Product Specification

Sunrise 1% CO2 Sensor (SE-11)

Sensor module for battery-powered applications
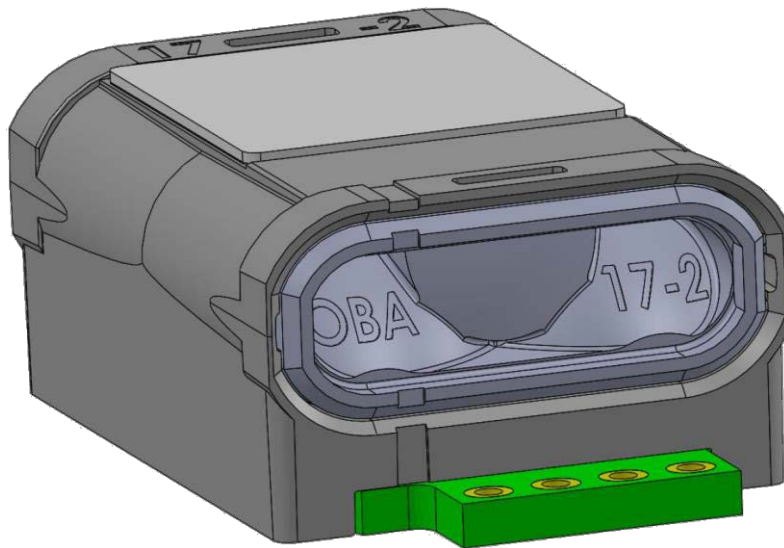
Table of Contents

General Specifications

Item	SE-11	-
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]	Filtered: 0.7ppm @ 400ppm, 25°C 1.4ppm @ 2000ppm, 25°C	Unfiltered: 6ppm @ 400ppm, 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 / I²C	

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

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 CO_2 measurement period and power consumption.

Applications

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 Sunrise Handling manual (ANO4947).

Gas Diffusion Area

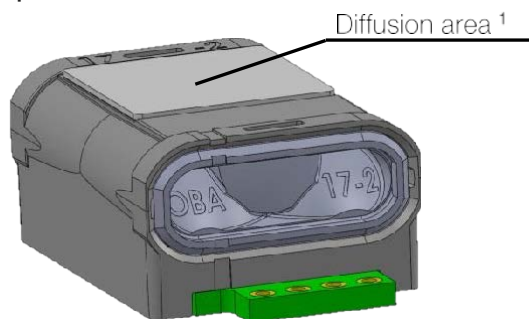### Sample Gas Diffusion Area

Figure 1 Sample Gas Diffusion Area

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

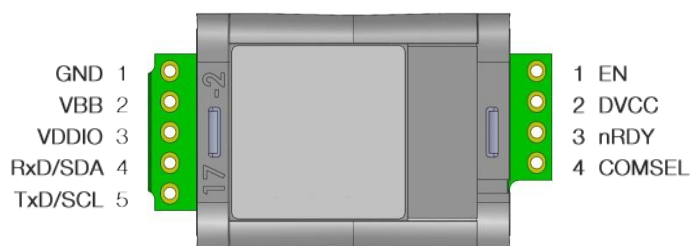## Pin Configuration and Functions

Pin Configuration

Figure 2 Pin Configuration (Top view)

