

## FEATURES

- Board mount pressure sensor series with analog voltage output and digital I2C output
- Calibrated and temperature compensated
- Differential/relative, bidirectional differential, absolute and barometric sensor versions
- Wide variety of pressure ranges: 0.054 psi (1.5 inch water) up to 100 psi full scale
- Piezoresistive sensor with high precision digital signal conditioning
- Total accuracy < 0.5 %FSO at room temperature for standard pressure ranges
- TEB < 1.0 %FSO (-25 ... 85 °C) for standard pressure ranges
- High long term stability
- Fast response time (typ. < 1 ms)
- Supply voltage range: 4.75 ... 5.25 V
- Analog output: 0.5 to 4.5 V ratiometric
- Digital output via I<sup>2</sup>C interface: 15 bit for pressure and temperature measurement
- Programmable I<sup>2</sup>C-address
- Ceramic DIP-8 package (width: 0.6 inch)
- Package options for tubing or manifold mount (O-Ring sealing)
- Substitute product for SM5852 / SM5812
- RoHS compliant

## TYPICAL APPLICATIONS

- Static and dynamic pressure measurement
- Barometric pressure measurement
- Vacuum monitoring
- Gas flow
- Fluid level measurement
- Medical instrumentation
- Heating, Ventilation and Air Conditioning (HVAC)

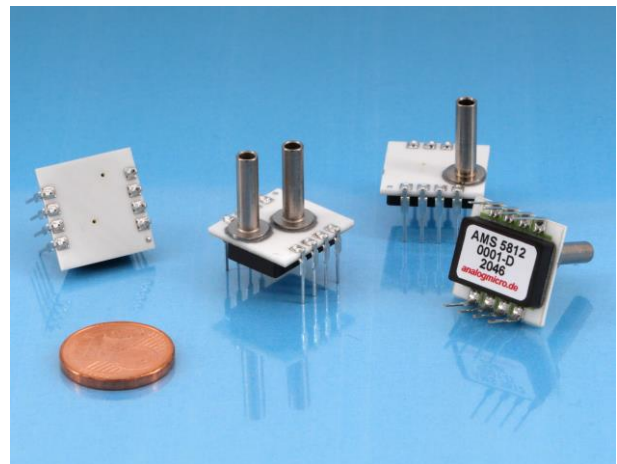
## GENERAL DESCRIPTION

The OEM pressure sensors in the AMS 5812 series are high-precision sensors with two different outputs, an analog output and a digital I2C output. The analog 0.5 to 4.5V output is ratiometric to the supply voltage and provides pressure measurement data only, while the I2C output provides pressure as well as temperature measurement data. Both outputs can be used simultaneously.

AMS 5812 sensors combine a micromachined, high quality piezoresistive pressure sensing element with a modern, signal conditioning CMOS-ASIC on a ceramic substrate. They are extensively calibrated and temperature compensated in a wide temperature range of -25 to 85 °C. This enables high precision measurements and excellent drift and long-term stability.

The AMS 5812 pressure sensors come in a compact and robust dual in-line ceramic package (DIP) for assembly on printed circuit boards (PCBs). Two package variants are available: one with vertical pressure ports for hose connection and one for O-ring sealing (N-package type for manifold mount). The sensors are operational without any additional components.

The sensors in the AMS 5812 series are available for all pressure types in various pressure ranges: differential (relative) pressure sensors in ranges from 0 ... 0.054 psi up to 0 ... 100 psi, absolute pressure types for 0 ... 5 psi up to 0 ... 30 psi and 11 ... 17.5 psi for barometric measurements. Bidirectional differential sensors are available from -0.054 ... +0.054 psi up to -15 ... +15 psi. Custom specific pressure ranges and modifications are available on request.



## PRESSURE RANGES

### Sensor types with vertical pressure ports (metal tubes for hose connection)

Sensor type (code)	Pressure type	Pressure range in psi	Burst pressure <sup>1)</sup> in psi	Pressure range in mbar	Burst pressure in bar
<b>Ultra low pressure ranges</b>					
AMS 5812-0000-D	differential / relative	0 ... 0.075	> 3	0 ... 5.17	> 0.2
AMS 5812-0001-D	differential / relative	0 ... 0.15	> 3	0 ... 10.34	> 0.2
AMS 5812-015W-D-B <sup>3)</sup>	bidirectional differential	-0.054 ... +0.054	> 3	-3.736 ... +3.736	> 0.2
AMS 5812-0000-D-B	bidirectional differential	-0.075 ... +0.075	> 3	-5.17 ... +5.17	> 0.2
AMS 5812-0001-D-B	bidirectional differential	-0.15 ... +0.15	> 3	-10.34 ... +10.34	> 0.2
<b>Low pressure ranges</b>					
AMS 5812-0003-D	differential / relative	0 ... 0.3	> 6	0 ... 20.68	> 0.4
AMS 5812-0004-D	differential / relative	0 ... 0.4	> 6	0 ... 27.58	> 0.4
AMS 5812-0008-D	differential / relative	0 ... 0.8	> 15	0 ... 55.16	> 1
AMS 5812-0015-D	differential / relative	0 ... 1.5	> 15	0 ... 103.4	> 1
AMS 5812-0003-D-B	bidirectional differential	-0.3 ... +0.3	> 6	-20.68 ... +20.68	> 0.4
AMS 5812-0008-D-B	bidirectional differential	-0.8 ... +0.8	> 15	-55.16 ... +55.16	> 1
AMS 5812-0015-D-B	bidirectional differential	-1.5 ... +1.5	> 15	-103.4 ... 103.4	> 1
<b>Standard pressure ranges</b>					
AMS 5812-0030-D	differential / relative	0 ... 3	> 25	0 ... 206.8	> 1.7
AMS 5812-0050-D	differential / relative	0 ... 5	> 25	0 ... 344.7	> 1.7
AMS 5812-0150-D	differential / relative	0 ... 15	> 72	0 ... 1034	> 5
AMS 5812-0300-D	differential / relative	0 ... 30	> 232	0 ... 2068	> 16
AMS 5812-0600-D	differential / relative	0 ... 60	> 232	0 ... 4137	> 16
AMS 5812-1000-D	differential / relative	0 ... 100	> 232	0 ... 6895	> 16
AMS 5812-0030-D-B	bidirectional differential	-3 ... +3	> 25	-206.8 ... +206.8	> 1.7
AMS 5812-0050-D-B	bidirectional differential	-5 ... +5	> 72	-344.7 ... +344.7	> 5
AMS 5812-0150-D-B	bidirectional differential	-15 ... +15	> 72	-1034 ... +1034	> 5
AMS 5812-0050-A	absolute	0 ... 5	> 72	0 ... 344.7	> 5
AMS 5812-0150-A	absolute	0 ... 15	> 72	0 ... 1034	> 5
AMS 5812-0300-A	absolute	0 ... 30	> 72	0 ... 2068	> 5
AMS 5812-0150-B	absolute (barometric)	11 ... 17.5	> 72	758.4 ... 1206	> 5

