

# Sensors



**BOSCH**

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

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General remark: Please note that this catalogue is for information only. The listed products do not constitute binding purchase offers. We reserve the right to update the products and the information given herein. Please feel free to contact our sales department in case of any questions, or if you would like to receive an individual offer.”

# 0 General Information

## Sensor IP degrees

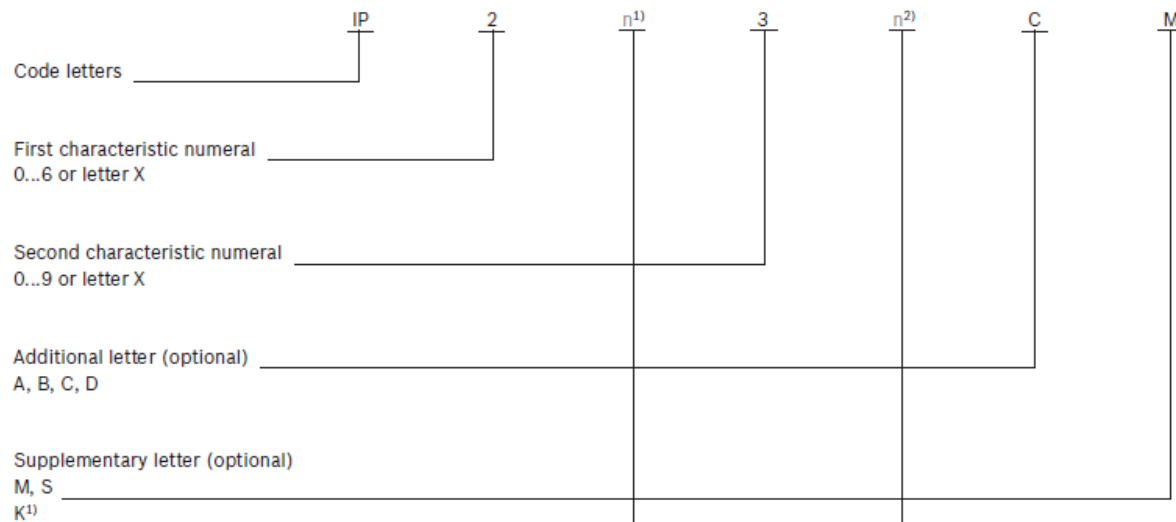


### IP degrees of protection

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If a characteristic numeral is not given, it must be superseded by the letter "X" (i. e. "XX" if both characteristic numerals are not given).  
The supplementary and/or additional letters can be omitted at will, and need not be superseded by other letters.

<sup>1)</sup> 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.

<sup>2)</sup> 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



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1st characteristic numeral and supplementary letter K	Protection of electrical equipment against ingress of solid foreign objects	Persons	2nd characteristic numeral and supplementary letter K	Protection of electrical equipment against the ingress of water	Additional letter (optional)	Protection of persons against contact with hazardous parts	Additional letter (optional)
0	Non-protected	Non-protected	0	Non-protected	A	Protection against contact with back of hand	M Movable parts of the equipment are in motion <sup>2)</sup>
1	Protection against foreign bodies $\varnothing \geq 50$ 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 <sup>2)</sup>
2	Protection against foreign bodies $\varnothing \geq 12.5$ 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 $\varnothing \geq 2.5$ mm	Protection against contact with tool	3	Protection against splash water	D	Protection against contact with wire	
4	Protection against foreign bodies $\varnothing \geq 1.0$ 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			

# 0 General Information

## CE-Identification and manufacturer declaration with EU directive



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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 where 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/](http://www.bosch-ibusiness.com/contact/)



# 1.1 Air-mass sensors

## 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. 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

$\dot{m}_N$	Nominal airflow
$\Delta \dot{m} / \dot{m}$	Relative accuracy
$\tau_{\Delta}$	Time until measurement error $\leq 5 \%$
$\tau_{63}$	Time until change in measured value 63%

# 1.1 Air-mass sensors

## HFM with analog interface



### Product type

**HFM7-R5**

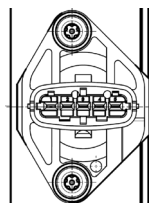
### Part number

**0 280 218 037**

### Picture



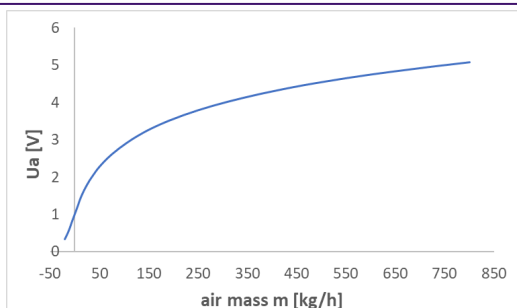
### Dimensional drawings



#### CONNECTIONS:

- 1: NTC
- 2: POWER SUPPLY
- 3: POWER GROUND
- 4: REFERENCE VOLTAGE
- 5: MASS AIR-OUTPUT

### Air-mass characteristic curve at ambient temperature



### Technical data

Features	With intake air temperature sensor	
Interface	analog	
Nominal airflow	$\dot{m}_N$	480 kg/h
Measuring range	$\dot{m}$	5 ... 640 kg/h
Rated supply voltage	$U_N$	14 V
Supply-voltage range	$U_V$	8 ... 17 V
Relative accuracy <sup>1)</sup>	$\Delta \dot{m} / \dot{m}$	± 3 %
Temperature range <sup>2)</sup>	°C	-40 ... +120
Pressure drop at $\dot{m}_N$	$\Delta p$	< 15 hPa
Current input	$I_V$	< 0,1 A
Time constant	$\tau_{63}$ <sup>3)</sup>	≤ 15 ms
Time constant	$\tau\Delta$ <sup>4)</sup>	≤ 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  $|\Delta \dot{m} / \dot{m}| \leq 5 \%$ .

### Accessories

Connector housing	5-pin	1 928 403 738
Contact pins	For Ø 0.5...1.0 mm <sup>2</sup> ; Contents: 100 x	1 928 498 056
Contact pins	For Ø 1.5...2.5 mm <sup>2</sup> ; Contents: 100 x	1 928 498 057
Single-wire seal	For Ø 0.5...1.0 mm <sup>2</sup> ; Contents: 10 x	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm <sup>2</sup> ; 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.



# 1.1 Air-mass sensors

## HFM with analog interface



### Product type

**HFM7-R5**

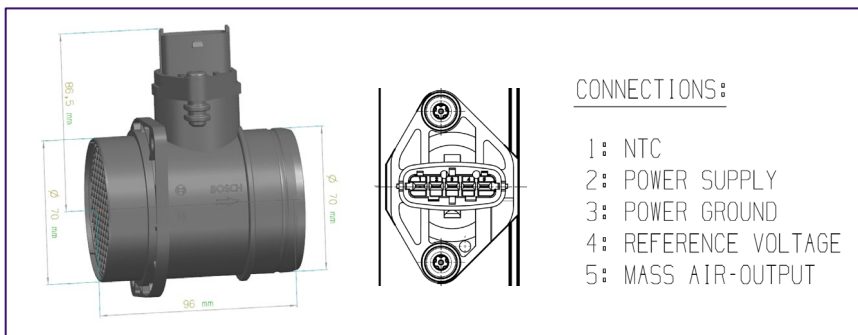
### Part number

**0 280 218 116**

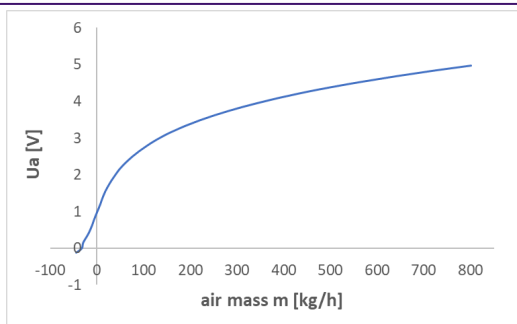
### Picture



### Dimensional drawings



### Air-mass characteristic curve at ambient temperature



### Technical data

Features	With intake air temperature sensor	
Interface	analog	
Nominal airflow	$\dot{m}_N$	480 kg/h
Measuring range	$\dot{m}$	-40 ... +640 kg/h
Rated supply voltage	$U_N$	14 V
Supply-voltage range	$U_V$	8 ... 17 V
Relative accuracy <sup>1)</sup>	$\Delta \dot{m} / \dot{m}$	± 3 %
Temperature range <sup>2)</sup>	°C	-40 ... +120
Pressure drop at $\dot{m}_N$	$\Delta p$	< 15 hPa
Current input	$I_V$	< 0,1 A
Time constant	$\tau_{63}$ <sup>3)</sup>	≤ 15 ms
Time constant	$\tau \Delta$ <sup>4)</sup>	≤ 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  $|\Delta \dot{m} / \dot{m}| \leq 5 \%$ .

### Accessories

Compact connector	5-pin	1 928 403 813
Contact pins	For Ø 0.5...1.0 mm <sup>2</sup>	Tyco 929 939 – 3
Contact pins	For Ø 1.5...2.5 mm <sup>2</sup>	Tyco 929 937 – 3
Single-wire seals	For Ø 0.5...2.5 mm <sup>2</sup>	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.

# 1.1 Air-mass sensors

## HFM with analog interface



### Product type

**HFM7-R5**

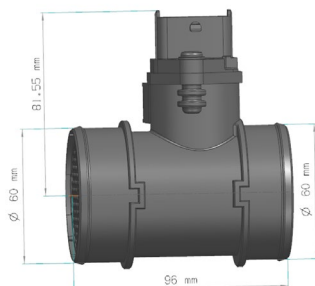
### Part number

**0 280 218 405**  
(successor of 0 280 217 123)

### Picture



### Dimensional drawings



#### CONNECTIONS:

- 1: NTC
- 2: POWER SUPPLY
- 3: POWER GROUND
- 4: REFERENCE VOLTAGE
- 5: MASS AIR-OUTPUT

### Technical data

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

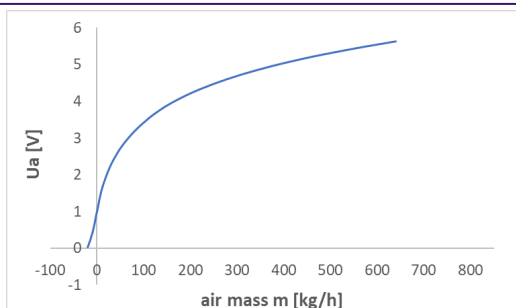
1) for  $0,04 \leq \Delta \dot{m} / \dot{m}_N \leq 1,3$

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

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.

# 1.1 Air-mass sensors

## HFM with analog interface



### Product type

**HFM7-R5**

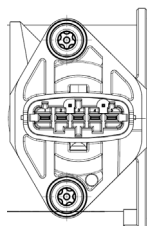
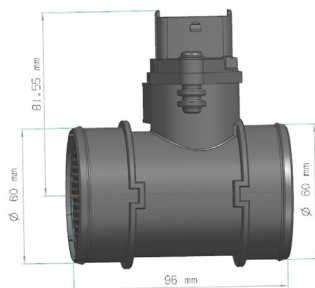
### Part number

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

### Picture



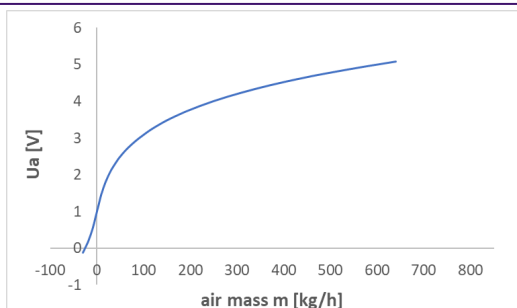
### Dimensional drawings



#### CONNECTIONS:

- 1: NTC
- 2: POWER SUPPLY
- 3: POWER GROUND
- 4: REFERENCE VOLTAGE
- 5: MASS AIR-OUTPUT

### Air-mass characteristic curve at ambient temperature



### Technical data

Features	With intake air temperature sensor	
Interface	analog	
Nominal airflow	$\dot{m}_N$	370 kg/h
Measuring range	$\dot{m}$	-15 ... +480 kg/h
Rated supply voltage	$U_N$	14 V
Supply-voltage range	$U_V$	6 ... 17 V
Relative accuracy <sup>1)</sup>	$\Delta \dot{m} / \dot{m}$	± 3 %
Temperature range <sup>2)</sup>	°C	-40 ... +120
Pressure drop at $\dot{m}_N$	$\Delta p$	< 15 hPa
Current input	$I_V$	< 0,1 A
Time constant	$\tau_{63}$ <sup>3)</sup>	≤ 15 ms
Time constant	$\tau\Delta$ <sup>4)</sup>	≤ 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  $|\Delta \dot{m} / \dot{m}| \leq 5 \%$ .

### Accessories

Compact connector	5-pin	1 928 403 813
Contact pins	For Ø 0.5...1.0 mm <sup>2</sup>	Tyco 929 939 – 3
Contact pins	For Ø 1.5...2.5 mm <sup>2</sup>	Tyco 929 937 – 3
Single-wire seals	For Ø 0.5...2.5 mm <sup>2</sup>	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.

# 1.1 Air-mass sensors

## HFM with analog interface



### Product type

**HFM7-R5**

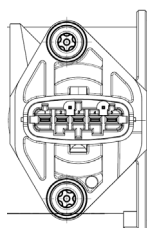
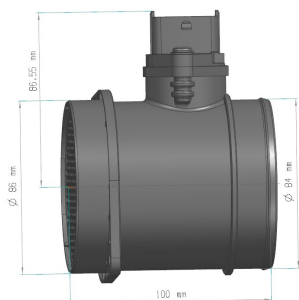
### Part number

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

### Picture



### Dimensional drawings



#### CONNECTIONS:

- 1: NOT CONNECTED
- 2: POWER SUPPLY
- 3: POWER GROUND
- 4: REFERENCE VOLTAGE
- 5: MASS AIR-OUTPUT

### Technical data

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

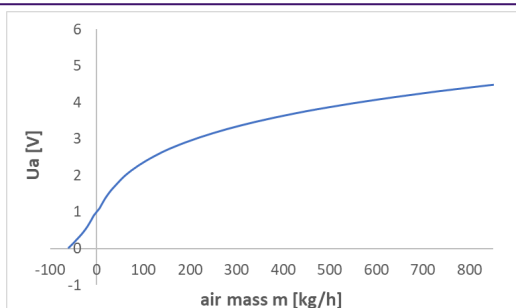
1) for  $0,04 \leq \Delta \dot{m} / \dot{m}_N \leq 1,3$

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

Compact connector	5-pin	1 928 403 813
Contact pins	For Ø 0.5...1.0 mm <sup>2</sup>	Tyco 929 939 – 3
Contact pins	For Ø 1.5...2.5 mm <sup>2</sup>	Tyco 929 937 – 3
Single-wire seals	For Ø 0.5...2.5 mm <sup>2</sup>	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.

# 1.1 Air-mass sensors

## HFM with analog interface



### Product type

**HFM-7**

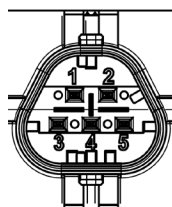
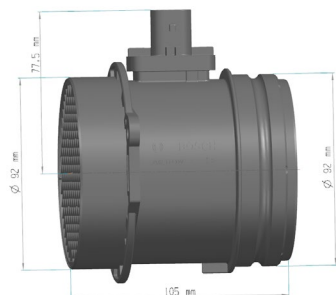
### Part number

**0 280 218 218**

### Picture



### Dimensional drawings



#### CONNECTIONS:

- 1: POWER GROUND
- 2: REFERENCE VOLTAGE
- 3: POWER SUPPLY
- 4: NTC
- 5: MASS AIR-OUTPUT

### Technical data

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

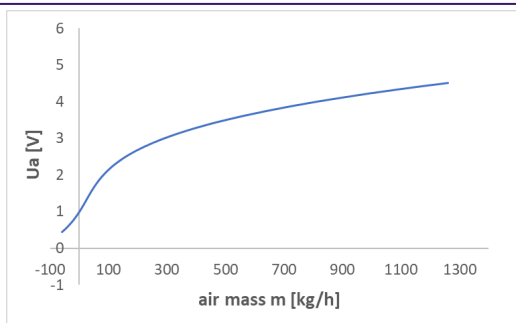
1) for  $0,04 \leq \Delta \dot{m} / \dot{m}_N \leq 1,3$

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	1 928 405 159
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.

## 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

$\dot{m}_N$	Nominal airflow
$\Delta \dot{m} / \dot{m}$	Relative accuracy
$\tau_{\Delta}$	Time until measurement error $\leq 5\%$
$\tau_{63}$	Time until change in measured value 63%

## 1.2 Air-mass sensors

### HFM with digital interface



#### Product type

**HFM-7**

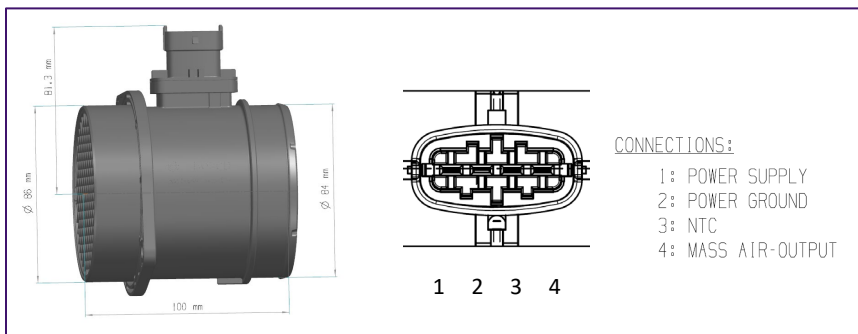
#### Part number

**0 280 218 416**

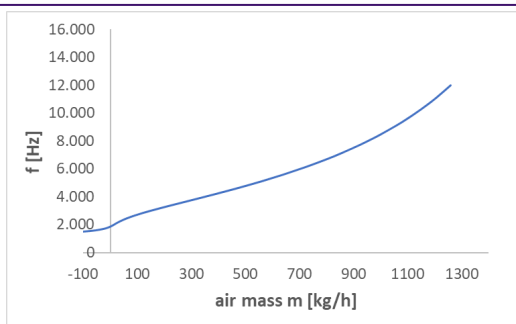
#### Picture



#### Dimensional drawings



#### Air-mass characteristic curve at ambient temperature



#### Technical data

Features	With intake air temperature sensor	
Interface	FAS (frequency analog signal)	
Nominal airflow	$\dot{m}_N$	850 kg/h
Measuring range	$\dot{m}$	-90 ... +1150 kg/h
Rated supply voltage	$U_N$	14 V
Supply-voltage range	$U_V$	6 ... 17 V
Relative accuracy <sup>1)</sup>	$\Delta \dot{m} / \dot{m}$	± 5 %
Temperature range <sup>2)</sup>	°C	-40 ... +120
Pressure drop at $\dot{m}_N$	$\Delta p$	< 12 hPa
Current input	$I_V$	< 0,1 A
Time constant	$\tau_{63}$ <sup>3)</sup>	≤ 10 ms
Time constant	$\tau\Delta$ <sup>4)</sup>	≤ 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  $|\Delta \dot{m} / \dot{m}| \leq 5 \%$ .

#### Accessories

Connector housing	4-pin	1 928 404 160
Contact pins	For Ø 0.5...1.0 mm <sup>2</sup> ; Contents: 100 x	1 928 498 056
Contact pins	For Ø 1.5...2.5 mm <sup>2</sup> ; Contents: 100 x	1 928 498 057
Single-wire seal	For Ø 0.35...1.0 mm <sup>2</sup> ; Contents: 10 x	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm <sup>2</sup> ; 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.

