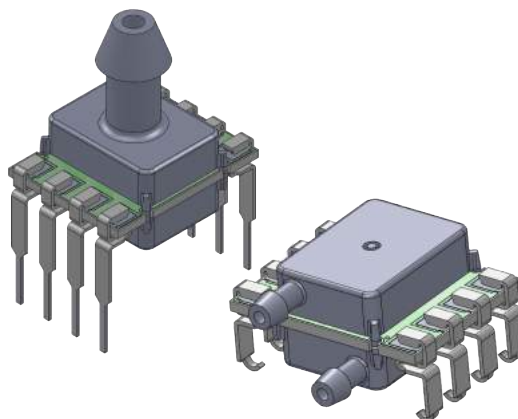


ELV Series - Analog and Digital Pressure Sensor Product Families

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Introduction

The ELV Analog and Digital Pressure Sensor Series consists of four new product families featuring All Sensors' ultra low pressure CoBeam²™ 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.

The ELV 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.

<https://www.allsensors.com/products/elv-series>



ELV SERIES: ANALOG & DIGITAL PRESSURE SENSORS

Features

- Pressure Ranges from ± 0.5 inH₂O to 150 psi and ± 2.5 mbar to ± 10 bar
- Precision ASIC Conditioning
- Digital I²C or SPI Interface or Analog Only Options
- 3V, 3.3V and 5V Supply Voltage Options

Applications

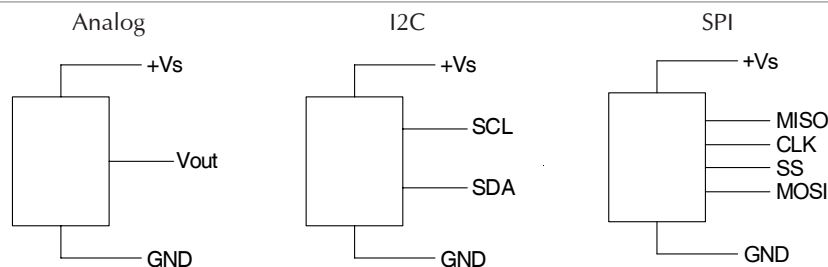
- Medical Devices
- Medical Instrumentation
- Respiratory
- Portable / Hand-Held Equipment
- Environmental Controls
- Environmental Instrumentation
- Environmental Monitoring
- HVAC
- Industrial Controls
- Altimeters
- Chemical Analysis
- Meteorology

Wetted Media

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

Pressure Sensor Maximum Ratings		Environmental Specifications		
Supply Voltage (Vs)	2.7 to 5.5 Vdc	Temperature Ranges		
		Compensated:	Standard Industrial	0°C to 50°C -20°C to 85°C
Maximum Device Temperature	245°	Operating		-25°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.

ELV SERIES - DIGITAL AND ANALOG PRESSURE SENSOR PRODUCT FAMILIES

ELVH Product Family Highlights

- 0.5 inH₂O up to 30 inH₂O and 1 psi up to 150 psi pressure ranges. 100 mbar up to 10 bar pressure ranges
- Offered in Differential, Gage and Absolute pressure modes
- 0 to 50°C and -20 to 85°C Temperature compensation options
- Output offered as
 - Digital I²C or SPI in 14 bit output or Ratiometric Analog option
 - 6 unique I²C address options
 - 4 unique transfer function options
- 3.3V and 5V Supply Voltage offerings
- Available in Numerous Port options:
 - No port
 - Barbed axial port
 - Needle big port
 - Side port
 - Other packages also available, check with factory
- Numerous lead options:
 - SMT J-lead
 - DIP lead
 - SIP lead
- Parylene Coating offered on pressure ranges of 10 inH₂O and above

ELVI, ELVE & ELVA 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
- Parylene Coating offered on pressure ranges of 100 mbar and above



ELVH Series Pressure Ranges

Pressure Range ¹				Proof Pressure ²			Burst Pressure ³		Common Mode Pressure ⁴	
CODE	P _{min} inH2O	P _{max}	Pressure Mode	kPa	inH2O	kPa	inH2O	kPa	inH2O	kPa
F50D	-0.5	0.5	Differential	0.1	270	67	415	103	415	103
L01D	-1	1	Differential	0.2	270	67	415	103	415	103
L02D	-2	2	Differential	0.5	270	67	415	103	415	103
L04D	-4	4	Differential	1.0	300	75	415	103	415	103
L05D	-5	5	Differential	1.2	300	75	415	103	415	103
L10D	-10	10	Differential	2.5	350	87	415	103	415	103
L20D	-20	20	Differential	5.0	350	87	415	103	415	103
L30D	-30	30	Differential	7.5	350	87	415	103	415	103
L01G	0	1	Gage	0.2	270	67	415	103	415	103
L02G	0	2	Gage	0.5	270	67	415	103	415	103
L04G	0	4	Gage	1.0	300	75	415	103	415	103
L05G	0	5	Gage	1.2	300	75	415	103	415	103
L10G	0	10	Gage	2.5	350	87	415	103	415	103
L20G	0	20	Gage	5.0	350	87	415	103	415	103
L30G	0	30	Gage	7.5	350	87	415	103	415	103

CODE	P _{min} psi	P _{max}	Pressure Mode	kPa	psi	kPa	psi	kPa	psi	kPa
001D	-1	1	Differential	7	10	69	15	103	15	103
005D	-5	5	Differential	34	15	103	75	517	250	1724
015D	-15	15	Differential	103	30	207	150	1034	250	1724
030D	-30	30	Differential	207	60	414	250	1724	250	1724
060D	-60	60	Differential	414	120	827	250	1724	250	1724
001G	0	1	Gage	7	10	69	15	103	15	103
005G	0	5	Gage	34	15	103	15	103	15	103
015G	0	15	Gage	103	30	207	75	517	250	1724
030G	0	30	Gage	207	60	414	150	1034	250	1724
060G	0	60	Gage	414	120	827	250	1724	250	1724
100G	0	100	Gage	690	250	1724	250	1724	250	1724
150G	0	150	Gage	1034	250	1724	250	1724	250	1724
015A	0	15	Absolute	103	15	103	15	103	15	103
030A	0	30	Absolute	207	60	414	150	1034	250	1724
060A	0	60	Absolute	414	120	827	250	1724	250	1724
100A	0	100	Absolute	690	250	1724	250	1724	250	1724
150A	0	150	Absolute	1034	250	1724	250	1724	250	1724

Note 1: Pressure ranges in Pa and kPa are expressed as an approximate value.

Note 2: Differential Proof Pressure: The maximum pressure which may safely be applied to one port of the product for it to remain in specification once pressure is returned to the operating pressure range. Exposure to higher pressures may cause permanent damage to the product.

Note 3: Differential Burst Pressure: The maximum pressure that may be applied to one port of the product without causing escape of pressure media. Product should not be expected to function after exposure to any pressure beyond the burst pressure.

Note 4: Common Mode Pressure: The maximum pressure that can be applied simultaneously to both ports of a differential pressure sensor without causing escape of pressure media. Product should not be expected to function after exposure to any pressure beyond the this maximum pressure.

ELVH Series Pressure Ranges (Cont'd)

Pressure Range ¹				Proof Pressure ²			Burst Pressure ³		Common Mode Pressure ⁴	
CODE	Pmin mbar	Pmax	Pressure Mode	kPa	mbar	kPa	mbar	kPa	mbar	kPa
MF25D	-2.5	2.5	Differential	0.25	675	67.5	1034	103	1034	103
MF12D	-12.5	12.5	Differential	1.25	750	75	1034	103	1034	103
M025D	-25	25	Differential	2.5	850	85	1034	103	1034	103
M050D	-50	50	Differential	5	850	85	1034	103	1034	103
M075D	-75	75	Differential	7.5	850	85	1034	103	1034	103
M100D	-100	100	Differential	10	850	85	1034	103	1034	103
M250D	-250	250	Differential	25	850	85	5171	517	17237	1724
M500D	-500	500	Differential	50	2000	200	5171	517	17237	1724
MF25G	0	2.5	Gage	0	675	68	1034	103	1034	103.4
MF12G	0	12.5	Gage	1.25	675	67.5	1034	103	1034	103
M025G	0	25	Gage	3	750	75	1034	103	1034	103.4
M050G	0	50	Gage	5	850	85	1034	103	1034	103
M075G	0	75	Gage	8	850	85	1034	103	1034	103.4
M100G	0	100	Gage	10	850	85	1034	103	1034	103
M250G	0	250	Gage	25	1034	103	1034	103	1034	103.4
M500G	0	500	Gage	50	1034	103	5171	517	17237	1724
MN50G	-500	0	Gage	-50 to 0	1034	103	5171	517	17237	1724
M611A	600	1100	Absolute	60 to 110	1034	103	5171	517	17237	1724
CODE	Pmin bar	Pmax	Pressure Mode	kPa	bar	kPa	bar	kPa	bar	kPa
B001D	-1	1	Differential	100	3.1	310	10.3	1034	17.2	1724
BF25D	-2.5	2.5	Differential	250	7.2	720	17.2	1724	17.2	1724
B005D	-5	5	Differential	500	12.4	1240	17.2	1724	17.2	1724
B010D	-10	10	Differential	1000	17	1700	17.2	1724	17.2	1724
BN01G	-1	0	Gage	-100 to 0	2	200	5.2	517	17.2	1724
B001G	0	1	Gage	100	2	200	5.2	517	17.2	1724
BF25G	0	2.5	Gage	250	6.2	620	10.3	1034	17.2	1724
B005G	0	5	Gage	500	8	800	17.2	1724	17.2	1724
B010G	0	10	Gage	1000	17	1700	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

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ELVI, ELVE, ELVA Series Pressure Ranges

Pressure Range ¹					Proof Pressure ²		Burst Pressure ³		Common Mode Pressure ⁴	
CODE	P _{min} mbar	P _{max} mbar	Pressure Mode	kPa	mbar	kPa	mbar	kPa	mbar	kPa
M100D	-100	100	Differential	10	1034	103	1034	103	1034	103
M250D	-250	250	Differential	25	1034	103	5171	517	17237	1724
M500D	-500	500	Differential	50	1034	103	5171	517	17237	1724
M100G	0	100	Gage	10	1034	103	1034	103	1034	103
M250G	0	250	Gage	25	1034	103	5171	517	17237	1724
M500G	0	500	Gage	50	1034	103	5171	517	17237	1724
CODE	P _{min} bar	P _{max} 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	P _{min} psi	P _{max} 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

ELVH Output Series Performance Table

3.3V or 5V, Ref temp 25°C. Positive Pressure applied to Port B (top port)

