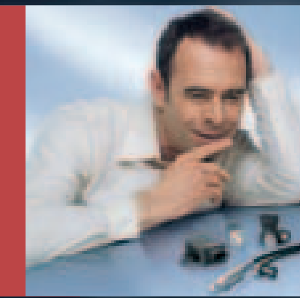
Part number: 1 987 721 540

Part number: 1 987 721 074

Part number: 1 987 721 021

**Sensors for angles,
rotation rate, speed, pressure,
air-mass flow rate,
oxygen, temperature,
structure-borne sound**



**The Bosch Program
for industrial applications**

Have we succeeded in arousing your curiosity? Simply get into contact with us using the Fax form on the inside of the cover. You will hear from us promptly.

Sensors

2013 | 2014

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BOSCH

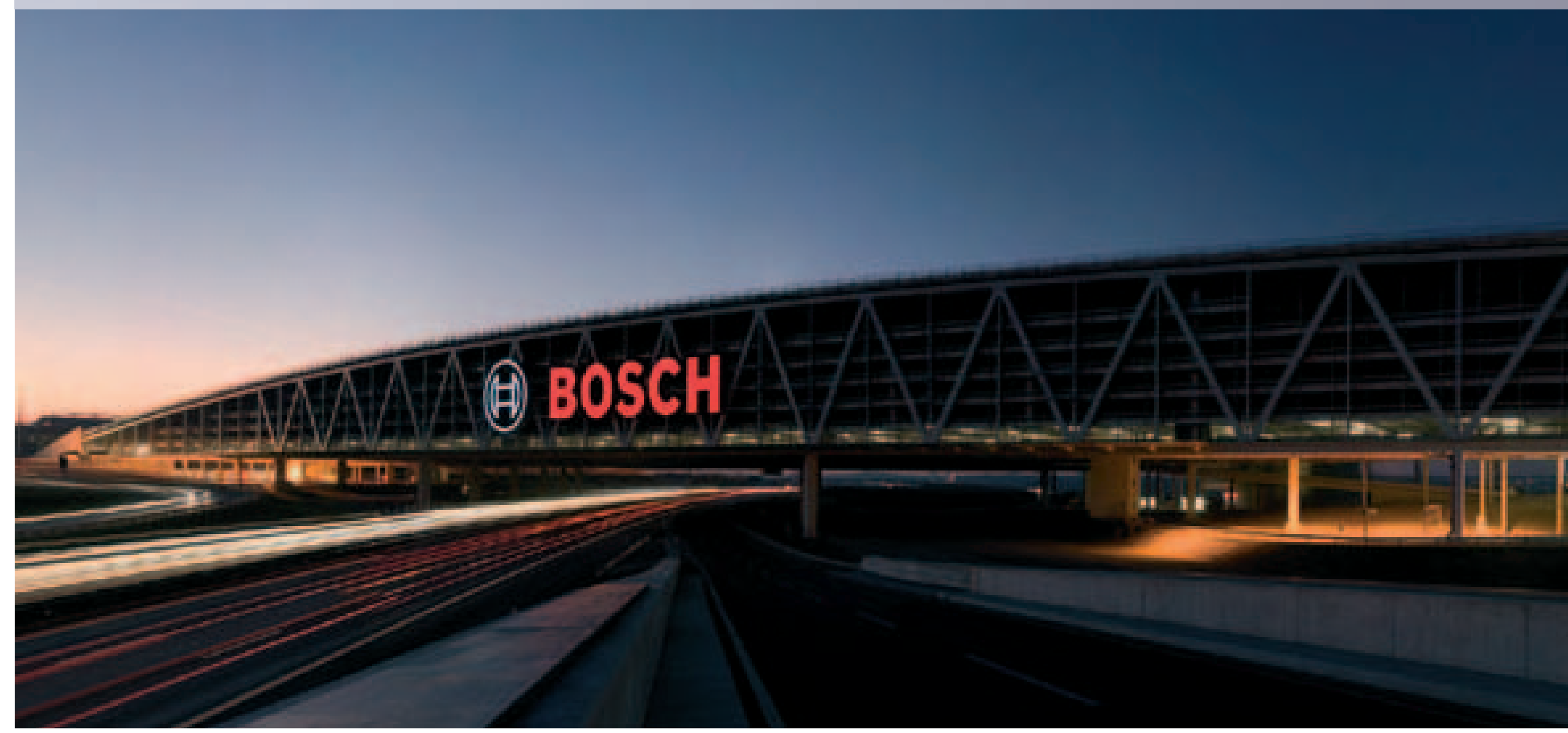
Sensors – the vehicle's "Sensory System"

Vehicle electronics are constantly gaining in significance. Here, sensors are the vehicle's "sensory system" for travel, angle, speed, velocity, acceleration, vibration, pressure, flow rate, gas concentration, temperature and other influencing variables. Their signals have, in the meantime, become indispensable for many control and regulating functions of the various management systems for engine and vehicle control, safety and comfort. Electronic data processing has ultimately made it possible to evaluate the stated influencing variables faster, and to condition them for the required vehicle functions.

These sensors, which have demonstrated their value in millions of vehicles covering numerous kilometers under rough vehicle service conditions, also harbor a tremendous potential for **industrial applications.** Particularly in those areas dependent on high reliability, and where low prices can be achieved through high-volume production.

The areas in which they can be used are almost limitless: wherever tests, closed and open-loop controls, and monitoring are required; wherever computers have to be "fed" with physical data, or even simply wherever automatic switch-on of the heating is required in the cold or of the air conditioner when temperatures climb. Constant further development and refinement of the sensors by Bosch, including their **miniaturization**, means that Bosch is well equipped for tomorrow's challenges and is able to actively participate in shaping state-of-the-art technology.

Our **philosophy**



Our philosophy
With the quality, value for money and function of our products, we wish to set standards and capture a peak position in the market. By working towards economical solutions, we reinforce our innovative strength and thus our future. For our customers, we are an active, receptive partner who is aware of their goals and gives complete satisfaction. We react rapidly and flexibly to the requirements of our customers and colleagues. We accomplish our agreed tasks creatively, with the emphasis on quality and on the protection of the environment.

Our staff
We prefer target-oriented team-work, and treat problems as an opportunity for continual improvement. All management personnel delegate responsibility and support their workers by stipulating clear targets and by the appropriate control of resources. They set an example in putting our philosophy into practice.

Our organization
Bosch is never far from its clients. We are close to vehicle manufacturers, working in close cooperation with them in the development of new solutions. But we are also close to the users of sensors, who can enjoy competent service all over the world from nearly 10,000 Bosch Service Agents. Bosch has agents in 130 countries. In our international alliance, we develop and produce sensors in Europe, the USA and Asia.

Our technology
From drafting through design to production, we use the latest techniques and facilities, such as
- Finite-element calculations,
- Fully automated production lines,
- Quality assurance by computer-aided, statistical closed-loop process control and 100% testing of all parameters which are relevant for correct function.

Our contribution to environmental protection
Our sensors are made from materials which can be recycled, which, thanks to thermal and magnetic separation processes, can be reintroduced into the material cycle. We use re-cyclable cardboard packaging containing a high proportion of recycled paper, or, on request, reusable packaging.

Content

We reserve the right to make technical changes.

de

Elektronischer Katalog für Kraftfahrzeug-Ausrüstung

en

Electronic Catalogue for Automotive Parts

fr

Catalogue électronique de pièces détachées et de rechange

it

Catalogo elettronico per ricambi di automobili

es

Catálogo electrónico de los componentes del automóvil

Einfacher und schneller Zugriff auf Kfz-Ausrüstungsdaten von Bosch in 18 Sprachen.

Easy and quick access to vehicle application data from Bosch in 18 languages.

Accès facile et rapide aux données de rechange automobile Bosch – en 18 langues.

Ricerca semplice e veloce dei dati Bosch di equipaggiamento veicoli in 18 lingue.

Fácil y rápido acceso a la información de equipamiento Bosch para vehículos en 18 idiomas.

Techniques and applications

This catalog features the most important technical data required for selecting a given sensor. To date, the sensors listed have all been used in automotive applications, but their universal and highly versatile characteristics also make them ideally suitable for industrial applications. For instance in:

- **Manufacturing engineering**
- **Mechanical engineering**
- **Automation**
- **Materials handling and conveying**
- **Heating and air-conditioning**
- **Chemical and process engineering**
- **Environmental and conservation technology**
- **Installation and plant engineering**

Brief descriptions and examples of application are to be found in the Table below.

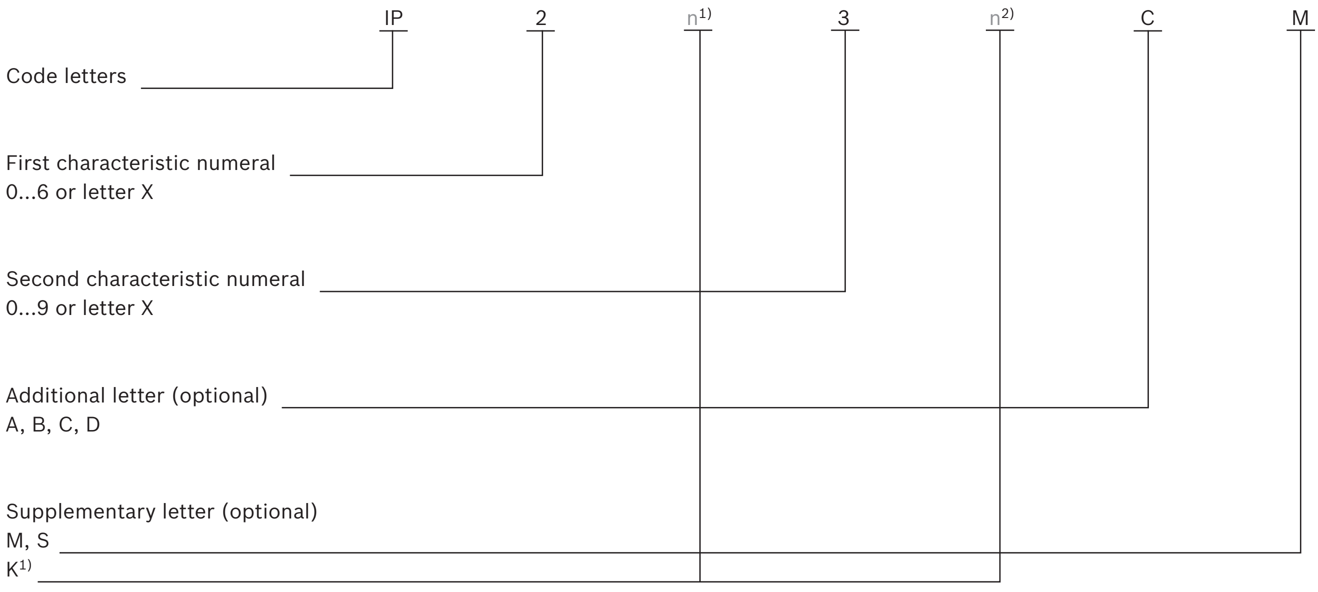
For the applications listed below, prior clarification of the technical suitability is imperative. This Catalog only lists those products which are available from series manufacture. If your problem cannot be solved with this range of products, please inform of us of your requirements using the Enquiry Data Sheet.

Sensors	Automotive application	Examples of non-automotive applications
Angular position sensors measure simple angular settings and changes in angle.	Throttle-valve-angle measurement for engine management on gasoline (SI) engines.	Door/window opening angle, setting-lever angles in monitoring and control installations.
Rotational-speed sensors measure rotational speeds, positions and angles in excess of 360°.	Wheel-speed measurement for ABS/TCS, engine speeds, positioning angle for engine management, measurement of steering-wheel angle, distance covered, and curves/bends for vehicle navigation systems.	Proximity or non-contact measurement of rotational speed, displacement and angular measurement, definition of end and limit settings for industrial machines, robots, and installations of all types.
Spring-mass acceleration sensors measure changes in speed, such as are common in road traffic.	Registration of vehicular acceleration and deceleration. Used for the Antilock Braking System (ABS) and the Traction Control System (TCS).	Acceleration and deceleration measurement for safety, control, protective systems in lifts, cable railways, fork-lift trucks, conveyor belts, machines, wind power stations.
Bending-beam acceleration sensors register shocks and vibration which are caused by impacts on rough/unpaved road surfaces or contact with kerbstones.	For engine management, detection of vibration on rough/unpaved road surfaces.	Forced switch-off for machines, industrial robots, manufacturing plant, and gaming machines in case of sudden acceleration or deceleration caused by shock or impact.
Piezoelectric acceleration sensors measure shocks and vibration which occur when vehicles and bodies impact against an obstacle.	Impact detection used for triggering airbags and belt tighteners.	Detection of impact in monitoring/surveillance installations, detection of foreign bodies in combine harvesters, filling machines, and sorting plants. Registration of score during rifleman competitions.
Yaw sensors measure skidding movements, such as occur in vehicles under road traffic conditions.	Used on the vehicle dynamics control (Electronic Stability Program, ESP) for measuring yaw rate and lateral acceleration, and for vehicle navigation sensors.	Stabilization of model vehicles and airplanes, safety circuits in carousels and other entertainment devices on fairgrounds etc.
Piezoelectric vibration sensors measure structure-borne vibrations which occur at engines, machines, and pivot bearings.	Engine-knock detection for anti-knock control in engine-management systems.	Machine-tool safety, cavitation detection, pivot-bearing monitoring, structure-borne-noise detection in measurement systems.
Absolute-pressure sensors measure the pressure ranges from about 50 % to 500 % of the earth's atmospheric pressure.	Manifold vacuum measurement for engine management. Charge-air-pressure measurement for charge-air pressure control, altitude-pressure-dependent fuel injection for diesel engines.	Pressure control in electronic vacuum cleaners, monitoring of pneumatic production lines, meters for air-pressure, altitude, blood pressure, manometers, storm-warning devices.
Differential-pressure sensors measure differential gas pressures, e.g. for pressure-compensation purposes.	Pressure measurement in the fuel tank, evaporative-emissions control systems.	Monitoring of over and underpressure. Pressure limiters, filled-level measurement.
Temperature sensors measure the temperature of gaseous materials and, inside a suitable housing, the temperatures of liquids in the temparature range of the earth's atmosphere and of water.	Display of outside and inside temperature, control of air conditioners and inside temperature, control of radiators and thermostats, measurement of lube-oil, coolant, and engine temperatures.	Thermometers, thermostats, thermal protection, frost detectors, air-conditioner control, temperature and central heating, refrigerant-temperature monitoring, regulation of hot-water and heat pumps.
Lambda oxygen sensors determine the residual oxygen content in the exhaust gas.	Control of A/F mixture for minimization of pollutant emissions on gasoline and gas engines.	Pollutants reduction during combustion, smoke measurement, gas analysis.
Air-mass meters measure the flow rate of gases.	Measurement of the mass of the air drawn in by the engine.	Flow-rate measurement for gases on test benches and in combustion plant.

IP degres of protection
Valid for the electrical equipment
of road vehicles as per DIN 40050 (Part 9).

- ▶ Protection of the electrical equipment inside the enclosure against the effects of solid foreign objects including dust.
- ▶ Protection of the electrical equipment inside the enclosure against the ingress of water.
- ▶ Protection of persons against contact with dangerous parts, and rotating parts, inside the enclosure.

Structure of the IP code



If a characteristic numeral is not given, it must be superseded by the letter “X” (i.e. “XX” if both characteristic numerals are not given).
The supplementary and/or additional letters can be omitted at will, and need not be superseded by other letters.

1) The supplementary letter “K” is located either directly after the first characteristic numerals 5 and 6, or directly after the second characteristic numerals 4, 6 and 9.

2) During the water test. Example: IP16KB protection against the ingress of solid foreign bodies with diameter ≥ 50 mm, protection against high-pressure hose water, protection against access with a finger.

Comments IP code

1st characteristic numeral and supplementary letter K	Protection of electrical equipment against ingress of solid foreign objects	Persons	2nd characteristic numeral and supplementary letter K	Protection of electrical equipment against the ingress of water	Additional letter (optional)	Protection of persons against contact with hazardous parts	Additional letter (optional)	
0	Non-protected	Non-protected	0	Non-protected	A	Protection against contact with back of hand	M	Movable parts of the equipment are in motion [2)]
1	Protection against foreign bodies Ø ≥ 50 mm	Protection against contact with back of hand	1	Protection against vertically dripping water	B	Protection against contact with finger	S	Movable parts of the equipment are stationary [2)]
2	Protection against foreign bodies Ø ≥ 12.5 mm	Protection against contact with finger	2	Protection against dripping water (at an angle of 15°)	C	Protection against contact with tool	K	For the electrical equipment of road vehicles
3	Protection against foreign bodies Ø ≥ 2.5 mm	Protection against contact with tool	3	Protection against splash water	D	Protection against contact with wire		
4	Protection against foreign bodies Ø ≥ 1.0 mm	Protection against contact with wire	4	Protection against spray water				
5K	Dust-protected	Protection against contact with wire	4K	Protection against high- pressure spray water				
6K	Dust-proof	Protection against contact with wire	5	Protection against jets of water				
			6	Protection against powerful jets of water				
			6K	Protection against high-pressure jets of water				
			7	Protection against temporary immersion				
			9	Protection against continuous immersion				
			9K	Protection against high-pressure/ steam-jet cleaners				

CAN-Bus
Controller Area Network

Present-day motor vehicles are equipped with a large number of electronic control units (ECUs) which have to exchange large volumes of data with one another in order to perform their various functions. The conventional method of doing so by using dedicated data lines for each link is now reaching the limits of its capabilities. On the one hand, it makes the wiring harnesses so complex that they become unmanageable, and on the other the finite number of pins on the connectors becomes the limiting factor for ECU development. The solution is to be found in the use of specialized, vehicle-compatible serial bus systems among which the CAN has established itself as the standard.

Applications
There are four areas of application for CAN in the motor vehicle, each with its own individual requirements:

Real-time applications
Real-time applications, in which electrical systems such as Motronic, transmission-shift control, electronic stability-control systems are networked with one another, are used to control vehicle dynamics. Typical data transmission rates range from 125 kbit/s to 1 Mbit/s (high-speed CAN) in order to be able to guarantee the real-time characteristics demanded.

Multiplex applications
Multiplex applications are suitable for situations requiring control and regulation of body-component and luxury/convenience systems such as air conditioning, central locking and seat adjustment. Typical data transmission rates are between 10 kbits and 125 kbit/s (low-speed CAN).

Mobile-communications applications
Mobile-communications applications connect components such as the navigation system, cellular phone or audio system with central displays and controls. The basic aim is to standardize control operations and to condense status information so as to minimize driver distraction. Data transmission rates are generally below 125 kbit/s; whereby direct transmission of audio or video data is not possible.

Diagnostic applications
Diagnostic applications for CAN aim to make use of existing networking for the diagnosis of the ECUs incorporated in the network. The use of the “K” line (ISO 9141), which is currently the normal practice, is then no longer necessary. The data rate envisaged is 500 kbit/s.

Bus configuration
CAN operates according to the multimaster principle, in which a linear bus structure connects several ECUs of equal priority rating (Fig. ①). The advantage of this type of structure lies in the fact that a malfunction at one node does not impair bus-system access for the remaining devices. Thus the probability of a total system failure is substantially lower than with other logical architectures (such as ring or active star structures). When a ring or active star structure is employed, failure at a single node or at the CPU is sufficient to cause a total failure.

Content-based addressing
Addressing is message-based when using CAN. This involves assigning a fixed identifier to each message. The identifier classifies the content of the message (e.g., engine speed). Each station processes only those messages whose identifiers are stored in its acceptance list (message filtering, Fig. ②). Thus CAN requires no station addresses for data transmission, and the nodes are not involved in administering system configuration. This facilitates adaptation to variations in equipment levels.

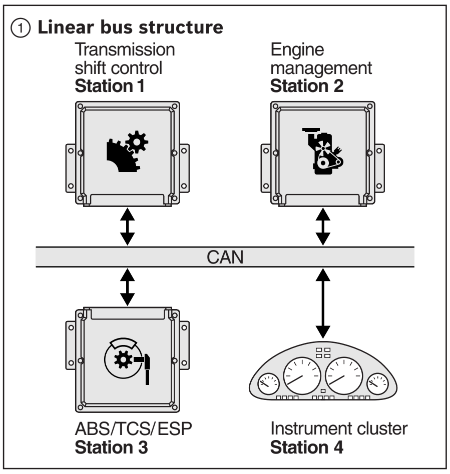
Logical bus states
The CAN protocol is based on two logical states: The bits are either “recessive” (logical 1) or “dominant” (logical 0). When at least one station transmits a dominant bit, then the recessive bits simultaneously sent from other stations are overwritten.

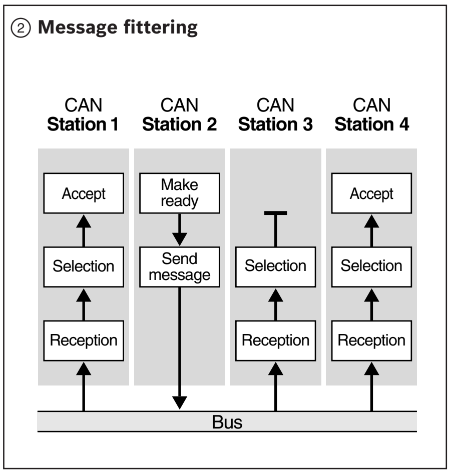
Priority assignments
The identifier labels both the data content and the priority of the message being sent. Identifiers corresponding to low binary numbers enjoy a high priority and vice versa.

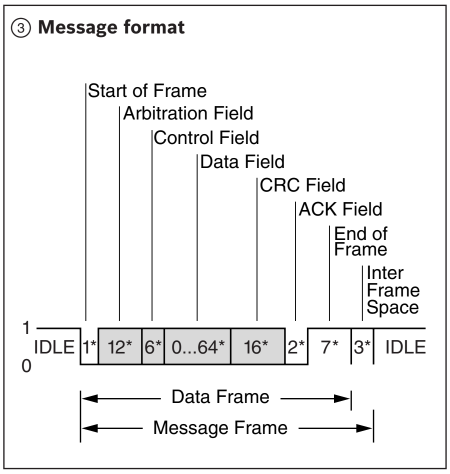
Bus access
Each station can begin transmitting its most important data as soon as the bus is unoccupied. When several stations start to transmit simultaneously, the system responds by employing “Wired-AND” arbitration to sort out the resulting contentions over bus access. The message with the highest priority is assigned first access, without any bit loss or delay. Transmitters respond to failure to gain bus access by automatically switching to receive mode; they then repeat the transmission attempt as soon as the bus is free again.

Message format
CAN supports two different data-frame formats, with the sole distinction being in the length of the identifier (ID). The standard-format ID is 11 bits, while the extended version consists of 29 bits. Thus the transmission data frame contains a maximum of 130 bits in standard format, or 150 bits in the extended format. This ensures miminal waiting time until the subsequent transmission (which could be urgent). The data frame consists of seven consecutive bit fields (Fig. ③):

“Start of frame”
indicates the beginning of a message and synchronizes all stations.
“Arbitration field”
consists of the message’s identifier and an additional control bit. While this field is being transmitted, the transmitter accompanies the transmission of each bit with a check to ensure that no higher-priority message is being transmitted (which would cancel the access authorization). The control bit determines whether the message is classified under “data frame” or “remote frame”.
“Control field”
contains the code for number of data bytes in „Data Field“.
“Data field’s”
information content comprises between 0 and 8 bytes. A message of data length 0 can be used to synchronize distributed processes.
“CRC field”
(Cyclic Redundancy Check) contains the check word for detecting possible transmission interference.
“Ack field”
contains the acknowledgement signals with which all receivers indicate receipt of non-corrupted messages.
“End of frame”
marks the end of the message.







Transmitter initiative
The transmitter will usually initiate a data transfer by sending a data frame. However, the receiver can also request data from the transmitter. This involves the receiver sending out a "remote frame". The "data frame" and the corresponding "remote frame" have the same identifier. They are distinguished from one another by means of the bit that follows the identifier.

Error detection
CAN incorporates a number of monitoring features for detecting errors. These include:

- 15 Bit CRC (Cyclic Redundancy Check): Each receiver compares the CRC sequence which it receives with the calculated sequence.
- Monitoring: Each transmitter compares transmitted and scanned bit.
- Bit stuffing: Between "start of frame" and the end of the "CRC field", each "data frame" or "remote frame" may contain a maximum of 5 consecutive bits of the same polarity. The transmitter follows up a sequence of 5 bits of the same polarity by inserting a bit of the opposite polarity in the bit stream; the receivers eliminate these bits as the messages arrive.
- Frame check: The CAN protocol contains several bit fields with a fixed format for verification by all stations.

Error handling
When a CAN controller detects an error, it aborts the current transmission by sending an "error flag". An error flag consists of 6 dominant bits; it functions by deliberately violating the conventions governing stuffing and/or formats.

Fault confinement with local failure
Defective stations can severely impair the ability to process bus traffic. Therefore, the CAN controllers incorporate mechanisms which can distinguish between intermittent and permanent errors and local station failures. This process is based on statistical evaluation of error conditions.

Implementations
In order to provide the proper CPU support for a wide range of different requirements, the semiconductor manufacturers have introduced implementations representing a broad range of performance levels. The various implementations differ neither in the message they produce, nor in their arrangements for responding to errors. The difference lies solely in the type of CPU support required for message administration. As the demands placed on the ECU's processing capacity are extensive, the interface controller should be able to administer a large number of messages and expedite data communications with, as far as possible, no demands on the CPU's computational resources. Powerful CAN controllers are generally used in this type of application. The demands placed on the controllers by multiplex systems and present-day mobile communications are more modest. For that reason, more basic and less expensive chips are preferred for such uses.

Standardization
CANs for data exchange in automotive applications have been standardized both by the ISO and the SAE – in ISO 11519-2 for low-speed applications ≤ 125 kbit/s and in ISO 11898 and SAE J 22584 (cars) and SAE J 1939 (trucks and busses) for high-speed applications >125 kbit/s. There is also an ISO standard for diagnosis via CAN (ISO 15765 – Draft) in the course of preparation.

Steering-angle sensor
Measurement of angles from -780° to +780°

- „True Power on“ function
- Multiturn capability
- CAN interface

Design and operation

The steering column drives two measurement gears by way of a gear wheel. Magnets are incorporated into the measurement gears. AMR elements, the resistance of which changes as a function of the magnetic field direction, detect the angular position of the magnets. The analog measured values are supplied to the microprocessor via an A/D converter. The measurement gears have different numbers of teeth and their rotational position thus changes at different rates. The total steering angle can be calculated by combining the two current angles. After several turns of the steering wheel, the two measurement gears have returned to their original positions. This measurement principle can therefore be used to cover a measuring range of several turns of the steering wheel without the need for a revolution counter. The steering angle is output as an absolute value over the total angle range (turning range) of the steering column. A special feature of the sensor is the correct angle output immediately after switching on the ignition without moving the steering wheel (True Power On). Steering angle and velocity are output via CAN.

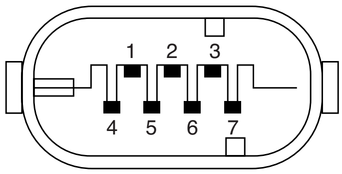
Application

The steering-angle sensor was developed for use in electronic stability programs (ESP). Integrated plausibility checks and special self-diagnosis functions make the steering-wheel angle sensor suitable for use in safety systems.

Further areas of application

Using the standardized CAN bus, the steering wheel angle information can be utilized, for example for chassis control, navigation and electrical power- steering systems.
Different types of mechanical connection and electrical interface versions are available on request.

Pin assignment



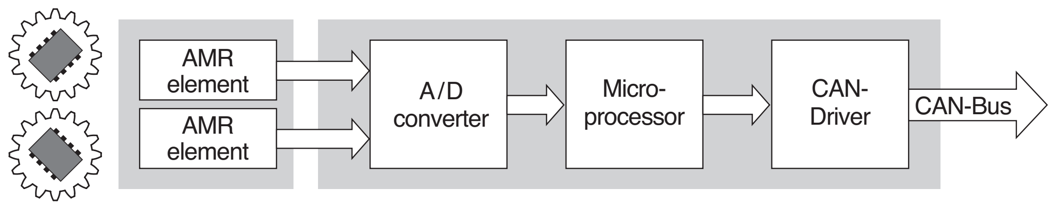
Pin 1 Ground
Pin 2 12 V
Pin 3 CAN High
Pin 4 CAN Low
Pin 5 -
Pin 6 -
Pin 7 -

Technical data

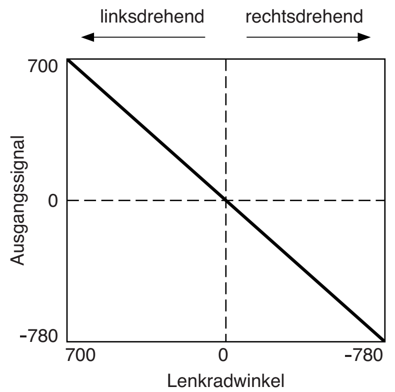
Storage temperature	- 40 ...+ 50 °C

Steering-angle sensor
Measurement of angles from -780° to +780°

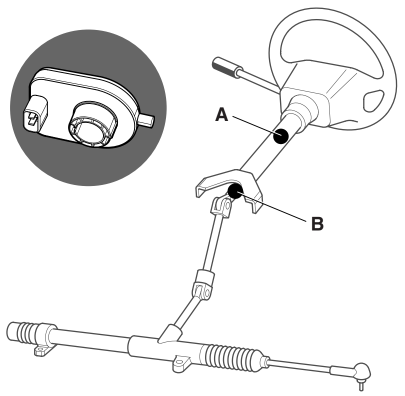
Block diagram



Characteristic curve

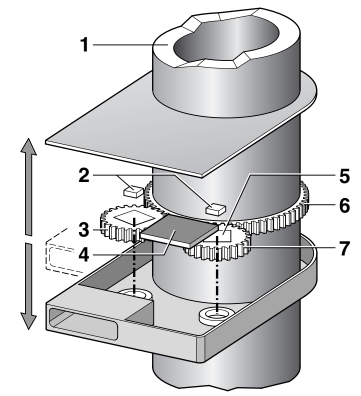


Attachment options



A Steering-column switch
B Steering column

Design and operation



1 Steering column
2 AMR measurement cells
3 Gear wheel with m teeth
4 Evaluation electronics
5 Magnets
6 Gear wheel with n>m teeth
7 Gear wheel with m+1 teeth

Steering-angle sensor
Measurement of angles from -780° to +780°

Part number 0 265 005 411

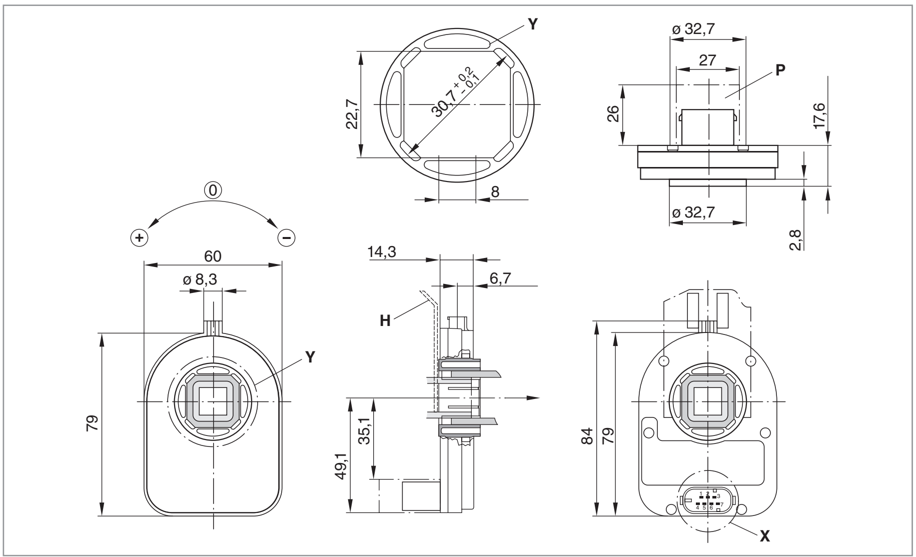
Technical data

Measuring range, angle	- 780 ...+ 780 °
Measuring range, steering-angle velocity	0 ... 1016 °/s
Sensitivity and resolution over measuring range, angle	0,1 °
Sensitivity and resolution over measuring range, steering-angle velocity	4 °/s
Non-linearity over measuring range	- 2,5 ...+ 2,5 °
Hysteresis over measuring range	0 ... 5 °
Steering-wheel angle velocity, maximum	± 2000 °/s
Steering-wheel angle velocity, displayed	0 ... 1016 °/s
Operating temperature	- 40 ...+ 85 °C
Supply voltage	12 V nominal
Supply-voltage range U_V	8 ... 16 V
Current consumption at 12 V	< 150 mA

Other designs on request.

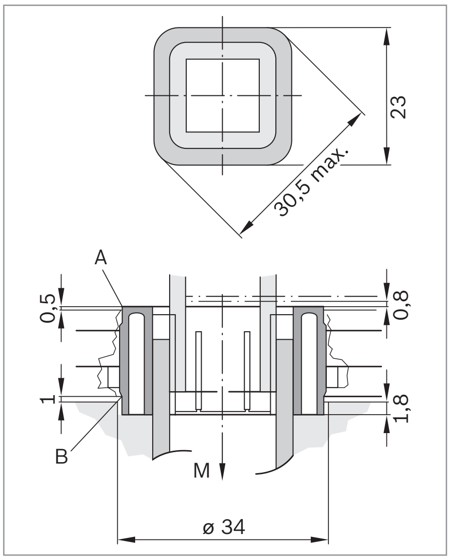
Figure

Dimensional drawing



H Retaining plate
P Space for mating connector and wiring harness
X Pin assignment

Dimensional drawing



A Distance between hub and holder
B Distance between steering-angle sensor and steering-column assembly flange
M Fitting direction

Accessories		Part number
Connector housing	7-pin	1 928 404 025
Contact pins	For Ø 0.5 - 0.7 mm^2; Contents: 100 x	1 928 498 001

Other designs on request.

Notes

Throttle valve angle sensor
Measurement of angles up to 86°

- ▶ Potentiometric angular-position sensors with linear characteristic curve.
- ▶ Sturdy design for exacting demands.
- ▶ Compact size.

Design and operation

The throttle-valve angular-position sensor is a potentiometric angular-position sensor with a linear characteristic curve. It is used with fuel-injection engines to convert the angle of rotation of the throttle valve into a proportional voltage ratio. To do so, the rotor with its special wipers connected to the throttle-valve shaft travels along corresponding resistance tracks, with the position of the throttle valve being converted into the above-mentioned voltage ratio. The throttle-valve angular-position sensors have no return spring.

Explanation of characteristic quantities

U_A Output voltage
U_V Supply voltage
φ Angle of rotation
U_{A1} Output-voltage characteristic curve 2
U_{A2} Output-voltage characteristic curve 3

Application

Sensors of this type are used in motor vehicles to record the angle of rotation of the throttle valve. They are exposed to extreme operating conditions, being attached directly to the throttle valve housing by means of an extended throttle valve shaft in the engine compartment. To maintain reliable operation under such conditions, the sensors are resistant to fuels, oils, saline fog and industrial atmospheres.

Throttle valve angle sensor
Measurement of angles up to 86°

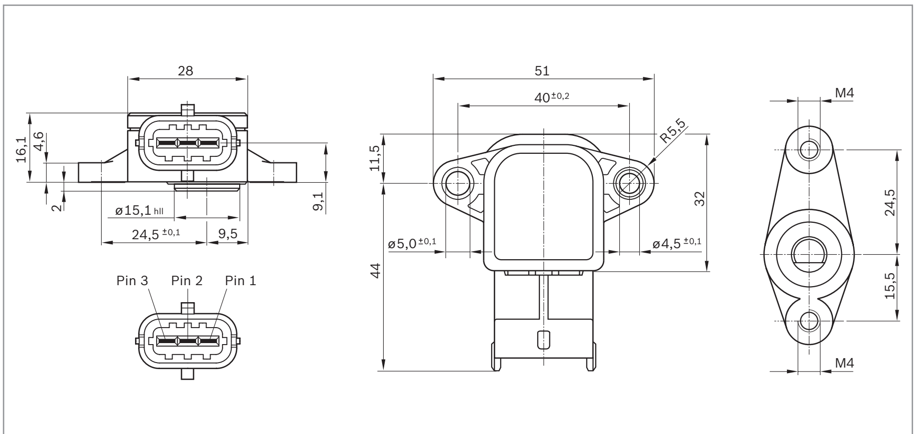
Part number **0 280 122 024**

Technical data

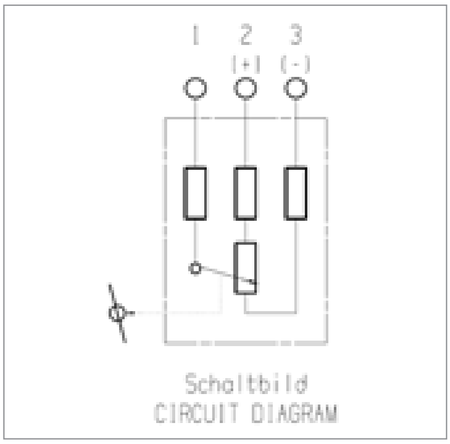
Useful electrical angle range	degrees	≤ 86
Useful mechanical angle range	degrees	≤ 96
Angle between internal stops (must not be reached when fitted)	degrees	≥ 96
Direction of rotation		Any
Total resistance (term. 1-2)	kΩ	2 ± 20 %
Wiper protective resistor (wiper in zero position, term. 2-3)	Ω	710 ... 1380
Operating voltage U_V	V	5
Load		Ohmic res.
Permissible wiper current	µA	≤ 10
Voltage ratio from stop to stop - characteristic curve 1		0,05 = UA / UV = 0,95
Slope of nominal characteristic curve	deg^{-1}	0,009375
Operating temperature		- 40 °C ...+ 130 °C
Approximate value for permissible vibration acceleration	m/s^2	≤ 800
Service life (rotary cycles)	Mill.	2

Figure

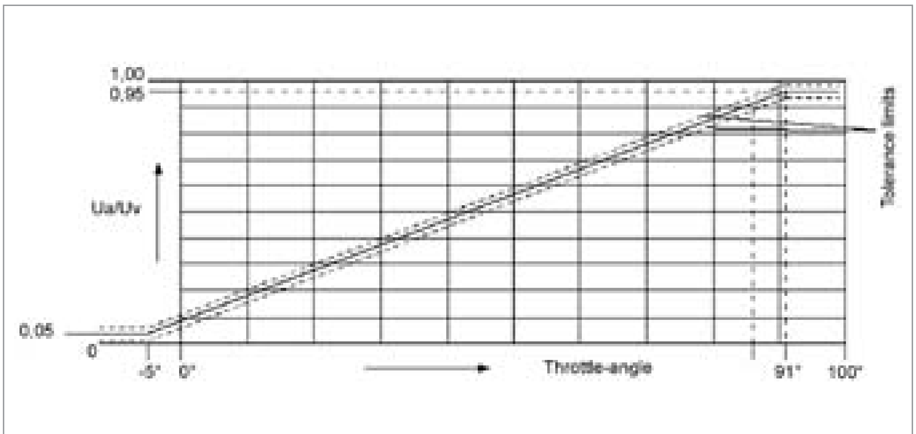
Dimensional drawings



Circuit diagram



Characteristic curve



Yaw sensor with CAN interface
with micromechanical acceleration sensor

- Flexible and cost-effective sensor cluster with highly integrated electronics.
- Modular concept for different integration stages.
- Multiple use of sensor signals for future highly dynamic safety and convenience systems.
- Optimised monitoring and safety concept.

Design

The sensor cluster uses a new generation of micromechanical elements for the measurement and digital processing of angular velocity and acceleration. Based on PCB technology, they form a modular hardware and software concept with many new safety features providing a versatile and reliable solution for a wide variety of motor-vehicle applications.

Principle of operation

The new micromechanical element for yaw-rate measurement is a member of the established group of vibrating gyrometers operating on the Coriolis principle (CVG = Coriolis Vibrating Gyros). It consists of an inverse tuning fork with two mutually perpendicular linear vibration modes, drive circuit and evaluation circuit. A comb-like structure provides electrostatic drive and evaluation. The Coriolis acceleration is measured electrostatically by way of engaging electrodes. The measurement element is made up of two masses connected by way of a spring with the same resonance frequency for both vibration modes. This is typically 15 kHz and thus outside the normal vehicle interference spectrum, making it resistant to disturbance acceleration. The evaluation circuit ASIC and the micromechanical measurement element are located in a prefabricated housing with 20 connections (Premold 20).
The design of the acceleration module is comparable to that of the yaw-sensor module and consists of a micromechanical measurement element, an electronic evaluation circuit and a housing with 12 connections (Premold 12).

Operating principle 2

The spring-mass structure is moved in its sensitive axis by external acceleration and evaluated using a differential capacitor in the form of a comb structure.

Application

The introduction of the ESP system, the link with other chassis convenience systems and the development of advanced vehicle stabilization systems gave rise to the need for inertial signals to meet with exacting demands, particularly in terms of signal quality and stability, as well as additional measurement axes with a high degree of reliability. Bosch therefore developed a third generation, the versatile and inexpensive sensor cluster DRS MM3.x to meet the requirements of functions such as the hill-starting assistant, automatic parking brake, adaptive cruise and distance control, four-wheel drive, rollover intervention, electronic active steering and spring-damper control systems.
DRS-MM3.7k is the basic version of the MM3 generation for ESP applications. It comprises a yaw sensor and an integrated lateral acceleration module.