## 1.2 Air-mass sensors

### HFM with digital interface



#### Product type

**HFM-7 SF**

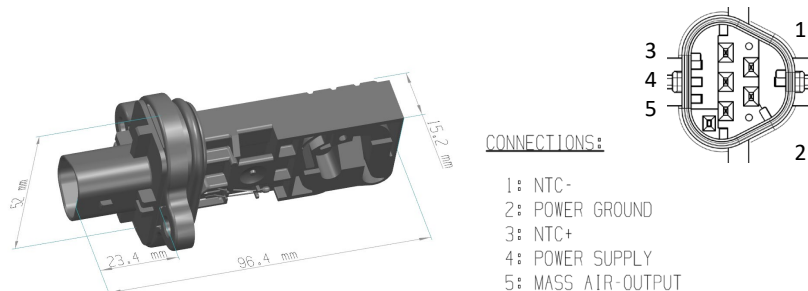
#### Part number

**0 280 218 429**

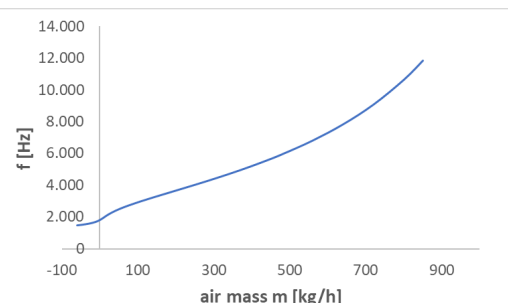
#### Picture



#### Dimensional drawings



#### Air-mass characteristic curve at ambient temperature



#### Technical data

Features	With intake air temperature sensor	
Interface	FAS (frequency analog signal)	
Nominal airflow	$\dot{m}_N$	640 kg/h
Measuring range	$\dot{m}$	-60 ... +800 kg/h
Rated supply voltage	$U_N$	14 V
Supply-voltage range	$U_V$	6 ... 17 V
Relative accuracy <sup>1)</sup>	$\Delta \dot{m} / \dot{m}$	± 2 %
Temperature range <sup>2)</sup>	°C	-40 ... +120
Pressure drop at $\dot{m}_N$	$\Delta p$	depending on size and design of cross section area
Current input	$I_V$	< 0,1 A
Time constant	$\tau_{63}$ <sup>3)</sup>	≤ 25 ms
Time constant	$\tau \Delta$ <sup>4)</sup>	≤ 80 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  $|\Delta \dot{m} / \dot{m}| \leq 5 \%$ .

#### Accessories

Connector housing	5-pin	1 928 405 138
Contact pins	For Ø 0.35...0.5 mm <sup>2</sup> ; Contents: 100 x	1 928 498 143
Contact pins	For Ø 0.75...1.0 mm <sup>2</sup> ; Contents: 100 x	1 928 498 144
Single-wire seal	For Ø 1.2...1.6 mm <sup>2</sup> ; Contents: 10 x	1 928 300 934
Single-wire seal	For Ø 1.7...2.1 mm <sup>2</sup> ; 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.



## 1.2 Air-mass sensors

### HFM with digital interface



#### Product type

**HFM-7**

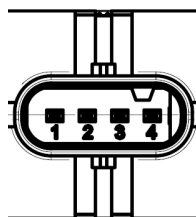
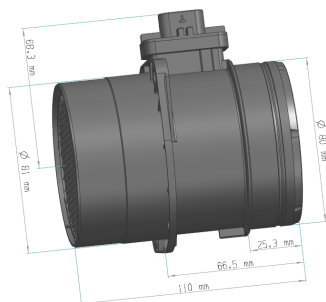
#### Part number

**0 281 002 956**

#### Picture



#### Dimensional drawings



#### CONNECTIONS:

- 1: POWER SUPPLY
- 2: POWER GROUND
- 3: REFERENCE\_FREQUENCY
- 4: MASS AIR-OUTPUT

#### Technical data

Features	Without intake air temperature sensor	
Interface	FAS (frequency analog signal)	
Nominal airflow	$\dot{m}_N$	640 kg/h
Measuring range	$\dot{m}$	-60 ... +800 kg/h
Rated supply voltage	$U_N$	14 V
Supply-voltage range	$U_V$	6 ... 17 V
Relative accuracy <sup>1)</sup>	$\Delta \dot{m} / \dot{m}$	$\pm 2 \%$
Temperature range <sup>2)</sup>	°C	-40 ... +120
Pressure drop at $\dot{m}_N$	$\Delta p$	< 12 hPa
Current input	$I_V$	< 0,1 A
Time constant	$\tau_{63}$ <sup>3)</sup>	$\leq 10$ ms
Time constant	$\tau \Delta$ <sup>4)</sup>	$\leq 30$ ms

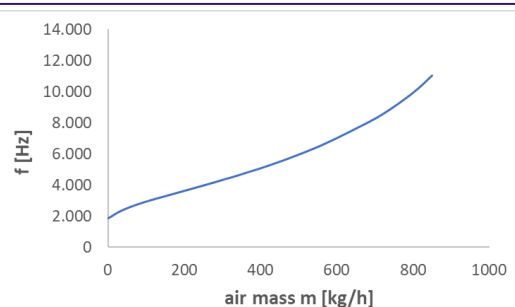
1) for  $0,04 \leq \Delta \dot{m} / \dot{m}_N \leq 1,3$

2) short-time ( $\leq 3$  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



## 8.2 Air-mass sensors

### HFM with digital interface



#### Product type

**HFM-8-PTH SF**

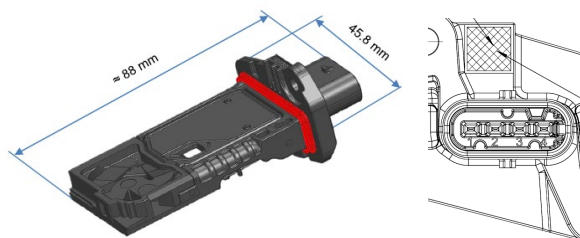
#### Part number

**0 280 218 03X**  
(successor of 0 280 218 00W)

#### Picture



#### Dimensional drawing



#### CONNECTIONS:

- 1: POWER SUPPLY 5V
- 2: GROUND
- 3: SENT
- 4: ---

#### Technical data

Features	With integrated pressure, humidity and intake air temperature sensor	
Interface	SENT	
Nominal airflow	$\dot{m}_N$	640 kg/h
Measuring range airflow	$\dot{m}$	-90 ... +1000 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 <sup>1)</sup>	$\Delta \dot{m} / \dot{m}$	± 1.5 %
Temperature range <sup>2)</sup>	°C	-40 ... +130
Pressure drop at $\dot{m}_N$	$\Delta p$	depending on size and design of cross section area
Current input	$I_V$	< 0,03 A
Time constant	$\tau_{63}$ <sup>3)</sup>	≤ 10 ms
Time constant	$\tau_{\Delta}$ <sup>4)</sup>	≤ 30 ms

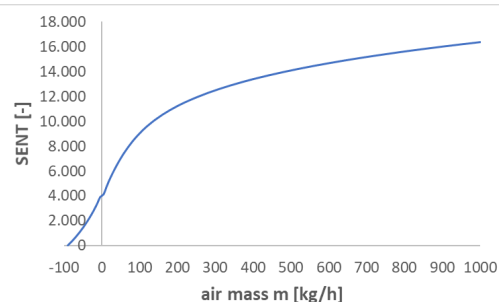
1) for  $0,025 \leq \Delta \dot{m} / \dot{m}_N \leq 1,0$

2) short-time (≤ 3 min.) to 140 °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	4-pin	Hirschmann 872-975-...02
		Option 1, Spec. 2, Code A

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

## 8.2 Air-mass sensors

### HFM with digital interface



#### Product type

**HFM-8-PTH 4.7**

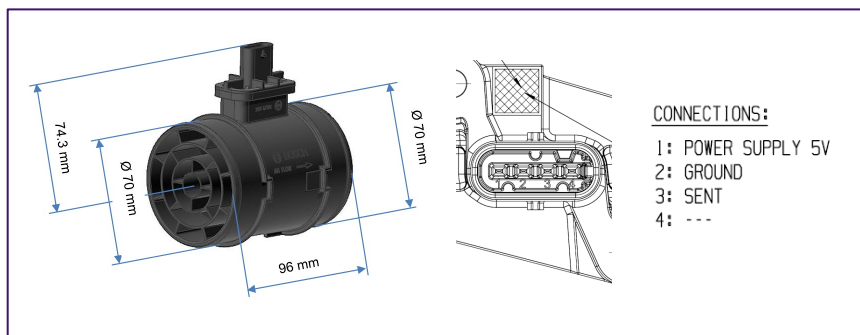
#### Part number

**0 280 218 07T**

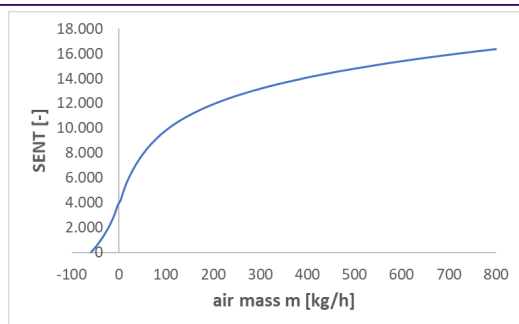
#### Picture



#### Dimensional drawing



#### Air-mass characteristic curve at ambient temperature



#### Technical data

Features	With integrated pressure, humidity and intake air temperature sensor	
Interface	SENT	
Nominal airflow	$\dot{m}_N$	480 kg/h
Measuring range airflow	$\dot{m}$	-60 ... +800 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 <sup>1)</sup>	$\Delta \dot{m} / \dot{m}$	± 1.5 %
Temperature range <sup>2)</sup>	°C	-40 ... +130
Pressure drop at $\dot{m}_N$	$\Delta p$	≤ 7 hPa
Current input	$I_V$	< 0,03 A
Time constant	$\tau_{63}$ <sup>3)</sup>	≤ 10 ms
Time constant	$\tau\Delta$ <sup>4)</sup>	≤ 30 ms

1) for  $0,025 \leq \Delta \dot{m} / \dot{m}_N \leq 1,0$

2) short-time (≤ 3 min.) to 140 °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  $|\Delta \dot{m} / \dot{m}| \leq 5 \%$ .

#### Accessories

Connector	4-pin	Hirschmann 872-975-...02
		Option 1, Spec. 2, Code A

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

## 8.2 Air-mass sensors

### HFM with digital interface



#### Product type

**HFM-8-PTH 6.4**

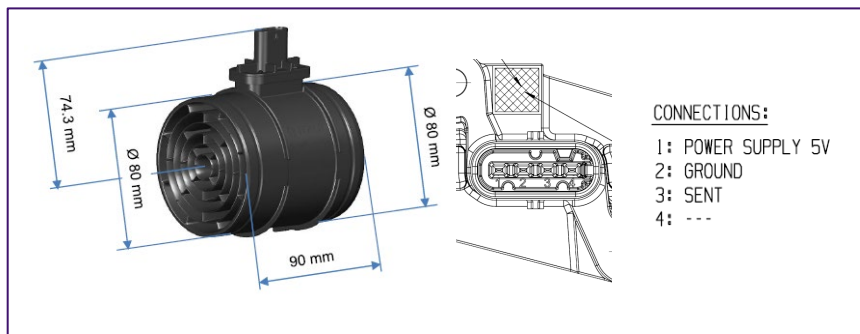
#### Part number

**0 280 218 07U**

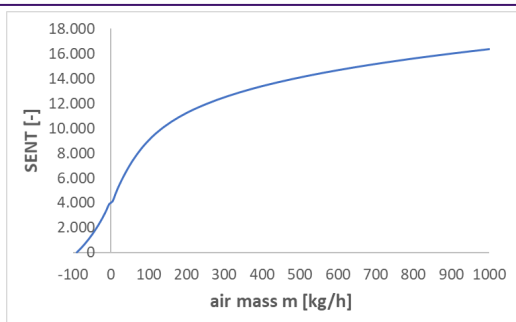
#### Picture



#### Dimensional drawing



#### Air-mass characteristic curve at ambient temperature



#### Technical data

Features	With integrated pressure, humidity and intake air temperature sensor	
Interface	SENT	
Nominal airflow	$\dot{m}_N$	640 kg/h
Measuring range airflow	$\dot{m}$	-90 ... +1000 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 <sup>1)</sup>	$\Delta \dot{m} / \dot{m}$	± 1.5 %
Temperature range <sup>2)</sup>	°C	-40 ... +130
Pressure drop at $\dot{m}_N$	$\Delta p$	≤ 5 hPa
Current input	$I_V$	< 0,03 A
Time constant	$\tau_{63}$ <sup>3)</sup>	≤ 10 ms
Time constant	$\tau\Delta$ <sup>4)</sup>	≤ 30 ms

1) for  $0,025 \leq \Delta \dot{m} / \dot{m}_N \leq 1,0$

2) short-time (≤ 3 min.) to 140 °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  $|\Delta \dot{m} / \dot{m}| \leq 5 \%$ .

#### Accessories

Connector	4-pin	Hirschmann 872-975-...02
		Option 1, Spec. 2, Code A

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

## 8.2 Air-mass sensors

### HFM with digital interface



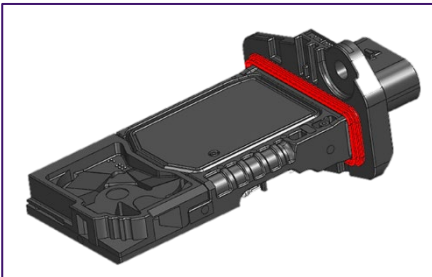
#### Product type

**HFM-8-T SF**

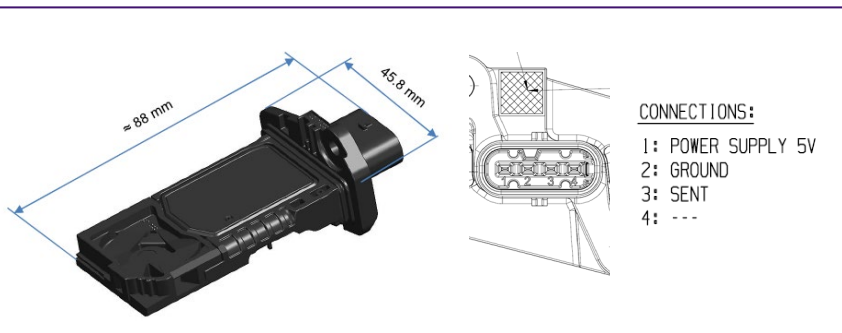
#### Part number

**0 281 006 597**

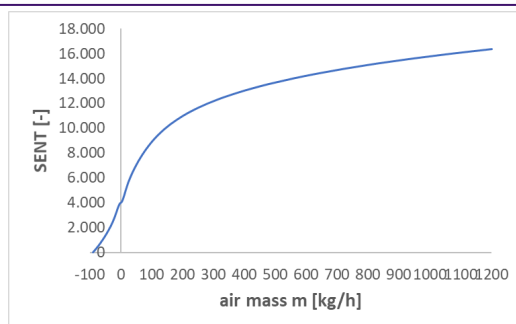
#### Picture



#### Dimensional drawing



#### Air-mass characteristic curve at ambient temperature



#### Technical data

Features	With intake air temperature sensor	
Interface	SENT	
Nominal airflow	$\dot{m}_N$	640 kg/h
Measuring range airflow	$\dot{m}$	-60 ... +1200 kg/h
Rated supply voltage	$U_N$	5 V
Supply-voltage range	$U_V$	4,85 ... 5,15 V
Relative accuracy <sup>1)</sup>	$\Delta \dot{m} / \dot{m}$	± 2.0 %
Temperature range <sup>2)</sup>	°C	-40 ... +130
Pressure drop at $\dot{m}_N$	$\Delta p$	depending on size and design of cross section area
Current input	$I_V$	< 0,02 A
Time constant	$\tau_{63}$ <sup>3)</sup>	≤ 10 ms
Time constant	$\tau\Delta$ <sup>4)</sup>	≤ 30 ms

<sup>1)</sup> for  $0,01 \leq \Delta \dot{m} / \dot{m}_N \leq 1,7$

<sup>2)</sup> short-time (≤ 3 min.) to 140 °C

<sup>3)</sup> 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

<sup>4)</sup> Delay on switch-on and after any change in flow rate until the output voltage has attained the relative measurement deviation  $|\Delta \dot{m} / \dot{m}| \leq 5 \%$ .

#### Accessories

Connector	4-pin	Hirschmann 872-975-...02
		Option 1, Spec. 2, Code C

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

## 8.2 Air-mass sensors

### HFM with digital interface



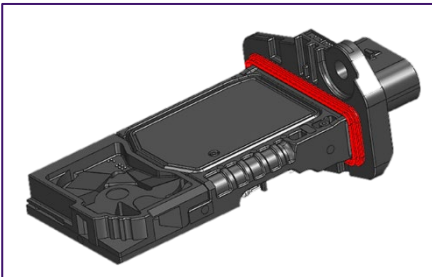
#### Product type

**HFM-8-T SF**

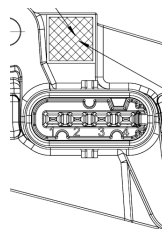
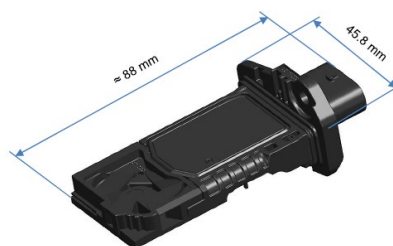
#### Part number

**0 280 218 07K**

#### Picture



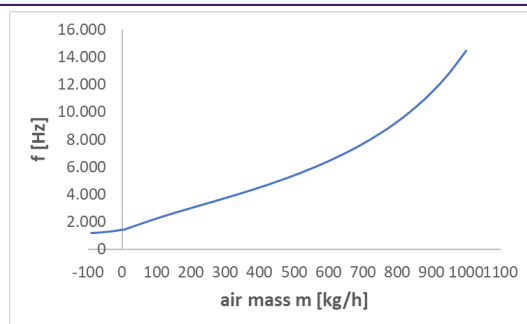
#### Dimensional drawing



#### CONNECTIONS:

- 1: POWER SUPPLY 5V
- 2: POWER GROUND
- 3: MASS AIR-OUTPUT
- 4: NTC

#### Air-mass characteristic curve at ambient temperature



#### Technical data

Features	With intake air temperature sensor	
Interface	FAS (frequency analog signal)	
Nominal airflow	$\dot{m}_N$	640 kg/h
Measuring range airflow	$\dot{m}$	-90 ... +1000 kg/h
Rated supply voltage	$U_N$	5 V
Supply-voltage range	$U_V$	4,85 ... 5,15 V
Relative accuracy <sup>1)</sup>	$\Delta \dot{m} / \dot{m}$	± 2.0 %
Temperature range <sup>2)</sup>	°C	-40 ... +130
Pressure drop at $\dot{m}_N$	$\Delta p$	depending on size and design of cross section area
Current input	$I_V$	< 0,02 A
Time constant	$\tau_{63}$ <sup>3)</sup>	≤ 10 ms
Time constant	$\tau \Delta$ <sup>4)</sup>	≤ 30 ms

1) for  $0,025 \leq \Delta \dot{m} / \dot{m}_N \leq 1,0$

2) short-time (≤ 3 min.) to 140 °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  $|\Delta \dot{m} / \dot{m}| \leq 5 \%$ .

