Product Specification

Senseair S8 LP

Miniature CO_2 sensor module with NDIR technique



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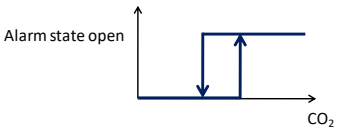
Item	Senseair S8 LP Article No. 004-0-0053
Operating principle	Non-dispersive infrared (NDIR)
Measured gas	Carbon dioxide (CO_2)
Measurement range	400–10 000 ppm [1, 2]
Measurement interval	4 s
Accuracy [CO_2] (ANSI/ASHRAE Standard 62.1)	400–2500 ppm: ±75 ppm [3]
Accuracy [CO_2] (Operating conditions)	400–2500 ppm: ±40 ppm ±3% of reading [3, 4, 5]
Operating conditions	0–50 °C, 0–85% RH (non-condensing)
Warm-up time	< 60 s
Response time $\tau_{63\%}$	≤ 40 s
Power supply	4.5–5.25 V unprotected against surges and reverse connection
Peak current	≤ 300 mA
Average current, typical	≤ 18 mA
Communication	UART, UART, Modbus protocol [6]. Direction control pin for direct connection to RS485 receiver integrated circuit. / I²C
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, 1kHz	0–100% duty cycle for 0–2000 ppm 3.3 V push-pull CMOS output, unprotected
Pressure dependence	1.6% reading per kPa deviation from normal pressure
Compliance	ANSI/ASHRAE Standard 62.1-2022 +Addendum ab (October 31, 2023) RESET grade B WELL Building Standard® (WELL v2™) Title 24, California Energy Code
Maintenance	Maintenance-free when using Senseair ABC algorithm (Automatic Baseline Correction).
Life expectancy	> 15 years
Dimensions (LxWxH)	33.9x19.8x8.7 [mm]
Weight	< 8 g
Storage conditions	-40–70 °C

Table 1. Key technical specification for the Senseair S8 LP

Note 1: Sensor is designed to measure in the range 400–2500ppm with specified in the table accuracy. Exposure to concentrations below 400ppm 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 table one.

Note 3: ANSI/ASHRAE Addendum ab to ANSI/ASHRAE Standard 62.1-2022 specifies sensor to be accurate within ±75 ppm at concentrations of 600, 1000, and 2500 ppm when measured at sea level at 77 °F (25 °C). See figure 4.

Note 4: In normal IAQ applications. Accuracy is defined after minimum three (3) ABC periods of continuous operation with ABC. However, some industrial applications do require maintenance. Contact Senseair for further information!

Note 5: Accuracy is specified over operating temperature range. Specification is referenced to certified calibration mixtures. Uncertainty of calibration gas mixtures (±1% currently) is to be added to the specified accuracy for absolute measurements.

Note 6: See specification TDE2067 Modbus on Senseair S8.

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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	µA	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 LP

