

## ASDX Series Silicon Pressure Sensors

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Low Pressure and Ultra-Low Pressure Digital Output,  $\pm 2\%$  Total Error Band, 10 Inches H<sub>2</sub>O to 100 psi



### DESCRIPTION

The ASDX Series is a Silicon Pressure Sensor offering either an I<sup>2</sup>C or SPI digital interface for reading pressure over the specified full scale pressure span and temperature range.

The ASDX is fully calibrated and temperature compensated for sensor offset, sensitivity, temperature effects and non-linearity using an on-board Application Specific Integrated Circuit (ASIC). Calibrated output values for pressure are updated at approximately 1 kHz.

The standard ASDX is calibrated over the temperature range of 0 °C to 85 °C [32 °F to 185 °F]. The sensor is characterized for operation from a single power supply of either 3.3 Vdc or 5.0 Vdc.

### FEATURES

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- Output options: I<sup>2</sup>C- or SPI-compatible 12-bit digital
- Precision ASIC conditioning and temperature compensated over 0 °C to 85 °C [32 °F to 185 °F] temperature range
- Low operating voltage
- Absolute, differential and gage types
- Pressure ranges from 10 inches H<sub>2</sub>O to 100 psi
- Standard calibrations in inches H<sub>2</sub>O, cm H<sub>2</sub>O, psi, mbar, bar, kPa
- Total error band of  $\pm 2.0\%$  of full scale span maximum
- RoHS compliant

These sensors are available to measure absolute, differential and gage pressures. The absolute versions have an internal vacuum reference and an output value proportional to absolute pressure. Differential versions allow application of pressure to either side of the sensing diaphragm. Gage versions are referenced to atmospheric pressure and provide an output proportional to pressure variations from atmosphere.

The ASDX Series sensors are intended for use with non-corrosive, non-ionic working fluids such as air and dry gases. They are designed and manufactured according to standards in ISO 9001.

### POTENTIAL APPLICATIONS

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- Flow calibrators
- Ventilation and air flow monitors
- Gas flow instrumentation
- Sleep apnea monitoring and therapy equipment
- Barometry
- Pneumatic controls
- HVAC

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**Table 1. Absolute Maximum Ratings<sup>1</sup>**

| Parameter  | Min       | Max                       | Unit    |
|--|-----------|---------------------------|---------|
| Supply voltage ( $V_{\text{supply}}$ )                                   | -0.3      | 6.0                       | Vdc     |
| Voltage to any pin   | -0.3      | $V_{\text{supply}} + 0.3$ | Vdc     |
| Digital clock frequency:   |           |                           |         |
| I <sup>2</sup> C   | 100       | 400                       | kHz     |
| SPI  | 50        | 800                       |         |
| ESD susceptibility (human body model)                                    | 3         | -                         | kV      |
| Storage temperature  | -50 [-58] | 125 [257]                 | °C [°F] |
| Lead temperature (2 s to 4 s)  | -         | 250 [482]                 | °C [°F] |
| External capacitance between $V_{\text{supply}}$ and ground <sup>2</sup> | 100       | 470                       | nF      |

**Table 2. Operating Specifications**

| Parameter  | Min.                                | Typ.             | Max.      | Unit                |
|--|-------------------------------------|------------------|-----------|---------------------|
| Supply voltage: ( $V_{\text{supply}}$ ) <sup>3</sup>                             |                                     |                  |           | Vdc                 |
| 3.3 Vdc  | 3.0                                 | 3.3 <sup>4</sup> | 3.6       |                     |
| 5.0 Vdc  | 4.75                                | 5.0 <sup>4</sup> | 5.25      |                     |
| <i>Sensors are either 3.3 Vdc or 5.0 Vdc per the Order Guide (see Figure 1).</i> |                                     |                  |           |                     |
| Supply current   | 2.0                                 | 3.5              | 5.0       | mA                  |
| Compensated temperature range <sup>5</sup>                                       | 0 [32]                              | -                | 85 [185]  | °C [°F]             |
| Operating temperature range <sup>6</sup>   | -20 [-4]                            | -                | 105 [221] | °C [°F]             |
| Overpressure <sup>7</sup>  | 2X operating pressure range minimum |                  |           |                     |
| Burst pressure <sup>8</sup>  | 3X operating pressure range minimum |                  |           |                     |
| Startup time (power up to data ready)  | -                                   | 2.8              | 7.3       | ms                  |
| Response time  | -                                   | 0.46             | -         | ms                  |
| I <sup>2</sup> C or SPI voltage level low  | -                                   | -                | 0.2       | $V_{\text{supply}}$ |
| I <sup>2</sup> C or SPI voltage level high                                       | 0.8                                 | -                | -         | $V_{\text{supply}}$ |
| Pull-up on SDA and SCL (I <sup>2</sup> C output only)                            | 1                                   | -                | -         | kOhm                |
| Total error band <sup>9</sup>  | -                                   | -                | 2.0       | %FSS <sup>10</sup>  |
| Output resolution  | 12                                  | -                | -         | bits                |

**Table 3. Environmental Specifications**

| Parameter | Characteristic              |
|-----------|-----------------------------|
| Humidity  | 0% to 95% RH non-condensing |
| Vibration | 10 G at 20 Hz to 2000 Hz    |
| Shock     | 100 G for 11 ms             |
| Life      | 1 million cycles minimum    |

**Table 4. Wetted Materials<sup>11</sup>**

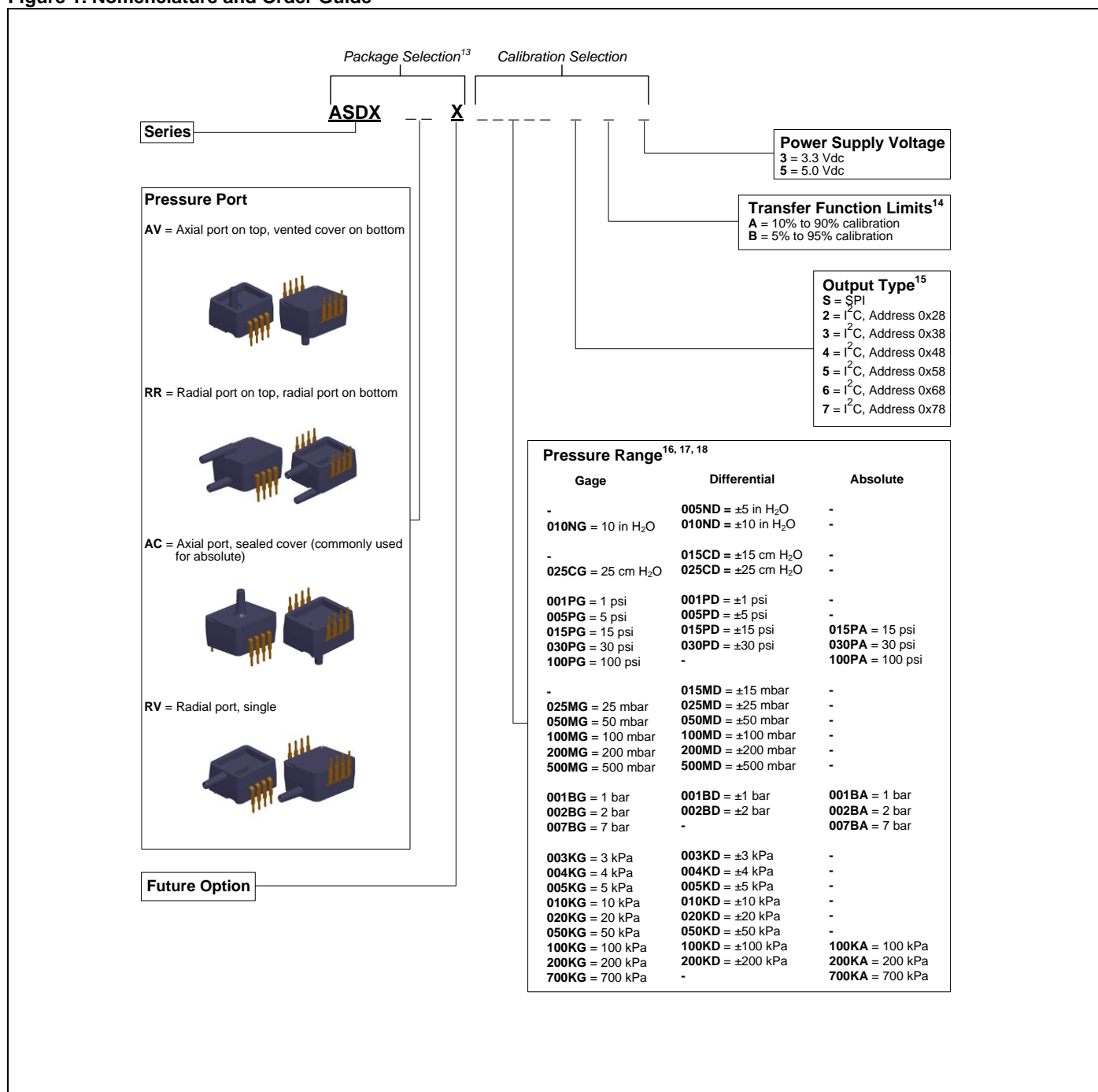
| Parameter             | Port 1 (Pressure Port) <sup>12</sup> | Port 2 (Reference Port) <sup>12</sup> |
|-----------------------|--------------------------------------|---------------------------------------|
| Covers                | glass-filled PBT                     | glass-filled PBT                      |
| Adhesives             | silicone                             | silicone and epoxy                    |
| Electronic components | silicon and glass                    | silicon, glass, and gold              |

**Notes:**

- Absolute maximum ratings are the extreme limits that the device will withstand without damage to the device.
- An external bypass capacitor is **required** across the supply voltage (Pins 6 and 3 – see Figure 4) as close to the sensor supply pin as possible for correct sensor operation.
- Ratiometricity of the sensor (the ability of the output to scale to the input voltage) is achieved within the specified operating voltage for each option. Other custom supply voltages are available, please contact Honeywell Customer Service.
- The sensor is not reverse polarity protected. Incorrect application of excitation voltage or ground to the wrong pin may cause electrical failure.
- The compensated temperature range is the temperature range (or ranges) over which the sensor will produce an output proportional to pressure within the specified performance limits.
- The operating temperature range is the temperature range over which the sensor will produce an output proportional to pressure but may not remain within the specified performance limits.
- Overpressure is 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.
- Burst pressure is 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.
- Total error band is the maximum deviation in output from 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. Specification units are in percent of full scale span (%FSS).
- Full scale span (FSS) is the algebraic difference between the output signal measured at the maximum (Pmax.) and minimum (Pmin.) limits of the pressure range.
- Consult Honeywell Customer Service for detailed material information.
- For AC pressure port configuration, the “pressure” and “reference” ports are reversed.

# Low and Ultra-Low Pressure Digital Output

Figure 1. Nomenclature and Order Guide



**Notes:**

- Other package combinations are possible, please contact Honeywell Customer Service.
- The transfer function limits define the output of the sensor at a given pressure input. By specifying the output signal at the maximum (Pmax.) and minimum (Pmin.) limits of the pressure range, the complete transfer curve for the sensor is defined. See Figure 2 for a graphical representation of each calibration. For the 12-bit digital output, Table 6 provides the output of the sensor at significant percentages. These outputs are valid at the rated input voltage of the sensor.
- The output type defines which communication protocol the sensor uses to communicate. Available protocols are I<sup>2</sup>C or half duplex SPI (sensor acts only as a slave). This communication protocol is not field selectable, and must be defined when ordering the sensor.
- Custom pressure ranges are available, please contact Honeywell Customer Service.
- The pressure units (inches H<sub>2</sub>O, cm H<sub>2</sub>O, psi, mbar, bar, kPa) define the units used during calibration and in the application.
- See Table 5 for an explanation of sensor types.

# ASDX Series Silicon Pressure Sensors

Table 5. Sensor Types

| Type         | Description   |
|--------------|---|
| Absolute     | Output is proportional to difference between applied pressure and built-in reference to vacuum (zero pressure). |
| Gage         | Output is proportional to difference between applied pressure and atmospheric (ambient) pressure.               |
| Differential | Output is proportional to difference between pressure applied to each of the pressure ports (Port 1 – Port 2).  |

Figure 2. Transfer Functions and Limits

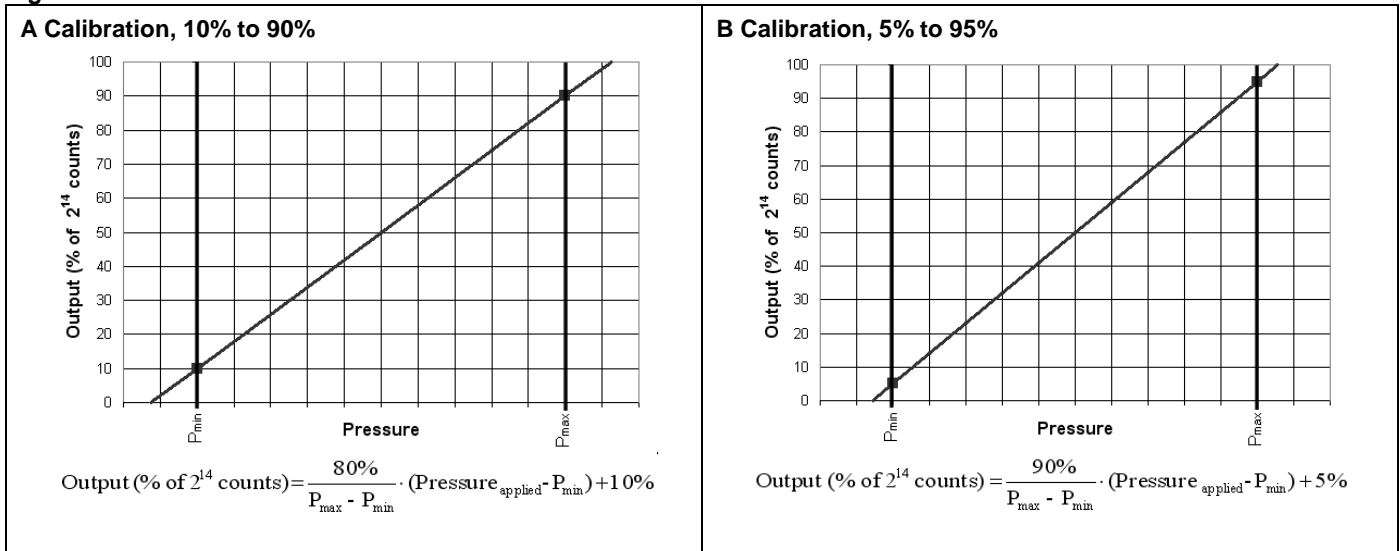
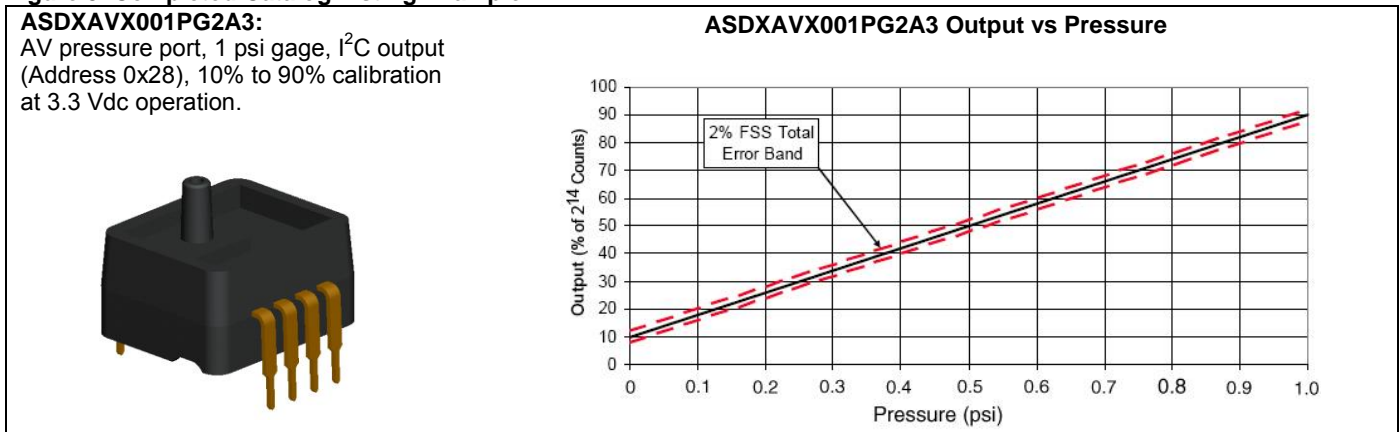


Table 6. Sensor Output at Significant Percentages

| % Output | Digital Counts (dec) | Digital Counts (hex) |
|----------|----------------------|----------------------|
| 0%       | 0                    | 0x0000               |
| 5%       | 819                  | 0x0333               |
| 10%      | 1638                 | 0x0666               |
| 50%      | 8192                 | 0x2000               |
| 90%      | 14746                | 0x399A               |
| 95%      | 15565                | 0x3CCD               |
| 100%     | 16383                | 0x3FFF               |

Figure 3. Completed Catalog Listing Example



# Low and Ultra-Low Pressure Digital Output

Figure 4. Dimensional Drawings (For reference only: mm [in].)

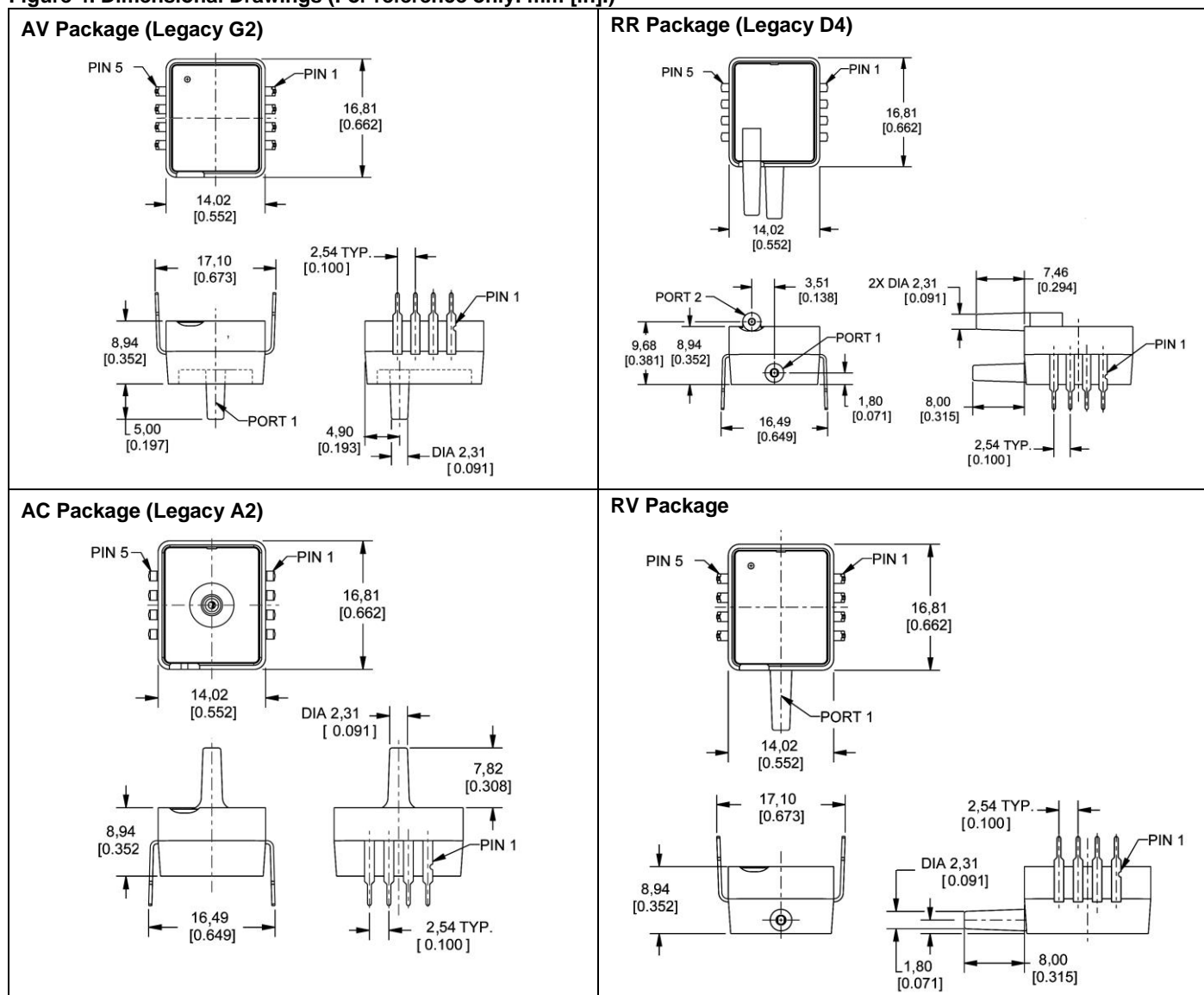


Table 7. Pinout

| I <sup>2</sup> C |            |                |   | SPI |            |                |  |
|------------------|------------|----------------|---|-----|------------|----------------|--|
| Pin              | Definition | Type           | Description   | Pin | Definition | Type           | Description  |
| 1                | SDA        | digital I/O    | serial bidirectional data; data is clocked in or out on clock edge of SCL | 1   | MISO       | digital output | "Master In Slave Out" - serial output data; data is clocked out on clock edge of SCK |
| 2                | SCL        | digital input  | serial clock input; used to clock data on SDA                             | 2   | SCK        | digital input  | serial clock input; used to clock data on MISO                                       |
| 3                | GND        | supply         | power supply ground   | 3   | GND        | supply         | power supply ground  |
| 4                | N/C        | not used       | do not connect in the application   | 4   | N/C        | not used       | do not connect in the application  |
| 5                | SS         | digital output | interrupt signal (conversion complete output)                             | 5   | SS         | digital input  | slave select   |
| 6                | Vsupply    | supply         | power supply source   | 6   | Vsupply    | supply         | power supply source  |
| 7                | N/C        | not used       | do not connect in the application   | 7   | N/C        | not used       | do not connect in the application  |
| 8                | N/C        | not used       | do not connect in the application   | 8   | N/C        | not used       | do not connect in the application  |

## **WARNING**

### **PERSONAL INJURY**

DO NOT USE these products as safety or emergency stop devices or in any other application where failure of the product could result in personal injury.

**Failure to comply with these instructions could result in death or serious injury.**

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## **WARNING**

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- The information presented in this product sheet is for reference only. Do not use this document as a product installation guide.
- Complete installation, operation, and maintenance information is provided in the instructions supplied with each product.

**Failure to comply with these instructions could result in death or serious injury.**

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