**Table 1: AMS 5812 standard pressure ranges (other ranges on request)**

#### Notes:

- 1) Burst pressure is defined as the maximum pressure which may be applied to one pressure port relative to the other port (or while only one pressure port is connected) without causing leaks in the sensor.
- 2) All differential pressure sensors with vertical metal tubes can be ordered with inverted pressure direction for enhanced media compatibility in relative pressure measurements (option -I, for more information on ordering codes see page 14)
- 3) AMS 5812-015-W-D-B is calibrated from -1.5 to 1.5 inH<sub>2</sub>O.

## PRESSURE RANGES continued

### Sensor types for manifold assembly (-N package option without tubes for O-ring sealing)

Sensor type (code)	Pressure type	Pressure range in psi	Burst pressure <sup>1)</sup> in psi	Pressure range in mbar	Burst pressure in bar
<b>Ultra low pressure ranges</b>					
AMS 5812-0000-D-N	differential / relative	0 ... 0.075	> 3	0 ... 5.17	> 0.2
AMS 5812-0001-D-N	differential / relative	0 ... 0.15	> 3	0 ... 10.34	> 0.2
AMS 5812-015W-D-B-N <sup>3)</sup>	bidirectional differential	-0.054 ... +0.054	> 3	-3.736 ... +3.736	> 0.2
AMS 5812-0000-D-B-N	bidirectional differential	-0.075 ... +0.075	> 3	-5.17 ... +5.17	> 0.2
AMS 5812-0001-D-B-N	bidirectional differential	-0.15 ... +0.15	> 3	-10.34 ... +10.34	> 0.2
<b>Low pressure ranges</b>					
AMS 5812-0003-D-N	differential / relative	0 ... 0.3	> 6	0 ... 20.68	> 0.4
AMS 5812-0004-D-N	differential / relative	0 ... 0.4	> 6	0 ... 27.58	> 0.4
AMS 5812-0008-D-N	differential / relative	0 ... 0.8	> 15	0 ... 55.16	> 1
AMS 5812-0015-D-N	differential / relative	0 ... 1.5	> 15	0 ... 103.4	> 1
AMS 5812-0003-D-B-N	bidirectional differential	-0.3 ... +0.3	> 6	-20.68 ... +20.68	> 0.4
AMS 5812-0008-D-B-N	bidirectional differential	-0.8 ... +0.8	> 15	-55.16 ... +55.16	> 1
AMS 5812-0015-D-B-N	bidirectional differential	-1.5 ... +1.5	> 15	-103.4 ... 103.4	> 1
<b>Standard pressure ranges</b>					
AMS 5812-0030-D-N	differential / relative	0 ... 3	> 25	0 ... 206.8	> 1.7
AMS 5812-0050-D-N	differential / relative	0 ... 5	> 25	0 ... 344.7	> 1.7
AMS 5812-0150-D-N	differential / relative	0 ... 15	> 72	0 ... 1034	> 5
AMS 5812-0300-D-N	differential / relative	0 ... 30	> 232	0 ... 2068	> 16
AMS 5812-0600-D-N	differential / relative	0 ... 60	> 232	0 ... 4137	> 16
AMS 5812-1000-D-N	differential / relative	0 ... 100	> 232	0 ... 6895	> 16
AMS 5812-0030-D-B-N	bidirectional differential	-3 ... +3	> 25	-206.8 ... +206.8	> 1.7
AMS 5812-0050-D-B-N	bidirectional differential	-5 ... +5	> 72	-344.7 ... +344.7	> 5
AMS 5812-0150-D-B-N	bidirectional differential	-15 ... +15	> 72	-1034 ... +1034	> 5

**Table 2: AMS 5812 standard pressure ranges for manifold assembly (-N option, other ranges on request)**

**Note:**

- 1) Burst pressure is defined as the maximum pressure which may be applied to one pressure port relative to the other port (or while only one pressure port is connected) without causing leaks in the sensor.
- 2) Differential sensor types for manifold assembly (option -N, without tubes) can be ordered with inverted pressure direction for enhanced media compatibility in relative pressure measurements (option -I, for more information on ordering codes see page 14).
- 3) AMS 5812-015-W-D-B-N is calibrated from -1.5 to 1.5 inH<sub>2</sub>O.

## MAXIMUM RATINGS

Parameter	Minimum	Typical	Maximum	Units
Maximum supply voltage: $V_{S,max}$			6.0	V
Operating temperature: $T_{op}$	-25		85	°C
Storage temperature: $T_{amb}$	-40		125	°C
Common mode pressure $p_{CM}$ <sup>1)</sup>			175	psi

**Table 3: 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 without causing damages, while no differential pressure is applied.

## SPECIFICATIONS

All parameters apply to  $V_S = 5.0$  V,  $p_{CM} = 0$  psi and  $T_{op} = 25$  °C, unless otherwise stated.

Parameter	Minimum	Typical	Maximum	Units
<b>Analog output signal (pressure only)</b> <sup>1)</sup>				
@ specified minimum pressure (see Table 1 and Table 2)		0.5		V
@ specified maximum pressure (see Table 1 and Table 2)		4.5		V
Full span output (FSO) <sup>2)</sup>		4		V
Without pressure (bidirectional differential)		2.5		V
<b>Digital output signal (pressure)</b> <sup>3)</sup>				
@ specified minimum pressure (see Table 1 and Table 2)		3277		counts
@ specified maximum pressure (see Table 1 and Table 2)		29491		counts
Full span output (FSO)		26214		counts
Without pressure (bidirectional differential)		16384		counts
<b>Digital output signal (temperature)</b> <sup>4)</sup>				
@ minimum temperature $T = -25$ °C		3277		counts
@ maximum temperature $T = 85$ °C		29491		counts
<b>Total Accuracy</b> <sup>5)</sup> (pressure measurement) @ $T_{op} = 25$ °C				
Ultra low pressure types ( $\leq 0.15$ psi)			±1.5	%FSO
Low pressure types ( $0.15 < p \leq 1.5$ psi)			±1.0	%FSO
Standard pressure types ( $> 1.5$ psi)			±0.5	%FSO
<b>TEB / Overall error</b> <sup>6)</sup> (pressure meas.) @ $T_{op} = -25 \dots 85$ °C				
Ultra low pressure types ( $\leq 0.15$ psi)			±2.0	%FSO
Low pressure types ( $0.15 < p \leq 1.5$ psi)			±1.5	%FSO
Standard pressure types ( $> 1.5$ psi)			±1.0	%FSO
<b>Total error for temperature measurement</b>				
All types of AMS 5812 $T = -25 \dots 85$ °C			±3.0	%FSO
Long term stability			<0.5	%FSO/a
Ratiometricity error (@ $V_S = 4.75 \dots 5.25$ V)			500	ppm