#### Accessories

Connector	4-pin	Hirschmann 872-975-...02
		Option 1, Spec. 2, Code A

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

## 8.2 Air-mass sensors

### HFM with digital interface



#### Product type

**HFM-8-TH SF**

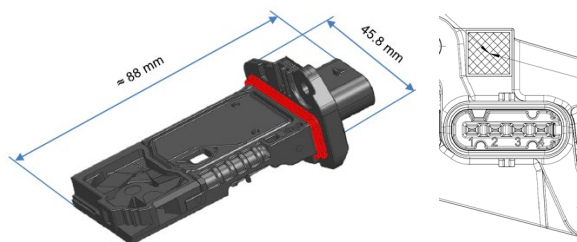
#### Part number

**0 281 006 812**

#### Picture



#### Dimensional drawing



#### CONNECTIONS:

- 1: POWER SUPPLY 5V
- 2: GROUND
- 3: SENT
- 4: ---

#### Technical data

Features	With integrated humidity and intake air temperature sensor	
Interface	SENT	
Nominal airflow	$\dot{m}_N$	640 kg/h
Measuring range airflow	$\dot{m}$	-60 ... +1200 kg/h
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 <sup>1)</sup>	$\Delta \dot{m} / \dot{m}$	± 2.0 %
Temperature range <sup>2)</sup>	°C	-40 ... +130
Pressure drop at $\dot{m}_N$	$\Delta p$	depending on size and design of cross section area
Current input	$I_V$	< 0,02 A
Time constant	$\tau_{63}$ <sup>3)</sup>	≤ 10 ms
Time constant	$\tau\Delta$ <sup>4)</sup>	≤ 30 ms

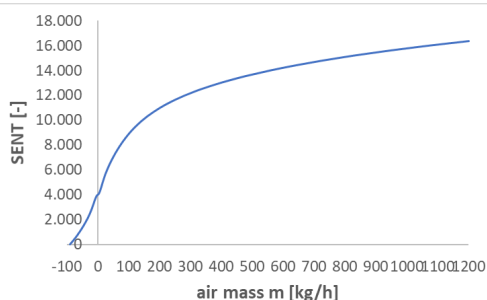
1) for  $0,01 \leq \Delta \dot{m} / \dot{m}_N \leq 1,7$

2) short-time (≤ 3 min.) to 140 °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	4-pin	Hirschmann 872-975-...02
		Option 1, Spec. 2, Code D

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

## 1.3 Air-mass sensors

### PFM pressure based flow meter



- ▶ 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 diffuser. 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	$\dot{m}$	= 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		



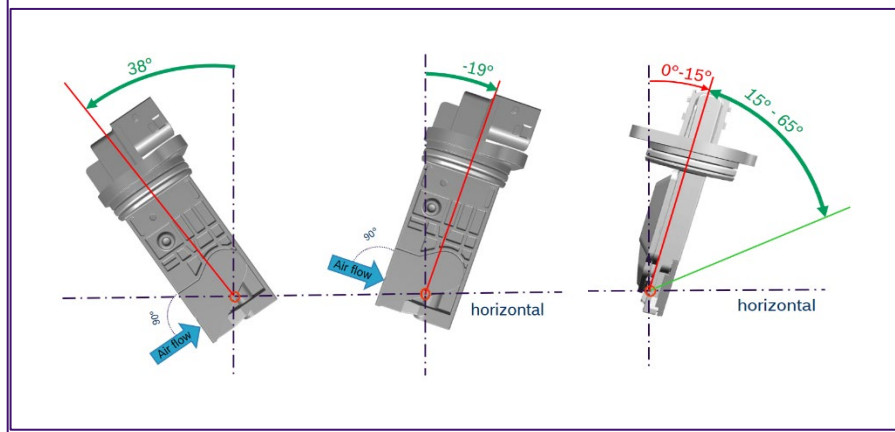
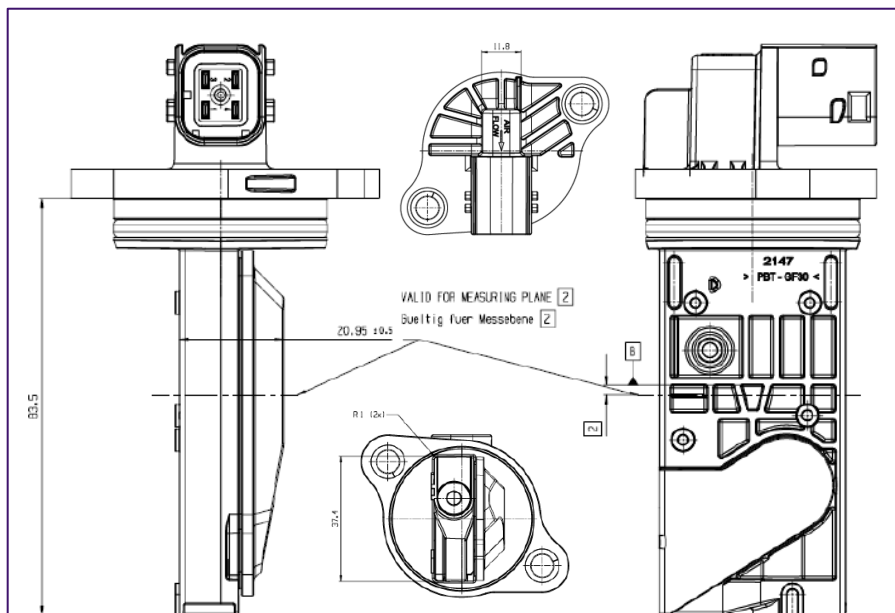


## 1.3 Air-mass sensors

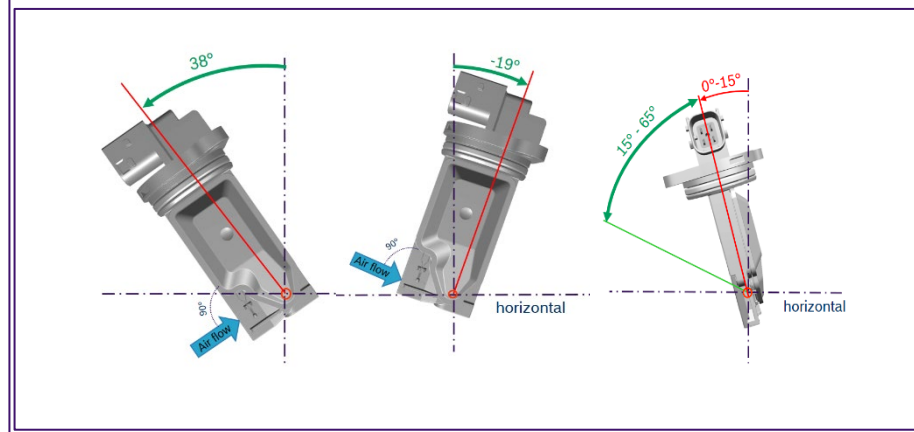
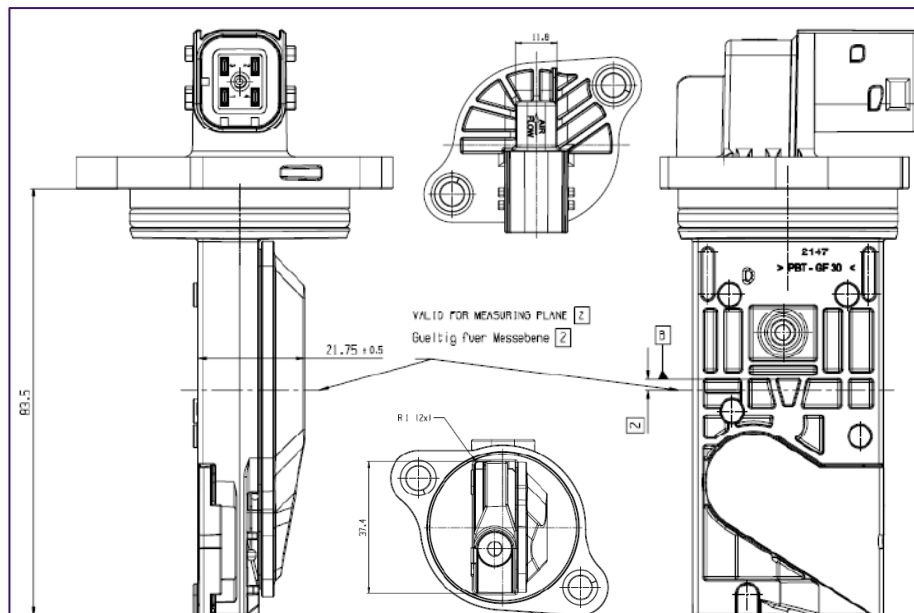
### PFM pressure based flow meter



Dimensional drawings for VarA with positioning angles



Dimensional drawings for VarB with positioning angles



### 1.3 Air-mass sensors

#### PFM with digital interface



## Product type

## PFM VarA

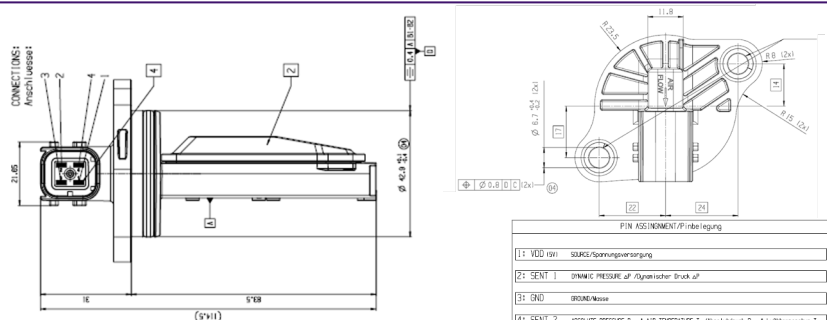
## Part number

**0 280 218 902**

## Picture



## Dimensional drawings

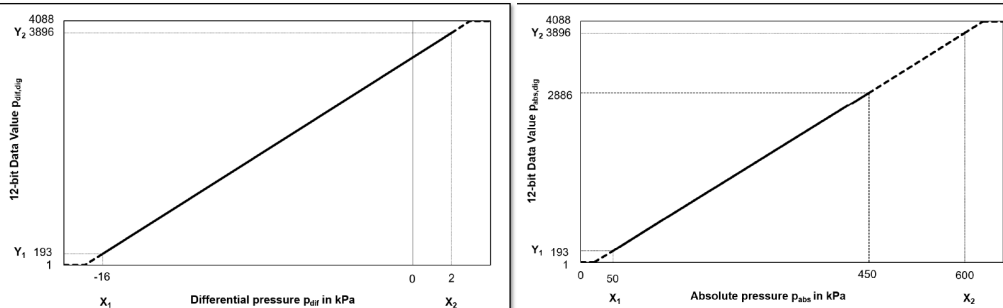


## Technical data

Features	With integrated ambient-temperature sensor.	
Interface	SENT	
Measuring range differential pressure	$p_{diff}$	-16 ... 2 kPa
Measuring range absolute pressure	$p_{abs}$	50 ... 450 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	°C	-40 ... +130
Pressure drop at $\dot{m}_N$	$\Delta p$	depending on size and design of cross section area
Current input	$I_{DD}$	0,018 A ... 0,045 A
Time constant	$\tau_{IDD}^{1)}$	≤ 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
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Accessories are not included in the scope of delivery of the sensor and therefore to be ordered separately as required.

# 1.3 Air-mass sensors

## PFM with digital interface



### Product type

**PFM VarB**

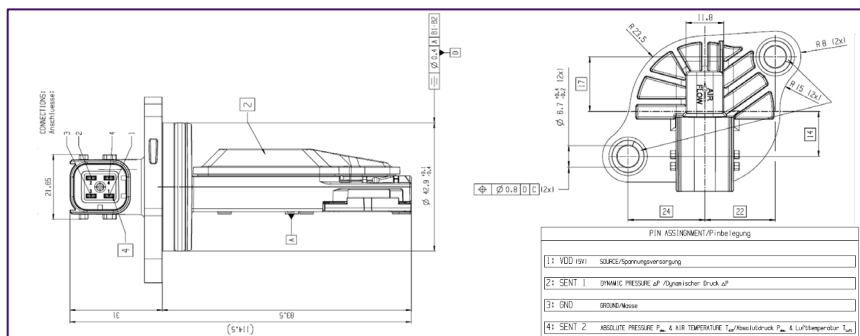
### Part number

**0 280 218 900**

### Picture



### Dimensional drawings

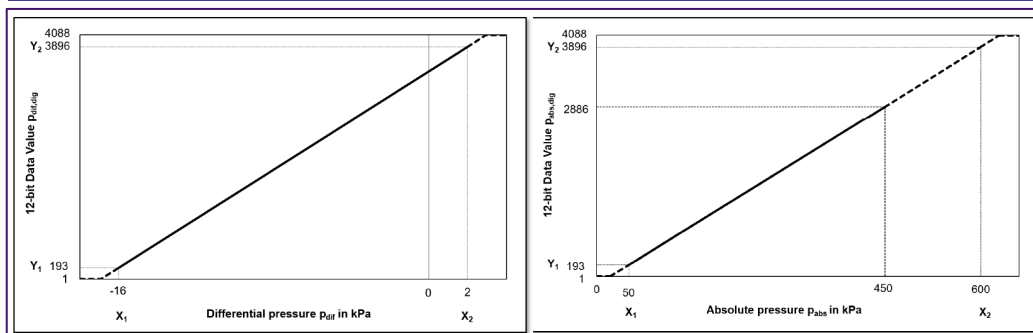


### Technical data

Features	With integrated ambient-temperature sensor.	
Interface	SENT	
Measuring range differential pressure	$p_{diff}$	-16 ... 2 kPa
Measuring range absolute pressure	$p_{abs}$	50 ... 450 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	°C	-40 ... +130
Pressure drop at $\dot{m}_N$	$\Delta p$	depending on size and design of cross section area
Current input	$I_{DD}$	0,018 A ... 0,045 A
Time constant	$\tau_{IDD}^{1)}$	≤ 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 B
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Accessories are not included in the scope of delivery of the sensor and therefore to be ordered separately as required.

## 2.1 Lambda sensors

### Type LSF-4.2 (Switching type)



► compared to the wideband lambda sensor LSU4.9 the switching type LSF4.2 type is limited to applications in the near operation vicinity of  $\lambda=1$



#### Application

Engine management

- Gas engines
- Combined heat and thermal power units (CHP)
- Gasoline 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

#### Design and application

The LSF4.2 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 350 °C. The integrated heater ensures that the sensor functions at exhaust-gas temperatures.

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

#### 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,
- low heater rating,
- stable control characteristic,
- short switch-on time.

## Type LSF-4.2 (Switching type)



## Product type

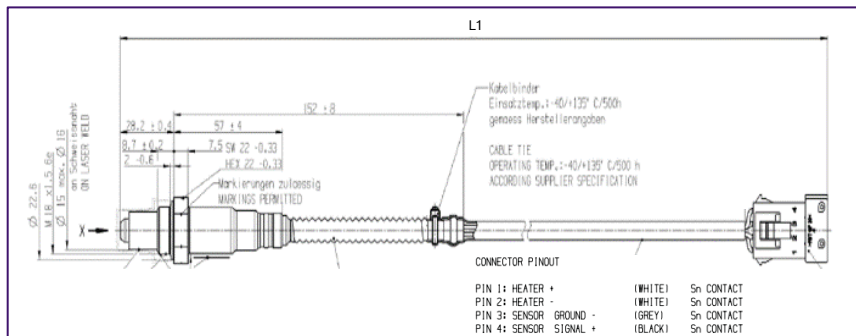
## LSF-4.2

## Part number

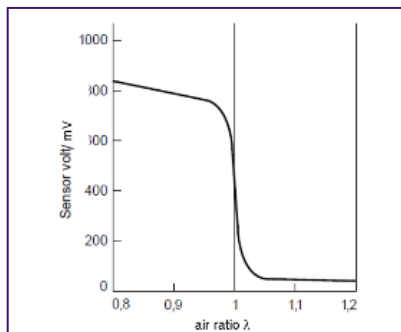
## Several available



## 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	Voltage	Cable length L1
0258 006 956	No	12 V	460 mm
0258 986 784	Yes	12 V	1135 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.

## 2.2 Lambda sensors

### Type LSU-4.9 (wideband)



- ▶ The wideband Lambda sensor LSU is a planar  $\text{ZrO}_2$  dual-cell limit current sensor with integrated heater.
- ▶ It is used for measuring the oxygen content and the  $\lambda$  value of exhaust gases in vehicle engines.
- ▶ Thanks to a steady characteristic curve in the range  $\lambda = 0.65$  to air, it is universally applicable for  $\lambda = 1$  and for other  $\lambda$  ranges.



#### Application

##### Engine management

- 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  $\text{ZrO}_2$  dual-cell limit current sensor with integrated heater. It is suitable for measuring the oxygen content and the  $\lambda$  value of exhaust gases in vehicle engines (gasoline and diesel). A constant characteristic curve in the range from  $\lambda = 0.65$  to air makes it suitable for universal use for  $\lambda = 1$  and for other  $\lambda$  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. ETAS 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  $10^\circ$  with respect to the horizontal. This prevents the accumulation of liquid between the sensor housing and sensor element. An angle of  $90^\circ$  is desirable, however no greater than  $90^\circ + 15^\circ$  gas inlet hole with respect to the exhaust gas flow or  $90^\circ - 30^\circ$ . 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

- $\lambda$  Air fuel ratio
- $U_N$  Nernst voltage
- $U_P$  Variable pump voltage

## 2.2 Lambda sensors

### Type LSU-4.9 (wideband)



#### Product type

**LSU-4.9**

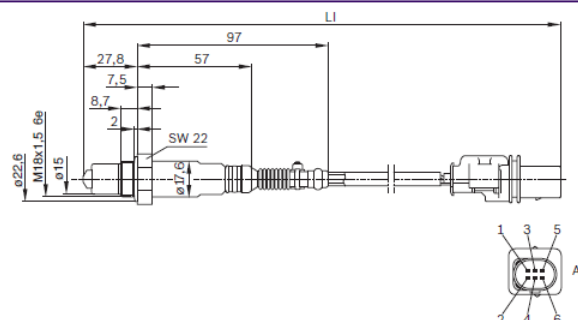
#### Part number

**Several available**

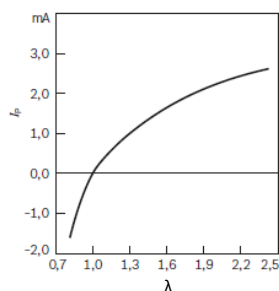
#### Picture



#### Dimensional drawings

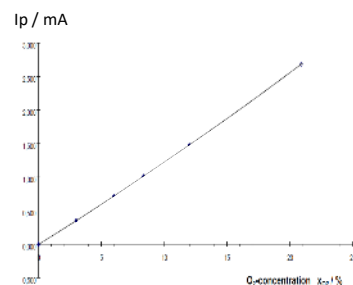


#### Characteristic curve



$I_p$  = Pump current  
 $\lambda$  = Air ratio

#### Characteristic curve



#### Technical data

Measuring range of lambda	0,65 ... $\infty$
Heater power (with 7,5V heater voltage)	7,5 W
Heater nominal voltage supply	7,5 V
Exhaust gas temperature	$\leq 930^{\circ}\text{C}$

#### Part number

#### TSP

#### Voltage

#### Cable length L1

**0281 004 805**

Yes

12 V <sup>2)</sup>

1000 mm

**0281 004 107**

No

24 V <sup>1)</sup>

1000 mm

**0258 017 025**

No

12 V <sup>2)</sup>

1000 mm

- 1) Heater voltage need to be PWM (Pulse-width modulation) controlled
- 2) 24V possible with converter system

#### Accessories

Mating connector parts set	Connector housing, contacts, grommet	1 987 280 016
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## 2.3 Lambda sensors

### Type LSU-5.2 (wideband)



- ▶ The wideband Lambda sensor LSU is a planar  $\text{ZrO}_2$  dual-cell limit current sensor with integrated heater.
- ▶ It is used for measuring the oxygen content and the  $\lambda$  value of exhaust gases in vehicle engines.
- ▶ Thanks to a steady characteristic curve in the range  $\lambda = 0.65$  to air, it is universally applicable for  $\lambda = 1$  and for other  $\lambda$  ranges.



