

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

The MPX5010/MPXV5010G series piezoresistive transducers are state-of-the-art monolithic silicon pressure sensors designed for a wide range of applications, but particularly those employing a microcontroller or micro-processor 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.

Features

- 5.0% Maximum Error over 0° to 85°C
- Ideally Suited for Microprocessor or Microcontroller-Based Systems
- Durable Epoxy Unibody and Thermoplastic (PPS) Surface Mount Package
- Temperature Compensated over -40° to +125°C
- Patented Silicon Shear Stress Strain Gauge
- Available in Differential and Gauge Configurations
- Available in Surface Mount (SMT) or Through-hole (DIP) Configurations

Application Examples

- Hospital Beds
- HVAC
- Respiratory Systems
- Process Control

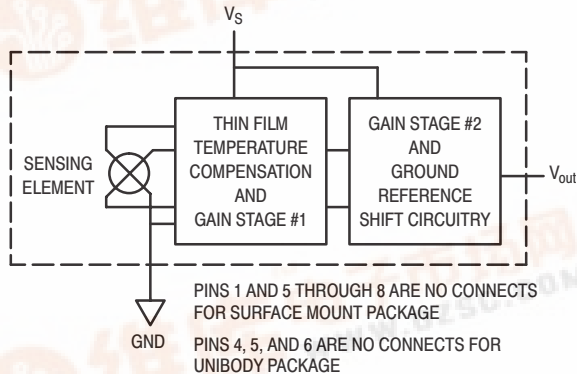


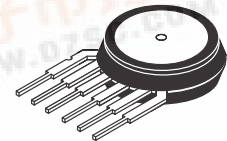
Figure 1. Fully Integrated Pressure Sensor Schematic

MPX5010 MPXV5010G SERIES

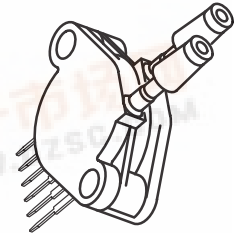
Motorola Preferred Device

**INTEGRATED
 PRESSURE SENSOR**
 0 to 10 kPa (0 to 1.45 psi)
 0.2 to 4.7 V Output

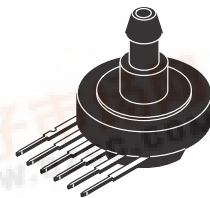
UNIBODY PACKAGE



MPX5010D
 CASE 867

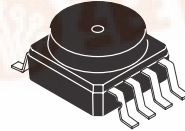


MPX5010DP
 CASE 867C

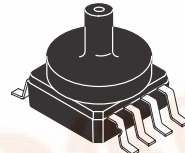


MPX5010GS
 CASE 867E

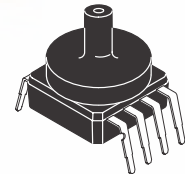
SMALL OUTLINE PACKAGE



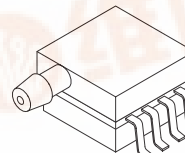
MPXV5010G6U
 CASE 482



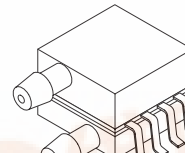
MPXV5010GC6U
 CASE 482A



MPXV5010GC7U
 CASE 482C



MPXV5010GP
 CASE 1369



MPXV5010DP
 CASE 1351

PIN NUMBER			
1	N/C	5	N/C
2	V _S	6	N/C
3	Gnd	7	N/C
4	V _{out}	8	N/C

PIN NUMBER			
1	V _{out}	4	N/C
2	Gnd	5	N/C
3	V _S	6	N/C

NOTE: Pins 1, 5, 6, 7, and 8 are internal device connections. Do not connect to external circuitry or ground. Pin 1 is noted by the notch in the lead.

NOTE: Pins 4, 5, and 6 are internal device connections. Do not connect to external circuitry or ground. Pin 1 is noted by the notch in the lead.



MPX5010 MPXV5010G SERIES

MAXIMUM RATINGS(NOTE)

Parametrics	Symbol	Value	Unit
Maximum Pressure (P1 > P2)	P_{max}	75	kPa
Storage Temperature	T_{stg}	-40 to +125	°C
Operating Temperature	T_A	-40 to +125	°C

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

OPERATING CHARACTERISTICS ($V_S = 5.0$ Vdc, $T_A = 25^\circ\text{C}$ unless otherwise noted, $P1 > P2$. Decoupling circuit shown in Figure 3 required to meet specification.)

Characteristic	Symbol	Min	Typ	Max	Unit
Pressure Range ⁽¹⁾	P_{OP}	0	—	10	kPa
Supply Voltage ⁽²⁾	V_S	4.75	5.0	5.25	Vdc
Supply Current	I_o	—	5.0	10	mAdc
Minimum Pressure Offset ⁽³⁾ @ $V_S = 5.0$ Volts (0 to 85°C)	V_{off}	0	0.2	0.425	Vdc
Full Scale Output ⁽⁴⁾ @ $V_S = 5.0$ Volts (0 to 85°C)	V_{FSO}	4.475	4.7	4.925	Vdc
Full Scale Span ⁽⁵⁾ @ $V_S = 5.0$ Volts (0 to 85°C)	V_{FSS}	4.275	4.5	4.725	Vdc
Accuracy ⁽⁶⁾ (0 to 85°C)	—	—	—	±5.0	% V_{FSS}
Sensitivity	V/P	—	450	—	mV/kPa
Response Time ⁽⁷⁾	t_R	—	1.0	—	ms
Output Source Current at Full Scale Output	I_{O+}	—	0.1	—	mAdc
Warm-Up Time ⁽⁸⁾	—	—	20	—	ms
Offset Stability ⁽⁹⁾	—	—	±0.5	—	% V_{FSS}

