

AMS 4710

Miniaturized pressure transmitter with analog 0 ... 10 V output

FEATURES

- Amplified, calibrated and temperature compensated pressure sensor with 0 ... 10 V output voltage
- Variants for differential / gage, bidirectional differential, absolute and barometric pressure
- Wide variety of pressure ranges: 5 mbar up to 2 bar full scale pressure
- Piezoresistive sensing principle
- High precision digital signal conditioning
- Typical total accuracy < 0.5 %FSO at room temperature for standard pressure ranges
- Typical TEB < 0.7 %FSO (-25 ... 85 °C) for standard pressure ranges
- Wide supply voltage range: 12 ... 36 V
- Integrated circuit protection against reverse polarity, current limited output
- Compact and robust package
- Dust-and water-tight (IP67)
- M5 circular sensor connector
- Compact size (35 mm x 25 mm x 13.5 mm)
- Ready to use, simple and quick installation
- RoHS and REACH compliant

TYPICAL APPLICATIONS

- Static pressure sensing
- Dynamic pressure sensing
- Barometric pressure sensing
- Vacuum measurement
- Level measurement
- Gas flow measurement
- Heating, Ventilation and Air Conditioning (HVAC)
- Medical Instrumentation

GENERAL DESCRIPTION

AMS 4710 is a series of ready-to-use, miniaturized pressure transmitters suitable for industrial and medical applications. The matchbox-sized pressure transmitters are calibrated and temperature compensated in a wide temperature range of -25 ... 85 °C and allow precise pressure measurements with high long term stability.

AMS 4710 features a large supply voltage range of 12 ... 36 V, reverse polarity protection ($V_s - GND$) and a current limited 0 ... 10 V voltage output. It comes in a robust plastic package, which is dust- and water-tight conforming to IP67.

Pressure is either applied through two barbed side ports for differential (relative) or bidirectional differential pressure transmitter types or through a single port for absolute or barometric types. The electrical connection is realized with an M5 circular sensor connector.

The pressure transmitters in the AMS 4710 series are available for all pressure types and various pressure ranges: differential pressure sensors (also for relative/gage measurements) in pressure ranges from 0 ... 5 mbar up to 0 ... 2 bar, absolute pressure sensors for 0 ... 1 bar and 0 ... 2 bar as well as a barometric sensor for 0.7 ... 1.2 bar. Bidirectional differential sensors are available from -5 ... 5 mbar up to -1 ... 1 bar for the measurement of positive and negative differential pressure.

Custom pressure ranges or modifications are available on request.



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March 2020 - Rev. 1.0, preliminary

