Freescale Semiconductor

MPXV4115V
Rev 3, 10/2010

Integrated Silicon Pressure Sensor On-Chip Signal Conditioned, Temperature Compensated, and Calibrated

MPXV4115V Series

INTEGRATED PRESSURE SENSOR
-115 to 0 kPa (-16.7 to 0 psi)
0.2 to 4.6 V Output

The MPXV4115V series piezoresistive transducer is a state-of-the-art monolithic silicon pressure sensor designed for a wide range of applications, particularly those employing a microcontroller with A/D inputs. This transducer combines advanced micromachining techniques, thin-film metallization and bipolar processing to provide an accurate, high-level analog output signal that is proportional to the applied pressure/vacuum. The small form factor and high reliability of on-chip integration make the sensor a logical and economical choice for the automotive system designer. Figure 1 shows a block diagram of the internal circuitry integrated on a pressure sensor chip.

Application Examples

- Vacuum Pump Monitoring
- Brake Booster Monitoring

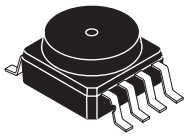
Features

- 1.5% Maximum error over 0° to 85°C
- Temperature Compensated from -40° + 125°C
- Ideally Suited for Microprocessor or Microcontroller-Based Systems
- Durable Thermoplastic (PPS) Surface Mount Package

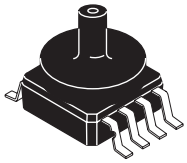
ORDERING INFORMATION

Device Name	Package Options	Case No.	# of Ports			Pressure Type			Device Marking
			None	Single	Dual	Gauge	Differential	Absolute	
Small Outline Package (MPXV4115V Series)									
MPXV4115V6U	Rails	482	•			Vacuum/ Gauge			MPXV4115V
MPXV4115V6T1	Tape and Reel	482	•			Vacuum/ Gauge			MPXV4115V
MPXV4115VC6U	Rails	482A		•			Vacuum/ Differential		MPXV4115V

SMALL OUTLINE PACKAGES



MPXV4115V6U
MPXV4115V6T1
CASE 482



MPXV4115VC6U
CASE 482A

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Operating Characteristics

Table 1. Operating Characteristics (V_S = 5.0 Vdc, T_A = 25°C unless otherwise noted. Decoupling circuit shown in Figure 3 required to meet electrical specifications.)

Characteristic		Symbol	Min	Typ	Max	Unit
Pressure Range (Differential mode, Vacuum on metal cap side, Atmospheric pressure on back side)		P_{OP}	-115	—	0	kPa
Supply Voltage(1)		V_S	4.75	5.0	5.25	Vdc
Supply Current		I_o	—	6.0	10	mAdc
Full Scale Output(2) (Pdiff = 0 kPa)[2]	(0 to 85°C)	V_{FSO}	4.535	4.6	4.665	Vdc
Full Scale Span(3) @ V_S = 5.0 V	(0 to 85°C)	V_{FSS}	—	4.4	—	Vdc
Accuracy(4)	(0 to 85°C)	—	—	—	1.5%	$\%V_{FSS}$
Sensitivity		V/P	—	38.26	—	mV/kPa
Response Time(5)		t_R	—	1.0	—	ms
Output Source Current at Full Scale Output		I_o	—	0.1	—	mAdc
Warm-Up Time(6)		—	—	20	—	ms
Offset Stability(7)		—	—	±0.5	—	$\%V_{FSS}$

1. Device is ratiometric within this specified excitation range.
2. Full Scale Output is defined as the output voltage at the maximum or full-rated pressure.
3. Full Scale Span is defined as the algebraic difference between the output voltage at full-rated pressure and the output voltage at the minimum-rated pressure.
4. Accuracy is the deviation in actual output from nominal output over the entire pressure range and temperature range as a percent of span at 25°C due to all sources of errors, including the following:

   Linearity: Output deviation from a straight line relationship with pressure over the specified pressure range.

   Temperature Hysteresis: Output deviation at any temperature within the operating temperature range, after the temperature is cycled to and from the minimum or maximum operating temperature points, with zero differential pressure applied.