NOTES:

- 1.0 kPa (kiloPascal) equals 0.145 psi.
- Device is ratiometric within this specified excitation range.
- Offset (V_{off}) is defined as the output voltage at the minimum rated pressure.
- Full Scale Output (V_{FSO}) is defined as the output voltage at the maximum or full rated pressure.
- 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.
- 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.
 - 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.
- 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.
- Warm-up Time is defined as the time required for the product to meet the specified output voltage after the Pressure has been stabilized.
- Offset Stability is the product's output deviation when subjected to 1000 hours of Pulsed Pressure, Temperature Cycling with Bias Test.

MECHANICAL CHARACTERISTICS

Characteristics	Typ	Unit
Weight, Basic Element (Case 867)	4.0	grams
Weight, Basic Element (Case 482)	1.5	grams

MPX5010 MPXV5010G SERIES

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 Differential or 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 sensor diaphragm.

The MPX5010 and MPXV5010G 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 3 shows the recommended decoupling circuit for interfacing 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 pressure input. Typical, minimum, and maximum output curves are shown for operation over a temperature range of 0° to 85°C using the decoupling circuit shown in Figure 4. The output will saturate outside of the specified pressure range.

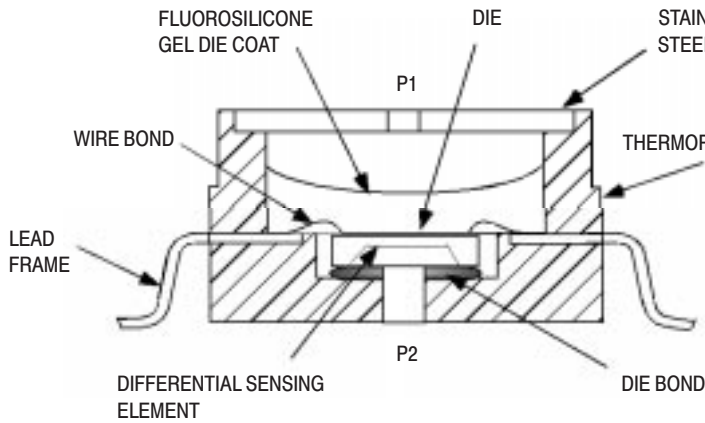


Figure 2. Cross-Sectional Diagram SOP (Not to Scale)

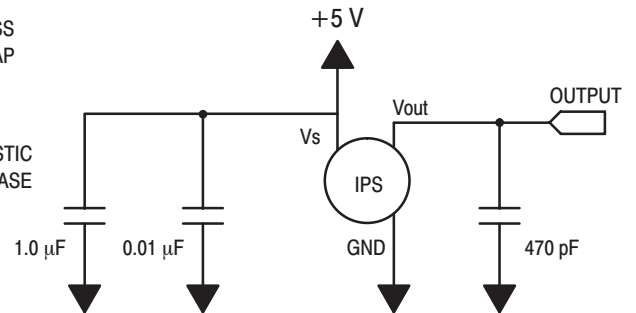


Figure 3. Recommended power supply decoupling and output filtering. For additional output filtering, please refer to Application Note AN1646.

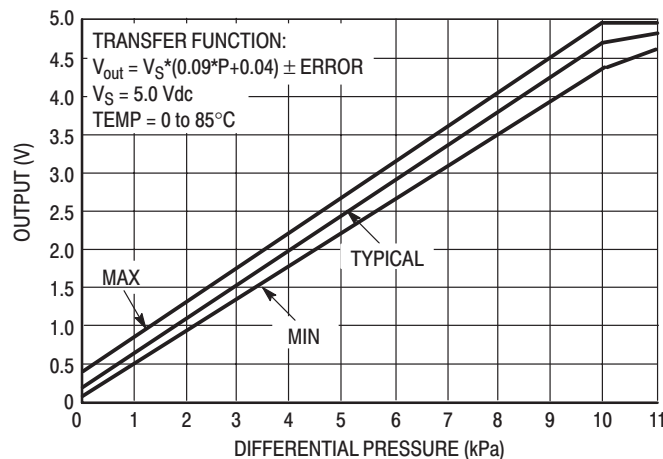


Figure 4. Output versus Pressure Differential

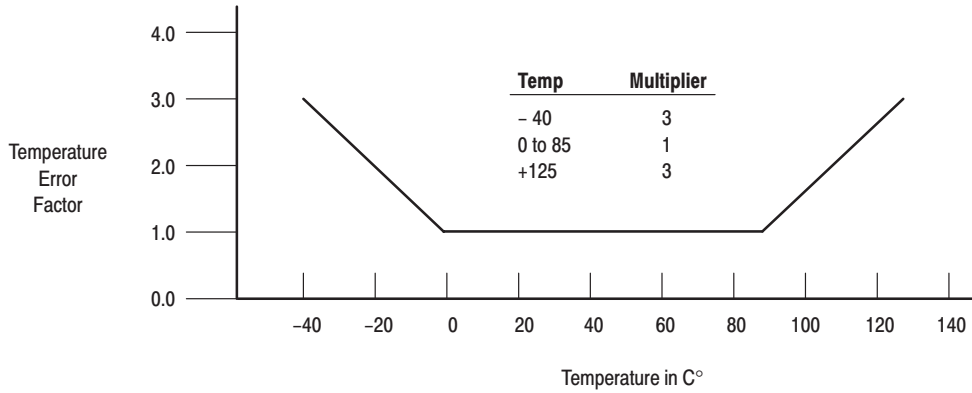
MPX5010 MPXV5010G SERIES

Transfer Function (MPX5010, MPXV5010G)

