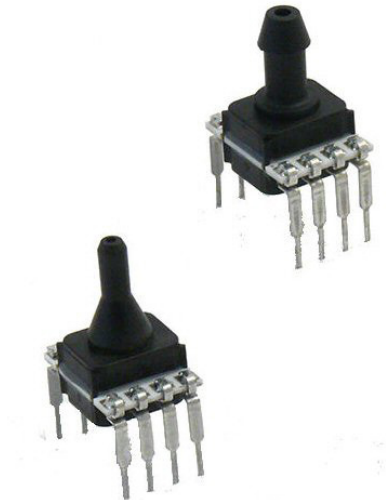


## HME series – amplified pressure sensors

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The HME pressure sensors provide digital output signals via a SPI bus interface and utilise precision digital signal conditioning to achieve high accuracies. The sensors offer an increased media compatibility to measure gases and liquids. 5 V and 3 V supply versions are available. Very small DIP housings allow for space-saving PCB-mounting. All HME pressure sensors can be modified according to customer specific requirements.



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### Features

- Pressure ranges from 2.5 mbar to 1 bar, 1 psi to 150 psi gage or differential pressure
- Increased media compatibility<sup>(1)</sup>
- Digital SPI bus output
- Precision ASIC signal conditioning
- Calibrated and temperature compensated<sup>(2)</sup>
- DIP housings

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### Certificates

- Quality Management System according to EN ISO 13485:2003 and EN ISO 9001:2008
- RoHS and REACH compliant

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### Media compatibility

**High pressure port:**

To be used with gases and liquids which are compatible with the wetted materials (high temperature polyamide, ceramic  $AL_2O_3$ , epoxy, fluorosilicone, glass, silicon).

**Low pressure port:**

To be used with non-corrosive, non-ionic working fluids such as clean dry air, dry gases and the like.

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### Applications

- Industrial controls
- Pneumatic controls
- Environmental controls
- HVAC
- Instrumentation
- Analytical instruments
- Medical devices

#### Specification notes

(1) All wetted materials are selected to give a high level of media compatibility. Media compatibility refers to media inside the pressure port and lid. Improved media compatibility on high pressure port (backward side of sensor chip) since media has no contact to electronic components. Nevertheless tests with the media used in the specific application are recommended.

(2) Sensor is calibrated in air, changes in sensor behaviour based on physical effects caused by the specific media can occur. Weight of the media and wetting forces can influence the sensor characteristics.

## HME series – amplified pressure sensors

### Maximum ratings

Parameter		Min.	Typ.	Max.	Unit
Supply voltage ( $V_s$ ) <sup>(3)</sup>	HME...3	2.7	3.0	4.2	$V_{dc}$
	HME...5	4.2	5.0	5.5	
Output current	Sink		1		mA
	Source		1		
Temperature ranges	Compensated	-20		+85	
	Operating	-20		+85	°C
	Storage <sup>(4)</sup>	-40		+125	
Humidity limits (non-condensing) <sup>(5)</sup>				95	%RH
Vibration	10...2000 Hz, random (EN 60068-2-64)			10	g
Mechanical shock	11 ms (EN60068-2-27)			50	
Lead solder temperature	(JESD22-B106D)			270	°C

### Pressure sensor characteristics

Part no.	Operating pressure	Proof pressure <sup>(6)</sup>
HMEM2x5U...	0...2.5 mbar	100 mbar
HMEM2x5B...	0...±2.5 mbar	
HMEM005U...	0...5 mbar	
HMEM005B...	0...±5 mbar	
HMEM010U...	0...10 mbar	300 mbar
HMEM010B...	0...±10 mbar	
HMEM020U...	0...20 mbar	
HMEM020B...	0...±20 mbar	
HMEM050U...	0...50 mbar	2 bar
HMEM050B...	0...±50 mbar	
HMEM100U...	0...100 mbar	
HMEM100B...	0...±100 mbar	
HMEM250U...	0...250 mbar	10 bar
HMEM250B...	0...±250 mbar	
HMEB001U...	0...1 bar	5 bar
HMEB001B...	0...±1 bar	14 bar
HMEB2x5U...	0...2.5 bar	
HMEB005U...	0...5 bar	30 psi
HMEB010U...	0...10 bar	
HMEP001U...	0...1 psi	200 psi
HMEP001B...	0...±1 psi	
HMEP100U...	0...100 psi	

Other pressure ranges are available on request. Please contact First Sensor.

