SenSym

# SCX C Series
# 0 to 1psi to 0 to 150psi
## Low Cost Compensated Pressure Sensors

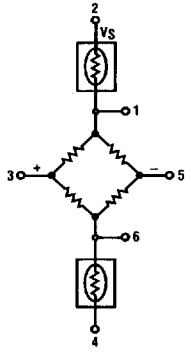
## FEATURES

- Low Cost
- Temperature Compensation
- Calibrated Zero and Span
- Small Size
- Low Noise
- High Impedance for Low Power Applications

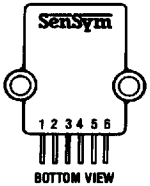
## APPLICATIONS

- Medical Equipment
- Computer Peripherals
- Pneumatic Controls
- HVAC

## EQUIVALENT CIRCUIT




## ELECTRICAL CONNECTION




Pin 1) Temperature Output (+)
Pin 2) VS
Pin 3) Output (+)
Pin 4) Ground
Pin 5) Output (−)
Pin 6) Temperature Output (−)

**Note:** The polarity indicated is for pressure applied to port B. (For Absolute devices, pressure is applied to port A and the output polarity is reversed.)

## GENERAL DESCRIPTION

The SCX C series sensors will provide a very cost effective solution for pressure applications that require operation over a wide temperature range. These internally calibrated and temperature compensated sensors give an accurate and stable output over a 0°C to 70°C temperature range. This series is intended for use with non-corrosive, non-ionic working fluids such as air, dry gases, and the like.

Devices are available to measure absolute, differential, and gage pressures from 1psi (SCX01) up to 150psi (SCX150). 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 pressure sensing diaphragm and can be used for gage or differential pressure measurements.

The SCX devices feature an integrated circuit sensor element and laser trimmed thick film ceramic housed in a compact nylon case. This package provides excellent corrosion resistance and provides isolation to external package stresses. The package has convenient mounting holes and pressure ports for ease of use with standard plastic tubing for pressure connection.

All SCX devices are calibrated for span to within ±5% and provide an offset (zero pressure output) of ±1 millivolt maximum. These parts were designed for low cost applications where the user can typically provide fine adjustment of zero and span in external circuitry. For higher accuracies, refer to the standard SCX series datasheet. If the application requires extended temperature range operation, beyond 0 to 70°C, two pins which provide an output voltage proportional to temperature are available for use with external circuitry.

The output of the bridge is ratiometric to the supply voltage and operation from any D.C. supply voltage up to +30V is acceptable.

Because these devices have very low noise and 100 microsecond response time they are an excellent choice for medical equipment, computer peripherals, and pneumatic control applications.

For further technical information on the SCX series, please contact your local Sensym office or the factory.

## PRESSURE SENSOR CHARACTERISTICS

**SCX C Series**

### STANDARD PRESSURE RANGES

| PART NUMBER | OPERATING PRESSURE | PROOF PRESSURE* | FULL-SCALE SPAN |
|---|---|---|---|
| SCX01DNC | 0 – 1 psid | 20 psid | 18mV |
| SCX05DNC | 0 – 5 psid | 20 psid | 60mV |
| SCX15ANC | 0 – 15 psia | 30 psia | 90mV |
| SCX15DNC | 0 – 15 psid | 30 psid | 90mV |
| SCX30ANC | 0 – 30 psia | 60 psia | 90mV |
| SCX30DNC | 0 – 30 psid | 60 psid | 90mV |
| SCX100ANC | 0 – 100 psia | 150 psia | 100mV |
| SCX100DNC | 0 – 100 psid | 150 psid | 100mV |
| SCX150ANC | 0 – 150 psia | 150 psia | 90mV |
| SCX150DNC | 0 – 150 psid | 150 psid | 90mV |

* Maximum pressure above which causes permanent sensor failure.