Pin Functions

Pin#	Symbol	1/0 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; 100kO 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= I2C (Connect to GND).
			JP2 (5-pin header)
1	GND	Power	Ground
2	VBB	Power	Sensor supply voltage
3	VDDIO	Power	1/0 supply voltage
4	RxD/SDA	1/0	Sensor UART receive input / I2C bidirectional serial data; True Open-Drain when operating as output.
5	TxD/SCL	1/0	Sensor UART transmit output / I2C clock input; True Open-Drain when operating as output, 100kO 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 / I²C				
TxD/SCL	UART / I²C				
EN	Enable		-0.3	< VBB + 0.3	V
DVCC	Internal supply voltage output				
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 / I²C	0		VDDIO	V	
TxD/SCL	UART / I²C	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.
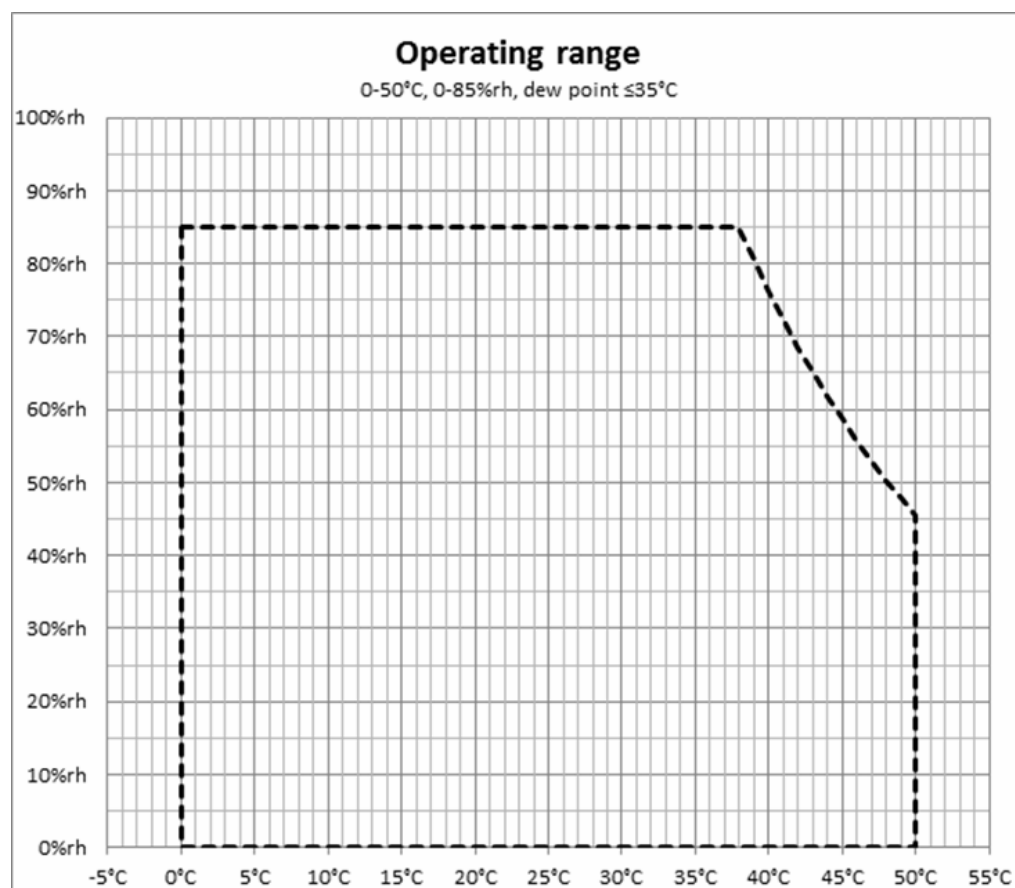Note 2:   Must be limited to the value specified.

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	COMSEL, RxD/SDA, TxD/SCL	1.96			V
		ENABLE	1.2			V
V_{IL}	Input low voltage	COMSEL, RxD/SDA, TxD/SCL			0.84	V
		ENABLE			0.4	V
V_{HYS}	Input hysteresis	COMSEL, RxD/SDA, TxD/SCL	168			mV
	Operating current					
I_{VBB}	Operating peak current	$V_{EN} \geq 1.2V$; $3.05 \leq V_{BB} \leq 5.5V$			125	mA
	Operating average current				150	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 $T_A = 25°C$.

Measurement mode

The Sunrise SE-11 supports two modes of operation for measurement of CO2
concentration: Continuous measurement mode and Single measurement mode.
The default operation is Continuous mode.

