

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

The MPX5700 series piezoresistive transducer is a state-of-the-art monolithic silicon pressure sensor designed for a wide range of applications, but particularly those employing a microcontroller or microprocessor with A/D inputs. This patented, single element 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

- 2.5% Maximum Error over 0° to 85°C
- Ideally Suited for Microprocessor or Microcontroller-Based Systems
- Available in Absolute, Differential and Gauge Configurations
- Patented Silicon Shear Stress Strain Gauge
- Durable Epoxy Unibody Element

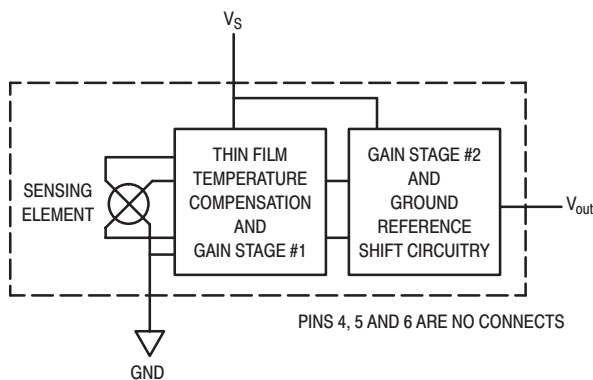
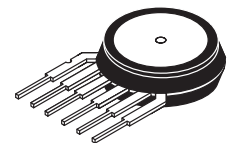


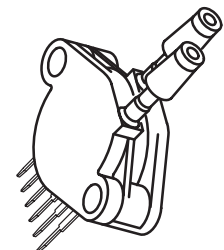
Figure 1. Fully Integrated Pressure Sensor Schematic

## MPX5700 SERIES

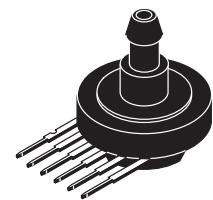
**INTEGRATED PRESSURE  
SENSOR**  
0 to 700 kPa (0 to 101.5 psi)  
15 to 700 kPa  
(2.18 to 101.5 psi)  
0.2 to 4.7 V OUTPUT



MPX5700D  
CASE 867



MPX5700DP  
CASE 867C



MPX5700AS  
CASE 867E

PIN NUMBER			
1	V <sub>out</sub>	4	N/C
2	Gnd	5	N/C
3	V <sub>S</sub>	6	N/C

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.

## MPX5700 SERIES

### MAXIMUM RATINGS<sup>(1)</sup>

Parametrics	Symbol	Value	Unit
Maximum Pressure <sup>(2)</sup> ( $P_2 \leq 1$ Atmosphere)	$P_{1\max}$	2800	kPa
Storage Temperature	$T_{\text{stg}}$	-40 to +125	°C
Operating Temperature	$T_A$	-40 to +125	°C

#### NOTES:

- Maximum Ratings apply to Case 867 only. Extended exposure at the specified limits may cause permanent damage or degradation to the device.
- This sensor is designed for applications where  $P_1$  is always greater than, or equal to  $P_2$ .  $P_2$  maximum is 500 kPa.

**OPERATING CHARACTERISTICS** ( $V_S = 5.0$  Vdc,  $T_A = 25^\circ\text{C}$  unless otherwise noted,  $P_1 > P_2$ . Decoupling circuit shown in Figure 4 required to meet electrical specifications.)