Parameter	Minimum	Typical	Maximum	Units
Resolution A/D converter	14			bits
Resolution D/A converter	11			bits
Resolution analog output signal	0.05			%FSO
Resolution digital output signals	12			bit
Reaction time (10%...90% rise time)		1	2	ms
Supply voltage ( $V_s$ )	4.75	5	5.25	V
Current consumption <sup>7)</sup>			5	mA
Load resistance at output RL	2k			$\Omega$
Capacitive load			50	nF
<b>I2C-interface</b>				
Input High Level	90		100	% $V_s$
Input Low Level	0		10	% $V_s$
Output Low Level	0		10	% $V_s$
Load capacitance @ SDA			400	pF
Clock frequency SCL			400	kHz
Pull-up resistor	500			$\Omega$
Pressure cycles (0 to 120 % full scale pressure)	$>10^6$			cycles
Lifetime / MTTF	$>10$			years
Compensated temperature range	-25		85	$^{\circ}\text{C}$
Weight		3		g
Media compatibility	See "Specification notes" <sup>8) 9)</sup>			

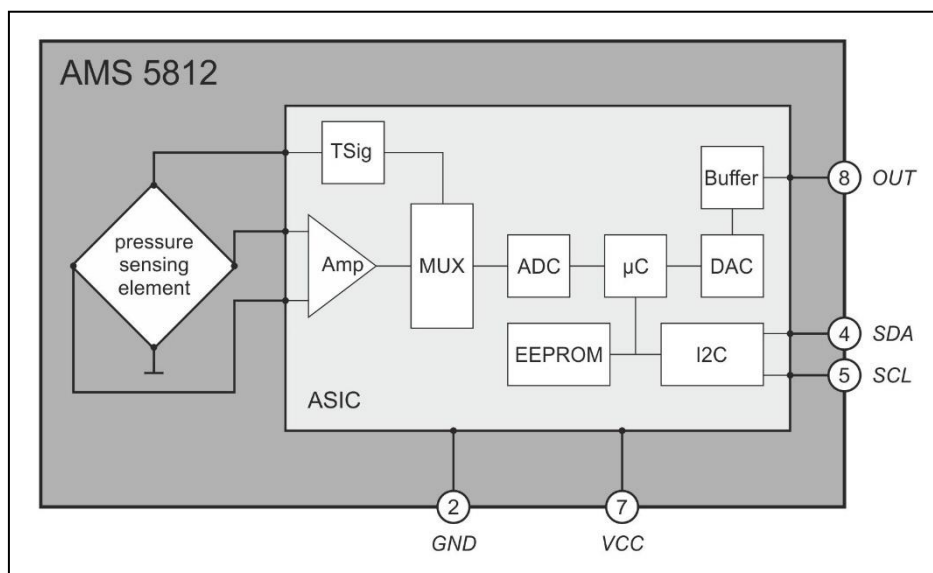
**Table 4: Specifications****SPECIFICATION NOTES**

- 1) The analog output signal (pressure measurement only) is ratiometric to the supply voltage.
- 2) The Full Span Output (FSO) is the algebraic difference between the output signal at the specified maximum pressure and the output signal at the specified minimum pressure (see *Table 1* and *Table 2*).
- 3) The digital output pressure signal is not ratiometric to the supply voltage.
- 4) The digital output temperature signal is not ratiometric to the supply voltage. The temperature value is measured at the sensor's piezoresistive sensing element and is the sensor temperature (including self-heating).
- 5) Total accuracy is defined as the maximum deviation of the measurement value from the ideal characteristic curve 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 this pressure is cycled to and from the minimum or maximum rated pressure. Repeatability is the maximum deviation of the output value at any pressure within the specified range after 10 pressure cycles.
- 6) The TEB (total error band or overall error) is defined as the maximum deviation of the measurement value from the ideal characteristic curve in %FSO across the entire temperature range (-25 ... 85  $^{\circ}\text{C}$ ).
- 7) For use in 4 - 20 mA current-loop applications a customized version with 3.5 mA current consumption is available.
- 8) Media compatibility of pressure port 1 (for a description of port 1, see *Figure 5* and *Figure 6*): clean, dry gases, non-corrosive to silicon, RTV silicone rubber, gold, nickel-plated steel (alkaline or acidic liquids can destroy the sensor).
- 9) Media compatibility of pressure port 2 (for a description of port 2, see *Figure 5* and *Figure 6*): fluids and gases non-corrosive to silicon, Pyrex, RTV silicone rubber, nickel-plated steel.

## FUNCTIONAL DESCRIPTION

The pressure sensors in the AMS 5812 series combine a high quality piezoresistive silicon sensing element with a modern mixed-signal CMOS ASIC for signal-conditioning on a ceramic substrate. This enables a low total error band, an excellent temperature behavior and high long-term stability.

The functional principle of the AMS 5812 sensors is explained using *Figure 1*.



**Figure 1: Functional principle**

The physical pressure applied to AMS 5812's pressure port(s) is converted into a differential voltage signal at AMS 5812's piezoresistive pressure sensing element. This differential voltage, which is roughly proportional to the applied pressure, is signal-conditioned and converted into a standardized output signal in the following way:

At first, the sensing element's differential voltage signal is pre-amplified and transmitted by the multiplexer block to the A/D converter block (ADC), where it is converted into a digital signal with 14-bit resolution. This digitized signal is mathematically processed by the ASIC's integrated microcontroller unit ( $\mu\text{C}$ ) to obtain a calibrated and temperature compensated output signal. For this purpose, the  $\mu\text{C}$  uses a correction algorithm and individual correction coefficients which are stored in the ASIC's EEPROM during AMS 5812's factory calibration process. This permits sensor-specific calibration and correction (i.e., linearization and temperature compensation) of the digitized pressure signal. The temperature signal required for the temperature compensation is measured at the pressure sensing element and is transmitted via the multiplexer to the ADC, where it is digitized, too.

