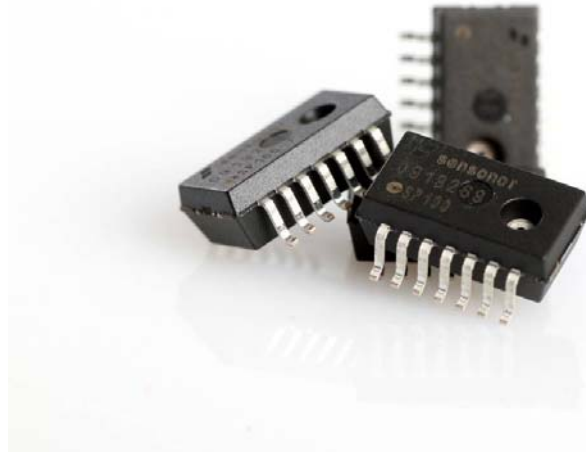




## **SP100 Series Compensated Pressure Sensors**

The SP100 pressure sensors are calibrated and digitally compensated silicon piezoresistive sensors with SPI interface. In addition to pressure, the sensors provide acceleration ('A' version sensors), temperature and supply voltage measurements. Each sensor has a unique electronic sensor ID, and has a built in self diagnosis system. The SP100 series of sensors can easily be used in a broad range of applications and interfaces directly to a micro controller without the need of any additional components.

SP100 series has excellent media compatibility due to a patented bulk micromachined triple stack sensor die design, utilizing buried piezoresistive elements and backside media access to pressure diaphragm. With this design the internal connectors and piezoresistive elements of the pressure bridge are isolated from the measurement media. The isolation is of great advantage in terms of sensor stability and reliability over a very long lifetime.

The SP100 pressure sensor design has been proven in harsh environment applications during a period of more than 10 years, making these sensors ideal choices for demanding applications where simple solutions are needed to quickly implement reliable and accurate pressure measurements.

SP100-7 and SP100-12 sensors belong to the medium pressure range of SP100 sensors.

**SP100-7**

**SP100-7T**

**SP100-7A**

**SP100-7AT**

**SP100-12A**

**Edition 2009-06-03**

**Published by**

**Sensoror Technologies AS**

**P.O. Box 196**

**N-3192 Horten**

**Norway**

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# 1 Product Description

## 1.1 Features

- o Digital interface, SPI
- o Absolute pressure sensor
- o Calibrated and compensated
- o Sensor self diagnosis
- o Unique electronic sensor ID
- o High reliability and accuracy over long lifetime
- o High media compatibility
- o Wide temperature operating range
- o Temperature and supply voltage measurement
- o Low standby current (0.3  $\mu$ A)
- o Robust miniature surface mount package
- o No external discrete components required
- o On-chip accelerometer (option)
- o High static acceleration and shock capability (2000 g)
- o Tube connection (option)

## 1.2 Overview

SP100 is an integrated MEMS pressure sensor designed for air pressure measurements. The sensor has a digital interface designed for use in microcontroller applications. SP100 is housed in a 14 pin small outline package, and requires no external components. SP100 has an accelerometer for measuring acceleration (option for 'A' version sensors) and a tube connection (option for 'T' version sensors).

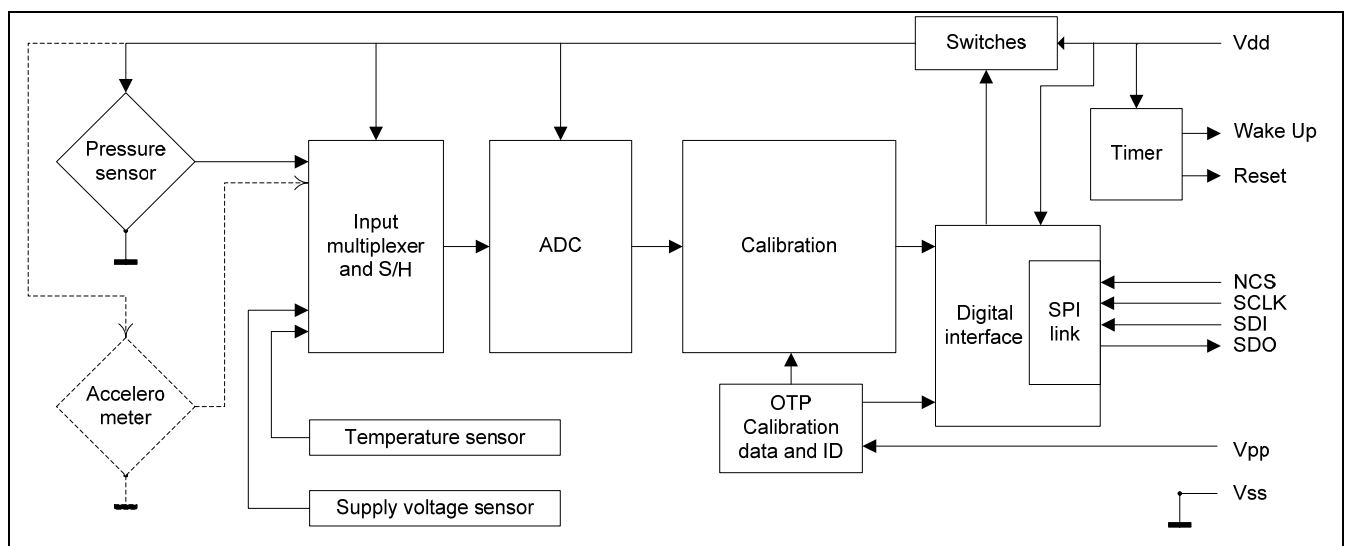


Figure 1.1 SP100 block diagram



## 2 Measurement Performance

The ADC of the sensor is an integrating charge balancing converter. Monotonic operation and no missing codes are guaranteed over the full operating range. All the following specification limits are to be understood as typical values unless otherwise is stated.

