Sensors

BOSCH

Air-mass, lambda, pressure, rotational-speed, structure-borne sound, temperature

Bosch-ibusiness.com

Content

(Press buttons for more information)

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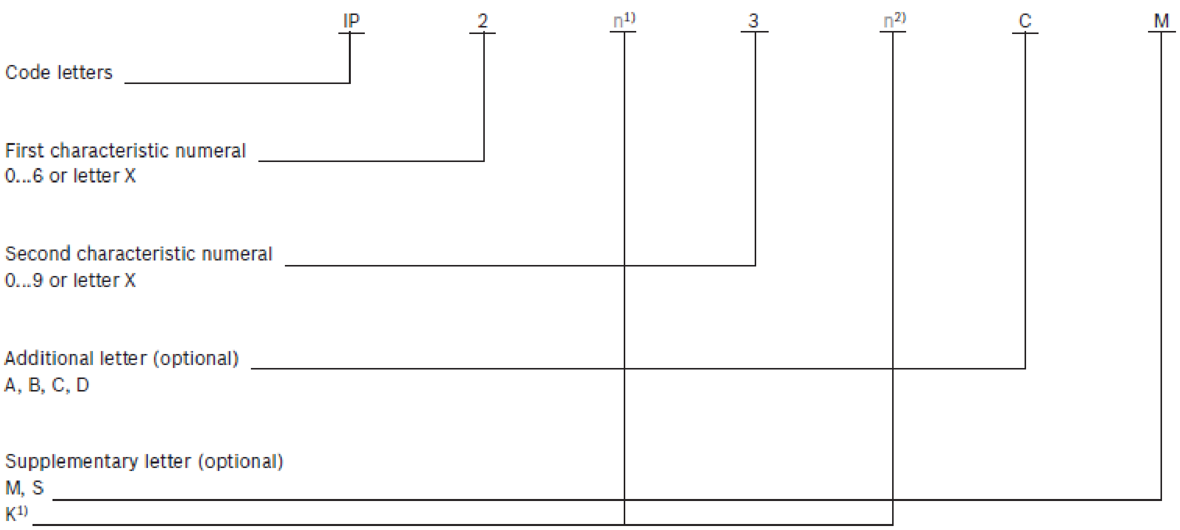
0 General Information
Sensor IP degrees

IP degrees of protection
Valid for the electrical equipment of road vehicles as per DIN 40 050 (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If a characteristic numeral is not given, it must be superseded by the letter “X” (i. e. “XX” if both characteristic numerals are not given).
The supplementary and/or additional letters can be omitted at will, and need not be superseded by other letters.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.

0 General Information
Sensor IP codes

1st characteristic numeral and sup-plementary 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			

▶ Product groups

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
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 con-dense 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 multi-master 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 trans-mission, 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 150 bits in the extended format. This ensures minimal 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.

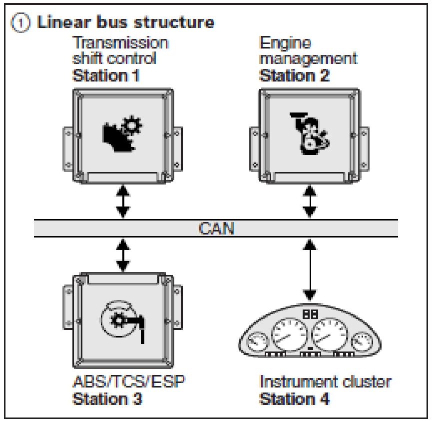
“CRC field”
(Cyclic Redundancy Check) contains the check word for detecting possible transmission interference.

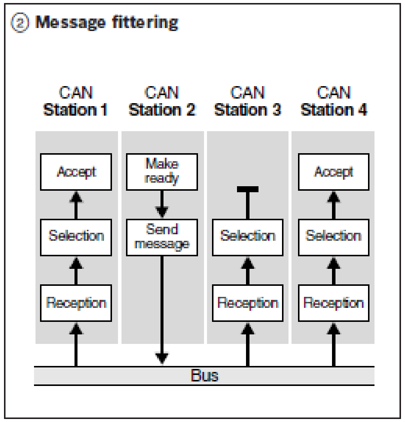
“Ack field”
contains the acknowledgement signals with which all receivers indicate receipt of non-corrupted messages.

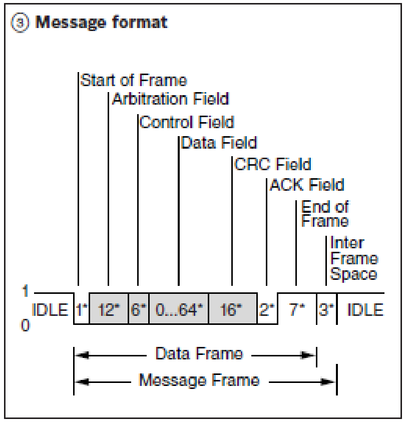
“End of frame”
marks the end of the message.

► Product groups

CAN-Bus - Controller Area Network







Transmitter initiative
The transmitter will usually initiate a data transfer by sending a data frame. However, the receiver can also request data from the trans-mitter. 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.
► 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 imple-mentations 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 de-mands placed on the ECU's pro-cessing 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 re-sources. 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.

► Product groups

0 General Information

CE-Identification and manufacturer declaration with EU directive

As under the EU Directive all electrically-powered machines, devices and systems, which are manufactured, imported and sold within the borders of the European Union must have a CE-label attached to them. The EU Directive also includes the following individual guidelines, which are of significance for sensor users.

1. Machine Directive
It is valid for self-contained operational machines or any interlinking of machines to form integral systems. It is not valid for machine components however, such as, for example, electrical control systems or sensors which have no independent function. The entire machine or system must always comply with the Directive.

2. EMC Directive
This Directive is valid for all electrical and electronic devices, installations and systems. However, this Directive is also valid for complex components such as, e.g. sensors, although this only applies were they are openly available for purchase by the public. The sensors listed in this catalogue are solely shipped as supplied parts or replacement parts, and are not subject to § 5 paragraph 5 of the EMC Act regarding a mandatory CE label. The limits for the relaying and the radiation of high-frequency interference are specified in EN 55014 of the EMC Act. Because of the previously-mentioned reasons, Bosch sensors are on no account subject to mandatory CE labeling. We will gladly assist you with information in all matters relating to the acceptance of your application.

0 General Information
Liability disclaimer

For applications listed in the catalogue, prior clarification of the technical suitability is imperative. All listed products are designed for automotive vehicles in its intended use. If you use these products within specification, but outside its intended use, you are responsible for establishing the suitability of our products for your intended purpose, if other than for its approved application (in particular, if subjected to different loads or under different technical conditions) by taking suitable action (especially testing). We would like to point out to you that the responsibility for the overall system also lies solely with you.

If your application cannot be solved with this range of products or in case you need our consultancy, please inform us about your requirements and contact us via e-mail address www.bosch-ibusiness.com/contact/

► Product groups

HFM with analog interface

- Nominal air-flow up to 1.050 kg/h
- Analog interface
- Compact design
- Low weight
- Fast response time
- Low power input
- Pulsation flow detection

Application

The air-mass sensor (HFM) is designed to measure the air mass and temperature of the intake air in motor vehicles with diesel and gasoline applications. The sensor measures the actual air mass flow rate for an optimized air-fuel mixture, supporting an efficient fuel combustion and powerful engine performance.

Design and operation

The standard HFM consists of a plug-in sensor and cylinder housing. The electronic module, with the evaluation circuit and the sensor element, is located in the plug-in sensor. The sensor element is positioned on the electronic module and extends into the metering duct (bypass channel) of the connector housing. The location of the temperature sensor (NTC) is on the backside of the connector housing.

The HFM is a thermal flowmeter. From the intake air flow within the cylinder housing, a portion of the total mass air flow will pass across the sensor element in the bypass channel. In the center exists a heating zone which is controlled to a certain temperature, depending on the temperature of the intake air. With-out air flow, the temperature from the heating zone to the edges decreases linearly, and the temperature sensors up- and downstream of the heating zone indicate the same value. With air flow, the sensor area upstream will be cooled by the heat transfer in the boundary layer.

The downstream temperature sensor will keep its temperature because the air is heated as it passes over the heating zone. The temperature sensors show a temperature difference which depends on amount and direction of the air flow. The difference between the signals of the temperature sensors is evaluated in a bridge circuit.

Explanation of characteristic data

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

► Product groups

1.1 Air-mass sensors
HFM with analog interface

Attention: product will be discontinued, successor product in development. Please approach us via contact page.

BOSCH

Product type

HFM-5

Part number

0 280 217 123

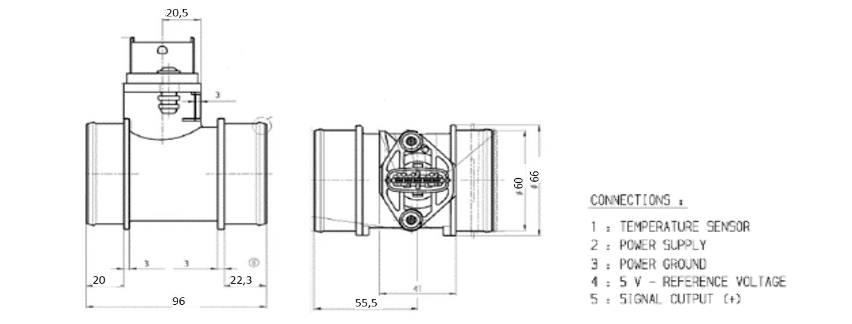
Picture

Technical data

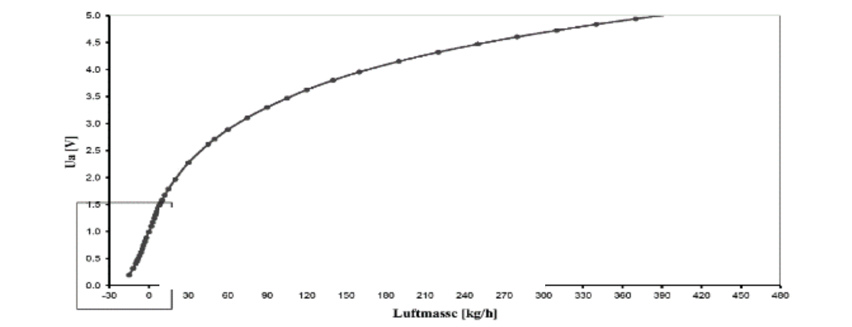
Features	With ambient-temperature sensor.	
Nominal airflow	$\dot{m}_N$	370 kg/h
Measuring range	$\dot{m}_N$	-15 ... 480 kg/h
Rated supply voltage	U_N	14 V
Supply-voltage range	U_V	8 ... 17 V
Relative accuracy [1])	$\Delta \dot{m} / \dot{m}$	± 3 %
Temperature range [2])	°C	-40 ... +120
Pressure drop at $\dot{m}_N$	Δp	< 15 hPa
Current input	I_V	< 0,1 A
Time constant	τ_{63} [3])	≤ 15 ms
Time constant	$\tau\Delta$ [4])	≤ 30 ms

1) for $0{,}04 \le \Delta \dot{m} / \dot{m}N \le 1{,}3$
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 $|\Delta \dot{m} / \dot{m}| \le 5$ %.

Dimensional drawings



Air-mass characteristic curve at ambient temperature



Accessories

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 therefore to be ordered separately as required.

▶ Product groups

HFM with analog interface

BOSCH

Product type

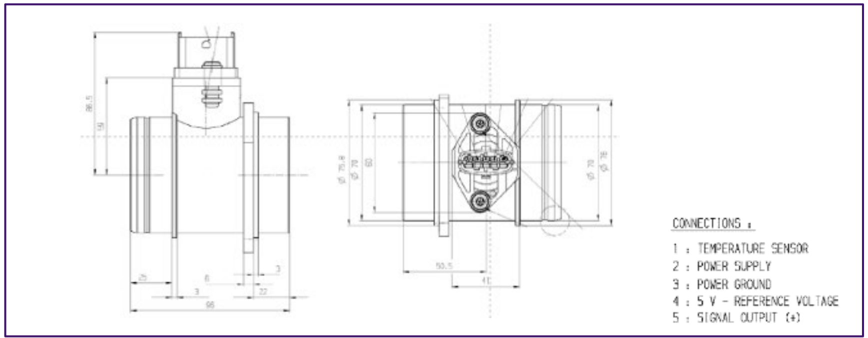
HFM7-R5

Part number

0 280 218 037

Picture

Dimensional drawings

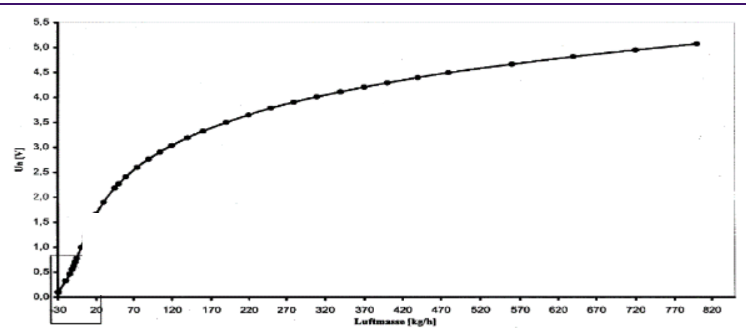


Technical data

Features	With ambient-temperature sensor.	
Nominal airflow	$\dot{m}_N$	480 kg/h
Measuring range	$\dot{m}_N$	5 ... 480 kg/h
Rated supply voltage	U_N	14 V
Supply-voltage range	U_V	8 ... 17 V
Relative accuracy [1]	$\Delta \dot{m} / \dot{m}$	± 3 %
Temperature range [2]	°C	-40 ... +120
Pressure drop at $\dot{m}_N$	Δp	< 15 hPa
Current input	I_V	< 0,1 A
Time constant	τ_{63} [3]	≤ 15 ms
Time constant	$\tau\Delta$ [4]	≤ 30 ms

1) for $0{,}04 \leq \Delta \dot{m} / \dot{m}N \leq 1{,}3$
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 $| \Delta \dot{m} / \dot{m} | \leq 5$ %.

Air-mass characteristic curve at ambient temperature



Accessories

Connector housing	5-pin	1 928 403 738
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 therefore to be ordered separately as required.

▶ Product groups

1.1 Air-mass sensors

HFM with analog interface

BOSCH

Product type

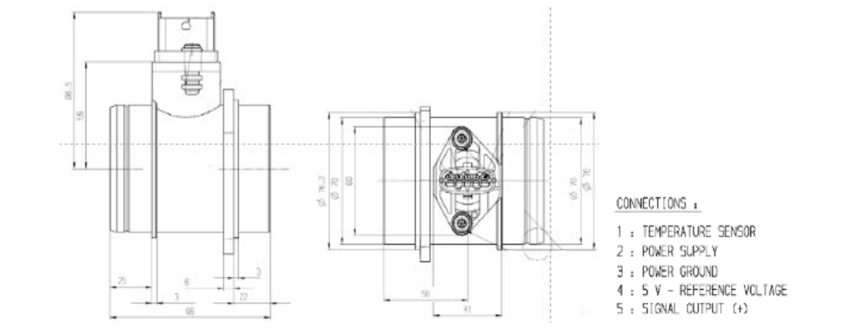
HFM7-R5

Part number

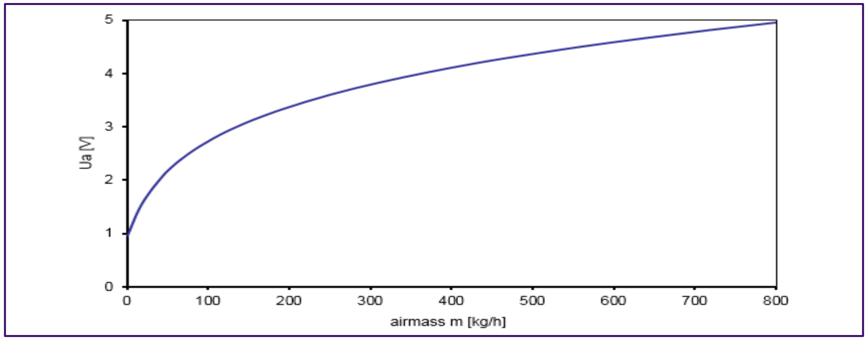
0 280 218 116

Picture

Dimensional drawings



Air-mass characteristic curve at ambient temperature



Technical data

Features	With ambient-temperature sensor.	
Nominal airflow	$\dot{m}_N$	480 kg/h
Measuring range	$\dot{m}_N$	-40 ... +640 kg/h
Rated supply voltage	U_N	14 V
Supply-voltage range	U_V	8 ... 17 V
Relative accuracy 1)	$\Delta \dot{m} / \dot{m}$	± 3 %
Temperature range 2)	°C	-40 ... +120
Pressure drop at $\dot{m}_N$	Δp	< 15 hPa
Current input	I_V	< 0,1 A
Time constant	τ_{63} 3)	≤ 15 ms
Time constant	$\tau\Delta$ 4)	≤ 30 ms

1) for $0{,}04 \le \Delta \dot{m} / \dot{m}N \le 1{,}3$
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 $| \Delta \dot{m} / \dot{m} | \le 5$ %.

Accessories

Compact connector	5-pin	1 928 403 813
Contact pins	For Ø 0.5...1.0 mm²	Tyco 929 939 – 3
Contact pins	For Ø 1.5...2.5 mm²	Tyco 929 937 – 3
Single-wire seals	For Ø 0.5...2.5 mm²	Tyco 828 905
Dummy plug		Tyco 828 922

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

▶ Product groups

1.1 Air-mass sensors

HFM with analog interface

Product type

HFM 7R5

Part number

0 280 218 335
(successor of 0 280 218 088)

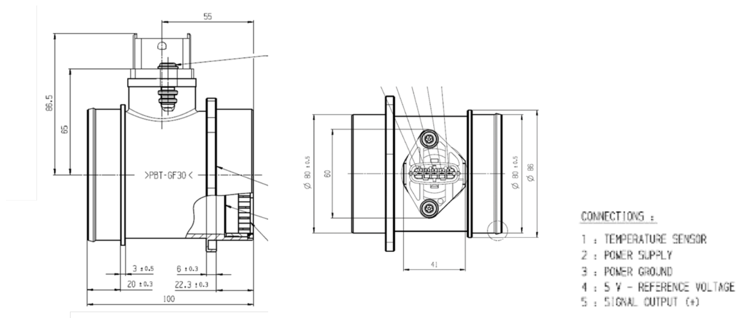
Picture

Technical data

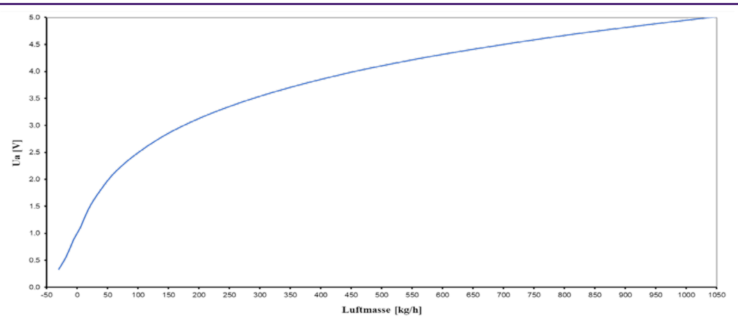
Features	With ambient-temperature sensor.	
Nominal airflow	$\dot{m}_N$	640 kg/h
Measuring range	$\dot{m}_N$	+30 ... 850 kg/h
Rated supply voltage	U_N	14 V
Supply-voltage range	U_V	6 ... 17 V
Relative accuracy [1]	$\Delta \dot{m} / \dot{m}$	± 3 %
Temperature range [2]	°C	-40 ... +120
Pressure drop at $\dot{m}_N$	Δp	< 15 hPa
Current input	I_V	< 0,1 A
Time constant	τ_{63} [3]	≤ 10 ms
Time constant	$\tau\Delta$ [4]	≤ 30 ms

1) for 0,04 ≤ $\Delta \dot{m} / \dot{m}N$ ≤ 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 %.

Dimensional drawings



Air-mass characteristic curve at ambient temperature



Accessories

Compact connector	5-pin	1 928 403 813
Contact pins	For Ø 0.5...1.0 mm²	Tyco 929 939 – 3
Contact pins	For Ø 1.5...2.5 mm²	Tyco 929 937 – 3
Single-wire seals	For Ø 0.5...2.5 mm²	Tyco 828 905
Dummy plug		Tyco 828 922

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

▶ Product groups

HFM with analog interface

BOSCH

Product type

HFM 7R5

Part number

0 280 218 440
(successor of 0 280 218 119)

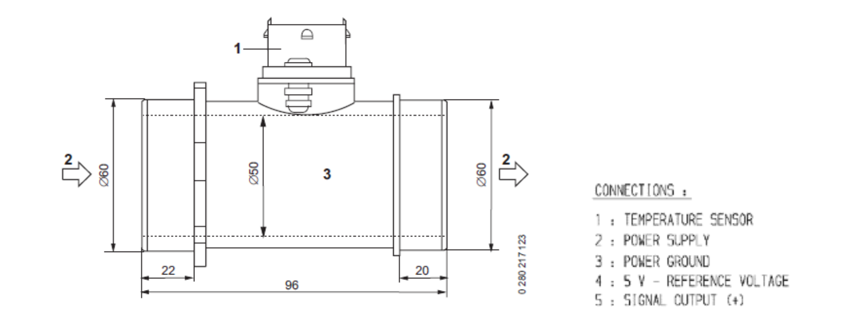
Picture

Technical data

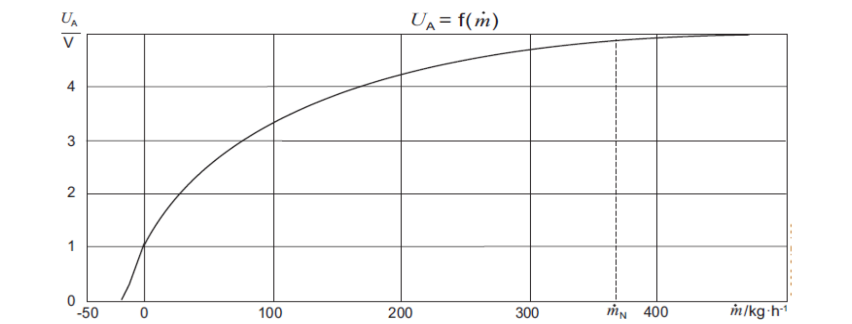
Features	With ambient-temperature sensor.	
Nominal airflow	$\dot{m}_N$	370 kg/h
Measuring range	$\dot{m}_N$	-15 ... +480 kg/h
Rated supply voltage	U_N	14 V
Supply-voltage range	U_V	6 ... 17 V
Relative accuracy [1]	$\Delta \dot{m} / \dot{m}$	± 3 %
Temperature range [2]	°C	-40 ... +120
Pressure drop at $\dot{m}_N$	Δp	< 15 hPa
Current input	I_V	< 0,1 A
Time constant	τ_{63} [3]	≤ 15 ms
Time constant	$\tau\Delta$ [4]	≤ 30 ms

1) for $0,04 \leq \Delta \dot{m} / \dot{m}N \leq 1,3$
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 $|\Delta \dot{m} / \dot{m}| \leq 5$ %.