Parameter	Digital					Analog				
	Min	Typ	Max	Units	Notes	Min	Typ	Max	Units	Notes
Full Scale Span										
(10% - 90%, 5% - 85% Transfer Function Options)										
xxxD (Differential)	-	±6553	-	Count (Dec)	5	-	±40% VS	-	V	5
xxxG (Gage), xxxA (Absolute)	-	13107	-	Count (Dec)	5	-	80% VS	-	V	5
(5% - 95%, 4% - 94% Transfer Function Options)										
xxxD (Differential)	-	±7373	-	Count (Dec)	5	-	±45% VS	-	V	5
xxxG (Gage), xxxA (Absolute)	-	14746	-	Count (Dec)	5	-	90% VS	-	V	5
Offset										
(10% - 90% Transfer Function Option)										
xxxD (Differential)	-	8192	-	Count (Dec)	-	-	50% VS	-	V	-
xxxG (Gage), xxxA (Absolute)	-	1638	-	Count (Dec)	-	-	10% VS	-	V	-
(5% - 95% Transfer Function Option)										
xxxD (Differential)	-	8192	-	Count (Dec)	-	-	50% VS	-	V	-
xxxG (Gage), xxxA (Absolute)	-	819	-	Count (Dec)	-	-	5% VS	-	V	-
(5% - 85% Transfer Function Option)										
xxxD (Differential)	-	7373	-	Count (Dec)	-	-	45% VS	-	V	-
xxxG (Gage), xxxA (Absolute)	-	819	-	Count (Dec)	-	-	5% VS	-	V	-
(4% - 94% Transfer Function Option)										
xxxD (Differential)	-	8028	-	Count (Dec)	-	-	49% VS	-	V	-
xxxG (Gage), xxxA (Absolute)	-	655	-	Count (Dec)	-	-	4% VS	-	V	-
Accuracy	-	-	±0.25	%FSS	6	-	-	±0.25	%FSS	6
Total Error Band (TEB)										
F50D & L01G	-	±0.5	±3	%FSS	7	-	±0.5	±3	%FSS	7
L01D & L02G	-	±0.5	±2	%FSS	7	-	±0.5	±2	%FSS	7
L04G	-	±0.5	±1.5	%FSS	7	-	±0.5	±1.5	%FSS	7
Remaining ranges	-	±0.5	±1	%FSS	7	-	±0.5	±1	%FSS	7
Position Sensitivity										8
L02x and Below	-	±0.2	-	%FSS	8	-	±0.2	-	%FSS	
Above L02x	-	±0.1	-	%FSS	8	-	±0.1	-	%FSS	
Startup Time	-	-	3	ms	-	-	-	5	ms	-
Response Time	-	0.46	-	ms	-	-	1	-	ms	-
Supply Current										
3.3V Supply Option	-	3.1	3.9	mA	-	-	2.1	2.8	mA	-
5V Supply Option	-	3.7	4.6	mA	-	-	2.7	3.5	mA	-

ELVH 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 is calculated from a combination of all possible errors, including offset, span temperature, calibration, linearity, pressure hysteresis, offset warm-up shift, offset position sensitivity, and long term offset drift.

Note 8: Parameter is characterized and not 100% tested.

ELVI & ELVE Output Series Performance Table

3 or 5V, 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)	5
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	6
Total Error Band (TEB)	-	-	±1.5	%FSS	7
A/D Resolution	-	12	-	bit	-
Response Delay	-	0.5	-	ms	9
Current Consumption					
3V Supply Option	-	4.5	-	mA	-
5V Supply Option	-	5.3	-	mA	-

ELVI & ELVE 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 is calculated from a combination of all possible errors, including offset, span temperature, calibration, linearity, pressure hysteresis, offset warm-up shift, offset position sensitivity, and long term offset drift.

Note 9: Max. delay time between pressure change at the pressure die and signal change at the output.

ELVA Output Series Performance Table

3 or 5V, 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	9
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 is calculated from a combination of all possible errors, including offset, span temperature, calibration, linearity, pressure hysteresis, offset warm-up shift, offset position sensitivity, and long term offset drift.

Note 9: Max. delay time between pressure change at the pressure die and signal change at the output.

How to Order ELVH Series

For example, **ELVH-L01D-HRRD-C-NAA4** defines an All Sensors ELVH Series Analog + Digital Pressure Sensor, 1 inH2O differential pressure range, HRRD package (DIP with dual same side barbed ports), compensated temperature range from 0°C to 50°C, no parylene coating, Analog output, 10 to 90% of Vsupply transfer function, 3.3 Vdc supply voltage.

ELVH - L01D - HRRD - C - NAA4

Product Series

ELV Digital and Analog Series

Pressure Ranges Note 10

	Differential	Gage	Absolute
F50D	± 0.5 inH2O	L01G 0 to 1 inH2O	015A 0 to 15 psi
L01D	± 1 inH2O	L02G 0 to 2 inH2O	030A 0 to 30 psi
L02D	± 2 inH2O	L04G 0 to 4 inH2O	060A 0 to 60 psi
L04D	± 4 inH2O	L05G 0 to 5 inH2O	100A 0 to 100 psi
L05D	± 5 inH2O	L10G 0 to 10 inH2O	150A 0 to 150 psi
L10D	± 10 inH2O	L20G 0 to 20 inH2O	M611A 600 to 1100 mbar
L20D	± 20 inH2O	L30G 0 to 30 inH2O	B001A 0 to 1 bar
L30D	± 30 inH2O	001G 0 to 1 psi	B002A 0 to 2 bar
001D	± 1 psi	005G 0 to 5 psi	
005D	± 5 psi	015G 0 to 15 psi	
015D	± 15 psi	030G 0 to 30 psi	
030D	± 30 psi	060G 0 to 60 psi	
060D	± 60 psi	100G 0 to 100 psi	
MF25D	± 2.5 mbar	150G 0 to 150 psi	
MF12D	± 12.5 mbar	MF25G 0 to 2.5 mbar	
M025D	± 25 mbar	MF12G 0 to 12.5 mbar	
M050D	± 50 mbar	M025G 0 to 25 mbar	
M075D	± 75 mbar	M050G 0 to 50 mbar	
M100D	± 100 mbar	M075G 0 to 75 mbar	
M250D	± 250 mbar	M100G 0 to 100 mbar	
M500D	± 500 mbar	M250G 0 to 250 mbar	
B001D	± 1 bar	M500G 0 to 500 mbar	
BF25D	± 2.5 bar	MN50G -500 to 0 mbar	
B005D	± 5 bar	BN01G -1 to 0 bar	
B010D	± 10 bar	B001G 0 to 1 bar	
		BF25G 0 to 2.5 bar	
		B005G 0 to 5 bar	
		B010G 0 to 10 bar	

Coating

N	No Parylene
P	Parylene

Compensated Temperature Range

C	0°C to 50°C
I	-20°C to 85°C

Supply Voltage

4	3.3 Vdc
5	5.0 Vdc

Transfer Function

A	10% to 90% of Vsupply (analog), 2 ¹⁴ counts (digital)
B	5% to 95% of Vsupply (analog), 2 ¹⁴ counts (digital)
C	5% to 85% of Vsupply (analog), 2 ¹⁴ counts (digital)
D	4% to 94% of Vsupply (analog), 2 ¹⁴ counts (digital)

Package Pinout Offering Code*

Output interface	DIP (8 pin)	SMT (8 pin)	SIP (4 pin)	
A	Analog, (H-Style)	3	3	4
S	SPI	2	2	Not Available
2	FC, Address 0x28	1	1	5
3	FC, Address 0x38	1	1	5
4	FC, Address 0x48	1	1	5
5	FC, Address 0x58	1	1	5
6	FC, Address 0x68	1	1	5
7	FC, Address 0x78	1	1	5

Package Selection (4 Character Code) Note 10

	DIP	SMT J-Lead	SIP
HNND		HNNJ	HNNH
HAND		HANJ	HANH
-	-	-	HAAH
HRND		HRNJ	HRNH
HRRD		HRRJ	HRRH
HDRD		HDRJ	HDRH
HKND		HKNJ	-

***Package Pinout Offering Code Legend**

Pin Code	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8
1	GND	VS	SDA	SCL	N/C	N/C	N/C	N/C
2	GND	VS	MISO	SCL	SS	N/C	N/C	N/C
3	N/C	VS	VOUT	GND	N/C	N/C	N/C	N/C
4	N/C	VS	VOUT	GND	-	-	-	-
5	GND	VS	SDA	SCL	-	-	-	-

N/C: Not Internally Connected

Note 10: Sideport packages (HRNx, HRRx, HDRx) are limited to maximum pressure ranges of 60 psid / 60 psig / 60 psia.

Refer to the Part Number Builder application on All Sensors' website for help with cross reference to alternative suppliers' part numbers.

Note: Parylene Coating is not available for pressure ranges below 10 inH2O or for J-Lead configurations.

How to Order ELVI Series

For example, **ELVI-M100D-HNNJ-C-N2E3** defines an All Sensors ELVI Series Digital Pressure Sensor, 100 mbar differential pressure range, HNNJ package (SMT J-Lead with no ports), 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 - HNNJ - C - N2E3

Product Series

ELV Digital and Analog Series

Pressure Ranges Note 10

Differential	Gage	Absolute
M100D ± 100 mbar	M100G 0 to 100 mbar	B001A 0 to 1 bar
M250D ± 250 mbar	M250G 0 to 250 mbar	B002A 0 to 2 bar
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	
	T00G 0 to 100 psi	

Coating

N	No Parylene
P	Parylene

Compensated Temperature Range

C	0°C to 50°C
I	-20°C to 85°C

Supply Voltage

3	3 Vdc
5	5 Vdc

Transfer Function

E 9.16% to 91.55% of 2^{15} counts (digital)

Package Selection (4 Character Code) Note 10

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

Output Interface

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

***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

Note 10: Sideport packages (HRNx, HRRx, HDRx) are limited to maximum pressure ranges of 60 psid / 60 psig / 60 psia.

Refer to the Part Number Builder application on All Sensors' website for help with cross reference to alternative suppliers' part numbers.

Note: Parylene Coating is not available for pressure ranges below 10 inH₂O or for J-Lead configurations.

How to Order ELVE Series

For example, **ELVE-M100D-HNND-C-NTE3** defines an All Sensors ELVE Series Digital Pressure Sensor, 100 mbar differential pressure range, HNNF package (DIP with no ports), 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 - HNND - C - NTE3








Product Series

ELV Digital and Analog Series

Pressure Ranges Note 10

Differential	Gage	Absolute
M100D ± 100 mbar	M100G 0 to 100 mbar	B001A 0 to 1 bar
M250D ± 250 mbar	M250G 0 to 250 mbar	B002A 0 to 2 bar
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	

Package Selection (4 Character Code)

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

Coating

N	No Parylene
P	Parylene

Compensated Temperature Range

C	0°C to 50°C
I	-20°C to 85°C

Transfer Function

E	9.16% to 91.55% of 2^{15} counts (digital)
---	--

Supply Voltage

3	3 Vdc
5	5 Vdc

Output Interface

		Package Pinout Offering Code*		
		DIP (8 pin)	SMT (8 pin)	SIL (4 pin)
T	SPI	2	2	Not Available

*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

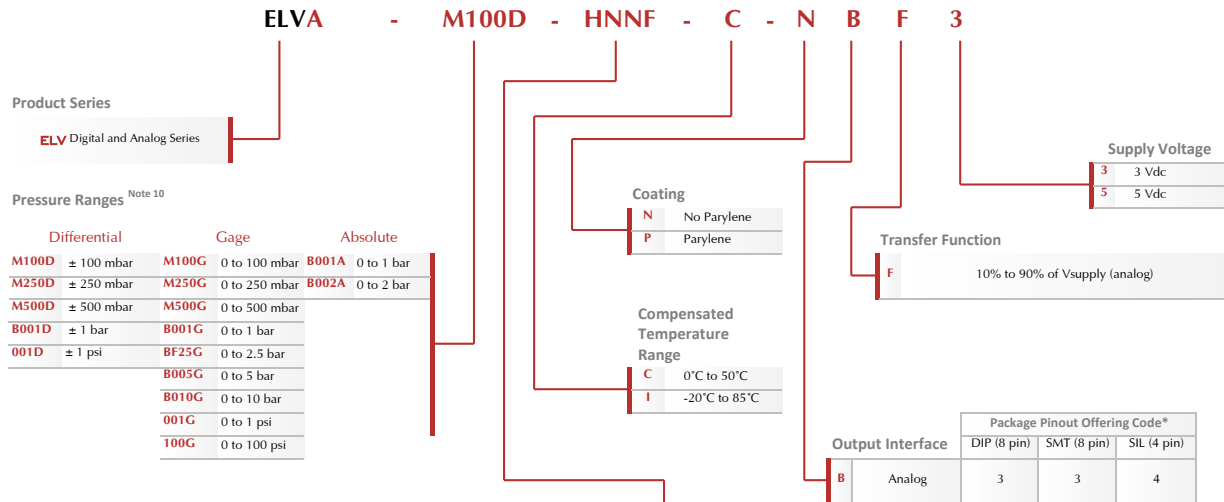
Note 10: Sideport packages (HRNx, HRRx, HDRx) are limited to maximum pressure ranges of 60 psid / 60 psig / 60 psia.

