Driesen + Kern GmbH

Product Specification

SenseAir® S8

Miniature CO2 sensor

Document	Rev	Page
PSP 107	8	1 (10)

Driesen+Kern GmbH
Am Hasselt 25
D-24576 Bad Bramstedt

www.driesen-kern.de
www.driesen-kern.com

Tel. +49 (0) 4192 8170-0
Fax +49 (0) 4192 8170-99
info@driesen-kern.de

SenseAir® S8 Miniature infrared CO_2 sensor module

Warning! ESD sensitive device!

Figure 1. SenseAir® S8 Article no. 004-0-0013

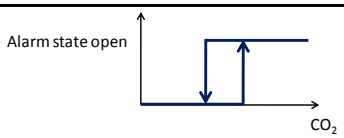
Item	*SenseAir® S8*
Target gas	CO_2
Operating Principle	Non-dispersive infrared (NDIR)
Measurement range	400 to 2000 ppm (Note 1). 0 to 10000 ppm extended range (Note 2)
Accuracy	±70ppm +3% of reading (Notes 3 and 4)
Response time	2 minutes by 90%
Operating temperature	5 to 30° C
Operating humidity	0 to 85% RH non condensed
Storage temperature	-40 to +70 C
Dimensions	32.7 x 19.7 x 7.7 mm
Weight	< 8 grams
Power supply	4.5 V to 5.25 V unprotected against surges and reverse connection
Power consumption	300 mA peak, 30 mA average
Life expectancy	15+ years
Compliance with	Emission: EN 61000-6-3:2007, EN 61000-6-4:2007 Immunity: EN 61000-6-1:2007 RoHS directive 2002/95/EG
Serial communication	UART, Modbus protocol (Note 5). Direction control pin for direct connection to RS485 receiver integrated circuit.
Alarm output, Open Collector	 1000/800 ppm Normal state is conducting max 100 mA. Transistor open at CO_2 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 for normal indoor applications with SenseAir® ABC on.

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 specification in the table one.

Note 3: In normal IAQ applications. Accuracy is defined after minimum 3 weeks of continuous operation with ABC. 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: See specification *{Modbus on SenseAir_R_S8 rev_P11_1_00.doc preliminary specification}*

Absolute maximum ratings

Stress greater than those listed in Table 2 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	12	V	1,3

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

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

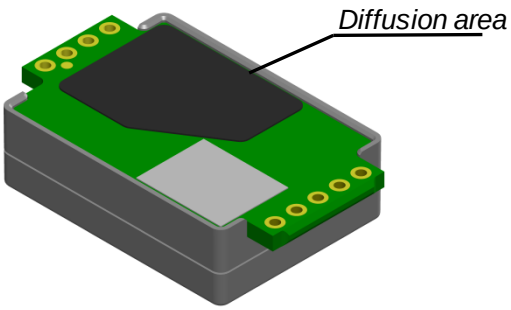


Figure 2. Diffusion area

Pin assignment

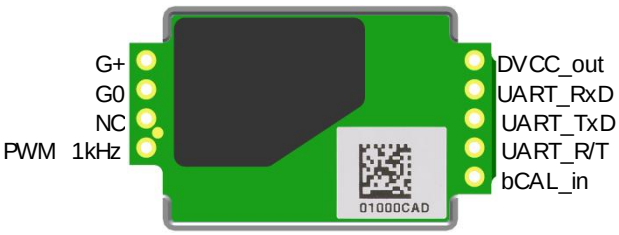


Figure 3. Attachment to customer's PCB, not in scale.

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! 4.5 V to 5.25 V
DVCC_out	**Output** from sensor's voltage regulator Output may be used to logical level converter if master processor runs at 5V supply voltage. Series resistance Nominal voltage Allowed source current Voltage precision (Note 1)	Induced noise or excessive current drawn may affect sensor performance. External series resistor is strongly recommended if this pin is used No internal protection! 3.3 VDC 6 mA max ± 0.75% is typical, ± 3% is max
Communication pins		
UART_TxD	UART data transmission line Configured as digital output Absolute max voltage range (Note 1) Internal pull up to DVCC_out resistor Output low level (Note 1) Output high level (Note 1)	No internal protection Pulled up to DVCC_out at processor reset (power up and power down) G0 - 0.3V to DVCC_out + 0.5V 120k 0.75 VDC max at 10mA sink 2.4 VDC at 2mA source
UART_RxD	UART data receive line Configured as digital input Absolute max voltage range(Note 1) Internal pull up to DVCC_out resistor Input low level (Note 1) Input high level (Note 1)	No internal protection Pulled up to DVCC_out at processor reset (power up and power down) G0 - 0.3V to DVCC_out + 0.5V 120k - 0.3V to 0.75V 2.3V to DVCC_out + 0.3V
UART_R/T	Direction control line for half duplex RS485 transceiver like MAX485. Configured as digital output Absolute max voltage range(Note 1) Internal pull down to G0 resistor Output low level (Note 1) Output high level (Note 1)	No internal protection, Pulled down at processor reset (power up and power down) G0 - 0.3V to DVCC_out + 0.5V 120k 0.75 VDC max at 10mA sink 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 CO2 sensor exposure Zero calibration (when closed for minimum 16 seconds) CAL (zero calibration) assuming 0 ppm CO2 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 1 kHz	PWM output Configured as digital output Used for direct reading by customer's microcontroller or to provide analog output. Refer "Use scenario suggestion" for details and ideas	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).

