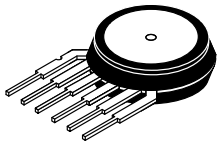
0 to 1000 kPa (0 to 150 PSI) On-Chip Signal Conditioned, 0.2 V to 4.7 V Output, Temperature Compensated and Calibrated, Silicon Pressure Sensors

MPX5999 SERIES

X–ducer™ SILICON PRESSURE SENSORS



BASIC CHIP CARRIER ELEMENT CASE 867–04 Style 1

Features

- Temperature Compensated Over 0 to 85°C
- Ideally Suited for Microprocessor or Microcontroller–Based Systems
- Patented Silicon Shear Stress Strain Gauge
- Available in Differential and Gauge Configurations
- Durable Epoxy Unibody Element

Pin Number					
1	2	3	4	5	6
V_{out}	Ground	V_S	N/C	N/C	N/C

NOTE: Pins 4, 5 and 6 are internal device connections. Do not connect to external circuitry or ground.

MAXIMUM RATINGS (T_C = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Overpressure(6) (P1 > P2)	P_{max}	4000	kPa
Burst Pressure(6) (P1 > P2)	P_{burst}	6000	kPa
Storage Temperature	T_{stg}	–50 to +150	°C
Operating Temperature	T_A	–40 to +125	°C

The MPX5999 series piezoresistive transducer is a state–of–the–art pressure sensor designed for a wide range of applications, but particularly for those employing a microcontroller or microprocessor with A/D inputs. This patented, single element X–ducer combines advanced micromachining techniques, thin–film metallization and bipolar semiconductor processing to provide an accurate, high level analog output signal that is proportional to applied pressure.

Figure 1 shows a block diagram of the internal circuitry integrated on the stand–alone sensing chip.

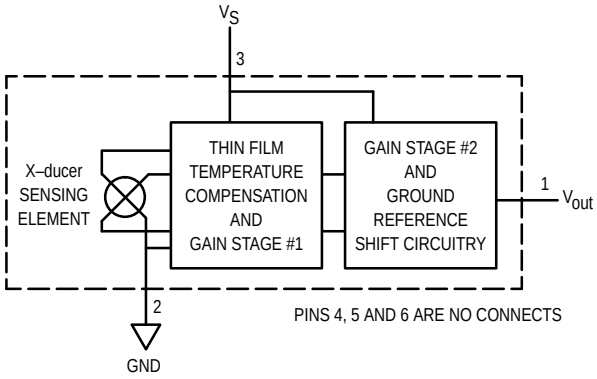


Figure 1. Fully Integrated Pressure Sensor Schematic

X–ducer is a trademark of Motorola, Inc.

OPERATING CHARACTERISTICS (V_S = 5.0 Vdc, T_A = 25°C unless otherwise noted, P1 > P2)

Characteristic		Symbol	Min	Typ	Max	Unit
Pressure Range		P_{OP}	0	–	1000	kPa
Supply Voltage (1)		V_S	4.75	5.0	5.25	Vdc
Supply Current		I_o	–	7.0	10	mAdc
Full Scale Span (2)	(0 to 85°C)	V_{FSS}	4.388	4.7	4.613	V
Zero Pressure Offset (3)	(0 to 85°C)	V_{off}	0.088	0.2	0.313	V
Sensitivity		V/P	–	5.0	–	mV/kPa
Accuracy (4)	(0 to 85°C)	–	–	–	± 2.5	$\%V_{FSS}$
Response Time (5)		t_R	–	1.0	–	ms
Output Source Current at Full Scale Output		I_{O+}	–	0.1	–	mA

MECHANICAL CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Weight, Basic Element (Case 867)	–	–	4.0	–	Grams
Warm–Up	–	–	15	–	Sec
Cavity Volume	–	–	–	0.01	IN^3
Volumetric Displacement	_	–	–	0.001	IN^3

NOTES:

1. Device is ratiometric within this specified excitation range.
2. Full Scale Span (V_{FSS}) is defined as the algebraic difference between the output voltage at full rated pressure and the output voltage at the minimum rated pressure.
3. Offset (V_{off}) is defined as the output voltage at the minimum rated pressure.
4. Accuracy (error budget) consists of 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 the minimum or maximum rated pressure, at 25°C.
   - Offset Stability: Output deviation, after 1000 temperature cycles, – 40 to 125°C, and 1.5 million pressure cycles, with minimum rated pressure applied.
   - TcSpan: Output deviation over the temperature range of 0 to 85°C, relative to 25°C.
   - TcOffset: Output deviation with minimum rated pressure applied, over the temperature range of 0 to 85°C, relative to 25°C.
   - Variation from nominal: The variation from nominal values, for offset or full scale span, as a percent of V_{FSS}, at 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. Common mode pressures beyond specified may result in leakage at the case–to–lead interface.
7. Exposure beyond these limits may cause permanent damage or degradation to the device.

ON–CHIP TEMPERATURE COMPENSATION, CALIBRATION AND SIGNAL CONDITIONING

Figure 2 shows the sensor output signal relative to pressure input. Typical, minimum and maximum output curves are shown for operation over 0°C to 85°C. (Device output may be nonlinear outside of the rated pressure range.)

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 3 illustrates the differential or gauge configuration in the basic chip carrier (Case 867). A fluoro silicone gel isolates the die surface and wire bonds from harsh environments, while allowing the pressure signal to be transmitted to the silicon diaphragm.

The MPX5999 series pressure sensor operating characteristics, and internal reliability and qualification tests are based on use of dry air as the pressure media. Media other than dry air may have adverse effects on sensor performance and long–term reliability. Contact the factory for information regarding media compatibility in your application.

