

## Senseair S12 CO<sub>2</sub> DT

### CO<sub>2</sub> sensing in permanently occupied environments

Engineered for demanding 24/7 applications, Senseair S12 CO<sub>2</sub> DT combines a robust optical architecture with integrated dual-technology to eliminate the need for calibration in permanently occupied environments.

The optical design ensures that any drift or aging effects are automatically compensated. Meanwhile, the integrated dual technology continuously adapts to component aging throughout the sensor's lifetime.

#### Product overview \*

Article number	Prototype
Operating principle	Non-dispersive infrared (NDIR)
Measured gas	CO <sub>2</sub>
Measurement range	0–10 000 ppm
Accuracy	±(30 ppm + 3 % of reading)
Operating conditions	-10–60 °C 0–95 %RH
Power supply	3.0–5.5 V
Average current	< 34 µA
Communication	UART, I <sup>2</sup> C
Maintenance	Maintenance free
Life expectancy	> 10 years
Dimensions	18 x 15 x 6 mm

\* Preliminary specifications. May be changed without notice.

#### Key benefits

- No ABC/ASC or field calibration required
- Dual Technology, integrated
- High precision true NDIR CO<sub>2</sub> Sensing
- Ultra Compact "Micro" Format
- Versatile mounting and placement options
- Very low peak current
- Compliant with building standards:
  - ANSI/ASHRAE Standard 62.1-2025
  - RESET grade B
  - WELL Building Standard® (WELL v2™)
  - Title 24, California Energy Code

#### Applications

- Indoor air quality monitoring
- Demand-controlled ventilation (DCV)
- 24/7 occupied environment e.g.
  - Hospitals
  - Nursing homes
  - Control rooms

# 1. Sensor performance \*

## 1.1 CO<sub>2</sub> Sensing performance

Parameter	Conditions	Value
Target gas	-	Carbon dioxide (CO <sub>2</sub> )
Operating principle	-	Non-dispersive infrared (NDIR)
Gas sampling method	-	Diffusion
Measurement range <sup>1</sup>	Standard	0–5000 ppm
	Extended	5001–10 000 ppm
Accuracy <sup>2,3,4</sup>	ANSI/ASHRAE environments <sup>5</sup>	±(30 ppm + 3% of reading)
	0–5000 ppm	±(50 ppm + 3% of reading)
	5001–10 000 ppm	±(70 ppm + 3% of reading) or ±10% of reading – whichever is greater
Resolution	-	1 ppm
Measurement interval	Default	2 s; Configurable from 2 s
Sampling	Default	59 samples; Configurable
Response time	T <sub>63%</sub>	< 30 s
Compensation <sup>6</sup>	Temperature	On-board sensor element
	Pressure	Pressure value must be provided by host system. Otherwise, dependency is 1.6% reading per kPa deviation from normal pressure

\* Preliminary specifications. May be changed without notice.

- Sensor is designed to measure in the range of 400–5000 ppm (extended range up to 10 000 ppm). Exposure to concentrations below 400 ppm may affect performance. For measurements of concentrations below 400 ppm, ABC shall be turned off.
- Accuracy in the table is defined at 25 °C, 1013 mbar ambient pressure and 50% RH. The accuracy for the complete operating conditions is specified in chapter 4.2. Specification is referenced to uncertainty of calibration gas mixtures ±1 %.
- Shipping, rough handling and assembly can temporarily affect the accuracy of the sensor. Accuracy can be fully restored by forced recalibration or after a maximum of 3 ABC periods after mounting the sensor.
- Continuous mode, filtered concentration readings.
- S12 CO<sub>2</sub> complies with ANSI/ASHRAE Standard 62.1-2022 + addendum d, concentrations 600, 1000, and 2500 ppm measured at sea level at 25 °C.
- CO<sub>2</sub> readings are temperature compensated. Optional host system can provide an ambient pressure value for pressure compensated CO<sub>2</sub> readings. The Sunrise does not have an integrated pressure sensor.

