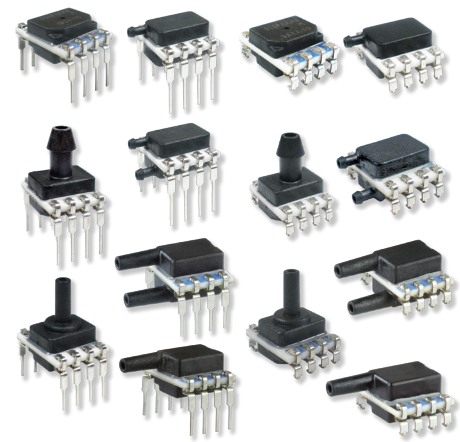
# TRUSTABILITY™ RSC SERIES

**32321348**
*Issue G*

## Board Mount Pressure Sensors

## High Resolution, High Accuracy, Compensated ±1.6 mbar to ±10 bar | ±160 Pa to ±1 MPa | ±0.5 in $H_2O$



The RSC Series is a piezoresistive silicon pressure sensor offering a digital output for reading pressure over the specified full scale pressure span and temperature range. It is calibrated and temperature compensated for sensor offset, sensitivity, temperature effects, and non-linearity using a 24-bit analog-to-digital converter with integrated EEPROM. Pressure data may be acquired at rates between 20 and 2000 samples per second over an SPI interface. It is intended for use with non-corrosive, non-ionic gases, such as air and other dry gases, designed and manufactured according to ISO 9001 standards, and is REACH and RoHS compliant.

### VALUE TO CUSTOMERS

- Enhances performance: Output accelerates performance through reduced conversion requirements and direct interface to microprocessors. Proprietary Honeywell technology combines high sensitivity with high burst and over pressure while providing industry leading stability (performance factors difficult to achieve in the same sensor), providing flexibility in implementation and minimizing requirements for protecting the sensor without sacrificing ability to sense very small changes in pressure.
- Cost-effective, high volume solution with a variety of options.
- Enhances reliability: High burst pressures promote system reliability, minimize downtime, and can simplify design. High working pressures allow ultra-low sensors to be used continuously above the calibrated pressure range.
- Easy to design in: Package is small when compared to many similar sensors, occupying less area on the PCB. Port and housing options simplify integration. Wide pressure range simplifies use.
- Meets IPC/JEDEC J-STD-020D.1 Moisture Sensitivity Level 1 requirements: Allows avoidance of thermal and mechanical damage during solder reflow attachment and/or repair that lesser rated sensors would incur, allows unlimited floor life when stored as specified (simplifying storage and reducing scrap), eliminates lengthy bakes prior to reflow, and allows for lean manufacturing due to stability and usability shortly after reflow.
- Energy efficient: Reduces system power requirements and enables extended battery life.

### DIFFERENTIATION

- Industry-leading long-term stability: Minimizes system calibration needs and significantly reduces downtime.
- Industry-leading accuracy: Reduces software to correct system inaccuracies, which minimizes design time, helps improve efficiency, and often simplifies development.
- Industry-leading flexibility: Modular design with many package styles and options simplify integration.
- Total Error Band: Provides true performance over the compensated temperature range, which eliminates the need to test and calibrate every sensor, thereby reducing manufacturing cost. Improves system accuracy and offers ease of sensor interchangeability due to minimal part-to-part variation (see Figure 1 on page 3).

### POTENTIAL APPLICATIONS

- **Medical:** Airflow monitors, anesthesia machines, blood analysis machines, gas chromatography, gas flow instrumentation, hospital room air pressure, kidney dialysis machines, nebulizers, pneumatic controls, respiratory machines, sleep apnea equipment, spirometers, ventilators
- **Industrial:** Barometry, drones, flow calibrators, gas chromatography, gas flow instrumentation, HVAC clogged filter detection, HVAC systems, HVAC transmitters, indoor air quality, life sciences, pneumatic control, VAV (Variable Air Volume) control, weather balloons

### FEATURES

- Pressure range: ±1.6 mbar to ±10 bar | ±160 Pa to ±1 MPa | ±0.5 in$H_2O$ to ±150 psi; absolute range 1 bar to 8 bar | 15 psi to 150 psi
- Pressure types: Absolute, gage, and differential
- Total Error Band: As low as ±0.25 %FSS depending on pressure range (after auto zero)
- Accuracy: ±0.1 %FSS BFSL (Full Scale Span Best Fit Straight Line)
- Compensated temperature range: 40°C to 85°C [-40°F to 185°F]
- Power consumption: Less than 10 mW, typ.
- Size: Miniature 10 mm x 12,5 mm [0.39 in x 0.49 in] package
- Output: 24-bit digital SPI-compatible
- Meets IPC/JEDEC J-STD-020D.1 Moisture Sensitivity Level 1 requirements

### PORTFOLIO

Honeywell offers a wide range of board mount pressure sensors for potential use in a variety of applications. To view the entire product portfolio, click here.

Honeywell

# TABLE OF CONTENTS

**FIGURE 1. TEB COMPONENTS FOR TRUSTABILITY™ BOARD MOUNT PRESSURE SENSORS**

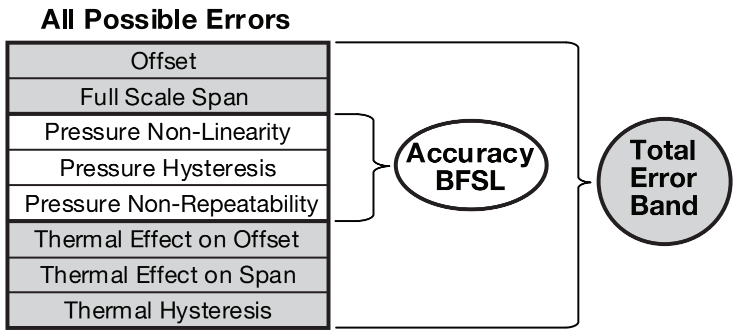



**TABLE 1. ABSOLUTE MAXIMUM RATINGS[1]**

| Characteristic | Min. | Max. | Unit |
|---|---|---|---|
| **Supply voltage ($V_{supply}$)** | 2.7 | 6.0 | Vdc |
| **Voltage on any pin** | -0.3 | $V_{supply}$ + 0.3 | V |
| **Digital interface clock frequency** | — | 6.66 | MHz |
| **ESD susceptibility (human body model)** | — | 2 | kV |
| **Storage temperature** | -40 [-40] | 85 [185] | °C [°F] |
| **Soldering time and temperature:**<br>**lead solder temperature (DIP)**<br>**peak reflow temperature (SMT)** | <br>4 s max. at 250°C [482°F]<br>15 s max. at 250°C [482°F] | | |

1. Absolute maximum ratings are the extreme limits the device will withstand without damage.

**TABLE 2. ENVIRONMENTAL SPECIFICATIONS**

| Characteristic | Parameter |
|---|---|
| **Humidity (gases only)** | 0% to 95% RH, non-condensing |
| **Vibration** | 15 g, 10 Hz to 2 kHz |
| **Shock** | 100 g, 6 ms duration |
| **Life[1]** | 1 million pressure cycles minimum |
| **Solder reflow** | J-STD-020-D.1 Moisture Sensitivity Level 1<br>(unlimited shelf life when stored at ≤30°C/85 % RH) |

1. Life may vary depending on specific application in which the sensor is utilized.

**TABLE 3. WETTED MATERIALS[1]**

| Component | Port 1 (Pressure Port) | Port 2 (Reference Port) |
|---|---|---|
| **Ports and covers** | high temperature polyamide | high temperature polyamide |
| **Substrate** | alumina ceramic | alumina ceramic |
| **Adhesives** | epoxy, silicone | epoxy, silicone |
| **Electronic components** | plastic, silicon, glass, solder | silicon, glass, gold |

1. Contact Honeywell Customer Service for detailed material information.

**TABLE 4. SENSOR PRESSURE TYPES**

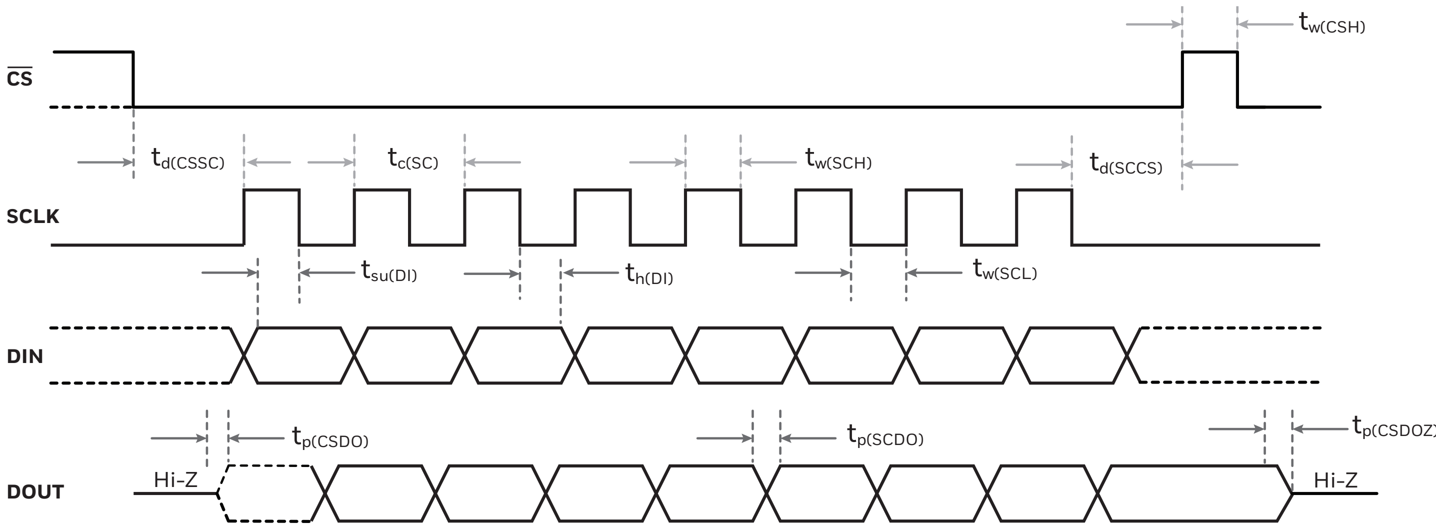
| Pressure Type | Description |
|---|---|
| **Absolute** | Output is proportional to the difference between applied pressure and a built-in vacuum reference. |
| **Differential** | Output is proportional to the difference between the pressures applied to each port (Port 1 – Port 2). |
| **Gage** | Output is proportional to the difference between applied pressure and atmospheric (ambient) pressure. |

**TABLE 5. DIGITAL OPERATING SPECIFICATIONS**

| Characteristic | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|
| **Supply voltage ($V_{supply}$):[1, 2, 3]**<br>**pressure ranges ≥60 mbar \| 6 kPa \| 1 psi:**<br>**3.3 Vdc**<br>**5.0 Vdc**<br>**pressure ranges ≤40 mbar \| 4 kPa \| 20 in$H_2O$:**<br>**3.3 Vdc**<br>**5.0 Vdc** | <br><br>3.0<br>4.75<br><br>3.27<br>4.95 | <br><br>3.3<br>5.0<br><br>3.3<br>5.0 | <br><br>3.6<br>5.25<br><br>3.33<br>5.05 | Vdc |
| **Supply current:**<br>**3.3 Vdc:**<br>**standby mode**<br>**active mode**<br>**5.0 Vdc:**<br>**standby mode**<br>**active mode** | <br><br>—<br>—<br><br>—<br>— | <br><br>1.3<br>1.7<br><br>2.1<br>2.6 | <br><br>—<br>—<br><br>—<br>— | mA |
| **Operating temperature range[4]** | -40 [-40] | — | 85 [185] | °C [°F] |
| **Compensated temperature range[5]:**<br>**medical**<br>**industrial**<br>**extended** | <br>0 [32]<br>-20 [-4]<br>-40 [-40] | <br>—<br>—<br>— | <br>50 [122]<br>85 [185]<br>85 [185] | °C [°F] |
| **Startup time (power up to be ready to receive commands)** | — | — | 2 | ms |
| **Data rate** | 20, 40, 45, 90, 175, 180, 330, 350, 600, 660, 1000, 1200, 2000 | | | samples per second |
| **SPI voltage level:**<br>**low**<br>**high** | <br>—<br>80 | <br>—<br>— | <br>20<br>— | $\%V_{supply}$ |
| **Pull up on MISO, SCLK, CS_ADC, CS_EE, MOSI** | 1 | — | — | kOhm |
| **Accuracy[6]** | — | — | 0.1 | %FSS BFSL[6] |
| **Orientation sensitivity (±1 g)[7, 9]:**<br>**pressure ranges ≤40 mbar \| 4 kPa \| 20 in$H_2O$**<br>**pressure ranges ≤2.5 mbar \| 250 Pa \| 1 in$H_2O$** | <br>—<br>— | <br>±0.1<br>±0.2 | <br>—<br>— | %FSS[8] |

1. Sensors are either 3.3 Vdc or 5.0 Vdc based on the catalog listing selected.
2. Ratiometricity of the sensor (the ability of the device output to scale to the supply voltage) is achieved within the specified operating voltage.
3. The sensor is not reverse polarity protected. Incorrect application of supply voltage or ground to the wrong pin may cause electrical failure.
4. Operating temperature range: The temperature range over which the sensor will produce an output proportional to pressure.
5. Compensated temperature range: The temperature range over which the sensor will produce an output proportional to pressure within the specified performance limits (Total Error Band).
6. Accuracy: The maximum deviation in output from a Best Fit Straight Line (BFSL) fitted to the output measured over the pressure range. Includes all errors due to pressure non-linearity, pressure hysteresis, and non-repeatability.
7. Orientation sensitivity: The maximum change in offset of the sensor due to a change in position or orientation relative to Earth's gravitational field.
8. Full Scale Span (FSS): The algebraic difference between the output signal measured at the maximum (Pmax.) and minimum (Pmin.) limits of the pressure range. (See Figure 1 for ranges.)
9. Insignificant for pressure ranges above 40 mbar | 4 kPa | 20 in$H_2O$.

