PRESSURE SENSORS

# Low Pressure Digital & Analog Sensor

## SM6291, SM6391, SM6491 Gauge and Differential Pressure Sensor

### FEATURES

- Pressure range from 0.3 to 0.79 psi; gauge, differential or asymmetric differential outputs
- Digital Accuracy: +/- 1 %FS; Analog Accuracy: +/- 1.5 %FS
- 16-bit digital, pressure calibrated and temperature compensated output
- I2C and analog Output interface available
- Compensated temperature range: -20 to 85°C
- Robust JEDEC SOIC-16 package for automated assembly
- Manufactured according to ISO9001 and ISO/TS 16949 standards

### DESCRIPTION

The SM6X91 series are a low pressure MEMS sensor family offering state-of-the-art pressure transducer technology and CMOS mixed signal processing technology to produce a digital & analog output, fully conditioned, multi-order pressure and temperature compensated sensor in JEDEC standard SOIC-16 package with a dual vertical or horizontal ports. It is available in gauge, differential, asymmetric differential configurations. With the dual porting, a reference measurement is possible to minimize errors due to changes in ambient pressure.

Combining the pressure sensor with a signal-conditioning ASIC in a single package simplifies the use of advanced silicon micro-machined pressure sensors. The pressure sensor can be mounted directly on a standard printed circuit board and a high level, calibrated pressure signal can be acquired from the digital interface. This eliminates the need for additional circuitry, such as a compensation network or microcontroller containing a custom correction algorithm.

**Customer-specified pressure ranges and supply voltages are available.**

The SM6291, SM6391 and SM6491 series shipped in sticks or tape & reel.

| Medical | Industrial | Consumer |
|---|---|---|
| Sleep Apnea | Airflow Measurement | Sports Equipment |
| CPAP | Pneumatic Gauges | Appliances |
| Ventilators | Pressure Switches | |
| Gas Flow Instrumentation | Safety Cabinets | |
| Air Flow Monitors | Life Sciences | |
| Negative Pressure Wound Therapy | Gas Flow Instrumentation | |

## 1. Absolute Maximum Ratings

All parameters are specified at VDD = 3.3 V / 5.0 V supply voltage at 25°C, unless otherwise noted.

| No. | Characteristic | Symbol | Minimum | Maximum | Units |
|---|---|---|---|---|---|
| 1 | Compensated Temperature | $T_{COMP}$ | -20 | 85 | °C |
| 2 | Operating Temperature[a] | $T_{OP}$ | -40 | 105 | °C |
| 3 | Storage Temperature[a] | $T_{STG}$ | -40 | 125 | °C |
| 4 | Proof Pressure[a, c] | $P_{Proof}$ | | 4.5 | psi |
| 5 | Burst Pressure[a, d] | $P_{Burst}$ | | 6 | psi |
| 6 | Supply voltage | $VDD_{MIN/MAX}$ | -0.3 | 6 | V |
| 7 | Media Compatibility(a, b) | | | | |

**Notes:**

a. Tested on a sample basis.

b. Clean, dry gas compatible with wetted materials. Wetted materials include silicon, epoxy, RTV, gold and aluminum.

c. Proof pressure is defined as the maximum pressure to which the device can be taken and still perform within specifications after returning to the operating pressure range

d. Burst pressure is the pressure at which the device suffers catastrophic failure resulting in pressure loss through the device.

## 2. ESD

All parameters are specified at VDD = 3.3 V / 5.0 V supply voltage at 25°C, unless otherwise noted.

| No. | Description | Condition | Symbol | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|---|
| 8 | ESD HBM Protection at all Pins | AEC Q100-002 (HBM) chip level test | $V_{ESD(HBM)}$ | -2 | | +2 | kV |

## 3. Electrical Characteristics

All parameters are specified at VDD = 5.0 V / 3.3 V DC supply voltage at 25°C, unless otherwise noted.

| No. | Description | Symbol | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| 9 | Supply Voltage | $V_{DD}$ | 4.75 | 5.0 | 5.25 | V |
| | | | 3 | 3.3 | 3.6 | |
| 10 | Low level input voltage at Digital I/O | $V_{IN,I2C,lo}$ | -0.3 | | 0.9 | V |
| 11 | High level input voltage at Digital I/O | $V_{IN,I2C,hi}$ | 0.8*VDD | | VDD + 0.3 | V |
| 12 | Current Consumption with analog output | | | 4.5 | | mA |
| 13 | Current Consumption without analog output | | | 3 | | mA |

## 4. External Components

| No. | Description | Symbol | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| 14 | Supply bypass capacitor | $C_{VDD}$ | | 100 | | nF |

## 5. OPERATING CHARACTERISTICS TABLE

All parameters are specified at VDD = 5.0 V / 3.3 V DC supply voltage at 25°C, unless otherwise noted.