Nominal Transfer Value: $V_{out} = V_S \times (0.09 \times P + 0.04)$
 $\pm (\text{Pressure Error} \times \text{Temp. Factor} \times 0.09 \times V_S)$
 $V_S = 5.0 \text{ V} \pm 0.25 \text{ Vdc}$

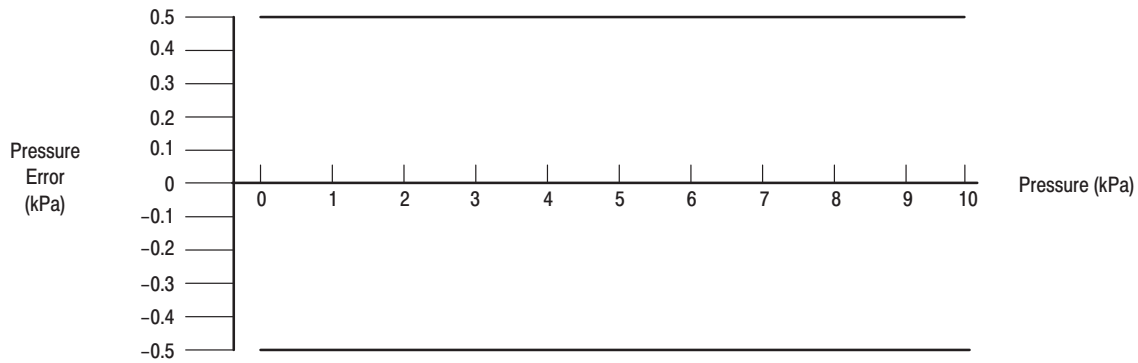
Temperature Error Band

MPX5010, MPXV5010G Series



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

Pressure Error Band



Pressure	Error (Max)
0 to 10 kPa	± 0.5 kPa

MPX5010 MPXV5010G SERIES

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
MPX5010D	867	Stainless Steel Cap
MPX5010DP	867C	Side with Part Marking
MPX5010GP	867B	Side with Port Attached
MPX5010GS	867E	Side with Port Attached
MPX5010GSX	867F	Side with Port Attached
MPXV5010G6U	482	Stainless Steel Cap
MPXV5010G7U	482B	Stainless Steel Cap
MPXV5010GC6U/T1	482A	Side with Port Attached
MPXV5010GC7U	482C	Side with Port Attached
MPXV5010GP	1369	Side with Port Attached
MPXV5010DP	1351	Side with Part Marking

ORDERING INFORMATION — UNIBODY PACKAGE (MPX5010 SERIES)

Device Type	Options	Case Type	MPX Series	
			Order Number	Device Marking
Basic Element	Differential	867	MPX5010D	MPX5010D
Ported Elements	Differential, Dual Port	867C	MPX5010DP	MPX5010DP
	Gauge	867B	MPX5010GP	MPX5010GP
	Gauge, Axial	867E	MPX5010GS	MPX5010D
	Gauge, Axial PC Mount	867F	MPX5010GSX	MPX5010D

ORDERING INFORMATION — SMALL OUTLINE PACKAGE (MPXV5010G SERIES)

Device Type	Options	Case No.	MPX Series Order No.	Packing Options	Marking
Basic Elements	Gauge, Element Only, SMT	482	MPXV5010G6U	Rails	MPXV5010G
	Gauge, Element Only, DIP	482B	MPXV5010G7U	Rails	MPXV5010G
Ported Elements	Gauge, Axial Port, SMT	482A	MPXV5010GC6U	Rails	MPXV5010G
	Gauge, Axial Port, DIP	482C	MPXV5010GC7U	Rails	MPXV5010G
	Gauge, Axial Port, SMT	482A	MPXV5010GC6T1	Tape and Reel	MPXV5010G
	Gauge, Side Port, SMT	1369	MPXV5010GP	Trays	MPXV5010G
	Differential, Dual Port, SMT	1351	MPXV5010DP	Trays	MPXV5010G

MPX5010 MPXV5010G SERIES

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.