Explanation of characteristic quantities

Ω Yaw rate
g Acceleration due to gravity 9.8065 m/s^2

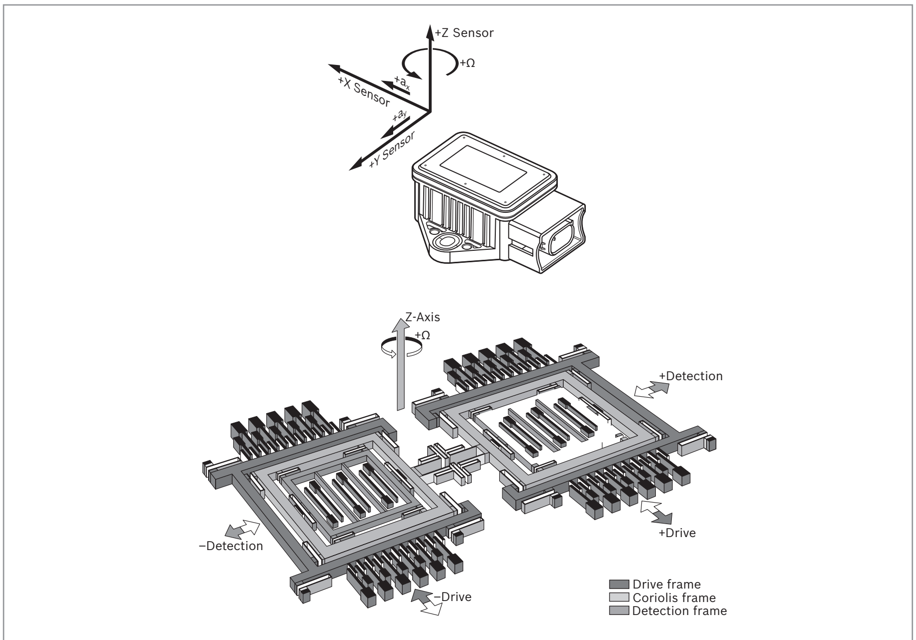
Yaw sensor with CAN interface
with micromechanical acceleration sensor

Technical data

Yaw sensor/type	DRS-MM 3.7K
Maximum yaw rate Ω_{max} about axis of rotation (Z-axis)	± 100 °/s
Minimum resolution $\Delta\Omega_{max}$	± 0,1 °/s
Sensitivity	200 LSB/°/s
Sensitivity tolerance over service life [1])	≤ 5 %
Offset error over service life [1])	≤ 2 °/s
Non-linearity, max. deviation from optimum linear approximation	≤ 1 °/s
Start-up time	≤ 1 s
Electrical noise (measured with 100 Hz bandwidth)	≤ 0,2 °/ s_{rms}
Linear acceleration sensor	
Maximum acceleration a_{qmax}	± 1,8 *g*
Sensitivity tolerance over service life [1])	≤ 5 %
Offset	≤ 0,03 *g*
Offset error over service life [1])	≤ 0,1 *g*
Electrical noise (measured with 100 Hz bandwidth)	≤ 0,01 P_N
General information	
Operating-temperature range	-40 ... 85 °C
Supply-voltage range	7 ... 18 V
Current consumption at 12V	< 130 mA

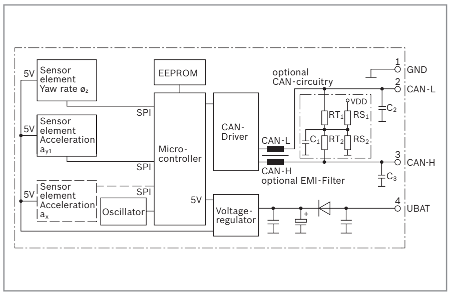
[1]) Service life: 6,000 h, over 15 years.

Principle of operation

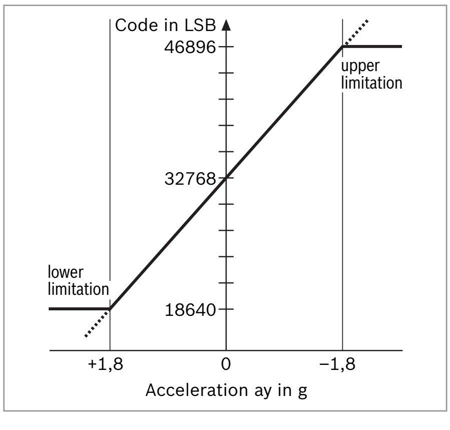


Ω Angular velocity (to be measured)
a_y, a_x and Ω are the signals that the (illustrated) sensor supplies, where:
Ω Angular velocity
a_y Acceleration in y direction = Lateral acceleration
a_x Acceleration in x direction = Longitudinal acceleration

Block diagram



Acceleration characteristic curve



Yaw sensor with CAN interface
with micromechanical acceleration sensor

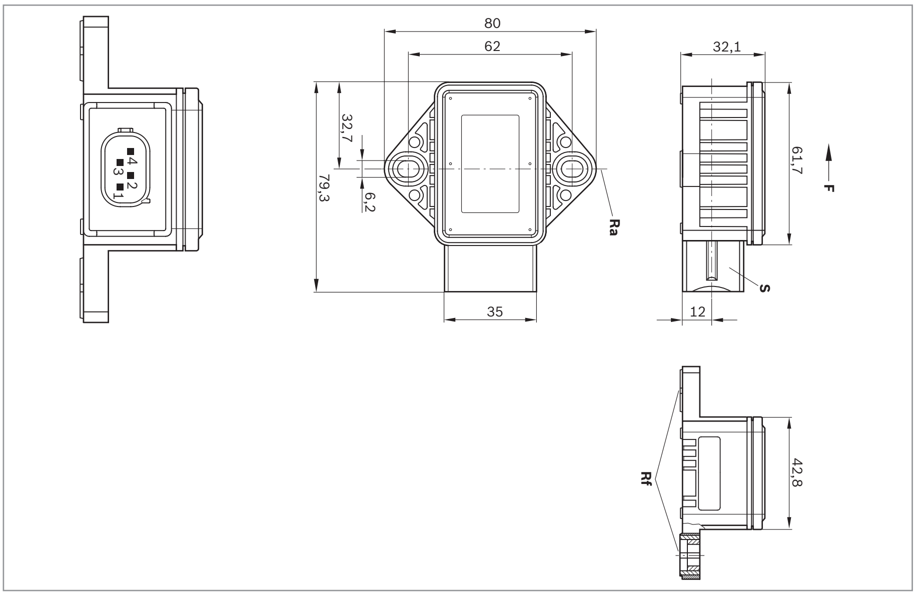
Part number 0 265 005 642

Technical data

Yaw-rate offset	≤ 1,5 °/s
Linear acceleration sensor	
Sensitivity	800 LSB/m/s²
Sensitivity	7845 LSB/g
Non-linearity, max. deviation from optimum linear approximation	≤ 4 % FSO
Start-up time	≤ 0,25 s
Dynamics	15 Hz
General information	
Storage-temperature range	-40 ... 50 °C
Supply voltage	12 V nominal

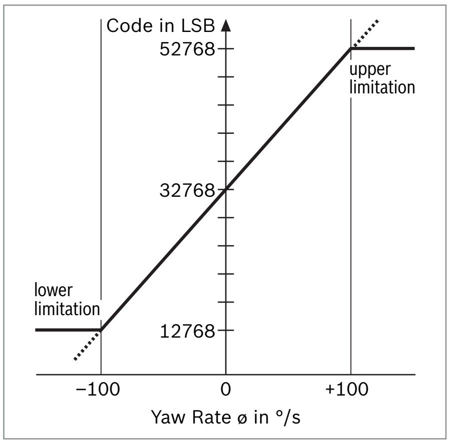
Figure

Dimensional drawing



F Direction of travel
S 4-pin connector
Ra Reference axis
Rf Reference surface
Pin 1 GND
Pin 2 CANL
Pin 3 CANH
Pin 4 12 V

Yaw rate characteristic curve



Accessories	Part number
Connector	TYCO 114-18063-014, MQS code A
Pin	114-18063-001
Catch	TYCO C-208-15641

Yaw sensor with CAN interface
with micromechanical acceleration sensor

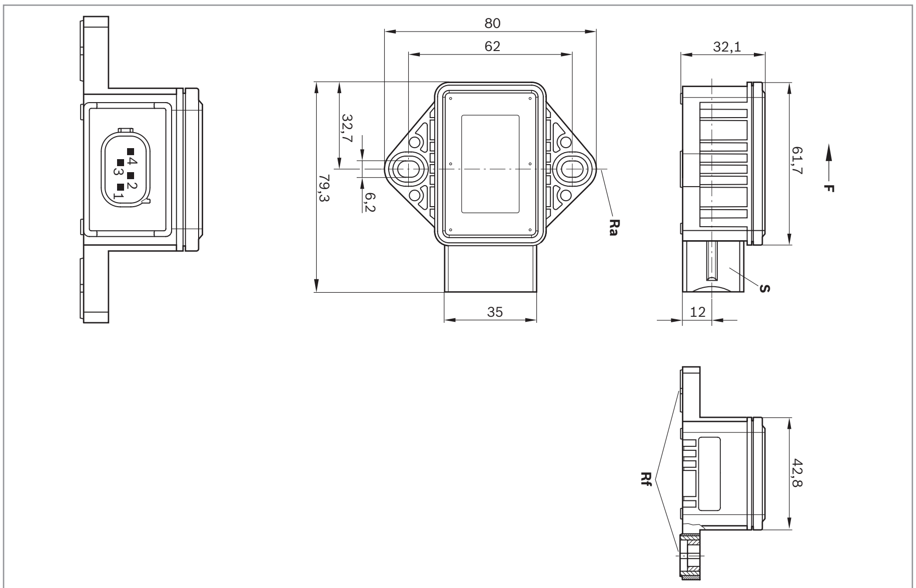
Part number 0 265 005 764

Technical data

Yaw-rate offset	≤ 3,5 °/s
Linear acceleration sensor	
Sensitivity	7849 LSB/g
Start-up time	≤ 5 s
Dynamics	15 Hz
General information	
Storage-temperature range	-40 ... 85 °C
Supply voltage	14 V nominal

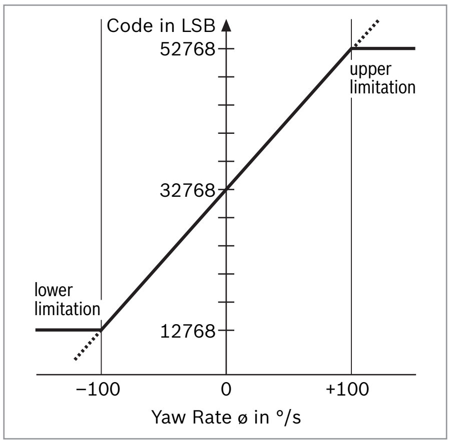
Figure

Dimensional drawing



F Direction of travel
S 4-pin connector
Ra Reference axis
Rf Reference surface
Pin 1 GND
Pin 2 CANL
Pin 3 CANH
Pin 4 12 V

Yaw rate characteristic curve



Hall speed sensor without cable
Digital measurement of rotational speeds

- ► Precise, reliable digital measurement of rotational speed, angles and distances.
- ► Non-contacting measurement.
- ► Hall IC in sensor with open collector output.
- ► Not susceptible to contamination.
- ► Resistant to mineral-oil products (fuel, engine oil).
- ► Transmission of information on sensor signal quality.

Design

Hall sensors consist of a semiconductor wafer with integrated driver circuits (e.g. Schmitt trigger) for signal conditioning, a transistor as output driver and a permanent magnet. These are hermetically sealed in a plastic connector housing. In an active rotational-speed sensor, magnets assume the function of the sensor-ring teeth. The magnets are integrated into a multiple rotor for example and are arranged with alternating polarity around its periphery. The measuring cell of the active rotational-speed sensor is exposed to the constantly changing magnetic field of these magnets. There is thus a constant change in the magnetic flux through the measuring cell as the multiple rotor turns.

Application

Hall speed sensors are suitable for non-contacting and thus wear-free rotational-speed measurement. Thanks to its compact design and low weight, the active rotational-speed sensor can be installed at or in a wheel bearing.

Installation instructions

- Standard installation conditions ensure full sensor operating capacity. - Route connecting leads in parallel to minimise interference. - Protect sensor against the destructive effect of static discharge (CMOS elements).

Principle of operation

The principal sensor components are either Hall elements or magneto-resistive elements. Both elements generate a voltage which is governed by the magnetic flux through the measuring element. The voltage is conditioned in the active speed range. In contrast to an inductive sensor, the voltage to be evaluated is not a function of the wheel speed. The wheel speed can thus be measured almost until the wheel has stopped.
A typical feature of an active speed sensor is the local amplifier. This is integrated into the sensor housing together with the measurement cell. A two-core cable provides the connection to the control unit. The speed information is transmitted in the form of a load-independent current.
As with an inductive speed sensor, the frequency of the current is proportional to the wheel speed. This form of transmission using conditioned digital signals is not susceptible to inductive disturbance voltages as is the case with the type of transmission with inductive speed sensors.

Explanation of characteristic quantities

$n_{min.}$=0	Static operation possible.
$n_{min.}$>0	Only dynamic operation possible.
U_V	Max. LOW output voltage with
I_A	Output current = 20 mA.
I_V	Supply current for Hall sensor.
t_f	fall time (trailing signal edge).
t_r	rise time (leading signal edge).

Hall speed sensor without cable
Digital measurement of rotational speeds

Part number 0 232 103 097

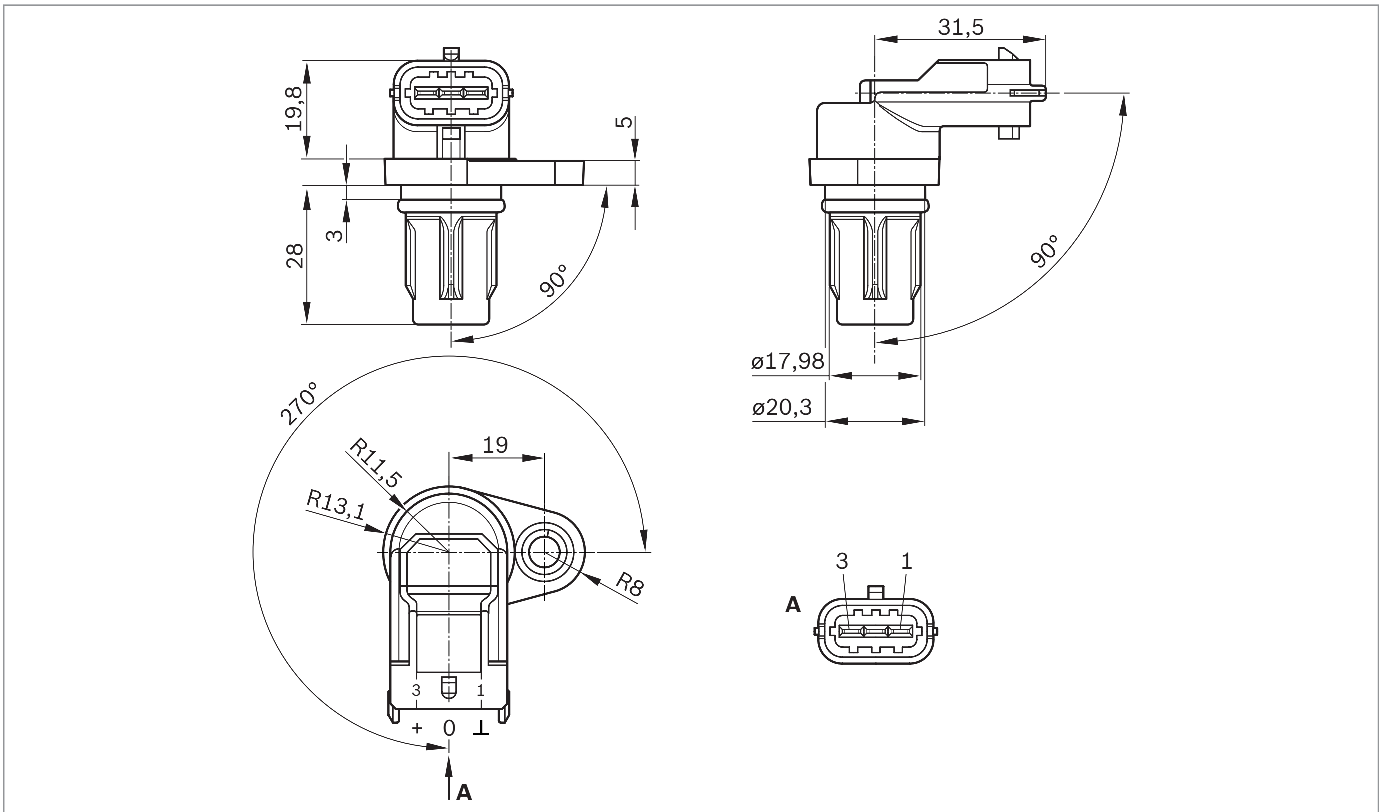
Technical data

Minimum trigger-wheel speed	$n_{min.}$	0 min.$^{-1}$
Maximum trigger-wheel speed	$n_{max.}$	4500 min.$^{-1}$
Maximum working air gap		1,8 mm
Minimum working air gap		0,2 mm
Rated supply voltage	U_N	5 V
Supply voltage range	U_V	4,5 ...16V
Supply current	I_V	Typically 5.6
Output current	I_A	0 ... 20 mA
Output saturation voltage	U_s	≤ 0,5 V
Switching time	t_f [1])	≤ 1 µs
Switching time	t_f [2])	≤ 15 µs
Steady-state temperature in sensor and transition zone		-40°C...+150°C
Steady-state temperature in connector zone		-40°C...+130°C

[1]) Time from HIGH to LOW, measured between connections (0) and (–) from 90% to 10%.
[2]) Time from LOW to HIGH, measured between connections (0) and (–) from 10% to 90%.
[3]) -40...+150 °C permissible for brief period.
[4]) -40...+130 °C permissible for brief period.

Figure

Dimensional drawings



Hall speed sensor without cable
Digital measurement of rotational speeds

Part number 0 232 103 099

Technical data

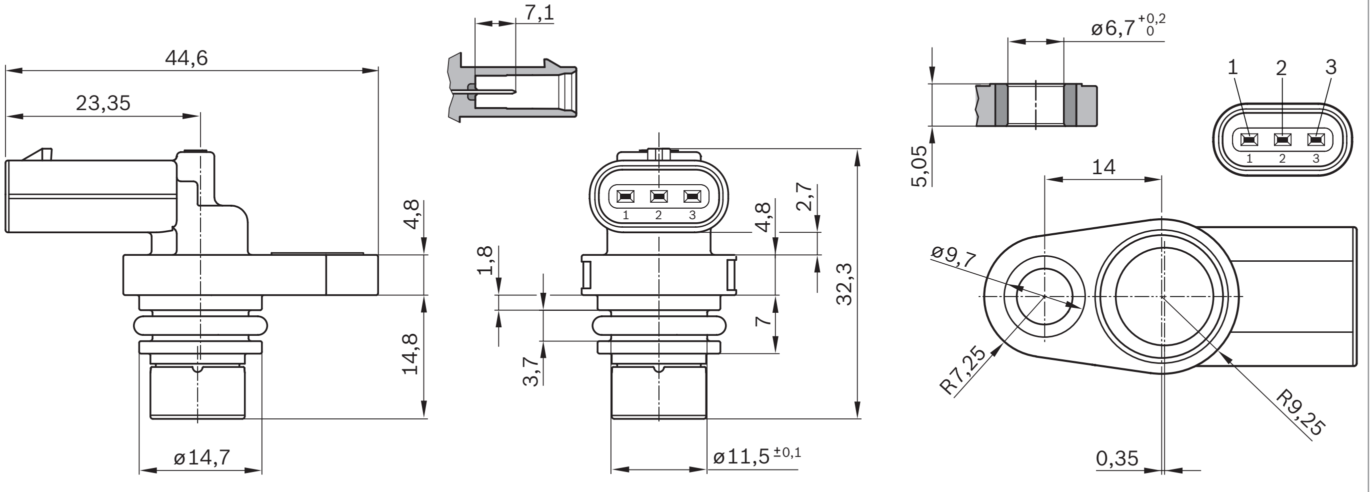
Minimum trigger-wheel speed	$n_{min.}$	0 min.$^{-1}$
Maximum trigger-wheel speed	$n_{max.}$	4000 min.$^{-1}$
Maximum working air gap		1,8 mm
Minimum working air gap		0,2 mm
Rated supply voltage	U_N	5 V
Supply voltage range	U_V	4,75V ... 18V
Supply current	I_V	Typically 5V
Output current	I_A	0 ... 18 mA
Output voltage	U_A	0 ...U_V
Output saturation voltage	U_s	≤ 0,52 V
Switching time	t_f [1])	≤ 1 µs
Switching time	t_f [2])	≤ 17 µs
Steady-state temperature in sensor and transition zone		-40°C ... 150°C
Steady-state temperature in connector zone		-40°C ... 150°C

µA) At ambient temperature 23 ± 5 °C.

[1]) Time from HIGH to LOW, measured between connections (0) and (–) from 90% to 10%.
[2]) Time from LOW to HIGH, measured between connections (0) and (–) from 10% to 90%.
[3]) -40...+150 °C permissible for brief period.
[4]) -40...+130 °C permissible for brief period.

Figure

Dimensional drawings



Hall speed sensor without cable
Digital measurement of rotational speeds

Part number 0 261 210 303

Technical data

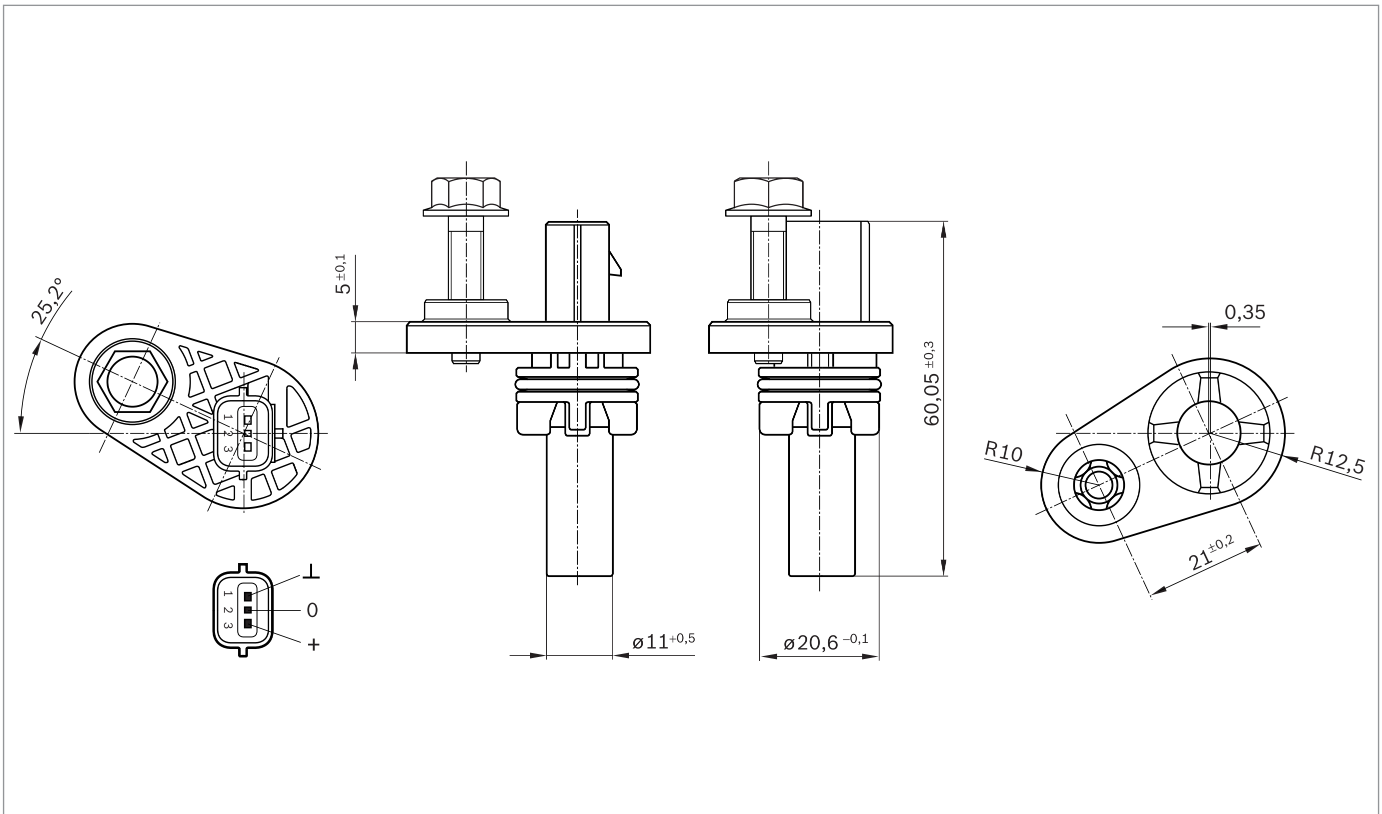
Minimum trigger-wheel speed	$n_{min.}$	0 min.$^{-1}$
Maximum trigger-wheel speed	$n_{max.}$	8000 min.$^{-1}$
Maximum working air gap		1,5 mm
Minimum working air gap		0,3 mm
Rated supply voltage	U_N	5 V
Supply voltage range	U_V	4,5...18V
Supply current	I_V	Typically 6.7
Output current	I_A	0 ... 20 mA
Output saturation voltage	U_s	≤ 0,5 V
Switching time	t_f [1])	≤ 1,3 µs
Switching time	t_f [2])	≤ 20 µs
Steady-state temperature in sensor and transition zone		-40°C...+150°C
Steady-state temperature in connector zone		-40°C...+130°C

µA) At ambient temperature 23 ± 5 °C.

[1]) Time from HIGH to LOW, measured between connections (0) and (–) from 90% to 10%.
[2]) Time from LOW to HIGH, measured between connections (0) and (–) from 10% to 90%.
[3]) -40...+150 °C permissible for brief period.
[4]) -40...+130 °C permissible for brief period.

Figure

Dimensional drawings



Hall speed sensor without cable
Digital measurement of rotational speeds

Part number 0 261 210 318

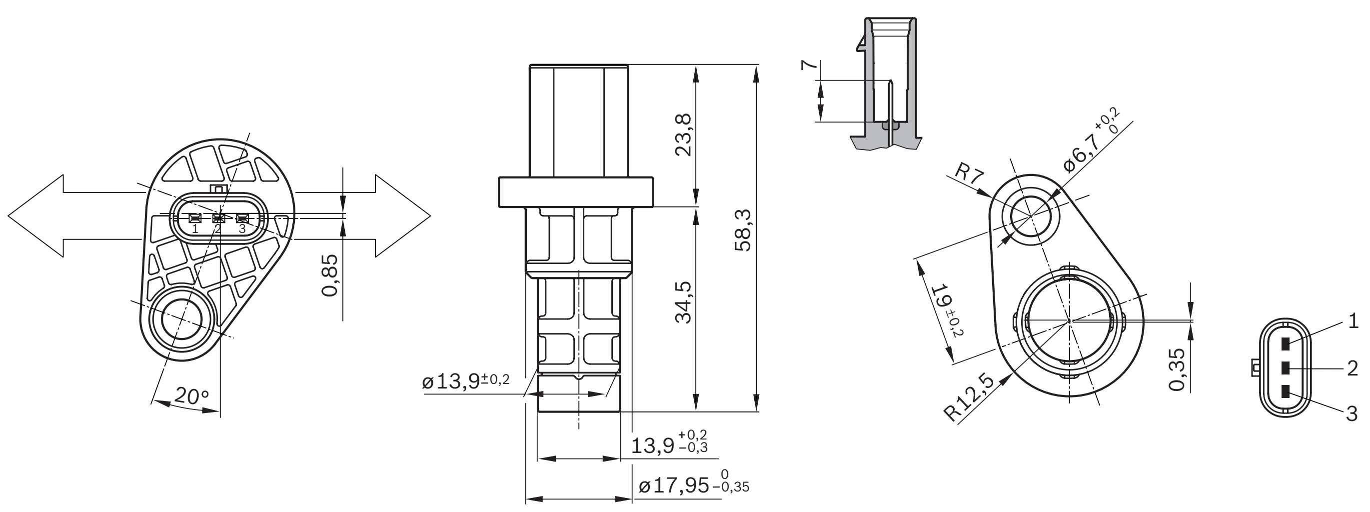
Technical data

Minimum trigger-wheel speed	$n_{min.}$	0 min.$^{-1}$
Maximum trigger wheel speed, forwards	$n_{max.}$	8000 1/min
Maximum trigger wheel speed, reverse	$n_{max.}$	4000 1/min
Maximum working air gap		1,5 mm
Minimum working air gap		0,5 mm
Rated supply voltage	U_N	5 V
Supply voltage range	U_V	4,5...5,5 V
Supply current	I_V	Typically 5.0 mA
Output current	I_A	0 ... 20 mA
Output saturation voltage	U_s	≤ 0,5 V
Switching time	t_f [1])	≤ 1,3 µs
Switching time	t_f [2])	≤ 17 µs
Steady-state temperature in sensor and transition zone		-40°C...+150°C
Steady-state temperature in connector zone		-40°C...+130°C

[1]) Time from HIGH to LOW, measured between connections (0) and (–) from 90% to 10%.
[2]) Time from LOW to HIGH, measured between connections (0) and (–) from 10% to 90%.
[3]) -40...+150 °C permissible for brief period.
[4]) -40...+130 °C permissible for brief period.

Figure

Dimensional drawings



Hall speed sensor without cable
Digital measurement of rotational speeds

Part number 0 261 210 329

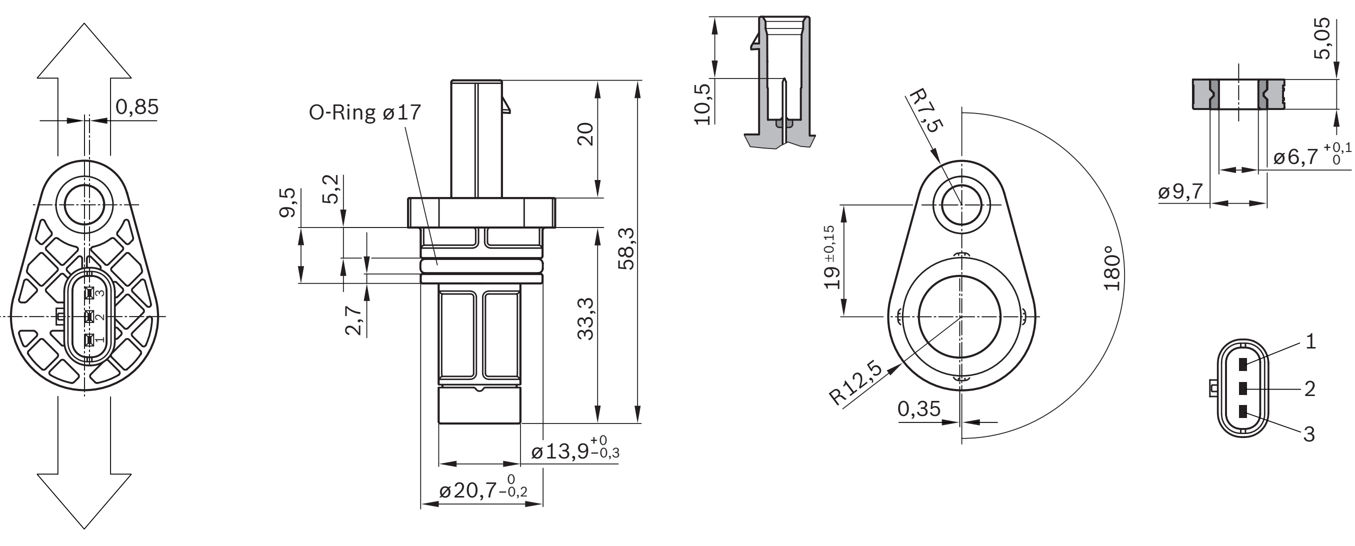
Technical data

Minimum trigger-wheel speed	$n_{min.}$	0 min.$^{-1}$
Maximum trigger-wheel speed	$n_{max.}$	5000 min.$^{-1}$
Maximum working air gap		1,8 mm
Minimum working air gap		0,2 mm
Rated supply voltage	U_N	5 V
Supply voltage range	U_V	4,5...18 V
Supply current	I_V	Typically 10 mA
Output current	I_A	0 ... 20 mA
Output saturation voltage	U_s	≤ 0,5 V
Switching time	t_f [1])	≤ 1,3 µs
Switching time	t_f [2])	≤ 17 µs
Steady-state temperature in sensor and transition zone		-40°C...+150°C
Steady-state temperature in connector zone		-40°C...+130°C

[1]) Time from HIGH to LOW, measured between connections (0) and (–) from 90% to 10%.
[2]) Time from LOW to HIGH, measured between connections (0) and (–) from 10% to 90%.
[3]) -40...+150 °C permissible for brief period.
[4]) -40...+130 °C permissible for brief period.

Figure

Dimensional drawings



Hall speed sensor without cable
Digital measurement of rotational speeds

Part number 0 281 002 667

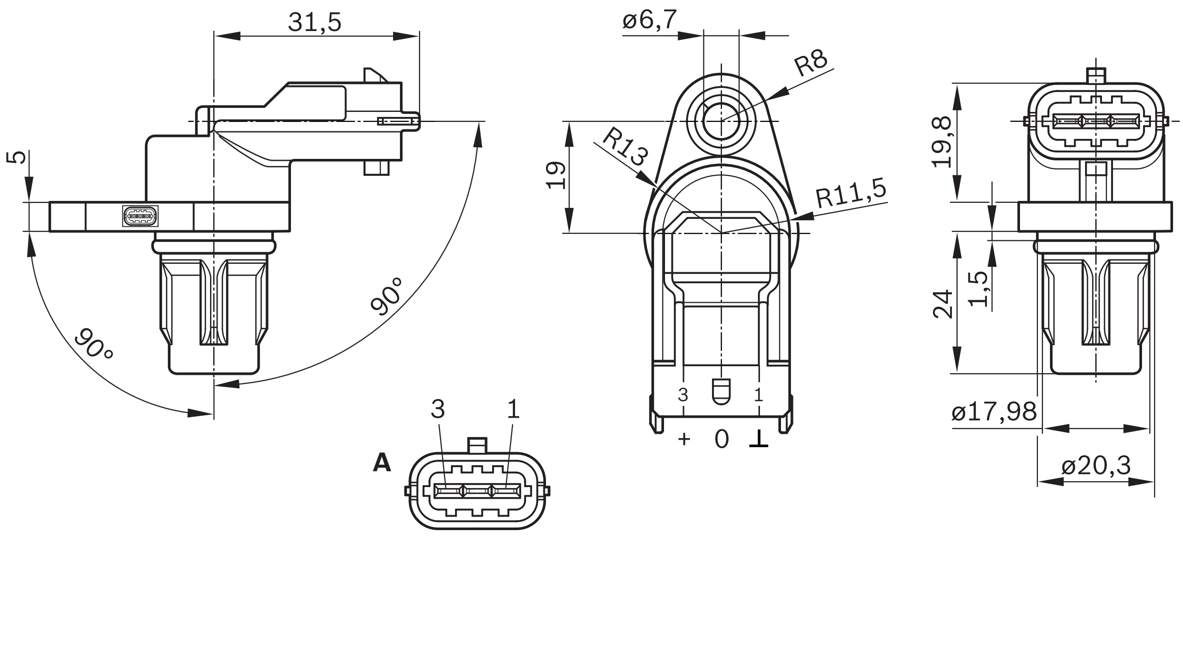
Technical data

Minimum trigger-wheel speed	$n_{min.}$	0 min.$^{-1}$
Maximum trigger-wheel speed	$n_{max.}$	4500 min.$^{-1}$
Maximum working air gap		1,8 mm
Minimum working air gap		0,2 mm
Rated supply voltage	U_N	5 V
Supply voltage range	U_V	4,7...18 V
Supply current	I_V	Typically 5.6 mA
Output current	I_A	0 ... 20 mA
Output saturation voltage	U_s	≤ 0,5 V
Switching time	t_f [1])	≤ 1 µs
Switching time	t_f [2])	≤ 15 µs
Steady-state temperature in sensor and transition zone		-40°C...+150°C
Steady-state temperature in connector zone		-40°C...+130°C

[1]) Time from HIGH to LOW, measured between connections (0) and (–) from 90% to 10%.
[2]) Time from LOW to HIGH, measured between connections (0) and (–) from 10% to 90%.
[3]) -40...+150 °C permissible for brief period.
[4]) -40...+130 °C permissible for brief period.

Figure

Dimensional drawings



Hall speed sensor without cable
Digital measurement of rotational speeds

Part number 0 281 006 101

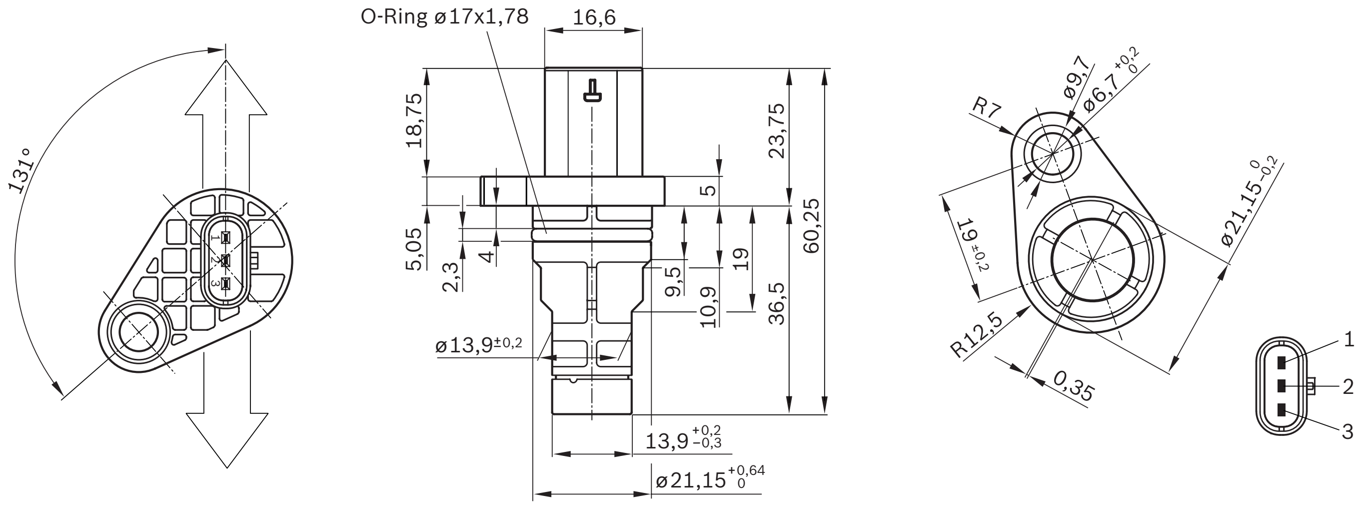
Technical data

Minimum trigger-wheel speed	$n_{min.}$	0 min.$^{-1}$
Maximum trigger wheel speed, forwards	$n_{max.}$	8000 1/min
Maximum trigger wheel speed, reverse	$n_{max.}$	4000 1/min
Maximum working air gap		1,8 mm
Minimum working air gap		0,2 mm
Rated supply voltage	U_N	5 V
Supply voltage range	U_V	4,5...18 V
Supply current	I_V	Typically 10 mA
Output current	I_A	0 ... 20 mA
Output saturation voltage	U_s	≤ 0,5 V
Switching time	t_f [1])	≤ 1,3 µs
Switching time	t_f [2])	≤ 17 µs
Steady-state temperature in sensor and transition zone		-40°C...+150°C
Steady-state temperature in connector zone		-40°C...+130°C

[1]) Time from HIGH to LOW, measured between connections (0) and (–) from 90% to 10%.
[2]) Time from LOW to HIGH, measured between connections (0) and (–) from 10% to 90%.
[3]) -40...+150 °C permissible for brief period.
[4]) -40...+130 °C permissible for brief period.

Figure

Dimensional drawings



Hall speed sensors
Digital speed measurement

- Precise and reliable digital measurement of speeds, angles and distances.
- Non-contacting measurement.
- Hall IC in sensor with open collector output.
- Not susceptible to dirt.
- Resistant to mineral oil products (fuel, engine oil).
- Transmission of information on sensor signal quality.

Design

Hall sensors consist of a semi-conductor chip with integrated driver circuits (e.g. Schmitt trigger) for signal conditioning and a transistor as output driver as well as a permanent magnet. These are hermetically sealed into a plastic connector housing.?With an active speed sensor, magnets assume the function of the sensor ring teeth. The magnets are integrated for example into a multi-pole ring and are arranged with alternating polarity around its circumference.?The measurement cell of the active speed sensor is exposed to the constantly changing magnetic field of these magnets. There is thus a constant change in the magnetic flux through the measurement cell as the multi-pole ring rotates.

Application

Hall speed sensors are suitable for non-contacting and thus wear-free speed measurement.?Thanks to its compact size and low weight, the active speed sensor can be installed at or in a vehicle wheel bearing.

Installation instructions

- Standard installation conditions guarantee full sensor functioning.?- Route the connecting cables in parallel to minimise interference.?- Protect the sensor against the destructive action of static discharge (CMOS components).

Principle of operation

The principal sensor components are either Hall elements or magnetoresistive elements. Both elements generate a voltage which is governed by the magnetic flux through the measuring element. The voltage is conditioned in the active speed range. In contrast to an inductive sensor, the voltage to be evaluated is not a function of wheel speed. The wheel speed can thus be measured almost down to zero.?A typical feature of the active speed sensor is the local amplifier. This is integrated into the sensor housing together with the measurement cell. A two-core cable forms the connection to the control unit. The speed information is transmitted in the form of a load-independent current. As with an inductive speed sensor, the frequency of the current is proportional to the wheel speed. This form of transmission employing conditioned digital signals is not susceptible to inductive disturbance voltages as is the case with the type of transmission with inductive speed sensors.

Explanation of characteristic quantities

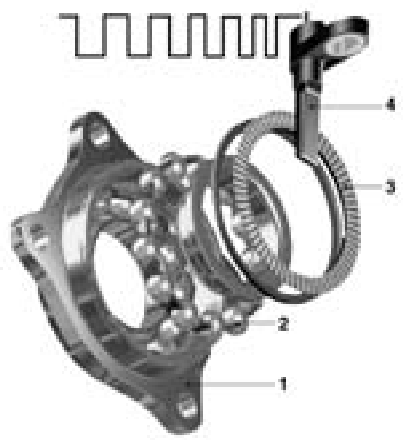
$n_{min.}$=0	Static operation possible.
$n_{min.}$>0	Dynamic operation only.
U_V	Max. output voltage at LOW with
I_A	output current = 20 mA.
I_V	Supply current for Hall sensor.
t_f	Fall time (trailing signal edge).
t_r	Rise time (leading signal edge).