#### Application

Engine management

- Gas engines
- Gasoline engines
- Lean combustion engines

Industrial processes

- Tempering furnaces
- Chemical industry
- Packaging equipment
- Process engineering
- Drying plants
- Metallurgy
- Baking oven application

Measurement and analysis processes

- Flue gas measurement
- Gas analysis
- Determination of Wobbe index
- Incineration plants

#### Design and operation

The LSU broadband Lambda sensor is a planar  $\text{ZrO}_2$  dual-cell limit current sensor with integrated heater. It is suitable for measuring the oxygen content and the  $\lambda$  value of exhaust gases in vehicle engines (gasoline). A constant characteristic curve in the range from  $\lambda = 0.65$  to air makes it suitable for universal use for  $\lambda = 1$  and for other  $\lambda$  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. ETAS 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  $U_N$  at 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 signal is 0, as when using the evaluation circuit. However, at air the signal scatters  $\pm 12\%$ . 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. The LSU5.2 has a "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, should be limited (max. 60  $\mu\text{l}$  droplet size and max. 25  $\mu\text{l}/\text{sec}$  liquid flow)
- If possible, the installation position should be vertically upwards, however at least at an angle of  $10^\circ$  with respect to the horizontal. This prevents the accumulation of liquid between the sensor housing and sensor element. An angle of  $90^\circ$  is desirable, however no greater than  $90^\circ + 15^\circ$  gas inlet hole with respect to the exhaust gas flow or  $90^\circ - 30^\circ$ . 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

$\lambda$  Air fuel ratio

$U_N$  Nernst voltage

$U_P$  Variable pump voltage



## 2.3 Lambda sensors

### Type LSU-5.2 (wideband)



#### Product type

**LSU-5.2**

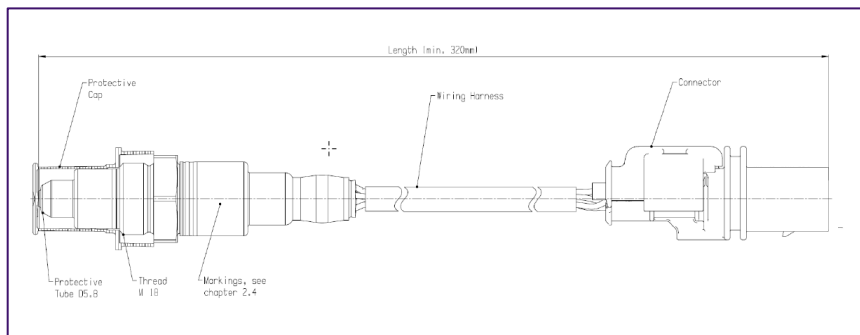
#### Part number

**Several available**

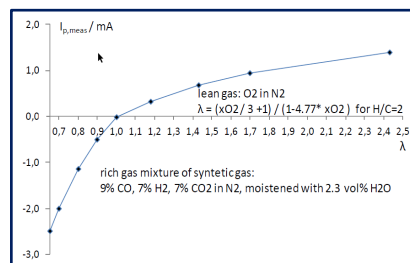
#### Picture



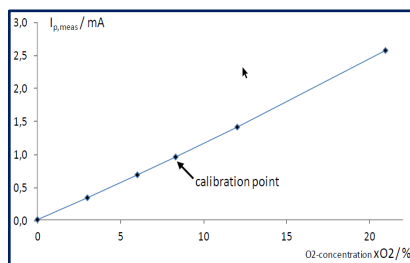
#### Dimensional drawings



#### Characteristic curve



#### Characteristic curve



#### Technical data

Measuring range of lambda	0,65 ... ∞
Heater power (with 6,8V heater voltage)	8,1 W
Heater nominal voltage supply	6,8 V
Exhaust gas temperature	≤ 980°C

#### Part number

**0 258 037 007**

#### Remark

#### Cable length L1

**500 mm**

#### Accessories

Mating connector parts set	Connector housing, contacts, grommet	1 986 280 016
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$I_p$  = Pump current  
 $\lambda$  = Air fuel ratio

## 3.1 Pressure sensors

### 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.

## 3.1 Pressure sensors

### Differential pressure sensor



#### Product type

**DS-T3**

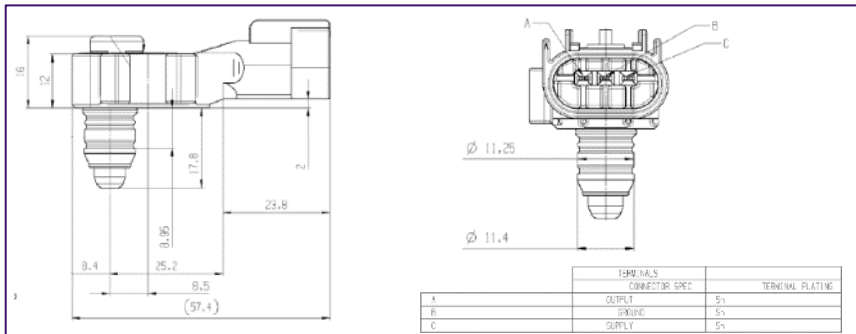
#### Part number

**0 261 230 161**

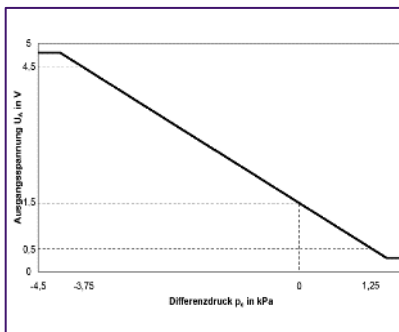
#### Picture



#### Dimensional drawings



#### Characteristic curve



#### Technical data

		min.	type	Max.
Pressure range ( $p_1 \dots p_2$ )	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
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## 3.2 Pressure sensors

### Absolute pressure sensors



- ▶ Pressure range 0 – 1000 kPa
- ▶ High level of accuracy
- ▶ EMC protection better than  $100 \text{ V m}^{-1}$
- ▶ 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.).

## 3.2 Pressure sensors

### Absolute pressure sensors

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



**BOSCH**

#### Product type

**DS-S2-TF**

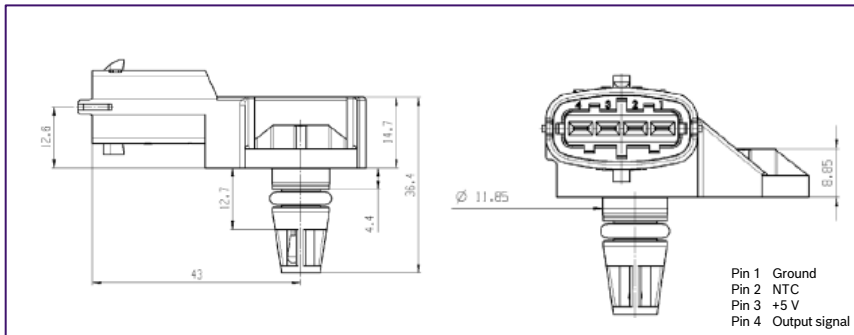
#### Part number

**0 261 230 133**

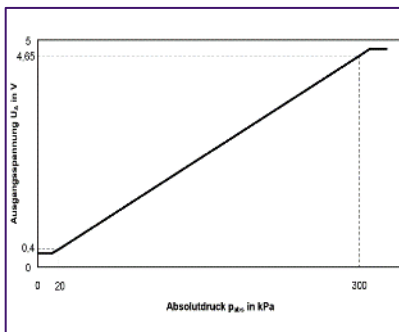
#### Picture



#### 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
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#### Accessories

Connector housing	4-pin	1 928 403 736
Contact pins	For Ø 0.5...1.0 mm <sup>2</sup> ; Contents: 100 x	1 928 498 056
Contact pins	For Ø 1.5...2.5 mm <sup>2</sup> ; Contents: 100 x	1 928 498 057
Single-wire seal	For Ø 0.5...1.0 mm <sup>2</sup> ; Contents: 10 x	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm <sup>2</sup> ; 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.

## 3.2 Pressure sensors

### Absolute pressure sensors

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



**BOSCH**

#### Product type

**DS-S2-TF**

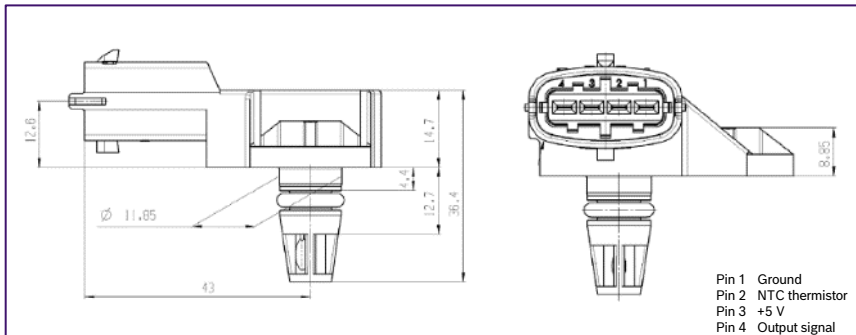
#### Part number

**0 281 002 456**

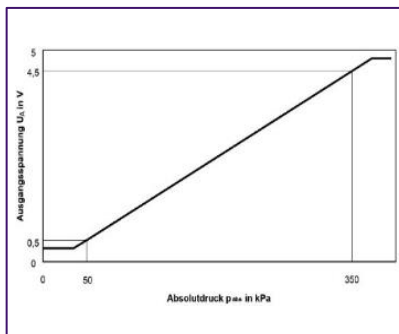
#### Picture



#### Dimensional drawings



#### Characteristic curve



#### Technical data

Parameter		min.	type	Max.
Features	Integrated temperature sensor			
Pressure range ( $p_1 \dots p_2$ )	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
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#### Temperature sensor

Measuring range	°C	-40	+130
Measurement current <sup>1)</sup>	mA		1
Rated resistance at +20°C	kΩ	2,5 ± 5 %	
Temperature/time constant $\tau_{63}$ <sup>2)</sup>	s		10

<sup>1)</sup> Operation with 1 kΩ series resistance.

<sup>2)</sup> 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 mm <sup>2</sup> ; Contents:	1 928 498 060
Contact pins (tin-plated)	For Ø 1.5...2.5 mm <sup>2</sup> ; Contents:	1 928 498 061
Single-wire seal	For Ø 0.5...1.0 mm <sup>2</sup> ; Contents:	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm <sup>2</sup> ; 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.

## 3.2 Pressure sensors

### Absolute pressure sensors

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



#### Product type

**DS-S2**

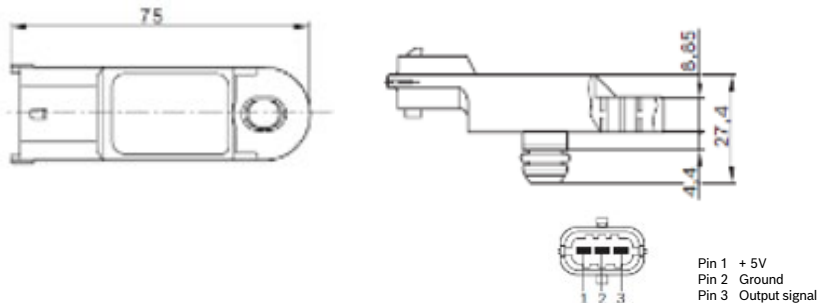
#### Part number

**0 281 002 616**

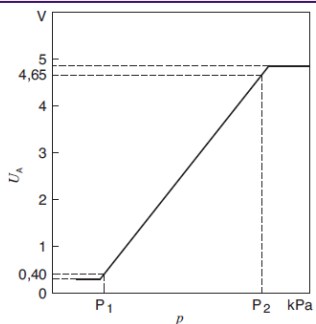
#### Picture



#### Dimensional drawings



#### Characteristic curve



#### Technical data

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

#### Limit data

Storage temperature	$\vartheta_L$	°C	-40	+130
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#### 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.

## 3.2 Pressure sensors

### Absolute pressure sensors



#### Product type

**DS-S3-TF**

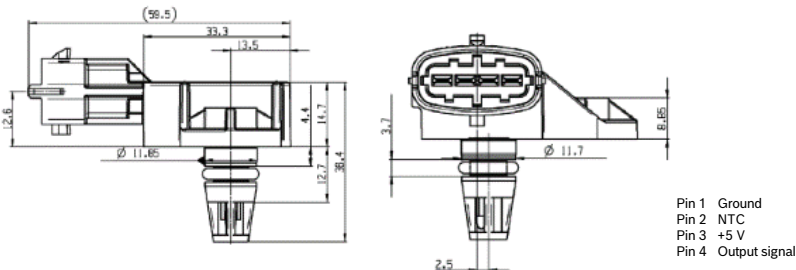
#### Part number

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

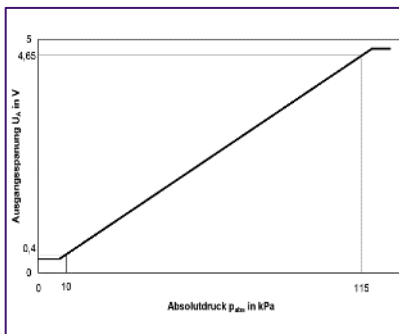
#### Picture



#### Dimensional drawings



#### Characteristic curve



#### Technical data

Parameter		min.	type	Max.
Features		Integrated temperature sensor		
Pressure range ( $p_1 \dots p_2$ )	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
-----------------------	----	-----	--	------

#### Accessories

Connector housing	4-pin	1 928 403 736
Contact pins	For $\varnothing 0.5 \dots 1.0 \text{ mm}^2$ ; Contents: 100 x	1 928 498 056
Contact pins	For $\varnothing 1.5 \dots 2.5 \text{ mm}^2$ ; Contents: 100 x	1 928 498 057
Single-wire seal	For $\varnothing 0.5 \dots 1.0 \text{ mm}^2$ ; Contents: 10 x	1 928 300 599
Single-wire seal	For $\varnothing 1.5 \dots 2.5 \text{ mm}^2$ ; Contents: 10 x	1 928 300 600
Dummy plug		1 928 300 601

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



## 3.2 Pressure sensors

### Absolute pressure sensor



#### Product type

**DS-S3-TF**

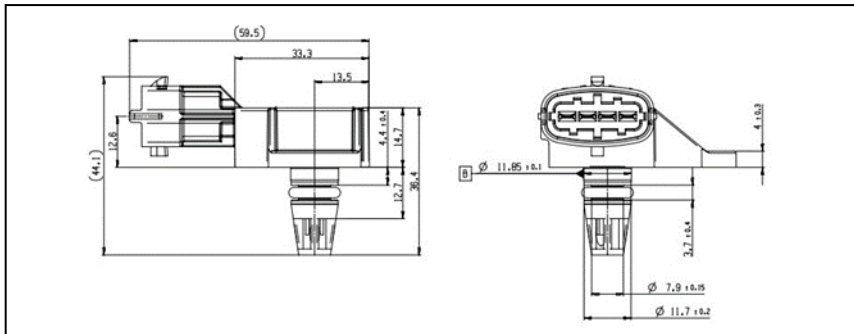
#### Part number

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

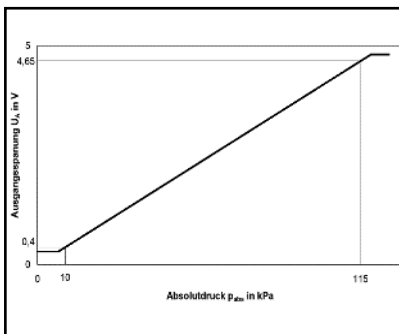
#### Picture



#### Dimensional drawings



#### Characteristic curve



#### Technical data

Parameter		min.	type	Max.
Features				
Integrated temperature sensor				
Pressure range ( $p_1 \dots p_2$ )	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 $U_S$ or ground $R_{pull up}$	k $\Omega$	5	68	
Load resistance to $U_S$ or ground $R_{pull down}$	k $\Omega$	10	100	
Lower limit at $U_S = 5 V$	V	0,25	0,3	0,35
Upper limit at $U_S = 5 V$	V	4,65	4,7	4,75

#### Accessories

Connector housing	4-pin	1 928 404 745
Contact pins (tin-plated)	For $\varnothing 0.5 \dots 1.0 \text{ mm}^2$	1 928 498 056
Contact pins (tin-plated)	For $\varnothing 1.5 \dots 2.5 \text{ mm}^2$	1 928 498 057
Single-wire seal	For $\varnothing 0.35 \dots 1.0 \text{ mm}^2$	1 928 300 599
Single-wire seal	For $\varnothing 1.5 \dots 2.5 \text{ mm}^2$	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.

## 3.2 Pressure sensors

### Absolute pressure sensor



#### Product type

**DS-S3-TF**

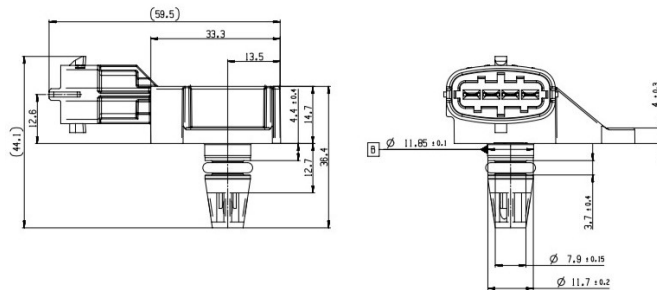
#### Part number

**0 261 230 247**

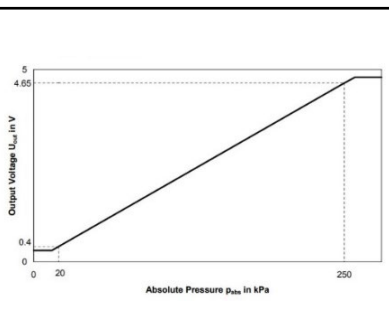
#### Picture



#### Dimensional drawings



#### Characteristic curve



#### Technical data

Parameter		min.	type	Max.
Features	Integrated temperature sensor			
Pressure range ( $p_1 \dots p_2$ )	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 $U_S = 5\text{ V}$	V	0,25	0,3	0,35
Upper limit at $U_S = 5\text{ V}$		4,65	4,7	4,75

#### Accessories

Connector housing	4-pin	1 928 404 745
Contact pins (gold-plated)	For $\varnothing 0.5 \dots 1.0\text{ mm}^2$	1 928 498 054
Contact pins (gold-plated)	For $\varnothing 1.5 \dots 2.5\text{ mm}^2$	1 928 498 055
Single-wire seal	For $\varnothing 0.35 \dots 1.0\text{ mm}^2$	1 928 300 599
Single-wire seal	For $\varnothing 1.5 \dots 2.5\text{ mm}^2$	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.

## 3.2 Pressure sensors

### Absolute pressure sensor



#### Product type

**DS-S3-TF**

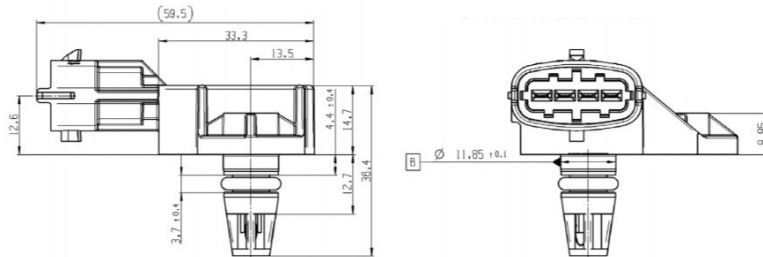
#### Part number

**0 261 230 280**

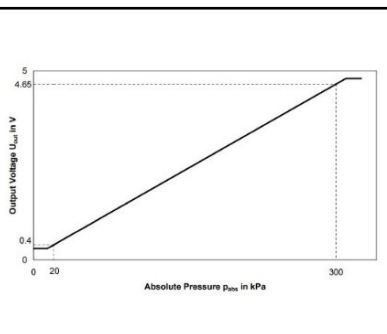
#### Picture



#### Dimensional drawings



#### Characteristic curve



#### Technical data

Parameter		min.	type	Max.
Features	Integrated temperature sensor			
Pressure range ( $p_1 \dots p_2$ )	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 $U_S = 5\text{ V}$	V	0.25	0,3	0,35
Upper limit at $U_S = 5\text{ V}$		4.65	4,7	4,75

#### Accessories

Connector housing	4-pin	1 928 404 745
Contact pins (tin-plated)	For $\varnothing 0.5 \dots 1.0\text{ mm}^2$	1 928 498 056
Contact pins (tin-plated)	For $\varnothing 1.5 \dots 2.5\text{ mm}^2$	1 928 498 057
Single-wire seal	For $\varnothing 0.35 \dots 1.0\text{ mm}^2$	1 928 300 599
Single-wire seal	For $\varnothing 1.5 \dots 2.5\text{ mm}^2$	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.