**FIGURE 2. SPI TIMING REQUIREMENTS[1]**




| Characteristic | Description | Min. | Max. | Unit |
|---|---|---|---|---|
| $t_{d(CSSC)}$ | delay time; CS falling edge to first SCLK rising edge | 50 | — | ns |
| $t_{d(SCCS)}$ | delay time,;final SCLK falling edge to CS rising edge | 30 | — | ns |
| $t_{w(CSH)}$ | pulse duration; CS high | 80 | — | ns |
| $t_{c(SC)}$ | SCLK period | 150 | — | ns |
| $t_{w(SCH)}$ | pulse duration; SCLK high | 75 | — | ns |
| $t_{w(SCL)}$ | pulse duration; SCLK low | 75 | — | ns |
| $t_{su(DI)}$ | setup time; DIN valid before SCLK falling edge | 50 | — | ns |
| $t_{h(DI)}$ | hold time; DIN valid after SCLK falling edge | 25 | — | ns |
| $t_{p(CSDO)}$ | propagation delay time; CS falling edge to DOUT driven | — | 50 | ns |
| $t_{p(SCDO)}$ | propagation delay time; SCLK rising edge to valid new DOUT | 0 | 50 | ns |
| $t_{p(CSDOZ)}$ | propagation delay time; CS rising edge to DOUT high impedance | — | 50 | ns |

1. Single byte communication is shown. Actual communication may be several bytes.

## FIGURE 3. NOMENCLATURE AND ORDER GUIDE

For example, **RSCDNNM150PGSE3** defines an RSC Series TruStability™ Pressure Sensor, DIP package, NN pressure port, medical compensated temperature range,150 psi gage pressure range, SPI output type, external math transfer function, 3.3 Vdc supply voltage.

**R S C D N N M 1 5 0 P G S E 3**

### Product Series

| | |
|---|---|
| **RSC** | High Resolution, High Accuracy, Compensated/Amplified |

### Package

| | |
|---|---|
| **D** | DIP (Dual Inline Pin) |
| **M** | SMT (Surface Mount Technology) |

### Pressure Port

| DIP | | SMT | |
|---|---|---|---|
| **NN** | No ports | **NN** | No ports |
| **AN** | Single axial barbed port | **AN** | Single axial barbed port |
| **LN** | Single axial barbless port | **LN** | Single axial barbless port |
| **RN**[2] | Single radial barbed port | **RN**[2] | Single radial barbed port |
| **RR**[2] | Dual radial barbed ports, same side | **RR**[2] | Dual radial barbed ports, same side |
| **JN** | Single radial barbless port | **JN** | Single radial barbless port |
| **JJ** | Dual radial barbless ports, same side | **JJ** | Dual radial barbless ports, same side |

### Compensated Temperature Range[1]

| | |
|---|---|
| **M** | Medical (0°C to 50°C [32°F to 122°F]) |
| **I** | Industrial (-20°C to 85°C [-4°F to 185°F]) |
| **E** | Extended (-40°C to 85°C [-40°F to 185°F]) |

### Pressure Range[1]

| ±1.6 mbar to ±10 bar | | ±160 Pa to ±1 MPa | | ±0.5 inH$_2$O to ±150 psi | |
|---|---|---|---|---|---|
| *Absolute* | | *Absolute* | | *Absolute* | |
| **001BA** | 0 bar to 1 bar | **100KA** | 0 kPa to 100 kPa | **015PA** | 0 psi to 15 psi |
| **1.6BA** | 0 bar to 1.6 bar | **160KA** | 0 kPa to 160 kPa | **030PA** | 0 psi to 30 psi |
| **2.5BA** | 0 bar to 2.5 bar | **250KA** | 0 kPa to 250 kPa | **060PA** | 0 psi to 60 psi |
| **004BA** | 0 bar to 4 bar | **400KA** | 0 kPa to 400 kPa | **100PA** | 0 psi to 100 psi |
| **006BA** | 0 bar to 6 bar | **600KA** | 0 kPa to 600 kPa | **150PA** | 0 psi to 150 psi |
| **010BA** | 0 bar to 10 bar | **001GA** | 0 kPa to 1 MPa | | |
| *Differential* | | *Differential* | | *Differential* | |
| **1.6MD** | ±1.6 mbar | **160LD** | ±160 Pa | **0.5ND** | ±0.5 inH$_2$O |
| **2.5MD** | ±2.5 mbar | **250LD** | ±250 Pa | **001ND** | ±1 inH$_2$O |
| **004MD** | ±4 mbar | **400LD** | ±400 Pa | **002ND** | ±2 inH$_2$O |
| **006MD** | ±6 mbar | **600LD** | ±600 Pa | **004ND** | ±4 inH$_2$O |
| **010MD** | ±10 mbar | **001KD** | ±1 kPa | **005ND** | ±5 inH$_2$O |
| **016MD** | ±16 mbar | **1.6KD** | ±1.6 kPa | **010ND** | ±10 inH$_2$O |
| **025MD** | ±25 mbar | **2.5KD** | ±2.5 kPa | **020ND** | ±20 inH$_2$O |
| **040MD** | ±40 mbar | **004KD** | ±4 kPa | **030ND** | ±30 inH$_2$O |
| **060MD** | ±60 mbar | **006KD** | ±6 kPa | **001PD** | ±1 psi |
| **100MD** | ±100 mbar | **010KD** | ±10 kPa | **005PD** | ±5 psi |
| **160MD** | ±160 mbar | **016KD** | ±16 kPa | **015PD** | ±15 psi |
| **250MD** | ±250 mbar | **025KD** | ±25 kPa | **030PD** | ±30 psi |
| **400MD** | ±400 mbar | **040KD** | ±40 kPa | **060PD** | ±60 psi |
| **600MD** | ±600 mbar | **060KD** | ±60 kPa | **100PD** | ±100 psi |
| **001BD** | ±1 bar | **100KD** | ±100 kPa | **150PD** | ±150 psi |
| **1.6BD** | ±1.6 bar | **160KD** | ±160 kPa | | |
| **2.5BD** | ±2.5 bar | **250KD** | ±250 kPa | | |
| **004BD** | ±4 bar | **400KD** | ±400 kPa | | |
| **006BD** | ±6 bar | **600KD** | ±600 kPa | | |
| **010BD** | ±10 bar | **001GD** | ±1 MPa | | |
| *Gage* | | *Gage* | | *Gage* | |
| **2.5MG** | 0 mbar to 2.5 mbar | **250LG** | 0 Pa to 250 Pa | **001NG** | 0 inH$_2$O to 1 inH$_2$O |
| **004MG** | 0 mbar to 4 mbar | **400LG** | 0 Pa to 400 Pa | **002NG** | 0 inH$_2$O to 2 inH$_2$O |
| **006MG** | 0 mbar to 6 mbar | **600LG** | 0 Pa to 600 Pa | **004NG** | 0 inH$_2$O to 4 inH$_2$O |
| **010MG** | 0 mbar to 10 mbar | **001KG** | 0 kPa to 1 kPa | **005NG** | 0 inH$_2$O to 5 inH$_2$O |
| **016MG** | 0 mbar to 16 mbar | **1.6KG** | 0 kPa to 1.6 kPa | **010NG** | 0 inH$_2$O to 10 inH$_2$O |
| **025MG** | 0 mbar to 25 mbar | **2.5KG** | 0 kPa to 2.5 kPa | **020NG** | 0 inH$_2$O to 20 inH$_2$O |
| **040MG** | 0 mbar to 40 mbar | **004KG** | 0 kPa to 4 kPa | **030NG** | 0 inH$_2$O to 30 inH$_2$O |
| **060MG** | 0 mbar to 60 mbar | **006KG** | 0 kPa to 6 kPa | **001PG** | 0 psi to 1 psi |
| **100MG** | 0 mbar to 100 mbar | **010KG** | 0 kPa to 10 kPa | **005PG** | 0 psi to 5 psi |
| **160MG** | 0 mbar to 160 mbar | **016KG** | 0 kPa to 16 kPa | **015PG** | 0 psi to 15 psi |
| **250MG** | 0 mbar to 250 mbar | **025KG** | 0 kPa to 25 kPa | **030PG** | 0 psi to 30 psi |
| **400MG** | 0 bar to 400 mbar | **040KG** | 0 kPa to 40 kPa | **060PG** | 0 psi to 60 psi |
| **600MG** | 0 bar to 600 mbar | **060KG** | 0 kPa to 60 kPa | **100PG** | 0 psi to 100 psi |
| **001BG** | 0 bar to 1 bar | **100KG** | 0 kPa to 100 kPa | **150PG** | 0 psi to 150 psi |
| **1.6BG** | 0 bar to 1.6 bar | **160KG** | 0 kPa to 160 kPa | | |
| **2.5BG** | 0 bar to 2.5 bar | **250KG** | 0 kPa to 250 kPa | | |
| **004BG** | 0 bar to 4 bar | **400KG** | 0 kPa to 400 kPa | | |
| **006BG** | 0 bar to 6 bar | **600KG** | 0 kPa to 600 kPa | | |
| **010BG** | 0 bar to 10 bar | **001GG** | 0 kPa to 1 MPa | | |

### Output Type

| | |
|---|---|
| **S** | SPI |

### Transfer Function

| | |
|---|---|
| **E** | External math |

### Supply Voltage

| | |
|---|---|
| **3** | 3.3 Vdc |
| **5** | 5.0 Vdc |

1. Custom pressure and temperature ranges are available. Contact Honeywell Customer Service for more information.
2. RR and RN pressure ports: The maximum applied pressure is 60 psi.

**TABLE 6. PRESSURE RANGE SPECIFICATIONS FOR ±1.6 MBAR TO ±10 BAR**

| Pressure Range (see Figure 3) | Pressure Range Pmin. | Pressure Range Pmax. | Unit | Working Pressure[1] | Over Pressure[2] | Burst Pressure[3] | Common Mode Pressure[4] | Total Error Band[5] (%FSS) | Total Error Band after Auto-Zero[6] (%FSS) | Long-term Stability 1000 hr, 25°C (%FSS) | Effective Number of Bits (ENOB) at 20 SPS[7] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Absolute** | | | | | | | | | | | |
| **001BA** | 0 | 1 | bar | — | 2 | 4 | — | ±0.75 | ±0.25 | ±0.25 | 16 |
| **1.6BA** | 0 | 1.6 | bar | — | 4 | 8 | — | ±0.75 | ±0.25 | ±0.25 | 16 |
| **2.5BA** | 0 | 2.5 | bar | — | 6 | 8 | — | ±0.75 | ±0.25 | ±0.25 | 16 |
| **004BA** | 0 | 4 | bar | — | 8 | 16 | — | ±0.75 | ±0.25 | ±0.25 | 16 |
| **006BA** | 0 | 6 | bar | — | 17 | 17 | — | ±0.75 | ±0.25 | ±0.25 | 15 |
| **010BA** | 0 | 10 | bar | — | 17 | 17 | — | ±0.75 | ±0.25 | ±0.25 | 16 |
| **Differential** | | | | | | | | | | | |
| **1.6MD** | -1.6 | 1.6 | mbar | 335 | 675 | 1000 | 3450 | ±3 | ±0.5 | ±0.5 | 16 |
| **2.5MD** | -2.5 | 2.5 | mbar | 335 | 675 | 1000 | 3450 | ±2 | ±0.5 | ±0.35 | 14 |
| **004MD** | -4 | 4 | mbar | 335 | 675 | 1000 | 3450 | ±2 | ±0.5 | ±0.35 | 15 |
| **006MD** | -6 | 6 | mbar | 335 | 675 | 1000 | 3450 | ±2 | ±0.5 | ±0.35 | 16 |
| **010MD** | -10 | 10 | mbar | 375 | 750 | 1250 | 5450 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **016MD** | -16 | 16 | mbar | 375 | 850 | 1000 | 5450 | ±1 | ±0.25 | ±0.25 | 16 |
| **025MD** | -25 | 25 | mbar | 435 | 850 | 1350 | 10450 | ±1 | ±0.25 | ±0.25 | 18 |
| **040MD** | -40 | 40 | mbar | 435 | 850 | 1350 | 10450 | ±0.75 | ±0.25 | ±0.25 | 15 |
| **060MD** | -60 | 60 | mbar | — | 850 | 1000 | 10000 | ±0.75 | ±0.25 | ±0.25 | 15 |
| **100MD** | -100 | 100 | mbar | — | 1400 | 2500 | 10000 | ±0.75 | ±0.25 | ±0.25 | 15 |
| **160MD** | -160 | 160 | mbar | — | 1400 | 2500 | 10000 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **250MD** | -250 | 250 | mbar | — | 1400 | 2500 | 10000 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **400MD** | -400 | 400 | mbar | — | 2000 | 4000 | 10000 | ±0.75 | ±0.25 | ±0.25 | 15 |
| **600MD** | -600 | 600 | mbar | — | 2000 | 4000 | 10000 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **001BD** | -1 | 1 | bar | — | 4 | 8 | 10 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **1.6BD** | -1.6 | 1.6 | bar | — | 8 | 16 | 10 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **2.5BD** | -2.5 | 2.5 | bar | — | 8 | 16 | 10 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **004BD** | -4.0 | 4.0 | bar | — | 16 | 17 | 10 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **006BD** | -6 | 6 | bar | — | 17 | 17 | 17 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **010BD** | -10 | 10 | bar | — | 17 | 17 | 17 | ±0.75 | ±0.25 | ±0.25 | 17 |

1. Working Pressure: The maximum pressure that may be applied to any port of the sensor in continuous use. This pressure may be outside the operating pressure range limits (Pmin. to Pmax.) in which case the sensor may not provide a valid output until presssure is returned to within the operating pressure range. Tested to 1 million cycles, minimum.
2. Overpressure: The maximum pressure which may safely be applied to the product for it to remain in specification once pressure is returned to the operating pressure range. Exposure to higher pressures may cause permanent damage to the product. Unless otherwise specified this applies to all available pressure ports at any temperature with the operating temperature range.
3. Burst Pressure: The maximum pressure that may be applied to any port of the product without causing escape of pressure media. Product should not be expected to function after exposure to any pressure beyond the burst pressure.
4. Common Mode Pressure: The maximum pressure that can be applied simultaneously to both ports of a differential pressure sensor without causing changes in specified performance.
5. Total Error Band: The maximum deviation from the ideal transfer function over the entire compensated temperature and pressure range. Includes all errors due to offset, full scale span, pressure non-linearity, pressure hysteresis, repeatability, thermal effect on offset, thermal effect on span, and thermal hysteresis (see Figure 1).
6. Total Error Band after Auto-Zero: The maximum deviation from the ideal transfer function over the entire compensated pressure range for a minimum of 24 hours after an auto-zero operation. Includes all errors due to full scale span, pressure non-linearity, pressure hysteresis, and thermal effect on span.
7. Effective Number of Bits (ENOB): A measure of the dynamic performance of an analog-to-digital converter (ADC) and its related circuitry. ENOB is defined for the RSC Series per the following equation: ENOB = $\log_2$ (Full Scale Span/Noise).

