

0 to 100 kPa (0 to 14.5 PSI) On-Chip Temperature Compensated & Calibrated, Silicon Pressure Sensors

**MPX2100
MPX2101
SERIES**

Motorola Preferred Devices

**X-ducer™
SILICON
PRESSURE SENSORS**

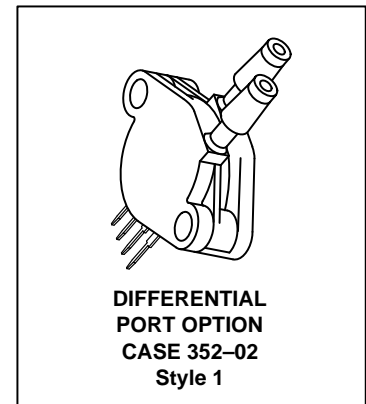
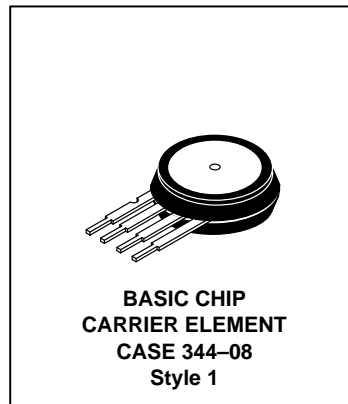
The MPX2100 and MPX2101 series device is a silicon piezoresistive pressure sensors providing a highly accurate and linear voltage output — directly proportional to the applied pressure. The sensor is a single, monolithic silicon diaphragm with the strain gauge and a thin-film resistor network integrated on-chip. The chip is laser trimmed for precise span and offset calibration and temperature compensation.

Features

- Temperature Compensated Over 0°C to +85°C
- Unique Silicon Shear Stress Strain Gauge
- Full Scale Span Calibrated to 40 mV (typical)
- Easy to Use Chip Carrier Package Options
- Available in Absolute, Differential and Gauge Configurations
- Ratiometric to Supply Voltage

Application Examples

- Pump/Motor Controllers
- Robotics
- Level Indicators
- Medical Diagnostics
- Pressure Switching
- Barometers
- Altimeters



Pin Number			
1	2	3	4
Ground	+V _{out}	V _S	-V _{out}

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Overpressure ⁽⁸⁾ (P1 > P2)	P _{max}	400	kPa
Burst Pressure ⁽⁸⁾ (P1 > P2)	P _{burst}	1000	kPa
Storage Temperature	T _{stg}	-50 to +150	°C
Operating Temperature	T _A	-40 to +125	°C

VOLTAGE OUTPUT versus APPLIED DIFFERENTIAL PRESSURE

The differential voltage output of the X-ducer is directly proportional to the differential pressure applied.

The absolute sensor has a built-in reference vacuum. The output voltage will decrease as vacuum, relative to ambient, is drawn on the pressure (P1) side.

The output voltage of the differential or gauge sensor increases with increasing pressure applied to the pressure (P1) side relative to the vacuum (P2) side. Similarly, output voltage increases as increasing vacuum is applied to the vacuum (P2) side relative to the pressure (P1) side.

Figure 1 illustrates a block diagram of the internal circuitry on the stand-alone pressure sensor chip.

X-ducer is a trademark of Motorola, Inc.

Preferred devices are Motorola recommended choices for future use and best overall value.

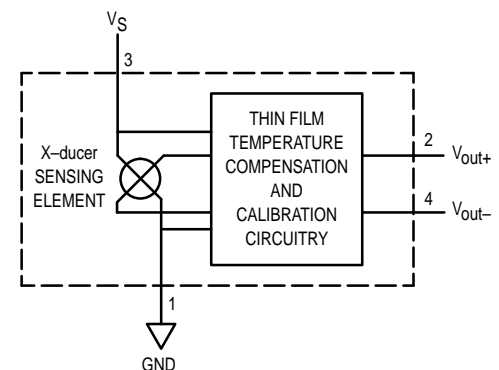


Figure 1. Temperature Compensated Pressure Sensor Schematic

MPX2100 MPX2101 SERIES

OPERATING CHARACTERISTICS ($V_S = 10$ Vdc, $T_A = 25^\circ\text{C}$ unless otherwise noted, $P_1 > P_2$)