   Pressure Hysteresis: Output deviation at any pressure within the specified range, when this pressure is cycled to and from minimum or maximum rated pressure at 25°C.

   TcSpan: Output deviation over the temperature range of 0° to 85°C, relative to 25°C.

   TcOffset: Output deviation with minimum pressure applied, over the temperature range of 0° to 85°C, relative to 25°C.
5. Response Time is defined as the time for the incremental change in the output to go from 10% to 90% of its final value when subjected to a specified step change in pressure.
6. Warm-up Time is defined as the time required for the product to meet the specified output voltage after the Pressure has been stabilized.
7. Offset Stability is the product's output deviation when subjected to 1000 hours of Pulsed Pressure, Temperature Cycling with Bias Test.

Maximum Ratings

Table 2. MAXIMUM RATINGS(1)

Rating	Symbol	Value	Unit
Maximum Pressure	P_{max}	400	kPa
Storage Temperature	T_{stg}	-40 to +125	°C
Operating Temperature	T_A	-40 to +125	°C

1. Exposure beyond the specified limits may cause permanent damage or degradation to the device.

Figure 1 shows a block diagram of the internal circuitry integrated on a pressure sensor chip.

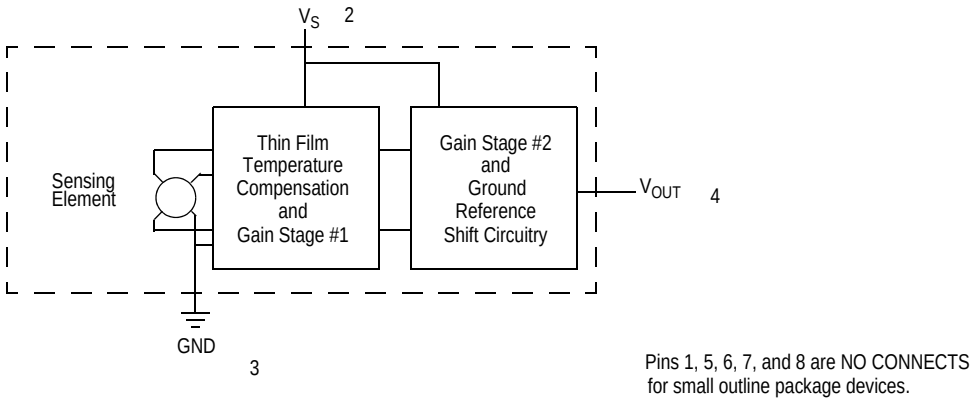


Figure 1. Fully Integrated Pressure Sensor Schematic for Small Outline Package

On-chip Temperature Compensation, Calibration, and Signal Conditioning

The performance over temperature is achieved by integrating the shear-stress strain gauge, temperature compensation, calibration and signal conditioning circuitry onto a single monolithic chip.

Figure 2 illustrates the gauge configuration in the basic chip carrier (Case 482). A fluorosilicone gel isolates the die surface and wire bonds from the environment, while allowing the pressure signal to be transmitted to the silicon diaphragm.

The MPXV4115V series sensor operating characteristics are based on use of dry air as pressure media. Media, other than dry air, may have adverse effects on sensor performance and long-term reliability. Internal reliability and qualification test for dry air, and other media, are available from the factory. Contact the factory for information regarding media tolerance in your application.

Figure 3 shows the recommended decoupling circuit for interfacing the output of the integrated sensor to the A/D input of a microprocessor or microcontroller. Proper decoupling of the power supply is recommended.

Figure 4 shows the sensor output signal relative to differential pressure input. Typical, minimum and maximum output curves are shown for operation over a temperature range of 0°C to 85°C using the decoupling circuit shown in Figure 3. The output will saturate outside of the specified pressure range.