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PRESSURE RANGES

| Pressure transmitter type (code) | Pressure type | Pressure range in mbar | Burst pressure ¹⁾ in bar | Pressure range in PSI | Burst pressure ¹⁾ in PSI |
|----------------------------------|----------------------------|------------------------|-------------------------------------|-----------------------|-------------------------------------|
| Ultra low pressure ranges | | | | | |
| AMS 4710-0005-D | differential / relative | 0 ... +5 | > 0.2 | 0 ... 0.073 | > 3 |
| AMS 4710-0010-D | differential / relative | 0 ... 10 | > 0.2 | 0 ... 0.145 | > 3 |
| AMS 4710-0005-D-B | bidirectional differential | -5 ... +5 | > 0.2 | -0.073 ... +0.073 | > 3 |
| AMS 4710-0010-D-B | bidirectional differential | -10 ... +10 | > 0.2 | -0.145 ... +0.145 | > 3 |
| Low pressure ranges | | | | | |
| AMS 4710-0020-D | differential / relative | 0 ... 20 | > 0.4 | 0 ... 0.290 | > 6 |
| AMS 4710-0050-D | differential / relative | 0 ... 50 | > 1 | 0 ... 0.725 | > 15 |
| AMS 4710-0100-D | differential / relative | 0 ... 100 | > 1 | 0 ... 1.450 | > 15 |
| AMS 4710-0020-D-B | bidirectional differential | -20 ... +20 | > 0.4 | -0.290 ... +0.290 | > 6 |
| AMS 4710-0050-D-B | bidirectional differential | -50 ... +50 | > 1 | -0.725 ... +0.725 | > 15 |
| AMS 4710-0100-D-B | bidirectional differential | -100 ... +100 | > 1 | -1.450 ... +1.450 | > 15 |
| Standard pressure ranges | | | | | |
| AMS 4710-0200-D | differential / relative | 0 ... 200 | > 5 | 0 ... 2.901 | > 72 |
| AMS 4710-0350-D | differential / relative | 0 ... 350 | > 5 | 0 ... 5.076 | > 72 |
| AMS 4710-0500-D | differential / relative | 0 ... 500 | > 5 | 0 ... 7.251 | > 72 |
| AMS 4710-1000-D | differential / relative | 0 ... 1000 | > 5 | 0 ... 14.50 | > 72 |
| AMS 4710-2000-D | differential / relative | 0 ... 2000 | > 5 | 0 ... 29.01 | > 72 |
| AMS 4710-0200-D-B | bidirectional differential | -200 ... +200 | > 5 | -2.901 ... +2.901 | > 72 |
| AMS 4710-0350-D-B | bidirectional differential | -350 ... +350 | > 5 | -5.076 ... +5.076 | > 72 |
| AMS 4710-1000-D-B | bidirectional differential | -1000 ... +1000 | > 5 | -14.50 ... +14.50 | > 72 |
| AMS 4710-1000-A | absolute | 0 ... 1000 | > 5 | 0 ... 14.50 | > 72 |
| AMS 4710-2000-A | absolute | 0 ... 2000 | > 5 | 0 ... 29.010 | > 72 |
| AMS 4710-1200-B | barometric | 700 ... 1200 | > 5 | 10.15 ... 17.40 | > 72 |

Table 1: AMS 4710 standard pressure ranges (other ranges on request)

Notes:

- 1) Burst pressure is defined as the maximum pressure, which can be applied to one pressure port relative to the other port (or while only one pressure port is connected) without causing damages / leaks.

MAXIMUM RATINGS

| Parameter | Minimum | Typical | Maximum | Units |
|--|---------|---------|---------|-------|
| Absolute maximum supply voltage: V_{max} | | | 36 | V |
| Operating and storage temperature: T | -25 | | 85 | °C |
| Common mode pressure: $p_{CM}^{1)}$ | | | 5 | bar |

Table 2: Maximum ratings

Notes:

- 1) Common mode pressure is defined as the maximum pressure, which can be applied simultaneously on both pressure ports of a differential or bidirectional pressure sensor module without causing damages, while no differential pressure is applied.

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SPECIFICATIONS

All parameters apply to $V_S = 24\text{ V}$, $T_{op} = 25\text{ °C}$, $R_L = 10\text{ k}\Omega$ and $p_{CM} = 0\text{ mbar}$, unless otherwise stated.

| Parameter | Minimum | Typical | Maximum | Units |
|--|------------------|-----------------------------|---------|-----------------|
| Analog output signal | | | | |
| @ specified minimum pressure (see "pressure ranges") ¹⁾ | 0 | < 0.025 | 0.05 | V |
| @ specified maximum pressure (see "pressure ranges") ¹⁾ | | 10 | | V |
| Full span output (FSO) ²⁾ | | 10 | | V |
| without pressure (only bidirectional differential types) | | 5 | | V |
| Total accuracy³⁾ @ $T_{op} = 25\text{ °C}$ | | | | |
| Ultra low pressure types (5, 10 mbar) | | ±1.0 | ±1.5 | %FSO |
| Low pressure types (20, 50, 100 mbar) | | ±0.5 | ±1.0 | %FSO |
| Standard pressure types (≥ 200 mbar) | | ±0.5 | ±1.0 | %FSO |
| TEB / Overall error⁴⁾ @ $T_{op} = -25 \dots 85\text{ °C}$ | | | | |
| Ultra low pressure types (5, 10 mbar) | | ±1.5 | ±2.5 | %FSO |
| Low pressure types (20, 50, 100 mbar) | | ±1.0 | ±2.0 | %FSO |
| Standard pressure types (≥ 200 mbar) | | ±0.7 | ±1.5 | %FSO |
| Long term stability | | | < 0.5 | %FSO/a |
| Nonlinearity ⁵⁾ | -0.3 | < 0.1 | 0.3 | %FSO |
| Resolution analog output signal | | | 0.05 | %FSO |
| Supply voltage (V_S to Ground) | 12 | 24 | 36 | V |
| Current consumption | | | 10 | mA |
| Response time (10% .. 90% rise time) | | 1 | 2 | ms |
| Load resistor R_L | 1 | | | kΩ |
| Capacitive load | | | 50 | nF |
| Dependency of V_{OUT} on V_S ⁶⁾ | | | < 0.1 | %FSO |
| Pressure changes | 10 ⁶⁾ | | | |
| Compensated operating temperature range | -25 | | 85 | °C |
| Weight without cable | | 20 | | gram |
| Dimensions (l x w x h, standard version without tubes) | | 35.0 x 25 x 13.5 | | mm ³ |
| Media compatibility | | See notes ^{7), 8)} | | |

