

## Preliminary Datasheet SDP8xx-Digital Digital Differential Pressure Sensor

- Excellent repeatability, no drift, no offset
- Extended feature set – smart averaging
- Calibrated and temperature compensated



### Product Summary

The SDP800 sensor family is Sensirion's series of digital differential pressure sensors designed for high-volume applications. The sensors measure the pressure of air and non-aggressive gases with superb accuracy and no offset drift. The sensors cover a pressure range of up to  $\pm 500$  Pa ( $\pm 2$  inch H<sub>2</sub>O /  $\pm 5$  mbar) and deliver outstanding accuracy, also at the bottom end of the measuring range.

The SDP800 features a digital 2-wire interface, which makes it easy to connect directly to a microprocessor.

The outstanding performance of these sensors is based on Sensirion's patented CMOSens® sensor technology, which combines the sensor element, signal processing and digital calibration on a small CMOS chip. The differential pressure is measured by a thermal sensor element using flow-through technology. The well-proven CMOS technology is perfectly suited for high-quality mass production and is the ideal choice for demanding and cost-sensitive OEM applications.

### Benefits of Sensirion's CMOSens® Technology

- High reliability and long-term stability
- Best signal-to-noise ratio
- Industry-proven technology with a track record of more than 15 years
- Designed for mass production
- High process capability

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## 1. Sensor Performance

### 1.1 Differential Pressure Specification<sup>1</sup>

| Parameter                                  | SDP800/SDP810-500Pa                                    | SDP800/SDP810-125Pa                                    |
|--|--|--|
| Measurement range <sup>2</sup>             | -500 to + 500 Pa<br>(-2.0 to 2.0 in. H <sub>2</sub> O) | -125 to + 125 Pa<br>(-0.5 to 0.5 in. H <sub>2</sub> O) |
| Zero point accuracy <sup>3,4</sup>         | 0.1 Pa   | 0.08 Pa  |
| Span accuracy <sup>3,4</sup>               | 3% of reading  | 3% of reading  |
| Zero point repeatability <sup>4</sup>      | 0.05 Pa  | 0.04 Pa  |
| Span repeatability <sup>4</sup>            | 0.5% of reading  | 0.5% of reading  |
| Span shift due to temperature variation    | < 0.5% of reading per 10°C                             | < 0.5% of reading per 10°C                             |
| Offset stability                           | < 0.05 Pa/year   | < 0.05 Pa/year   |
| Flow step response time (τ <sub>63</sub> ) | < 3ms  |  |
| Resolution                                 | 16 bit   |  |
| Calibrated for                             | Air, N <sub>2</sub>                                    |  |
| Media compatibility                        | Air, N <sub>2</sub> , O <sub>2</sub> , non-condensing  |  |
| Calibrated temperature range               | -20 °C to +85 °C                                       |  |

### 1.2 Temperature Specification<sup>5</sup>

| Parameter         | Value  |
|-------------------|--|
| Measurement range | -40 °C to +85 °C                                   |
| Resolution        | 16 bit   |
| Accuracy          | 2 °C (-10 °C to +60 °C)<br>3 °C (-40 °C to +85 °C) |
| Repeatability     | 0.1°C  |

<sup>1</sup> Unless otherwise noted, all sensor specifications are valid at 25°C with VDD = 3.3 V and absolute pressure = 966 mbar.

<sup>2</sup> For other pressure ranges contact Sensirion

<sup>3</sup> Includes repeatability

<sup>4</sup> Total accuracy/repeatability is a sum of zero-point and span accuracy/repeatability.

<sup>5</sup> The measured temperature is the temperature of the bulk silicon in the sensor. This temperature value is not only depending on the gas temperature, but also on the sensor's surroundings. Using the signal to measure solely the gas temperature will need special precautions, such as isolating the sensor from external temperature influences.

## 2. Specifications

### 2.1 Electrical Specifications

| Parameter           | Symbol    | Condition  | Min. | Typ. | Max. | Units | Comments |
|---------------------|-----------|------------|------|------|------|-------|----------|
| Supply Voltage      | $V_{DD}$  |            | 3.0  |      | 5.5  | V     |          |
| Power-up/down level | $V_{POR}$ |            | 2.3  | 2.5  | 2.7  | V     |          |
| Supply current      | $I_{DD}$  | Measuring  |      | 3.8  | 5.5  | mA    |          |
|                     |           | Idle state |      |      | 1.1  | mA    |          |
|                     |           | Sleep mode |      |      | 1    | µA    |          |

