Techniques and applications

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

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

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

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

IP 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

IP 2 ▢[1] 3 ▢[2] C M

Code letters — IP

First characteristic numeral 0...6 or letter X — 2

Second characteristic numeral 0...9 or letter X — 3

Additional letter (optional) A, B, C, D — C

Supplementary letter (optional) M, S — M

K[1] — ▢[1], ▢[2]

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

[1] The supplementary letter "K" is located either directly after the first characteristic numerals 5 and 6, or directly after the second characteristic numerals 4, 6 and 9.

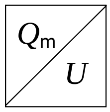
[2] During the water test. Example: IP16KB protection against the ingress of solid foreign bodies with diameter ≥ 50 mm, protection against high-pressure hose water, protection against access with a finger.

Comments on IP code

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

Hot-film air-mass meter, type HFM 2

Measurement of air-mass throughflow up to 1080 kg / h

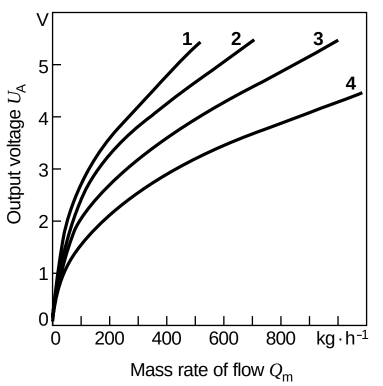


- Measurement of air mass (gas mass) throughflow per unit of time, independent of density and temperature.
- Extensive measuring range.
- Highly sensitive, particularly for small changes in flow rate.
- Wear-free since there are no moving parts.
- Insensitive to dirt and contamination.

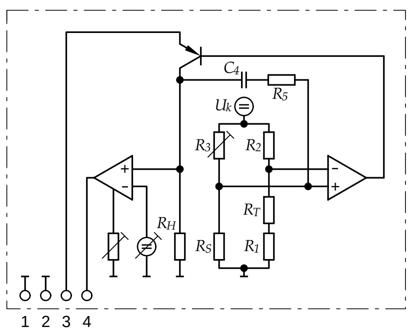
Application
Measurement of air-mass flow rate to provide data needed for clean combustion. Air-mass meters are suitable for use with other gaseous mediums.

Design and function
The sensor element comprises a ceramic substrate containing the following thick-film resistors which have been applied using silk-screen printing techniques: Air-temperature-sensor resistor R_ϑ, heater resistor R_H, sensor resistor R_S, and trimmer resistor R_1.
The heater resistor R_H maintains the platinum metallic-film resistor R_S at a constant temperature above that of the incoming air. The two resistors are in close thermal contact.
The temperature of the incoming air influences the resistor R_ϑ with which the trimmer resistor R_1 is connected in series. Throughout the complete operating-temperature range it compensates for the bridge circuit's temperature sensitivity. Together with R_2 and R_ϑ, R_1 forms one arm of the bridge circuit, while the auxiliary resistor R_3 and sensor resistor R_S form the other arm. The difference in voltage between the two arms is tapped off at the bridge diagonal and used as the measurement signal.
The evaluation circuit is contained on a second thick-film substrate. Both hybrids are integrated in the plastic housing of the plug-in sensor.
The hot-film air-mass meter is a thermal flowmeter. The film resistors on the ceramic substrate are exposed to the air mass under measurement. For reasons associated with flow, this sensor is far less sensitive to contamination than, for example, a hot-wire air-mass meter, and there is no need for the ECU to incorporate a self-cleaning burn-off function.

Characteristic curves.



Operating principle.

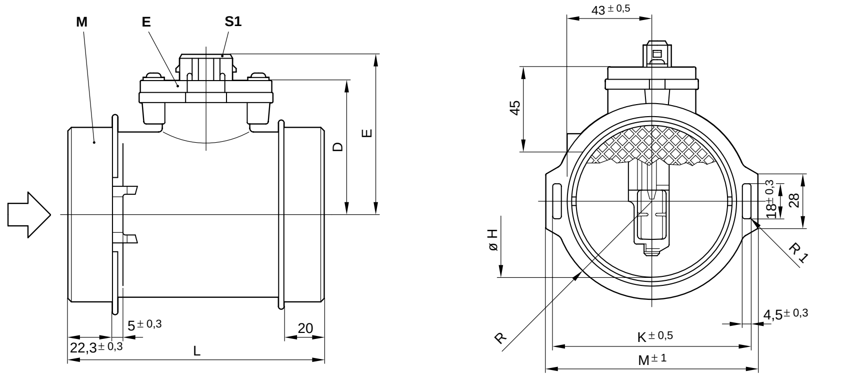


Technical data / Range

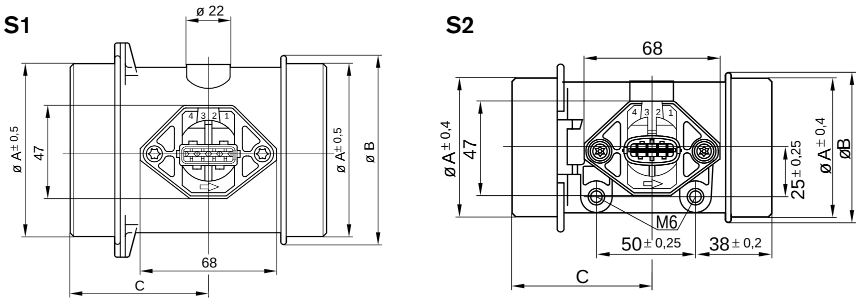
Part number		0 280 217 102	0 280 217 120 0 280 217 107	0 280 217 519	0 280 217 801
Characteristic curve		1	2	3	4
Installation length L	mm	130	130 96	130	130
Air-flow measuring range	$kg \cdot h^{-1}$	10...350	10...480	12...640	20...1080
Accuracy referred to measured value	%	±4	±4	±4	±4
Supply voltage	V	14	14	14	14
Input current at 0 $kg \cdot h^{-1}$	A	≤ 0,25	≤ 0,25	≤ 0,25	≤ 0,25
at $Q_{m\ nom.}$	A	≤ 0,8	≤ 0,8	≤ 0,8	≤ 0,8
Time constant [1])	ms	≤20	≤20	≤20	≤20
Temperature range Sustained	°C	–30...+110	–30...+110	–30...+110	–30...+110
Short-term	°C	–40...+125	–40...+125	–40...+125	–40...+125
Pressure drop at nominal air mass hPa	mbar	<15	<15	<15	<15
Vibration acceleration max.	$m \cdot s^{-2}$	150	150	150	150

[1]) In case of sudden increase of the air-mass flow from 10 $kg \cdot h^{-1}$ auf 0.7 $Q_{m\ nominal}$, time required to reach 63% of the final value of the air-mass signal.

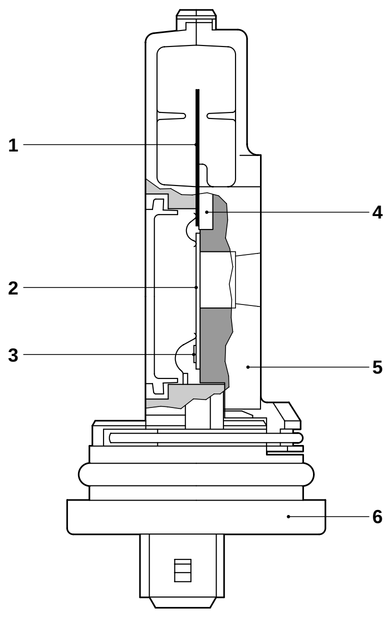
Dimension drawings.
E Plug-in sensor, **M** Measurement venturi, S1/S2 Plug connection



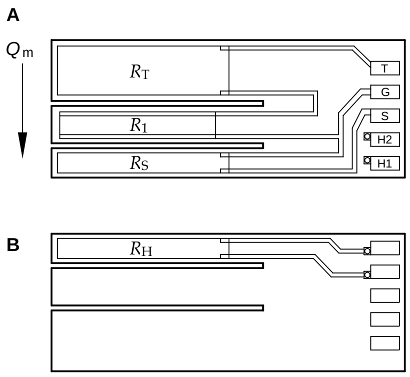
Ø A	Ø B	C	D	E	H	K	L	M	R	Measure-ment venturi	Plug-in connection	Part number
60	66	70	73	86	33	75	130	82	37	KS	S1	**0 280 217 102**
70	76	50	69	82	34.8	–	96	–	42	KS	S1	**0 280 217 107**
70	76	70	69	82	33.5	85	130	92	42	KS	S2	**0 280 217 120**
80	86	70	73	86	39	–	130	–	–	KS	S2	**0 280 217 519**
95.6	102	70	76.2	91.2	45	110	130	117	54	Alu	S1	**0 280 217 801**



Plug-in sensor.
1 Sensor, **2** Hybrid, **3** Power module,
4 Mounting plate, **5** Heat sink, **6** Plug housing



Sensor element with thick-film resistors.
Q_M Mass rate of flow, R_1 Trimmer resistor,
R_H Heater resistor, R_S Sensor resistor,
R_T Air-temperature measuring resistor,
A Front, **B** Rear



Installation instructions

Water and other liquids must not collect in the measurement venturi. The measurement venturi must therefore be inclined by at least 5° relative to the horizontal. Since care must be taken that the intake air is free of dust, it is imperative that an air filter is fitted.

Explanation of symbols:

R_1 Trimmer resistor
R_2, R_3 Auxiliary resistors
R_5, C_4 RC element
R_H Heater resistor
R_S Platinum metal-film resistor
R_T Resistance of the air-temperature-sensor resistor
U_K Bridge supply voltage
U_A Output voltage
U_V Supply voltage

Connector-pin assignment

Pin 1 Ground
Pin 2 U_A (–)
Pin 3 U_V
Pin 4 U_A (+)

Accessories

For 0 280 217 102, .. 107, .. 801

Plug housing	**1 284 485 118**
Receptacle	**1 284 477 121** [1])
Protective cap	**1 280 703 023** [1])

Each 4-pole plug requires 1 plug housing, 4 receptacles, and 1 protective cap.
[1]) Quantity 5 per package

For 0 280 217 120, .. 519

Desig-nation	For conductor cross-section	Part number
Plug housing	–	**1 928 403 112**
Contact pin	0.5...1.0 mm²	**1 987 280 103**
	1.5...2.5 mm²	**1 987 280 105**
Individual gasket	0.5...1.0 mm²	**1 987 280 106**
	1.5...2.5 mm²	**1 987 280 107**

Each 4-pole plug requires 1 plug housing, 4 contact pins, and 4 individual gaskets.

Note

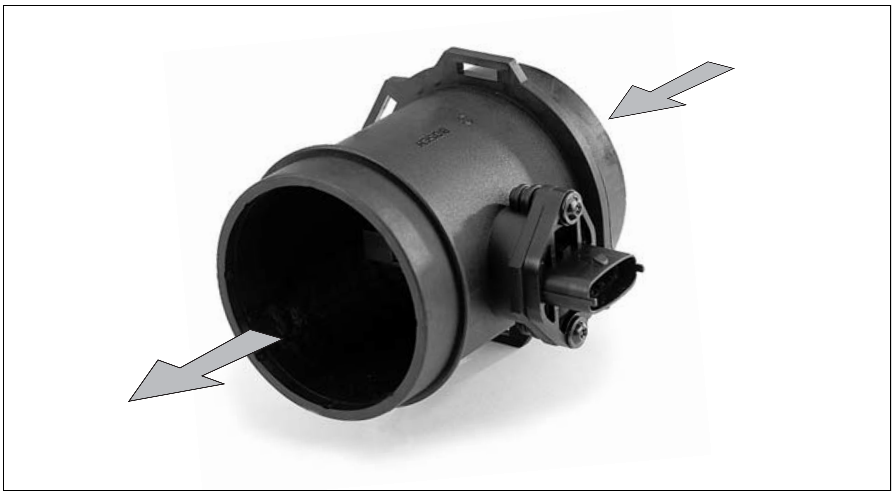
For automotive applications, original AMP crimping tools must be used.

Hot-film air-mass meter, Type HFM 5

Measurement of air-mass throughflow up to 1000 kg/h

Q_m / U

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



Application
In order to comply with the vehicle emission limits demanded by law, it is necessary to maintain a given air/fuel ratio exactly.
This requires sensors which precisely register the actual air-mass flow and output a corresponding electrical signal to the open and closed-loop control electronics.

Design
The micromechanical sensor element is located in the plug-in sensor's flow passage. This plug-in sensor is suitable for incorporating in the air filter or, using a measurement venturi, in the air-intake passages. There are different sizes of measurement venturi available depending upon the air throughflow. The micromechanical measuring system uses a hybrid circuit, and by evaluating the measuring data is able to detect when return flow takes place during air-flow pulsation.

Operating principle
The heated sensor element in the air-mass meter dissipates heat to the incoming air. The higher the air flow, the more heat is dissipated. The resulting temperature differential is a measure for the air mass flowing past the sensor.
An electronic hybrid circuit evaluates this measuring data so that the air-flow quantity can be measured precisely, and its direction of flow.
Only part of the air-mass flow is registered by the sensor element. The total air mass flowing through the measuring tube is determined by means of calibration, known as the characteristic-curve definition.

Technical data / range

Nominal supply voltage U_N	14 V
Supply-voltage range U_V	8...17 V
Output voltage U_A	0...5 V
Input current I_V	< 0.1 A
Permissible vibration acceleration	≤ 150 ms^{-2}
Time constant τ_{63} 1)	≤ 15 ms
Time constant τ_{Δ} 2)	≤ 30 ms
Temperature range	–40...+120 °C 3)

Part number	**0 280 217 123**	**0 280 218 019**	**0 280 217 531**	**0 280 218 008**	**0 281 002 421**
Measuring range Q_m	8...370 kg/h	10...480 kg/h	12...640 kg/h	12...850 kg/h	15...1000 kg/h
Accuracy 4)	≤ 3%	≤ 3%	≤ 3%	≤ 3%	≤ 3%
Fitting length L_E	22 mm	22 mm	22 mm	16 mm	22 mm
Fitting length L_A	20 mm	20 mm	20 mm	16 mm	20 mm
Installation length L	96 mm	96 mm	130 mm	100 mm	130 mm
Connection diam. D	60 mm	70 mm	80 mm	86/84 mm 6)	92 mm
Venturi ID	50 mm	62 mm	71 mm	78 mm	82 mm
Pressure drop at nominal air mass 5)	< 20 hPa	< 15 hPa	< 15 hPa	< 15 hPa	< 15 hPa
Temperature sensor	Yes	Yes	Yes	No	Yes
Version	1	2	3	4	5

1) In case of sudden increase of the air-mass flow from 10 kg · h^{-1} auf 0,7 $Q_{m\,nominal}$, time required to reach 63% of the final value of the air-mass signal.
2) Period of time in case of a throughflow jump of the air mass | $\Delta\, m/m$ | ≤ 5%.
3) For a short period up to +130 °C.
4) $|\Delta Q_m/Q_m|$: The measurement deviation ΔQ_m from the exact value, referred to the measured value Q_m.
5) Measured between input and output
6) Inflow/outflow end

Accessories for connector

Plug housing	Contact pins	Individual gaskets	For conductor cross-section
1 928 403 836	**1 987 280 103**	**1 987 280 106**	0.5...1 mm^2
	1 987 280 105	**1 987 280 107**	1.5...2.5 mm^2

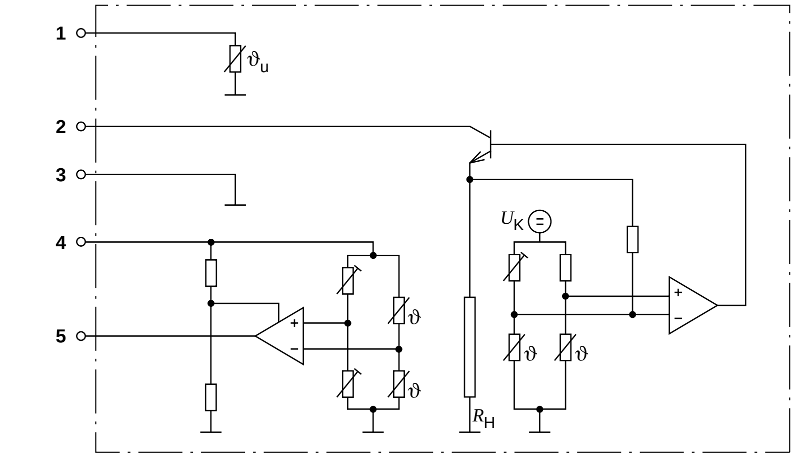
Note: Each 5-pole plug requires 1 plug housing, 5 contact pins, and 5 individual gaskets.
For automotive applications, original AMP crimping tools must be used.

Application
In internal-combustion engines, this sensor is used for measuring the air-mass flow so that the injected fuel quantity can be adapted to the presently required power, to the air pressure, and to the air temperature.

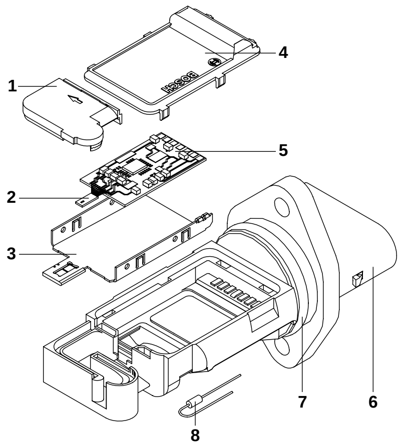
Explanation of symbols

Q_m	Air-mass flow rate
ΔQ_m	Absolute accuracy
$\Delta Q_m/Q_m$	Relative accuracy
τ_{Δ}	Time until measuring error is ≤ 5%
τ_{63}	Time until measured-value change 63%

Function diagram with connector-pin assignment.
1 Additional temperature sensor ϑ_u (not on version 4, Part number 0 280 218 008),
2 Supply voltage U_V, **3** Signal ground, **4** Reference voltage 5 V, **5** Measurement signal U_A.
ϑ Temperature-dependence of the resistor, R_H Heater resistor, U_K Constant voltage



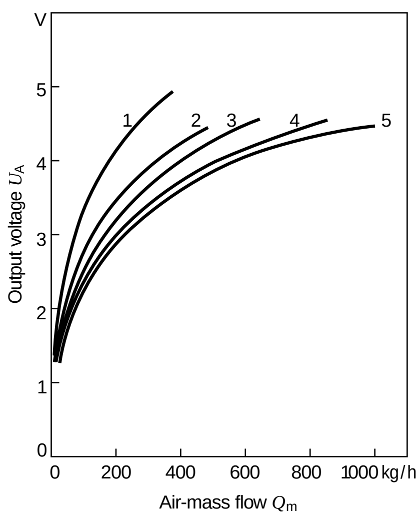
HFM 5 plug-in sensor design.
1 Measuring-passage cover, **2** Sensor,
3 Mounting plate, **4** Hybrid-circuit cover,
5 Hybrid, **6** Plug-in sensor, **7** O-ring,
8 Auxiliary temperature sensor.



Output voltage U_A = f(Q_m) of the air-mass meter

Part number	**0 280 217 123**	**0 280 218 019**	**0 280 217 531**	**0 280 218 008**	**0 280 002 421**
Characteristic curve	1	2	3	4	5
Q_m/kg/h	U_A/V	U_A/V	U_A/V	U_A/V	U_A/V
8	1.4837	1.2390	–	–	–
10	1.5819	1.3644	1.2695	–	–
15	1.7898	1.5241	1.4060	1.3395	1.2315
30	2.2739	1.8748	1.7100	1.6251	1.4758
60	2.8868	2.3710	2.1563	2.0109	1.8310
120	3.6255	2.9998	2.7522	2.5564	2.3074
250	4.4727	3.7494	3.5070	3.2655	2.9212
370	4.9406	4.1695	3.9393	3.6717	3.2874
480	–	4.4578	4.2349	3.9490	3.5461
640	–	–	4.5669	4.2600	3.8432
850	–	–	–	4.5727	4.1499
1000	–	–	–	–	4.3312

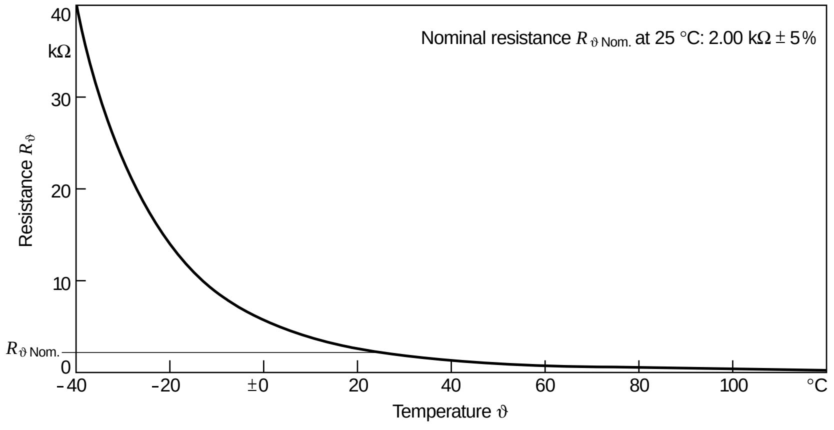
Air-mass meter output voltage.



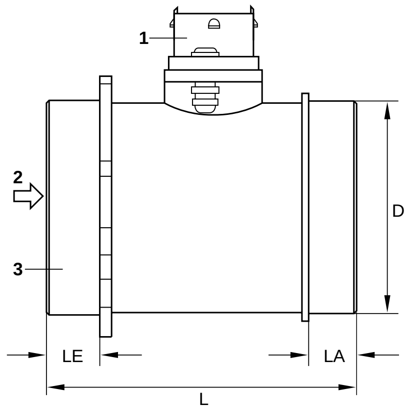
Temperature-dependence R_ϑ = f(ϑ) of the temperature sensor

Temperature ϑ	°C	–40	–30	–20	–10	±0	10	20	30	40
Resistance R_ϑ	kΩ	39.26	22.96	13.85	8.609	5.499	3.604	2.420	1.662	1.166
Temperature ϑ	°C	50	60	70	80	90	100	110	120	130
Resistance R_ϑ	Ω	835	609	452	340	261	202	159	127	102

Temperature-resistance diagram of the temperature sensor.

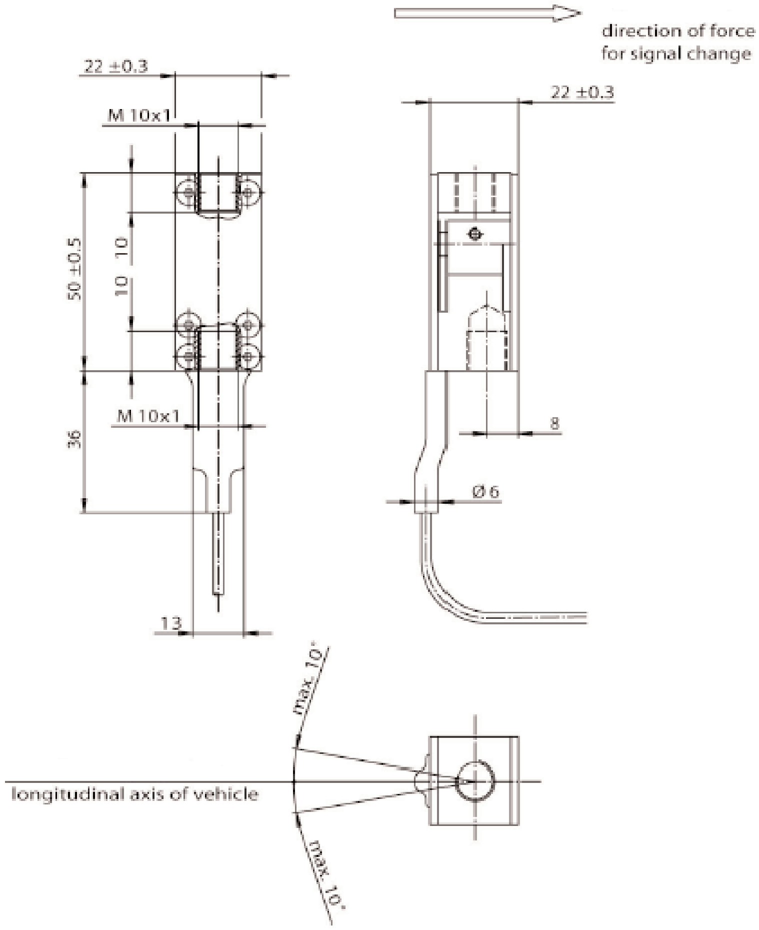


Dimensions overview of the HFM 5.
1 Plug-in sensor, **2** Throughflow direction,
3 Measurement venturi.



GEAR SHIFT SENSORS

Purpose and Function.
These sensors are designed for precision gearshift force measurement. These sensors can be integrated into the gearshift lever of a sequential gearbox. Manufactured in a DR-25 sleeve, various connector options are available.