Characteristic	Symbol	Min	Typ	Max	Unit	
Pressure Range ⁽¹⁾	P_{OP}	0	—	100	kPa	
Supply Voltage ⁽²⁾	V_S	—	10	16	Vdc	
Supply Current	I_o	—	6.0	—	mAdc	
Full Scale Span ⁽³⁾	MPX2100A, MPX2100D, MPX2101D MPX2101A	V_{FSS}	38.5 37.5	40 40	41.5 42.5	mV
Offset ⁽⁴⁾	MPX2100D, MPX2101D MPX2100A MPX2101A	V_{off}	-1.0 -2.0 -3.0	— — —	1.0 2.0 3.0	mV
Sensitivity		$\Delta V/\Delta P$	—	0.4	—	mV/kPa
Linearity ⁽⁵⁾	MPX2100D MPX2100A MPX2101D MPX2101A	—	-0.25 -1.0 -0.5 -2.0	— — — —	0.25 1.0 0.5 2.0	% V_{FSS}
Pressure Hysteresis ⁽⁵⁾ (0 to 100 kPa)		—	—	± 0.1	—	% V_{FSS}
Temperature Hysteresis ⁽⁵⁾ (-40°C to $+125^\circ\text{C}$)		—	—	± 0.5	—	% V_{FSS}
Temperature Effect on Full Scale Span ⁽⁵⁾		TCV_{FSS}	-1.0	—	1.0	% V_{FSS}
Temperature Effect on Offset ⁽⁵⁾		TCV_{off}	-1.0	—	1.0	mV
Input Impedance		Z_{in}	1000	—	2500	Ω
Output Impedance		Z_{out}	1400	—	3000	Ω
Response Time ⁽⁶⁾ (10% to 90%)		t_R	—	1.0	—	ms
Offset Stability ⁽⁵⁾		—	—	± 0.5	—	% V_{FSS}

MECHANICAL CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Weight (Basic Element Case 344)	—	—	2.0	—	Grams
Warm-Up	—	—	15	—	Sec
Cavity Volume	—	—	—	0.01	IN^3
Volumetric Displacement	—	—	—	0.001	IN^3
Common Mode Line Pressure ⁽⁷⁾	—	—	—	690	kPa

NOTES:

- 1.0 kPa (kiloPascal) equals 0.145 psi.
- Device is ratiometric within this specified excitation range. Operating the device above the specified excitation range may induce additional error due to device self-heating.
- 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.
- Offset (V_{off}) is defined as 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, using end point method, 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 zero differential pressure applied.
 - TcSpan: Output deviation at full rated pressure 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 .
- 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.
- Common mode pressures beyond specified may result in leakage at the case-to-lead interface.
- Exposure beyond these limits may cause permanent damage or degradation to the device.

LINEARITY

Linearity refers to how well a transducer's output follows the equation: $V_{out} = V_{off} + \text{sensitivity} \times P$ over the operating pressure range. There are two basic methods for calculating nonlinearity: (1) end point straight line fit (see Figure 2) or (2) a least squares best line fit. While a least squares fit gives the "best case" linearity error (lower numerical value), the calculations required are burdensome.

Conversely, an end point fit will give the "worst case" error (often more desirable in error budget calculations) and the calculations are more straightforward for the user. Motorola's specified pressure sensor linearities are based on the end point straight line method measured at the midrange pressure.

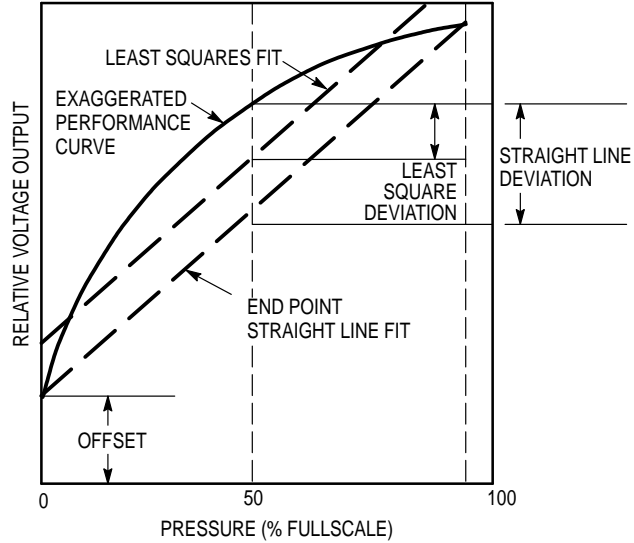


Figure 2. Linearity Specification Comparison

ON-CHIP TEMPERATURE COMPENSATION and CALIBRATION

Figure 3 shows the output characteristics of the MPX2100 series at 25°C. The output is directly proportional to the differential pressure and is essentially a straight line.

The effects of temperature on Full Scale Span and Offset are very small and are shown under Operating Characteristics.