### 2.2 Timing Specifications

| Parameter                               | Symbol    | Condition       | Min.  | Typ. | Max.  | Units | Comments  |
|---|-----------|-----------------|-------|------|-------|-------|---|
| Power-up time                           | $t_{PU}$  |                 |       |      | 25    | ms    | Time to sensor ready  |
| Soft reset time                         | $t_{SR}$  |                 |       |      | 2     | ms    | Time between soft reset command or exit sleep mode and sensor ready |
| I2C SCL frequency                       | $f_{I2C}$ |                 |       | 400  | 1000  | kHz   |   |
| Update rate differential pressure value |           | Continuous mode | 1800  | 2000 | 2200  | Hz    |   |
| Update rate temperature value           |           | Continuous mode | 112.5 | 125  | 137.5 | Hz    | Temperature value is updated once every 16 pressure values          |
| Measurement time                        |           | Triggered mode  | 40    | 45   | 50    | ms    |   |

### 2.3 Mechanical Specifications

| Parameter              | Symbol      | Condition | Min. | Typ. | Max. | Units | Comments |
|------------------------|-------------|-----------|------|------|------|-------|----------|
| Allowable overpressure | $P_{max}$   |           |      |      | 1    | bar   |          |
| Rated burst pressure   | $P_{burst}$ |           | 5    |      |      | bar   |          |
| Weight                 | $W$         |           |      |      | 6    | g     |          |

### 2.4 Materials

| Parameter        |   |
|------------------|---|
| Wetted materials | PBT (polybutylene terephthalate), glass (silicon nitride, silicon oxide), silicon, gold, FR4, silicone as static sealing, epoxy, copper alloy, lead-free solder |
| REACH, RoHS      | REACH and RoHS compliant  |

### 2.5 Absolute Minimum and Maximum Ratings

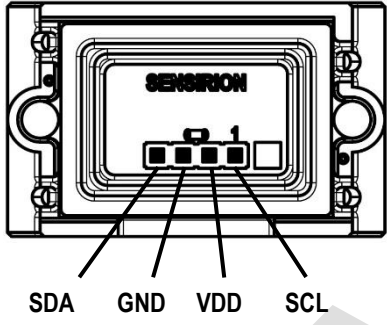
| Parameter                                | Rating               | Units |
|--|----------------------|-------|
| Supply Voltage $V_{DD}$                  | -0.3 to 5.5          | V     |
| Max Voltage on pins (SDA, SCL)           | -0.3 to $V_{DD}+0.3$ | V     |
| Input current on any pin                 | $\pm 70$             | mA    |
| Operating temperature range <sup>1</sup> | -40 to +85           | °C    |
| Storage temperature range                | -40 to +85           | °C    |
| Max. humidity for long term exposure     | 40°C dew point       |       |
| ESD HBM (human body model)               | 2                    | kV    |

<sup>1</sup> For Air and N<sub>2</sub>. Long term exposure to (high concentrations of) O<sub>2</sub> at high temperatures can reduce the product lifetime

### 3. Pin Assignment

The pin assignments of the SDP8xx-Digital can be found in Table 1

| Pin no. | Name | Description  |
|---------|------|--|
| 1       | SCL  | Serial Clock (I <sup>2</sup> C Interface)              |
| 2       | VDD  | VDD Supply   |
| 3       | GND  | Connect to ground                                      |
| 4       | SDA  | Bidirectional Serial Data (I <sup>2</sup> C Interface) |



The diagram shows the bottom view of the SDP8xx-Digital sensor. It features a central square chip with the 'SENSIRION' logo. Four pins are located at the bottom edge of the chip, labeled from left to right as SDA, GND, VDD, and SCL. Lines connect these labels to their respective pins on the chip.

**Table 1:** SDP8xx-Digital pin assignment (bottom view).

## 4. Measurement Modes

The SDP8xx-Digital is a highly versatile differential pressure sensor and is very flexible regarding the measurement speed. This flexibility not only allows for optimizing the sensor's performance to a specific application, but also for adapting the sensor to different use cases. For example, in one use case the sensor is detecting the smallest and quickest changes, whereas at another time the sensor can measure in larger intervals while consuming only little energy.

### 4.1 Continuous Mode vs Triggered Mode

In continuous mode the sensor is measuring at the highest speed and writes the measurement values to the I<sup>2</sup>C results buffer, where the I<sup>2</sup>C master can read out the value when it requires.

In triggered mode the sensor is default in an idle state and wakes up when the command is sent. It then powers up the heater and does a measurement. During this time the sensor doesn't acknowledge any I<sup>2</sup>C read header or stretches the clock. When the measurement is finished the sensor returns to the idle state and makes the measurement result available to be read out.

For more details see chapter 5.3.3.

|                            | Continuous mode   | Triggered mode   |
|----------------------------|---|--|
| Description                | Measures continuously   | Measures once after command is sent  |
| Measurement speed and rate | Measurement result can be read out continuously and at any time, but not faster than 0.5ms. | Measurement result is available in +/- 45ms after command.<br>Clock stretching is available. |
| Measurement method         | Sensor configuration is optimized for speed and accuracy.                                   | Sensor configuration is optimized for low power consumption.                                 |
| Recommended use            | Best used where speed and accuracy are most important.                                      | Best used where energy consumption is more important than speed.                             |

### 4.2 Continuous Mode and 'Average till Read'

In continuous measurement modes a new measurement result is available every 0.5ms. A new value can be read out every 0.5ms.

If the 'average till read' option is chosen, the sensor averages all values ( $x_i$ ) prior to the read out. This has the benefit that the user can read out the sensor at its own desired speed, without losing information and thus prevents aliasing. During the first 25 ms of averaging the averaged value is obtained as the arithmetic mean.

$$\bar{x} = \sum_{i=1}^N \frac{x_i}{N} \quad \text{for } t < 25 \text{ ms}$$

When the reading speed is even slower than 25 ms, the sensor will continue to average, but with another algorithm. In this algorithm exponential smoothing is used, with a smoothing factor  $\alpha = 0.05$ .

$$S_k = \alpha \cdot x_i + (1 - \alpha) \cdot S_{k-1}, \quad S_0 = \bar{x}, \quad \text{for } t > 25 \text{ ms}$$

Where  $S_0$  is the arithmetic value after the first 25 ms.

Please refer to relevant literature for more information about exponential smoothing.

### 4.3 Temperature Compensation Modes and Absolute Pressure Dependency

The SDP8xx is temperature compensated both for differential pressure and for mass flow compensated differential pressure. In use cases where the SDP8xx is used to measure mass flow it is advised to use mass flow temperature compensation. In this case no absolute pressure compensation is required.

For more information about temperature and absolute pressure compensation for differential pressure sensors, for example volume flow measurements in bypass, refer to the selection guide in the differential pressure download center on our website.

## 5. Digital Interface Description

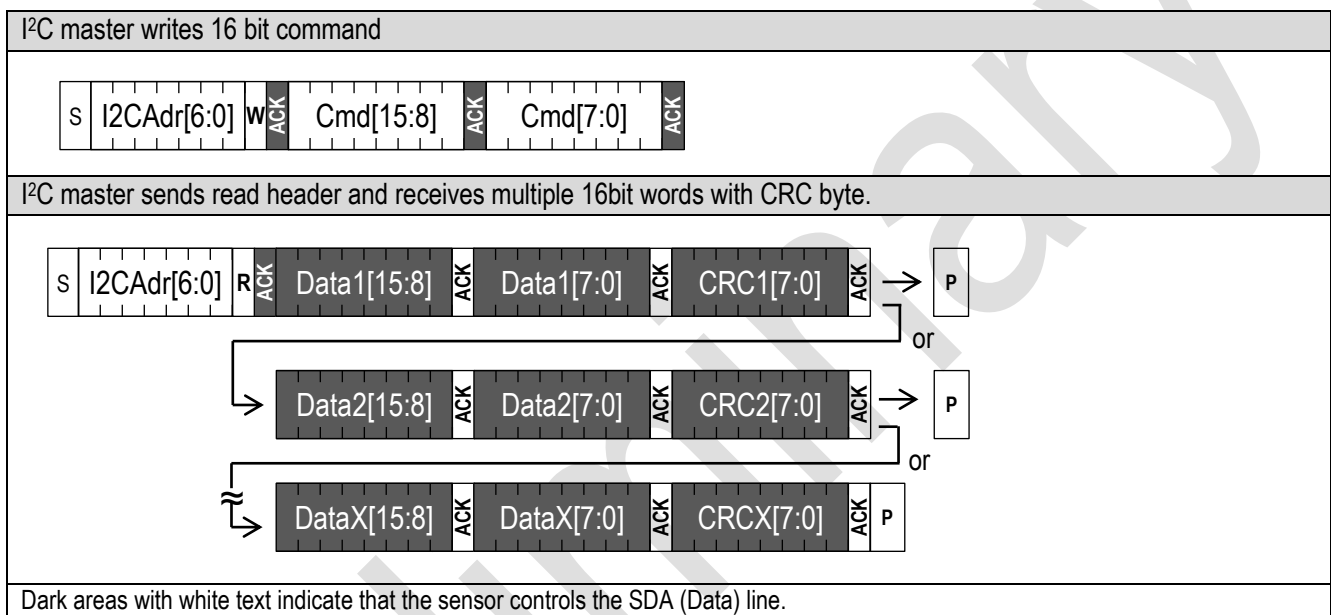
The SDP8xx-digital interface is compatible with the I<sup>2</sup>C protocol. This chapter describes the command set for SDP8xx-digital. For detailed information about the I<sup>2</sup>C protocol, please check the document "NXP I<sup>2</sup>C-bus specification and user manual".

### 5.1 I<sup>2</sup>C Address

The I<sup>2</sup>C address for SDP8xx-digital is 0x25 (b 0100101). The address is followed by a read or write bit. For other I<sup>2</sup>C addresses contact Sensirion.

### 5.2 I<sup>2</sup>C Sequences

The commands are 16-bit. Data is read from the sensor in multiples of 16-bit words, each followed by an 8-bit checksum to ensure communication reliability.



I<sup>2</sup>C sequences can be aborted with a NACK and STOP condition.

### 5.3 I<sup>2</sup>C Commands

The command set of the SDP8xx-digital consists of a set of different commands:

- Continuous measurement
  - o Start Continuous measurement commands
  - o Stop measurement command
- Triggered measurement commands
- Soft reset
- Entering and exiting sleep mode
- Read product identifier and serial number

### 5.3.1 Start Continuous Measurement

The sensor measures both the differential pressure and temperature. Both measurement results can be read out through one single I<sup>2</sup>C read header.

Continuous measurements can be started up in different configurations by a set of commands.

| Command code (Hex) | Temperature compensation | Averaging                |
|--------------------|--------------------------|--------------------------|
| 0x3603             | Mass flow                | Average till read        |
| 0x3608             | Mass flow                | None - Update rate 0.5ms |
| 0x3615             | Differential pressure    | Average till read        |
| 0x361E             | Differential pressure    | None - Update rate 0.5ms |

After one of the commands has been sent, the chip continuously measures and updates the measurement results. New results can be read continuously with only an I<sup>2</sup>C read header. (Measurement) commands must not be sent until the stop measurement command has been sent.

After the start measurement command is sent:

- the first measurement result is available after 8ms;
- small accuracy deviations (%mv) can occur during the next 12ms.

When no measurement data is yet available the sensor will respond with a NACK to the I<sup>2</sup>C read header (I<sup>2</sup>C address + read bit).

| Preceding command      | Consecutive read   | Description  |
|------------------------|--|--|
| continuous measurement | Byte1: DP 8msb<br>Byte2: DP 8lsb<br>Byte3: CRC<br>Byte4: Temp 8msb<br>Byte5: Temp 8lsb<br>Byte6: CRC<br>Byte7: Scale Factor differential pressure 8msb<br>Byte8: Scale Factor differential pressure 8lsb<br>Byte9: CRC | After a start continuous measurement commands, the measurement results can be read out.<br>The temperature and scale factor don't need to be read out (every time). The read sequence can be aborted by a NACK and a STOP condition. |

### 5.3.2 Stop Continuous Measurement

| Command                     | Command code (Hex) | Description  |
|-----------------------------|--------------------|--|
| Stop continuous measurement | 0x3FF9             | This command stops the continuous measurement and puts the sensor in idle mode. It powers off the heater and makes the sensor receptive to another command.<br>The Stop command is also required when switching between different continuous measurement commands. |

When the sensor is in continuous measurement mode, the sensor must be stopped before it can accept another command. The only exception is the soft reset command as described in section 0.

In idle mode the sensor will consume less power, but consider the sleep mode for most effective energy saving.

### 5.3.3 Triggered Measurement

During a triggered measurement the sensor measures both differential pressure and temperature. The measurement starts directly after the command has been sent. The command needs to be repeated with every measurement.

| Command code (Hex) | Temperature compensation | Clock stretching |
|--------------------|--------------------------|------------------|
| 0x3624             | Mass flow                |                  |
| 0x3726             | Mass flow                | Yes              |
| 0x362F             | Differential pressure    |                  |
| 0x372D             | Differential pressure    | Yes              |

During the 45ms that the sensor is measuring, no command can be sent to the sensor. After the 45ms the result can be read out and any command can be sent to the sensor.

Monitoring whether or not the sensor is ready with its measurement can be done with the following methods.

| Method           | Available                              | Description  |
|------------------|--|--|
| Clock stretching | Only for clock stretching commands     | The sensor starts the measurement after the triggered measurement command with clock stretching. When an I <sup>2</sup> C read header is sent within 45ms the sensor performs clock stretching after acknowledging the read header.<br>When the sensor has finished the measurement, it makes the result available by releasing the SCL. |
| Polling          | Only for non-clock stretching commands | In this mode the sensor does not acknowledge (NACK) an I <sup>2</sup> C read header as long as no measurement result is available.   |

When new measurement data is available it can be read out by sending an I<sup>2</sup>C read header and reading out the data from the sensor. In the table below the data layout of the results can be found.

| Preceding command     | Consecutive read   | Description   |
|-----------------------|--|---|
| Triggered measurement | Byte1: DP 8msb<br>Byte2: DP 8lsb<br>Byte3: CRC<br>Byte4: Temp 8msb<br>Byte5: Temp 8lsb<br>Byte6: CRC<br>Byte7: Scale Factor differential pressure 8msb<br>Byte8: Scale Factor differential pressure 8lsb<br>Byte9: CRC | After a triggered measurement command, the results can be read out when the sensor is finished with the measurement.<br>The temperature and scale factor don't need to be read out (every time). The read sequence can be aborted by a NACK and a STOP condition. |

### 5.3.4 Soft Reset

| Command            | I <sup>2</sup> C address + W bit + command code (Hex) | Consecutive read | Description   |
|--------------------|---|------------------|---|
| General call reset | 0x0006  | NA               | This sequence resets the sensor with a separate reset block, which is as much as possible detached from the rest of the system on chip.<br><u>Note that the I<sup>2</sup>C address is 0x00, which is the general call address, and that the command is 8 bit.</u> The reset is implemented according to the I <sup>2</sup> C specification. |

After the reset command the sensor will take maximum 2ms to reset. During this time the sensor will not acknowledge its address nor accept commands.



### 5.3.5 Entering and Exiting Sleep Mode

In sleep mode the sensor uses the minimum amount of current. The mode can only be entered from idle mode, i.e. when the sensor is not measuring.

This mode is particularly useful for battery operated devices. To minimize the current in this mode, the complexity of the sleep mode circuit has been reduced as much as possible, which is mainly reflected by the way the sensor exits the sleep mode.

In sleep mode the sensor cannot be soft reset.

| Command          | Command code (Hex) | Consecutive read | Description  |
|------------------|--------------------|------------------|--|
| Enter Sleep mode | 0x3677             | NA               | <b>Triggered mode:</b> the sleep command can be sent after the result have been read out and the sensor is in idle mode.<br><b>Continuous mode:</b> the sleep command can be sent after a stop continuous measurement command has been issued and is in idle mode.   |
| Exit Sleep mode  | NA                 | NA               | The sensor exits the sleep mode and enters the idle mode when it receives the <b>valid I<sup>2</sup>C address and a write bit ('0')</b> . Note that the I <sup>2</sup> C address is <b>not</b> acknowledged. It is necessary to poll the sensor to see whether the sensor has received the address and has woken up. This should take maximum 2ms. |

### 5.3.6 Read Product Identifier

During assembly and start-up of the machine it might be required to check some basic parameters in the sensor - for example to check if the correct sensor is integrated.

The product identifier and serial number can be read out after sending a sequence of two commands.

| Command                 | Command code     | Consecutive read  | Description   |
|-------------------------|------------------|---|---|
| Read product identifier | 0x367C<br>0xE102 | Byte1: Product number [31:24]<br>Byte2: Product number [23:16]<br>Byte3: CRC<br>Byte4: Product number [15:8]<br>Byte5: Product number [7:0]<br>Byte6: CRC<br>Byte7: Serial number [63:56]<br>Byte8: Serial number [55:48]<br>Byte9: CRC<br>Byte10: Serial number [47:40]<br>Byte11: Serial number [39:32]<br>Byte12: CRC<br>Byte13: Serial number [31:24]<br>Byte14: Serial number [23:16]<br>Byte15: CRC<br>Byte16: Serial number [15:8]<br>Byte17: Serial number [7:0]<br>Byte18: CRC | Note that both commands need to be preceded with an I <sup>2</sup> C write header (I <sup>2</sup> C address + W).<br>The second command returns: <ul style="list-style-type: none"> <li>- 32 bit unique product and revision number. The number is listed in the table below.<br/><i>Note that the last 8 bits are the revision number and are subject to change as long as the datasheet is preliminary.</i></li> <li>- 64 bit unique serial number</li> </ul> |

| Product      | Product number |
|--------------|----------------|
| SDP800-500Pa | 0x03020186     |
| SDP810-500Pa | 0x03020A86     |
| SDP800-125Pa | 0x03020286     |
| SDP810-125Pa | 0x03020B86     |

## 5.4 Checksum Calculation

The checksum byte is generated by a CRC algorithm with the following properties:

| Property       | Value                          |
|----------------|--------------------------------|
| Name           | CRC-8                          |
| Protected data | read data                      |
| Width          | 8 bit                          |
| Polynomial     | 0x31 ( $x^8 + x^5 + x^4 + 1$ ) |
| Initialization | 0xFF                           |
| Reflect input  | False                          |
| Reflect output | False                          |
| Final XOR      | 0x00                           |
| Example        | $CRC(0xBEEF) = 0x92$           |

## 5.5 Conversion to Physical Values

Conversion of the differential pressure and temperature sensor signals to a physical value is done with the scale factor.