Characteristic	Symbol	Min	Typ	Max	Unit
Pressure Range <sup>(1)</sup> Gauge, Differential: MPX5700D Absolute: MPX5700A	$P_{\text{OP}}$	0 15	—	700 700	kPa
Supply Voltage <sup>(2)</sup>	$V_S$	4.75	5.0	5.25	Vdc
Supply Current	$I_o$	—	7.0	10	mAdc
Zero Pressure Offset <sup>(3)</sup> Gauge, Differential: Absolute	$V_{\text{off}}$	0.088 0.184	0.2	0.313 0.409	Vdc
Full Scale Output <sup>(4)</sup> (0 to 85°C)	$V_{\text{FSO}}$	4.587	4.7	4.813	Vdc
Full Scale Span <sup>(5)</sup> (0 to 85°C)	$V_{\text{FSS}}$	—	4.5	—	Vdc
Accuracy <sup>(6)</sup> (0 to 85°C)	—	—	—	$\pm 2.5$	% $V_{\text{FSS}}$
Sensitivity	V/P	—	6.4	—	mV/kPa
Response Time <sup>(7)</sup>	$t_R$	—	1.0	—	ms
Output Source Current at Full Scale Output	$I_{O+}$	—	0.1	—	mAdc
Warm-Up Time <sup>(8)</sup>	—	—	20	—	ms

#### NOTES:

- 1.0 kPa (kiloPascal) equals 0.145 psi.
- Device is ratiometric within this specified excitation range.
- Offset ( $V_{\text{off}}$ ) is defined as the output voltage at the minimum rated pressure.
- Full Scale Output ( $V_{\text{FSO}}$ ) is defined as the output voltage at the maximum or full rated pressure.
- Full Scale Span ( $V_{\text{FSS}}$ ) 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  $V_{\text{FSS}}$ , 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 device to meet the specified output voltage after the pressure has been stabilized.

### MECHANICAL CHARACTERISTICS

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

ON-CHIP TEMPERATURE COMPENSATION, CALIBRATION AND SIGNAL CONDITIONING

Figure 3 illustrates the Differential/Gauge basic chip carrier (Case 867). 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. (For use of the MPX5700D in a high pressure, cyclic application, consult the factory.)

The MPX5700 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 2 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 4 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.

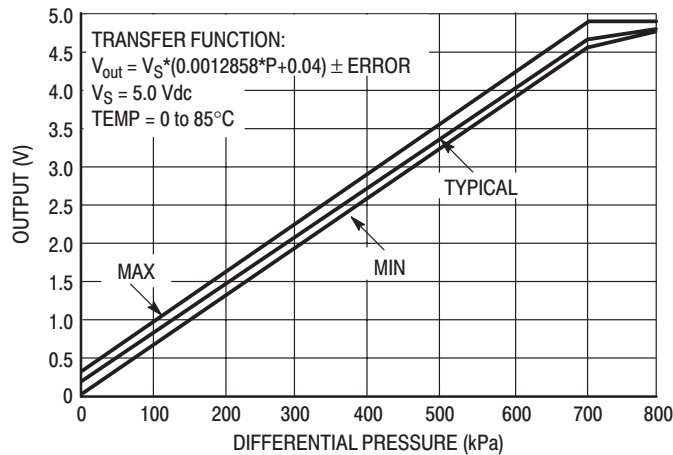


Figure 2. Output versus Pressure Differential

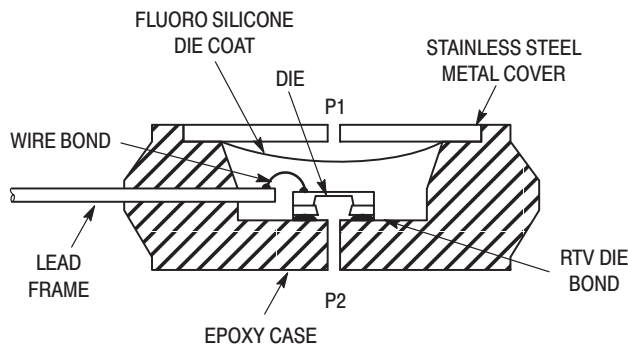


Figure 3. Cross-Sectional Diagram (Not to Scale)

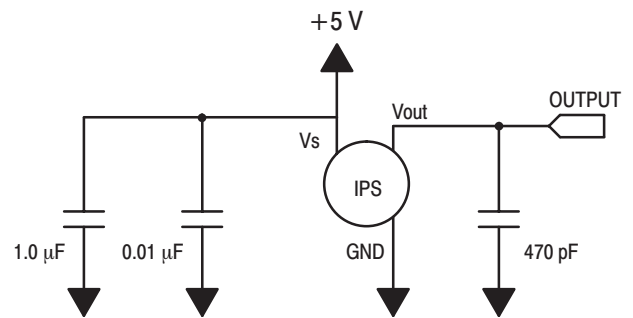


Figure 4. Recommended power supply decoupling and output filtering.