## 1.2 General performance

Parameter	Conditions	Value
Operating temperature <sup>1</sup>		-10–60 °C
Operating humidity	Non-condensing	0–95% RH
Power supply		3.05–5.5 V
Peak current <sup>2</sup>		< 20 mA
Average Current <sup>3</sup>	Default settings	< 34 µA
Nominal dimensions	(L x W x H)	18 x 15 x 6 mm
Life expectancy		> 10 years
Storage temperature		-40–85 °C
Weight		< 3 g
Communication interface		UART / I <sup>2</sup> C
Maintenance <sup>4</sup>		Maintenance-free

1. Sensor is calibrated to meet product specifications within standard range 15–35 °C, extended range -10–60 °C. Sensor can survive temperatures outside of operating range, but measurement accuracy is not guaranteed.
2. To guarantee the functionality of the sensor, the voltage supply must be kept, and the maximum current must be considered.
3. The average current consumption depends on configured measurement period and number of samples per measurement.
4. For maintenance-free operation, ABC (Automatic Baseline Correction) must be enabled.

## 2. Pin configuration and functions

Pin #	Symbol	I/O Type	Description
1	GND	Power	Ground
2	VDD	Power	Supply voltage
3	RxD / SDA	I/O	UART receive input / I <sup>2</sup> C bidirectional serial data.
4	TxD / SCL	I/O	UART transmit output / I <sup>2</sup> C clock input.
5	EN	Input	Power down pin
6	DE	Output	UART transmit enable pin
7	RDYN	Output	Interrupt pin. Open drain output. Can be changed to push-pull output by register setting
8	COMSEL	Input	Communication select High = UART (Internal pull-up, can be left floating) Low = I <sup>2</sup> C (Connect to GND)

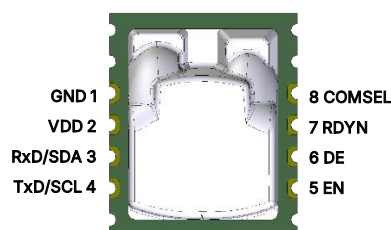


Figure 1. Pin configuration of S12 CO<sub>2</sub>

### 3. Drawing - Dimensions

Dimensional drawing of sensor with dimensions and their tolerances in millimetres.

