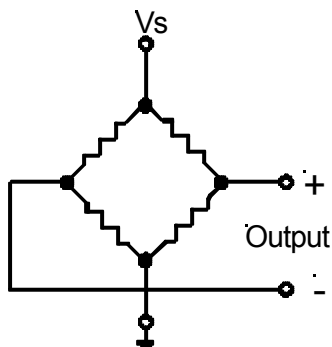**SenSym**

FEATURES

- 0...1 to 0...300 psi
- Absolute, differential and gage devices
- High impedance bridge
- Low power consumption for battery operation
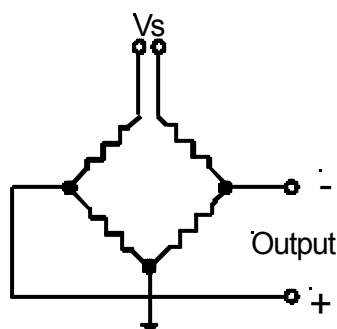
APPLICATIONS

- **Industrial controls**
- **Pneumatic controls**
- **Medical instrumentation**
- **Barometry**

EQUIVALENT CIRCUIT

Button sensor or "N" package


TO can or DIP package

GENERAL DESCRIPTION

The SX series of pressure sensors provides the most cost effective method of measuring pressures up to 300 psi. These sensors were specifically designed to be used with non-corrosive and non-ionic media, such as air and dry gases. Convenient pressure ranges are available to measure differential, gage and absolute pressures from 0 to 1 psi (SX01) up to 0 to 300 psi (SX7300D).

The absolute (A) devices have an internal vacuum reference and an output voltage proportional to absolute pressure. The differential (D) devices allow application of pressure to either side of the diaphragm and can be used for gage or differential pressure measurements.

However, 300 psi (SX7300D) can be applied to pressure port P2 only. Pressure port P1 is able to handle operating pressures up to 150 psi only.

This product is packaged either in SenSym's standard low cost chip carrier "button" package, a plastic ported "N" package, a metal TO can package or a dual inline package (DIP). All packages are designed for applications where the sensing element is to be integral to the OEM equipment.
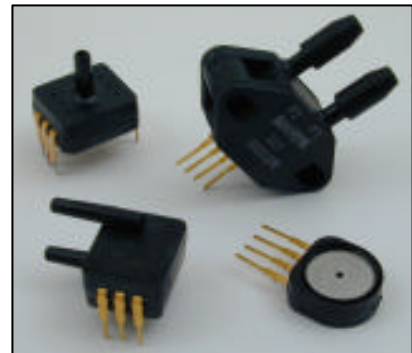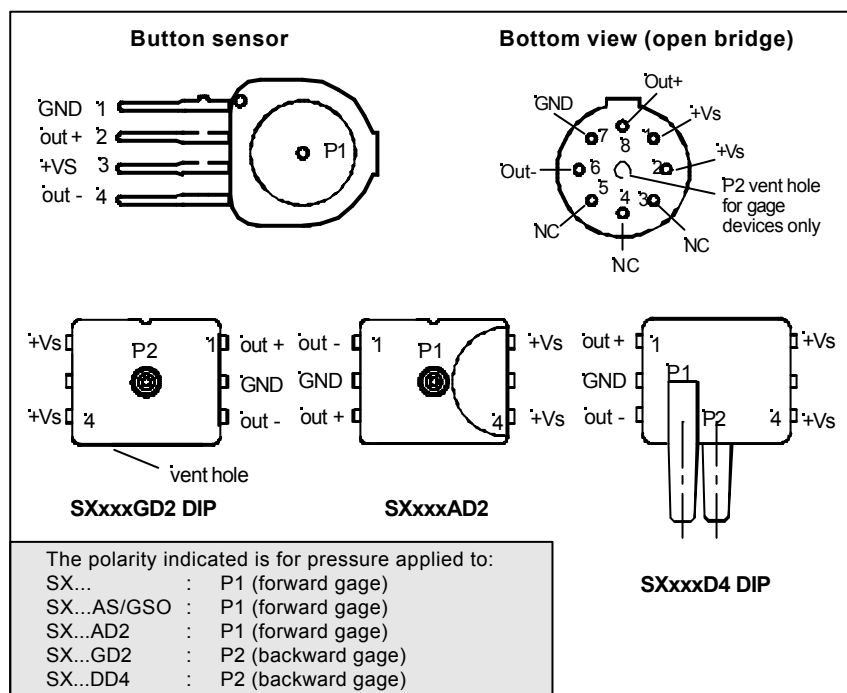

| Scale: | ⊢——⊣ | 1 cm |
| | ⊢——⊣ | ½ inch |

These packages can be o-ring sealed, epoxied, and/or clamped onto a pressure fitting. A closed bridge 4-pin SIP configuration is provided for electrical connection to the button or "N" package. The TO can offers a 5-pin open bridge configuration.

Because of its high-impedance bridge, the SX series is ideal for portable and low power or battery operated systems. Due to its low noise, the SX is an excellent choice for medical and low pressure measurements.