Table 3: Specifications

SPECIFICATION NOTES:

- 1) Pressure ranges are specified in *Table 1*.
- 2) The Full Span Output (FSO) is the algebraic difference between the output signal at the specified minimum pressure and the output signal at the specified maximum pressure (nominal FSO = 10 V).
- 3) The total accuracy is defined as the maximum deviation of the measurement value from the ideal transfer function at room temperature (RT) in %FSO including the adjustment error (offset and span), nonlinearity, pressure hysteresis and repeatability. Nonlinearity is the measured deviation from the best fit straight line (BFSL) across the entire pressure range. Pressure hysteresis is the maximum deviation of the output value at any pressure within the specified range when the pressure is cycled to and from the specified minimum or maximum pressure. Repeatability is the maximum variation of the output value at any pressure within the specified range over 10 pressure cycles.
- 4) The overall error (also known as total error band, TEB) is defined as the maximum deviation of the measurement value from the ideal transfer function in %FSO across the entire temperature range (-25 ... 85 °C).

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- 5) Defined as best fit straight line (BFSL).
- 6) The given value is the maximum deviation from the output voltage at $V_S = 24\text{ V}$ over the complete supply voltage range at any pressure in the specified range. It is normalized to the FSO.
- 7) Media compatibility of pressure port 1 (for a description of port 1, see *Figure 3*): fluids and gases non-corrosive to PA66, ceramics, silicon, Pyrex and RTV silicone rubber.
- 8) Media compatibility of pressure port 2 (for a description of port 2, see *Figure 3*): clean, dry gases, non-corrosive to PA66, ceramics, silicon, RTV silicone rubber, gold and tin (alkaline or acidic liquids can destroy AMS 4710).

FUNCTIONAL DESCRIPTION

AMS 4710 pressure transmitters are based on piezoresistive pressure sensing technology. They combine a high quality piezoresistive silicon sensing element with a modern mixed-signal conditioning circuit, which are assembled together on a ceramic substrate and housed in a robust plastic package.

The physical pressure applied at the sensor's pressure ports is converted into a differential voltage signal at AMS 4710's piezoresistive pressure sensing element. This differential voltage is signal-conditioned and converted into a standardized 0 ... 10 V voltage output signal in the following way (see *Figure 1*):

The sensing element's differential voltage signal is amplified and compensated by a mixed-signal conditioning ASIC. At first the differential voltage is pre-amplified and converted into a digital signal using a 14-bit ADC. This digitized signal is mathematically processed by the ASIC's integrated microcontroller unit (μC) to obtain a calibrated and temperature compensated output signal. For this purpose the μC uses a correction algorithm and individual correction coefficients stored in the ASIC's EEPROM during AMS 4710's factory calibration process. The temperature value needed for temperature compensation is measured directly at the pressure sensing element. An 11-bit DAC unit converts the corrected digital signal back into an analog voltage signal. The following amplifier output stage generates a short circuit protected, standardized 0 ... 10 V output voltage signal V_{OUT} .

AMS 4710's output voltage V_{OUT} is independent of the applied supply voltage and a linear function of the applied pressure p^1 . It is given by:

$$V_{OUT}(p) = \frac{p - p_{min}}{p_{max} - p_{min}} \cdot 10\text{ V} \quad (1)$$

wherein p_{min} is the sensor's specified minimum pressure and p_{max} is the specified maximum pressure, given by the sensor's pressure range in *Table 1*.