**Maximum Ratings** (For All Devices)

| | |
|---|---|
| Supply Voltage, $V_S$ | +30 $V_{DC}$ |
| Common-mode Pressure | 50 psig |
| Lead Temperature (Soldering, 10 seconds) | 300°C |

**Environmental Specifications** (For All Devices)

| | |
|---|---|
| Temperature Range | |
| Compensated | 0 to 70°C |
| Operating | −40°C to +85°C |
| Storage | −55°C to +125°C |
| Humidity Limits | 0 to 100% RH |

## SCX01DNC PERFORMANCE CHARACTERISTICS (Note 1)

| CHARACTERISTIC | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|
| Operating Pressure Range | | — | 1 | psid |
| Sensitivity | — | 18 | — | mV/psi |
| Full-scale Span (Note 2) | 17.00 | 18.00 | 19.00 | mV |
| Zero Pressure Offset | −1.0 | 0 | +1.0 | mV |
| Combined Linearity and Hysteresis (Note 3) | — | ±0.2 | ±1.0 | %FSO |
| Temperature Effect on Span (0–70°C) (Note 4) | — | ±0.4 | ±2.0 | %FSO |
| Temperature Effect on Offset (0–70°C) (Note 4) | — | ±0.20 | ±1.0 | mV |
| Repeatability (Note 5) | — | ±0.2 | ±0.5 | %FSO |
| Input Impedance (Note 6) | — | 4.0 | — | kΩ |
| Output Impedance (Note 7) | — | 4.0 | — | kΩ |
| Common-mode Voltage (Note 8) | 5.7 | 6.0 | 6.3 | $V_{DC}$ |
| Response Time (Note 9) | — | 100 | — | μsec |
| Long Term Stability of Offset and Span (Note 10) | — | ±0.1 | — | %FSO |

## PRESSURE SENSOR CHARACTERISTICS (Cont.) SCX C Series

### SCX05DNC PERFORMANCE CHARACTERISTICS (Note 1)

| CHARACTERISTIC | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|
| Operating Pressure Range | | — | 5 | psid |
| Sensitivity | — | 12.0 | — | mV/psi |
| Full-scale Span (Note 2) | 57.5 | 60.0 | 62.5 | mV |
| Zero Pressure Offset | −1.0 | 0 | +1.0 | mV |
| Combined Linearity and Hysteresis (Note 3) | — | ±0.1 | ±1.0 | %FSO |
| Temperature Effect on Span (0–70°C) (Note 4) | — | ±0.4 | ±2.0 | %FSO |
| Temperature Effect on Offset (0–70°C) (Note 4) | — | ±0.20 | ±1.0 | mV |
| Repeatability (Note 5) | — | ±0.2 | ±0.5 | %FSO |
| Input Impedance (Note 6) | — | 4.0 | — | kΩ |
| Output Impedance (Note 7) | — | 4.0 | — | kΩ |
| Common-mode Voltage (Note 8) | 5.7 | 6.0 | 6.3 | $V_{DC}$ |
| Response Time (Note 9) | — | 100 | — | μsec |
| Long Term Stability of Offset and Span (Note 10) | — | ±0.1 | — | %FSO |

### SCX15C PERFORMANCE CHARACTERISTICS (Note 1)

| CHARACTERISTIC | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|
| Operating Pressure Range | | — | 15 | psi |
| Sensitivity | — | 6.0 | — | mV/psi |
| Full-scale Span (Note 2) | 85.0 | 90.0 | 95.0 | mV |
| Zero Pressure Offset | −1.0 | 0 | +1.0 | mV |
| Combined Linearity and Hysteresis (Note 3) | — | ±0.1 | ±1.0 | %FSO |
| Temperature Effect on Span (0–70°C) (Note 4) | — | ±0.4 | ±2.0 | %FSO |
| Temperature Effect on Offset (0–70°C) (Note 4) | — | ±0.20 | ±1.0 | mV |
| Repeatability (Note 5) | — | ±0.2 | ±0.5 | %FSO |
| Input Impedance (Note 6) | — | 4.0 | — | kΩ |
| Output Impedance (Note 7) | — | 4.0 | — | kΩ |
| Common-mode Voltage (Note 8) | 5.7 | 6.0 | 6.3 | $V_{DC}$ |
| Response Time (Note 9) | — | 100 | — | μsec |
| Long Term Stability of Offset and Span (Note 10) | — | ±0.1 | — | %FSO |

