# | P1J
Pressure Sensor

## Description

The P1J series of pressure sensors incorporates a piezo-resistive sensing element in a compact package. Using a 2.7 to 5.5 VDC supply voltage, the P1J provides a SPI or I2C digital output as required by your application. Internal temperature compensation provides and accurate, easy to use sensor. The industry standard terminal pins provides ease of use for your printed circuit board designs.
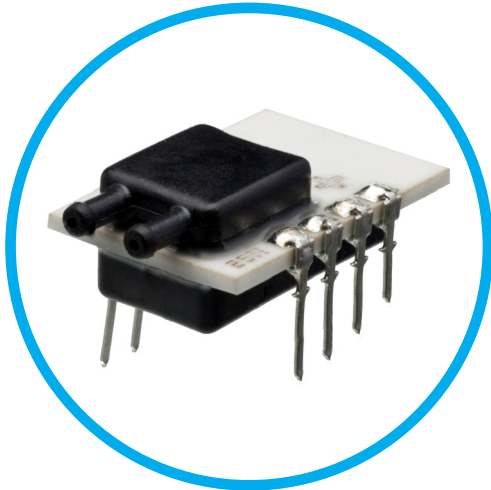


## Features

- Compact Package
- Amplified Temperature Compensated Digital Output
- No Position Sensitivity above 0-2"H2O
- EMI/RFI and ESD Protected
- Superior Output Signal Stability
- Printed Circuit Board through Hole Mounting

## Applications

- Variable Air Volume Systems
- Filter Pressure Monitoring
- Duct Air Flow
- Modulated Furnace Controls
- Combustion Airflow
- Gaseous Leak Detection
- **Medical Applications:**
  Oxygen Concentrators, Ventilators, Anesthesia Equipment, CPAP, Wound Therapy.

## MAIN FEATURES

| | |
|---|---|
| **Pressure Ranges** | 2, 5, 10, +/-2, +/- 5, +/- 10 inches of water; 5, 12.5, 25, +/- 5, +/- 6, +/- 12.5, +/- 25 mbar |
| **Electrical Connection** | PCB thru hole terminal pins, 2.54 mm [.100 inch] pitch |
| **Pressure Connection** | Barbed port, 1.9[.08] diameter |
| **Housing Material** | PPS, 40% glass filled, black |
| **Terminal Pin Material** | Phosphor bronze, tin plated |
| **Supply Voltage** | 2.7 to 5.5 VDC |
| **Output Signal** | 14 Bit Digital Output Count – Digital count at null (0% FS): 1638<br>Digital count at full scale (100% FS) 14745 |

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## Pressure Ranges

| from 0 to... | 2" H2O | 5" H2O | 10" H2O | +/- 2" mBar | +/- 5" mBar |
|---|---|---|---|---|---|
| from 0 to... | 5mbar | 12.5mbar | 20mbar | +/- 5mbar | +/- 12.5 mbar |
| Proof Pressure Factor | 1.0 PSI/ (70mbar) | 1.0 PSI/ (70mbar) | 1.0 PSI/ (70mbar) | 1.0 PSI/ (70mbar) | 1.0 PSI/ (70mbar) |
| Burst Pressure Factor | 1.8 PSI/ (125mbar) | 1.8 PSI/ (125mbar) | 1.8 PSI/ (125mbar) | 1.8 PSI/ (125mbar) | 1.8 PSI/ (125mbar) |

## Physical

| | |
|---|---|
| Expected Operating Life | 10 million full pressure life cycles |
| Shelf Life | 10 years minimum |
| Stability | +/- 0.5% of full scale span for 1 year |
| Vibration | 10 G's peak to peak sinusoidal (20 to 1600Hz) |
| Shock Resistance | 50 G's ½ Sinewave, 11 mSec pulse, 18 pulses (6 per axis) |
| Weight | 3.5g max. |
| Operating Temperature | -20°C to 85°C |
| Storage Temperature | -40°C to 85°C |
| Humidity | Up to 92% RH in a non-condensing environment |
| Media | Dry air |

