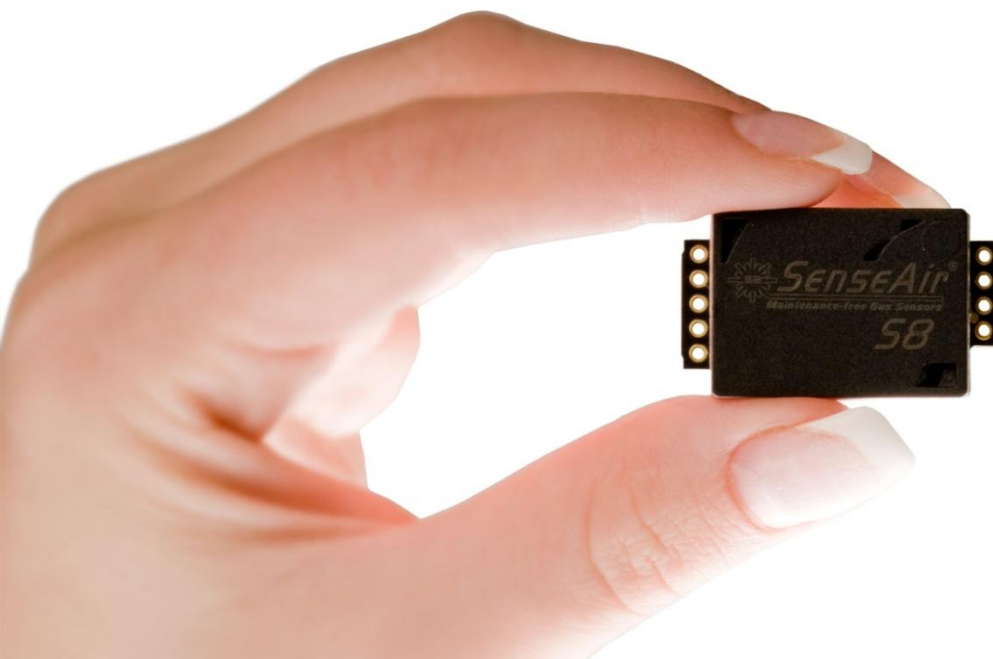Product Specification

SenseAir® S8

Miniature CO_2 sensor module

SenseAir ® S8   **Miniature infrared CO$_2$ sensor module**

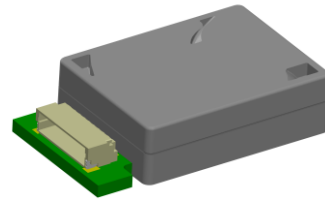**Warning! ESD sensitive device!**

Figure 1a. *SenseAir® S8* *Article no. 004-0-0010*

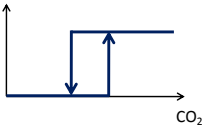*Figure 1b*. *SenseAir® S8 Article no. 004-0-0011*

Item	SenseAir ® S8
Target gas	CO2
Operating Principle	Non-dispersive infrared (NDIR)
Measurement range	400 to 2000 ppm (Note 1). Up to 10000ppm extended range (Note 2)
Accuracy	±30ppm ±3% of reading (Notes 3 and 4)
Response time	2 minutes by 90%
Operating temperature	0 to 50C
Operating humidity	0 to 95% RH non condensed (Note 5)
Storage temperature	-40 to +70 C
Dimensions (mm)	Article No 004-0-0010: 32.7 x 19.7 x 9.9 Article No 004-0-0011: 33.3 x 19.7 x 9.9
Weight	< 8 grams
Power supply	5V ±5% unprotected against surges and reverse connection
Power consumption	300 mA peak, 30 mA average
Life expectancy	15+ years
Compliance with	Tested according Emission: EN 61000-6-3:2007, EN 61000-6-4:2007
Serial communication	UART, Modbus protocol (Note 6). Direction control pin for direct connection to RS485 receiver integrated circuit.
Alarm output, Open Collector	Alarm state open 1000/800 Normal state is conducting max 100 mA. Transistor open at CO2 High, OR Power Low, OR at Sensor Failure
PWM output, 1 kHz	0 to 100% duty cycle for 0 to 2000 ppm 3.3V push-pull CMOS output, unprotected
Maintenance	Maintenance-free with using SenseAir ABC logic Self calibration using for normal indoor applications

Table 1. Key technical specification for the SenseAir® S8

Note 1: Sensor is designed to measure in the range 400 to 2000 ppm with specified in the table accuracy. Nevertheless exposure to concentrations below 400 ppm may result in incorrect operation of ABC algorithm and shall be avoided for model with ABC on.

