ALL SENSORS®
an Amphenol company

ELVA/ ELVE/ ELVI Series - Analog and Digital Pressure Sensor Product Series

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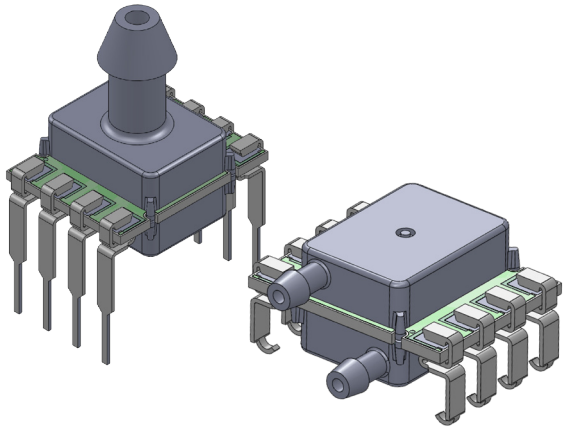

Introduction

The ELVA/ ELVE/ ELVI Analog and Digital Pressure Sensor Series consists of four new product families featuring All Sensors' ultra low pressure CoBeam^{2} ™ Technology. This innovative sensing element technology provides best-in-class stability for low and ultra low pressure ranges, with the ability to customize calibrations and pressure ranges from a proven world class supplier.

This set of product families series gives design engineers outstanding flexibility with an exceptional number of choices in package combination.

The digital interface eases integration of the sensors into a variety of process control and measurement systems, allowing direct connection to serial communications channels.

These calibrated and compensated sensors provide accurate, stable output over a wide temperature range. This series is intended for use with non-corrosive, non-ionic working fluids such as air and other dry gases. A protective parylene coating is optionally available for moisture/harsh media protection.

For All Sensors Corporation's most recent quality certification documents, please visit www.allsensors.com

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Features

- Pressure Ranges from ±1 psi to 100 psi and ±100 mbar to ±10 bar
- Precision ASIC Conditioning
- Digital I²C or SPI Interface or Analog Only Options
- 3V and 5V Supply Voltage Options

Applications

- Medical Devices
- Medical Instrumentation
- Respiratory
- Portable / Hand-Held Equipment
- Environmental Controls
- Environmental Instrumentation
- Environmental Monitoring
- HVAC
- Industrial Controls
- Altimeters
- Chemical Analysis
- Meteorology

Wetted Media

- Silicon
- RTV
- Gold
- Ceramic
- Epoxy
- Nylon Plastic
- Aluminum

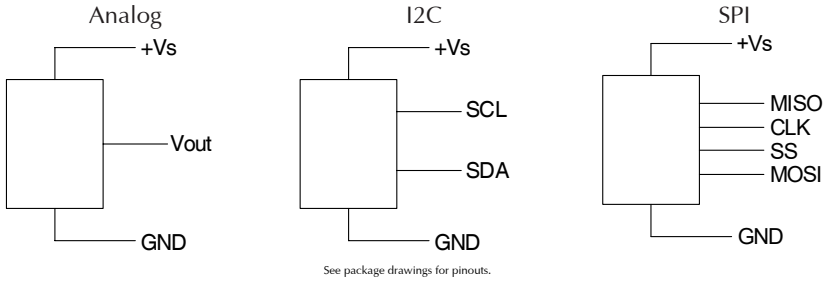
Pressure Sensor Maximum Ratings

Supply Voltage (Vs)	2.7 to 5.5 Vdc
Lead Temperature (soldering 2-4 sec.)	270°C
Device Temperature (reflow soldering)	245°C

Environmental Specifications

Temperature Ranges		
Compensated:	Standard	0°C to 50°C
	Industrial	-20°C to 85°C
Operating		-40°C to 85°C
Storage		-40°C to 125°C
Humidity Limits (non condensing)		0 to 95% RH

Equivalent Circuit



See package drawings for pinouts.

ELVA, ELVE, ELVI Product Family Highlights

- 100 mbar up to 10 bar pressure ranges
- Offered in Differential, Gage and Absolute pressure modes
- -20 to 85°C Temperature compensation
- Output options offered:
    - ELVI I2C only, non-ratiometric
    - ELVE SPI only, non-ratiometric
    - ELVA Analog only, ratiometric
- 3V and 5V Supply Voltage offerings
- Available in Numerous Port options:
    - No port
    - Barbed axial port
    - Needle big port
    - Other packages also available, check with factory
- Numerous lead options:
    - SMT J-lead
    - DIP lead
    - SIL lead
- Optional Parylene Coating available

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ELVI, ELVE, ELVA Series Pressure Ranges

Pressure Range[1]					Proof Pressure[2]		Burst Pressure[3]		Common Mode Pressure[4]	
CODE	Pmin mbar	Pmax mbar	Pressure Mode	kPa	mbar	kPa	mbar	kPa	mbar	kPa
M100D	-100	100	Differential	10	1034	103	1034	103	1034	103
M160D	-160	160	Differential	16	1034	103	1034	103	1034	103
M250D	-250	250	Differential	25	1034	103	1034	103	1034	103
M500D	-500	500	Differential	50	1034	103	1034	103	1034	103
M100G	0	100	Gage	10	850	85	1034	103	1034	103
M160G	0	160	Gage	16	1034	103	1034	103	1034	103
M250G	0	250	Gage	25	1034	103	1034	103	1034	103
M500G	0	500	Gage	50	1034	103	1034	103	1034	103
CODE	Pmin bar	Pmax bar	Pressure Mode	kPa	bar	kPa	bar	kPa	bar	kPa
B001D	-1	1	Differential	100	3.1	310	10.3	1034	17.2	1724
B001G	0	1	Gage	100	3.1	310	10.3	1034	17.2	1724
BF25G	0	2.5	Gage	250	6	620	17.2	1724	17.2	1724
B005G	0	5	Gage	500	12	1240	17.2	1724	17.2	1724
B010G	0	10	Gage	1000	14	1400	17.2	1724	17.2	1724
B001A	0	1	Absolute	100	1	100	1.0	103	1.0	103
B002A	0	2	Absolute	200	5	500	10.3	1034	17.2	1724
CODE	Pmin psi	Pmax psi	Pressure Mode	kPa	psi	kPa	psi	kPa	psi	kPa
001D	-1	1	Differential	7	15	103	15	103	15	103
001G	0	1	Gage	7	15	103	15	103	15	103
100G	0	100	Gage	690	200	1379	250	1724	250	1724

ELVI & ELVE Output Series Performance Table

Performance specified @ 5V ± 5% for 5V nominal Vs, 3V ± 5% for 3V nominal Vs, Ref temp 25°C.
Positive Pressure applied to Port B (top port)

Parameter	Digital				
	Min	Typ	Max	Units	Notes
Full Scale Span (FSS)	-	27000	-	Count (Dec)	1
Full Scale Output (FSO)					
Min Pressure	2595	3000	3405	Count (Dec)	-
Max Pressure	29595	30000	30405	Count (Dec)	-
Offset					
xxxD (Differential)	16095	16500	16905	Count (Dec)	-
xxxG (Gage), xxxA (Absolute)	2595	3000	3405	Count (Dec)	-
Accuracy	-	-	±0.25	%FSS	2
Total Error Band (TEB)	-	-	±1.5	%FSS	3
A/D Resolution	-	12	-	bit	-
Response Delay	-	0.5	-	ms	4
Current Consumption					
3V Supply Option	-	4.5	-	mA	-
5V Supply Option	-	5.3	-	mA	-

ELVI & ELVE Output Performance Specification Notes

Note 1: Full Scale Span (FSS) is the algebraic difference between the output signal for the highest and lowest specified pressure.