Refer to the Part Number Builder application on All Sensors' website for help with cross reference to alternative suppliers' part numbers.












Note: Parylene Coating is not available for pressure ranges below 10 inH₂O or for J-Lead configurations.

How to Order ELVA Series

For example, **ELVA-M100D-HNNF-C-NBF3** defines an All Sensors ELVA Series Analog Pressure Sensor, 100 mbar differential pressure range, HNNF package (SIL with no ports), compensated temperature range from 0°C to 50°C, no parylene coating, Analog Output, 10 to 90% V_{supply} transfer function and 3 Vdc supply voltage.



Package Selection (4 Character Code) ^{Note 10}

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

*Package Pinout Offering Code Legend

Pin Code	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8
3	V _s	GND	VOUT	N/C	N/C	N/C	N/C	N/C
4	V _s	GND	VOUT	N/C	-	-	-	-

N/C: Not Internally Connected

Note 10: Sideport packages (HRNx, HRRx, HDRx) are limited to maximum pressure ranges of 60 psid / 60 psig / 60 psia.

Refer to the Part Number Builder application on All Sensors' website for help with cross reference to alternative suppliers' part numbers.

Note: Parylene Coating is not available for pressure ranges below 10 inH₂O or for J-Lead configurations.

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.

This option is only available for pressure ranges of ± 10 inH₂O and above and is not available for J-lead configurations.

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 critical interfaces within the package, and is not covered by warranty.

I2C Interface for ELVH Series

The part enters Free Running mode (see table 1) after power-up: it performs an initial complete measurement, writes the calculated data to the output registers, sets the INT pin high, then starts the next reading. Note that a “special cycle” occurs every 255 cycles (~120 msec), which adds 400 µsec to the update time for that cycle.

I2C Communications Overview

The I2C interface uses a set of signal sequences for communication. The following is a description of the supported sequences. Refer to Figure 3 for usage.

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

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

Slave address (An): The I2C-bus requires a unique address for each device. After setting a START condition the master sends the address byte containing the 7 bit sensor address followed by a data direction bit (R/W). A "0" indicates a transmission from master to slave (WRITE), a "1" indicates a data request (READ).

Acknowledge (A or N): Data is transferred in units of 8 bits (1 byte) at a time, MSB first. Each data-receiving device, whether master or slave, is required to pull the data line LOW to acknowledge receipt of the data. The Master must generate an extra clock pulse for this purpose. If the receiver does not pull the data line down, a NACK condition exists, and the slave transmitter becomes inactive. The master determines whether to send the last command again or to set the STOP condition, ending the transfer.

DATA valid (Dn): State of data line represents valid data when, after a 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 data bit.

DATA operation: The sensor starts to send 4 data bytes containing the current pressure and temperature values. The transmission may be halted by the host after any of the bytes by responding with a NACK.

STOP condition (P): LOW to HIGH transition of the SDA line while clock (SCL) is HIGH indicates a STOP condition. STOP conditions are always generated by the master.



I2C Exceptions

1. Sending a Start condition, then a Stop condition, without any transitions on the CLK line, creates a communication error for the next communication, even if the next start condition is correct and the clock pulse is applied. A second Start condition must be set, which clears the error and allows communication to proceed.
2. The Restart condition—a falling SDA edge during data transmission when the CLK clock line is still high—creates the same stall/deadlock. In the following data request, an additional Start condition must be sent for correct communication.
3. A falling SDA edge is not allowed between the start condition and the first rising SCL edge. If using an I2C address with the first bit 0, SDA must be held low from the start condition through the first bit.

Figure 3 - I2C Communication Diagram

I2C Communications Diagram

1. Read Data (with examples of reading pressure, pressure plus 8 bits of temperature and pressure plus 11 bits of temperature)

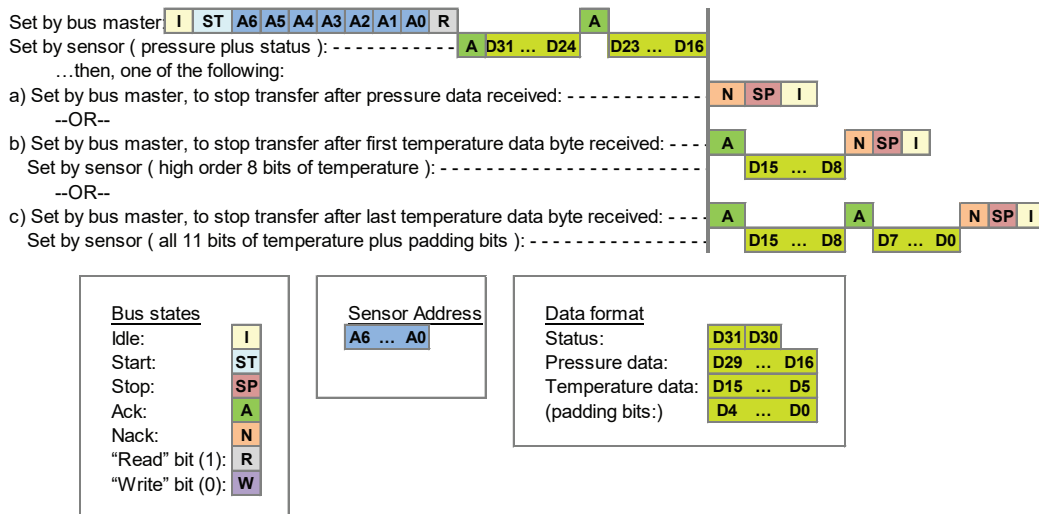


Figure 3 illustrates the sequence of signals set by both the host and the sensor for each command. Note that for the ReadData command, the host has the option of responding to the second or third bytes of data with a NACK instead of ACK. This terminates the data transmission after the pressure data, or after the pressure data and upper byte of temperature, have been transmitted. See Figure 6 for the I2C timing details.

SPI Interface for ELVH Series

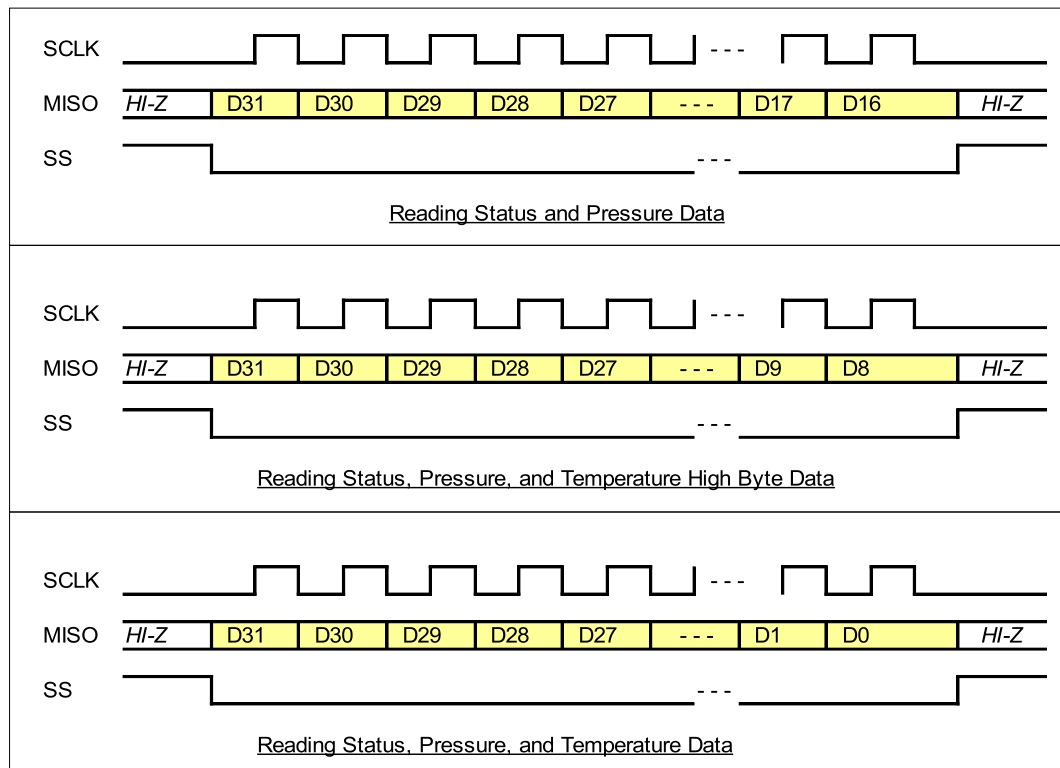
After power-up, the part enters Free Running mode and begins its periodic conversion cycle. The only bus interaction with the host is the SPI DataRead operation. Polling the sensor at a rate slower than the internal update rate will minimize bus activity and ensure that new values are presented with each transfer. Note that the Status bits should still be checked to verify updated data and the absence of error conditions.

ELVH sensors using the SPI interface option provide 3 signals for communication: SCLK, SS (Slave Select), and MISO.

SPI Bit Pattern

The sequence of bits and bus signals are shown in the following illustration (Figure 4). Refer to Figure 5 in the Interface Timing Diagram section for detailed timing data. As previously described, the incoming data may be terminated by raising SS after 2, 3, or 4 bytes have been received as illustrated below.