ELECTRICAL CONNECTION

Button sensor

GND 1
out + 2
+VS 3
out - 4

P1

Bottom view (open bridge)

GND
Out+
+Vs
+Vs
Out-
P2 vent hole for gage devices only
NC
NC
NC

+Vs P2 out +
out + out - +Vs
GND GND
+Vs out - out +
vent hole

SXxxxGD2 DIP

P1
out - out +
+Vs
GND
out -
+Vs

SXxxxAD2

out + +Vs
+Vs
P1 GND
out - P2 +Vs

SXxxxD4 DIP

The polarity indicated is for pressure applied to:
SX...	:	P1 (forward gage)
SX...AS/GSO	:	P1 (forward gage)
SX...AD2	:	P1 (forward gage)
SX...GD2	:	P2 (backward gage)
SX...DD4	:	P2 (backward gage)

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SX Series
Pressure sensors

SenSym

PRESSURE SENSOR CHARACTERISTICS

Maximum ratings (for all devices)

Suppy voltage, V_S	+12 V_{DC}	Proof pressure[10]	
Temperature ranges		SX01	20 psi
Operating	-40°C to +85°C	SX05	20 psi
Storage	-55°C to +125°C	SX15	30 psi
		SX30	60 psi
Maximum pressure at any port[11]	150 psig	SX100	150 psi
		SX150	200 psi
Lead temperature (soldering 4 sec.)	250 °C	SX7300 forward gage, P1	250 psi
		SX7300, backward gage, P2	500 psi

Part number	Operating pressure	Proof pressure[10]	Full scale span		
			Min.	Typ.	Max.
SX01...	0 - 1 psid	20 psi	15 mV	20 mV	25 mV
SX05...	0 - 5 psid	20 psi	50 mV	75 mV	100 mV
SX15...	0 - 15 psi (a) d	30 psi	75 mV	110 mV	150 mV
SX30...	0 - 30 psi (a) d	60 psi	75 mV	110 mV	150 mV
SX100...	0 - 100 psi (a) d	150 psi	100 mV	150 mV	200 mV
SX150...	0 - 150 psi (a) d	200 psi	75 mV	110 mV	150 mV
SX7300 forward gage	0 - 100 psig	250 psi	---	---	---
SX7300 backward gage	0 - 300 psig	500 psi	45 mV	70 mV	95 mV

PERFORMANCE CHARACTERISTICS[1]

SX01, SX05

Characteristics	Min.	Typ.	Max.	Unit
Temperature coefficient of span[6,9]	-2550	-2300	-2050	ppm/°C
Zero pressure offset T_A = 25°C[12]	-35	-20	0	mV
Temperature coefficient of offset[5,9]	---	+4	---	µV/V/°C
Combined linearity and hysteresis[3]	---	0.2	0.5	%FS
Long term stability of offset and sensitivity[8]	---	0.1	---	mV
Response time (10 % to 90 %)[7]	---	0.1	---	ms
Input resistance T_A = 25°C	---	4.65	---	kΩ
Temperature coefficient of resistance[6,9]	+690	+750	+810	ppm/°C
Output impedance	---	4.65	---	kΩ
Repeatability[4]	---	0.5	---	%FS

SX15..., SX30..., SX100..., SX150...

Characteristics	Min.	Typ.	Max.	Unit
Temperature coefficient of span[6,9]	-2400	-2150	-1900	ppm/°C
Zero pressure offset T_A = 25°C[12]	-35	-20	0	mV
Temperature coefficient of offset[5,9]	---	+4	---	µV/V/°C
Combined linearity and hysteresis[3]	---	0.2	0.5	%FS
Long term stability of offset and sensitivity[8]	---	0.1	---	mV
Response time (10% to 90%)[7]	---	0.1	---	ms
Input resistance T_A = 25°C	---	4.65	---	kΩ
Temperature coefficient of resistance[6,9]	+690	+750	+810	ppm/°C
Output impedance	---	4.5	---	kΩ
Repeatability[4]	---	0.5	---	%FS

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SX7300...

Characteristic	Min	Typ	Max	Unit
Temperature coefficient of span[6,9]	-2400	-2150	-1900	ppm/°C
Zero pressure offset $T_A = 25°C$	-40	0	40	mV
Temperature coefficient of offset[5,9]	---	+4	---	µV/V/°C
Combined linearity and hysteresis[3]	---	0.1	0.5	%FS
Long term stability of offset and sensitivity[8]	---	0.1	---	mV
Response time (10 % to 90 %)[7]	–	0.1	---	ms
Input resistance $T_A = 25°C$	3.0	4.5	6.0	kΩ
Temperature coefficient of resistance[6,9]	---	+750	---	ppm/°C
Output impedance	---	4.65	---	kΩ
Repeatability[4]	---	0.3	---	%FS