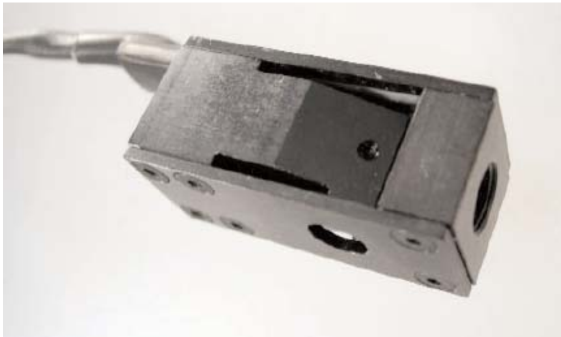
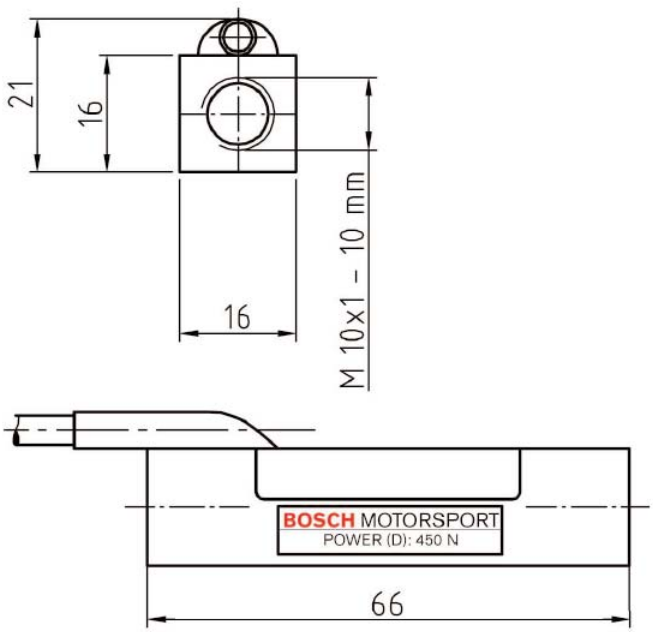


Image and Dimensional drawing [A]of sensor B 261 209 222

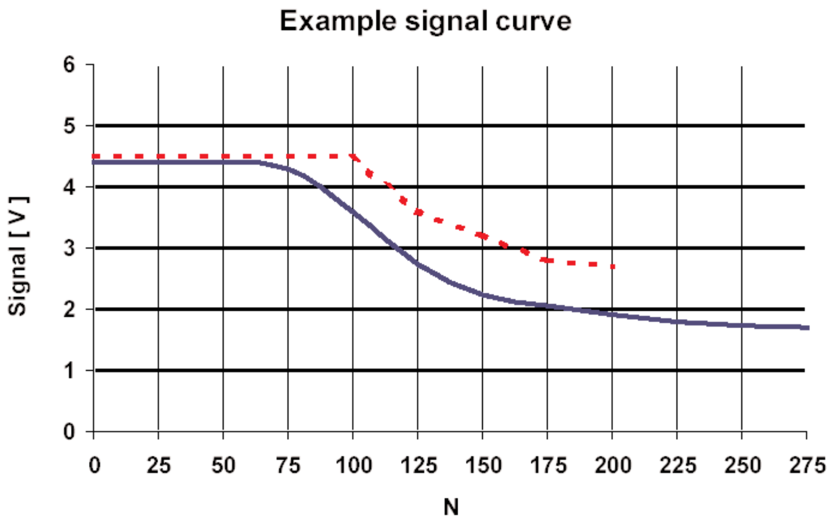
Image and Dimensional drawing [B]of sensor GSS2



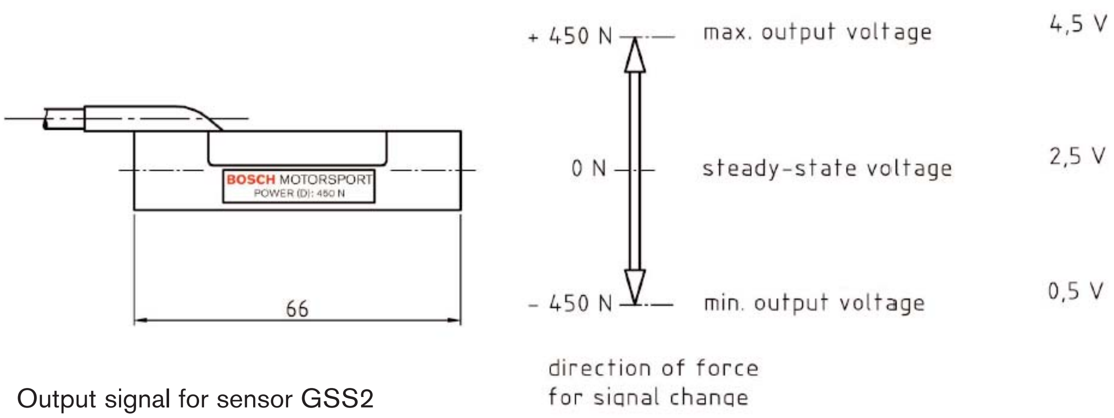
GEAR SHIFT SENSOR TECHNICAL DATA

	Part Number		
	B 261 209 222	**B 261 209 224**	**GSS2**
Weight	90 Grams	90 Grams	90 Grams
Max. Deviation	+/- 10 deg	+/- 10 deg	+/- 10 deg
Fixing	M10x1mm	M10x1mm	M10x1mm
Tightening Torque [Nm]	16	16	16
Supply Voltage	10	10	12
Input Current [mA]	< 1	< 1	---
Signal Output [Volts]	1.0 - 4.0 (+/- 0.5)	1.0 - 4.0 (+/- 0.5)	0.5 - 4.5
Zero Output [Volts]	4.0 (+/- 0.3)	4.0 (+/- 0.3)	2.5
Temperature Range	0 - 80	0 - 80	0 - 85
Vibration	80g @ 5 - 2000 Hz	80g @ 5 - 2000 Hz	80g @ 5 - 2000 Hz
Characteristic Curve	A	A	---
Dimensional Drawing	A	A	B

Important Notes -
Customer required cable length & connector type must be specified when ordering
Due to the unique and application specific nature of these products, confirmed orders can not be cancelled.
These products are non-returnable



Characteristic curve A



Output signal for sensor GSS2

Pressure sensors

For pressures up to 1800 bar (180 Mpa)

● Ratiometric signal evaluation (referred to supply voltage).
● Self-monitoring of offset and sensitivity.
● Protection against polarity reversal, overvoltage, and short circuit of output to supply voltage or ground.
● High level of compatibility with media since this only comes into contact with stainless steel.
● Resistant to brake fluids, mineral oils, water, and air.

Application
Pressure sensors of this type are used to measure the pressures in automotive braking systems, or in the fuel-distributor rail of a gasoline direct-injection engine, or in a diesel engine with Common Rail injection.

Design and function
Pressure measurement results from the bending of a steel diaphragm on which are located polysilicon strain-gauge elements. These are connected in the form of a Wheatstone bridge. This permits high signal utilisation and good temperature compensation.
The measurement signal is amplified in an evaluation IC and corrected with respect to offset and sensitivity. At this point, temperature compensation again takes place so that the calibrated unit comprising measuring cell and ASIC only has a very low temperature-dependence level.
Part of the evaluation IC is applied for a diagnostic function which can detect the following potential defects:
– Fracture of a bonding wire to the measuring cell.
– Fracture anywhere on any of the signal lines.
– Fracture of the bridge supply and ground.

Only for 0 265 005 303
This sensor differs from conventional sensors due to the following diagnostic functions:
– Offset errors
– Amplification errors
can be detected by comparing two signal paths in the sensor.

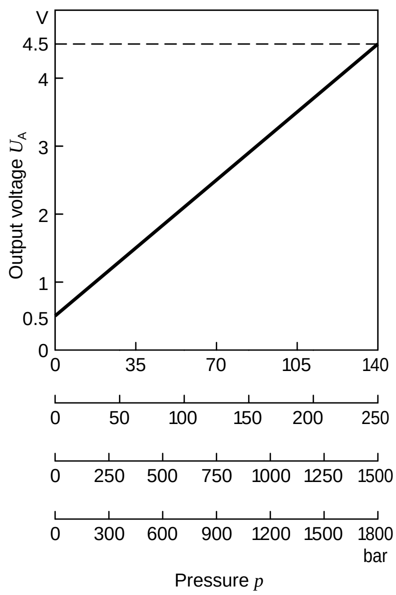
Storage conditions

Temperature range	–30...+60 °C
Relative air humidity	0...80 %
Maximum storage period	5 years

Through compliance with the above storage conditions, it is ensured that the sensor functions remain unchanged.
If the maximum storage conditions are exceeded, the sensors should no longer be used.

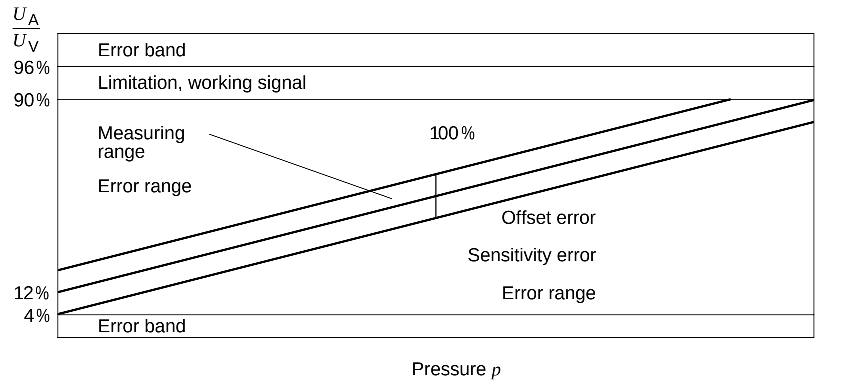
Explanation of symbols
U_A Output voltage
U_V Supply voltage
bar Pressure

Characteristic curve.
$U_A = (0.8 \cdot p / p_{Nom.} + 0.1) U_V$

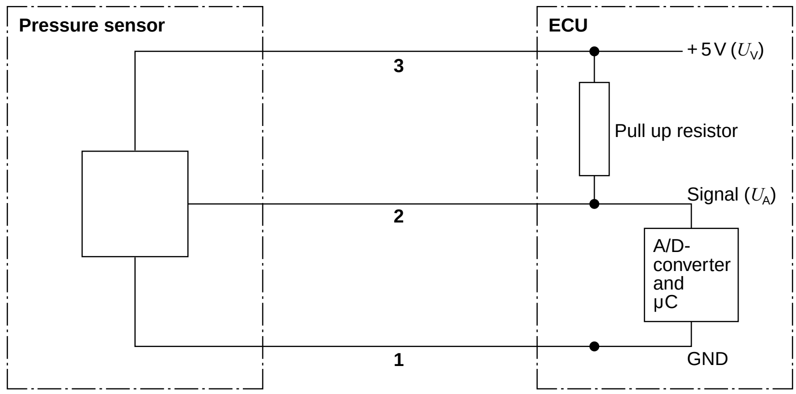


Pressure sensors (contd.)
For pressures up to 1800 bar (180 MPa)

Self-monitoring. Offset and sensitivity. Only for 0 265 005 303.



Measuring circuit.



Diagnostic function during self-test (following switch-on). Only for 0 265 005 303.
– Correctness of the calibration values
– Function of the sensor signal path from the sensor to the A/D converter of the evaluation unit
– Check of the supply lines.
Diagram:
Characteristic of the output voltage following switch-on
– Function of the signal and alarm paths
– Detection of offset errors
– Detection of short circuits in wiring harness
– Detection of overvoltage and undervoltage
– If an error is detected during the sensor's self-test, the signal output is switched to the voltage range > 96% U_V.

Diagnostic function during normal operation.
Only for 0 265 005 303.
– Detection of offset errors
– Detection of sensitivity errors (with pressure applied)
– Wiring-harness function, detection of wiring-harness short circuits
– Detection of overvoltage and undervoltage
– If an error is detected during the sensor's self-test, the signal output is switched to the voltage range >96% U_V.

Range

Pressure range bar	(MPa)	Sensor Type	Thread	Connector	Pin	Dimens. drawing	Page	Part number
140	(14)	KV2 BDE	M 10x1	Compact 1.1	Gold-plated	1	47	**0 261 545 006**
250	(25)	–	M 10x1	PSA	–	2	48	**0 265 005 303**
1500	(150)	RDS2	M 12x1.5	Working circuit	Silber-plated	3	48	**0 281 002 238**
			M 12x1.5	Compact 1.1	Gold-plated	4	48	**0 281 002 405**
		RDS3	M 12x1.5	Working circuit	Silber-plated	5	48	**0 281 002 498**
			M 12x1.5	Compact 1.1	Gold-plated	6	49	**0 281 002 522**
1800	(180)	RDS2	M 12x1.5	Compact 1.1	Gold-plated	4	48	**0 281 002 398**
			M 18x1.5	Compact 1.1	Gold-plated	7	49	**0 281 002 472**
		RDS3	M 18x1.5	Compact 1.1	Gold-plated	8	49	**0 281 002 534**
			M 18x1.5	Working circuit	Silber-plated	9	49	**0 281 002 504**

Accessories

For 0 265 005 303

Plug housing	–	Quantity required: 1	AMP No.	**2-967 642-1** [1])
Contact pins	for 0.75 mm²	Quantity required:3	AMP No.	**965 907-1** [1])
Gaskets	for 1.4...1.9 mm²	Quantity required: 3	AMP No.	**967 067-1** [1])

[1]) To be obtained from AMP Deutschland GmbH, Amperestr. 7–11, D-63225 Langen, Tel. 0 61 03/7 09-0, Fax 0 61 03/7 09 12 23, E-Mail: AMP.Kontakt@tycoelectronics.com

Technical data

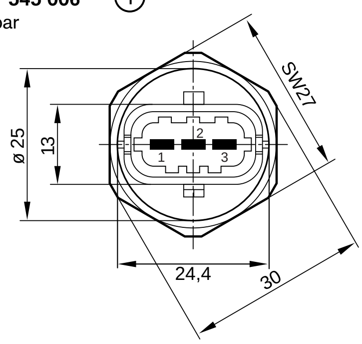
Pressure sensor		**0 261 545 006**	**0 265 005 303**	**0 281 002 238 0 281 002 405**	**0 281 002 498 0 281 002 522**	**0 281 002 398 0 281 002 472**	**0 281 002 534 0 281 002 504**
Pressure-sensor type		KV2 BDE	–	RDS2	RDS3	RDS2	RDS3
Application/Medium		Unlead. fuel	Brake fluid	Diesel fuel or RME [1])	Diesel fuel or RME [1])	Diesel fuel or RME [1])	Diesel fuel or RME [1])
Pressure range	bar (MPa)	140 (14)	250 (25)	1500 (150)	1500 (150)	1800 (180)	1800 (180)
Offset accuracy	U_V	0.7 % FS	2.0 %	1.0 % FS 1.5 % FS	0.7 % FS	1.0 % FS	0.7 % FS
Sensitivity accuracy at 5 V							
In range 0...35 bar	FS [2]) of meas- ured value	–	≤ 0.7 %	1.0 % FS 1.5 % FS	0.7 % FS	1.0 % FS	0.7 % FS
In range 35...140 bar		1.5 %	–	–	–	–	–
In range 35...250 bar		–	≤ 5.0 % [3])	–	–	–	–
In range 35...1500 bar		–	–	2.0 % FS 2.5 % FS	1.5 % FS	–	–
In range 35...1800 bar		–	–	–	–	2.3 % FS	1.5 % FS
Input voltage, max. U_s	V	16	–	16	16	16	16
Power-supply voltage U_V	V	5 ±0.25	5 ±0.25	5 ±0.25	5 ±0.25	5 ±0.25	5 ±0.25
Power-supply current I_V	mA	9...15	≤ 20	9...15	9...15	9...15	9...15
Output current I_A	µA...mA	–	–100...3	2.5 mA [4])	–	2.5 mA [4])	–
Load capacity to ground	nF	13	–	10	13	10	13
Temperature range	°C	–40...+130	–40...+120	–40...+120 [5])	–40...+130	–40...+120 [5])	–40...+130
Overpressure max. p_{max}	bar	180	350	1800	2200	2100	2200
Burst pressure p_{burst}	bar	> 300	> 500	3000	4000	3500	4000
Tightening torque M_a	Nm	22 ±2	20 ±2	35 ±5	35 ±5	70 ±2	70 ±2
Response time $T_{10/90}$	ms	2	–	5	2	5	2

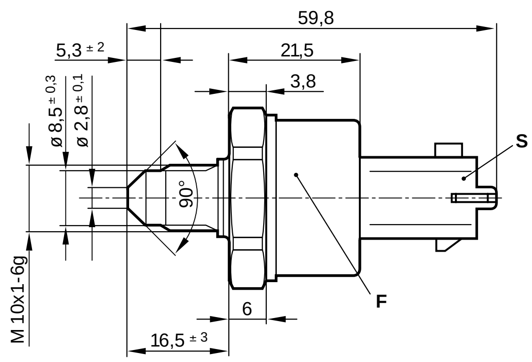
Note: All data are typical values
[1]) RME = Rapeseed methyl ester
[2]) FS = Full Scale
[3]) Of measured value
[4]) Output current with pull-up resistor
[5]) +140 °C for max. 250 h

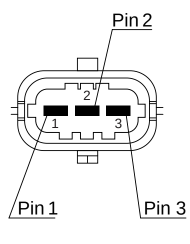
Dimension drawings
Space required by plug, approx. 25 mm
Space required when plugging/unplugging, approx. 50 mm
SW = A/F size

Connector-pin assignment
Pin 1 Ground
Pin 2 Output voltage U_A
Pin 3 Supply voltage U_V

0 261 545 006 ①
140 bar







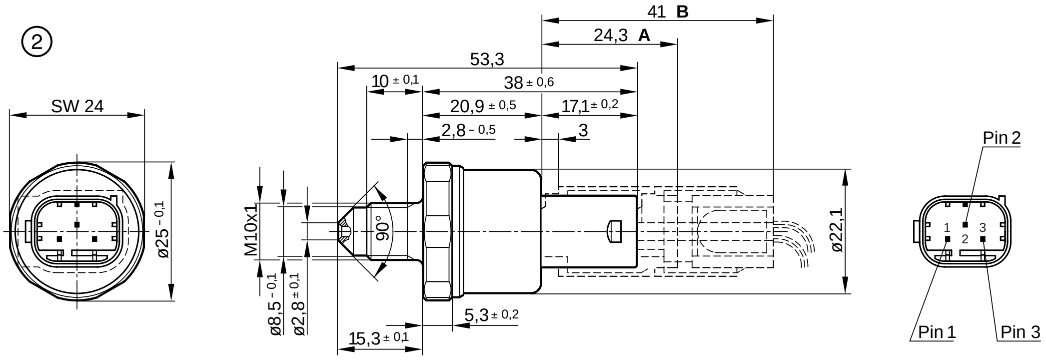
Pressure sensors (contd.)
For pressures up to 1800 bar (180 MPa)

Dimension drawings
Space required by plug, approx. 25 mm
Space required when plugging/unplugging, approx. 50 mm
SW = A/F size

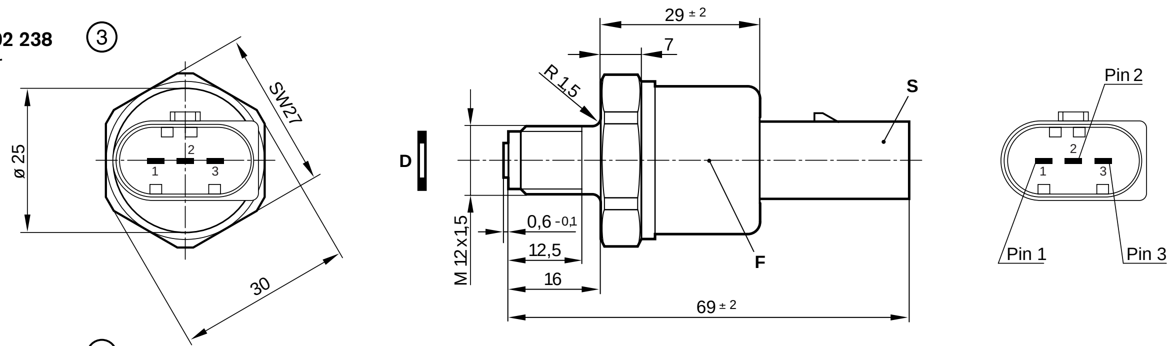
D Gasket
F Date of manufacture
S 3-pin plug

Connector-pin assignment
Pin 1 Ground
Pin 2 Output voltage U_A
Pin 3 Supply voltage U_V

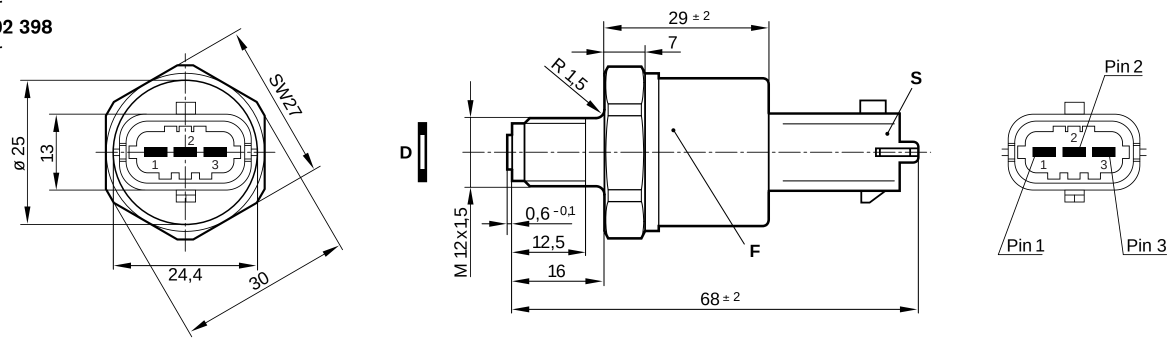
0 265 005 303 ②
250 bar



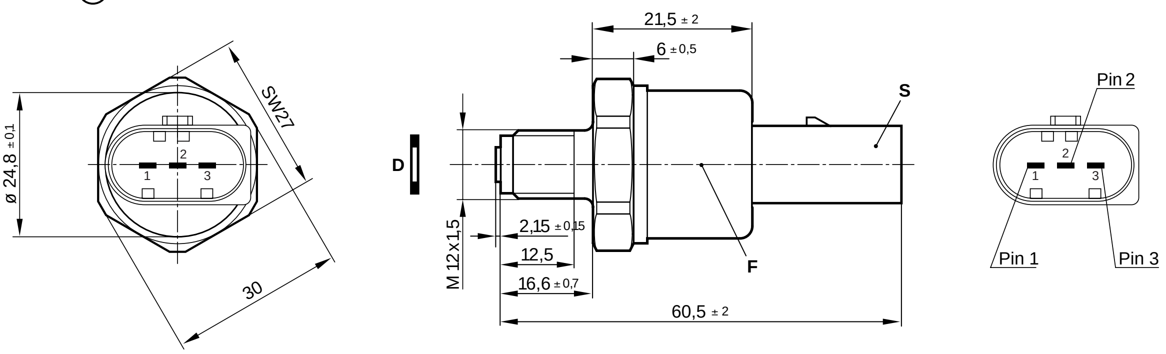
0 281 002 238 ③
1500 bar



0 281 002 405 ④
1500 bar
0 281 002 398
1800 bar



0 281 002 498 ⑤
1500 bar

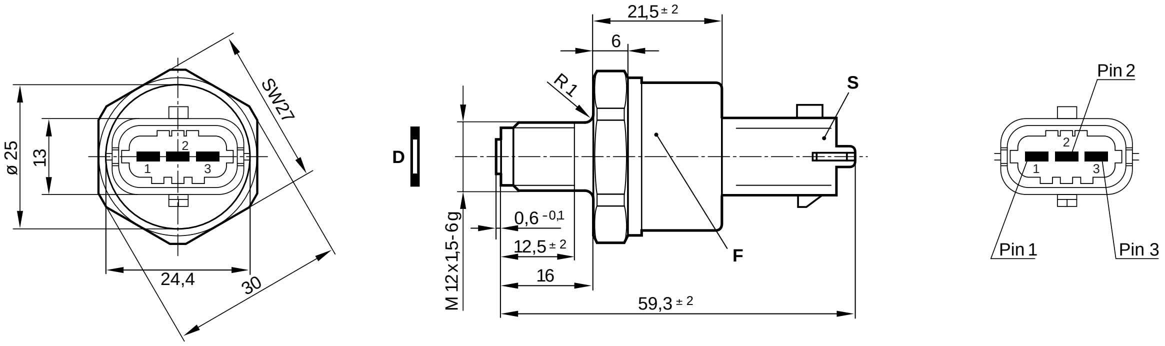


Dimension drawings
Space required by plug, approx. 25 mm
Space required when plugging/unplugging, approx. 50 mm
SW = A/F size

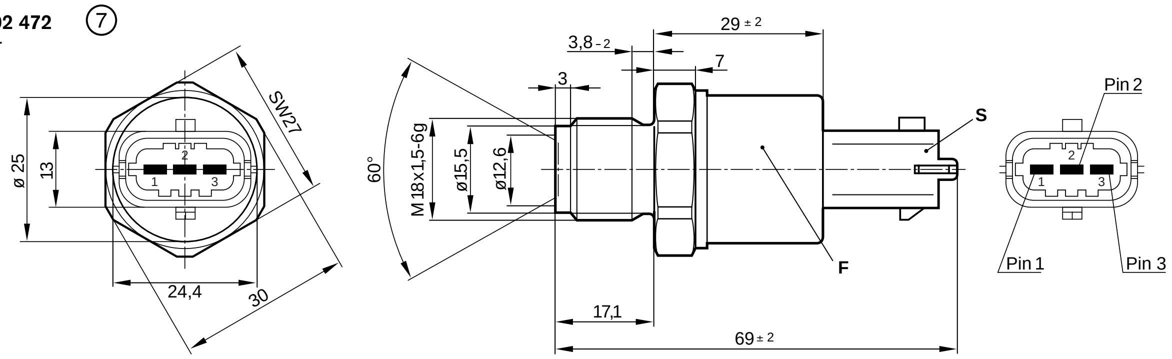
D Gasket
F Date of manufacture
S 3-pin plug

Connector-pin assignment
Pin 1 Ground
Pin 2 Output voltage U_A
Pin 3 Supply voltage U_V

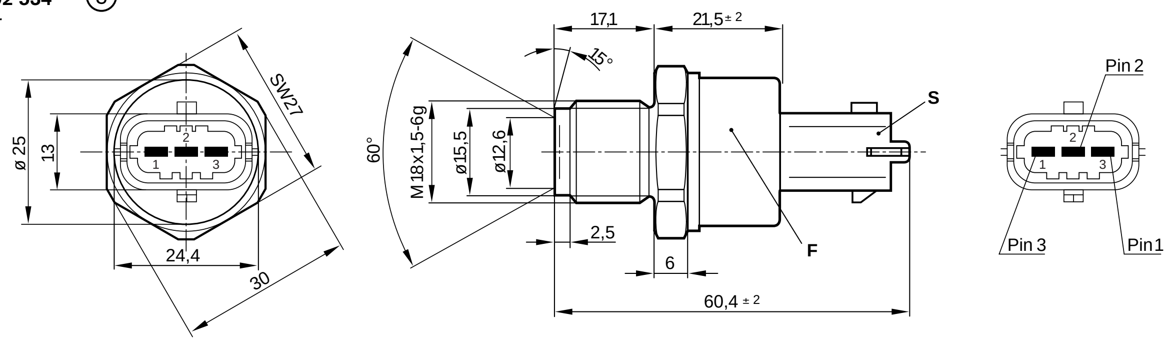
0 281 002 522 ⑥
1500 bar



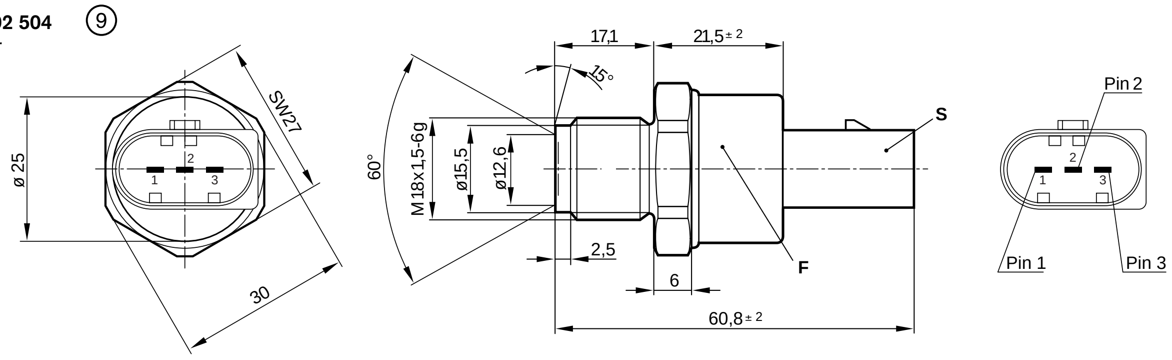
0 281 002 472 ⑦
1800 bar



0 281 002 534 ⑧
1800 bar



0 281 002 504 ⑨
1800 bar



Piezoelectric vibration sensors

Measurement of structure-borne noise/acceleration

- Reliable detection of structure-borne noise for protecting machines and engines.
- Piezo-ceramic with high degree of measurement sensitivity.
- Sturdy compact design.

