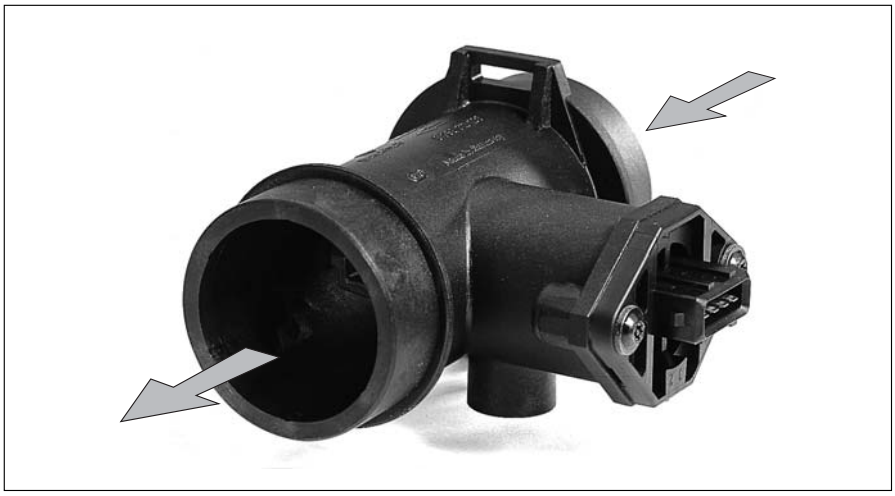
meeknet.co.uk/e64

Hot-film air-mass meter, type HFM 2

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

Q_m / U

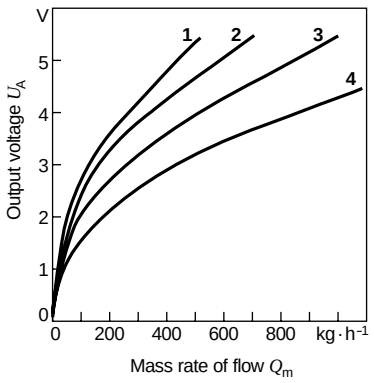
- Measurement of air mass (gas mass) throughflow per unit of time, independent of density and temperature.
- Extensive measuring range.
- Highly sensitive, particularly for small changes in flow rate.
- Wear-free since there are no moving parts.
- Insensitive to dirt and contamination.



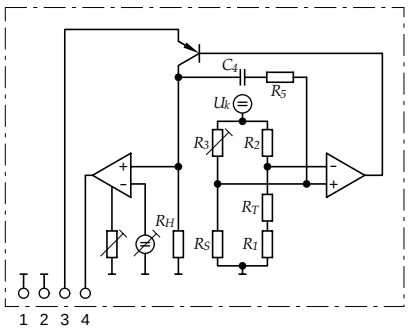
Application
Measurement of air-mass flow rate to provide data needed for clean combustion. Air-mass meters are suitable for use with other gaseous mediums.

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.

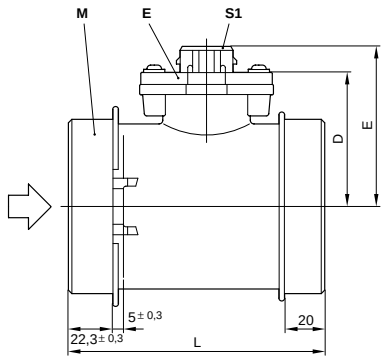


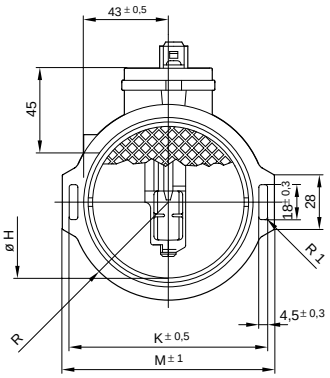
Technical data / Range

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 · 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 · 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 · s⁻²	150	150	150	150

[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.

