Product Specification

Senseair ® S8 2%

Miniature infrared CO_2 sensor module

Senseair
AsahiKASEI

Key technical specification

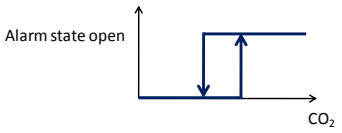
Item	Senseair® S8 2% Article No. 004-0-0050
Target gas	CO_2
Operating Principle	Non-dispersive infrared (NDIR)
Measurement range	0.04 — 2% volume CO_2 (Note 1)
Measurement interval	2 seconds
Accuracy	±0.02% volume CO_2 ±3% of reading (Notes 2 and 3)
Pressure dependence	+1.6 % reading per kPa deviation from normal pressure
Response time	2 minutes by 90%
Operating temperature	0 — 50°C
Operating humidity	0 — 85%RH non condensed
Storage temperature	-40 — 70°C
Dimensions Max (L x W x H)	33.9 x 19.8 x 8.7mm (max dimensions)
Weight	<8 grams
Power supply	4.5 — 5.25V unprotected against surges and reverse connection
Power consumption	300mA peak, 30mA average
Life expectancy	15+ years in normal commercial environments
Serial communication	UART, Modbus protocol (Note 4). Direction control pin for direct connection to RS485 receiver integrated circuit.
Alarm output, Open Collector	 8500/6500ppm normally conducting max 100mA. Transistor open at CO_2 High, OR Power Low, OR at Sensor Failure
PWM output, 1 kHz	0 — 100% duty cycle for 0 — 20000ppm 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 2%

Note 1: Sensor is designed to measure in the range 0 — 20000ppm with 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: In normal IAQ applications. Sensor requires to be exposed to fresh air at least every four weeks. Accuracy is defined after minimum two (2) ABC periods of continuous operation. However, some industrial applications do require maintenance. Please, contact Senseair for further information!

Note 3: 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 4: See specification TDE2067 { Modbus on S8}

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 2%

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

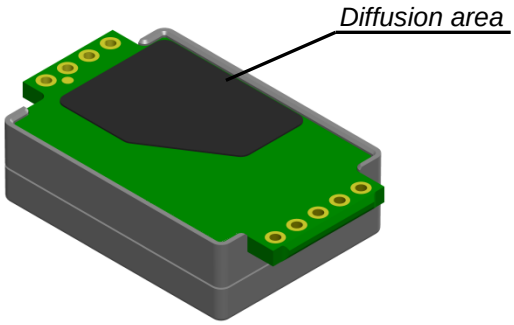


Figure 1. Diffusion area

Pin assignment

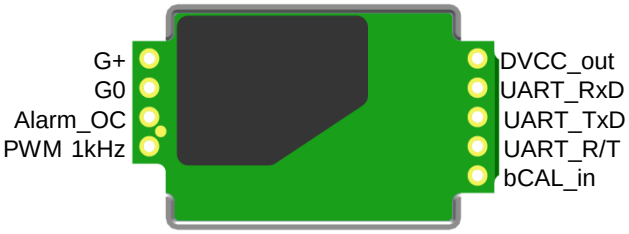


Figure 2. Pin assignment

Terminals description

The table below specifies terminals and I/O options dedicated in Senseair® S8 2% model.

Pin Function	Pin description / Parameter description	Electrical specification
Power pins		
G0	Power supply minus terminal Reference (ground) terminal of sensor	
G+ referred to G0	Power supply plus terminal Operating voltage range	Unprotected against reverse connection! 4.5 — 5.25V
DVCC_out	Output from voltage regulator of sensor 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! 3.3VDC 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 - 0.3V 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 -0.3 — 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 0.75VDC max at 10mA sink 2.4VDC at 2mA source

Table 3. I/O notations, description and electrical specification (continued on 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 400ppm CO2 sensor exposure Zero calibration (when closed for minimum 16 seconds) CAL (zero calibration) assuming 0ppm 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)	-0.3 – 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	0.5us ± 4%
	PWM period	1ms ± 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)	0.75VDC max at 10mA sink
	Output high level (Note 1)	2.4VDC 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)	100mA
	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

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

Installation and soldering

See Handling manual for Senseair S8 (ANO102).

Maintenance and ABC (Automatic Baseline Correction)

The models based on Senseair® S8 2% platform are basically 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.
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 two (2) ABC periods after installation with ABC turned ON)!

ABC parameter	Specification
ABC period	15 days

Table 4. ABC default configuration for Senseair® S8 2%

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 150ppm/ABC period.

For post calibration convenience, in the event that one cannot wait for the ABC algorithm to cure any 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 2%

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 communication port. *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 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 and action plan

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 sensor probe mounted (if any) can be defect, 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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