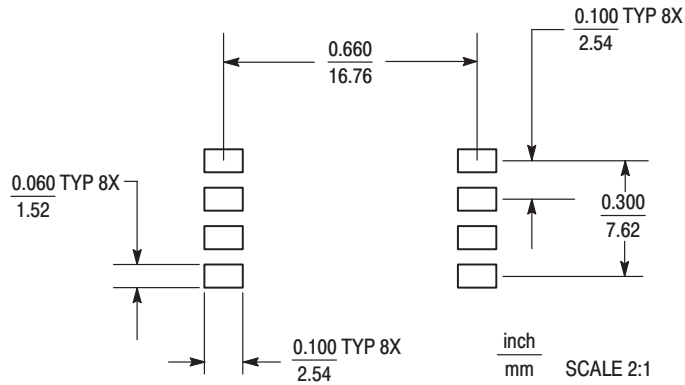
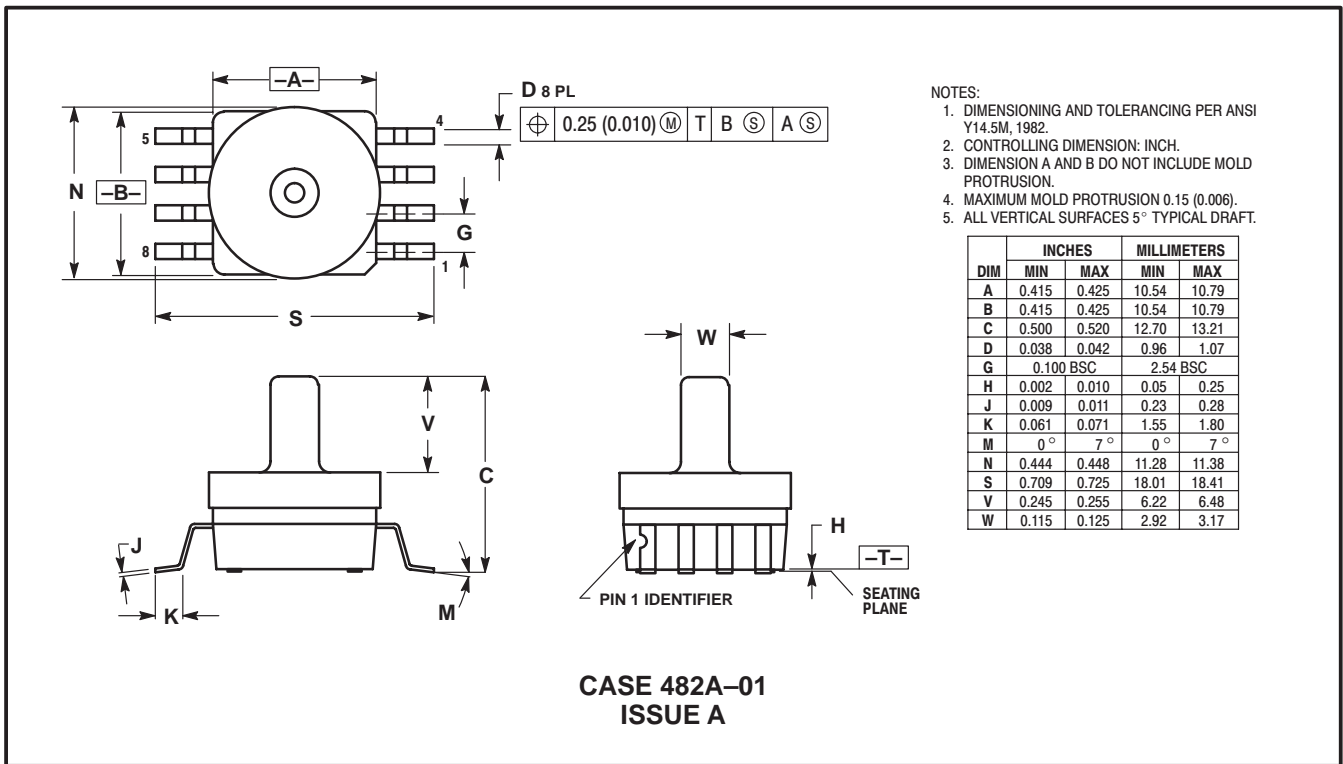
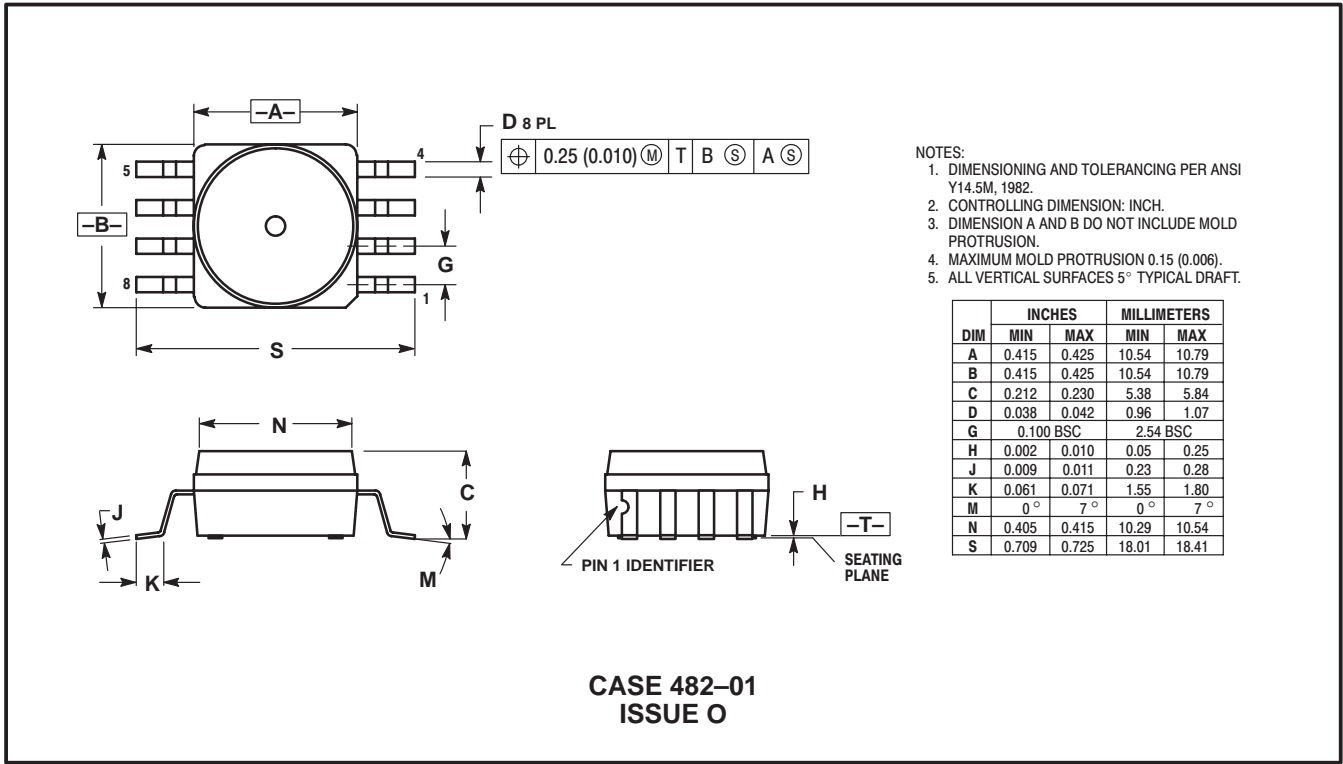