Hall speed sensors
Digital speed measurement

Technical data

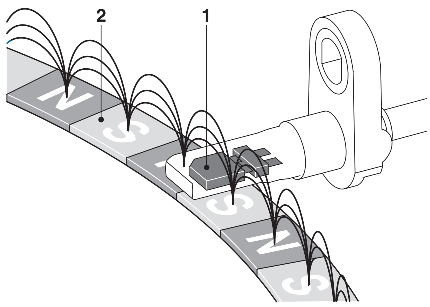
The signal strength is governed by the working air gap and the properties of the steel and multiple rotor.	
Rated supply voltage U_N	12 V
Supply-voltage range U_V	4,5 ... 12 V
Output current I_A	5,9 ... 16,8 mA
Sustained temperature in sensor and transition zone [1])	-40 ...+ 150 °C
Sustained temperature in connector zone	-40 ...+ 115 °C
Signal frequency	1 ... 2500 Hz

Exploded view



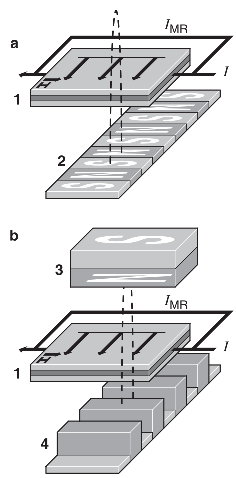
1 Wheel hub
2 Ball bearing
3 Multiple rotor
4 Wheel-speed sensor

Sectional view through active rotational-speed sensor



1 Sensor element
2 Multiple rotor with alternating North and South magnetisation

Diagrammatic figure for rotational-speed sensing



U_{Hall} Generated Hall voltage (in Volt)
I_{Const} Constant current (in amps)
B Magnetic flux density (in Tesla)
N North pole
S South pole

Hall speed sensors
Digital speed measurement

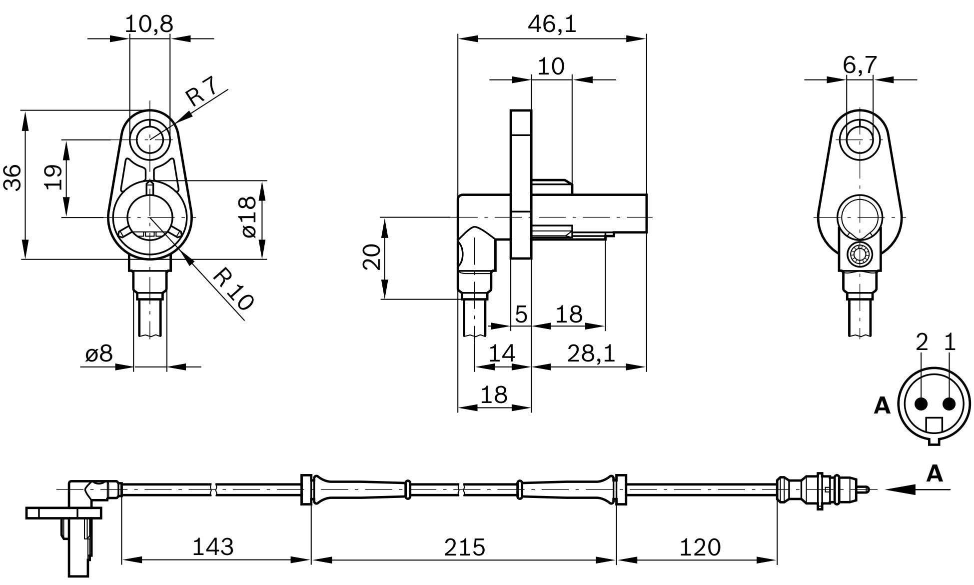
Part number 0 265 007 527

Technical data	
The signal strength is governed by the working air gap and the properties of the steel and multiple rotor.	
Rated supply voltage U_N	12 V
Supply-voltage range U_V	4,5 ... 12 V
Output current I_A	5,9 ... 16,8 mA
Sustained temperature in sensor and transition zone [1])	-40 ...+ 150 °C
Sustained temperature in connector zone	-40 ...+ 115 °C
Signal frequency	1 ... 2500 Hz

[1]) Short-term –40...+170°C permissible.

Figure

Dimensional drawing



Pin 1 Supply voltage (white wire)
Pin 2 Signal (black wire)

Accessories		Part number
Connector housing	2-pin	2 264 420 424
Contact pins	For Ø 0,5...2,5 mm²; Content: 100 x	2 263 124 303
O-ring		2 260 210 308

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.
Customer must provide mating connector/contacts.
If a different connector is used, the cable must be sealed against the incidence of moisture.

Hall speed sensors
Digital speed measurement

Part number 0 265 007 544

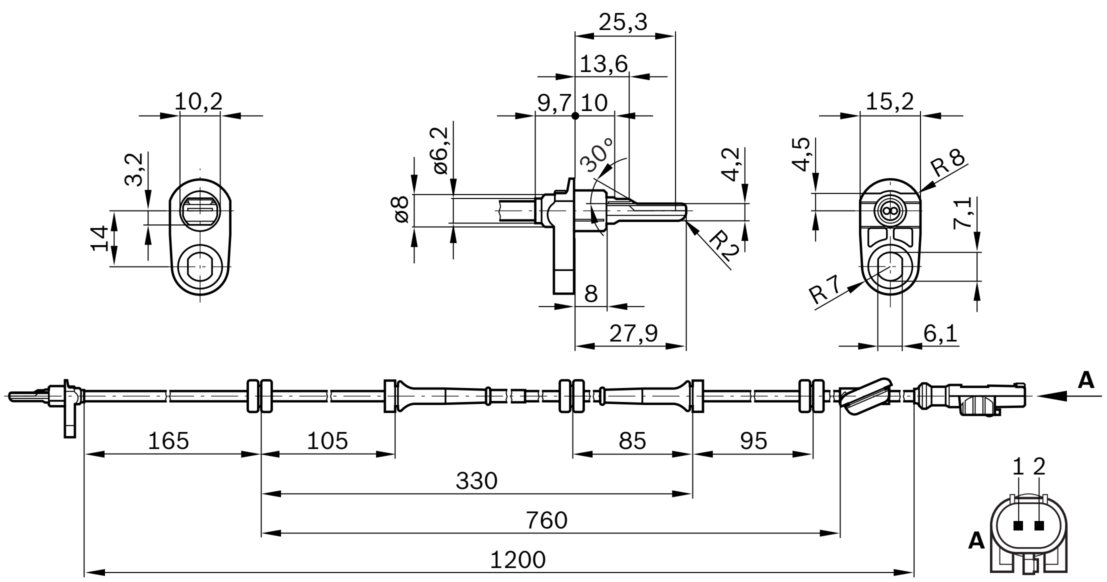
Technical data

The signal strength is governed by the working air gap and the properties of the steel and multiple rotor.	
Rated supply voltage U_N	12 V
Supply-voltage range U_V	4,5 ... 12 V
Output current I_A	5,9 ... 16,8 mA
Sustained temperature in sensor and transition zone [1])	-40 ...+ 150 °C
Sustained temperature in connector zone	-40 ...+ 115 °C
Signal frequency	1 ... 2500 Hz

[1]) -40...+170°C permissible for brief periods.

Figure

Dimensional drawing



Pin 1 Supply voltage (white wire)
Pin 2 Signal (black wire)

Accessories

Accessories			Part number
Connector housing	2-pin	Tyco number	1-967 644-1[1])
Contact pins	For Ø 0.5...2.5 mm²	Tyco number	962 885-1[1])
Single-wire seal	For Ø 0.5...1.0 mm²	Tyco number	967 067-2[1])
Single-wire seal	For Ø 1.5...2.5 mm²	Tyco number	967 067-1[1])

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.
Customer must provide mating connector/contacts.
If a different connector is used, the cable must be sealed against the incidence of moisture.

[1]) Available from Tyco Electronics.

Piezoelectric vibration sensor
Measurement of structure-borne sound and acceleration

- ▶ Reliable detection of structure-borne sound to protect machines and motors.
- ▶ Piezoceramic element with high measurement sensitivity.
- ▶ Sturdy compact design.

Design and operation

On account of its inertia, a mass exerts compressive forces on an annular piezoceramic element in the same rhythm as the vibrations causing them. As a result of these forces, charge transfer occurs within the ceramic element and a voltage is generated between the upper and lower sides of the ceramic element. The voltage is tapped via contact washers - often filtered and integrated - and is available for use as a measurement signal. Vibration sensors are bolted to the object to be measured so as to relay the vibrations at the measurement location directly to the sensors.

Areas of application

- Knock control for internal-combustion engines
- Machine-tool protection
- Cavitation detection
- Monitoring of pivot bearings
- Anti-theft systems

Note

1 connector housing, contact pins and individual seals are required for a connector. Use must be made of genuine Tyco crimping tools for motor vehicle applications.

Explanation of characteristic quantities

E Sensitivity
f Frequency
g Acceleration due to gravity

Measurement sensitivity

Each vibration sensor has individual transmission characteristics closely related to the measuring sensitivity. The sensitivity is defined as the output voltage per unit of acceleration due to gravity (refer to characteristic curve). The production-related sensitivity scatter is acceptable for applications in which the main emphasis is on recording the occurrence of vibrations rather than on their amplitude.
The low voltages supplied by the sensor can be evaluated using a high-impedance AC voltage amplifier.

Installation instructions

The sensors must rest directly on their metal surfaces. Use must not be made of packing plates, spring or toothed lock washers for support. The contact surface of the mounting hole must be of high quality to ensure low-resonance coupling of the sensors to the measurement location. The sensor cable is to be laid such that no resonance vibration can occur. The sensor must not be allowed to have contact with liquids for lengthy periods.

Application

Vibration sensors of this type are suitable for detecting structure-borne vibration occurring for example in motor-vehicle engines due to irregular combustion and in machines. Thanks to their robust design, these vibration sensors can withstand even the most severe operating conditions.

Evaluation

The signals from these sensors can be evaluated with an electronic module.

Pin assignment

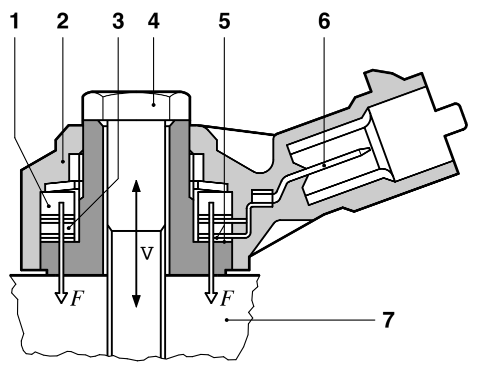
Pin 1, 2	Measurement signal
Pin 3	Screen, dummy; if provided

Piezoelectric vibration sensor
Measurement of structure-borne sound and acceleration

Technical data

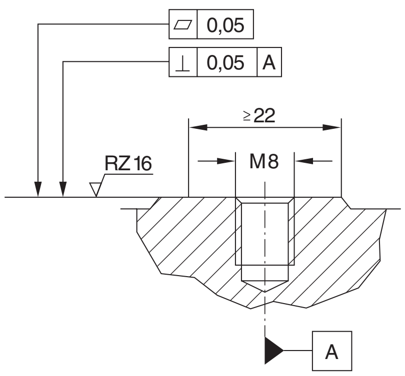
Sensitivity at 5 kHz	30 ± 6 mV/*g*
Linearity between 5...20 kHz at resonance	10 %
Main resonance frequency	> 30 kHz
Capacitance range	950 ... 1350 pF
Temperature dependence of sensitivity	≤ 0,04 mV/*g* · K
Permissible short-term vibration	≤ 400 *g*
Installation	
Grey cast iron bolt	M 8 x 25 ; Quality 8.8
Aluminium bolt	M 8 x 30 ; Quality 8.8
Tightening torque (possible with lubrication)	20 ± 5 Nm
Installation position	Any

Vibration sensor (design)



1 Seismic element with compressive forces F
2 Housing
3 Piezoceramic element
4 Screw
5 Contact
6 Electrical connection
7 Machine block, V Vibration.

Mounting hole



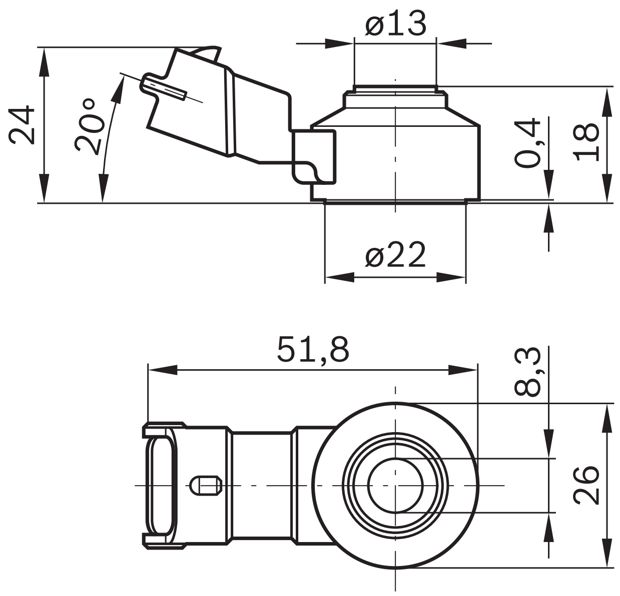
Piezoelectric vibration sensor
Measurement of structure-borne sound and acceleration

Part number 0 261 231 173

Technical data	
Vibration sensors	2-pole, without cable
Frequency range	3 ... 22 kHz
Self-impedance	> 1 MΩ
Operating temperature range	- 40 ...+ 150 °C
Permissible sustained vibration	≤ 80 *g*

Figure

Dimensional drawing



Accessories		Part number
Connector housing	2-pin	1 928 403 874
Contact pins	For Ø 0.5...1.0 mm²; Contents: 100 x	1 928 498 056
Contact pins	For Ø 1.5...2.5 mm²; Contents: 100 x	1 928 498 057
Individual seal	for Ø 0.5...1.0 mm²; content: 10 x	1 928 300 599
Individual seal	for Ø 1.5...2.5 mm²; content: 10 x	1 928 300 600
Dummy plug	For Ø 1.5...2.5 mm²; Contents: 10 x	1 928 300 601

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

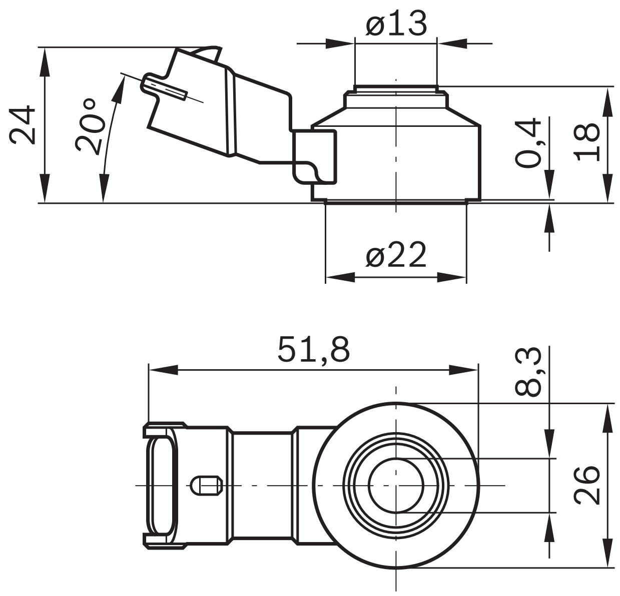
Piezoelectric vibration sensor
Measurement of structure-borne sound and acceleration

Part number 0 261 231 176

Technical data	
Vibration sensors	2-pole, without cable
Frequency range	3 ... 22 kHz
Self-impedance	> 30 MΩ
Operating temperature range	- 40 ...+ 130 °C
Permissible sustained vibration	≤ 50 *g*

Figure

Dimensional drawing



Accessories		Part number
Connector housing	2-pin	1 928 403 874
Contact pins	For Ø 0.5...1.0 mm²; Contents: 100 x	1 928 498 056
Contact pins	For Ø 1.5...2.5 mm²; Contents: 100 x	1 928 498 057
Individual seal	For Ø 0.5...1.0 mm²; Contents: 10 x	1 987 300 599
Individual seal	For Ø 1.5...2.5 mm²; Contents: 10 x	1 987 300 600
Dummy plug	For Ø 1.5...2.5 mm²; Contents: 10 x	1 928 300 601

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

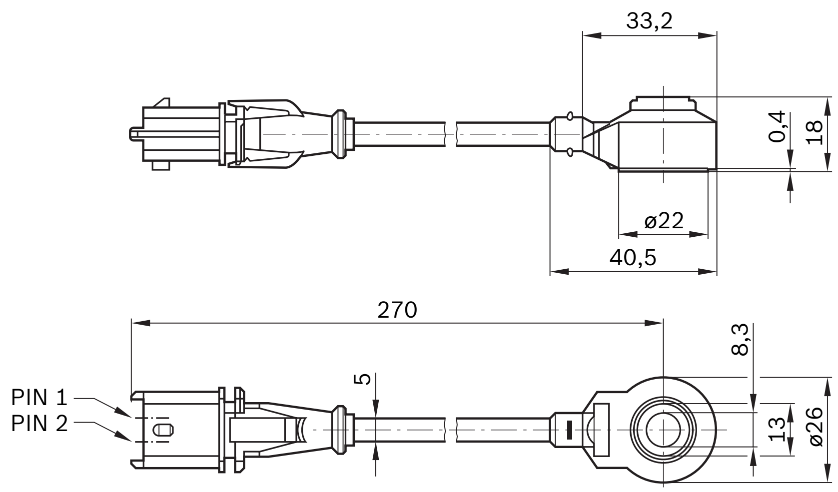
Piezoelectric vibration sensor
Measurement of structure-borne sound and acceleration

Part number 0 261 231 196

Technical data	
Vibration sensors	2-pole, with cable, up to 130 °C
Frequency range	0 ... 24 kHz
Self-impedance	> 1 MΩ
Operating temperature range	- 40 ...+ 130 °C
Permissible sustained vibration	≤ 80 *g*

Figure

Dimensional drawing



Accessories		Part number
Connector housing	2-pin	1 928 403 874
Contact pins	For Ø 0.5...1.0 mm²; Contents: 100 x	1 928 498 054
Contact pins	For Ø 1.5...2.5 mm²; Contents: 100 x	1 928 498 055
Individual seal	For Ø 0.5...1.0 mm²; Contents: 10 x	1 987 300 599
Individual seal	For Ø 1.5...2.5 mm²; Contents: 10 x	1 987 300 600
Dummy plug	For Ø 1.5...2.5 mm²; Contents: 10 x	1 928 300 601

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

Notes

Signal evaluation for vibration sensors
Signal-evaluation module

- ▶ Programmable amplification.
- ▶ Programmable band pass filter.
- ▶ No external calibration required.
- ▶ Choice of 4 selectable sensor inputs or 2 symmetrical inputs.
- ▶ Integrated programmable frequency divider.
- ▶ Analog stage with signal test.
- ▶ Suitable for a wide range of micro controller types.
- ▶ PLCC28 housing.

Note

On account of the MOS inputs, the electronic module is to be handled with extreme care:
- No direct contact
- Use MOS workstation
- Only switch on the operating voltage with a rise of < 1 V · μs^{-1}

Design and operation

A circuit integrated into the module evaluates the analog signals. The circuit contains a programmable amplifier, a band pass filter, a rectifier, an integrator and control logic. The use of „SC“ circuitry ensures reliable operation without the need for external calibration. The fully programmable circuit can be readily employed for a variety of applications. The start and end of integration are controlled by the „Measurement window“ input. A frequency divider programmed by way of three inputs generates the system clock of the analog stage for various externally applied clock frequencies (8 stages from 1...16 MHz) and the test frequencies (9 centre frequencies of 5...16 kHz) depending on the setting of the filter. By altering the frequency, the internal clock frequency can be set from a nominal level of 100 kHz to values between 50 kHz and 150 kHz. The band-filter centre frequencies, the test frequencies and the integration time constant are shifted in parallel with this.

Application

Evaluation of analog signals with piezoelectric acoustic pick-ups (vibration sensors)

Technical data

Parameter			Conditions	min	max
Supply voltage	U_V	V	-	4,75	5,25
Supply current	I_V	mA	$U_V/2$		30
Input voltage, analog	U_{KE}	V	-	0	2
Input current, analog	I_{KE}	µA	U_{KE} = 2 V		10
Signal amplification	V		-	2	128
Signal amplification, tolerance	d_v	%	-	-3	+3
Clock frequency	f_x	MHz	-	0,5	27
Input signal frequency	f_{KE}	kHz	-		30
Band-pass filter center frequency	f_M	kHz	-	5	16
Filter quality	Q		-	3	
Filter quality, tolerance	d_α		-	-0,5	+0,3
Integrator deviation, useful	d_{VKU}	V	-	3,8	4,5
Integrator offset	mV	t_{MF} > 0 °C		-300	+300
Integrator offset	mV	t_{MF} < 0 °C		-400	+400
Integration time constant	t_I	µs	-	148	152
Integrator output impedance	Z_{KL}	kΩ	-		2
Operating temperature	ϑ	°C	-	-40	+125

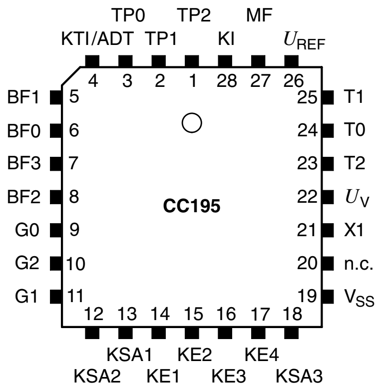
Limit values

Parameter			min	type	max
Max. supply voltage	-	V	-0,5		6,7
Rate of rise of max. supply voltage	-	µV		1	
Max. current in all inputs and outputs	-	mA	-2,5		+2,5
Protection of inputs and outputs against destruction by electrostatic discharge	-	kV	-2		+2
Storage temperature	-	°C	-55		+135
Ambient temperature during operation	-	°C	-40		+125

Signal evaluation for vibration sensors
Signal-evaluation module

Part number **0 272 230 424**

Pin assignment



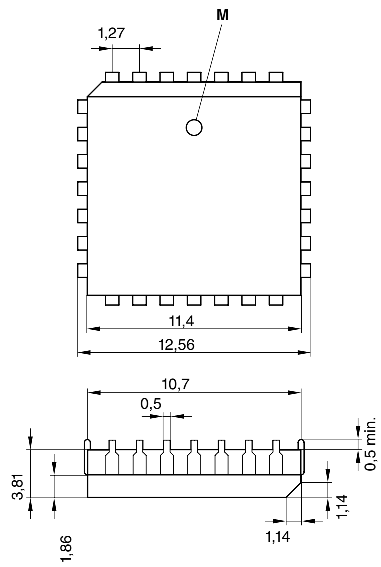
Pin assignment.

U_{REF}	Reference voltage
$U_V/2$	(output ±0.5mA load capacity)
U_V	Supply voltage 5 V
V_{ss}	Earth
BF0/BF1/BF2/BF3*)	Bandpass centre frequency setting
G0/G1/G2*)	Gain setting
KE1/2/3/4	Sensor inputs
KI	Signal integral output
KSA1/2/3*)	Sensor selection
KTI/ADT	Controlled input/test output
FM*)	Measurement window
N.C.	not connected
T0/T1/T2	Clock frequency selection
TP0/TP1/TP2	For clock purposes
X1	Clock supply

*) TTL-compatible static inputs of microcomputer port driver

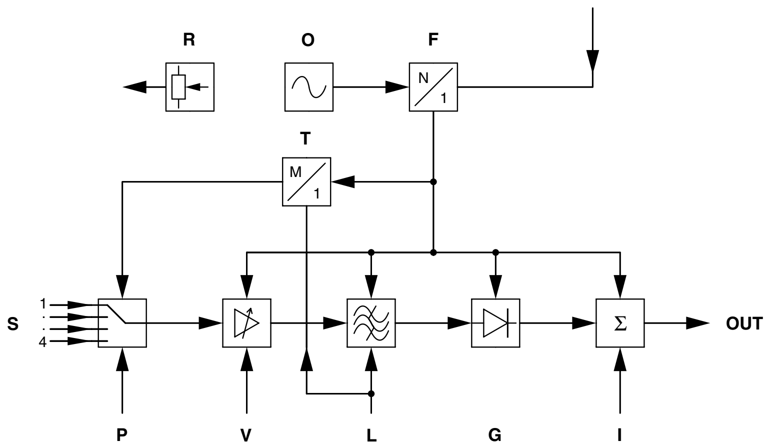
Figure

Dimensional drawing



M Marking Pin 1

Design and operation



F	Frequency divider
G	Rectifier
L	Filter
I	Integrator
O	Oscillator
P	Multiplexer
R	Reference signals
S	Sensor inputs
T	Test pulse divider
V	Amplifier
OUT	Output.

Differential pressure sensor
Micromechanics, hybrid design

- High level of accuracy
- EMC protection better than 100 Vm^{-1}
- With temperature compensation

Recommendation for signal evaluation

The design of the electrical output of the pressure sensor is such that appropriate circuitry in the downstream electronics can detect malfunctions caused by breaks in the cable or short circuits. The diagnosis ranges beyond the characteristic curve limits are intended for fault diagnosis. Example circuit for detection of all fault situations using signals beyond the characteristic curve limits.

Application

This sensor is used to measure the difference between the intake-manifold pressure of the intake air flow of internal-combustion engines and a reference pressure applied by way of a hose.

Design and operation

The piezoresistive pressure-sensor element and appropriate signal amplification and temperature-compensation electronics are integrated on a silicon chip. The pressure measured acts on the back of the silicon diaphragm. The reference pressure acts from above on the active side of the silicon diaphragm. Thanks to the coating process employed, both sides are resistant to the gases and liquids occurring in the intake manifold.

Installation instructions

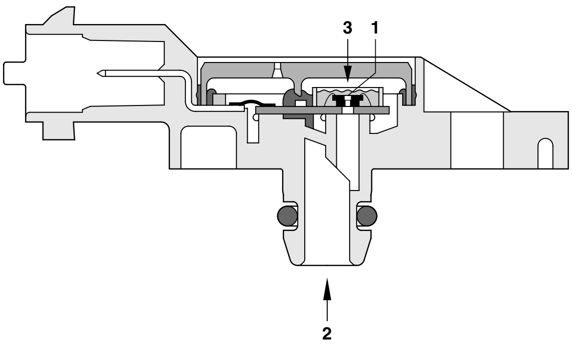
The sensor is designed for attachment to a flat surface at the intake manifold of motor vehicles. The pressure connection projects into the intake manifold and is sealed off from the atmosphere by an O-ring. The sensor should be installed such that condensate cannot accumulate in the pressure cell or the reference opening (pressure sampling point at top of intake manifold, pressure connection angled downwards etc.). As a general rule, the installation position should ensure that liquids cannot accumulate in the sensor and pressure hose. If it freezes, water in the sensor will lead to malfunctioning.

Differential pressure sensor
Micromechanics, hybrid design

Technical data

Parameter			min	type	max
Supply voltage	U_V	V	4,75	5	5,25
Current input at U_V = 5 V	I_V	mA	6,0	9,0	12,5
Load current at output	I_L	mA	-1,0		0,5
Load resistance to U_V or ground	„	kΩ	10		
Response time	$\tau_{10/90}$	ms			1
Voltage limitation at U_V = 5 V - lower limit	$U_{A\,min}$	V	0,25	0,3	0,35
Voltage limitation at U_V = 5 V - upper limit	$U_{A\,max}$	V	4,75	4,8	4,85
Limit data					
Supply voltage	U_V	V			16

Sectional view of pressure sensor (entire system)



1 Sensor cell
2 Measurement pressure
3 Reference pressure

Differential pressure sensor
Micromechanics, hybrid design

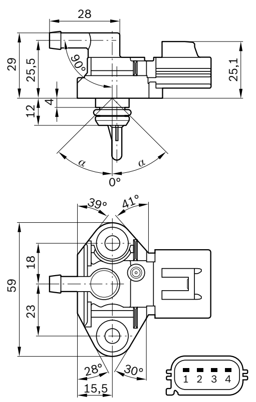
Part number 0 261 230 093

Technical data

Parameter			min	max
Pressure measuring range (U_{AA}...p_2)	p_e	kPa	0	500
Operating temperature	ϑ_B	°C	-40	+125
Load resistance to U_V or ground	$R_{pull\text{-}up}$	kΩ	4,7	
Limit data				
Pressure	p_e	kPa	+3000	
Storage temperature	v_L	°C	+130	

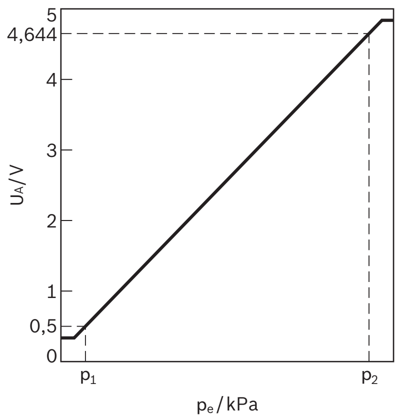
Figure

Dimensional drawing

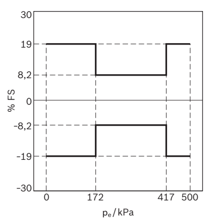


Pin 1 Ground
Pin 2 NTC
Pin 3 +5 V
Pin 4 Output signal

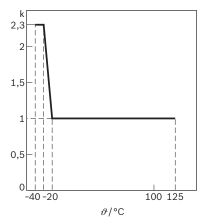
Characteristic curve



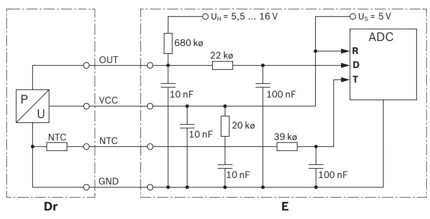
Characteristic-curve tolerance



Tolerance extension factor



Recommendation for signal evaluation



D Pressure signal
R Reference
Dr Pressure sensor
E Electronic control unit

Accessories

Accessories			Part number
Connector housing	4-pin	Yazaki number	7283-5886-30[1])
Contact pins	For Ø 0.35...0.5 mm²	Yazaki number	7116-4102-08[1])
Contact pins	For Ø 0.75...1.0 mm²	Yazaki number	7116-4103-08[1])
Single-wire seal	For Ø 0.35...0.5 mm²	Yazaki number	7158-3030-50[1])
Single-wire seal	For Ø 0.75...1.0 mm²	Yazaki number	7158-3031-90[1])
Dummy plug		Yazaki number	7158-3032-60[1])

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required. [1]) Available from Yazaki Europe LTD.

Differential pressure sensor
Micromechanics, hybrid design

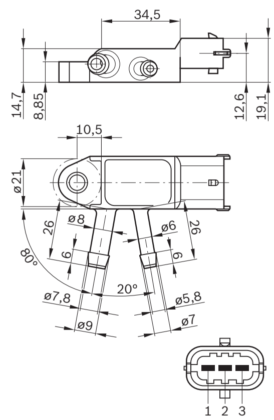
Part number **0 281 002 772**

Technical data

Parameter			min	max
Pressure measuring range (U_{AA}...p_2)	p_e	kPa	0	100
Operating temperature	ϑ_B	°C	-40	+130
Load resistance to U_V or ground	$R_{pull\text{-}up}$	kΩ	5	
Limit data				
Pressure	p_e	kPa	-350	+350
Storage temperature	v_L	°C	-40	+130

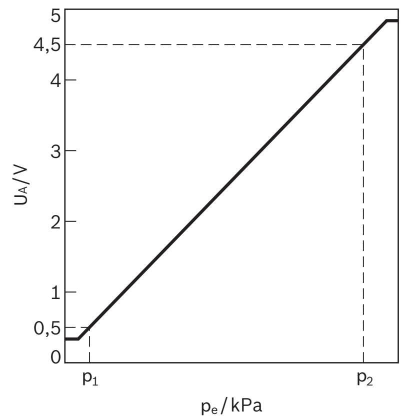
Illustration

Dimensional drawing

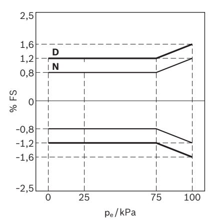


Pin 1 +5 V
Pin 2 Ground
Pin 3 Output signal

Characteristic curve

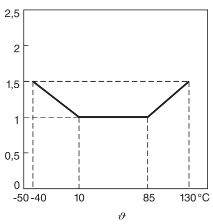


Characteristic-curve tolerance

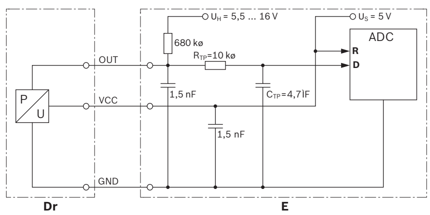


D After endurance test
N As-new condition

Tolerance extension factor



Recommendation for signal evaluation



D Pressure signal
R Reference
Dr Pressure sensor
E Electronic control unit

Accessories

Accessories		Part number
Connector housing	3-pin	1 928 403 966
Contact pins	For Ø 0.5...1.0 mm²; Contents: 100 x	1 928 498 056
Contact pins	For Ø 1.5...2.5 mm²; Contents: 100 x	1 928 498 057
Single-wire seal	For Ø 0.5...1.0 mm²; Contents: 10 x	1 928 300 599
Single-wire seal	For Ø 0.5...2.5 mm²; Contents: 10 x	1 928 300 600
Dummy plug		1 928 300 601

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

Differential pressure sensor
Micromechanics, TO cell

- Resistant to measurement medium.
- Piezoresistive sensor element.
- Integral moisture protection.

Application

Pressure sensors of this type are used in motor vehicles to measure the pressure in the fuel tank. The measurement principle involves determining the difference in pressure with respect to ambient pressure.

Design and operation

The main component of the differential-pressure sensor is a micromechanical sensor element with diaphragm and pressure connection. The diaphragm is resistant to the measurement medium. For measurement purposes, the measurement medium is routed through the pressure connection onto the diaphragm, which transmits the pressure applied to the piezoresistive sensor element. This is integrated together with appropriate signal amplification and temperature-compensation electronics on a silicon chip. The silicon chip is provided with a TO-type enclosure which forms the inner sensor cell. The active surface is exposed to the ambient pressure by way of an opening in the cap and a reference connection and is protected against moisture by a silicone gel. The pressure sensor supplies an analog output signal which has a ratiometric relationship with the supply voltage.

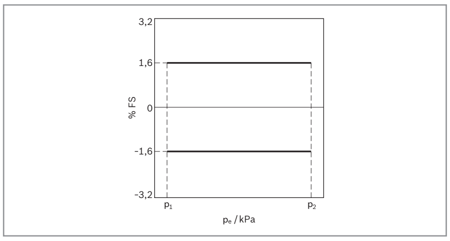
Explanation of characteristic quantities

p_e Differential pressure
U_A Output voltage (signal voltage)
U_V Supply voltage
k Tolerance multiplier
D After endurance test
N As-new condition

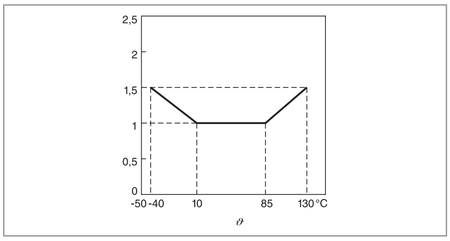
Installation instructions

The sensor is designed for horizontal attachment to a horizontal surface. Suitability for other installation angles is to be checked on a case-to-case basis. As a general rule, the installation position should ensure that liquids cannot accumulate in the sensor and pressure hose. If it freezes, water in the sensor will lead to malfunctioning.

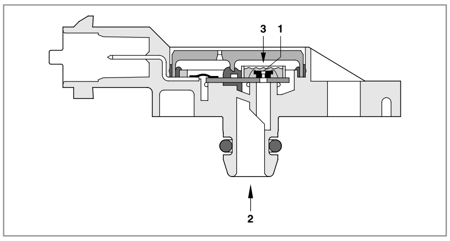
Characteristic-curve tolerance



Tolerance extension factor

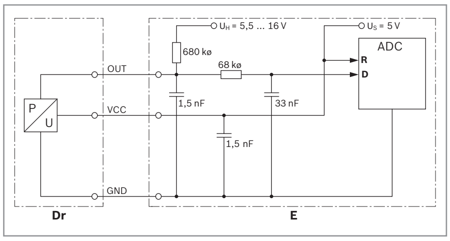


Sectional view of pressure sensor (entire system)



1 Sensor cell
2 Measurement pressure
3 Reference pressure

Recommendation for signal evaluation



D Pressure signal
R Reference
Dr Pressure sensor
E Electronic control unit

Differential pressure sensor
Micromechanics, TO cell

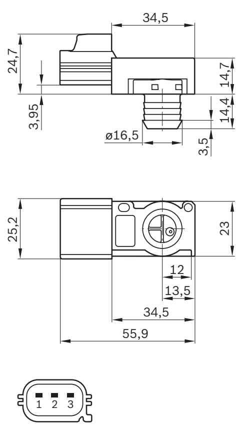
Part number **0 261 230 121**

Technical data

Parameter			min	type	max
Pressure measuring range (U_{AA}...p_2)	p_e	kPa	-100		0
Operating temperature	ϑ_B	°C	-40		+130
Supply voltage	U_V	V	4,75	5	5,25
Current input at U_V = 5 V	I_V	mA	6,0	9,0	12,5
Load current at output	I_L	mA	-1,0		0,5
Load resistance to U_V or ground	$R_{pull-up}$	kΩ	5		
Load resistance to U_V or ground	$R_{pull-down}$	kΩ	10		
Response time	$\tau_{10/90}$	ms			1
Voltage limitation at U_V = 5 V - lower limit	$U_{A\,min}$	V	0,25	0,3	0,35
Voltage limitation at U_V = 5 V - upper limit	$U_{A\,max}$	V	4,75	4,8	4,85
Limit data					
Supply voltage	U_V	V			16
Pressure	p_e	kPa	-500		+500
Storage temperature	v_L	°C	-40		+130

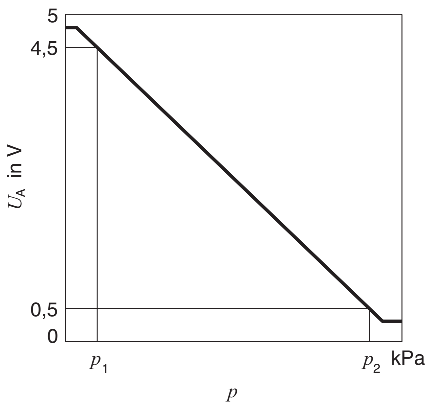
Figure

Dimensional drawing



Pin 1 Output signal
Pin 2 Ground
Pin 3 +5 V

Characteristic curve



Accessories

Accessories			Part number
Connector housing	3-pin	Yazaki number	7283-5880-10[1])
Contact pins	For Ø 0.35...0.5 mm²	Yazaki number	7116-4102-02[1])
Contact pins	For Ø 0.75...1.0 mm²	Yazaki number	7116-4103-02[1])
Single-wire seal	For Ø 0.35...0.5 mm²	Yazaki number	7158-3030-50[1])
Single-wire seal	For Ø 0.75...1.0 mm²	Yazaki number	7158-3031-90[1])
Dummy plug		Yazaki number	7158-3032-60[1])

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required. [1]) Available from Yazaki Europe LTD.

Absolute-pressure sensors
Micromechanics, hybrid design

- High level of accuracy
- EMC protection better than 100 V m^{-1}.
- With temperature compensation.
- Version with additional integrated temperature sensor.

Tolerances

The piezo-resistive pressure-sensor element and appropriate signal amplification and temperature compensation electronics are integrated on a silicon chip.
The measured pressure acts from above on the active side of the silicon diaphragm. A reference vacuum is enclosed between the rear side and a glass base. The temperature-sensor element is an NTC thermistor. Thanks to an appropriate coating method, the pressure and temperature sensor are resistant to the gases and liquids occurring in the intake manifold.

Design and operation

The piezo-resistive pressure-sensor element and appropriate signal amplification and temperature compensation electronics are integrated on a silicon chip.
The measured pressure acts from above on the active side of the silicon diaphragm. A reference vacuum is enclosed between the rear side and a glass base. The temperature-sensor element is an NTC thermistor. Thanks to an appropriate coating method, the pressure and temperature sensor are resistant to the gases and liquids occurring in the intake manifold.

Application

This sensor is used to measure the absolute intake-manifold pressure. The version with integrated temperature sensor additionally measures the temperature of the intake-air flow.

Installation instructions

The sensor is designed for attachment to a flat surface at the intake manifold of motor vehicles. The pressure connection and the temperature sensor jointly project into the intake manifold and are sealed off from the atmosphere by an O-ring. The sensor should be installed in the vehicle such that condensate cannot accumulate in the pressure cell (pressure sampling point at top of intake manifold, pressure connection angled downwards etc.).

Explanation of characteristic quantities

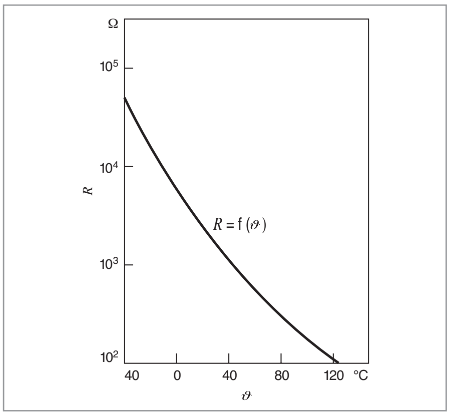
U_A Output voltage
U_V Supply voltage
k Tolerance multiplier
D After endurance testing
N As new

Absolute-pressure sensors
Micromechanics, hybrid design

Technical data

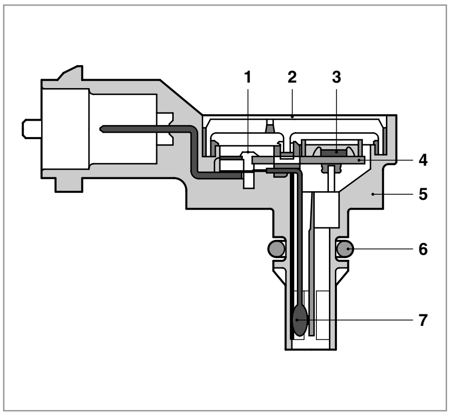
Parameter			min	type	max
Current input at U_V = 5 V	I_V	mA	6	9	12,5
Load current at output	I_L	mA	-1		0,5
Voltage limitation at U_V = 5 V - lower limit	$U_{A\,min}$	V	0,25	0,3	0,35
Voltage limitation at U_V = 5 V - upper limit	$U_{A\,max}$	V	4,75	4,8	4,85
Limit data					
Supply voltage	$U_{V\,max}$	V			16

Characteristic curve for temperature sensor



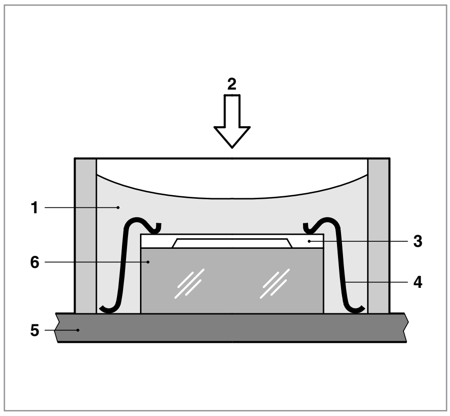
Applies to products with integrated temperature sensor.

