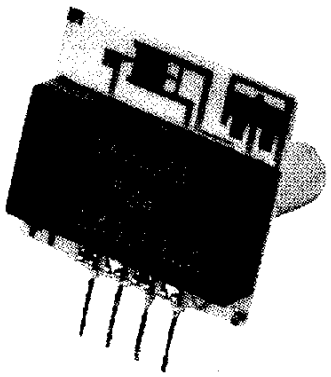
SenSym

LX06XXXG, LX06XXXD, and LX06XXXA Series Temperature Compensated Monolithic Pressure Transducers



General Description

The monolithic pressure transducers are piezoresistive integrated circuits which provide an output voltage proportional to applied pressure. The devices are provided in compact packages with pressure ports, suitable for PC board mounting and attachment of flexible tubing.

The LX06XXXG is a gage transducer with a single tube and an ambient inlet. It is well suited for use with package-compatible working fluids, including water.

The LX06XXXD is a differential pressure transducer with 2 pressure ports, suitable for use with non-ionic working fluids in either pressure port, and package-compatible working fluids in the positive pressure port.

The LX06XXXA is an absolute pressure transducer with a single tube pressure port, suitable for use with non-ionic working fluids.

See Application Guide—Media Compatibility.

ADVANTAGES OF MONOLITHIC

The monolithic transducers include only the basic monolithic pressure IC chip used in Sensym's signal-conditioned pressure transducer products. This greatly reduces unit cost and allows the electronic designer greater freedom in implementing transducer circuits.

Calibrated sensitivity, a calibrated offset and low noise allow easy amplification. These devices are especially useful in applications requiring battery power, circuit flexibility, or compatibility with microprocessors.

TEMPERATURE COMPENSATION

All LX06XXX series transducers have thick film thermistor temperature compensation external to the sensor element. This compensation is equally distributed above and below the bridge so as to maintain a consistent common-mode voltage across the bridge, thereby decreasing common-mode signal errors. The temperature compensated is linearized and matched to each sensor using advanced laser trimming techniques.

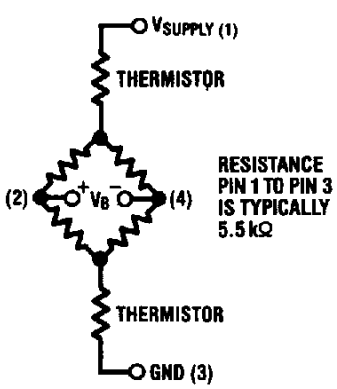
Features

- Low cost
- Low noise
- Temperature compensated
- Wide operating temperature range
- Small size and light weight
- High natural frequency
- Low volumetric displacement
- Alternate source available
- Vibration and shock insensitive
- Ratiometric output voltage
- Offset and sensitivity calibrated
- Compact package suitable for PC board mounting

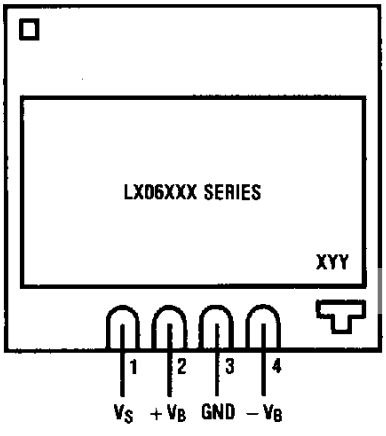
Applications

- Medical diagnostics
- Automotive diagnostics and controls
- Barometry
- Computer peripherals, control and diagnostics

Schematic Diagram



Electrical Connection



Pressure Transducer Characteristics

Maximum Ratings

Supply Voltage, V_S	16V
Temperature Range	
Operating	−40°C to +125°C
Storage	−55°C to +125°C
Common-Mode Line Pressure, LX06XXXD	100psid
Lead Temperature (Soldering, 10 seconds)	200°C

Reference Conditions (Note 1)

Supply Voltage, V_S	10V
Reference Temperature	25°C
Common-Mode Line Pressure, LX06XXXD	0psid