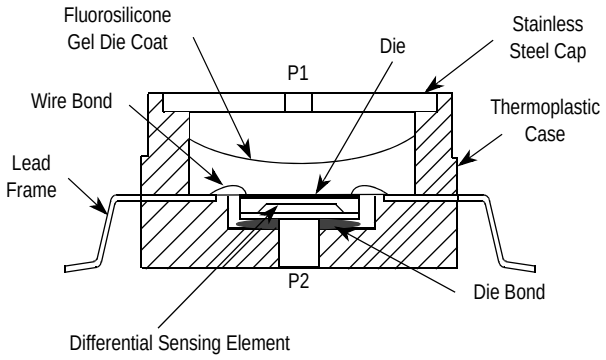


Figure 2. Cross-Sectional Diagram (not to scale)

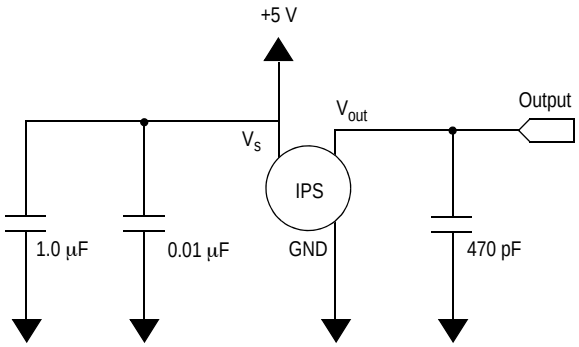


Figure 3. Recommended Power Supply Decoupling and Output Filtering
(For output filtering recommendations, refer to Application Note AN1646.)

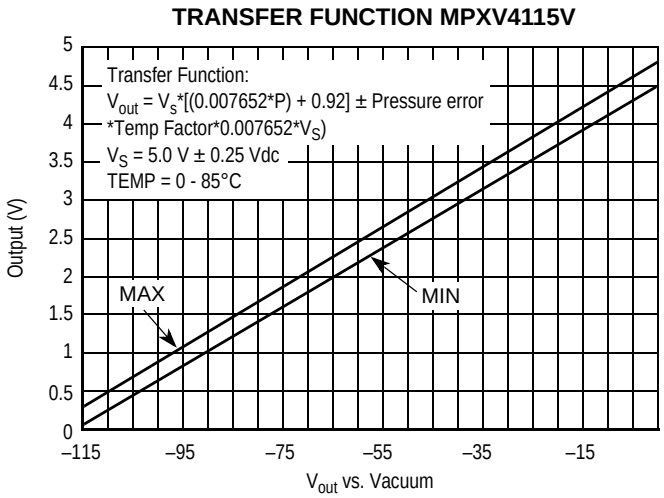
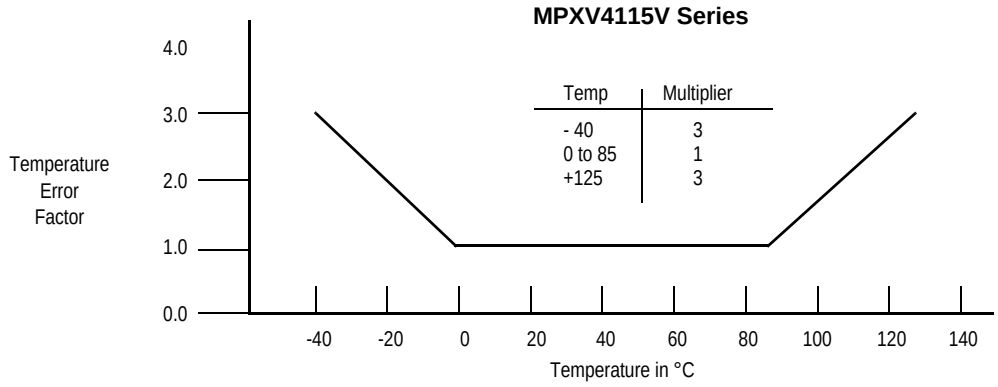


Figure 4. Applied Vacuum in kPa (below atmospheric pressure)

Transfer Function (MPXV4115V)