Dimensional drawings



Air-mass characteristic curve at ambient temperature



Accessories

Compact connector	5-pin	1 928 403 813
Contact pins	For Ø 0.5...1.0 mm²	Tyco 929 939 – 3
Contact pins	For Ø 1.5...2.5 mm²	Tyco 929 937 – 3
Single-wire seals	For Ø 0.5...2.5 mm²	Tyco 828 905
Dummy plug		Tyco 828 922

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

▶ Product groups

1.1 Air-mass sensors

HFM with analog interface

Product type

HFM7-R5

Part number

0 280 218 446
(successor of 0 280 218 089)

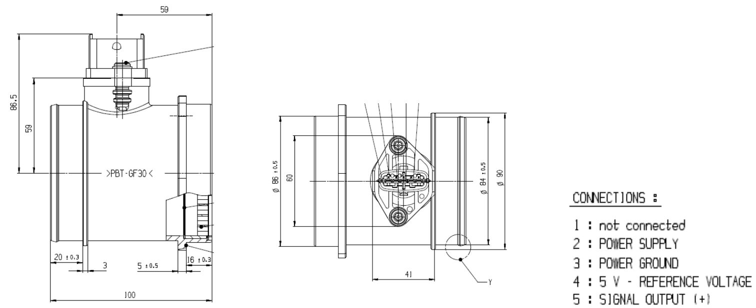
Picture

Technical data

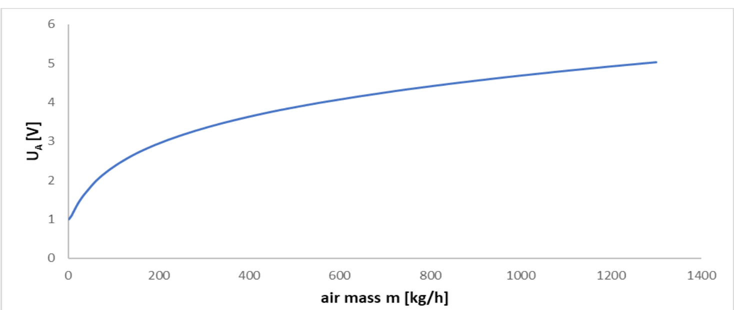
Features	Without ambient-temperature sensor.	
Nominal airflow	$\dot{m}_N$	850 kg/h
Measuring range	$\dot{m}_N$	-50 ... +1100 kg/h
Rated supply voltage	U_N	14 V
Supply-voltage range	U_V	8 ... 17 V
Relative accuracy [1]	$\Delta \dot{m} / \dot{m}$	± 3 %
Temperature range [2]	°C	-40 ... +120
Pressure drop at $\dot{m}_N$	Δp	< 15 hPa
Current input	I_V	< 0,1 A
Time constant	τ_{63} [3]	≤ 15 ms
Time constant	$\tau\Delta$ [4]	≤ 30 ms

1) for $0,04 \leq \Delta \dot{m} / \dot{m}N \leq 1,3$
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 $| \Delta \dot{m} / \dot{m} | \leq 5$ %.

Dimensional drawings



Air-mass characteristic curve at ambient temperature



Accessories

Compact connector	5-pin	1 928 403 813
Contact pins	For Ø 0.5...1.0 mm²	Tyco 929 939 – 3
Contact pins	For Ø 1.5...2.5 mm²	Tyco 929 937 – 3
Single-wire seals	For Ø 0.5...2.5 mm²	Tyco 828 905
Dummy plug		Tyco 828 922

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

▶ Product groups

1.1 Air-mass sensors

HFM with analog interface

BOSCH

Product type

HFM-7 (analog)

Part number

0 280 218 218

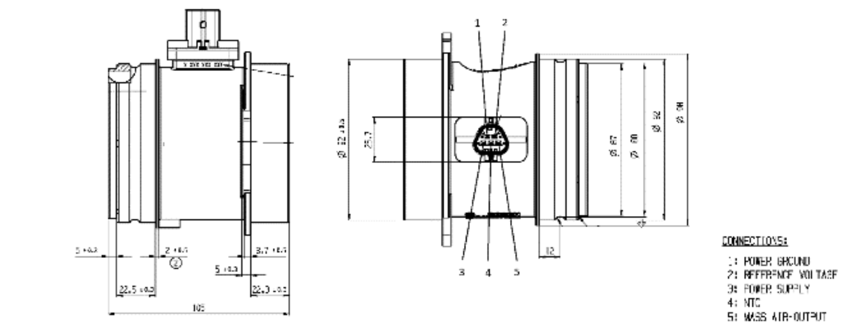
Picture

Technical data

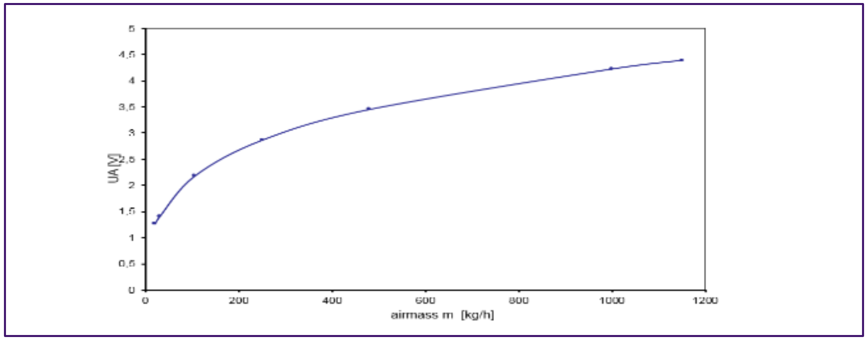
Features	With ambient-temperature sensor.	
Nominal airflow	$\dot{m}_N$	1050 kg/h
Measuring range	$\dot{m}_N$	-90 ... 1150 kg/h
Rated supply voltage	U_N	14 V
Supply-voltage range	U_V	6 ... 17 V
Relative accuracy [1]	$\Delta \dot{m} / \dot{m}$	± 2 %
Temperature range [2]	°C	-40 ... +120
Pressure drop at $\dot{m}_N$	Δp	< 10 hPa
Current input	I_V	< 0,06 A
Time constant	τ_{63} [3]	≤ 10 ms
Time constant	$\tau\Delta$ [4]	≤ 30 ms

1) for 0,04 ≤ $\Delta \dot{m} / \dot{m}N$ ≤ 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 %.

Dimensional drawings



Air-mass characteristic curve at ambient temperature



▶ Product groups

1.2 Air-mass sensors

HFM with digital interface

- Nominal air-flow up to 2.300 kg/h
- Digital interface (frequency/SENT)
- Compact design
- Low weight
- Fast response time
- Low power input
- Pulsation flow detection

Application

The air-mass sensor (HFM) is designed to measure the air mass and temperature of the intake air in motor vehicles with diesel and gasoline applications. The sensor measures the actual air mass flow rate for an optimized air-fuel mixture, supporting an efficient fuel combustion and powerful engine performance.

Design and operation

The standard HFM consists of a plug-in sensor and cylinder housing. The electronic module, with the evaluation circuit and the sensor element, is located in the plug-in sensor. The sensor element is positioned on the electronic module and extends into the metering duct (bypass channel) of the connector housing. The location of the temperature sensor (NTC) is on the backside of the connector housing.

The HFM is a thermal flowmeter. From the intake air flow within the cylinder housing, a portion of the total mass air flow will pass across the sensor element in the bypass channel. In the center exists a heating zone which is controlled to a certain temperature, depending on the temperature of the intake air. Without air flow, the temperature from the heating zone to the edges decreases linearly, and the temperature sensors up- and downstream of the heating zone indicate the same value. With air flow, the sensor area upstream will be cooled by the heat transfer in the boundary layer.

The downstream temperature sensor will keep its temperature because the air is heated as it passes over the heating zone. The temperature sensors show a temperature difference which depends on amount and direction of the air flow. The difference between the signals of the temperature sensors is evaluated in a bridge circuit.

Explanation of characteristic data

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

▶ Product groups

1.2 Air-mass sensors
HFM with digital interface

Product type

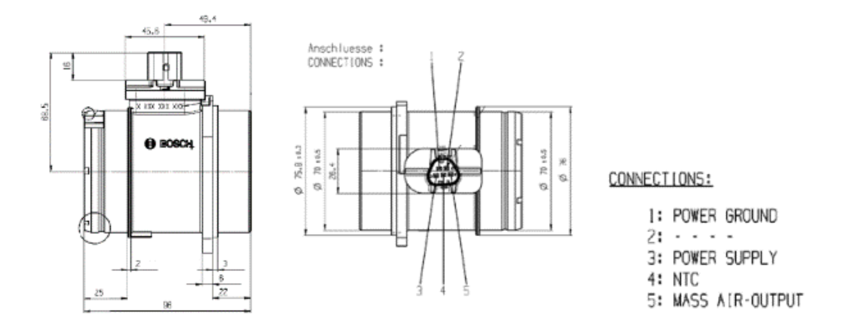
HFM-7

Part number

0 280 218 225

Picture

Dimensional drawings

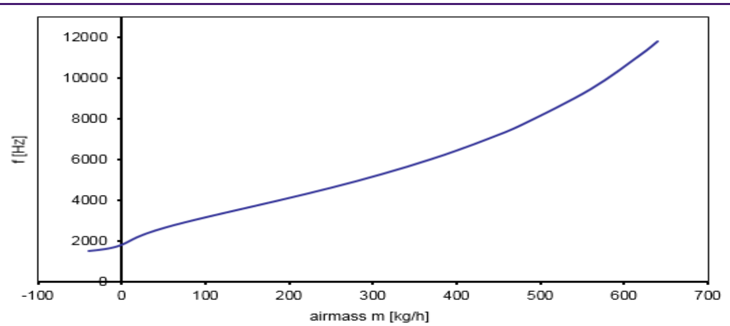


Technical data

Features	With ambient-temperature sensor.	
Nominal airflow	$\dot{m}_N$	480 kg/h
Measuring range	$\dot{m}_N$	-40 ... 620 kg/h
Rated supply voltage	U_N	14 V
Supply-voltage range	U_V	6 ... 17 V
Relative accuracy [1]	$\Delta \dot{m} / \dot{m}$	± 5 %
Temperature range [2]	°C	-40 ... +120
Pressure drop at $\dot{m}_N$	Δp	< 12 hPa
Current input	I_V	< 0,06 A
Time constant	τ_{63} [3]	≤ 10 ms
Time constant	$\tau\Delta$ [4]	≤ 30 ms

1) for 0,04 ≤ $\Delta \dot{m} / \dot{m}N$ ≤ 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 %.

Air-mass characteristic curve at ambient temperature



Accessories

Connector housing	5-pin	1 928 405 159
Contact pins	For Ø 0.35...0.5 mm²; Contents: 100 x	1 928 498 143
Contact pins	For Ø 0.75...1.0 mm²; Contents: 100 x	1 928 498 144
Single-wire seal	For Ø 1.2...1.6 mm²; Contents: 10 x	1 928 300 934
Single-wire seal	For Ø 1.7...2.1 mm²; Contents: 10 x	1 928 300 936
Dummy plug		1 928 300 935

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

▶ Product groups

HFM with digital interface

BOSCH

Product type

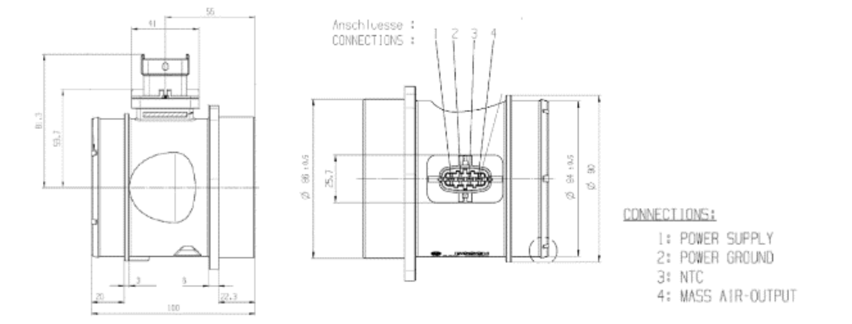
HFM-7

Part number

0 280 218 416

Picture

Dimensional drawings

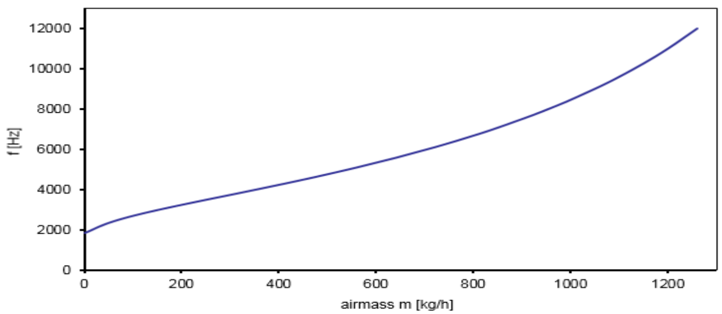


Technical data

Features	With ambient-temperature sensor.	
Nominal airflow	$\dot{m}_N$	850 kg/h
Measuring range	$\dot{m}_N$	-90 ... 1150 kg/h
Rated supply voltage	U_N	14 V
Supply-voltage range	U_V	6 ... 17 V
Relative accuracy [1]	$\Delta \dot{m} / \dot{m}$	± 5 %
Temperature range [2]	°C	-40 ... +120
Pressure drop at $\dot{m}_N$	Δp	< 12 hPa
Current input	I_V	< 0,06 A
Time constant	τ_{63} [3]	≤ 10 ms
Time constant	$\tau\Delta$ [4]	≤ 30 ms

1) for $0{,}04 \le \Delta \dot{m} / \dot{m}N \le 1{,}3$
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 $| \Delta \dot{m} / \dot{m} | \le 5$ %.

Air-mass characteristic curve at ambient temperature



Accessories

Connector housing	4-pin	1 928 404 160
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 0.35...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 therefore to be ordered separately as required.

▶ Product groups

1.2 Air-mass sensors
HFM with digital interface

BOSCH

Product type

HFM-7-SF

Part number

0 280 218 429

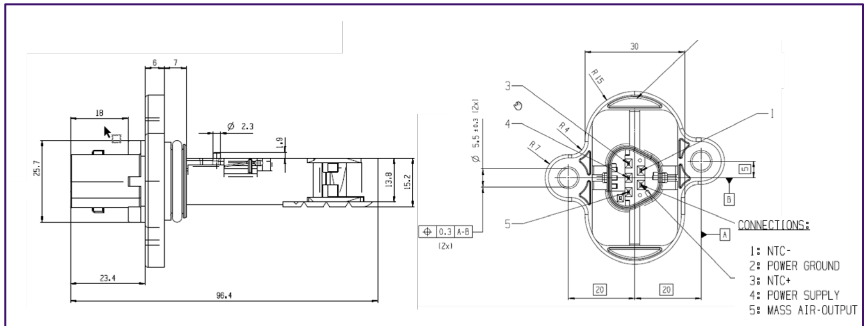
Picture

Technical data

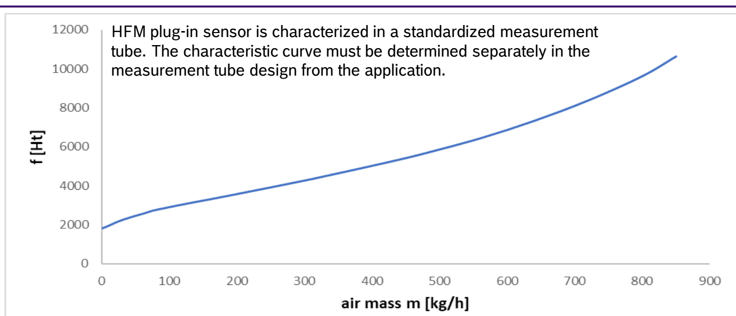
Features	With ambient-temperature sensor.	
Nominal airflow	$\dot{m}_N$	640 kg/h
Measuring range	$\dot{m}_N$	-60 ... 800 kg/h
Rated supply voltage	U_N	14 V
Supply-voltage range	U_V	6 ... 17 V
Relative accuracy [1]	$\Delta \dot{m} / \dot{m}$	± 2 %
Temperature range [2]	°C	-40 ... +120
Pressure drop at $\dot{m}_N$	Δp	depending on size and design of cross section area
Current input	I_V	< 0,06 A
Time constant	τ_{63} [3]	≤ 25 ms
Time constant	$\tau\Delta$ [4]	≤ 80 ms

1) for 0,04 ≤ $\Delta \dot{m} / \dot{m}N$ ≤ 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 %.

Dimensional drawings



Air-mass characteristic curve at ambient temperature



Accessories

Connector housing	5-pin	1 928 405 138
Contact pins	For Ø 0.35...0.5 mm²; Contents: 100 x	1 928 498 143
Contact pins	For Ø 0.75...1.0 mm²; Contents: 100 x	1 928 498 144
Single-wire seal	For Ø 1.2...1.6 mm²; Contents: 10 x	1 928 300 934
Single-wire seal	For Ø 1.7...2.1 mm²; Contents: 10 x	1 928 300 936
Dummy plug		1 928 300 935

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

► Product groups

1.2 Air-mass sensors
HFM with digital interface

Product type

HFM-7

Part number

0 281 002 956

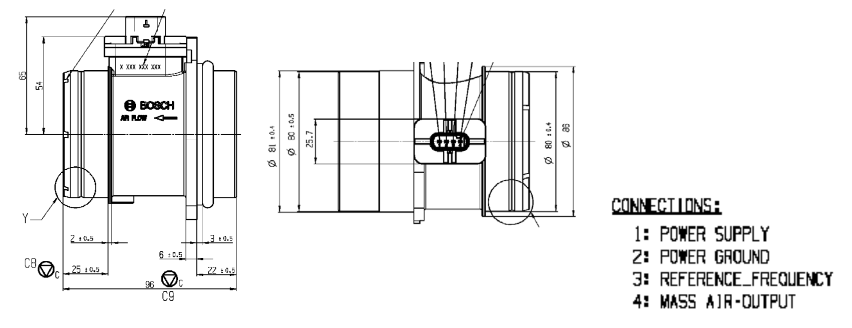
Picture

Technical data

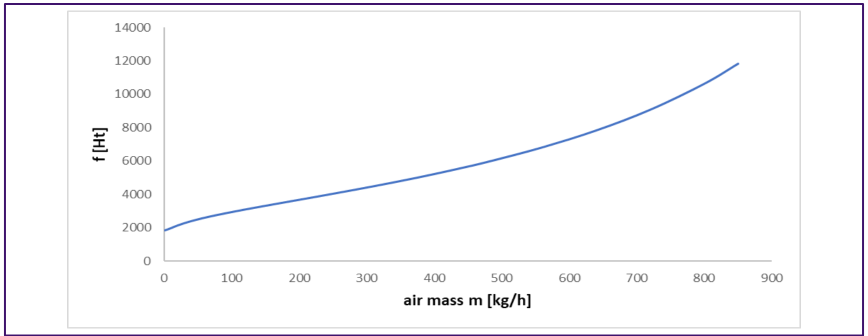
Features	Without ambient-temperature sensor.	
Nominal airflow	$\dot{m}_N$	640 kg/h
Measuring range	$\dot{m}_N$	-60 ... 800 kg/h
Rated supply voltage	U_N	14 V
Supply-voltage range	U_V	6 ... 17 V
Relative accuracy [1]	$\Delta \dot{m} / \dot{m}$	± 2 %
Temperature range [2]	°C	-40 ... +120
Pressure drop at $\dot{m}_N$	Δp	< 12 hPa
Current input	I_V	< 0,06 A
Time constant	τ_{63} [3]	≤ 10 ms
Time constant	$\tau\Delta$ [4]	≤ 30 ms

1) for 0,04 ≤ $\Delta \dot{m} / \dot{m}N$ ≤ 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 %.

Dimensional drawings



Air-mass characteristic curve at ambient temperature



▶ Product groups

HFM with digital interface

BOSCH

Product type

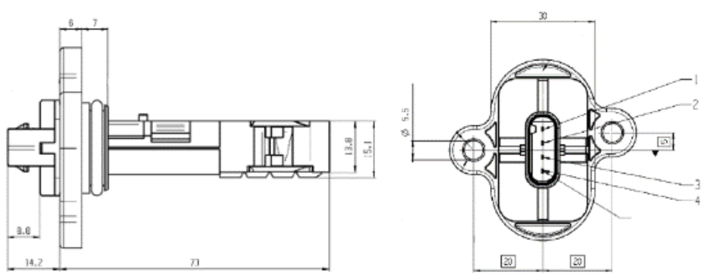
HFM-7-SF

Part number

0 281 006 069

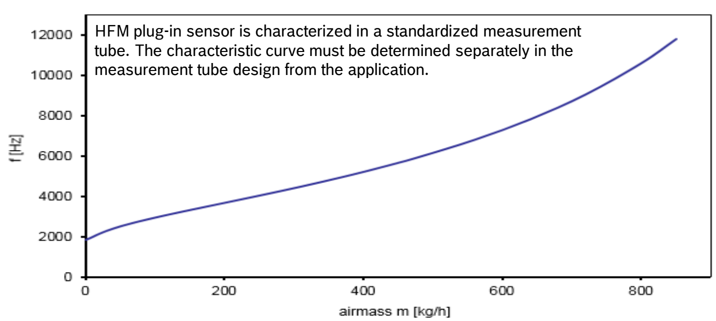
Picture

Dimensional drawings



1 Power supply
2 Power ground
3 Reference frequence
4 Mass air-output

Air-mass characteristic curve at ambient temperature



Technical data

Features	With ambient-temperature sensor.	
Nominal airflow	$\dot{m}_N$	640 kg/h
Measuring range	$\dot{m}_N$	-60 ... 800 kg/h
Rated supply voltage	U_N	14 V
Supply-voltage range	U_V	6 ... 17 V
Relative accuracy [1]	$\Delta \dot{m} / \dot{m}$	± 5 %
Temperature range [2]	°C	-40 ... +120
Pressure drop at $\dot{m}_N$	Δp	depending on size and design of cross section area
Current input	I_V	< 0,06 A
Time constant	τ_{63} [3]	≤ 25 ms
Time constant	$\tau\Delta$ [4]	≤ 80 ms

1) for 0,04 ≤ $\Delta \dot{m} / \dot{m}N$ ≤ 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 %.

▶ Product groups

HFM with digital interface

Product type

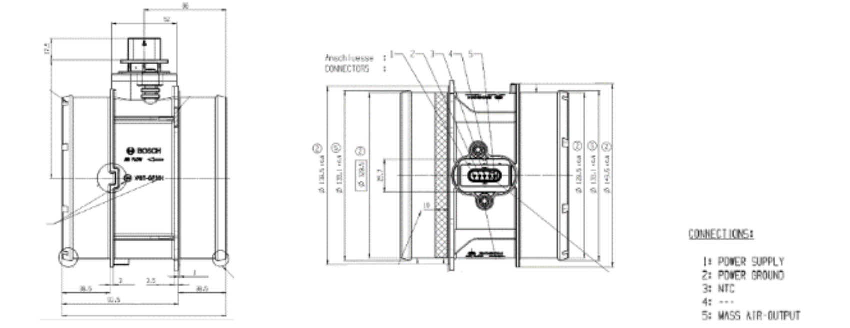
HFM-7

Part number

0 281 006 275

Picture

Dimensional drawings



Air-mass characteristic curve at ambient temperature

Due to the replacement concept of the HFM plug-in sensor, it has to be calibrated individually, w/o cylinder housing. Since these characteristic curves depend on the specific layout of the air intake system, no characteristic curves of the assembly can be given here.

Technical data

Features	With ambient-temperature sensor.	
Nominal airflow	$\dot{m}_N$	2300 kg/h
Measuring range	$\dot{m}_N$	-140 ... 2900 kg/h
Rated supply voltage	U_N	14 V
Supply-voltage range	U_V	6 ... 17 V
Relative accuracy 1)	$\Delta \dot{m} / \dot{m}$	± 5 %
Temperature range 2)	°C	-40 ... +120
Pressure drop at $\dot{m}_N$	Δp	< 15 hPa
Current input	I_V	< 0,08 A
Time constant	τ_{63} 3)	≤ 10 ms
Time constant	$\tau\Delta$ 4)	≤ 30 ms

1) for $0,04 \leq \Delta \dot{m} / \dot{m}N \leq 1,3$
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 $|\Delta \dot{m} / \dot{m}| \leq 5$ %.