For additional output filtering, please refer to Application Note AN1646.

## MPX5700 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,  $P1 > P2$ .

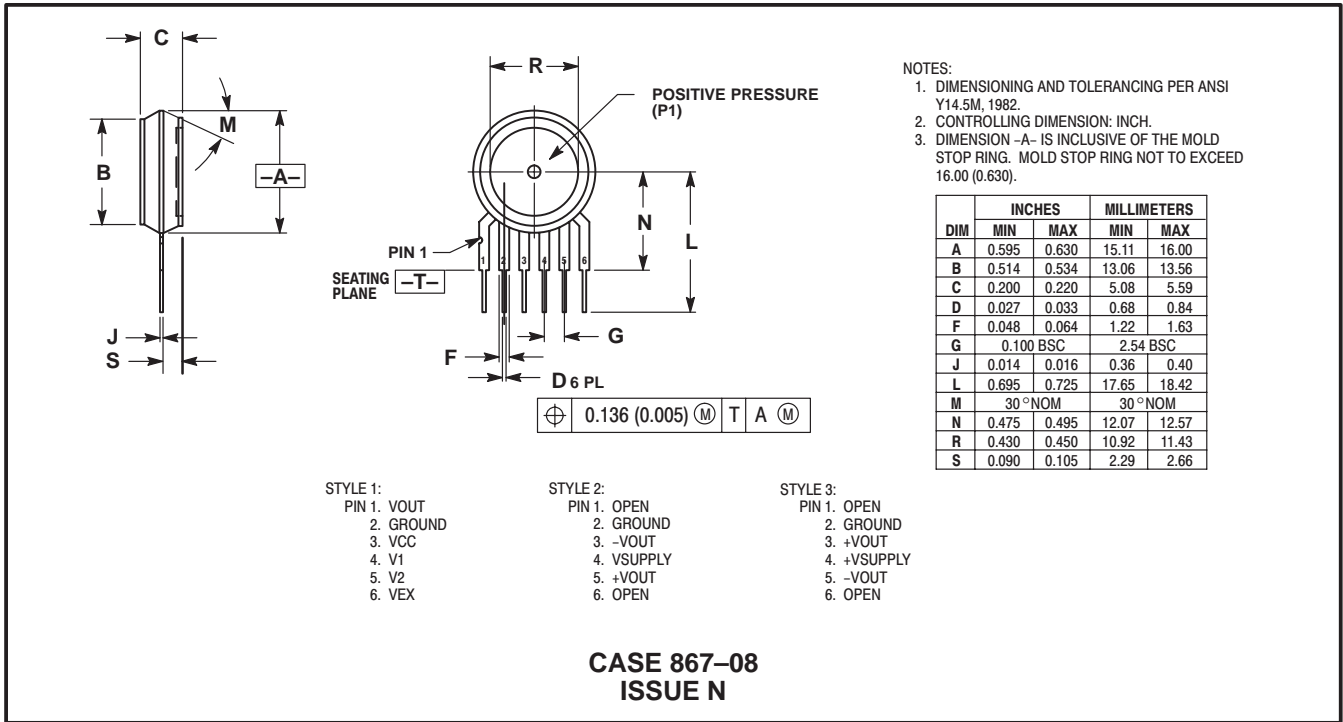
The Pressure (P1) side may be identified by using the table below:

Part Number	Case Type	Pressure (P1) Side Identifier
MPX5700D, MPX5700A	867	Stainless Steel Cap
MPX5700DP	867C	Side with Part Marking
MPX5700GP, MPX5700AP	867B	Side with Port Attached
MPX5700GS, MPX5700AS	867E	Side with Port Attached

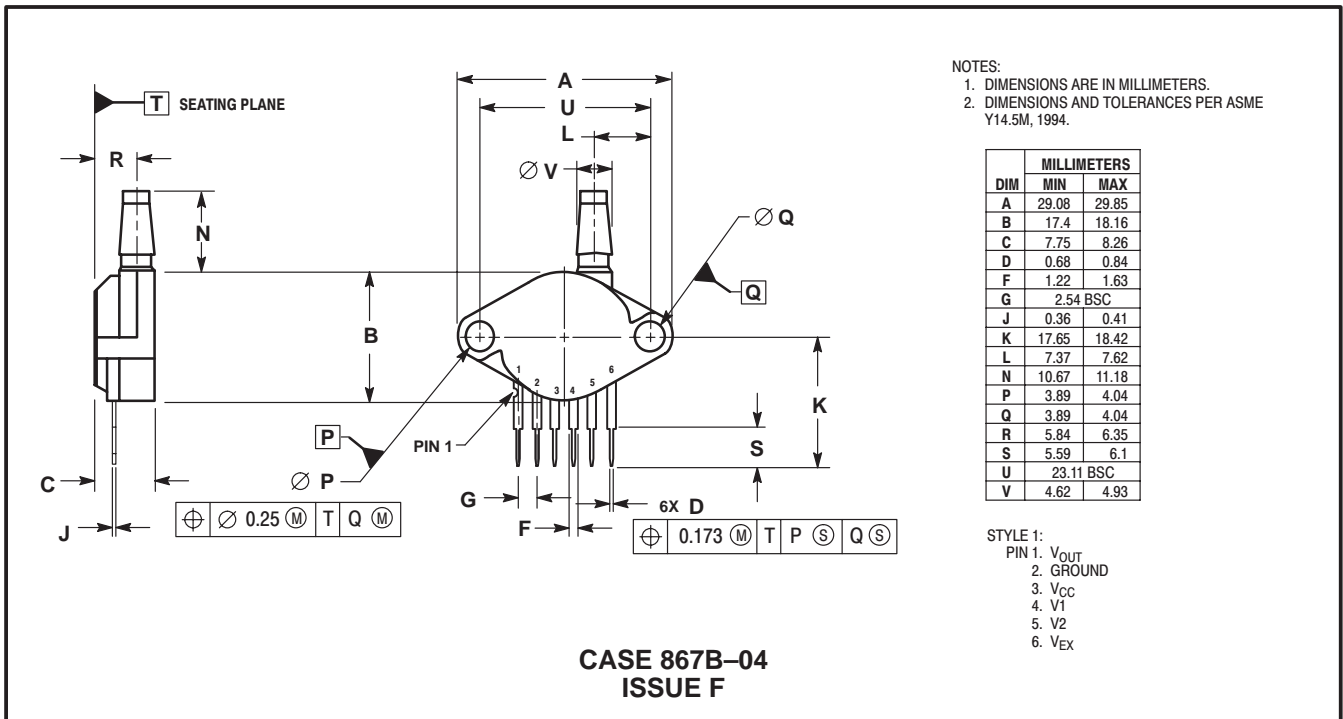
### ORDERING INFORMATION

Device Type	Options	Case Type	MPX Series	
			Order Number	Device Marking
Basic Element	Differential	867	MPX5700D	MPX5700D
	Absolute	867	MPX5700A	MPX5700A
Ported Elements	Differential Dual Ports	867C	MPX5700DP	MPX5700DP
	Gauge	867B	MPX5700GP	MPX5700GP
	Gauge, Axial	867E	MPX5700GS	MPX5700D
	Absolute	867B	MPX5700AP	MPX5700AP
	Absolute, Axial	867E	MPX5700AS	MPX5700A