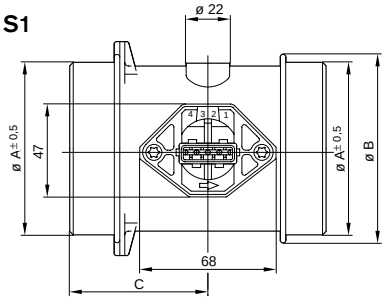
Dimension drawings.
E Plug-in sensor, **M** Measurement venturi, S1/S2 Plug connection



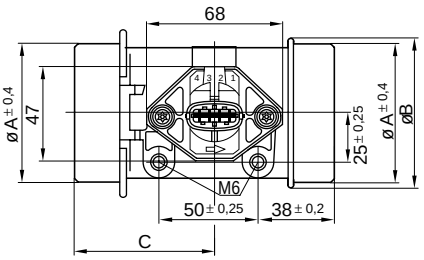


Ø A	Ø B	C	D	E	H	K	L	M	R	Measure-ment venturi	Plug-in connection	Part number
60	66	70	73	86	33	75	130	82	37	KS	S1	**0 280 217 102**
70	76	50	69	82	34.8	–	96	–	42	KS	S1	**0 280 217 107**
70	76	70	69	82	33.5	85	130	92	42	KS	S2	**0 280 217 120**
80	86	70	73	86	39	–	130	–	–	KS	S2	**0 280 217 519**
95.6	102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

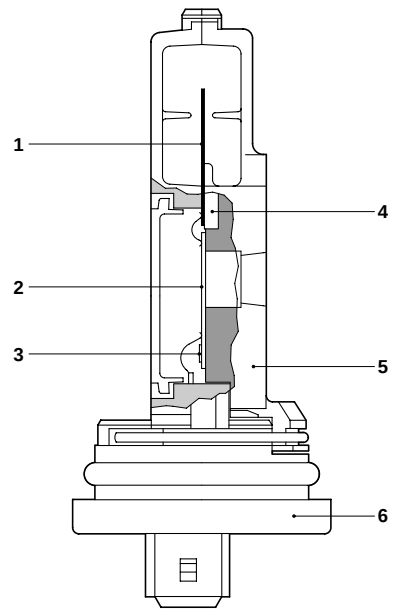
S1



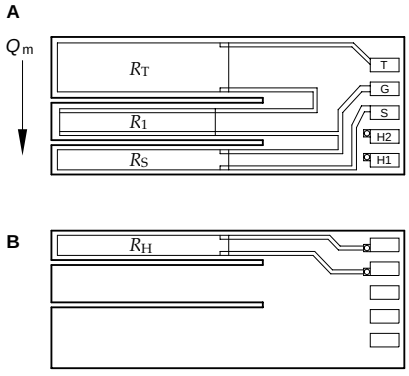
S2



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.

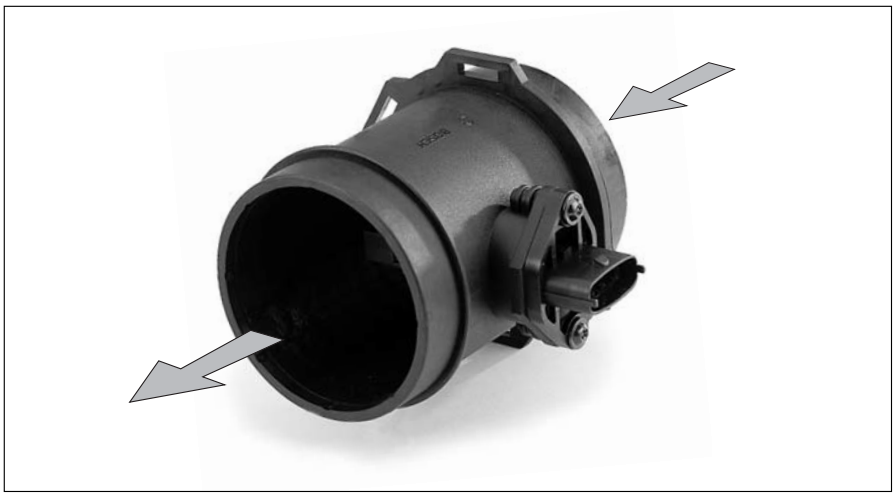
Note
For automotive applications, original AMP crimping tools must be used.