Section through pressure sensor



1 Bond
2 Cover
3 Sensor chip
4 Ceramic substrate
5 Housing with pressure-sensor connection
6 Seal
7 NTC element.

Section through sensor cell



1 Protective gel
2 Pressure
3 Sensor chip
4 Bond
5 Ceramic substrate
6 Glass base.

Absolute-pressure sensors
Micromechanics, hybrid design

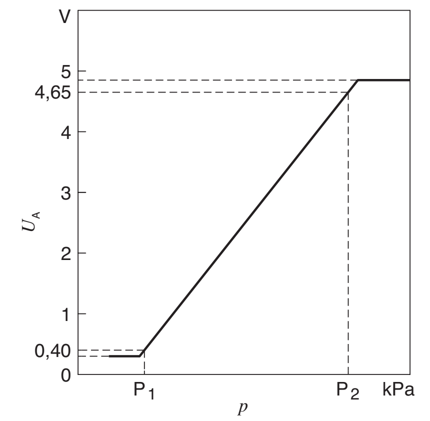
Part number 0 261 230 083

Technical data

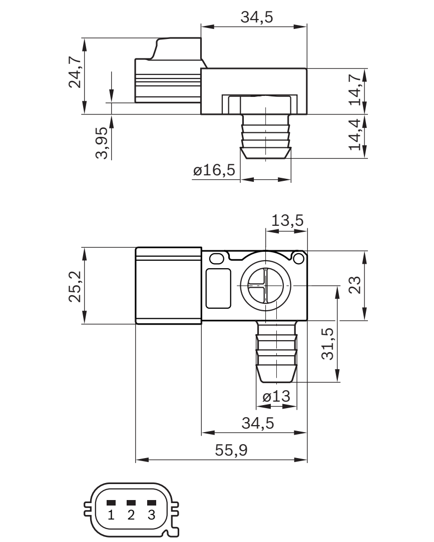
Parameter			min.	type	max.
Pressure range kPa ($p_1 \ldots p_2$)			10		115
Operating temperature	ϑ_B	°C	-40		+130
Supply voltage (1 min)	U_V	V	4,75	5	5,25
Load resistance to U_V or ground	$R_{pull\text{-}up}$	kΩ	5	680	
Load resistance to U_V or ground	$R_{pull\text{-}down}$	kΩ	10	100	
Response time	$\tau_{10/90}$	ms			1
Limit data					
Storage temperature	ϑ_L	°C	-40		+130

Figure

Characteristic curve

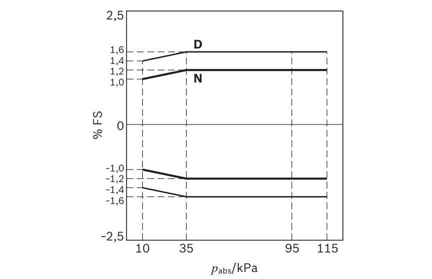


Dimensional drawing

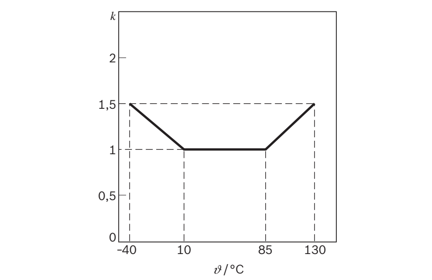


Pin 1 Output signal
Pin 2 Ground
Pin 3 +5 V

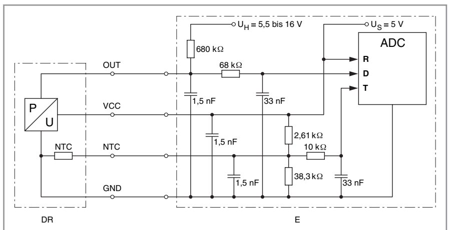
Characteristic-curve tolerance



Tolerance extension factor



Recommendation for signal evaluation.



R Reference
D Pressure signal
T Temperature signal
Dr Pressure sensor
E Electronic control unit

Accessories

Accessories		Part number
Connector housing	Quantity required: 1 x	1 928 403 966
Contact pins	Quantity required: 3 x; Contents: 100 x	1 928 498 060
Individual seals	Quantity required: 3 x; Contents: 10 x	1 928 300 599

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

Absolute-pressure sensors
Micromechanics, hybrid design

Part number 0 261 230 105

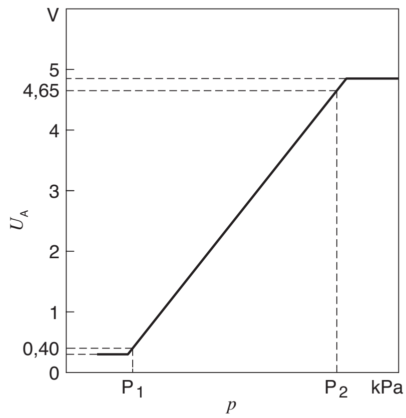
Technical data

Parameter			min.	type	max.
Feature	Integrated temperature sensor				
Pressure range kPa (p_1...p_2)			20		300
Operating temperature	ϑ_B	°C	-40		+130
Supply voltage (1 min)	U_V	V	4,75	5	5,25
Load resistance to U_V or ground	$R_{pull-up}$	kΩ	5		
Load resistance to U_V or ground	$R_{pull-down}$	kΩ	10		
Response time	$\tau_{10/90}$	ms			1
Limit data					
Storage temperature	ϑ_L	°C	-40		+130
Temperature sensors					
Measuring range	ϑ_M	°C	-40		+130
Measurement current	I_M	mA			1[1])
Rated resistance at +20 °C		kΩ		2,5 ± 5 %	
Temperature/time constant	τ_{63}	s			10[2])

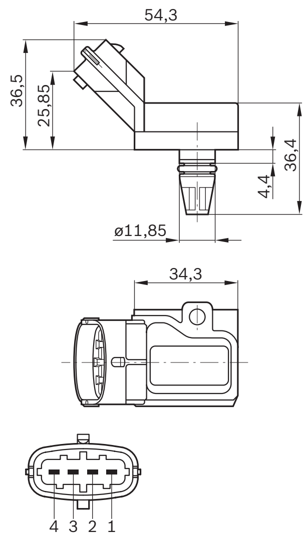
[1]) Operation at 5 V with 1 kΩ series resistance.
[2]) In air with flow velocity 6 m/s.

Figure

Characteristic curve

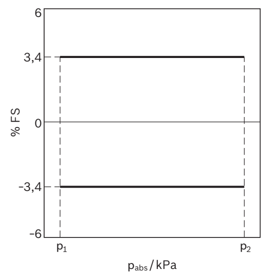


Dimensional drawing

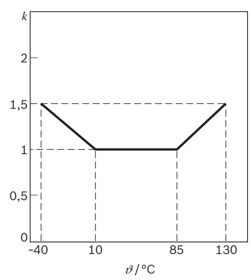


Pin 1 Ground
Pin 2 NTC thermistor
Pin 3 +5 V
Pin 4 Output signal

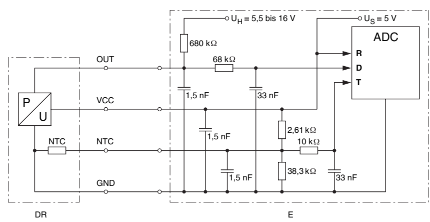
Characteristic-curve tolerance



Tolerance extension factor



Recommendation for signal evaluation.



R Reference
D Pressure signal
T Temperature signal
Dr Pressure sensor
E Electronic control unit

Accessories

Accessories		Part number
Connector housing	Quantity required: 1 x	1 928 403 736
Contact pins	Quantity required: 4 x; Contents: 100 x	1 928 498 060
Individual seals	Quantity required: 4 x; Contents: 10 x	1 928 300 599

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

Absolute-pressure sensors
Micromechanics, hybrid design

Part number 0 281 002 487

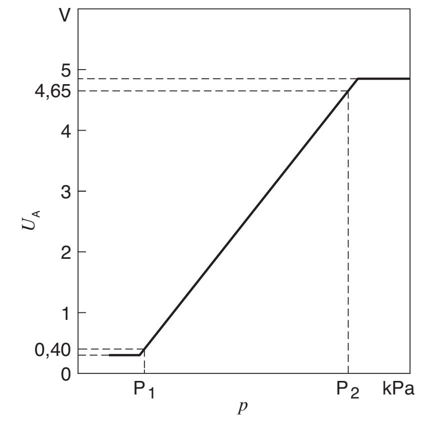
Technical data

Parameter			min.	type	max.
Pressure range kPa ($p_1 \ldots p_2$)			20		250
Operating temperature	ϑ_B	°C	-40		+130
Supply voltage (1 min)	U_V	V	4,5	5	5,5
Load resistance to U_V or ground	$R_{pull\text{-}up}$	kΩ	5	680	
Load resistance to U_V or ground	$R_{pull\text{-}down}$	kΩ	10	100	
Response time	$\tau_{10/90}$	ms		1	

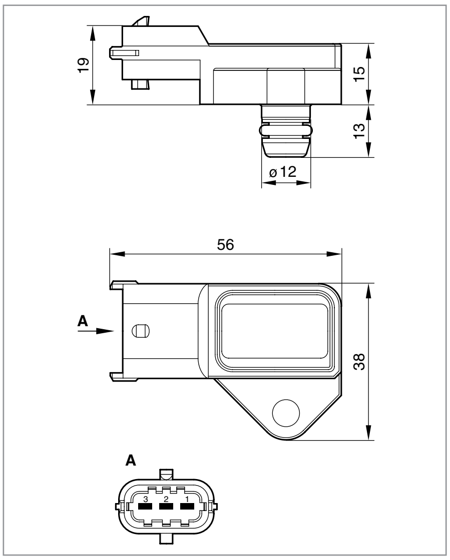
Limit data					
Storage temperature	ϑ_L	°C	-40		+130

Figure

Characteristic curve

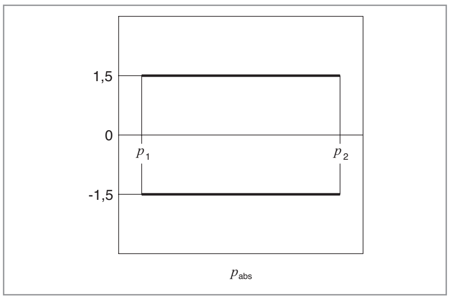


Dimensional drawing

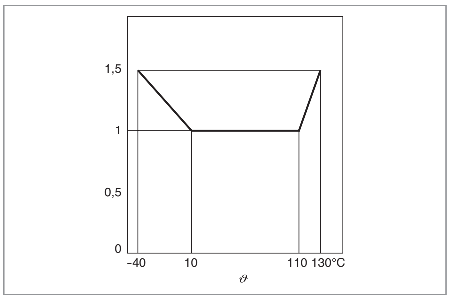


Pin 1 +5 V
Pin 2 Ground
Pin 3 Output signal

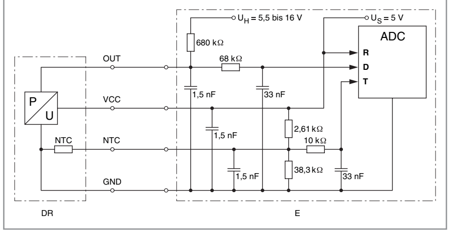
Characteristic-curve tolerance



Tolerance extension factor



Recommendation for signal evaluation.



R Reference
D Pressure signal
T Temperature signal
Dr Pressure sensor
E Electronic control unit

Accessories

Accessories		Part number
Connector housing	Quantity required: 1 x	1 928 403 966
Contact pins	Quantity required: 3 x; Contents: 100 x	1 928 498 060
Individual seals	Quantity required: 3 x; Contents: 10 x	1 928 300 599

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

Absolute-pressure sensors
Micromechanics, hybrid design

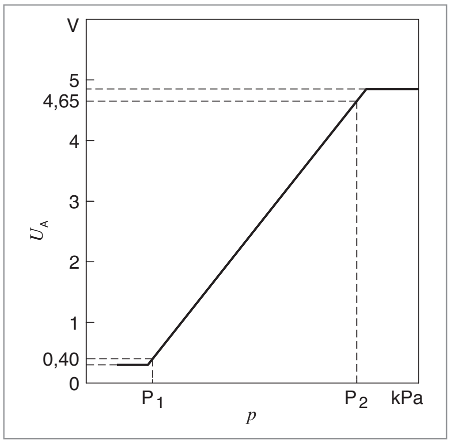
Part number 0 281 002 566

Technical data

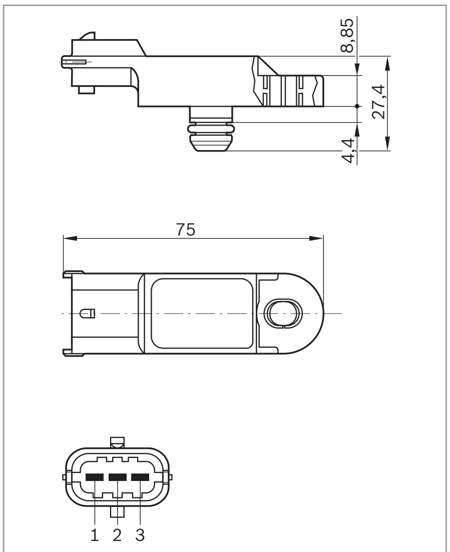
Parameter			min.	type	max.
Pressure range kPa ($p_1 \ldots p_2$)			20		300
Operating temperature	ϑ_B	°C	-40		+130
Supply voltage (1 min)	U_V	V	4,75	5	5,25
Load resistance to U_V or ground	$R_{pull\text{-}up}$	kΩ	5		
Load resistance to U_V or ground	$R_{pull\text{-}down}$	kΩ	10		
Response time	$\tau_{10/90}$	ms			1
Limit data					
Storage temperature	ϑ_L	°C	-40		+130

Figure

Characteristic curve

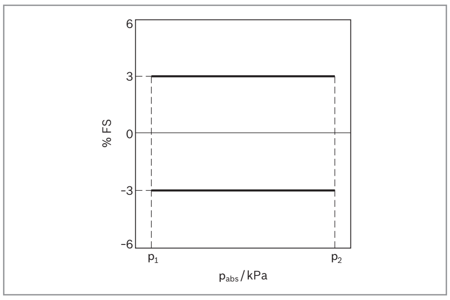


Dimensional drawing

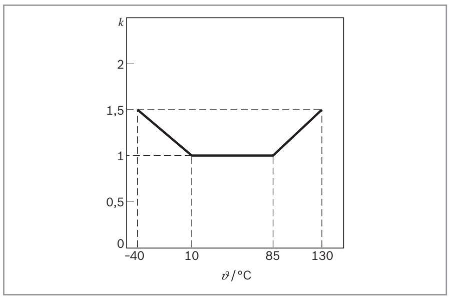


Pin 1 +5 V
Pin 2 Ground
Pin3 Output signal

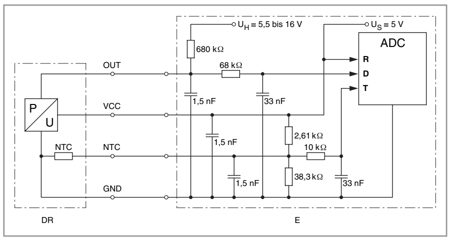
Characteristic-curve tolerance



Tolerance extension factor



Recommendation for signal evaluation.



R Reference
D Pressure signal
T Temperature signal
Dr Pressure sensor
E Electronic control unit

Accessories

Accessories		Part number
Connector housing	Quantity required: 1 x	1 928 403 966
Contact pins	Quantity required: 3 x; Contents: 100 x	1 928 498 060
Individual seals	Quantity required: 3 x; Contents: 10 x	1 928 300 599

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

Absolute-pressure sensors
Micromechanics, hybrid design

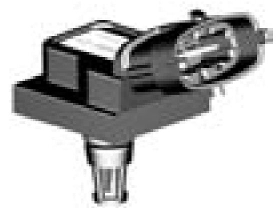
Part number 0 281 002 573

Technical data

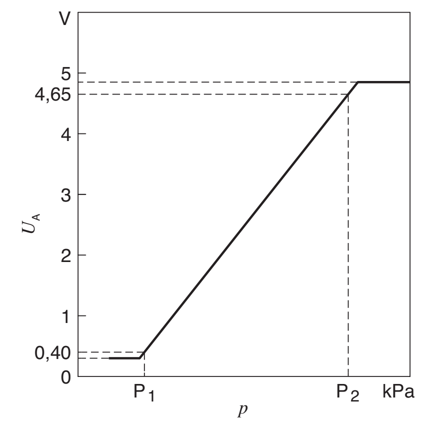
Parameter			min.	type	max.
Feature	Integrated temperature sensor				
Pressure range kPa ($p_1...p_2$)			20		250
Operating temperature	ϑ_B	°C	-40		+130
Supply voltage (1 min)	U_V	V	4,75	5	5,25
Load resistance to U_V or ground	$R_{pull\text{-}up}$	kΩ	5	680	
Load resistance to U_V or ground	$R_{pull\text{-}down}$	kΩ	10	100	
Response time	$\tau_{10/90}$	ms			1
Limit data					
Storage temperature	ϑ_L	°C	-40		
Temperature sensors					
Measuring range	ϑ_M	°C	-40		+130
Measurement current	I_M	mA			1[1])
Rated resistance at +20 °C		kΩ	2,5 ± 5 %		
Temperature/time constant	τ_{63}	s			10[2])

[1]) Operation at 5 V with 1 kΩ series resistance.
[2]) In air with flow velocity 6 m/s.

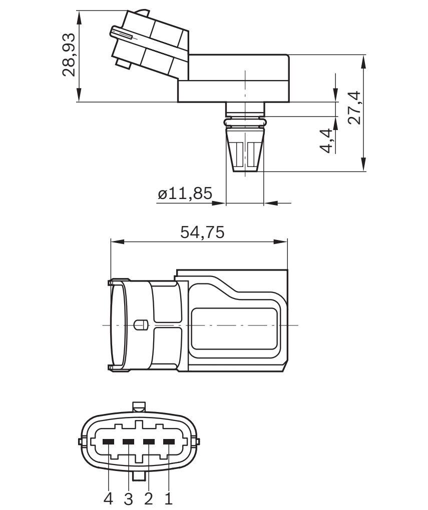
Figure



Characteristic curve

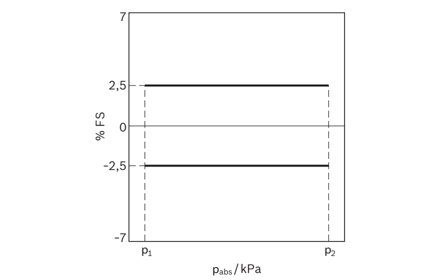


Dimensional drawing

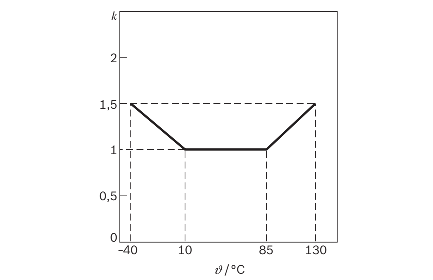


Pin assignment
Pin 1 Ground
Pin 2 NTC signal
Pin 3 +5 V
Pin 4 Output signal

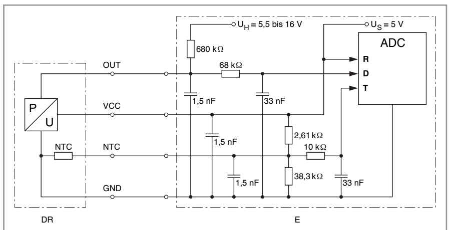
Characteristic-curve tolerance



Tolerance extension factor



Recommendation for signal evaluation.



R Reference
D Pressure signal
T Temperature signal
Dr Pressure sensor
E Electronic control unit

Accessories

Accessories		Part number
Connector housing	Quantity required: 1 x	1 928 403 736
Contact pins	Quantity required: 4 x; Contents: 100 x	1 928 498 060
Individual seals	Quantity required: 4 x; Contents: 10 x	1 928 300 599

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

Absolute-pressure sensors
Micromechanics, hybrid design

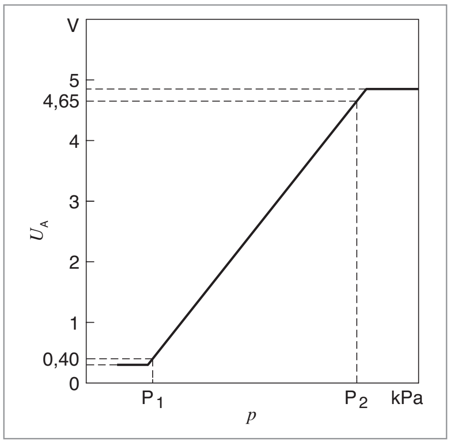
Part number 0 281 002 593

Technical data

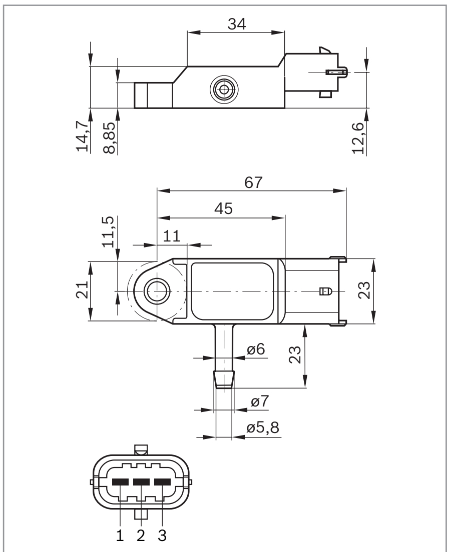
Parameter			min.	type	max.
Pressure range kPa ($p_1 \ldots p_2$)			20		250
Operating temperature	ϑ_B	°C	-40		+130
Supply voltage (1 min)	U_V	V	4,75	5	5,25
Load resistance to U_V or ground	$R_{pull\text{-}up}$	kΩ	5		
Load resistance to U_V or ground	$R_{pull\text{-}down}$	kΩ	10		
Response time	$\tau_{10/90}$	ms			1
Limit data					
Storage temperature	ϑ_L	°C	-40		+130

Figure

Characteristic curve

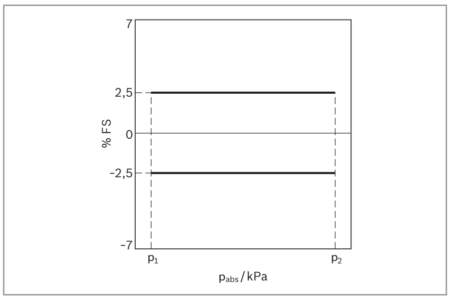


Dimensional drawing

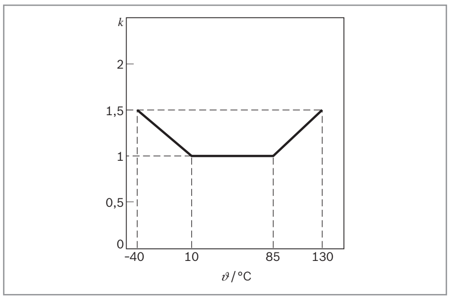


Pin 1 +5 V
Pin 2 Ground
Pin 3 Output signal

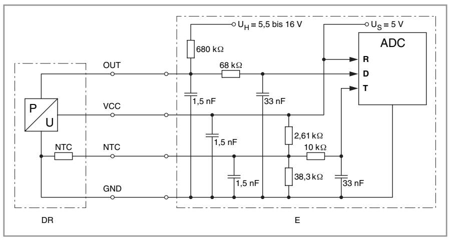
Characteristic-curve tolerance



Tolerance extension factor



Recommendation for signal evaluation.



R Reference
D Pressure signal
T Temperature signal
Dr Pressure sensor
E Electronic control unit

Accessories

Accessories		Part number
Connector housing	Quantity required: 1 x	1 928 403 966
Contact pins	Quantity required: 3 x; Contents: 100 x	1 928 498 060
Individual seals	Quantity required: 3 x; Contents: 10 x	1 928 300 599

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

Absolute-pressure sensors
Micromechanics, hybrid design

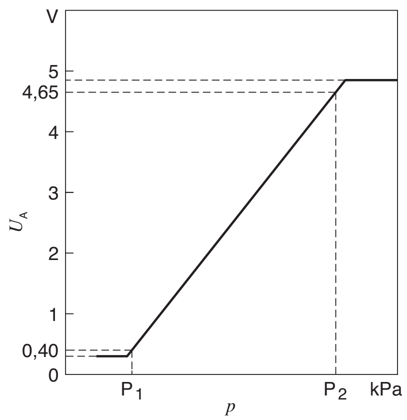
Part number 0 281 002 616

Technical data

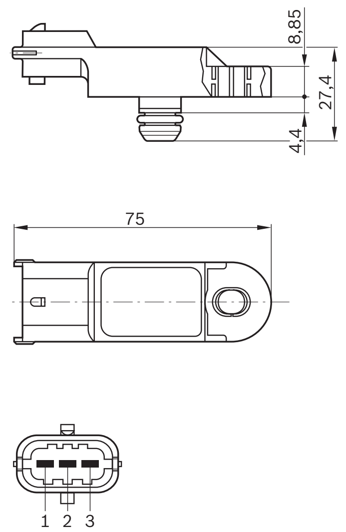
Parameter			min.	type	max.
Pressure range kPa ($p_1 \ldots p_2$)			20		250
Operating temperature	ϑ_B	°C	-40		+130
Supply voltage (1 min)	U_V	V	4,75	5	5,25
Load resistance to U_V or ground	$R_{pull\text{-}up}$	kΩ	5		
Load resistance to U_V or ground	$R_{pull\text{-}down}$	kΩ	10		
Response time	$\tau_{10/90}$	ms			1
Limit data					
Storage temperature	ϑ_L	°C	-40		+130

Figure

Characteristic curve

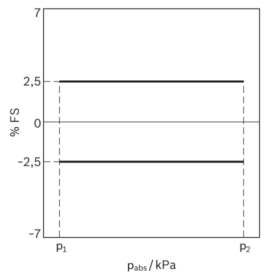


Dimensional drawing

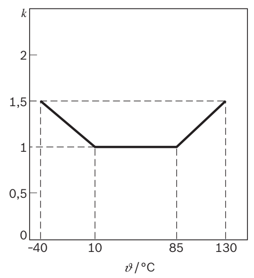


Pin 1 +5 V
Pin 2 Ground
Pin 3 Output signal

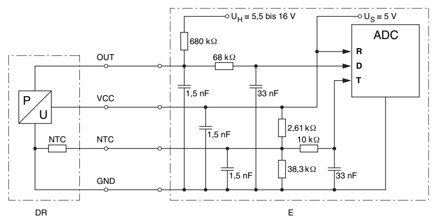
Characteristic-curve tolerance



Tolerance extension factor



Recommendation for signal evaluation.



R Reference
D Pressure signal
T Temperature signal
Dr Pressure sensor
E Electronic control unit

Accessories

Accessories		Part number
Connector housing	Quantity required: 1 x	1 928 403 966
Contact pins	Quantity required: 3 x; Contents: 100 x	1 928 498 060
Individual seals	Quantity required: 3 x; Contents: 10 x	1 928 300 599

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

Absolute-pressure sensors
Micromechanics, hybrid design

Part number 0 281 002 693

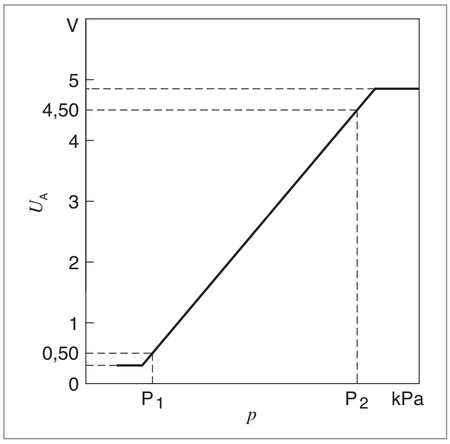
Technical data

Paramter			min.	type	max.
Feature	Integrated temperature sensor				
Pressure range kPa (p_1...p_2)			50		1000
Operating temperature	ϑ_B	°C	-40		+125
Supply voltage (1 min)	U_V	V	4,75	5	5,25
Load resistance to U_V or ground	$R_{pull\text{-}up}$	kΩ	5		
Load resistance to U_V or ground	$R_{pull\text{-}down}$	kΩ	10		
Response time	$\tau_{10/90}$	ms			1
Limit data					
Storage temperature	ϑ_L	°C	-40		+130
Temperature sensors					
Measuring range	ϑ_M	°C	-40		+125
Measurement current	I_M	mA			1[1])
Rated resistance at +20 °C	kΩ		2,5 ± 6 %		
Temperature/time constant	τ_{63}	s			45[2])

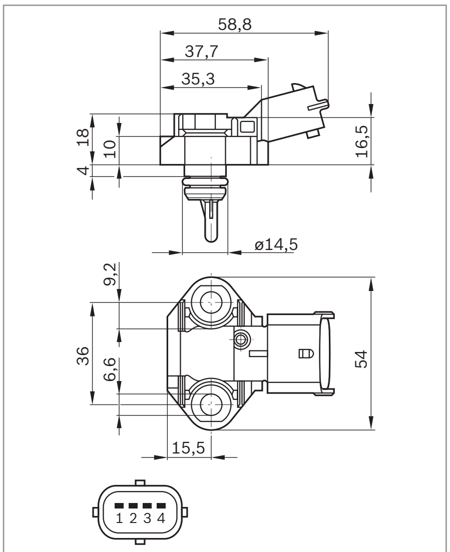
[1]) Operation at 5 V with 1 kΩ series resistance.
[2]) In air with flow velocity 6 m/s.
TO cell

Figure

Characteristic curve

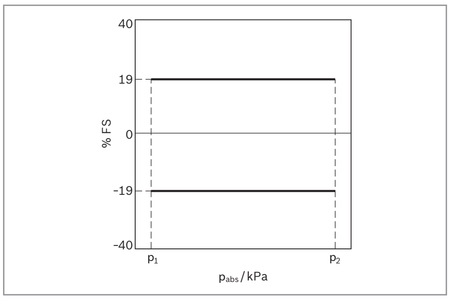


Dimensional drawing

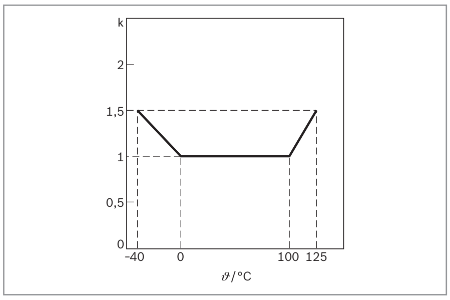


Pin 1 Ground
Pin 2 NTC thermistor
Pin 3 +5 V
Pin 4 Output signal

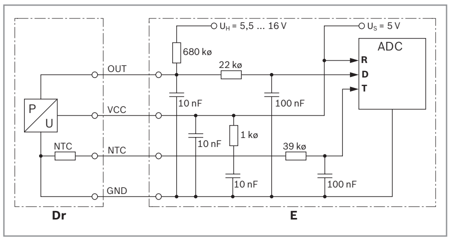
Characteristic-curve tolerance



Tolerance extension factor



Recommendation for signal evaluation



R Reference
D Pressure signal
T Temperature signal
Dr Pressure sensor
E Electronic control unit

Accessories		Part number
Connector housing	Quantity required: 1 x	1 928 403 736
Contact pins	Quantity required: 4 x; Contents: 100 x	1 928 498 060
Individual seals	Quantity required: 4 x; Contents: 10 x	1 928 300 599

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

Absolute-pressure sensors
Media-resistant, micromechanical

- Available as separate component or fitted in an extremely robust housing.
- EMC protection up to 100 Vm^{-1}
- With temperature compensation
- Ratiometric output signal
- All sensors and sensor cells are resistant to fuels (including diesel) and oils such as engine oil.

Application

Monolithically integrated silicon pressure sensors are extremely precise measuring elements for determining absolute pressure. They are particularly suitable for use under harsh ambient conditions, such as the measurement of the absolute intake-manifold pressure in internal-combustion engines.

Signal evaluation

The pressure sensor supplies an analog output signal which has a ratiometric relationship with the supply voltage. It is advisable to fit the input stage of the downstream electronics with an RC low-pass filter (e.g. t = 2 ms) to suppress any interference due to harmonics. In the version with integrated temperature sensor, this consists of an NTC thermistor (to be used in conjunction with a series resistor) for measurement of the ambient temperature.

Design and operation

The sensor contains a silicon chip with etched pressure diaphragm. A change in pressure causes elongation of the diaphragm and this is recorded by an evaluation circuit on the basis of changes in resistance. The circuit is integrated on the silicon chip together with electronic calibration elements. When manufacturing the silicon chip, a silicon wafer containing a number of sensor elements is attached to a glass plate. Once sawn into individual chips, each chip is soldered onto a metal base with pressure connection. The pressure is routed via the connection and the base to the back of the pressure diaphragm. A reference vacuum permitting measurement of the absolute pressure and at the same time protecting the front of the pressure diaphragm is enclosed beneath the cap, which is welded to the base. The programming logic on the chip performs calibration. The calibration parameters are permanently stored by means of thyristors (zener zapping) and etched conductive paths. The calibrated and tested sensors are fitted in a special housing for attachment to the intake manifold (refer to product range).

Version

Sensors with housing:
This version features a sturdy housing. On the version with temperature sensor, the sensor is located in the housing.
Sensors without housing:
Enclosure similar to TO, pressure is supplied through a central pressure connection.
The solder-pin assignment is as follows:
Pin 6 Output voltage UA, Pin 7 Ground,
Pin 8 +5 V.

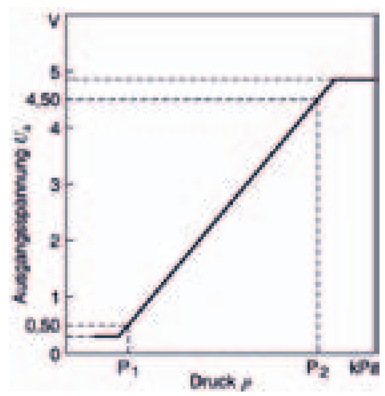
Note

1 connector housing, 3 contact pins and 3 individual seals are required for a 3-pin connector. 1 connector housing, 4 contact pins and 4 individual seals are required for a 4-pin connector.

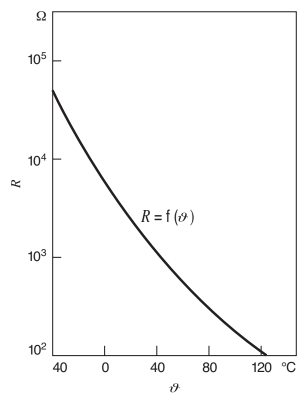
Installation instructions

On installation, the pressure connection should face downwards to stop condensate accumulating in the pressure cell.

Characteristic curve



Characteristic curve for temperature sensor



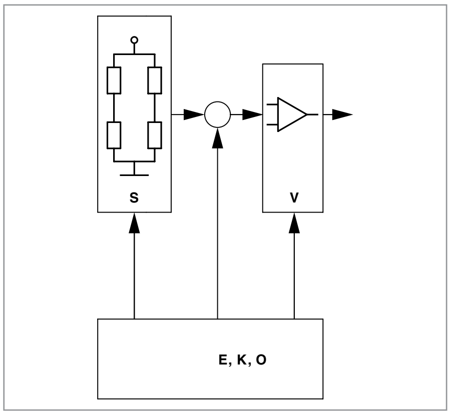
Applies to products with integrated temperature sensor.

Absolute-pressure sensors
Media-resistant, micromechanical

Technical data

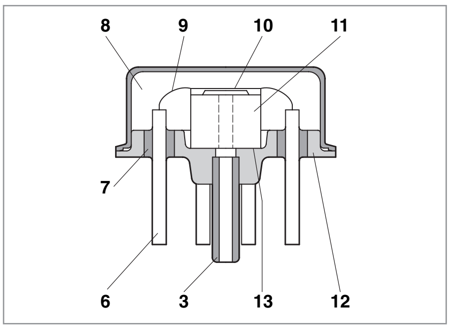
Parameter		min	type	max
Current input I_V at U_V = 5 V	mA	6	9	12,5
Lower limit at U_V = 5 V	V	0,25	0,3	0,35
Upper limit at U_V = 5 V	V	4,75	4,8	4,85
Output resistance to ground, U_V open	kΩ	2,4	4,7	8,2
Output resistance to U_V, ground open	kΩ	3,4	5,3	8,2
Limit data				
Supply voltage U_V	V			16
Recommendation for signal evaluation				
Load resistance to U_H = 5.5...16 V	kΩ		680	

Block diagram



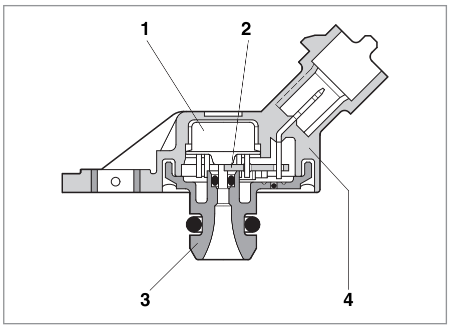
E Sensitivity
O Offset
K Compensation circuit
S Sensor bridge
V Amplifier

Pressure sensor in housing



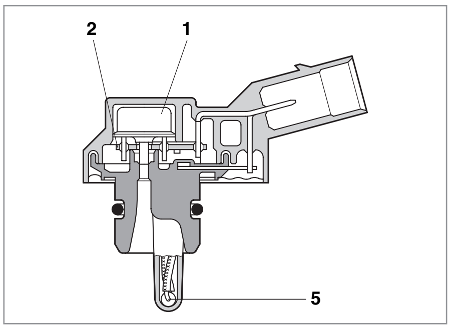
3 Pressure connection
6 Gland
7 Glass coating
8 Reference vacuum
9 Aluminium bond (bonding wire)
10 Sensor chip
11 Glass base
12 Welded joint
13 Soldered joint

Section through installed pressure sensor



1 Pressure sensor
2 PCB
3 Pressure connection
4 Housing

Pressure sensor installed



Version with temperature sensor
1 Pressure sensor
2 PCB
5 Temperature sensor

Absolute-pressure sensors
Media-resistant, micromechanical

Part number 0 261 230 109

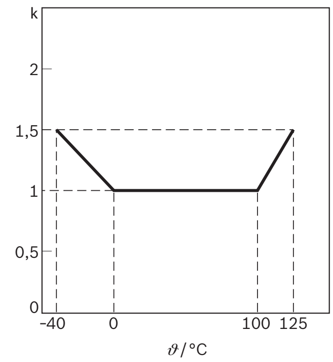
Technical data

Parameter		min.	type	max.
Features	Integrated temperature sensor			
Pressure range (p_1...p_2)	kPa	50		600
Supply voltage U_V	V	4,75	5	5,25
Load current I_L at output	mA	-1		0,5
Response time $\tau_{10/90}$	ms			1
Operating temperature	°C	-40		+130
Limit data				
Operating temperature	°C	-40		+130
Temperature sensor				
Measuring range	°C	-40		+130
Measurement current[1])	mA			1
Rated resistance at +20°C	kΩ		2,5 ± 3,5 %	

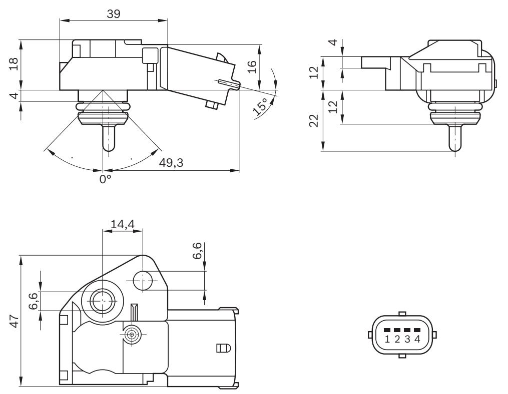
[1]) Operation with 1 kΩ series resistance.

Figure

Tolerance extension factor

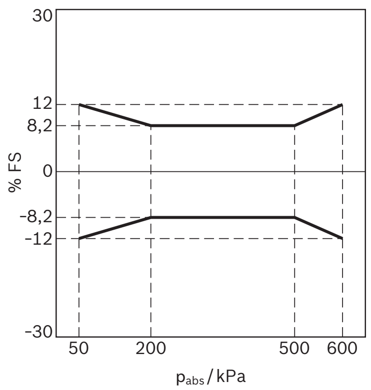


Dimensional drawing



Pin 1 Ground
Pin 2 NTC thermistor
Pin 3 +5 V
Pin 4 Output signal

Characteristic-curve tolerance



Accessories

Accessories		Part number
Connector housing	4-pin	1 928 403 736
Contact pins	For Ø 0.5...1.0 mm²; Contents: 100 x	1 928 498 056
Contact pins	For Ø 1.5...2.5 mm²; Contents: 100 x	1 928 498 057
Single-wire seal	For Ø 0.5...1.0 mm²; Contents: 10 x	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm²; Contents: 10 x	1 928 300 600
Dummy plug		1 928 300 601

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

Absolute-pressure sensors
Media-resistant, micromechanical

Part number 0 261 230 110

Technical data

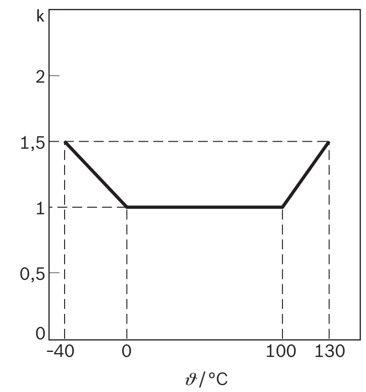
Parameter		min.	type	max.
Features	Integrated temperature sensor			
Pressure range ($p_1 \ldots p_2$)	kPa	50		1000
Supply voltage U_V	V	4,75	5	5,25
Load current I_L at output	mA	-1		0,5
Response time $\tau_{10/90}$	ms			1
Operating temperature	°C	-40		130

Temperature sensor				
Measuring range	°C	-40		+130
Measurement current[1])	mA			1
Rated resistance at +20°C	kΩ		2,5 ± 3,5 %	

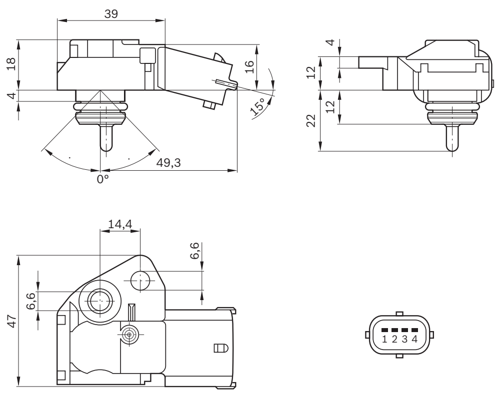
[1]) Operation with 1 kΩ series resistance.