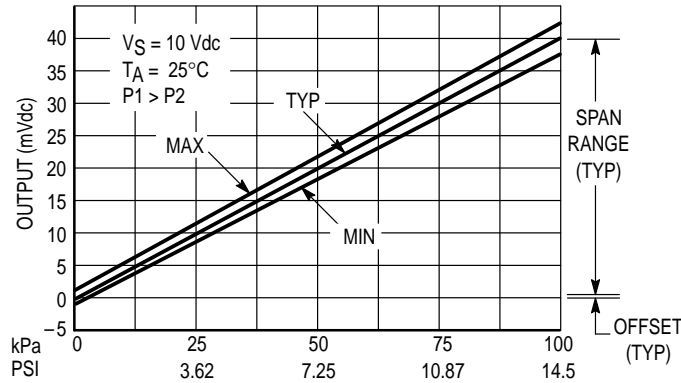


Figure 3. Output versus Pressure Differential

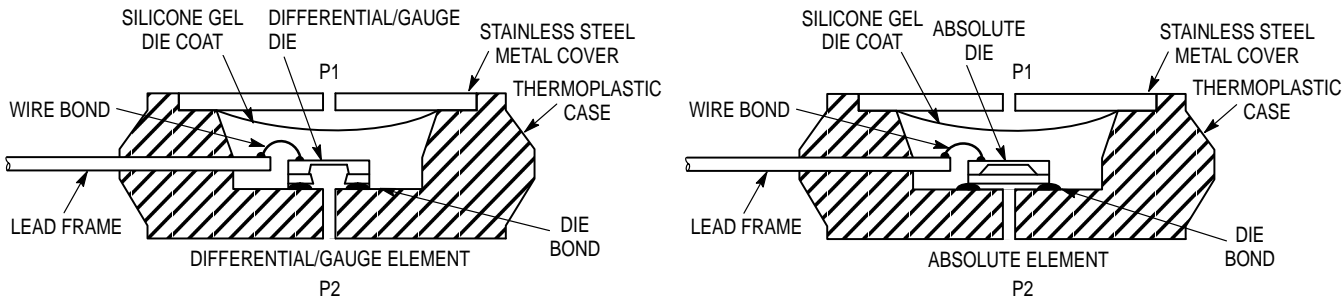


Figure 4. Cross-Sectional Diagrams (Not to Scale)

Figure 4 illustrates the absolute sensing configuration (right) and the differential or gauge configuration in the basic chip carrier (Case 344). A 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 MPX2100 series pressure sensor operating charac-

teristics 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.

MPX2100 MPX2101 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 the silicone gel which protects the die. The differential or gauge sensor is designed to operate with positive differential pressure

applied, $P1 > P2$. The absolute sensor is designed for vacuum applied to P1 side.


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

Part Number				Case Type	Pressure (P1) Side Identifier
MPX2100A	MPX2100D	MPX2101A	MPX2101D	344-08	Stainless Steel Cap
MPX2100DP		MPX2101DP		352-02	Side with Part Marking
MPX2100AP	MPX2100GP	MPX2101AP	MPX2101GP	350-03	Side with Port Attached
MPX2100GVP		MPX2101GVP		350-04	Stainless Steel Cap
MPX2100AS	MPX2100GS	MPX2101AS	MPX2101GS	371-06	Side with Port Attached
MPX2100GVS		MPX2101GVS		371-05	Stainless Steel Cap
MPX2100ASX	MPX2100GSX	MPX2101ASX	MPX2101GSX	371C-02	Side with Port Attached
MPX2100GVSX		MPX2101GVSX		371D-02	Stainless Steel Cap

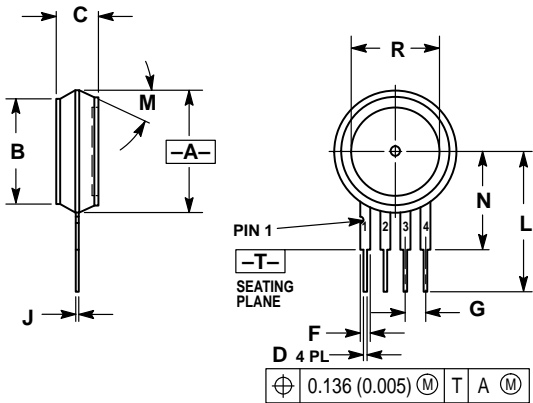
ORDERING INFORMATION

MPX2100 series pressure sensors are available in absolute, differential and gauge configurations. Devices are available in the basic element package or with pressure port fittings which provide printed circuit board mounting ease and barbed hose pressure connections.