## Performance

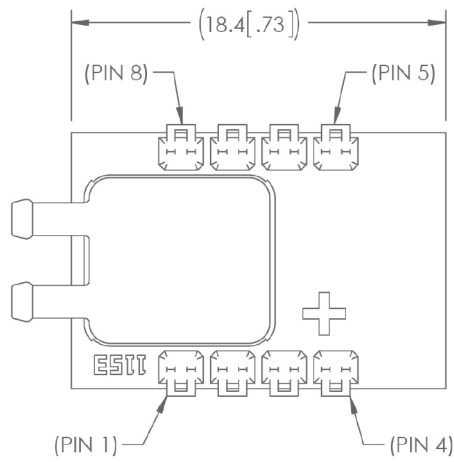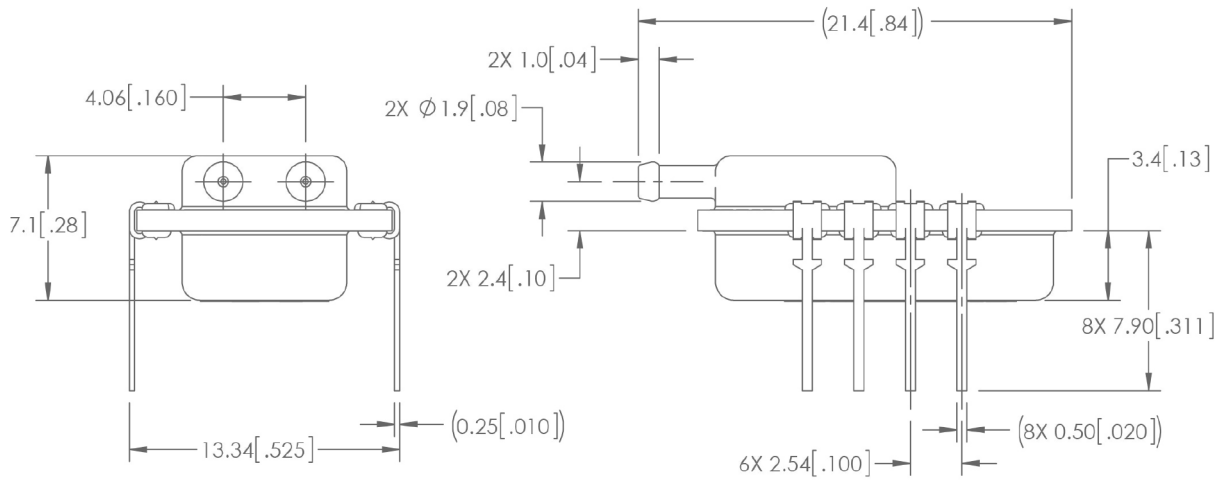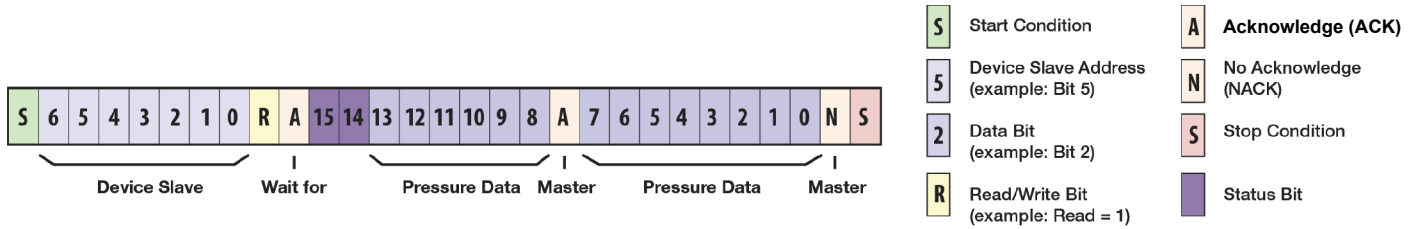| | |
|---|---|
| Accuracy | 0.25% Max (% of full scale span) (RSS of linearity, hysteresis and repeatability) |
| Temp. Error | 0.05%/ C [% of full scale span] |
| Temp. Error | 5% full scale span within temperature range -20° to 0°C and 60° to 85°C 0 to 60°C |

## Electrical

| | |
|---|---|
| Input Voltage Protection | -0.3 to 6 VDC on Vin PIN, -0.3 to Vs+0.3 on all other pins |
| Excitation Current | < 2.5mA |
| Minimum Load | 25k Ohms between output and ground |
| Response Time | 0.5 ms |

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4.06[.160]

7.1[.28]

13.34[.525]

(0.25[.010])

(21.4[.84])

2X 1.0[.04]

2X ⌀ 1.9[.08]

2X 2.4[.10]

3.4[.13]

8X 7.90[.311]

(8X 0.50[.020])

6X 2.54[.100]

(18.4[.73])

(PIN 8)

(PIN 5)