#### Specification notes

(3) The sensor might not function or be operable above an absolute maximum rating of  $V_s=6.5$  V.

(4) Storage temperature of the sensor without package.

(5) Tested 1h, up to 85 °C. 100 % condensing or direct liquid media on high pressure port.

(6) Proof pressure is the maximum pressure which may be applied without causing durable shifts of the electrical parameters of the sensing element.

## HME series – amplified pressure sensors

### Performance characteristics <sup>(7)</sup>

(T<sub>A</sub>=25 °C, RH=50 %,

for HME...3 devices (V<sub>S</sub>=3.0 V<sub>DC</sub>) digital output signal is non-ratiometric to V<sub>S</sub> in the range of V<sub>S</sub> =2.7...4.2 V,  
for HME...5 devices (V<sub>S</sub>=5.0 V<sub>DC</sub>) digital output signal is non-ratiometric to V<sub>S</sub> in the range of V<sub>S</sub> =4.2...5.5 V)

Parameter		Min.	Typ.	Max.	Unit
Non-linearity (-20...85 °C) <sup>(8)</sup>				±0.25	
Accuracy <sup>(9)</sup>				±0.25	
Total accuracy (-20...85 °C) <sup>(10)</sup>	up to 5 mbar			±2	%FSS
	10 mbar to 50			±1.25	
	all others			±0.75	
Response delay <sup>(11)</sup>			0.5		ms
A/D resolution			12		bit
D/A resolution				11	bit
Current consumption	5 V devices	<1 bar	4.2		mA
		all others	5.3		
	3 V devices	<1 bar	3.7		
		all others	4.5		

### Pressure ranges up to 5 mbar

#### Unidirectional devices

Parameter	Min.	Typ.	Max.	Unit
Zero pressure offset	2460	3000	3540	
Full scale span (FSS) <sup>(12)</sup>		27000		counts
Full scale output	29460	30000	30540	

#### Bidirectional devices

Parameter	Min.	Typ.	Max.	Unit
Zero pressure offset	15960	16500	17040	
Full scale span (FSS) <sup>(12)</sup>		27000		counts
Full scale output	@ max. specified pressure	29460	30000	30540
	@ min. specified pressure	2460	3000	3540

#### Specification notes (cont.)

(7) Sensor is calibrated in air, changes in sensor behaviour based on physical effects caused by the specific media can occur. Weight of the media and wetting forces can influence the sensor characteristics.

(8) Non-linearity is the measured deviation based on Best Fit Straight Line (BFSL).

(9) Accuracy is the combined error from non-linearity and hysteresis. Hysteresis is the maximum output difference at any point within the operating pressure range for increasing and decreasing pressure.

(10) Total accuracy is the combined error from offset and span calibration, non-linearity, pressure hysteresis, and temperature effects. Calibration errors include the deviation of offset and full scale from nominal values.

(11) Max. delay time between pressure change at the pressure die and signal change at the output.

(12) Full Scale Span (FSS) is the algebraic difference between the output signal for the highest and lowest specified pressure.

## HME series – amplified pressure sensors

### Performance characteristics (cont.)<sup>(7)</sup>

(TA=25 °C, RH=50 %, for HME...3 devices (VS=3.0 VDC) digital output signal is non-ratiometric to VS in the range of VS =2.7...4.2 V, for HME...5 devices (VS=5.0 VDC) digital output signal is non-ratiometric to VS in the range of VS =4.2...5.5 V)

#### Pressure ranges from 10 mbar to 50 mbar / 1 psi

##### Unidirectional devices

Parameter	Min.	Typ.	Max.	Unit
Zero pressure offset	2663	3000	3338	
Full scale span (FSS) <sup>(12)</sup>		27000		counts
Full scale output	29663	30000	30338	

##### Bidirectional devices

Parameter	Min.	Typ.	Max.	Unit	
Zero pressure offset	16163	16500	17040		
Full scale span (FSS) <sup>(12)</sup>		27000		counts	
Full scale output	@ max. specified pressure	29663	30000	30338	
	@ min. specified pressure	2663	3000	3338	