Note 2: Accuracy is the measured deviation based on Best Fit Straight Line (BFSL).

Note 3: Total Error Band (TEB) is the combination of errors including offset, span, linearity, pressure hysteresis, temperature effect on offset, and temperature effect on span.

Note 4: Max. delay time between pressure change at the pressure die and signal change at the output.

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ELVA Output Series Performance Table

Performance specified @ 5V ± 5% for 5V nominal Vs, 3V ± 5% for 3V nominal Vs, Ref temp 25°C. Positive Pressure applied to Port B (top port)

Parameter	Analog				
	Min	Typ	Max	Units	Notes
Full Scale Span (FSS)					
3V Supply Option	-	2.4	-	V	5
5V Supply Option	-	4	-	V	5
Full Scale Output (FSO) (3V Option)					
Min Pressure	0.26	0.3	0.34	V	-
Max Pressure	2.66	2.7	2.74	V	-
Full Scale Output (FSO) (5V Option)					
Min Pressure	0.44	0.5	0.56	V	-
Max Pressure	4.44	4.5	4.56	V	-
Offset (3V Option)					
xxxD (Differential)	1.46	1.5	1.54	V	-
xxxG (Gage), xxxA (Absolute)	0.26	0.3	0.34	V	-
Offset (5V Option)					
xxxD (Differential)	2.44	2.5	2.56	V	-
xxxG (Gage), xxxA (Absolute)	0.44	0.5	0.56	V	-
Accuracy	-	-	±0.25	%FSS	6
Total Error Band (TEB)	-	-	±1.5	%FSS	7
A/D Resolution	-	12	-	bit	-
D/A Resolution	-	11	-	bit	-
Response Delay	-	0.5	-	ms	8
Current Consumption					
3V Supply Option	-	4.5	-	mA	-
5V Supply Option	-	5.3	-	mA	-

ELVA Output Performance Specification Notes

Note 5: Full Scale Span (FSS) is the algebraic difference between the output signal for the highest and lowest specified pressure.

Note 6: Accuracy is the measured deviation based on Best Fit Straight Line (BFSL).

Note 7: Total Error Band (TEB) is the combination of errors including offset, span, linearity, pressure hysteresis, temperature effect on offset, and temperature effect on span.

Note 8: Max. delay time between pressure change at the pressure die and signal change at the output.

How to Order ELVI Series

For example, **ELVI-M100D-HAAF-C-N2E3** defines an All Sensors ELVI Series Digital Presure Sensor, 100 mbar differential pressure range, HAAF package (SIL F-Lead with barbed top port), compensated temperature range from 0°C to 50°C, no parylene coating, I2C Output, Address 0x28, 9.16% to 91.55% of 2^{15} counts (digital) transfer function and 3 Vdc supply voltage.

ELVI - M100D - HAAF - C - N 2 E 3

Product Series

ELVI	Digital Series

Pressure Ranges Note 10

Differential		Gage		Absolute	
M100D	± 100 mbar	M100G	0 to 100 mbar	B001A	0 to 1 bar
M160D	± 160 mbar	M160G	0 to 160 mbar	B002A	0 to 2 bar
M250D	± 250 mbar	M250G	0 to 250 mbar		
M500D	± 500 mbar	M500G	0 to 500 mbar		
B001D	± 1 bar	B001G	0 to 1 bar		
001D	± 1 psi	BF25G	0 to 2.5 bar		
		B005G	0 to 5 bar		
		B010G	0 to 10 bar		
		001G	0 to 1 psi		
		100G	0 to 100 psi		

Compensated Temperature Range

C	0°C to 50°C
I	-20°C to 85°C

Coating

N	No Parylene
P	Parylene

Supply Voltage

3	3 Vdc
5	5 Vdc

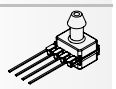
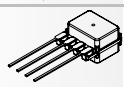
Transfer Function

E	3,000 to 30,000 Digital Counts

Output Interface

		Package Pinout Offering Code*		
		DIP (8 Pin)	SMT (8 Pin)	SIL (4 Pin)
2	I²C, Address 0x28	1	1	5
3	I²C, Address 0x38	1	1	5
4	I²C, Address 0x48	1	1	5
5	I²C, Address 0x58	1	1	5
6	I²C, Address 0x68	1	1	5
7	I²C, Address 0x78	1	1	5

Package Selection (4 Character Code) Note 10

DIP	SIL F-Lead	SMT J-Lead
—	HAAF 	—
HAND 	HANF 	HANJ 
HCND 	—	—
HKND 	HKNF 	HKNJ 
HNND 	HNNF 	HNNJ 

***Package Pinout Offering Code Legend**

Pin Code	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8
1	Vs	GND	N/C	N/C	SCL	N/C	N/C	SDA
5	Vs	GND	SCL	SDA	-	-	-	-

N/C: Not Internally Connected

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How to Order ELVE Series

For example, **ELVE-M100D-HAND-C-NTE3** defines an All Sensors ELVE Series Digital Presure Sensor, 100 mbar differential pressure range, HAND package (DIP with barbed top port), compensated temperature range from 0°C to 50°C, no parylene coating, SPI Output, 9.16% to 91.55% of 2^{15} counts transfer function and 3 Vdc supply voltage.

ELVE - M100D - HAND - C - N T E 3

Product Series

ELVE	Digital Series

Pressure Ranges Note 10

Differential		Gage		Absolute	
M100D	± 100 mbar	M100G	0 to 100 mbar	B001A	0 to 1 bar
M160D	± 160 mbar	M160G	0 to 160 mbar	B002A	0 to 2 bar
M250D	± 250 mbar	M250G	0 to 250 mbar		
M500D	± 500 mbar	M500G	0 to 500 mbar		
B001D	± 1 bar	B001G	0 to 1 bar		
001D	± 1 psi	BF25G	0 to 2.5 bar		
		B005G	0 to 5 bar		
		B010G	0 to 10 bar		
		001G	0 to 1 psi		
		100G	0 to 100 psi		

Compensated Temperature Range

C	0°C to 50°C
I	-20°C to 85°C

Coating

N	No Parylene
P	Parylene

Supply Voltage

3	3 Vdc
5	5 Vdc

Transfer Function

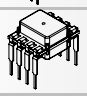
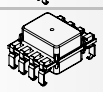
E	3,000 to 30,000 Digital Counts

Output Interface

T	SPI

Package Pinout Offering Code*		
DIP (8 Pin)	SMT (8 Pin)	SIL (4 Pin)
2	2	Not Available

Package Selection (4 Character Code) Note 10

DIP		SMT J-Lead	
HAND		HANJ	
HCND		—	
HKND		HKNJ	
HNND		HNNJ	

***Package Pinout Offering Code Legend**

Pin Code	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8
2	Vs	GND	N/C	MISO	SCLK	SS	N/C	MOSI

N/C: Not Internally Connected

How to Order ELVA Series

For example, **ELVA-M100D-HAAF-C-NBF3** defines an All Sensors ELVA Series Analog Presure Sensor, 100 mbar differential pressure range, HAAF package (SIL F-Lead with barbed top port), compensated temperature range from 0°C to 50°C, no parylene coating, Analog Output, 10 to 90% Vsupply transfer function and 3 Vdc supply voltage.