▶ Product groups

1.2 Air-mass sensors

HFM with digital interface

Product type

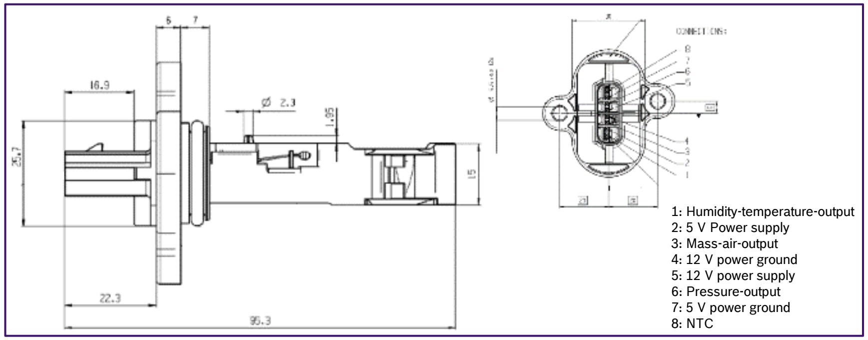
HFM-7-SF-IPH

Part number

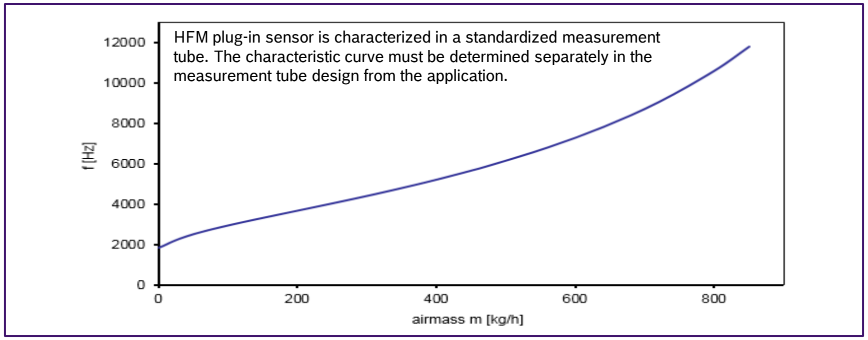
0 280 218 419

Picture

Dimensional drawings



Air-mass characteristic curve at ambient temperature



Technical data

Features	With integrated pressure, humidity and ambient-temperature sensor.	
Nominal airflow	$\dot{m}_N$	640 kg/h
Measuring range airflow	$\dot{m}_N$	-60 ... 800 kg/h
Measuring range pressure	kPa	12,5 ... 115
Measuring range humidity	%rH	10 ... 90
Rated supply voltage	U_N	14 V
Supply-voltage range	U_V	6 ... 17 V
Relative accuracy [1]	$\Delta \dot{m} / \dot{m}$	± 5 %
Temperature range [2]	°C	-40 ... +120
Pressure drop at $\dot{m}_N$	Δp	depending on size and design of cross section area
Current input	I_V	< 0,06 A
Time constant	τ_{63} [3]	≤ 25 ms
Time constant	$\tau\Delta$ [4]	≤ 80 ms

1) for 0,04 ≤ $\Delta \dot{m} / \dot{m}N$ ≤ 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 %.

▶ Product groups

1.2 Air-mass sensors
HFM with digital interface

Product type

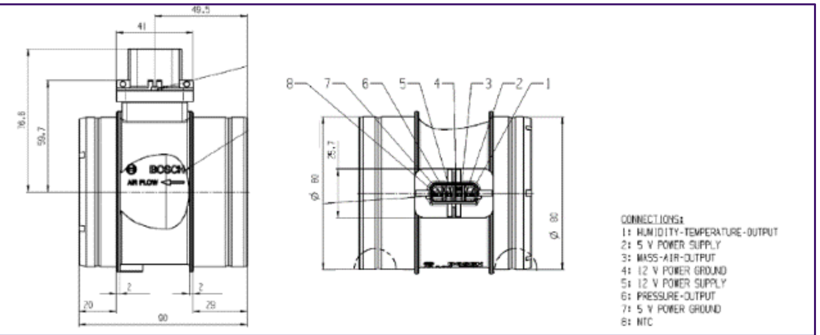
HFM-7-IPH

Part number

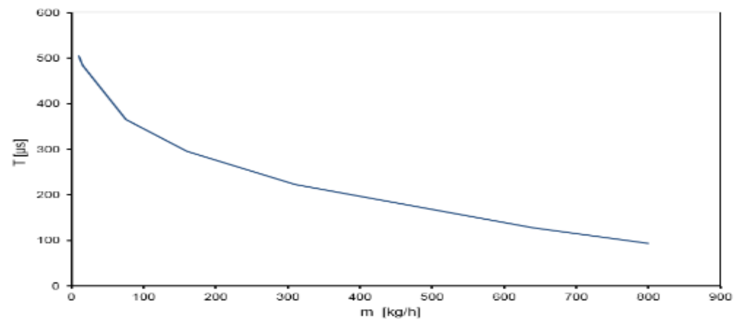
0 281 006 426

Picture

Dimensional drawings



Air-mass characteristic curve at ambient temperature



Technical data

Features	With integrated pressure, humidity and ambient-temperature sensor.	
Nominal airflow	$\dot{m}_N$	640 kg/h
Measuring range airflow	$\dot{m}_N$	-40 ... 800 kg/h
Measuring range pressure	kPa	12,5 ... 115
Measuring range humidity	%rH	10 ... 90
Rated supply voltage	U_N	14 V
Supply-voltage range	U_V	6 ... 17 V
Relative accuracy [1]	$\Delta \dot{m} / \dot{m}$	± 5 %
Temperature range [2]	°C	-40 ... +120
Pressure drop at $\dot{m}_N$	Δp	< 12 hPa
Current input	I_V	< 0,06 A
Time constant	τ_{63} [3]	≤ 25 ms
Time constant	$\tau\Delta$ [4]	≤ 30 ms

1) for $0{,}04 \leq \Delta \dot{m} / \dot{m}N \leq 1{,}3$
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 $| \Delta \dot{m} / \dot{m} | \leq 5$ %.

▶ Product groups

HFM with digital interface

Product type

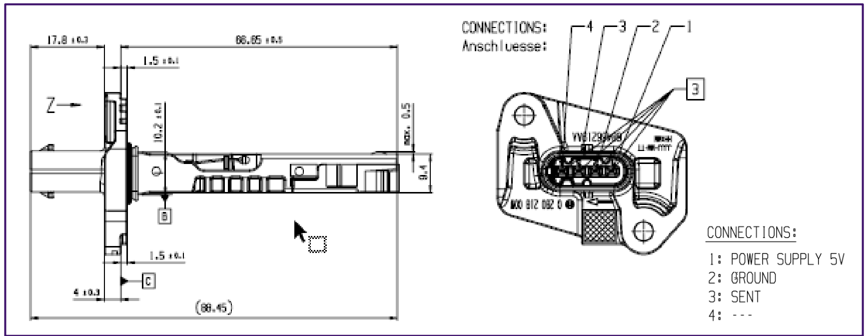
HFM-8-SF-PTH

Part number

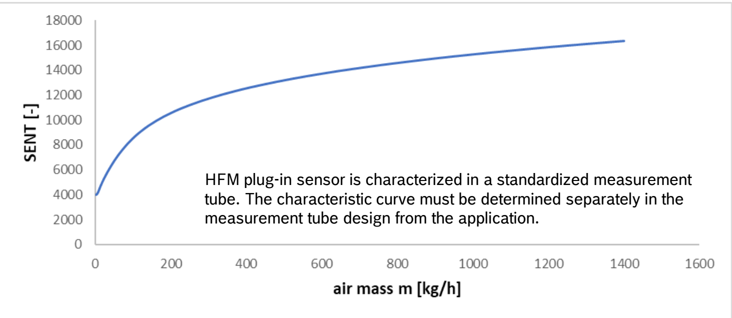
0 280 218 00W

Picture

Dimensional drawings



Air-mass characteristic curve at ambient temperature



Technical data

Features	With integrated pressure, humidity and ambient-temperature sensor.	
Nominal airflow	$\dot{m}_N$	640 kg/h
Measuring range airflow	$\dot{m}_N$	-90 ... 1400 kg/h
Measuring range pressure	kPa	10 ... 120
Measuring range humidity	%rH	0 ... 100
Rated supply voltage	U_N	5 V
Supply-voltage range	U_V	4,85 ... 5,15 V
Relative accuracy 1)	$\Delta \dot{m} / \dot{m}$	± 1.5 %
Temperature range 2)	°C	-40 ... +140
Pressure drop at $\dot{m}_N$	Δp	depending on size and design of cross section area
Current input	I_V	< 0,03 A
Time constant	τ_{63} 3)	≤ 10 ms
Time constant	$\tau\Delta$ 4)	≤ 30 ms

1) for 0,04 ≤ $\Delta \dot{m} / \dot{m}N$ ≤ 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 %.

▶ Product groups

1.3 Air-mass sensors

PFM pressure based flow meter

BOSCH

- ► Pressure range up to 4,5 bar
- ► Digital interface (SENT, 2 channels)
- ► Compact design
- ► Low weight
- ► Fast response time
- ► Efficient, robust & dynamic mass flow measurement
- ► High level of robustness & accuracy

Application

The pressure based air mass flow meter PFM is a sensor to measure the fresh air mass (without exhaust gas recirculation) within air ducts of CV-engines. It is usually mounted downstream of the charge air intercooler.

With the air mass flow measurement the fuel injection quantities can be optimized, which helps to minimize the exhaust gas emissions. The PFM detects the single values, which are used for the air mass flow calculation.

The single values are:
- Differential pressure (difference of total pressure and static pressure)
- Absolute pressure (static pressure)
- Temperature

Design and operation

The PFM measurement technique is based on the pitot-static tube concept, whereby two pressure sensors and one temperature sensor are installed in the sensor for the determination of the air mass flow. The differential pressure sensor is placed in the lower part of the sensor housing and its pressure taps are exposed to the air flow. Similarly, the temperature sensor is placed in the lower housing part to be directly immersed in the flow. The absolute pressure sensor is positioned in the upper part of the sensor housing, since its membrane does not have to be exposed to the flow.

The PFM is designed as a plug-in sensor, which is mounted in a measuring tube with three main parts: a nozzle, a measurement section and a diffusor. The design of the measurement tube uses engine specific data and conditions the flow for an optimal air mass flow measurement with the PFM.

The two analog pressure sensor signals are AD converted, the signal of the temperature sensor is digitized via the absolute pressure sensor. Finally, the sensor signals are transmitted to the ECU via the SENT communication protocol.

The sensor signals of
- the differential pressure sensor
- the absolute pressure sensor
- the temperature sensor
are the input for the air mass flow calculation on the ECU.

The PFM is mounted downstream of the charge air intercooler and upstream of the throttle valve. Thereby, the PFM static pressure measurement can be used as boost pressure signal at this position.

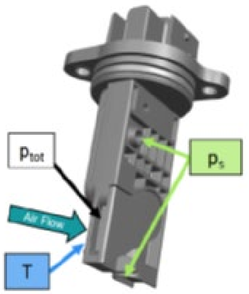
The temperature signal of the PFM can not only be used for the calculation of the air mass flow, but also as an additional temperature signal at the PFM position between the charge air intercooler and the throttle valve.

Explanation of characteristic data

$$\dot{m} = \sqrt{\frac{2 \cdot p_{diff} \cdot p_s}{R_s \cdot T}} \cdot A_{eff}$$

Signals of the 3 integrated sensors: p_{diff}, p_s, T

- $\dot{m}$ = Air mass flow
- p_{diff} = Differential pressure ($p_{diff}=p_{tot}-p_s$)
- p_s = Static pressure
- T = Temperature
- R_s = gas-constant for air
- A_{eff} = Effective area at mounting position



► Product groups

PFM with digital interface

BOSCH

Product type

PFM VarA

Part number

0 280 218 902

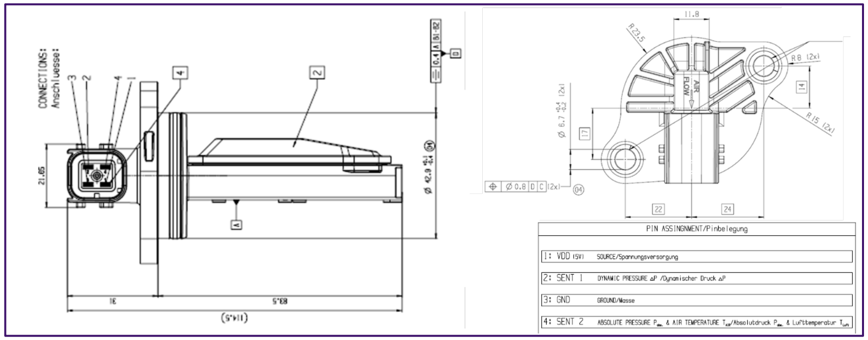
Picture

Technical data

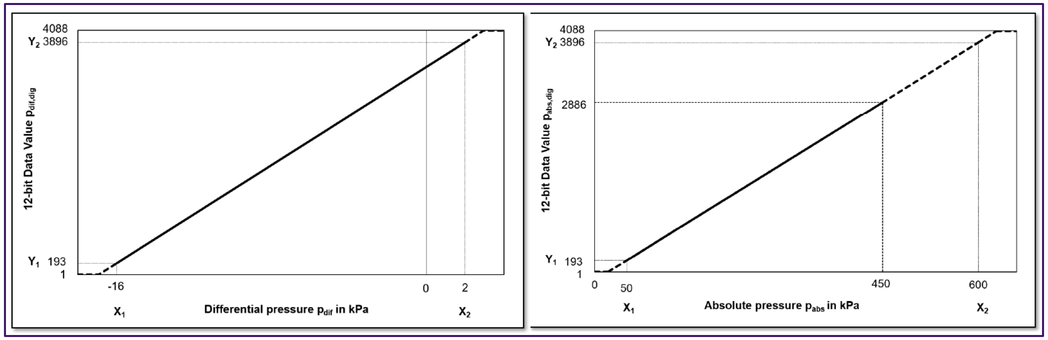
Features		With integrated ambient-temperature sensor.
Measuring range differential pressure	p_{diff}	-16 ... 2 kPa
Measuring range absolute pressure	p_{abs}	50 ... 600 kPa
Rated supply voltage	U_N	5 V
Supply-voltage range	U_V	4,85 ... 5,15 V
accuracy	$\Delta \dot{m} / \dot{m}$	*approx. 2 ... 4 %* calculation for each engine
Temperature range [2]	°C	-40 ... +130
Pressure drop at $\dot{m}_N$	Δp	depending on size and design of cross section area
Current input	I_{DD}	0,018 A ... 0,045 A
Time constant	τ_{IDD} [1]	≤ 7 ms
Time constant	$\tau_{up,p,SENT}$ [2]	≤ 5 ms

1) Transient time until supply current settled
2) Time until 1st valid pressure value transfer

Dimensional drawings



pressure characteristic curves at ambient temperature



Accessories

Connector	4-pin	Tyco HDSCS Code A

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

▶ Product groups

PFM with digital interface

Product type

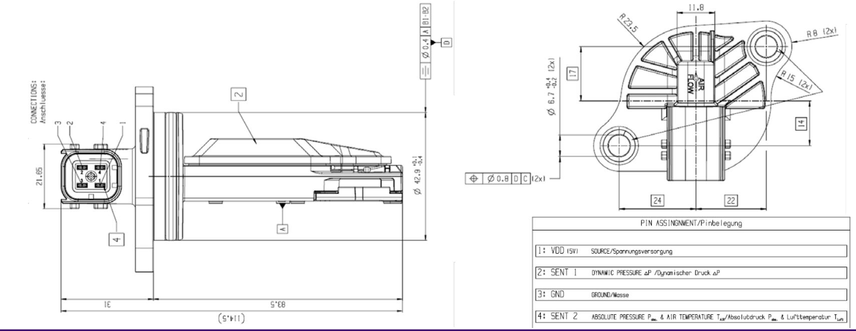
PFM VarB

Part number

0 280 218 900

Picture

Dimensional drawings

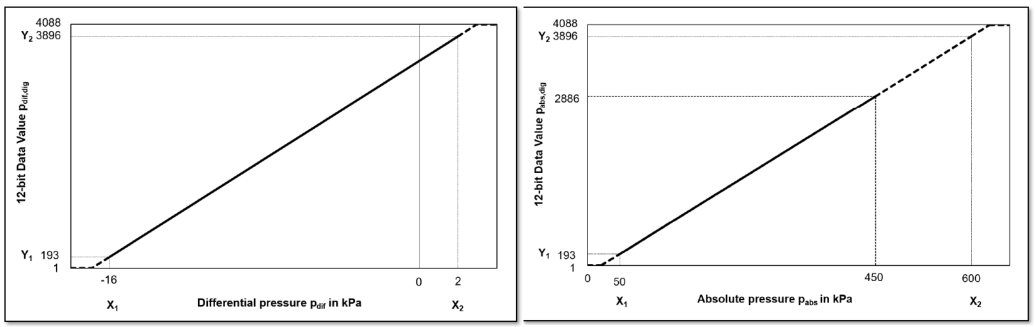


Technical data

Features		With integrated ambient-temperature sensor.
Measuring range differential pressure	p_{diff}	-16 ... 2 kPa
Measuring range absolute pressure	p_{abs}	50 ... 600 kPa
Rated supply voltage	U_N	5 V
Supply-voltage range	U_V	4,85 ... 5,15 V
accuracy	$\Delta \dot{m} / \dot{m}$	*approx. 2 ... 4 %* calculation for each engine
Temperature range [2]	°C	-40 ... +130
Pressure drop at $\dot{m}_N$	Δp	depending on size and design of cross section area
Current input	I_{DD}	0,018 A ... 0,045 A
Time constant	τ_{IDD} [1]	≤ 7 ms
Time constant	$\tau_{up,p,SENT}$ [2]	≤ 5 ms

1) Transient time until supply current settled
2) Time until 1st valid pressure value transfer

pressure characteristic curves at ambient temperature



Accessories

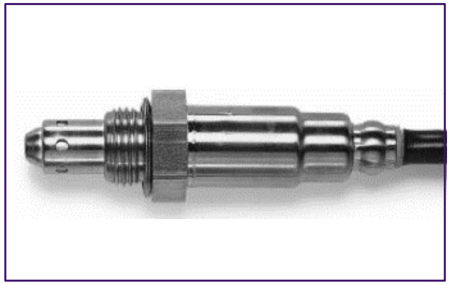
Connector	4-pin	Tyco HDSCS Code A

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

▶ Product groups

Type LSF-4.2 (narrow band)

► compared to the wideband lambda sensor LSU4.9 the narrow band LSF4 type is limited to applications in the near operation vicinity of lambda=1



Application

Engine management
- Natural Gas engines
- Combined heat and thermal power units (CHP)
- 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 index
- Incineration plants
- Wood
- Biomass

Design and application

The LSF4 lambda sensor operates according to the principle of a galvanic oxygen concentration cell with solid electrolyte. The sensor element is in the form of a long wafer with rectangular cross section. The measuring cell and the heater are integrated in this planar ceramic. The measuring cell's surfaces are coated with microporous layers of noble metal. On the one side, due to their catalytic activity, these layers define the sensor's characteristic curve, while on the other they serve as contact elements. On the surface of the ceramic exposed to the exhaust gas, the noble-metal electrode is protected by a porous ceramic layer which, across the whole operating-temperature range, prevents erosion damage due to the deposits in the exhaust gas. This protective layer is applied using sintering techniques and, due among other things to its perfect adhesion and structure, it guarantees a long service life and compliance with the high functional demands made upon the sensor.

The heater is a wave-shaped element and contains noble metals. It is insulated, and integrated in the ceramic wafer. Even at low heater inputs it ensures that the sensor heats up quickly. The Lambda sensor operates as a reference-gas sensor, and compares the residual oxygen in the exhaust gas with the oxygen in the reference atmosphere (air circulating inside the sensor).
In the stoichiometric region of the air/fuel mixture (lambda = 1), there is a sudden jump in the sensor output voltage. The system is closed-loop controlled to lambda = 1 (two-state controller), and this voltage jump is evaluated in the 450...500 mV area of the system's characteristic curve.
The following approximate values apply as guidelines for sensor voltage:
- rich mixture (lambda < 1) 800...1000 mV,
- lean mixture (lambda > 1)
- in the area around 100 mV.

A prerequisite for efficient and reliable functioning is that the active sensor ceramic has a temperature of ³ 350 °C. The integrated heater ensures that the sensor functions at exhaust-gas temperatures as low as 150 °C. Since this sensor‘s ceramic temperature is determined by the electrical heating at low engine loads (i.e. low exhaust-gas temperatures), this means that it can also be installed in the exhaust system at a point remote from the engine. The electrical sensor heating means that the exhaust-gas temperature's influence on the sensor-ceramic temperature, and therefore upon the temperature-dependent sensor. functions, are considerably reduced. In addition, the direct sensor heating ensures that the sensor element heats up so rapidly that lambda closed loop control can come into operation within 10 secs. after engine start.
These advantages make an important contribution towards achieving low, stable exhaust-gas emission values. There are product variants with an additional “Thermal Shock Protection” (TSP). TSP increases robustness, especially against cold water droplets in cold start case of motor engines. An additional ceramic layer reduces the heat transition by distributing the drops to a larger area in case a water droplet hits the already heated sensor. This allows an earlier signal readiness in the vehicle since it is possible to heat sensor already with engine start.

Characteristics

- Field-proven,
- robust and compact,
- reliable,
- high-temperature-resistant up to 1000 °C exhaust-gas temperature
- resistant to stone impact,
- resistant to corrosion,
- isolated ground sensor signal circuit,
- submersible,
- low heater rating,
- resistant to coating and poisoning,
- stable control characteristic,
- short switch-on time.

► Product groups

2.1 Lambda sensors
Type LSF-4.2 (narrow band)

Product type

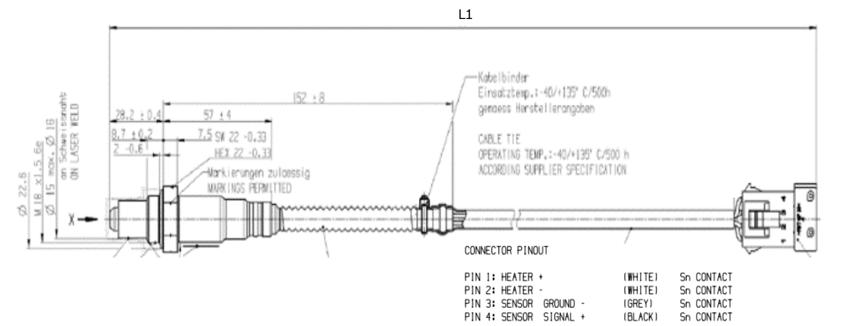
LSF-4.2

Part number

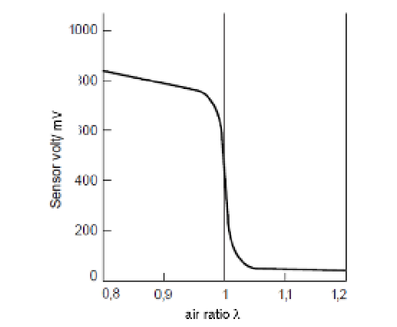
Several available

Picture

Dimensional drawing



Characteristic curve



Technical data

Measuring range of lambda	0,97 ... 1,10
Sensor voltage at lambda = 0,97	800 ± 55 mV
Sensor voltage at lambda = 1,10	50 ± 30 mV
Internal resistance	≤ 0,5 kΩ
Response time (600mV ... 300mV)	< 125 ms
Response time (300mV ... 600mV)	< 60 ms
Heater current	0,48 ± 0,1 A
Heater power (with 13V heater voltage)	7 W
Heater nominal voltage supply	12 V
Exhaust gas temperature	350°C .... 930°C

Part number	TSP?	Cable length L1
0258006026	-	1260 mm
0258006956	-	460 mm
0258010450	-	288 mm
0258010451	TSP	403 mm

Accessories

Connector housing	4-pin	Tyco 185 001-61
Contact pins	Sn	Tyco 1-962915-1
Single-wire seal		Tyco 828 904-1
Single-wire seal		Tyco 1 251 039 001

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

▶ Product groups

2.2 Lambda sensors

Type LSU-4.9 (wideband)

- ► 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
- Natural Gas engines
- Combined heat and thermal power units (CHP)
- 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 index
- Incineration plants
- Wood
- Biomass

Design and operation

The LSU broadband Lambda sensor is a planar ZrO_2 dual-cell limit current sensor with integrated 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 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. There are product variants with an additional “Thermal Shock Protection” (TSP). TSP increases robustness, especially against cold water droplets in cold start case of motor engines. An additional ceramic layer reduces the heat transition by distributing the drops to a larger area in case a water droplet hits the already heated sensor. This allows an earlier signal readiness in the vehicle since it is possible to heat sensor already with engine start.