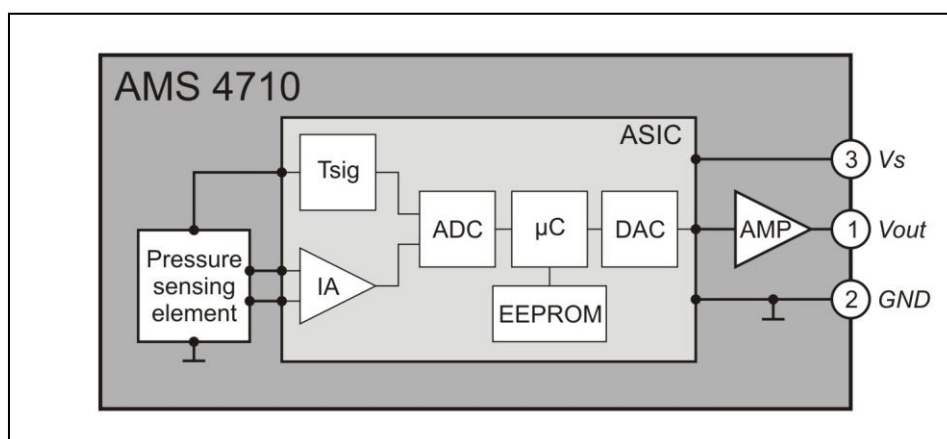


Figure 1: AMS 4710's block diagram

¹ The applied pressure p is the pressure difference between port 1 and 2 for differential and bidirectional differential pressure sensors. For relative pressure types it is the pressure difference between port 1 and ambient pressure and for absolute and barometric pressure types it is the pressure at port 2 (for the definition of ports see *Figure 3*).

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INITIAL OPERATION

AMS 4710's package can be screw mounted in a fast and easy way using the two through bores (\varnothing 3.2 mm) at the package's edges.

The electrical connection is established using the integrated M5 circular sensor connector (for pinout see *Figure 3*) and a suitable cable with female M5 sensor connector (see "additional equipment"). As shown in *Figure 2* pin 1 (Vs) is directly connected to the power supply's positive output and pin 4 (GND) is connected to GND. Pin 3 can be connected to a voltmeter directly to measure the output signal voltage V_{OUT} (referenced to GND) or a load resistor R_L can be connected between pin 3 and GND and V_{OUT} can be measured parallel to R_L ². Please take care that the power supply is set to a voltage in the range between 12 and 36 V and that it is able to source at least 10 mA (for $R_L \geq 10$ k Ω).

The pressure connection is made using the package's pressure ports (barbed hose connectors). Depending on the used pressure transmitter type and the type of measuring pressure one or two of the pressure ports have to be connected to the measuring media/volume. For the pressures at port 1 and port 2 (for definition of the ports see *Figure 3*) the following requirements have to be fulfilled, where p_1 is the pressure at port 1 and p_2 is the pressure at port 2:

for differential pressure (type AMS 4710-XXXX-D):

$$p_1 > p_2$$

for relative / gage pressure (type AMS 4710-XXXX-D):

$$p_1 > p_{ambient}, p_1 = \text{measuring pressure}$$

for bidirectional differential pressure (type AMS 4710-XXXX-D-B):

$$p_1 > p_2 \text{ or } p_1 < p_2 \text{ possible}$$

for absolute pressure (type AMS 4710-XXXX-A):

$$p_2 = \text{measuring pressure}$$

for barometric pressure (type AMS 4710-XXXX-B):

$$p_2 = \text{measuring pressure}$$

The maximum pressures (see *Table 1*) and the guidelines concerning media compatibility (specification notes 7) and 8)) have to be taken into account.

Once electrical and pressure connections are established, AMS 4710's package provides a dust-and water-tight protection and a maintenance-free lifetime.