ELVA - M100D - HAAF - C - N B F 3

Product Series

ELVA	Analog Series

Pressure Ranges Note 10

Differential		Gage		Absolute	
M100D	± 100 mbar	M100G	0 to 100 mbar	B001A	0 to 1 bar
M160D	± 160 mbar	M160G	0 to 160 mbar	B002A	0 to 2 bar
M250D	± 250 mbar	M250G	0 to 250 mbar		
M500D	± 500 mbar	M500G	0 to 500 mbar		
B001D	± 1 bar	B001G	0 to 1 bar		
001D	± 1 psi	BF25G	0 to 2.5 bar		
		B005G	0 to 5 bar		
		B010G	0 to 10 bar		
		001G	0 to 1 psi		
		100G	0 to 100 psi		

Compensated Temperature Range

C	0°C to 50°C
I	-20°C to 85°C

Coating

N	No Parylene
P	Parylene

Supply Voltage

3	3 Vdc
5	5 Vdc

Transfer Function

F	10% to 90% of Vs

Output Interface

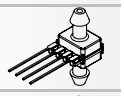
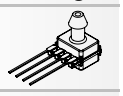
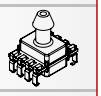
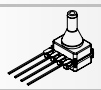
		Package Pinout Offering Code*		
		DIP (8 Pin)	SMT (8 Pin)	SIL (4 Pin)
B	Analog	3	3	4

***Package Pinout Offering Code Legend**

Pin Code	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8
3	Vs	GND	Vout	N/C	N/C	N/C	N/C	N/C
4	Vs	GND	Vout	N/C	-	-	-	-

N/C: Not Internally Connected

Package Selection (4 Character Code) Note 10

DIP	SIL F-Lead	SMT J-Lead
—	HAAF 	—
HAND 	HANF 	HANJ 
HCND 	—	—
HKND 	HKNF 	HKNJ 
HNND 	HNNF 	HNNJ 

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Device Options

Parylene Coating:

Parylene coating provides a moisture barrier and protection from some harsh media. Unlike other pressure sensor suppliers offering a Parylene coating, All Sensors performs this process in-house and uses an advanced production system to achieve the highest accuracy and reliability. This avoids transferring products out of and back to the pressure sensor manufacturing facility, provides complete quality control and improves the delivery time to customers. Specially designed masking techniques allow All Sensors to apply a cost-effective, high-volume Parylene coating in-house.

Consult factory for applicability of Parylene for the target application and sensor type.

Soldering Recommendations:

1) If possible, solder parts as a second operation only.
2) Post reflow and other high temperature processes, wait for 48 hrs before performing any calibration operations.
3) Perform spot cleaning as necessary only by hand. **DO NOT** wash or submerge device in cleaning liquid.
4) Max 270°C lead temperature (manual soldering 2-4 sec.)

If these devices are to be subjected to solder reflow assembly or other high temperature processing, they must be baked for 1 hour at 125°C within 24 hours prior to exposure. Failure to comply may result in cracking and/or delamination of critcal interfaces within the package, and is not covered by warranty.

Evaluation Kit:

All Sensors offers evaluation kits to help design engineers evaluate potential devices early in the development process.

For the ELVA/ELVE/ELVI series, All Sensors offers the EK-02 and EK-03 to allow for easy testing of the sensors.

Sensor Application Information

Transfer Functions:

Measurement systems employing ELV sensors typically need to process the sensor output in terms of standard pressure units. Converting the sensor outputs to these units is done using the transfer function equations defined below.

ELVI and ELVE sensors provide a *Full Scale Range (FSR)* of 32767 counts.

ELVA sensors have a corresponding output FSR from 0 volts (relative to sensor Ground pin) up to the sensor supply voltage (Vs). Unlike digital sensors, which provide an output in digital counts independent of changes in Vs, the Analog output is ratiometric, or proportional to the supply voltage.

The **difference** in output at the maximum and minimum calibrated pressures is the *Full Scale Span (FSS)* of the sensor.

The general form of the equation for converting sensor output to pressure is:

$$\textbf{P(units)} = \boldsymbol{Offset\ Pressure(Units)} + \left(\frac{\boldsymbol{SensorOutput - Offset\ Output}}{\boldsymbol{Full\ Scale\ Span}}\right) * \boldsymbol{Calibrated\ Range(Units)}$$

where

Offset Pressure (Units) is the minimum absolute value of pressure applied: for all Standard Gage, Differential, and Absolute products, this value is zero.

SensorOutput is the pressure reading, whether digital (in counts for I2C or SPI output) or analog (the sensor voltage output)

OffsetOutput is the sensor reading with no pressure applied; this is specified in the Performance Tables as **Offset**, for both digital and analog outputs. The ELVA Performance Table reports the Offset for each of the supply voltage options as the expected output for nominal Vs.

Full Scale Span as defined above is the difference in output at maximum and minimum calibrated pressures. This is specified in the Performance Tables as Full Scale Span.

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Sensor Application Information (Cont'd.)

For ELVI and ELVE sensors, the Full Scale Span is defined as 27000 counts (82.39% of FSR) in the Performance Tables.
For ELVA sensors, the Performance Table reports this as an expected output of 2.4V for Vs of 3V or 4V for Vs of 5V.

Calibrated Range is the difference between highest and lowest calibrated pressures.
For standard symmetrical Differential sensors, this is **twice** the maximum positive calibrated pressure.
That is, for example, a 5 PSID pressure range would have a 10 PSI Calibrated Span.

For Analog sensors, ELVA, it is important to note that the actual supply voltage (Vs) is the reference for sensor readings, *not* the nominal calibration voltage (3.0V or 5V). Both Sensor Offset and Full Scale Span must be derived from Vs for correct interpretation of the sensor voltage output.

For ELVA sensors, this requires normalizing the Performance Table values from the noted nominal Vs to actual Vs. In the case where an Analog to Digital converter is used, this is done simply by connecting the sensor Vs to the same supply rail as the ADC Reference Supply input.

Transfer Function Calculation Examples:

For ELVE or ELVI sensors:

Example 1: ELVE-M160D-xxxx-x-xTEx
Calibrated from -160 to 160 mbar; SPI output; standard transfer function.
From the Performance Table, Sensor Offset is 16500 counts, Full Scale Span is 27000 counts.
The Calibrated Range is 160mbar – (-160 mbar) = 320 mbar.
For a reading of 11350 counts, the pressure is then:
Pout = 0 + ((11350 – 16500)/27000) * 320 mbar
Pout = (-5150/27000) * 320 mbar = **-61.04 mbar**.

Example 2: ELVI-M250G-xxxx-x-x4Ex
Calibrated range of 0 to 250 mbar; I2C output; standard transfer function.
From the Performance Table, Sensor Offset is 3000 counts, Full Scale Span is 27000 counts.
The Calibrated Range is 250mbar – (0 mbar) = 250 mbar.
For a reading of 13500 counts, the pressure is then:
Pout = 0 + ((13500 – 3000)/27000) * 250 mbar
Pout = (13200/27000) * 250 mbar = **97.22 mbar**.

For ELVA sensors:

Example 3: ELVA-B001A-xxxx-x-xBF5
Calibrated from 0 to 1 bar; Analog output; 10% - 90% FSR transfer function,
5.0V *nominal* supply voltage.
For example, suppose that an *actual* Vs of 4.92V is present, not 5.00V.
The actual Full Scale Span is then:
FSS = 80% of Vs, = 0.80 * 4.92 = **3.94V**.
The Offset is 10% FSR, or
SensorOffset = 0.10 * 4.92V = **0.492V**.