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 characteristics quantities

λ Air ratio
U_N Nernst voltage
U_P Variable pump voltage

► Product groups

2.2 Lambda sensors
Type LSU-4.9 (wideband)

BOSCH

Product type

LSU-4.9

Part number

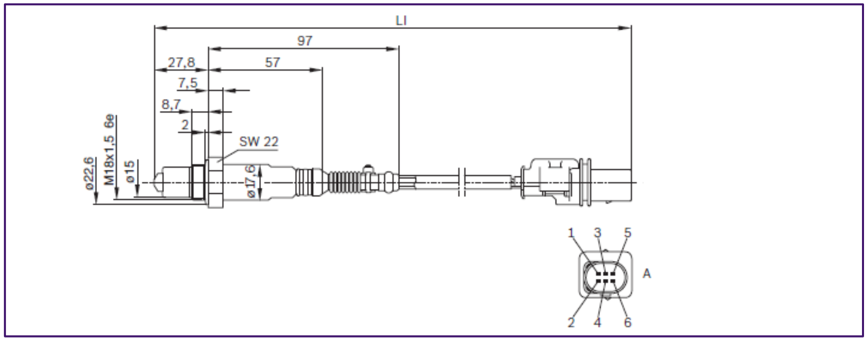
Several available

Picture

Technical data

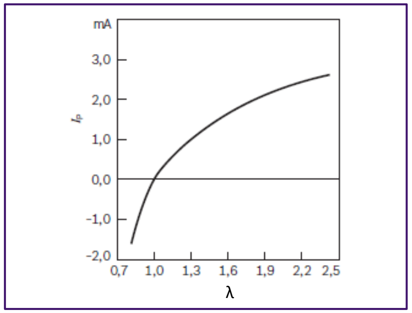
Measuring range of lambda	0,65 … ∞
Heater power (with 7,5V heater voltage)	7,5 W
Heater nominal voltage supply	7,5 V
Exhaust gas temperature	≤ 930°C

Dimensional drawings



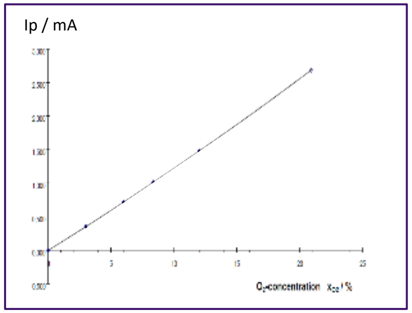
Part number	TSP?	Cable length L1
0258017462	-	450 mm
0258017594	TSP	450 mm
0258017025	-	1000 mm
0281004805	TSP	1000 mm

Characteristic curve



I_p = Pump current
λ = Air ratio

Characteristic curve



Accessories

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

▶ Product groups

Differential pressure sensor

- Pressure range -100 to 500 kPa
- High level of accuracy
- With temperature compensation

Application

This sensor is used for either measurement of the differential pressure at the diesel particulate filter to determine its load condition, or fuel tank vapor pressure.

Design and operation

The piezo-resistive pressure sensor element and a suitable circuitry for signal amplification and temperature compensation are integrated on a silicon chip. The pressure measured operates to the back side of the silicon diaphragm, which is resistant to corrosive media and protected by a gel film against diaphragm cracks. The reference pressure operates from above to the active side of the silicon diaphragm. The upper chip surface and the wire-bonding onto the ceramic substrate are protected from corrosion by a anti-corrosive gel.

Explanation of characteristic data

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 attachment to the bodywork or to the engine of motor vehicles. The sensor should be installed to avoid condensate accumulating 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 can lead to malfunction.

▶ Product groups

Differential pressure sensor

Attention: product will be discontinued, successor product in development. Please approach us via contact page.

Product type

DS-D2

Part number

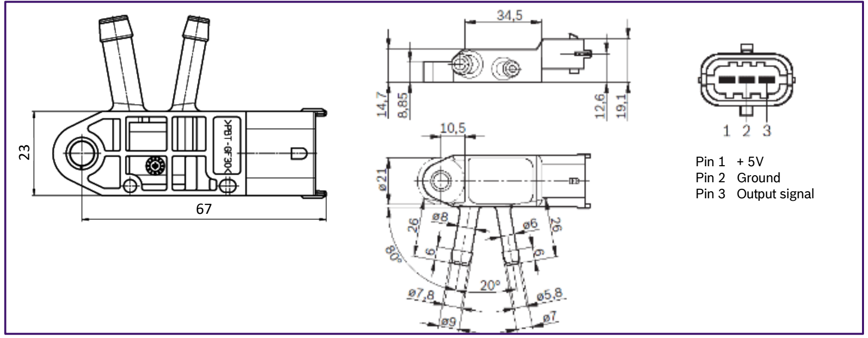
0 281 002 772

Picture

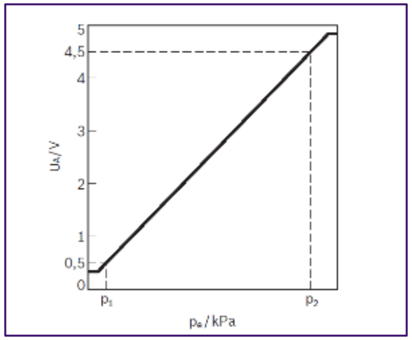
Technical data

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	$R_{pull-up}$	kΩ	5	680
Limit data				
Pressure	p_e	kPa	-350	+350
Storage temperature	v_L	°C	-40	+130

Dimensional drawings



Characteristic curve



Accessories

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 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 therefore to be ordered separately as required.

► Product groups

3.1 Pressure sensors

Differential pressure sensor

BOSCH

Product type

DS-T3

Part number

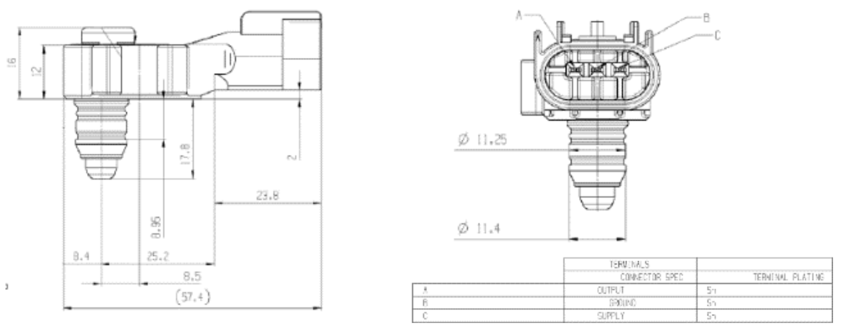
0 261 230 161

Picture

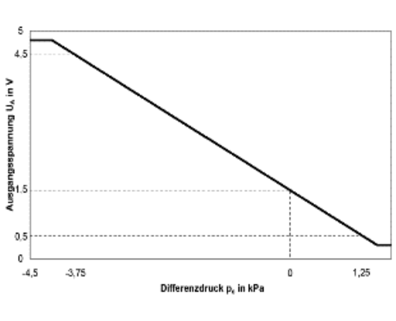
Technical data

		min.	type	Max.
Pressure range (p_1...p_2)	kPa	-3,75		+1,25
Supply voltage U_V	V	4,75	5	5,25
Load current I_L at output	mA	-1,0		0,5
Response time $\tau_{10/90}$	ms			5,0
Operating temperature	°C	0		+80
Limit data				
Operating temperature	°C	-50		+90

Dimensional drawings



Characteristic curve



▶ Product groups

Absolute pressure sensors

- Pressure range 0 – 1000 kPa
- High level of accuracy
- EMC protection better than 100 V m^{-1}
- With temperature compensation
- Version with additional integrated temperature sensor

Application

The sensor is used to measure the absolute intake-manifold or boost pressure. Some variants can be used to measure the absolute fuel or oil pressure. The version with integrated temperature sensor additionally measures the temperature of the detected medium.

Design and operation

The piezo-resistive pressure sensor element and a suitable circuitry for signal amplification and temperature compensation are integrated on a silicon chip. The measured pressure operates from above to the active side of the silicon diaphragm. Between the backside and a glass socket a reference vacuum is enclosed. The temperature sensor element is an NTC-resistor. By a suitable coating process the pressure and temperature sensor are protected against vapors and fluids existing in the intake-manifold, exhaust gas or exhaust gas condensate, however, may affect the sensor lifetime.

Explanation of characteristic data

U_A	Output voltage
U_V	Supply voltage
k	Tolerance multiplier
D	After endurance test
N	As-new condition

Installation instruction

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 to avoid condensate accumulating in the pressure cell (pressure sampling point at top of intake manifold, pressure connection angled downwards etc.).

► Product groups

Absolute pressure sensors

Attention: product will be discontinued, successor product in development. Please approach us via contact page.

BOSCH

Product type

DS-S2-TF

Part number

0 261 230 133

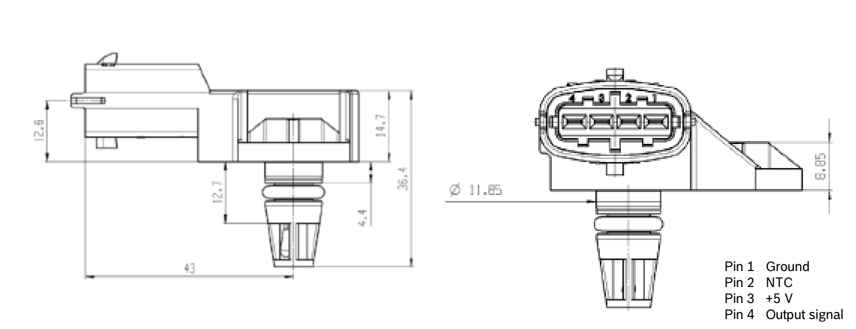
Picture

Technical data

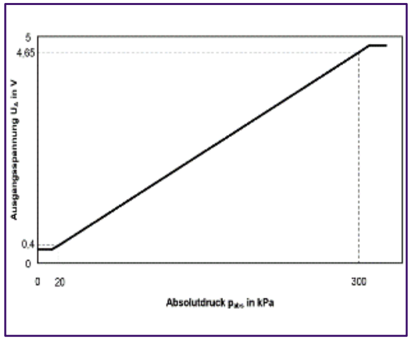
Parameter		min.	type	Max.
Features		Integrated temperature sensor		
Pressure range (p_1...p_2)	kPa	20		300
Supply voltage U_V	V	4,75	5	5,25
Load current I_L at output	mA	-1		0,5
Response time $\tau_{10/90}$	ms			1
Operating temperature	°C	-40		+130

Limit data				
Operating temperature	°C	-40		+130

Dimensional drawings



Characteristic curve



Accessories

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 therefore to be ordered separately as required.

▶ Product groups

Absolute pressure sensors

Attention: product will be discontinued, successor product in development. Please approach us via contact page.

BOSCH

Product type

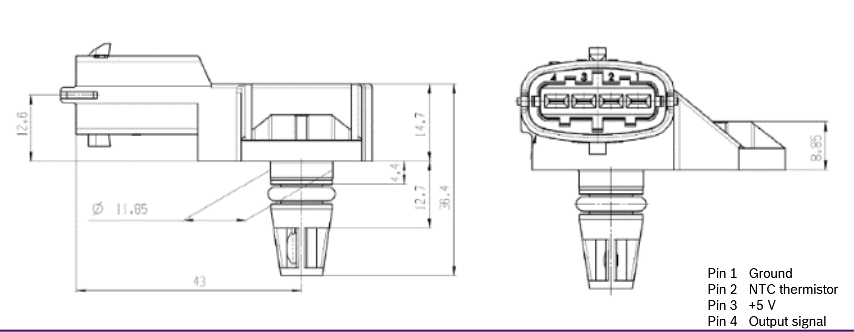
DS-S2-TF

Part number

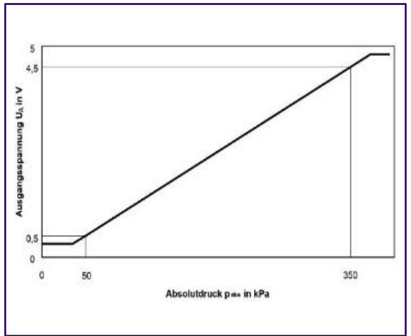
0 281 002 456

Picture

Dimensional drawings



Characteristic curve



Technical data

Parameter		min.	type	Max.
Features		Integrated temperature sensor		
Pressure range ($p_1 \ldots p_2$)	kPa	50		350
Supply voltage U_V	V	4,5	5	5,5
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 ± 5 %	
Temperature/time constant τ_{63} [2)]	s			10

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

Accessories

Connector housing	4-pin	1 928 403 736
Contact pins (tin-plated)	For Ø 0.5...1.0 mm²; Contents:	1 928 498 060
Contact pins (tin-plated)	For Ø 1.5...2.5 mm²; Contents:	1 928 498 061
Single-wire seal	For Ø 0.5...1.0 mm²; Contents:	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm²; Contents:	1 928 300 600
Dummy plug		1 928 300 601

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

▶ Product groups

Absolute pressure sensors

Attention: product will be discontinued, successor product in development. Please approach us via contact page.

BOSCH

Product type

DS-S2

Part number

0 281 002 616

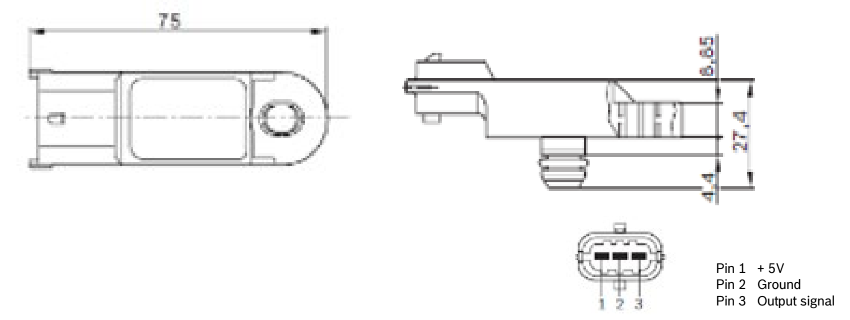
Picture

Technical data

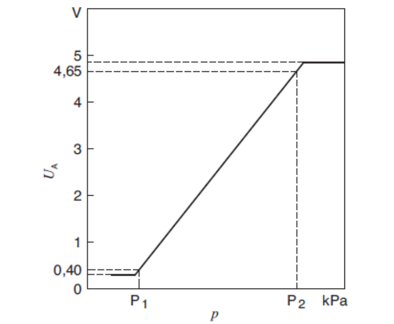
Parameter			min.	type	max.
Pressure range kPa ($p_1 \ldots p_2$)			20		250
Operating temperature	ϑ_B	°C	-40		+130
Supply voltage	U_V	V	4,75	5	5,25
Load resistance to U_V or ground	$R_{pull\text{-}up}$	kΩ	5		
Load resistance to U_V or ground	$R_{pull\text{-}down}$	kΩ	10		
Response time	$\tau_{10/90}$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

Limit data					
Storage temperature	ϑ_L	°C	-40		+130

Dimensional drawings



Characteristic curve



Accessories

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 therefore to be ordered separately as required.

▶ Product groups

Absolute pressure sensors

Product type

DS-S3-TF

Part number

0 261 230 217
(successor of 0 261 230 099)

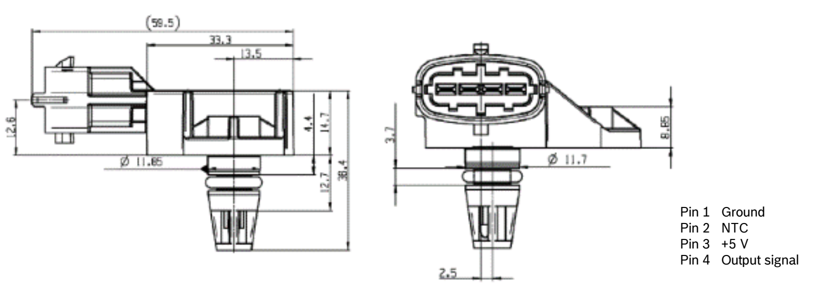
Picture

Technical data

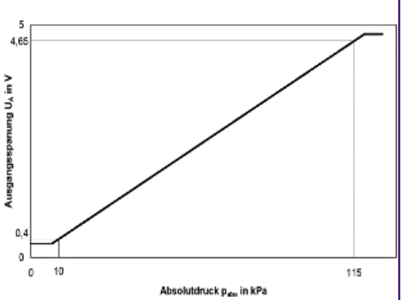
Parameter		min.	type	Max.
Features		Integrated temperature sensor		
Pressure range (p_1...p_2)	kPa	10		115
Supply voltage U_V	V	4,75	5	5,25
Load current I_L at output	mA	-1		0,5
Response time $\tau_{10/90}$	ms			1
Operating temperature	°C	-40		+130

Limit data				
Operating temperature	°C	-40		+130

Dimensional drawings



Characteristic curve



Accessories

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 therefore to be ordered separately as required.

▶ Product groups

Absolute pressure sensor

Product type

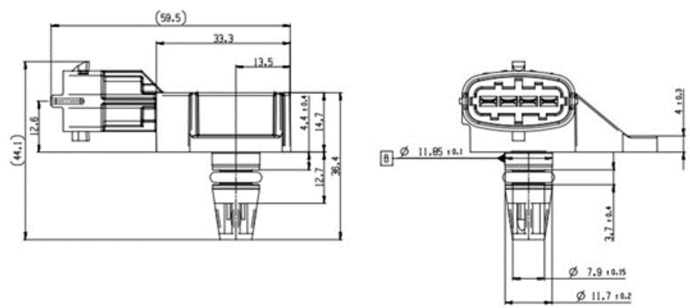
DS-S3-TF

Part number

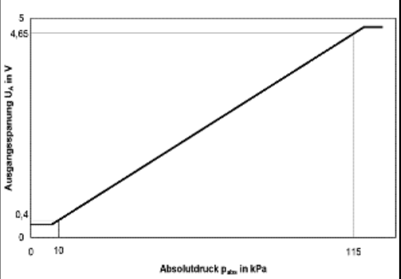
0 261 230 245
(successor of 0 261 230 030)

Picture

Dimensional drawings



Characteristic curve



Technical data

Parameter		min.	type	Max.
Features		Integrated temperature sensor		
Pressure range (p_1...p_2)	kPa	10		115
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			1.0
Operating temperature	°C	-40		+130
Load resistance to Us or ground *R pull up*	kΩ	5	68	
Load resistance to Us or ground *R pull down*	kΩ	10	100	
Lower limit at US = 5 V Upper limit at US = 5 V	V	0.25 4.65	0,3 4,7	0,35 4,75

Accessories

Connector housing	4-pin	1 928 404 745
Contact pins (tin-plated)	For Ø 0.5...1.0 mm²	1 928 498 056
Contact pins (tin-plated)	For Ø 1.5...2.5 mm²	1 928 498 057
Single-wire seal	For Ø 0.35...1.0 mm²	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm²	1 928 300 600
Dummy plug		1 928 300 601

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

▶ Product groups

Absolute pressure sensor

BOSCH

Product type

DS-S3-TF

Part number

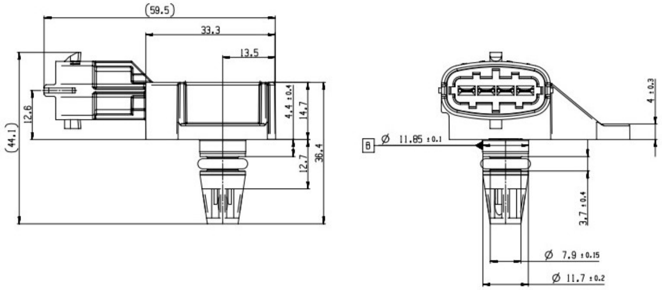
0 261 230 247

Picture

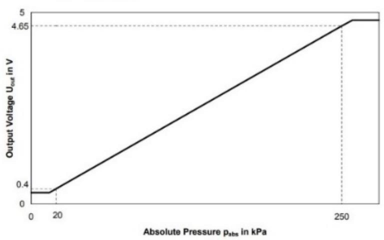
Technical data

Parameter		min.	type	Max.
Features		Integrated temperature sensor		
Pressure range (p_1...p_2)	kPa	20		250
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
Lower limit at US = 5 V Upper limit at US = 5 V	V	0.25 4.65	0,3 4,7	0,35 4,75

Dimensional drawings



Characteristic curve



Accessories

Connector housing	4-pin	1 928 404 745
Contact pins (gold-plated)	For Ø 0.5...1.0 mm²	1 928 498 054
Contact pins (gold-plated)	For Ø 1.5...2.5 mm²	1 928 498 055
Single-wire seal	For Ø 0.35...1.0 mm²	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm²	1 928 300 600
Dummy plug		1 928 300 601

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

► Product groups

Absolute pressure sensor

Product type

DS-S3-TF

Part number

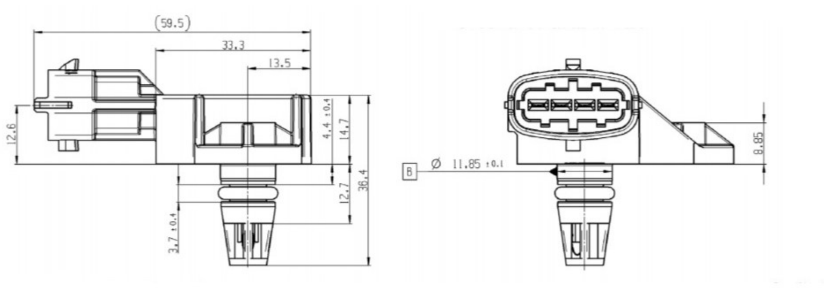
0 261 230 280

Picture

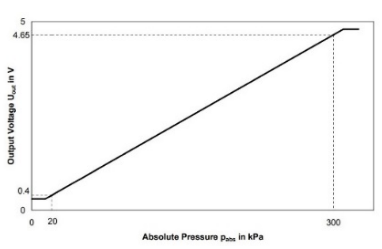
Technical data

Parameter		min.	type	Max.
Features		Integrated temperature sensor		
Pressure range (p_1...p_2)	kPa	20		300
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
Lower limit at US = 5 V Upper limit at US = 5 V	V	0.25 4.65	0,3 4,7	0,35 4,75

Dimensional drawings



Characteristic curve



Accessories

Connector housing	4-pin	1 928 404 745
Contact pins (tin-plated)	For Ø 0.5...1.0 mm²	1 928 498 056
Contact pins (tin-plated)	For Ø 1.5...2.5 mm²	1 928 498 057
Single-wire seal	For Ø 0.35...1.0 mm²	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm²	1 928 300 600
Dummy plug		1 928 300 601

