensor's clamping can be programmed with fuses. The sensor also incorporates a pre-programmed temperature compensation for increased stability.

Features

- Linear ratiometric output
- Programmable in sensitivity (gain), offset and clamping
- Temperature coefficient typically calibrated to 350ppm/°C
- Slim package PG-SSO-4-1 (1.0mm thickness)
- High voltage capability and reverse polarity protection
- On-board diagnostics (OBD) for broken wire detection
- Fully pre-programmed type (TLE 4990 E6782) available with sensitivity 20mV/mT, offset 2.5V and no clamping

Parameter	Derivatives					Unit
	TLE 4990	TLE 4997	TLE 4998P	TLE 4998S	TLE 4998C	
Interface	analog	analog	PWM (digital)	SENT (digital)	SPC (digital)	
Programmable	OTPROM	EEPROM	EEPROM	EEPROM	EEPROM	
Number of pins	4	3	3/4	3/4	3/4	
Package	PG-SSO-4-1	PG-SSO-3-10	PG-SSO-3-10 PG-SSO-4-1	PG-SSO-3-10 PG-SSO-4-1	PG-SSO-3-10 PG-SSO-4-1	
Sensitivity	15 ... 180	±12.5 ... ±300	±0.2 ... ±6	±8.2 ... ±245	±8.2 ... ±245	mV/mT
Magnetic offset	—	< ±400	< ±400	< ±400	< ±400	µT
Supply voltage (extended range)	5 ±10%	5 ±10% (7)	5 ±10% (16)	5 ±10% (16)	5 ±10% (16)	V

TLE 4997: Programmable Analog Linear Hall Sensor

The high precision 12-bit Linear Hall sensor TLE 4997 provides a ratiometric analog output voltage and incorporates EEPROM memory for flexible programming of many parameters. Digital signal processing using a 16-bit DSP architecture and digital temperature compensation guarantees excellent temperature stability compared to analog compensation methods.

Features

- 20-bit digital signal processing
- 12-bit overall resolution at wide output range
- 3 magnetic ranges: $\pm 50/100/200\text{mT}$
- Low ratiometric error, low integral & excellent differential nonlinearity
- Fully digital and deterministic second order temperature compensation
- Programmable transfer function (gain, offset), clamping, bandwidth and temperature characteristic
- Wide temperature range: $-40 \dots 150^\circ\text{C}$
- Low zero field offset and exceptionally low offset drift
- On-board diagnostics for pull-up/down loads
- Over/under voltage detection
- Mechanical robustness
- EMC, micro-break, reverse polarity and short circuit robustness on all pins
- Ultra low noise figure
- Parameter EEPROM with single bit error correction

Calibration and Programming Tools for the TLE499x family

- Programming tool for laboratory and evaluation purposes
- Supports two sensors in parallel
- Allows two-point calibration
- Fast connection to PC
- High resolution output value measurements
- Standard hardware box in robust case

TLE 4998P/S/C: Programmable Digital Linear Hall Sensors

The TLE 4998 is based on a similar concept to the TLE 4997. The analog interface is replaced by a selection of digital output protocols. The interface options include Pulse Width Modulation (PWM), Single Edge Nibble Transmission (SENT) as well as Short PWM Codes (SPC). The sensor is conveniently programmable in EEPROM and is available in two different leaded packages. With its temperature and stress compensation features, it provides outstanding performance stability over both temperature and lifetime.

Features

- 20-bit digital signal processing
- 12-bit overall resolution
- 3 magnetic ranges: $\pm 50/100/200\text{mT}$
- Low drift of output signal over temperature and lifetime
- Digital temperature compensation
- Programmable transfer function (gain, offset), clamping, bandwidth and temperature characteristic
- Wide temperature range: $-40 \dots 150^\circ\text{C}$
- Re-programmable until memory lock
- Single supply voltage 4.5–5.5V ($4.1\text{--}16\text{V}$ in extended range)
- On-board diagnostics (overvoltage, EEPROM error)
- Reverse polarity and overvoltage protection for all pins as well as output short-circuit protection
- High immunity against EMC, ESD and mechanical stress (stress compensation)
- Temperature information transmitted in SENT and SPC types
- Synchronous operation, range selection and bus capability with SPC interface



Magnetic Sensors for Safety and Powertrain Applications

OUR DIFFERENTIAL Hall ICs ARE ESPECIALLY DESIGNED for rotational speed measurement such as ABS, cam/crankshaft and automatic transmissions, as well as for position sensing, e.g. for power steering. The rotational speed sensors support both gear tooth and magnetic pole wheels. In order to provide the best fit for your individual application, we offer different options, e.g. voltage and current interfaces, with or without direction detection or vibration suppression. Also available are sensors with integrated capacitors (-C types) for EMC robustness or sensors for higher ESD requirements. Our angle sensor offers full 0–360° angle measurement, based on the Nobel Prize-winning GMR effect, realized with our unique technology. With more than half a billion magnetic Infineon sensors providing reliable service in cars all over the world, in both highly safety relevant applications such as ABS and extremely harsh environments such as engine and transmission, Infineon has proven once more its outstanding automotive excellence.