Figure 4 - SPI Bit Pattern



Interface Timing Diagrams for ELVH Series

Figure 5 - SPI Timing Diagram

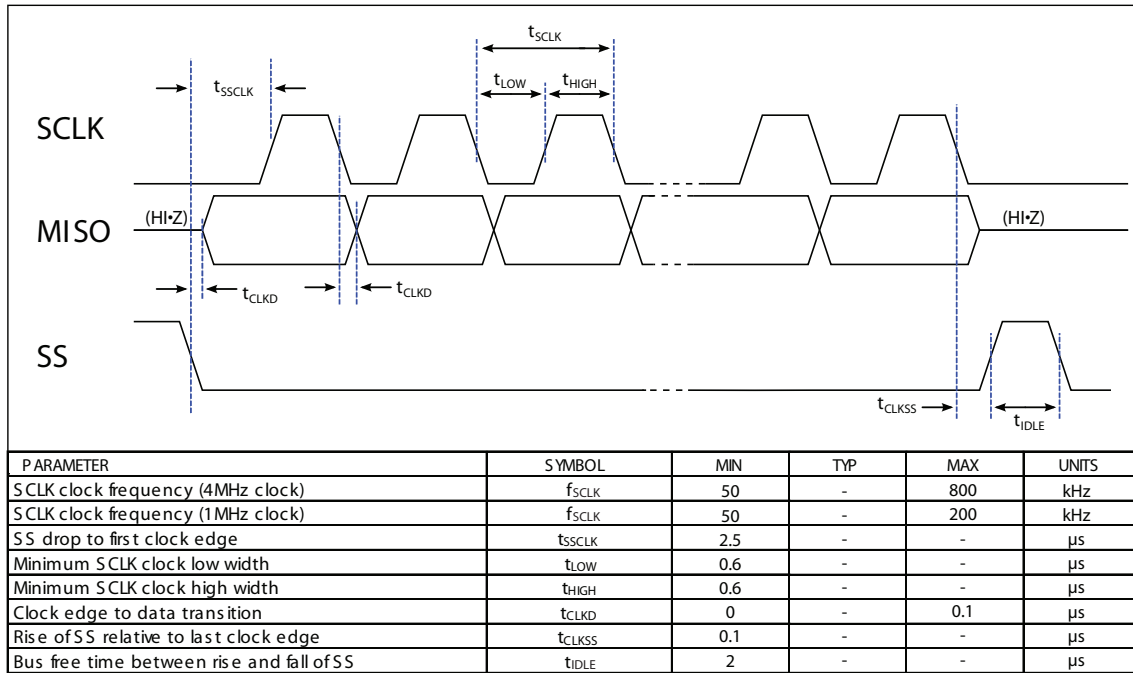
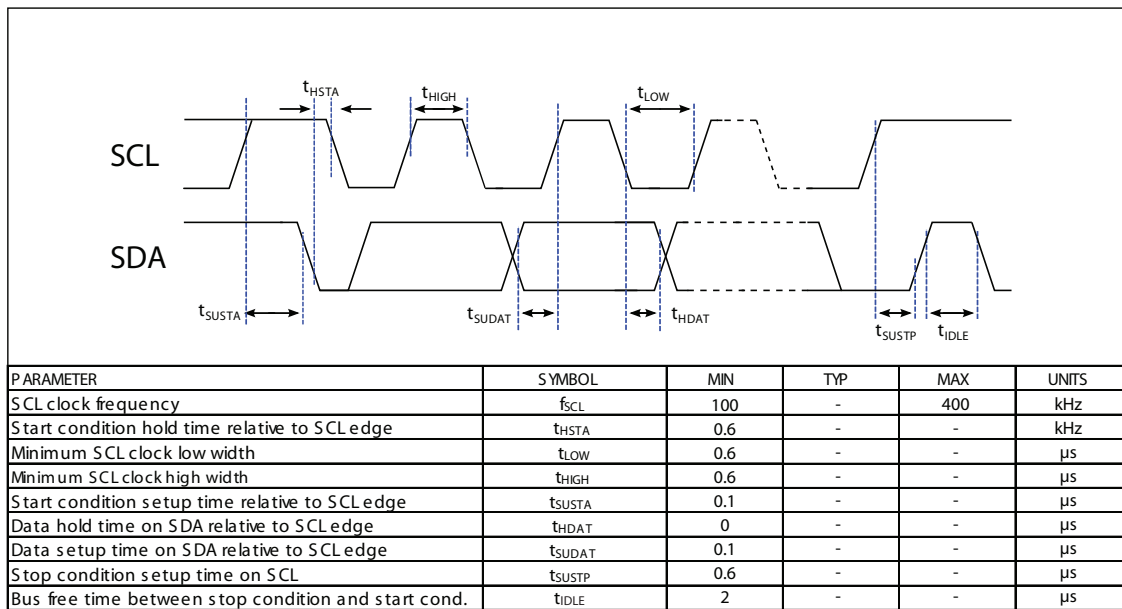


Figure 6 - I2C Timing Diagram



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 7, and timing as specified in Table 1 and Figure 8.

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 generation 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 11. 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 transmission 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.

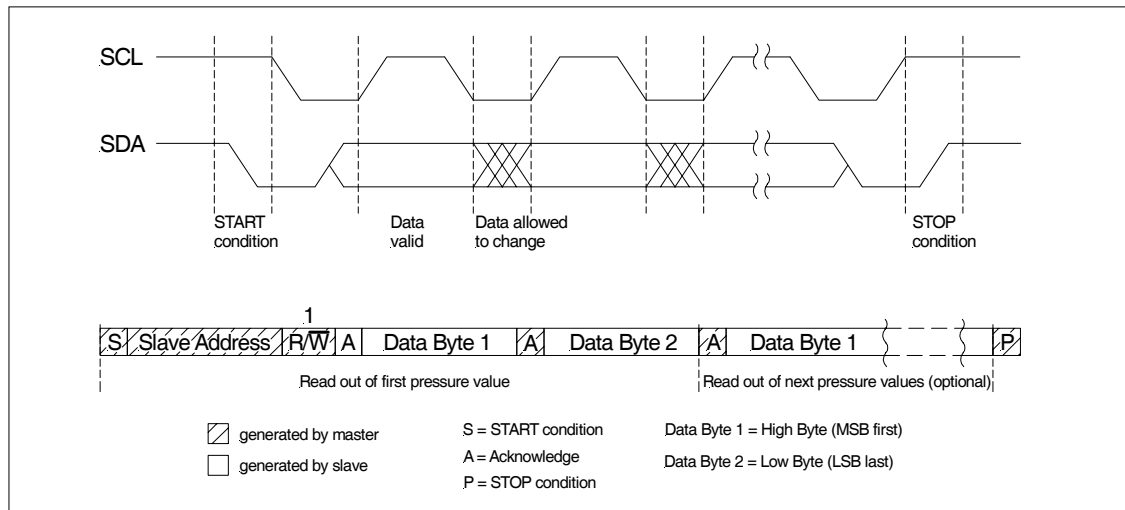


Figure 7: I²C bus protocol



ELVI I²C BUS INTERFACE (Cont'd)

Table 1
I²C Interface Parameters

Parameter	Symbol	Minimum	Nominal	Maximum	Unit	Specification Notes
Input High Level	-	90	-	100	% of V _s	8
Input Low Level	-	0	-	10	% of V _s	8
Output Low Level	-	-	-	10	% of V _s	8
Pull-Up Resistor	-	500	-	-	Ω	8
Load Capacitance @ SDA	C _{SDA}	-	-	400	pF	8
Input Capacitance @ SDA/SCL	C _{I2C_IN}	-	-	10	pF	8
Signal Clock Frequency	F _{SCL}	100*	-	400	kHZ	8
Bus Free Time Between STOP and START Condition	t _{BUF}	1.3	-	-	μs	8
Hold Time (Repeated) START Condition, to First Clock Pulse	t _{HD,STA}	0.8	-	-	μs	8
Low Period of SCL	t _{Low}	1.3	-	-	μs	8
High Period of SCL	t _{High}	0.6	-	-	μs	8
Setup Time Repeated START Condition	t _{SU,STA}	1	-	-	μs	8
Data Hold Time	t _{HD,DAT}	0	-	-	μs	8
Data Setup Time	t _{SU,DAT}	0.2	-	-	μs	8
Rise Time of Both SDA and SCL	t _R	-	-	0.3	μs	8
Fall Time of Both SDA and SCL	t _F	-	-	0.3	μs	8
Setup Time for STOP Condition	t _{SU,STO}	0.6	-	-	μs	8

Note 8: Parameter is characterized and not 100% tested.

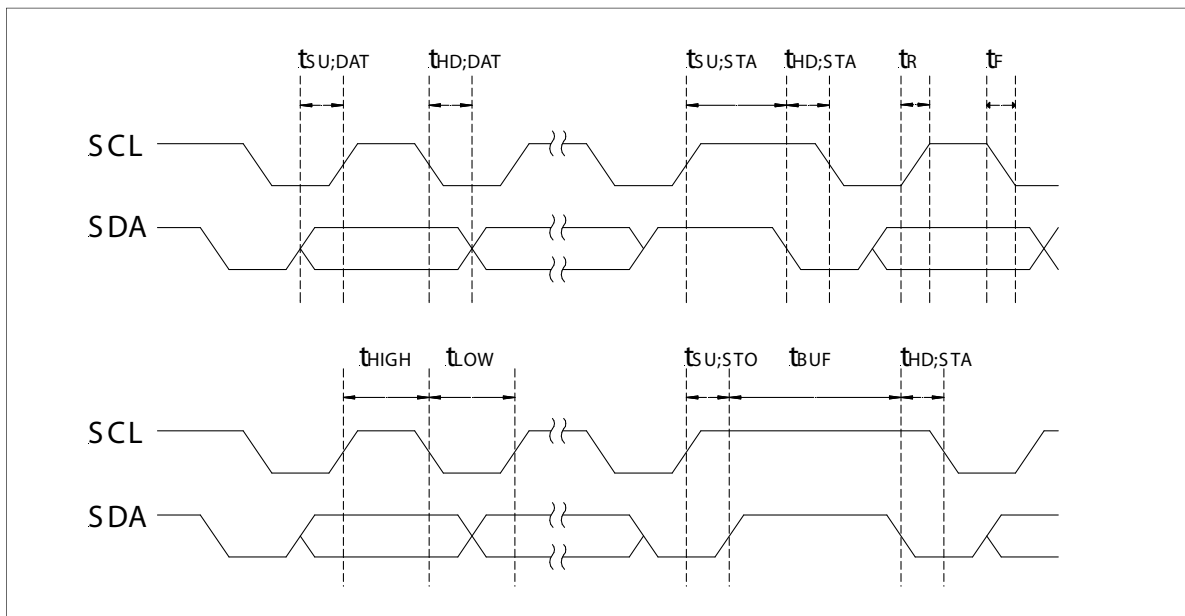


Figure 8. Timing Characteristics

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 11.

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 10.)

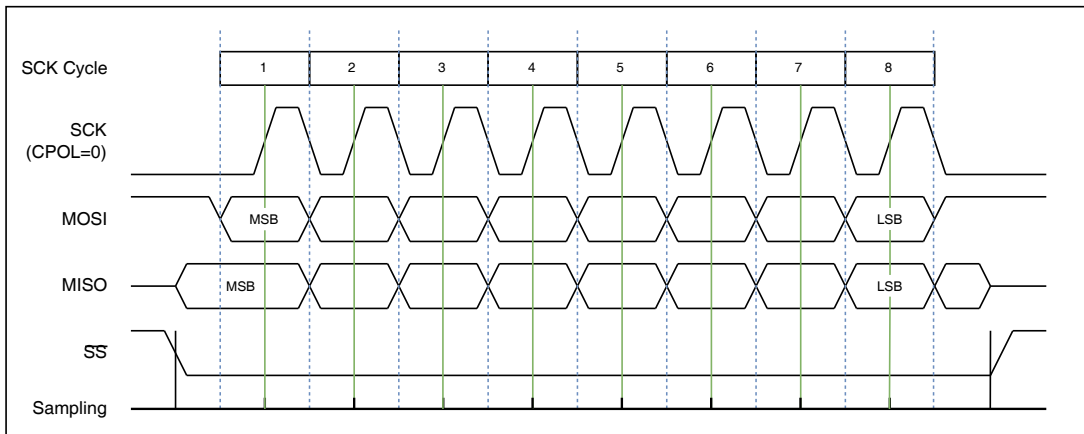


Figure 9: Example of a standard 1 byte SPI data transfer for CPHA=0 and CPOL=0

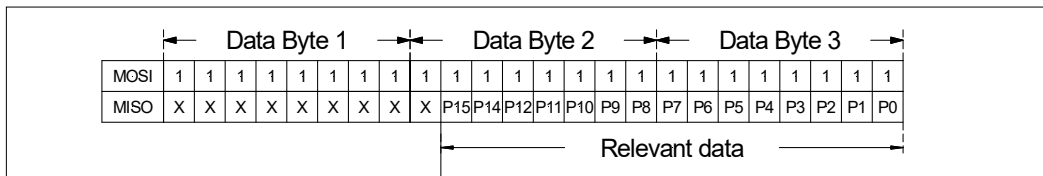


Figure 10: 3 byte data stream between ELVF sensor and master containing the pressure value as a 15 bit value.