## Absolute pressure sensor



### Product type

**DS-S3-TF**

## Part number

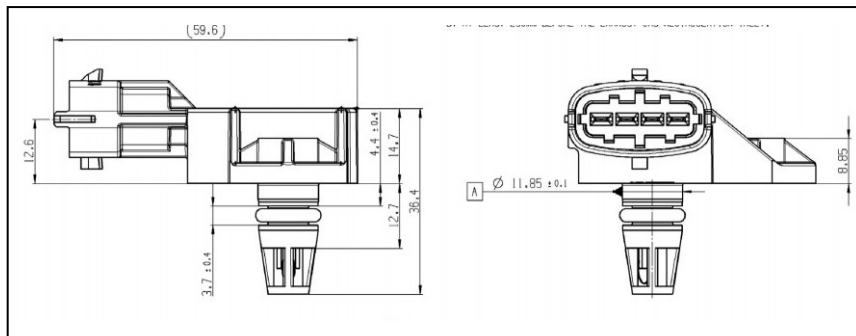
**(successor of 0 281 002 514)**

## Dimensional drawings

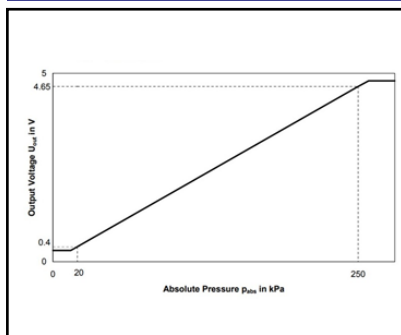


## Technical data

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



## Characteristic curve



## 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.

## 3.2 Pressure sensors

### Absolute pressure sensor



#### Product type

**DS-S3-TF**

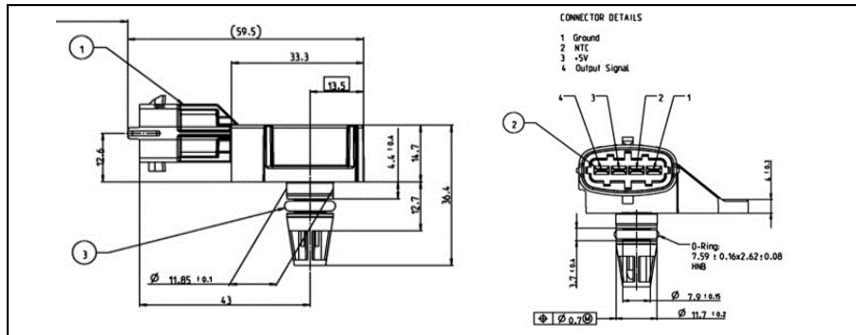
#### Part number

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

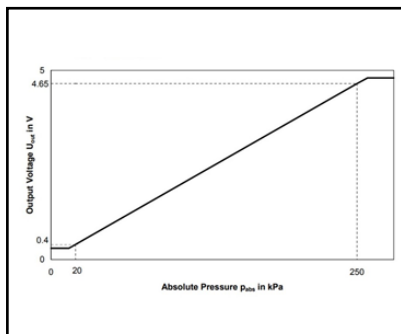
#### Picture



#### 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 $U_S = 5\text{ V}$	V	0.25	0,3	0,35
Upper limit at $U_S = 5\text{ V}$		4.65	4,7	4,75

#### Accessories

Connector housing	4-pin	1 928 404 745
Contact pins (gold-plated)	For $\varnothing 0.5...1.0\text{ mm}^2$	1 928 498 054
Contact pins (gold-plated)	For $\varnothing 1.5...2.5\text{ mm}^2$	1 928 498 055
Single-wire seal	For $\varnothing 0.35...1.0\text{ mm}^2$	1 928 300 599
Single-wire seal	For $\varnothing 1.5...2.5\text{ mm}^2$	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.

## 3.2 Pressure sensors

### Absolute pressure sensor



#### Product type

**DS-S3-TF**

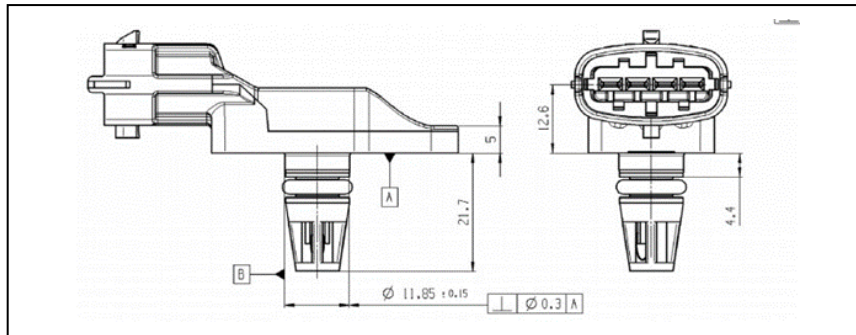
#### Part number

**0 261 230 310**

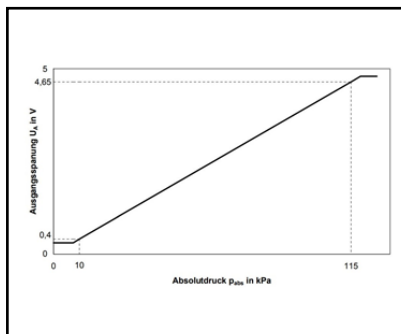
#### Picture



#### Dimensional drawings



#### Characteristic curve



#### Technical data

Parameter		min.	type	Max.
Features	Integrated temperature sensor			
Pressure range ( $p_1 \dots p_2$ )	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 $U_S = 5$ V	V	0.25	0,3	0,35
Upper limit at $U_S = 5$ V	V	4.65	4,7	4,75

#### Accessories

Connector housing	4-pin	1 928 404 745
Contact pins (gold-plated)	For $\varnothing 0.5 \dots 1.0$ mm <sup>2</sup>	1 928 498 054
Contact pins (gold-plated)	For $\varnothing 1.5 \dots 2.5$ mm <sup>2</sup>	1 928 498 055
Single-wire seal	For $\varnothing 0.35 \dots 1.0$ mm <sup>2</sup>	1 928 300 599
Single-wire seal	For $\varnothing 1.5 \dots 2.5$ mm <sup>2</sup>	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.

## 3.2 Pressure sensors

### Absolute pressure sensors



#### Product type

**DS-S3-TF**

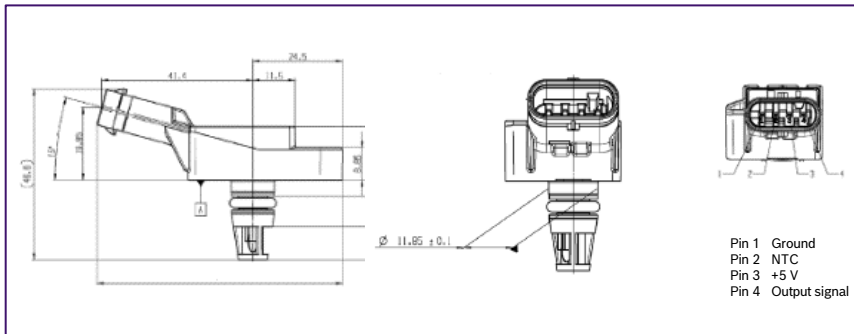
#### Part number

**0 261 230 416**

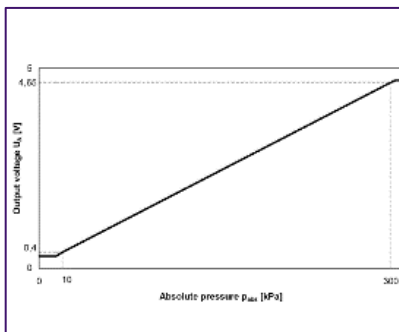
#### Picture



#### Dimensional drawings



#### Characteristic curve



#### Technical data

Parameter		min.	type	Max.
Features	Integrated temperature sensor			
Pressure range ( $p_1 \dots p_2$ )	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

## 3.2 Pressure sensors

### Absolute pressure sensors



#### Product type

**DS-S3-TF**

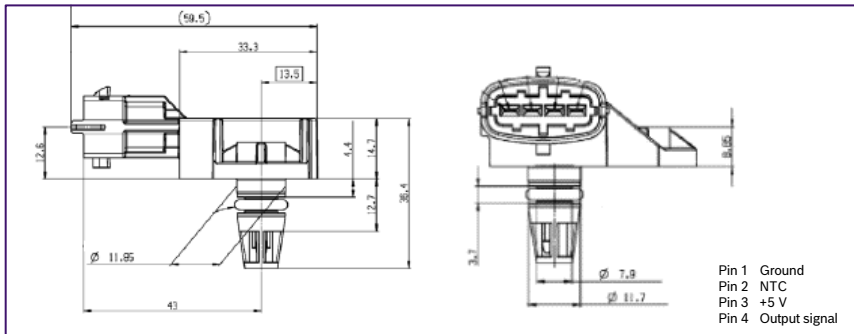
#### Part number

**0 281 006 028**

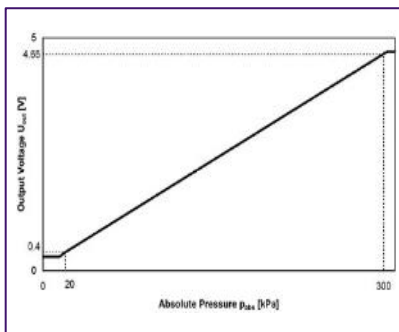
#### Picture



#### Dimensional drawings



#### Characteristic curve



#### Technical data

Parameter		min.	type	Max.
Features	Integrated temperature sensor			
Pressure range ( $p_1 \dots p_2$ )	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

#### Accessories

Connector housing	4-pin	1 928 403 736
Contact pins	For Ø 0.5...1.0 mm <sup>2</sup> ; Contents: 100 x	1 928 498 056
Contact pins	For Ø 1.5...2.5 mm <sup>2</sup> ; Contents: 100 x	1 928 498 057
Single-wire seal	For Ø 0.5...1.0 mm <sup>2</sup> ; Contents: 10 x	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm <sup>2</sup> ; 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.



## 3.2 Pressure sensors

### Absolute pressure sensors



#### Product type

**DS-S3-TF**

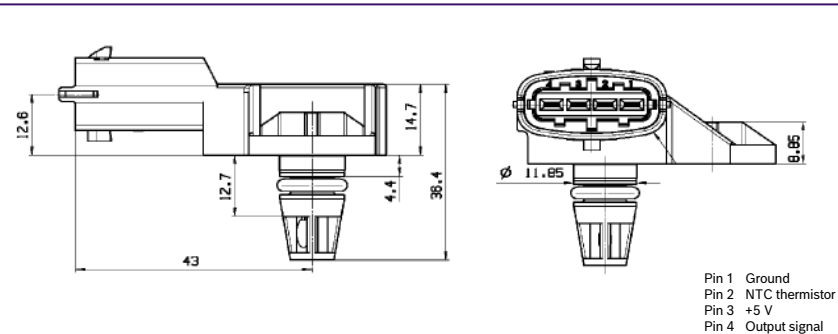
#### Part number

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

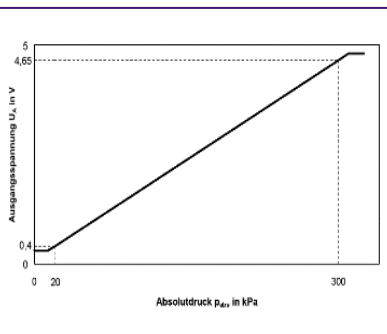
#### Picture



#### Dimensional drawings



#### Characteristic curve



#### Technical data

Parameter		min.	type	Max.
Features	Integrated temperature sensor			
Pressure range ( $p_1 \dots p_2$ )	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 <sup>1)</sup>	mA		1
Rated resistance at +20°C	kΩ	2,5 ± 5 %	
Temperature/time constant $\tau_{63}$ <sup>2)</sup>	s		10

<sup>1)</sup> Operation with 1 kΩ series resistance.

<sup>2)</sup> 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 mm <sup>2</sup> ; Contents: 100 x	1 928 498 056
Contact pins	For Ø 1.5...2.5 mm <sup>2</sup> ; Contents: 100 x	1 928 498 057
Single-wire seal	For Ø 0.5...1.0 mm <sup>2</sup> ; Contents: 10 x	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm <sup>2</sup> ; 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.

### 3.2 Pressure sensors

#### Absolute pressure sensors



## Product type

**DS-S3-TF**

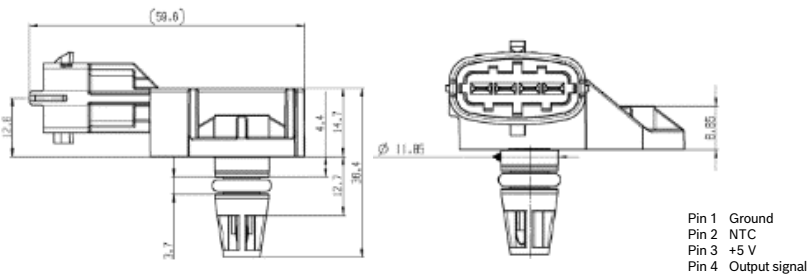
## Part number

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

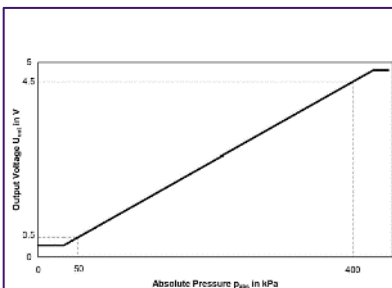
## Picture



## Dimensional drawings



## Characteristic curve



## Technical data

Parameter		min.	type	Max.
Features		Integrated temperature sensor		
Pressure range ( $p_1 \dots p_2$ )	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 <sup>1)</sup>	mA		1
Rated resistance at +20°C	kΩ	2,5 ± 5 %	
Temperature/time constant $\tau_{63}^{2)}$	s		10

1) Operation with 1 k $\Omega$  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.

## 3.3 Pressure sensors

### Pressure sensors for CNG



- ▶ Pressure range 20 – 1000 kPa
- ▶ High level of accuracy
- ▶ EMC protection up to 100 Vm<sup>-1</sup>
- ▶ 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 O-ring. The hole on the customer side for holding and fastening the sensor in place shall be such that a permanently tight fit 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.



## 3.3 Pressure sensors

### Pressure sensors for CNG



#### Product type

**DS-G3-TF**

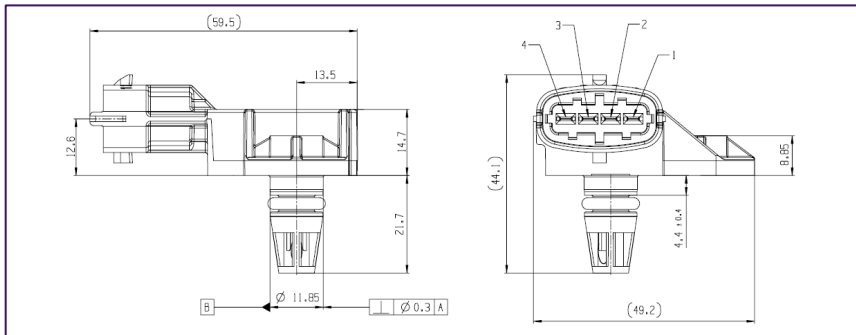
#### Part number

**0 261 230 499**

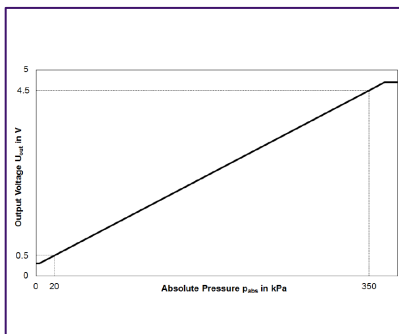
#### Picture



#### Dimensional drawings



#### Characteristic curve



#### Technical data

Parameter	min.	type	Max.
Features	integrated temperature sensor		
Application/medium	approved for CNG		
Pressure range ( $p_1 \dots p_2$ )	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 mm <sup>2</sup>	1 928 498 056
Contact pins (tin-plated)	For Ø 1.5...2.5 mm <sup>2</sup>	1 928 498 057
Single-wire seal	For Ø 0.5...1.0 mm <sup>2</sup>	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm <sup>2</sup>	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.

## 3.3 Pressure sensors

### Pressure sensors for CNG



#### Product type

**DS-G3-TF**

#### Part number

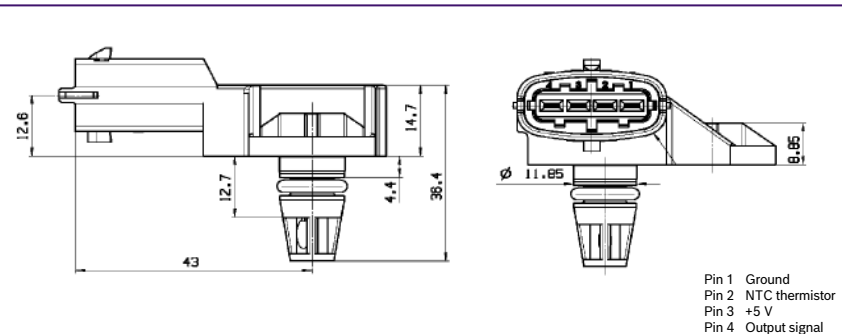
**0 261 230 01F**

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

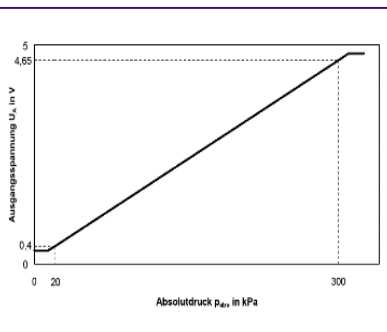
#### Picture



#### Dimensional drawings



#### Characteristic curve



#### Technical data

Parameter		min.	type	Max.
Features	Integrated temperature sensor			
Application/medium	approved for CNG			
Pressure range ( $p_1 \dots p_2$ )	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
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#### Temperature sensor

Measuring range	°C	-40		+130
Measurement current <sup>1)</sup>	mA			1
Rated resistance at +20°C	kΩ		2,5 ± 5 %	
Temperature/time constant $\tau_{63}$ <sup>2)</sup>	s			10

<sup>1)</sup> Operation with 1 kΩ series resistance.

<sup>2)</sup> 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 mm <sup>2</sup> ; Contents: 100 x	1 928 498 056
Contact pins	For Ø 1.5...2.5 mm <sup>2</sup> ; Contents: 100 x	1 928 498 057
Single-wire seal	For Ø 0.5...1.0 mm <sup>2</sup> ; Contents: 10 x	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm <sup>2</sup> ; 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.

## 3.3 Pressure sensors

### Pressure sensors for CNG



#### Product type

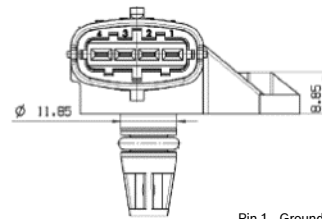
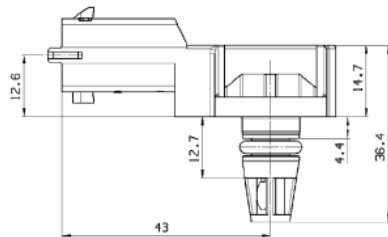
**DS-G3-TF**

#### 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

#### Picture



#### Technical data

Parameter		min.	type	Max.
Features		Integrated temperature sensor		
Application/medium		approved for CNG		
Pressure range ( $p_1 \dots p_2$ )	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
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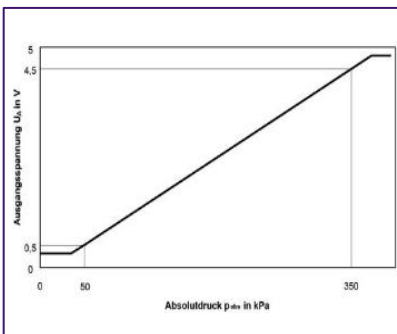
#### Temperature sensor

Measuring range	°C	-40		+130
Measurement current <sup>1)</sup>	mA			1
Rated resistance at +20°C	kΩ		2,5 ± 5 %	
Temperature/time constant $\tau_{63}$ <sup>2)</sup>	s			10

<sup>1)</sup> Operation with 1 kΩ series resistance.

<sup>2)</sup> 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.