TYPICAL PERFORMANCE CHARACTERISTICS

Span vs Temperature

Bridge Resistance vs Temperature

0.1Hz to 10Hz Noise

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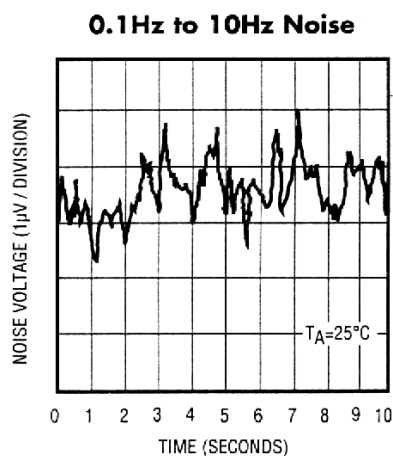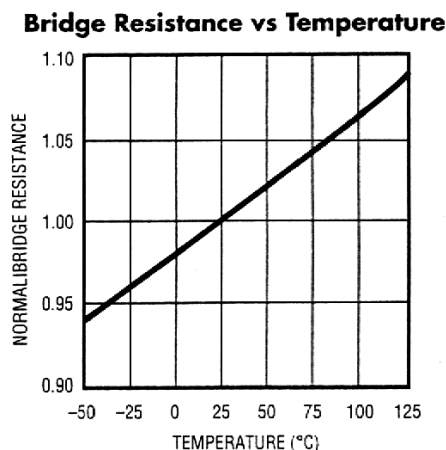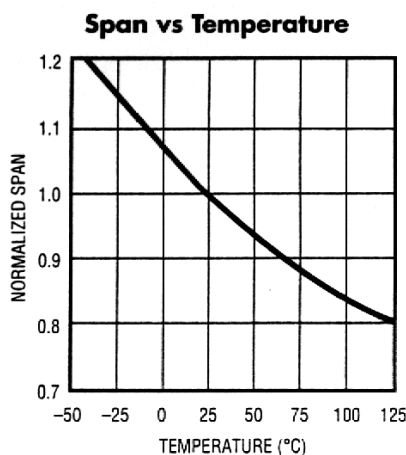
MECHANICAL AND MOUNTING CONSIDERATIONS

Button sensor element
The button sensor element was designed to allow easy interface with additional cases and housings which then allow pressure connection. The device can be mounted with an o-ring, gasket, or RTV seals on one or both sides of the device. The device can then be glued or clamped into a variety of fixtures and the leads can be bent as necessary to allow for ease of electrical connection. However, caution is advised as repeated bending of the leads will cause eventual breakage.

For most gage applications, pressure should be applied to the top side of the device (see Physical Construction Drawing). For differential applications, the top side of the device (P1) should be used as the high pressure port and the bottom (P2) as the low pressure port (except for SX7300D, where P2 is the high pressure port).

The button SX package has a very small internal volume of 0.06 cubic centimeters for P1 and 0.001 cubic centimeters for P2.

"N" packaged sensor
The "N" packaged sensor is designed for convenient pressure connection and easy PC board mounting. To mount the device horizontally to a PC board, the leads can be bent downward and the package attached to the board using either tie wraps or mounting screws. For pressure attachment, tygon or silicon tubing is recommended.

The "N" package version of the sensor has two (2) tubes available for pressure connec-

tion. For gage devices, pressure should be applied to port P1. For differential pressure applications, port P1 should be used as the high pressure port and P2 should be used as the low pressure port.

TO package
The TO package parts are available with pressure access only to P1 for absolute and gage pressure. Therefore, on gage devices the bottom of the TO package must be left open so atmosphere.

Typically, tubing is attached directly around the top of the TO can or the package can be glued or o-ring sealed into a fixture. As always care should be taken not to stress the package.

For all sensor packages care should be taken not to expose the parts to caustic media. This includes washers for board cleaning, etc..

GENERAL DISCUSSION

Output characteristics
The SX series devices give a voltage output which is directly proportional to applied pressure. The devices will give an increase in positive going output when increasing pressure is applied to pressure port P1 of the device. If the devices are operated in the backward gage mode, the output will increase with decreases in pressure. The devices are ratiometric to the supply voltage. Changes in supply voltage will cause proportional changes in the offset voltage and full-scale span.

User calibration
SX series devices feature the button IC pressure sensor element. This will keep overall system costs down by allowing the user to select calibration and temperature compensation circuits which specifically match individual application needs. In most cases, the primary signal conditioning elements to be added to the SX by the user are: offset and span calibration and temperature compensation.

Some typical circuits are shown in the application section.

Vacuum reference (absolute devices)
Absolute sensors have a hermetically sealed vacuum reference chamber. The offset voltage on these units is therefore measured at vacuum, 0 psia. Since all pressure is measured relative to a vacuum reference, all changes in barometric pressure or changes in altitude will cause changes in the device output.

Media compatibility
SX devices are compatible with most non-corrosive gases. Because the circuitry is coated with a protective silicon gel (parylene coating for all TO can devices), some otherwise corrosive environments can be compatible with the sensors. As shown in the physical construction diagram below for the button sensor element and ,,N" package, fluids must generally be compatible with silicon gel, RTV, plastic, and aluminum for forward gage use and RTV, silicon, glass and aluminum for backward gage or differential applications. For questions concerning media compatibility, contact the factory.