Device Type	Options	Case Type	MPX Series	
			Order Number	Device Marking
Basic Element	Absolute, Differential	Case 344-08	MPX2100A MPX2100D MPX2101A MPX2101D	MPX2100A MPX2100D MPX2101A MPX2101D
Ported Elements	Differential	Case 352-02	MPX2100DP MPX2101DP	MPX2100DP MPX2101DP
	Absolute, Gauge	Case 350-03	MPX2100AP MPX2100GP MPX2101AP MPX2101GP	MPX2100AP MPX2100GP MPX2101AP MPX2101GP
	Gauge Vacuum	Case 350-04	MPX2100GVP MPX2101GVP	MPX2100GVP MPX2101GVP
	Absolute, Gauge Stove Pipe	Case 371-06	MPX2100AS MPX2100GS MPX2101AS MPX2101GS	MPX2100A MPX2100D MPX2101A MPX2101D
	Gauge Vacuum Stove Pipe	Case 371-05	MPX2100GVS MPX2101GVS	MPX2100D MPX2101D
	Absolute, Gauge Axial	Case 371C-02	MPX2100ASX MPX2100GSX MPX2101ASX MPX2101GSX	MPX2100A MPX2100D MPX2101A MPX2101D
	Gauge Vacuum Axial	Case 371D-02	MPX2100GVSX MPX2101GVSX	MPX2100D MPX2101D

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PACKAGE DIMENSIONS



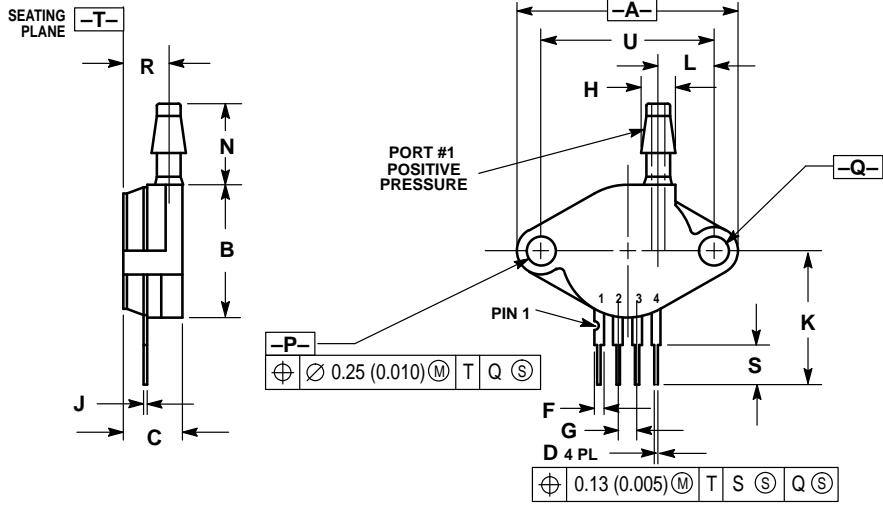
NOTES:
 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: INCH.

DIM	INCHES		MILLIMETERS	
	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	0.016	0.020	0.41	0.51
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	0.480	0.500	12.19	12.70
R	0.420	0.450	10.67	11.43

STYLE 1:
 PIN 1. GROUND
 2. + OUTPUT
 3. + SUPPLY
 4. - OUTPUT

CASE 344-08
 ISSUE M

BASIC ELEMENT (A, D)



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

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	1.140	1.180	28.95	29.97
B	0.685	0.751	17.39	18.16
C	0.305	0.321	7.74	8.15
D	0.016	0.020	0.40	0.50
F	0.048	0.052	1.21	1.32
G	0.100 BSC		2.54 BSC	
H	0.182	0.194	4.62	4.92
J	0.014	0.016	0.35	0.40
K	0.685	0.715	17.39	18.16
L	0.290	0.300	7.34	7.62
N	0.420	0.440	10.67	11.12
P	0.153	0.158	3.88	4.01
Q	0.153	0.158	3.88	4.01
R	0.231	0.250	5.86	6.35
S	0.230 REF		5.84 REF	
U	0.910 BSC		23.11 BSC	