**TABLE 6. PRESSURE RANGE SPECIFICATIONS FOR ±1.6 MBAR TO ±10 BAR CONTINUED**

| Pressure Range (see Figure 3) | Pressure Range | | Unit | Working Pressure[1] | Over Pressure[2] | Burst Pressure[3] | Common Mode Pressure[4] | Total Error Band[5] (%FSS) | Total Error Band after Auto-Zero[6] (%FSS) | Long-term Stability 1000 hr, 25°C (%FSS) | Effective Number of Bits (ENOB) at 20 SPS[7] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pmin. | Pmax. | | | | | | | | | |
| | | | | | | Gage | | | | | |
| **2.5MG** | 0 | 2.5 | mbar | 335 | 675 | 1000 | 3450 | ±3 | ±0.5 | ±0.5 | 15 |
| **004MG** | 0 | 4 | mbar | 335 | 675 | 1000 | 3450 | ±3 | ±0.5 | ±0.5 | 16 |
| **006MG** | 0 | 6 | mbar | 335 | 675 | 1000 | 3450 | ±2 | ±0.5 | ±0.35 | 15 |
| **010MG** | 0 | 10 | mbar | 335 | 675 | 1000 | 3450 | ±0.75 | ±0.25 | ±0.35 | 15 |
| **016MG** | 0 | 16 | mbar | 335 | 675 | 1000 | 3450 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **025MG** | 0 | 25 | mbar | 375 | 750 | 1250 | 5450 | ±1 | ±0.25 | ±0.25 | 17 |
| **040MG** | 0 | 40 | mbar | 375 | 750 | 1250 | 5450 | ±0.75 | ±0.25 | ±0.25 | 15 |
| **060MG** | 0 | 60 | mbar | — | 850 | 1000 | 5450 | ±0.75 | ±0.25 | ±0.25 | 14 |
| **100MG** | 0 | 100 | mbar | — | 850 | 1000 | 10000 | ±0.75 | ±0.25 | ±0.25 | 15 |
| **160MG** | 0 | 160 | mbar | — | 850 | 1000 | 10000 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **250MG** | 0 | 250 | mbar | — | 1400 | 2500 | 10000 | ±0.75 | ±0.25 | ±0.25 | 15 |
| **400MG** | 0 | 400 | mbar | — | 2000 | 4000 | 10000 | ±0.75 | ±0.25 | ±0.25 | 14 |
| **600MG** | 0 | 600 | mbar | — | 2000 | 4000 | 10000 | ±0.75 | ±0.25 | ±0.25 | 15 |
| **001BG** | 0 | 1 | bar | — | 2 | 4 | 10 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **1.6BG** | 0 | 1.6 | bar | — | 4 | 8 | 10 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **2.5BG** | 0 | 2.5 | bar | — | 8 | 16 | 10 | ±0.75 | ±0.25 | ±0.25 | 15 |
| **004BG** | 0 | 4 | bar | — | 8 | 16 | 16 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **006BG** | 0 | 6 | bar | — | 17 | 17 | 17 | ±0.75 | ±0.25 | ±0.25 | 15 |
| **010BG** | 0 | 10 | bar | — | 17 | 17 | 17 | ±0.75 | ±0.25 | ±0.25 | 16 |

1. Working Pressure: The maximum pressure that may be applied to any port of the sensor in continuous use. This pressure may be outside the operating pressure range limits (Pmin. to Pmax.) in which case the sensor may not provide a valid output until presssure is returned to within the operating pressure range. Tested to 1 million cycles, minimum.
2. Overpressure: The maximum pressure which may safely be applied to the product for it to remain in specification once pressure is returned to the operating pressure range. Exposure to higher pressures may cause permanent damage to the product. Unless otherwise specified this applies to all available pressure ports at any temperature with the operating temperature range.
3. Burst Pressure: The maximum pressure that may be applied to any port of the product without causing escape of pressure media. Product should not be expected to function after exposure to any pressure beyond the burst pressure.
4. Common Mode Pressure: The maximum pressure that can be applied simultaneously to both ports of a differential pressure sensor without causing changes in specified performance.
5. Total Error Band: The maximum deviation from the ideal transfer function over the entire compensated temperature and pressure range. Includes all errors due to offset, full scale span, pressure non-linearity, pressure hysteresis, repeatability, thermal effect on offset, thermal effect on span, and thermal hysteresis (see Figure 1).
6. Total Error Band after Auto-Zero: The maximum deviation from the ideal transfer function over the entire compensated pressure range for a minimum of 24 hours after an auto-zero operation. Includes all errors due to full scale span, pressure non-linearity, pressure hysteresis, and thermal effect on span.
7. Effective Number of Bits (ENOB): A measure of the dynamic performance of an analog-to-digital converter (ADC) and its related circuitry. ENOB is defined for the RSC Series per the following equation: ENOB = $\log_2$ (Full Scale Span/Noise).

## TABLE 7. PRESSURE RANGE SPECIFICATIONS FOR ±160 PA TO ±1 MPA

| Pressure Range (see Figure 3) | Pressure Range | | Unit | Working Pressure[1] | Over Pressure[2] | Burst Pressure[3] | Common Mode Pressure[4] | Total Error Band[5] (%FSS) | Total Error Band after Auto-Zero[6] (%FSS) | Long-term Stability 1000 hr, 25°C (%FSS) | Effective Number of Bits (ENOB) at 20 SPS[7] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pmin. | Pmax. | | | | | | | | | |
| **Absolute** | | | | | | | | | | | |
| **100KA** | 0 | 100 | kPa | — | 200 | 400 | — | ±0.75 | ±0.25 | ±0.25 | 16 |
| **160KA** | 0 | 160 | kPa | — | 400 | 800 | — | ±0.75 | ±0.25 | ±0.25 | 16 |
| **250KA** | 0 | 250 | kPa | — | 600 | 800 | — | ±0.75 | ±0.25 | ±0.25 | 16 |
| **400KA** | 0 | 400 | kPa | — | 800 | 1600 | — | ±0.75 | ±0.25 | ±0.25 | 16 |
| **600KA** | 0 | 600 | kPa | — | 1700 | 1700 | — | ±0.75 | ±0.25 | ±0.25 | 15 |
| **001GA** | 0 | 1 | MPa | — | 1700 | 1700 | — | ±0.75 | ±0.25 | ±0.25 | 16 |
| **Differential** | | | | | | | | | | | |
| **160LD** | -160 | 160 | Pa | 33500 | 67500 | 100000 | 345000 | ±3 | ±0.5 | ±0.5 | 16 |
| **250LD** | -250 | 250 | Pa | 33500 | 67500 | 100000 | 345000 | ±2 | ±0.5 | ±0.35 | 14 |
| **400LD** | -400 | 400 | Pa | 33500 | 67500 | 100000 | 345000 | ±2 | ±0.5 | ±0.35 | 15 |
| **600LD** | -600 | 600 | Pa | 33500 | 67500 | 100000 | 345000 | ±2 | ±0.5 | ±0.35 | 16 |
| **001KD** | -1 | 1 | kPa | 37.5 | 75 | 125 | 545 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **1.6KD** | -1.6 | 1.6 | kPa | 37.5 | 85 | 100 | 545 | ±1 | ±0.25 | ±0.25 | 16 |
| **2.5KD** | -2.5 | 2.5 | kPa | 43.5 | 85 | 135 | 1045 | ±1 | ±0.25 | ±0.25 | 18 |
| **004KD** | -4 | 4 | kPa | 43.5 | 85 | 135 | 1045 | ±0.75 | ±0.25 | ±0.25 | 15 |
| **006KD** | -6 | 6 | kPa | — | 85 | 100 | 1000 | ±0.75 | ±0.25 | ±0.25 | 15 |
| **010KD** | -10 | 10 | kPa | — | 140 | 250 | 1000 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **016KD** | -16 | 16 | kPa | — | 140 | 250 | 1000 | ±0.75 | ±0.25 | ±0.25 | 17 |
| **025KD** | -25 | 25 | kPa | — | 140 | 250 | 1000 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **040KD** | -40 | 40 | kPa | — | 200 | 400 | 1000 | ±0.75 | ±0.25 | ±0.25 | 17 |
| **060KD** | -60 | 60 | kPa | — | 200 | 400 | 1000 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **100KD** | -100 | 100 | kPa | — | 400 | 800 | 1000 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **160KD** | -160 | 160 | kPa | — | 800 | 1600 | 1000 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **250KD** | -250 | 250 | kPa | — | 800 | 1600 | 1000 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **400KD** | -400 | 400 | kPa | — | 1600 | 1700 | 1000 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **600KD** | -600 | 600 | kPa | — | 1700 | 1700 | 1700 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **001GD** | -1 | 1 | MPa | — | 1.7 | 1.7 | 1.7 | ±0.75 | ±0.25 | ±0.25 | 17 |

1. Working Pressure: The maximum pressure that may be applied to any port of the sensor in continuous use. This pressure may be outside the operating pressure range limits (Pmin. to Pmax.) in which case the sensor may not provide a valid output until presssure is returned to within the operating pressure range. Tested to 1 million cycles, minimum.
2. Overpressure: The maximum pressure which may safely be applied to the product for it to remain in specification once pressure is returned to the operating pressure range. Exposure to higher pressures may cause permanent damage to the product. Unless otherwise specified this applies to all available pressure ports at any temperature with the operating temperature range.
3. Burst Pressure: The maximum pressure that may be applied to any port of the product without causing escape of pressure media. Product should not be expected to function after exposure to any pressure beyond the burst pressure.
4. Common Mode Pressure: The maximum pressure that can be applied simultaneously to both ports of a differential pressure sensor without causing changes in specified performance.
5. Total Error Band: The maximum deviation from the ideal transfer function over the entire compensated temperature and pressure range. Includes all errors due to offset, full scale span, pressure non-linearity, pressure hysteresis, repeatability, thermal effect on offset, thermal effect on span, and thermal hysteresis (see Figure 1).
6. Total Error Band after Auto-Zero: The maximum deviation from the ideal transfer function over the entire compensated pressure range for a minimum of 24 hours after an auto-zero operation. Includes all errors due to full scale span, pressure non-linearity, pressure hysteresis, and thermal effect on span.
7. Effective Number of Bits (ENOB): A measure of the dynamic performance of an analog-to-digital converter (ADC) and its related circuitry. ENOB is defined for the RSC Series per the following equation: ENOB = $\log_2$ (Full Scale Span/Noise).

## TABLE 7. PRESSURE RANGE SPECIFICATIONS FOR ±160 PA TO ±1 MPA CONTINUED

| Pressure Range (see Figure 3) | Pressure Range | | Unit | Working Pressure[1] | Over Pressure[2] | Burst Pressure[3] | Common Mode Pressure[4] | Total Error Band[5] (%FSS) | Total Error Band after Auto-Zero[6] (%FSS) | Long-term Stability 1000 hr, 25°C (%FSS) | Effective Number of Bits (ENOB) at 20 SPS[7] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pmin. | Pmax. | | | | | | | | | |
| | | | | | Gage | | | | | | |
| **250LG** | 0 | 250 | Pa | 33500 | 67500 | 100000 | 345000 | ±3 | ±0.5 | ±0.5 | 15 |
| **400LG** | 0 | 400 | Pa | 33500 | 67500 | 100000 | 345000 | ±3 | ±0.5 | ±0.5 | 16 |
| **600LG** | 0 | 600 | Pa | 33500 | 67500 | 100000 | 345000 | ±2 | ±0.5 | ±0.35 | 15 |
| **001KG** | 0 | 1 | kPa | 33.5 | 67.5 | 100 | 345 | ±0.75 | ±0.25 | ±0.35 | 15 |
| **1.6KG** | 0 | 1.6 | kPa | 33.5 | 67.5 | 100 | 345 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **2.5KG** | 0 | 2.5 | kPa | 37.5 | 75 | 125 | 545 | ±1 | ±0.25 | ±0.25 | 17 |
| **004KG** | 0 | 4 | kPa | 37.5 | 75 | 125 | 545 | ±0.75 | ±0.25 | ±0.25 | 15 |
| **006KG** | 0 | 6 | kPa | — | 85 | 100 | 545 | ±0.75 | ±0.25 | ±0.25 | 14 |
| **010KG** | 0 | 10 | kPa | — | 85 | 100 | 1000 | ±0.75 | ±0.25 | ±0.25 | 15 |
| **016KG** | 0 | 16 | kPa | — | 85 | 100 | 1000 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **025KG** | 0 | 25 | kPa | — | 140 | 250 | 1000 | ±0.75 | ±0.25 | ±0.25 | 15 |
| **040KG** | 0 | 40 | kPa | — | 200 | 400 | 1000 | ±0.75 | ±0.25 | ±0.25 | 14 |
| **060KG** | 0 | 60 | kPa | — | 200 | 400 | 1000 | ±0.75 | ±0.25 | ±0.25 | 15 |
| **100KG** | 0 | 100 | kPa | — | 200 | 400 | 1000 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **160KG** | 0 | 160 | kPa | — | 400 | 800 | 1000 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **250KG** | 0 | 250 | kPa | — | 800 | 1600 | 1000 | ±0.75 | ±0.25 | ±0.25 | 15 |
| **400KG** | 0 | 400 | kPa | — | 800 | 1600 | 1600 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **600KG** | 0 | 600 | kPa | — | 1700 | 1700 | 1700 | ±0.75 | ±0.25 | ±0.25 | 15 |
| **001GG** | 0 | 1 | MPa | — | 1.7 | 1.7 | 1.7 | ±0.75 | ±0.25 | ±0.25 | 16 |