PACKAGE DIMENSIONS

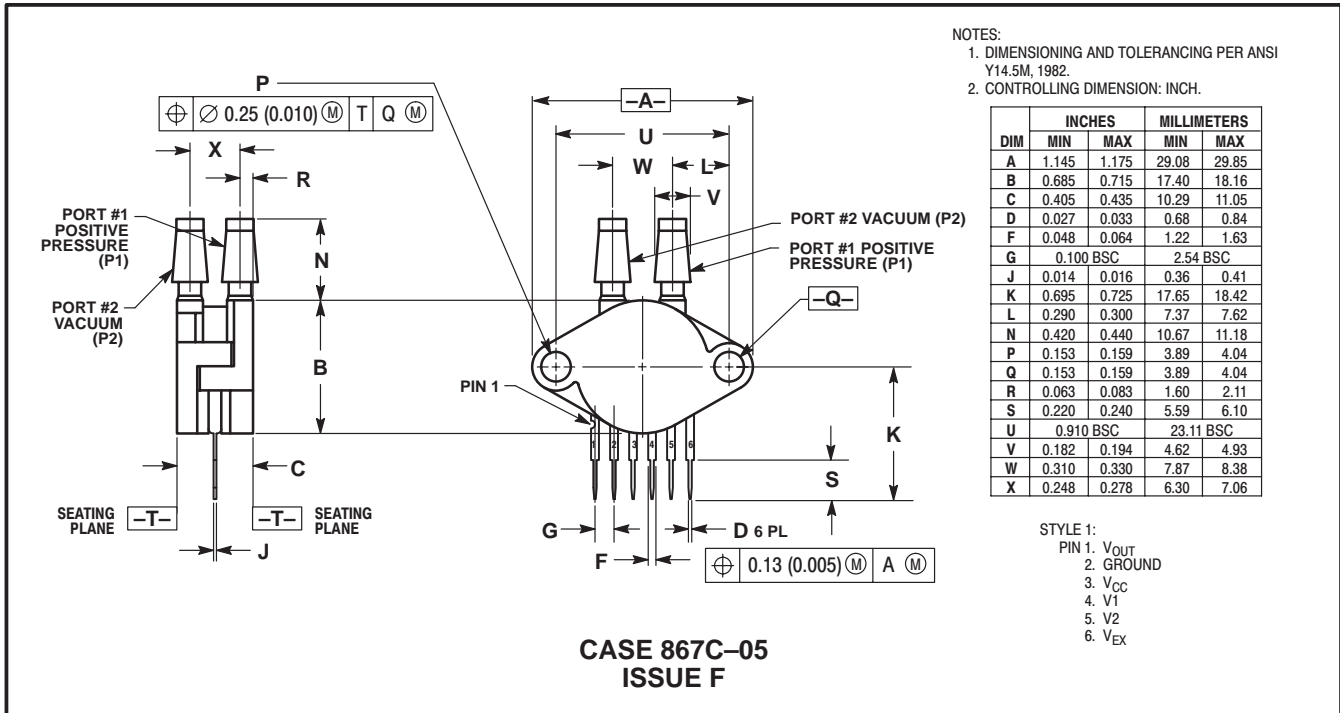


BASIC ELEMENT



PRESSURE SIDE PORTED (AP, GP)