Performance Characteristics

Device Type	Operating Pressure Range	Maximum Over Pressure	Offset Calibration mV			Sensitivity mV/psi	Linearity (Note 2) %FS	Repeatability and Hysterisis %FS	Offset Shift with Temperature (0 to 50°C) mV	Sensitivity Shift with Temperature (0 to 50°C) %FS	Full Scale Output Calibration (Note 3) mV		
			Min.	Typ.	Max.	Typ.	Typ.	Typ.	Typ.	Typ.	Min.	Typ.	Max.
LX06001G	0 to ±1psig	20psig	−2	0	+2	27.7	±1.5	0.10	±2	±1.5	25.5	28	30.5
LX06001D	±1psid	20psid	−2	0	+2	27.7	±1.5	0.10	±2	±1.5	25.5	28	30.5
LX06002G	0 to ±2psig	20psig	−2	0	+2	20.0	±1.5	0.10	±2	±1.5	38.5	40	41.5
LX06002D	±2psid	20psid	−2	0	+2	20.0	±1.5	0.10	±2	±1.5	38.5	40	41.5
LX06005G	0 to ±5psig	20psig	−1	0	+1	10.0	±1.5	0.10	±2	±1.5	48.5	50	51.5
LX06005D	±5psid	20psid	−1	0	+1	10.0	±1.5	0.10	±2	±1.5	48.5	50	51.5
LX06015A	0 to 15psia	40psia	−2	0	+2	−6.67	±1.0	0.10	±2	±1.5	−97.5	−100	−102.5
LX06015G	0 to ±15psig	40psig	−1	0	+1	6.67	±1.0	0.10	±2	±1.5	98.5	100	101.5
LX06015D	±15psid	40psid	−1	0	+1	6.67	±1.0	0.10	±2	±1.5	98.5	100	101.5
LX06030A	0 to 30psia	60psia	−2	0	+2	−2.63	±0.50	0.10	±2	±1.5	−74	−79	−84
LX06030G	0 to30psig	60psig	−1	0	+1	2.63	±0.50	0.10	±2	±1.5	75	79	83
LX06030D	±30psid	60psid	−1	0	+1	2.63	±0.50	0.10	±2	±1.5	75	79	83
LX06100A	0 to 100psia	200psia	−1	0	+1	−1.4	±0.50	0.10	±2	±1.5	−136	−140	−144
LX06100G	0 to ±100psig	200psig	−1	0	+1	1.4	±0.50	0.10	±2	±1.5	136	140	144

Specification Notes:

Note 1: Conditions at which device "Performance Characteristics" apply.

Note 2: Linearity—the maximum deviation of measured output, at constant temperature (25°C), from "best straight line" through three points (offset pressure, full scale pressure, one-half full scale pressure).

$$\%\ \text{FS error} = \frac{V_{½\ \text{full scale}} - \left\{\left(\frac{(V_{\text{full scale}} - V_{\text{offset}})}{\text{full scale pressure}}\right) \times \left(½\ \text{full scale pressure}\right) + V_{\text{offset}}\right\}}{2(V_{\text{full scale}})} \times 100\%$$

(V = measured value for each device)

Note 3: Full-scale is the algebraic difference between endpoints. Where one endpoint is actual offset voltage and the other endpoint is the upper limit of the range.

TESTING

All guaranteed parameters are tested on multiple occasions in production and are assured in conformance to specification by outgoing quality assurance inspection. A Mensor pressure reference is used as a calibrated pressure reference source. All voltage readings are verified by a 4½-digit calibrated voltmeter. Non-guaranteed parameters are characterized during initial product characterization and reflect the performance of the product at that time. To guarantee any of these parameters requires a request for special product. Consult your Sensym distributor or representative for details.

Application Guide

MEDIA COMPATIBILITY—HUMIDITY

The heart of the transducer is a monolithic silicon chip with a cavity etched out to form a diaphragm. The top side of the diaphragm contains the transducer pressure sensing circuitry.

Absolute pressure devices (LX06XXXA) have a brass tube on the negative pressure inlet port only. The sensor cavity is a vacuum reference and the positive pressure port is sealed closed. A silicone gel material covers the sensor and provides immunity to high humidity environments. However, this material does not provide long term protection against water, other aqueous fluids, nor ionic fluids.

Gage pressure devices (LX06XXXG) have a brass tube on the positive pressure inlet port only. Ambient pressure is the reference pressure and is applied through a vent hole in the ceramic substrate. A silicone gel material covers the sensor and provides immunity to high humidity environments. The working fluid is applied through the positive pressure port and must be compatible with brass, ceramic, silicon, and polyimide. Silicon is at the same voltage potential as the supply voltage. Therefore the fluid must be electrically non-conductive or electrically isolated from the supply voltage.