1. Working Pressure: The maximum pressure that may be applied to any port of the sensor in continuous use. This pressure may be outside the operating pressure range limits (Pmin. to Pmax.) in which case the sensor may not provide a valid output until presssure is returned to within the operating pressure range. Tested to 1 million cycles, minimum.
2. Overpressure: The maximum pressure which may safely be applied to the product for it to remain in specification once pressure is returned to the operating pressure range. Exposure to higher pressures may cause permanent damage to the product. Unless otherwise specified this applies to all available pressure ports at any temperature with the operating temperature range.
3. Burst Pressure: The maximum pressure that may be applied to any port of the product without causing escape of pressure media. Product should not be expected to function after exposure to any pressure beyond the burst pressure.
4. Common Mode Pressure: The maximum pressure that can be applied simultaneously to both ports of a differential pressure sensor without causing changes in specified performance.
5. Total Error Band: The maximum deviation from the ideal transfer function over the entire compensated temperature and pressure range. Includes all errors due to offset, full scale span, pressure non-linearity, pressure hysteresis, repeatability, thermal effect on offset, thermal effect on span, and thermal hysteresis (see Figure 1).
6. Total Error Band after Auto-Zero: The maximum deviation from the ideal transfer function over the entire compensated pressure range for a minimum of 24 hours after an auto-zero operation. Includes all errors due to full scale span, pressure non-linearity, pressure hysteresis, and thermal effect on span.
7. Effective Number of Bits (ENOB): A measure of the dynamic performance of an analog-to-digital converter (ADC) and its related circuitry. ENOB is defined for the RSC Series per the following equation: ENOB = $\log_2$ (Full Scale Span/Noise).

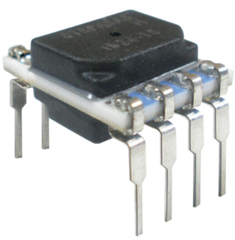
## TABLE 8. PRESSURE RANGE SPECIFICATIONS FOR ±0.5 INH$_2$O TO ±150 PSI

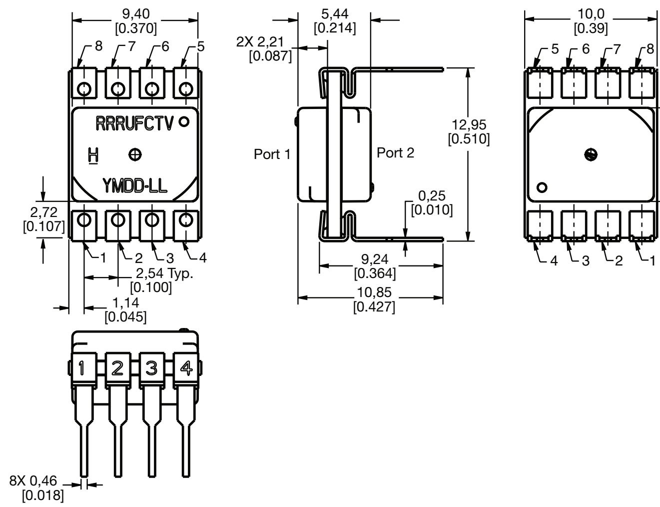
| Pressure Range (see Figure 3) | Pressure Range | | Unit | Working Pressure[1] | Over Pressure[2] | Burst Pressure[3] | Common Mode Pressure[4] | Total Error Band[5] (%FSS) | Total Error Band after Auto-Zero[6] (%FSS) | Long-term Stability 1000 hr, 25°C (%FSS) | Effective Number of Bits (ENOB) at 20 SPS[7] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pmin. | Pmax. | | | | | | | | | |
| **Absolute** | | | | | | | | | | | |
| **015PA** | 0 | 15 | psi | — | 30 | 60 | — | ±0.75 | ±0.25 | ±0.25 | 16 |
| **030PA** | 0 | 30 | psi | — | 60 | 120 | — | ±0.75 | ±0.25 | ±0.25 | 16 |
| **060PA** | 0 | 60 | psi | — | 120 | 240 | — | ±0.75 | ±0.25 | ±0.25 | 16 |
| **100PA** | 0 | 100 | psi | — | 250 | 250 | — | ±0.75 | ±0.25 | ±0.25 | 16 |
| **150PA** | 0 | 150 | psi | — | 250 | 250 | — | ±0.75 | ±0.25 | ±0.25 | 16 |
| **Differential** | | | | | | | | | | | |
| **0.5ND** | -0.5 | 0.5 | inH$_2$O | 135 | 270 | 415 | 1400 | ±3 | ±0.5 | ±0.5 | 16 |
| **001ND** | -1 | 1 | inH$_2$O | 135 | 270 | 415 | 1400 | ±2 | ±0.5 | ±0.35 | 15 |
| **002ND** | -2 | 2 | inH$_2$O | 135 | 270 | 415 | 1400 | ±2 | ±0.5 | ±0.35 | 16 |
| **004ND** | -4 | 4 | inH$_2$O | 150 | 300 | 500 | 2200 | ±0.75 | ±0.25 | ±0.25 | 17 |
| **005ND** | -5 | 5 | inH$_2$O | 150 | 300 | 500 | 2200 | ±1 | ±0.5 | ±0.25 | 19 |
| **010ND** | -10 | 10 | inH$_2$O | 175 | 350 | 550 | 4200 | ±1 | ±0.25 | ±0.25 | 19 |
| **020ND** | -20 | 20 | inH$_2$O | 175 | 350 | 550 | 4200 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **030ND** | -30 | 30 | inH$_2$O | 175 | 350 | 550 | 4200 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **001PD** | -1 | 1 | psi | — | 10 | 15 | 150 | ±0.75 | ±0.25 | ±0.25 | 15 |
| **005PD** | -5 | 5 | psi | — | 30 | 40 | 150 | ±0.75 | ±0.25 | ±0.25 | 17 |
| **015PD** | -15 | 15 | psi | — | 60 | 120 | 150 | ±0.75 | ±0.25 | ±0.25 | 17 |
| **030PD** | -30 | 30 | psi | — | 120 | 240 | 150 | ±0.75 | ±0.25 | ±0.25 | 17 |
| **060PD** | -60 | 60 | psi | — | 250 | 250 | 250 | ±0.75 | ±0.25 | ±0.25 | 17 |
| **100PD** | -100 | 100 | psi | — | 250 | 250 | 250 | ±0.75 | ±0.25 | ±0.25 | 17 |
| **150PD** | -150 | 150 | psi | — | 250 | 250 | 250 | ±0.75 | ±0.25 | ±0.25 | 17 |
| **Gage** | | | | | | | | | | | |
| **001NG** | 0 | 1 | inH$_2$O | 135 | 270 | 415 | 1400 | ±3 | ±0.5 | ±0.5 | 16 |
| **002NG** | 0 | 2 | inH$_2$O | 135 | 270 | 415 | 1400 | ±2 | ±0.5 | ±0.35 | 15 |
| **004NG** | 0 | 4 | inH$_2$O | 135 | 270 | 415 | 1400 | ±0.75 | ±0.25 | ±0.35 | 16 |
| **005NG** | 0 | 5 | inH$_2$O | 135 | 270 | 415 | 1400 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **010NG** | 0 | 10 | inH$_2$O | 150 | 300 | 500 | 2200 | ±1 | ±0.25 | ±0.25 | 18 |
| **020NG** | 0 | 20 | inH$_2$O | 175 | 350 | 550 | 4200 | ±0.75 | ±0.25 | ±0.25 | 15 |
| **030NG** | 0 | 30 | inH$_2$O | 175 | 350 | 550 | 4200 | ±0.75 | ±0.25 | ±0.25 | 15 |
| **001PG** | 0 | 1 | psi | — | 10 | 15 | 150 | ±0.75 | ±0.25 | ±0.25 | 14 |
| **005PG** | 0 | 5 | psi | — | 30 | 40 | 150 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **015PG** | 0 | 15 | psi | — | 30 | 60 | 150 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **030PG** | 0 | 30 | psi | — | 60 | 120 | 150 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **060PG** | 0 | 60 | psi | — | 120 | 240 | 250 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **100PG** | 0 | 100 | psi | — | 250 | 250 | 250 | ±0.75 | ±0.25 | ±0.25 | 16 |
| **150PG** | 0 | 150 | psi | — | 250 | 250 | 250 | ±0.75 | ±0.25 | ±0.25 | 16 |

1. Working Pressure: The maximum pressure that may be applied to any port of the sensor in continuous use. This pressure may be outside the operating pressure range limits (Pmin. to Pmax.) in which case the sensor may not provide a valid output until presssure is returned to within the operating pressure range. Tested to 1 million cycles, minimum.
2. Overpressure: The maximum pressure which may safely be applied to the product for it to remain in specification once pressure is returned to the operating pressure range. Exposure to higher pressures may cause permanent damage to the product. Unless otherwise specified this applies to all available pressure ports at any temperature with the operating temperature range.
3. Burst Pressure: The maximum pressure that may be applied to any port of the product without causing escape of pressure media. Product should not be expected to function after exposure to any pressure beyond the burst pressure.
4. Common Mode Pressure: The maximum pressure that can be applied simultaneously to both ports of a differential pressure sensor without causing changes in specified performance.
5. Total Error Band: The maximum deviation from the ideal transfer function over the entire compensated temperature and pressure range. Includes all errors due to offset, full scale span, pressure non-linearity, pressure hysteresis, repeatability, thermal effect on offset, thermal effect on span, and thermal hysteresis (see Figure 1).
6. Total Error Band after Auto-Zero: The maximum deviation from the ideal transfer function over the entire compensated pressure range for a minimum of 24 hours after an auto-zero operation. Includes all errors due to full scale span, pressure non-linearity, pressure hysteresis, and thermal effect on span.
7. Effective Number of Bits (ENOB): A measure of the dynamic performance of an analog-to-digital converter (ADC) and its related circuitry. ENOB is defined for the RSC Series per the following equation: ENOB = $\log_2$ (Full Scale Span/Noise).

