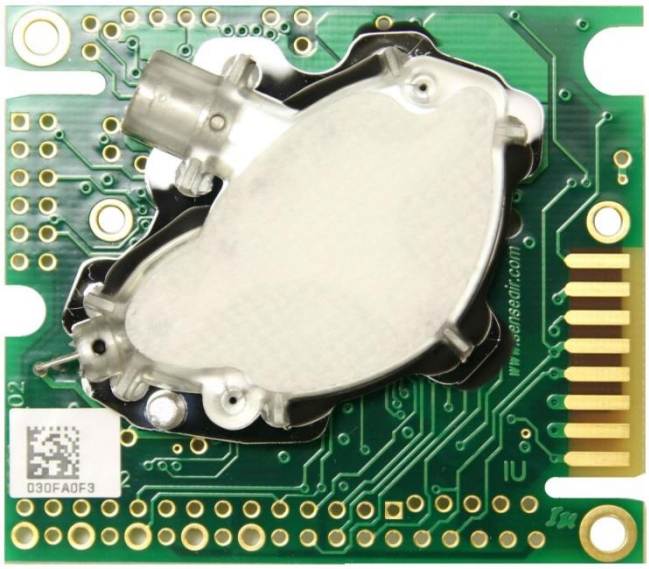
Product Specification

Senseair K30 3%

Sensor and OEM Platform



General

The Senseair K30 sensor platform Senseair K30 3% can be customised for a variety of sensing and control applications. This platform is designed to be an OEM module for built-in applications in a host apparatus, and hence should be optimised for its tasks during a dialog between Senseair and the OEM customer. This document is to be considered as the starting point for such a dialog.

Item	Senseair K30 3% Art. No. 030-7-0001
Target gas	Carbon dioxide (CO_2)
Operating principle	Non-dispersive infrared (NDIR)
Measurement range	0 — 3%$_{vol}$ (extended range up to 4%$_{vol}$)
Accuracy	±300 ppm ±3% of reading [1, 2]
Response time ($T_{1/e}$)	20 sec diffusion time
Rate of measurement	0.5 Hz
Operating temperature	0 — 50 °C
Operating humidity	0 — 95% RH non condensing
Storage temperature	-30 — 70 °C
Dimensions	51 x 57 x 14 mm (Length x Width x approximate Height)
Power supply	4.5 — 14.0 V DC maximum rating (without reverse polarity protection) stabilised to ±5% over load and line changes. Ripple voltage less than 100 mV. [3]
Current consumption	40 mA average <150 mA peak current (averaged during IR lamp ON, 120 msec) <300 mA peak power (during IR lamp start-up, the first 50 msec)
Warm-up time to spec precision	1 min
Life expectancy	>15 years
Serial communication	UART, Modbus protocol. Direction control pin for direct connection to RS485 receiver integrated circuit.
OUT 1	D/A Resolution: 10 mV (10 bit) Linear Conversion Range: 1 — 4 V = 0 — 2% Electrical Characteristics: R_{OUT} <100 Ohm R_{LOAD} >5 kOhm
OUT 2	D/A Resolution: 5 mV (10 bit) Linear Conversion Range: 1 to 4V = 0 — 2% Electrical Characteristics: R_{OUT} <100 Ohm R_{LOAD} >5 kOhm
OUT 3	-
OUT 4	-
Maintenance	Maintenance-free with using Senseair ABC logic self calibration using for normal indoor applications

Table 1. Key technical specification for the Senseair K30 3%

[1] Accuracy is specified over operating temperature range at normal pressure 101.3 kPa. 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.

[2] In normal IAQ applications. Accuracy is defined after minimum three (3) ABC periods of continuous operation with ABC. Some industrial applications do require maintenance. Please, contact Senseair for further information!

[3] Notice that absolute maximum rating is 14 V, so that sensor can be used with a 12 V±10% supply.

Terminal descriptions

The table below specifies what terminals and I/O options are available in the general K30 platform. Please note, however, that in the Senseair K30 3% default configuration, only OUT1, OUT2, Din1, Din2 and Status have any pre-programmed functions. These are described in the chapter *"Default Configuration"*.