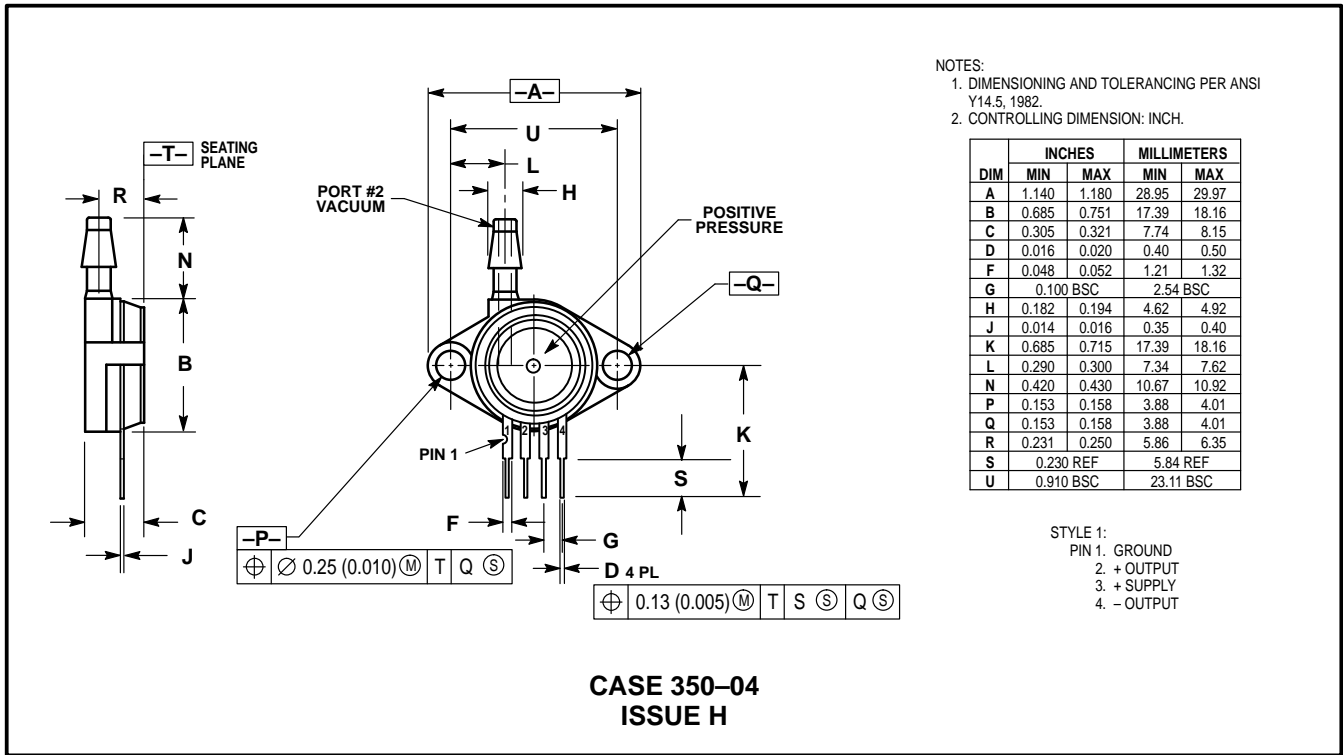
STYLE 1:
 PIN 1. GROUND
 2. + OUTPUT
 3. + SUPPLY
 4. - OUTPUT

CASE 350-03
 ISSUE H

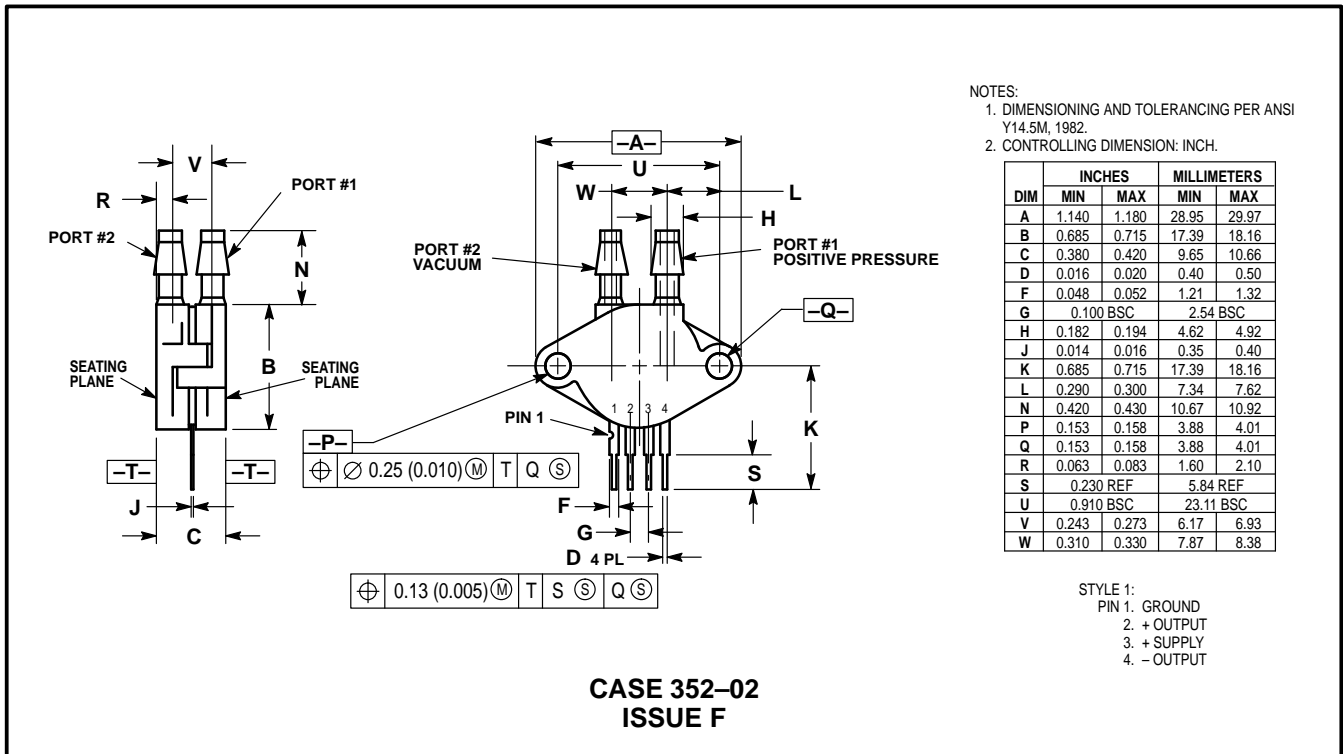
PRESSURE SIDE PORTED (AP, GP)