The ASIC's microcontroller unit ( $\mu\text{C}$ ) executes a cyclic program, which continuously calculates the current standardized and corrected digital pressure value based on the current digitized pressure and temperature measurement values and the stored correction coefficients. Additionally, a standardized digital value of the current temperature is calculated.

The final conditioned digital 15-bit pressure and temperature values are written to the ASIC's output registers and continuously updated (typically every 0.5 ms). The readout of these standardized digital pressure and temperature measurement values, which are not ratiometric to the supply voltage, is done via the sensor's I2C interface at PIN4 (SDA) and PIN5 (SCL).

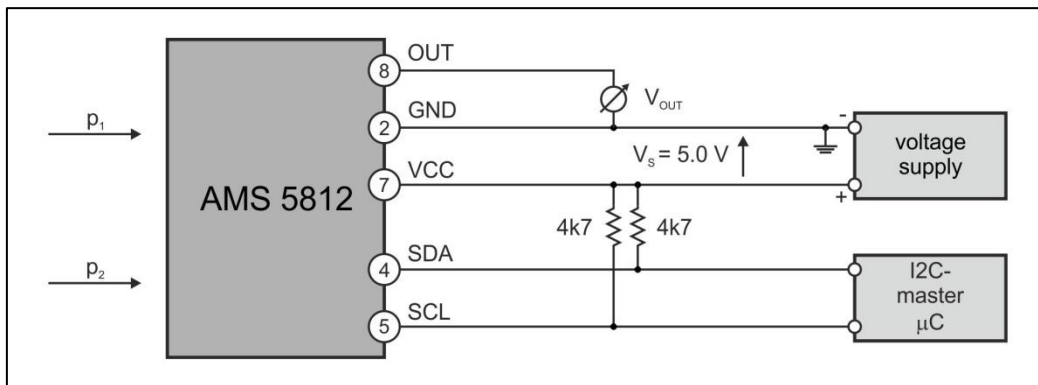
The analog voltage output signal is generated from the current corrected digital pressure value by an 11-bit D/A converter (DAC). This standardized 0.5 ... 4.5 V analog output voltage at the sensor's PIN8 (OUT) is ratiometric to the supply voltage.

## INITIAL OPERATION

### Electrical Connection

The electrical connection of AMS 5812 sensors is typically made by soldering them directly on a printed circuit board or by mounting them on a suitable socket. The basic circuit of the AMS 5812 sensor with analog and digital output in use is shown in *Figure 2*. To use the analog ratiometric voltage output only, it is sufficient to connect PIN2 (GND), PIN7 (VCC) and PIN8 (OUT). To read the digital output only, it is enough to connect PIN2 (GND), PIN7 (VCC) and the I2C-bus lines to PIN4 (SDA) and PIN5 (SCL).

**Important:** For I2C-bus communication, each bus line (SCL and SDA) has to be connected to the positive supply voltage (pin Vcc or +5.0 V) via a pull-up resistor. Please add pull-up resistors (4.7 kΩ are recommended) to your bus line if they are not integrated in the I2C-master.



**Figure 2: Principle electric circuitry**

### Pressure Connection

The pressure connection is established by mounting hoses / flexible tubing on the sensor's metal pressure ports or by sealing the pressure ports or the N-type package via O-rings to a suitable flange. Depending on the sensor type and the type of measuring pressure, one or two of the pressure ports are connected to the measuring medium / volume, as described in the table below:

Sensor type	Pressure type to measure	Port 1	Port 2	Requirement
AMS 5812-xxxx-D	differential	connected to p <sub>1</sub>	connected to p <sub>2</sub>	p <sub>1</sub> ≥ p <sub>2</sub>
	positive gage	connected to p <sub>1</sub>	open	p <sub>1</sub> ≥ p <sub>ambient</sub>
	negative gage (vacuum)	open	connected to p <sub>2</sub>	p <sub>2</sub> ≤ p <sub>ambient</sub>
AMS 5812-xxxx-D-I	differential	connected to p <sub>1</sub>	connected to p <sub>2</sub>	p <sub>1</sub> ≤ p <sub>2</sub>
	positive gage	open	connected to p <sub>2</sub>	p <sub>2</sub> ≥ p <sub>ambient</sub>
	negative gage (vacuum)	connected to p <sub>1</sub>	open	p <sub>1</sub> ≤ p <sub>ambient</sub>
AMS 5812-xxxx-D-B	differential (bidirectional)	connected to p <sub>1</sub>	connected to p <sub>2</sub>	p <sub>1</sub> ≥ p <sub>2</sub> OR p <sub>1</sub> ≤ p <sub>2</sub>
AMS 5812-xxxx-A	absolute pressure	connected to p <sub>1</sub>	not connected	p <sub>1</sub> = meas. pressure
AMS 5812-xxxx-B	barometric pressure	connected to p <sub>1</sub>	not connected	p <sub>1</sub> = meas. pressure

wherein p<sub>1</sub> = pressure at port 1 and p<sub>2</sub> = pressure at port 2, for port declaration see *Figure 5* and *Figure 6*. The media compatibility of pressure port 1 and port 2 can be found in "Specification notes", 7 and 8.

#### Notes:

- For pressure connections up to 30 psi we recommend a silicone tubing (inner diameter Ø = 2 mm, outer diameter Ø = 6 mm) and above 30 psi PU or PA tubing. Suitable tubing can be found on [AMS 5812's product page](#).
- ESD precautions are necessary, it is essential to ground machines and personnel properly during assembly and handling of the device.