### 2.1 Pressure Measurement Performance

| Parameter                 | Specification                                |        |            | Ambient conditions |                |
|---------------------------|----------------------------------------------|--------|------------|--------------------|----------------|
|                           | Model                                        | Unit   | Typ        | Temperature [°C]   | Pressure [kPa] |
| Resolution                | SP100-7<br>SP100-7T<br>SP100-7A<br>SP100-7AT | kPa/lb | 1.25       | -40 to 125         | 0 to 700       |
|                           | SP100-12A                                    | kPa/lb | 1.25       | -40 to 125         | 0 to 1200      |
| Accuracy <sub>1)</sub>    | SP100-7<br>SP100-7T<br>SP100-7A<br>SP100-7AT | kPa    | ± 6.3      | 0 to 50            | 0 to 700       |
|                           |                                              | kPa    | ± 7.8      | -20 to 70          | 0 to 450       |
|                           |                                              | kPa    | ± 11       | -20 to 70          | 450 to 700     |
|                           |                                              | kPa    | ± 15       | -40 to 125         | 0 to 700       |
|                           | SP100-12A                                    | kPa    | ± 11       | 0 to 50            | 0 to 1000      |
|                           |                                              | kPa    | ± 14       | -40 to 125         | 0 to 1000      |
|                           |                                              | kPa    | ± 20       | 0 to 50            | 1000 to 1200   |
|                           |                                              | kPa    | ± 23       | -40 to 125         | 1000 to 1200   |
| Pressure measurement time | All                                          | ms     | 6<br>(max) |                    |                |

### 2.2 Temperature Measurement Performance

| Parameter                 | Specification |       |              | Ambient conditions |
|---------------------------|---------------|-------|--------------|--------------------|
|                           | Model         | Unit  | Typ          | Supply voltage [V] |
| Resolution                | All           | °C/lb | 1            | 2.1 to 3.6         |
| Accuracy                  | All           | °C    | ± 2.4        | 2.5 to 3.6         |
|                           |               | °C    | ± 3.0        | 2.5 to 3.6         |
|                           |               | °C    | ± 4.8        | 2.5 to 3.6         |
|                           |               | °C    | ± 4.2        | 2.1 to 2.5         |
|                           |               | °C    | ± 6.0        | 2.1 to 2.5         |
| Pressure measurement time | All           | ms    | 1.5<br>(max) | 2.1 to 3.6         |

The temperature read is known to have a deviation from actual temperature. A correction term is given by:

$$\Delta T_{corr} = -0.92 + 0.004 * T_{PRODUCT} + 0.0002 * T_{PRODUCT}^2$$

Where:  $T_{PRODUCT}$  is the temperature reported by the product, and  $\Delta T_{corr}$  is the correction term. See Figure 2.1.

$\Delta T_{corr}$  should be subtracted from the reported temperature to achieve specified accuracy.

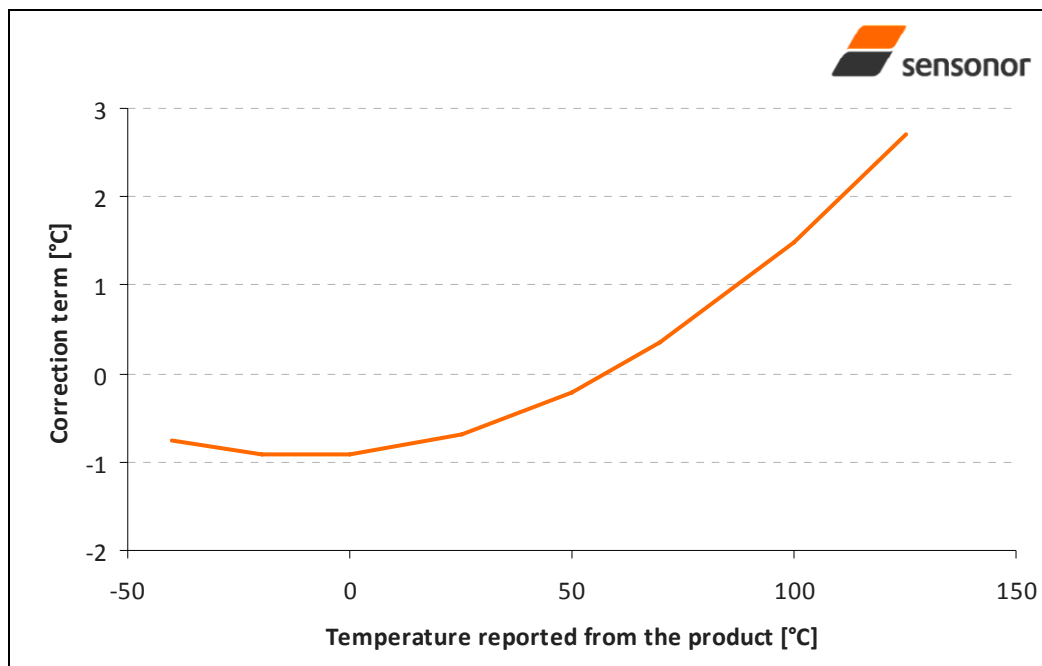


Figure 2.1 Temperature correction term

## 2.3 Acceleration Measurement Performance (option)

The SP100 devices with 'A' in the model name feature an on-chip accelerometer sensor for acceleration measurements.

All accelerometer specifications are valid when sensors are not subject to electrostatic charge.