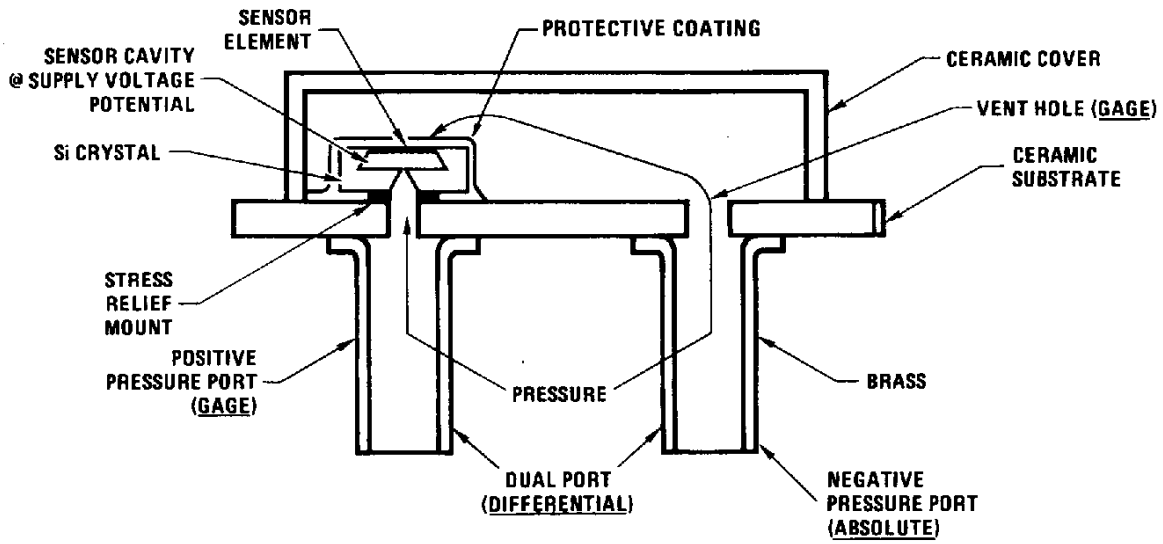
Differential pressure devices (LX06XXXD) have two brass tubes, one on each pressure port. Fluids applied to the negative pressure port must conform to conditions specified for absolute pressure devices. Fluids applied to the positive pressure port must conform to conditions specified for gage pressure devices.

PACKAGE LEAK RATE

The PX6 package is not hermetic. Sensym's pressure transducers are guaranteed to have an effective leak area less than 10^{-7} cm². Each transducer is leak tested at room temperature with 45 psig compressed air. However, the user should be aware that the leak rate can depend on the type, viscosity, pressure, and temperature of the working fluid and can increase with fatigue resulting from pressure cycling. This is especially important in static systems where a fluid under pressure is to be maintained for an extended period in an enclosure without replenishment. This leak rate applies to package leak rate and not the reference chamber in absolute (A) devices which is hermetic.