## PRESSURE SENSOR CHARACTERISTICS (Cont.)

**SCX C Series**



### SCX30C PERFORMANCE CHARACTERISTICS (Note 1)

| CHARACTERISTIC | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|
| Operating Pressure Range | | — | 30 | psi |
| Sensitivity | — | 3.0 | — | mV/psi |
| Full-scale Span (Note 2) | 85.0 | 90.0 | 95.0 | mV |
| Zero Pressure Offset | −1.0 | 0 | +1.0 | mV |
| Combined Linearity and Hysteresis (Note 3) | — | ±0.2 | ±1.0 | %FSO |
| Temperature Effect on Span (0–70°C) (Note 4) | — | ±0.4 | ±2.0 | %FSO |
| Temperature Effect on Offset (0–70°C) (Note 4) | — | ±0.2 | ±1.0 | mV |
| Repeatability (Note 5) | — | ±0.2 | ±0.5 | %FSO |
| Input Impedance (Note 6) | — | 4.0 | — | kΩ |
| Output Impedance (Note 7) | — | 4.0 | — | kΩ |
| Common-mode Voltage (Note 8) | 5.7 | 6.0 | 6.3 | $V_{DC}$ |
| Response Time (Note 9) | — | 100 | — | μsec |
| Long Term Stability of Offset and Span (Note 10) | — | ±0.1 | — | %FSO |

### SCX100C PERFORMANCE CHARACTERISTICS (Note 1)

| CHARACTERISTIC | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|
| Operating Pressure Range | | — | 100 | psi |
| Sensitivity | — | 1.0 | — | mV/psi |
| Full-scale Span (Note 2) | 95.0 | 100.0 | 105.0 | mV |
| Zero Pressure Offset | −1.0 | 0 | +1.0 | mV |
| Combined Linearity and Hysteresis (Note 3) | — | ±0.2 | ±1.0 | %FSO |
| Temperature Effect on Span (0–70°C) (Note 4) | — | ±0.4 | ±2.0 | %FSO |
| Temperature Effect on Offset (0–70°C) (Note 4) | — | ±0.20 | ±1.0 | mV |
| Repeatability (Note 5) | — | ±0.2 | ±0.5 | %FSO |
| Input Impedance (Note 6) | — | 4.0 | — | kΩ |
| Output Impedance (Note 7) | — | 4.0 | — | kΩ |
| Common-mode Voltage (Note 8) | 5.7 | 6.0 | 6.3 | $V_{DC}$ |
| Response Time (Note 9) | — | 100 | — | μsec |
| Long Term Stability of Offset and Span (Note 10) | — | ±0.1 | — | %FSO |

## PRESSURE SENSOR CHARACTERISTICS (Cont.)

**SCX C Series**

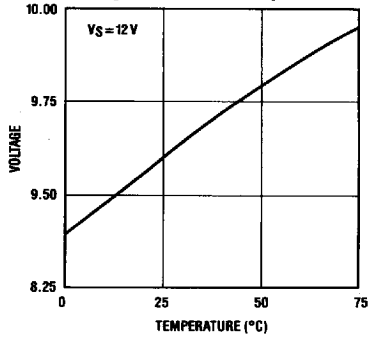
### SCX150C PERFORMANCE CHARACTERISTICS (Note 1)

| Characteristic | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|
| Operating Pressure Range | — | — | 150 | psi |
| Sensitivity | — | 0.6 | — | mV/psi |
| Full-scale Span (Note 2) | 85.0 | 90.0 | 95.0 | mV |
| Zero Pressure Offset | –1.0 | 0 | +1.0 | mV |
| Combined Linearity & Hysterisis (Note 3) | — | ±0.2 | ±1.0 | %FSO |
| Temperature Effect on Span (0°C to 70°C) (Note 4) | — | ±0.4 | ±2.0 | %FSO |
| Temperature Effect on Offset (0°C to 70°C) (Note 4) | — | ±0.20 | ±1.0 | mV |
| Repeatability ( Note 5) | — | ±0.2 | ±0.5 | %FSO |
| Input Impedance (Note 6) | — | 4.0 | — | kΩ |
| Output Impedance (Note 7) | — | 4.0 | — | kΩ |
| Common-mode Voltage (Note 8) | 5.7 | 6.0 | 6.3 | $V_{DC}$ |
| Response Time (Note 9) | — | 100 | — | µsec |
| Long Term Stability of Offset and Span (Note 10) | — | ±0.1 | — | %FSO |