For a reading of 1.125V, the pressure is then:
Pout = 0 + ((1.125V – 0.492V)/3.94V) * 1 bar.
Pout = (0.633/2.28) * 1 bar = **0.161 bar**.

I²C Interface for ELVI Series

Introduction

The ELVI series sensors provide a digital output signal. The device runs a continuous program, which will store a corrected pressure value every 0.5 ms in the output registers of the internal ASIC.

According to the I²C-bus specification, the bus is controlled by a master device, which generates the clock signal, controls the bus access, and generates START and STOP conditions. These sensors are designed to work as slave devices, and will only respond to requests from a master device.

Digital I²C Interface

These devices comply with the following protocol in Figure 1, and timing as specified in Table 3 and Figure 3.

Bus not busy : During idle periods, both data line (SDA) and clock line (SCL) remain HIGH.

START condition (S) : HIGH to LOW transition of SDA line while clock (SCL) is HIGH is interpreted as START condition. START conditions are always generated by the master. Each initial request for a pressure value has to begin with a START condition.

STOP condition (P) : LOW to HIGH transition of SDA line while clock (SCL) is HIGH determines STOP condition. STOP conditions are always generated by the master. More than one request for the current pressure value can be transmitted without genration of intermediate STOP condition.

DATA valid (D) : State of data line represents valid data when, after START condition, data line is stable for duration of HIGH period of clock signal. Data on line must be changed during LOW period of clock signal. There is one clock pulse per bit of data.

Acknowledge (A) : HIGH to LOW transition of SDA line while clock (SCL) is HIGH is interpreted as START condition. START conditions are always generated by the master. Each initial request for a pressure value has to begin with a START condition.

Slave address : The I²C-bus master-slave concept requires a unique address for each device. These sensors have a preconfigured slave address, see the ELVI "How to Order" table on page 7. The sensor will then listen to both this address and 0x78. After generating a START condition the master sends the address byte containing a 7 bit address followed by a data direction bit (R/W). A "0" indicates a trasmission from master to slave (WRITE), a "1" indicates a data request (READ).

DATA operation : The sensor sends 2 data bytes containing the current pressure value as a 15 bit value placed in the output registers.

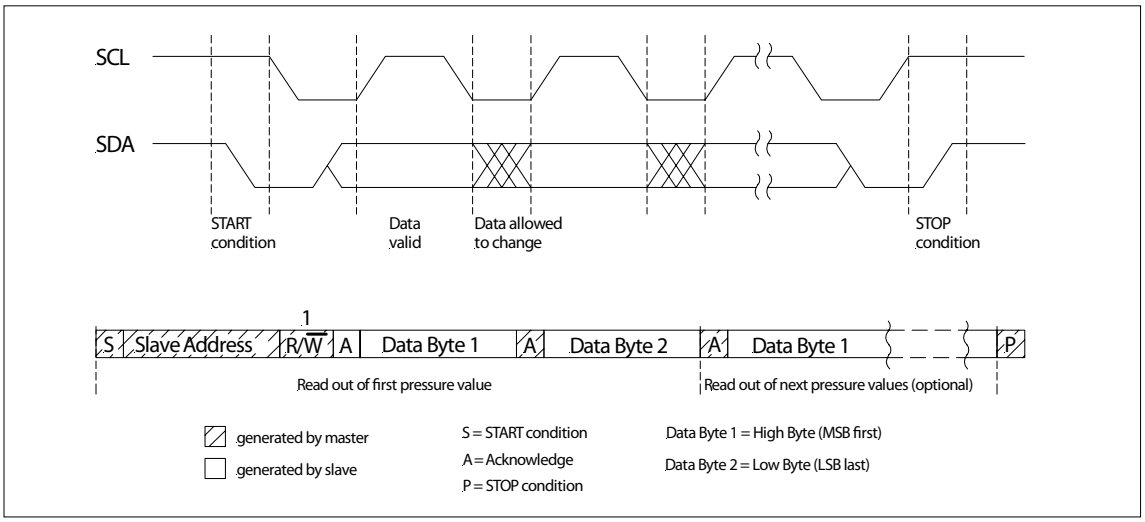

Figure 1: I²C bus protocol

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Table 3 - I2C Interface Parameters

I^2C Interface Parameters

Parameter	Symbol	Minimum	Nominal	Maximum	Unit	Specification Notes
Input High Level	-	70	-	100	% of Vs	9
Input Low Level	-	0	-	30	% of Vs	9
Output Low Level	-	-	-	10	% of Vs	9
Pull-Up Resistor	-	500	-	-	Ω	9
Load Capacitance @ SDA	C_{SDA}	-	-	400	pF	9
Input Capacitance @ SDA/SCL	C_{I2C_IN}	-	-	10	pF	9
Signal Clock Frequency	F_{SCL}	100*	-	400	kHZ	9
Bus Free Time Between STOP and START Condition	t_{BUF}	1.3	-	-	µs	9
Hold Time (Repeated) START Condition, to First Clock Pulse	$t_{HD.STA}$	0.8	-	-	µs	9
Low Period of SCL	t_{Low}	1.3	-	-	µs	9
High Period of SCL	t_{High}	0.6	-	-	µs	9
Setup Time Repeated START Condition	$t_{SU.STA}$	1	-	-	µs	9
Data Hold Time	$t_{HD.DAT}$	0	-	-	µs	9
Data Setup Time	$t_{SU.DAT}$	0.2	-	-	µs	9
Rise Time of Both SDA and SCL	t_R	-	-	0.3	µs	9
Fall Time of Both SDA and SCL	t_F	-	-	0.3	µs	9
Setup Time for STOP Condition	$t_{SU.STO}$	0.6	-	-	µs	9

Note 9: Parameter is characterized and not 100% tested.

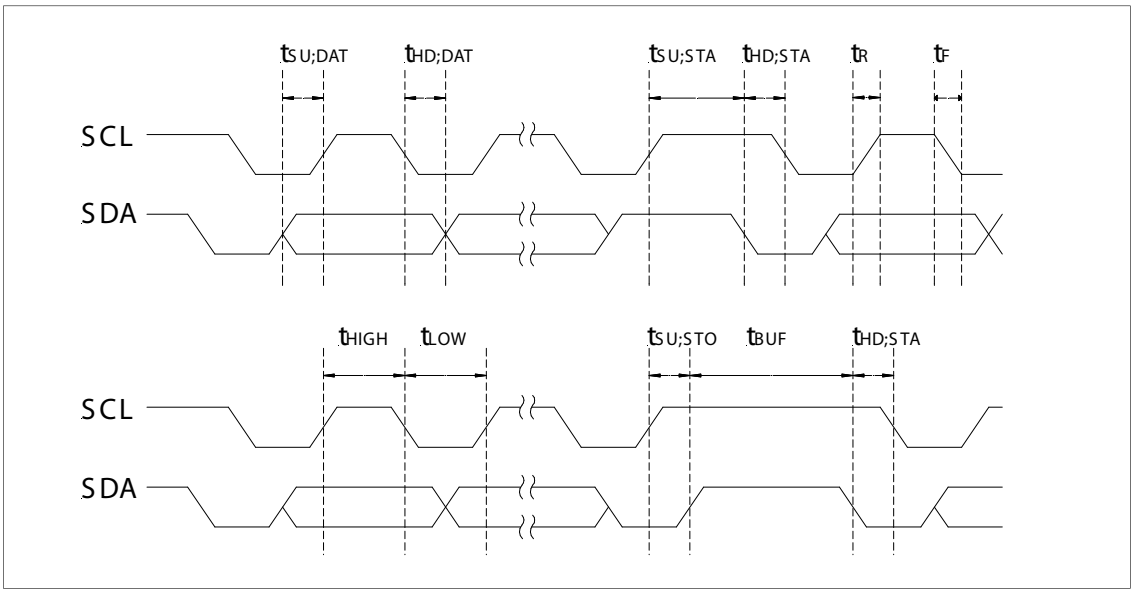

Figure 2. Timing Characteristics

SPI - SERIAL PERIPHERAL INTERFACE for ELVE Series

Introduction

The ELVE series sensors present a digital output signal. The device runs a continuous program, which will store a corrected sensor value about every 0.5 ms in the output registers of the internal ASIC. This cyclic program runs independently from the bus communication.