MPX2100 MPX2101 SERIES

PACKAGE DIMENSIONS — CONTINUED

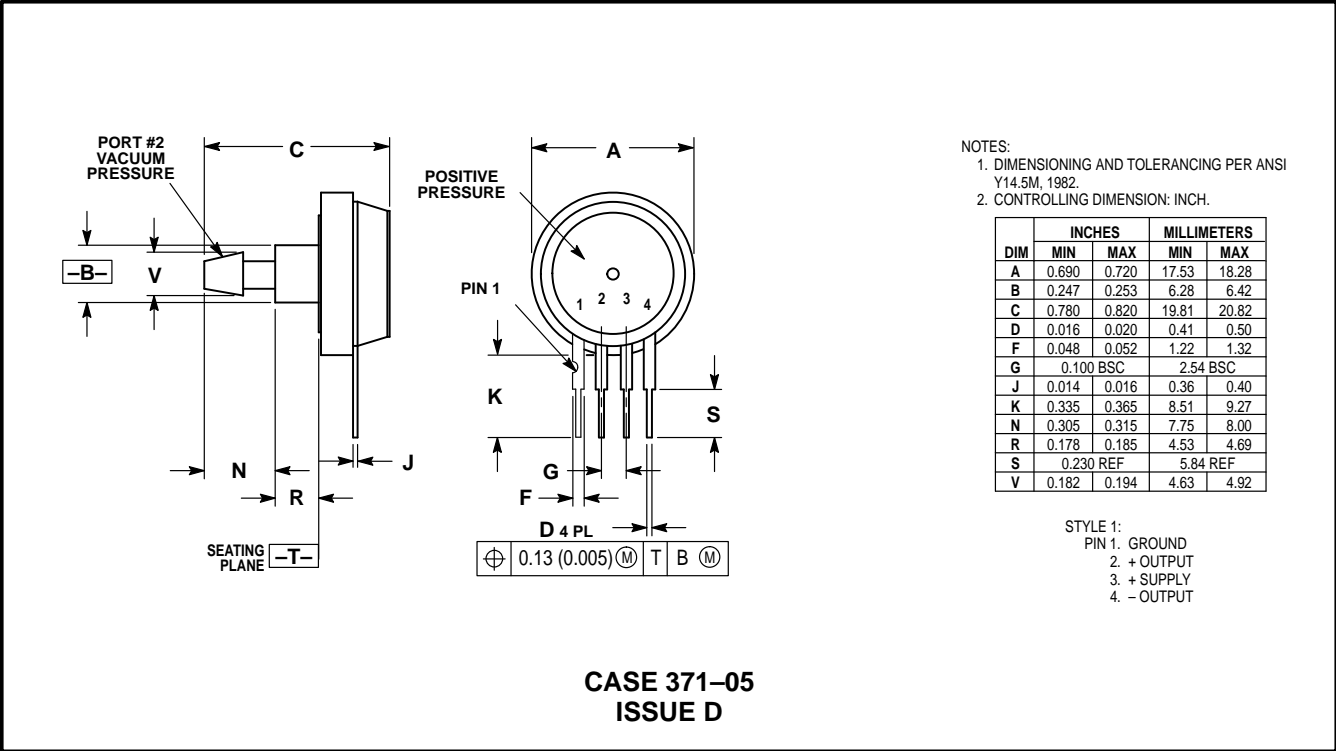


VACUUM SIDE PORTED (GVP)

