

Product Specification

Senseair Sunrise

Sensor module for battery-powered applications

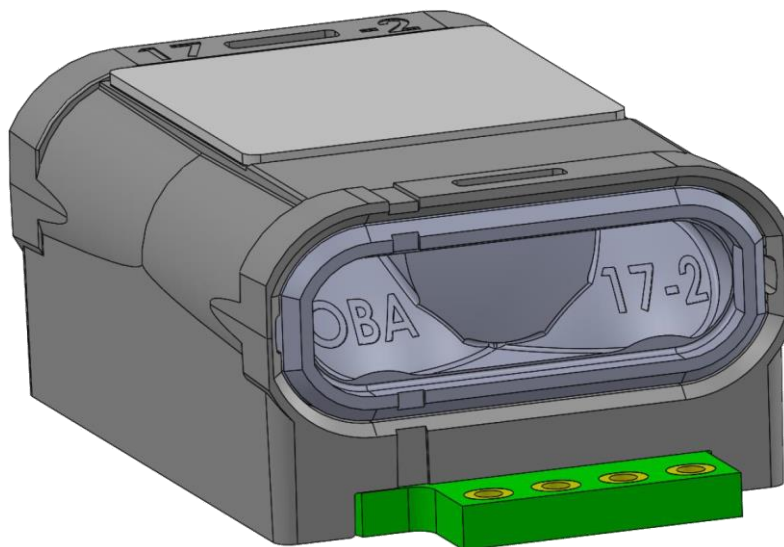


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General Specifications

| Item | Senseair Sunrise Article No. 006-0-0002 |
|------------------------------------|---|
| Target gas | Carbon dioxide (CO ₂) |
| Operating principle | Non-dispersive infrared (NDIR) |
| Operating range | 0 – 50°C, 0 – 85%RH (non-condensing), (see figure 3) |
| Measurement range | 400 – 5000ppm; extended range up to 10000ppm ¹ |
| Accuracy [CO ₂] | ±(30ppm +3% of reading) ^{2, 3} (extended range ±10% of reading) ^{2, 3, 4} |
| Pressure dependence | 1.6% reading per kPa deviation from normal pressure |
| RMS noise, Typ. [CO ₂] | <u>Filtered:</u> 0.7ppm @ 400ppm, 25°C 1.4ppm @ 2000ppm, 25°C <u>Unfiltered:</u> 6ppm @ 400ppm, 25°C 13ppm @ 2000ppm, 25°C |
| Power supply | 3.05 – 5.5V ⁵ |
| Peak current | <125mA |
| Average current | <150µA ⁶ |
| Measurement period | Default : 16s (adjustable by host) ⁶ |
| Dimensions (Max. L x W x H) | 33.9 x 19.8 x 12.3mm |
| Life expectancy | >15 years |
| Storage temperature | -40 – 70°C |
| Weight | 5.0 ±0.5g |
| Serial communication | UART / I ² C |

Table 1 General Specifications

Note 1: Sensor is designed to measure in the range 400 – 5000ppm, extended range up to 10000ppm, which is specified in the table accuracy. Nevertheless, exposure to concentrations below 400ppm may result in incorrect operation of ABC algorithm and shall be avoided for model with ABC ON.

Note 2: 15 – 35°C, 0 – 80%RH, after three (3) ABC periods.

Note 3: Specification is referenced to uncertainty of calibration gas mixtures (±1%).

Note 4: Extended range accuracy is not calibrated or guaranteed, it is extrapolated from calibrated range.

Note 5: Unprotected against surges and reverse connection.

Note 6: See Measurement mode for detailed information

Description

Senseair Sunrise is a miniature sensor module for battery-powered applications. It gives full control over sensor's integration into a host system, flexibility in changing of the CO₂ measurement period and power consumption.

Applications

Senseair Sunrise is designed for battery powered applications.

Key Benefits

- Wide supply voltage range enables a variety of battery options
- Adjustable measurement period by host
- Adjustable ABC period by host
- Ultra-low power consumption

Installation and Soldering

Refer to Senseair Sunrise Handling manual (ANO4947).