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

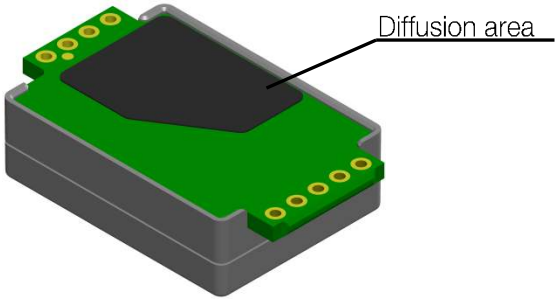


Figure 1. Diffusion area

Pin assignment

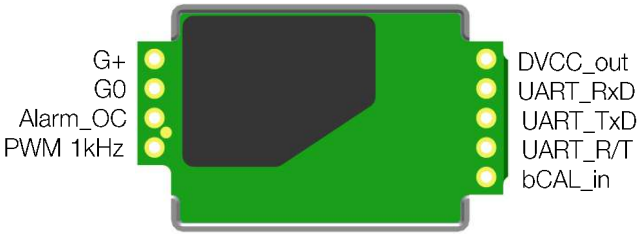


Figure 2. Pin assignment

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Terminals description

The table below specifies terminals and I/O options dedicated in Senseair S8 LP 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! 4.5–5.25 V
DVCC_out	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 6mA 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 - 0.3 V to DVCC_out + 0.5 V 120 kOhm 0.75 VDC max at 10 mA sink 2.4 VDC at 2 mA 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 - 0.3 V to DVCC_out + 0.5 V 120 kOhm -0.3–0.75 V 2.3 V to DVCC_out + 0.3 V
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 - 0.3 V to DVCC_out + 0.5 V 120 kOhm 0.75 VDC max at 10 mA sink 2.4 VDC at 2 mA source

Table 3. I/O notations, description and electrical specification (continued on next page)

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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 400ppm CO_2 sensor exposure Zero calibration (when closed for minimum 16 seconds) CAL (zero calibration) assuming 0ppm CO_2 sensor exposure 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 - 0.3 V to DVCC_out + 0.5 V 120 kOhm -0.3–0.75 V 2.3 V to DVCC_out + 0.3 V
PWM 1 kHz	PWM output Configured as digital output Used for direct reading by customer's microcontroller or to provide analog output. Duty cycle min Duty cycle max PWM resolution PWM period 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) 0%, output Low 100%, output High 0.5 µs ±4% 1 ms ±4% G0 - 0.3 V to DVCC_out + 0.5 V 120 kOhm 0.75 VDC max at 10 mA sink 2.4 VDC at 2 mA source
Alarm_OC	Open Collector output for alarm indication Absolute max voltage range (Note 1) Internal pull up to G+ resistor Max sink current (Note 1) Saturation voltage (Note 1)	No internal protection, Pulled up to G+ at processor reset (power up and power down) G0 - 0.3 V to 5.5 V 10 kOhm 100 mA 2.3 V to DVCC_out + 0.3 V

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

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Operating conditions

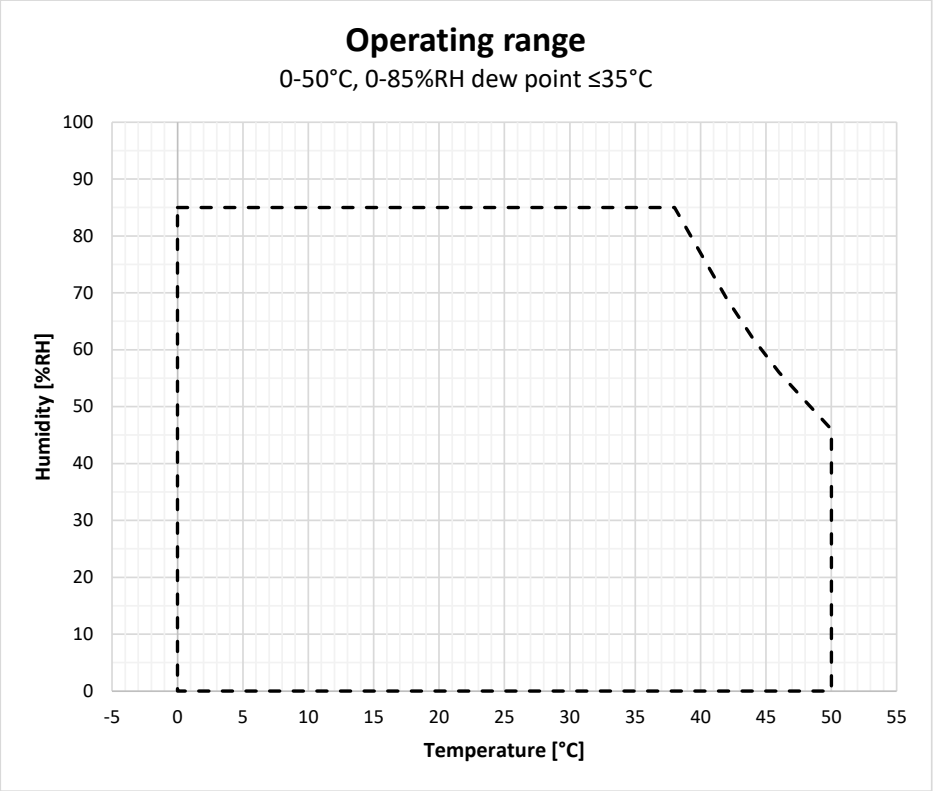


Figure 3. Operating range for specified in Table 1 accuracy.