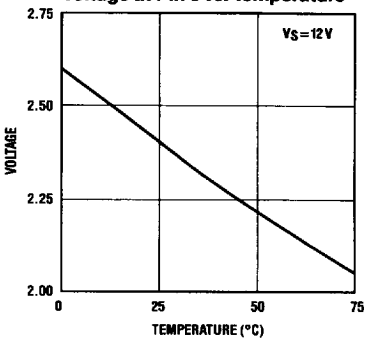
## TYPICAL PERFORMANCE CHARACTERISTICS

**SCX C Series**

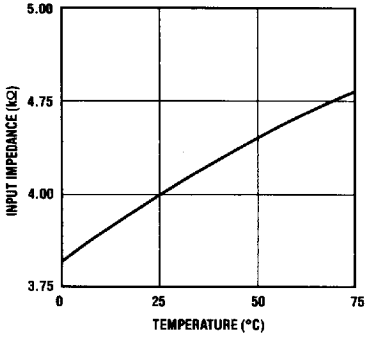
**Voltage at Pin 1 vs. Temperature**



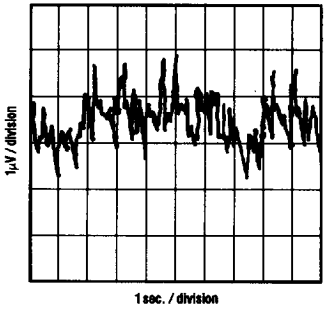

**Voltage at Pin 6 vs. Temperature**




**Input Impedance vs. Temperature**




**0.1Hz to 10Hz Noise**




**Specification Notes:** (For All Devices)

**Note 1:** Reference Conditions: Unless otherwise noted: Supply Voltage, $V_S = 12 V_{DC}$, $T_A = 25°C$, Common-mode Line Pressure = 0 psig, Pressure Applied to Port B. For absolute devices only, pressure is applied to Port A and the output polarity is reversed.

**Note 2:** Span is the algebraic difference between the output voltage at full-scale pressure and the output at zero pressure. Span is ratiometric to the supply voltage.

**Note 3:** See Definition of Terms.
Hysteresis — the maximum output difference at any point within the operating pressure range for increasing and decreasing pressure.

**Note 4:** Maximum error band of the offset voltage and the error band of the span, relative to the 25°C reading.

**Note 5:** Maximum difference in output at any pressure with the operating pressure range and temperature within 0°C to +70°C after:
a) 1,000 temperature cycles, 0°C to +70°C
b) 1.5 million pressure cycles, 0 psi to full-scale span.

**Note 6:** Input impedance is the impedance between pins 2 and 4.

**Note 7:** Output impedance is the impedance between pins 3 and 5.

**Note 8:** This is the common-mode voltage of the output arms (Pins 3 and 5) for $V_S = 12 V_{DC}$.

**Note 9:** Response time for a 0 psi to full-scale span pressure step change, 10% to 90% rise time.

**Note 10:** Long term stability over a one year period.

## GENERAL DISCUSSION

The SCX series devices give a voltage output which is directly proportional to applied pressure. The devices will give an increasing positive going output when increasing pressure is applied to pressure port $P_B$ of the device. If the input pressure connections are reversed, the output will increase with decreases in pressure. The devices are ratiometric to the supply voltage and changes in the supply voltage will cause proportional changes in the offset voltage and full-scale span. Since for absolute device pressure is applied to port $P_A$, output polarity will be reversed.

### User Calibration

The SCX devices are fully calibrated for offset and span and should therefore require little user adjustment in most applications. For precise span and offset adjustments, refer to the applications section herein or contact the Sensym factory.