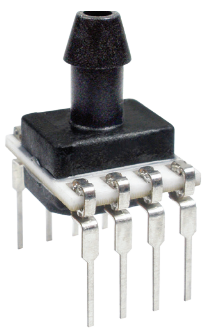
**FIGURE 4. DIP PACKAGE DIMENSIONAL DRAWINGS (FOR REFERENCE ONLY: MM [IN].)**

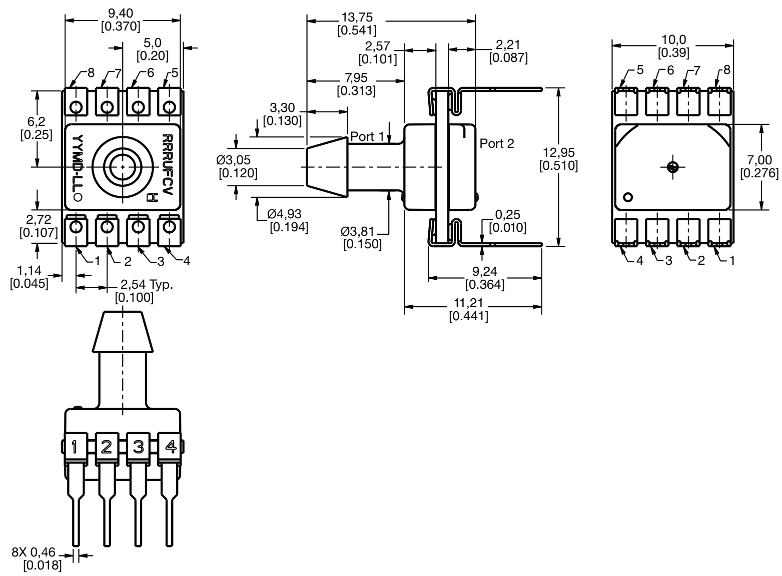
**DIP NN:** No ports



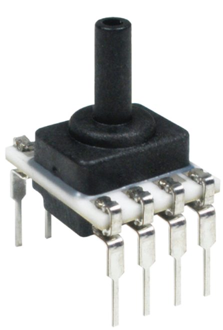


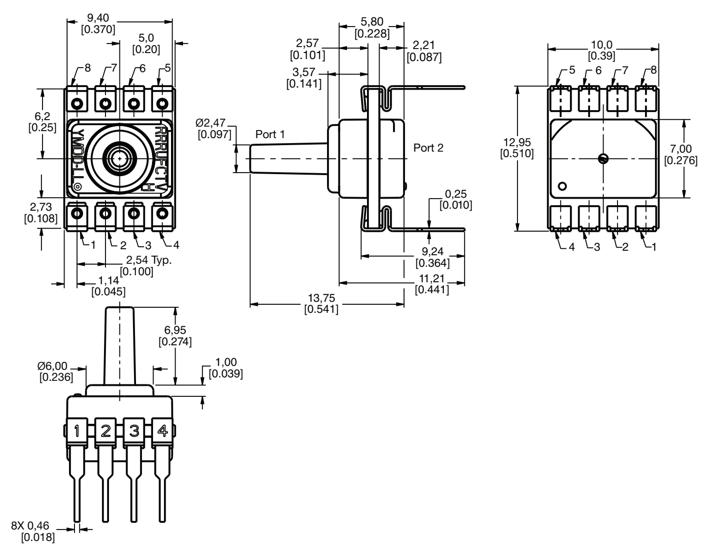

**DIP AN:** Single axial barbed port





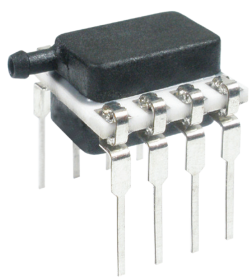

**DIP LN:** Single axial barbless port

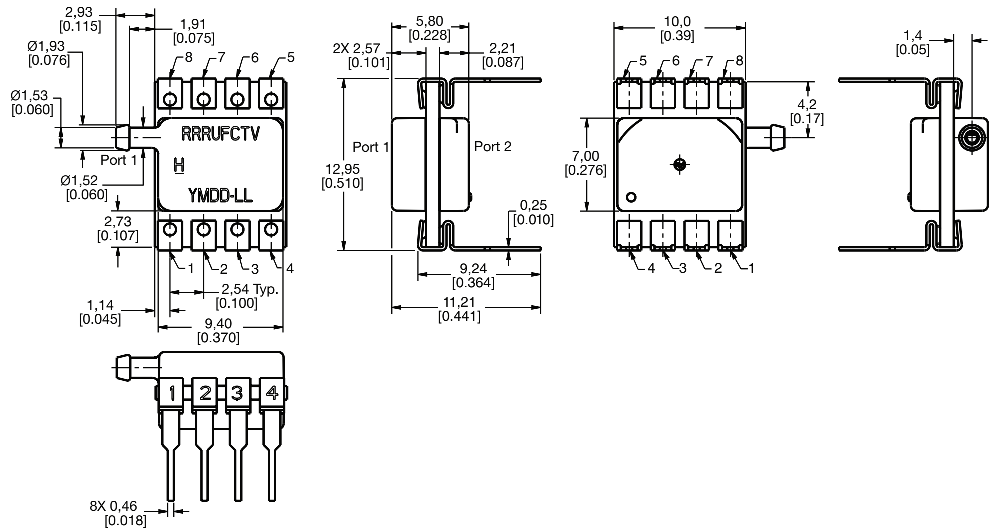




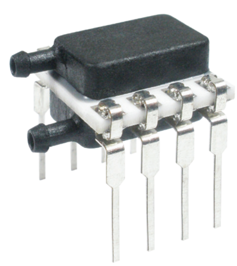
## FIGURE 4. DIP PACKAGE DIMENSIONAL DRAWINGS (CONTINUED)

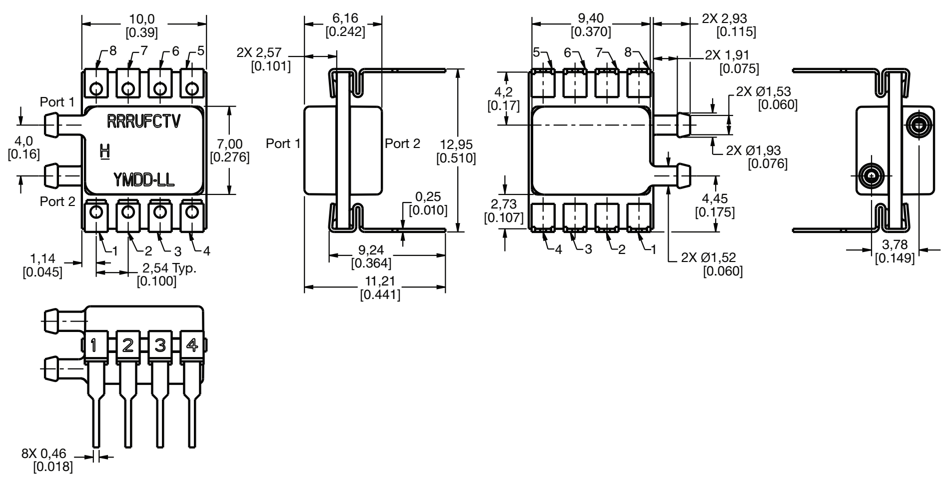
**DIP RN:** Single radial barbed port



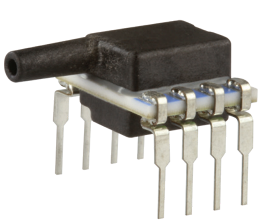



**DIP RR:** Dual radial barbed ports, same side






**DIP JN:** Single radial barbless port



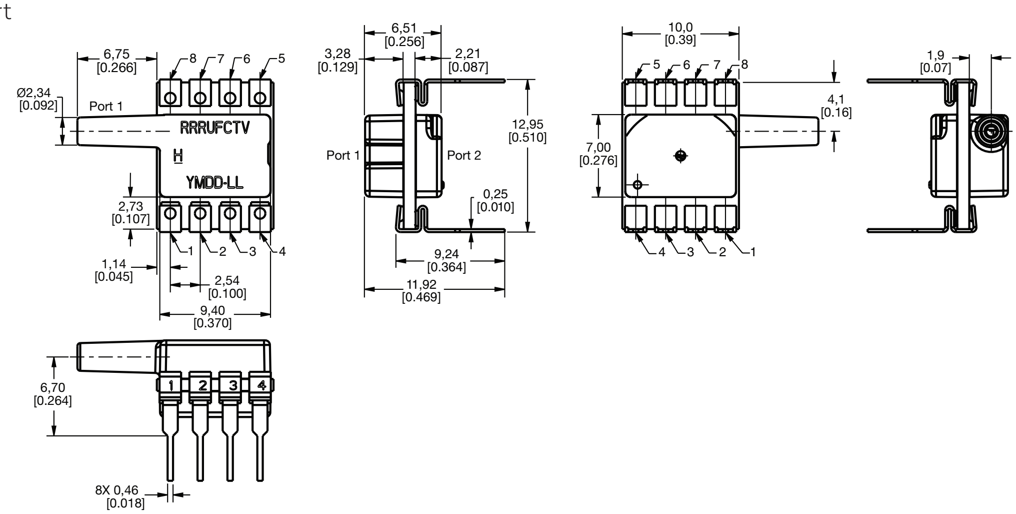
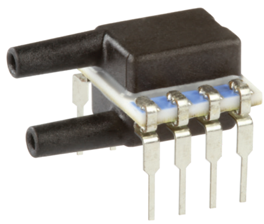


**FIGURE 4. DIP PACKAGE DIMENSIONAL DRAWINGS (CONTINUED)**

**DIP JJ:** Dual radial barbless ports, same side



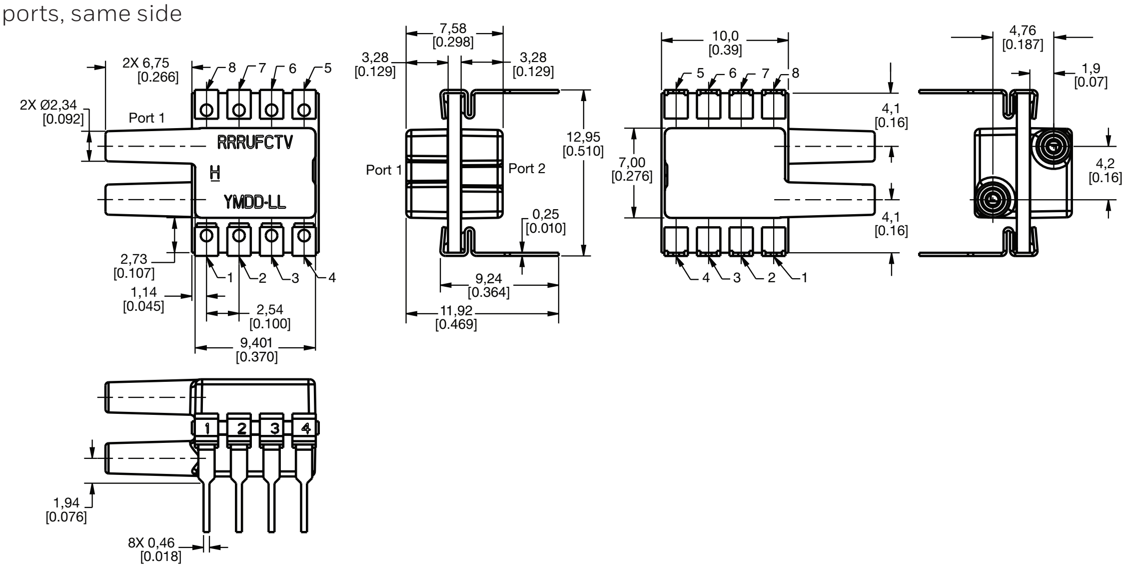
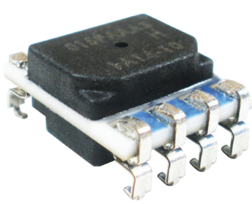
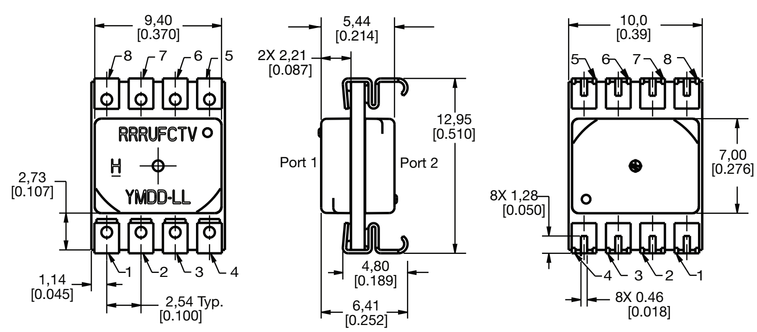



**FIGURE 5. SMT PACKAGE DIMENSIONAL DRAWINGS (FOR REFERENCE ONLY: MM [IN].)**

**SMT NN:** No ports






**SMT AN:** Single axial barbed port

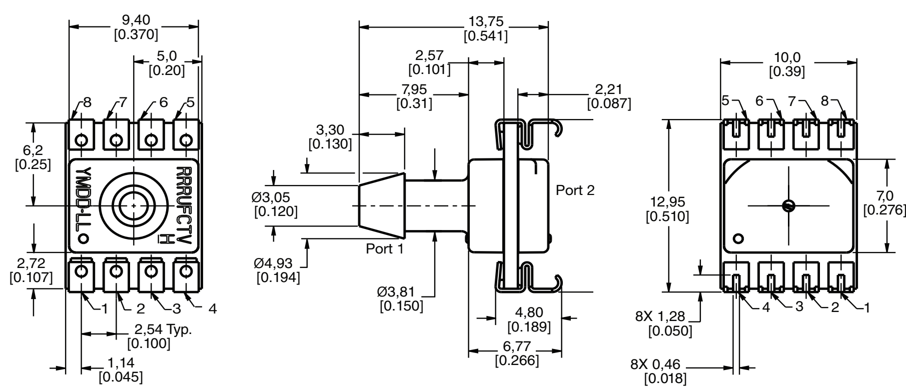
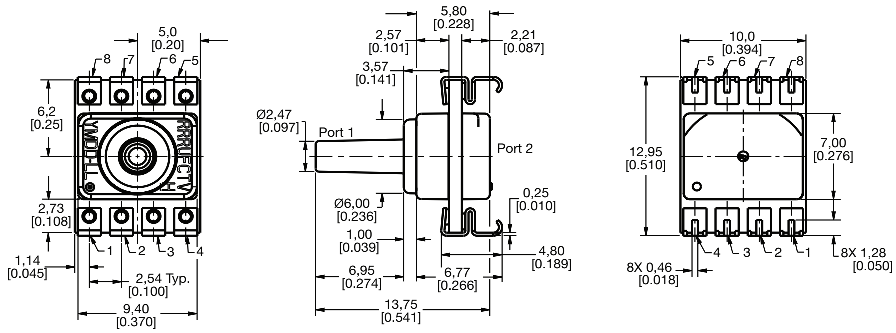
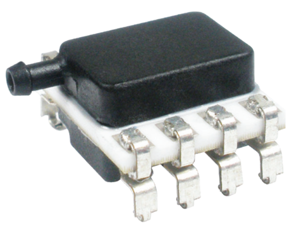


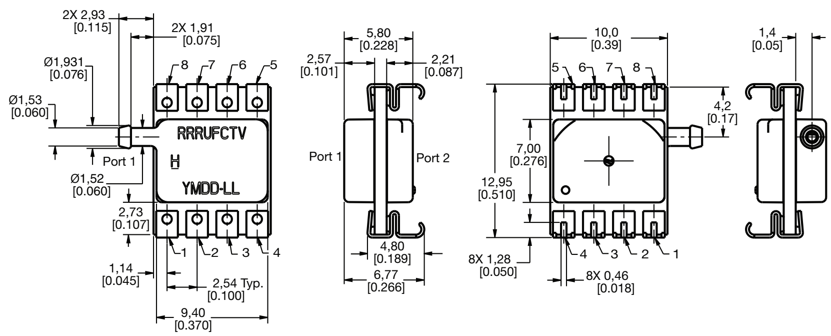
**FIGURE 5. SMT PACKAGE DIMENSIONAL DRAWINGS (CONTINUED)**

**SMT LN:** Single axial barbless port

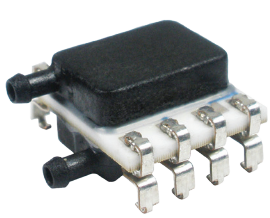


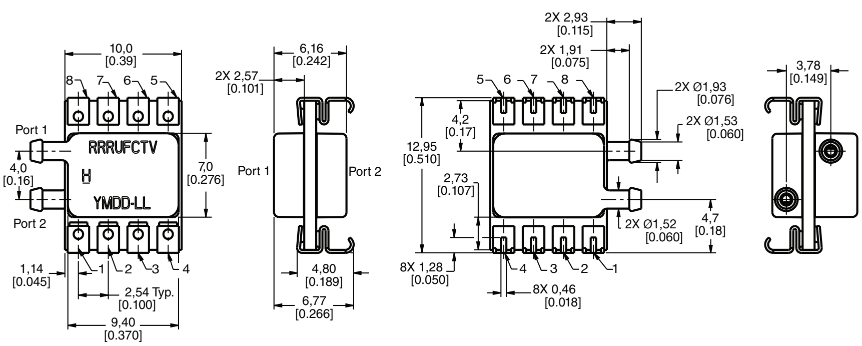

**SMT RN:** Single radial barbed port





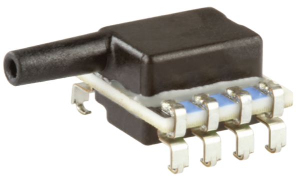

**SMT RR**: Dual radial barbed ports, same side

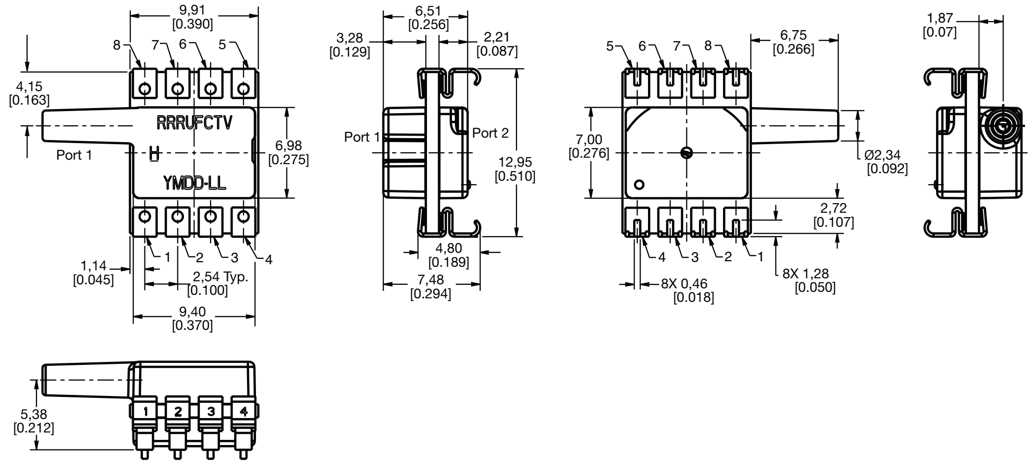




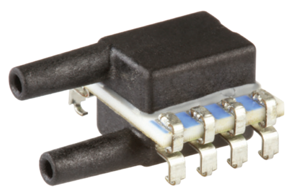
## FIGURE 5. SMT PACKAGE DIMENSIONAL DRAWINGS (CONTINUED)

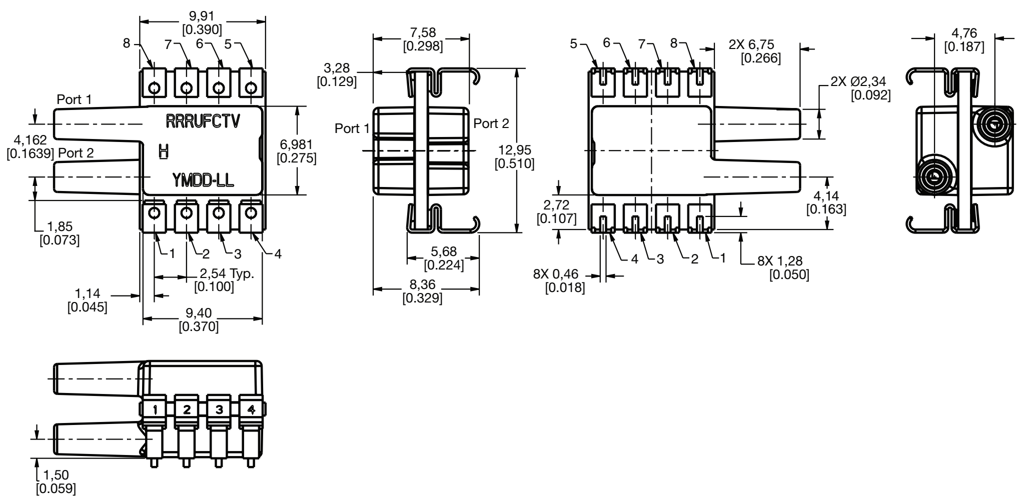
**SMT JN:** Single radial barbless port





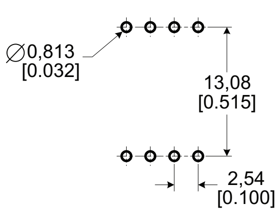

**SMT JJ:** Dual radial barbless ports, same side



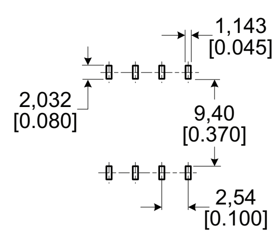



## FIGURE 6. RECOMMENDED PCB PAD LAYOUTS

**DIP**

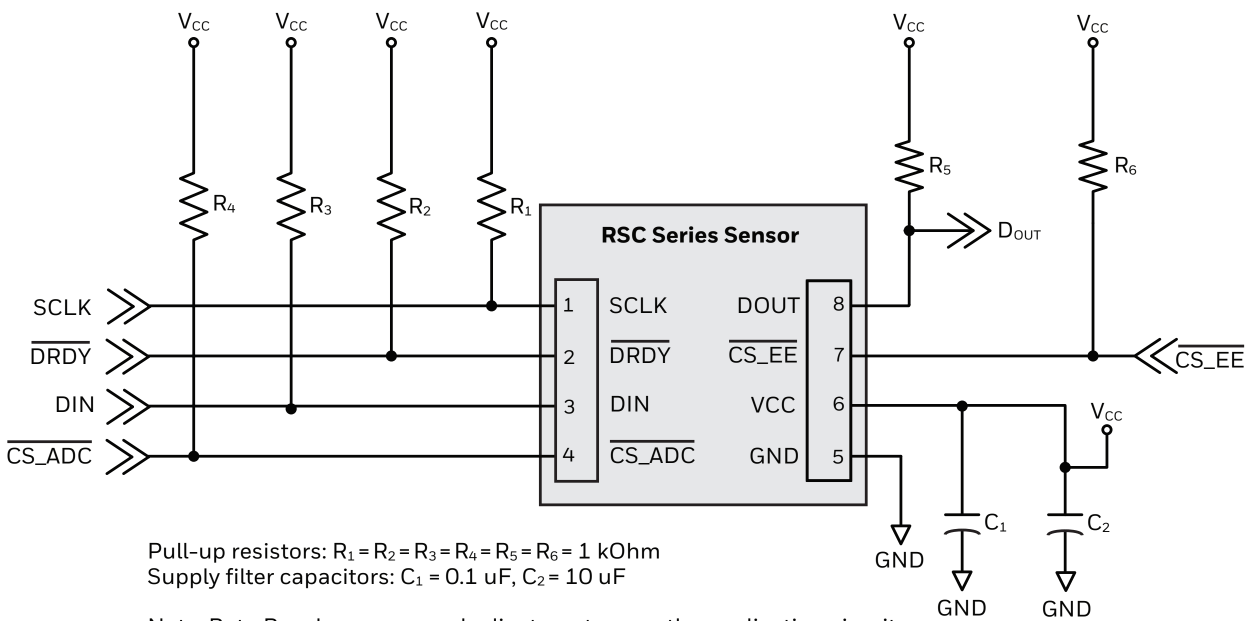



**SMT**



| TABLE 9. PINOUT | | |
|---|---|---|
| **Pin** | **Name** | **Description** |
| **1** | SCLK | external clock source |
| **2** | $\overline{\text{DRDY}}$ | data ready: active low |
| **3** | DIN | serial data input |
| **4** | $\overline{\text{CS\_ADC}}$ | ADC chip select: active low |
| **5** | GND | ground |
| **6** | $V_{CC}$ | positive supply voltage |
| **7** | $\overline{\text{CS\_EE}}$ | EEPROM chip select: active low |
| **8** | DOUT | serial data output |

**FIGURE 7. RECOMMENDED CIRCUIT**




Pull-up resistors: $R_1 = R_2 = R_3 = R_4 = R_5 = R_6$ = 1 kOhm
Supply filter capacitors: $C_1$ = 0.1 uF, $C_2$ = 10 uF

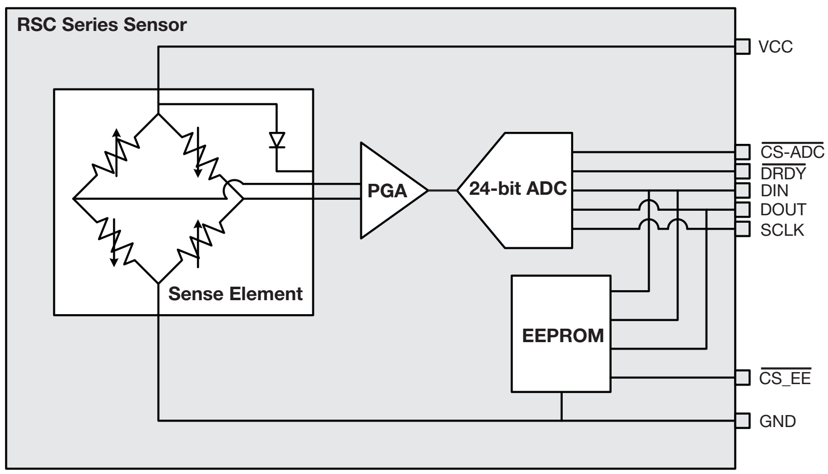
Note: $R_1$ to $R_6$ values may need adjustment as per the application circuit.

## 1.0 SYSTEM OVERVIEW

### 1.1 Major System Blocks (see Figure 1-1)

- A piezoresistive Sense Element that provides a signal that changes when pressure is applied to the device.
- An Analog to Digital Converter (ADC) with an integrated amplifier that measures this signal. (Unlike many conventional sensors, this digital signal is neither compensated nor calibrated.)
- An onboard EEPROM Memory that contains the coefficients for compensating equations that can be used to correct the raw signal and provide a fully temperature-compensated, pressure-calibrated value.

**FIGURE 1-1. BLOCK DIAGRAM**




### 1.2 High-level Operating Sequence

The following operating sequence is required to make the device function. Each step is discussed in detail in the following sections.

1. Read the ADC settings and the compensation values from EEPROM.
2. Initialize the ADC converter using the settings provided in EEPROM.
3. Adjust the ADC sample rate if desired.
4. Command the ADC to begin temperature conversion.
5. Give delay for maximum conversion time or wait until the falling edge of the data ready line (DRDY).
6. Clock out the data for the temperature reading.
7. Command ADC to begin pressure conversion.
8. Give delay for maximum conversion time or wait until the falling edge of the data ready line DRDY.
9. Clock out the data for the pressure reading.

10 Apply compensation formula for the temperature and pressure reading to provide a compensated pressure value.

11. Repeat steps 4 through 10 to continue taking additional measurements as desired.

It is not necessary to take a new temperature reading in conjunction with every pressure reading. If a fast response to pressure is required, it is possible to take several pressure readings in a row and use an earlier temperature reading to compensate. The exact timing of this will be application specific and depend on the rapidity of possible temperature changes. A temperature reading approximately every 100 ms should be adequate for most applications except those with rapid temperature transients. Longer times between temperature readings may be possible for applications where rapid temperature changes are not possible. If multiple pressure readings for a single temperature reading are desired, the sequence of steps above becomes:

4. Command the ADC to begin temperature conversion.
5. Give delay for maximum conversion time or wait until the falling edge of the data ready line (DRDY).
6. Clock out the data for the temperature reading.
7. Command the ADC to begin pressure conversion.
8. Give delay for maximum conversion time or wait until the falling edge of the data ready line DRDY.
9. Clock out the data for the pressure reading.
10. Apply compensation formula for the temperature and pressure reading to provide a compensated pressure value.
11. Repeat steps 8 through 10 to continue taking additional measurements as desired.
12. After a predetermined number of loops, based on application and the temperature stability, repeat steps 4 through 11.

### 1.3 Compensation Mathematics (see Table 1-1)

This section gives a high-level overview of the compensation mathematics. Please refer to Section 2.0 for details on exact numeric formats and EEPROM addresses. It is assumed that all values have been correctly converted to a floating-point decimal format.

**TABLE 1-1. COEFFICIENTS READ FROM EEPROM**

| Coefficient | Description |
|---|---|
| $P_{Range}$ | pressure range read from EEPROM |
| $P_{min}$ | pressure offset read from EEPROM |
| Eng Units | engineering units read from EEPROM |
| $P_{raw}$ | uncompensated pressure reading from ADC |
| $T_{raw}$ | uncompensated temperature reading from ADC |
| $P_{int1}$ | intermediate value in calculations |
| $P_{int2}$ | intermediate value in calculations |
| $P_{Comp\_FS}$ | compensated output pressure |
| $P_{Comp}$ | compensated output pressure, in engineering units |

$OffsetCoefficient_3 ... OffsetCoefficient_0$ = Correction values from EEPROM
$SpanCoefficient_3 ... SpanCoefficient_0$ = Correction values from EEPROM
$ShapeCoefficient_3 ... ShapeCoefficient_0$ = Correction values from EEPROM

$$P_{int1} = P_{raw} - (OffsetCoefficient_3 * T_{raw}^3 + OffsetCoefficient_2 * T_{raw}^2 + OffsetCoefficient_1 * T_{raw} + OffsetCoefficient_0)$$

$$P_{int2} = P_{int1} / (SpanCoefficient_3 * T_{raw}^3 + SpanCoefficient_2 * T_{raw}^2 + SpanCoefficient_1 * T_{raw} + SpanCoefficient_0)$$

$$P_{Comp\_FS} = ShapeCoefficient_3 * P_{int2}^3 + ShapeCoefficient_2 * P_{int2}^2 + ShapeCoefficient_1 * P_{int2} + ShapeCoefficient_0$$

$$P_{Comp} = (P_{Comp\_FS} * P_{Range}) + P_{min} \text{ [Engineering Units]}$$

## 2.0 SYSTEM INITIALIZATION – EEPROM

The device on-board memory contains serialization, pressure range, ADC configuration and compensation information.

### 2.1 EEPROM Contents

#### 2.11 Serialization and pressure range information: Stored in bytes 0 to 40 (see Table 2-1).

**TABLE 2-1. SERIALIZATION AND PRESSURE RANGE INFORMATION**

| Relative Address | Item | Detail | Data Type | Byte Order |
|---|---|---|---|---|
| 0 | sensor catalog listing | | ASCII Char | MSB |
| 1 | | | ASCII Char | |
| 2 | | | ASCII Char | |
| 3 | | | ASCII Char | |
| 4 | | | ASCII Char | |
| 5 | | | ASCII Char | |
| 6 | | | ASCII Char | |
| 7 | | | ASCII Char | |
| 8 | | | ASCII Char | |
| 9 | | | ASCII Char | |
| 10 | | | ASCII Char | |
| 11 | | | ASCII Char | |
| 12 | | | ASCII Char | |
| 13 | | | ASCII Char | |
| 14 | | | ASCII Char | |
| 15 | | | ASCII Char | LSB |
| 16 | serial number (YYYYDDDXXXX) | YYYY | ASCII Char | MSB |
| 17 | | | ASCII Char | |
| 18 | | | ASCII Char | |
| 19 | | | ASCII Char | LSB |
| 20 | | DDD | ASCII Char | MSB |
| 21 | | | ASCII Char | |
| 22 | | | ASCII Char | LSB |
| 23 | | XXXX | ASCII Char | MSB |
| 24 | | | ASCII Char | |
| 25 | | | ASCII Char | |
| 26 | | | ASCII Char | LSB |
| 27 | pressure range | | Float | LSB |
| 28 | | | | |
| 29 | | | | |
| 30 | | | | MSB |
| 31 | pressure minimum | | Float | LSB |
| 32 | | | | |
| 33 | | | | |
| 34 | | | | MSB |
| 35 | pressure unit | | ASCII Char | MSB |
| 36 | | | ASCII Char | |
| 37 | | | ASCII Char | |
| 38 | | | ASCII Char | |
| 39 | | | ASCII Char | LSB |
| 40 | pressure reference | | ASCII Char | |

### 2.12 ADC Configuration Settings: Stored in bytes 61, 63, 65 and 67 (See Table 2-2).

**TABLE 2-2. ADC CONFIGURATION SETTTINGS**

| Relative Address | Item | Detail | Data Type | Byte Order |
|---|---|---|---|---|
| 60 | ADC configuration math | | | |
| 61 | | ADC CONFIG_00 | unsigned character | — |
| 62 | | | | |
| 63 | | ADC CONFIG_01 | unsigned character | — |
| 64 | | | | |
| 65 | | ADC CONFIG_02 | unsigned character | — |
| 66 | | | | |
| 67 | | ADC CONFIG_03 | unsigned character | — |

### 2.13 Polynomial coefficients: Stored in bytes 130 to 145 (see Table 2-3).

**TABLE 2-3. POLYNOMIAL COEFFICIENTS**

| Relative Address | Item | Detail | Data Type | Byte Order |
|---|---|---|---|---|
| 130 | offset matrix | $OffsetCoefficient_0$ | float | LSB |
| 131 | | | | |
| 132 | | | | |
| 133 | | | | MSB |
| 134 | | $OffsetCoefficient_1$ | float | LSB |
| 135 | | | | |
| 136 | | | | |
| 137 | | | | MSB |
| 138 | | $OffsetCoefficient_2$ | float | LSB |
| 139 | | | | |
| 140 | | | | |
| 141 | | | | MSB |
| 142 | | $OffsetCoefficient_3$ | float | LSB |
| 143 | | | | |
| 144 | | | | |
| 145 | | | | MSB |

### 2.14 Span coefficients: Stored in bytes 210 to 225 (see Table 2-4).

**TABLE 2-4. SPAN COEFFICIENTS**

| Relative Address | Item | Detail | Data Type | Byte Order |
|---|---|---|---|---|
| 210 | span matrix | $SpanCoefficient_0$ | float | LSB |
| 211 | | | | |
| 212 | | | | |
| 213 | | | | MSB |
| 214 | | $SpanCoefficient_1$ | float | LSB |
| 215 | | | | |
| 216 | | | | |
| 217 | | | | MSB |
| 218 | | $SpanCoefficient_2$ | float | LSB |
| 219 | | | | |
| 220 | | | | |
| 221 | | | | MSB |
| 222 | | $SpanCoefficient_3$ | float | LSB |
| 223 | | | | |
| 224 | | | | |
| 225 | | | | MSB |

### 2.15 Shape Coefficients: Stored in bytes 290 to 305 (see Table 2-5).

**TABLE 2-5. SHAPE COEFFICIENTS**

| Relative Address | Item | Detail | Data Type | Byte Order |
|---|---|---|---|---|
| 290 | shape matrix | ShapeCoefficient$_0$ | float | LSB |
| 291 | | | | |
| 292 | | | | |
| 293 | | | | MSB |
| 294 | | ShapeCoefficient$_1$ | float | LSB |
| 295 | | | | |
| 296 | | | | |
| 297 | | | | MSB |
| 298 | | ShapeCoefficient$_2$ | float | LSB |
| 299 | | | | |
| 300 | | | | |
| 301 | | | | MSB |
| 302 | | ShapeCoefficient$_3$ | float | LSB |
| 303 | | | | |
| 304 | | | | |
| 305 | | | | MSB |

### 2.16 Checksum address: Stored in byte 450 (see Table 2-6).

**TABLE 2-6. CHECKSUM ADDRESS**

| Relative Address | Item | Detail | Data Type | Byte Order |
|---|---|---|---|---|
| 450 | Checksum | | unsigned short int | LSB |
| 451 | | | | MSB |

Any unspecified EEPROM addresses below address 451 are reserved for future enhancements.

### 2.2 EEPROM Communications

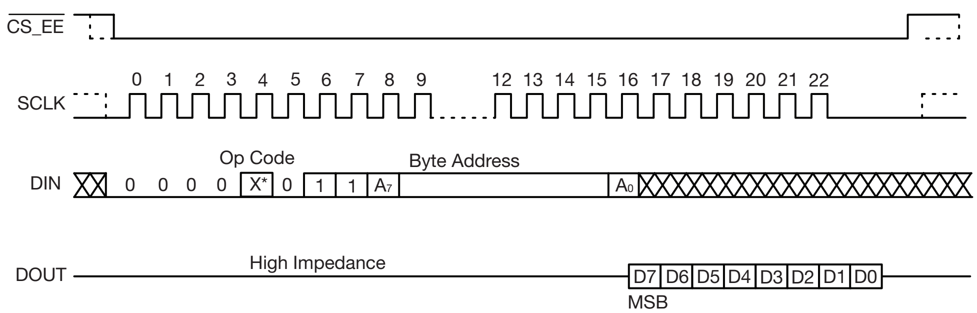
The $\overline{\text{CS\_EE}}$ pin of the sensor selects the EEPROM for SPI communication. When $\overline{\text{CS\_EE}}$ is high, the EEPROM is in stand-by mode, and communications with the ADC are possible. When $\overline{\text{CS\_EE}}$ is low, the EEPROM is enabled. $\overline{\text{CS\_EE}}$ and $\overline{\text{CS\_ADC}}$ must never be simultaneously low. EEPROM operates in SPI mode 0 where CPOL = 0 and CPHA = 0 (0,0) and mode 3 where CPOL = 1 and CPHA = 1 (1,1).

Each memory of EEPROM contains 8-bit data or one byte. To read from memory, the host sends an EAD_EEPROM instruction [0000 X011] followed by an 8-bit address. The 'X' bit in the read instruction is the ninth (MSB) address bit.

Example:
1. To read data at address 1, the command sequence is [0000 **0**011] [0000 0001].
2. To read data at address 290, the command sequence is [0000 **1**011] [0010 0010].

After receiving the last address bit, the EEPROM responds by shifting out data on the DOUT pin, as shown in Figure 2-1. Sequentially stored data can be read out by simply continuing to run the clock. The internal address pointer is automatically incremented to the next higher address as data is shifted out. After reaching the highest memory address, the address counter "rolls over" to the lowest memory address, and the read cycle can be continued indefinitely. The read operation is terminated by taking $\overline{CS\_EE}$ high.

**FIGURE 2-1. EEPROM COMMUNICATIONS**




## 3.0 SYSTEM OPERATION – ADC

### 3.1 ADC Communications and Initialization

The $\overline{CS\_ADC}$ pin of the sensor selects the ADC for SPI communication. When $\overline{CS\_ADC}$ is high, the ADC is in stand-by mode, and communications with the EEPROM are possible. When $\overline{CS\_ADC}$ is low, the ADC is enabled. $\overline{CS\_EE}$ and $\overline{CS\_ADC}$ must never be simultaneously low. The ADC interface operates in SPI mode 1 where CPOL = 0 and CPHA = 1.

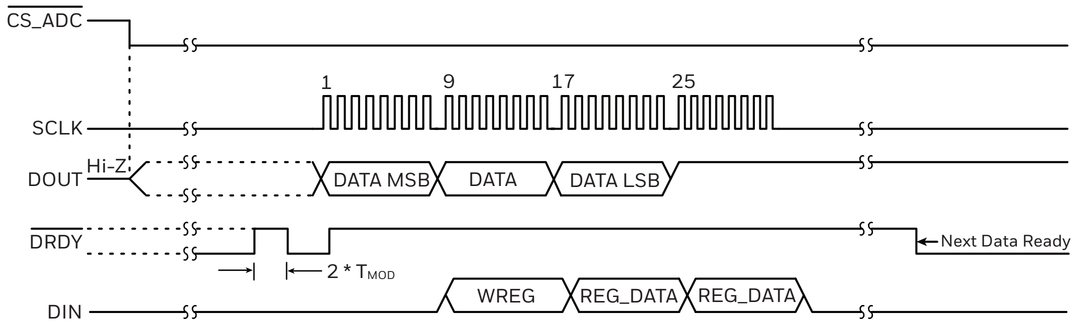
The ADC has four configuration registers. Three registers are 'reserved' and must be set to the default values contained in EEPROM. These registers contain setup values that are specific to the pressure sense element, and should not be changed. Configuration register 1 toggles the ADC between pressure and temperature readings and controls the data rate of the ADC.

To program a configuration register, the host sends a WREG command [0100 RRNN], where 'RR' is the register number and 'NN' is the number of bytes to be written –1.

Example: To write the single byte default configuration to register 3, the command is [0100 1100]. It is possible to write the default values to all configuration registers with a single command by setting the address to 0 and the number of bytes to (4 -1) = 3, followed by all four configuration bytes in sequence. The command for this is [0100 0011].

The ADC is capable of full-duplex operation, which means commands are decoded at the same time that conversion data are read. Commands may be sent on any 8-bit data boundary during a data read operation. This allows for faster toggling between pressure and temperature modes. A WREG command can be sent without corrupting an ongoing read operation. Figure 3-1 shows an example of sending a WREG command while reading conversion data. Note that after the command is clocked in (after the 32nd SCLK falling edge), the sensor changes settings and starts converting using the new register settings. The WREG command can be sent on any of the 8-bit boundaries – the first, ninth, 17th or 25th SCLK rising edges as shown in Figure 3-1.

**FIGURE 3-1. ADC COMMUNCIATIONS AND INITIALIZATION**




### 3.2 Programming the Data Rate and Pressure/Temperature Modes

The ADC configuration register 1 contains the settings for the data rate and determines whether the ADCS takes a pressure reading or a temperature reading. This register can be changed as shown in Table 3-1 by using a WREG command. Typical data conversion times are shown in Table 3-2.

**TABLE 3-1. ADC CONFIGURATION REGISTER**

| ADC_CONFIG_01 [HEX] | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|---|---|---|---|---|---|---|---|---|
| 01h | DR[2:0] | | | MODE[1:0] | | 1 | TS | 0 |
| | Data Rate<br><br>Normal Mode (SPS)<br>000: 20 (default)<br>001: 45<br>010: 90<br>011: 175<br>100: 330<br>101: 600<br>110: 1000<br>111: not used<br><br>Fast Mode (SPS)<br>000: 40 (default)<br>001: 90<br>010: 180<br>011: 350<br>100: 660<br>101: 1200<br>110: 2000<br>111: not used | | | Operating Mode<br><br>00: **Normal Mode** (256 kHz modulator clock) (default)<br>01: not used<br>10: **Fast Mode** (512 kHz modulator clock) | | set to 1 | Temperature Sensor Mode<br><br>0: Pressure (sense element) reading<br>1: Temperature reading | set to 0 |

The conversion time for each selected data rate is within ±5% of the times shown in Table 3-2.

**TABLE 3-2. TYPICAL DATA CONVERSION TIMES**

| Normal Mode | | Fast Mode | |
|---|---|---|---|
| **SPS** | **Time (ms)** | **SPS** | **Time (ms)** |
| **20** | 49.99 | **40** | 25.00 |
| **45** | 22.25 | **90** | 11.12 |
| **90** | 11.26 | **180** | 5.63 |
| **175** | 5.78 | **350** | 2.89 |
| **330** | 3.04 | **660** | 1.52 |
| **600** | 1.68 | **1200** | 0.84 |
| **1000** | 1.01 | **2000** | 0.51 |

### 3.3 ADC Reset Command

The ADC reset command RESET [0000 0110] resets the ADC to the default values.

### 3.4 ADC Programming Sequence – Power Up

At power-up it is necessary to initialize all the ADC registers. The sequence is:

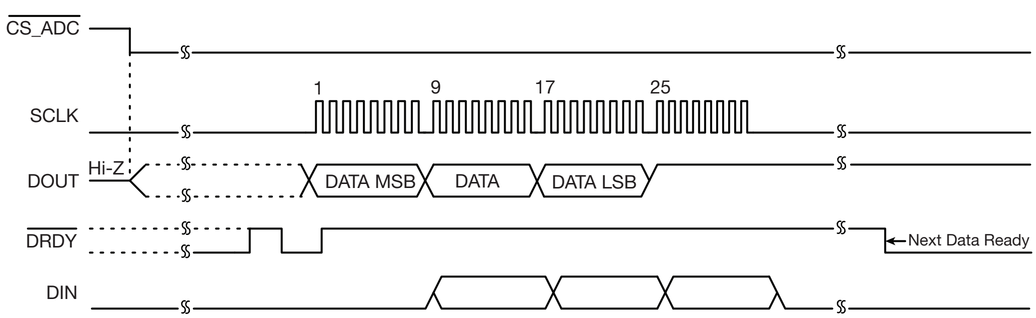
1. Set the CS_EE to high to disable EEPROM communication.
2. Set the CS_ADC to low to enable ADC communication.
3. Send the Reset command (06h) to make sure the ADC is properly reset after power up.
4. Initialize all four configuration registers with the values read from EEPROM's Relative addresses 61, 63, 65 and 67 by sending a WREG command to address 0 [0100 0011] followed by these four bytes of data.

Both a temperature and an uncompensated pressure reading are necessary to calculate a compensated value (see Section 3.5).

### 3.5 ADC Programming and Read Sequence – Temperature Reading (see Figure 3-2 and Table 3-3)

1. Set the CS_ADC low to enable ADC communication.
2. Configure the sensor to temperature mode and the desired data rate by setting configuration register 1 by sending a WREG command to address 1, [0100 0100] followed by the single configuration byte. Bit 1 (TS) of the configuration register should be set to 1.
3. Send 08h command to start data conversion on ADC.
4. Give delay for maximum conversion time or wait until the falling edge of the data ready line DRDY.
5. The sensor will start to output the requested data on DOUT at the first SCLK rising edge.

**FIGURE 3-2. ADC PROGRAMMING AND READ SEQUENCE – TEMPERATURE READING**




6. Interpret the data as follows: Temperature data are output starting with MSB. When reading 24 bits, the first 14 bits are used to indicate the temperature measurement result. The last 10 bits are random data and must be ignored. Negative temperature is represented in 2's complement format. MSB = 0 indicates positive result, MSB = 1 indicates negative value.

   To convert the digital value to a Celsius temperature, first check if the MSB is 0 or 1. If the MSB = 0, simply multiply the decimal code by 0.03125°C to obtain the result. If the MSB = 1, subtract 1 from the result and complement all bits, multiply the result by -0.03125°C.

**TABLE 3-3. DATA INTERPRETATION TABLE**

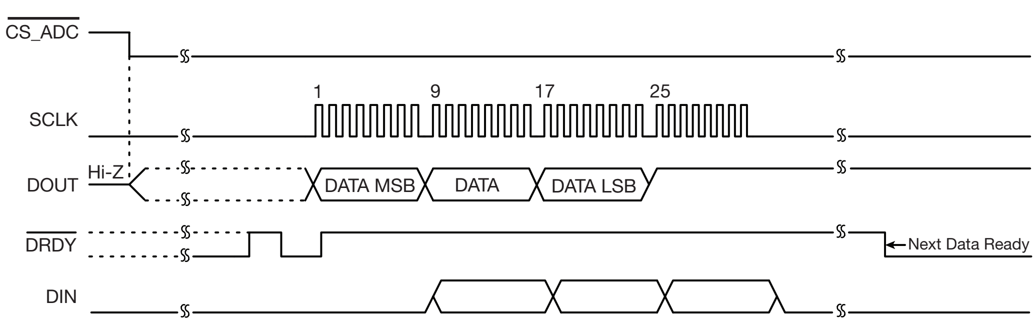
| Temperature (°C) | Digital Output (Binary) | Hex |
|---|---|---|
| **128** | 01 0000 0000 0000 | 1000 |
| **127.96875** | 00 1111 1111 1111 | 0FFF |
| **100** | 00 1100 1000 0000 | 0C80 |
| **80** | 00 1010 0000 0000 | 0A00 |
| **75** | 00 1001 0110 0000 | 0960 |
| **50** | 00 0110 0100 0000 | 0640 |
| **25** | 00 0011 0010 0000 | 0320 |
| **0.25** | 00 0000 0000 1000 | 0008 |
| **0** | 00 0000 0000 0000 | 0000 |
| **-0.25** | 11 1111 1111 1000 | 3FF8 |
| **-25** | 11 1100 1110 0000 | 3CE0 |
| **-40** | 11 1011 0000 0000 | 3B00 |

**Example 1:** The ADC reads back 0960h: 0960h has an MSB = 0. (0960h) × (0.03125°C) = (2400) × (0.03125°C) = 75°C
**Example 2:** The ADC reads back: 3CE0h: 3CE0h has an MSB = 1. Complement the result: 3CE0h = 0320h (0320h) × (–0.03125°C) = (800) × (–0.03125°C) = –25°C

### 3.6 ADC Programming and Read Sequence – Pressure Reading (see Figure 3-3)

1. Set the CS_ADC low to enable ADC communication.
2. Configure the sensor to the pressure mode and the desired data rate by setting configuration register 1 by sending a WREG command to address 1, [0100 0100] followed by the single configuration byte. Bit 1 (TS) of the configuration register should be set to 0.
3. Send 08h command to start data conversion on ADC.
4. Give delay for maximum conversion time or wait until the falling edge of the data ready line DRDY.
5. The sensor will start to output the requested data on DOUT at the first SCLK rising edge.

**FIGURE 3-3. ADC PROGRAMMING AND READ SEQUENCE – PRESSURE READING**




5. Interpret the data as shown in Table 3-4. Pressure data are output starting with MSB, in 24-bit 2’s complement format.

**TABLE 3-4. COMPRETURN_STRUCT**

| Input Signal, VIN (AINP-AINN) | DEAL OUTPUTCODE |
|---|---|
| **$\geq +FS(2^{23} - 1) / 2^{23}$** | 7FFFFFh |
| **$+FS / 2^{23}$** | 000001h |
| **0** | 0 |
| **$-FS / 2^{23}$** | FFFFFh |
| **$\leq -FS$** | 800000h |

# 4.0 EXAMPLE SOFTWARE

## 4.1 Data Types

Specific data types defined by the Pressure_Comp module defined in “Pressure_Comp.h” are needed while interacting with the pressure compensation function (see Table 4-1).

**TABLE 4-1. DATA TYPES**

| Name | Description | |
|---|---|---|
| **CompStatus_Enum** | Provides an enumerated data type to hold the status of pressure compensation module; pressure compensation states are given below: | |
| | COMPINIT_OK<br>COMPINIT_NOK<br>CRC_FAILURE<br>IP_PRESSURE_OUTOFRANGE<br>IP_TEMP_OUTOFRANGE<br>PRESSURE_VALID<br>PRESSURE_INVALID | Compensation init successful<br>Compensation init failure<br>CRC check failure<br>Input pressure out of range<br>Input temperature out of range<br>Output pressure is valid<br>Output pressure is invalid |
| **CompReturn_Struct** | Provides structured a data type containing two elements such as f32PressureOutput and CompStatus; details are given below: | |
| | f32PressureOutput<br>CompStatus | Provides output pressure of “float” data type<br>Provides status of pressure compensation of “CompStatus_Enum” data type |

## 4.2 Function Descriptions – Pressure_Comp.c

“Pressure_Comp.c” provides the source code that provides functions to initialize the module by extracting all the coefficients from EEPROM after CRC validation and extracting the coefficients from it. This file also provides the function to compensate the pressure by having uncompensated raw pressure and temperature input. The “Pressure_Comp.h” file provides the interfaces to the functions implemented in the “Pressure_Comp.c” file that need to be included in the application where the pressure compensation is needed. Dependencies: “float.h”, “crc.h” (see Tables 4-2, 4-3 and 4-4 ).

**TABLE 4-2. COMPENSATE_PRESSURE_INIT()**

| Entity | Name | Description |
|---|---|---|
| **Function** | Compensate_Pressure_Init | Initializes the pressure compensation module |
| **Parameter** | u8EEPROM_ptr | Data Type: (unsigned char *)<br>Provides a pointer to the EEPROM image which is read byte-wise in a contiguous memory buffer |
| **Return Type** | CompStatus_Enum | Returns the status of compensation initialization (either of the compensation states given below)<br>COMPINIT_OK Compensation init successful<br>COMPINIT_NOK Compensation init failure |

| TABLE 4-3. COMPENSATE_PRESSURE() | | |
|---|---|---|
| **Entity** | **Name** | **Description** |
| **Function** | Compensate_Pressure | Provides the compensated pressure based on the polynomial correction. |
| **Parameter** | u32PressureInput | Data Type: (unsigned long int)<br>Inputs the uncompensated pressure as read by the sensor. |
| | u32Temperature | Data Type: (unsigned long int)<br>Inputs the temperature as read by the sensor. |
| **Return type** | CompReturn_Struct.<br>CompStatus | Data Type: (CompStatus_Enum)<br>Provides the status of the compensation initialization. |
| | CompReturn_Struct.<br>f32PressureOutput | Data Type: (float)<br>Returns the compensated pressure output in engineering units per the sensor's specification. |

| TABLE 4-4. AUTOZERO_PRESSURE() | | |
|---|---|---|
| **Entity** | **Name** | **Description** |
| **Function** | Autozero_Pressure | Sets a known, preset pressure to 50% full scale pressure (this function should only be used at a known preset pressure that has to be output as 50% full scale pressure).<br>The term "autozero" refers to 50% full scale pressure. |
| **Parameter** | u32PressureZero | Data Type: (unsigned long int)<br>Inputs uncompensated pressure as read by the TSHUR sensor at preset 50% full scale pressure. |
| | u32TemperatureZero | Data Type: (unsigned long int)<br>Inputs temperature as read by the TSHUR sensor at preset 50% full scale pressure. |
| **Return type** | CompReturn_Struct.<br>CompStatus | Data Type: (CompStatus_Enum)<br>Returns the status of AutoZero Correction. |

### 4.3 Checksum Calculation

"crc.c" provides a source code which, in turn, provides the functions to compute the 16-bit CCITT CRC. "crc.h" is an interface file for "pressure_Comp.c" to get the interfaces to the functions which are implemented in the "crc.c"file (see Table 4-5).

| TABLE 4-5. CRCCOMPUTECRC16() | | |
|---|---|---|
| **Entity** | **Name** | **Description** |
| **Function** | CrcComputeCrc16 | Computes the 16-bit CRC-16-CCITT checksum.<br>Uses a lookup table to compute the CRC-16-CCITT checksum with the generator polynomial = 0x1021. |
| **Parameter** | u8Data | Data Type: (unsigned char)<br>Provides the current data passed to compute the CRC. |
| | u16CurrCrc | Data Type: (unsigned short int)<br>Provides the previously computed CRC Checksum. |
| **Return type** | unsigned short int | Returns the updated CCITT 16 bit CRC. |

### 4.4 Compensation Sequence

1. Set the endianness of the processor/controller where the sample code is planned to be integrated in "Pressure_Comp.h" file Defines section (set only one of the following):
   - If little-endian, set "#define LITTLE_ENDIAN_FORMAT"
   - If big-endian, set "#define BIG_ENDIAN_FORMAT"
2. Include the four source files "Pressure_Comp.c", "Pressure_Comp.h", "crc.c", "crc.h" into the project build directory structure.
3. Include the interface "#include "Pressure_Comp.h" in the source file where the pressure needs to be compensated.
4. Read and store the EEPROM contents in the application memory.
5. Initialize the "Pressure_Comp" module by calling the Compensate_Pressure_Init() function by passing the buffer pointer to the function. Check for the return status of type "CompStatus_Enum" ensure the same is "COMPINIT_OK".
6 Set the reference pressure and temperature at which the AutoZero correction should happen. Read the raw pressure and temperature data from the sensor, pass the same as parameters to the AutoZero_Pressure() function. Check for the return status of type "CompStatus_Enum" to ensure it is the same as "COMPINIT_OK".
7. Read the raw pressure and temperature data from the sensor, pass the same as parameters to the Compensate_Pressure() function. Check "CompReturn_Struct.CompStatus" returned is PRESSURE_VALID and get the compensated pressure data from "CompReturn_Struct. f32PressureOutput".

## NOTICE

Initialization of the "Pressure_Comp" module is done by calling the Compensate_Pressure_Init() function prior to calling the Compensate_Pressure() function. If the initialization is not successful the same status is outputted from the Compensate_Pressure() function. When the Compensate_Pressure() function returns any status other than the PRESSURE_VALID status, the output pressure data should be discarded and should not be processed further.

### 4.5 Constraints

The following considerations must be met to ensure the compiler settings are set to achieve the data type sizes shown in Table 4-6.

- Ensure the "float" data type is as per the IEEE 754 single-precision binary floating-point format: binary32.
- Ensure the endianness of the microcontroller has been configured correctly in the "Pressure_Comp.h" function.
- Ensure the sample code has a minimum of 1 kB of RAM for its operation.

**TABLE 4-6. DATA TYPE SIZES**

| Data Type | Size |
|---|---|
| **Unsigned char 1** | 1 byte |
| **Float** | 4 byte (IEEE754) |
| **Unsigned short int** | 2 byte |
| **Unsigned long int** | 4 byte |

## NOTICE

The sample code provided has been tested on a limited number of microcontrollers and compliers to ensure proper functionality on a well defined/designed target system. The application developer needs to ensure compiler dependence as well as compatibility of the code with target environment.

### 5.0 SENSOR OFFSET ZERO CORRECTION PROCEDURE

Offset correction is a compensation technique based on sampling the output at a known reference condition within the compensated temperature and compensated pressure range of the sensor. Typically, a zero pressure reference, such as atmospheric pressure (or equal pressures on both pressure ports for a differential device), is used to allow the external correction of the offset error. Use the following sequence:

1. Set the sensor to zero pressure.
2. Measure $P_{raw}$ and $T_{raw}$ at a known zero reference ($P_{raw0}$, $T_{raw0}$, for example).
3. Calculate $P_{raw\_AZero}$ = ($OffsetCoefficient_3 * T_{raw0}^3$ + $OffsetCoefficient_2 * T_{raw0}^2$ + $Offset\ Coefficient_1 * T_{raw0}$ + $OffsetCoefficient_0$) - $P_{raw0}$.
4. Add the $P_{raw\_AZero}$ value to all $P_{raw}$ values for use in the standard algorithm (see Section 1.3).
5. Calculate $P_{int1}$ and $P_{int2}$ as usual but use the modified $P_{raw}$ values.

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