Applications
Vibration sensors of this type are suitable for the detection of structure-borne acoustic oscillations as can occur for example in case of irregular combustion in engines and on machines. Thanks to their ruggedness, these vibration sensors can be used even under the most severe operating conditions.

Areas of application
- Knock control for internal-combustion engines
- Protection of machine tools
- Detection of cavitation
- Monitoring of bearings
- Theft-deterrent systems

Design and function
On account of its inertia, a mass exerts compressive forces on a ring-shaped piezo-ceramic element in time with the oscillation which generates the excitation. Within the ceramic element, these forces result in charge transfer within the ceramic and a voltage is generated between the top and bottom of the ceramic element. This voltage is picked-off using contact discs – in many cases it is filtered and integrated – and made available as a measur-ing signal. In order to route the vibration directly into the sensor, vibration sensors are securely bolted to the object on which measurements take place.

Measurement sensitivity
Every vibration sensor has its own individual response characteristic which is closely linked to its measurement sensitivity. The measurement sensitivity is defined as the output voltage per unit of acceleration due to gravity (see characteristic curve). The production-related sensitivity scatter is acceptable for applications where the primary task is to record that vibration is occurring, and not so much to measure its severity.
The low voltages generated by the sensor can be evaluated using a high-impedance AC amplifier.

Technical data

Frequency range		1...20 kHz
Measuring range		≈ 0.1...400 g [1])
Sensitivity at 5 kHz		26 ±8 mV/g
Linearity between 5...15 kHz at resonances		+20/–10 % of 5 kHz-value (15...41 mV/g)
Dominant resonant frequency		> 25 kHz
Self-impedance		> 1 MΩ
Capacitance range		800...1400 pF
Temperature dependence of the sensitivity		≤ 0.06 mV/(g · °C)
Operating-temperature range:		
Type 0 261 231 118		–40...+150 °C
Type 0 261 231 148		–40...+150 °C
Type 0 261 231 153		–40...+130 °C
Permissible oscillations	Sustained	≤ 80 g
	Short-term	≤ 400 g

Installation

Fastening screw	Grey cast iron	M 8 x 25; quality 8.8
	Aluminum	M 8 x 30; quality 8.8
Tightening torque (oiled permitted)		20 ±5 N · m
Mounting position		Arbitrary

[1]) Acceleration due to gravity g = 9.81 m · s^{-2}.
Resistant to saline fog and industrial climate.

Range

Vibration sensor

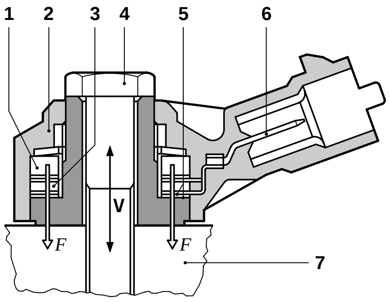
2-pole without cable	**0 261 231 148**
2-pole, with cable, length 480 mm, up to +130 °C	**0 261 231 153**
3-pole, with cable, length 410 mm, up to +150 °C	**0 261 231 118**

Accessories

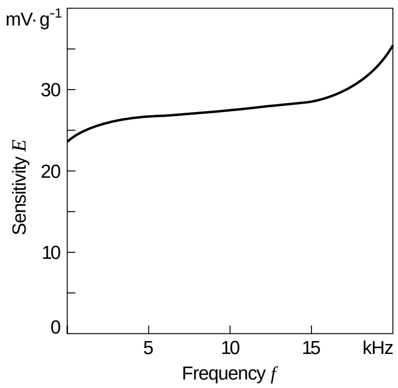
Sensor	Plug housing	Contact pins	Individual gasket	For cable cross section
0 261 231 148	**1 928 403 137**	**1 987 280 103**	**1 987 280 106**	0.5...1.0 mm²
		1 987 280 105	**1 987 280 107**	1.5...2.5 mm²
0 261 231 153	**1 928 403 826**	**1 928 498 060**	**1 928 300 599**	0.5...1.0 mm²
		1 928 498 061	**1 928 300 600**	1.5...2.5 mm²
0 261 231 118	**1 928 403 110**	**1 987 280 103**	**1 987 280 106**	0.5...1.0 mm²
		1 987 280 105	**1 987 280 107**	1.5...2.5 mm²

Note: A 3-pole plug requires 1 plug housing, 3 contact pins, and 3 individual gaskets.
In automotive applications, original AMP crimping tools must be used.

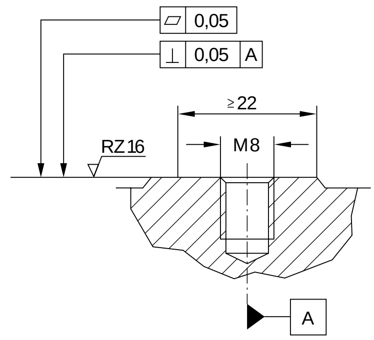
Vibration sensor (design).
1 Seismic mass with compressive forces F, **2** Housing, **3** Piezo-ceramic, **4** Screw, **5** Contact, **6** Electrical connection, **7** Machine block, **V** Vibration.



Response characteristic as a function of frequency.

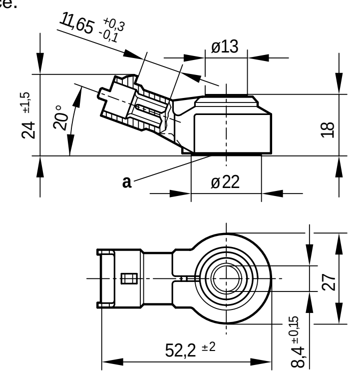


Mounting hole.



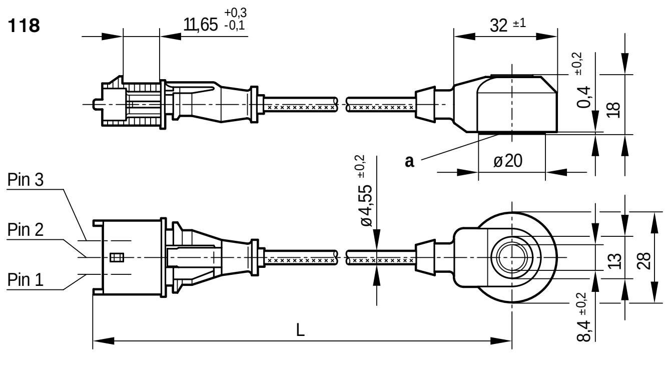
Dimension drawings.
a Contact surface.

0 261 231 148

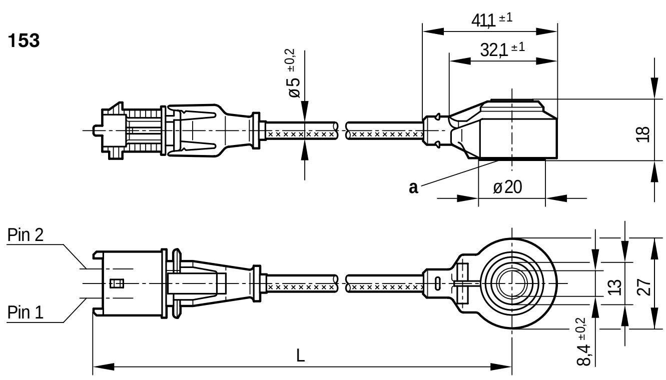


Part number	L mm
.. 118	410 ±10
.. 153	430 ±10

0 261 231 118



0 261 231 153



Evaluation

The sensor's signals can be evaluated using an electronic module.
This is described on Pages 26/27.

Installation instructions

The sensor's metal surfaces must make direct contact. No washers of any type are to be used when fastening the sensors. The mounting-hole contact surface should be of high quality to ensure low-resonance sensor coupling at the measuring point. The sensor cable is to be laid such that there is no possibility of sympathetic oscillations being generated. The sensor must not come into contact with liquids for longer periods.

Explanation of symbols

E	Sensitivity
f	Frequency
g	Acceleration due to gravity

Connector-pin assignments

Pin 1, 2	Measuring signal
Pin 3	Shield, dummy

MAP SENSORS

Purpose and Function.
Manifold Absolute Pressure Sensors, or MAP Sensors as they are more commonly known, are used to measure inlet manifold “pressure’ to give an indication of engine load.
These sensors are generally used in “Speed/Density” or “Manifold Pressure Controlled” engine management systems that do not use an Air Flow/Mass Sensor.
The MAP sensor measures “Absolute” pressure not “Gauge” pressure, so normal atmospheric pressure is a value of 1 bar. If used on a turbocharged vehicle where manifold pressure can be higher than atmospheric pressure, a sensor that measures up to 2 bar or more may be required, dependent on boost pressure developed.
The diagram below visually represents range requirements of the sensor to suit certain applications. For example a normally aspirated engine would not require anything higher than 1 bar.
A turbocharged engine with 0.5 bar boost would require a 2 bar sensor.
Evolution of the MAP Sensor by Bosch has seen the creation of an integrated temperature and MAP Sensor referred to as a
“T-MAP” sensor. These sensors allow the engine management system to accurately detect both manifold pressure and inlet air temperature within one sensor in order to make an accurate assessment of the weight or mass of air being inducted by the engine.
For more detailed information about these products refer to our website
www.bosch.com.au

MAP SENSOR TECHNICAL DATA

Part Number	Measurement Range [bar]	Supply Voltage	Operating Current @ 5v	Connector Details	Figure	Comment
0 261 230 004	0.2 - 1.05	5.0	< 10 mA	1 237 000 039	A	Hose Connection
0 281 002 119	0.2 - 2.5	5.0	< 10 mA	1 237 000 039	A	Hose Connection
0 281 002 437	0.2 - 3.0	5.0	6.0 - 12.5 mA	Ref "A"	B	T-MAP Sensor
0 281 002 456	0.5 - 3.5	5.0	6.0 - 12.5 mA	Ref "A"	B	T-MAP Sensor
0 281 002 576	0.5 - 4.0	5.0	6.0 - 12.5 mA	Ref "A"	B	T-MAP Sensor

"A" = Connector 1 928 403 736, Terminal 1 928 498 060, Seal 1 928 300 599

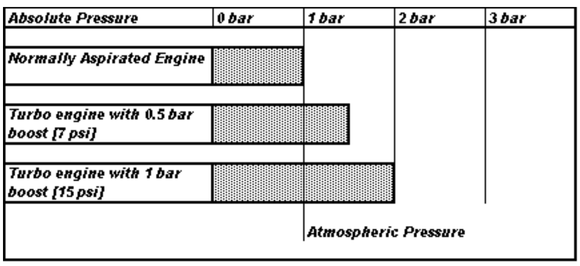
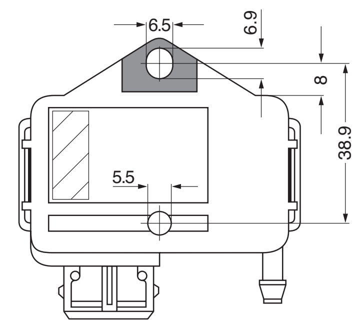


Fig. A



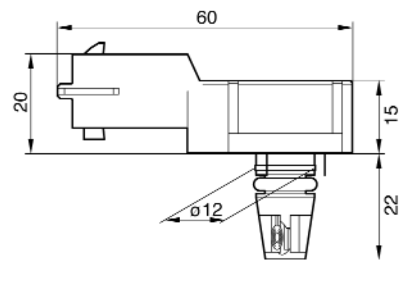
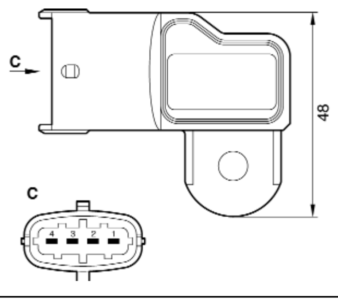


Fig. B



Piezoresistive absolute-pressure sensors in thick-film technology

Measurement of pressures in gases up to 250 kPa

p / *U*

- Thick-film pressure-measuring element ensures a high degree of measurement sensitivity.
- Thick-film sensor element and IC on the same substrate guarantee problem-free signal transmission.
- Integrated evaluation circuit for signal amplification, temperature compensation, and characteristic-curve adjustment
- Sensor enclosed by robust housing.

Design and function

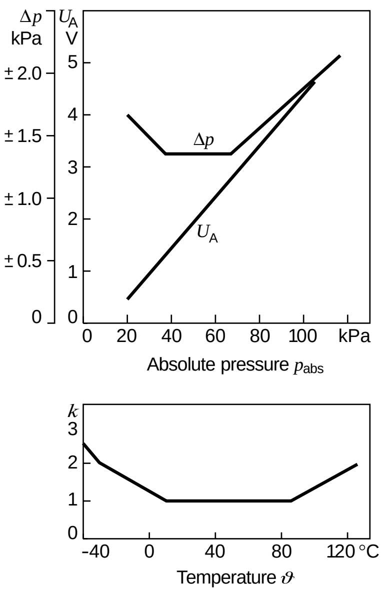
The heart of this sensor is the "sensor bubble" (pressure-measuring element) produced using 100% thick-film techniques.
It is hermetically sealed on a ceramic substrate and contains a given volume of air at a reference pressure of approx. 20 kPa. Piezo-resistive thick-film strain gauges are printed onto the bubble and protected with glass against aggressive media. The strain gauges are characterized by high measurement sensitivity (gauge factor approx. 12), as well as by linear and hysteresis-free behavior. When pressure is applied, they convert mechanical strain into an electric signal. A full-wave bridge circuit provides a measurement signal which is proportional to the applied pressure, and this is amplified by a hybrid circuit on the same substrate. It is therefore impossible for interference to have any effect through the leads to the ECU. DC amplification and individual temperature compensation in the –40 °C...+125 °C range, produce an analog, ratiometric (i.e. proportional to the supply voltage U_V) output voltage U_A. The pressure sensors are resistant to gauge pressures up to 600 kPa.
Outside the temperature range 10 °C...85 °C the permissible tolerance increases by the tolerance multiplier. To protect the sensors, the stipulated maximum values for supply voltage, operating-temperature, and maximum pressure are not to be exceeded.

Explanation of symbols

U_V Supply voltage
U_A Output voltage
Δp Permissible accuracy in the range 10 °C...85 °C
k Tolerance multiplier
ϑ Temperature
p_{abs} Absolute pressure

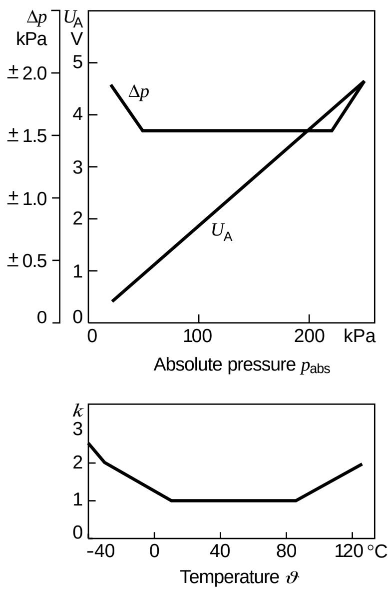
Characteristic curves 1 (U_V = 5 V).

$$U_A = U_V \cdot \left(0{,}01 \frac{p_{abs}}{\text{kPa}} - 0{,}12\right)$$



Characteristic curves 2 (U_V = 5 V).

$$U_A = U_V \cdot \left(\frac{0{,}85}{230} \cdot \frac{p_{abs}}{\text{kPa}} + 0{,}0061\right)$$



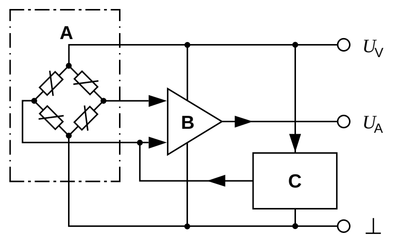
Technical data / Range

Part number		**0 261 230 004**	**0 281 002 119**
Characteristic curve		1	2
Measuring range	kPa	20…105	20…250
Max. pressure (1 s, 30 °C)	kPa	600	500
Pressure-change time	ms	≤ 10	≤ 10
Supply voltage U_V	V	4.75…5.25	4.75…5.25
Max. supply voltage	V	16	16
Input current I_V	mA	< 10	< 10
Load impedance R_L	kΩ	> 50	> 50
Operating temperature range	°C	–40…+125	–40…+120
Degree of protection		IP 54 A	–

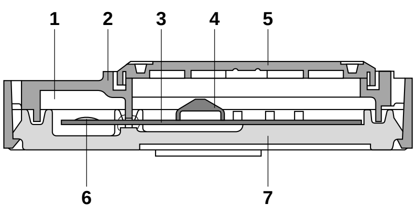
Accessories

Connector	**1 237 000 039**

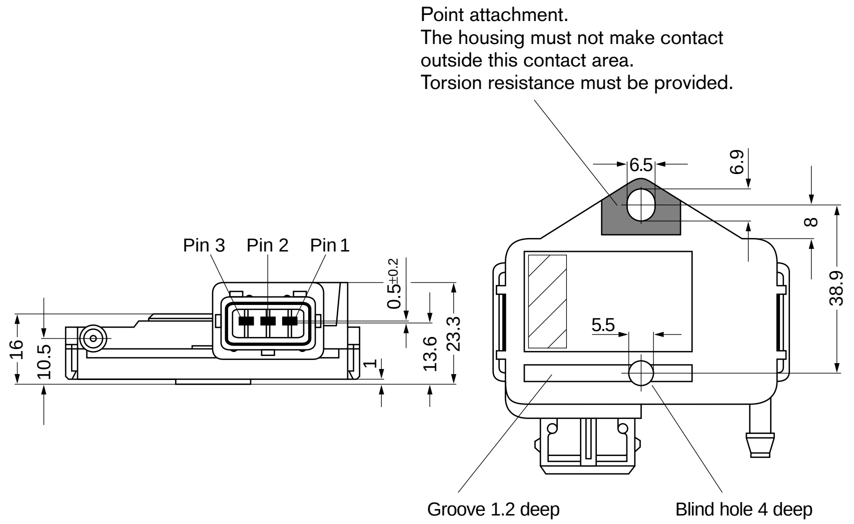
Block diagram.
A Strain-gauge pressure-measuring cell,
B Amplifier,
C Temperature-compensation circuit



Design.
1 Strain-gauge pressure-measuring cell, **2** Plastic housing, **3** Thick-film hybrid (sensor and evaluation circuit), **4** Operational amplifier, **5** Housing cover, **6** Thick-film sensor element (sensor bubble), **7** Aluminum base plate.



Dimension drawings.



Installation instructions

A hose forms the connection between the sensor and the gas pressure to be measured. Upon installation, the sensor pressure connection should point downwards to prevent the ingress of moisture.
The angular position referred to the vertical must be +20°...–85°, preferably 0°.
Suggested fastening:
M6 screw with spring washer.

Connector-pin assignment

Terminal 1 $+U_V$
Terminal 2 Ground
Terminal 3 U_A

Absolute-pressure sensors in micromechanical hybrid design

Measurement of pressures in gases up to 400 kPa

- High accuracy.
- EMC protection better than 100 V m^{-1}.
- Temperature-compensated.
- Version with additional integral temperature sensor.

Applications
This sensor is used to measure the absolute intake-manifold pressure. On the version with integral temperature sensor, the temperature of the drawn-in air flow is also measured.

Design and function
The piezoresistive pressure-sensor element and suitable electronic circuitry for signal-amplification and temperature compensation are mounted on a silicon chip. The measured pressure is applied from above to the diaphragm's active surface. A reference vacuum is enclosed between the rear side and the glass base. Thanks to a special coating, both pressure sensor and temperature sensor are insensitive to the gases and liquids which are present in the intake manifold.

Installation information
The sensor is designed for mounting on a horizontal surface of the vehicle's intake manifold. The pressure fitting together with the temperature sensor extend into the manifold and are sealed-off to atmosphere by O-rings. By correct mounting in the vehicle (pressure-monitoring point on the top at the intake manifold, pressure fitting pointing downwards etc.) it is to be ensured that condensate does not collect in the pressure cell.

Range

Pressure range kPa (p_1...p_2)	Characteristic curve[1]	Features	Dimension drawing[2]	Order No.
10...115	1		1	**B 261 260 136**[3]
10...115	1		2	**0 261 230 052**
20...250	1		1	**0 281 002 487**
10...115	1	Integral temperature sensor	3	**0 261 230 030**
20...250	1	Integral temperature sensor	3	**0 261 230 042**
20...300	1	Integral temperature sensor	3	**0 281 002 437**
50...350	2	Integral temperature sensor	3	**0 281 002 456**
50...400	2	Integral temperature sensor	3	**B 261 260 508**[3]

[1]) The characteristic-curve tolerance and the tolerance expansion factor apply for all versions, see Page 36
[2]) See Page 37
[3]) Provisional draft number, order number available upon enquiry. Available as from about the end of 2001

Accessories

Plug housing	Qty. required: 1[4])	**1 928 403 966**
Plug housing	Qty. required: 1[5])	**1 928 403 736**
Contact pin	Qty. required: 3 or 4[6])	**1 928 498 060**
Individual gasket	Qty. required: 3 or 4[6])	**1 928 300 599**

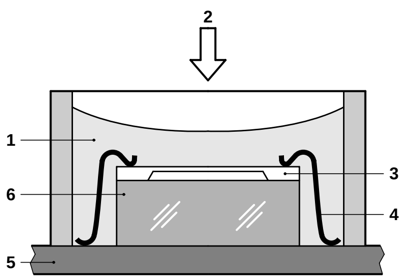
[4]) Plug housing for sensors without integral temperature sensor
[5]) Plug housing for sensors with integral temperature sensor
[6]) Sensors without temperature sensor each need 3 contacts and gaskets. Sensors with integral temperature sensor each need 4 contacts and gaskets

Technical data

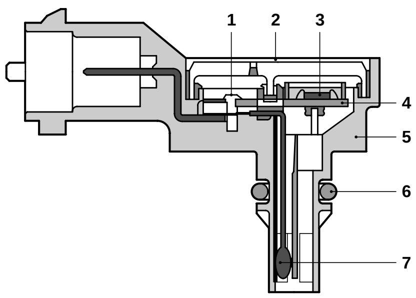
			min.	typ.	max.
Operating temperature	ϑ_B	°C	–40	–	+130
Supply voltage	U_V	V	4.5	5.0	5.5
Current consumption at U_V = 5 V	I_V	mA	6.0	9.0	12.5
Load current at output	I_L	mA	–1.0	–	0.5
Load resistance to U_V or ground	$R_{pull\text{-}up}$	kΩ	5	680	–
	$R_{pull\text{-}down}$	kΩ	10.0	100	–
Response time	$t_{10/90}$	ms	–	1.0	–
Voltage limitation at U_V = 5 V					
Lower limit	$U_{A\,min}$	V	0.25	0.3	0.35
Upper limit	$U_{A\,max}$	V	4.75	4.8	4.85
Limit data					
Supply voltage	$U_{V\,max}$	V	–	–	+16
Storage temperature	ϑ_L	°C	–40	–	+130
Temperature sensor					
Measuring range	ϑ_M	°C	–40	–	+130
Measured current	I_M	mA	–	–	1[1])
Nominal resistance at +20 °C		kΩ	–	2.5±5%	–
Thermal time constant	t_{63}	s	–	–	10[2])

[1]) Operation at 5 V with 1 kΩ series resistor
[2]) In air with a flow rate of 6 $m \cdot s^{-1}$

Sectional view.
Section through the sensor cell



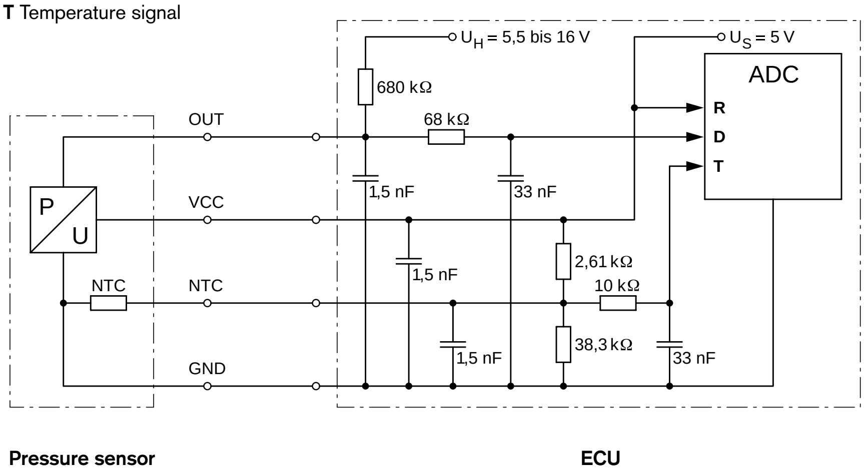
Section through the DS-S2 pressure sensor



Section through the sensor cell.
1 Protective gel, **2** Pressure, **3** Sensor chip, **4** Bonded connection, **5** Ceramic substrate, **6** Glass base.