Sample Gas Diffusion Area

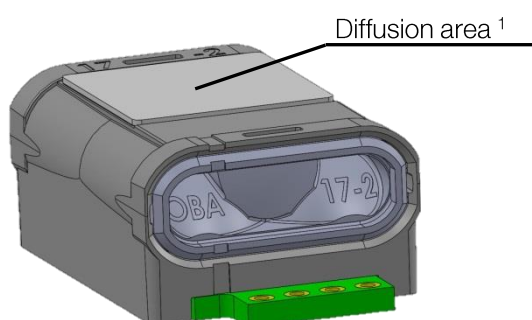


Figure 1 Sample Gas Diffusion Area

Note 1: Diffusion area must not be covered. Diminished sample gas circulation may affect response time.

Pin Configuration and Functions

Pin Configuration

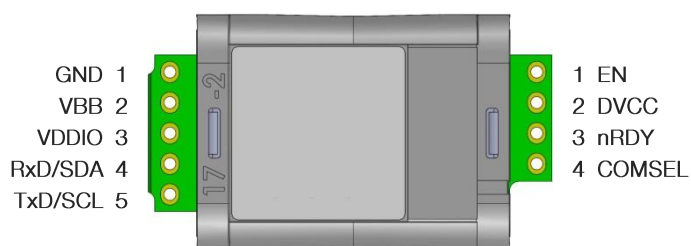


Figure 2 Pin Configuration (Top view)

Pin Functions

| Pin # | Symbol | I/O Type | Description |
|---------------------------|---------|----------|---|
| JP1 (4-pin header) | | | |
| 1 | EN | Input | Enable (active high). Drive this pin over 1.2V to turn on the sensor. Drive this pin below 0.4V to put the sensor into shutdown mode. Do not leave floating. Connect to VBB if not used. |
| 2 | DVCC | Power | 2.8V internal supply voltage output. Not intended to supply external systems, leave floating if not used. |
| 3 | nRDY | Output | Measurement ready output; True Open-Drain, active LOW; 100k Ω internal Pull-Up to VDDIO. |
| 4 | COMSEL | Input | Communication select, valid at power-up: HIGH = UART (Default, internal Pull-Up, can be left floating); LOW = I ² C (Connect to GND). |
| JP2 (5-pin header) | | | |
| 1 | GND | Power | Ground |
| 2 | VBB | Power | Sensor supply voltage |
| 3 | VDDIO | Power | I/O supply voltage |
| 4 | RxD/SDA | I/O | Sensor UART receive input / I ² C bidirectional serial data; True Open-Drain when operating as output. |
| 5 | TxD/SCL | I/O | Sensor UART transmit output / I ² C clock input; True Open-Drain when operating as output, 100k Ω internal Pull-Up to VDDIO. |

Table 2 Pin Functions

Specifications

Absolute Maximum Ratings

Over operating temperature range (unless otherwise noted); all voltages are with respect to GND ⁽¹⁾

| Symbol | Description | | Min | Max | Unit |
|--------------------------------|-------------------------------------|------------------------|--------------------|-------------|------|
| Voltage | | | | | |
| VBB | Supply voltage | | | | |
| VDDIO | I/O supply voltage | | | | |
| nRDY | Ready output | | -0.3 | 6 | V |
| RxD/SDA | UART / I ² C | | | | |
| TxD/SCL | UART / I ² C | | | | |
| EN | Enable | | | | |
| DVCC | Internal supply voltage output | | -0.3 | < VBB + 0.3 | V |
| COMSEL | Communication select | 3.05 ≤ VBB, EN = HIGH | -0.3 | DVCC + 0.3V | |
| | | VBB ≤ 3.05V, EN = HIGH | -0.3 | DVCC + 0.3V | V |
| | | EN = LOW | -0.3 | 0.3 | |
| Current | | | | | |
| DVCC | Maximum output current | | Internally limited | | A |
| COMSEL, RxD/SDA, TxD/SCL | Instantaneous maximum current limit | | 25 | | mA |

Table 3 Absolute Maximum Ratings

Note 1: Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

Recommended Operating Conditions

Over operating temperature range (unless otherwise noted)

| Symbol | Description | Min | Typ | Max | Unit | Test conditions |
|----------------------------------|---|------|------|-------|------|---|
| Voltage | | | | | | |
| VBB | Supply voltage | 3.05 | 3.3V | 5.5 | V | |
| VDDIO | I/O supply voltage | 2.03 | | 5.5 | V | |
| COMSEL | Communication select | 0 | | DVCC | V | |
| DVCC | Internal supply voltage output ¹ | 0 | | 2.8 | V | |
| EN | Enable | 0 | | VBB | V | |
| RxD/SDA | UART / I ² C | 0 | | VDDIO | V | |
| TxD/SCL | UART / I ² C | 0 | | VDDIO | V | |
| Current | | | | | | |
| I _{COMSEL} ² | DC injection current | -2 | | 2 | mA | (V _{IN} <GND, V _{IN} >DVCC) |
| I _{DVCC} ^{1,2} | Internal supply voltage current | 0 | | 25 | mA | |

Table 4 Recommended Operating Conditions

Note 1: Output is not intended to supply external systems, leave floating if unused.