| No. | Characteristic | Symbol | Minimum | Typical | Maximum | Units |
|---|---|---|---|---|---|---|
| 15 | Digital Pressure Output @ $P_{MIN}$ | $DOUT_{MIN}$ | | -26214 | | Counts |
| 16 | Digital Pressure Output @ $P_{MAX}$ | $DOUT_{MAX}$ | | 26214 | | Counts |
| 17 | Digital Full Scale Span | DFS | | 52428 | | Counts |
| 18 | Resolution | | | 16 | | Bits |
| 19 | Digital Output Accuracy (f, g, h) | DACC | -1 | | +1 | %FS |
| 20 | Analog Pressure Output @ $P_{MIN}$ | $AOUT_{MIN}$ | | 10 | | %VDD |
| 21 | Analog Pressure Output @ $P_{MAX}$ | $AOUT_{MAX}$ | | 90 | | %VDD |
| 22 | Analog Full Scale Span | AFS | | 80 | | %VDD |
| 23 | Analog Output Accuracy (f, g, h) | AACC | -1.5 | | +1.5 | %FS |

| Calibrated Pressure Ranges | | | | |
|---|---|---|---|---|
| No. | Device Type | $P_{MIN}$ (psi) | $P_{MAX}$ (psi) | Comment |
| 24 | SM6291 – Gauge | 0 | +0.3 to +0.79 | |
| 25 | SM6391 – Differential | -0.79 to -0.3 | +0.3 to +0.79 | Absolute value of $P_{MIN}$ must match absolute value of $P_{MAX}$ |
| 26 | SM6491 -- Asymmetric | -0.79 to 0 | 0 to +0.79 | Delta between $P_{MAX}$ and $P_{MIN}$ must be at least 0.3 psi |

**Notes:**

e. Only the typical values are shown here. However, the digital output values can be customized or changed upon request. Please refer to the tear sheet for the specific product to get updated information.

f. The accuracy specification applies across the compensated temp range. This specification includes the combination of linearity, repeatability, and hysteresis errors over pressure, temperature, and voltage.

g. Maximum 10-year total output shift < ±1%FS based on 1000 hours of HTOL testing.

h. For less demanding applications, devices with relaxed accuracy specifications are available.

***Custom calibration pressures and voltages are available to meet specific customer demands.**

## 5. Sensor Transfer Function

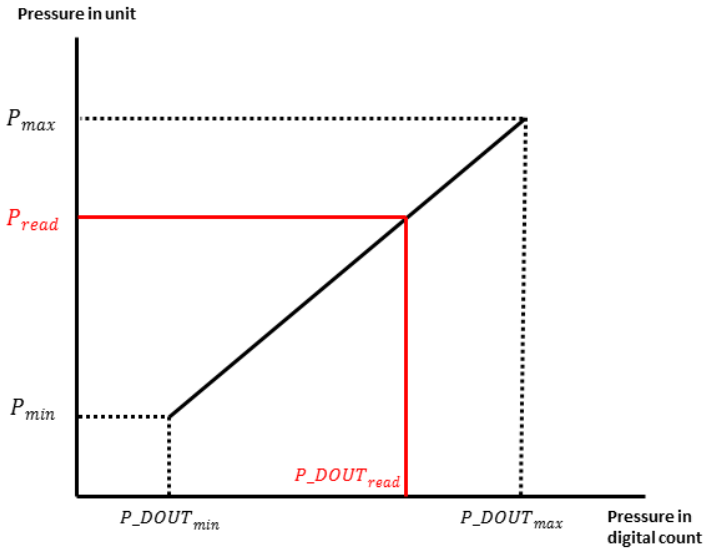
**Digital Pressure Transfer Function**

$$P_{read} = P_{min} + \frac{P\_DOUT_{read} - P\_DOUT_{min}}{P\_DOUT_{max} - P\_DOUT_{min}} (P_{max} - P_{min})$$

$P_{min}$ and $P_{max}$ are minimum and maximum rating pressure in specified pressure unit on the specification.

$P\_DOUT_{min}$ and $P\_DOUT_{max}$ are minimum and maximum digital counts on the specification.

$P\_DOUT_{read}$ is digital reading from the output and $P_{read}$ is the converted pressure output based on $P\_DOUT_{read}$.