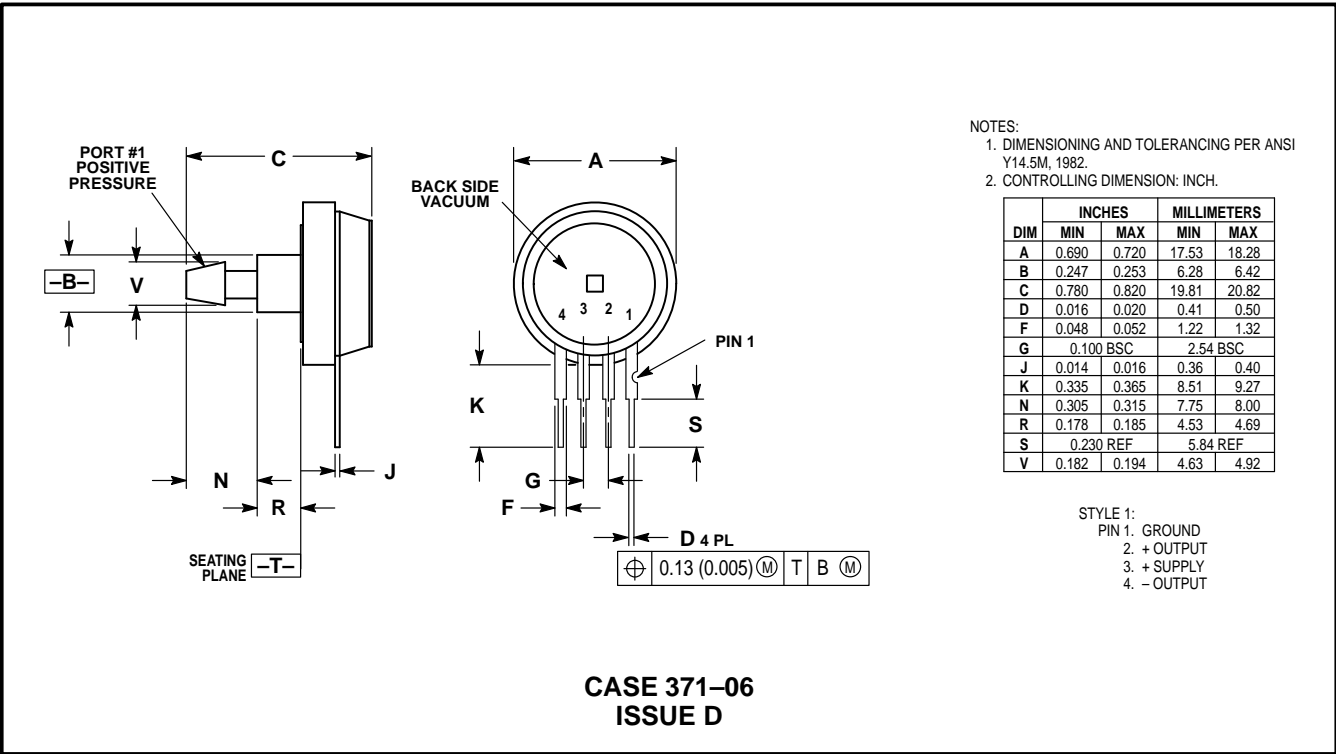


PRESSURE AND VACUUM SIDES PORTED (DP)

PACKAGE DIMENSIONS — CONTINUED



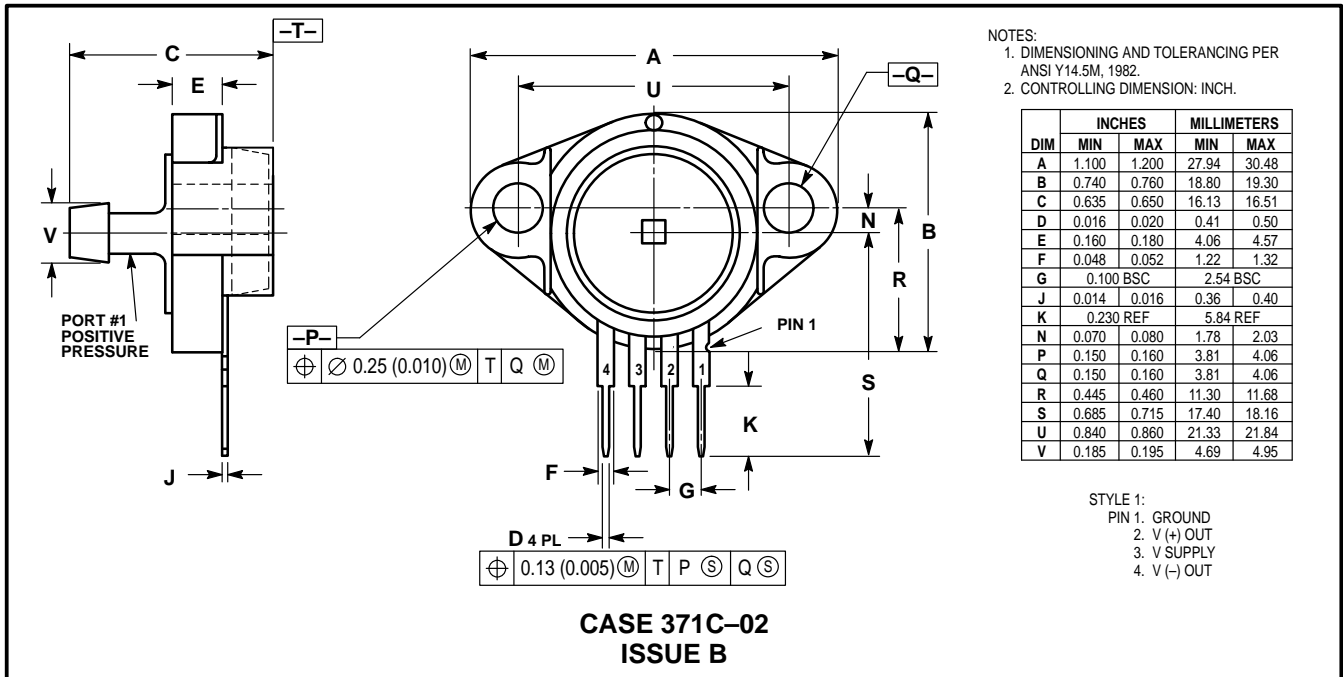
VACUUM SIDE PORTED (GVS)