Note 2: Must be limited to the value specified.

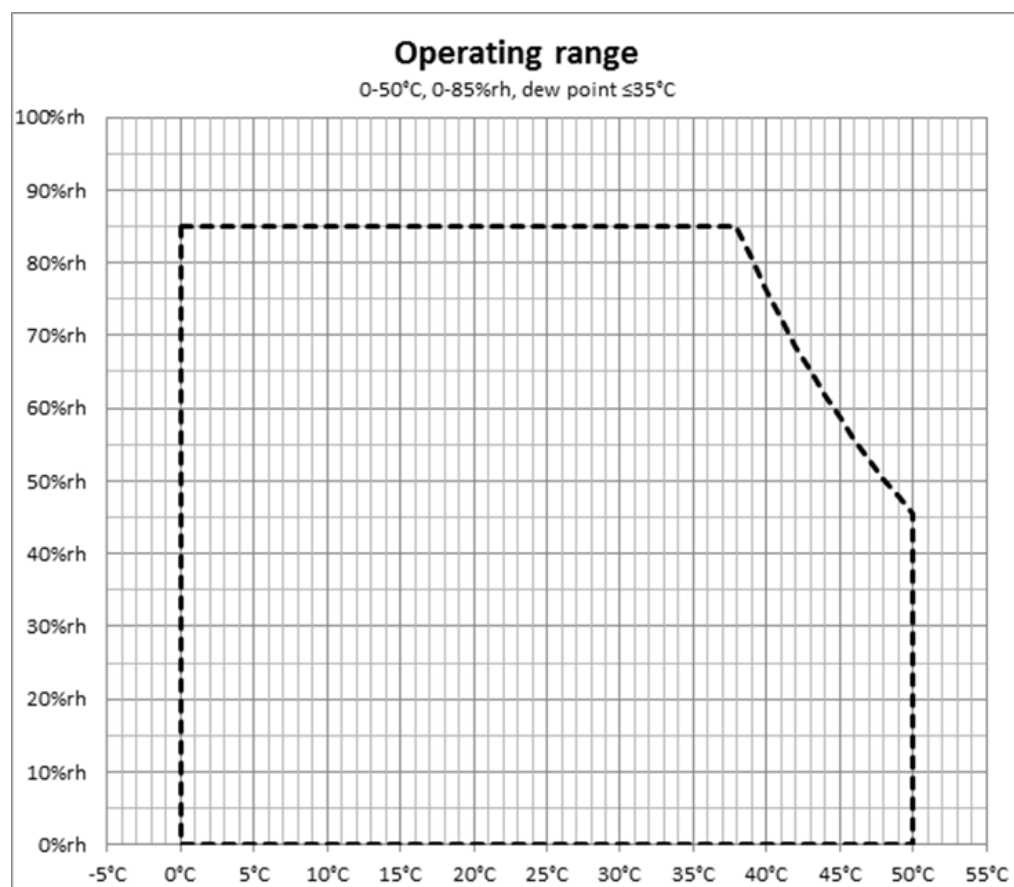


Figure 3 Operating range

Electrical Characteristics

Over operating temperature range, $V_{EN} = V_{BB} = 3.3V$, 16s measurement period, unless otherwise noted.