The SPI protocol 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.

Timing requirements for these signals is shown in Table 2 and Figure 5.

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.

The ELVE series supports clock phase (CPHA)=0 and polarity (CPOL)=0, which means that SCK is low when idle and data is sampled on the rising edge.

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. Because of internal configuration, the slave will answer the first byte with a value of 0xFF. The second and third byte contain the 15 bit pressure information (see Figure 4.)

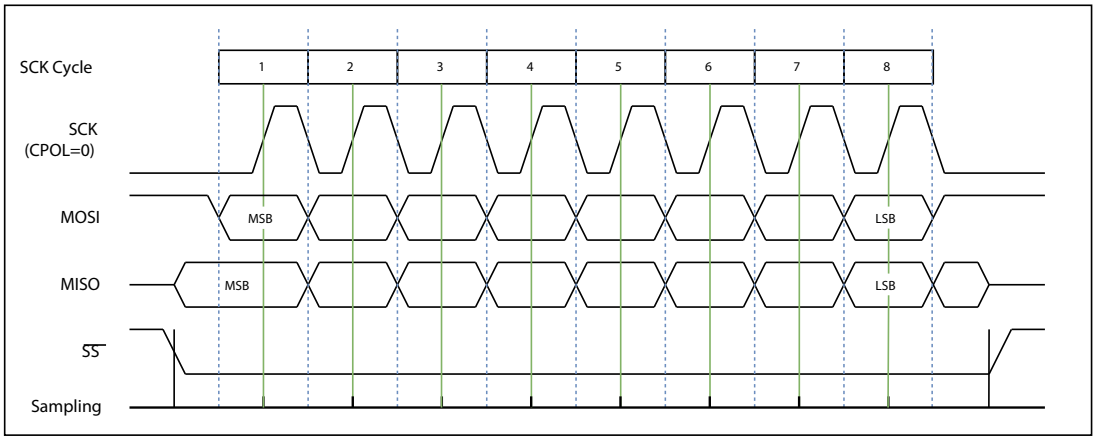

Figure 3: Example of a standard 1 byte SPI data transfer for CPHA=0 and CPOL=0

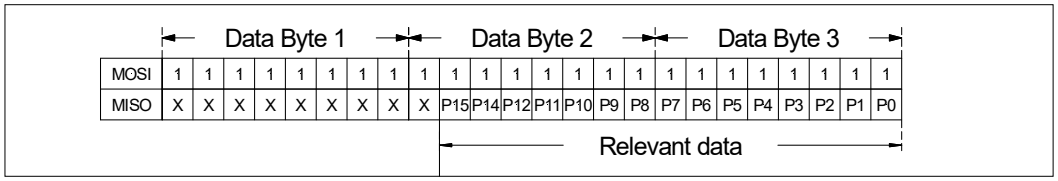

Figure 4: 3 byte data stream between ELVE sensor and master containing the pressure value as a 15 bit value.

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Table 4 - Interface Parameters

Parameter	Symbol	Minimum	Nominal	Maximum	Unit	Specification Notes
Input High Level	-	90	-	100	% of Vs	10
Input Low Level	-	0	-	10	% of Vs	10
Output Low Level	-	-	-	10	% of Vs	10
Pull-Up Resistor	-	500	-	-	Ω	10
Load Capacitance @ MISO	C_{MISO}	-	-	400	pF	10
Input Capacitance @ Each Pin	C_{SPI_IN}	-	-	10	pF	10
Signal Clock Frequency	f_{SCK}	100	-	640	kHZ	10
MISO Hold Time after SCK Sample Slope	$t_{SPI\_HD\_MISO}$	200	-	-	ns	10
MOSI Setup Time Before SCK Sample Slope	$t_{SPI\_SU\_MOSI}$	$2/f_{CLK}$	-	-	-	10
/SS Setup Time Before SCK Sample Slope	$t_{SPI\_SU\_SS}$	10	-	-	ns	10
/SS Hold Time After SCK Sample Slope	$t_{SPI\_HD\_SS}$	$1/f_{CLK}$	-	-	-	10

Note 10: Parameter is characterized and not 100% tested.

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

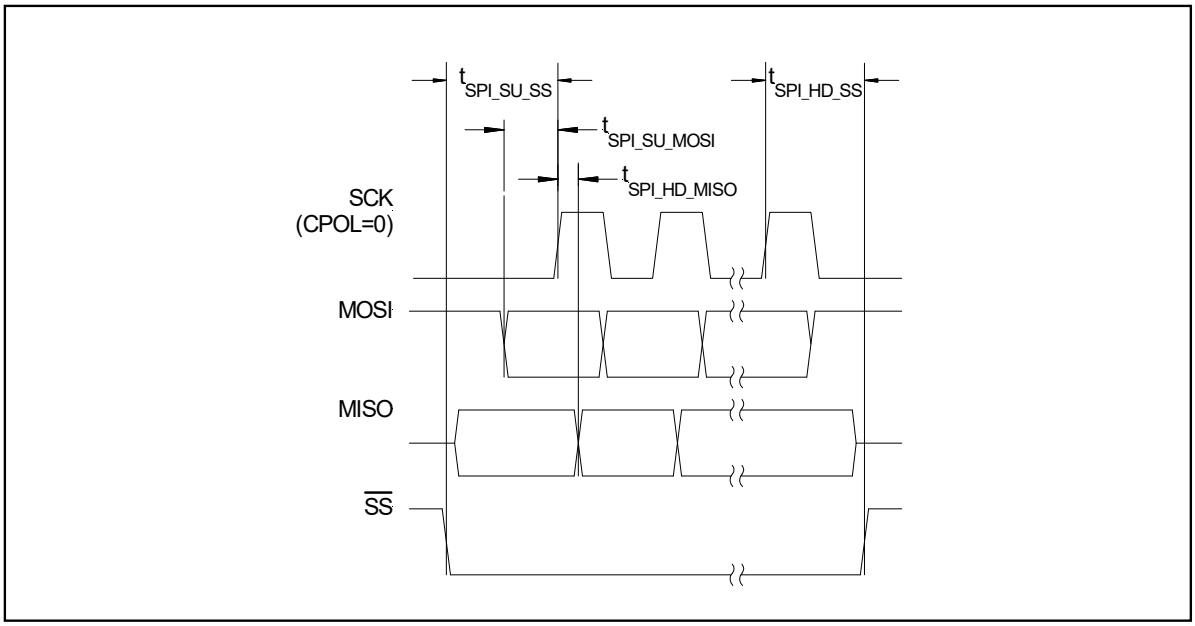
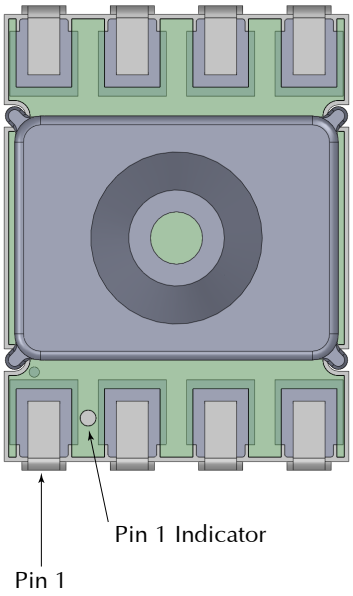
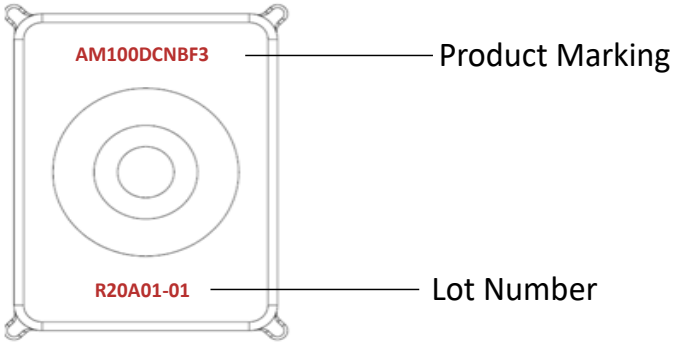