Table 2.1 Acceleration measurement performance (option)

| Parameter                     | Specification                      |       |         | Ambient conditions |                    |
|-------------------------------|------------------------------------|-------|---------|--------------------|--------------------|
|                               | Model                              | Unit  | Typ     | Temperature [°C]   | Supply voltage [V] |
| Resolution                    | SP100-7A<br>SP100-7AT<br>SP100-12A | g/lsb | 0.5     | -40 to 125         | 2.1 to 3.6         |
| Sensitivity accuracy          | SP100-7A<br>SP100-7AT<br>SP100-12A | %     | ± 11    | -40 to 90          | 2.1 to 3.6         |
|                               |                                    | %     | ± 14    | 90 to 125          | 2.1 to 3.6         |
| Offset                        | SP100-7A<br>SP100-7AT<br>SP100-12A | g     | ± 3.6   | 25                 | 2.1 to 3.6         |
|                               |                                    | g     | ± 5.3   | -40 to 90          | 2.1 to 3.6         |
|                               |                                    | g     | ± 7.2   | 90 to 125          | 2.1 to 3.6         |
| Random error <sup>1)</sup>    | SP100-7A<br>SP100-7AT<br>SP100-12A | g     | ± 2     | -40 to 90          | -                  |
|                               |                                    | g     | ± 4     | 90 to 125          | -                  |
| Acceleration measurement time | SP100-7A<br>SP100-7AT<br>SP100-12A | ms    | 6 (max) | -40 to 125         | 2.1 to 3.6         |

Note:

1) Including quantification error, noise and repeatability.



### 2.4 Supply Voltage Measurement Performance

| Parameter                                      | Specification |       |           | Ambient conditions |
|------------------------------------------------|---------------|-------|-----------|--------------------|
|                                                | Model         | Unit  | Typ       | Supply voltage [V] |
| Input range <sup>1)</sup>                      | All           | V     | 1.8 – 3.6 | 2.1 to 3.6         |
| Resolution                                     | All           | mV/lb | 18.4      | 2.1 to 3.6         |
| Accuracy                                       | All           | mV    | ± 60      | 2.1 to 3.6         |
| Delay between measurement command and sampling | All           | ms    | 3.5       | -                  |
| Delay between sampling and A/D conversion      | All           | ms    | 10        | -                  |
| Supply voltage measurement total time          | All           | ms    | 17 (max)  | 2.1 to 3.6         |

Note:

- 1) The sampling operates down to 1.8 V. The specification applies to the A/D-conversion.

## 3 Recommended Operating Conditions

| Description                                     | Min                                          | Typ | Max  | Units |
|-------------------------------------------------|----------------------------------------------|-----|------|-------|
| Temperature range, operational                  | -40                                          |     | +125 | °C    |
| Supply voltage during measurement <sup>1)</sup> | 2.1                                          |     | 3.6  | V     |
| Supply voltage between measurements             | 1.8                                          |     | 5.5  | V     |
| Input pressure <sup>2)</sup>                    | SP100-7<br>SP100-7T<br>SP100-7A<br>SP100-7AT | 0   | 700  | kPa   |
|                                                 | SP100-12A                                    | 0   | 1200 | kPa   |
| Static acceleration                             |                                              |     | 2000 | g     |

Notes:

- 1) This is the voltage range where measurement accuracy is specified.  
2) All pressure values given in this specification are absolute values.

## 4 Absolute Maximum Ratings

| Description                                        | Min               | Typ | Max       | Units |
|----------------------------------------------------|-------------------|-----|-----------|-------|
| Input pressure                                     |                   |     | 1600      | kPa   |
| Temperature <sup>1)</sup>                          | -40               |     | +150      | °C    |
| Temperature transient <sup>2)</sup>                | -40               |     | +175      | °C    |
| Storage temperature <sup>3)</sup>                  | -40               |     | +150      | °C    |
| Supply voltage                                     | -0.3              |     | 6.0       | V     |
| Input voltage, any pin                             | -0.3              |     | VDD + 0.3 | V     |
| Input current, any pin (transient)                 | -100              |     | +100      | mA    |
| ESD protection (human body model) <sup>4)</sup>    | ±2000V to any pin |     |           |       |
| ESD protection (charge device model) <sup>5)</sup> | ±500V to any pin  |     |           |       |
| Mechanical shock                                   |                   |     | 2000      | g     |

Notes:

- 1) The component will also withstand standard reflow soldering, accumulated time < 2.5 hours.  
2) Less than 3 min.  
3) Accumulated time at 150°C not to exceed 500hours to avoid permanent damage. Solder ability may be affected with less exposure.  
4) According to AEC-Q100-002 Rev. C or JESD22-A114 Rev. F  
5) According to AEC-Q100-011 Rev. B or JESD22-C101 Rev. D

Prolonged exposure to values between recommended operating conditions and absolute maximum ratings might affect the performance and reliability of the device.



## 5 Wake-Up and Reset Outputs

The product provides two outputs, which may be used to interrupt or reset a microcontroller. Each output provides a pulse at regular intervals. The “wake-up and reset” are active low outputs. The Wake Up period typical value is programmable from 1 to 256 seconds, in 1 second intervals.

**Table 5.1 Wake-up and reset outputs**

| Parameter                                               | Min  | Typ | Max | Unit |
|---------------------------------------------------------|------|-----|-----|------|
| Wake Up Width                                           | 0.13 |     | 2.5 | ms   |
| Reset period                                            |      | 51  |     | min  |
| Reset width                                             | 0.13 |     | 2.5 | ms   |
| Interval timing drift over temperature <sup>1)</sup>    |      | 0.6 | 1   | %/°C |
| Interval timing drift over supply voltage <sup>1)</sup> |      | -15 | -40 | %/V  |

Notes:

1) See text describing oscillators below.

The product has two oscillators: One low-power oscillator, which runs at about 2.5 kHz and is used for interval timing, and a 2 MHz oscillator used for measurements and data transmission. Due to its very low current consumption, the low-power oscillator is sensitive to temperature and supply voltage variation. To keep the interval lengths constant under different conditions, the low-power oscillator is compared to the 2 MHz oscillator during each measurement, and a correction is applied to the interval count. This operation is called an auto calibration. The stability of the interval depends on the change in temperature or supply voltage since the last measurement.

## 6 Serial Interface

The SPI interface is the communication protocol to the external microcontroller. This maximum serial clock frequency is 500 kHz.

