

# AMS 2712

## PCB pressure sensor module with 4 .. 20 mA current output

### FEATURES

- Universal pressure sensor module with two-wire 4 .. 20 mA current-loop output
- Fully calibrated and temperature compensated sensor module
- Differential / gage, bidirectional differential, absolute and barometric versions
- Wide variety of pressure ranges: 5 mbar up to 2 bar
- Piezoresistive sensing principle
- High precision digital signal conditioning
- Accuracy < 0.5 %FSO @ room temperature for standard pressure ranges
- Overall error < 1 %FSO within -25 .. +85 °C for standard pressure ranges
- Supply voltage range: 8 .. 36 V
- Integrated circuit protection against reverse polarity, current limitation
- Different product versions with solder pads, terminal block or DIL pins
- Ready for packaging or integration in other assemblies
- Compact size (30 mm x 27.5 mm x 14.3 mm)
- 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)

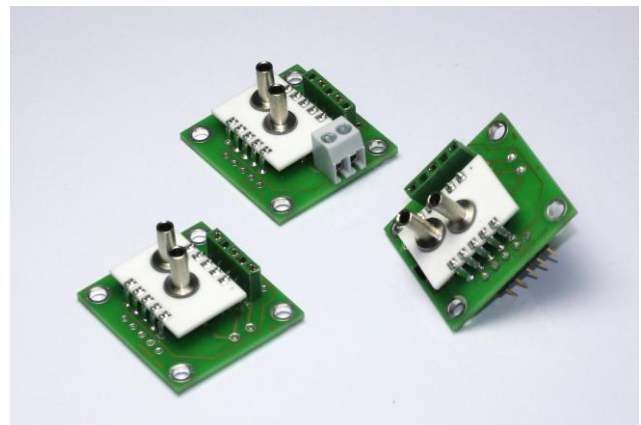
### GENERAL DESCRIPTION

AMS 2712 is a series of compact OEM pressure sensor modules with 4 .. 20 mA current-loop output in various pressure ranges. The sensor modules are calibrated and temperature compensated and allow precise pressure measurements in a wide temperature range of -25 .. 85 °C.

With its large supply voltage range of 8 .. 36 V and the rugged, reverse polarity and short circuit protected current-loop output the AMS 2712 are especially suitable for applications in industrial environments.

AMS 2712 are compact pressure sensor modules, which can be easily integrated in other assemblies or used stand alone in a suitable package. Pressure is applied via metal pressure ports, the electrical connection can be done via solder pads, pin connectors or a PCB terminal block.

The pressure sensor modules in the AMS 2712 series are available for various ranges and types: Differential (relative) devices in pressure ranges from 0 .. 5 mbar up to 0 .. 2 bar, absolute pressure variants for 0 .. 1 and 0 .. 2 bar as well as a barometric type for 0.7 .. 1.2 bar. Bidirectional differential devices are available from -5 .. +5 mbar up to -1 .. +1 bar for measurement of positive and negative pressure differences. Other pressure ranges or modifications are available on request.



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May 2017 - Rev. 1.0, preliminary

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### PRESSURE RANGES

Pressure sensor module type (code)	Pressure type	Pressure range in mbar	Burst pressure <sup>1)</sup> in bar	Pressure range in PSI	Burst pressure <sup>1)</sup> in PSI
<b>Ultra low pressure</b>					
AMS 2712-0005-D	differential / relative	0 .. +5	> 0.35	0 .. 0.073	> 5
AMS 2712-0010-D	differential / relative	0 .. 10	> 0.35	0 .. 0.145	> 5
AMS 2712-0005-D-B	bidirectional differential	-5 .. +5	> 0.35	-0.073 .. +0.073	> 5
AMS 2712-0010-D-B	bidirectional differential	-10 .. +10	> 0.35	-0.145 .. +0.145	> 5
<b>Low pressure</b>					
AMS 2712-0020-D	differential / relative	0 .. 20	> 0.5	0 .. 0.290	> 7
AMS 2712-0050-D	differential / relative	0 .. 50	> 1	0 .. 0.725	> 15
AMS 2712-0100-D	differential / relative	0 .. 100	> 1	0 .. 1.450	> 15
AMS 2712-0020-D-B	bidirectional differential	-20 .. +20	> 0.5	-0.290 .. +0.290	> 7
AMS 2712-0050-D-B	bidirectional differential	-50 .. +50	> 1	-0.725 .. +0.725	> 15
AMS 2712-0100-D-B	bidirectional differential	-100 .. +100	> 1	-1.450 .. +1.450	> 15
<b>Standard pressure</b>					
AMS 2712-0200-D	differential / relative	0 .. 200	> 5	0 .. 2.901	> 72
AMS 2712-0350-D	differential / relative	0 .. 350	> 5	0 .. 5.076	> 72
AMS 2712-0500-D	differential / relative	0 .. 500	> 5	0 .. 7.251	> 72
AMS 2712-1000-D	differential / relative	0 .. 1000	> 5	0 .. 14.50	> 72
AMS 2712-2000-D	differential / relative	0 .. 2000	> 5	0 .. 29.01	> 72
AMS 2712-0200-D-B	bidirectional differential	-200 .. +200	> 5	-2.901 .. +2.901	> 72
AMS 2712-0350-D-B	bidirectional differential	-350 .. +350	> 5	-5.076 .. +5.076	> 72
AMS 2712-1000-D-B	bidirectional differential	-1000 .. +1000	> 5	-14.50 .. +14.50	> 72
AMS 2712-1000-A	absolute	0 .. 1000	> 5	0 .. 14.50	> 72
AMS 2712-2000-A	absolute	0 .. 2000	> 5	0 .. 29.010	> 72
AMS 2712-1200-B	barometric	700 .. 1200	> 5	10.15 .. 17.40	> 72