PHYSICAL CONSTRUCTION

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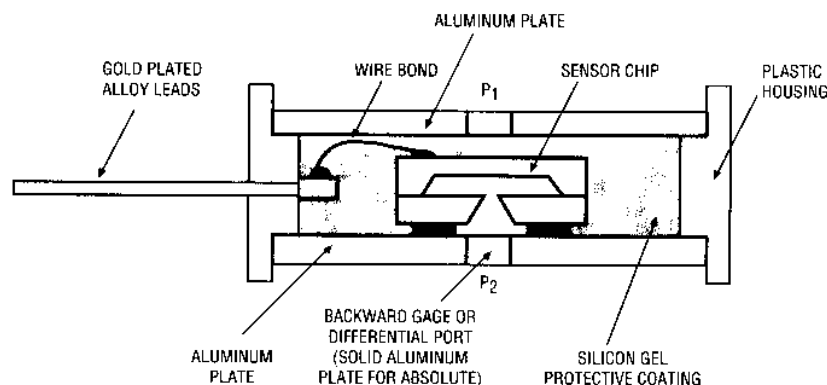
APPLICATION INFORMATION

General

The SX family of pressure sensors functions as a Wheatstone bridge. When pressure is applied to the device (see Figure I) the resistors in the arms of the bridge change by an amount Δ.
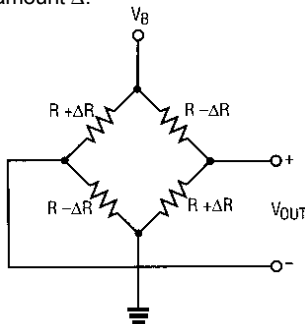

Figure I. Button sensor bridge schematic

The resulting differential output voltage V_0 is easily shown to be $V_O = V_B \times \Delta$. Since the change in resistance is directly proportional to pressure, V_O can be written as:

$$V_O = S \times P \times V_B \pm V_{OS} \qquad (1)$$

Where: V_O is the output voltage in mV
S is the sensitivity in mV/V per psi
P is the pressure in psi
V_B is the bridge voltage in volts.

V_{OS} is the offset error (the differential output voltage when the applied pressure is zero). The offset voltage presents little problem in most applications, since it can easily be corrected for in the amplifier circuitry, or corrected digitally if a microprocessor is used in the system.

Temperature effects

In this discussion, for simplicity of notation, the change of a variable with temperature will be designated with a dot (•) over the variable. For example,

$$\dot{S} = \frac{\text{change in sensitivity}}{\text{change in temperature}} = \frac{\delta S}{\delta T}$$

From equation (1), and ignoring the V_{OS} term, it in seen that for a given constant pressure, the output voltage change, as a function of temperature*, is:

$$\dot{V}_O = S P \dot{V}_B \qquad (2)$$

Thus, in order for output voltage to be independent of temperature, the voltage across the bridge, V_B, must change with temperature in the "opposite direction" from the sensitivity change with temperature. From the typical curves for the temperature dependence of span (span = $S \times P \times V_B$),

it can be seen that the sensitivity change with temperature is slightly non-linear and can be correlated very well with an equation of he form:

$$S = S_O[(1 - \beta T_D) + \rho T_D^2] \qquad (3)$$

where T_D is the temperature difference between 25°C and the temperature of interest, S_O is the sensitivity at 25°C, and beta (ß) and rho (ρ) are correlation constants. Fortunately, between 0°C and 70°C the change in sensitivity with temperature is quite linear, and excellent results can be obtained over this temperature range by ignoring the second-order temperature dependent term. Operating outside the 0°C and 70°C temperature range will require a more rigorous mathematical approach and the use of non-linear compensating circuitry, if accuracy of better than ±1 % is required. Because the majority of SX applications fall within the 0°C to 70°C operating temperature range, the discussion and circuit designs given here will ignore the non-linear effects.
Thus:

$$S = S_O (1 - \beta T_D) \qquad (4)$$

Substituting equation (4) into equation (1) and ignoring V_{OS}, it can be shown that the necessary bridge voltage, V_B, will be of the form:

$$V_B = \frac{V_{BO}}{(1 - \beta T_D)} = V_{BO} [(1 - \beta T_D + (\beta T_D)^2 + ...)]$$

where V_{BO} is the bridge voltage at 25°C.

This equation is again non-linear. However, for the temperature range of interest, and since ß is small (0.215%/°C from the electrical tables), the above expression can be approximated by:

$$V_B = V_{BO} [1 + \beta T_D]$$

with less than 1 % error. Thus to compensate for a negative 2150 ppm/°C sensitivity change with temperature, the bridge voltage should increase with temperature at a rate of +2150 ppm/°C.
The above value of bridge voltage change will be used in the circuit discussions that follow. That is to say, the required change in terms of ppm/°C is:

$$\left(\frac{\dot{V}_B}{V_B}\right) = +2050 \text{ ppm/°C}$$

The bridge input resistance*, R_B also changes with temperature and is quite linear in the temperature range of interest. The bridge resistance has a temperature coefficient of typically:

$$\left(\frac{\dot{R}_B}{R_B}\right) = +750 \text{ ppm/°C}$$

This term enters into several compensation circuit equations, particularly when the bridge excitation is from a constant current source.

To summarize, the following list indicates how the sensor variables can be accommodated

- Full-scale span from device to device. Make the gain adjustment in the op amp circuitry
- Temperature coefficient of span:
  1) temperature compensate the bridge or
  2) temperature compensate the op amp gain
- Offset voltage:
  Adjustment in op amp circuitry
- Offset voltage temperature coefficient: Usually can be ignored. For more precise design requirements, contact the factory for information on how to compensate for this term.