ELVE SPI - SERIAL PERIPHERAL INTERFACE (Cont'd)

Table 2
Interface Parameters

Parameter	Symbol	Minimum	Nominal	Maximum	Unit	Specification Notes
Input High Level	-	90	-	100	% of V_s	8
Input Low Level	-	0	-	10	% of V_s	8
Output Low Level	-	-	-	10	% of V_s	8
Pull-Up Resistor	-	500	-	-	Ω	8
Load Capacitance @ MISO	C_{MISO}	-	-	400	pF	8
Input Capacitance @ Each Pin	C_{SPI_IN}	-	-	10	pF	8
Signal Clock Frequency	f_{SCK}	100	-	640	kHZ	8
MISO Hold Time after SCK Sample Slope	$t_{SPI_HD_MISO}$	200	-	-	ns	8
MOSI Setup Time Before SCK Sample Slope	$t_{SPI_SU_MOSI}$	$2/f_{CLK}$	-	-	-	8
/SS Setup Time Before SCK Sample Slope	$t_{SPI_SU_SS}$	10	-	-	ns	8
/SS Hold Time After SCK Sample Slope	$t_{SPI_HD_SS}$	$1/f_{CLK}$	-	-	-	8

Note 8: 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.

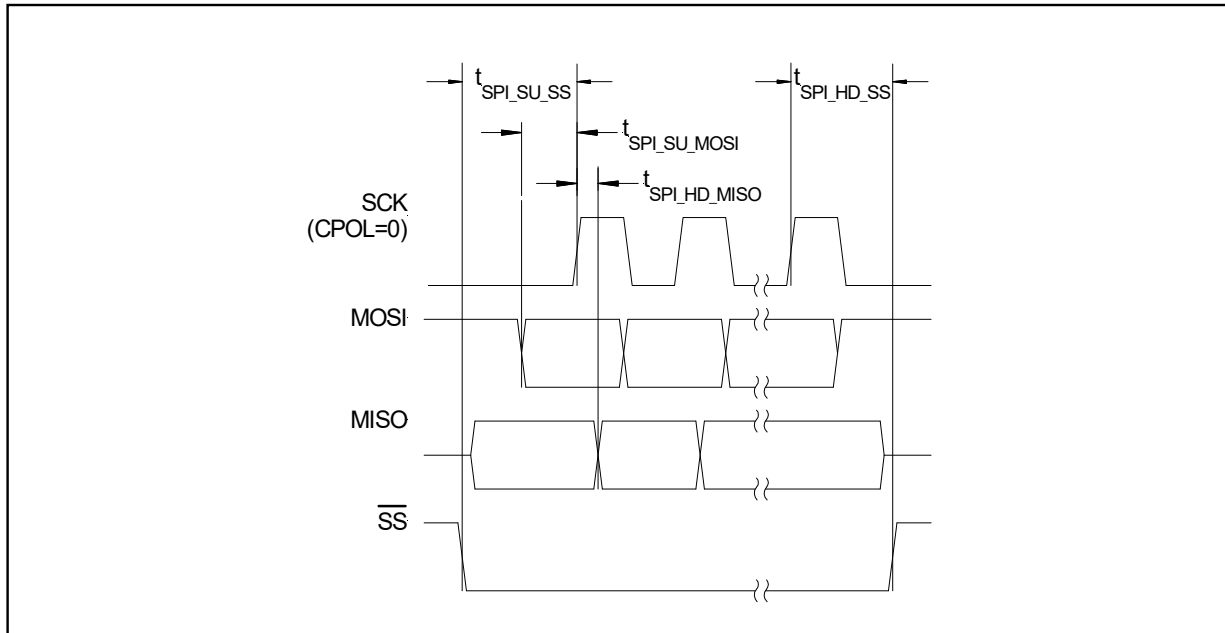
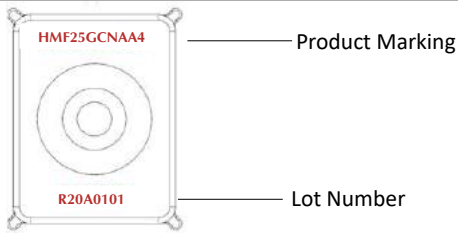
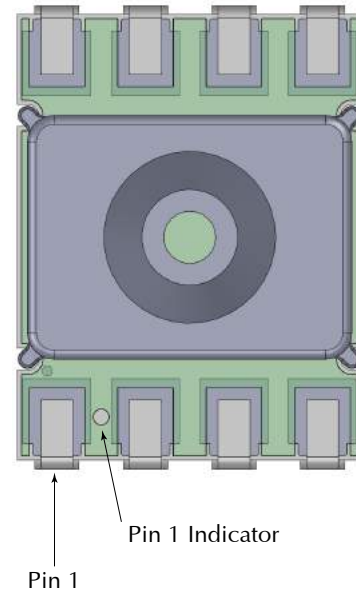
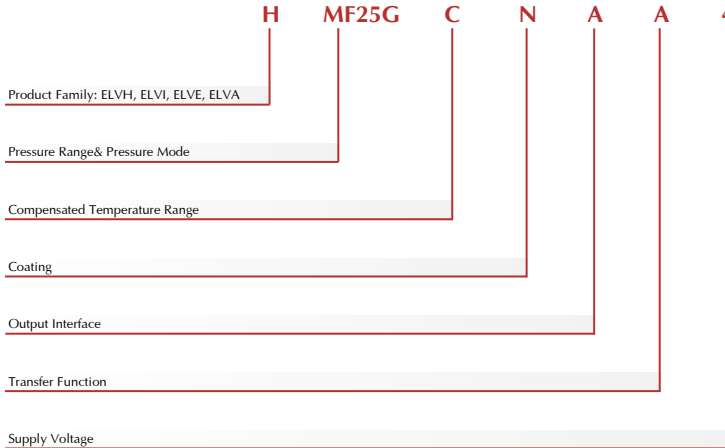


Figure 11: Timing characteristics

Product Labeling and Pin Indicator



Example Product Laser Marking: HMF25GCNAA4

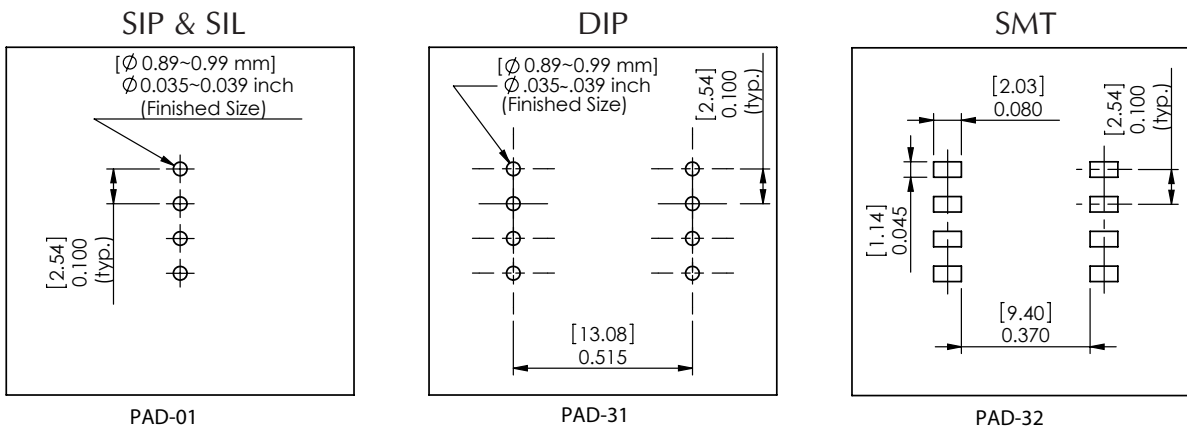


Pressure Tubing Recommendations

Tubing Recommendations				
Lid Type	ID	OD	Material*	
			Low Pressure	High Pressure
A	5/32"	1/4"	Silicone	Polyurethane
R	1/16"	1/8"	Silicone	Polyurethane
C	1/8"	1/4"	Silicone	Polyurethane
K	3/32"	5/32"	Silicone	Polyurethane
N	O-ring face seal			

Low Pressure is defined as pressure ranges below 15 psi. High Pressure is defined as pressure ranges above 15 psi.
 Note: 15 psi absolute is considered low pressure, whereas 15 psi differential and gage are considered high pressure.

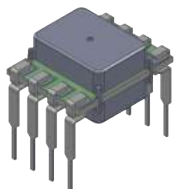
Suggested Pad Layouts



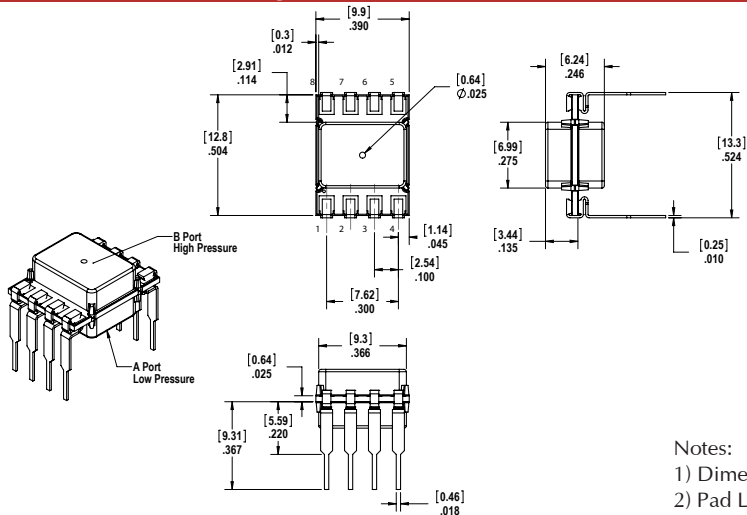
Dimensional Drawings - DIP Packages

Package Dimensions

DIP NN: No Port (Flat)



HNND
PACKAGE

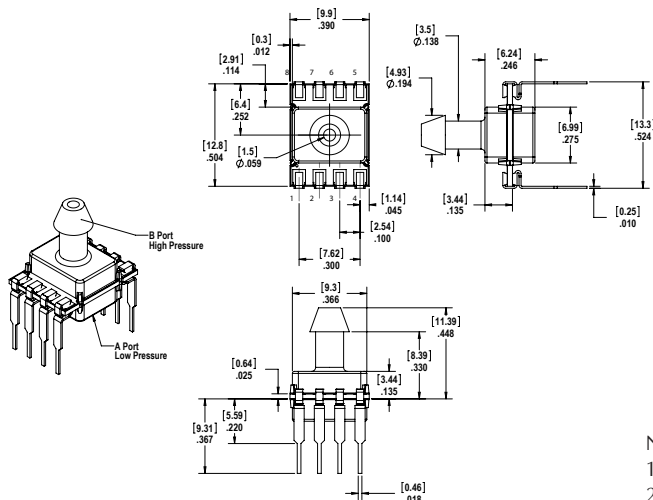


Notes:
1) Dimensions are in inches [mm].
2) Pad Layout: PAD-31.