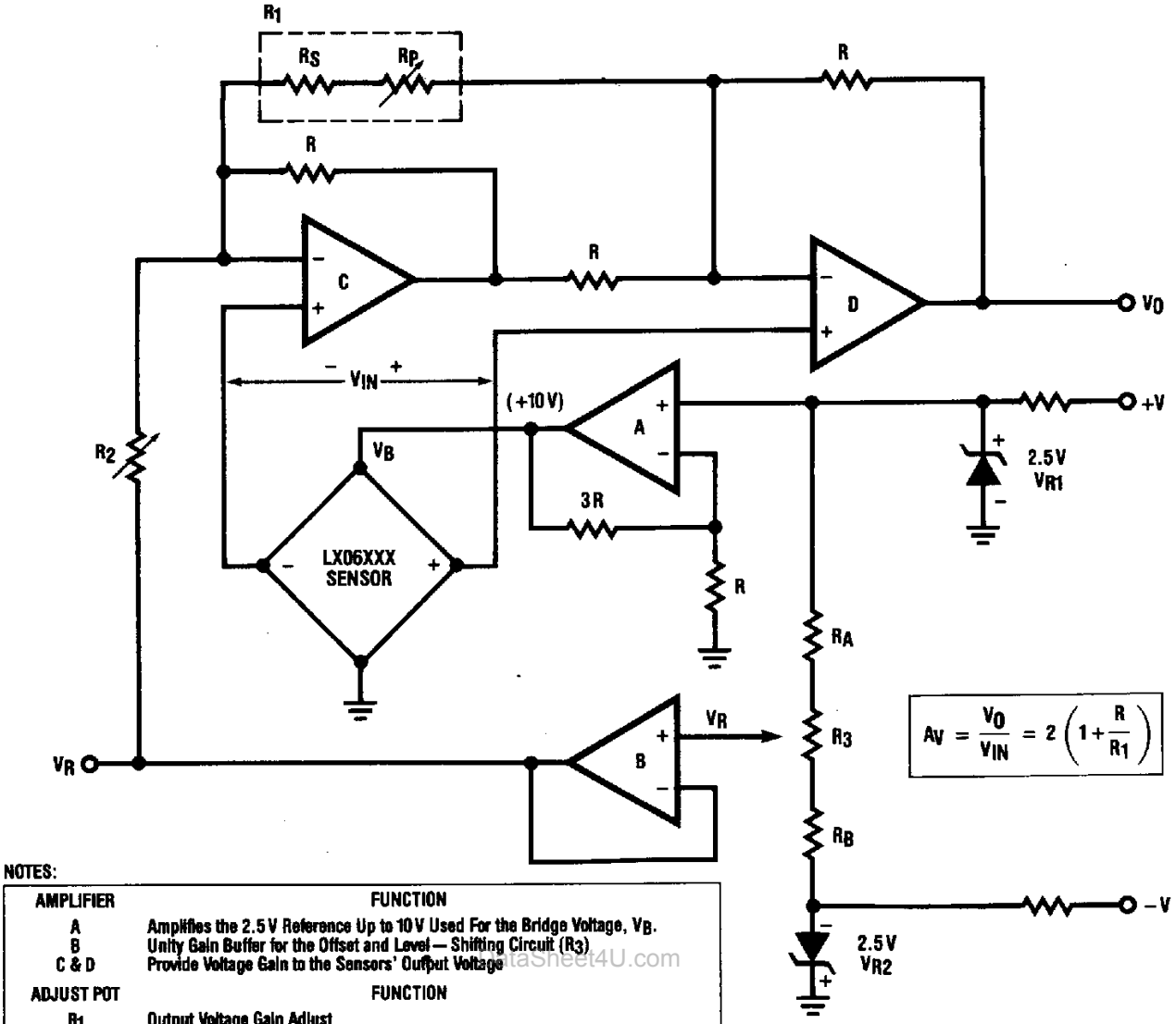
SIGNAL AMPLIFICATION

Figures 1 and *2* show the LX06XXX series in use with some simple amplifier schemes. These circuits are described fully in application notes SSAN-17 and SSAN-18.



LX06XXX Pressure Transducer Structure

Application Guide (Continued)



NOTES:

AMPLIFIER	FUNCTION
A	Amplifies the 2.5 V Reference Up to 10 V Used For the Bridge Voltage, V_B.
B	Unity Gain Buffer for the Offset and Level — Shifting Circuit (R_3)
C & D	Provide Voltage Gain to the Sensors' Output Voltage
ADJUST POT	**FUNCTION**
R_1	Output Voltage Gain Adjust
R_2	Common-Mode Rejection Adjust
R_3	Zero-Pressure Offset Adjust

FIGURE 1. Amplified Output Using Dual Supplies (See Application Note SSAN-18 for details)