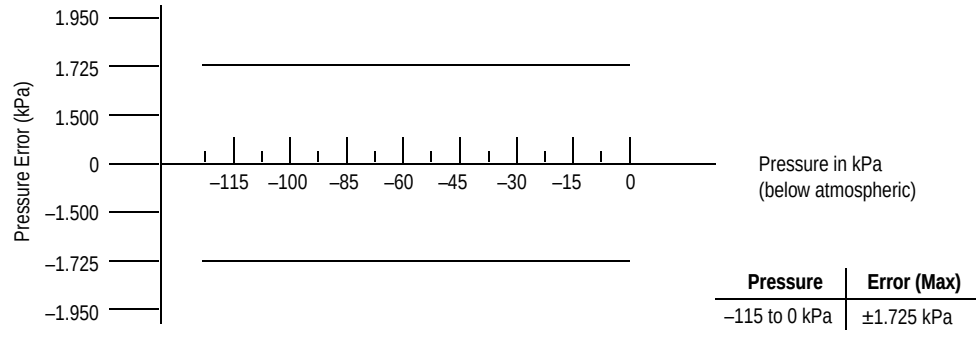
Nominal Transfer Value: $V_{out} = V_S (P \times 0.007652 + 0.92)$
$\pm$ (Pressure Error x Temp. Factor x 0.007652 x V_S)
$V_S = 5\ V \pm 0.25$ Vdc

Temperature Error Band



NOTE: The Temperature Multiplier is a linear response from 0°C to -40°C and from 85°C to 125°C.

Pressure Error Band



PRESSURE (P1)/VACUUM (P2) SIDE IDENTIFICATION TABLE

The two sides of the pressure sensor are designated as the Pressure (P1) side and the Vacuum (P2) side. The Pressure (P1) side is the side containing fluorosilicone gel, which protects the die from harsh media. The MPX pressure sensor is designed to operate with positive differential pressure applied, P1 > P2.

The Pressure (P1) side may be identified by using the following table:

Part Number	Case Type	Pressure (P1) Side Identifier
MPXV4115V6U	482	Side with Part Marking
MPXV4115V6T1	482	Side with Part Marking
MPXV4115VC6U	482A	Side with Port Attached

INFORMATION FOR USING THE SMALL OUTLINE PACKAGE (CASE 482)

MINIMUM RECOMMENDED FOOTPRINT FOR SURFACE MOUNTED APPLICATIONS

Surface mount board layout is a critical portion of the total design. The footprint for the surface mount packages must be the correct size to ensure proper solder connection interface between the board and the package. With the correct footprint, the packages will self align when subjected to a solder reflow process. It is always recommended to design boards with a solder mask layer to avoid bridging and shorting between solder pads.

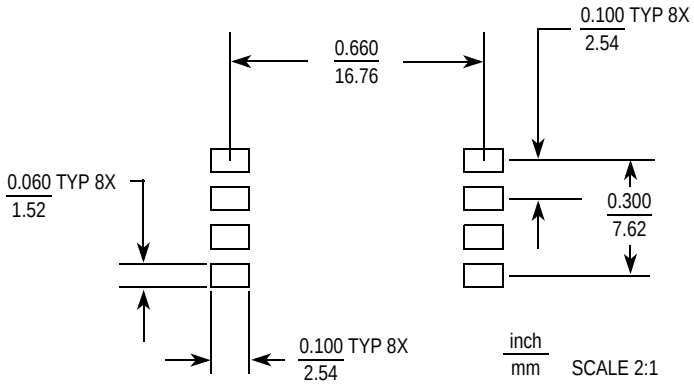
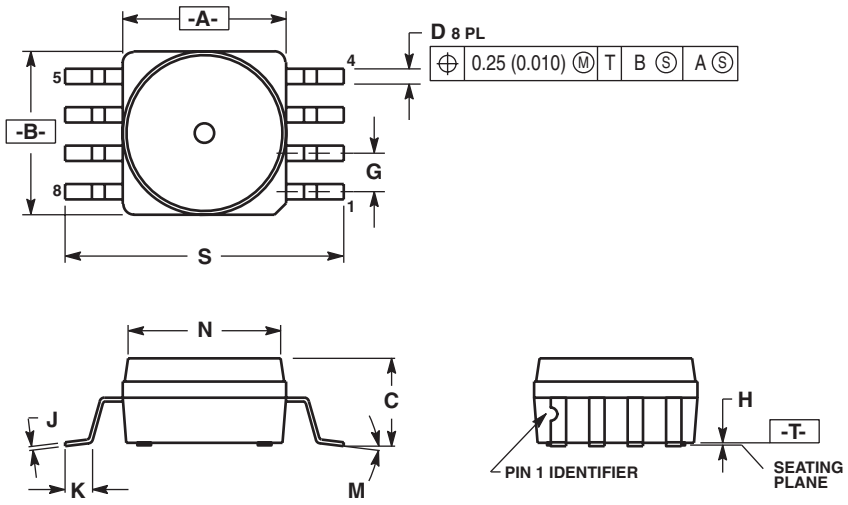