Bridge compensation circuits

Although thermistors can be used to temperature compensate the bridge (and in fact will be required for extended temperature operation), they are inherently non-linear, difficult to use in volume production, and more expensive than the circuit approaches shown here, which use inexpensive semiconductor devices The circuits shown have been designed to incorporate a minimum number of adjustments and allow interchangeability of devices with little variation from device to device. In general, equations for the bridge voltage and its change with temperature are given to enable the user to modify or adjust the circuitry as required.

1. Diode string (Figure II)

For systems using 6 V supplies, this method of compensating for the effects of span over temperature is the lowest cost solution The diodes are small signal silicon diodes, such as 1N914 or 1N4148, and do not have to be matched.
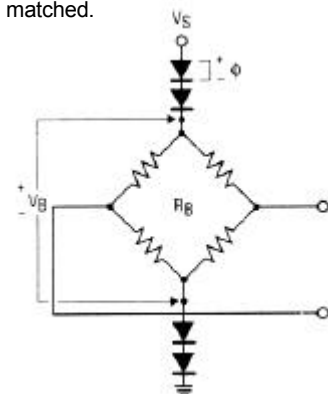

Figure II. Diode String Span Compensation

APPLICATION INFORMATION (cont.)

a) $V_B = V_S - 4\phi$

b) $\left(\dfrac{\dot{V}_B}{V_B}\right) = \dfrac{\left(\dfrac{\dot{\phi}}{\phi}\right)}{\left(\dfrac{V_S}{\phi} - 4\right)}$

c) $\left(\dfrac{\dot{\phi}}{\phi}\right)$ = -2500 ppm/°C for silicon diodes

Figure II. Equations

For example, solving equation (b) for V_B/V_B when

$V_S = 6.0\,V$

$\phi = 0.7\,V$

Yields:

$\dfrac{\dot{V}_B}{V_B}$ = 2188 ppm/°C

Since the sensor's span changes with temperature at -2150 ppm/°C, this technique will typically result in an overall negative TC of 38 ppm/C. This error is acceptable in most applications.

For operation with V_S above 6V, it is recommended to use the transistor or constant current compensation technique.

2. Transistor compensation network
Figure III uses a single transistor to simulate a diode string, with the equations as shown. The values shown in Table I were found to give excellent results over 0°C to 70°C. Again, if precision temperature compensation is required for each device, the fixed value resistors shown for R1 in Table I can be replaced by a 3.24k resistor in series with a 1k pot. Then, each devices temperature compensation can be individually adjusted.
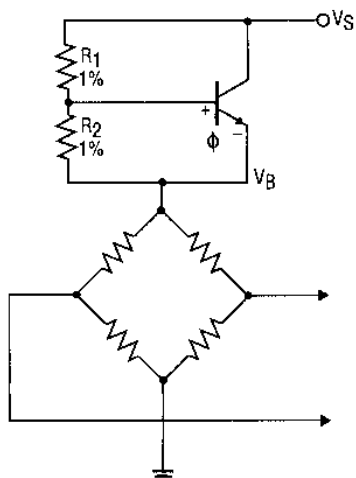

Figure III. Transistor/Resistor span TC compensation

a) $V_B = V_S - \alpha\,\phi$

b) $\left(\dfrac{\dot{V}_B}{V_B}\right) = -\left(\dfrac{\dot{\phi}}{\phi}\right) \times \left(\dfrac{\alpha}{\dfrac{V_S}{\phi} - \alpha}\right)$

c) $\alpha = 1 + \dfrac{R_1}{R_2}$

d) $\left(\dfrac{\dot{\phi}}{\phi}\right) = $ -2500 ppm/°C

Table I. Selected R values vs V_S for figure III

V_S	R_1 (W)	R_2 (W)
5V	3.32k	1.43k
9V	4.02k	806
12V	4.22k	604

3. Constant current excitation
(Figure IV)
The circuits shown in Figures II and III, although simple and inexpensive, have one drawback in that the voltage across the bridge is determined by the compensation network. That is, the compensation network is determined and what voltage is "leftover" is across the bridge. The circuit of Figure IV solves this problem and allows the bridge voltage to be independently selected. In Figure IV, the bridge is driven from a constant current source, the LM334, which has a very well known and repeatable temperature coefficient of +3300 ppm/°C. This temperature coefficient (TC), in conjunction with the TC of the bridge resistance, is too high to compensate the sensitivity TC, hence resistor R_2 is added to reduce the total circuit TC.

The basic design steps for this method of temperature compensation are shown below. However, please refer to SenSym's Application Note SSAN-16 for details on the temperature compensation technique.
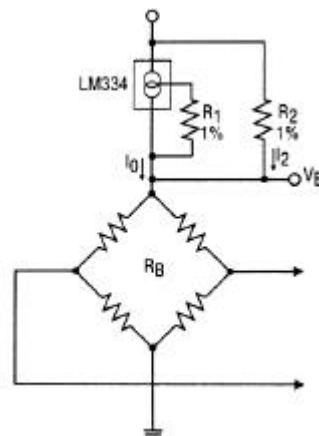

Figure IV. Constant current span TC Compensation

a) $V_B = \alpha\,(V_S + I_O R_2)$

b) $\left(\dfrac{\dot{V}_B}{V_B}\right) = \left(\dfrac{\dot{R}_B}{R_B}\right)(1 - \alpha) + \left(\dfrac{\dot{I}_O}{I_O}\right)\left[1 - \alpha\left(\dfrac{V_S}{V_B}\right)\right]$

c) $\alpha = \dfrac{R_B}{R_2 + R_B}$

d) $\left(\dfrac{\dot{I}_O}{I_O}\right)$ = 3360 ppm/°C, $\left(\dfrac{\dot{R}_B}{R_B}\right)$ = +750ppm/°C

e) $I_O = \dfrac{67.7\,mV}{R_1}$

The design steps are straight forward:

1) Knowing V_S and the desired bridge voltage V_B, solve equation (b) for α.
2) Now, solve equation (c) for R_2, letting $R_B = 4650\Omega$.
3) Solve equation (a) for I_O.
4) Find R_1 or its nearest 1% tolerance value from equation (e).