TLE 4941/42-x(C): Wheel Speed Sensing Family

THE TLE4941 IS THE HIGH RUNNER of Infineon's differential Hall sensor IC family for active wheel speed sensing. The product combines Hall sensor elements and both analog and digital signal processing in one chip. The TLE4941 has a standard two-wire current interface and high ESD robustness, and works within the wide temperature range present in the harsh automotive environment. Magnetic and device off sets are cancelled by a sophisticated self-calibration algorithm immediately after start-up. The sensor is available in different versions, including an integrated 1.8nF capacitor (-C types) and first edge detection (-1 types). The TLE4941 is an extremely robust product, due to Infineon's high quality standards as an experienced automotive semiconductor supplier. After several hundred million units sold, the TLE4941 has proven to be the perfect match for wheel speed sensing in all aspects of functionality, robustness and flexibility.

Features

- Two-wire current interface (TLE 4941-x(C))
- Two-wire PWM current interface (TLE 4942-1(C))
 - with smart features
 - Direction detection
 - Air gap warning
 - Assembly position diagnosis
- Dynamic self-calibration algorithm
- High sensitivity, fast power-on and low cut-off frequency (1Hz)
- High ESD resistivity (12kV HBM)
- Slim leaded packages (PG-SSO-x)
- Package option with an integrated 1.8nF capacitor for enhanced EMC (-C versions in PG-SSO-x)
- No external components needed

Applications

- Anti-lock Braking System (ABS)
- Vehicle Stability Control (VSC)
- Automatic Transmissions
- General Speed Sensing

Type	Interface	Package	Comment
TLE 4941	Two-wire current standard (7/14mA)	PG-SSO	Economical active ABS entry level
TLE 4941C	Two-wire current standard (7/14mA)	PG-SSO	Enhanced EMC performance
TLE 4941-1	Two-wire current standard (7/14mA)	PG-SSO	As TLE 4941 but with 1st edge detection
TLE 4941-1C	Two-wire current standard (7/14mA)	PG-SSO	As TLE 4941C but with 1st edge detection
TLE 4942-1	Two-wire PWM current	PG-SSO	With direction detection, air gap warning and assembly position diagnosis
TLE 4942-1C	Two-wire PWM current	PG-SSO	With direction detection, air gap warning and assembly position diagnosis

TLE4947-1(C): Wheel Speed Sensing Family

THE TLE4947C IS AN INTEGRATED HALL effect IC for active wheel speed sensing, specially designed for high ESD robustness on system level according to the ISO10605 standard (gun shot). The sensors work without any external components and combine a fast power-up time with a low cut-off frequency. The sensor processes excellent accuracy and sensitivity, a wide temperature range, particularly high ESD robustness and large EMC resistance to satisfy the requirements of harsh environmental conditions prevalent in automotive applications. The TLE4947 comes in the successful PG-SSO package with the option of an integrated 1.8nF capacitor. These unique features, together with the state-of-the-art circuit design and Infineon's high quality standards as an experienced automotive semiconductor supplier, make the TLE4947 a key product for reliable operation in all kinds of wheel speed sensing applications.

Features

- Economic
 - Two-wire current interface: minimizes wiring
- Stable
 - Dynamic self-calibration principle: compensates magnetic off sets
- Sensitive
 - High sensitivity: can be used for large airgap solutions
- Flexible
 - South and north pole pre-induction possible: works for both encoders and tonewheels
- Robust
 - High resistance to Piezo effects: suits sensor overmolding
- Wide operating temperature range: adapted to braking system environment
- Option of a 1.8nF overmolded capacitor: enhances EMC & microbreak resistance, no external components needed
- Extended protection diode structures: reinforces ESD immunity according to ISO10605

Applications

- Anti-lock Braking System (ABS)
- Vehicle Stability Control (VSC)
- Automatic Transmissions
- General Speed Sensing

Type	Sales code	Package
TLE4947-1	SP000374675	PG-SSO-2-1
TLE4947-1C	SP000015017	PG-SSO-2-2





TLE 4921-5U

The robust, economical solution for wheel speed sensing

Features

- Dynamic differential sensor
- Dynamic offset cancellation
- -40 ... 150°C temperature range
- Temperature compensated magnetic performance
- High sensitivity
- Customer selectable cut-off frequency
- EMI, reverse polarity, and over-voltage protected

Applications

- Crankshaft speed and position
- Transmission speed
- Speedometer
- Camshaft position

TLE 4927C

The robust, economical solution for wheel speed sensing

Features

- High sensitivity
- Single chip solution
- Symmetrical thresholds
- High resistance to Piezo effects
- Advanced performance by dynamic self-calibration principle
- South and north pole pre-induction possible
- 1Hz low cut-off frequency
- Digital output signal
- Two-wire and three-wire configuration possible
- Wide operating temperature range
- Fast start-up time
- Large operating airgaps
- Reverse voltage protection at V_S - PIN
- Short circuit and over temperature protection of output
- No external filter capacitor required
- Digital output signal (voltage interface)
- Module style package with two 4.7nF integrated capacitors
- Hidden adaptive hystereses