Figure 5. SOP Footprint (Case 482)

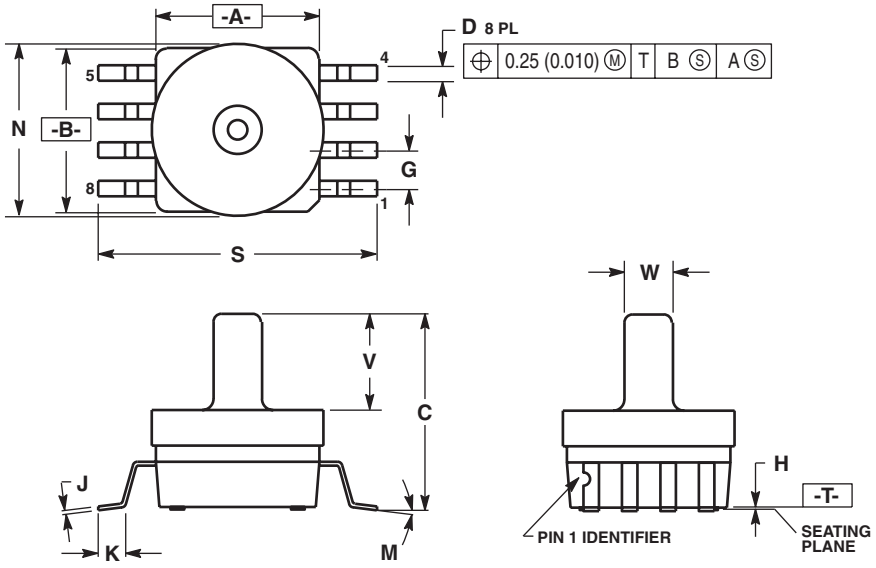
PACKAGE DIMENSIONS



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006).
5. ALL VERTICAL SURFACES 5˚ TYPICAL DRAFT.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.415	0.425	10.54	10.79
B	0.415	0.425	10.54	10.79
C	0.212	0.230	5.38	5.84
D	0.038	0.042	0.96	1.07
G	0.100 BSC		2.54 BSC	
H	0.002	0.010	0.05	0.25
J	0.009	0.011	0.23	0.28
K	0.061	0.071	1.55	1.80
M	0˚	7˚	0˚	7˚
N	0.405	0.415	10.29	10.54
S	0.709	0.725	18.01	18.41

CASE 482-01
ISSUE O
SMALL OUTLINE PACKAGE



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	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.415	0.425	10.54	10.79
B	0.415	0.425	10.54	10.79
C	0.500	0.520	12.70	13.21
D	0.038	0.042	0.96	1.07
G	0.100 BSC		2.54 BSC	
H	0.002	0.010	0.05	0.25
J	0.009	0.011	0.23	0.28
K	0.061	0.071	1.55	1.80
M	0˚	7˚	0˚	7˚
N	0.444	0.448	11.28	11.38
S	0.709	0.725	18.01	18.41
V	0.245	0.255	6.22	6.48
W	0.115	0.125	2.92	3.17

CASE 482A-01
ISSUE A
SMALL OUTLINE PACKAGE

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