Note 2: Sensor provides readings via UART in the extended range but the accuracy is degraded compared to specified in the table one.

Note 3: In normal IAQ applications. Accuracy is defined after minimum 3 weeks of continuous operation. However, some industrial applications do require maintenance. Please, contact SenseAir for further information!

Note 4: Accuracy is specified over operating temperature range. Specification is referenced to certified calibration mixtures. Uncertainty of calibration gas mixtures (+-2% currently) is to be added to the specified accuracy for absolute measurements.

Note 5: 100% of sensors tested in production at 85% RH.

Note 6: See specification { Modbus on SenseAir_R_ S8 rev_P11_1_00.doc preliminary specification}

Absolute maximum ratings

Stress greater than those listed in Table II may cause permanent damage to the device. These ratings are stress ratings only. Operation of the device at any condition outside those indicated in the operational section of these specifications is not implied. Exposure to absolute maximum rating for extended periods may affect device reliability.

Parameter	Minimum	Maximum	Units	Notes
Ambient temperature under bias	- 40	85	C	
Voltage on G+ pin with respect to G0 pin	- 0.3	5,5	V	1,2
Maximum output current from active output pin	- 25	+ 25	mA	1
Maximum current on input	- 5	+ 5	uA	1
Maximum voltage on UART lines, PWM and bCAL_in	- 0.3	DVCC_out + 0.5	V	1
Maximum voltage on Alarm_OC	- 0.3	G+	V	1,3

Table 2. Absolute maximum ratings specification for the *SenseAir® S8*

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Note 1:   Specified parameter relies on specification of subcontractor and is not tested by SenseAir
Note 2:   Refer chapter "Terminal Description" for rated voltage information
Note 3:   Alarm_OC pin is internally pulled up to G+. External pull up to higher voltage will provide resistive divider powering sensor via high resistance.
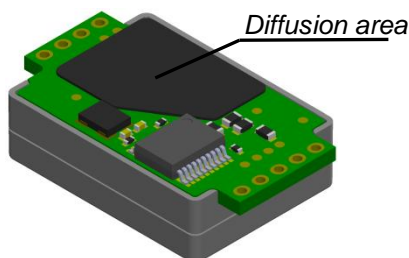
Sample gas diffusion area

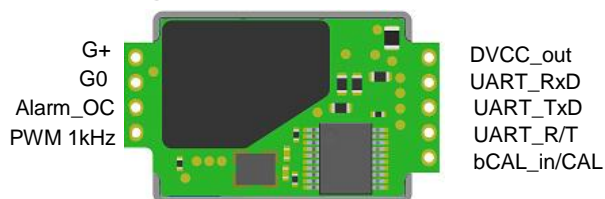*Diffusion area*

Figure 2. Diffusion area

Pin assignment

G+
G0
Alarm_OC
PWM 1kHz

DVCC_out
UART_RxD
UART_TxD
UART_R/T
bCAL_in/CAL

Figure 3a. Attachment to customer's PCB, not in scale. Article No 004-0-0010

G+
G0
Alarm_OC
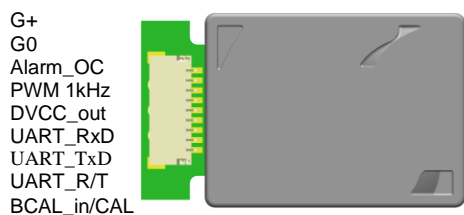PWM 1kHz
DVCC_out
UART_RxD
UART_TxD
UART_R/T
BCAL_in/CAL

Figure 3b. Attachment to customer's PCB,not in scale. Article No 004-0-0011

Terminals description

The table below specifies terminals and I/O options dedicated in *SenseAir® S8* model.