(PIN 1)

(PIN 4)

ESII

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| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| S | Start Condition | | | A | Acknowledge (ACK) | | | | |
| 5 | Device Slave Address (example: Bit 5) | | | N | No Acknowledge (NACK) | | | | |
| 2 | Data Bit (example: Bit 2) | | | S | Stop Condition | | | | |
| R | Read/Write Bit (example: Read = 1) | | | | Status Bit | | | | |

## Output

| Signal Resolution | 12 Bits (11 bits minimum for 0-2" H2O and 0-5 mBar range) | | | |
|---|---|---|---|---|
| **Update Rate** | 0.5 ms | | | |
| **Digital Count at 0% Pressure** | 1638 (10% of 2^14 counts or 0x666) | | | |
| **Digital Count at 100% Pressure** | 14745 (90% of 2^14 counts or 0x3999) | | | |
| **Sensor Slave Addresses** | 40 (0x28), 56 (0x38), 72 (0x48), 88 (0x58), 104 (0x68), 120 (0x78) | | | |
| **PARAMETER** | **SYMBOL** | **MIN** | **MAX** | **UNITS** |
| **Analog Supply Voltage to Gnd** | VDD | 2.7 | 5.5 | V |
| **High-level input voltage** | VIH | $0.8 \times VDD$ | VDD | V |
| **Low-level input voltage** | VIL | 0 | $0.2 \times VDD$ | V |
| **High-level output voltage** | VOH | VDD - 0.2 | - | V |
| **Low-level output voltage** | VOL | - | 0.2 | V |
| **Output Sourcing Current** | IOH_SDA | -1.9 | -4.8 | mA |
| **Output Sink Current** | IOL_SDA | 2.3 | 6.2 | mA |
| **Load Capacitance at SDA (@ 400 kHz)** | CSDA | | 200 | pF |
| **Pull-up Resistor** | RI2C_PU | 500 | | Ω |
| **Input Capacitance (each pin)** | CI2C_IN | | 10 | pF |
| **SCL clock frequency** | fSCL | 100 | 400 | kHz |
| **START condition hold time relative to SCL range** | tHDSTA | 0.1 | - | µs |
| **Minimum SCL clock low width 1)** | tLOW | 0.6 | | µs |
| **Minimum SCL clock high width 1)** | tHIGH | 0.6 | | µs |
| **Start condition setup time relative to SCL edge** | tSUSTA | 0.1 | | µs |
| **Data hold time on SDA relative to SCL edge** | tHDDAT | 0 | | µs |
| **Data setup time on SDA relative to SCL edge** | tSUDAT | 0.1 | | µs |
| **Stop condition setup time on SCL** | tSUSTO | 0.1 | | µs |
| **Bus free time between stop condition and start condition** | tBUS | 2 | | µs |
| 1) Combined low and high widths must equal or exceed minimum SCLK period. | | | | |
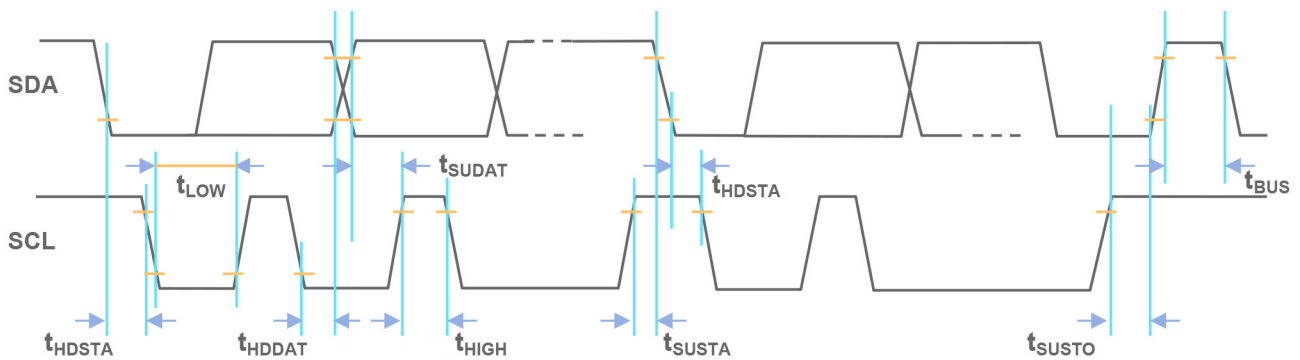
## Note

There are three adjustments to the I2C implementation compared with the original I2C™ protocol:

- Sending a start-stop condition without any transitions on the CLK line (no clock pulses in between) creates a communication error for the next communication, even if the next start condition is correct and the clock pulse is applied. An additional start condition must be sent, which results in restoration of proper communication.
- The restart condition—a falling SDA edge during data transmission when the CLK clock line is still high—creates the same situation. The next communication fails, and an additional start condition must be sent for correct communication.
- A falling SDA edge is not allowed between the start condition and the first rising SCL edge. If using an I2C™ address with the first bit 0, SDA must be held low from the start condition through the first bit.