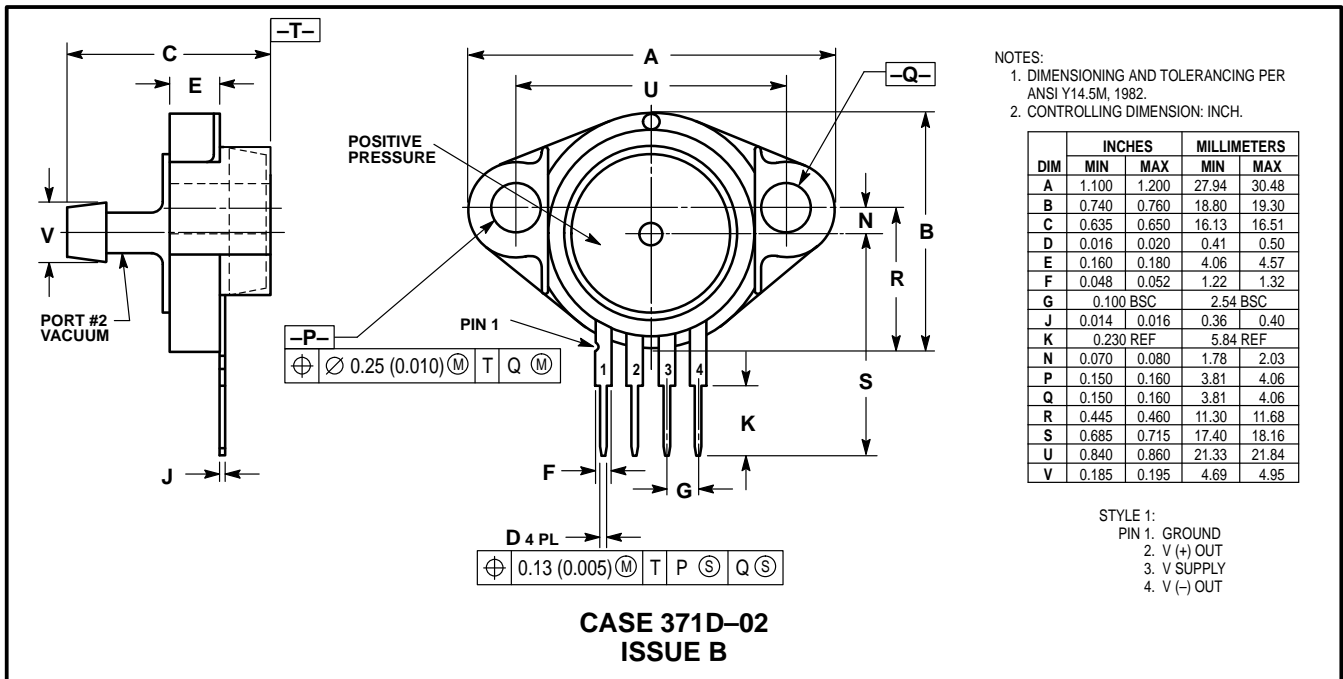
PRESSURE SIDE PORTED (AS, GS)

MPX2100 MPX2101 SERIES

PACKAGE DIMENSIONS — CONTINUED



PRESSURE SIDE PORTED (ASX, GSX)



VACUUM SIDE PORTED (GV SX)

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