Table II gives specific 1% resistor values in ohms, for several popular system voltages. For best results, the resistors should be 1% metal film with a low temperature coefficient.

Table II. Selected R values vs V_S for figure IV

V_S	V_B	R_1(W)	R_2(W)
5V	3V	147	11.0k
6V	4V	105	9.53k
9V	6V	68.1	9.53k
12V	9V	43.2	8.25k
15V	10V	41.2	9.53k

Amplifier design
There are hundreds of instrumentation amplifier designs, and the intent here will be to briefly describe one circuit which:
- does not load the bridge
- involves minimal components
- provides excellent performance

Amplifier adjustment procedure
1. Without pressure applied,
  (a) Short points A and B together as shown in Figure V. Adjust the 1 k common-mode rejection (CMRR) pot until the voltage at test point (T_p) V_X is equal to the voltage at test point (T_p) V_R.

  This is easily accomplished by placing a digital voltmeter between these test points and adjusting for 0.000.

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APPLICATION INFORMATION (cont.)

(b) Remove the short and adjust the 500 Ω offset adjust pot until V_X is again equal to V_R.

(c) Adjust the 2k reference (V_R) adjust pot to get an output voltage (V_O) equal to 1.00V.

2. Apply the full-scale pressure and adjust the span adjust pot, R_5, to get the output voltage that is desired to represent full-scale.

The choice of the operational amplifiers to use is based on individual cost/performance trade-offs. The accuracy will be primarily limited by the amplifier's common-mode rejection, offset voltage drift with temperature and noise performance. Low cost, low performance devices, such as the LM324 can be used if the temperature ranges limited to 25°C +15°C and an accuracy of +2% is adequate.

For more precise applications amplifiers such as the LT1014 and LT1002 have been found to be excellent.

An amplifier that uses a single supply is shown in Figure V. Table III gives resistor values for various supply and full-scale output combinations.

Factory compensated devices
This application note provides the necessary information for temperature compensating and calibrating the SX sensors. In some case, the customer may find that SX devices which have been factory adjusted for temperature compensation and span are more economical for a particular application. SenSym does offer devices with this feature. For more information on these factory calibrated and compensated devices, the SCX series and SDX series, please contact Sensortechnics.

Table III. For 0 to 70°C operation

				SPAN		
V_S	V_B	R_2	R_1	FS	R_5	R_p
5V	3.5V	9.09k	118Ω	3V	604Ω	2k
6V	4.5V	8.45k	86.6Ω	4V	604Ω	2k
9V	7V	7.87k	54.9Ω	5V	1k	2k
12V	10V	7.15k	36.5Ω	5V	1.82k	5k
12V	10V	7.15k	36.5Ω	10V	511Ω	2k
15V	12V	7.68k	31.6Ω	5V	1.4k	5k
15V	12V	8.87k	31.6Ω	10V	604Ω	2k

Note: Application information shown here is based on the closed bridge configuration.
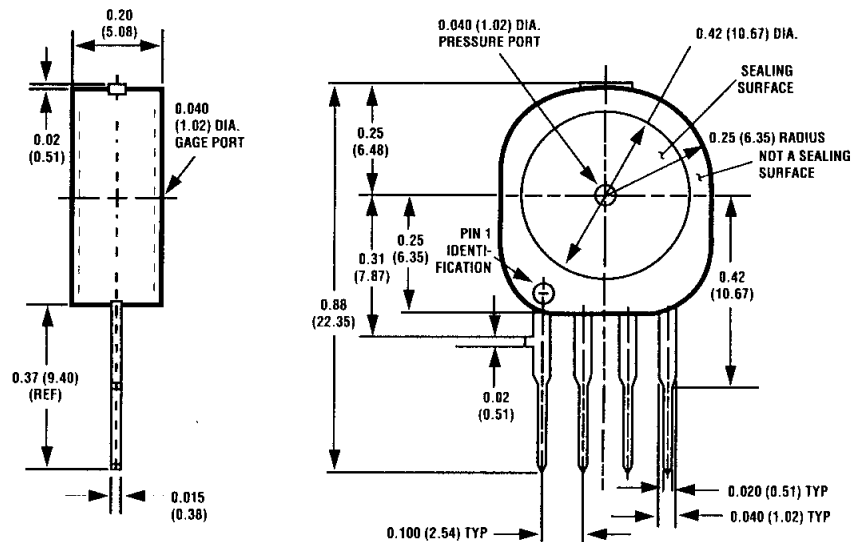