Pin Function	Pin description / Parameter description	Electrical specification
Power pins		
G0	Power supply minus terminal Sensor's reference (ground) terminal	
G+ referred to G0	Power supply plus terminal Operating voltage range	Unprotected against reverse connection! 5VDC ± 5%
DVCC_out	**<u>Output</u>** from sensor's voltage regulator Output may be used to logical level converter if master processor runs at 5V supply voltage.	Induced noise or excessive current drawn may affect sensor performance. External series resistor is strongly recommended if this pin is used
	Series resistance	No internal protection!
	Nominal voltage	3.3 VDC
	Allowed source current	6 mA max
	Voltage precision (Note 1)	± 0.75% is typical, ± 3% is max
Communication pins		
UART_TxD	UART data transmission line Configured as digital output	No internal protection Pulled up to DVCC_out at processor reset (power up and power down)
	Absolute max voltage range (Note 1)	G0 - 0.3V to DVCC_out + 0.5V
	Internal pull up to DVCC_out resistor	120k
	Output low level (Note 1)	0.75 VDC max at 10mA sink
	Output high level (Note 1)	2.4 VDC at 2mA source
UART_RxD	UART data receive line Configured as digital input	No internal protection Pulled up to DVCC_out at processor reset (power up and power down)
	Absolute max voltage range(Note 1)	G0 - 0.3V to DVCC_out + 0.5V
	Internal pull up to DVCC_out resistor	120k
	Input low level (Note 1)	- 0.3V to 0.75V
	Input high level (Note 1)	2.3V to DVCC_out + 0.3V
UART_R/T	Direction control line for half duplex RS485 transceiver like MAX485. Configured as digital output	No internal protection, Pulled down at processor reset (power up and power down)
	Absolute max voltage range(Note 1)	G0 - 0.3V to DVCC_out + 0.5V
	Internal pull down to G0 resistor	120k
	Output low level (Note 1)	0.75 VDC max at 10mA sink
	Output high level (Note 1)	2.4 VDC at 2mA source

Table 3. I/O notations, description and electrical specification. Please, continue on the next page!

Pin Function	Pin description / Parameter description	Electrical specification
Input / output		
bCAL_in/ CAL	Digital input forcing background calibration. Configured as digital input (when closed for minimum 4, max 8 seconds) bCAL (background calibration) assuming 400 ppm CO_2 sensor exposure Zero calibration (when closed for minimum 16 seconds) CAL (zero calibration) assuming 0 ppm CO_2 sensor exposure	No internal protection, Pulled up to DVCC_out at processor reset (power up and power down)
	Absolute max voltage range(Note 1)	G0 - 0.3V to DVCC_out + 0.5V
	Internal pull up to DVCC_out resistor	120k
	Input low level (Note 1)	- 0.3V to 0.75V
	Input high level (Note 1)	2.3V to DVCC_out + 0.3V
PWM 1kHz	PWM output Configured as digital output Used for direct reading by customer's microcontroller or to provide analog output.	No internal protection, Pulled down at processor reset (power up and power down)
	Duty cycle min	0%, output Low
	Duty cycle max	100%, output High
	PWM resolution	0.5usec ± 4%
	PWM period	1 msec ± 4%
	Absolute max voltage range (Note 1)	G0 - 0.3V to DVCC_out + 0.5V
	Internal pull down do G0 resistor	120k
	Output low level (Note 1)	0.75 VDC max at 10mA sink
	Output high level (Note 1)	2.4 VDC at 2mA source
Alarm_OC	Open Collector output for alarm indication	No internal protection, Pulled up to G+ at processor reset (power up and power down)
	Absolute max voltage range(Note 1)	G0 - 0.3V to 5.5V
	Internal pull up to G+ resistor	120k
	Max sink current (Note 1)	100 mA
	Saturation voltage (Note 1)	2.3V to DVCC_out+0.3V

Table 3. I/O notations, description and electrical specification (continue, see previous page).