The SPI consists of a shift register, a command latch and failure latches, and encoder/decoder logic.

### 6.1 SPI Protocol

When NCS is high, any signals at the *SCLK* and *SDI* pins are ignored, and *SDO* is forced into a high impedance state.

During the *NCS* high-to-low transition, the SPI response word is multiplexed from the latch(es) that was(were) defined by the last command present in the shift register. The *SCLK* pin must be low when *NCS* goes low.

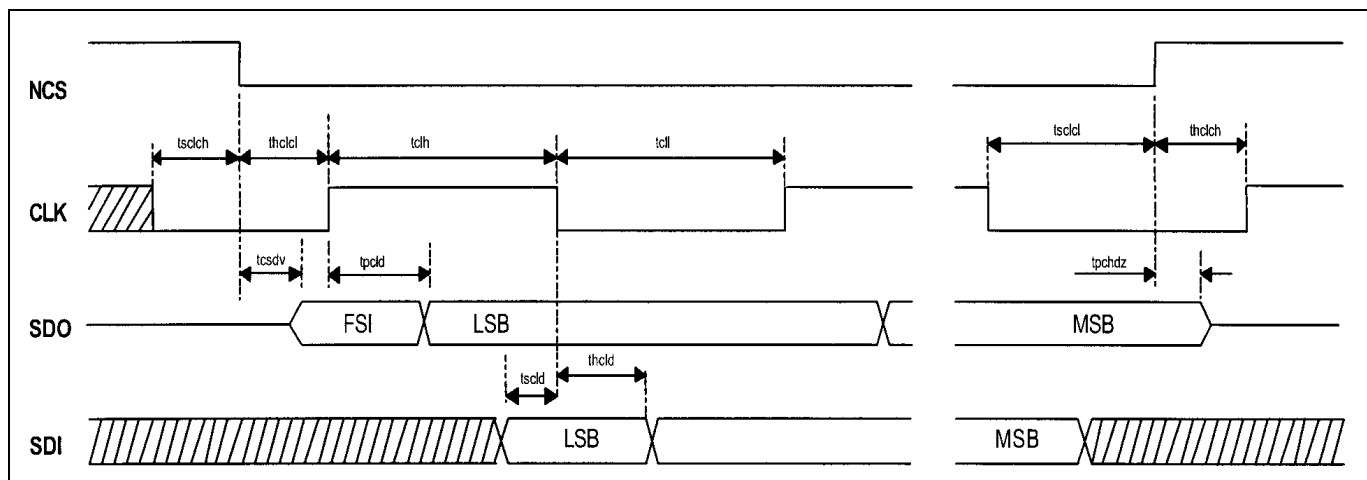
At each clock rising edge after *NCS* has gone low, the response word is serially shifted out of the ASIC at the *SDO* pin, LSB first. At each clock falling edge after *NCS* has gone low, the new control word is serially shifted into the ASIC at the *SDI* pin, LSB first.

The command bits of the received SPI word are then decoded to determine the destination address for the data bits. After the 8<sup>th</sup> clock falling edge has occurred, the following *NCS* low-to-high transition causes the data bits stored in the ASIC SPI shift register to be transferred into the latch which address was decoded from the SPI shift register command bits.

If the number of clock pulses before *NCS* goes high is different from 0, 8 or 16, a digital filter prevents execution of the received command (A valid *NCS* pulse with 0 clock pulses will cause the previous command to be executed again).

The Failure Status Indicator (FSI) is the logical OR of all bits in the status register, except bit 6.

The FSI appears at the *SDO* pin after *NCS* has gone low and before *SCLK* goes high (see timing diagram).



**Table 6.1 SPI timing diagram**

The FSI is valid only in response bytes that contain a measurement result value. If FSI is high, at least one of the error bits in the status byte has been set, and the measurement result should be rejected.

Control bytes and response bytes are 8 bits, the content of which depends upon the command given. When a control byte is shifted in, the response byte that is shifted out during the same transition time will be the response byte from the previous command: Shift in control byte « n », shift out response byte « n - 1 ». Therefore, each control/response pair requires two full 8-bit shift cycles to complete. The control bytes are described in chapter 6.2. Some control bytes require an additional data byte. For such command, the data byte must be transmitted first, before the command byte.



### 6.2 SPI Commands

| Command            | Code      | Address | Response                                                    | Description                                                                          |
|--------------------|-----------|---------|-------------------------------------------------------------|--------------------------------------------------------------------------------------|
| MEASURE_A          | 1000 0101 |         | Read back command code                                      | Measure acceleration                                                                 |
| RCAD               | 1000 0000 |         | Compensated acceleration data                               | Read compensated acceleration data (for 'A' models only)                             |
| RRADH              | 1000 0001 |         | Raw acceleration data, high byte                            | Read raw acceleration data, high byte (for 'A' models only)                          |
| RRADL              | 1000 0011 |         | Raw acceleration data, low byte                             | Read raw acceleration data, low byte (for 'A' models only)                           |
| MEASURE_P          | 0011 0001 |         | Read back command code                                      | Measure pressure                                                                     |
| RCPDH              | 0010 1100 |         | Compensated pressure data, high byte                        | Read compensated pressure data, high byte                                            |
| RCPDL              | 0010 1101 |         | Compensated pressure data, low byte                         | Read compensated pressure data, low byte                                             |
| RRPDH              | 0000 1000 |         | Raw pressure data, high byte                                | Read raw pressure data, high byte                                                    |
| RRPDL              | 0000 0100 |         | Raw pressure data, low byte                                 | Read raw pressure data, low byte                                                     |
| READIDH            | 0011 1101 |         | ID, high byte                                               | Read ID, high byte                                                                   |
| READIDM            | 0011 1000 |         | ID, mid byte                                                | Read ID, mid byte                                                                    |
| READIDL            | 0011 0100 |         | ID, low byte                                                | Read ID, low byte                                                                    |
| MEASURE_B          | 0010 0101 |         | Read back command code                                      | Measure battery voltage                                                              |
| RCBD               | 0010 1001 |         | Compensated supply data                                     | Read compensated supply data                                                         |
| MEASURE_T          | 1010 1101 |         | Read back command code                                      | Measure temperature                                                                  |
| RCTMP              | 1011 0000 |         | Compensated temperature data                                | Read compensated temperature                                                         |
| RSR                | 1011 0101 |         | Common general Status register (see byte description below) | Read common general status register                                                  |
| READ               | 1011 1000 | A       | One byte of shadow register                                 | Read one byte of shadow register (OTP coefficients)                                  |
| OTP_PWR            | 1111 0110 | A       | Read back command code                                      | Turn OTP power on/off                                                                |
| RADDR              | 1100 0001 |         | Read register at applied address                            | Read applied address (test of SPI)                                                   |
| STANDBY            | 0000 0001 |         | Last response repeated                                      | Go in Stand-by mode and shift out the response from the previous measurement command |
| LDOTP              | 1011 1100 |         | Read back command code                                      | Reset of product: Load OTP content to shadow register.                               |
| SETWK <sub>1</sub> | 0010 1110 | A       | Read back command code                                      | Set length of WAKEUP interval in address field (1 - 256 s)                           |
| GETWK              | 0010 1111 |         | Programmed value of wakeup interval (0-255)                 | Read back length of wakeup interval                                                  |