Section through the pressure sensor.
1 Bonded connection, **2** Cover, **3** Sensor chip, **4** Ceramic substrate, **5** Housing with pressure-sensor fitting, **6** Gasket, **7** NTC element.

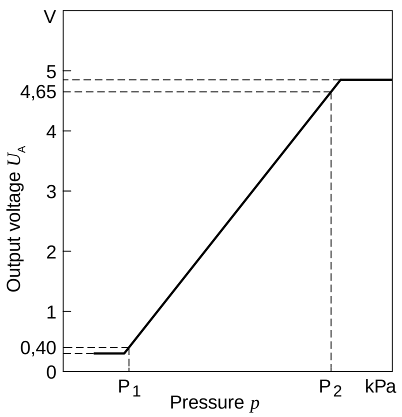
Signal evaluation: Recommendation.
R Reference
D Pressure signal
T Temperature signal



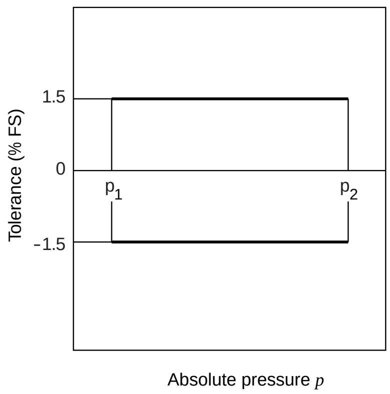
Signal evaluation: Recommendation.
The pressure sensor's electrical output is so designed that malfunctions caused by cable open-circuits or short circuits can be detected by a suitable circuit in the following electronic circuitry. The diagnosis areas situated outside the characteristic-curve limits are provided for fault diagnosis. The circuit diagram shows an example for detection of all malfunctions via signal outside the characteristic-curve limitation.

Absolute-pressure sensors in micromechanical hybrid design (contd.)
Measurement of pressures in gases up to 400 kPa

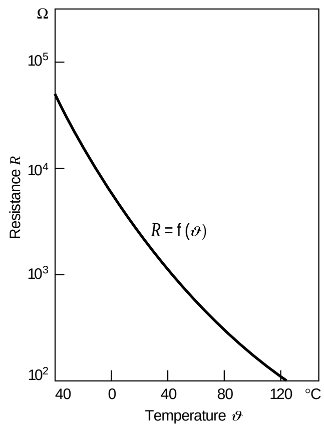
Characteristic curve 1 (U_V = 5.0 V).



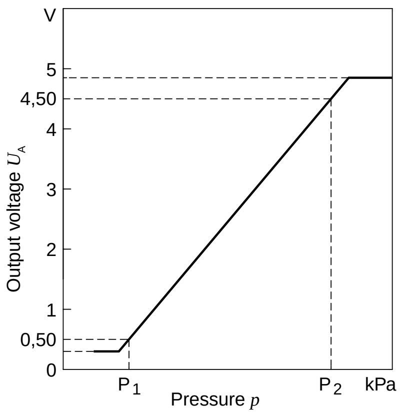
Characteristic-curve tolerance.



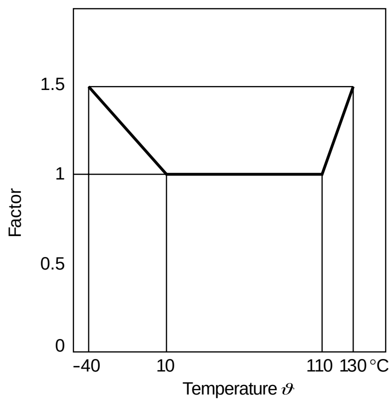
Temperature-sensor characteristic curve.



Characteristic curve (U_V = 5.0 V).



Tolerance-expansion factor.



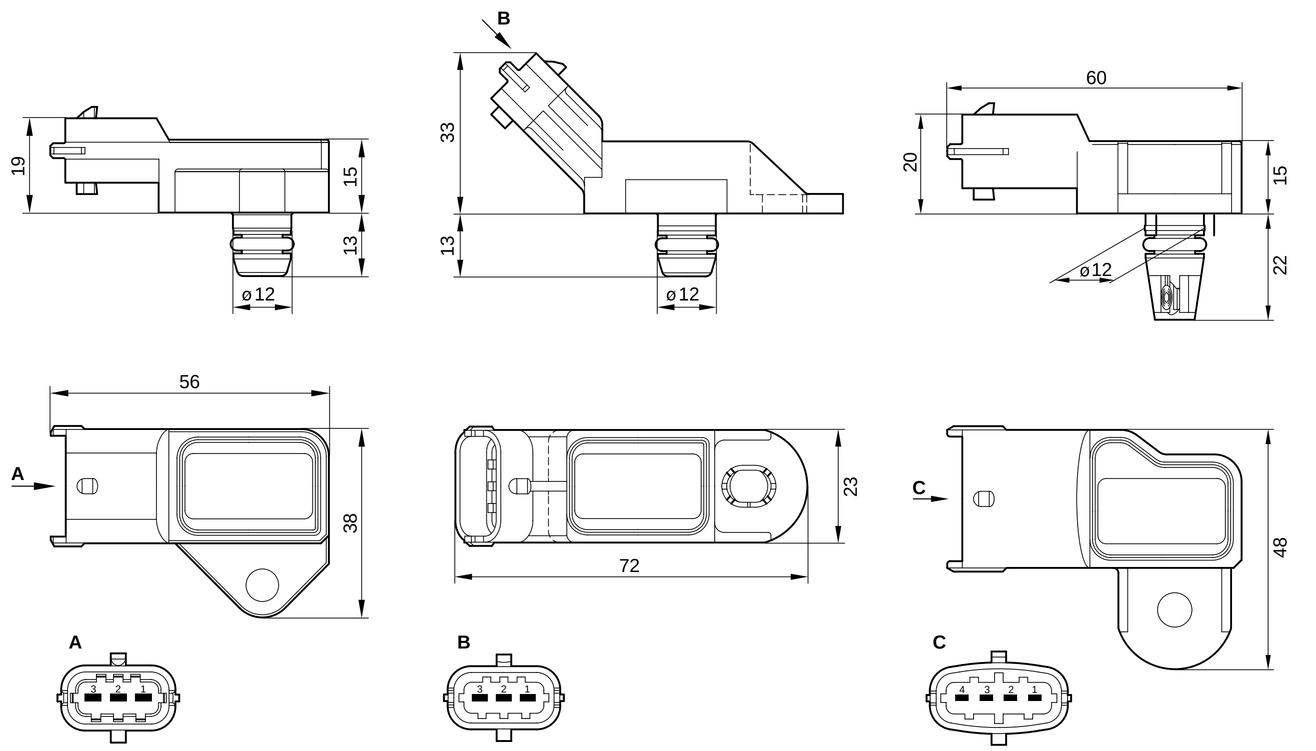
Explanation of symbols.
U_A Output voltage
U_V Supply voltage
k Tolerance multiplier
D After continuous operation
N As-new state

Dimensions drawings.

①
Connector-pin assignment
Pin 1 +5 V
Pin 2 Ground
Pin 3 Output signal

②
Connector-pin assignment
Pin 1 +5 V
Pin 2 Ground
Pin 3 Output signal

③
Connector-pin assignment
Pin 1 Ground
Pin 2 NTC resistor
Pin 3 +5 V
Pin 4 Output signal



Piezoresistive absolute-pressure sensor with moulded cable

Measurement of pressures in gases up to 400 kPa

p / U

- Pressure-measuring element with silicon diaphragm ensures extremely high accuracy and long-term stability.
- Integrated evaluation circuit for signal amplification and characteristic-curve adjustment.
- Very robust construction.

Applications

This type of absolute-pressure sensor is highly suitable for measuring the boost pressure in the intake manifold of turbo-charged diesel engines. They are needed in such engine assemblies for boost-pressure control and smoke limitation.

Design and function

The sensors are provided with a pressure-connection fitting with O-ring so that they can be fitted directly at the measurement point without the complication and costs of installing special hoses. They are extremely robust and insensitive to aggressive media such as oils, fuels, brake fluids, saline fog, and industrial climate.

In the measuring process, pressure is applied to a silicon diaphragm to which are attached piezoresistive resistors. Using their integrated electronic circuitry, the sensors provide an output signal the voltage of which is proportional to the applied pressure.

Installation information

The metal bushings at the fastening holes are designed for tightening torques of maximum 10 N · m.

When installed, the pressure fitting must point downwards. The pressure fitting's angle referred to the vertical must not exceed 60°.

Tolerances

In the basic temperature range, the maximum pressure-measuring error Δp (referred to the excursion: 400 kPa–50 kPa = 350 kPa) is as follows:

Pressure range 70...360 kPa

As-new state	±1.0 %
After endurance test	±1.2 %

Pressure range < 70 and > 360 kPa (linear increase)

As-new state	±1.8 %
After endurance test	±2.0 %

Technical data / Range

Part number	**0 281 002 257**
Measuring range	50...400 kPa
Basic measuring range with enhanced accuracy	70...360 kPa
Resistance to overpressure	600 kPa
Ambient temperature range/sustained temperature range	–40...+120 °C
Basic range with enhanced accuracy	+20...+110 °C
Limit-temperature range, short-time	≤ 140 °C
Supply voltage U_V	5 V ±10 %
Current input I_V	≤ 12 mA
Polarity-reversal strength at I_V ≤ 100 mA	$-U_V$
Short-circuit strength, output	To ground and U_V
Permissible loading	
Pull down	≥ 100 kΩ
	≤ 100 nF
Response time $t_{10/90}$	≤ 5 ms
Vibration loading max.	20 g
Protection against water	
Strong hose water at increased pressure	IPX6K
High-pressure and steam-jet cleaning	IPX9K
Protection against dust	IP6KX

Throughout the complete temperature range, the permissible temperature error results from multiplying the maximum permissible pressure measuring error by the temperature-error multiplier corresponding to the temperature in question.

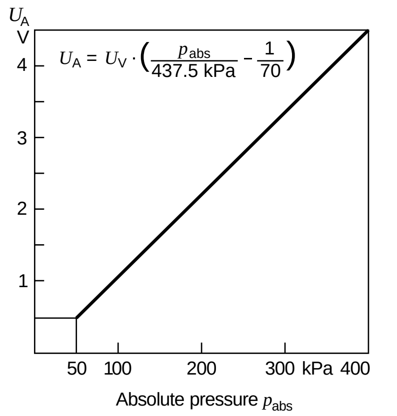
Basic temperature range	+20...+110 °C	1.0 [1])
	+20... – 40 °C	3.0 [1])
	+110...+120 °C	1.6 [1])
	+120...+140 °C	2.0 [1])

[1]) In each case, increasing linearly to the given value.

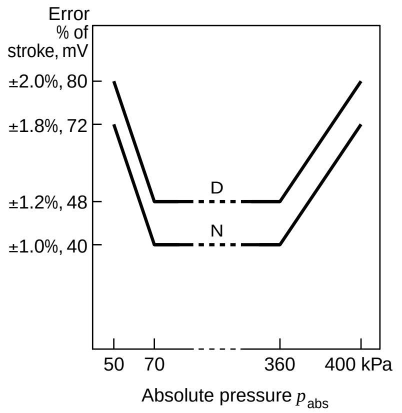
Accessories

Connector	**1 237 000 039**

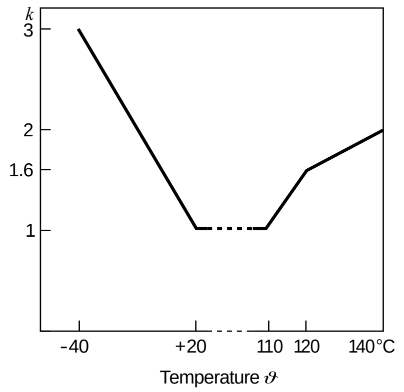
Characteristic curve (U_V = 5 V).



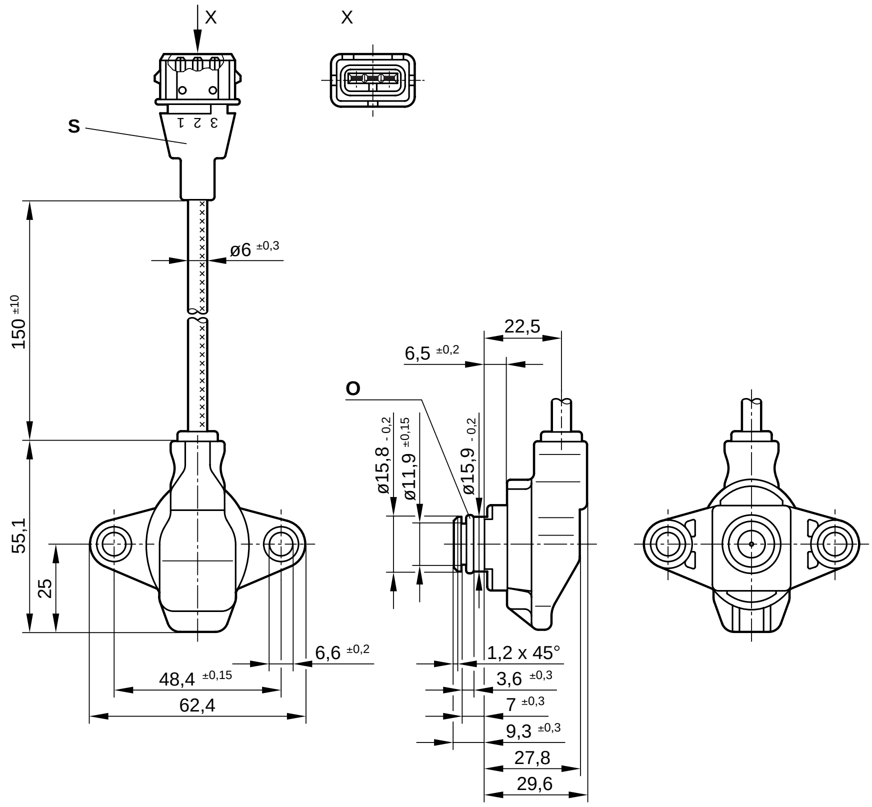
Maximum permissible pressure-measuring error.



Temperature-error multiplier.



Dimension drawings.
S 3-pole plug
O1 O-ring dia. 11.5x2.5 mm HNBR-75-ShA



Explanation of symbols

U_V Supply voltage
U_A Output voltage (signal voltage)
k Temperature-error multiplier
p_{abs} Absolute pressure
g Acceleration due to gravity 9.81 $m \cdot s^{-2}$
D After endurance test
N As-new state

Connector-pin assignment

Pin 1 U_A
Pin 2 +5 V
Pin 3 Ground

Medium-resistant absolute-pressure sensors Micromechanical type

Measurement of pressure in gases and liquid mediums up to 600 kPa

p / U

- Delivery possible either without housing or inside rugged housing.
- EMC protection up to 100 V · m⁻¹.
- Temperature-compensated.
- Ratiometric output signal.
- All sensors and sensor cells are resistive to fuels (incl. diesel), and oils such as engine lube oils.

① ④

②

③

⑤ ⑥

⑦

Applications
These monolithic integrated silicon pressure sensors are high-precision measuring elements for measuring the absolute pressure. They are particularly suitable for oper-ations in hostile environments, for instance for measuring the absolute manifold pressure in internal-combustion engines.

Design and function
The sensor contains a silicon chip with etched pressure diaphragm. When a change in pressure takes place, the diaphragm is stretched and the resulting change in resistance is registered by an evaluation circuit. This evaluation circuit is integrated on the silicon chip together with the electronic calibration elements. During production of the silicon chip, a silicon wafer on which there are a number of sensor elements, is bonded to a glass plate. After sawing the plate into chips, the individual chips are soldered onto a metal base complete with pressure connection fitting. When pressure is applied, this is directed through the fitting and the base to the rear side of the pressure diaphragm. There is a reference vacuum trapped underneath the cap welded to the base. This permits the absolute pressure to be measured as well as protecting the front side of the pressure diaphragm. The programming logic integrated on the chip performs a calibration whereby the calibration parameters are permanently stored by means of thyristors (Zener-Zapping) and etched conductive paths. The calibrated and tested sensors are mounted in a special housing for attachment to the intake manifold.

Signal evaluation
The pressure sensor delivers an analog output signal which is ratiometric referred to the supply voltage. In the input stage of the downstream electronics, we recommend the use of an RC low-pass filter with, for instance, t = 2 ms, in order to suppress any disturbance harmonics which may occur. In the version with integrated temperature sensor, the sensor is in the form of an NTC resistor (to be operated with series resistor) for measuring the ambient temperature.

Installation information
When installed, the pressure connection fitting must point downwards in order that condensate cannot form in the pressure cell.

Construction
Sensors with housing:
This version is equipped with a robust housing. In the version with temperature sensor, the sensor is incorporated in the housing.
Sensors without housing:
Casing similar to TO case, pressure is applied through a central pressure fitting. Of the available soldering pins the following are needed:
Pin 6 Output voltage U_A,
Pin 7 Ground,
Pin 8 +5 V.

Range

Pressure sensor integrated in rugged, media-resistant housing

Pressure range kPa (p1...p2)	Chara. curve [1]	Features	Dimension drawing [2]		Part number
20...115	1	–	4	1	**0 261 230 020**
20...250	1	–	4	1	**0 281 002 137**
10...115	1	Integrated temperature sensor	2	2	**0 261 230 022**
20...115	1	Integrated temperature sensor	2	2	**0 261 230 013**
20...250	1	Integrated temperature sensor	2	2	**0 281 002 205**
50...350	2	Integrated temperature sensor	5	(5) [3]	**0 281 002 244**
50...400	2	Integrated temperature sensor	–	–	**0 281 002 316**
50...600	2	Integrated temperature sensor	6	6	**0 281 002 420**
10...115	1	Hose connection	1	(1) [3]	**0 261 230 009**
15...380	2	Clip-type module with connection cable	3	3	**1 267 030 835**

Pressure-sensor cells in casings similar to transistors
Suitable for installation inside devices

Pressure range kPa (p1...p2)	Chara. curve [1]	Features	Dimension drawing [2]		Part number
10...115	1	–	7	7	**0 273 300 006**
15...380	2	–	7	7	**0 273 300 017**
15...380	2	–	8	(7) [3]	**0 261 230 036**
20...105	1	–	7	7	**0 273 300 001**
20...115	1	–	7	7	**0 273 300 002**
20...250	1	–	7	7	**0 273 300 004**
50...350	2	–	7	7	**0 273 300 010**
50...400	2	–	7	7	**0 273 300 019**
50...400	2	–	8	(7) [3]	**0 261 230 033**
50...600	2	–	7	7	**0 273 300 012**

1) The characteristic-curve tolerance and the tolerance extension factor apply to all versions, refer to Page 42.
2) See Page 43/44 3) For similar drawing, see dimension drawing on Pages 43/44
4) To be obtained from AMP Deutschland GmbH, Amperestr. 7–11, D-63225 Langen, Tel. 0 61 03/7 09-0, Fax 0 61 03/7 09 12 23, E-Mail: AMP.Kontakt@tycoelectronics.com

Accessories

For 0 261 230 009, .. 020; 0 281 002 137

Plug housing	**1 928 403 870**
Contact pin	**2-929 939-1** [4]
Individual gasket	**1 987 280 106**

For 0 261 230 013, .. 022; 0 281 002 205, ..420

Plug housing	**1 928 403 913**
Contact pin	**2-929 939-1** [4]
Individual gasket	**1 987 280 106**

For 0 281 002 244

Plug housing	**1 928 403 913**
Contact pin	**2-929 939-6** [4]
Individual gasket	**1 987 280 106**

For 0 281 002 420

Plug housing	**1 928 403 736**
Contact pin	**1 928 498 060**
Individual gasket	**1 928 300 599**

Note
Each 3-pole plug requires 1 plug housing, 3 contact pins, and 3 individual gaskets. 4-pole plugs require 1 plug housing, 4 contact pins, and 4 individual gaskets.

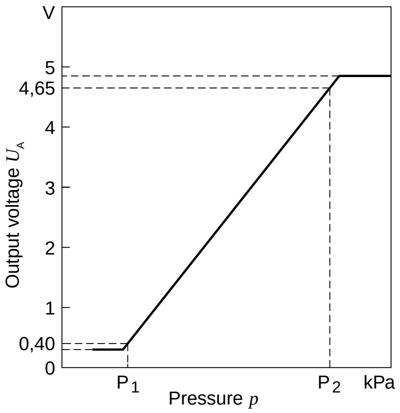
Technical data

		min.	typical	max.
Supply voltage U_V	V	4.5	5	5.5
Current input I_V at U_V = 5 V	mA	6	9	12.5
Load current at output	mA	–0.1	–	0.1
Load resistance to ground or U_V	kΩ	50	–	–
Lower limit at U_V = 5 V	V	0.25	0.30	0.35
Upper limit at U_V = 5 V	V	4.75	4.80	4.85
Output resistance to ground U_V open	kΩ	2.4	4.7	8.2
Output resistance to U_V, ground open	kΩ	3.4	5.3	8.2
Response time $t_{10/90}$	ms	–	0.2	–
Operating temperature	°C	–40	–	+125
Limit data				
Supply voltage U_V	V	–	–	16
Operating temperature	°C	–40	–	+130
Recommendation for signal evaluation				
Load resistance to U_H = 5.5...16 V	kΩ	–	680	–
Load resistance to ground	kΩ	–	100	–
Low-pass resistance	kΩ	–	21.5	–
Low-pass capacitance	nF	–	100	–
Temperature sensor				
Measuring range	°C	–40	–	+125
Nominal voltage	mA	–	–	1 [5]
Measured current at +20 °C	kΩ	–	2,5 ±5 %	–
Temperature time constant t_{63} [6]	s	–	–	45

5) Operation with series resistor 1 kΩ.
6) In air with airflow speed 6 m · s^{-1}.

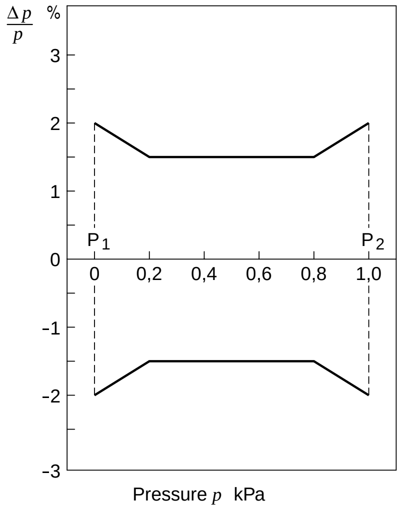
Micromechanical TO-design absolute-pressure sensors (contd.)
Measurement of pressures in gases and liquid media up to 600 kPa

Characteristic curve 1 (U_V = 5.0 V).

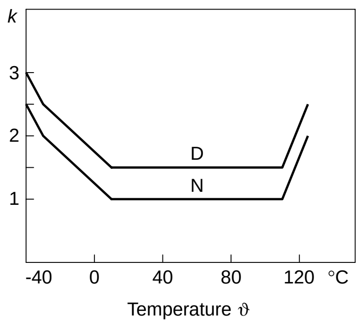


Characteristic curve 2 (U_V = 5.0 V).

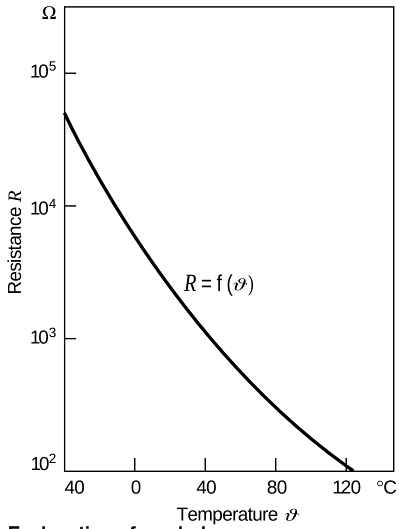
Characteristic-curve tolerance.



Tolerance extension factor.



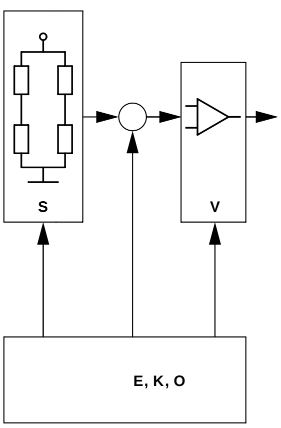
Temperature-sensor characteristic curve.



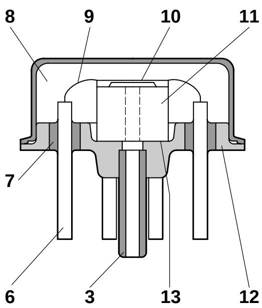
Explanation of symbols

U_A Output voltage
U_V Supply voltage
k Tolerance multiplication factor
D Following endurance test
N As-new state

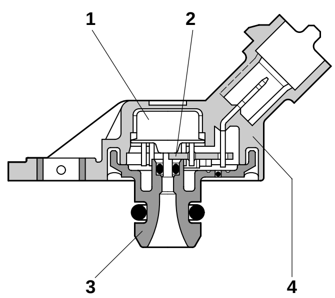
Block diagram.
E Characteristic curve: Sensitivity,
K Compensation circuit
O Characteristic curve: Offset,
S Sensor bridge, **V** Amplifier



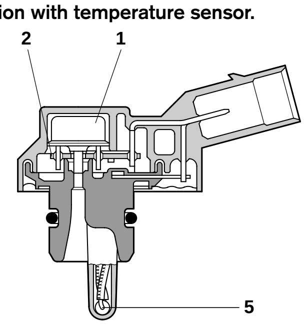
Sectional views.
Pressure sensor in housing.
1 Pressure sensor, **2** pcb, **3** Pressure fitting,
4 Housing, **5** Temperature sensor,
6 Electrical bushing, **7** Glass insulation,
8 Reference vacuum,
9 Aluminum connection (bonding wire),
10 Sensor chip, **11** Glass base,
12 Welded connection,
13 Soldered connection.



Section through the installed pressure sensor.