### 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

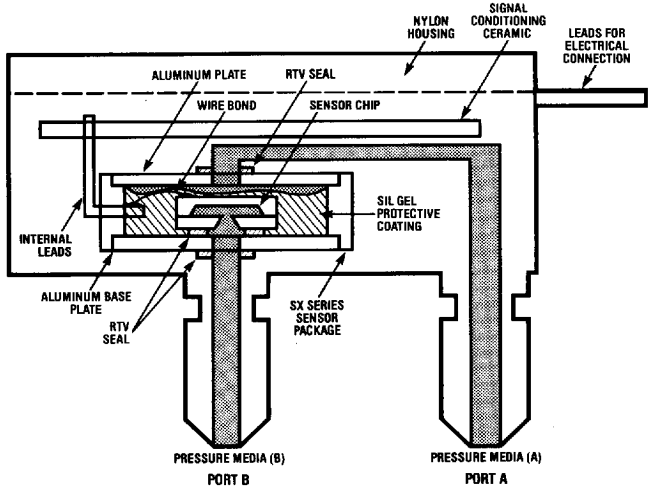
SCX devices are compatible with most non-corrosive gases. Because the circuitry is coated with a protective silicon gel, many otherwise corrosive environments can be compatible with the sensors. As shown in the physical construction diagram below, fluids must generally be compatible with silicon gel, plastic, aluminum, RTV, silicon, and glass for use with Port B. For questions concerning media compatibility, contact the factory.

## MECHANICAL AND MOUNTING CONSIDERATIONS

The SCX nylon housing 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.

All versions of the SCX sensors have two (2) tubes available for pressure connection. For absolute devices, only port $P_A$ is active. Applying pressure through the other port will result in pressure dead ending into the backside of the silicon sensor and the device will not give an output signal with pressure.

For gage applications, pressure should be applied to port $P_B$. Port $P_A$ is then the vent port which is left open to the atmosphere. For differential pressure applications, to get proper output signal polarity, port $P_B$ should be used as the high pressure port and $P_A$ should be used as the low pressure port.




**Physical Construction (Cutaway Diagram)**

(Not Drawn to Scale)

## APPLICATION INFORMATION

Shown here is a popular circuit which gives a high level 2–5 $V_{DC}$ output for a 0–10 inch W.C. pressure input. Additional applications circuits are shown in the standard SCX series datasheet and SCX-EB evaluation board literature. For further applications information or assistance, please contact your nearest Sensym sales office or the Sensym factory.

### Low Pressure Application

For sensing pressure below 1 psi, the circuit shown in Figure A uses the SCX01DN to provide a 2 to 5 V output for a 0 to 10 inch of water column input pressure. This output signal is compatible with many A/D converters and hence can be used to interface to a microprocessor system. This low-cost circuit is easily adaptable to lower full-scale pressure down to 5 inches of water column.

### Circuit Description

The LM10 is used to provide a voltage reference for the excitation voltage ($V_E$), and for the voltage node $V_{REF}$. With this configuration, $V_E$ and $V_{REF}$ are not affected by noise or voltage variations in the 12 V power supply. $R_3$ is used to adjust $V_{REF}$ to set the initial offset voltage at the output, $V_{OUT}$.

The pressure signal, $V_{IN}$, is amplified by amplifiers $B_1$, and $B_2$. (See Sensym Application Note SSAN-17 for details on this amplifier) $R_2$ is used to adjust the signal gain of the circuit. The output equation is given below.

$$V_{OUT} = V_{IN}\left[\ 2\left(1+\frac{R}{R_1}\right)\right] + V_{REF}$$

For the best circuit performance, a careful selection of components is necessary. Use wirebound pots to insure low temperature coefficients and low long-term drift. A five-element resistor array (10 kΩ) SIP should be used for the resistors in the amplifier stage in order to obtain closely matched values and temperature coefficients. All other resistors should be 1% metal film. Amplifiers $B_1$, and $B_2$ should have low offset voltages and low noise. Signal lines should be as short as possible and the power supply should be capacitively bypassed on the PC board.

### Adjustment Procedure

1. With zero-pressure applied, adjust the offset adjust $R_3$, until $V_{OUT} = 2.000$ V.
2. Apply full-scale pressure (10 in. W.C.) to port B, and adjust the full-scale adjust $R_2$, so that $V_{OUT} = 5.000$ V.
3. Repeat procedure if necessary.