Notes:

- 1) This command is expected with parameter in front (one byte, LSB first).

### 6.3 SPI Timing Parameters

| SPI (Load capacitor at SDO = 300pF) |                                                             | Min | Max | Unit |
|-------------------------------------|-------------------------------------------------------------|-----|-----|------|
| fSCLK                               | Max. allowed application frequency (50% duty cycle)         |     | 500 | kHz  |
| tSDO_trans                          | SDO transition speed, 20% to 80% (with 60pF load capacitor) | 5   | 25  | ns   |
| tclh                                | Minimum time SCLK = HIGH                                    | 100 |     | ns   |
| tcil                                | Minimum time SCLK = LOW                                     | 100 |     | ns   |
| tpcid                               | Propagation delay (SCLK to data edge at SDO valid)          |     | 100 | ns   |
| tcsdv                               | NCS = LOW to data edge at SDO active                        |     | 100 | ns   |
| tsclch                              | SCLK low before NCS low (setup time SCLK to NCS edge H/L)   | 100 |     | ns   |
| thclcl                              | SCLK edge L/H after NCS edge H/L                            | 100 |     | ns   |
| tsclcl                              | SDI input setup time (SCLK edge H/L after SDI data valid)   | 20  |     | ns   |
| thclcl                              | SDI input hold time (SDI data hold after SCLK edge H/L)     |     | 20  | ns   |
| tsclcl                              | SCLK low before NCS high                                    | 150 |     | ns   |
| thclch                              | SCLK high after NCS high                                    | 150 |     | ns   |
| tpchdz                              | NCS edge L/H to SDO at high impedance                       |     | 100 | ns   |
| tonNCS                              | NCS min. high time                                          | 60  |     | µs   |
|                                     | Capacitance at SDI, SDO, SCLK, NCS                          |     | 10  | pF   |
| tfNCS                               | NCS filter time (Pulses shorter than tfNCS will be ignored) | 10  | 100 | ns   |
|                                     | NCS pulse filter <sub>1</sub>                               |     |     |      |

Note:

- 1) Digital filter for driver control register latch function. Output latch function is only enabled if positive NCS occurs after 8 CLK cycles (or a multiple of 8) since last negative NCS edge.



If an invalid command is received, no action will be taken and the response word will be all zeros (00 hex). Spare commands can be used for test mode if test mode can be disabled by hardware (test pin).

The three bytes of the ID (Identifier) code are programmed in the product PROM, giving the possibility for unique ID values for close to 16.8 million of sensors.

## 6.4 Status Byte

- Bit 0: Overflow/underflow
- Bit 1: Parity error in PROM data
- Bit 2: Checksum error in shadow register
- Bit 3: PROM reload / Internal Reset
- Bit 4: Unspecified measurement accuracy due to low supply voltage
- Bit 5: Sensor fault (Mechanical integrity of pressure and acceleration sensors and inter-chip bonding wires)
  - 0 = no error
  - 1 = pressure sensor or acceleration sensor or interchip bondwires broken
- Bit 6: Direction of positive acceleration for 'A' version sensors. (Not in use for SP100-7(T)). Not included in FSI calculation
- Bit 7: Measurement in progress:
  - 0 = Measurement completed, data can be read
  - 1 = Measurement in progress, data not available

## 6.5 Temperature Byte

The value in the temperature byte is  $(T+50)$ , where T is temperature in °C. The allowed range (for which the accuracy is specified) for this byte is 10-175, corresponding to temperatures from -40 to 125°C. Remark: the temperature byte may show values outside this range, which have an undefined accuracy.

## 6.6 Pressure Byte

The pressure (in kPa) is obtained by multiplying the value in the pressure byte by the given resolution in kPa/lb (see section 2.1).

## 6.7 Supply Voltage Byte

The supply voltage (in V) is obtained by multiplying the value in the supply byte by 0.0184, and adding 1.73.

## 6.8 Acceleration Byte

(This is valid for 'A' version sensors.) The acceleration (in g) is obtained by multiplying the output by 0.5 and subtracting 12.

# 7 Digital Output Characteristics

These characteristics are valid for VDD 2.7V to 3.6V, temperature -40 to 125 °C , and load current less than 1 mA.