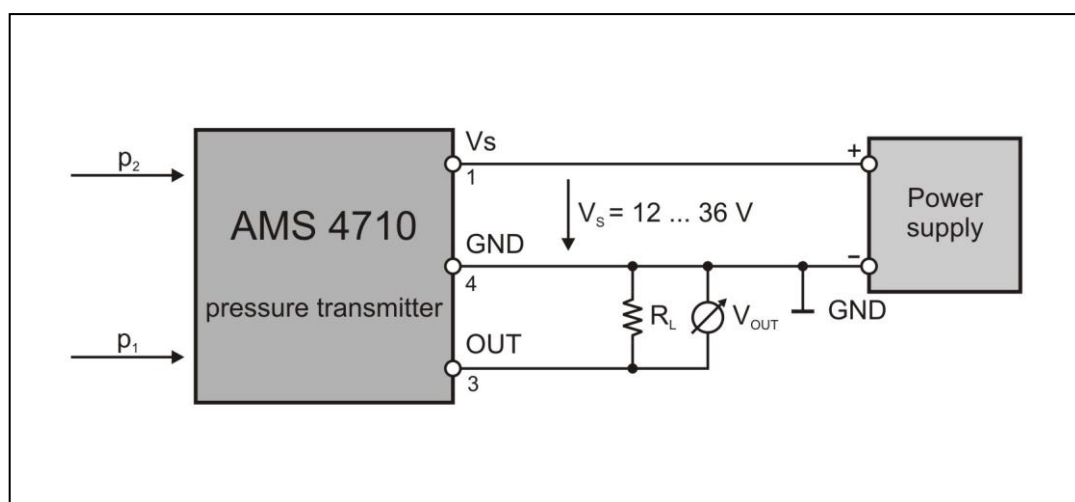


Figure 2: Electrical connection of AMS 4710

² Connecting pin 3 (OUT) to pin 1 (Vs) will permanently damage the sensor.