Figure

Tolerance extension factor

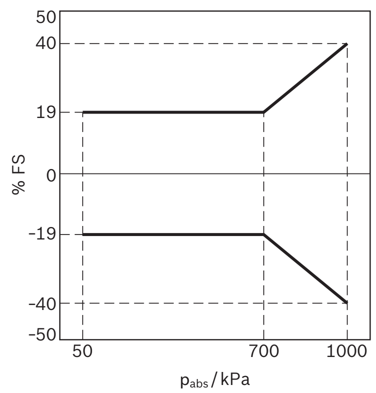


Dimensional drawing



Pin 1 Ground
Pin 2 NTC thermistor
Pin 3 +5 V
Pin 4 Output signal

Characteristic-curve tolerance



Accessories

Accessories		Part number
Connector housing	4-pin	1 928 403 736
Contact pins	For Ø 0.5...1.0 mm²; Contents: 100 x	1 928 498 056
Contact pins	For Ø 1.5...2.5 mm²; Contents: 100 x	1 928 498 057
Single-wire seal	For Ø 0.5...1.0 mm²; Contents: 10 x	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm²; Contents: 10 x	1 928 300 600
Dummy plug		1 928 300 601

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

Absolute-pressure sensors
Media-resistant, micromechanical

Part number 0 261 230 112

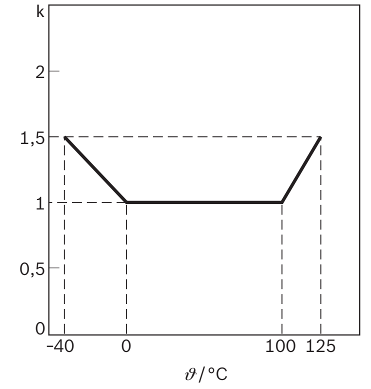
Technical data

Parameter		min.	type	max.
Features	Integrated temperature sensor			
Pressure range (p_1...p_2)	kPa	50		1000
Supply voltage U_V	V	4,75	5	5,25
Load current I_L at output	mA	-1		0,5
Response time $\tau_{10/90}$	ms			1
Operating temperature	°C	-40		+125
Limit data				
Operating temperature	°C	-40		+130
Temperature sensor				
Measuring range	°C	-40		+125
Measurement current[1])	mA			1
Rated resistance at +20°C	kΩ		2,5 ± 6 %	
Temperature/time constant τ_{63} [2])	s			45

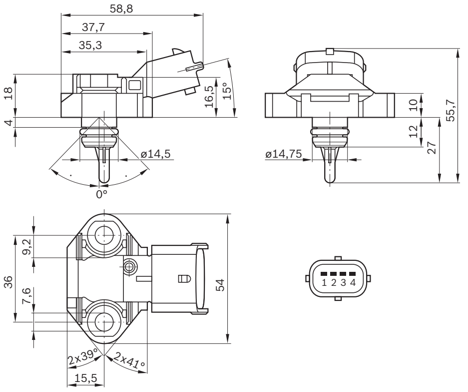
[1]) Operation with 1 kΩ series resistance.
[2]) In air with flow velocity 6 m/s.

Figure

Tolerance extension factor

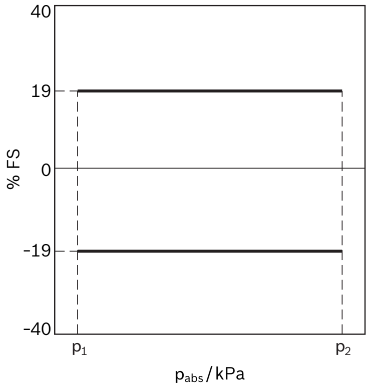


Dimensional drawing



Pin 1 Ground
Pin 2 NTC thermistor
Pin 3 +5 V
Pin 4 Output signal

Characteristic-curve tolerance



Accessories

Accessories		Part number
Connector housing	4-pin	1 928 403 736
Contact pins	For Ø 0.5...1.0 mm²; Contents: 100 x	1 928 498 056
Contact pins	For Ø 1.5...2.5 mm²; Contents: 100 x	1 928 498 057
Single-wire seal	For Ø 0.5...1.0 mm²; Contents: 10 x	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm²; Contents: 10 x	1 928 300 600
Dummy plug		1 928 300 601

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

Absolute-pressure sensors
Media-resistant, micromechanical

Part number **0 281 002 244**

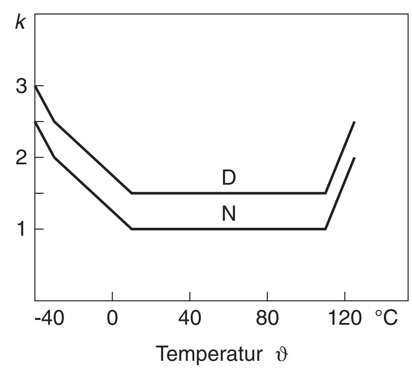
Technical data

Parameter		min.	type	max.
Features	Integrated temperature sensor			
Pressure range (p_1...p_2)	kPa	50		350
Supply voltage U_V	V	4,5	5	5,5
Load current I_L at output	mA	-0,1		0,1
Load resistance to ground or U_V	kΩ	50		
Response time $\tau_{10/90}$	ms		0,2	
Operating temperature	°C	-40		+125
Limit data				
Operating temperature	°C	-40		+130
Recommendation for signal evaluation				
Load resistance to ground	kΩ		100	
Low-pass resistance	kΩ		21,5	
Low-pass capacitance	nF		100	
Temperature sensor				
Measuring range	°C	-40		+125
Measurement current[1])	mA			1
Rated resistance at +20°C	kΩ		2,5 ± 5 %	
Temperature/time constant τ_{63} [2])	s			45

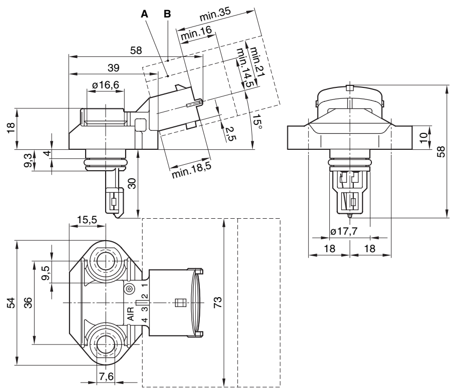
[1]) Operation with 1 kΩ series resistance.
[2]) In air with flow velocity 6 m/s.

Figure

Tolerance extension factor

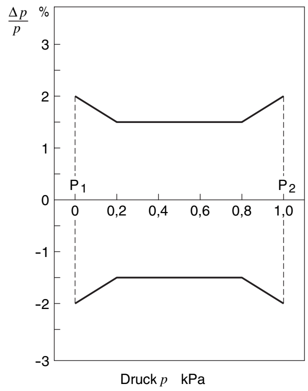


Dimensional drawing



A	Space required for connector.	Pin 2	NTC
B	Space required for connection.	Pin 3	+5 V
Pin 1	Ground	Pin 4	Output signal

Characteristic-curve tolerance



Accessories

Accessories		Part number
Connector housing		1 928 403 913
Contact pin	Tyco number	2-929 939-6 [1])
Individual seal	Contents: 50 x	1 987 280 106

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

[1]) Available from Tyco Electronics.

Absolute-pressure sensors
Media-resistant, micromechanical

Part number 0 281 002 316

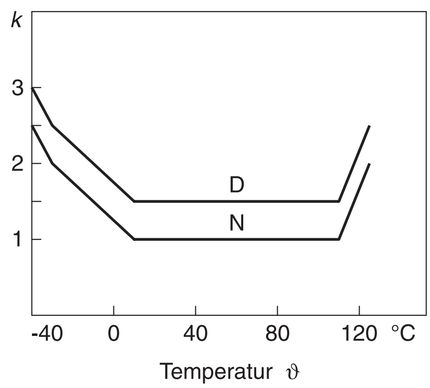
Technical data

Parameter		min.	type	max.
Features	Integrated temperature sensor			
Pressure range ($p_1 \dots p_2$)	kPa	50		400
Supply voltage U_V	V	4,5	5	5,5
Load current I_L at output	mA	-0,1		0,1
Load resistance to ground or U_V	kΩ	50		
Response time $\tau_{10/90}$	ms		0,2	
Operating temperature	°C	-40		+125
Limit data				
Operating temperature	°C	-40		+130
Recommendation for signal evaluation				
Load resistance to ground	kΩ		100	
Low-pass resistance	kΩ		21,5	
Low-pass capacitance	nF		100	
Temperature sensor				
Measuring range	°C	-40		+125
Measurement current[1])	mA			1
Rated resistance at +20°C	kΩ		2,5 ± 5 %	
Temperature/time constant τ_{63} [2])	s			45

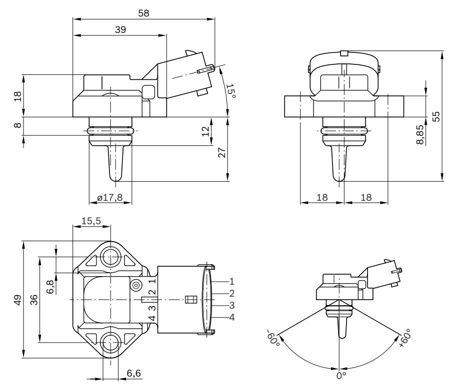
[1]) Operation with 1 kΩ series resistance.
[2]) In air with flow velocity 6 m/s.

Figure

Tolerance extension factor

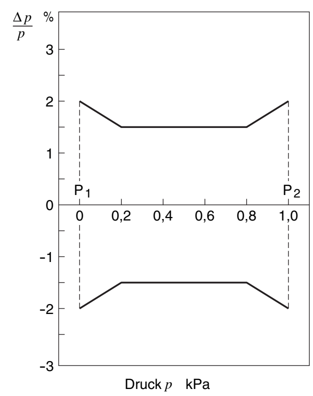


Dimensional drawing



Pin 1 Ground
Pin2 NTC
Pin 3 +5 V
Pin 4 Output signal

Characteristic-curve tolerance



Accessories

		Part number
Connector housing	4-pin	1 928 403 736
Contact pins	For Ø 0.5...1.0 mm²; Contents: 100 x	1 928 498 056
Contact pins	For Ø 1.5...2.5 mm²; Contents: 100 x	1 928 498 057
Individual seal	For Ø 0.5...1.0 mm2²; Contents: 10 x	1 928 300 599
Individual seal	For Ø 1.5...2.5 mm²; Contents: 10 x	1 928 300 600
Dummy plug		1 928 300 601

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

Absolute-pressure sensors
Media-resistant, micromechanical

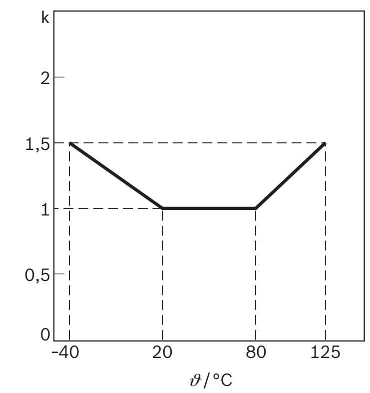
Part number 0 281 002 668

Technical data

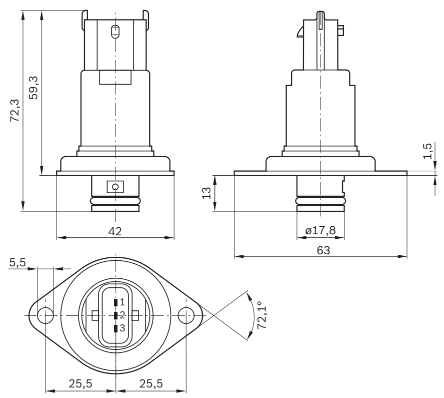
Parameter		min.	type	max.
Pressure range (p_1...p_2)	kPa	50		600
Supply voltage U_V	V	4,75	5	5,25
Load current I_L at output	mA	-1		0,5
Response time $\tau_{10/90}$	ms		1	
Operating temperature	°C	-40		+125
Limit data				
Operating temperature	°C	-40		+125

Figure

Tolerance extension factor

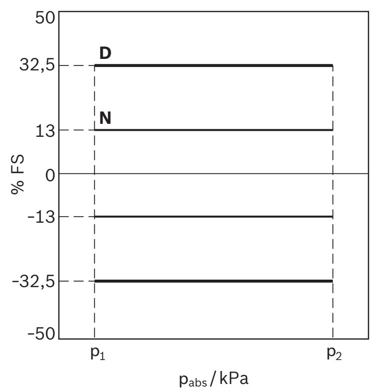


Dimensional drawing



Pin 1 +5 V
Pin 2 Ground
Pin 3 Output signal

Characteristic-curve tolerance



D After endurance test
N As-new condition

Accessories

Accessories		Part number
Connector housing	3-pin	1 928 403 966
Contact pins	For Ø 0.5...1.0 mm^2; Contents: 100 x	1 928 498 056
Contact pins	For Ø 1.5...2.5 mm^2; Contents: 100 x	1 928 498 057
Single-wire seal	For Ø 0.5...1.0 mm^2; Contents: 10 x	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm^2; Contents: 10 x	1 928 300 600
Dummy plug		1 928 300 601

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

Absolute-pressure sensors
Media-resistant, micromechanical

Part number 0 281 006 282

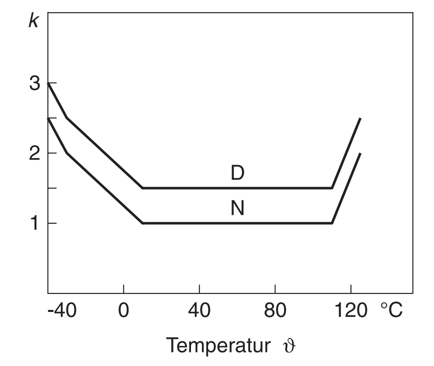
Technical data

Parameter		min.	type	max.
Features	Integrated temperature sensor			
Pressure range (p_1...p_2)	kPa	50		600
Supply voltage U_V	V	4,5	5	5,5
Load current I_L at output	mA	-0,1		0,1
Load resistance to ground or U_V	kΩ	50		
Response time $\tau_{10/90}$	ms		0,2	
Operating temperature	°C	-40		+125
Limit data				
Operating temperature	°C	-40		+130
Recommendation for signal evaluation				
Load resistance to ground	kΩ		100	
Low-pass resistance	kΩ		21,5	
Low-pass capacitance	nF		100	
Temperature sensor				
Measuring range	°C	-40		+125
Measurement current[1])	mA			1
Rated resistance at +20°C	kΩ		2,5 ± 5 %	
Temperature/time constant τ_{63} [2])	s			45

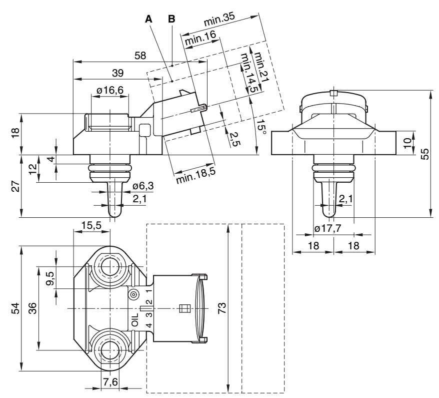
[1]) Operation with 1 kΩ series resistance.
[2]) In air with flow velocity 6 m/s.

Figure

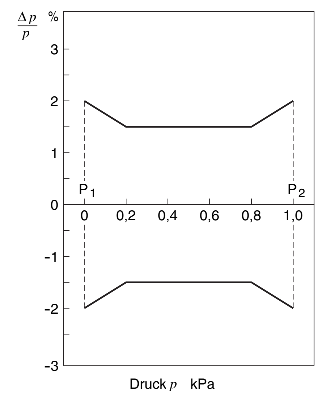
Tolerance extension factor



Dimensional drawing



Characteristic-curve tolerance



A	Space required for connector.	Pin 2	NTC
B	Space required for connection.	Pin 3	+5 V
Pin 1	Ground	Pin 4	Output signal

Accessories

Accessories		Part number
Connector housing	4-pin	1 928 403 736
Contact pins	for Ø 0.5...1.0 mm²; content: 100 x	1 987 498 056
Contact pins	for Ø 1.5...2.5 mm²; content: 100 x	1 928 498 057
Single-wire seal	for Ø 0.5...1.0 mm²; content: 10 x	1 928 300 599
Single-wire seal	for Ø 1.5...2.5 mm²; content: 10 x	1 928 300 600
Dummy plug		1 928 300 601

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

Notes

High-pressure sensors

- ► Ratiometric signal evaluation (relative to supply voltage)
- ► Self-monitoring offset and sensitivity.
- ► Excellent media resistance as the medium only comes into contact with stainless steel.
- ► Resistant to brake fluids, mineral oils, fuel, water and air.
- ► Protection against reverse polarity, overvoltage and short circuit of the output to supply voltage or ground.

Storage conditions

Temperature range: -30...+60 °C
Rel. humidity: 0...80 % rF
Maximum storage time: 5 years
The specified storage conditions do not cause any change in function.
The sensors are no longer to be used once the maximum storage time has expired.

Application

Pressure sensors of this type are used in motor vehicles to measure the pressure in a braking system or in the fuel rail of direct-injection gasoline engines or common-rail system diesel engines.

Explanation of characteristic quantities

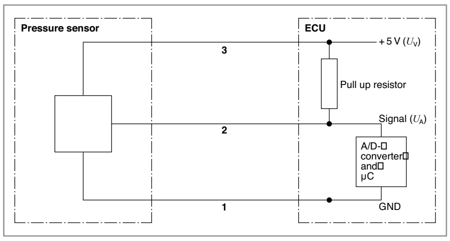
U_A	Output voltage
U_V	Supply voltage
bar	Pressure
U_S	Input voltage
p	Pressure [MPa]
C_0	0.1
C_1	0.8 · p / P_N
P_N	Rated pressure [MPa]
For	0 265 005 303:
C_0	0.75
C_1	0.12 · p / P_N

Design and operation

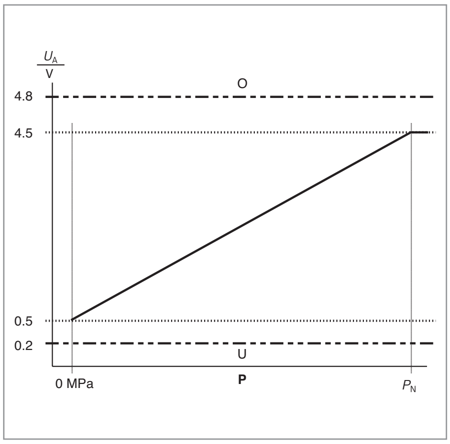
Use is made of polysilicon metal thin-film strain gauge elements. These are connected to form a Wheatstone bridge. This permits good signal utilisation and temperature compensation. The measurement signal is amplified in an evaluation IC and corrected with regard to offset and sensitivity. Further temperature compensation is then implemented, so that the calibrated measurement cell and ASIC unit exhibits only a low degree of dependence on temperature. The evaluation IC also incorporates a diagnosis function for detection of the following possible faults: - Break in bonding wire to measurement cell. - Break in any signal wire at any point. - Break in supply and ground wire at any point.

Only for 0 265 005 303 The following additional diagnosis function distinguishes this sensor from conventional sensors: The comparison of two signal paths in the sensor permits detection of - Offset error - Amplification error.

Measurement circuit



Characteristic curve



$U_A = (C_1 + C) \cdot U_S$
O Upper range for signal range check SRC
U Lower range for signal range check SRC

High-pressure sensors
Measurement up to 14 MPa

Part number 0 261 545 053

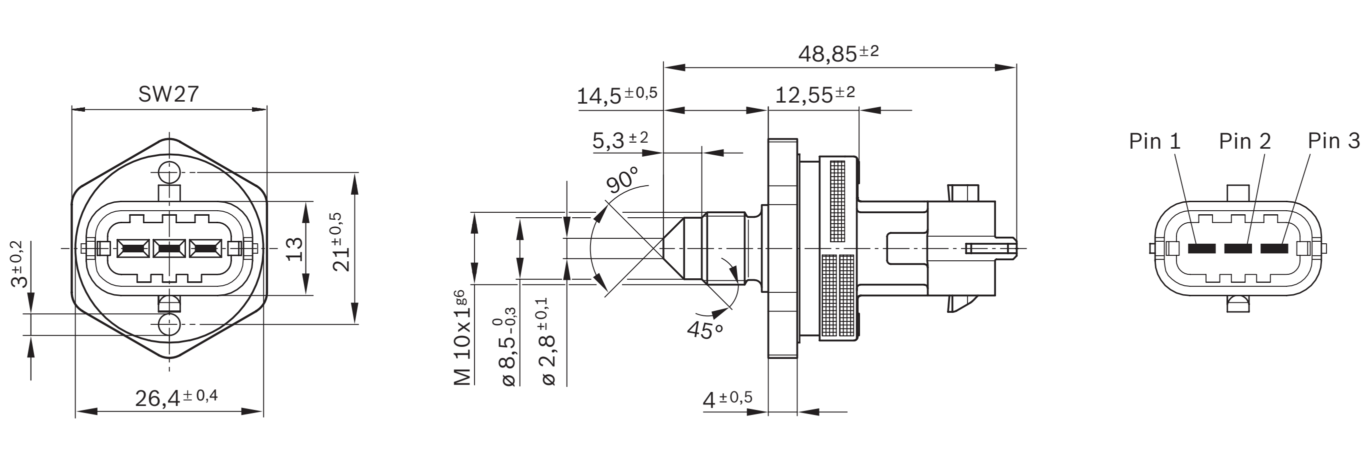
Technical data

Pressure range	P_N	bar (MPa)	140 (14)
Pressure-sensor type			KV4.2
Thread			M 10 x 1
Connector			Compact 1.1
Application/medium			Unleaded fuel
Max. feed voltage	U_s	V	16
Supply voltage	U_V	V	5 ± 0,25
Supply current	I_V	mA	12...15
Load capacitance to ground		nF	13
Temperature range		°C	- 40 ...+ 130
Max. overpressure	p_{max}	bar	1800
Rupture pressure	p_{berst}	bar	>1500
Response time	$\tau_{10/90}$	ms	2

[1])FS=Full Scale

Figure

Dimensional drawings



High-pressure sensors
Measurement up to 25 MPa

Part number 0 265 005 303

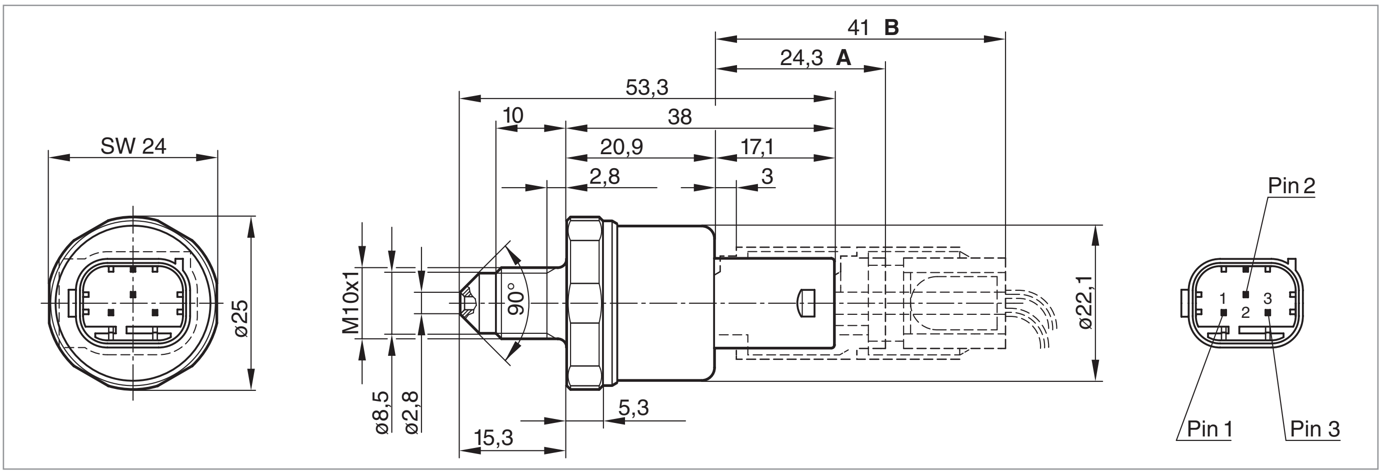
Technical data

Pressure range	P_N	bar (MPa)	250 (25)
Thread			M 10 x 1
Connector			PSA
Application/medium			Brake fluid
Accuracy of offset	U_V		2,0 %
Accuracy of sensitivity at 5 V - in range 0...35 bar	FS [1]) of measured value		≤ 0,7 %
Accuracy of sensitivity at 5 V - in range 35...250 bar	FS [1]) of measured value		≤ 5,0 % [3])
Supply voltage	U_V	V	5 ± 0,25
Supply current	I_V	mA	≤ 20
Output current	I_A	μA...mA	-100...3
Temperature range		°C	- 40 ...+ 120
Max. overpressure	p_{max}	bar	350
Rupture pressure	p_{berst}	bar	> 500
Tightening torque	M_a	Nm	20 ± 2

[1]) FS = Full Scale.
[3]) of measured value.

Figure

Dimensional drawing



A Space required for connector, approx. 25 mm
B Space required for connector, approx. 50 mm

SW Width across flats
Pin 1 GND ground
Pin 2 Output voltage U_A
Pin 3 Supply voltage U_V

Accessories

Accessories		Part number
Connector housing	Tyco number	2-967 642-1[1])
Contact pins	Tyco number	965 907-1[1])
Individual seal	Tyco number	967 067-1[1])

Accessories are not included in the scope of delivery and are therefore to be ordered separately as required.
1) Available from Tyco Electronics

High-pressure sensors
Measurement up to 150 MPa

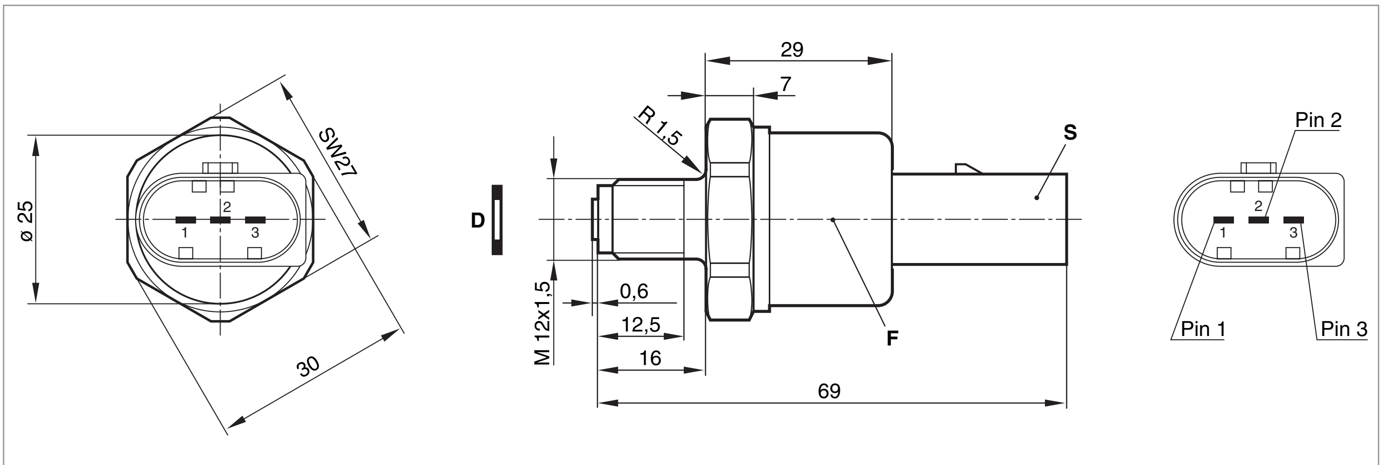
Part number 0 281 002 238

Technical data			
Pressure range	P_N	bar (MPa)	1500 (150)
Thread			M 12 x 1,5
Application/medium			Diesel fuel or biodiesel [2])
Max. feed voltage	U_s	V	16
Supply voltage	U_V	V	5 ± 0,25
Supply current	I_V	mA	9...15
Tightening torque	M_a	Nm	35 ± 5
Pressure-sensor type			RDS2
Connector			Make circuit
Pin			Silver-plated
Accuracy of offset	U_V		1,0 % FS
Accuracy of sensitivity at 5 V - in range 0...35 bar	FS [1]) of measured value		1,0 %
Accuracy of sensitivity at 5 V - in range 35...1500 bar	FS [1]) of measured value		2,0 %
Output current	I_A	µA...mA	2,5 mA [4])
Load capacitance to ground		nF	10
Temperature range		°C	- 40 ...+ 120 [5])
Max. overpressure	p_{max}	bar	1800
Rupture pressure	p_{berst}	bar	3000
Response time	$\tau_{10/90}$	ms	5

[1]) FS = Full Scale. [2]) RME rapeseed methyl ester. [4]) Output current with pull-up resistor. [5]) +140 °C for max. 250 h.

Figure

Dimensional drawing



D Sealing washer
F Date of manufacture
SW Width across flats
S 3-pin connector

Pin 1 GND ground
Pin 2 Output voltage U_A
Pin 3 Supply voltage U_V

Accessories		Part number
Connector housing	Kostal number	9 441 391[1])
Contact pins	Kostal number	22 124 492 060[1])
Single-wire seal	Kostal number	10 800 444 522[1])

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.
[1]) Available from Kostal Deutschland.

High-pressure sensors
Measurement up to 150 MPa

Part number 0 281 002 522

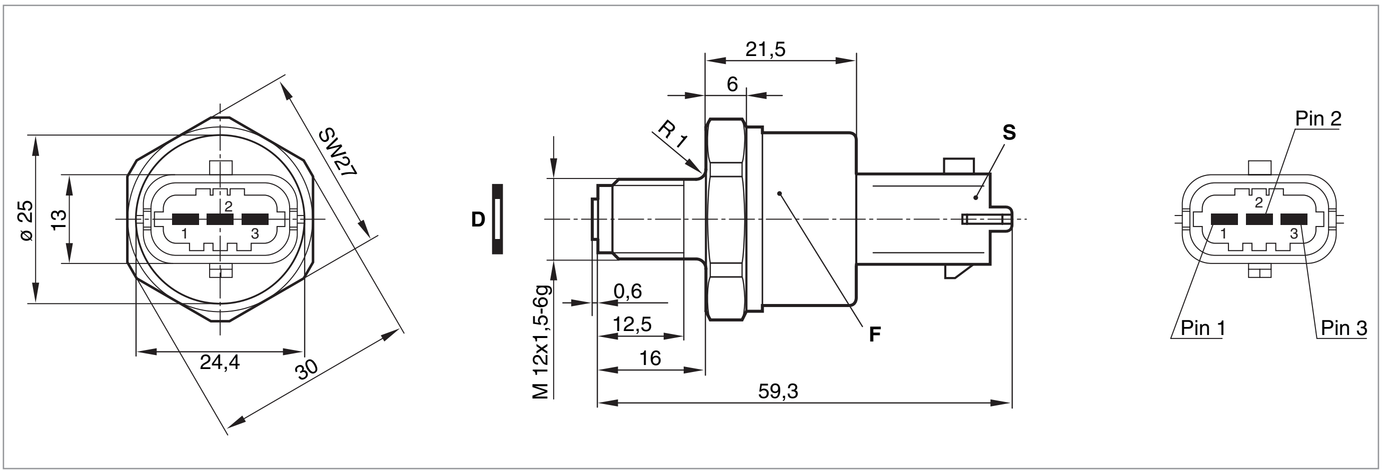
Technical data

Pressure range	P_N	bar (MPa)	1500 (150)
Thread			M 12 x 1,5
Application/medium			Diesel fuel or biodiesel [2])
Max. feed voltage	U_s	V	16
Supply voltage	U_V	V	5 ± 0,25
Supply current	I_V	mA	9...15
Tightening torque	M_a	Nm	35 ± 5
Pressure-sensor type			RDS3
Connector			Compact 1.1
Pin			Gold-plated
Accuracy of offset	U_V		0,7 % FS
Accuracy of sensitivity at 5 V - in range 35...1500 bar	FS [1]) of measured value		1,5 %
Load capacitance to ground		nF	13
Temperature range		°C	- 40 ...+ 130
Max. overpressure	p_{max}	bar	2200
Rupture pressure	p_{berst}	bar	4000
Response time	$\tau_{10/90}$	ms	2

[1]) FS = Full Scale.
[2]) RME rapeseed methyl ester.

Figure

Dimensional drawing



D	Sealing washer	Pin 1	GND ground
F	Date of manufacture	Pin 2	Output voltage U_A
SW	Width across flats	Pin 3	Supply voltage U_V
S	3-pin connector		

Accessories		Part number
Connector housing		1 928 403 968
Contact pins	Contents: 100 x	1 928 498 054
Single-wire seal	Contents: 10 x	1 928 300 599

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

High-pressure sensors
Measurement up to 180 MPa

Part number 0 281 002 398

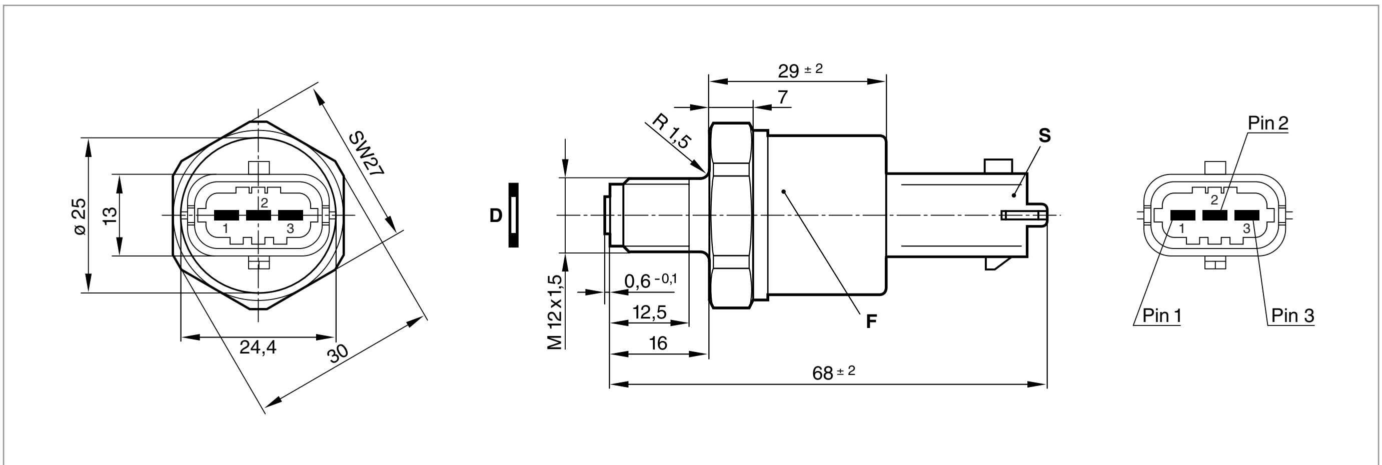
Technical data

Pressure range	P_N	bar (MPa)	1800 (180)
Max. feed voltage	U_s	V	16
Supply voltage	U_V	V	5 ± 0,25
Load capacitance to ground		nF	10
Pressure-sensor type			RDS2
Thread			M 12 x 1,5
Connector			Compact 1.1
Pin			Gold-plated
Application/medium			Diesel fuel or biodiesel [2])
Accuracy of offset	U_V		1,0 % FS
Accuracy of sensitivity at 5 V - in range 0...35 bar	FS [1]) of measured value		1,0 %
Accuracy of sensitivity at 5 V - in range 35...1800 bar	FS [1]) of measured value		2,3 %
Supply current	I_V	mA	9...15
Output current	I_A	µA...mA	2,5 [4])
Temperature range		°C	- 40 ...+ 120
Max. overpressure	p_{max}	bar	2100
Rupture pressure	p_{berst}	bar	3500
Tightening torque	M_a	Nm	70 ± 2
Response time	$\tau_{10/90}$	ms	5

[1]) FS = Full Scale. [2]) RME rapeseed methyl ester. [4]) Output current with pull-up resistor. [5]) +140°C for max. 250 h.

Figure

Dimensional drawing



D Sealing washer
F Date of manufacture
S 3-pin connector
SW Width across flats

Pin 1 GND Ground
Pin 2 Output voltage U_A
Pin 3 Supply voltage U_V

Accessories

Accessories		Part number
Connector housing		1 928 403 968
Contact pins	Contents: 100 x	1 928 498 054
Single-wire seal	Contents: 10 x	1 928 300 599

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

High-pressure sensors
Measurement up to 180 MPa

Part number 0 281 002 671

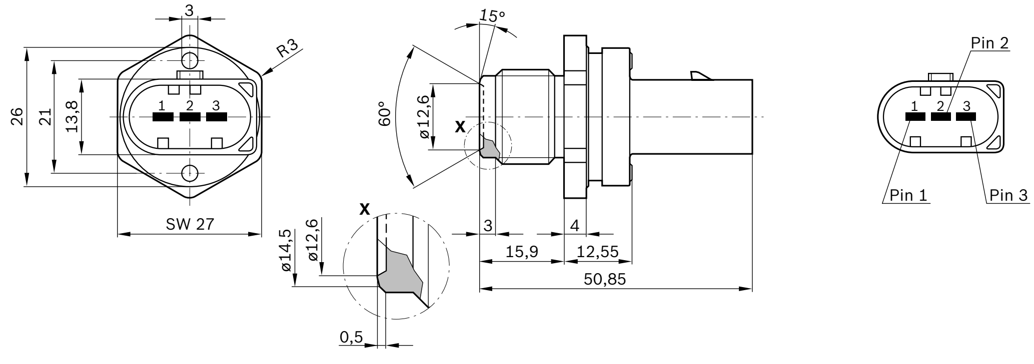
Technical data

Pressure range	P_N	bar (MPa)	1800 (180)
Max. feed voltage	U_s	V	16
Supply voltage	U_V	V	5 ± 0,25
Load capacitance to ground		nF	10
Pressure-sensor type			RDS4.1
Thread			M 18 x 1,5
Pin			Silver-plated
Application/medium			Diesel fuel or biodiesel [2])
Supply current	I_V	mA	9...15
Temperature range		°C	- 40 ...+ 130
Max. overpressure	p_{max}	bar	230
Rupture pressure	p_{berst}	bar	400
Response time	$\tau_{10/90}$	ms	2

[2]) RME rapeseed methyl ester.
Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

Figure

Dimensional drawing



Pin 1 Ground
Pin 2 Output
Pin 3 Supply

Accessories

Accessories		Part number
Connector housing	Kostal number	9 441 391[1])
Contact pins	Kostal number	22 124 492 060[1])
Single-wire seal	Kostal number	10 800 444 522[1])

[1]) Available from Kostal Deutschland.

High-pressure sensors
Measurement up to 180 MPa

Part number 0 281 002 767

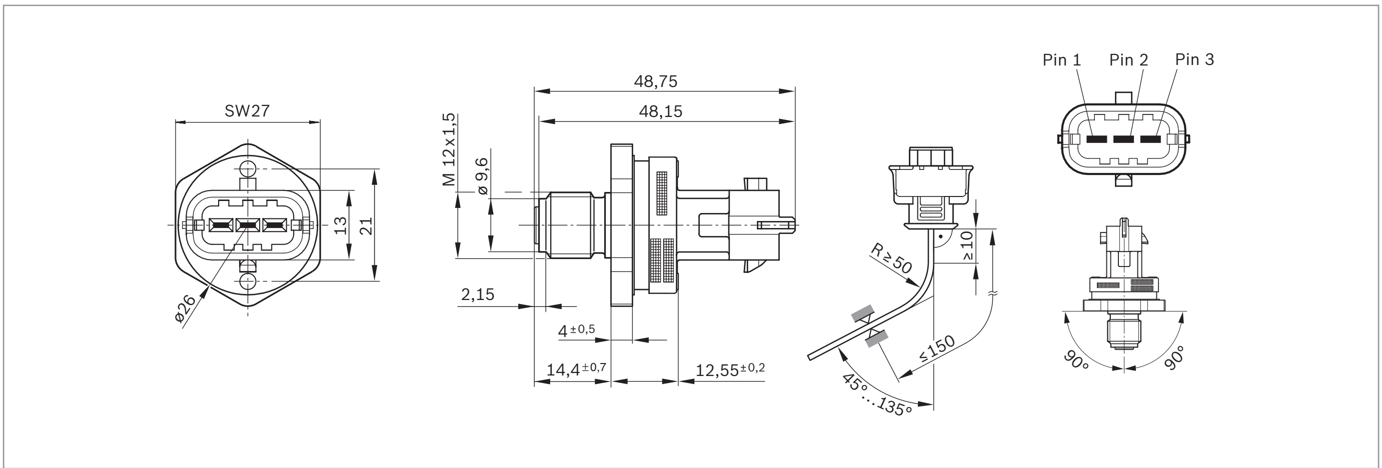
Technical data

Pressure range	P_N	bar (MPa)	1800 (180)
Max. feed voltage	U_s	V	16
Supply voltage	U_V	V	5 ± 0,25
Load capacitance to ground		nF	10
Pressure-sensor type			RDS4.1
Thread			M 12 x 1,5
Connector			Compact 1.1
Pin			Gold-plated
Application/medium			Diesel fuel or biodiesel [2])
Supply current	I_V	mA	9...15
Temperature range		°C	- 40 ...+ 130
Max. overpressure	p_{max}	bar	230
Rupture pressure	p_{berst}	bar	400
Response time	$\tau_{10/90}$	ms	2

[2]) RME rapeseed methyl ester.

Figure

Dimensional drawing



SW Width across flats
Pin 1 Ground
Pin 2 Output
Pin 3 Supply

Accessories

Accessories		Part number
Connector housing	1 928 403 968	
Contact pins	Contents: 100 x	1 928 498 054
Single-wire seal	Contents: 10 x	1 928 300 599

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

High-pressure sensors
Measurement up to 180 MPa

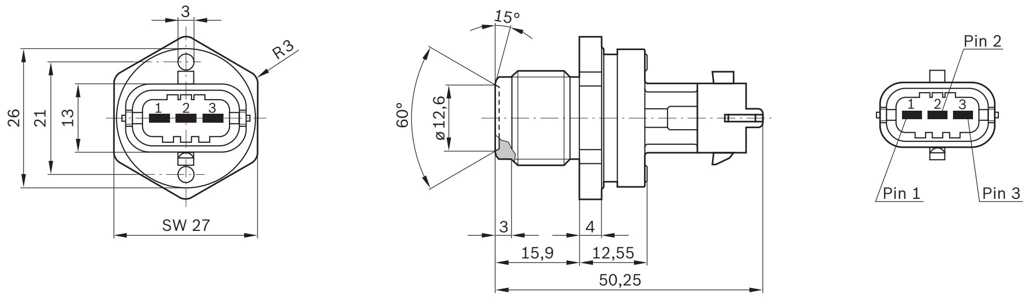
Part number 0 281 002 841

Technical data			
Pressure range	P_N	bar (MPa)	1800 (180)
Max. feed voltage	U_s	V	16
Supply voltage	U_V	V	5 ± 0,25
Load capacitance to ground		nF	10
Pressure-sensor type			RDS4.1
Thread			M 18 x 1,5
Connector			Compact 1.1
Pin			Gold-plated
Application/medium			Diesel fuel or biodiesel [2])
Supply current	I_V	mA	9...15
Temperature range		°C	- 40 ...+ 130
Max. overpressure	p_{max}	bar	230
Rupture pressure	p_{berst}	bar	400
Response time	$\tau_{10/90}$	ms	2

[2]) RME rapeseed methyl ester.