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

Mechanical properties

Sensor PCB may be colour green or black. Optical bench assembly (OBA) may be colour silver or black. Please refer to figure 5 and for mechanical drawing and detailed specification of dimensions and tolerances.

WARNING!
Under no circumstances should any force be applied to the OBA, this may permanently harm the sensor and most definitely affect performance.

Sensor should be handled holding PCB only. Never touch sensor with bare hands, make sure that operators use ESD gloves.

Note! ESD sensitive device!

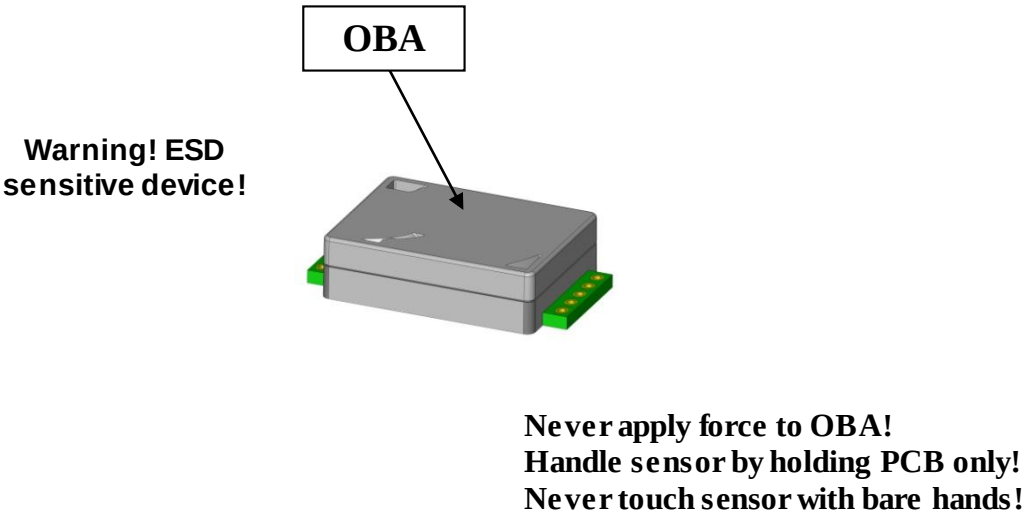


Figure 4. Mechanical drawing SenseAir® S8 Article No 004-0-0013

Installation and soldering

During installation and assembly of sensor to PCB it is essential that compatible materials are used and that soldering process is managed. Avoid introduction of stress to the sensor's PCB or OBA. SenseAir recommends hand soldering only.

NB! Transport, handling and assembly may affect calibration. Accuracy is defined after minimum 3 weeks of continuous operation with ABC in normal IAQ applications. However, some industrial applications do require maintenance.

Please, contact SenseAir for further information!