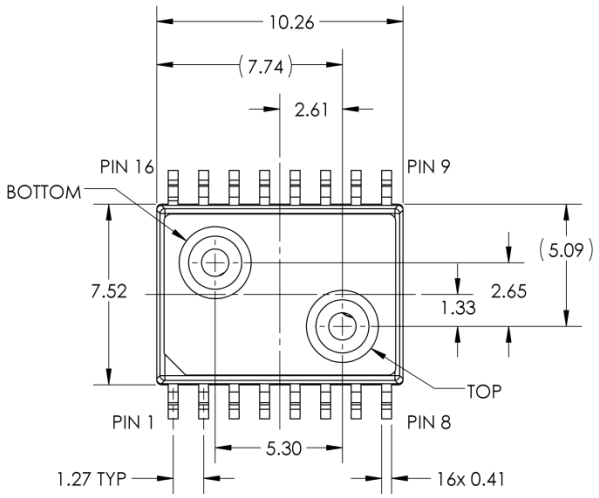


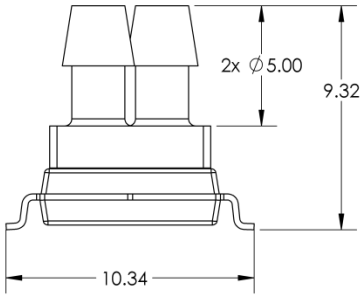

For example, the $P_{min}$ and $P_{max}$ for the sensor are specified as -0.3 and +0.3 psi. The $DOUT_{min}$ and $DOUT_{max}$ are -26214 and +26214. So,

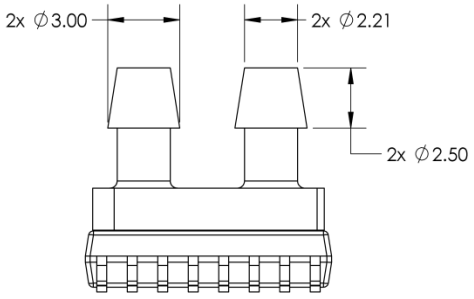
$$P_{read} = -0.3 + \frac{DOUT_{read} + 26214}{52428} \times 0.6\ psi$$

## 6. Package Dimensions

### SOIC-16 (C) Vertical Package Dimensions



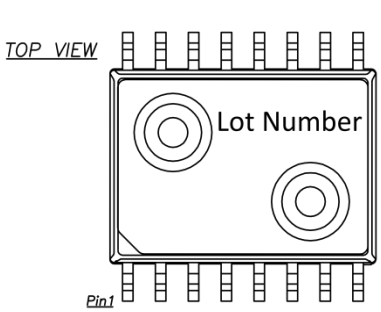



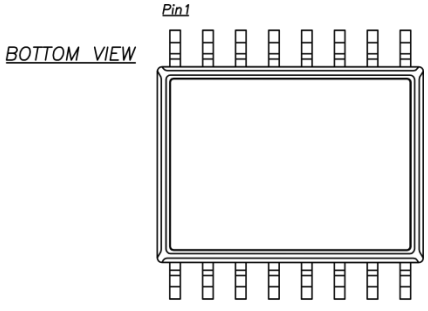




**Notes:**

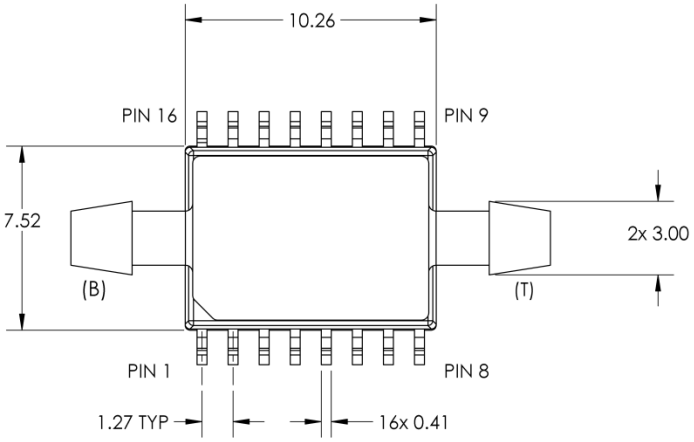
- All dimensions in units of [mm]
- Moisture Sensitivity Level (MSL): Level 3
- Wetted materials: Silicon, glass, gold, aluminum, copper, silicone, epoxy, mold compound.
- [B] is tube connected to bottom side of sensor die.
- [T] is tube connected to top side of sensor die. Topside pressure is positive pressure. An increase in topside pressure will result in an increase in sensor output unless otherwise noted on the tear sheet.