1) In continuous 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 hosts 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 ROY-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.
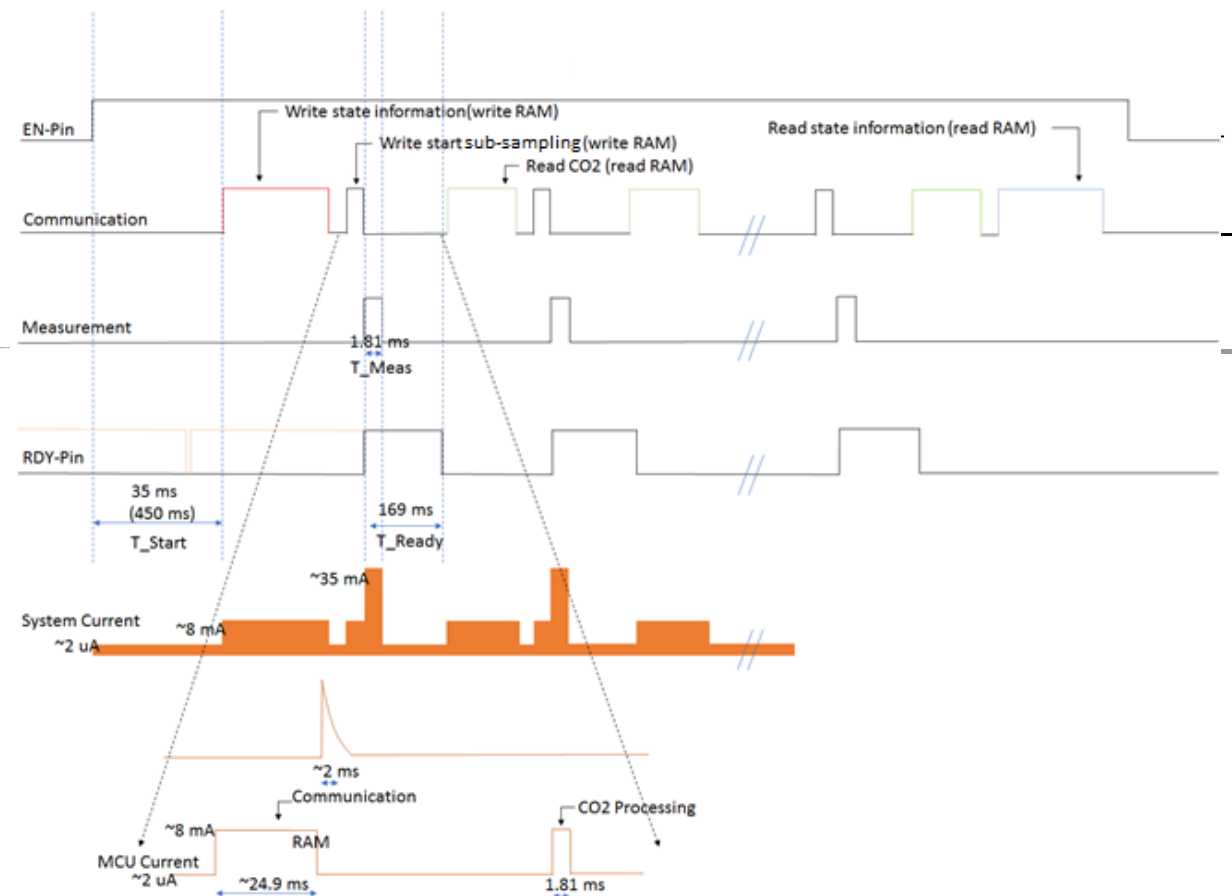10. Go back to #1, after waiting until the time to do next measurement.

Figure 4 Timing diagram for the Single measurement mode (VBB=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/12C. In the case of I^2C, 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)
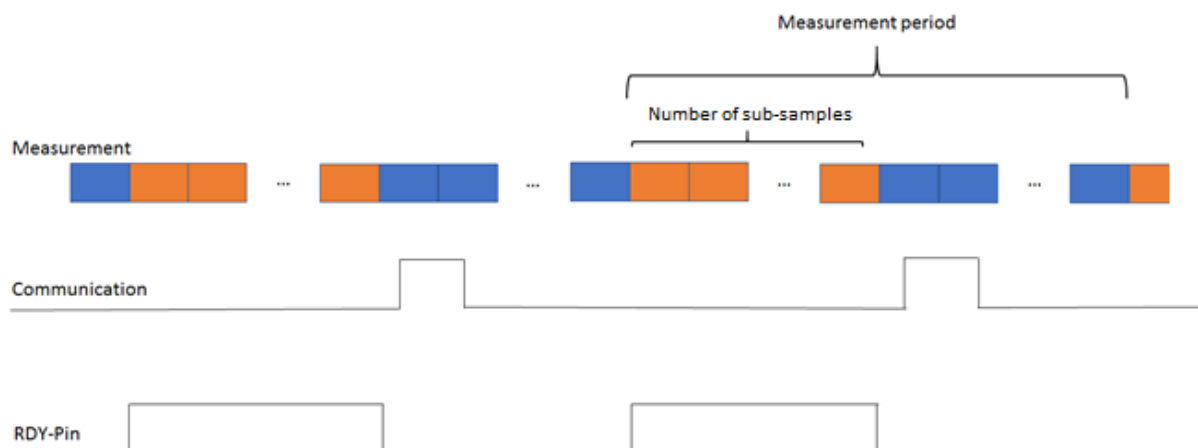2) Default number of sub-samples: 32 (range 1 - 32)