DIP AN: Barbed Top
Port Gage



HAND
PACKAGE

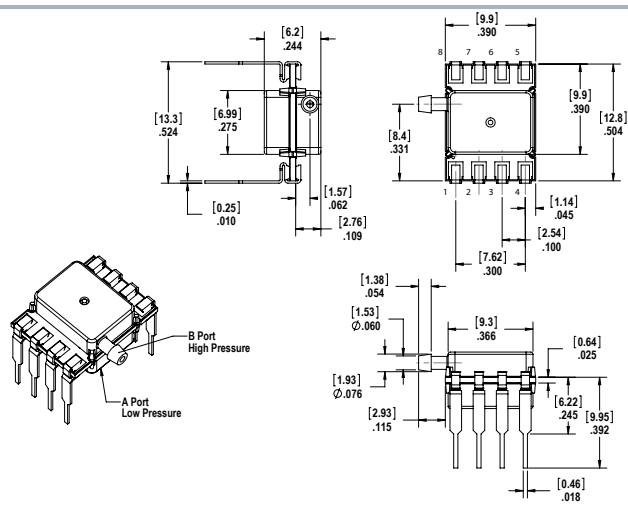


Notes:
1) Dimensions are in inches [mm].
2) Pad Layout: PAD-31.

DIP RN: Barbed Side
Port Gage



HRND
PACKAGE



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

* Refer to How to Order Tables for pinouts

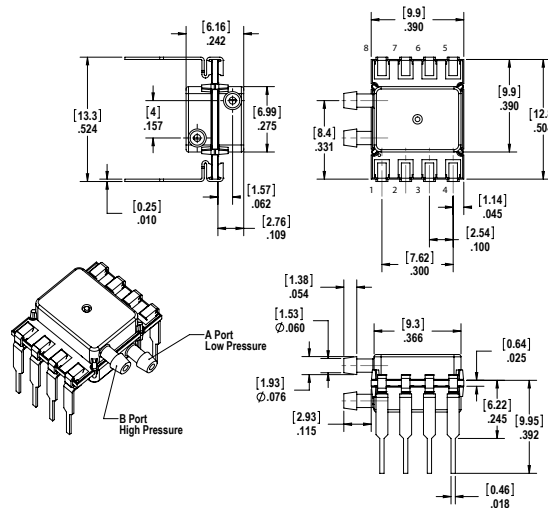
Dimensional Drawings - DIP Packages (Cont'd)

Package Dimensions

DIP RR: Barbed Side Port Differential

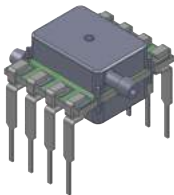


HRRD PACKAGE

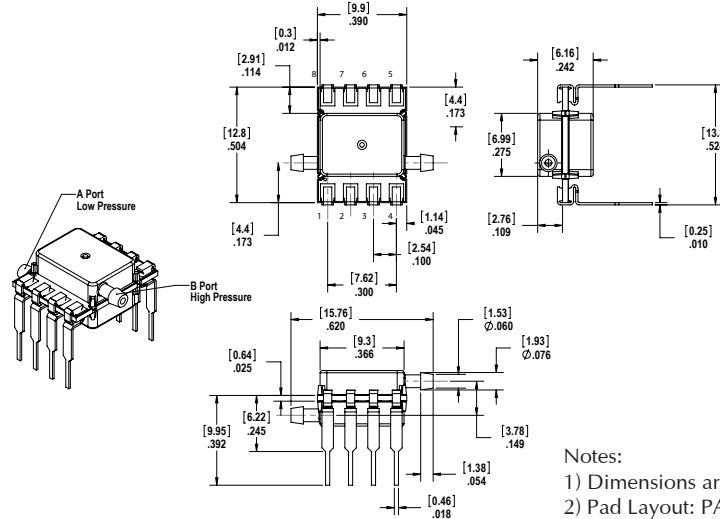


Notes:
 1) Dimensions are in inches [mm].
 2) Pad Layout: PAD-31.

DIP DR: Barbed Opposite Side Port Differential



HDRD PACKAGE

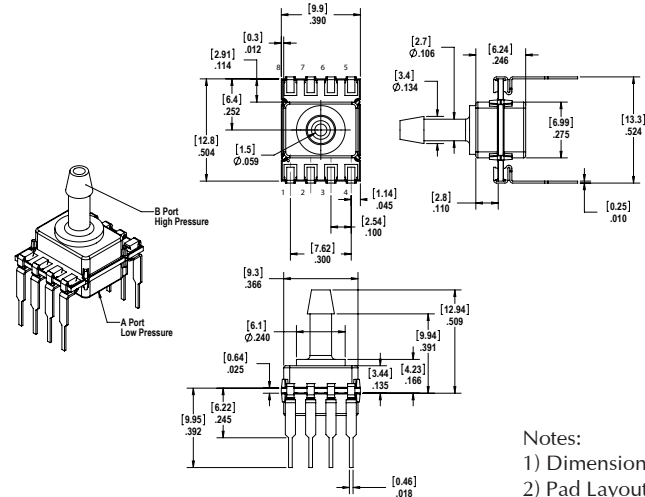


Notes:
 1) Dimensions are in inches [mm].
 2) Pad Layout: PAD-31.

DIP CN: Barbed Top Port



HCND PACKAGE



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

* Refer to How to Order Tables for pinouts



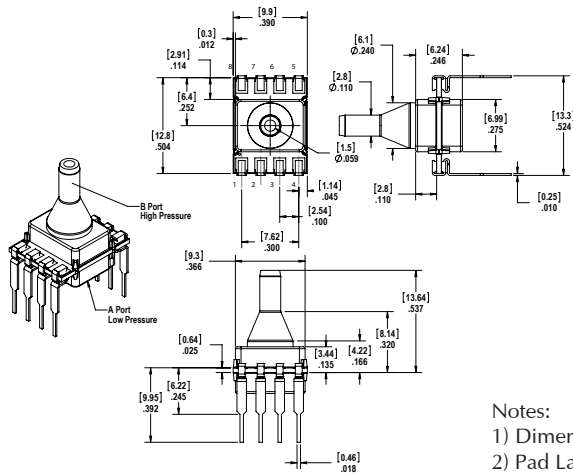
Dimensional Drawings - DIP Packages (Cont'd)

Package Dimensions

DIP KN: Non Barbed
Needle Top Port



HKND
PACKAGE



Notes:

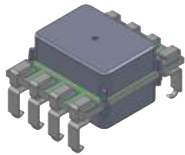
- 1) Dimensions are in inches [mm].
- 2) Pad Layout: PAD-31.

* Refer to How to Order Tables for pinouts

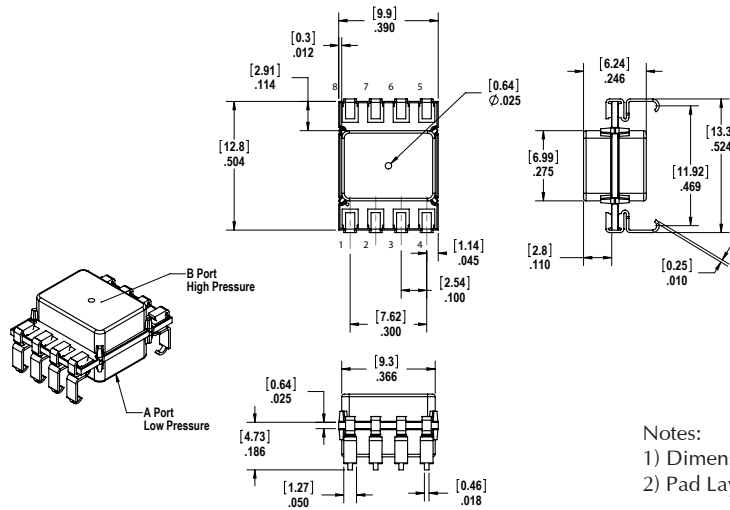
Dimensional Drawings - SMT Packages

Package Dimensions

SMT NN: No Port (Flat)



HNNJ
PACKAGE

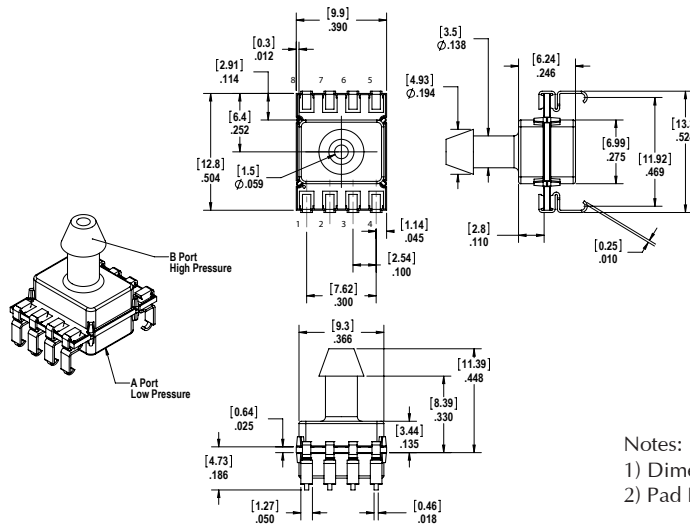


Notes:
1) Dimensions are in inches [mm].
2) Pad Layout: PAD-32.

SMT AN: Barbed Top Port Gage

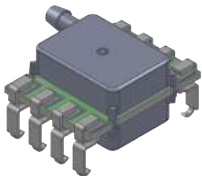


HANJ
PACKAGE

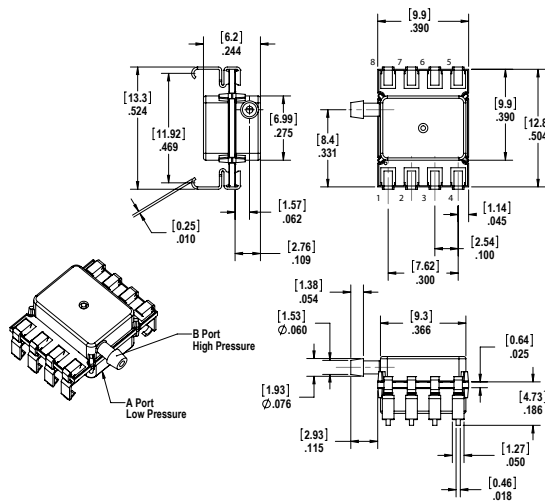


Notes:
1) Dimensions are in inches [mm].
2) Pad Layout: PAD-32.