Figure 5: Timing characteristics

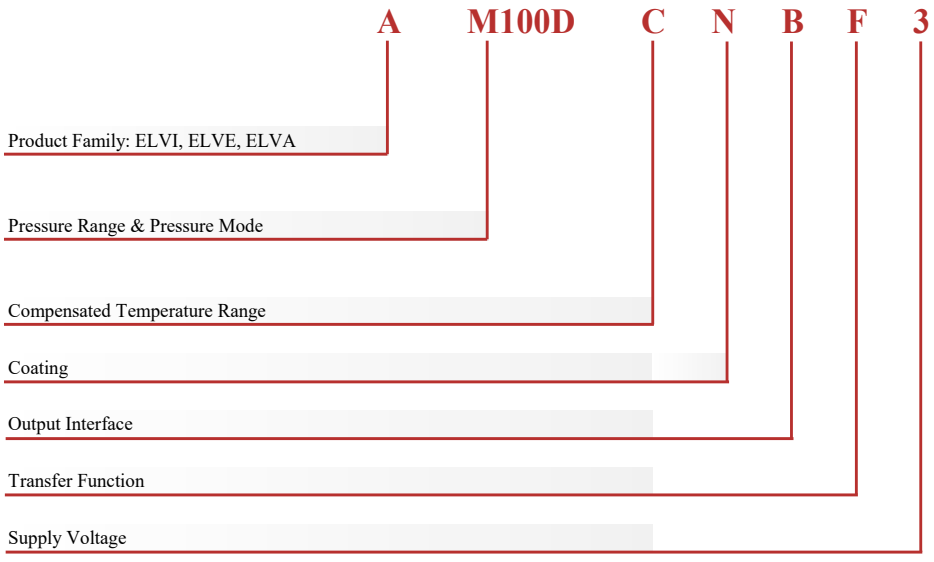
Pin Indicator



Product Marking



Example Product Marking: AM100DCNBF3



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Pressure Tubing Recommendations

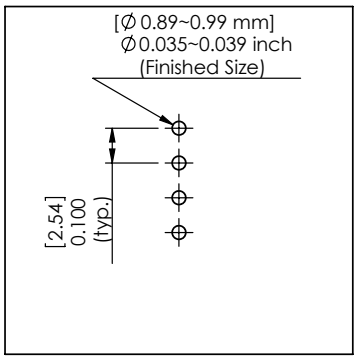
Tubing Recommendations				
Lid Type	ID	OD	Material*	
			Low Pressure	High Pressure
A	5/32"	1/4"	Silicone	Polyurethane
C	1/8"	1/4"	Silicone	Polyurethane
K	3/32"	5/32"	Silicone	Polyurethane
N	O-ring face seal			

For the purposes of tubing recommendations, “Low Pressure” is defined as pressure ranges below 1 bar and “High Pressure” is defined as pressure ranges above 1 bar.

*Note: 1 bar absolute is considered low pressure, whereas 1 bar differential and gage are considered high pressure.

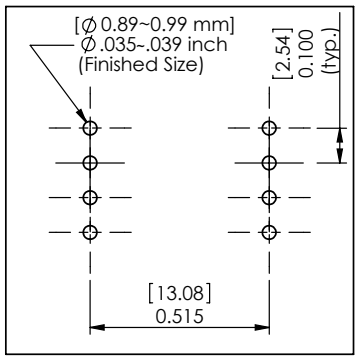
Suggested Pad Layouts

SIL



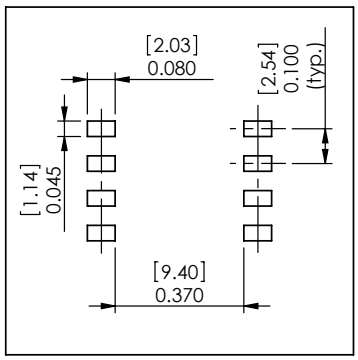
PAD-01

DIP



PAD-31

SMT

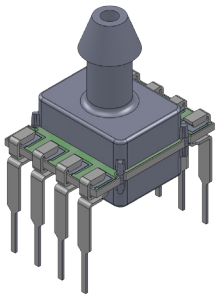


PAD-32

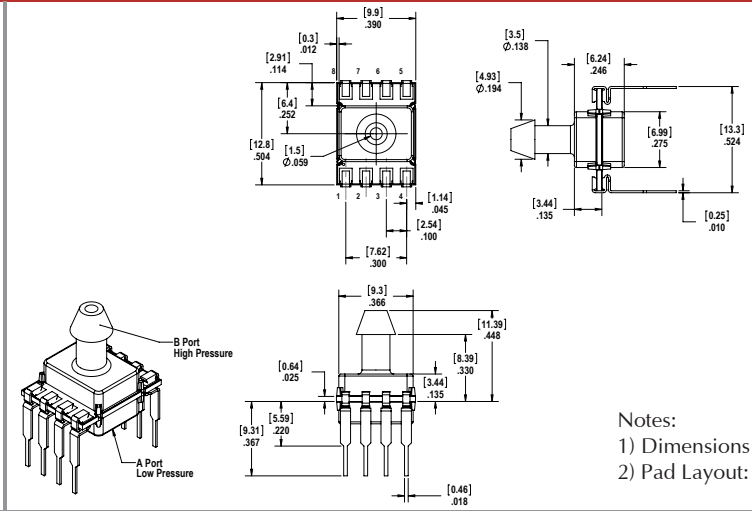
Dimensional Drawings - DIP Packages

Package Dimensions

DIP AN: Barbed Top Port Gage

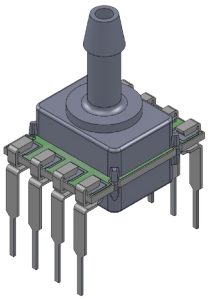


HAND Package

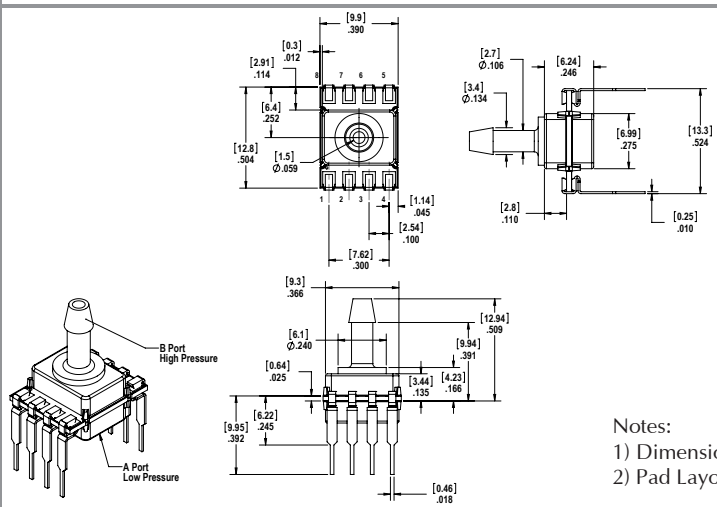


Notes:
1) Dimensions are in inches [mm].
2) Pad Layout: PAD-31.