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Note 1: Specified parameter relies on specification of subcontractor and is not tested by SenseAir

General mechanical overview

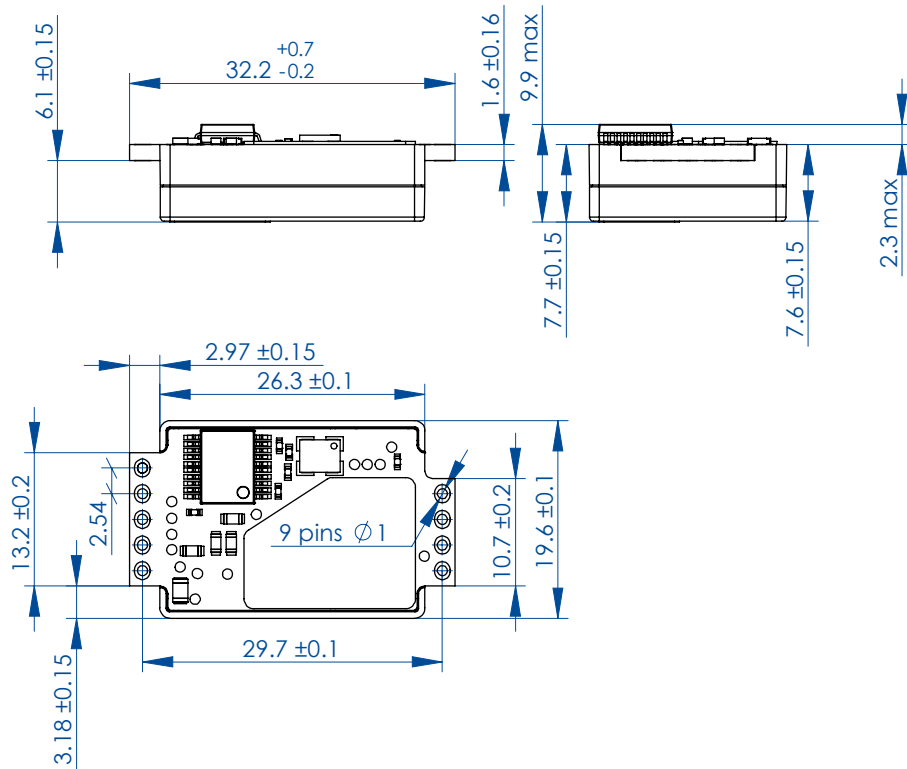

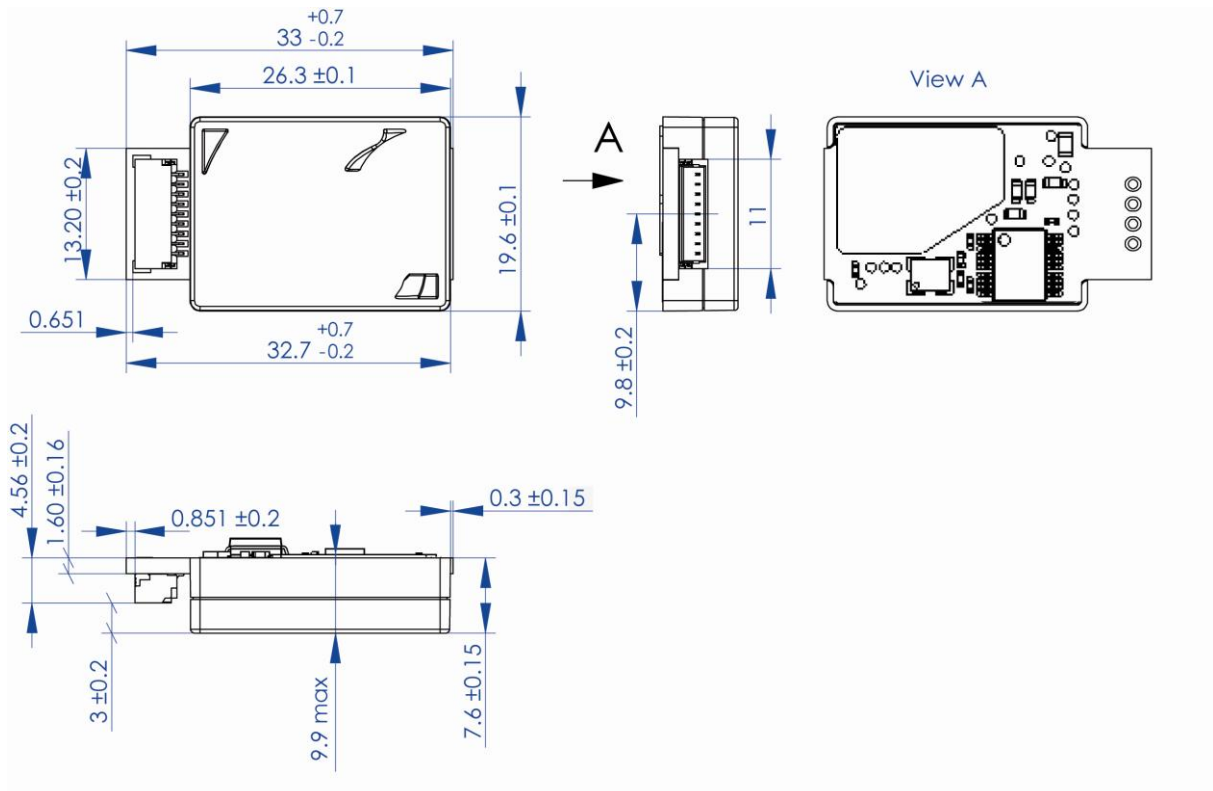Figure4a. Mechanical drawing *SenseAir® S8* Article No 004-0-0010