Applications

- Crankshaft speed and position
- Automatic Transmissions



TLE 4926C-HT(N) E6747

Features

- High sensitivity
- Single chip solution
- Symmetrical thresholds
- High resistance to Piezo effects
- Advanced performance by dynamic self-calibration principle
- South and north pole pre-induction possible
- 1Hz low cut-off frequency
- Digital output signal
- Two-wire and three-wire configuration possible
- Wide operating temperature range
- Fast start-up time
- Large operating airgaps
- Reverse voltage protection at V_S - PIN
- Short circuit and over temperature protection of output
- No external filter capacitor required
- Digital output signal (voltage interface)
- Module style package with two integrated capacitors
 - 4.7nF between Q and GND
 - 47nF between V_S and GND: needed for micro cuts in power supply
- High temperature profile

Applications

- Crankshaft speed and position

TLE 4928C

Features

- High sensitivity
- Single chip solution
- Symmetrical thresholds
- High resistance to Piezo effects
- Advanced performance by dynamic self-calibration principle
- South and north pole pre-induction possible
- 1Hz low cut-off frequency
- Digital output signal
- Two-wire and three-wire configuration possible
- Wide operating temperature range
- Fast start-up time
- Large operating airgaps
- Reverse voltage protection at V_S - PIN
- Short circuit and over temperature protection of output
- No external filter capacitor required
- Digital output signal (voltage interface)
- Module style package with two 4.7nF
- Integrated capacitors

Applications

- Three-wire low-end automatic transmission applications



TLE 4953C

New differential two-wire Hall IC designed for transmission speed sensing

Features

- Two-wire PWM current interface
- Detection of rotation direction
- Dynamic self-calibration principle and high sensitivity
- Vibration suppression algorithm
- Adaptive hysteresis
- Single-chip solution—no external components
- South and north pole pre-induction possible
- High resistance to Piezo effects
- Large operating air gaps
- Broad operating temperature range
- From zero speed up to 12kHz
- 1.8nF overmolded capacitor
- For fine and coarse transmission target wheels

Applications

- Automatic transmission systems, particularly suitable for high-end transmission applications

TLE 4983/TLE 4984 (C)–Family

True-Power-On Hall ICs for automotive camshaft applications

Features

- Chopped mono-cell Hall IC with True-Power-On (TPO) feature
- High phase accuracy for best fuel injection time
- Twisted Independent Mounting (TIM) capability
- Dynamic self-calibration algorithm with programmable power-on and dynamic switching point
- Over-temperature and reverse polarity protected
- No external filter capacitor required
- Digital output signal (voltage interface)
- Module style package with two integrated capacitors
 - 4.7nF between Q and GND
 - 47nF between V_S and GND: needed for micro cuts in power supply
- High temperature profile

Applications

- Camshaft position

TLE 5011: GMR-Based Angular Sensor

The TLE 5011 is a 360° angle sensor, which detects the orientation of a magnetic field. This is achieved by measuring sine and cosine angle components with monolithic integrated Giant Magneto Resistance elements (iGMR). The data communication is accomplished via a bi-directional Synchronous Serial Communication (SSC) Interface that is SPI compatible.

Features

- Giant Magneto Resistance (GMR)-based principle
- Full 0° to 360° angle measurement
- Highly accurate single bit SD-ADC
- 16-bit representation of sine/cosine values on the interface
- Bi-directional SSC Interface up to 2Mbit/s
- 3-pin SSC Interface, SPI compatible with Open Drain
- Patented online diagnoses for sensor elements and circuitry with PRO-SIL™ support IEC 61508 and ISO WD 26262
- 0.25µm CMOS technology
- Automotive qualified: -40 ... 150°C (junction temperature)
- ESD > 2kV (HBM)
- Green package with lead-free (Pb-free) plating

Applications

- Steering Angle
- Brushless DC Motor Commutation (e.g. Electric Power Steering (EPS))
- Rotary Switch
- General Angular Sensing

iGMR





Integrated Pressure Sensor ICs for Safety and Engine Management Applications

TODAY'S AUTOMOTIVE RESTRAINT SYSTEMS use Infineon's side airbag pressure sensors to fulfill the steadily increasing safety requirements for passenger cars. In this application, the pressure sensor is assembled within the car's side doors and provides digital crash signals to the central airbag unit. In automotive engine management systems, Infineon's barometric air pressure sensor family is used to control spark advance to optimize engine efficiency for diesel and gasoline engines. Infineon's integrated pressure sensor family uses a surface micro-machined capacitive sensor cell, which is integrated together with digital read-out circuitry monolithically onto one chip by using a standard BiCMOS process.

KP106/KP200: Integrated Pressure Sensor IC for Side Crash Detection

Features

- PSI5 compliant/Multi-Protocol
- Synchronous or asynchronous data transmission
- User-specified protocol available
- two-wire interface with on chip current modulator for Manchester communication
- EEPROM for ID number, calibration and mode selection
- Patented online diagnoses for pressure cells and circuitry with PRO-SIL™ support IEC 61508 and ISO WD 26262
- Serial service interface
- On chip voltage regulator
- Reverse polarity protection
- “Green” SMD package



KP23x: Barometric Air Pressure Sensor IC Family

Features

- Family of derivatives (automotive/industrial/consumer available)
- Absolute air pressure measurement based on capacitive principle
- Excellent accuracy of 1.0kPa over a large temperature range
- Ratiometric analog output proportional to the applied pressure
- Output signal fully compensated over pressure and temperature
- Pressure range from 40 to 115kPa
- Temperature range from -40 to 125°C
- Output clamping (optional)
- Serial service interface
- Open bond detection for supply and GND (OBD)
- Detection of broken pressure cells
- Inverse polarity protection
- “Green” SMD package