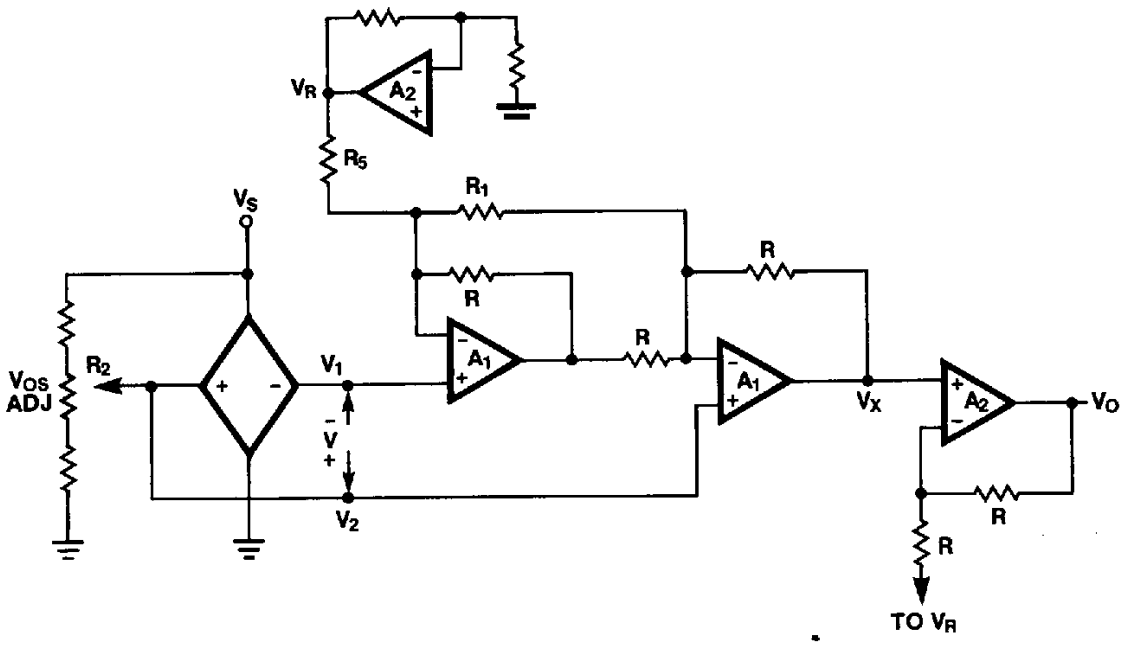


FIGURE 2. Amplified Output Using A Single Supply (See Application Note SSAN-17 for details)

Application Guide (Continued)

SINGLE SUPPLY, RATIOMETRIC, RAIL-TO-RAIL SIGNAL CONDITIONING CIRCUIT

Typically this circuit is employed in single supply 5V systems in conjunction with a ratiometric analog-to-digital converter (ADC0801 series). It could just as easily be incorporated into any fixed voltage system.

Circuit Description

In *Figure 3*, a sensor is used with one NSC LM324 and one NSC LM10. The NSC LM10 reference is used to minimize common-mode voltage error across the first stage differential input. The voltage at V2 is set to one-half the supply voltage. This is the same voltage as pins 2 and 4 of the sensor with an unstrained bridge.

$$V2 = V_R + V_R \frac{R10}{R9}.$$

With R1 equal to R4 and R3 equal to R2 and a change in voltage of ΔV_B across the bridge results in

$$V1 = \Delta V_B \left(1 + \frac{R1}{R2}\right) + V2.$$

R8 and R7 are used to set the offset voltage. At offset conditions, these resistors are adjusted for the desired offset voltage. For zero output voltage, typically R7 = 40Ω and R8 = 400Ω and are adjusted so that the NSC LM10 is on the threshold of saturation at offset conditions.

i.e., for $V_S = 5V$ and R5 = 4k,
R6 = 40k (output stage gain of 10) at offset
V2 = 2.5V, set $V_O = 0V$

$$V3 = 2.5 - \frac{2.5}{10} = 2.27V$$

The gain of this amplifier is equal to the gain of the first stage times the output stage gain

$$V_O = -(V1 - V3)\frac{R6}{R5} + V3.$$

For LX06015G and 0V to 5V operation, this requires a total gain of 50.