**Table 1: AMS 2712 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: $V_{max}$			40	V
Operating and storage temperature: $T$	-25		85	°C
Common mode pressure: $p_{CM}$ <sup>1)</sup>			16	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  $V_S = 24\text{ V}$ ,  $T_{op} = 25^\circ\text{C}$  and  $R_L = 100\ \Omega$ , unless otherwise stated.

Parameter	Minimum	Typical	Maximum	Units
<b>Current-loop output signal</b>				
@ specified minimum pressure (see "pressure ranges") <sup>1)</sup>		4		mA
@ specified maximum pressure (see "pressure ranges") <sup>1)</sup>		20		mA
Full span output (FSO) <sup>2)</sup>		16		mA
without pressure (only bidirectional differential types)		12		mA
<b>Accuracy<sup>3)</sup> @ <math>T_{op} = 25^\circ\text{C}</math></b>				
Ultra low pressure types (5, 10 mbar)		$\pm 1.0$	$\pm 1.5$	%FSO
Low pressure types (20, 50, 100 mbar)		$\pm 0.5$	$\pm 1.0$	%FSO
Standard pressure types ( $\geq 200$ mbar)		$\pm 0.3$	$\pm 0.5$	%FSO
<b>Overall error<sup>4)</sup> @ <math>T_{op} = -25 \dots 85^\circ\text{C}</math></b>				
Ultra low pressure types (5, 10 mbar)		$\pm 1.5$	$\pm 2.5$	%FSO
Low pressure types (20, 50, 100 mbar)		$\pm 1.0$	$\pm 2.0$	%FSO
Standard pressure types ( $\geq 200$ mbar)		$\pm 0.5$	$\pm 1.0$	%FSO
Long term stability			$< 0.5$	%FSO/a
Nonlinearity <sup>5)</sup>	-0.3	$< 0.1$	0.3	%FSO
Resolution analog output signal			0.05	%FSO
Supply voltage ( $V_S$ to Ground)	$V_{S,min}$ <sup>6)</sup>	24	36	V
Power consumption ( $I_{OUT} = 20\text{ mA}$ , $R_L = 0\ \Omega$ )			0.48	W
Current limitation $I_{OUT,max}$			22.5	mA
Protection against reverse polarity			40	V
Response time (10% .. 90% rise time)		2.5	4	ms
Load resistor $R_L$			600	$\Omega$
Dependency of $I_{OUT}$ on $V_S$ <sup>7)</sup>			$< 0.1$	%FSO
Pressure Changes	$10^6$			
Compensated operating temperature range	-25		85	$^\circ\text{C}$
Weight (AMS2712 without terminal block)		6.5		gram
Dimensions (l x w x h, standard version with tubes)		30.0 x 27.5 x 14.3		$\text{mm}^3$
Media compatibility		See notes <sup>8), 9)</sup>		

**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 current-loop output at the specified minimum pressure and the current-loop output at the specified maximum pressure (nominal FSO = 16 mA).
- 3) The 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.