Figure

Dimensional drawing



Pin 1 Ground
Pin 2 Output
Pin 3 Supply

Accessories		Part number
Connector housing	1 928 403 968	
Contact pins	Contents: 100 x	1 928 498 054
Single-wire seal	Contents: 10 x	1 928 300 599

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

High-pressure sensors
Measurement up to 180 MPa

Part number 0 281 002 842

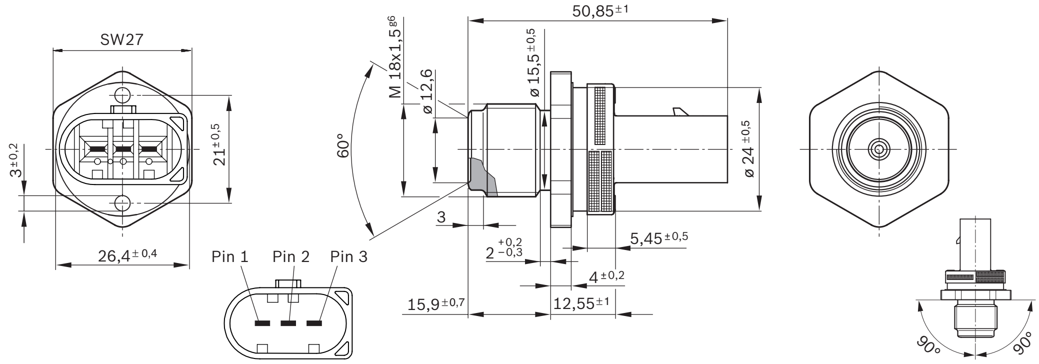
Technical data

Pressure range	P_N	bar (MPa)	1800 (180)
Max. feed voltage	U_s	V	16
Supply voltage	U_V	V	5 ± 0,25
Load capacitance to ground		nF	10
Pressure-sensor type			RDS4
Thread			M 18 x 1,5
Application/medium			Diesel or biodiesel [2])
Temperature range		°C	- 40 ...+ 130
Max. overpressure	p_{max}	bar	2300
Rupture pressure	p_{berst}	bar	4000
Response time	$\tau_{10/90}$	ms	2

[2]) RME rapeseed methyl ester.

Figure

Dimensional drawings



High-pressure sensors
Measurement up to 180 MPa

Part number 0 281 002 930

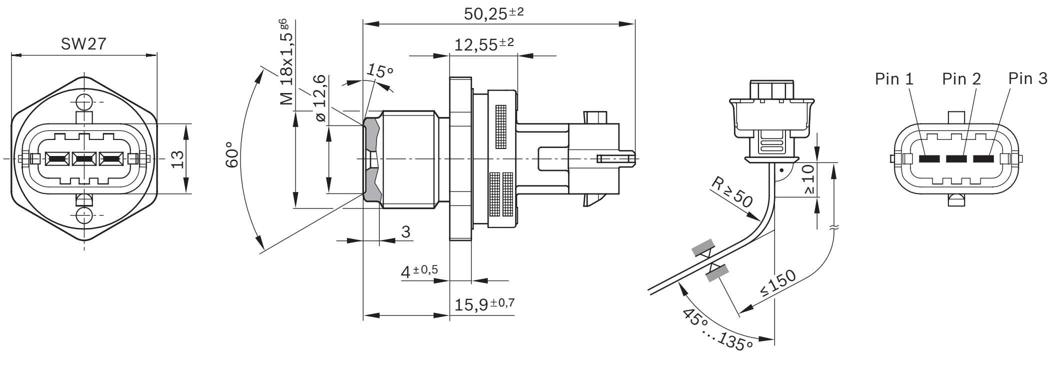
Technical data

Pressure range	P_N	bar (MPa)	1800 (180)
Max. feed voltage	U_s	V	16
Supply voltage	U_V	V	5 ± 0,25
Load capacitance to ground		nF	10
Pressure-sensor type			RDS4
Thread			M 18 x 1,5
Application/medium			Diesel or biodiesel[2])
Temperature range			- 40 ...+ 130
Max. overpressure	p_{max}	bar	2300
Rupture pressure	p_{berst}	bar	4000
Response time	$\tau_{10/90}$	ms	2

[1]) FS = Full Scale.
[2]) RME rapeseed methyl ester.
[4]) Output current with pull-up resistor.
[5]) +140°C for max. 250 h.

Figure

Dimensional drawings



High-pressure sensors
Measurement up to 180 MPa

Part number 0 281 002 937

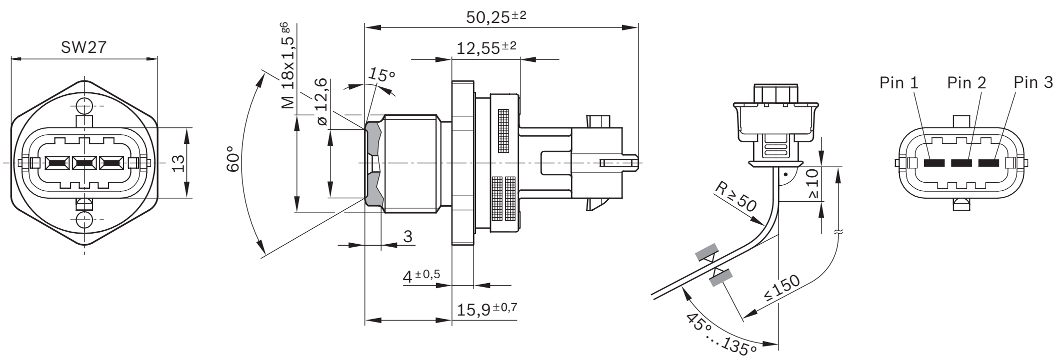
Technical data

Pressure range	P_N	bar (MPa)	1800 (180)
Max. feed voltage	U_s	V	16
Supply voltage	U_V	V	5 ± 0,25
Load capacitance to ground		nF	10
Pressure-sensor type			RDS4
Thread			M 18 x 1,5
Application/medium			Diesel or biodiesel[2])
Temperature range		°C	- 40 ...+ 130
Max. overpressure	p_{max}	bar	2300
Rupture pressure	p_{berst}	bar	4000
Response time	$\tau_{10/90}$	ms	2

[1]) FS = Full Scale.
[2]) RME rapeseed methyl ester.
[4]) Output current with pull-up resistor.
[5]) +140°C for max. 250 h.

Figure

Dimensional drawings



High-pressure sensors
Measurement up to 200 MPa

Part number 0 281 002 755

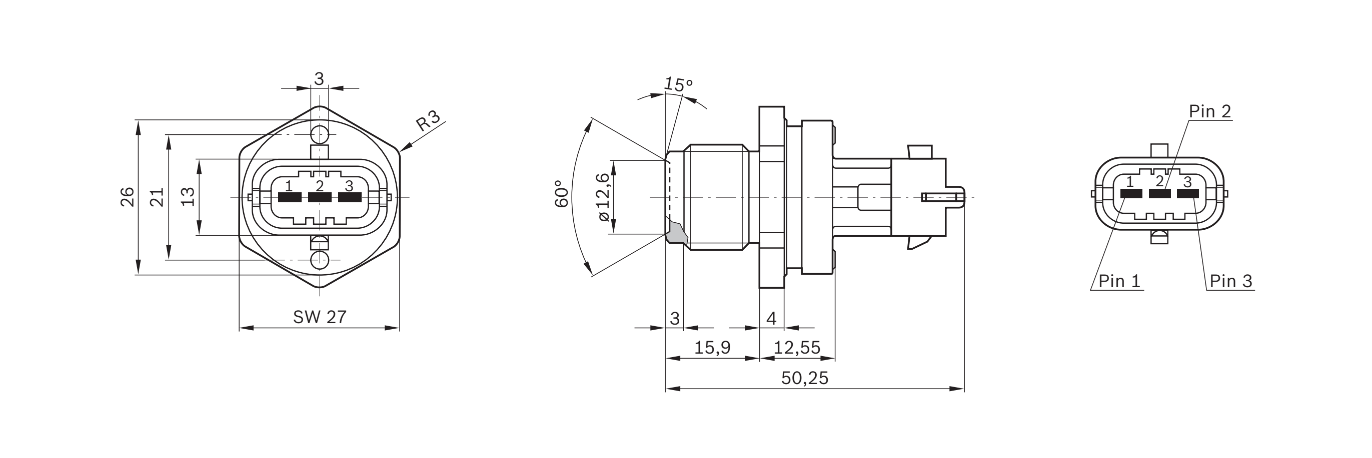
Technical data

Pressure range	P_N	bar (MPa)	2000 (200)
Pressure-sensor type			RDS4.1
Thread			M 18 x 1,5
Connectors			Compact 1.1
Pin			Gold-plated
Application/medium			Diesel fuel or biodiesel [2])
Max. feed voltage	U_s	V	16
Supply voltage	U_V	V	5 ± 0,25
Supply current	I_V	mA	9...15
Load capacitance to ground		nF	10
Temperature range		°C	- 40 ...+ 130
Max. overpressure	p_{max}	bar	230
Rupture pressure	p_{berst}	bar	400
Response time	$\tau_{10/90}$	ms	2

[2]) RME rapeseed methyl ester.

Figure

Dimensional drawing



Pin 1 Ground
Pin 2 Output
Pin 3 Supply

Accessories		Part number
Connector housing		1 928 403 968
Contact pins	Contents: 100 x	1 928 498 054
Single-wire seal	Contents: 10 x	1 928 300 599

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

High-pressure sensors
Measurement up to 200 MPa

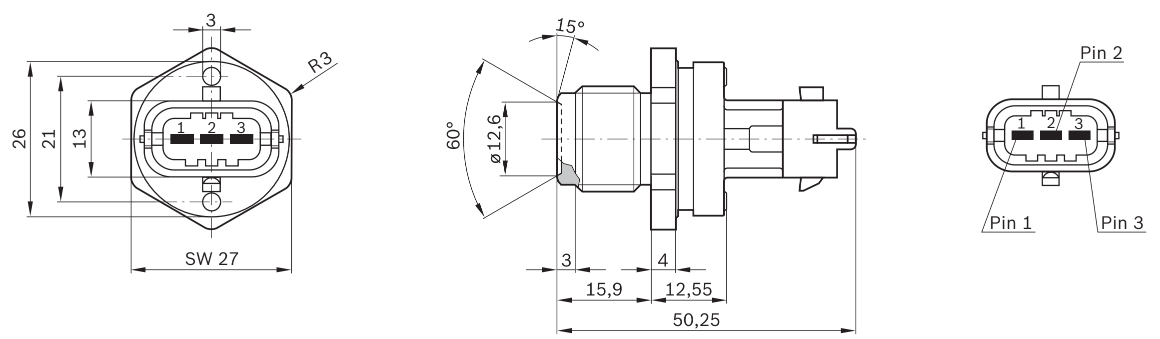
Part number 0 281 002 787

Technical data			
Pressure range	P_N	bar (MPa)	2000 (200)
Pressure-sensor type			RDS4.1
Thread			M 18 x 1,5
Connectors			Compact 1.1
Pin			Gold-plated
Application/medium			Diesel fuel or biodiesel [2])
Max. feed voltage	U_s	V	16
Supply voltage	U_V	V	5 ± 0,25
Supply current	I_V	mA	9...15
Load capacitance to ground		nF	10
Temperature range		°C	- 40 ...+ 130
Max. overpressure	p_{max}	bar	230
Rupture pressure	p_{berst}	bar	400
Response time	$\tau_{10/90}$	ms	2

[2]) RME rapeseed methyl ester.

Figure

Dimensional drawing



Pin 1 Ground
Pin 2 Output
Pin 3 Supply

Accessories		Part number
Connector housing		1 928 403 968
Contact pins	Contents: 100 x	1 928 498 054
Single-wire seal	Contents: 10 x	1 928 300 599

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

Pressure sensors for CNG and LPG
Media-resistant, micromechanics

- Available both non-fitted and fitted in an extremely robust housing.
- EMC protection up to 100 Vm^{-1}
- With temperature compensation
- Ratiometric output signal
- All sensors and sensor cells are resistant to fuels (including diesel) and oils, e.g. engine oil.

Application

Monolithically integrated silicon pressure sensors are high-precision measuring elements for determining absolute pressure. They are particularly suitable for use under rough ambient conditions e.g. for measuring the absolute intake manifold pressure of internal combustion engines.

Signal evaluation

The pressure sensor supplies an analog output signal with a ratiometric relationship to the supply voltage. An RC low-pass filter with e.g. t = 2 ms is recommended in the input section of the downstream electronics to suppress any harmonic interference. On the version with integrated temperature sensor, this consists of an NTC thermistor (to be operated with a series resistor) for measuring the ambient temperature.

Design and operation

The sensor contains a silicon chip with an etched pressure diaphragm. A change in pressure produces elongation of the diaphragm, which is recorded by an evaluation circuit by way of changes in resistance. The circuit is integrated on the silicon chip together with electronic?compensating elements. ?Manufacture of the silicon chip involves joining a silicon wafer carrying numerous sensor elements to a glass plate. Following a sawing process to divide this into individual chips, one such chip is soldered onto a metal base with a pressure connection. The pressure is routed by way of the connection and base to the back of the pressure diaphragm. A reference vacuum enclosed under the cap welded to the base permits measurement of the absolute pressure and at the same time protects the front of the pressure?diaphragm. The programming logic on the chip permits adjustment of the output characteristic curve for increased accuracy. The fully calibrated and checked sensors are installed in a special housing for?intake manifold attachment (refer to quotation).

Version

Sensors with housing:?This version is provided with a robust housing. On the version with temperature sensor, the sensor is accommodated in the housing.? Sensors without housing:?Housing similar to TO, pressure supply through a central pressure connection. The following soldering pins are required:?Pin 6 Output voltage UA,?Pin 7 Earth,?Pin 8 +5 V.

Note

1 connector housing, 3 contact pins and 3 individual seals are required for a 3-pin connector.
1 connector housing, 4 contact pins and 4 individual seals are required for a 4-pin connector.

Installation instructions

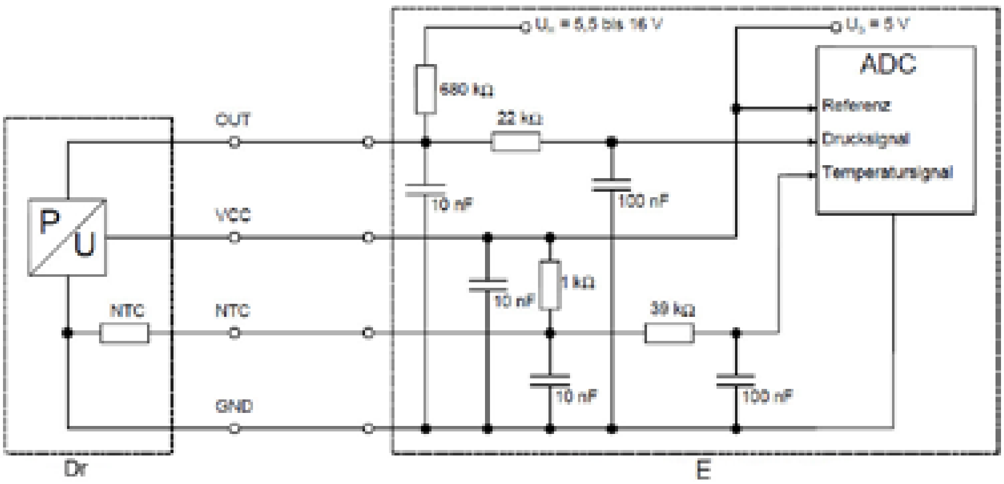
On installation, the pressure connection should be facing downwards to prevent the accumulation of condensate in the pressure cell.

Pressure sensors for CNG and LPG
Media-resistant, micromechanics

Technical data

Parameter		min	typ	max
Load current I_L at output	mA	-1		0,5
Load resistance to ground or U_V	kΩ	5		10
Lower limit at U_V = 5 V	V	0,25	0,3	0,35
Upper limit at U_V = 5 V	V	4,75	4,8	4,85
Output resistance to ground, U_V open	kΩ			
Output resistance to U_V, ground open	kΩ			
Response time $\tau_{10/90}$	ms		1	
Operating temperature	°C	-40		130

Recommendation for signal evaluation



Dr Pressure sensor
E Electronic control unit

Pressure sensors for CNG and LPG
Media-resistant, micromechanics

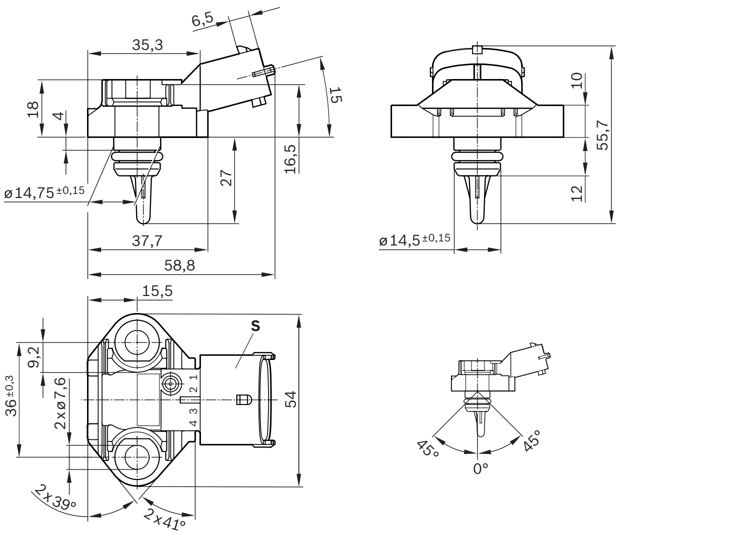
Part number 0 261 230 145

Technical data

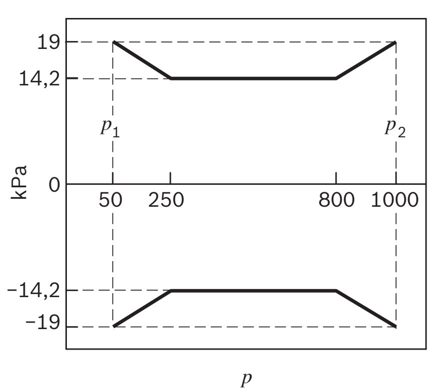
Parameter		min.	type	max.
Product text	Only suitable for CNG			
Pressure range ($p_1 ... p_2$)	kPa	50		1000

Figure

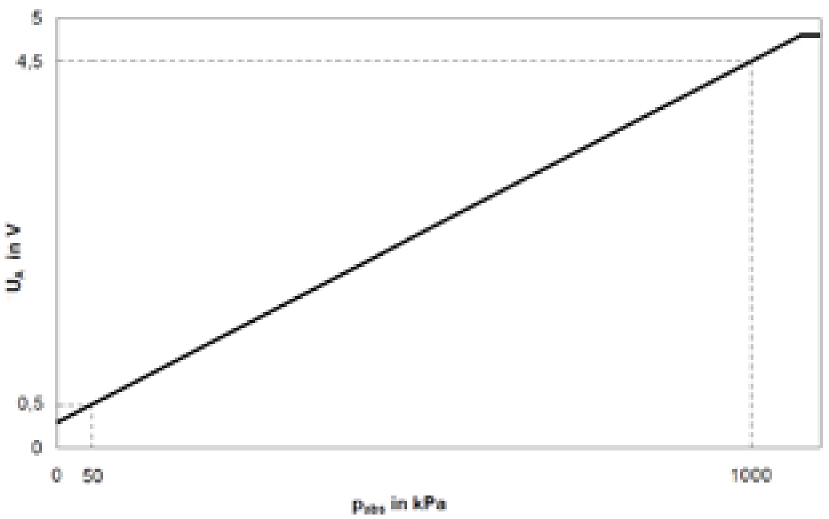
Dimensional drawings



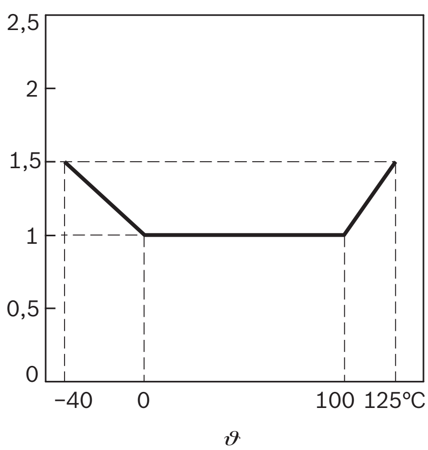
Characteristic curve tolerance



Characteristic curve



Tolerance extension factor



Pressure sensors for CNG and LPG
Media-resistant, micromechanics

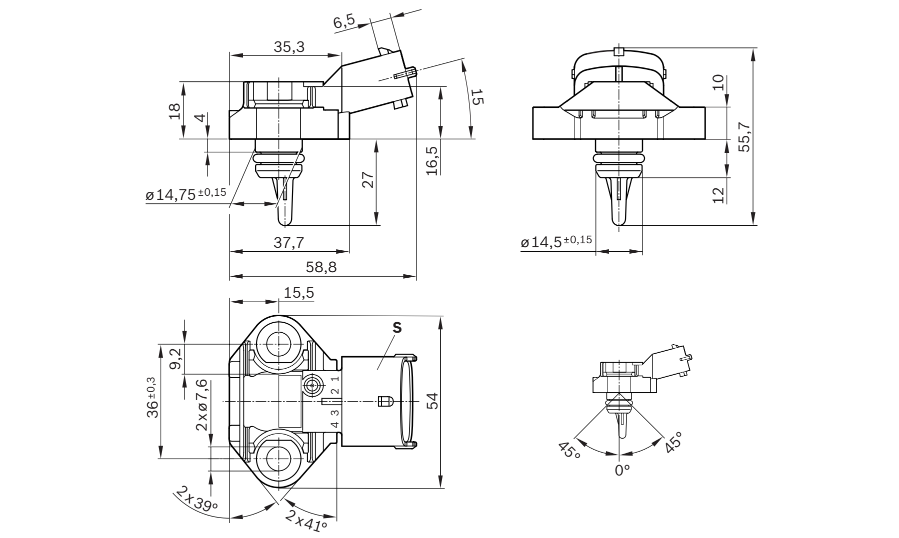
Part number 0 261 230 249

Technical data

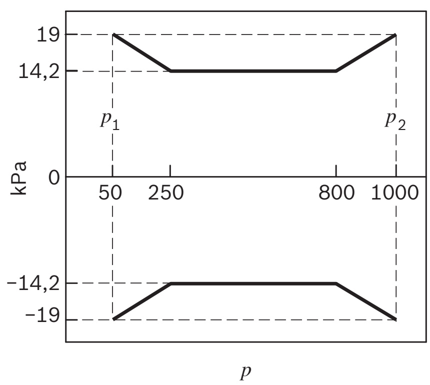
Parameter		min.	type	max.
Product text	Only suitable for CNG			
Pressure range ($p_1 \dots p_2$)	kPa	50		1000
Supply voltage U_V	V	4,75	5	5,25

Figure

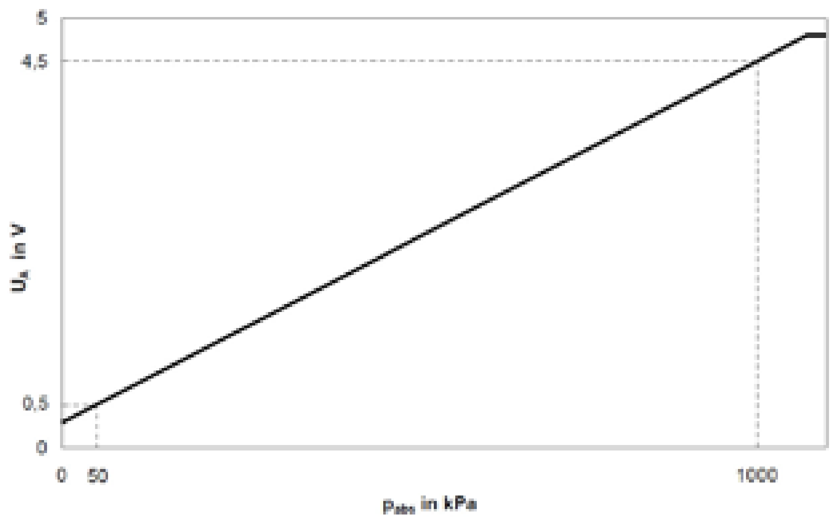
Dimensional drawings



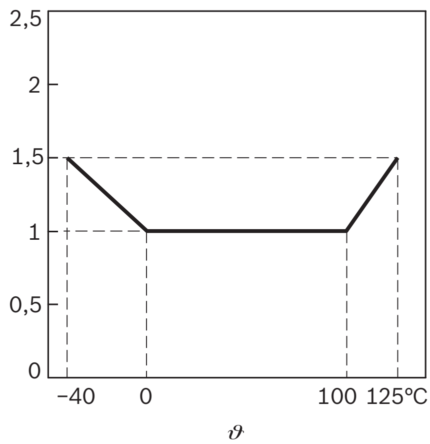
Characteristic curve tolerance



Characteristic curve



Tolerance extension factor



Pressure sensors for CNG and LPG

Media-resistant, micromechanics

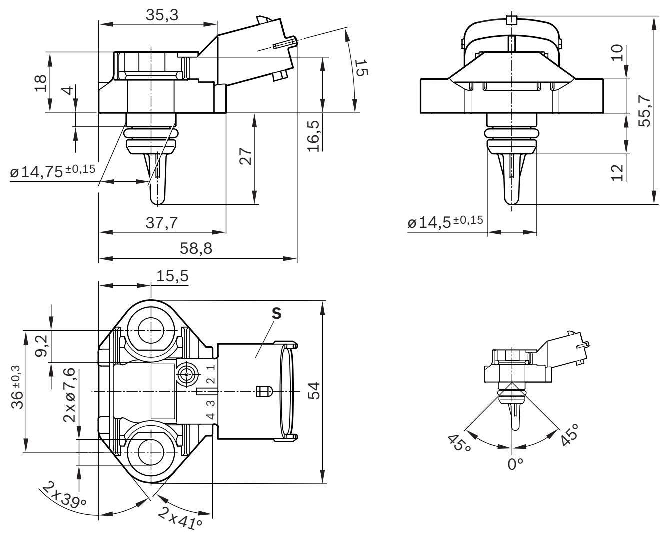
Part number 0 261 230 255

Technical data

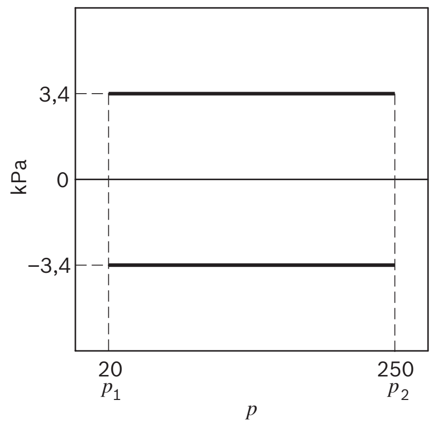
Parameter		min.	type	max.
Pressure range ($p_1...p_2$)	kPa	20		250
Supply voltage U_V	V	4,75	5	5,25
Current input I_V at U_V = 5 V	mA	6	9	12,5

Figure

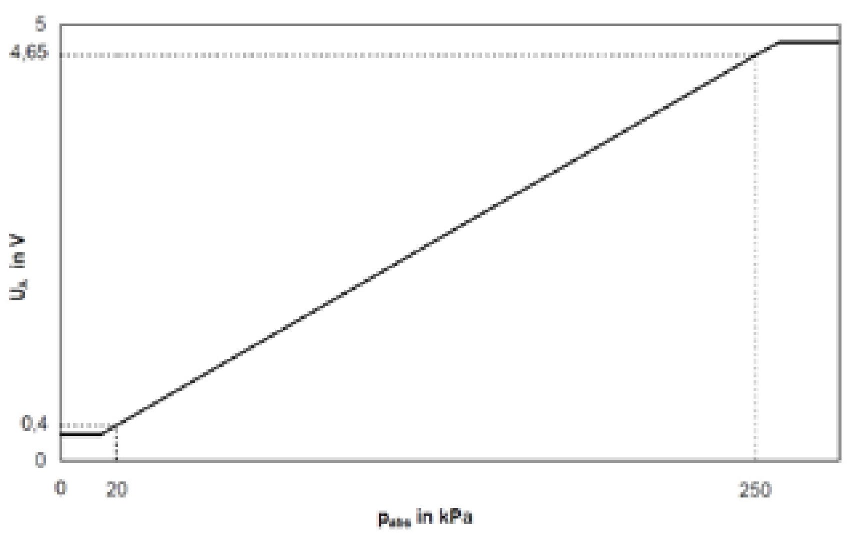
Dimensional drawings



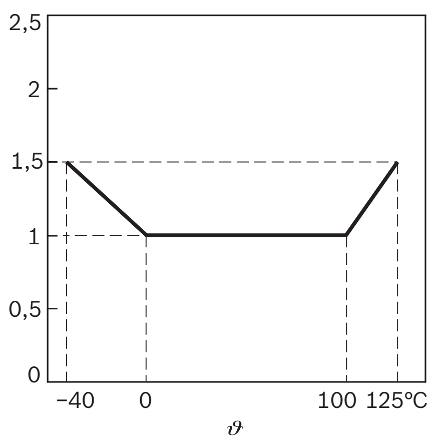
Characteristic curve tolerance



Characteristic curve



Tolerance extension factor



Pressure sensors for CNG and LPG
Media-resistant, micromechanics

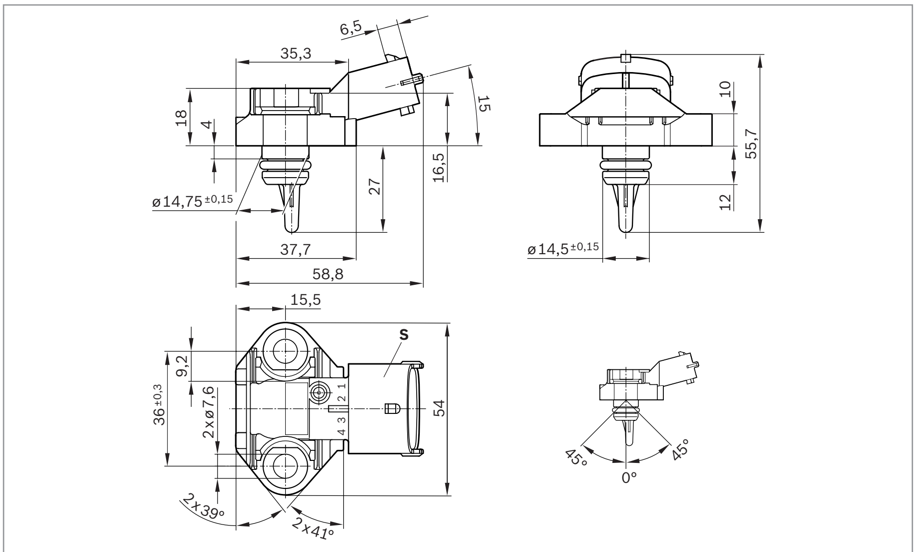
Part number 0 261 230 274

Technical data

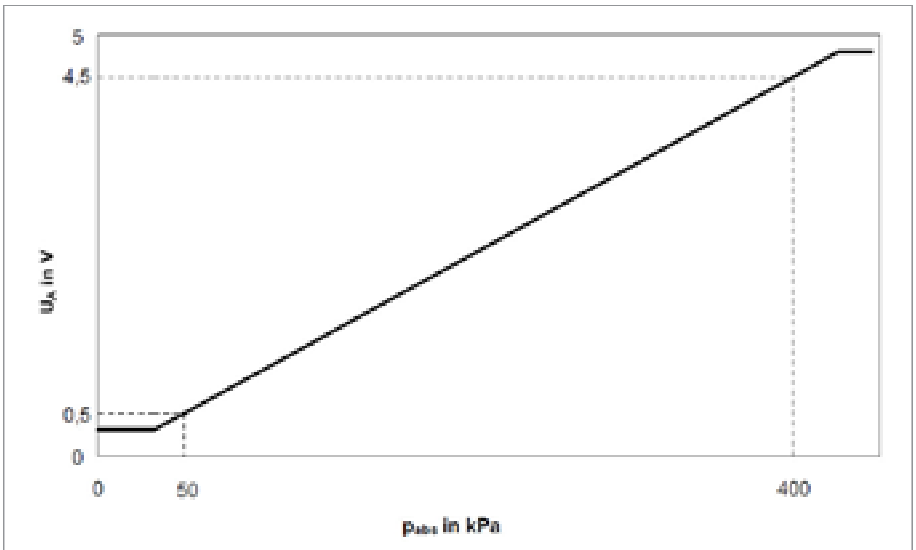
Parameter		min.	type	max.
Pressure range ($p_1 \dots p_2$)	kPa	50		400
Supply voltage U_V	V	4,75	5	5,25
Current input I_V at U_V = 5 V	mA	6	9	12,5

Figure

Dimensional drawings



Characteristic curve



Pressure sensors for CNG and LPG
Media-resistant, micromechanics

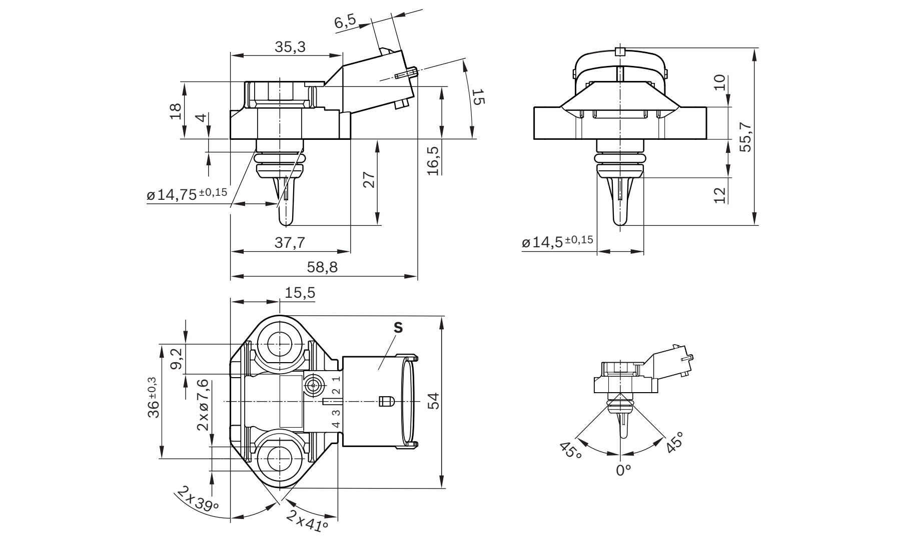
Part number 0 261 230 275

Technical data

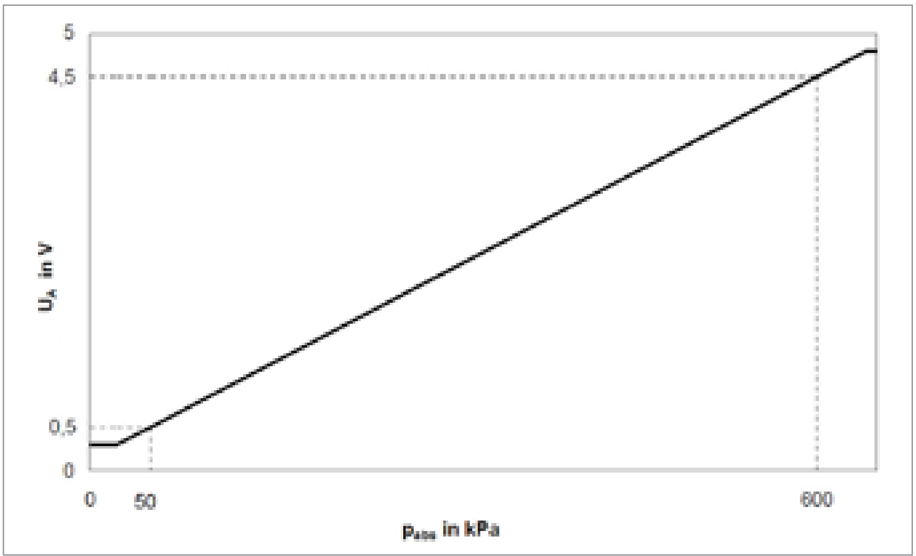
Parameter		min.	type	max.
Product text	Only approved for CNG			
Pressure range ($p_1 \ldots p_2$)	kPa	50		600
Supply voltage U_V	V	4,75	5	5,25
Current input I_V at U_V = 5 V	mA	6	9	12,5

Figure

Dimensional drawings



Characteristic curve



Pressure sensors for CNG and LPG
Media-resistant, micromechanics

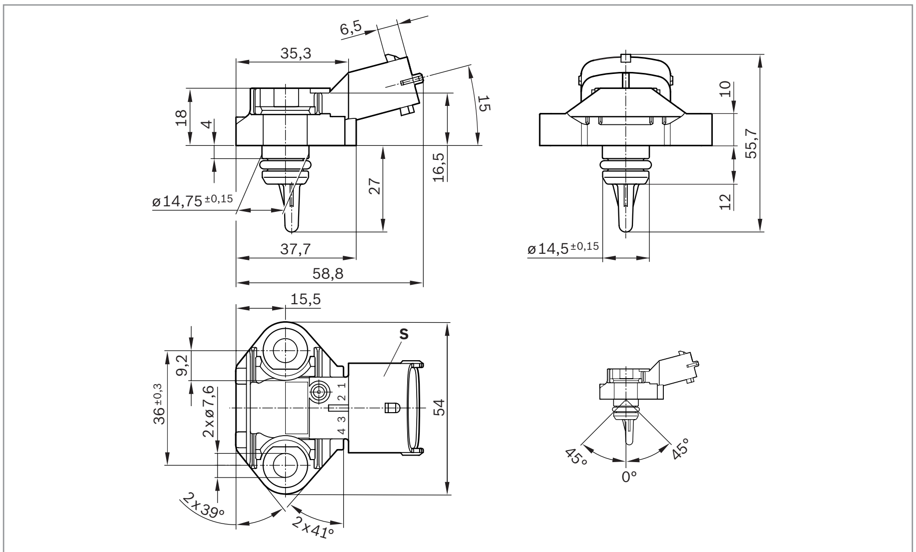
Part number 0 280 005 620

Technical data

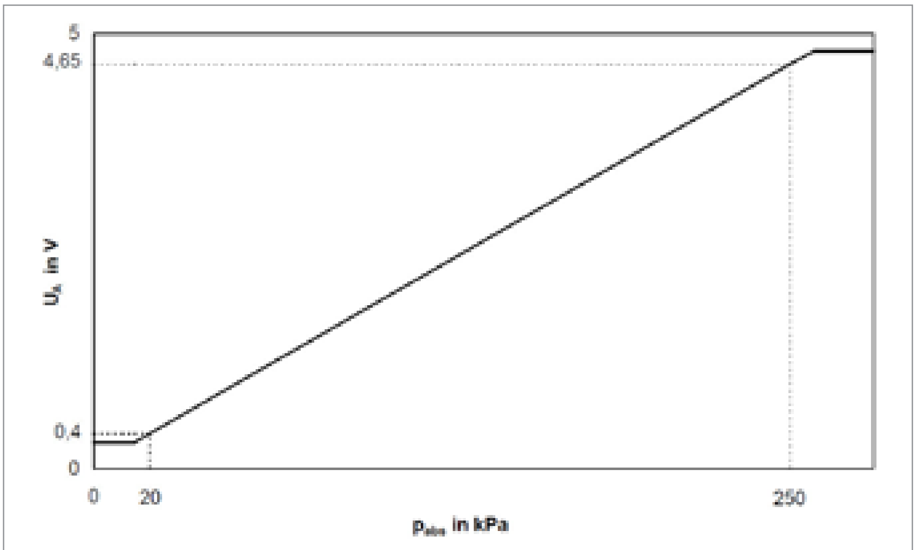
Parameter		min.	type	max.
Pressure range ($p_1 \ldots p_2$)	kPa	20		250
Supply voltage U_V	V	4,75	5	5,25
Current input I_V at U_V = 5 V	mA	6	9	12,5

Figure

Dimensional drawings



Characteristic curve



Pressure sensors for CNG and LPG
Media-resistant, micromechanics

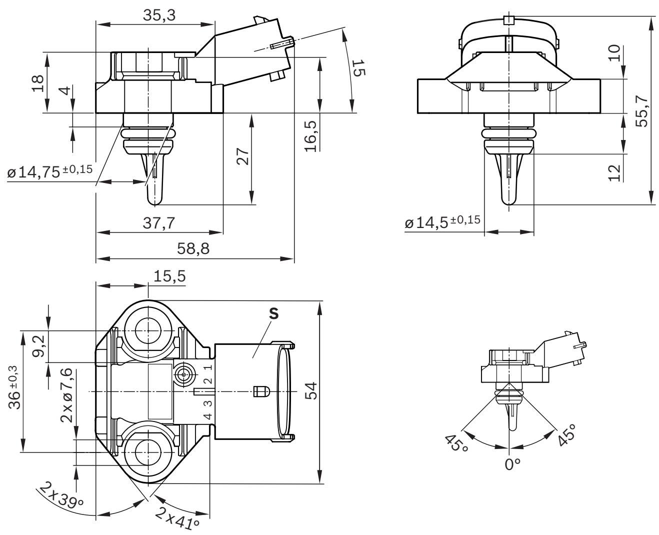
Part number 0 281 006 243

Technical data

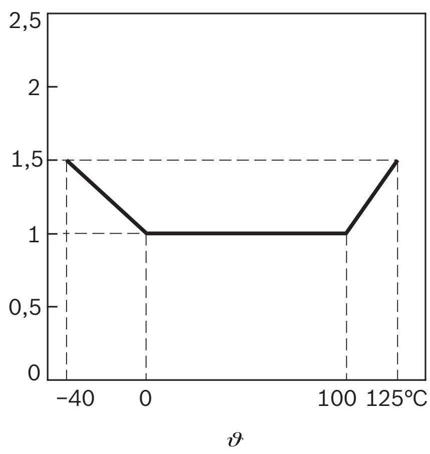
Parameter		min.	type	max.
Pressure range (p_1...p_2)	kPa	20		300
Supply voltage U_V	V	4,75	5	5,25
Current input I_V at U_V = 5 V	mA	6	9	12,5

Figure

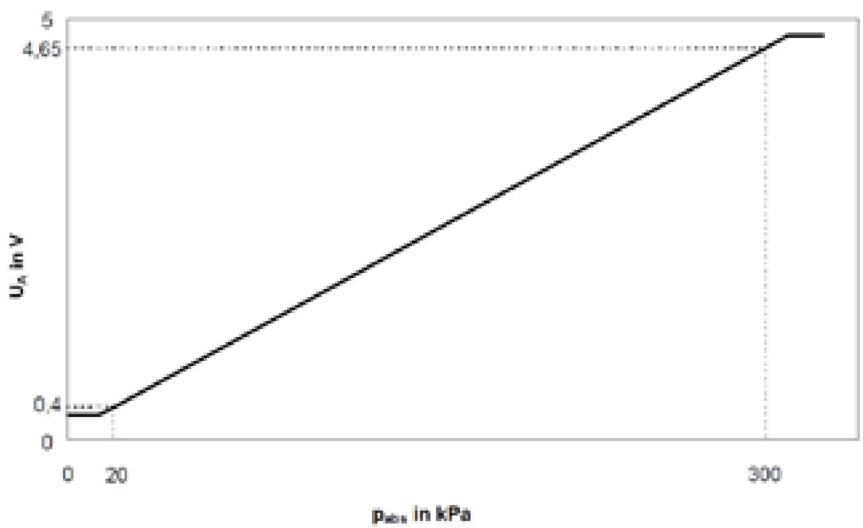
Dimensional drawings



Tolerance extension factor



Characteristic curve



Notes

NTC temperature sensors: -40°C to 130°C
Measurement of air temperatures

- ▶ Measurement with temperature-sensitive resistors.
- ▶ Broad temperature range.