Figure 5 Timing diagram for the Continuous measurement mode

Typical Applications
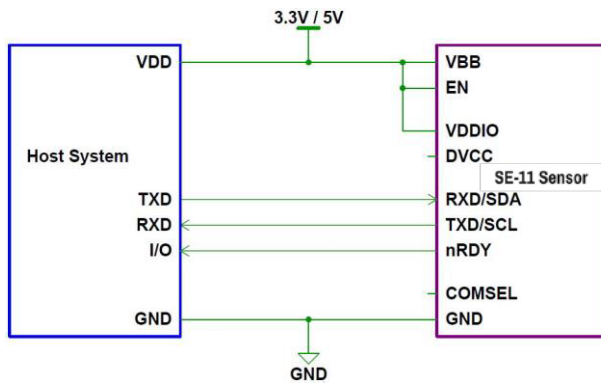
UART Connection

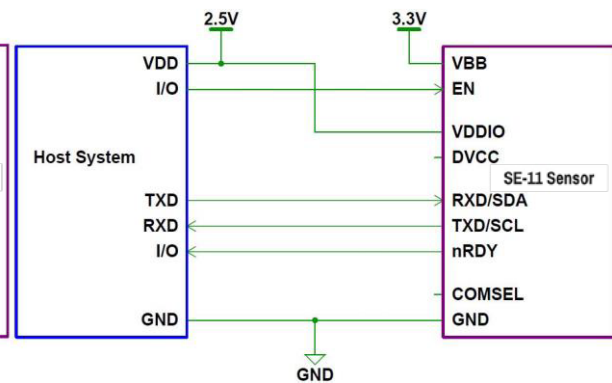Figure 6 UART, Continuous measurement mode

Figure 7 Low voltage UART, Single / Continuous measurement mode
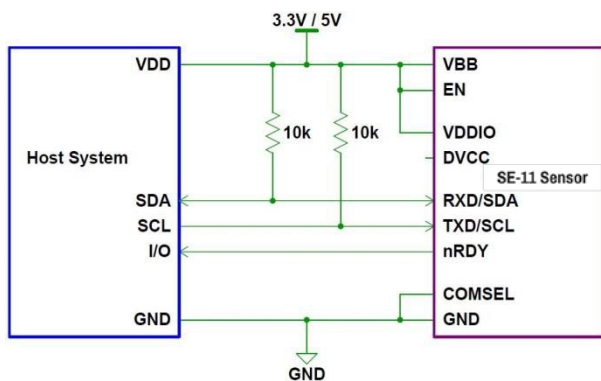
I²C Connection
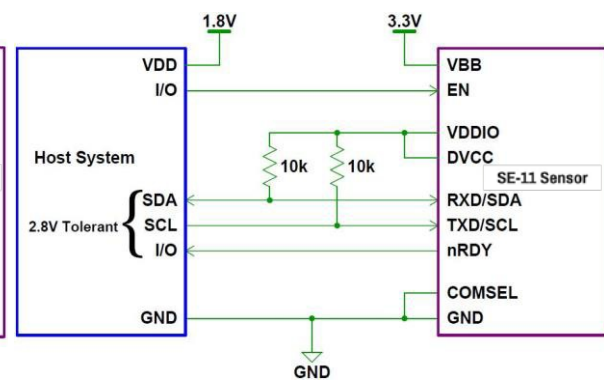

Figure 8 I²C, Continuous measurement mode

Figure 9 Low voltage I²C, Single / Continuous measurement mode

Communication

Refer to "Modbus on **SE-11 Sensor** (TDE5514) and "I2C on **SE-11 Sensor** (TDE5531).

Dimensions

Refer to drawing 832-00073

Maintenance

The Sunrise has a built-in self-correcting ABC algorithm. ABC period is adjustable by host.
Discuss your application with GasLab in order to get advice for a proper calibration strategy,
info@gaslab.com

IMPORTANT

NOTICE Warranty

- The sensor module comes with a **90** day warranty starting from the date the sensor was shipped to the buyer.

- For more information, vist our website: www.gaslab.com

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