SMT RN: Barbed Side Port Gage



HRNJ
PACKAGE



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

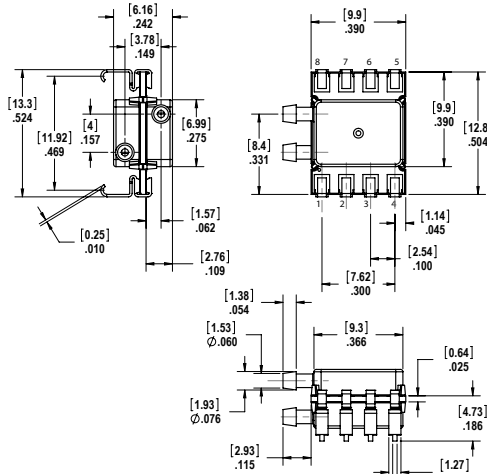
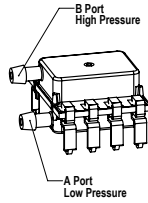
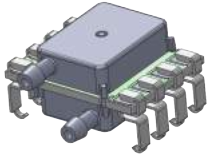
* Refer to How to Order Tables for pinouts



Dimensional Drawings - SMT Packages (Cont'd)

Package Dimensions

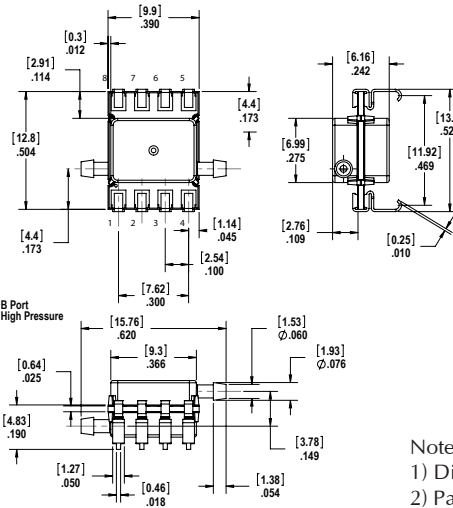
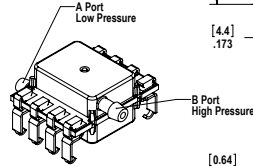
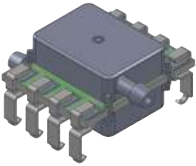
SMT RR: Barbed Side Port Differential



HRRJ
PACKAGE

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

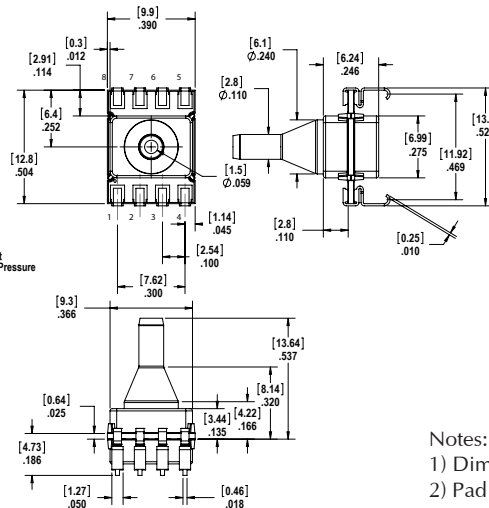
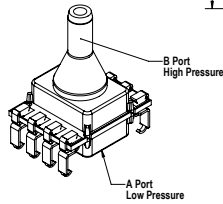
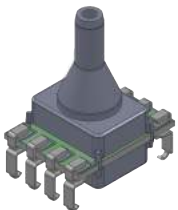
SMT DR: Barbed Opposite Side Port Differential



HDRJ
PACKAGE

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

SMT KN: Non Barbed Needle Top Port



HKNJ
PACKAGE

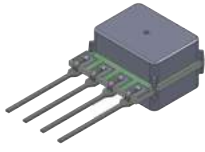
Notes:
1) Dimensions are in inches [mm].
2) Pad Layout: PAD-32.

* Refer to How to Order Tables for pinouts

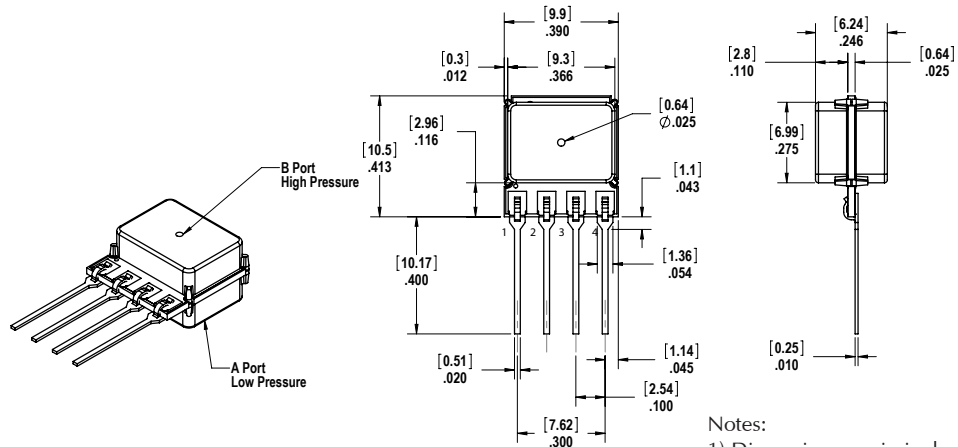
Dimensional Drawings - SIP H-Lead Packages

Package Dimensions

SIP H-Lead NN: No Port (Flat)



HNNH PACKAGE

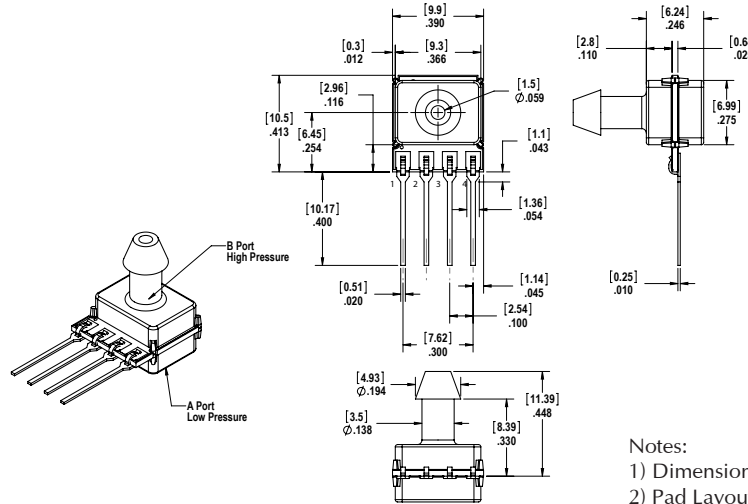


Notes:
1) Dimensions are in inches [mm].
2) Pad Layout: PAD-1.

SIP H-Lead AN: Barbed Top Port Gage

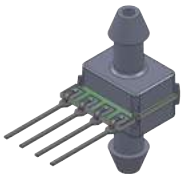


HANH PACKAGE

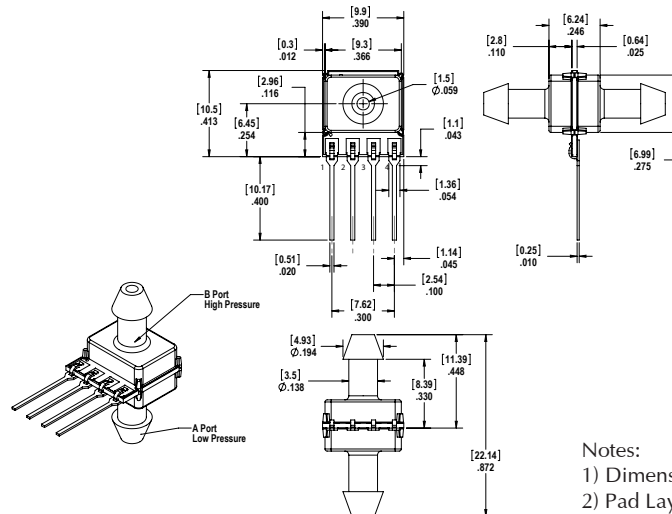


Notes:
1) Dimensions are in inches [mm].
2) Pad Layout: PAD-1.

SIP H-Lead AA: Barbed Top Port Differential



HAAH PACKAGE



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

* Refer to How to Order Tables for pinouts

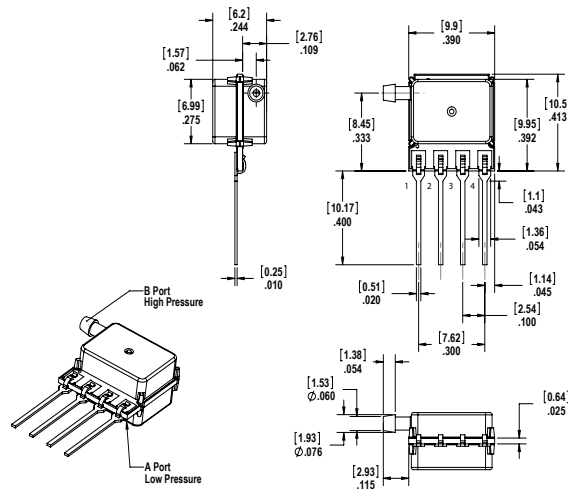
Dimensional Drawings - SIP H-Lead Packages (Cont'd)

Package Dimensions

SIP H-Lead RN: Barbed Side Port Gage

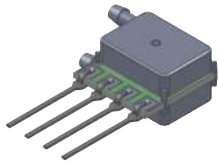


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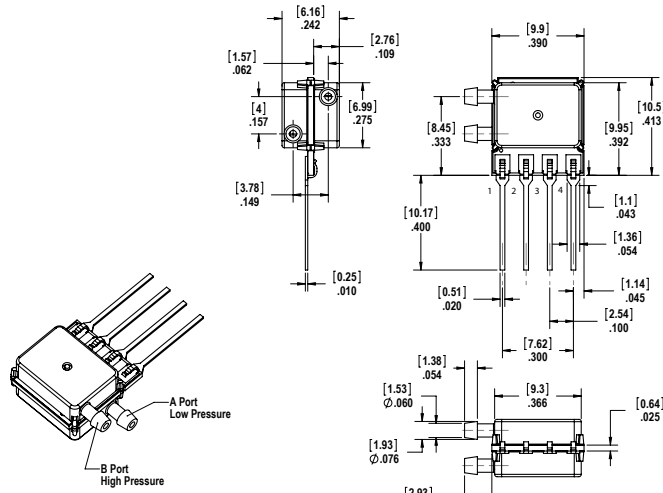


Notes:
1) Dimensions are in inches [mm].
2) Pad Layout: PAD-1.

SIP H-Lead RR: Barbed Side Port Differential

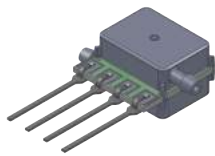


HRRH PACKAGE

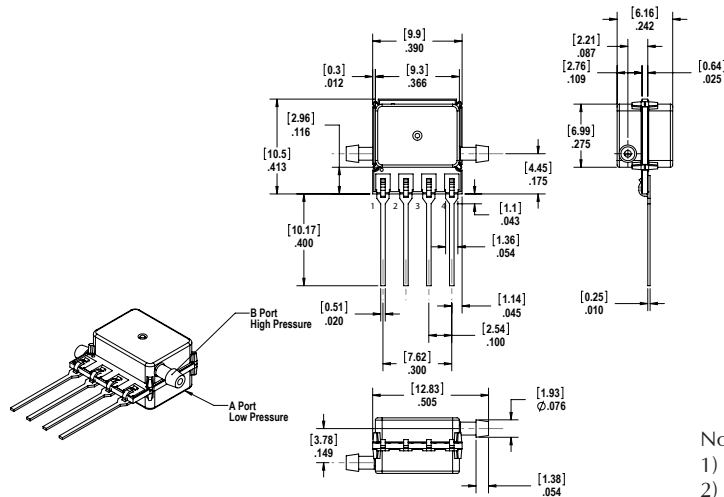


Notes:
1) Dimensions are in inches [mm].
2) Pad Layout: PAD-1.