Parameter	Derivatives				Unit
	KP234	KP235	KP236	KP236N6165	
Target application	Autom.	Autom.	Autom.	Autom.	
Basic accuracy	1.5% F.S.	1.2	1.0	1.0	kPa
Transfer function pressure min.	15	40	40	60	kPa
Transfer function pressure max.	115	115	115	165	kPa
Transfer function voltage min.	0.2	0.5	0.5	0.2	V
Transfer function voltage max.	4.7	4.5	4.5	4.8	V
Operating pressure range	40–115	40–115	40–115	60–165	kPa



SP30T: System-in-a-Package Tire Pressure Sensors

- A high integration level enables low component count, low weight and perfect robustness for wheel modules
- Fully compliant with requirements as stated in the NHTSA Tread Act
- Microcontroller with integrated memory (EEPROM, M-ROM)
 - System SW library included
 - Application SW customer programmable
- Robust pressure sensor
 - Perfect media compatibility due to patented back ported bulk MEMS technology
 - Versatile pressure ranges for motorcycles, cars and trucks
- Temperature sensor for thermal compensation
- High sensitive accelerometer for motion detection
- Advanced power management for long battery lifetime at low battery weight and cost
 - < 500mAh for 10 years in standard application
- 125kHz LF receiver for optional trigger and control functionality
- 14-pin SMD package (P-DSOSP-14-6)

Product Type	Pressure Range [kPa]	Temperature Range [°C]	Integrated g-sensor	Acceleration Range [g]	Supply Voltage Range [V]
SP30T-00E00-06B	100–1600	-40 ... +125	yes	-12 ... +115	2.1 ... 3.6

SP37: Tire Pressure Sensor

SINGLE PACKAGE IC FOR Tire Pressure Monitoring Systems (TPMS) with Pressure and Acceleration Sensor, embedded 8051 Microcontroller, LF 125kHz ASK Receiver and FSK/ASK 315/434MHz Transmitter.

Major Functional Blocks of SP37 Tire Pressure Sensor

- Pressure sensor
- Radial acceleration sensor
- Temperature sensor
- Battery voltage sensor
- 8051 compatible microcontroller
- 6 kByte on chip FLASH memory
- 256 byte RAM
- Advanced power control/wake-up system to minimize battery consumption
- RF transmitter for 315 and 434MHz
- Selectable output power 5 or 8dBm
- LF receiver for 125kHz
- P-DSOSP-14-6 package

Parameter	Symbol	Limit Values		Unit	Test Conditions
		min.	max.		
Input range	P_{Range}	100	450	kPa	$T = -40 \dots 125^{\circ}\text{C}$
Measurement error	P_{Error}	-7	7	kPa	$T = 0 \dots 50^{\circ}\text{C}$
Measurement error	P_{Error}	-9	9	kPa	$T = 50 \dots 70^{\circ}\text{C}$
Measurement error	P_{Error}	-17.5	17.5	kPa	$T = -40 \dots 125^{\circ}\text{C}$

Pressure measurements

Pressure measurement specifications,
100 to 450kPa

Pressure sensor characteristics

($V_{\text{bat}} = 2.1 \dots 3.6\text{V}$)

Parameter	Symbol	Limit Values		Unit	Test Conditions
		min.	max.		
Input range	A_{Range}	-115	115	g	$T = -40 \dots 125^{\circ}\text{C}$
Sensitivity accuracy	A_{Sens}	-18.75	18.75	%	$T = -40 \dots 90^{\circ}\text{C}$
Offset accuracy	A_{Offset}	-6	6	g	$T = -20 \dots 70^{\circ}\text{C}$
Offset accuracy	A_{Offset}	-8.5	8.5	g	$T = -40 \dots 90^{\circ}\text{C}$
Offset accuracy	A_{Offset}	-12	12	g	$T = 90 \dots 125^{\circ}\text{C}$
Measurement error	T_{Error}	-3	3	$^{\circ}\text{C}$	$T = -20 \dots 70^{\circ}\text{C}$
Measurement error	T_{Error}	-5	5	$^{\circ}\text{C}$	$T = -40 \dots 125^{\circ}\text{C}$
Measurement error	V_{Error}	-100	100	mV	$T = -40 \dots 125^{\circ}\text{C}$

Acceleration measurements

Acceleration sensor characteristics

($V_{\text{bat}} = 2.1 \dots 3.6\text{V}$)

Temperature measurements

Temperature sensor characteristics

($V_{\text{bat}} = 2.1 \dots 3.6\text{V}$)

Supply voltage measurements

Battery sensor characteristics

($V_{\text{bat}} = 1.9 \dots 3.6\text{V}$)



Wireless Control

WIRELESS CONTROL HAS BECOME an indispensable item of everyday life. For automotive applications like remote keyless entry and tire pressure monitoring systems, wireless control devices have established themselves as a cost-efficient and robust solution.