Figure 4 shows a typical decoupling circuit for interfacing the output of the MPX5999 to the A/D microprocessor. Proper decoupling of the power supply is recommended.

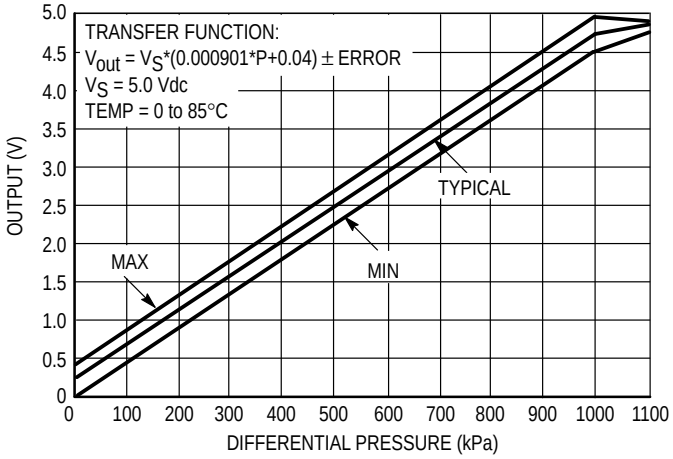


Figure 2. Output versus Pressure Differential

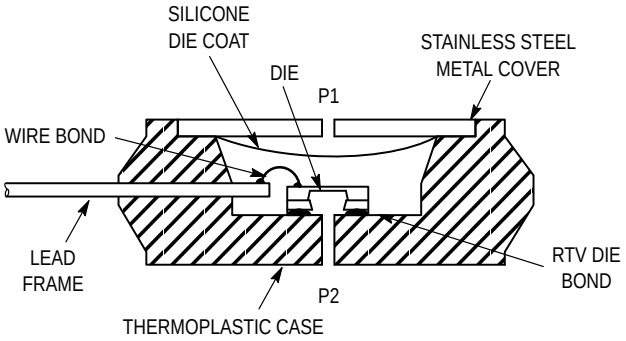


Figure 3. Cross–Sectional Diagram (Not to Scale)

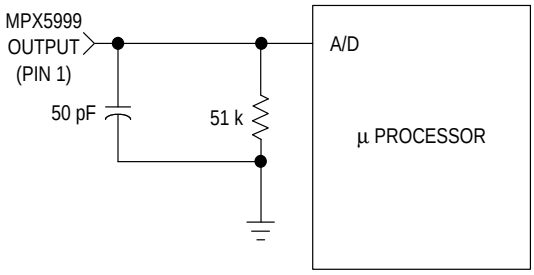


Figure 4. Typical Decoupling Filter for Sensor to Microprocessor Interface

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

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

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

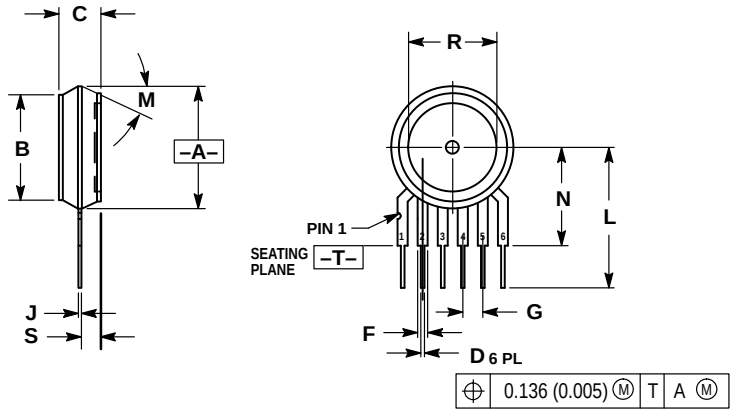
Part Number	Case Type	Pressure (P1) Side Identifier
MPX5999D	867–04	Stainless Steel Cap

ORDERING INFORMATION

The MPX5999 pressure sensor is available as an element only.

Device Type	Options	Case Type	MPX Series	
			Order Number	Device Marking
Basic Element	Differential	867–04	MPX5999D	MPX5999D

PACKAGE DIMENSIONS



NOTES:
8. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
9. CONTROLLING DIMENSION: INCH.
10. DIMENSION –A– DOES NOT INCLUDE MOLDED FLASH RING. MOLDED FLASH RING NOT TO EXCEED 16.00 (0.630).

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.590	0.615	14.99	15.62
B	0.505	0.525	12.83	13.34
C	0.195	0.225	4.95	5.72
D	0.027	0.033	0.68	0.84
F	0.048	0.052	1.22	1.32
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.40
L	0.685	0.715	17.40	18.16
M	30 ° NOM		30 ° NOM	
N	0.490	0.510	12.45	12.95
R	0.420	0.450	10.67	11.43
S	0.090	0.105	2.29	2.66

STYLE 1:
PIN 1. V_{OUT}
2. GROUND
3. V_{CC}
4. V1
5. V2
6. V_{EX}

CASE 867–04
ISSUE H

BASIC ELEMENT (A, D)

Literature Distribution Centers:
USA: Motorola Literature Distribution; P.O. Box 20912; Phoenix, Arizona 85036.
EUROPE: Motorola Ltd.; European Literature Centre; 88 Tanners Drive, Blakelands, Milton Keynes, MK14 5BP, England.
JAPAN: Nippon Motorola Ltd.; 4–32–1, Nishi–Gotanda, Shinagawa–ku, Tokyo 141, Japan.
ASIA PACIFIC: Motorola Semiconductors H.K. Ltd.; Silicon Harbour Center, No. 2 Dai King Street, Tai Po Industrial Estate, Tai Po, N.T., Hong Kong.