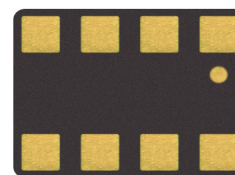




## WF280AI

### Digital Pressure Sensor



#### Key parameters

- Pressure range: 0 ... 1600kPa
- Package: 8-pin LGA metal-lid  
Footprint:  $2.0 \times 2.5\text{mm}^2$ , height: 1.0mm
- Relative accuracy:  $\pm 1.5\text{kPa}$ ,  
(0 ... 1000kPa,  $-15\text{...}+80^\circ\text{C}$ )
- Absolute accuracy: typ.  $\pm 2\text{kPa}$   
(0 ... 1000kPa,  $-15\text{...}+80^\circ\text{C}$ )
- Temperature coefficient offset: 5 Pa/K,  
equiv. to 12 cm/K  
( $25\text{...}+40^\circ\text{C}$  @ 100kPa)
- Digital interface: I<sup>2</sup>C
- Current consumption: 5.4 $\mu\text{A}$  @1Hz  
sampling rate
- Temperature range:  $-40\text{...}+125^\circ\text{C}$
- RoHs compliant, halogen-free

#### Typical applications

- Indoor navigation (floor detection,  
elevator detection)
- Outdoor navigation, leisure and sports  
applications
- Enhancement of GPS navigation
- Weather forecast
- Health care applications (e.g.  
spirometry)
- Vertical velocity indication (e.g.  
rise/sink speed)

#### Target devices

- Handsets such as mobile phones,  
tablet PCs, GPS devices
- Navigation systems
- Portable health care devices
- Home weather stations
- Flying toys
- Sport watches

#### Brief Description

WF280AI is a high precision barometer and altimeter especially designed for consumer applications. It measures the pressure based on piezo-resistive MEMS pressure sensor.

The ultra-low power, low voltage electronics of the WF280AI is optimized for use in mobile phones, smart watches, PDAs,

GPS navigation devices and outdoor equipment. The sensor module is housed in a compact 8-pin metal-lid LGA package with a footprint of only  $2.0 \times 2.5\text{mm}^2$  and 1.0 mm package height. Its small dimensions and its low power consumption allow the implementation in battery driven devices. With a low altitude noise of merely 0.1m and very low offset temperature coefficient (TCO), the WF280AI offers superior performance and are perfectly suitable for applications like floor detection, health care as well as GPS refinement. The I<sup>2</sup>C interface allows for easy system integration with a microcontroller.



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# 1 Specification

VDD = 3.3V, T=25°C, unless otherwise noted.

Table 1 Parameter specification

| Parameter                                                  | Symbol                         | Condition                                  | Min  | Typ   | Max    | Units |
|------------------------------------------------------------|--------------------------------|--------------------------------------------|------|-------|--------|-------|
| Operating temperature range                                | T <sub>A</sub>                 | operational                                | -40  | 25    | +125   | °C    |
|                                                            |                                | full accuracy                              | 0    |       | 85     |       |
| Operating pressure range                                   | P                              | full accuracy                              | 0    |       | 1600   | kPa   |
| Sensor supply voltage                                      | V <sub>DD</sub>                |                                            | 1.8  |       | 3.6    | V     |
| Supply current                                             | I <sub>DD, LP</sub>            | 1Hz, lowest osr_p and osr_t                |      | 5.4   |        | μA    |
| Peak current                                               | I <sub>peak</sub>              | during pressure measurement                |      | 760   |        | μA    |
| Current at temperature measurement                         | I <sub>DDT</sub>               |                                            |      | 541   |        | μA    |
| Sleep current                                              | I <sub>DDSL</sub>              | 25°C                                       |      | 0.1   | 0.3    | μA    |
| Relative accuracy                                          | A <sub>rel</sub>               | 1000kPa<br>-15...80°C                      |      | ±1.5  |        | kPa   |
| Offset temperature coefficient                             | TCO                            | 100kPa<br>25...40°C                        |      | ±5    |        | Pa/K  |
| Absolute accuracy pressure                                 | A <sub>ext</sub> <sup>P</sup>  | 0 ...100kPa<br>-20...0°C                   |      | ±2    |        | kPa   |
|                                                            | A <sub>full</sub> <sup>P</sup> | 0 ...100kPa<br>0...65°C                    |      | ±2    |        | kPa   |
| Resolution of output data in O4 ultra high resolution mode | R <sup>P</sup>                 | Pressure                                   |      | 0.095 |        | Pa    |
|                                                            | R <sup>T</sup>                 | Temperature                                |      | 0.01  |        | °C    |
| Noise in pressure                                          | V <sub>P,full</sub>            | Full bandwidth, O4 ultra high resolution   |      | 10    |        | Pa    |
|                                                            | V <sub>P,filtered</sub>        | Lowest bandwidth, O4 ultra high resolution |      | 5     |        | Pa    |
| Absolute accuracy temperature                              | A <sup>T</sup>                 | @25°C                                      |      | ±2.0  |        | °C    |
|                                                            |                                | -15 ...+85°C                               |      | ±3.0  |        | °C    |
| PSRR (DC)                                                  | PSSR                           | Full V <sub>DD</sub> range                 |      |       | ±0.005 | Pa/mV |
| Long term stability                                        | ΔPstab                         | 12 months                                  |      | ±TBD  |        | hPa   |
| Solder drifts                                              |                                |                                            | -0.5 |       | +2     | hPa   |
| Possible sampling                                          | f <sub>sample</sub>            |                                            | 157  | 182   | TBD    | Hz    |