#### All other pressure ranges

##### Unidirectional devices

Parameter	Min.	Typ.	Max.	Unit
Zero pressure offset	2798	3000	3203	
Full scale span (FSS) <sup>(12)</sup>		27000		counts
Full scale output	29798	30000	30203	

##### Bidirectional devices

Parameter	Min.	Typ.	Max.	Unit	
Zero pressure offset	16298	16500	16703		
Full scale span (FSS) <sup>(12)</sup>		27000		counts	
Full scale output	@ max. specified pressure	29798	30000	30203	
	@ min. specified pressure	2798	3000	3203	

#### Specification notes (cont.)

(7) Sensor is calibrated in air, changes in sensor behaviour based on physical effects caused by the specific media can occur. Weight of the media and wetting forces can influence the sensor characteristics.

(12) Full Scale Span (FSS) is the algebraic difference between the output signal for the highest and lowest specified pressure.

## HME series – amplified pressure sensors

### SPI - Serial Peripheral Interface

#### Introduction

The HME is capable to generate a digital output signal. The device runs a cyclic program, which will store a corrected sensor value with 12 bit resolution about every 500  $\mu$ s within the output registers of the internal ASIC. This cyclic program runs independent from the bus communication. In order to use the pressure sensor for digital signal readout, it should be connected to a SPI Master device.

SPI specifies four signals: The clock (CLK) is generated by the master and input to all slaves. MOSI carries data from master to slave. MISO carries data from slave back to master. A slave select line (SS) allows individual selection of a slave device.

#### SPI Modes

A pair of parameters called clock polarity (CPOL) and clock phase (CPHA) determine the edges of the clock signal on which the data are driven and sampled. Each of the two parameters has two possible states, which allows for four possible combinations, all of which are incompatible with one another.

In general the HME series supports all combinations of clock phase (CPHA) and polarity (CPO). By default it is programmed to CPHA = 0 and CPOL = 0, which means that data transmission starts with the rising first clock edge (see Fig. 1).

#### Slave select

The falling edge of the SS line indicates the beginning of the transfer. Additionally the SS line must not be negated and reasserted between the three bytes to be transmitted.

#### Data Operation

The MOSI line should always be set to high level. So there is no data transmission from master to slave. Because of internal configuration the slave will answer the first byte with an FFh. The second and third byte contain the 15 bit pressure information (see Fig. 2).

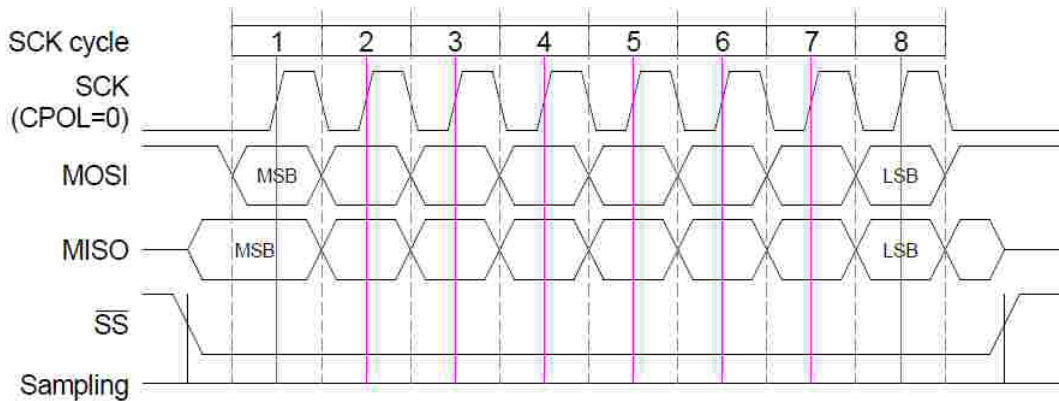


Fig. 1: Example of a standard 1 byte SPI data transfer for CPHA = 0 and CPOL = 0

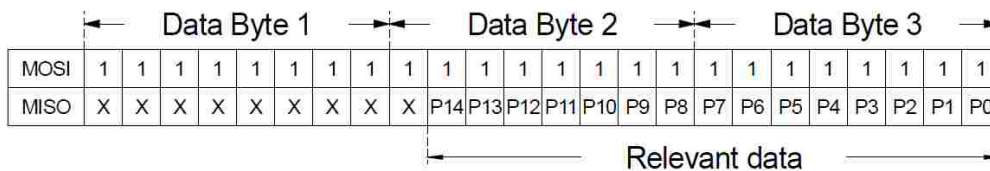


Fig. 2: 3 byte data stream between HME sensor and master containing the pressure value as a 15 bit information