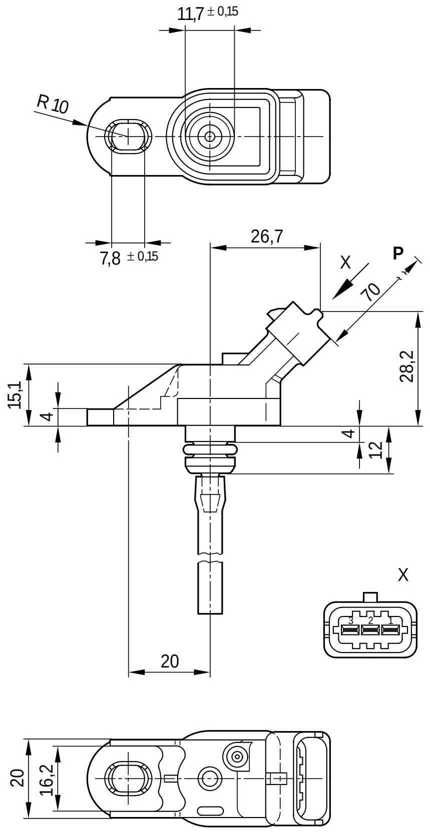


Installed pressure sensor.
Version with temperature sensor.

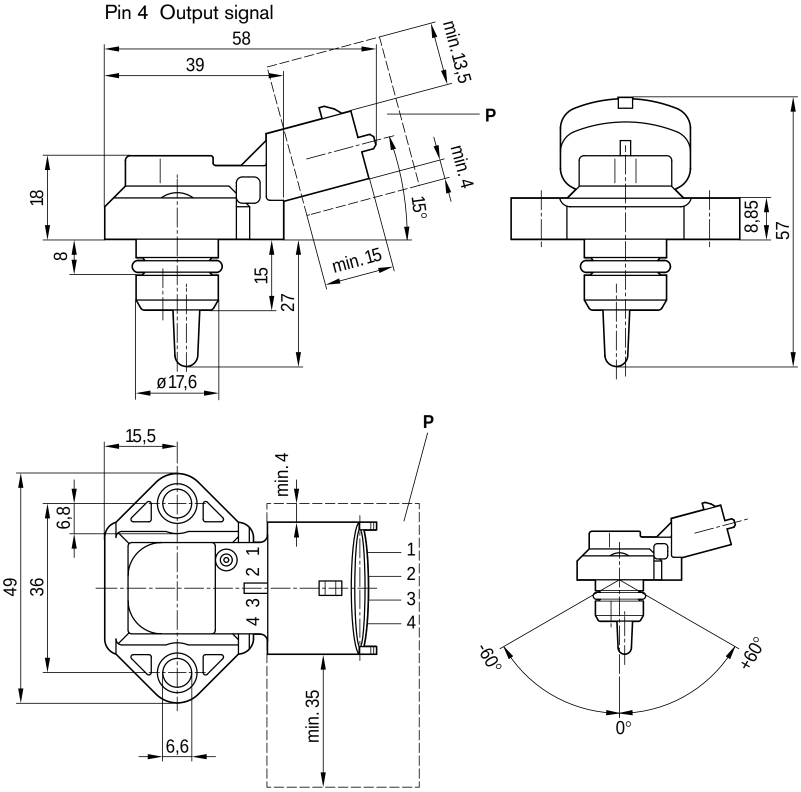


Dimension drawings. P Space required by plug and cable.

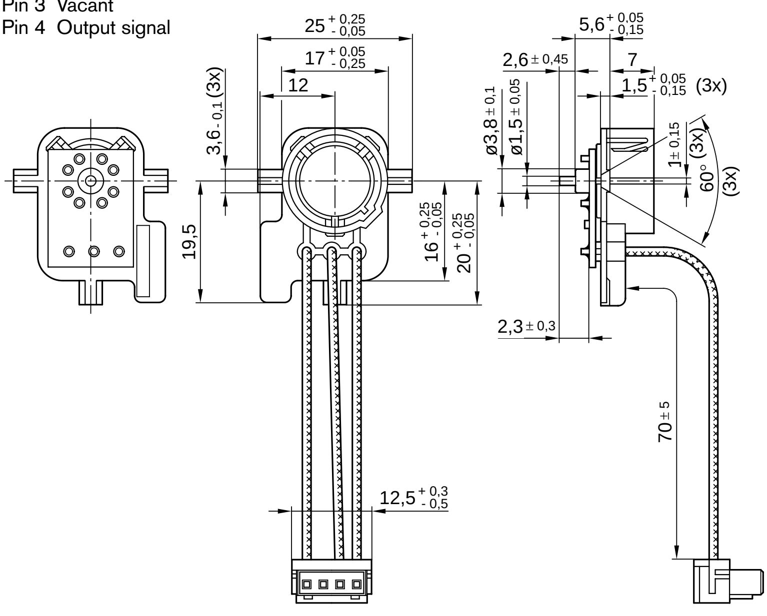
① **0 261 230 009**
Connector-pin assignment
Pin 1 +5 V
Pin 2 Ground
Pin 3 Output signal



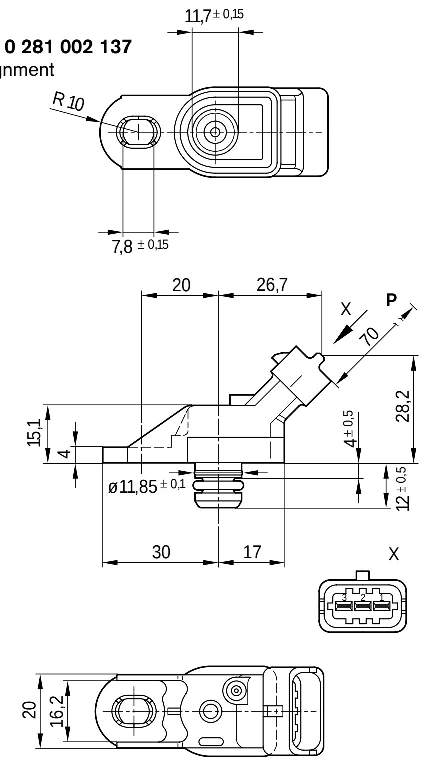
② **0 261 230 013, 0 261 230 022, 0 281 002 205**
Connector-pin assignment
Pin 1 Ground
Pin 2 NTC resistor
Pin 3 +5 V
Pin 4 Output signal



③ **1 267 030 835**
Connector-pin assignment
Pin 1 Ground
Pin 2 +5 V
Pin 3 Vacant
Pin 4 Output signal



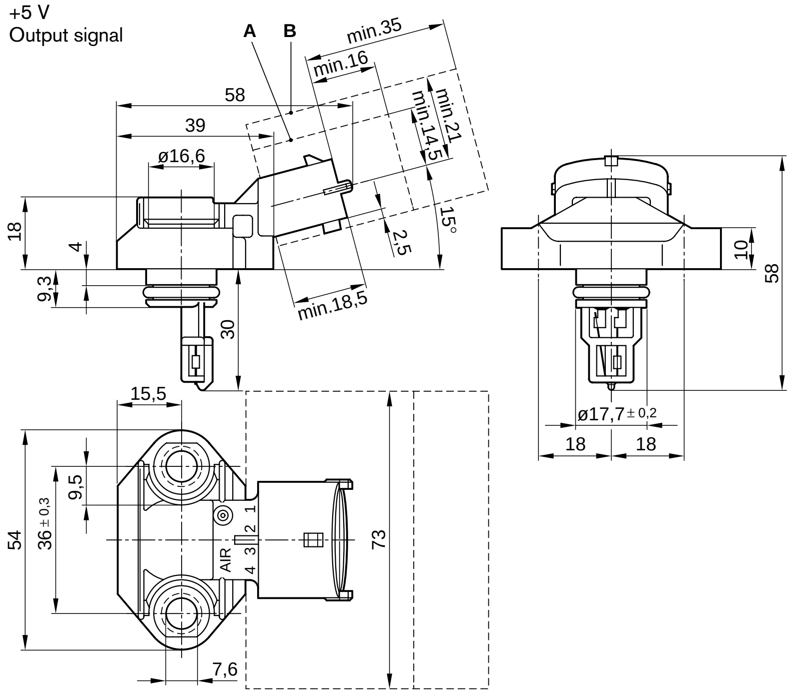
④ **0 261 230 020, 0 281 002 137**
Connector-pin assignment
Pin 1 +5 V
Pin 2 Ground
Pin 3 Output signal



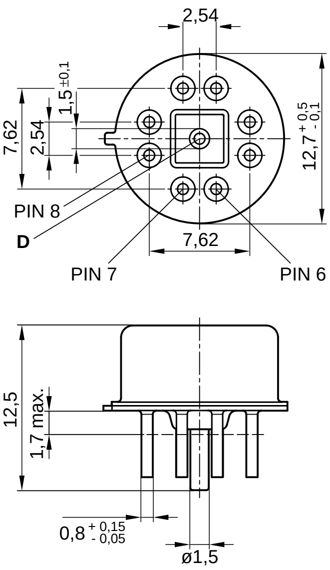
Micromechanical TO-design absolute-pressure sensors (contd.)
Measurement of pressures in gases and liquid media up to 600 kPa

Dimension drawings A Space required by plug and cable
B Space required when plugging in/unplugging

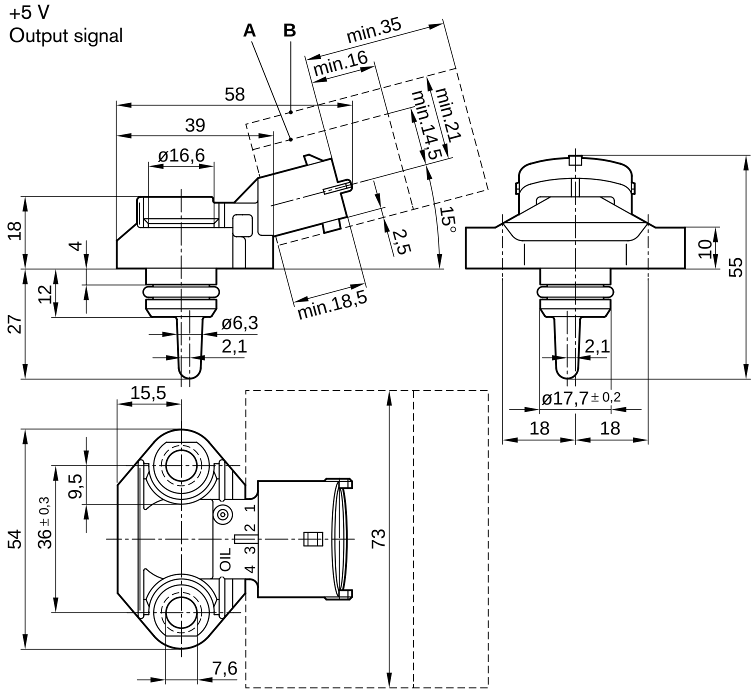
⑤ **0 281 002 244**
Connector-pin assignment
Pin 1 Ground
Pin 2 NTC resistor
Pin 3 +5 V
Pin 4 Output signal



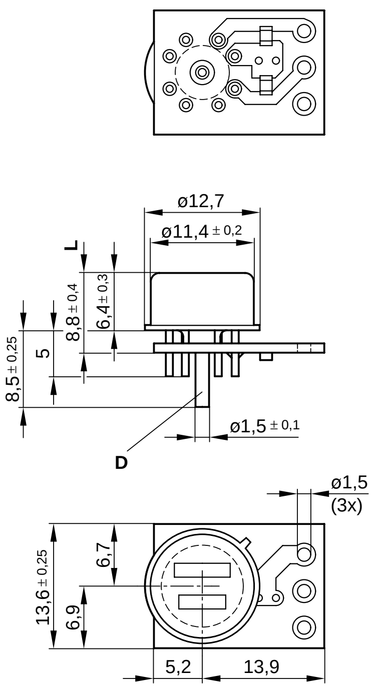
⑦ **0 273 300 ..**
Sensor without housing
D Pressure-connection fitting
Pin 6 Output signal
Pin 7 Soldered



⑥ **0 281 002 246**
Connector-pin assignment
Pin 1 Ground
Pin 2 NTC resistor
Pin 3 +5 V
Pin 4 Output signal

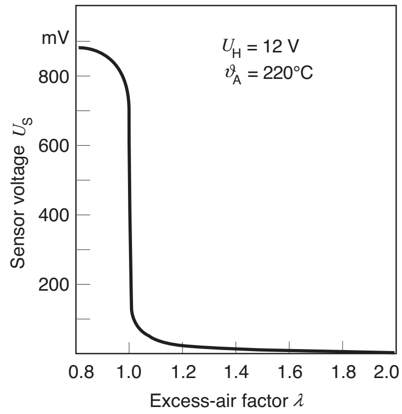


⑧ **0 261 230 036 ..**
D Pressure connection
L In the area of the measuring surface



OXYGEN SENSORS

Purpose and Function.
Oxygen Sensors are used to detect the amount of excess oxygen in the exhaust gas after combustion to indicate the relative richness or leanness of mixture composition.
The oxygen sensor contains two porous platinum electrodes with a ceramic electrolyte between them. It compares exhaust gas oxygen levels to atmospheric oxygen and produces a voltage in relation to this.
The voltage produced by the oxygen sensor will be typically as small as 100 mV *[lean]* up to a maximum of 900 mV *[rich]*. An active oxygen sensor would cycle between these two points as the engine management system drives the mixture rich and lean to achieve an average sensor voltage of ~465mV. This would represent the mixture ratio of 14.7:1.
This type of operation is normal for a “narrow band” style of sensor; these are used for the majority of standard vehicle applications.
Bosch also produces “lean” sensors *[type code LSM11]* for testing applications, these provided a broader operational range by extending the lean scale, a detailed curve can be seen below. These sensors are not recommended for standard vehicle use.
The introduction of “Planar” manufacturing technology has allowed Bosch to produce a “wide band” oxygen sensor that has an extended mixture operating range *[type code LSU4]*. These sensors operate on a completely different principle to the standard “thimble” type sensor manufactured by Bosch. The operation of this type of sensor requires various software controls to manage oxygen cell current requirements, signal interpretation and heater management. Bosch produces these sensors for use with our engine management systems that are developed in conjunction with individual vehicle manufacturers.
It should be noted that these sensors require a complex heater management system in order to maintain sensor accuracy across various operating conditions. Sensors not operated in conjunction with an appropriate heater management strategy may be damaged due to thermal stress. Consultation with the engine management system provider should take place prior to use of these sensors to ensure they are supported.



OXYGEN SENSOR TECHNICAL DATA

Part Number	Measurement Range [Lambda]	Type Code	Number of Wires	Heater Power [W]	Mounting Thread Size [mm]	Cable Length [mm]	Connector Type
0 258 001 027	> 1	LS	1	NA	M18 x 1.5	40	Bullet Terminal
0 258 003 957	>1	LSH 15	3	11	M18 x 1.5	1150	9 122 067 011
0 258 003 074	>1	LSH 6	4	11	M18 x 1.5	200	9 122 067 011 & 1 287 013 002
0 258 104 002	0.8 -1.6	LSM 11	4	16	M18 x 1.5	2500	9 122 067 011 & 1 287 013 002
0 258 104 004	0.8 -1.6	LSM 11	4	16	M18 x 1.5	650	9 122 067 011 & 1 287 013 002
0 258 006 065	0.7 - infinity	LSU 4.2	6 (5 used)	---	M18 x 1.5	600	D 261 205 138
0 258 006 066	0.7 - infinity	LSU 4.2	6 (5 used)	---	M18 x 1.5	460	D 261 205 138

“Lambda” oxygen sensors, Type LSM 11

For measuring the oxygen content

● Principle of the galvanic oxygen concentration cell with solid electrolyte permits measurement of oxygen concentration, for instance in exhaust gases.
● Sensors with output signal which is both stable and insensitive to interference, as well
as being suitable for extreme operating conditions.

Application

Combustion processes
– Oil burners
– Gas burners
– Coal-fired systems
– Wood-fired systems
– Bio refuse and waste
– Industrial furnaces

Engine-management systems
– Lean-burn engines
– Gas engines
– Block-type thermal power stations

Industrial processes
– Packaging machinery and installations
– Process engineering
– Drying plants
– Hardening furnaces
– Metallurgy (steel melting)
– Chemical industry (glass melting)

Measuring and analysis processes
– Smoke measurement
– Gas analysis
– Determining the Wobb index

Range

Sensor	
Total length = 2500 mm	**0 258 104 002***
Total length = 650 mm	**0 258 104 004**

* Standard version

Accessories

Connector for heater element	
Plug housing	**1 284 485 110**
Receptacles [1])	**1 284 477 121**
Protective cap	**1 250 703 001**

Connector for the sensor	
Coupler plug	**1 224 485 018**
Blade terminal [1])	**1 234 477 014**
Protective cap	**1 250 703 001**

Special grease for the screw-in thread	
Tin 120 g	**5 964 080 112**

[1]) 5 per pack
2 needed in each case

Special accessories

Please enquire regarding analysing unit LA2. This unit processes the output signals from the Lambda oxygen sensors listed here, and displays the Lambda values in digital form. At the same time, these values are also made available at an analog output, and via a multislave V24 interface.

Installation instructions

The Lambda sensor should be installed at a point which permits the measurement of a representative exhaust-gas mixture, and which does not exceed the maximum permissible temperature. The sensor is screwed into a mating thread and tightened with 50…60 N · m.

– Install at a point where the gas is as hot as possible.
– Observe the maximum permissible temperatures.
– As far as possible install the sensor vertically, whereby the electrical connections should point upwards.
– The sensor is not to be fitted near to the exhaust outlet so that the influence of the outside air can be ruled out. The exhaust-gas passage opposite the sensor must be free of leaks in order to avoid the effects of leak-air.
– Protect the sensor against condensation water.
– The sensor body must be ventilated from the outside in order to avoid overheating.
– The sensor is not to be painted, nor is wax to be applied or any other forms of treatment. Only the recommended grease is to be used for lubricating the threads.
– The sensor receives the reference air through the connection cable. This means that the connector must be clean and dry. Contact spray, and anti-corrosion agents etc. are forbidden.
– The connection cable must not be soldered. It must only be crimped, clamped, or secured by screws.

Technical data

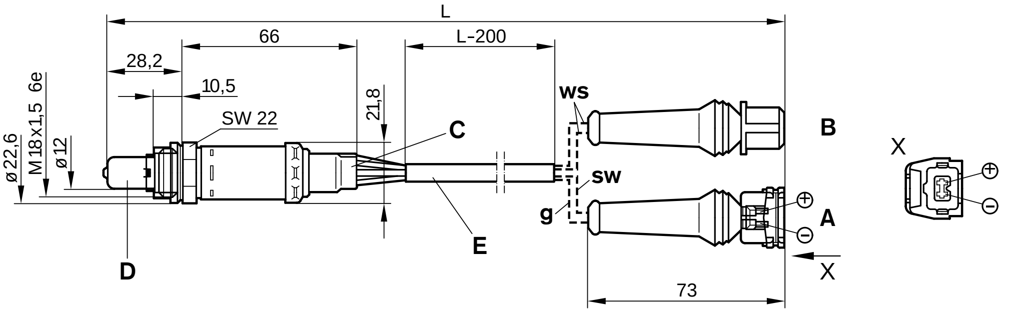
Application conditions	
Temperature range, passive (storage-temperature range)	–40…+100 °C
Sustained exhaust-gas temperature with heating switched on	+150…+600 °C
Permissible max. exhaust-gas temperature with heating switched on (200 h cumulative)	+800 °C
Operating temperature	
of the sensor-housing hexagon	≤ +500 °C
At the cable gland	≤ +200 °C
At the connection cable	≤ +150 °C
At the connector	≤ +120 °C
Temperature gradient at the sensor-ceramic front end	≤ +100 K/s
Temperature gradient at the sensor-housing hexagon	≤ +150 K/s
Permissible oscillations at the hexagon	
Stochastic oscillations – acceleration, max.	≤ 800 m · s^{-2}
Sinusoidal oscillations – amplitude	≤ 0.3 mm
Sinusoidal oscillations – acceleration	≤ 300 m · s^{-2}
Load current, max.	±1 µA
Heater element	
Nominal supply voltage (preferably AC)	12 V_{eff}
Operating voltage	12…13 V
Nominal heating power for ϑ_{Gas} = 350 °C and exhaust-gas flow speed of ≈ 0.7 m · s^{-1} at 12 V heater voltage in steady state	≈ 16 W
Heater current at 12 V steady state	≈ 1.25 A
Insulation resistance between heater and sensor connection	> 30 MΩ
Data for heater applications	
Lambda control range λ	1.00…2.00
Sensor output voltage for λ = 1.025…2.00 at ϑ_{Gas} = 220 °C and a flow rate of 0.4…0.9 m · s^{-1}	68…3.5 mV 2)
Sensor internal resistance R_i~ in air at 20 °C and at 12 V heater voltage	≤ 250 Ω
Sensor voltage in air at 20 °C in as-new state and at 13 V heater voltage	–9...–15 mV 3)
Manufacturing tolerance $\Delta\lambda$ in as-new state (standard deviation 1 s) at ϑ_{Gas} = 220 °C and a flow rate of approx. 0.7 m · s^{-1}	
at λ = 1.30	≤ ±0.013
at λ = 1.80	≤ ±0.050
Relative sensitivity $\Delta U_S/\Delta\lambda$ at λ = 1.30	0.65 mV/0.01
Influence of the exhaust-gas temperature on sensor signal for a temperature increase from 130 °C to 230 °C, at a flow rate ≤ 0.7 m · s^{-1} at λ = 1.30; $\Delta\lambda$	≤ ±0.01
Influence of heater-voltage change ±10 % of 12 V at ϑ_{Gas} = 220 °C	
at λ = 1.30; $\Delta\lambda$	≤ ±0.009
at λ = 1.80; $\Delta\lambda$	≤ ±0.035
Response time at ϑ_{Gas} = 220 °C and approx. 0.7 m · s^{-1} flow rate As-new values for the 66% switching point; λ jump = 1.10 ↔ 1.30	
for jump in the "lean" direction	2.0 s
for jump in the "rich" direction	1.5 s
Guideline value for sensor's "readines for control" point to be reached after switching on oil burner and sensor heater; ϑ_{Gas} ≈ 220 °C; flow rate approx. 1.8 m · s^{-1}; λ = 1.45; sensor in exhaust pipe dia. 170 mm	70 s
Sensor ageing $\Delta\lambda$ in heating-oil exhaust gas after 1,000 h continuous burner operation with EL heating oil; measured at ϑ_{Gas} = 220 °C	
at λ = 1.30	≤ ±0.012
at λ = 1.80	≤ ±0.052
Useful life for ϑ_{Ga} < 300 °C	In individual cases to be checked by customer; guideline value > 10,000 h

2) See characteristic curves. 3) Upon request –8.5...–12 mV.

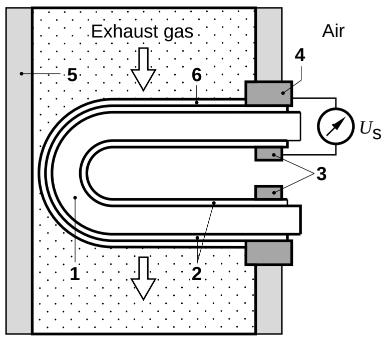
Warranty claims
In accordance with the general Terms of Delivery A17, warranty claims can only be accepted under the conditions that permissible fuels were used. That is, residue-free, gaseous hydrocarbons and light heating oil in accordance with DIN 51 603.

λ / U

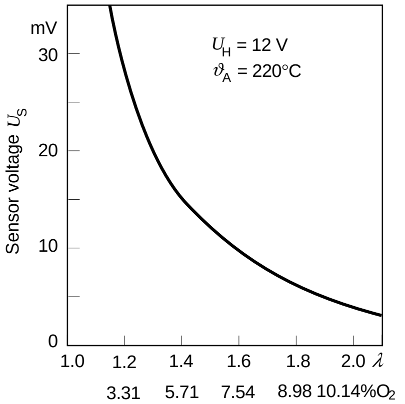
Dimension drawing.
A Signal voltage, **B** Heater voltage, **C** Cable sleeve and seals, **D** Protective tube, **E** Protective sleeve, **L** Overall length. **ws** White, **sw** Black, **g** Grey.



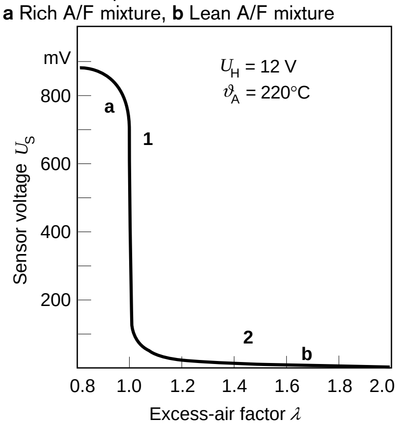
Lambda sensor in exhaust pipe (principle).
1 Sensor ceramic, **2** Electrodes, **3** Contact, **4** Housing contact, **5** Exhaust pipe, **6** Ceramic protective coating (porous).



Characteristic curve: Propane gas (lean range).



Characteristic curve: Complete range.
1 Closed-loop control λ = 1; **2** Lean control
a Rich A/F mixture, **b** Lean A/F mixture



Design and function

The ceramic part of the Lambda sensor (solid electrolyte) is in the form of a tube closed at one end. The inside and outside surfaces of the sensor ceramic have a microporous platinum layer (electrode) which, on the one hand, has a decisive influence on the sensor characteristic, and on the other, is used for contacting purposes. The platinum layer on that part of the sensor ceramic which is in contact with the exhaust gas is covered with a firmly bond-ed, highly porous protective ceramic layer which prevents the residues in the exhaust gas from eroding the catalytic platinum layer. The sensor thus features good long-term stability.
The sensor protrudes into the flow of exhaust gas and is designed such that the exhaust gas flows around one electrode, whilst the other electrode is in contact with the outside air (atmosphere).
Measurements are taken of the residual oxygen content in the exhaust gas.
The catalytic effect of the electrode surface at the sensor's exhaust-gas end produces a step-type sensor-voltage profile in the area around λ = 1. [1])

The active sensor ceramic (ZrO_2) is heated from inside by means of a ceramic Wolfram heater so that the temperature of the sensor ceramic remains above the 350 °C function limit irrespective of the exhaust-gas temperature. The ceramic heater features a PTC characteristic, which results in rapid warm-up and restricts the power requirements when the exhaust gas is hot. The heater-element connections are completely decoupled from the sensor signal voltage (R ≥ 30 MΩ). Additional design measures serve to stabilize the lean characteristic-curve profile of the Type LSM11 Lambda sensor at λ > 1.0...1.5 (for special applications up to λ = 2.0):
– Use of powerful heater (16 W)
– Special design of the protective tube
– Modified electrode/protective-layer system.