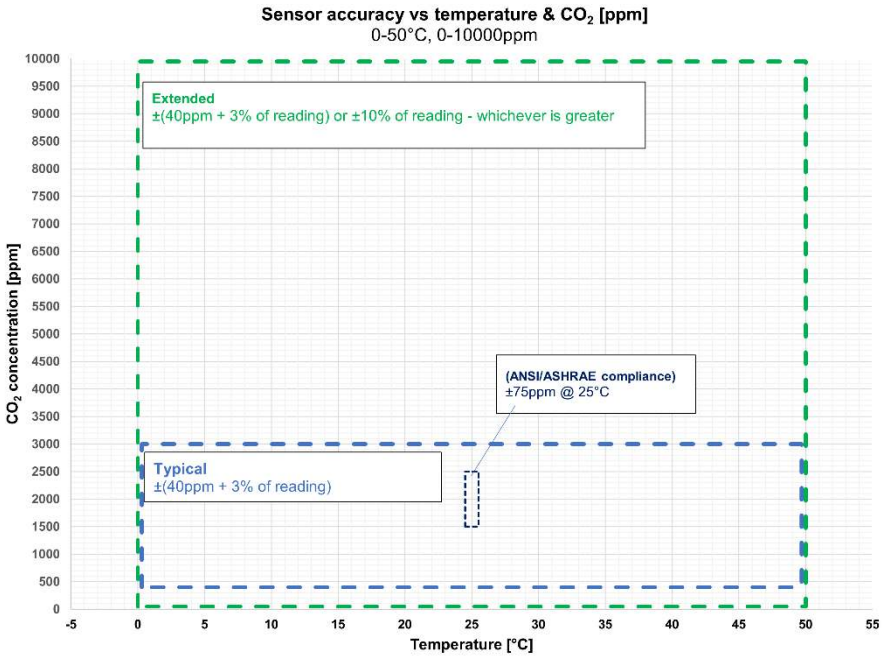


Figure 4. Accuracy over complete operating range (temperature and measurement of CO_2).

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Mechanical properties

Refer to mechanical drawing for detailed specification of dimensions and tolerances.
See Handling manual for S8 (ANO102).

Installation and soldering

See Handling manual for S8 (ANO102).

Maintenance and ABC (Automatic Baseline Correction)

The models based on Senseair S8 LP platform are basically maintenance free in normal environments thanks to the built-in self-correcting **ABC algorithm**. This algorithm constantly keeps track of lowest reading of the sensor 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.

Discuss your application with Senseair in order to get advice for a proper calibration strategy.

When checking the sensor accuracy, NOTE that the sensor accuracy is defined at continuous operation (at least three (3) ABC periods (see table 4) after installation with ABC turned on)!

ABC parameter	Specification
ABC period	8 days

Table 4. ABC default configuration for Senseair S8 LP

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 limited to about 30-50ppm/ABC period.

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 (400ppm 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 400ppm CO_2 sensor exposure
CAL_in	**(when closed for minimum 16 seconds)** **CAL** (zero calibration) assuming 0ppm CO_2 sensor exposure

Table 5. Switch input default configurations for Senseair S8 LP

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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 UART communication port)

Bit #	Error code	Error description	Suggested action
0	1	Fatal error	Try to restart sensor by power OFF/ON. Contact local distributor.
1	2	Offset error	Recovery procedure. Recovery failure - next step will be Fatal Error
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 LP

Note 1. Any probe is out of range. It 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. It could also indicate the need of zero-point calibration. If the CO_2 readings are normal, and still the error code remains, any other mounted sensor probe (if any) can be defected, or the connection to this probe is broken.

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

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