## HME series – amplified pressure sensors

### SPI - Serial Peripheral Interface (cont.)

Interface parameters

Parameter		Min.	Typ.	Max.	Unit
Input high level		90		100	
Input low level		0		10	% of $V_s$
Output low level				10	
Pull-up resistor		1		5	$k\Omega$
Load capacitance @ MISO	$C_{MISO}$			400	pF
Input capacitance @ each pin	$C_{SPI\_IN}$			10	
Signal clock frequency	$f_{SCK}$	100*		640	kHz
MISO hold time after SCK sample slope	$t_{SPI\_HD\_MISO}$	200			ns
MISO setup time before SCK sample slope	$t_{SPI\_SU\_MISO}$	$2/f_{CLK}$			
/SS setup time before SCK sample slope	$t_{SPI\_SU\_SS}$	10			ns
/SS hold time after SCK sample slope	$t_{SPI\_HD\_SS}$	$1/f_{CLK}$			

\*recommended

**Note:** First Sensor recommends communication speeds of at least 100 kHz (max. 640 kHz).  
Please contact your nearest First Sensor sales office for further information.

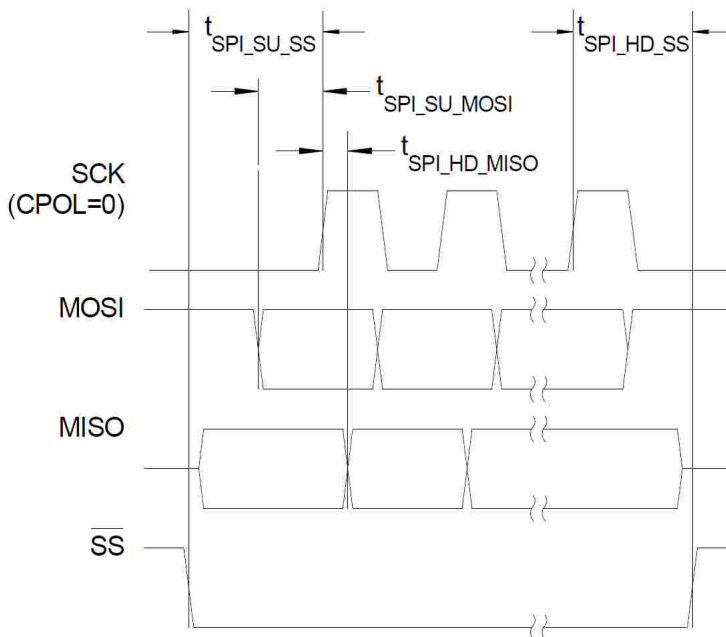