Figure 5. SOP Footprint (Case 482)

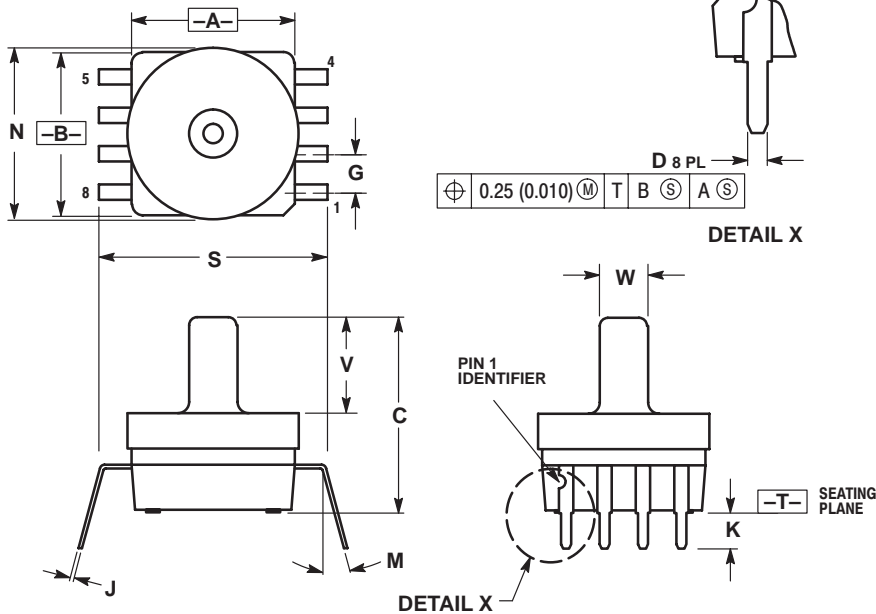
MPX5010 MPXV5010G SERIES

SMALL OUTLINE PACKAGE DIMENSIONS



MPX5010 MPXV5010G SERIES

SMALL OUTLINE PACKAGE DIMENSIONS—CONTINUED



NOTES:

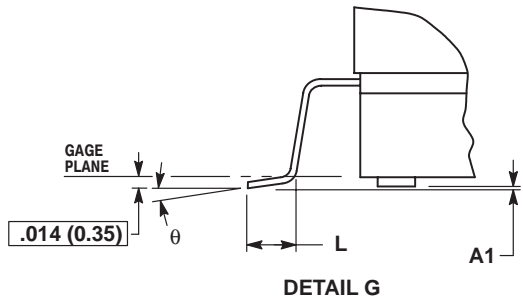
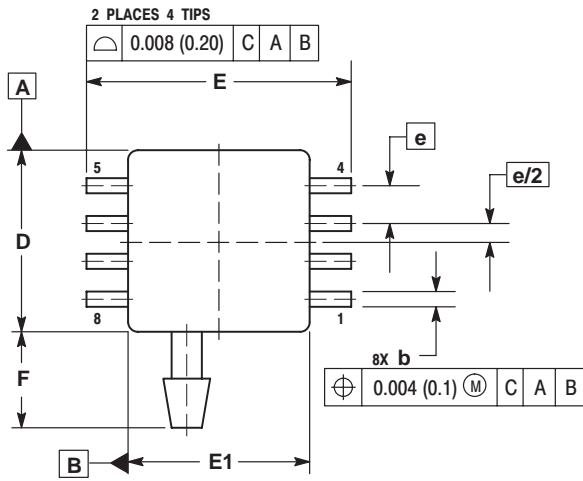
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006).
5. ALL VERTICAL SURFACES 5° TYPICAL DRAFT.
6. DIMENSION S TO CENTER OF LEAD WHEN FORMED PARALLEL.