Safety and Comfort with Wireless Control

INFINEON OFFERS A COMPREHENSIVE and complementary product portfolio of transmitter, receiver and transceiver products for the sub 1GHz frequency bands. The new generation SmartLEWIS™ products stand for Smart Low Energy Wireless Systems, which have a high level of integration and help to reduce system complexity and current consumption in an intelligent way. The SmartLEWIS™ RX products have an integrated digital baseband, enabling autonomous receive functionality without the need to wake up the microcontroller, and as such minimizing the system's current consumption. The SmartLEWIS™ MCU products include a transmitter with embedded 8051 microcontroller, on-chip memory and many exciting peripherals, and as such form a highly efficient system-on-a-chip solution.

Wireless Control Product Portfolio Overview:

Type		Description
Transmitter	TDK 510x /F	ASK/FSK Transmitter family for low power (2 – 5dBm)
	TDK 511x /F	ASK/FSK Transmitter family for high power (10dBm)
Receiver	TDA 520x	ASK Receiver family
	TDA 521x	ASK/FSK Receiver family
	TDA 522x	ASK/FSK Receiver family with switchable peak detector
SmartLEWIS™ RX	TDA 523x	ASK/FSK Receiver family with digital baseband processing, multi-channel
SmartLEWIS™ MCU	PMA 51xx	ASK/FSK Transmitter family with embedded 8051 Microcontroller
Transceiver	TDA 525x	ASK/FSK Transceiver family



TDK 510x Transmitter Series for Low and Medium Power (2dBm–5dBm)

Features

- Frequency ranges 433–435MHz/311–317MHz/868–870MHz
- VCO without external components
- ASK and FSK modulation
- High efficiency power amplifier
- Low supply current (typically 7mA)
- Voltage supply range 2.1 ... 4V
- Temperature range -40 ... 125°C
- Power down mode
- FSK switch

Additional features TDK 5100

- Switchable frequency ranges
433–435MHz/868–870MHz
- Selectable crystal oscillator
6.78MHz/13.56MHz

Transmitter ICs for Wireless Control

THE WIRELESS CONTROL TRANSMITTER SERIES offers a high level of integration and needs only a few external components. The device contains a fully integrated PLL synthesizer and a high efficiency power amplifier to drive a loop antenna. A special circuit design and a unique power amplifier design are used to save current consumption and therefore to save battery life. In addition, features like a power down mode, a low power detect, a selectable crystal oscillator frequency and a divided clock output are implemented. The ICs can be used for both ASK and FSK modulation.

TDK 511xF Transmitter Series for High Power (10dBm)

Features

- High efficiency power amplifier, typically 10dBm @ 3V
- ASK/FSK modulation
- Voltage supply range 2.1 ... 4V
- Low supply current (typically 14mA @ 3V)
- Fully integrated frequency synthesizer
- VCO without external components
- Power down mode
- FSK switch



Low/Medium Power							
Type	Frequency [MHz]	P_{OUT} [dBm]	Modulation	V_S [V]	I_S [mA]	Temperature [°C]	Package
TDA 5102	905–925	2	ASK/FSK	2.1 ... 4.0	7	-25 ... 85	PG-TSSOP-16
TDA 5103A	344–347	5	ASK	2.1 ... 4.0	7	-25 ... 85	PG-TSSOP-10
TDK 5100	433–435 868–870	5	ASK/FSK	2.1 ... 4.0	7	-40 ... 125	PG-TSSOP-16
		2	ASK/FSK				
TDK 5101	311–317	5	ASK/FSK	2.1 ... 4.0	7	-40 ... 125	PG-TSSOP-16
TDK 5100F	433–435	5	ASK/FSK	2.1 ... 4.0	7	-40 ... 125	PG-TSSOP-10
TDK 5101F	311–317	5	ASK/FSK	2.1 ... 4.0	7	-40 ... 125	PG-TSSOP-10
TDA 7100	433–435	5	ASK/FSK	2.4 ... 4.0	7	-20 ... 70	PG-TSSOP-10
High Power							
TDK 5110F	433–435	10	ASK/FSK	2.1 ... 4.0	13.8	-40 ... 125	PG-TSSOP-10
TDK 5111F	314–317	10	ASK/FSK	2.1 ... 4.0	14	-40 ... 125	PG-TSSOP-10
TDK 5116F	866–870	10	ASK/FSK	2.1 ... 4.0	14.2	-40 ... 125	PG-TSSOP-10

TDA 520x ASK Receiver Family

Features

- Frequency ranges
308–312MHz, 343–347MHz, 433–435MHz and 868–870MHz
- ASK demodulation
- Fully integrated VCO and PLL synthesiser
- RF input sensitivity < -107dBm
- Limiter with RSSI generation, operating at 10.7MHz
- Selectable reference frequency
- 2nd order low pass data filter with external capacitors
- Data slicer with self-adjusting threshold
- Power down mode with very low supply current (typically 50nA)
- Low supply current
- Supply voltage range 5V \pm 10%
- Temperature range -40 ... 85°C

Receiver ICs for Wireless Control

THE WIRELESS CONTROL RECEIVER SERIES is made up of a group of very low power consumption single chip ASK and FSK/ASK Superheterodyne Receivers (SHR).

The IC offers a high level of integration and needs only a few external components.

The devices contain a low noise amplifier (LNA), a double balanced mixer, a fully integrated VCO, a PLL Synthesizer and a crystal oscillator. The TDA522x family also integrates, a limiter with RSSI generator, a PLL FSK demodulator, a data filter, a data comparator (slicer) and a peak detector. Additionally there is a power down feature to save battery life.