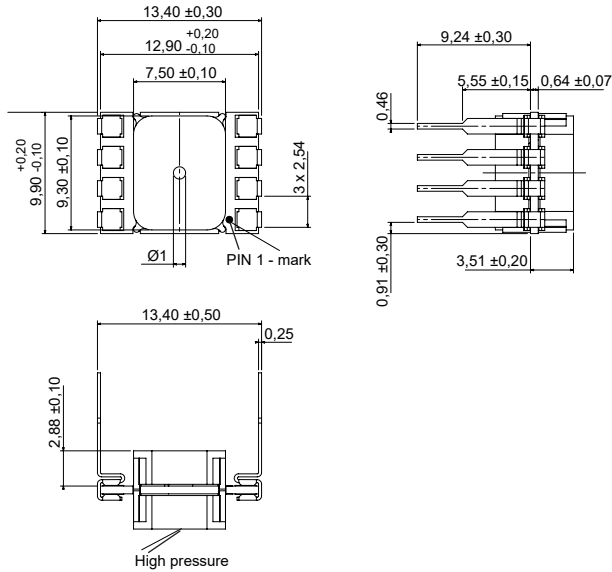
Fig. 3: Timing characteristics

## HME series – amplified pressure sensors

### Dimensional drawing

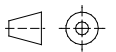
### Electrical connection

#### HME...W1... (DIP, axial no ports)



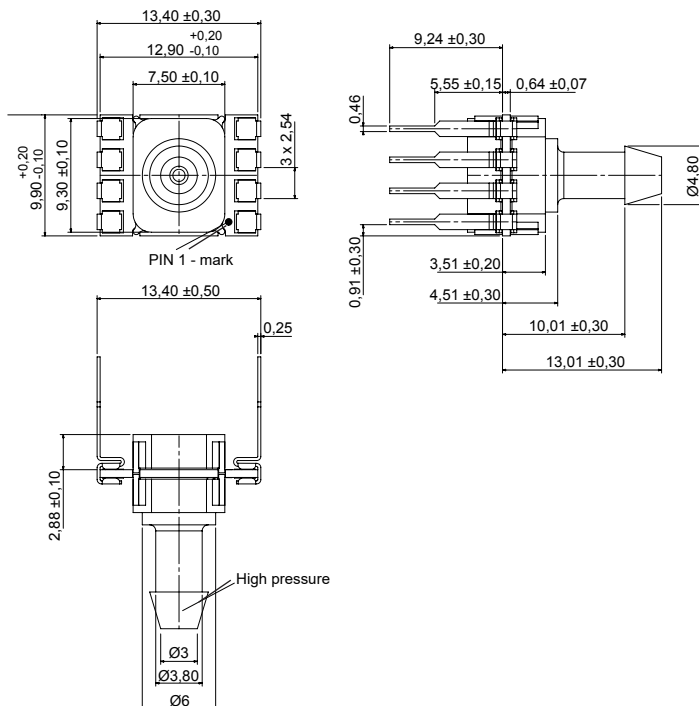
Pin	connection
1	+Vs
2	GND
3	C
4	MISO
5	CLK
6	SS
7	I / C*
8	MOSI

\* internal connection. Do not connect for any reason



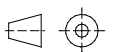
first angle projection  
dimensions in mm

#### HME...Z7... (DIP, 1 port axial, barbed)



Pin	connection
1	+Vs
2	GND
3	C
4	MISO
5	CLK
6	SS
7	I / C*
8	MOSI

\* internal connection. Do not connect for any reason

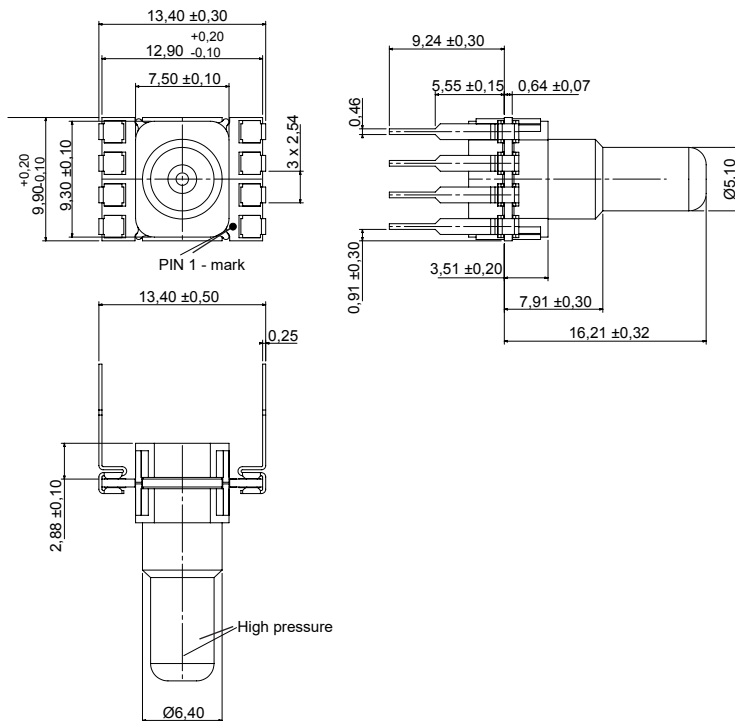


first angle projection  
dimensions in mm

## HME series – amplified pressure sensors

### Dimensional drawing

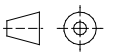
#### HME...Z6... (DIP, 1 port axial, straight big)