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

▶ Product groups

Absolute pressure sensor

BOSCH

Product type

DS-S3-TF

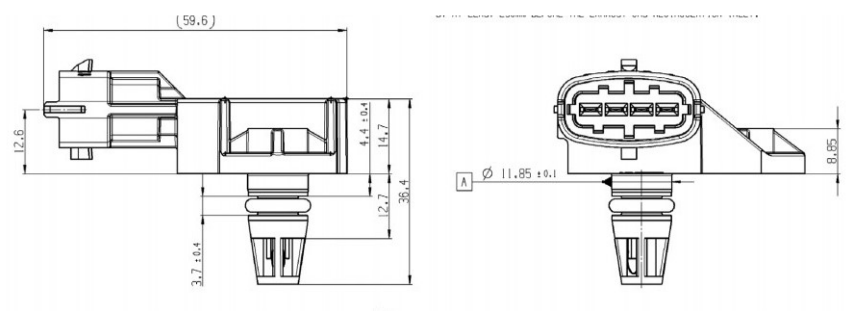
Part number

0 261 230 283

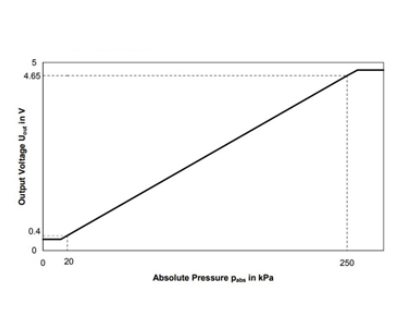
(successor of 0 281 002 514)

Picture

Dimensional drawings



Characteristic curve



Technical data

Parameter		min.	type	Max.
Features		Integrated temperature sensor		
Pressure range (p_1...p_2)	kPa	20		250
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
Lower limit at US = 5 V Upper limit at US = 5 V	V	0.25 4.65	0,3 4,7	0,35 4,75

Accessories

Connector housing	4-pin	1 928 403 736
Contact pins (tin-plated)	For Ø 0.5...1.0 mm²	1 928 498 056
Contact pins (tin-plated)	For Ø 1.5...2.5 mm²	1 928 498 057
Single-wire seal	For Ø 0.35...1.0 mm²	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm²	1 928 300 600
Dummy plug		1 928 300 601

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

► Product groups

Absolute pressure sensor

BOSCH

Product type

DS-S3-TF

Part number

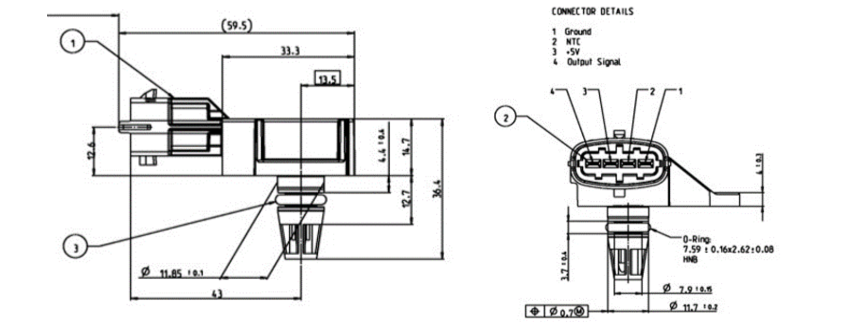
0 261 230 302
(successor of 0 261 230 042)

Picture

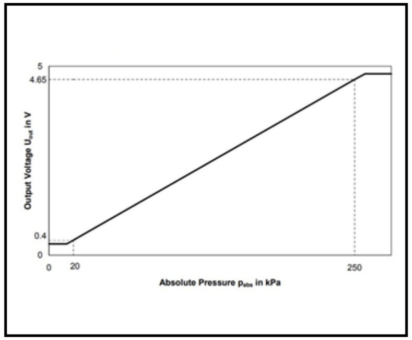
Technical data

Parameter		min.	type	Max.
Features		Integrated temperature sensor		
Pressure range (p_1...p_2)	kPa	20		250
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
Lower limit at US = 5 V Upper limit at US = 5 V	V	0.25 4.65	0,3 4,7	0,35 4,75

Dimensional drawings



Characteristic curve



Accessories

Connector housing	4-pin	1 928 404 745
Contact pins (gold-plated)	For Ø 0.5...1.0 mm²	1 928 498 054
Contact pins (gold-plated)	For Ø 1.5...2.5 mm²	1 928 498 055
Single-wire seal	For Ø 0.35...1.0 mm²	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm²	1 928 300 600
Dummy plug		1 928 300 601

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

► Product groups

Absolute pressure sensor

BOSCH

Product type

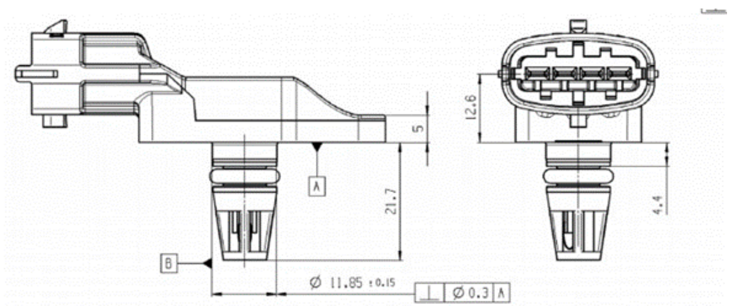
DS-S3-TF

Part number

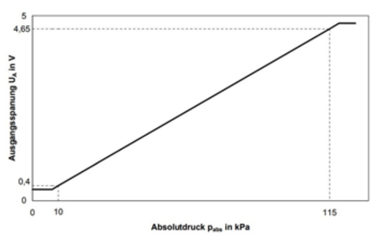
0 261 230 310

Picture

Dimensional drawings



Characteristic curve



Technical data

Parameter		min.	type	Max.
Features		Integrated temperature sensor		
Pressure range (p_1...p_2)	kPa	10		115
Supply voltage U_V	V	4,75	5	5,25
Response time $\tau_{10/90}$	ms			1
Operating temperature	°C	-40		+130
Load current I_L at output	mA	-1		0,5
Operating temperature	°C	-40		+130
Lower limit at US = 5 V Upper limit at US = 5 V	V	0.25 4.65	0,3 4,7	0,35 4,75

Accessories

Connector housing	4-pin	1 928 404 745
Contact pins (gold-plated)	For Ø 0.5...1.0 mm²	1 928 498 054
Contact pins (gold-plated)	For Ø 1.5...2.5 mm²	1 928 498 055
Single-wire seal	For Ø 0.35...1.0 mm²	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm²	1 928 300 600
Dummy plug		1 928 300 601

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

▶ Product groups

Absolute pressure sensors

Product type

DS-S3-TF

Part number

0 261 230 416

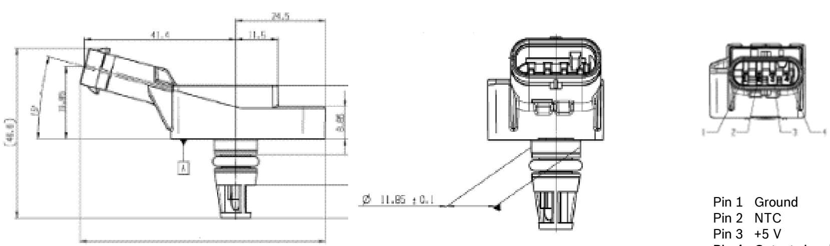
Picture

Technical data

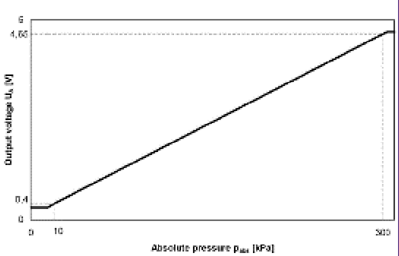
Parameter		min.	type	Max.
Features		Integrated temperature sensor		
Pressure range (p_1...p_2)	kPa	10		300
Supply voltage U_V	V	4,75	5	5,25
Response time $\tau_{10/90}$	ms			1
Operating temperature	°C	-40		+130

Limit data				
Operating temperature	°C	-40		+130

Dimensional drawings



Characteristic curve



▶ Product groups

Absolute pressure sensors

BOSCH

Product type

DS-S3-TF

Part number

0 281 006 028

Picture

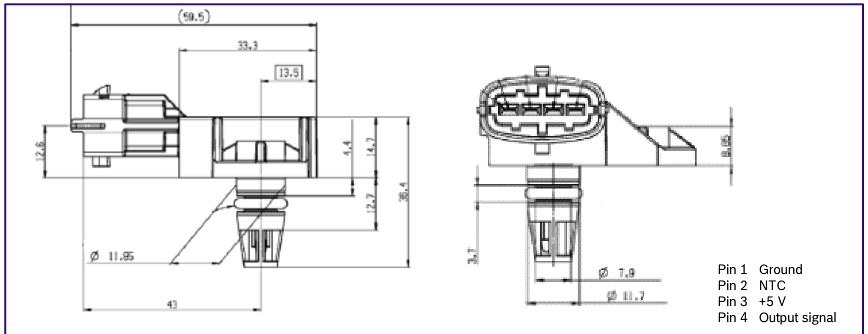
Technical data

Parameter		min.	type	Max.
Features		Integrated temperature sensor		
Pressure range (p_1...p_2)	kPa	20		300
Supply voltage U_V	V	4,75	5	5,25
Response time $\tau_{10/90}$	ms			1
Operating temperature	°C	-40		+130

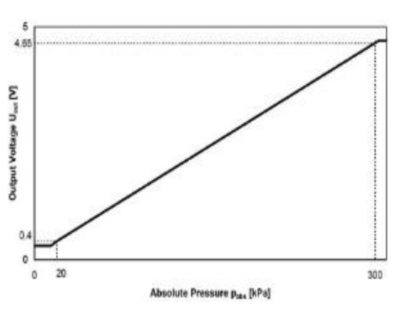
Limit data

Operating temperature	°C	-40		+130

Dimensional drawings



Characteristic curve



Accessories

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 therefore to be ordered separately as required.

► Product groups

Absolute pressure sensors

Product type

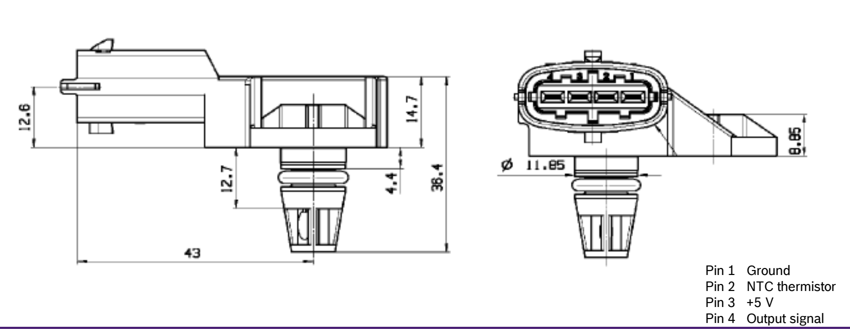
DS-S3-TF

Part number

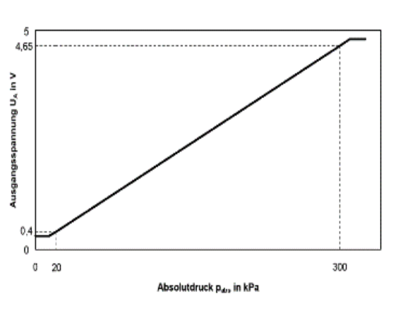
0 281 006 076
(successor of 0 281 002 437)

Picture

Dimensional drawings



Characteristic curve



Technical data

Parameter		min.	type	Max.
Features		Integrated temperature sensor		
Pressure range (p_1...p_2)	kPa	20		300
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 ± 5 %	
Temperature/time constant τ_{63} [2)]	s			10

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

Accessories

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 therefore to be ordered separately as required.

▶ Product groups

Absolute pressure sensors

Product type

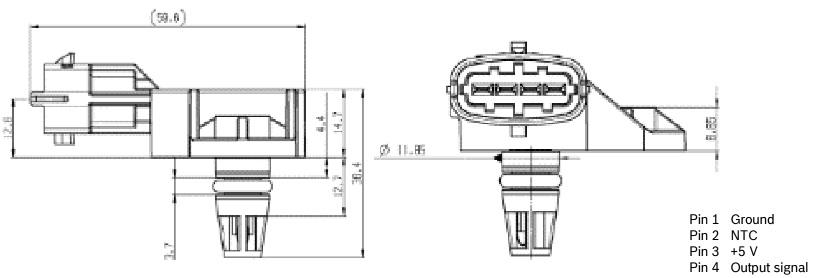
DS-S3-TF

Part number

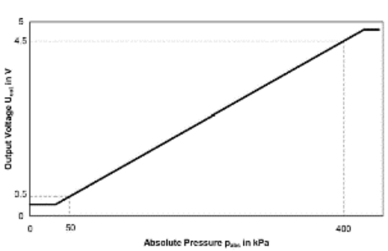
0 281 006 102
(successor of 0 281 002 576)

Picture

Dimensional drawings



Characteristic curve



Technical data

Parameter		min.	type	Max.
Features		Integrated temperature sensor		
Pressure range (p_1...p_2)	kPa	50		400
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
Measurement current[1]	mA			1
Rated resistance at +20°C	kΩ		2,5 ± 5 %	
Temperature/time constant τ_{63} [2]	s			10

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

Accessories

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 therefore to be ordered separately as required.

▶ Product groups

Pressure sensors for CNG

BOSCH

- Pressure range 20 – 1000 kPa
- High level of accuracy
- EMC protection up to 100 Vm^{-1}
- With temperature compensation
- Ratiometric output signal
- All sensors and sensor cells are resistant against natural gas (CNG)

Application

The sensor is used to measure and regulate the absolute pressure and the temperature in the fuel rail pipe of natural-gas systems that are operated with CNG. The fuel pressure sensor is resistant against natural gas (CNG).

Design and operation

The piezo-resistive pressure sensor element and a suitable circuitry for signal amplification and temperature compensation are integrated on a silicon chip. The measured pressure operates from above to the active side of the silicon diaphragm. The temperature sensor element is an NTC-resistor.

Explanation of characteristic data

U_A	Output voltage
U_V	Supply voltage
k	Tolerance multiplier
D	After endurance test
N	As-new condition

Installation instructions

The sensor has been designed for attachment to a flat surface. Both pressure port piece and temperature sensor project into the line, and sealing from the atmosphere is by means of an 0-ring. The hole on the customer side for holding and fastening the sensor in place shall be such that a permanently tight sit at the pressure port as well as stability towards the measuring medium will be assured. The installed position in the vehicle shall be only on the side of medium purity. Neither substances that can freeze nor any condensates at the pressure port are allowed, and neither shall be introduced during transportation of assembly.

► Product groups

Pressure sensors for CNG

Product type

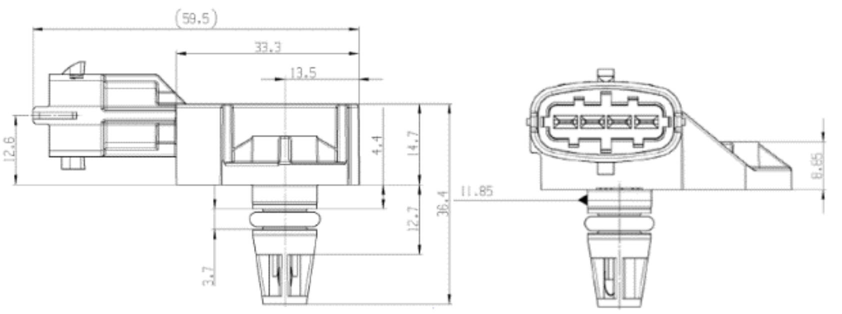
DS-G3-TF

Part number

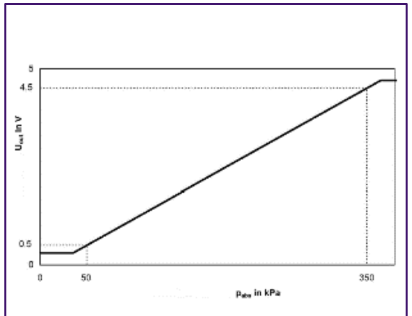
0 261 230 373

Picture

Dimensional drawings



Characteristic curve



Technical data

Parameter		min.	type	Max.
Features		integrated temperature sensor		
Application/medium		approved for CNG		
Pressure range (p_1...p_2)	kPa	50		350
Supply voltage U_V	V	4,75	5	5,25
Current input I_v at U_V = 5 V	mA	6	9	12,5
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	4,65	4,7	4,75
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		120

Accessories

Connector housing	4-pin	1 928 403 736
Contact pins (tin-plated)	For Ø 0.5...1.0 mm²	1 928 498 056
Contact pins (tin-plated)	For Ø 1.5...2.5 mm²	1 928 498 057
Single-wire seal	For Ø 0.5...1.0 mm²	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm²	1 928 300 600
Dummy plug		1 928 300 601

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

► Product groups

Pressure sensors for CNG

BOSCH

Product type

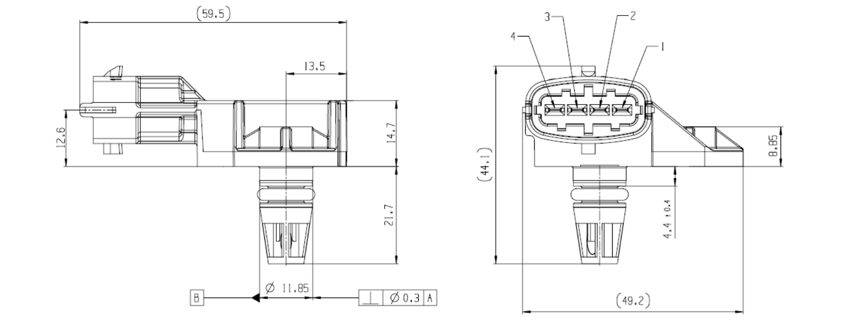
DS-G3-TF

Part number

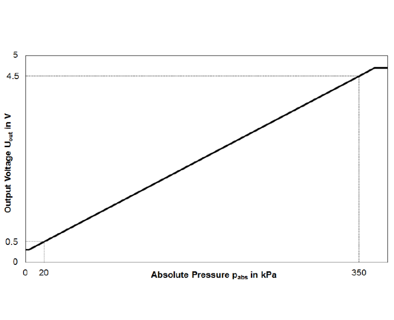
0 261 230 499

Picture

Dimensional drawings



Characteristic curve



Technical data

Parameter		min.	type	Max.
Features		integrated temperature sensor		
Application/medium		approved for CNG		
Pressure range (p_1...p_2)	kPa	20		350
Supply voltage U_V	V	4,75	5	5,25
Current input I_v at U_V = 5 V	mA	6	9	12,5
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	4,65	4,7	4,75
Output resistance to ground, U_V open	kΩ	1	1,6	2
Output resistance to $U_{V,}$ ground open	kΩ	1	1,6	2
Response time $\tau_{10/90}$	ms			1
Operating temperature	°C	-40		120

Accessories

Connector housing	4-pin	1 928 403 736
Contact pins (tin-plated)	For Ø 0.5...1.0 mm²	1 928 498 056
Contact pins (tin-plated)	For Ø 1.5...2.5 mm²	1 928 498 057
Single-wire seal	For Ø 0.5...1.0 mm²	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm²	1 928 300 600
Dummy plug		1 928 300 601

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

▶ Product groups

Pressure sensors for CNG

Product type

DS-G3-TF

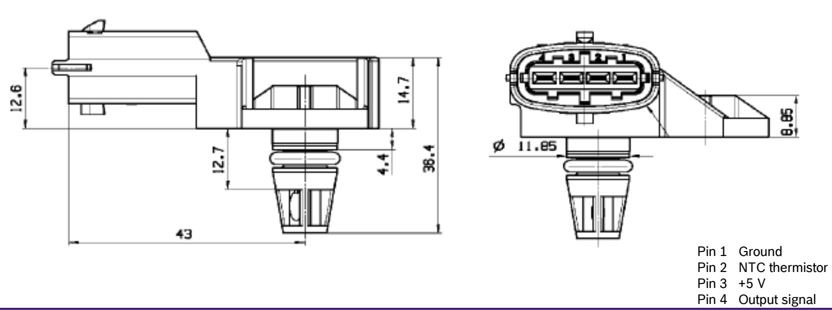
Part number

0 261 230 01F

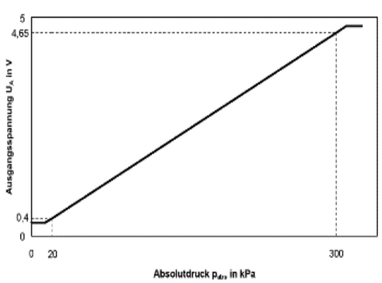
(successor of 0 281 002 437 for usage with CNG)

Picture

Dimensional drawings



Characteristic curve



Technical data

Parameter		min.	type	Max.
Features		Integrated temperature sensor		
Application/medium		approved for CNG		
Pressure range (p_1...p_2)	kPa	20		300
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 ± 5 %	
Temperature/time constant τ_{63} [2]	s			10

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

Accessories

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 therefore to be ordered separately as required.

▶ Product groups

Pressure sensors for CNG

BOSCH

Product type

DS-G3-TF

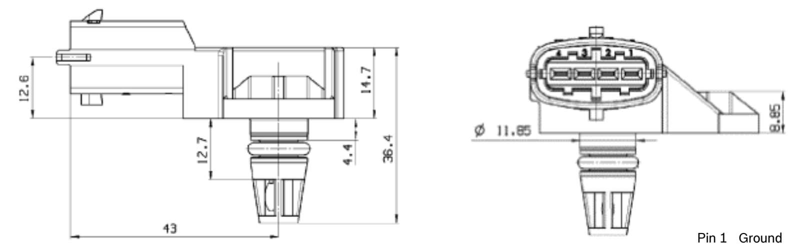
Picture

Part number

0 261 230 01G

(successor of 0 281 002 576 for usage with CNG)

Dimensional drawings



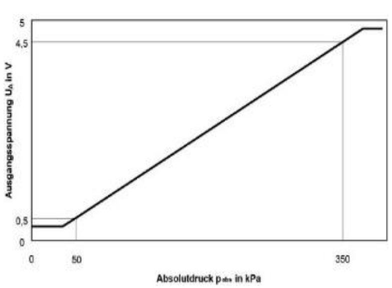
Pin 1 Ground
Pin 2 NTC thermistor
Pin 3 +5 V
Pin 4 Output signal

Technical data

Parameter		min.	type	Max.
Features		Integrated temperature sensor		
Application/medium		approved for CNG		
Pressure range ($p_1 ... p_2$)	kPa	50		400
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 ± 5 %	
Temperature/time constant τ_{63} [2)]	s			10

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

Characteristic curve



Accessories

Connector housing	4-pin	1 928 403 736
Contact pins (tin-plated)	For Ø 0.5...1.0 mm²; Contents:	1 928 498 060
Contact pins (tin-plated)	For Ø 1.5...2.5 mm²; Contents:	1 928 498 061
Single-wire seal	For Ø 0.5...1.0 mm²; Contents:	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm²; Contents:	1 928 300 600
Dummy plug		1 928 300 601

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

► Product groups

High pressure sensors

- Pressure range 5 – 340 MPa
- Ratiometric signal evaluation (relative to supply voltage)
- Self-monitoring offset and sensitivity.
- Excellent media resistance (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

Application

High pressure sensors are used in motor vehicles to measure the pressure in the fuel rail of direct-injection gasoline and common-rail diesel engines or further hydraulic applications.

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 utilization 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.