Installation instructions

The sensor is installed such that the front section with the sensing element is directly exposed to the air flow.

NTC temperature sensor

Plastic-sheathed NTC thermistor

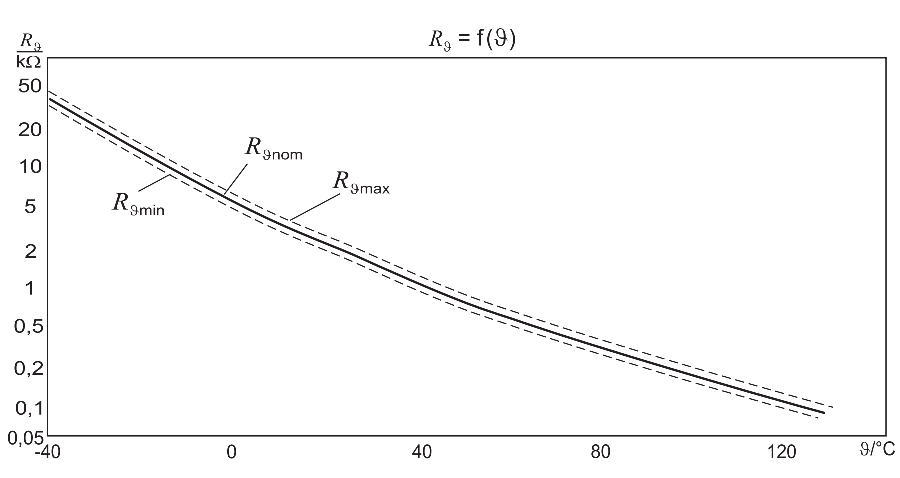
Design and operation

NTC thermistors have a negative temperature coefficient, i.e. their conductivity increases with increasing temperature: Their resistance decreases. The conductive element of the temperature sensor consists of semi-conducting heavy metal oxides and oxidized mixed crystals pressed or sintered into wafers or beads with the aid of binding agents and provided with a protective casing. In combination with a suitable evaluation circuit, such resistors permit precise temperature determination. Depending on the housing design, the sensors are suitable for measuring temperatures in liquids and gases. In motor vehicles they are used to measure the temperature of the intake air, i.e. in the range -40...130 °C.

Note

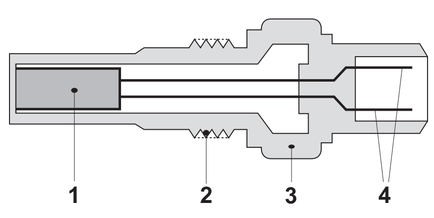
For a 2-pin connector, 1 connector housing, 2 contact pins and 2 individual seals are required.
Genuine Tyco crimping tools must be used for motor vehicle applications.

Resistance profile of temperature sensor



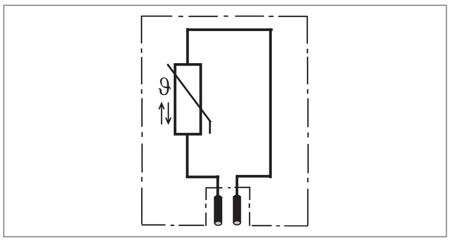
R Resistance
ϑ Temperature

Temperature sensor (block diagram)



1 NTC thermistor
2 Screw-in thread
3 Housing
4 Electrical connection

Circuit diagram



NTC temperature sensors: -40°C to 130°C
Measurement of air temperatures

Part number 0 280 130 039

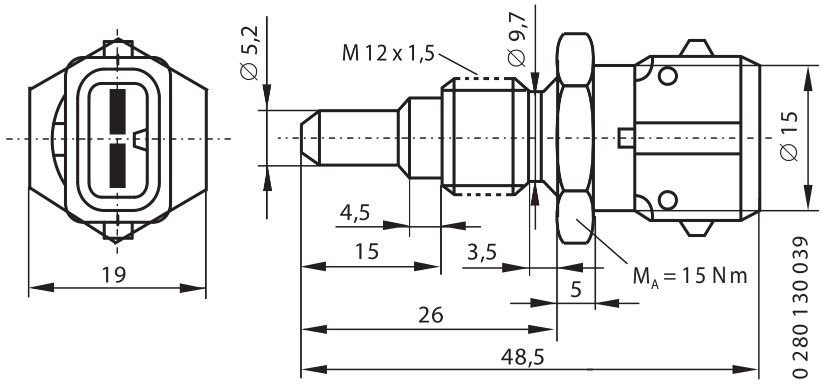
Technical data

Product text Sensor in steel housing with threaded connection.		
Perm. temperature max.	°C	130
Rated resistance at 20 °C	kΩ	2,5 ± 5 %
Resistance at -10 °C	kΩ	8,325 ... 10,572
Resistance at +20 °C	kΩ	2,280 ... 2,736
Resistance at +80 °C	kΩ	0,288 ... 0,359
Nominal voltage	V	5 ± 0,15
Max. measurement current	mA	1
Self-heating with max. perm. power loss of P = 2 mW and still air (23 °C)	K	≤ 2
Temperature/time constant τ_{63} [1])	s	≤ 38
Approximate value for permissible vibration acceleration a_{sin} (sinusoidal vibration)	m/s²	300
Corrosion-tested as per		DIN 50 018

[1]) Time required to attain a difference in resistance of 63% of the final value given an abrupt change in measurement temperature from 20°C to 80°C; flow velocity of air 6 m/s .

Figure

Dimensional drawing



P_N Tightening torque

Accessories

Accessories			Part number
Jetronic connector	2-pin		1 928 402 078
Protective cap	Temperature-resistant; Contents: 1 x		1 280 703 031
Contact pins	For Ø 0.5...1.0 mm²	Tyco number	929 939-3[1])
Contact pins	For Ø 1.5...2.5 mm²	Tyco number	929 937-3[1])
Individual seal	For Ø 0.5...1.0 mm²; Contents: 50 x		1 987 280 106
Individual seal	For Ø 1.5...2.5 mm²; Contents: 20 x		1 987 280 107

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.
[1]) Available from Tyco Electronics.

NTC temperature sensors: -40°C to 130°C
Measurement of liquid temperatures

- Wide range of liquid temperature measurements with temperature-sensitive resistors.

NTC temperature sensor

NTC thermistor in brass housing.

Design and operation

NTC thermistors have a negative temperature coefficient, i.e. their conductivity increases with increasing temperature: Their resistance decreases.?The conductive element of the temperature sensor consists of semi-conducting heavy metal oxides and oxidized mixed crystals pressed or sintered into wafers or beads with the aid of binding agents and provided with a protective casing. In combination with a suitable evaluation circuit, such resistors permit precise temperature determination. Depending on the housing design, the sensors are suitable for measuring temperatures in liquids and gases.?In motor vehicles they are used to measure the temperature of engine oil, coolant and fuel, i.e. in the range -40...130 °C.

Note

For a 2-pin connector, 1 connector housing, 2 contact pins and 2 individual seals are required.
Genuine AMP crimping tools must be used for motor vehicle applications.

Explanation of characteristic quantities

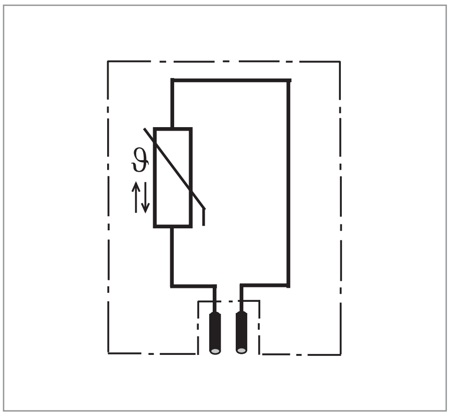
R Resistance
ϑ Temperature

NTC temperature sensors: -40°C to 130°C
Measurement of liquid temperatures

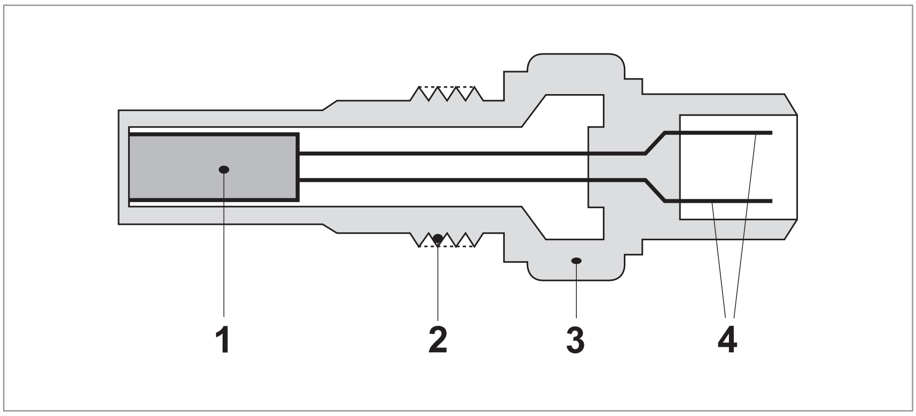
Technical data

Measuring range	°C	- 40 ...+ 130
Approximate value for permissible vibration acceleration a_{sin} (sinusoidal vibration)	m/s²	300
Max. measurement current	mA	1

Circuit diagram

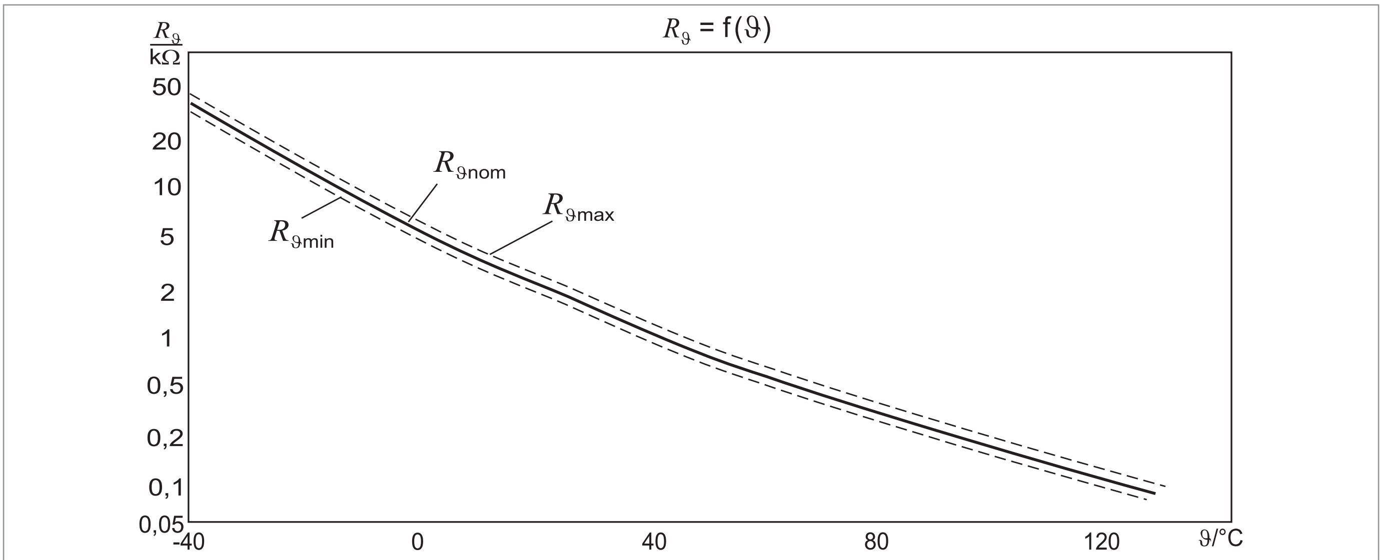


Temperature sensor (block diagram)



1 NTC thermistor
2 Screw-in thread
3 Housing
4 Electrical connection

Resistance profile of temperature sensor



NTC temperature sensors: -40°C to 130°C
Measurement of liquid temperatures

Part number 0 281 002 209

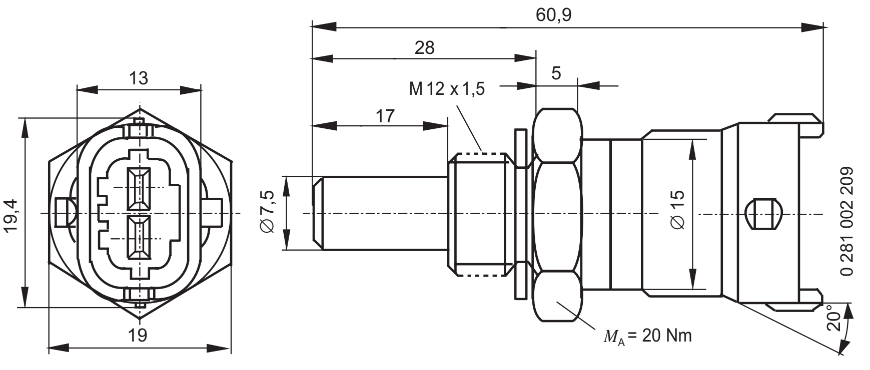
Technical data

Product text	Sensor in brass housing.	
Application/medium		Oil/water
Tolerance at +100 °C	K	0,1886 ± 2%
Rated resistance at 100 °C	kΩ	2,5 ± 6 %
Resistance at -10 °C	kΩ	8,640 ... 10,149
Resistance at +20 °C	kΩ	2,351 ... 2,648
Resistance at +80 °C	kΩ	0,313 ... 0,332
Temperature/time constant τ_{63} [1])	s	≤ 15
Degree of protection [1])		IP 5K 9K
Thread		M 12 x 1,5
Corrosion-tested as per		DIN 50 021
Connector		Compact 1.1, tinned pins
Tightening torque	Nm	25
Rated voltage	V	5 ± 0,15

[1]) With single-wire seal.

Figure

Dimensional drawing



Accessories

Accessories		Part number
Compact connector 1.1a	2-pin	1 928 403 874
Contact pins	For Ø 0.5 ... 1.0 mm²; Contents: 100 x	1 928 498 056
Contact pins	For Ø 1.5 ... 2.5 mm²; Contents: 100 x	1 928 498 057
Single-wire seal	For Ø 0.5 ... 1.0 mm²; Contents: 10 x	1 928 300 599
Single-wire seal	For Ø 1.5 ... 2.5 mm²; Contents: 10 x	1 928 300 600

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

NTC temperature sensors: -40°C to 130°C
Measurement of liquid temperatures

Part number 0 281 002 412

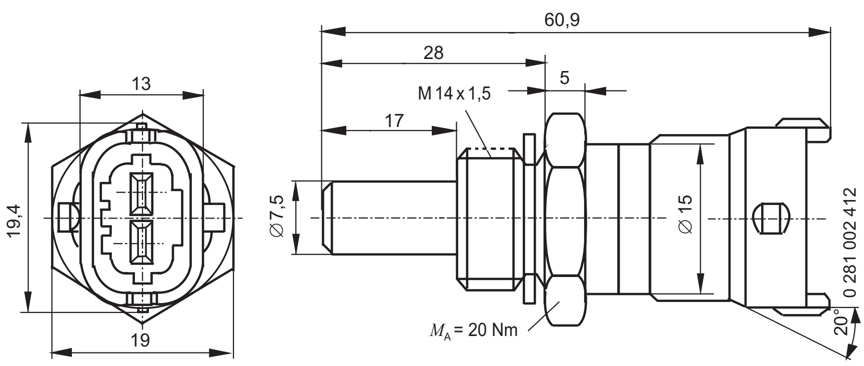
Technical data

Product text	Sensor in brass housing.	
Application/medium		Oil/water
Tolerance at +100 °C	K	0,1886 ± 2%
Rated resistance at 100 °C	kΩ	2,5 ± 6 %
Resistance at -10 °C	kΩ	8,640 ... 10,149
Resistance at +20 °C	kΩ	2,351 ... 2,648
Resistance at +80 °C	kΩ	0,313 ... 0,332
Temperature/time constant τ_{63} [1])	s	≤ 15
Degree of protection [1])		IP 5K 9K
Thread		M 14 x 1,5
Corrosion-tested as per		DIN 50 021
Connector		Compact 1.1, tinned pins
Tightening torque	Nm	20
Rated voltage	V	5 ± 0,15

[1]) With single-wire seal.

Figure

Dimensional drawing



Accessories

Accessories		Part number
Compact connector 1.1a	2-pin	1 928 403 874
Contact pins	For Ø 0.5 ... 1.0 mm²; Contents: 100 x	1 928 498 056
Contact pins	For Ø 1.5 ... 2.5 mm²; Contents: 100 x	1 928 498 057
Single-wire seal	For Ø 0.5 ... 1.0 mm²; Contents: 10 x	1 928 300 599
Single-wire seal	For Ø 1.5 ... 2.5 mm²; Contents: 10 x	1 928 300 600

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

NTC temperature sensors: -40°C to 130°C
Measurement of liquid temperatures

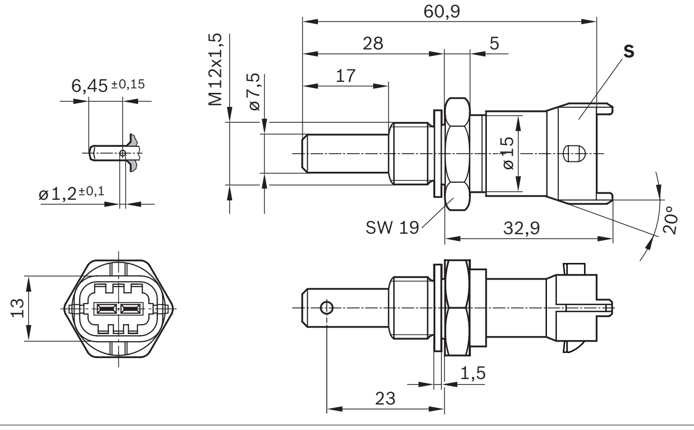
Part number 0 281 002 704

Technical data

Application/medium		Coolants, fuel, oil
Rated resistance at 100 °C	kΩ	0,1886 ± 2 %
Resistance at -10 °C	kΩ	8,640 ... 9,395
Resistance at +20 °C	kΩ	2,351 ... 2,648
Resistance at +80 °C	kΩ	0,313 ... 0,332
Temperature/time constant τ_{63} [1])	s	≈ 15 s
Degree of protection [1])		IP 5K 9K
Thread		M12 x 1,5
Corrosion-tested as per		DIN EN 60068-2-11
Connector		Compact 1.1, pins gold-plated
Tightening torque	Nm	20
Rated voltage	V	5 ± 1,5

Figure

Dimensional drawing



NTC temperature sensors: -40°C to 130°C
Measurement of liquid temperatures

Part number 0 280 130 026

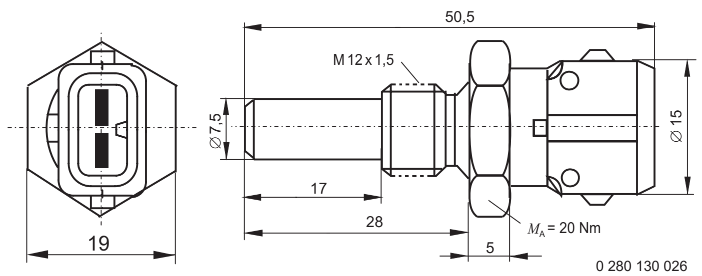
Technical data

Product text		Sensor in brass housing.
Application/medium		Oil/water
Rated resistance at 100 °C	kΩ	2,5 ± 5 %
Resistance at -10 °C	kΩ	8,325 ... 10,572
Resistance at +20 °C	kΩ	2,280 ... 2,736
Resistance at +80 °C	kΩ	0,288 ... 0,359
Temperature/time constant τ_{63} [1])	s	≤ 15
Degree of protection [1])		IP 5K9K
Thread		M 12 x 1,5
Corrosion-tested as per		DIN 50 021
Connector		Jetronic, tinned pins
Tightening torque	Nm	20
Rated voltage	V	5 ± 0,15

[1]) With individual seal.

Figure

Dimensional drawing



Accessories

Accessories			Part number
Jetronic connector	2-pin		1 928 402 078
Protective cap	Temperature-resistant; Contents: 1 x		1 280 703 031
Contact pins	For Ø 0.5...1.0 mm²	Tyco number	929 939-3[1])
Contact pins	For Ø 1.5...2.5 mm²	Tyco number	929 937-3[1])
Single-wire seal	For Ø 0.5...1.0 mm²; Contents: 50 x		1 928 498 106
Single-wire seal	For Ø 1.5...2.5 mm²; Contents: 20 x		1 987 280 107

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

[1]) Available from Tyco Electronics.

Hot-film air mass meter, type HFM 5
Measurement of air-mass flow up to 1200 kg/h

- Compact design.
- Low weight
- Fast response time
- Low power input.
- Return flow detection

Principle of operation

In the air mass meter, the amount of heat extracted from a heated sensor element by heat transfer from the heating element to the air flow increases with an increasing air mass. The resulting difference in temperature is a measure of the air mass flow. An electronic hybrid circuit evaluates the measurement data and thus permits precise recording of the air volume, including the direction of flow.
The sensor element only detects part of the air mass flow. The total air mass flowing through the measurement tube is determined by calibration (characteristic curve definition).

Design

The micromechanical sensor element is located in the flow duct of the plug-in sensor. The plug-in sensor is suitable for installation in air filters or, together with a measurement tube, in the air duct. Measurement tubes of various sizes are available to suit the required air throughput.
A micromechanical measurement system with a hybrid circuit permits evaluation of the measurement data to also detect backflow in a pulsating air-mass flow.

Application

To comply with the legally specified emission limits for motor vehicles, a specific air-fuel ratio must be precisely maintained. This requires the use of sensors which accurately record the actual air-mass flow and output this in the form of an electrical signal to the control electronics. The sensor is used to measure the air-mass flow in internal-combustion engines for precise adaption of the injected fuel quantity to the current power requirement, atmospheric pressure and air temperatures.

Explanatory notes on characteristic quantities

$\dot{m}_N$	Air mass throughput
$\Delta\dot{m}$	Absolute accuracy
$\Delta\dot{m}/\dot{m}$	Relative accuracy
$\tau\Delta$	Time until measurement error <5%
τ_{63}	Time until change in measured value 63%

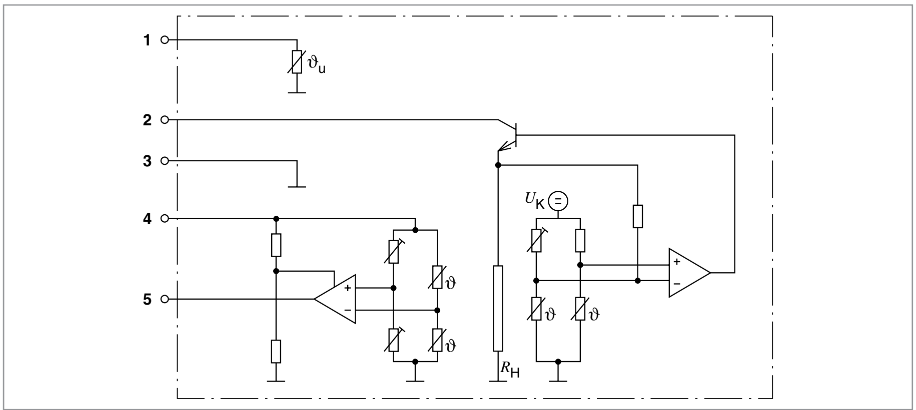
Hot-film air mass meter, type HFM 5
Measurement of air-mass flow up to 1200 kg/h

Technical data

Rated supply voltage	U_N	14V
Supply-voltage range	U_V	8 ... 17 V
Accuracy	$\Delta \dot{m}/\dot{m}$	≤ 3 %
Pressure drop at $\dot{m}_N$ [1])	Δp	< 15 hPa
Output voltage	U_A	0 ... 5 V
Current input	I_V	< 0,1 A
Permissible vibration acceleration	a_v	≤ 150 m/s²
Time constant	τ_{63} [2])	≤ 15 ms
Time constant	$\tau\Delta$ [3])	≤ 30 ms
Temperature range[4])		-40 ...+ 120 °C

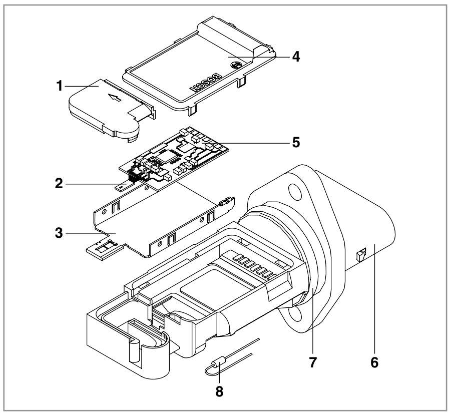
[1]) Measured between input and output.
[2]) Time required for step response of output voltage to 63% of final value given an abrupt change in air mass from 10 kg/h to 310 kg/h.
[3]) Delay on switch-on and after any change in flow rate until the output voltage has attained the relative measurement deviation $|\Delta \dot{m}/\dot{m}|$ ≤ 5 %.
[4]) Up to 130°C for brief periods (≤ 3 min.).

Block diagram with pin assignment



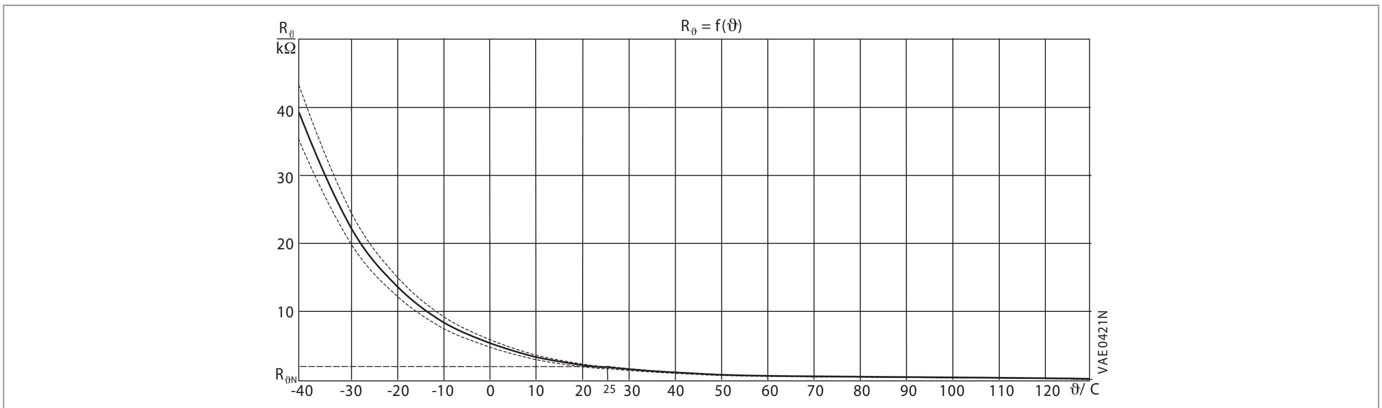
1 Additional temperature sensor ϑ_u (not for version 4, part no. 0 280 218 008)
2 Supply voltage U_V
3 Signal ground
4 Reference voltage
5 V 5 Measurement signal U_A.
ϑ Temperature-sensitivity of resistor
R_H Heating resistor
U_K Constant voltage

Design of HFM 5 plug-in sensor



1 Measurement-channel cover
2 Sensor
3 Mounting plate
4 Hybrid cover
5 Hybrid
6 Plug-in sensor
7 O-ring
8 Additional temperature sensor

Resistance profile of temperature sensor



Hot-film air mass meter, type HFM 5
Measurement of air-mass flow up to 1200 kg/h

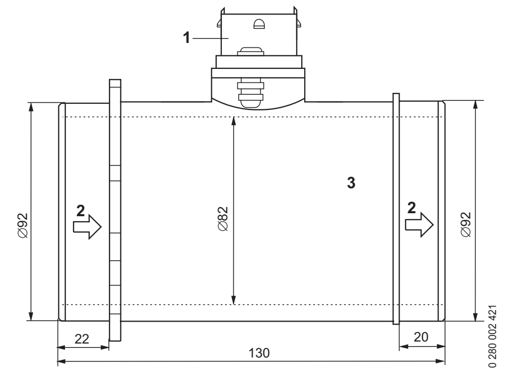
Part number 0 281 002 421

Technical data

Product text	With ambient-temperature sensor.	
Measuring range	$\dot{m}_N$	-50 ... 1200 kg/h

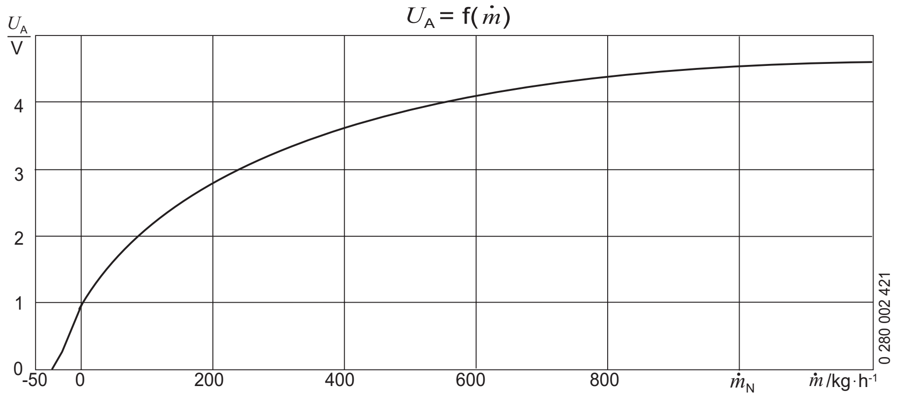
Figure

Dimensional drawing



1 Plug-in sensor
2 Flow direction
3 Measurement tube

Air-mass characteristic curve at ambient temperature



Accessories

Accessories		Part number
Compact connector	5-pin	1 928 403 836
Contact pins	For Ø 0.5...1.0 mm²; Contents: 100 x	1 928 498 056
Contact pins	For Ø 1.5...2.5 mm²; Contents: 100 x	1 928 498 057
Single-wire seals	For Ø 0.5...1.0 mm²; Contents: 10 x	1 928 300 599
Single-wire seals	For Ø 0.5...1.0 mm²; Contents: 10 x	1 928 300 599

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

Hot-film air mass meter, type HFM 5
Measurement of air-mass flow up to 1200 kg/h

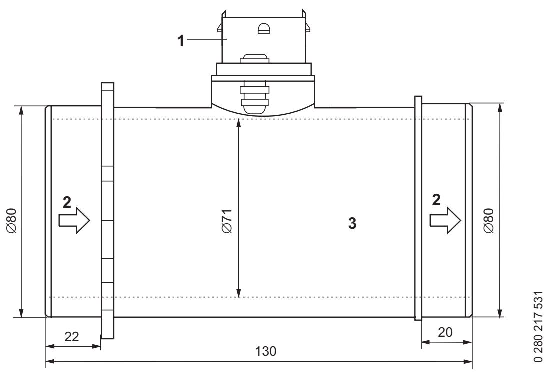
Part number 0 280 218 087

Technical data

Product text	With ambient-temperature sensor.	
Measuring range	$\dot{m}_N$	-30 ... 850 kg/h

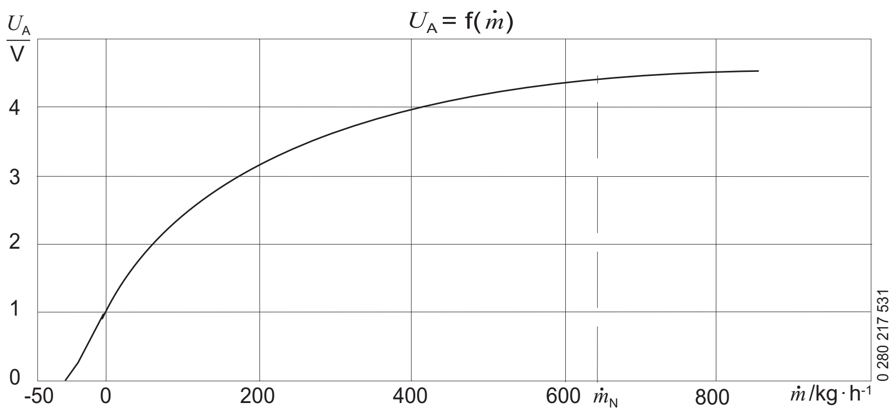
Figure

Dimensional drawing



1 Plug-in sensor
2 Flow direction
3 Measurement tube

Air-mass characteristic curve at ambient temperature



Accessories		Part number
Compact connector	5-pin	1 928 403 836
Contact pins	For Ø 0.5...1.0 mm²; Contents: 100 x	1 928 498 056
Contact pins	For Ø 1.5...2.5 mm²; Contents: 100 x	1 928 498 057
Single-wire seals	For Ø 0.5...1.0 mm²; Contents: 10 x	1 928 300 599
Single-wire seals	For Ø 0.5...1.0 mm²; Contents: 10 x	1 928 300 599

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

Hot-film air mass meter, type HFM 5
Measurement of air-mass flow up to 1200 kg/h

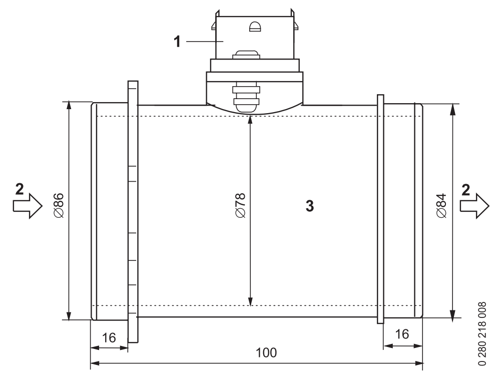
Part number 0 280 218 089

Technical data

Product text	Without ambient-temperature sensor.	
Measuring range	$\dot{m}_N$	-50 ... 1100 kg/h

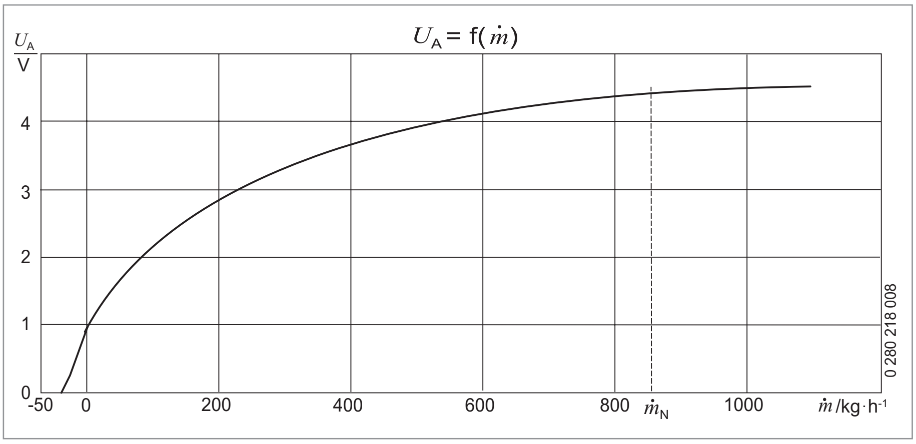
Figure

Dimensional drawing



1 Plug-in sensor
2 Flow direction
3 Measurement tube

Air-mass characteristic curve at ambient temperature



Accessories		Part number
Compact connector	5-pin	1 928 403 836
Contact pins	For Ø 0.5...1.0 mm²; Contents: 100 x	1 928 498 056
Contact pins	For Ø 1.5...2.5 mm²; Contents: 100 x	1 928 498 057
Single-wire seals	For Ø 0.5...1.0 mm²; Contents: 10 x	1 928 300 599
Single-wire seals	For Ø 0.5...1.0 mm²; Contents: 10 x	1 928 300 599

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

Hot-film air mass meter, type HFM 5
Measurement of air-mass flow up to 1200 kg/h

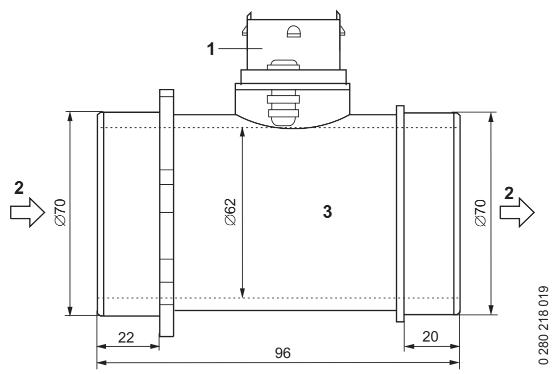
Part number **0 280 218 113**

Technical data

Measuring range	$\dot{m}_N$	10 ... 480 kg/h

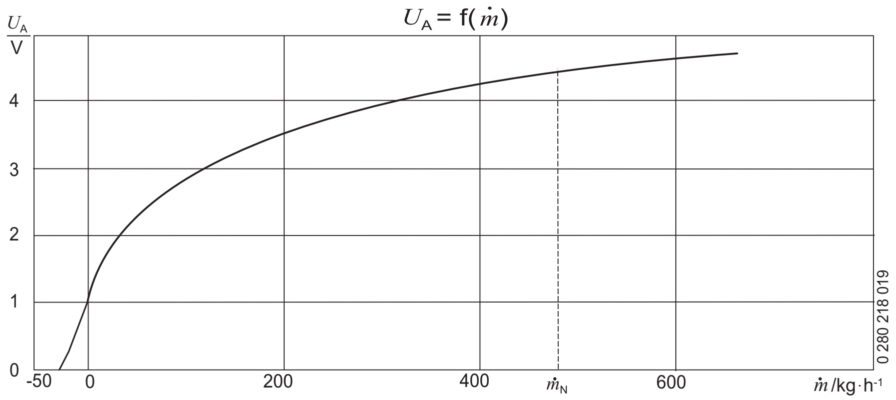
Figure

Dimensional drawing



1 Plug-in sensor
2 Flow direction
3 Measurement tube

Air-mass characteristic curve at ambient temperature



Accessories		Part number
Compact connector	5-pin	1 928 403 836
Contact pins	For Ø 0.5...1.0 mm²; Contents: 100 x	1 928 498 056
Contact pins	For Ø 1.5...2.5 mm²; Contents: 100 x	1 928 498 057
Single-wire seals	For Ø 0.5...1.0 mm²; Contents: 10 x	1 928 300 599
Single-wire seals	For Ø 0.5...1.0 mm²; Contents: 10 x	1 928 300 599

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

Hot-film air mass meter, type HFM 5
Measurement of air-mass flow up to 1200 kg/h

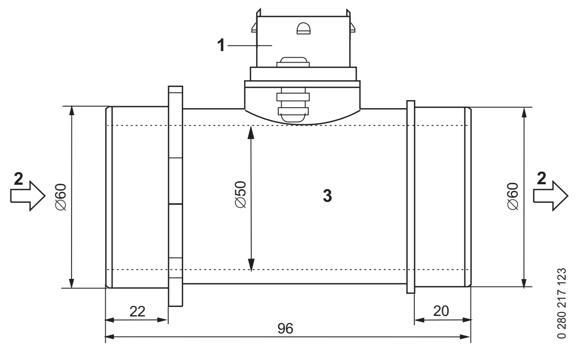
Part number 0 280 218 119

Technical data

Product text	With ambient-temperature sensor.	
Measuring range	$\dot{m}_N$	-15 ... 480 kg/h

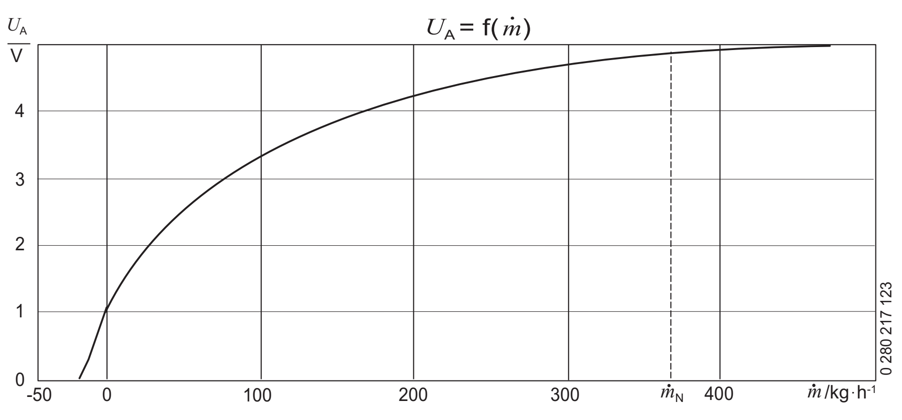
Figure

Dimensional drawing



1 Plug-in sensor
2 Flow direction
3 Measurement tube

Air-mass characteristic curve at ambient temperature



Accessories

Accessories		Part number
Compact connector	5-pin	1 928 403 836
Contact pins	For Ø 0.5...1.0 mm²; Contents: 100 x	1 928 498 056
Contact pins	For Ø 1.5...2.5 mm²; Contents: 100 x	1 928 498 057
Single-wire seals	For Ø 0.5...1.0 mm²; Contents: 10 x	1 928 300 599
Single-wire seals	For Ø 0.5...1.0 mm²; Contents: 10 x	1 928 300 599

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

Notes

Hot-film air mass meter, type HFM 6

Measurement of air mass flow rate up to 1150 kg/h

Design

Air mass meters consist of a measurement tube into which the plug-in sensor with the sensor element is inserted. The dimensions of the measurement tube vary depending on the measuring range requirements. There are measurement tubes of different sizes and design to suit the required air throughput. In principle, it is also possible to integrate the plug-in sensor directly into the intake tract, for example in the air cleaner housing or intake connection.
The sensor element is located in the air flow (measurement duct) of the plug-in sensor and forms part of a Wheatstone bridge. The configuration is such that the inevitable contamination does not affect the flow of air around the sensor. This obviates the need for a self-cleaning process as always used to be necessary prior to starting with earlier hot-wire air mass meters.

Application

To comply with the applicable legislation, the pollutant levels in the exhaust gas from internal combustion engines must be minimized and the combustion process optimized. This involves mixing the air and fuel in a precisely defined ratio. It is therefore necessary to exactly record the air mass flow and transmit this in the form of an electrical signal to the control electronics. Other applications are in measurement, testing and control units for combustion systems of all kinds and in special gas engines. With appropriate calibration, air mass meters are also suitable for recording the mass flow rate of almost all non-aggressive gases.