Rev.1.1



## 2 Absolute maximum ratings

Table 2 Absolute maximum ratings

| Parameter              | Symbol            | Condition | Min  | Max                  | Units |
|------------------------|-------------------|-----------|------|----------------------|-------|
| Supply voltage         | V <sub>DD</sub>   |           | -0.3 | +3.6                 | V     |
| Voltage at all IO Pins | V <sub>DDIO</sub> | all pins  | -0.3 | V <sub>DD</sub> +0.3 | V     |
| Overpressure           | P                 |           | 0    | 1700                 | kPa   |
| Storage temperature    | T <sub>STOR</sub> |           | -45  | +85                  | °C    |
| ESD rating             | ESD               | HBM       |      | ±2                   | kV    |



## 3 Operation

### 3.1 Brief description

The WF280AI is designed to be connected directly to an external microcontroller of a mobile device via the I<sup>2</sup>C bus. The pressure and temperature data has to be compensated by the calibration data of the on-chip Non-Volatile Memory (NVM) which is individually factory calibrated for each device.

### 3.2 Function description

The WF280AI consists of a piezo-resistive micro-machined pressure sensor, an analog to digital converter and a control unit with Non-Volatile Memory (NVM) and a serial I<sup>2</sup>C interface. The WF280AI delivers the compensated values of the pressure and the temperature.