**Table 7.1 Digital output characteristics**

| Description       | Min        | Typ        | Max | Unit |
|-------------------|------------|------------|-----|------|
| Output logic low  |            | 0.1        | 0.2 | V    |
| Output logic high | VDD – 0.25 | VDD – 0.13 |     | V    |



## 8 Power-On Reset

To guarantee a power-on reset, VDD must be at 0 V for a minimum of 1 ms. This will cause a hardware reset, and start a 10 ms timer. After the 10 ms, a negative pulse on the RESET pin will be generated and the PROM will be read. If this is successful, the product will enter normal operation. If the PROM reading is not successful, error handling will be as described in section 10.

**Table 8.1 Power-on reset specifications**

| Description                              | Min  | Typ | Max  | Unit |
|------------------------------------------|------|-----|------|------|
| VDD level to initiate power-on reset     |      |     | 0    | V    |
| VDD level not to initiate power-on reset | 1.0  |     |      | V    |
| VDD rise time (to 2.2V or higher)        | 0.1  |     |      | μs   |
| Power-on reset duration                  |      | 22  |      | ms   |
| VDD required to complete power-on reset  | 2.2  |     |      | V    |
| Delay before power-on reset pulse        | 0.83 |     | 12.5 | ms   |
| Duration of power-on reset pulse         | 0.16 |     | 2.5  | ms   |

## 9 Current Consumption

### 9.1 Standby Current

The standby current is the current drawn by the product when only the low-power oscillator and the interval counters are running.

### 9.2 Measurement Current

During measurement, various analog modules will be switched on and off as required, to minimize the total current consumption.

**Table 9.1 Measurement current**

| Parameter                                   | Comment      | Typ | Max  | Unit |
|---------------------------------------------|--------------|-----|------|------|
| Supply current in standby mode              | 25°C, 2.1 V  | 0.3 | 0.45 | μA   |
|                                             | 90°C, 2.1V   | 2   | 3    | μA   |
|                                             | 120°C, 2.1 V | 11  | 16.5 | μA   |
| Supply current, all analog modules active   | 25°C, 2.1 V  | 2.1 | 2.9  | mA   |
|                                             | 90°C, 2.1 V  | 2.2 | 3.0  | mA   |
|                                             | 120°C, 2.1 V | 2.2 | 3.1  | mA   |
| Supply current, digital activity incl. MCLK | 25°C, 2.1 V  | 0.5 | 0.8  | mA   |
|                                             | 90°C, 2.1 V  | 0.5 | 0.8  | mA   |
|                                             | 120°C, 2.1 V | 0.6 | 0.9  | mA   |
| Supply current in standby mode              | 25°C, 3V     | 0.4 | 0.6  | μA   |
|                                             | 90°C, 3 V    | 2.3 | 3.45 | μA   |
|                                             | 120°C, 3V    | 13  | 19.5 | μA   |
| Supply current, all analog modules active   | 25°C, 3V     | 2.7 | 3.5  | mA   |
|                                             | 90°C, 3V     | 2.8 | 3.7  | mA   |
|                                             | 120°C, 3V    | 2.8 | 3.8  | mA   |
| Supply current, digital activity incl. MCLK | 25°C, 3V     | 0.6 | 1.0  | mA   |
|                                             | 90°C, 3V     | 0.6 | 1.1  | mA   |
|                                             | 120°C, 3V    | 0.7 | 1.2  | mA   |

## 10 Error Handling and Recovery

### 10.1 PROM Data

The PROM contains calibration data and the identification code (ID). It is read at power-on reset, when its



contents are copied to the shadow register. The PROM contains one parity bit. If a parity error occurs during reading of the PROM, the product will enter the PROM Reload state, as described below.

## 10.2 PROM Reload

In this state, the product will read the PROM contents again with 1 s intervals until a successful read is completed. The PROM reading can fail for two reasons:

- Parity error in PROM data
- Reading not allowed due to supply voltage below minimum for read operation

If command via SPI is activated while the product is in the PROM reload/reset state, the FSI will be set.

## 10.3 Shadow Register Protection

After copying the PROM contents to the shadow register, a 16 bit CRC is calculated using the CCITT polynomial. This checksum is stored with the data, and is verified for each measurement cycle. If an error is detected, the product will return a single byte with an error code, and then enter PROM Reload / Reset state.

## 10.4 Low Supply Voltage

A supply voltage below 2.1 V (nominal) has two consequences:

- Reading of the PROM is not allowed
- The measurement accuracy cannot be guaranteed

The product uses a separate circuit with an output signal called VMIN, to detect this condition. VMIN = 1 will occur if  $VDD < 2.1 \pm 0.1V$ .

If low supply voltage causes the information in the shadow register to be corrupted, the product will enter PROM reload state as described in section 10.2.

## 10.5 High Temperature

If high temperature causes the information in the shadow register to be corrupted, the SP100 will enter PROM reload state as described in section 10.2.