| Symbol | Description | Min | Typ | Max | Unit |
|--------------------------|---|---|-------|-------------|---------------|
| Operating voltage | | | | | |
| V_{DVCC} | Supply voltage output | | 2.8 | | V |
| V_{IH} | Input high voltage | 1.96 1.2 | | | V V |
| V_{IL} | Input low voltage | | | 0.84 0.4 | V V |
| V_{HYS} | Input hysteresis | 168 | | | mV |
| Operating current | | | | | |
| I_{VBB} | Operating peak current Operating average current | $V_{EN} \geq 1.2V$; $3.05 \leq V_{BB} \leq 5.5V$ | | 125 150 | mA μA |
| Shutdown current | | | | | |
| I_{VBB} | Supply quiescent current | $V_{EN} \leq 0.3V$; $3.05 \leq V_{BB} \leq 5.5V$ | 0.018 | 1 | μA |
| I_{EN} | Enable pin leakage current | $V_{EN} = V_{BB} = 5.5V$ | | 40 | nA |
| I_{VDDIO} | I/O supply leakage current | $V_{DDIO} = 3.3V$ | 0.2 | 1.1 | μA |
| I_{IN} | Input leakage current | $V_{DDIO} = 3.3V$; RxD/SDA, TxD/SCL | 0.1 | 1 | μA |

Table 5 Electrical Characteristics, Typical values at $T_A = 25^\circ C$.

Measurement mode

The Senseair Sunrise supports two modes of operation for measurement of CO_2 concentration: Continuous measurement mode and Single measurement mode. The default operation mode for Senseair Sunrise is Continuous measurement mode.

- 1) In Continuous measurement mode, the sensor measures at regular intervals (measurement period, default setting 16s). The host can read measurement data after each measurement and does not need to send any command to trigger measurements.
- 2) In the Single measurement mode, the sensor waits for the hosts command to measure. The host needs to send a command sequence (see Single measurement mode) to trigger each measurement.

Single measurement mode

In this mode, a measurement is executed by the host's instruction. The host system needs to read the state information after the measurement and write back the state information before executing the measurement. The timing diagram with estimated power consumption and parameters are described in Figure 4 and Table 6, respectively.

Measurement sequence in Single measurement mode:

1. The host MCU enables the sensor by inputting H to the EN-pin.
2. The host MCU waits specified time for start-up of the sensor.
3. The host MCU writes the state registers values back to the sensor.
4. The sensor starts a new measurement by an instruction from the host MCU.
5. After completion of the measurement, the sensor pulls the RDY-pin down (the sensor does NOT start next measurement automatically).
6. The host MCU reads a CO₂ concentration value from the sensor.
7. Depending on the customer's requirement, #4-#6 are iterated.
8. The host MCU reads state register values from the sensor.
9. The host MCU disables the sensor by inputting L to the EN-pin.
10. Go back to #1, after waiting until the time to do next measurement.