Explanation of characteristic data

U_A	Output voltage
U_V	Supply voltage
bar	Pressure
U_S	Input voltage
p	Pressure [MPa]
C_O	0.1
C_1	$0.8 \cdot p / P_N$
P_N	Rated pressure [MPa]

Installation instruction

The pressure sensor is designed for different use cases, which have different sealing concepts. Water must not be allowed to collect on the membrane.

The pressure sensor consists of a pressure port of metal and a housing of plastic. The pressure port has a sealing surface and a hexagon. The housing must not be twisted against the pressure port during installation. The pressure sensor has to be handled during screwing-in only at the hexagon. Tools for installation, e. g. socket wrench, must be applied only at the hexagon. After the pressure sensor has been correctly tightened to its installation position, a gap remains between the hexagon of the pressure sensor and the fuel rail or similar interface.

High pressure sensor (hydraulic applications)

BOSCH

Product type

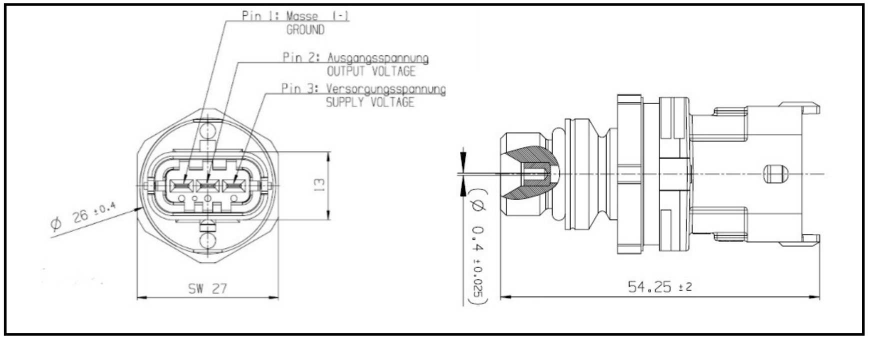
PS-HPS4-MA

Part number

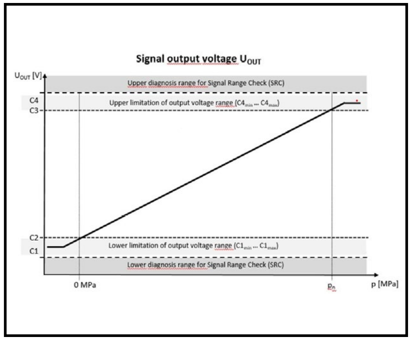
0 261 546 00M

Picture

Dimensional drawings



Characteristic curve



Technical data

Pressure range	P_N	bar (Mpa)	600 (60)
Thread			7/16-20
Connector			Compact 1.1
Application/medium			Hydraulic applications with oil or hydraulic fluids
Max. feed voltage	U_s	V	18
Supply voltage	U_V	V	5 ± 0,25
Supply current	I_s	mA	15
Load capacitance to ground		nF	13
Temperature range		°C	- 40 ...+ 150
Max. overpressure	p_{max}	bar	840
Rupture pressure	p_{max}	bar	4500
Response time	$\tau_{10/90}$	ms	0,2...0,8

[1] FS = Full Scale

Attention: product also available with other pressure ranges, such as 280 or 420 bar. For details, please approach us via contact page.

Accessories

Connector housing	3-pin	1 928 403 966
Contact pins (gold-plated)	For Ø 0.5...1.0 mm²	1 928 498 054
Contact pins (gold-plated)	For Ø 1.5...2.5 mm²	1 928 498 055
Single-wire seal	For Ø 0.35...1.0 mm²	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm²	1 928 300 600
Dummy plug		1 928 300 601

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

▶ Product groups

High pressure sensor (hydraulic applications)

Product type

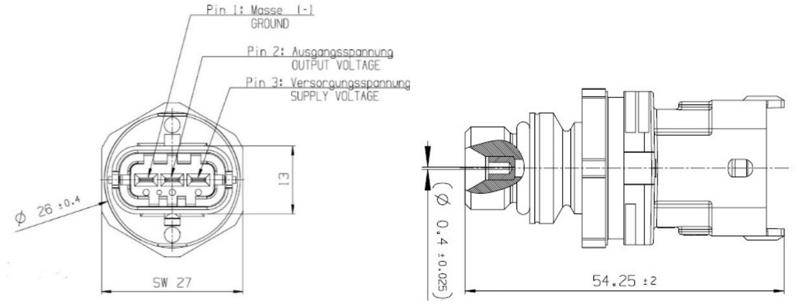
PS-HPS4

Part number

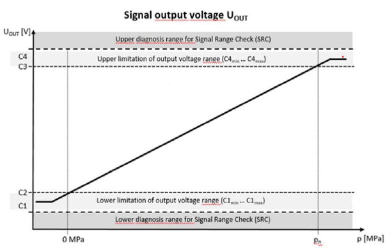
0 261 546 00A

Picture

Dimensional drawings



Characteristic curve



Technical data

Pressure range	P_N	bar (Mpa)	400 (40)
Thread			M 14 x 1,5
Connector			Compact 1.1
Application/medium			Hydraulic applications with oil or hydraulic fluids
Max. feed voltage	U_s	V	18
Supply voltage	U_V	V	5 ± 0,25
Supply current	I_s	mA	15
Load capacitance to ground		nF	13
Temperature range		°C	- 40 ...+ 130
Max. overpressure	p_{max}	bar	840
Rupture pressure	p_{max}	bar	4500
Response time	$\tau_{10/90}$	ms	0,2...0,8

[1)] FS = Full Scale

Attention: product also available with other pressure ranges, such as 600 bar. For details, please approach us via contact page.

Accessories

Connector housing	3-pin	1 928 403 966
Contact pins (gold-plated)	For Ø 0.5...1.0 mm²	1 928 498 054
Contact pins (gold-plated)	For Ø 1.5...2.5 mm²	1 928 498 055
Single-wire seal	For Ø 0.35...1.0 mm²	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm²	1 928 300 600
Dummy plug		1 928 300 601

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

▶ Product groups

High pressure sensor (hydraulic applications)

BOSCH

Product type

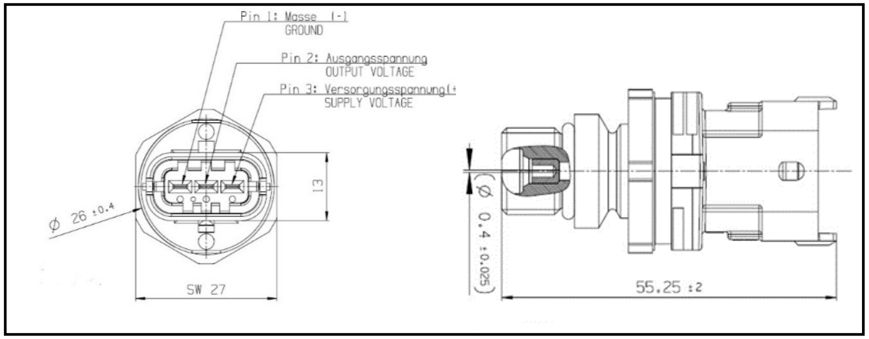
PS-HPS4-MA

Part number

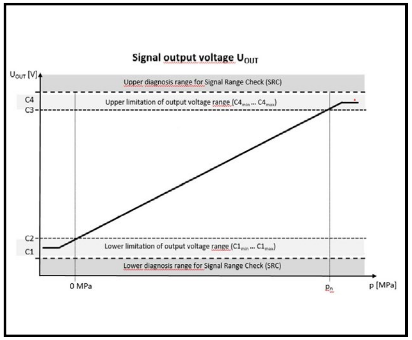
0 261 546 00W

Picture

Dimensional drawings



Characteristic curve



Technical data

Pressure range	P_N	bar (Mpa)	280 (28)
Thread			9/16-18
Connector			Compact 1.1
Application/medium			Hydraulic applications with oil or hydraulic fluids
Max. feed voltage	U_s	V	18
Supply voltage	U_V	V	5 ± 0,25
Supply current	I_s	mA	15
Load capacitance to ground		nF	13
Temperature range		°C	- 40 ...+ 150
Max. overpressure	p_{max}	bar	400
Rupture pressure	p_{max}	bar	2500
Response time	$\tau_{10/90}$	ms	0,2...0,8

[1] FS = Full Scale

Attention: product also available with other pressure ranges, such as 420 or 600 bar. For details, please approach us via contact page.

Accessories

Connector housing	3-pin	1 928 403 966
Contact pins (gold-plated)	For Ø 0.5...1.0 mm²	1 928 498 054
Contact pins (gold-plated)	For Ø 1.5...2.5 mm²	1 928 498 055
Single-wire seal	For Ø 0.35...1.0 mm²	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm²	1 928 300 600
Dummy plug		1 928 300 601

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

▶ Product groups

High pressure sensor (hydraulic applications)

BOSCH

Product type

PS-HPS4-MA

Part number

0 261 546 001

Picture

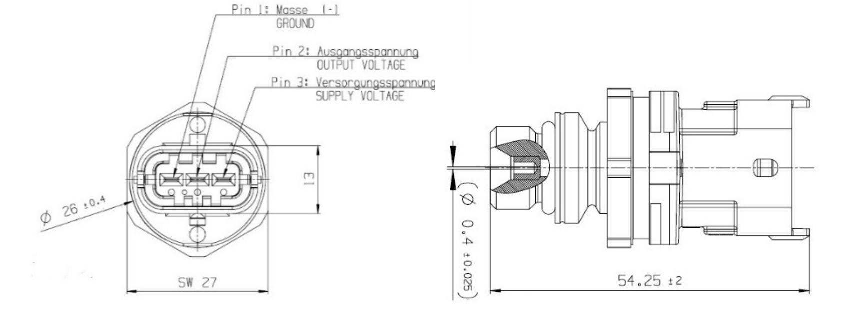
Technical data

Pressure range	P_N	bar (Mpa)	420 (42)
Thread			G1/4 A
Connector			Compact 1.1
Application/medium			Hydraulic applications with oil or hydraulic fluids
Max. feed voltage	U_s	V	18
Supply voltage	U_V	V	5 ± 0,25
Supply current	I_s	mA	15
Load capacitance to ground		nF	13
Temperature range		°C	- 40 ...+ 150
Max. overpressure	p_{max}	bar	560
Rupture pressure	p_{max}	bar	3750
Response time	$\tau_{10/90}$	ms	0,2...0,8

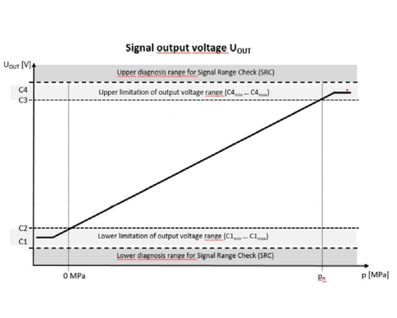
[1] FS = Full Scale

Attention: product also available with other pressure ranges, such as 50 or 420 bar. For details, please approach us via contact page.

Dimensional drawings



Characteristic curve



Accessories

Connector housing	3-pin	1 928 403 966
Contact pins (gold-plated)	For Ø 0.5...1.0 mm²	1 928 498 054
Contact pins (gold-plated)	For Ø 1.5...2.5 mm²	1 928 498 055
Single-wire seal	For Ø 0.35...1.0 mm²	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm²	1 928 300 600
Dummy plug		1 928 300 601

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

▶ Product groups

High pressure sensor (hydraulic applications)

Hydraulic sensor program

Nominal Pressure	series number	electrical Interface	mechanical interface
600 bar	0261 546 000	analog	M14x1,5 acc. ISO 6149-1 w. O-Ring
420 bar	0261 546 001	analog	G1/4 acc. ISO1179-1 w. form gasket
400 bar	0261546 00A	analog	M14x1,5 acc. ISO 6149-1 w. O-Ring
280 bar	0261 546 002	analog	G1/4 acc. ISO1179-1 w. form gasket
100 bar	0261546 00B	analog	G1/4 acc. ISO1179-1 w. form gasket
50 bar	0261 546 003	analog	G1/4 acc. ISO1179-1 w. form gasket
600 bar	0261 546 004	digital (SENT)	M14x1,5 acc. ISO 6149-1 w. O-Ring
420 bar	0261 546 005	digital (SENT)	G1/4 acc. ISO1179-1 w. form gasket
280 bar	0261 546 006	digital (SENT)	G1/4 acc. ISO1179-1 w. form gasket
50 bar	0261 546 007	digital (SENT)	G1/4 acc. ISO1179-1 w. form gasket

Attention: program is regularly adjusted based on market requirements.

▶ Product groups

High pressure sensor (gasoline)

BOSCH

Product type

PS-HPS4

Part number

0 261 545 188

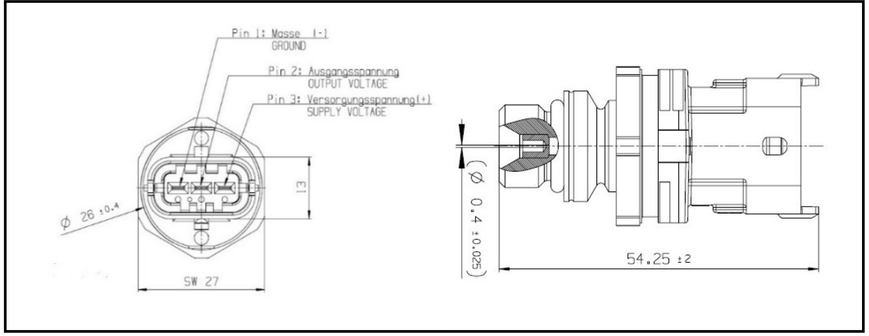
Picture

Technical data

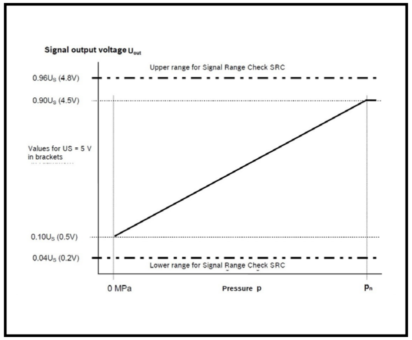
Pressure range	P_N	bar (Mpa)	260 (26)
Thread			M10 x1
Connector			Compact 1.1
Application/medium			CNG
Max. feed voltage	U_s	V	18
Supply voltage	U_V	V	5 ± 0,25
Supply current	I_s	mA	15
Load capacitance to ground		nF	13
Temperature range		°C	- 40 ...+ 140
Max. overpressure	p_{max}	bar	400
Rupture pressure	p_{max}	bar	2500
Response time	$\tau_{10/90}$	ms	1.0

[1)] FS = Full Scale

Dimensional drawings



Characteristic curve



Accessories

Connector housing	3-pin	1 928 403 966
Contact pins (gold-plated)	For Ø 0.5...1.0 mm²	1 928 498 054
Contact pins (gold-plated)	For Ø 1.5...2.5 mm²	1 928 498 055
Single-wire seal	For Ø 0.35...1.0 mm²	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm²	1 928 300 600
Dummy plug		1 928 300 601

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

▶ Product groups

High pressure sensor (gasoline)

Product type

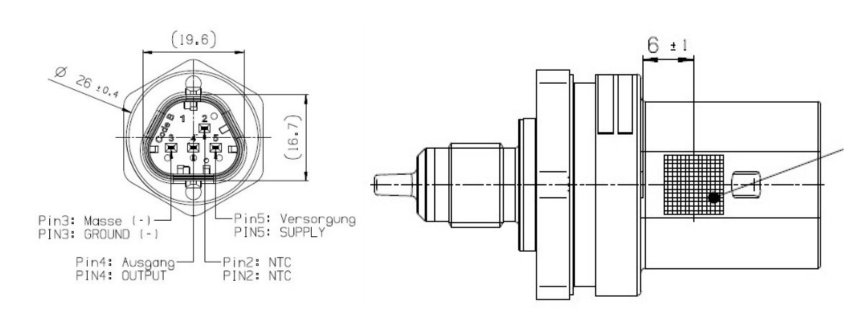
PS-HPS4-TF

Part number

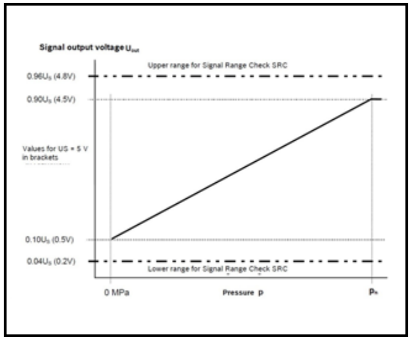
0 261 545 161

Picture

Dimensional drawings



Characteristic curve



Technical data

Pressure range	P_N	bar (Mpa)	260 (26)
Thread			M10x1
Connector			Compact 1.1
Application/medium			gasoline direct injection systems with approved fuels
Max. feed voltage	U_s	V	18
Supply voltage	U_V	V	5 ± 0,25
Supply current	I_s	mA	15
Load capacitance to ground		nF	13
Temperature range		°C	- 40 ...+ 140
Max. overpressure	p_{max}	bar	2500
Rupture pressure	p_{max}	bar	>7000
Response time	$\tau_{10/90}$	ms	0,2...0,8

[1] FS = Full Scale

Attention: product also available with other pressure ranges, such as 140 or 280 bar. For details, please approach us via contact page.

Accessories

Connector housing	4-pin	1 928 405 159
Matrix-Hv Terminal	For Ø 0.35...0.5 mm²; Contents: 4 x	1 928 498 810
Mating single wire seal	For Ø 0.35...0.5 mm²; Contents: 4 x	1 928 300 934
Cavity Plug	For Ø 0.35 ... 0.5 mm²; Contents: 1 x	1 928 300 935

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

▶ Product groups

High pressure sensor (diesel)

Product type

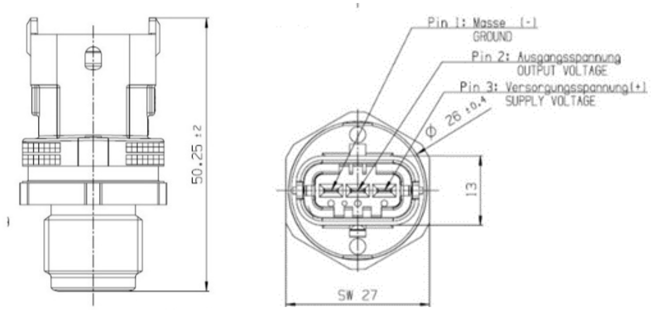
DS-HD-RDS4.2

Part number

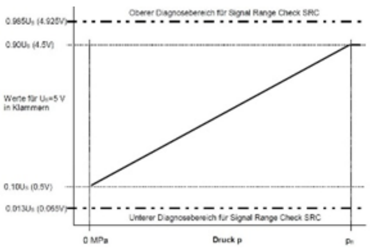
0 281 002 930

Picture

Dimensional drawings



Characteristic curve



Technical data

Pressure range	P_N	bar (MPa)	2000 (200)
Max. feed voltage	U_s	V	16
Supply voltage	U_V	V	5 ± 0,25
Load capacitance to ground		nF	13
Thread			M 18 x 1,5
Application/medium			Diesel or biodiesel*
Temperature range		°C	- 40 ...+ 130
Max. overpressure	p_{max}	bar	2300
Rupture pressure	p_{berst}	bar	4000
Response time	τ_{ini}	ms	2

*RME rapeseed methyl ester.

Attention: product also available with other pressure ranges, such as 1500 or 1800 bar. For details, please approach us via contact page.

Accessories

Connector housing	3-pin	1 928 403 966
Contact pins (gold-plated)	For Ø 0.5...1.0 mm²	1 928 498 054
Contact pins (gold-plated)	For Ø 1.5...2.5 mm²	1 928 498 055
Single-wire seal	For Ø 0.35...1.0 mm²	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm²	1 928 300 600
Dummy plug		1 928 300 601

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

▶ Product groups

High pressure sensor (diesel)

BOSCH

Product type

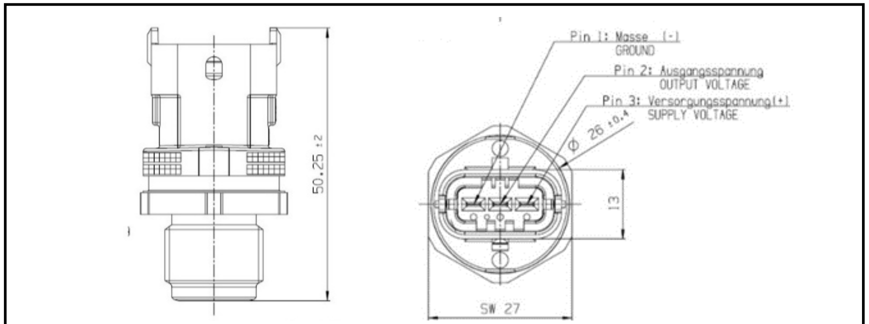
PS-RPS4-22

Part number

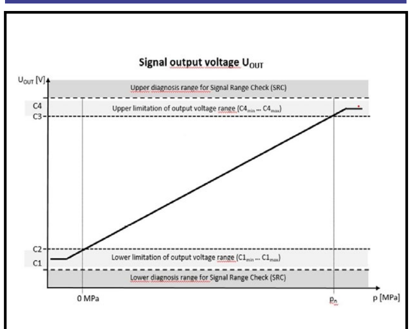
0 281 008 003

Picture

Dimensional drawings



Characteristic curve



Technical data

Pressure range	P_N	bar (MPa)	2400 (240)
Max. feed voltage	U_s	V	16
Supply voltage	U_V	V	5 ± 0,25
Load capacitance to ground		nF	13
Thread			M 18 x 1,5
Application/medium			Diesel or biodiesel*
Temperature range		°C	- 40 ...+ 130
Max. overpressure	p_{max}	bar	2150
Rupture pressure	p_{berst}	bar	>7000
Response time	τ_{ini}	ms	0,2...0,8

*RME rapeseed methyl ester.

Accessories

Connector housing	3-pin	1 928 403 966
Contact pins (gold-plated)	For Ø 0.5...1.0 mm²	1 928 498 054
Contact pins (gold-plated)	For Ø 1.5...2.5 mm²	1 928 498 055
Single-wire seal	For Ø 0.35...1.0 mm²	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm²	1 928 300 600
Dummy plug		1 928 300 601

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

▶ Product groups

Hall speed sensor

- Precise and reliable digital measurement of speeds and angles
- 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

Application

Hall speed sensors are suitable for non-contacting and thus wear-free speed measurement of crank speed, cam speed or similar.

Design and operation

Hall sensors consist of a semiconductor 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.

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 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 data

$n_{min.}=0$	Static operation possible.
$n_{min.}>0$	Dynamic operation only.
U_S	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).

Installation instructions

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

▶ Product groups

Hall speed sensor

BOSCH

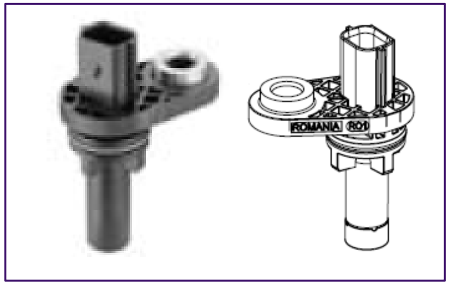
Product type

DG-23

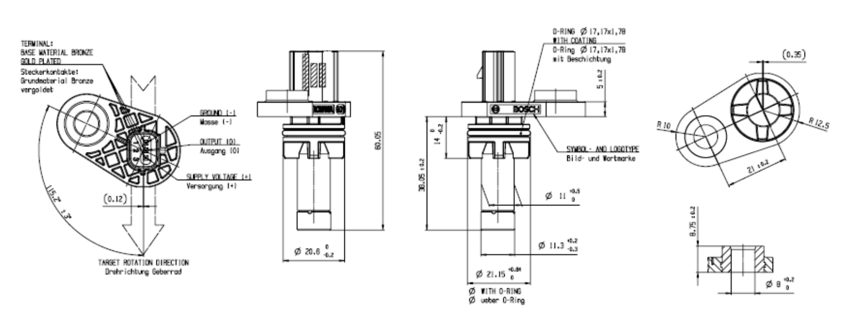
Part number

0 261 210 303

Picture



Dimensional drawings



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 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])	≤ 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.