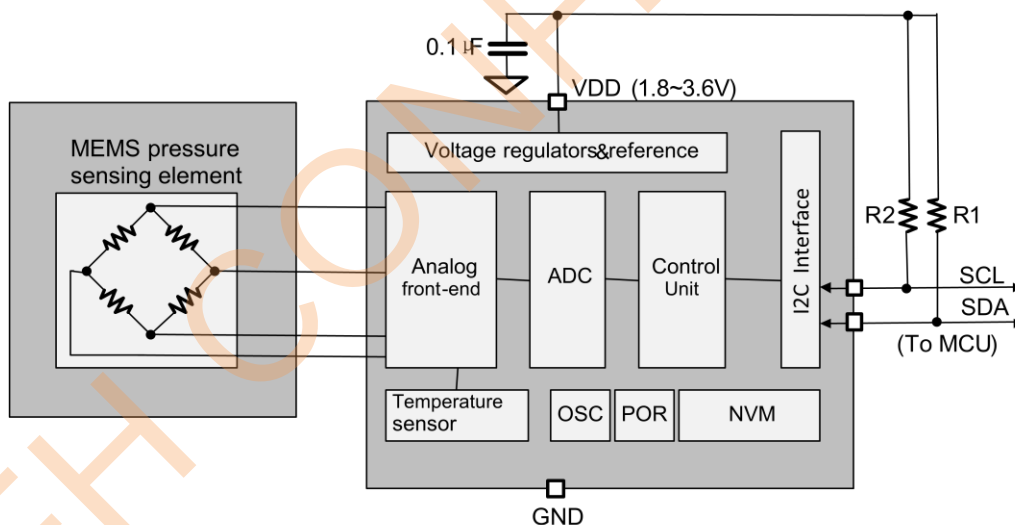


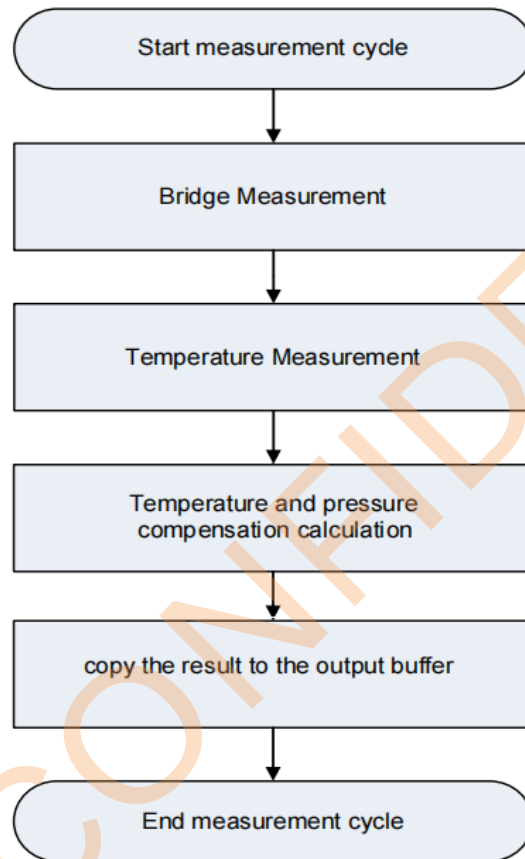
Figure 1 Block diagram of WF280AI



### 3.3 Measurement of pressure and temperature

The WF280AI must actively send a control command to trigger a measurement process by external controller(MCU),otherwise the chip remains in sleep state.

Each measurement process of the bridge sensor and the temperature sensor may include the following processes:



### 3.4 Measurement Time&Noise

ADC OSR setting

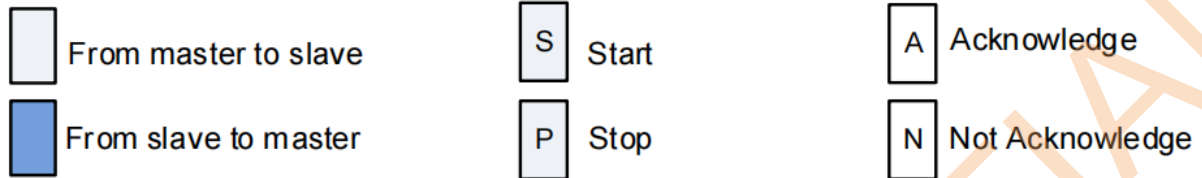
| OSR<br>(BIN) | OSR_P / OSR_T      | Measurement<br>Time [ms] | 3-sigma Noise for<br>20-bit bridge data [counts]* |
|--------------|--------------------|--------------------------|---------------------------------------------------|
| 000b         | oversampling × 128 | 69.6                     | 10.2                                              |
| 001b         | oversampling × 64  | 35.6                     | 11.4                                              |
| 010b         | oversampling × 32  | 18.8                     | 17.7                                              |
| 011b         | oversampling × 16  | 10.4                     | 22.8                                              |
| 100b         | oversampling × 8   | 6.2                      | 30.3                                              |
| 101b         | oversampling × 4   | 4.0                      | 44.7                                              |
| 110b         | oversampling × 2   | 3.0                      | 58.5                                              |
| 111b         | oversampling × 1   | 2.4                      | 76.5                                              |

\* Test conditions: bridge resistance 1.1kΩ, Gain=51x, ADC\_Offset=-8/16~8/16, VDD=3.3V, NOR mode, 256 sampling times, interval 400ms, IIR filter disabled