Figure V: Button Sensor Amplifier Circuit

A LT1014C
B LM10CN

$$V_O = 4\left[1 + \frac{10k}{R_G}\right]V_{IN} + V_R$$

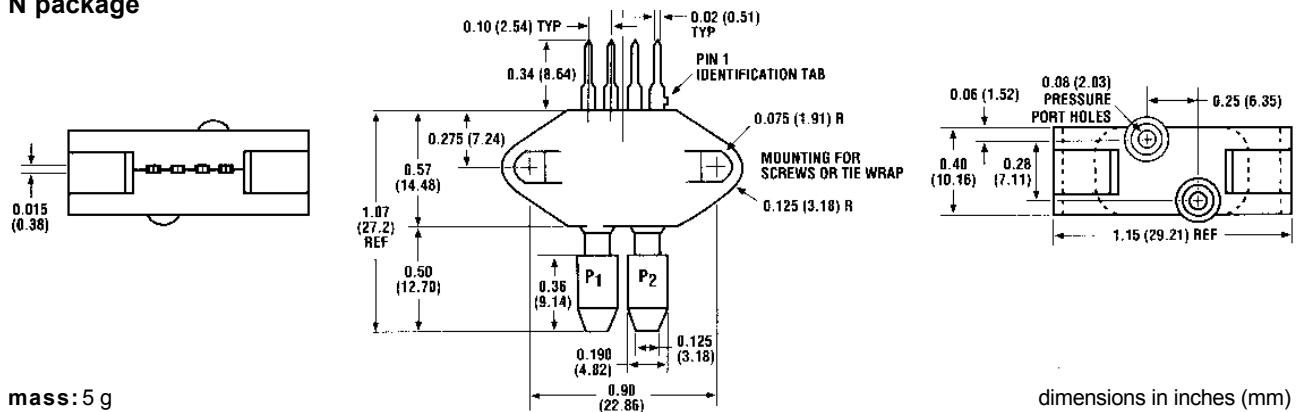Resistors labled R_3, R_4 are 5-Element Resistor Arrays 10 kΩ. Two required

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PHYSICAL DIMENSIONS

Button package
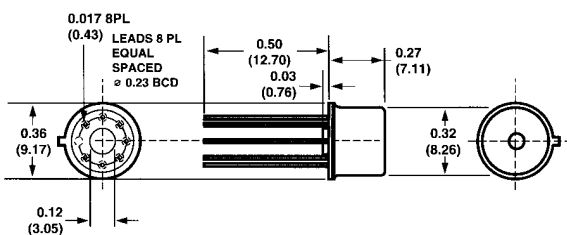
mass: 1 g

dimensions in inches (mm)

N package

mass: 5 g

dimensions in inches (mm)
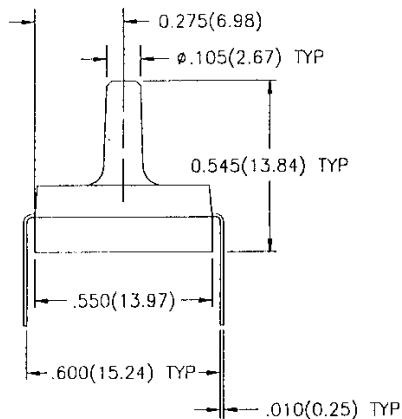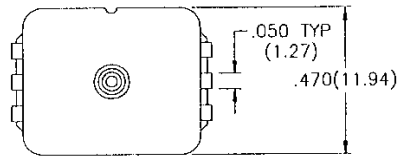
AHO package (TO-5)

GSO package (TO-39)

mass: 1 g

dimensions in inches (mm)

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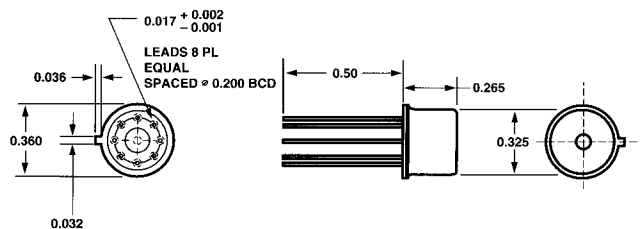
PHYSICAL DIMENSIONS

Basic sensor DIP "D2" package

- .050 TYP
(1.27)
.470(11.94)

0.275(6.98)
ø.105(2.67) TYP
0.545(13.84) TYP
.550(13.97)
.600(15.24) TYP
.010(0.25) TYP

0.430(10.92) TYP
0.230(5.84)
0.345(8.76) TYP
0.110(2.79) TYP
0.020(0.51) TYP
0.100(2.54) TYP
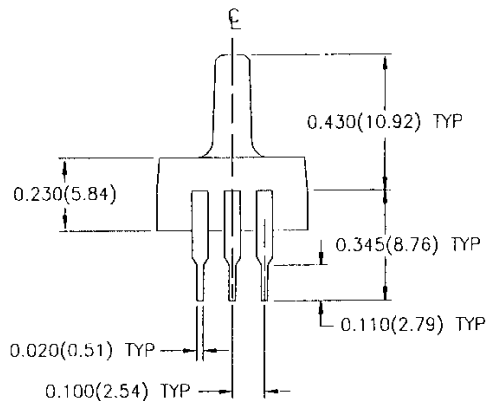
mass: 1 g   dimensions in inches (mm)