Functional group	Descriptions and ratings
Power supply	
G+ referred to G0:	Absolute maximum ratings 4.5 — 14 V, stabilised to within 5% 5.0 to 9 V preferred operating range. **Unprotected against reverse connection!**
Outputs	
OUT1	Buffered linear output 0 — 5 or 1 — 5 V DC or 0 — 10 V or 2 — 10 V, depending on specified power supply and sensor configuration. **Load to ground only**! Resolution: 10 mV (8.5 bits in the range 1 — 5 V). Can be used as an overview alternative to OUT2, or in an independent linear control loop, such as housing temperature stabilisation.
OUT2	Buffered linear output 0 — 5 or 1 — 5 V DC, depending on specified power supply and sensor configuration. **Load to ground only!** Resolution: 5 mV (10 bits)
OUT3	CMOS **unprotected**. Digital (High/Low) output. High Output level in the range 2.3 V min to DVDD = 3.3V. (1mA source) Low output level 0.75 V max (4mA sink) Can be used for gas alarm indication, or for status indication etc.
OUT4	CMOS **unprotected.** Digital (High/Low) output. High Output level in the range 2.3 V min to DVDD = 3.3 V. (1 mA source) Low output level 0.75 V max (4 mA sink) Can be used for gas alarm indication, or for status indication etc.
Status	CMOS **unprotected.** High Output level in the range 2.3 V min to DVDD = 3.3 V. (1 mA source) Low output level 0.75 V max (4 mA sink)
Serial communication	
UART (TxD, RxD)	CMOS, ModBus communication protocol. Logical levels corresponds 3.3V powered logics. Refer TDE2336"ModBus on Senseair K30, Senseair K33 and eSENSE" for electrical specification.
I^2C extension.	
Contact SenseAir	Pull-up of SDA and SCL lines to 3.3V.
Inputs & optional jumper field	
Din0, Din1, Din2, Din3, Din4	Digital switch inputs have pull-up 120 kOhm to DVCC 3.3 V most of the time. Pull-up resistance is decreased to 4 — 10 kOhm only during read of input / jumper to provide cleaning of the contacts by larger currents. They are the same as inputs on IDC connector. Can be used to initiate calibration or to switch output range or to force output to predefined state. All depends on customer needs.

Table 2. I/O notations used in this document for the Senseair K30 platform with some descriptions and ratings.

Installation

The modules are factory calibrated and ready for use directly after power up. There are several alternative ways to connect the Senseair K30 3% to a host system:

Do not use edge connector for connection to the host system without discussion with Senseair!

1. Using "UART connector", including terminals for power supply (G+ and G0), UART (TxD, RxD).

2. Using the 3 pins **main terminal**. Available signals are power supply (G+ and G0) and the buffered analogue output (OUT1). A variety of user selections exists for this option regarding standard 5.08 mm pitch components and mounting alternatives (top/bottom).

3. Using 20 pin connector strips, or **IDC connector**, most of the system information is reached.

Host integration considerations and EMI shielding

If an IDC connector is being used to connect the K30 module to a host PCB, this connector can in some situations be used as the only fixture. If instead fixing the K30 PCB using mechanical poles and screws, no more than two (2) positions should be considered. This is because the PCB should not be exposed to any mechanical stress, and it is small and lightweight enough for just two (2) attachment points.

To provide means for attachments, there are four (4) possible screw holes available, all of them having a collar that is electrically connected to ground (G0). These connections are, not totally equivalent:

- The two screw points in the upper left corner (having the IDC and edge connectors faced downwards, are connected to the *analogue* ground. They are the preferred choice for connection to some EMI shield, if so is required. This is normally necessary only if the application is such that large EMFs are foreseen. If this option is being used, precaution must be taken so as to exclude any power supply currents! Sensor reading instability is an indication of the need for shielding, or of improper enclosure system groundings.

- The two screw points in the right bottom corner are connected to the *digital* ground. Connection to some EMI housing shield is less effective when this option is used, but on the other hand the sensor may be powered via these connections.

Note 1: To avoid ground loops, one should avoid connecting the analogue and digital grounds externally! They are connected internally on the K30 PCB.

Note 2: The terminals are not protected against reverse voltages and current spikes! Proper ESD protection is required during handling, as well as by the host interface design.