TDA 521x/TDA 522x ASK/FSK Receiver Family

Features

- Frequency ranges
300–340MHz, 400–440MHz and 810–870MHz
- FSK and ASK demodulation
- Fully integrated VCO and PLL synthesizer
- ASK sensitivity < -107 dBm, FSK sensitivity < -100dBm
- Limiter with RSSI generation, operating at 10.7MHz
- Selectable reference frequency
- 2nd order low pass data filter with external capacitors
- Data slicer with self-adjusting threshold
- Switchable peak detector (TDA 5220/21 only)
- Switchable comparator
- Power down mode with very low supply current (typically 50nA)
- Supply voltage range 5V \pm 10%
- Low supply current (typically at 868MHz
 $I_s = 5.9\text{mA}$ in FSK mode, $I_s = 5.2\text{mA}$ in ASK mode)
- Temperature range -40 ... 105°C

Additional features TDA 5221

- Dual modulus PLL (315/317MHz, 316/318MHz)

ASK						
Type	Frequency [MHz]	Sensitivity [dBm]	1dBc Point [dBm]	V_s [V]	I_s [mA]	Temperature [°C]
TDA 5200	433–435 868–870	-107	-15	5	4.6 4.8	-40 ... 85
TDA 5201	311–317 343–347	-110	-14	5	4.6	-40 ... 85
ASK/FSK						
TDA 5210/ TDA 5220	400–440 810–870	-107 (ASK) -100 (FSK)	-15	5	5.2 (ASK) 5.9 (FSK)	-40 ... 105
TDA 5211/ TDA 5221	300–340	-102 (FSK) -110 (ASK)	-14	5	5.6 (ASK) 6.4 (FSK)	-40 ... 105

SmartLEWIS™ RX, TDA 523x Series

ASK/FSK Autonomous Receiver Family

WIRELESS CONTROL—THE TDA 523x SERIES is a family of autonomous ASK/FSK receivers for the frequency bands 302–320MHz, 433–450MHz and 865–870MHz. A fully integrated RF synthesizer offers multi-channel capability. The IC integrates an image-reject RF front-end together with digital base band processing. The digital baseband features fast symbol clock recovery based on a digital PLL plus automatic extraction of telegrams from run-in data. The data telegram can be screened for IDs before being stored in a FiFo data buffer. Autonomous self-polling reduces power consumption because it offloads the host in the receiver application. The device can switch between two configurations.

Features

- Frequency ranges
302–320MHz, 433–450MHz
and 865–870MHz
- ASK/FSK demodulation
- Fully integrated RF synthesizer
- Multi-channel capability
- ASK sensitivity < -108dBm @ 434MHz
- Power down mode with very
low supply current (typically 1µA)
- Low supply current
(< 8mA active mode, < 50µA self polling mode)
- Two supply voltage ranges possible:
3.3V ±10% or 5V ±10%
- Temperature range -40 ... 105°C
- Digital baseband processing with
configurable data filter
- Fast symbol clock recovery
- Frame synchronization for automatic
Payload extraction
- Message content screening
- Dual configuration capability
- FIFO data buffer
- Digitally trimmable crystal oscillator
- External LNA controlled by receiver

Type	TDA 5230	TDA 5231
Frequency range	433–450MHz, 865–870MHz	302–320MHz
Sensitivity	< -108dBm (ASK)	< -108dBm (ASK)
Frequency setting	Intergrated multi-channel PLL/VCO	Intergrated multi-channel PLL/VCO
Loop filter	Internal	Internal
Data rate	0.5 ... 20kbit/s Manchester	0.5 ... 20kbit/s Manchester
Supply voltage	3.3V or 5V	3.3V or 5V
Supply current typ. (active mode/ self-polling mode)	8mA/50µA	8mA/50µA
Standby current (power down mode)	1µA	1µA
Demodulation	ASK/FSK	ASK/FSK
IP3	-22dBm	-22dBm
1dBC point	-33dBm	-33dBm
Package	PG-TSSOP-28	PG-TSSOP-28
Temperature range	-40 ... 105°C	-40 ... 105°C

SmartLEWIS™ MCU PMA 51xx Family

WIRELESS CONTROL–THE NEW SmartLEWIS™ MCU PMA 51xx family comprises an ASK/FSK transmitter for the sub 1GHz ISM frequency bands with embedded 8051 microcontroller as base functionality. Additionally, exciting peripheral functions are integrated, building a fully flexible product family. You can use the internal multi-channel 10-bit analog to digital converter with its flexible high-gain settings as interface for a broad variety of analog sensors. The integrated LF Receiver enables wireless wake-up in battery operated applications with an ultra-long lifetime or even contactless configuration of the device. An associated Software Function Library provides powerful functions like AES encryption. The combination with state-of-the-art software development tools makes RF easy to use for everyone, allowing simple and fast time-to-market. Additionally, with only a few external components, you can build a running system. The advanced power control system makes this family ideal for battery-operated applications where low current consumption is necessary. The PMA 51xx family is automotive qualified, serves a wide temperature range and perfectly suits applications for rough environment and high quality requirements. Test the PMA 71xx/51xx USB RF kit! It contains everything you need and it takes just a few steps to run.