## 3.4 Pressure sensors

### 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.



## 3.4 Pressure sensors

### High pressure sensor (hydraulic applications)



#### Product type

**PS-HPS4-MA**

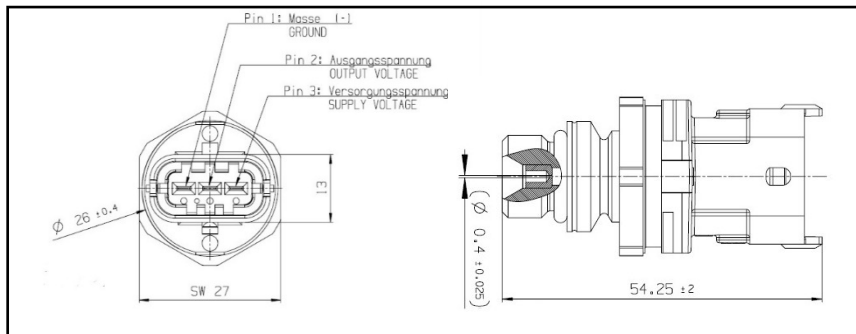
#### Part number

**0 261 546 00M**

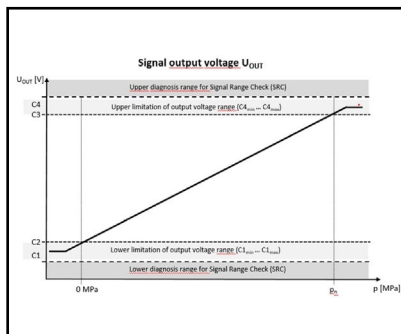
#### Picture



#### 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	$5 \pm 0,25$
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

<sup>1)</sup> 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 $\varnothing 0.5...1.0 \text{ mm}^2$	1 928 498 054
Contact pins (gold-plated)	For $\varnothing 1.5...2.5 \text{ mm}^2$	1 928 498 055
Single-wire seal	For $\varnothing 0.35...1.0 \text{ mm}^2$	1 928 300 599
Single-wire seal	For $\varnothing 1.5...2.5 \text{ mm}^2$	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.

## 3.4 Pressure sensors

### High pressure sensor (hydraulic applications)



#### Product type

**PS-HPS4**

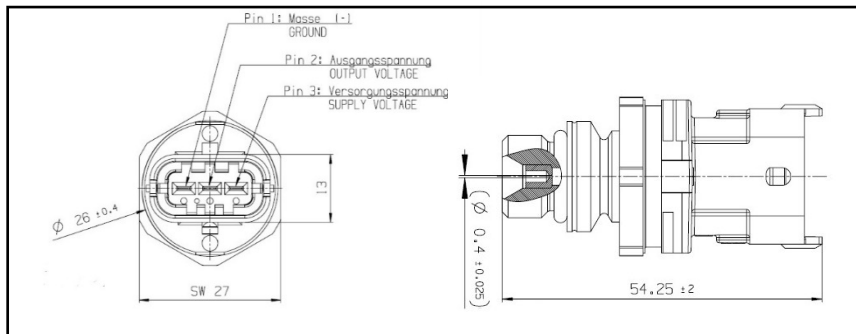
#### Part number

**0 261 546 00A**

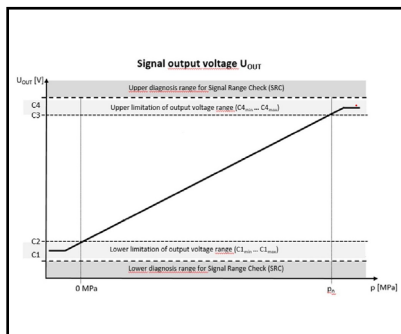
#### Picture



#### 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

<sup>1)</sup> 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 mm <sup>2</sup>	1 928 498 054
Contact pins (gold-plated)	For Ø 1.5...2.5 mm <sup>2</sup>	1 928 498 055
Single-wire seal	For Ø 0.35...1.0 mm <sup>2</sup>	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm <sup>2</sup>	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.

## 3.4 Pressure sensors

### High pressure sensor (hydraulic applications)



#### Product type

**PS-HPS4-MA**

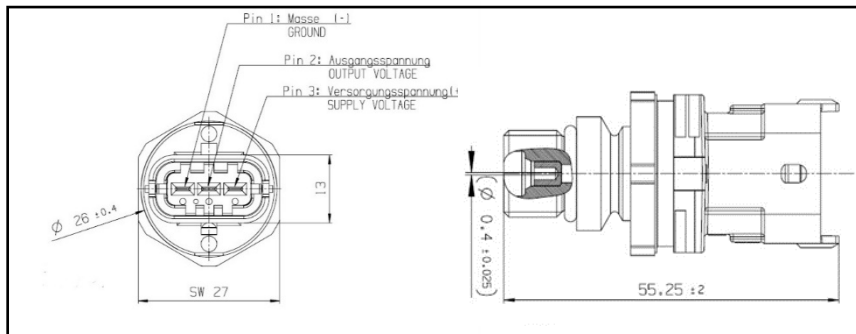
#### Part number

**0 261 546 00W**

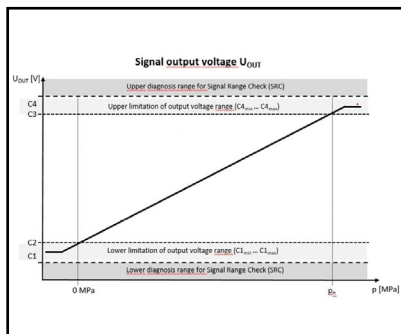
#### Picture



#### 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	$5 \pm 0,25$
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

<sup>1)</sup> 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 $\varnothing 0.5...1.0 \text{ mm}^2$	1 928 498 054
Contact pins (gold-plated)	For $\varnothing 1.5...2.5 \text{ mm}^2$	1 928 498 055
Single-wire seal	For $\varnothing 0.35...1.0 \text{ mm}^2$	1 928 300 599
Single-wire seal	For $\varnothing 1.5...2.5 \text{ mm}^2$	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.

## 3.4 Pressure sensors

### High pressure sensor (hydraulic applications)



#### Product type

**PS-HPS4-MA**

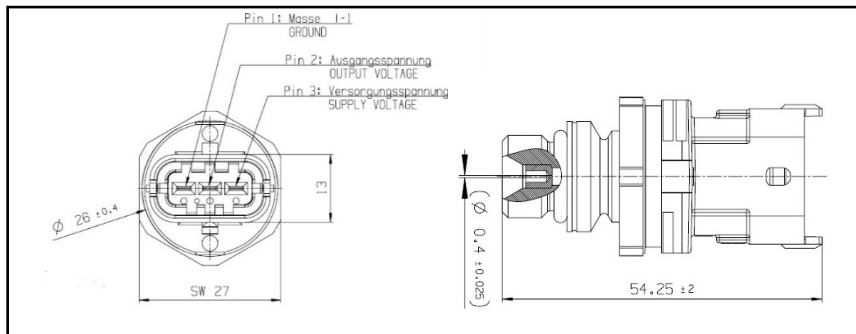
#### Part number

**0 261 546 001**

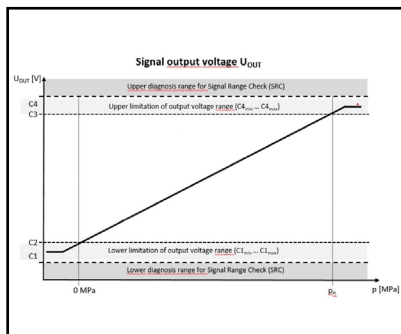
#### Picture



#### Dimensional drawings



#### Characteristic curve



#### 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	$5 \pm 0,25$
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

<sup>1)</sup> 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.**

#### Accessories

Connector housing	3-pin	1 928 403 966
Contact pins (gold-plated)	For $\varnothing 0.5...1.0 \text{ mm}^2$	1 928 498 054
Contact pins (gold-plated)	For $\varnothing 1.5...2.5 \text{ mm}^2$	1 928 498 055
Single-wire seal	For $\varnothing 0.35...1.0 \text{ mm}^2$	1 928 300 599
Single-wire seal	For $\varnothing 1.5...2.5 \text{ mm}^2$	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.

## 3.4 Pressure sensors

### 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.**

## 3.4 Pressure sensors

### High pressure sensor (gasoline)



#### Product type

**PS-HPS4**

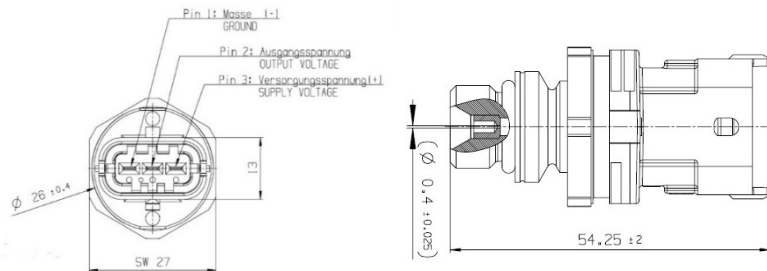
#### Part number

**0 261 545 188**

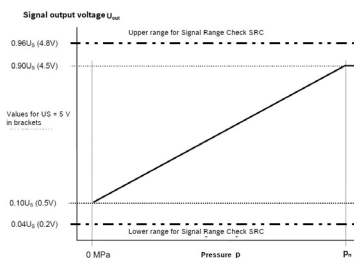
#### Picture



#### Dimensional drawings



#### Characteristic curve



#### 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	$5 \pm 0,25$
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

<sup>1)</sup> FS = Full Scale

#### Accessories

Connector housing	3-pin	1 928 403 966
Contact pins (gold-plated)	For $\varnothing 0.5...1.0 \text{ mm}^2$	1 928 498 054
Contact pins (gold-plated)	For $\varnothing 1.5...2.5 \text{ mm}^2$	1 928 498 055
Single-wire seal	For $\varnothing 0.35...1.0 \text{ mm}^2$	1 928 300 599
Single-wire seal	For $\varnothing 1.5...2.5 \text{ mm}^2$	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.

## 3.4 Pressure sensors

### High pressure sensor (gasoline)



#### Product type

**PS-HPS4-TF**

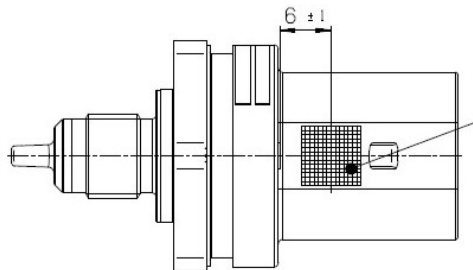
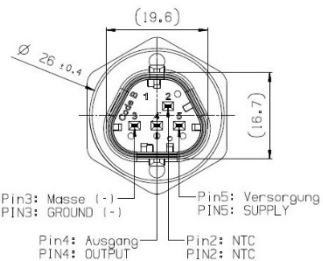
#### Part number

**0 261 545 161**

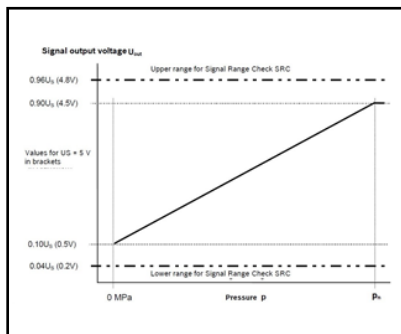
#### Picture



#### 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	$5 \pm 0,25$
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

<sup>1)</sup> 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 mm <sup>2</sup> ; Contents: 4 x	1 928 498 810
Mating single wire seal	For Ø 0.35...0.5 mm <sup>2</sup> ; Contents: 4 x	1 928 300 934
Cavity Plug	For Ø 0.35 ... 0.5 mm <sup>2</sup> ; 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.

## 3.4 Pressure sensors

### High pressure sensor (diesel)



#### Product type

**DS-HD-RDS4.2**

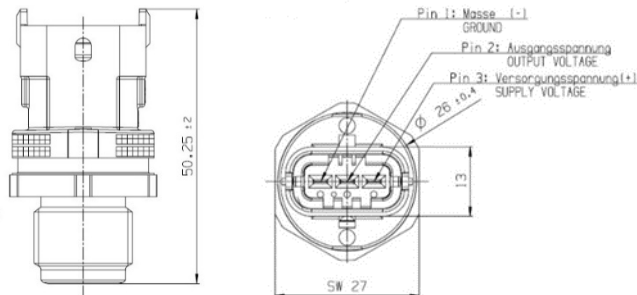
#### Part number

**0 281 002 930**

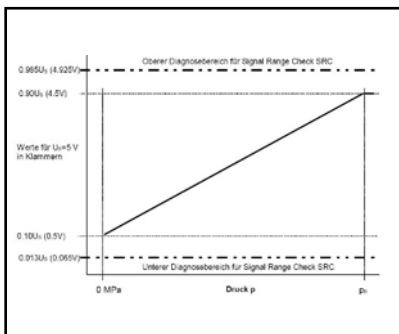
#### Picture



#### 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	$5 \pm 0,25$
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	$\tau_{ini}$	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 $\varnothing 0.5...1.0 \text{ mm}^2$	1 928 498 054
Contact pins (gold-plated)	For $\varnothing 1.5...2.5 \text{ mm}^2$	1 928 498 055
Single-wire seal	For $\varnothing 0.35...1.0 \text{ mm}^2$	1 928 300 599
Single-wire seal	For $\varnothing 1.5...2.5 \text{ mm}^2$	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.



## 3.4 Pressure sensors

### High pressure sensor (diesel)



#### Product type

**PS-RPS4-22**

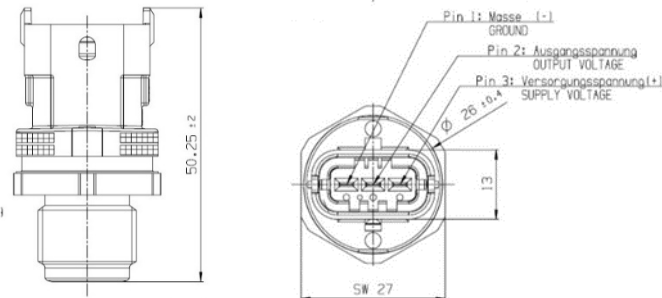
#### Part number

**0 281 008 003**

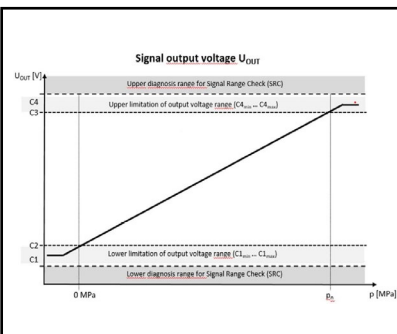
#### Picture



#### 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	$5 \pm 0,25$
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	$\tau_{ini}$	ms	0,2...0,8

\*RME rapeseed methyl ester.

#### Accessories

Connector housing	3-pin	1 928 403 966
Contact pins (gold-plated)	For $\varnothing 0.5...1.0 \text{ mm}^2$	1 928 498 054
Contact pins (gold-plated)	For $\varnothing 1.5...2.5 \text{ mm}^2$	1 928 498 055
Single-wire seal	For $\varnothing 0.35...1.0 \text{ mm}^2$	1 928 300 599
Single-wire seal	For $\varnothing 1.5...2.5 \text{ mm}^2$	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.

## 4.1 Rotational-speed sensors

### 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 output current = 20 mA.
$I_A$	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).

## 4.1 Rotational-speed sensors

### Hall speed sensor



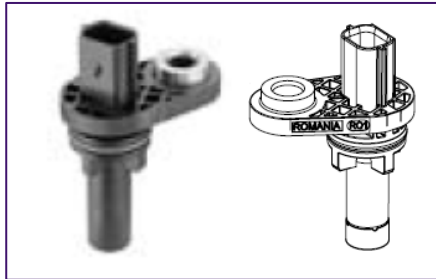
### Product type

# DG-23

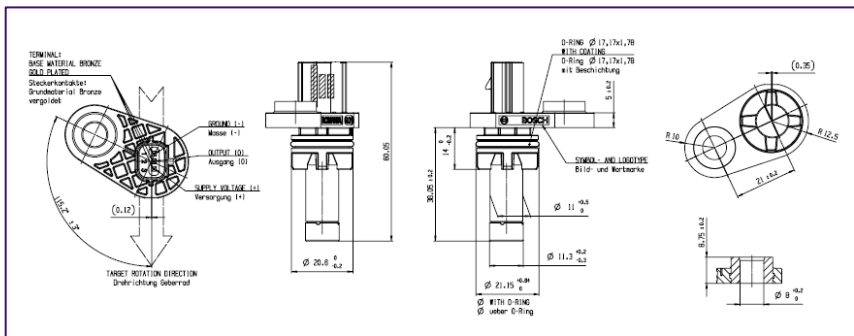
## Part number

**0 261 210 303**

## Picture



## Dimensional drawings



## Technical data

Minimum trigger-wheel speed	$n_{\min.}$	0 min. <sup>-1</sup>
Maximum trigger-wheel speed	$n_{\max.}$	8000 min. <sup>-1</sup>
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	$t_i$ 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  $23 \pm 5$  °C.

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

## 4.1 Rotational-speed sensors

### Hall speed sensor



**BOSCH**

#### Product type

**DG-23-I**

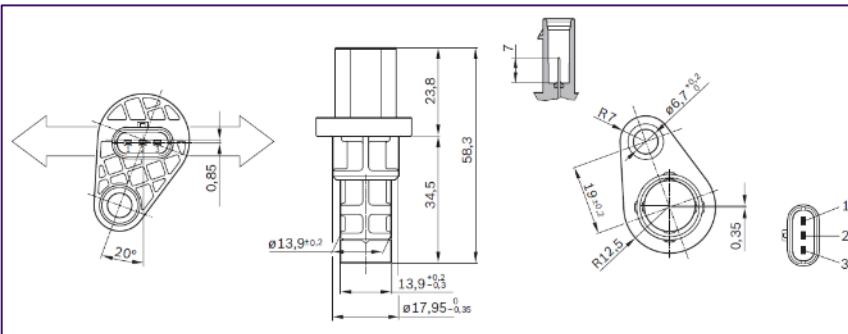
#### Part number

**0 261 210 30E**

#### Picture



#### Dimensional drawings



#### Technical data

Minimum trigger-wheel speed	$n_{min.}$	0 min. <sup>-1</sup>
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.

## 4.1 Rotational-speed sensors

### Hall speed sensor



#### Product type

**DG-23-I**

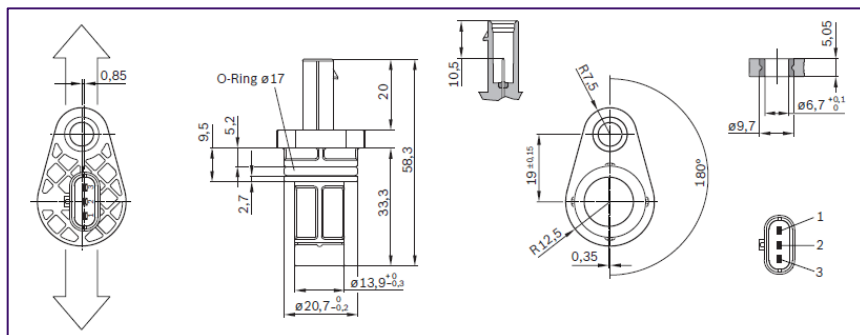
#### Part number

**0 261 210 383**

#### Picture



#### Dimensional drawings



#### Technical data

Minimum trigger-wheel speed	$n_{\min.}$	0 min. <sup>-1</sup>
Maximum trigger-wheel speed	$n_{\max.}$	5000 min. <sup>-1</sup>
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	$t_1^{1)}$	≤ 1,3 μs
Switching time	$t_2^{2)}$	≤ 17 μs
Steady-state temperature in sensor and transition zone		-40°C...+150°C
Steady-state temperature in connector zone		-40°C...+130°C

<sup>1)</sup> Time from HIGH to LOW, measured between connections (0) and (-) from 90% to 10%.

<sup>2)</sup> Time from LOW to HIGH, measured between connections (0) and (-) from 10% to 90%.

<sup>3)</sup> -40...+150 °C permissible for brief period.

<sup>4)</sup> -40...+130 °C permissible for brief period.