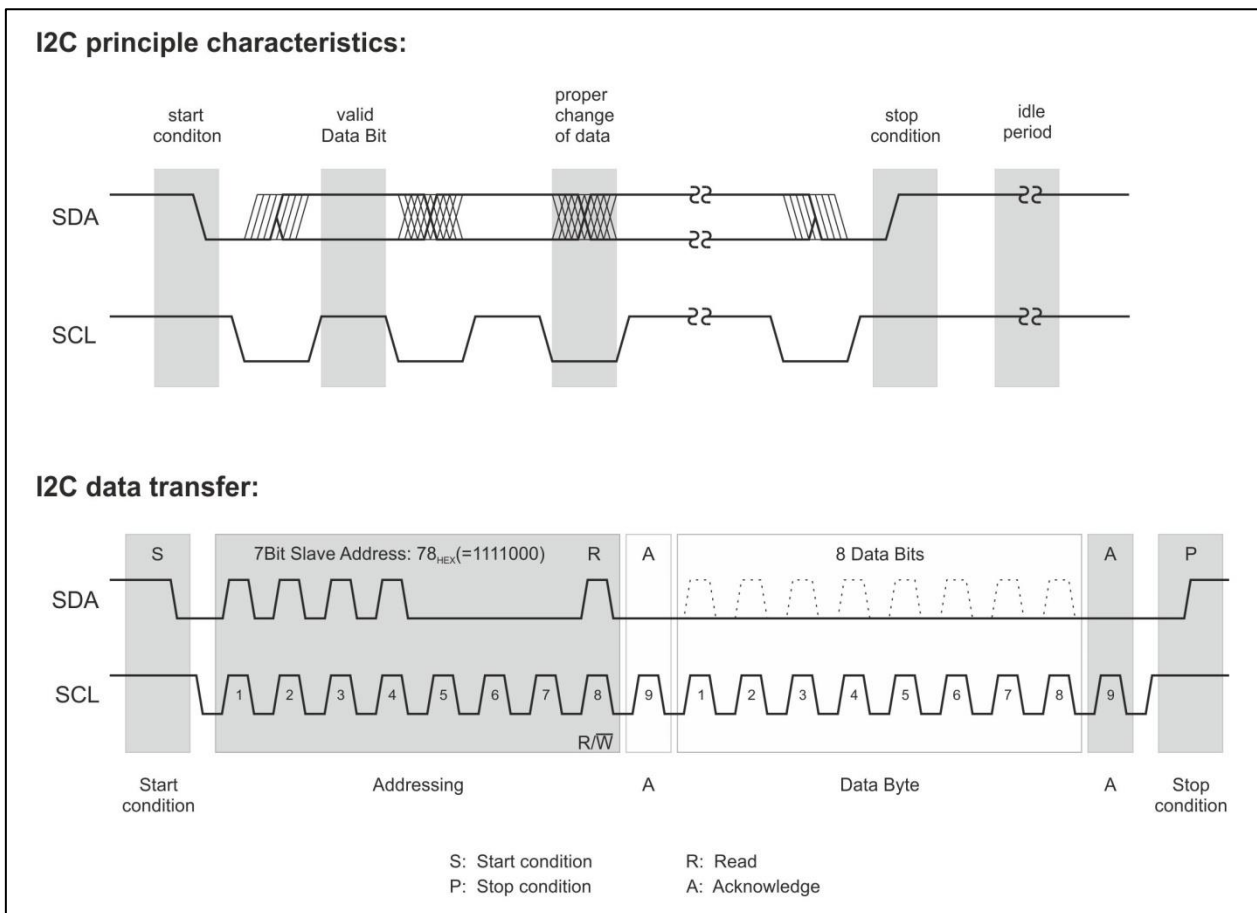
## I2C-INTERFACE

AMS 5812 pressure sensors have a digital output realized via an I2C-interface. When connected to a bidirectional I2C-bus, the current corrected digital pressure and temperature values can be read from AMS 5812's output register.

The I2C-bus requires only two bus lines: a serial data line (SDA) and a serial clock line (SCL). SDA and SCL are bidirectional lines connected to the positive supply voltage via pull-up resistors (see *Figure 2*).

Communication via the I2C-bus follows a simple master-slave principle. Data transfer is always initialized by a master (e.g., a microcontroller), which sends a data request to the sensor; the AMS 5812 sensor – which always operates as slave – responds then.

AMS 5812's communication protocol follows a standard I2C communication protocol (see *Figure 3*)<sup>1</sup>.



**Figure 3: Standard I<sup>2</sup>C protocol**

<sup>1</sup> The I2C-bus is a simple, 8-bit-oriented bus which enables communication between different I2C devices. Each device connected to the bus can be addressed by software using the device's unique address.



The I2C communication phases are as follows:

**Idle period** (bus is free)

When the bus is free, both I2C-bus lines (SDA and SCL) are pulled up to the supply voltage level ("high level").

**Start S** (start condition)

A start condition has to be generated prior to every data transfer on the bus. The start condition is always sent by the I2C-master and is defined as a transition from "high level" to "low level" on the SDA line while the SCL line is at "high level". The digital data readout from the AMS 5812 is always initiated by a start condition.

**Stop P** (stop condition)

The stop condition is always generated by the I2C-master after a data transfer has been completed. The stop condition is defined as a transition from "low level" to "high level" on the SDA line while the SCL line is at "high level". The digital data readout from the AMS 5812 is always terminated by a stop condition.

**Valid data**

Data is transmitted in bytes (8 bits), starting with the most significant bit (MSB). One data bit is transmitted with each clock pulse. The transmitted bits are only valid when, following a start condition, the level on the SDA line is constant for as long as the SCL line is at "high level". Changes to the SDA level must be made while the SCL line is at "low level".

**Acknowledge A**

After the transmission of a byte, the respective receiver (master or slave) has to send an acknowledge (additional acknowledge bit), which confirms the correct receipt of the data. For this purpose, the master generates an extra acknowledge-related clock pulse. The receiver sends the acknowledge bit by pulling down the SDA line to "low level" during the additional clock pulse.

**Addressing / Slave address** (I2C-address AMS 5812)

After the start condition, the master sends an addressing byte (the first byte after the start condition) that determines which slave is selected. The addressing byte contains the individual 7-bit slave address of the selected slave (AMS 5812) and a data direction bit ( $\overline{R/W}$ ). A "0" for the  $\overline{R/W}$  bit indicates a transmission from the master to the slave ( $\overline{W}$ : write; the master wants to transmit data to the selected slave), a "1" indicates a data request ( $\overline{R}$ : read; the master requests data from the slave).