Features

- Integrated RF transmitter
 - ISM band 315/434/868/915MHz
 - 5/8/10dBm output power supported
- Embedded 8051 microcontroller
 - 6 kbyte code flash
 - Comprehensive SW library in ROM reduces user code size for flash memory
 - 2*128 bytes flash for EEPROM emulation supporting e.g. rolling codes
 - Four 16-bit timers
 - License-free encryption algorithms supported (e.g. AES)
- Embedded peripherals:
 - Manchester/biphase encoder/decoder
 - 16-bit CRC generator/checker
 - Pseudo-random number generator
 - Watchdog timer
 - 125kHz LF ASK receiver
- Multiple interfaces: I²C, SPI, 10 GPIOs
- Multiple wakeup sources
 - LF receiver
 - GPIOs
 - Interval timer
- 10-bit ADC with single-ended or differential inputs and four different high gain levels
- Embedded temperature and supply voltage sensors
- Ultra low power down current: < 0.5µA
- Thermal shutdown at 125°C
- Operating voltage range: 1.9 ... 3.6V
- Temperature range: -40°C ... 125°C
- Quick start development kit available with USB interface and rechargeable battery

Type	8051 µC + Flash	ASK/FSK Transmitter	3-channel 10-bit ADC	LF Receiver 125kHz	Operating Temperature Range	Target Applications
PMA 5105	✓	✓	–	–	-40°C ... 125°C	– Applications in rough environments and with high quality requirements (automotive qualification) – Remote keyless entry
PMA 5110	✓	✓	✓	✓	-40°C ... 125°C	– High end applications in rough environments and with high quality requirements (automotive qualification) – Advanced remote keyless entry

Transceiver ICs for Wireless Control

THE WIRELESS CONTROL TRANSCEIVER SERIES is a family of low power consumption single chip FSK/ASK transceivers for half duplex low data rate communication in the 868MHz, 315MHz, 434MHz and 915MHz bands.

The IC offers a very high level of integration and needs only a few external components. It contains a highly efficient power amplifier, a low noise amplifier (LNA) with AGC, a double balanced mixer, a complex direct conversion stage, I/Q limiters with RSSI generation, an FSK demodulator, a fully integrated VCO and PLL synthesizer, a tunable crystal oscillator, an onboard data filter, a data comparator (slicer), positive and negative peak detectors, a data rate detection circuit and a 2/3 wire bus interface. Additionally, there is a power down feature to save battery power.

Features

- Frequency ranges 868MHz, 315MHz, 434MHz, 915MHz
- Low supply current
- Supply voltage range 2.1 ... 5.5V
- Power down mode with very low supply current consumption
- FSK and ASK modulation and demodulation capability
- Fully integrated VCO and PLL synthesizer and loop filter on chip with on chip crystal oscillator tuning
- I²C/3-wire microcontroller Interface
- On chip low pass channel select filter and data filter with tuneable bandwidth
- Data slicer with self-adjusting threshold and 2 peak detectors
- FSK sensitivity < -109dBm, ASK sensitivity < -109dBm
- Transmit power up to +13dBm
- Data rates up to 64kbit/s Manchester encoded
- Self-polling logic with ultra fast data-rate detection



ASK/FSK							
Type	Frequency [MHz]	Rx Sensitivity [dBm]	Tx P _{OUT} [dBm]	V _S [V]	Tx I _s [mA]	Rx I _s [mA]	Temperature [°C]
TDA 5250	868	-109	9	2.1 ... 5.5	11.9	8.6 (ASK) 9.0 (FSK)	-40 ... 85
TDA 5251	315	-109	9	2.1 ... 5.5	14.1	8.8 (ASK) 9.3 (FSK)	-40 ... 85
TDA 5252	915	-109	9	2.1 ... 5.5	11.9	8.6 (ASK) 9.0 (FSK)	-40 ... 85
TDA 5255	434	-109	9	2.1 ... 5.5	13.3	8.6 (ASK) 9.0 (FSK)	-40 ... 85





RASIC™—Frontend ICs for Automotive Radar

WITH RASIC™, INFINEON INTRODUCES a family of Automotive Radar components developed for the 77GHz sensor market. These Radar Systems ICs are designed to work in applications like Long Range Radar (LRR), Lane Change Assist (LCA), Collision Mitigation Systems (CMS) and similar applications. Due to the global regulation of the 76 to 77GHz frequency band, sensors built using the RASIC™ components can be used worldwide in a wide range of sensors.

THE HIGH PERFORMANCE SiliconGermanium (SiGe) technology allows for a high degree of integration while delivering best-in-class performance. The first members of the product family include a 4-channel transceiver product (RXN 7740) and a Reference Oscillator (RON 7701), which are optimized for building a system with a minimum number of components.

RXN 7740—Single Chip Transceiver for 76–77GHz

The RXN 7740 is a Silicon Germanium (SiGe) transceiver for automotive long and mid-range radar (LRR/MRR) applications in the frequency range of 76–77GHz. It also features on chip pre-scalers as well as sensors for output power and temperature. With this product, Infineon is launching the latest RF technology (B7HF200) with automotive qualification AEC-Q100 on the market.