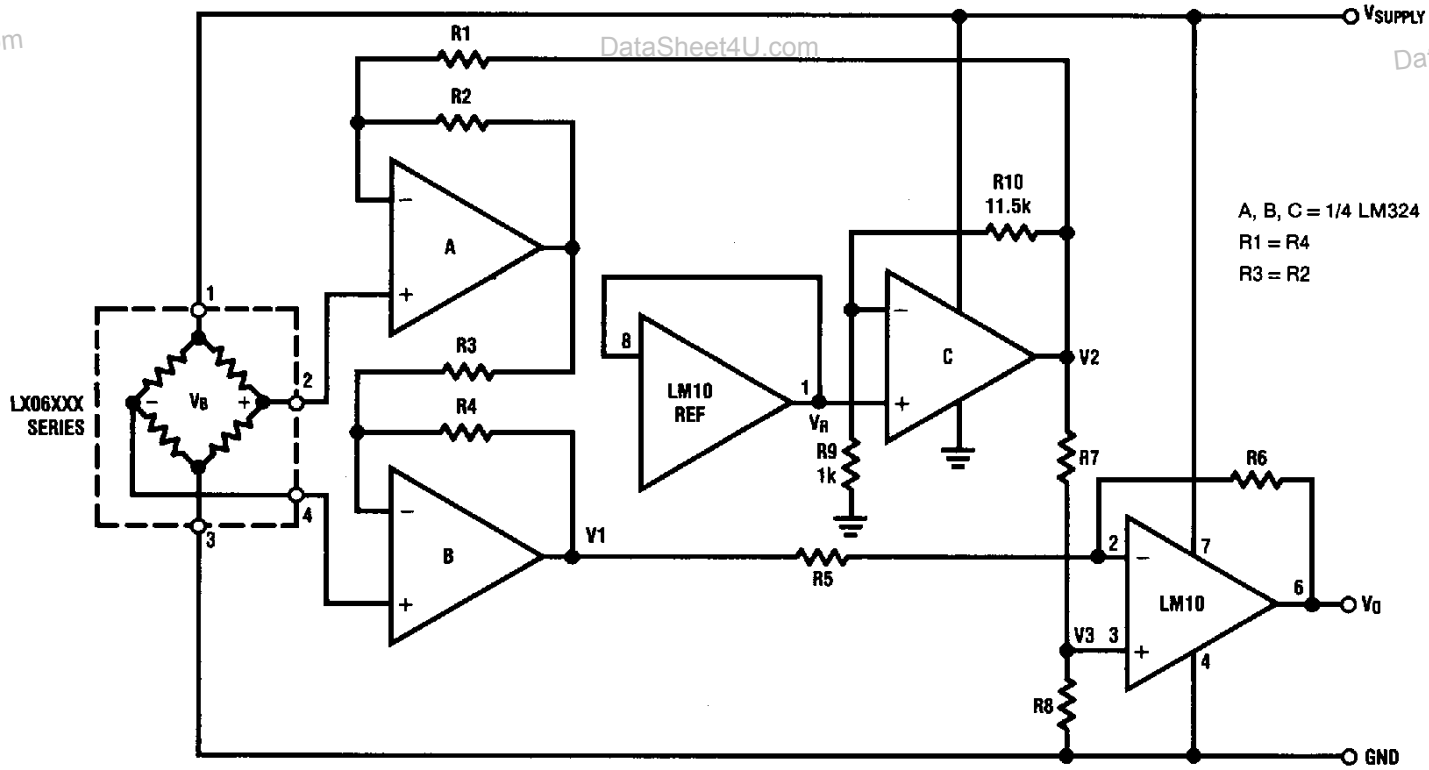


FIGURE 3. Single Supply, Ratiometric, Rail-to-Rail Signal Conditioning Circuit (for absolute devices pins 2 and 4 are reversed)

Application Guide (Continued)

LOW COST 15V SUPPLY SIGNAL CONDITIONING CIRCUIT *(Figure 4)*

The LH0070 is a precision 10.00V reference. All aspects of this circuit follow the details as described for the single supply, ratiometric, rail-to-rail signal conditioning circuit previously.