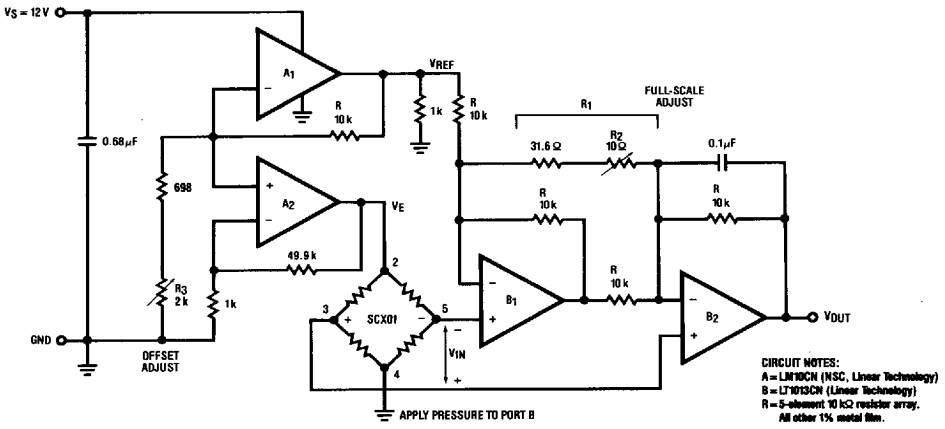
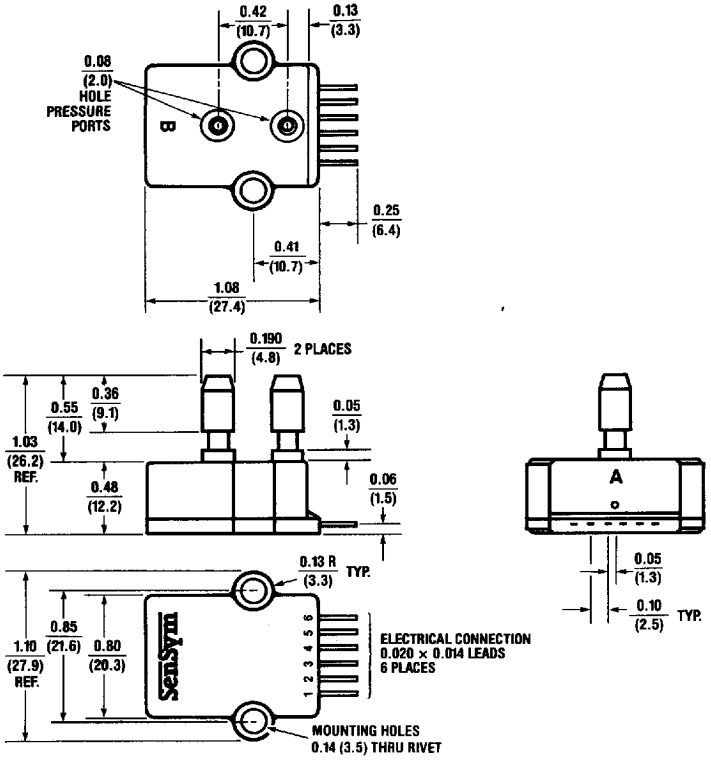



**Figure A. Low Pressure Circuits Provide a 2 to 5 V Output for a 0–10 in. W.C. Pressure Input.**

## PHYSICAL DIMENSIONS

**SCX C Series**




DIMENSIONS IN INCHES (MILLIMETERS)
WEIGHT: 5 GRAMS
CASE MATERIAL: GLASS FILLED NYLON

WETTED MATERIAL
PORT A: GLASS FILLED NYLON, RTV, SILGEL
PORT B: GLASS FILLED NYLON, SILICON, RTV
SEE PHYSICAL CONSTRUCTION DRAWING

## ORDERING INFORMATION

To order, use the following part numbers:

| Description | Part Number |
|---|---|
| 0 to 1 psi Differential/Gage | SCX01DNC |
| 0 to 5 psi Differential/Gage | SCX05DNC |
| 0 to 15 psi Absolute | SCX15ANC |
| 0 to 15 psi Differential/Gage | SCX15DNC |
| 0 to 30 psi Absolute | SCX30ANC |
| 0 to 30 psi Differential/Gage | SCX30DNC |
| 0 to 100 psi Absolute | SCX100ANC |
| 0 to 100 psi Differential/Gage | SCX100DNC |
| 0 to 150 psi Absolute | SCX150ANC |
| 0 to 150 psi Differential/Gage | SCX150DNC |