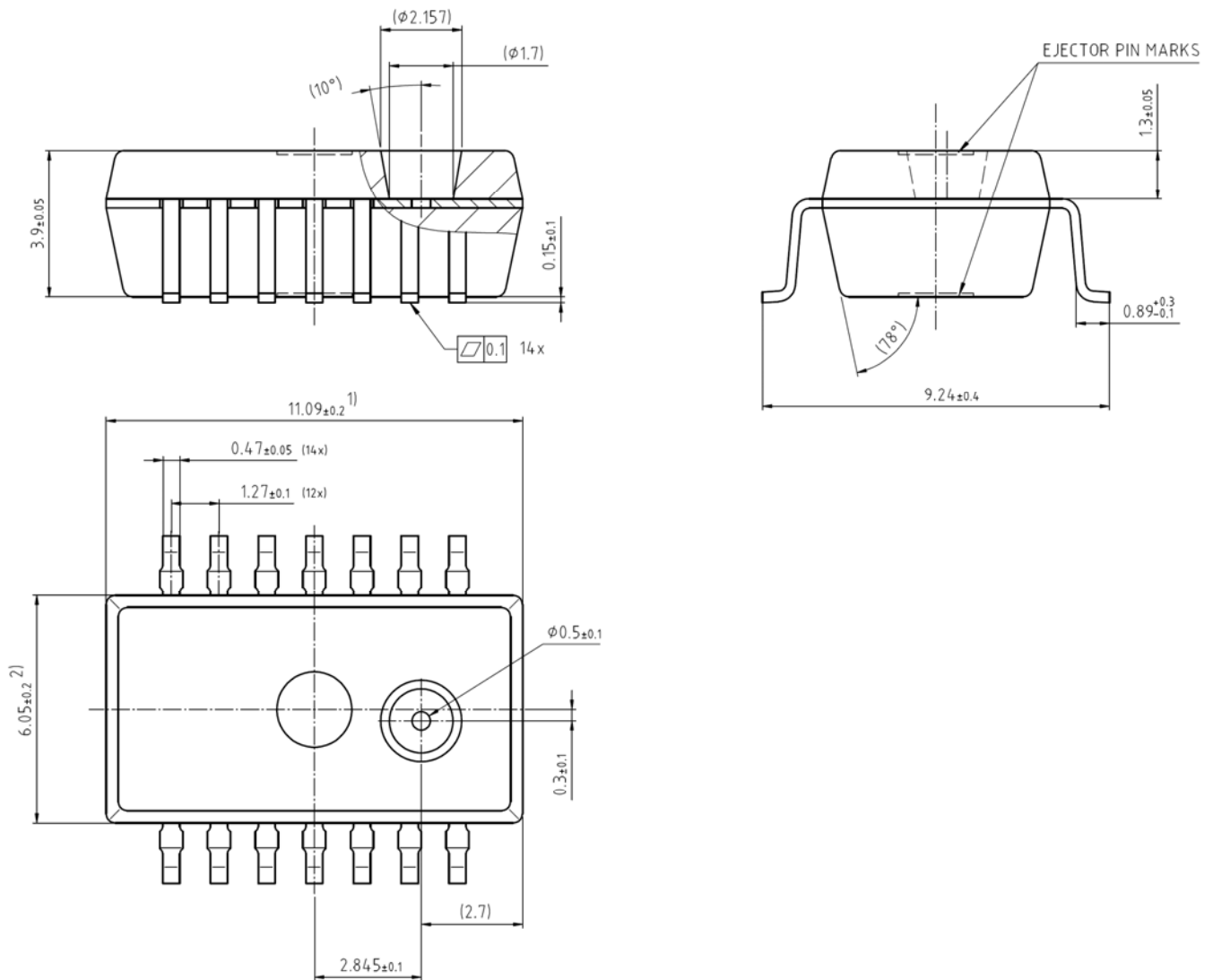
## 10.6 Overflow/Underflow

The overflow bit will be set by an over- or underflow in the ADC or compensation module. For temperature and supply measurements, ADC overflow will not saturate the compensated output value.

## 11 Mechanical Specifications

## 11.1 Physical Dimensions

The sensor package is a proven 14 pin, SOIC package that can be handled by automatic production lines.

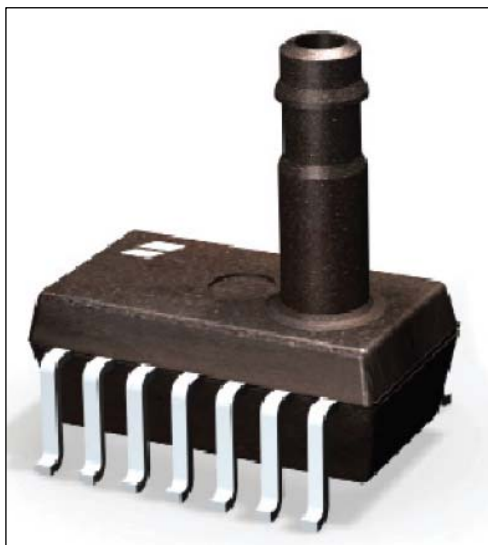


### Figure 11.1 Physical dimensions drawing

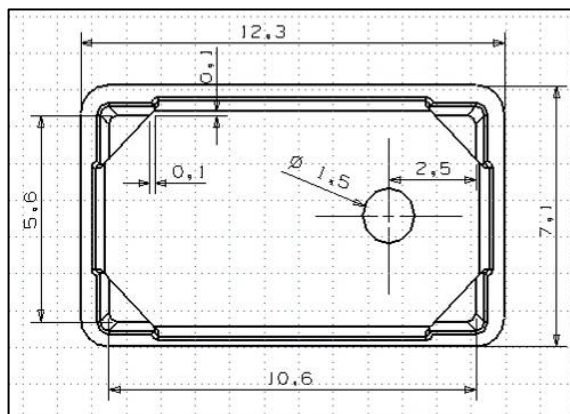
- 1) Dimension does not include mold flash, protrusions or gate burrs. Mold flash, protrusions and gate burrs do not exceed 0.15mm (0.006 inch) per side.
- 2) Dimension does not include inter-lead flash or protrusions. Inter-lead flash and protrusions do not exceed 0.25mm (0.010 inch) per side.

## 11.2 Tube Connection (option)

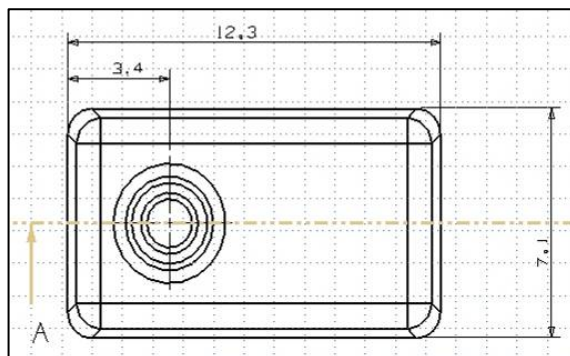
The SP100 models with 'T' in the model name features two different tube connection options to ease pressure connection.