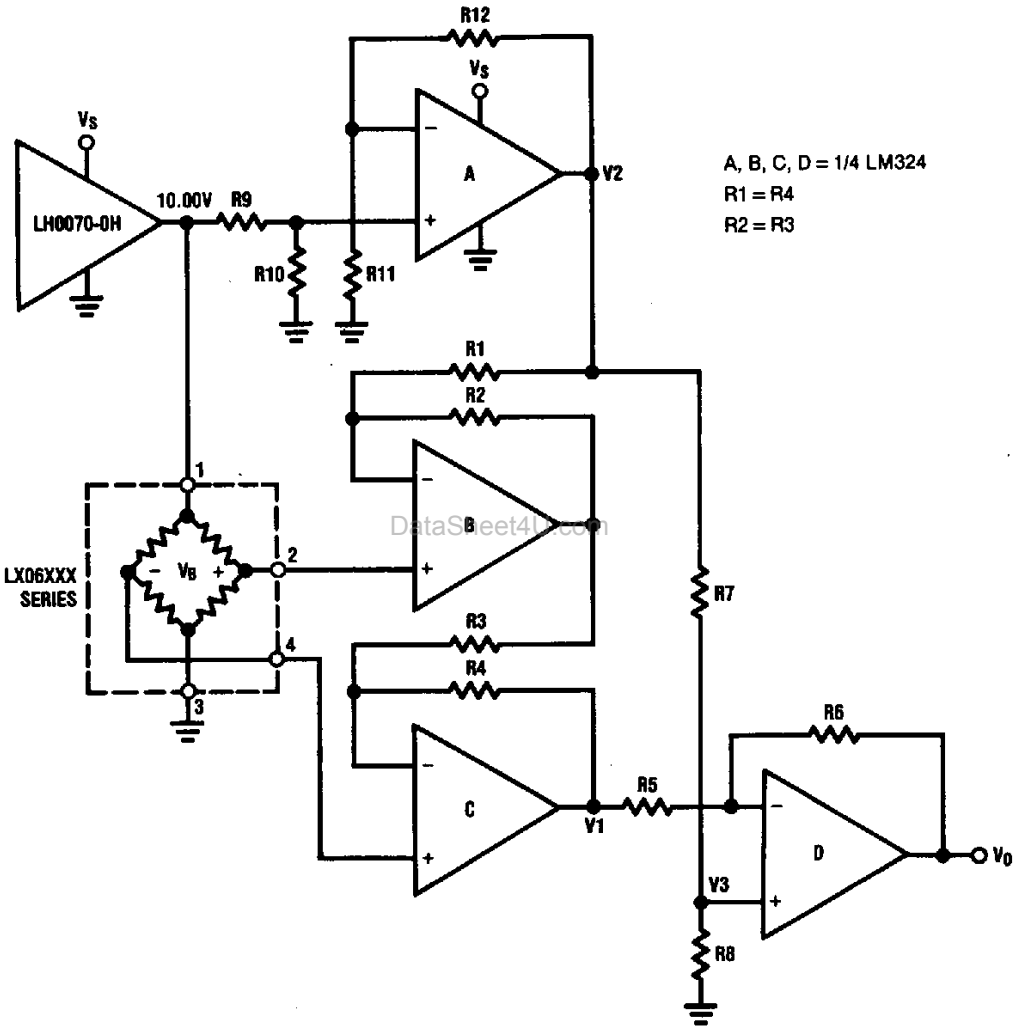


FIGURE 4. Low Cost 15V Supply Signal Conditioning Circuit

Application Guide (Continued)

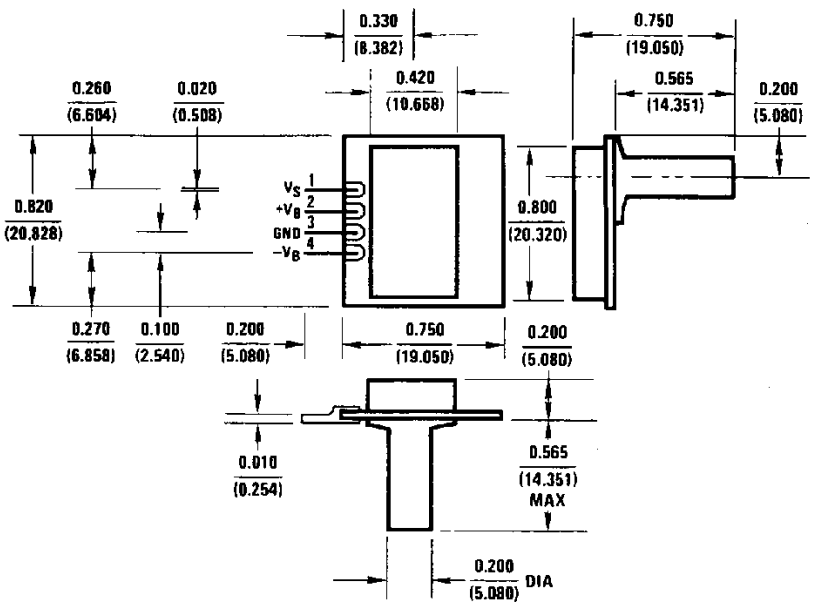
SECOND SOURCE

As a second source, the Honeywell/Microswitch 126 and 136 series parts are pin-for-pin equivalent to the LX06XXX series. There is one difference in the two products. The common-mode voltage upon which the output voltage changes is typically one-half the supply voltage for Sensym's products; for Honeywell devices this is typically one-third the supply voltage. For Sensym's products this allows full use of the pressure rating symmetrically around this voltage. See Typical Physical Dimensions section for pressure port locations.

Sensym Part #	Honeywell Part #	Sensitivity @10V (mV/psi)	Maximum Calibrated Pressure
LX06001G		27.7	1psig
LX06001D		27.7	1psid
LX06002G		20	2psig
LX06002D		20	2psid
LX06005G	126PC05G1, 136PC05G1	10	5psig
LX06005D	126PC05D1	10	5psid
LX06015A	126PC15A1, 136PC15A1	−6.67	15psia
LX06015G	126PC15G1	6.67	15psig
LX06015D	126PC15D1	6.67	15psid
LX06030A	126PC30A1, 136PC30A1	−2.63	30psia
LX06030G	126PC30G1, 136PC30G1	2.63	30psig
LX06030D	126PC30D1	2.63	30psid
LX06100G		1.4	100psig