Features

- High VCO output power at 77GHz with power control
- Four integrated mixers in two isolating and two transferring configurations (ITTI)
- On chip test logic (Tx dividers, temperature sensor, power sensor)
- Delivery is unpacked bare die
- Evaluation kit

RON 7701—Dielectric Resonance Oscillator (DRO)

The RON 7701 is a Silicon Germanium (SiGe) dielectric resonator oscillator (DRO)-based 19GHz down-converter for use within a PLL circuitry for automotive radar applications. The DRO uses an external ceramic resonator, is optimized for low phase noise as well as low frequency pushing and typically operates at 18GHz. The balanced mixer converts the by-4-divided signal of a 77GHz fundamental oscillator to around 1GHz.

Features

- High quality DRO on local oscillator (LO) signal stability
- Balanced Gilbert cell mixer for down-conversion
- Built-in test equipment (BITE) for production test
(on-chip resonator circuitry, LO signal by-8-divider, LO signal power sensor)
- Delivery is unpacked bare die
- AEC-Q100 qualified SiGe process

RXN 7740				
Parameter	min.	typ.	max.	Unit
Max. chip backside temperature	-40		125	°C
Operating voltage	5.225	5.5	5.775	V
Supply current		600		mA
Output power		11		dBm
RON 7701				
Max. chip backside temperature	-40		125	°C
Operating voltage	5.225	5.5		V
Supply current		18		mA
Phase noise @ 100kHz offset	-97			dBc/Hz
Frequency pushing			1	MHz/V

Key benefits of RXN 7740 and RON 7701

- Up to a 4-channel solution can be built using a single chip transceiver
- Built-in AEC-Q100 qualified SiGe process
- Minimum number of components needed to build complete 77GHz RF frontend
- Power and temperature sensors allow in-operation monitoring

Living Automotive Excellence – on the Way to Zero-Defect Products and Services

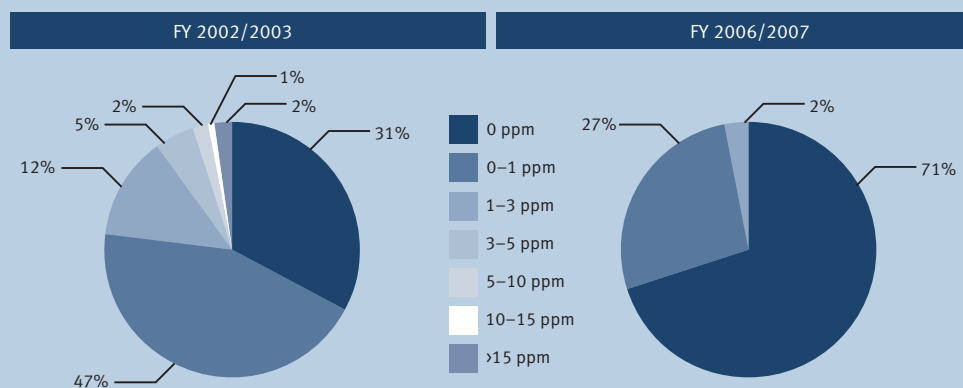
THE MOST VALUABLE ASPECT OF CARS is the people they carry. Therefore, safety should never be compromised. This is the most important consideration for everybody involved in making automobiles—from the smallest suppliers to the manufacturers themselves.

No compromise when it comes to quality

Infineon established the most comprehensive quality program in the semiconductor industry in 2003. The Automotive Excellence Program is founded on four pillars: people, products, processes and production. Due to our “no compromise” policy in all four pillars, our program really works. Our employees truly live the credos, considering the highest quality requirements and understanding the importance of prevention. They are trained to deeply understand the tools and methods used to avoid deviations and to solve problems proactively.

Automotive Excellence is your competitive advantage

In five years the ppm rate for our automotive products decreased by a factor of seven down to approximately 0.2 ppm. This means that there are only two fails within ten million delivered devices. In addition, we see that zero defects are really possible. Amazingly, in fact, two-thirds of our delivery volume today show zero defects, up by one third in comparison to the beginning of our program. Our quality is clearly seen as the industry benchmark by almost all our automotive customers.



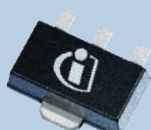
We are obtaining customer-proven results

Our efforts are bearing fruit. Many of our customers have expressed their satisfaction with the quality of our products and the way we execute Automotive Excellence:

- “Supplier Performance Award” for the year 2008 from Continental
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- German “ToPIT Award” for the year 2008 for the Automotive Excellence Program

For more information, please request our eLearning kit “Living Automotive Excellence”

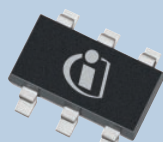
SMD Hall ICs



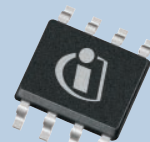
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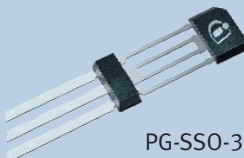
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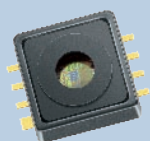


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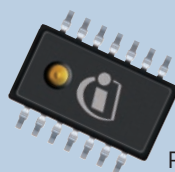


PG-SSO-4-1

Pressure Sensor ICs



PG-DSOF-8-16



PG-DSOSP-14-6

ICs for Wireless Control



PG-TSSOP-10



PG-TSSOP-16



PG-TSSOP-28



PG-TSSOP-38

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