### 5.5.1 Scale Factors

| Parameter             | SDP8xx-500Pa         | SDP8xx-125Pa         |
|-----------------------|----------------------|----------------------|
| Differential Pressure | 60 Pa <sup>-1</sup>  | 240 Pa <sup>-1</sup> |
| Temperature           | 200 °C <sup>-1</sup> | 200 °C <sup>-1</sup> |

### 5.5.2 Differential Pressure

The digital calibrated differential pressure signal read from the sensor is a signed integer number (two's complement number). The integer value can be converted to the physical value by dividing it by the scale factor (differential pressure in Pascal = sensor output ÷ scale factor).

### 5.5.3 Temperature

The digital calibrated temperature signal read from the sensor is a signed integer number (two's complement number). The integer value can be converted to the physical value by dividing it by the scale factor (temperature in °C = sensor output ÷ scale factor).

## 6. Package Outline

### 6.1 Dimensions SDP80x – Manifold Connection

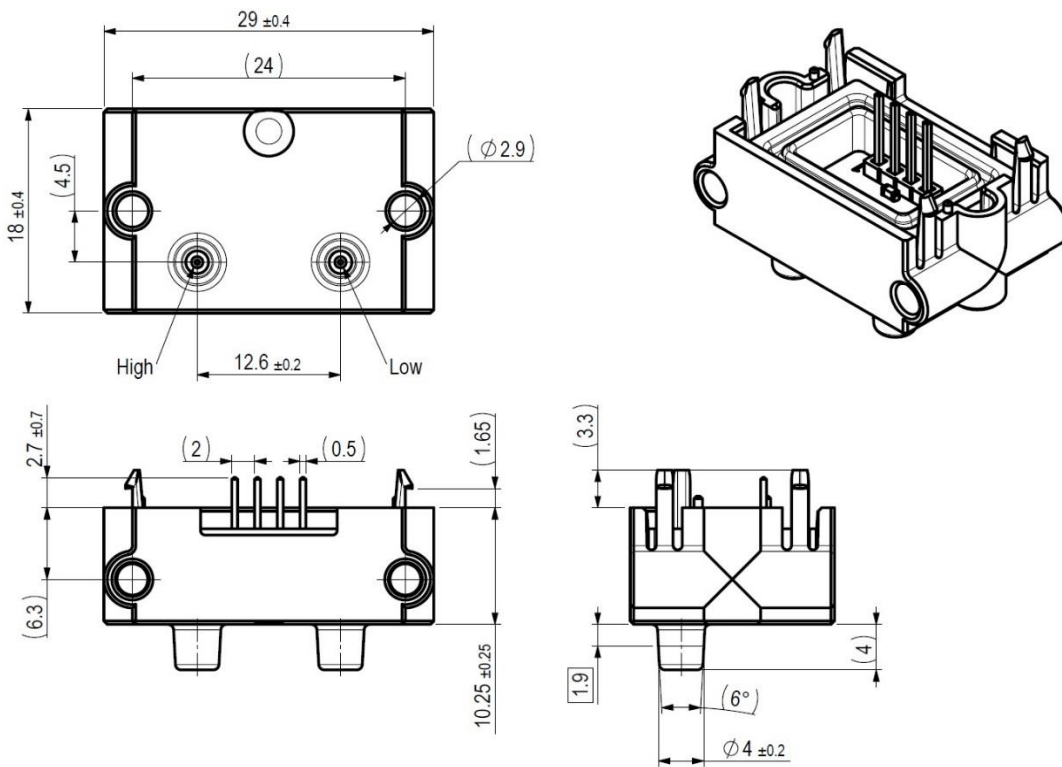


Figure 1: SDP80x. All dimensions in mm.