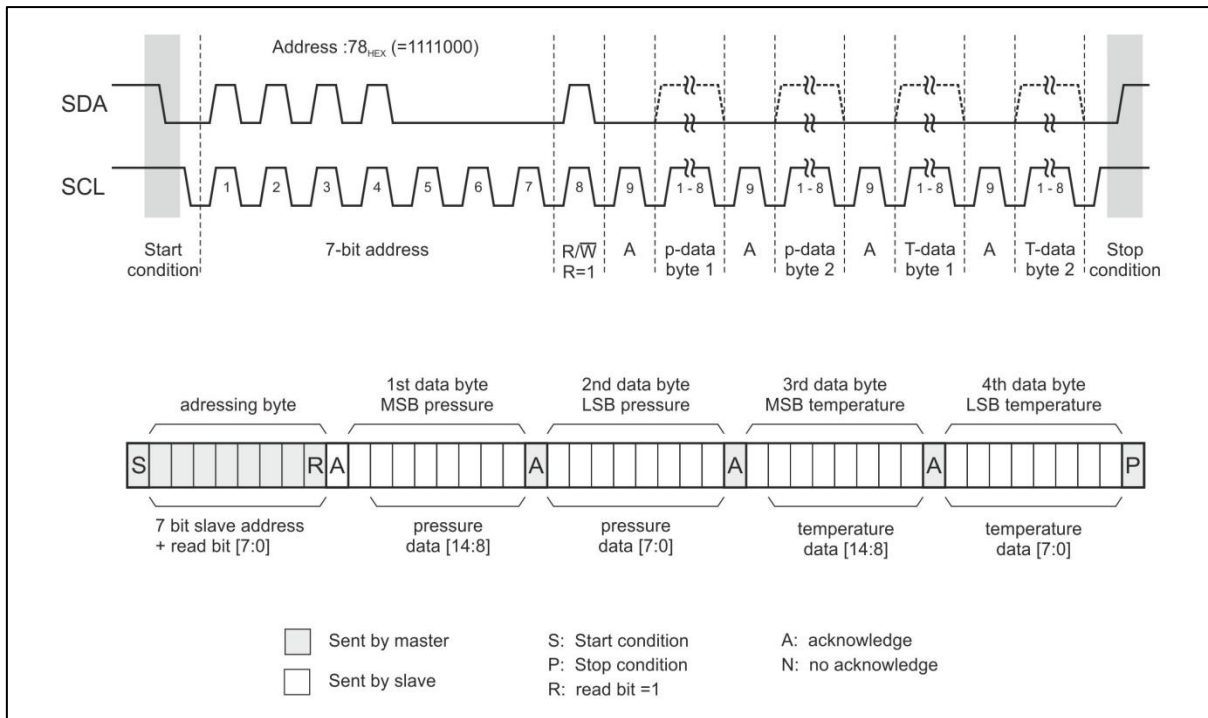
The pressure sensors in the AMS 5812 series have a default, factory-programmed 7-bit slave address of 0x78<sub>Hex</sub> (1111000<sub>bin</sub>), which is stored in the sensor's EEPROM.

If more than one AMS 5812 are to be connected to the same I2C-bus, each pressure sensor requires its individual slave address. For this purpose, AMS 5812 can be ordered with a second, individually programmed 7-bit slave address. AMS 5812 pressure sensors programmed in this way will then respond to both addresses. In general, the 7-bit addressing allows 128 different addresses.

Using the AMS 5812 USB Starter Kit the customer can program / change the second individual slave address himself.

### DATA READOUT VIA THE I2C-INTERFACE

The digital output values for pressure and temperature (15-bit values) are read from AMS 5812's output register via AMS 5812's I2C-interface. The data readout, which is illustrated in *Figure 4*, is done byte by byte.



**Figure 4: Data readout of the digital pressure and temperature values**

A data transfer via the I2C-bus is always initialized by a data request from the I2C-master. For this purpose, the I2C-master generates a start condition on the I2C-bus lines. After the start condition, the I2C-master sends the addressing byte containing the 7-bit slave address of the selected pressure sensor (the AMS 5812 slave address is factory programmed to  $0x78_{Hex} = 1111000_{Bin}$ ) and the data direction bit  $R/W = 1$  which indicates a data request. The selected pressure sensor first responds with an acknowledge bit and starts the data transfer from the output register then.

For a complete pressure and temperature value readout, four data bytes are transmitted from the pressure sensor to the I2C-master. First the two bytes for the current digital pressure value are sent, followed by the two bytes for the current digital temperature value, always beginning with the most significant byte. On each transferred data byte the I2C-master sends an acknowledge bit confirming the correct receipt of data. If no acknowledge bit is generated by the receiving master, the pressure sensor is set to inactive.

The I2C-master terminates the data transfer by sending a stop condition instead of an acknowledge bit. If the master sends an acknowledge bit after the last of the four data bytes, AMS 5812 continues with the transmission of the current pressure and temperature value from the output register, again starting with the most significant pressure byte.

The 15-bit pressure value is derived from the last 7 bits of the first data byte and the 8 bits of the second data byte, always starting with the most significant bit. The 15-bit temperature value results from the last 7 bits of the third data byte and the 8 bits of the fourth data byte.

### Calculating the current pressure and temperature value

The digital pressure and temperature values are 15-bit words<sup>2</sup> (without units) which have to be converted in order to generate the desired information on pressure and temperature in physical units.

The current pressure in psi (or bar) is calculated from the digital pressure value using the following equations:

$$p = \frac{Digoutp(p) - Digoutp_{min}}{Sensp} + p_{min} \quad \text{with} \quad Sensp = \frac{Digoutp_{max} - Digoutp_{min}}{p_{max} - p_{min}} \quad (1)$$

wherein  $p$  is the current pressure in psi<sup>3</sup>,  $p_{min}$  is the sensor's specified minimal pressure and  $p_{max}$  is the sensor's specified maximum pressure in psi; depending on the specified pressure range,  $Digoutp(p)$  is the current digital 15-bit pressure value in counts,  $Digoutp_{min}$  and  $Digoutp_{max}$  are the digital pressure values at minimum and maximum specified pressure in counts and  $Sensp$  is the sensitivity of the pressure sensor in counts/psi.

The current sensor temperature in °C is calculated from the digital temperature output value using the following equation:

$$T = \frac{DigoutT(T) - 3277}{26214} * 110 \text{ °C} - 25 \text{ °C} \quad (2)$$

#### Example:

At the digital output of an AMS 5812-0015-D (0 ... 1.5 psi differential pressure sensor) the following data bytes 1 ... 4 are read

Byte 1: 01010101      Byte 2: 00001010      Byte 3: 00111010      Byte 4: 10011010

Taking the last 15 bits of byte 1 and byte 2 the current 15 bit digital pressure value is:

$$Digoutp(p) = 101010100001010_{bin} = 550A_{Hex} = 21770_{Dec} \text{ counts}$$

and with the last 15 bits of byte 3 and byte 4 the digital temperature value is:

$$DigoutT(T) = 011101010011010_{bin} = 3A9A_{Hex} = 15002_{Dec} \text{ counts}$$

Using equation (1) and the specified values for AMS 5812-0015-D:  $p_{min} = 0$  psi,  $p_{max} = 1.5$  psi and  $Digoutp_{min} = 3277$ ,  $Digoutp_{max} = 29491$ , the current pressure in psi can be calculated to:

$$p = \frac{(21770 - 3277) \text{ counts}}{(26214 / 1.5) \text{ counts/psi}} + 0 \text{ psi} = 1.058 \text{ psi}$$