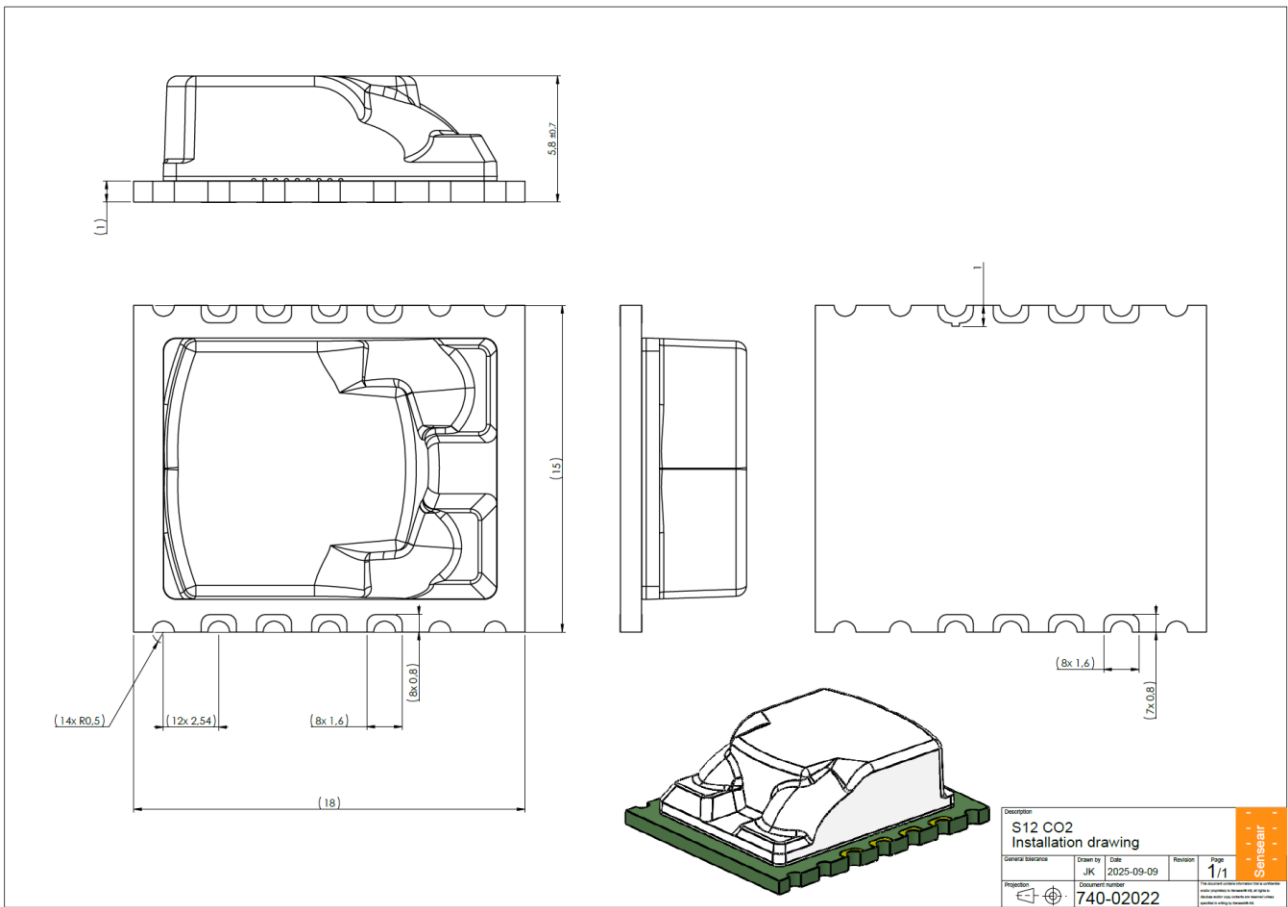


Figure 2. Dimensions of S12 CO<sub>2</sub>

## 4. Recommended operating conditions

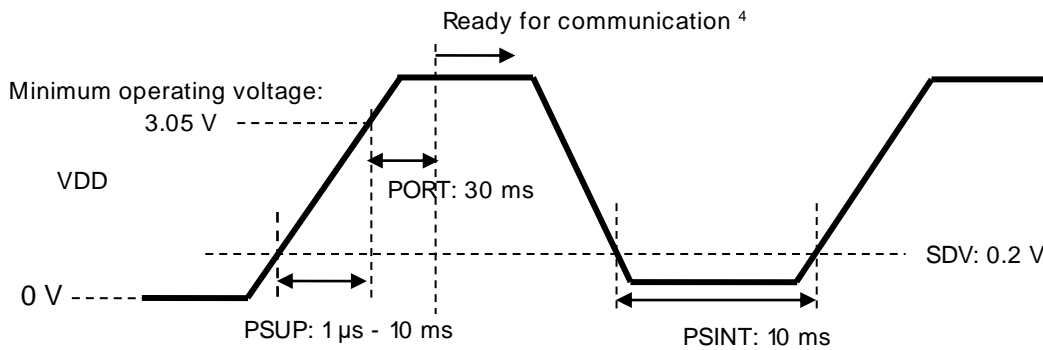
Over operating temperature range, unless otherwise noted.

### 4.1 Recommended operating conditions

Symbol	Description	Min	Typ	Max	Unit
VDD	Supply voltage	3.05	3.3	5.5	V
COMSEL	Communication select	-0.3	-	VDD+0.3	V
EN	Enable	-0.3	-	VDD+0.3	V
RxD/SDA	UART / I <sup>2</sup> C	-0.3	-	VDD+0.3	V
TxD/SCL	UART / I <sup>2</sup> C	-0.3	-	VDD+0.3	V

Parameter	Description	Symbol	Min	Typ	Max	Unit
Power supply rise time <sup>1,2</sup>	Time until VDD is set to the operating voltage from 0.2 V.	PSUP	1 μ		10 m	s
Power-on reset time <sup>1,2</sup>	Time until ready for communication after PSUP.	PORT			30	ms
Shutdown voltage <sup>2,3</sup>	Shutdown voltage for POR re-starting.	SDV			0.2	V
Power supply interval time <sup>1,2,3</sup>	Voltage retention time below SDV for POR re-starting.	PSINT	10			ms

- Values of these parameters are not guaranteed and not tested in production. Therefore, for applications that require high reliability, please do not use Power-On Reset (POR) and do reset using the PDN pin.
- POR circuit detects rising edge of AVDD, resets the internal circuit, and initializes the registers. The host system must take into account PSUP and PORT times to communicate with the S12.
- Unless this condition is satisfied, reset may not be correctly performed.