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- 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).
- 5) Defined as best fit straight line (BFSL).
- 6) The minimum supply voltage  $V_{S,min}$  depends on the used load  $R_L$  and is given by  $V_{S,min} = 8 V + 20 mA \cdot R_L$ .
- 7) The given value is the maximum deviation from the output voltage at  $V_S = 24 V$  over the complete supply voltage range at any pressure in the specified range. It is normalized to the FSO.
- 8) Media compatibility of pressure port 1 (for a description of port 1, see *Figure 3*): fluids and gases non-corrosive to ceramics, silicon, Pyrex and RTV silicone rubber.
- 9) Media compatibility of pressure port 2 (for a description of port 2, see *Figure 3*): clean, dry gases, non-corrosive to ceramics, silicon, RTV silicone rubber, gold and tin (alkaline or acidic liquids can destroy AMS 2712).

### FUNCTIONAL DESCRIPTION

AMS 2712 pressure sensor modules combine piezoresistive pressure sensing technology with modern mixed-signal conditioning and circuit protection on a compact PCB.

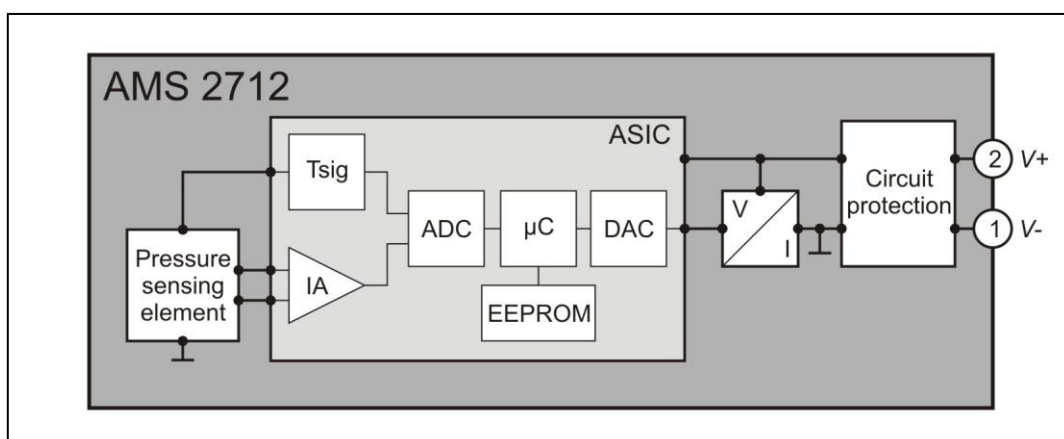
The physical pressure to be measured is converted into a differential voltage signal at AMS 2712's piezoresistive pressure sensing element. This differential voltage is signal-conditioned and converted into a standardized 4 .. 20 mA current-loop output signal in the following way (see *Figure 1*):

At first the sensing element's differential voltage signal is pre-amplified and converted into a digital signal using a 14-bit ADC. This digitized signal is processed mathematically by the ASIC's integrated microcontroller unit ( $\mu C$ ) to achieve a calibrated and temperature compensated output signal. Herefore the  $\mu C$  uses a correction algorithm and individual correction coefficients stored in the ASIC's EEPROM during AMS 2712's factory calibration process. The temperature value needed for temperature compensation is also measured directly at the pressure sensing element. An 11-bit DAC reconverts the corrected digital signal into a voltage signal, which is converted into a short-circuit and reverse polarity protected two-wire current-loop output signal by the voltage-to-current (V/I) converter and the circuit protection unit.

AMS 2712's output current  $I_{OUT}$  is independent of the applied supply voltage and a linear function of the applied pressure  $p^1$ . It is given by:

$$I_{OUT}(p) = \frac{p - p_{min}}{p_{max} - p_{min}} \cdot 16 mA + 4 mA \quad (1)$$

wherein  $p_{min}$  is the sensor's specified minimum pressure and  $p_{max}$  is the specified maximum pressure.



**Figure 1: AMS 2712's block diagram**

<sup>1</sup> The applied pressure  $p$  is the pressure difference between port 1 and 2 for differential and bidirectional differential pressure sensor modules. 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 2712 can be screw mounted using the four through bores ( $\varnothing$  3 mm for M2.5 screws) at its edges. As an alternative the DIL version can be plugged or soldered on a PCB using its ten DIL pins.

AMS 2712's electrical connection is shown in *Figure 2*. V+ is directly connected to the power supply's positive output and V- is connected to Ground via a load resistor  $R_L$ , which can be installed far away from the pressure sensor module. The current  $I_{OUT}$  flowing in the current-loop can be measured using the voltage drop  $V_A$  over  $R_L$  with  $I_{OUT} = V_A / R_L$ .