Basic sensor DIP "D4" package

0.050 TYP
(1.27)
.470(11.94)

3.4 (.135)
6.4 (.250)
.550(13.97)
.600(15.24) TYP
.010(.25) TYP

.300(7.62)
ø.090(2.28) TYP
0.380(9.65) TYP
0.285(7.24)
0.070(1.78)
0.170(4.32) TYP
0.110(2.79) TYP
.020(0.51) TYP
.100(2.54) TYP

mass: 1 g   dimensions in inches (mm)

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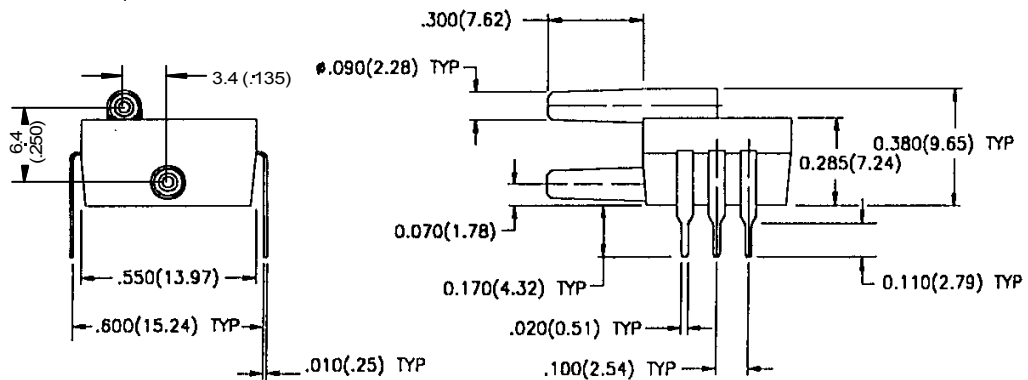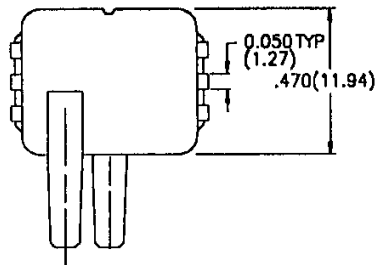
http://www.sensortechnics.com

Specification notes (for all devices)**:**

1. Reference conditions: supply voltage, V_S = 5 V_{DC}, T_A = 0°C to 70°C, common-mode line pressure = 0 psig, pressure applied to P_1, unless otherwise noted.
2. Span is the algebraic difference between the output voltage at full-scale pressure and the output at zero pressure.
3. See Definition of Terms. Hysteresis - the maximum output difference at any point within the operating pressure range for increasing and decreasing pressure.
4. Maximum difference in output at any pressure with the operating pressure range and temperature within 0°C to +70°C after:
   a) 100 temperature cycles, 0°C to +70°C
   b) 1.0 million pressure cycles, 0 psi to full scale span
5. Slope of the best straigth line from 0°C to +70°C.
6. This is the best straight line fit for operation between 0°C and 70°C. For operation outside this temperature, contact factory for more specific applications information.
7. Response time for a 0 psi to full-scale span pressure step change.
8. Long term stability over a one year period .
9. This parameter is not 100 % tested. It is guaranteed by process design and tested on a sample basis only.
10. If the proof pressure is exceeded, even momentarily, the package may leak or burst, or the pressure sensing die may fracture. Note: The proof pressure for the forward gage of all devices in the D4-package and the SX7300 is the specified value or 100 psi, whatever is less.
11. Maximum pressure at any port is the maximum operating plus common-mode pressure which can be applied.
12. The zero pressure offset is 0 mV Min, 20 mV Typ and 35 mV Max for part nos. SXxxxGD2 and SXxxxDD4.

ORDERING INFORMATION

To order, use the following part numbers:

Pressure range	Order part number				
	Button package	**"N" package**	**TO metal can package**	**DIP"D2" package (single ported)**	**DIP"D4" package (dual ported)**
Absolute Pressure					
0 - 15 psi	SX15A	SX15AN	SX15AHO	SX15AD2	---
0 - 30 psi	SX30A	SX30AN	SX30AHO	SX30AD2	---
0 -100 psi	SX100A	SX100AN	SX100AHO	SX100AD2	---
0 -150 psi	SX150A	---	---	---	---
Gage Pressure					
0 - 1 psi	use SX01D	use SX01DN	SX01GSO	SX01GD2	---
0 - 5 psi	use SX05D	use SX05DN	SX05GSO	SX05GD2	---
0 - 15 psi			SX15GSO	SX15GD2	---
0 -30 psi	use differential devices	use differential devices	SX30GSO	SX30GD2	---
0 - 100 psi			SX100GSO	SX100GD2	---
0 - 150 psi			SX150GSO	---	---
0 - 300 psi	SX7300D	---	---	---	---
Differential Pressure					
0 - 1 psi	SX01D	SX01DN	---	---	SX01DD4
0 - 5 psi	SX05D	SX05DN	---	---	SX05DD4
0 -15 psi	SX15D	SX15DN	---	---	SX15DD4
0 - 30 psi	SX30D	SX30DN	---	---	SX30DD4
0 - 100 psi	SX100D	SX100DN	---	---	SX100DD4
0 -150 psi	SX150D	SX150DN	---	---	---

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