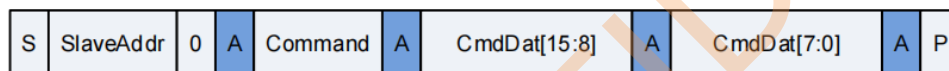
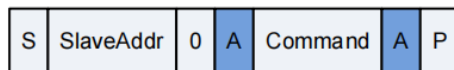
## 4 I<sup>2</sup>C Interface

### 4.1 I<sup>2</sup>C Operation



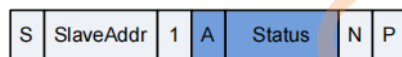
The default 7-bit I<sup>2</sup>C device address of WF280AI is binary 0111000.

### 4.2 I<sup>2</sup>C Write

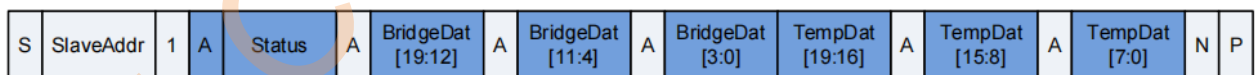


### 4.3 I<sup>2</sup>C Read

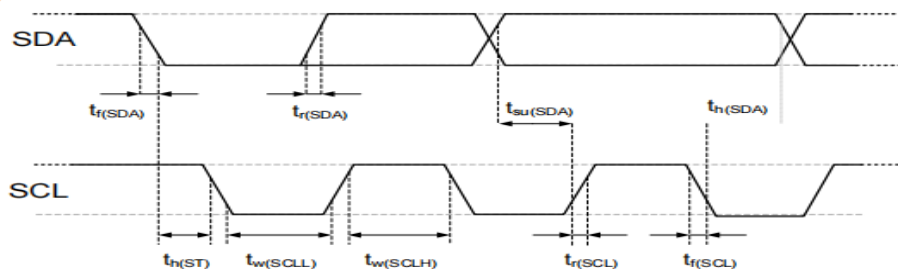
Readout status byte at any time



Readout 20-bit bridge measurement and 20-bit temperature measurement when the FIFO is disabled



### 4.4 I<sup>2</sup>C Timing





**WF280AI 16 BA**  
**Digital Pressure Sensor**  
Data Sheet

| Symbol              | Parameter                                      | Conditions                                            |        |      | Units |
|---------------------|------------------------------------------------|-------------------------------------------------------|--------|------|-------|
|                     |                                                |                                                       | Min.   | Max  |       |
| f <sub>SCL</sub>    | SCL clock frequency                            |                                                       | 0      | 100  | kHz   |
| t <sub>HD;STA</sub> | Hold time (repeated) START condition           | After this period, the first clock pulse is generated | 4.0    | -    | μs    |
| t <sub>LOW</sub>    | LOW period of the SCL clock                    |                                                       | 4.7    | -    | μs    |
| t <sub>HIGH</sub>   | HIGH period of the SCL clock                   |                                                       | 4.0    | -    | μs    |
| t <sub>SU;STA</sub> | Set-up time for a repeated START condition     |                                                       | 4.7    | -    | μs    |
| t <sub>HD;DAT</sub> | Data hold time                                 |                                                       | 0.09   | 3.45 | μs    |
| t <sub>SU;DAT</sub> | Data setup time                                |                                                       | 250    | -    | ns    |
| t <sub>r</sub>      | Rise time of SDA, SCL                          |                                                       | -      | 1000 | ns    |
| t <sub>f</sub>      | Fall time of SDA, SCL                          |                                                       | -      | 300  | ns    |
| t <sub>SU;STO</sub> | Set-up time for STOP condition                 |                                                       | 4.0    | -    | μs    |
| t <sub>BUF</sub>    | Bus free time between STOP and START condition |                                                       | 4.7    | -    |       |
| C <sub>b</sub>      | Capacitive load for each bus line              |                                                       | -      | 400  | pF    |
| t <sub>VD;DAT</sub> | Data valid time                                |                                                       | -      | 3.45 | μs    |
| t <sub>VD;ACK</sub> | Data valid acknowledge time                    |                                                       | -      | 3.45 | Ms    |
| V <sub>nL</sub>     | Noise margin at the LOW level                  |                                                       | 0.1VDD | -    | V     |
| V <sub>nH</sub>     | Noise margin at the HIGH level                 |                                                       | 0.2VDD | -    | V     |

Notice: The SCL and SDA IO of Master(MCU) must be open drain output but not Push pull output.