The current sensor temperature in °C is calculated using equation (2):

$$T = \frac{(15002 - 3277) \text{ counts}}{26214 \text{ counts}} * 110 \text{ °C} - 25 \text{ °C} = 24.2 \text{ °C}$$

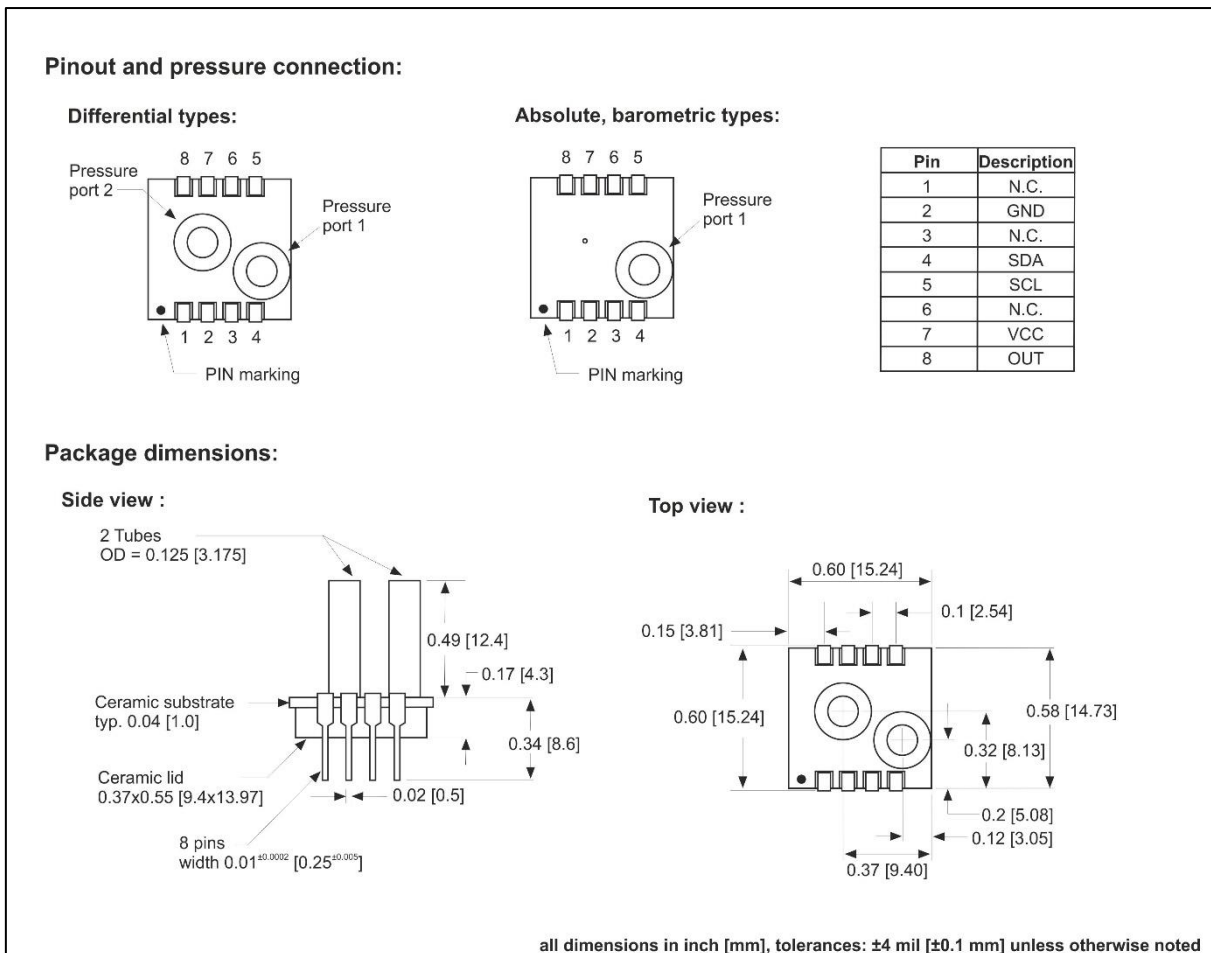
<sup>2</sup> Each pressure and temperature value is transmitted as a 15-bit word; however, the resolution of the internal A/D converter is set to 14 bits.

<sup>3</sup> If the current pressure is required in another physical unit, we suggest calculating the current pressure value in psi as described above and converting the value into the required physical unit then.