DIM	INCHES		MILLIMETERS	
	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	0.026	0.034	0.66	0.864
G	0.100 BSC		2.54 BSC	
J	0.009	0.011	0.23	0.28
K	0.100	0.120	2.54	3.05
M	0°	15°	0°	15°
N	0.444	0.448	11.28	11.38
S	0.540	0.560	13.72	14.22
V	0.245	0.255	6.22	6.48
W	0.115	0.125	2.92	3.17

**CASE 482C-03
ISSUE B**

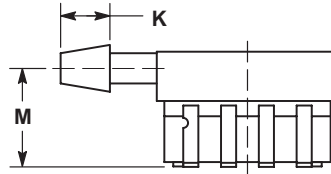
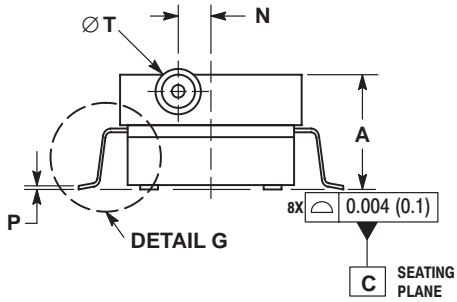
MPX5010 MPXV5010G SERIES

SMALL OUTLINE PACKAGE DIMENSIONS—CONTINUED



NOTES:

1. CONTROLLING DIMENSION: INCH.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
3. DIMENSIONS "D" AND "E1" DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.006 (0.152) PER SIDE.
4. DIMENSION "b" DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.008 (0.203) MAXIMUM.

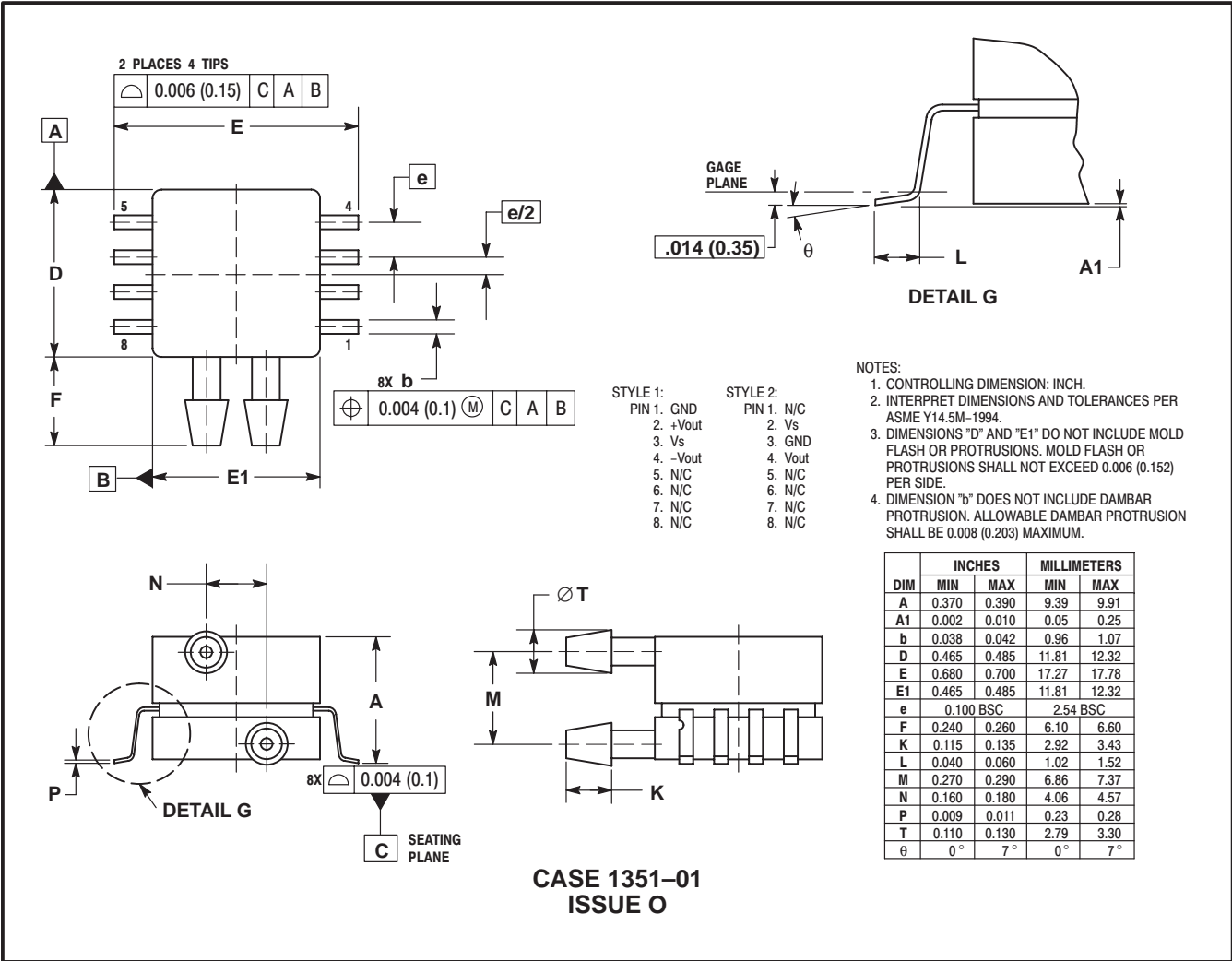


DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.300	0.330	7.11	7.62
A1	0.002	0.010	0.05	0.25
b	0.038	0.042	0.96	1.07
D	0.465	0.485	11.81	12.32
E	0.717 BSC		18.21 BSC	
E1	0.465	0.485	11.81	12.32
e	0.100 BSC		2.54 BSC	
F	0.245	0.255	6.22	6.47
K	0.120	0.130	3.05	3.30
L	0.061	0.071	1.55	1.80
M	0.270	0.290	6.86	7.36
N	0.080	0.090	2.03	2.28
P	0.009	0.011	0.23	0.28
T	0.115	0.125	2.92	3.17
θ	0°	7°	0°	7°