[1]) The excess-air factor (λ) is the ratio be-tween the actual and the ideal air/fuel ratio.

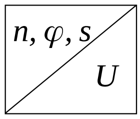
The special design permits:
– Reliable control even with low exhaust-gas temperatues (e.g. with engine at idle),
– Flexible installation unaffected by external heating,
– Function parameters practically independent of exhaust-gas temperature,
– Low exhaust-gas values due to the sensor's rapid dynamic response,
– Little danger of contamination and thus long service life,
– Waterproof sensor housing.

Explanation of symbols

U_S Sensor voltage
U_H Heater voltage
ϑ_A Exhaust-gas temperature
λ Excess-air factor [1])
O_2 Oxygen concentration in %

Hall-effect rotational-speed sensors

Digital measurement of rotational speeds



- Precise and reliable digital measurement of rotational speed, angle, and distance travelled.
- Non-contacting (proximity) measurement.
- Hall-IC in sensor with open-collector output.
- Insensitive to dirt and contamination.
- Resistant to mineral-oil products (fuel, engine lubricant).

Design
Hall sensors comprise a semiconductor wafer with integrated driver circuits (e.g. Schmitt-Trigger) for signal conditioning, a transistor functioning as the output driver, and a permanent magnet. These are all hermetically sealed inside a plastic plug-type housing.

Application
Hall-effect rotational-speed sensors are used for the non-contacting (proximity), and therefore wear-free, measurement of rotational speeds, angles, and travelled distances. Compared to inductive-type sensors, they have an advantage in their output signal being independent of the rotational speed or relative speed of the rotating trigger-wheel vane. The position of the tooth is the decisive factor for the output signal.
Adaptation to almost every conceivable application requirement is possible by appropriate tooth design. In automotive engineering, Hall-effect sensors are used for information on the momentary wheel speed and wheel position as needed for braking and drive systems (ABS/TCS), for measuring the steering-wheel angle as required for the vehicle dynamics control system (Electronic Stability Program, ESP), and for cylinder identification.

Operating principle
Measurement is based upon the Hall effect which states that when a current is passed through a semiconductor wafer the so-called Hall voltage is generated at right angles to the direction of current. The magnitude of this voltage is proportional to the magnetic field through the semiconductor. Protective circuits, signal conditioning circuits, and output drivers are assembled directly on this semiconductor. If a magnetically conductive tooth (e.g. of soft iron) is moved in front of the sensor, the magnetic field is influenced arbitrarily as a function of the trigger-wheel vane shape. In other words, the output signals are practically freely selectable.

Technical Data [1] / Range

Part number		**0 232 103 021**	**0 232 103 022**
Minimum rotational speed of trigger wheel n_{min}		0 min^{-1}	10 min^{-1}
Maximum rotational-speed of trigger wheel $n_{max.}$		4000 min^{-1}	4500 min^{-1}
Minimum working air gap		0.1 mm	0.1 mm
Maximum working air gap		1.8 mm	1.5 mm
Supply voltage U_N		5 V	12 V
Supply-voltage range U_V		4.75...5.25 V [2]	4.5...24 V
Supply current I_V	Typical	5.5 mA	10 mA
Output current I_A		0...20 mA	0...20 mA
Output voltage U_A		0... U_V	0... U_V
Output saturation voltage U_S		≤ 0.5 V	≤ 0.5 V
Switching time t_f [3] at $U_A = U_N$, I_A = 20 mA (ohmic load)		≤ 1 µs	≤ 1 µs
Switching time t_r [4] at $U_A = U_N$, I_A = 20 mA (ohmic load)		≤ 15 µs	≤ 15 µs
Sustained temperature in the sensor and transition region		–40...+150 °C	–30...+130 °C [5]
Sustained temperature in the plug area		–40...+130 °C	–30...+120 °C [6]

[1]) At ambient temperature 23 ±5 °C. [2]) Maximum supply voltage for 1 hour: 16.5 V
[3]) Time from HIGH to LOW, measured between the connections (0) and (–) from 90% to 10%
[4]) Time from LOW to HIGH, measured between the connections (0) and (–) from 10% to 90%
[5]) Short-time –40...+150 °C permissible. [6]) Short-time –40...+130 °C permissible.

Accessories for connector

Plug housing	Contact pins	Individual gaskets	For cable cross section
1 928 403 110	**1 987 280 103**	**1 987 280 106**	0.5...1 mm^2
	1 987 280 105	**1 987 280 107**	1.5...2.5 mm^2

Note: For a 3-pin plug, 1 plug housing, 3 contact pins, and 3 individual gaskets are required.
For automotive applications, original AMP crimping tools must be used.

Installation information
– Standard installation conditions guarantee full sensor functioning.
– Route the connecting cables in parallel in order to prevent incoming interference.
– Protect the sensor against destruction by static discharge (CMOS components).
– The information on the right of this page must be observed in the design of the trigger wheel.

Symbol explanation
n_{min} = 0: Static operation possible.
n_{min} > 0: Only dynamic operation possible.
U_S: Max. output voltage at LOW with
I_A: Output current = 20 mA.
I_V: Supply current for the Hall sensor.
t_f: Fall time (trailing signal edge).
t_r: Rise time (leading signal edge).

Trigger-wheel design
0 232 103 021
The trigger wheel must be designed as a 2-track wheel. The phase sensor must be installed dead center. Permissible center offset: ±0.5 mm.
Segment shape:

Mean diameter	≥ 45 mm
Segment width	≥ 5 mm
Segment length	≥ 10 mm
Segment height	≥ 3.5 mm

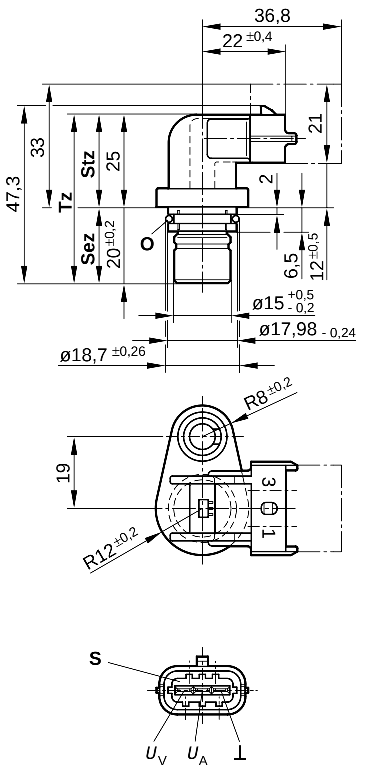
0 232 103 022
The trigger wheel is scanned radially.
Segment shape:

Diameter	≥ 30 mm
Tooth depth	≥ 4.5 mm
Tooth width	≥ 10 mm
Material thickness	≥ 3.5 mm

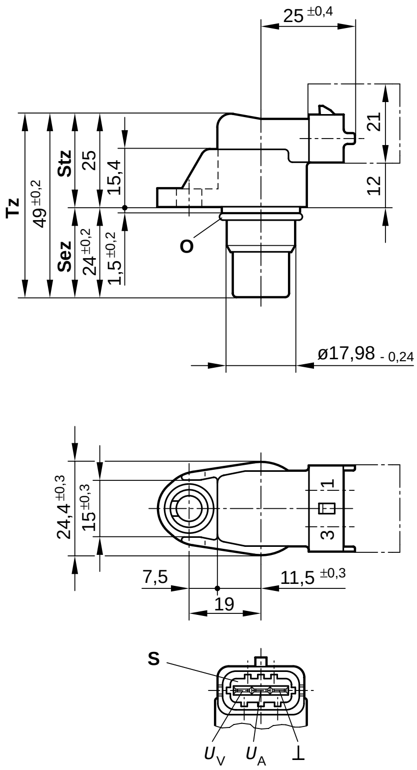
Dimension drawings.

S 3-pin plug-in connection
Sez Sensor area
Stz Plug area
Tz Temperature area
O O-ring

0 232 103 021

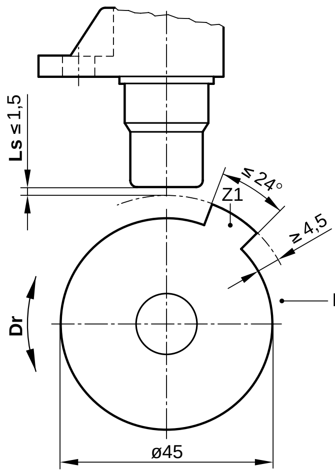


0 232 103 022

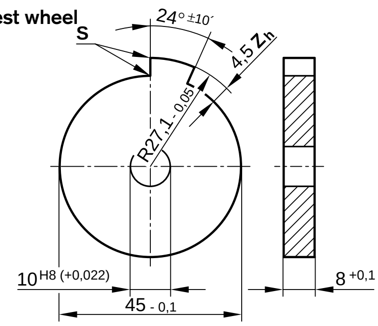


Installation stipulation 0 232 103 022.

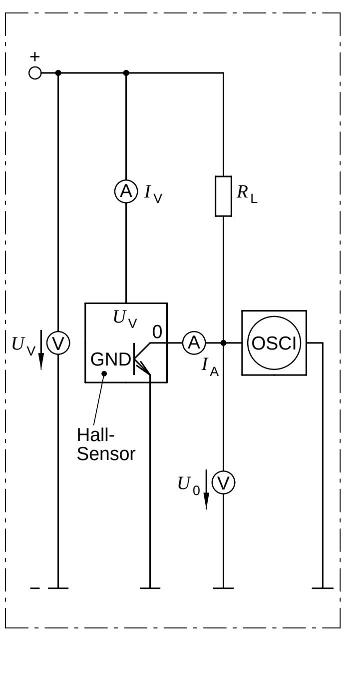
Dr Direction of rotation
Ls Air gap
S Sharp-edged
Zh Tooth height



Test wheel



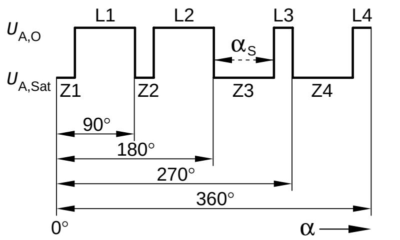
Block diagram.



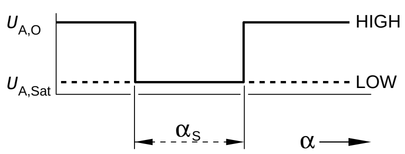
Output-signal shape.

$U_{A,O}$ Output voltage
$U_{A,SAT}$ Output saturation voltage
α Angle of rotation
α_S Signal width

0 232 103 021

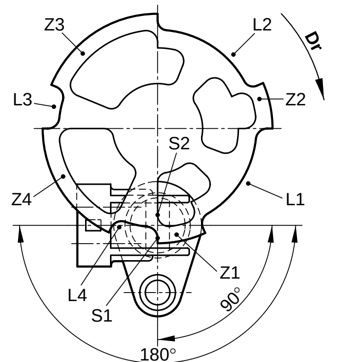


0 232 103 022

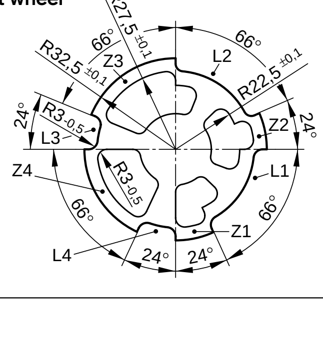


Installation stipulation 0 232 103 021.

Dr Direction of rotation



Test wheel



Inductive rotational-speed sensors

Incremental* measurement of angles and rotational speeds

n / U

- Non-contacting (proximity) and thus wear-free, rotational-speed measurement.
- Sturdy design for exacting demands.
- Powerful output signal.
- Measurement dependent on direction of rotation.

Application
Inductive rotational-speed sensors of this type are suitable for numerous applications involving the registration of rotational speeds. Depending on design, they measure engine speeds and wheel speeds for ABS systems, and convert these speeds into electric signals.

Design and function
The soft-iron core of the sensor is surrounded by a winding, and located directly opposite a rotating toothed pulse ring with only a narrow air gap separating the two. The soft-iron core is connected to a permanent magnet, the magnetic field of which extends into the ferromagnetic pulse ring and is influenced by it. A tooth located directly opposite the sensor concentrates the magnetic field and amplifies the magnetic flux in the coil, whereas the magnetic flux is attenuated by a tooth space. These two conditions constantly follow on from one another due to the pulse ring rotating with the wheel. Changes in magnetic flux are generated at the transitions between the tooth space and tooth (leading tooth edge) and at the transitions between tooth and tooth space (trailing tooth edge). In line with Faraday's Law, these changes in magnetic flux induce an AC voltage in the coil, the frequency of which is suitable for determining the rotational speed.

Wheel-speed sensor (principle).
1 Shielded cable, **2** Permanent magnet, **3** Sensor housing, **4** Housing block, **5** Soft-iron core, **6** Coil, **7** Air gap, **8** Toothed pulse ring with reference mark.

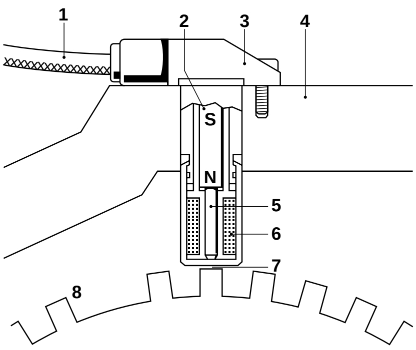
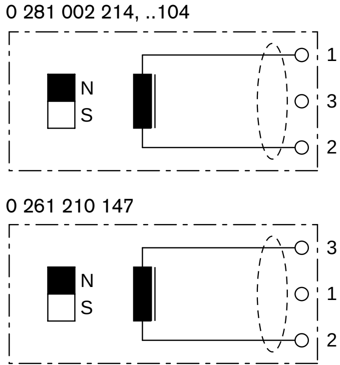


Diagram.
Connections:
1 Output voltage,
2 Ground, **3** Shield.



Range

Cable length with plug	Fig./ Dimension drawing	Order No.
360 ± 15	1	**0 261 210 104**
553 ± 10	2	**0 261 210 147**
450 ± 15	3	**0 281 002 214**

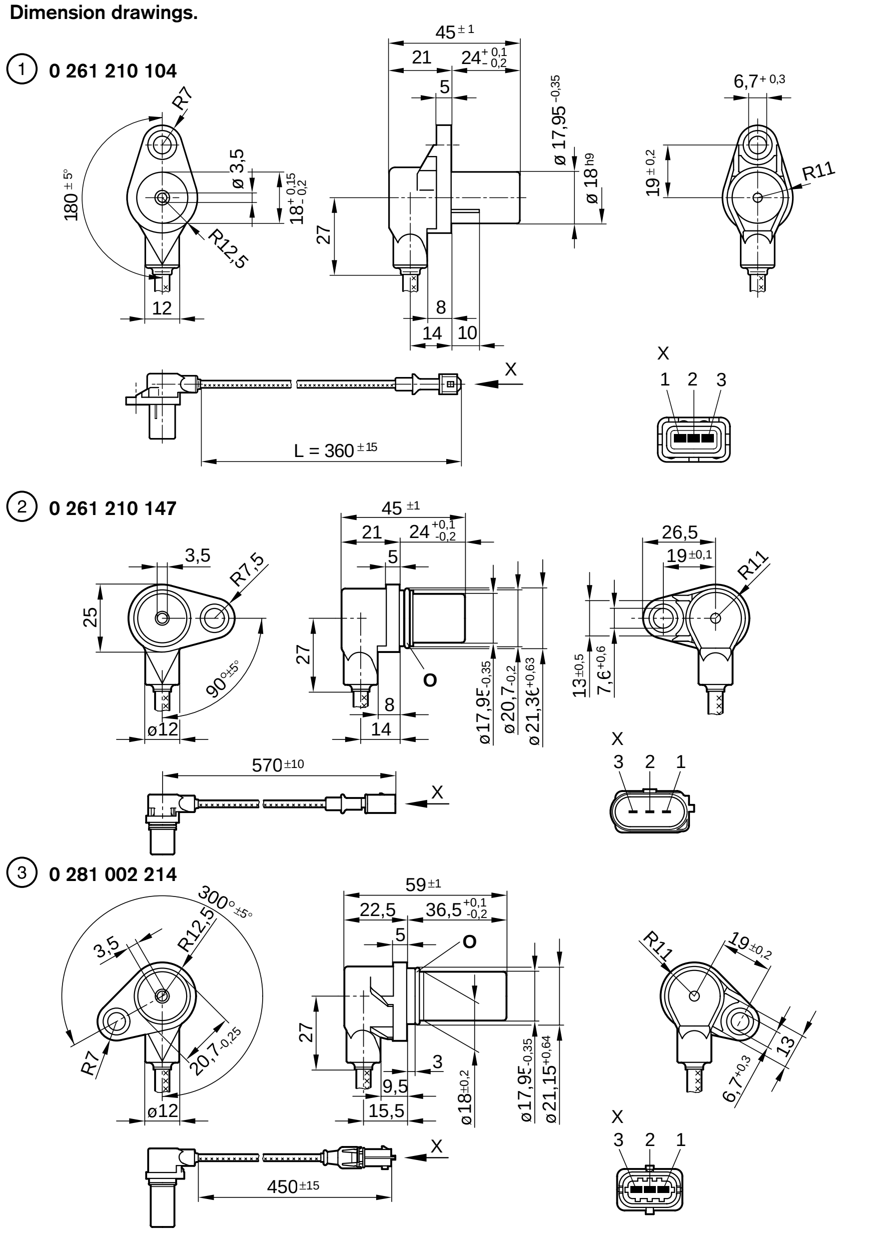
* A continuously changing variable is replaced by a frequency proportional to it.

Technical Data

Rotational-speed range n 1)	min^{-1}	≈ 20...7000
Permanent ambient temperature in the cable area		
For 0 261 210 104, 0 281 002 214	°C	–40...+120
For 0 261 210 147	°C	–40...+130
Permanent ambient temperature in the coil area	°C	–40...+150
Vibration stress max.	$m \cdot s^{-2}$	1200
Number of turns		4300 ±10
Winding resistance at 20 °C 2)	Ω	860 ±10 %
Inductance at 1 kHz	mH	370 ±15 %
Degree of protection		IP 67
Output voltage U_A 1)	V	0...200

1) Referred to the associated pulse ring.
2) Change factor $k = 1+0.004\ (\vartheta_W - 20\ °C)$; ϑ_W winding temperature

Dimension drawings.



The sensor generates one output pulse per tooth. The pulse amplitude is a function of the air gap, together with the toothed ring's rotational speed, the shape of its teeth, and the materials used in its manufacture. Not only the output-signal amplitude increases with speed, but also its frequency. This means that a minimum rotational speed is required for reliable evaluation of even the smallest voltages.
A reference mark on the pulse ring in the form of a large "tooth space" makes it possible not only to perform rotational-speed measurement, but also to determine the pulse ring's position. Since the toothed pulse ring is an important component of the rotational-speed measuring system, exacting technical demands are made upon it to ensure that reliable, precise information is obtained. Pulse-ring specifications are available on request.

Explanation of symbols

U_A Output voltage
n Rotational speed
s Air gap

Accessories

For rot-speed sensor	From offer drawing	Plug part number
0 261 210 104	A 928 000 019	**1 928 402 412**
	A 928 000 012	**1 928 402 579**
0 261 210 147		Enquire at AMP
0 261 002 214	A 928 000 453	**1 928 402 966**

TEMPERATURE SENSORS

Purpose and Function

Temperature sensors used in modern engine management systems are of NTC [negative temperature co-efficient] design. Simply as temperature rises the resistance of the NTC element reduces. These sensors are used for their logarithmic resistance characteristics as well broad sensitivity range.

These sensors are designed for use in a broad range of purposes and applications involving temperature measurement of water or oil.

Air temperature can be measured with sensor number 0 280 130 085.

For more detailed information about these products refer to our website **www.bosch.com.au**

TEMPERATURE SENSOR TECHNICAL DATA

Part Number	Measurement Range	Characteristic Curve	Max Circuit Current [A]	Thread Size	Connector	Figure	Comment
0 280 130 023	- 40 to + 130	A	1.0	M12 x 1.5	9 122 067 011	A	For fuel, oil and water measurement
0 280 130 026	- 40 to + 130	A	1.0	M12 x 1.5	9 122 067 011	A	For fuel, oil and water measurement
0 280 130 032	- 40 to + 130	A	1.0	M12 x 1.5	9 122 067 011	A	Dual Element - water measurement
0 280 130 039	- 40 to + 130	A	1.0	M12 x 1.5	9 122 067 011	A	For air temperature measurement
0 280 130 085	- 40 to + 130	B	1.0	---	9 122 067 011	B	For air temperature measurement

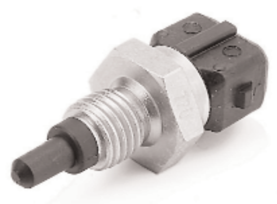
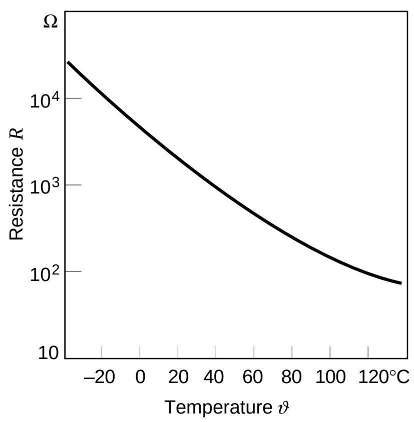


Fig. A



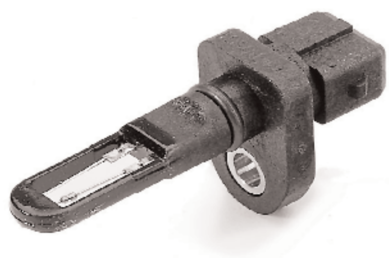
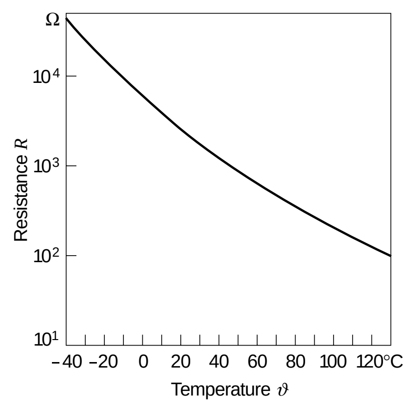
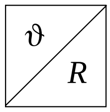


Fig. B

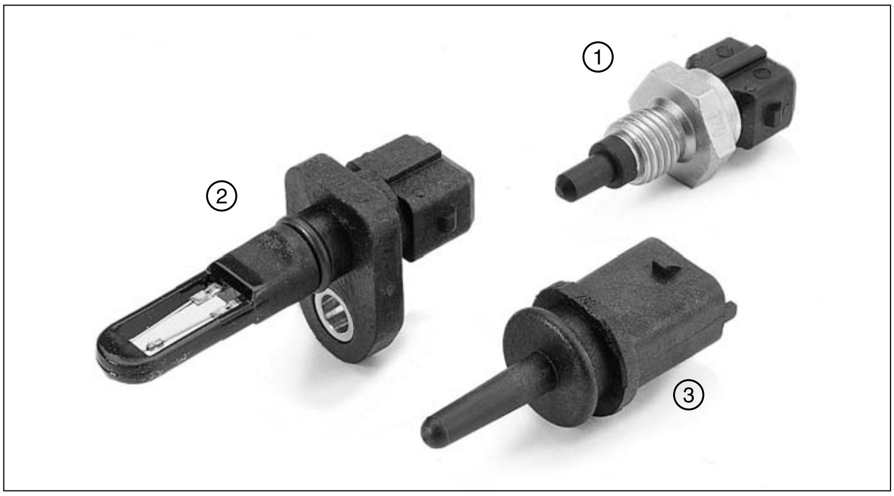


NTC temperature sensors

Measurement of air temperatures between –40 °C and +130 °C



- Measurement with temperature-dependent resistors.
- Broad temperature range.



Range

NTC temperature sensor
NTC resistor in plastic sheath

Steel housing	
Screw fastening	**0 280 130 039**
Polyamide housing	
Plug-in mounting	**0 280 130 092**
Plug-in mounting	**0 280 130 085**

Accessories

For 0 280 130 039; .. 085	
Connector	**1 237 000 036**

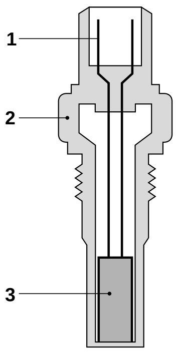
For 0 280 130 092

Designation	For cable cross-section	Part number
Plug housing	–	**1 928 403 137**
Contact pins	0.5...1.0 mm²	**1 987 280 103**
	1.5...2.5 mm²	**1 987 280 105**
Individual gaskets	0.5...1.0 mm²	**1 987 280 106**
	1.5...2.5 mm²	**1 987 280 107**

Note
Each 2-pole plug requires 1 plug housing, 2 contact pins, and 2 individual gaskets. For automotive applications, original AMP crimping tools must be used.