# 4.1 Rotational-speed sensors

## Hall speed sensor



### Product type

RSC-D5

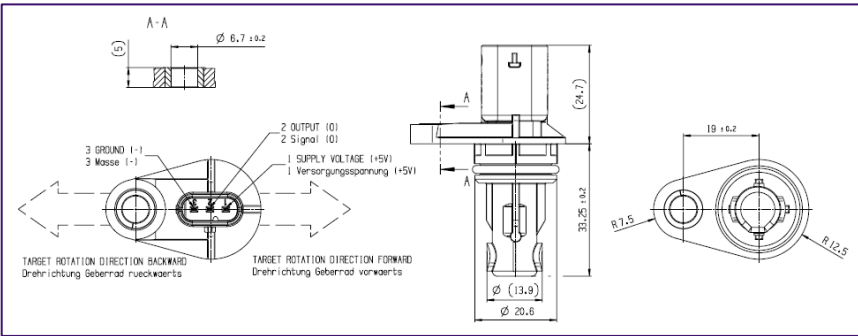
### Part number

0 261 210 399

### Picture



### Dimensional drawings



### Technical data

Minimum trigger-wheel speed	$n_{min.}$	0 min. <sup>-1</sup>
Maximum trigger-wheel speed, forward	$n_{max.}$	10 000 min. <sup>-1</sup>
Maximum trigger-wheel speed, reverse	$n_{max.}$	4 000 min. <sup>-1</sup>
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)		

# 4.1 Rotational-speed sensors

## Hall speed sensor



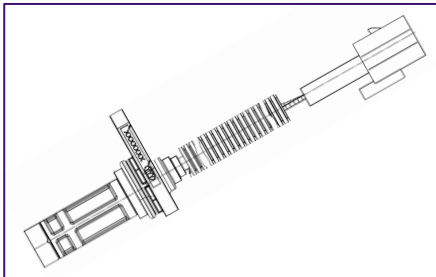
### Product type

**DG-23-I**

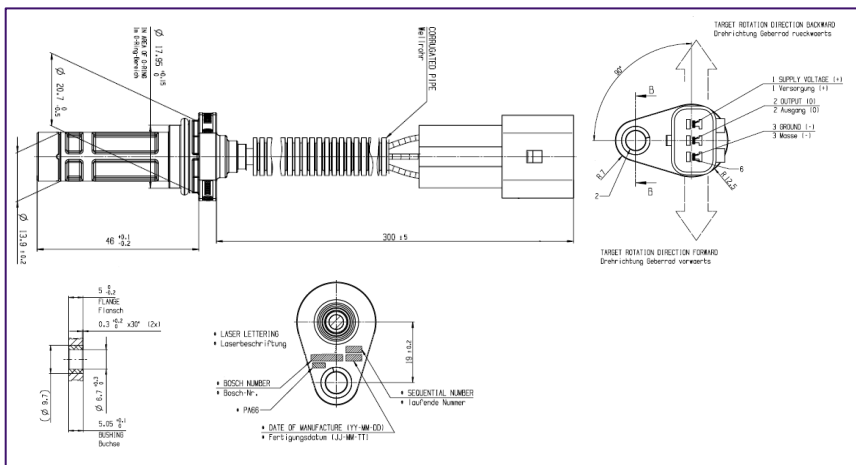
### Part number

**0 261 210 404**

### Picture



### Dimensional drawings



### Technical data

Minimum trigger-wheel speed	$n_{min.}$	0 min. <sup>-1</sup>
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.

## 4.1 Rotational-speed sensors

### Hall speed sensor



#### Product group

**PG-3-8**

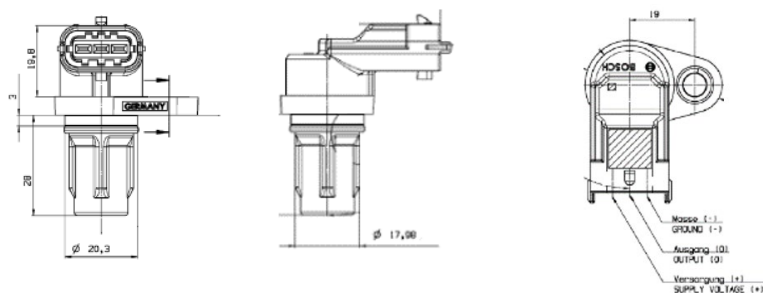
#### Part number

**0 232 103 048**

#### Picture



#### Dimensional drawings



#### Technical data

Minimum trigger-wheel speed	$n_{\min.}$	0 min. <sup>-1</sup>
Maximum trigger-wheel speed	$n_{\max.}$	4500 min. <sup>-1</sup>
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	$t_1^{1)}$	≤ 1 μs
Switching time	$t_2^{2)}$	≤ 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 mm <sup>2</sup> ; Contents: 100 x	1 928 498 054
Contact pins (gold plated)	For Ø 1.5...2.5 mm <sup>2</sup> ; Contents: 100 x	1 928 498 055
Single-wire seal	For Ø 0.5...1.0 mm <sup>2</sup> ; Contents: 10 x	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm <sup>2</sup> ; 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.



## 4.1 Rotational-speed sensors

### Hall speed sensor



## Product group

**PG-3-8**

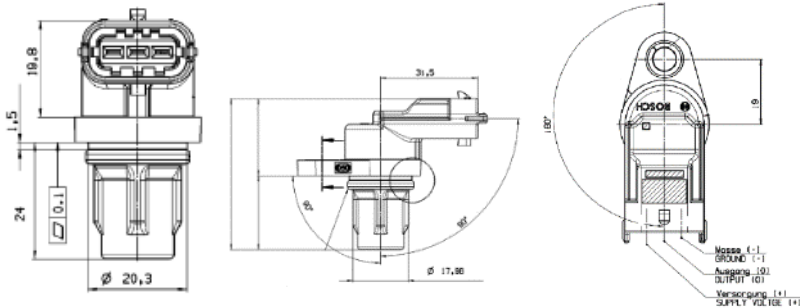
## Part number

**0 232 103 063**

## Picture



## Dimensional drawings



## Technical data

Minimum trigger-wheel speed	$n_{\min.}$	0 min. <sup>-1</sup>
Maximum trigger-wheel speed	$n_{\max.}$	4500 min. <sup>-1</sup>
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	$t_i$ 1)	≤ 1 μs
Switching time	$t_i$ 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

<sup>1)</sup> Time from HIGH to LOW, measured between connections (0) and (-) from 90% to 10%.

<sup>2)</sup> 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.

## 4.1 Rotational-speed sensors

### Hall speed sensor



#### Product group

**PG-3-8**

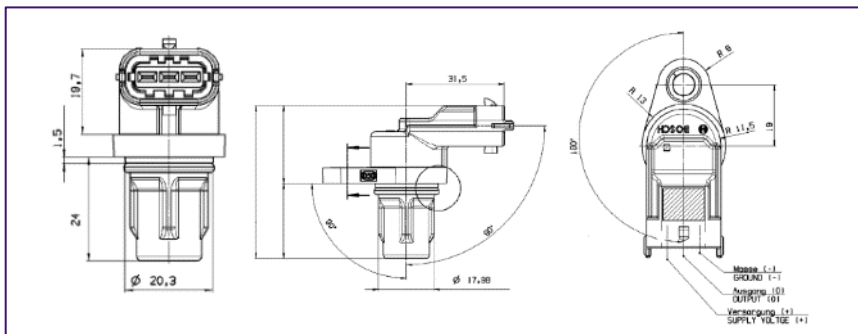
#### Part number

**0 232 103 067**

#### Picture



#### Dimensional drawings



#### Technical data

Minimum trigger-wheel speed	$n_{\min.}$	0 min. <sup>-1</sup>
Maximum trigger-wheel speed	$n_{\max.}$	4500 min. <sup>-1</sup>
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	$t_1^{1)}$	≤ 1 μs
Switching time	$t_2^{2)}$	≤ 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 mm <sup>2</sup> ; Contents: 100 x	1 928 498 056
Contact pins (tin plated)	For Ø 1.5...2.5 mm <sup>2</sup> ; Contents: 100 x	1 928 498 057
Single-wire seal	For Ø 0.5...1.0 mm <sup>2</sup> ; Contents: 10 x	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm <sup>2</sup> ; 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.

## 4.1 Rotational-speed sensors

### Hall speed sensor



#### Product group

**PG-3-8**

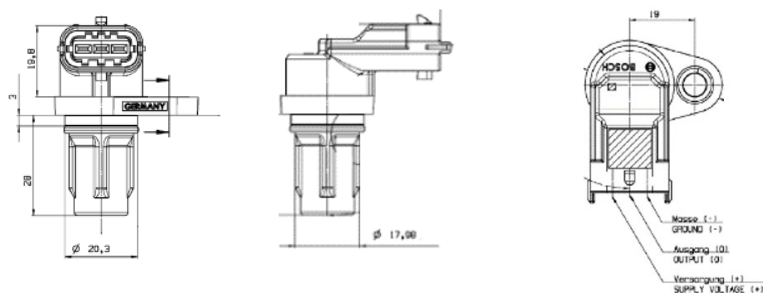
#### Part number

**0 232 103 097**

#### Picture



#### Dimensional drawings



#### Technical data

Minimum trigger-wheel speed	$n_{\min.}$	0 min. <sup>-1</sup>
Maximum trigger-wheel speed	$n_{\max.}$	4500 min. <sup>-1</sup>
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	$t_1^{1)}$	≤ 1 μs
Switching time	$t_2^{2)}$	≤ 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 mm <sup>2</sup> ; Contents: 100 x	1 928 498 054
Contact pins (gold plated)	For Ø 1.5...2.5 mm <sup>2</sup> ; Contents: 100 x	1 928 498 055
Single-wire seal	For Ø 0.5...1.0 mm <sup>2</sup> ; Contents: 10 x	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm <sup>2</sup> ; 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.

# 4.1 Rotational-speed sensors

## Hall speed sensor



### Product group

CPS-4

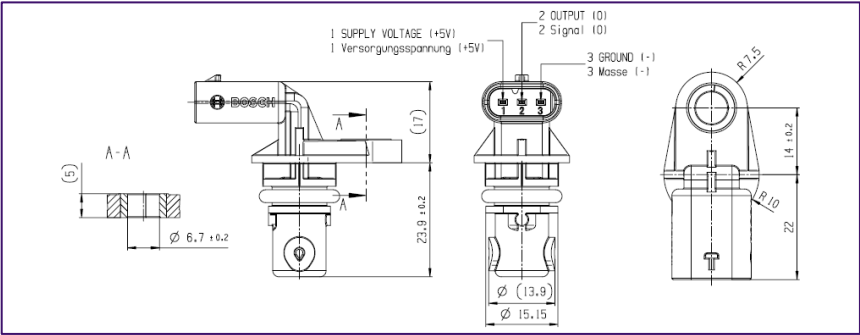
### Part number

0 232 103 502

### Picture



### Dimensional drawings



### Technical data

Minimum trigger-wheel speed	$n_{min.}$	0 min. <sup>-1</sup>
Maximum trigger-wheel speed	$n_{max.}$	5000 min. <sup>-1</sup>
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	$t_1^1)$	≤ 3.5 μs
Switching time	$t_2^2)$	≤ 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.

## 4.1 Rotational-speed sensors

### Hall speed sensor



#### Product type

**CPS-4**

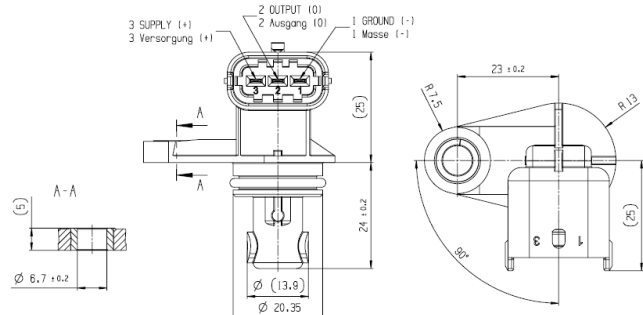
#### Part number

**0 232 103 506**

#### Picture



#### Dimensional drawings



#### Technical data

Minimum trigger-wheel speed	$n_{\min.}$	0 min. <sup>-1</sup>
Maximum trigger-wheel speed	$n_{\max.}$	5000 min. <sup>-1</sup>
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 ... 5,5 V / 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	$t_r^{1)}$	≤ 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

<sup>1)</sup> Time from HIGH to LOW, measured between connections (0) and (-) from 90% to 10%.

<sup>2)</sup> 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 mm <sup>2</sup> ; Contents: 100 x	1 928 498 056
Contact pins (tin plated)	For Ø 1.5...2.5 mm <sup>2</sup> ; Contents: 100 x	1 928 498 057
Single-wire seal	For Ø 0.5...1.0 mm <sup>2</sup> ; Contents: 10 x	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm <sup>2</sup> ; 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.

## 4.1 Rotational-speed sensors

### Hall speed sensor



#### Product type

**PG-3-8**

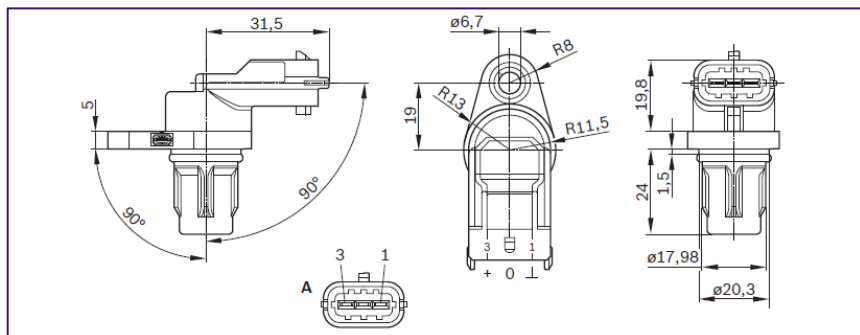
#### Part number

**0 281 002 667**

#### Picture



#### Dimensional drawings



#### Technical data

Minimum trigger-wheel speed	$n_{\min.}$	0 min. <sup>-1</sup>
Maximum trigger-wheel speed	$n_{\max.}$	4500 min. <sup>-1</sup>
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	$t_r^{2)}$	≤ 15 μs
Steady-state temperature in sensor and transition zone		-40°C...+150°C
Steady-state temperature in connector zone		-40°C...+130°C

<sup>1)</sup> Time from HIGH to LOW, measured between connections (0) and (-) from 90% to 10%.

<sup>2)</sup> Time from LOW to HIGH, measured between connections (0) and (-) from 10% to 90%.

<sup>3)</sup> -40...+150 °C permissible for brief period.

<sup>4)</sup> -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 mm <sup>2</sup> ; Contents: 100 x	1 928 498 056
Contact pins (tin plated)	For Ø 1.5...2.5 mm <sup>2</sup> ; Contents: 100 x	1 928 498 057
Single-wire seal	For Ø 0.5...1.0 mm <sup>2</sup> ; Contents: 10 x	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm <sup>2</sup> ; 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.

## 4.1 Rotational-speed sensors

### Hall speed sensor



#### Product group

**PG-3-9**

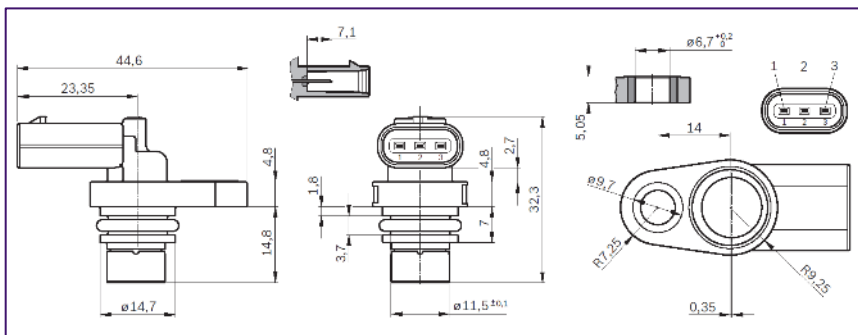
#### Part number

**0 232 103 099**

#### Picture



#### Dimensional drawings



#### Technical data

Minimum trigger-wheel speed	$n_{\min.}$	0 min. <sup>-1</sup>
Maximum trigger-wheel speed	$n_{\max.}$	4500 min. <sup>-1</sup>
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	$t_1^{1)}$	≤ 1 μs
Switching time	$t_2^{2)}$	≤ 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  $23 \pm 5$  °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.

## 4.1 Rotational-speed sensors

### Hall speed sensor



#### Product group

**PG-3-9**

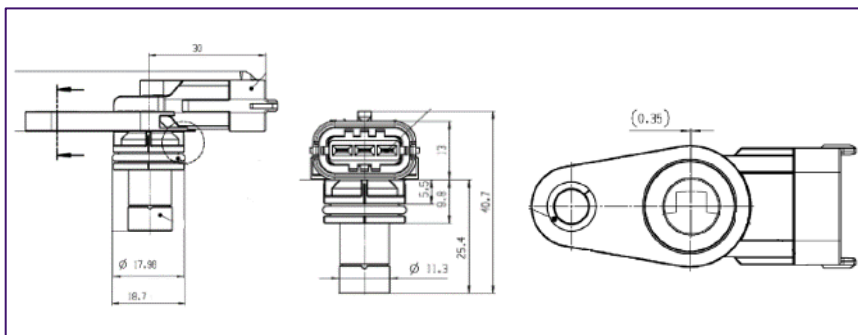
#### Part number

**0 232 103 122**

#### Picture



#### Dimensional drawings



#### Technical data

Minimum trigger-wheel speed	$n_{\min.}$	0 min. <sup>-1</sup>
Maximum trigger-wheel speed	$n_{\max.}$	4500 min. <sup>-1</sup>
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	$t_1^{1)}$	≤ 1 μs
Switching time	$t_2^{2)}$	≤ 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  $23 \pm 5$  °C.

<sup>1)</sup> Time from HIGH to LOW, measured between connections (0) and (-) from 90% to 10%.

<sup>2)</sup> Time from LOW to HIGH, measured between connections (0) and (-) from 10% to 90%.

<sup>3)</sup> -40...+150 °C permissible for brief period.

<sup>4)</sup> -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 mm <sup>2</sup> ; Contents: 100 x	1 928 498 058
Contact pins (silver plated)	For Ø 1.5...2.5 mm <sup>2</sup> ; Contents: 100 x	1 928 498 059
Single-wire seal	For Ø 0.5...1.0 mm <sup>2</sup> ; Contents: 10 x	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm <sup>2</sup> ; 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.



## 4.2 Rotational-speed sensors

### Inductive speed sensor



- 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 $U_{SEP}$
n	Speed $n_{SEP}$
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).

## 4.2 Rotational-speed sensors

### Inductive speed sensor



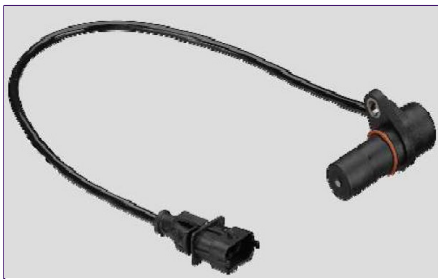
#### Product group

**DG-6-K**

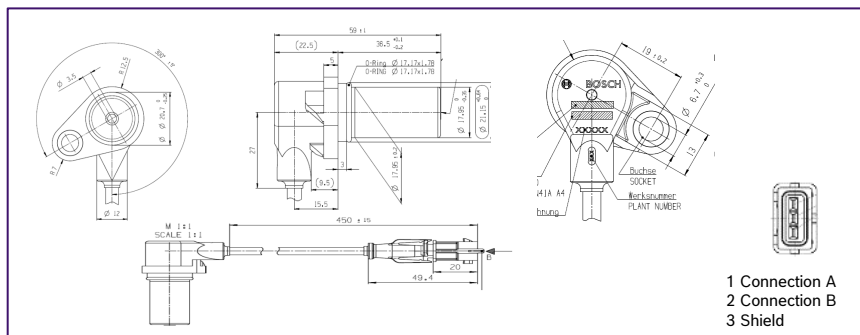
#### Part number

**0 281 002 214**

#### Picture



#### Dimensional drawings



#### Technical data

Rotational-speed measuring range <sup>1)</sup> $n$	$\text{min}^{-1}$	20 ... 7000
Sustained ambient temperature/coil zone	$^{\circ}\text{C}$	- 40 ... + 130
Sustained ambient temperature/cable zone	$^{\circ}\text{C}$	- 40 ... + 130
Max. vibration	$\text{m/s}^2$	300
Number of turns		4300 turns/windings
Winding resistance at 20 $^{\circ}\text{C}$ <sup>2)</sup> $U_A$	$\Omega$	860 $\pm 10\%$
Inductance at 1 kHz	mH	370 $\pm 60$
Degree of protection	IP	IPx9K
Output voltage <sup>2)</sup> $U_A$	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)

<sup>1)</sup> Referenced to corresponding trigger wheel.