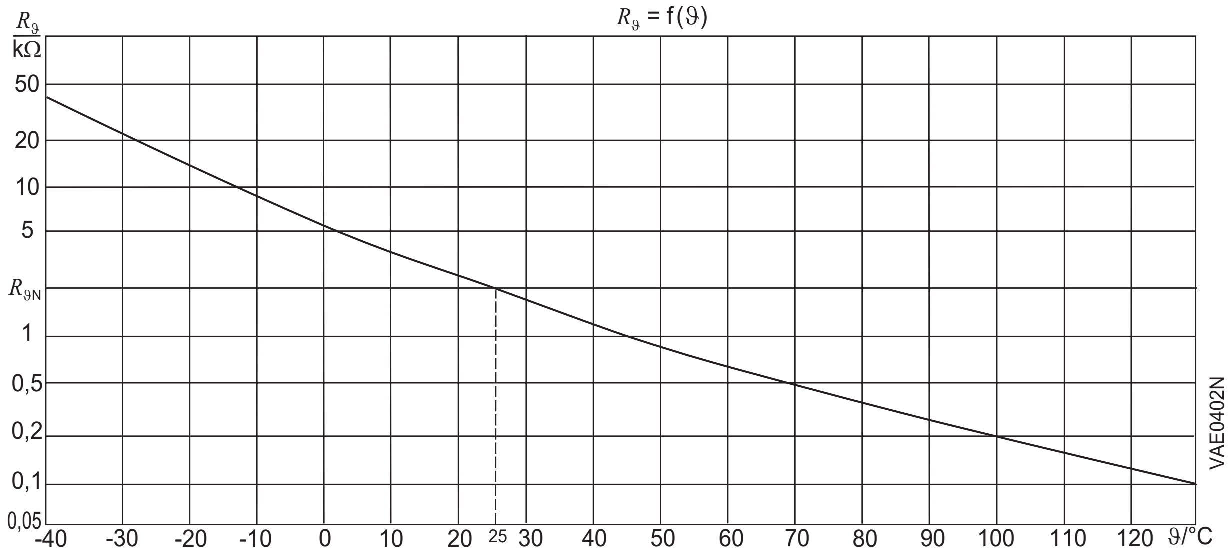
Hot-film air mass meter, type HFM 6
Measurement of air mass flow rate up to 1150 kg/h

Technical data

Rated supply voltage	U_N	14V
Supply-voltage range	U_V	7,5 ... 17 V
Relative accuracy[1])	$\Delta \dot{m}/\dot{m}$	± 2 %
Temperature range[2])		-40 ... 120 °C
Pressure drop at $\dot{m}_N$	Δp	< 18 hPa
Current input	I_V	< 0,06 A
Vibration acceleration	a_v	≤ 180 m/s²
Time constant	τ_{63} [3])	≤ 10 ms
Time constant	$\tau\Delta$ [4])	≤ 30 ms

[1]) For 0.04 ≤ $\dot{m}/\dot{m}_N$ ≤ 1.3
[2]) Up to 130 °C for brief periods (≤ 3 min.).
[3]) Time required for step response of output voltage to 63% of final value given an abrupt change in air mass from 10 kg/h to 310 kg/h.
[4]) Delay on switch-on and after any change in flow rate until the output voltage has attained the relative measurement deviation $|\Delta \dot{m}/\dot{m}|$ ≤ 5 %.

Resistance of temperature sensor



Hot-film air mass meter, type HFM 6

Measurement of air mass flow rate up to 1150 kg/h

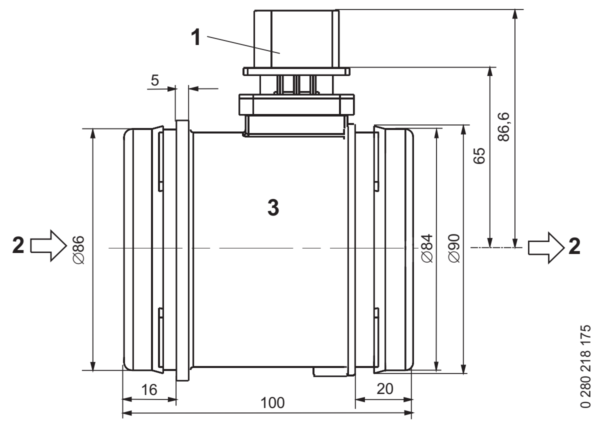
Part number 0 280 218 176

Technical data

Measuring range	$\dot{m}_N$	-40 ... 620 kg/h

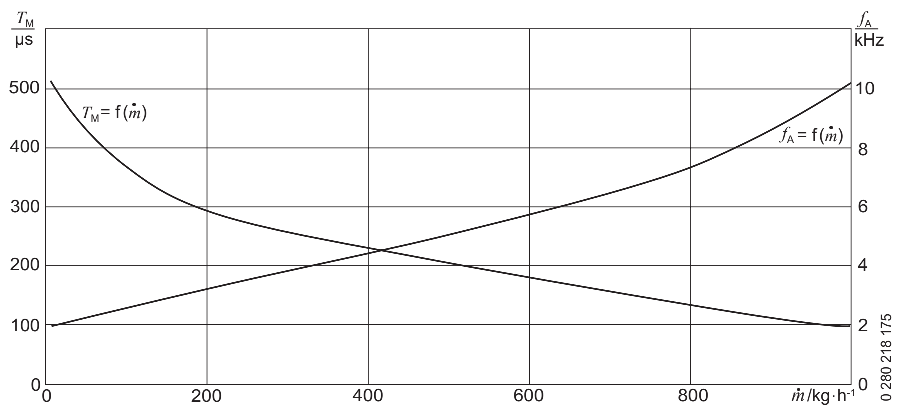
Figure

Dimensional drawing



1 Plug-in sensor
2 Flow direction
3 Measurement tube

Air mass characteristic curve at ambient temperature



Accessories		Part number
Compact connector	4-pin	1 928 403 736
Compact connector	5-pin	1 928 403 836
Contact pins	For Ø 0.5...1.0 mm²; Contents: 100 x	1 928 498 056
Contact pins	For Ø 1.5...2.5 mm²; Contents: 100 x	1 928 498 057
Single-wire seals	For Ø 0.5...1.0 mm²; Contents: 10 x	1 928 300 599
Single-wire seals	For Ø 1.5...2.5 mm²; Contents: 10 x	1 928 300 600

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

Hot-film air mass meter, type HFM 6

Measurement of air mass flow rate up to 1150 kg/h

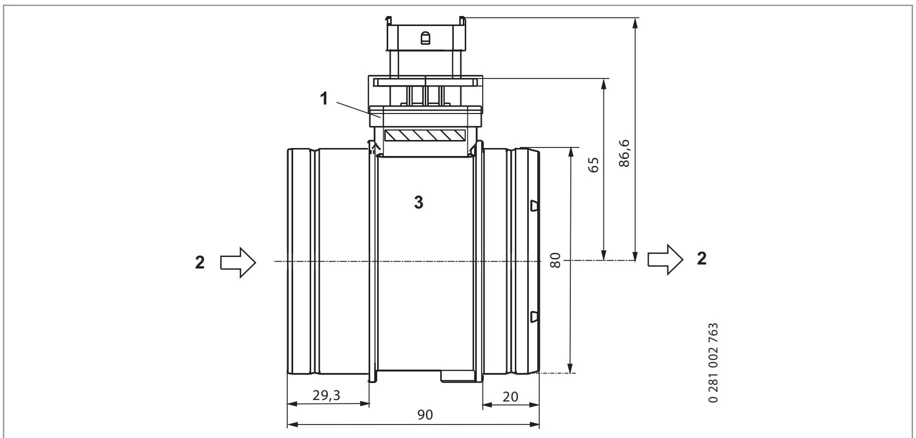
Part number 0 281 002 764

Technical data

Measuring range	$\dot{m}_N$	-60 ... 800 kg/h

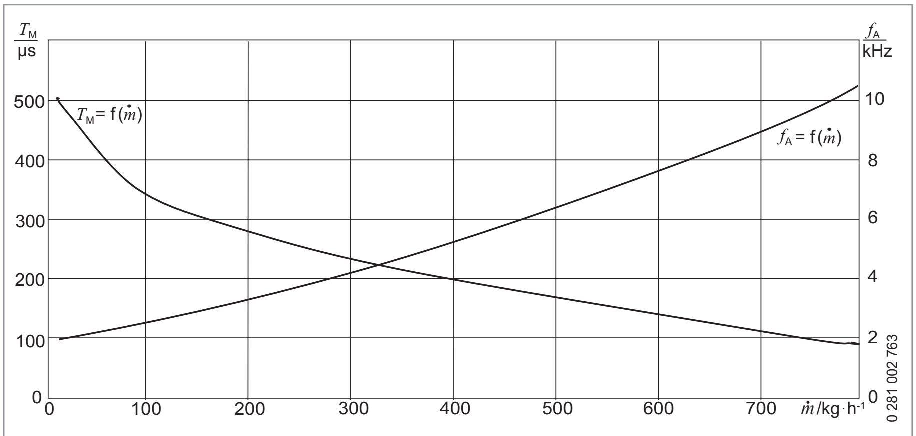
Figure

Dimensional drawing



1 Plug-in sensor
2 Direction of flow
3 Measurement tube

Air mass characteristic curve at ambient temperature



Accessories		Part number
Compact connector	4-pin	1 928 403 736
Compact connector	5-pin	1 928 403 836
Contact pins	For Ø 0.5...1.0 mm²; Contents: 100 x	1 928 498 056
Contact pins	For Ø 1.5...2.5 mm²; Contents: 100 x	1 928 498 057
Single-wire seals	For Ø 0.5...1.0 mm²; Contents: 10 x	1 928 300 599
Single-wire seals	For Ø 1.5...2.5 mm²; Contents: 10 x	1 928 300 600

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

Hot-film air mass meter, type HFM 6

Measurement of air mass flow rate up to 1150 kg/h

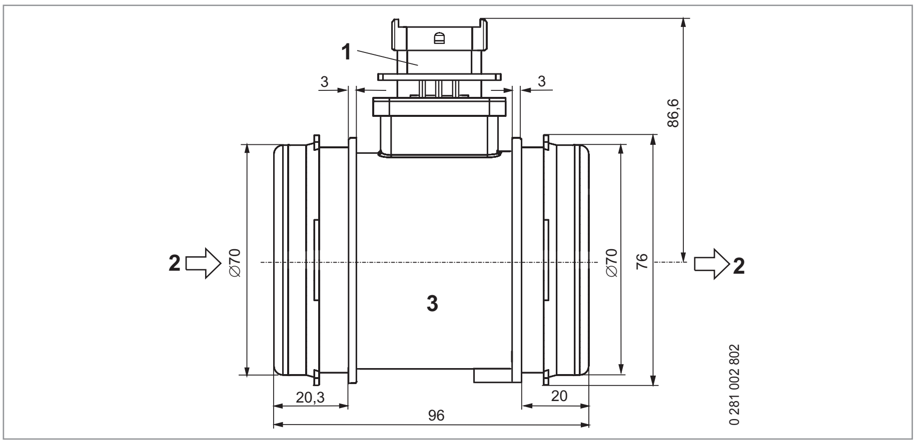
Part number 0 281 002 802

Technical data

Measuring range	$\dot{m}_N$	-40 ... 620 kg/h

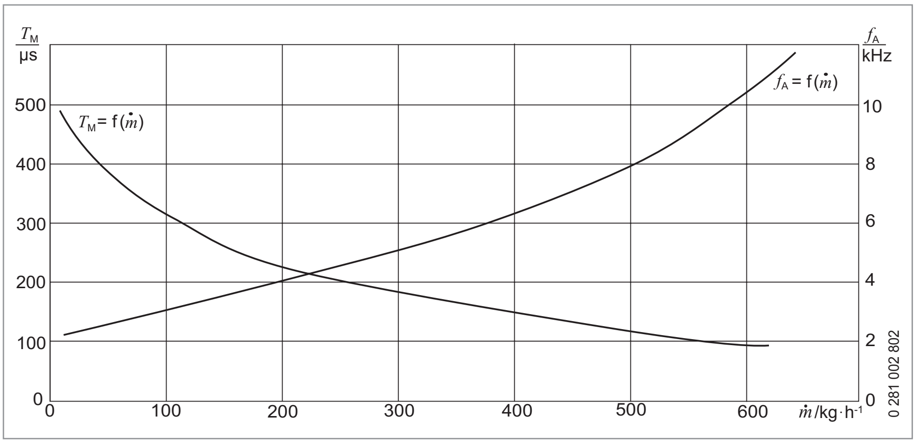
Figure

Dimensional drawing



1 Plug-in sensor
2 Flow direction
3 Measurement tube

Air mass characteristic curve at ambient temperature



Accessories

Accessories		Part number
Compact connector	4-pin	1 928 403 736
Compact connector	5-pin	1 928 403 836
Contact pins	For Ø 0.5...1.0 mm²; Contents: 100 x	1 928 498 056
Contact pins	For Ø 1.5...2.5 mm²; Contents: 100 x	1 928 498 057
Single-wire seals	For Ø 0.5...1.0 mm²; Contents: 10 x	1 928 300 599
Single-wire seals	For Ø 1.5...2.5 mm²; Contents: 10 x	1 928 300 600

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.

Notes

Hot-film air mass meter, type HFM 7

Design

Air mass meters consist of a measurement tube into which the plug-in sensor with the sensor element is inserted. The dimensions of the measurement tube vary depending on the measuring range requirements. There are measurement tubes of different sizes and design to suit the required air throughput. It is basically also possible to integrate the plug-in sensor directly in the intake tract, for example in the air filter housing or intake connection.?The sensor element is located in the air flow (measurement duct) of the plug-in sensor and forms part of a Wheatstone bridge. The configuration is such that the inevitable contamination does not affect the flow of air around the sensor. This obviates the need for a self-cleaning process as always used to be necessary with earlier hot-wire air mass meters prior to starting.

Application

To comply with the pertinent legislation, the pollutant levels in the exhaust gas of internal combustion engines must be minimized and the combustion process optimized. This involves mixing the air and fuel in a precisely defined ratio. It is therefore necessary to exactly record the air mass flow and transmit this in the form of an electrical signal to the control electronics.?Other applications include measuring instruments, testers and control units for all types of combustion system as well as in special gas engines. Given appropriate calibration, an air mass meter is also suitable for recording the mass flow of almost all non-corrosive gases.

Hot-film air mass meter, type HFM 7

Part number 0 281 006 054

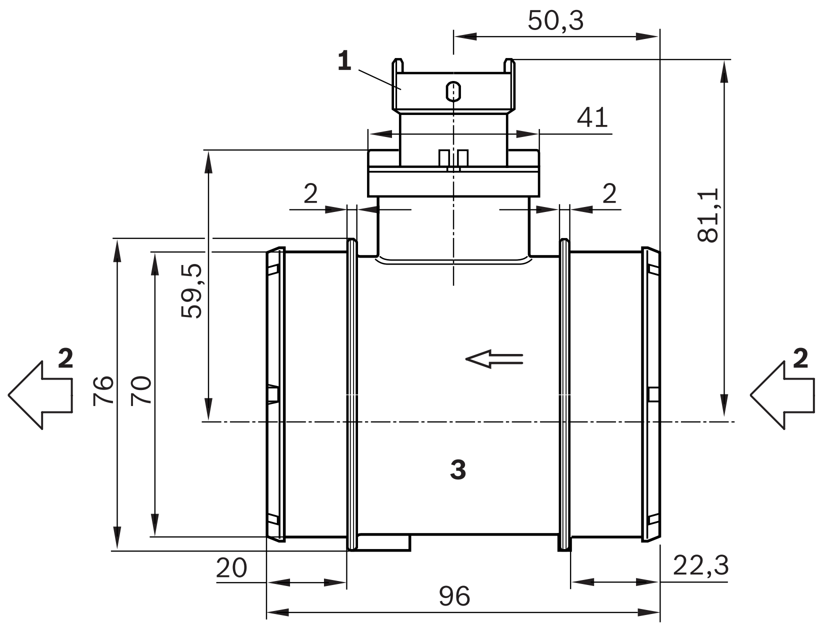
Technical data

Measuring range	$\dot{m}_N$	250 ... 1050 kg/h
Rated supply voltage	U_N	14V
Supply-voltage range	U_V	6 ... 17 V
Relative accuracy[1])	$\Delta\dot{m}/\dot{m}$	± 5 %
Temperature range[2])		-40 ... 130 °C
Pressure drop at $\dot{m}_N$	Δp	< 12 hPa
Current input	I_V	< 6 A
Time constant	τ_{63} [3])	≤ 10 ms
Time constant	$\tau\Delta$ [4])	≤ 30 ms

[1]) for 0,04 ≤ $\dot{m}/\dot{m}_N$ ≤ 1,3
[2]) short-time (≤ 3 min.) to 130 °C.
[3]) Time required for step response of output voltage to 63% of final value given an abrupt change in air mass from 10 kg/h to 310 kg/h.
[4]) Delay on switch-on and after any change in flow rate until the output voltage has attained the relative measurement deviation $|\Delta\dot{m}/\dot{m}|$ ≤ 5 %.

Figure

Dimensional drawings



1 Plug-in sensor
2 Flow direction
3 Measurement tube

Lambda sensor LSU 1
Measurement of oxygen content

- It is suitable for industrial applications such as waste gas measurements in gas and oil burners.
- Module CJ125: 1267379259 can be used for evaluation.
- The dual-cell wideband sensor is a new type of zirconium dioxide Lambda sensor which can be used for a broad Lambda range from λ > 0.7 to infinity (air).

Application

Combustion processes
– Oil burner
– Gas burner

Design and operation

The Lambda sensor consists of two cells. It is made up of a Nernst type potentiometric oxygen concentration cell and an amperometric oxygen pump cell. Nernst cells have the property that oxygen ions diffuse through their ceramic at high temperatures, as soon as there are differences in the partial oxygen pressure at both ends of the ceramic. The transport of ions results in an electrical voltage between them, which is measured using electrodes.
In an oxygen pump cell, the application of an electrical voltage to a zirconium dioxide ceramic "pumps" oxygen ions from the cathode to the anode. If the continued flow of oxygen molecules out of the exhaust gas to the cathode is prevented by a diffusion barrier, the so-called limit current condition means that a current saturation is reached above a pump voltage threshold. The resulting limit current is proportional to the oxygen concentration in the exhaust gas.
In the oxygen sensor, the pump and Nernst cells are arranged in such a way that a diffusion gap of only around 10 – 50 μm exists between them. The gap is connected with the exhaust gas by a gas inlet hole and it acts as a diffusion barrier. This narrow diffusion duct also contains the porous platinum electrodes, one of the pump cells and one of the Nernst cells on the opposite side. The other electrode for the Nernst cell is located in a reference air duct and is exposed to the surrounding atmosphere by an aperture. Under normal conditions, the air here has an oxygen content of 20.9 percent by volume.

The components of the exhaust gas diffuse through the diffusion duct to the electrodes for the pump and Nernst cell, where they are brought to thermodynamic equilibrium. Control electronics record the Nernst voltage U_N in the concentration cell and supply the pump cell with a variable pump voltage U_P. If U_N takes on a value of less than 450 mV, the exhaust gas is lean and the pump cell is supplied with a current that causes oxygen to be pumped out of the duct. By contrast, if the exhaust gas is rich, U_N> 450 mV and the flow direction is reversed, causing the cell to pump oxygen into the duct.
An integrated module (CJ125) can be used for signal evaluation. As well as the controller for the pump flow and the controller that keeps the Nernst cell at 450 mV, this module includes an amplifier.
The sensor element is manufactured using thick-film techniques, which results in production distribution. This means that the characteristic curves for different sensors will vary. At an oxygen concentration of 0%, the output voltage is a uniform 0 V, as when using the evaluation circuit. However, at air the voltage scatters between approx. 6 and 8 V. This means that each sensor has to be individually calibrated so that a clear relationship between the measured oxygen concentration and the output voltage can be created. Calibration can be carried out on air in which the oxygen content is 20.9%. Calibration is recommended at each maintenance.

Explanation of characteristic quantities

λ Air ratio
U_N Nernst voltage
U_P Variable pump voltage

Special accessory

Connectors (mating connectors) are available under order number: 3623 05 K31V167 from

Karl Lumberg GmbH & Co
Postfach 13 60
D-58569 Schalksmühle
Tel.: 02355/83-01
Fax: 02355/83-263

Installation instructions

We recommend that the sensor element is installed in the flue gas tube suspended, i.e. vertically downward with the connections pointing upwards. A further option is to select an angular installation position of at least 10 from the horizontal (connector outlet upwards). This prevents liquid from accumulating between the sensor housing and the sensor element.
The sensor element should be used in condensation protection mode (standby mode). It is heated to prevent condensation of the moist exhaust gas on the sensor surface. The sensor temperature must be > 75C so that it lies above the dew point temperature.
The sensor is resistant to aggressive exhaust gases such as carbon monoxide, carbon dioxide, nitrogen oxide and low tem-

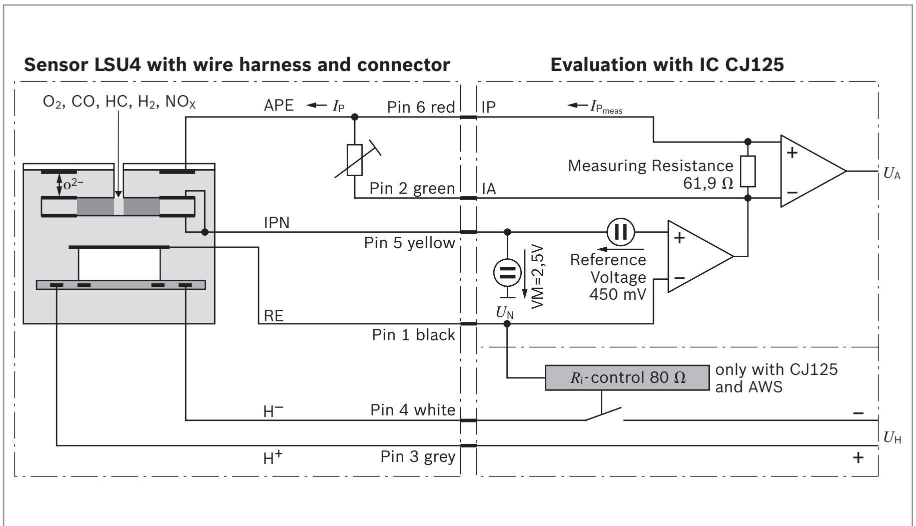
Lambda sensor LSU 1
Measurement of oxygen content

perature carbonization gas throughout its entire service life. However, if the sensor is exposed to lead, phosphorous, silicon, halogens or very high sulfur concentrations, this can reduce its service life.

Warranty claims

As set out in the general terms of delivery A 17, warranty claims can only be accepted if residue-free gaseous hydrocarbons and light fuel oil in accordance with DIN 51603 are used as permissible fuels.

Block diagram



Lambda sensor LSU 1
Measurement of oxygen content

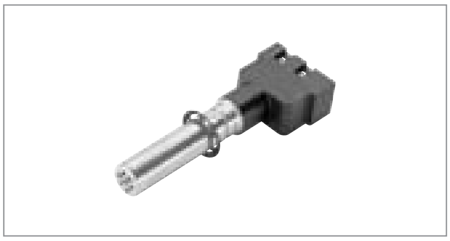
Part number 0 258 004 010

Technical data

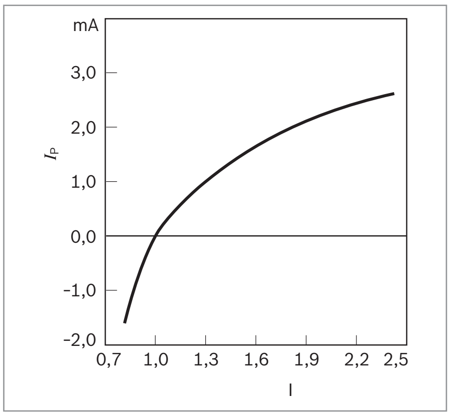
Measuring range in λ	0,7 ... ∞
Measuring range for oxygen concentration	0 ... 21 %
Rated heating-voltage value U_H (DC or AC voltage)	9,5 V ± 0,5 V
Max. heating power	≤ 15 W
Typical heat output in operation	11 W
Max. switch-on current at -40 °C	≤ 5 A
Heater resistance at room temperature	3 Ω ± 0,5 Ω
Protection of heating circuit with slow-blow fuse	4 A
Sensor storage temperature	- 40 °C ... + 80 °C
Permissible exhaust-gas temperature at sensor	≤ 250 °C
Permissible ambient temperature at sensor housing (connector side)	≤ 80 °C
Temperature of heated sensor element in exhaust-gas area	≤ 800 °C
Reaction time τ with abrupt change of λ by 0.2?	≤ 5 sec.
Permissible vibration capacity during operation	≤ 50 m/s²
Permissible short-term impact capacity	≤ 300 m/s²
Service life in operation	≥ 12.000 hours
Service life in standby mode	≥ 50.000 hours

Output signals with CJ125	
Output voltage at λ = 0.8 ... 1,2	U_A ≈ 0,5 ... 2 V
Output voltage at λ = 1; O_2 = 0.0 %	U_A = 1.5 V
Output voltage at λ → ∞; O_2 = 20,9 %	U_A ≈ 4.7 V

Figure

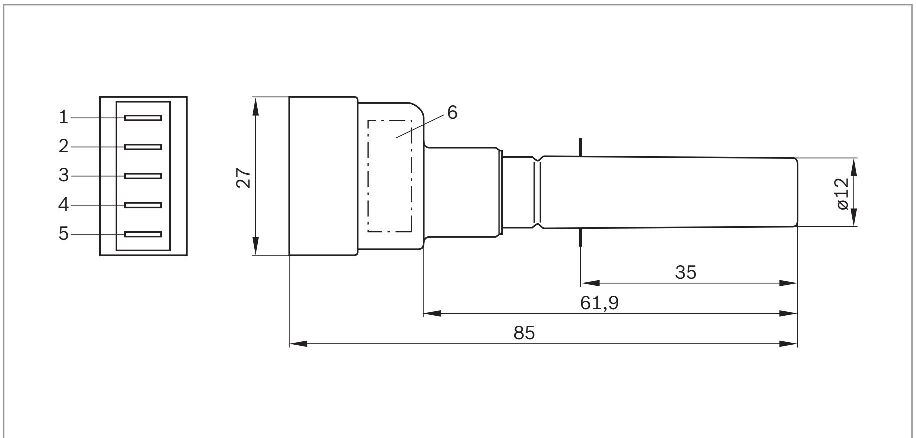


Characteristic curve



I_P* = Pump current
λ = Air ratio

Dimensional drawing



1 Pump outer electrode
2 Inner Pump-/Nernst electrode
3 Reference electrode
4 Sensor heater +
5 Sensor heater -

Notes

Lambda sensor LSU 4.9
Measurement of oxygen content

- The wideband Lambda sensor LSU is a planar ZrO_2 dual-cell limit current sensor with integrated heater.
- It is used for measuring the oxygen content and the λ value of exhaust gases in vehicle engines.
- Thanks to a steady characteristic curve in the range λ = 0.65 to air, it is universally applicable for λ = 1 and for other λ ranges.

Application

Engine management
– Gas engines
– Block-type thermal power stations
– Diesel engines
– Gasoline engines
– Lean combustion engines

Industrial processes
– Tempering furnaces
– Chemical industry
– Packaging equipment
– Process engineering
– Drying plants
– Metallurgy

Measurement and analysis processes
– Flue gas measurement
– Gas analysis
– Determination of Wobbe indexIncineration plants
– Wood
– Biomass

Design and operation

The LSU broadband Lambda sensor is a planar ZrO_2 two-cell limit current sensor with integral heater. It is suitable for measuring the oxygen content and the λ value of exhaust gases in vehicle engines (gasoline and diesel). A constant characteristic curve in the range from λ = 0.65 to air makes it suitable for universal use for λ =1 and for other λ ranges. The connector module includes a trimming resistor, which determines the characteristics of the sensor and is necessary for the sensor to function. To function, the LSU requires special operating electronics (e.g. AWS. LA4 or IC CJ125 evaluation circuit) and may only be operated in conjunction with these.

The Lambda sensor consists of two cells. It is made up of a Nernst type potentiometric oxygen concentration cell and an amperometric oxygen pump cell. Nernst cells have the property that oxygen ions diffuse through their ceramic at high temperatures, as soon as there are differences in the partial oxygen pressure at both ends of the ceramic. The transport of ions results in an electrical voltage between them, which is measured using electrodes.

The components of the exhaust gas diffuse through the diffusion duct to the electrodes for the pump and Nernst cell, where they are brought to thermodynamic equilibrium. Control electronics record the Nernst voltage U_N in the concentration cell and supply the pump cell with a variable pump voltage U_P. If U_N takes on a value of less than 450 mV, the exhaust gas is lean and the pump cell is supplied with a current that causes oxygen to be pumped out of the duct. By contrast, if the exhaust gas is rich, U_N> 450 mV and the flow direction is reversed, causing the cell to pump oxygen into the duct.

An integrated module (CJ125) can be used for signal evaluation. As well as the controller for the pump flow and the controller that keeps the Nernst cell at 450 mV, this module includes an amplifier.

The sensor element is manufactured using thick-film techniques, which results in production distribution. This means that the characteristic curves for different sensors will vary. At an oxygen concentration of 0%, the output voltage is a uniform 0 V, as when using the evaluation circuit. However, at air the voltage scatters between approx. 6 and 8 V. This means that each sensor has to be individually calibrated so that a clear relationship between the measured oxygen concentration and the output voltage can be created. Calibration can be carried out on air in which the oxygen content is 20.9%. Calibration is recommended at each maintenance.

Lambda sensor LSU 4.9
Measurement of oxygen content

Installation instructions

- Installation in exhaust gas pipes at a location exhibiting a representative exhaust gas composition given compliance with the specified temperature limits.
- The ceramic sensor element warms up rapidly after switching on the sensor heating. Once the ceramic element has warmed up, the occurrence of condensate, which could damage the hot ceramic sensor element, must be avoided.
- If possible, the installation position should be vertically upwards, however at least at an angle of 10 ° with respect to the horizontal. This prevents the accumulation of liquid between the sensor housing and sensor element. An angle of 90 ° is desirable, however no greater than 90 ° + 15 ° gas inlet hole with respect to the exhaust gas flow or 90 ° - 30 °. Other angular positions are to be assessed separately if applicable.
- Tightening torque: 40 - 60 Nm, the material properties and strength of the thread must be designed accordingly.

Explanation of characteristic quantities

λ Air ratio
U_N Nernst voltage
U_P Variable pump voltage

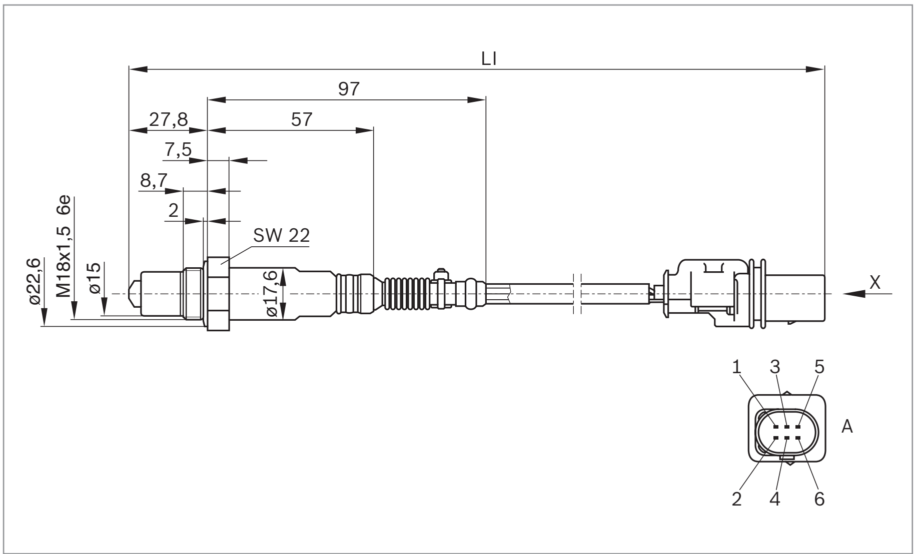
Lambda sensor LSU 4.9
Measurement of oxygen content

Technical data	
Sensor element	
Nominal internal resistance of Nernst cell $R_{i,N}$ As new (operating point, calibration value), (measurement with 1...4 kHz):	300 Ω
Max. current load of Nernst cell Continuous AC ?(f = 1...4 kHz) for $R_{i,N}$ measurement	≤ 250 µA
Recommended reference pump current (sustained)	= 20 µA
Max. pump current to pump cell for rich-gas signal (λ ≥ 0.65)	≥ - 9 mA
Max. pump current to pump cell for lean-gas signal (air)	≤ 6 mA
Heater supply	
Nominal voltage	7,5 V
Nominal heat output at 7.5 V Heating voltage in steady-state condition with air	approx. 7,5 W
Typical cold resistance of heater at room temperature, including cable and connector	3,2 Ω
Minimum cold resistance of heater at -40C	1,8 Ω
When switching on the heater, the heating power is to be limited as follows:	
Heater voltage in condensate phase $U_{H,eff}$	≤ 2 V
Maximum permissible effective heater voltage $U_{H,eff}$ for attainment of operating point briefly ≤ 30 s (200 h cumulated)	≤ 13 V
Maximum permissible effective heater voltage $U_{H,eff}$ for attainment of operating point steady-state	≤ 12 V
Maximum permissible vehicle electrical system voltage $U_{Batt,max}$	≤ 16,5 V
Minimum vehicle electrical system voltage	≥ 10,8 V
Operating temperatures	
Exhaust gas ($T_{Exhaustgas}$)	≤ 930 °C
Hexagon at sensor housing ($T_{Hexagon}$)	≤ 600 °C
Cable outlet (PTFE sheath) - sensor side (PTFE socket, $T_{Grommet}$)	≤ 250 °C
Cable outlet (PTFE sheath) - cable side (upper sleeve, $T_{Upperhose}$)	≤ 200 °C
Cable and protective sheathing	≤ 250 °C
Connector	≤ 120 °C
Maximum temperatures (max. 250 h cumulative over service life)	
Exhaust gas ($T_{Exhaustgas}$)	≤ 1030 °C
Hexagon at sensor housing ($T_{Hexagon}$)	≤ 680 °C
Maximum temperatures (max. 40 h cumulative over service life in intervals of max. 10 min)	
Cable outlet (PTFE sheath) - sensor side (PTFE socket, $T_{Grommet}$)	≤ 280 °C
Cable outlet (PTFE sheath) - cable side (upper sleeve, $T_{Upperhose}$)	≤ 230 °C
Cable and protective sheathing	≤ 280 °C
Exhaust gas back pressure	
Continuous operation	≤ 2,5 bar
Brief maximum pressure, max. 250 h accumulated over service life	≤ 4 bar
Note: If the operating temperatures or the permissible exhaust gas back pressure for continuous operation are exceeded, the sensor accuracy is impaired.	
Permissible oscillating load	
Stochastic oscillations (peak value)	≤ 1000 m/s²
Sinusoidal oscillations	≤ 300 m/s²
Readiness for operation	
Approximate value for sensor ON time („Light-off“)	≤ 10 s

Lambda sensor LSU 4.9
Measurement of oxygen content

Part number 0 258 017 025

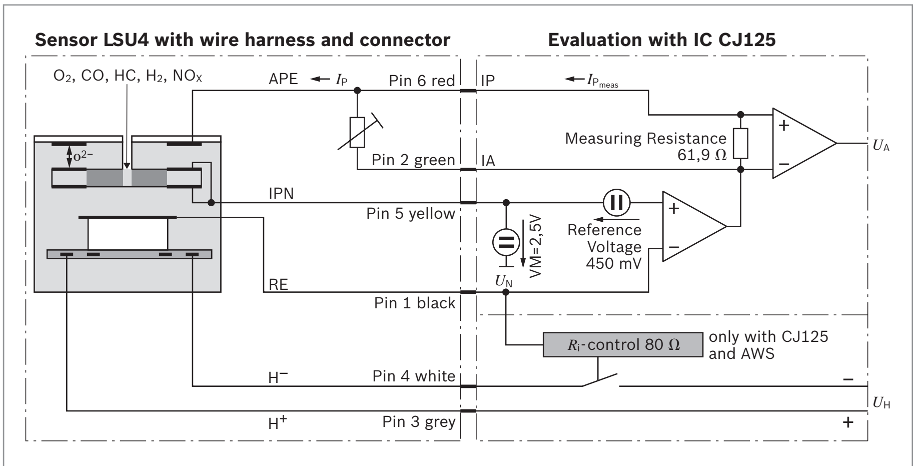
Dimensional drawing



1 Pumping electricity (red)
2 Virtual ground (yellow)
3 Heater clock - (white)
4 Heater clock + U Batt (grey)
5 Trimming potentiometers (green)
6 Nernst voltage (black)

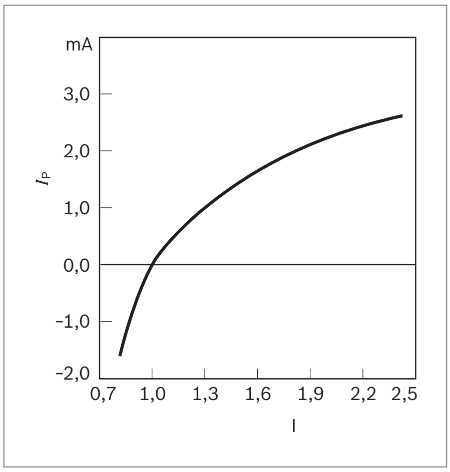
Figure

Block diagram



The evaluation module CJ 125 is required for operation of the LSU 4.9. Further details on request.

Characteristic curve



I_P = Pump current
λ = Air ratio

Accessories		Order number
Mating connector parts set	Connector housing, contacts, grommet	1 986 280 016

List of part numbers

Notes

de

"Online"-Katalog für Kraftfahrzeug-Ausrüstung

en

"Online" Catalogue for Automotive Parts

fr

Catalogue »online« de pièces détachées et de rechange

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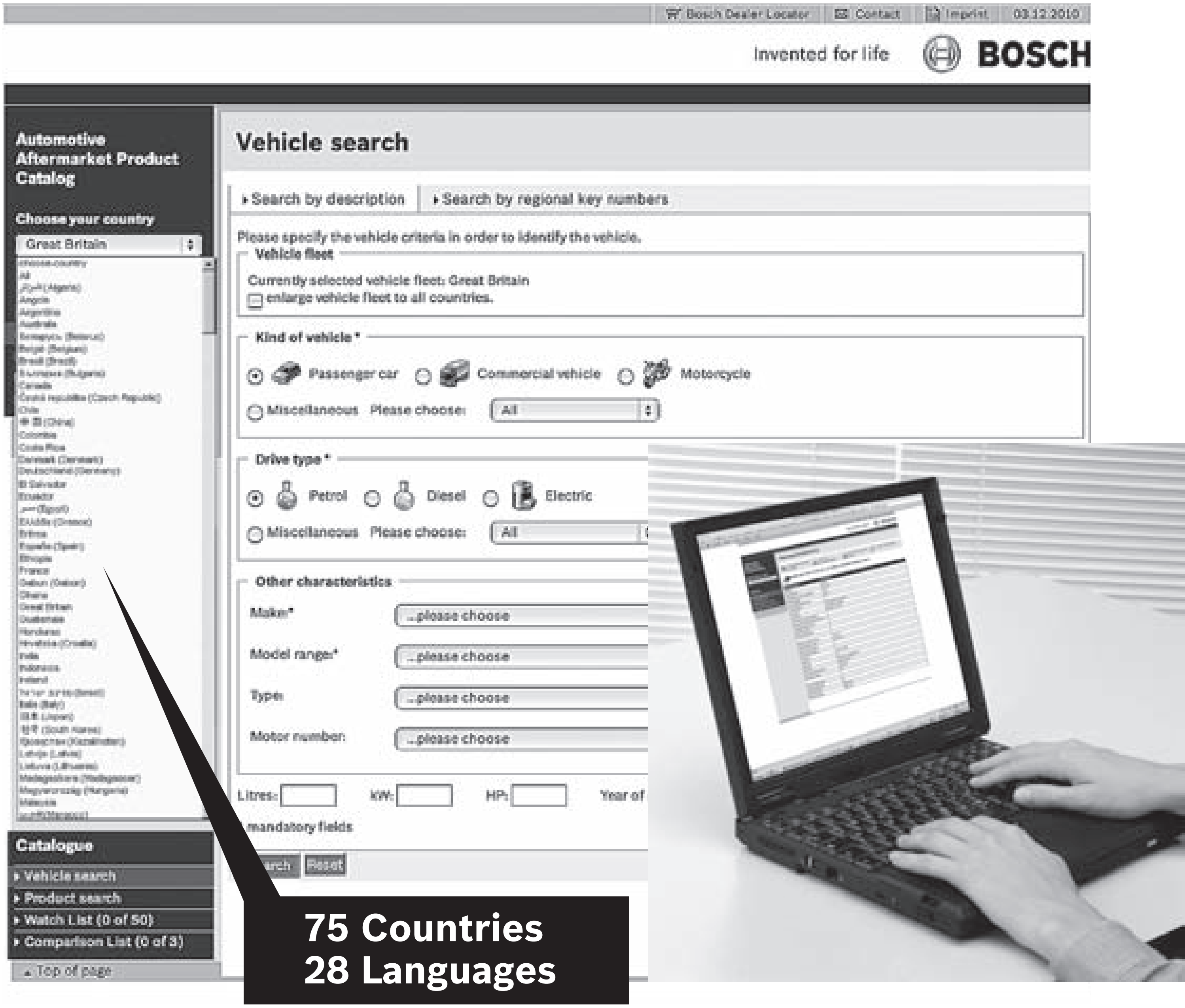
Catalogo »online« per ricambi di automobili

es

Catálogo »online« de los componentes del automóvil



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Please use this printed data sheet as a master copy and return the filled out copy.

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	Company: ____________
	Department: ____________
	Address: ____________
	Town/Zip: ____________
	Tel.: ____________
	Fax: ____________
	E-mail: ____________

Your reference/dated:	Our dept./person in charge:	Telephone (extension):	Date:

Project description:

Application / intended use:

New project:	Specification available: ☐ Yes ☐ No
Replacement for existing solution:	Drawing available: ☐ Yes ☐ No
Competitors used:	External sample available: ☐ Yes ☐ No

Required quantity:	☐ One-off _______units					Type part no.:
Required delivery date:						Forecast service life produced:
Specified quantity on following dates:						Customer price expectation:
Date:						Notes:
Quantity:						
☐ Annual _______units	☐ Monthly _______units					

Sensor requirements:

Measurement value:
Additional conditions:
Conditions of use:

Remarks: