

TruStability™ Silicon Pressure Sensors: HSC Series – High Accuracy

±1 % Total Error Band, Digital Output, SIP, 60 mbar to 10 bar



DESCRIPTION

The TruStability™ High Accuracy Silicon Ceramic (HSC) Series is a piezoresistive silicon pressure sensor offering a ratiometric analog output for reading pressure over the specified full scale pressure span and temperature range.

The HSC Series 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 2 kHz.

The HSC Series is calibrated over the temperature range of 0 °C to 50 °C [32 °F to 122 °F]. The sensor is characterized for operation from a single power supply of either 3.3 Vdc or 5.0 Vdc.

These sensors 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 and compound versions are referenced to atmospheric pressure and provide an output proportional to pressure variations from atmosphere.

The HSC 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.

FEATURES

- Industry-leading long-term stability
- Extremely tight accuracy of ±0.25 % FSS BFSL*
- Total error band of ±1 % full scale span maximum
- Modular and flexible design offer customers a variety of package styles and options, all with the same industry-leading performance specifications
- Miniature 10 mm x 10 mm [0.39 in x 0.39 in] package
- Low operating voltage
- Extremely low power consumption
- Ratiometric 12-bit analog output
- Precision ASIC conditioning and temperature compensated over 0 °C to 50 °C [32 °F to 122 °F] temperature range
- RoHS compliant
- Virtually insensitive to mounting orientation
- Internal diagnostic functions increase system reliability
- Also available with I²C and SPI digital output, and in SMT and DIP packages
- Absolute, differential, gage and compound types
- Pressure ranges from 60 mbar to 10 bar (1 psi to 150 psi)
- Custom calibration available
- Various pressure port options

* Full Scale Span Best Fit Straight Line

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POTENTIAL APPLICATIONS

- | | |
|---|--|
| <ul style="list-style-type: none"> • Medical: <ul style="list-style-type: none"> - Airflow monitors - Anesthesia machines - Blood analysis machines - Gas chromatography - Gas flow instrumentation - Kidney dialysis machines - Oxygen concentrators - Pneumatic controls - Respiratory machines - Sleep apnea equipment - Ventilators | <ul style="list-style-type: none"> • Industrial: <ul style="list-style-type: none"> - Barometry - Flow calibrators - Gas chromatography - Gas flow instrumentation - HVAC - Life sciences - Pneumatic controls |
|---|--|

Table 1. Absolute Maximum Ratings¹

| Parameter | Min. | Max. | Unit |
|--|-----------|---------------------------|-----------|
| Supply voltage (V_{supply}) | -0.3 | 6.0 | V |
| Voltage on any pin | -0.3 | $V_{\text{supply}} + 0.3$ | V |
| Digital interface clock frequency | 100 | 400 | kHz |
| ESD susceptibility (human body model) | 3 | - | kV |
| Storage temperature | -40 [-40] | 85 [185] | ° C [° F] |
| Lead temperature (2 s to 4 s) | - | 250 [482] | ° C [° F] |

Table 2. Operating Specifications

| Parameter | Min. | Typ. | Max. | Unit |
|--|----------|------------------|----------|---------------------|
| Supply voltage (V_{supply}) ² | | | | |
| 3.3 V | 3.0 | 3.3 ³ | 3.3 | Vdc |
| 5.0 V | 4.75 | 5.0 ³ | 5.25 | |
| <i>Sensors are either 3.3 or 5.0 V based on model selected</i> | | | | |
| Supply current | | | | |
| 3.3 V supply | - | 1.6 | 2.1 | mA |
| 5.0 V supply | - | 2 | 3 | |
| Compensated temperature range ⁴ | 0 [32] | - | 50 [122] | ° C [° F] |
| Operating temperature range ⁵ | -20 [-4] | - | 85 [185] | ° C [° F] |
| Startup time (power up to data ready) | - | 2.8 | 7.3 | ms |
| Response time | - | 0.46 | - | ms |
| I ² C voltage level low | - | - | 0.2 | V_{supply} |
| I ² C voltage level high | 0.8 | - | - | V_{supply} |
| Pull up on SDA and SCL | 1 | - | - | kOhm |
| Accuracy ⁶ | - | - | ±0.25 | %FSS BFUL |
| Total error band ⁷ | - | - | ±1 | %FSS ⁸ |
| Output resolution | 12 | - | - | bits |

Table 3. Environmental Specifications

| Parameter | Characteristic |
|-------------------|--|
| Humidity | 0 % to 95 % RH, non-condensing |
| Vibration | MIL-STD-202F, Curve AK (20.7 g random) |
| Shock | MIL-STD-202F, Method 213B, Condition F |
| Life ⁹ | 1 million cycles minimum |

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Table 4. Wetted Materials¹⁰

| Parameter | Port 1 (Pressure Port) | Port 2 (Reference Port) |
|-----------------------|---------------------------------|------------------------------|
| Covers | high temperature polyamide | high temperature polyamide |
| Substrate | alumina ceramic | alumina ceramic |
| Adhesives | epoxy, RTV | epoxy, RTV |
| Electronic components | ceramic, glass, solder, silicon | silicon, glass, gold, solder |

Notes:

1. Absolute maximum ratings are the extreme limits the device will withstand without damage.
2. Ratiometricity of the sensor (the ability of the device to scale to the supply voltage) is achieved within the specified operating voltage for each option. Other custom supply voltages are available, please contact Honeywell Customer Service.
3. The sensor is not reverse polarity protected. Incorrect application of supply voltage or ground to the wrong pin may cause electrical failure.
4. The compensated temperature range is the temperature range over which the sensor will produce an output proportional to pressure within the specified performance limits.
5. 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.
6. Accuracy: The maximum deviation in output from a Best Fit Straight Line (BFSL) fitted to the output measured over the pressure range at 25 °C [77 °F]. Includes all errors due to pressure non-linearity, pressure hysteresis, and non-repeatability.
7. 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.
8. Full Scale Span (FSS) is the algebraic difference between the output signal measured at the maximum (P_{max}) and minimum (P_{min}) limits of the pressure range. (See Figure 1 for ranges).
9. Life may vary depending on specific application in which sensor is utilized.
10. Contact Honeywell Customer Service for detailed material information.

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Figure 1. Nomenclature and Order Guide



Notes:

- The transfer function limits define the output of the sensor at a given pressure input. By specifying P_{min} and P_{max} , the output at P_{min} and P_{max} the complete transfer function of the sensor is defined. See Figure 2 for a graphical representation of the transfer function. Other transfer functions are available. Contact Honeywell Customer Service for more information.
- Digital outputs (SPI and I²C) are also available. Contact Honeywell Customer Service for more information.
- Custom pressure ranges are available. Contact Honeywell Customer Service for more information.
- See Table 5 for an explanation of sensor types.

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Figure 2. Transfer Functions and Limits



Figure 3. Completed Catalog Listing Example

HSCSANN010BGSA3: SIP, AN ports, no diagnostics, 10 bar gage sensor, 10 % to 90 % calibration at 3.3 V.



Table 5. Sensor Types

| Pressure Type | Description |
|---------------|--|
| Absolute | Output is proportional to the difference between applied pressure and a built-in reference to vacuum. P _{min} is set at absolute zero pressure (full vacuum). |
| Compound | Output is proportional to the difference between applied pressure and atmospheric (ambient) pressure. P _{min} is set at -1 bar G, referenced to atmospheric pressure. |
| Differential | Output is proportional to the difference between the pressures applied to each port. (Port1 – Port2) 50% point of transfer function set at Port1 = Port2. |
| Gage | Output is proportional to the difference between applied pressure and atmospheric (ambient) pressure. P _{min} is set at atmospheric pressure. |

Table 6. Sensor Output at Significant Percentages

| % Output | Digital Counts (decimal) | Digital Counts (hex) |
|----------|--------------------------|----------------------|
| 0 | 0 | 0x0000 |
| 10 | 1638 | 0x0666 |
| 50 | 8192 | 0x2000 |
| 90 | 14746 | 0x399A |
| 100 | 16383 | 0x3FFF |

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Table 7. Pressure Range Specifications

| Pressure Range Order Code | Pressure Range | | Over-pressure ¹⁴ | Burst Pressure ¹⁵ | Common Mode Pressure ¹⁶ | Long-term Stability (1000 hr, 25 °C [77 °F]) |
|---------------------------|------------------|------------------|-----------------------------|------------------------------|------------------------------------|--|
| | P _{min} | P _{max} | | | | |
| Absolute | | | | | | |
| 600AM | 0 mbar A | 600 mbar A | 2 bar A | 4 bar A | NA | ±0.35 % |
| 001AB | 0 bar A | 1 bar A | 2 bar A | 4 bar A | NA | ±0.25 % |
| 1.6AB | 0 bar A | 1.6 bar A | 4 bar A | 8 bar A | NA | ±0.25 % |
| 2.5AB | 0 bar A | 2.5 bar A | 6 bar A | 8 bar A | NA | ±0.25 % |
| 004AB | 0 bar A | 4 bar A | 8 bar A | 16 bar A | NA | ±0.25 % |
| 006AB | 0 bar A | 6 bar A | 17 bar A | 17 bar A | NA | ±0.25 % |
| 010AB | 0 bar A | 10 bar A | 17 bar A | 17 bar A | NA | ±0.25 % |
| Differential | | | | | | |
| 060MD | -60 mbar | 60 mbar | 500 mbar | 700 mbar | 10 bar | ±0.35 % |
| 100MD | -100 mbar | 100 mbar | 500 mbar | 700 mbar | 10 bar | ±0.35 % |
| 160MD | -160 mbar | 160 mbar | 500 mbar | 700 mbar | 10 bar | ±0.35 % |
| 250MD | -250 mbar | 250 mbar | 1.4 bar | 2.5 bar | 10 bar | ±0.35 % |
| 400MD | -400 mbar | 400 mbar | 1.4 bar | 2.5 bar | 10 bar | ±0.35 % |
| 600MD | -600 mbar | 600 mbar | 2 bar | 4 bar | 10 bar | ±0.25 % |
| 001BD | -1 bar | 1 bar | 2 bar | 4 bar | 10 bar | ±0.25 % |
| Gage | | | | | | |
| 060MG | 0 mbar to | 60 mbar | 500 mbar | 700 mbar | 3.5 bar | ±0.35 % |
| 100MG | 0 mbar to | 100 mbar | 500 mbar | 700 mbar | 10 bar | ±0.35 % |
| 160MG | 0 mbar to | 160 mbar | 500 mbar | 700 mbar | 10 bar | ±0.35 % |
| 250MG | 0 mbar to | 250 mbar | 1.4 bar | 2.5 bar | 10 bar | ±0.35 % |
| 400MG | 0 mbar to | 400 mbar | 1.4 bar | 2.5 bar | 10 bar | ±0.35 % |
| 600MG | 0 mbar to | 600 mbar | 2 bar | 4 bar | 10 bar | ±0.35 % |
| 001BG | 0 bar | 1 bar | 2 bar | 4 bar | 10 bar | ±0.25 % |
| 1.6BG | 0 bar | 1.6 bar | 4 bar | 8 bar | 10 bar | ±0.25 % |
| 2.5BG | 0 bar | 2.5 bar | 6 bar | 8 bar | 10 bar | ±0.25 % |
| 004BG | 0 bar | 4 bar | 8 bar | 16 bar | 16 bar | ±0.25 % |
| 006BG | 0 bar | 6 bar | 17 bar | 17 bar | 17 bar | ±0.25 % |
| 010BG | 0 bar | 10 bar | 17 bar | 17 bar | 17 bar | ±0.25 % |
| Compound | | | | | | |
| 2.5BC | -1 bar | 2.5 bar | 6 bar | 8 bar | 10 bar | ±0.25 % |
| 004BC | -1 bar | 4 bar | 8 bar | 16 bar | 16 bar | ±0.25 % |
| 006BC | -1 bar | 6 bar | 17 bar | 17 bar | 17 bar | ±0.25 % |
| 010BC | -1 bar | 10 bar | 17 bar | 17 bar | 17 bar | ±0.25 % |

Notes:

15. 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.
16. 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.
17. 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.

Table 8. Pinout for All Port Styles

| Output Type | Pin 1 | Pin 2 | Pin 3 | Pin 4 |
|------------------|--------|---------------------|-------|-------|
| I ² C | Ground | V _{supply} | SDA | SCL |

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Figure 4. Package Dimensional Drawings

(For reference only: mm [in])

(Other package combinations are possible, please contact Honeywell Customer Service.)



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Figure 4. Package Dimensional Drawings (continued)



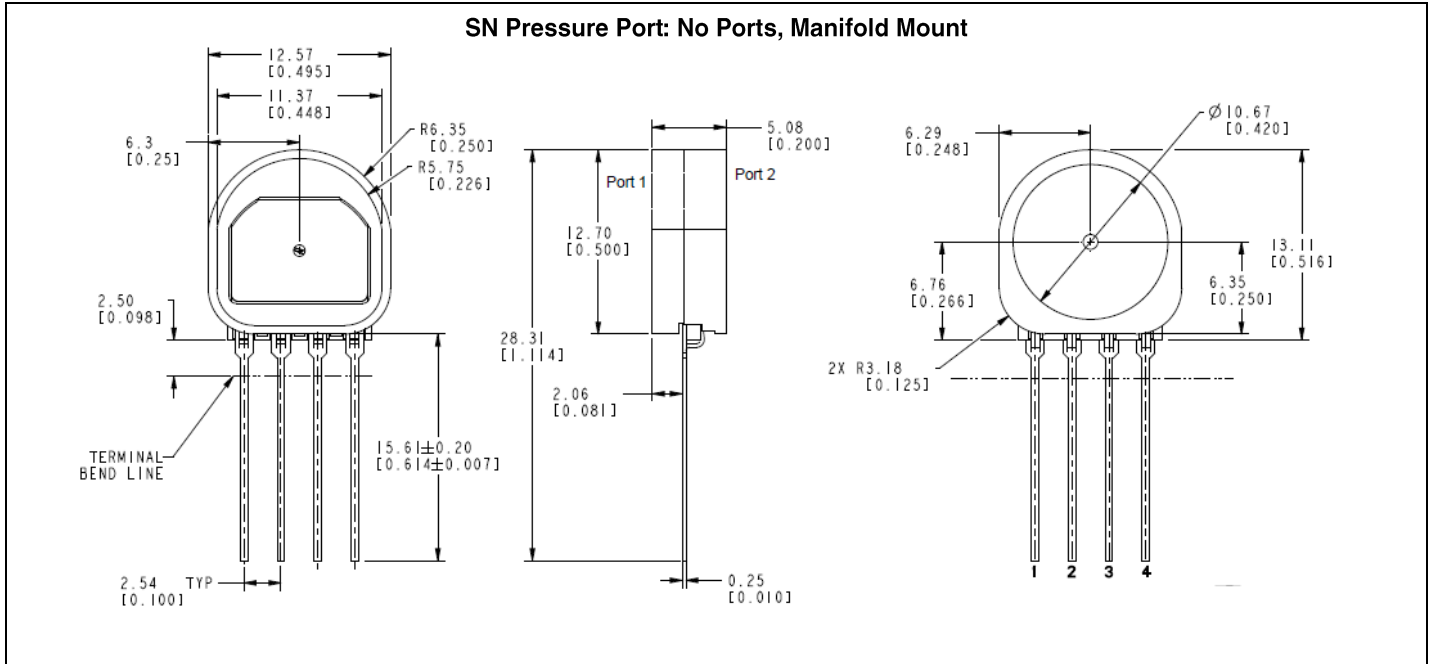
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Figure 4. Package Dimensional Drawings (continued)



$\pm 1\%$ Total Error Band, SIP, Digital Output, 60 mbar to 10 bar

Figure 4. Package Dimensional Drawings (continued)



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.

WARRANTY/REMEDY

Honeywell warrants goods of its manufacture as being free of defective materials and faulty workmanship. Honeywell's standard product warranty applies unless agreed to otherwise by Honeywell in writing; please refer to your order acknowledgement or consult your local sales office for specific warranty details. If warranted goods are returned to Honeywell during the period of coverage, Honeywell will repair or replace, at its option, without charge those items it finds defective. **The foregoing is buyer's sole remedy and is in lieu of all other warranties, expressed or implied, including those of merchantability and fitness for a particular purpose. In no event shall Honeywell be liable for consequential, special, or indirect damages.**

While we provide application assistance personally, through our literature and the Honeywell web site, it is up to the customer to determine the suitability of the product in the application.

Specifications may change without notice. The information we supply is believed to be accurate and reliable as of this printing. However, we assume no responsibility for its use.

WARNING

MISUSE OF DOCUMENTATION

- 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.

SALES AND SERVICE

Honeywell serves its customers through a worldwide network of sales offices, representatives and distributors. For application assistance, current specifications, pricing or name of the nearest Authorized Distributor, contact your local sales office or:

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