Hall speed sensor

Product type

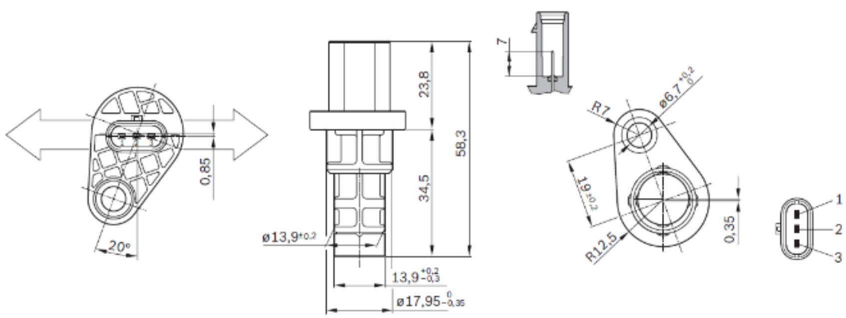
DG-23-I

Part number

0 261 210 30E

Picture

Dimensional drawings



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.

▶ Product groups

Hall speed sensor

BOSCH

Product type

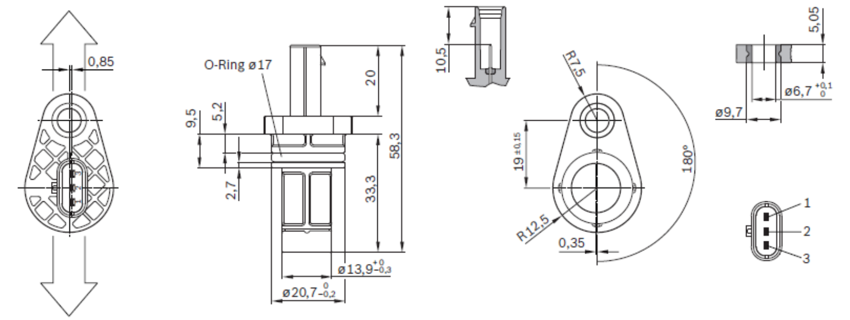
DG-23-I

Part number

0 261 210 383

Picture

Dimensional drawings



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...18V
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.

▶ Product groups

Hall speed sensor

Product type

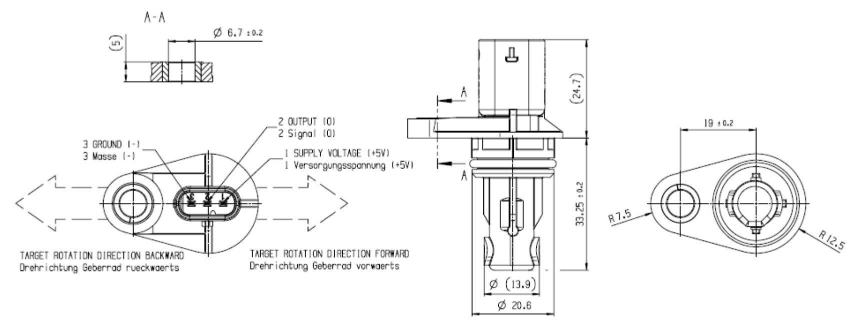
RSC-D5

Part number

0 261 210 399

Picture

Dimensional drawings



Technical data

Minimum trigger-wheel speed	$n_{min.}$	0 min.$^{-1}$
Maximum trigger-wheel speed, forward	$n_{max.}$	10 000 min.$^{-1}$
Maximum trigger-wheel speed, reverse	$n_{max.}$	4 000 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...5,5V
Supply current	I_V	Typically 13 mA
Output current	I_A	0 ... 20 mA
Output saturation voltage	U_s	≤ 0,55 V
Switching time	t_f [2])	≤ 4,25 µs
Switching time	t_f [3])	≤ 10 µs
Steady-state temperature in sensor and transition zone		-40°C...+160°C
Steady-state temperature in connector zone		-40°C...+150°C

[2]) Time from HIGH to LOW, measured between connections (0) and (-) from 90% to 10%.
[3]) Time from LOW to HIGH, measured between connections (0) and (-) from 10% to 90%.

Accessories

Connector housing	3-pin	Hirschmann 872-978-...00
Contact pins (gold plated)		

▶ Product groups

Hall speed sensor

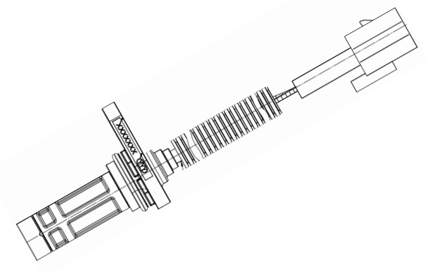
Product type

DG-23-I

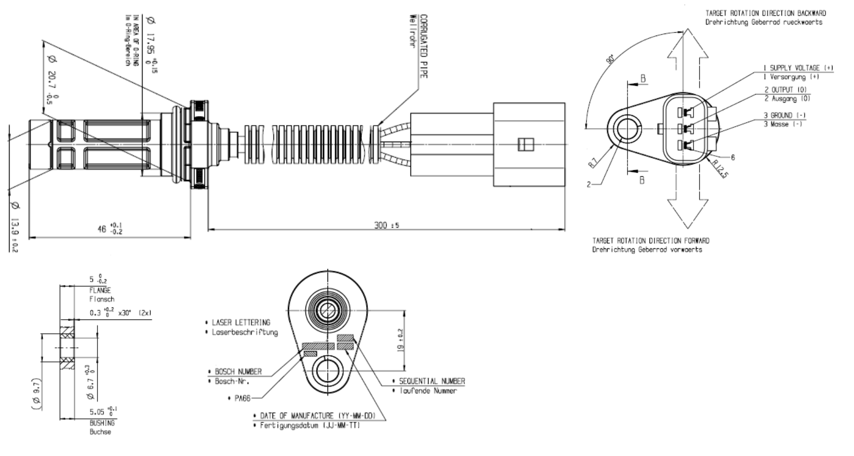
Part number

0 261 210 404

Picture



Dimensional drawings



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.

▶ Product groups

Hall speed sensor

Product group

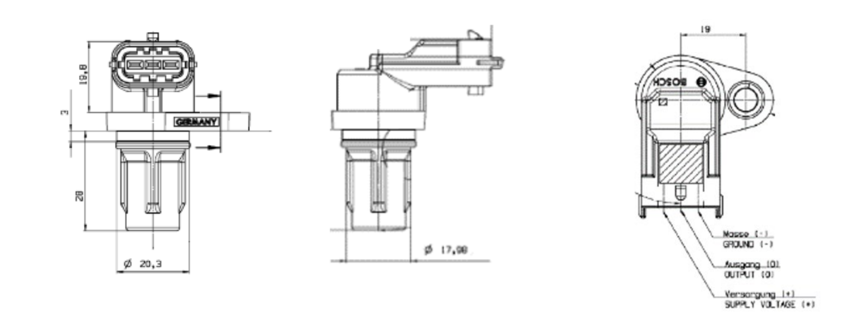
PG-3-8

Part number

0 232 103 048

Picture

Dimensional drawings



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 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.

Accessories

Connector housing	3-pin	1 928 403 966
Contact pins (gold plated)	For Ø 0.5...1.0 mm²; Contents: 100 x	1 928 498 054
Contact pins (gold plated)	For Ø 1.5...2.5 mm²; Contents: 100 x	1 928 498 055
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 therefore to be ordered separately as required.

► Product groups

Hall speed sensor

BOSCH

Product group

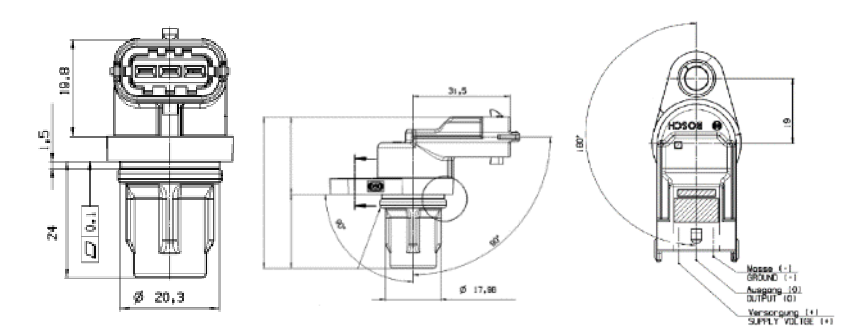
PG-3-8

Part number

0 232 103 063

Picture

Dimensional drawings



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 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.

Accessories

Connector housing	3-pin	1 928 403 966
Contact pins (tin plated)	For Ø 0.5...1.0 mm²; Contents: 100 x	1 928 498 056
Contact pins (tin plated)	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 therefore to be ordered separately as required.

► Product groups

4.1 Rotational-speed sensors

Hall speed sensor

Product group

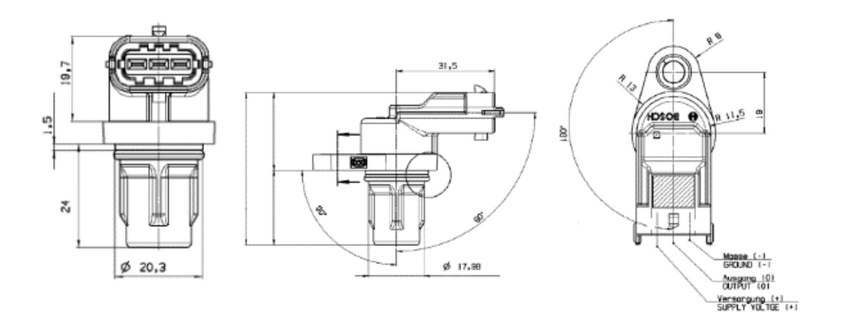
PG-3-8

Part number

0 232 103 067

Picture

Dimensional drawings



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 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.

Accessories

Connector housing	3-pin	1 928 403 966
Contact pins (tin plated)	For Ø 0.5...1.0 mm²; Contents: 100 x	1 928 498 056
Contact pins (tin plated)	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 therefore to be ordered separately as required.

Hall speed sensor

BOSCH

Product group

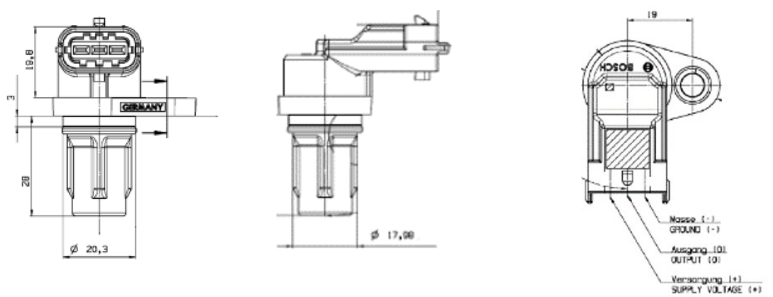
PG-3-8

Part number

0 232 103 097

Picture

Dimensional drawings



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 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.

Accessories

Connector housing	3-pin	1 928 403 966
Contact pins (gold plated)	For Ø 0.5...1.0 mm²; Contents: 100 x	1 928 498 054
Contact pins (gold plated)	For Ø 1.5...2.5 mm²; Contents: 100 x	1 928 498 055
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 therefore to be ordered separately as required.

▶ Product groups

Hall speed sensor

Product group

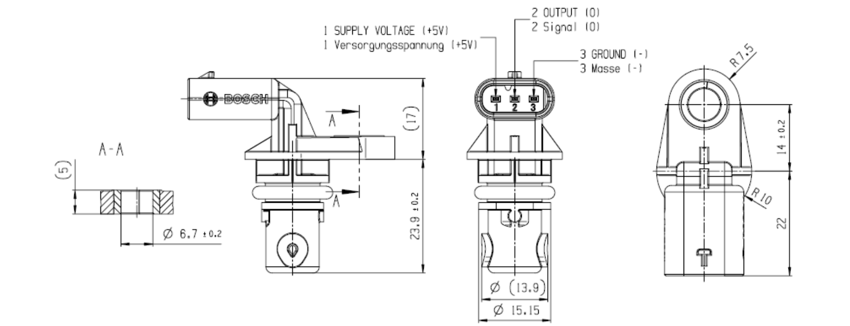
CPS-4

Part number

0 232 103 502

Picture

Dimensional drawings



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 / 12V
Supply voltage range	U_V	4,5 ...5,5V / 4,75 ...16 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])	≤ 3.5 µs
Switching time	t_f [2])	≤ 20.5 µs
Steady-state temperature in sensor and transition zone		-40°C...+160°C
Steady-state temperature in connector zone		-40°C...+150°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%.

Accessories

Connector housing	3-pin	Hirschmann 872-978-...00
		Coding B, Silver plated

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

▶ Product groups

Hall speed sensor

BOSCH

Product type

CPS-4

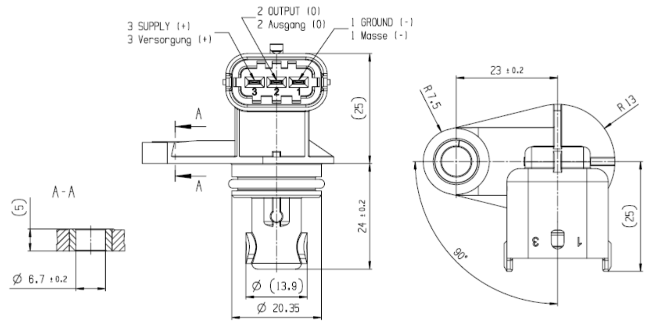
Part number

0 232 103 506

Picture

(generic photo)

Dimensional drawings



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 / 12 V
Supply voltage range	U_V	4,5 ...5,5V / 4,75 ...16 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)	≤ 3.5 µs
Switching time	t_f 2)	≤ 20.5 µs
Steady-state temperature in sensor and transition zone		-40°C...+160°C
Steady-state temperature in connector zone		-40°C...+150°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%.

Accessories

Connector housing	3-pin	1 928 405 524
Contact pins (tin plated)	For Ø 0.5...1.0 mm²; Contents: 100 x	1 928 498 056
Contact pins (tin plated)	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 therefore to be ordered separately as required.

▶ Product groups

Hall speed sensor

BOSCH

Product type

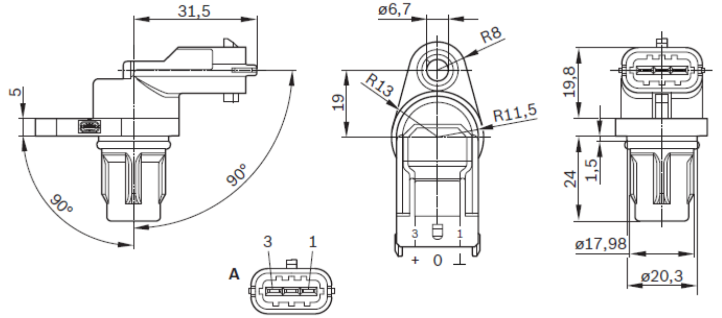
PG-3-8

Part number

0 281 002 667

Picture

Dimensional drawings



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	4,75 ...18V
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 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.

Accessories

Connector housing	3-pin	1 928 403 966
Contact pins (tin plated)	For Ø 0.5...1.0 mm²; Contents: 100 x	1 928 498 056
Contact pins (tin plated)	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 therefore to be ordered separately as required.

▶ Product groups

Hall speed sensor

Product group

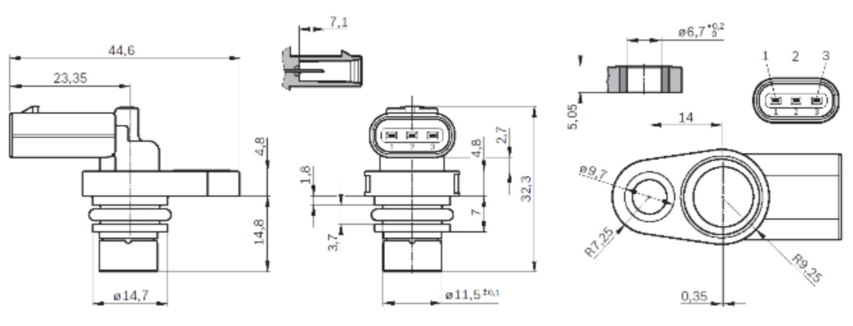
PG-3-9

Part number

0 232 103 099

Picture

Dimensional drawings



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	4,75 ...18V
Supply current	I_V	Typically 5,6 mA
Output current	I_A	0 ... 20 mA
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.

Hall speed sensor

Product group

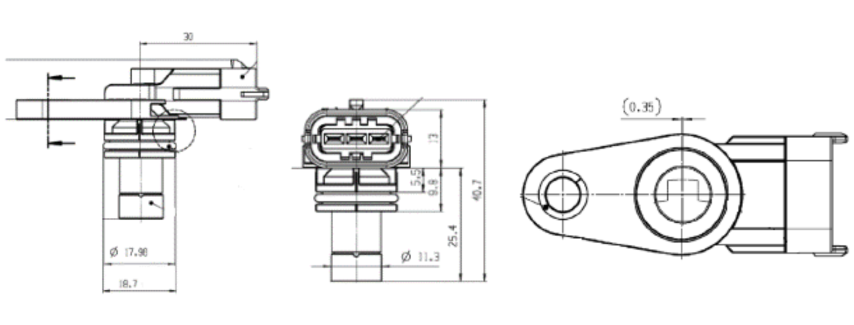
PG-3-9

Part number

0 232 103 122

Picture

Dimensional drawings



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	4,75 ...18V
Supply current	I_V	Typically 5,6 mA
Output current	I_A	0 ... 20 mA
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...+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.

Accessories

Connector housing	3-pin	1 928 403 968
Contact pins (silver plated)	For Ø 0.5...1.0 mm²; Contents: 100 x	1 928 498 058
Contact pins (silver plated)	For Ø 1.5...2.5 mm²; Contents: 100 x	1 928 498 059
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 therefore to be ordered separately as required.

► Product groups

4.2 Rotational-speed sensors

Inductive speed sensor

BOSCH

- Precise and reliable measurement of speeds
- Non-contacting measurement
- Not susceptible to dirt
- Resistant to mineral oil products (fuel, engine oil)

Application

Inductive speed sensors of this type are suitable for a variety of speed recording applications. Depending on design, they use completely non-contacting and wear-free methods to measure engine speeds (cam or crank) and convert these speeds into electrical signals.

Design and operation

The soft iron core of the speed sensor, surrounded by a winding, is positioned directly opposite a rotating trigger wheel and only separated from this by a narrow air gap. The soft iron core is connected to a permanent magnet, the magnetic field of which extends into the ferromagnetic trigger wheel, by which it is influenced. A tooth directly opposite the sensor concentrates the magnetic field and thus intensifies the magnetic flux in the coil. A gap on the other hand attenuates the flux in the coil. These two states alternate constantly due to the rotation of the ring gear. The transition from gap to tooth (leading tooth edge) and from tooth to gap (trailing tooth edge) produces changes in the magnetic flux which induce an alternating voltage in the coil in line with Faraday's law. The frequency of this voltage can be used for speed determination.

Per tooth the sensor supplies an output pulse, the magnitude of which is governed by the speed, the size of the air gap, the tooth shape and the rotor materials used. Together with the frequency, the amplitude of the output signal also increases with the speed. A minimum speed is therefore necessary to permit reliable evaluation of even very low voltages. A reference mark on the trigger wheel in the form of a large "tooth gap" permits determination of the position of the trigger wheel in addition to the actual speed measurement. The trigger wheel sensor ring forms part of the speed detection system. Sensor rings must be of a high technical standard to provide reliable speed information. Trigger wheel sensor ring specifications are available on request.

Explanation of characteristic data

U	Output voltage
n	Speed
s	Air gap

Installation instructions

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

▶ Product groups

Inductive speed sensor

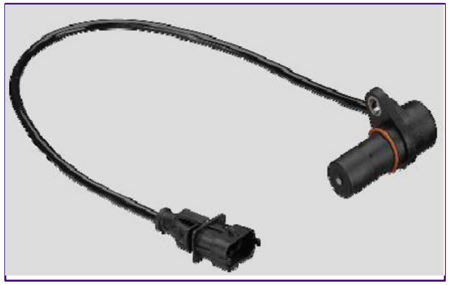
Product group

DG-6-K

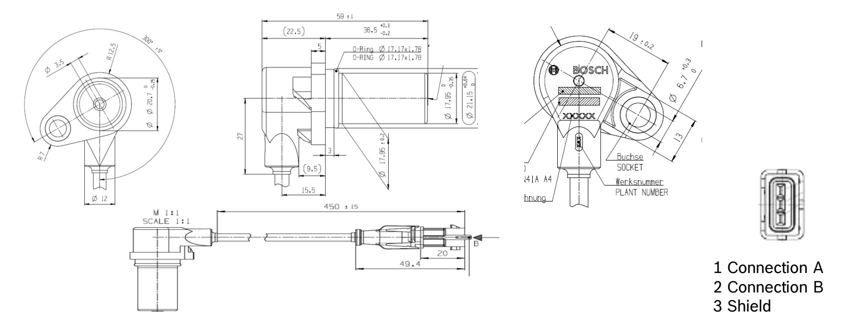
Part number

0 281 002 214

Picture



Dimensional drawings



Technical data

Rotational-speed measuring range [1] n	min^{-1}	20 ... 7000
Sustained ambient temperature/coil zone	°C	- 40 ... + 130
Sustained ambient temperature/cable zone	°C	- 40 ... + 130
Max. vibration	m/s^2	300
Number of turns		4300 turns/windings
Winding resistance at 20 °C [2] U_A	Ω	860 ±10%
Inductance at 1 kHz	mH	370 ±60
Degree of protection	IP	IPx9K
Output voltage [2] U_A	V/mV	210 V (0.3mm air-gap, 7000 RPM) 170 mV (1.5mm air-gap, 50 RPM)
Signal frequency	Hz	7000 (for 60-2 type wheel)

[1] Referenced to corresponding trigger wheel.
[2] Change factor k= 1+0.004 (v_w -20°C); v_w Winding temperature.

Accessories

Connector housing	3-pin	1 928 403 734
Contact pins (tin plated)	For Ø 0.5...1.0 mm²; Contents: 100 x	1 928 498 056
Contact pins (tin plated)	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 therefore to be ordered separately as required.

▶ Product groups

Inductive speed sensor

Product group

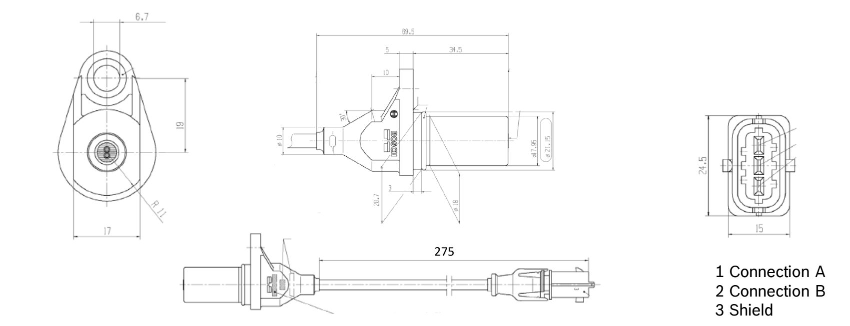
DG-6-K

Part number

0 281 002 629

Picture

Dimensional drawings



Technical data

Rotational-speed measuring range [1] n	min^{-1}	20 ... 7000
Sustained ambient temperature/coil zone	°C	- 40 ... + 150
Sustained ambient temperature/cable zone	°C	- 40 ... + 130
Max. vibration	m/s^2	300
Number of turns		4300 turns/windings
Winding resistance at 20 °C [2] U_A	Ω	860 ±10%
Inductance at 1 kHz	mH	370 ±60
Degree of protection	IP	IPx9K
Output voltage [2] U_A	V/mV	210 V (0.3mm air-gap, 7000 RPM) 170 mV (1.5mm air-gap, 50 RPM)
Signal frequency	Hz	7000 (for 60-2 type wheel)

[1] Referenced to corresponding trigger wheel.
[2] Change factor k= 1+0.004 (v_w -20°C); v_w Winding temperature.