SIP H-Lead DR: Barbed Opposite Side Port Differential



HDRH PACKAGE



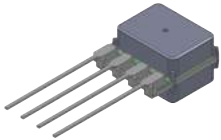
Notes:
1) Dimensions are in inches [mm].
2) Pad Layout: PAD-1.

* Refer to How to Order Tables for pinouts

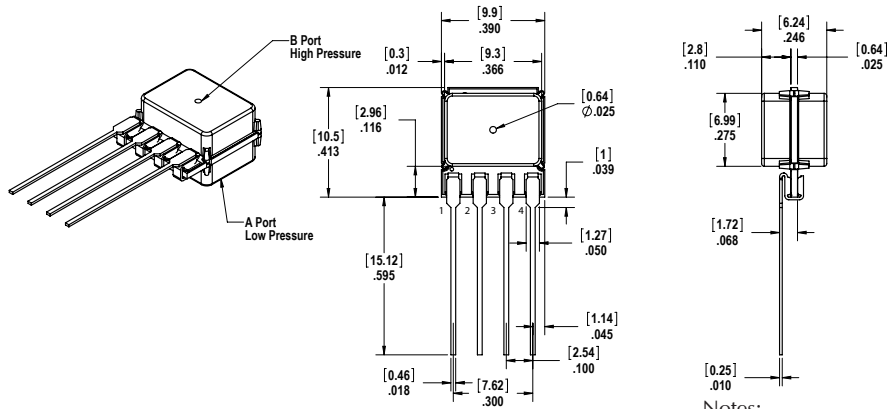
Dimensional Drawings - SIL F-Lead Packages

Package Dimensions

SIL F-Lead NN: No Port (Flat)



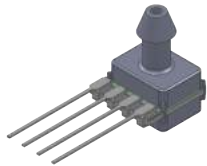
HNNF PACKAGE



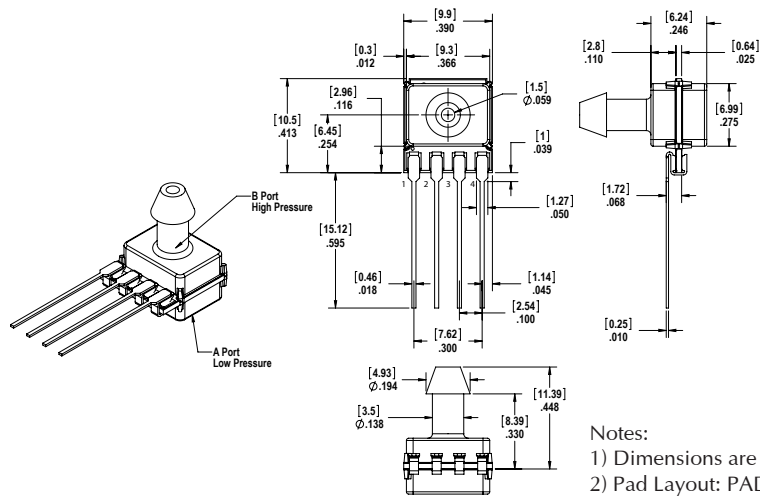
Notes:

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

SIL F-Lead AN: Barbed Top Port Gage



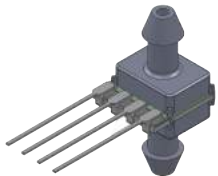
HANF PACKAGE



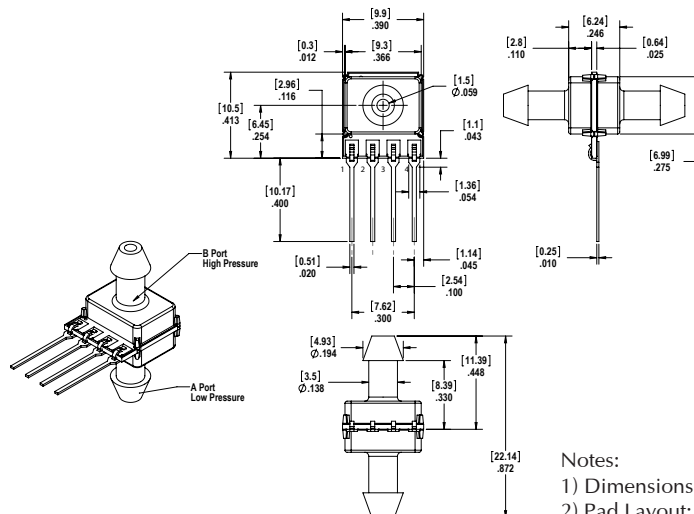
Notes:

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

SIL F-Lead AA: Barbed Top Port Differential



HAAF PACKAGE



Notes:

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

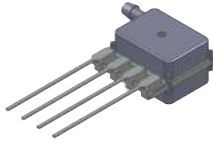
* Refer to How to Order Tables for pinouts



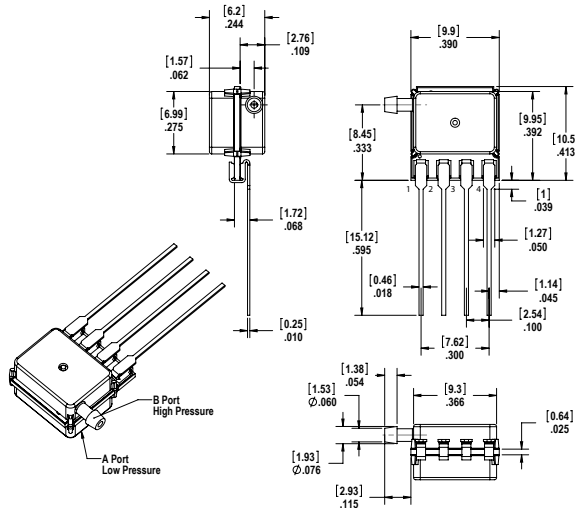
Dimensional Drawings - SIL F-Lead Packages (Cont'd)

Package Dimensions

SIL F-Lead RN: Barbed Side Port Gage

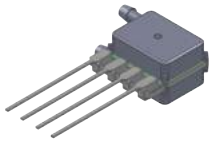


HRNF PACKAGE

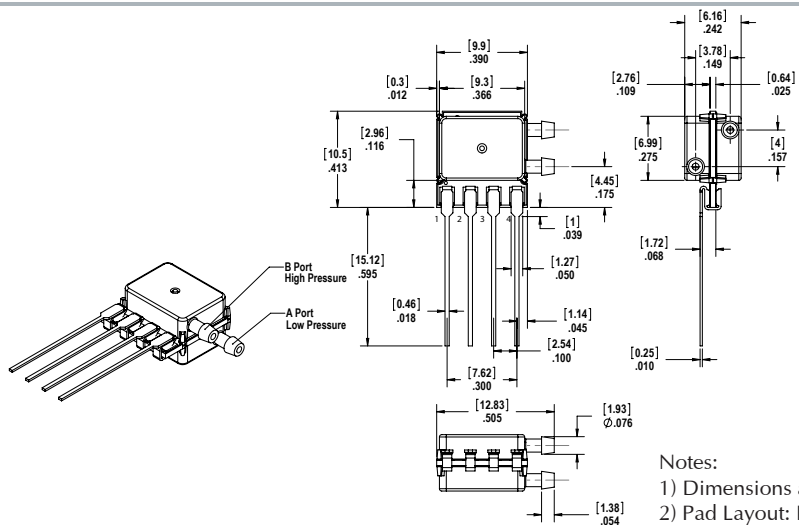


Notes:
1) Dimensions are in inches [mm].
2) Pad Layout: PAD-1.

SIL F-Lead RR: Barbed Side Port Differential

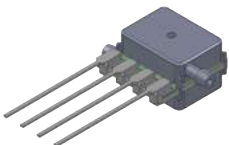


HRRF PACKAGE

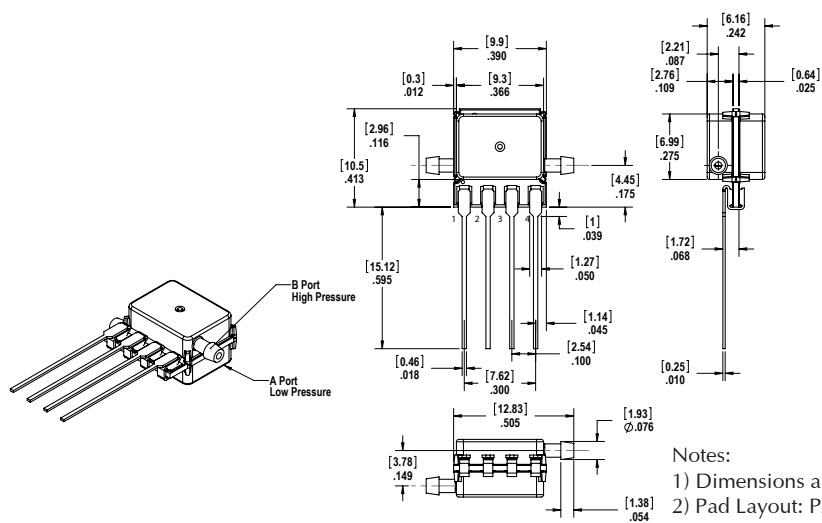


Notes:
1) Dimensions are in inches [mm].
2) Pad Layout: PAD-1.

SIL F-Lead DR: Barbed Opposite Side Port Differential



HDRF 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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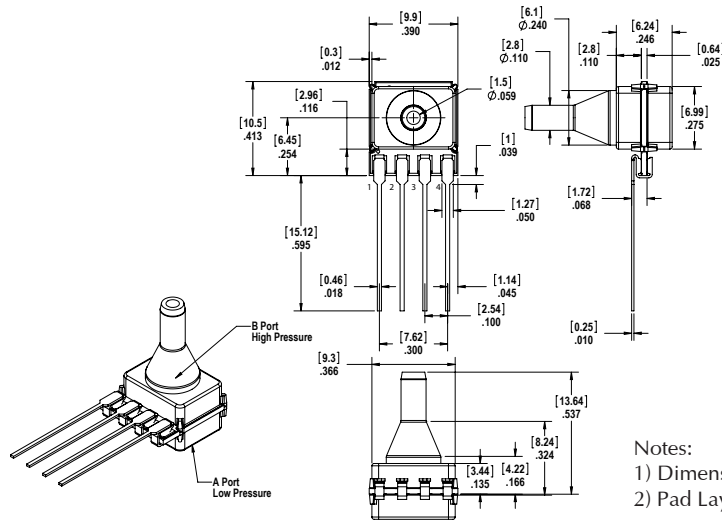
Dimensional Drawings - SIL F-Lead Packages (Cont'd)

Package Dimensions

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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Revisions

Rev	Date	Change Description(s)
A	02/03/20	Initial Release

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