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DIMENSIONS AND PINOUT

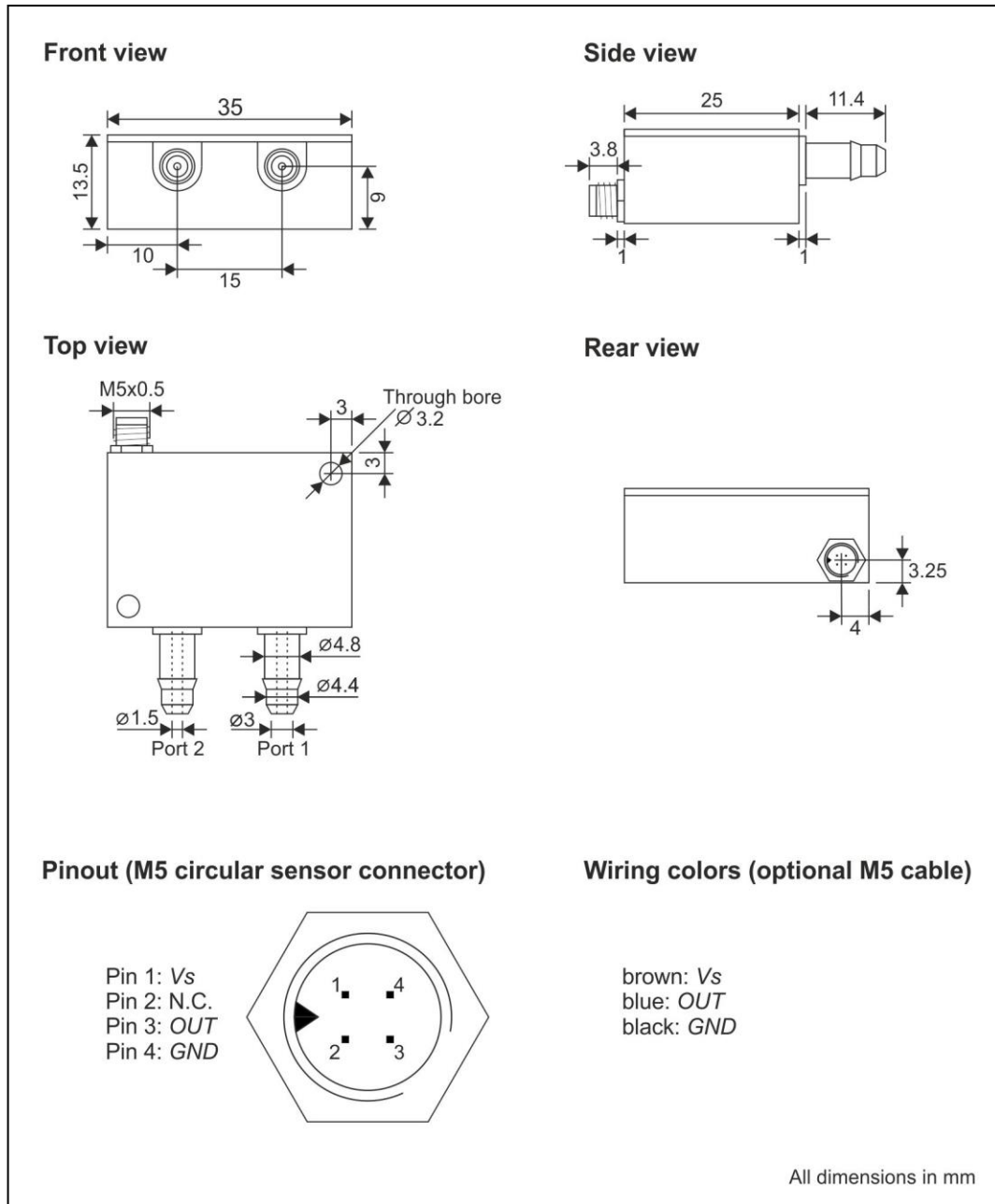


Figure 3: Dimensions and pinout of AMS 4710

Notes:

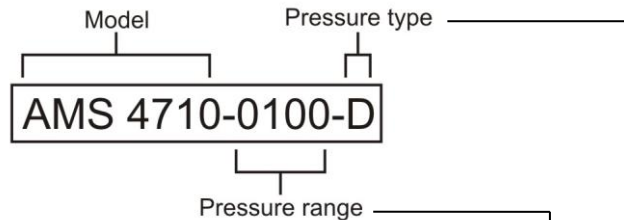
1. Absolute and barometric pressure types only have pressure port 2.
2. Package material is Zytel PA66.
3. The electrical connection is established using an M5 sensor connector series 707 from Binder GmbH.
4. For pressure connections Analog Microelectronics recommends a silicone tubing (inner diameter $\varnothing_{ID} = 3.2$ mm, outer diameter $\varnothing_{OD} = 6.4$ mm or $\varnothing_{ID} = 3$ mm, $\varnothing_{OD} = 7$ mm) or a soft PU tubing ($\varnothing_{ID} = 4$ mm, $\varnothing_{OD} = 6$ mm)
5. If silicone tubing is used it is recommended to use hose clamps.

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INFORMATION ON ORDERING

Example ordering code:



Pressure range:

| Pressure range code | Mbar | PSI | kPa |
|---------------------|------|-------|-----|
| 0005 | 5 | 0.073 | 0.5 |
| 0010 | 10 | 0.145 | 1 |
| 0020 | 20 | 0.290 | 2 |
| 0050 | 50 | 0.725 | 5 |
| 0100 | 100 | 1.450 | 10 |
| 0200 | 200 | 2.901 | 20 |
| 0350 | 350 | 5.076 | 35 |
| 0500 | 500 | 7.251 | 50 |
| 1000 | 1000 | 14.50 | 100 |
| 1200 | 1200 | 17.40 | 120 |
| 2000 | 2000 | 29.01 | 200 |

| Code | Pressure type | Available pressure ranges |
|------|--------------------------------|--|
| D | Differential / relative (gage) | 0 ... 5 mbar to 0 ... 2 bar |
| D-B | Bidirectional differential | -5 ... +5 mbar to -1000 ... +1000 mbar |
| A | Absolute | 0 ... 1000 mbar and 0 ... 2000 mbar |
| B | Barometric (absolute) | 700 ... 1200 mbar |

ADDITIONAL EQUIPMENT

| ORDER NUMBER | DELIVERY FORM |
|--------------------|---|
| M5-Cable | 3-wire cable with mating M5 sensor connector (2 m long) wiring: brown – Vs, blue – OUT, black – GND |
| PU-tubing-4-6 | matching soft PU-tubing (please order in m) |
| Silicon tubing-3-6 | matching silicon tubing (please order in m) |

Table 4: Additional Equipment

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NOTES

Analog Microelectronics GmbH reserves the right to amend any dimensions, technical data or other information contained herein without prior notification.