## 5 Command list

### 1) PT\_MEAS: Measure bridge sensor and temperature

| Command Byte | Data Byte 0 |       |   |   |   |   |       |   | Data Byte 1 |   |      |   |   |   |   |   |
|--------------|-------------|-------|---|---|---|---|-------|---|-------------|---|------|---|---|---|---|---|
| --           | 7           | 6     | 5 | 4 | 3 | 2 | 1     | 0 | 7           | 6 | 5    | 4 | 3 | 2 | 1 | 0 |
| 0xAC         | 0           | OSR_T |   |   |   | 0 | OSR_P |   |             |   | 0x00 |   |   |   |   |   |

This control command is used to start a temperature and bridge sensor measurement with specified over sampling rate (OSR).

When this command is executed, both the 20-bit bridge data and the 20-bit temperature data can be read in the next read operation, in the format shown below:

| Return Status Byte |   |   |   |   |   |   |   | Return Data Byte 0  |   |   |   |   |   |   |   | Return Data Byte 1 |   |   |   |   |   |   |   |
|--------------------|---|---|---|---|---|---|---|---------------------|---|---|---|---|---|---|---|--------------------|---|---|---|---|---|---|---|
| 7                  | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 7                   | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 7                  | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Status [7:0]       |   |   |   |   |   |   |   | Bridge data [19:12] |   |   |   |   |   |   |   | Bridge data [11:4] |   |   |   |   |   |   |   |

| Return Data Byte 2  |   |   |   |                    |   |   |   | Return Data Byte 3      |    |    |    |    |    |   |   | Return Data Byte 4     |   |   |   |   |   |   |   |
|---------------------|---|---|---|--------------------|---|---|---|-------------------------|----|----|----|----|----|---|---|------------------------|---|---|---|---|---|---|---|
| 7                   | 6 | 5 | 4 | 3                  | 2 | 1 | 0 | 15                      | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7                      | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Pressure data [3:0] |   |   |   | Temp. data [19:16] |   |   |   | Temperature data [15:8] |    |    |    |    |    |   |   | Temperature data [7:0] |   |   |   |   |   |   |   |

### 2) Readout status byte at any time

| Return Status Byte |   |   |   |   |   |   |   |
|--------------------|---|---|---|---|---|---|---|
| 7                  | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Status [7:0]       |   |   |   |   |   |   |   |

Status byte bits definition

| Bit       | Function           | Description                                                                                         |
|-----------|--------------------|-----------------------------------------------------------------------------------------------------|
| Bit[7]    | Busy indication    | 1 – the chip is busy<br>0 – the chip is sleeping                                                    |
| Bit [6:5] | Mode Status        | 00 NOR mode                                                                                         |
| Bit [4]   | For test only      | 0                                                                                                   |
| Bit [3]   | Calibration Enable | 0 – Calibration disabled; raw data is output<br>1 – Calibration enabled; compensated data is output |
| Bit [2]   | For test only      | 0                                                                                                   |
| Bit [1]   | For test only      | 0                                                                                                   |
| Bit [0]   | For test only      | 1                                                                                                   |