DIP CN: Barbed Top Port

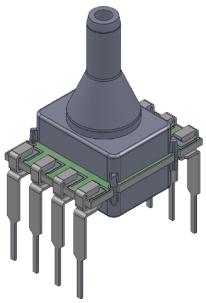


HCND Package

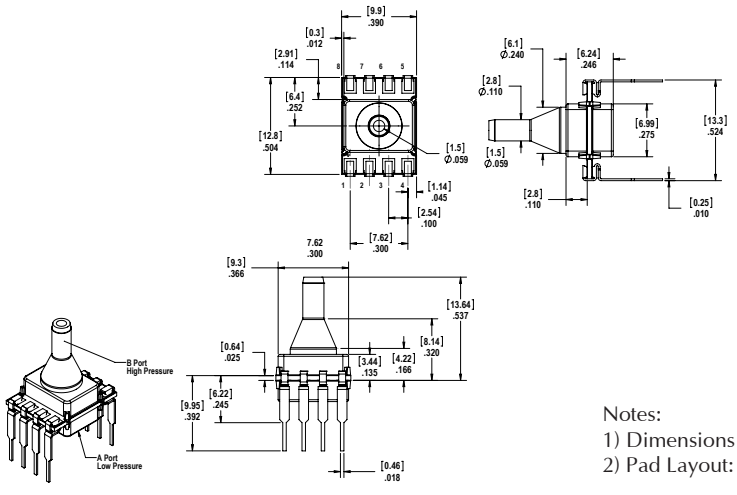


Notes:
1) Dimensions are in inches [mm].
2) Pad Layout: PAD-31.

DIP KN: Non-Barbed Needle Top Port



HKND Package



Notes:
1) Dimensions are in inches [mm].
2) Pad Layout: PAD-31.

* Refer to How to Order Tables for pinouts

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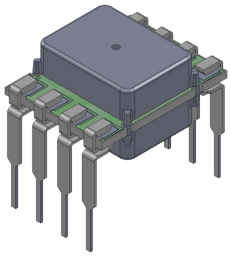
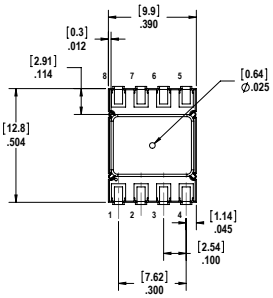
Dimensional Drawings - DIP Packages (Cont'd.)

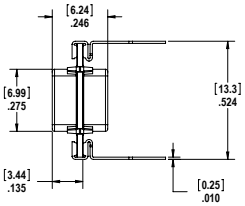
Package Dimensions

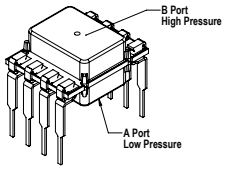
DIP NN: No Port (Flat)

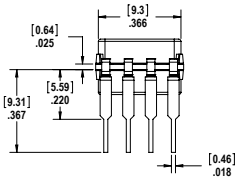


HNND Package









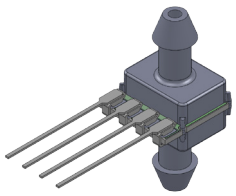
Notes:
1) Dimensions are in inches [mm].
2) Pad Layout: PAD-31.

* Refer to How to Order Tables for pinouts

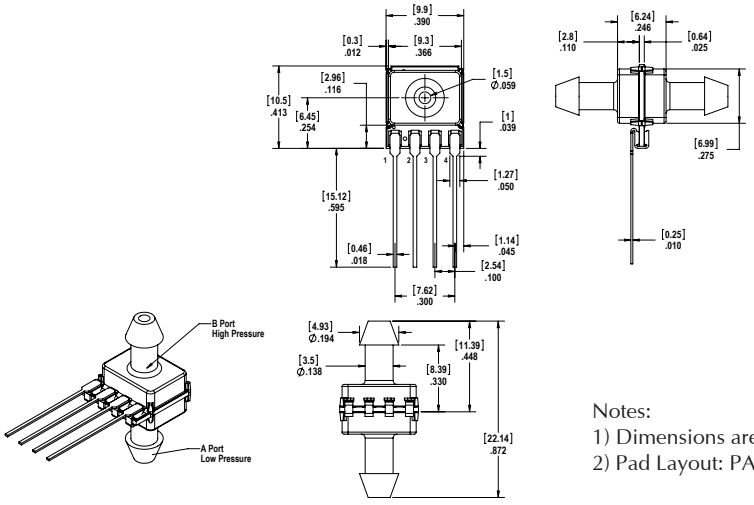
Dimensional Drawings - SIL Packages

Package Dimensions

SIL F-Lead AA: Barbed Top Port Differential

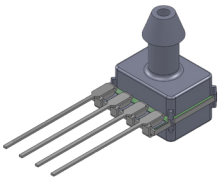


HAAF Package

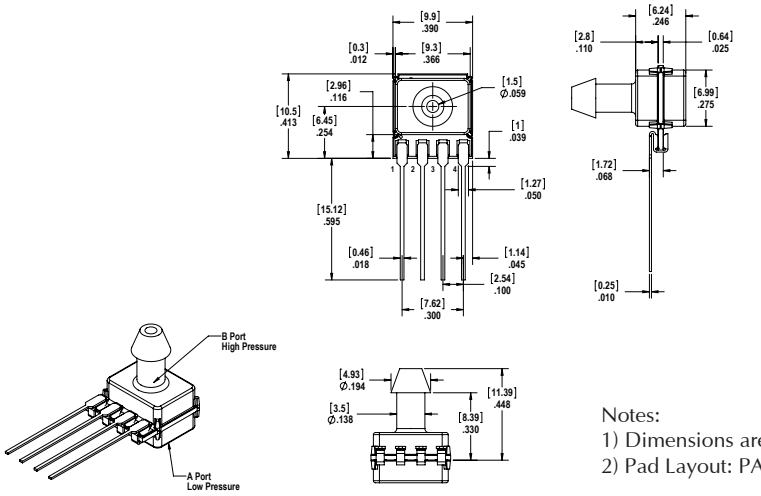


Notes:
1) Dimensions are in inches [mm].
2) Pad Layout: PAD-1.