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## Output Packet with Positive Edge Sampling
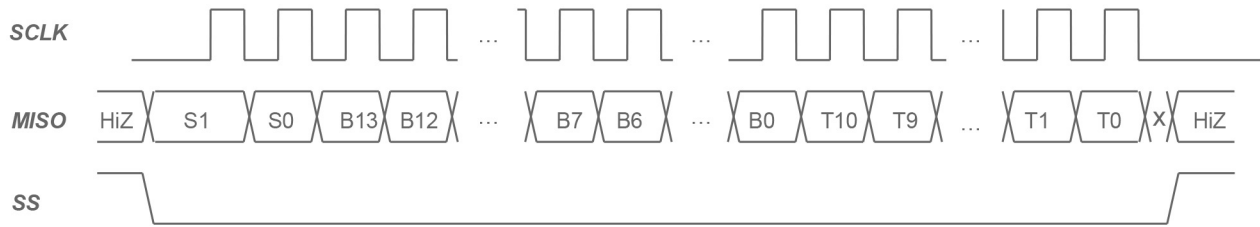


Packet = [ {S(1:0), B(13:8)}, {B(7:0)}, {T(10:3)}, {T(2:0),xxxxx}] Where

   S(1:0) = Status bits of packet (normal, command, busy, diagnostic)

   B(13:8) = Upper 6 bits of 14-bit bridge data

   B(7:0) = Lower 8 bits of 14-bit bridge data

   T(10:0) = NOT corrected temperature data (mask out or terminate read early)

## Output

| Signal Resolution | 12 Bits (11 bits minimum for 0-2" H2O and 0-5 mBar range) | | | |
|---|---|---|---|---|
| **Update Rate** | 0.5 ms | | | |
| **Digital Count at 0% Pressure** | 1638 (10% of 214 counts or 0x666) | | | |
| **Digital Count at 100% Pressure** | 14746 (90% of 214 counts or 0x3999) | | | |
| **PARAMETER** | **SYMBOL** | **MIN** | **MAX** | **UNITS** |
| **Analog Supply Voltage to Gnd** | VDD | 2.7 | 5.5 | V |
| **High-Level Input Voltage** | VIH | $0.8 \times VDD$ | VDD | V |
| **Low-Level Input Voltage** | VIL | 0 | $0.2 \times VDD$ | V |
| **High-Level Output Voltage** | VOH | VDD - 0.2 | - | V |
| **Low-Level Output Voltage** | VOL | - | 0.2 | V |
| **Output Sourcing Current @ VOH** | IOH_MISO | 1.9 | -4.8 | mA |
| | IOH_SS | -0.63 | -1.9 | mA |
| **Output Sink Current @ VOL** | IOL_MISO | 2.3 | 6.2 | mA |
| | IOL_SS | 0.85 | 3.0 | mA |
| **Input Capacitance (Each Pin)** | CI2C_IN | | 10 | pF |
| **SCLK Clock Frequency (4 MHz clock)** | fSCL | 50 | 800 | kHz |
| **SCLK Clock Frequency (1 MHz clock)** | tSCL | 50 | 200 | kHz |
| **SS Drop to First Clock Edge** | tHDSS | 2.5 | | µs |
| **Minimum SCL Clock Low Width 1)** | tLOW | 0.6 | | µs |
| **Minimum SCL Clock High Width 1)** | tHIGH | 0.6 | | µs |
| **Clock Edge to Data Transition** | tCLKD | 0 | 0.1 | µs |
| **Rise of SS Relative to Last Clock Edge** | tSUSS | 0.1 | | µs |
| **Bus Free Time Between Rise and Fall of SS** | tBUS | 2 | | µs |
| 1) Combined low and high widths must equal or exceed minimum SCLK period. | | | | |