## 6 Pin-out and connection diagram

### 6.1 Pin-out

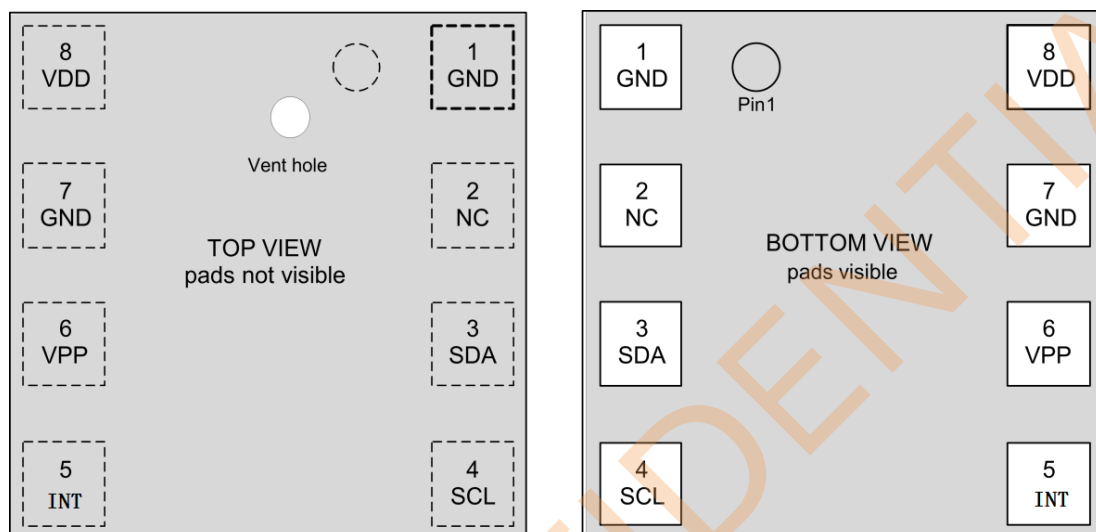


Figure 11 Pin-out top and bottom view

| Pin | Name | I/O Type | Description                  | Connect to                       |
|-----|------|----------|------------------------------|----------------------------------|
| 1   | GND  | Supply   | Ground                       | GND                              |
| 2   | NC   | --       | Not Connected                | Not connected                    |
| 3   | SDA  | In/Out   | Serial data input and output | I <sup>2</sup> C SDA             |
| 4   | SCL  | In       | Serial clock input           | I <sup>2</sup> C SCL             |
| 5   | INT  | OUT      | Interrupt signal             | Interrupt input or not connected |
| 6   | VPP  | Supply   | NVM programming supply       | Not connected                    |
| 7   | GND  | Supply   | Ground                       | GND                              |
| 8   | VDD  | Supply   | Power supply                 | VDD                              |