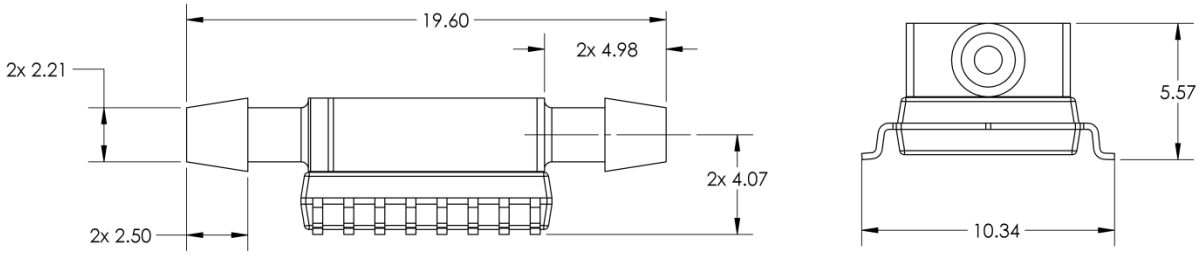
### Part & Lot Number Identification



## SOIC-16 Horizontal (B) Package Dimensions

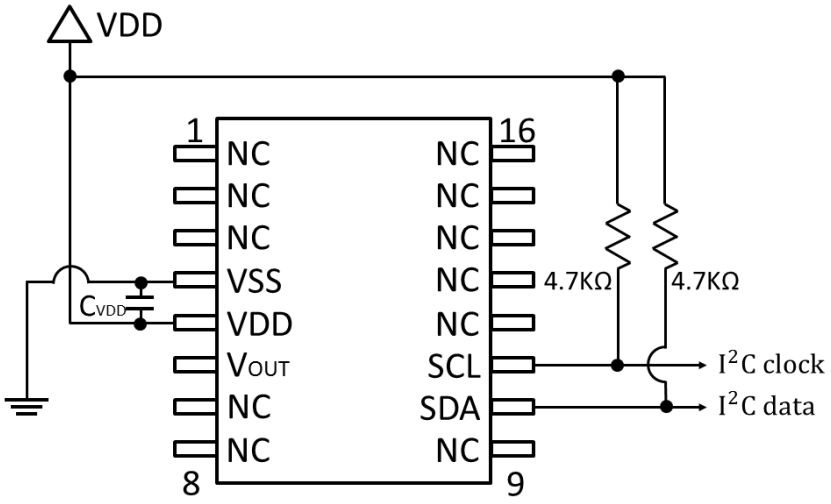



## Qualification Standards

REACH Compliant
RoHS Compliant
PFOS/PFOA Compliant
For qualification specifications, please contact Sales at sales@si-micro.com

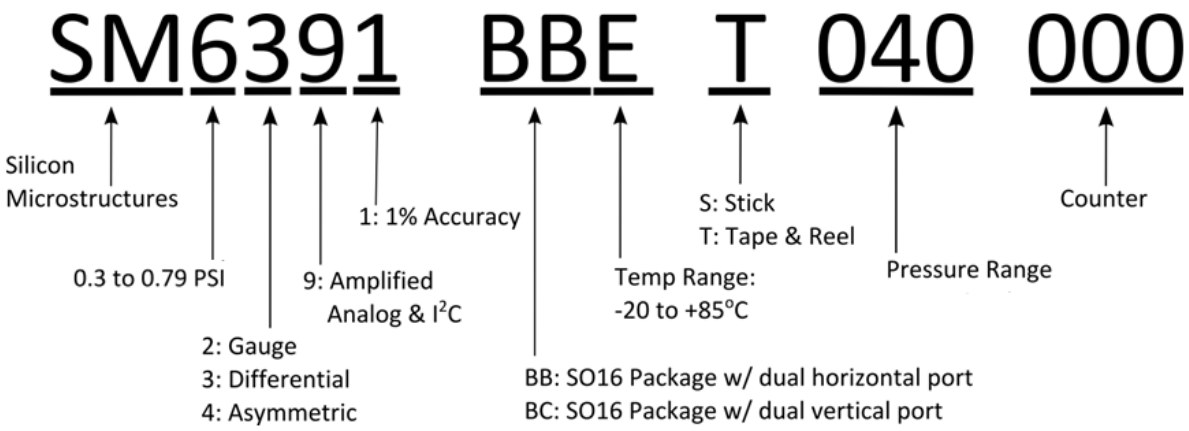
## SM6X91 + Family Applications Circuit




| Pin No. | Pin function | Pin No. | Pin function |
|---|---|---|---|
| 1 | NC | 9 | NC |
| 2 | NC | 10 | SDA |
| 3 | NC | 11 | SCL |
| 4 | VSS | 12 | NC |
| 5 | VDD | 13 | NC |
| 6 | VOUT (analog output) | 14 | NC |
| 7 | NC | 15 | NC |
| 8 | NC | 16 | NC |

**Ordering Information: Specific part number information is provided on a separate tear sheet for each product. The general part number ordering information is provided below:**

## Part Number Legend



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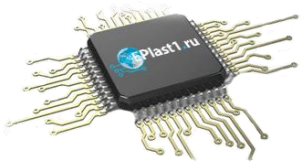


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