The required minimum supply voltage  $V_{S,min}$  depends on the used load  $R_L$  and is given by the following equation:<sup>2</sup>

$$V_{S,min} = 8 \text{ V} + 20 \text{ mA} \cdot R_L \quad (2)$$

Please take care that the power supply can provide at least 20 mA.

In practice AMS 2712's electrical connection can be established in the following ways: In the standard version (type AMS 2712-XXXX-Y-1, where XXXX has to be replaced with the four-digit pressure range and Y with the symbol for the pressure type, see "Information for Ordering") it is possible to solder wires to the respective soldering pads (see *Figure 3*) or to use a male multipoint connector (matching to TE connector 215297-5). In the terminal block version (type AMS 2712-XXXX-Y-2) a terminal block allows the installation of a cable without soldering. The DIL version (type AMS2712-XXXX-Y-3) can be easily plugged or soldered onto a PCB using its DIL pins.

The pressure connection is made using AMS 2712's metal pressure ports. Depending on the used type of pressure sensor module 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 2712-XXXX-D-..):

$$p_1 > p_2$$

for relative / gage pressure (type AMS 2712-XXXX-D-..):

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

for bidirectional differential pressure (type AMS 2712-XXXX-D-B-..):

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

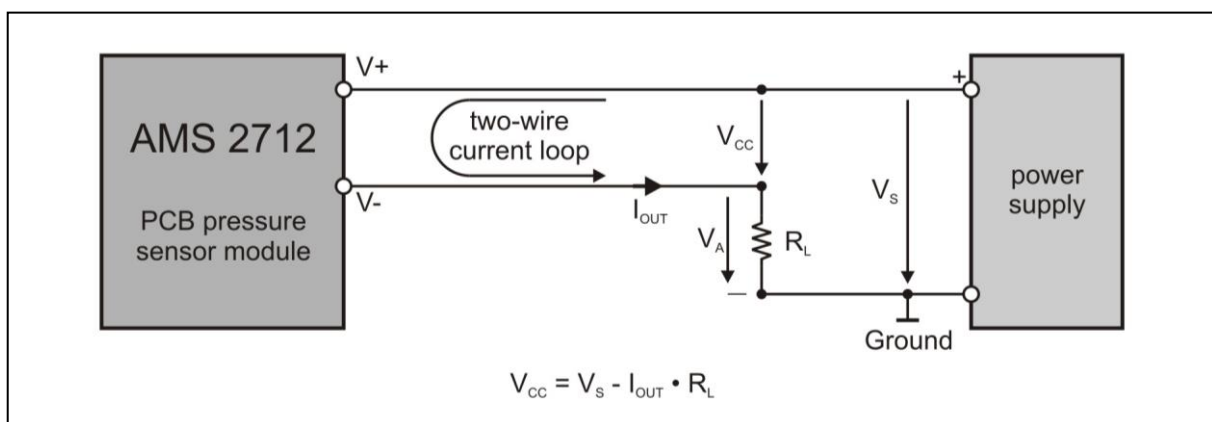
for absolute pressure (type AMS 2712-XXXX-A-..):

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

for barometric pressure (type AMS 2712-XXXX-B-..):

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

The maximum pressures (see *Table 1*) and the guidelines concerning media compatibility (specification notes 8) and 9)) have to be taken into account.



**Figure 2: Electrical connection of AMS 2712**

<sup>2</sup> If very long cables are used to connect AMS 2712 with  $R_L$  the voltage drop over the cable resistance should be taken into account for the determination of  $V_S$ .