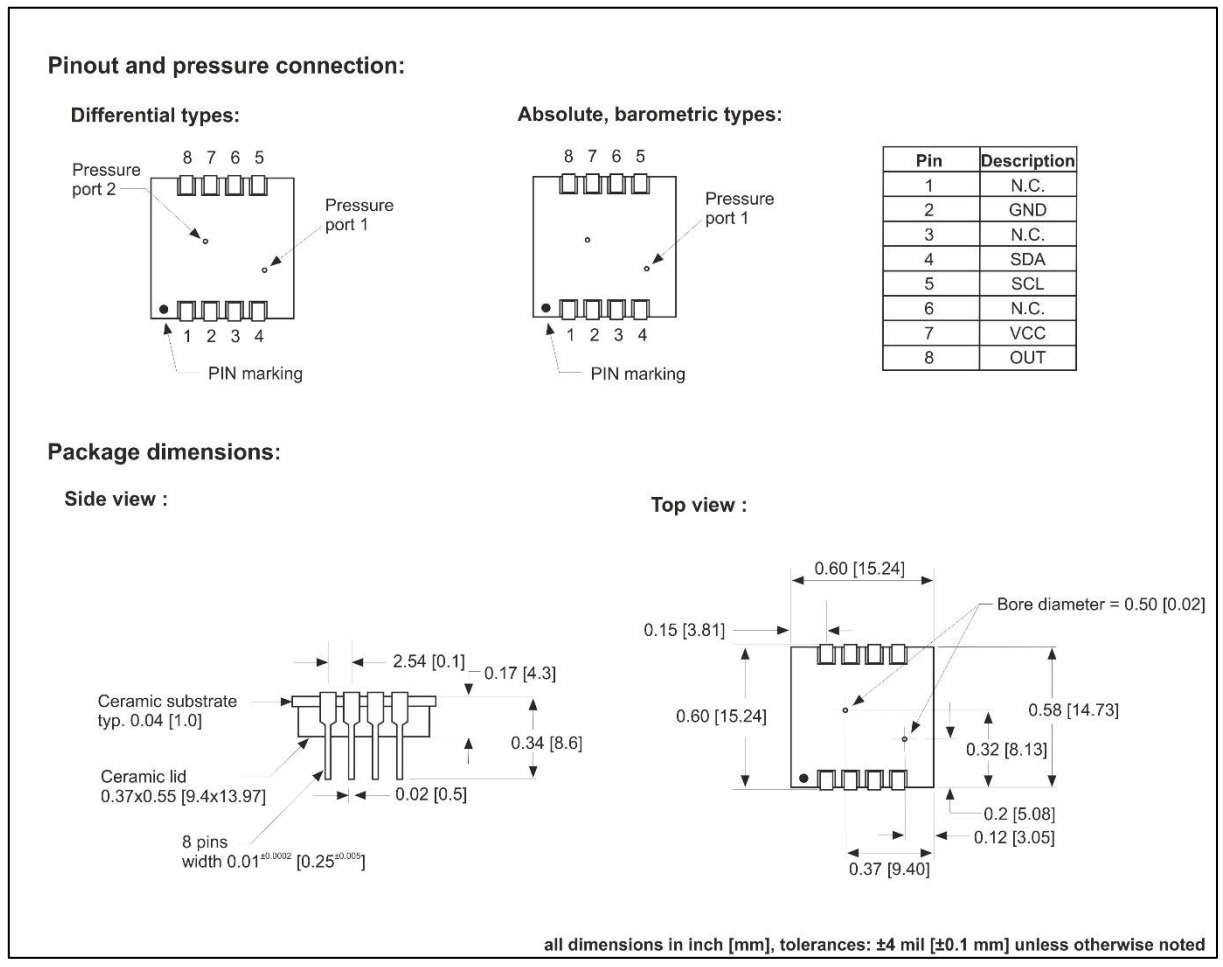
### DIMENSIONS AND PINOUT

AMS 5812 pressure sensors come in a dual-in-line package (DIP-08, width: 600 mil) for assembly on printed circuit boards (PCB).

The pinout and dimensions of AMS 5812's dual-in-line package are shown in *Figure 5* for sensor types with vertical metal tubes (for connection with pressure hoses) and in *Figure 6* for sensor types for manifold assembly (-N option without tubes).



**Figure 5: Dimensions and pinout for AMS 5812's standard package with vertical metal tubes**



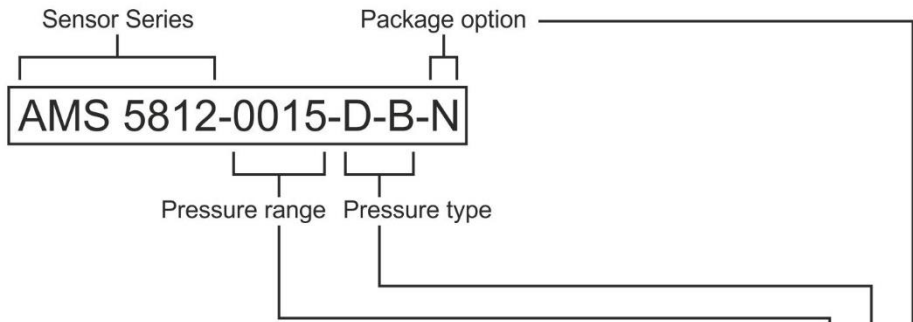
**Figure 6: Dimensions and pinout for AMS 5812's -N package option (package for manifold assembly without tubes)**

**Notes on “Dimensions and Pinout” (Figure 5 and Figure 6):**

1. Packages with SMT Pins (J-Lead) are available on request.
2. A package variant with one single tube for relative / gage pressure sensors is available on request.
3. Pressure port 2 applies pressure to the piezoresistive silicon sensing element's backside and is therefore compatible with non-corrosive liquids. For media compatibility of pressure port 1 and port 2 see “Specification notes”, 7 and 8.
4. For automatic soldering (lead-free wave or reflow soldering) of AMS 5812 a peak temperature of 250 °C for a maximum of 20 to 30 seconds is recommended. A typical temperature profile for Pb-free assembly is given by IPC/JEDEC J-STD-020D, Table 5-2.
5. All sensors in the AMS 5812 series are maintenance free during their lifetime.

INFORMATION FOR ORDERING

Ordering code:



Pressure range code	psi	mbar	kPa
015W	0.054	3.73	0.373
0000	0.075	5.17	0.517
0001	0.15	10.34	1.034
0003	0.3	20.68	2.068
0004	0.4	27.58	2.758
0008	0.8	55.16	5.516
0015	1.5	103.4	10.34
0030	3.0	206.8	20.68
0050	5.0	344.7	34.47
0150	15	1034	103.4
0300	30	2068	206.8
0600	60	4137	413.7
1000	100	6895	689.5

Code	Pressure Type	Available pressure ranges
D	Differential / relative (gage)	0 ... 0.075 psi to 0 ... 100 psi
D-I	Inverted differential / relative (gage)	0 ... 0.075 psi to 0 ... 100 psi
D-B	Bidirectional differential	-0.054 ... +0.054 psi to -100 ... +100 psi
A	Absolute	0 ... 5 psi to 0 ... 30 psi
B	Barometric (absolute)	11 ... 17.5 psi

Code	Package option	Available pressure ranges
	Standard package	0 ... 0.075 psi to 0 ... 100 psi
N	Manifold mount package	0 ... 0.075 psi to 0 ... 100 psi

**ADDITIONAL EQUIPMENT**

Ordering code	Description
USB starter kit AMS 5812	A USB starter kit interfacing AMS 5812 to a Windows PC (Windows XP, 7 or 10) via a USB port. It consists of two PCBs and software. The kit can be used for quick and easy evaluation of AMS 5812, data readout, data logging and to change AMS 5812's I2C address.
AMS 5812 – Arduino PCB	An adapter PCB board, which can be used to interface AMS 5812 with an Arduino Uno. A library and example code for Arduino's IDE are available for download at <a href="http://www.analog-micro.com">www.analog-micro.com</a>
AMS 5812 Arduino Nano Kit	A kit used to interface AMS 5812 to an Arduino Nano directly. It consists of two PCBs, an AMS Arduino Nano Shield and an AMS 5812 Mini PCB, as well as a matching ribbon cable. A library and example code for Arduino's IDE is available for download at <a href="http://www.analog-micro.com">www.analog-micro.com</a>

For more information on additional equipment see [AMS 5812's product page](#)

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