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## SPI TIMING DIAGRAM
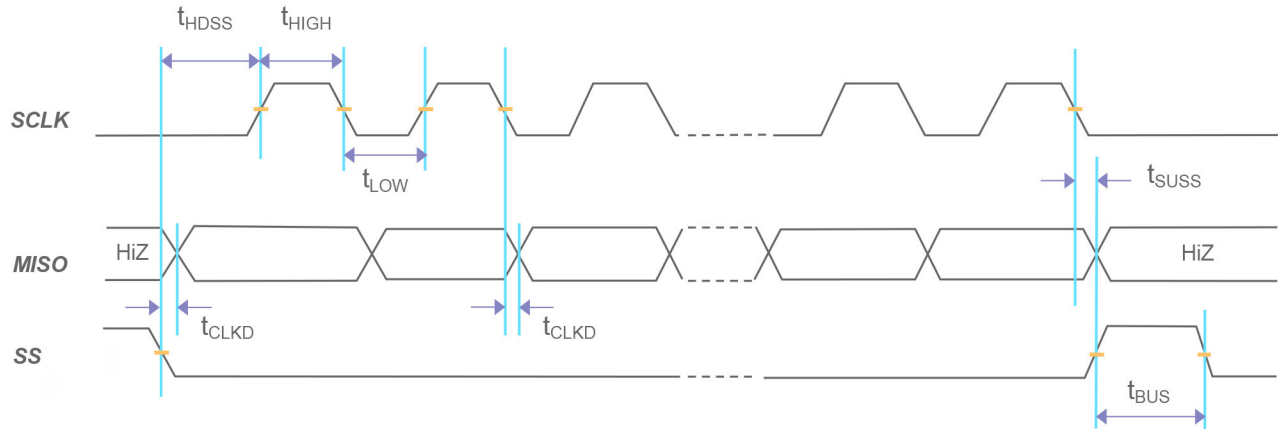


## Note

The MISO line is setup to change state on the falling edge of the SCLK clock. Accordingly, the master should sample the data on the rising edge of the SCLK signal.

## I2C/SPI DIAGNOSTIC FEATURES

The P1J offers a full suite of diagnostic features to ensure robust system operation. The diagnostic states are indicated by a transmission of the status of the 2 MSBs of the bridge high byte data or by a saturated output at 3FFFH.

| STATUS BITS (2 MSB'S OF OUTPUT PACKAGE) | DEFINITION |
|---|---|
| Signal resolution | 12 Bits (11 bits minimum for 0-2" H2O and 0-5 mBar range) |
| Update rate | 0.5 ms |
| Digital count at 0% pressure | 1638 (10% of 214 counts or 0x666) |
| Digital count at 100% pressure | 14746 (90% of 214 counts or 0x3999) |

When the two MSBs are 11, one of the following faults listed below is indicated.
- Invalid EEPROM signature
- Loss of bridge positive or negative
- Bridge input short
- Loss of bridge source
- Loss of bridge sink

All diagnostics are detected in the next measurement cycle and reported in the subsequent data fetch. Once a diagnostic is reported, the diagnostic status bits will not change unless both the cause of the diagnostic is fixed and a power-on-reset is performed.

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P1J Pressure sensor 0 -1" H20, I2C 28 Hex digital output, no internal material seal, barbed tube fitting port with PCB Terminal Pin connection, no external material seal.

**P1J** — **2** — **A** **X** **16** **P** **A**

### Family

**P1J**

### Pressure Ranges

| | |
|---|---|
| **2:** | 0-2" H2O |
| **2B:** | +/- 2" H2O |
| **5:** | 0-5" H2O |
| **5B:** | +/- 5" H2O |
| **10:** | 0-10" H2O |
| **10B:** | +/- 10" H2O |
| **5MB:** | 0-5 mbar |
| **5MBB:** | +/- 5 mbar |
| **6MBB:** | +/- 6 mbar |
| **12.5MB:** | 0-12.5 mbar |
| **12.5MBB:** | +/-12.5 mbar |
| **25MB:** | 0-25 mbar |
| **25MBB** | +/- 25 mbar |

### Output Type

**8:** SPI
**A:** I2C, 28 HEX
**B:** I2C, 38 HEX
**C:** I2C, 48 HEX
**D:** I2C, 58 HEX
**E:** I2C, 68 HEX
**F:** I2C, 78 HEX

### Seal Material

**X:** None

### Pressure Connection

**16:** Barb or Tube Fitting

### Built-in Connector

**P:** PCB Terminal Pins

### Seal Material

**A:** None

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# AGENCY APPROVALS & CERTIFICATIONS

RoHS

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