SIL F-Lead AN: Barbed Top Port Gage

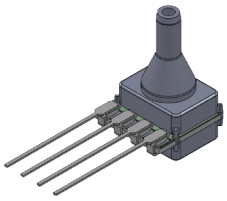


HANF Package

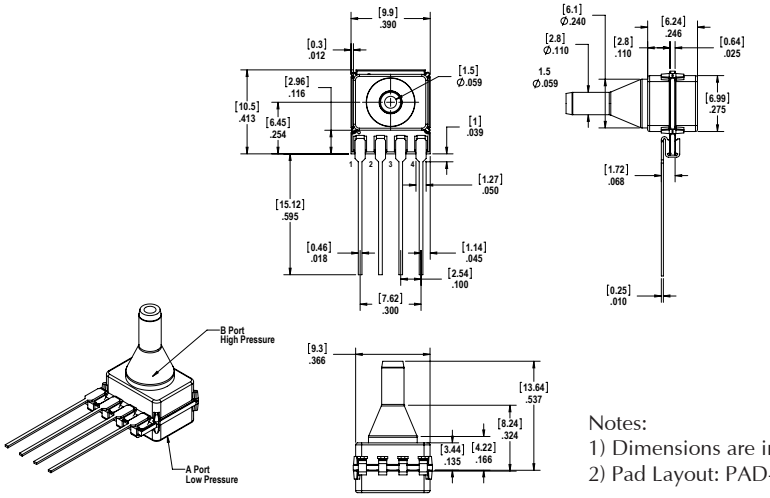


Notes:
1) Dimensions are in inches [mm].
2) Pad Layout: PAD-1.

SIL F-Lead KN: Non-Barbed Needle Top Port



HKNF Package



Notes:
1) Dimensions are in inches [mm].
2) Pad Layout: PAD-1.

* Refer to How to Order Tables for pinouts

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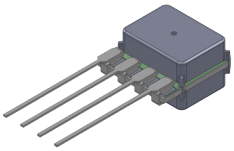
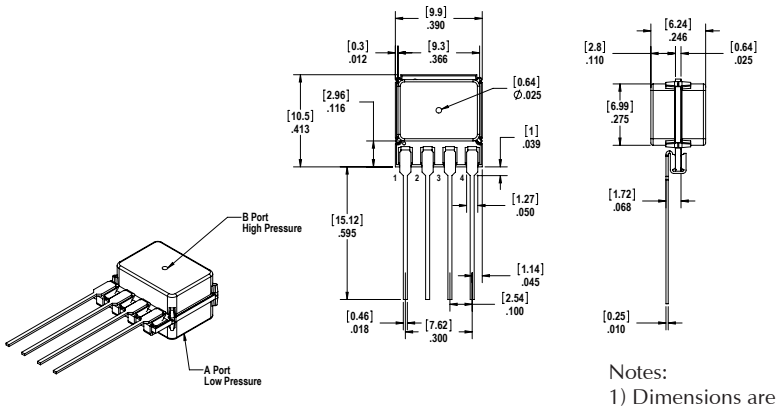
Dimensional Drawings - SIL Packages (Cont'd.)

Package Dimensions

SIL F-Lead NN: No Port (Flat)



HNNF Package



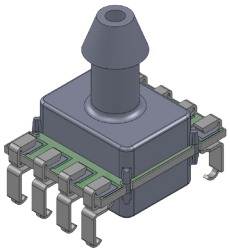
Notes:
1) Dimensions are in inches [mm].
2) Pad Layout: PAD-1.

* Refer to How to Order Tables for pinouts

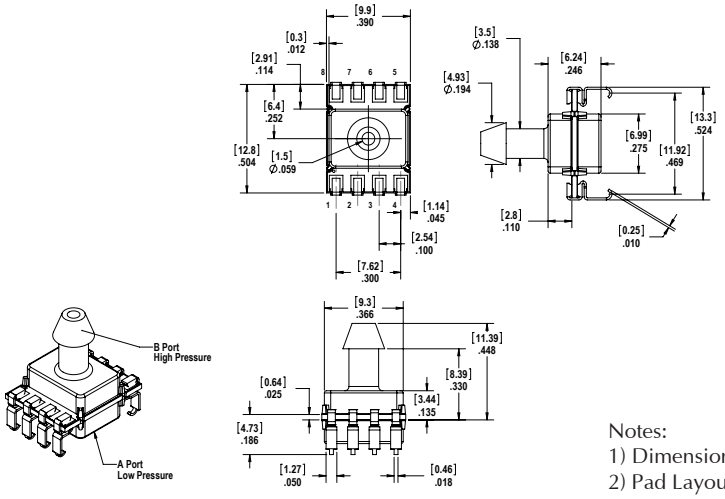
Dimensional Drawings - SMT Packages

Package Dimensions

SMT AN: Barbed Top Port Gage

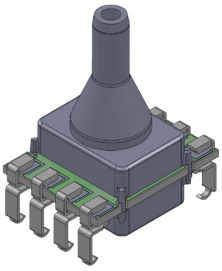


HANJ Package

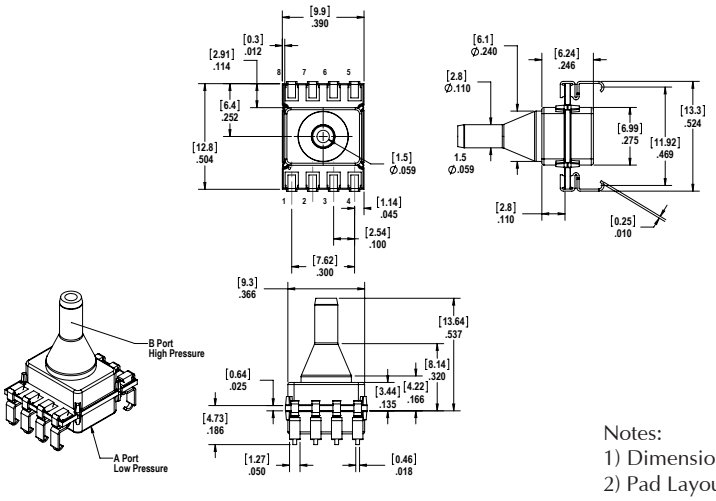


Notes:
1) Dimensions are in inches [mm].
2) Pad Layout: PAD-32.

SMT KN: Non-Barbed Needle Top Port

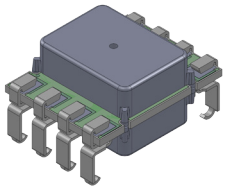


HKNJ Package

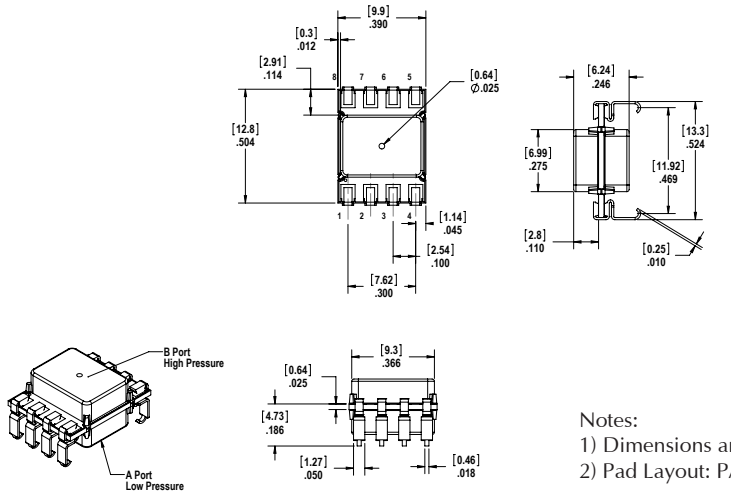


Notes:
1) Dimensions are in inches [mm].
2) Pad Layout: PAD-32.

SMT NN: No Port (Flat)



HNNJ Package



Notes:
1) Dimensions are in inches [mm].
2) Pad Layout: PAD-32.

* Refer to How to Order Tables for pinouts

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