General mechanical overview

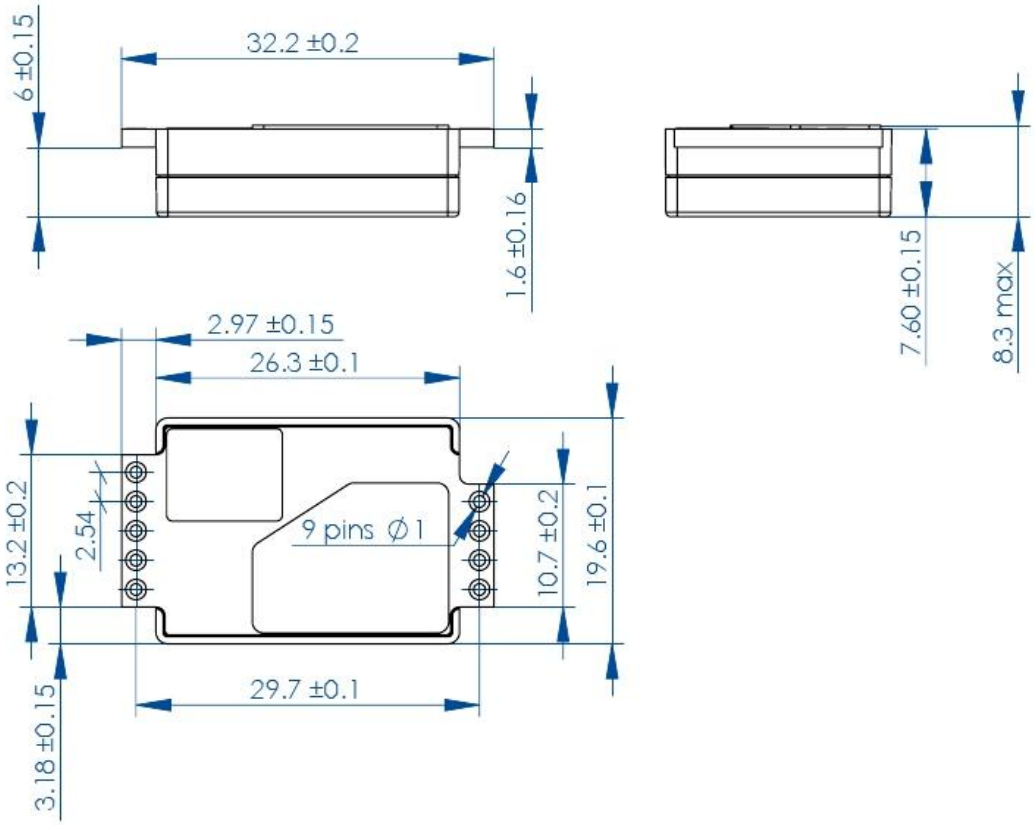


Figure 5 Mechanical drawing SenseAir® S8 Article No 004-0-0013

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, PLEASE NOTE that the sensor accuracy is defined at continuous operation (at least 25 days after installation with ABC turned on)!

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 configuration for SenseAir® S8 Article no. 004-0-0013

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. The default "tuning speed" is however limited to about 150 ppm/week.

For post calibration convenience, in the event that one cannot wait for the ABC algorithm to compensate for possible calibration offset two manual calibration procedures are offered. A switch input is defined for the operator or master system to select one of the two prepared calibration codes. Optional calibrations are **bCAL** *(background calibration)*, which requires that the sensor is exposed to fresh air (400 ppm CO_2) and **CAL** *(zero calibration),* which requires the sensor measuring cell to be completely evacuated from CO_2 e.g. by exposing it to 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.

Error code and action plan

(Error code can be read via one of the communication channels)

Bit #	Error code	Error description	Suggested action
0	1	**Fatal Error**	Try to restart sensor by power OFF/ON. Contact local distributor.
1	2	**Reserved**	
2	4	**Algorithm Error**. Indicate wrong configuration.	Try to restart sensor by power OFF/ON. Check detailed settings and configuration with software tools. Contact local distributor.
3	8	**Output Error** Detected errors during output signals calculation and generation.	Check connections and loads of outputs. Check detailed status of outputs with software tools.
4	16	**Self-Diagnostic Error**. May indicate the need of zero calibration or sensor replacement.	Check detailed self-diagnostic status with software tools. Contact local distributor.
5	32	**Out of Range Error** Accompanies most of other errors. Can also indicate overload or failures of sensors and inputs. Resets automatically after source of error disappearance.	Try sensor in fresh air. Perform CO_2 background calibration. Check detailed status of measurements with software tools. *See Note 1!*
6	64	**Memory Error** Error during memory operations.	Check detailed settings and configuration with software tools.
7	128	**Reserved**	

Table 6. Error codes for SenseAir® S8

Note 1. Any probe is out of range. Occurs, for instance, during over-exposure of CO_2 sensor, in which case the error code will automatically reset when the measurement values return to normal. Could also indicate the need of zero point calibration. If the CO_2 readings are normal, and still the error code remains, any other sensor probe mounted (if any) can be defect, or the connection to this probe is broken.

Please note: If several errors are detected at the same time the different error code numbers will be added together into one combined error code!

Driesen+Kern GmbH
Am Hasselt 25
D-24576 Bad Bramstedt

www.driesen-kern.de
www.driesen-kern.com

Tel. +49 (0) 4192 8170-0
Fax +49 (0) 4192 8170-99
info@driesen-kern.de