Accessories

Connector housing	3-pin	1 928 404 073
Contact pins	For Ø 0.5...1.0 mm²	1 928 498 056
Contact pins	For Ø 1.5...2.5 mm²	1 928 498 057
Single-wire seal	For Ø 0.5...1.0 mm²	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm²	1 928 300 600
Dummy plug		1 928 300 601

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

▶ Product groups

Inductive speed sensor

BOSCH

Product group

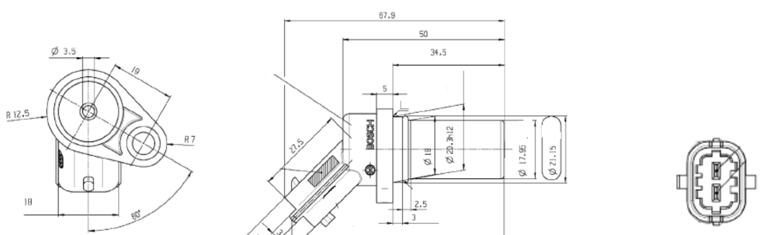
DG-6-S

Part number

0 281 002 315

Picture

Dimensional drawings



1 Connection B
2 Connection A

Technical data

Rotational-speed measuring range [1] n	min^{-1}	20 ... 7000
Sustained ambient temperature/coil zone	°C	- 40 ... + 150
Sustained ambient temperature/cable zone	°C	- 40 ... + 130
Max. vibration	m/s^2	300
Number of turns		4300 turns/windings
Winding resistance at 20 °C [2] U_A	Ω	860 ±10%
Inductance at 1 kHz	mH	370 ±60
Degree of protection	IP	IPx9K
Output voltage [2] U_A	V/mV	210 V (0.3mm air-gap, 7000 RPM) 170 mV (1.5mm air-gap, 50 RPM)
Signal frequency	Hz	7000 (for 60-2 type wheel)

[1] Referenced to corresponding trigger wheel.
[2] Change factor k= 1+0.004 (v_w -20°C); v_w Winding temperature.

Accessories

Connector housing	2-pin	1 928 404 072
Contact pins (tin-plated)	For Ø 0.5...1.0 mm²	1 928 498 056
Contact pins (tin-plated)	For Ø 1.5...2.5 mm²	1 928 498 057
Single-wire seal	For Ø 0.5...1.0 mm²	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm²	1 928 300 600
Dummy plug		1 928 300 601

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

▶ Product groups

4.2 Rotational speed sensor

Speed sensor for exhaust-gas turbochargers

Product type

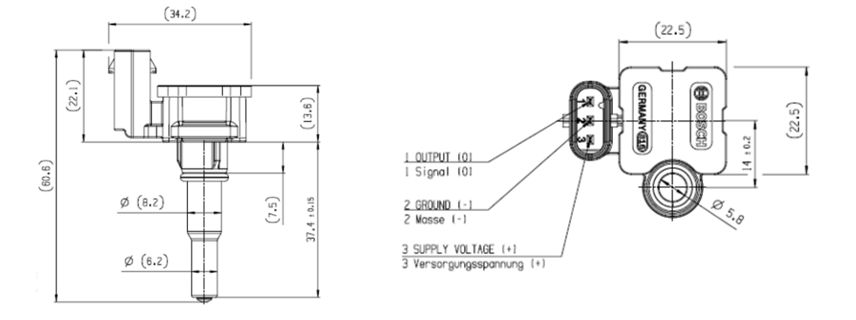
RS-T1

Part number

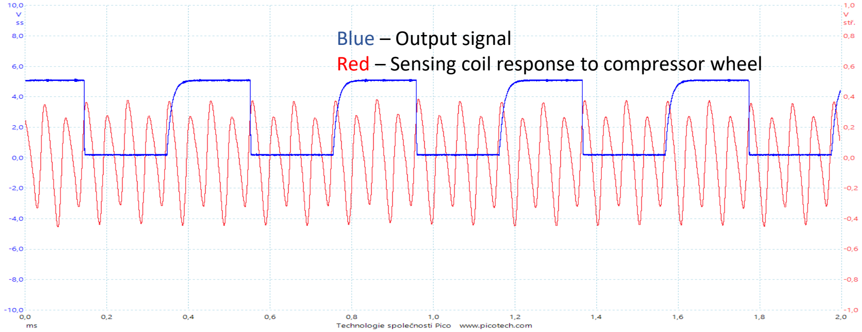
0 261 210 903

Picture

Dimensional drawings



Typical output signal



Technical data

Passive sensor „eddy current“ principle, **NOT** a through hole sensor.

5V supply voltage line and output pull-up resistor (typ. 1kOhm) required.

Sensor output proportional to: $f_{out} = \frac{(n_{TC} \cdot n_{blade})}{n \cdot 60} [s^{-1}]$;

n_{TC} = turbocharger RPM; n_{blade} = number of blades; n = selectable integer divider factor [1,4,**8**,16]

Speed range differs depending on aplication, typically 50k – 200k RPM.

Ambient temperature range: -40°C ... 150°C (Sensor tip short time 200°C).

Sensor features:

-TIM – Twist Insensitive Mounting

- Self diagnostic function

▶ Product groups

Piezoelectric vibration sensor

BOSCH

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

Application

Vibration sensors of this 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.

Areas of application

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

Design and operation

On account of its inertia, a mass exerts compressive forces on an annular piezo-ceramic 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.

Explanation of characteristic data

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.

► Product groups

5 Structure-borne sound

Piezoelectric vibration sensor

BOSCH

Product type

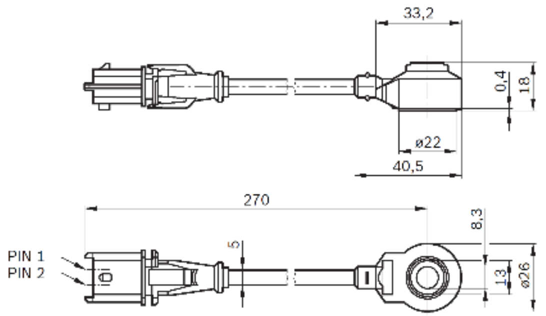
KS-4-K

Part number

0 261 231 196

Picture

Dimensional drawings



Technical data

Vibration sensors	2-pole, with cable
Frequency range	0 ... 24 kHz
Self-impedance	> 1 MΩ
Operating temperature range	- 40 ...+ 130 °C (sensor head +150 °C)
Permissible sustained vibration	≤ 80 g
Pin coating	Gold-plated

Accessories

Connector housing	2-pin RB compact connector code-1, tin plated terminals	
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	1 928 300 599
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 therefore to be ordered separately as required.

▶ Product groups

Piezoelectric vibration sensor

Product type

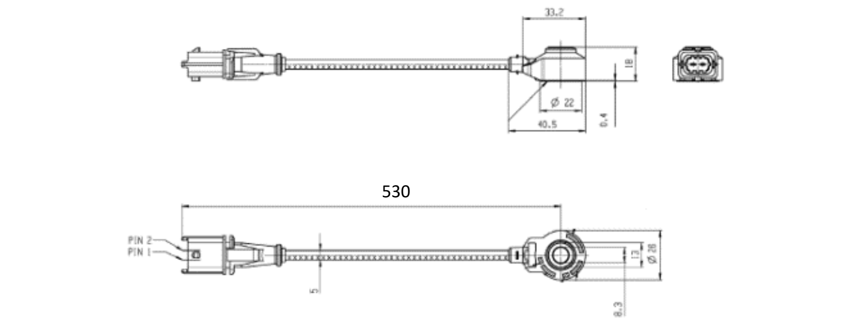
KS-4-K

Part number

0 261 231 218

Picture

Dimensional drawings



Technical data

Vibration sensors	2-pole, with cable
Frequency range	0 ... 24 kHz
Self-impedance	> 1 MΩ
Operating temperature range	- 40 ...+ 130 °C (sensor head 150 °C)
Permissible sustained vibration	≤ 80 g
Pin coating	Gold-plated

Accessories

Connector housing	2-pin RB compact connector code-1, tin plated terminals	
Connector housing	2-pin	1 928 403 137

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

▶ Product groups

Piezoelectric vibration sensor

BOSCH

Product type

KS-4-S

Part number

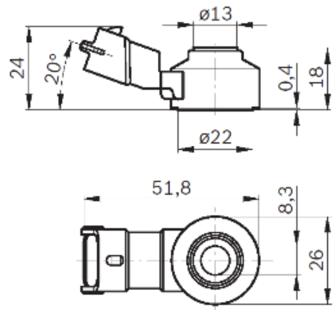
0 261 231 173

Picture

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
Pin coating	Gold-plated

Dimensional drawings



Accessories

Connector housing	2-pin RB compact connector code-1, gold plated terminals	
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	1 928 300 599
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 therefore to be ordered separately as required.

▶ Product groups

Piezoelectric vibration sensor

Product type

KS-4-S

Part number

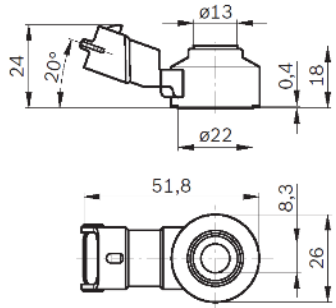
0 261 231 176

Picture

Technical data

Vibration sensors	2-pole, without cable
Frequency range	3 ... 22 kHz
Self-impedance	> 1 MΩ
Operating temperature range	- 40 ...+ 130 °C
Permissible sustained vibration	≤ 50 g
Pin coating	Tin-plated

Dimensional drawings



Accessories

Connector housing	2-pin RB compact connector code-1, gold plated terminals	
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	1 928 300 599
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 therefore to be ordered separately as required.

▶ Product groups

Piezoelectric vibration sensor

BOSCH

Product type

KS-4-S

Part number

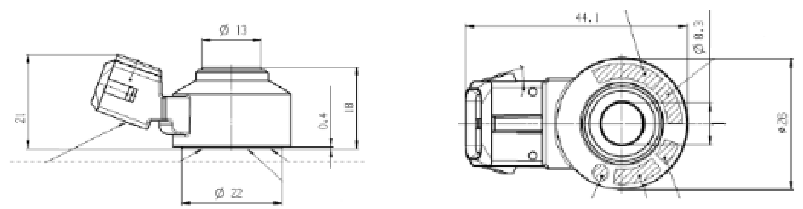
0 261 231 208

Picture

Technical data

Vibration sensors	2-pole, without cable
Frequency range	0 ... 24 kHz
Self-impedance	> 1 MΩ
Operating temperature range	- 40 ...+ 130 °C
Permissible sustained vibration	≤ 80 g
Pin coating	Tin-plated

Dimensional drawings



Accessories

Connector housing	2-pin Jetronics connector, gold plated terminals	
Connector housing	2-pin	1 284 485 070

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

Piezoelectric vibration sensor

BOSCH

Product type

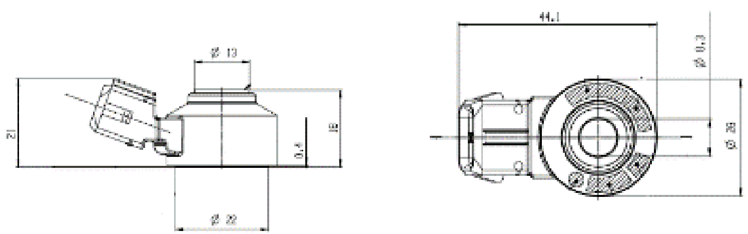
KS-4-S

Part number

0 261 231 300

Picture

Dimensional drawings



Technical data

Vibration sensors	2-pole, without cable
Frequency range	0 ... 24 kHz
Self-impedance	> 1 MΩ
Operating temperature range	- 40 ...+ 150 °C
Permissible sustained vibration	≤ 80 g
Pin coating	Gold-plated

Accessories

Connector housing	2-pin	1 928 402 070

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

▶ Product groups

Measurement of air/liquid temperatures

- Temperature range -40C - 130C
- Measurement of air, coolant, fuel and oil
- Measurement with temperature sensitive resistors
- Broad temperature range

Application

The temperature sensor is a sensor, converting a temperature into an electrical signal. Available for air, coolant, fuel and oil temperature measurement.

In motor vehicles they are used to measure the temperature of the intake air in the range -40…130 °C.

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.

Explanation of characteristic data

R	Resistance
ϑ	Temperature

Installation instructions

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

► Product groups

Measurement of air/liquid temperatures

BOSCH

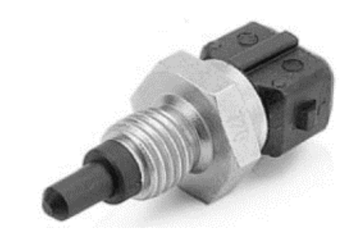
Product type

TF-L

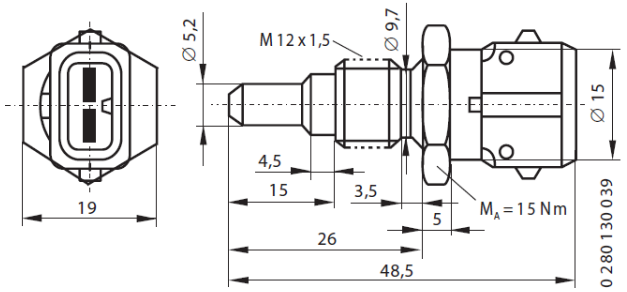
Part number

0 280 130 039

Picture



Dimensional drawings



Technical data

Temperature range	°C	-40 ... + 130
Features		Sensor in steel housing with threaded connection.
Application/medium		air
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.

Accessories

Connector housing	2-pin Jetronics connector, tin plated terminals	
Connector housing	2-pin	1 928 402 078
Protective cap	Temperature-resistant	1 280 703 031
Contact pins	For Ø 0.5...1.0 mm²	AMP 929 939-3
Contact pins	For Ø 1.5...2.5 mm²	AMP 929 937-3
Individual seal	For Ø 0.5...1.0 mm²	1 987 280 106
Individual seal	For Ø 1.5...2.5 mm²	1 987 280 107

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

▶ Product groups

Measurement of air/liquid temperatures

Product type

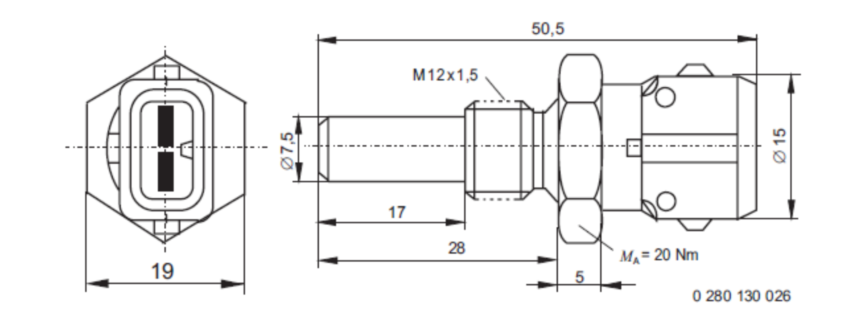
TF-W

Part number

0 280 130 026

Picture

Dimensional drawings



Technical data

Measuring range	°C	-40 ... +130
Features		Sensor in brass housing.
Application/medium		Oil/water
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
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
Tightening torque	Nm	20
Rated voltage	V	5 ± 0,15

1) With individual seal.

Accessories

Connector housing	2-pin	1 928 402 078
Protective cap	Temperature-resistant	1 280 703 031
Contact pins	For Ø 0.5...1.0 mm²	AMP 929 939-3
Contact pins	For Ø 1.5...2.5 mm²	AMP 929 937-3
Individual seal	For Ø 0.5...1.0 mm²	1 987 280 106
Individual seal	For Ø 1.5...2.5 mm²	1 987 280 107

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

Measurement of air/liquid temperatures

Product type

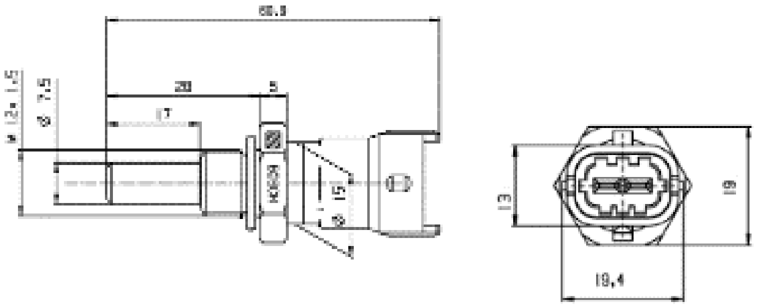
TF-W

Part number

0 280 130 093

Picture

Dimensional drawings



Technical data

Temperature range	°C	-40 ... +130
Features		Sensor in brass housing.
Application/medium		Coolants, fuel, oil
Tolerance at +100 °C	kΩ	0,1886 ± 2%
Rated resistance at 20 °C	kΩ	2,5 ± 5%
Resistance at -10 °C	kΩ	8,727 ... 10,067
Resistance at +20 °C	kΩ	2,375 ... 2,625
Resistance at +80 °C	kΩ	0,323 ... 0,349
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
Tightening torque	Nm	20
Rated voltage	V	5 ± 1,5

Accessories

Connector housing	2-pin RB compact connector code-1, tin plated terminals	
Connector housing	2-pin	1 928 403 137
Contact pins (tin-plated)	For Ø 0.5...1.0 mm²	AMP 929 939-3
Contact pins (tin-plated)	For Ø 1.5...2.5 mm²	AMP 929 937-3
Single-wire seal	For Ø 0.5...1.0 mm²	AMP 828 904
Single-wire seal	For Ø 1.5...2.5 mm²	AMP 828 905
Dummy plug		AMP 828 922

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

▶ Product groups

Measurement of air/liquid temperatures

BOSCH

Product type

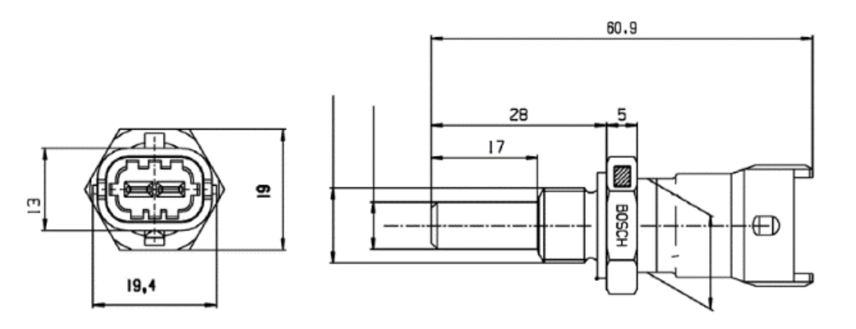
TF-W

Part number

0 281 002 170

Picture

Dimensional drawings



Technical data

Temperature range	°C	-40 ... +130
Features		Sensor in brass housing.
Application/medium		Oil/water
Rated resistance at 100 °C	kΩ	0,19 ± 2 %
Resistance at -10 °C	kΩ	8,64 ... 10,15
Resistance at +20 °C	kΩ	2,35 ... 2,65
Resistance at +80 °C	kΩ	0,31 ... 0,33
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 38 52-1
Tightening torque	Nm	25
Rated voltage	V	5 ± 0,15

[1] With single-wire seal.

Accessories

Connector housing	2-pin RB compact connector code-1, gold plated terminals	
Connector housing	2-pin	1 928 403 137
Contact pins (gold-plated)	For Ø 0.5...1.0 mm²	AMP 2 929 939-1
Contact pins (gold-plated)	For Ø 1.5...2.5 mm²	AMP 2 929 937-1
Single-wire seal	For Ø 0.5...1.0 mm²	AMP 828 904
Single-wire seal	For Ø 1.5...2.5 mm²	AMP 828 905
Dummy plug		AMP 828 922

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

▶ Product groups

Measurement of air/liquid temperatures

Product type

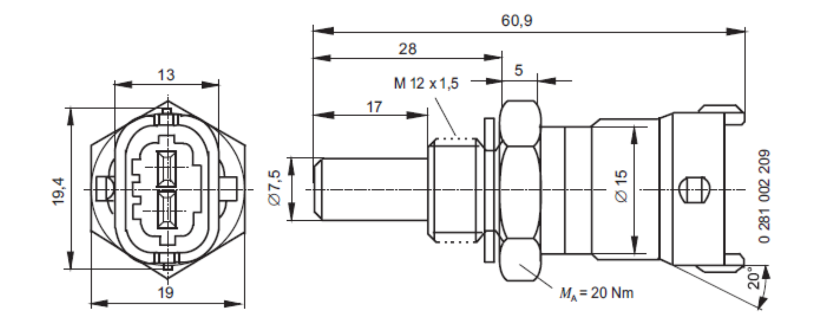
TF-W

Part number

0 281 002 209

Picture

Dimensional drawings



Technical data

Temperature range	°C	-40 ... + 130
Features		Sensor in brass housing.
Application/medium		Oil/water
Rated resistance at 20 °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
Tightening torque	Nm	25
Rated voltage	V	5 ± 0,15

[1)] With single-wire seal.

Accessories

Connector housing	2-pin RB compact connector code-1, Tin plated terminals	
Connector housing	2-pin	1 928 403 874
Contact pins	For Ø 0.5...1.0 mm²	1 928 498 056
Contact pins	For Ø 1.5...2.5 mm²	1 928 498 057
Single-wire seal	For Ø 0.5...1.0 mm²	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm²	1 928 300 600

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

► Product groups

Measurement of air/liquid temperatures

BOSCH

Product type

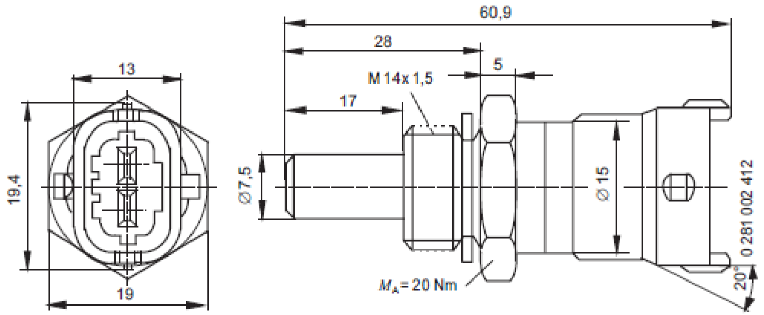
TF-W

Part number

0 281 002 412

Picture

Dimensional drawings



Technical data

Temperature range	°C	-40 ... +130
Features		Sensor in brass housing.
Application/medium		Oil/water
Tolerance at +100 °C	K	0,1886 ± 2%
Rated resistance at 20 °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
Tightening torque	Nm	20
Rated voltage	V	5 ± 0,15

1) With single-wire seal.

Accessories

Connector housing	2-pin RB compact connector code-1, tin plated terminals	
Connector housing	2-pin	1 928 403 874
Contact pins	For Ø 0.5...1.0 mm²	1 928 498 056
Contact pins	For Ø 1.5...2.5 mm²	1 928 498 057
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▶ Product groups

List of part numbers

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▶ Product groups