Explanation of symbols:
R Resistance
ϑ Temperature

Temperature sensor (principle).
1 Electrical connection
2 Housing
3 NTC resistor



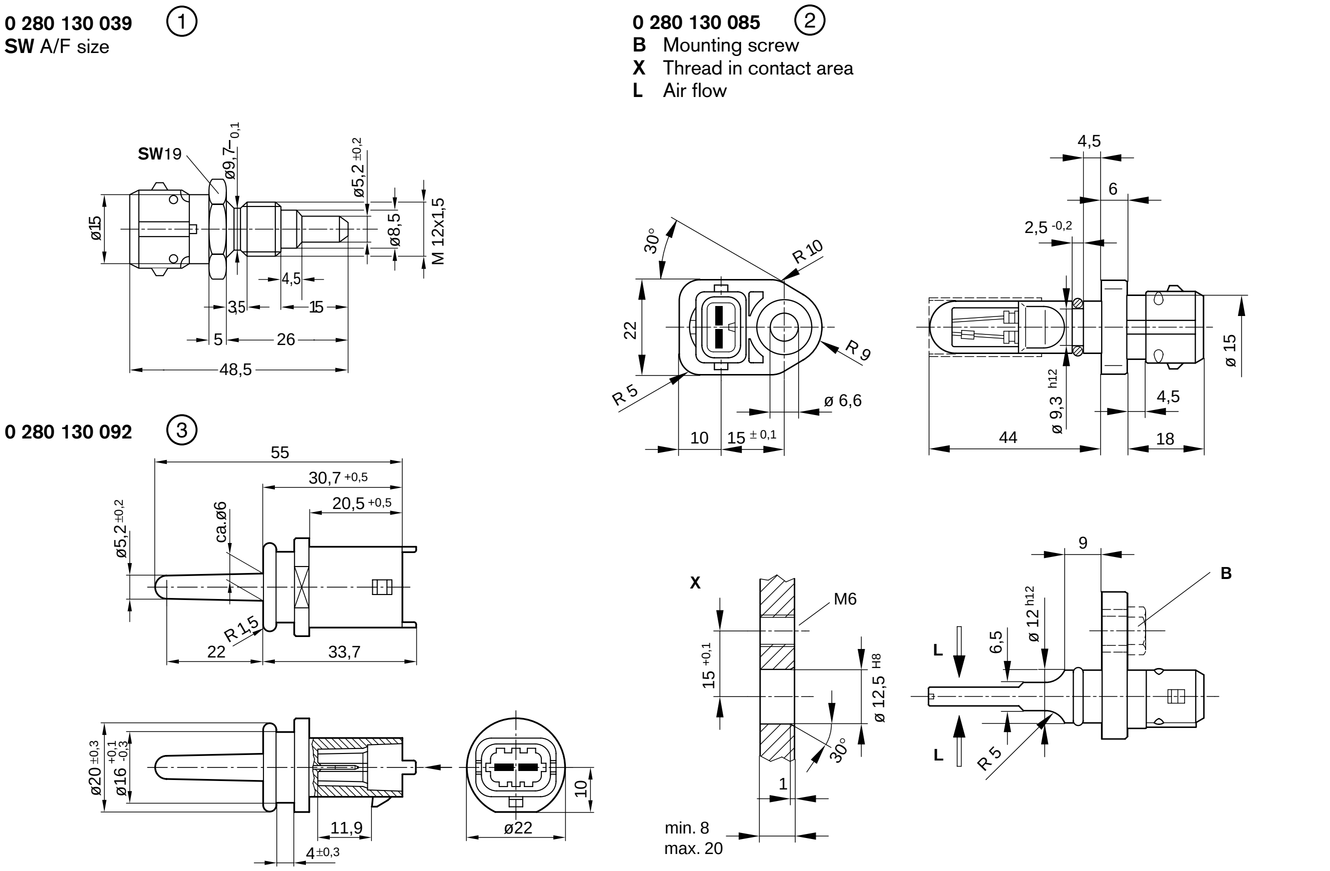
Block diagram.

Technical data

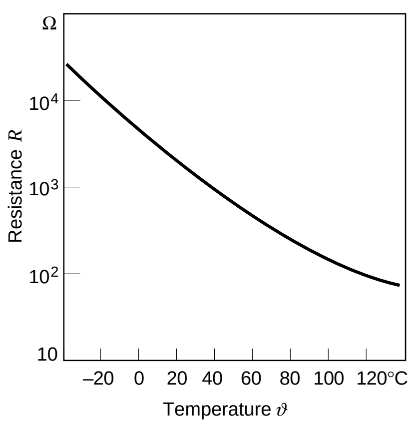
Part number		**0 280 130 039**	**0 280 130 085**	**0 280 130 092**
Illustration		1	2	3
Characteristic curve		1	2	1
Measuring range	°C	–40...+130	–40...+130	–40...+130
Permissible temp., max.	°C	+130	+140	+130
Electrical resistance at 20 °C	kΩ	2.5 ±5 %	2.4 ±5.4 %	2.5 ±5 %
Electrical resistance at –10 °C	kΩ	8.26...10.56	–	8.727...10.067
+20 °C	kΩ	2.28...2.72	2.290...2.551	2.375...2.625
+80 °C	kΩ	0.290...0.364	–	–
Nominal voltage	V	≤ 5	≤ 5	≤ 5
Measured current, max.	mA	1	1	1
Self-heating at max. permissible power loss *P* = 2 mW and stationary air (23 °C)	K	≤ 2	–	≤ 2
Thermal time constant [1]	s	ca. 20	≤ 5 [2]	44
Guide value for permissible vibration acceleration (sinusoidal vibration)	$m \cdot s^{-2}$	100	100	≤ 300
Corrosion-tested as per		DIN 50 018	DIN 50 018	DIN 50 018

[1]) At 20 °C. Time required to reach 63% of final value for difference in resistance, given an abrupt increase in air temperature; air pressure 1000 mbar; air-flow rate 6 $m \cdot s^{-1}$.
[3]) Time constant τ_{63} in air for a temperature jump of –80 °C to +20 °C at an air-flow rate of ≥ 6 $m \cdot s^{-1}$.

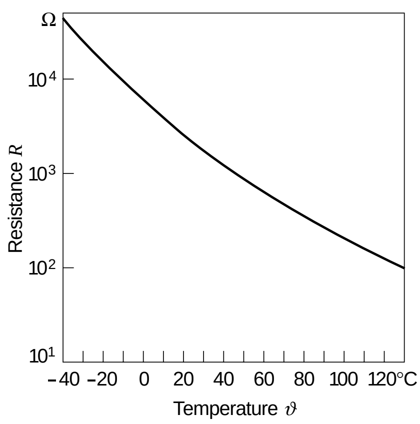
Dimension drawings.



Characteristic curve 1.



Characteristic curve 2.



Design and function

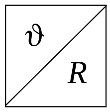
NTC sensor:
The sensing element of an NTC temperature sensor (NTC = **N**egative **T**emperature **C**oefficient), is a resistor comprised of metal oxides and oxidized mixed crystals. This mixture is produced by sintering and pressing with the addition of binding agents. For automotive applications, NTC resistors are enclosed in a protective sheath.
If NTC resistors are exposed to external heat, their resistance drops drastically and, provided the supply voltage remains constant, their input current climbs rapidly. This property can be utilised for temperature measurement. NTC resistors are suitable for an extremely wide range of ambient conditions, and with them it is possible to measure a wide range of temperatures.

Installation instructions

Installation is to be such that the front part of the sensing element is directly exposed to the air flow.

NTC temperature sensors

Measurement of liquid temperatures from –40 °C to +130 °C



● For a wide variety of liquid-temperature measurements using temperature-dependent resistors.

NTC temperature sensor
Plastic-sheathed NTC resistor in a brass housing

Design and function
NTC sensor:
The sensing element of the NTC temperature sensor (NTC = **N**egative **T**emperature **C**oefficient) is a resistor comprised of metal oxides and oxidized mixed crystals. This mixture is produced by sintering and press-ing with the addition of binding agents.
For automotive applications, NTC resistors are enclosed in a protective housing.
If NTC resistors are exposed to external heat, their resistance drops drastically and, provided the supply voltage remains constant, their input current climbs rapidly. This property can be utilised for temperature measurement. NTC resistors are suitable for use in the most varied ambient conditions, and with them it is possible to measure a wide range of liquid temperatures.

Note
Each 2-pole plug requires 1 plug housing, 2 contact pins, and 2 individual gaskets. For automotive applications, original AMP crimping tools must be used.

Explanation of symbols
R Resistance
ϑ Temperature

Temperature sensor (principle)
1 Electrical connection
2 Housing
3 NTC resistor

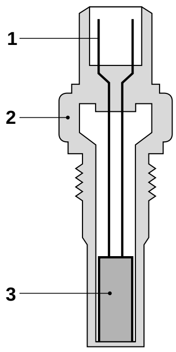
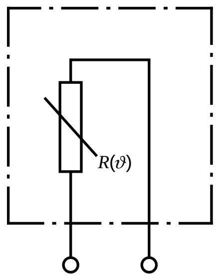
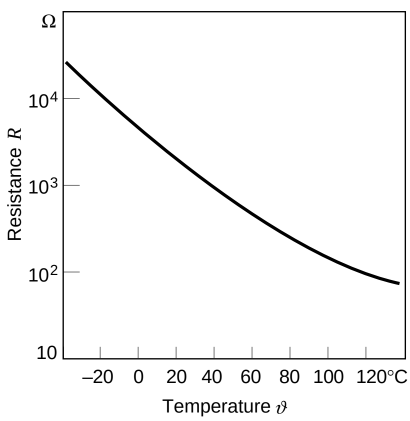
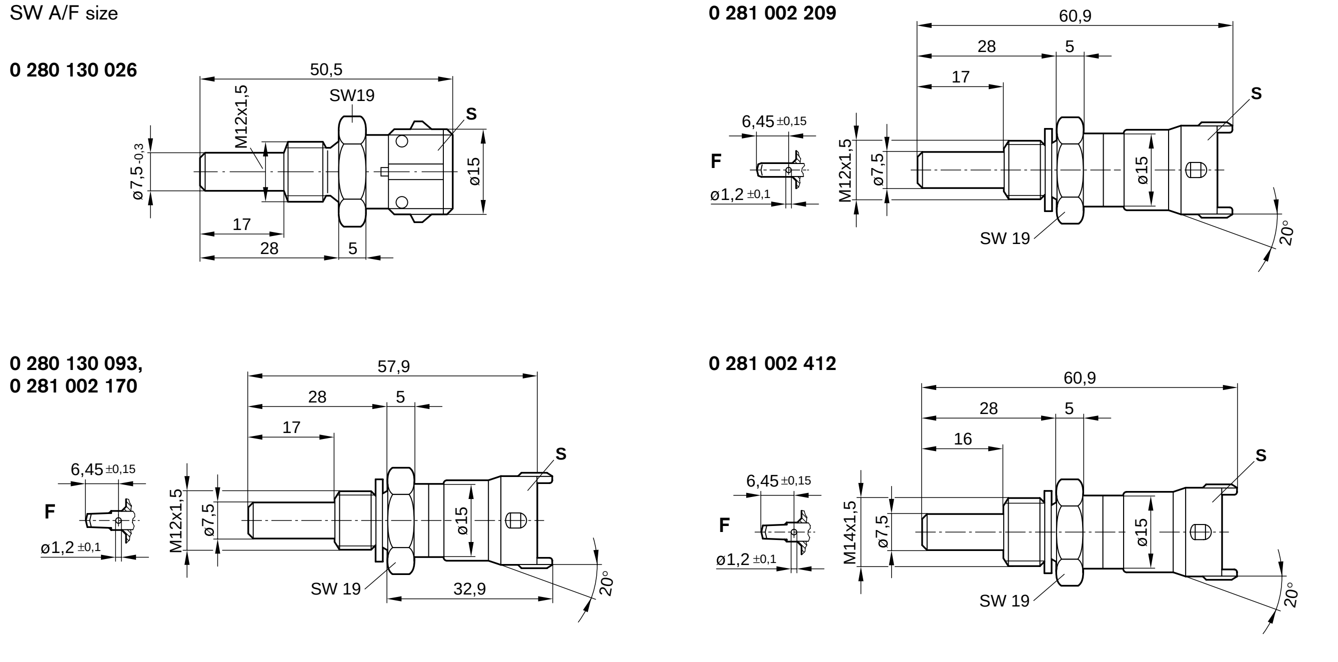


Diagram.



Characteristic curve.





Dimension drawing.
S Plug
F Blade terminal
SW A/F size

Technical data

Part number			**0 280 130 026**	**0 280 130 093**	**0 281 002 170**	**0 281 002 209**	**0 281 002 412**
Application/medium			Water	Water	Oil/Water	Water	Water
Measuring range		°C	–40...+130	–40...+130	–40...+150	–40...+130	–40...+130
Tolerance at	+20 °C	°C	1.2	1.2	±1.5	±1.5	±1.5
	+100 °C	°C	3.4	3.4	±0.8	±0.8	±0.8
Nominal resistance at 20 °C		kΩ	2.5 ±5 %	2.5 ±5 %	2.5 ±6 %	2.5 ±6 %	2.5 ±6 %
Electrical resistance at	–10 °C	kΩ	8.26…10.56	8.727...10.067	8.244...10.661	8.244...10.661	8.244...10.661
	+20 °C	kΩ	2.28…2.72	2.375...2.625	2.262...2.760	2.262...2.760	2.262...2.760
	+80 °C	kΩ	0.290…0.364	–	0.304…0.342	0.304…0.342	0.304…0.342
Nominal voltage		V	≤ 5	≤ 5	≤ 5	≤ 5	≤ 5
Measured current, max.		mA	1	1	1	1	1
Thermal time constant		s	44	44	15	15	15
Max. power loss at ΔT ≈ 1K and stationary air 23 °C		$m \cdot s^{-2}$	100	≤ 300	≤ 300	≤ 300	≤ 300
Degree of protection 1)				IP 54A	IP 64K	IP 64K	IP 64K IP 64K
Thread			M 12 x 1.5	M 12 x 1.5	M 12 x 1.5	M 12 x 1.5	M 14 x 1.5
Corrosion-tested as per			DIN 50 018	DIN 50 018	DIN 50 021 2)	DIN 50 021 2)	DIN 50 021 2)
Plugs			Jetronic, Tin-plated pins	Compact 1, Tin-plated pins	Compact 1, Gold-plated pins	Compact 1.1, Tin-plated pins	Compact 1.1, Tin-plated pins
Tightening torque		Nm	25	18	18	25	20

1) With single-conductor sealing
2) Saline fog 384 h

Accessories

For 0 280 130 026

Designation	Part number
Connector	**1 237 000 036**

For 0 280 130 093, 0 281 002 170

Designation	For cable cross-section	Part number
Plug housing	–	**1 928 403 137**
Contact pins	0.5 ... 1.0 mm^2	**1 987 280 103**
	1.5 ... 2.5 mm^2	**1 987 280 105**
Individual gaskets	0.5 ... 1.0 mm^2	**1 987 280 106**
	1.5 ... 2.5 mm^2	**1 987 280 107**

For 0 281 002 209, 0 281 002 412

Designation	For cable cross-section	Part number
Plug housing	–	**1 928 403 874**
Contact pins	0.5 ... 1.0 mm^2	**1 928 498 060**
	1.5 ... 2.5 mm^2	**1 928 498 061**
Individual gaskets	0.5 ... 1.0 mm^2	**1 928 300 599**
	1.5 ... 2.5 mm^2	**1 928 300 600**

Temperature Sensor NTC M12

Temperature range: -30 … 130°C

A shockproof sensor for measurements under pressure up to 25 bar. Good thermal conductivity allows fast response temperature measurement. The integrated connector provides a low-cost connection for automotive applications.

General fields of application: oil-, fuel-, water temperature measurement.

Mechanical data	
Thread	M12 x 1,5
Tightening torque	25 Nm
Wrench size	19 mm
Weight	30 g

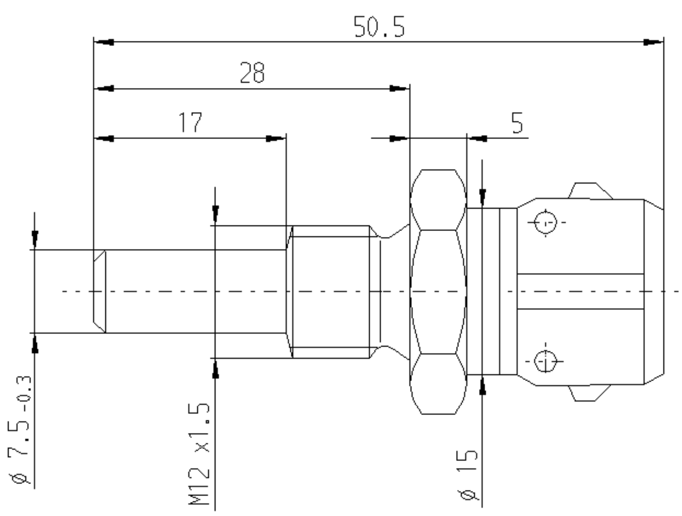
Conditions for use	
Temperature range	-30 … 130°C
Vibration	60 g/5 ... 250 Hz

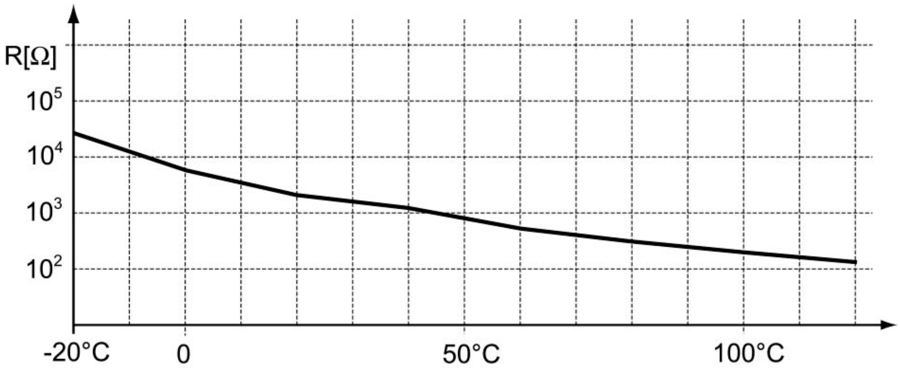
Chatacteristic
NTC 2,5 kΩ

Electronic data	
Nominal resistance	2,5 kΩ/20°C
Measuring range	-30 ... 130°C
Accuracy	± 1,5 K
Response time 90 %	< 10 s

Connector	
Cable harness connector	1 284 485 198

Order numbers	
1 284 485 198	**O 280 130 026**
KPSE 6E8-33P-DN	**B 261 209 160**
Offer drawing	**A 261 209 160**





°C	R(Ω)
-40	45 313
-35	34 281
-30	26 114
-25	20 003
-20	15 462
-15	12 002
-10	9 397
-5	7 415
0	5 896
5	4 712
10	3 792
15	3 069
20	2 500
25	2 057
30	1 707
35	1 412
40	1 175
45	987,6
50	833,9
55	702,8
60	595,5

°C	R(Ω)
65	508,3
70	435,7
75	374,2
80	322,5
85	279,6
90	243,2
95	212,7
100	186,6
105	163,8
110	144,2
115	127,3
120	112,7
125	100,2
130	89,30
135	79,65
140	71,20
145	63,86
150	57,41
155	51,82
160	46,88

BOSCH

Thermocouple Probe TCP-N / TCP-NF

Measuring range: -40 ... 1000°C

A flexible N-type thermocouple for measuring of exhaust-gas temperatures.

TCP-NF is used in FIA F3 since 2005.

Mechanical data	
Thread	M12 x 1
Tightening torque	15 Nm
Wrench size	17 mm
Length	630 mm
Weight	60 g

Conditions for use	
Vibration	80 g/5 ... 500 Hz
DIN EN 60584	
Temperature range	-40 ... 115°C

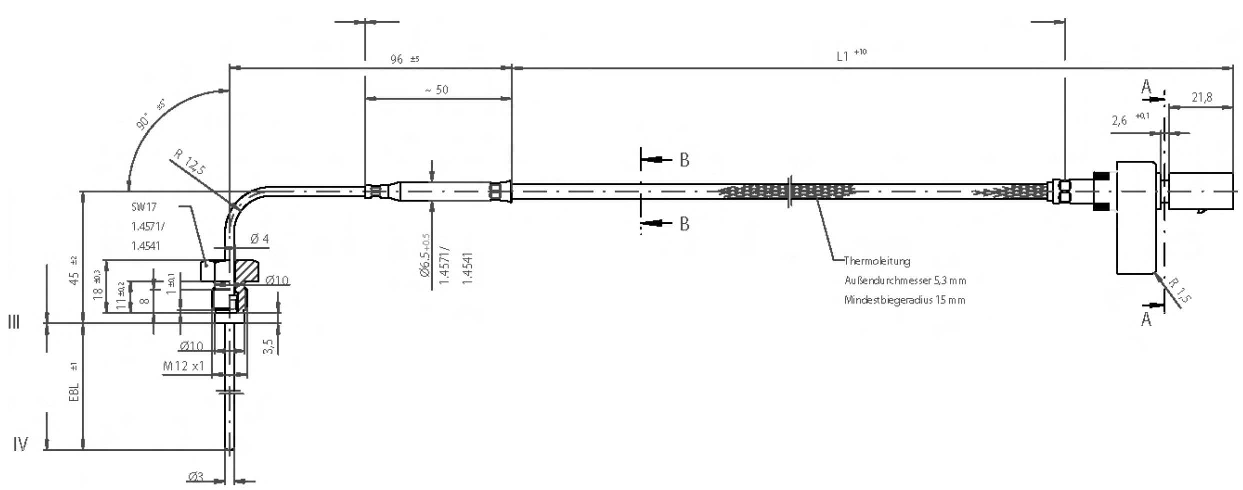
Characteristic	
DIN IEC 584	

Electronic data	
Power supply	12 V
Full scale output	0,5 ... 4,5 V
Thermocouple	NiCrSi-NiSi
Measuring range	-40 ... 1100°C
Response time:	
TCP-N	20 s
TCP-NF	33 s

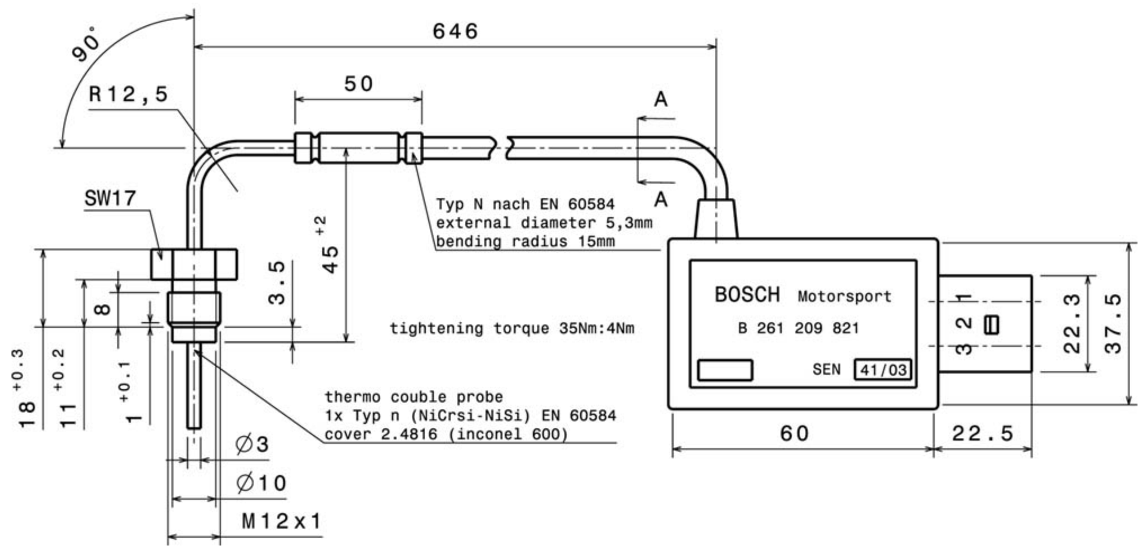
Connector	
TCP-N	1-J0973-70
TCP-NF	D 261 205 357

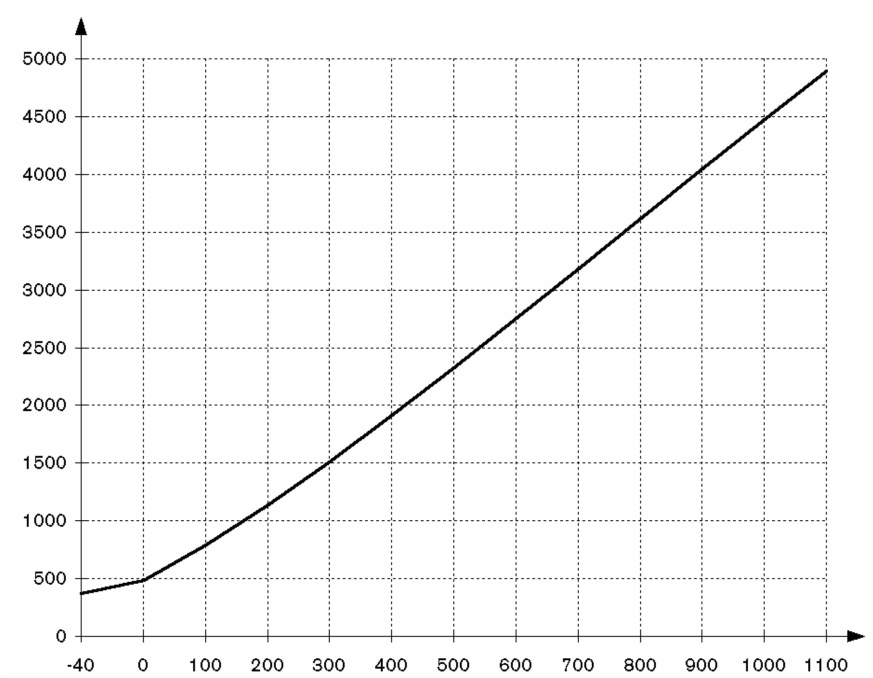
Order numbers	
TCP-N	**B 261 209 387**
Offer drawing	A 261 209 387
TCP-NF	**B 261 209 821**
Offer drawing	A 261 209 821

Design TCP-N



Design TCP-NF





Input °C	Output mV
-40	372
0	485
100	790
200	1135
300	1513
400	1912
500	2327

Input °C	Output mV
600	2752
700	3183
800	3615
900	4046
1000	4473
1100	4845

THROTTLE POSITION SENSORS

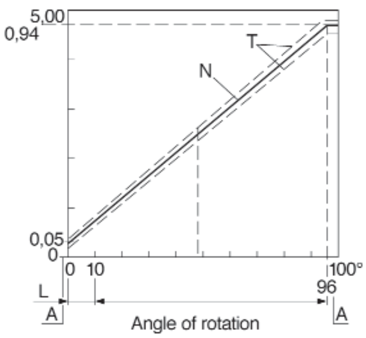
Purpose and Function.
Modern engine management systems require detailed information about throttle position and rate of change. As many vehicle systems are influenced by throttle activity including fuelling requirements, transmission control strategy and accessories such as air conditioning accurate data is essential, a simple switch cannot provide this detail.
The sensors described below are full range sensors capable of operating in clockwise or anti-clockwise directions and are compact for fitment in restricted spaces.
For more detailed information about these products refer to our website **www.bosch.com.au**

THROTTLE POSITION SENSOR TECHNICAL DATA

Part Number	Electrical Measurement Range	Operating Voltage	Connector	Drive Type	Direction of Rotation	Max. Circuit Current	Figure
0 280 122 001	< 86°	5.0	1 237 000 039	"D"	Optional	< 18 uA	A
0 261 211 003	< 93°	5.0	Non-Bosch	Dual "V"	C/Clockwise	< 10 mA	B
0 261 211 004	< 93°	5.0	Non-Bosch	Dual "V"	Clockwise	< 10 mA	B

Details of sensor 0 280 122 001 (fig. A)

Characteristic curve 1.
A Internal stop, L Positional tolerance of the wiper when fitted, N Nominal characteristic curve, T Tolerance limit.