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### DIMENSIONS AND PINOUT

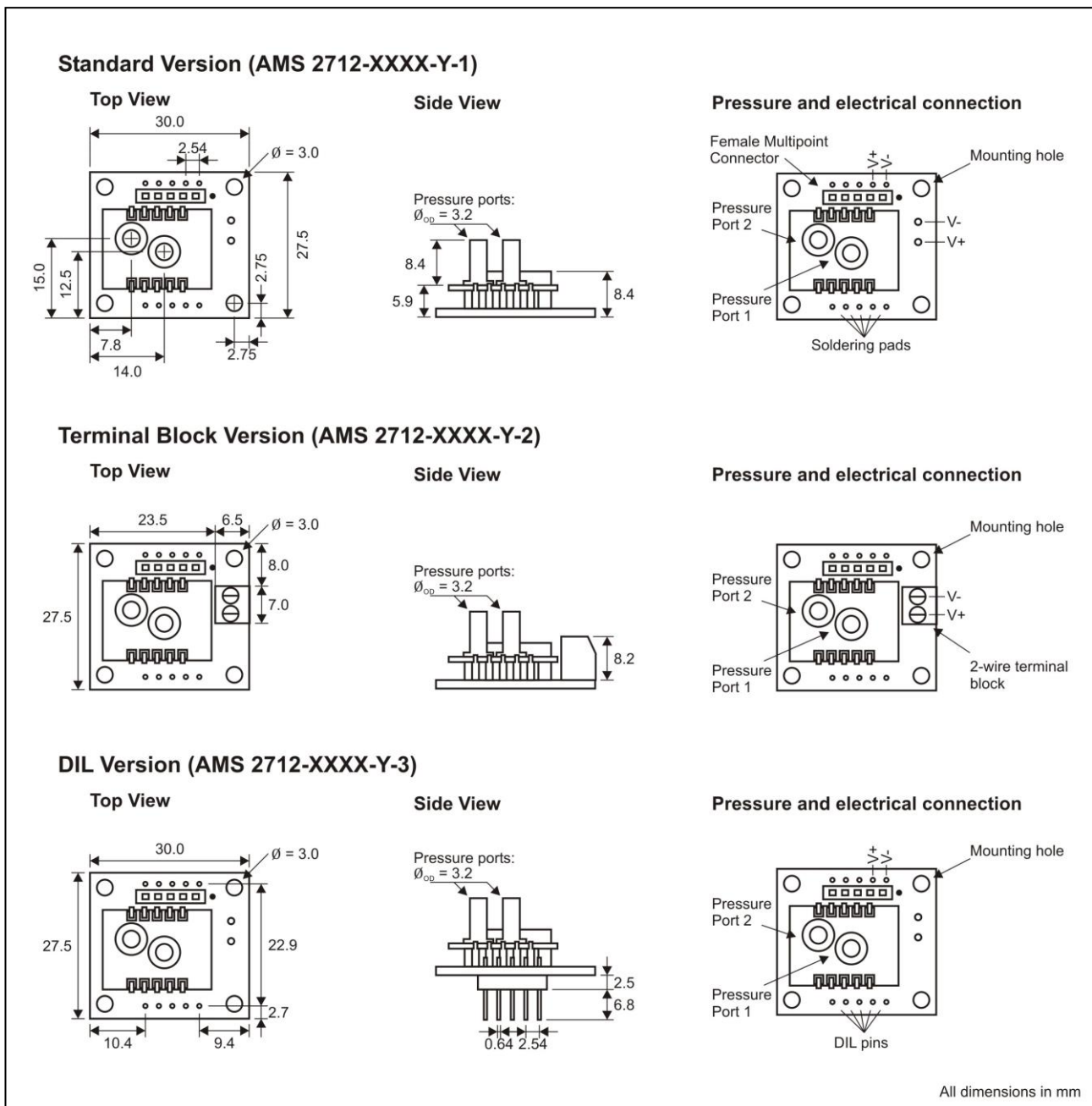


Figure 3: Dimensions and pinout of AMS 2712

#### Notes:

1. Absolute and barometric pressure types only have pressure port 2.
2. The electrical connection can be established using the soldering pads, a male multipoint connector (matching to TE connector 215297-5), a terminal block or DIL pins.
3. For pressure connections Analog Microelectronics recommends a silicone tubing (inner diameter  $\varnothing_{ID} = 2$  mm, outer diameter  $\varnothing_{OD} = 6$  mm).
4. If silicone tubing is used it is recommended to use hose clamps.

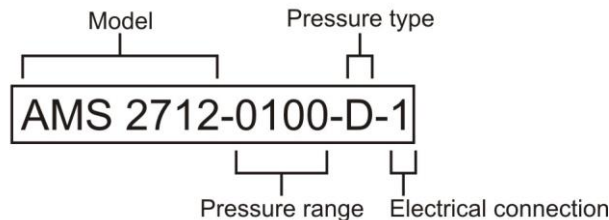


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### INFORMATION FOR ORDERING

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

Table 4: Pressure ranges

Pressure type:

Pressure type code	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

Table 5: Pressure types

Electrical connection type:

Code	Connection type
1 standard version	Soldering pads and female connector
2 terminal block version	Terminal block with screws
3 DIL version	Pins

Table 6: Electrical connections

# AMS 2712

PCB pressure sensor module with 4 .. 20 mA current output

## ADDITIONAL EQUIPMENT

ORDER NUMBER	DELIVERY FORM
AMS2712-TUBING	matching silicone tubing (please order in meters)

## NOTES

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