Figure 4b. Mechanical drawing *SenseAir® S8* Article No 004-0-0011

Maintenance

The models based on *SenseAir® S8* platform are basically maintenance free in normal environments thanks to the built-in self-correcting **ABC algorithm**. Discuss your application with SenseAir in order to get advice for a proper calibration strategy.

When checking the sensor accuracy, <u>PLEASE NOTE</u> that the sensor accuracy is defined at continuous operation (at least 3 weeks after installation for sensors with long period ABC)!

ABC (Automatic Baseline Correction)

The default sensor OEM unit is maintenance free in normal environments thanks to the built-in self-correcting **ABC algorithm** *(Automatic Baseline Correction)*. This algorithm constantly keeps track of the sensor's lowest reading over preconfigured time interval and slowly corrects for any long-term drift detected as compared to the expected fresh air value of 400ppm (or 0.04%$_{vol}$) CO_2.

ABC parameter	Specification
ABC period	**8 days**

Table 4. ABC default configurations for SenseAir® S8 Article no. 004-0-0010 and Article no. 004-0-00011

Calibration

Rough handling and transportation might result in a reduction of sensor reading accuracy. With time, the ABC function will tune the readings back to the correct numbers. For post calibration convenience, in the event that one cannot wait for the ABC algorithm to cure any calibration offset, switch input is defined for the operator or master system to select one out of two prepared calibration codes. One of internal calibration codes is **bCAL** *(background calibration)*, in which case it is assumed that the sensor is operating in a fresh air environment (400 ppm CO_2). Another operation code is **CAL** *(zero calibration),* in which case the sensor must be purged by some gas mixture free from CO_2 (i.e. Nitrogen or Soda Lime CO_2 scrubbed air). Make sure that the sensor environment is steady and calm!

Input	Default function
bCAL_in	**(when closed for minimum 4, max 8 seconds)** **bCAL** (background calibration) assuming 400 ppm CO_2 sensor exposure
CAL_in	**(when closed for minimum 16 seconds)** **CAL** (zero calibration) assuming 0 ppm CO_2 sensor exposure

Table 5. Switch input default configurations for SenseAir® S8

Self-diagnostics

The system contains complete self-diagnostic procedures. A full system test is executed automatically every time the power is turned on. In addition, constantly during operation, the sensor probes are checked against failure by checking the valid dynamic measurement ranges. All EEPROM updates, initiated by the sensor itself, as well as by external connections, are checked by subsequent memory read back and data comparisons. These different system checks return error bytes to the system RAM. The full error codes are available from the UART port communication. *Out of Range* error is the only bit that is reset automatically after return to normal state. All other error bits have to be reset after return to normal by UART overwrite, or by power off/on.

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