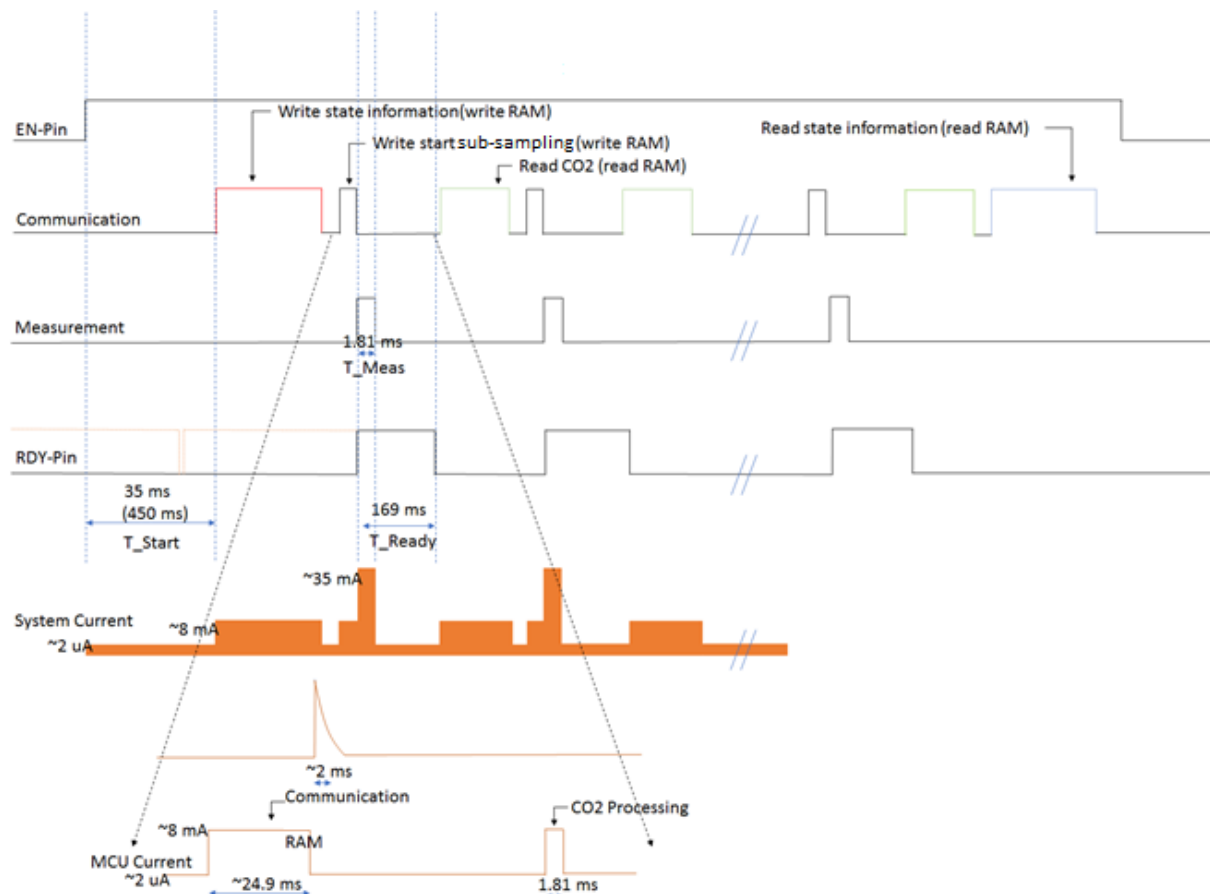


Figure 4 Timing diagram for the Single measurement mode (V_{BB}=3.3V, 25 °C)

- Note:
- 1) The diagram only shows the major activities for the measurement.
 - 2) The current is estimated, and it is an estimated average for T_{Meas} .
 - 3) The read/write interval depends on the communication protocol used, i.e., Modbus/I²C. In the case of I²C, it also depends on the SCL clock frequency.

| Parameters | Min | Typical (ms) | Max (ms) | Timing Control | Comments |
|------------|-----|--------------|----------|--|---|
| T_Start | | 35 | | Ready for communication after MCU start | Bootloader is skipped for single measurement mode |
| | | 450 | | | Bootloader is enabled during start-up in multi-measurement mode |
| T_Ready | | 169 | 250 | Measurement data ready after measuring command is issued | The time depends on if the calibration is also executed |
| T_Meas | | 1.81 | TBD | Measurement time | The time for CO2 measurement |

Table 6 Timing parameters for measurements

Continuous measurement mode

In the Continuous measurement mode, the measurement is performed automatically according to the measurement period and number of sub-samples per measurement set by the user. The timing diagram is illustrated in Figure 5. Please refer to Table 6 for relevant timing and parameter values.

Measurement parameters:

- 1) Default measurement period: 16s (the minimum period is 2s)
- 2) Default number of sub-samples: 32 (range 1 — 32)