- In single measurement mode, the "External capacitor charge time" setting should also be considered.

### 4.2 Sensor accuracy over operating range

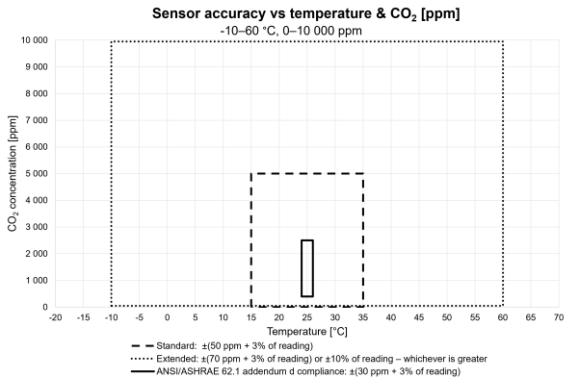


Figure 3: Accuracy over temperature and CO<sub>2</sub>

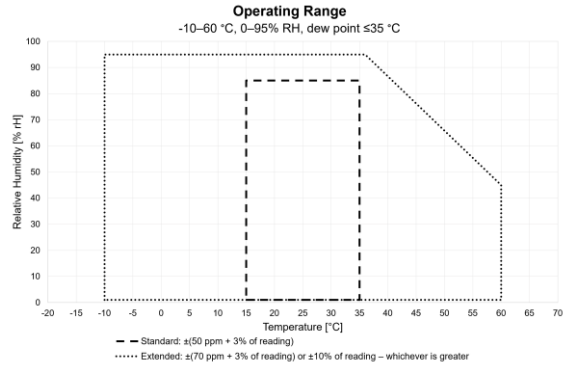


Figure 4: Operating Range

### 4.3 EEPROM Characteristics

Parameter	Min	Typ	Max	Unit
Retention	15			years
Endurance <sup>1</sup>			100 000	cycles
Writing time <sup>2</sup>			180	ms

1. Values of these parameters are not guaranteed and not tested in production.
2. When the values of the following registers in the EEPROM register are rewritten at a time.
  - Measurement Mode
  - Measurement Period
  - Number of samples
  - ABC period
  - ABC Target
  - Static IIR filter parameter
  - Meter control
  - MB / I<sup>2</sup>C address

## 5. Sensor documentation

### 5.1 Measurement mode

The S12 CO<sub>2</sub> supports two modes of operation:

1. Continuous measurement mode
2. Single measurement mode

The **default** operation mode for S12 CO<sub>2</sub> is **Continuous measurement mode**.

1) In Continuous measurement mode, the sensor measures at regular intervals (measurement period, default setting 2 s). The host can read measurement data after each measurement and does not need to send any command to trigger measurements.

2) In Single measurement mode, the sensor waits for the hosts command to measure. The host needs to send a command sequence to trigger each measurement. By using this function, the current consumption can be further optimized and gives more flexibility how often the sensor should start a measurement without changing basic settings of the sensor.

### 5.2 Communication

See "Modbus on S12 CO<sub>2</sub>" (TDE15927) and "I<sup>2</sup>C on S12 CO<sub>2</sub>" (TDE15933).

### 5.3 Maintenance

Senseair S12 CO<sub>2</sub> has a built-in self-correcting ABC algorithm. ABC period is adjustable by host and per default enabled. Discuss your application with Senseair in order to get advice for a proper calibration strategy.

## 5.4 Revision History

Date	Revision	Page(s)	Changes
May 2026	1	1	Initial release document.

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