PACKAGE DIMENSIONS—CONTINUED

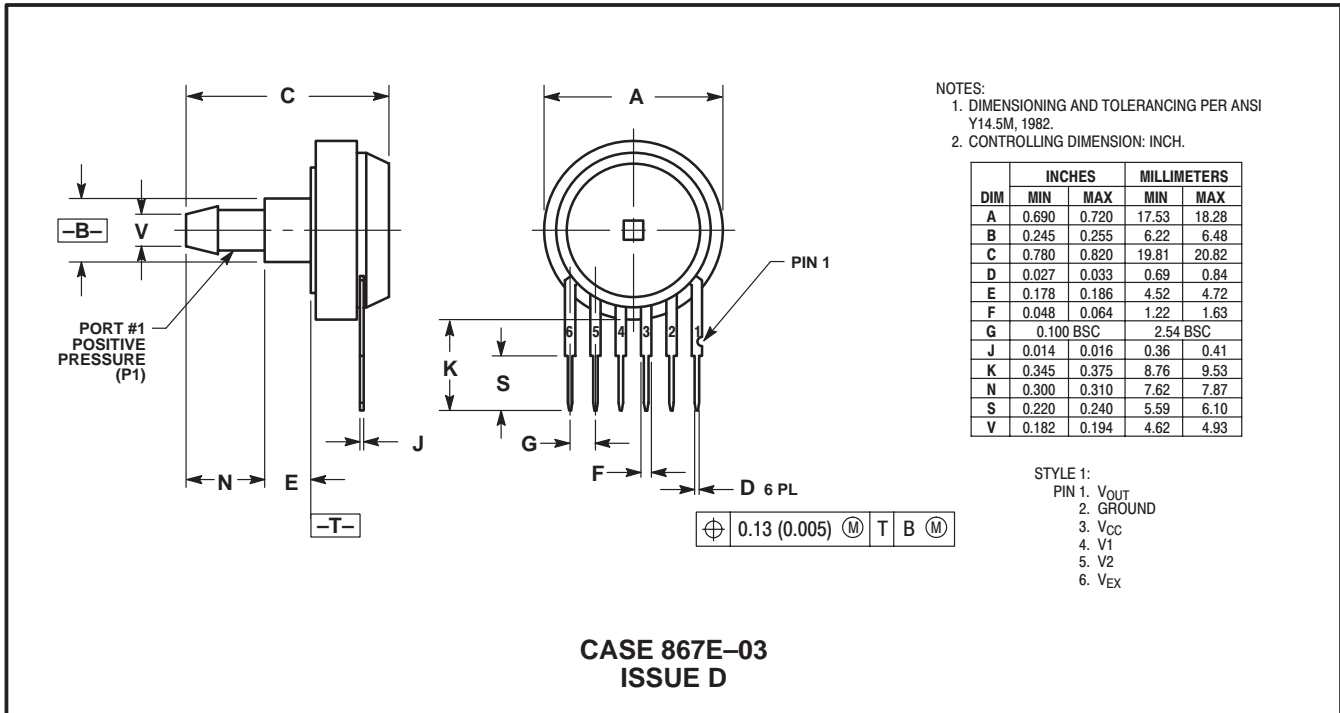


NOTES:  
 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
 2. CONTROLLING DIMENSION: INCH.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	1.145	1.175	29.08	29.85
B	0.685	0.715	17.40	18.16
C	0.405	0.435	10.29	11.05
D	0.027	0.033	0.68	0.84
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	0.695	0.725	17.65	18.42
L	0.290	0.300	7.37	7.62
N	0.420	0.440	10.67	11.18
P	0.153	0.159	3.89	4.04
Q	0.153	0.159	3.89	4.04
R	0.063	0.083	1.60	2.11
S	0.220	0.240	5.59	6.10
U	0.910 BSC		23.11 BSC	
V	0.182	0.194	4.62	4.93
W	0.310	0.330	7.87	8.38
X	0.248	0.278	6.30	7.06

STYLE 1:  
 PIN 1. V<sub>OUT</sub>  
 2. GROUND  
 3. V<sub>CC</sub>  
 4. V<sub>1</sub>  
 5. V<sub>2</sub>  
 6. V<sub>EX</sub>

PRESSURE AND VACUUM SIDES PORTED (DP)




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<sub>OUT</sub>  
 2. GROUND  
 3. V<sub>CC</sub>  
 4. V<sub>1</sub>  
 5. V<sub>2</sub>  
 6. V<sub>EX</sub>

PRESSURE SIDE PORTED (AS, GS)

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