Default functions /configurations

Outputs

The basic Senseair K30 3% configuration is a simple analogue output sensor transmitter signal directed to OUT1 and OUT2. Output OUT1 is configured to give a measurement overview, whereas OUT2 by default is to provide more exact measurements. Via the edge connector serial communication terminal, the CO_2 readings are available to an even higher precision (Modbus protocol), together with additional system information such as sensor status, analogue outputs, and other variables.

The user can modify the output ranges at any time using a dedicated development kit, including PC software and a special serial communication cable.

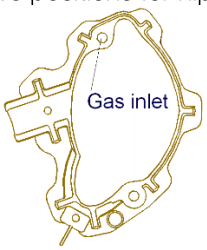
Terminals	Output	Correspondence
OUT1	1.0 — 4.0 V DC	0 — 2% CO_2
OUT2	1.0 — 4.0 V DC	0 — 2% CO_2

Table 3. Default analogue output configuration for CO_2 Engine® K30 3%

Background- / Zero calibration procedure

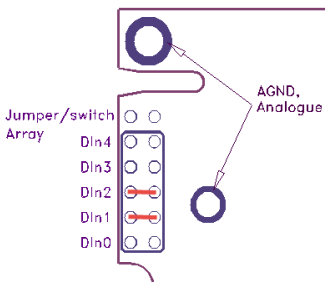
The sensor has two calibration functions: zCal that will adjust the sensor to show 0ppm, and bCal that will adjust the sensor to 400ppm. The reference gas used should contain a CO_2 concentration of 0 or 400ppm. If the reference gas has a concentration that differs from 0 or 400ppm, we recommend to calibrate using UIP5 instead of the method described below.

1. Connect sensor with tube and nipple (two alternative positions for nipple attachment).
   - Soft Tube: 2x4 mm
   - Nipple: nylon hose, 30x0.8x2.2 mm



2. Let gas mixture flow into the sensor through applied tube.
   - **bCal:** 400 ppm CO_2 **zCal:** 0 ppm, e.g. Nitrogen
   - Flow time: ≥3 minutes
   - Flow range: 0.3 — 1.0 litre/minute

3. Short circuit **Din1** (bCal)/**Din2** (zCal)
   - Shortcut Time: ≥8 seconds



Top view

4. Calibration executed?

Yes	No
(Sensor shows 400ppm (bCal)/0ppm (zCal) CO_2)	(sensor detected unstable gas concentration) 1. wait 10 seconds 2. repeat step 3 and 4

5. Remove shortcut!

Input switch terminal (normally open)	Default function (when closed for minimum 8 seconds)
Din1	bCAL (background calibration) assuming 400ppm CO_2 sensor exposure
Din2	zCAL (zero calibration) assuming 0ppm CO_2 sensor exposure

Table 4. Switch input default configurations for K30 3% ext. range 10%

ABC algorithm

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 lowest reading of sensor over **a 7.5 days interval** and slowly corrects for any long-term drift detected as compared to the expected fresh air value of 400 ppm CO_2.

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

Rough handling and transportation might result in a reduction of sensor reading accuracy. With time, however, if actuated the ABC function will tune the readings back to the correct numbers. The default "tuning speed" is limited to about 200 ppm/week.

Maintenance

The Senseair K30 is 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.

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. If this byte is not zero, the logic output terminal **Status** would be put into Low level state. The full error codes are available from the UART port or via I^2C communication. *Offset regulation error* and *Out of Range* are the only bits that are 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.

Output Terminal	Default function
Status	High level = OK Low level = Fault

Table 5. Default Logic output configured for CO_2 Engine® K30 3%

Error code and action plan

(error code can be read via one of 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	**Offset regulation error**	Try to restart sensor by power OFF/ON. Contact local distributor.
2	4	**Algorithm error.** Indicate wrong EEPROM 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.	Check connections of temperature and relative humidity probe (if mounted). Try sensor in fresh air. Perform CO_2 background calibration. Check detailed status of measurements with software tools. *See Note!*
6	64	**Memory error** Error during memory operations.	Check detailed settings and configuration with software tools.
7	128	**Reserved**	

Table 6. Error code and action plan

Note. If any probe is out of range. It occurs during over exposure of CO2 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 CO2 readings are normal, and still the error code remains, the temperature sensor can be defect or the connections to it are broken.

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

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