<sup>2)</sup> Change factor  $k = 1 + 0.004 (v_w - 20^{\circ}\text{C})$ ;  $v_w$  Winding temperature.

#### Accessories

Connector housing	3-pin	1 928 403 734
Contact pins (tin plated)	For $\varnothing 0.5 \dots 1.0 \text{ mm}^2$ ; Contents: 100 x	1 928 498 056
Contact pins (tin plated)	For $\varnothing 1.5 \dots 2.5 \text{ mm}^2$ ; Contents: 100 x	1 928 498 057
Single-wire seal	For $\varnothing 0.5 \dots 1.0 \text{ mm}^2$ ; Contents: 10 x	1 928 300 599
Single-wire seal	For $\varnothing 1.5 \dots 2.5 \text{ mm}^2$ ; Contents: 10 x	1 928 300 600
Dummy plug		1 928 300 601

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

## 4.2 Rotational-speed sensors

### Inductive speed sensor



#### Product group

**DG-6-K**

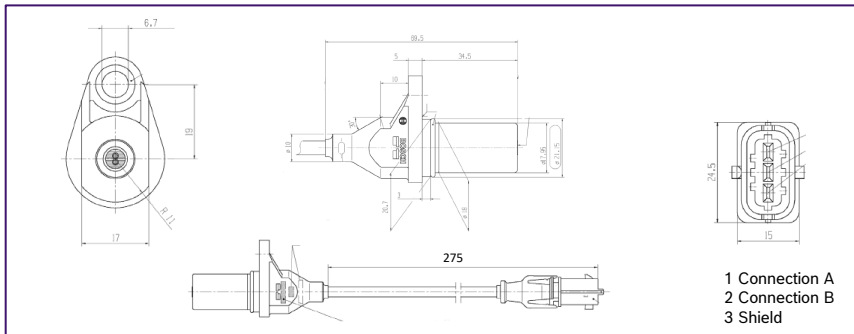
#### Part number

**0 281 002 629**

#### Picture



#### Dimensional drawings



#### Technical data

Rotational-speed measuring range <sup>1)</sup> $n$	$\text{min}^{-1}$	20 ... 7000
Sustained ambient temperature/coil zone	$^{\circ}\text{C}$	- 40 ... + 150
Sustained ambient temperature/cable zone	$^{\circ}\text{C}$	- 40 ... + 130
Max. vibration	$\text{m/s}^2$	300
Number of turns		4300 turns/windings
Winding resistance at 20 $^{\circ}\text{C}$ <sup>2)</sup> $U_A$	$\Omega$	860 $\pm 10\%$
Inductance at 1 kHz	mH	370 $\pm 60$
Degree of protection	IP	IPx9K
Output voltage <sup>2)</sup> $U_A$	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)

<sup>1)</sup> Referenced to corresponding trigger wheel.

<sup>2)</sup> Change factor  $k = 1 + 0.004 (v_w - 20^{\circ}\text{C})$ ;  $v_w$  Winding temperature.

#### Accessories

Connector housing	3-pin	1 928 404 073
Contact pins	For $\varnothing 0.5 \dots 1.0 \text{ mm}^2$	1 928 498 056
Contact pins	For $\varnothing 1.5 \dots 2.5 \text{ mm}^2$	1 928 498 057
Single-wire seal	For $\varnothing 0.5 \dots 1.0 \text{ mm}^2$	1 928 300 599
Single-wire seal	For $\varnothing 1.5 \dots 2.5 \text{ mm}^2$	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.

## 4.2 Rotational-speed sensors

### Inductive speed sensor



#### Product group

**DG-6-S**

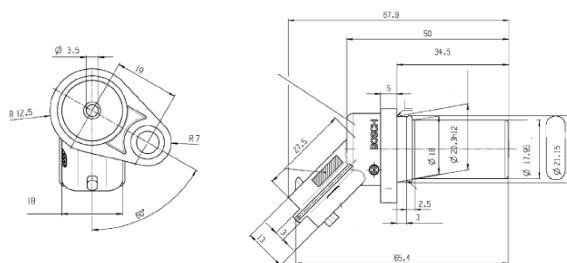
#### Part number

**0 281 002 315**

#### Picture



#### Dimensional drawings



1 Connection B  
2 Connection A

#### Technical data

Rotational-speed measuring range <sup>1)</sup> $n$	$\text{min}^{-1}$	20 ... 7000
Sustained ambient temperature/coil zone	$^{\circ}\text{C}$	- 40 ... + 150
Sustained ambient temperature/cable zone	$^{\circ}\text{C}$	- 40 ... + 130
Max. vibration	$\text{m/s}^2$	300
Number of turns		4300 turns/windings
Winding resistance at 20 $^{\circ}\text{C}$ <sup>2)</sup> $U_A$	$\Omega$	860 $\pm 10\%$
Inductance at 1 kHz	mH	370 $\pm 60$
Degree of protection	IP	IPx9K
Output voltage <sup>2)</sup> $U_A$	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)

<sup>1)</sup> Referenced to corresponding trigger wheel.

<sup>2)</sup> Change factor  $k = 1 + 0.004 (v_w - 20^{\circ}\text{C})$ ;  $v_w$  Winding temperature.

#### Accessories

Connector housing	2-pin	1 928 404 072
Contact pins (tin-plated)	For Ø 0.5...1.0 mm <sup>2</sup>	1 928 498 056
Contact pins (tin-plated)	For Ø 1.5...2.5 mm <sup>2</sup>	1 928 498 057
Single-wire seal	For Ø 0.5...1.0 mm <sup>2</sup>	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm <sup>2</sup>	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.

# 5 Structure-borne sound

## Piezoelectric vibration sensor



- 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 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

<i>E</i>	Sensitivity
<i>F</i>	Frequency
<i>g</i>	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.

## 5 Structure-borne sound

### Piezoelectric vibration sensor



#### Product type

**KS-4-K**

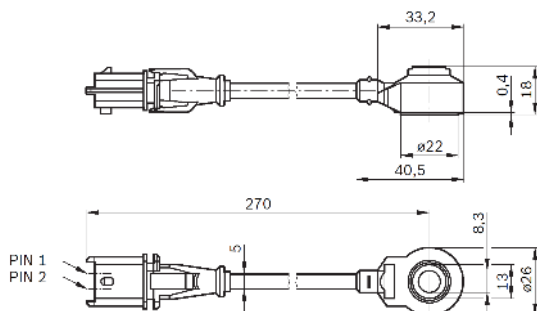
#### Part number

**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.

# 5 Structure-borne sound

## Piezoelectric vibration sensor



### Product type

KS-4-K

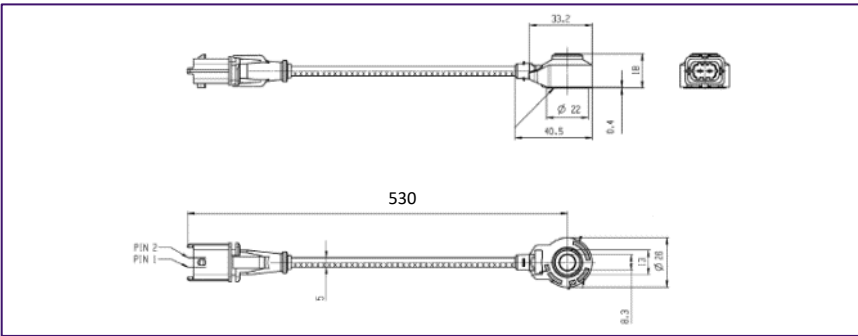
### Part number

0 261 231 218

### Picture



### Dimensional drawings



### Technical data

Vibration sensors	2-pole, with cable
Frequency range	0 ... 24 kHz
Self-impedance	> 1 M $\Omega$
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, gold 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.

## 5 Structure-borne sound

### Piezoelectric vibration sensor



#### Product type

**KS-4-S**

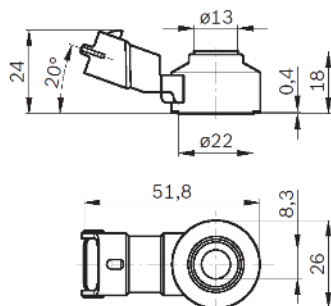
#### Part number

**0 261 231 173**

#### Picture



#### Dimensional drawings



#### 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

#### 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.



## 5 Structure-borne sound

### Piezoelectric vibration sensor



#### Product type

**KS-4-S**

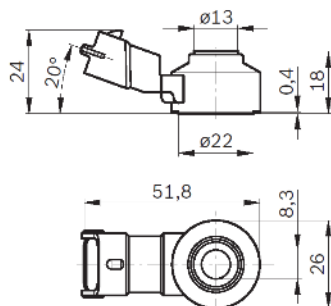
#### Part number

**0 261 231 176**

#### Picture



#### Dimensional drawings



#### 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

#### 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.

# 5 Structure-borne sound

## Piezoelectric vibration sensor



### Product type

**KS-4-S**

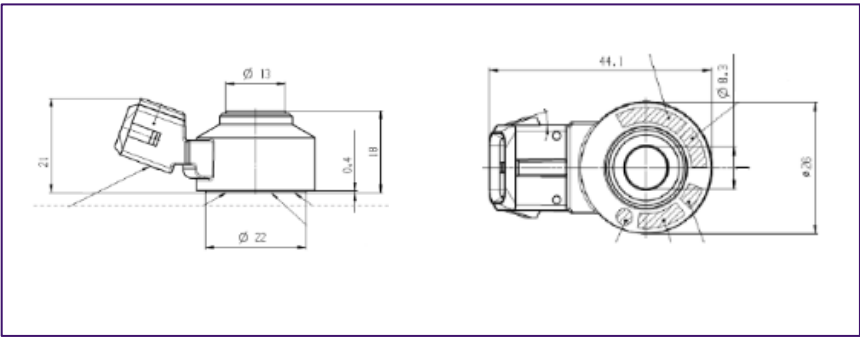
### Part number

**0 261 231 208**

### Picture



### Dimensional drawings



### 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

### 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.

# 5 Structure-borne sound

## Piezoelectric vibration sensor



### Product type

KS-4-S

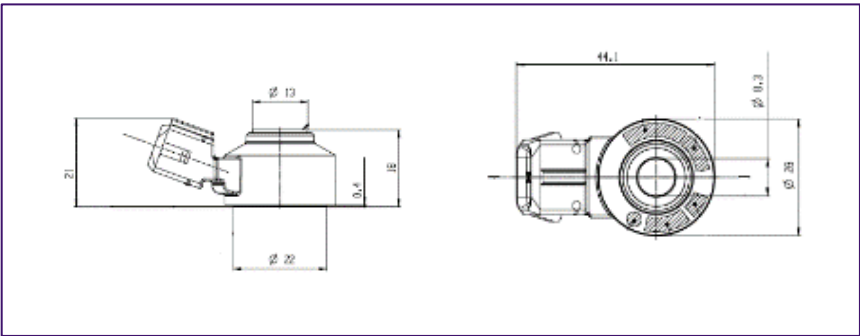
### Part number

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.

## 6 Temperature sensors

### 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  
 Temperature

#### Installation instructions

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

## 6 Temperature sensors

### Measurement of air/liquid temperatures



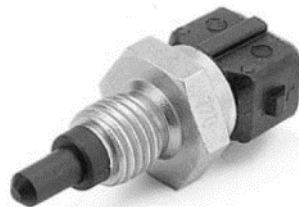
#### Product type

**TF-L**

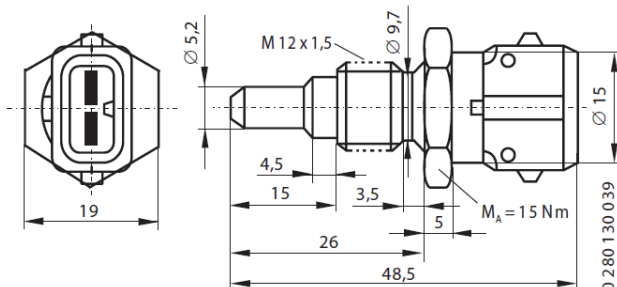
#### Part number

**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 $\tau_{63}^{1)}$	s	≤ 38
Approximate value for permissible Vibration acceleration $a_{sin}$ (sinusoidal vibration)	m/s <sup>2</sup>	300
Corrosion-tested as per	DIN 50 018	

<sup>1)</sup> 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 mm <sup>2</sup>	AMP 929 939-3
Contact pins	For Ø 1.5...2.5 mm <sup>2</sup>	AMP 929 937-3
Individual seal	For Ø 0.5...1.0 mm <sup>2</sup>	1 987 280 106
Individual seal	For Ø 1.5...2.5 mm <sup>2</sup>	1 987 280 107

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

## 6 Temperature sensors

### Measurement of air/liquid temperatures



**BOSCH**

#### Product type

**TF-W**

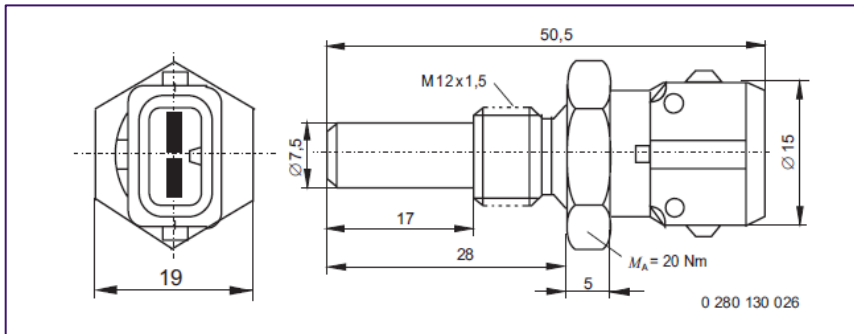
#### Part number

**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 $\tau_{63}$ <sup>1)</sup>	s	≤ 15
Degree of protection <sup>1)</sup>	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

<sup>1)</sup> 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 mm <sup>2</sup>	AMP 929 939-3
Contact pins	For Ø 1.5...2.5 mm <sup>2</sup>	AMP 929 937-3
Individual seal	For Ø 0.5...1.0 mm <sup>2</sup>	1 987 280 106
Individual seal	For Ø 1.5...2.5 mm <sup>2</sup>	1 987 280 107

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

## 6 Temperature sensors

### Measurement of air/liquid temperatures



#### Product type

**TF-W**

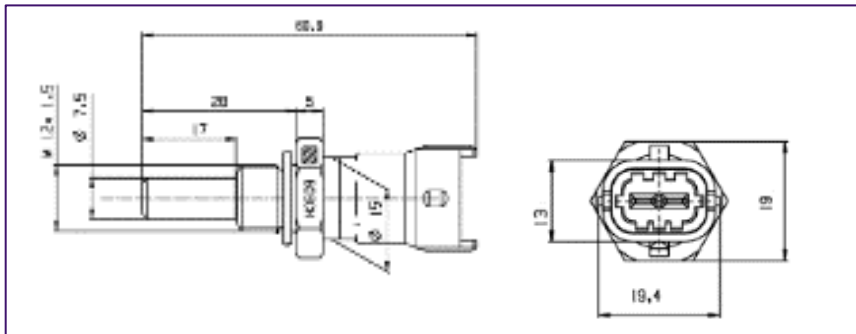
#### Part number

**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 $\tau_{63}^{1)}$	s	= 15 s
Degree of protection <sup>1)</sup>	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.

## 6 Temperature sensors

### Measurement of air/liquid temperatures



**BOSCH**

#### Product type

**TF-W**

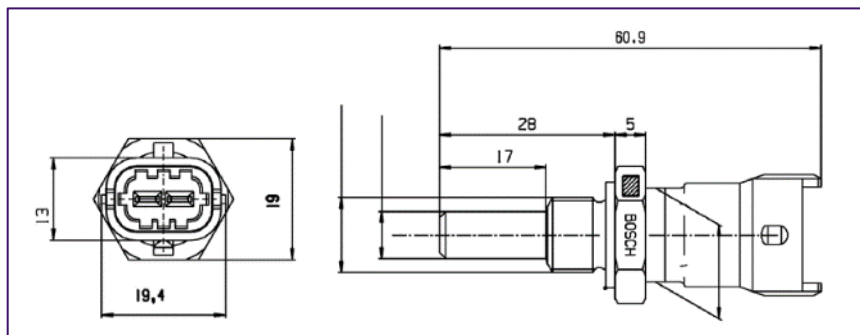
#### Part number

**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 $\tau_{63}$ <sup>1)</sup>	s	≤ 15
Degree of protection <sup>1)</sup>	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

<sup>1)</sup> 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 mm <sup>2</sup>	AMP 2 929 939-1
Contact pins (gold-plated)	For Ø 1.5...2.5 mm <sup>2</sup>	AMP 2 929 937-1
Single-wire seal	For Ø 0.5...1.0 mm <sup>2</sup>	AMP 828 904
Single-wire seal	For Ø 1.5...2.5 mm <sup>2</sup>	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.



## 6 Temperature sensors

### Measurement of air/liquid temperatures



#### Product type

**TF-W**

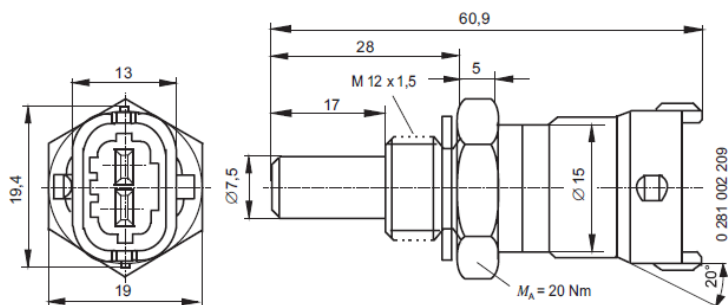
#### Part number

**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 $\tau_{63}$ <sup>1)</sup>	s	≤ 15
Degree of protection <sup>1)</sup>	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

<sup>1)</sup> 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 mm <sup>2</sup>	1 928 498 056
Contact pins	For Ø 1.5...2.5 mm <sup>2</sup>	1 928 498 057
Single-wire seal	For Ø 0.5...1.0 mm <sup>2</sup>	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm <sup>2</sup>	1 928 300 600

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

## 6 Temperature sensors

### Measurement of air/liquid temperatures



#### Product type

**TF-W**

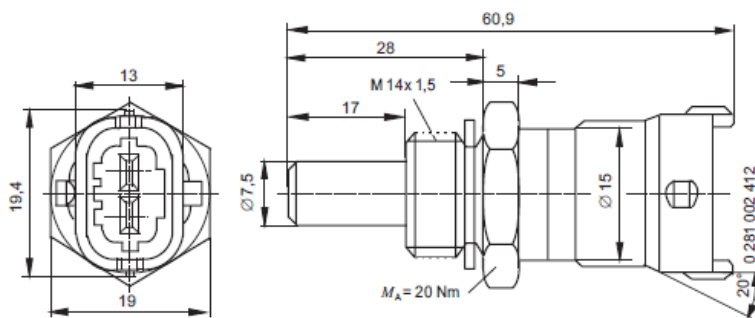
#### Part number

**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 $\tau_{63}^{1)}$	s	≤ 15
Degree of protection <sup>1)</sup>	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

<sup>1)</sup> 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 mm <sup>2</sup>	1 928 498 056
Contact pins	For Ø 1.5...2.5 mm <sup>2</sup>	1 928 498 057
Single-wire seal	For Ø 0.5...1.0 mm <sup>2</sup>	1 928 300 599
Single-wire seal	For Ø 1.5...2.5 mm <sup>2</sup>	1 928 300 600

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

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