### 6.2 Dimensions SDP81x – Tube Connection

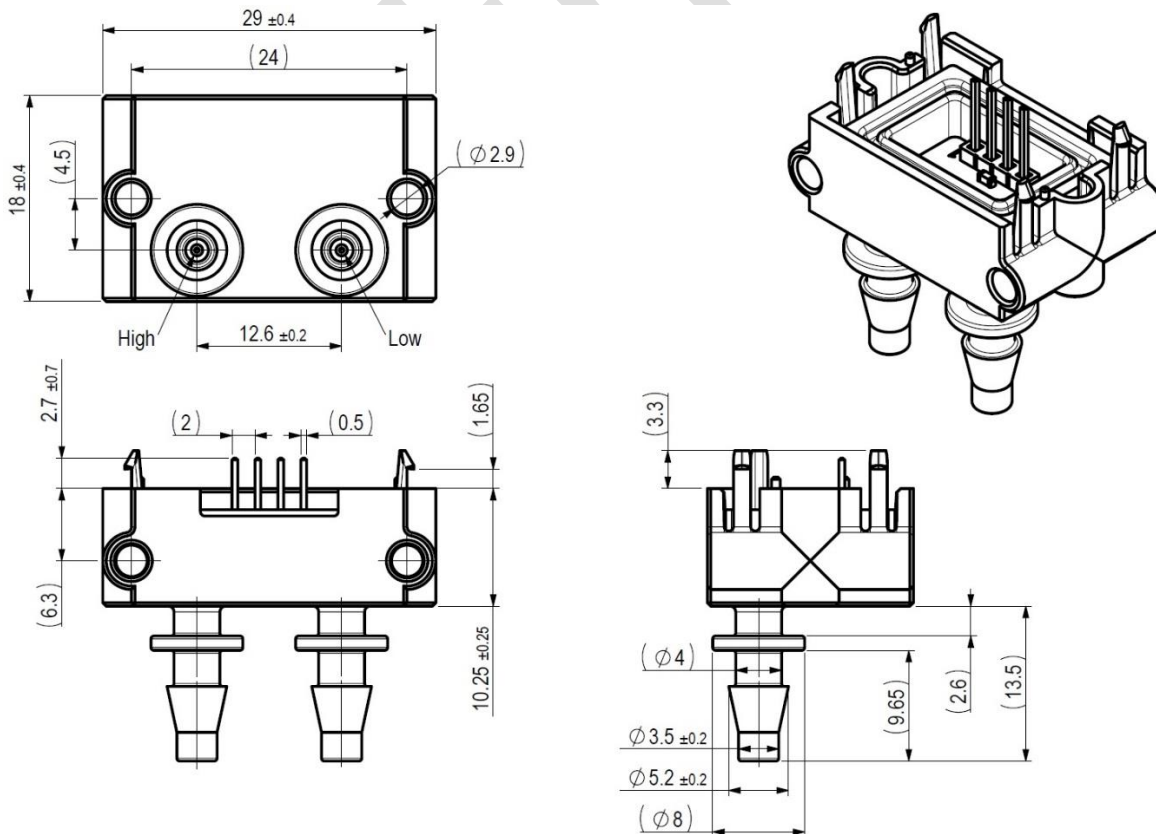
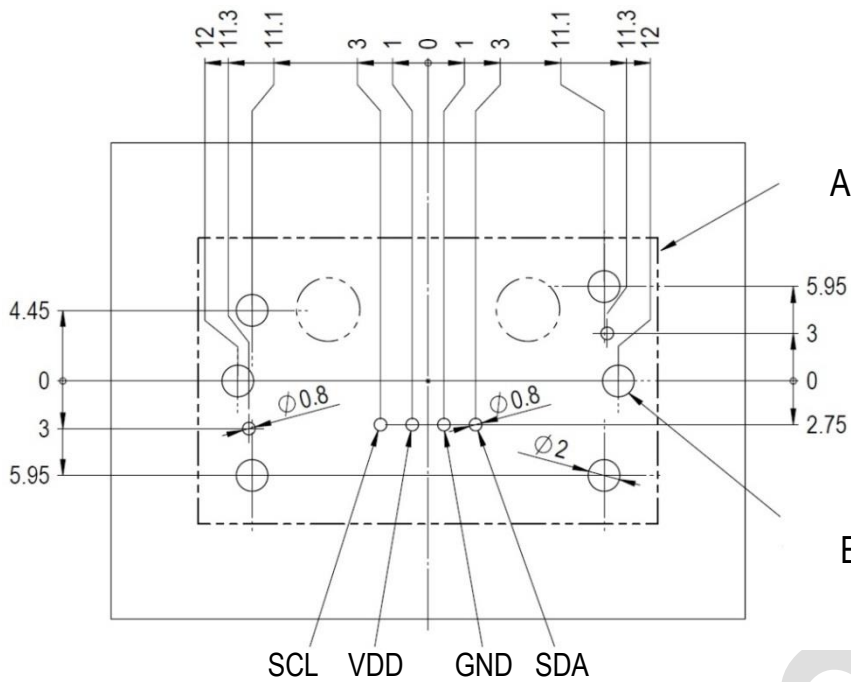


Figure 2: SDP81x. All dimensions in mm.