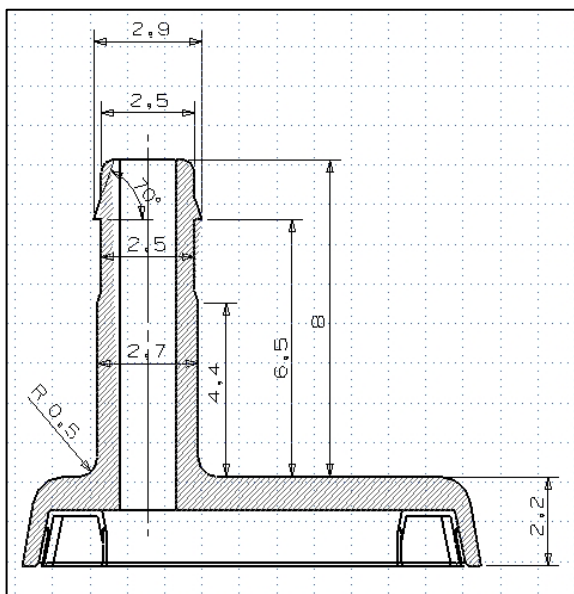
**Figure 11.3** Illustration of the SP100 series with tube connection (type A)



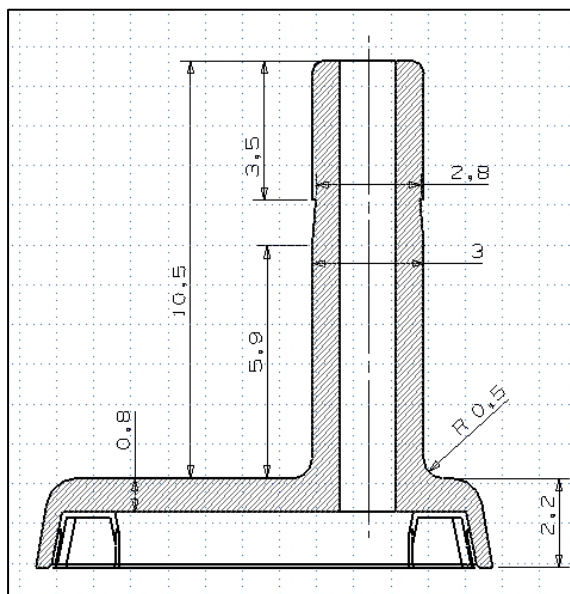
**Figure 11.2** Mechanical drawing: Underside of tube connection (type A and type B)



**Figure 11.4** Mechanical drawing: Upside of tube connection (type A and type B)



**Figure 11.5** Mechanical drawing: Section A in Figure 11.4 of tube connection (type A)

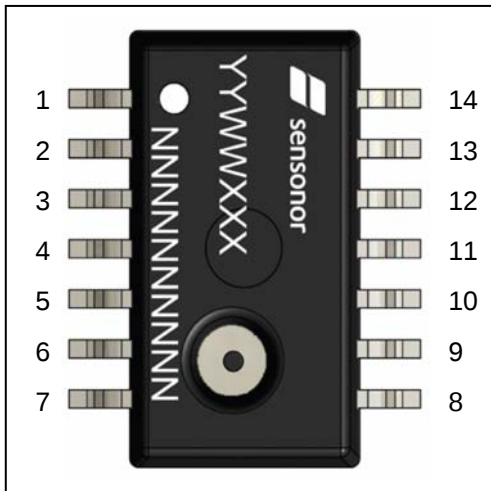


**Figure 11.6** Mechanical drawing: Section A Figure 11.4 of tube connection (type B)



### 11.3 Pin Configuration

Table 11.1 Pin configuration description



| PIN | NAME       | FUNCTION                     | NOTE                  |
|-----|------------|------------------------------|-----------------------|
| 1   | WAKE UP    | Wake up output signal        |                       |
| 2   | RESET      | Reset output signal          |                       |
| 3   | TEST/GND   | Test in fabrication          | Ground in application |
| 4   | VSS        | Ground                       |                       |
| 5   | NC         | Not connected                | Ground in application |
| 6   | DIG IN/GND | Digital input in fabrication | Ground in application |
| 7   | VSS        | Ground                       |                       |
| 8   | VSS        | Ground                       |                       |
| 9   | VDD        | Supply voltage               |                       |
| 10  | VPP        | Programmation voltage        | Leave open            |
| 11  | SDI        | Serial data input            |                       |
| 12  | SCLK       | Serial clock input           |                       |
| 13  | SDO        | Serial data output           |                       |
| 14  | NCS        | Negative chip select input   |                       |

Figure 11.7 Pin configuration, top view

### 11.4 Marking

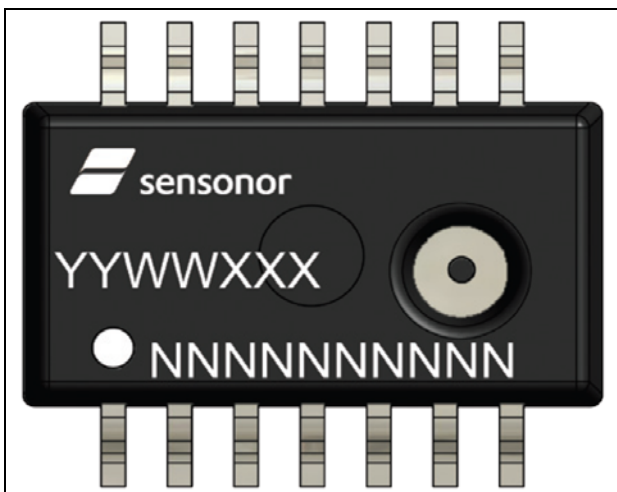


Figure 11.8 Marking of the SP100 series

The variables in Figure 11.8 have the following meaning:

YYWWXXX : Lot number  
 NNNNNNNNNN: Product name  
 O: Pin 1 marking