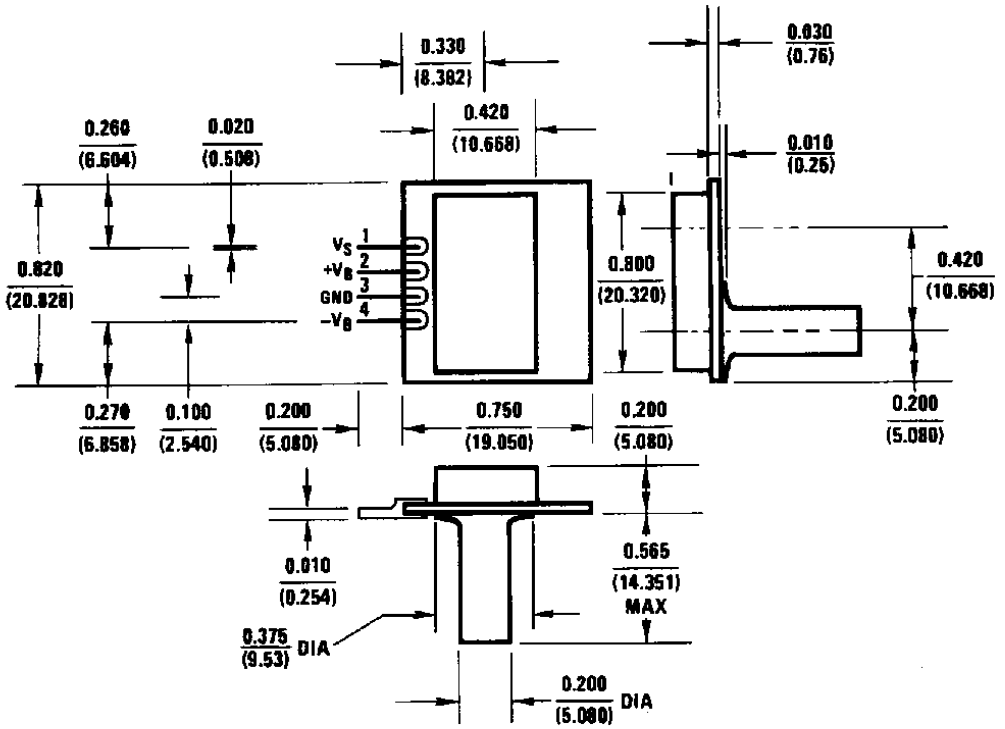
*Linearity is typically 0.25% full-scale.

Typical Physical Dimensions inches (millimeters) for reference only

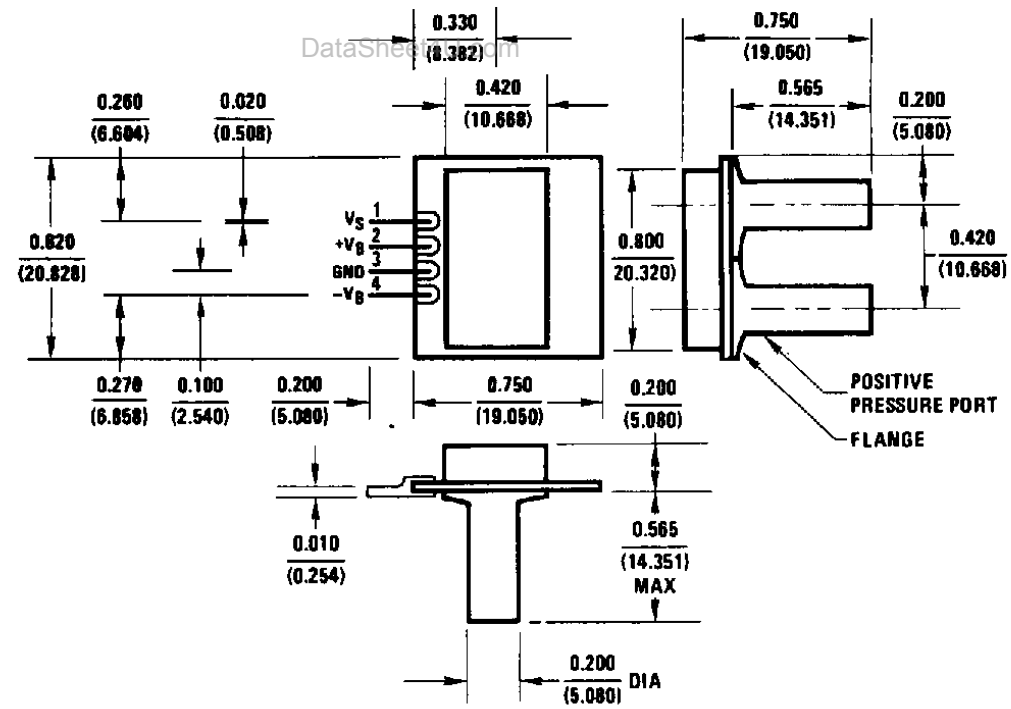


PX6A
Package for LX06XXXA Series Pressure Transducers
Weight: 5 grams

Typical Physical Dimensions (Continued) inches (millimeters) for reference only



PX6B
Package for LX06XXXG Series Pressure Transducers
Weight: 5 grams



PX6D
Package for LX06XXXD Series Pressure Transducers
Weight: 5 grams