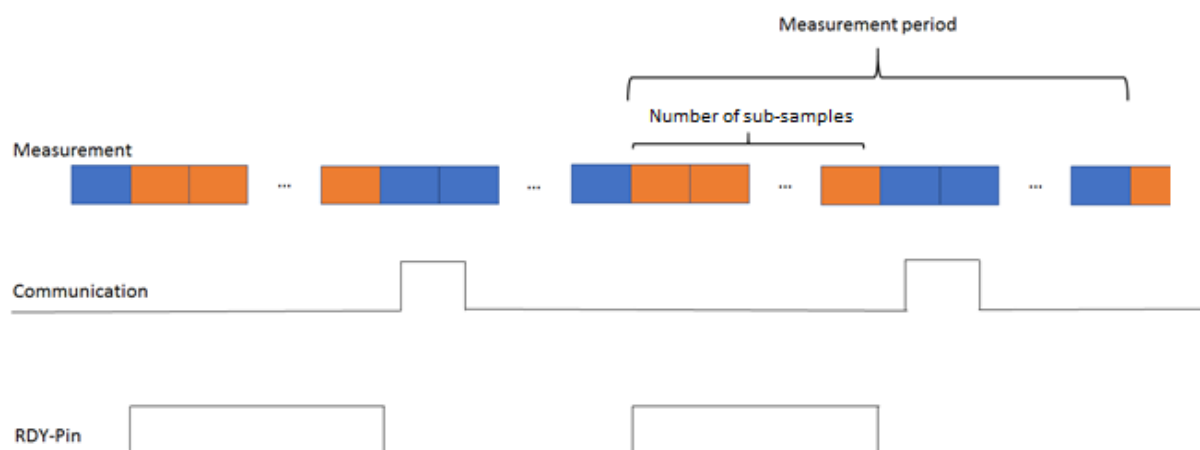


Figure 5 Timing diagram for the Continuous measurement mode

Typical Applications

UART Connection

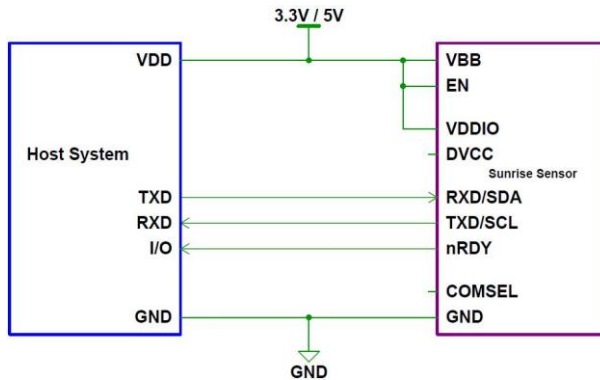


Figure 6 UART, Continuous measurement mode

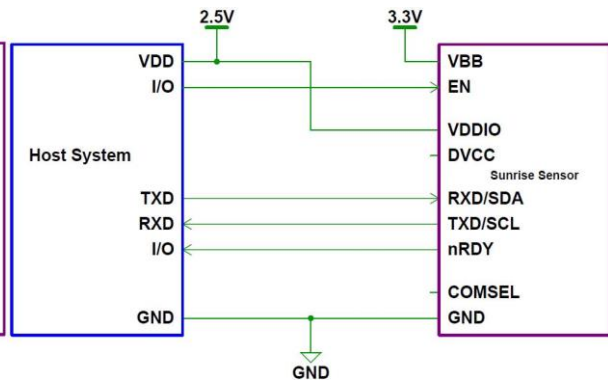


Figure 7 Low voltage UART, Single / Continuous measurement mode

I²C Connection

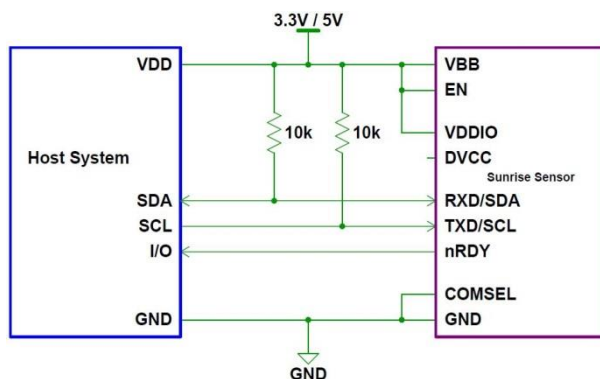


Figure 8 I²C, Continuous measurement mode

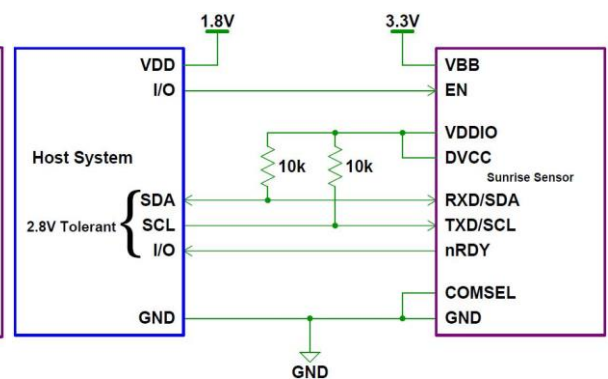


Figure 9 Low voltage I²C, Single / Continuous measurement mode

Communication

Refer to "Modbus on Senseair Sunrise" (TDE5514) and "I²C on Senseair Sunrise" (TDE5531).

Dimensions

Refer to drawing 832-00073

Maintenance

Senseair Sunrise has a built-in self-correcting ABC algorithm. ABC period is adjustable by host. Discuss your application with Senseair in order to get advice for a proper calibration strategy.

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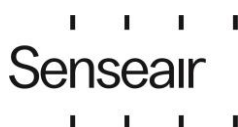
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