### Electrical connection

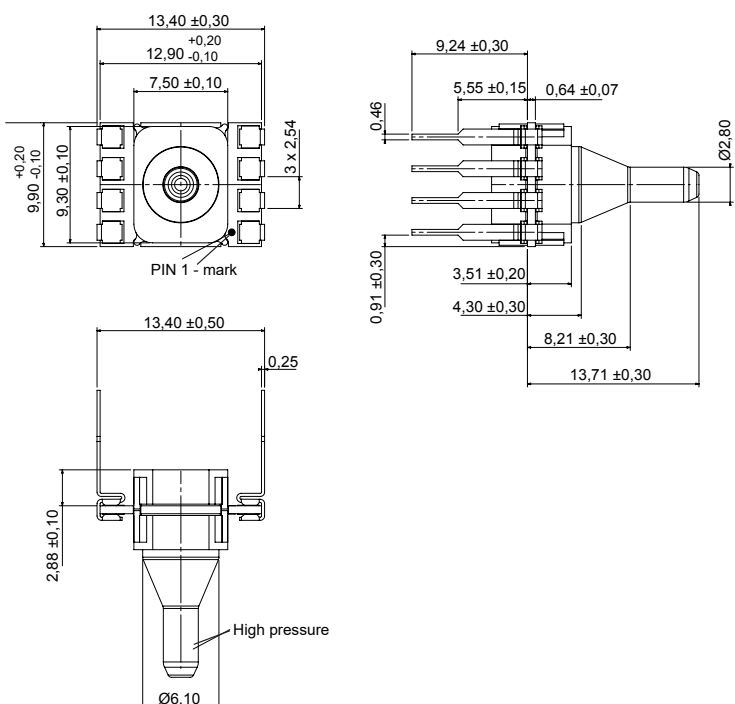
Pin	connection
1	+Vs
2	GND
3	C
4	MISO
5	CLK
6	SS
7	I / C*
8	MOSI

\* internal connection. Do not connect for any reason



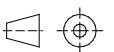
first angle projection  
dimensions in mm

#### HME...Z5... (DIP, 1 port axial, needle big)



Pin	connection
1	+Vs
2	GND
3	C
4	MISO
5	CLK
6	SS
7	I / C*
8	MOSI

\* internal connection. Do not connect for any reason

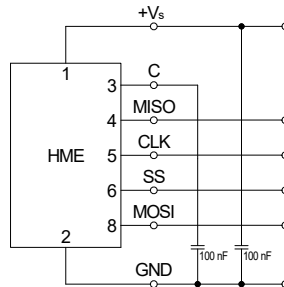


first angle projection  
dimensions in mm



## HME series – amplified pressure sensors

### Electrical connection (cont.)



### Ordering information

Series	Pressure range	Calibration	Housing	Porting	Grade	Voltage	
HME	M2x5	2.5 mbar	B Bidirectional	W [DIP, 2 ports axial, opposite side]	1 no port	H High	3 3 V
	M005	5 mbar	U Unidirectional	Z [DIP, 1 port axial]	7 Barbed		5 5 V
	M010	10 mbar			5 Needle big		
	M020	20 mbar			6 Straight big		
	M050	50 mbar					
	M100	100 mbar					
	M250	250 mbar					
	B001	1 bar					
	B2x5	2.5 bar					
	B005	5 bar					
	B010	10 bar					
	P001	1 psi					
	P100	100 psi					

**Note: Not all possible sensor configurations are active products. MOQ may apply. Custom specific pressure and temperature ranges as well as mechanical or electronic sensor modifications are widely available. Please contact First Sensor.**

Order code example: HMEB010UZ7H3

### Label information

Digit	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Series		Pressure range	Pressure unit / pressure mode / calibration		Housing	Porting	Grade / voltage		Rev	Date code (year)		Production code	
Char	M	E	HME	1	2.5 mbar	U	bar, gage/differential, unidirectional	W	DIP, 2 ports axial, opposite side	1	no port	-	High, 5 V	
				2	5 mbar					7	Barbed	/	High, 3 V	
				3	10 mbar	B	bar, gage/differential, bidirectional	Z	DIP, 1 port axial	5	Needle big			
				4	20 mbar					6	Straight big			
				5	50 mbar									
				6	1 psi									
				7	100 mbar									
				8	250 mbar									
				A	1 bar									
				B	2.5 bar									
				C	5 bar									
				L	100 psi									
				M	10 bar									