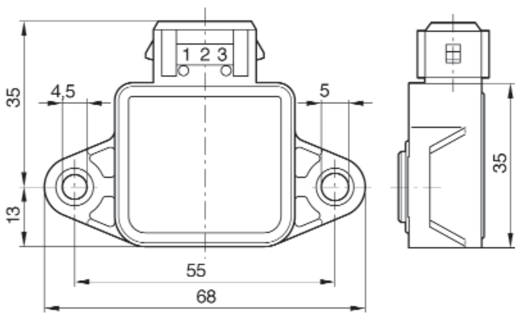
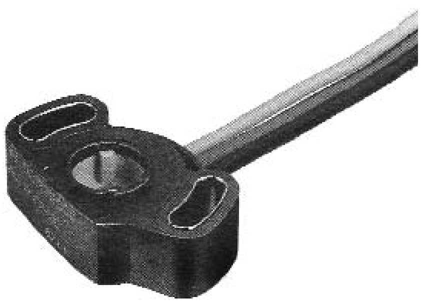


Image of sensor 0 261 211 003 / 4 (fig. B)



Throttle-valve angular-position sensor

Measurement of angles up to 88°

φ / R

- Potentiometic angular-position sensor with linear characteristic curve.
- Sturdy construction for extreme loading.
- Very compact.

Application
These sensors are used in automotive applications for measuring the angle of rotation of the throttle valve. Since these sensors are directly attached to the throttle-valve housing at the end of the throttle-shaft extension, they are subject to extremely hostile underhood operating conditions. To remain fully operational, they must be resistant to fuels, oils, saline fog, and industrial climate.

Design and function
The throttle-valve angular-position sensor is a potentiometric sensor with a linear characteristic curve. In electronic fuel injection (EFI) engines it generates a voltage ratio which is proportional to the throttle valve's angle of rotation. The sensor's rotor is attached to the throttle-valve shaft, and when the throttle valve moves, the sensor's special wipers move over their resistance tracks so that the throttle's angular position is transformed into a voltage ratio. The throttle-valve angular-position sensor's are not provided with return springs.

Design
The position sensor 0 280 122 001 has one linear characteristic curve.
The position sensor 0 280 122 201 has two linear characteristic curves.
This permits particularly good resolution in the angular range 0°...23°.

Explanation of symbols
U_A Output voltage
U_V Supply voltage
φ Angle of rotation
U_{A2} Output voltage, characteristic curve 2
U_{A3} Output voltage, characteristic curve 3

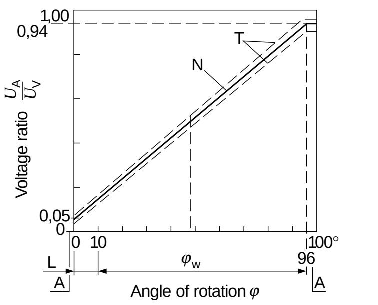
Accessories for 0 280 122 001

Connector	**1 237 000 039**

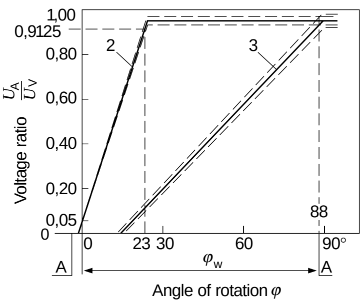
Accessories for 0 280 122 201

Plug housing	**1 284 485 118**
Receptacles, 5 per pack, Qty. required: 4	**1 284 477 121**
Protective cap, 5 per pack, Qty. required: 1	**1 280 703 023**

Characteristic curve 1.
A Internal stop, L Positional tolerance of the wiper when fitted, N Nominal characteristic curve, T Tolerance limit,
φ_W Electrically usable angular range.



Characteristic curves 2 and 3.
A Internal stop,
φ_W Electrically usable angular range.



Technical data / Range

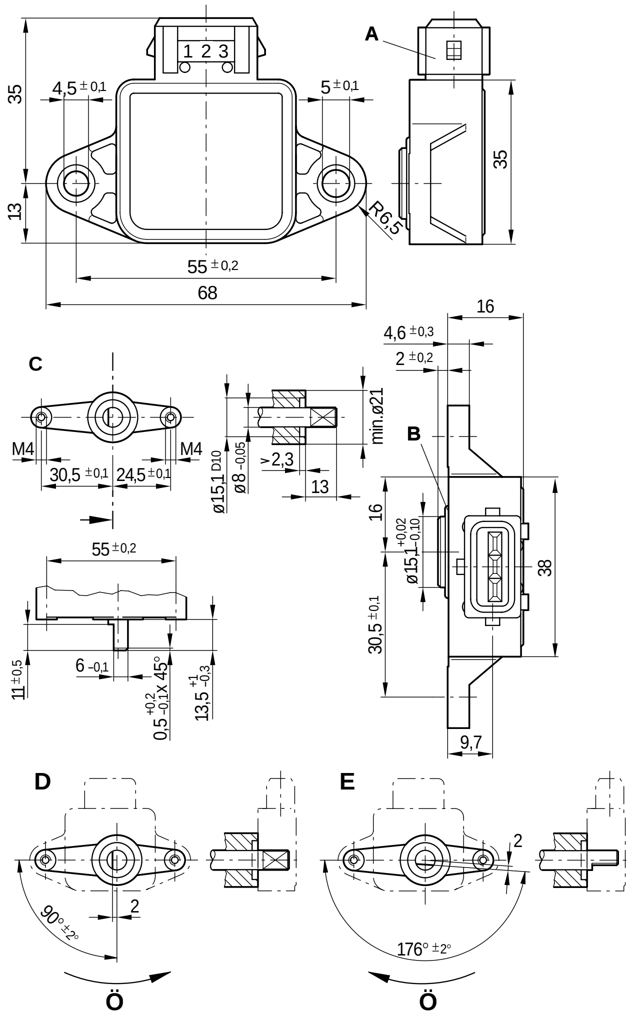
Part number		**0 280 122 001**	**0 280 122 201**
Diagram		1; 2	3
Useful electrical angular range	Degree	≤ 86	≤ 88
Useful mechanical angular range	Degree	≤ 86	≤ 92
Angle between the internal stops (must not be contacted when sensor installed)	Degree	≥ 95	–
Direction of rotation		Optional	Counterclockwise
Total resistance (Terms. 1–2)	kΩ	2 ±20 %	–
Wiper protective resistor (wiper in zero setting, Terms. 2–3)	Ω	710...1380	–
Operating voltage U_V	V	5	5
Electrical loading		Ohmic resistance	Ohmic resistance
Permissible wiper current	µA	≤ 18	≤ 20
Voltage ratio from stop to stop Chara. curve 1		$0.04 \le U_A/U_V \le 0.96$	–
Voltage ratio in area 0...88 °C Chara. curve 2		–	$0.05 \le U_{A2}/U_V \le 0.985$
Chara. curve 3		–	$0.05 \le U_{A3}/U_V \le 0.970$
Slope of the nominal characteristic curve	deg^{-1}	0.00927	–
Operating temperature	°C	–40...+130	–40...+85
Guide value for permissible vibration acceleration	$m \cdot s^{-2}$	≤ 700	≤ 300
Service life (operating cycles)	Mio	2	1.2

Dimension drawings.

A Plug-in connection,
B O-ring 14.65 x 2 mm,
C Fixing dimensions for throttle-valve housing, **D** Clockwise rotation [1]),
E Counterclockwise rotation [1]), **Ö** Direction of throttle-valve opening.
[1]) Throttle valve in idle setting.

F O-ring 16.5 x 2.5 mm, **G** 2 ribs, 2.5 mm thick,
H Plug-in connection, **I** Blade terminal,
K This mounting position is only permissible when the throttle-valve shaft is sealed against oil, gasoline, etc., **Ö** Direction of throttle-valve opening,
L Fixing dimensions for throttle-valve potentiometer.

0 280 122 001



0 280 122 201

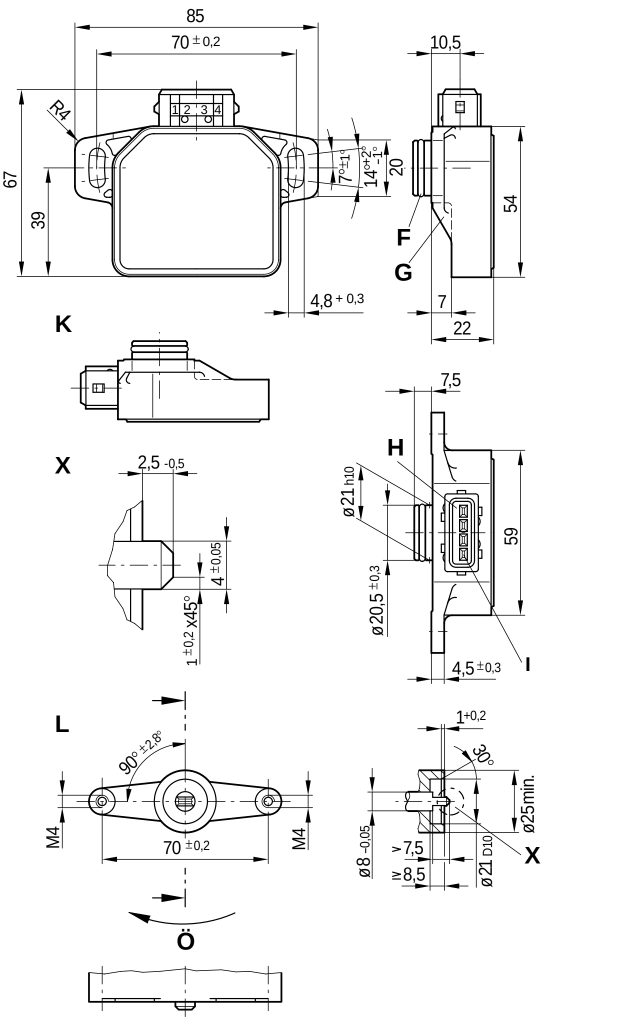


Diagram 1.

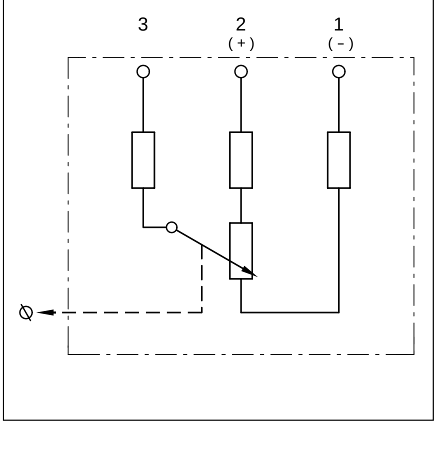


Diagram 2.

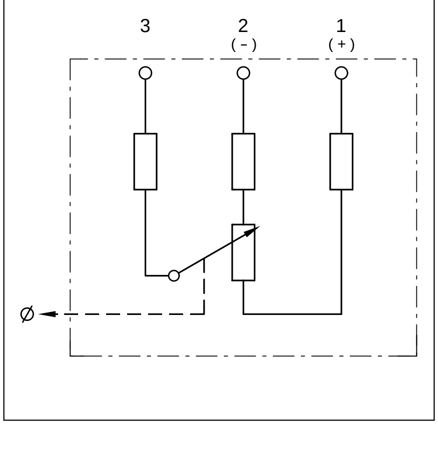
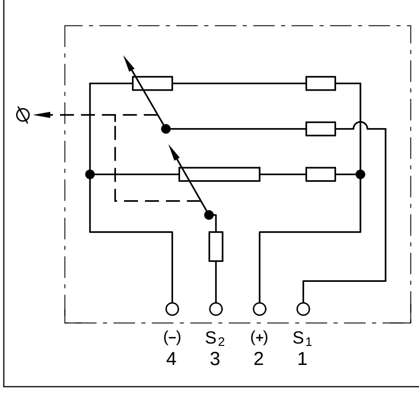


Diagram 3.
Throttle valve in idle setting.



Yaw sensor (gyrometer)

with micromechanical acceleration sensor

Ω / *U*

- Compact system design with highly integrated electronics.
- Insensitive to mechanical or electrical interference.
- Simultaneous measurement of yaw rate and acceleration vertical to the rotary axis.
- Extensive yaw-rate measuring range from 0.2...100 degrees per second (corresponds to 2...1,000 rotations per hour).
- Capacitive measuring concept.

Design
The complete unit is comprised of a yaw sensor and an acceleration sensor, together with evaluation electronics. These components are all mounted on a hybrid and hermetically sealed in a metal housing.

Application
This sensor is used in automotive engineering for the vehicle dynamics control (Electronic Stability Program, ESP) and measures the vehicle's rotation around its vertical axis, while at the same time measuring the acceleration at right angles to the driving direction. By electronically ervaluating the measured values, the sensor is able to differentiate between normal cornering and vehicle skidding movements.

Operating principle
Two oscillatory masses each have a conductor attached through which alternating current (AC) flows. Since both of the masses are located in a constant magnetic field, they are each subjected to an electrodynamic force which causes them to oscillate. If the masses are also subjected to a rotational movement, Coriolis forces are also generated. The resulting Coriolis acceleration is a measure for the yaw rate.The linear acceleration values are registered by a separate sensor element.

Installation information
– Installation near to the vehicle's center of gravity
– Max. reference-axis deviation transverse to the direction of movement ±3°
– Refer to sketch on Page 9
– Tightening torque for fastening screws: 6 +2/–1 Nm.

Explanation of symbols
Ω Yaw rate
g Acceleration due to gravity 9.8065 m · s^{-2}
a_q Linear (transverse) acceleration

Technical data / Range

Part number	**0 265 005 258**
Yaw sensor	DRS-MM1.0R
Maximum yaw rate $\Omega_{max.}$ about the rotary axis (Z-axis)	±100°/s
Minimum resolution ΔΩ	±0.2°/s
Sensitivity	18 mV/°/s
Change of sensitivity	≤ 5%
Offset yaw rate	2°/s [1])
Change of offset	≤ 4°/s
Non-linearity, max. deviation from best linear approximation	≤ 1% FSO
Ready time	≤ 1 s
Dynamic response	≥ 30 Hz
Electrical noise (measured with 100 Hz bandwidth)	≤ 5 mV_{rms}
Linear acceleration sensor	
Maximum acceleration a_{qmax}	±1.8 g
Sensitivity	1000 mV/g
Change of sensitivity	≤ 5%
Offset	0 g [1])
Change of offset	≤ 0,06 g
Non-linearity, max. deviation from best linear approximation	≤ 3% FSO
Ready time	≤ 1.0 s
Dynamic response	≥ 30 Hz
Electrical noise (measured with 100 Hz bandwidth)	≤ 5 mV_{rms}
General data	
Operating-temperature range	–30...+85 °C
Storage-temperature range	–20...+50 °C
Supply voltage	12 V nominal
Supply-voltage range	8.2...16 V
Current consumption at 12 V	< 70 mA
Reference voltage	2.5 V ±50 mV [1])

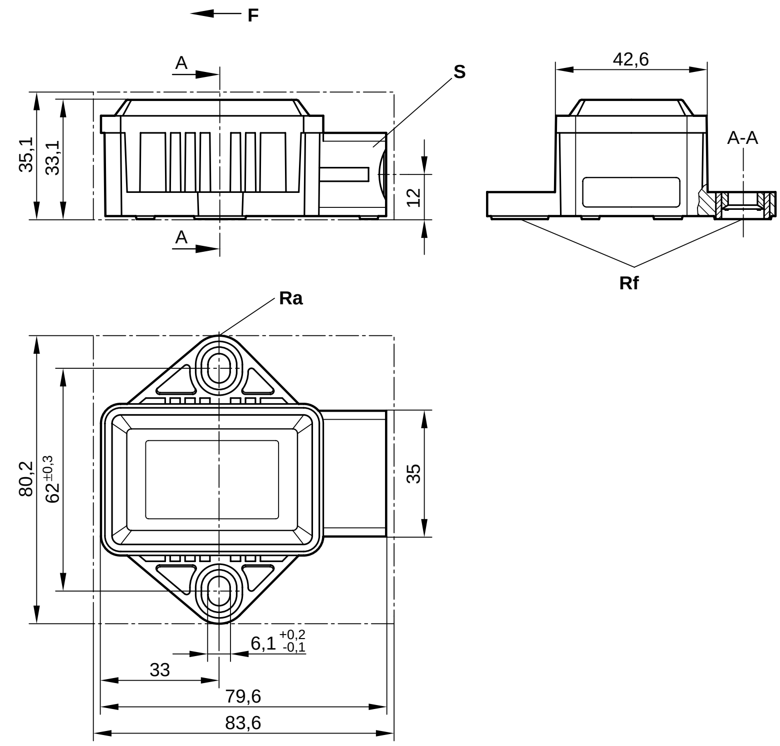
[1]) Zero point is 2.5 V (reference).

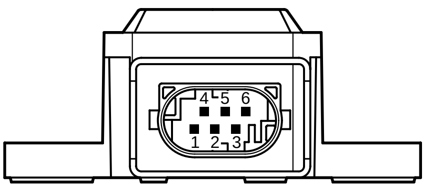
Accessories [2])

Plug housing	–	Qty. required: 1	AMP-No:	**1-967 616-1**
Contact pins	for 0.75 mm²	Qty. required: 6	AMP-No:	**965 907-1**
Gaskets	for Ø 1.4...1.9 mm²	Qty. required: 6	AMP-No:	**967 067-1**

[2]) To be obtained from AMP Deutschland GmbH, D-63225 Langen,
Tel. 0 61 03/7 09-0, Fax 0 61 03/7 09-12 23, E-Mail: AMP.Kontakt@tycoelectronics.com

Dimension drawings.
F Forward driving direction
S 6-pole plug
Ra Reference axis
Rf Reference surface
$\mathbf{a_c}$ Acceleration direction



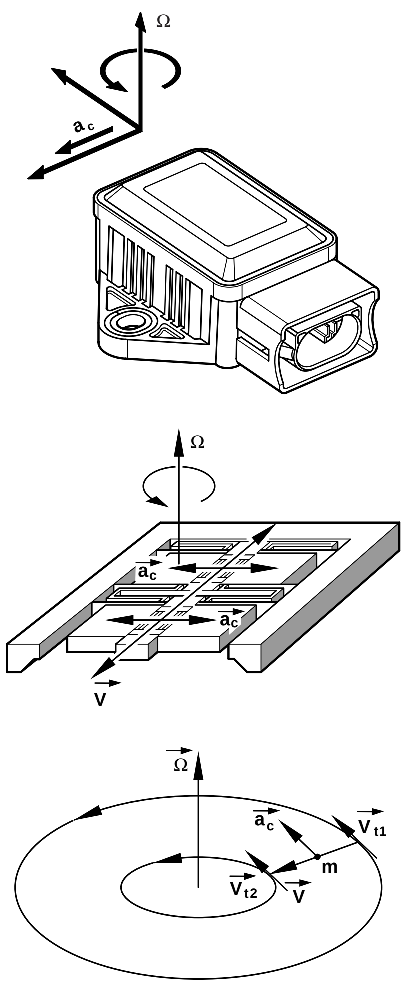


Connector-pin assignment
Pin 1 Reference
Pin 2 BITE
Pin 3 12 V
Pin 4 Out: Yaw-rate sensor
Pin 5 Out: Acceleration sensor
Pin 6 Ground

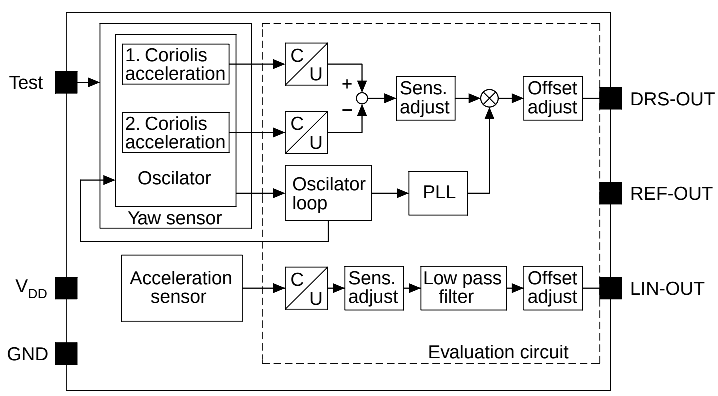
Operating principle.
$\vec{a}_c$ Coriolis acceleration
$\vec{V}$ Speed of oscillation
$\vec{\Omega}$ Angular velocity

$\vec{a}_c = 2\vec{V} \times \vec{\Omega}$

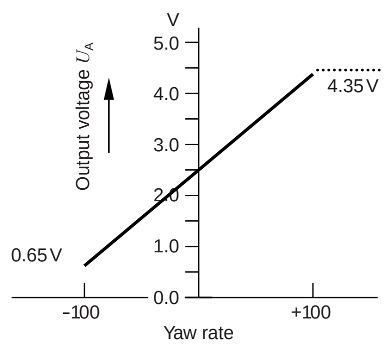
Deviation of $\vec{\Omega}$-axis to reference surface ±3°



Block diagram.

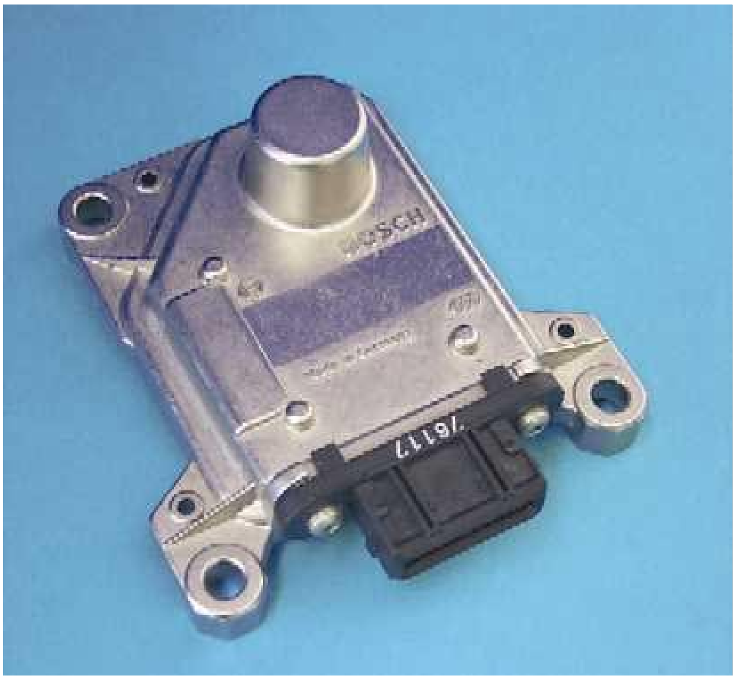


Characteristic curve.



Yaw Rate Sensor YRS

The principle of the angular rate sensor is based on a vibrating cylinder-gyrometer. A metal cylinder is excited to an amplitude controlled resonance vibration. Occuring nodes are displaced by the impact of a coriolis force. This displacement is shifted back to its “zero” position by a closed loop control. The required measure to do so is a measure for the applied angular rate.



Mechanical data

Measuring range	100°/s
Overload	300°/s
Weight	210 g

Conditions for use

Temperature range	-30 … +85°C
Shock	300 g

Connector

Cable harness connector	1 284 485 232

Electrical data

Supply voltage	8,2 … 16 V
Current consumption	<40 mA
Power consumption	0,7 W
Output range	0,6 … 4,4 V
Reference voltage	2,5 V
Voltage range	1,8 V
Electrical noise	<0,25°s/0,1 … 100 Hz
Sensitivity	18 mVs/° [-100 … +100°/s]

Order number

	0 265 005 206
Offer drawing	A 265 466 074

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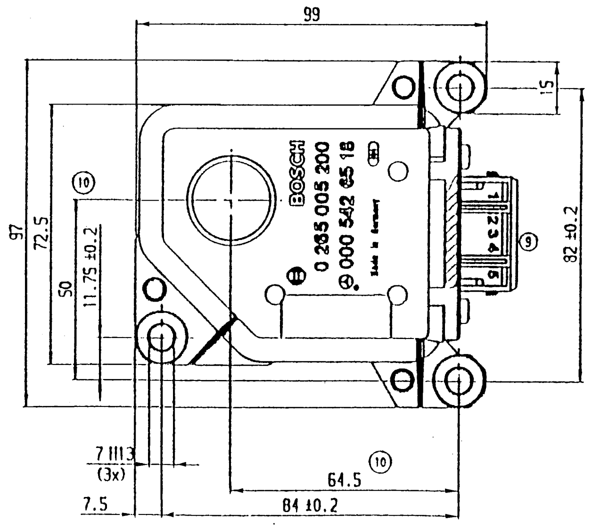
Design

Example drawing



BOSCH

Absolute Pressure Sensor PSP

Pressure range: 0,2 ... 3 bar nominal

An absolute pressure sensor modified for precision air pressure measurement.

Mechanical data	
Max. pressure	5 bar
Characteristic	20°C/2,5 kΩ
Fitting	∅ 11,8 mm
Weight	17 g
Sealing	O-ring

Conditions for use	
Temperature range	-40 ... 130°C
Max. vibration	4 g/20 ... 71 Hz
Max. temp. of location	130 °C

Characteristic	
Sensitivity	1517 mV/bar
Offset	96 mV

Electronic data	
Power supply	5 V
Compensated range	-40 ... 125°C
Non linearity	0,25 %
Therm. zero point drift	< 0,5 %
Therm. sensitivity drift	< 0,5 %
Long time drift	< 0,5 %
Full scale output	0,4 ... 4,65 V

Order number	
ASL 6-06-05PC-HE	**B 261 209 690**
Offer drawing	**A 261 260 139**