### 6.3 Footprint



**Figure 3:** Footprint for PCB mounting (top view = sensor side). All dimensions in mm.

A: Overall sensor dimensions

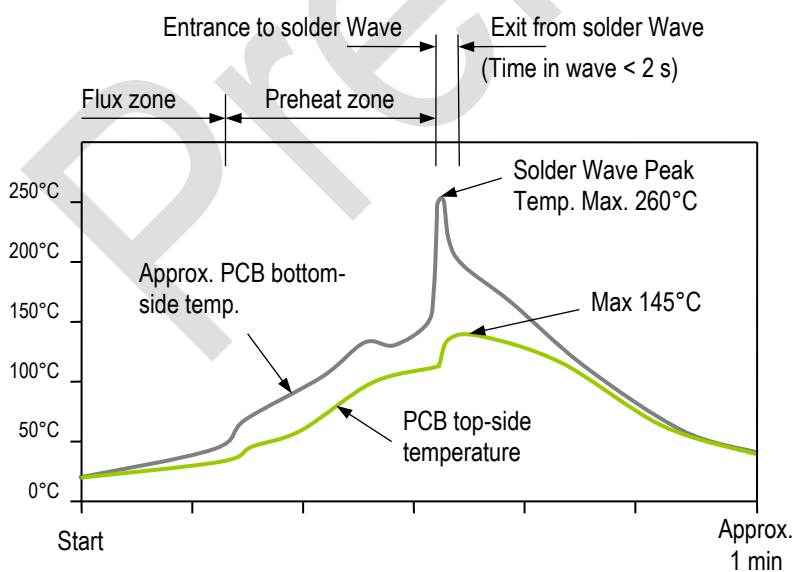
B: Holes for additional mounting screws (optional)

In case the sensor is not mounted on a PCB and is connected with a cable the SDP800/SDP600 series cap is recommended.

## 7. Soldering

Standard wave soldering systems may be used for soldering SDP800 series sensors. Reflow soldering is **not** feasible and may damage the sensor.

The sensor ports must be protected from solder splash and flux during soldering. *Figure 4* shows an appropriate temperature profile with maximum temperature values.



**Figure 4:** Suitable wave soldering profile.

The characteristics of wave soldering machines vary, so any soldering setup must be tested before production use.

## 8. Shipping Package

SDP8xx are shipped in trays of 80pcs. The tray dimension is 355mm x 255mm x 21.5mm. By piling them up, the height per tray can be considered as 19mm.

## 9. Ordering Information

Use the part names and item numbers shown in the following table when ordering SDP800 series differential pressure sensor. For the latest product information and local distributors, visit [www.sensirion.com](http://www.sensirion.com).

| Part name    | Description / Output                                  | Product number |
|--------------|---|----------------|
| SDP800-500Pa | Manifold mount, 500Pa, I <sup>2</sup> C Address 0x25  | 1-101551-01    |
| SDP810-500Pa | Tube connection, 500Pa, I <sup>2</sup> C Address 0x25 | 1-101532-01    |
| SDP800-125Pa | Manifold mount, 125Pa, I <sup>2</sup> C Address 0x25  | 1-101599-01    |
| SDP810-125Pa | Tube connection, 125Pa, I <sup>2</sup> C Address 0x25 | 1-101597-01    |

## Revision History

| Date       | Author | Version | Changes   |
|------------|--------|---------|---|
| 01.05.2016 | ANB    | V0.1    | First Draft   |
| 08.08.2016 | ANB    | V0.2    | Update product IDs and added 125Pa variants   |
| 09.09.2016 | ANB    | V0.3    | Product number added. Soft reset time and triggered measurement time changed. Product revision updated. |
| 06.12.2016 | ANB    | V0.4    | Product numbers added. Minor changes.   |
| 27.01.2017 | ANB    | V0.5    | Drawings updated. Sleep mode added.   |

## Important Notices

### Warning, personal injury

**Do not use this product as safety or emergency stop devices or in any other application where failure of the product could result in personal injury (including death). Do not use this product for applications other than its intended and authorized use. Before installing, handling, using or servicing this product, please consult the datasheet and application notes. Failure to comply with these instructions could result in death or serious injury.**

If the Buyer shall purchase or use SENSIRION products for any unintended or unauthorized application, Buyer shall defend, indemnify and hold harmless SENSIRION and its officers, employees, subsidiaries, affiliates and distributors against all claims, costs, damages and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if SENSIRION shall be allegedly negligent with respect to the design or the manufacture of the product.

### ESD Precautions

The inherent design of this component causes it to be sensitive to electrostatic discharge (ESD). To prevent ESD-induced damage and/or degradation, take customary and statutory ESD precautions when handling this product.

See application note "Handling Instructions" for more information.

### Warranty

SENSIRION warrants solely to the original purchaser of this product for a period of 12 months (one year) from the date of delivery that this product shall be of the quality, material and workmanship defined in SENSIRION's published specifications of the product. Within such period, if proven to be defective, SENSIRION shall repair and/or replace this product, in SENSIRION's discretion, free of charge to the Buyer, provided that:

- notice in writing describing the defects shall be given to SENSIRION within fourteen (14) days after their appearance;

- such defects shall be found, to SENSIRION's reasonable satisfaction, to have arisen from SENSIRION's faulty design, material, or workmanship;
- the defective product shall be returned to SENSIRION's factory at the Buyer's expense; and
- the warranty period for any repaired or replaced product shall be limited to the unexpired portion of the original period.

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