**CASE 1369-01
 ISSUE O**

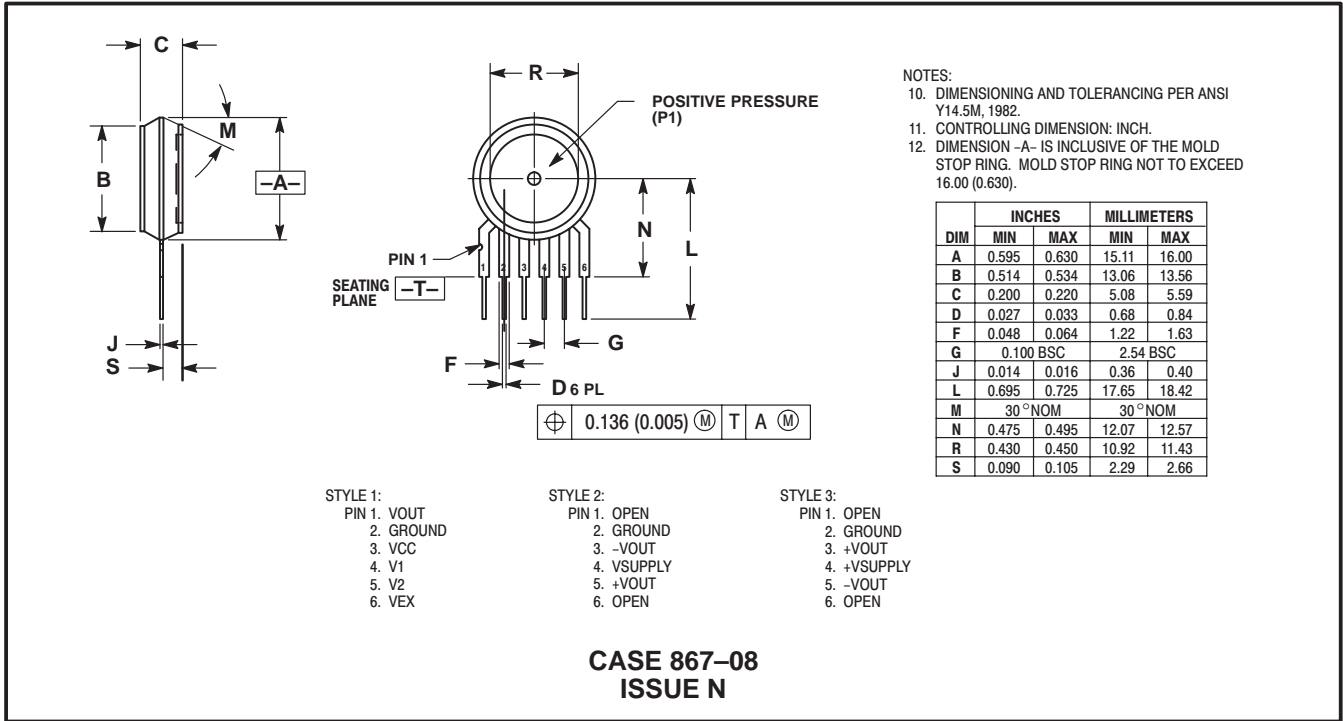
MPX5010 MPXV5010G SERIES

SMALL OUTLINE PACKAGE DIMENSIONS—CONTINUED

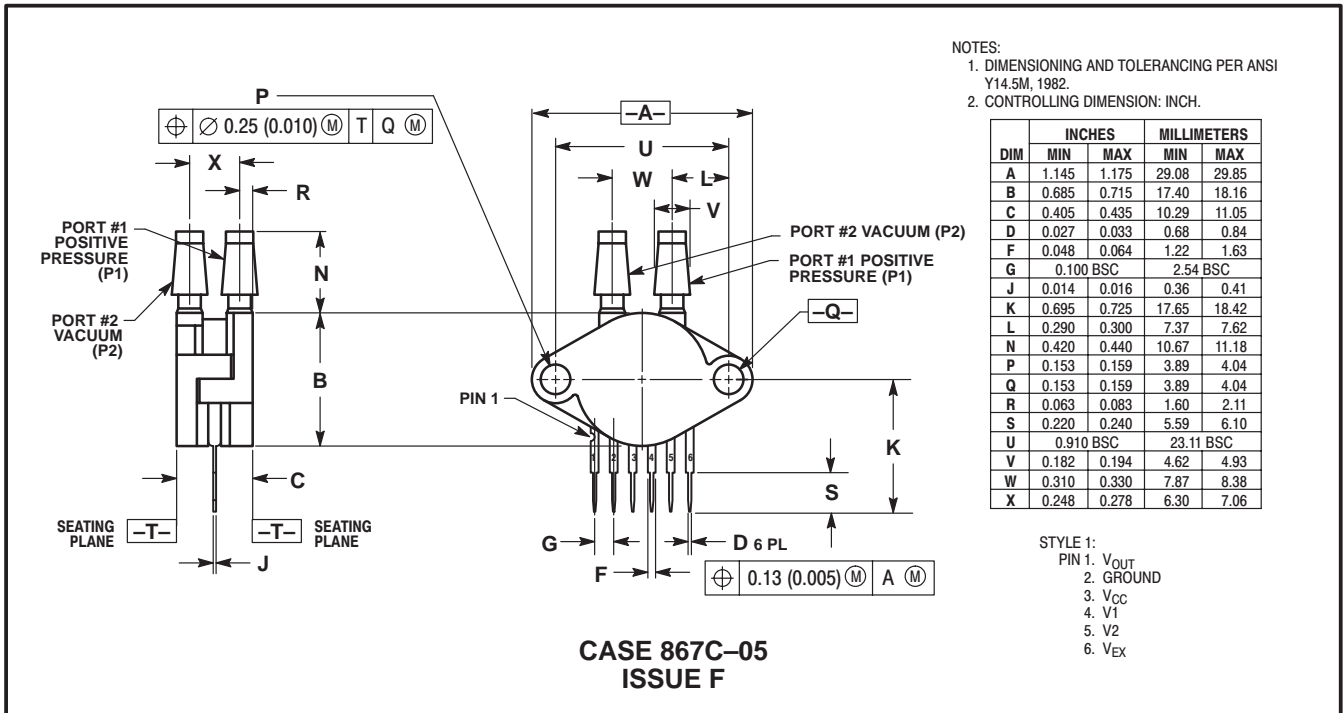


MPX5010 MPXV5010G SERIES

UNIBODY PACKAGE DIMENSIONS



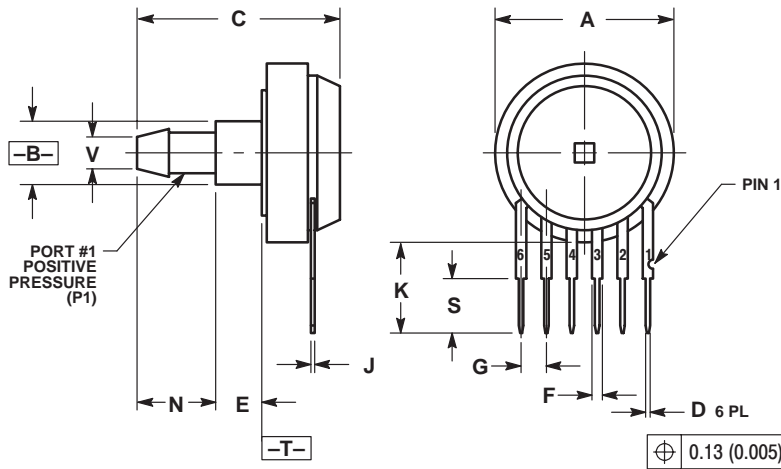
BASIC ELEMENT



PRESSURE AND VACUUM SIDES PORTED (DP)

MPX5010 MPXV5010G SERIES

UNIBODY PACKAGE DIMENSIONS—CONTINUED



- NOTES:
 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: INCH.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.690	0.720	17.53	18.28
B	0.245	0.255	6.22	6.48
C	0.780	0.820	19.81	20.82
D	0.027	0.033	0.69	0.84
E	0.178	0.186	4.52	4.72
F	0.048	0.064	1.22	1.63
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.41
K	0.345	0.375	8.76	9.53
N	0.300	0.310	7.62	7.87
S	0.220	0.240	5.59	6.10
V	0.182	0.194	4.62	4.93

- STYLE 1:
 PIN 1. V_{OUT}
 2. GROUND
 3. V_{CC}
 4. V_1
 5. V_2
 6. V_{EX}

**CASE 867E-03
 ISSUE D**

PRESSURE SIDE PORTED (AS, GS)

NOTES

MPX5010 MPXV5010G SERIES

NOTES



NOTES

MPX5010 MPXV5010G SERIES

Motorola reserves the right to make changes without further notice to any products herein. Motorola makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does Motorola assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. "Typical" parameters can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. Motorola does not convey any