## 6.2 Connection diagram

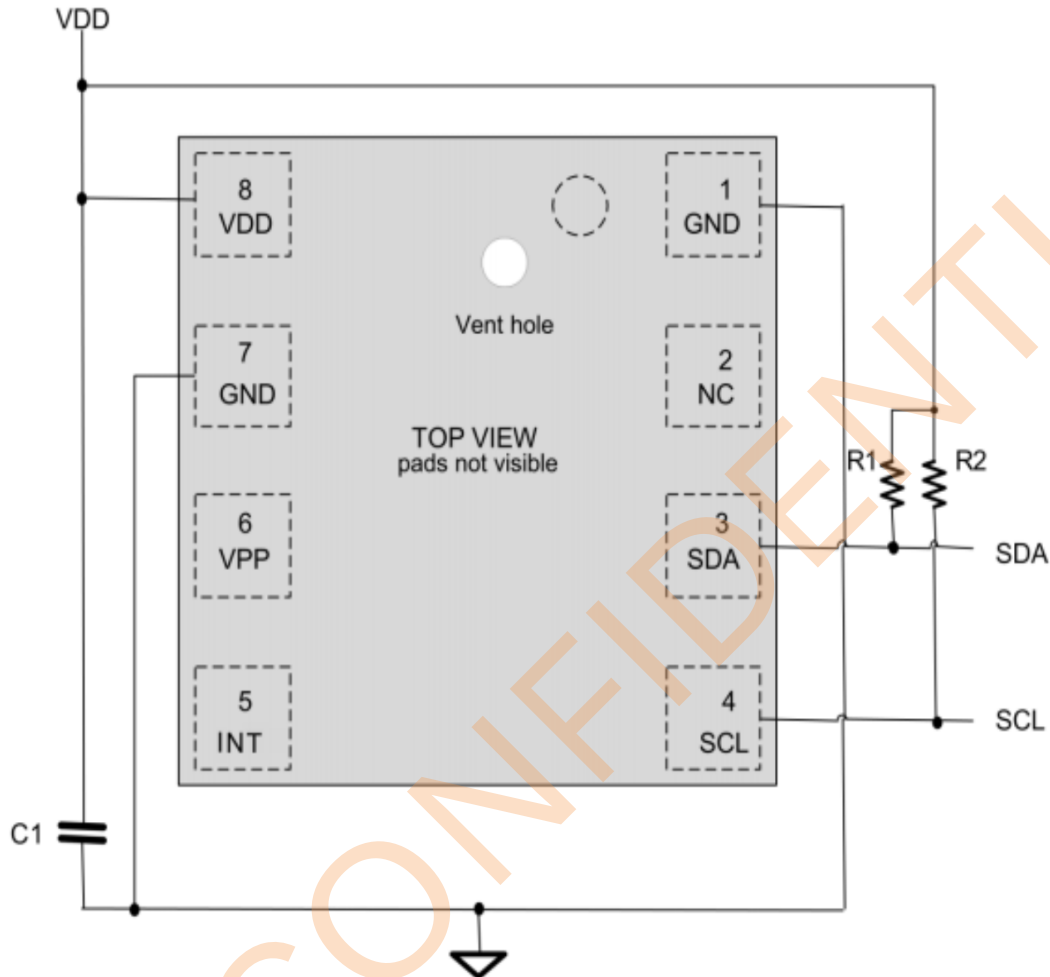


Figure 12 Connection diagram

### Notes:

- The recommended value for C1 is 100nF
- The value for the pull-up resistors R1, R2 should be based on the interface timing and the bus load; the typical value is 4.7 k $\Omega$  for both resistors.



## 7 Package, reel and environment

### 7.1 Outline dimensions

The sensor housing is an 8-pin metal-lid LGA 2.0 × 2.5 × 1.0mm<sup>3</sup> package. Its dimensions are depicted in Figure 13.

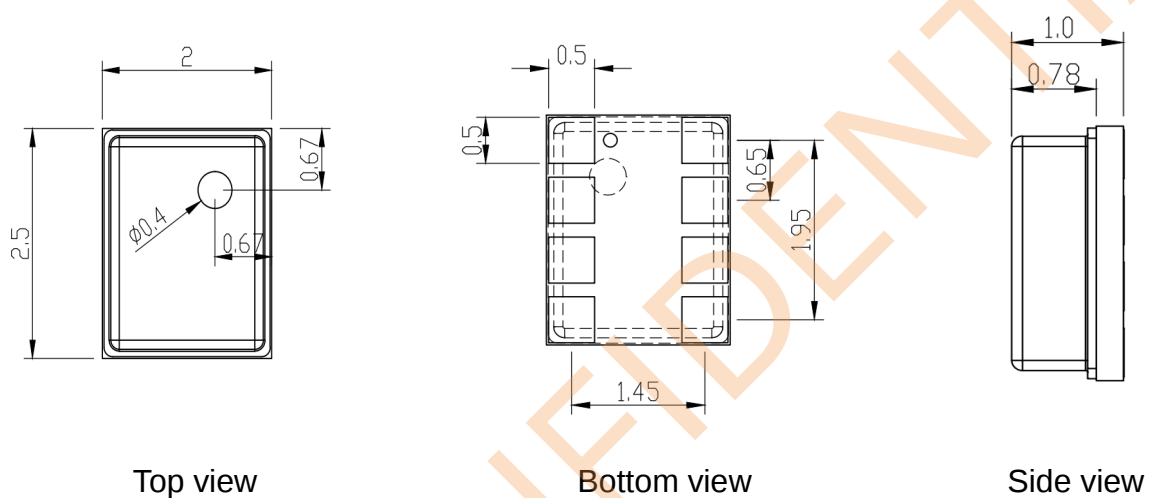


Figure 13 Package outline dimensions for top, bottom and side view



## 8 Document history and modification

| Version | Description     | Date          |
|---------|-----------------|---------------|
| 1.0     | Initial release | Mar. 20, 2024 |
|         |                 |               |