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.

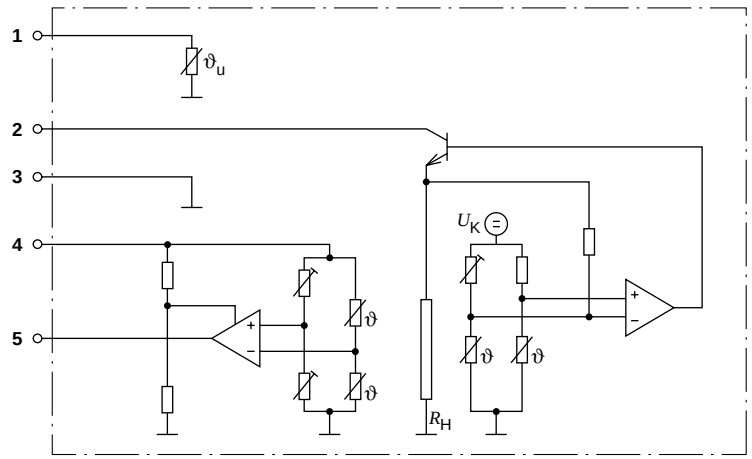
Application

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.

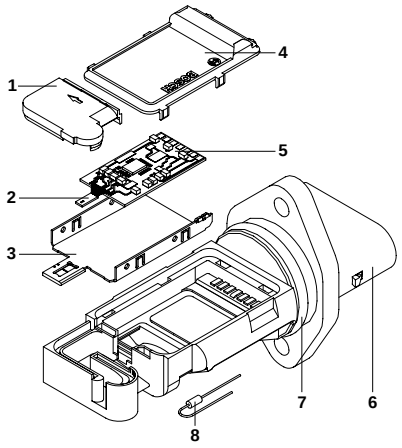
Explanation of symbols

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



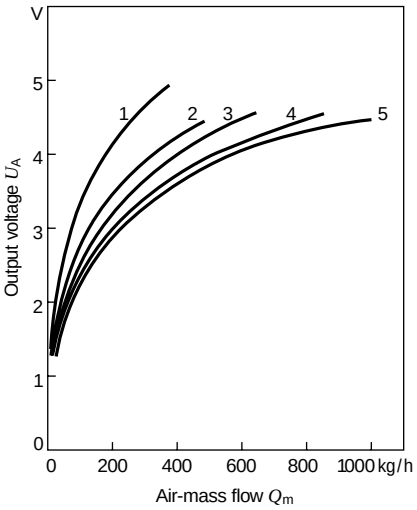
HFM 5 plug-in sensor design.
1 Measuring-passage cover, **2** Sensor,
3 Mounting plate, **4** Hybrid-circuit cover,
5 Hybrid, **6** Plug-in sensor, **7** O-ring,
8 Auxiliary temperature sensor.



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

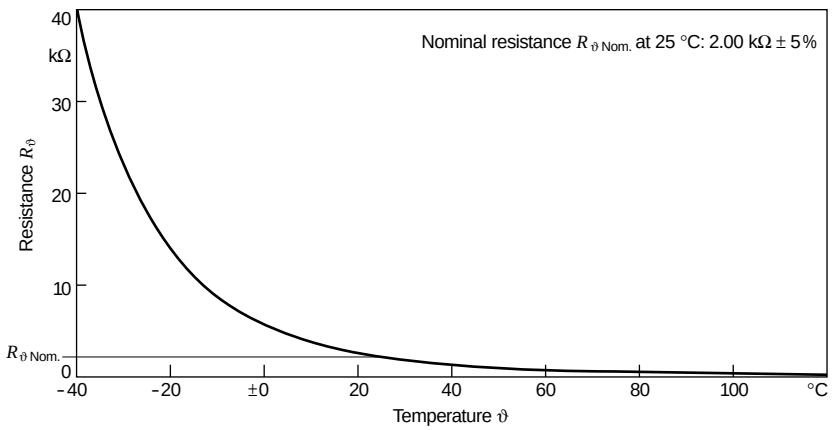
Air-mass meter output voltage.



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.