license under its patent rights nor the rights of others. Motorola products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the Motorola product could create a situation where personal injury or death may occur. Should Buyer purchase or use Motorola products for any such unintended or unauthorized application, Buyer shall indemnify and hold Motorola and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that Motorola was negligent regarding the design or manufacture of the part. Motorola and the Stylized M Logo are registered trademarks of Motorola, Inc. Motorola, Inc. is an Equal Opportunity/Affirmative Action Employer.

MOTOROLA and the Stylized M Logo are registered in the US Patent & Trademark Office. All other product or service names are the property of their respective owners.

© Motorola, Inc. 2002.

How to reach us:

USA/EUROPE/Locations Not Listed: Motorola Literature Distribution; P.O. Box 5405, Denver, Colorado 80217. 1-303-675-2140 or 1-800-441-2447

JAPAN: Motorola Japan Ltd.; SPS, Technical Information Center, 3-20-1, Minami-Azabu. Minato-ku, Tokyo 106-8573 Japan. 81-3-3440-3569

ASIA/PACIFIC: Motorola Semiconductors H.K. Ltd.; Silicon Harbour Centre, 2 Dai King Street, Tai Po Industrial Estate, Tai Po, N.T., Hong Kong. 852-26668334

Technical Information Center: 1-800-521-6274

HOME PAGE: <http://www.motorola.com/semiconductors/>

